European Union

esa

4th SENTINEL-2 VALIDATION TEAM MEETING

15–17 March 2021 | Virtual Event

## Sen2Cor 3.0 for Landsat-8 Data

Copernicus
Europe's eyes on Earth

Purpose

❑ Upgrading the existing Sen2Cor Level 2A processor to convert Landsat Level 1 data to Level 2A, using the same algorithm as for Sentinel-2, which is based on a modified ATCOR algorithm, originating from DLR.

❑ This is possible, as both satellites cover a comparable spectral range as is shown next:
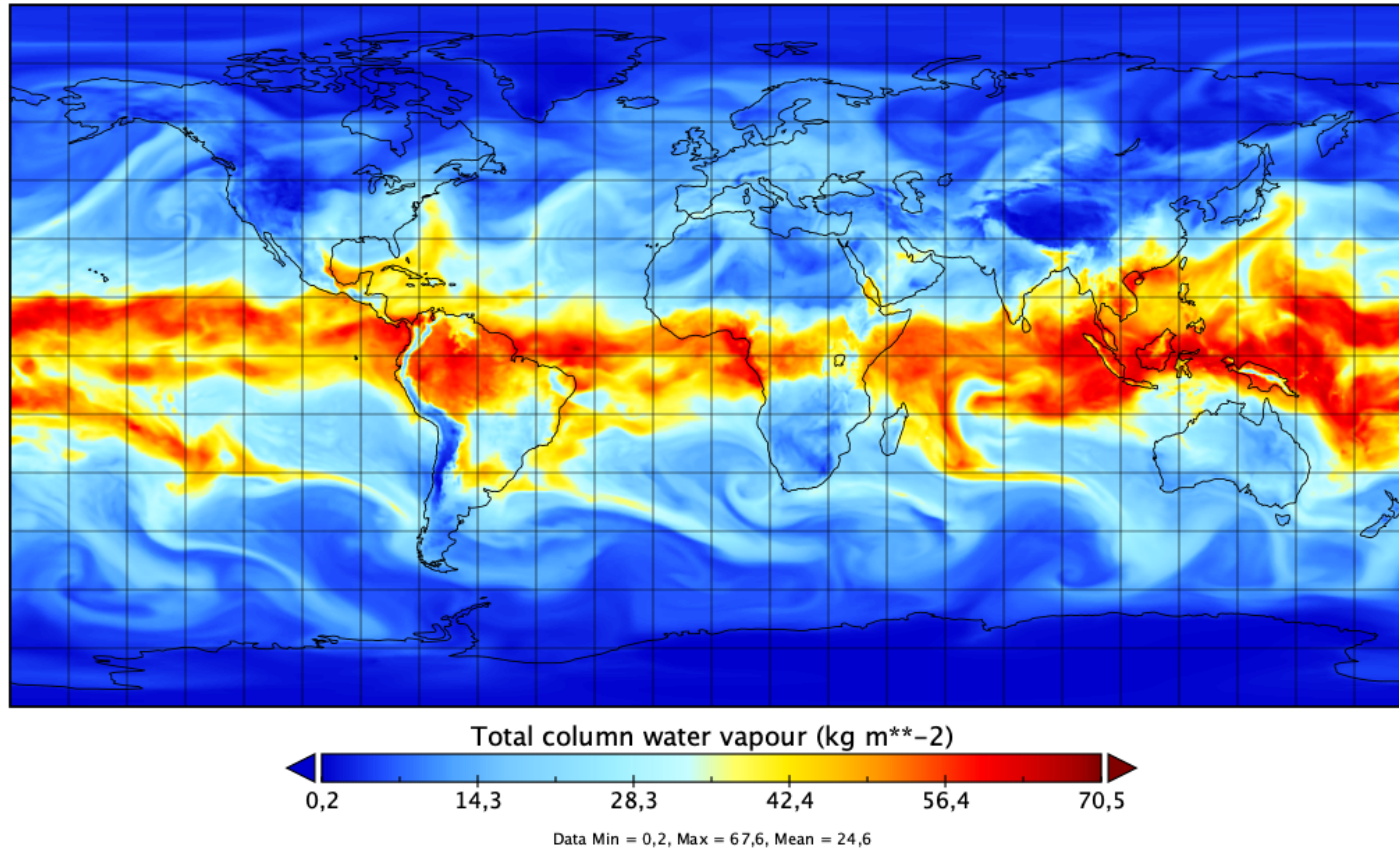
Comparison: Sentinel-2 vs. Landsat 8 Bands
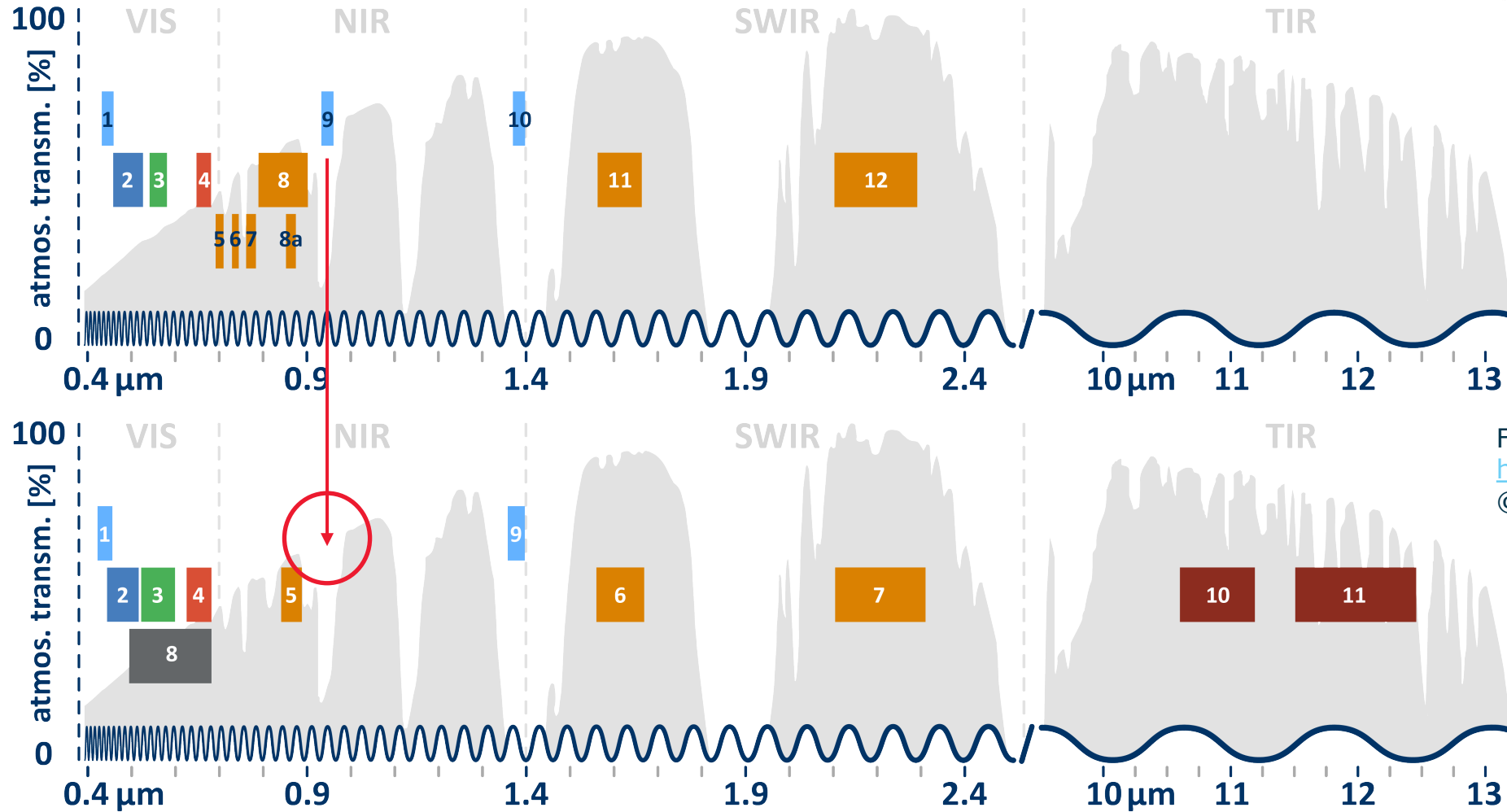
From:
https://blogs.fu-berlin.de/reseda/
© Freie Universität Berlin

