Geomagnetic indices for the period from June 2014 to March 2015

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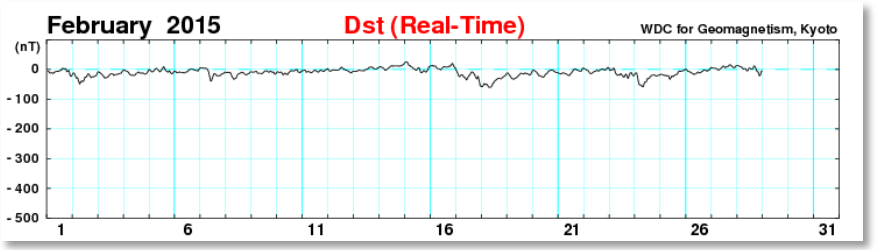
Data Holdings of WDC for Geomagnetism, Kyoto

1. Collection of geomagnetic field data
   - 1848 to Present (Primarily 1957 and after)
   - ~400 geomagnetic observatories
   - Microfilm (~9300 volumes), Microfiche (~10000 sheets), Data book (~3400 volumes), Digital data (~20 TB)

Data Service of WDC for Geomagnetism, Kyoto

2. Distribution of geomagnetic field data
   http://wdc.kugi.kyoto-u.ac.jp
   - Online data plot
   - Digital data download
   - Realtime plot
   - Digital images of magnetograms
   - Earth's magnetic field tutorial
   - Magnetic field model
   - … and much more!

3. Calculation of geomagnetic indices (AE, Dst, and ASY/SYM indices)

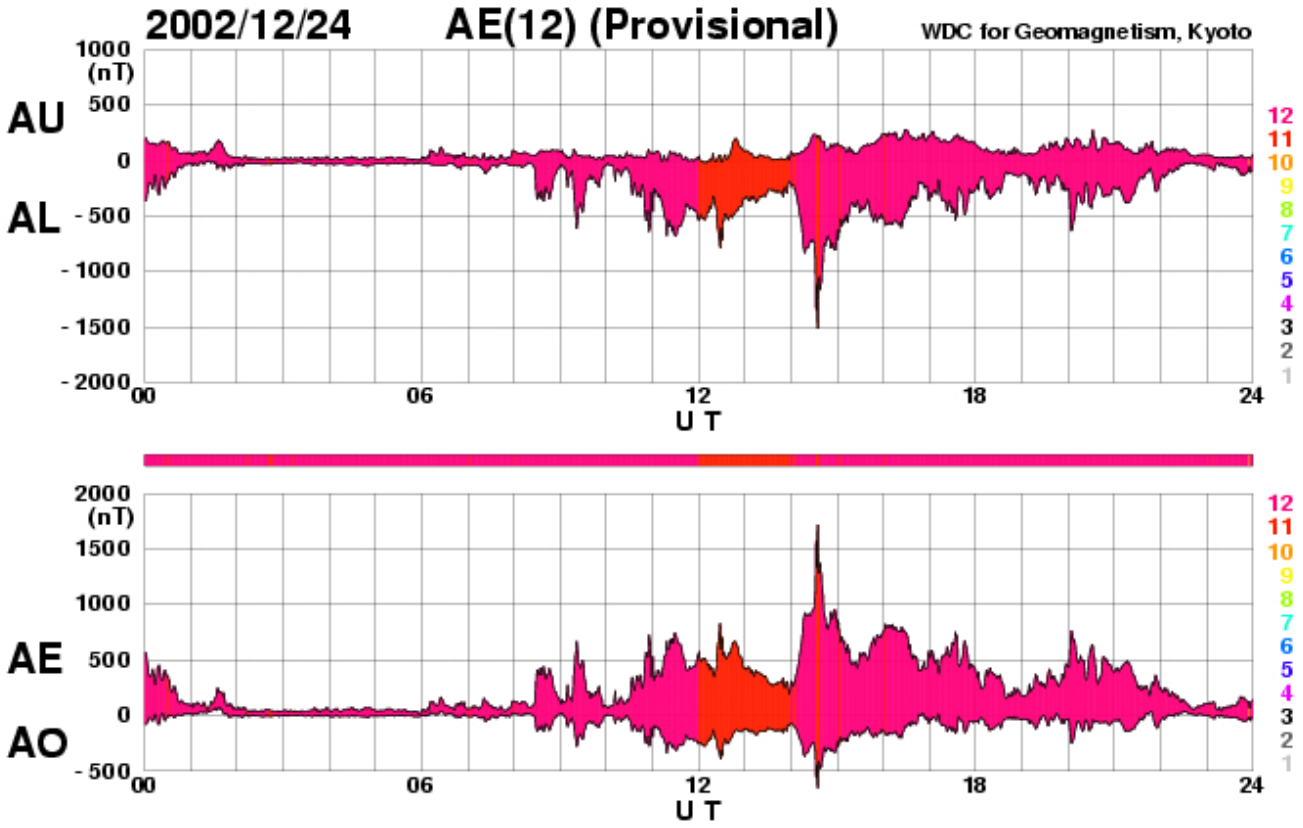


(1) AE Index

AE (Auroral Electrojet) Index

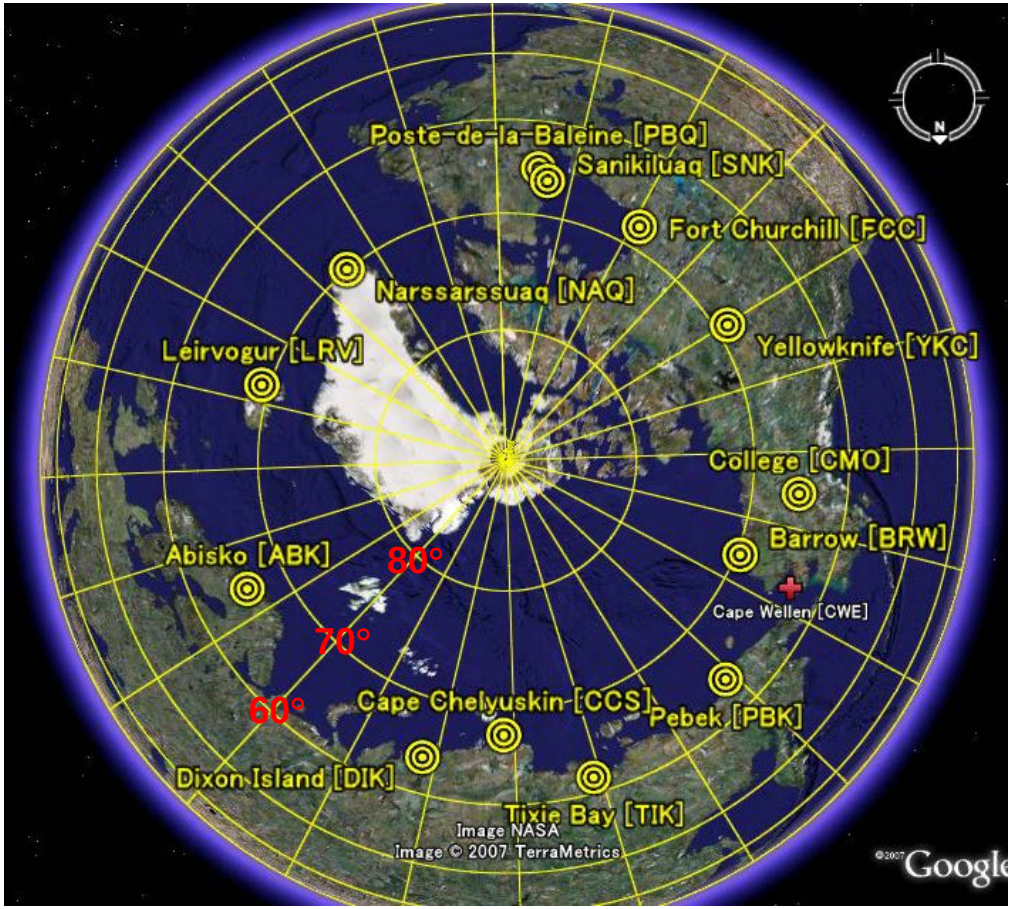
General Features

- Proposed by Davis and Sugiura [1966]
- Intends to measure the intensity of auroral electrojet flowing in the ionosphere



AE Index

- Derived from geomagnetic field variations in the H component
- Uses data from 12 stations at auroral/sub-auroral latitude (61°-70° GMLAT)
- 1-min resolution



