



2015-2016

**Boletín del
Observatorio del Ebro.
Observaciones
geomagnéticas en la
isla de Livingston, Antártida.
2015 y campaña 2015-2016**

*Observacions geomagnètiques
a l'illa de Livingston, Antàrtida.
2015 i campanya 2015-2016*

*Geomagnetic observations at
Livingston island, Antarctica.
2015 and 2015-2016 survey.*

**BOLETÍN DEL OBSERVATORIO DEL EBRO.
OBSERVACIONES GEOMAGNÉTICAS EN LA ISLA DE
LIVINGSTON, ANTÁRTIDA.**



2015 Y CAMPAÑA 2015-2016.

Por

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1. INTRODUCCIÓ

En aquest butlletí es presenten les observacions magnètiques enregistrades per l'*Observatori de l'Ebre* a l'illa antàrtica de Livingston durant l'any 2015 i campanya 2015-2016. L'estació magnètica té assignat el codi LIV de la IAGA.

La instal·lació i operació de l'Observatori Geomagnètic de l'Illa Livingston es van emmarcar en el projecte ANT95-0994-C03 del 'Programa Nacional de Investigación en la Antártida'. Durant la campanya 1995-1996 es va procedir al muntatge de les casetes que actualment alberguen l'estació magnètica, ubicada a la Base Antàrtica Espanyola (BAE) Juan Carlos I de l'Illa Livingston (arxipèlag de les Shetland del Sud).

Paral·lelament, es va dur a terme la verificació de l'estació magnètica i dels equips de mesura absoluta del camp geomagnètic a la seu de l'*Observatori de l'Ebre*, a Roquetes. Una avaluació de l'homogeneïtat espacial de les variacions enregistrades, així com de l'anomalia magnètica cortical de la zona, poden trobar-se a TORTA et al. (1999). Durant la campanya 1996-1997 es va instal·lar el variòmetre, del qual es disposa de registres des del 7 de desembre de 1996, i es van dur a terme les primeres mesures absolutes.

En els anteriors butlletins (p. ex. MARSAL et al., 2015) s'han anat resumint tant el procés de les dades com les principals incidències ocorregudes des dels inicis de l'observatori fins al febrer de 2015. Cal assenyalar que les instal·lacions es troben ateses només durant els mesos d'estiu austral, de manera que, en finalitzar cada campanya, normalment a finals de febrer, tot el personal abandona la base però els magnetòmetres queden en registre continu automàtic. Les dades registrades durant la hivernada es recuperen al principi de la campanya següent. La nostra activitat durant la campanya 2015-2016 ha quedat compresa entre el 18 de desembre de 2015 i el 21 de febrer de 2016.

Els valors del camp enregistrats a l'observatori es transmeten a través del satèl·lit GOES-E amb una cadència de dotze minuts fins al node d'informació geomagnètica (GIN) que INTERMAGNET té a Ottawa. Les dades són recuperades posteriorment per l'*Observatori de l'Ebre*, i mostrades a la seva plana web: <http://www.obsebre.es/ca/ca-livingston>.

Es pot obtenir més informació dirigint-se a:

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2. SITUACIÓ GEOGRÀFICA

La instal·lació de l'observatori va requerir l'edificació de tres casetes tèrmicament aïllades i construïdes amb materials amagnètics. La zona de l'emplaçament de l'estació magnètica va ser definida després d'un estudi realitzat per l'*Instituto Geográfico Nacional* (CASAS et al., 1992) durant la campanya 1990-1991. Els resultats de l'aixecament magnètic van mostrar que la ubicació més idònia és la zona de Punta Polaca, situada vora 350 m de distància de les instal·lacions de la BAE, en direcció oest. A més, el lloc es troba prou allunyat del conjunt de les esmentades instal·lacions per tal que no existeixi risc de contaminació dels registres magnètics per la influència de la base o degut a efectes antropogènics. De les tres casetes inicialment instal·lades, una allotja un magnetòmetre vector que té com a sensor un magnetòmetre de protons (PVM); l'altra conté l'electrònica del sistema de control i adquisició de dades; i la tercera alberga el magnetòmetre per a la realització de mesures absolutes. Durant la campanya 2007-2008 es va incorporar una nova caseta que conté un variòmetre de tipus fluxgate triaxial (FGE).

Les coordenades del pilar fonamental són:

Latitud Geogràfica	62°	39'	44" S
Longitud Geogràfica	60°	23'	41" W
Altitud s. n. m.	19,4 m		
Latitud Geomagnètica*	53°	2'	28" S
Longitud Geomagnètica*	9°	26'	36" E

*Coordenades geomagnètiques calculades a partir de la 12a generació de l'IGRF per a l'època 2016,0 després de convertir les coordenades geodèsiques de més amunt a geocèntriques.

A 460 m en direcció est del pilar fonamental es va situar un jaló com a marca de referència per a la determinació de les mesures absolutes de declinació magnètica. L'azimut geodèsic determinat entre la línia pilar - jaló i el nord geogràfic és 90° 52' 04".

3. INSTRUMENTS I OPERACIÓ

3.1. VARIÒMETRES

Els dos instruments principals de l'estació magnètica automàtica són el fluxgate triaxial suspès (model FGE) i el magnetòmetre vector de protons (PVM), ubicats a sengles casetes.

El FGE, construït pel *Danish Meteorological Institute* (DMI) (veure detalls a DANISH METEOROLOGICAL INSTITUTE, 2006), inclou tres sensors fluxgate suspesos disposats ortogonalment sobre un suport de marbre. En el nostre cas, el conjunt s'orienta aproximadament d'acord amb els tres eixos magnètics locals, H (Nord), E (Est) i Z (Nadir). La sortida analògica d'aquest magnetòmetre és digitalitzada per mitjà de dos convertidors A/D de 16 bits que es mostregen a 1 i 0,1 Hz. El primer està configurat per a un rang dinàmic de 3200 nT i una resolució teòrica de 0,05 nT, mentre que el segon té un rang dinàmic de 6400 nT i una resolució de 0,3 nT.

El sensor del PVM el constitueix un magnetòmetre de precessió de protons Geomag SM90R d'efecte Overhauser que mesura la intensitat total del camp (F). Aquest sensor està muntat en el centre de dos conjunts de bobines de Helmholtz mútuament perpendiculars, orientats respectivament segons les direccions donades per la declinació i la inclinació locals. En aplicar corrent a aquestes bobines i mesurar la magnitud dels vectors resultants, es poden obtenir els canvis en la declinació, D, i la inclinació, I, raó per la qual el sistema es coneix com a configuració $\delta I/\delta D$. El procés requereix un cicle complet de polaritzacions de les bobines, que en el nostre cas es produeix una vegada per minut. L'estació va ser originalment desenvolupada pel Geomagnetism Group del *British Geological Survey* (BGS) a Edimburg. Els detalls tècnics es poden trobar a RIDDICK et al. (1995), tot i que alguns aspectes tècnics han estat posteriorment adaptats a les necessitats canviants d'observació pel personal de l'*Observatori de l'Ebre*. Una descripció resumida del seu fonament i operació es poden trobar a TORTA et al. (1997) i a MARSAL et al. (2007).

També es disposa d'un magnetòmetre escalar d'efecte Overhauser (GSM90-F1) per a les mesures del camp total F. Aquest magnetòmetre es mostreja cada 10 s (0,1 Hz) i es troba situat en un emplaçament proper a la resta de sensors, però prou allunyat perquè no es pertorbin entre ells.

Tant el mostreig dels instruments com la sincronització de temps es realitzen sota control de maquinari basat en un microcontrolador PIC 18F4550 i un receptor GPS. Els processos d'adquisició, emmagatzematge, monitoratge i transmissió de dades es realitzen per mitjà de programari desenvolupat en llenguatge C en un PC embegut sobre LINUX (TORTA et al., 2009). Aquests elements es van duplicar durant la campanya 2010-2011 per evitar pèrdua de dades en cas d'avaria. Tots ells s'allotgen en una tercera caseta, juntament amb l'electrònica que permet subministrar corrent estable a les bobines $\delta I/\delta D$ del PVM, i la font d'alimentació del conjunt de l'estació.

3.2. MESURES ABSOLUTES

El tipus d'instrument utilitzat per a la realització de mesures absolutes és el DIFLUX, que consta d'un magnetòmetre fluxgate de la casa ELSEC, model 810A, el sensor del qual està muntat sobre un teodolit amagnètic de la casa Zeiss, model 015B. El procediment d'observació està basat en la determinació de camp nul per a l'obtenció de D i I. Per eliminar els errors de col·limació entre el sensor i l'eix òptic del teodolit, així com els deguts a l'offset de camp nul generats per l'electrònica, es realitzen observacions en les quatre posicions possibles per a cada element (veure, p. ex., JANKOWSKI I SUCKSDORFF, 1996; TORTA et al., 1997; o MARSAL I TORTA, 2007). Els observadors durant la campanya 2015-2016 han estat Miquel Ibañez i Javier Carmona.

Les determinacions absolutes de la intensitat total (F) es realitzen amb un magnetòmetre de protons GEM Systems GSM19 d'efecte Overhauser. Aquestes mesures es realitzen esporàdicament pel fet que cal substituir el DIFLUX per aquest element sobre el pilar fonamental. Així, es duen a terme diverses sèries de mesures absolutes d'F durant la campanya. Per tal de traçar la línia de base es necessita la mesura contemporània amb un altre magnetòmetre de protons en registre continu. Com a segon magnetòmetre s'utilitza el GSM90-F1. La diferència mitjana per a la darrera campanya és de -22,2 nT ($F_{\text{pilar_fonamental}} - F_{\text{GSM90-F1}}$). En cas de falta de dades del GSM90-F1 s'utilitza l'SM90R ubicat a l'interior del PVM. La diferència en aquest cas ha estat de -1,3 nT ($F_{\text{pilar_fonamental}} - F_{\text{SM90R}}$).

4. PROCÉS DE LES DADES

El procés preliminar de les dades inclou la detecció i eventual eliminació de valors espuris per comparació dels diferents tipus de registres: d'una banda es comparen els valors mostrejats a 1 i 0,1 Hz del FGE, utilitzant la derivada de les diferències entre aquestes dues freqüències per tal de ressaltar possibles incidències en el registre. Paral·lelament, es comparen els valors minut dels dos variòmetres: el FGE (valor mitjà de minut) i el PVM (valor puntual). S'inclou també una comparativa entre la intensitat total F enregistrada cada 10 s directament pel magnetòmetre escalar GSM90-F1 i la deduïda a partir de les dades corresponents als tres components del fluxgate.

Després de la compilació de la sèrie de mesures absolutes, s'ha procedit a la determinació de les línies de base definitives. El procediment seguit es detalla a continuació.

Per a cada element observat F, D i I (o el seu equivalent en coordenades cartesianes) s'han sostret dels valors de les mesures absolutes els valors corresponents del FGE d'una banda, i del PVM de l'altra, donant lloc així a dues sèries de diferències o línies de base observades, una per a cada variòmetre. Sobre aquestes dues sèries de diferències s'ha realitzat una anàlisi seqüencial que finalitza amb l'obtenció de les línies de base adoptades per a cada dia. Aquest procés inclou l'anàlisi de certs observables que determinen la validesa de les mesures absolutes individuals, el rebuig dels valors de línia de base observada amb diferències excessives, i un ajust de les dades no rebutjades d'acord amb un filtre gaussià amb una amplada (sigma) de 5,5 dies.

Les diferències observades i les corresponents línies de base adoptades per al FGE per a la campanya 2015-2016 s'il·lustren a la Figura 1. Malgrat que l'evolució de les línies de base dels diferents elements magnètics durant el període sense mesures absolutes és desconeguda, cal ressaltar la seva considerable estabilitat interanual en els darrers anys, essent la màxima variació entre les dues darreres campanyes de l'ordre de 1,8 nT en el component H (nord magnètic).

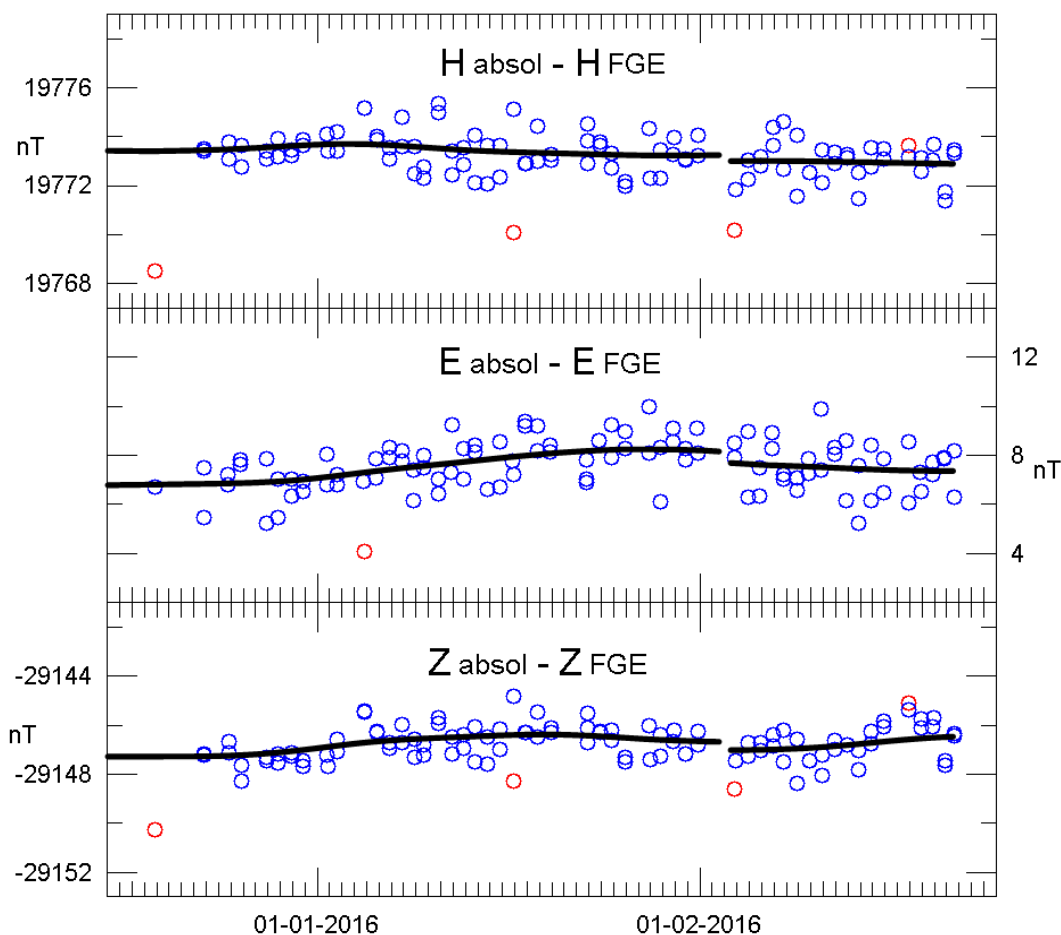


Fig. 1. Diferències observades entre el Diflux i el FGE (cercles blaus), i línies de base adoptades (línies contínues) per als elements H, E (est magnètic local) i Z. Els cercles vermells corresponen a les diferències descartades abans de l'adopció de la línia de base. Període corresponent a la campanya 2015-2016.

Tenint en compte la conducta manifestada durant les darreres campanyes en les que s'han realitzat mesures absolutes, les línies de base que s'han adoptat per al període entre elles obeeix a funcions lineals amb els pendents necessaris per a passar de les diferències adoptades al final d'una campanya a les del principi de la següent (Figura 2).

Després d'afegir les línies de base a les mesures dels variòmetres (i traslladar-les així a les referències absolutes) s'han produït els valors d'1 i 10 segons corresponents al FGE, i els valors d'1 minut corresponents al PVM. Les dades definitives reportades fins a 31 de desembre de 2011 es van obtenir utilitzant el PVM com a instrument semiabsolut, portant les mesures del FGE fins al nivell donat pel PVM en una finestra de cent minuts al voltant del minut d'interès. Aquesta decisió quedava justificada per la consideració que el PVM era el variòmetre més estable en temperatura. Tanmateix, un estudi realitzat comparant les dades d'ambdós variòmetres (FGE i PVM) amb dades d'una estació relativament propera, Argentine Islands (AIA), va revelar que el FGE tenia una dependència en temperatura semblant, o fins i tot menor, que la del PVM (veure detalls a MARSAL et al., 2013). Aquesta troballa va fer replantejar el procés de les dades fins aleshores, i a partir de l'1 de gener de 2012 s'ha optat per utilitzar el FGE com a únic variòmetre. El nou procediment descrit no hauria de diferir de l'anterior en més d'algunes dècimes de nanotesla en els components magnètics durant la campanya, però podria donar lloc a diferències d'algunes unitats durant la hivernada, donat que és el període en el que manquen les mesures absolutes. El PVM passa així a tenir un paper secundari, i serà utilitzat com a variòmetre de reserva en cas d'avaria o falta perllongada de dades del FGE. Durant el període que cobreix aquest butlletí, i degut als greus problemes de subministrament energètic des de la BAE, les dades del PVM s'han utilitzat per recuperar nombrosos gaps curts, tant durant la campanya

com durant la hivernada. Així, s'han recuperat hores disperses de març i juny de 2015, i de gener i febrer de 2016.

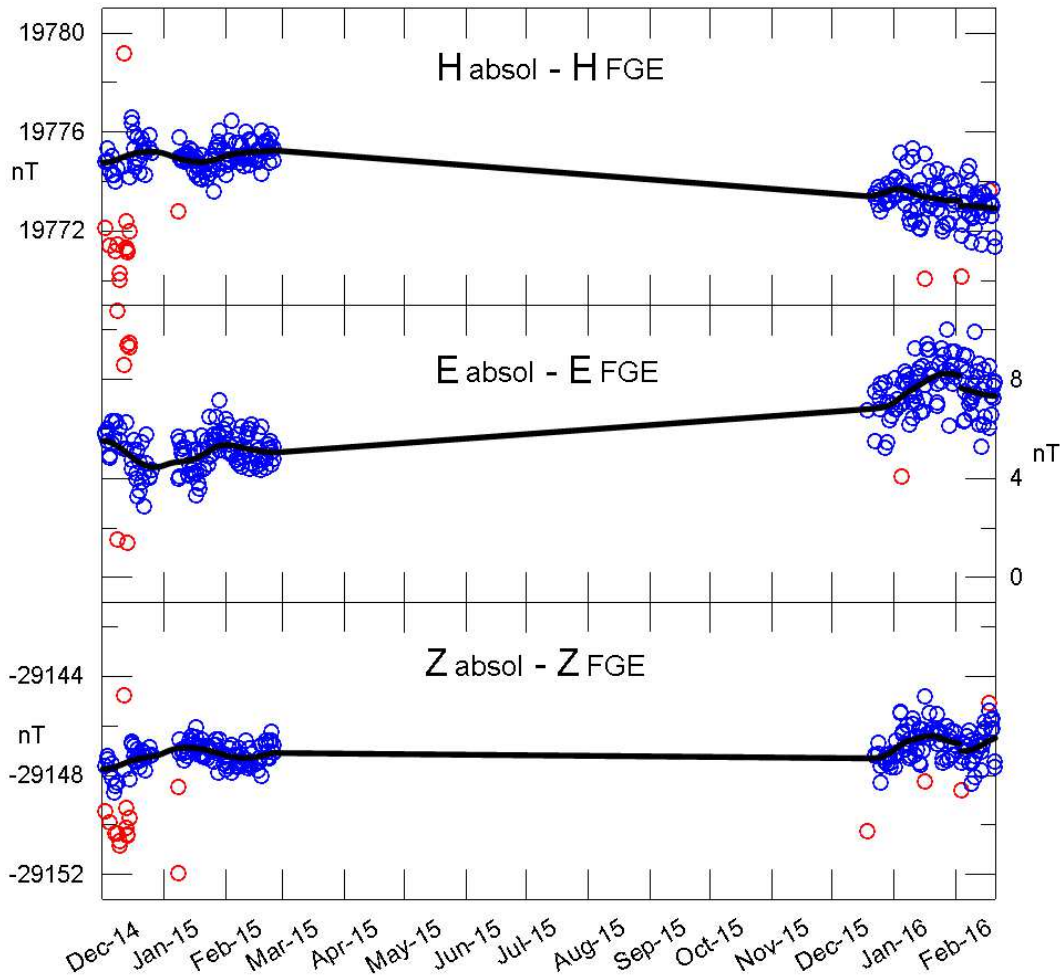


Fig. 2. Equivalent a la figura anterior per al període complet de registre des de desembre de 2014 fins a febrer de 2016.

5. INCIDÈNCIES I ACCIONS

En aquest apartat es relacionen les incidències i accions més importants que d'alguna manera afecten les dades presentades en aquest butlletí.

- Tal com se sospitava gràcies als indicis de què disposàvem a través de la transmissió satèl·lit, el sistema d'energies alternatives de la base va col·lapsar entre els dies 5 i 7 de març de 2015, pocs dies després del tancament de la campanya 2014-2015. Pics transitoris de sobretensió van comportar tant la desconfiguració del convertidor A/D responsable del mostreig a 1 Hz del FGE com l'avaria d'un dels ordinadors embeguts que desen les dades, que no es van recuperar fins l'arribada del personal de l'Observatori de l'Ebre a mitjan desembre de 2015. Els mostrejors de reserva a 0,1 Hz i els del variòmetre dI/dD són també escassos. Concretament, s'han pogut recuperar un total de 15 dies de març, 7 dies entre finals de maig i principis de juny, i 2 dies d'octubre, a part de certs trams aïllats durant la hivernada, tots ells de longitud inferior a 1 dia.

- Un cop començada la campanya 2015-16, una sèrie d'avaries en els sistemes d'alimentació des de la base provoca un tall en el subministrament elèctric entre els dies 19 i 21 de desembre de 2015. No es disposa de dades per aquest període.
- El dia 26 de gener de 2016, degut a un problema en un convertidor DC/DC, es produeix un tall que s'allarga fins al dia 27.
- El dia 1 de febrer de 2016 es produeix un tall de corrent a causa d'un cable tallat accidentalment per les màquines que duen a terme les obres de remodelació de la base. La reconexió del cable tallat s'efectua unes hores més tard, però la sobretensió transitòria de l'incident afecta el convertidor A/D de les dades del FGE d'1 s, que queda saturat. Es recuperen les dades el dia 2 de febrer un cop substituït el convertidor. El fet d'accedir a la caseta del FGE i moure l'electrònica produeix un petit salt en les línies de base d'aquest variòmetre (veure Fig. 1).
- Durant tota la campanya es realitzen les obres de construcció de la base de ciment d'una nova caseta que previsiblement albergarà un DIFlux automàtic a partir de la propera campanya. El soroll magnètic provocat per les obres és mínim, i és degudament eliminat dels registres definitius.

Malauradament, al llarg de l'any 2015 i campanya 2015-2016 s'han perdut un total de 391753 minuts de registre (que equival a uns 272 dies o al 65 % de les dades) corresponents als elements X, Y, Z; i un total de 391652 minuts (272 dies) per a F. El tall més llarg es produeix entre principis de juny i mitjan octubre de 2015.

6. PRESENTACIÓ DE LES DADES

Els valors mitjans anuals per a tots els elements del camp magnètic i per als últims deu anys es presenten a la Taula 1. Pel fet que les línies de base adoptades a la Figura 2 per al període sense mesures absolutes podrien diferir de les reals, a la Taula 2 presentem les mitjanes corresponents únicament als períodes amb referències absolutes, que corresponen bàsicament a les mitjanes sobre els mesos de desembre, gener i febrer de cada campanya.

Any	D	H	Z	X	Y	I	F
2006.5	14 ^º 36.3'	20072	-29471	19423	5061	-55 ^º 44.5'	35657
2007.5	14 ^º 33.5'	20025	-29414	19382	5034	-55 ^º 45.2'	35583
2008.5	14 ^º 30.4'	19970	-29347	19333	5002	-55 ^º 46.0'	35497
2009.5	-	-	-	-	-	-	-
2010.5	14 ^º 25.6'	19856	-29214	19230	4947	-55 ^º 47.8'	35323
2011.5	14 ^º 23.5'	19799	-29147	19178	4921	-55 ^º 48.7'	35236
2012.5	14 ^º 21.6'	19743	-29076	19126	4897	-55 ^º 49.4'	35145
2013.5	14 ^º 18.8'	19691	-29002	19080	4868	-55 ^º 49.5'	35055
2014.5	14 ^º 15.8'	19638	-28934	19033	4839	-55 ^º 50.1'	34969
2015.5	-	-	-	-	-	-	-

Taula 1. Valors mitjans anuals per a tots els elements del camp magnètic durant els darrers deu anys. H, Z, X, Y i F estan expressats en unitats de nT. La manca prolongada de dades durant la hivernada impedeix donar un valor mitjà fiable per a l'any 2015,5.

Any	D	H	Z	X	Y	I	F
2007.0	14 ^º 35.0'	20048	-29438	19402	5048	-55 ^º 44.6'	35616
2008.0	14 ^º 31.8'	19999	-29372	19359	5018	-55 ^º 45.0'	35534
2009.0	14 ^º 28.9'	19950	-29310	19316	4989	-55 ^º 45.5'	35455
2010.0	14 ^º 26.3'	19895	-29240	19267	4961	-55 ^º 46.1'	35366
2011.1	14 ^º 24.7'	19829	-29171	19205	4935	-55 ^º 47.7'	35273
2012.0	14 ^º 22.6'	19780	-29101	19161	4911	-55 ^º 47.8'	35187
2013.1	14 ^º 19.9'	19724	-29027	19110	4883	-55 ^º 48.2'	35094

2014.1	14 ^o 16.7'	19664	-28955	19057	4850	-55 ^o 49.1'	35001
2015.1	14 ^o 14.7'	19607	-28899	19005	4825	-55 ^o 50.6'	34923
2016.1	14 ^o 12.2'	19561	-28851	18963	4799	-55 ^o 51.7'	34857

Taula 2. Valors mitjans de campanya per a tots els elements del camp magnètic durant els darrers deu anys. H, Z, X, Y i F estan expressats en unitats de nT.

Les dades que es presenten tot seguit són:

- i) Índexs trihoraris K i índexs diaris SK (sumatori de K) i Ak . Els primers han estat calculats automàticament mitjançant el mètode adaptatiu suavitzat recomanat per INTERMAGNET (NOVOŽIŃSKI et al., 1991) sobre la base d'un valor K_9 de 450 nT (límit inferior per a $K = 9$). Els índexs ak es calculen d'acord amb una recomanació de la IAGA WG V-5, de 1993 (veure, p. ex., BERTHELIER I MENVIELLE, 1993), segons la qual a cada índex trihorari K de 0 a 9 li correspon una variació lineal de 2,5, 7,5, 15, 30, 55, 95, 160, 265, 415 i 666 nT, respectivament. L'índex ak per a cada observatori es calcula multiplicant els valors anteriors pel factor $K_9/500$ ($= 0,9$ per a LIV). Finalment, Ak correspon a la mitjana diària dels diferents ak . (Nota: Els índexs K tan sols haurien de ser sensibles a perturbacions magnètiques degudes a la injecció de partícules a altes latituds. Malgrat això, aquest índex automàtic ha demostrat ser sensible a efectes radiatius solars com els SFE). Q i D indiquen els cinc dies internacionals de calma i pertorbats de cada mes, respectivament.
- ii) Gràfica de la variació secular (evolució dels valors mitjans anuals dels diferents elements del camp magnètic) de l'estació magnètica LIV des de 1997. Noteu que no es presenta cap valor per a l'any 2015,5 degut a la manca de dades durant la hibernada.
- iii) Variació típica diària dels elements D, H, Z per a les diferents estacions de Lloyd de 2015 i per a tot l'any en funció del temps universal ($LT \approx UT - 04$ h per a LIV, on LT és el temps local i UT el temps universal, en hores). Valors sense tendències i portats a la seva mitjana. Noteu que només es presenten les gràfiques corresponents a l'estiu austral (estació de Lloyd D), període per al qual es disposa de dades.
- iv) Magnetogrames diaris de la declinació (D), intensitat horitzontal (H) i intensitat vertical (Z), mostrats seqüencialment i per mesos.
- v) Magnetogrames diaris de la intensitat total (F), mostrats seqüencialment i per mesos.
- vi) Taules mensuals dels valors mitjans horaris de D, H, Z i F. Totes les mitjanes han estat calculades a partir de valors minut.

Aquesta campanya no es presenten les hodògrafes de la variació diària degut a la manca de dades.

Les mitjanes definitives de minut i horàries es poden trobar als centres mundials de dades (WDC) i al web de l'Observatori de l'Ebre (<http://www.obsebre.es/ca/ca-om-cataleg-dades-livingston>), on també es poden trobar dades definitives de segon i mitjanes diàries i mensuals.

Agraïments. Aquests resultats formen part dels projectes i accions especials o complementàries ANT95-0994-C03, ANT97-1863-E, ANT98-0886, ANT-981604-E, REN2000-0833, REN2000-2468-E, REN2003-08376-C02-02, CGL2005-24190-E/ANT, CGL2006-12437-C02-02, CTM2008-03033-E, CTM2009-13843-02-01, CTM2010-21312-C03-01 i CTM2014-52182-C3-1-P dels successius Planes Nacionales de I+D+i del *Ministerio de Ciencia e Innovación* o equivalent, i del "Convenio Específico de Colaboración entre la Universitat Ramon Llull y el Instituto Geológico y Minero de España para el Mantenimiento del Observatorio Geofísico y Registro de Series Históricas en la Isla Livingston, Antártida, durante la Campaña Antártica Española 2015-2016". A més dels autors d'aquest butlletí, formen o han format part dels grups investigadors les següents persones: L. F. Alberca, E. M. Apostolov, C. Bianchi, I. Blanco, E. Blanch, J. O. Cardús, B. Casas, A. García, L. R.

Gaya-Piqué, J. Merino, P. Quintana, E. Sanclement, A. De Santis, J. Seguí i A. Ugalde. Els autors volen expressar el seu agraïment al personal tècnic i científic de la BAE en les diferents campanyes des que es va instal·lar l'observatori, també al *Servicio Geográfico del Ejército* per la determinació de posicions i azimuts, i al Geomagnetic Laboratory del *Geological Survey of Canada*, a Ottawa, per la recepció i gestió de les dades transmeses a través del satèl·lit GOES-E. El recolzament tècnic rebut per part del Global Seismology and Geomagnetism Group del *British Geological Survey*, especialment per part de Christopher W. Turbitt i Simon Flower, han resultat ser també fonamentals. El disseny i desenvolupament original de l'electrònica que governa l'estació va ser a càrrec de l'exmembre del *British Geological Survey* John C. Riddick, a qui estem particularment agraïts pel temps que ens ha dedicat de manera desinteressada.

1. INTRODUCCIÓN

En este boletín se presentan las observaciones magnéticas registradas por el *Observatori de l'Ebre* en la isla antártica de Livingston durante el año 2015 y la campaña 2015-2016. La estación magnética tiene asignado el código LIV de la IAGA.

La instalación y operación del Observatorio Geomagnético de la Isla Livingston se enmarcaron en el Proyecto ANT95-0994-C03 del Programa Nacional de Investigación en la Antártida. Durante la campaña 1995-1996 se realizó el montaje de las casetas que en la actualidad albergan la estación magnética, ubicada en la Base Antártica Española (BAE) Juan Carlos I de la Isla Livingston (archipiélago de las Shetland del Sur).

Paralelamente, se procedió a la verificación de la estación magnética, así como de los equipos de medida absoluta del campo geomagnético, en la sede del *Observatori de l'Ebre*. Una evaluación de la homogeneidad espacial de las variaciones registradas, así como de la particular anomalía magnética cortical en el observatorio pueden encontrarse en TORTA et al. (1999). Durante la campaña 1996-1997 se instaló el variómetro, del que se tienen registros desde el 7 de diciembre de 1996, y se procedió a la realización de las primeras medidas absolutas.

En los anteriores boletines (p.e. MARSAL et al., 2015) se han ido resumiendo tanto el proceso de los datos como las principales incidencias ocurridas desde los inicios del observatorio hasta el mes de febrero de 2015. Cabe señalar que el observatorio se encuentra atendido sólo durante los meses del verano austral, de modo que al finalizar cada campaña, normalmente a finales de febrero, todo el personal abandona la base, pero los magnetómetros se dejan en registro continuo automático. Los datos registrados durante la invernada se recuperan al inicio de la campaña siguiente. Nuestra actividad durante la campaña 2015-2016 quedó comprendida entre el 18 de diciembre de 2015 y el 21 de febrero de 2016.

Los valores del campo registrados por el observatorio son transmitidos a través del satélite GOES-E con una cadencia de doce minutos hasta el nodo de información geomagnética (GIN) que INTERMAGNET posee en Ottawa. Los datos son recuperados posteriormente por el *Observatori de l'Ebre* y mostrados en su página web: <http://www.obsebre.es/es/es-livingston>.

Se puede obtener más información dirigiéndose a:

Observatori de l'Ebre
Horta Alta, 38
43520 Roquetes

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2. SITUACIÓN GEOGRÁFICA

La instalación del observatorio requirió la edificación de tres casetas térmicamente aisladas y construidas con materiales amagnéticos. La zona de emplazamiento de la estación magnética fue definida después de un estudio realizado por el *Instituto Geográfico Nacional* (CASAS et al., 1992) durante la campaña 1990-1991. Los resultados del levantamiento magnético efectuado mostraron que el lugar más apropiado es la zona de Punta Polaca, situada al Oeste de las instalaciones de la BAE y a unos 350 m de distancia de ellas aproximadamente. Asimismo, el lugar se encuentra suficientemente alejado del conjunto de instalaciones de la BAE para que no existan riesgos de contaminación de los registros magnéticos debido a la influencia de la base o a efectos antropogénicos. De las tres casetas inicialmente instaladas, una aloja un magnetómetro vector cuyo sensor es un magnetómetro de protones (PVM); otra contiene la electrónica del sistema de control y adquisición de datos; y la tercera alberga el magnetómetro para la realización de medidas absolutas. Durante la campaña 2007-2008 se incorporó una nueva caseta que alberga un variómetro de tipo fluxgate triaxial (FGE).

Las coordenadas del pilar fundamental son las siguientes:

Latitud Geográfica	62°	39'	44" S
Longitud Geográfica	60°	23'	41" W
Altitud s. n.m.	19,4 m		
Latitud Geomagnética*	53°	2'	28" S
Longitud Geomagnética*	9°	26'	36" E

*Coordenadas geomagnéticas calculadas a partir de la 12ª generación del IGRF para la época 2016,0, después de convertir las coordenadas geodésicas indicadas anteriormente a geocéntricas.

A 460 m en dirección Este del pilar fundamental se clavó un jalón como marca de referencia para la determinación de las medidas de declinación magnética. El acimut geodésico determinado entre la línea pilar-jalón y el Norte Geográfico es 90° 52' 04".

3. INSTRUMENTOS Y OPERACIÓN

3.1. VARIÓMETROS

Los dos instrumentos principales de la estación magnética automática son el fluxgate triaxial suspendido (modelo FGE) y el magnetómetro vector (PVM), ubicados en sendas casetas.

El FGE, construido por el *Danish Meteorological Institute* (DMI) (ver detalles en DANISH METEOROLOGICAL INSTITUTE, 2006), incluye tres sensores fluxgate suspendidos dispuestos ortogonalmente sobre un soporte de mármol. En nuestro caso, el conjunto se orienta de acuerdo con los tres ejes magnéticos locales, H (Norte), E (Este) y Z (Nadir). La salida analógica de este magnetómetro es digitalizada por medio de dos conversores A/D de 16 bits que se muestrean a 1 y 0,1 Hz. El primero está configurado para un rango dinámico de 3200 nT y una resolución teórica de 0,05 nT, mientras que el segundo posee un rango dinámico de 6400 nT y resolución 0,3 nT.

El sensor del PVM lo constituye un magnetómetro de precesión de protones Geomag SM90R de efecto Overhauser que mide la intensidad total del campo (F). Dicho sensor está montado en el centro de dos conjuntos de bobinas de Helmholtz mutuamente perpendiculares orientados respectivamente según las direcciones dadas por la Declinación e Inclinación locales. Al aplicar corriente a esas bobinas y medir la magnitud de los vectores resultantes, pueden obtenerse los cambios en la Declinación, D, y la Inclinación, I, con lo que el sistema se conoce como configuración $\delta D/\delta I$. El proceso requiere un ciclo completo de polarización de las bobinas, que en nuestro caso se produce una vez por minuto. La estación fue desarrollada por el Geomagnetism Group del *British Geological Survey* (BGS) en Edimburgo. Los detalles técnicos de la misma pueden encontrarse en RIDDICK et al. (1995), aunque algunos aspectos técnicos han sido posteriormente adaptados a las cambiantes necesidades de observación por el personal del *Observatori de l'Ebre*. Una descripción resumida de su fundamento y operación se halla en TORTA et al. (1997) y en MARSAL et al. (2007).

También se dispone de un magnetómetro escalar de efecto Overhauser (GSM90-F1) para las medidas del campo total F. Este magnetómetro se muestrea cada 10 s (0,1 Hz) y se encuentra ubicado en un emplazamiento cercano al del resto de sensores, pero suficientemente alejado para que no se perturben entre ellos.

Tanto el muestreo de ambos variómetros como la sincronización de tiempo se realizan bajo control de hardware basado en un microcontrolador PIC 18F4550 y un receptor GPS. Los procesos de adquisición, almacenamiento, monitorización y transmisión de datos se realizan por medio de software desarrollado en lenguaje C en un PC embebido sobre LINUX (TORTA et al., 2009). Estos elementos se duplicaron durante la campaña 2010-2011 para mayor respaldo en caso de avería. Todos ellos se alojan en una tercera caseta, junto con la electrónica que permite suministrar corriente estable a las bobinas $\delta D/\delta I$ del PVM, y la fuente de alimentación del conjunto de la estación.

3.2. MEDIDAS ABSOLUTAS

El tipo de instrumento utilizado para la realización de medidas absolutas es el DIflux, que consta de un magnetómetro fluxgate de la casa ELSEC, modelo 810 A, cuyo sensor viene montado en un teodolito amagnético Zeiss modelo 015B. El procedimiento de observación está basado en la determinación de campo nulo para la obtención de D e I. Para eliminar los errores de colimación entre el sensor y el eje óptico del teodolito, así como los debidos al “offset” de campo nulo generados por la electrónica, se realizan observaciones en las cuatro posiciones posibles para cada elemento (ver, p.e., JANKOWSKI Y SUCKSDORFF, 1996, TORTA et al., 1997, o MARSAL Y TORTA, 2007). Los observadores durante la campaña 2015-2016 fueron Miquel Ibañez y Javier Carmona.

Las determinaciones absolutas de la intensidad total (F) se realizan con un magnetómetro de protones GEM Systems GSM19 de efecto Overhauser. Dichas medidas son esporádicas, ya que para realizarlas debe substituirse el DIflux por el citado magnetómetro de protones en el pilar fundamental. Se realizan así varias series de medidas absolutas de F a lo largo de la campaña. Para poder trazar la línea de base de F es necesaria la medida contemporánea con otro magnetómetro de protones en registro continuo. Como segundo magnetómetro se utiliza el GSM90-F1, siendo la diferencia promedio de -22,2 nT ($F_{\text{pilar fundamental}} - F_{\text{GSM90-F1}}$) para la presente campaña. En caso de falta de datos del GSM90-F1 se utiliza el SM90R ubicado en el interior del PVM. La diferencia promedio en este caso ha sido de -1,3 nT ($F_{\text{pilar fundamental}} - F_{\text{SM90R}}$).

4. PROCESO DE LOS DATOS

El proceso preliminar de los datos incluye la detección y eventual eliminación de valores espurios por comparación de los diferentes tipos de registro: por una parte se comparan los valores muestreados a 1 y 0,1 Hz del FGE, utilizando la derivada de las diferencias entre estas dos frecuencias con el fin de resaltar posibles incidencias en el registro. Paralelamente, se comparan los valores minuto de los dos variómetros: el FGE (valor medio de minuto) y el PVM (valor puntual). También se incluye una comparativa entre la intensidad total F registrada cada 10 s directamente por el magnetómetro escalar GSM90-F1 y la deducida a partir de los datos correspondientes a las tres componentes del fluxgate.

Tras la compilación de la serie de medidas absolutas, se ha procedido a la determinación de las líneas de base definitivas. El procedimiento seguido se detalla a continuación.

Para cada elemento observado F, D e I (o su equivalente en coordenadas cartesianas) se han abstraído de los valores de las medidas absolutas los valores correspondientes del PVM por un lado y del FGE por otro (dando lugar a las diferencias o líneas de base observadas). Sobre estas dos series de diferencias se ha realizado un análisis secuencial que finaliza con la obtención de las líneas de base adoptadas para cada día. Este proceso incluye el análisis de ciertos observables que determinan la validez de las medidas absolutas individuales, el descarte de los valores de línea de base observada con diferencias excesivas, y un ajuste de los datos no rechazados de acuerdo con un filtro gaussiano con una anchura (sigma) de 5,5 días.

Las diferencias observadas y las correspondientes líneas de base adoptadas para el FGE para la campaña 2015-2016 se ilustran en la Figura 1. Aunque la evolución de las líneas de base de los diferentes elementos magnéticos durante el periodo sin medidas absolutas es desconocida, cabe resaltar su considerable estabilidad interanual a lo largo de los últimos años, siendo la máxima variación entre las dos últimas campañas de unos 1.8 nT en la componente H (norte magnético).

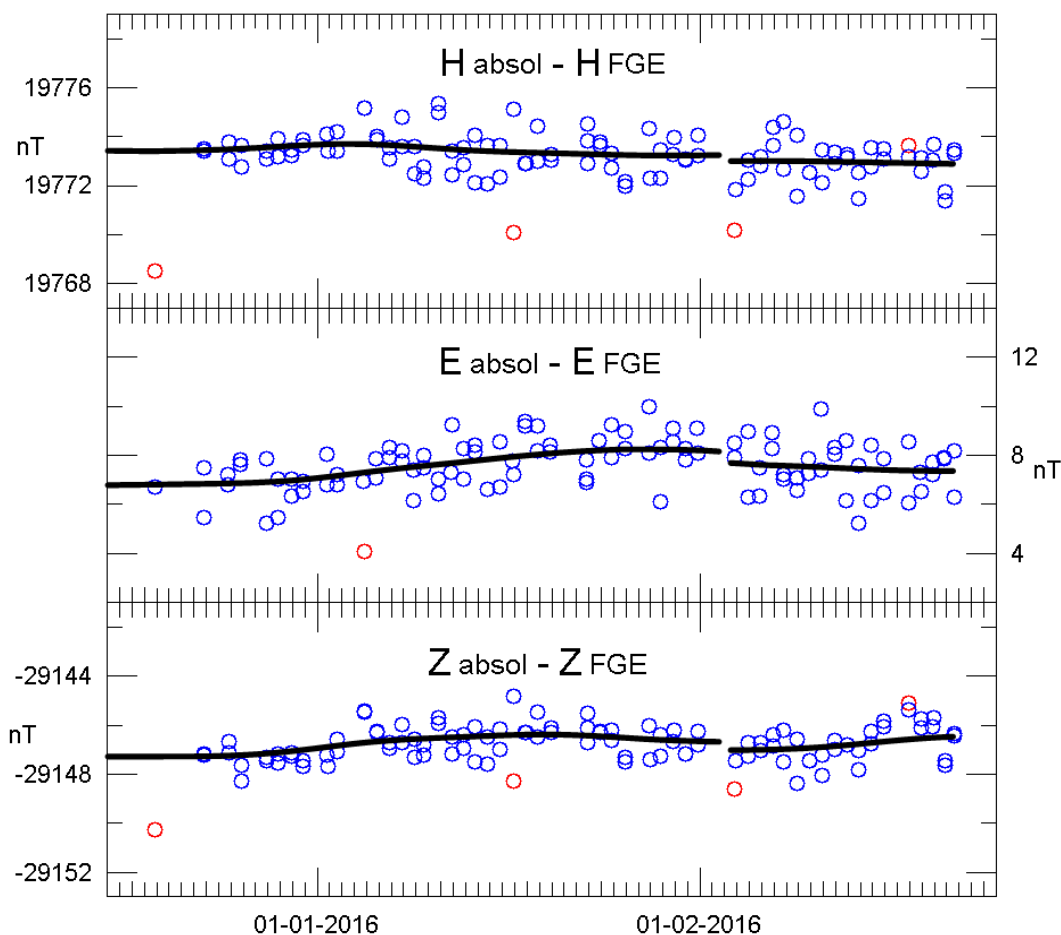


Fig. 1. Diferencias observadas entre el DIFlux y el FGE (círculos azules) y líneas de base adoptadas (líneas continuas) para los elementos H, E (este magnético local) y Z. Los círculos rojos corresponden a las diferencias descartadas antes de la adopción de la línea de base. Periodo correspondiente a la campaña 2015-2016.

Teniendo en cuenta la conducta manifestada durante las últimas campañas en las que se han realizado medidas absolutas, las líneas de base que se han adoptado para el período entre ellas obedecen a funciones lineales con las pendientes necesarias para pasar de las diferencias adoptadas al final de una campaña a las del principio de la siguiente (Figura 2).

Tras añadir las líneas de base a las medidas de los variómetros (y trasladarlas así a las referencias absolutas) se han producido los valores minuto del PVM y los valores de 1 y 10 segundos del magnetómetro FGE. Los datos definitivos reportados hasta 31 de diciembre de 2011 se obtuvieron utilizando el PVM como instrumento semiabsoluto, llevando las medidas del FGE hasta el nivel del PVM en una ventana de cien minutos alrededor del minuto de interés. Esta decisión quedaba justificada por la consideración de que el PVM era el variómetro más estable en temperatura. Sin embargo, un estudio realizado comparando los datos de ambos variómetros (FGE y PVM) con datos de una estación relativamente cercana, Argentine Islands (AIA), reveló que el FGE tenía una dependencia en temperatura parecida, si no menor que la del PVM (ver detalles en MARSAL et al., 2013). Dicho hallazgo replanteó el proceso de los datos hasta el momento, y a partir del 1 de enero de 2012 se ha optado por utilizar el FGE como único variómetro. Este nuevo procedimiento no debería diferir del anterior en más de algunas décimas de nanotesla en las componentes magnéticas reportadas durante la campaña; sin embargo, podría dar lugar a diferencias de unas pocas unidades durante la invernada, periodo del que no se dispone de medidas absolutas. El PVM pasa así a tener un papel secundario, y será utilizado como variómetro de reserva en caso de avería o de falta prolongada de datos del FGE. Durante el periodo que cubre este boletín, y debido a los graves problemas de suministro energético desde la BAE, los datos del PVM se han utilizado para recuperar numerosos

huecos cortos, tanto durante la campaña como durante la invernada. Así, se han recuperado horas dispersas de marzo y junio de 2015, y de enero y febrero de 2016.

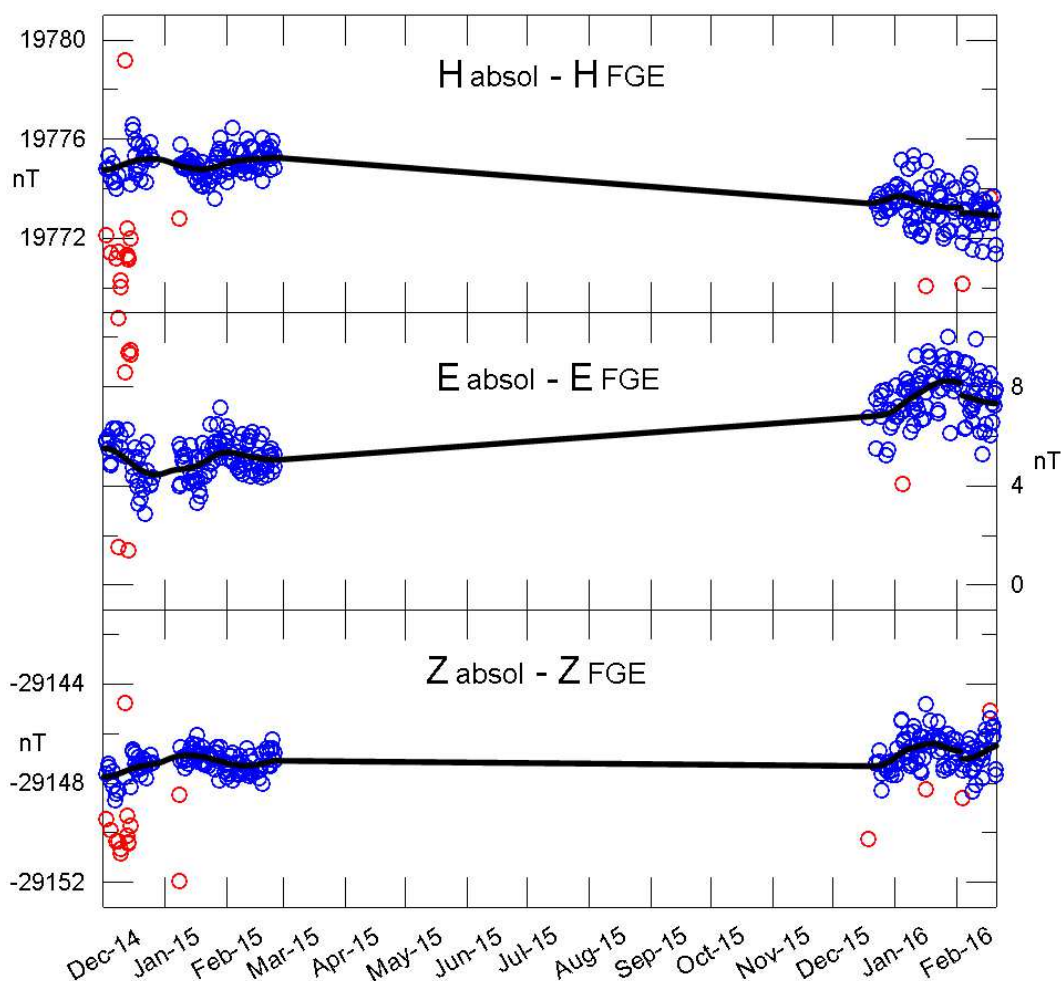


Fig. 2. Equivalente a la figura anterior para el periodo completo de registro desde finales de diciembre de 2014 hasta febrero de 2016.

5. INCIDENCIAS Y ACCIONES

En este apartado se relacionan las incidencias más importantes que afectan a los datos, ocurridas durante el periodo que abarca este boletín.

- Tal y como se sospechaba gracias a los indicios de que disponíamos a través de la transmisión vía satélite, el sistema de energías alternativas de la base colapsó entre los días 5 y 7 de marzo de 2015, pocos días después del cierre de la campaña 2014-2015. Picos transitorios de sobretensión comportaron tanto la desconfiguración del convertidor A/D responsable del muestreo a 1 Hz del FGE como la avería de uno de los ordenadores embebidos que almacena los datos, y que no se recuperó hasta la llegada del personal del *Observatori de l'Ebre* a mediados de diciembre de 2015. Los muestreos de reserva a 0,1 Hz y los del variómetro dI/dD también son escasos. Concretamente, se ha podido recuperar un total de 15 días de marzo, 7 días entre finales de mayo y principios de junio, y dos días de octubre, a parte de ciertos tramos aislados durante la invernada, todos ellos de longitud inferior a un día. Una vez iniciada la campaña 2015-16, una serie de averías en los sistemas de alimentación desde la base provoca un corte en el suministro eléctrico entre los días 19 y 21 de diciembre de 2015. No se dispone de datos durante este periodo. El día 26 de enero de 2016, debido a un problema en un convertidor DC/DC, se produce un corte que se extiende hasta el día 27.

- El día 1 de febrero de 2016 se produce un corte de corriente a causa del corte accidental de un cable por las máquinas que llevan a cabo las obras de remodelación de la base. La reconexión del cable cortado se realiza unas horas más tarde, pero la sobretensión transitoria del incidente afecta al convertidor A/D de los datos del FGE de 1 s, que queda saturado. Se recuperan los datos el día 2 de febrero, una vez substituido el convertidor. El hecho de acceder a la caseta del FGE y mover la electrónica produce un pequeño salto en las líneas de base de este variómetro (ver Fig.1).
- Durante toda la campaña se realizan las obras de construcción de la base de cemento de una nueva caseta que previsiblemente albergará un DIFlux automático a partir de la próxima campaña. El ruido magnético provocado por las obras es mínimo, siendo debidamente eliminado de los registros definitivos.

Desafortunadamente, a lo largo del año 2015 y la campaña 2015-2016 se han perdido un total de 391753 minutos de registro (que equivalen a unos 272 días o al 65 % de los datos) correspondientes a los elementos X, Y, Z; y un total de 391652 minutos (272días) para F. El corte más largo se produce entre principios de junio y mediados de octubre de 2015.

