

Measurements of MSTIDs and Plasma Structures conducted with the LISN distributed observatory

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Presentation deals with

Data:

Plasma density observed with SWARM constellation and C/NOFS satellite on December 10 & 18, 2013, 2013. Detection of narrow bubbles.

VIPIR measurements of bottomside densities during December 10 and 18, 2013.

TEC and TEC depletions calculated using GPS observations.

Processing:

Bubble Velocity field based on TEC measurements conducted with GPS receivers in South and Central America.

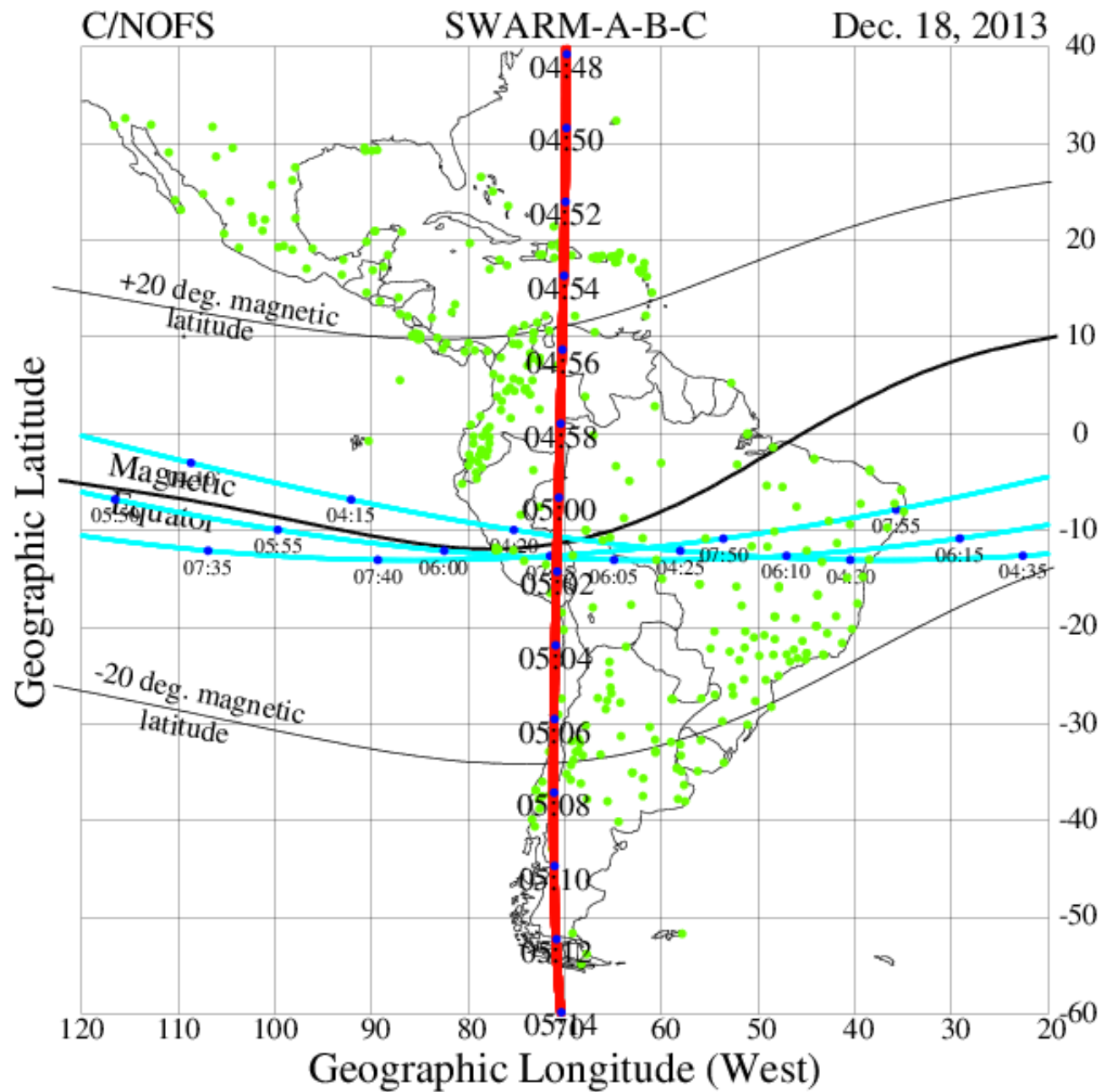
Bubble locations are trace backward and forward in time.

Mapping to magnetic equator.

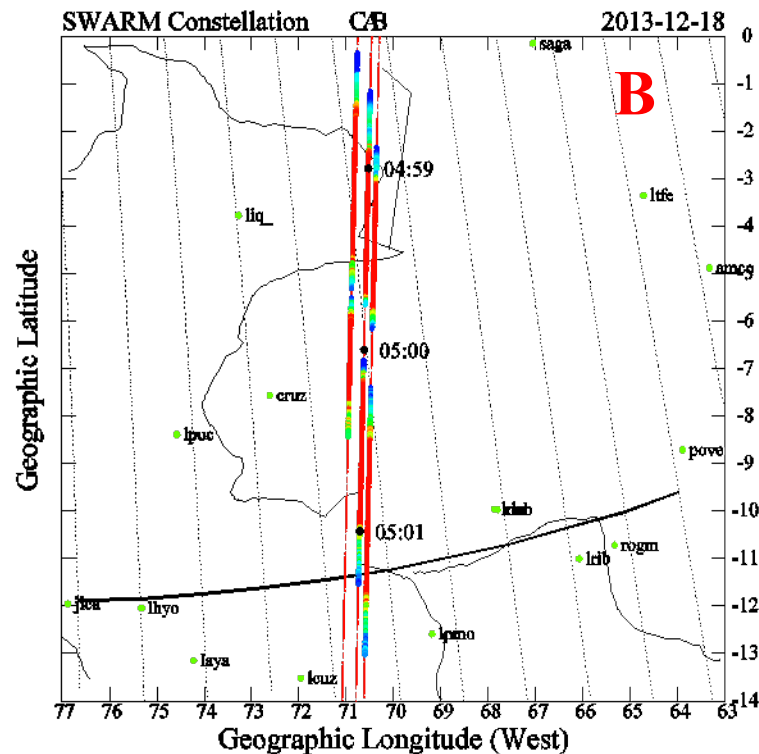
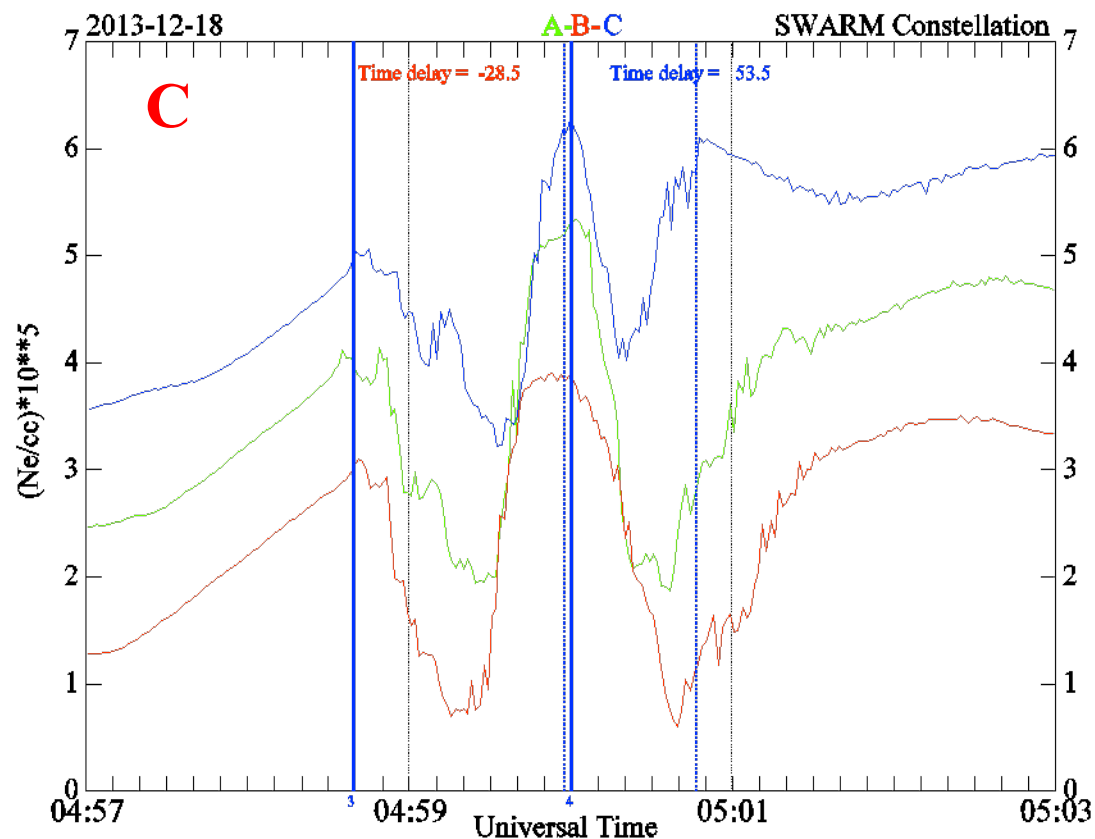
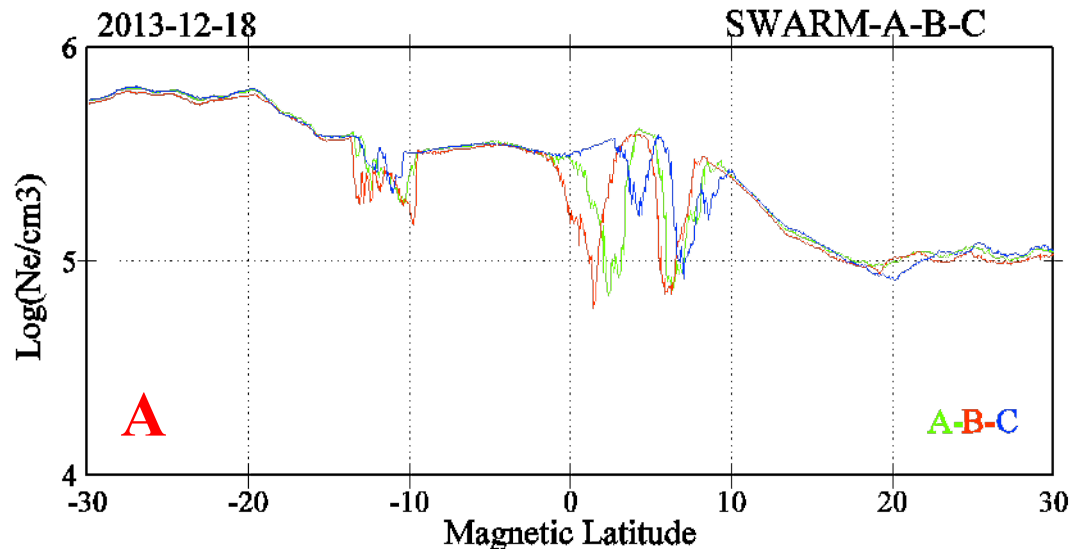
Results:

3D view of plasma bubbles observed during December 10 & 18, 2013.

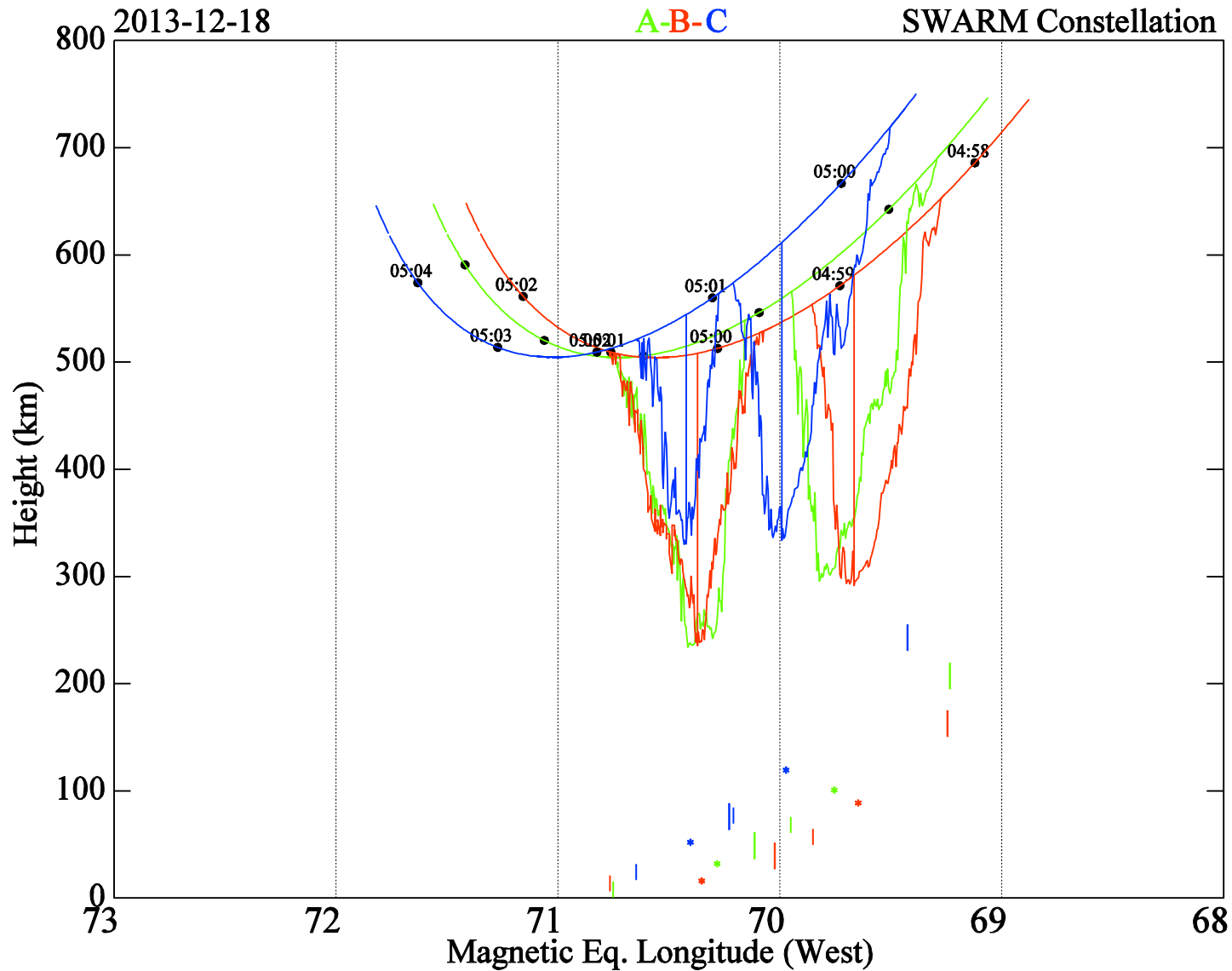
SWARM and CNOFS passes during December 18, 2013



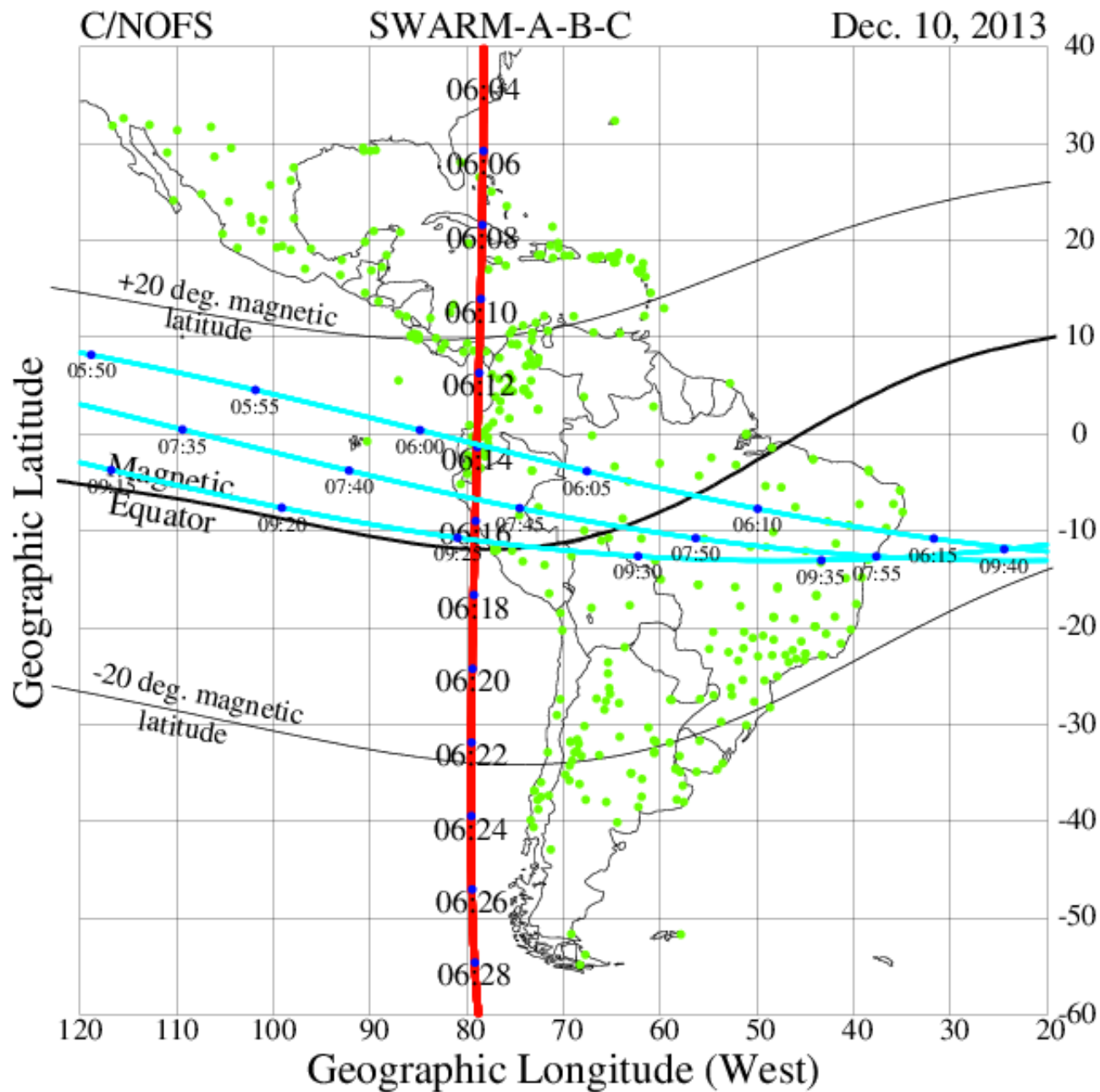
Density measurements during early lifetime of SWARM satellites. Plasma density depletions are not similar even when passes are only 1-2 min apart (A). All 3 passes are between 1 degree in longitude (B). However, density variability exists(C).



