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Magnetic variations caused by the acoustic and internal gravity waves observed on ground and by the CHAMP satellite

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Small amplitude magnetic oscillations with periods of several minutes, in particular around 4 minutes, are often observed on the ground in mid- or low-latitudes not only at special occasions such as earthquakes or typhoons but also almost at any time if we analyze the data with very high resolution. Because of the localized nature and their spectral characteristics, they differ from well-known geomagnetic micro-pulsations generated in the magnetosphere, and at least part of them seems to be generated through the ionospheric dynamo driven by neutral wind associated with the acoustic gravity waves or the internal gravity waves. On the other hand, the CHAMP satellite showed a ubiquitous existence of small amplitude and short period magnetic oscillations of the transverse components along its orbit on the dayside in mid- and low-latitudes. From their frequency characteristic, increasing period towards the magnetic equator, we interpret the variations as spatial structure of field-aligned currents. The characteristics of their appearance such as the seasonal, local time and geographical dependence strongly suggest that they are also caused by the lower atmospheric disturbances through the ionospheric dynamo. These ground and satellite observations could be the indication of the same phenomenon and they could provide a new method to investigate the short period atmospheric waves from ground and satellite magnetic observations.