

Neutral-Ion Coupling Explorer NICE

Mission Definition

NICE will discover how winds and composition of the upper atmosphere drive the electric fields and chemical reactions that control Earth's ionosphere. The mission will resolve competing theories about the low-latitude ionospheric dynamo, and will explain how large-scale waves from the lower atmosphere can couple to the ionosphere and upper atmosphere. Understanding neutral-ion coupling in Earth's atmosphere has applications for solar and planetary atmospheres including Mars and Jupiter. NICE will be the first mission to simultaneously measure all the key parameters that both characterize and drive the ionosphere. It will remotely measure the neutral wind, temperature, composition, atmospheric and ionospheric density distributions as well as make in-situ measurements of the ion motion. NICE uses flight-tested science instruments in a low-inclination orbit where the geometry magnetically links the in-situ and remote sensing measurements.

Mission Goals and Objectives

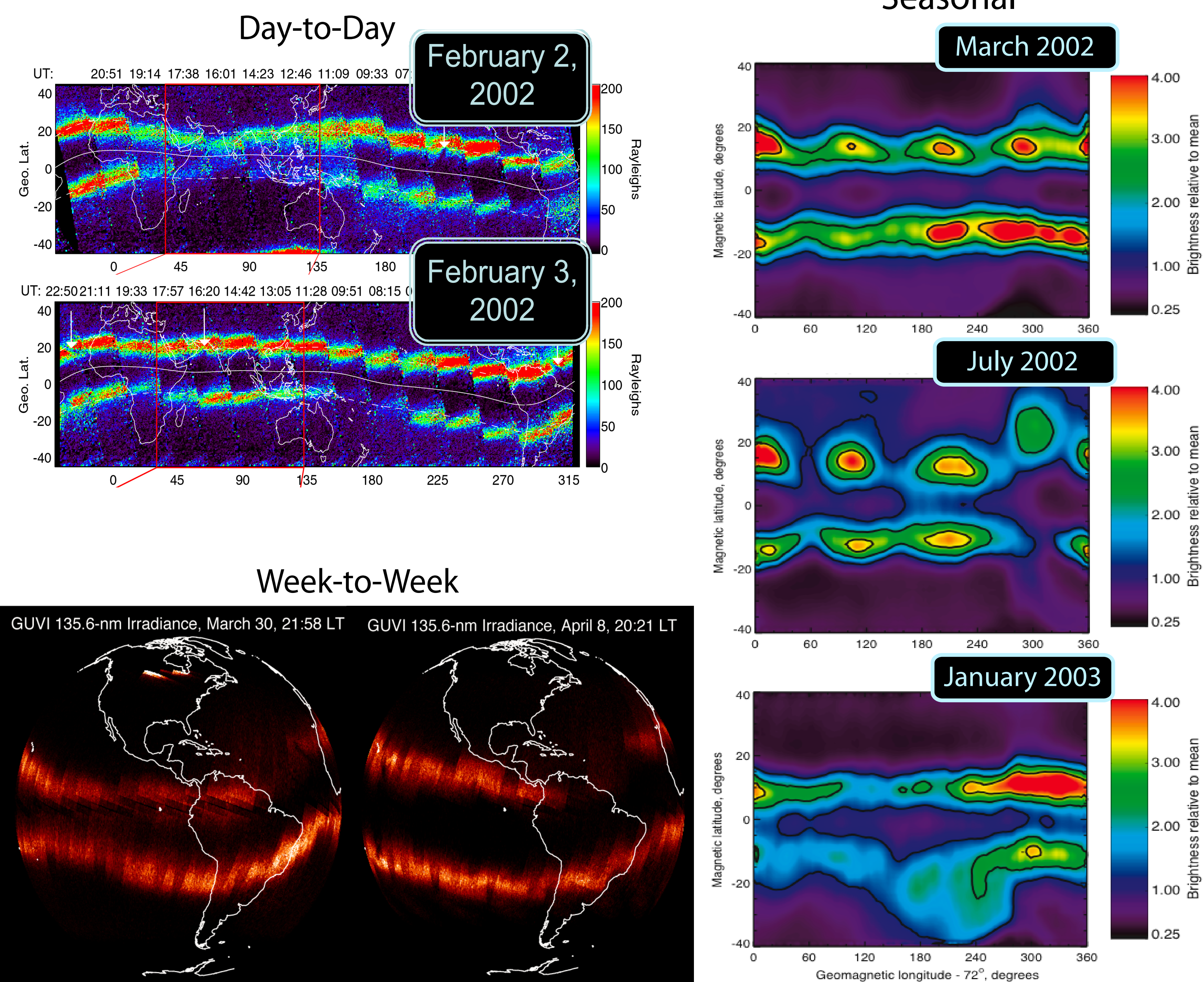
The NICE mission addresses the major task in the "Science Plan for NASA's Science Mission Directorate 2007-2016" to "understand the coupling between planetary ionospheres and their upper atmospheres mediated by strong ion-neutral interactions."

