Using EISCAT incoherent scatter radar co-aligned with GPS satellites to obtain details about plasma structures and scattering mechanisms originating scintillation at L band

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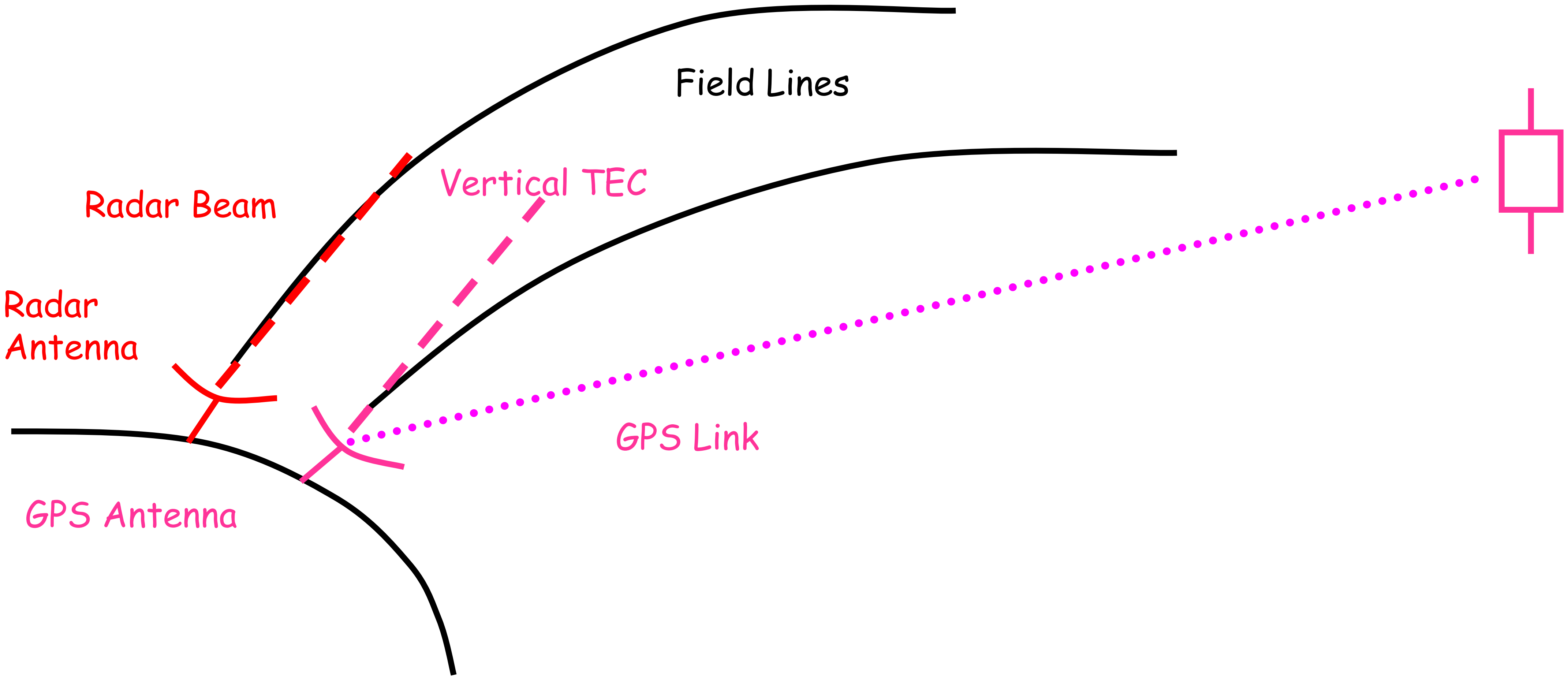
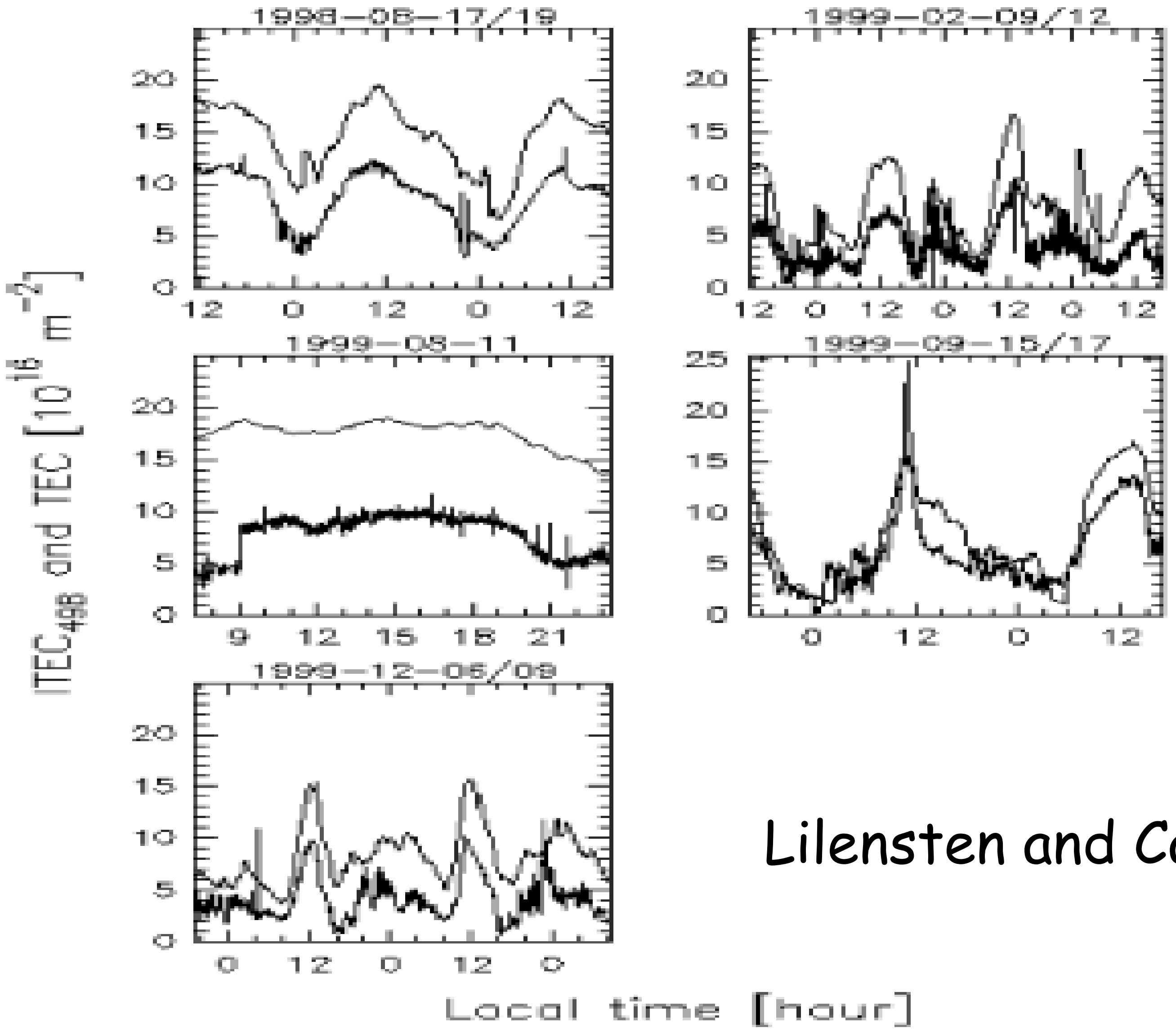
EISCAT vs GPS
TEC Estimates from different instruments

