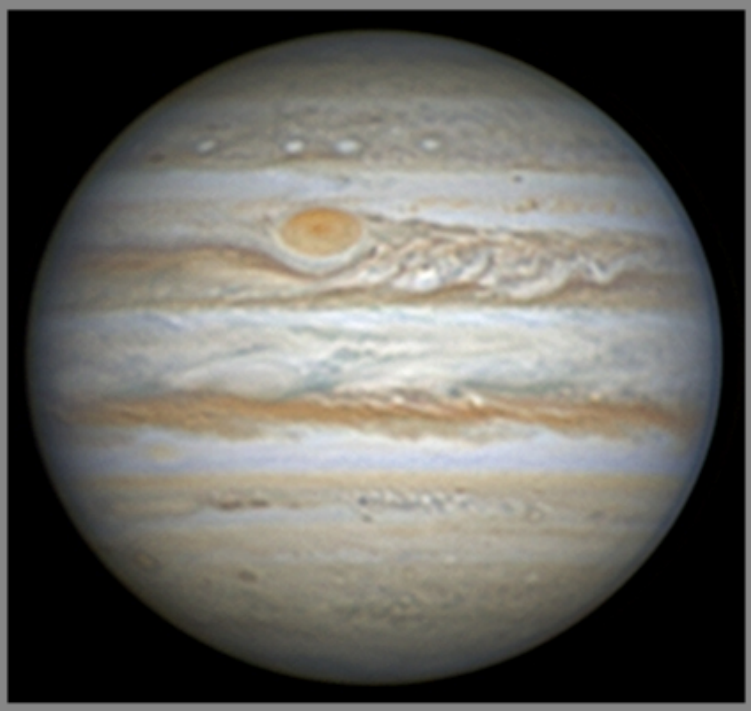
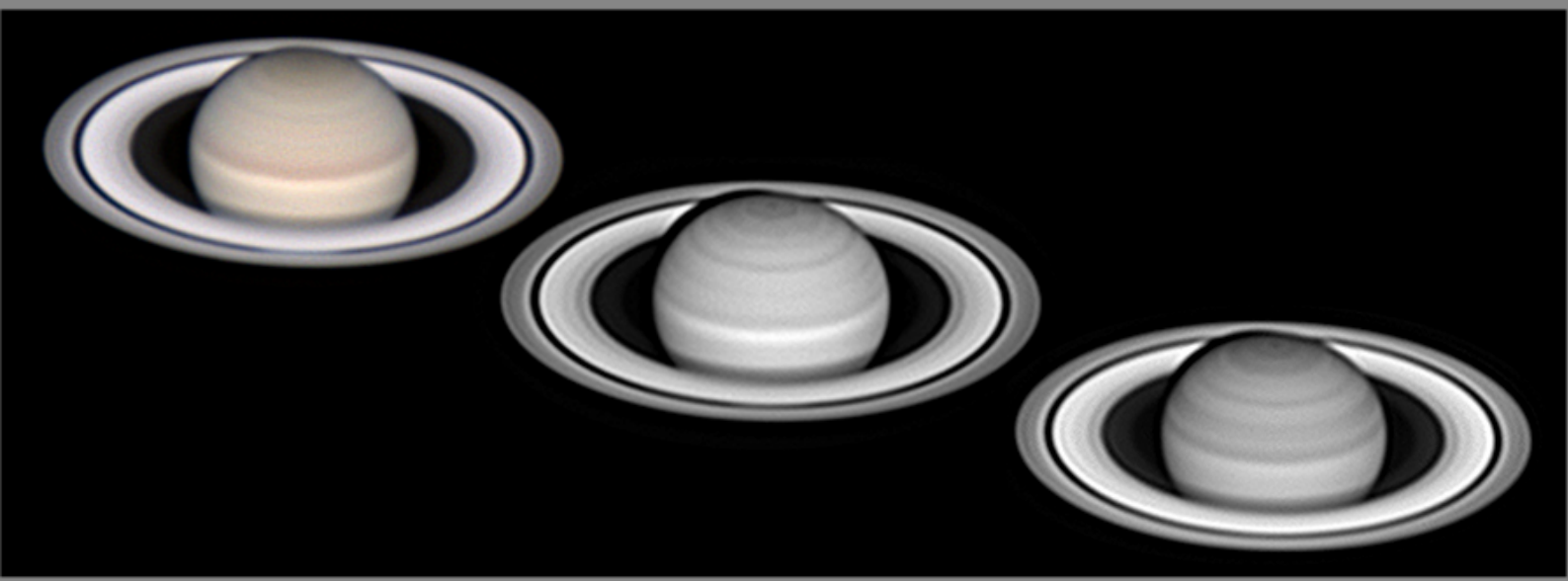
Get successful planetary images

2018 edition

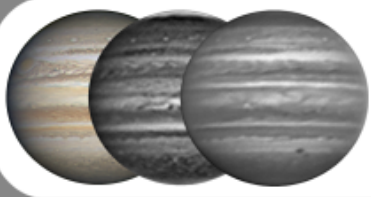


A complete approach

In 10 fundamental steps



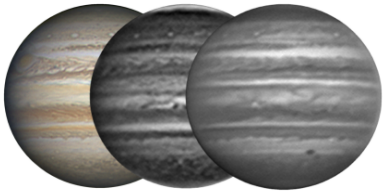
A guide of the blog



PLANETARY ASTRONOMY

A website by Christophe Pellier

"*Get successful planetary images*" is a free guide offered to the readers of the blog



PLANETARY ASTRONOMY

A website by Christophe Pellier

Christophe

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« How can I get good planetary images ? »

If this is a question you ask yourself, or even if you don't because they are already fine, but if you just wonder if they could be better, then here are the most important tips I would give. The guide is not a collection of tutorials but a synthesis of my personal approach to planetary imaging. It explains **how to take things in order.** And not get lost !