The goal of the NICE mission is to answer the question: **How do neutral dynamics drive ionospheric variability?** NICE will approach this goal with three targeted investigations of neutral-ion coupling:

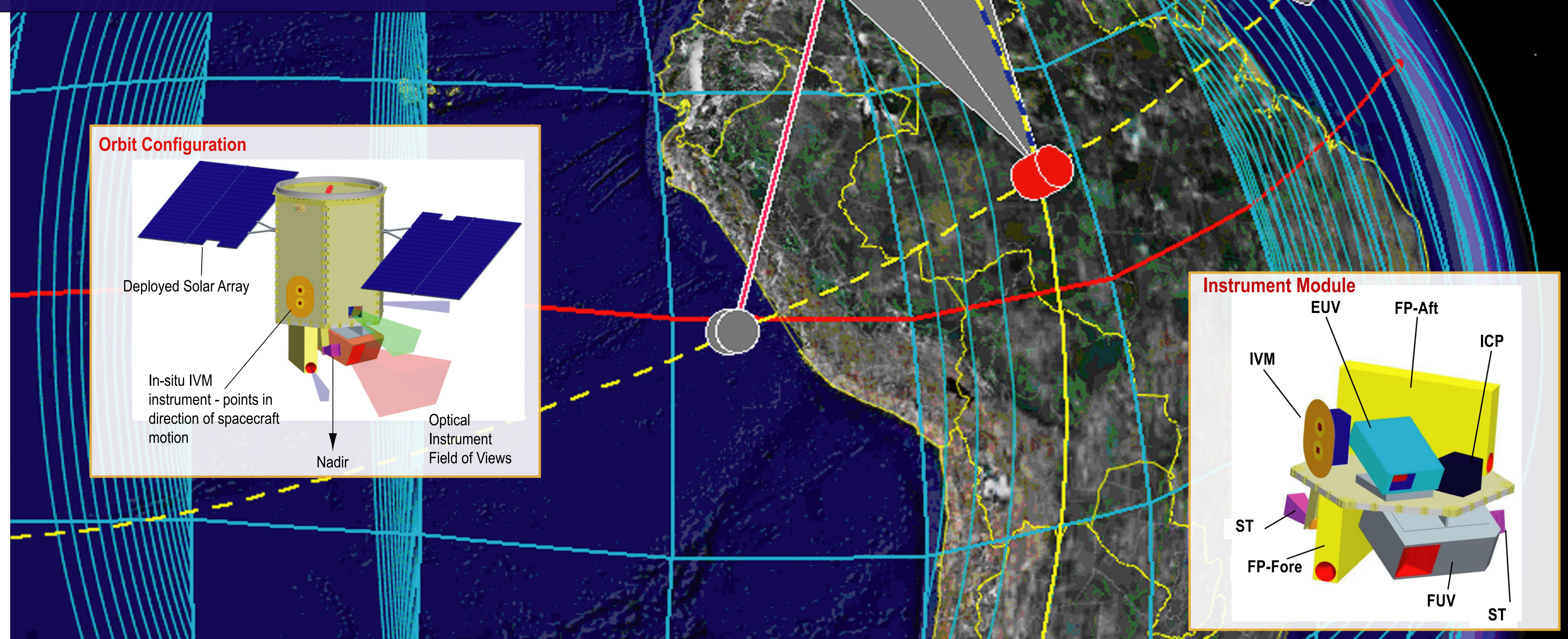
1. How do large-scale atmospheric waves control the ionosphere at low latitudes?
2. What causes the day-to-day variability in the low-latitude ionosphere observed by plasma drift measurements?
3. During magnetic storms, what causes the enhancement of ionospheric plasma at low latitudes?

Ionospheric Variability

NICE is equipped to measure and understand ionospheric variability across a wide range of spatial and temporal scales, with simultaneous remote and in-situ measurements of both drivers and effects.



