GEOMAGNETIC FIELD REAL STATE DESCRIBING BY SATELLITE MAGNETIC MEASUREMENTS

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ABSRACT

The geomagnetic field current state is commonly estimated from geomagnetic activity indexes, which are obtained from ground-based data. Here we suggest evaluating the geomagnetic field state from satellite magnetic data by comparing the measurements with the modern near-earth space models of the geomagnetic field state. The calculated discrepancy between observations and predictions has to determine a class of the geomagnetic field state for a time period equal to two-satellite orbits. Only the mid-latitude data set have been used. We demonstrate the workability of this scheme using CHAMP magnetic data and "paraboloid" model of magnetospheric magnetic field [1]. The geomagnetic field current states to be obtained have been compared with the estimations obtained by using the classic geomagnetic activity indexes**.**

REAL-TIME DESCRIPTION OF THE GEOMAGNETIC ACTIVITY LEVEL DERIVED FROM CHAMP MANETIC DATA

To use CHAMP measurements for real-time description of geomagnetic activity the data is processed in the following way. To isolate time-varying field of external origin main field model IGRF2005 has been extracted. The residual field along high latitudinal segment of CHAMP pass may be very large during abrupt ejection for any level of geomagnetic activity. Using CHAMP data to create a model of magnetic field of magnetosphere current systems is possible after smoothing by running average (with step equal 81). Middle-latitudinal segments of CHAMP passes have been chosen for modeling only.

Fig. 1 shows the magnetic field components measured by CHAMP during first two passes on October 10, 2003 without IGRF field.

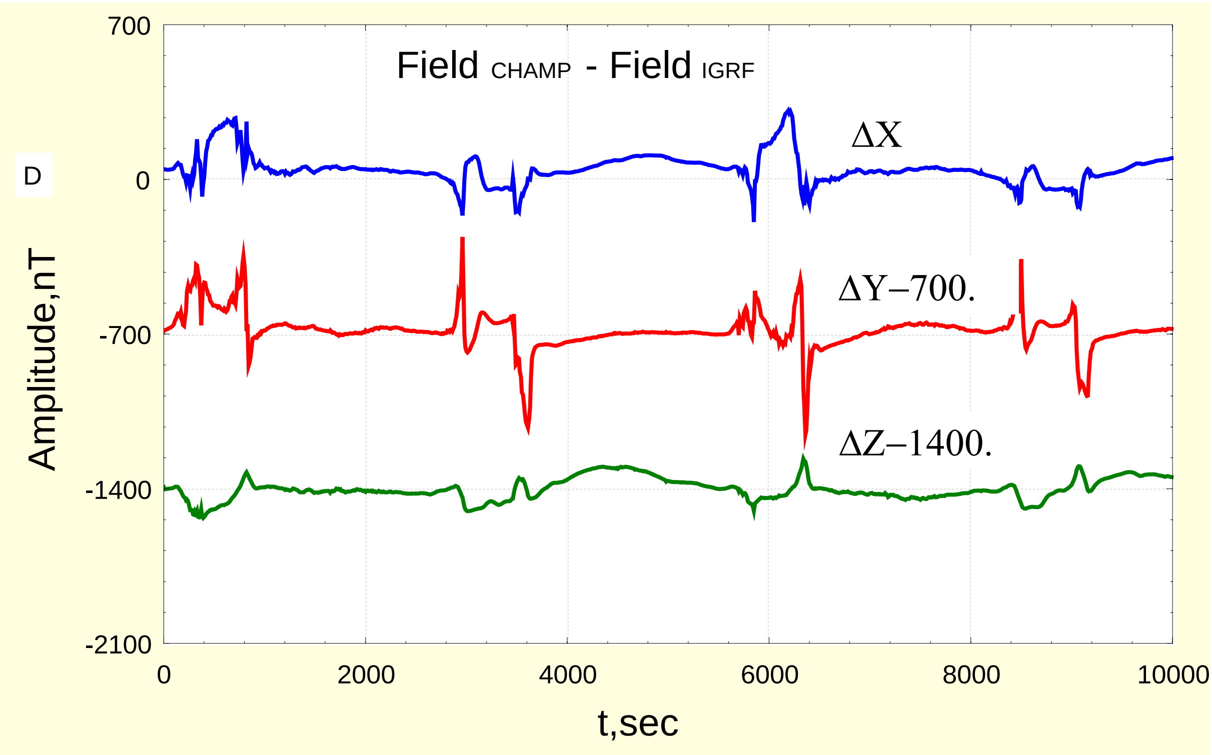

Figure 1. The components of the field, measured by CHAMP during first two passes on October 10, 2003 without IGRF field. The curves ΔY and Δ Z are shifted by 700 and 1400 units respectively.