Some of them are already well known *(this is not a reason to lay them aside:-)))* but some others are not, because most papers or books that talk about planetary imaging reduce it to its technical aspects (the telescope, the camera, the softwares...)

But this is a world in itself and you wil have to go beyond the technique to familiarize with the planets themselves. You have not learnt everything about this captivating thing that is planetary astronomy (neither have I) !

On the next page you can proceed to the First Step !

Christophe

1 Learn about the planets you want to image

No one talks about this necessary step: how to image an object that you don't know well? This would be like writing an article about a topic you have just discovered. Success is not granted;)

Of course, mastering the technique only will already allow you to get nice images. This is even enough for the stage of high resolution imaging. **But becoming well informed about planetary activity, that is to say about the details visible on the planet, will help you to progress more quickly. If you are already skilful, this might get you 5-10 % more quality.**

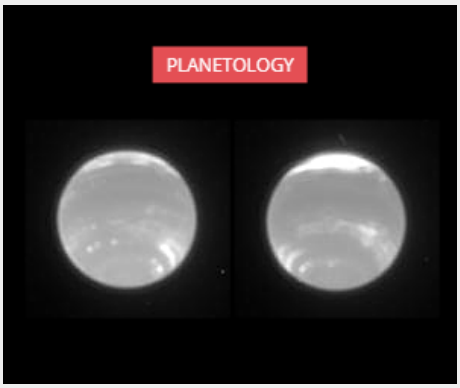
More over, you will be more able **to detect artefacts, equivocal details, and to evaluate more precisely the impact of some processing techniques**.

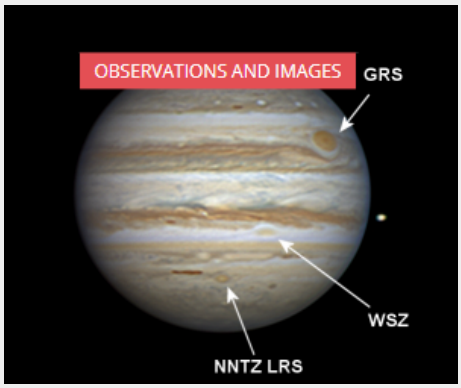
And one last thing: planetary activity is just fascinating anyway;)

In practice

You don't need to become a planetology expert. But you need to know that Mars has clouds, clouds of different types, that the color and aspect of the belts of Jupiter and Saturn will vary a lot with the time, that Venus shows more contrasted details in UV than in any other color band...

On my blog, two categories of articles are dedicated to planetary activity. *Planetology* presents informations rather from scientific and professional data and *Observations and images* is in the same spirit but from my own work.





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On Mars, the best publication you must follow is the review *Communications in Mars Observations* (CMO) where you will find every month papers about observing Mars. I also recommend the reading of Richard McKim's work (the Director of the BAA Mars section). On the ALPO side, the *Mars Observers Cafe* by Jeff Beish contains many articles from ALPO studies..

For Jupiter, the best work is done by John Rogers, Director of the BAA Jupiter section along with the JUPOS project (with our images!). His papers are a true scientific value but can still be read easily by amateurs. They are moreover realised thanks to amateur images sent to the Jupos project. Our images !

And finally these are two blogs of scientific caracter but very accessible to the amateur reader : that of the Planetary Society, and the one written by Leigh Fletcher, astronomer at the Oxford University.

If you read french:

The website of the Commission des observations planétaires of the French astronomical society regularily publishes notes and articles about the actuality of planetary observations.

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2 Watch images – a lot, and frequently

Step 2 is the logical following of Step 1 but only on the technical side. Reviewing planetary images published by the other amateurs will train your eye.

The idea is to become able to decide what images are correctly done, and those that present problems. Time only will train your eye, but keep in mind that the Step 2 must always be seen in the light of Step 1 : a good image **is an image that best reproduces the reality of the planet as you see it with your knowledge.** At the beginning do not trust too much your aesthetic impressions ; a good image must be nice to look at, but an image that your eye finds nice to look at is not necessarily a good image !.

