Topside ionospheric response to geomagnetic storms: multi-instrumental observations

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ere response

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Unusual topside ionospheric density response to the November 2003 superstorm

E. Yizengaw,[1] M. B. Moldwin,[1] A. Komjathy,[2] and A. J. Mannucci[2]

Received 17 September 2005; revised 10 November 2005; accepted 28 November 2005; published 17 February 2006

[1] We use observa
including ionosond
receivers, magneto
(ACE), to examine
2003 superstorm. V
20 November 2003
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Ionospheric F-layer
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Citation: Yizengaw,
the November 2003 su

JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 114, A12313, doi:10.1029/2009JA014568, 2009

Observations of the ionospheric response to the 15 December 2006 geomagnetic storm: Long-duration positive storm effect

N. M. Pedatella,[1] J. Lei,[1] K. M. Larson,[1] and J. M. Forbes[1]

Received 15 June 2009; revised 29 July 2009; accepted 21 August 2009; published 22 December 2009

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15 December. T
GPS TEC and
ionosphere/plasr
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observations sug
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Citation: Pedatell
15 December 2006

AGU PUBLICATIONS

Opposite hemispheric asymmetries during the ionospheric storm of 29–31 August 2004

Elvira Astafyeva[1], Irina Zakharenkova[1,2], and Eelco Doornbos[3]

[1]Institut de Physique du Globe de Paris, Paris Sorbonne Cité, Université Paris Diderot, UMR CNRS 7154, Paris, France, [2]Op
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Accepted article online 12 DEC 2014

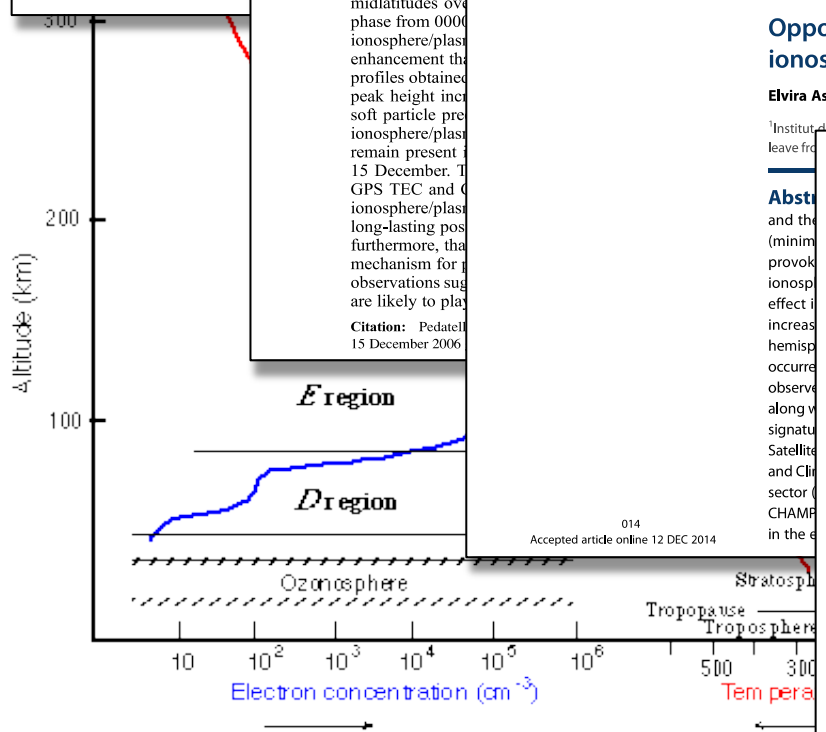
AGU PUBLICATIONS

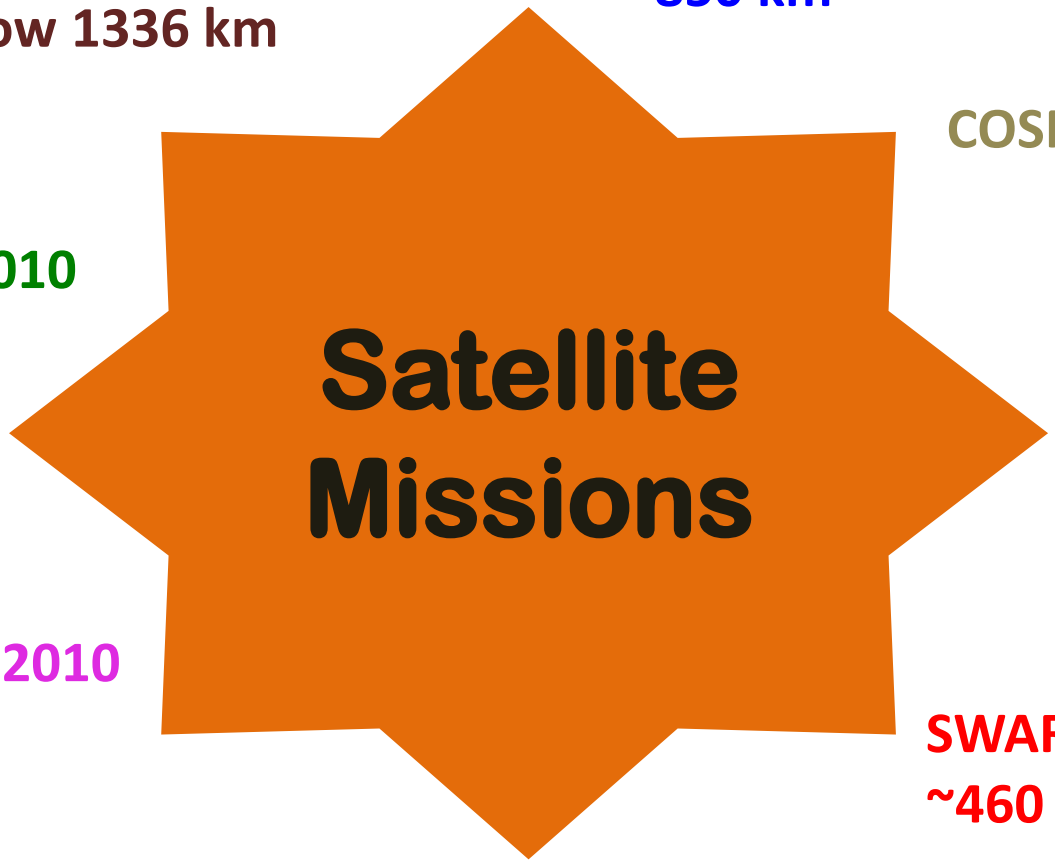
Response of the topside and bottomside ionosphere at low and middle latitudes to the October 2003 superstorms

Jiuhou Lei[1], Qingyu Zhu[1], Wenbin Wang[2], Alan G. Burns[2], Biqiang Zhao[3], Xiaoli Luan[1], Jiahao Zhong[1], and Xiankang Dou[1]

[1]CAS Key Laboratory of Geospace Environment, University of Science and Technology of China, Hefei, China, [2]High Altitude Observatory, National Center for Atmospheric Research, Boulder, Colorado, USA, [3]Institute of Geology and Geophysics, Chinese Academy of Sciences, Beijing, China

Abstract Ionospheric observations from the ground-based GPS receiver network, CHAMP and GRACE satellites and ionosondes were used to examine topside and bottomside ionospheric variations at low and middle latitudes over the Pacific and American sectors during the October 2003 superstorms. The latitudinal variation and the storm time response of the ground-based GPS total electron content (TEC) were generally consistent with those of the CHAMP and GRACE up-looking TEC. The TECs at heights below the satellite altitudes during the main phases were comparable to, or even less than, the quiet time values. However, the storm time CHAMP and GRACE up-looking TECs showed profound increases at low and middle latitudes. The ground-based TEC and ionosonde data were also combined to study the





