The Earth’s Magnetosphere-Ionosphere-Thermosphere (MIT) system is strongly controlled by the laws of electrodynamics, which include significant contributions from all three components. Today, we face a growing need for a better representation of this MIT system, mostly at low latitudes due to the growing use of GNSS satellites for positioning, which face accuracy and forecasting challenges that are not accessible with current data coverage and processing tools.

The IRAP Plasmasphere-Ionosphere Model (IPIM) is one of the only physical models developed in Europe and validated on observations for its high-latitude version. The IPIM model solves plasma transport equation along magnetic field lines and provides a complete 3D coverage of Earth’s ionosphere and plasmasphere in latitudes, longitudes and altitudes.
The main inputs of the model come from the solar irradiance (FISM model) and the neutral atmosphere (MSIS for neutral densities and temperature and HWM14 for winds). We are extending the IPIM model with a module solving the electrodynamics of the low and mid-latitudes. The specificity of this module is that it is developed using a new orthogonal magnetic coordinate system (called Generalized Eccentric Dipole) which is suited for any analytical representation of the magnetic field, like the International Geomagnetic Reference Field (IGRF). It provides a projection basis and a metric which account for the structures of the Earth's magnetic field, especially near the equatorial region at low altitude and is very similar to a dipolar system at high altitude (or high latitudes).
The final goal of this work is to have a good representation of low-mid latitudes ionosphere-upper atmosphere couplings, mostly in regions with sparse data coverage.

We will present interesting first results of the coupling between IPIM and this new electrodynamical module showing expected low- and mid-latitudes phenomena such as the equatorial ionization anomaly detected on global total electron content and foF2 maps or the presence of the Equatorial ElectroJet and Solar quiet currents during the day.
Finally, we will discuss the results and the perspectives of applications and developments.