The Earth’s magnetic field results from different sources in the Earth’s interior and in near Earth space. Commonly, when investigating solar-terrestrial interactions where the Earth’s internal field plays a major role, scientists concentrate on strong (tens to thousands of nanotesla) and rapid (seconds to days) magnetic field variations that are caused by currents in the ionosphere and magnetosphere when solar activity, and correspondingly the electric currents in Earth’s environment, are enhanced. However, for studying the internal sources of the geomagnetic field, originating in the core and crust, scientists use observations from so called “geomagnetic quiet” times, when external field variations are expected to be weak. However, even these weak variations impact internal field modelling, and incomplete knowledge of them hinders their separation. Difficulties arise in particular in characterizing the long term behaviour of external sources, e.g., seasonal and solar cycle variations of the magnetospheric ring current, polar convection currents or ionospheric dynamo currents driven by atmospheric tides, since they have amplitudes and spatial scales similar to those of the core field’s secular variation or the lithospheric field. Since such external currents are also present during geomagnetic quiet conditions they may result in biased core and crustal field models. An additional complexity arises from magnetic observations taken by satellites because of the movement of the platform, leading to a possible space-time ambiguity.