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Cloud-fronts Activity on Mars in Northern Summer: A General Overview

By

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ISMO 2013/14 Mars Note (#01)

During the last 2013/14 apparition, we focused a great part of our interest to Mars on the observations of so-called "polar cyclones" near the north polar cap, popularized by the famous HST image taken on 28th April 1999 [1]. In 2014, amateurs gathered a great wealth of data that we are going to analyse on coming CMOs issues. Before going into details, this essay as the 1st 2013/2014 CMO/ISMO Note offers a general overview of the activity.

What are we talking about exactly ?

The "hurricane-like shape" must not conceal the exact nature of the activity. The topic is about white cloud fronts observed at the southern boundary of the north polar cap, over Baltia, north of Mare Acidalium. The most circular occurrences are not a different kind of activity: particular conditions or motions are going to produce this shape, but activity is the same.

Why do we see frontal activity there ?

Frontal activity on Mars happens under the same conditions that can be met on the Earth: At the boundary of two air masses having different temperatures, one cold, one warm, the circulation is not stable. Because the colder air is denser, it will soon develop a tendency to slip beneath the warmer air,

lifting it from the ground and raising up the humidity toward an altitude where it will condense into clouds. The limit between the two air masses becomes visible because of those clouds and this is why we see cloudy fronts.

On Mars, conditions north of Mare Acidalium are particular because of the topography, between the low plain of Acidalia and the higher Tharsis bulge. The ISMO/CMO publications had intensely talked about this as a storm zone responsible for many frontal dust activity observed during northern fall and winter, following scientific data published from Mars Global Surveyor (MGS) data [2]. The storm zone is still active during spring and especially summer, but conditions are different, and activity as well. During northern summer, winds are westward at the boundary of the residual summer cap, but flow eastward further south. As a

result, a "cyclonic gyre" exists there, allowing the mixing of cold polar air and warmer air found over Tharsis or Acidaliu [3].

At high resolution, it's generally easy to identify the cold front and the position of the low pressure. See Figure 1 for a comparison between the MGS and the Earth data.

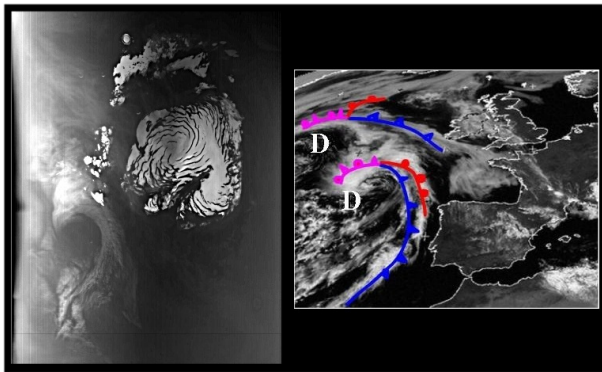


Figure 1: Blue light MGS image taken on 2nd March 2001 ($\lambda=125^\circ\text{Ls}$) at left, showing a curving front over Baltia. It's not possible to identify the different kind of fronts as in the terrestrial image at right (*blue*: cold front, *red*: warm front, *pink*: occluded front), but the position of the low pressure at the right end is obvious, with the same pointed-end shape. Earth image is (c) Wikipedia commons [4].

When do we observe such cloud fronts?

As it has been already said on previous CMO issues, frontal activity there is a phenomenon belonging to mid-northern summer on Mars. The seasonal first limit is around $\lambda=120^\circ\text{Ls}$ each Martian year (mid summer being at $\lambda=135^\circ\text{Ls}$). Nothing is observed before $\lambda=120^\circ\text{Ls}$, although frontal activity is active before summer solstice at $\lambda=090^\circ\text{Ls}$, but more in the dusty form [5]. The activity is therefore supposed to increase in strength, as the northern polar region is gradually advancing toward the fall equinox. $\lambda=135^\circ\text{Ls}$ is said to be another step, and from $\lambda=150^\circ\text{Ls}$, we may see dust fronts involved with white fronts, until the polar hood finally develop. It's not clear if the 2014 data will be good enough to see this, otherwise it will be one major

point of the following 2016 apparition.

How about the daily evolution?

Finally, we must say a few words about the evolution of the frontal activity during the Sol (the Martian day). Obviously, white cloud fronts are forming at the end of the night and are especially conspicuous during the first morning hours. As local time increases, the contrast of clouds is decreasing, showing a partial dissipation of clouds due to solar heating. Figure 2 compares the famous HST data of 28th April 1999, at morning and afternoon views.

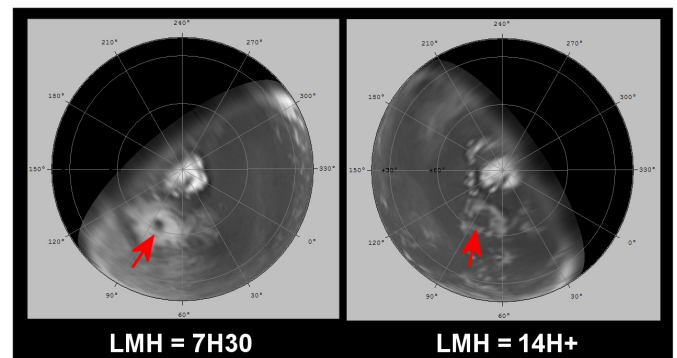


Figure 2: Circular cloud front observed by the HST in 1999 at $\lambda=130^\circ\text{Ls}$ (blue light images). The first image shows the feature at 7H30 AM in Local Martian Hour (LMH). On the second one, the same feature is observed at 2H PM in LMH. More than 6 hours later, it has noticeably lost contrast, but did not move that much. Images (c) Jim Bell/HST, map-projected by the author.

Apart of cloud dissipation, cloud movement is a debated question. Scientists say that even the circular shape does not rotate, in contrary to terrestrial forms. It's exact if we say that the circle shape is nothing more than a rolled-up front.

Detection of front movement during hours must happen however. Winds there are supposed to blow between 10 to 15 m/s (36 to 54 km/h). We will have to try to make measurements on images.

