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Longevity of geomagnetic field features from decades to millennia

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Global geomagnetic field models on different time scales offer the possibility to study the longevity of characteristics and outstanding features of the geomagnetic field. Recently developed models based on different sets of archeomagnetic data and/or magnetic sediment records of the past 3000 years provide improved estimates of the reliability of features observed in long-term models.

The tilted dipole contribution is clearly standing out in terms of power in spherical harmonic descriptions. Models from the earliest available direct field observations up to today show that the dipole moment has been strongly decreasing for 180 years and the dipole tilt increased from 5 to 11 degrees over the past 400 years. Millennial scale models suggest that while the dipole moment has been higher during the past 3000 years the present rate of change is not exceptional. A general variation of dipole tilt with lower values around AD 100 and 1400 is shown by all the millennial scale models. The models suggest that the maximum tilts observed around 1000 BC and AD 1000 could have been significantly weaker than today (only about 5 degrees), but large uncertainties remain for this field characteristic.

Two pairs of distinct magnetic flux lobes in the northern and southern hemisphere field at the core-mantle boundary have been observed in historical and recent field models and a growing patch of reversed flux in the southern hemisphere is causing the so-called South Atlantic Anomaly. Time averages of the 3000 year models suggest a preference for a similar flux lobe configuration and possibly for an intensity minimum in the South Atlantic region, but the features also show clear temporal changes on this time-scale.