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CHAMP, SWARM, and WDMAM magnetic data; three reasons for further developing techniques for modeling the lithospheric magnetic field at regional scales

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The spatial resolution of all available data monitoring the Earth's lithospheric magnetic field range from thousands to few kilometers at the regional spatial scale. The data type and measurement platforms covering these various wavelengths are in general different. For instance, Low Earth Orbiting satellites, such as CHAMP and the forthcoming SWARM, measure the vector field and are sensitive to large-scale and deep lithospheric magnetic field structures, while aeromagnetic and marine data or grids, like the World Digital Magnetic Anomaly Map (WDMAM), which are mostly scalar, in general fetch better shallow and small spatial scale signals. For quantitative geophysical interpretations, there is therefore a need for methodologies allowing for the reconstruction of the full magnetic field spectrum.
During the last decades, various methodologies have been proposed in an effort to merge all kinds of magnetic data available over particular regions. We first briefly review the methods proposed by the scientific community and will more specifically focus on new progresses in developing the Revised Spherical Cap modeling approach. In particular, we will discuss the concept of spectrum with this formalism and its applicability in the framework of geomagnetism. Since a regional modeling approach can only be applied on high quality data we then propose some strategies to first obtain a better signal to noise ratio in satellite data and second to better account for its nature. We will illustrate our conclusions with issues faced with the data processing of single satellite missions such as CHAMP. Finally, we discuss how a constellation such as the Swarm mission will alleviate some of, so far, unresolved problems and how important it is to have the metadata information about the aeromagnetic and marine anomaly data.