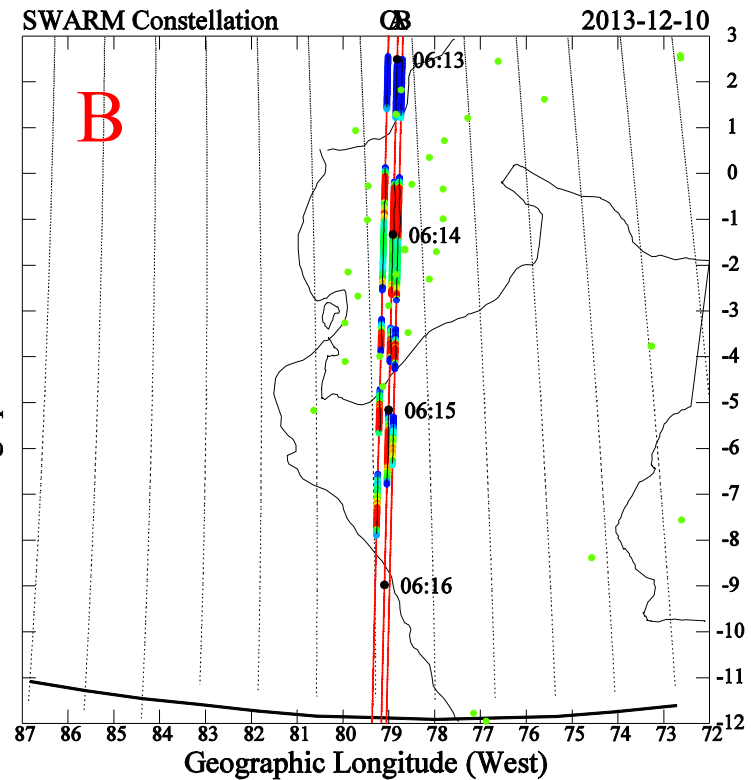
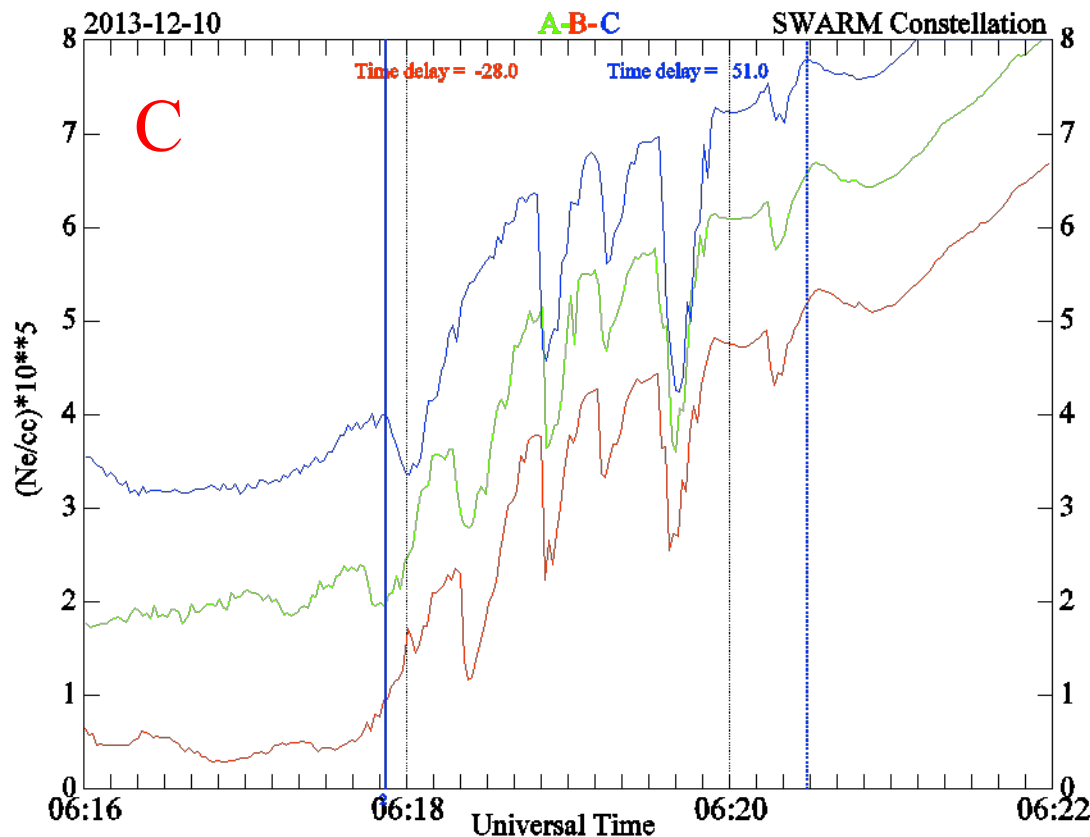
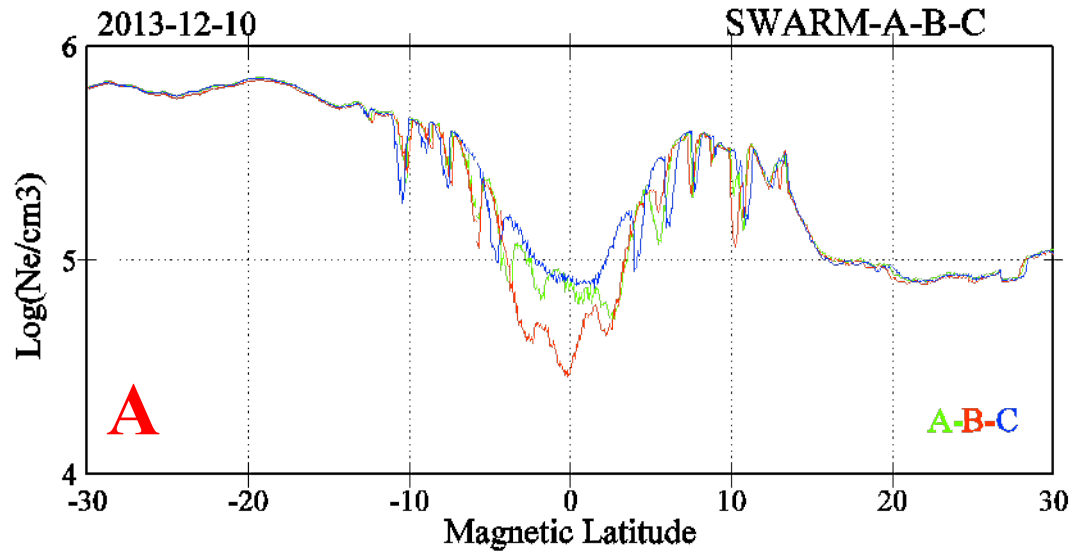
Bubble detections mapped to magnetic equator



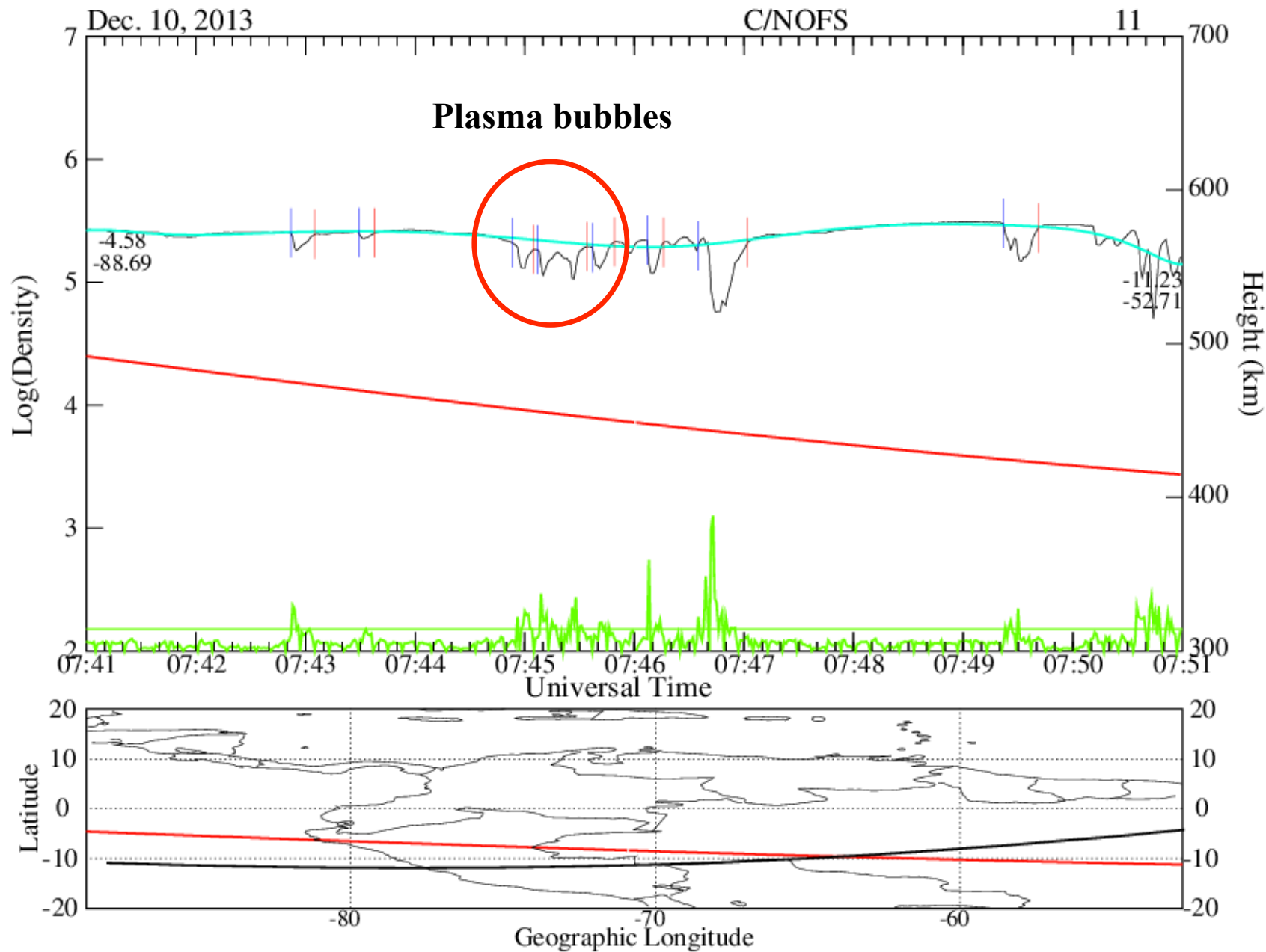
Altitude distribution of Plasma Depletions that show strong westward tilt.



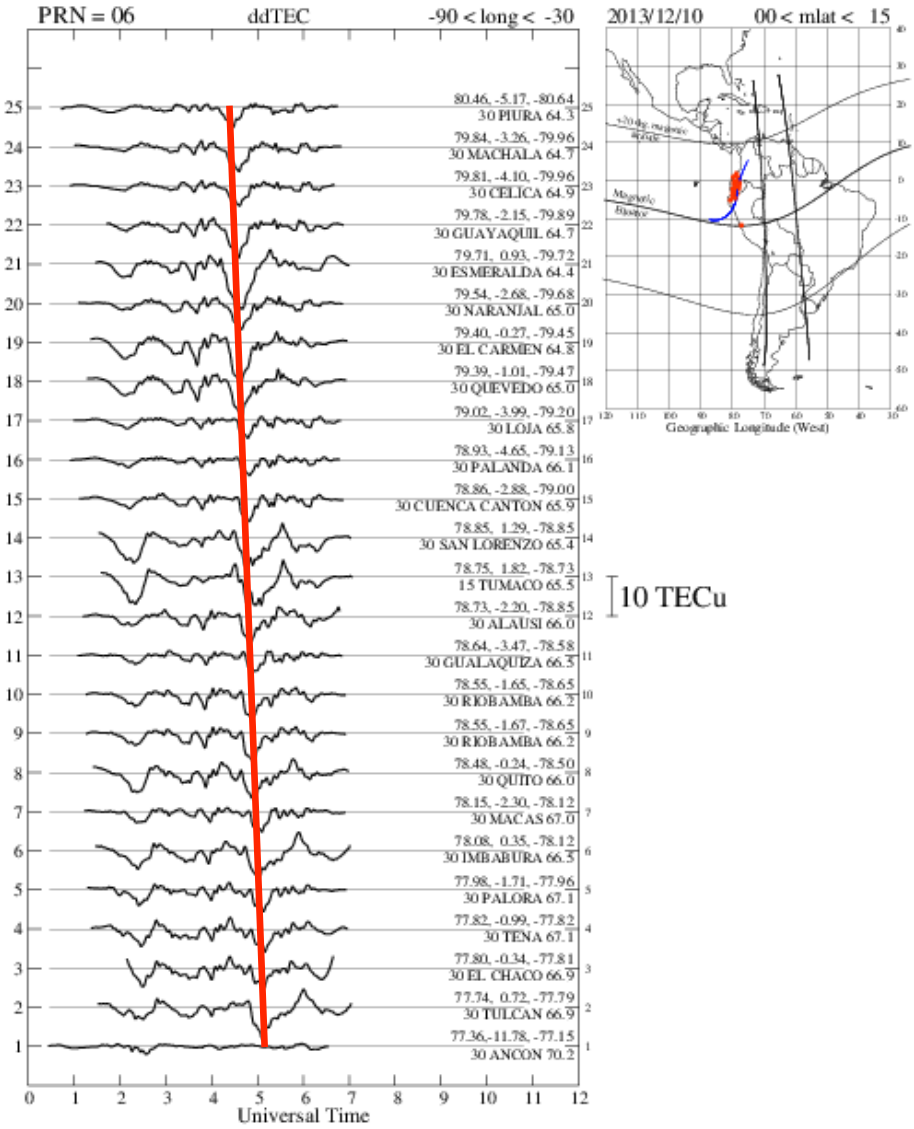
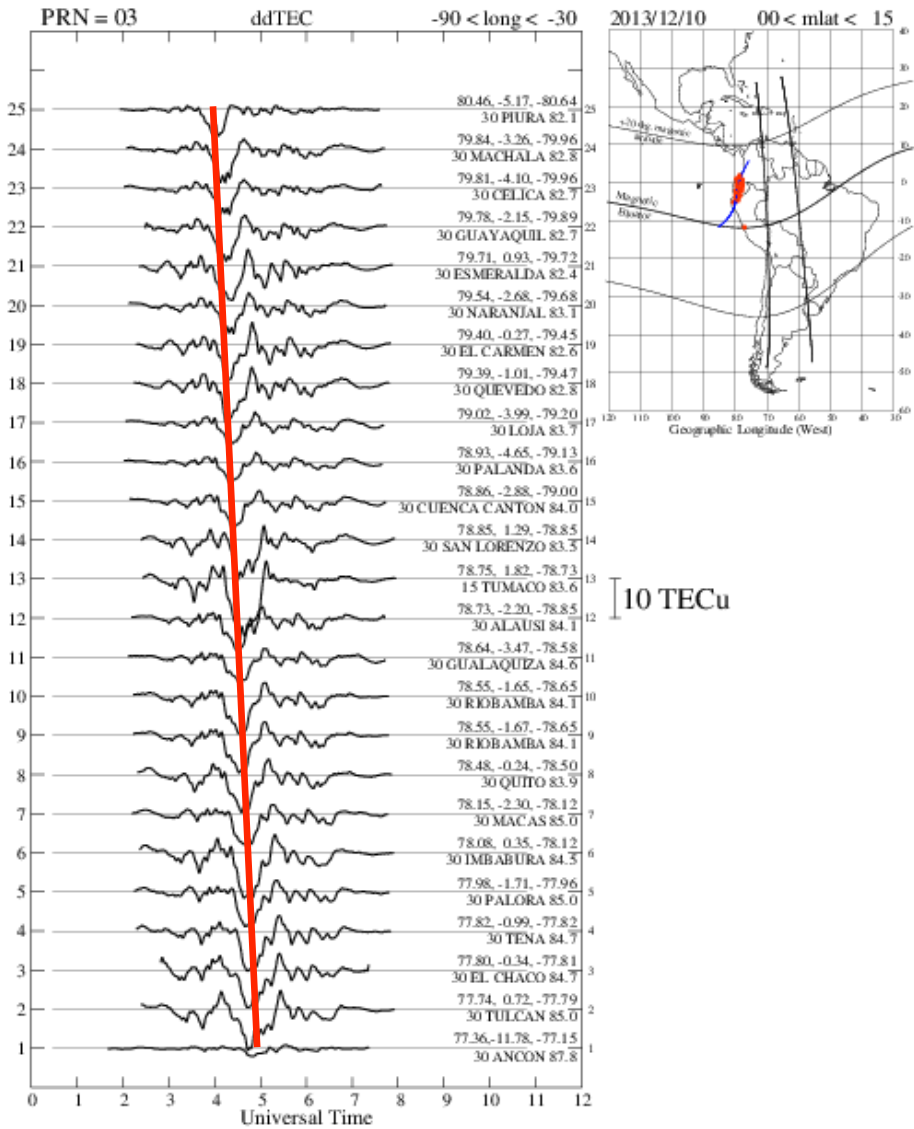
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C/NOFS pass over the western part of South America

