

Comparison of GOLD nighttime measurements of OI 135.6 nm radiance with the total electron content map: preliminary results

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Abstract

The unambiguous 2-dimensional (2D) maps of OI 135.6 nm radiance retrieved from the Global Observation of Limb and Disk (GOLD) after sunset are compared with the total electron content (TEC) maps measured by GPS receivers in the America sector. The OI 135.6 nm radiance observed by GOLD is an indicator of the peak electron density of the ionosphere, while the TEC depends on the total electron density in the column. The comparisons show that both of them are able to capture the large structures in the equatorial ionization anomaly (EIA) well, and sometimes they both also capture bubbles. Both show that the ionosphere after sunset is quite dynamic and has strong day-to-day variability. A statistical study has also been carried out to check the occurrence rate of bubbles and the apparent EIA structure between Oct 17, 2018 to May 31, 2019. GOLD is able to image the areas where it is difficult to situate GPS receivers such as the ocean, while TEC data covers the full-diurnal cycle. In all, the GOLD and TEC have valuable synergy to allow us to gain a better understanding of the equatorial ionosphere.

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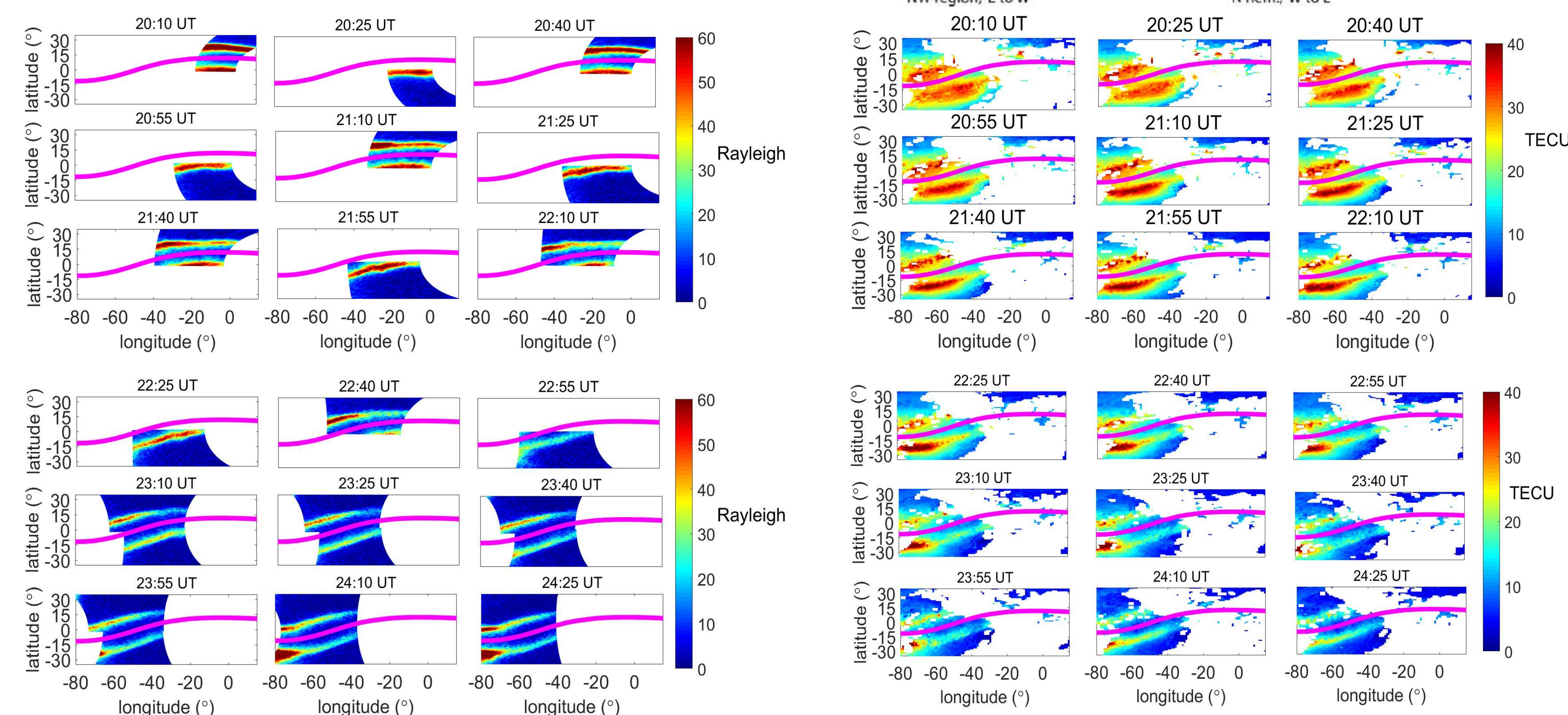
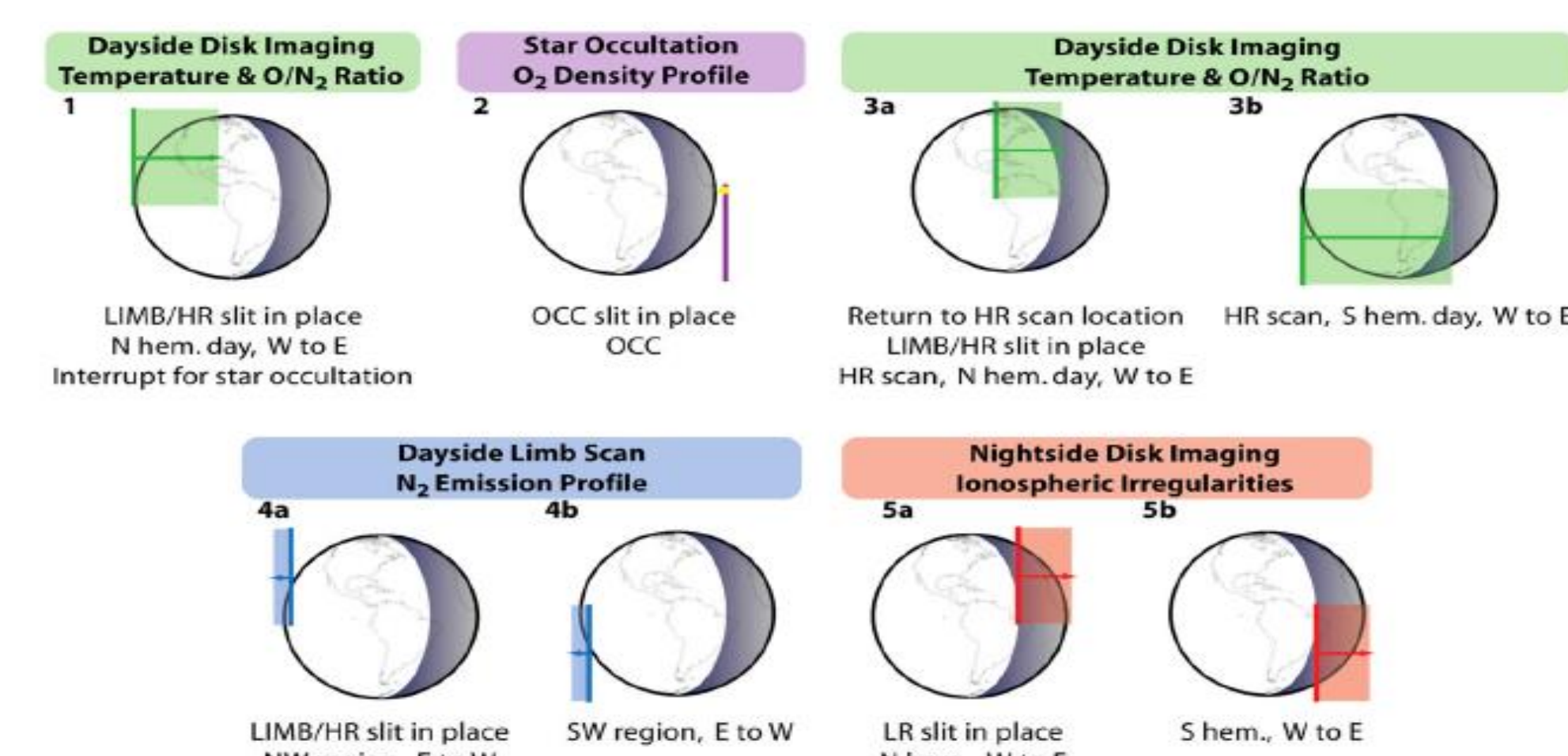
Abstract