6. PRESENTACIÓN DE LOS DATOS

Los valores medios anuales de los diez últimos años para todos los elementos del campo se presentan en la Tabla 1. Puesto que las líneas de base adoptadas en la Figura 2 para el período sin medidas absolutas podrían diferir de las reales, damos en la Tabla 2 las medias correspondientes únicamente a los períodos con referencias absolutas. Corresponden básicamente a las medias sobre los meses de diciembre, enero y febrero de cada campaña.

Año	D	H	Z	X	Y	I	F
2006.5	14º 36.3'	20072	-29471	19423	5061	-55º 44.5'	35657
2007.5	14º 33.5'	20025	-29414	19382	5034	-55º 45.2'	35583
2008.5	14º 30.4'	19970	-29347	19333	5002	-55º 46.0'	35497
2009.5	-	-	-	-	-	-	-
2010.5	14º 25.6'	19856	-29214	19230	4947	-55º 47.8'	35323
2011.5	14º 23.5'	19799	-29147	19178	4921	-55º 48.7'	35236
2012.5	14º 21.6'	19743	-29076	19126	4897	-55º 49.4'	35145
2013.5	14º 18.8'	19691	-29002	19080	4868	-55º 49.5'	35055
2014.5	14º 15.8'	19638	-28934	19033	4839	-55º 50.1'	34969
2015.5	-	-	-	-	-	-	-

Tabla 1. Valores medios anuales para todos los elementos del campo magnético. H, Z, X, Y y F vienen dados en unidades de nT. La falta prolongada de datos durante la invernada impide dar un valor promedio fiable para el año 2015,5.

Año	D	H	Z	X	Y	I	F
2007.0	14º 35.0'	20048	-29438	19402	5048	-55º 44.6'	35616
2008.0	14º 31.8'	19999	-29372	19359	5018	-55º 45.0'	35534
2009.0	14º 28.9'	19950	-29310	19316	4989	-55º 45.5'	35455
2010.0	14º 26.3'	19895	-29240	19267	4961	-55º 46.1'	35366
2011.1	14º 24.7'	19829	-29171	19205	4935	-55º 47.7'	35273
2012.0	14º 22.6'	19780	-29101	19161	4911	-55º 47.8'	35187
2013.1	14º 19.9'	19724	-29027	19110	4883	-55º 48.2'	35094
2014.1	14º 16.7'	19664	-28955	19057	4850	-55º 49.1'	35001
2015.1	14º 14.7'	19607	-28899	19005	4825	-55º 50.6'	34923
2016.1	14º 12.2'	19561	-28851	18963	4799	-55º 51.7'	34857

Tabla 2. Valores medios de la campaña con referencias absolutas para todos los elementos del campo magnético. H, Z, X, Y y F vienen dados en unidades de nT.

Los datos que se presentan a continuación son:

- i) Índices trihorarios K , índices diarios SK (sumatorio de K) y Ak . Los primeros han sido calculados automáticamente mediante el método adaptativo suavizado recomendado por INTERMAGNET (NOVOŽIŃSKI et al., 1991) sobre la base de un valor K_9 de 450 nT (límite inferior per a $K = 9$). Los índices ak se calculan de acuerdo a una recomendación de la IAGA WG V-5, de 1993 (ver, p.e., BERTHELIER Y MENVIELLE, 1993), según la cual a cada índice trihorario K de 0 a 9 le corresponde una variación lineal de 2,5, 7,5, 15, 30, 55, 95, 160, 265, 415 y 666 nT, respectivamente. El índice ak para cada observatorio se calcula multiplicando los valores anteriores por el factor $K_9/500$ ($= 0,9$ para LIV). Finalmente, Ak corresponde a la media diaria de los diferentes ak . (Nota: los índices K sólo deberían ser sensibles a perturbaciones magnéticas debidas a la inyección de partículas a altas latitudes. A pesar de ello, este índice automático ha demostrado ser sensible a efectos radiativos solares como los SFE). Q y D indican los cinco días internacionales de calma y perturbados de cada mes, respectivamente.
- ii) Gráfica de la variación secular (evolución de los valores medios anuales de los diferentes elementos del campo magnético) de la estación magnética LIV desde 1997. Nótese que no se presenta valor para el año 2015,5 debido a la falta de datos durante la invernada.
- iii) Variación típica diaria de los elementos D, H, Z para las diferentes estaciones de Lloyd y para todo el año en función del tiempo universal ($LT \approx UT - 04$ h para LIV, donde LT es el tiempo local y UT el tiempo universal, en horas). Valores sin tendencias y llevados a su media. Nótese que sólo se presentan los gráficos correspondientes al verano austral (estación de Lloyd D), periodo para el cual se dispone de datos.
- iv) Magnetogramas diarios de la declinación (D), intensidad horizontal (H) e intensidad vertical (Z), mostrados secuencialmente y por meses.
- v) Magnetogramas diarios de la intensidad total (F), mostrados secuencialmente y por meses.
- vi) Tablas mensuales de los valores medios horarios de D, H, Z y F. Todas las medias han sido calculadas a partir de valores minuto.

En esta campaña no se presentan las hodógrafas de la variación diaria debido a la falta de datos.

Las medias definitivas de minuto y horarias pueden encontrarse en los centros mundiales de datos (WDC), y en la web del *Observatori de l'Ebre* (<http://www.obsebre.es/es/es-om-catalogo-datos-livingston>), donde también pueden encontrarse datos definitivos de segundo y medias diarias y mensuales.

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GOES-E. El apoyo técnico recibido por parte del Global Seismology and Geomagnetism Group del *British Geological Survey*, especialmente por parte de Christopher W. Turbitt y Simon Flower, ha resultado ser también fundamental. El diseño y desarrollo original de la electrónica que controla la estación fue llevado a cabo por el ex-miembro del *British Geological Survey* John C. Riddick, a quien estamos particularmente agradecidos por el tiempo que nos ha dedicado de forma desinteresada.

1. INTRODUCTION

In this bulletin we give details of the magnetic observations recorded by *Observatori de l'Ebre* at Livingston Island, Antarctica, during the year 2015 and the 2015-201 austral summer survey. The IAGA code for this station is LIV.

Both the observatory installation and operation of the geomagnetic observatory were on behalf of the *Programa Nacional de Investigación en la Antártida (National Program for Antarctic Research) Project ANT95-0994-C03*. For this objective to be achieved, during the 1995-1996 survey, the magnetic observatory accommodation was deployed at the Spanish Antarctic Station Juan Carlos I (Livingston Island, in the South Shetland Island group). In parallel with this work both the variometer station and the absolute observing instruments were tested and calibrated at Ebre observatory, in Roquetes (Tarragona, Spain). An assessment of the spatial homogeneity of the recorded variations, as well as of the particular observatory crustal anomaly biases are given in TORTA et al. (1999). Both the variometer, deployed in a set of $\delta D/\delta I$ coils and the absolute instruments were installed during December 1996, with continuous recording and the absolute observing program beginning on December 7, 1996.

In the previous bulletins (e.g., MARSAL et al., 2015), the measurements made between that date and February 2015 were summarized, as well as the data processing and the main incidents occurred. As this site is only manned during the austral summer, all staff departs at the end of February each survey, but the magnetometers are left recording in automatic mode. We retrieve the data recorded throughout the winter at the beginning of the next survey season. Our activity during the 2015-2016 survey covered the period between December 18, 2015 and February 21, 2016.

Data recorded at the observatory are transmitted via the GOES-E satellite to the INTERMAGNET Geomagnetic Information Node (GIN) at Ottawa, being them afterwards retrieved by the *Observatori de l'Ebre* and made available in its website: <http://www.obsebre.es/en/en-livingston>.

It is possible to obtain more information applying to:

Observatori de l'Ebre
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e_mail: smarsal@obsebre.es
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gsole@obsebre.es

2. POSITION

The installation of the observatory required the erection of three thermally isolated huts which had been prefabricated using non-magnetic materials. The location of the observatory was determined using the results of a study made by the *Instituto Geográfico Nacional* (CASAS et al., 1992) during the 1990-1991 Antarctic survey. The results of this magnetic survey showed the most appropriate site to be around the area named as Punta Polaca, located to the west of the Station settlement and approximately 350 m away from the main base. Located at this position, the site is far enough from the settlement to avoid man-made disturbances. One hut houses the Proton Vector Magnetometer (PVM); the second contains the control electronics and the data acquisition system; and the third accommodates the D/I fluxgate theodolite for the absolute observations. During the 2007-2008 survey a new hut was added up, which houses a tri-axial fluxgate magnetometer (FGE).

The coordinates of the absolute pillar are:

Geographic latitude	62°	39'	44" S
Geographic longitude	60°	23'	41" W
Height above msl	19.4 m		
Geomagnetic latitude*	53°	29'	28" S
Geomagnetic longitude*	9°	26'	36" E

*Geomagnetic coordinates are calculated using the 12th generation of the International Geomagnetic Reference Field (IGRF) at epoch 2015.0, after the conversion of the above geodetic coordinates into geocentric coordinates.

At a position 460 m to the west of the absolute pillar, a fixed mark was constructed which is used as the reference mark in the determination of declination. The angle viewed from the D/I pillar between the azimuth mark and the geographic north (i.e., the azimuth of the mark) is 90° 52' 04".

3. INSTRUMENTS AND OPERATION

3.1. VARIOMETERS

The two main instruments in the automatic magnetic observatory are a suspended tri-axial fluxgate (model FGE) and a Proton Vector Magnetometer (PVM), located in their respective huts.

The FGE, made by the *Danish Meteorological Institute* (DMI) (see details in DANISH METEOROLOGICAL INSTITUTE, 2006), includes three suspended fluxgate sensors arranged orthogonally on a stable support made of marble. In our case, this trihedron is oriented by the variometer frame in the direction of the local magnetic axes, H (North), E (East) and Z (Nadir). The analog output of this magnetometer is digitized by means of two 16-bit A/D converters sampling at both 1 and 0.1 Hz frequencies. The first one is set to a dynamic range of 3200 nT and a theoretical resolution of 0.05 nT, while the second one has a dynamic range of 6400 nT and a resolution of 0.3 nT.

The sensor of the PVM is made up of a Geomag SM90R Overhauser magnetometer intended to measure the total field intensity (F). This magnetometer is deployed at the centre of a pair of dual axis Helmholtz coils which are deployed parallel to the directions given by the local declination and inclination. By applying bias currents through these coils and measuring the resultant vectors, changes in declination, D, and inclination, I, may be obtained; reason by which its configuration is known as $\delta D/\delta I$. A complete cycle of PVM $\delta D/\delta I$ coil polarisations is needed for the process, which takes one minute in our case. The equipment was developed by the Geomagnetism Group of the British Geological Survey (BGS) in Edinburgh, though some technical aspects have been adapted to the evolving needs of observation by the Ebre observatory staff. Its technical details are described by RIDDICK et al. (1995), and a summarized description of its principles and operation by TORTA et al. (1997) and MARSAL et al. (2007).

Finally, there is an Overhauser magnetometer (GSM90-F1) which was placed near the existing instruments, but far enough to avoid interferences. This scalar magnetometer is sampled every 10 s (0.1 Hz).

All sampling and timing are carried out under the control of hardware based on a PIC 18F4550 microcontroller and a GPS receiver. The data acquisition, storage, monitoring and transmission processes are supervised using control software developed in C-language, which runs on a low power LINUX-based embedded PC (TORTA et al., 2009). These elements were duplicated during the 2010-2011 survey for a better support in case of failure. They are located in a third hut, which also accommodates the electronics that generates stable currents to the $\delta D/\delta I$ bias coils of the PVM, as well as the power supply for the whole station.

3.2. ABSOLUTE OBSERVATIONS

An ELSEC 810A D/I-fluxgate theodolite is used for the absolute measurements of declination and inclination. It comprises a single axis fluxgate magnetometer sensor element mounted on a Zeiss 015B nonmagnetic theodolite.

The D/I observation procedure is based on the null-field technique to measure D and I. To remove the errors due to the misalignment of the magnetic axis of the fluxgate and the optical axis of the theodolite, as well as those due to the zero-field offset generated by the control electronics, the observations are made in four positions for each element (see, e.g., JANKOWSKI & SUCKSDORFF, 1996, TORTA et al., 1997, or MARSAL & TORTA, 2007). The observers during the 2015-2016 survey were Miquel Ibañez and Javier Carmona.

The total field intensity (F) in the absolute pillar is determined by a Gem Systems GSM19 Overhauser effect magnetometer. These measurements are sporadic because the D/I-flux needs to be replaced by the above mentioned magnetometer to carry them out. Several series of F measurements are performed during the survey. In order to determine the F baseline, the simultaneous determination of F with a second scalar magnetometer left in continuous recording mode is needed. The second magnetometer, a GSM90-F1, has yielded a mean difference of -22.2 nT ($F_{\text{absolute pillar}} - F_{\text{GSM90-F1}}$) for this survey. In case of failure of the GSM90-F1, use is made of the SM90R, located inside the PVM. The mean difference in this case is -1.3 nT ($F_{\text{absolute pillar}} - F_{\text{SM90R}}$).

4. DATA PROCESSING

The preliminary data processing includes the detection and rejection of spikes in the data by comparing the values obtained with the different datasets: on the one hand, FGE values sampled at 1 and 0.1 Hz are compared, using the derivative of the differences between these two frequencies to highlight possible problems in the records. In parallel, the minute values from both variometers are compared, i.e., those of the FGE (mean minute values) and those of the PVM (spot values). Also, the total intensity F recorded every 10 s by the GSM90-F1 scalar magnetometer is compared with that derived from the three components of the fluxgate.

After the compilation of the absolute measurements series, the definitive baselines were determined. The following procedure was adopted to allocate them:

For each observed element F, D and I (or its equivalent in Cartesian coordinates), the absolute measurements were subtracted from the corresponding values of the PVM on the one hand, and from the FGE values on the other hand (giving rise to the observed differences or observed baselines). On these two series of differences, a sequential analysis was applied towards the determination of the adopted baselines. This process includes an analysis of a series of observable quantities that determine the validity of the individual absolute measurements, the rejection of outliers in the observed baseline values, and the most suitable interpolation of the accepted data according to a 5.5 days wide (sigma) Gaussian filter.

The observed differences and the corresponding baselines adopted for the FGE for the 2015-2016 survey are plotted in Figure 1. Although the baseline evolution during the period without absolute control is unknown, its present year-to-year stability should be noted, being the maximum variation between the two last surveys of about 1.8 nT in the H (magnetic North) component.

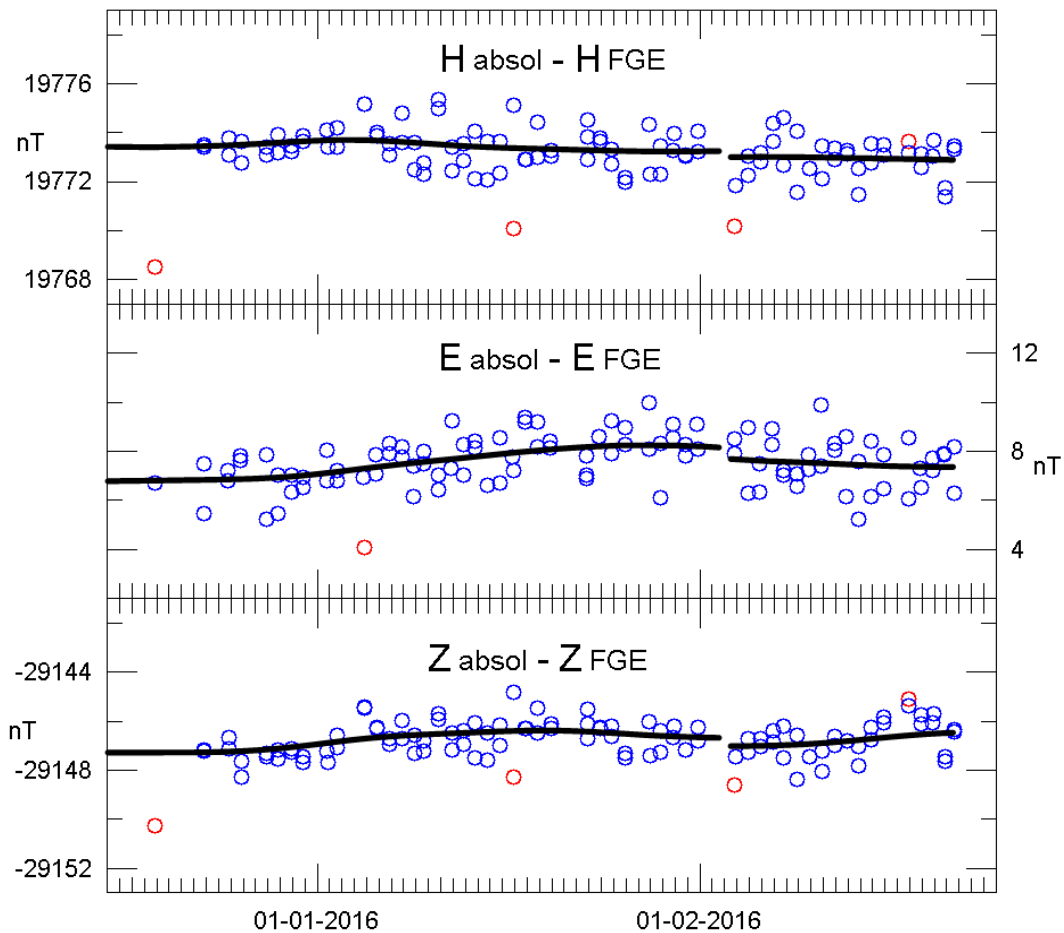


Fig. 1. Observed differences between the D/I-fluxgate and the FGE (blue circles) and adopted baselines (solid lines) for the elements H, E (local magnetic East) and Z. Red circles correspond to differences rejected before baseline adoption. Period corresponding to the 2015-2016 survey.

Taking into account the behaviour exhibited during the last surveys in which absolute measurements were made, the baselines adopted for the period in between are linear functions with the necessary slopes to pass from the adopted differences at the end of the penultimate survey to those at the beginning of the last one (Figure 2).

By adding the baselines to the vector magnetometer values (and thus translating the vector data to the absolute references) both the definitive minute values of the PVM and the 1- and 10-second values of the FGE magnetometer were produced. The final data reported through December 31, 2011, were obtained using the PVM as a semi-absolute instrument, translating the measures of the FGE until the level of the PVM in a time window of one-hundred minutes around the minute of interest. This decision was justified considering the PVM as the most stable variometer against temperature variations. However, a study comparing the data from both variometers (FGE and PVM), with data from a relatively nearby station, Argentine Islands (AIA), revealed that the FGE had a dependency on temperature similar, if not lower, than that of the PVM (see details in MARSAL et al., 2013). Such a finding restated the data processing and it was decided to use the FGE as the only variometer since January 1, 2012. The PVM will thus be used as a backup variometer in case of breakdown or prolonged lack of FGE data. This new procedure should not differ from the former one in more than a few tenths of a nanotesla in the reported magnetic components during the survey season; however, it could give rise to differences of up to a few nanoteslas during the winter season, when no absolute control is carried out. During the period that covers this bulletin, and due to the serious problems of power supply from the base, the PVM data have been used to recover numerous short gaps, both during the survey and during the winter. Thus, some dispersed hours have been recovered in March and June 2015 and in January and February 2016.

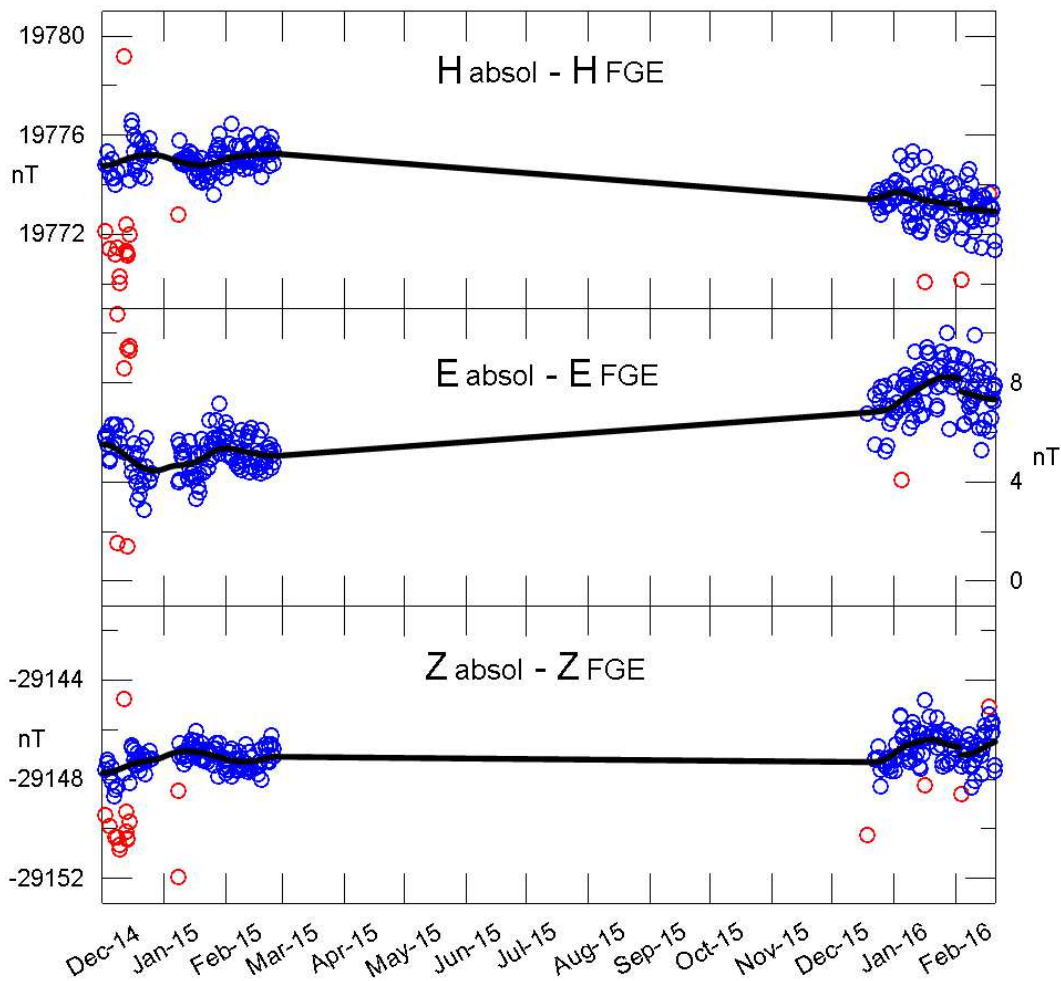


Fig. 2. As the previous figure but for the complete recording period from December 2014 to February 2016.

5. INCIDENTS AND ACTIONS

In this section we list the most important incidents on the data occurring on the time span to which this bulletin corresponds.

- As it was suspected from the evidences provided by the satellite transmission, the alternative energy system in the base collapsed between 5 and 7 March 2015, a few days after the end of the 2014-2015 survey. Transient overvoltage spikes involved the misconfiguration of the A/D converter responsible for the 1 Hz sampling of the FGE, as well as the fault of one of the embedded computers storing the data, and the acquisition did not recover until the arrival of the *Observatory de l'Ebre* staff at mid-December, 2015. The 0.1 Hz spare samplings and those of the $\delta I/\delta D$ variometer are also scarce. Specifically, it has been possible to recover a total of 15 days in March, 7 days between late May and early June, and two days in October, besides certain isolated intervals during the winter, all of them shorter than one day.
- Once the 2015-16 survey started, a series of breakdowns in the power supply system from the base led to a power cut between 19 and 21 December 2015. No data are available during this period.
- Because of a problem in a DC/DC converter, data acquisition is interrupted between January 26 and 27, 2016.

- Accidentally, on February 1, 2016, the machines that carry out remodeling works at the Spanish station caused an overvoltage by cutting the power supply line. The wire was repaired a few hours later, but the transitory surge of the incident affected the A/D converter of the 1 s FGE data, which remained saturated. The data was retrieved on February 2, once the damaged converter was replaced. As a result of accessing the FGE hut and moving the electronics, a small jump in the baselines of this variometer was produced (see Fig.1).
- The works of construction of the concrete base of a new hut, which is expected to house an automatic DIFlux the next year, were carried out throughout the 2015-2016 survey. The magnetic disturbances caused by the works are minimal, and have been properly removed from the definitive records.

Unfortunately, throughout the year 2015 and the 2015-2016 survey a total of 391753 minutes (which is about 272 days or 65 % of the whole dataset) corresponding to the X, Y and Z elements were lost, while 391652 minutes (272 days) were lost in the case of F. The longest gap took place between late June and mid-October 2015.

6. PRESENTATION OF DATA

The annual mean values for all magnetic elements obtained during the last ten years are presented in Table 1. Since the adopted baselines of Figure 2 for the period without absolute measurements might differ from the actual ones, in Table 2 we give the means corresponding to only the periods with absolute references, basically corresponding to the means over December, January and February of each Survey.

Year	D	H	Z	X	Y	I	F
2006.5	14° 36.3'	20072	-29471	19423	5061	-55° 44.5'	35657
2007.5	14° 33.5'	20025	-29414	19382	5034	-55° 45.2'	35583
2008.5	14° 30.4'	19970	-29347	19333	5002	-55° 46.0'	35497
2009.5	-	-	-	-	-	-	-
2010.5	14° 25.6'	19856	-29214	19230	4947	-55° 47.8'	35323
2011.5	14° 23.5'	19799	-29147	19178	4921	-55° 48.7'	35236
2012.5	14° 21.6'	19743	-29076	19126	4897	-55° 49.4'	35145
2013.5	14° 18.8'	19691	-29002	19080	4868	-55° 49.5'	35055
2014.5	14° 15.8'	19638	-28934	19033	4839	-55° 50.1'	34969
2015.5	-	-	-	-	-	-	-

Table 1. Annual mean values for all magnetic elements. H, Z, X, Y and F are given in nT units. The prolonged lack of data during the last winter season prevents allocating reliable mean values for the year 2015.5.

Year	D	H	Z	X	Y	I	F
2007.0	14° 35.0'	20048	-29438	19402	5048	-55° 44.6'	35616
2008.0	14° 31.8'	19999	-29372	19359	5018	-55° 45.0'	35534
2009.0	14° 28.9'	19950	-29310	19316	4989	-55° 45.5'	35455
2010.0	14° 26.3'	19895	-29240	19267	4961	-55° 46.1'	35366
2011.1	14° 24.7'	19829	-29171	19205	4935	-55° 47.7'	35273
2012.0	14° 22.6'	19780	-29101	19161	4911	-55° 47.8'	35187
2013.1	14° 19.9'	19724	-29027	19110	4883	-55° 48.2'	35094
2014.1	14° 16.7'	19664	-28955	19057	4850	-55° 49.1'	35001
2015.1	14° 14.7'	19607	-28899	19005	4825	-55° 50.6'	34923
2016.1	14° 12.2'	19561	-28851	18963	4799	-55° 51.7'	34857

Table 2. Mean values for periods with absolute references. H, Z, X, Y and F are given in nT units.

The data presented below in this bulletin are:

- i) Three-hourly activity indices K , and daily indices SK (sum of K) and Ak . The former have been automatically calculated by the adaptive smoothing method recommended by INTERMAGNET (NOVOŽYŇSKI et al., 1991) on the basis of a K_9 value of 450 nT (lower limit for $K = 9$). ak indices are calculated in accordance with a recommendation of the IAGA WG V-5, in 1993 (see, e.g., BERTHELIER & MENVIELLE, 1993), according to which each three-hourly K -index from 0 to 9 corresponds to a linear variation of 2.5, 7.5, 15, 30, 55, 95, 160, 265, 415 and 666 nT, respectively. The ak index for each observatory is calculated by multiplying the previous values by the factor $K_9/500$ (= 0.9 for LIV). Finally, Ak corresponds to the daily average of the different ak 's. (Note: K indices should only be sensitive to magnetic perturbations arising from particle injection at high latitudes. However, this automatic index proves to be sensitive to radiative solar phenomena such as SFEs). Q and D stand for the five international Quiet and Disturbed days of each month, respectively.
- ii) Plot of the secular variation (i.e., evolution of annual mean values of the different elements of the magnetic field) at the LIV magnetic station since 1997. Note that the lack of data during the last winter season prevents the computation of the 2015.5 value.
- iii) Typical daily variation of D, H, Z elements for the different Lloyd seasons and for the whole year as a function of Universal Time ($LT \approx UT - 04$ h for LIV, where LT is Local Time and UT is Universal Time, in hours). Values have been detrended and referred to their mean values. Note that only the plots for the austral summer (Lloyd season D) are presented, corresponding to the period with data.
- iv) Month-at-a-glance daily magnetograms of declination (D), horizontal intensity (H) and vertical intensity, (Z).
- v) Month-at-a-glance daily magnetograms of total intensity (F).
- vi) Monthly tables of hourly mean values of D, H, Z and F. All means have been calculated from minute values.

The hodographs of the daily variation are not presented this survey due to the lack of data.

Definitive minute and hourly mean values are available in the World Data Centres (WDC) and in the *Observatori de l'Ebre* (www.obsebre.es/en/en-om-data-catalogs-livingston) websites, where definitive 1-second data, as well as daily and monthly mean values can also be found.

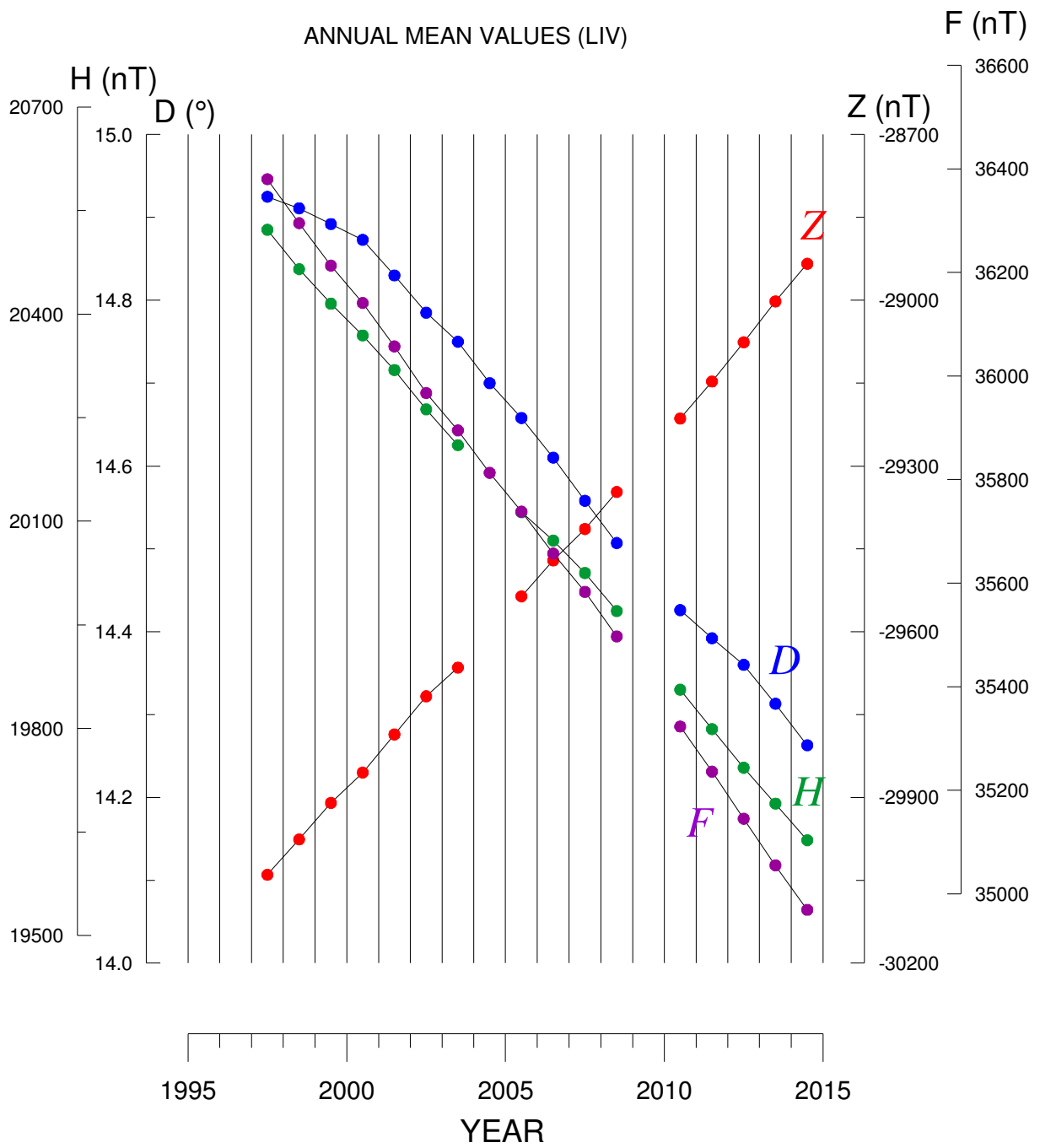
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be fundamental. The original design and development of the electronics governing the station was carried out by John C. Riddick, ex-member of the *British Geological Survey*, to whom we are particularly grateful for the time he has unselfishly spent with us.

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SECULAR VARIATION



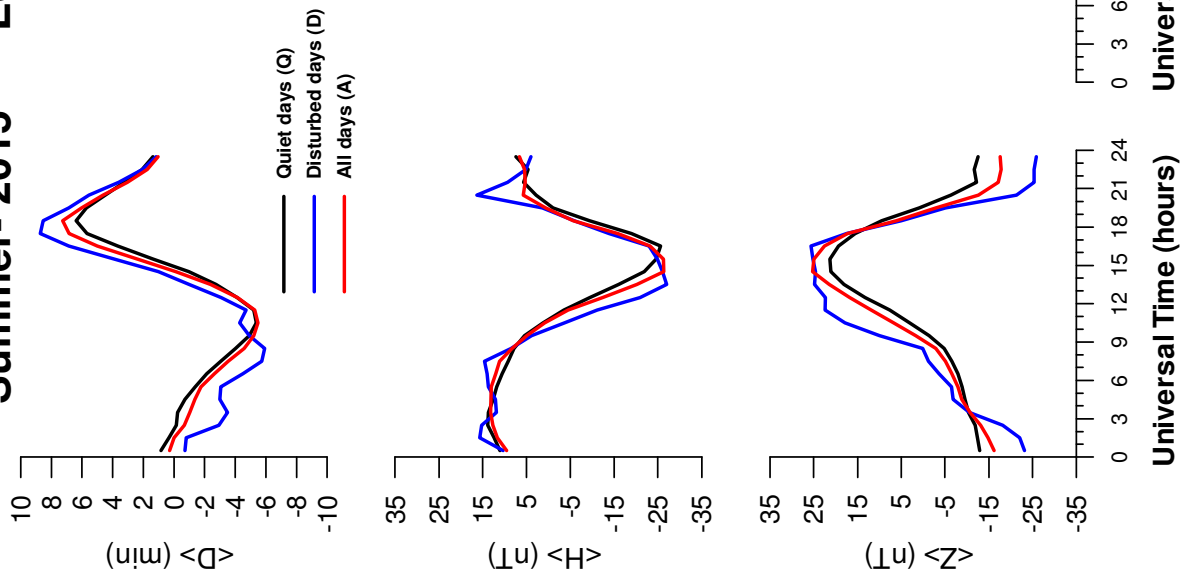
TYPICAL DAILY VARIATION

Year-2015

Winter-2015

Equinox-2015

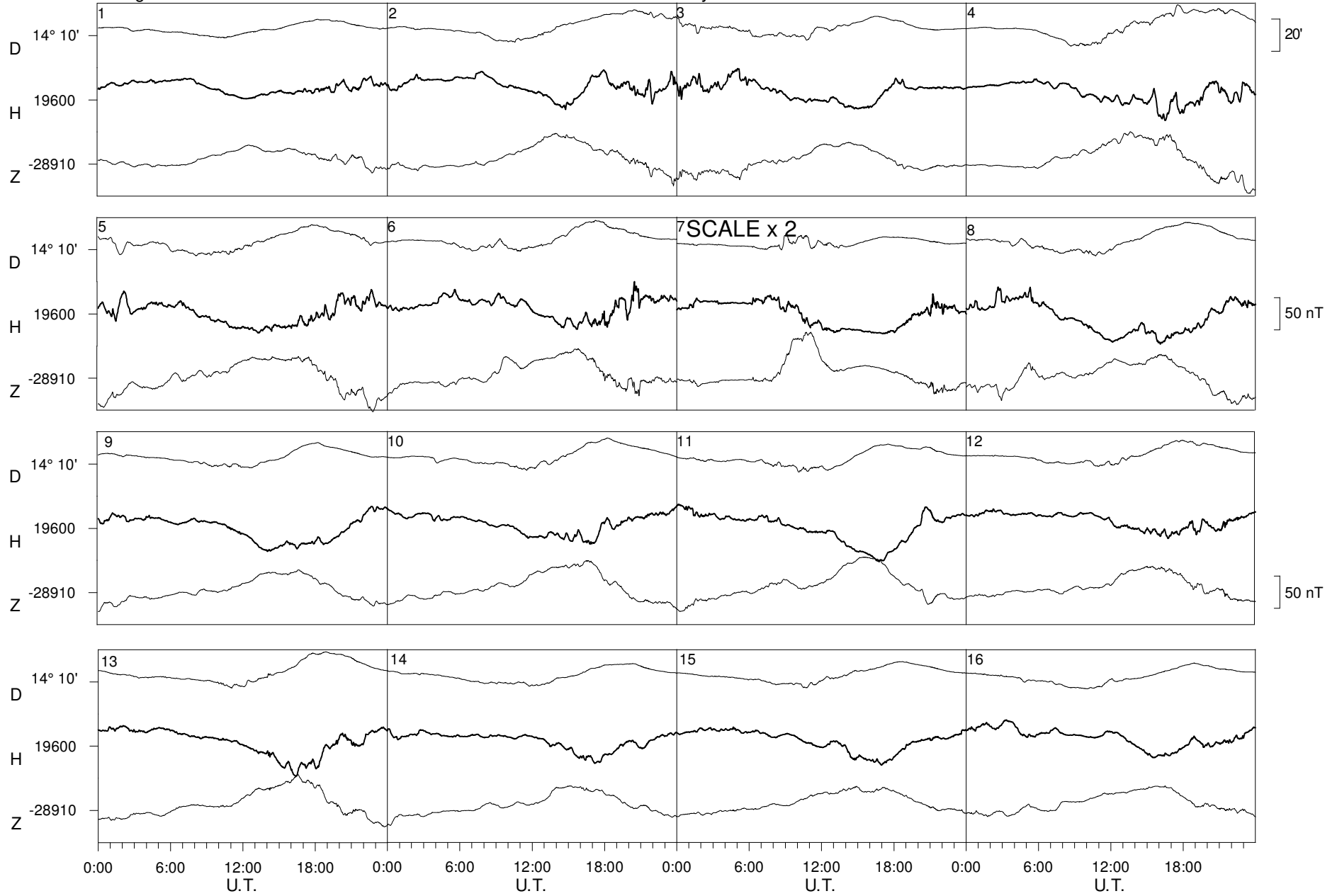
Summer- 2015



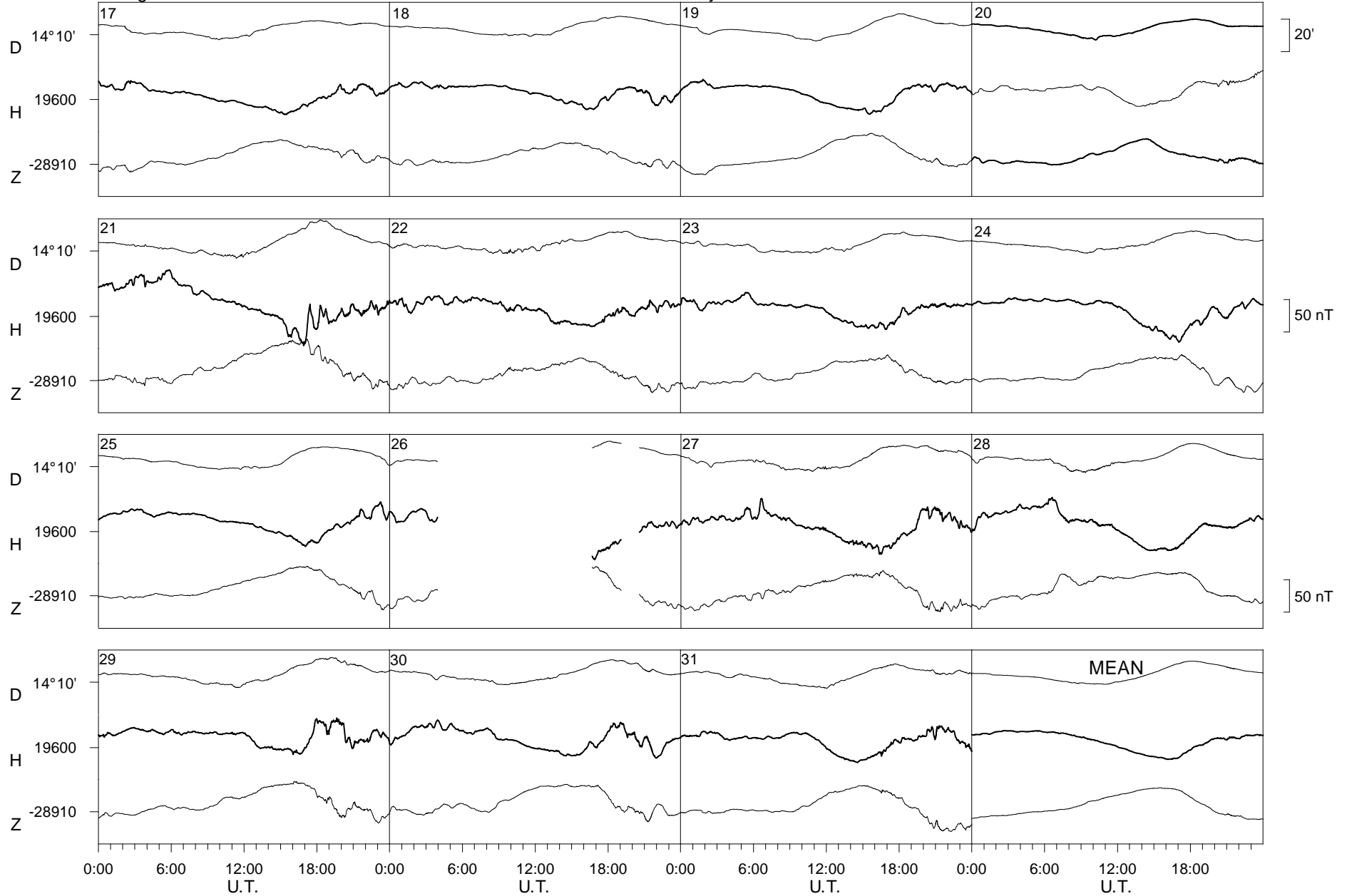
Livingston Island

January

2015



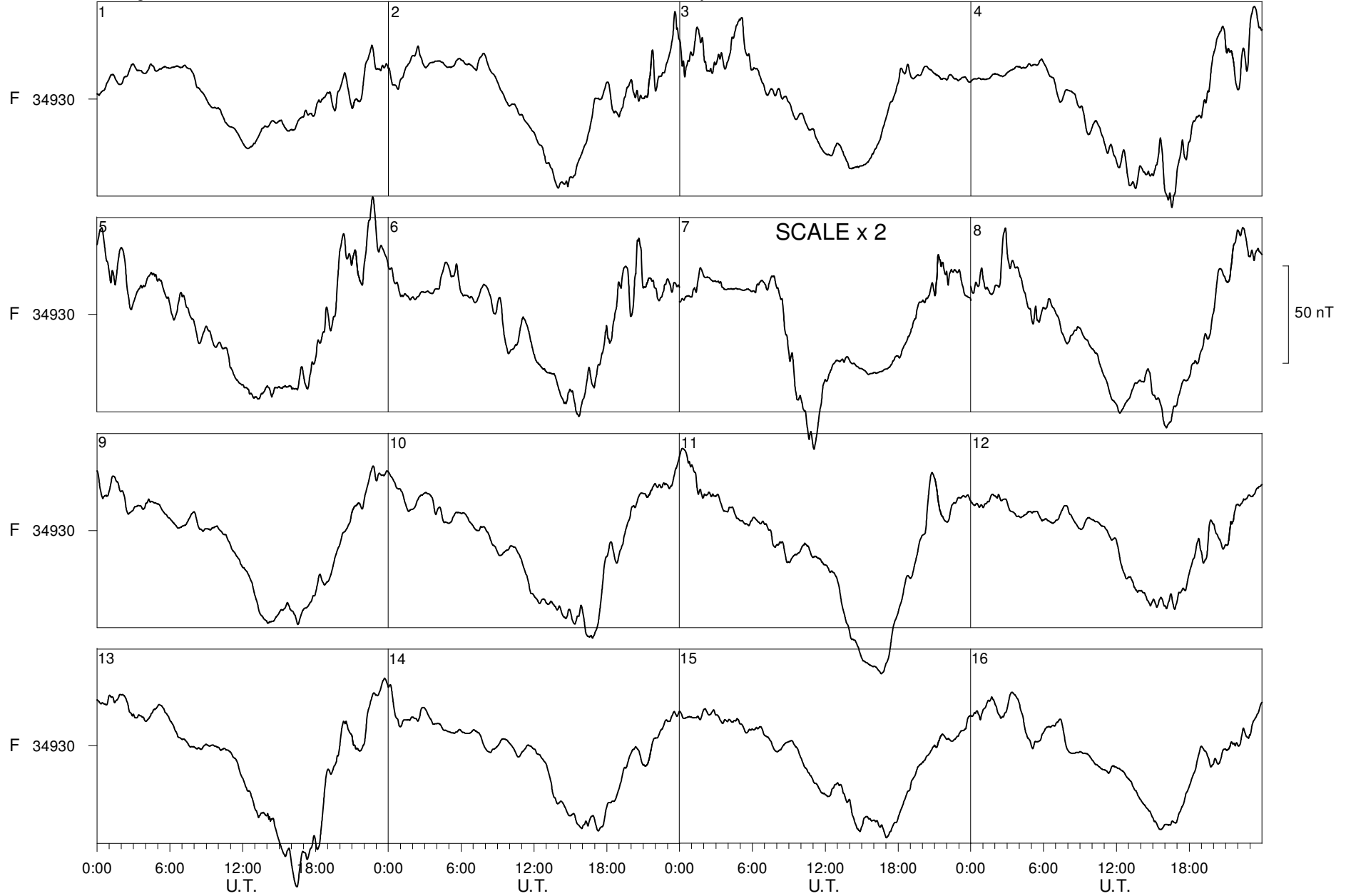
Livingston Island January 2015



Livingston Island

January

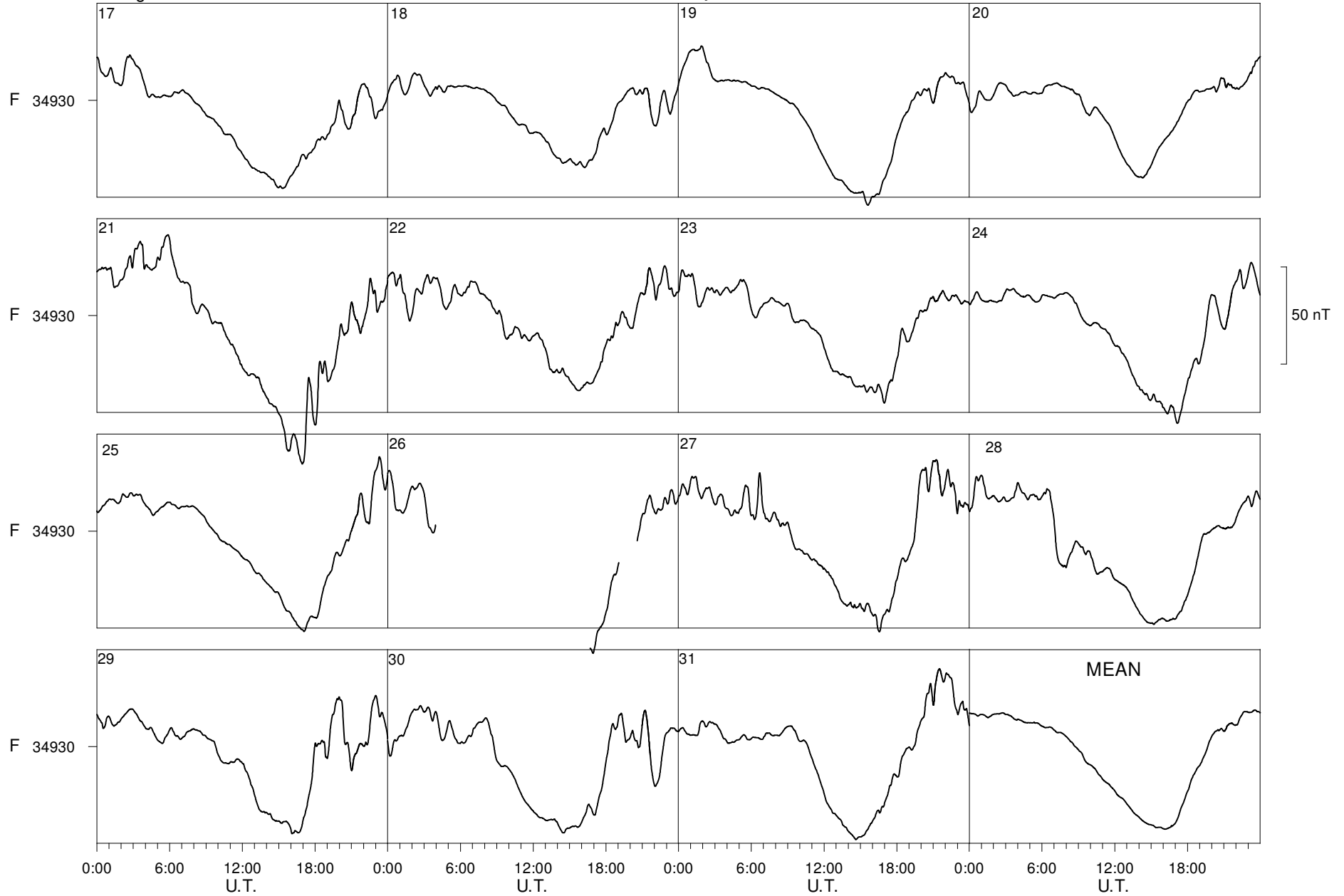
2015



Livingston Island

January

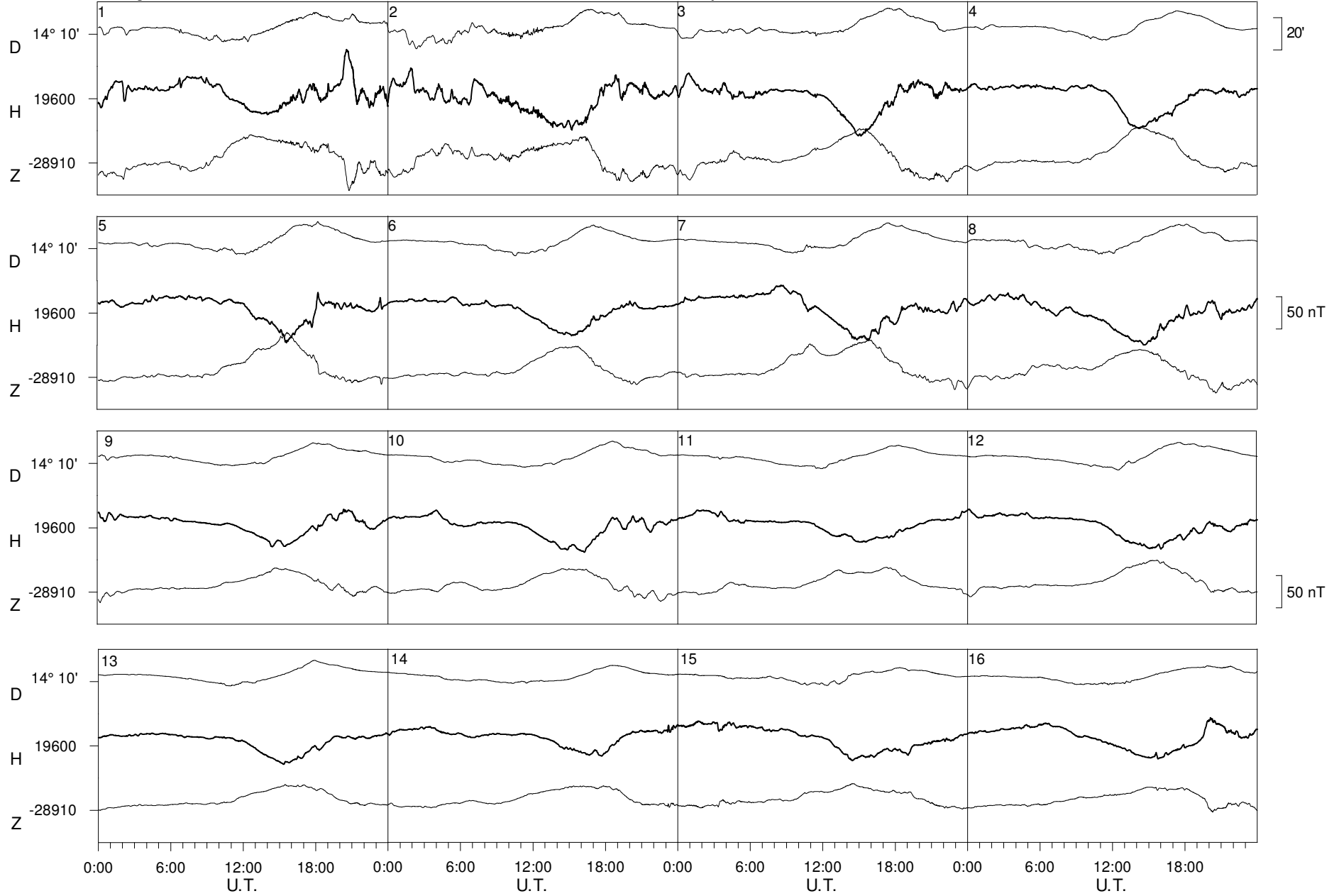
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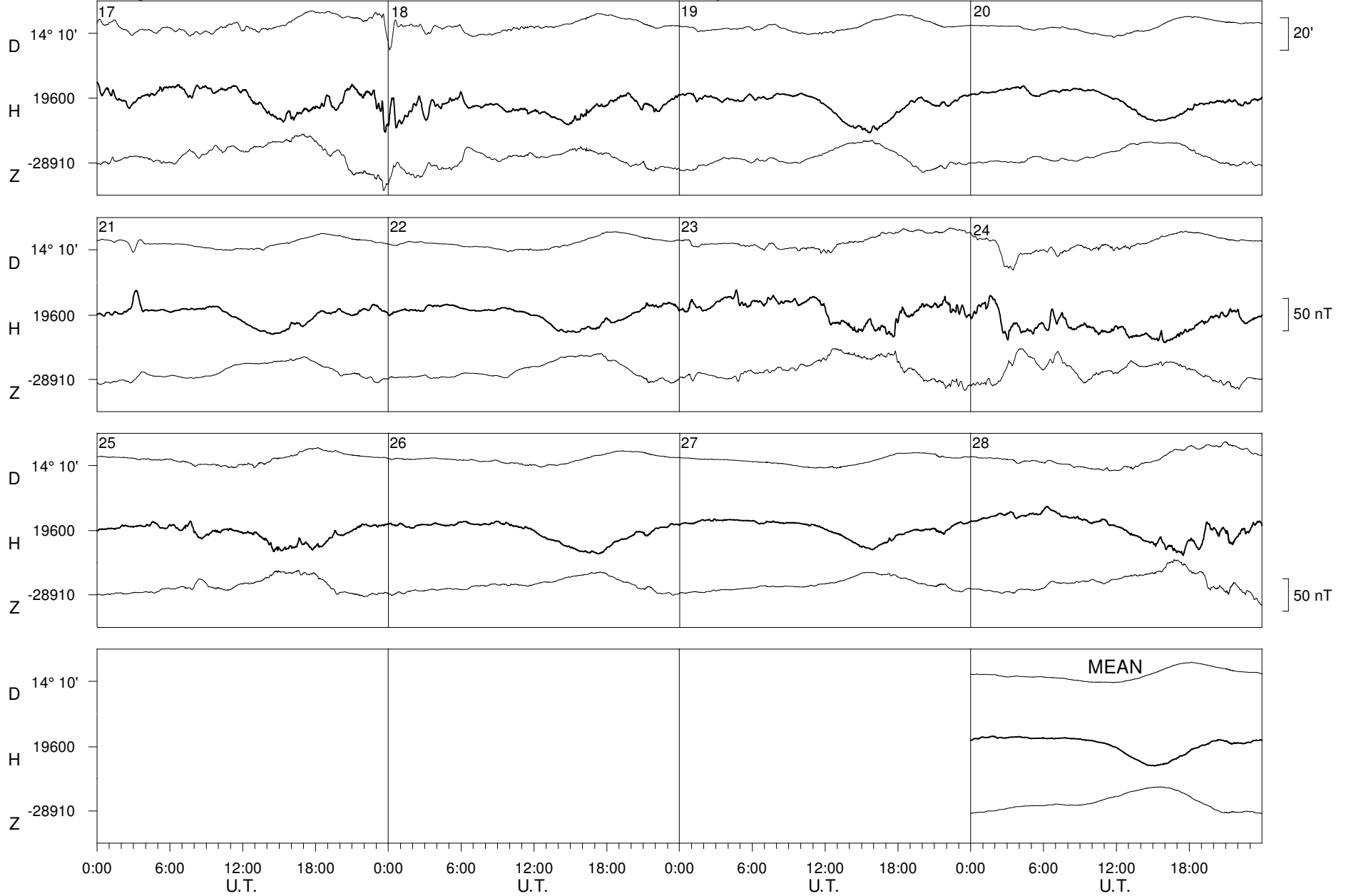
Livingston Island

