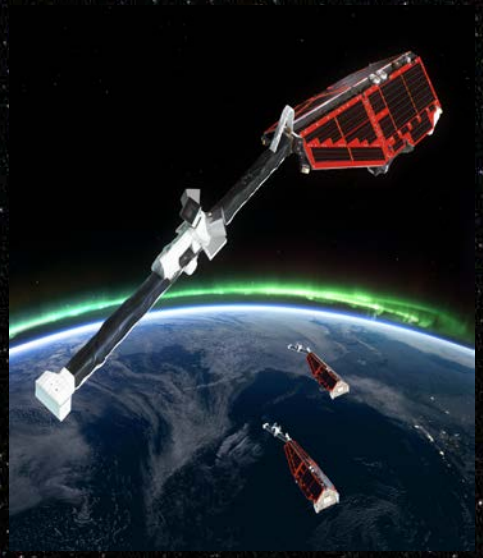
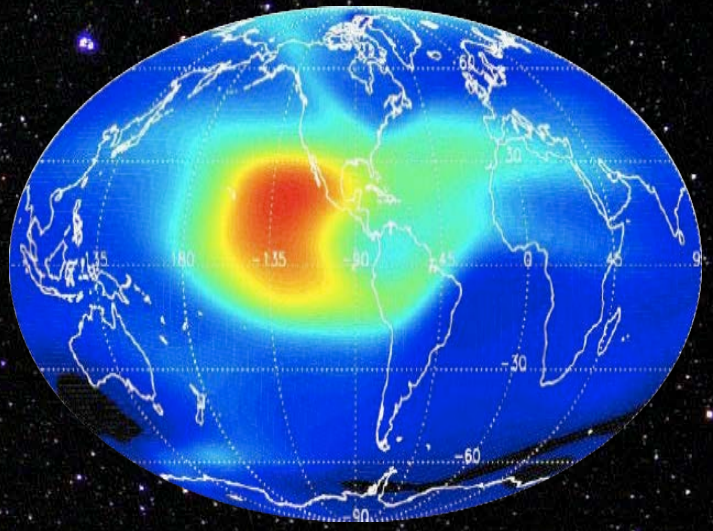
Ionosphere/plasmasphere response to the 22-23 June 2015 geomagnetic storm: observations and SAMI3/RCM model results



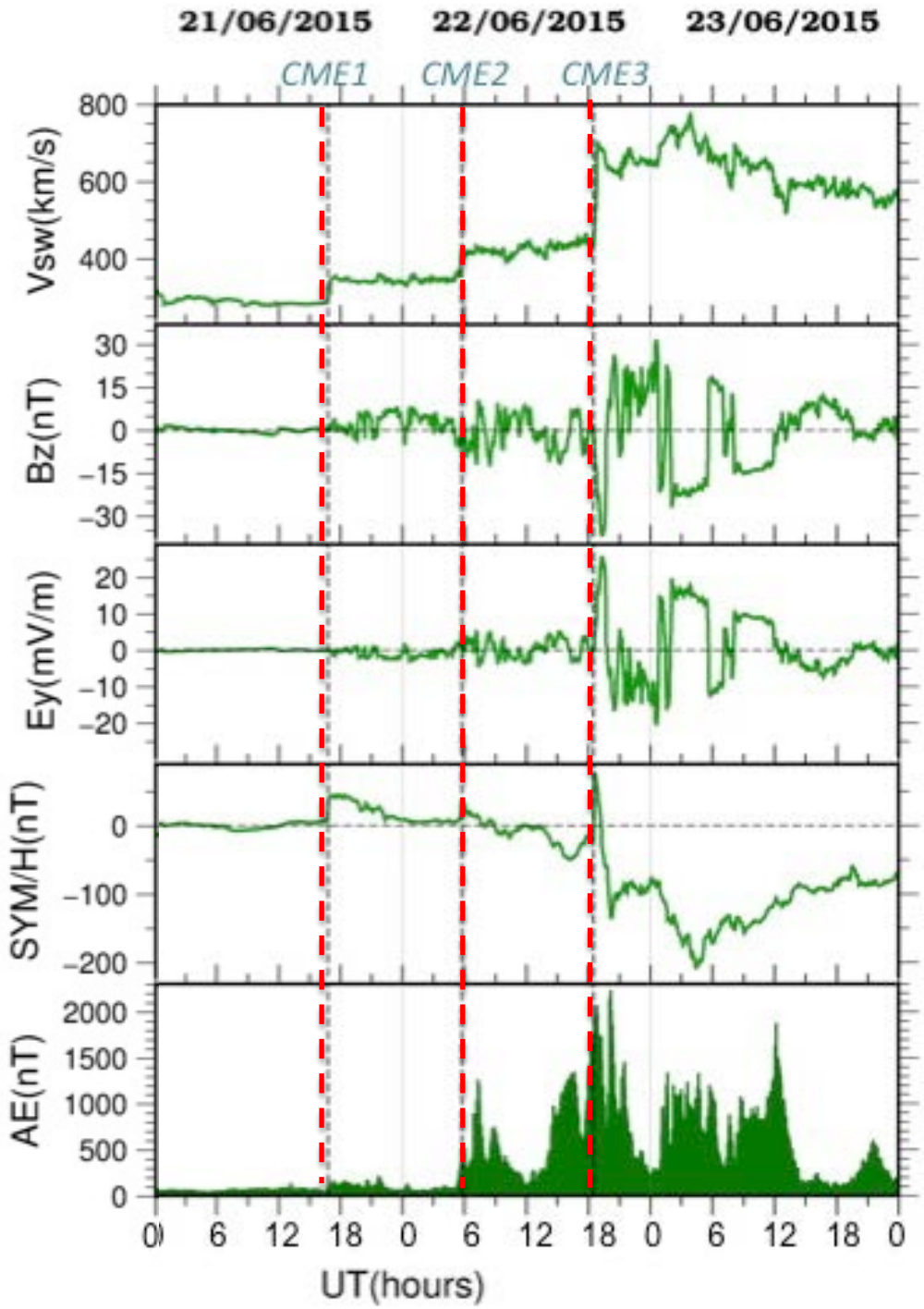


E. Astafyeva[1], J. D. Huba[2], I. Zakharenkova[1], S. Sazykin[3]

1 – IPGP, Paris, France; 2 – NRL, Washington DC, USA; 3 - William Marsh Rice University, Houston, USA

astafyeva@ipgp.

Solar & Geomagnetic parameters



IMF Bz_min = -37 nT

IEF Ey … ˜super-storm

SYM-H_min = -207 nT

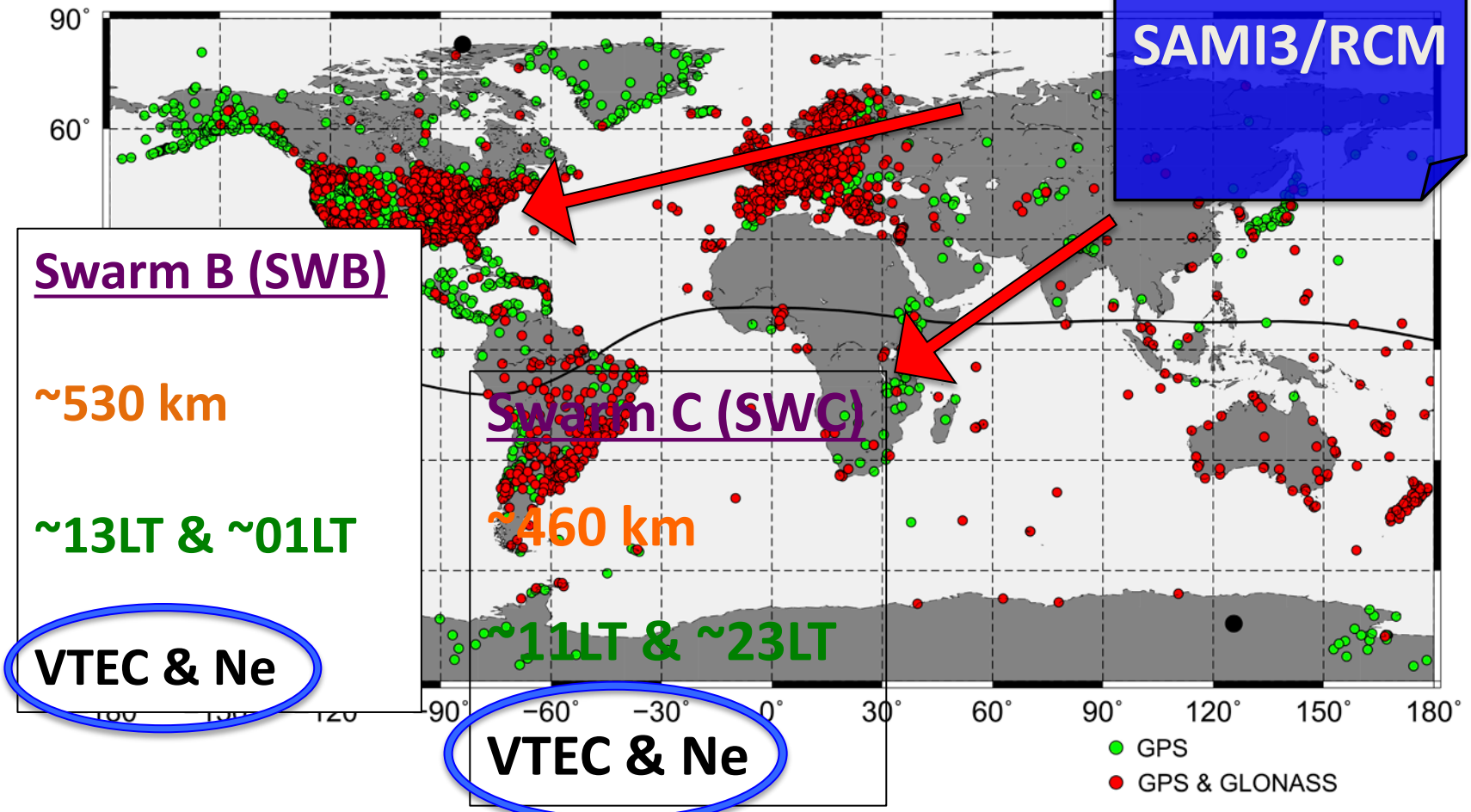
2nd largest storm in the 24th solar cycle

