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The active Sun and its implication for the heliosphere
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Time-Distance Helioseismology with SDO/HMI: Inferences and Simulations

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The HMI instrument onboard SDO provides continuous observations of the acoustic wavefield in the solar photosphere. For routine processing of these observations, a time-distance helioseismology pipeline was developed, and has provided results for more than a full year. New measurements of large-scale subsurface flows, sound-speed structures, differential rotation and meridional circulation have been obtained. The pipeline currently provides inversion results for the near-surface down to about 20 Mm below the photosphere. Using numerical simulations, we test the accuracy of helioseismic inferences and study how these can be reliably extended to deeper depths. The simulations model the propagation of acoustic waves in the global solar interior, from the chromosphere to the center of the Sun, and take into account 3D flows, rotation and the thermal structure of the Sun. In addition, we have performed high-resolution 3D simulations of MHD oscillations and waves in strong magnetic field regions of sunspots. These simulations reveal the complex interaction of the oscillations with sunspots. We present recent results from the SDO/HMI observations, their assessment based on theoretical simulation models, and discuss future perspectives of acoustic imaging of the deep interior.