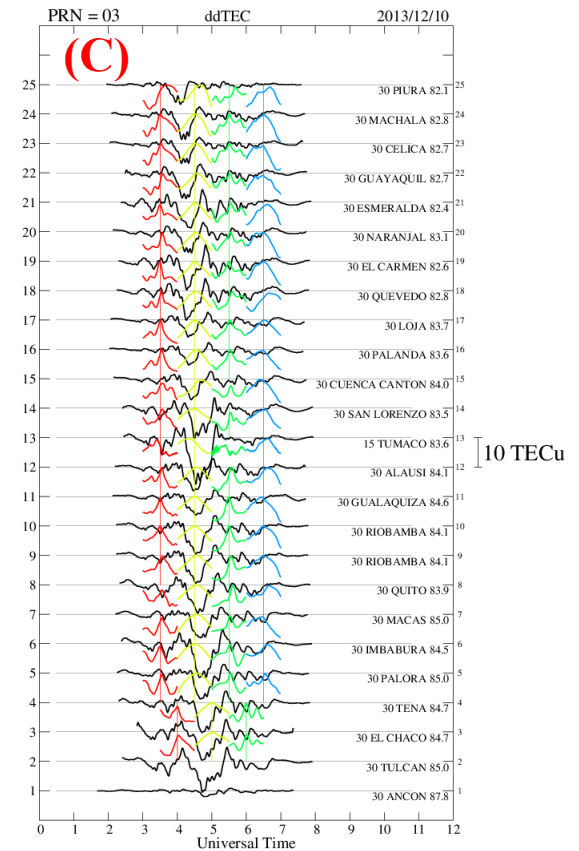
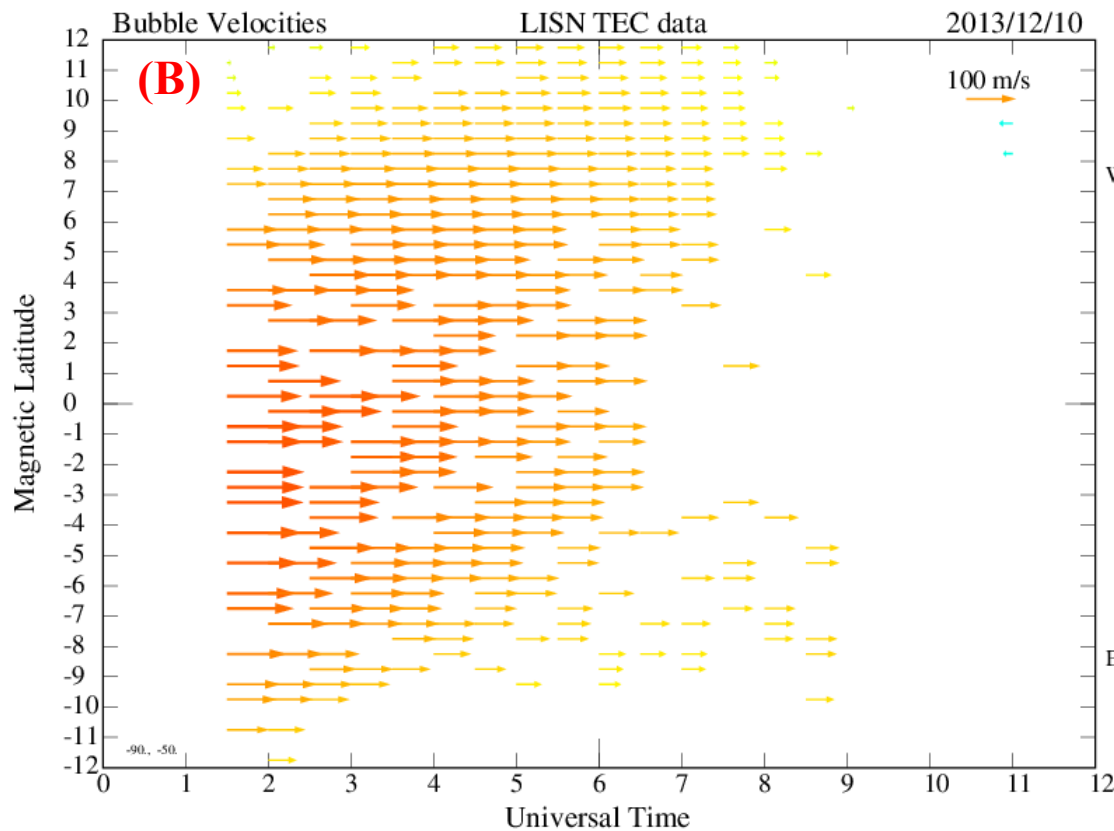
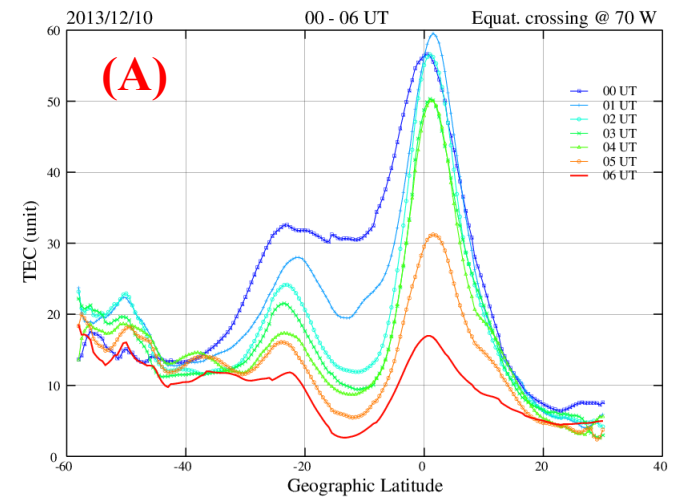


TEC perturbation from PRN = 03, 06 recorded on December 10, 2013

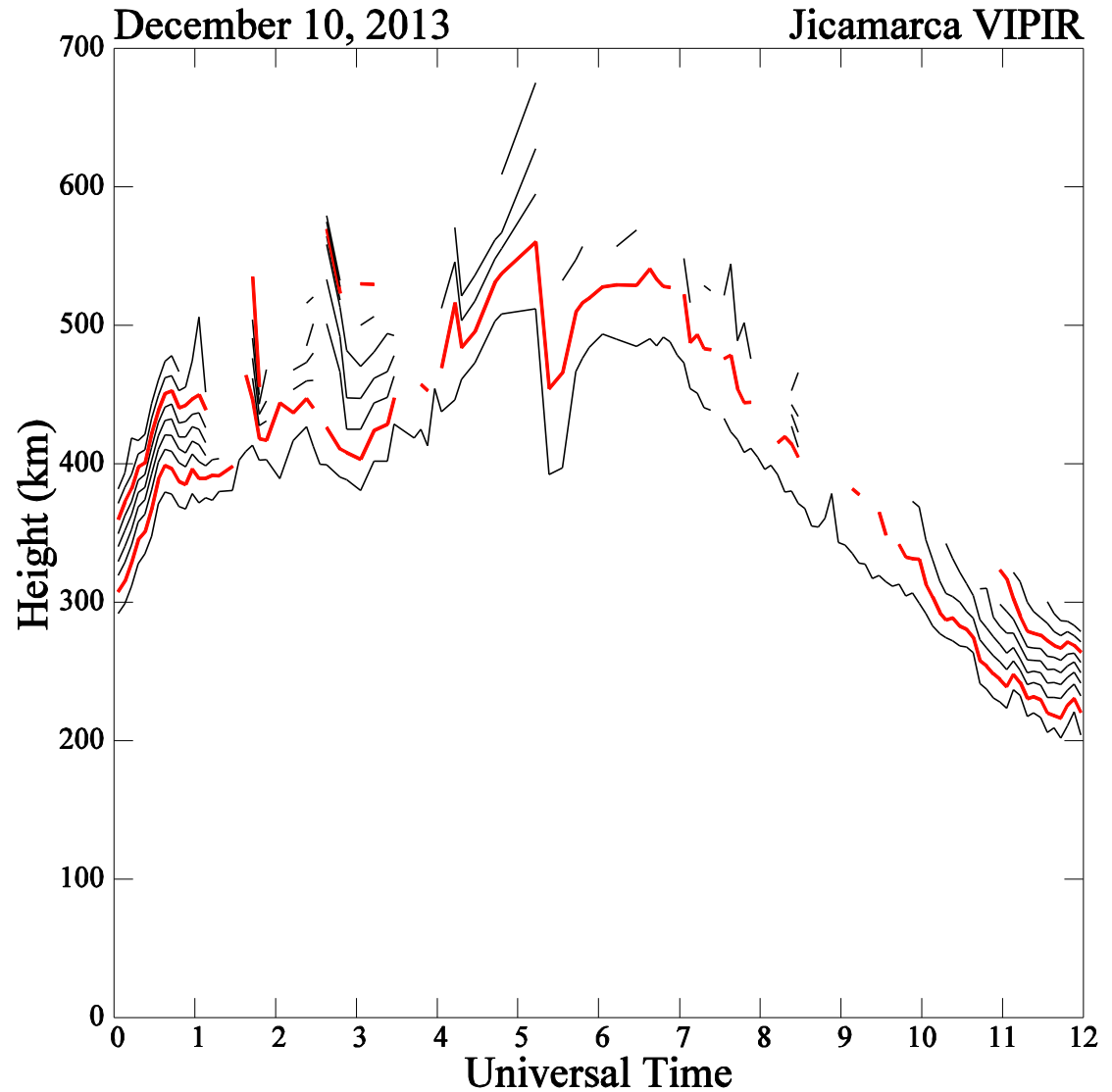
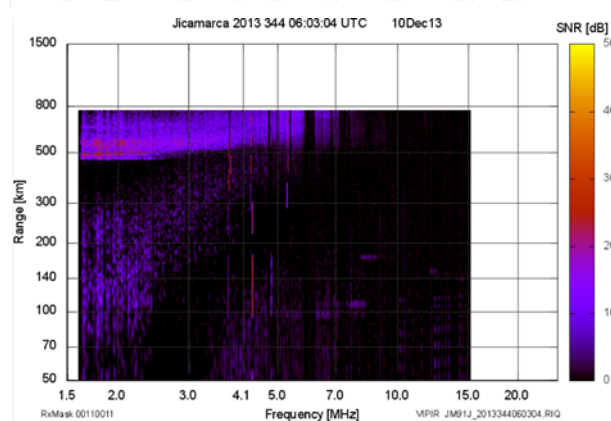
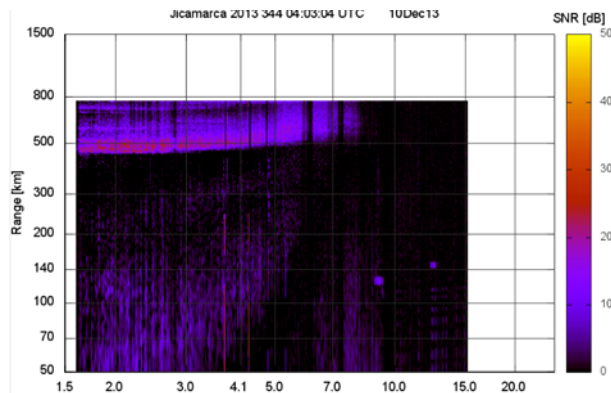
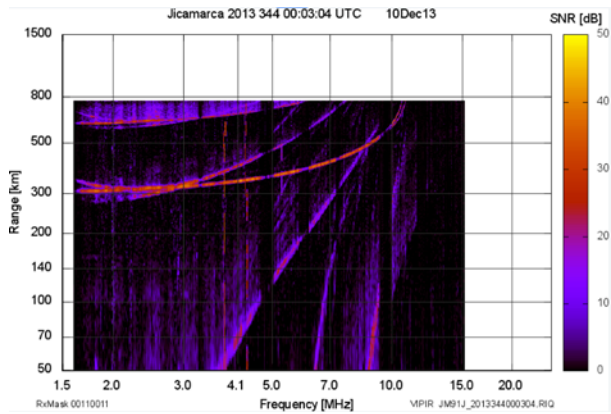


Velocity of plasma bubbles ~125 m/s

Analysis of TEC depletions to calculate the drift velocity of plasma bubbles using the LISN TEC data corresponding to December 10, 2013. **(A)** TEC latitudinal profiles showing the anomaly lasting until 06 UT at 70° W. **(B)** cross-correlations of adjacent stations aligned from West to East in magnetic coordinates. **(C)** Velocity field based on all stations in South and Central America.

