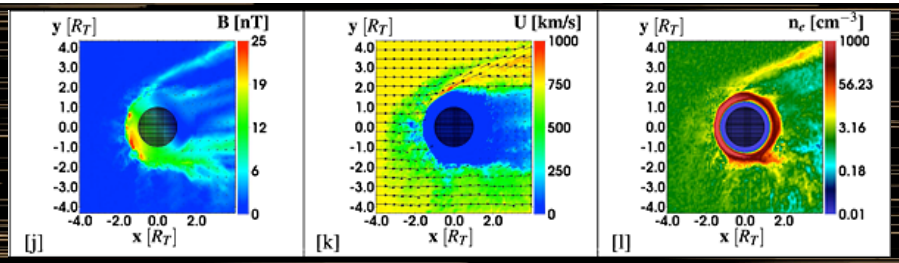
Titan as a Natural Space Weather Station

On rare occasions, Titan's orbit takes it outside of Saturn's fluctuating magnetic environment, and on December 1, 2013, after 9 years in the Saturn system, Cassini observed Titan immersed in the supersonic solar wind.

- The observed interaction showed that Titan's interaction is similar to other unmagnetized planets, such as Mercury and Venus. However Titan's magnetosphere showed a more complex structure which was attributed partly to Titan's richer atmospheric chemistry.
- Modeling of the plasma environment around Titan indicated that the large-scale observed features could be described as a steady state interaction between the moon's ionosphere and the high-pressure solar wind flow.
- However, one of the more interesting observations was that Titan's ionosphere "remembered" its immersion in the solar wind in the form of "fossilized" magnetic fields. These fields are trapped in the ionosphere between 1000-1800km, and Cassini found that these preserved evidence of variations in space weather for nearly an hour after the moon crossed into the solar environment.
- The changes detected in Titan's ionosphere allowed scientists to reconstruct the solar wind at Saturn's distance, and this second-hand space weather report, courtesy of Titan, provides the first such measurement so far away from the sun. It is also the last opportunity for such a measurement, as the orbital dynamics in the remaining mission lifetime does not bring the Cassini spacecraft past Titan under these conditions again.



Plasma quantities of a model run in the gyroplane. Magnetic field magnitude (j), plasma bulk velocity (k), and electron number density (l). Arrows denote the projection of the respective vector field on the cutting plane.

Feyerabend, et al., *GRL* 2016
& Bertucci, et al., *GRL*, 2015.