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Day-to-Day Variability of Tidal Waves and Its Impact on the Prereversal Enhancement in the Vertical Ion Drift

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Whole atmosphere model simulations show that atmospheric tides undergo strong day-to-day variability. This has been confirmed by recent analysis of satellite observations. The tidal variability is caused by the variability of the wave sources, propagation condition, and interaction with other atmosphere waves of different scales. In this study we examine the impact of tidal variability on the ionospheric prereversal enhancement (PRE) of E x B drift, which is a important driver of the equatorial plasma bubbles (EPBs). Although the seasonal variation of PRE and EPB have been generally associated with F and E region dynamo, large variability of EPB occurrence from one day to the next is still puzzling and poses a challenge for equatorial space weather research and forecast. Our analysis shows that the PRE variability is strongly affected by the tidal day-to-day variability through the E region dynamo at middle latitudes in the summer hemisphere. The whole atmosphere general circulation model with interactive ionosphere electrodynamics employed in the study does not resolve EPB due to insufficient model resolution, but EPB occurrence rate can be deduced from the simulated PRE using an empirical relation. The deduced EPB rate is in good agreement with the observed rates, suggesting the important role of large-scale dynamics and electrodynamics in preconditioning EPB and the feasibility of probabilistic forecast of EPB using a whole atmosphere model.