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Understanding the Earth's magnetic field through observation and theory

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There is now a fairly reliable record of the evolution of the magnetic field through time for the last 400 years or so. This has been based on the rich record of actual observations of the magnetic field taken by mariners, explorers and scientists, observatories and surveys (both ground, airborne and satellite) over the centuries. From this we have gleaned a great deal, and there are many points of convergence between observation, theory and the results of numerical simulations.

I will discuss the three different domains in the core, namely the cylinders above and below the inner core, the region immediately outside this region and the equatorial belt. Of the three the latter poses the most challenges, since the observations (and palaeomagnetic observations to a lesser extent) indicate the presence of features rarely, if ever, seen in numerical simulations.

Of great interest in the observations are the indications that oscillations of cylinders of fluid, moving quasi-rigidly, are present; these are predicted theoretically and contain information on the interior structure of the field. We will discuss how these apparently unite the fields of geomagnetism and fluctuations in earth rotation.