Globolakes LSWT

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Outline

Introduction

- Lake Surface Temperature (LSWT) time series for 1000 Globolakes lakes from 1995 to 2106
- The work was built on work done during the ARCLake project, during the ESA CCI SST project and from results of the ESA CCI Land Cover project
- The repository for the data from the Globolake and ARCLake projects at the University of Reading is at www.laketemp.net
- The dataset will be released through the CEOS (Commitee on Earth Observations Satellite)/CGMS (Coordination Group for Meteorological Satellite) WGClimate ECV Inventory

Outline

Globolakes dataset

The dataset consists on:

- Daily full-globe L3S files: Level 3 super-collated data where data from multiple instruments that have been combined and mapped onto a space-time grid
- Retrieval performed only for day-time and on nadir-view data
- File format: netCDF-4
- Spatial resolution: 0.05°
- Time span: from 01/08/1995 to 31/12/2016
- Instruments:
  - ATSR2 on ERS-2 (01/08/1995 - 30/06/2002)
  - AATSR on Envisat (20/05/2002 - 08/04/2012)
  - AVHRR on EUMETSAT Metop-A (01/03/2007 - 31/12/2016)

Outline

Overview on the algorithm

The algorithm to derive LSWT products from imagery of visible and infrared radiometers consists of many components which aim to retrieve the LSWT from the observed reflectance and brightness temperature for only-water pixels.

- The core of the algorithm is the retrieval part which is based on optimal estimation Optimal Estimation (OE)[1] given simulations and observations.
- OE is based on a a-priori knowledge of the LSWT
- The other components of the algorithm prepare the inputs for the retrieval part, namely simulate the brightness temperatures and classify a pixel as water or non-water.
- Finally the observations are gridded in a regular 0.05° resolution grid.
- The dataset is validated against insitu measurements for some lakes.

[1] S. MacCallum C.J.Merchant (2012) Surface water temperature observations of large lakes by optimal estimation,Canadian Journal of Remote Sensing, 38(1), 25-45

Contribution during the Globolakes project

- The Optimal Estimation for lakes was developed during the ARCLake project
- The simulations for the OE is based on radiative transfer modelling. Two different approaches were tested and implemented during the ESA CCI SST project.
- The work within Globolakes was focussed on:
  - classification of a pixel as water or non-water
  - derivation of a a-priori LSWT for Globolakes lakes
  - adaptation of the ESA CCI SST processor for lake processing for different instruments
  - combination of multiple instruments data in a regular grid
  - collection and quality control of insitu data
  - validation of the final dataset

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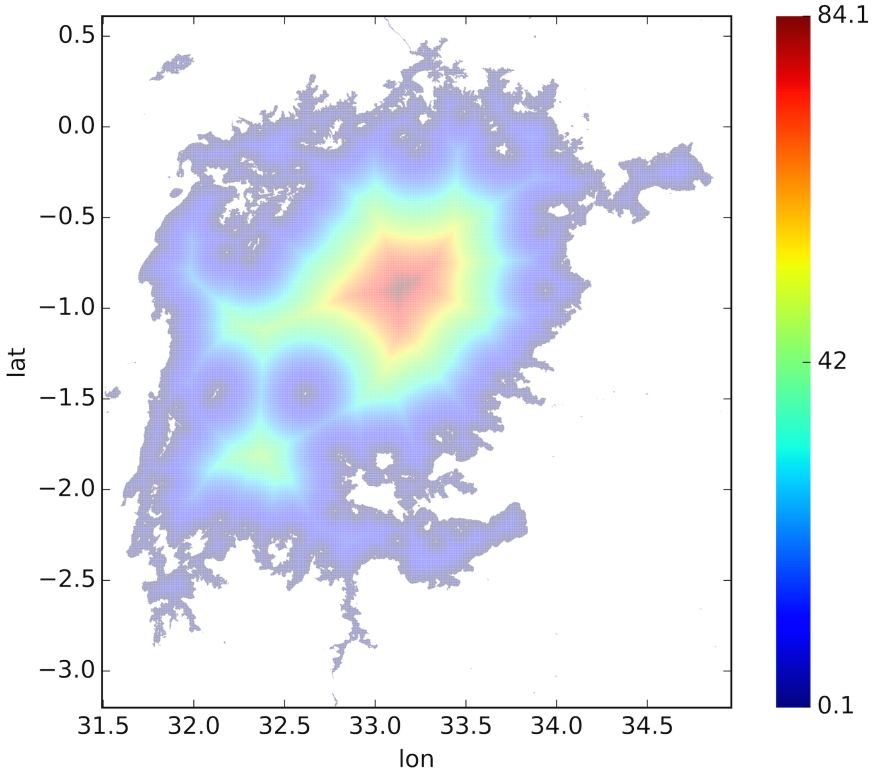
Outline