Previous studies



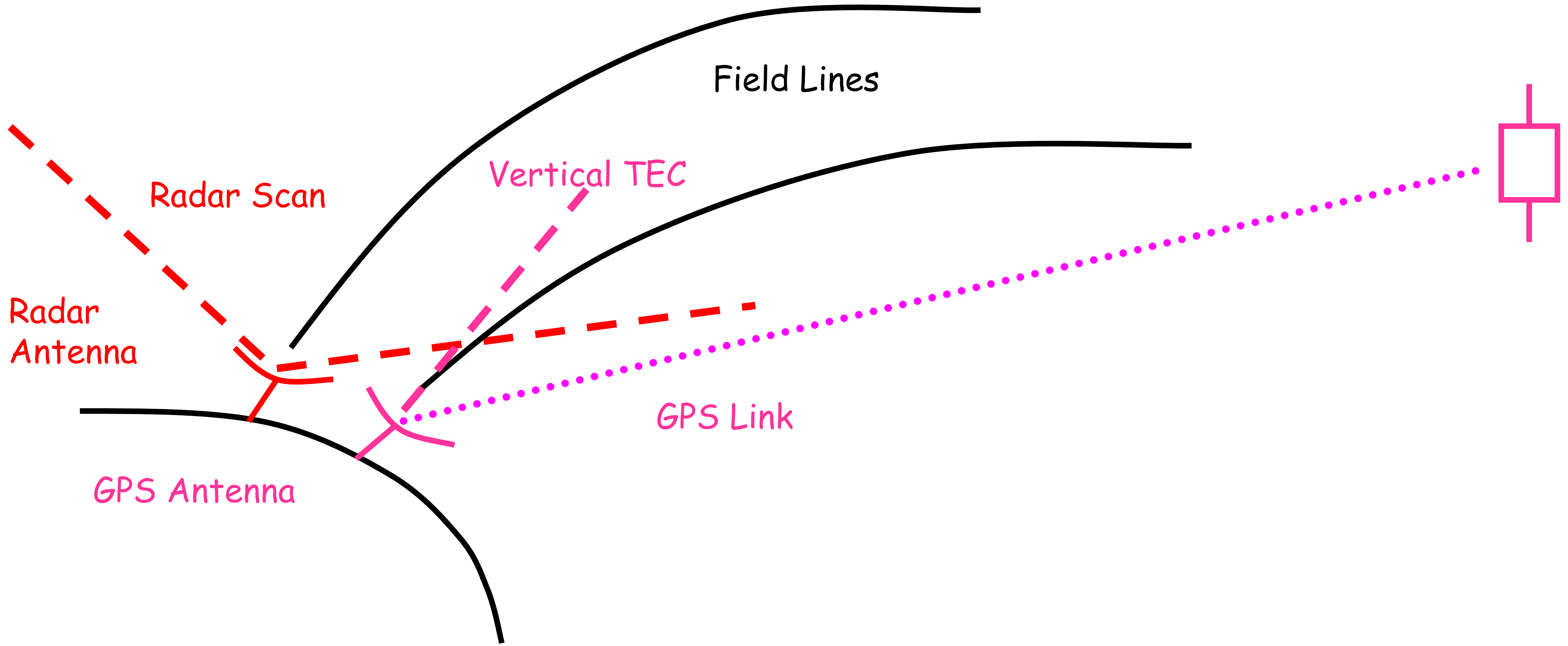
Lilensten and Cander, 2003

Previous studies



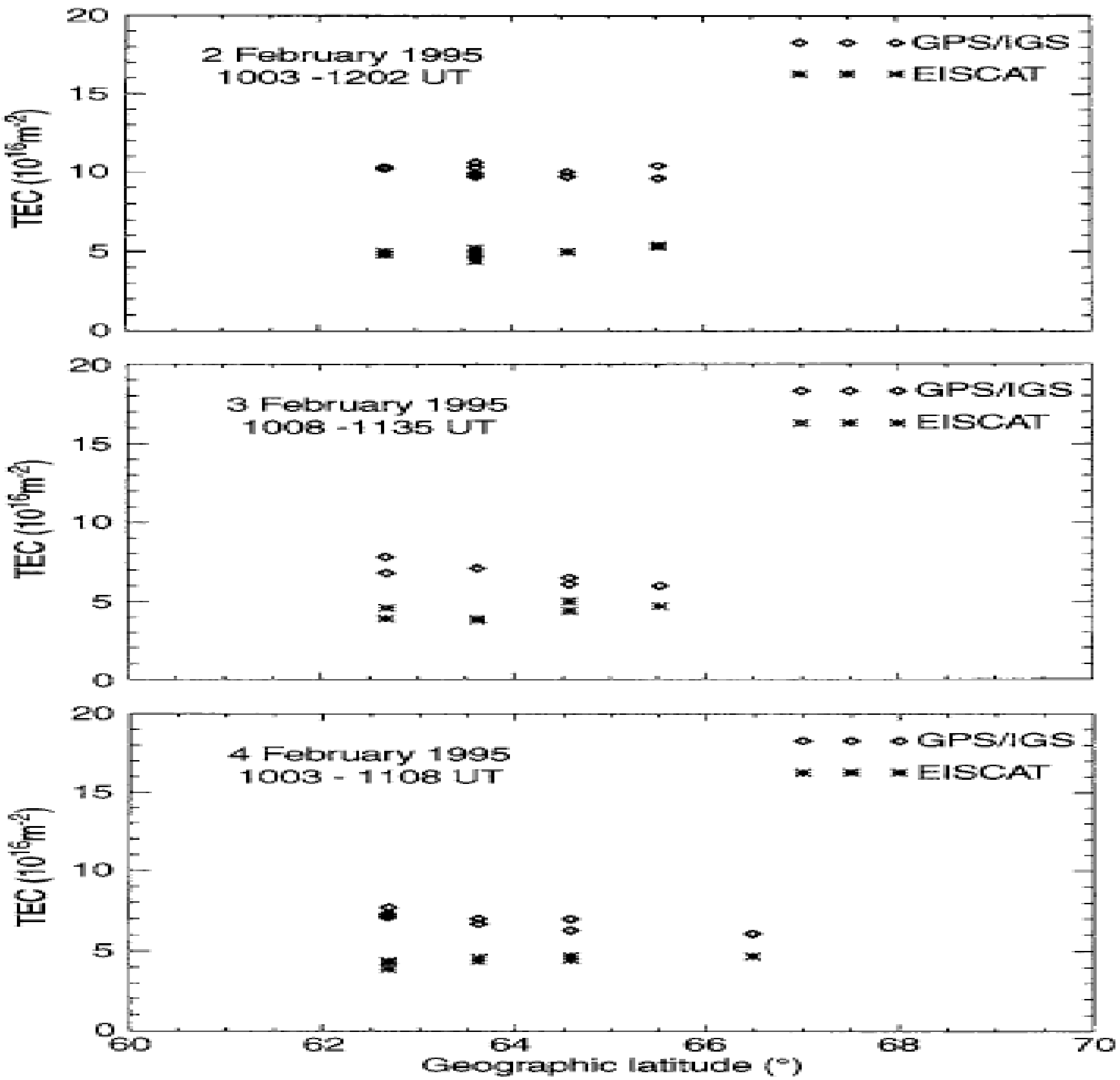
Lilensten and Cander, 2003

Previous studies



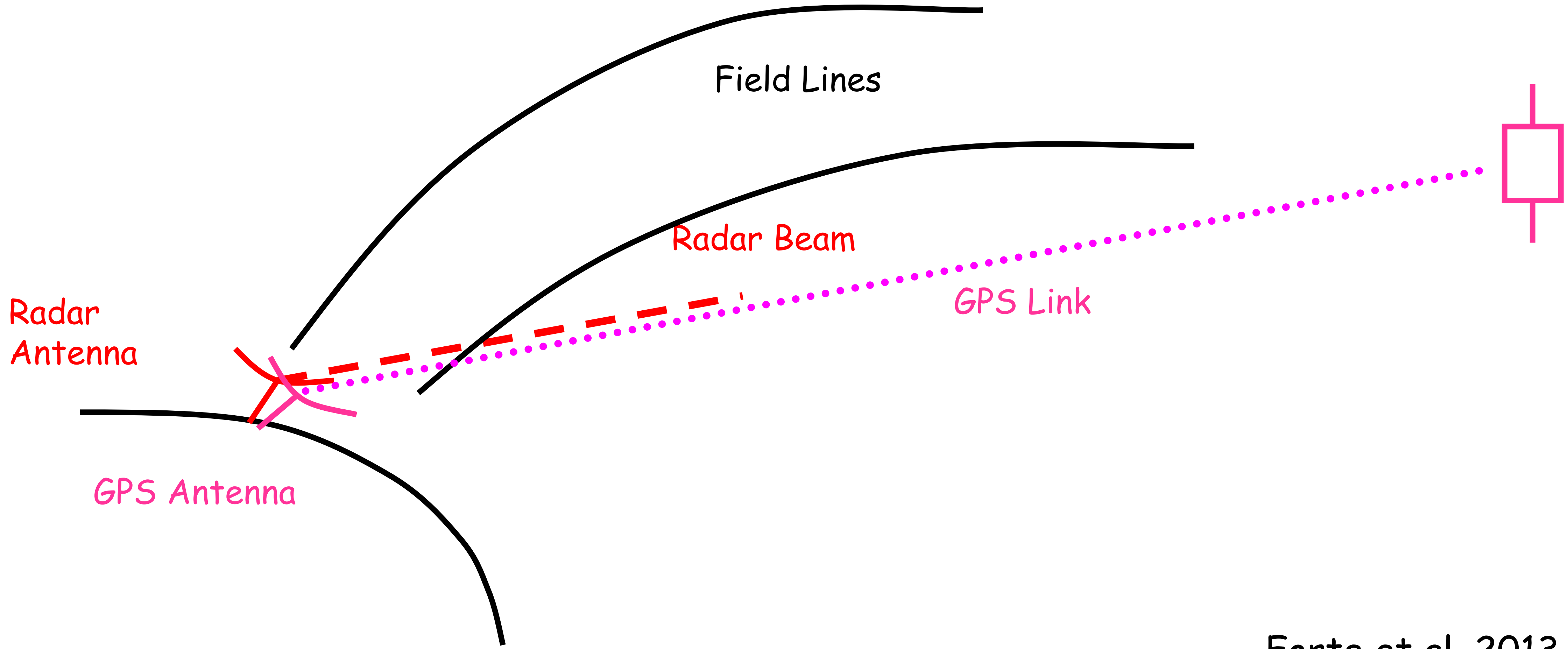
Jakowski et al, 1996

Previous studies



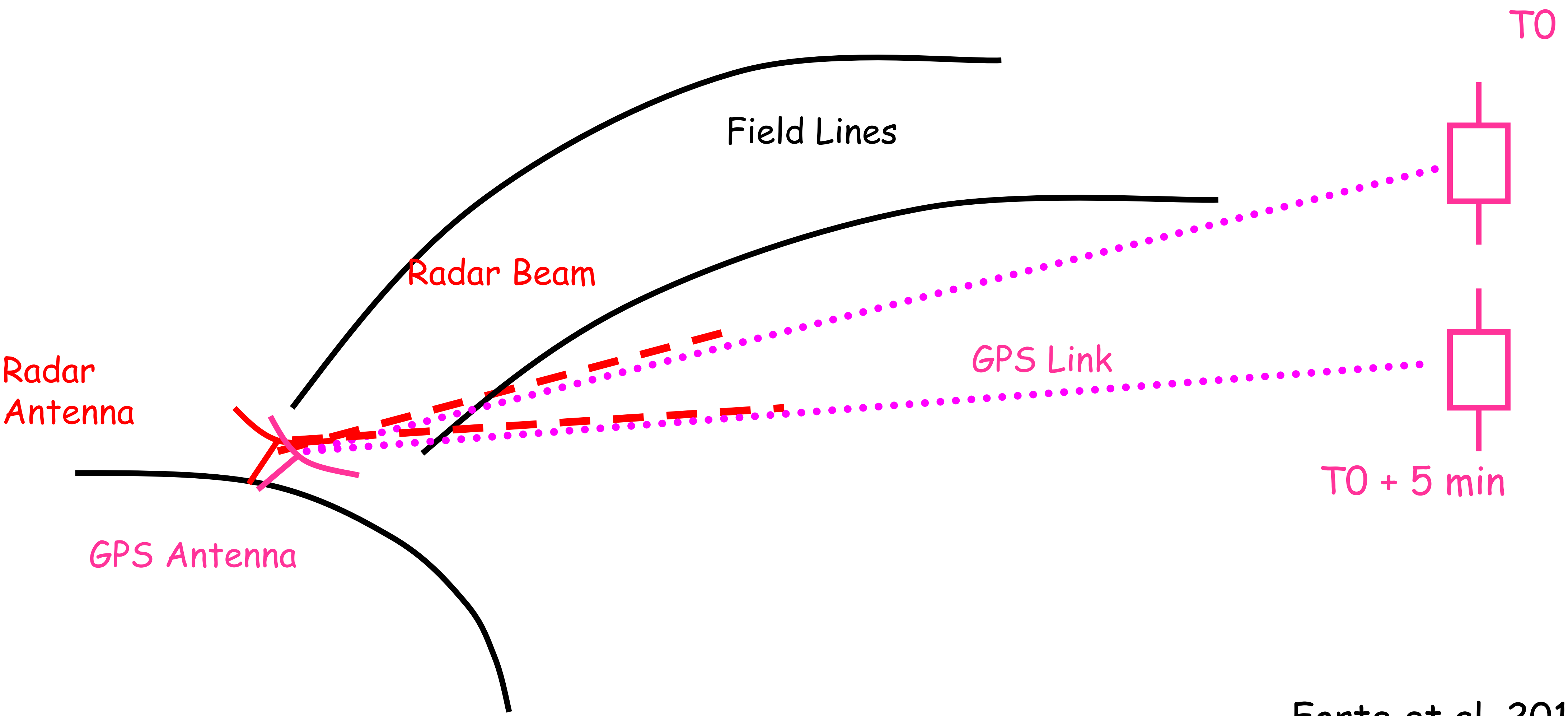
Jakowski et al, 1996

EISCAT measurement geometry – new experiment



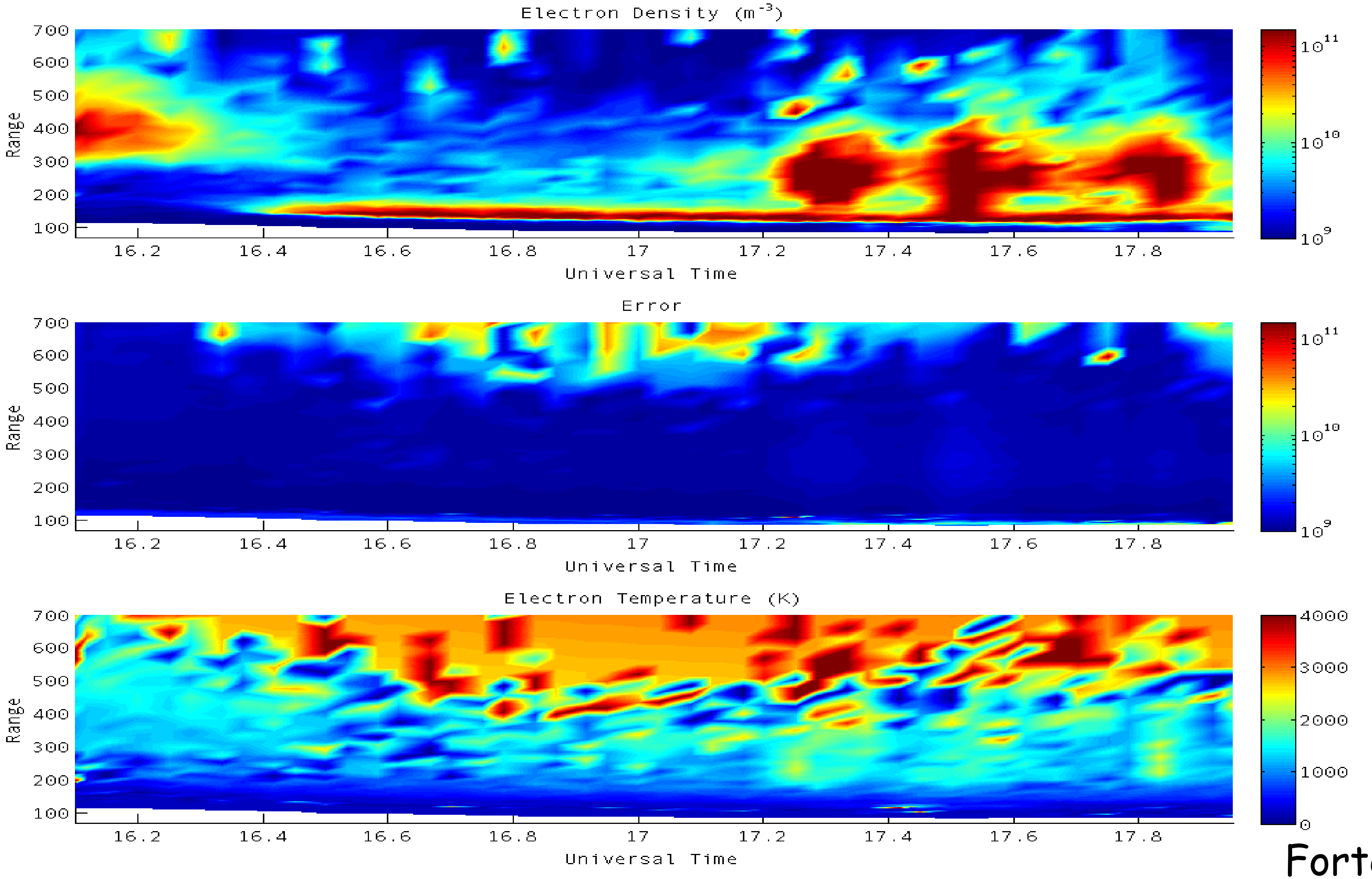
Forte et al, 2013