References

- [1] Refer to CMO n°416 & n°412
- [2] Refer to the author's talk at IWC MO in 2009: A REVIEW OF THE LAST MARTIAN DUST STORMS:

http://www.kwasan.kyoto-u.ac.jp/~cmo/cmomn5/2009Paris_Meudon_Talks_CPl.htm

[3] Huiqun Wang & Andrew P. Ingersoll, *Cloud-tracked winds for the first Mars Global Surveyor mapping year*, JOURNAL OF GEOPHYSICAL RESEARCH, Vol. 108, No. E9, 5110, doi:10.1029/2003JE002107, 2003.

[4] http://upload.wikimedia.org/wikipedia/commons/c/c0/Mapa_meteorologico_fr.jpg?uselang=fr

[5] H. Wang & A. P. Ingersoll, *Martian clouds observed by Mars Global Surveyor Mars*, JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 107, No. E10, 5078, doi:10.1029/2001JE001815, 2002.

CMO/ISMO 2013/14 Mars Report #14

2013/2014 Mars Observations in August 2014

♂.....Four months have passed since the time of the 2014 Mars opposition, and hence the planet in August moved forward from the Constellation Vir to the neighbour Lib. It passed by the planet Saturn in Lib on 27 August. The apparent declination was 13°S at the beginning of the month, while it went down to 19°S at the end (but vice versa went up on the Southern Hemisphere). The angular diameter was $\delta=7.9''$ down to $\delta=6.8''$ at the end of August. The central latitude moved from $\phi=21^\circ\text{N}$ up to 16°N : However the south polar cap (spc) did show merely the northern range. The phase angle was upto $i=43^\circ\sim 42^\circ$, and the north polar area became shadowy. The Martian season proceeded from $\lambda=170^\circ\text{Ls}$ to $\lambda=188^\circ\text{Ls}$, passing the northern autumnal equinox on 17 August. The southern dust season was coming, and Maurice VALIMBERTI (MVI) nicely detected a local dust on 27 August ($\lambda=185^\circ\text{Ls}$) near Hellas.

♂.....On the terrestrial Northern Hemisphere, the altitude of the planet at the sunset time was lower, and the observable season has entered to the final stage. No observation was from Europe, while the planet remained still at the evening sky seen from the Southern Hemisphere, and some important observations were made by MVI in Melbourne at the end of August. A total of 29 observations were received in August from no more than five members. One observer joined domestically, three observers in the US and Puerto Rico sent us 11 observations, and we received from MVI a total of 17 observations.

♂.....The following is a list of the observers who contributed this time:

MELILLO, Frank (FMI) Holtsville, New York, the USA

7 Colour Images (1, 5, 9, 14, 18, 24, 28 August 2014) 25cm SCT with a ToUcam Pro II

MORALES-RIVERA, Efrain (EMr) Aguadilla, PUERTO RICO

2 Sets of RGB Images (3, 11 August 2014) 31cm SCT with a Flea 3

MORITA Yukio (Mo) Hatsuka-ichi, Hiroshima, JAPAN

1 Set of RGB + 1 LRGB Colour + 1 L Images (17 August 2014) 36cm SCT with a Flea 3

PARKER, Donald (DPk) Coral Gables, Florida, the USA

2 Sets of RGB Images (7, 12 August 2014) 36cm SCT @f/24 with an ASI 120MM

VALIMBERTI, Maurice (MVI) Melbourne, AUSTRALIA

17 Sets of RGB + 17 IR Images (11, 14, 15, 21, 22, 25, ~30 August 2014)
36cm SCT @f/24 with an ASI 120MM

♂.....We shall now try to review shortly each observation in August chronologically as before:

On 1 August 2014 ($\lambda=171^\circ\text{Ls}$, $\delta=7.9''\sim 7.8''$)

Frank MELILLO (FMI) made a single colour image at $\omega=098^\circ\text{W}$ where the traces of Nilokeras and Solis L are checked near the preceding limb which looks whitish strong.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140801/FMI01Aug14.jpg>

3 August 2014 ($\lambda=172^\circ\text{Ls}$, $\delta=7.8''$)

Efrain MORALES (EMr) sent us a set of three-colour ingredients and the RGB image at $\omega=066^\circ\text{W}$. On the afternoon side the areas of M Acidalium on the north and Solis L on the south are visible. The north polar cap (npc) is no more explicit ($i=43^\circ$).

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140803/EMr03Aug14.jpg>

5 August 2014 ($\lambda=173^\circ\text{Ls}$, $\delta=7.7''$)

FMI obtained a single colour image at $\omega=059^\circ\text{W}$. M Acidalium now enters into the afternoon side. The area around Solis L is shadowy. The north polar area is whitish, and the southern limb is also a bit whitish.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140805/FMI05Aug14.jpg>

7 August 2014 ($\lambda=174^\circ\text{Ls}$ – 175°Ls , $\delta=7.6''$)

Don PARKER (DPk) produced a set of excellent images at $\omega=027^\circ\text{W}$. In R, in addition to the Aryn's nails, two spines of Sigeus Portus are nicely caught near the preceding limb. $\delta=7.6''$. Details of Brangæna, of the area of Oxia Palus, as well as of the southern part of M Acidalium are shown up. The areas of Oxus and Oxia are also well described with some complex patchy light areas. The zone between Oxus and the preceding shore of M Acidalium looks quite complex light in R and also in G and B. The minute *Oxus Dark Segment* looks to be checked. In G and B, a vapour-like misty streak stands southward from around the area of the npc and it curves down to the misty morning terminator. The npc however is not evident even in R. On the other side, the southern limb shows a thick covering by the white spc which may also cover a part of Argyre.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140807/DPk07Aug14.jpg>

9 August 2014 ($\lambda=175^\circ\text{Ls}$ – 176°Ls , $\delta=7.6''$ – $7.5''$)

FMI took a single colour image at $\omega=018^\circ\text{W}$. M Acidalium is dark near the morning terminator. Near the preceding limb, the traces of S Meridiani and the north end of S Margaritifer are suggested. The northern end is dull whitish.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140809/FMI09Aug14.jpg>

11 August 2014 ($\lambda=176^\circ\text{Ls}$ – 177°Ls , $\delta=7.5''$)

EMr took a set of ingredient images at $\omega=000^\circ\text{W}$. Sabæus S is rather evident and near the preceding limb Syrtis Mj is faintly checked in a bluish tint. Near the other terminator M Acidalium is caught. The npc is not evident but from around the npc area a whitish misty band extend to the morning side to the north of M Acidalium (also in R, not so thick in G and B). The area also suggests a presence of a white mist, but at the preceding area of M Acidalium suggests a rather brownish colour (maybe free from the mist).

