

# Application of Euler potentials for finding shell currents in the ionosphere

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## Abstract

Ionospheric data and empirical models provide field-aligned currents (FAC) and induced magnetic field variations with good temporal and spatial resolution. On the other hand, merging between FAC and shell currents (SLC) is not described in all details. This can be done with the Euler potentials. So far, Euler potentials have been found analytically only for a few magnetic field distributions. Magnetic field induced by FAC and SLC are usually calculated with Biot-Savart integration. This way makes practically impossible tracing particle motion. On the other hand, Euler potentials, once they are found as in Romashets and Vandas (2022), allow easy integration along the field-lines. To determine the distribution of SLC in the ionosphere, and Joule heating as well, one usually needs to know conductivity profiles in the ionosphere. With Euler potentials, shell currents can be found first. And then conductivity maps could be recovered from there. In other words, SLC are to be found in much easier and reliable way.

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