An open source framework for processing daily satellite images (AVHRR) over last 28 years

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Abstract

The space-borne sensor Advanced Very High Resolution Radiometer (AVHRR) nowadays offers high resolution data for last 30 years which are publicly available through the National Oceanic and Atmospheric Administration (NOAA) archives. The data are available at level 1B in its original spatial resolution (1.1 km) and known as Local Area Coverage (LAC) products (Kidwell, 1996). The data archive includes images acquired by multiple NOAA polar orbiting satellites – from TIROS-N, NOAA (6 – 19). These data are valuable to regional level studies for assessing long term environmental and climatic changes. Achieving sub-pixel accuracy in image to image geo-correction is crucial in avoiding spurious trends from time series analysis. However, due to on-board malfunctions and instrument decaying especially with the older NOAA satellites, earlier images from AVHRR are often difficult to calibrate and georectify accurately. The main contributors to the errors are the well documented clock drift and attitude shifts due to decaying of the instruments (Kaufmann et al., 2000).

In this study, we are leveraging the power of existing open source spatial tools to establish an automated workflow to correct images for the entire 30 years time period covering the study area of Northern Italy. Concisely, we developed time series of daily calibrated and geo-corrected thermal bands (Brightness Temperatures – BT) from 1986 onwards by integrating multiple open source geospatial tools. We used the Pytroll libraries (URL: www.pytroll.org) to read the original data format, to correct for bow-tie effects, clock drift and attitudinal errors followed by calibration of the AVHRR LAC images (Kaufmann et al., 2000; Khlopenkov & Trishchenko, 2008). We extended the data readers in pytroll to support the LAC data. Sub-pixel level accuracy between temporal images in geo-rectification is accomplished by using SIFT image matching technique implemented with Orfeo Toolbox (Lowe, 2004)(URL: www.orfeo-toolbox.org). Final steps of polynomial rectification, cloud removal, filtering for outliers, and temporal database development we performed in GRASS GIS 7.0 (Neteler et al., 2012). The resulting temporal database can be used to calculate Lake Surface

Water Temperature (LSWT) for the sub-alpine lakes in the Northern Italy facilitating ongoing project in monitoring the long term trend in surface temperature variation.

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