



Global Morphology of Equatorial Ionization Anomaly: New Insights using ICON observations

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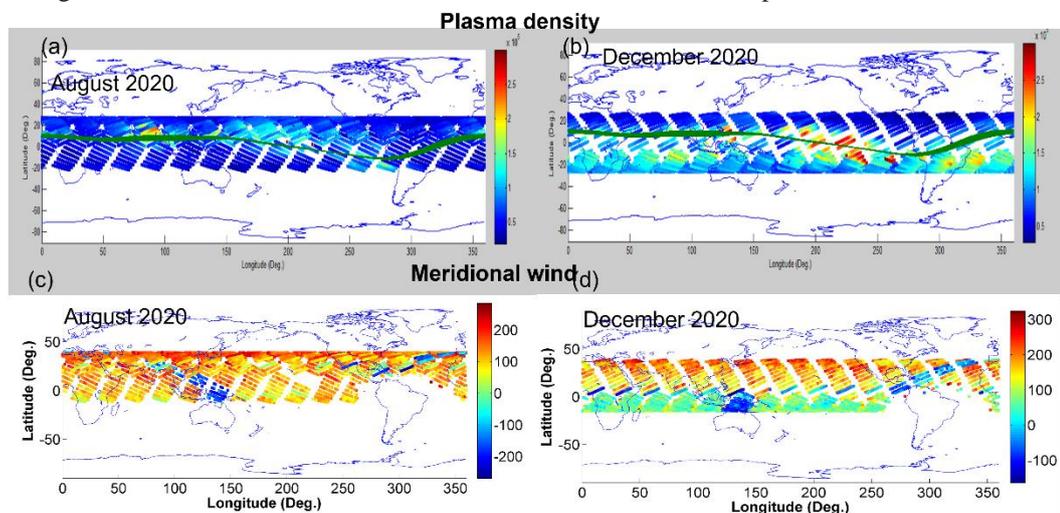
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Equatorial Ionization Anomaly (EIA) refers to the anomalous distribution of plasma in the ionosphere with respect to the geomagnetic equator. The distribution is such a way that maximum plasma density is situated near to ~ 15 degree apart from the geomagnetic equator in both northern and southern hemispheres [1]. EIA has been the subject of decades of research, since they do have a critical impact on ionospheric variability and has significant effects on communications and navigation systems. Still, they are not understood sufficiently up their forecast level.

The global morphological features of EIA are analyzed for a time period of one year, encompassing all seasons, using ICON (Ionospheric Connection Explorer) observations in the present study. EIA crest is observed to be manifested at different latitudes at different longitude sectors. Further, EIA is highly asymmetric in North and South regime with respect to the geomagnetic equator, which also varies with the longitudes (Figure.1). EIA is observed to be stronger in December compared to August in all longitudinal sectors (Figure.1). Intense EIA is observed to be manifested at $(75^{\circ}-100^{\circ})$ and $(180^{\circ}-260^{\circ})$ longitude sectors.

In August 2020 (autumnal equinox season), in most of the longitude sectors EIA crest is intensified in northern region (global average of plasma density $1.75 \times 10^5 \text{ cm}^{-3}$) in comparison with southern region (global average of $0.7 \times 10^5 \text{ cm}^{-3}$). In December 2020 (winter solstitial month), in most of the longitude sectors EIA crest is intensified in southern region (global average $2 \times 10^5 \text{ cm}^{-3}$) in comparison with northern region (global average $1.25 \times 10^5 \text{ cm}^{-3}$). To account for this, the meridional component of wind in the thermosphere is analyzed. Northward wind is observed to be stronger in August 2020 (speed of $\sim 170 \text{ m/s}$ in northern and southern hemispheres) than December 2020 (120 m/s in northern hemisphere and $2-4 \text{ m/s}$ in southern hemisphere). Over all, the northward component of wind weakens in December compared to August. The plausible explanation for the intensified North crest of EIA in August is as follows. In August, since the northward wind is stronger, it carries the plasma from the equatorial region to northern off-equatorial regions along the magnetic field lines. This results in strong northern EIA crest in August. Since the northward wind is weaker in December, the same phenomenon is not occurring as



in August.

Figure.1: Global morphology of EIA and Meridional wind for the month August 2020 and December 2020.

1. Appleton, E.V, "Two Anomalies in the Ionosphere", Nature, 157, 691,1946.