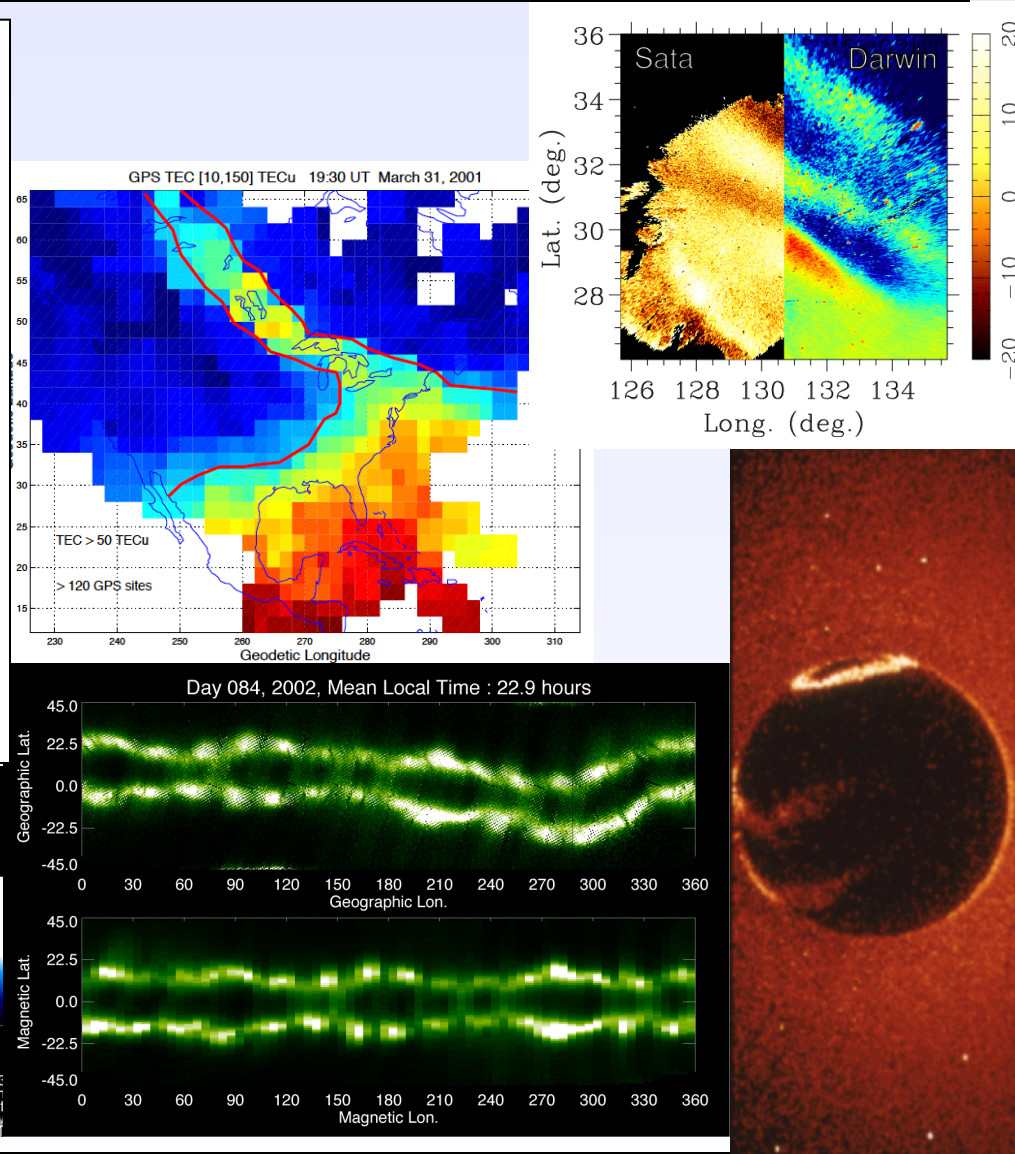

The Ionospheric Connection Explorer ICON

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R. A. Heelis; J. Harlander; A. J. Cox; G. Crowley; M. Bester; J. D. Huba; J. Edelstein; J. J. Makela; G. R.
Swenson; A. W. Stephan; A. Maute; H. U. Frey; K. Harps*