TOPEX/Jason-1,2,3: 1992-
VTEC below 1336 km

DMSP: 1962-
~850 km

COSMIC/F3: 2006-

CHAMP: 2000-2010
~425… 300 km

GRACE: 2002-
~460km

DEMETER: 2004 -2010
~710 km

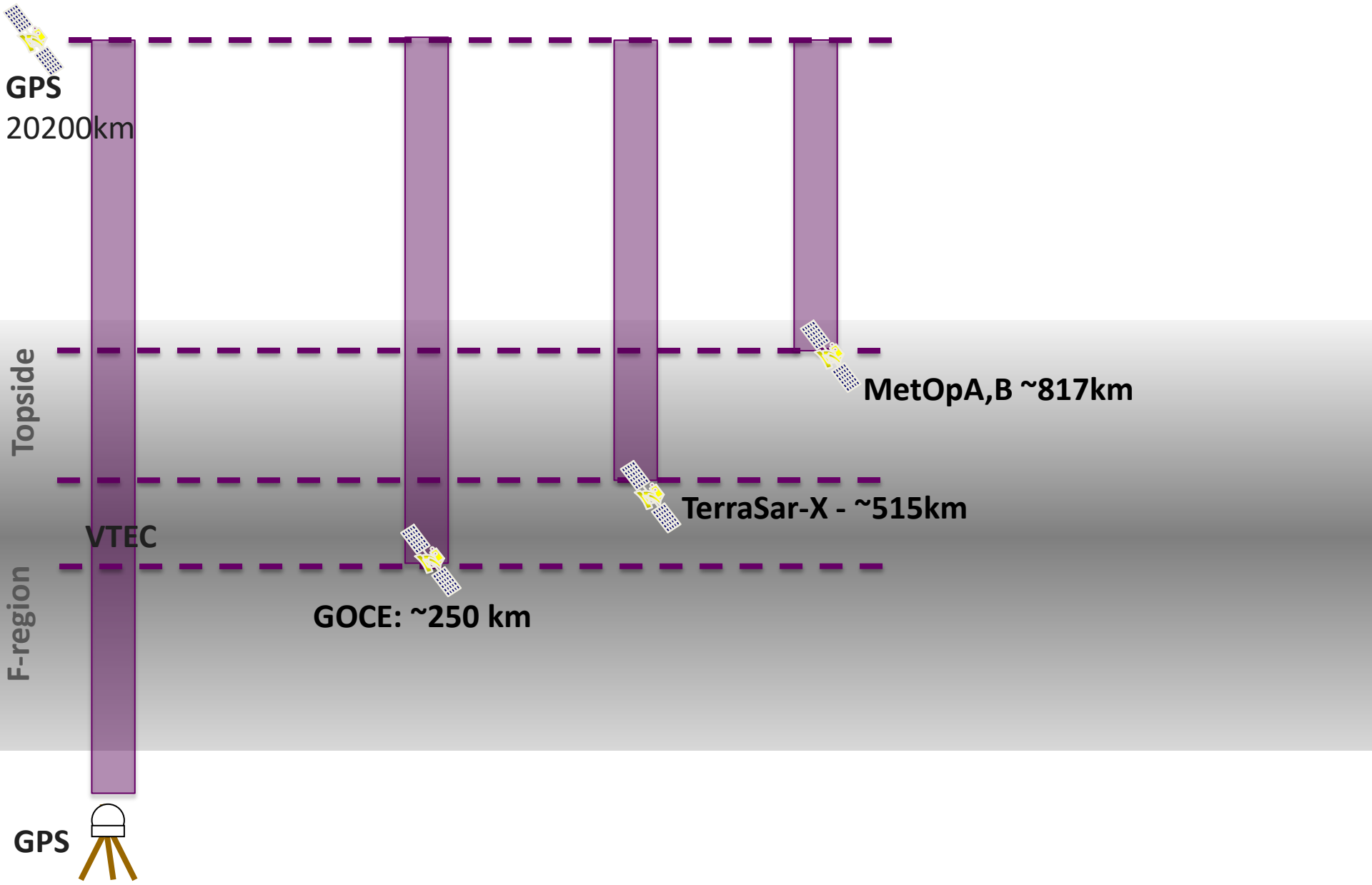
SWARM A,B,C: 2013-
~460 & ~520 km

C/NOFS: 2008-2015
405÷803 km

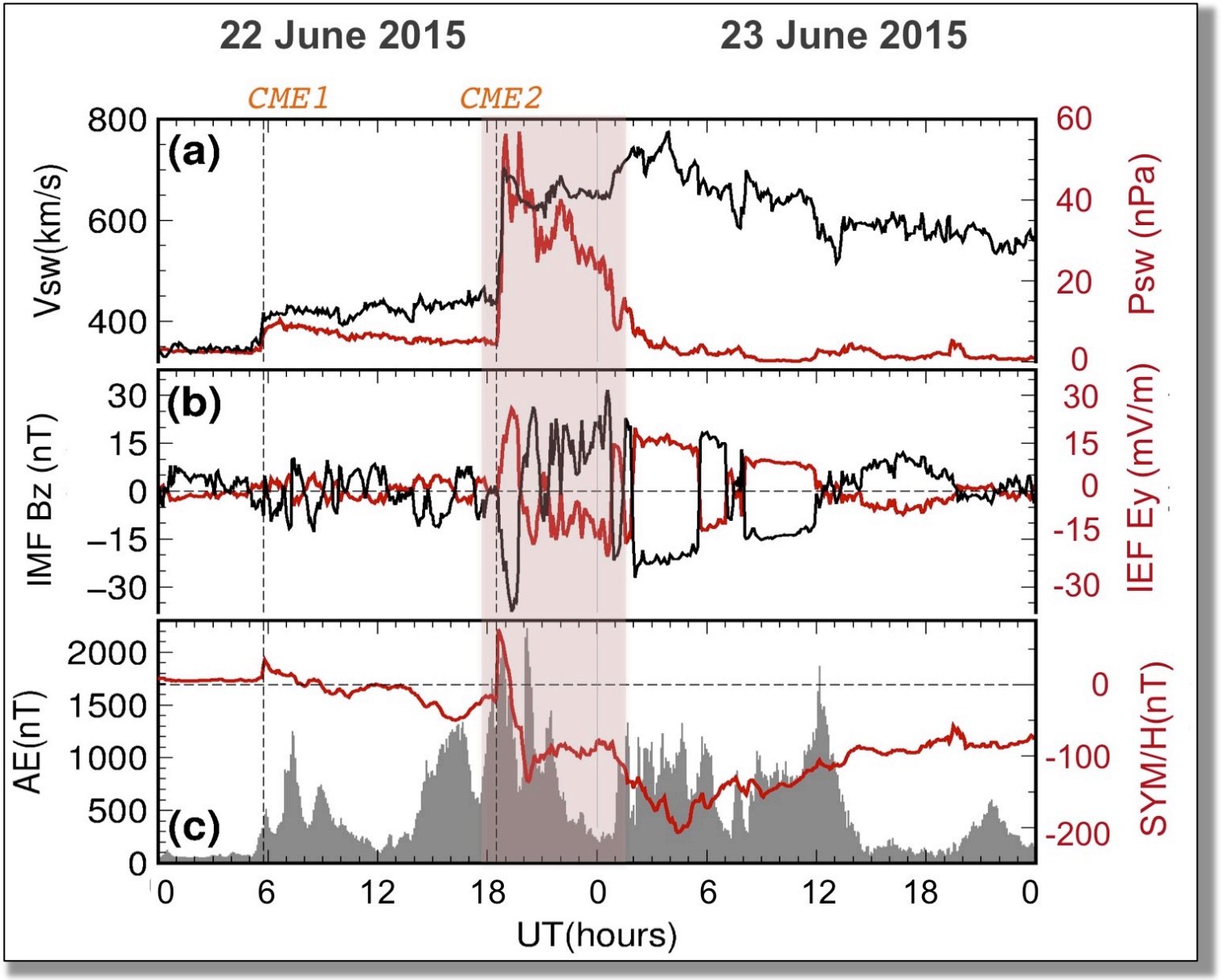
GUVI: >2001
~612 km

IDM, (P)LP, acc, magnetometers, imagers etc…

Space-borne GPS-only



1. Geomagnetic storm 22-23 June 2015

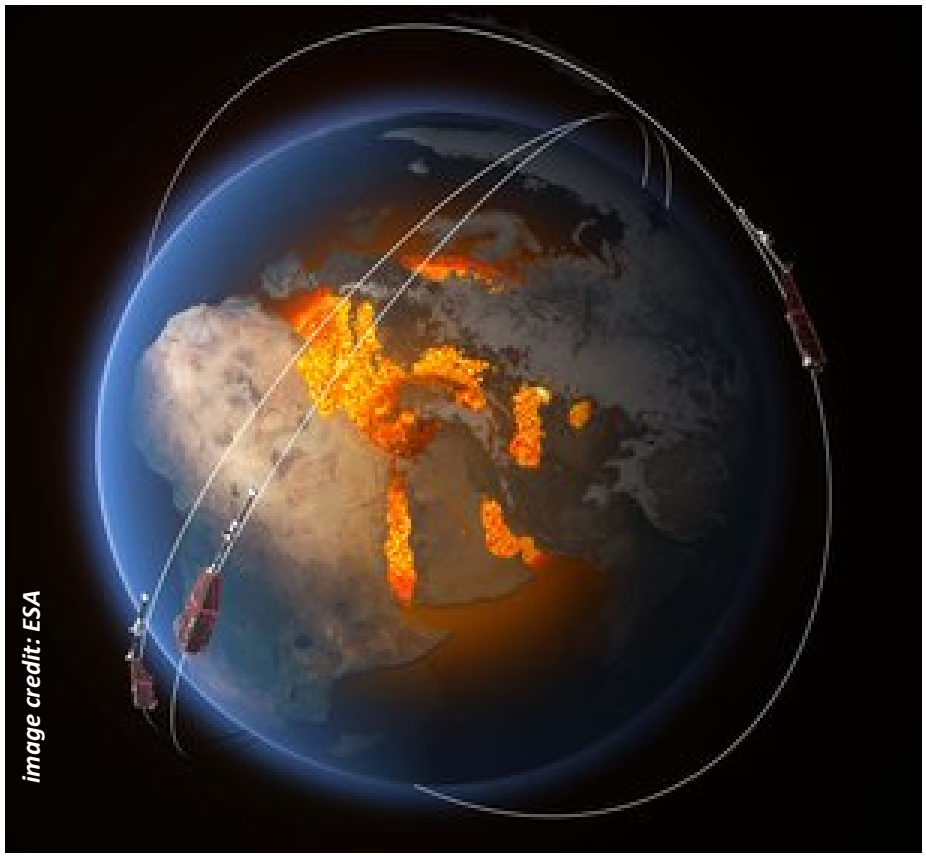


SSC
18:30UT

Instruments: Swarm constellation

A & C – at ~460 km → ~11LT & ~23LT

B – at ~530 km → ~13LT & ~01LT



A - Alpha, B - Bravo, C- Charlie

Parameters:

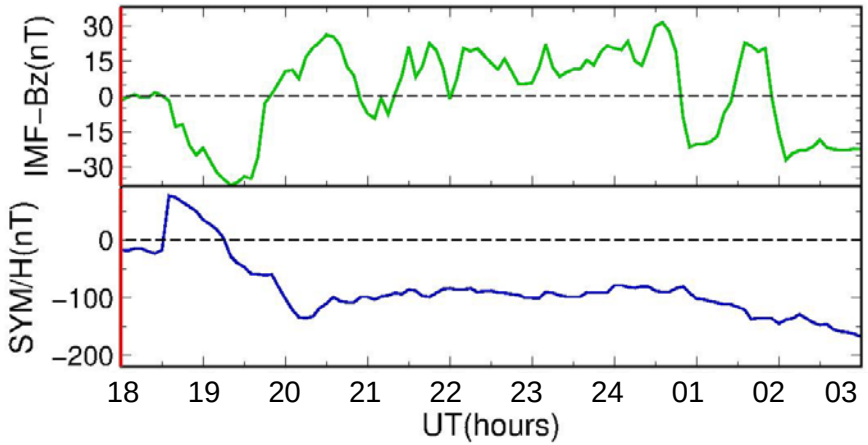
VTEC

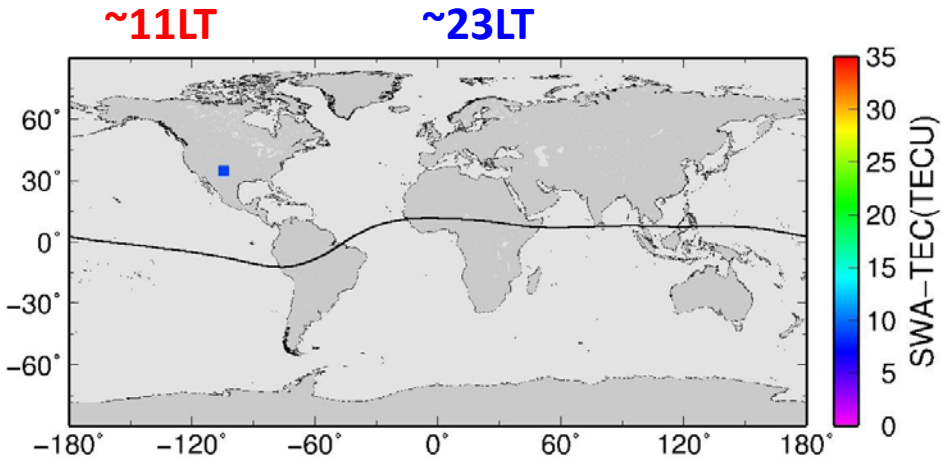
Ne

EEF/EEJ

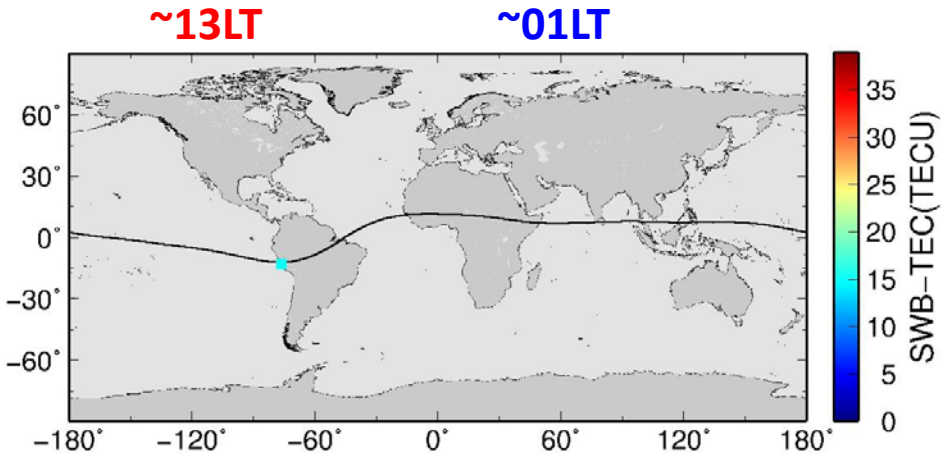
Storm of 22-23 June 2015

Swarm A & B





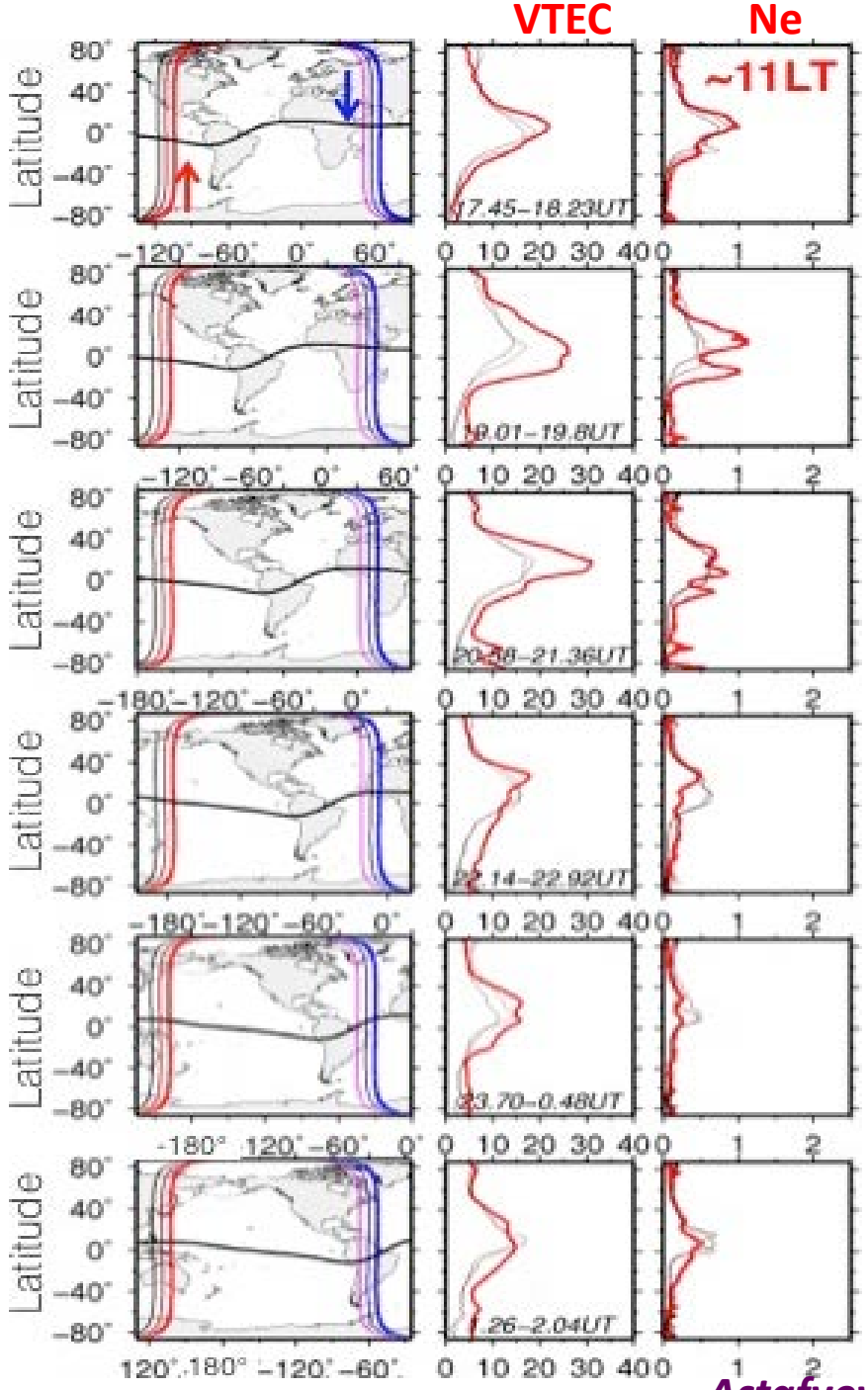
SWA, >460 km



SWB, >520 km