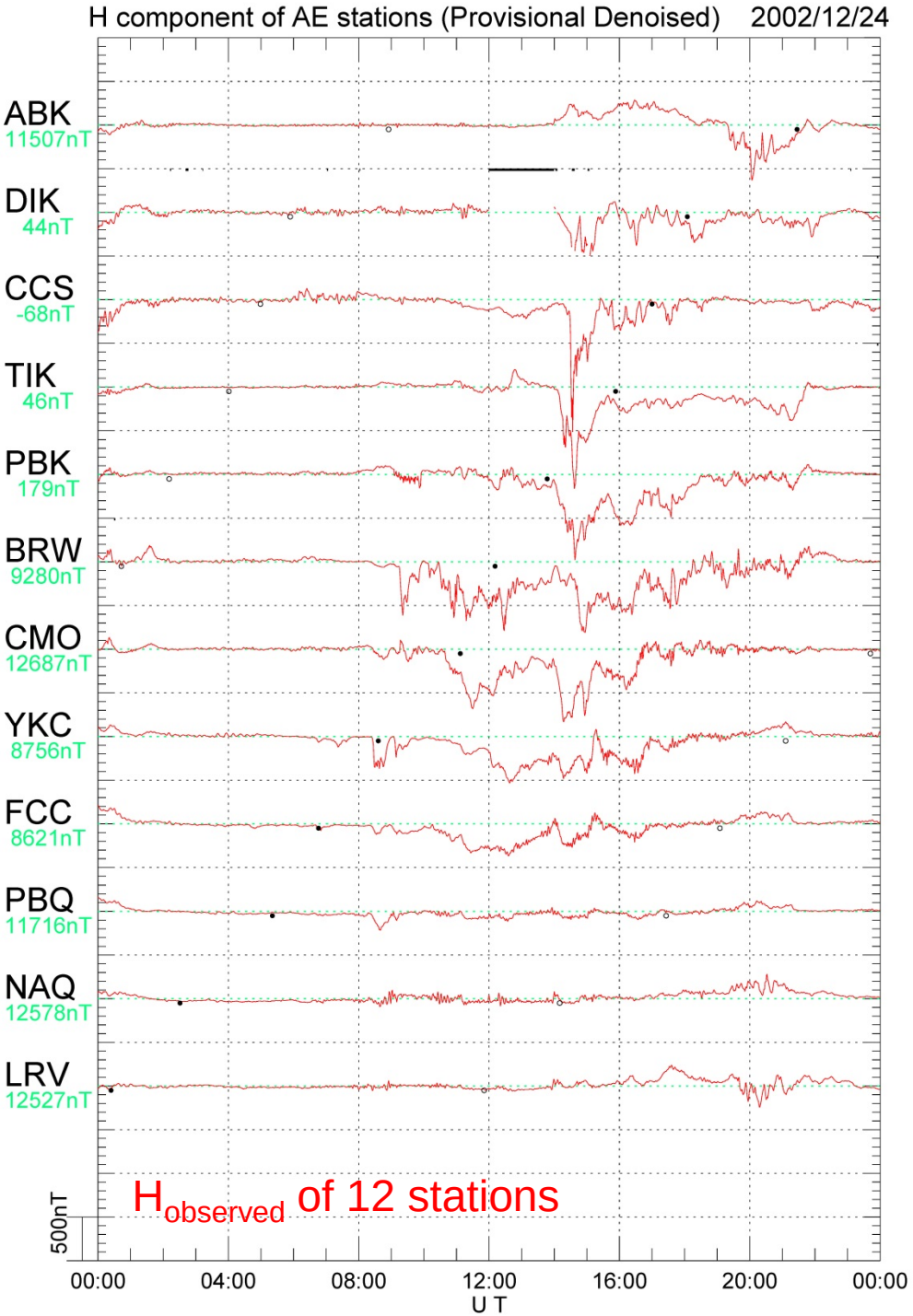
AE Index

Derivation scheme

1. Variations in the H component are calculated for each station by

$$\Delta H = H_{observed} - H_{quiet}$$

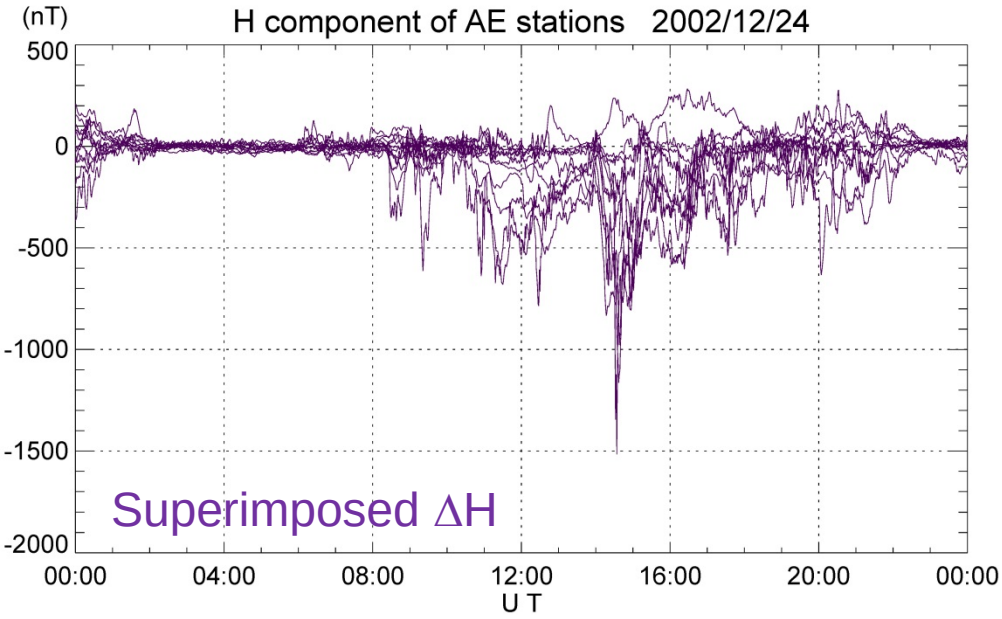
where H_{quiet} is a quiet-time value (i.e., average over the international 5 quietest days).

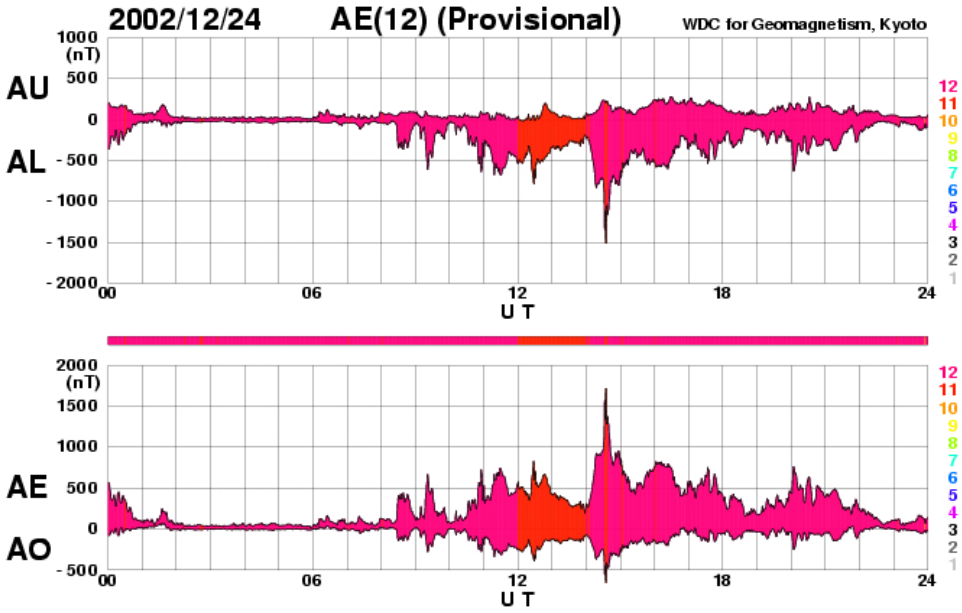


$H_{observed}$ of 12 stations

AE Index

2. ΔH from the 12 stations are superimposed.
3. AU is the upper envelope of the superimposed data.
   AL is the lower envelope.
4. AE can be calculated as follows.
   $AE = AU - AL$