DATA SET

~5300 Ground-based GNSS

GPS + GLONASS

VTEC



Swarm B (SWB)

~530 km

~13LT & ~01LT

VTEC & Ne

Swarm C (SWC)

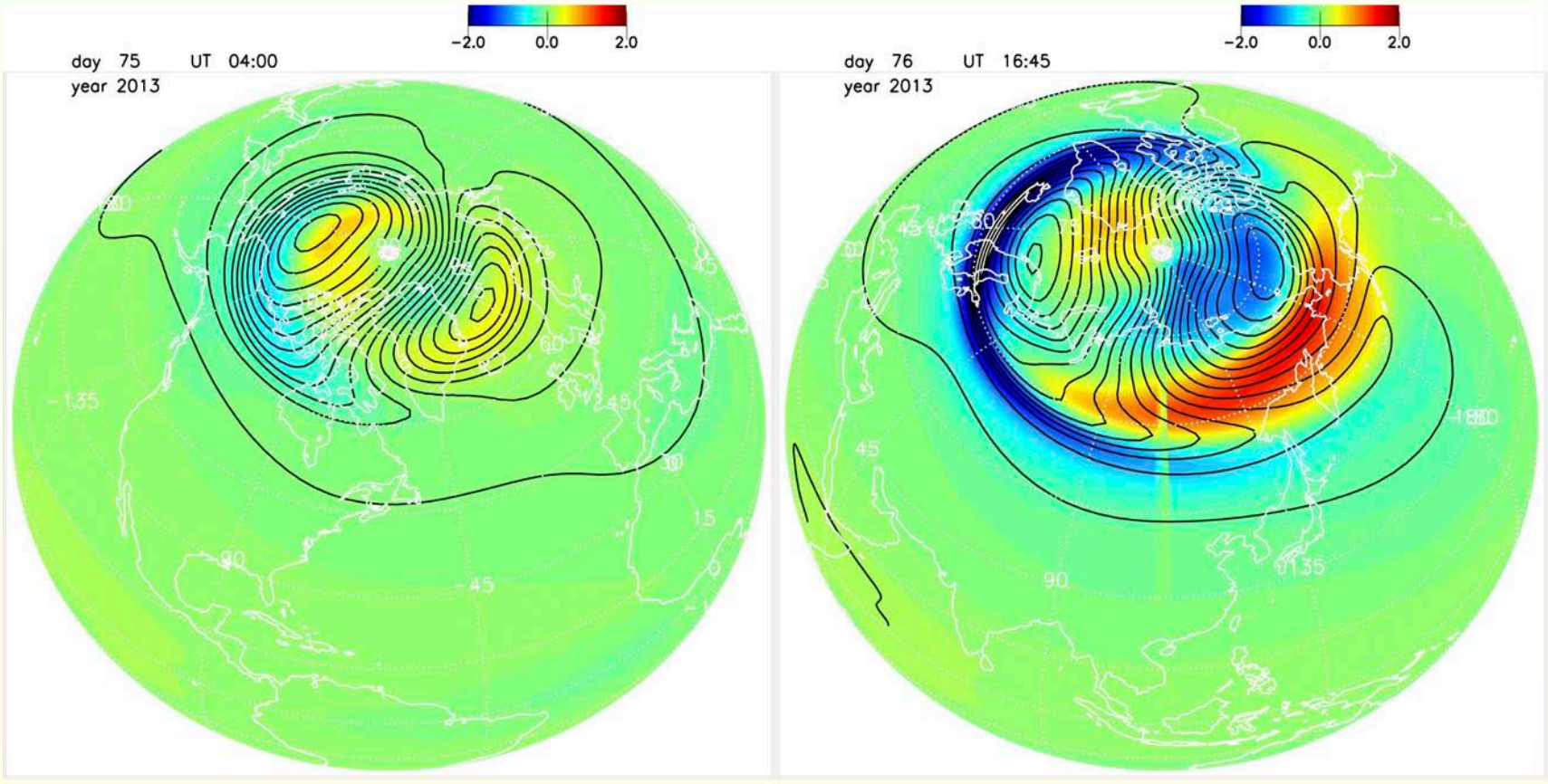
~460 km

~11LT & ~23LT

VTEC & Ne

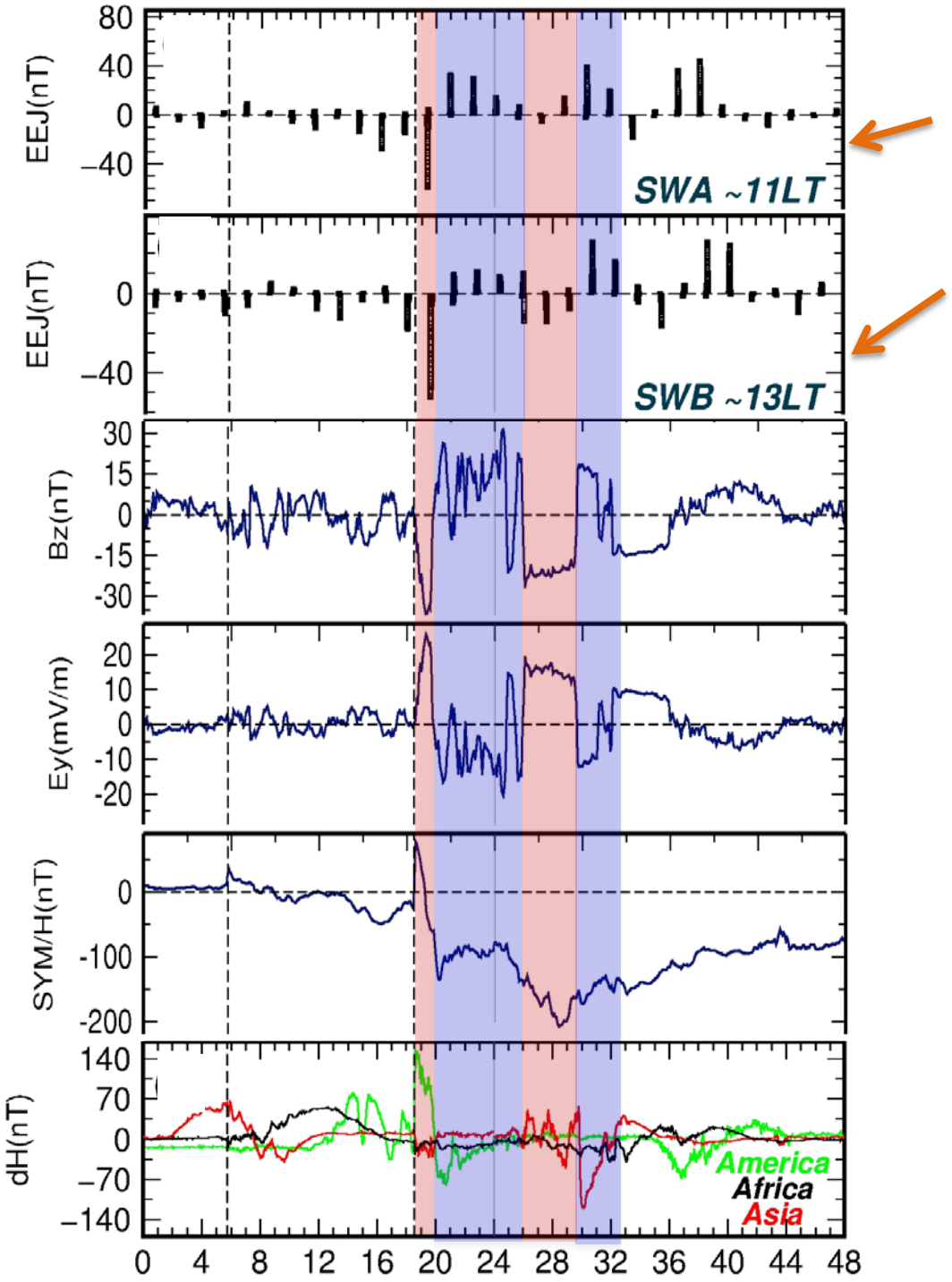
SAMI3/RCM COUPLED MODEL

$$\nabla \cdot (\underbrace{\Sigma}_{\text{SAMI3}} + \underbrace{\Sigma_a}_{\text{RCM}})\nabla\Phi = S(\underbrace{V_n}_{\text{HWM}}, \underbrace{J_{\parallel}(t)}_{\text{RCM}})$$



