

Motivations

- GLOW model is widely used but includes outdated versions of atmospheric (MSIS-00), ionospheric (IRI-90) and magnetic (POGO68) models.
- Airglow measurements are often wide-field and include slant observations.
- GLOW model is 1-D, calculating altitude profiles of volume emission rate (VER)

Approach

- Update 1-D GLOW model to use MSIS-2.1 (thermosphere), IRI-2020 (ionosphere) and IGRF-14 (magnetic field).
- Extend 1-D GLOW model to 2 dimensions:
 - Arbitrary observation geometry.
 - Account for local solar position and earth curvature.

GLOW Model Inputs

- Neutral: Altitude profiles of O, O₂, N, N₂, NO densities, T_n.
- Ions: Altitude profiles of electron density, T_i, T_e.
- F10.7-scaled solar EUV flux (EUVAC or Hinteregger model).

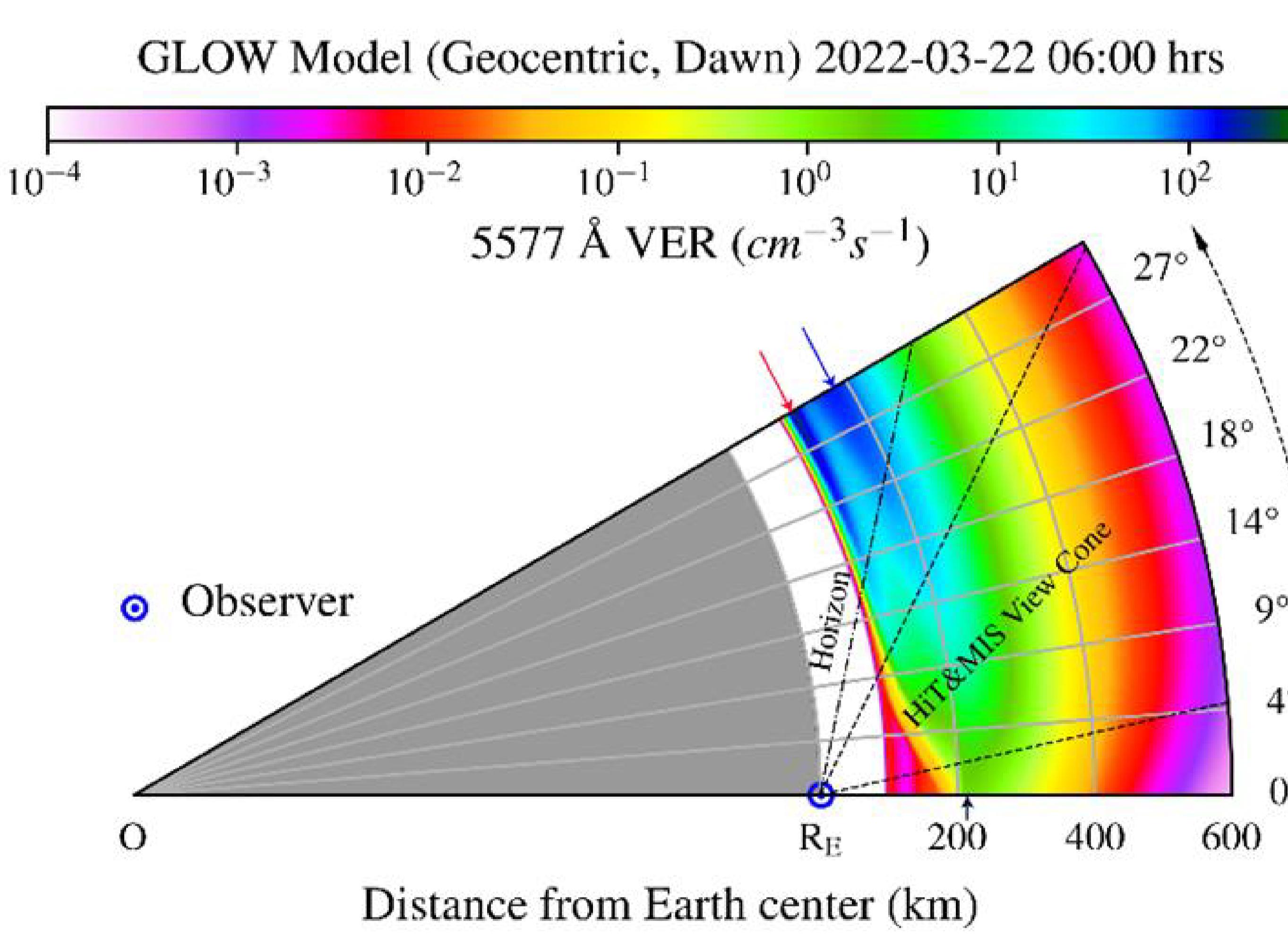
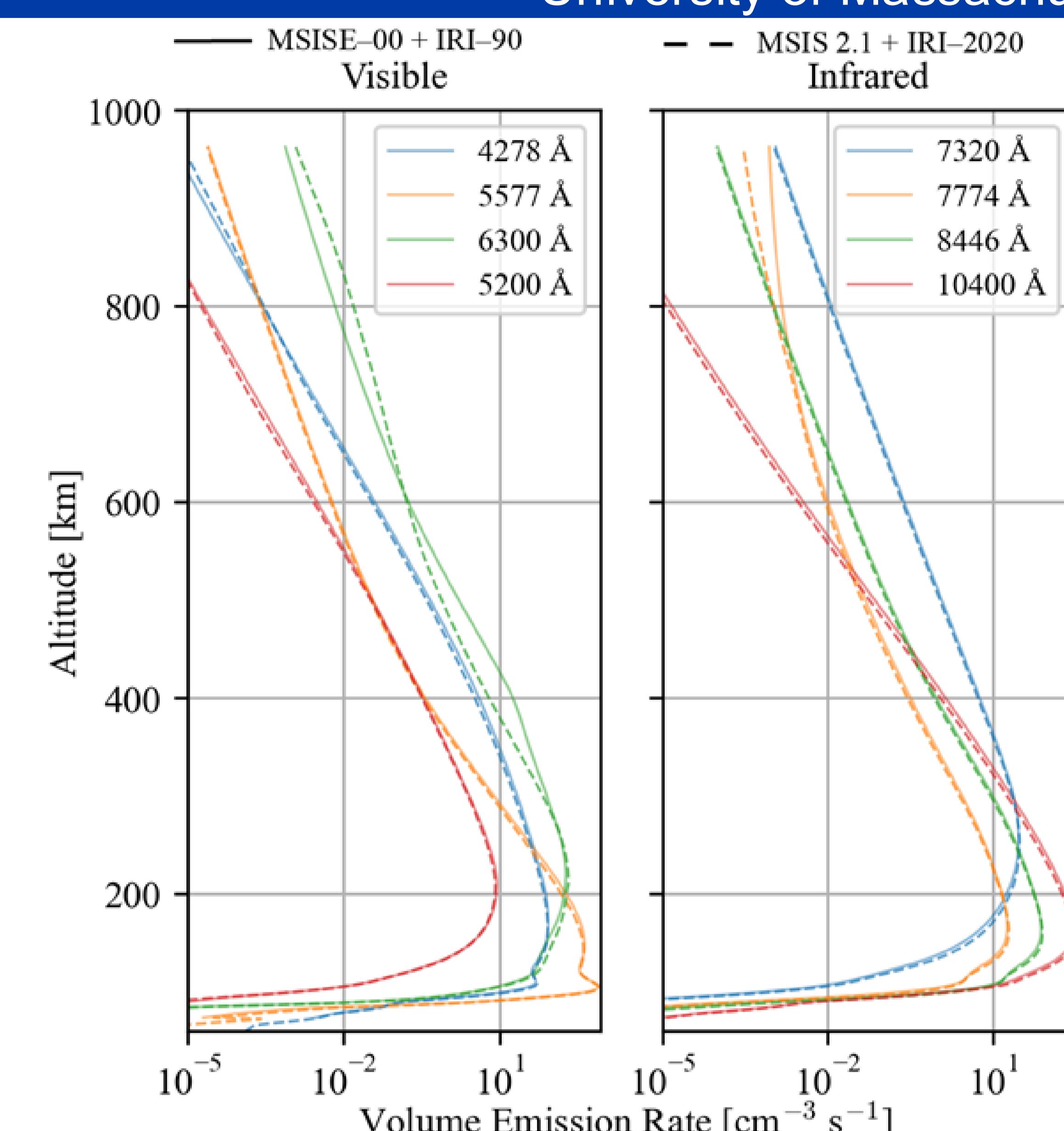
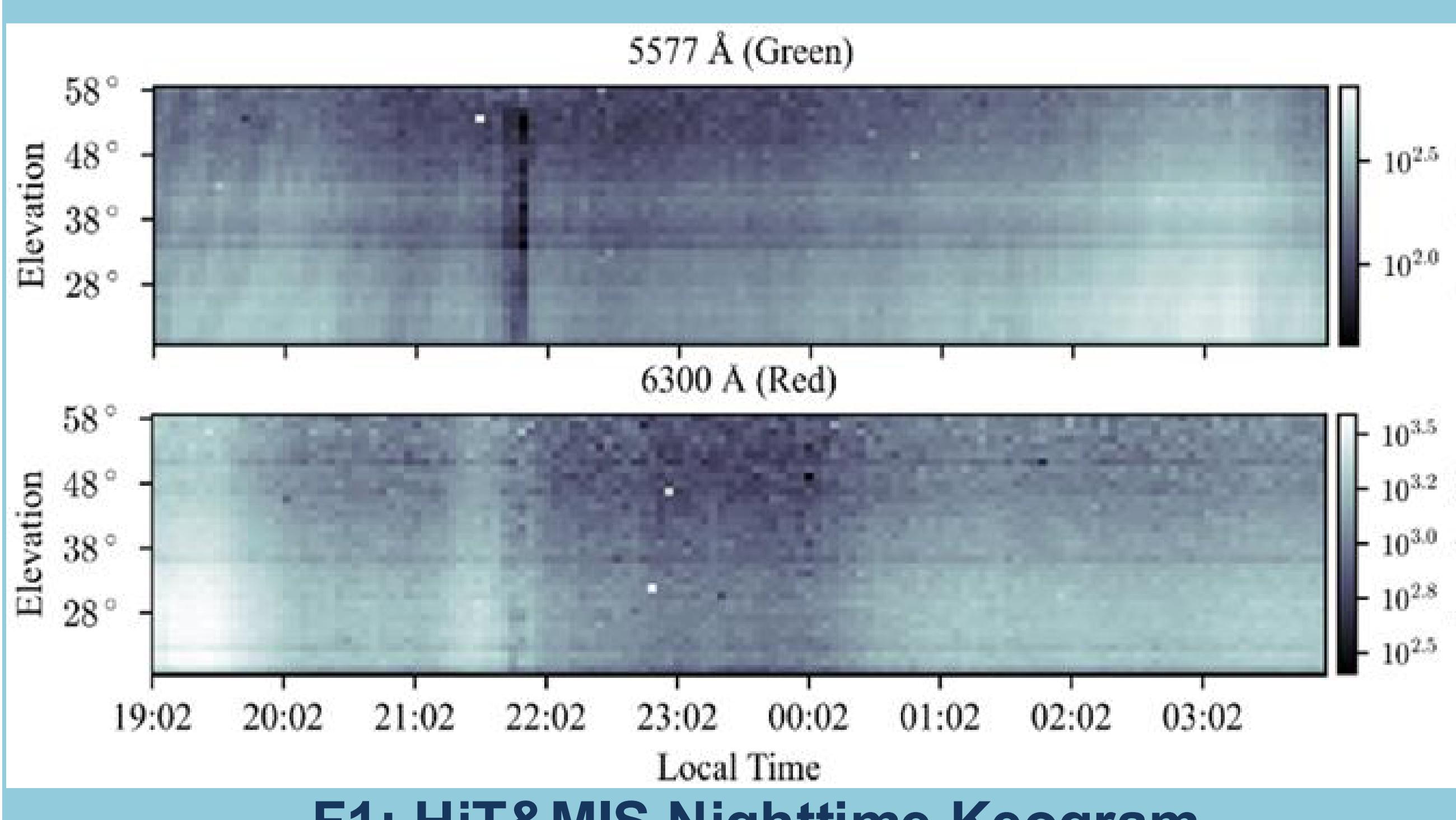
Forward Modeling

