“Electrodynamics of ionospheric weather over low latitudes”

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Low inclination geomagnetic field lines and the relatively larger fraction of the solar incident radiation make the ionosphere over earth’s low latitude to be distinct from that of other latitudes. Here the dynamic state of the ionosphere is largely controlled by electric fields originating from the dynamo actions driven by atmospheric waves from below and the solar wind-magnetosphere interaction from above. These electric fields are basically responsible for the structuring of the ionosphere in wide ranging spatial and time scales that affect in a variety of ways our technology-dependent day-to-day lives. The electric field also drives the electrojet current system and associated smaller scale irregularities. The largest of the ionosphere structures, the equatorial ionization anomaly with global maximum of plasma densities at its crests cause significant propagation delay in the GNSS signals. The electrodynamics peculiar to the sunset transition is responsible for the generation of plasma depleted flux tubes (plasma bubbles) with cascading irregularities that can cause scintillation or even interruption of these signals. Known to be driven basically by the zonal and vertical winds of the upward propagating migrating tides, these electric fields can suffer significant modulations from perturbation winds due to upward propagating gravity waves, planetary and Kelvin waves and non migrating tides, as recent observational and modeling results have demonstrated. The changing state of the plasma distribution arising from these highly variable electric fields (and to a lesser extend from meridional winds) constitute an important component of the ionospheric weather disturbances. The other, often dominating, component arises from solar weather disturbances when CME interaction with the earth’s magnetosphere results in energy transport to low latitudes in the form of storm time prompt penetration electric fields, followed by thermospheric disturbances generated by auroral heating, during which drastic modifications can occur in the form of layer restructuring (Es, F3 layers etc.) large TEC increases and EIA latitudinal expansion/contraction, anomalous polarization electric fields/vertical drifts, enhanced growth/suppression of plasma structuring etc. This lecture will present a summary of our current understanding of the ionospheric weather variations and the electrodynamic processes underlying them, highlighting some outstanding questions to be focused in our continuing research.