Long term changes in the band/zone pattern of Jupiter

Jupiter’s atmosphere is generally organized in dark belts and bright zones the presence, latitudinal limits, color and intensities of which are changeable [1]. The study of these changes may reveal some secrets of the atmosphere of the giant planet. We have developed two different methodologies (AFO [2] and AFMO [3]) in order to track these long-term changes in the banded pattern. The philosophy of both is to make average images of Jupiter from short term observing periods that smear details and reveal the general banding pattern. Of course we avoid the presence of Great Red Spot.

In the AFO method a Jupiter observer captures static images or continuous videos with the camera on the telescope for some hours. Then he stacks all the images/videos without derotating them:

Although AFO methodology produce very smooth results it can’t be used to compare past observations since it is based on a specific video capturing methodology. Moreover, requires that someone is continuously following this procedure in different wavelength bands.

In the second method (AFMO), we download from PVOL as many as possible regular observations made in a short period of time. We than stack them as they were made in a specific date-time. It is time-consuming with a lower quality result than AFO but it takes advantage of an already existing database going back many years. In this page AFMO method will be used.

Long-term changes in Jupiter's banded pattern will systematically monitored in this page in the following ways:

a) Presentation of color vs 0.89 μm methane absorption band average images through an observing year (Fig.1).

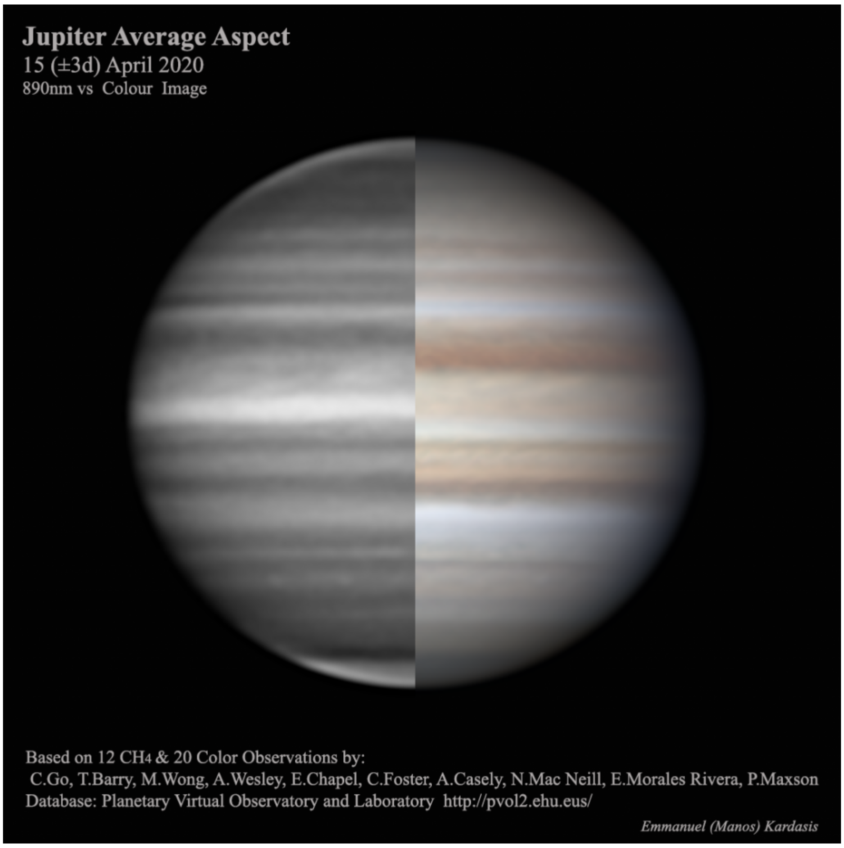

Figure 1. Average aspect of Jupiter on April 2020 in the visual and 890nm methane absorpton band

b) Tracking long term changes by presenting-comparing average images (in the days around every opposition) in different wavelength bands from year to year (Fig.2)