February

2015



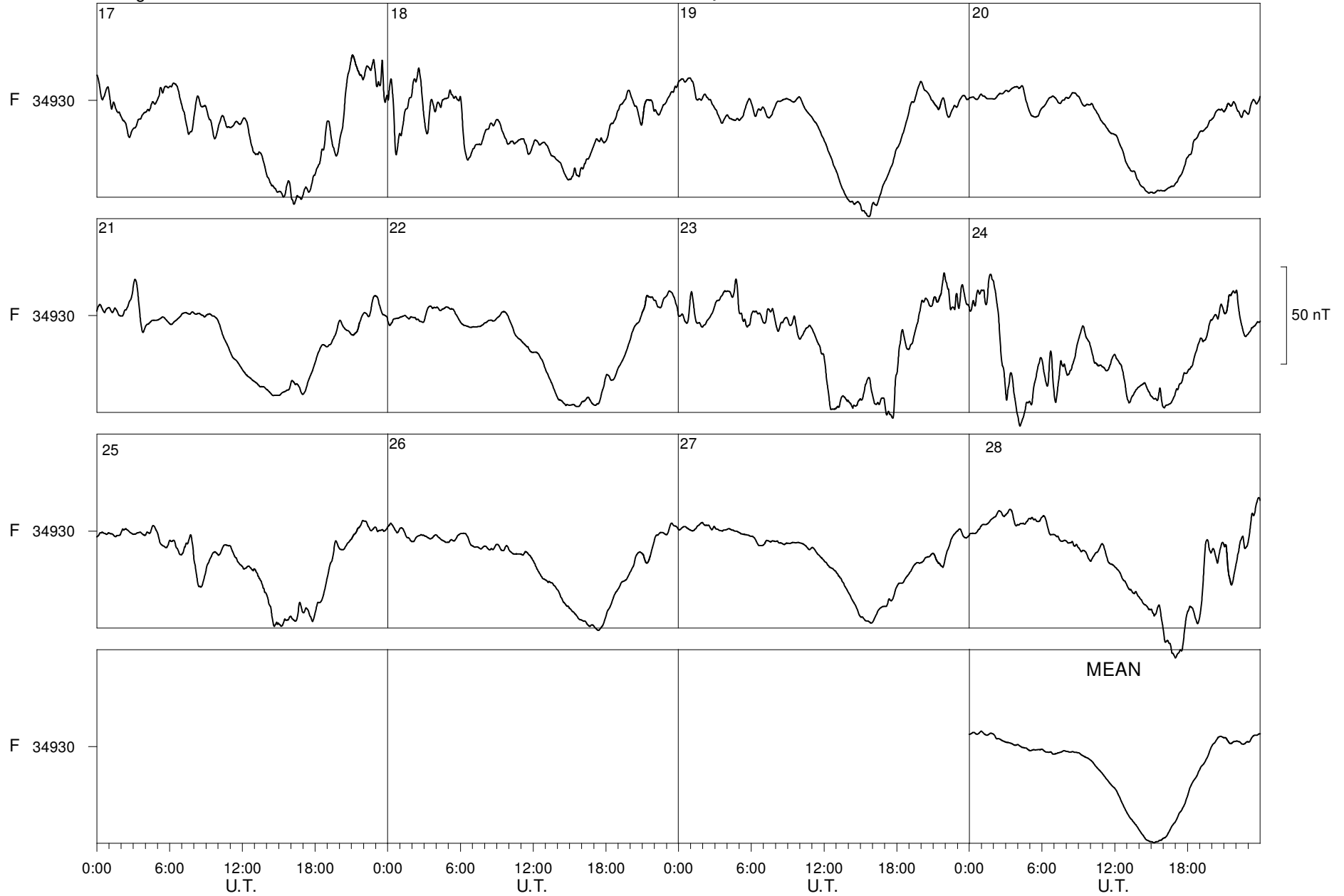
Livingston Island February 2015



Livingston Island

February

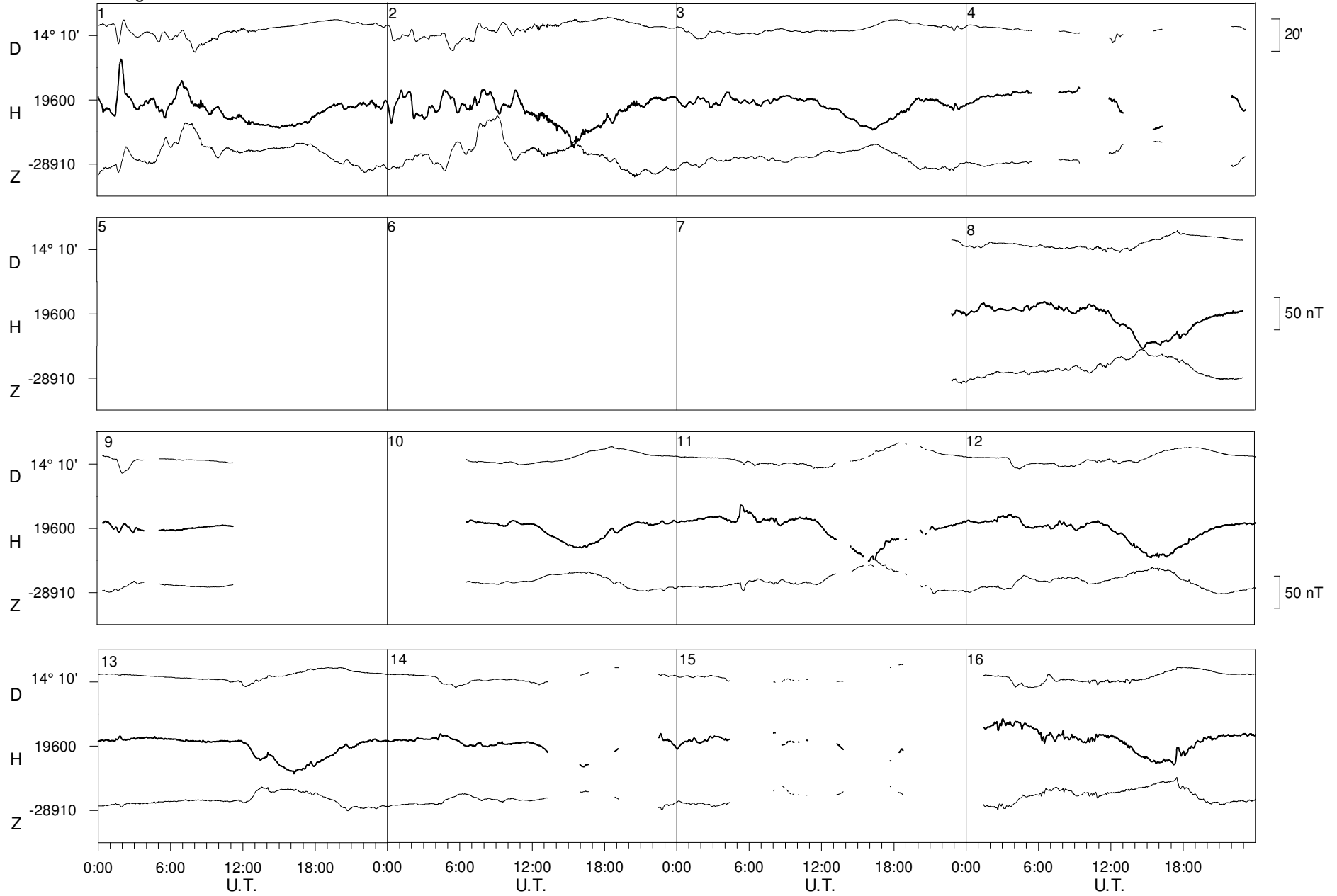
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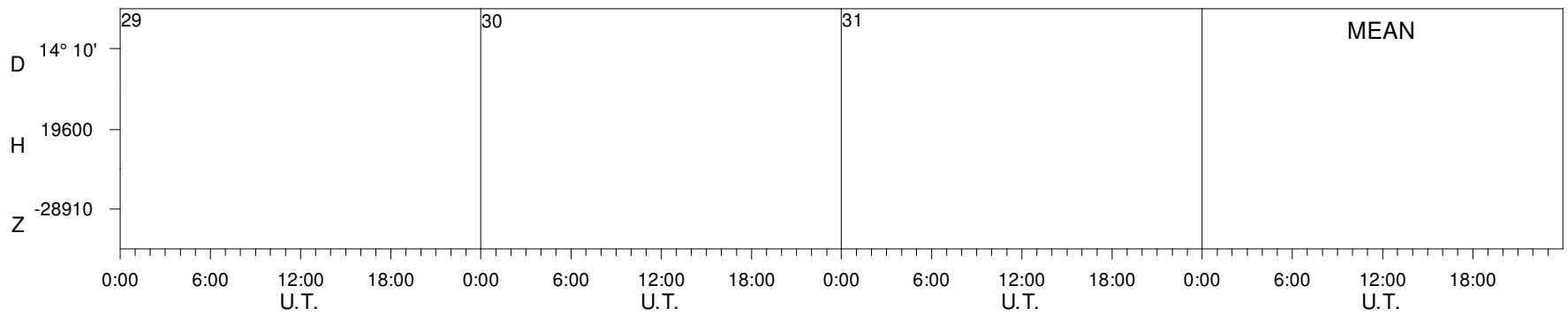
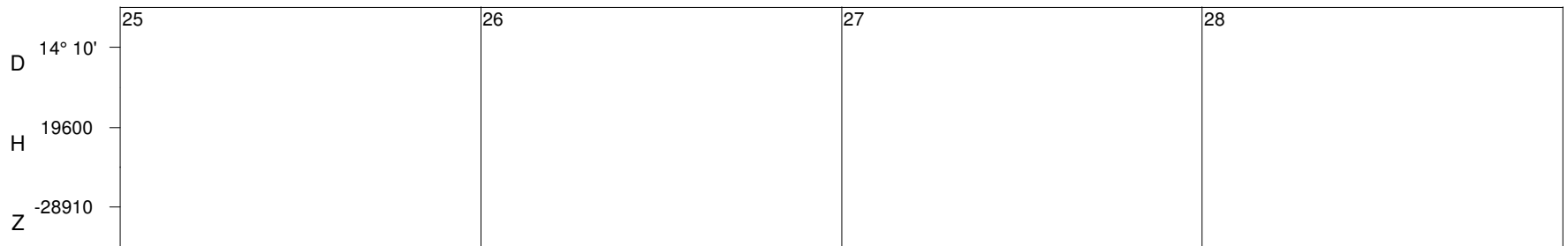
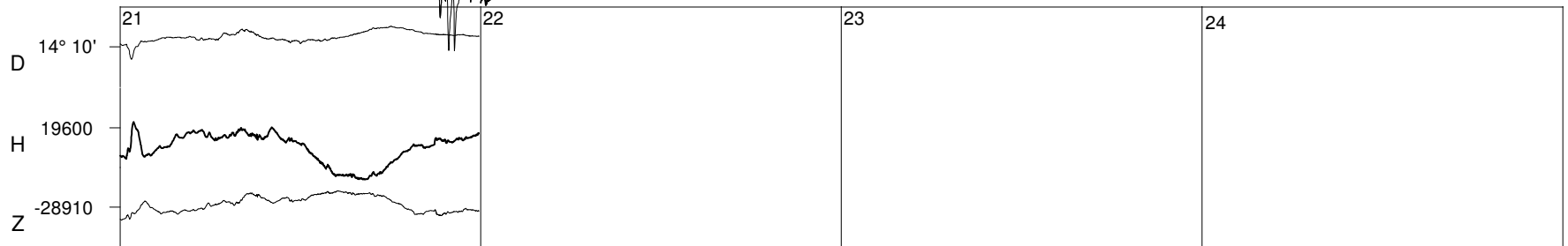
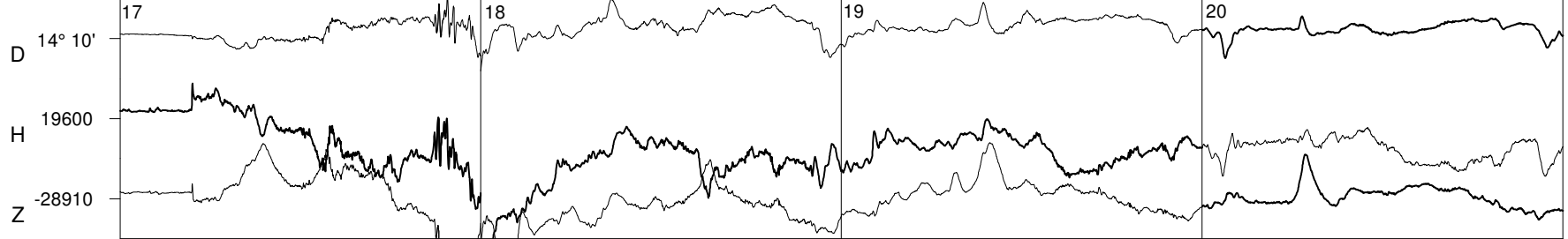
Livingston Island

March

2015



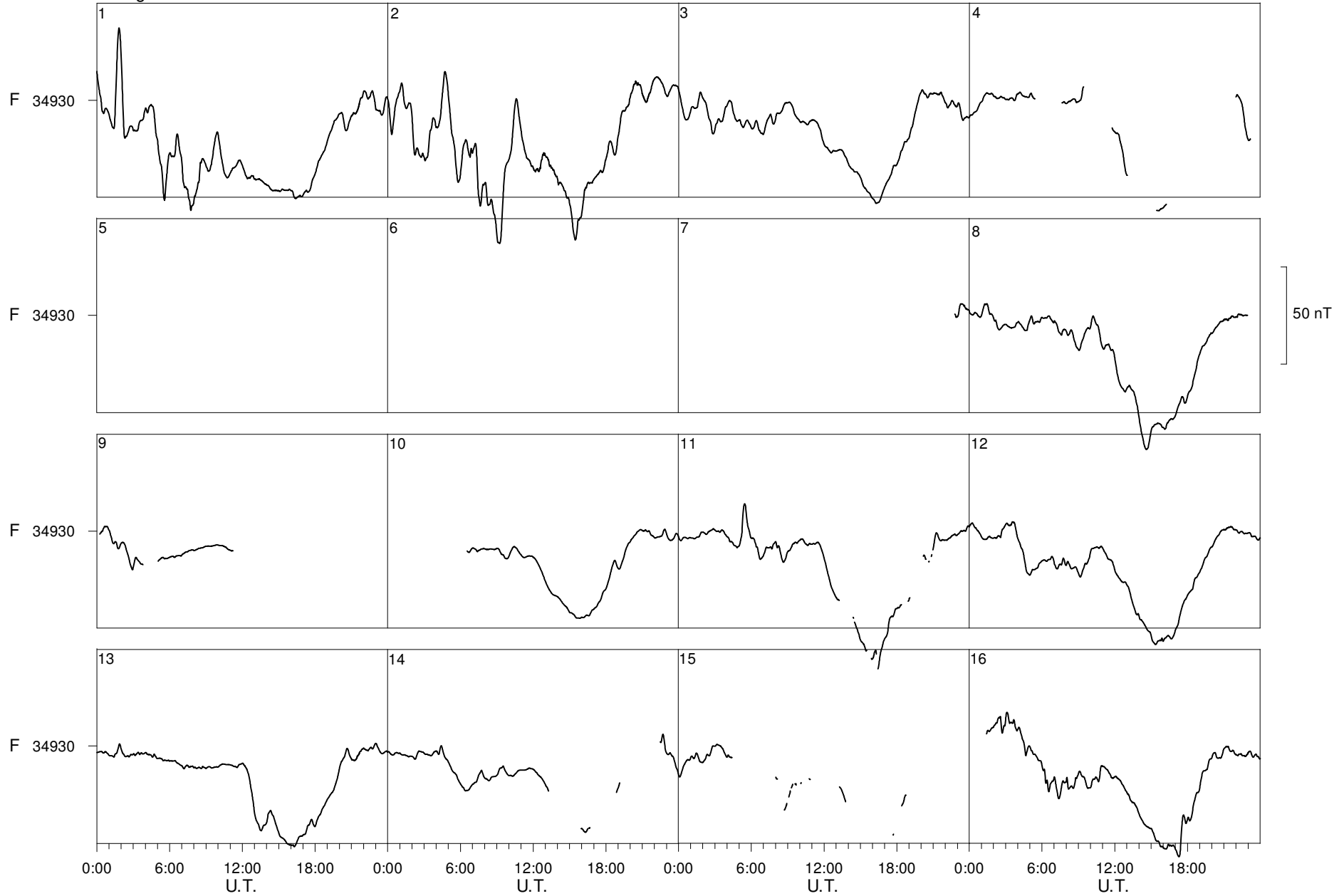
Livingston Island SCALE x 2 March 2015



Livingston Island

March

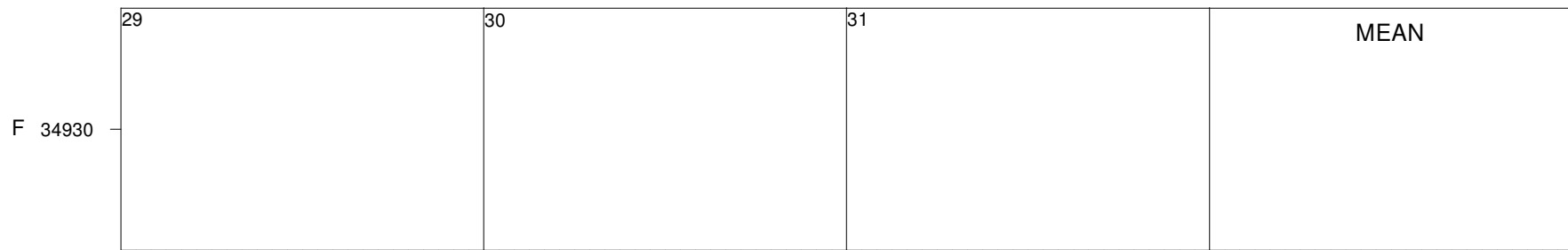
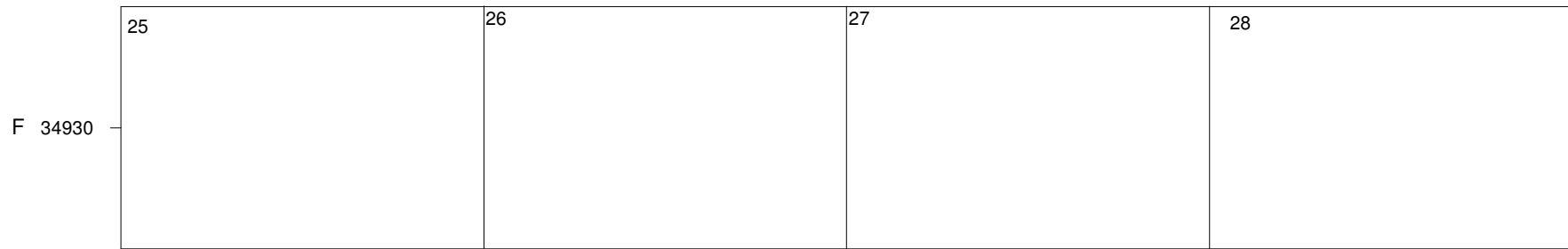
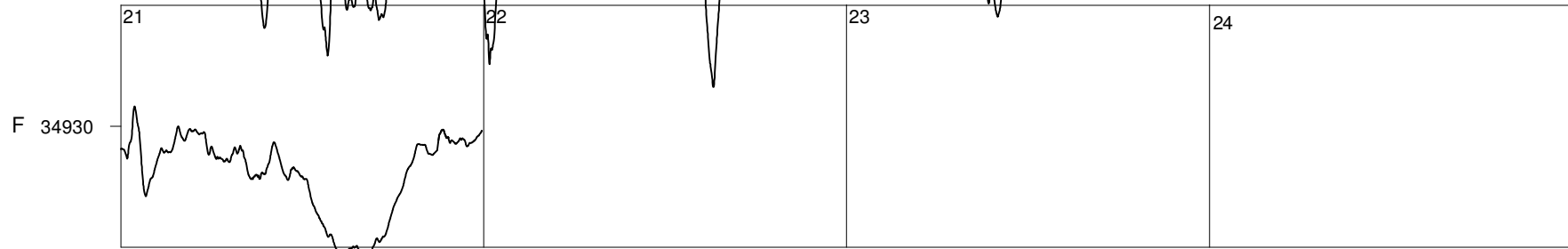
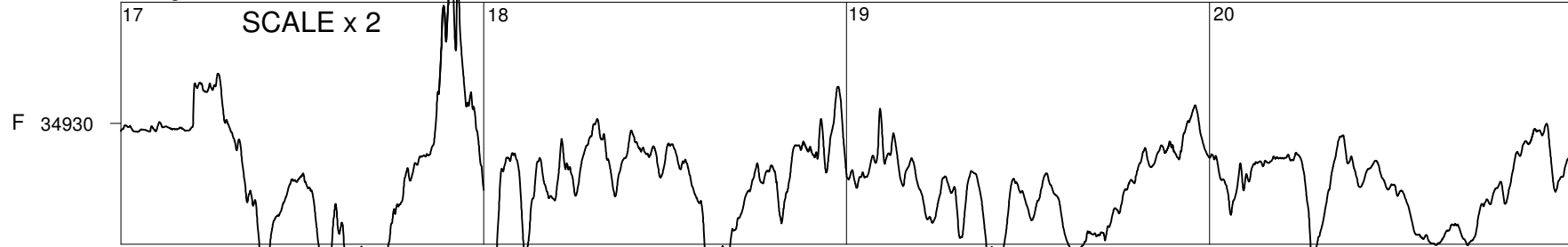
2015



Livingston Island

March

2015



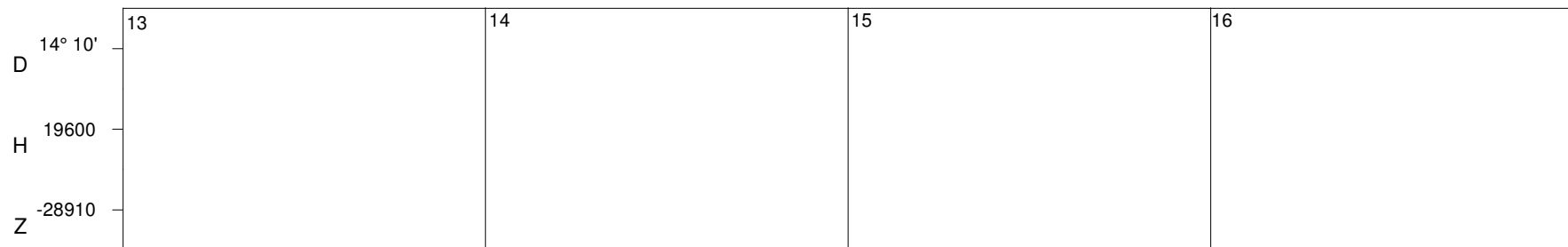
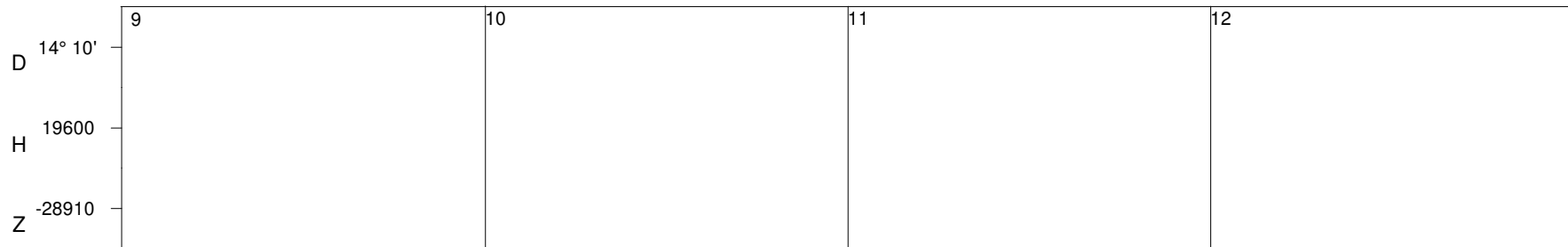
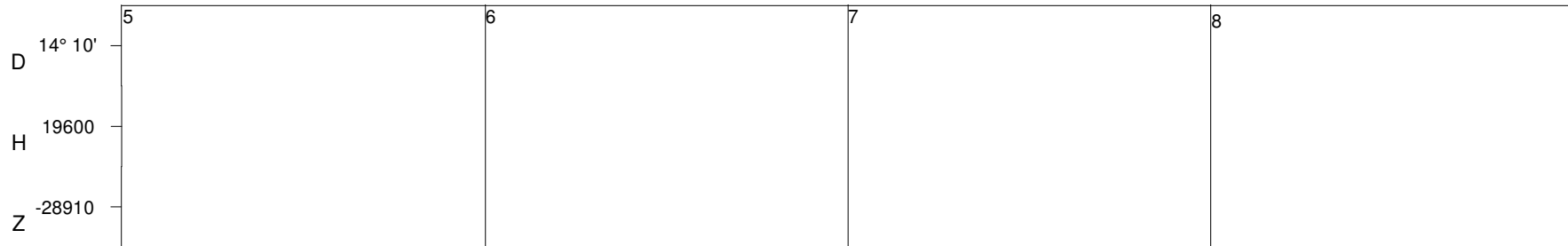
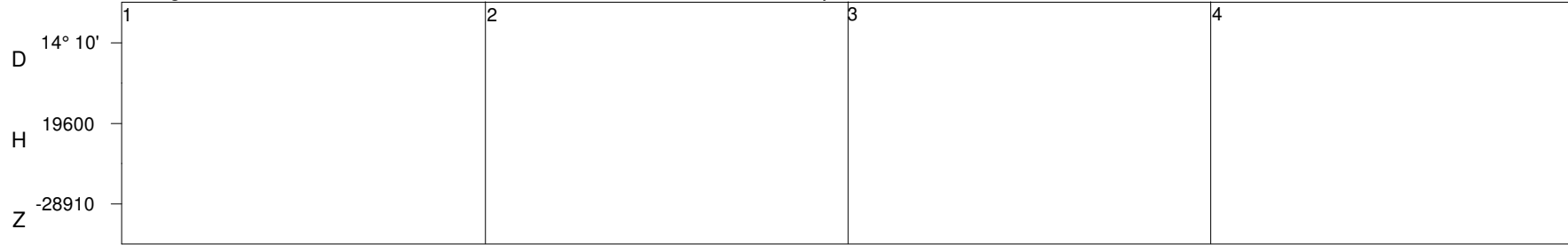
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Livingston Island

April

2015

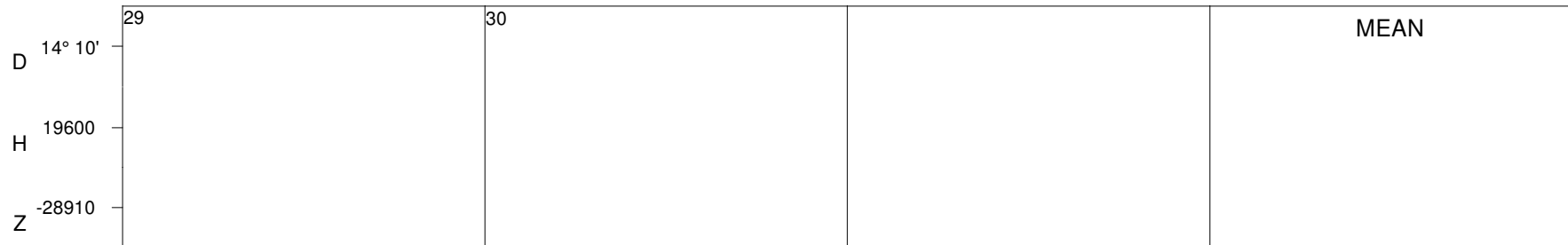
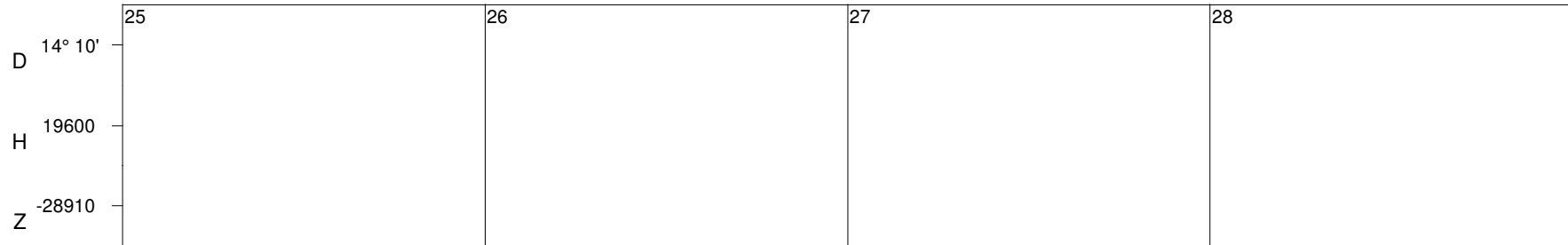
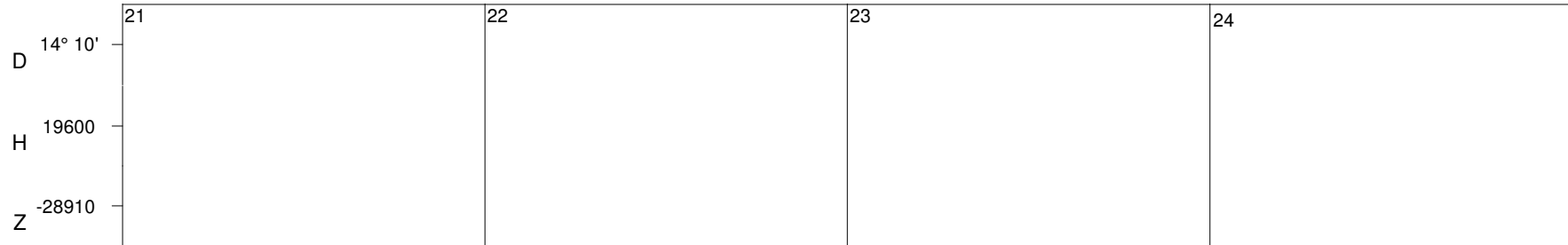
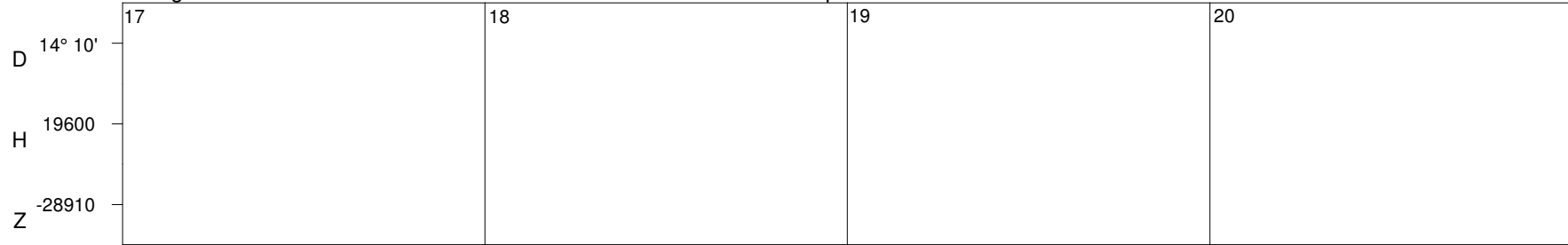


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Livingston Island

April

2015

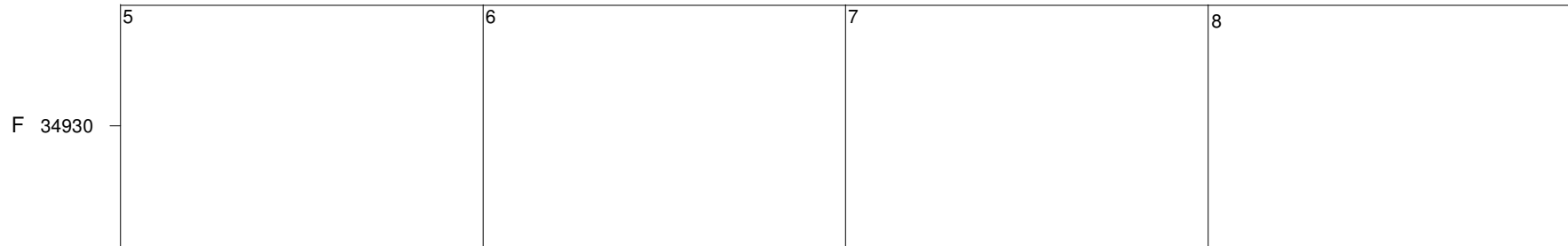
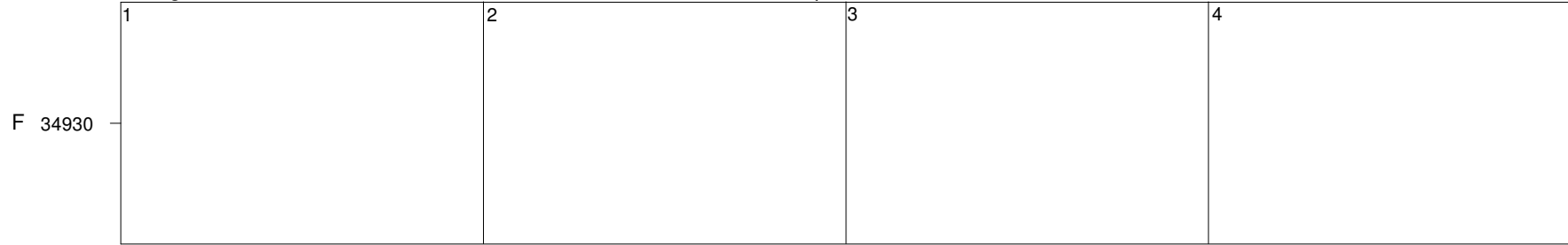


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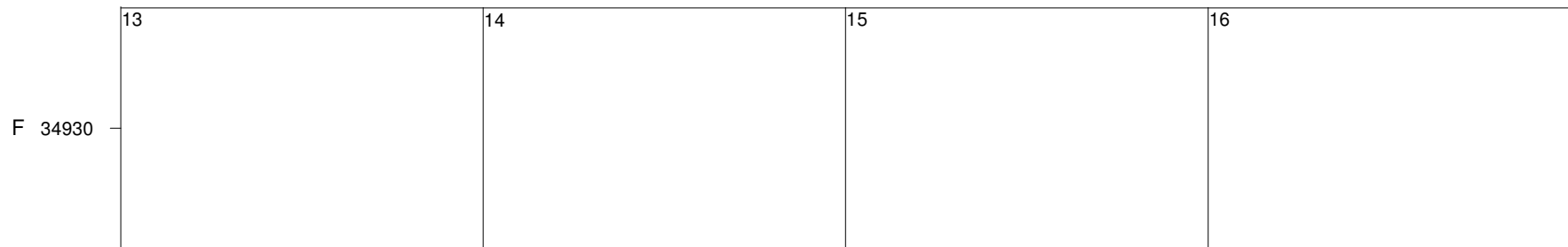
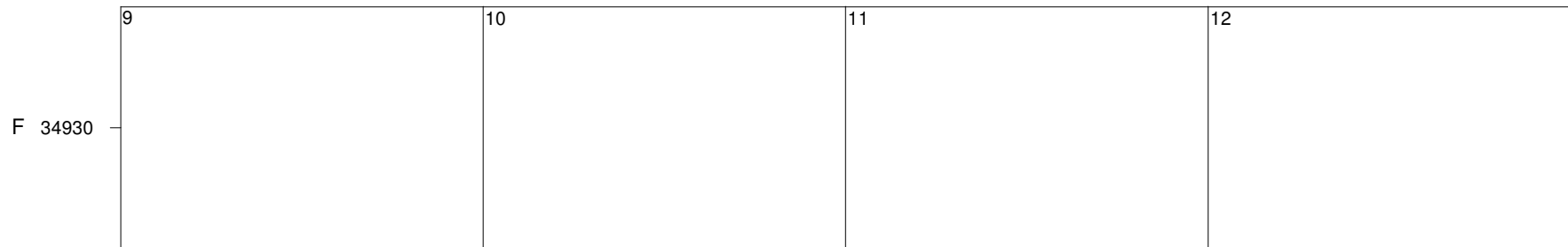
Livingston Island

April

2015



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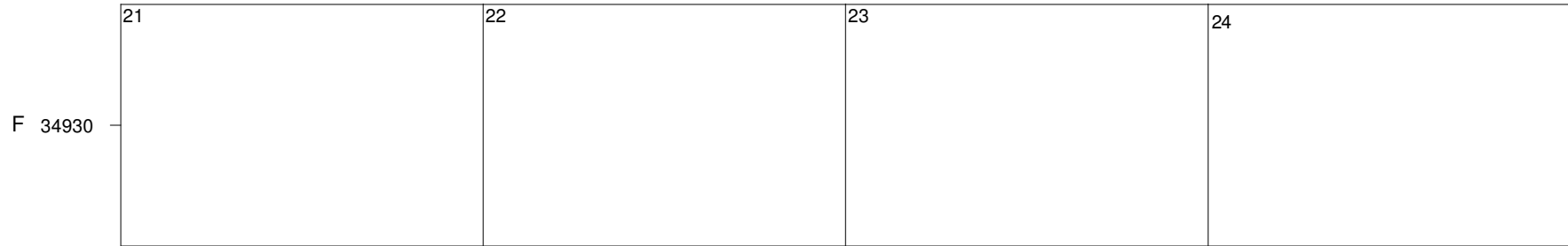
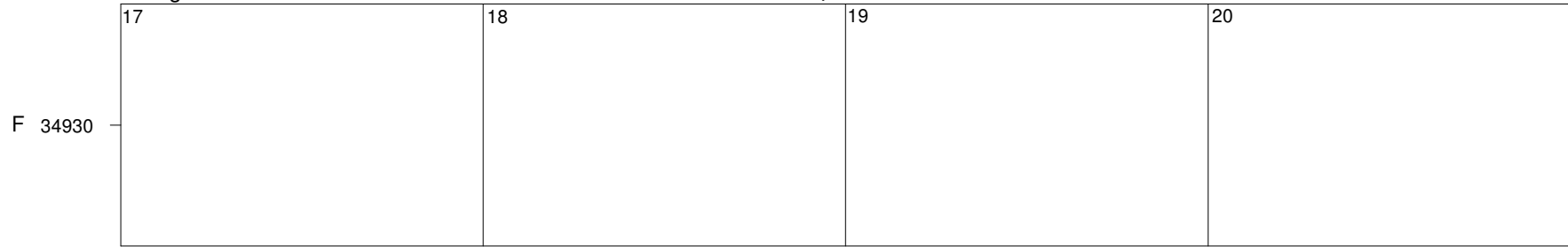


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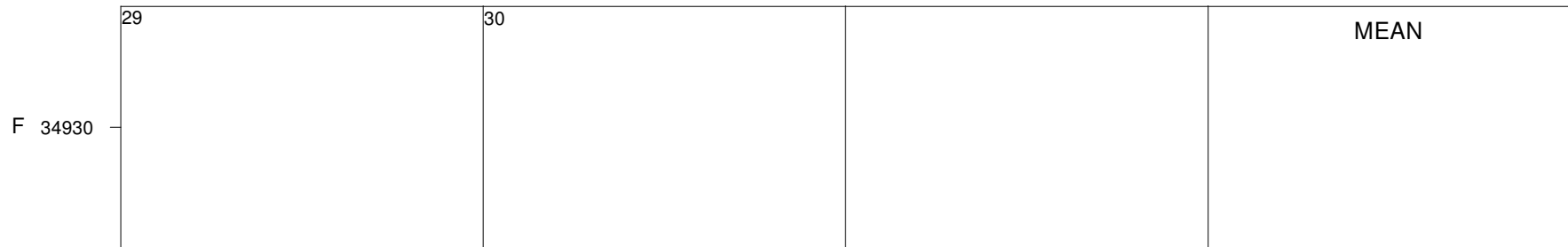
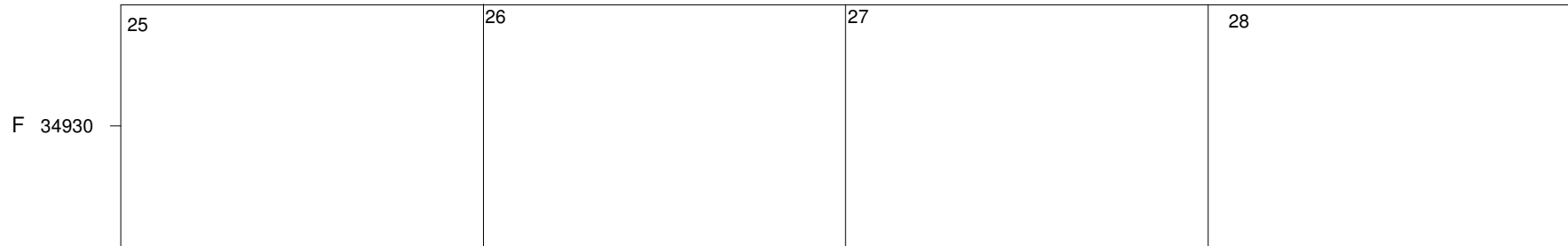
Livingston Island

April

2015



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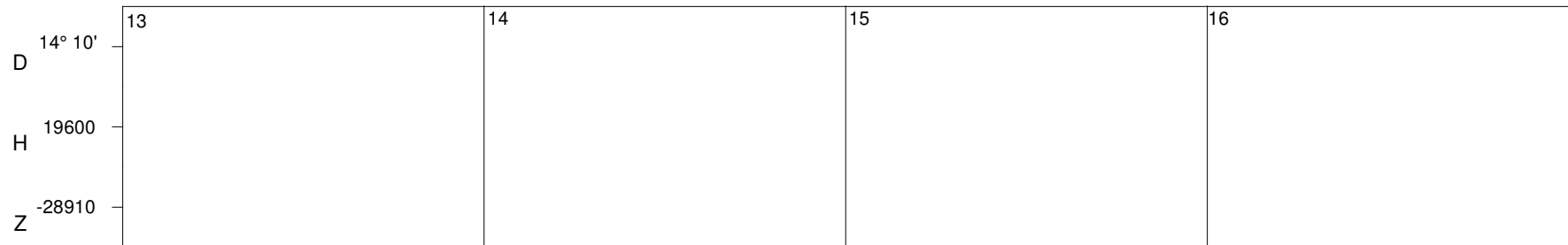
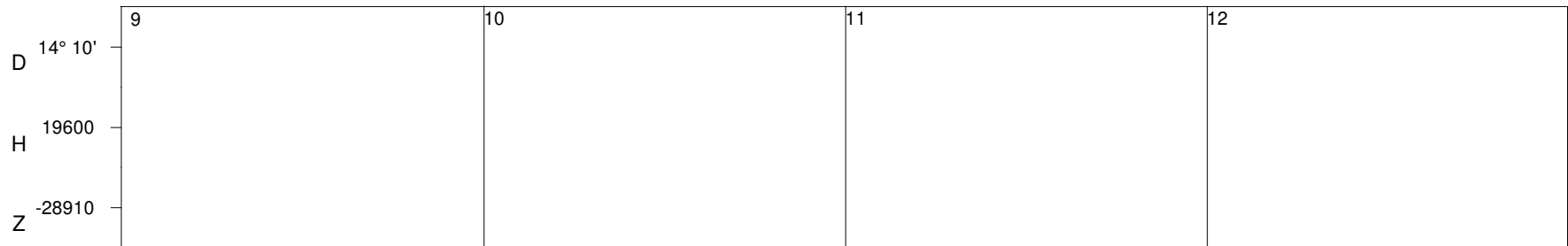
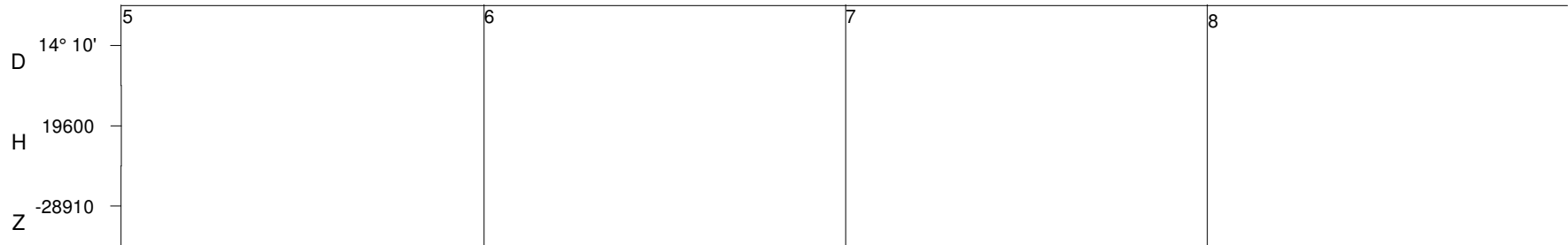