21 June 2015 (day = 172, F10.7 = 136, F10.7A = 118 and Ap = 1)
22 June 2015 (day = 173, F10.7 = 200, F10.7A = 118 and Ap = 7)
23 June 2015 (day = 174, F10.7 = 120, F10.7A = 118 and Ap = 57)

Storm 22-23 June 2015



EEJ - Swarm

(

©Patrick Alken)

EEJ<0 = eastward

EEJ>0 = westward (CEJ)

dH (ground-based)

American: LT = UT- 4.5h

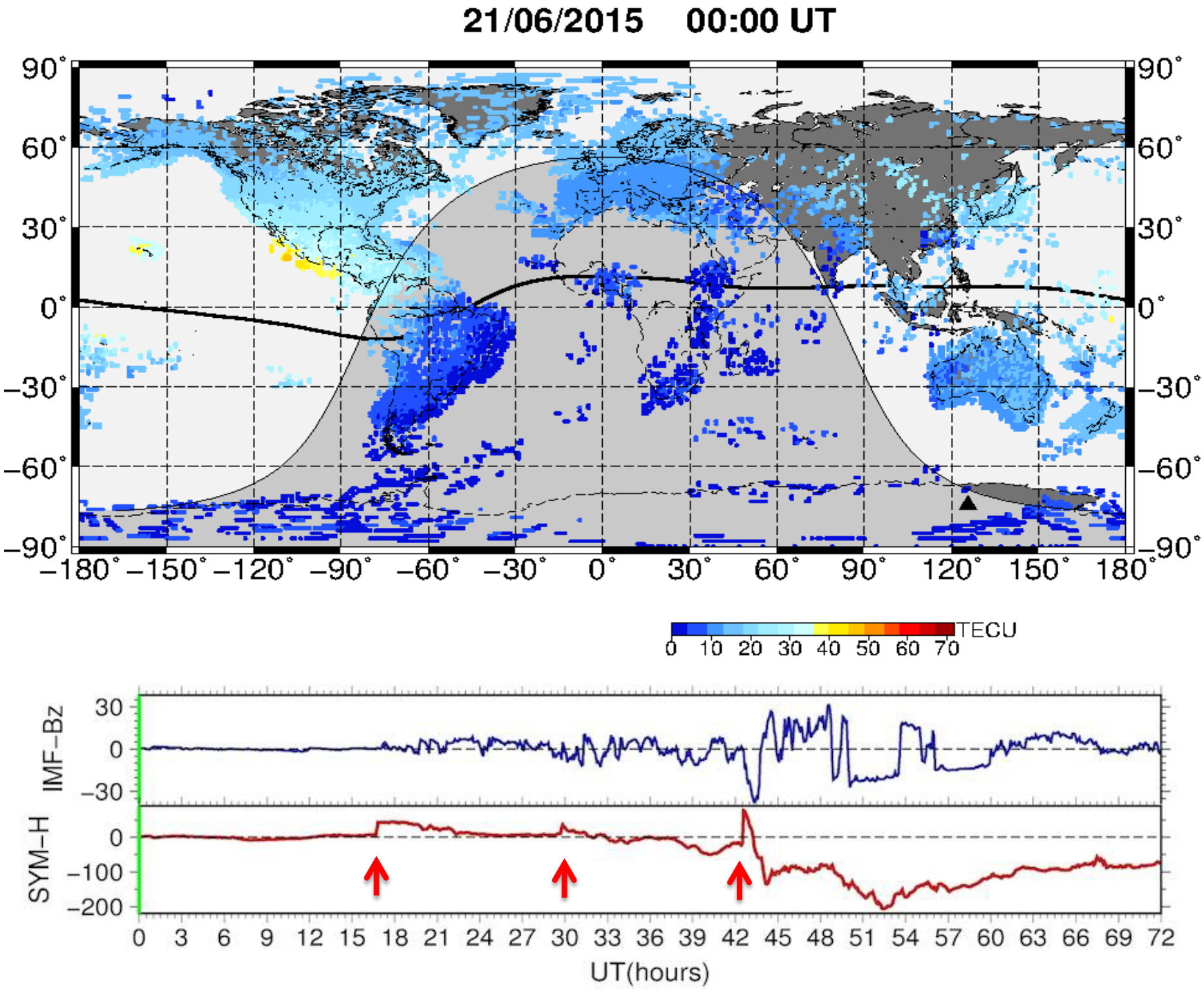
Africa: LT=UT-1

Asia: LT = UT + 6.5h

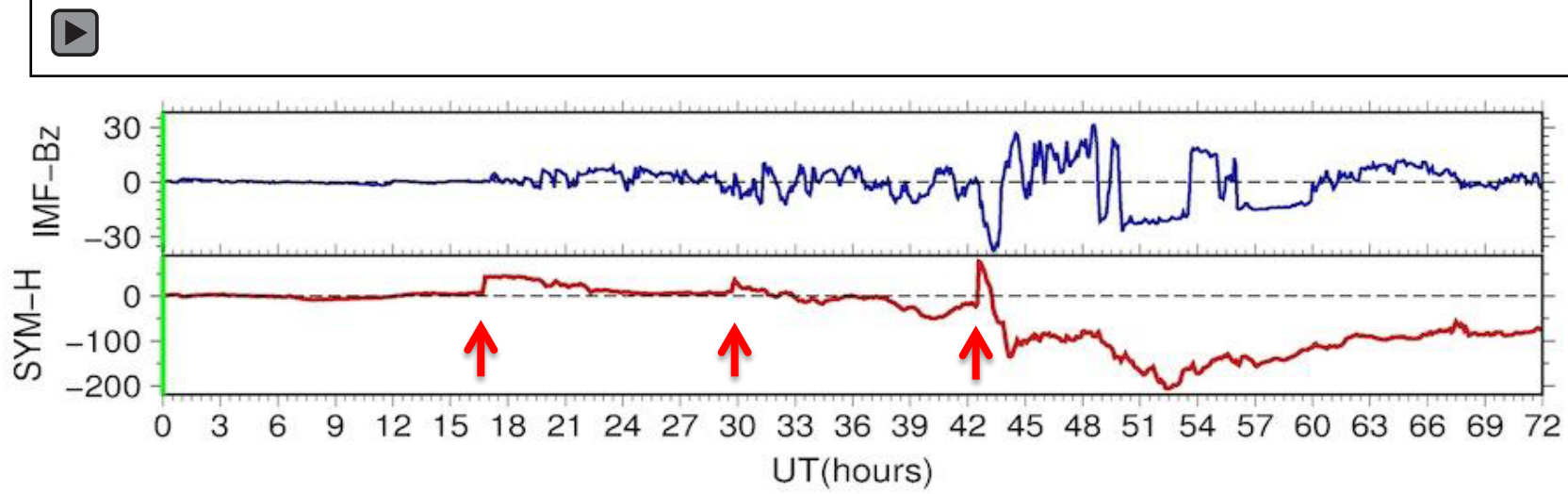
Comparison with Ground-based observations:

VTEC between 0 and 20200km

GPS - GLONASS VTEC

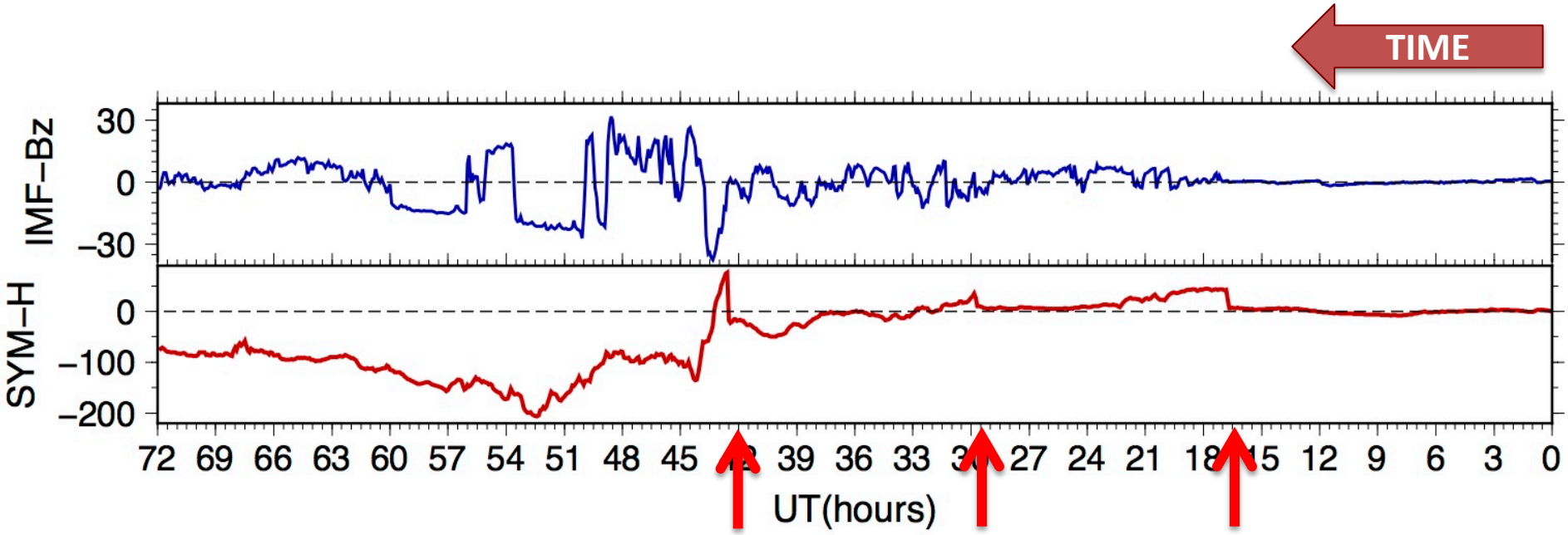


SAMI3/RCM -- VTEC

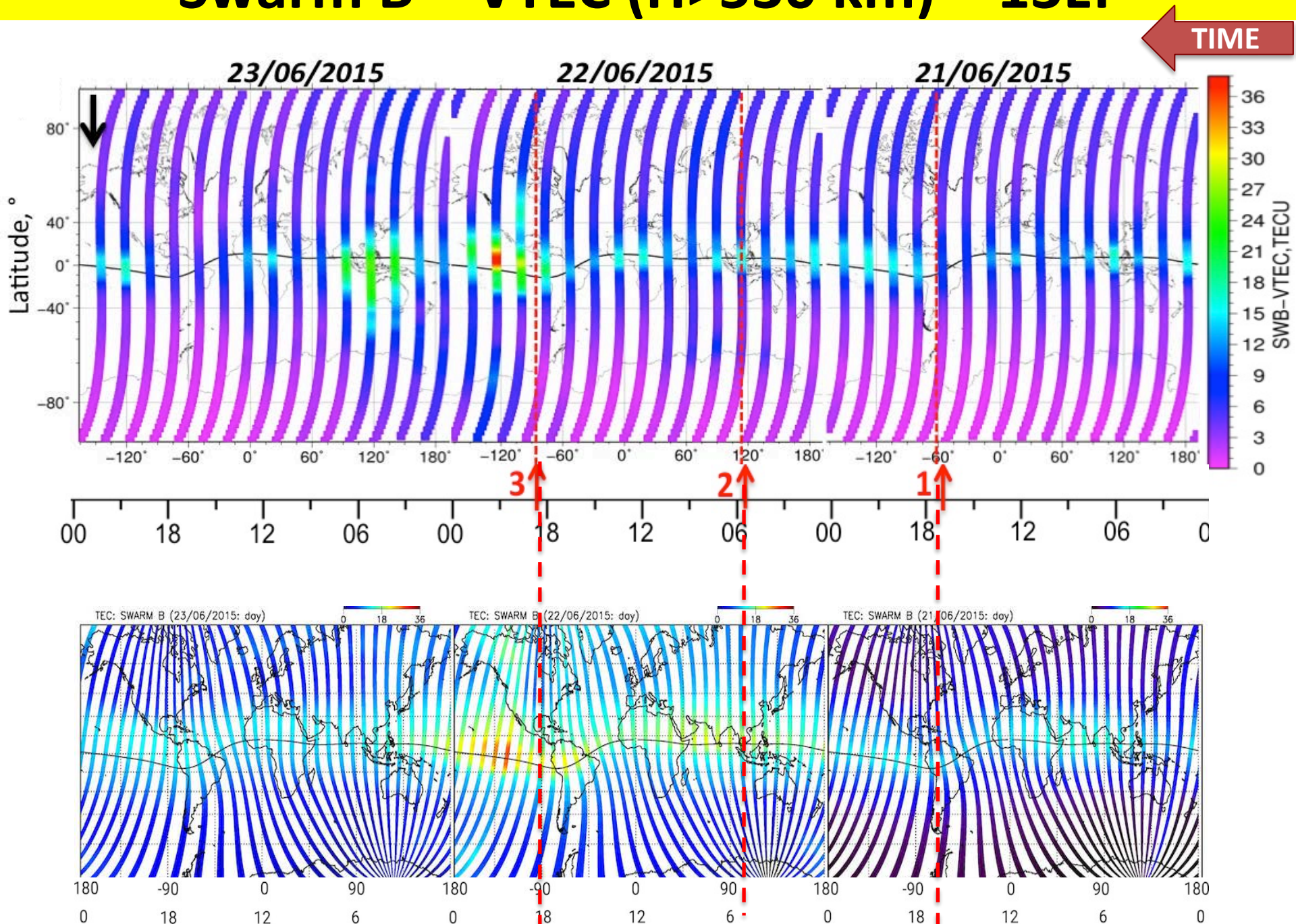


Comparison with Swarm data:

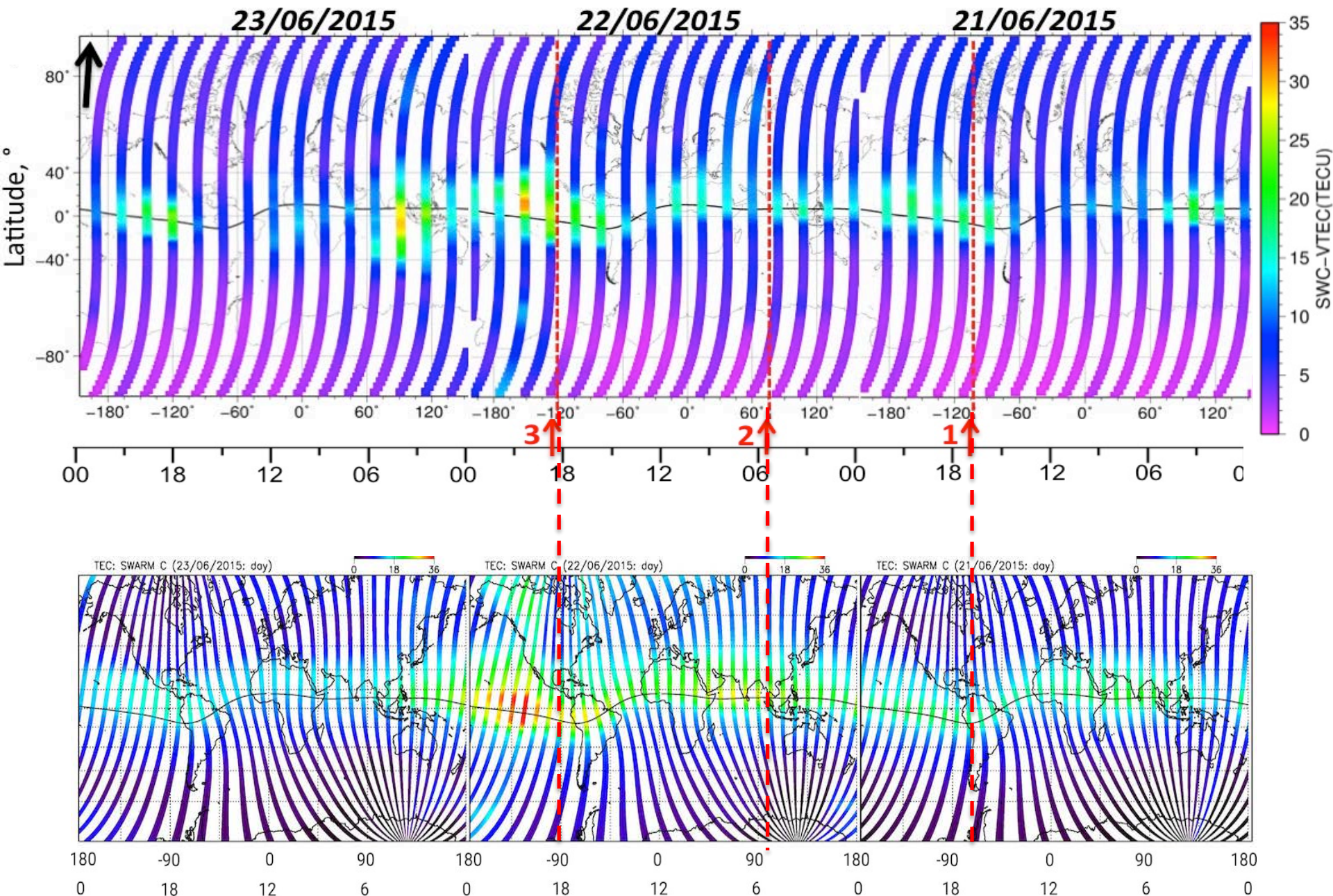
VTEC & Ne



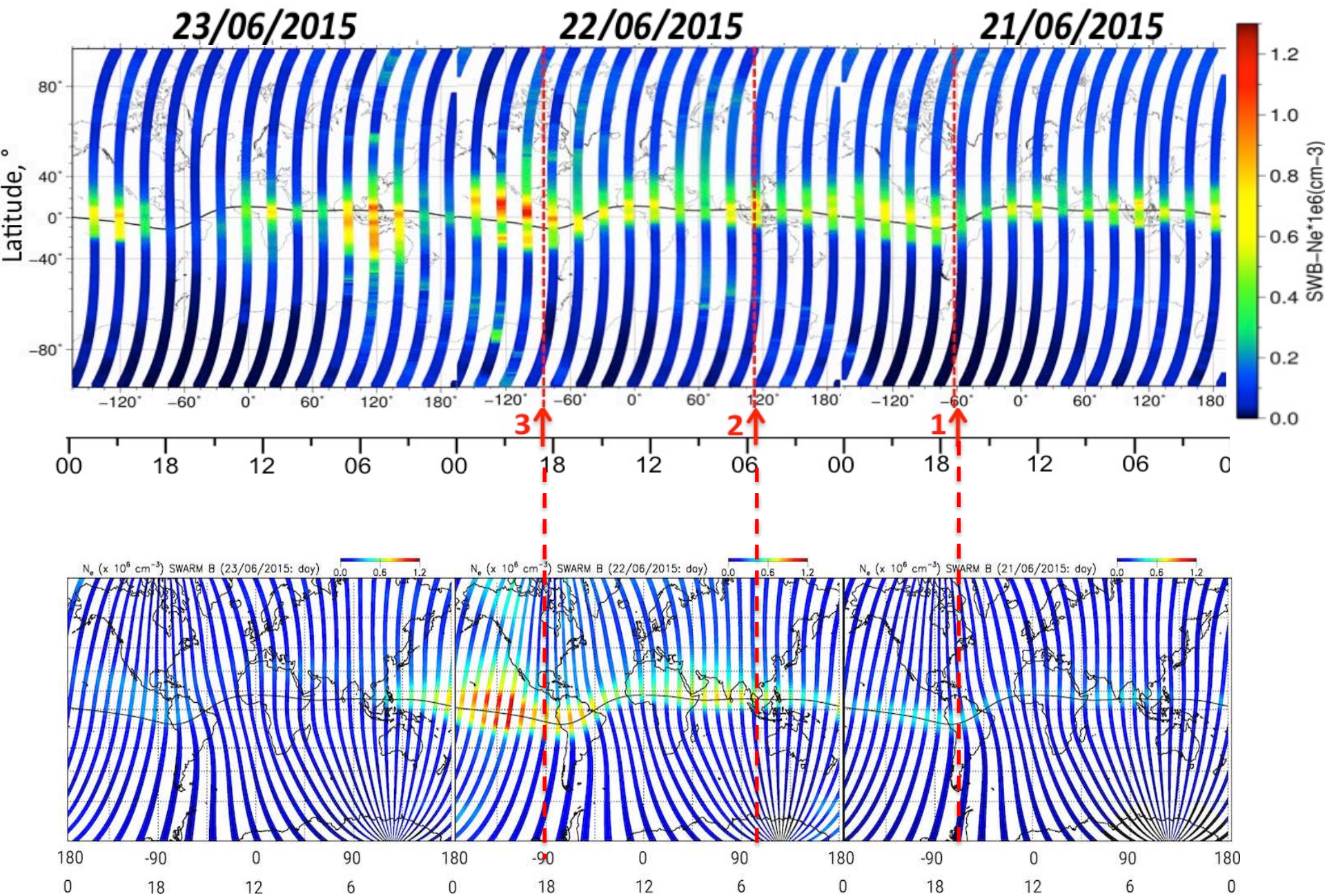
Swarm B – VTEC (H>530 km) – 13LT



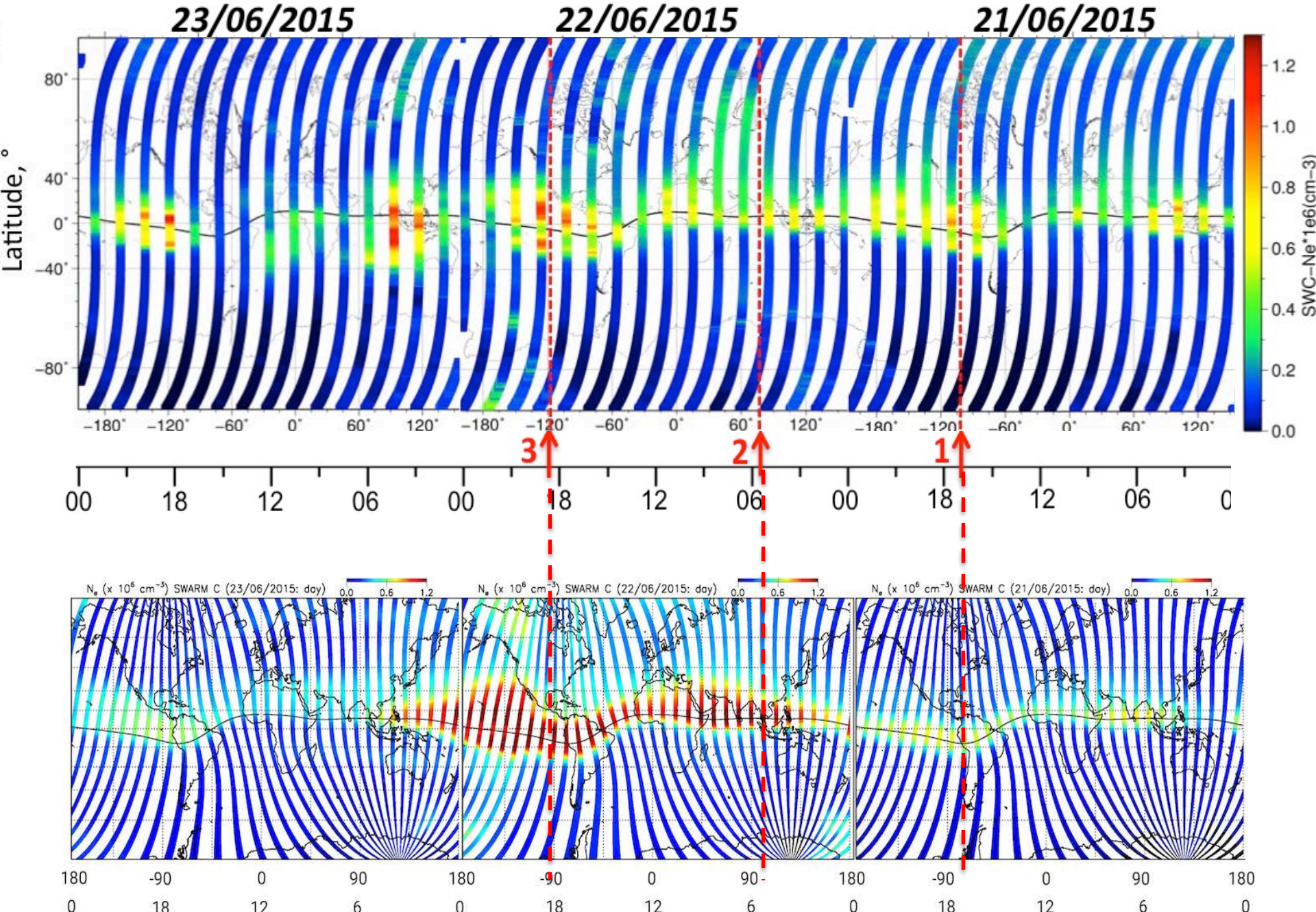
Swarm C – VTEC (H>460 km) – 11 LT



Swarm B – Ne (H=530 km) – 13LT



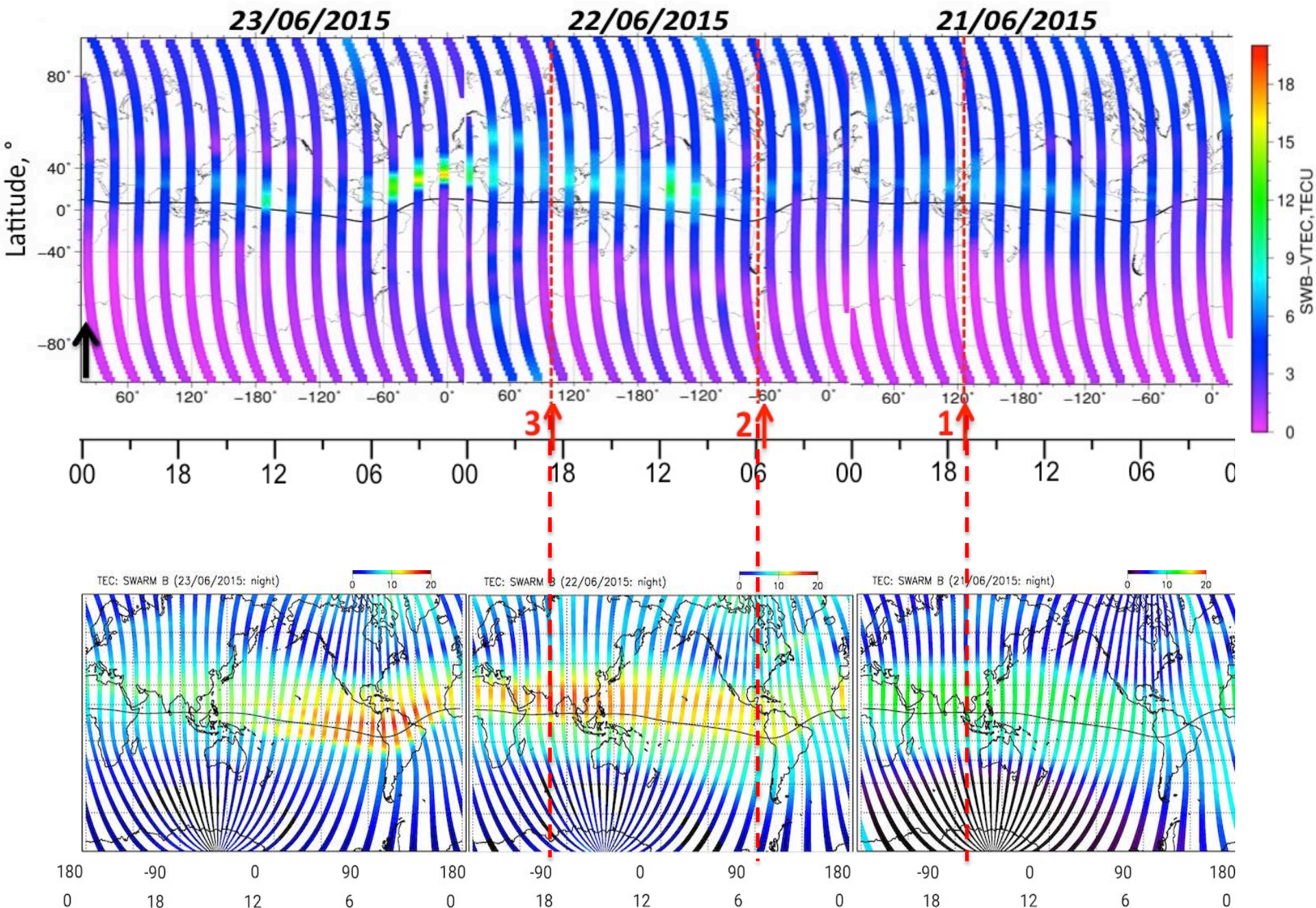
Swarm C – Ne (H=460 km) – 11 LT