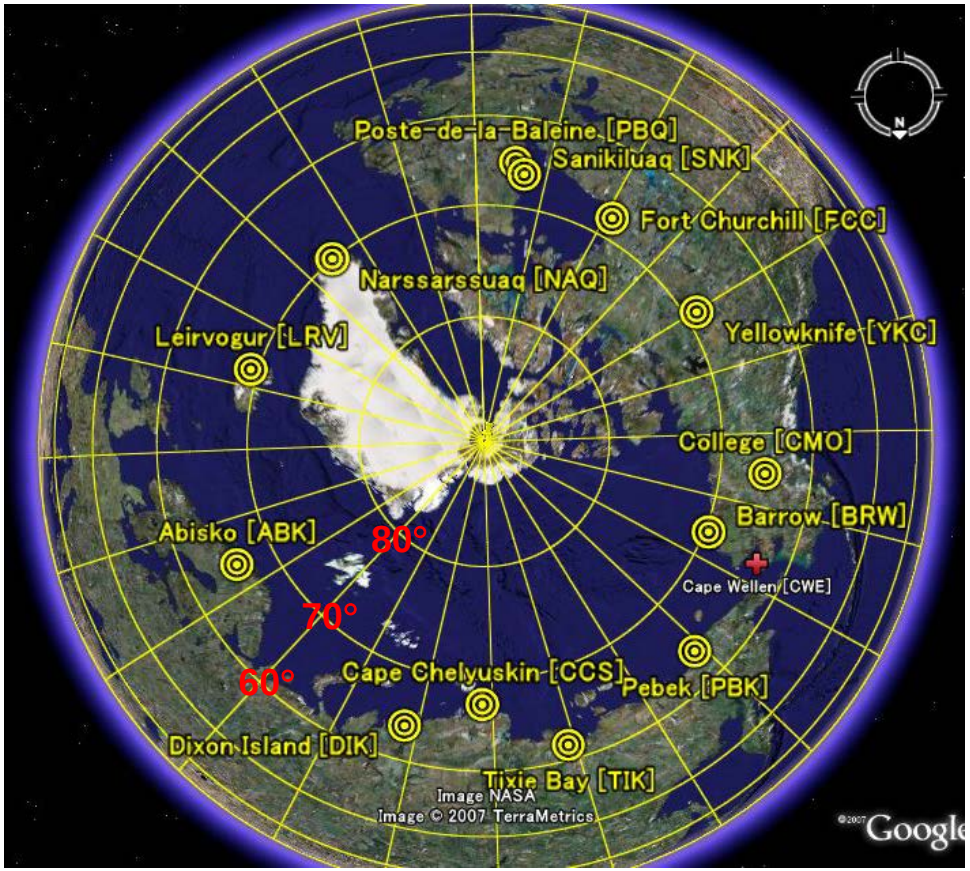




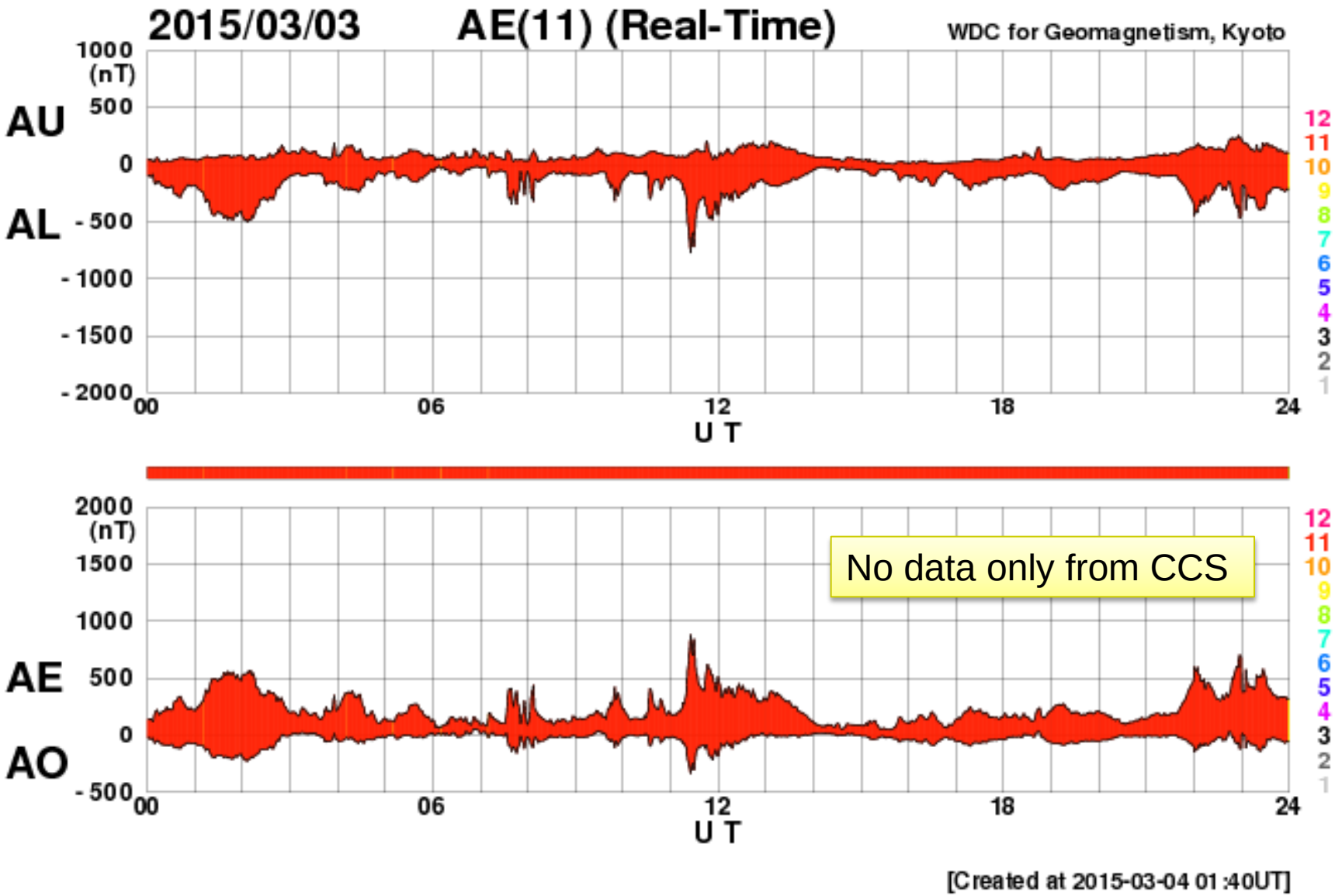
Collection of Real-time Data for AE Index

- Realtime derivation started in 1996

- BRW, CMO
  - US Geological Survey
  - http with ~5 min delay
- YKC, FCC, PBQ(SNK)
  - Geological Survey of Canada
  - E-mail with ~15 min delay
- NAQ
  - Technical University of Denmark
  - E-mail with ~5 min delay
- LRV
  - University of Iceland
  - sftp with ~1 hour delay
- ABK
  - Geological Survey of Sweden
  - E-mail with ~1 hour delay
- DIK, CCS, TIK, PBK
  - Arctic and Antarctic Research Institute
  - E-mail with ~5 min delay

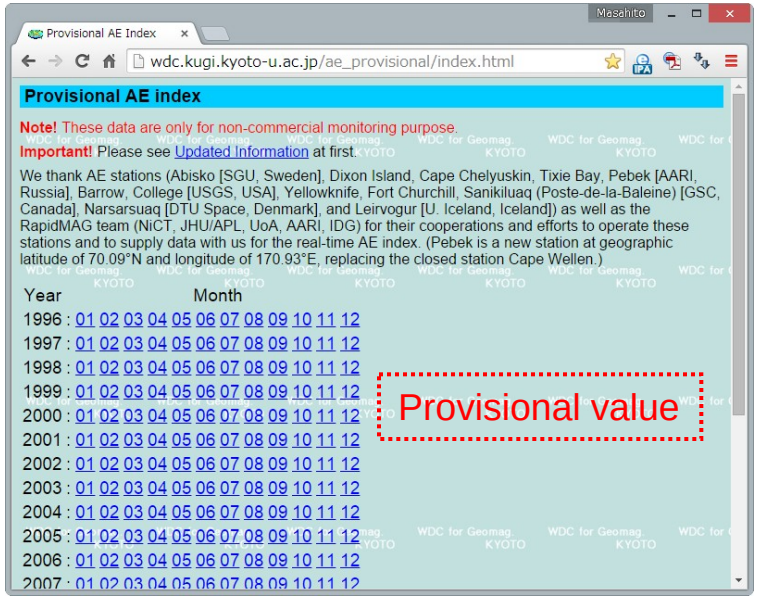


AE Index of Yesterday



AE Index in Archive

- Real-time value: 2014/12-present
  - Derived from data of 10-11 stations
  - Possibly includes artificial noises or baseline shift
- Provisional/Final value: 1978/01-2014/11
  - Derived from data with noise removal by visual inspection
  - Updated when additional data are supplied from stations
  - For some periods, data from 12 stations are available.



http://wdc.kugi.kyoto-u.ac.jp/aedir/index.html

(2) Dst Index

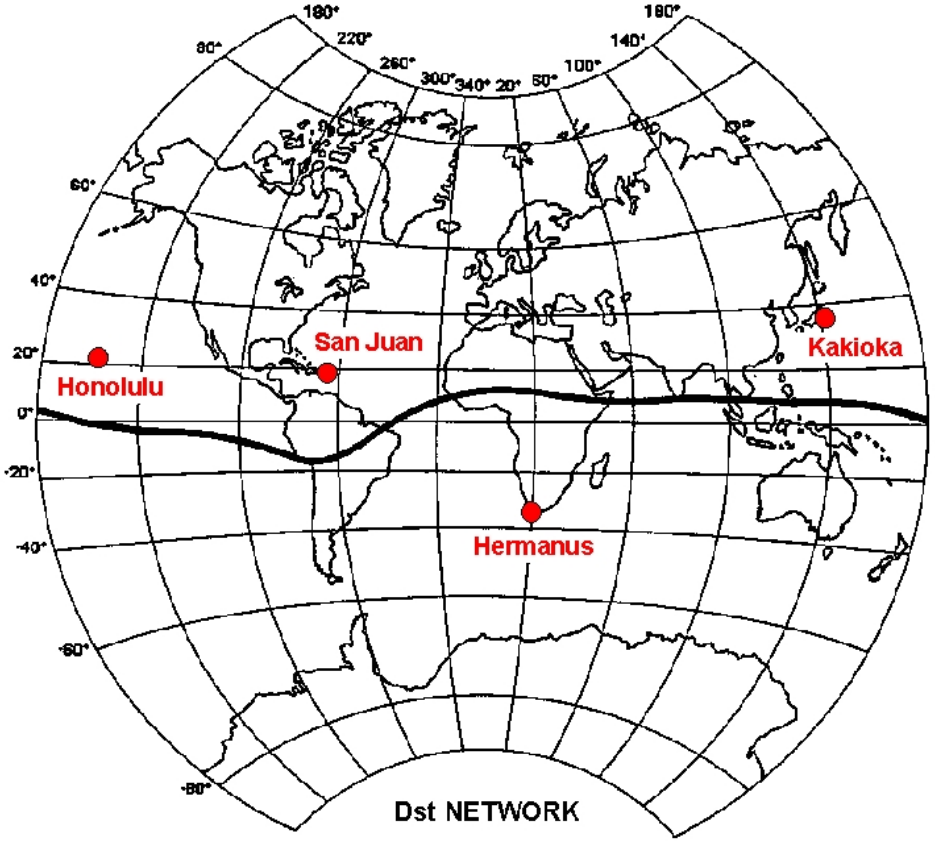
Dst Index

General Features

- Proposed by Sugiura [1964].
- Intends to measure the magnitude of the current which produces the axially symmetric disturbance field
  (not only the ring current but also other currents)

Dst Index

- Derived from geomagnetic field variations in the H component
- Uses data from 4 stations at low latitude (|GMLAT|<35°).
- 1-hour resolution