In practice

Follow especially the most recognized observers (but keep always a critical distance)

Follow the images galleries on the web (forums are nice as well, but you will find more images on galleries)

In french :

Planètes-SAF offers interactive galleries that you can browse by observer or by time period:

In english :

ALPO-Japan has been gathering images for around twenty years and is certainly the most popular gallerie. It contains many images and is quickly updated, even it does not offer search tools :

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Then you will find more specialized galleries, by planets. That one of the International society of the Mars Observers (ISMO), that publishes the CMO, is dedicated to Martian apparitions and allows searching by time period or observer. The Planetary Virtual Observatory and Laboratory (PVOL) is a *professional* gallery studying the four gas giants. It welcomes amateur images because they have become important for science research.

the International Society of the Mars Observers (ISMO)

PVOL
Planetary Virtual Observatory & Laboratory

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3 Forecast good observing nights for your site

The quality of images is highly dependent from the *seeing* and to a less extent to the *transparency.* Not all nights are fine for planetary imaging and you can't observe every time : **how can you anticipate the best ones ?**

The experience of planetary observers reveals a few meteorological situations that favors the good seeing : a weak jetstream in altitude, the presence of a high pressure, the temperature inversion (in spring or fall), the moment of twilight and dawn, and I would add on my side : the origin of winds when they come from the ocean. These situations are not always favorable but they are those you must look for. After a time, you should be able to forecast the good nights for your site !

In practice

When you observe, note the conditions of macro-meteorology : winds, pressure, jetstream. Don't pay too much attention to absolute temperature or humidity, and other immediate environnement data.

Download the following weather maps of the night : pressure, ground wind, jetstream, from websites such as Topkarten, Meteosurf, SkippySky.

Wetterzentrale Top Karten

Météo SURF .com

SkippySky

Follow the seeing forecast on **Meteoblue**, **SkippySky, 7Timer**

7Timer!

SkippySky

meteoblue weather close to you

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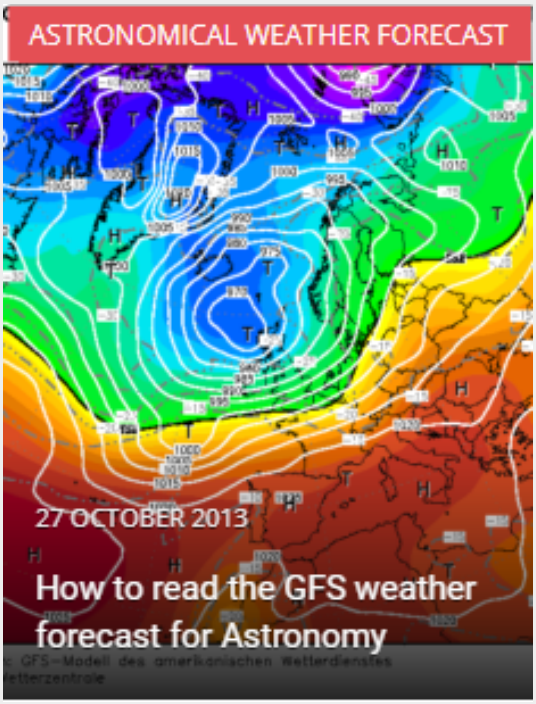
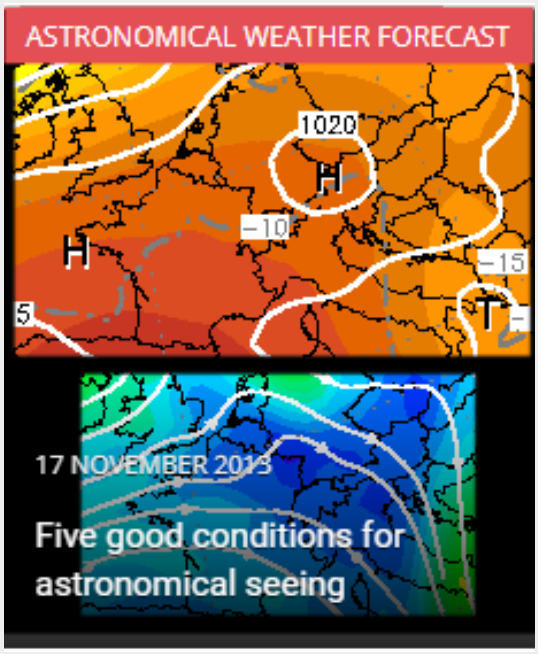
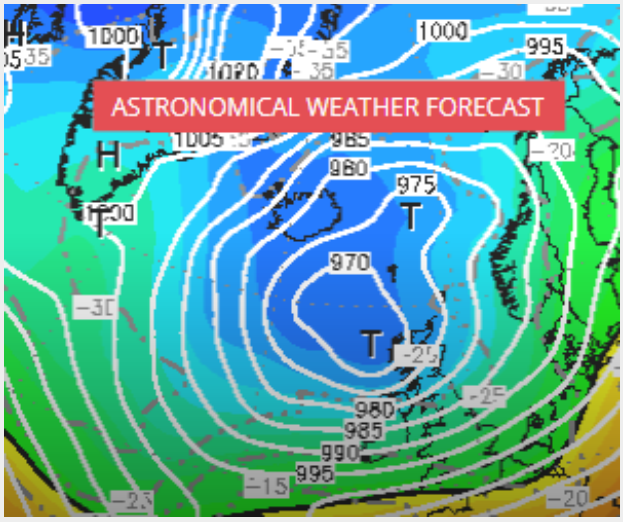
On my blog, read the category ***Astronomical weather forecast*** and especially the following articles:







Keep in mind that even under mediocre nights you can get interesting images, noticeably from a scientific point of view. As an example, the JUPOS project needs ALL the images, even the average ones...