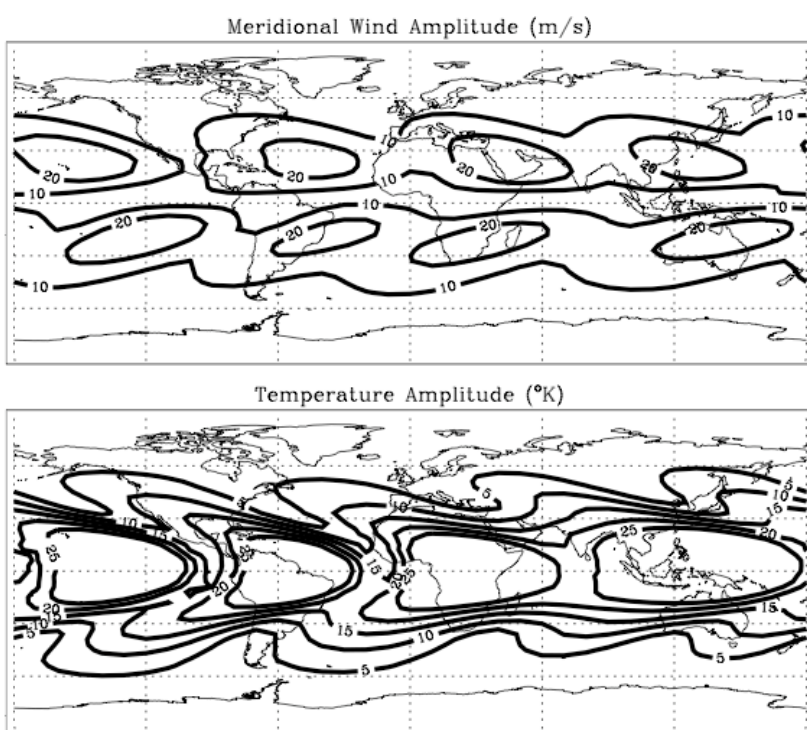
Introduction

- The densest plasma between Earth and Sun is created and trapped in the magnetic field of Earth's equatorial ionosphere.
- Recently, global-scale imaging from LEO, HEO, and radio tomographic platforms have provided an unexpected view of new ionospheric phenomena. Ground-based imaging has also identified a number of new physical phenomena.
- After a decade of scientific surprises, it is clear that without a complete set of observations of all drivers and effects in this remarkable region of space, we cannot answer the high priority scientific questions that are now plain.

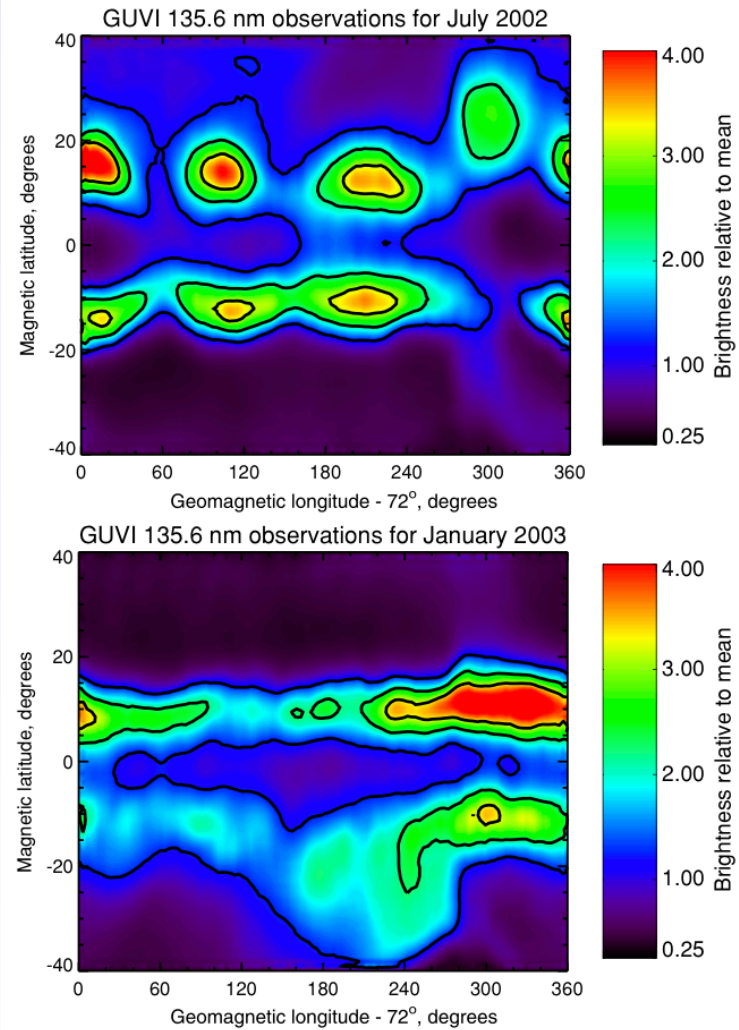


Variability in the Ionosphere

- The ionosphere varies constantly, but often in patterns that recur over seasons. These seasonal variations correspond to similar changes in rainfall rates in the tropics, indicating a close coupling to atmospheric tides propagating across the boundary of space. *By what means does the troposphere drive the density of space plasma?*