ECMWF provides TCWV Data 4 x / Day

Total column water vapour

Total column water vapour (kg m**−2)

0,2   14,3   28,3   42,4   56,4   70,5

Data Min = 0,2, Max = 67,6, Mean = 24,6

The Copernicus Atmosphere Monitoring Service (CAMS) from ECMWF provides near real time data four times a day, which can be used to retrieve the necessary information in a sufficient manner. The World data for the required timestamp can be downloaded and the Area of Interest for the dedicated tile can be extracted using the GDAL Tools. The preparation of the WVP columns follows the already implemented mechanisms for the extraction of other auxiliary data such as DEM or ESA CCI data, using the GDAL API for geospatial data formats.

From: https://apps.ecmwf.int/datasets/data/cams-nrealtime/levtype=sfc/

Processor Modifications

With this, the following modifications of Sen2Cor for upcoming Version 3.0 have been applied:

❑ Sen2Cor detects a Sentinel or Landsat product by filtering of the filename, which is the only command-line argument required:

➢ `L2A_Process LC08_L1TP_194027_20180425_20180502_01_T1 or:`
➢ `L2A_Process S2A_MSIL1C_20191203T102401_N0208_R065_T32TNT_20191203T105732.SAFE`

Based on this inputs it:
❑ Filters the applicable configuration parameters;
❑ Switches into the appropriate processing mode;
❑ Reads the applicable metadata and bands from the input product and
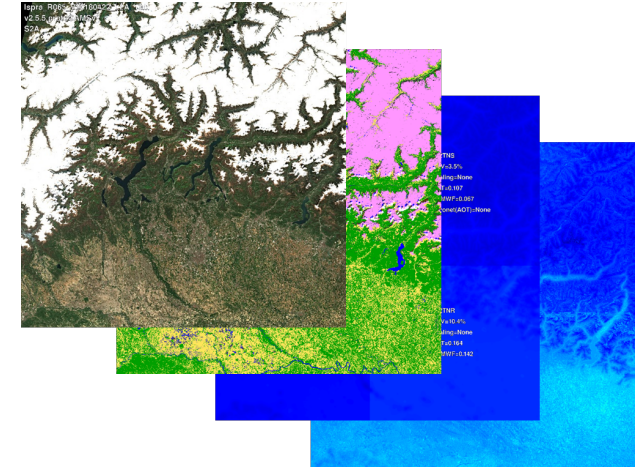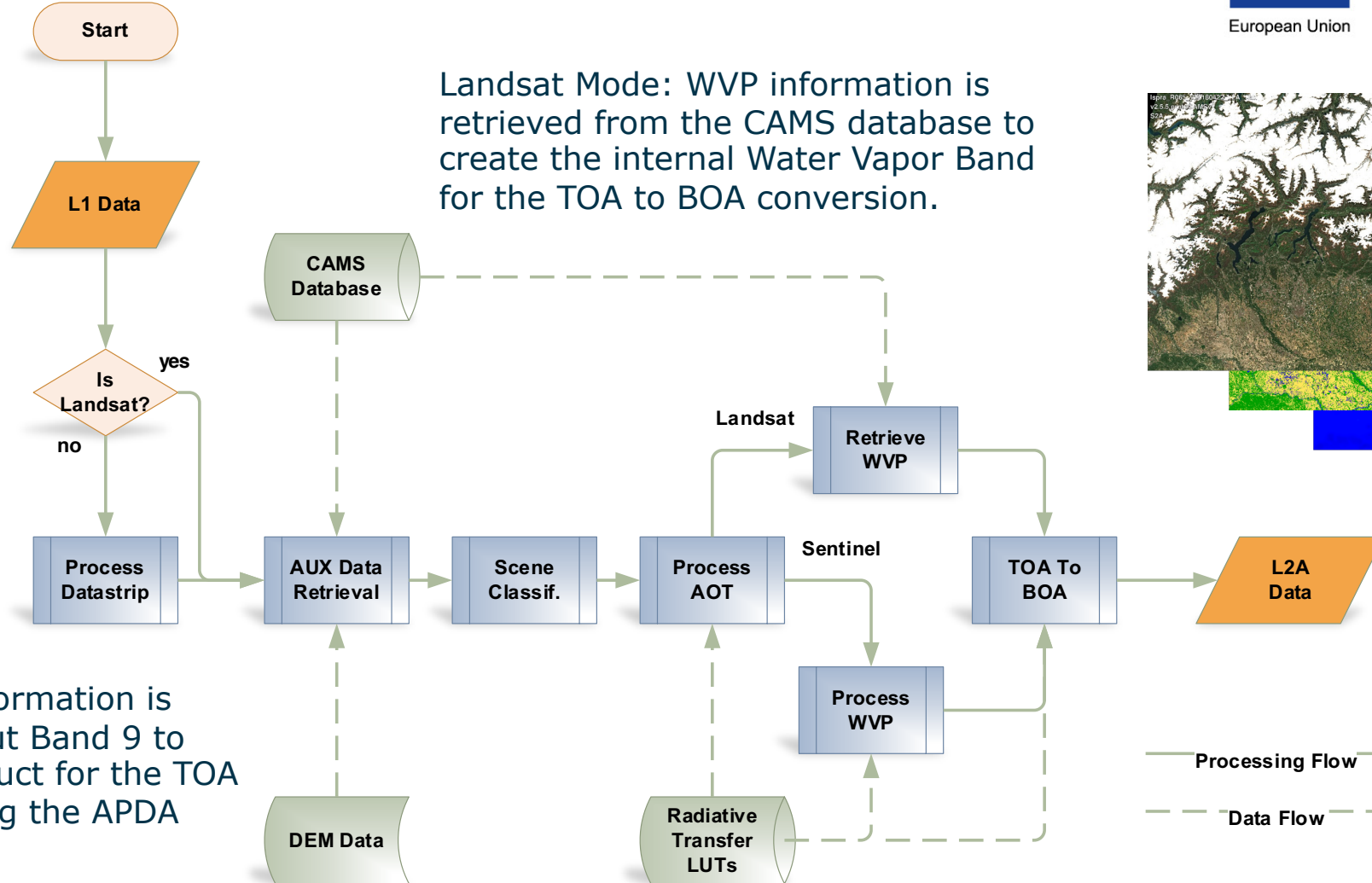❑ Performs the processing.

