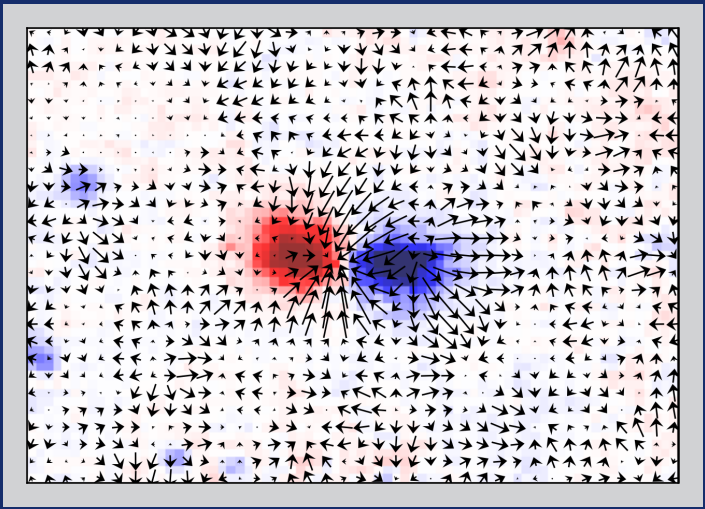
Solar surface flows during active region emergence



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Active regions (ARs) are concentrations of strong magnetic field at the surface of the Sun. To help better understand the role of ARs in the conversion of toroidal to poloidal field in the context of the solar dynamo, the surface flows associated with active regions are measured during their emergence phase.
In the first part of this dissertation, the flows of 182 emerging active regions are analyzed. The flows are derived using the method of granulation tracking and SDO/HMI observations. We find that one day prior to emergence, converging flows towards the AR location form, irrespective of the eventual total unsigned flux of the AR. After emergence, inflows form around the ARs. The time interval between emergence and the time at which these inflows form increases with the AR magnetic flux, from one to four days. These inflows are mainly in the latitudinal direction, have velocities on the order of $50\,\mathrm{m\,s^{-1}}$, and extend to about 8° from the centers of ARs.
In the second part, we simulate the evolution of the magnetic field of 17 active regions using a local surface flux transport model (SFTM) with flow measurements from granulation tracking and a parametrization of the observed flows as input. We find that the supergranular motions buffet the magnetic field in a way that is consistent with the evolution of the observed magnetic field.

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