EPSC Abstracts
Vol. 7 EPSC2012-934-1 2012
European Planetary Science Congress 2012

Saturn northern hemisphere's atmosphere after the 2010/2011 Great White Spot

M. Delcroix (1), G. Fischer (2) and T. Barry (3)
(1) Commission des observations planétaires, Société Astronomique de France (delcroix.marc@free.fr) (2) Space Research Institute, Austrian Academy of Sciences (georg.fischer@oeaw.ac.at) (3) The Astronomical Society of New South Wales, Australia (trevb@iinet.net.au)

Abstract

In 2012, after the 2010/2011 Great White Spot (GWS), amateur observations made it possible to follow the evolution of the "GWS zone" centered around 41° planetographic north latitude, in particular the regions where the northern and southern tails of the GWS had developed. We also make a correlation between Saturn Electrostatic Discharge (SED) observations and a bright NNTB (North North Temperate Band) re-occurring spot.

1. Introduction

In 2010, an unexpected GWS occurred in the northern hemisphere of Saturn only 20 years after the last occurrence (cf. [1]). In the NTrZ (North Tropical Zone) much activity has been observed throughout the 2010-2011 apparition by amateurs, till August 2011. Strong associated SEDs were also observed by Cassini's RPWS instrument from December 2010 to July 2011 (cf. [2], [3]), a clear sign of strong thunderstorm activity within the GWS.

Amateur's contribution to professional studies was very important for the GWS observations. When Saturn emerged from solar conjunction, the amateur astronomers continued to observe and track changes in the northern hemisphere after the GWS, consisting of white and dark spots in a wide range of latitudes.

2. Amateur data

2.1 Amateur observations

Amateurs use mostly reflectors with an aperture from 15 to 40 cm. Since a few years, their image coverage has been very good during 6 months around Saturn's opposition. Images from different sources (French Astronomical Society planetary observations commission, ALPO Japan, IOPW cf [4], …) taken by more than 170 observers, starting end of November 2011 have been studied, yielding more than 600 individual measures of white and dark spots, usually in visual wavelengths (more often in red), or in near infrared (not more than 830nm long-pass filters).

So many images from observers all around the world, allowed to cover in detail the evolution of Saturn's northern hemisphere's atmosphere almost rotation after rotation.

2.2 Measurements

WinJUPOS software (cf. [5]), used by amateur astronomer associations on Jupiter and Saturn (cf. [6]), was used to measure the position of features, and derive their drift rates in longitude.

3. Results

The aspect of the "GWS zone" in 2012 is shown on figure 1, with various dark and white spots visible.

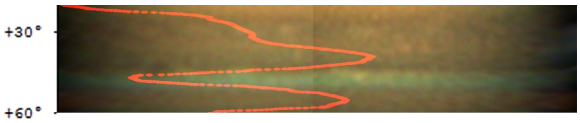

Figure 1: Map projection from Feb. 23rd 2012 images from Trevor Barry (latitude [20°,60°], longitude [120°,310°] CMIII). The superposed wind profile shows the east and westward jets.

3.1 White zones and dark spot within the northern part of the "GWS zone"

Throughout the apparition, the zone where the northern tail had developed in 2011 presented the aspect of a continuous white belt, with sporadic brighter zones within.

In March 2012, a dark spot located in the NTrZ, was observed at several occasions. It appeared to drift at -2,9°/JD (Julian Day) at a latitude around 43,5° planetographic latitude, in the "GWS zone". Another dark spot appeared in May in the same zone.

3.2 White zones within the southern part of the "GWS zone"

During all apparition, the zone where the southern tail had developed in 2011 showed an intriguing aspect, with several very diffuse and spread (both in longitude and latitude) brighter zones hard to make out in the images.

3.3 A single bright white spot in the North North Temperate Band

In April 2012, a bright spot located in an unusual latitude, in the NNTB, was observed at several occasions. It appeared to drift at 0,27°/JD around 57° planetographic latitude.

3.4 SEDs

During the 2011-2012 apparition, SEDs have been observed by RPWS mainly in April 2012, at an estimated longitude around 330° CMIII. Marginal SED activity was also present at the end of December 2011.

4. A possible long-lived source of SEDs

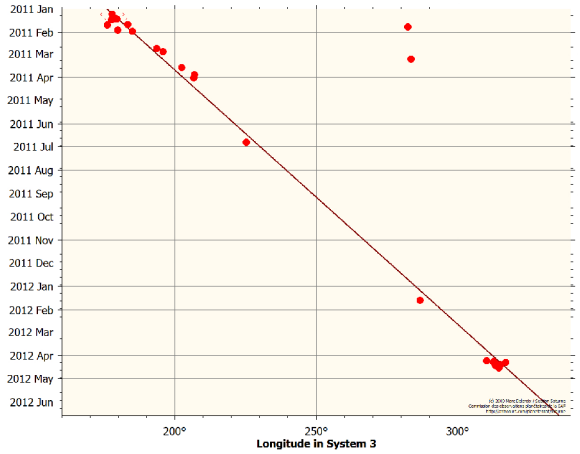

Figure 2: White spots in the [+50°,+60°] latitude range. April 2012 spots observations are located on the drift line from the 2011 spot observations.

Analysing amateur images during the April 2012 SED episode, the most probable source for these SEDs is the NNTB bright spot, whose visibility and longitude match the SEDs observations.

Furthermore, this spot is right on the drift rate line of a NNTB spot which was mostly observed from the beginning of January 2011 to the end of March 2011 (cf. Figure 2). At that time some SEDs were also observed, not matching in longitude and intensity the GWS activity. The April 2012 activity could be a resurgence of the same SED source, more than one year later.

5. Summary and Conclusions

Amateur observations proved useful to observe the appearance of the whole latitude range where the GWS occurred in 2010-2011. The southern tail, which was prominent in the GWS, became more diffuse and spread, maybe because of the wind profile in this zone showing a bump in the eastward jet around 30° north. On the other hand, the northern tail, which was less prominent in the GWS transformed into a plain white belt, maybe stabilized by a strong and symmetric eastward jet, with some brighter zones showing activity.

The coverage of the amateur observations even allowed recovering a bright spot in the NNTB, the probable source of SEDs in both early 2011 and April 2012, thereby making it the first SED source with reoccurring activity after more than one year.

This proves that amateur observations continue to be valuable for studying Saturn's atmosphere evolution and relate it to lightning observations by Cassini.

Acknowledgements

We would like to thank all amateurs who have been providing their images for their time and dedication.

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