Local diurnal variations of the geomagnetic field during magnetically quiet conditions

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The Earth’s magnetic field as measured from ground-based magnetometers is composed of a variety of fields generated by diverse sources, spanning a broad amplitude and frequency spectrum. Long-term variable sources induce smooth changes, whereas short-term variable sources are able to induce rapid spikes in the geomagnetic field. An important aspect of Space Weather research is to understand the contribution and impact of each of these sources. In particular, knowing the amplitude and frequency of steady-like sources, like diurnal variations, enables us to determine the impact of sudden and hazardous events such as solar storms. The basic approach to this challenge is to identify the quiet magnetic field information within the recorded time-varying signal.

In this work, we examine the variance of the magnetically quiet diurnal and semi-diurnal components of the geomagnetic field, as recorded by ground-based magnetic observatories of the INTERMAGNET network. These variations are extracted by applying appropriately designed digital filters on the geomagnetic field time series. The residual signal is analysed in terms of local time and seasonal variations for selected locations under quiet magnetic conditions. This approach allows us to evaluate the applicability of the introduced filtering method. The obtained results improve our understanding of the driving sources of quiet currents such as the Sq current and the variations of their distributions with respect to regular solar irradiance variations. They will also contribute to a better extraction and description of the remaining/residual signal related to solar wind stimuli (e.g. ICMEs, CIRs) causing magnetic storms.