



## The International Outer Planets Watch atmospheres node database of giant-planet images

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### Abstract

The Atmospheres Node of the International Outer Planets Watch (IOPW) is aimed to encourage the observations and study of the atmospheres of the Giant Planets. One of its main activities is to provide an interaction between the professional and amateur astronomical communities maintaining an online and fully searchable database of images of the giant planets obtained from amateur astronomers and available to both professional and amateurs [1]. The IOPW database contains about 13,000 image observations of Jupiter and Saturn obtained in the visible range with a few contributions of Uranus and Neptune. We describe the organization and structure of the database as posted in the Internet and in particular the PVOL software (Planetary Virtual Observatory & Laboratory) designed to manage the site and based in concepts from Virtual Observatory projects. The database is available in the following address: <http://www.pvol.ehu.es/pvol/>

### 1. Introduction

The Giant Planets Jupiter and Saturn have dynamic atmospheres with weather patterns that vary in time in an unpredictable way. Studying the recurrent changes and activity of these atmospheres require almost continuous observations of the planets. Large convective storms leading to planetary scale disturbances, color changes, mergers of large-scale vortices have been observed by amateurs around the world many times discovering the onset of these atmospheric changes. Besides the atmospheric phenomena Jupiter has been hit three times by small solar system objects in the last 3 years with all the impacts being discovered by members of the amateur community [2, 3]. Adding to the original discoveries of these changes the popularization of planet imaging between amateurs has led to an impressive improvement in the temporal sampling of images of Jupiter and Saturn that allow studying these changes,

the unexpected impacts and to follow the overall activity of these planets.

### 2. The IOPW-PVOL database

A recent and comprehensive description of the database is provided in [1]. The database contains more than 10,000 observations of Jupiter since 2000 and 2600 image observations of Saturn since 2001. The number of observations increases as a power law and doubles every 5 years. To give a simple numerical example there are 715 images of Saturn latest GWS covering the December 2010-May 2011 time period [4]. The images in the database can be used by any amateur or professional astronomer. Figure 1 shows an example of the online search engine that allows selecting data. Figures 2 and 3 show the kind of retrievals that can be instantaneously produced by the PVOL software managing the database.

The screenshot shows the PVOL search interface. The top navigation bar includes 'Main', 'Images', 'Tools', and 'Users'. The main search area is titled 'Search PVOL Images' with a 'Back' link. It features a 'Basic Tools' sidebar with buttons for 'Search PVOL Images', 'Search IOPW Images', and 'Julian Date & CM calculator'. The main search form includes fields for 'Target' (set to 'Saturn'), 'Initial date' (01/05/2011), 'Final date' (30/05/2011), 'Author ID' (empty), 'Filter' (empty), 'Show longitude' (0:359), 'System I', 'System II', 'System III' (checked), 'All', 'Sort by...' (Date and Time, Descending), 'Show' (50 results), and 'Send' and 'Clear' buttons. The 'Advanced Tools' sidebar is partially visible with a 'HTTP-GAT & VOTables' button.

Figure 1: An example of a typical search that can be done online using PVOL.