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Livingston Island

May

2015

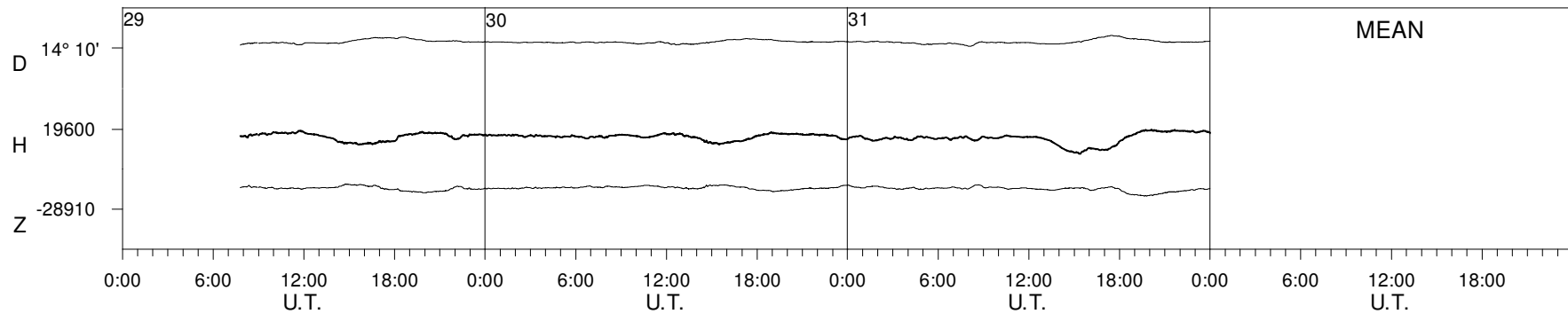
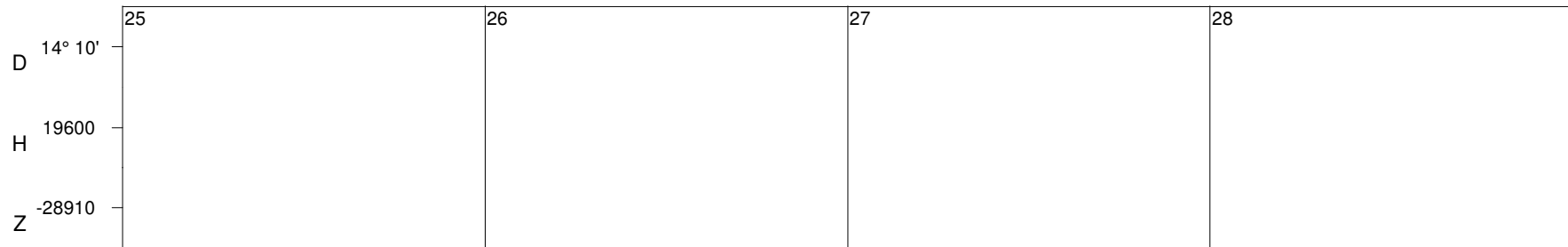
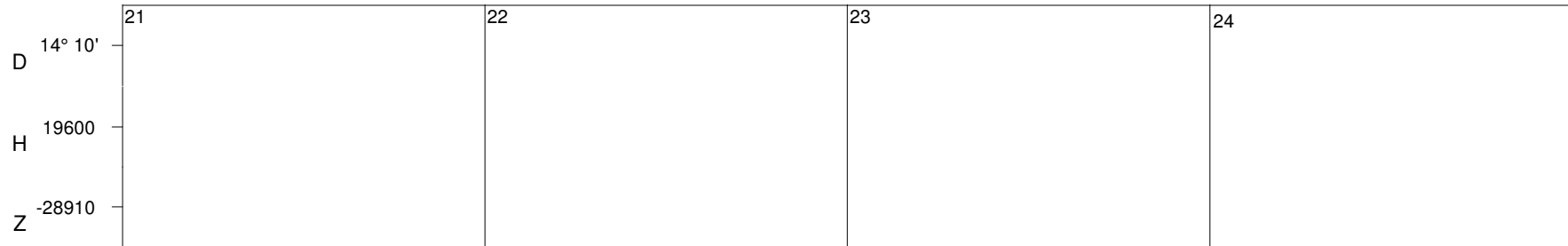
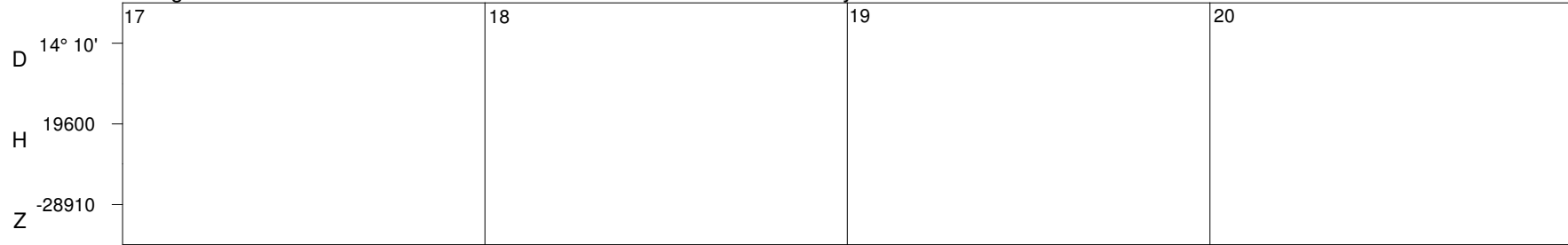


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Livingston Island

May

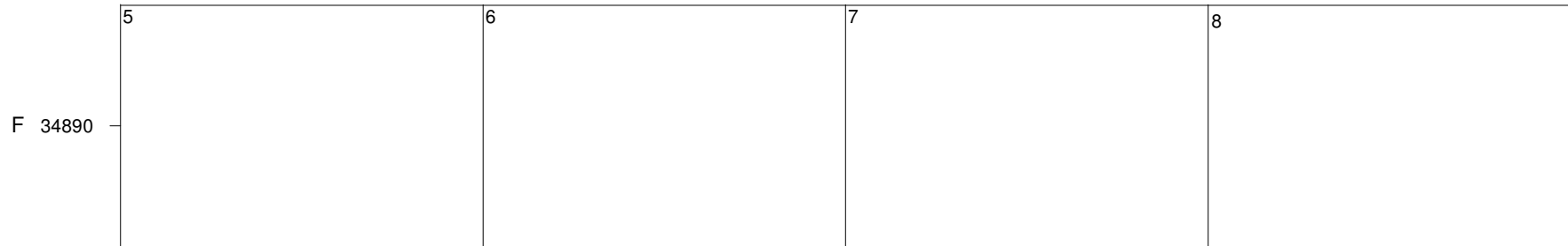
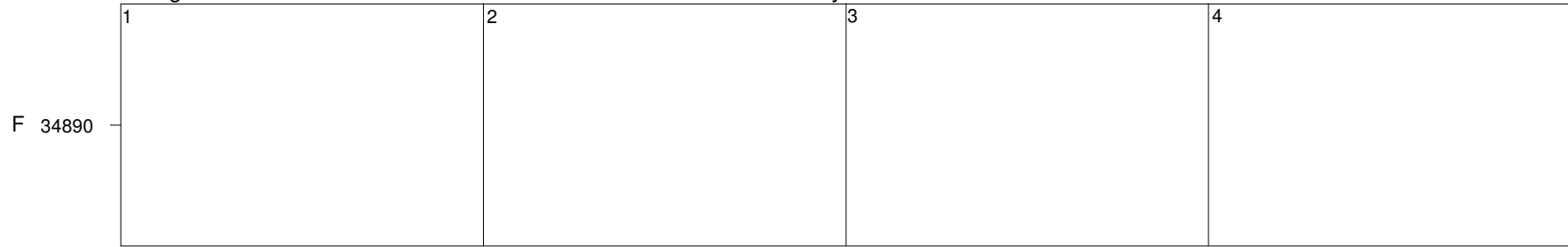
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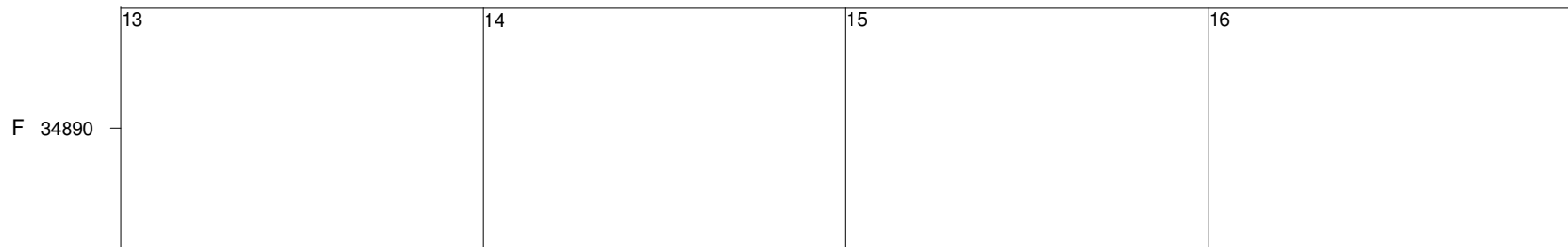
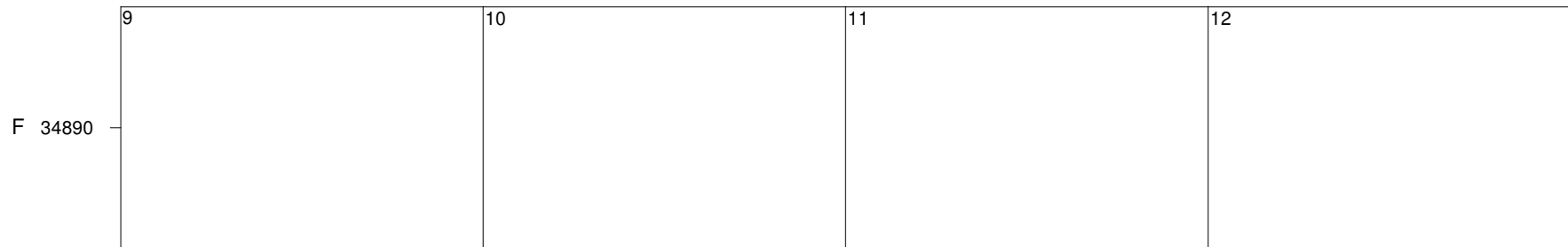
Livingston Island

May

2015



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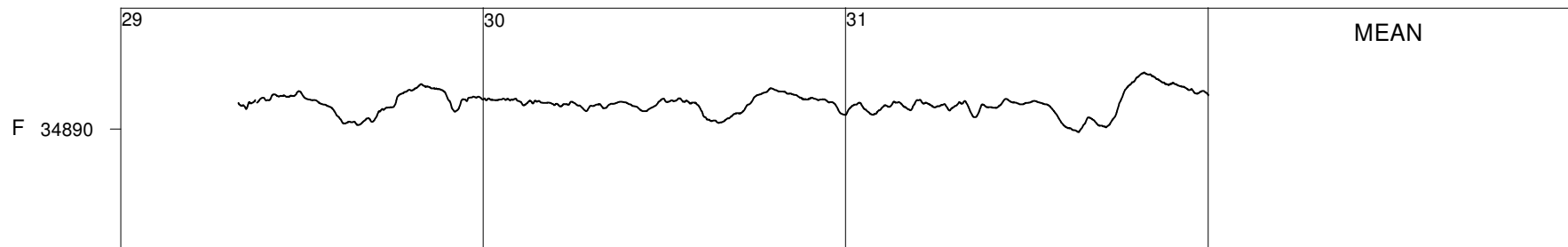
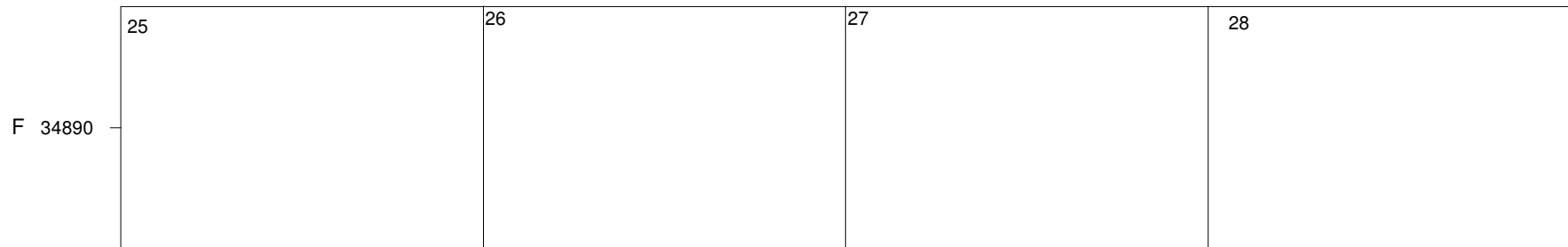
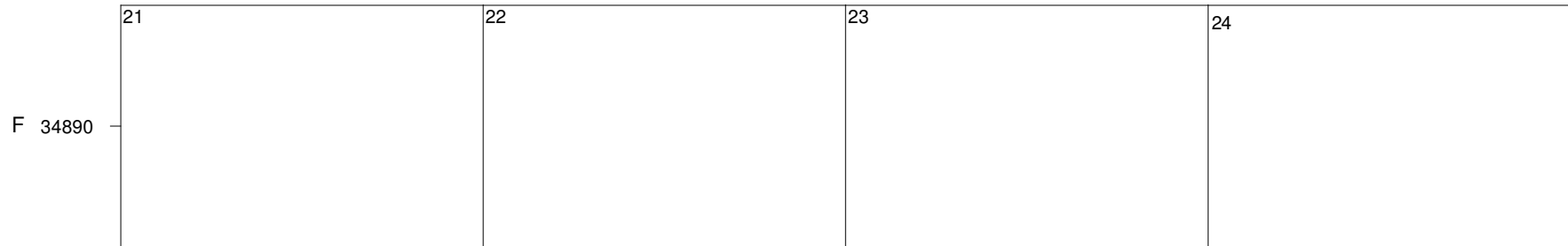
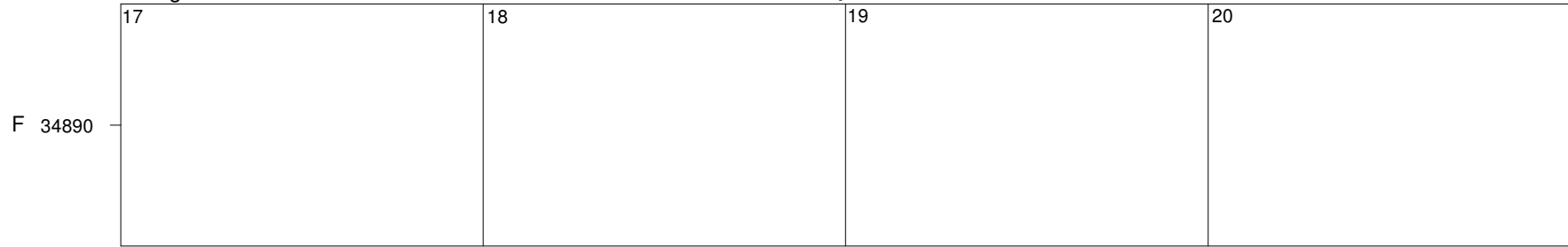


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Livingston Island

May

2015



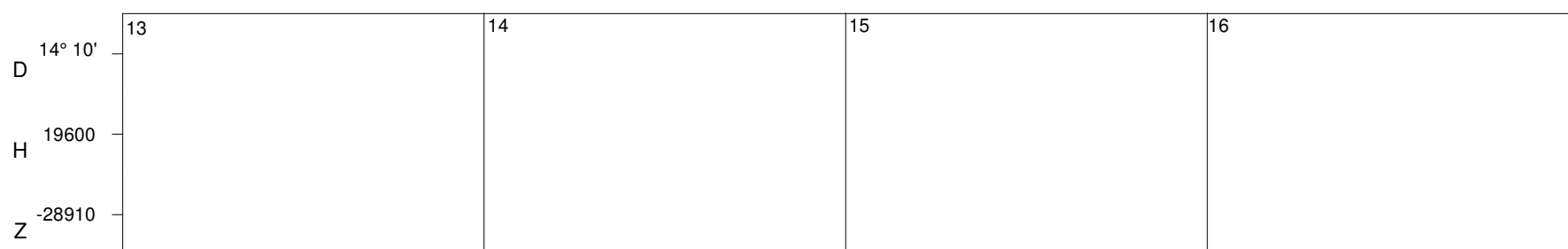
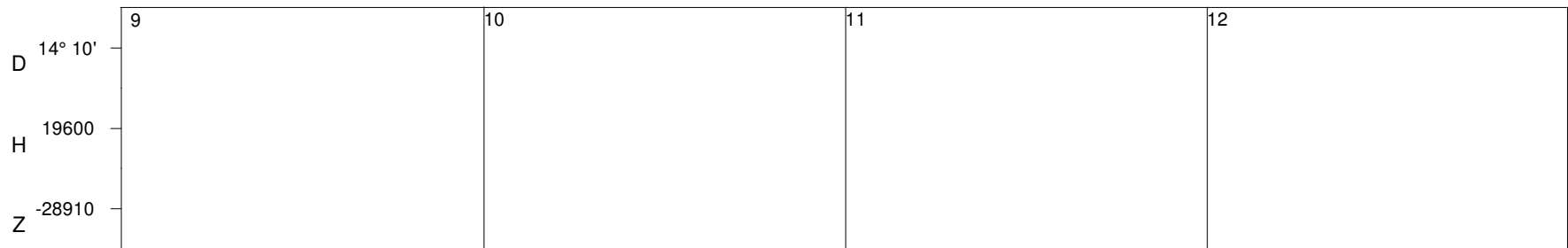
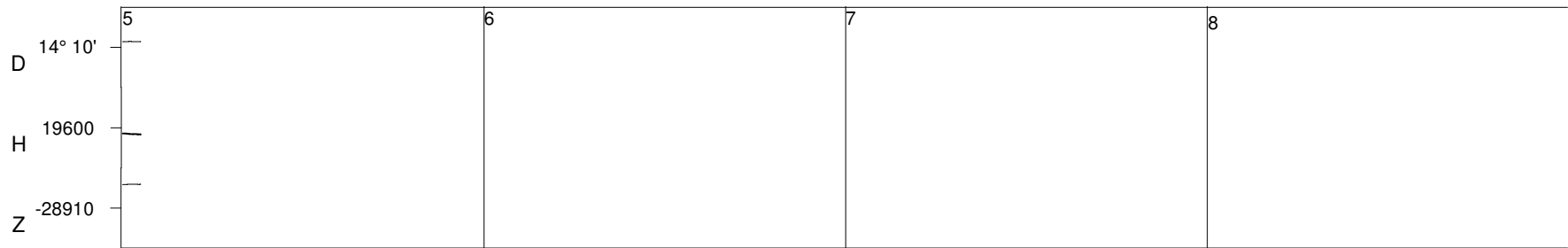
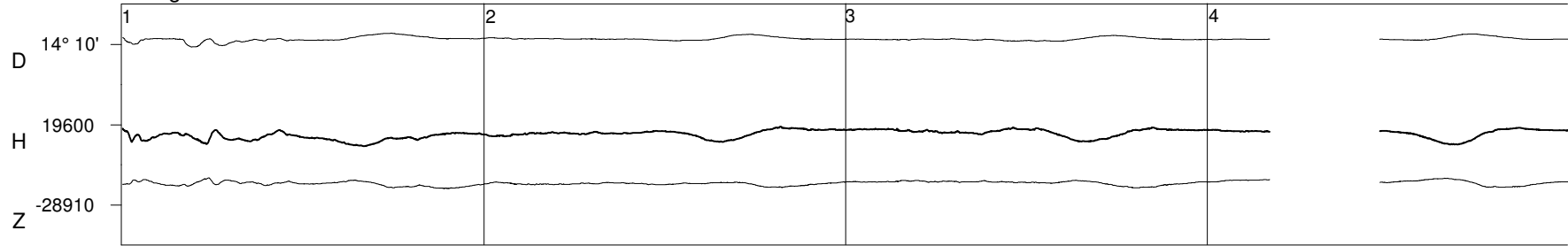
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Livingston Island

June

2015

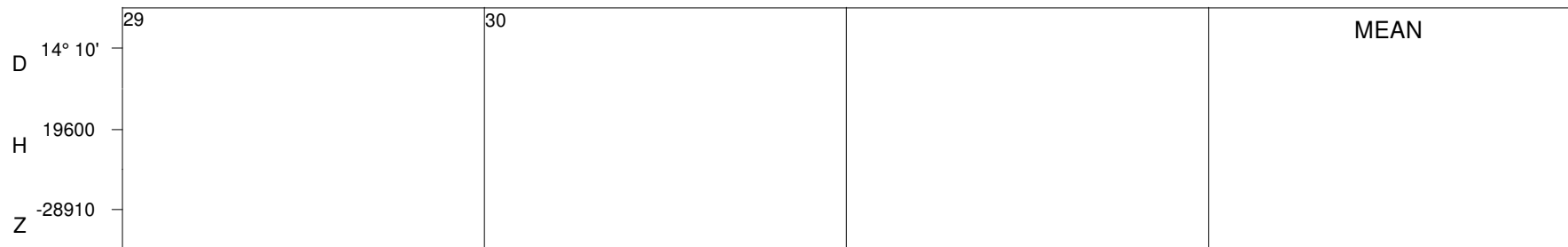
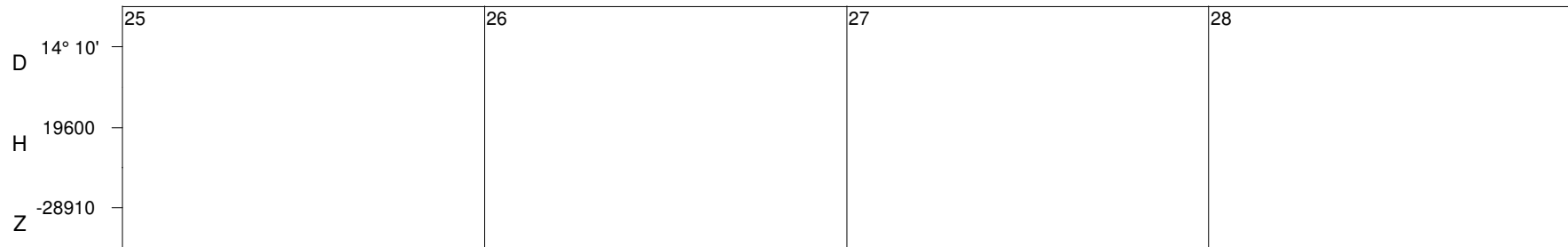
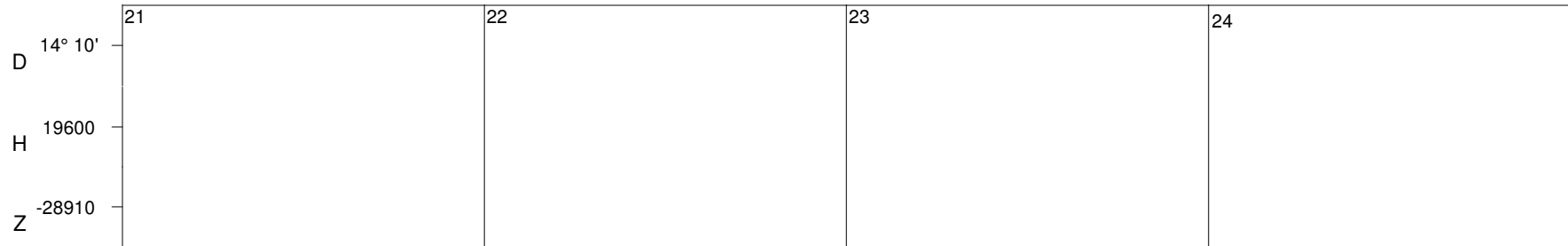
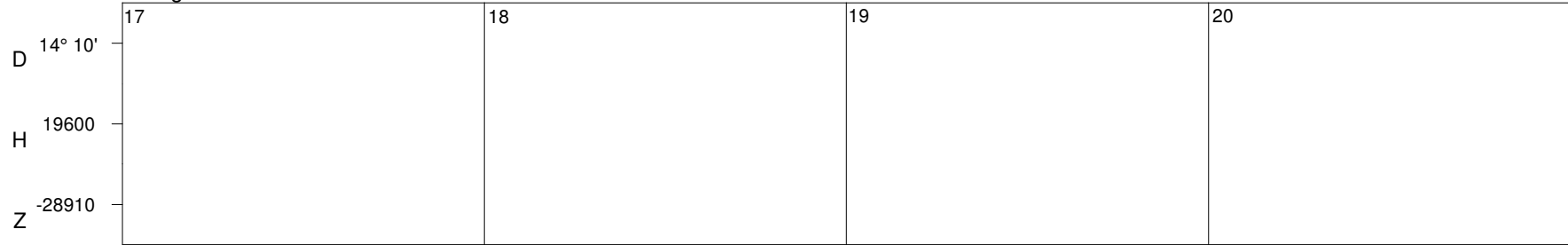


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Livingston Island

June

2015

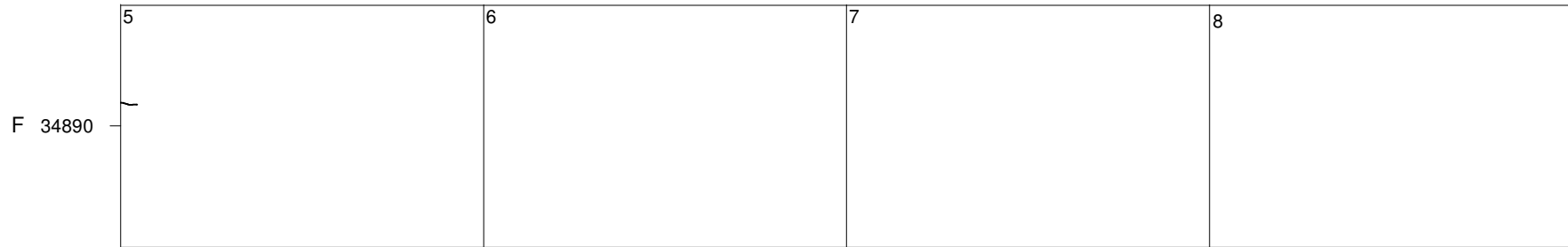
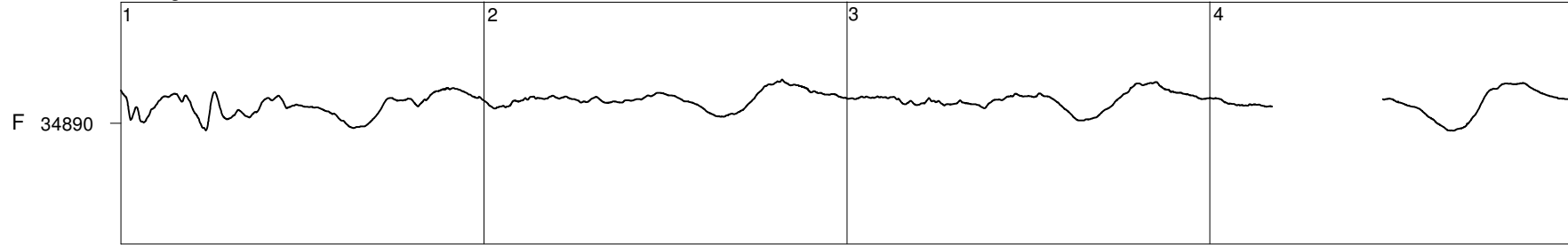


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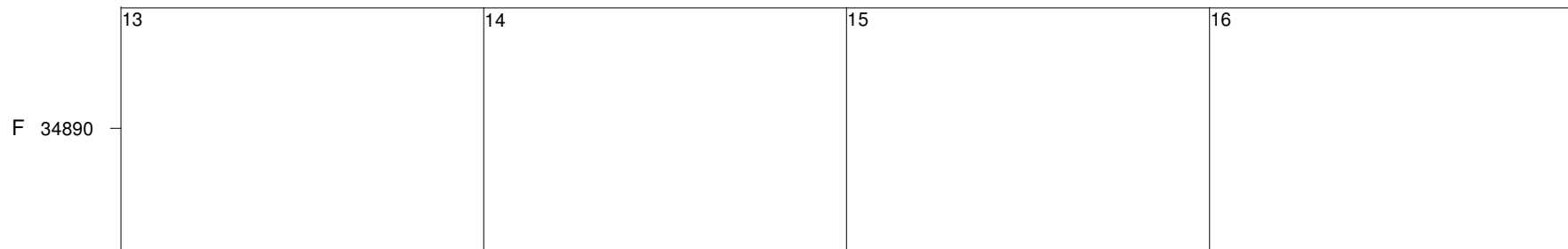
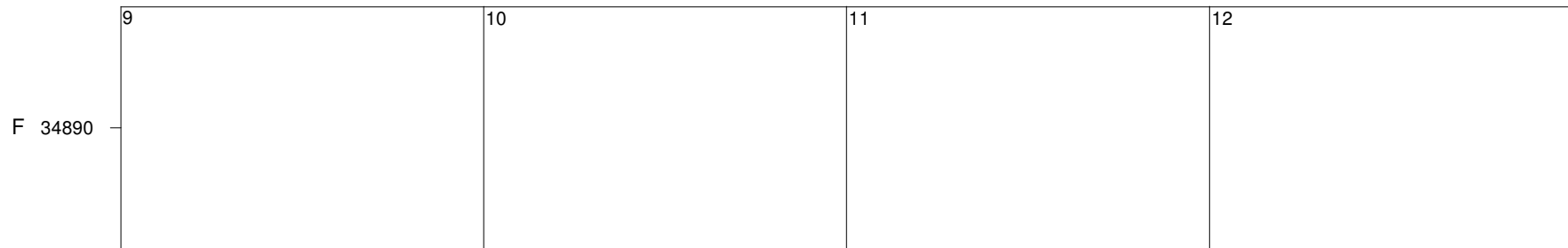
Livingston Island

June

2015



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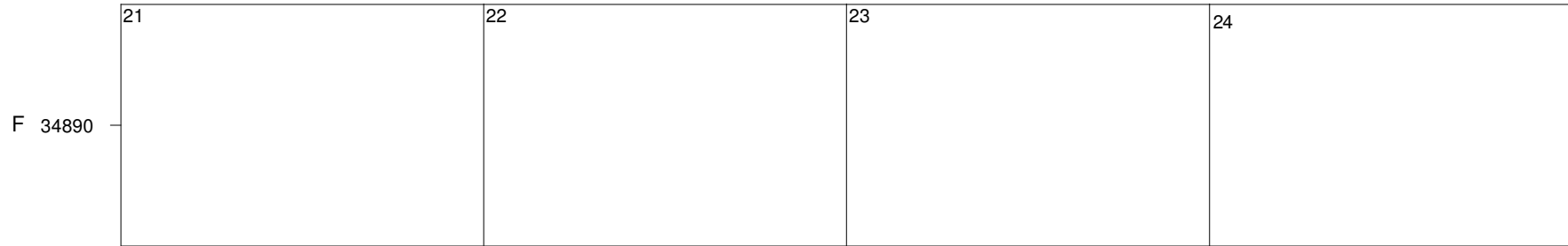
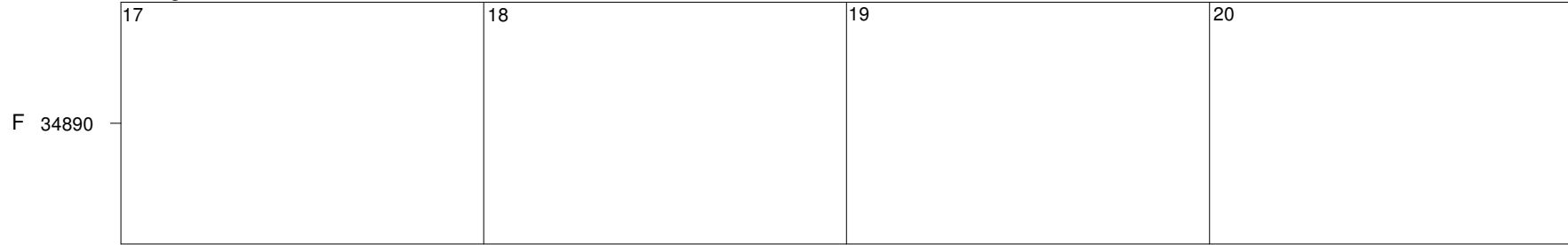


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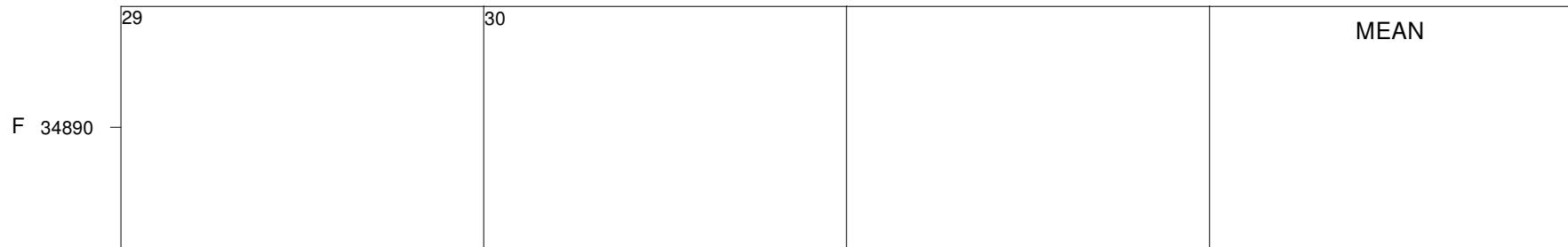
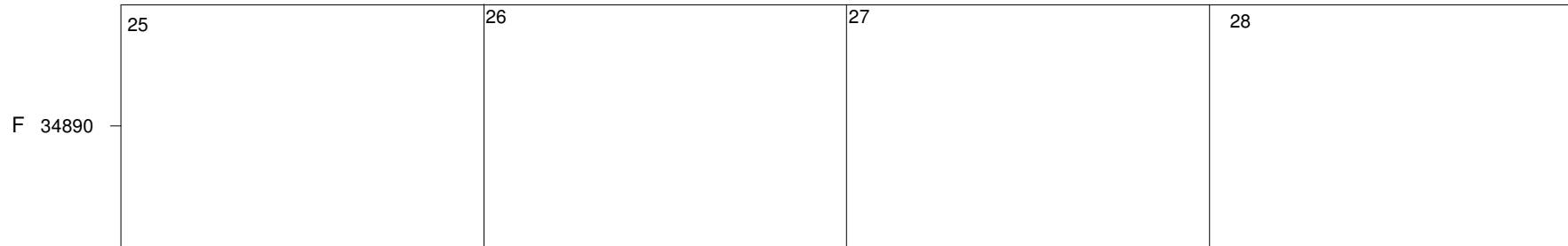
Livingston Island

June

2015



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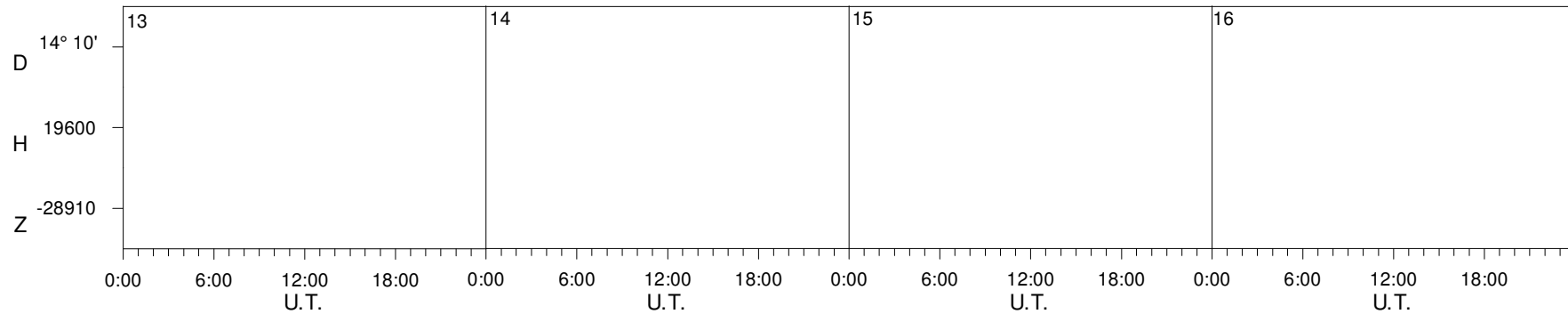
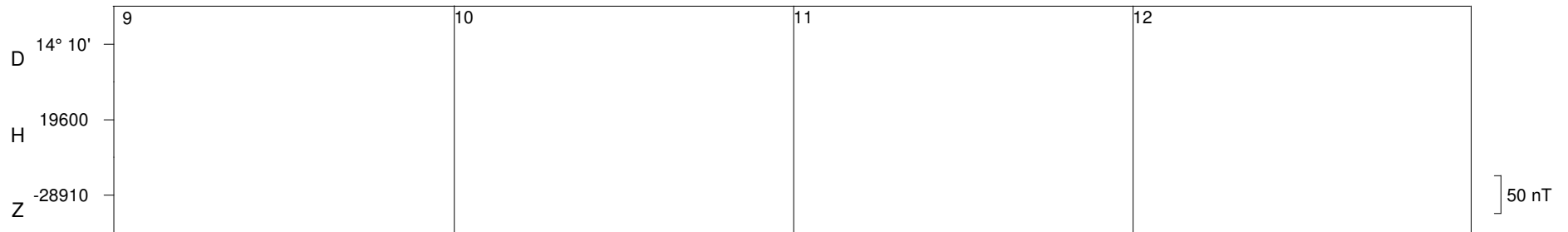
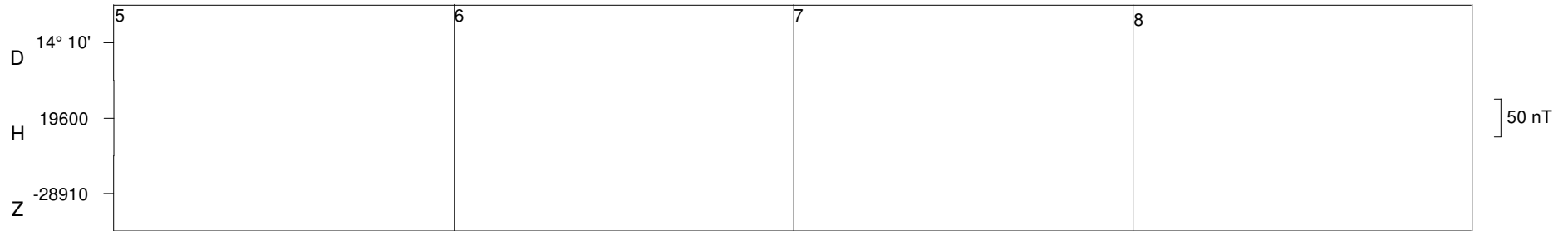
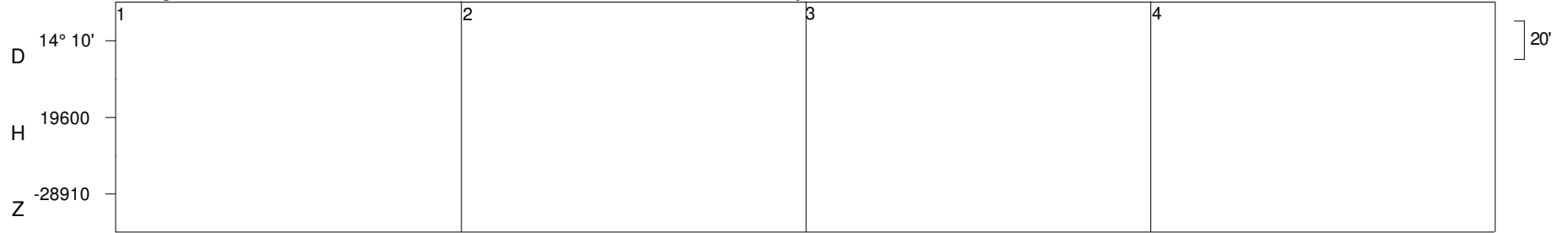


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Livingston Island

July

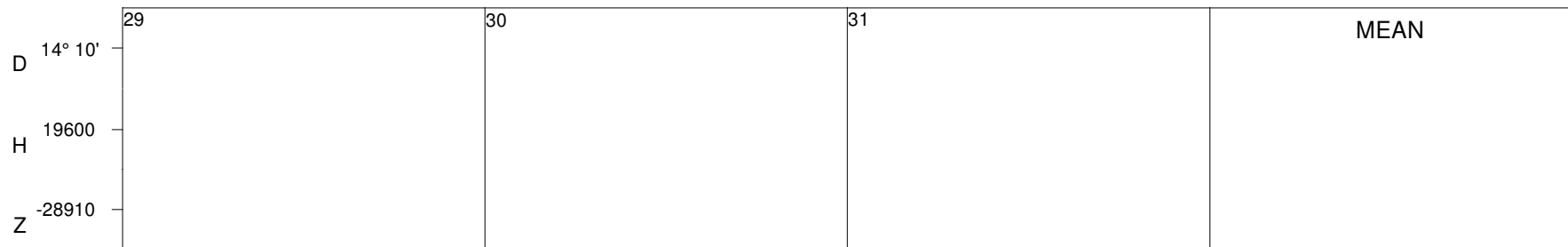
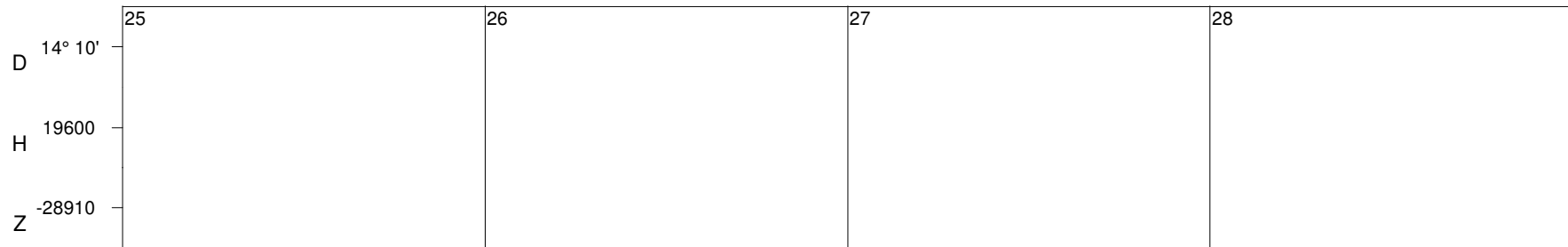
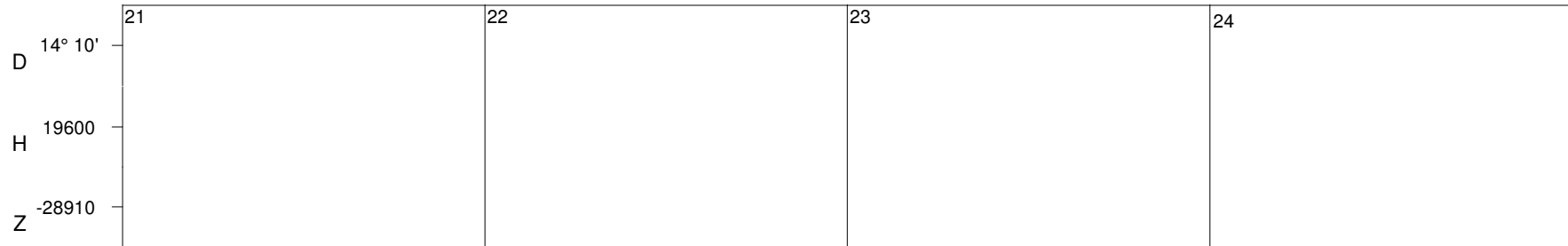
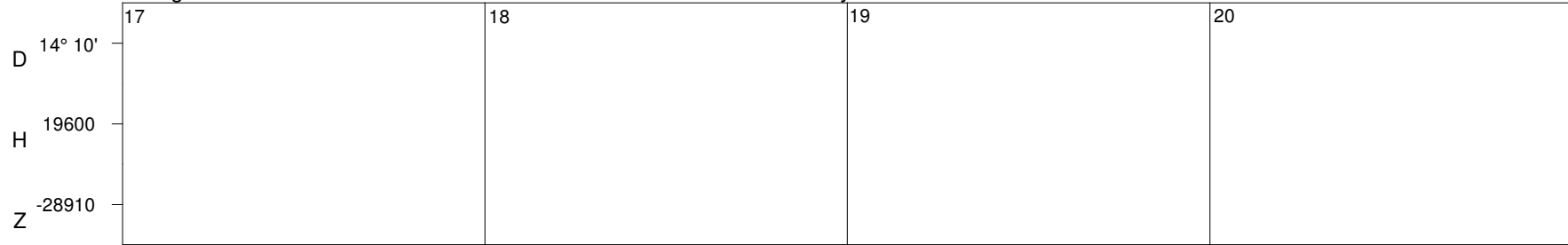
2015



Livingston Island

July

2015

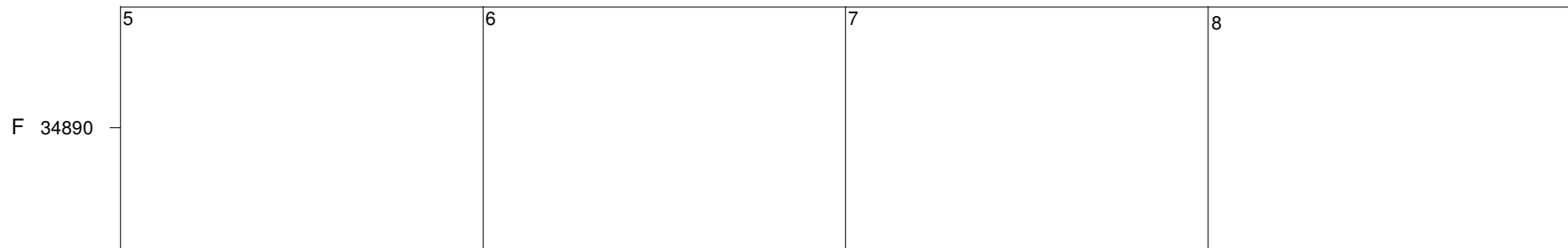
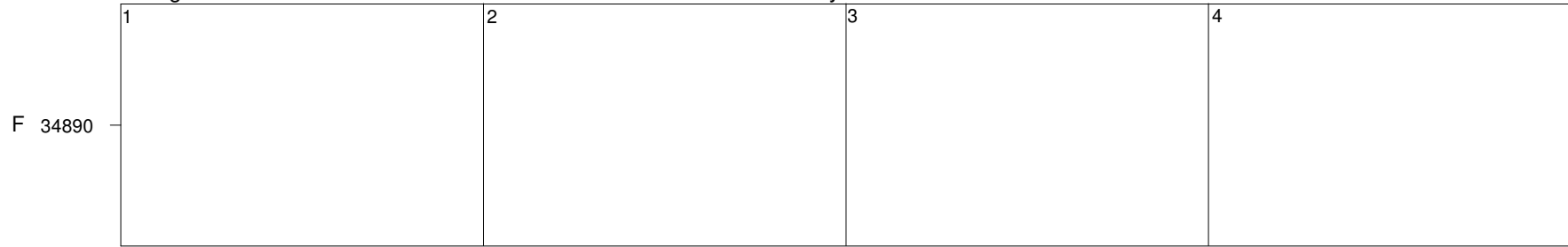


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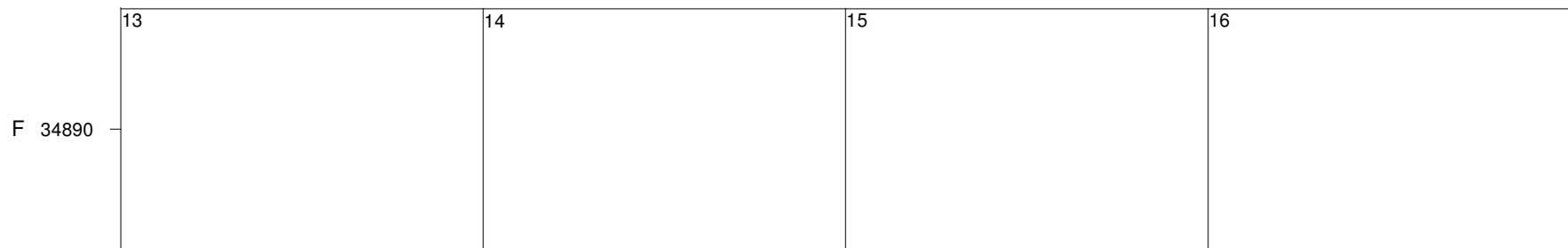
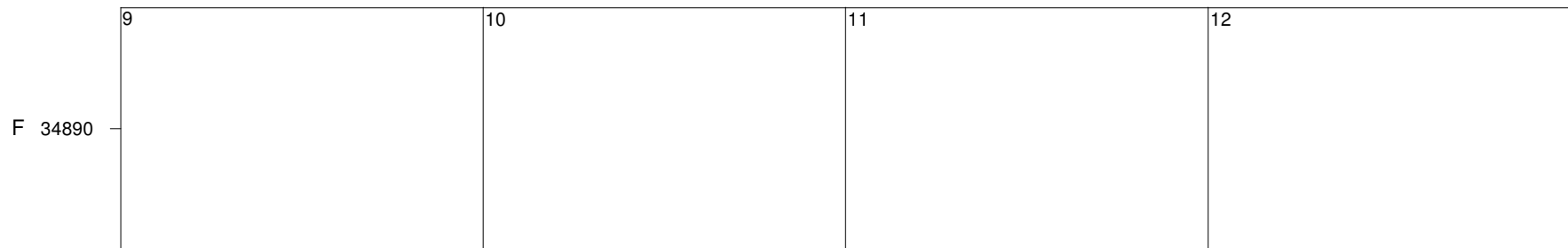
Livingston Island

July

2015



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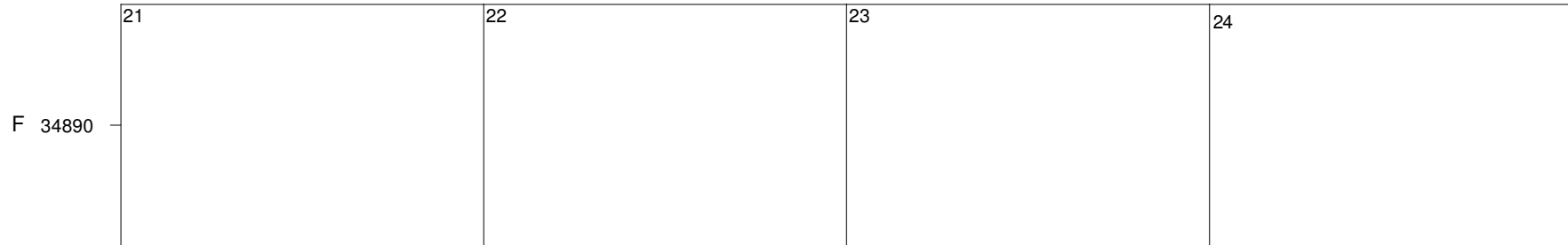
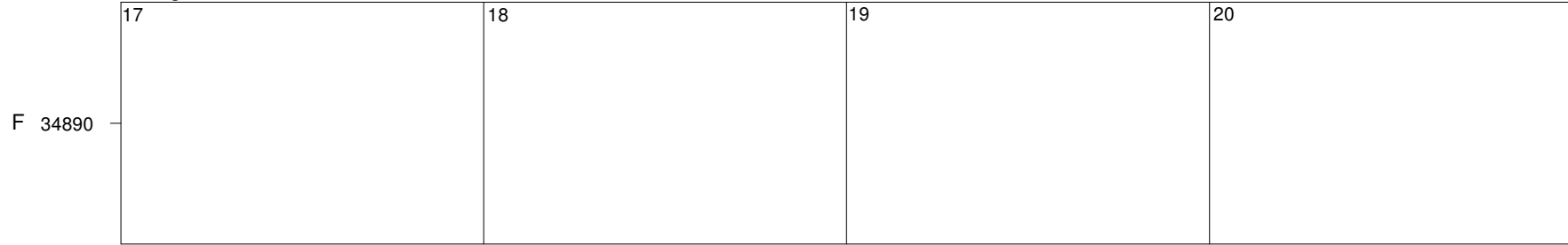


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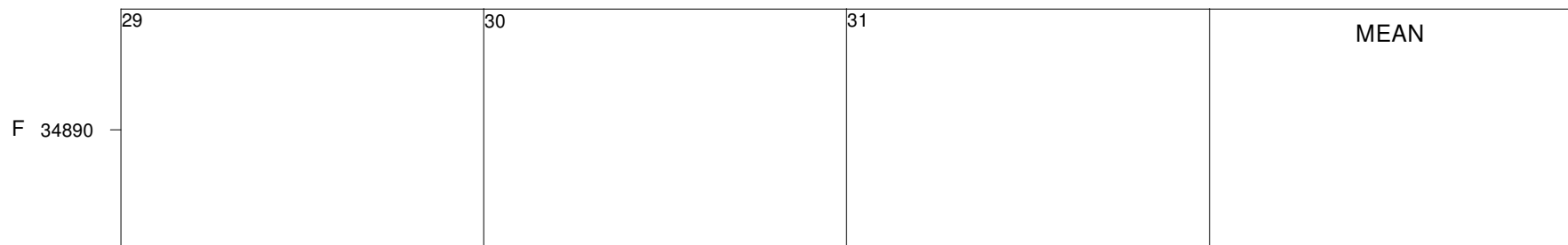
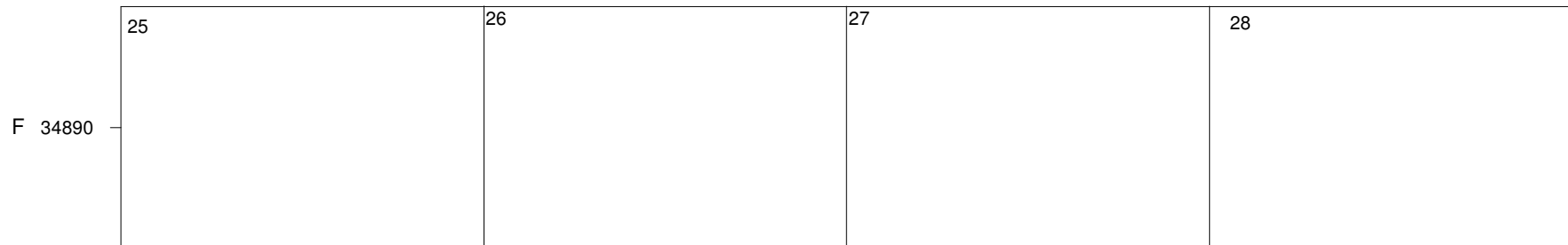
Livingston Island