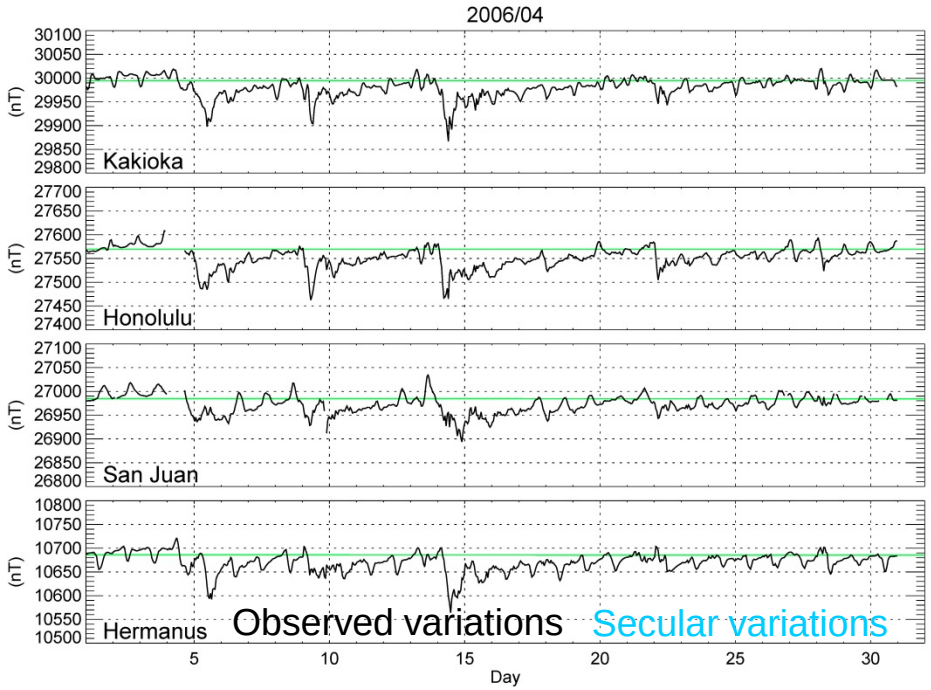
Dst Index

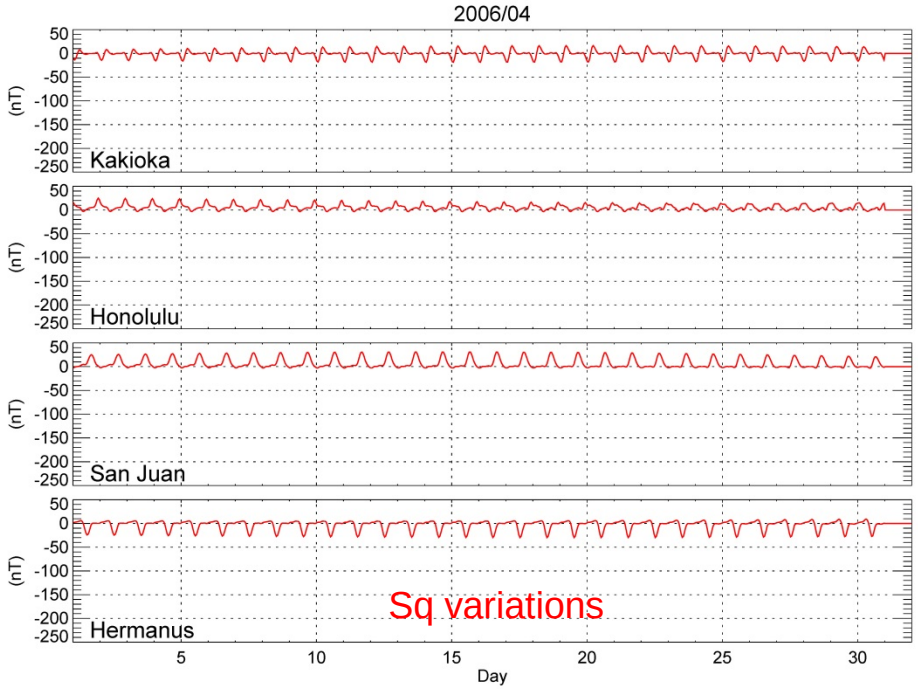
Deviation scheme

1. Variations in the H component are calculated for each station by

$$\Delta H = H_{observed} - H_{secular} - H_{Sq}$$

where $H_{secular}$ is secular variations and H_{Sq} is Sq variations.

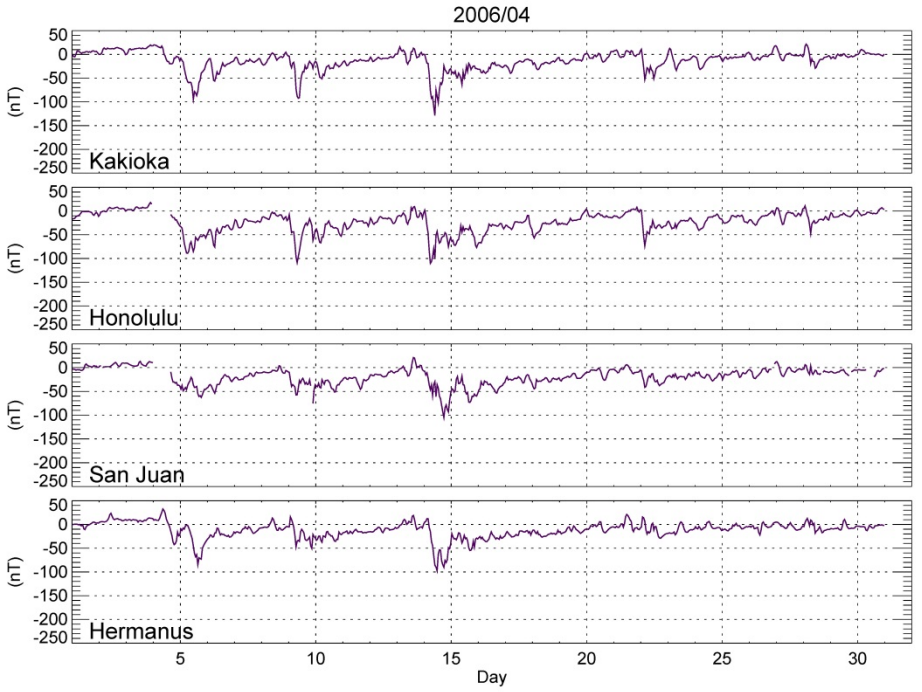




Dst Index

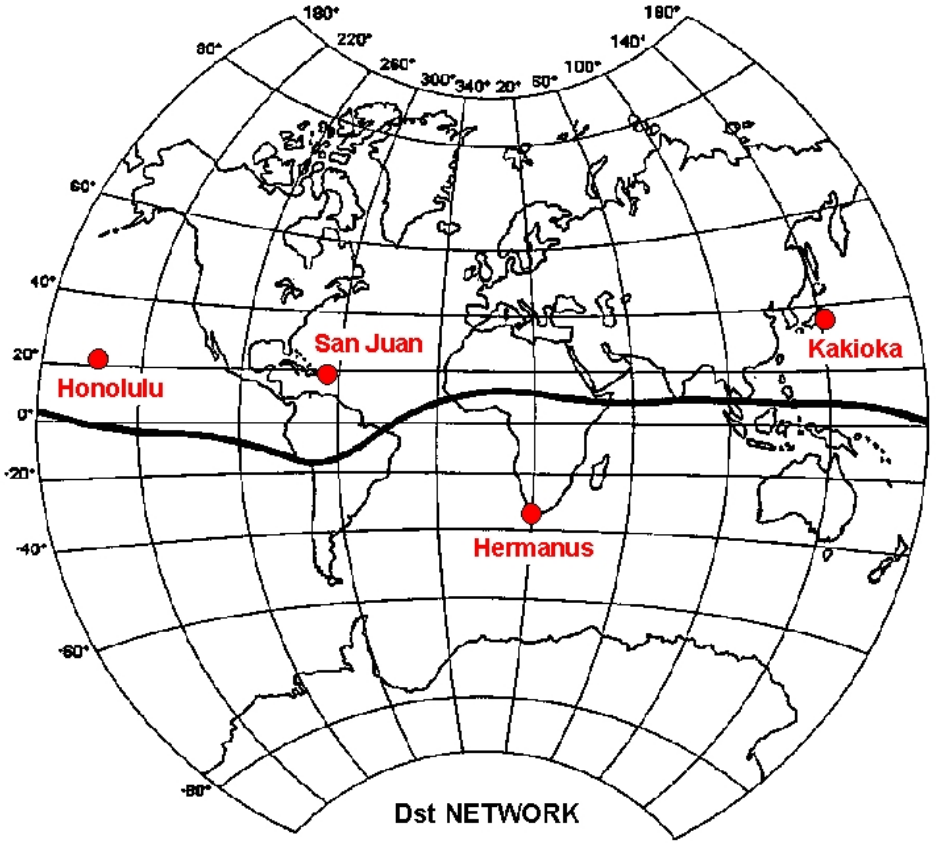
2. **ΔH** from 4 stations are corrected for latitude and averaged longitudinally with the following equation.

$$Dst = \frac{\frac{1}{4}\sum_{i=1}^{4}\Delta H_i}{\frac{1}{4}\sum_{i=1}^{4}\cos\lambda_i}$$