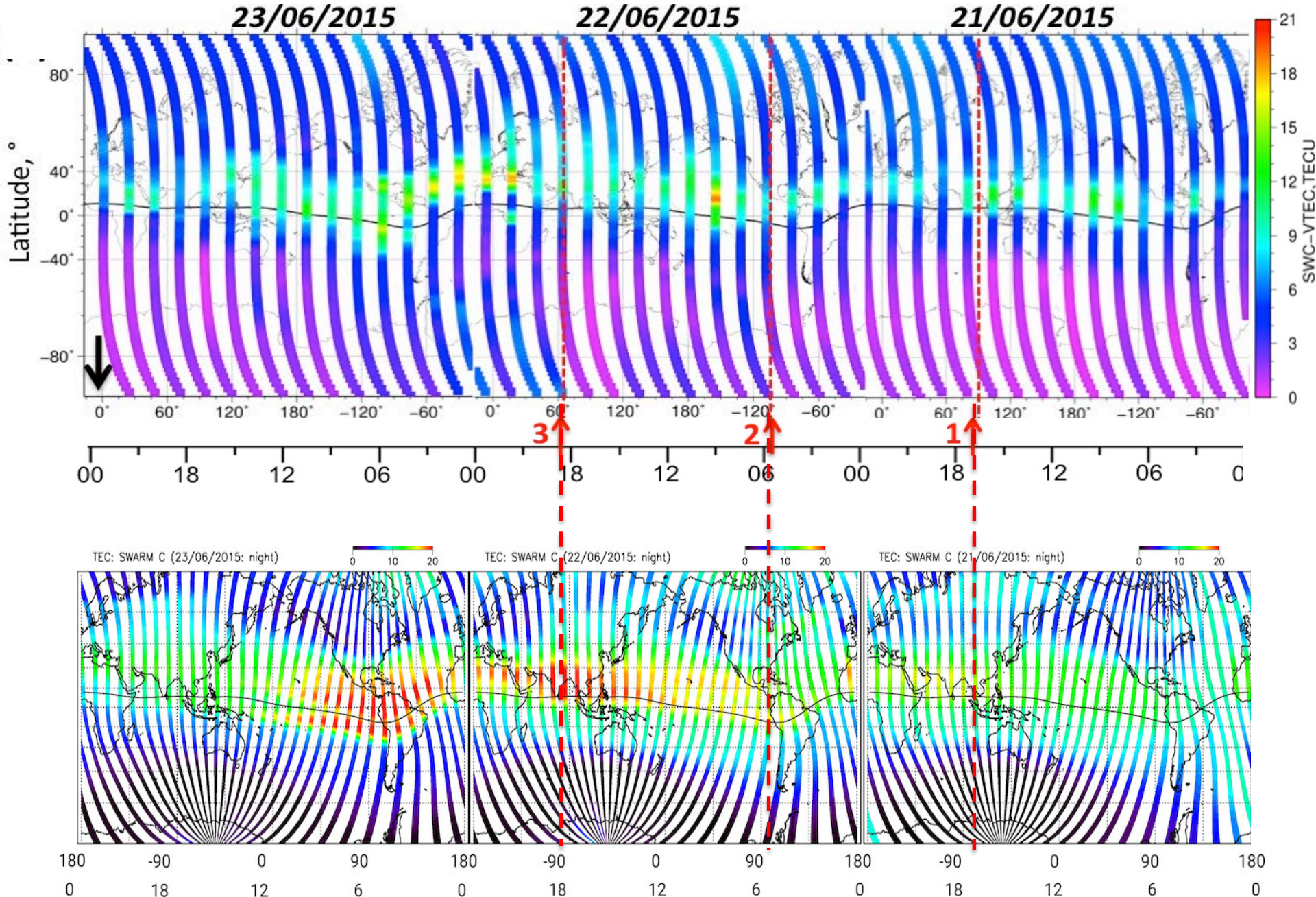
2. Nightside

- SWB - 01LT – 530km
- SWC - 23LT – 460km

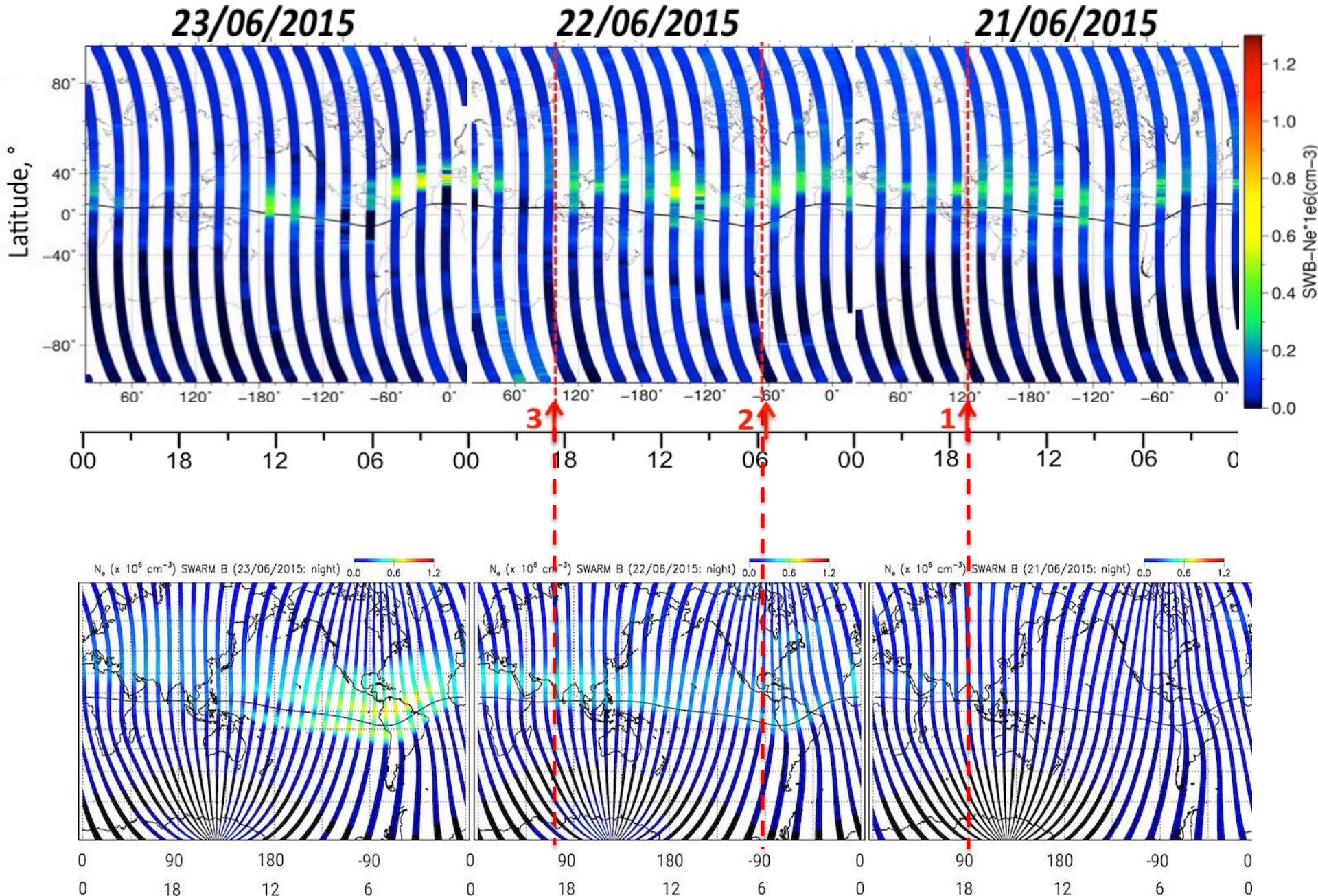
Swarm B – VTEC (H>530 km) – 01LT



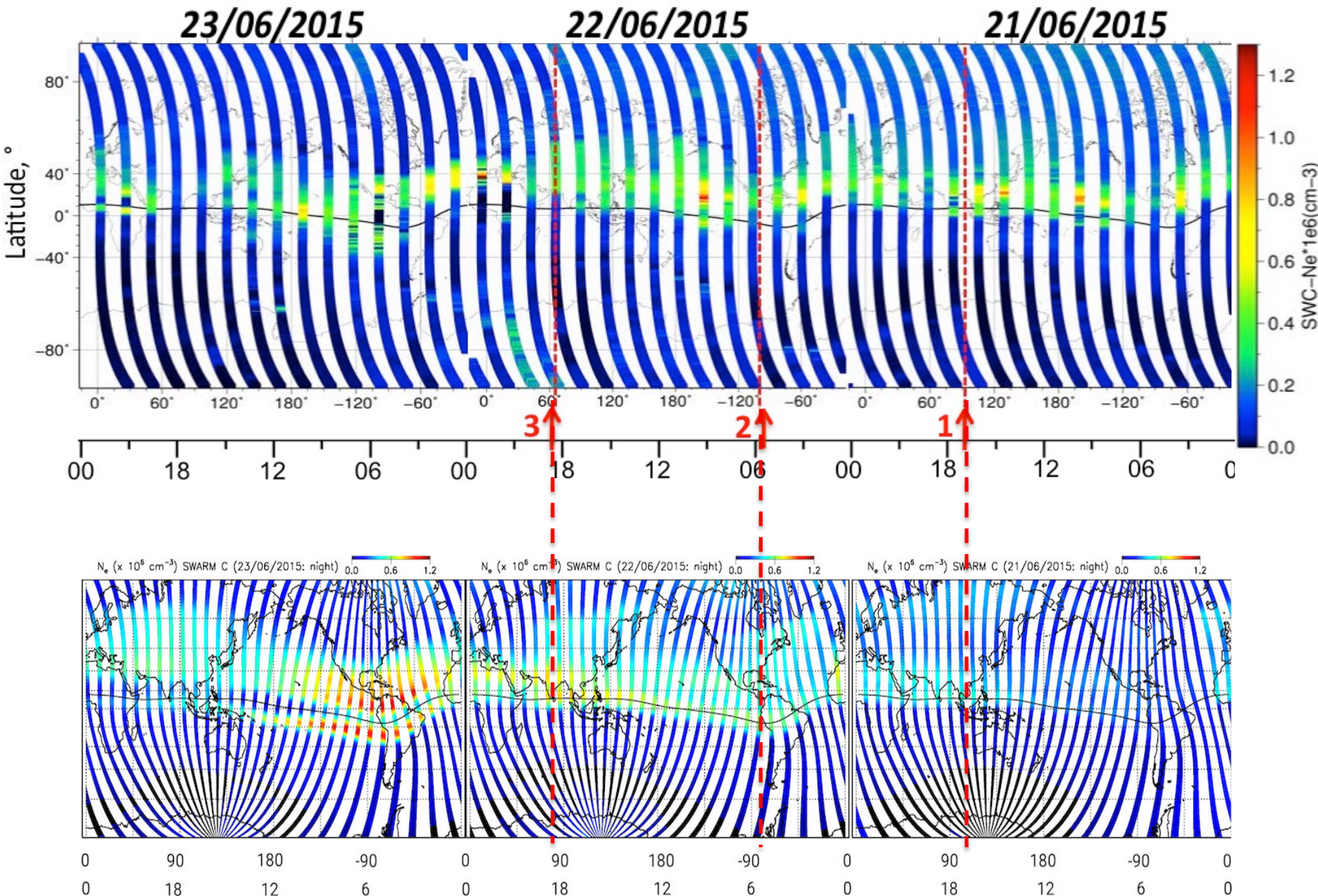
Swarm C – VTEC (H>460 km) – 23 LT



Swarm B – Ne (H=530 km) – 01LT



Swarm C – Ne (H=460 km) – 23 LT



Conclusions

- **PPEF is the main driver at the beginning and during the main phase of the storm. At the end –> PPEF+DDEF**
- **2 positive sub-phases, 2 negative sub-phases. Strong effect in the topside**
- **SAMI3/RCM reproduces well the PPEF effect, but the DDEF is yet to improve…**

Thank you!