July

2015



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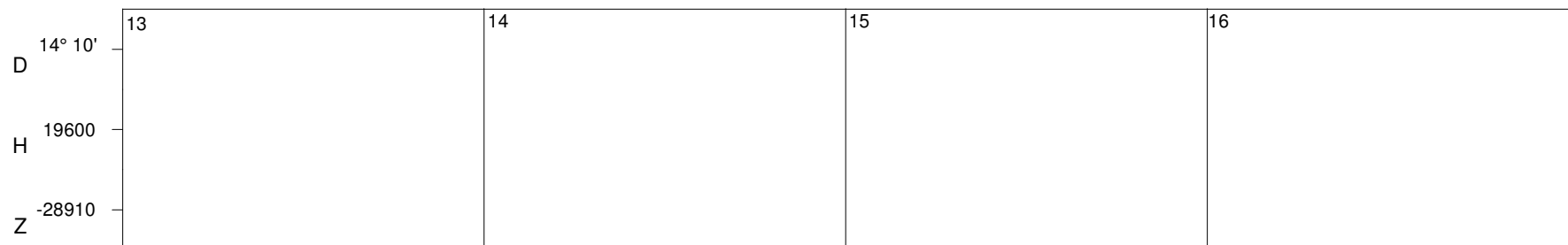
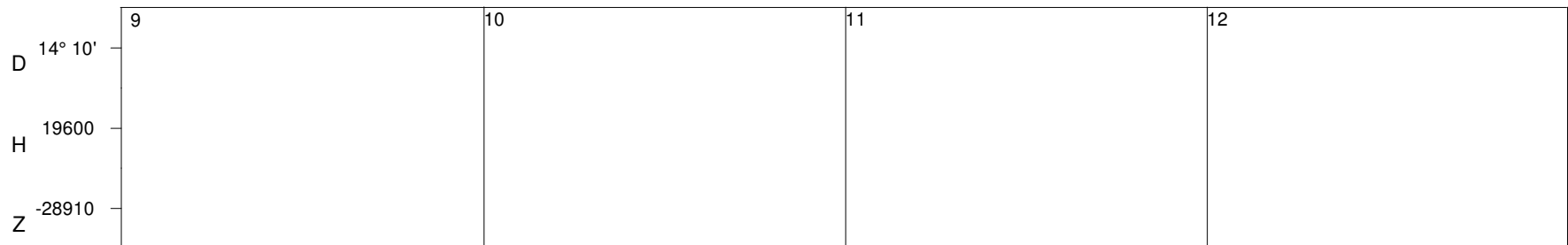
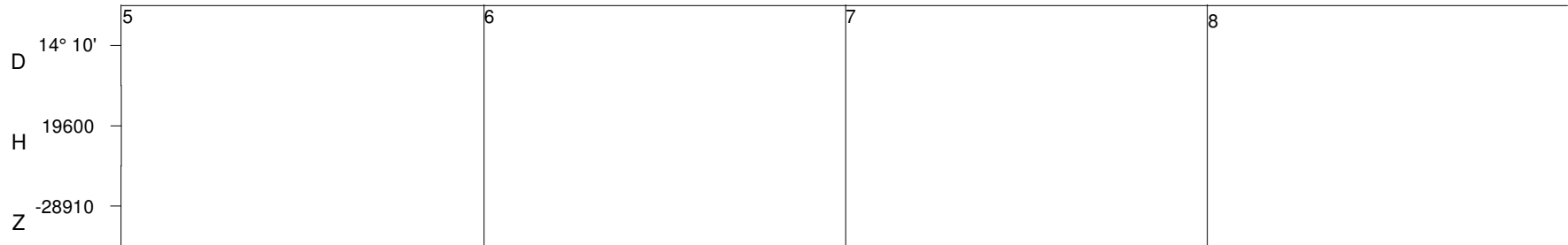
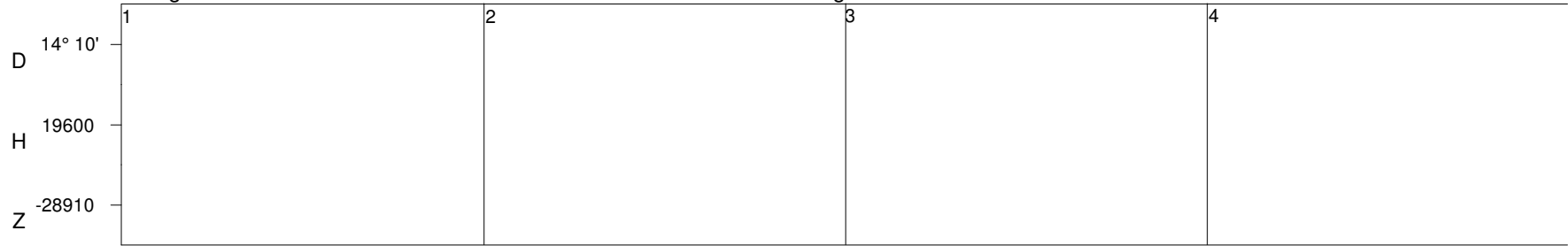


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Livingston Island

August

2015

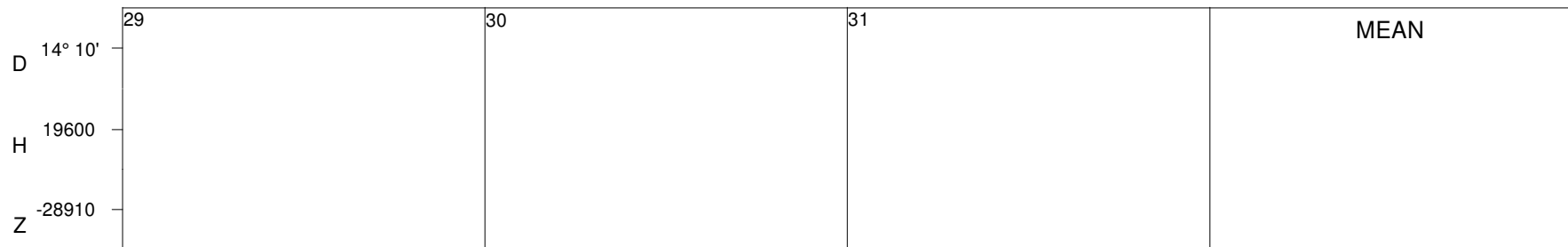
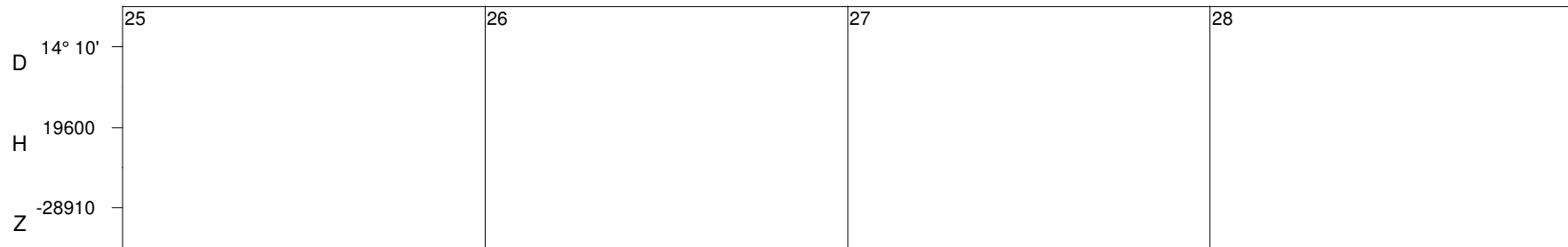
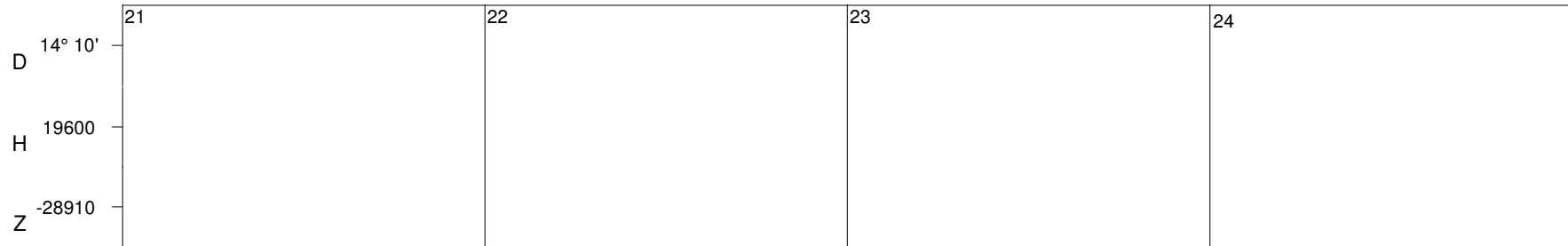
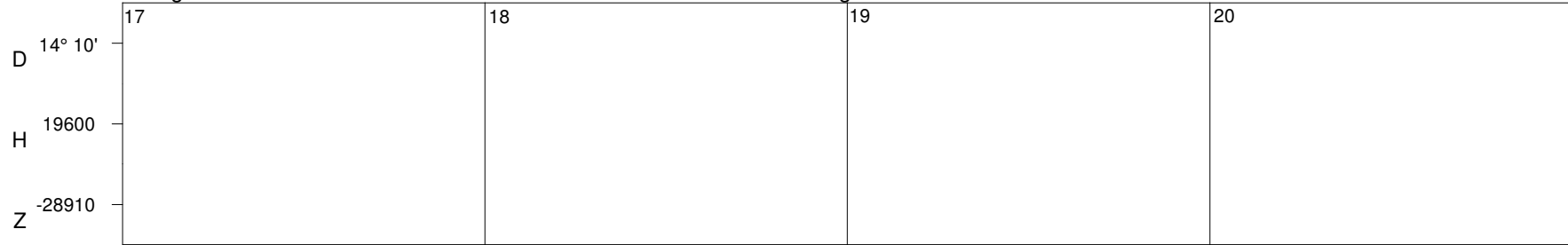


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Livingston Island

August

2015

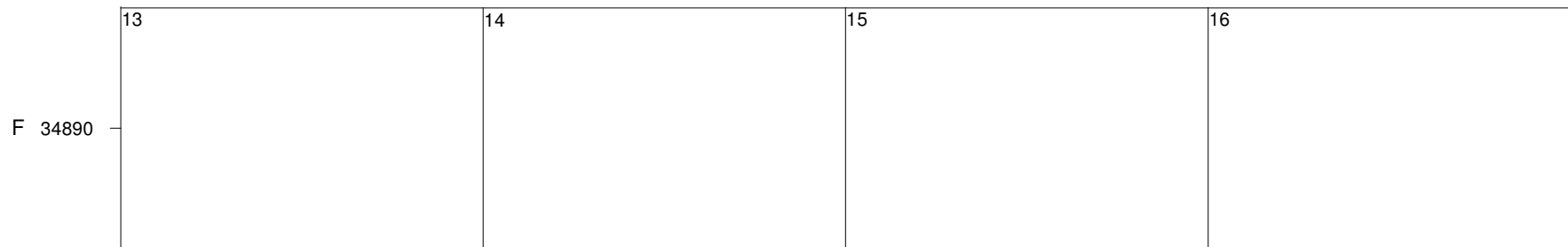
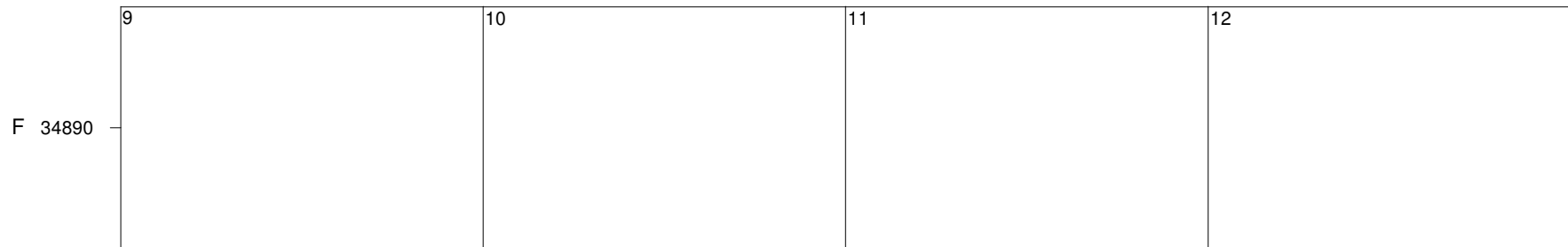
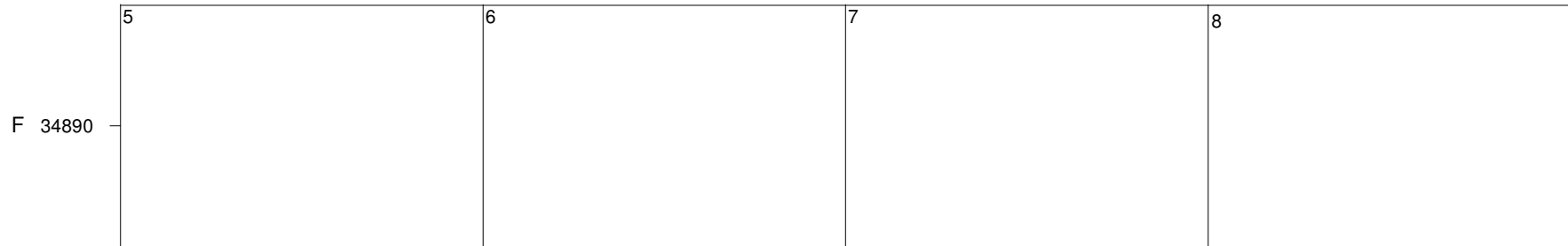
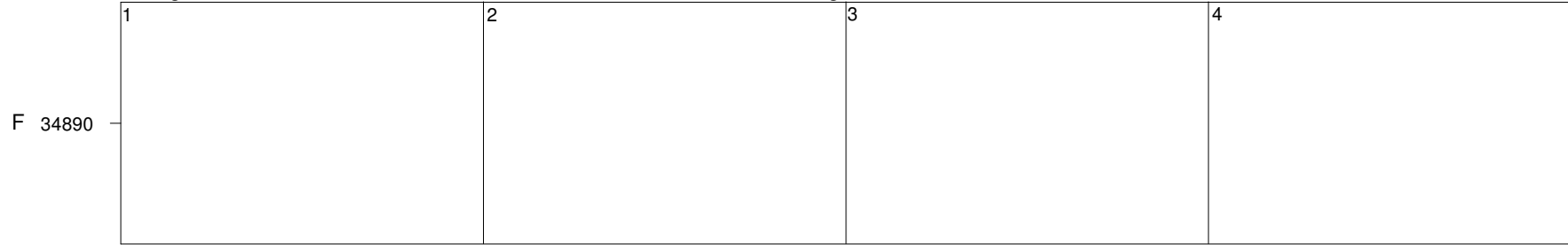


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Livingston Island

August

2015



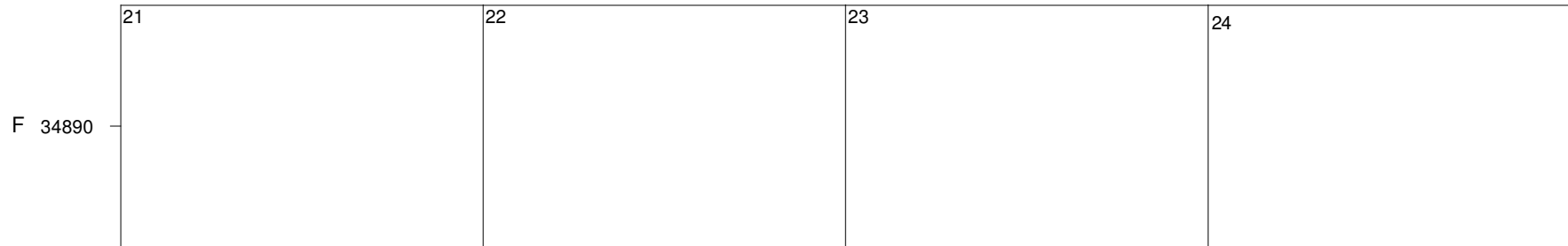
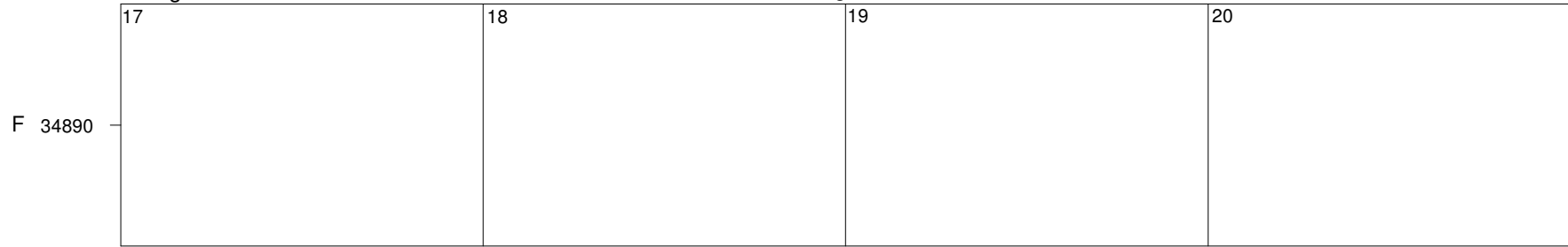
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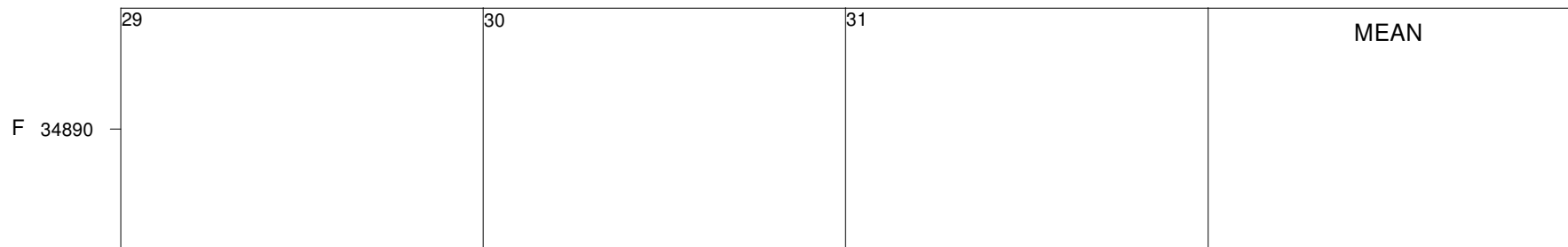
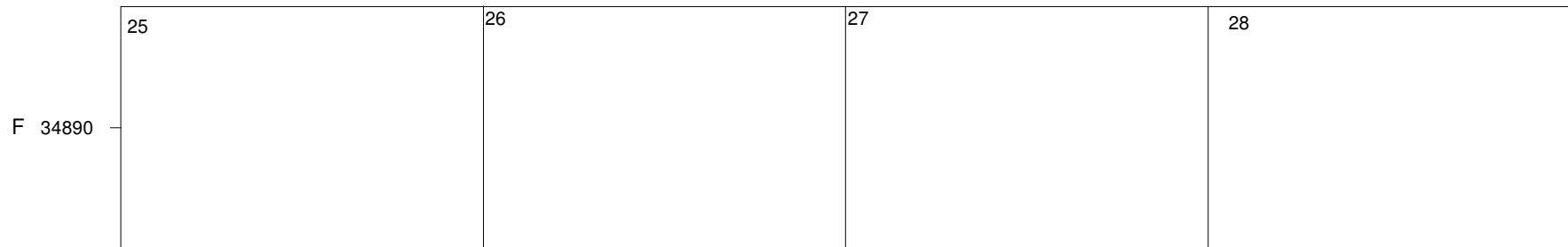
Livingston Island

August

2015



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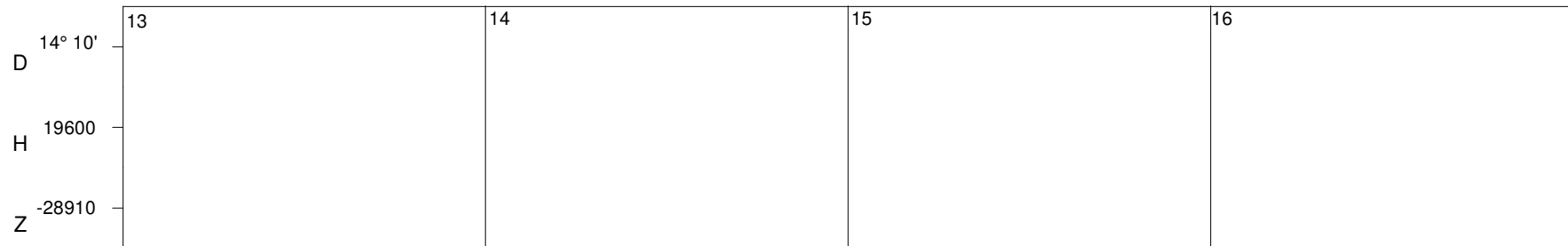
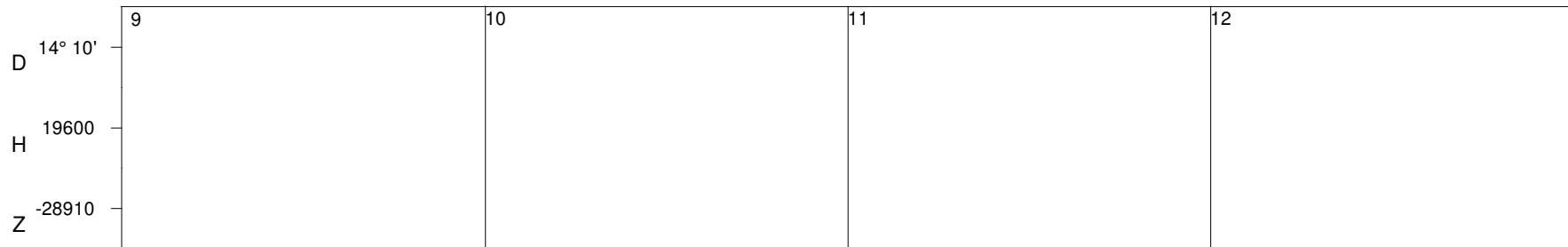
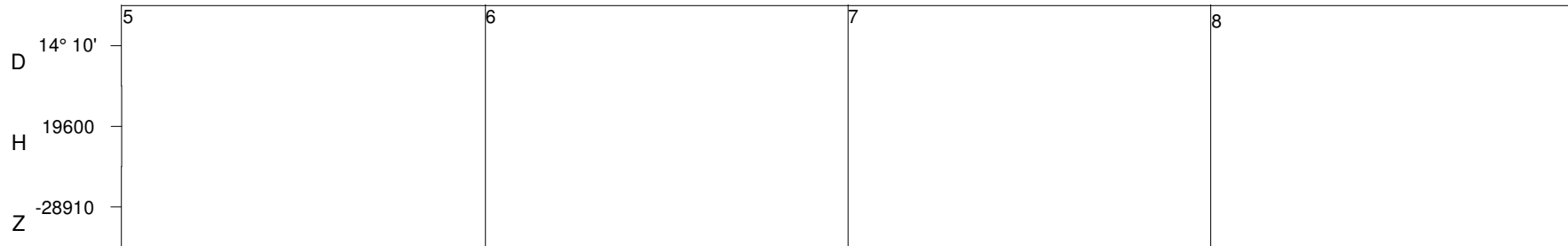
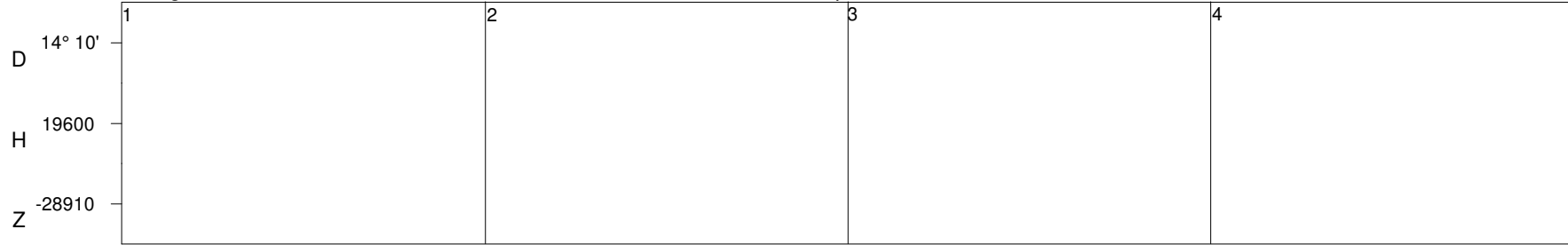


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Livingston Island

September

2015

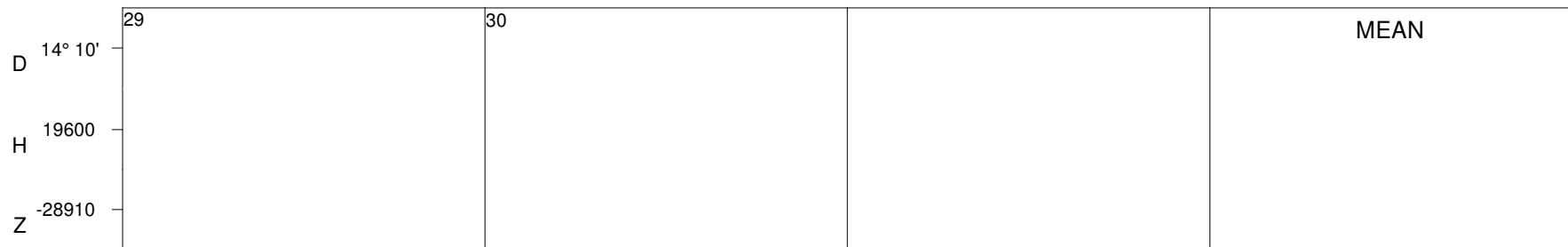
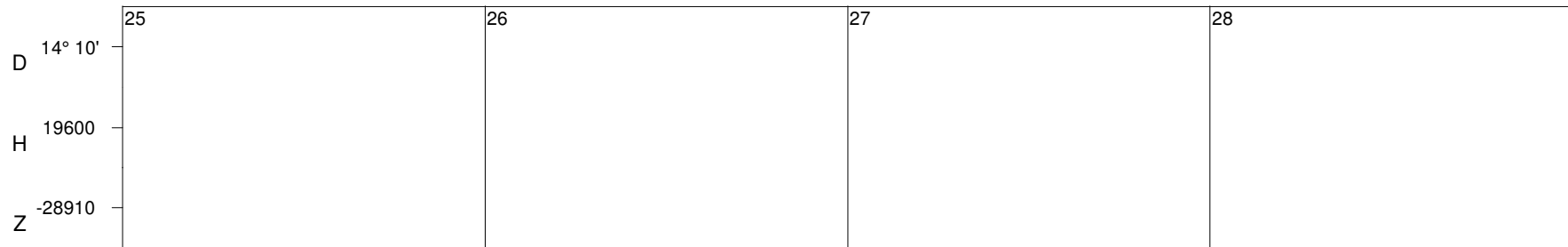
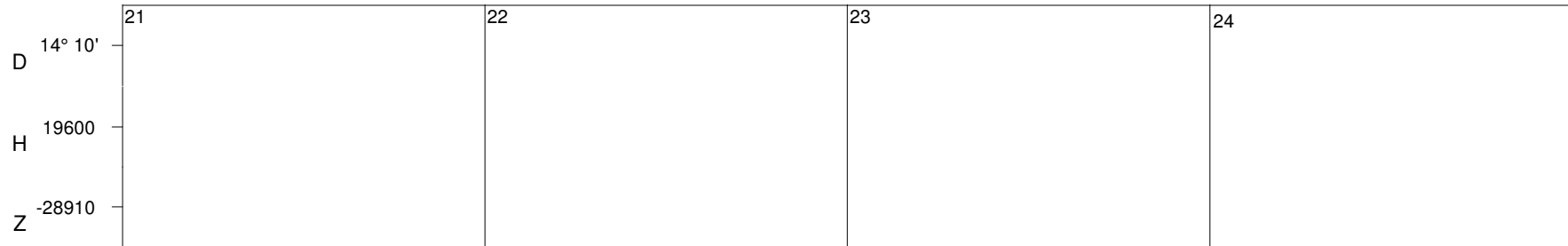
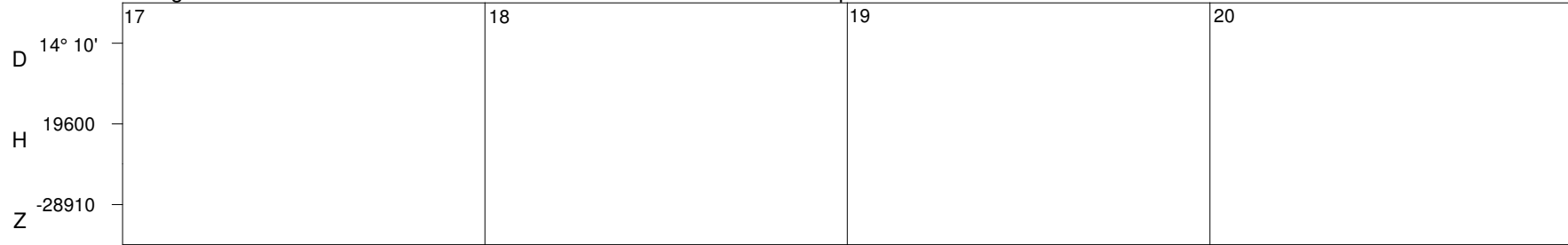


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Livingston Island

September

2015

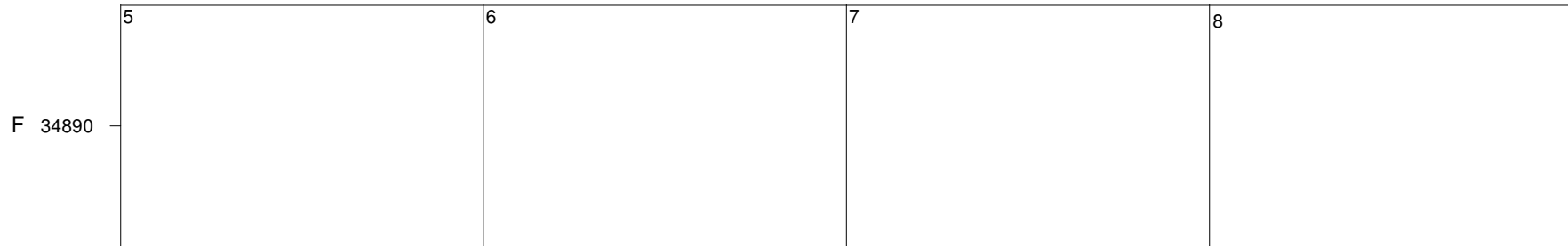
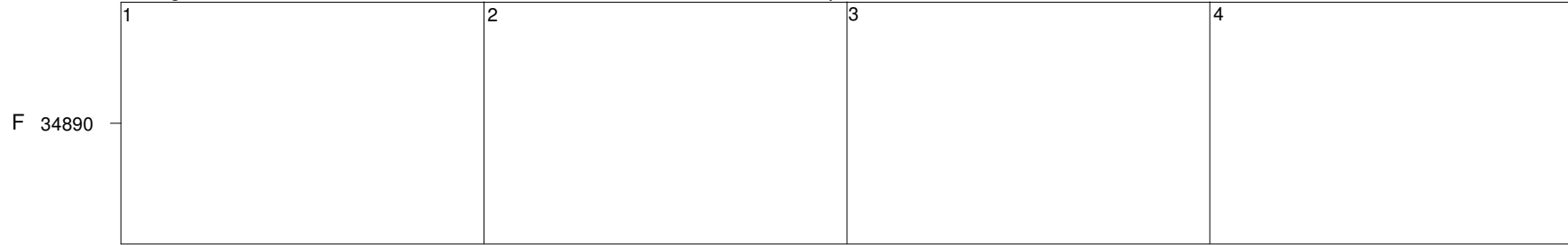


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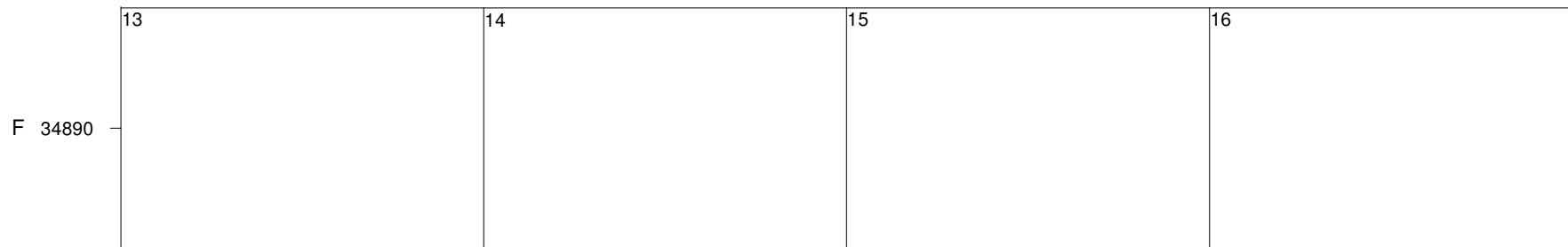
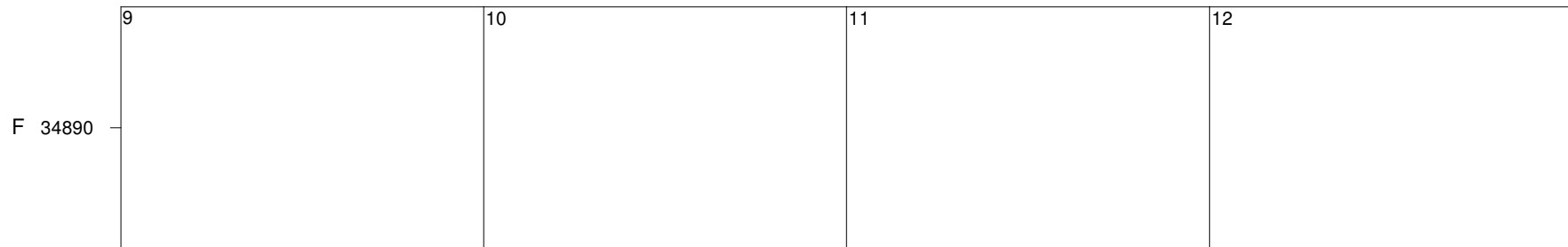
Livingston Island

September

2015



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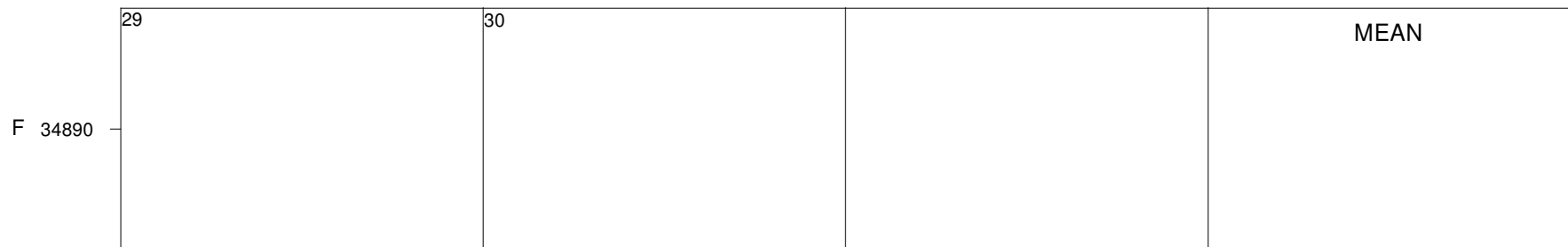
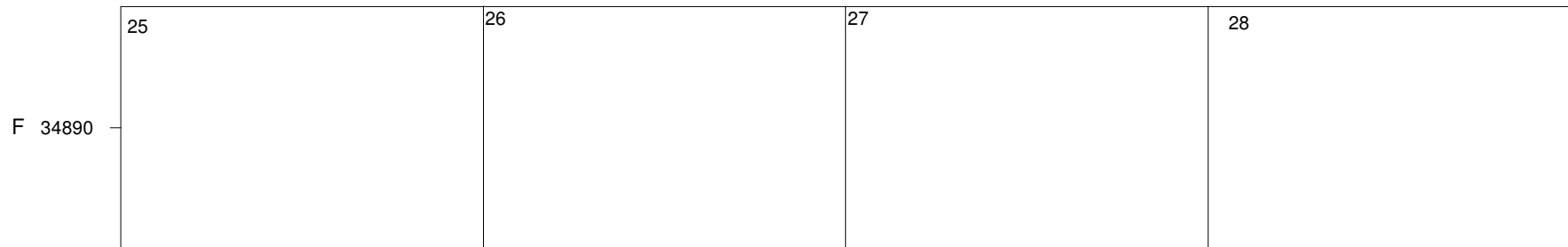
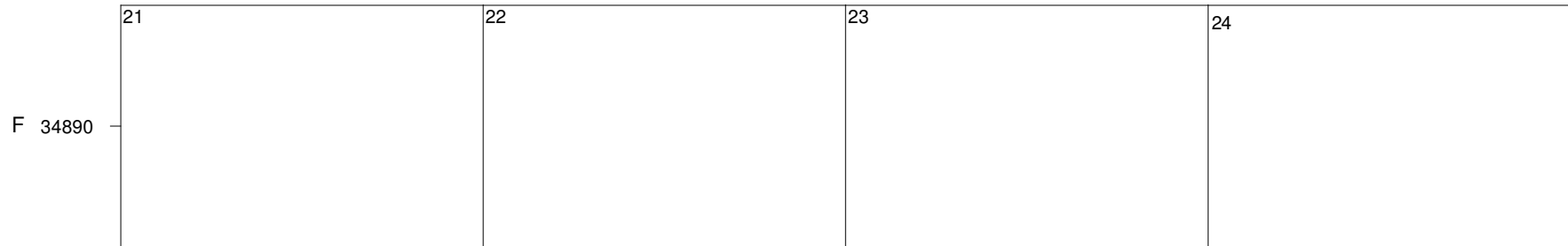
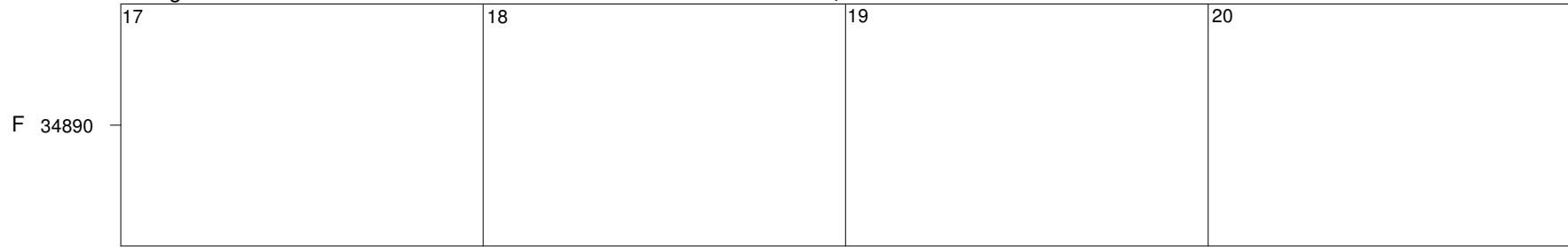


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Livingston Island

September

2015



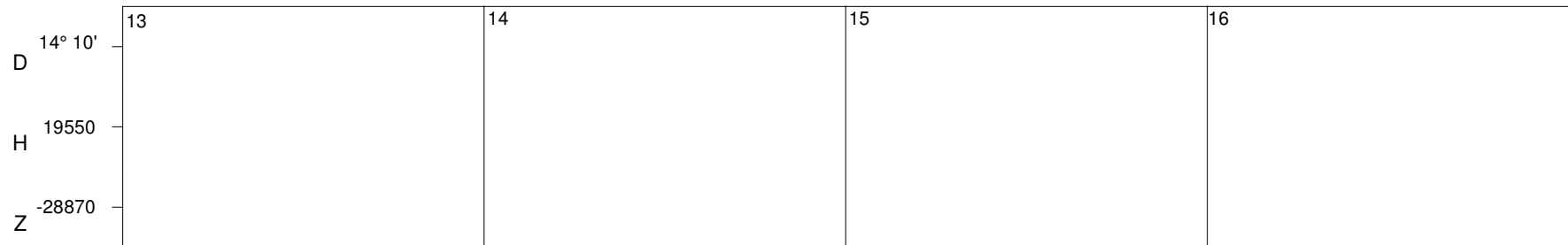
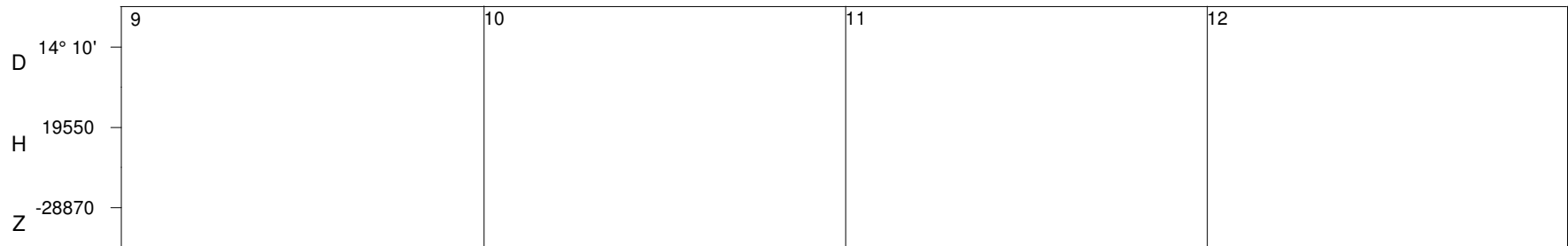
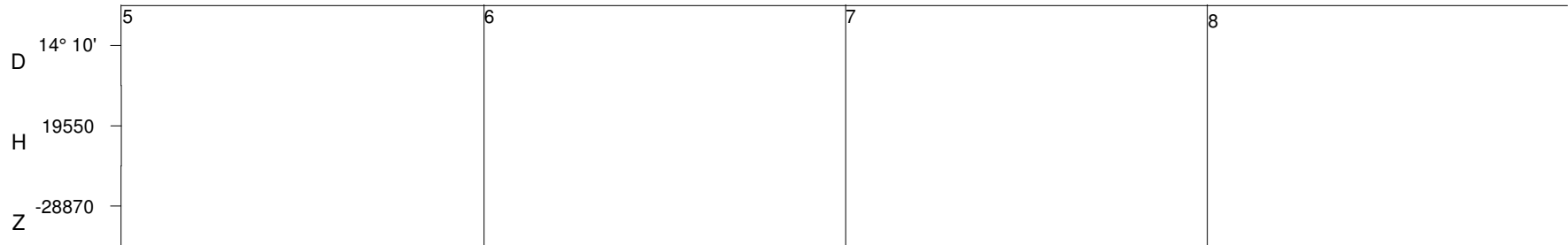
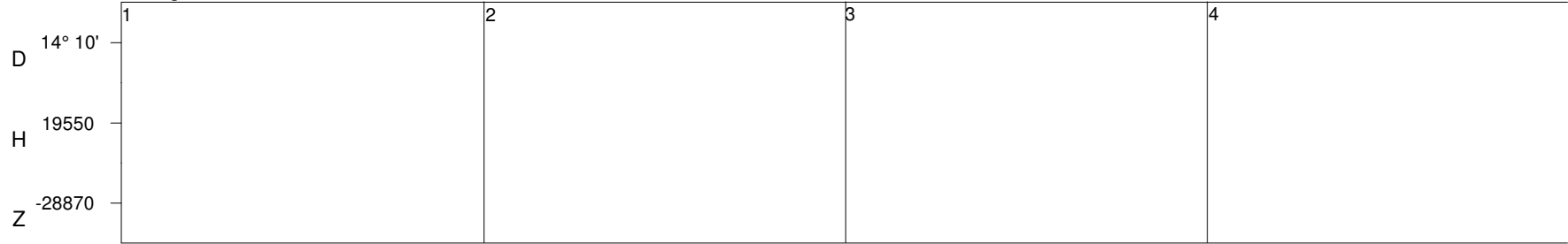
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Livingston Island

October

2015

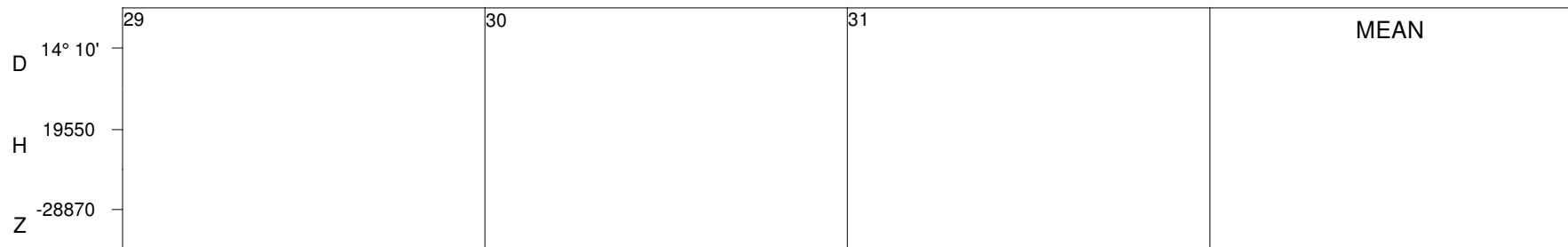
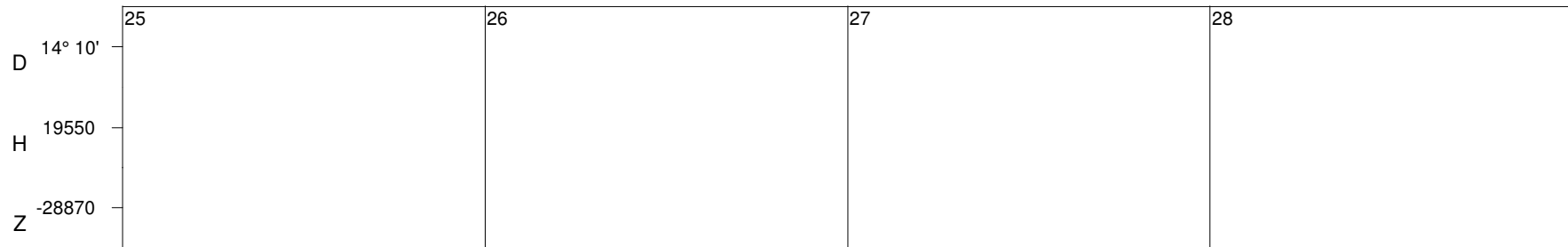
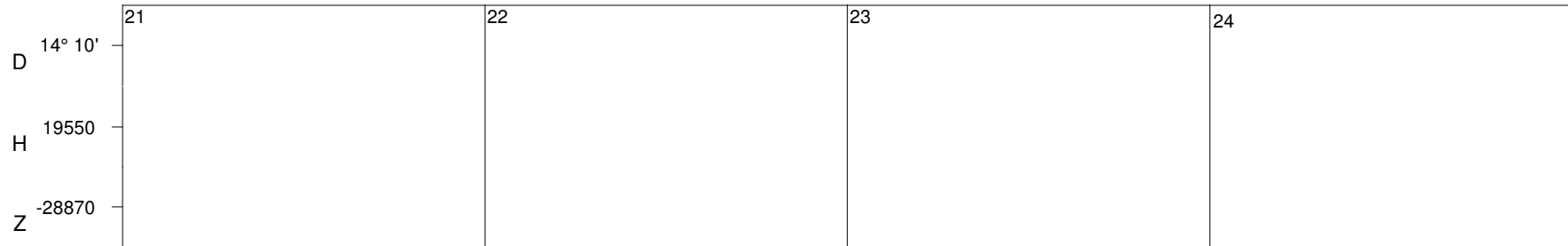
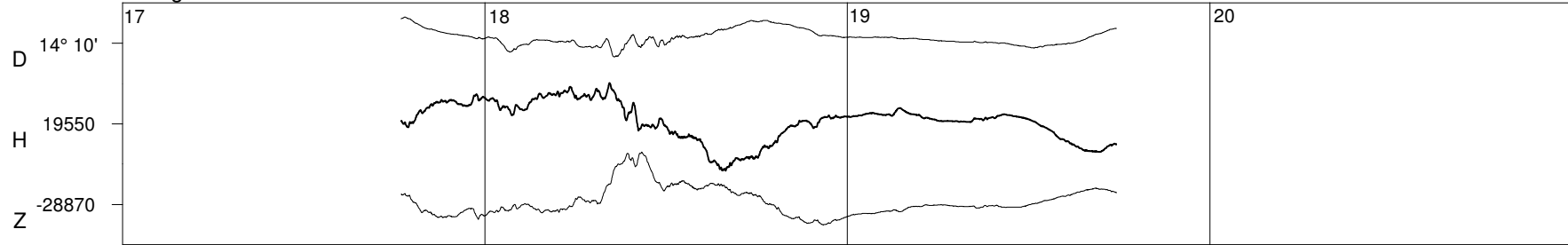


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Livingston Island

October

2015

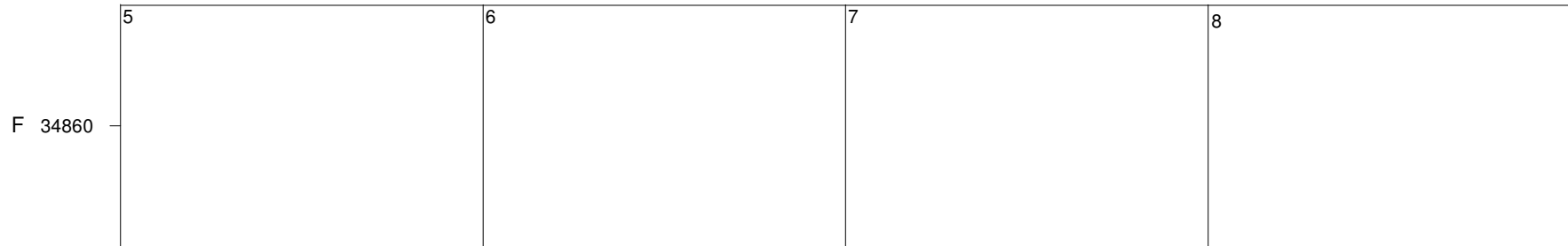
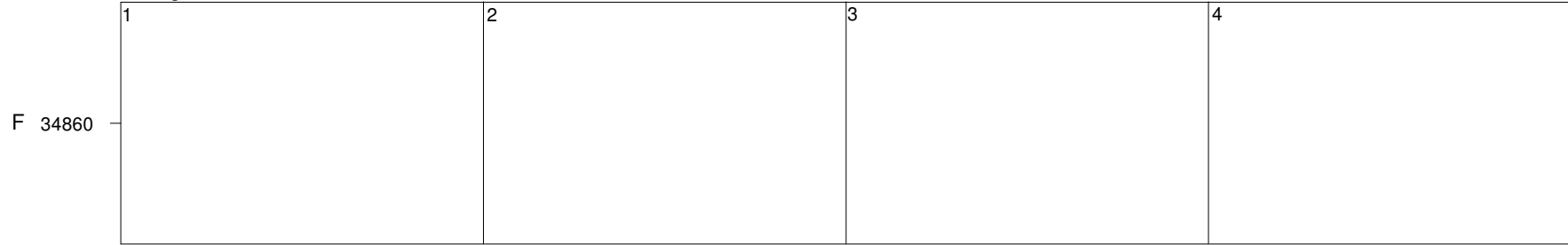


