

NSF CEDAR post-doc final report

Imaging studies of ionospheric irregularities

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Airglow emissions at 630.0 nm are used to study perturbations associated with low and mid latitude instabilities.

- 1- **ESF** signatures at Arecibo and simultaneous observations in the Southern Hemisphere.**
- 2- Statistics of airglow features (**ESF, MSTIDs, and BW**) at Arecibo**
- 3- Modeling of **ESF** airglow enhancements**
- 4. Conjugate observations of **MSTIDs****

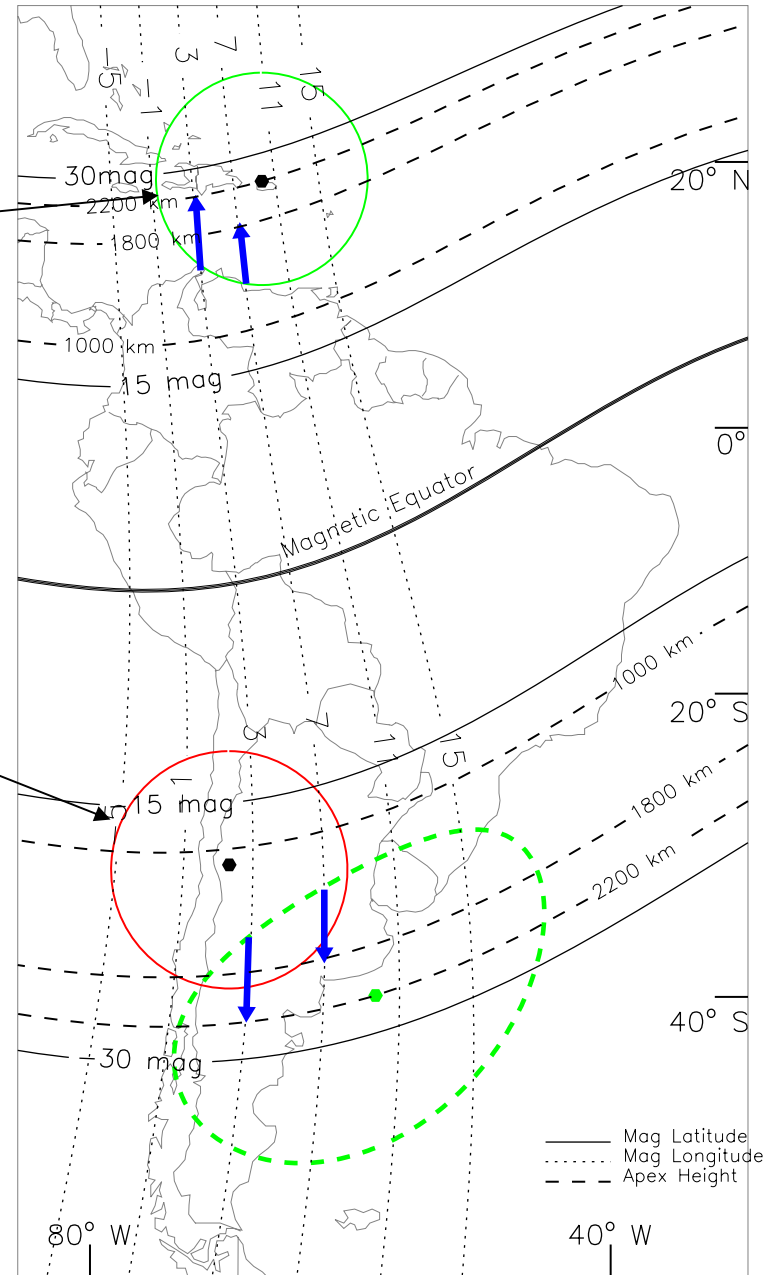
ARECIBO:

mid-latitude, $\sim 27^\circ$ mag
Apex height ~ 2200 km

EL LEONCITO:

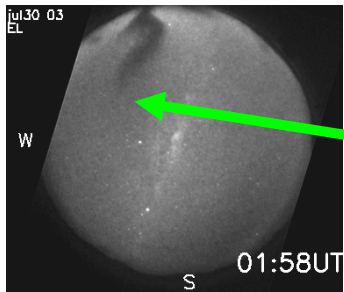
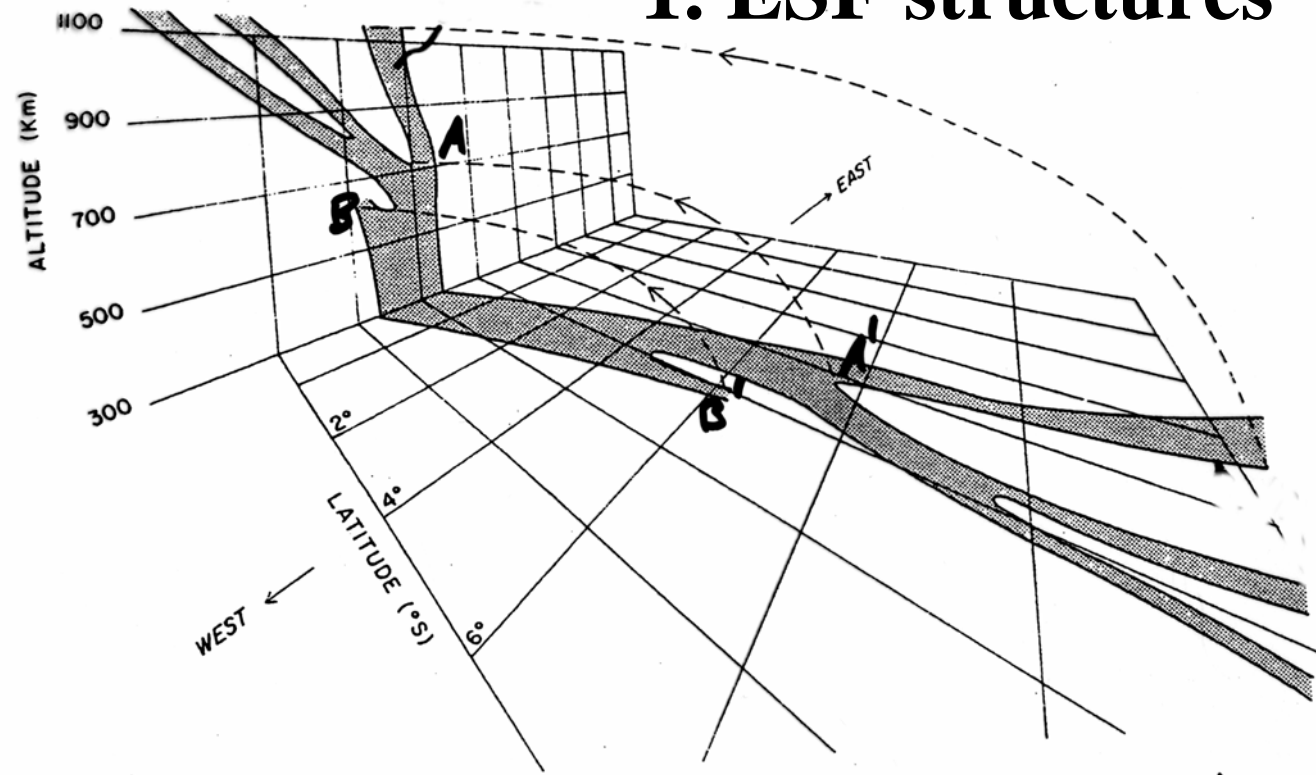
low-latitude, $\sim 18^\circ$ mag
Apex height ~ 1000 km