EISCAT measurement geometry – new experiment



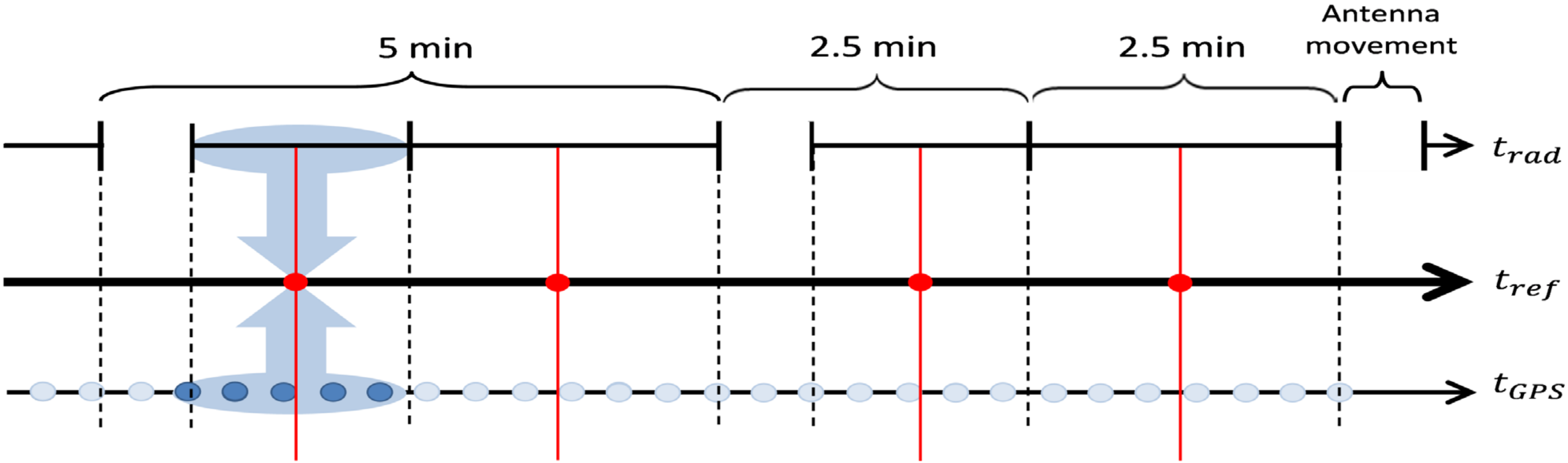
Forte et al, 2013

Electron density profiles – 150 sec average



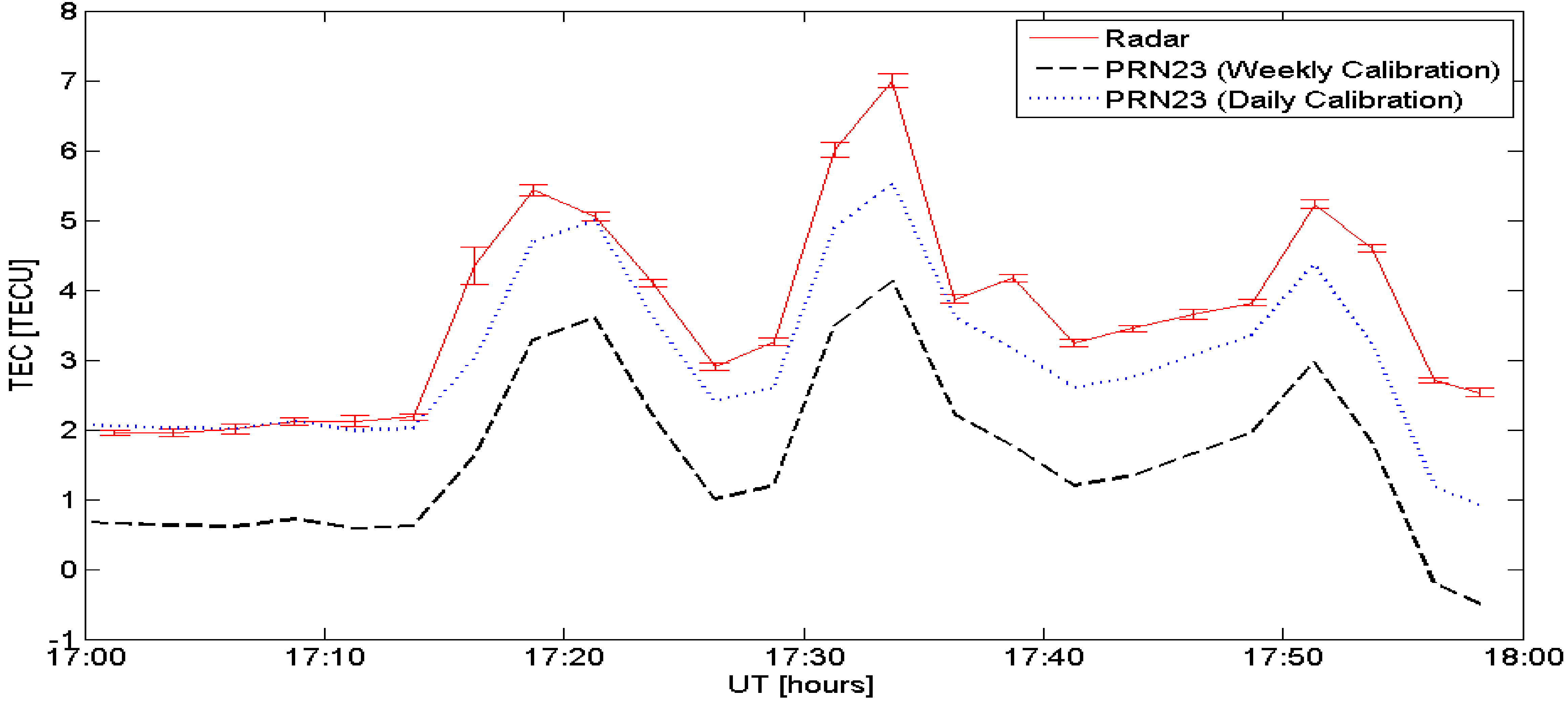
Forte et al, 2013

Time alignment



Forte et al, 2013

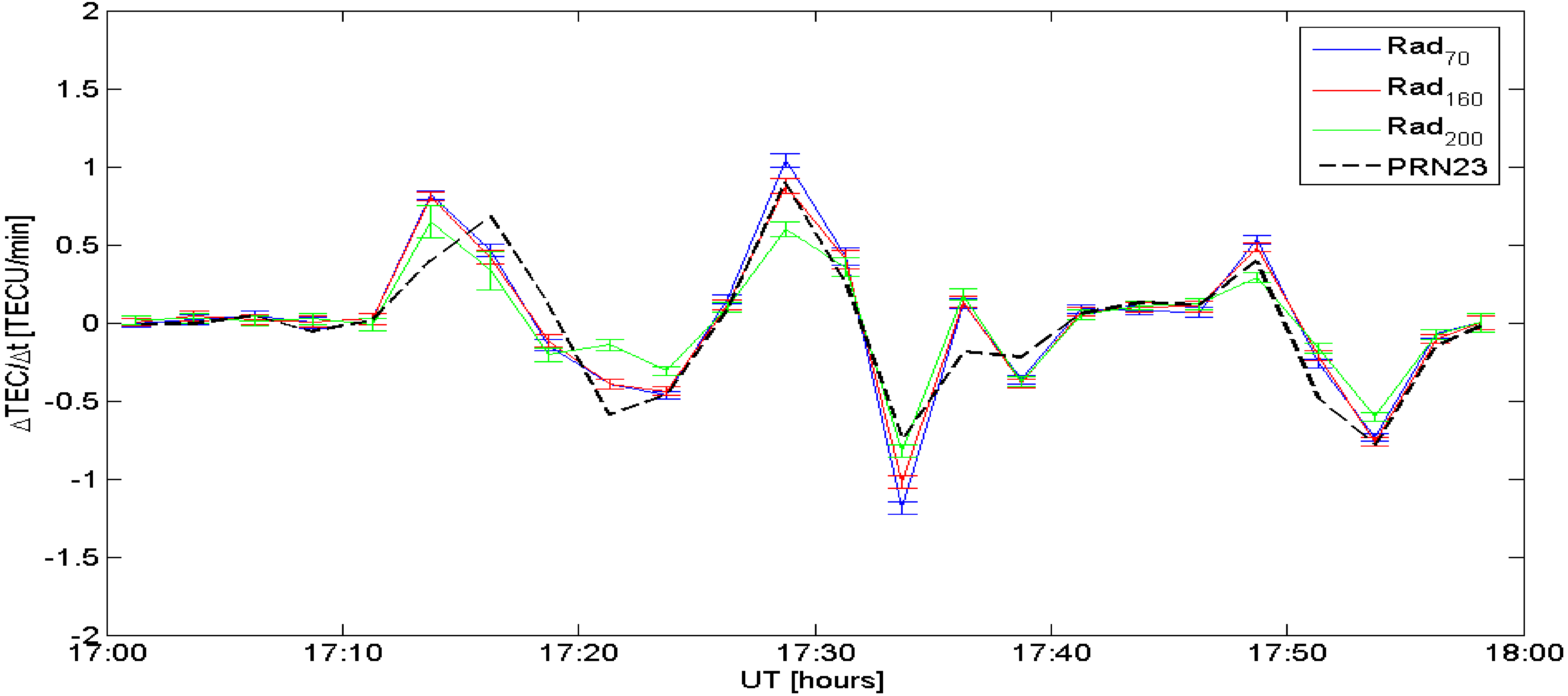
TEC: EISCAT vs GPS



Tromso, 12 December 2011

Forte et al, 2013

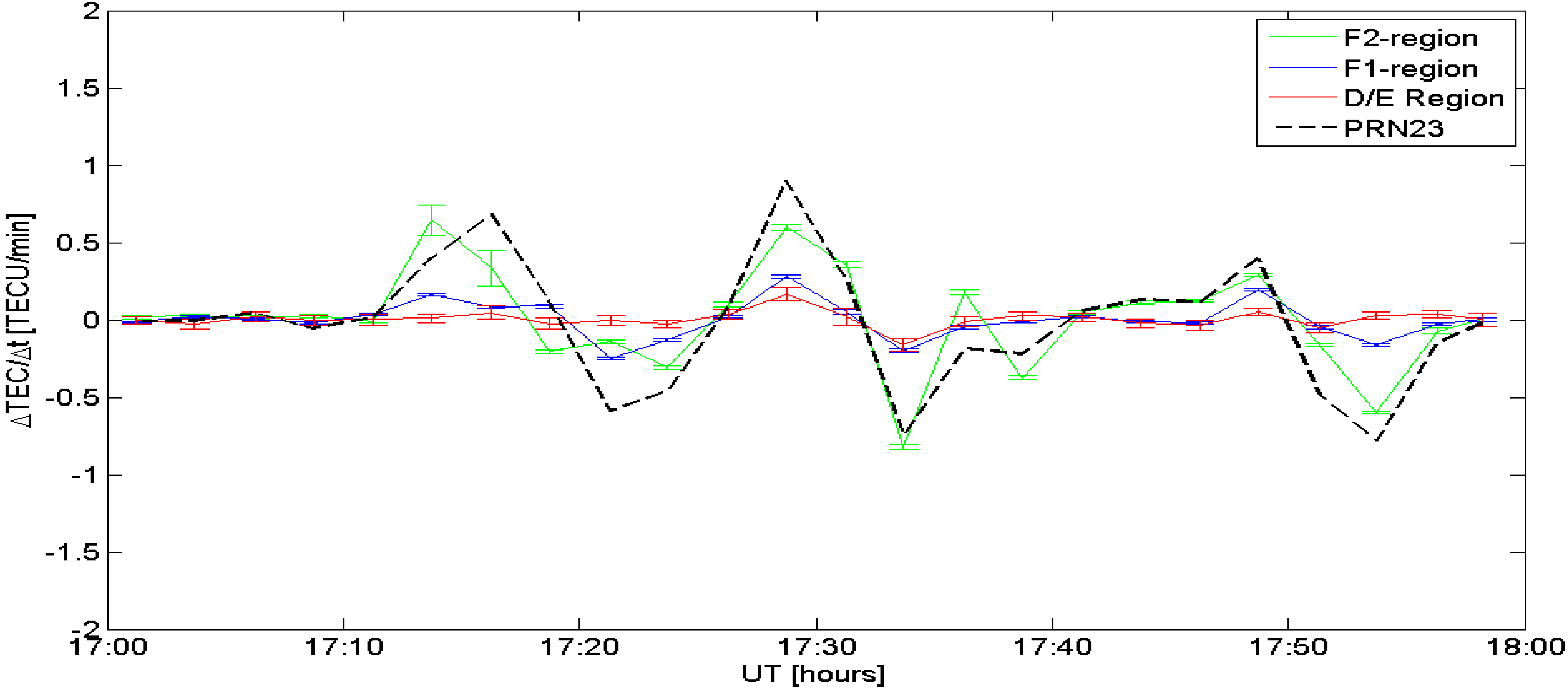
TEC Fluctuations: EISCAT vs GPS



Tromso, 12 December 2011