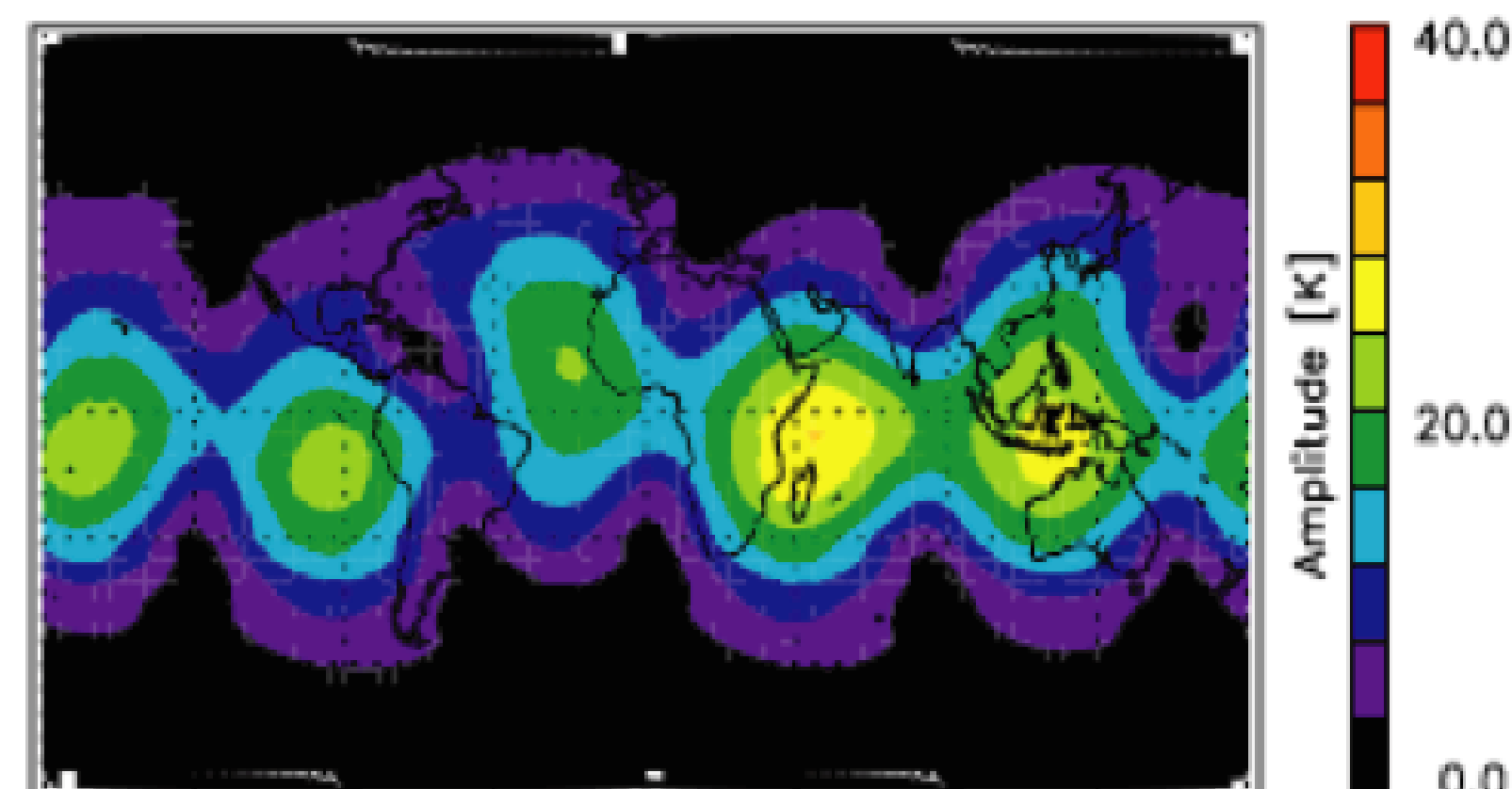
NICE travels eastwards and measures the thermosphere and ionosphere. The fore- and aft-viewing Fabry-Perot (FP) measures two vector wind components as a function of altitude ~7 minutes apart. The FUV and EUV instruments make coordinated measurements of the atmosphere and ionosphere near the footpoint of NICE's magnetic field line. In-situ drift meter measurements of the ion velocity can be directly related to the electric field, which is essentially constant along the magnetic field.