Storm of 22-23 June 2015

Swarm A

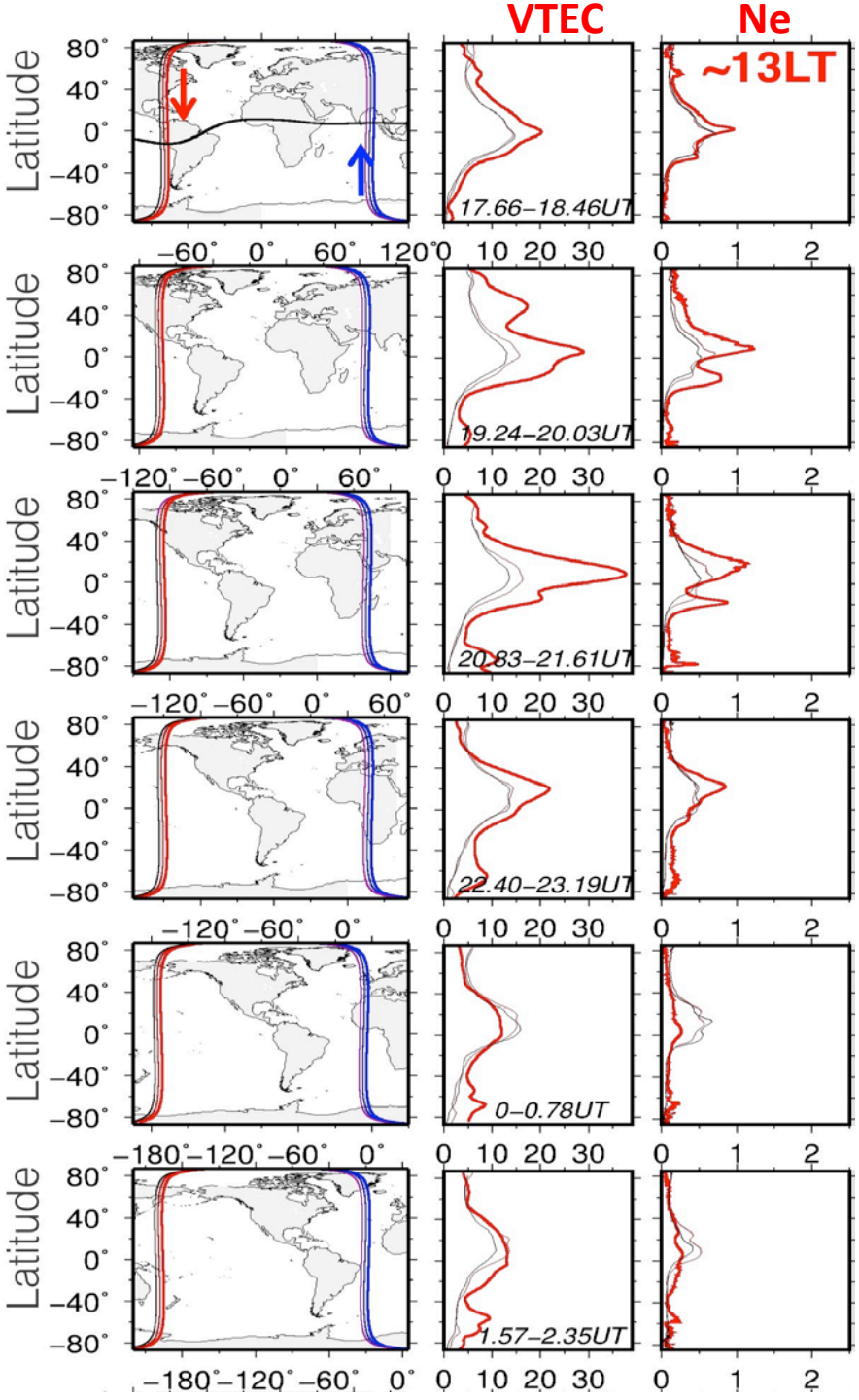


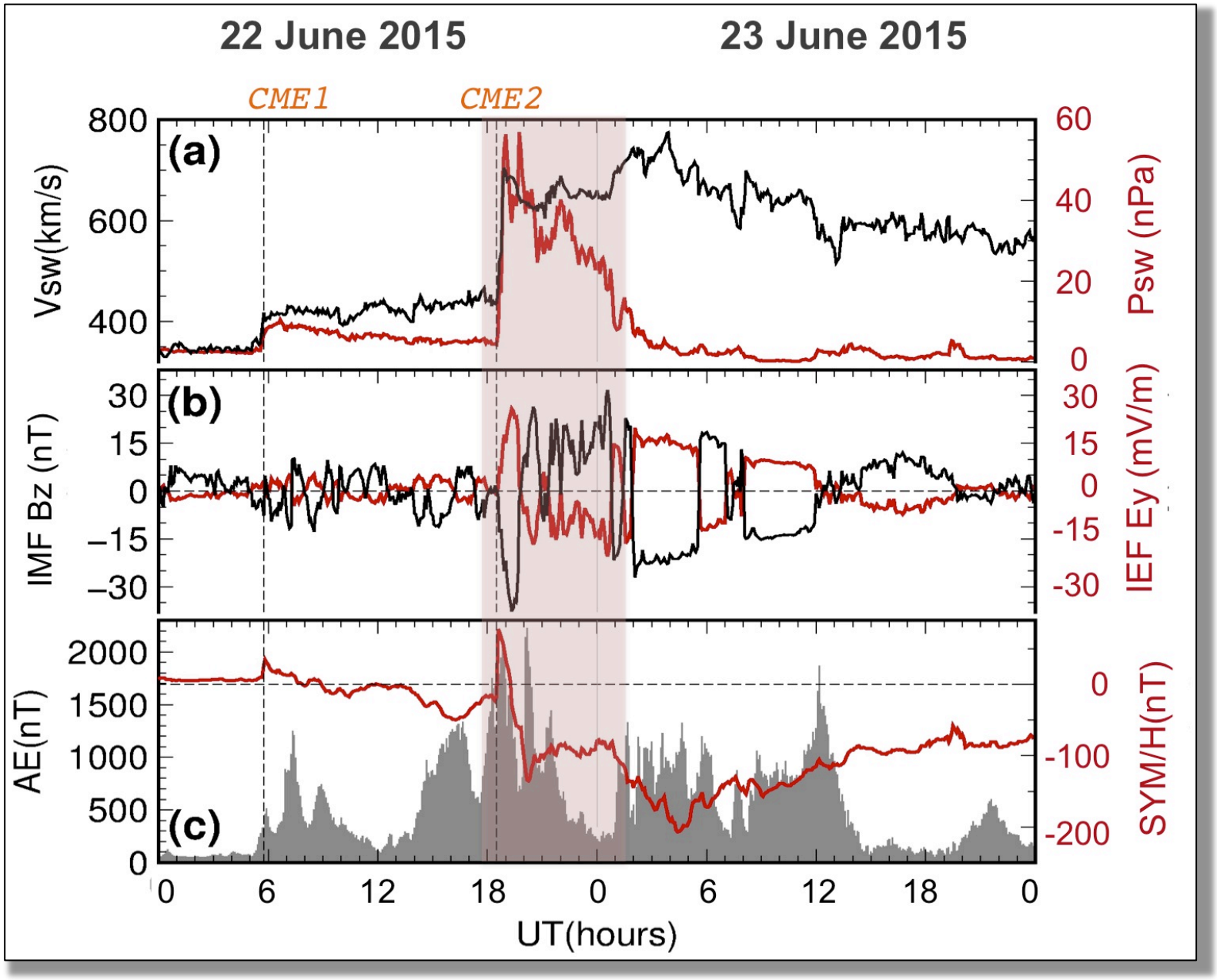
Summer Hemisphere

Astafyeva et al. (EPS, 2016, Submitted & Revised)

Storm of 22-23 June 2015

Swarm B



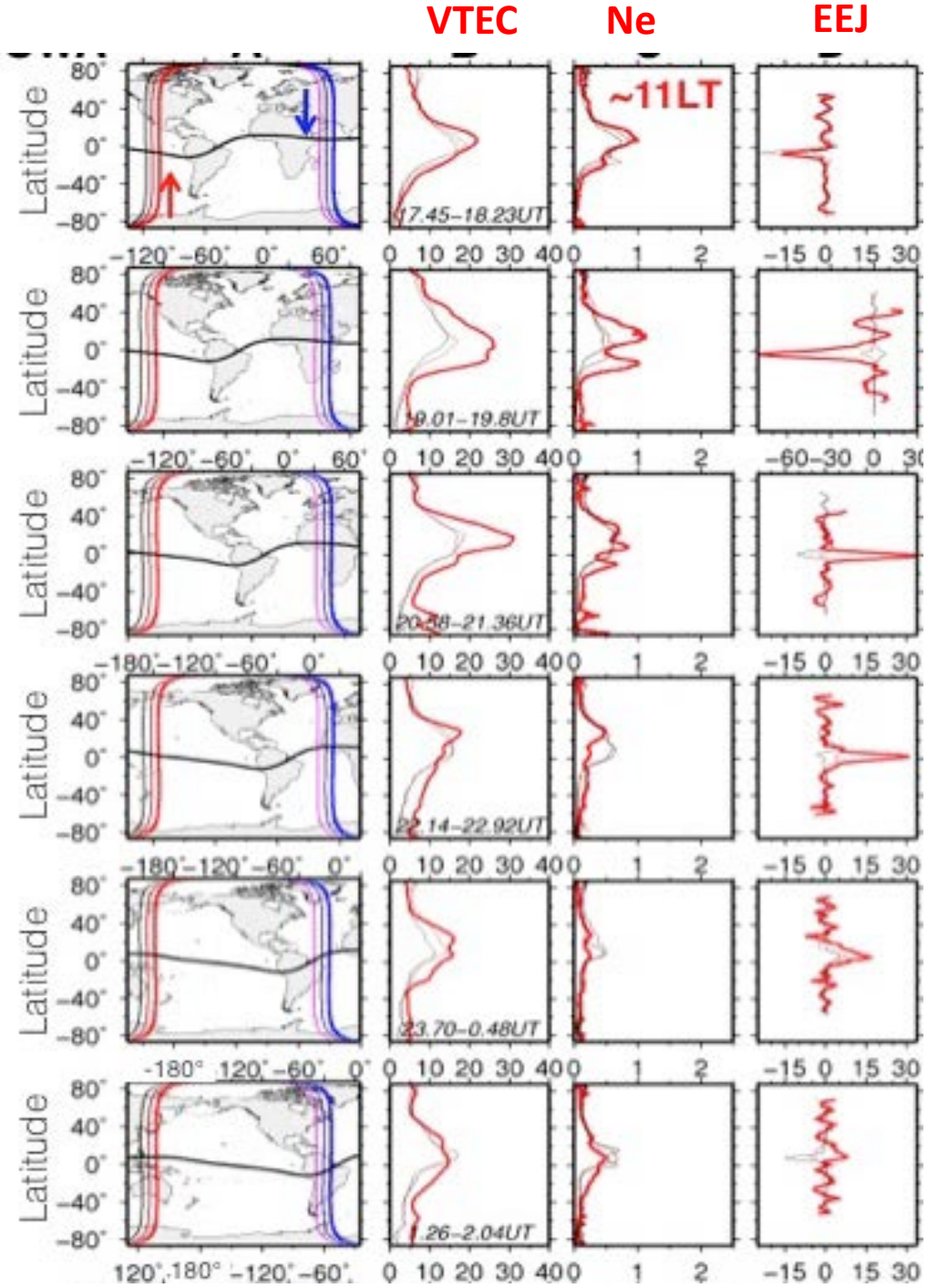


PPEF?

DD?

