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Amateurs' contributions to Saturn study during and after the Cassini era

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Abstract

During the Cassini mission around Saturn, amateurs' observations were useful to follow the evolution of the features observed by Cassini with the Imaging Science Subsystem cameras. It also proved particularly useful for identifying and following the source of Saturn Electrostatic Discharges (SEDs) observed by the Radio and Plasma Wave Science (RPWS) instrument, as shown by a recent study on 2008 data.

With the mission's end, amateur observations prove even more important to measure the wind profile on the planet and to be able to issue alerts for ground instruments in radio wavelengths to attempt observing SEDs from Earth in order to continue the study of Saturn's storm, as shown by the example of a bright polar spot observed by amateurs in 2018.

1. Introduction

Since 2004, multiple works demonstrated the importance of amateurs' observations which provide very good time coverage of Saturn's features, even if the resolution is inferior to the one of the professional instruments whether ground based or embarked in Cassini (see references [1]-[19]).

2. Atmospheric features' studies

The tracking of features in the atmosphere is possible thanks to amateurs' good coverage of the planet during the apparition. The evolution of the 2010/2011 Great White Spot (GWS) was an excellent example (see [10]-[18]). More generally, it allows retrieving wind profile information through calculating drift rates of the same features on several different observations.

As an example, in 2018 a bright polar spot was first identified by Maciel Bassani Sparrenberger from Brazil with a 320 mm Newton telescope. With the next observations, an ephemeris for the transit of this bright spot at Saturn's central meridian was issued and maintained to help observers plan their observations. This spot proved to be complex, with brightness variations and secondary spots being faintly visible on a few occasions.
From the good quantity (more than 35) of observations, its drift rate could be calculated as -11.7°/jd (at +66°.6 planetographic latitude), which is about +61.6 m/s (see Figure 1).

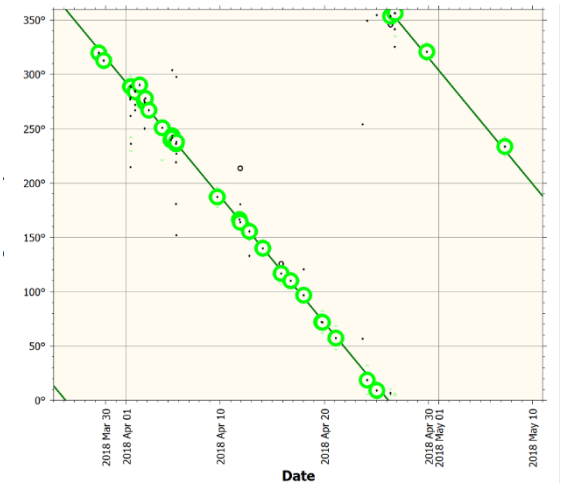

Figure 1: Longitude (system 3) of 2018 polar spot (green circles) over time, following a -11.7°/jd drift rate (blue line)

This spot is located at the latitude of a known jet, but the spot has a wind speed slower than the one derived from Cassini measurements (+95.6 m/s).

3. Storm studies

During the Cassini era, the RPWS instrument detected SEDs on many occasions. The instrument operating in radio wavelengths could not locate the exact longitude of the source of these. Here the amateurs' observations proved quite useful, identifying bright spots when SEDs were detected.

As an example, a complex two-cell lightning storm was observed between November 2007 and July 2008,

at 35°S planetocentric latitude (area known as storm alley). It started as a single convective cell, with a second bright one appearing ~25° latitude east of it in March 2008. With many amateur observations (see [8]), we could observe that the separation between the two cells stayed steady, and that both were drifting at ~0.34°/jd. It could be used as the context for interpreting all the complex SEDs observations. This was the first time that Saturn lightning from different cells was observed in parallel.

4. Future works and conclusion

After the Cassini end of mission in 2017 (which orbited half a Saturnian year around the planet), amateurs' observations can play an even more crucial role in the planet study, in the following area:

- tracking evolution of atmospheric features to help cloud and atmosphere modelling

- retrieving wind profile to detect possible changes

- detecting new events, possibly related to seasons:

    - As a 1994 huge equatorial activity appeared 4 years after 1990's GWS, a similar activity could appear about one Saturnian year after (which would be now)

    - Occurrence of storms in a possible northern storm alley (first one observed in the southern storm alley by Cassini was in 2004, so northern activity could be observed half a Saturnian year later, around 2019)

- detecting bright spots of storms, issuing observational ephemeris for ground-based radio instruments to attempt detecting SEDs activity

- observe equinox related events (satellites mutual phenomena, spokes – see [19])

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