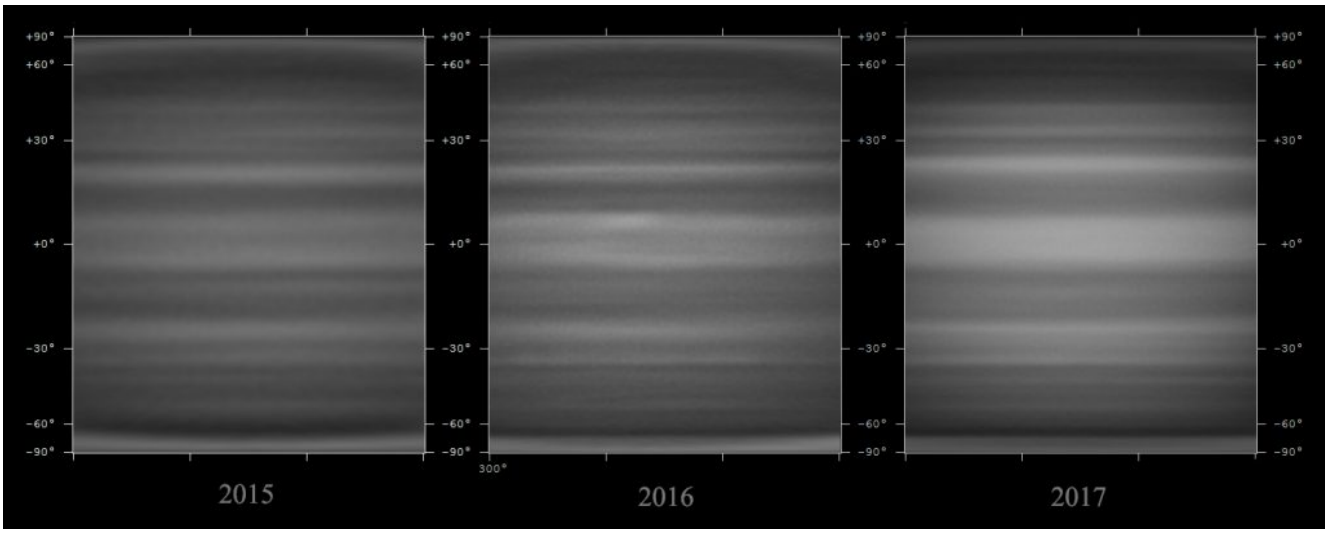

Figure 2. Average aspect of Jupiter banding in *890nm methane absorpton band near 2015-2016-2017 opposition*s

c) Measurements of the band/zone latitude limits (Fig.3)

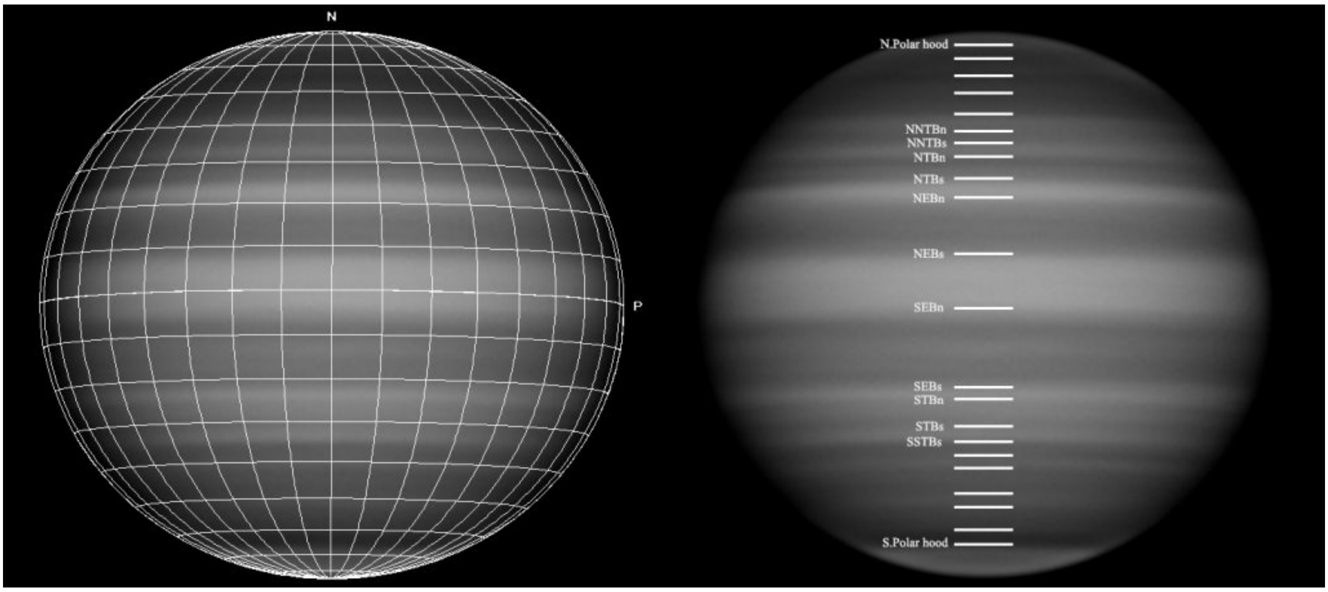

Figure 3. The Latitudinal limits of the bands that are measured with the use of WinJupos software

d) Reports on the results/changes observed

The first preliminary results of the method were presented in [3] and from time to time some more results will be published in this page as new posts at the bottom of the page.

The method is using WinJupos software [5]. Observations are downloaded from PVOL Database [6].The list of contributing observers will be presented separately in all cases. The work is supported by J.Rogers (Director of BAA Jupiter Section [7]) and Grigoris Maravelias (HAAA, NOA). Measurements are made by the author (HAAA) and Alexia Takoudi (HAAA, Student in Astronomy, Saint Petersburg State University). Use of data presented here may used elsewhere with appropriate referencing. Any researcher interested in making comments or request data may communicate with the author at *astromanos2002_at_yahoo.gr*

[1] Rogers,J.H . 1995, "The Giant Planet Jupiter", Chapter 3. Cambridge University Press

[2] Kardasis, E. 2017, "A simplified method to track long-term changes in Jupiter's belt/zone structure " EPSC 2017, 17 – 22 September 2017, Riga, Latvia. Available at: http://meetingorganizer.copernicus.org/EPSC2017/EPSC2017-236-1.pdf

[3] Kardasis, E. & Takoudi A. 2018, "Simplified measuring of belt/zone structure", RAS-Juno 2018EuroPlanet 2020 Workshop in London, 10-11 May 2018: 'New Views of Jupiter: Pro-Am Collaborations during and beyond the NASA Juno Mission', Presentation 3-20 available at : https://www2.le.ac.uk/departments/physics/research/projects/ras-juno-europlanet-meeting-2018

[4] Kardasis, E. & Takoudi A. 2018, "Jupiter's banded pattern changes in the 0.89μm band ", EPSC 2018, 16 – 21 September 2018, Berlin, Germany. Available at: https://meetingorganizer.copernicus.org/EPSC2018/EPSC2018-270.pd

