Lake surface temperature as a proxy of climate change – Satellite observations versus multi probe data

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Surface and epilimnetic temperature of a lake responds directly to any changes in the climate and considered as a good proxy of climate change. Satellite images are considered to be a good alternative to costly field based lake surface temperature data and offer high spatial and temporal coverage. A major disadvantage of satellite-based temperature data is the occurrence of gaps especially due to clouds that must be filled prior to analysis.

For this study we used the following products: Lake Surface Water Temperature dataset (Arc-Lake 1995-2009, http://hdl.handle.net/10283/88) at 0.05º spatial resolution retrieved using optimal estimation and probabilistic cloud screening from A(A)TSR (Advanced Along-Track Scanning Radiometer) aboard the Envisat satellite - raw daily A(A)TSR) and reconstructed time series (using Empirical orthogonal function techniques); Land Surface Temperature (LST) products from MODIS (Moderate Resolution Imaging Spectroradiometer; MOD11A1 and MYD11A2 – 1 km resolution, daily, available since 2000) aboard the Terra and Aqua satellites.

We present long term continuous daily lake surface temperatures for Lake Garda (one of the largest Sub-alpine lakes in Europe) from multiple satellite sensors. The objective of this study is threefold: i) Assessing the usability of satellite data by evaluating the correlation of surface temperature data retrieved from A(A)TSR and from MODIS sensors for last 10 years with the available field data collected monthly using a multi parameter probe, ii) Assessment of different reconstruction algorithms applied to fill data voids, iii) Time series analysis on the reconstructed dataset to study the changes in trend. We improved the aforementioned daily MODIS LST data by reconstructing them using a multi regression technique (FEM-CRI PGIS, http://gis.cri.fmach.it/modis-lst/, at 250 m resolution, four coverages per day). In order to evaluate different reconstruction methods, we applied the HANTS (Harmonic Analysis of Time Series) technique to gap-fill both A(A)TSR and MODIS LST data. The preliminary results show high correlation coefficients up to 0.90 between the differently reconstructed LST(x,y,t) and the field measurements f(x,y,t). For the trend analysis, we employed STL (Seasonal time series decomposition) and BFAST (Breaks for Additive Season and Trend) on the datasets. Finally, the capabilities of GRASS GIS (Geographic Resources Analysis Support System) open source system in handling big datasets and to perform time series analysis is explained in the context of image processing chain developed for this study.