Maurice VALIMBERTI (MVI) obtained a set of R, G, B, IR, and RGB images at $\omega=123^\circ\text{W}$. MVI was absent for a while and his last one was made on 5 June. Near the preceding limb, the area from

Nilokeras to Solis L looks shadowy. The southern limb shows a dull whitish layer, but no trace is visible in R and IR, so that it is hard to say it's a consequence of the spc. However in G and B it is suggested a mist expansion down to the north of the (plausible) spc.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140811/EMr11Aug14.jpg>

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140811/MV111Aug14.jpg>

12 August 2014 ($\lambda=177^\circ\text{Ls}$, $\delta=7.5''\sim7.4''$)

DPk gives also a good set of images at $\omega=352^\circ\text{W}$. Sabæus S and Meridiani S are completely inside the disk, and Syrtis Mj is dark near the preceding limb. The curved band from Sabæus S via M Serpentis to Hellespontus is explicitly dark, and its eastern limb side may show the area of Hellas, but it is never white. However the southern limb looks governed by the white spc. On the other side, the northern limb side looks whitish, maybe covered by a dull mist which also extends upto the morning terminator. In R the npc may be caught but not so explicit. Since the season is near $\lambda=180^\circ\text{Ls}$, most part of the npc is now under the polar night.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140812/DPk12Aug14.jpg>

14 August 2014 ($\lambda=178^\circ\text{Ls}$, $\delta=7.4''$)

MVI obtained two sets of images including an IR image at $\omega=092^\circ\text{W}$ and at $\omega=098^\circ\text{W}$. Both give a telling description at around Solis Lacus, Agathodæmon, Tithonius Lacus and so on. Ophir-Candor is light. These are evident in RGB thanks to the R image. They are also clearly shown on IR. Tharsis Montes remain visible as dark spots. Mare Acidalius is well seen near the preceding limb. To its north, there seems to exist a white mist which is connected with the arctic misty area. No explicit presence of the npc. The southern limb also shows a whitish layer, but it does not give further clear view.

FMI gives a single colour image at $\omega=316^\circ\text{W}$. Syrtis Mj is dark and its preceding area is misty white. The southern limb is also a bit whitish.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140814/MV14Aug14.jpg>

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140814/FM14Aug14.jpg>

15 August 2014 ($\lambda=178^\circ\sim179^\circ\text{Ls}$, $\delta=7.4''\sim7.3''$)

MVI gave two sets of images as before at $\omega=090^\circ\text{W}$ and $\omega=095^\circ\text{W}$. The areas from Solis L to Auroræ Sinus are well shown up. Ophir-Candor is light. The lying M Acidalius is near the preceding limb. The southern limb layer is a bit light. The arctic area is light in B but very dull in R and IR. The last set gives a set each of whose components looks a bit inferior due to the lowering of the planet.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140815/MV15Aug14.jpg>

17 August 2014 ($\lambda=180^\circ\text{Ls}$, $\delta=7.3''$)

Yukio MORITA (Mo) gives a set of images (R, G, B, L, and RGB and LRGB) at $\omega=094^\circ\text{W}$. The season finally reached $\lambda=180^\circ\text{Ls}$, and hence the half of the npc must be at the polar night. The images in LRGB and RGB look a bit rough due to the procedure, but the R image shows Solis Lacus, Tithonius Lacus, Auroræ Sinus, the northern part of Margaritifer Sinus and so on. Ophir-Candor is light. Some details of Nilokeras to Mare Acidalius are visible. In B, a preceding part of the npc area is light as well as at the morning part following the southern limb.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140817/Mo17Aug14.jpg>

18 August 2014 ($\lambda=180^\circ\text{Ls}$ ~ 181°Ls , $\delta=7.3''$ ~ $7.2''$)

FMI gives a single colour image with the three decompositions at $\omega=278^\circ\text{W}$. However these decompositions have no positive meaning, especially the B component where Syrtis Mj is very dark, due to the ultra-penetration of the IR light.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140818/FMI18Aug14.jpg>

21 August 2014 ($\lambda=182^\circ\text{Ls}$, $\delta=7.2''$ ~ $7.1''$)

MVI obtained an excellent set of images including IR at $\omega=033^\circ\text{W}$. On R, Sinus Meridiani is definite near the preceding limb, and Oxia Palus is dark. The Oxus canal is also explicit. In B, an arctic misty cloud is visible reaching deeply the inside of M Acidalium, also depicted on the RGB. M Acidalium shows so a striped pattern. The thin whitish layer at the southern limb is explicit.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140821/MVI21Aug14.jpg>

22 August 2014 ($\lambda=182^\circ\text{Ls}$ ~ 183°Ls , $\delta=7.1''$)

MVI gives another excellent set at $\omega=014^\circ\text{W}$. Aryn's nails now are quite inside. A small but bright dusty spot is visible adjacently following Oxia Palus, seen in R and IR. The arctic cloud band which invades upto an inside area of M Acidalium is located a bit easterly compared with the preceding day position, and very brighter in B.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140822/MVI22Aug14.jpg>

24 August 2014 ($\lambda=184^\circ\text{Ls}$, $\delta=7.1''$ ~ $7.0''$)

FMI gives a single colour image at $\omega=217^\circ\text{W}$ where the northern limb is whitish light. (Other decompositions have no positive meaning.)