Lake mask

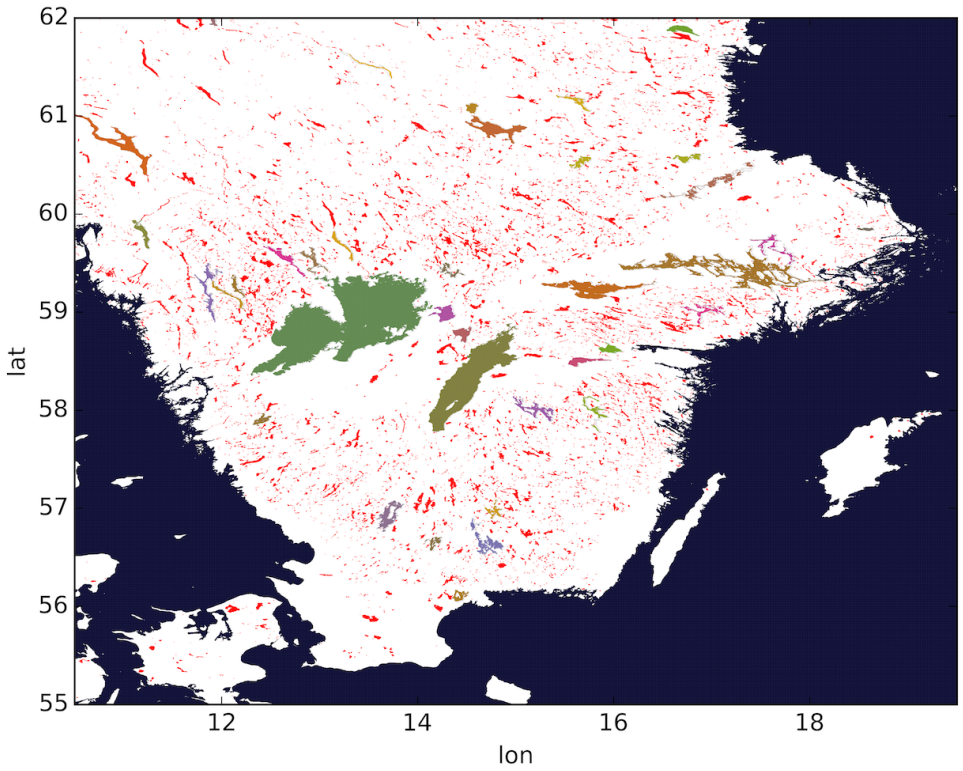
- The classification of a pixel as water or non-water started with the development of a lake mask.
- Based on the ESA CCI Land Cover Water body mask v3.0 at 300m resolution, we have derived[2]
  - the distance to the nearest land for each water pixel
  - a labelling for each water pixel as
    - -1 land
    - 0 sea
    - 1-3721 GLWD identifier + few Globolakes extra
    - 999999 all other water
- Definition of lake centre base on the distance to land