IEF Ey = - IMF Bz * Vsw

Storm of 22-23 June 2015



SWARM A EEJ

eastward

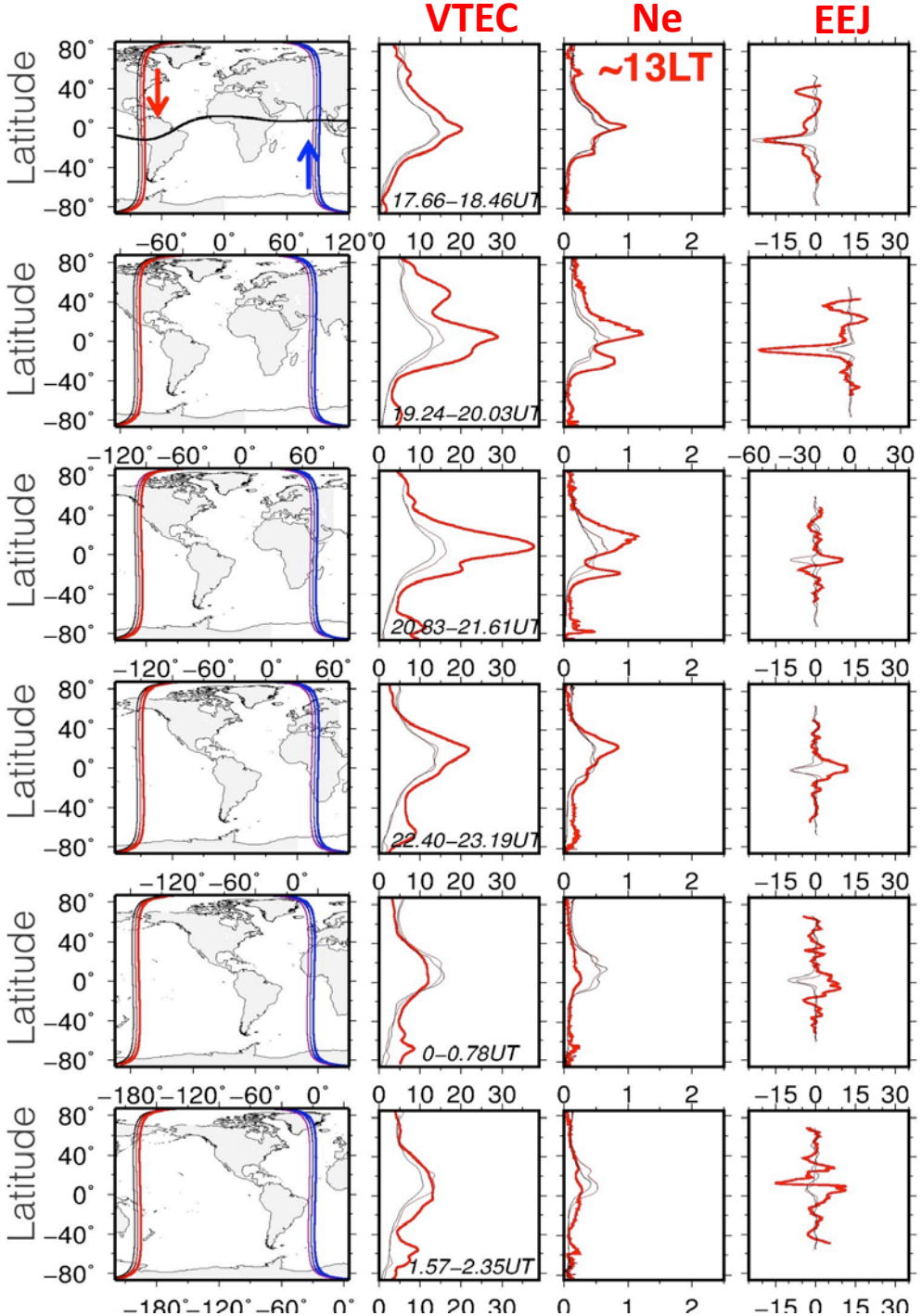
IEF Ey > 0

westward

IEF Ey < 0

IEF Ey < 0

Storm of 22-23 June 2015



SWARM B EEJ

eastward

IEF Ey > 0

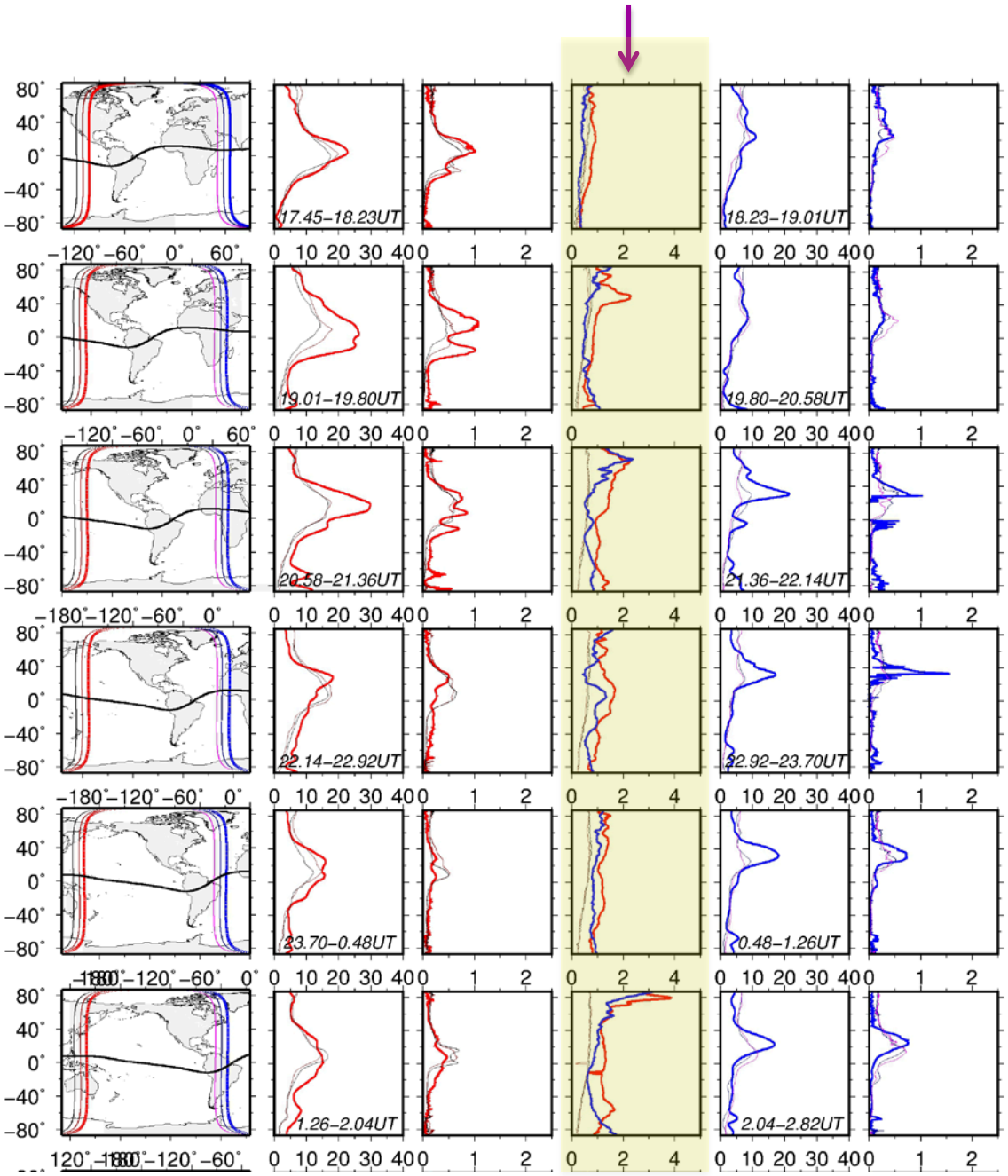
westward

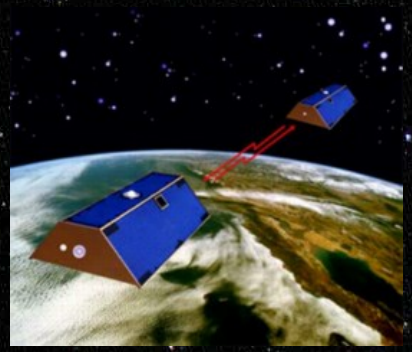
IEF Ey < 0

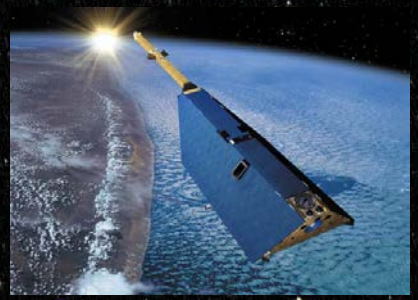
IEF Ey < 0

Neutral mass density - SWC

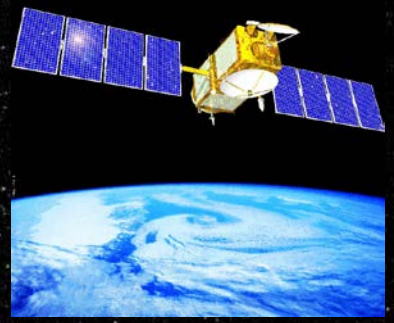
Storm of 22-23 June 2015







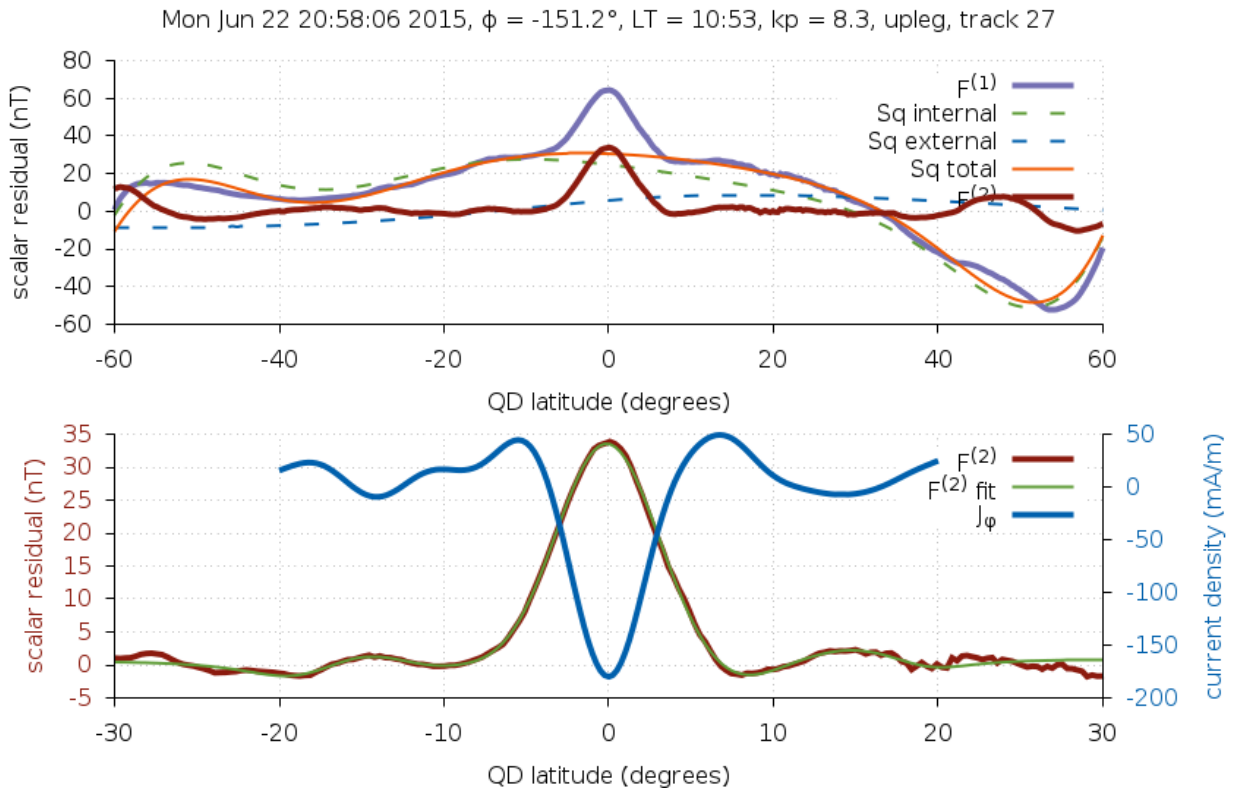
Thank you!