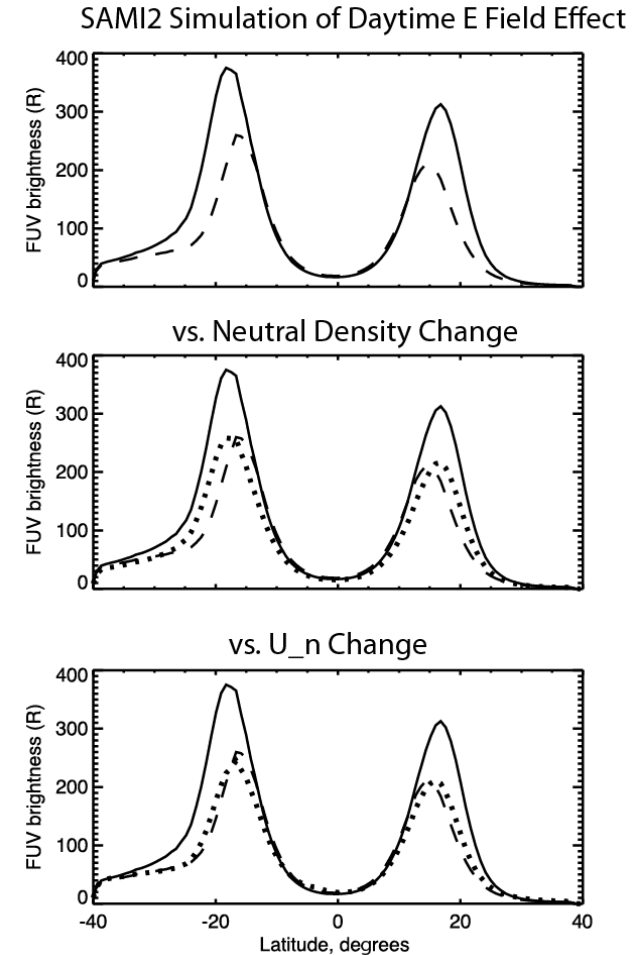
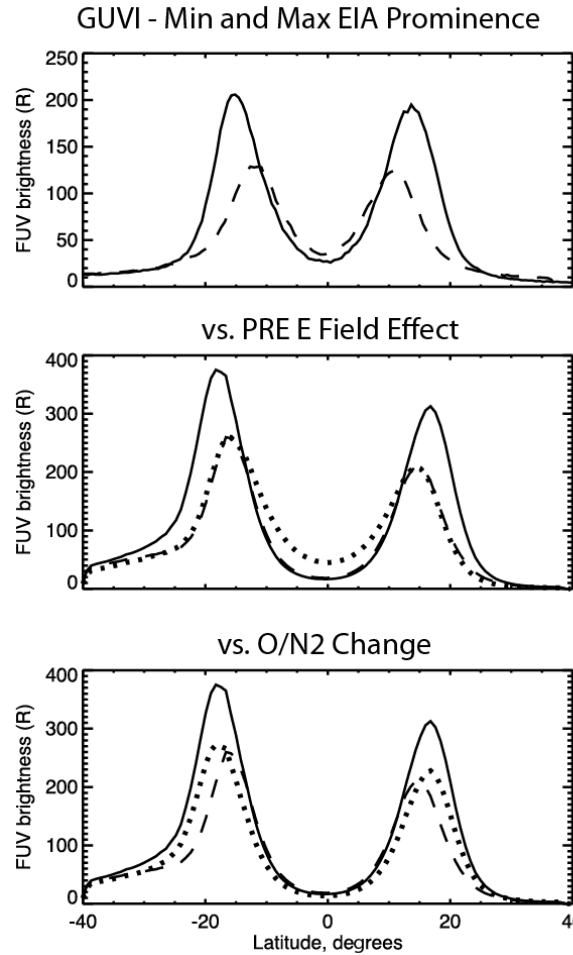
Hagan and Forbes, 2002