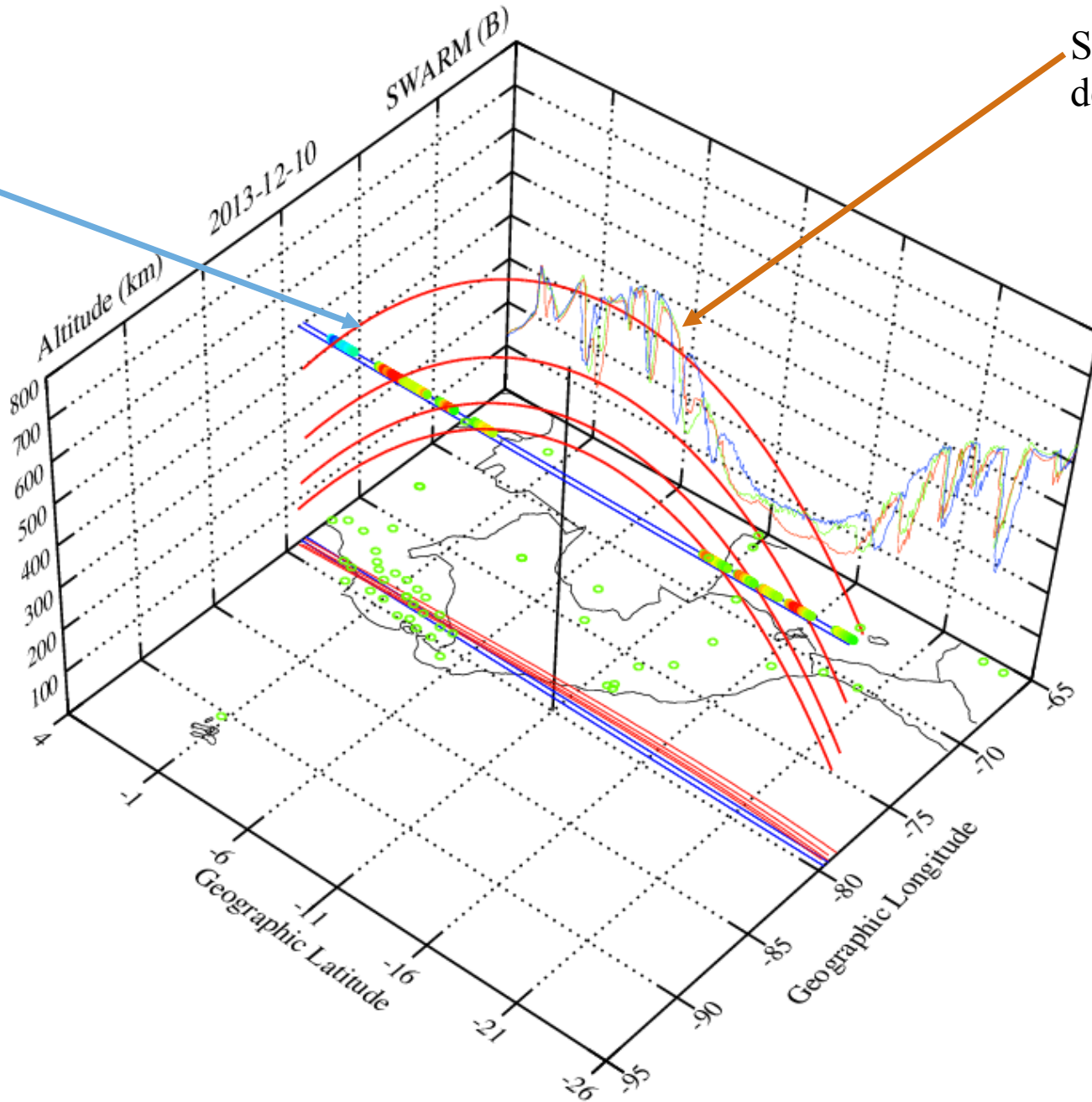


Ionograms and hand-scaled densities using VIPIR ionosonde



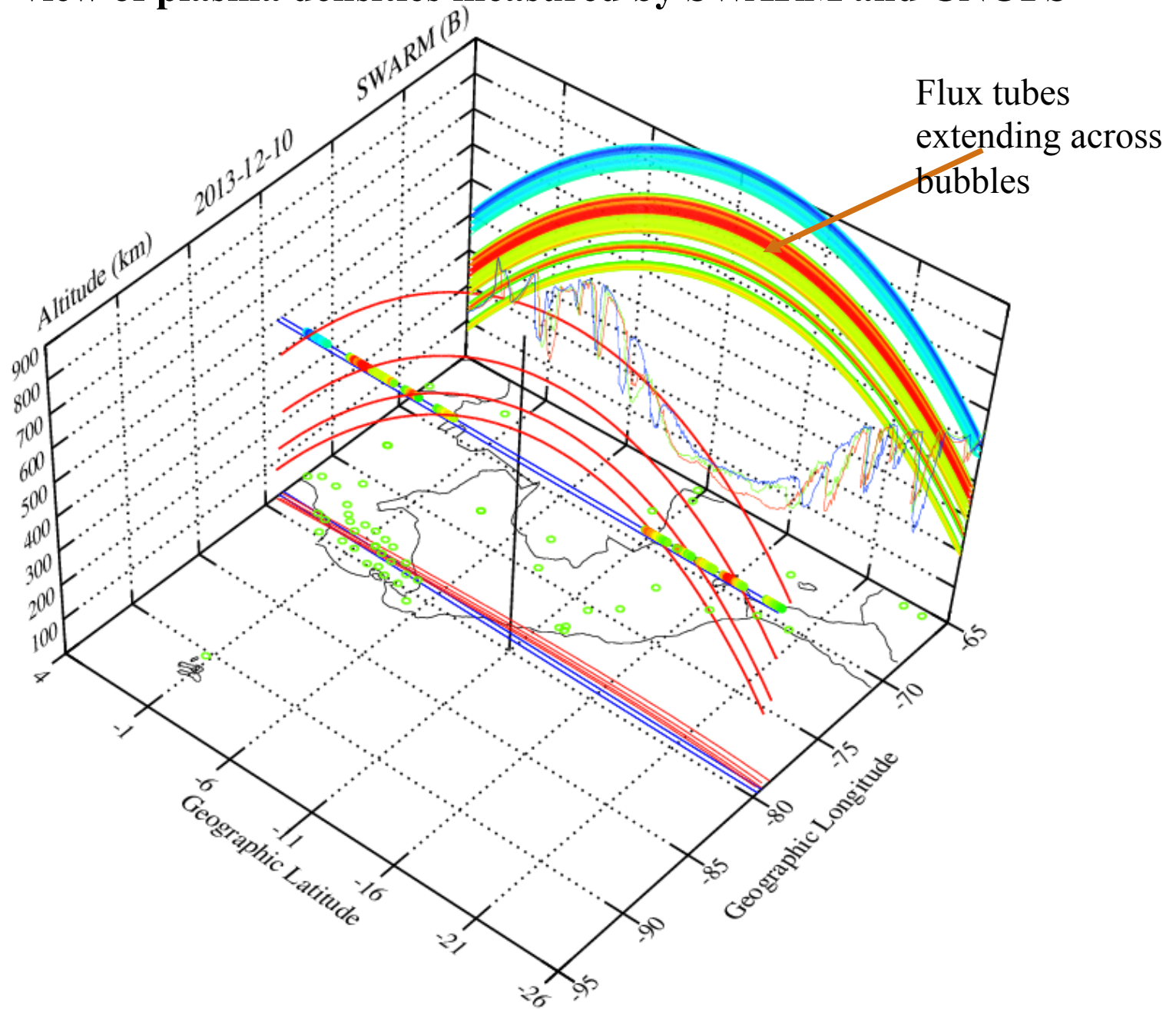
3D view of plasma densities measured by SWARM and CNOFS

Field lines
intersecting
bubbles



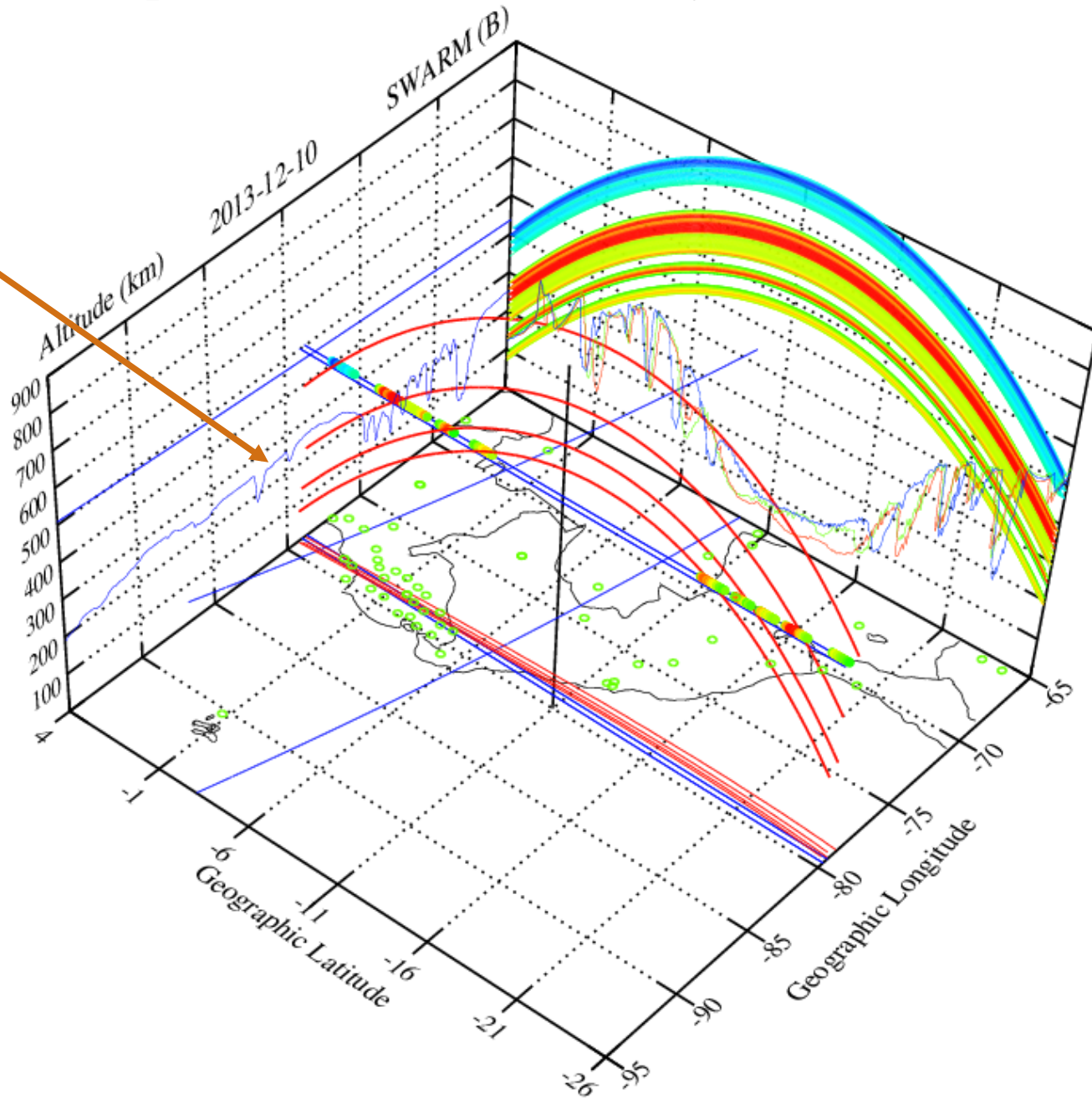
SWARM
density

3D view of plasma densities measured by SWARM and CNOFS



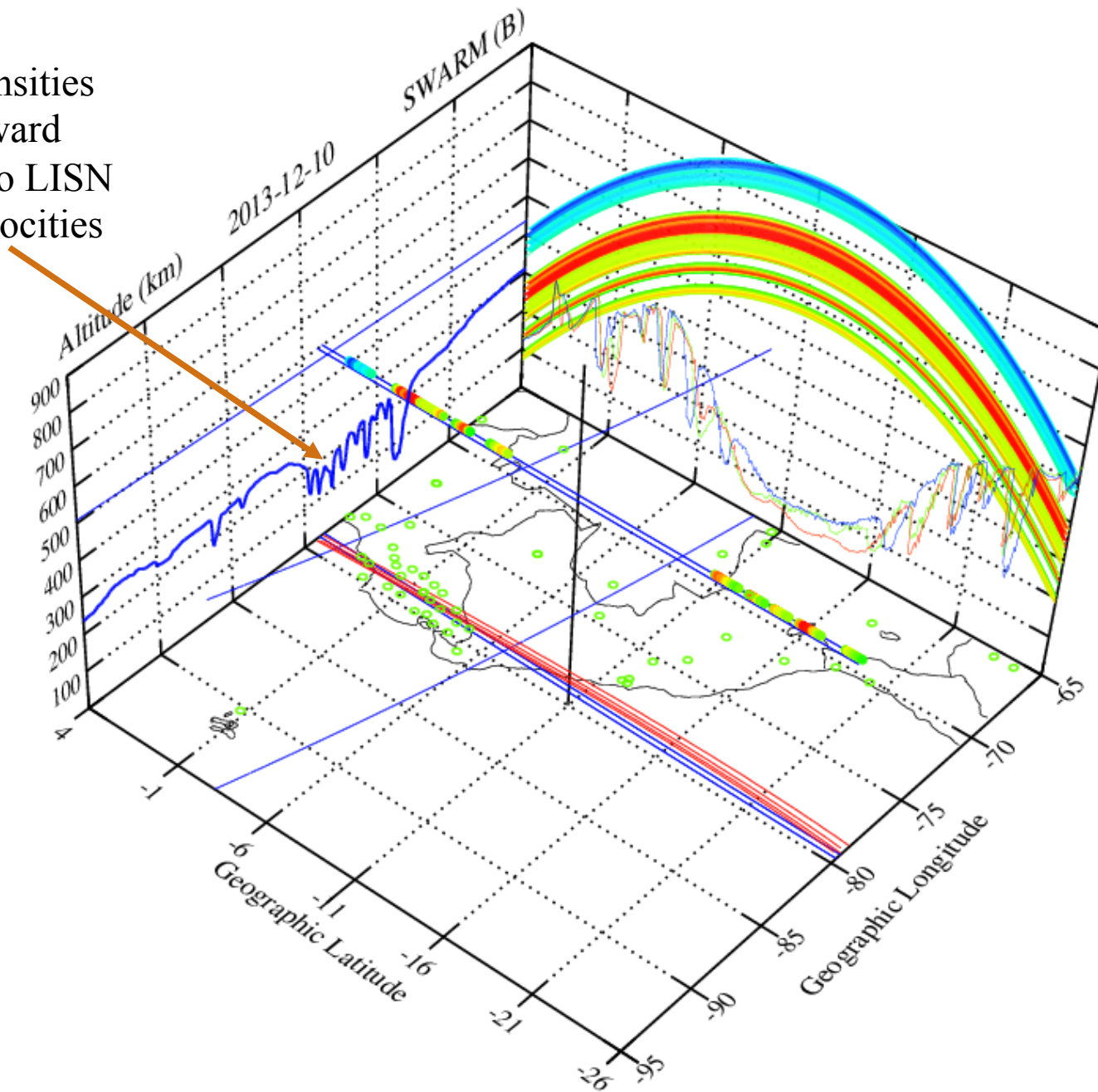
3D view of plasma densities measured by SWARM and CNOFS

CNOFS
densities

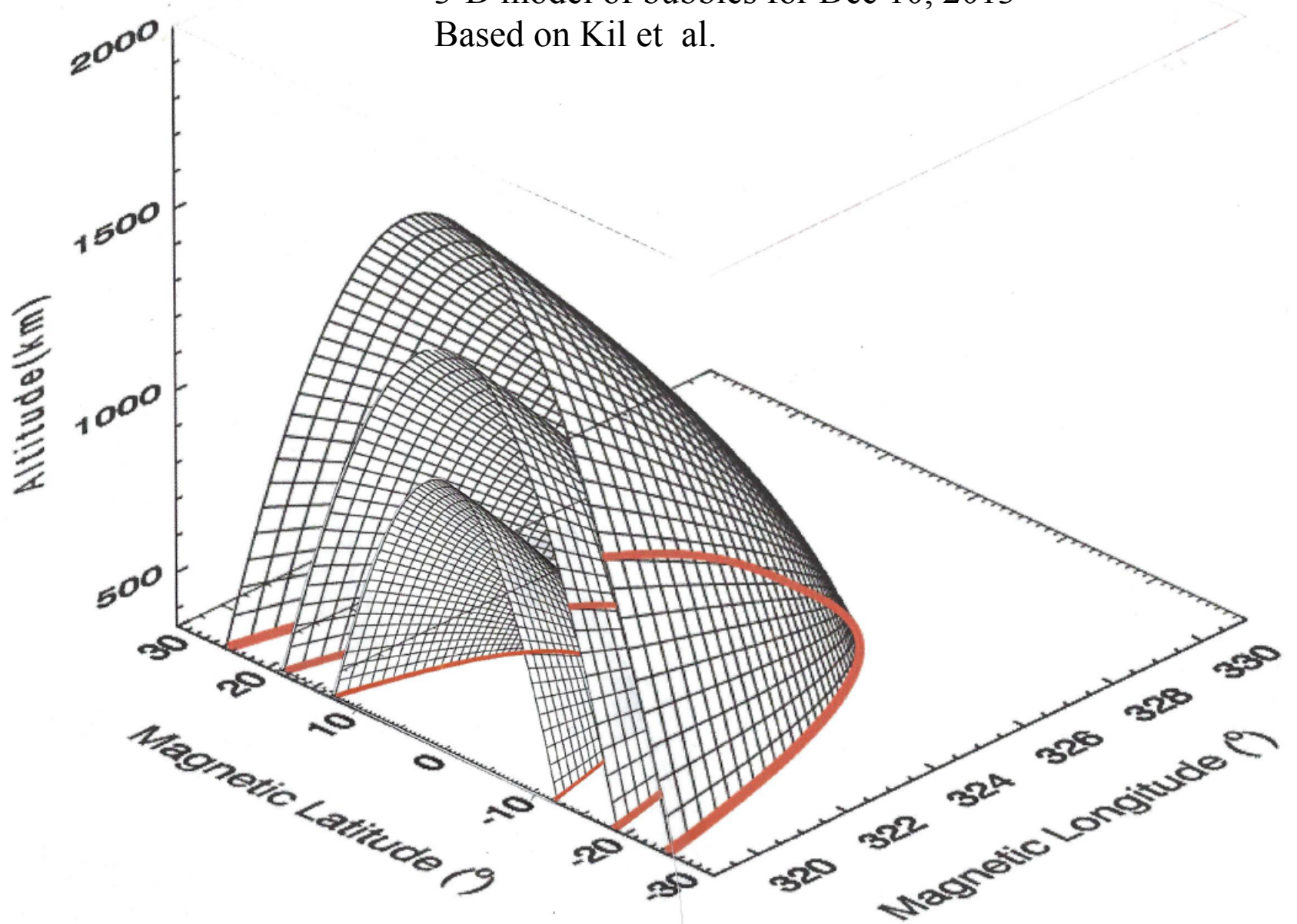


3D view of plasma densities measured by SWARM and CNOFS

CNOFS densities
moved forward
according to LISN
bubbles velocities



3-D model of bubbles for Dec 10, 2013
Based on Kil et al.