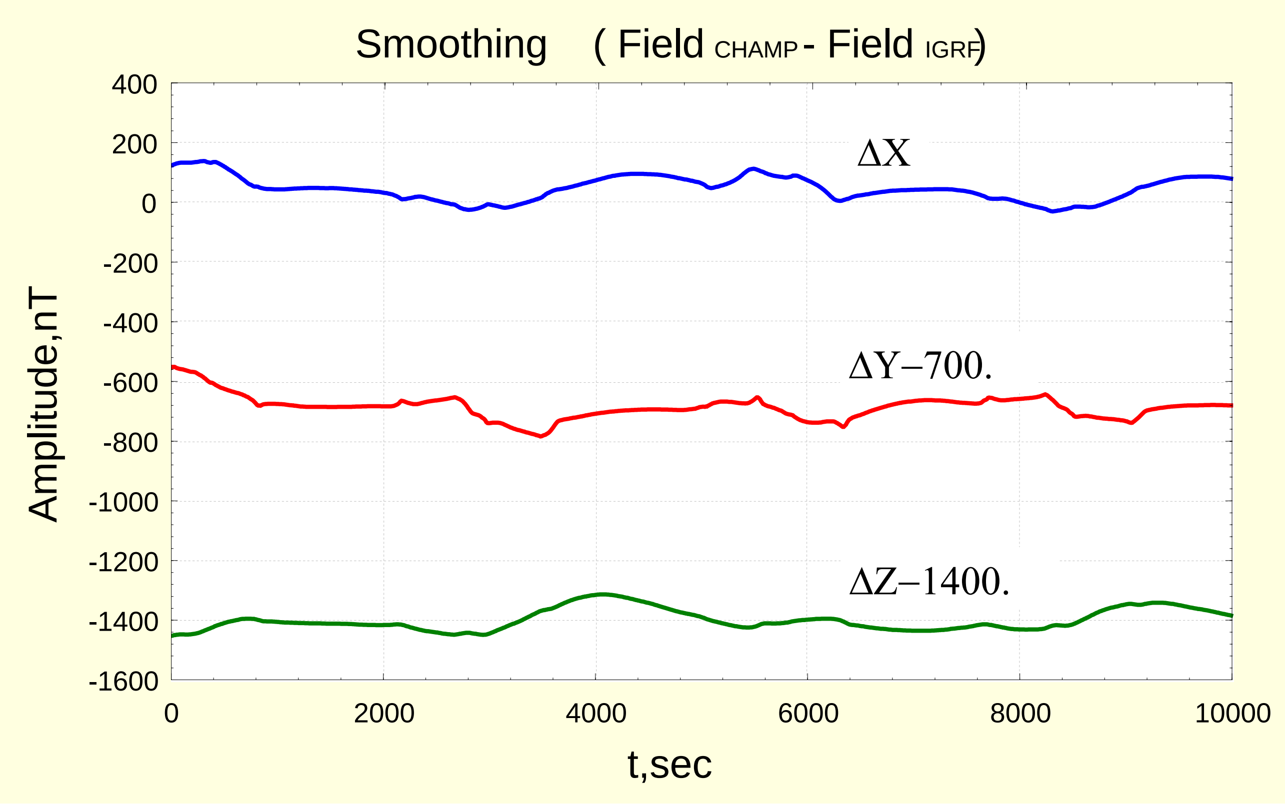

Figure 2. The same components of the field as on Fig.1, but smoothing by running average with step equal 81 measured by CHAMP during first two passes on October 10, 2003 without IGRF field. The curves ΔY and Δ Z are shifted by 700 and 1400 units respectively.

The same components smoothing by running average with step equal 81 are shown in Fig. 2. For real-time description of the geomagnetic activity levels three model states of the geomagnetic activity have been chosen: quiet (Q), disturbed (D), strongly disturbed (SD). Modeled magnetic field have been calculated for every point of two CHAMP passes using model of magnetospheric magnetic field [1]. For each interval of CHAMP passes real state of geomagnetic activity is determined by the minimum between magnitude of measured magnetic field and magnitude of magnetic field modeled for quiet, disturbed and strongly disturbed states.

Fig. 3 shows magnitudes of the magnetic field measured by CHAMP and magnitudes of modeled magnetic field for intervals with different level of geomagnetic activity: quiet state, disturbed state and strong disturbed state. Figure 4 shows variation of components (X, Y, Z, magnitude) of the magnetic field measured by CHAMP and the same components of modeled magnetic field magnitude during two CHAMP passes on February 6, 2005 (Q-state).

Table 1 presents results real-time describing geomagnetic activity. It contents date and UT of CHAMP passes, time-averaged discrepancies between measured data and modeled values of the magnetic field magnitude for each activity state, Kp-index value during CHAMP passes. Minimum discrepancies are selected by BOLD; they show geomagnetic activity state during CHAMP passes.

