GOCE ML-calibrated magnetic field data
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1. Licence

2. Citation

When using the data please cite:

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Table of contents

3. Data Description

The Gravity field and steady-state ocean circulation explorer (GOCE) satellite mission carries three platform magnetometers. After careful calibration, the data acquired through these can be used for scientific purposes by removing artificial disturbances from other satellite payload systems. This dataset is based on the dataset provided by Michaelis and Korte (2022) and uses a similar format. The platform magnetometer data has been calibrated against CHAOS7 magnetic field model predictions for core, crustal and large-scale magnetospheric field (Finlay et al., 2020) and is provided in the 'chaos' folder. The calibration results using a Machine Learning approach are provided in the 'calcorr' folder. Michaelis' dataset can be used as an extension to this dataset for additional information, as they are connected using the same timestamps to match and relate the same data points. The exact approach based on Machine Learning is described in the referenced publication (Styp-Rekowski et al., 2022). The data is provided in NASA CDF format (https://cdf.gsfc.nasa.gov/) and accessible at: ftp://isdcftp.gfz-potsdam.de/platmag/MAGNETIC_FIELD/GOCE/ML/v0204/ and further described in a README.

3.1. Sampling method

The data was recorded onboard the GOCE satellite mission with varying time intervals of the different subsystems measuring. The magnetometer measurements (16s intervals) were aligned to match the closest position measurement (1s intervals) and interpolated accordingly. All other available data of different intervals was interpolated and aligned to the same timestamps.

3.2. Analytical procedure and data processing

The data was calibrated using a Machine Learning approach involving Neural Networks, the whole method of calibration is described precisely in the referenced publication.

The data was mainly processed for its calibration which yields a lower residual compared to a reference model than the uncalibrated data, more details about the many steps involved can be found in the referenced publication.

4. File description

The repository consists of three folders, calcorr, chaos and fac, as well as a file named 'feature_list.csv'. The 'feature_list.csv' file contains all the features which were used as the input for the neural networks involved in the calibration, one feature per row. The folder 'calcorr' as well as 'chaos' contain the CDF files of the calibration, whereby one file per day is available. The timestamps of every file in both folders matches with each other, thus allowing to combine the two datasets using the timestamp, if needed.

Hereby, the 'chaos' folder contains the CHAOS7 reference model values, each CDF file contains the position (encoded in latitude, longitude, and radius) as well as the prediction of the core, crustal and large-scale magnetospheric field in NEC frame as well as the combined value of the three contributions in NEC frame, as well as in satellite frame (MAG).

The 'calcorr' folder contains the calibrated measurements of the platform magnetometer. Each CDF file contains the position (encoded in latitude, longitude, and radius) as well as the longitude and latitude according to the quasi-dipole coordinates. The calibrated measurements are provided in NEC and MAG frame. In addition, the quaternions are provided, which contain the rotation from the MAG to the NEC frame. Also, Flags are provided which are described in more detail in the referenced publication, 'B_FLAG' contains erroneous data, 'KP_DST_FLAG' shows magnetic activity as indicated by

the Kp and Dst indices, ‘NaN_FLAG’ describes data points where NaNs have been automatically filled up with values.

The ’FAC’ folder contains estimates for the Field-aligned currents as derived from the calibrated data in ‘calcorr’.

4.1.File naming convention

Examplary: GO_MAG_ACAL_CORR_ML_20091101T004915_20091101T235955_0301.cdf

With:

GO:	GOCE (satellite identifier)
MAG_ACAL_CORR_ML:	Magnetic field data, aligned, calibrated and corrected using ML (data category)
20180601T000000:	yyyymmddThhhhhh (time of first entry)
20180601T235959:	yyyymmddThhhhhh (time of last entry)
0301:	version 0301 (version identifier)

5. References

Finlay, C. C., Kloss, C., Olsen, N., Hammer, M. D., Tøffner-Clausen, L., Grayver, A., & Kuvshinov, A. (2020). The CHAOS-7 geomagnetic field model and observed changes in the South Atlantic Anomaly. Earth, Planets and Space, 72(1), 156. https://doi.org/10.1186/s40623-020-01252-9

Michaelis, I., & Korte, M. (2022). GOCE calibrated and characterised magnetometer data (Version 0205) [Data set]. GFZ Data Services, https://doi.org/10.5880/GFZ.2.3.2022.001

NASA CDF Format: https://cdf.gsfc.nasa.gov/

Styp-Rekowski, K.; Michaelis, I.; Stolle, C.; Baerenzung, J.; Korte, M.; Kao, O. (2022): Machine learning-based calibration of the GOCE satellite platform magnetometers. Earth, Planets and Space. 10.1186/s40623-022-01695-2

6. Changelog

07.12.2023: There was a version update to version 0301. The corresponding fields have been changed accordingly. For this, a new README file was created describing the data in the new version folder.