Conclusions

A new processing algorithm has been designed to determine the Bubble velocity field. The velocity has been calculated using hundreds of GPS/GNSS receivers that exist in South and Central America and the Caribbean region.

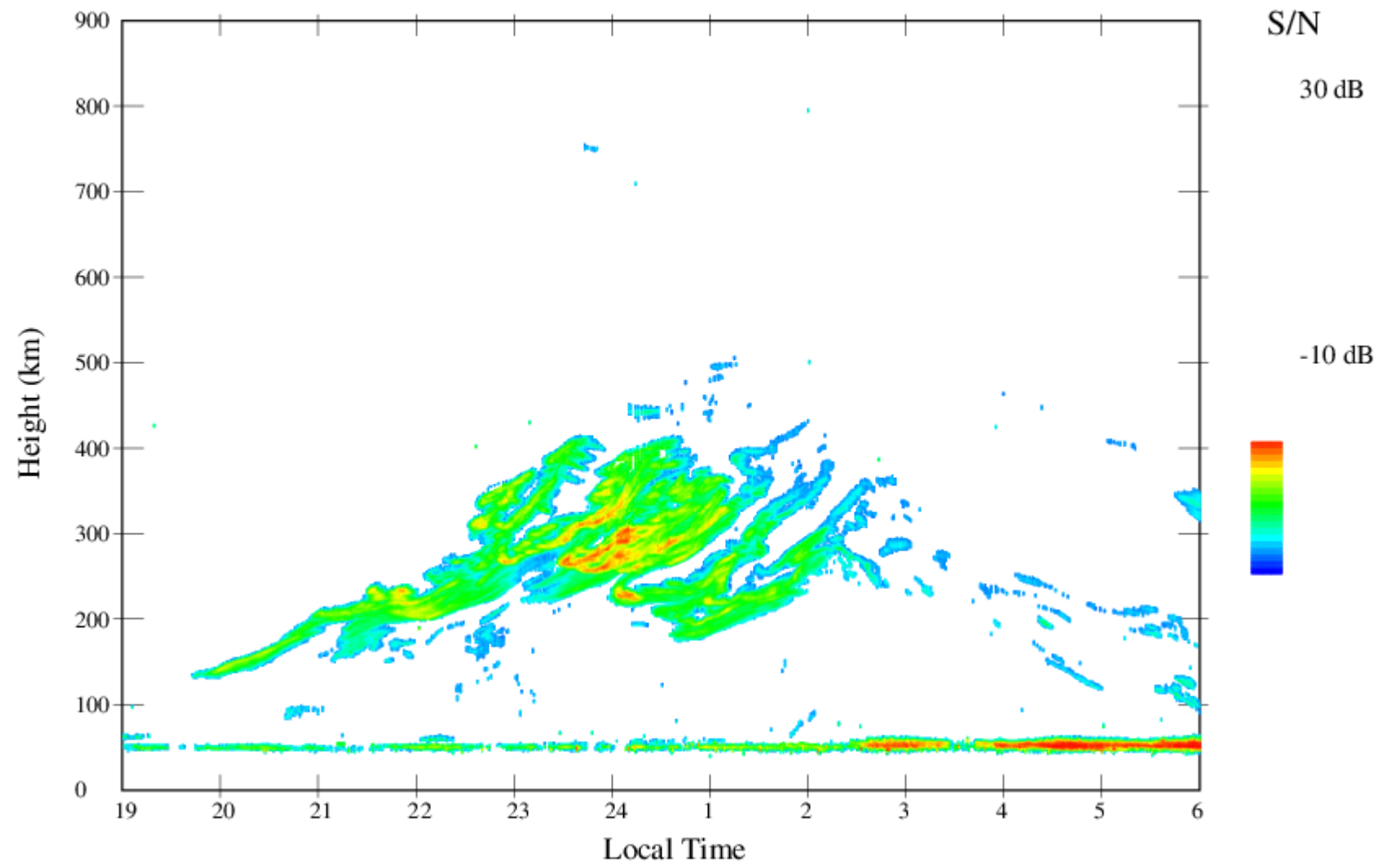
The velocity field can be used to trace backward/forward in time locations of plasma bubbles observed with different satellites/times.

Bubbles have a strong altitudinal variability that can be seen with multiple satellite/cubesats.

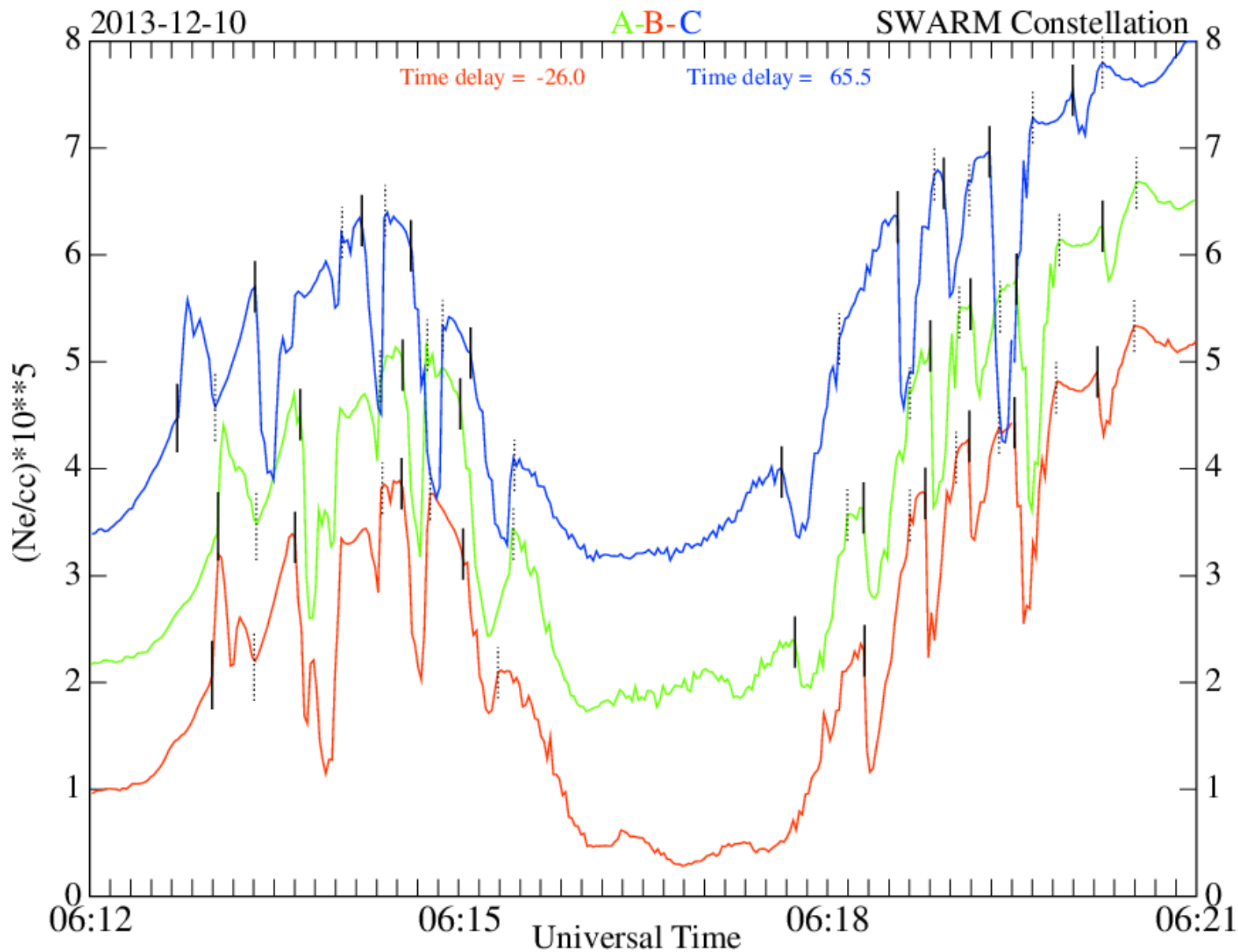
3D reconstruction of plasma bubbles for the month of December 2013 indicate that they are multi-layer embedded shells. Having a 3D model of plasma bubbles will help to construct a better model of scintillations.