This is shown in the following modified processing scheme:

Sen2Cor for Landsat: Process and Data Flow
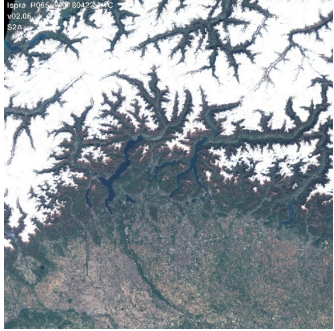
Sen2Cor is switching the two modes based on the information form the input filename.

Landsat Mode: WVP information is retrieved from the CAMS database to create the internal Water Vapor Band for the TOA to BOA conversion.

Sentinel Mode: WVP information is calculated from WV input Band 9 to create the internal product for the TOA to BOA conversion, using the APDA algorithm.

Start → L1 Data → Is Landsat? (yes/no)

CAMS Database

Process Datastrip → AUX Data Retrieval → Scene Classif. → Process AOT → Retrieve WVP (Landsat) / Process WVP (Sentinel) → TOA To BOA → L2A Data

DEM Data

Radiative Transfer LUTs

Processing Flow

Data Flow

Additional Modifications Applied

- Sen2Cor Version 3.0 is ported to Python 3.7;
- Band reader modules have been split to support both modes;
- Configuration module has been split to support the complete different metadata reading;
- Band indexing has completely reworked as Sen2Cor was strictly aligned to the Sentinel-2 band order and resolutions;
- New Look Up Tables (LUTs) for Landsat AOT retrieval have been added;
- User can configure a Region of Interest to process the same areas of a Landsat and a Sentinel tile for comparison purposes;
- Auxiliary data like DEMs can be used for Landsat in the same manner as for Sentinel;

Next slide shows first regression tests between Sen2Cor 3.0 and 2.9 for the Sentinel operation mode:

Regression Tests in Sentinel Mode
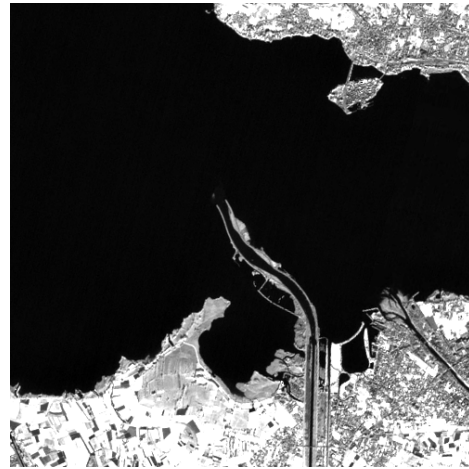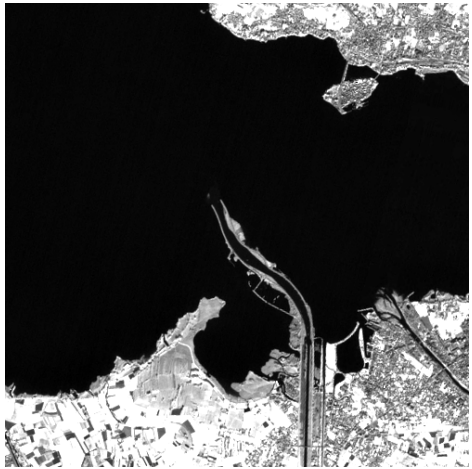
Top Row: WVP sensible Band 8A, Sen2Cor version 2.9 vs. version 3.0. Rightmost Image: Diff-comparison between both bands show no obvious differences between both versions.
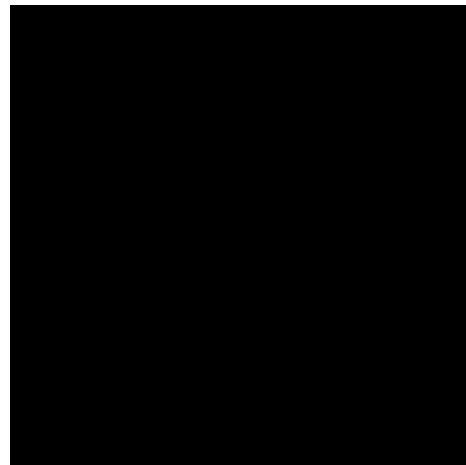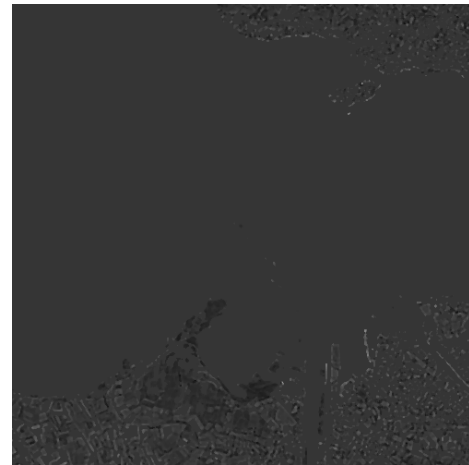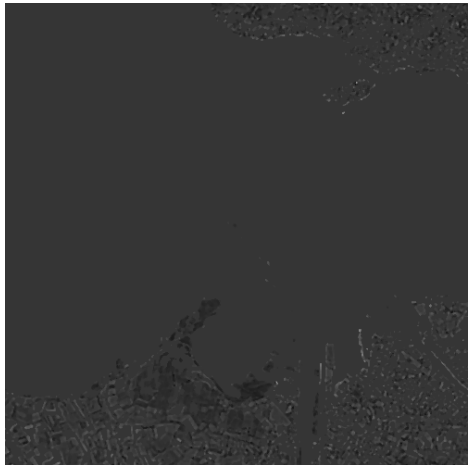
Bottom Row: Calculated WVP Band, Sen2Cor version 2.9 vs. version 3.0. Rightmost Image: Diff-comparison between both calculated WVP bands show no obvious differences between both versions.