- Generate ionosphere and thermosphere with F10.7 and Ap.
- Equate model ionosphere TEC to GNSS-measured TEC.
- Calculate intensities for HiT&MIS (wide-field imaging spectrograph, Chakrabarti et. al. 2012) observation geometry.

Intensity Fitting

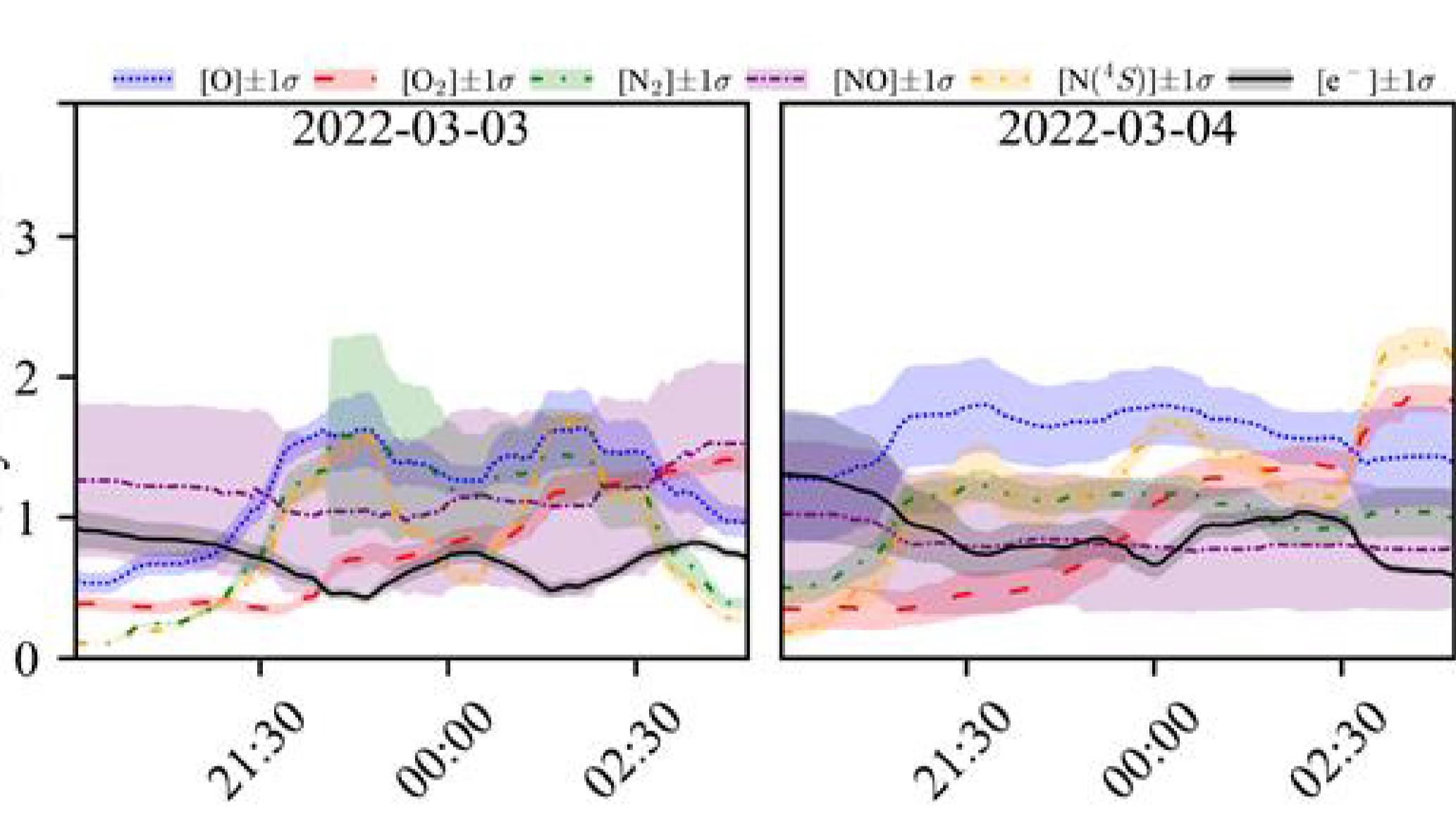
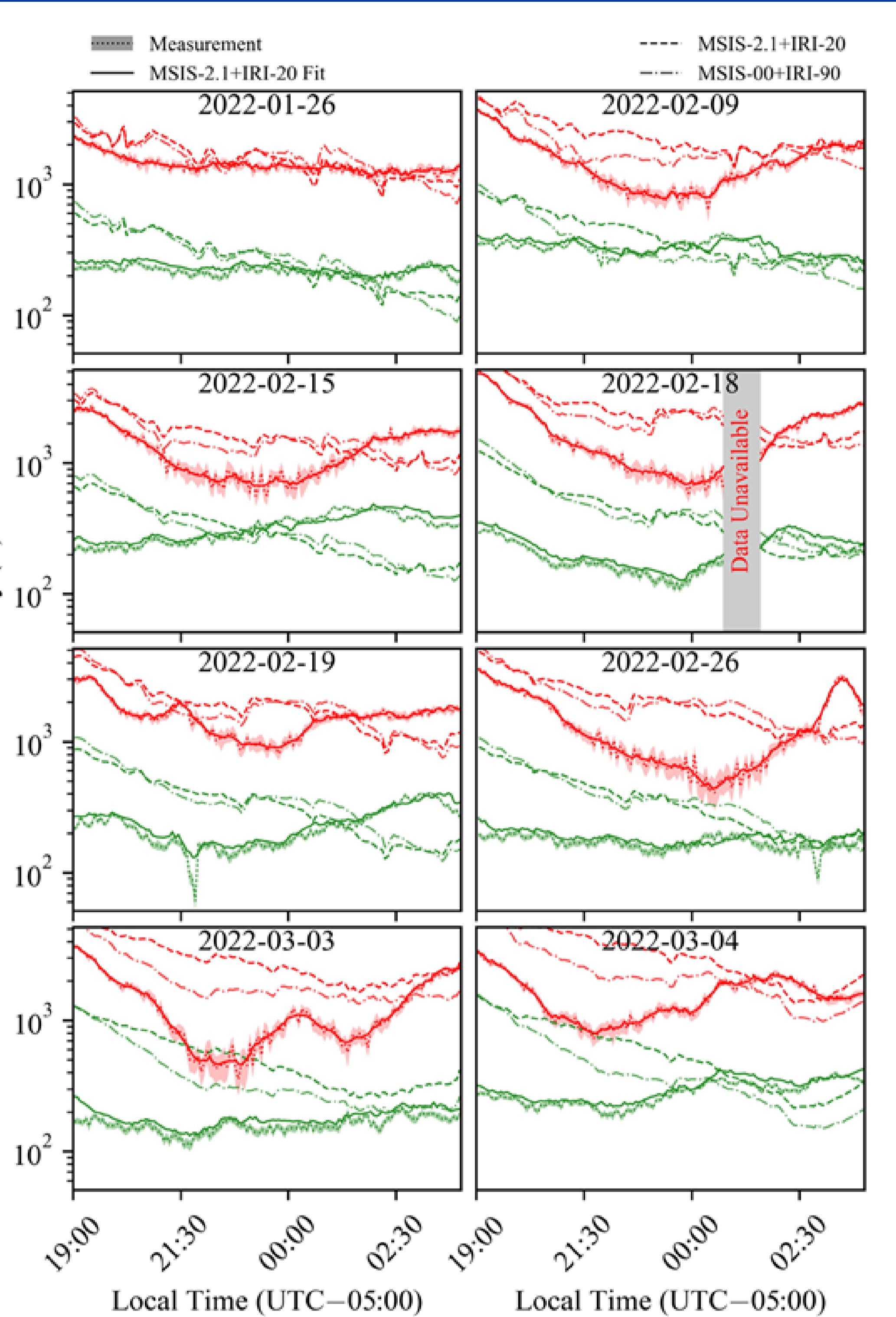
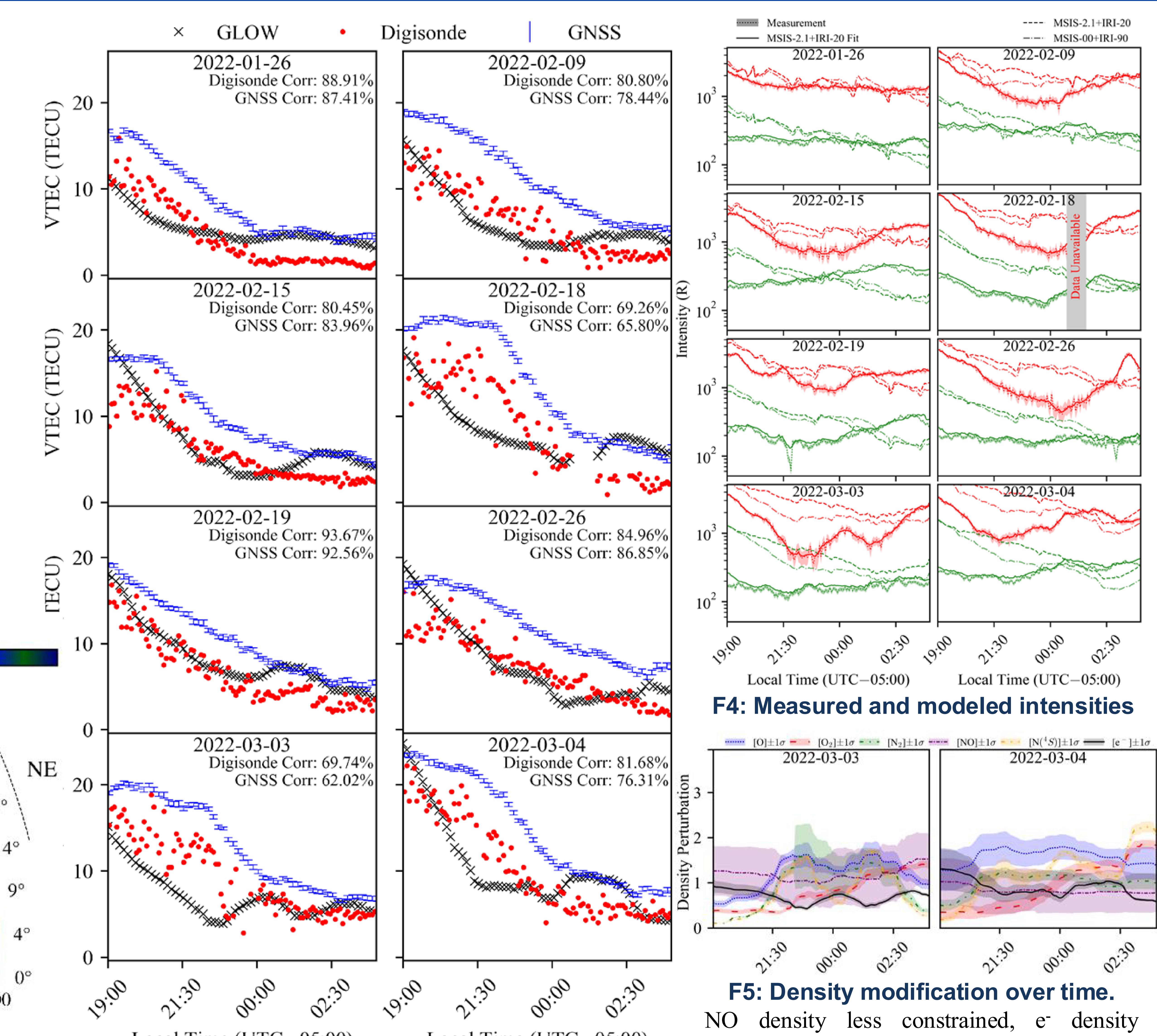
- Generate ionosphere and thermosphere with F10.7 and Ap.
- Adjust neutral and electron densities.
- Calculate intensities for HiT&MIS observation geometry.
- Repeat until model intensities match observations.

Observations



Results

- Forward modeling intensities do not match measured intensities.
- Intensity fitting approach fits the red line intensity almost exactly.
- Green line intensities have short term spatio-temporal features not captured by model (F4).
- TEC (F3) from intensity constrained e⁻ densities are correlated with TEC measured by Millstone Hill Digisonde⁴ (geommean 74% [old] and 79% [new]).
- Geomean correlation with GNSS network TEC 71% [old] and 77% [new].



NO density less constrained, e⁻ density anticorrelated with O, O₂, N, N₂.

Products

- GLOW model with selectable MSIS-2.1+IRI-2020, IGRF-14 models as well as MSISE-00+IRI-90 and POGO68.
- A 2-D framework around the GLOW model for line-of-sight intensity calculations for arbitrary observations.
- GLOW model outputs are compared between the older and newer models (F2A).
- Intensity fitting approach examined with new input models.

GLOW model repository



GLOW-2D repository



Community contributions welcome!