England et al., 2008

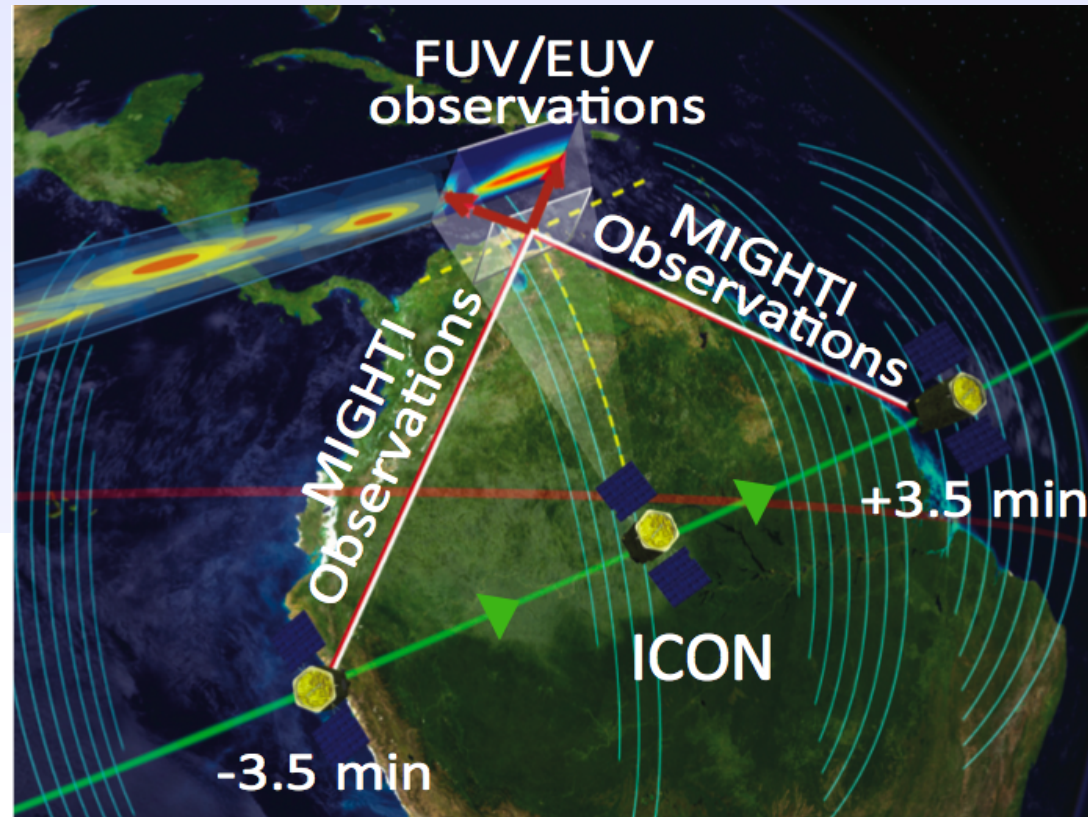
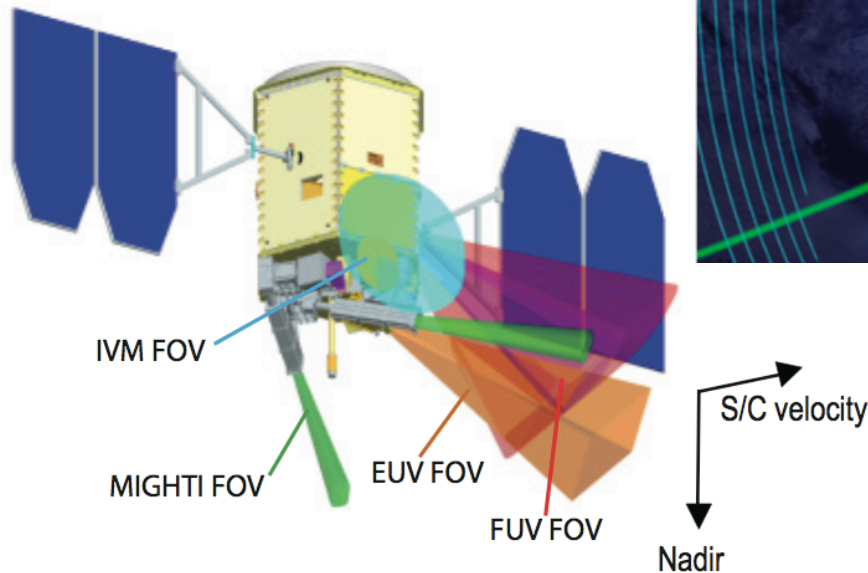
Variability in the Ionosphere

- Dynamo electric fields driven by tides in the E-region is the commonly attributed forcing mechanism.
- Simulations show that this explanation is plausible.
- Atmospheric tides will drive changes in *all other effective parameters of the neutral atmosphere* the I-T system , each of which *will compete* with dynamo drivers.
- Of the 5 shown here, only the modification of neutral density required to drive a concomitant change in ionospheric density is unbelievably large.



