RECONSTRUCTION OF PRECIPITATED ELECTRON FLUXES USING AURORAL DATA

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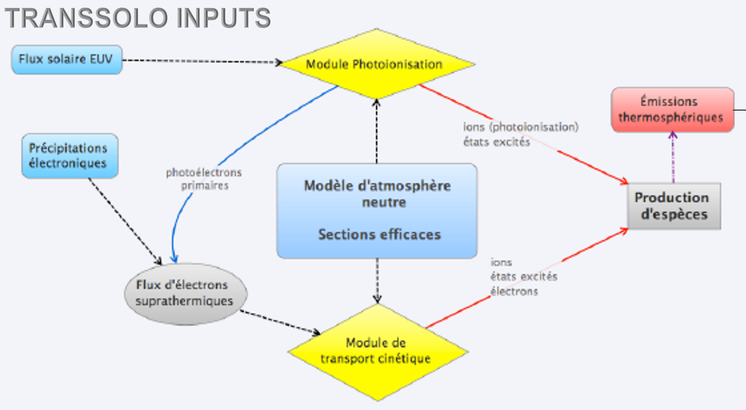
CONTEXT :

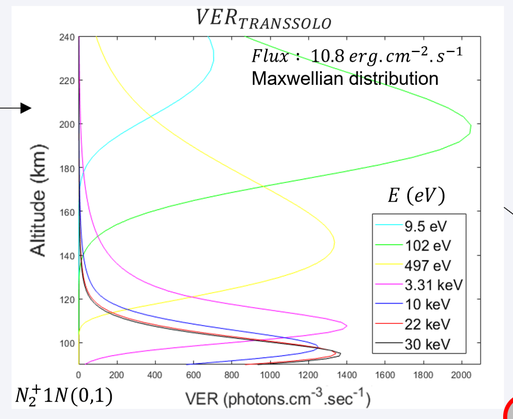
In this study, we explore a new approach using an optimization method to compare simulations of the blue line N_2^+1NG at 427.8 nm obtained with the Transsolo ionospheric transport code (Lummerzheim & Lilensten, (1994); Lilensten & Blelly, (2002)) and VER resulting from ALIS optical observations (Brändström (2003); Simon Wedlund et al., (2013)) enabling us to reconstruct electron precipitation characteristics over a large geographical region, approximately 150 km x 150 km in size. The reconstruction is performed by extracting the energy flux and the mean energy of the precipitating particles. Both Maxwellian and quasi-monoenergetic energy distributions are considered. To compare the validity and accuracy of our method, we use the same data set as in Simon Wedlund et al. (2013) obtained by March 5th, 2008 at 18:41:30 UT and 18:42:40 UT.
Results of the March 5th, 2008 at 18:41:30 UT with Maxwellian distribution are shown below.

METHOD :

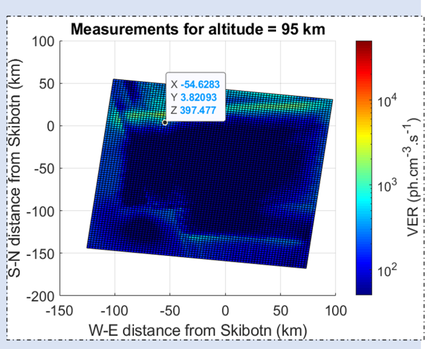
Implementation of an optimization method for the Transsolo code based on tomographic maps of the ALIS network. The cost function to minimize is calculated using the least squares method.

TRANSSOLO INPUTS

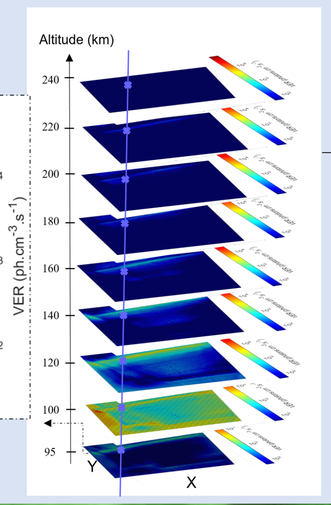


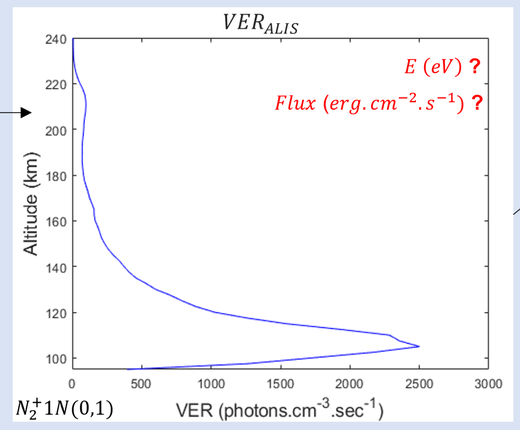


ALIS INPUTS



05 Mars 2008 - 18h41min30sec

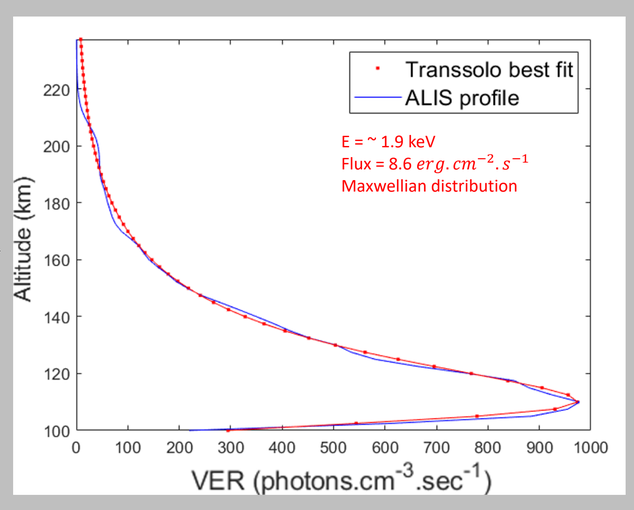




LEAST SQUARE MINIMIZATION

$$f = \sum \left(\frac{VER_{ALIS}}{\sum VER_{ALIS}} \right) * \left(\frac{VER_{TRANSSOLO} - VER_{ALIS}}{VER_{ALIS}} \right)^2$$