Forte et al, 2013

TEC Fluctuations: EISCAT vs GPS

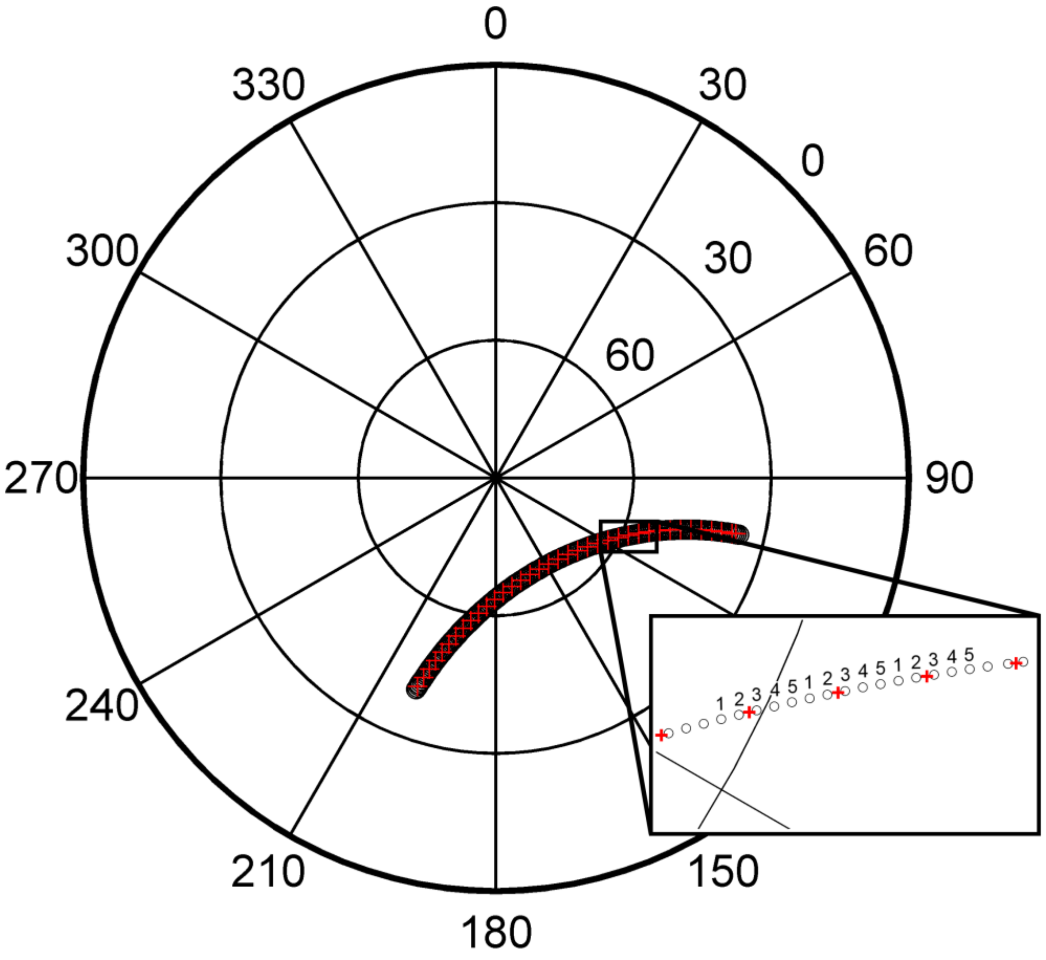


Tromso, 12 December 2011

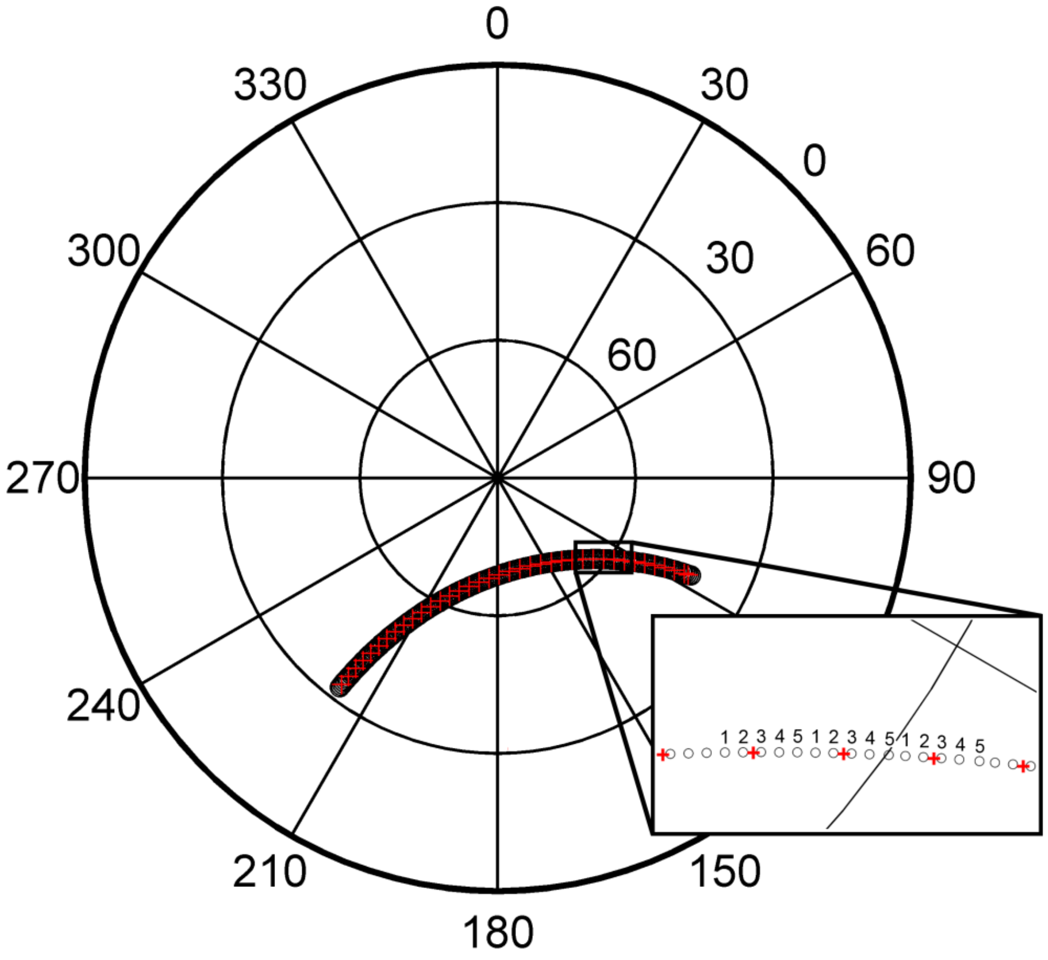
Forte et al, 2013

Ionisation structures causing L-band scintillation: EISCAT and GPS

Origin of L-band scintillation: EISCAT and GPS



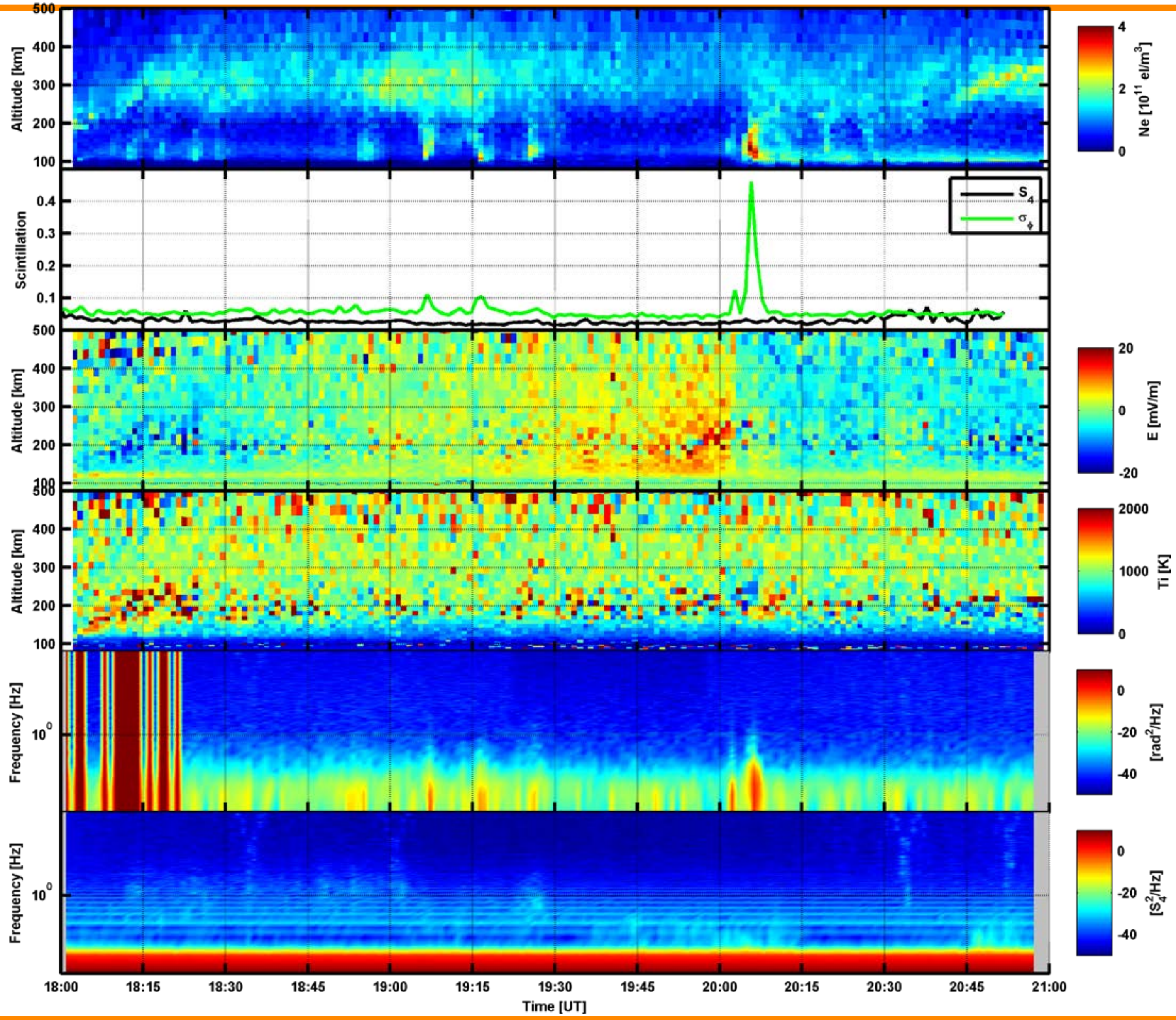
17 October 2013 PRN23



16 October 2013 PRN32

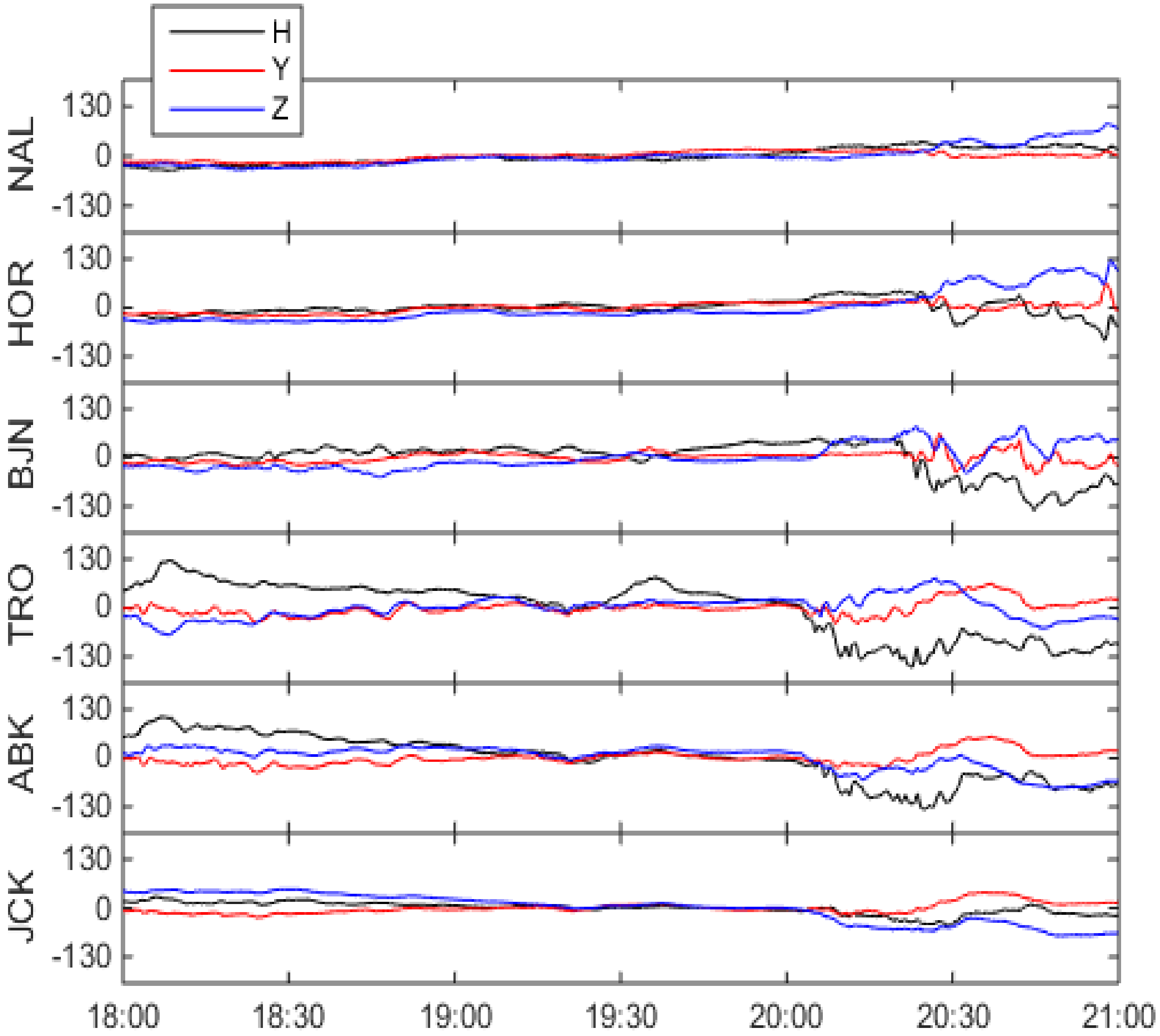
17 October 2013