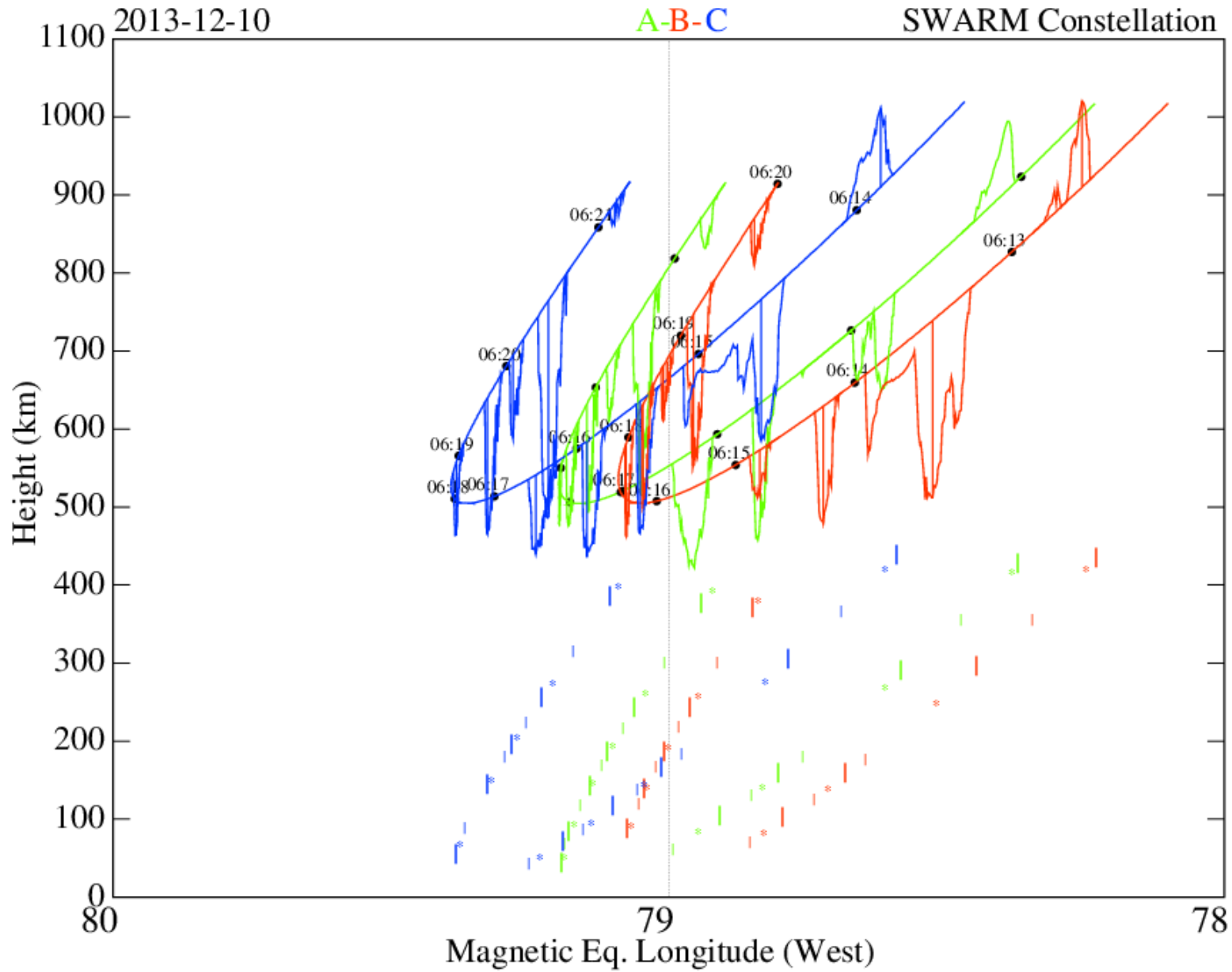
Dec. 09, 2003

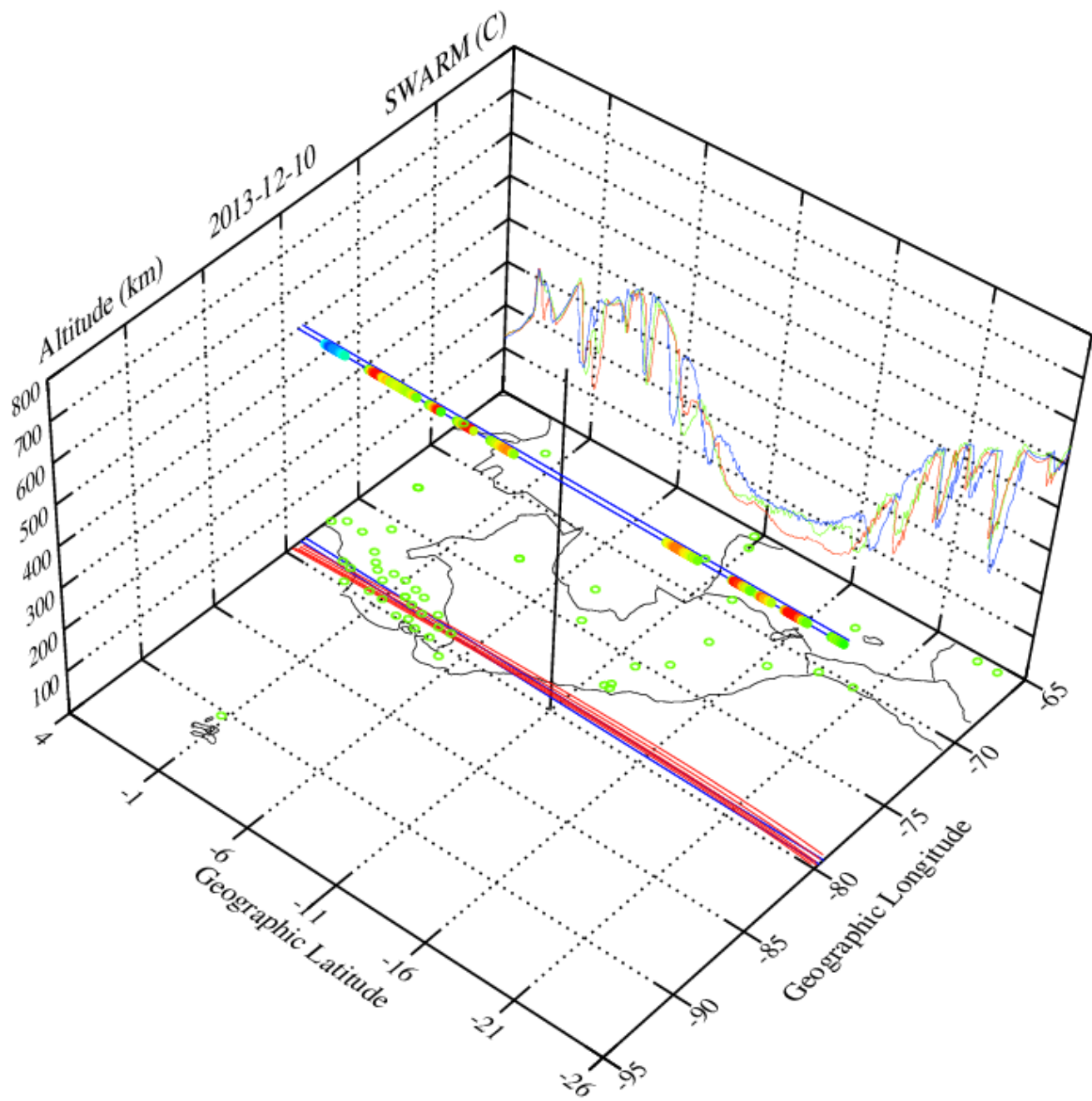
JULIA radar

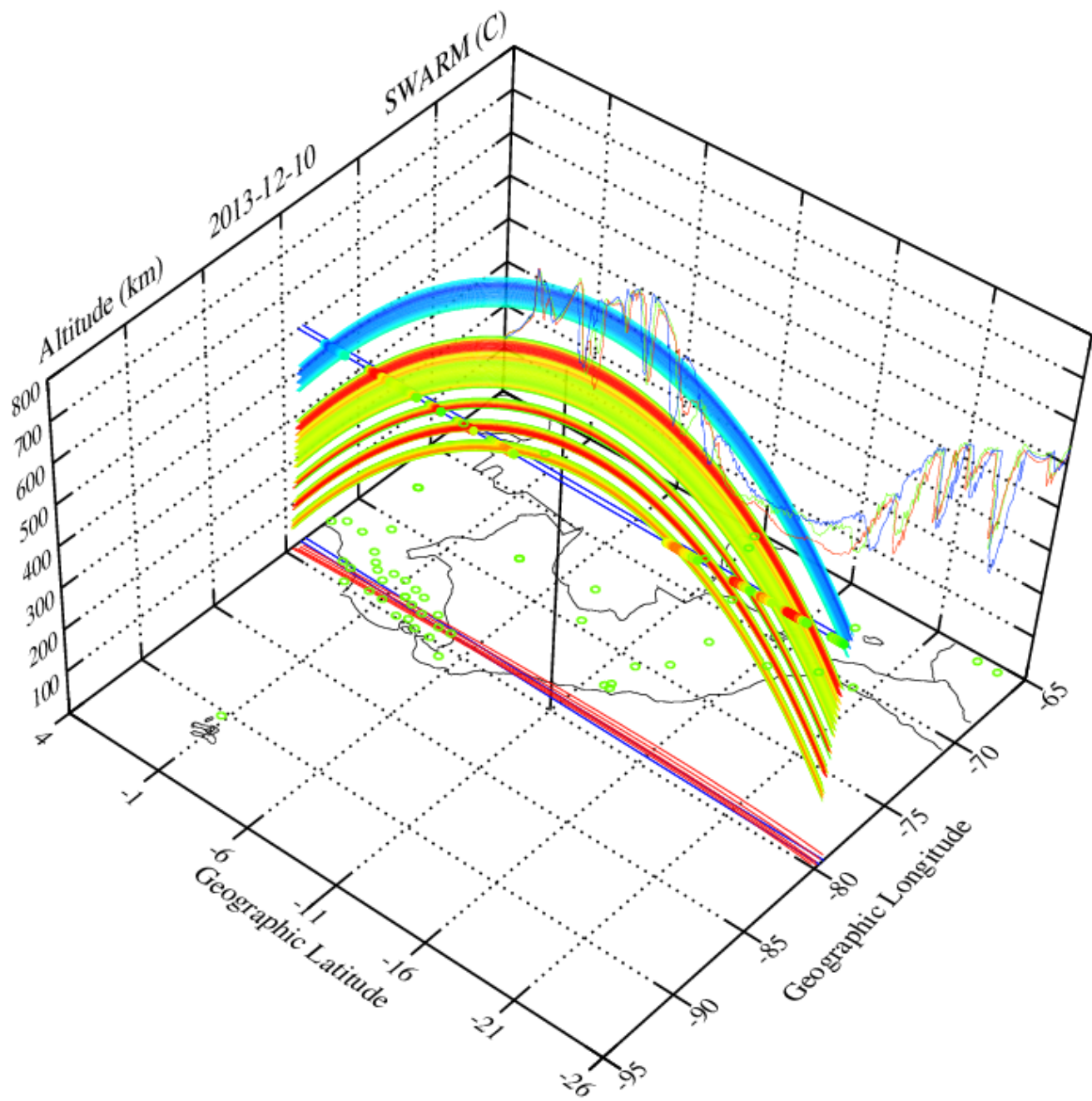


Bubble detection with SWARM during a pass close to magnetic meridian

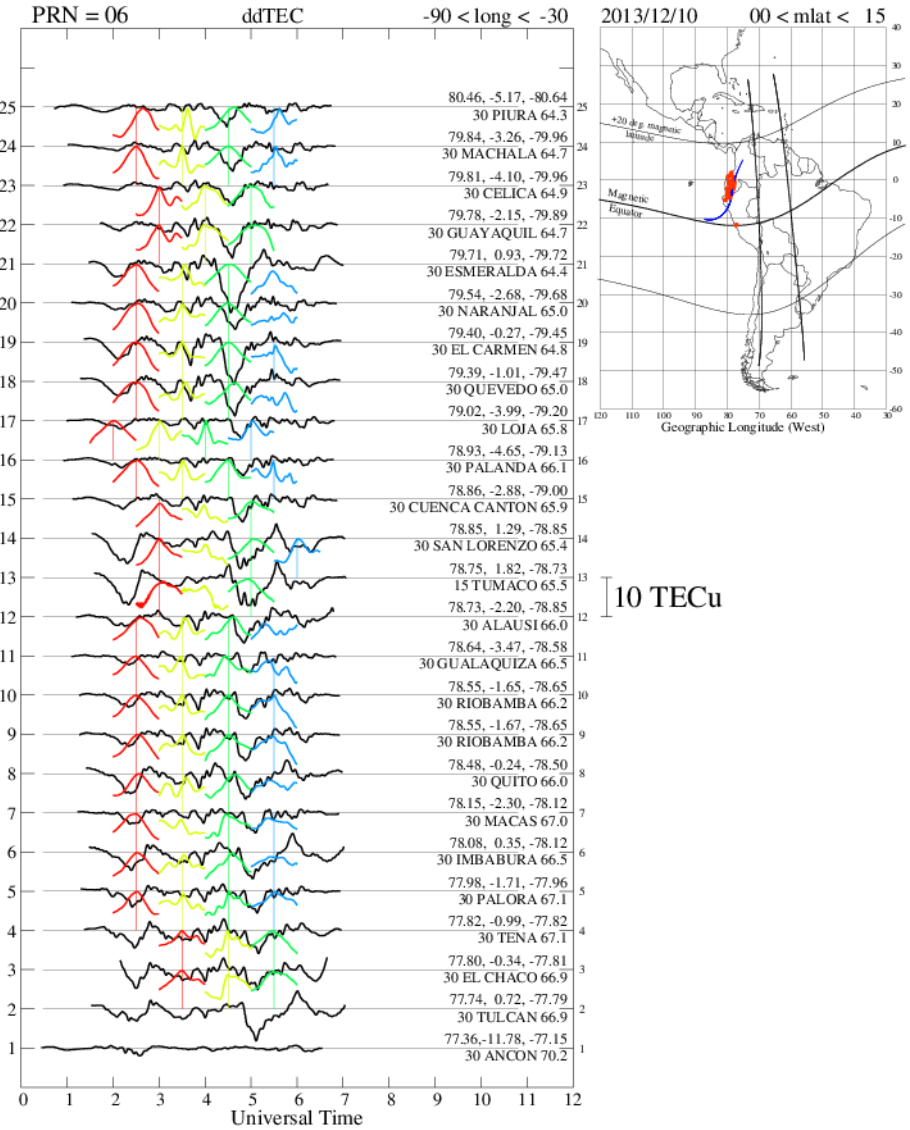
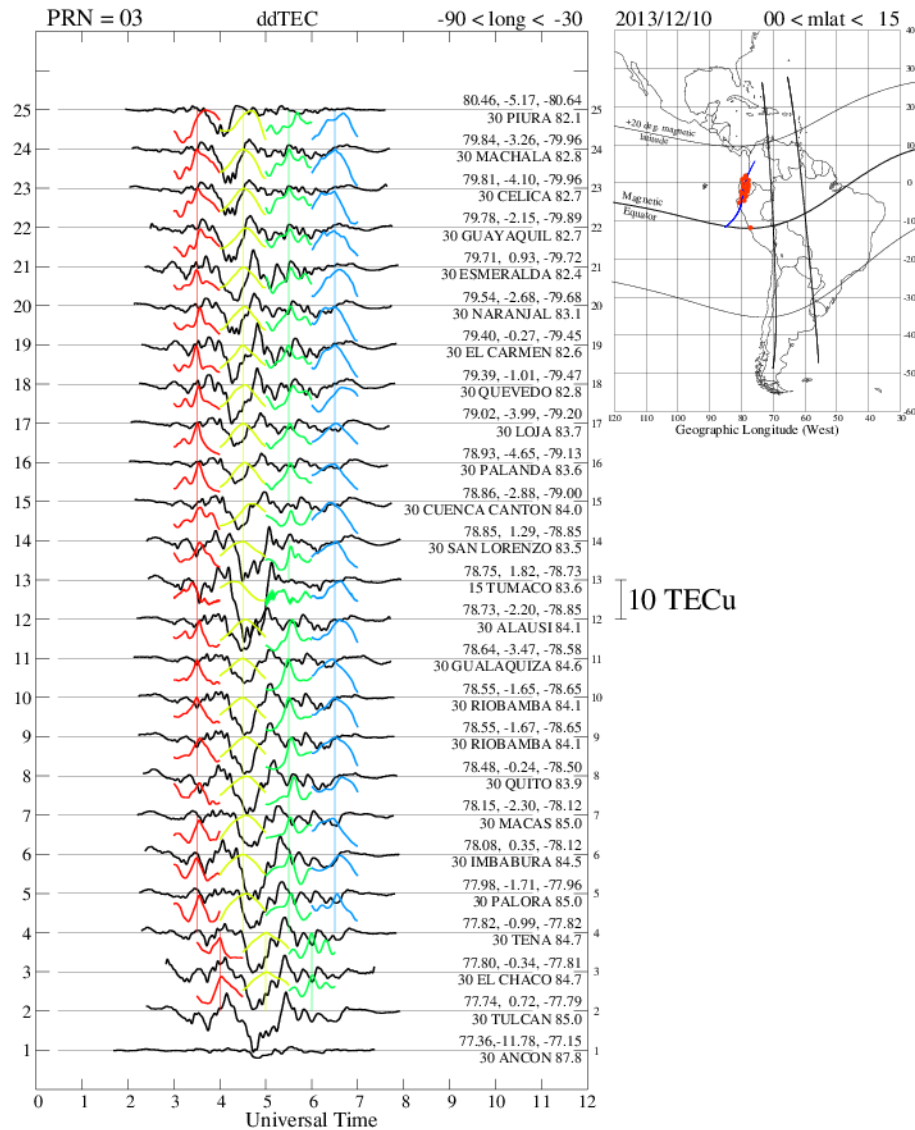




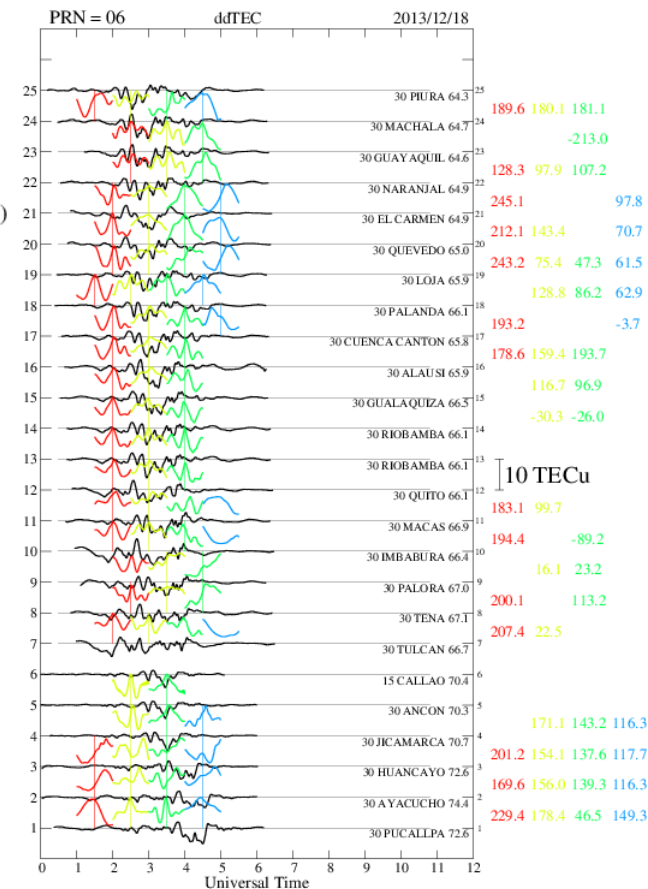
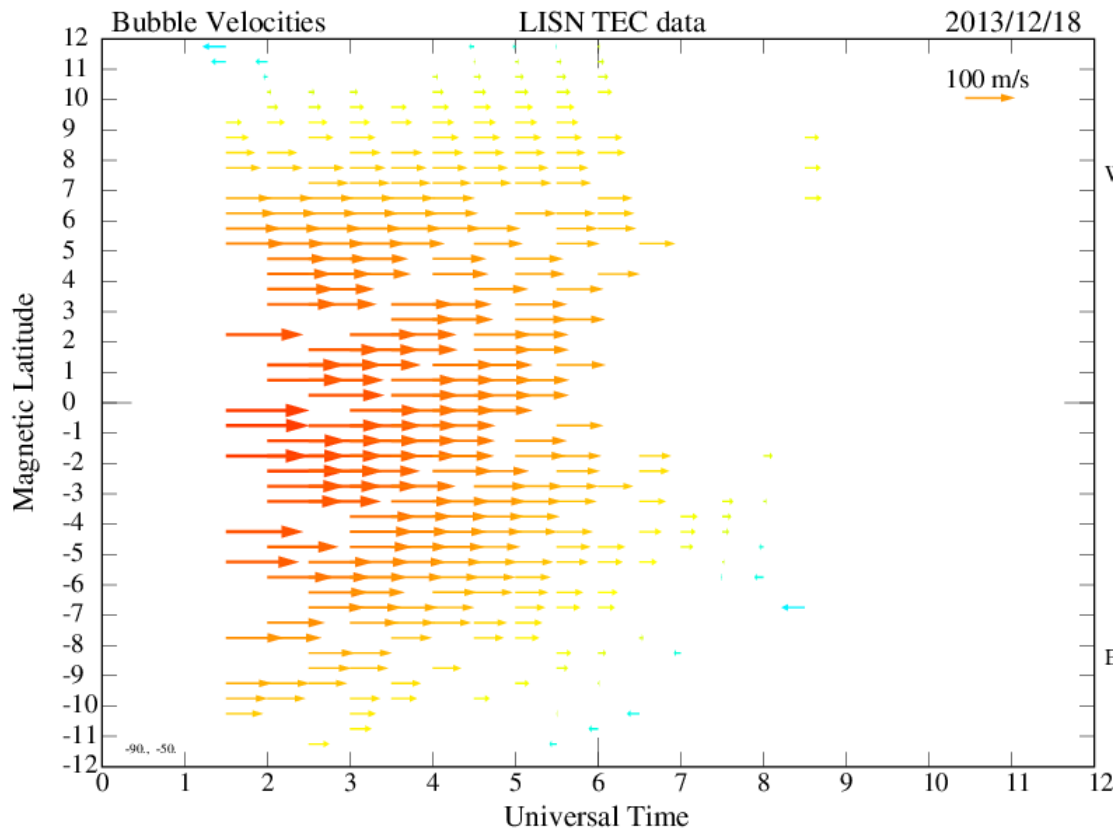
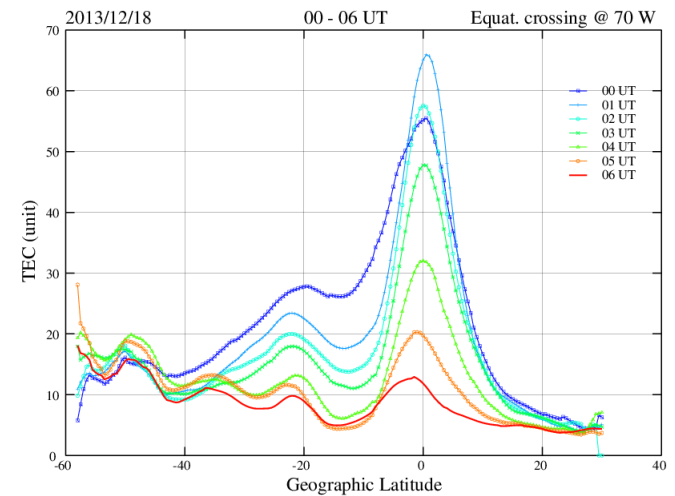