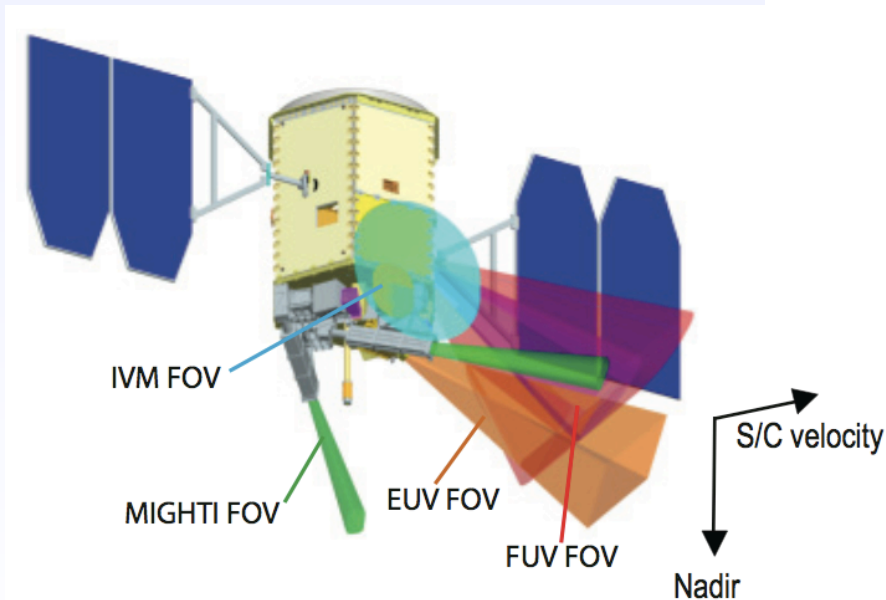
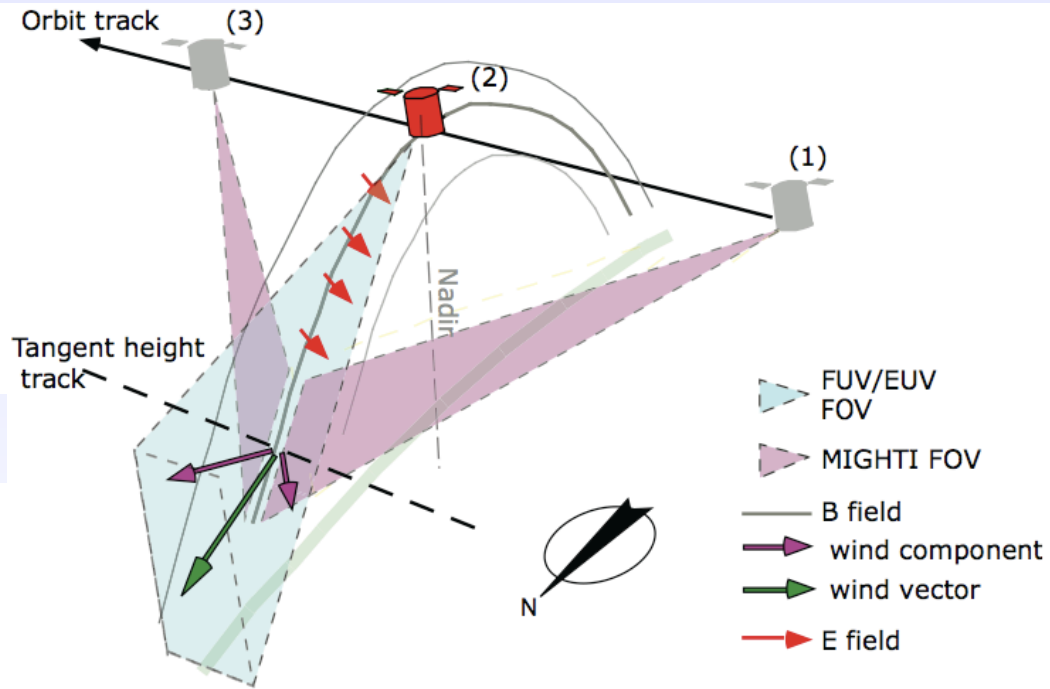
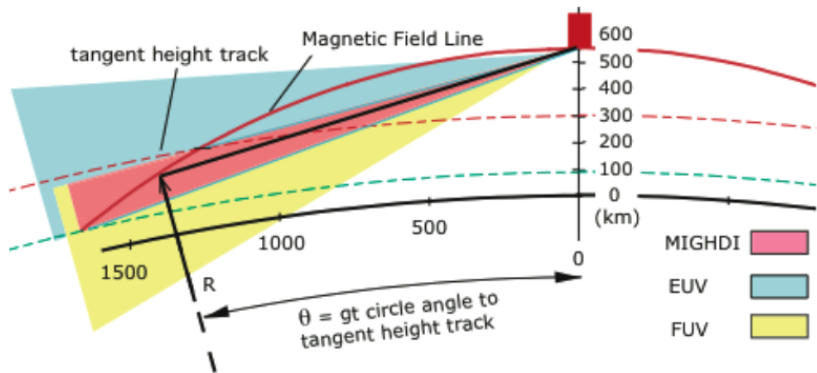
Measuring the Critical Parameters

In an elegant combination of observations allowed by the choice of instruments, orbit altitude and inclination, imaging geometry, and combined with Earth's magnetic geometry, ICON measures all the key drivers in the same place, at the same time.