Table 1. Real-time describing geomagnetic activity during CHAMP passes.

DATE	UT	Discrepancy			K_p
		Q	D	SD	
10.11.04	00-03	167.26	160.05	**145.86**	8-
04.12.04	00-03	**9.87**	18.41	26.37	0
12.12.04	00-03	29.30	**24.07**	28.36	5-
18.12.04	00-03	21.70	**20.94**	29.01	4+
23.12.04	00-03	**18.03**	25.14	33.18	2+
02.01.05	00-03	44.32	**35.65**	36.99	4+
08.01.05	00-03	88.48	76.30	**65.25**	7
10.01.05	00-03	**14.17**	25.65	33.87	1-
18.01.05	00-03	64.03	54.07	**47.06**	7
26.01.05	00-03	**14.54**	28.14	39.78	1-
05.02.05	00-03	**9.98**	25.90	39.22	0+
14.02.05	00-02	**11.75**	28.92	44.95	1-

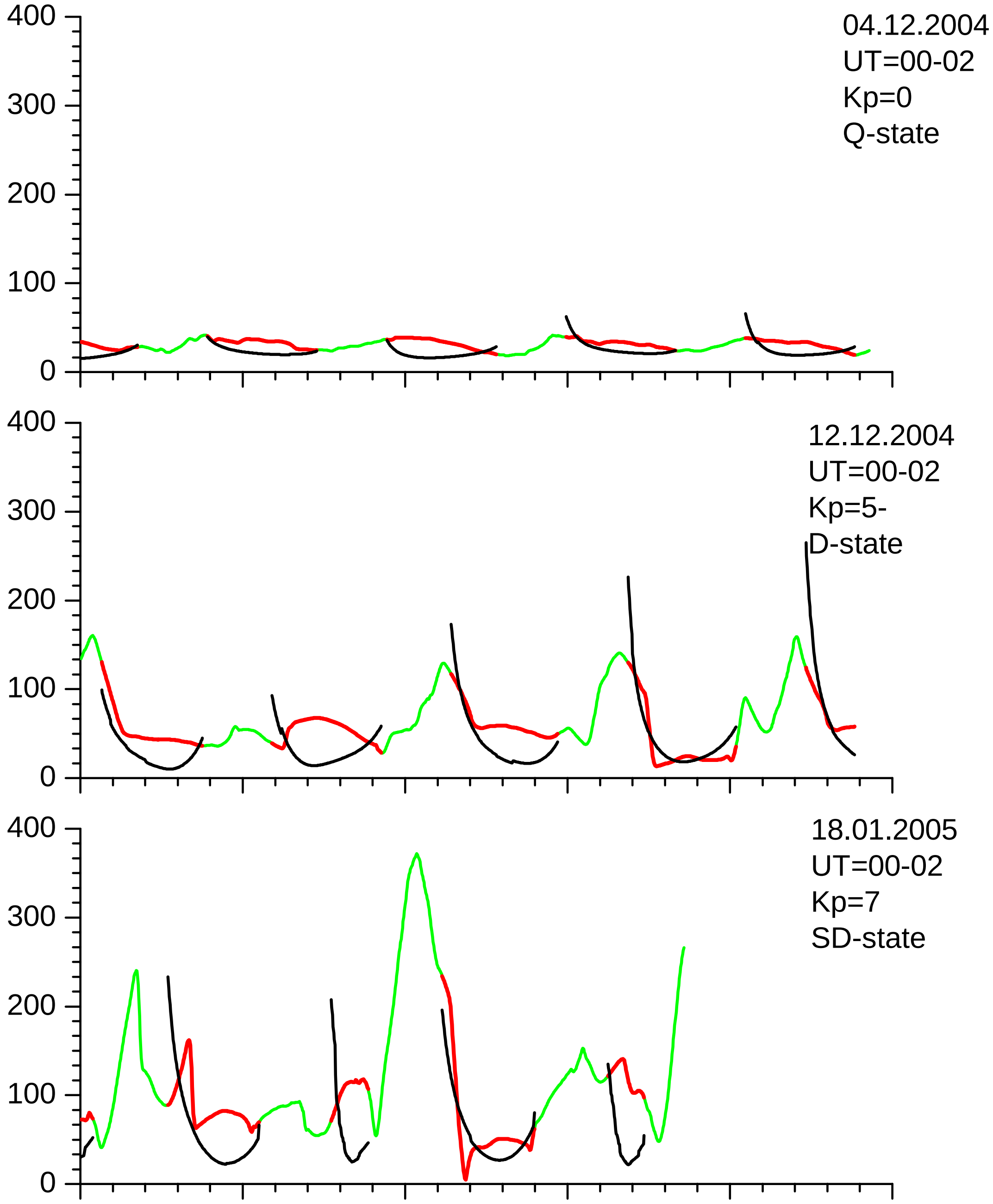

Figure 3. Magnitudes of the magnetic field measured by Champ (green+red line) and magnitudes of modeled magnetic field (black line) for intervals with different level of geomagnetic activity (from top to bottom): quiet state, disturbed state and strong disturbed state. Red lines mark intervals of middle latitudinal segment of Champ passes chosen for modeling.

