

Measuring and Modeling Magnetic Flux Transport on the Sun

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The three “big” problem areas in solar physics – the 11-year sunspot cycle, the solar eruptive events (flares, coronal mass ejections, and prominence eruptions), and coronal heating/solar wind acceleration – all have their roots in the magnetic field produced and transported by flows in and below the Sun’s surface. Models for the transport of magnetic flux at the Sun’s surface are key to understanding the solar dynamo that produces the sunspot cycle and as the inner boundary condition for driving flares, CMEs, and coronal heating. This transport is facilitated by the axisymmetric flows (differential rotation and meridional flow) and by the non-axisymmetric cellular flows (granules, supergranules, and giant cells). Previous work on magnetic flux transport parameterized the non-axisymmetric components as a diffusive process and often used meridional flow profiles that had little or no basis on observations. In this talk I will describe efforts to fully characterize all flows involved and to model the magnetic flux transport using these flows with data assimilated from full-disk observations of the Sun’s magnetic field. I will also present the first compelling evidence for giant convection cells on the Sun and discuss the possible role that their flows may play in magnetic flux transport.