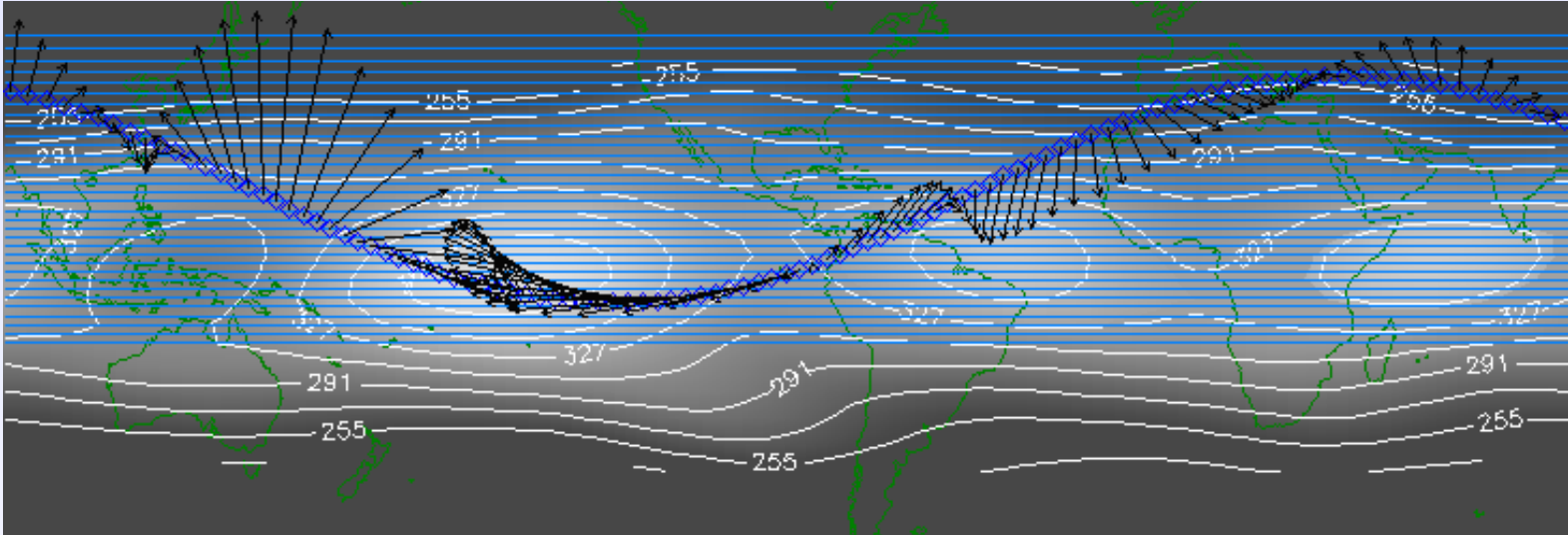
Instrument	Primary Quantity Measured
MIGHTI	Horizontal wind vector
EUV	Ion density
FUV	O/N ₂ ratio
IVM	Ion velocity vector

Measuring the Critical Parameters

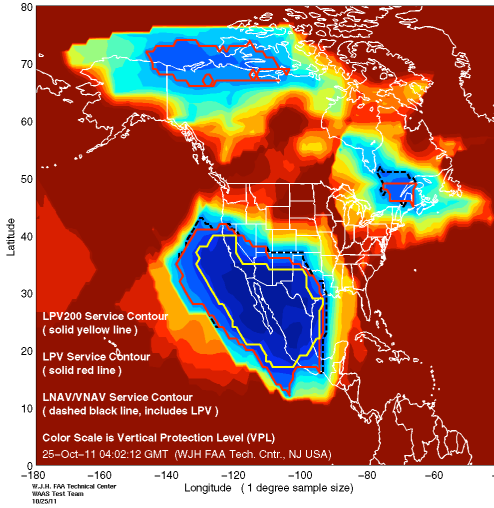


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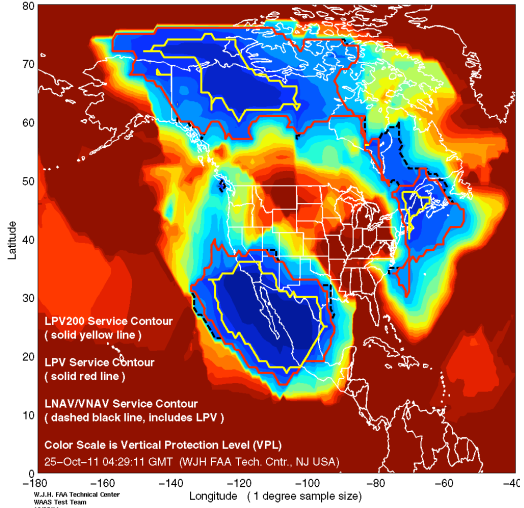
Tropics to Middle Latitudes