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4 Collimate your telescope. Before each session.

This is one of the most shared ever tip but it stilll looks a bit neglected. **The collimation of the telescope is absolutely required to get successful planetary images.**

If you don't collimate your telescope before each session, this is probably that your control of the operation is not good and that you are afraid of it. This is understandable because it's really a technical know-how. This is why **mastering it must be a goal for you.** To advance more rapidly sometimes you must accept to lose time at the beginning.

In practice

Once for all, dedicate one or more observing sessions to handle the collimation of your instrument. Make profit of nights without planets or those of average seeing (you might not be able to finalize the operation but you will experiment the settings).

Before or after, spend some time to read about collimation on the web, on forums, papers, books, or in your local club.

Read on my blog my personal advices to make this step more easy. I describle in this article 5 tips (really) convenient. In particular, if you were to memorize only one, the use of a red filter must become your compagnon tool to align your optics.

Following the instrument you have, maybe you won't have to touch the collimation everytime, but you **must** check it.

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5 Look in the eyepiece of your telescope !

"So how you guys process the color of your images ?"

You have certainly read this question once on a forum. Maybe you even asked it yourself.

From time to time I'm amazed to see planetary images with a completely strange color balance. A bluish Jupiter, a pink Venus... And each time I wonder why the observer can't see that such tints do not fit at all the planet ?

Before looking for advanced techniques of color processing, remember that you have at home one excellent mean to discover how the planet really look like : your telescope ! Visual observing must have lost some interest since the advent of the CCD era, but I'm convinced that it at least keeps this advantage: **providing landmarks for the processing of images, something the CCD is just not able to.**

Moreover, visual observing helps building an intimate knowledge of the planet as I recommend it on the first Step : colors are not a subjective element, they are the translation of the physical properties of the planet's details (the way they absorb, or reflect, the different wavelengths). Colors are science as well !

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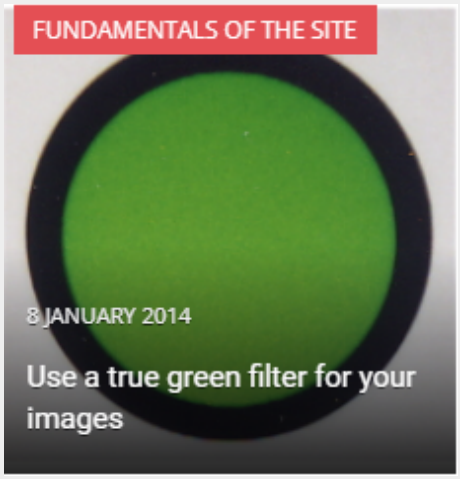
In practice

Before or after your imaging session, devote at least a few minutes to look seriously to the planet in your eyepiece. Try different magnifications.

Evaluate for yourself the color of the details you see (and test the conditions of seeing and transparency).

Finally, read on my blogs this articles that discuss color processing of images, which go beyond what you are used to hear on this topic :



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6 Choose your equipment following your projects

What kind of equipment do you need ?

For planetary imaging you must get a camera, and filters. Ok but which ones ?

The first question you must ask yourself is: do I need a color camera or a black&white one ?

Things have changed over the past years as CMOS sensors developped to become better performers than CCD. And now highly sensitive color cameras are available, while a few years ago, they used to be always noticeably less sensitive than black&white ones.

If you do not want to embrace the full complexity of planetary imaging and if you want only to take beautiful color images of planets, do not hesitate and take on of those modern color cameras (just take care of the sampling factor, see 7th point of this guide). In any case, **color imaging remains the most interesting tool to study most planets, even for scientific cooperation.** Moreover now those color cameras do give access to infrared imaging.

The b&w camera still remains none the less a powerful tool. It has a potential to make even better color images and opens the full width of planetary imaging, with wavelentghs sometimes inacessible to the color camera as Venus UV imaging.

Ideally if you possess both kind of cameras then you will be able to face every need !

In practice

Before choosing a particular model, take a look at those used by the best imagers. Do not choose untested models unless you are someone skillfull in camera technic. **In particular, again beware of the sampling** : is your telescope able to reach the required focal length ? (see next advice)

If you have a b&w camera, you must get a LRGB filter set. If possible choose one that is not specialized into deep sky imaging. Those sets present overlapping of bands (to increase gathering of signal from nebulae) as well as exclusion bands (to block light pollution) that are of no interest for planetary imaging and that will produce somehow twiked colors.

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Then a deep red filter (Wratten 25, RG610) and/or an infrared pass filter will allow you to make images of the martian surface, and especially of the lower atmospheric layers of the gas giants.

In my blog the corresponding article category is *Setting the equipment :*

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7 Find adequate sampling for the camera

Sampling is an **essential** parameter of your imaging setup. Like telescope collimation, it is a rather touchy learning point but that you must master.

The story is all about finding which focal length is right, the one that will give your telescope a chance to reveal all potential details without making the camera's settings to difficult to adjust.