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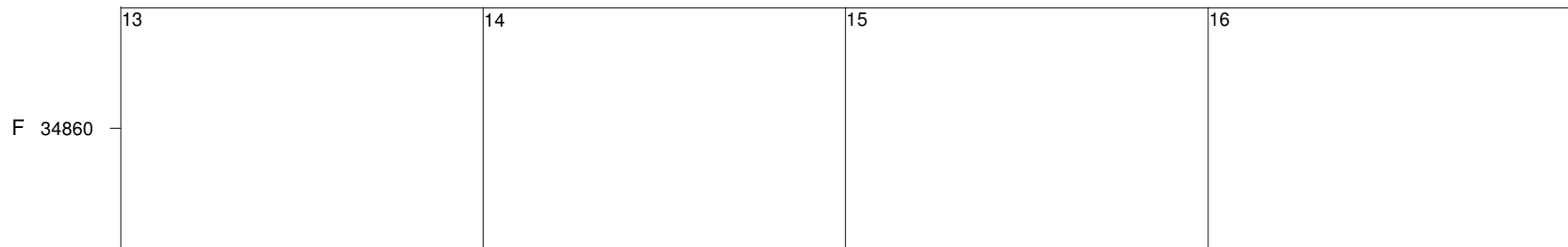
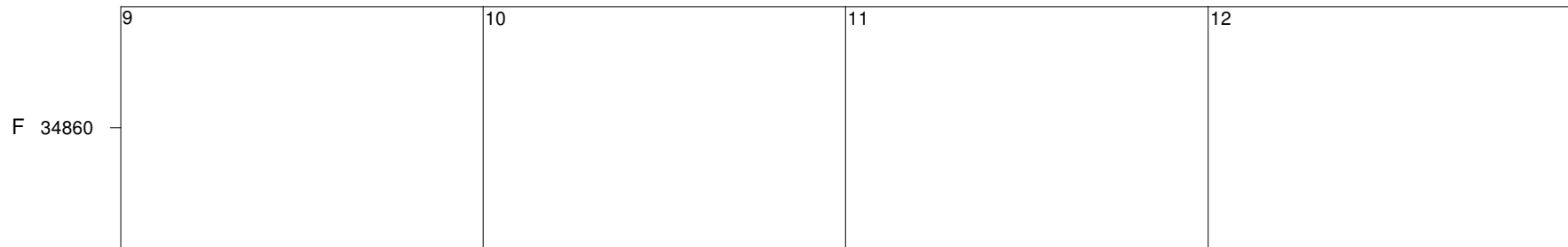
Livingston Island

October

2015



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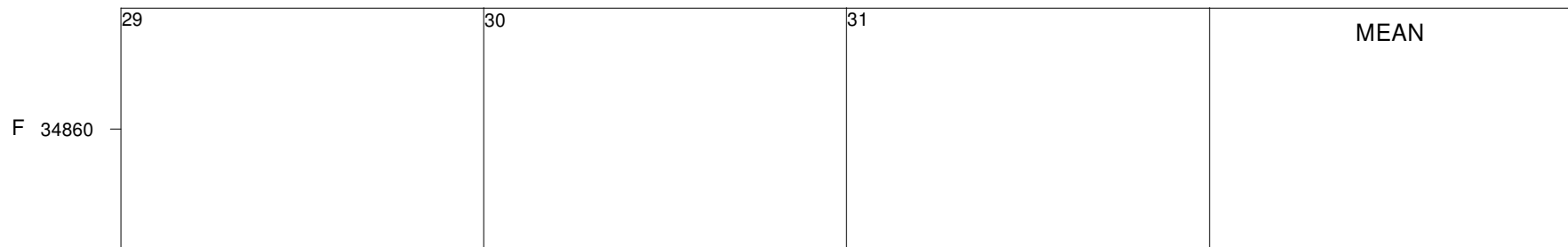
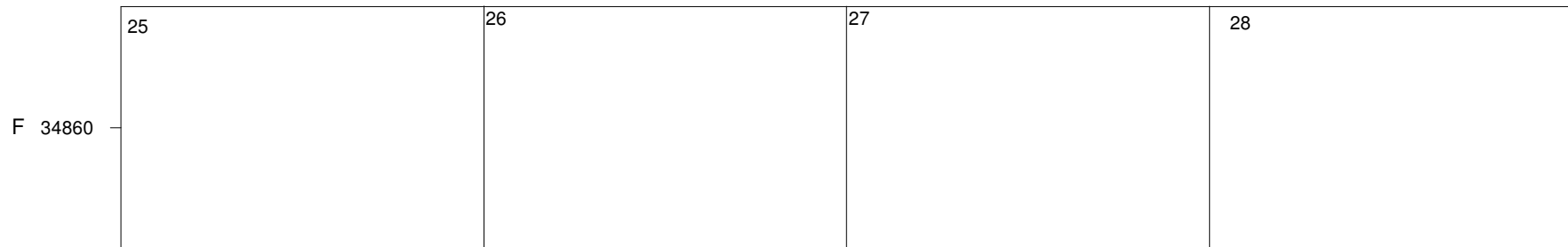
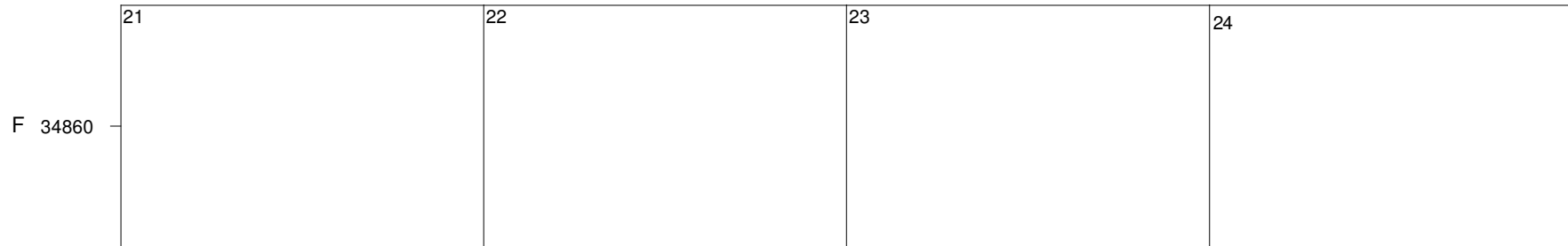
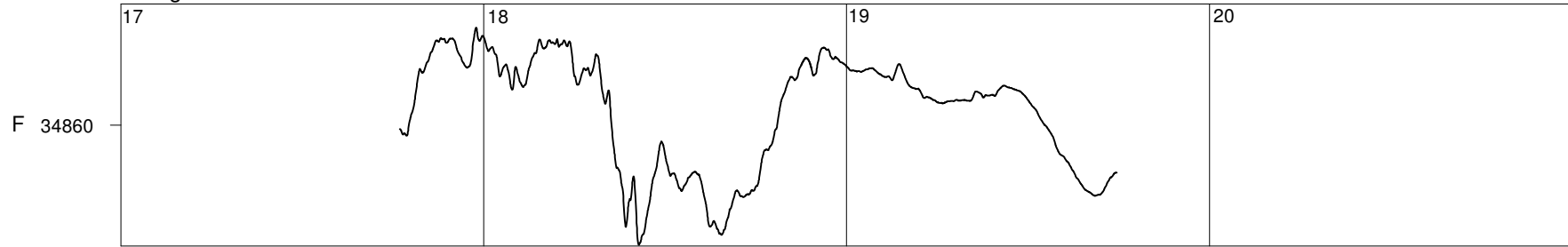


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Livingston Island

October

2015



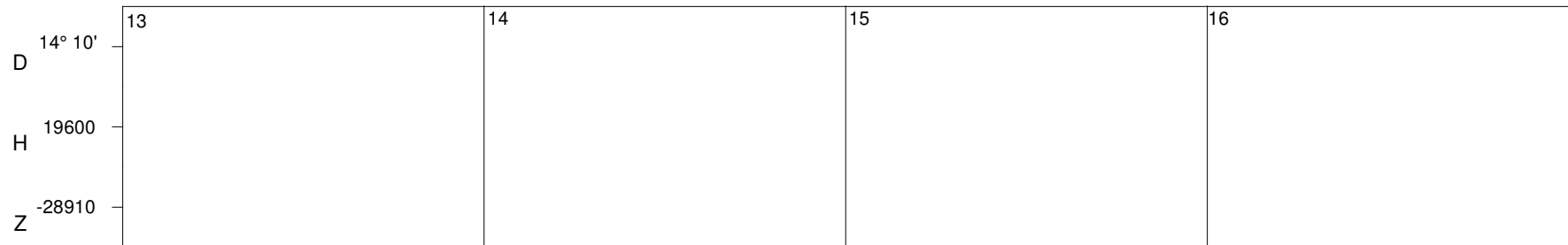
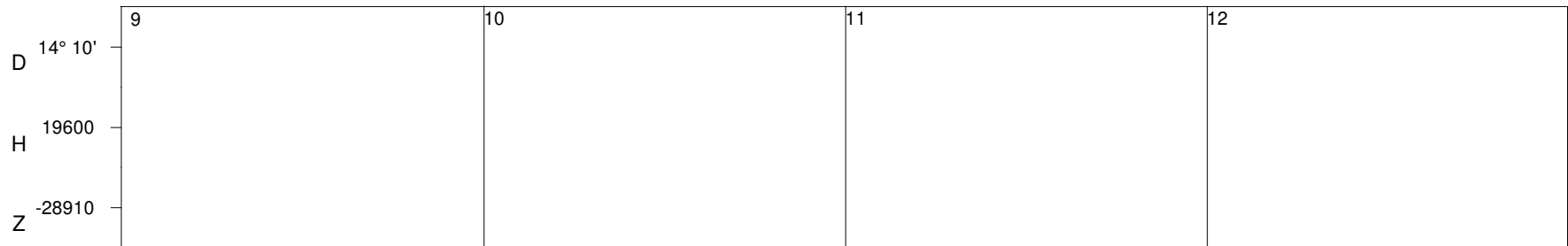
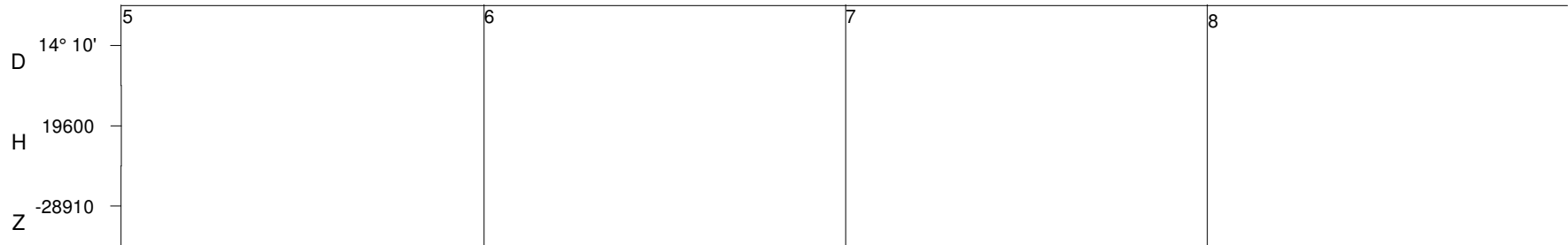
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Livingston Island

November

2015

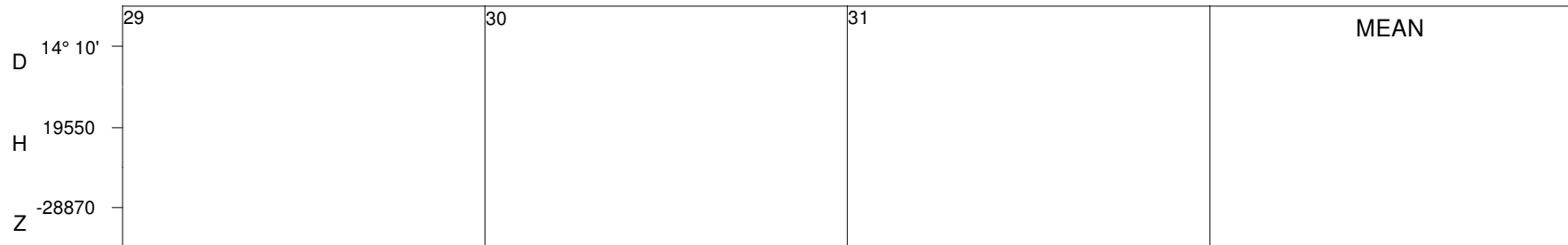
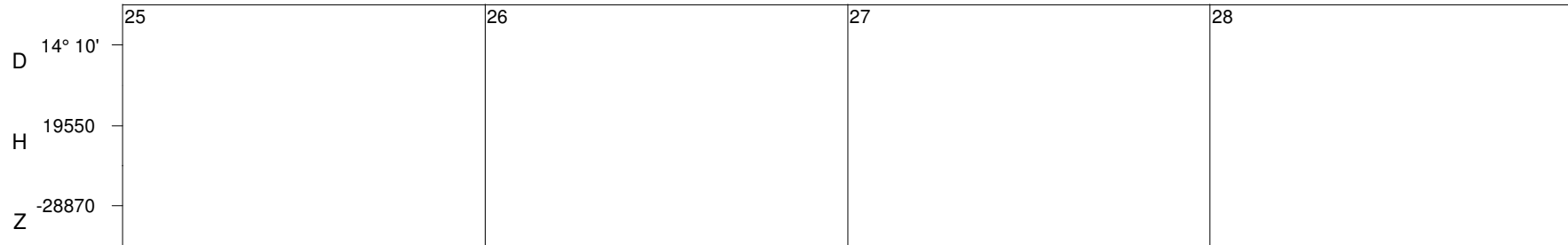
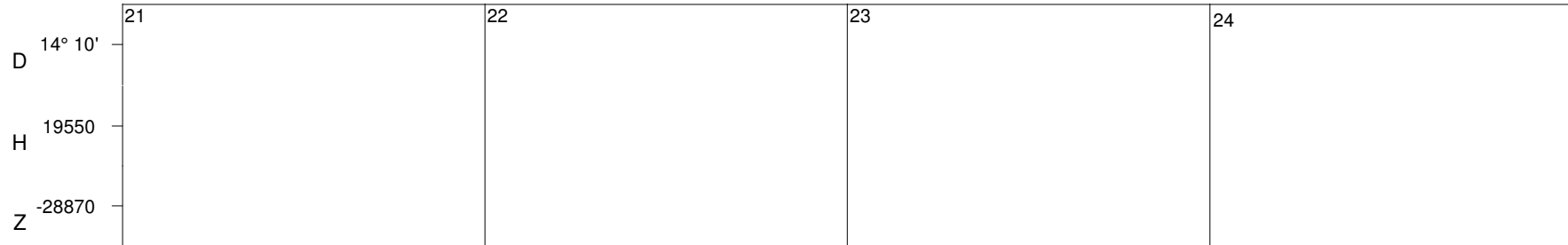
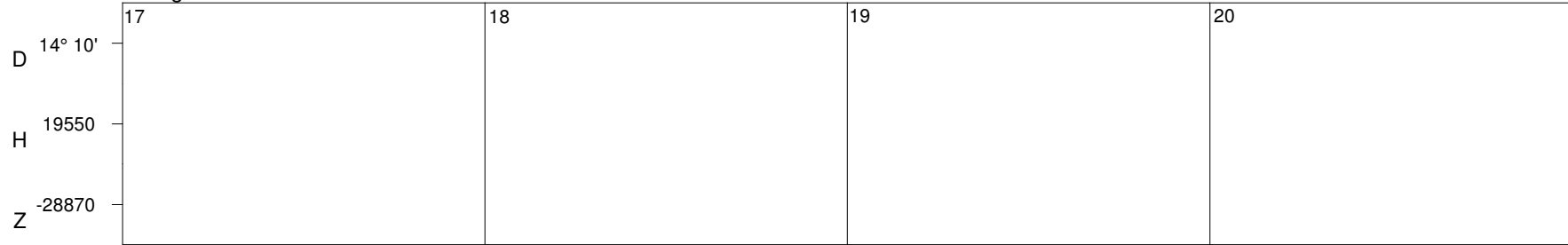


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Livingston Island

November

2015



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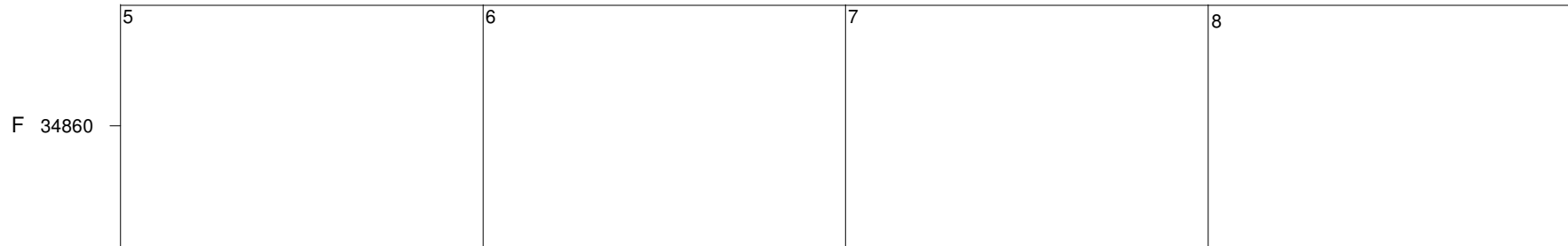
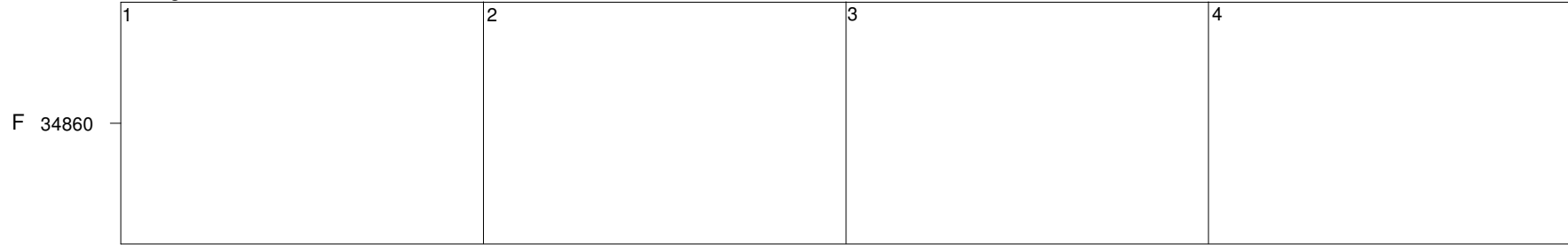
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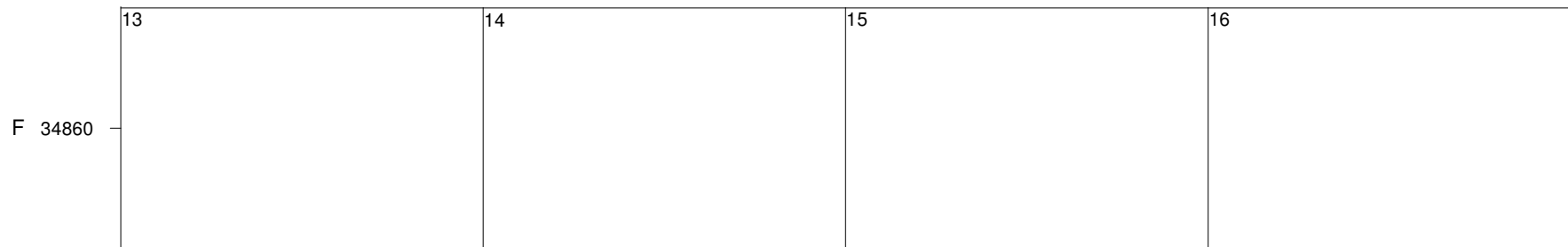
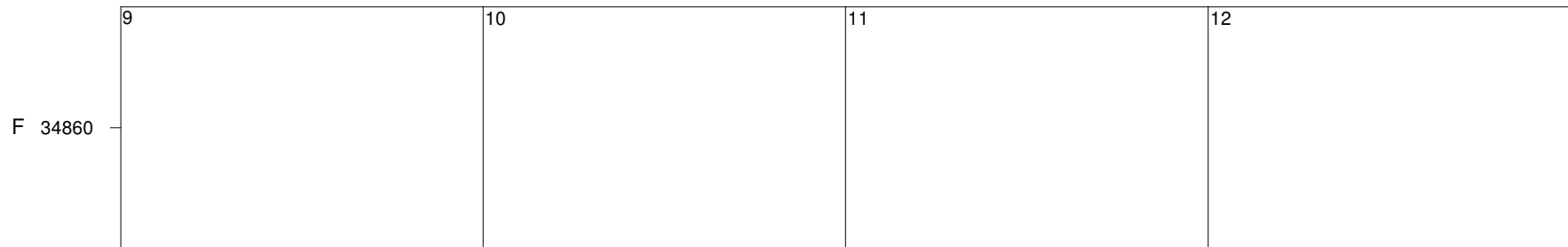
Livingston Island

November

2015



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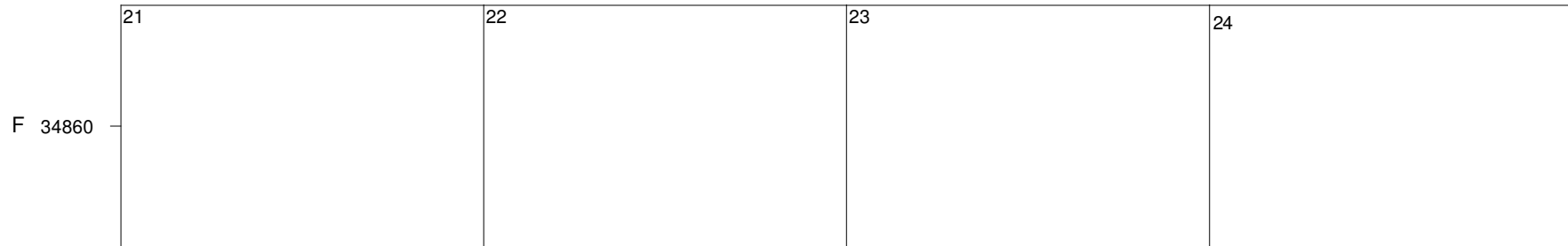
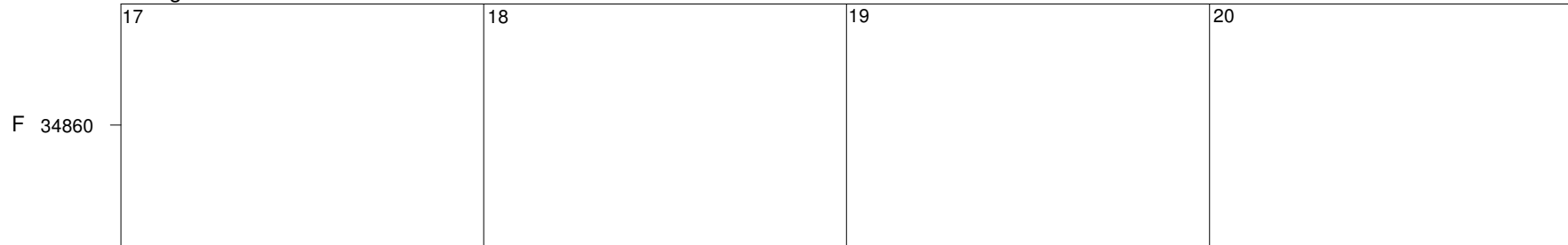


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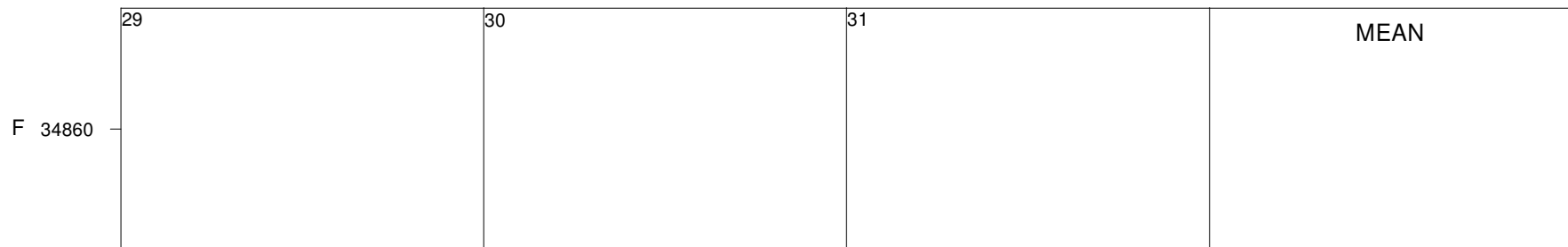
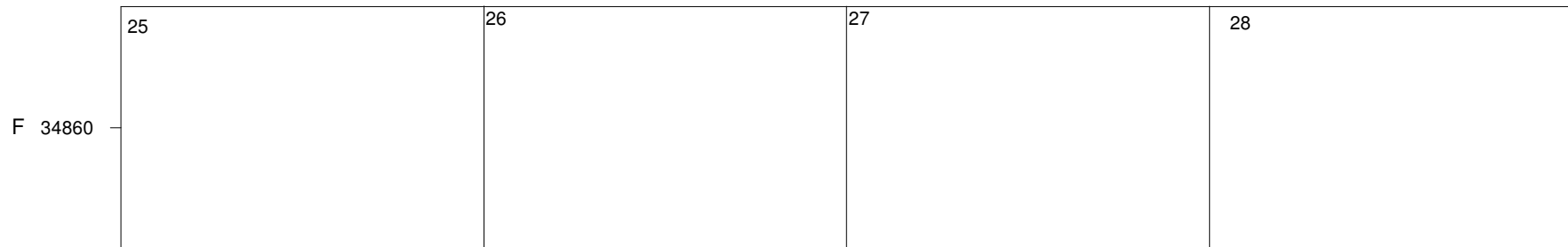
Livingston Island

November

2015



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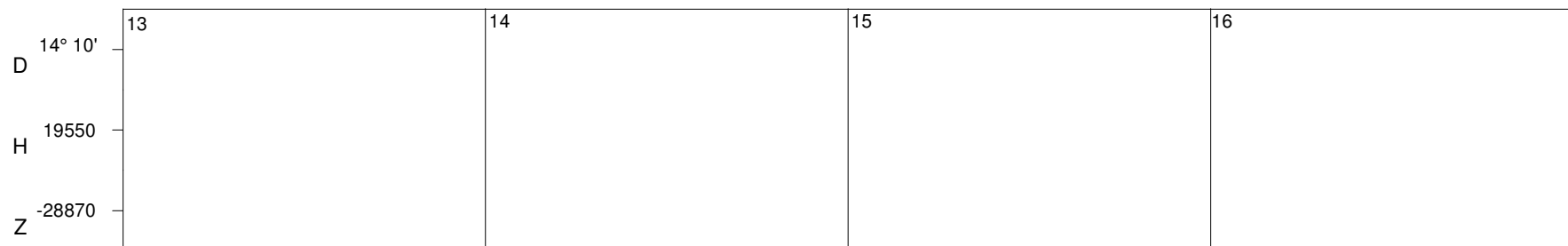
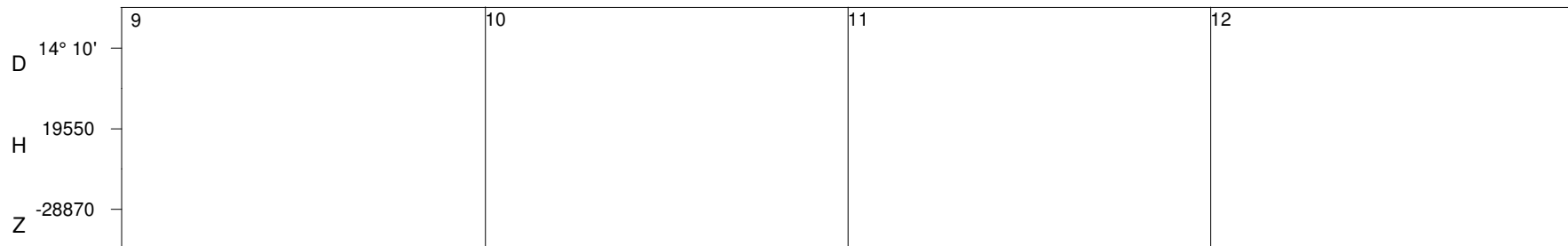
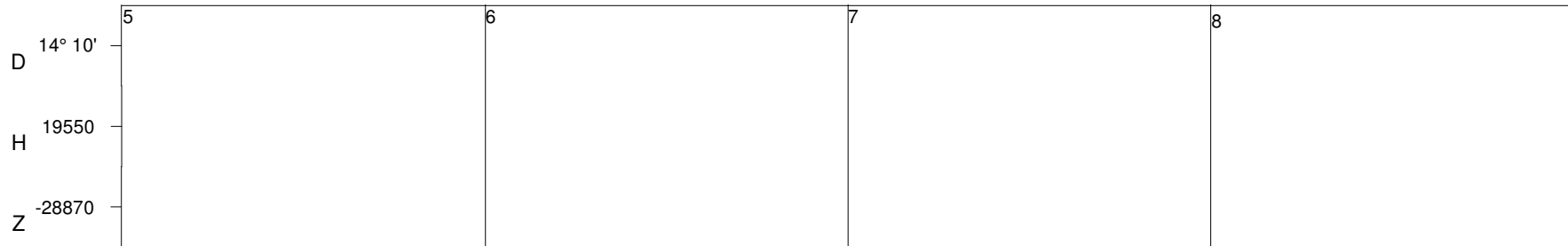
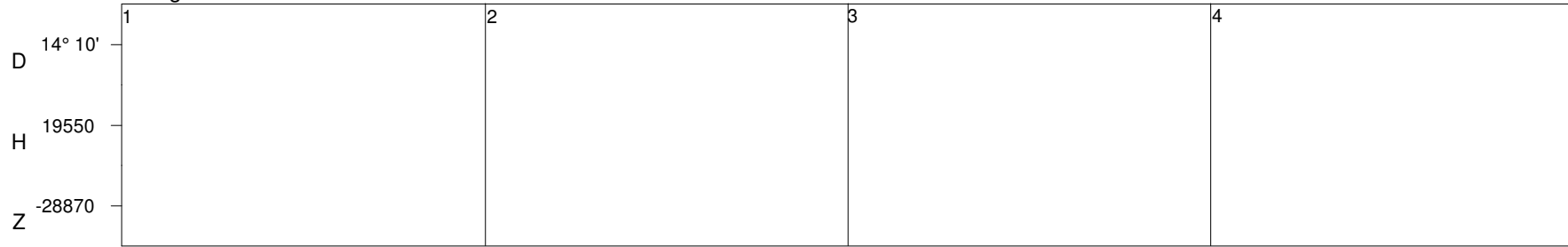


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Livingston Island

December

2015

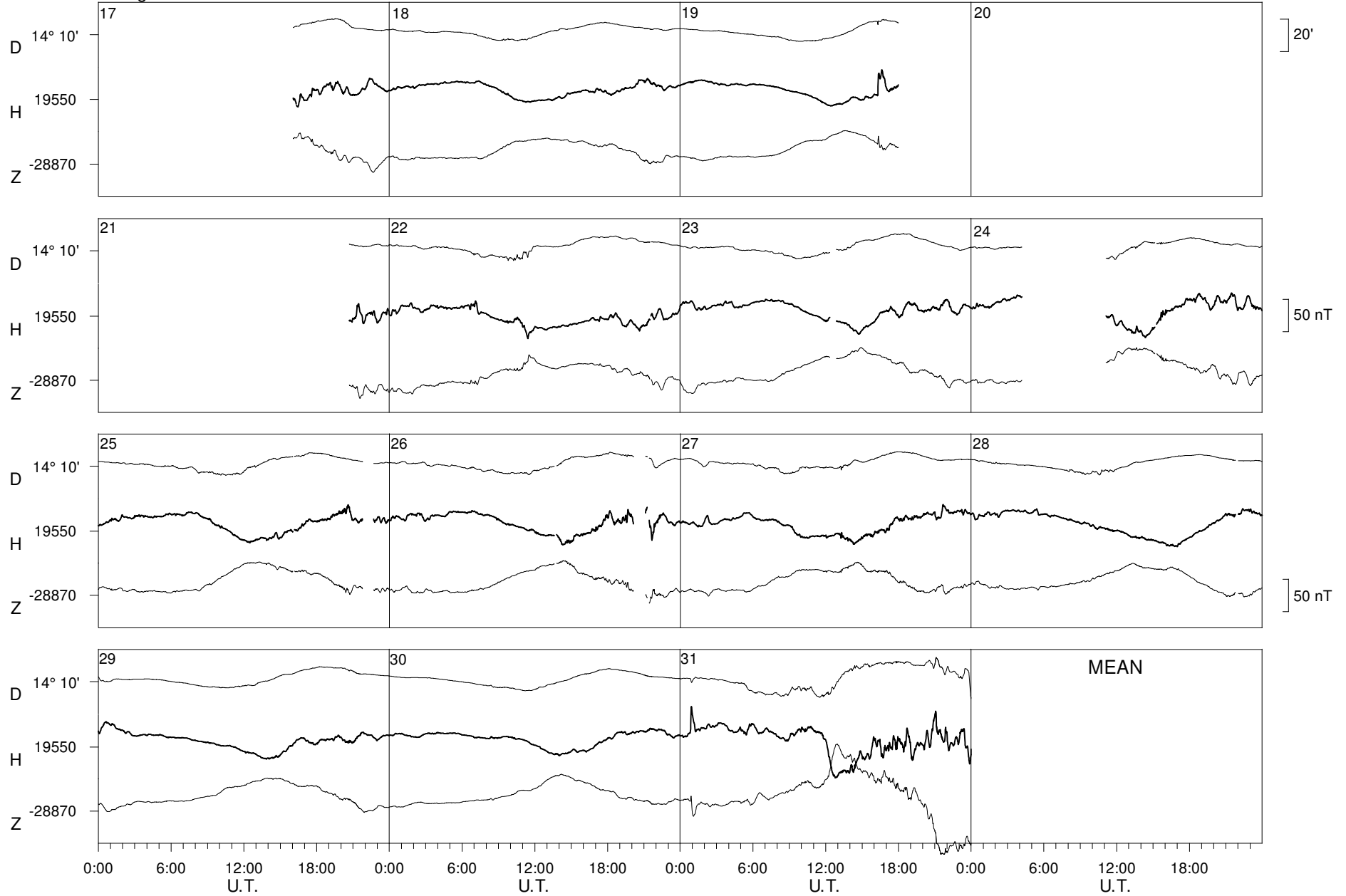


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Livingston Island

December

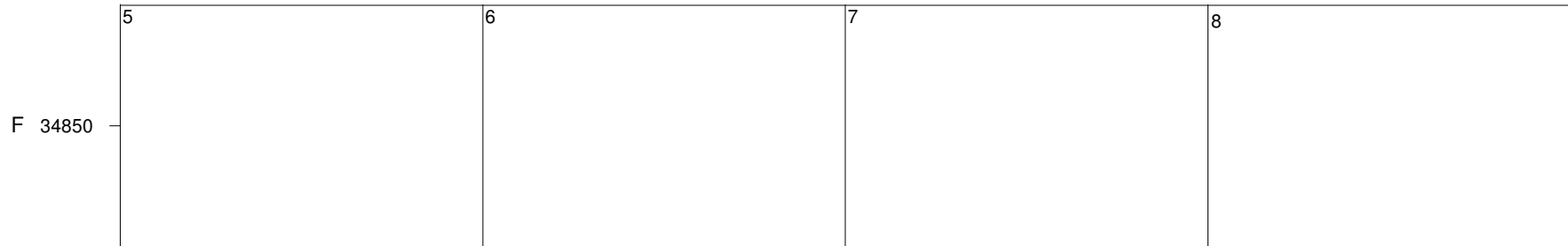
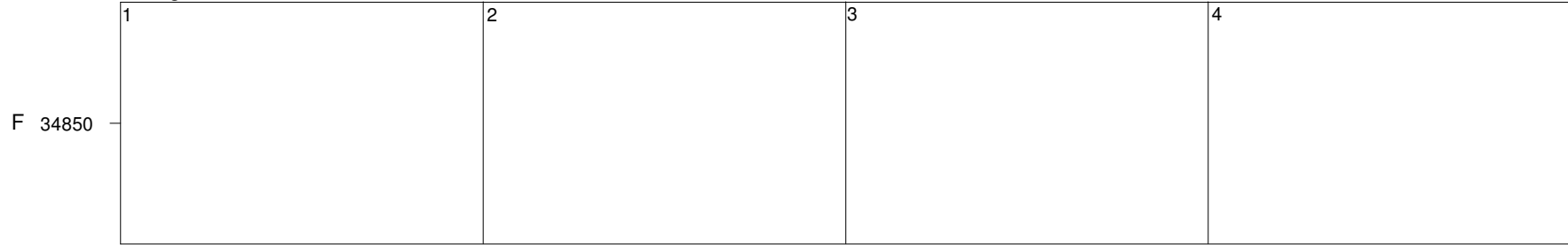
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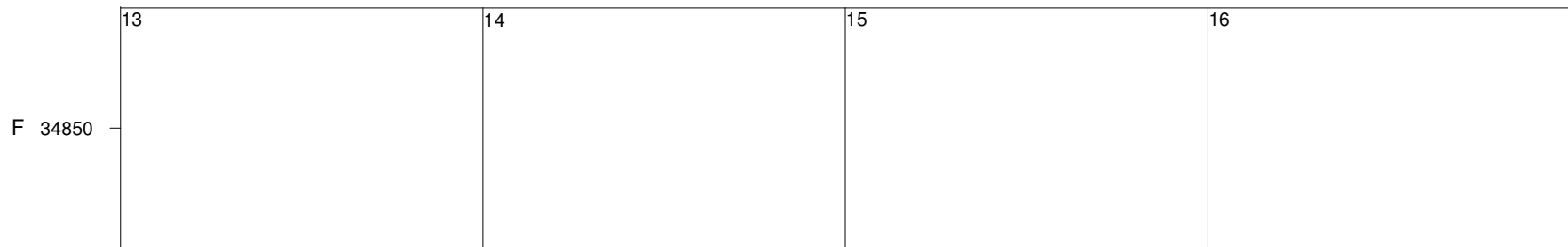
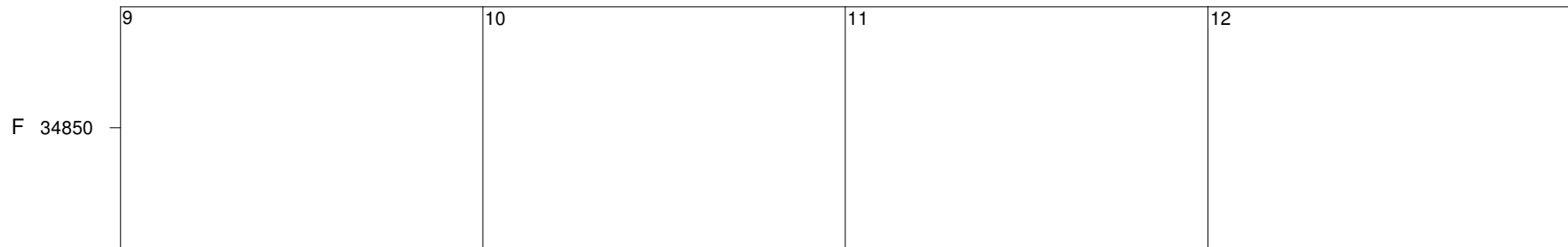
Livingston Island

December

2015



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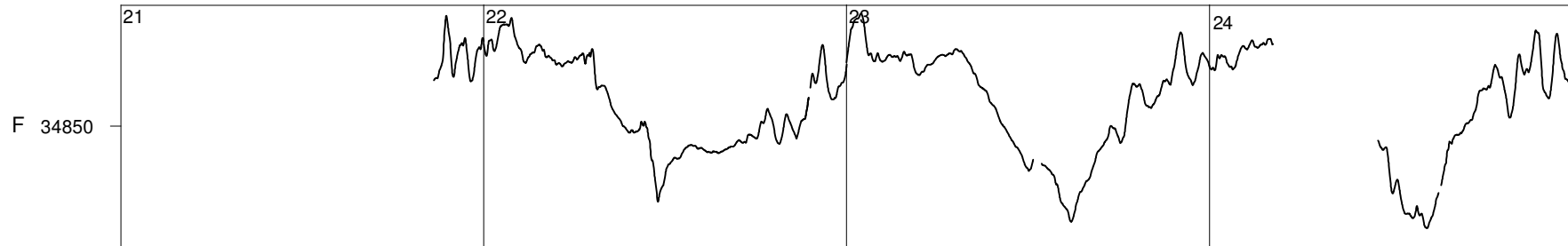
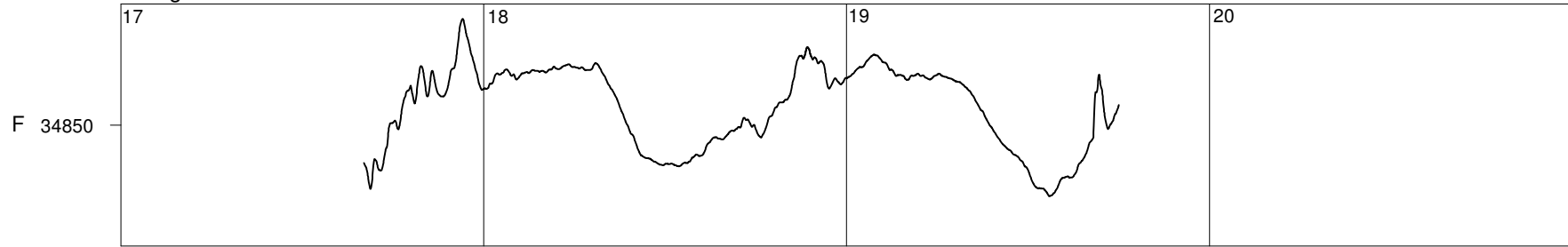


0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00
U.T. U.T. U.T. U.T.

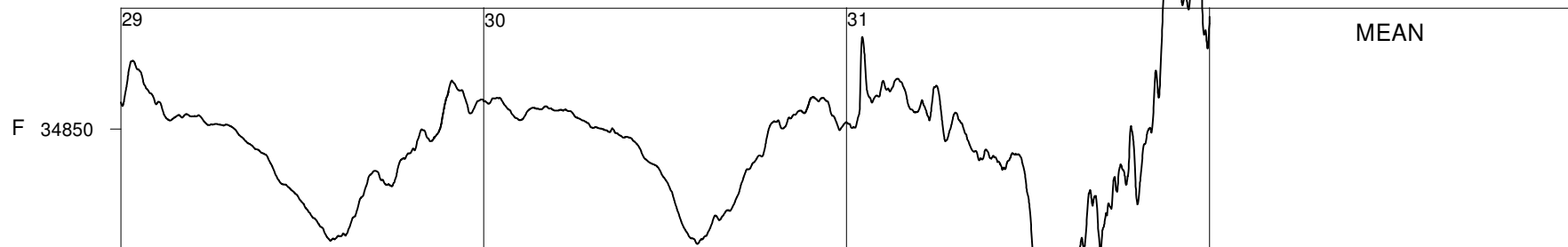
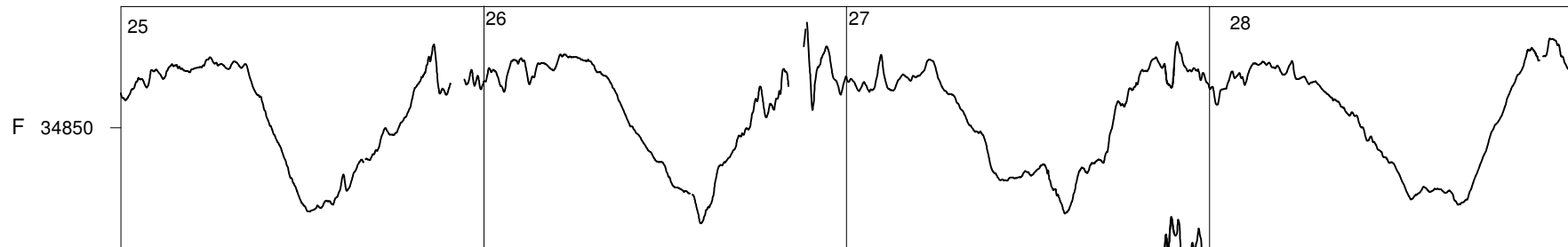
Livingston Island

December

2015



50 nT

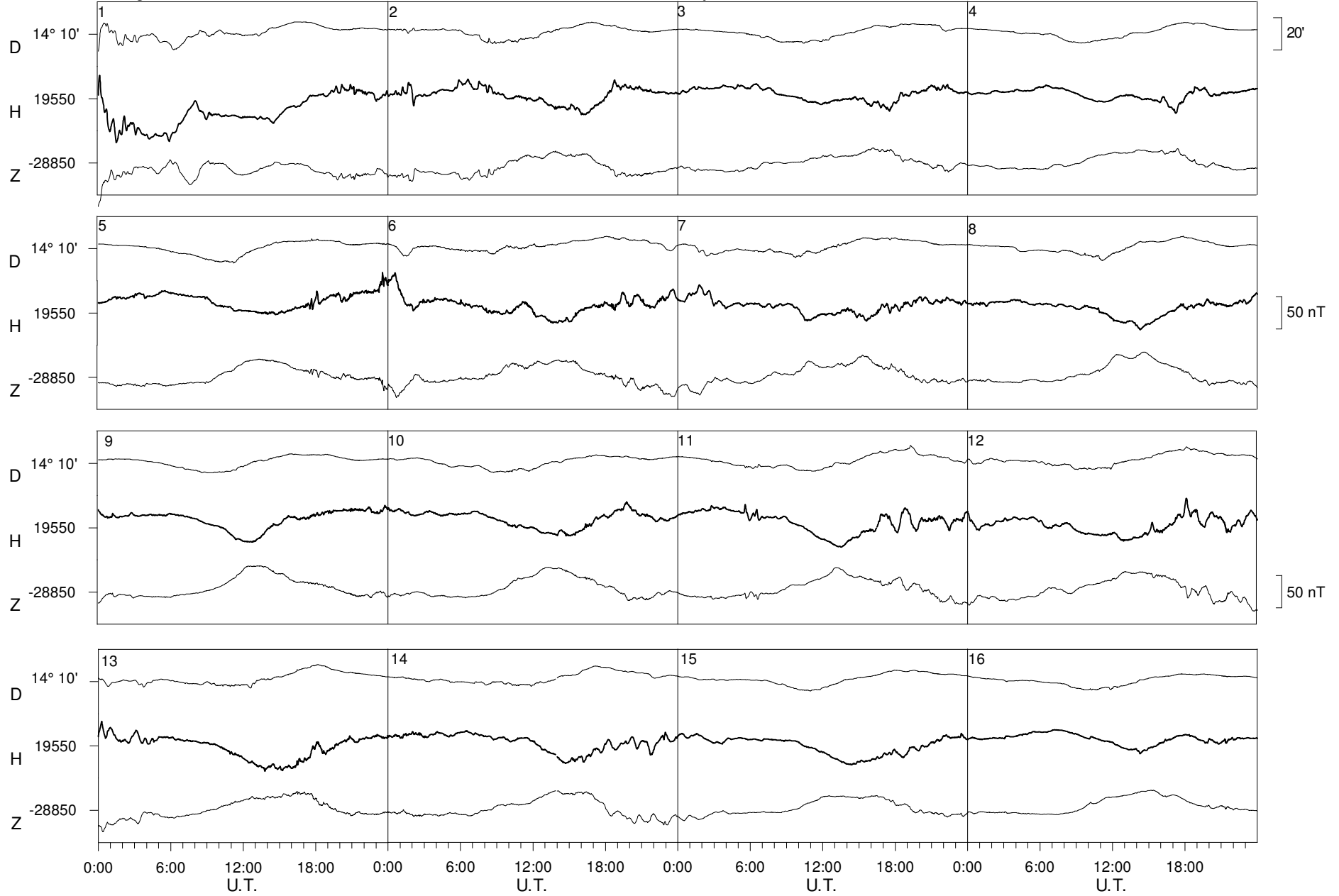


0:00 6:00 12:00 18:00 U.T. 0:00 6:00 12:00 18:00 U.T. 0:00 6:00 12:00 18:00 U.T. 0:00 6:00 12:00 18:00 U.T.