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140824/FMI24Aug14.jpg>

25 August 2014 ($\lambda=184^\circ\text{Ls}$ ~ 185°Ls , $\delta=7.0''$)

MVI gives two sets of images at $\omega=339^\circ\text{W}$ and at $\omega=346^\circ\text{W}$ (the former is also associated with an IR image). Syrtis Mj is quite inside the disk. The former images show that Sabæus S is connected with Hellespontus, and Hellas near the preceding limb is light in R but not so much in B. The images taken about 30 minutes later are inferior.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140825/MVI25Aug14.jpg>

26 August 2014 ($\lambda=185^\circ\text{Ls}$, $\delta=7.0''$)

MVI gives a set of images including an IR image at $\omega=333^\circ\text{W}$. The time is between the times of the first image set and the second one on the preceding day. Syrtis Mj is further inside, while the seeing is inferior to the preceding one. On the IR, Hellespontus looks to extend to Depressiones Hellesponticæ which is normal, and hence it is judged that the northern perimeter of the spc receded to around 65°S .

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140826/MVI26Aug14.jpg>

27 August 2014 ($\lambda=185^\circ\text{Ls}$ ~ 186°Ls , $\delta=7.0''$ ~ $6.9''$)

MVI gives a set of images including IR at $\omega=324^\circ\text{W}$. Syrtis Mj now shows the whole aspect. Hellas does not give the impression that it is quite inside, but a dust patch appears to have arisen from the NW perimeter of Hellas or from its outside. This is also inspected on the IR image. The icy aspect of

Hellas must have been resolved from around $\lambda=160^\circ\text{Ls}$, and so the ground surface of the bottom must have been exposed. However it should be noticed that the pressure at the bottom is high enough to prevent the dusty matters at the bottom from reaching the upper atmosphere. Thus this must be a kind of dust disturbance near at or outside the perimeter of the Hellas basin (unfortunately the MRO-MARCI weather data were unsuccessful on these days). In 2001, as a rare case, an important dust disturbance occurred at Hesperia at $\lambda=184^\circ\text{Ls}$ (on 24 June 2001), and therefore we should pay our careful attention to these areas at this season.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140827/MVI27Aug14.jpg>

28 August 2014 ($\lambda=186^\circ\text{Ls}$, $\delta=6.9''$)

MVI tried to take two sets at $\omega=312^\circ\text{W}$ and at $\omega=320^\circ\text{W}$ including IR images. The first image set is excellent, and shows that a dust patch is reborn near Yaonis Regio but it is now apparent that it is located outside Hellas as seen on R and IR (furthermore on the B image). This is also checked on the following image set, but the seeing deteriorated.

FMI shows a single colour image at $\omega=177^\circ\text{W}$ where some shadows are still visible.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140828/MVI28Aug14.jpg>

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140828/FMI28Aug14.jpg>

29 August 2014 ($\lambda=186^\circ\text{Ls}\sim 187^\circ\text{Ls}$, $\delta=6.9''$)

MVI gives two sets at $\omega=302^\circ\text{W}$ and at $\omega=307^\circ\text{W}$. The local dust patch in question is more apparent, but does not yet invade Hellespontus (or M Serpentis) and is quite local. The seeing condition is above average, and the details of the northern part of Syrtis Mj are well shown. This time the second set also gives nice images. The arctic area is misty in B.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140829/MVI29Aug14.jpg>

30 August 2014 ($\lambda=187^\circ\text{Ls}\sim 188^\circ\text{Ls}$, $\delta=6.9''$)

MVI checked at $\omega=296^\circ\text{W}$ and at $\omega=304^\circ\text{W}$. The second set was taken at a similar angle to the angle $\omega=302^\circ\text{W}$ on the preceding day, but the condition turned out to be poorer. The dust looks to imitate the status on the preceding day, though the present images may suggest a diffusion of dust. As the images, those at $\omega=296^\circ\text{W}$ are preferable. As the IR image shows, the dust does not yet look to invade Mare Serpentis.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140830/MVI30Aug14.jpg>

N.B. Unfortunately there is no report on 31 August. As September set in, **MVI** tried still to chase the dust while the weather must have been dismal for a few days: The next image was taken on 4 September by **MVI**, when however the angle in question was unfortunately away.

Masatsugu MINAMI & Masami MURAKAMI

Letters to the Editor

●.....Subject: Re: Mars 30 September
Received: 1 October 2014 at 03:56 JST

Good evening Gents, I imaged yesterday evening, but the seeing was very bad, and the resultant

image was very poor, so I did not send through. This evening the seeing was a bit better, although not ideal. As always any comments on the visible detail would be welcome. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140930/CFs30Sept14.jpg>

○...**Subject: Mars 4 October**
Received: 5 October 2014 at 03:22 JST

Good evening Gents, Conditions not too bad this evening, after some poor weather conditions. I will have a little celebration if I can get a reasonable first image below 6" :-) Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141004/CFs04Oct14.jpg>

○...**Subject: Mars 5 October**
Received: 6 October 2014 at 03:32 JST

Good evening Gents, My apologies for the poor color balance on my RGB- processing was a bit of a challenge this evening and still got plenty to learn. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141005/CFs05Oct14.jpg>

○...**Subject: Mars 6 October**
Received: 7 October 2014 at 03:02 JST

Good evening all, I have just started processing my images for this evening and noticed that there appears to be a bright area in the Niliacus Lacus region as well as possibly a second one towards Cydonia on my RED image. I will process the other channels to produce my RGB which I will send through later, but thought this may be of interest. Best regards

○...**Subject: Mars 6 October - POSSIBLE BRIGHT(RED CHANNEL) AREAS IN NILIACUS LACUS AND CYDONIA REGIONS**
Received: 7 October 2014 at 03:06 JST

Sorry, I should have highlighted this issue in my previous subject heading

○...**Subject: RE: Mars 6 October - BRIGHT AREAS IN NILIACUS LACUS AND CYDONIA REGIONS**
Received: 7 October 2014 at 04:58 JST

Hi all, Kindly find attached image for this evening. As noted earlier, there appears to be two fairly bright areas, showing well in the Red channel, but also visible in the IR and G (less so for Cydonia) channels. One in the Niliacus Lacus region and the other towards Cydonia region. I've only seen anything like this in my July dust storm images, but would appreciate any views or other interpretation.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141006/CFs06Oct14.jpg>

○...**Subject: RE: Mars 6 October - BRIGHT AREAS IN NILIACUS LACUS AND CYDONIA REGIONS RGB Rev1**
Received: 7 October 2014 at 05:31 JST

Hi all, Apologies for repeated e-mails, but I had a look at re-processing the RGB with a bit of assistance from my son, who is more skilled in Photoshop than I am, to try and get a better colour balance. Result attached as Rev 1.

