Data curation of IRS-P3-MOS data (1996 – 2004): Overview and Challenges

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Introduction: The Modular Optoelectric Scanner (MOS) was an experimental 18-band imaging spectrometer designed by the German Aerospace Center (DLR) and flewn aboard the Indian IRS-P3 satellite from 1996 to 2004. In the IRS-P3 MOS European Data Set Curation project, funded by ESA's Heritage Space Programme, the mission data is currently undergoing a complete revision and development up to L2 products. Implementing state-of-the-art algorithms, software, formats and reference datasets into a completely new processor setup allow for significant data quality improvements and will remove access barriers for the user community. The intensive examination of the data more than 20 years after the end of the mission also poses challenges related to incomplete documentation, as well as technical shortcomings. We provide a lab report and want to arouse user's interest in the upcoming data release.

Mission overview and scientific relevance: The MOS instrument was especially designed to provide data for the testing and validation of key variables within the atmosphere-ocean system [1]. MOS was a direct precursor mission for MERIS on Envisat, whose data timeseries is currently being continued by OLCI on Sentinel-3. The reprocessed MOS data will contribute to fill data gaps within CEOS's Ocean Color Radiance Virtual Constellation.
The MOS instrument consisted of three separated spectrometers for different tasks: MOS-A for atmospheric research, MOS-B for the visible range and the MOS-C line camera with a channel in the short-wave infrared range (SWIR).

Parameter	MOS-A	MOS-B	MOS-C
Spectral- Range (nm)	755 - 768	408- 1010	SWIR
No. of Channels	4	13	1
Wavelengths [nm]	756.7; 760.6; 763.5; 766.4 O_2A-band	408; 443; 485; 520; 570; 615; 650; 685; 750; 870; 1010 815; 945 (H_2O-vapor)	1600
spectral halfwidth [nm]	1.4	10	100
FOV along track x [deg]	0.344	0.094	0.14
across track y [deg]	13.6	14.0	13.4
Swath Width [km]	195	200	192
No. of Pixels	140	384	299

Figure 1: MOS instrument characteristics [1]

Geometric correction challenges: For the orthorectification of the MOS data, the exterior and interior orientation of the sensor are required. The measured exterior orientation is not available for all datatakes. For such cases, two-line-elements (TLE) of IRS-P3 were used to calculate the orbit assuming nadir-view. To improve the geometric accuracy, the images are matched against a Sentinel-2 reference image to optimize the attitude component of the sensor model.
For MOS, a detailed pre-flight characterization of the interior orientation is not available. To determine a view vector for each sensor pixel, an idealized model based on the field of view (FoV) of each sensor was used. The more precise FoV differences between the individual MOS-A and MOS-B bands were derived by comparison against a "master" band using the BRISK feature matching algorithm and determining the average across-track offset for the matches of each sensor pixel. Figure shows the results of this matching for the MOS-B sensor: for example, the first pixel of band 12 is shifted about 1.5 px to the left compared to band 4 and the last pixel about 2.5 px to the right.

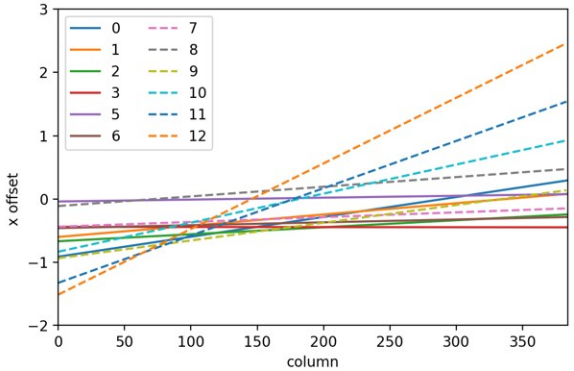

Figure 2: Across track deviation for all pixels of the MOS-B bands relative to "master" band 4

Conclusion: Processing historical MOS data is an exciting and rewarding task that requires a lot of detective work. During the L1C development phase, it ultimately went much better than expected, even though compromises had to be made, for example, in the geometric requirements due to technical constraints. Based on experience, careful documentation is a priority.

References:

[1] Zimmermann, G. & Neumann, A. (2000). *The imaging spectrometer experiment MOS on IRS-P3 - three years of experience*