[5] Grischa Hahn,WinJupos SW, http://www.grischa-hahn.homepage.t-online.de/

[6] PVOL, Planetary Virtual Observatory and Laboratory, Database of ground-based observations of solar system planets *http://pvol2.ehu.eus/pvol2*/

[7] British Astronomical Association, Jupiter section, https://www.britastro.org/section_front/15e

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The need for Professional-Amateur collaborations to the monitoring of gaseous planets – poster for the 11th HelAS conference

The Hellenic Astronomical conference is the biennial meeting of the Greek professional astronomers' society. During the 11th version of this conference (held in Athens, Sep. 8-12, 2013), we contributed with a poster presentation on the need of pro-am collaborations for Jupiter and Saturn. In particular:

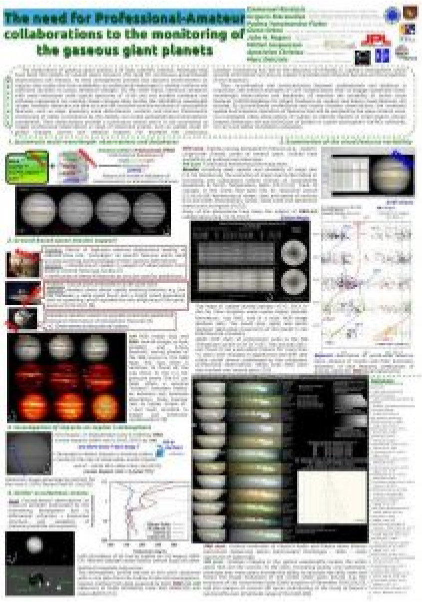
"The need for Professional-Amateur collaborations to the monitoring of the gaseous giant planets"

Emmanuel Kardasis, Grigoris Maravelias, Padma Yanamandra-

Fisher, Glenn Orton, John H. Rogers, Michel Jacquesson, Apostolos Christou, Marc Delcroix

Abstract:
The observation of gaseous giant planets is of high scientific interest. Although they have been the targets of several space missions, the need for continuous ground-based observations still remains. As their atmospheres present fast dynamic environments on various time scales the time availability at professional telescopes is neither uniform not sufficient duration to assess temporal changes. On the other hand, numerous amateurs with small telescopes (with typical apertures of 15-60 cm) and modern hardware and software equipment can monitor these changes daily (within the 360-900nm wavelength range). Amateur observers are able to trace the structure and the evolution of atmospheric features, such as major planetary scale disturbances, vortices, and storms. Photometric monitoring of stellar occultations by the planets can reveal spatial/temporal atmospheric variabilities. Their observations provide a continuous record and it is not uncommon to trigger professional observations in cases of important events, such as sudden onset of global changes, storms and celestial impacts. For example the continuous amateur monitoring has led to the discovery of fireballs in Jupiter’s atmosphere, which provide information not only on Jupiter’s gravitational influence but also on the properties of the impactors.
Thus, co-ordination and communication between professionals and amateurs is important. We present examples of such collaborations that: (i) engage systematic multi-wavelength observations and databases, (ii) examine the variability of Jovian cloud features (JUPOS-Database for Object Positions on Jupiter) and Saturn cloud features, (iii) provide, by ground-based professional and mainly amateur observations, the necessary spatial and temporal resolution of features that will be sampled by the space mission Juno, (iv) investigate video observations of Jupiter to identify impacts of small

objects (Jovian Impacts Detection-JID and DeTeCtion of bolides in Jupiter atmosphere -DeTeCt software), (v) carry out stellar occultation campaigns.



You can also download the poster as a pdf file: Kardasis-2013.

The need for Professional-Amateur collaborations in studies of Jupiter and Saturn – a JBAA publication

This work is a collective presentation of the type of contributions within the professional-amateur framework for the study of gaseous giants. In particular:

The need for Professional-Amateur collaborations in studies of Jupiter and Saturn

Emmanuel Kardasis, John H. Rogers, Glenn Orton, Marc Delcroix,

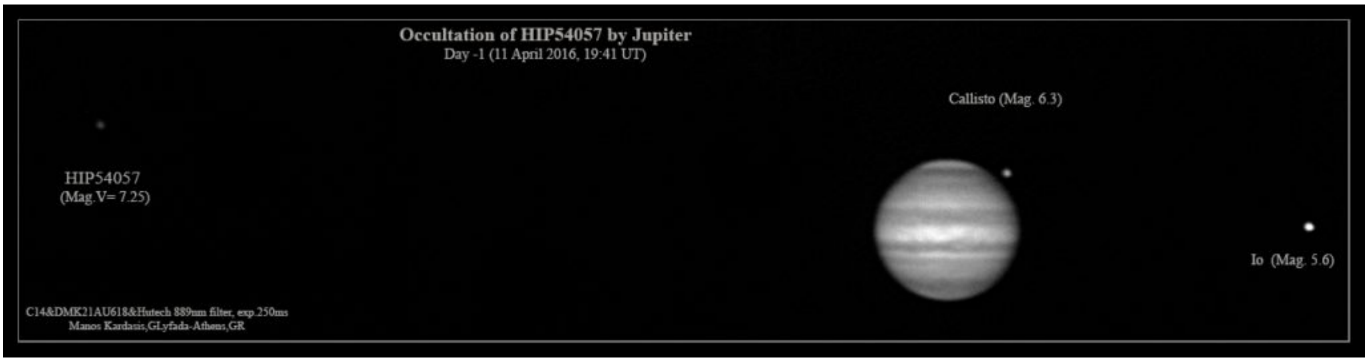
Apostolos Christou, Mike Foulkes, Padma Yanamandra-Fisher, Michel Jacquesson, Grigoris Maravelias