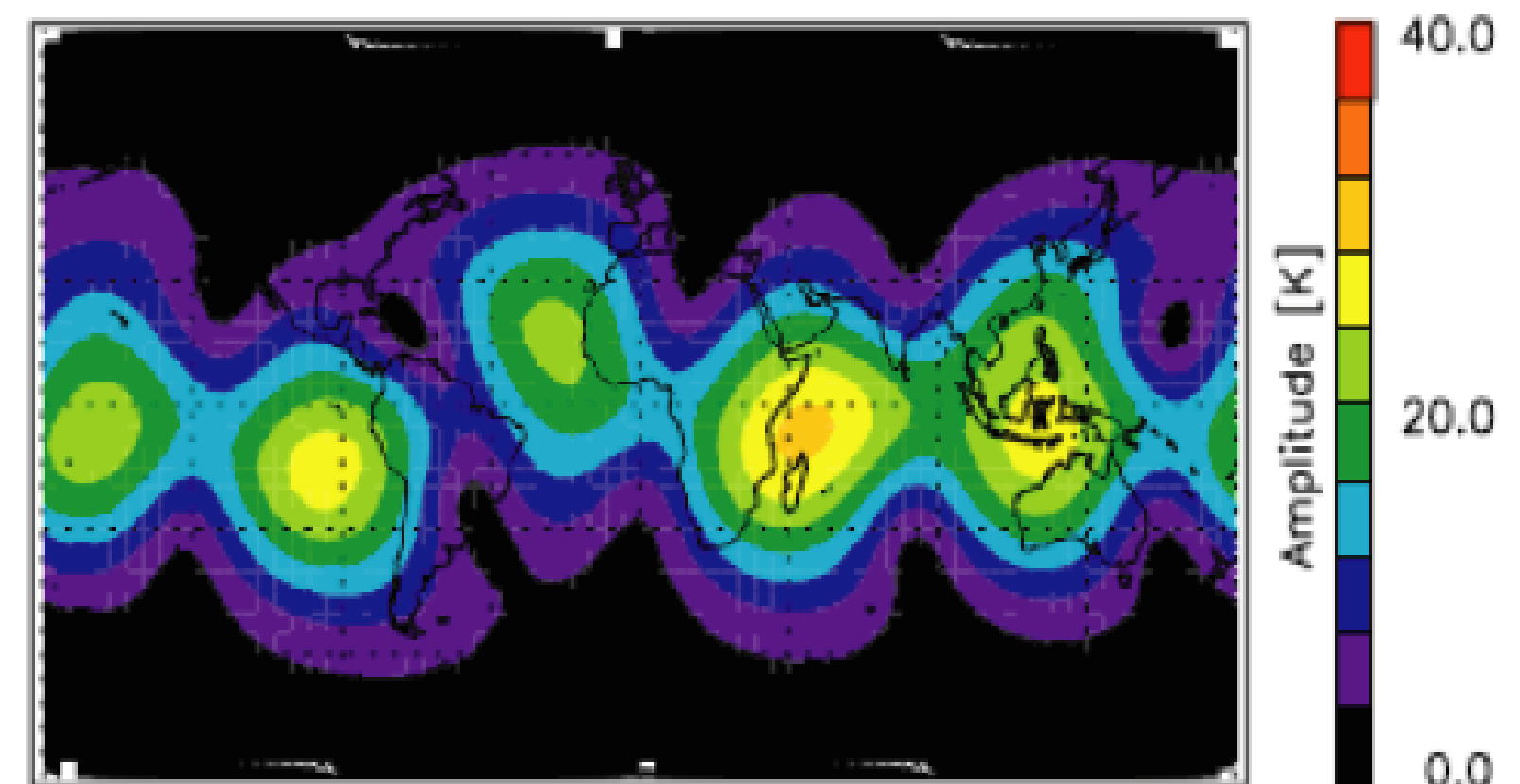
The NICE Mission

Tidal Reconstructions using TIMED/TIDI

Input limited to -5° to $+35^{\circ}$ latitude (NICE orbit)