Storm of 22-23 June 2015

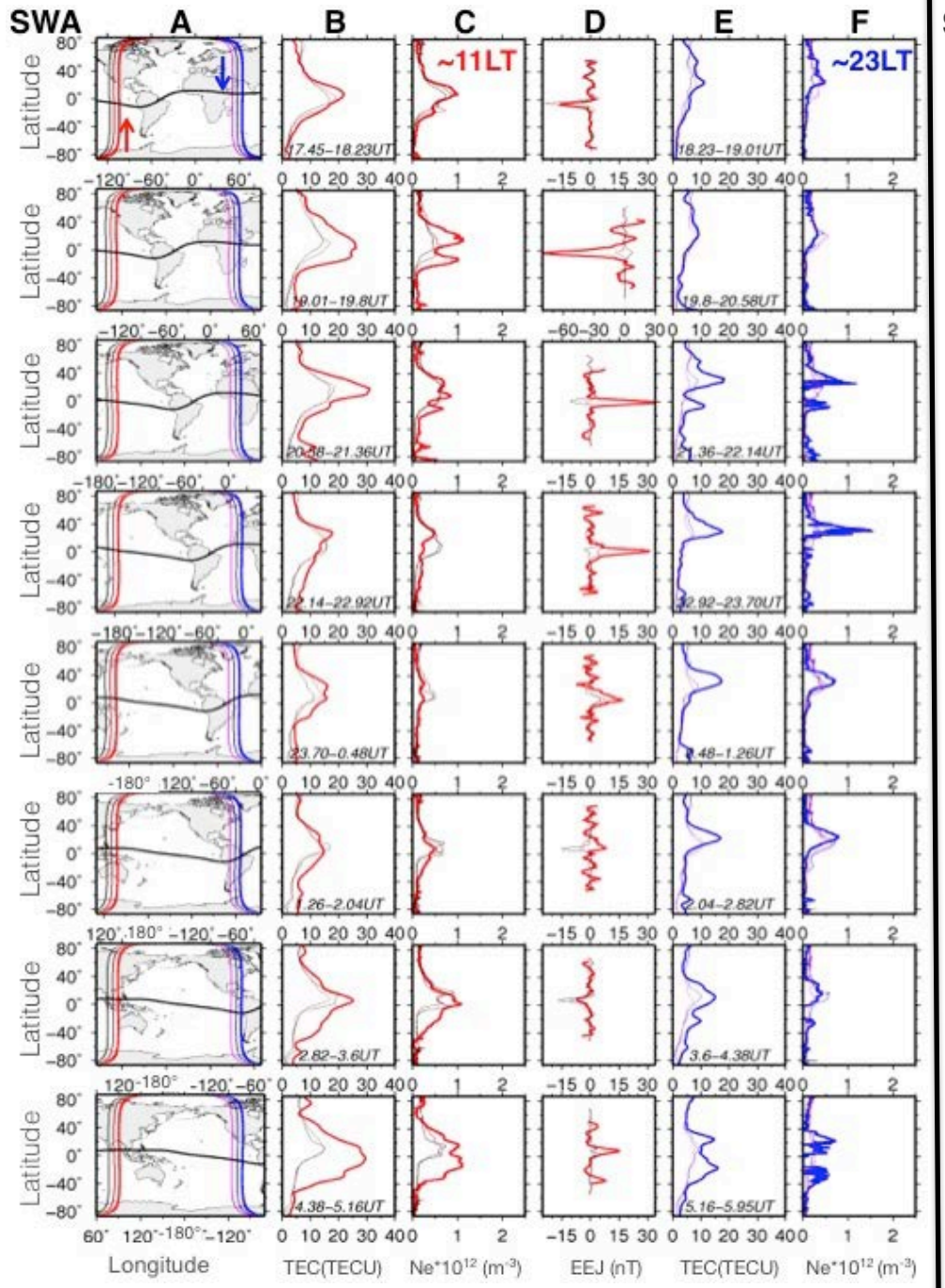
EEJ from magnetic observations

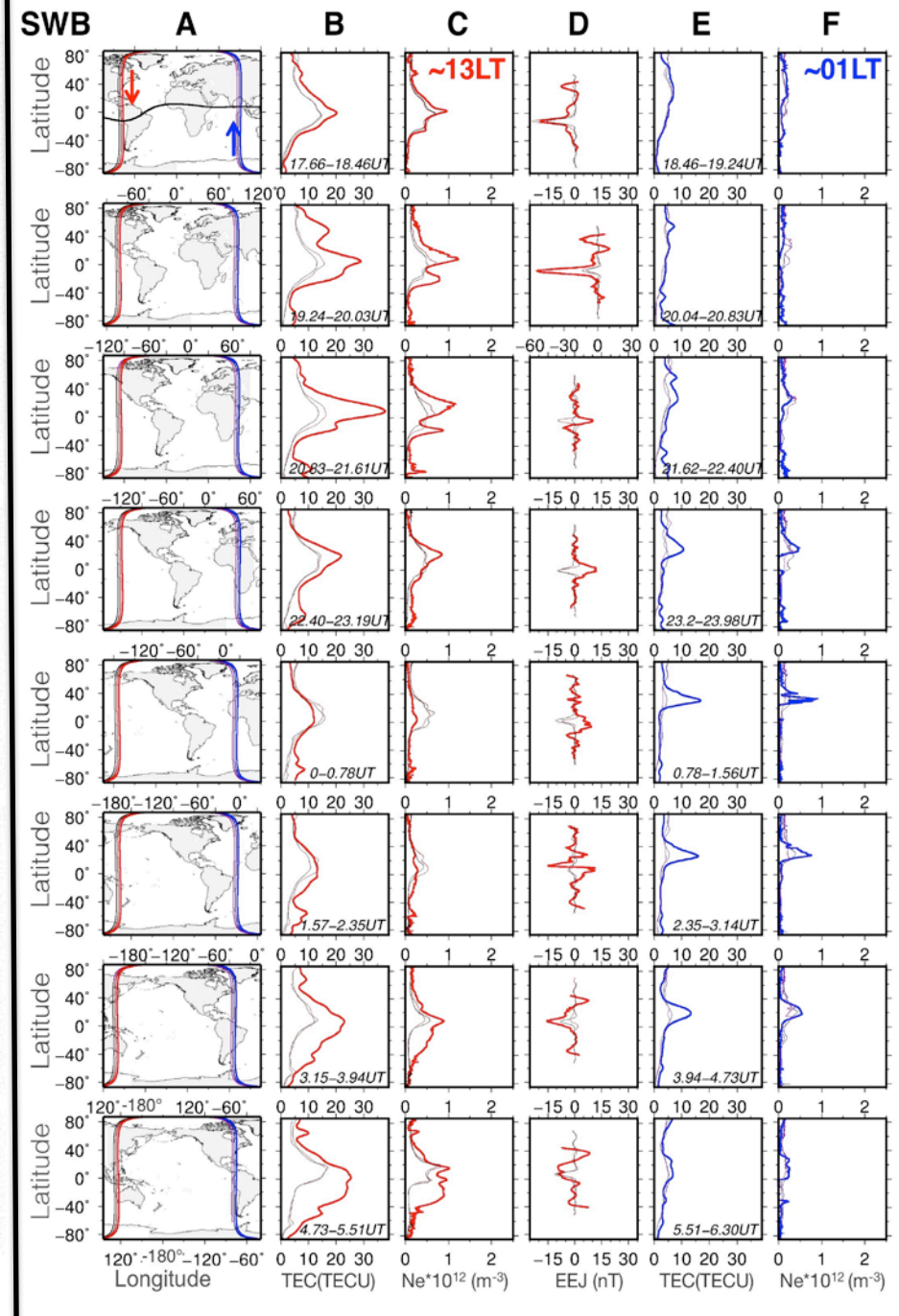
Scalar magnetic observations – Main– Crustal- Magnetospheric - Sq-sherical harmonics model → Scalar residual = EEJ (magnetic signal)



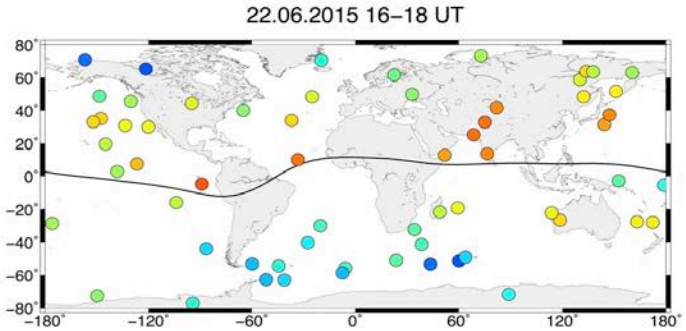
Dayside only!

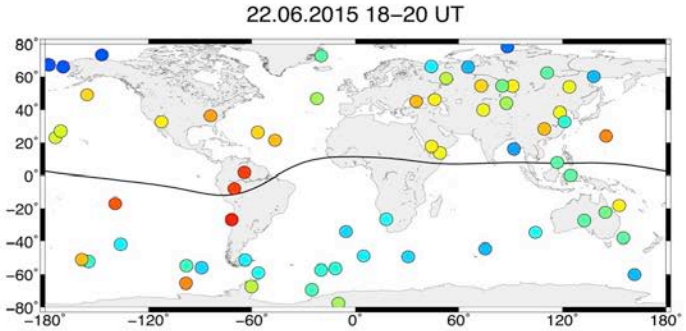
Courtesy of P. Alken (Univ. Of Colorado)

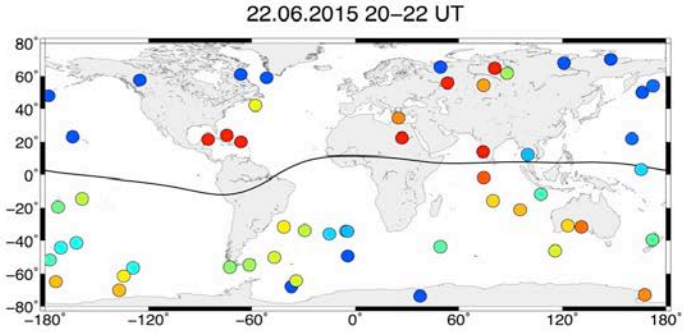

SWA
A
B
C
D
E
F
~11LT
~23LT
Latitude
17.45–18.23UT
18.23–19.01UT
19.01–19.8UT
19.8–20.58UT
20.58–21.36UT
21.36–22.14UT
22.14–22.92UT
22.92–23.70UT
23.70–0.48UT
0.48–1.26UT
1.26–2.04UT
2.04–2.82UT
2.82–3.6UT
3.6–4.38UT
4.38–5.16UT
5.16–5.95UT
Longitude
TEC(TECU)
Ne*10^12 (m^-3)
EEJ (nT)
TEC(TECU)
Ne*10^12 (m^-3)