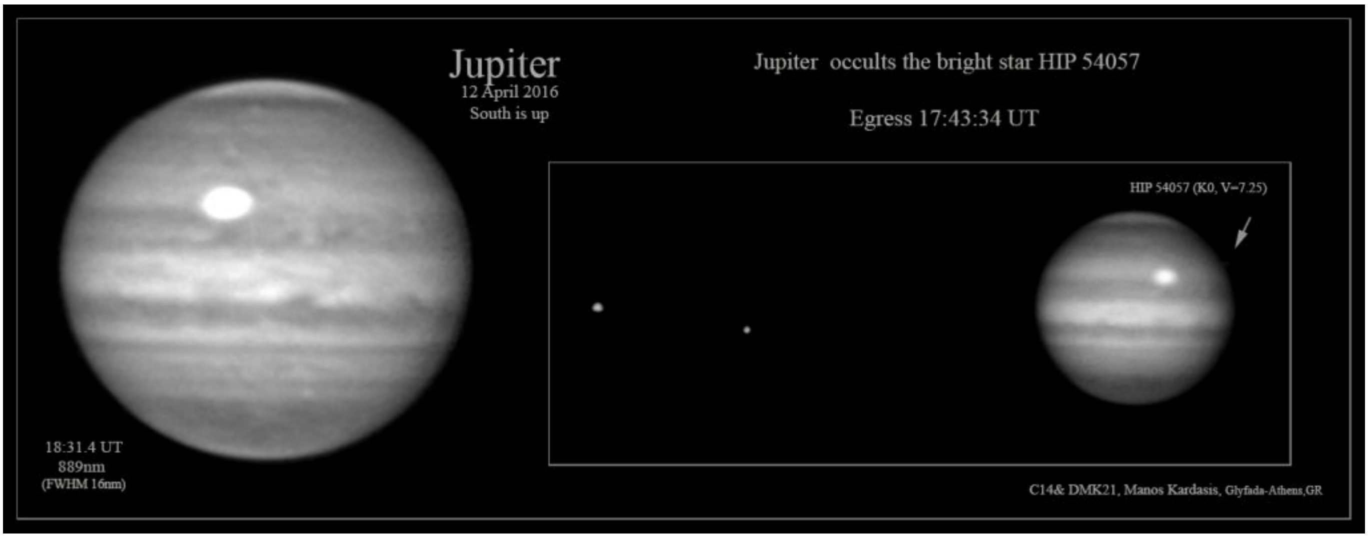
The observation of gaseous giant planets is of high scientific interest. Although they have been the targets of several spacecraft missions, there still remains a need for continuous ground-based observations. As their atmospheres present fast dynamic environments on various time scales, the availability of time at professional telescopes is neither uniform nor of sufficient duration to assess temporal changes. However, numerous amateurs with small telescopes (of 15-40 cm) and modern hardware and software equipment can monitor these changes daily (within the 360-900nm range). Amateurs are able to trace the structure and the evolution of atmospheric features, such as major planetary-scale disturbances, vortices, and storms. Their observations provide a continuous record and it is not uncommon to trigger professional observations in cases of important events, such as sudden onset of global changes, storms and celestial impacts. For example, the continuous amateur monitoring has led to the discovery of fireballs in Jupiter’s atmosphere, providing information not only on Jupiter’s gravitational influence but also on the properties and populations of the impactors. Photometric monitoring of stellar occultations by the planets can reveal spatial/temporal variability in their atmospheric structure. Therefore, co-ordination and communication between professionals and amateurs is important. We present examples of such collaborations that: (i) engage systematic multi-wavelength observations and databases, (ii) examine the variability of cloud features over timescales from days to decades, (iii) provide, by ground-based professional and amateur observations, the necessary spatial and temporal resolution of features that will be studied by the interplanetary mission Juno, (iv) investigate video observations of Jupiter to identify impacts of small objects, (v) carry out stellar-occultation campaigns.

The paper is available either through arXiv: 1503.07878 or directly from JBAA (2016, vol. 126, p. 29).

Stellar occultation of HIP 54057 by Jupiter and Ganymede

Results (15/04/2015):





Announcement (13/12/2015):

The structure and variability of the upper atmospheres of the giant planets may be investigated by occultation techniques [1]. Ground-based photometric monitoring of stellar occultations measure the attenuation of starlight by the planet’s intervening atmosphere due to differential refraction. This requires a sufficiently bright star to act as source and such opportunities are not frequent. A recent example was the occultation of the bright star 45 Capricornii (45 Cap) by the planet Jupiter on the night of 3-4 August, 2009.

