GEOACCA - A tool for assessment of the geolocation accuracy of medium resolution optical satellite data

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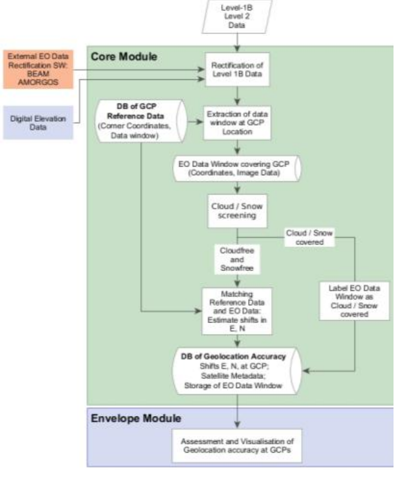
OBJECTIVES

Accurate geo-location is one of the fundamental requirements for Earth observation satellite imagery to be suitable for many applications, in particular to generate temporal composites of EO satellite products, and to support change detection and retrieval of bio-geophysical parameters over heterogeneous land surfaces.

In the GEOACCA project, funded by the European Space Agency (ESA) under the Quality Assurance framework for Earth Observation (QA4EO), we developed a tool for assessment of the geolocation accuracy of medium resolution optical satellite data (spatial resolution of 300 m to 1000 m). The tool currently supports ERS ATSR-2, ENVISAT AATSR and MERIS, and Proba-V VEGETATION.

METHODS

Processing line of the GEOACCA software



Reference Data:

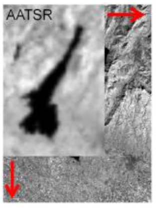
The tool uses a global reference data set of more than 350 Ground Control Points (GCPs), covering lakes and islands with an extension of a few to several km. For each GCP, a reference image chip is extracted from terrain corrected Landsat Level 1T scenes with 30 m pixel spacing.

Input Data:

The medium resolution images of a data take are rectified, cut to GCP data windows slightly smaller than the reference data windows and oversampled to the resolution of the reference images by bilinear interpolation.

Image chips affected by clouds, lake ice or snow are identified by a cloud and snow screening algorithm, labelled in the database and excluded from further processing.

Input image is shifted in comparison to reference image



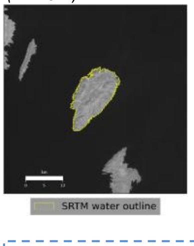
Template Matching:

The displacements in map projection (Northing, Easting) and in image coordinates (along-track and across-track direction) are estimated using an image cross correlation method. Thereby the smaller input image is shifted pixel by pixel in comparison to the reference image. At each location, a correlation coefficient between the two images is calculated and stored in a matrix. The location with the best match can be retrieved from the maximum correlation coefficient.

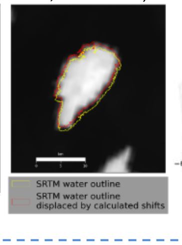
The calculated displacements are stored in a data base together with image metadata and quality information of the matching process.

AATSR nadir

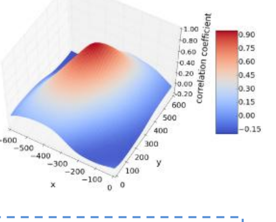
Kea, Greece (LANDSAT)



Kea, Greece (AATSR nadir, 22 June 2004)



Matrix of Correlation Coefficients between LANDSAT and AATSR image



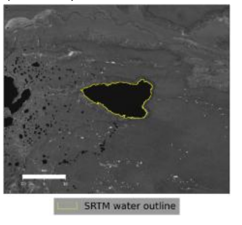
calculated displacements: x-direction: -210 m, y-direction: 870 m

across-track direction: 400 m, along-track direction: -601 m

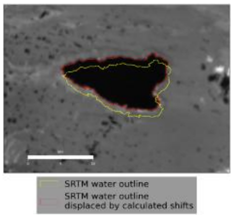
correlation coefficient: 0.96

MERIS FRS

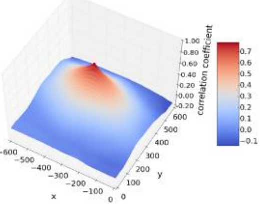
Lago Strobel, Argentina (LANDSAT)



Lago Strobel, Argentina (MERIS, 28 October 2003)



Matrix of Correlation Coefficients between LANDSAT and MERIS image



calculated displacements:

- x-direction: -390 m
- y-direction: 1140 m
- across-track direction: 735 m
- along-track direction: -955 m

correlation coefficient: 0.80

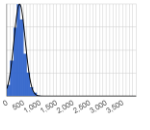
RESULTS

Calculated geolocation error (for correlation coefficients > 0.7) [m]:

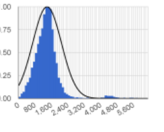
	AATSR nadir 2003 - 2012	AATSR forward 2003 - 2012	MERIS FRS 2003	PROBA-V 2015
magnitude	383 ± 171	1386 ± 699	182 ± 122	66 ± 44
across-track direction	-291 ± 199	-120 ± 511	-5 ± 85	n.a.
along-track direction	-132 ± 183	-850 ± 1188	26 ± 201	n.a.
x-direction (Eastwards)	-313 ± 189	337 ± 562	-3 ± 89	-11 ± 54
y-direction (Northwards)	51 ± 199	793 ± 1164	-27 ± 199	1 ± 58

Frequency distribution of magnitude of geolocation error (for correlation coefficients > 0.7) [m]:

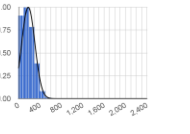
AATSR nadir, 2003-2012 (n = 26463, mean = 383, std = 171)



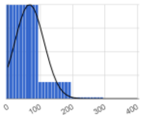
AATSR forward, 2003-2012 (n = 15739, mean = 1386, std = 699)



MERIS FRS, 2003 (n = 2825, mean = 182, std = 122)



PROBA-V, 2015 (n = 10847, mean = 66, std = 44)



CONCLUSIONS

The geolocation accuracy of satellite data is important knowledge needed for the interpretation of all satellite based products, i.e. maps of land surface classes, snow, water bodies etc. GEOACCA provides a general framework for estimating the geolocation accuracy for optical satellite data.

The tool has been successfully applied to several medium resolution optical data sets. Due to the modular design of the software, the tool can be extended to support additional sensors, like Sentinel-3 SLSTR and OLCI.