Because here is the point : the resulting focal length must be long enough to reveal details. But the longer it is, the most difficult the focusing will be, because the image is getting darker, noiser and shaky. You must find the right compromise.

Before choosing a camera, you must :

1) Identify the best cameras of the time. Do not look for the camera that fits your instrument : think about how (and if) the telescope can be adapted to that camera.

2) Calculate the adequate sampling for the considered camera and above all **verify that your instrument is able to reach the corresponding focal length.** This has become a central question because modern sensors have smaller and smaller photosites and some instruments have an already quite long native focal length that will be either too short or too long for the camera with no real intermediate solution. This is the case for typical Schmidt-Cassegrain F/10 telescopes that have a hard time adapt to the CMOS sensor IMX290, that requires a F/D ratio of around only 14 !

In practice

In every case keep in mind this simple rule to evaluate the capacity of the telescope to reach the good sampling : multply the photosite size of the sensor by 5. The resulting value is the ideal F/D ratio that will allow the camera to perform at its best. It's then easyer to know if the camera will fit the telescope !

What kind of instrument do you own ? If it is one of those modest diameter, but that have a very high optical quality, do not hesitate to use longer focal lengths if conditions are good. If you are using a big telescope, benefit from the ability of the instrument to reach a very high resolution without unusable focal lengths and use of the camera with performing, confortable settings.

What planet are you observing ? Of little size, but bright (Mars) : use a longer focal length. Less bright, but with a large diameter (Jupiter) : keep a moderate F/D ratio.

How are the observing conditions ? If seeing is not good, consider shortening the focal length or even use the binning mode of the camera.

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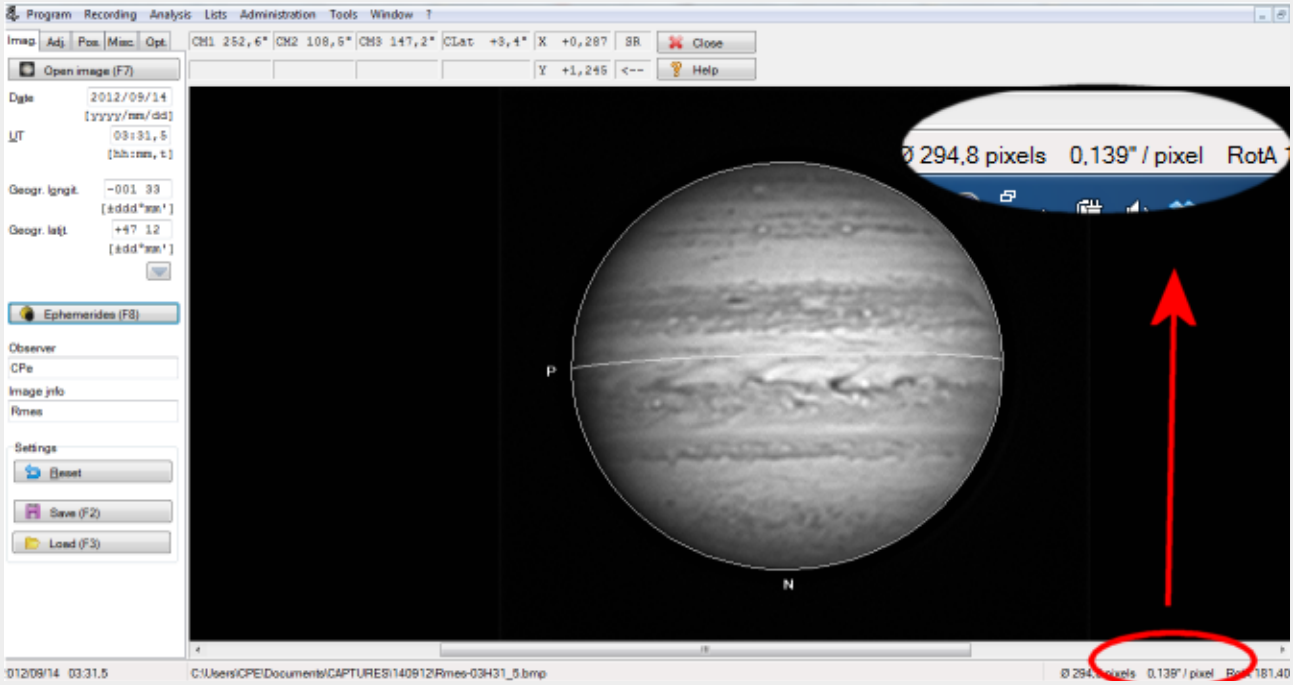
Read on my blog the article where I describe the sampling notion : What is the sampling ? Simply take an existing image and use WinJupos to avoid complex calculations.



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8 Find the right focus when using the camera

Focusing is another key step of planetary imaging. You should not be amazed to pass **a lot of time trying to find focus.** On the computer screen the planets seen by the camera in live mode are noisy, shaky, dim. How can you be sure that the focusing is correct ?

In practice

Pay attention to the limb of the planet (**the limb being the frontier between the enlightened disk and the background space,** not the terminator that separates the dayside from the nightside of the planet). Mercury, Mars and Venus are more easily focused this way.