The National Aeronautics and Space Administration (NASA) Global-scale Observations of the Limb and Disk (GOLD) has been imaging the thermosphere and ionosphere since October 2018. It provides continuous measurement over a large area from its geostationary orbit. The unambiguous 2-dimensional (2D) maps of OI 135.6 nm radiance retrieved from GOLD after sunset are compared with the total electron content (TEC) maps measured by GPS receivers in the America sector. The OI 135.6 nm radiance observed by GOLD is an indicator of the peak electron density of the ionosphere F2 region, while the TEC is the total electron density in the column. Our comparisons show that the two datasets match each other very well in the EIA morphology and its seasonal variability. Equatorial plasma bubbles (EPBs) are evident in GOLD night-time OI 135.6 radiance. The corresponding depletion is shown in TEC maps, but without GOLD data as a reference, it is difficult to discern if the depletions are EPBs. In addition, both GOLD 135.6 radiance and TEC maps observed third peaks of electron density southward of the southern EIA crest. Furthermore, both show that the ionosphere after sunset is quite dynamic and has strong day-to-day variability. In all, the GOLD and TEC have valuable synergy to allow us to gain a better understanding of the equatorial ionosphere.

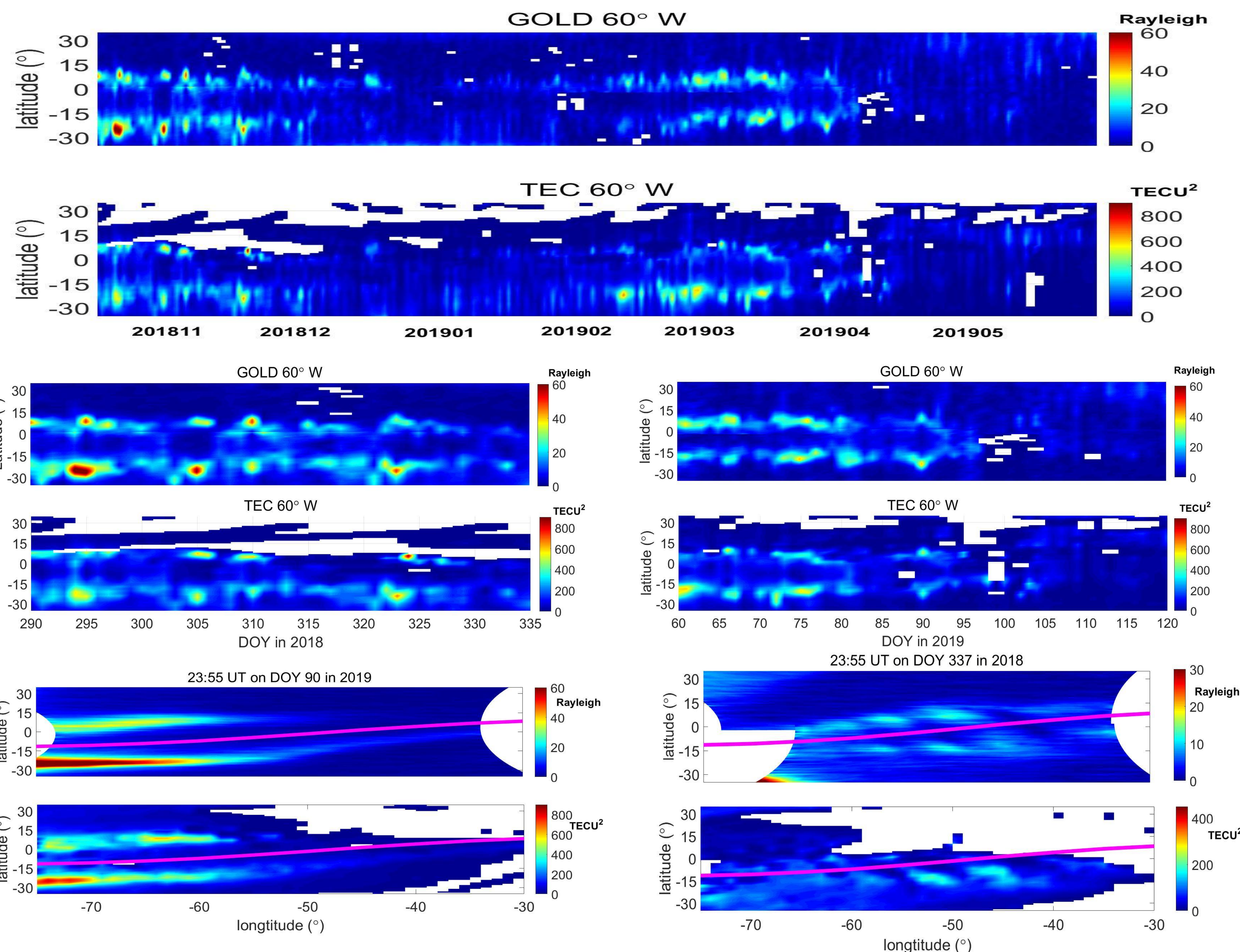
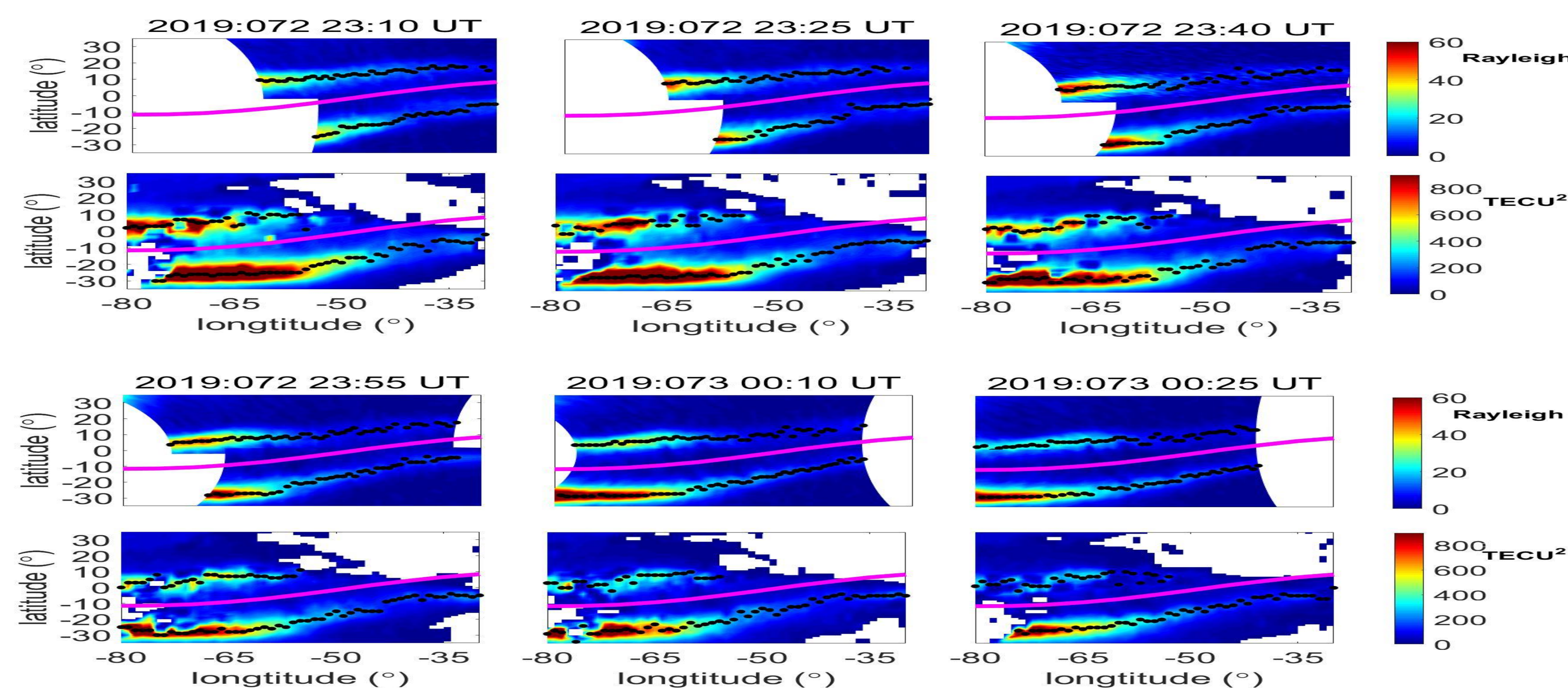
2 Brief introduction of GOLD