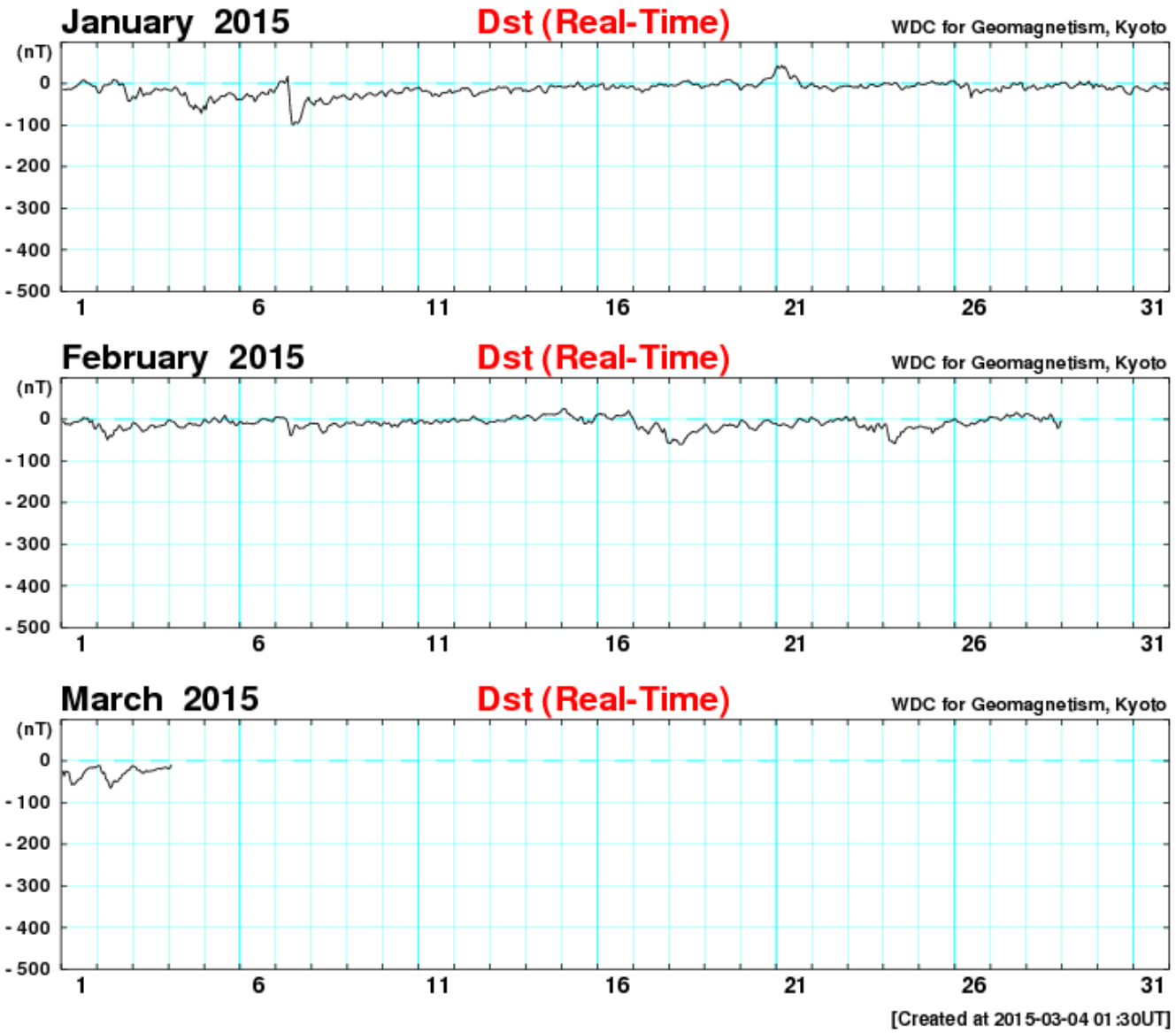


Collection of Real-time Data for Dst Index

- Realtime derivation started in 1996
- KAK
  - Kakioka Magnetic Observatory
  - sftp with ~5 min delay
- HON, SJG
  - US Geological Survey
  - http with ~5 min delay
- HER
  - Hermanus Magnetic Observatory
  - sftp with ~60 min delay

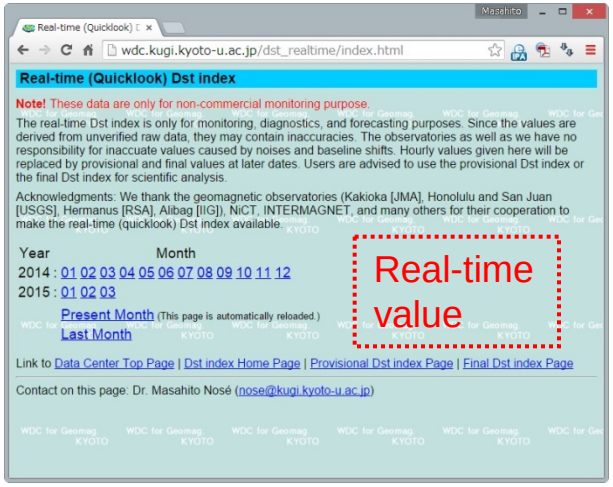


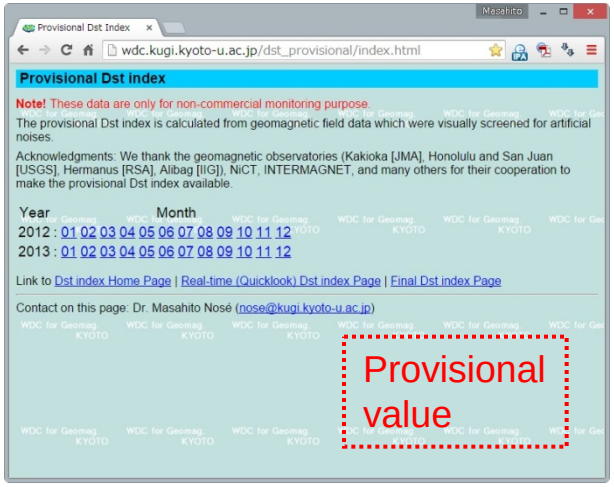
Dst Index in Recent Days

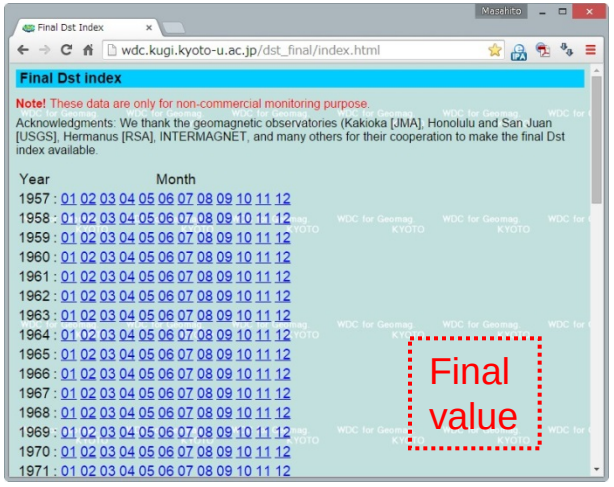


Dst Index in Archive

- Real-time value: 2014/01-present
  - Derived from real-time data of 4 stations
  - Possibly includes artificial noises or baseline shift
- Provisional value: 2012/01-2013/12
  - Derived from data with noise removal by visual inspection
  - Updated when final data is supplied from stations
- Final value: 1957/01-2011/12
  - Derived after calculation of secular variations and Sq variations



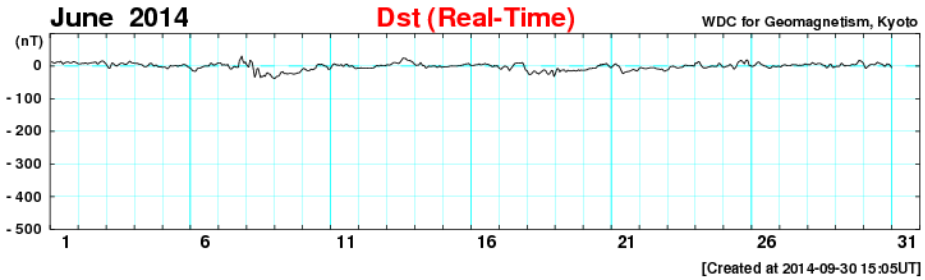


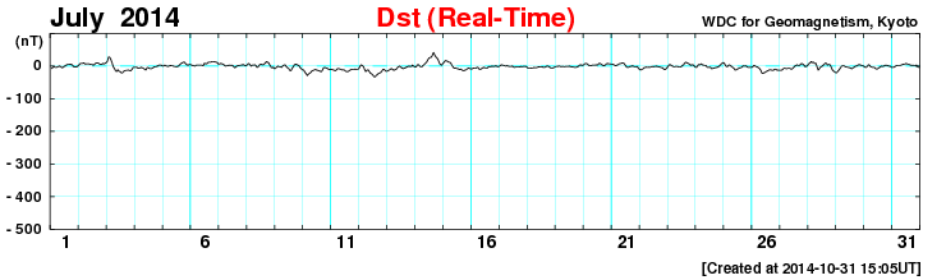


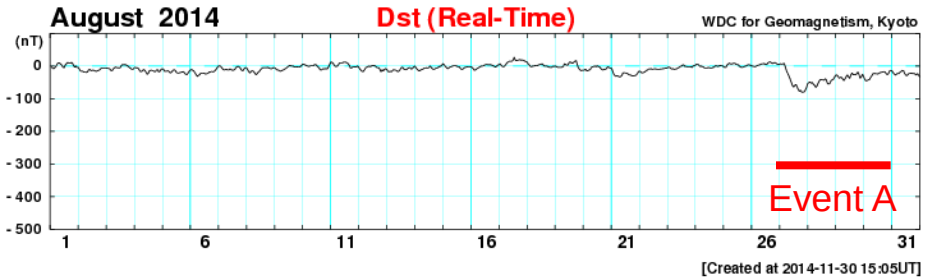
http://wdc.kugi.kyoto-u.ac.jp/dstdir/index.html