On the gas giants look for details a bit more contrasted. If you are lucky to see a shadow of satellite on Jupiter it will be very easy. But otherwise, find a belt or a belt's edge a bit more contrasted. Focusing on the Galileans is possible but I find that it must be verified by looking at the details on the globe. Saturn is easier : focus on the rings !

On harder targets like Uranus and Neptune, you can even launch the processing of very short movie files (like around 300 raw frames), and look if the limb of the tiny disk looks sharp with a bit of sharpening.

Do not hesitate to re-focus the blue filter : modern LRGB filters sets are supposed to be parfocal but in practice the focus point of blue light is different mainly because of the presence of lenses in the light path.

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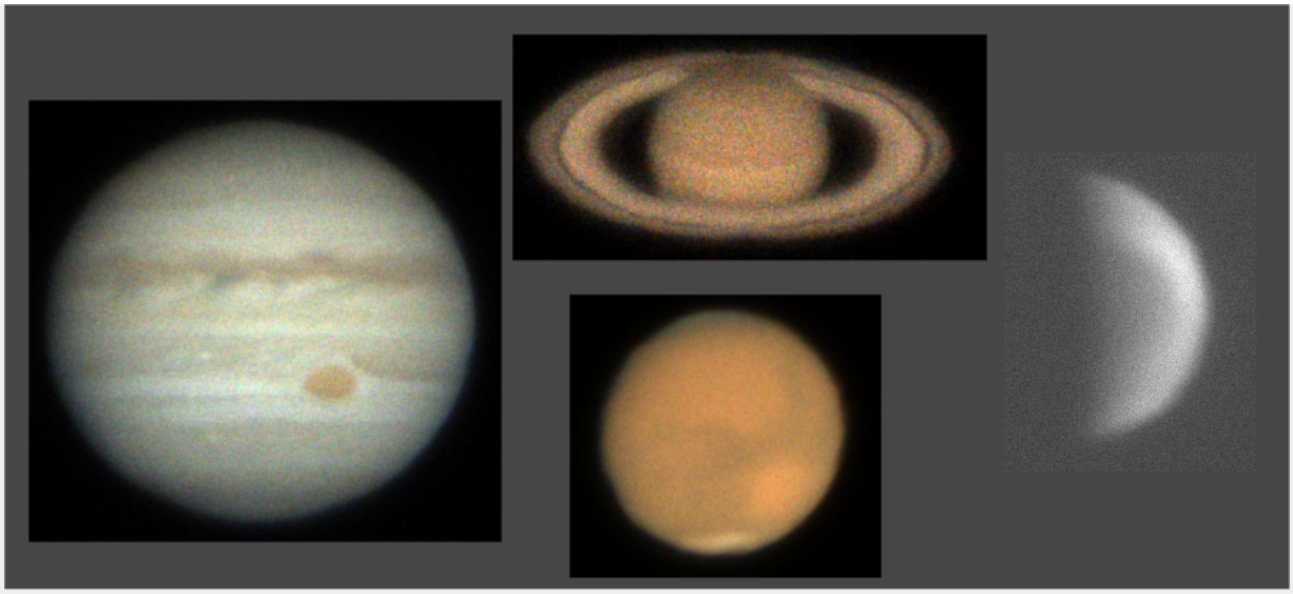

A few raw images. On Jupiter you can focus on some colored details, like the Great red spot, or the bluish festoons of the Equatorial zone. But a thin and well marked South temperate belt is an interesting landmark as well.
On Saturn, the situation is simple : focus on the rings and especially the Cassini division !
On Mars, the surface details are a help but the limb is often a more reliable details for focusing. On Venus this is even the only way to get a sharp image.

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9 Learn how to set your camera : framerate, gain, exposure

Your camera is certainly a very performing tool but there is so many settings to touch ! Can we find what are the most importants ?

There are several kinds of cameras and the idea is of course not to describe them all here, but some approches must be correct whichever you have chosen...

In practice

The first quality of a planetary camera is its capacity to capture videos with the highest framerate possible (the **fps**). The **fps** is logically the parameter that you must privilege. But beware that there is a limit, **that is the level of exposition of the raw frame** : it is not pertinent to use a frame rate so high that the image will become too dark. If so, noise will remain too important on the final image. **You need to find a good compromise.**

For this the right tool is the **histogram**. Every acquisition software has one and it must be activated. The histogram is what will prevent the image to be either under-exposed (too dark) or over-exposed (where the brightest areas reach photosite saturation). Of course, on some targets like Uranus or Neptune, Jupiter in the methan band, the level of exposition will most likely be sub-optimal. This is not so severe but this situatiion should be avoided when possible.

The **exposure time** is so never set for itself. It's only a *consequence* of the framerate setting. I mean : if I choose a framerate of the 50 fps, *then* I can calculate that the exposure time is 1/50 = 0,02 second. But I did never choose to set the camera at 0,02 second.

Other settings must not be changed: gamma, contrast, luminosity : they should be left at their default value.

Finally, the maximum length of the video to avoid the drift of details due to the rotation of planetary globes must be evaluated. In an empirical way and for a color image, maximum times will be around 1-2 mn for Jupiter, 2-3 mn for Mars or Saturn, 5-10 for Venus... Remember that the WinJupos software will allow you to go beyond these values thanks to « de-rotation » technics.