[2] L. Carrea O. Embury C.J. Merchant (2015) Datasets related to in-land water for limnology and remote sensing applications: distance-to-land, distance-to-water, water-body identifier and lake-centre co-ordinates. Geoscience Data Journal, 2(2), pp. 83-97

Lake mask



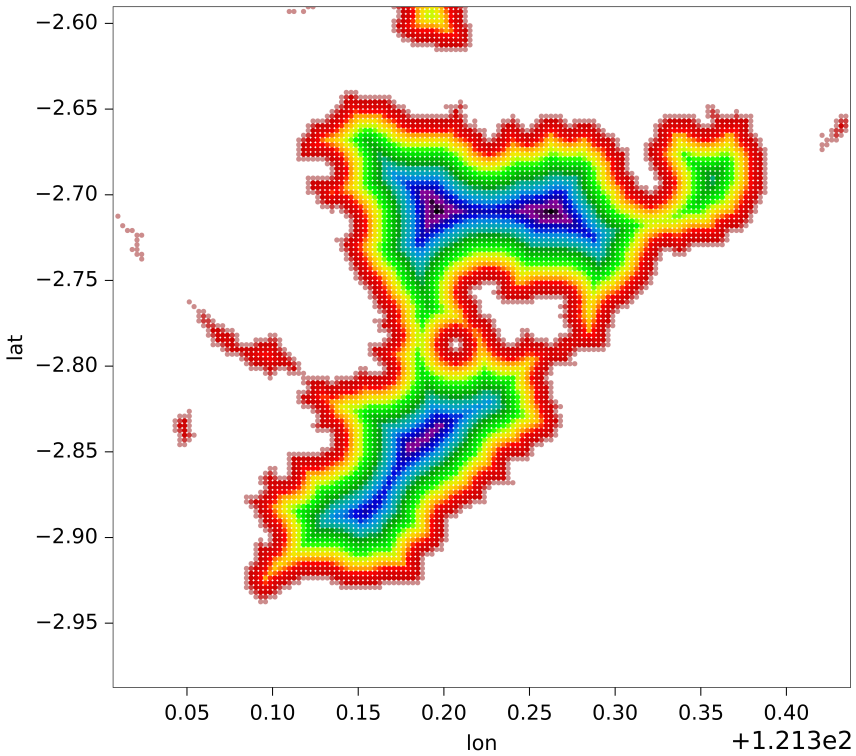
Distance to land



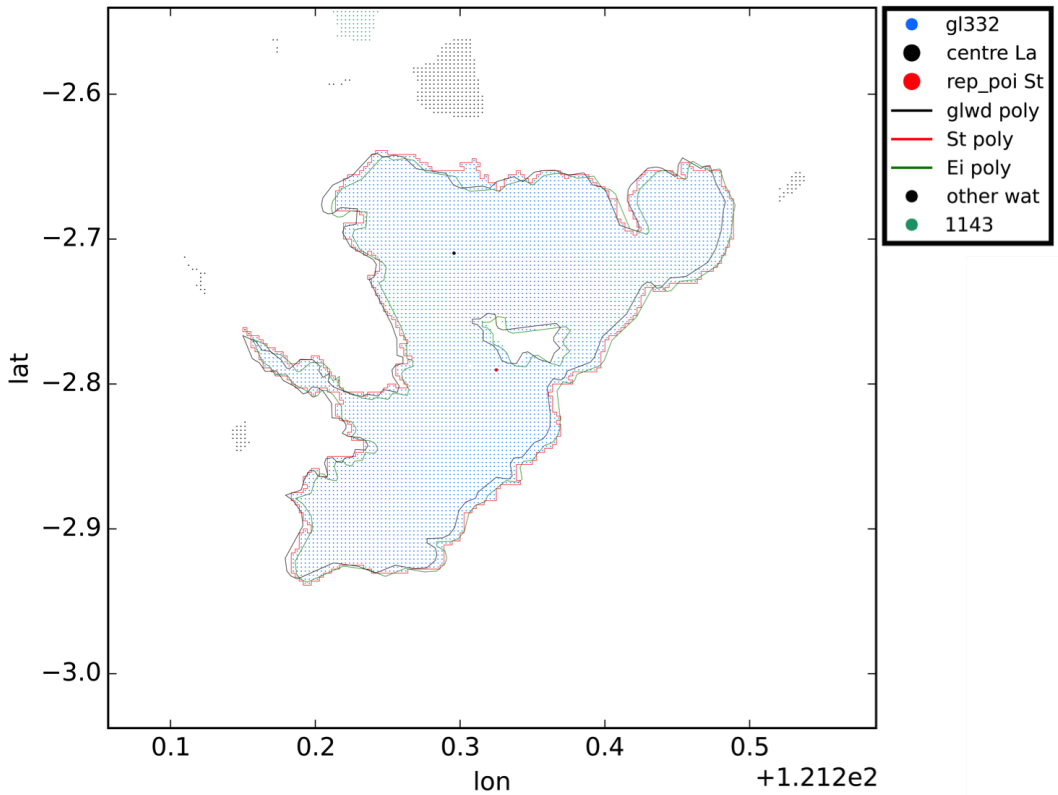
Lake identifiers

Lake centre

Lake 332 Towuti in Indonesia
Lake centre at lat=-2.71, lon=121.49
Max distance to land = 5.8 km



Distance to land



Lake identifiers

Water detection algorithm

- Initially developed within the ARCLake project to minimize the risk of land contaminated LSWT retrievals.
- Within Globolakes, it was modified to detect water in presence of clouds.
- The ARCLake water detection algorithm was based on threshold test over reflectances and combinations.
- The thresholds were tuned using the probability of clouds provided by PLM computed on MERIS data. MERIS was a instrument on Envisat. The thresholds were tuned using AATSR data.