○...**Subject: RE: Mars 6 October - BRIGHT AREAS IN NILIACUS LACUS AND CYDONIA REGIONS RGB Rev2**
Received: 7 October 2014 at 06:05 JST

Hi all, In amongst all the processing, I didn't update the date on my final image. Kindly find (hopefully) final version (Rev 2) for the evening with the correct date. Apologies for all the e-mails- been a busy evening. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141006/CFs06Oct14.jpg>

○...**Subject: Re: Mars 6 October - BRIGHT AREAS IN NILIACUS LACUS AND CYDONIA REGIONS RGB Rev2**
Received: 7 October 2014 at 15:53 JST

Hi All, I did a quick comparison across the two previous evenings. Not 100% sure, but it looks like there may have been a slight development already on the 5th October as indicated.



Comments welcome. Best regards

○...**Subject: Mars 7 October**
Received: 8 October 2014 at 02:57 JST

Hi All, Attached image from this evening. Central

storm looks like it has expanded and is dissipating. Not sure about the bright area near Cydonia from yesterday. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141007/CFs07Oct14.jpg>

○...**Subject: Mars 8 October**
Received: 9 October 2014 at 03:10 JST

Hi All, Attached image from this evening. Apologises for the greenish edge. Didn't have a lot of time to process this evening. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141008/CFs08Oct14.jpg>

○...**Subject: Mars 11 October**
Received: 12 October 2014 at 05:18 JST

Hi All, Attached image from this evening. There was a slight gap in the bad weather we have had over the last few days, and I just managed to capture between clouds, and in windy conditions. Seeing conditions were very poor and it was almost impossible to get any reasonable focus on the G and B channels. No apparent indication of anything out of the ordinary, as far as I can see. Mars is now below 6". Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141011/CFs11Oct14.jpg>

○...**Subject: Mars 12 October**
Received: 13 October 2014 at 02:51 JST

Good evening all, Better conditions this evening
Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141012/CFs12Oct14.jpg>

○...**Subject: Re: Mars 12 October**
Received: 13 October 2014 at 04:03 JST

Hi, Marc. My intent is to continue imaging, as long as I can still achieve "reasonable" (useful?) images, so yes, I hope to capture images during the comet "flyby" period. We are not having very good weather conditions at present, so this my impact on what I can do. Best regards, clyde

Sent via my BlackBerry from Vodacom - let your email find you!

○...**Subject: Mars 14 October**
Received: 15 October 2014 at 03:27 JST

Good evening all, Fairly good conditions again tonight. Hellas prominent. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141014/CFs14Oct14.jpg>

○...**Subject: Mars 15 October**
Received: 16 October 2014 at 05:53 JST

Good evening all, Unfortunately, poor seeing conditions this evening, and only able to capture between intermittent cloud. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141015/CFs15Oct14.jpg>

○...**Subject: Mars 17 October - POSSIBLE DUST ACTIVITY**
Received: 18 October 2014 at 03:12 JST

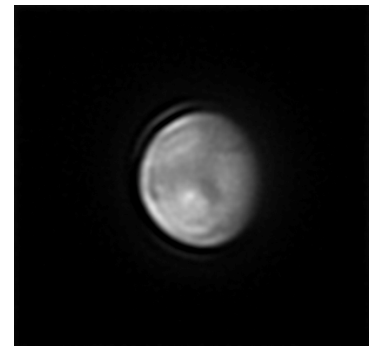
Good evening all, I suspect dust activity in the Libya/Osiris region, showing best in the red channel image, although also bright in RGB. Any comments welcome. Some detail visible in Hellas (Peneus and Zea Lacus?). Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141017/CFs17Oct14.jpg>

○...**Subject: Mars 17 October - POSSIBLE DUST ACTIVITY IN LIBYA/OSIRIDIS REGION?**

Received: 19 October 2014 at 01:48 JST

Hi Padma, I think I can confirm there is a dust storm in Libya region. Have just processed the red channel from this evening (attached). Will complete the others shortly. Regards



○...**Subject: Mars 18 October - DUST STORM ACTIVITY**
Received: 19 October 2014 at 04:42 JST

Good evening all, I can confirm development of dust storm in the Libya/Osiris region. There appears to have been two "cells" which were indicated yesterday. The southern cell certainly seems to have intensified somewhat. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141018/CFs18Oct14.jpg>

○...**Subject: Re: Mars 18 October - DUST STORM ACTIVITY**
Received: 19 October 2014 at 22:18 JST

Thanks for the comments Christophe. It has been pointed out to me that there is sometimes a bright area in the Osiris region (right up against Syrtis Major), which may account for the 2nd bright area (more northern). I am hoping to image this evening and see if there are any further developments. Best regards,

Sent via my BlackBerry from Vodacom - let your email find you!

○...**Subject: Re: Mars 19 October**

Received: 20 October 2014 at 05:03 JST

Good evening all, It looks to me that the Libya bright area has dissipated somewhat. One change to note from yesterdays image is the light extension from the northern side of Hellas towards the terminator (Iapygia region?). This gives Hellas a flattened "Q" shape as against the flattened "O" shape of yesterday. As this is my first apparition, and I am seeing areas that I have not observed previously, any comments are welcome.