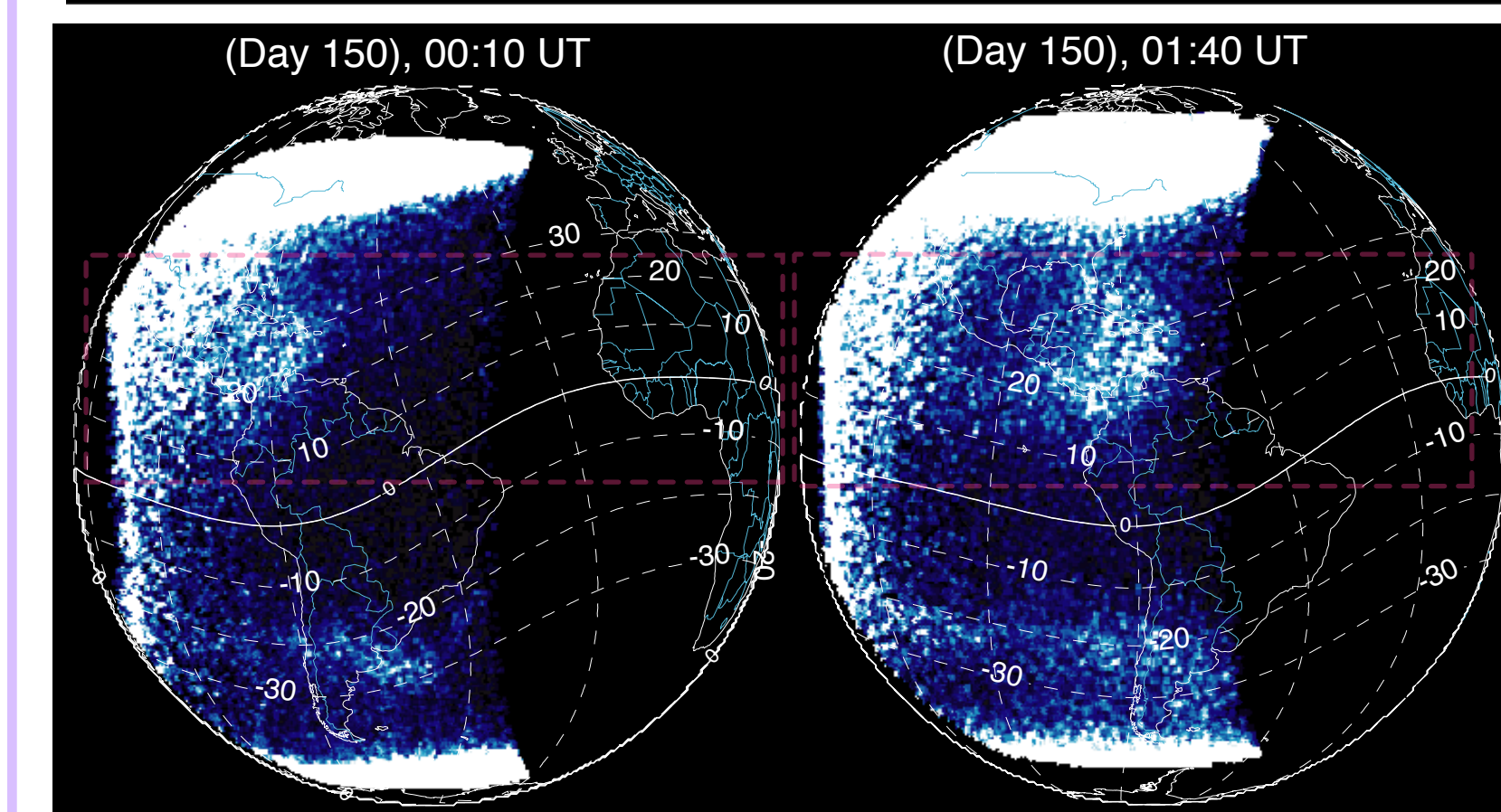
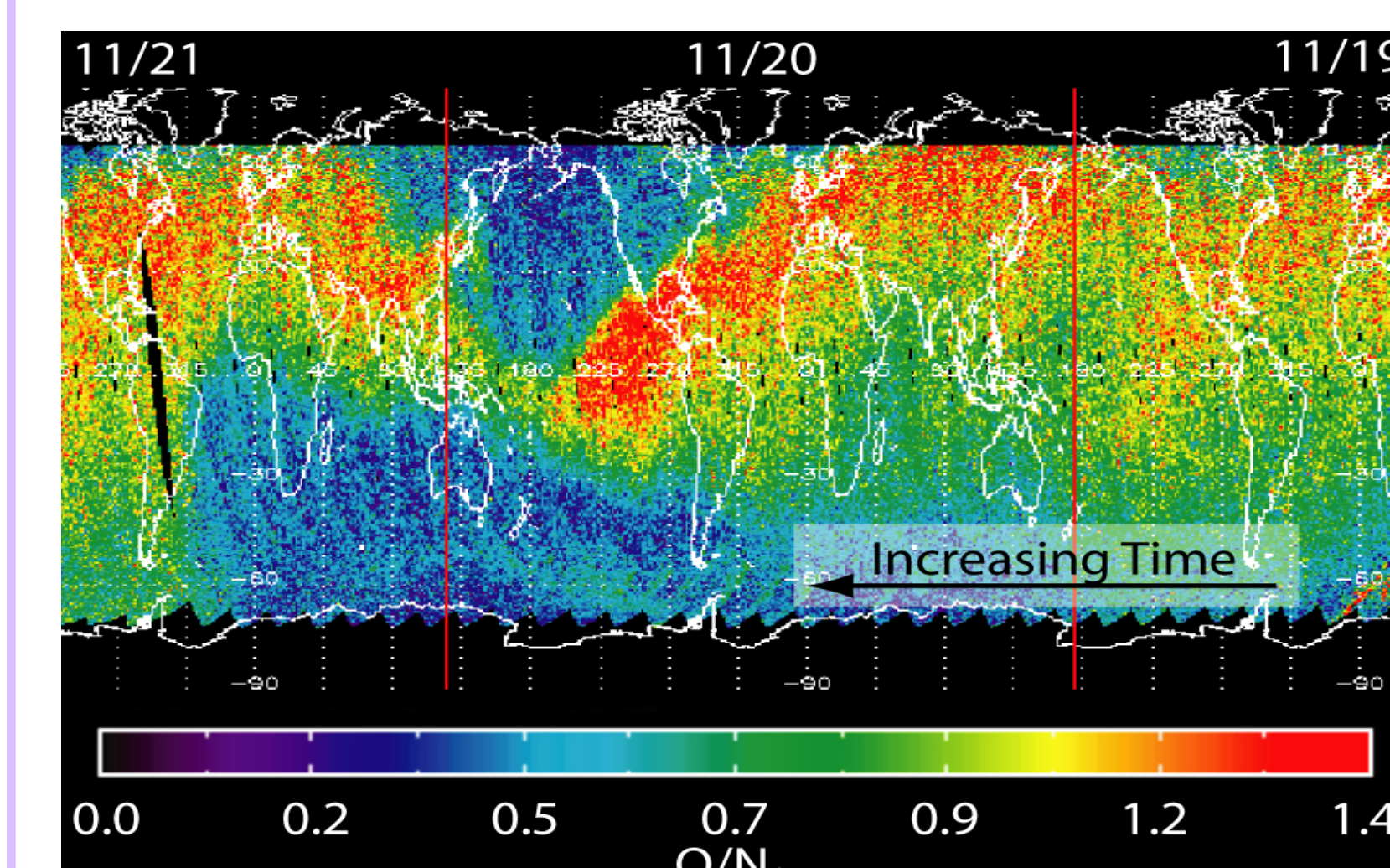