Forte et al, 2016
under final review



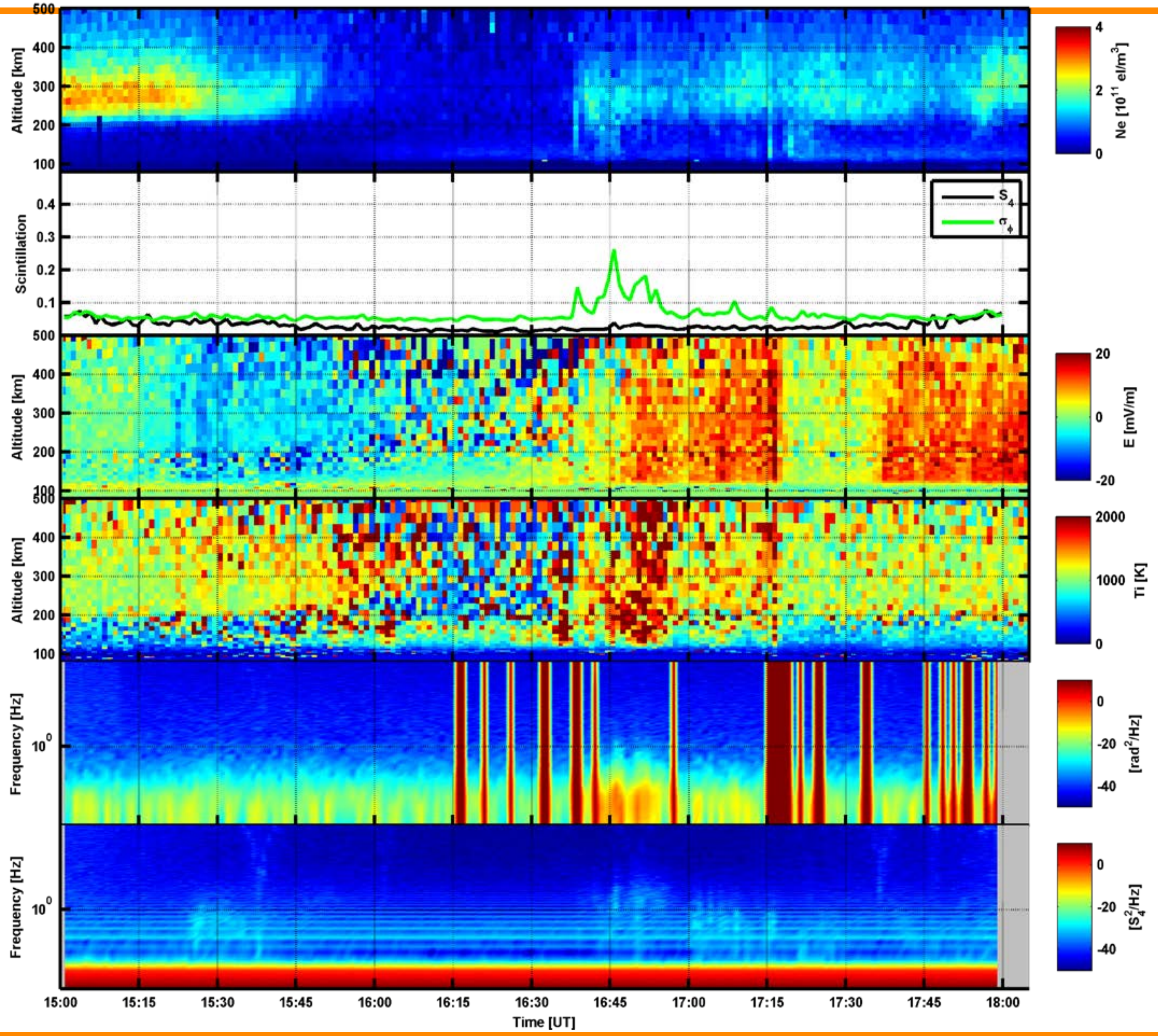
17 October 2013 – magnetic conditions

Forte et al, 2016 under final review



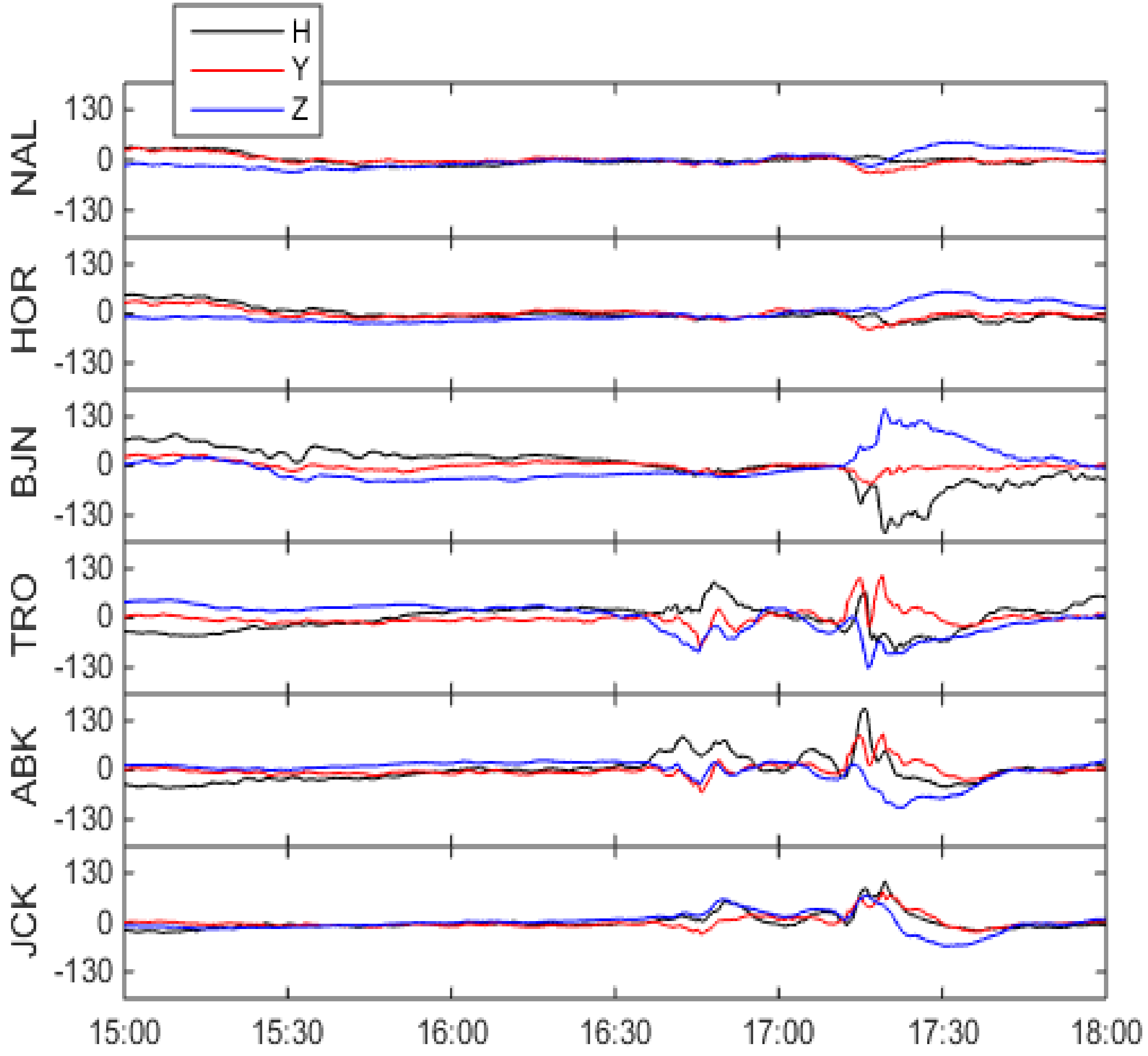
16 October 2013

Forte et al, 2016
under final review



16 October 2013 – magnetic conditions

Forte et al, 2016 under final review



Propagation through extended medium [Booker and MajidiAhi, 1981; Knepp 1983]

Forte et al, 2016 under final review

Phase fluctuations caused by propagation through an extended layer:

$$\overline{(\Delta\phi)^2} = 4r_e^2 N^2 \overline{\left(\frac{\Delta N}{N}\right)^2} \lambda^2 L_0 D \sec\chi$$

Similar approah in Knepp (1983)

By invoking the autocorrelation function $B_{\Delta NT}(\rho)$ for ΔN_T [Yeh and Liu, 1982; Forte, 2008; Forte, 2012]:

$$\overline{(\Delta\phi)^2} = \lambda^2 r_e^2 B_{\Delta N_T}(0) = \lambda^2 r_e^2 \overline{(\Delta N_T)^2}$$