Dashed lines: apex heights
Solid lines: magnetic latitudes



1. ESF structures

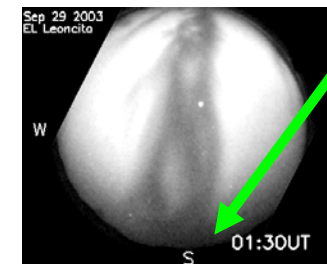
Diagram showing the flux-tube nature of the process. The images below indicate the extension of equatorial plasma bubbles as observed off the equator



El Leoncito

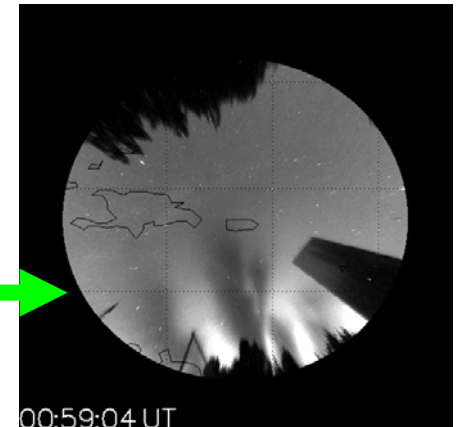
~900 km Apex height

~ 1700 km Apex height



Arecibo

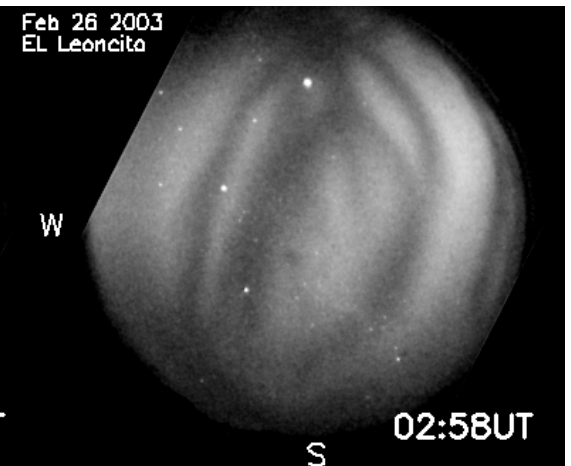
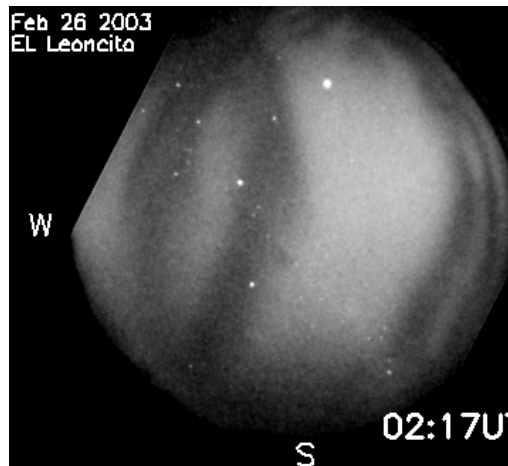
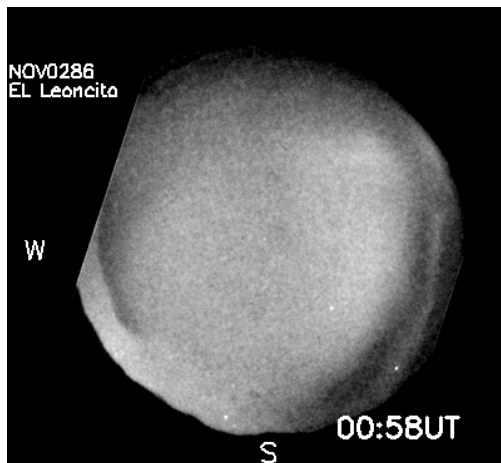
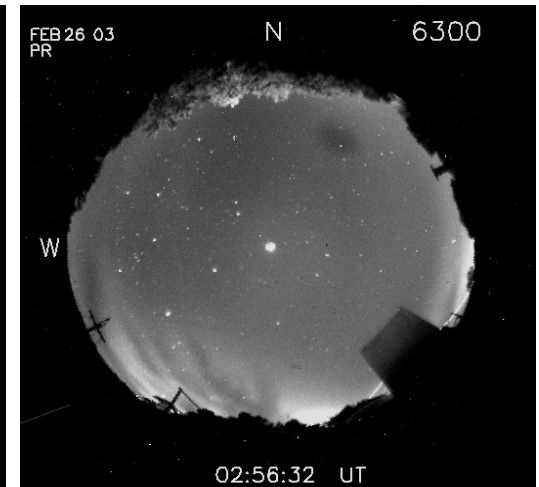
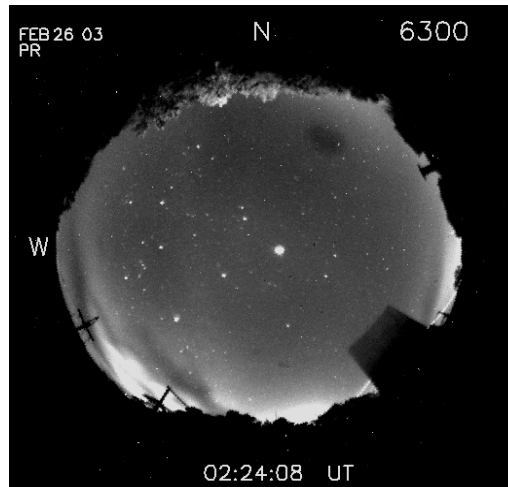
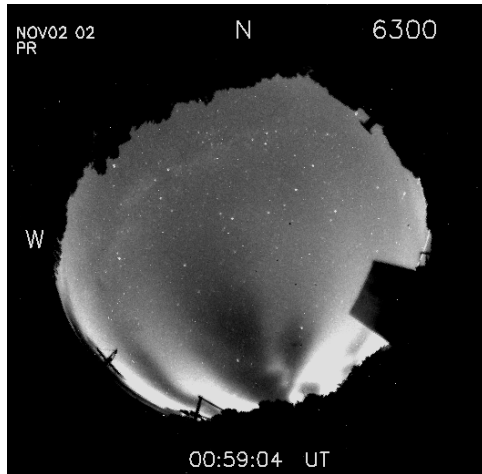
~1700 -2200km Apex height