GOLD is a high-resolution ($1^\circ \times 1^\circ$), far ultra-violet imaging spectrograph with two identical channels (132-162 nm). It mainly scans 135.6 and LBH in the daytime, and 135.6 at night [Eastes et al., 2017]

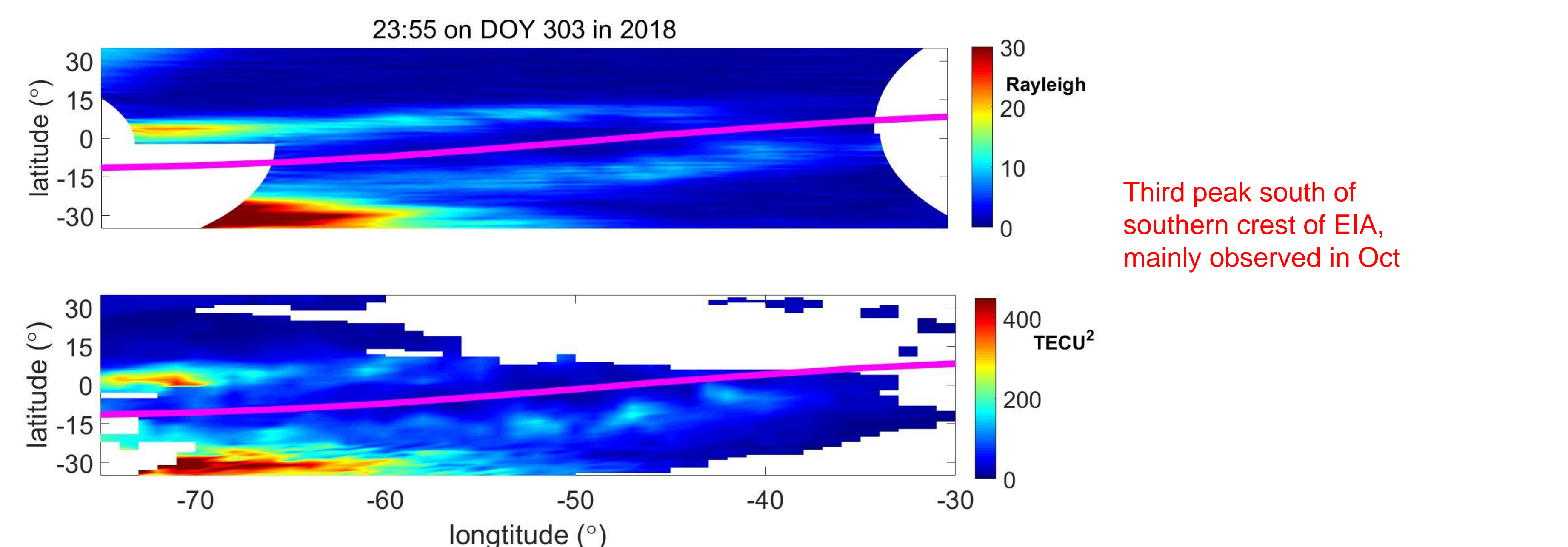
GOLD performs global-scale imaging of the Disk with 30-min cadence in daytime and nighttime, 15-min cadence in part of nighttime. (daytime fixed range 120W to 20E, 70S to 70N; nighttime range moving from east to west 80W to 20E, 70S to 70N)



3 Comparison of morphology between GOLD and TEC



New findings



Third peak south of southern crest of EIA, mainly observed in Oct

4 Conclusion

- 1 TEC and GOLD maps match well in morphology in the equatorial ionosphere
- 2 Combinations of TEC and GOLD maps are a promising tool to study the equatorial nighttime ionosphere
- 3 GOLD has great advantages over TEC in studying equatorial plasma bubbles (EPBs)
- 4 A third peak of EIA in southern hemisphere suggests an uncovered complexity of EIA

Reference

Eastes, R. W., McClintock, W. E., Burns, A. G., Anderson, D. N., Andersson, L., Codrescu, M., et al. (2017). The Global-scale Observations of the Limb and Disk (GOLD) mission. *Space Science Reviews*, 212(1-2), 383–408. <https://doi.org/10.1007/s11214-017-0392-2>