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- Building reliable forecasts of solar activity

- Solar ionizing radiation critically depends on the level of the Sun's magnetic activity.

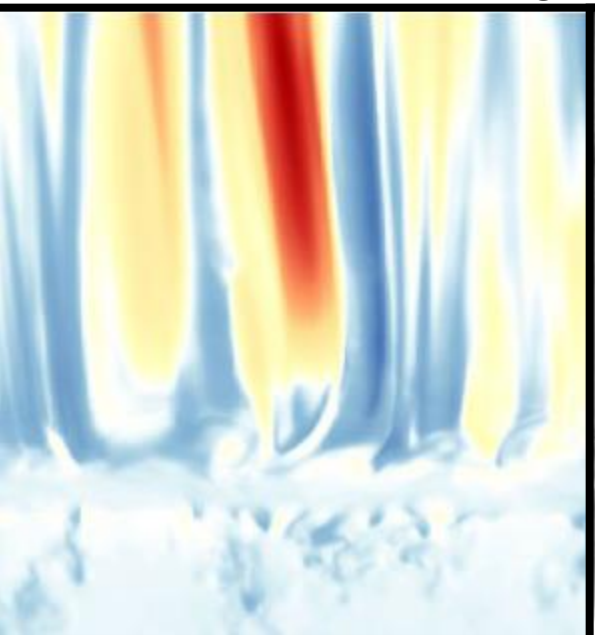
- For robust physics-based forecasts, we employ the procedure of *data assimilation*, which combines theoretical modeling and observational data such that uncertainties in both the model and the observations are taken into account.

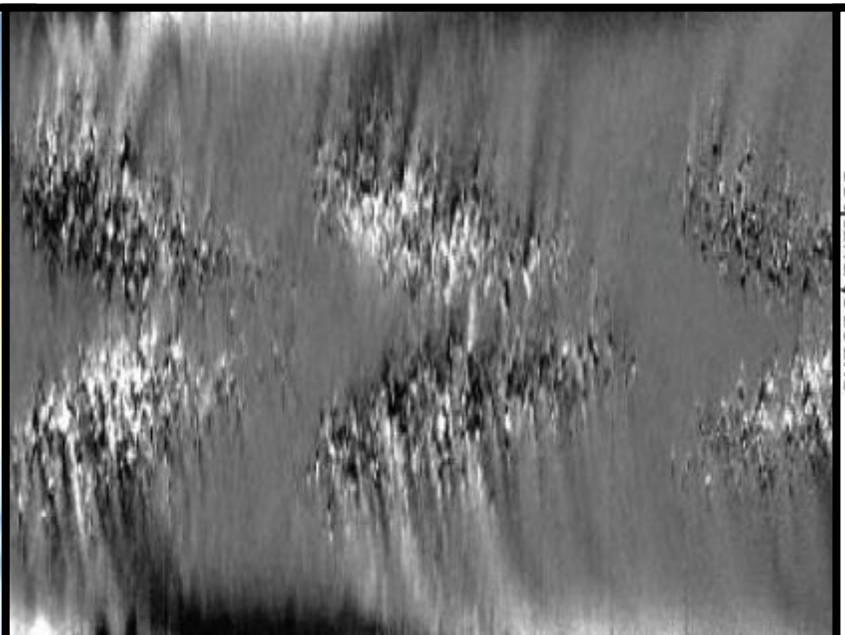
- Currently we are working in two major directions:

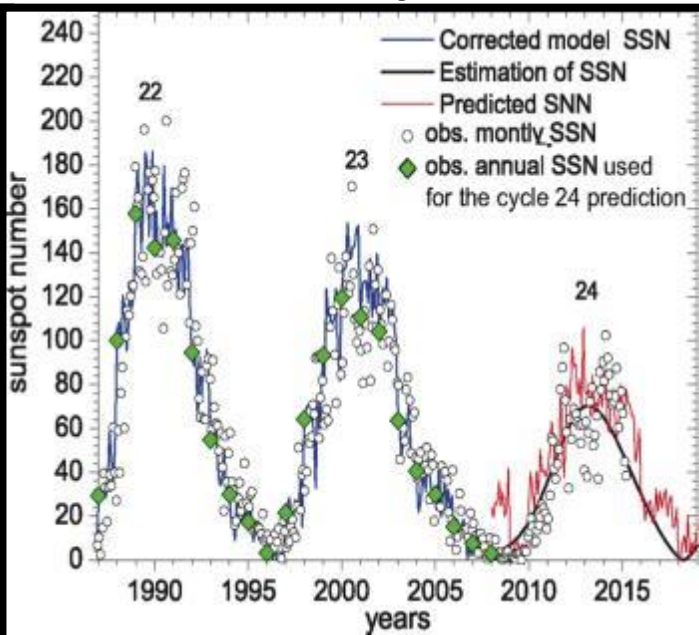
1) development of a new long-term forecast procedure on time-scales of the 11-year solar cycle, using a 2D mean-field dynamo model and synoptic magnetograms;

2) development 3D radiative MHD simulations to investigate the origin and precursors of local manifestations of magnetic activity, such as the formation of magnetic structures and eruptive dynamics.

3D MHD realistic modeling | **Observations** | **Solar activity forecast**







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- Our studies will provide a critical theoretical and practical background for building reliable forecasts of the space environment on temporal scales from days (high-energy eruptions and variation of local activity in magnetic structures, quiet-Sun regions, and coronal holes), to years (long-term solar-cycle variations of space environment conditions and changes in the global activity level).
- These studies are capable of providing essential input for modeling solar influence on the Earth's space environment and making better estimates of high-energy radiation and particles that can affect the performance of various types of sensors, GPS systems, and power grids.
- On long temporal scales these studies will provide probability estimates for the frequency of strong events up to 6 years ahead and allow us to calibrate existing models to improve short-term prediction of high-energy-release events.