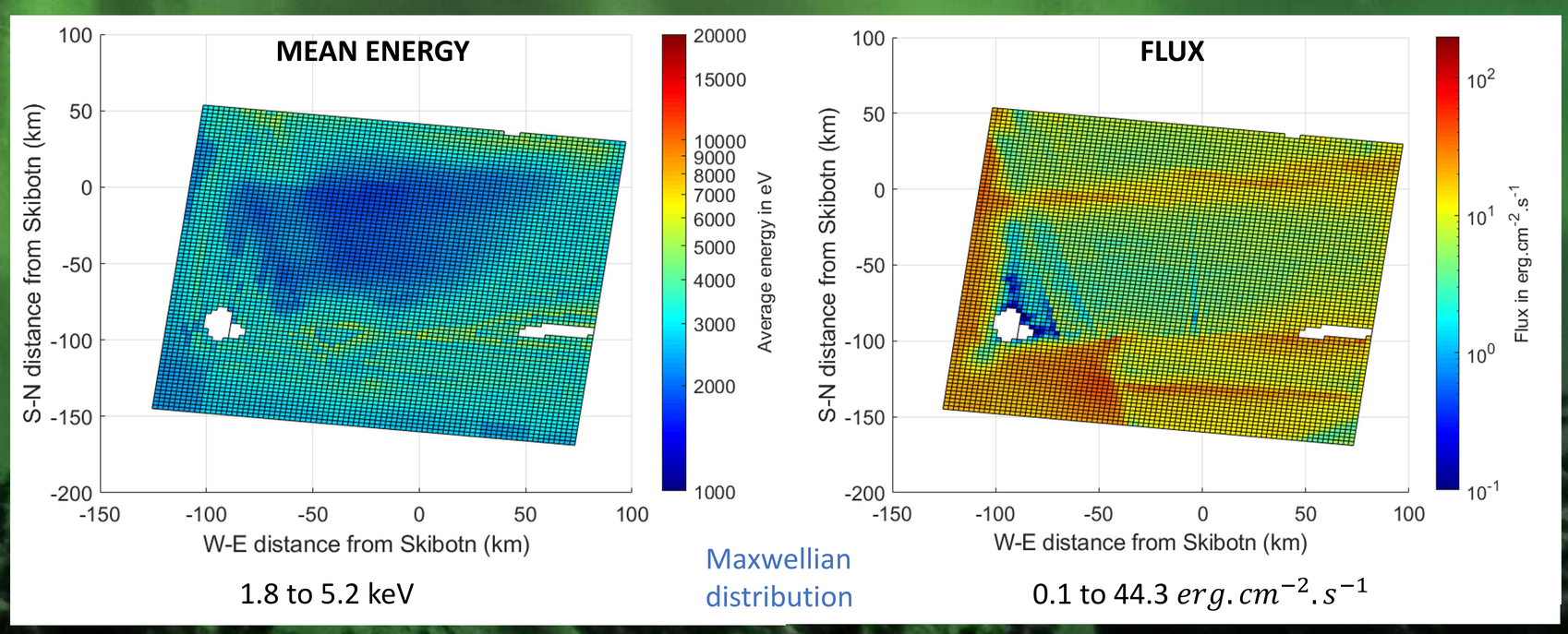
OUTPUT FOR A GIVEN VER ALIS PROFILE



RESULTS :

- The **altitude of the peak emission** of the A-VER profiles is **a proxy for the mean energy.**
- The **integral of the distribution** defined by the A-VER profiles is **a proxy of the flux.**
- The altitude **thickness of the emission peak** of the A-VER profiles is **a proxy for the width of the energy distribution.**

MAPS OF MEAN ENERGY AND FLUX REONSTRUCTED FROM THE OPTIMIZATION METHOD



1.8 to 5.2 keV

Maxwellian distribution

0.1 to 44.3 $erg.cm^{-2}.s^{-1}$

05 Mars 2008 - 18h41min30sec - Optimization is applied to all VER ALIS profiles of the tomographic map.

- Maps are also realized for Dirac distribution (not shown here).
- Results are coherent with the work of Simon Wedlund et al. (2013).

CONCLUSION :

- Optimization calculations performed with a Maxwellian energy distribution yielded a mean energy ranging from 1.8 to 5.2 keV with energy flux from 0.1 to 44.3 $erg.cm^{-2}.s^{-1}$.
- From Maxwellian and Dirac distributions we are able to differentiate between regions with monoenergetic acceleration processes such as potential drops from regions with other acceleration processes.
- The mean energy and flux maps present relevant information to quantify the energetic deposition of electrons in the upper atmosphere.
- Auroral tomography is one of the best way to reconstruct particles fluxes.