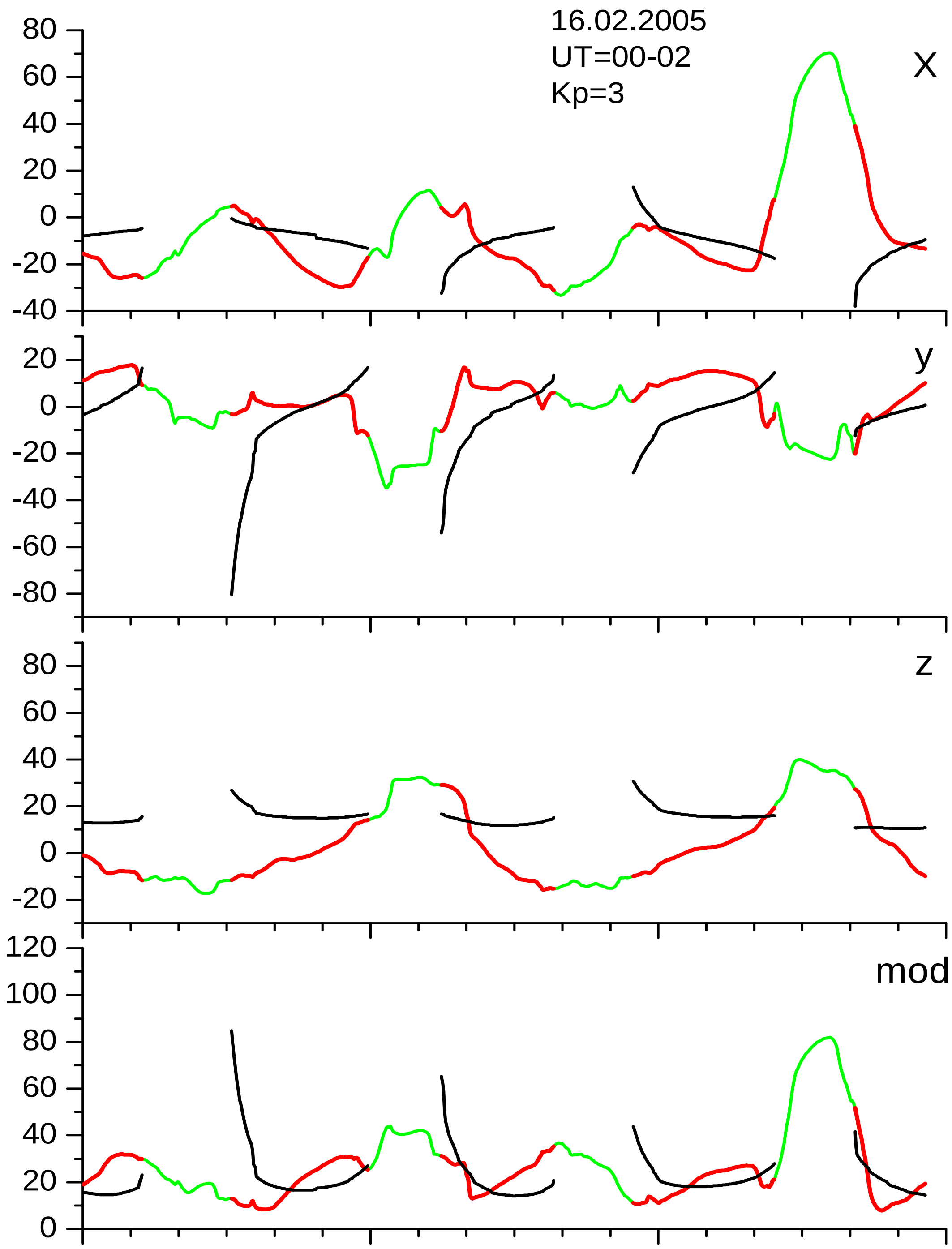

Figure 4. Components and magnitude of the magnetic field measured by Champ (green+red line) and components and magnitude of modeled magnetic field (black line), from top to bottom: X, Y, Z, magnitude during two Champ passes on February 6, 2005. Red lines mark intervals of middle latitudinal segment of Champ passes chosen for modeling.

CONCLUSIONS

Modern magnetospheric magnetic field models can be used for real-time description of geomagnetic activity during each pass of satellites such as CHAMP. Our results show a possibility to estimate an accuracy of modern models of magnetospheric magnetic field and calibrate them.

REFERENCES

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ACKNOLEGMENTS

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