The effect of ionospheric conductance on reconnection estimates based on ionospheric observations

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ABSTRACT

Ground magnetometer measurements are frequently used to study ionospheric electrodynamics. It is possible to relate and combine **ground magnetometer measurements** with **ionospheric convection** measurements through the **ionospheric Ohm's law** if the **auroral conductance** is known.

Auroral conductances are highly variable and very difficult to evaluate. In this study we use the **Lompe** data assimilation technique to investigate the effect of different methods to retrieve auroral conductances. Lompe uses the ionospheric Ohm's law to combine convection and magnetic field measurements from ground and space.

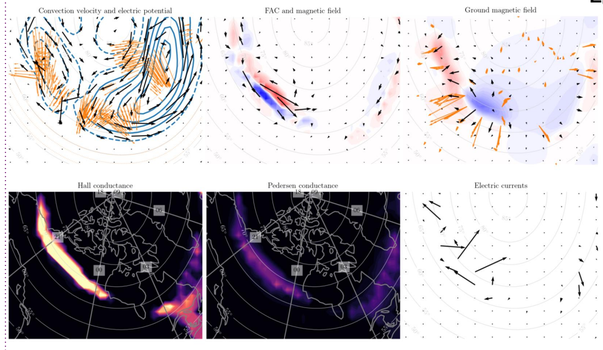
METHOD

• We use the **Lompe**[1] data assimilation technique with ground magnetometers and SuperDARN measurements as input to get estimates of **ionospheric convection v**

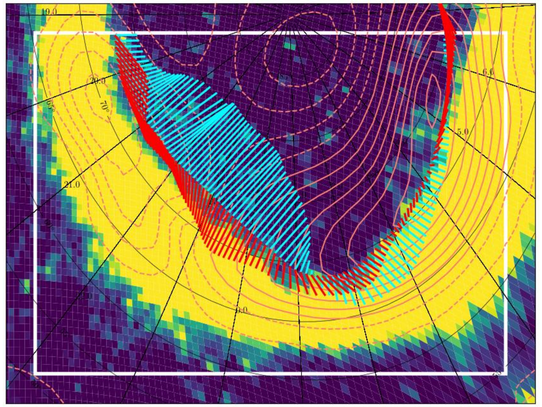
• We use global auroral images from the **IMAGE** satellite's **WIC** camera to trace the **open-closed boundary (OCB)** and OCB observations to calculate the boundary normal velocity **u**

• We use the Robinson's equations[2] to estimate **Hall** and **Pedersen** conductances input to the Lompe inversion. We use different assumptions for the conductances to see how different conductance estimates affect our results

- **Frey[3] 2003** (multispectral observations from IMAGE used to estimate average electron energy)
- **Hardy[4] 1987** (empirical Kp-driven model based on particle precipitation measurements)
- **E_0=3keV** (assuming constant electron energy but using WIC to get the spatial pattern of the energy flux)
- **E_0=1keV**

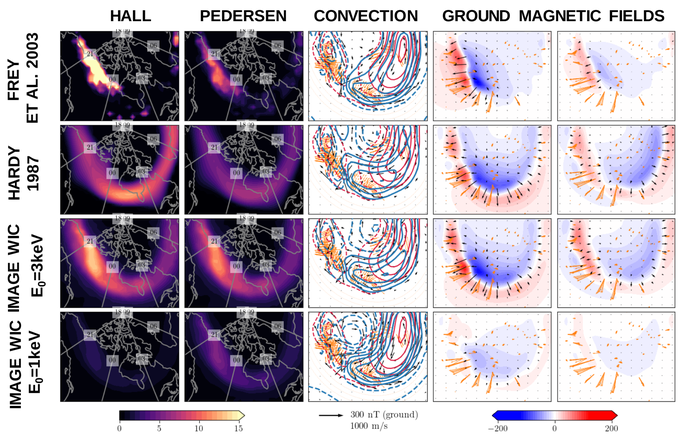


RESULTS



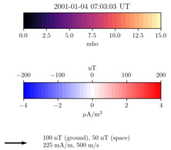
WIC counts, electric potential contours, convection velocities **v** and OCB velocities **u** along the OCB

Reconnection electric field estimates[3] **E = (v-u)×B**



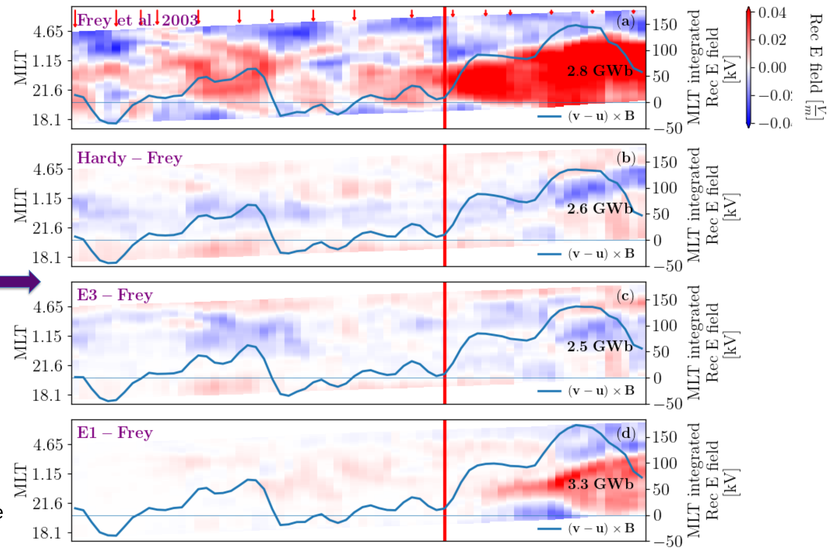
From left to right Hall and Pedersen conductances (mho), Lompe convection and electric potentials, Lompe ground magnetic field estimates (nT) (SuperDARN and SuperMAG in the inversion), Lompe ground magnetic fields (only SuperDARN in the inversion)

Differences in reconnection electric field estimates between Frey 2003 (panel 1) and the other three methods (2-4 panels).



Example of Lompe output

TEMPORAL EVOLUTION OF THE RECONNECTION E FIELDS



DISCUSSION & CONCLUSIONS

- Conductance values are crucial for determining ionospheric flows when using ground magnetometers in combination with ionospheric **convection measurements**. **Different conductance estimates** lead to different estimates of ionospheric convection patterns and a **different temporal evolution of the convection strength**.
- **Differences in conductance estimates** give rise to **differences in the temporal evolution of the reconnection electric field estimates**.
- Including ground magnetometers in the Lompe inversion reveals a more detailed structure in the reconstructed convection patterns.
- Poleward motion of the OCB faster than convection leads to negative reconnection electric fields (blue). Since this is physically unrealistic on the nightside, it illustrates the uncertainty in the method.

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