TIDI input, $\pm 45^{\circ}$ latitude



NICE will retrieve neutral winds and temperatures in a latitudinal range sufficient to retrieve a large range of tidal components with 12-day resolution, (compare to 30 days for TIMED). Initial tests show excellent reconstruction is achieved constraining TIDI data to the latitude/observation range of NICE.

Storm-time Ionosphere and Thermosphere



NICE will quantify the important storm-time drivers that control the ionosphere during magnetic storms; neutral winds, composition and electric fields, while measuring the effects of these competing processes remotely (both day (834 Å) and night (1356 Å)) and in-situ (n_e).

Instrument Module

Fabry-Perot (FP) - 2 view directions, dual wavelength visible Doppler measurements of 630.0 and 557.7 nm - Heritage from FPI on DE-2
Extreme Ultra-Violet (EUV) - 1D profiler of 61.7 and 83.4 nm - Heritage from EURD on MINISAT-1
Far Ultra-Violet (FUV) - 2D Imager of 135.6 and 155 nm - Heritage from FUV SI on IMAGE
Ion Velocity Meter (IVM) - drift meter and retarding potential analyzer - Heritage from IDM on DE2, IVM on ROCSAT-1 and IVM on C/NOFS

Core Team Members

U.C. Berkeley	PI Institution, Science/Mission Ops., UV instruments, Project Management
U. of Illinois	Interferometer management
Michigan Aerospace	Interferometer fabrication
U. Texas Dallas	In-situ ion-drift meter
U. CO, NRL, ASTRA	Science analyses and modeling
Orbital Sciences Inc.	Spacecraft

Mission Management

Principal Investigator: Stephen Mende, UCB
 Project Manager: Peter Harvey, UCB
 Industrial Partner: Orbital Sciences Inc.