



Outline

How many pieces of independent information about clouds are available in the Oxygen A band:

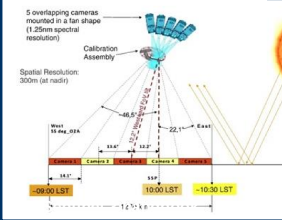
- at the spectral resolution provided by the OLCI CCD?
- which are detectable given OLCI's signal to noise?
- which are measured by the current spectral binning of the CCD?

Method - Basic Assumptions Made Here:

- The variability of top of atmosphere reflectance in the Oxygen A band is caused by physical parameters such as optical thickness, effective radius, cloud vertical profile, or viewing geometry.
- The variability that can be seen by GOSAT's hyper spectral measurements can be used to study the entire system for OLCI type measurements. The variability, which could be seen by OLCI, can be simulated using other proper measurements of top of atmosphere radiances. Here, we used more than two years of GOSAT (TANSO-FTS) data to generate a set of hypothetical OLCI measurements at the full resolution provided by OLCI's CCD.

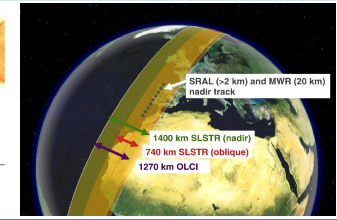
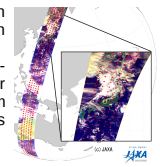
Sentinel 3: OLCI

- MERIS heritage plus additional channels for ocean, oxygen A band, and water vapor
- swath width of 1270km
- pixel footprint of 300m
- 21 bands, including: 753.75, 761.25, 764.375, 767.5, 778.5
- well characterized CCD for smile and response functions
- planned 1st launch in 2015, 2nd in 2016



GOSAT - TANSO-FTS

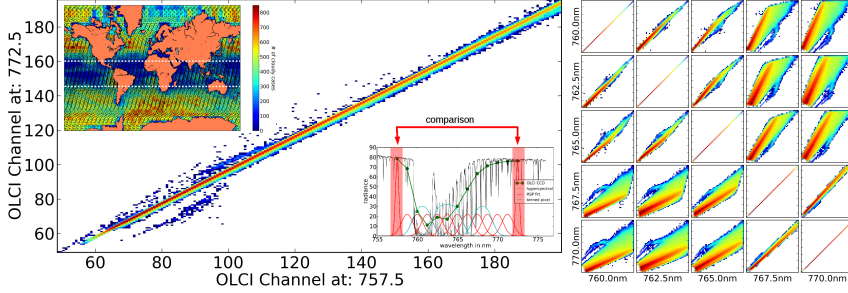
- GHG instrument with one of its channels in the Oxygen A band
- spot like measurements, with diameter of ~10km and ~90 km distance, 3 to 7 spots per "swath"
- ~1400 channels O₂A



Data Correlation – Channel vs. Channel Scatter Plots

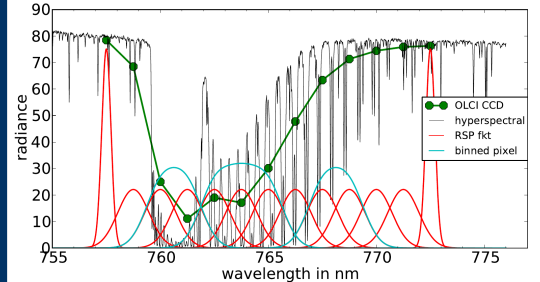
How correlated are measurements with respect to each other? Where does the data from? How linear is the correlation? Carry channels independent information?

OLCI channel scatter plot for 616940 cloudy cases.



From Hyperspectral Data to OLCI CCD

Measurements from the TANSO-FTS instrument are specially calibrated and folded with Gaussian OLCI instrument response functions for the whole CCD, then binned according to OLCI's band definition.



Spectral Reconstruction Using Principal Components Derived from the Total Dataset

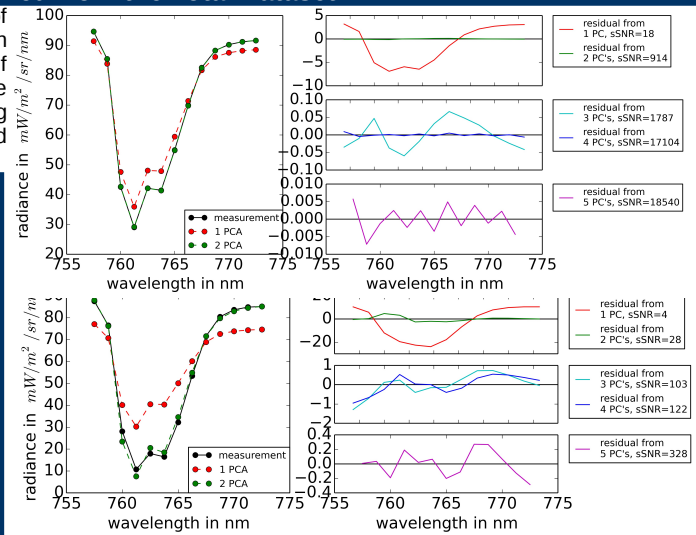
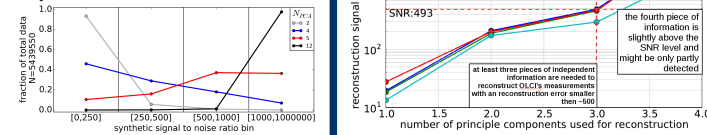
Synthetic measurements are reconstructed using increasing an number of principal components. The corresponding residual for each reconstruction step is shown for two cases, a "best case" and a "standard case" scenario. If the residual for a certain number of principal components is smaller than the instrument error, no further reconstruction accuracy can be achieved by using more principal components. Thus, a such defined reconstruction threshold can be determined for a specific instrument and spectral region.

Reconstruction Accuracy vs. Number of Components

The total dataset was analyzed with respect to mean reconstruction error in terms of synthetic SNR and number of employed principal components. The analyses were divided for northern, southern, middle, and all cases.

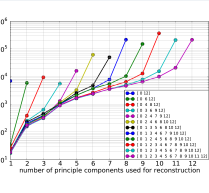
Global Results (All Data)

Here, all data was used and include also non cloudy cases and measurements for land.



Alternative Channel Selections

The channel setting of OLCI in the Oxygen A Band is not unique and can be analyzed with respect of the reconstruction error to the channel selection. Shown are results for a equal sampling scheme with respect to the number of principal components and the resulting noise level.



Conclusions – for Clouds over the Oceans

- **all cases:** OLCI's O2A band channels carries three independent pieces of information, which can be detected with the sensors SNR characteristic and channel setting. The measurements carry a fourth piece of independent information, which might be more complicated to retrieve, since the variations caused by it are below a signal to noise level of 500.
 - **interesting cases:** In GOSAT data from TANSO-FTS we found many cases which would need five principal components to be reconstructed within OLCI's SNR level.
- The current spectral setup by OLCI is an improvement when compared with MERIS, since additional information/variability is sensed and is carrying as much pieces of information as if would be sensed by all spectral O₂A band pixels at OLCI spectral resolution.
- This study is based purely on measurements. The variability in the dataset is provided by nature itself. Due to the much higher spatial of OLCI when compared to GOSAT, some pieces of additional information/variation might be missed. Therefore this study provides an lower bound for the information/variability carried by future OLCI measurements.

More Data to look at ...

