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Clouds and hazes vertical structure mapping of Saturn 2011 - 2012 giant vortex by means of Cassini VIMS data analysis

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Abstract.

On December 2010 a giant storm erupted in Saturn's North hemisphere. A giant vortex formed in the storm wake and persisted after the principal outburst exhausted on July 2011. The vortex had been imaged several times by the Visual and Infrared Mapping Spectrometer (VIMS) on board the Cassini probe starting from May 2011 and it was still present in observations recorded on June 2013. In this work we have analyzed the vortex data recorded by the visual channel of the spectrometer (VIMS-V) in August 2011 and January 2012. An inverse model, based on the Bayesian approach and using the Gauss-Newton iterative method to minimize the cost function, has been developed to analyze those data. The model takes advantage of the results of a supporting forward radiative transfer model which relies on the assumptions of plane parallel atmosphere, multiple scattering, Mie theory to compute particles single scattering properties, and molecular scattering adapted to Saturns atmosphere. Applying the inverse model we could retrieve the microphysical and geometrical properties of the clouds and hazes overlying the vortex and produce spatial maps for each retrieved parameter. Thanks to this study, the vertical structure of the hazes in this region has been quantitatively addressed for the first time. The comparative analysis of the results from the two observations seems to suggest that in 6 months the atmospheric dynamics, responsible for the formation and subsistence of the vortex, is weakening and the atmosphere is returning to a more stationary state. In addition, we suggest a correction for the imaginary part of the refractive index of the tropopause haze. This new value, that allows a better convergence between observed and simulated spectra, does not yet identify a composition of the haze and further investigation is needed to understand the real nature of the need for such a modification.