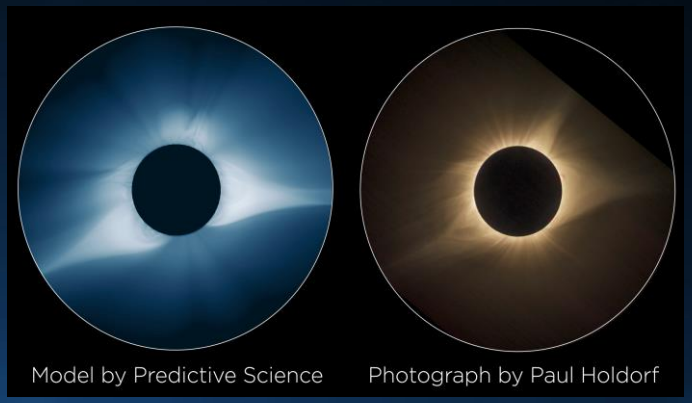
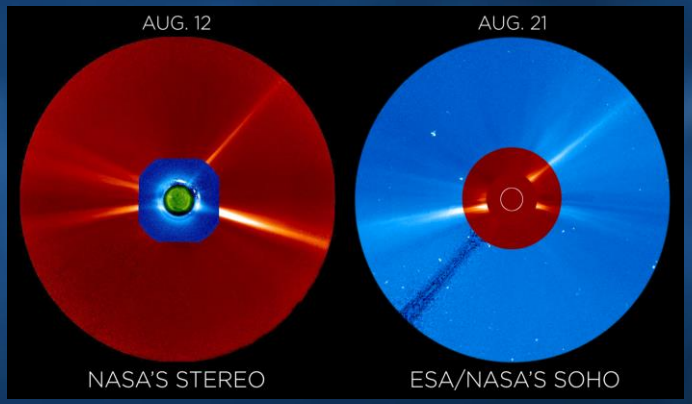
Solar Eclipse as Case Study for Space Weather Prediction



Predictive Science, Inc. developed a numerical model that simulated what the corona would look like during the Aug. 21, 2017 total solar eclipse. The model captures large-scale coronal features observed the day of the eclipse.



STEREO data on Aug. 12, 2017, is compared to observations nine days later from SOHO, which had a similar perspective of the corona as was seen from the ground during the eclipse on Aug. 21. The slight difference in the location of the streamers is due to the fact that STEREO-A and SOHO view the Sun from slightly different angles.

In advance of the total solar eclipse on Aug. 21, 2017, two NASA Heliophysics missions enabled predictions of what the corona would look like as viewed from the ground during the event -- offering a key opportunity to test how well our current predictive models of the Sun work. Two separate methods of forecasting compared favorably with the true shape and structure of the solar corona during the eclipse – valuable feedback that studying the fundamental processes of the Sun can support improved forecasting of solar events and space weather.

The first method – as used by Predictive Science, Inc., San Diego, California a private computational physics research company that has studies supported by NASA, the National Science Foundation and the Air Force Office of Scientific Research — incorporated data from NASA's Solar Dynamics Observatory (SDO) into an improved numerical model to simulate the corona during the total eclipse. Their model uses observations of magnetic fields at the Sun's surface to forecast how the magnetic field shapes the corona over time.

The model for their final prediction of the August 2017 eclipse was their most complex iteration yet. Each simulation required thousands of processers and took about two days of real time to complete. In its increased complexity, the model demonstrates that even the Sun's fine magnetic structures are intimately related to the vast structure of the corona.

Eclipse researchers also used a second method to help them decide where to focus their observations during the eclipse. They used NASA's Solar and Terrestrial Relations Observatory (STEREO) to observe the shape of the corona before it rotated to face Earth. STEREO-A's position from behind the Sun gave it a view of the corona on Aug. 12, 2017, which was virtually the same as Earth's view nine days later on Aug. 21.

Satellite images from STEREO-A on Aug. 12 and ESA/NASA's Solar and Heliospheric Observatory (SOHO) on Aug. 21 both feature a dominant three-streamer corona. The similarity between the two missions' observations on different days, indicate the corona is evolving slowly in its declining phase toward solar minimum.