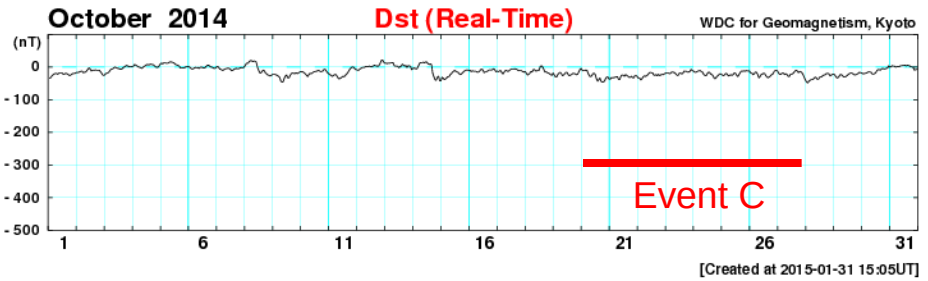
(3) AE and Dst indices for the period from June 2014 to March 2015

Dst index for 2014/06-2014/10

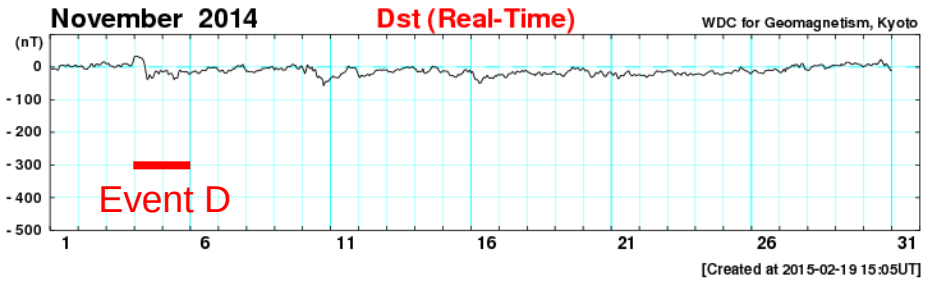


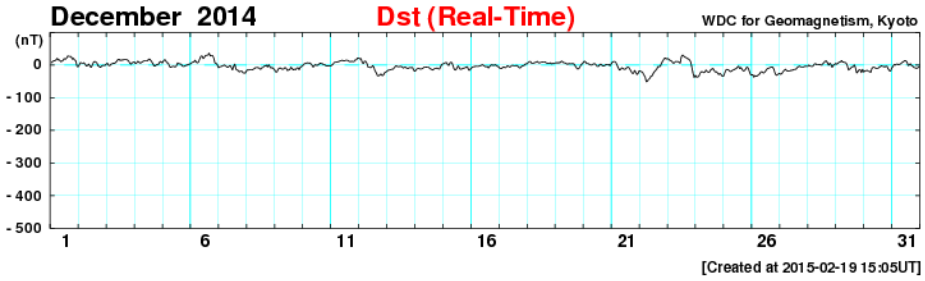


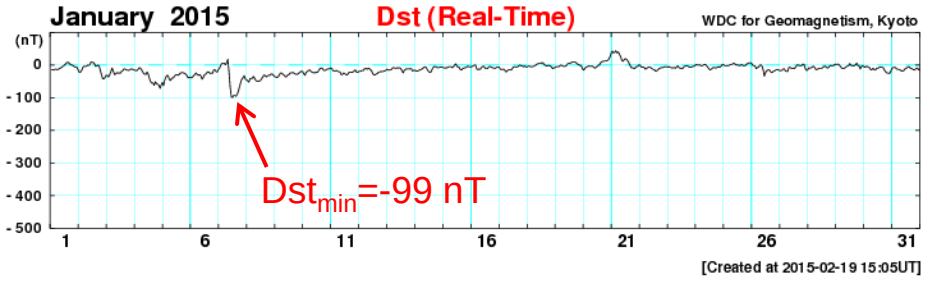


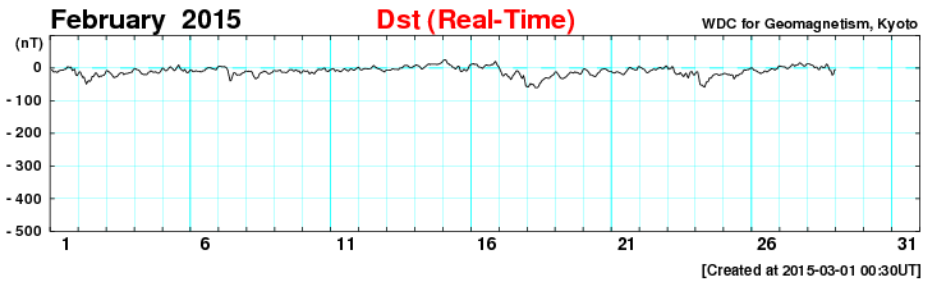


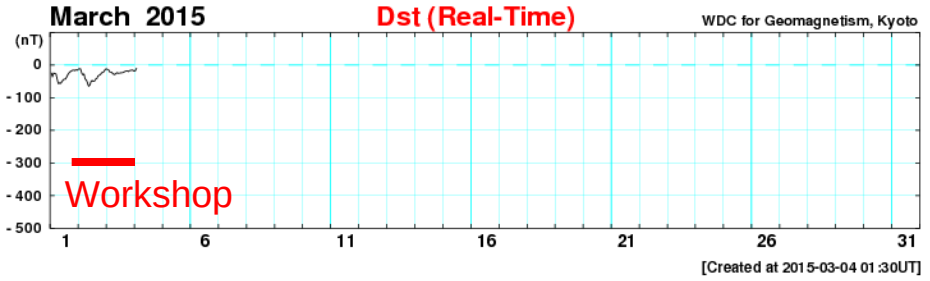
Dst index for 2014/11-2015/03