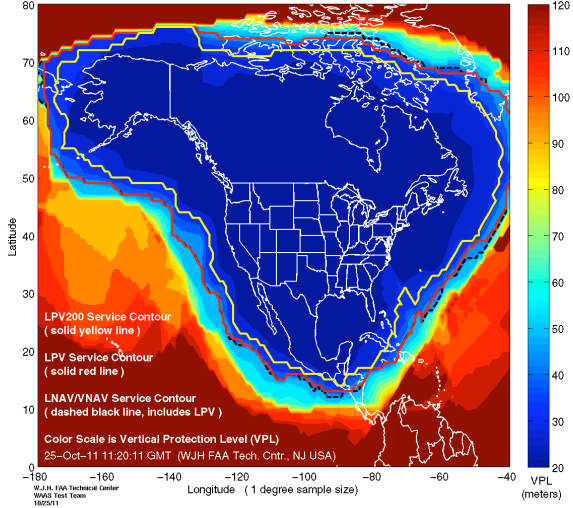
Current WAAS Vertical Navigation Service Snapshot Display



Current WAAS Vertical Navigation Service Snapshot Display

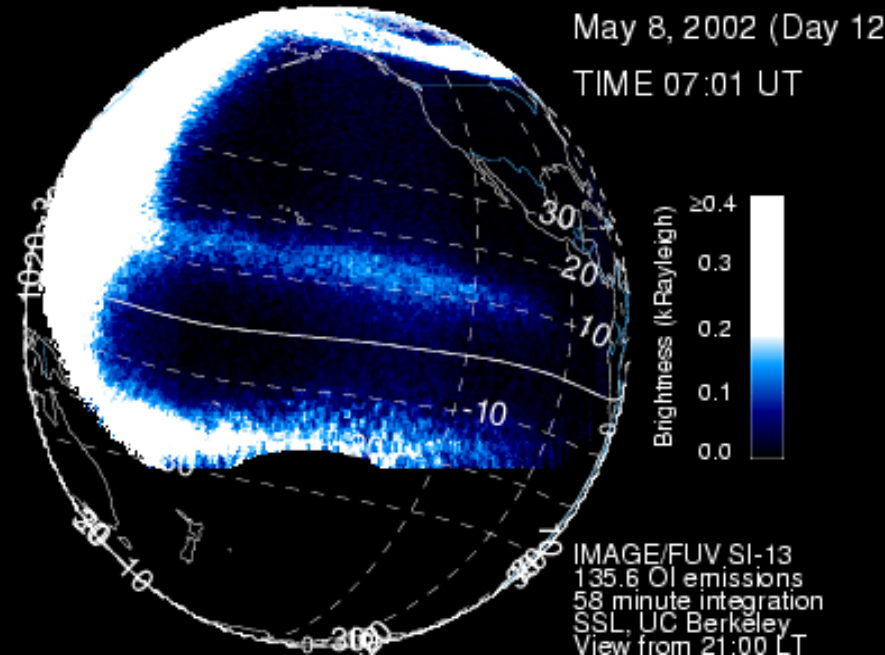
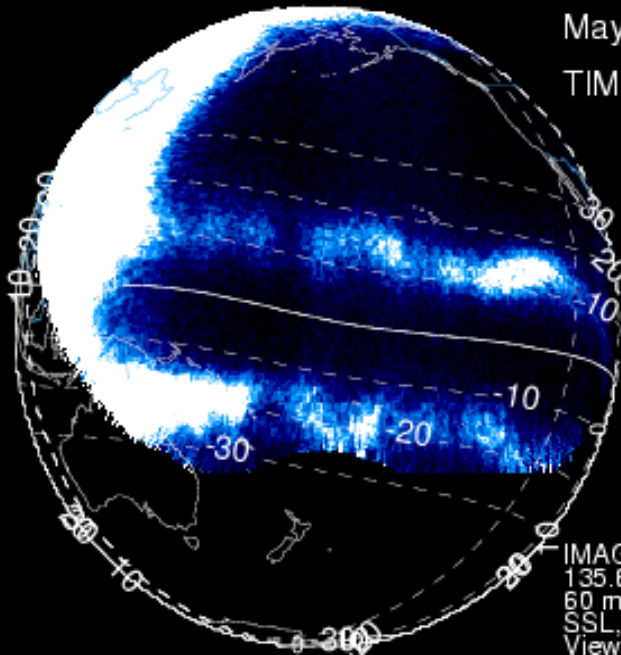
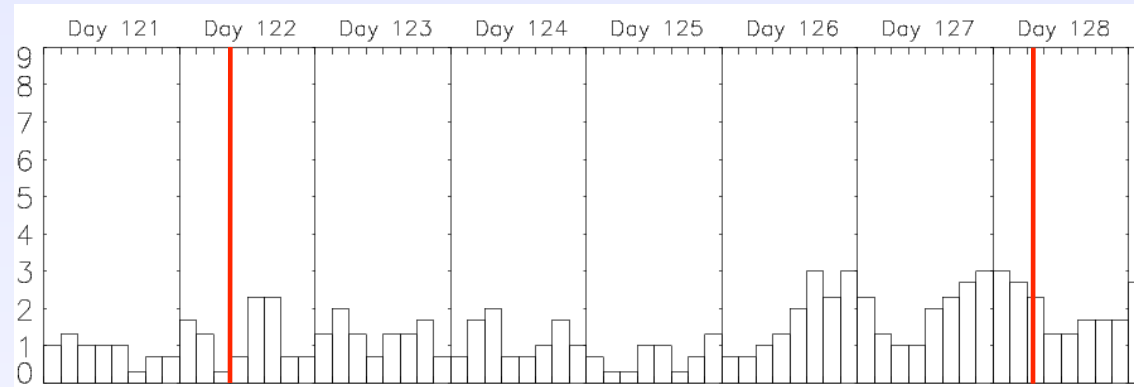