- The tuning was based on a maximum entropy technique to classify water/non-water pixels.
- The water detection algorithm has been implemented within the Globolakes processor and it is applied to each pixel belonging to the lake according to the lake mask.

Outline

Globolakes dataset

Globolakes LSWT dataset consists of:

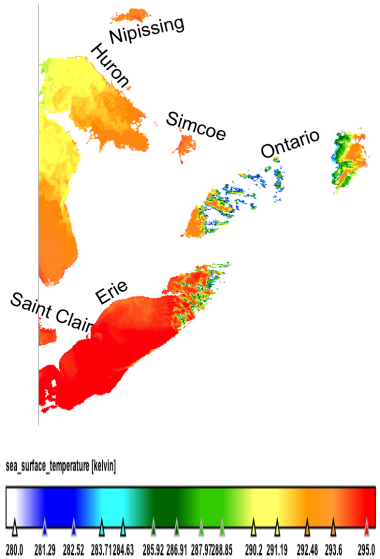
- LSWT
- LSWT uncertainty reflecting radiometric noise and the uncertainty in the retrieval.
- LSWT quality level reflecting the degree of confidence in the validity of the estimate. The quality level accounts for confidence level for
  - water detection
  - OE retrieval (ξ^2)
  - sensitivity to the prior
  - distance to land
  - satellite zenith angle
- LSWT harmonisation flag reflecting the fact that not always there were enough data to be able to estimate the difference in LSWT due to a different instrument used for the measurements