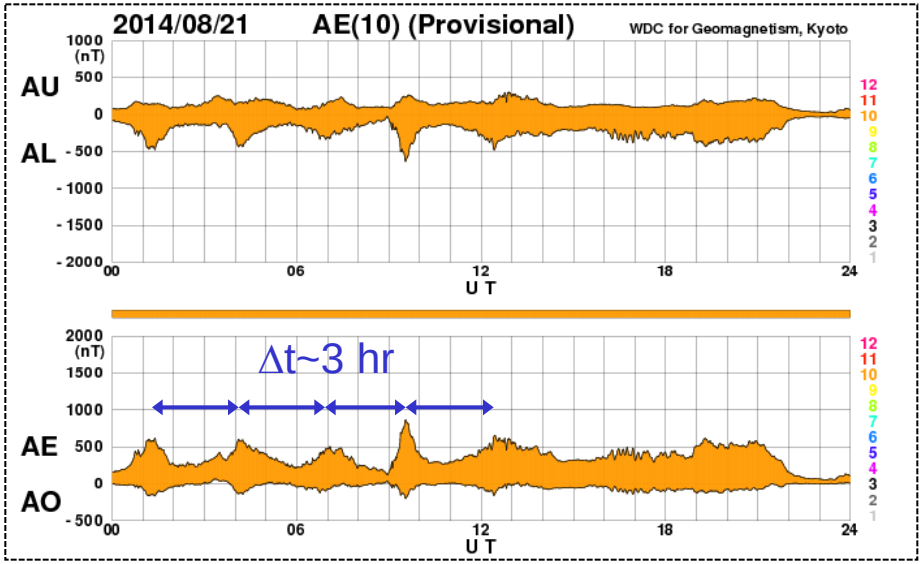


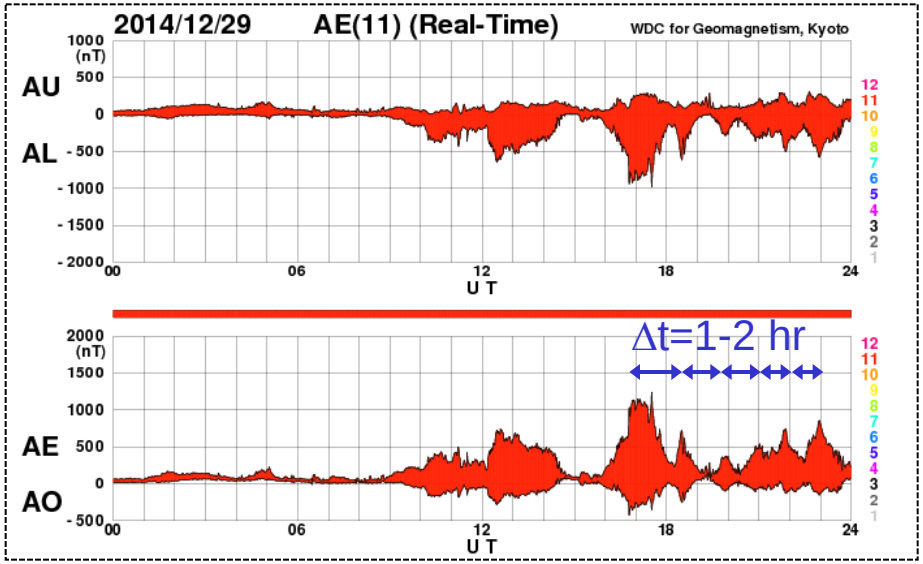


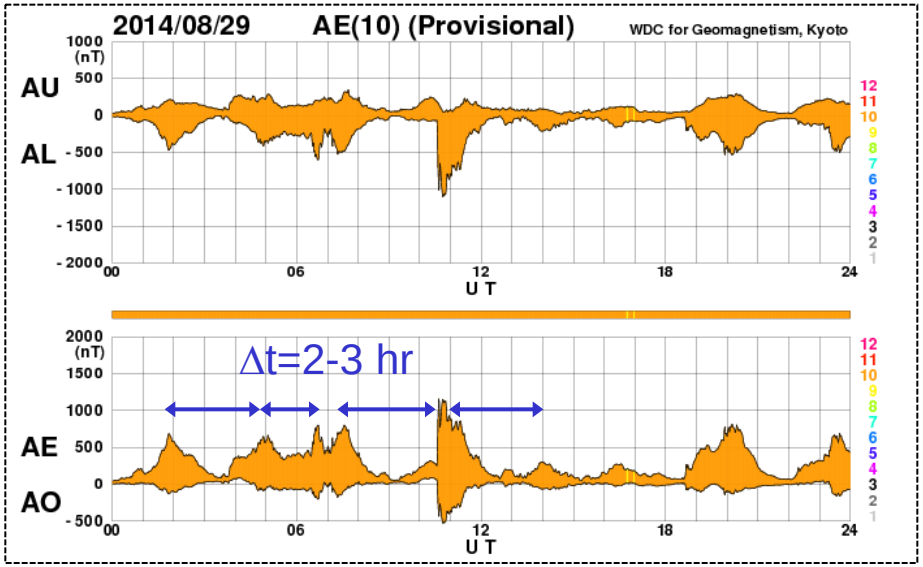


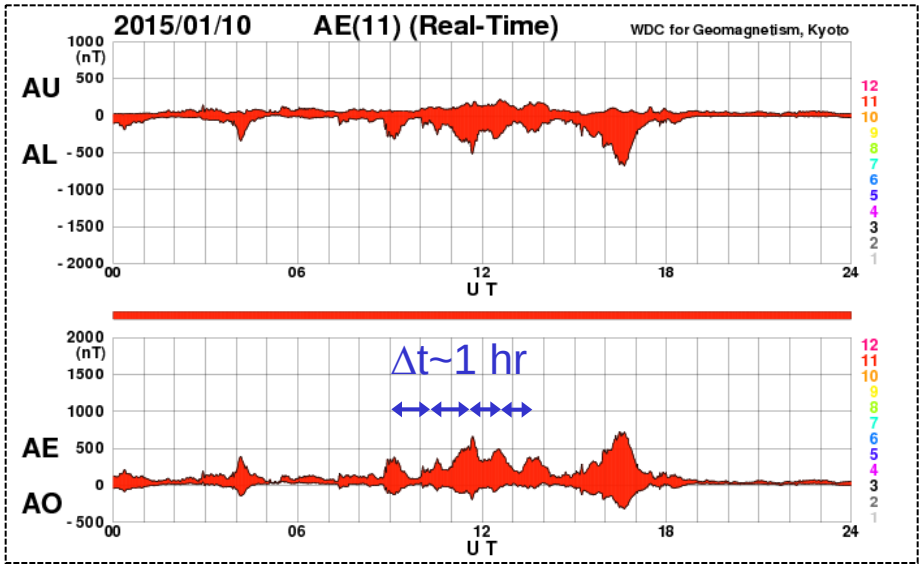


Periodicity of substorms

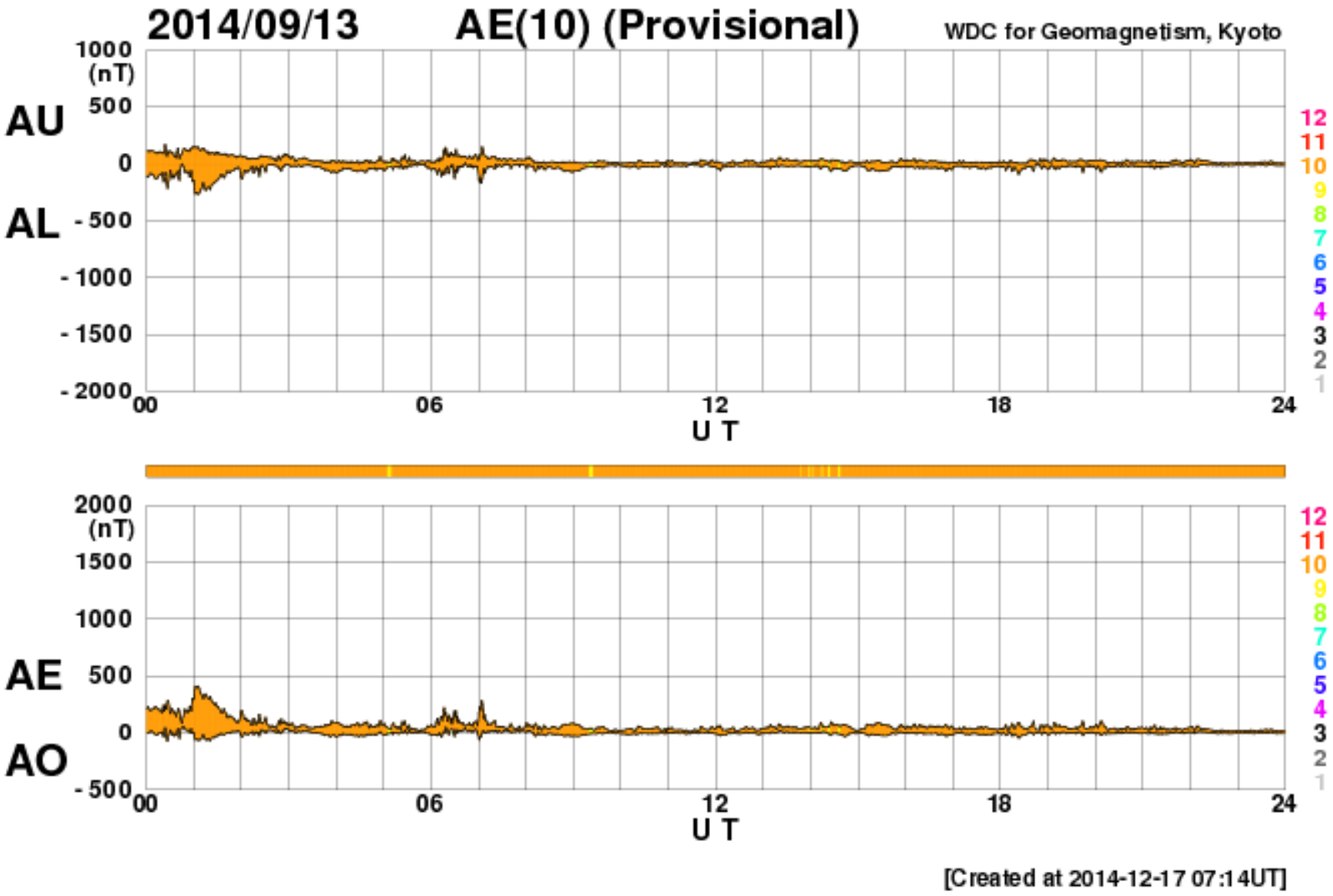






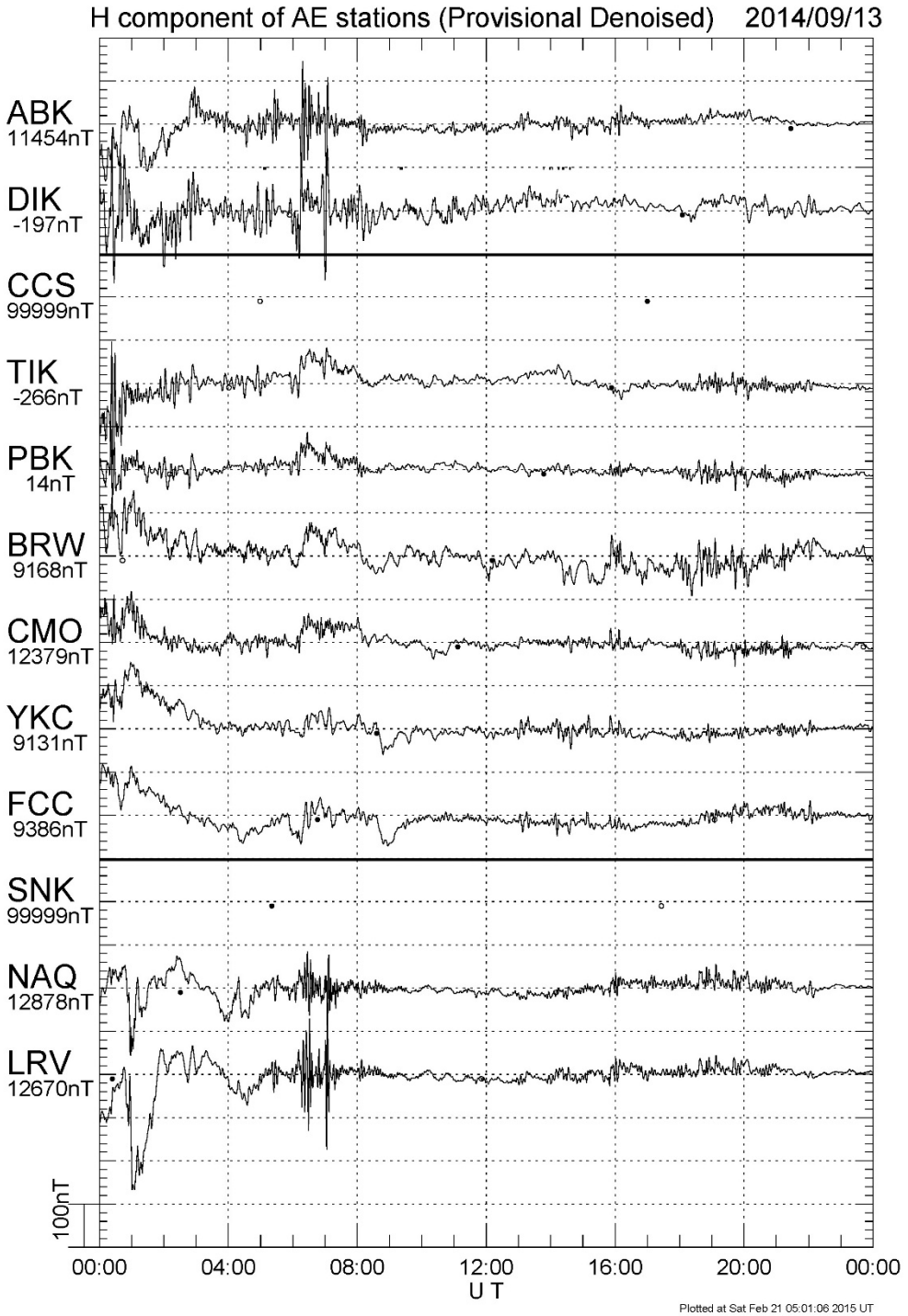


Fluctuations in AE index during storm recovery (2014/09/13, Selected event B)

