Improving Solar Wind Modeling and Forecasting

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Modeling the background solar wind is a crucial first step in modeling a whole chain of important space weather events like the propagation of coronal mass ejectios and solar energetic particle events which can impact NASA's assets in space as well as Earth and planetary technology systems. This is critical information for the Artemis Program. How can we improve our ability to calculate and forecast real-time solar wind conditions here at Earth?

We have developed a modified model of the Sun's outer atmosphere that we combined with a new model of solar wind propagation through the solar system. By running several thousand versions of the models with different parameters, we can compute an ensemble of solar wind models which is then used to produce an improved prediction of the solar wind speed at Earth.

The new prediction model improves all the investigated solar atmosphere and solar system propagation model combinations and produces better estimates of the solar wind speed at Earth.
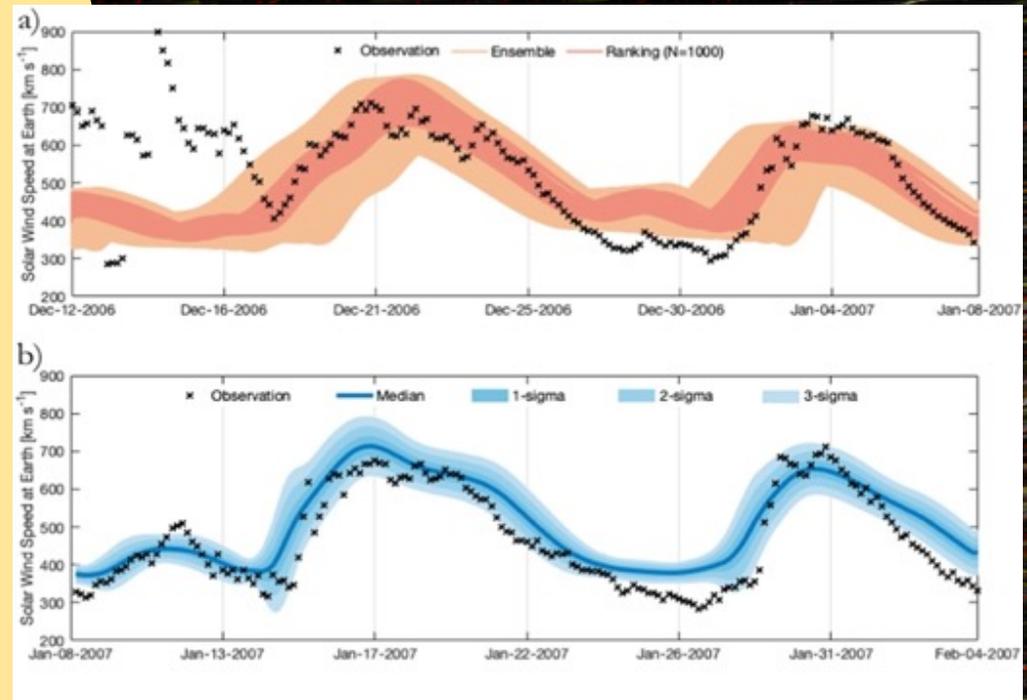
Illustration of model system using two rotation periods of the sun. The actual solar wind measurements are black crosses. The red shading represents the process of training an ensemble of solutions to match the solar wind. The best solutions are then used to update the model. The blue line is the best model solution deduced from the previous period –a better match to the data.

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