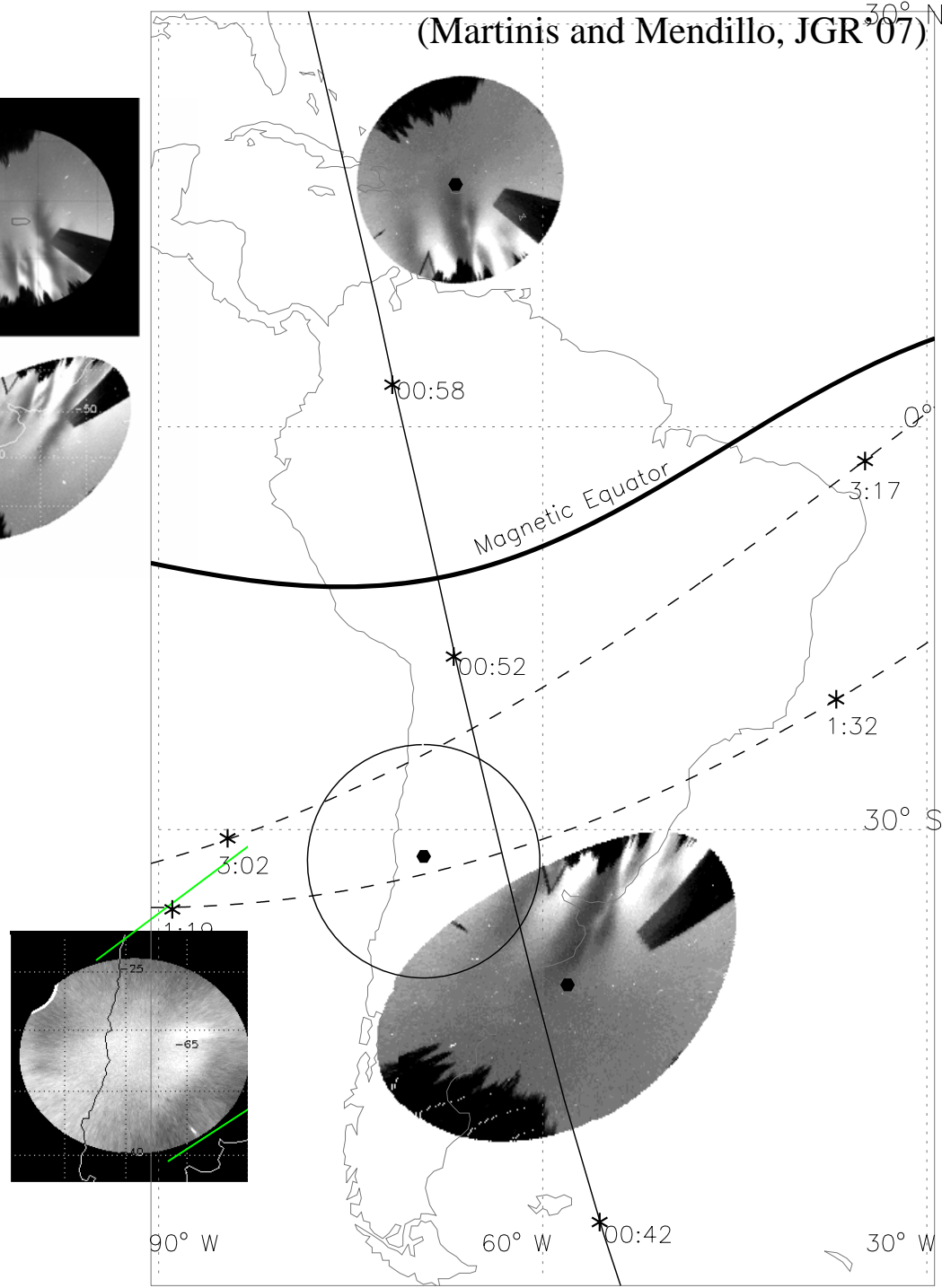
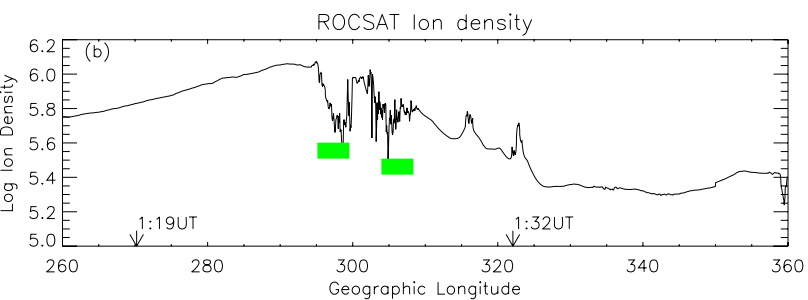
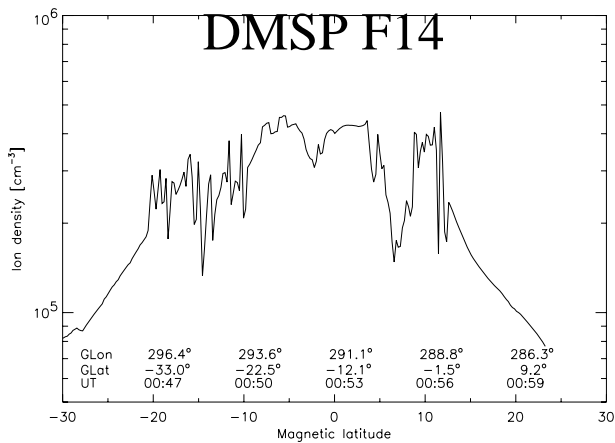
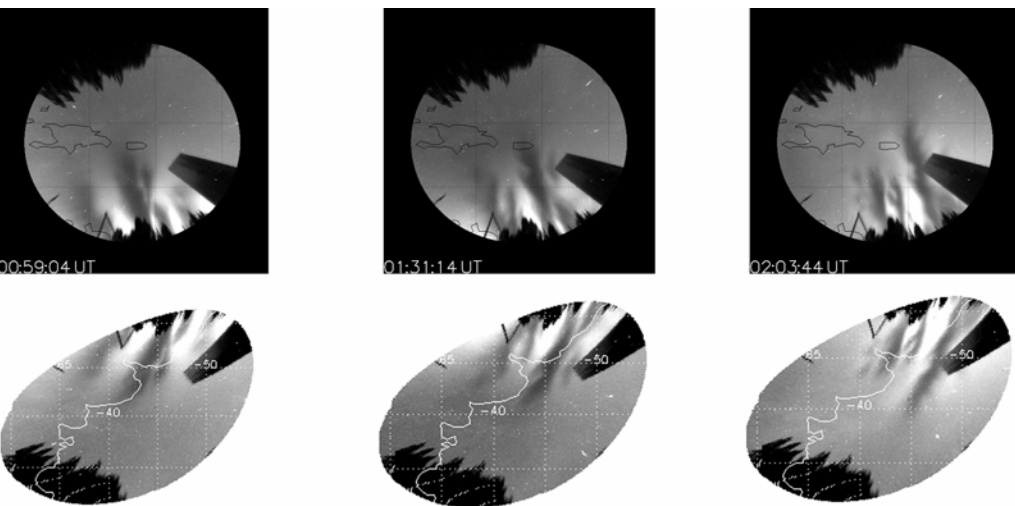
ESF Conjugate Observations