Current WAAS Vertical Navigation Service Snapshot Display



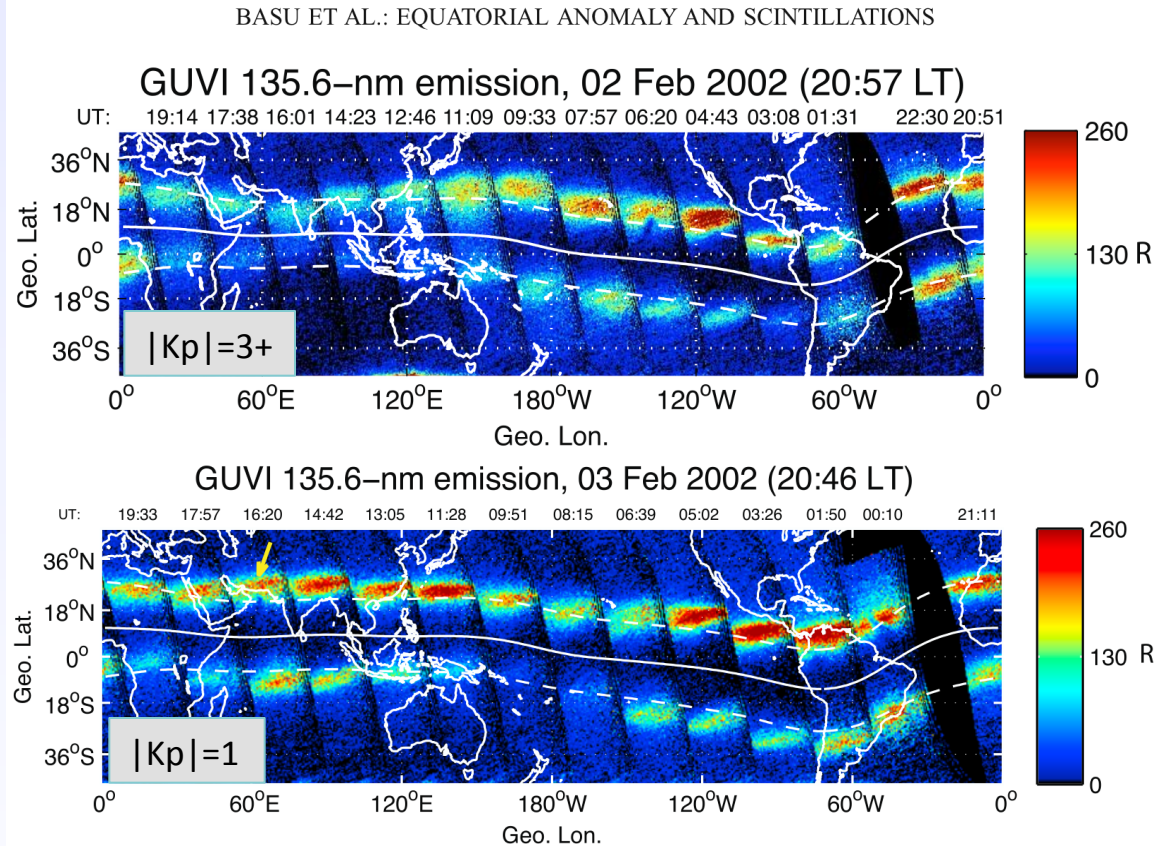
Variability in the Ionosphere

- The ionosphere exhibits extreme variability, and often at low levels of activity.



Nonmigrating Tides vs. Lunar Tides vs. Planetary Waves vs. Disturbance Dynamo

- Consider again a case of the equatorial ionosphere under different levels of activity on successive days.
- The Indian sector shows a remarkable change, attributed to the counter-electrojet conditions observed on Feb 2.
- Planetary waves and lunar tides interact in a complex manner to create counter-electrojet conditions.
- The Indian sector is regularly reduced in density by non-migrating tides, particularly the DE3.
- Along with disturbance dynamo effects, unraveling all the processes that contribute to the unique behavior of the ionosphere in the Asian sector is a work in progress.



Successive daily GUVI retrievals of nighttime FUV brightness