Contribution of amateur observations to Saturn storm studies

Marc Delcroix and Georg Fischer

Commission des observations planétaires
Société Astronomique de France
(delcroix.marc@free.fr)

Space Research Institute
Austrian Academy of Sciences
(georg.fischer@oeaw.ac.at)

EPSC2010, September 24th, 2010 (Rome, Italy)
Storms observations from Cassini

- The **Radio and Plasma Wave Science** (RPWS) instrument has been observing **Saturn Electrostatic Discharges** (SEDs, radio signatures of lightning) – regularly since 2004, giving:
  - **Occurrences in time** with a time coverage **24h/24h** on the hemisphere facing Cassini
  - **Number of SEDs** (with a frequency scan allowing **only detection of 1/3rd** of SEDs)
  - **very approximate positioning** and resolution of the lightning sources (**due to low resolution**)
  - allowing calculation of an **approximate longitudinal drift rate**

- The **Imaging Science System** (ISS) instrument performs **high-res observations** from UV to IR wavelengths giving:
  - extremely **accurate** in **positioning** and **resolution**
  - **Direct lightning observation** around equinox on the night side of Saturn
  - a **poor coverage** (very rare observations, one from March to July 2010 for example)

**Findings:** since Cassini arrived in orbit around Saturn, SEDs have been observed associated to storms located in the **same zone** of Saturn, around **-35° planetocentric latitude**, nicknamed « Storm Alley » (South Tropical Zone)
Storms observations from amateurs

- **Observations from amateurs** have the following characteristics:
  - in diverse wavelengths (different filters can be used, but usually visible wavelengths, sometimes infrared)
  - variable in resolution quality, processing, timing accuracy (~180 observers worldwide (Europe, USA, Asia))
  - give a good coverage (More than 2500 images starting in 1993) 6 months around opposition
  - major atmospheric features can be detected (780 large white spots positions measured)

- Their analysis (with WinJUPOS software by G.Hahn) brings:
  - Identification of white spots in storm alley
  - Longitudinal drift rate measurement after selection of measures
  - Shape evolution tracking

**Contribution of amateur observations to Saturn Storm studies - Marc Delcroix and Georg Fischer - EPSC 2010, Rome, Sep.24th 2010**
1. Collection of observations (http://astrosurf.com/planetessaf/saturne)

2. White spots measures (WinJUPOS http://www.grischa-hahn.homepage.t-online.de)

3. Selection of measures (WinJUPOS)

4. Drift rate calculations (WinJUPOS)
Saturn storms at 35°S during apparitions

2003-2004 A1, A2 before arrival of Cassini at Saturn (observations also in 2002-2003)

2005-2006-B2 consistent with 0.6°/day found by ISS and RPWS

For 2007-2008 C1,C3 and 2008-2009-D RPWS finds ~0.3°/day
Saturn storms in 2007-2008 apparition

Left figure shows **number of SEDs as a function of time** as measured by Cassini RPWS
(semi-logarithmic plot from Nov. 26, 2007 until July 23, 2008)

Right figure shows **drift in longitudes** of this storm
as measured by amateurs in this apparition
(from Dec. 1, 2007 until June 18, 2008)
Shape evolution tracking

Saturn's 2010 storm ("StormE") evolution - April 25th-May 31st, 2010
images compiled/scaled/reprocessed on 2010/07/02 by Marc Delcroix, Société Astronomique de France
(delcroix.marc@free.fr - http://astrosurf.com/planetasfaollecture)

Storm zone elongated

Storm spread and fading

Elongation 36.6° LII (34 500 km)

Bright storm E"2 preceded by elongated zone

Bright E"2, while average SED activity ongoing, preceded by E"1 less bright and trace of 3rd zone

Only E"2 visible, very bright

E"1/E"2 very bright and close, faint E"3 preceding

E"1/E"2 very bright looking connected and spread, E"3 preceding

Elongation 28.3° LII (25 100 km)

E"3 seems to have disappeared

E"2 seems to have disappeared, E"1 fading

Trace of maybe both E"1 and E"2, fading

Storm a bit brighter

Very faint trace of previously observed E"1/E"2/E"3 spread; E"1 being still the brightest

Elongation 38.1° LII (34 000 km)

Preliminary measures (planetographic lat.):
Storm E"1: 42.6° lat.; LII drift rate: +0.78°/day
Storm E"2: 41.1° lat.; LII drift rate: +1.12°/day
Storm E"3: 42.3° lat.; LII drift rate: +0.76°/day

*: measures to be considered only as indicative (affected by seeing and length of occultation time)

Other observations on rotations #131, 134, 136, 144, 146, 150, 152, 163, 165, 167, 169 by some observers: Torsten Hansen/Sylvia Kosswig (Germany).
Jean-Pierre Perrin/Marc Delcroix (France), Frank Meilich/ Jim Philp (USA),
Michel Lecomte/Peter Edwards (UK).
- Amateurs and RPWS both observe the storms around $-35^\circ$ planetocentric latitude

- Calculated drifts rates are similar (around 0.3 LIII/day or 0.6 LIII/day)

- Correlation is found between brightness of storms in amateurs images and SEDs detection (with a probable inertia of a few days)

- Correlation is found between longitude range of SED detection suggesting more than one source and several storms visible in the same amateur images (in 2008 and 2010), leading to the conclusion that lightning occurred in more than one cloud at the same time
Conclusions

-Amateurs can provide a good coverage of the larger spots and storms visible in Saturn’s atmosphere

-They can be triggered by RPWS SEDs observation providing approximate positioning, from which ephemerides can be calculated

-Amateur organizations can analyze this data to derive drift rates and track major shape evolution

-Pros can use this data as a complementary coverage of radio frequencies observation, joining the two data helping to determine how the storms behave

Ask amateur organizations whenever you need observations, they could help!