2 Nov 2002

26 Feb 2003



Conjugate observations



1. MSTIDs in airglow images

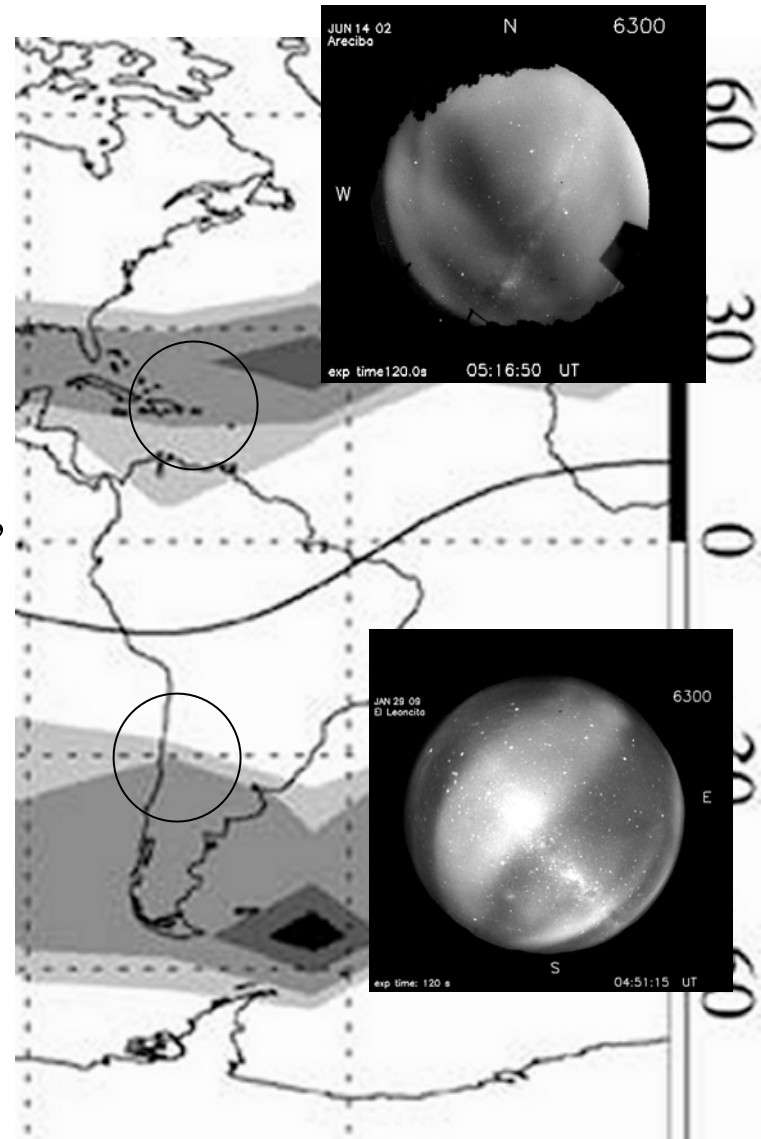
MSTIDs: gravity waves; Perkins instability;
Es-F region coupled instabilities;