Outline

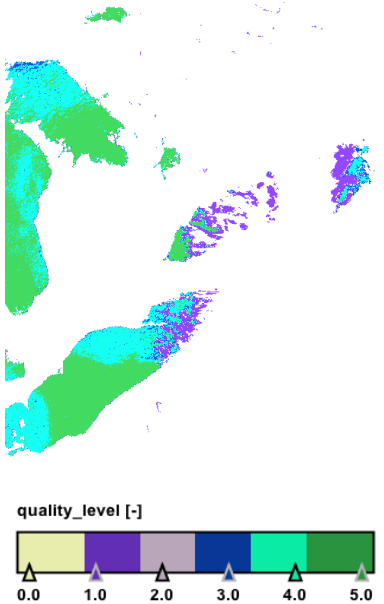
Globolakes L2 LSWT - Great lakes area

AATSR - 2003/09/12 15:11:35

LSWT



QL



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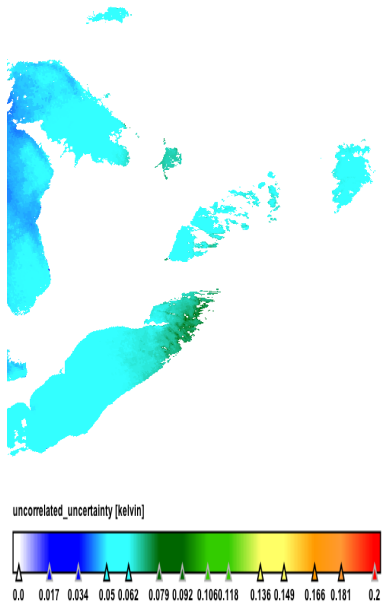


Globolakes L2 LSWT - Validation

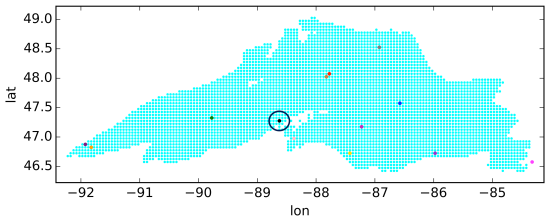
Validation carried out within 3 hours (where hourly data were available) and within 3km.