Identify layers causing scintillation

Estimate structure of irregularities

Identification of layers causing scintillation

17 October 2013

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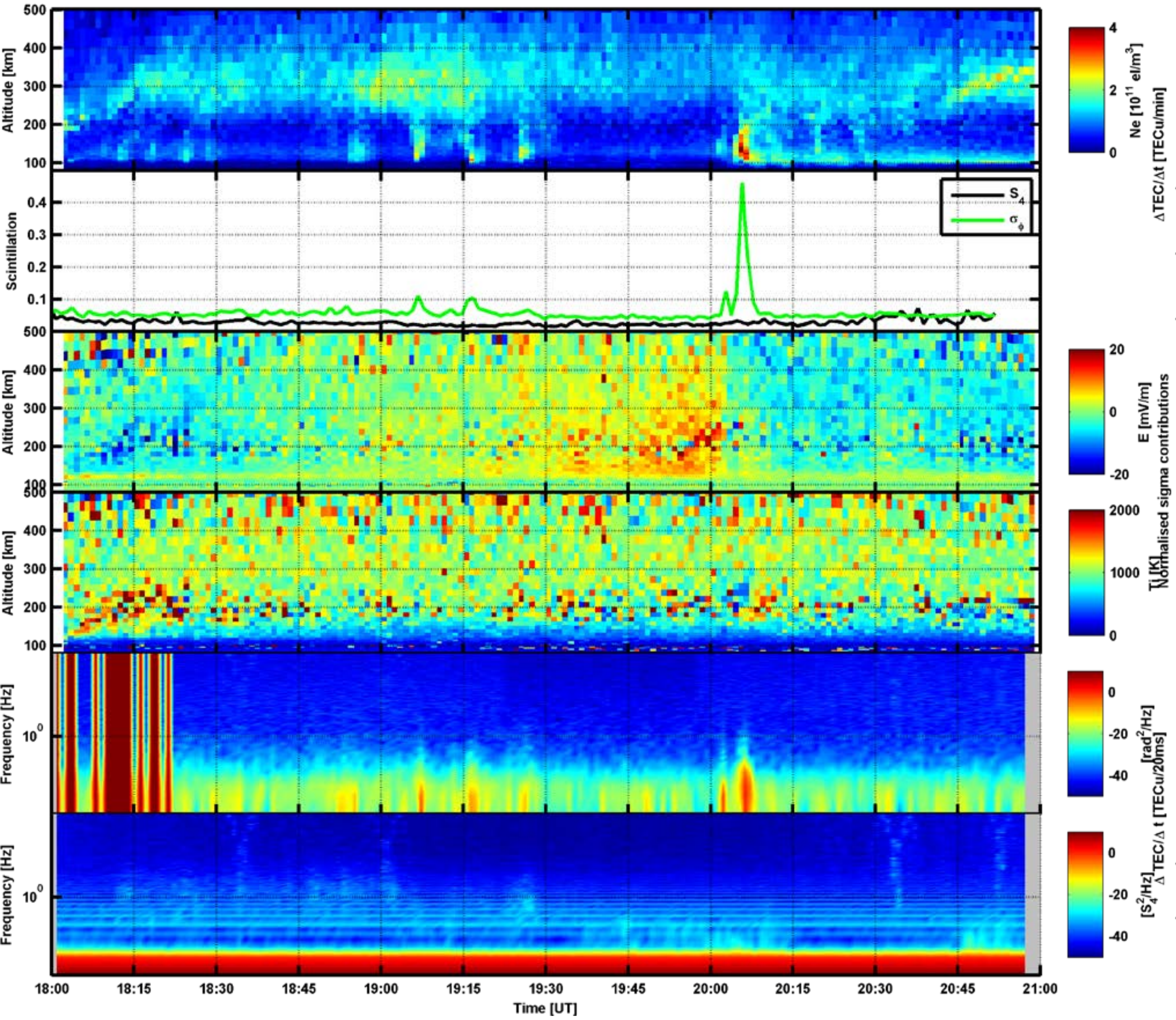
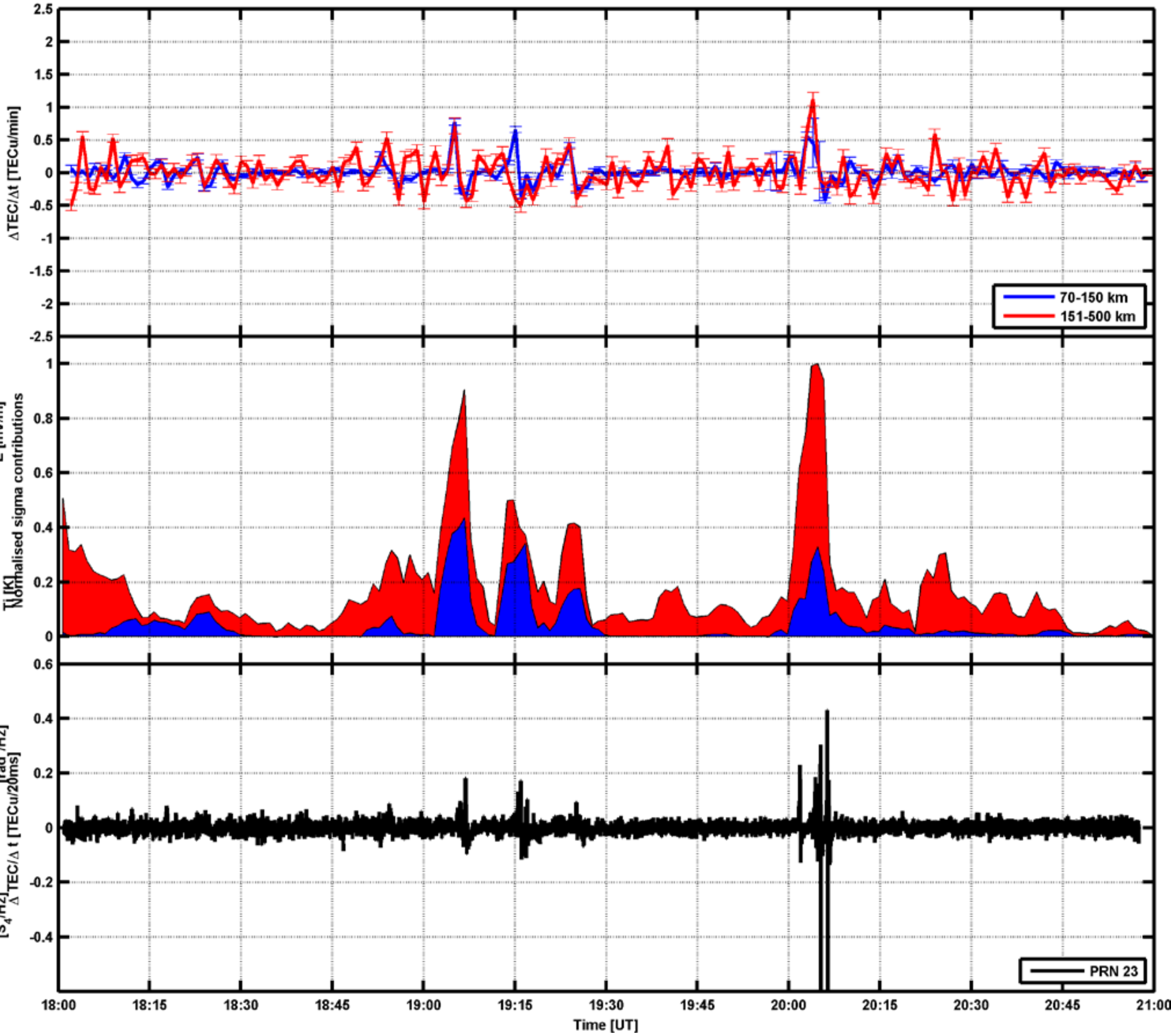
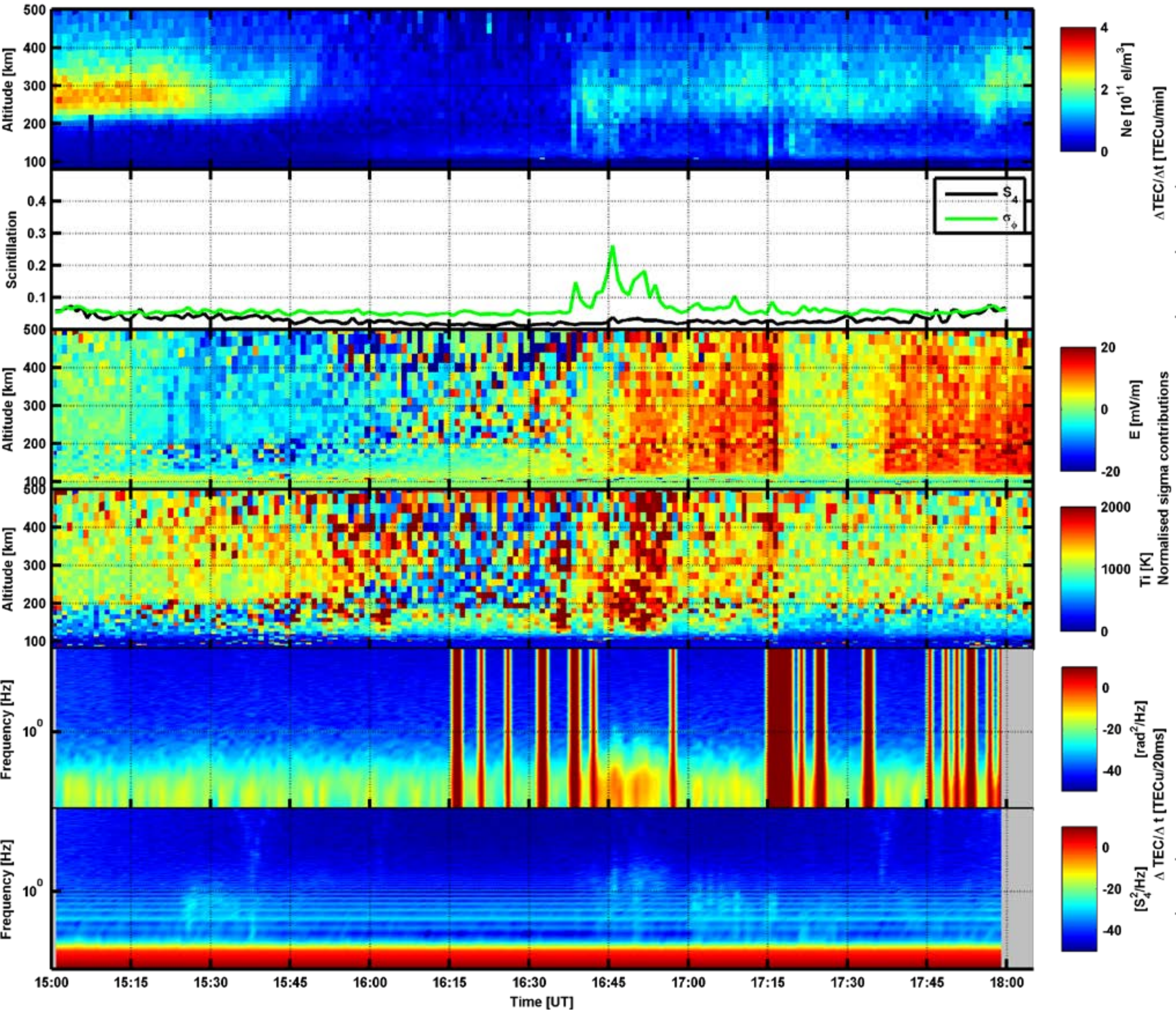
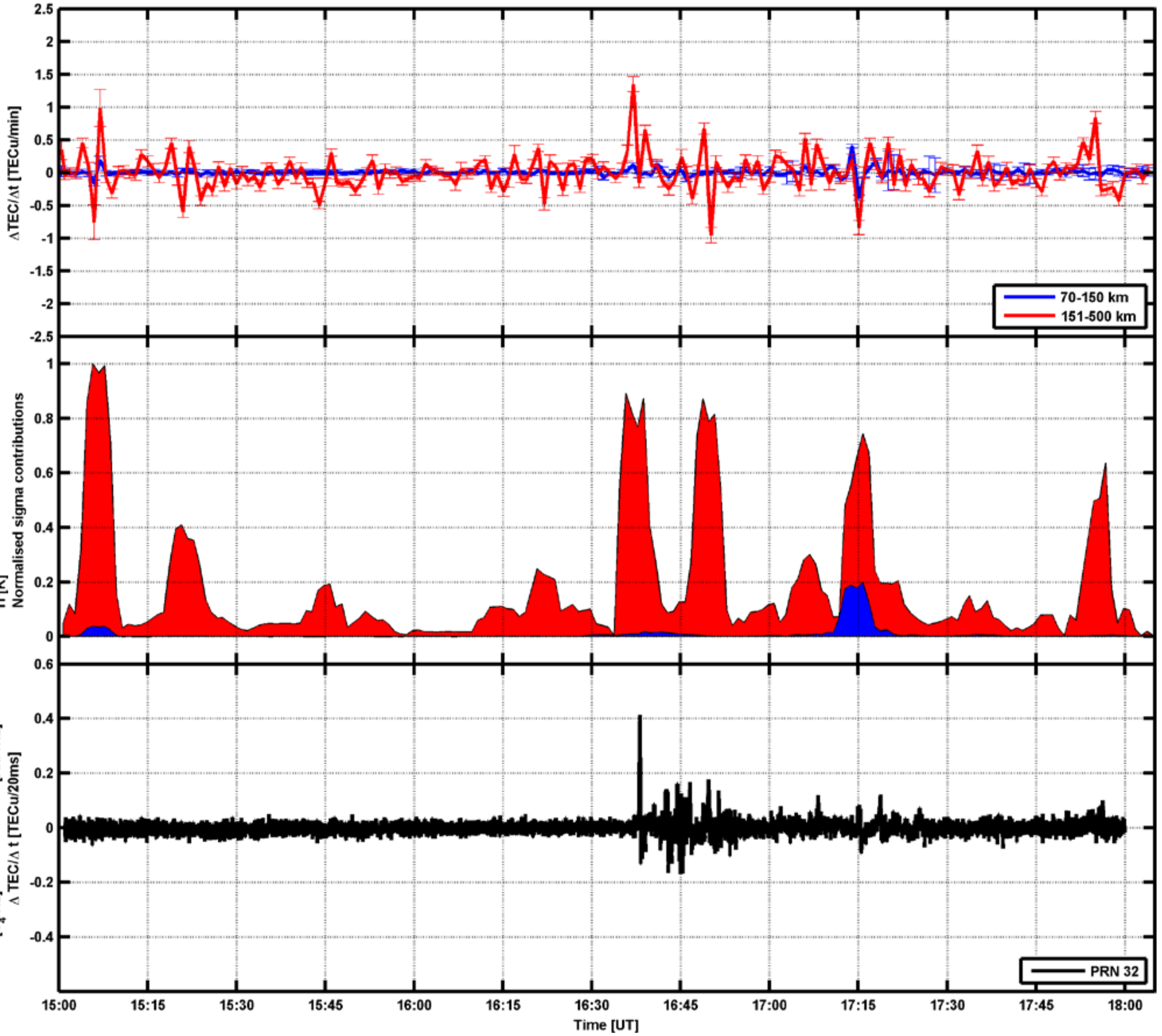