Conjugacy of MSTIDs

Magnetic latitude propagation limit

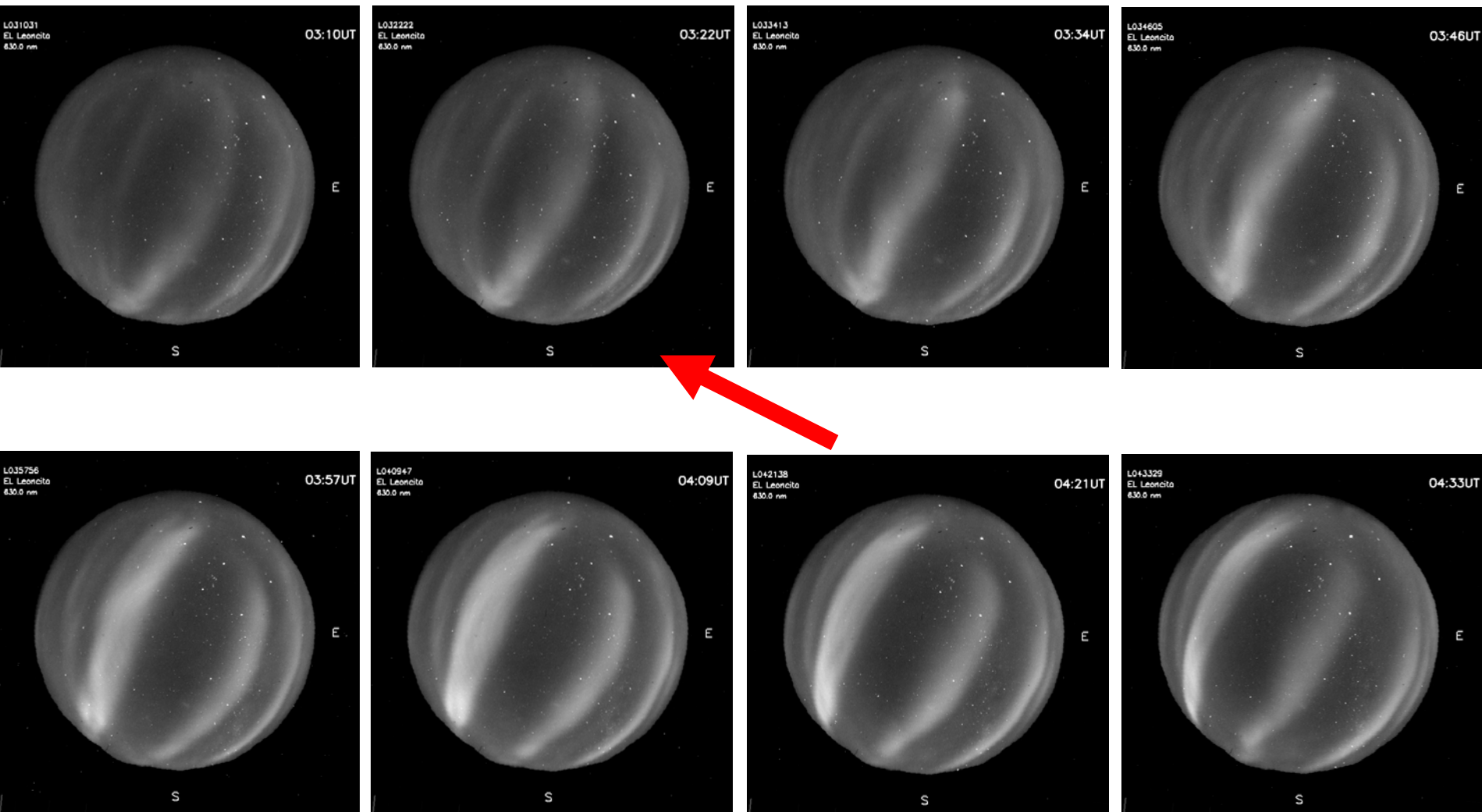
Seasonal behavior

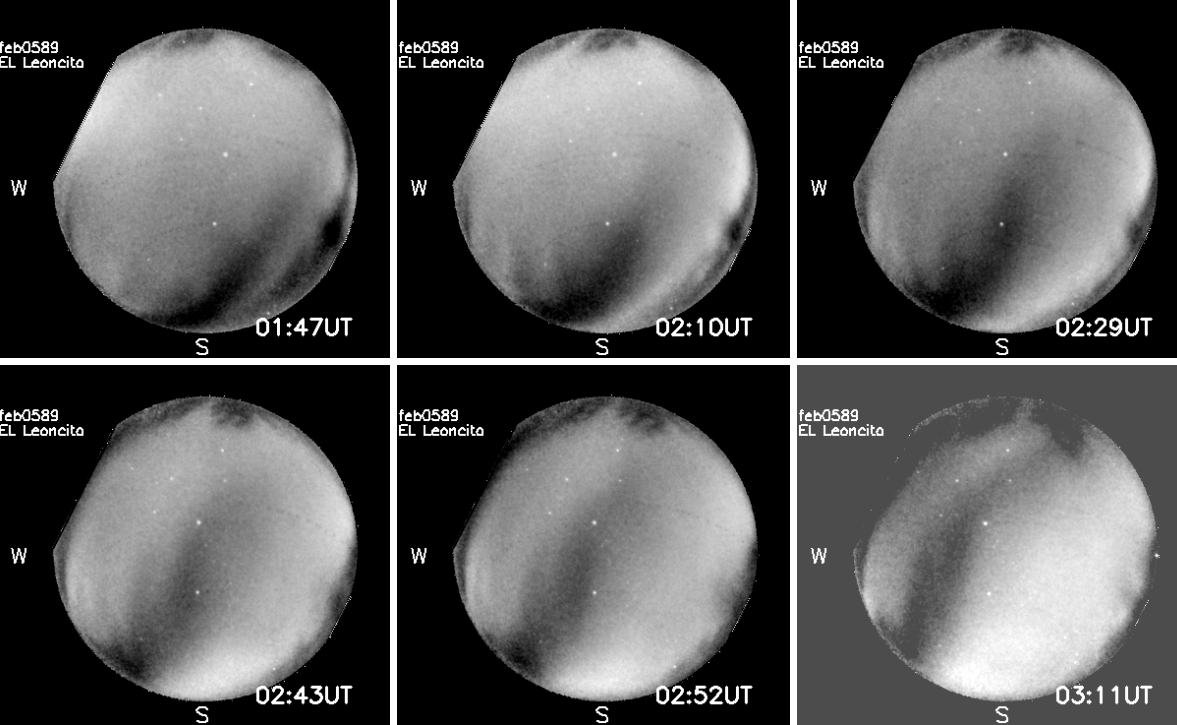
* MSTIDs associated with Midlatitude electric field fluctuations (MEF) (Saito et al, 1995). They occur poleward of the EIA; radial E



El Leoncito, Argentina (32° S, 69° W, 18^o mag)