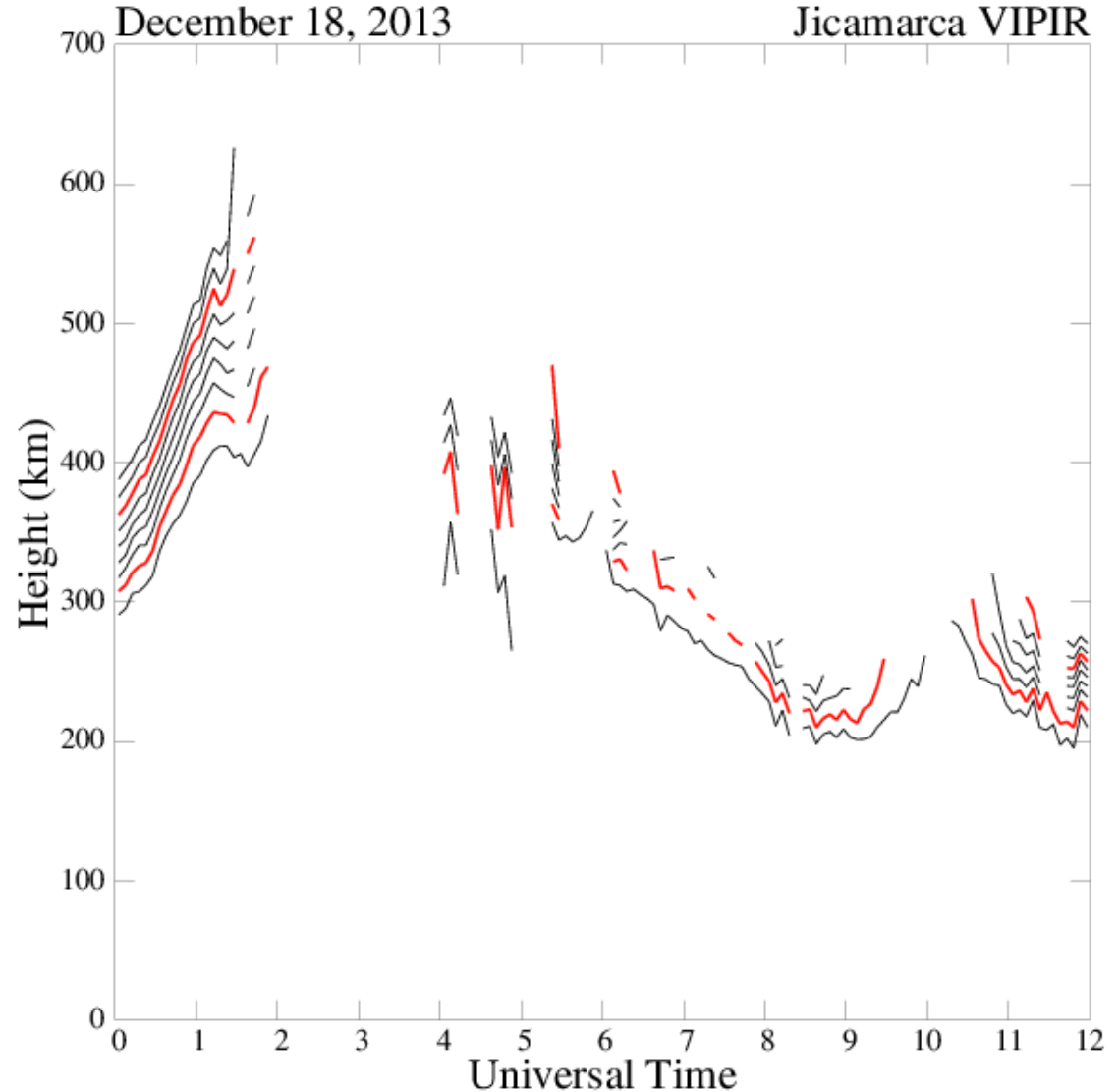
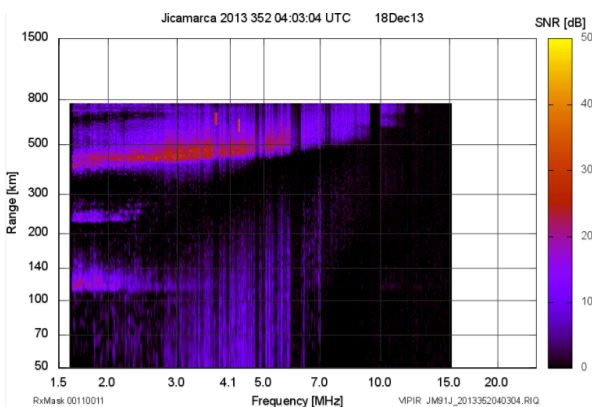
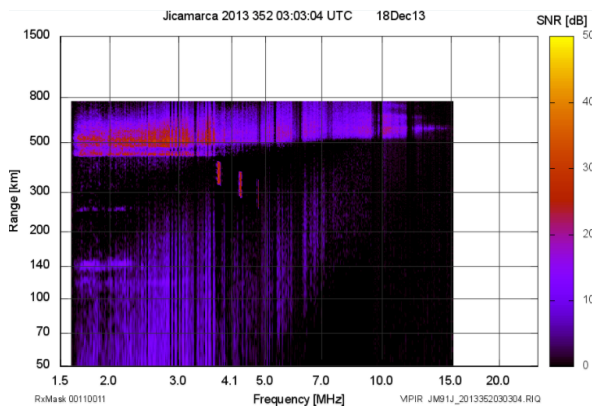
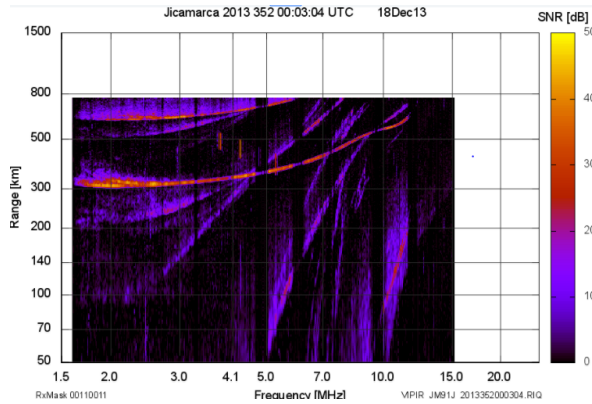
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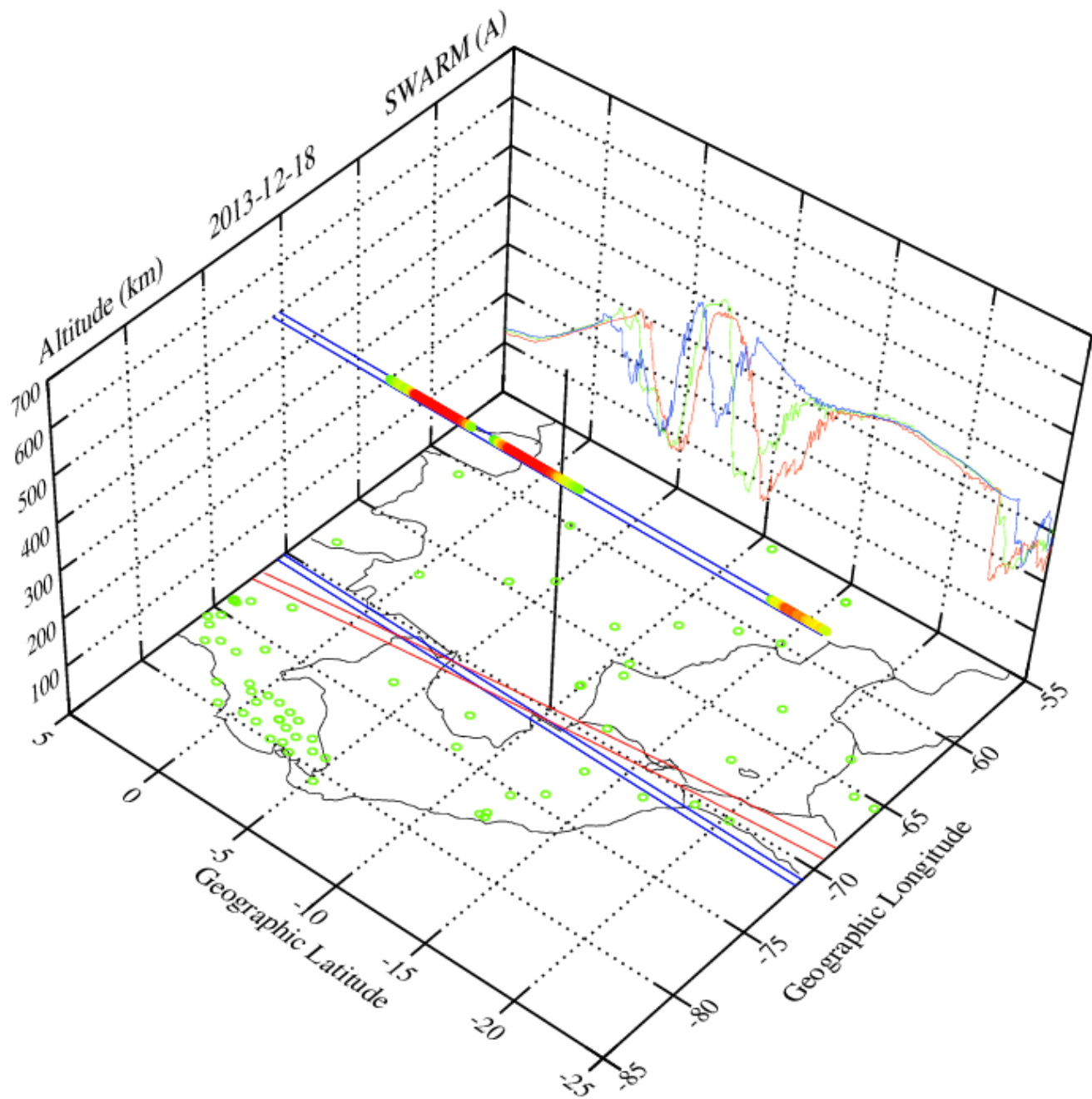


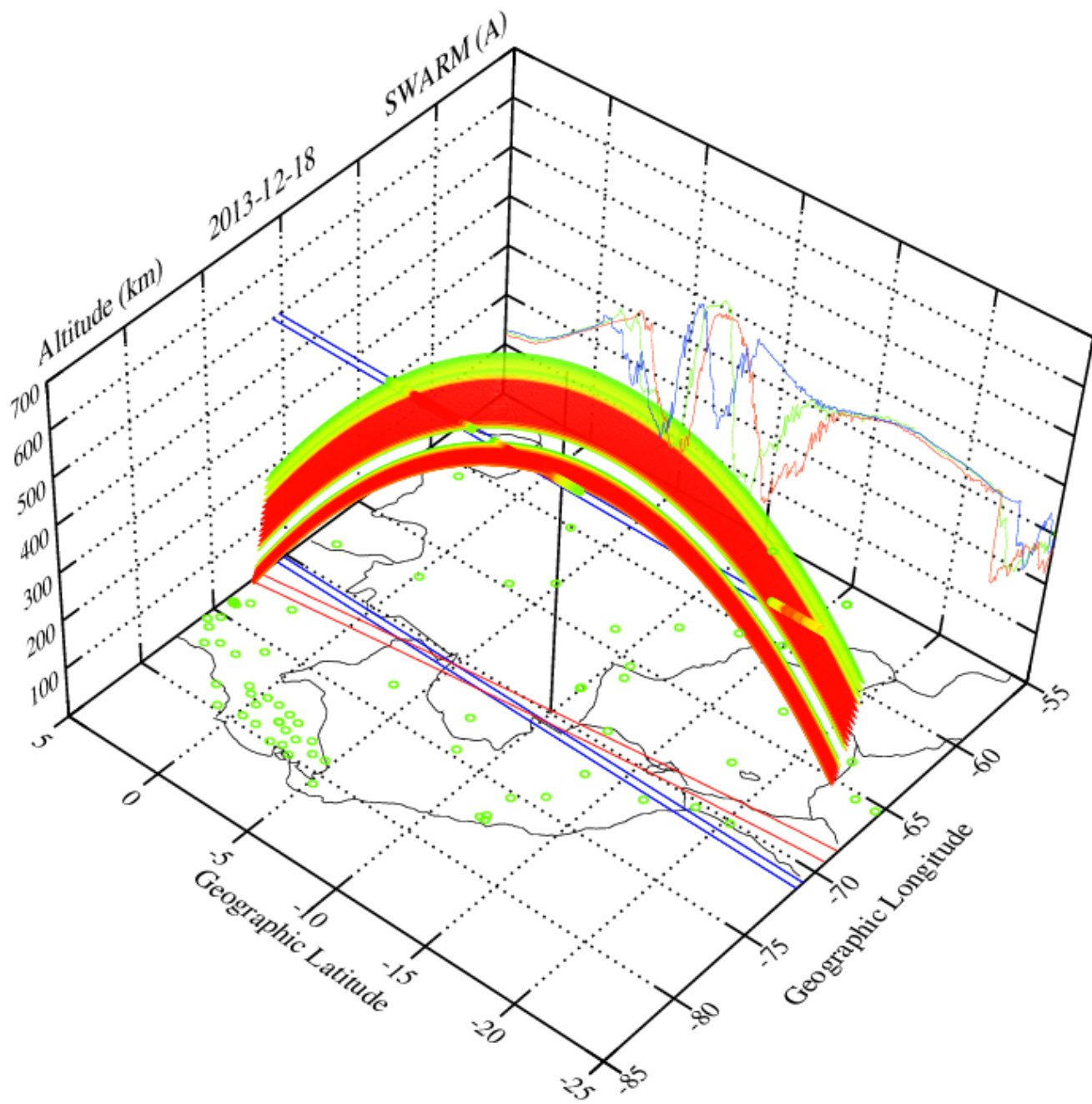
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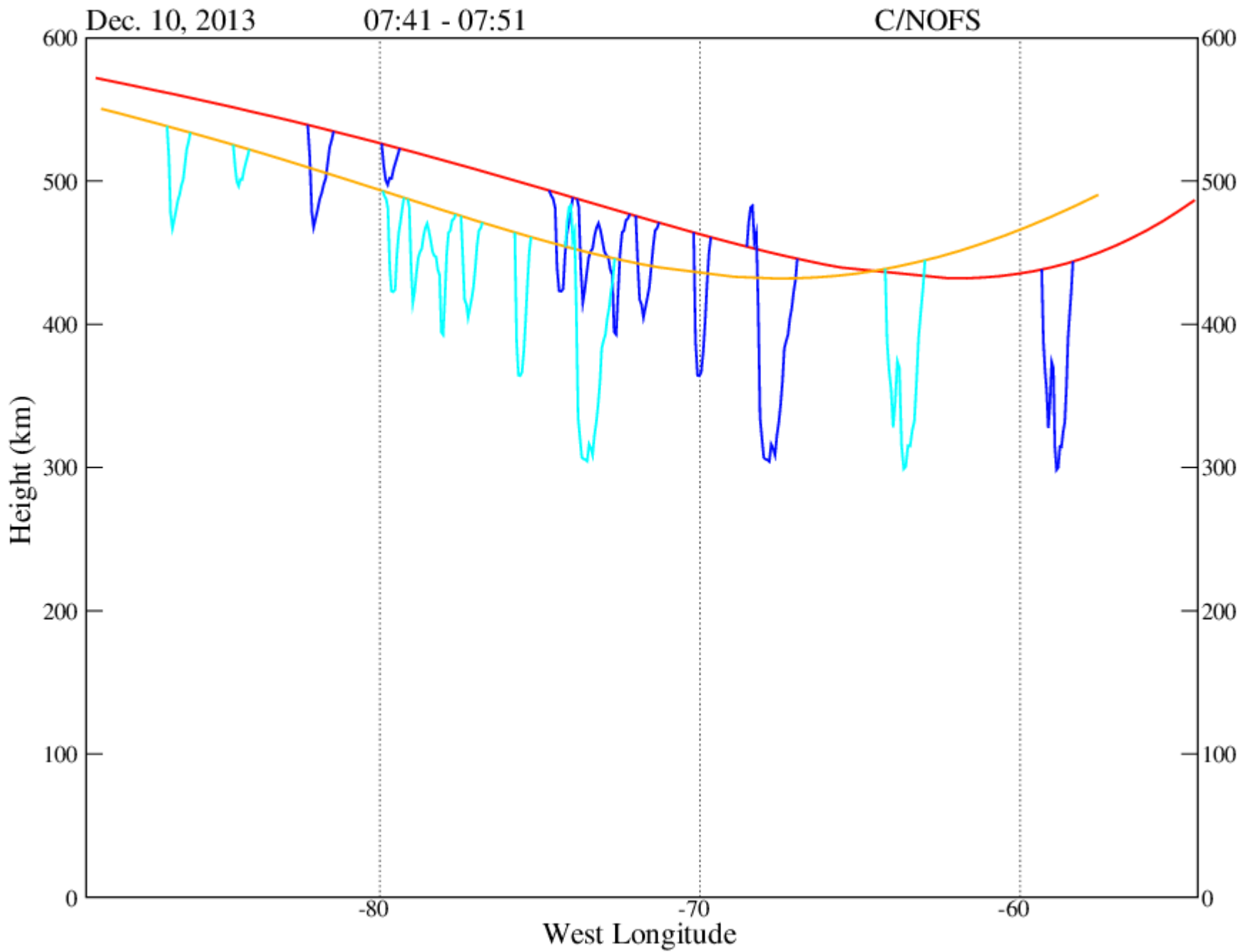