#	Date	Time	Author	Filter	System	SystemII	FileURL
1	2011-05-25	00:49:00	Efrain Morales	rgb	285.6	343.8	<a href="#">#2011-05-25_00-49_rgb_em.jpg</a>
2	2011-05-24	21:24:00	Antonio Lasala	r	165.4	228.5	<a href="#">#2011-05-24_21-24_r_el.jpg</a>
3	2011-05-24	20:20:00	Gari Amilaga	rgb	127.9	192.4	<a href="#">#2011-05-24_20-20_rgb_gar.jpg</a>
4	2011-05-23	18:07:00	Jesús R. Camarena	rgb	72.5	102.2	<a href="#">#2011-05-23_18-07_rgb_jrcam.jpg</a>
5	2011-05-23	23:40:00	Jesús R. Camarena	ir	85.7	180.4	<a href="#">#2011-05-23_23-40_ir_jrcam.jpg</a>
6	2011-05-23	22:10:00	Jesús R. Camarena	ir	69.1	163.6	<a href="#">#2011-05-23_22-10_ir_jrcam.jpg</a>
7	2011-05-23	20:42:00	Gari Amilaga	ir	16.5	114	<a href="#">#2011-05-23_20-42_ir_gar.jpg</a>
8	2011-05-23	20:35:00	Jean-Jacques Boureau	r	12.4	101.1	<a href="#">#2011-05-23_20-35_r_jpb.jpg</a>
9	2011-05-23	20:30:00	Gari Amilaga	rgb	9.4	107.3	<a href="#">#2011-05-23_20-30_rgb_gar.jpg</a>
10	2011-05-23	20:18:00	Gari Amilaga	rgb	2.4	100.5	<a href="#">#2011-05-23_20-18_rgb_gar.jpg</a>
11	2011-05-23	19:59:00	Jesús R. Camarena	r	351.3	89	<a href="#">#2011-05-23_19-59_r_jrcam.jpg</a>
12	2011-05-22	21:22:00	Carles Llobet	irgb	275.7	45	<a href="#">#2011-05-22_21-22_irgb_cl.jpg</a>
13	2011-05-22	20:50:00	Jesús R. Camarena	rgb	107.3	107.3	<a href="#">#2011-05-22_20-50_rgb_jrcam.jpg</a>
14	2011-05-22	20:29:00	Jesús R. Camarena	r	244.7	15.9	<a href="#">#2011-05-22_20-29_r_jrcam.jpg</a>
15	2011-05-22	04:09:00	Michael A. Phillips	rgb	30.1	184.1	<a href="#">#2011-05-22_04-09_rgb_mph.jpg</a>
16	2011-05-21	12:12:00	Christopher Go	rgb	188.1	5.4	<a href="#">#2011-05-21_12-12_rgb_cgo.jpg</a>
17	2011-05-21	03:11:00	Paul Maxton	rgb	243.5	72	<a href="#">#2011-05-21_03-31_rgb_pmax.jpg</a>
18	2011-05-20	21:09:00	Jesús R. Camarena	rgb	19.5	216.9	<a href="#">#2011-05-20_21-09_rgb_jrcam.jpg</a>
19	2011-05-20	21:07:00	Damian Peach	irgb	18.3	215.8	<a href="#">#2011-05-20_21-07_irgb_dpe.jpg</a>
20	2011-05-20	21:05:00	Jesús R. Camarena	r	17.2	214.7	<a href="#">#2011-05-20_21-05_r_jrcam.jpg</a>
21	2011-05-19	22:02:00	Jesús R. Sanchez	rgb	286.3	155.1	<a href="#">#2011-05-19_22-02_rgb_jsanchez.jpg</a>
22	2011-05-19	21:33:00	Antonio Gallardo	ir	269.3	139.6	<a href="#">#2011-05-19_21-33_ir_ag.jpg</a>

Figure 2: Part of the results retrieved from the search.



Figure 3: Example of the first image on the list above. Image from Efrain Morales observing from Puerto Rico.

### 3. Observers

Individual observers can register in the system and upload their images to the database. Alternatively they can send their observations by e-mail to [iopw@lg.ehu.es](mailto:iopw@lg.ehu.es). More than 170 individual observers contribute their images. They are distributed around the world as shown in Figure 3. They also contribute to other databases such as ALPO-Japan or the database maintained by the British Astronomical Association and several astronomical imaging forums in different countries. Many of these observers are able to provide their original video captures of the planet and their original data for calibration purposes. The quality of the observations varies from one observer to other depending on the telescope, camera used, atmospheric seeing, altitude of the planet and experience but a general steady improvement is found for contributions from individual observers.



Figure 3: Location of IOPW–PVOL active contributors. Size of the spot is a measure of the number of contributions incorporated in the database.

### 4. Summary and Conclusions

The PVOL database of IOPW observations of the giant planets is a powerful tool for exploring the variability of atmospheric phenomena in the Giant Planets. It grows from a large team collaboration. The quality of the images continuously improve as many of the regular observers have the skill, knowledge and experience to produce images of the planets that are in many cases only limited by diffraction of the small telescope apertures.

### Acknowledgements

We grateful acknowledge the continuous efforts and contributions from all IOPW&PVOL observers. They are far too numerous to mention all here but we are thankful to their continuous efforts to observe the outer planets. Thanks are also due to G. S. Orton for his long-term heading of the IOPW-Atmospheres node.

### References

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