6 December 2007- **MSTIDs**

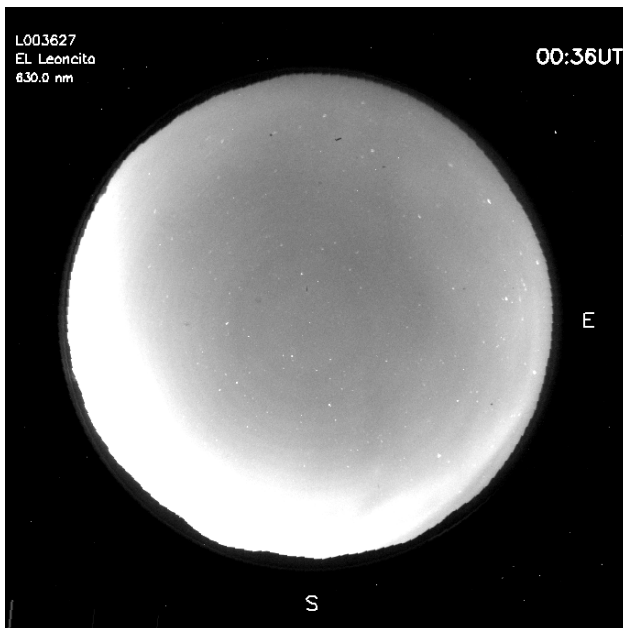




Simultaneous occurrence

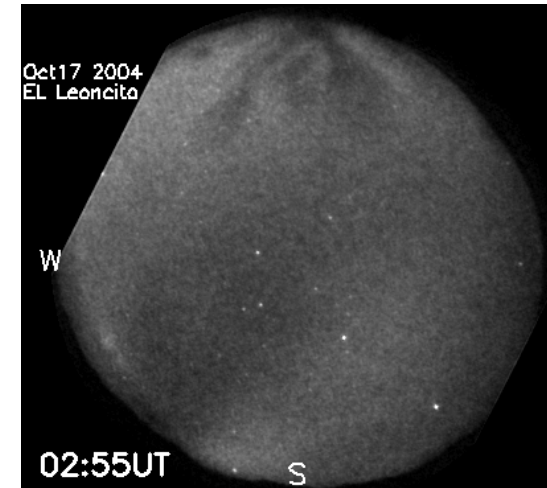
**ESF
Dark band**

5 Feb 2005



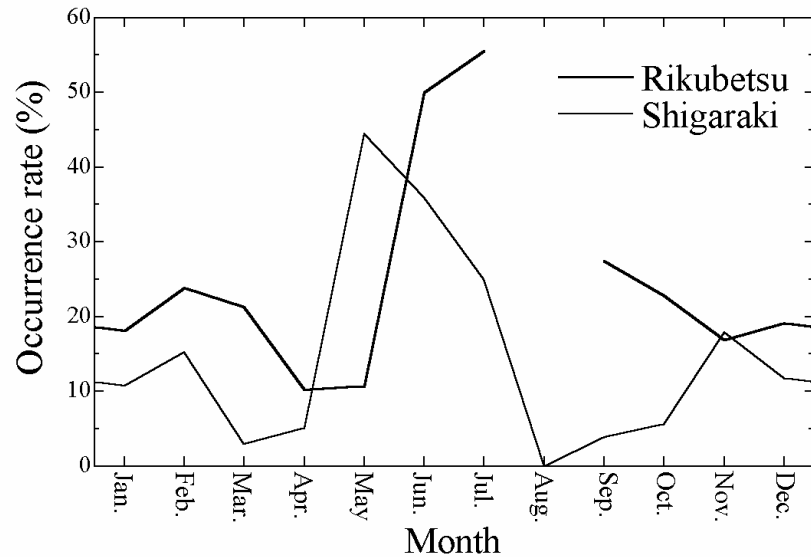
**ESF
MSTIDs
BW**

6 Dec 2007

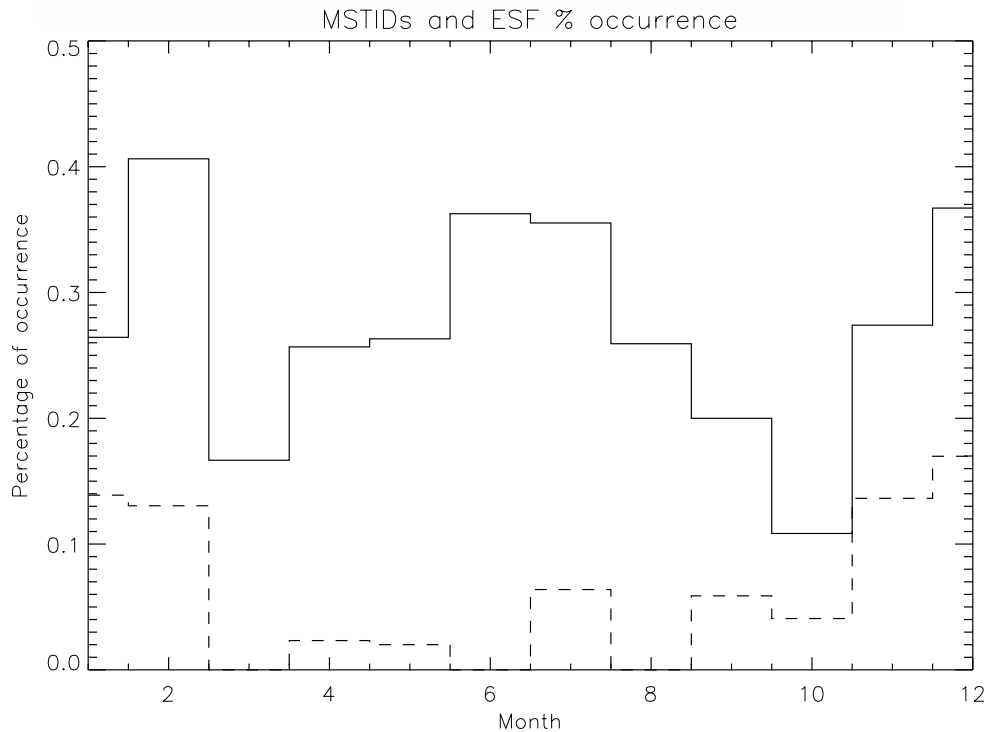


17 Oct 2005

2. MSTIDs statistics

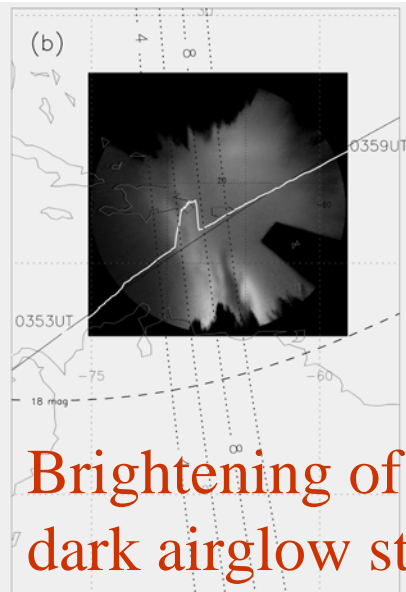
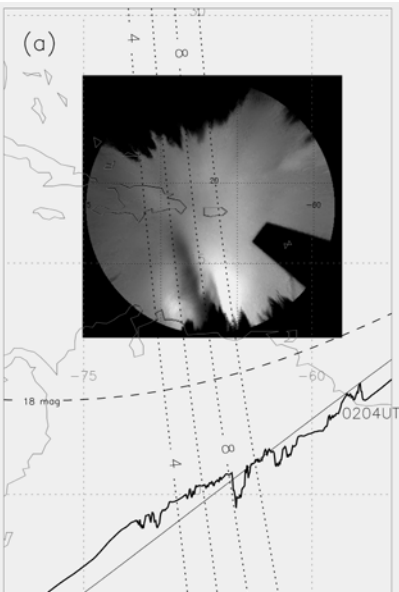
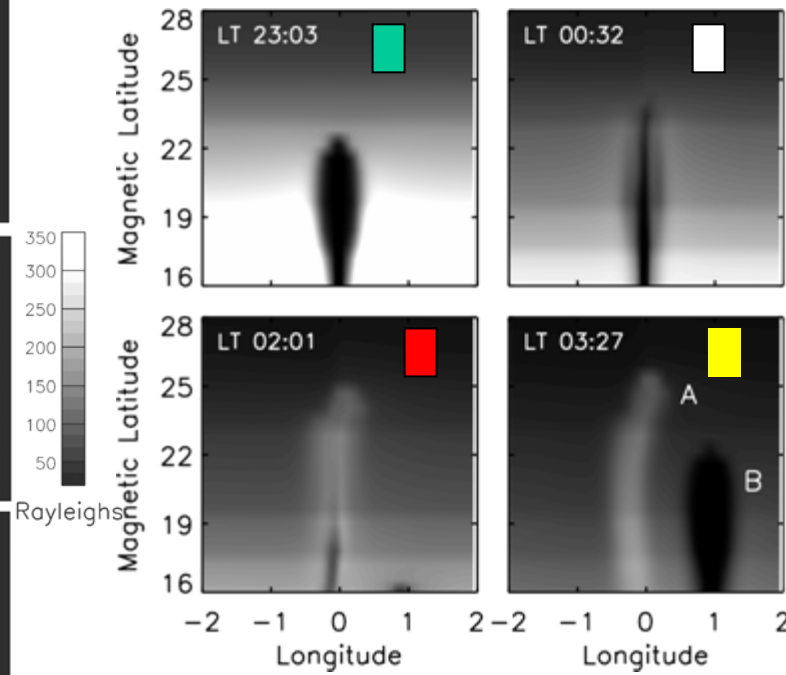
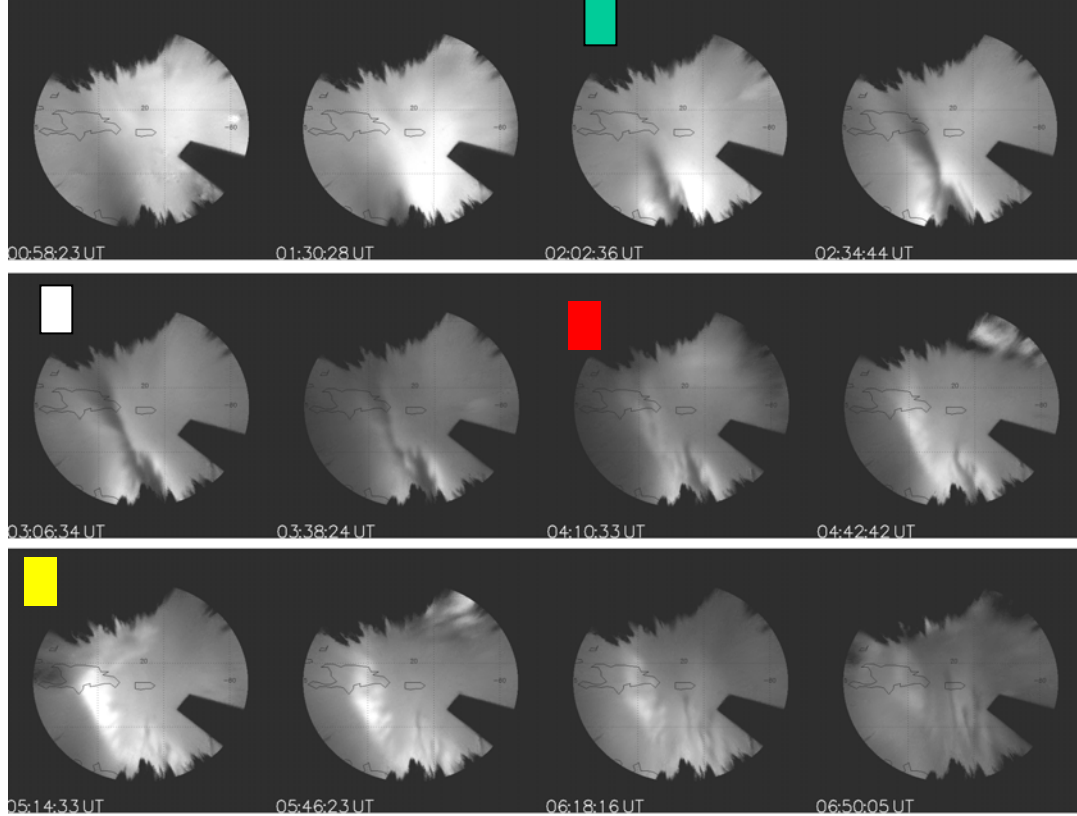