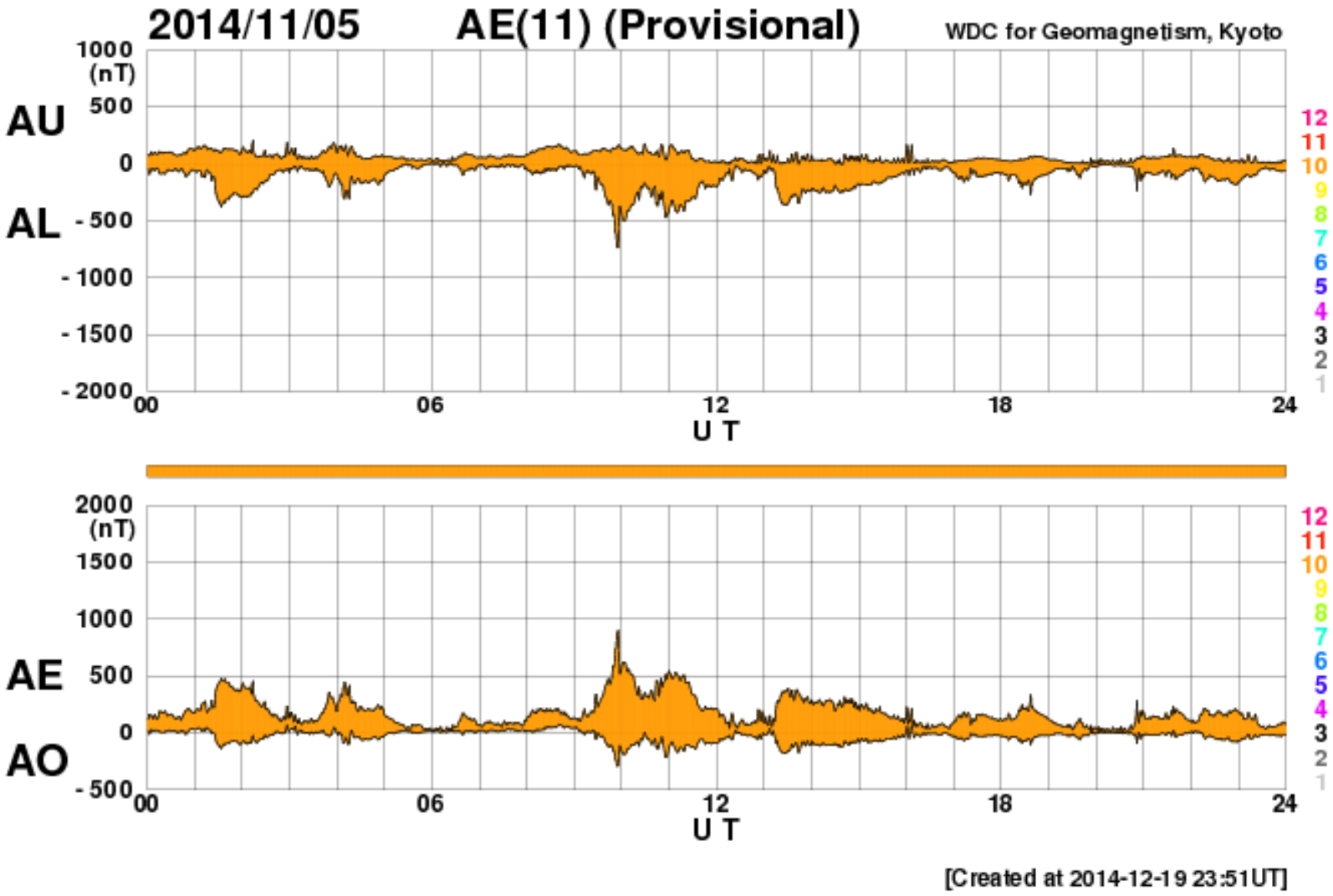


Magnetic field variations at AE stations (2014/09/13)

- Pc5 pulsations?
- May contribute to generation of radiation belt electrons via drift-bounce resonance.

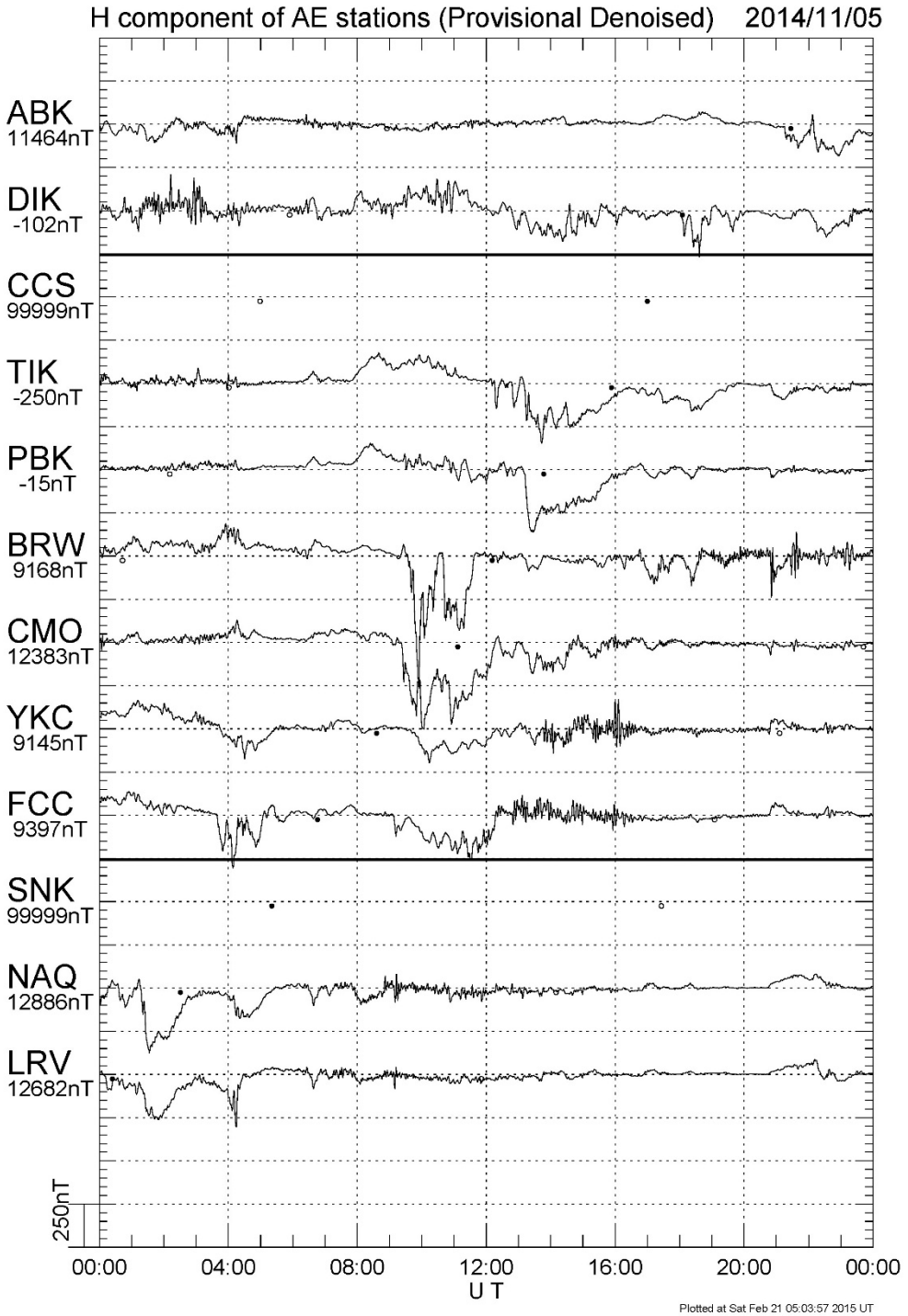


Fluctuations in AE index during storm recovery (2014/11/05, Selected event D)



Magnetic field variations at AE stations (2014/11/05)

- Pc5 pulsations?
- May contribute to generation of radiation belt electrons via drift-bounce resonance.



Summary

AE index

- Real-time data are transferred continuously.
- Real-time value: 2014/12-present
  - Derived from 9-11 stations. Possibly includes noises or baseline shift.
  - Updated every 20 min.
- Provisional/Final value: 1978/01-2014/11
  - Derived from 9-12 stations. Derivation is about 2-3 months behind.

Dst index

- Real-time data are transferred continuously.
- Real-time value: 2014/01-present
  - Possibly includes noises or baseline shift.
  - Updated every 30 min.
- Provisional value: 2013/01-2014/12
- Final value: January 1957/01-2012/12
  - Updated when final data is supplied from stations.

Summary

AE and Dst indices for the period from June 2014 to March 2015

- The largest magnetic storm occurred on January 7, 2015 with Dst_{min}=-99 nT.
- Periodicity of substorms were found in the AE index.
- During the recovery phase of magnetic storms, magnetic field at auroral latitude sometimes shows strong variations in Pc5 frequency range.