Venμs geometrical issues (solved)

As you probably know, Venμs is a an ambitious micro satellite, but still a micro satellite. It means for instance that, for cost and weight reasons, It cannot use the most accurate sensors to determine the satellite attitude as a function of time. Venμs does not have gyroscopes to monitor finely the orientation movements of the platform, but just reaction wheels to control the orientation of the satellite and star sensors to determine the orientation. When we obtained the first images, we figured out that despite the error budgets made before the launch, the quality of attitude auxiliary data were not sufficient to ensure an accurate registration of Venμs spectral bands. After a long period of tests and improvements of the attitude data filtering, CNES teams found out that the only way to obtain an accurate enough registration performance was to use image matching techniques to determine the attitude movements of the satellite.

This has been done through the successive versions of the Level 1C processing. However, all the landscapes observed by Venμs do not allow to obtain accurate results. Icy fields and water lack structure to match similar neighbourhoods from the images of the various spectral bands. Similarly, we are not able to use clouds as their altitude and motion is not known. And finally, sometimes, the platform movements are simply too irregular so that we can estimate them accurately. This results in some variability of the performances of the spectral band registration, and of the multi-temporal registration. As we do not know exactly the user priorities, we will provide all the images that we can match to the reference images, regardless of the registration performance obtained. But we will let you select the images you want to use via the use of two performance estimates, which are provided in the Quality Index fields of the header (HDR) of Level 1C products.

Regarding geometry, Venμs L1C processes data in two steps :

- A multi-temporal registration, where each image is compared to a reference image. Only the images with cloud free patches can be registered during this phase, which discards about 50% of the images
- A multi-spectral registration phase, which computes the variations of attitude. Up to now (V 0.9) only a few products survived this phase, and with version 1.0, the proportion will increase, as all products will be delivered, whatever the quality of their registration.

How to check the geometric quality

The two fields to check are provided in the Quality Index section (fields N°13 and N°18)

- IMAGE_RESIDUES_REFIMG

=> This index is useful for estimating the accuracy of the multitemporal registration. It provides a statistical error on the registration of the current image on the reference image, expressed in meter (here 1.29 m).

```
<Quality_Index sn="13">
   <Code>IMAGE_RESIDUES_REFIMG</Code>
   <Value>1.290</Value>
   <Band_Code>B05</Band_Code>
</Quality_Index>
```

- IMAGE_RESIDUES_INTERDETECTORS

=> This index is useful for estimating the accuracy of the multispectral registration. It provides a statistical error on the registration of the various spectral bands (here 0.31 m). It has to be noted that the first and last hundreds of lines of each image have degraded performances compared to the first ones.

```
<Quality_Index sn="18">
<Code>IMAGE_RESIDUES_INTERDETECTORS</Code>
   <Value>0.316</Value>
   <Band_Code>B05</Band_Code>
</Quality_Index>
```

To meet the Venµs Image quality specification we had issued before flight (which apply to 10m resolution images), you should check that

- IMAGE_RESIDUES_REFIMG < 2.85m

and

- IMAGE_RESIDUES_INTERDETECTORS < 1m.

Using these values might result in discarding several dates in your time series. Using higher values will discard less data, but probably provide higher geometrical errors.

Calendar :

Venµs L1C V1.0 products will start to appear Theia's website beginning of July. We will only process the new data, and start a complete reprocessing later on.