Processing Omega hyperspectral imagery for mineral mapping of the Nili Fossæ area on Mars

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An alternative method is presented for processing uncalibrated radiance data from the Omega sensor into pseudo-reflectance imagery using in-scene statistics without using an atmospheric model. The procedure includes the calculation of easy to interpret summary products and has been developed for the planetary mapping pilot project of the Nili Fossae area on Mars. The project is carried out by BGS, Deltares, UCLC and ITC for ESA.

In this procedure, calibration software from ESA was used together with IDL-scripts developed by ITC. Several tools that were used in this procedure were written in the Python language, such as the hyperspectral median filter, the hyperspectral edge detector, the kwik log residuals and the summary products. Six Omega scenes were selected from the the Planetary Science Archive, which cover different parts of Nili Fossæ in various resolutions.

Removal of atmospheric and albedo effects was done using kwik log residuals, which is a double normalization method that uses in-scene statistics only. This avoids artifacts that may be caused by the use of an atmospheric model that doesn't fit the atmospheric conditions of the scene, or by misregistration with the digital elevation model. This procedure has been compared to those that use scaling of atmospheric models to the depth of the CO_2 feature and results will be presented.

The pseudo-reflectance spectra produced by the kwik log residuals method still contain spike noise, called bad spectels, which are visible as pepper-and-salt patterns in the images. In order to reduce the spike noise, a hyperspectral 3D-median filter is applied that works both in the spatial and spectral domain in a 3x3x3 neighborhood. The effect is that noise is reduced, and spatial patterns related to surface composition become clearer.

A quick inventory of surface and atmospheric components present in the scene can be made by calculating summary products, which are a set of spectral parameters calculated form the spectra. The summary products have to be further analyzed to confirm the presence or absence of the various minerals and gases. For instance, OLINDEX, LCPINDEX and HCPINDEX give an indication for the three mafic minerals olivine, low-calcium pyroxene and high-calcium pyroxene respectively. Other indices hint at hydrated minerals, water vapour, water ice and CO_2 ice, for instance. In total, 39 summary products were calculated.

A number of color composites were created from the summary products. These color composites are useful for exploratory analysis of spectral variation

due to the presence of selected minerals and other surface materials.

Some of the resulting products will be presented and discussed at the workshop. The alternate processing procedure looks promising for mapping surface mineralogy and produces results that are comparable to results published earlier in literature.