On April 12, 2016 the planet Jupiter will occult the bright star HIP 54057 (K0, V=7.25) as viewed from areas of Europe, Africa and Asia. The occultation will sample similar planetographic latitudes at Jupiter as the 45 Cap event in 2009, allowing direct comparisons of the planet’s atmospheric state between the two epochs. The event has an added significance in view of the expected arrival of the *Juno* spacecraft to the Jovian system. For European observers, ingress occurs during daytime while egress takes place at approx 1745 UT when the sun is below the horizon from E & SE Europe. Due to the star being a K dwarf (V-I=1.02), use of a broadband R or I filter (a narrowband filter may be used with large aperture instruments) is recommended to suppress the twilight sky signal and increase the contrast between the limb of Jupiter and the star. Following this event, the star is occulted by the Galilean satellite Ganymede (V=5.3) as viewed from certain (tbd) areas of E Asia and the Pacific at approximately 1200 UT the next day, April 13. This secondary event may be useful in refining the ephemeris of the satellite and to constrain the existence of a tenuous atmosphere around it. Dense photometric observations are requested during ingress and egress. A visual summary of the event is provided in the following image (see also ref [6]) prepared by Apostolos Christou.

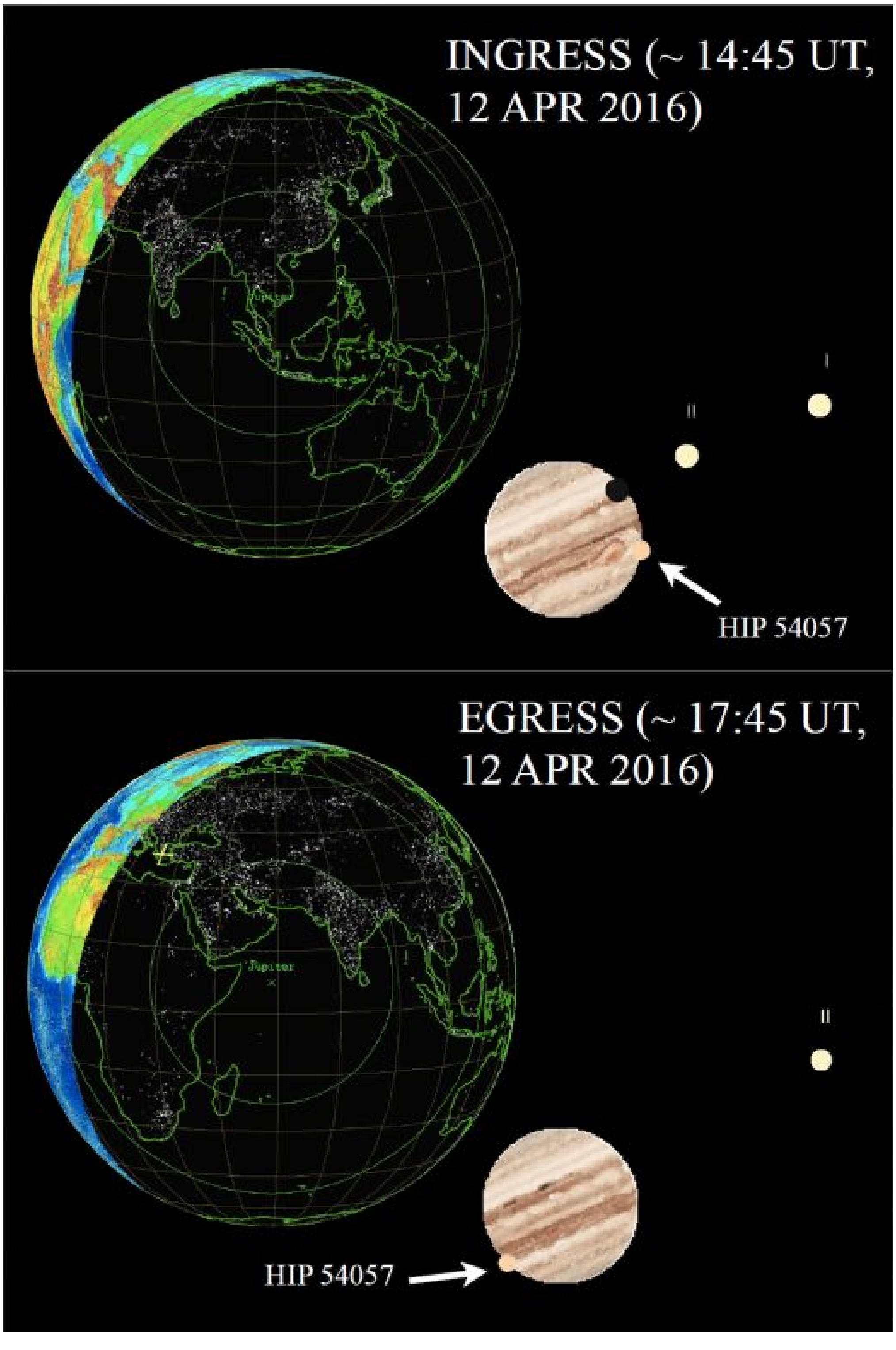
Stellar Occultation by Jupiter (and satellites) in 2016

HIP 54057

-K0, V=7.25, V-I = 1.02, K=4.9

-12 April 2016 (+ Ganymede occ. 13 April)

-visible from Asia, Oceania, E Africa & SE Europe



An optical summary of the observing conditions of the occultation of HIP 54057 by Jupiter (Credit: A. Christou).