Japanese sector (Shiokawa et al.,03)



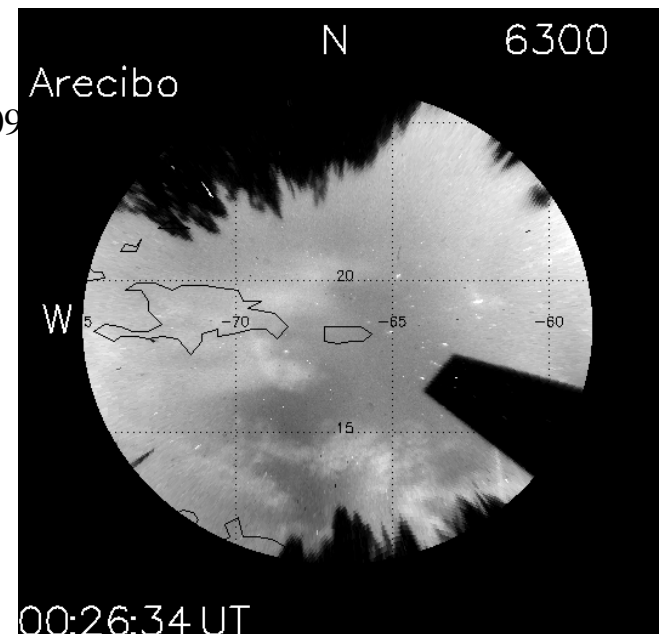
Arecibo (this work)
Almost 1,000 nights

Solid lines: MSTIDs
Dashed lines: ESF (BW)

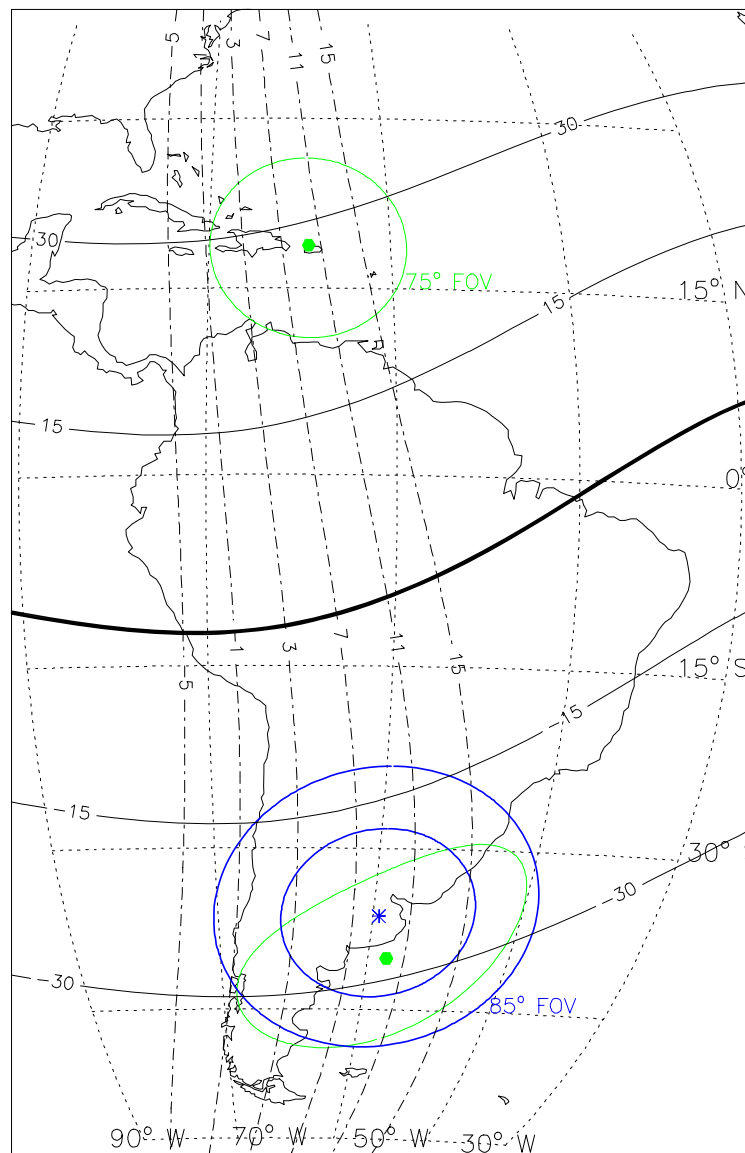
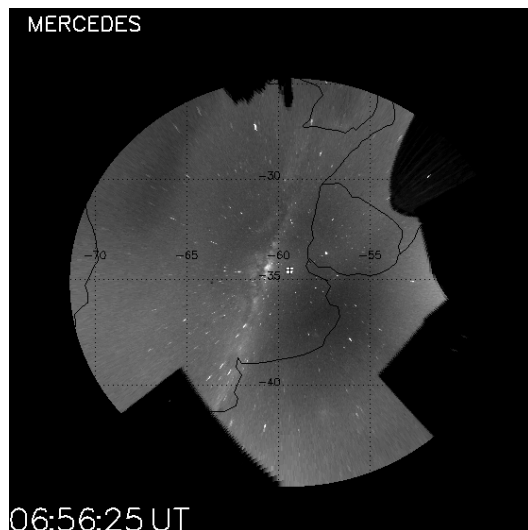
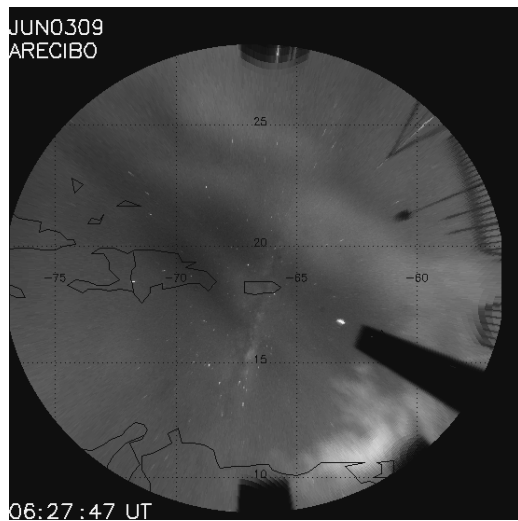


Martinis et al., JGR '09
Krall et al., GRL '09

Brightening of a previously
dark airglow structure.