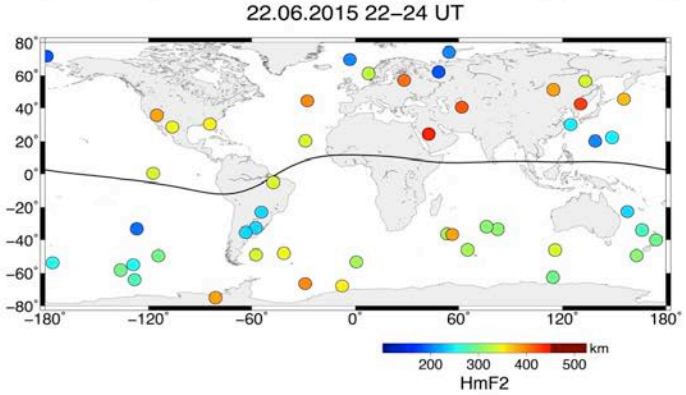

SWB
A
B
C
D
E
F
~13LT
~01LT
Latitude
17.66–18.46UT
18.46–19.24UT
19.24–20.03UT
20.04–20.83UT
20.83–21.61UT
21.62–22.40UT
22.40–23.19UT
23.2–23.98UT
0–0.78UT
0.78–1.56UT
1.57–2.35UT
2.35–3.14UT
3.15–3.94UT
3.94–4.73UT
4.73–5.51UT
5.51–6.30UT
Longitude
TEC(TECU)
Ne*10^12 (m^-3)
EEJ (nT)
TEC(TECU)
Ne*10^12 (m^-3)

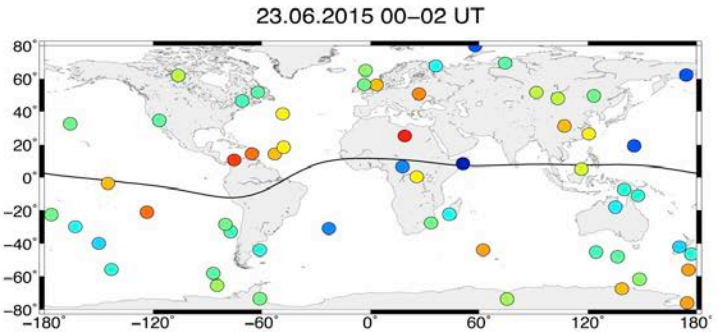
Storm of 22-23 June 2015

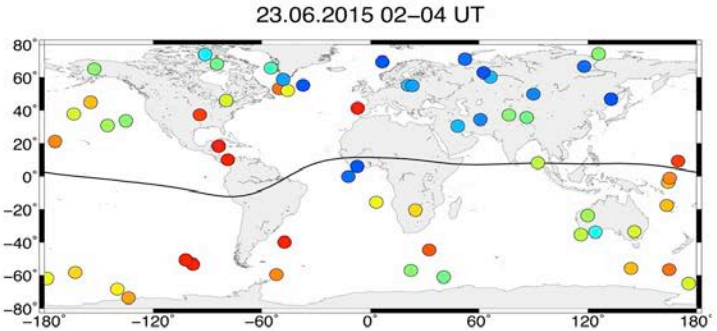


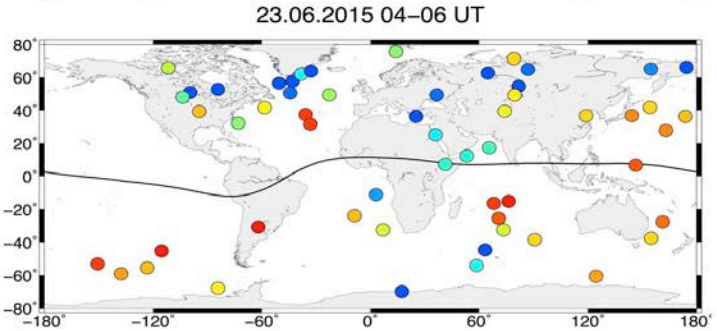


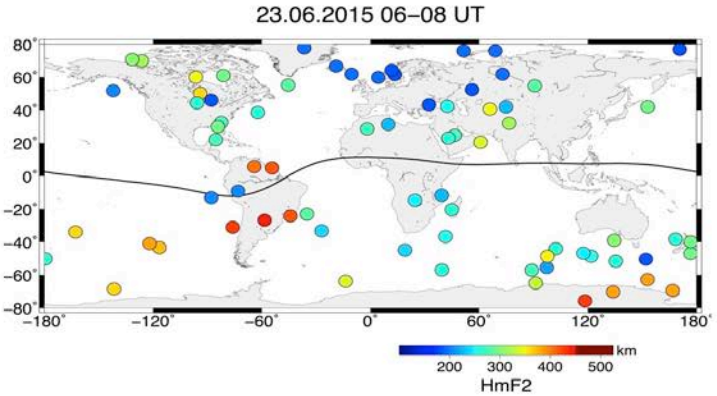




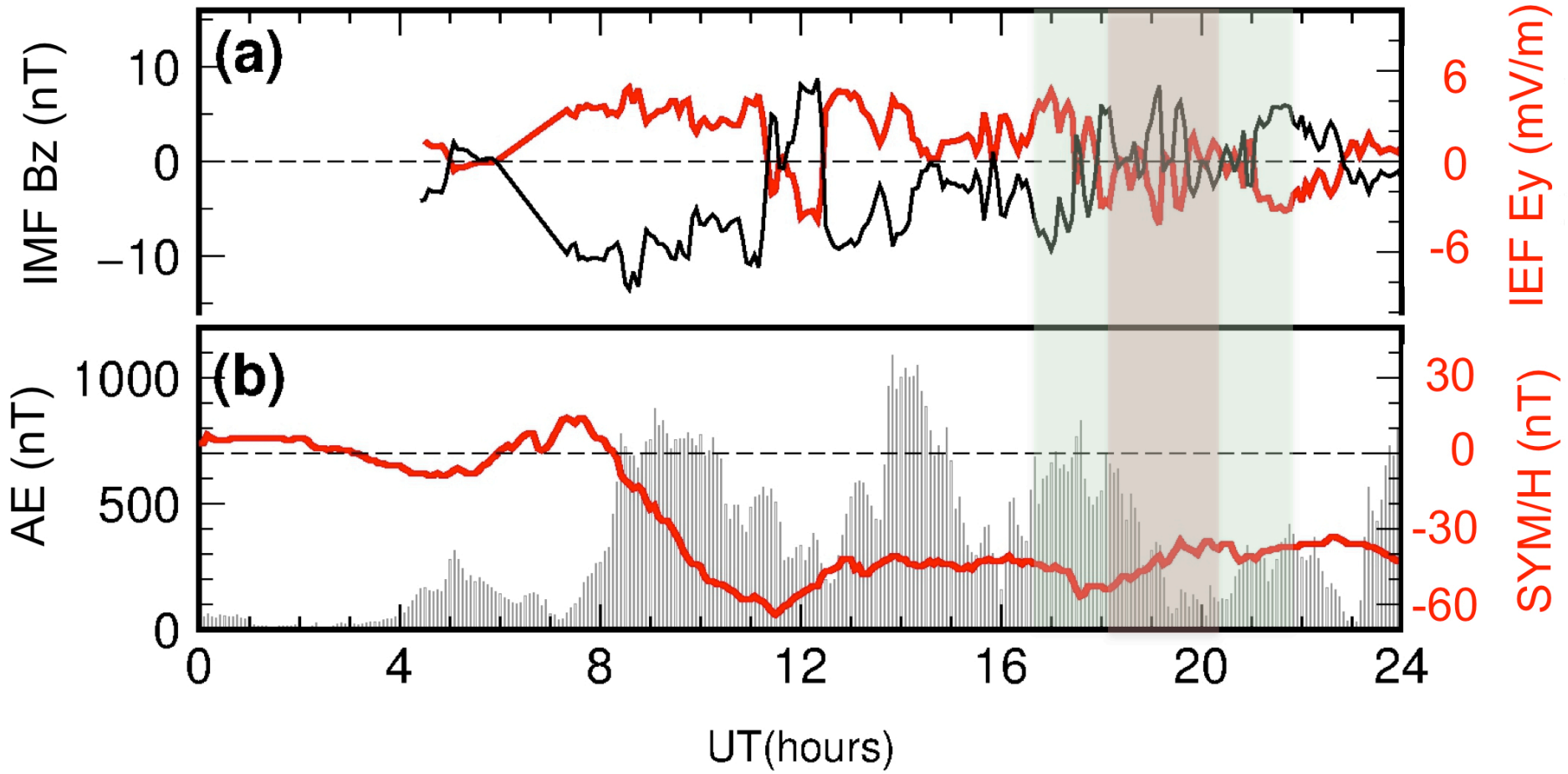








2. Storm of 11 October 2008



Astafyeva et al. (JGR, Accepted)