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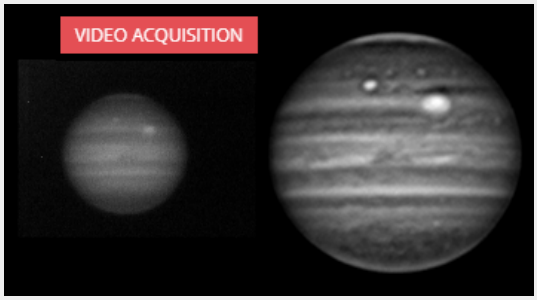
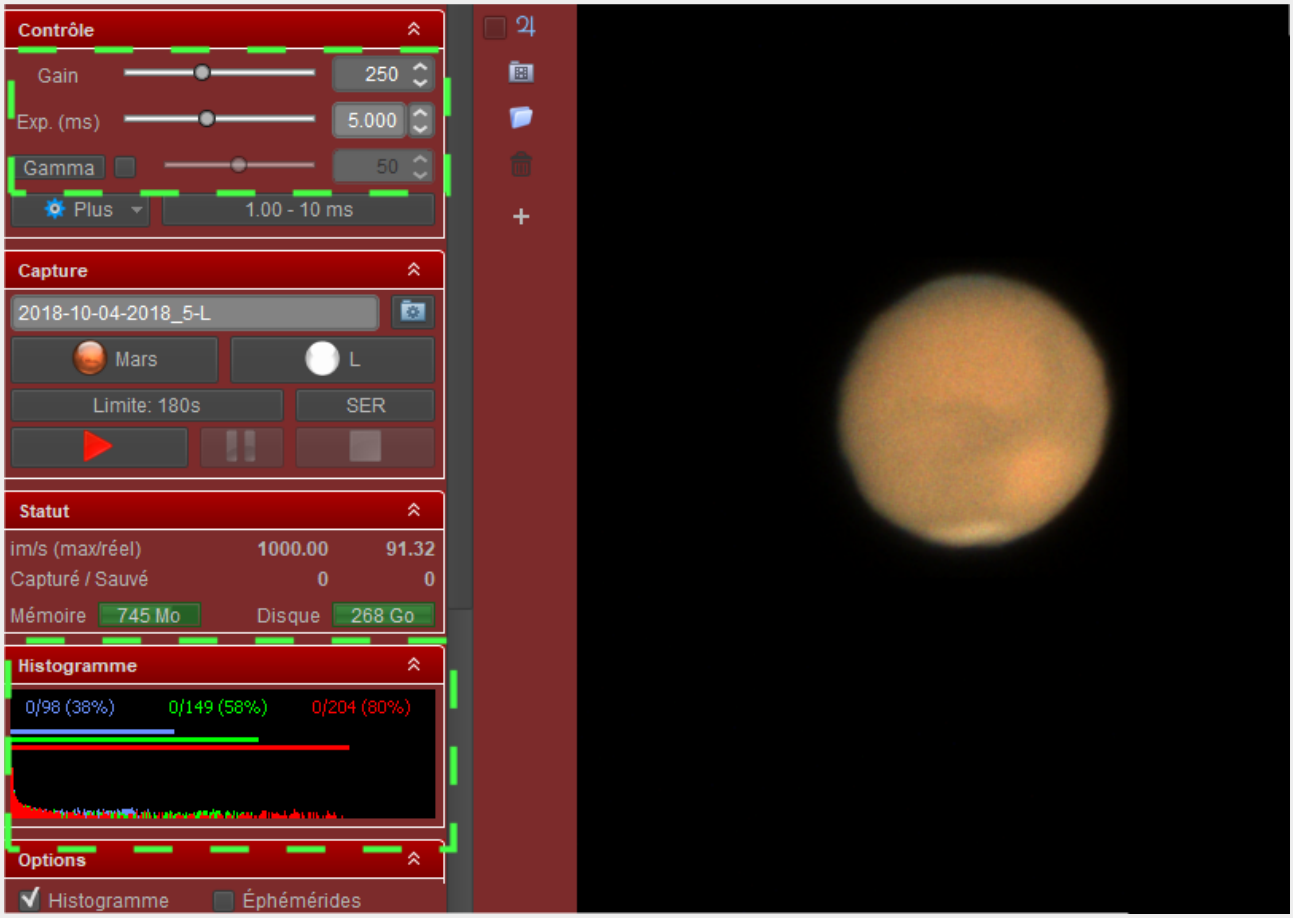
On my blog, read the category of articles *Videos acquisition* :



Below, a screenshot of a Mars video capture, set at an optimal level of histogram in the FireCapture software.



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10 Find landmarks for the processing of your images

Image processing is a world in itself. **Its role is to reveal the whole information present on the unprocessed images, without losing some, denaturing it, and of course without introducing artefacts.**

Ok, so how ?

In practice

Invest yourself in Step 1 and 2 !