Location of the 124 sites in 45 lakes

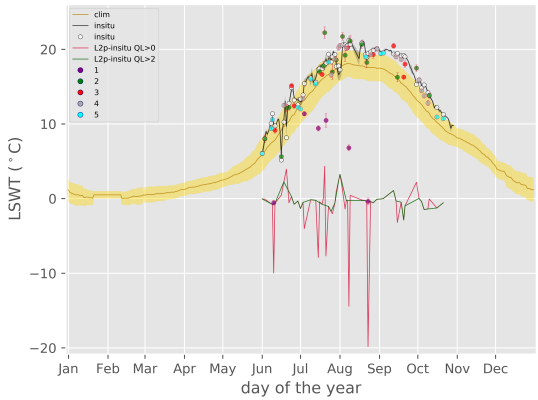
Globolakes L2 LSWT - Validation

AVHRR-MTA

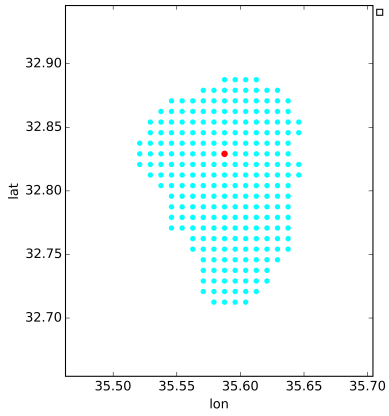
Superior 2016



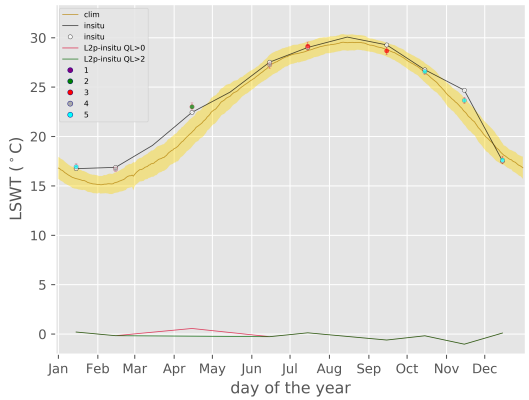
Lake 2 Site 05 sens AVHRRMTA year 2016



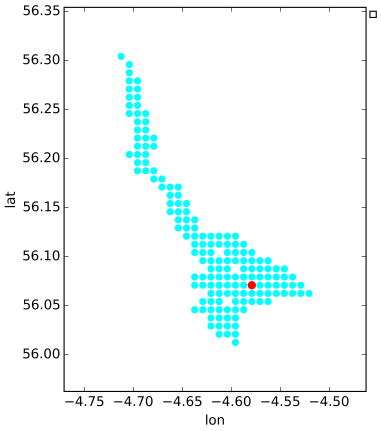
Sea of Galilee 2016



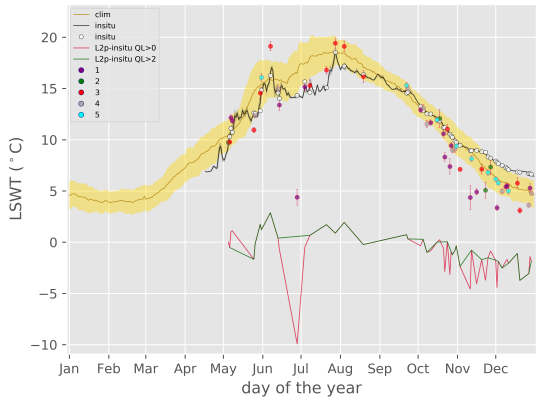
Lake 1196 Site 01 sens AVHRRMTA year 2016