References:

[1] Kardasis, Emmanuel, Rogers, John H., Orton, Glenn, Delcroix, Marc, Christou, Apostolos, Foulkes, Mike, Yanamandra-Fisher, Padma, Jacquesson, Michel, Maravelias, Grigoris, *'The need for Professional-Amateur collaborations in studies of Jupiter and Saturn',* Journal of the British Astronomical Association, vol. 126, n. 1, p. 29, (2016) https://britastro.org/sites/default/files/JBAA%20126-1%20Kardasis.pdf

[2] A. Christou et al., *'The occultation of HIP 107302 by Jupiter', Astronomy & Astrophysics', 556, A118,* (2013)

[3] IOTA European Section, *'Occultation of HIP 107302 by Jupiter on the 3rd of August 2009*
http://www.iota-es.de/jupiter2009/jupiteroccultation.html
[4] Doug Mink, *Occultations of PPM stars by Jupiter 2000-2050*
http://tdc-www.harvard.edu/occultations/jupiter/jupiter.ppm2000.html

[5] VizieR entry for HIP 54057
http://vizier.u-strasbg.fr/viz-bin/VizieR-S?HIP%2054057

[6]A. Christou, "Stellar Occultation by Jupiter (and satellites) in 2016 – HIP 54057"
http://hellas-astro.gr/wp-content/uploads/2018/10/Christou-occulatation-HIP54057-Jupiter.pdf

Jupiter maps (March 2014) and Methane absorption 889nm band report

Polar caps: Both caps look bright, the south cap is brighter, and the north cap more extended than the south cap.

SSTB: The white Ovals look bright. The oval between and north of A3 & A4 ovals("Mickey mouse") is still bright but less bright than at its discovery on Non 9th. The shape looks like it is more extended now.

STB: Oval BA is very bright. The "STB ghost" is a methane-dark formation. The material interacting with Oval BA is methane-dark too.

SEB: Most of the visually bright features are methane bright also. Some methane-bright plumes are visible on the rifted region F of the GRS. The interacting area between the "light patch" and the GRS is quite methane bright.

EZ: A methane-bright zone with dark sectors mainly in the middle.

EZn-NEBs: A very active area with about 10 dark projections (dark-blue in RGB) associated with bright areas on the F side. The most active area is in the middle-right of the map (associated with NEB rifted region).

NEB: Is mainly dark with some bright areas in the rifted region. NEBn is bright and hosts Spot Z (former WSZ) which is very methane-bright since the start of this apparition.

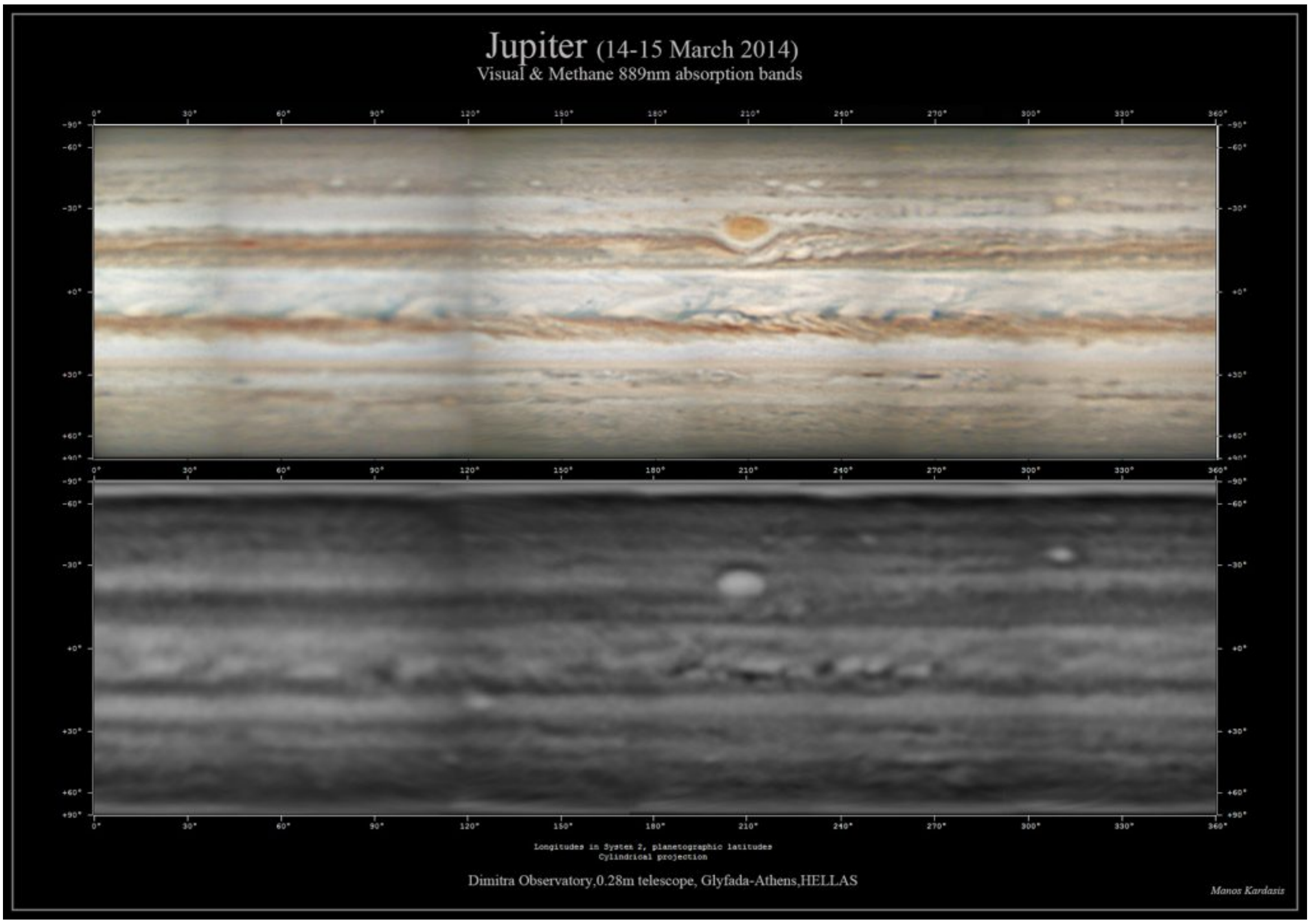
NTrZ: Is bright in all its length. NTB-NTZ: The NTBs edge (which is pale orange in visible light) is also methane-bright but the rest is quite dark. In L2=145-210 there is a great disturbance in the NTBn-NTZ mainly dark in the P side. In the center there are some brighter regions and a small methane-bright spot in a rift is visible at +29, L2=165. At L2= 250 & 270 there are two dark barges. In NTZ at L2=47 there is a very methane-dark spot, which has been visually very dark since early March.