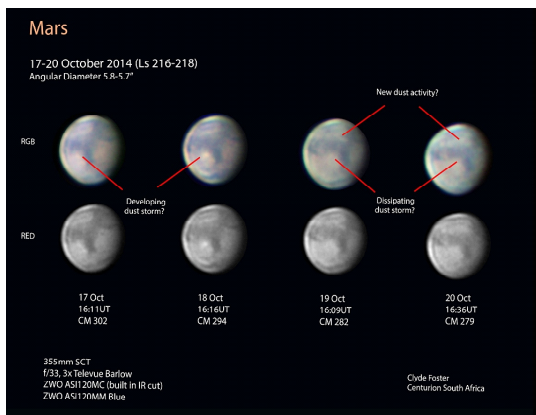
Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141019/CFs19Oct14.jpg>

○...**Subject: Mars 20 Oct-POSSIBLE DUST ACTIVITY IN IAPYGIA**

Received: 21 October 2014 at 04:20 JST

Good evening all, Kindly note that the subject of my e-mail yesterday evening should have been Mars 19 October and not Mars 18 October. It appears that the activity in the Iapygia region has expanded somewhat, although I am hesitant to make any absolute comments (you will note that there are a few question marks..... :-). Conditions were poor this evening due to me imaging a bit later than normal (I had a few camera problems).



I have also done a mosaic of the last 4 evenings just to get a feel for the changes taking place.

Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141020/CFs20Oct14.jpg>

○...**Subject: Re: Mars 20 Oct -POSSIBLE DUST ACTIVITY IN IAPYGIA**

Received: 21 October 2014 at 13:29 JST

Thanks for the comments Jim. I note that the "bright" areas that you mention also seem to show in the green channel image, although the activity in the Iapygia region shows as two possible "cells" in

the green image. Any comments on interpreting this? My previous dust storms showed bright in red, and to a lesser extent in green (but still clearly shown). Have attached the same image for easy reference. Interesting, and will certainly try and capture more images over the next few evenings.

Best regards

○...**Subject: Mars and bad weather on Earth**
Received: 25 October 2014 at 14:15 JST

Hi all, Just a quick update as you may have noticed I have been quiet for a few days. We have been having beautiful warm clear days, but as we move towards the end of the day, clouds move in with thunderstorms and high wind. Although I monitor for gaps, the conditions are exceptionally poor (I did some captures on the 22 Oct between storm clouds, but the result was very poor). As soon as I am able to get back up and going, I will do so. Best regards and have a great weekend

○...**Subject: RE: Mars and bad weather on Earth**
Received: 25 October 2014 at 14:25 JST

Hi all, I may be getting a bit imaginative, but just over a week ago, we had a very unusual (for this region) dust storm in Gauteng, South Africa. I went out for supper with my son, and when we came out after our meal we could see and smell the dust in the air, and it left a fine layer over everything. It was quite surreal. It was exceptionally fine, and from the fine dust seen in many Mars rover images, I can just imagine this type of condition occurring on Mars. A few years ago I landed in Dubai and the same afternoon a huge dust storm came over the city- very impressive to watch as it came in, but likely "small" compared with what we are seeing on Mars! Best regards

○...**Subject: Mars 25 October- RED ONLY**
Received: 26 October 2014 at 02:48 JST

Good evening all, Our poor weather conditions are continuing, although we do need the rain! During twilight, there were some small gaps in the clouds, and I JUST managed to capture a 90s red avi. By the time I switched to green, I was clouded over. I am thinking if its not best to try the colour camera

under these conditions..... I don't think the red image came out too badly, so am circulating for information anyway. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141025/CFs25Oct14.jpg>

○...**Subject: RE: CMO/ISMO updated**
Received: 26 October 2014 at 13:53 JST

Dear Masami and Masatsugu, Thank you very much for the latest CMO/ISMO. It is exciting and very encouraging, as a new Mars imager and observer, for me to see your comments. Thank you for taking the time to annotate the images. In the LtE I was particularly moved by the comments of Reiichi KONNAI. Please can you confirm what the title is of (Mr/Mrs/Dr?) KONNAI? If possible can you provide me with the e-mail address as I would like to thank him (her?) personally for the comments. Further, am I able to "copy and paste" sections of the CMO/ISMO/LtE for circulation/communication/ presentation purposes? I would of course always mention where the content has come from, and credit the CMO/ISMO accordingly.

Best regards

○...**Subject: Mars 26 October**
Received: 27 October 2014 at 02:48 JST

Good evening all, Finally got a break in the weather, with reasonable conditions. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141026/CFs26Oct14.jpg>

○...**Subject: Mars 26 October**
Received: 27 October 2014 at 02:48 JST

Good evening all, Images from this evening.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141027/CFs27Oct14.jpg>

○...**Subject: Mars 28 October**
Received: 29 October 2014 at 03:08 JST

Good evening all, Images from this evening. I also took a couple of quick pics of the observatory while I was imaging, as I thought you may be interested



in my backyard setup- my "hideaway" after a tough day in the office.....!! As you can see it was still quite light and Mars is still at a reasonably good

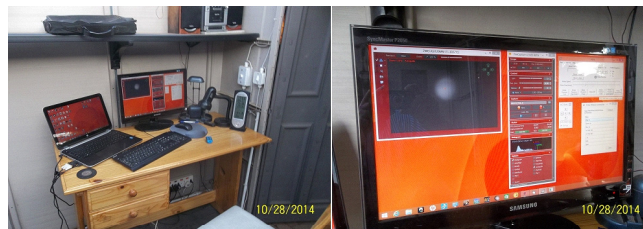
elevation. Will send a few more in a following e-mail, due to the size. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141028/CFs28Oct14.jpg>

○...**Received: 29 October 2014 at 03:19 JST**

Hi all, A couple of more images of the observatory. Apologies for the large size.