16 October 2013

Forte et al, 2016
under final review

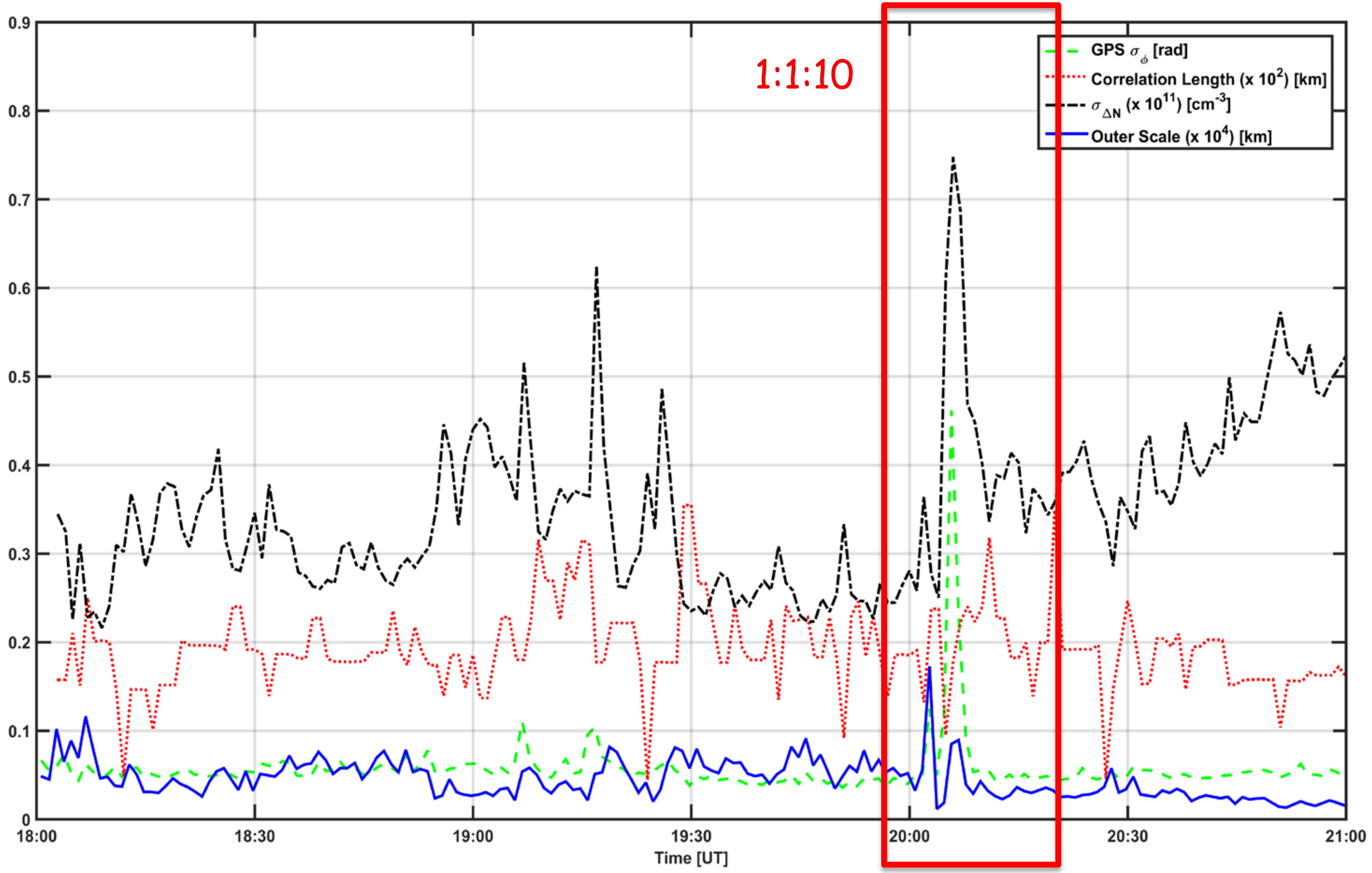




Identification of layers causing scintillation

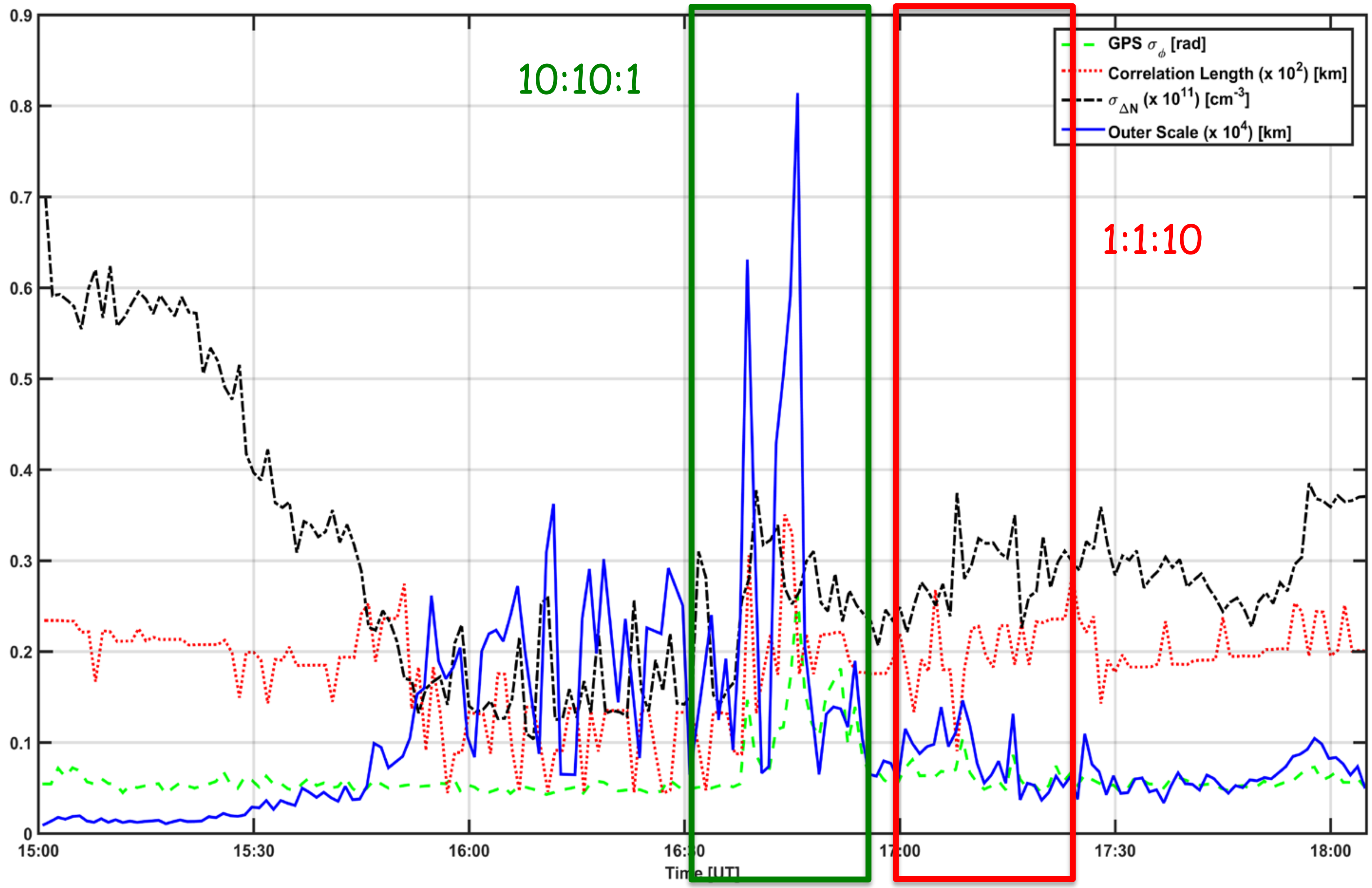
17 October 2013

Forte et al, 2016
under final review



16 October 2013

Forte et al, 2016
under final review



Conclusions

- Irregularities in the auroral E and F layers caused scintillation
- Axial ratios: 10:10:1 (trough), 1:1:10 (particle precipitation)
- Following measurements will include
  - ✓ HF, VHF, UHF, L (next campaign in September-October 2016)
  - ✓ Multiple GPS receivers (in collaboration with other groups)
  - ✓ KAIRA (Forte, Fallows, Coleman, Skone, and Bisi, in preparation)

Thank you for the attention