4. Conjugate observations in the American sector



3 June 2009

Arecibo-Mercedes MSTIDs

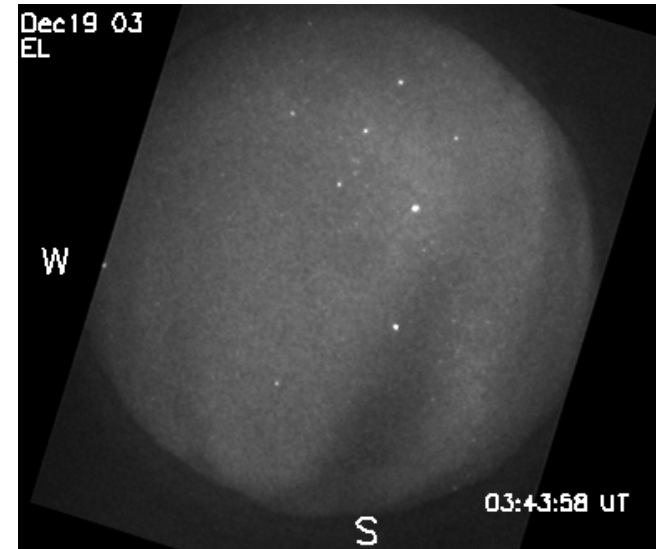
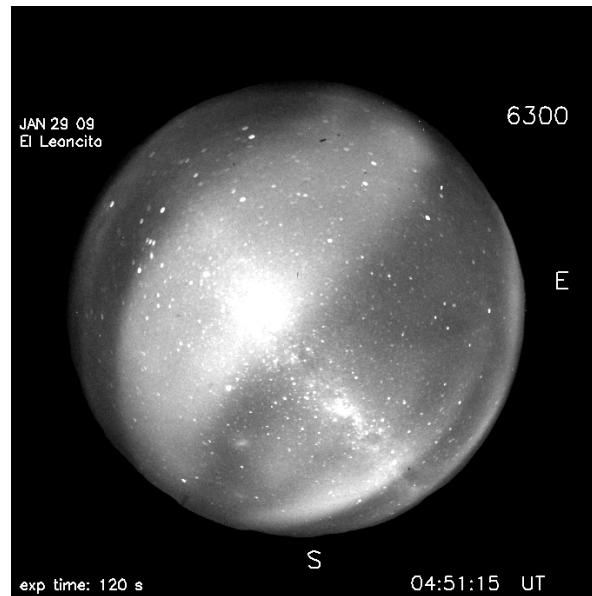
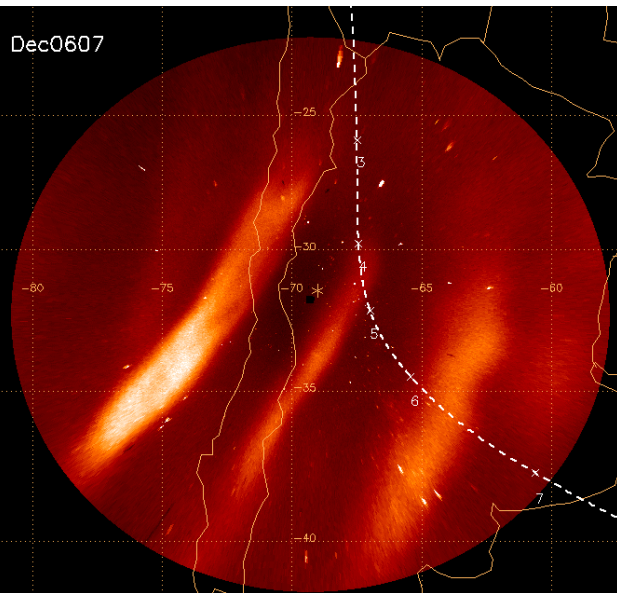
Summary

1. Airglow depletions associated with ESF can occur at Arecibo. Case studies show occurrence at both hemispheres. Airglow enhancements of previously depleted structures.
2. MSTIDs observed to propagate to low latitudes. Simultaneous occurrence of ESF and MSTIDs structures in the Southern hemisphere. Conjugate observations
3. Solstice peak occurrence of MSTIDs and Dec-Jan peak occurrence for ESF and MTM processes.

Coupling from low to mid latitudes (ESF, MTM) and from mid to low latitudes (MSTIDs)

Unsolved issues

- * How high plasma bubbles can grow? (36 cases from 546 nights)
- * Where and how MSTIDs are generated?



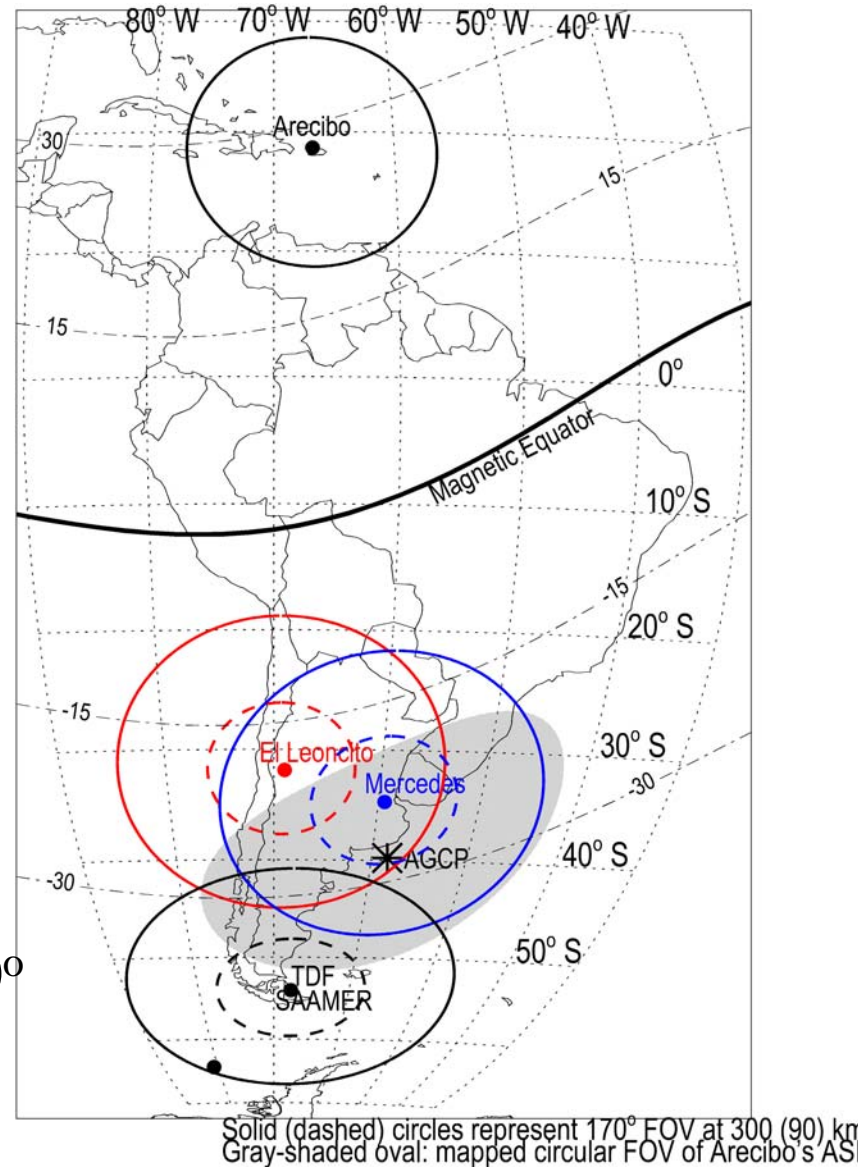
- * MSTIDs motion: equatorward and westward

Perkins and polarization electric field

VS

Coupling between Es instabilities and F region

- Installation of ASI at Mercedes: study conjugate processes; wide longitudinal coverage (C/NOFS support)
- Plans to install another ASI in the southern tip of South America: complete coverage of AGCP
- AMISR near the AGCP
- Processes occurring from -30° to -60° GLAT?: conjugate to Arecibo and Wallops.



**MANY THANKS TO NSF AND CEDAR
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