

Space Weather Prediction Through the Observation and Modeling of Coronal Magnetism

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Year 2 Report

**Sarah Gibson (HAO) – Project PI; Ed DeLuca (CfA PI),
Kevin Dalmasse (HAO), Giuliana de Toma (HAO), Yuhong Fan (HAO), Duncan
Mackay (U. St Andrews), Patricia Jibben (CfA), Karen Meyer (U. Abertay),
Antonia Savcheva (CfA), Steven Tomczyk (HAO)**

The goal of our project is to develop a new methodology for assimilating coronal magnetic diagnostic data into magnetohydrodynamic (MHD) models in order to establish not only the magnetic structure of the source region of coronal mass ejections, but also the global field into which it erupts. Our project name is **Data-Optimized Coronal Field Model**, or **DOC-FM**.

During this year we have successfully implemented a model-data fitting method and demonstrated its use with a synthetic testbed based on a numerical model of a magnetic flux rope. In particular, post-doc Dalmasse published a paper on a Radial-basis-function Optimization Approximation Method (ROAM) for diagnosing the 3D coronal magnetic field, that obtained orders of magnitude increases in speed vs a full grid search of parameter space. Currently, Dalmasse and Savcheva are applying ROAM to flux-rope-insertion models with the goal of finding the best fit to the synthetic test bed. They have presented results at the Fall 2015 AGU, and Summer 2016 SPD and SHINE meetings.

As part of the ROAM paper, we explored the best goodness-of-fit (GOF) measures using Stokes polarimetry. In addition, Gibson was lead author on a comprehensive review of forward modeling of multiwavelength magnetometric diagnostics, and co-author on another focusing on UV and IR line diagnostics, and with Tomczyk on diagnostics that would be made possible by the large COSMO solar telescope. We will test the sensitivity of our GOF measures to different observations, and currently Gibson, Fan, and Tomczyk are working to quantify the effects of noise on COSMO data, which will be explicitly taken into consideration in our GOF studies.

Fan and Dalmasse published papers on MHD models of dynamic phenomena and their precursors, and we can draw upon these models to generate synthetic testbeds for our DOCFM inversions. We also continued to work on CoMP data regions of interest, including cavities and pseudostreamers, in order to establish candidates for future model-data fitting. Jibben published a paper on observations of a cavity system and presented a talk at the Summer 2016 SPD, with evidence for magnetic flux rope topology, and de Toma and Gibson presented new results on coronal cavities and pseudostreamers at the SPD. In particular, we are currently analyzing how CoMP linear polarizations can be used to constrain coronal magnetic topology and flux-tube expansion.