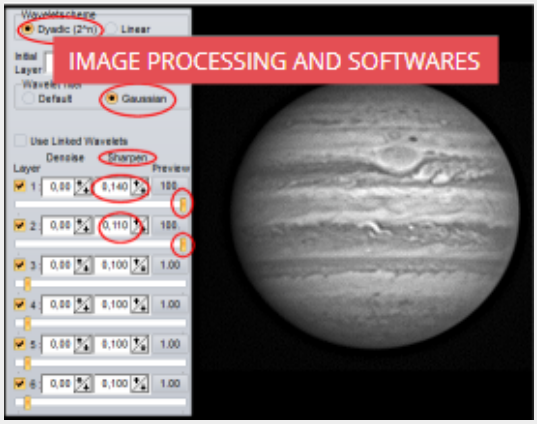
For color processing, I strongly advise you not to use those ones that give to red and infrared the importance they do not have in the reality : RRGB, IR-GB, etc. This induces losses of information, breakdown of the color rendition and even sometimes a reduction of resolution.

Know how to recognize unadequate processing at very small scale : small details must be contrasted (otherwise they are *underprocessed*) but not to the point where they would become too sharp, like laser cut (suspect *overprocessing*).

Avoid every complicated and long processing, that would see several filters applied and large cosmetic transformations (like oversizing, etc.)

In case of doubt, perform coherence tests : compare with other images, take several images, try different softwares...

On my blog follow the category *Image processing and softwares*



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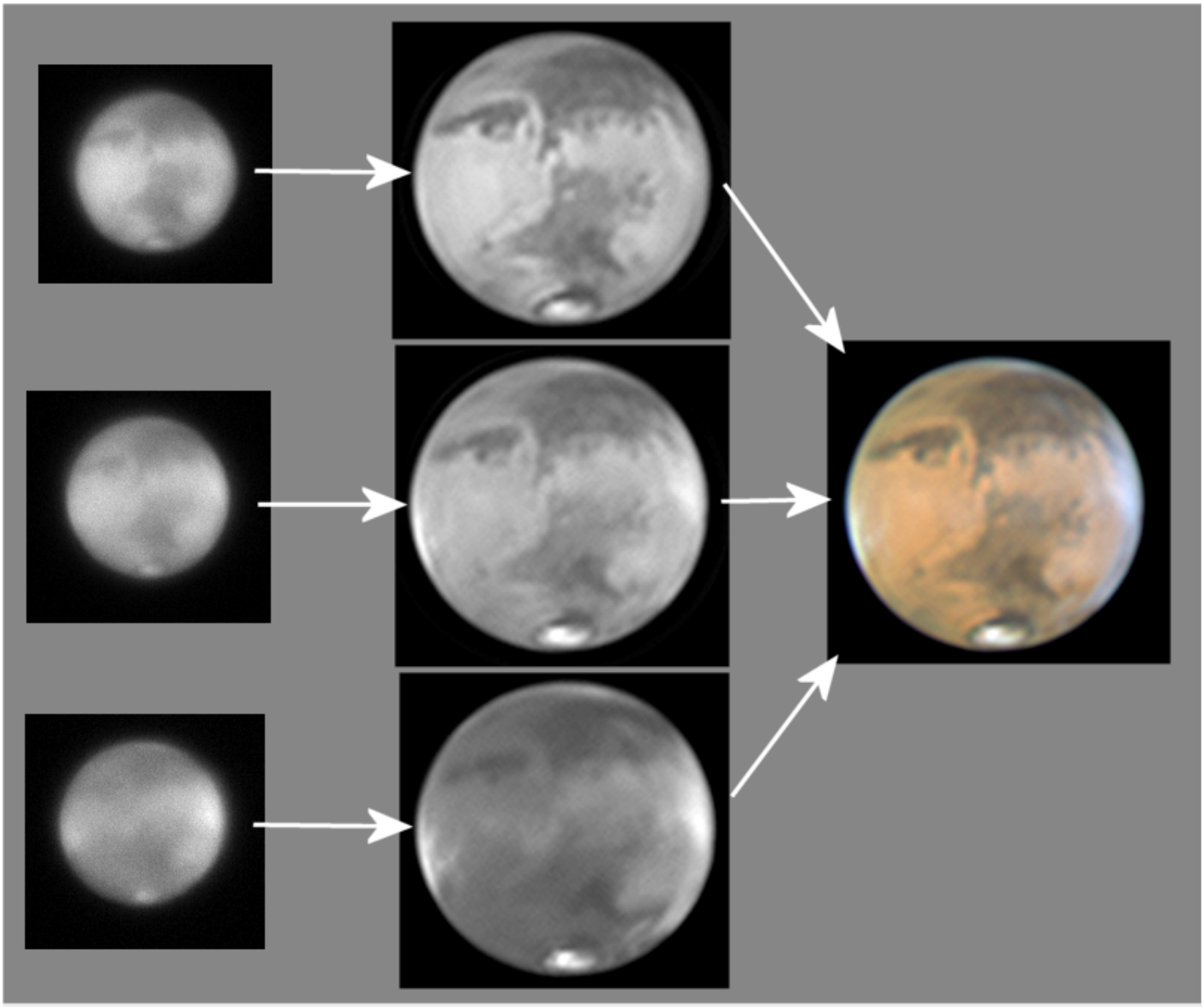

Mars in RGB on 2014 March the 13th... from raw frames to the final image.

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