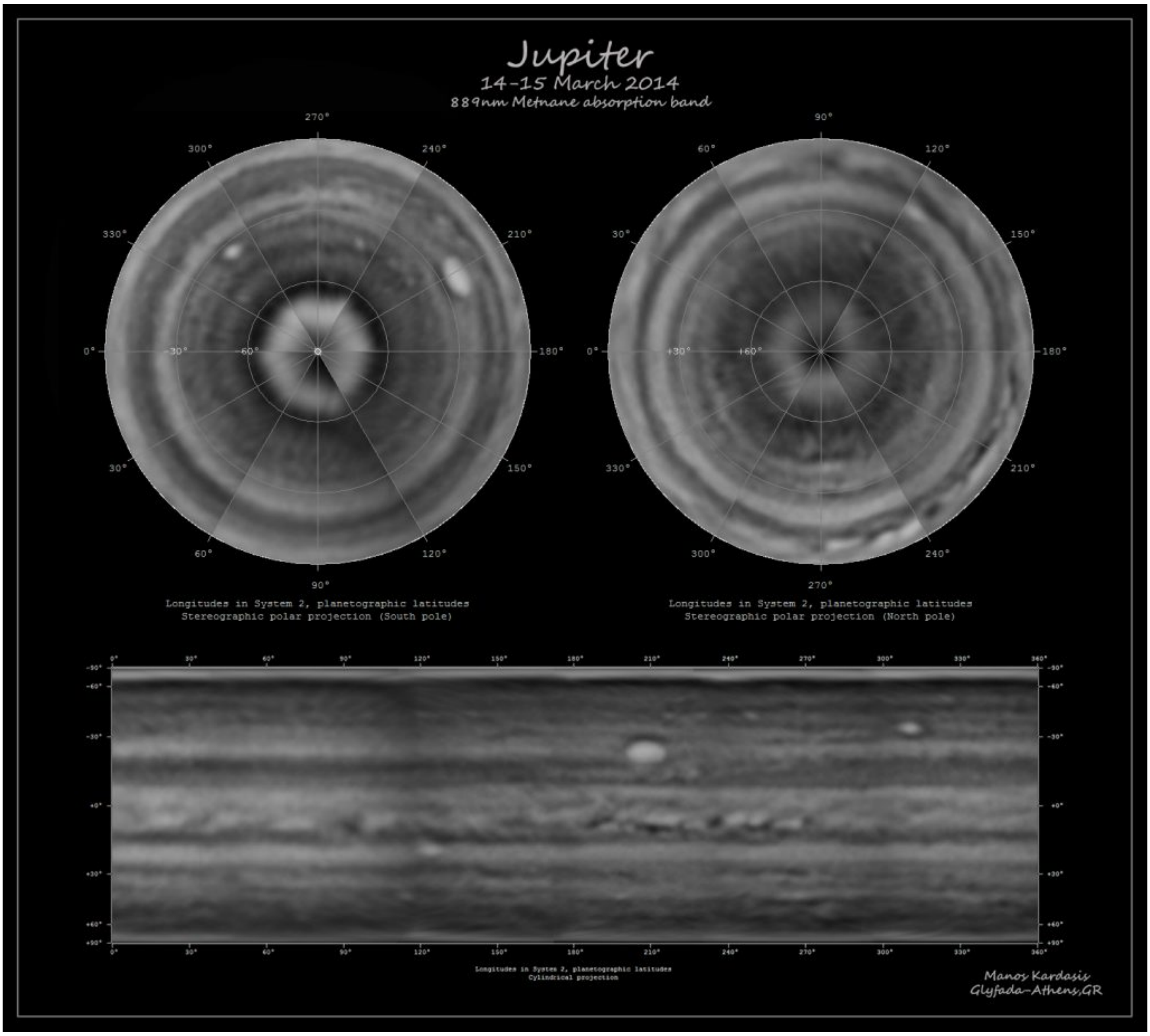
NNTB: It is not clearly separated from North Polar Region. It is mostly dark, but a very dark sector is present at L2=315-365.

