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Assessing geometric accuracy of the coarse-scale AVHRR GAC data at subpixel level

Xiaodan Wu (1,2) and Stefan Wunderle (1)

(1) Institute of Geography, University of Bern, Bern, Switzerland (xiaodan.wu@giub.unibe.ch), (2) College of Earth and Environmental Sciences, Lanzhou University, China

AVHRR GAC (Global Area Coverage) data provide a daily global coverage of the earth with a spatial resolution of 4 km, which are widely used for global environmental and climate studies. However, their usefulness are being hampered by their poor geometric accuracy because even a small geometric error can induce a significant influence on retrieval of thematic information. Therefore, in order to get more precise universal application results, the first priority is to assess the geo-location accuracy of this dataset. In this study, a correlation-based patch matching method was proposed to characterize and quantify the AVHRR GAC geo-location accuracy over different land cover types, different latitudes, and different topographies at different times.
The assessments was performed by comparing the AVHRR GAC images with Geo-located reference data, i.e. MODIS images. The method was attempted to find the best match between small image patches taken from the reference images and the AVHRR GAC images. By shifting the patch on the reference image in the column- (X-) and line- (Y-) directions, the geometric accuracy of AVHRR GAC data can be determined, which is indicated by the combination of X- and Y-shifts with the best correlation between the patch values on the reference image and AVHRR GAC image. The overall accuracy of AVHRR GAC images was finally computed by summarizing the measured shifts on each respective image part statistically. Furthermore, the influence of some factors on the geometric accuracy, such as off-nadir viewing angle ranging, topography, was also investigated in this study.
33*33 random combinations of X- and Y-shifts have been applied to each patch. The results from each patch are different, and therefore their results were presented in the form of histogram and summarized statistically using the indicators such as maximum, minimum, mean and standard errors. The results for AVHRR images from NOAA11, MetOp-A, MetOp-B were shown in this study. The along-track geo-location errors were smaller than the cross-track errors for the three satellites. The average shifts for NOAA11 are -0.7 km and -1.69 km in Y and X directions, respectively, with standard deviations of 1.0 km and 1.31 km in both directions. Whereas average values of -0.015 km and -1.9 km were reached for Y and X directions in the case of MetOp-A, with standard deviations of 0.79 km and 1.1 km in both directions. And the averaged shifts for MetOp-B are 0.958 km and -2.56 km in the Y and X directions, respectively, with standard deviations of 1.7 km and 2.189 km. Furthermore, the influence of topography is more significant in the case of larger off-nadir viewing angles in the X direction.