Storm of 11 October 2008

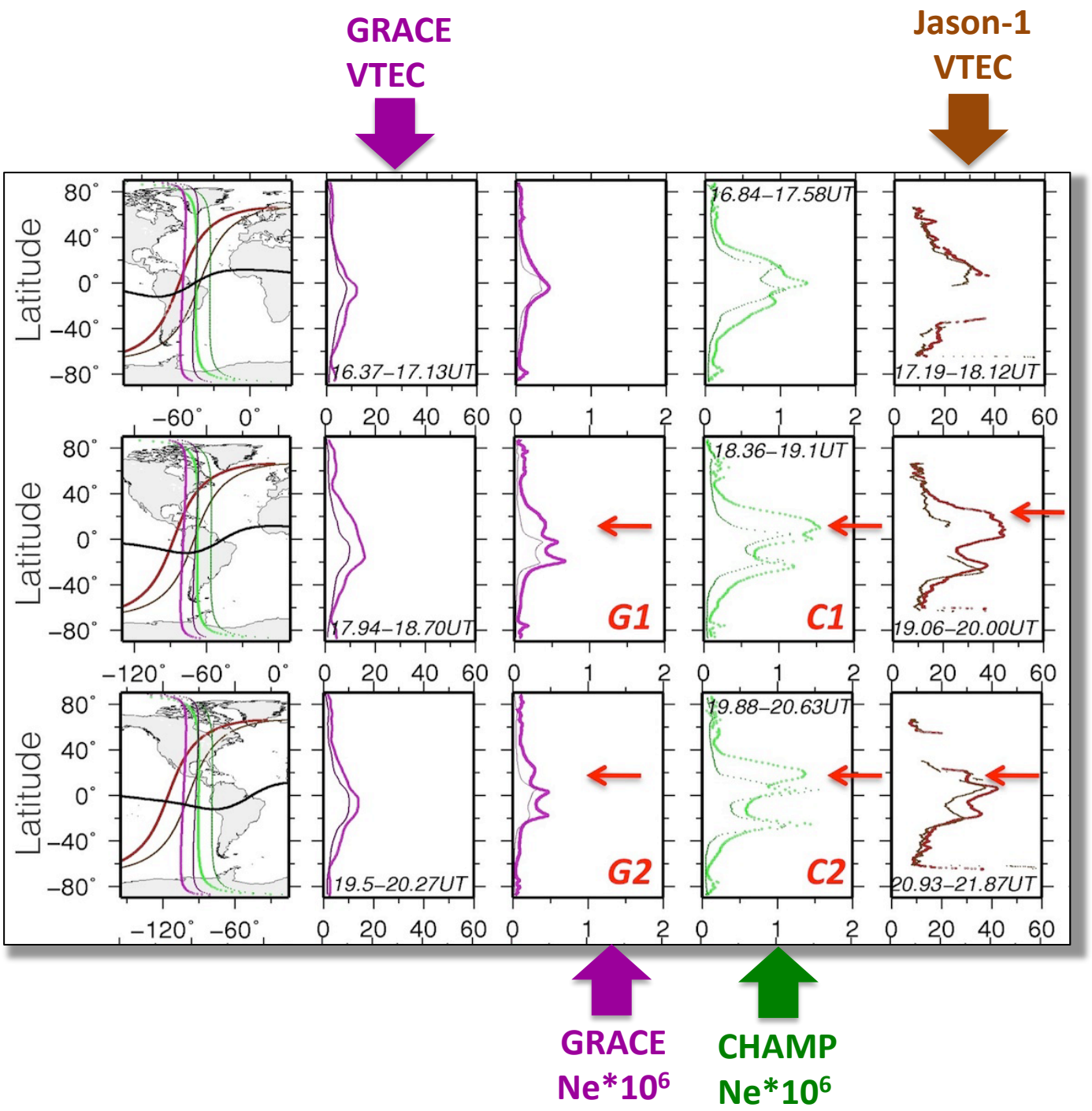
Instruments:

GRACE (VTEC, Ne)

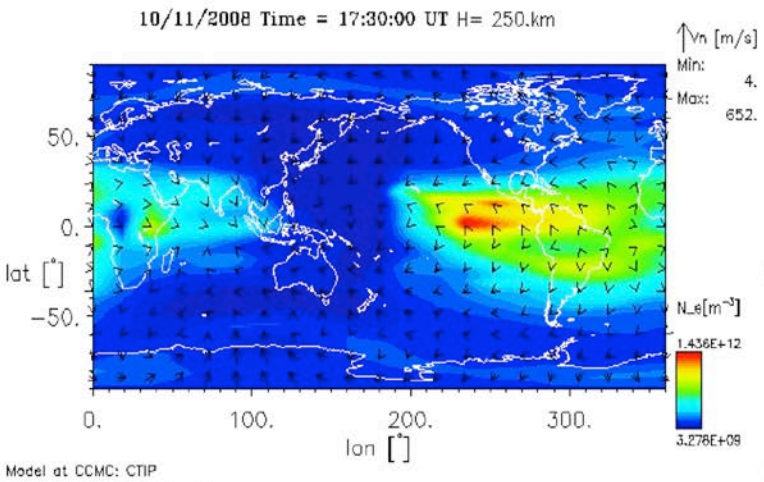
CHAMP (Ne)

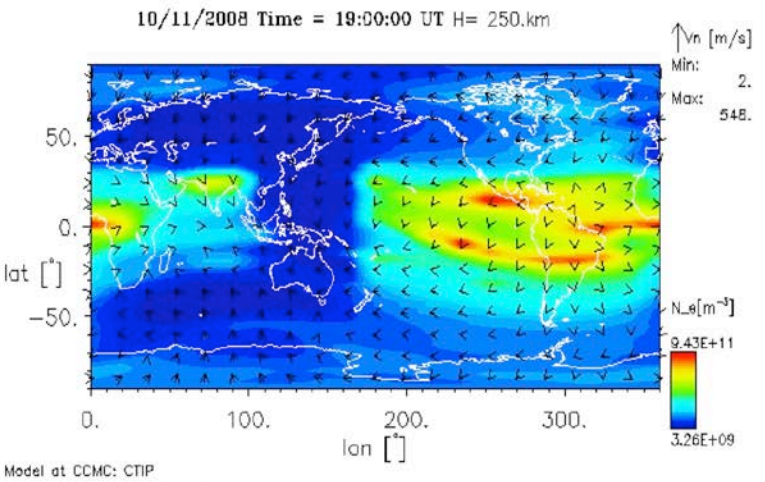
Jason-1 (VTEC below 1336 km)

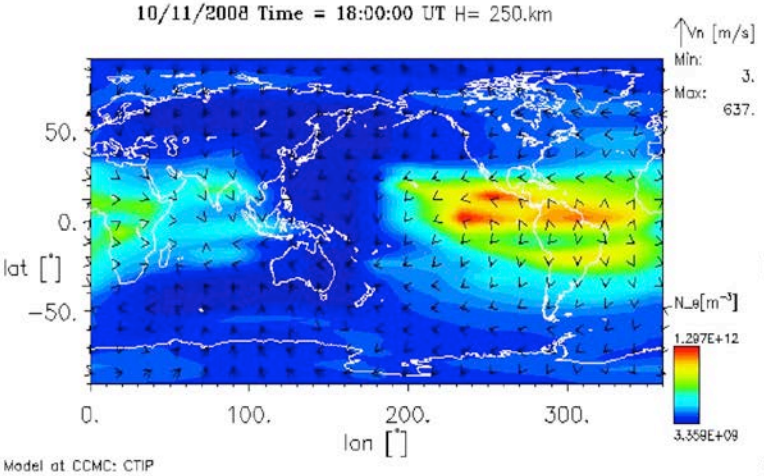
Storm of 11 October 2008

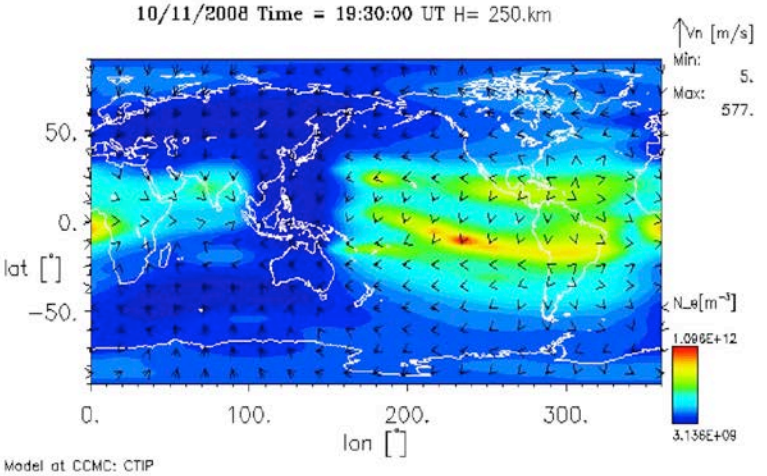


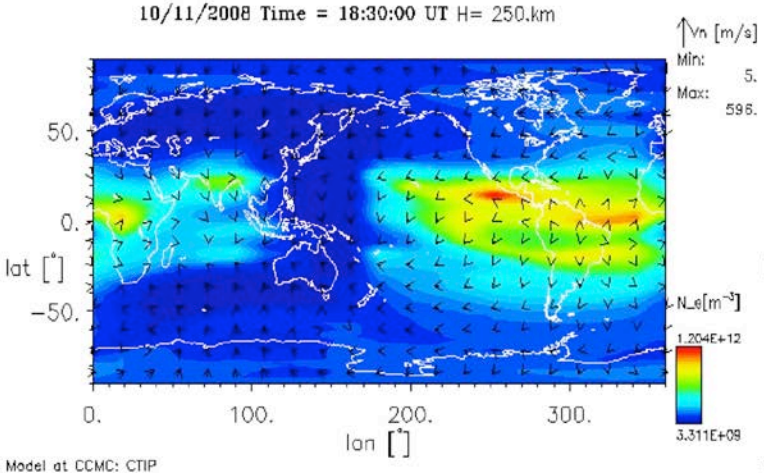
Storm of 11 October 2008

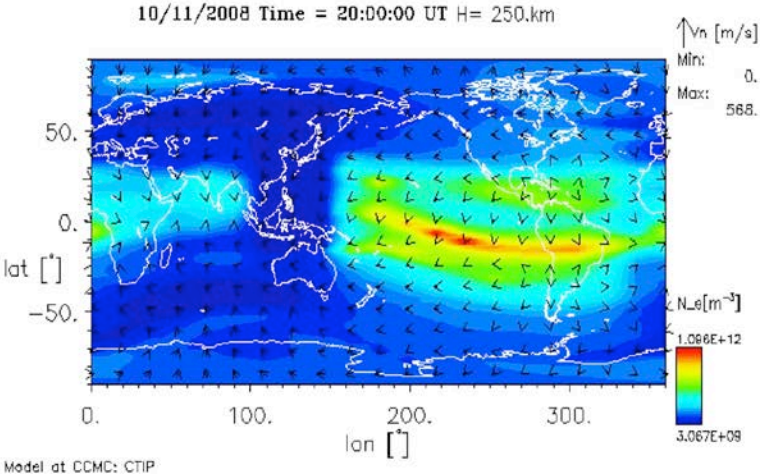












Storm of 11 October 2008