Chapter 5

Conclusion and Prospects

The research outlined in this thesis has focused on one major topic, a description of the secular variation of the Earth's magnetic field during 1980 and 2000. Of particular interests were the geomagnetic jerks occurred in this time interval. The endpoints of the time interval were chosen, because of the availability of high quality satellite field models for this epochs. In 1980 a model from MAGSAT and in 2000 from CHAMP and ØRSTED facilitated a spatially high resolved sampling of the Earth's magnetic field. The models derived from these satellite data were used to constrain the time-dependent model of the main field and its secular variation at these epochs. The time–dependent model, which is now named as P-UFM1, was set up by using secular variation estimates of geomagnetic observatories monthly means and repeat station data. The clear advantage of secular variation estimates lies in the fact that these data are unbiased by the crustal field. The figure depicts the

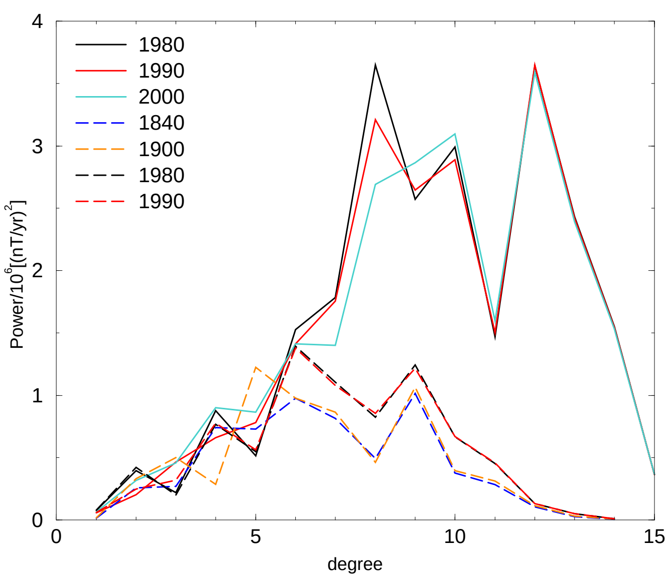

Figure 5.1: Mauersberger–Lowes spectra of the secular variation at the CMB of the *GUFM* (dashed lines) and of the P-UFM1 (solid lines).

Mauersberger–Lowes spectra (as given in (5.1)) of the P-UFM1 and *GUFM*. It clearly shows that the spatial power (and therefore the resolution) of the P-UFM1 is about a factor 2 higher than for the *GUFM*. This figure is crucial it clarifies the additional model content that the method brings.

$$\langle \mathbf{B}^2 \rangle = \sum_{l=1}^{\infty} (\frac{a}{c})^{2l+4} (l+1) \sum_{m=0}^{l} (\dot{g}_l^{m2} + \dot{h}_l^{m2}) \tag{5.1}$$

The individual spectra of P-UFM1 overlap from degree 10 onward and are equivalent with a linear interpolation of the two endpoint models. The degree 9 and greater of the *GUFM* are obviously affected by the damping, and the spectral peak at degree 12, which is present in the spectra of the P-UFM1, is not resolved anymore.

The main results of this study are:

1. A valuable extension of the hitherto existing time–dependent description of the secular variation, where the new model, the P-UFM1 shows a higher spatial and temporal resolution.

2. The model of the morphology of the radial field at the core-mantle boundary suggests the existence of two columnar rolls, which are linked to the geodynamo.

3. Further, the model provides a useful test of the frozen flux hypothesis.

4. This new model admit a inversion for core-surface flows and a hypothesis testing for the secular variation generation.

5. The flow models predict the secular variation and the length of the day predictions shows the correct sign for the trend, but two large an amplitude.

6. The causing of geomagnetic jerks is still not understood, but I tried to explain these features to be tightly linked to flux expulsion, which definitively occurred in the last 20 years.

The last point is certainly the one most capable of development, and in fact several lines of deployment are possible. One may be the invocation of diffusion in the inversion for core-surface flows as proposed by Gubbins [1996]. If jerks and diffusion are connected to each other, than this approach should certainly improve the drifting flow or a somehow time–dependent steady flow. This work was done in the hope to provide some new aspects about the processes at the core–mantle boundary.