Livingston Island

January

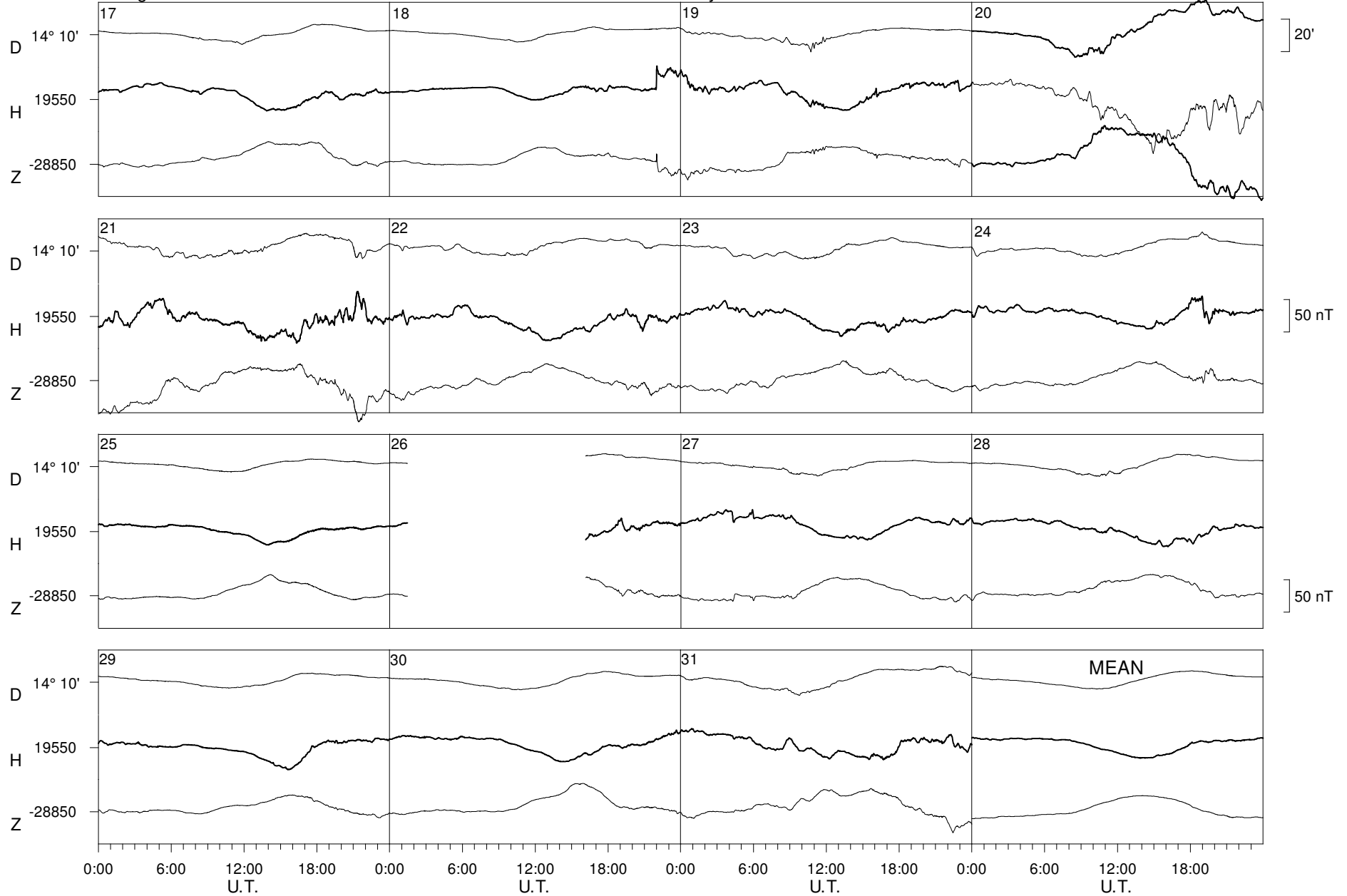
2016



Livingston Island

January

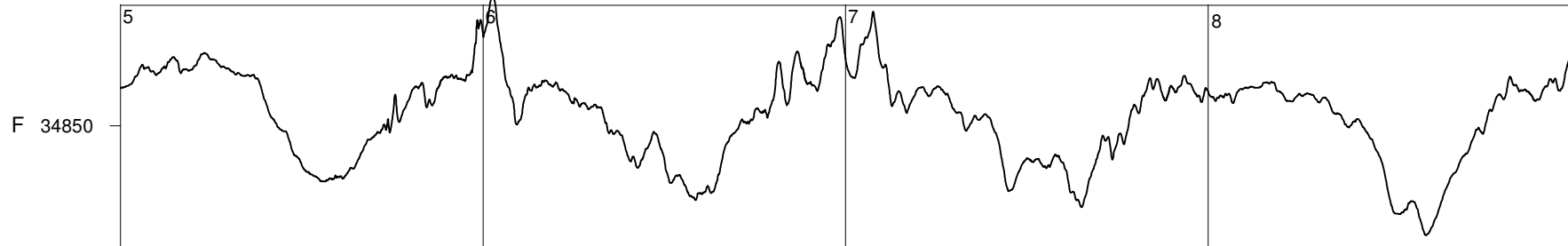
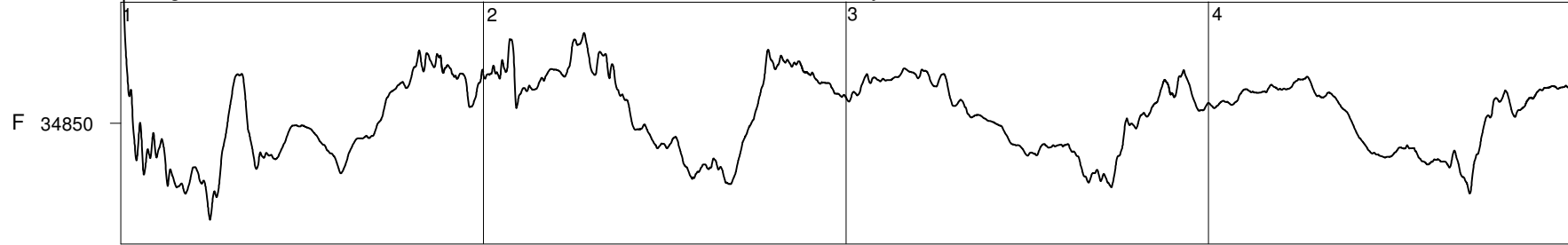
2016



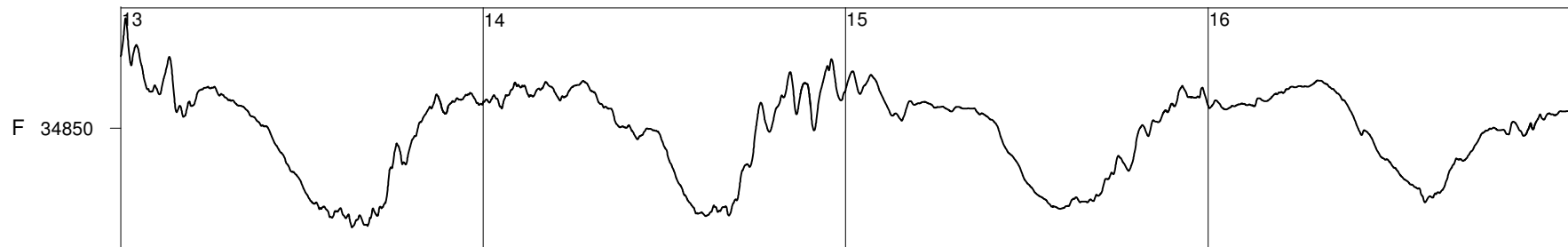
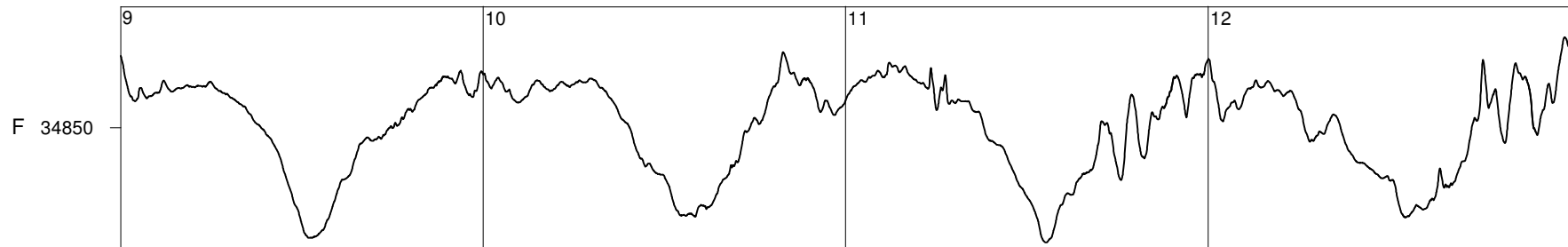
Livingston Island

January

2016



50 nT

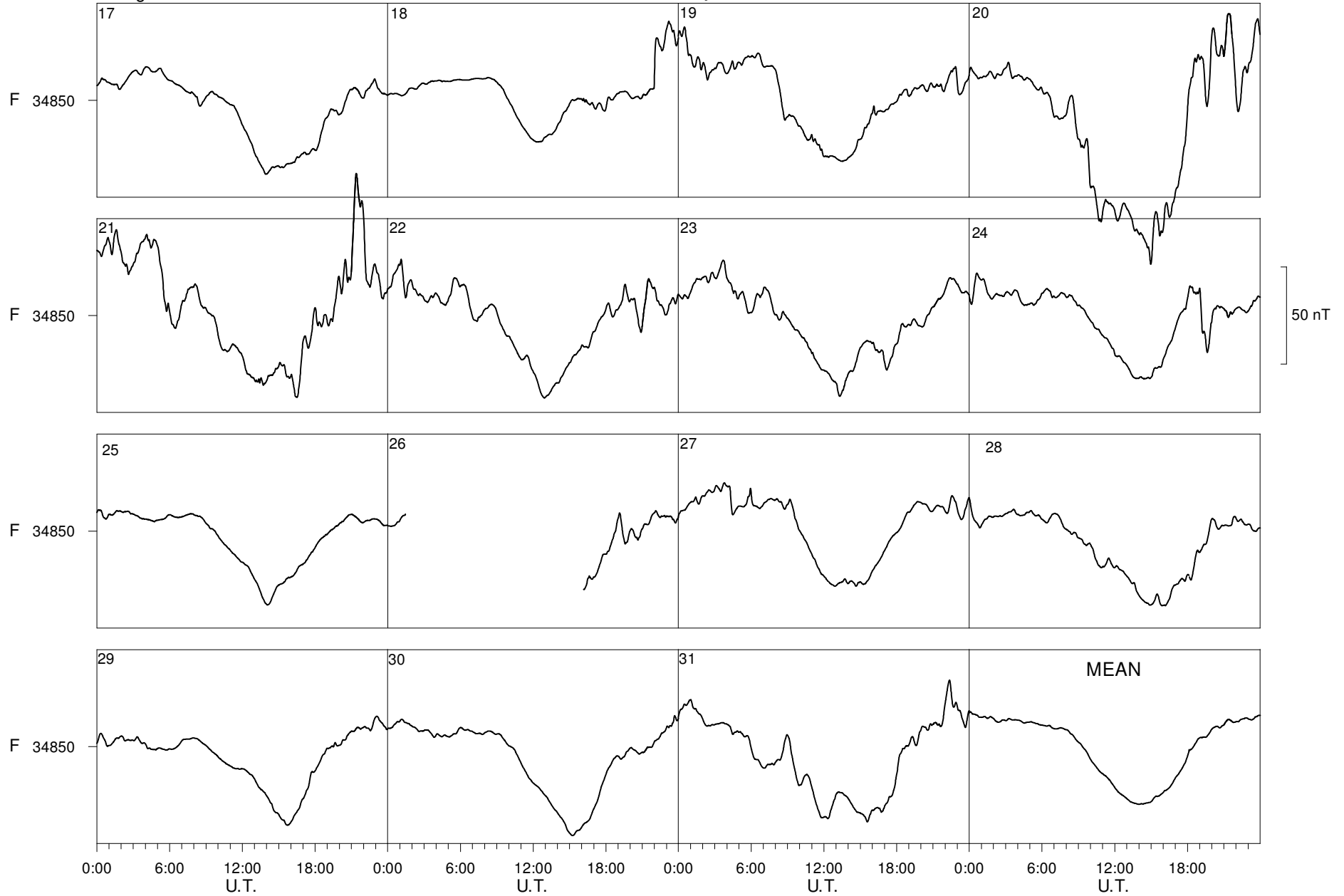


0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00
U.T. U.T. U.T. U.T.

Livingston Island

January

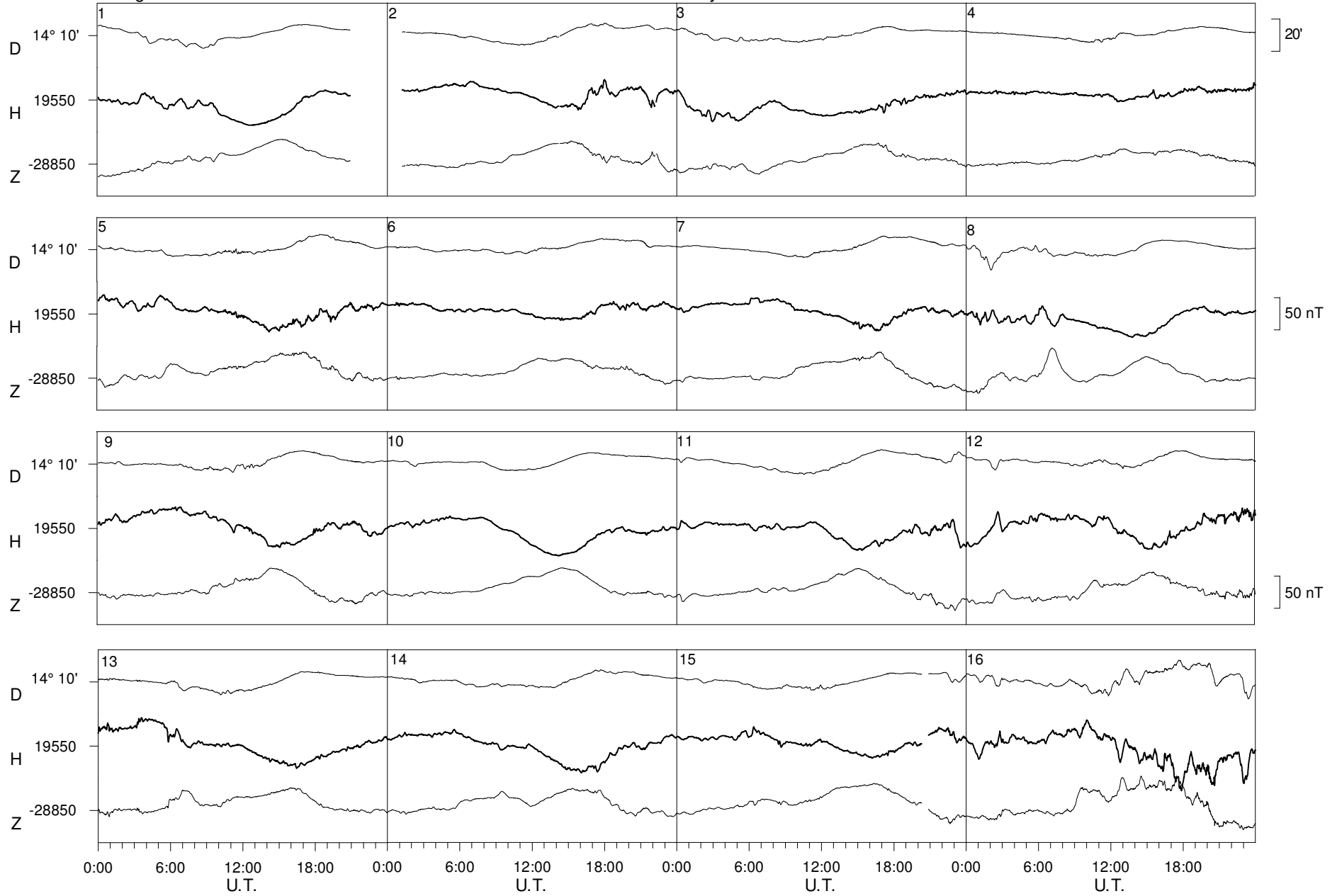
2016



Livingston Island

February

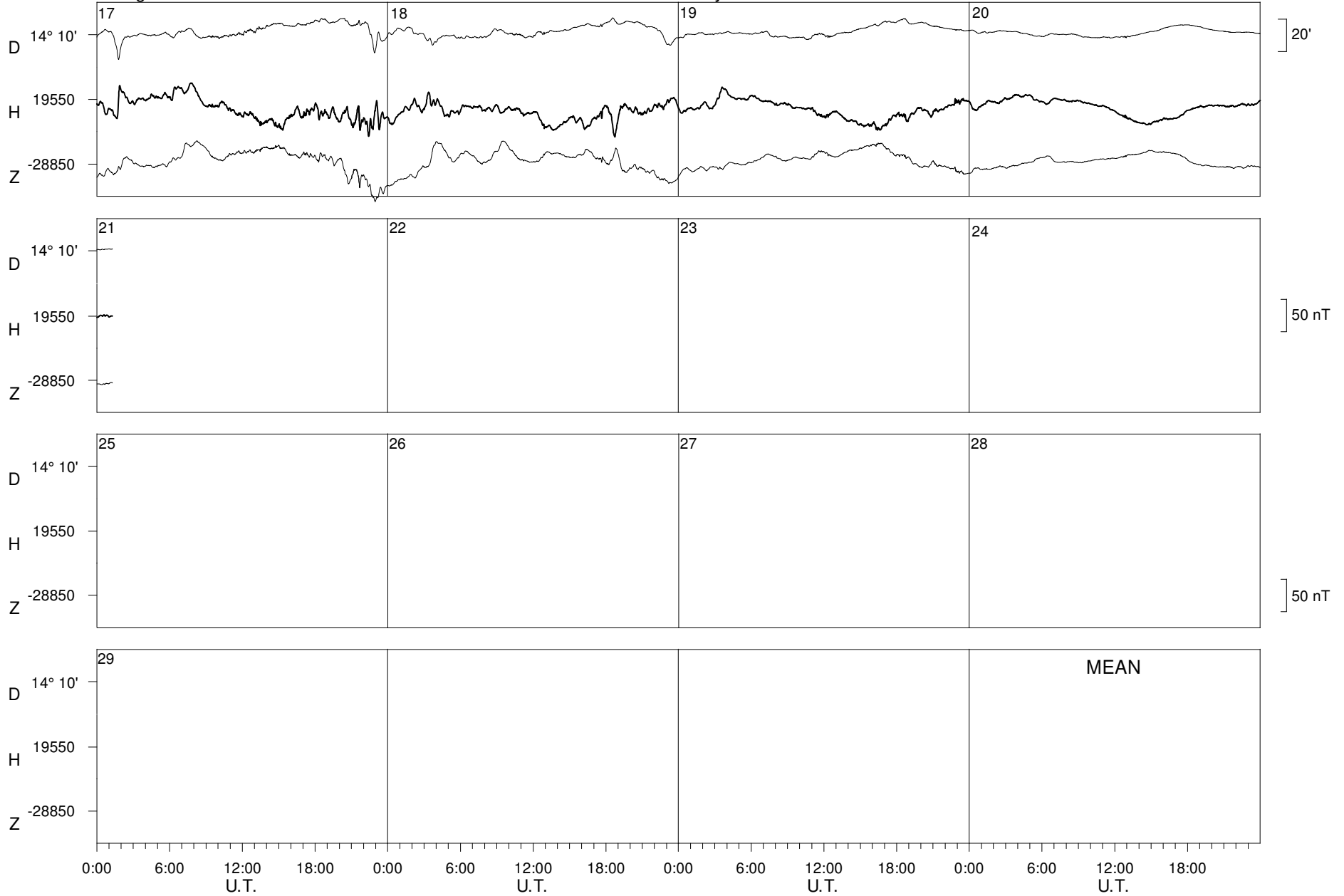
2016



Livingston Island

February

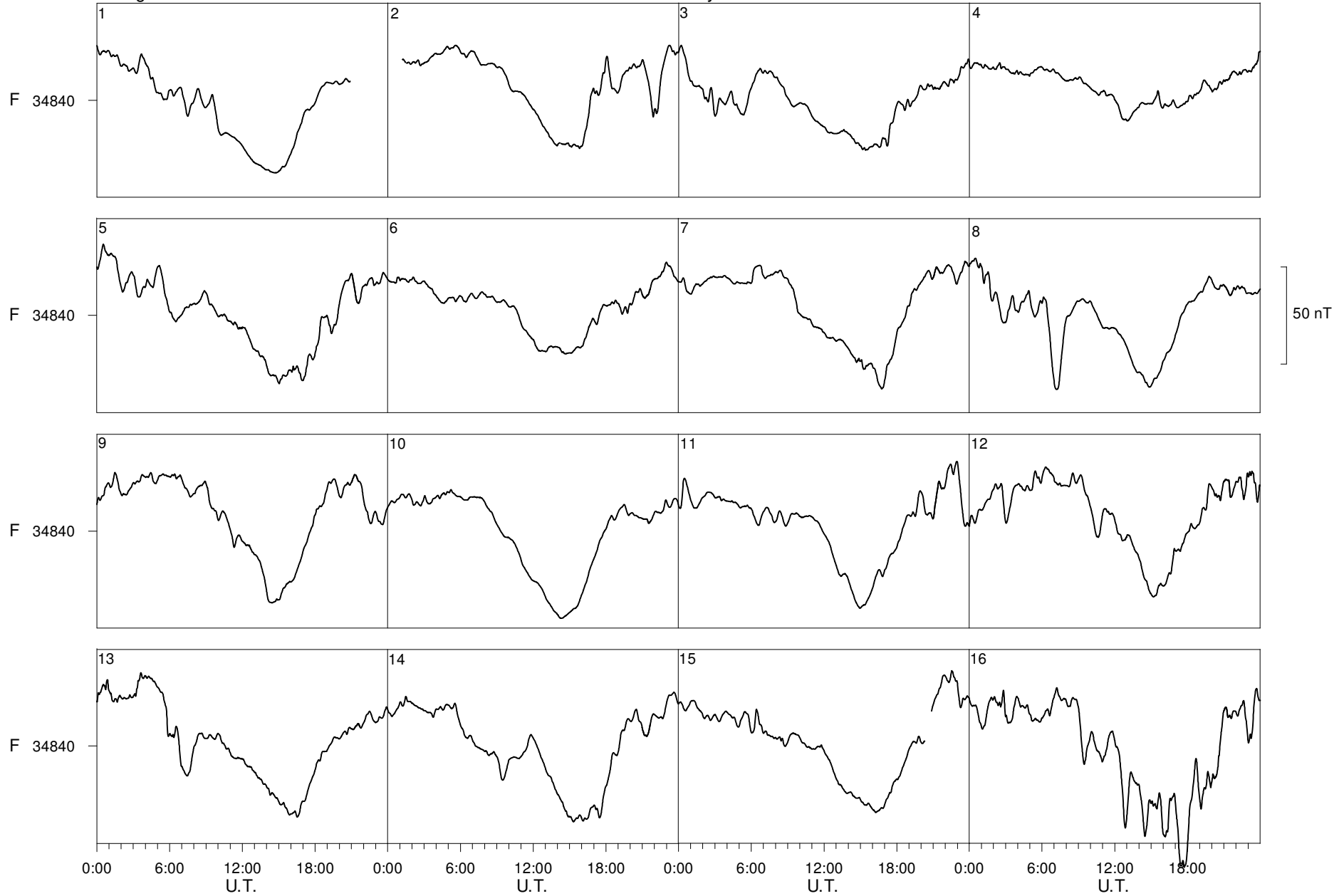
2016



Livingston Island

February

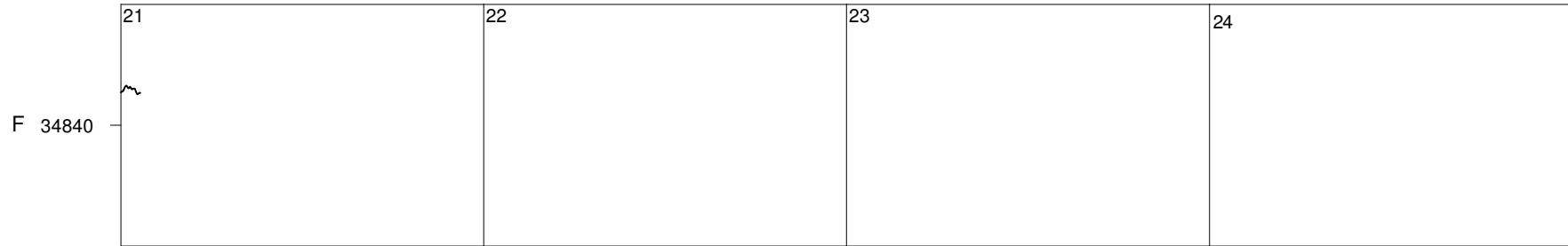
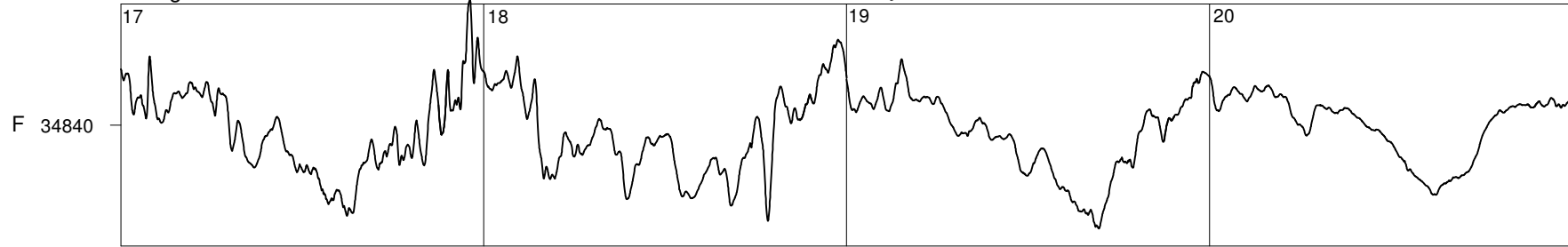
2016



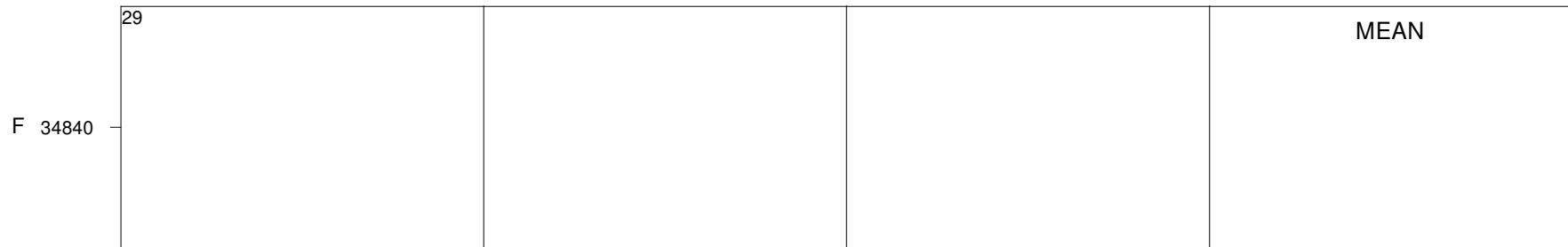
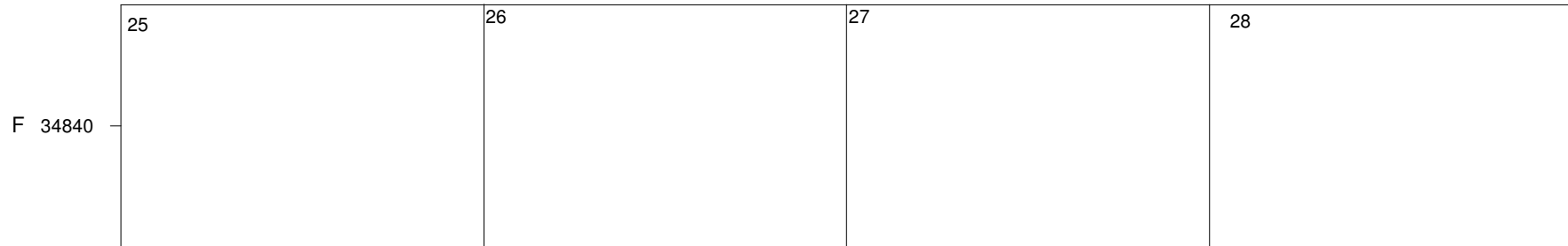
Livingston Island

February

2016



50 nT



0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00 0:00 6:00 12:00 18:00
U.T. U.T. U.T. U.T.

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2015

DECLINATION EAST

D = 14 DEGREES PLUS TABULAR QUANTITIES (UNITS 0.1 MINUTES)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1	151	151	140	134	135	125	123	114	103	95	91	103	121	134	139	155	175	190	200	194	183	165	152	144	142
2	151	153	142	144	139	132	124	118	91	69	70	81	101	129	164	180	199	219	234	240	255	241	226	211	159
3	178	151	149	154	150	130	101	104	108	99	89	134	140	159	173	195	218	206	190	162	144	137	140	143	148
4 D	147	152	145	145	144	136	113	87	52	44	50	86	124	164	183	193	230	262	251	251	258	251	246	208	163
5 D	168	117	127	128	143	130	93	84	72	78	83	97	127	152	176	199	222	247	244	219	204	183	146	144	149
6	151	159	158	155	150	134	108	105	121	142	101	108	122	143	183	231	265	275	240	224	200	178	167	165	166
7 D	159	148	151	146	133	130	114	105	138	200	242	147	155	125	137	184	225	241	238	228	206	180	160	163	169
8 D	161	162	156	142	151	121	110	88	90	94	76	84	123	151	173	211	237	252	266	257	234	200	173	161	161
9	163	158	152	147	140	135	124	115	109	90	92	93	81	105	124	148	194	222	222	202	185	166	148	145	144
10	139	144	148	140	118	134	124	107	103	107	84	72	95	110	143	176	222	241	252	227	209	194	176	156	151
11	136	132	123	118	122	124	118	106	95	87	62	78	71	93	134	175	210	219	210	197	200	185	162	153	138
12	151	152	151	148	144	134	113	109	103	112	104	101	107	139	154	185	215	242	238	222	216	198	182	171	158
13	165	149	142	129	130	130	121	118	110	103	82	76	94	120	148	169	211	265	278	276	263	229	198	176	162
14	164	151	151	147	139	127	112	100	94	94	93	87	81	100	127	140	168	192	207	210	209	186	169	159	142
15 Q	154	146	137	134	129	119	115	100	87	89	76	93	122	131	158	170	185	208	224	215	201	185	167	158	146
16	153	147	141	133	117	109	104	90	69	62	64	90	108	118	126	144	166	188	209	207	191	178	168	162	135
17	161	154	130	109	108	112	115	108	94	78	78	86	103	130	154	167	176	185	184	175	163	168	170	157	136
18 Q	150	150	145	143	141	131	117	105	100	100	101	97	101	111	141	167	181	199	209	211	200	186	170	162	147
19 Q	151	130	110	130	132	126	118	112	103	83	71	70	92	103	126	161	196	218	224	205	184	169	166	158	139
20 Q	164	160	154	148	140	129	117	106	94	79	84	93	102	118	143	167	179	188	195	185	164	152	153	153	140
21	152	148	138	132	125	116	109	91	98	81	73	67	89	114	154	194	224	267	284	245	209	180	156	148	150
22	128	137	129	132	119	127	114	110	94	95	101	117	119	146	163	164	174	200	216	217	189	175	167	162	146
23	150	148	140	140	134	136	101	99	97	93	92	102	114	108	132	159	193	207	209	196	194	183	167	162	144
24	160	154	145	140	135	129	123	109	101	90	110	113	123	133	145	172	201	216	222	210	202	180	169	163	152
25 Q	165	157	149	145	131	133	125	108	95	87	88	90	97	95	105	142	186	212	220	217	209	197	179	141	145
26 D	125	140	140	135	---	---	---	---	---	---	---	---	---	---	---	---	---	241	251	---	---	204	180	172	---
27	154	129	114	126	134	139	133	116	89	84	78	89	93	97	126	166	210	224	229	221	219	197	193	179	147
28	136	158	156	148	142	140	136	105	75	73	89	115	127	134	143	164	198	233	240	222	193	170	154	147	150
29	150	152	149	148	137	136	130	117	95	93	86	74	102	112	133	166	201	220	243	243	216	201	171	164	152
30	168	163	159	135	135	125	120	114	101	86	94	105	117	129	152	170	200	227	235	223	205	172	154	148	152
31	158	163	160	140	139	140	127	115	93	85	76	69	82	113	139	168	190	208	195	178	171	152	160	160	141
MEAN	154	149	143	139	135	129	117	105	96	92	89	94	108	124	147	173	202	223	228	216	203	185	171	161	150
MEAN Q	157	148	139	140	134	128	119	106	96	88	84	89	103	112	135	162	185	205	214	206	192	178	167	154	143
MEAN D	152	144	144	139	143	129	108	91	88	104	113	104	132	148	167	197	228	248	250	239	225	204	181	170	---

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2015

HORIZONTAL INTENSITY

H = 19500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN	
DAY																										
1	121	124	127	128	129	129	131	132	124	117	111	105	103	107	111	112	112	114	117	118	123	120	131	124	124	120
2	117	126	134	131	131	133	134	140	135	123	120	116	111	102	91	99	121	139	128	124	115	113	112	129	122	122
3	117	131	117	122	138	134	128	117	113	103	100	100	100	97	89	88	97	117	128	118	119	119	119	119	114	114
4 D	120	122	123	126	127	129	127	122	123	110	107	102	100	98	99	99	77	93	92	104	125	108	107	118	111	111
5 D	110	106	116	108	116	114	115	109	97	92	86	79	78	75	80	80	87	88	101	105	124	116	125	114	101	101
6	109	108	112	115	127	129	120	118	119	125	115	117	100	95	85	85	90	89	97	115	126	126	122	124	111	111
7 D	124	141	146	142	141	140	147	154	139	131	97	77	59	56	58	53	48	50	65	96	112	134	126	115	106	106
8 D	112	108	124	122	127	124	113	98	93	88	76	63	60	70	79	68	60	70	75	84	104	114	121	116	94	94
9	111	120	114	115	117	113	108	112	112	109	105	95	86	70	68	76	74	77	80	83	98	111	128	131	101	101
10	125	118	122	120	115	116	116	112	106	104	101	89	87	91	88	87	80	92	107	109	116	119	123	127	107	107
11	134	125	121	117	116	113	115	115	110	103	98	95	95	84	69	63	53	59	75	93	122	115	116	121	101	101
12	120	125	127	122	122	122	120	122	120	122	122	116	104	102	97	96	91	94	103	103	101	107	115	122	112	112
13	125	128	127	123	125	127	121	117	114	113	110	106	98	91	85	70	63	72	83	102	114	102	119	126	107	107
14	117	116	121	121	117	116	115	117	115	116	113	116	113	104	100	90	83	78	89	102	105	103	114	119	108	108
15 Q	120	124	126	125	126	122	123	118	116	117	108	101	102	104	86	82	76	77	91	105	110	113	113	121	109	109
16	127	133	129	138	122	116	120	125	118	116	114	120	120	108	96	85	86	92	106	105	103	107	112	124	113	113
17	122	118	125	124	114	112	111	110	106	100	98	97	91	88	83	79	87	95	103	112	113	121	115	112	106	106
18 Q	123	122	126	120	120	120	120	122	122	120	115	111	109	102	97	94	86	98	109	118	115	103	99	104	111	111
19 Q	122	128	122	119	121	122	121	120	117	113	106	97	92	87	85	82	85	98	116	122	119	122	121	117	111	111
20 Q	113	113	121	117	116	114	117	119	121	118	118	112	100	91	92	97	100	113	126	126	126	127	130	140	115	115
21	149	145	151	160	155	167	154	145	137	128	124	120	113	107	101	82	70	90	102	97	108	108	115	114	123	123
22	123	113	121	130	124	126	126	127	122	115	114	111	109	93	92	88	86	94	105	108	109	117	118	118	112	112
23	125	116	121	122	126	133	120	119	117	116	117	113	101	93	87	85	85	91	107	113	117	118	117	118	112	112
24	121	121	123	128	126	125	126	125	124	120	123	120	111	95	83	78	68	73	91	105	105	109	118	123	110	110
25 Q	124	128	133	133	125	128	128	128	126	120	116	114	112	105	99	94	84	83	93	107	113	126	129	133	116	116
26 D	121	123	133	120	---	---	---	---	---	---	---	---	---	---	---	---	---	70	81	---	---	111	110	111	---	---
27	115	118	120	121	119	129	133	127	120	112	106	105	97	86	83	78	73	81	96	115	132	127	120	108	109	109
28	116	126	129	134	137	139	147	125	118	117	111	108	97	84	72	73	73	84	102	111	108	107	116	121	111	111
29	120	121	129	128	126	123	123	124	123	123	122	122	115	100	98	97	93	118	135	139	117	109	119	119	118	118
30	112	124	133	136	132	130	123	127	122	112	109	101	98	95	89	89	103	111	132	127	111	102	96	113	114	114
31	118	120	123	117	114	116	114	116	118	122	120	108	93	83	79	84	92	107	113	114	123	129	121	104	110	110
MEAN	120	122	126	125	125	125	124	122	118	114	109	105	98	92	87	84	83	91	102	109	114	115	118	119	110	110
MEAN Q	120	123	125	123	122	121	122	121	120	118	113	107	103	98	92	90	86	94	107	116	116	118	118	123	112	112
MEAN D	117	120	128	124	128	127	125	121	113	105	91	80	74	75	79	75	67	74	83	97	115	116	118	115	---	---

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2015

VERTICAL INTENSITY

Z = -28500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1	-405	-409	-410	-412	-412	-412	-412	-410	-402	-397	-393	-388	-382	-387	-390	-388	-389	-394	-401	-401	-405	-399	-417	-416	-401
2	-412	-414	-417	-413	-414	-413	-412	-409	-407	-400	-393	-387	-377	-366	-366	-371	-378	-388	-391	-398	-406	-415	-419	-432	-400
3	-425	-428	-421	-422	-426	-422	-409	-405	-406	-402	-398	-386	-380	-381	-378	-382	-391	-400	-411	-415	-418	-414	-413	-412	-406
4 D	-412	-412	-412	-414	-414	-415	-410	-400	-399	-391	-390	-380	-373	-363	-367	-374	-368	-383	-403	-415	-435	-431	-430	-451	-402
5 D	-450	-436	-422	-422	-425	-419	-407	-410	-402	-403	-400	-388	-380	-380	-380	-381	-380	-383	-400	-414	-437	-430	-452	-443	-410
6	-429	-418	-416	-417	-420	-417	-410	-413	-409	-388	-385	-391	-382	-379	-372	-367	-376	-393	-410	-423	-422	-415	-411	-415	-403
7 D	-417	-426	-426	-421	-417	-416	-417	-417	-389	-312	-281	-302	-372	-387	-378	-373	-377	-387	-397	-416	-430	-446	-447	-434	-395
8 D	-423	-423	-429	-428	-407	-395	-409	-404	-406	-406	-401	-389	-383	-388	-388	-378	-376	-389	-400	-411	-431	-437	-446	-440	-408
9	-430	-429	-419	-417	-419	-416	-411	-411	-408	-408	-407	-400	-393	-382	-379	-381	-377	-383	-394	-404	-415	-420	-426	-426	-406
10	-426	-418	-417	-419	-411	-411	-410	-406	-402	-396	-400	-389	-378	-373	-370	-368	-363	-376	-394	-404	-420	-424	-425	-428	-401
11	-436	-425	-421	-417	-413	-409	-409	-400	-394	-395	-403	-398	-391	-375	-363	-355	-358	-374	-392	-401	-416	-418	-416	-419	-400
12	-415	-415	-414	-409	-408	-408	-405	-409	-406	-403	-402	-399	-389	-377	-373	-371	-374	-380	-396	-403	-407	-412	-421	-423	-401
13	-423	-423	-420	-415	-415	-417	-407	-403	-402	-404	-404	-398	-386	-377	-374	-368	-360	-367	-379	-399	-414	-410	-423	-432	-401
14	-426	-418	-418	-416	-412	-411	-410	-407	-400	-405	-400	-400	-398	-385	-374	-373	-378	-379	-387	-397	-405	-405	-413	-418	-401
15 Q	-417	-414	-416	-412	-410	-408	-408	-403	-401	-401	-392	-386	-383	-381	-376	-379	-379	-377	-384	-393	-401	-408	-408	-411	-398
16	-414	-417	-413	-417	-409	-404	-410	-406	-396	-396	-391	-385	-383	-381	-377	-374	-374	-382	-395	-403	-403	-408	-410	-414	-398
17	-416	-415	-418	-415	-406	-407	-409	-410	-404	-401	-395	-388	-380	-376	-374	-374	-381	-383	-386	-391	-392	-398	-404	-400	-397
18 Q	-409	-405	-410	-405	-407	-408	-408	-405	-401	-396	-390	-388	-386	-381	-377	-378	-383	-389	-394	-403	-408	-410	-409	-409	-398
19 Q	-420	-425	-419	-412	-411	-409	-407	-405	-403	-401	-395	-386	-375	-370	-366	-364	-367	-377	-390	-400	-405	-408	-413	-409	-397
20 Q	-403	-405	-408	-406	-407	-408	-410	-409	-404	-397	-394	-389	-381	-375	-372	-383	-391	-395	-399	-401	-405	-404	-402	-407	-398
21	-409	-404	-408	-412	-406	-411	-406	-400	-392	-392	-387	-376	-368	-365	-356	-351	-351	-359	-371	-383	-400	-404	-414	-413	-389
22	-421	-413	-412	-415	-409	-409	-412	-411	-405	-397	-394	-391	-393	-386	-382	-376	-379	-386	-398	-405	-410	-422	-422	-417	-403
23	-420	-416	-414	-413	-412	-408	-401	-409	-408	-401	-397	-392	-382	-381	-380	-378	-375	-378	-393	-398	-407	-413	-412	-409	-400
24	-409	-408	-407	-410	-407	-405	-407	-408	-407	-397	-391	-387	-383	-379	-375	-375	-376	-374	-387	-401	-413	-413	-423	-423	-399
25 Q	-412	-413	-413	-412	-408	-409	-410	-410	-407	-401	-395	-391	-385	-381	-377	-370	-366	-368	-375	-388	-396	-408	-409	-427	-397
26 D	-423	-414	-418	-405	---	---	---	---	---	---	---	---	---	---	---	---	-371	-392	---	---	-422	-421	-426	---	
27	-429	-429	-423	-417	-412	-413	-409	-403	-404	-398	-395	-389	-386	-380	-378	-380	-375	-382	-396	-407	-426	-429	-428	-424	-405
28	-427	-420	-413	-411	-412	-408	-402	-380	-388	-390	-382	-382	-382	-381	-377	-375	-376	-375	-384	-403	-410	-411	-418	-419	-397
29	-415	-413	-414	-411	-405	-402	-405	-405	-406	-400	-389	-389	-384	-374	-369	-367	-365	-372	-389	-403	-410	-403	-413	-420	-397
30	-406	-408	-414	-410	-401	-400	-401	-409	-406	-393	-385	-376	-371	-370	-369	-370	-370	-376	-398	-406	-410	-415	-404	-415	-395
31	-410	-408	-411	-410	-406	-408	-408	-409	-409	-407	-400	-390	-380	-377	-371	-371	-377	-384	-396	-407	-425	-435	-436	-433	-403
MEAN	-419	-417	-416	-414	-411	-410	-408	-406	-403	-396	-391	-386	-382	-378	-374	-373	-374	-381	-393	-403	-413	-416	-420	-421	-400
MEAN Q	-412	-413	-413	-409	-408	-408	-408	-406	-403	-399	-393	-388	-382	-378	-374	-375	-377	-381	-388	-397	-403	-407	-408	-413	-398
MEAN D	-425	-422	-421	-418	-416	-411	-411	-408	-399	-378	-368	-365	-377	-379	-378	-377	-375	-383	-398	-414	-431	-433	-439	-439	---

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2015

TOTAL INTENSITY
 F = 34500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1	435	440	443	445	446	446	447	446	435	426	420	413	406	413	418	416	417	422	430	430	437	430	451	446	432
2	439	446	452	448	448	449	448	450	445	432	425	417	406	392	387	395	414	432	428	431	433	439	442	462	432
3	450	460	446	450	462	457	443	433	432	423	417	407	403	402	395	398	410	429	444	442	445	441	441	440	432
4 D	440	441	442	445	447	448	443	432	432	418	415	404	397	388	392	398	380	402	418	435	462	450	448	472	427
5 D	466	453	447	442	450	443	433	433	420	418	412	397	391	389	391	393	395	399	420	434	463	453	477	463	428
6	448	439	440	442	451	450	439	440	437	424	416	421	404	399	388	384	394	408	426	447	452	446	441	445	428
7 D	447	464	467	460	457	455	460	464	432	364	319	326	373	384	378	371	371	381	397	431	451	476	473	456	419
8 D	446	443	457	456	440	429	434	422	420	417	407	390	382	393	397	384	377	393	405	420	447	458	469	461	423
9	451	455	443	442	445	440	433	435	433	431	428	417	406	388	384	390	386	393	404	413	431	443	457	459	425
10	455	444	446	446	437	437	437	431	425	419	420	404	394	392	388	386	378	395	418	428	445	450	453	458	424
11	469	454	448	443	439	434	435	428	420	417	421	415	409	390	372	362	358	375	399	416	445	442	442	447	420
12	443	446	447	440	438	438	435	440	435	434	434	428	412	402	395	393	393	400	418	424	426	433	445	450	427
13	452	455	451	445	446	448	438	431	429	430	428	421	406	395	390	376	365	377	393	420	439	429	449	460	424
14	450	443	446	444	439	437	437	435	428	432	427	429	425	409	398	391	391	390	402	418	426	425	438	445	425
15 Q	445	445	447	443	443	439	439	432	430	430	418	408	407	406	391	392	389	388	401	416	426	433	433	440	422
16	446	452	447	455	440	432	440	438	426	426	420	418	417	408	398	389	390	400	419	424	424	430	434	445	426
17	445	441	448	445	433	432	434	433	427	420	414	408	398	393	389	387	396	403	410	419	420	430	432	426	420
18 Q	439	436	443	435	436	437	437	436	433	427	420	415	413	405	399	398	398	410	419	432	435	429	426	429	424
19 Q	448	456	448	440	440	439	437	435	432	427	419	407	394	388	383	379	383	399	420	431	434	438	442	436	423
20 Q	429	431	437	434	434	434	437	438	435	427	425	417	404	393	392	403	413	423	433	435	438	438	438	448	426
21	454	448	454	464	455	466	455	444	434	428	422	410	400	394	384	369	362	379	397	404	424	427	439	438	423
22	450	438	441	449	440	441	444	444	436	425	422	418	418	404	400	393	395	405	420	428	432	447	448	443	428
23	450	442	443	443	444	445	432	438	436	429	426	420	406	400	395	393	391	396	417	425	435	440	439	437	426
24	439	437	438	443	440	438	440	441	439	428	425	420	412	399	390	386	381	383	403	423	433	435	448	451	424
25 Q	443	446	449	448	440	443	443	443	440	431	425	420	414	407	400	392	382	383	395	413	423	441	443	460	426
26 D	450	444	453	435	---	---	---	---	---	---	---	---	---	---	---	---	---	379	402	---	---	443	442	447	---
27	451	454	450	446	440	447	445	437	434	425	418	413	407	395	392	390	384	394	413	434	459	458	454	443	428
28	451	450	447	448	450	448	448	416	420	420	411	409	403	395	385	384	384	390	408	428	432	432	443	447	423
29	443	442	448	444	438	434	436	437	437	432	422	423	414	398	393	391	386	407	430	444	437	427	441	446	427
30	431	440	449	447	438	437	434	442	437	420	413	401	394	392	387	389	396	405	436	439	434	433	421	439	423
31	438	438	442	437	433	435	434	436	437	438	431	415	399	391	384	387	396	410	423	434	453	464	461	449	428
MEAN	447	446	447	445	443	442	440	437	432	424	417	410	404	397	391	389	388	398	414	427	438	441	446	448	426
MEAN Q	441	443	445	440	439	438	439	437	434	429	421	414	406	400	393	393	393	401	414	426	431	436	437	443	425
MEAN D	450	449	453	448	448	444	443	438	426	404	388	379	386	388	390	386	380	391	408	429	454	456	462	460	---

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2015

DECLINATION EAST

D = 14 DEGREES PLUS TABULAR QUANTITIES (UNITS 0.1 MINUTES)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	119	142	120	135	141	141	127	104	84	77	62	68	82	110	138	171	196	221	219	195	195	193	171	170	141
2 D	119	91	33	76	55	87	125	150	119	104	95	103	125	144	157	206	249	237	227	198	163	160	145	135	138
3	82	101	119	117	126	120	130	127	117	108	114	104	110	121	154	202	231	257	247	209	187	149	126	138	146
4	144	144	151	148	148	148	143	128	117	98	78	71	90	118	174	196	222	242	227	208	173	142	129	133	149
5	132	133	134	127	119	126	132	123	102	91	96	75	76	112	150	196	242	245	248	223	190	163	144	144	147
6	149	152	148	146	143	139	127	123	100	85	70	74	87	109	145	189	231	233	209	183	160	147	146	155	144
7	156	154	147	142	139	134	129	117	91	77	99	108	106	118	154	197	225	251	237	214	193	167	150	141	152
8	153	152	152	148	144	115	102	107	118	97	82	77	95	129	162	194	227	244	237	202	193	153	149	150	149
9	139	138	146	150	149	143	133	120	107	96	90	90	99	101	130	154	183	215	220	206	185	177	170	156	146
10	152	150	145	138	114	110	118	116	98	91	86	80	86	98	119	140	175	208	231	208	190	174	151	151	139
11	151	148	144	135	137	137	125	112	95	87	83	75	88	116	139	154	176	202	206	192	171	157	151	147	139
12 Q	142	148	146	145	141	133	126	119	107	95	85	77	69	106	133	174	209	224	218	206	198	181	163	148	146
13 Q	140	144	144	143	140	133	126	117	106	94	81	84	95	107	126	149	179	217	218	203	188	172	163	158	143
14 Q	153	148	141	136	124	111	106	111	105	95	94	99	104	104	109	127	152	180	198	192	171	153	147	142	133
15	145	141	138	134	121	121	121	128	120	104	85	89	88	96	142	155	159	170	183	170	166	150	137	131	133
16	133	135	133	131	127	126	120	107	91	84	85	87	90	102	119	142	159	175	186	191	190	190	173	157	135
17 D	164	163	111	116	113	131	122	100	105	108	142	152	131	121	133	155	197	232	229	223	200	190	197	176	155
18 D	104	149	141	118	136	144	100	89	95	115	129	138	138	140	153	172	200	218	208	191	178	148	139	147	146
19	141	122	119	127	127	136	126	151	133	108	98	101	108	122	135	165	187	206	213	198	173	147	141	147	143
20	148	147	145	144	130	124	134	136	125	107	94	83	91	110	118	143	179	200	201	189	175	168	162	165	142
21	161	155	136	138	137	138	136	130	117	108	100	104	105	106	128	140	160	179	197	191	177	163	155	142	142
22	131	145	148	141	137	131	120	119	112	98	99	102	99	113	125	144	169	194	210	203	186	170	159	156	142
23	158	125	135	138	139	125	117	128	106	107	111	101	98	140	149	166	192	204	220	218	206	210	228	214	156
24 D	176	163	73	6	76	92	99	80	116	113	114	118	114	126	143	172	194	210	206	194	175	161	158	155	135
25	154	151	148	140	137	136	129	117	104	105	96	96	105	109	136	151	173	201	199	187	171	160	153	149	142
26 Q	142	139	140	145	141	136	134	128	129	118	114	103	96	103	110	129	149	165	182	188	185	171	158	150	140
27 Q	146	141	139	137	133	127	122	117	111	100	90	86	88	93	106	120	141	164	175	178	175	157	148	151	131
28	150	146	142	129	124	126	125	110	96	87	76	73	82	92	118	139	184	201	211	220	225	226	202	171	144
MEAN	142	142	133	130	128	127	123	118	108	99	95	93	98	113	136	162	191	211	213	199	183	168	158	153	143
MEAN Q	145	144	142	141	136	128	123	118	111	101	93	90	91	103	117	140	166	190	198	193	183	167	156	150	139
MEAN D	136	142	96	90	104	119	115	105	104	103	109	116	118	128	145	175	207	224	218	200	182	170	162	157	143

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2015

HORIZONTAL INTENSITY
 H = 19500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	98	124	112	116	115	114	121	132	131	122	109	96	83	78	79	92	103	113	103	117	154	113	97	108	110
2 D	121	130	116	104	107	100	98	124	107	98	91	81	76	62	60	60	73	102	124	113	119	112	105	110	100
3	123	124	112	116	107	105	106	111	113	113	111	105	98	77	55	49	70	92	114	121	122	108	117	114	103
4	120	116	116	119	119	119	117	115	117	118	117	110	89	62	57	67	76	90	104	113	111	112	107	113	104
5	117	115	113	116	121	125	125	124	123	120	118	117	103	91	81	63	75	88	117	114	111	109	104	112	108
6	118	119	120	120	118	122	113	114	114	112	109	99	89	76	69	68	80	93	102	111	112	107	110	112	104
7	119	122	124	125	125	126	128	132	141	133	116	107	95	80	65	62	76	89	99	111	106	103	107	114	109
8	115	123	125	126	124	115	106	100	106	97	93	85	71	60	54	64	82	93	102	105	109	100	104	112	99
9	117	117	117	117	117	115	112	110	108	106	106	102	94	85	76	75	83	97	106	117	125	113	101	108	105
10	116	117	117	122	118	105	103	107	108	108	107	101	89	79	68	70	70	89	110	104	112	102	107	110	102
11	116	124	126	121	111	110	110	110	109	110	109	103	92	88	83	79	84	86	96	102	109	112	113	121	105
12 Q	122	118	121	120	121	116	116	115	114	112	110	102	88	78	73	70	77	85	93	98	105	97	103	110	103
13 Q	115	116	116	118	119	119	117	114	113	113	113	109	102	90	80	74	80	93	99	112	114	113	113	117	107
14 Q	122	125	127	128	122	119	116	115	118	118	118	118	114	109	98	93	88	89	99	114	122	123	123	127	114
15	131	135	135	130	133	130	129	124	125	122	115	115	108	93	81	84	87	94	92	97	103	108	110	116	112
16	121	123	124	126	129	130	134	130	122	115	112	105	99	91	84	83	87	96	101	119	137	125	117	118	114
17 D	113	103	91	100	106	115	118	107	117	112	114	115	104	89	73	71	74	83	91	89	107	110	107	73	99
18 D	75	72	90	84	90	100	91	88	91	84	82	80	79	72	63	68	79	89	96	105	92	88	86	100	85
19	106	101	102	97	97	101	100	101	106	105	104	96	82	65	56	51	56	70	85	98	94	90	93	104	90
20	107	109	112	116	114	104	110	112	114	113	110	102	94	81	69	66	69	78	88	92	95	96	91	98	98
21	102	103	109	122	108	108	107	110	110	114	106	96	85	76	72	77	87	91	105	106	104	104	112	109	101
22	104	108	108	115	116	114	109	107	108	111	107	103	98	84	76	75	80	86	91	96	106	115	116	116	102
23	110	114	112	125	129	117	121	125	121	121	123	122	93	89	78	86	80	76	103	107	115	118	112	104	108
24 D	108	122	93	81	76	82	91	94	80	84	76	77	79	68	69	64	63	73	83	93	100	105	93	96	85
25	102	103	107	107	110	105	105	107	91	97	101	100	96	91	75	72	78	76	78	92	95	105	108	108	96
26 Q	109	107	108	110	109	110	112	110	111	111	107	103	93	85	78	70	67	67	79	88	96	96	105	109	98
27 Q	111	114	116	116	117	115	112	113	112	112	109	106	98	91	80	73	77	87	96	101	102	98	107	112	103
28	116	121	125	125	124	126	133	124	120	115	115	110	103	93	84	82	73	71	79	100	100	87	98	110	106
MEAN	113	115	114	115	114	113	113	113	113	111	107	102	93	82	73	72	78	87	98	105	110	106	106	109	103
MEAN Q	116	116	118	118	117	116	115	113	114	113	111	108	99	91	82	76	78	84	93	102	108	105	110	115	105
MEAN D	103	110	100	97	99	102	104	109	105	100	94	90	84	74	69	71	78	92	100	103	114	106	98	98	96