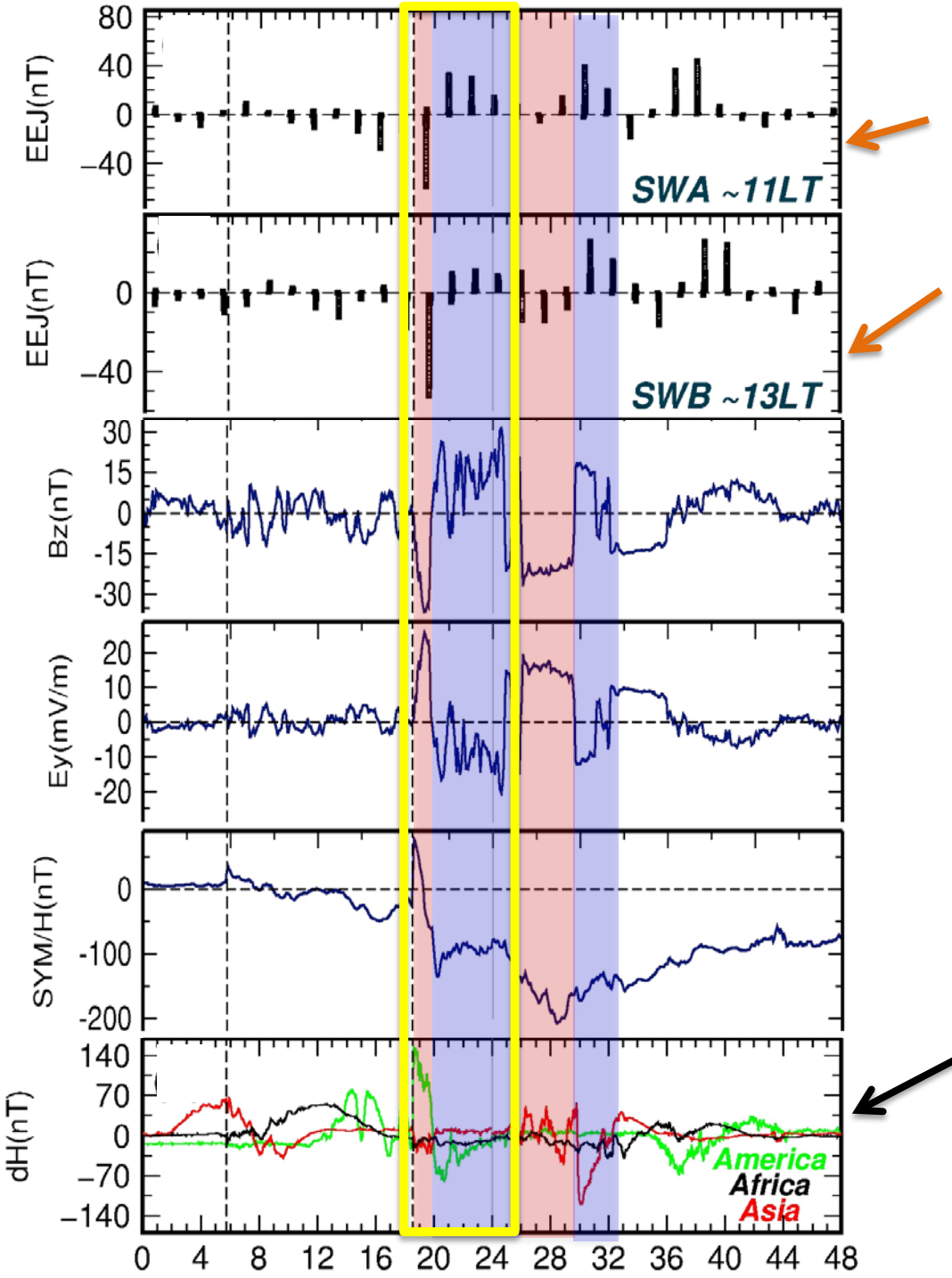
Merci

Grazie

ありがとう

謝謝

Storm 22-23 June 2015



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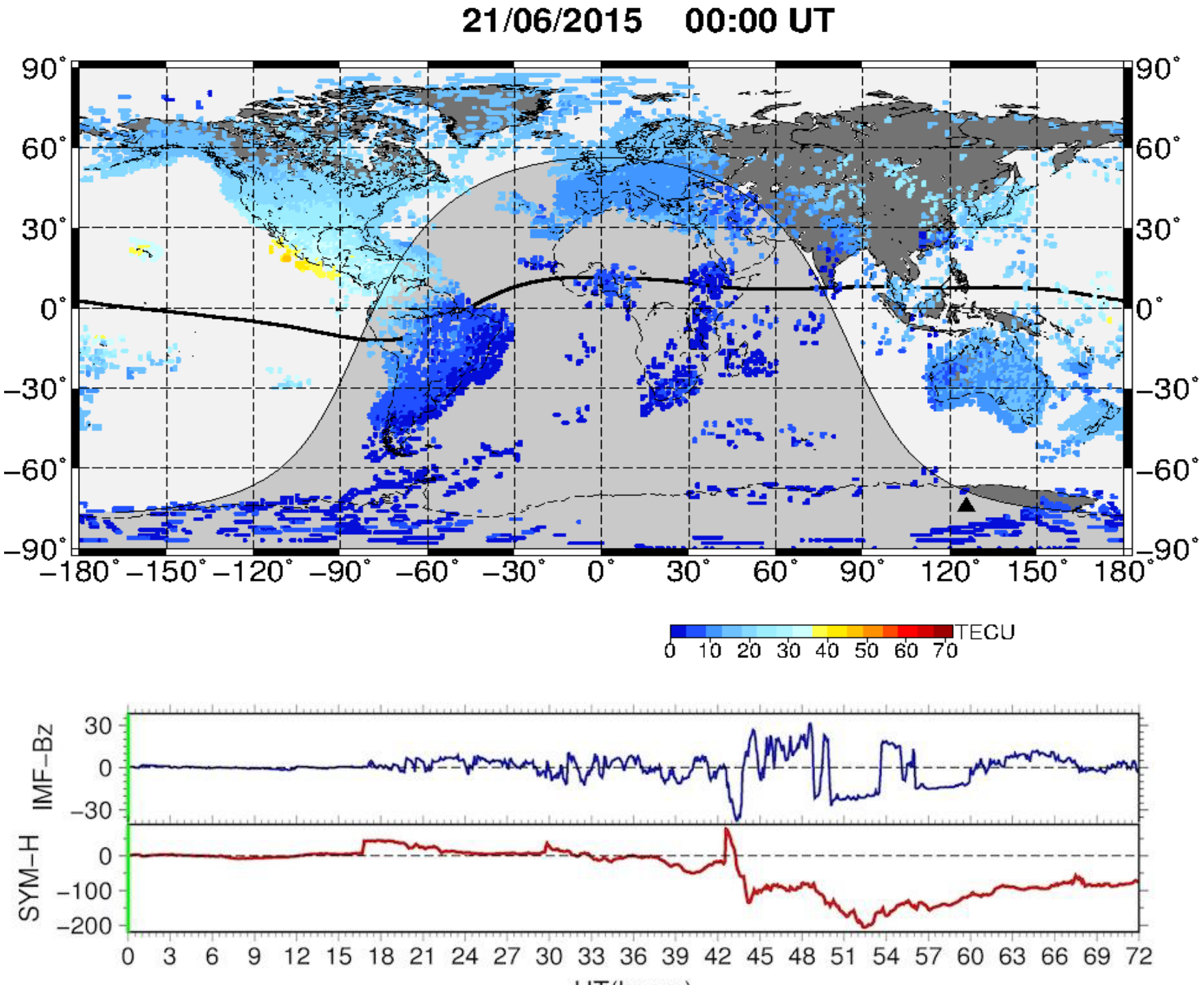
GPS - GLONASS VTEC