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A new way to identify and quantify the sources of ionospheric convection

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We have developed a new technique that enable us to identify, separate, and quantify the sources of high latitude ionospheric convection. Usually, the ionospheric convection is examined by the electrostatic potential, as the convection will follow contours of equipotentials. We will show that in order to identify, separate, and quantify the underlying processes responsible for the observed convection pattern, it can be more beneficial to look at a quantity we show is proportional to the divergence of the convection electric field. We here use the Spherical Elementary Convection Systems (SECS) technique to describe the ionospheric convection electric field as the sum of the fields from a distribution of artificial nodes on a spherical surface, each having their own curl-free elementary field. We show that such a representation is highly suitable for the identification and quantification of the sources of ionospheric convection as the strength of the elementary fields are proportional to the divergence of the convection electric field. We use this method to study the ionospheric convection using SuperDARN during northward IMF, and demonstrate its ability to separate the sources of ionospheric convection related to lobe reconnection and tail reconnection. Utilizing this ability, we isolate the effect from lobe reconnection and study how different orientations of the Earth's magnetic dipole axis affect the lobe convection strength inside the dayside polar cap, in which we relate to the lobe reconnection rate assuming a strong coupling between the two regions. We find that the inferred lobe reconnection rate increase linearly with increasing dipole tilt angle. Our findings indicate that the summer hemisphere can typically have twice the lobe reconnection rate compared to the opposite hemisphere.