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Development of geomagnetic total force models by applying Natural Orthogonal Component (NOC) method

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Geospatial Information Authority of Japan (GSI) has conducted nationwide continuous geomagnetic field vector observations since 1997. By utilizing these continuous data, we developed 2 types of geomagnetic total force models by applying Natural Orthogonal Component (NOC) method. One model is constructed from continuous total force observation data of proton and overhauser magnetometers. The other model is constructed from continuous 3-component geomagnetic vector observation data of fluxgate magnetometers. We call the models ”scalar model” and ”vector model” respectively. We developed the scalar model from total force observation data of 17 observatories operated by the GSI, Japan Meteorological Agency (JMA) and Earthquake Research Institute (ERI) and additional 2 observation stations operated by the ERI. We evaluated accuracy of the model by Leave-One-Out Cross-Validation (LOOCV), and the model reproduces total magnetic forces at the observatories and stations with the consistency of a standard deviation of 2.6nT. On the other hand, the vector model is developed from vector observation data of 17 observatories operated by the GSI, the JMA and the ERI. The model reproduces total magnetic forces at the observatories with the consistency of a standard deviation of 3.7nT. In order to remove a long wavelength trend of total geomagnetic force from total force observation data time series around a large volcano, we reproduced time series of total magnetic forces around Mt. Fuji and removed them from total force observation data at four observation stations around Mt. Fuji. The detrending revealed that detrended time series of one of the stations, Fujishi, contain clear seasonal variation with amplitude of 2nT. Time series of another station, Fuji-no-miya, also contain a clear step down which might be caused by piezomagnetic effect with an earthquake in the eastern part of Shizuoka Prefecture on March 15, 2011.

Keywords: Principle Component Analysis, Geomagnetic total force model, Natural Orthogonal Component, Geomagnetic charts