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The role of zonal plasma drift for the F-region dynamo: Lunitidal modulation

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In this study we describe the average zonal drift velocity of F-region plasma (or equivalently, vertical electric field) as derived indirectly from the Challenging Mini-Satellite Payload (CHAMP) observations. Two drivers are known for vertical currents flowing in the equatorial ionospheric F-region: (1) a vertical electric field and (2) the dynamo action of F-region zonal wind. The efficiency of these current drivers depends directly on local Pedersen conductivity. As for CHAMP, we can estimate the vertical current density from the magnetometer, the zonal wind from the accelerometer, and local Pedersen conductivity from a combination of magnetometer/accelerometer/Langmuir-Probe data. In this way the vertical electric field are determined, from which we can deduce the zonal drift velocity of F-region plasma. The obtained velocities are directly compared with the ion drift meter data onboard the Republic of China Satellite-1 (ROCSAT-1). The correlation coefficient between the observed and estimated velocities is about 0.8, the best-fit slope is close to unity, and the best-fit offset is smaller than the range of velocity variations. The result supports the validity of the indirectly estimated zonal velocity. We apply this method to data from a period around a sudden stratospheric warming event during which ionospheric parameters exhibit clear modulations by the lunar tide.

Keywords: equatorial ionosphere, ionospheric dynamo, plasma drift