Lomond 2008



Lake 2516 Site 01 sens AVHRRMTA year 2008



Globolakes L2 LSWT - Validation

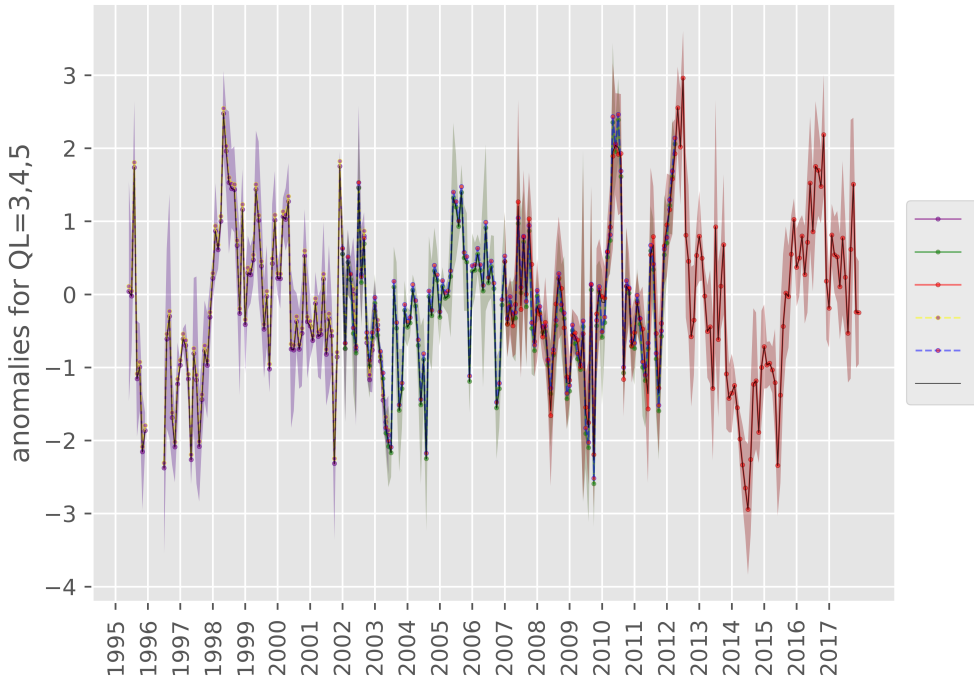
Table : **Globolakes L2P validation.**

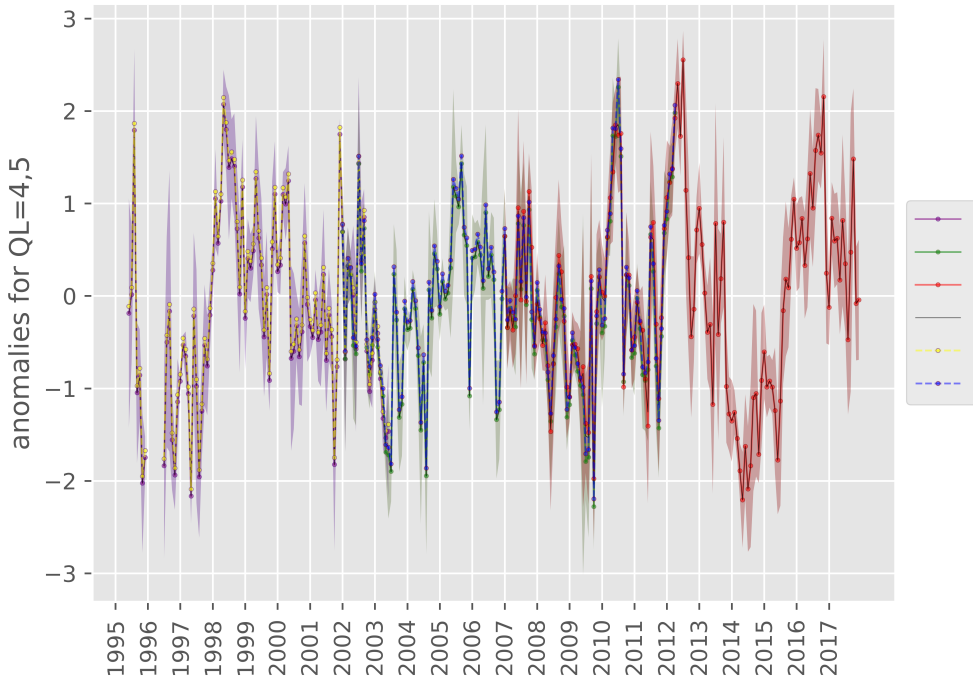
QL	SENSOR	Median diff	RSD	Mean diff	SD	N
=5	ATSR2	-0.220	0.489	-0.288	1.152	1428
=5	AATSR	-0.309	0.445	-0.429	0.987	2758
=5	AVHRRMTA	-0.120	0.489	-0.238	1.100	10693
=4	ATSR2	-0.370	0.712	-0.573	1.485	849
=4	AATSR	-0.460	0.667	-0.615	1.288	1828
=4	AVHRRMTA	-0.270	0.786	-0.411	1.340	6888
=3	ATSR2	-0.610	1.082	-0.897	1.686	446
=3	AATSR	-0.820	1.141	-1.016	1.670	824
=3	AVHRRMTA	-0.290	0.978	-0.533	1.545	8021

Outline

Harmonization between instruments to generate L3S data.