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2015

VERTICAL INTENSITY

Z = -28500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																										
1	D	-427	-428	-422	-413	-412	-409	-414	-420	-417	-405	-393	-376	-369	-370	-375	-377	-382	-385	-386	-394	-425	-424	-415	-425	-403
2	D	-428	-423	-404	-393	-388	-391	-397	-397	-400	-401	-401	-391	-387	-383	-380	-375	-376	-407	-426	-429	-434	-427	-416	-418	-403
3		-429	-421	-410	-408	-396	-401	-403	-406	-408	-404	-398	-389	-385	-373	-364	-359	-374	-393	-416	-425	-434	-430	-432	-419	-403
4		-419	-416	-409	-409	-407	-407	-408	-409	-409	-406	-399	-392	-378	-362	-356	-363	-369	-385	-403	-413	-417	-421	-414	-413	-399
5		-415	-413	-410	-409	-408	-407	-408	-408	-408	-405	-394	-389	-379	-366	-360	-345	-359	-376	-400	-409	-413	-416	-411	-412	-397
6		-411	-407	-406	-405	-404	-407	-403	-406	-405	-404	-401	-390	-380	-370	-364	-363	-375	-394	-404	-414	-418	-411	-408	-402	-398
7		-406	-406	-407	-406	-405	-405	-405	-400	-391	-376	-367	-367	-376	-370	-361	-354	-362	-382	-395	-407	-412	-415	-417	-420	-392
8		-414	-410	-410	-410	-405	-395	-391	-393	-396	-396	-396	-386	-376	-370	-368	-374	-387	-398	-408	-414	-429	-426	-421	-415	-399
9		-417	-412	-408	-405	-405	-404	-404	-404	-404	-402	-396	-393	-389	-383	-375	-375	-379	-387	-395	-403	-408	-412	-405	-406	-399
10		-411	-407	-406	-407	-404	-396	-397	-404	-407	-405	-402	-394	-384	-380	-375	-375	-377	-386	-399	-405	-413	-414	-419	-414	-399
11		-410	-412	-412	-405	-396	-399	-402	-403	-403	-403	-399	-392	-383	-378	-380	-380	-377	-373	-383	-392	-400	-402	-404	-409	-396
12	Q	-412	-402	-403	-402	-401	-400	-399	-400	-400	-398	-395	-390	-380	-371	-366	-362	-368	-377	-387	-396	-408	-406	-409	-410	-393
13	Q	-408	-406	-403	-402	-402	-402	-401	-400	-400	-400	-398	-393	-386	-381	-376	-372	-372	-374	-379	-388	-397	-400	-400	-401	-393
14	Q	-402	-404	-404	-405	-401	-399	-396	-397	-400	-398	-393	-386	-383	-379	-376	-373	-373	-374	-375	-385	-397	-401	-401	-402	-392
15		-403	-404	-403	-399	-398	-397	-397	-395	-394	-394	-385	-381	-381	-376	-371	-375	-379	-381	-383	-387	-395	-402	-405	-407	-391
16		-405	-403	-402	-402	-402	-402	-401	-396	-394	-390	-390	-387	-386	-383	-377	-375	-377	-377	-380	-392	-409	-403	-400	-403	-393
17	D	-410	-406	-402	-401	-405	-409	-408	-394	-399	-389	-389	-388	-390	-385	-378	-377	-369	-371	-385	-394	-408	-426	-428	-440	-398
18	D	-420	-424	-430	-414	-419	-415	-392	-394	-403	-404	-399	-397	-401	-399	-394	-389	-390	-395	-400	-410	-412	-418	-417	-418	-406
19		-421	-417	-411	-404	-403	-407	-406	-404	-408	-410	-405	-398	-391	-383	-379	-377	-382	-391	-402	-417	-422	-417	-411	-411	-403
20		-410	-408	-408	-409	-407	-401	-405	-405	-406	-402	-399	-393	-388	-381	-378	-379	-379	-383	-393	-401	-409	-412	-411	-412	-399
21		-416	-413	-413	-403	-403	-405	-405	-407	-406	-403	-395	-387	-385	-385	-383	-381	-378	-379	-388	-395	-402	-402	-409	-411	-398
22		-407	-406	-405	-407	-406	-405	-400	-401	-404	-406	-398	-391	-389	-382	-375	-374	-373	-372	-381	-390	-403	-412	-410	-413	-396
23		-405	-403	-403	-408	-408	-398	-399	-396	-394	-392	-388	-381	-368	-367	-372	-377	-373	-372	-392	-398	-411	-415	-416	-420	-394
24	D	-417	-415	-407	-379	-368	-385	-384	-378	-396	-412	-401	-398	-394	-385	-389	-386	-383	-390	-397	-406	-414	-419	-414	-409	-397
25		-410	-408	-408	-406	-406	-401	-400	-400	-389	-398	-402	-396	-392	-388	-378	-375	-376	-377	-386	-403	-407	-410	-410	-408	-397
26	Q	-408	-406	-404	-402	-402	-401	-400	-396	-395	-395	-394	-396	-392	-390	-385	-381	-378	-376	-383	-390	-398	-400	-408	-409	-395
27	Q	-407	-406	-405	-403	-402	-400	-398	-397	-397	-397	-397	-394	-392	-388	-381	-376	-378	-379	-385	-391	-395	-395	-402	-403	-394
28		-402	-404	-406	-405	-402	-402	-393	-392	-391	-389	-390	-389	-384	-380	-378	-374	-360	-363	-375	-391	-400	-399	-404	-417	-391
MEAN		-412	-410	-408	-404	-402	-402	-401	-400	-401	-399	-395	-389	-384	-379	-375	-373	-375	-382	-392	-401	-410	-412	-411	-412	-397
MEAN Q		-408	-405	-404	-403	-402	-400	-399	-398	-398	-398	-396	-392	-386	-382	-377	-373	-374	-376	-382	-390	-399	-400	-404	-405	-394
MEAN D		-420	-419	-413	-400	-398	-402	-399	-397	-403	-402	-397	-390	-388	-384	-383	-381	-380	-389	-399	-407	-419	-423	-418	-422	-401

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2015

TOTAL INTENSITY
 F = 34500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	441	456	444	439	438	435	443	454	451	436	419	398	384	382	387	396	406	415	409	424	471	447	430	445	427
2 D	454	456	432	416	414	412	416	431	423	419	415	401	396	384	380	377	385	426	455	451	458	448	435	440	422
3	456	450	434	435	420	424	425	431	433	430	424	413	406	385	364	357	382	409	440	452	460	449	456	442	424
4	447	442	436	437	436	436	436	435	436	435	429	418	396	367	359	370	381	401	424	437	440	444	435	438	421
5	442	439	435	436	438	439	440	440	439	435	424	420	404	387	376	353	371	392	429	435	437	438	431	436	421
6	438	437	436	435	433	437	429	432	431	429	426	411	397	381	372	371	388	410	424	437	442	433	431	428	420
7	435	437	439	439	438	438	440	438	435	418	401	396	396	384	367	360	374	399	415	431	433	434	437	444	418
8	439	440	442	442	437	424	415	414	419	415	412	399	383	372	367	378	398	414	427	434	449	441	439	439	418
9	443	439	436	433	433	431	430	428	428	425	420	415	407	398	386	384	393	407	419	431	440	437	424	429	421
10	438	435	434	437	432	419	419	427	430	428	425	415	400	391	381	382	384	402	424	426	437	432	440	437	420
11	437	443	444	436	423	424	427	428	427	428	424	415	401	394	394	391	391	389	403	414	424	428	430	438	419
12 Q	442	431	434	432	432	429	428	428	427	425	421	412	396	383	376	371	380	392	405	415	429	423	428	433	415
13 Q	434	433	431	431	432	432	429	427	427	426	425	418	409	398	389	382	386	394	401	417	424	427	427	430	418
14 Q	433	437	438	440	433	429	425	425	429	428	424	419	413	407	399	394	391	392	399	415	429	433	433	436	421
15	439	442	442	436	437	434	434	429	429	427	415	412	409	396	384	390	395	400	400	407	417	426	429	434	419
16	436	435	435	436	438	438	439	433	426	420	418	412	407	400	391	390	393	398	404	424	448	436	429	433	421
17 D	435	426	416	420	427	435	436	418	428	417	419	418	414	400	386	384	379	386	402	409	430	447	447	437	417
18 D	422	423	439	422	429	432	408	408	417	414	409	406	408	403	394	392	400	409	417	430	426	428	425	435	416
19	441	434	430	421	421	425	425	423	430	430	426	416	402	385	377	372	380	395	413	432	434	428	425	431	417
20	431	431	433	436	433	423	430	430	433	429	424	415	406	393	384	383	385	393	407	416	424	427	424	428	417
21	434	432	435	435	427	428	427	431	430	430	419	407	399	394	390	391	394	397	412	419	424	424	434	433	418
22	427	429	428	433	434	431	425	425	427	431	422	414	409	395	385	384	386	388	399	409	425	438	437	439	417
23	430	430	429	440	442	428	431	431	426	425	422	416	389	386	384	393	386	383	415	422	437	442	439	439	419
24 D	438	444	422	391	380	397	401	398	405	420	406	405	403	389	393	388	385	396	408	420	431	438	427	424	409
25	429	428	430	429	430	424	422	423	406	416	421	416	411	404	387	383	387	387	395	417	422	431	433	431	415
26 Q	432	428	427	427	426	426	427	422	421	421	419	418	409	403	394	387	382	381	394	404	416	417	428	432	414
27 Q	431	432	432	431	430	428	424	425	424	424	422	418	412	404	393	384	388	395	404	412	416	414	425	428	417
28	430	434	439	438	434	436	432	426	424	419	419	416	407	399	392	388	371	372	387	412	419	411	422	439	415
MEAN	437	437	434	431	429	428	427	427	427	425	420	412	403	392	383	381	386	397	412	423	434	433	432	435	419
MEAN Q	435	432	432	432	431	429	427	425	426	425	422	417	408	399	390	383	385	391	400	413	423	423	428	432	417
MEAN D	438	441	430	418	417	422	421	422	425	421	413	405	401	392	388	387	391	406	418	427	443	442	433	436	418

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
MARCH 2015

DECLINATION EAST

D = 14 DEGREES PLUS TABULAR QUANTITIES (UNITS 0.1 MINUTES)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	166	131	148	103	105	97	100	70	36	75	119	131	132	136	149	156	165	178	190	198	189	177	170	163	137
2 D	103	103	88	93	101	32	78	131	136	160	126	138	158	164	174	192	190	203	210	196	178	157	155	149	142
3	141	97	103	122	117	113	112	128	140	129	124	129	130	130	131	142	166	193	195	179	167	158	155	148	140
4	164	154	150	141	138	---	---	---	123	---	---	---	88	---	---	---	---	---	---	---	---	---	154	---	---
5 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	141	---
8	118	126	141	137	130	120	120	111	109	117	108	103	97	104	135	159	179	203	192	186	179	171	161	---	139
9 Q	---	109	75	---	---	132	127	125	124	119	111	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10 Q	---	---	---	---	---	---	---	114	110	107	106	98	110	116	124	145	172	187	201	192	178	160	151	149	---
11	144	141	138	137	130	112	101	104	97	104	98	79	81	---	---	---	202	---	---	---	173	157	149	---	
12	141	140	139	124	79	101	102	93	86	104	121	122	113	117	122	154	181	196	201	197	180	161	153	149	137
13	148	146	144	140	135	132	126	123	117	116	111	101	82	114	135	140	156	174	184	187	181	163	156	151	140
14 Q	146	146	141	137	101	78	89	110	111	116	113	104	91	---	---	---	---	---	---	---	---	---	---	139	---
15	134	132	135	131	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	137	120	79	68	107	114	114	104	102	102	103	108	115	134	160	184	188	180	164	150	147	148	129
17 D	145	144	142	138	127	101	109	19	24	92	91	84	102	140	272	215	233	283	277	293	293	287	246	108	165
18 D	59	162	96	117	111	130	133	182	243	188	160	183	159	141	164	236	224	218	236	253	208	185	109	37	164
19 D	96	131	162	151	143	145	138	182	171	219	133	168	214	184	197	191	195	207	212	209	193	166	99	139	168
20	131	69	137	149	147	149	166	123	131	153	167	135	123	132	141	158	182	192	190	187	161	173	117	101	146
21	89	120	137	147	147	138	146	165	179	148	138	128	132	134	146	161	183	196	196	182	167	161	159	---	152
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
30 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	117	115	114	110	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	114	134	127	120	117	101	112	117	122	147	126	141	153	153	191	198	201	218	225	230	212	195	156	119	155

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
MARCH 2015

HORIZONTAL INTENSITY
H = 19500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	90	107	110	90	97	83	111	109	91	83	75	73	65	61	59	59	62	68	81	91	89	91	94	92	85
2 D	86	109	77	82	99	96	89	101	107	87	102	84	75	68	54	36	50	59	70	83	93	94	102	103	84
3	94	98	96	96	105	97	95	97	103	104	100	98	88	82	70	59	57	67	79	93	100	99	90	90	90
4	96	105	107	108	112	---	---	---	113	---	---	---	92	---	---	---	---	---	---	---	---	---	97	---	---
5 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	103	---
8	103	113	107	107	107	111	117	111	105	107	112	104	88	77	53	55	57	66	75	89	96	100	103	---	94
9 Q	---	100	101	---	---	97	98	100	102	103	104	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10 Q	---	---	---	---	---	---	---	110	108	105	110	107	102	89	80	72	73	81	95	100	108	107	108	109	---
11	111	113	117	117	112	126	116	114	109	113	116	111	93	---	---	---	78	---	---	---	100	103	108	---	---
12	111	110	114	119	112	102	104	105	105	101	109	106	94	80	66	57	58	68	80	91	100	105	107	107	96
13	109	111	111	113	113	112	110	108	108	107	108	108	98	81	82	66	62	70	77	88	99	102	108	108	98
14 Q	109	109	111	112	115	111	102	102	101	104	104	106	101	---	---	---	---	---	---	---	---	---	---	106	---
15	103	108	110	114	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	133	136	135	129	115	115	114	109	112	117	112	100	85	77	77	84	94	109	113	116	117	118	110
17 D	120	118	121	120	129	152	155	132	120	81	80	70	56	5	38	10	-19	-26	-28	9	8	45	-10	-80	59
18 D	-68	-24	-19	6	11	43	41	54	60	84	70	70	69	65	43	24	36	51	57	42	47	42	32	53	37
19 D	39	44	72	77	72	62	68	70	81	86	86	74	71	69	41	31	34	40	49	58	59	60	67	68	62
20	60	51	69	69	71	73	76	70	78	76	84	76	64	49	43	42	41	40	49	46	62	72	51	50	61
21	76	77	72	83	92	94	88	92	94	90	92	83	73	55	41	39	38	47	63	76	78	84	85	---	75
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
30 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	104	103	104	106	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	53	71	72	75	82	87	93	93	92	85	83	74	67	53	47	32	32	38	46	57	59	67	57	47	65

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
MARCH 2015

VERTICAL INTENSITY
Z = -28500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	-419	-415	-393	-405	-407	-381	-375	-349	-372	-390	-389	-390	-389	-389	-385	-385	-379	-380	-390	-403	-407	-414	-420	-414	-393
2 D	-416	-407	-397	-401	-413	-386	-389	-365	-343	-357	-397	-390	-389	-393	-388	-379	-392	-396	-403	-416	-426	-421	-423	-418	-396
3	-411	-412	-405	-404	-403	-400	-399	-401	-405	-404	-399	-397	-390	-392	-389	-385	-381	-389	-397	-409	-417	-417	-417	-411	-401
4	-409	-413	-410	-408	-408	---	---	---	-404	---	---	---	-389	---	---	---	---	---	---	---	---	---	-408	---	---
5 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-415	---
8	-411	-407	-402	-401	-401	-402	-399	-397	-396	-395	-397	-390	-380	-379	-368	-375	-376	-381	-391	-403	-409	-411	-411	---	-395
9 Q	---	-406	-398	---	---	-398	-399	-400	-401	-401	-400	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10 Q	---	---	---	---	---	---	---	-395	-396	-395	-394	-392	-389	-382	-381	-379	-379	-383	-391	-398	-405	-407	-405	-403	---
11	-401	-400	-401	-401	-397	-399	-391	-393	-393	-395	-395	-396	-387	---	---	---	---	-371	---	---	---	-408	-407	-407	---
12	-407	-402	-401	-403	-389	-389	-393	-389	-387	-390	-396	-392	-387	-382	-377	-373	-375	-384	-393	-402	-409	-411	-408	-404	-393
13	-403	-401	-400	-399	-398	-396	-396	-394	-394	-395	-396	-395	-394	-377	-380	-377	-379	-383	-387	-395	-407	-405	-406	-404	-394
14 Q	-402	-401	-400	-400	-398	-389	-385	-391	-392	-395	-393	-394	-393	---	---	---	---	---	---	---	---	---	---	-401	---
15	-398	-400	-401	-402	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	-404	-404	-392	-387	-381	-377	-380	-385	-385	-385	-382	-378	-375	-370	-366	-367	-379	-392	-398	-399	-396	-395	-386
17 D	-395	-393	-395	-394	-396	-413	-405	-377	-329	-287	-338	-375	-372	-319	-344	-336	-351	-361	-427	-432	-457	-559	-561	-525	-398
18 D	-443	-476	-452	-447	-439	-431	-432	-441	-415	-411	-420	-414	-419	-412	-392	-379	-401	-412	-417	-416	-431	-439	-447	-447	-426
19 D	-426	-429	-421	-408	-406	-393	-402	-388	-397	-357	-368	-396	-391	-403	-397	-397	-402	-405	-413	-422	-424	-426	-433	-428	-406
20	-419	-410	-408	-414	-415	-414	-385	-385	-414	-406	-400	-402	-403	-397	-393	-396	-399	-400	-410	-416	-424	-426	-430	-425	-408
21	-422	-408	-414	-416	-414	-410	-406	-404	-395	-398	-402	-401	-398	-393	-391	-393	-393	-397	-406	-416	-416	-418	-415	---	-406
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
30 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	-395	-396	-397	-396	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	-420	-424	-412	-411	-412	-401	-400	-384	-371	-360	-382	-393	-392	-383	-381	-375	-385	-391	-410	-418	-429	-452	-457	-446	-404

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
MARCH 2015

TOTAL INTENSITY
F = 34500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	429	436	419	418	423	394	404	382	391	402	397	396	391	389	384	384	381	385	401	417	419	427	433	426	405
2 D	425	430	405	410	430	406	404	391	376	377	418	402	397	396	384	367	384	393	405	423	437	434	439	436	407
3	425	429	422	421	425	418	416	419	425	425	419	416	405	403	394	384	379	392	405	423	433	433	428	423	415
4	425	433	431	431	433	---	---	---	430	---	---	---	406	---	---	---	---	---	---	---	---	---	425	---	---
5 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	434	---
8	430	433	425	424	424	427	428	423	419	419	424	413	396	389	366	373	375	385	398	416	425	429	430	---	412
9 Q	---	424	418	---	---	416	417	419	421	422	422	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10 Q	---	---	---	---	---	---	---	421	421	418	420	417	412	399	393	386	387	395	409	417	428	429	428	427	---
11	426	427	430	430	424	433	421	421	419	423	424	422	405	---	---	---	---	383	---	---	---	426	427	430	---
12	432	426	429	433	417	411	415	413	412	411	421	416	405	393	381	373	375	388	403	416	427	431	429	427	412
13	427	427	425	426	425	423	422	419	419	419	420	420	413	390	393	381	381	388	396	408	424	425	429	428	414
14 Q	426	425	426	426	426	416	408	414	414	417	416	418	415	---	---	---	---	---	---	---	---	---	---	423	---
15	420	424	426	429	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	441	442	432	425	413	409	411	413	414	416	411	401	390	382	378	384	399	418	425	428	425	425	414
17 D	426	424	427	426	432	460	455	418	372	316	357	382	372	299	339	316	312	317	370	395	415	520	491	423	394
18 D	361	413	396	406	402	413	413	427	409	419	419	414	418	409	380	360	385	402	409	401	415	419	420	432	406
19 D	407	412	421	413	409	392	404	393	406	376	385	402	396	404	384	378	384	390	402	414	416	419	428	425	403
20	412	401	409	414	416	416	394	391	419	411	410	407	402	388	382	383	386	386	399	402	418	425	417	412	404
21	424	414	416	424	427	425	417	419	412	412	416	411	402	388	379	379	379	387	404	419	420	426	424	---	410
22	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
30 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
31	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	418	418	419	419	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	410	423	414	415	419	413	416	402	391	378	395	399	395	379	374	361	369	377	397	410	421	444	442	428	403

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JUNE 2015

VERTICAL INTENSITY

Z = -28500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1	-382	-380	-384	-386	-384	-379	-382	-381	-382	-384	-382	-382	-384	-383	-381	-380	-382	-387	-387	-386	-388	-389	-388	-385	-384
2 Q	-382	-383	-384	-384	-384	-384	-383	-383	-382	-383	-383	-384	-384	-383	-383	-382	-382	-383	-387	-388	-387	-385	-383	-382	-384
3 Q	-381	-381	-381	-380	-380	-381	-381	-381	-381	-381	-381	-382	-382	-383	-381	-380	-381	-384	-387	-388	-387	-384	-383	-381	-382
4 Q	-381	-379	-379	-379	---	---	---	---	---	---	---	---	-381	-380	-379	-377	-378	-381	-387	-388	-387	-385	-383	-381	---
5 Q	-380	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
8 D	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
9	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
10	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
11	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
12	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
13	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
14 D	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
15	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
16	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
17	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
18	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
19	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
20 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
21	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22 D	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23 D	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25 D	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
30	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	-381	-381	-381	-381	---	---	---	---	---	---	---	---	-382	-382	-381	-380	-380	-383	-387	-388	-387	-385	-383	-382	---
MEAN D	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2016

DECLINATION EAST

D = 14 DEGREES PLUS TABULAR QUANTITIES (UNITS 0.1 MINUTES)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	130	81	68	82	92	51	19	77	110	103	111	100	96	105	139	160	176	173	151	132	129	136	136	131	112
2	130	123	128	129	129	126	104	84	52	54	60	74	92	119	137	150	170	166	153	137	123	117	120	128	117
3	131	128	123	117	112	107	93	80	55	54	52	60	74	96	113	133	153	148	159	163	161	151	127	136	114
4	133	129	123	117	106	105	102	85	56	49	57	69	77	102	110	122	149	167	170	166	148	133	128	128	114
5	127	120	118	113	104	92	74	65	45	27	20	31	79	107	131	143	145	150	151	147	129	125	130	130	104
6 D	114	66	108	115	107	95	87	86	75	101	106	111	116	123	132	147	153	166	168	161	151	144	126	98	119
7 D	125	104	68	73	91	92	84	88	77	59	70	78	104	123	145	164	160	162	158	151	143	126	125	124	112
8	122	116	114	111	85	89	87	83	83	63	52	43	81	113	141	143	150	169	164	147	130	115	117	123	110
9	123	126	125	119	109	96	78	62	49	43	48	68	98	116	133	151	155	152	153	145	129	119	121	126	110
10	125	127	131	117	95	80	81	81	52	49	58	59	79	106	115	131	141	148	142	141	132	125	129	139	108
11	140	132	121	110	94	82	79	79	85	74	56	56	79	101	107	140	165	174	183	185	151	145	127	111	115
12	106	116	120	116	116	111	100	89	83	66	68	71	102	119	128	148	170	182	191	175	160	153	151	145	124
13	97	97	106	86	101	112	100	89	87	86	77	78	77	111	122	138	167	190	199	175	159	151	142	133	120
14	127	123	113	105	110	98	96	94	89	93	81	80	91	---	134	144	179	192	181	164	158	144	128	137	124
15	129	118	114	111	111	113	108	102	84	62	47	50	73	99	118	128	142	163	166	167	161	148	146	139	117
16 Q	128	119	114	104	106	104	95	90	71	53	52	60	69	86	111	127	133	145	144	145	140	132	132	129	108
17 Q	119	112	109	109	109	107	101	87	73	69	62	51	62	90	99	107	128	156	163	159	147	133	123	125	108
18	125	120	116	110	107	105	96	87	75	69	59	64	88	106	117	127	144	139	133	132	133	134	138	141	111
19	121	108	109	102	91	80	76	73	65	41	31	53	81	99	111	127	132	139	140	136	131	130	131	128	102
20 D	122	116	111	105	95	85	51	17	-23	-7	0	61	100	129	169	222	249	249	297	274	235	250	218	189	138
21 D	174	150	133	127	119	73	84	68	64	71	88	89	98	111	141	169	195	200	199	182	166	76	100	126	125
22	135	120	125	131	116	130	104	85	79	78	79	91	128	151	158	174	173	162	168	168	152	123	139	134	129
23	133	127	126	117	74	73	67	76	91	66	56	65	94	130	139	150	165	176	158	151	139	129	121	123	114
24	88	98	111	110	111	116	115	99	88	70	69	77	95	116	143	165	174	175	194	190	163	155	144	138	125
25 Q	132	125	120	117	115	111	105	95	86	76	69	70	83	106	122	132	135	145	144	137	131	128	119	120	114
26	123	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	176	173	161	157	152	145	138	---
27	127	122	122	116	107	99	95	89	81	56	54	50	74	83	104	124	132	132	135	136	129	126	126	123	106
28	122	119	118	112	104	94	84	82	62	51	46	60	73	94	121	147	165	174	168	159	155	143	138	137	113
29 Q	134	129	122	114	110	106	103	92	79	70	66	68	76	84	101	122	149	153	151	144	144	138	130	127	113
30 Q	123	120	119	116	110	103	90	79	70	63	55	59	69	86	116	137	153	162	161	149	138	137	140	142	112
31	122	122	124	116	106	82	64	57	56	31	41	58	86	112	136	162	178	177	177	175	181	194	181	154	121
MEAN	125	117	115	111	105	97	87	81	70	61	60	67	87	108	127	145	160	167	168	160	149	139	135	132	116
MEAN Q	127	121	117	112	110	106	99	89	76	66	61	62	72	90	110	125	140	152	153	147	140	134	129	129	111
MEAN D	133	103	97	100	101	79	65	67	61	65	75	88	103	118	145	172	186	190	195	180	165	146	141	133	121

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2016

HORIZONTAL INTENSITY
 H = 19500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	39	-1	10	-2	-9	-8	4	32	31	25	23	22	21	20	17	32	39	51	55	61	66	62	57	53	29
2	57	64	52	57	63	67	74	69	64	55	52	50	48	39	36	35	29	43	65	68	67	62	60	58	56
3	60	66	66	68	68	68	70	65	56	53	48	43	45	48	50	46	42	37	53	59	64	67	66	59	57
4	58	58	61	61	63	65	69	66	61	54	47	46	53	55	50	47	44	39	60	64	56	59	61	64	57
5	68	74	74	78	77	83	80	77	75	66	60	54	53	51	50	52	58	63	71	77	72	81	83	95	70
6 D	101	68	62	69	71	68	63	60	52	51	56	63	46	38	38	46	58	62	62	71	72	62	68	79	62
7 D	72	84	78	64	62	64	64	61	62	61	44	45	48	52	51	43	52	59	61	67	71	68	71	66	61
8	64	64	67	69	68	64	64	62	60	58	57	48	37	36	29	38	49	59	60	65	65	62	67	72	58
9	69	68	70	69	70	70	70	67	60	54	47	33	29	37	53	63	65	67	72	76	77	78	77	77	63
10	78	74	70	74	70	71	72	74	66	60	53	51	45	41	42	41	52	66	71	82	75	69	63	64	64
11	73	76	79	81	77	73	68	66	66	58	50	37	29	22	33	44	55	63	63	58	62	64	56	66	59
12	57	54	59	64	64	64	53	54	53	42	40	39	36	33	38	47	50	67	79	59	69	52	57	71	54
13	74	65	60	63	58	64	61	58	55	53	45	36	26	17	18	16	22	37	46	48	59	59	63	64	49
14	65	67	68	67	69	68	72	67	63	62	59	61	50	---	27	30	33	45	51	53	56	49	59	61	56
15	66	67	59	55	61	61	60	60	59	58	50	44	36	26	22	26	31	39	36	45	50	58	64	64	50
16 Q	62	61	62	64	67	71	72	75	71	65	62	57	50	45	42	50	58	65	66	58	57	59	61	62	61
17 Q	64	65	67	71	74	73	69	64	62	67	65	60	49	37	35	35	41	51	59	57	54	58	62	61	58
18	62	63	64	66	67	68	68	69	69	65	57	51	51	56	62	69	68	65	70	69	65	66	91	93	66
19	82	67	65	66	67	72	77	75	64	59	46	42	37	34	42	53	61	66	72	74	74	72	75	69	63
20 D	74	74	76	76	73	69	65	56	62	51	31	36	23	6	-14	-11	-6	7	38	26	41	42	13	39	39
21 D	41	49	39	59	71	68	47	54	49	44	38	40	27	17	21	24	22	41	45	47	51	73	47	45	44
22	49	48	48	50	51	62	62	50	50	42	34	29	18	15	23	31	31	42	50	55	42	48	44	49	43
23	54	61	64	68	61	57	55	59	58	53	42	31	27	25	33	40	36	33	43	43	45	50	59	58	48
24	59	60	59	66	59	58	62	60	58	55	50	45	40	36	33	39	46	61	77	52	59	55	56	59	54
25 Q	60	61	61	58	57	59	60	59	57	52	49	46	42	33	33	35	43	50	54	54	56	55	56	58	52
26	59	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	48	57	58	56	62	64	62	---
27	64	69	75	80	73	75	71	75	73	67	57	47	43	41	41	39	48	58	65	70	66	64	65	65	62
28	63	65	67	69	68	67	64	64	57	54	50	53	48	41	33	31	33	38	39	50	54	57	59	57	53
29 Q	57	57	56	55	51	51	52	54	51	49	47	45	41	33	24	18	27	46	57	59	60	61	61	63	49
30 Q	65	68	66	65	64	64	66	64	64	60	54	47	42	33	29	35	41	49	53	52	54	59	66	73	55
31	76	75	70	71	67	65	54	48	54	53	47	39	38	43	37	36	35	41	60	62	61	61	60	49	54
MEAN	64	63	63	64	63	64	63	62	59	55	49	45	39	35	34	38	42	50	58	59	60	61	62	64	55
MEAN Q	62	62	62	63	63	64	64	63	61	59	55	51	45	36	33	35	42	53	58	56	56	58	62	63	55
MEAN D	65	55	53	53	54	52	49	53	51	47	39	41	33	26	23	27	33	44	52	54	60	61	51	56	47

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2016

VERTICAL INTENSITY

Z = -28500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	-387	-370	-365	-357	-361	-356	-356	-379	-361	-350	-354	-367	-366	-359	-352	-352	-351	-358	-365	-370	-371	-370	-368	-363	-363
2	-370	-372	-364	-364	-367	-367	-374	-367	-366	-355	-346	-340	-341	-335	-337	-338	-338	-351	-361	-368	-369	-367	-364	-359	-358
3	-357	-361	-361	-362	-363	-361	-357	-350	-350	-349	-347	-342	-339	-340	-339	-332	-329	-332	-343	-346	-351	-356	-361	-352	-349
4	-354	-355	-358	-358	-359	-359	-359	-353	-354	-348	-340	-336	-334	-333	-331	-333	-333	-334	-345	-354	-352	-357	-361	-358	-348
5	-359	-362	-361	-362	-360	-362	-361	-359	-358	-353	-343	-334	-324	-323	-325	-329	-337	-340	-343	-350	-348	-352	-351	-359	-348
6 D	-372	-364	-349	-357	-356	-354	-352	-352	-346	-338	-330	-334	-327	-327	-325	-328	-340	-345	-349	-357	-360	-364	-367	-376	-349
7 D	-364	-374	-360	-353	-356	-358	-357	-348	-344	-344	-332	-331	-334	-330	-326	-318	-330	-334	-341	-351	-356	-355	-357	-355	-346
8	-355	-355	-357	-357	-357	-354	-356	-355	-350	-346	-342	-331	-316	-320	-313	-321	-330	-337	-347	-356	-359	-356	-359	-359	-345
9	-358	-354	-356	-356	-357	-358	-355	-353	-350	-345	-337	-324	-311	-310	-318	-325	-334	-336	-339	-344	-351	-355	-355	-352	-343
10	-354	-353	-350	-355	-356	-357	-358	-356	-353	-345	-332	-327	-319	-312	-315	-324	-329	-337	-343	-355	-360	-360	-353	-349	-344
11	-354	-357	-358	-359	-356	-355	-354	-352	-348	-340	-338	-331	-322	-315	-325	-328	-334	-336	-334	-340	-347	-359	-362	-367	-345
12	-363	-358	-360	-362	-359	-356	-347	-345	-351	-342	-338	-333	-325	-320	-320	-324	-327	-337	-350	-346	-363	-357	-360	-373	-346
13	-375	-368	-364	-362	-355	-360	-360	-357	-354	-349	-343	-337	-332	-331	-330	-327	-324	-326	-339	-348	-355	-355	-356	-355	-348
14	-354	-354	-358	-357	-357	-355	-357	-353	-348	-342	-341	-340	-331	---	-323	-324	-324	-336	-354	-358	-364	-364	-366	-364	-348
15	-363	-362	-358	-352	-355	-354	-353	-353	-353	-349	-342	-334	-328	-328	-330	-330	-328	-334	-342	-350	-353	-355	-358	-357	-347
16 Q	-354	-353	-354	-354	-355	-355	-356	-356	-353	-347	-339	-331	-328	-325	-321	-321	-328	-329	-338	-343	-345	-346	-348	-350	-343
17 Q	-352	-350	-351	-353	-353	-351	-348	-346	-342	-342	-340	-336	-328	-319	-318	-319	-319	-317	-323	-338	-346	-350	-350	-348	-339
18	-346	-346	-349	-350	-351	-351	-350	-351	-350	-346	-337	-329	-324	-325	-333	-337	-336	-336	-338	-342	-341	-344	-357	-363	-343
19	-367	-362	-358	-360	-359	-361	-359	-354	-341	-332	-331	-327	-324	-323	-325	-332	-336	-336	-339	-340	-342	-343	-349	-346	-344
20 D	-350	-349	-349	-350	-349	-346	-341	-335	-336	-319	-299	-295	-299	-304	-305	-311	-320	-340	-376	-382	-391	-394	-384	-395	-342
21 D	-398	-396	-388	-385	-382	-358	-349	-361	-362	-353	-338	-336	-331	-331	-334	-333	-328	-344	-351	-356	-373	-404	-380	-371	-360
22	-374	-373	-366	-360	-359	-361	-355	-349	-356	-348	-341	-336	-328	-327	-332	-338	-346	-352	-353	-358	-358	-365	-361	-358	-352
23	-359	-363	-365	-366	-359	-354	-357	-355	-344	-341	-339	-333	-328	-322	-331	-340	-338	-335	-346	-350	-352	-360	-365	-360	-348
24	-362	-359	-357	-354	-352	-353	-357	-356	-355	-349	-342	-337	-330	-323	-323	-324	-335	-344	-347	-339	-348	-348	-350	-352	-346
25 Q	-354	-354	-355	-353	-352	-352	-353	-354	-354	-350	-343	-337	-332	-324	-321	-329	-330	-334	-342	-349	-354	-355	-353	-350	-345
26	-348	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	-331	-339	-345	-344	-348	-351	-350	---	
27	-354	-356	-357	-357	-352	-351	-351	-352	-352	-350	-339	-330	-323	-324	-324	-326	-333	-339	-345	-352	-354	-356	-356	-352	-346
28	-349	-347	-348	-349	-348	-349	-348	-348	-344	-340	-332	-328	-327	-323	-318	-319	-320	-327	-336	-344	-351	-350	-350	-347	-339
29 Q	-349	-349	-350	-350	-348	-347	-349	-352	-353	-348	-342	-340	-340	-336	-330	-325	-325	-330	-337	-344	-349	-353	-355	-356	-344
30 Q	-353	-353	-350	-348	-348	-348	-350	-349	-350	-348	-344	-335	-329	-326	-317	-307	-311	-322	-338	-343	-344	-343	-346	-350	-340
31	-357	-355	-350	-350	-349	-347	-339	-340	-344	-338	-331	-320	-318	-325	-321	-316	-321	-326	-339	-346	-355	-358	-375	-369	-341
MEAN	-360	-359	-358	-357	-356	-355	-354	-353	-351	-345	-338	-333	-328	-325	-325	-327	-330	-336	-345	-350	-355	-358	-359	-359	-347
MEAN Q	-352	-352	-352	-352	-351	-351	-351	-351	-350	-347	-342	-336	-331	-326	-321	-320	-323	-326	-336	-344	-348	-349	-350	-351	-342
MEAN D	-374	-371	-362	-360	-361	-354	-351	-355	-350	-341	-330	-332	-331	-330	-328	-328	-334	-344	-356	-363	-370	-377	-371	-372	-352

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 JANUARY 2016

TOTAL INTENSITY
 F = 34500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1 D	374	338	340	326	326	323	329	364	349	336	338	348	347	340	333	342	345	357	365	373	376	374	369	363	349
2	371	376	363	366	371	373	384	375	371	357	348	342	342	332	331	332	328	347	368	375	375	371	367	362	359
3	361	368	368	370	371	369	367	358	353	351	346	340	338	341	341	333	328	328	345	352	359	364	368	357	353
4	358	359	363	363	365	366	368	362	360	350	340	336	338	339	334	334	333	330	352	361	355	361	365	365	352
5	367	373	373	376	373	379	376	372	371	362	350	339	331	328	329	334	344	349	356	365	361	370	370	383	360
6 D	397	372	357	366	367	363	359	357	348	340	337	343	329	324	322	329	346	352	356	368	371	369	375	388	356
7 D	373	389	374	361	362	364	364	354	352	352	332	331	336	335	331	320	335	342	348	360	367	364	368	363	353
8	362	362	366	367	366	361	363	361	355	351	347	333	315	317	308	320	333	344	353	364	366	362	367	370	350
9	368	364	366	366	367	368	366	362	356	348	338	319	305	310	325	337	345	348	353	359	366	370	369	367	352
10	369	366	362	368	366	368	369	368	361	351	337	332	321	314	317	323	334	349	356	372	372	369	359	358	353
11	366	370	373	375	370	367	364	361	358	346	340	327	314	306	320	328	339	346	345	346	355	366	363	373	351
12	365	358	363	368	366	363	349	348	352	339	334	330	322	315	318	327	331	349	366	352	372	357	362	381	349
13	384	373	367	367	358	366	365	361	356	351	341	331	321	316	315	312	313	323	339	347	359	359	362	362	348
14	362	362	367	365	366	364	368	363	356	350	348	348	334	321	315	317	319	336	354	358	365	362	368	367	351
15	369	369	362	355	360	360	358	358	357	354	344	333	324	319	318	320	322	331	335	347	352	359	365	363	347
16 Q	360	359	360	361	364	367	367	369	365	356	347	339	332	327	322	326	336	341	349	349	350	351	355	357	350
17 Q	360	358	361	365	366	364	359	355	350	353	350	344	331	317	315	316	320	323	333	344	349	354	357	355	346
18	353	354	357	359	360	360	361	361	361	355	344	333	329	333	343	350	349	347	351	354	351	354	379	385	354
19	382	369	365	368	367	371	372	367	351	341	332	327	321	319	324	336	344	347	353	355	357	357	363	357	352
20 D	364	363	364	365	362	357	351	341	345	325	297	296	293	287	277	284	294	317	364	363	378	382	357	381	338
21 D	385	388	376	384	388	366	348	361	359	349	333	333	321	316	320	322	316	340	348	354	369	407	373	365	355
22	370	368	362	359	358	365	361	349	355	344	333	327	313	312	320	330	336	347	353	359	352	362	356	357	348
23	360	367	370	374	364	357	358	359	350	344	336	326	319	313	325	336	332	328	343	346	349	358	368	363	348
24	365	363	360	362	357	357	362	361	359	352	344	336	328	320	318	323	335	351	363	342	354	352	353	357	349
25 Q	359	359	360	357	356	357	358	358	357	351	344	337	331	319	316	324	330	337	346	351	356	356	356	354	347
26	353	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	333	345	350	349	355	358	357	---
27	361	366	370	373	365	365	363	366	364	360	345	332	324	324	323	325	334	345	354	363	363	362	364	360	353
28	357	356	358	360	359	358	356	356	349	344	336	333	330	323	314	314	316	324	332	345	353	354	355	351	343
29 Q	354	353	354	353	349	349	350	354	353	348	342	339	337	329	319	311	317	331	343	350	354	359	360	362	345
30 Q	361	362	359	357	356	357	359	357	357	354	347	336	328	320	311	306	312	326	342	346	348	349	356	362	345
31	371	369	361	362	359	355	343	340	347	342	333	319	317	326	319	314	318	325	347	354	360	363	376	365	345
MEAN	366	365	363	364	363	362	360	359	356	349	339	333	326	321	321	324	329	338	350	356	360	363	364	365	350
MEAN Q	359	358	359	359	358	358	358	359	356	352	346	339	332	322	317	317	323	332	342	348	352	354	357	358	346
MEAN D	379	370	362	360	361	355	350	356	351	341	327	330	325	320	317	319	327	342	356	363	372	379	368	372	350

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2016

DECLINATION EAST

D = 14 DEGREES PLUS TABULAR QUANTITIES (UNITS 0.1 MINUTES)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1	157	143	124	106	63	78	70	44	33	47	85	87	93	112	128	148	166	167	158	143	137	---	---	---	---
2	---	---	117	117	113	103	92	86	67	57	46	46	59	85	---	141	163	166	163	147	153	162	143	142	113
3	141	115	100	78	76	75	71	77	77	65	65	75	86	96	107	123	147	156	141	131	134	131	129	128	105
4	123	119	116	112	106	99	92	86	80	67	65	75	98	112	102	108	126	135	147	154	151	143	129	121	111
5	110	105	97	89	92	80	60	65	66	71	86	85	82	86	97	108	143	175	190	171	152	142	118	111	108
6	116	115	113	96	89	94	97	95	95	80	82	82	102	107	111	130	148	162	164	158	156	131	122	121	115
7	119	124	117	111	105	100	91	84	71	60	56	78	90	95	106	133	164	178	176	175	158	139	129	126	116
8 D	113	50	27	87	107	106	91	65	70	78	64	67	68	87	119	149	157	154	150	139	126	114	106	106	100
9	107	108	94	100	100	97	94	80	66	71	68	78	84	95	135	160	178	176	160	145	124	113	111	117	111
10	119	113	96	108	112	112	111	113	93	66	62	65	72	91	119	148	167	166	159	152	149	146	137	132	117
11	127	130	127	117	104	98	83	71	60	46	42	48	66	94	119	155	179	182	170	161	146	131	119	161	114
12	134	125	93	124	125	113	115	111	99	93	111	117	96	82	96	127	157	180	172	147	133	130	129	125	122
13	116	116	110	107	100	94	87	58	62	43	33	44	49	68	89	120	152	161	156	145	140	134	130	131	102
14	129	120	104	106	109	108	87	74	80	79	81	77	70	68	89	120	147	170	158	161	156	142	134	125	112
15	119	116	100	110	106	91	70	57	64	73	66	60	63	81	96	114	131	150	152	154	---	151	134	115	104
16 D	141	121	104	109	107	100	82	76	100	82	40	37	93	150	123	160	173	210	191	206	140	127	141	40	119
17 D	116	51	79	101	97	105	101	129	88	88	89	102	120	137	163	161	159	170	191	179	186	164	108	75	123
18 D	119	137	109	64	85	89	84	85	109	121	104	88	109	119	126	146	161	158	185	175	176	152	109	57	119
19 D	93	107	104	110	112	108	110	104	89	82	78	101	92	111	125	146	165	179	190	170	167	148	135	128	123
20	119	115	122	120	109	94	99	102	102	88	82	84	86	94	111	126	149	160	156	139	126	117	116	112	114
21 Q	109	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	116	93	85	94	102	102	94	92	91	90	75	79	96	121	131	152	163	174	181	174	159	141	120	81	117

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2016

HORIZONTAL INTENSITY
 H = 19500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT) DAY	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN	
1	50	47	45	53	52	40	46	40	45	40	25	17	11	13	19	28	43	55	63	62	59	---	---	---	---	
2	---	---	65	68	71	73	74	74	68	65	61	58	50	42	---	40	52	66	63	65	68	55	57	64	61	
3	54	35	27	26	24	22	35	45	45	35	32	27	26	29	31	32	37	41	48	50	55	56	59	63	39	
4	62	61	62	61	60	62	61	59	59	58	57	58	51	50	55	57	57	59	66	67	64	65	65	68	60	
5	75	71	66	59	66	74	60	55	57	56	54	48	42	33	26	31	37	40	52	46	61	59	61	64	54	
6	64	65	65	62	56	56	56	56	56	55	56	50	45	43	42	43	49	58	65	61	64	59	64	62	56	
7	56	60	65	66	65	65	73	71	71	62	56	54	49	45	37	32	27	36	48	56	59	55	52	51	55	
8 D	49	43	45	41	43	41	53	38	43	38	33	28	23	16	17	22	34	48	56	60	54	51	52	53	41	
9	60	66	63	73	76	79	81	73	74	67	61	52	48	38	23	26	28	38	49	56	55	56	42	44	55	
10	54	58	56	61	65	66	64	66	61	50	44	30	19	11	9	14	26	40	46	49	45	43	48	50	45	
11	56	52	59	57	56	56	50	52	52	52	55	58	45	34	22	19	27	31	42	49	44	49	56	31	46	
12	25	37	60	55	59	64	71	64	67	66	58	66	48	41	26	21	29	40	49	62	64	68	71	73	54	
13	78	76	78	88	90	79	67	52	55	52	52	51	45	35	28	23	21	25	34	40	45	49	56	60	53	
14	62	68	68	67	70	72	65	57	54	48	50	49	43	31	20	14	14	18	34	47	51	50	57	65	49	
15	62	63	61	64	63	69	72	67	56	56	52	56	55	46	41	36	34	39	47	54	---	74	73	61	57	
16 D	50	47	57	60	62	56	60	70	72	75	76	64	47	51	34	33	26	0	20	15	6	32	30	23	44	
17 D	38	37	53	49	53	55	63	67	53	40	41	29	27	16	15	14	29	32	31	26	26	18	13	24	35	
18 D	19	35	40	47	36	30	39	37	36	34	35	28	21	6	13	20	11	28	18	37	32	33	40	48	30	
19 D	33	37	40	59	54	52	52	46	43	39	36	28	27	24	15	10	8	19	24	31	31	34	42	48	35	
20	38	45	47	54	56	50	46	50	48	46	41	37	26	18	12	16	20	26	36	40	41	40	42	43	38	
21 Q	51	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
23	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
24	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
25	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	38	40	47	51	50	46	53	52	49	45	44	36	29	23	19	20	22	25	30	34	30	33	36	39	37	

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2016

VERTICAL INTENSITY

Z = -28500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1	-368	-367	-362	-359	-351	-348	-346	-341	-343	-341	-334	-336	-330	-322	-314	-313	-320	-329	-336	-341	-344	---	---	---	---
2	---	---	-351	-352	-354	-355	-350	-347	-348	-346	-336	-333	-326	-320	---	-316	-325	-337	-342	-343	-347	-344	-344	-360	-341
3	-361	-357	-355	-352	-355	-353	-363	-359	-350	-346	-346	-340	-335	-333	-326	-320	-320	-327	-337	-339	-343	-342	-344	-350	-344
4	-352	-351	-351	-349	-347	-348	-349	-347	-344	-343	-338	-336	-330	-329	-332	-333	-330	-329	-330	-336	-337	-342	-345	-348	-341
5	-359	-357	-348	-348	-348	-340	-330	-339	-343	-340	-334	-333	-330	-324	-317	-313	-312	-315	-328	-336	-349	-347	-351	-351	-337
6	-349	-350	-349	-347	-343	-344	-345	-346	-345	-343	-337	-327	-321	-322	-321	-321	-329	-333	-335	-334	-340	-347	-354	-356	-339
7	-352	-349	-351	-351	-349	-348	-351	-349	-349	-342	-332	-327	-325	-324	-321	-319	-313	-321	-336	-349	-356	-362	-364	-366	-342
8 D	-371	-364	-346	-349	-352	-348	-329	-316	-346	-355	-350	-345	-343	-331	-320	-320	-327	-338	-344	-351	-353	-353	-353	-350	-344
9	-354	-357	-353	-355	-353	-352	-351	-348	-350	-343	-339	-332	-329	-324	-313	-318	-329	-344	-355	-363	-361	-365	-353	-350	-346
10	-353	-355	-351	-350	-350	-350	-349	-348	-342	-337	-333	-326	-324	-318	-312	-315	-325	-338	-348	-352	-351	-350	-353	-356	-341
11	-358	-353	-355	-353	-352	-349	-346	-347	-344	-347	-344	-337	-331	-322	-316	-315	-326	-334	-345	-353	-356	-363	-372	-366	-345
12	-364	-366	-356	-353	-359	-360	-361	-357	-358	-354	-336	-339	-337	-335	-325	-320	-327	-336	-341	-347	-352	-353	-353	-353	-348
13	-354	-350	-349	-351	-352	-345	-331	-323	-340	-342	-338	-330	-329	-327	-323	-318	-317	-329	-342	-348	-349	-350	-352	-350	-339
14	-351	-353	-350	-347	-348	-346	-335	-332	-330	-324	-331	-339	-339	-329	-321	-318	-319	-322	-337	-349	-355	-349	-352	-358	-339
15	-354	-354	-348	-347	-346	-342	-337	-333	-337	-341	-337	-333	-324	-315	-313	-311	-309	-317	-327	-338	---	-357	-365	-360	-337
16 D	-360	-361	-361	-351	-355	-350	-353	-355	-350	-323	-320	-330	-320	-314	-308	-312	-311	-307	-330	-335	-361	-371	-372	-376	-341
17 D	-365	-361	-343	-352	-353	-351	-342	-323	-319	-336	-341	-333	-331	-327	-325	-329	-337	-336	-339	-345	-362	-367	-387	-393	-346
18 D	-380	-371	-363	-341	-324	-342	-333	-345	-340	-320	-335	-345	-342	-333	-336	-338	-332	-342	-340	-356	-355	-361	-372	-377	-347
19 D	-360	-358	-357	-355	-349	-350	-344	-336	-343	-341	-341	-333	-336	-335	-328	-323	-319	-330	-337	-349	-353	-352	-357	-364	-344
20	-359	-358	-355	-354	-349	-343	-340	-347	-347	-347	-343	-342	-339	-335	-332	-331	-332	-337	-348	-352	-354	-355	-355	-353	-346
21 Q	-356	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
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27 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	-367	-363	-354	-350	-346	-348	-340	-335	-340	-335	-338	-337	-335	-328	-323	-324	-325	-331	-338	-347	-357	-361	-368	-372	-344

LIVINGSTON ISLAND MAGNETIC OBSERVATORY
 FEBRUARY 2016

TOTAL INTENSITY
 F = 34500 nT PLUS TABULAR QUANTITIES (UNITS nT)

HOUR(UT)	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	MEAN
DAY																									
1	365	362	357	359	352	342	345	337	341	337	323	320	312	306	303	307	322	335	345	349	350	---	---	---	---
2	---	---	359	362	365	367	364	361	359	355	345	340	331	320	---	316	331	348	351	352	358	348	348	366	349
3	361	348	341	338	340	337	353	354	348	338	337	329	324	324	320	315	318	326	338	341	347	347	350	357	339
4	358	357	357	355	354	356	356	353	351	349	344	343	334	333	338	340	338	338	342	348	347	352	355	358	348
5	371	367	357	353	357	356	339	344	348	345	339	335	329	319	309	309	311	315	333	336	356	352	357	359	342
6	358	358	357	354	348	349	349	350	349	347	343	331	323	323	321	322	332	341	346	343	350	353	361	362	345
7	355	355	359	360	357	357	363	360	361	351	339	334	329	326	319	314	307	318	337	352	360	363	363	364	346
8 D	367	357	344	344	348	343	334	315	343	347	341	333	329	316	307	309	322	339	348	356	355	353	354	352	340
9	359	365	360	367	367	369	368	361	363	354	347	336	332	322	304	310	320	338	354	364	362	366	349	347	349
10	355	358	354	356	359	359	357	357	350	339	333	319	312	301	296	301	316	334	346	351	348	346	351	355	340
11	360	354	359	357	355	353	347	349	346	348	348	344	332	318	306	304	317	327	341	352	351	360	372	352	344
12	347	356	360	356	363	366	371	364	366	362	343	350	338	333	316	309	319	333	342	355	360	363	364	365	350
13	369	365	365	372	374	362	344	329	344	345	341	334	330	323	315	308	306	319	334	342	347	350	355	355	343
14	358	363	360	357	360	359	346	339	336	328	334	340	337	322	309	303	305	309	330	348	354	350	356	365	340
15	361	361	355	355	354	354	351	346	343	345	341	339	331	319	314	310	307	317	329	342	---	369	375	364	343
16 D	359	357	363	357	361	354	358	366	363	341	340	342	323	320	306	309	305	286	317	318	334	357	357	357	340
17 D	356	352	346	351	355	354	351	338	326	333	338	325	321	312	309	312	328	328	331	332	346	346	360	371	338
18 D	357	359	355	341	320	332	330	338	334	317	329	334	328	311	318	323	313	331	324	347	344	349	363	371	336
19 D	349	349	350	360	351	351	346	337	340	337	335	324	326	323	312	305	301	316	325	338	341	342	351	360	336
20	350	354	352	355	353	345	339	348	346	345	339	336	328	320	314	315	319	326	341	346	348	348	349	349	340
21 Q	355	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
22 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
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26	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
27 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
28 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
29 Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN Q	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
MEAN D	357	355	352	350	347	347	344	339	341	335	336	332	326	316	311	312	314	320	329	338	344	349	357	362	338