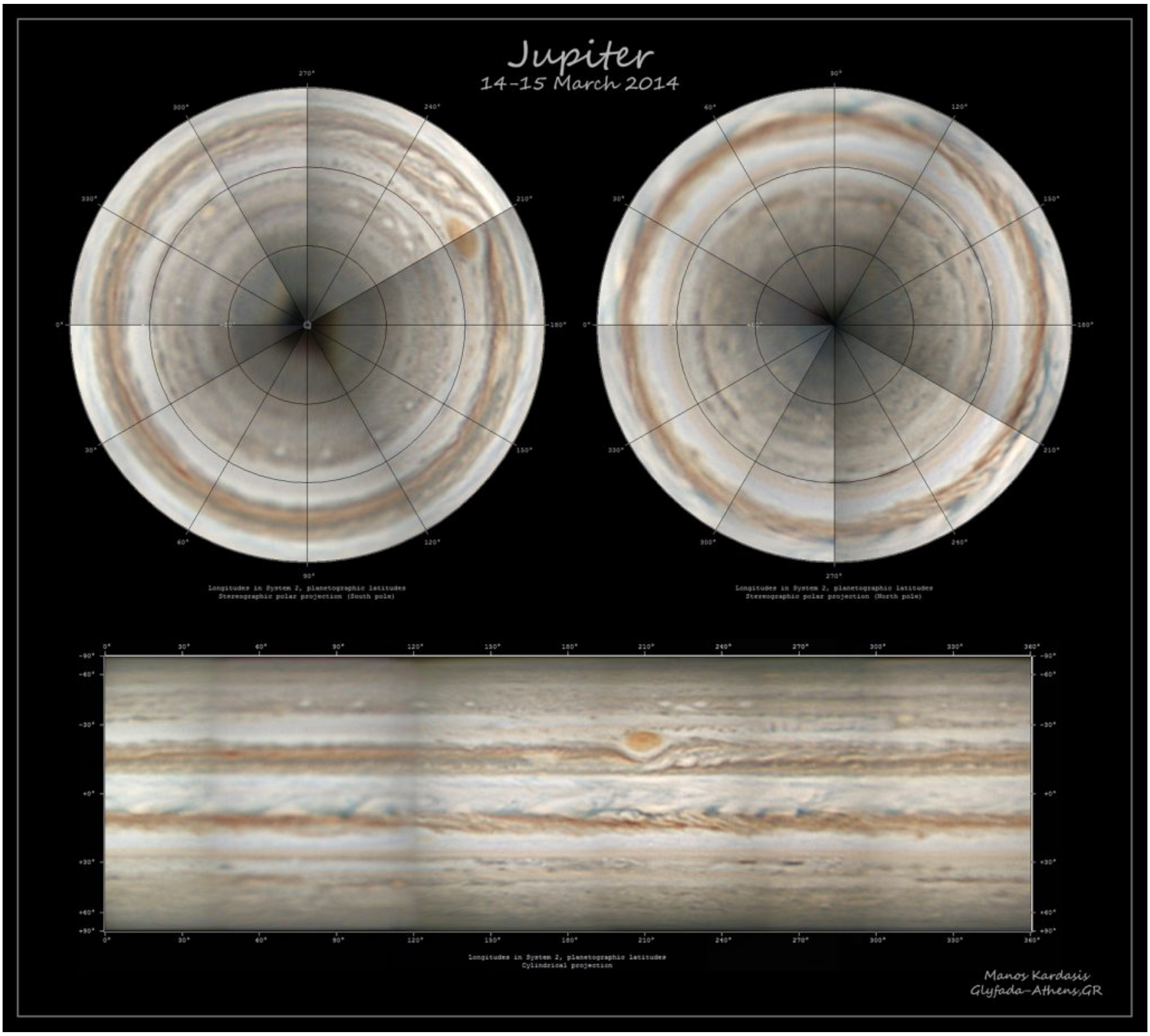
NNTZ: LRS-1 is very bright and there is a dark sector P-F and south of it.There is another bright spot at L2=200.

NPR: There are some bright and dark areas.

Thanks to J.Rogers for making comments. For more 2013-14 reports on Jupiter please visit: http://www.britastro.org/jupiter/2013_14reports.htm


Jupiter (14-15 March 2014)
Visual & Methane 889nm absorption bands
0° 30° 60° 90° 120° 150° 180° 210° 240° 270° 300° 330° 360°
-90° -60° -30° +0° +30° +60° +90°
Longitudes in System 2, planetographic latitudes
Cylindrical projection
Dimitra Observatory,0.28m telescope, Glyfada-Athens,HELLAS
Manos Kardasis


Jupiter
14-15 March 2014
889nm Methane absorption band
Longitudes in System 2, planetographic latitudes
Stereographic polar projection (South pole)
Longitudes in System 2, planetographic latitudes
Stereographic polar projection (North pole)
Longitudes in System 2, planetographic latitudes
Cylindrical projection
Manos Kardasis
Glyfada-Athens,GR



EPSC 2013: Digital daylight observations of the planets with small telescopes

During the European Planetary Science Congress 2013 (Sep 8-13, 2013, London, UK) we presented the following work:

Digital daylight observations of the planets with small telescopes

Emmanuel (Manos) I. Kardasis

Abstract
Planetary atmospheres are extremely dynamic, showing a variety of phenomena at different spatial and temporal scales, therefore continuous monitoring is required. Amateur astronomers have provided the astronomical community with a great amount of observations, some of which are unique, made under difficult observational conditions. When the planets are close to the sun, observations can only be made either in twilight or in broad daylight. The use of digital technology in recent years has made feasible daytime planetary observing programs. In this work we present the methodology and some results of digital daylight observations (DDO) of planets obtained with a small telescope (11inches, 0.28 m). This work may motivate more observers to digitally observe the planets during the day especially when this can be important and unique.

You can find the poster either from a local file (Kardasis-EPSC2013.pdf), or from the EPSC site (2013, EPSC, 8, 795).