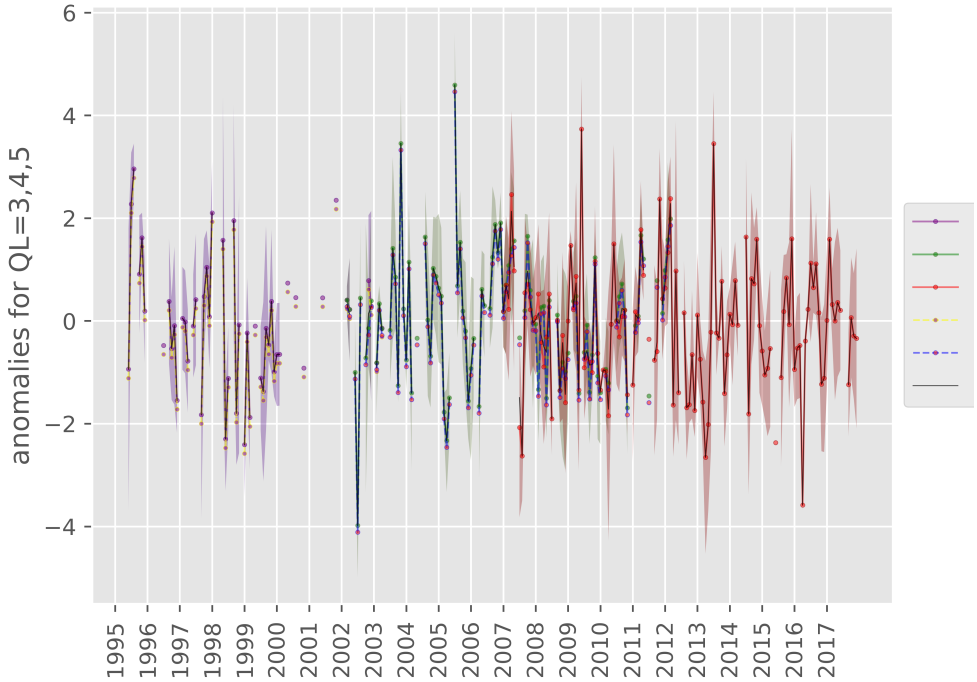
Lake 6 - Michigan

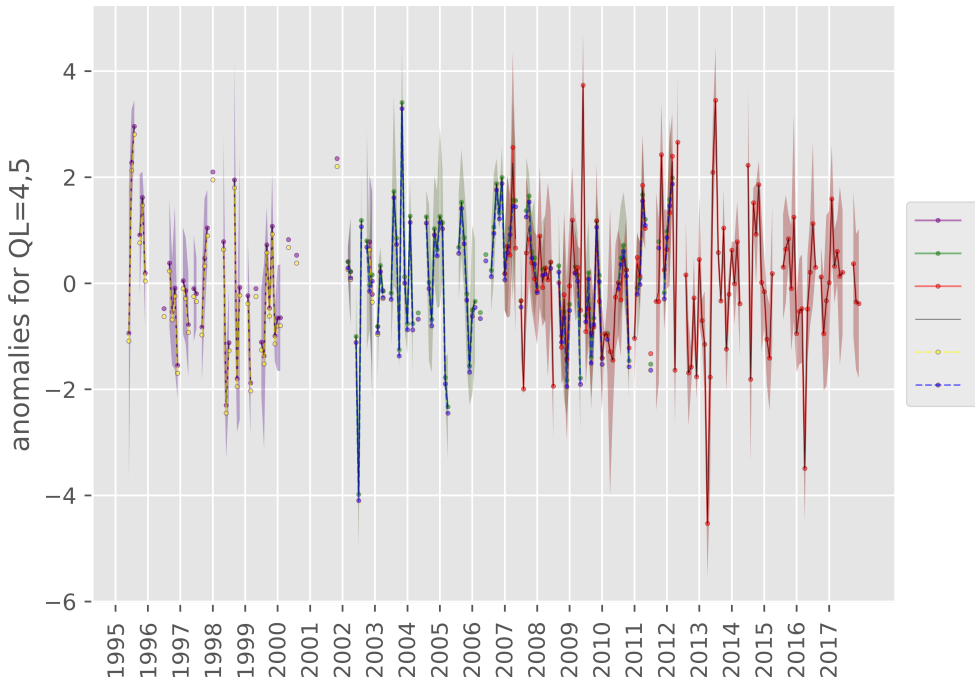




Harmonization between instruments to generate L3S data.

Lake 12262 - Loch Leven





Globolakes L3S

- Only data for about 650 lakes have been successfully harmonised (for both the overlapping periods)
- All LSWT are present in the dataset. A flag is indicating which LSWT have been harmonised.

Outline

Globolakes LSWT

- 2 contributions to the State of the Climate Report for 2016 and 2017 (BAMS)
- Contribution to CGLOPS - Copernincus Global Land Operation
- C3S Hydrology LSWT based on Globolakes algorithm
- CCI Lakes

THANK YOU