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Temporal evolution of Saturn's last Great Storm between 2011 and 2013

Saturn's atmosphere usually appears less active than its tumultuous neighbour Jupiter. But the 5th December of 2010, this steady evolution was disrupted by a perturbation in the troposphere in the northern hemisphere at 40°N, visible in the form of a bright white cloud (Fletcher et al. 2011, Fischer et al. 2011, Sanchez-Lavega et al. 2011). This storm quickly spread out in latitude over 30° and totally encircled the planet within a few weeks. Five previous giant storms were reported (Sanchez-Lavega et al. 2016), showing a periodicity of about 30 years (one per saturnian year). Given that the last one occurred in 1990, the giant storm of 2010 broke the cycle by showing up 10 years earlier than expected.

The initial tropospheric disturbance significantly altered the stratosphere, by changing temperatures, winds, transport and chemical composition (Fletcher et al. 2011, Fletcher et al. 2012, Moses et al. 2015). Only a month after the storm onset, two giant stratospheric hot spots, nicknamed « beacons », were reported at 40°N with a strong infrared emission. The differential velocities between these beacons resulted in their merging in May 2011, leading to a total increase of the temperature inside the new beacon of about 80 K compared to quiescent conditions. This increase in temperature had substantial consequences on the chemical composition inside the beacon (Fletcher et al. 2012) and in particular this might have completely altered the water profile (Moses et al. 2015).

We have conducted an observational campaign with the Herschel Space Observatory and its instrument PACS (Photodetector Array Camera and Spectrometer) in spectroscopy mode during the storm, from its beginning in 2011 up to 2013. In total, we have performed eight observations of the stratospheric water emission at 66 or 67 microns, with the aim of mapping the distribution of water inside and outside the beacon at different stages of its evolution. The analysis of the first observation one month after the onset did not show any significant alteration of the water profile during the storm (Cavalié et al. 2019).

Here we report preliminary results of the analysis of the full dataset.

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