Best regards



○...**Subject: RE: RE: Mars and bad weather on the Earth**
Received: 29 October 2014 at 04:14 JST

Dear Masatsugu, Thank you very much for your e-mail and the anecdotes. I will definitely respond when I have a little more time and can respond properly! Best regards

○...**Subject: Mars 28 October**
Received: 30 October 2014 at 03:27 JST

Good evening all, Images from this evening. Unfortunately rather poor conditions. Blue channel very difficult to capture. Best regards

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141029/CFs29Oct14.jpg>

Clyde FOSTER (Centurion, SOUTH AFRICA)

●...**Subject: Updated Mars Alerts and Recent ...**
Received: 1 October 2014 at 07:12 JST

Hi folks, See Alerts and Recent Observations. Comments or questions always welcome. Thanks

<http://www.alpo-astronomy.org/marsblog/observing-alerts-recent-observations/>

○...**Subject: Re: Mars 20 October - POSSIBLE DUST**
Received: 21 October 2014 at 08:05 JST

Thanks for the Mosaic Clyde! I'm concentrating on your red image on Oct. 20 that shows numerous 'bright spots over most of Mare Tyrrhenem compared with the Oct 19 image. From my experience with planetwide or global dust storms, they start spontaneously as individual dust clouds and then coalesce. Yes, I think that is a large dust cloud in Iapygia. This is really getting interesting! Let's see what happens. Good seeing,

○...**Subject: Mars highlights page updated**
Received: 30 October 2014 at 06:08 JST

Hi everyone, Please see

<http://www.alpo-astronomy.org/marsblog/2013/10/20/201112-features-observations/>

Comments or questions most welcome.

Good seeing,

Jim MELKA (Chesterfield, MO)

●.....*Subject: Mars 29th September 2014*

Received: 1 October 2014 at 20:37 JST

Attached are three sets of Mars images taken on the 29th September in average seeing. Please excuse the blue colour cast of the RGB in the first two sets as these were taken 20min before sunset, and at sunset respectively. This made colour balance difficult as the sky was still very bright at this time.

Best wishes

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140929/MV129Sept14.jpg>

○.....*Subject: Mars 5th October 2014*

Received: 5 October 2014 at 20:16 JST

Attached is an image set of Mars taken this evening in poor seeing conditions. NW Hellas appears a little bright as does the NE Limb of Mars.

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141005/MV105Oct14.jpg>

○.....*Subject: Mars 20th October 2014*

Received: 20 October 2014 at 21:08 JST

Unfortunately, the seeing here in the early evenings has been very poor, and appears to be getting worse as our seasons change. Attached is an image of Mars taken this evening in poor seeing. Electris appears to be very bright in the R filter and also prominent in G & IR... I could not resolve any details visually due to the poor seeing conditions.

Best wishes

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/141020/MV120Oct14.jpg>

Maurice VALIMBERTI

(Melbourne, AUSTRALIA)

●.....*Subject: Re: Mars 6 October - BRIGHT AREAS IN ...Received: 7 October 2014 at 06:30 JST*

Hi Clyde, It looks like a cross-equatorial storm to me, common at this martian season. Please try to get more images :)

○.....*Subject: Re: Mars 6 October - BRIGHT AREAS IN NILIACUS LACUS AND CYDONIA REGIONS RGB Rev2*

Received: 8 October 2014 at 06:08 JST

Hi Padma, It could be interesting yes. Although I

think Clyde is going to cover it by himself ;)

○.....*Subject: Re: Mars 18 October - DUST STORM ACTIVITY IN LIBYA/OSIRIDIS REGION*

Received: 19 October 2014 at 18:34 JST

Very interesting Clyde, A storm probably identical to that observed in July 2003 when activity crossed the martian equator through Isidis planitia and triggered an active regional storm around Hellas/Syrtis Major. Let's see how it behaves on the following days!

Christophe PELLIER (Nantes, FRANCE)

●.....*Subject: Re: Mars 6 October - BRIGHT AREAS IN*

Received: 7 October 2014 at 15:51 JST

Dear Clyde, Many thanks and this is without doubt a storm over Chryse Planitia. Similar events occurred at similar seasons in the past and it is only unusual to have caught one from Earth upon such a tiny disk! Those in 1954 and 1990 were particularly well documented in the past, for example, in the pre CCD days, and there have been other events since then. Such events can achieve regional but not encircling status. Do keep up the excellent work!

Many thanks,

Richard McKIM (Peterborough, The UK)

●.....*Subject: Mars observation Sept 23*

Received: 9 October 2014 at 15:32 JST

Dear Mr. Minami, I hope you are well. Please find attached a Mars observation I made on the 23rd September, apologies for the delay in getting it to you. Again I am not seeing very much detail, but I still hope the images are useful to you. All the best,

<http://www.kwasan.kyoto-u.ac.jp/~cmo/cmons/2013/140923/DWd23Sept14.jpg>

David WELDRAGE (NSW, AUSTRALIA)

●.....*Subject: From bill sheehan: book*

Received: 10 October 2014 at 23:29 JST

Dear Masatsugu, Chris Conselice of U of Nottingham and I have published a book, "Galactic Encounters"--not Mars, exactly, though one chapter discusses Percival Lowell and Slipher. If you or one of our CMO/ISMO colleagues would like to review it, I can see if Springer can send a complimentary re-

view copy. Also I will need the address to which it must be sent. Kind regards,

○····Subject: *The Way to Noto*

Received: 12 October 2014 at 10:08 JST

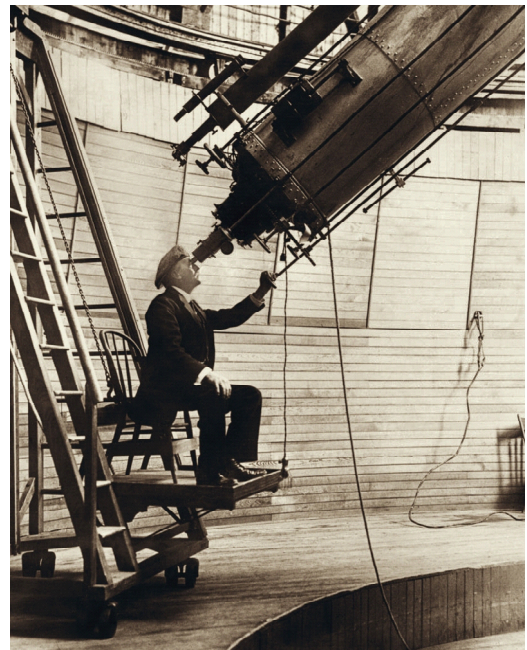
Dear Masatsugu, After hearing of the eruption of Mt. Ontaké, I located the photo album with images I took of the sacred mountain while traveling with you and Asada. I have some good images. I also looked up the day-book I kept while on that journey, and realized it has been ten years already since we traveled the Lowell route to Noto. I am going to transcribe some passages for the CMO/ISMO, so that will be my next contributed essay. ···· It really was the adventure of a lifetime traveling with you in Japan and I am very glad I took such detailed notes, as otherwise I would have only remembered but a little. Atrocious how fallible is the human memory! Meanwhile, I am still hoping your health improves enough so you can visit Lowell Observatory in 2015 or 2016. It would not be right for a Mars observer as diligent and gifted as your good self not to visit Flagstaff of all places! Of course, we will wait on events. Best wishes,