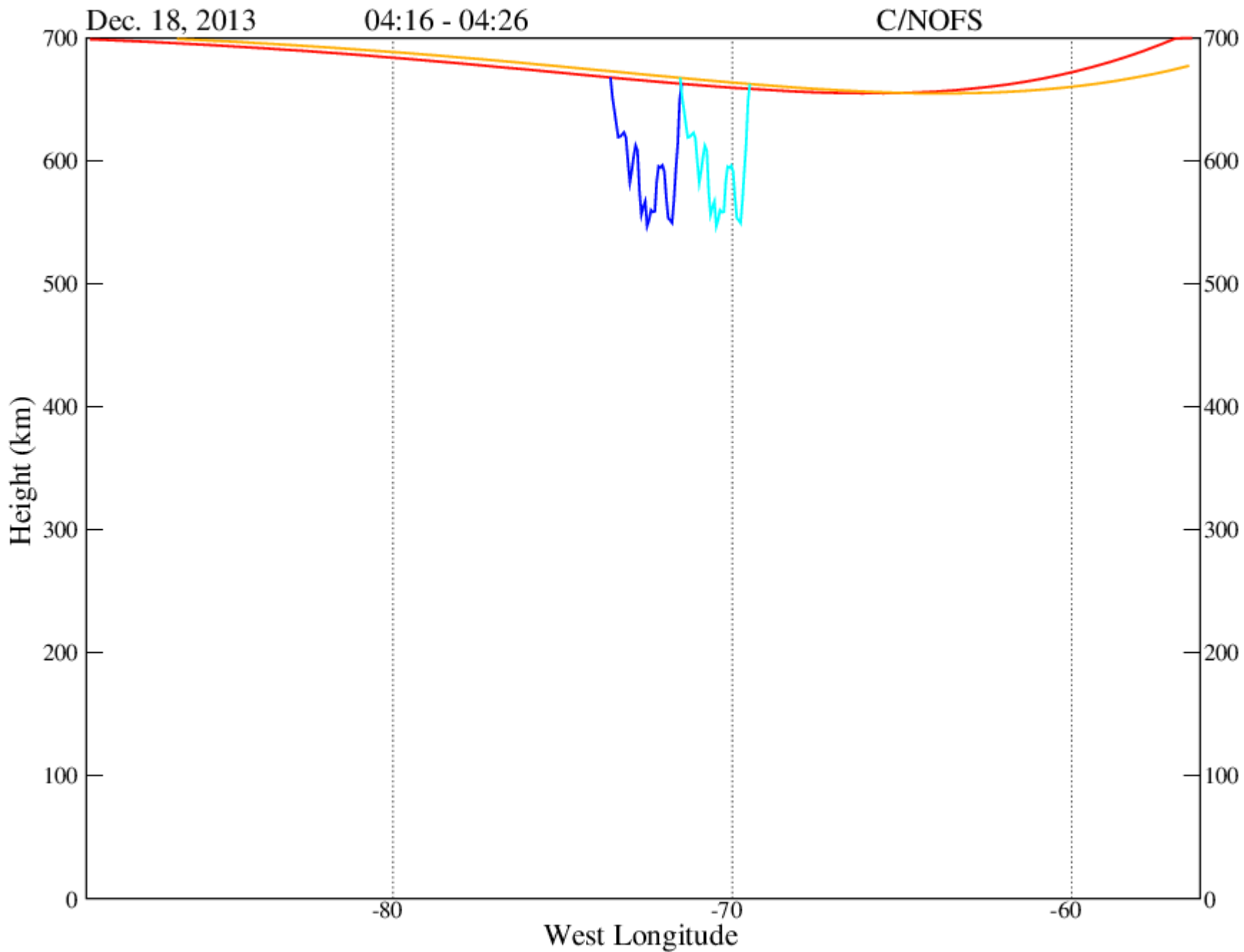
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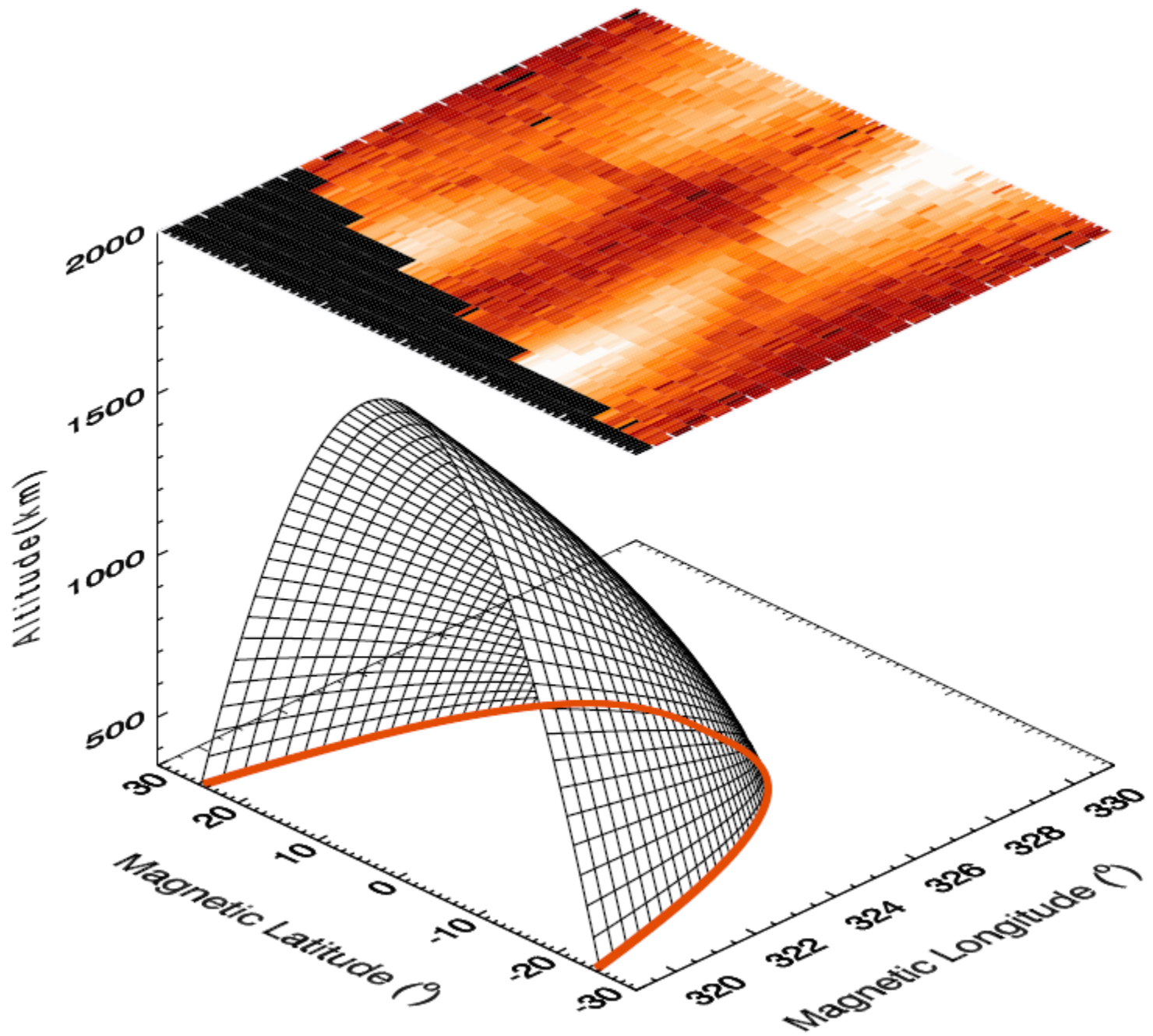


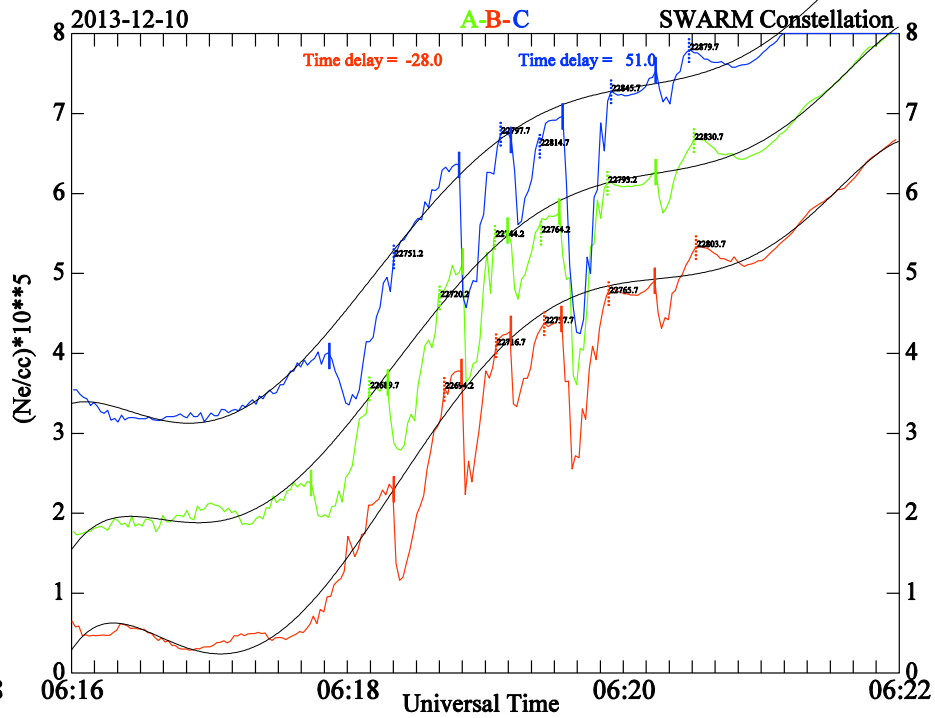
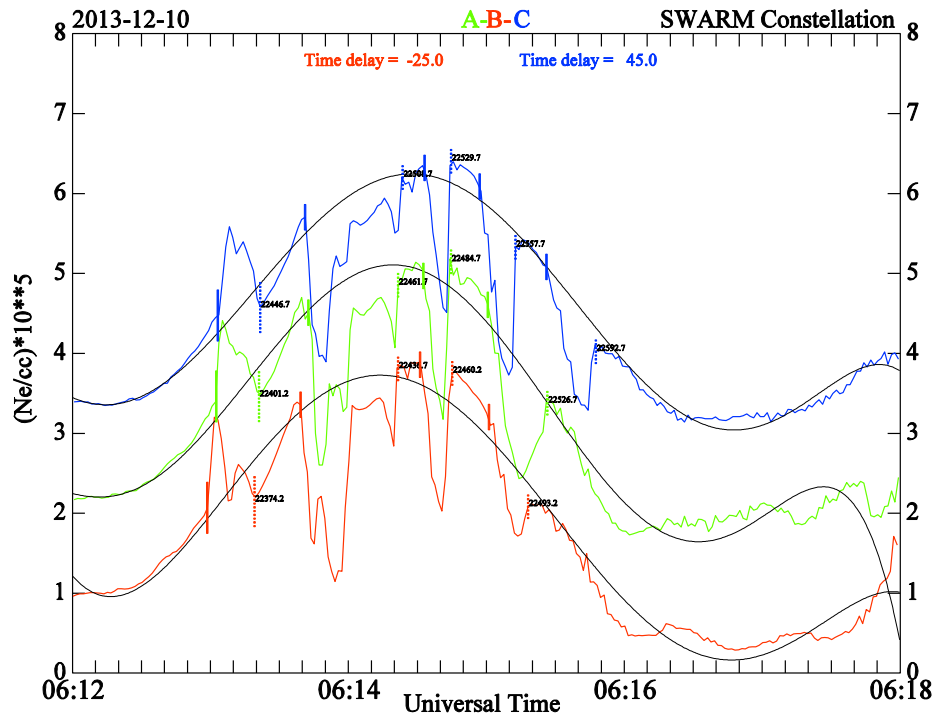


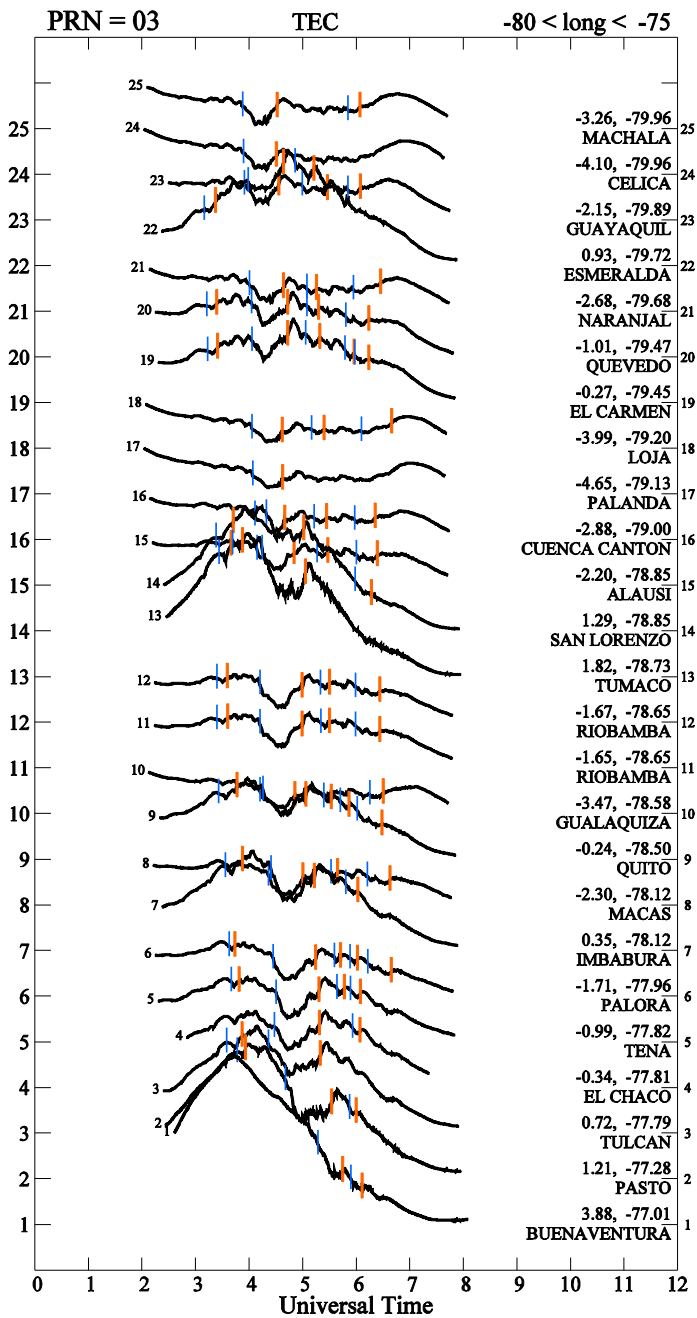




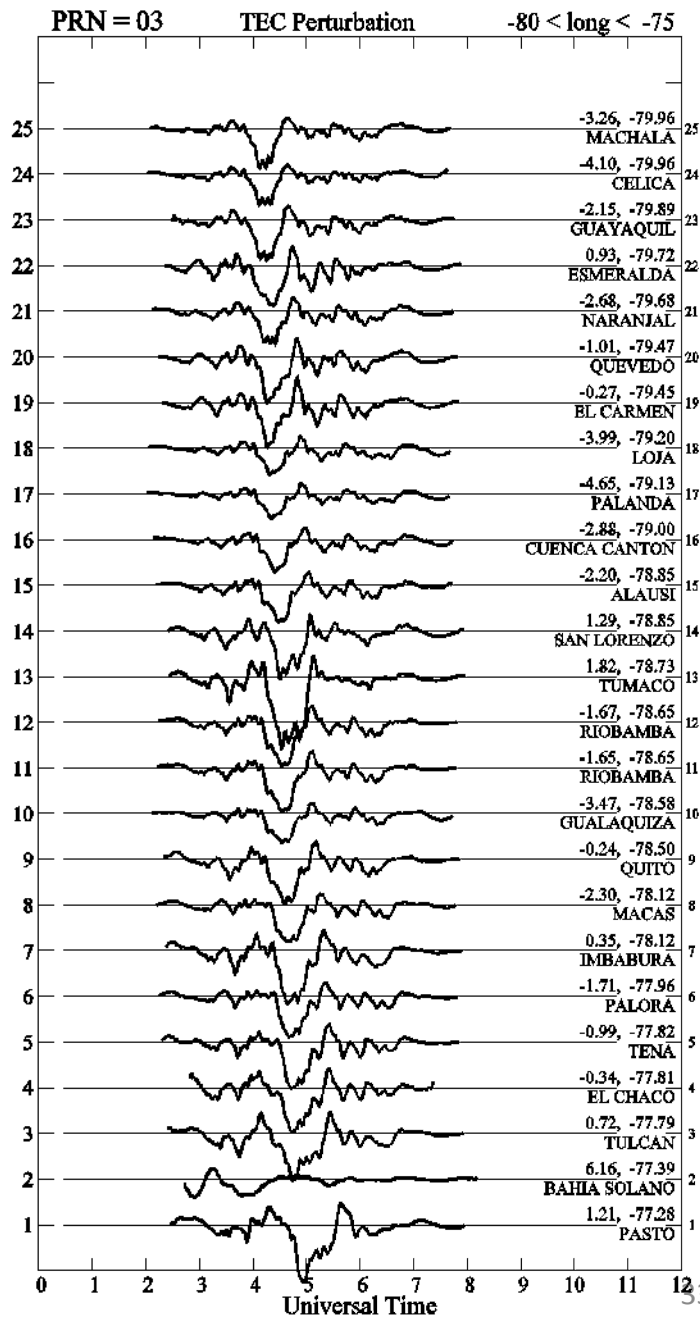








20 TECu



10 TECu

