ÉCOLE DOCTORALE SCIENCES DE LA TERRE

Subject offered for a contract starting in September 2011

SUBJECT TITTLE: MODELING THE EARTH'S MAGNETIC FIELD TO HIGH SPATIAL RESOLUTIONS

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Financing: Doctoral contract with or without assignment

For more information go to http://ed109.ipgp.fr, section: Offres de these (PhD offer), You must apply on the Doctoral School website

The Earth's magnetic field results from the superimposition of sources of various origins, which are located in the outer core, in the Earth's crust, and between 100-km to several Earth's radii for ionospheric and magnetospheric field sources that are external to the Earth's surface. The physics of these magnetic fields may also vary geographically. The strength of the external field is more important near Polar and Equatorial regions than at mid latitudes, which requires dedicated tools. A good understanding of the different sources and their interaction is challenging and exceeds the scope of science only. Earth's magnetic field maps and models are ubiquitous in many societal applications. For instance, the main Earth's magnetic field may be used for aeronautic navigation, the maps of the crustal field exploited for geological prospecting, and monitoring of the external field useful for "space weather" interests.

This thesis project aims at modelling the Earth's magnetic field as a whole in space and in time. First, this will require collecting available magnetic field measurements at different locations and epochs for the last decades. Such measurements may come from Earth's magnetic observatories, ground stations, aeronautic or marine campaigns, past satellite missions and, if available, from the forthcoming European *Swarm* satellite mission schedule to be launched in 2012. Secondly, the candidate will derive the mathematical formalism to take into account the geographical differences of the physics describing the different Earth's magnetic field sources. This modelling will be performed, for instance, by using regional basis functions and establishing the relevant boundary conditions between the geographical regions. Thirdly, the candidate will code the equations and solve numerically for the inverse problem in order to obtain a continuous model in space and time from a discrete set of magnetic field measurements. After the completion of this work, the candidate will be able to propose an innovative tool to compute the Earth's magnetic field to high spatial resolution.

In this framework, the candidate will have the opportunity to contribute to the preparation and the exploitation of the data from the Swarm satellite mission. This will be done in collaboration with some of our colleagues involved in the scientific preparation of this mission. The candidate should have demonstrated a strong expertise in mathematics, physics and computer programming.