○····Subject: *A hundred years ago tomorrow*

Received: 18 October 2014 at 01:07 JST

Dear Fellow Martians and other planetary enthusiasts, When I was last at Lowell Observatory, I was able to establish that the attached photo -perhaps the most iconic in planetary astronomy- was taken by Philip Fox on October 17, 1914 - in other words, a century ago tomorrow. (Also a Saturday). Based on the position of the telescope, etc., I really think that Lowell was observing Venus as the caption says, in which case it would appear that Lowell, like Tycho, usually observed in sartorial splendor, rather than informally and for comfort as later astronomers have been wont to do. I find that Venus crossed the meridian in Flagstaff at an altitude of 28.4 degrees, at 3:54 pm (local time). It was then 30% phase. I would assume, without indulging in much more detailed investigations, that this would have been close to the time the photo was taken. Please join me in celebrating (or at least noting) this

remarkable moment in time, frozen forever in time in this iconic image. Best,



○····Subject: *FW: A hundred years ago tomorrow*

Received: 18 October 2014 at 01:18 JST

Dear colleagues, Embarrassed to say I was off a day. Today is Oct. 17, and so today-not tomorrow- is the centennial of the Lowell photo. But all of you knew that! Best,

○····Subject: *Re: For CMO/ISMO essay*

Received: 18 October 2014 at 04:04 JST

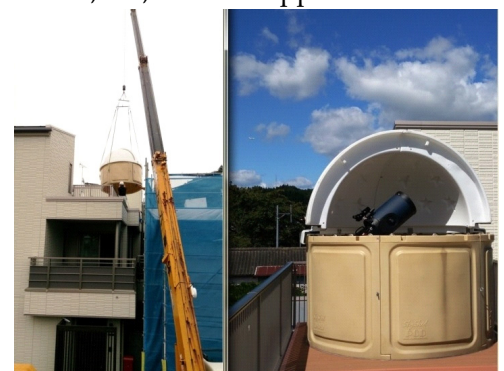
Dear Masatsugu, ····I shall tackle the important subject of W. H. Pickering. All the best, P.S. Could you gauge for me Reiichi KONNAI's interest in coming to Flagstaff for an event in 2016? I have still not given up hope you can attend too.

Bill SHEEHAN (Willmar, MN)

●····Subject: *Stars of Hope*

Received: 18 October 2014 at 01:23 JST

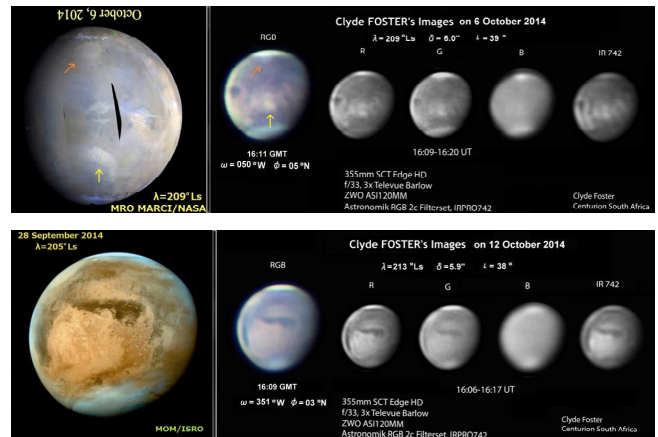
Dear Dr. Minami, all, In this apparition I hadn't been able to observe Mars since the last June because of the construction of our new dental clinic/house/observatory. And when my



Personal Observatory Dome and the MEADE LX-200-30ACF (305mm SCT) were crane lifted and moved onto the rooftop terrace of our new house, Mars was already dipping beneath the south-western mountain range in the late afternoon when our clinic closed. It was most regrettable that my observation of Mars in this opposition have ended up halfway....in the last 2011/12 apparition I had visually chased the red planet up until 05 August 2012 when it was as small as 5.7" across, almost disappearing behind the western mountain ridge!

Southern hemisphere observers' unyielding focus on the retreating Mars is most applaudable. Please find attached a montage comparing C. FOSTER's ground-based image with one by the MRO/MARCI taken on the same day 6 Oct 2014. Note the prominent regional dust over Xanthe (yellow arrowed) explicitly shown either on the ground based image and on the probe's one, just looks like a cross-equatorial storm common in this Martian season as Ch. PELLIER suggested in his LtE dated 6 Oct 2014. Moreover classical "Mons Argenteus", a whitish inverted triangular spot just north off almost touching the SPC border often observed around this Martian season, is just discernable on FOSTER's image (red arrowed). As shown on the MRO image, it may be inferred that the Argyre Planitia and the northern adjoining lower flatter area in Nereidum Montes collectively looks as a bright inverted triangle patch

(also red arrowed). Refer to M. MINAMI's 2001 Mars CMO Note #12 Mons Argenteus (CMO #266) : <http://www.kwasan.kyoto-u.ac.jp/~cmo/cmohk/266Note12/index.html>



Also attached here is a montage consists of FOSTER's complete set of images on 12 Oct 2014 and the similar angle image by MOM/ISRO taken some two weeks before. Note the Indian probe's exquisite image shows a good match with the FOSTER's ones: fully exposed SPC, bare Hellas, NPH, and the familiar albedo markings as well. It is quite encouraging that those large scale Martian meteorological phenomena can be recorded by our colleague observers still pursuing that tiny waygoing red planet! May our Stars of Hope in the southern hemisphere go on shining through the future apparitions! Best Regards,

Reiichi KONNAI (Fukushima, JAPAN)



International Society of the Mars Observers (ISMO)

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CMO #428/ ISMO #54 (25 November 2014)

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