Substorm electric fields at mid-latitudes and equatorial electrojets on the nightside

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The convection electric field increases during the growth phase of substoms, driving the DP2 currents and leading to an increase in the eastward equatorial electrojet on the dayside (EEJ). By analyzing isolated substorms with magnetometer network and SuperDARN data, we have shown that the electric field and currents are often reversed in direction, i.e., overshielding occurs at subauroral to equatorial latitudes causing the CEJ on the dayside during the substorm expansion phase. In order to examine the overshielding electric fields on the nightside, we analyze HF Doppler sounders data at low latitude stations Oarai and Sugadaira in Japan. The Doppler frequency of the HF radio signals at 5 and 8 MHz represents vertical plasma drift of the ionospheric F region due to zonal electric fields. We found that the westward (overshielding) electric field reaches around 2 mV/m on the nightside during substorm expansion. Taking the geometrical attenuation into account, we estimate the equatorial electric field to be about 1.5 mV/m. By comparing the HF Doppler data with the equatorial EEJ/CEJ, we also found that the correlation coefficient was 0.94 between the overshielding electric field and eastward equatorial electrojet at YAP on the night side. The overshielding electric field drives the westward and eastward electrojets in the equatorial ionosphere on the day- and night-side, respectively. These results suggest that the overshielding electric field associated with the Region-2 field-aligned currents becomes dominant during substorms at low latitude on the nightside as well as on the dayside.