Landsat 8, L1 vs L2 Scene Processed with Sen2Cor

Sen2Cor V.3.0: Landsat 8, L1 vs. L2

Landsat 8 scene acquired 4. March 2018 and processed with Sen2Cor 3.0 with a configured region at East of Lake Constance. Input (left) was generated with the Scene Class only feature, of Sen2Cor which does not manipulate the Level 1C TCI bands, but provides the same calibration as for the Level 2 processed Bands 2,3 and 4 (right).
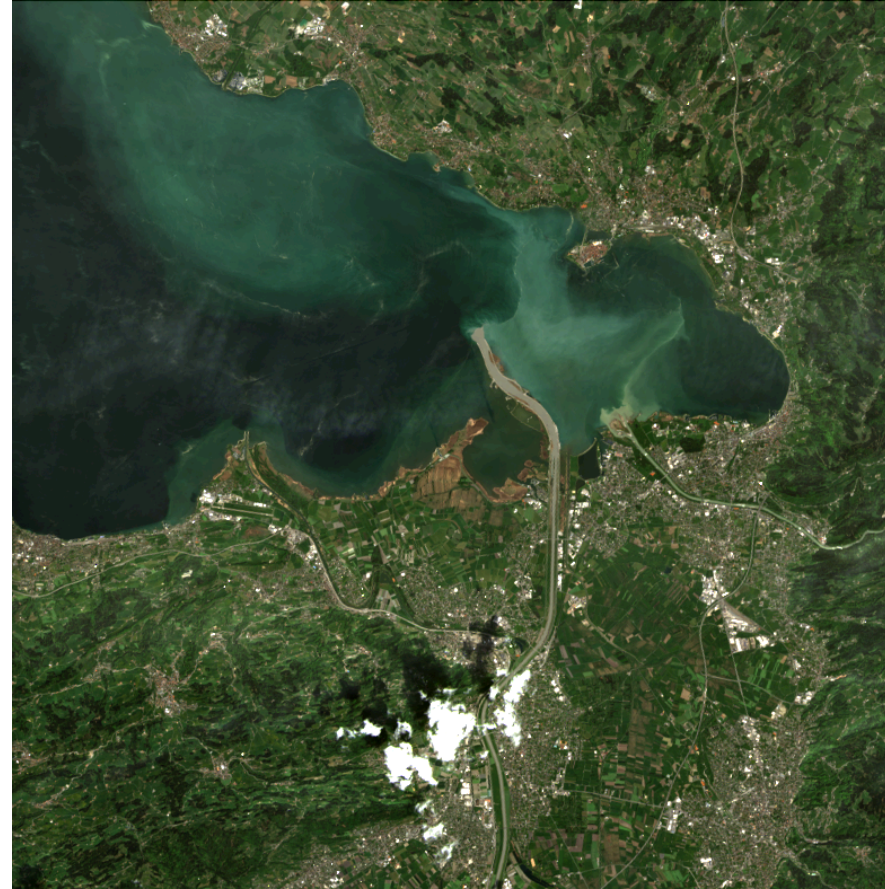
Level 2 TCl, Comparison S2 vs L8 Scene
L2 Processing of Landsat Data needs to be fine-tuned

L2A_T32TNT_A023228_20191203T102415

LC08_L2TP_194027_20180425_20210228_01_T1

Sentinel 2 scene acquired on 3. Dec 2019 at the area of lake Constance vs. equivalent scene acquired on 4. March 2018 with Landsat 8. Both L2A scenes processed with Sen2Cor 3.0 and the same configured Region of Interest around the stream in of the Rhine river in the area of Bregenz.

To Do's

- ❑ The algorithm for the WVP retrieval of the CAMs Data must be consolidated and an optimized strategy for the data retrieval must be established;
- ❑ Some already known issues in the Landsat 8 processing need to be fixed;
- ❑ Metadata output for the Landsat L2A product must be finished;
- ❑ A merge with the parallel development of sen2Cor 2.10 needs to be performed, as the code and the module structure for version 3.0 is considerably different from versions 2.X;
- ❑ Thus, a public Version of Sen2Cor 3.0 needs to follow the release of Sen2Cor 2.10;
- ❑ At current, no validation for Sen2Cor processed Landsat L2A products with respect to Sentinel 2 products can be presented. This will be the topic of upcoming months.

Thank you for your attention !

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