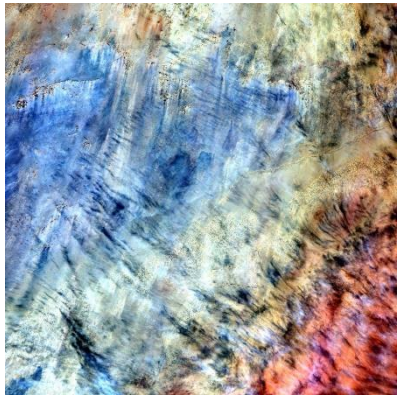
CorA – CORrection of the Atmosphere






Grit Kirches, Martin Boettcher, Gunnar Brandt, Carsten Brockmann,

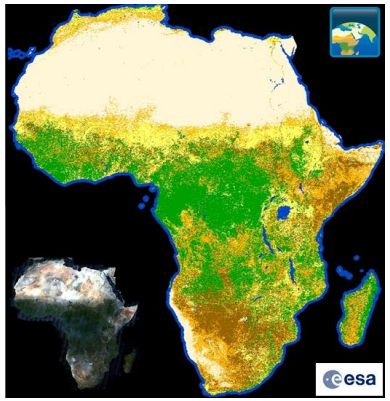
Olaf Danne, Tonio Fincke, Jan Wevers & Kerstin Stelzer

Brockmann Consult GmbH

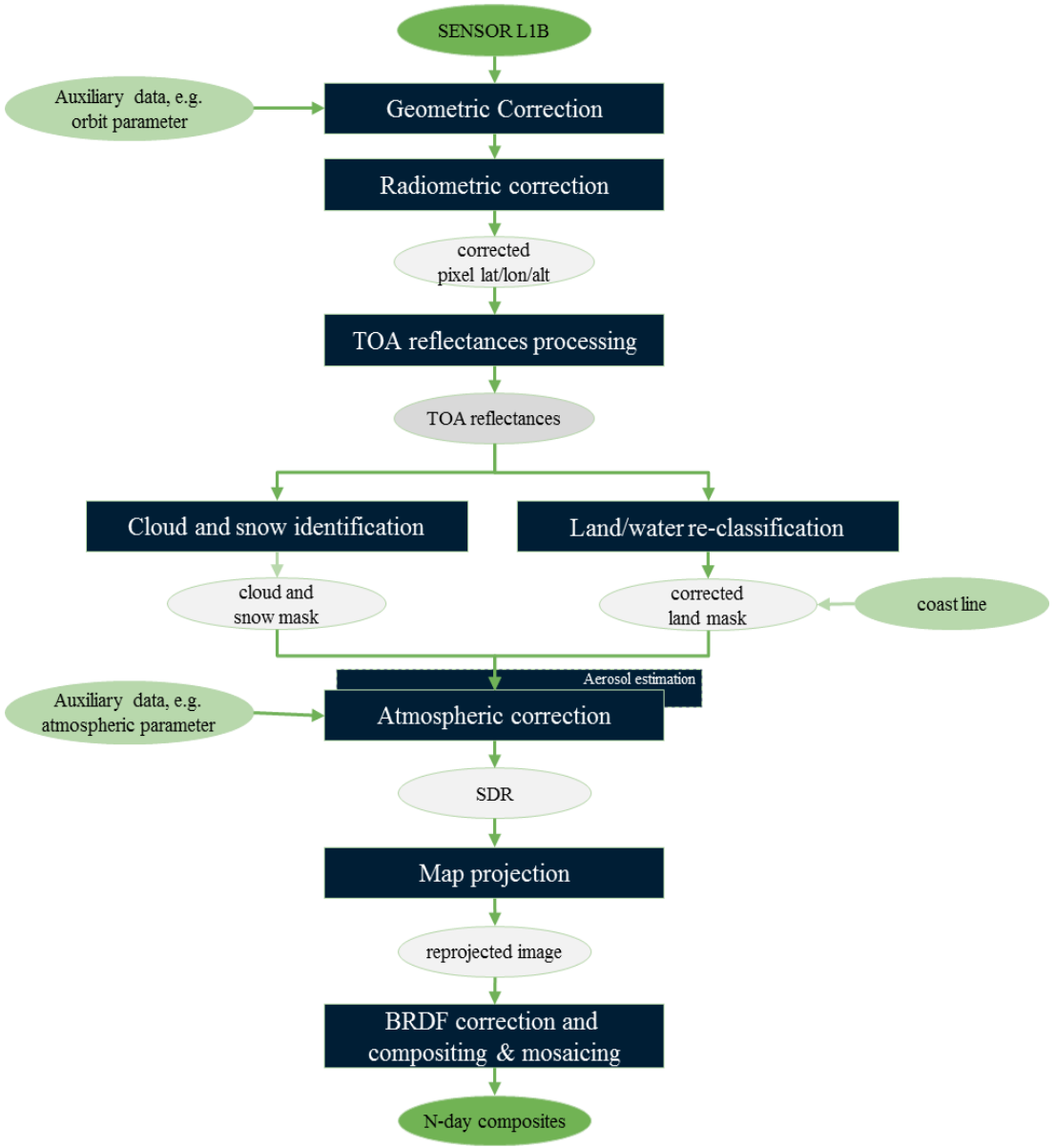
PRE-PROCESSING CHAIN

- Starting from Sensor L1b data (medium resolution) or L1c Sentinel 2 – generating n-day composites of surface reflectance
- System correction:
  - Instrument radiometric corrections
  - Inter-sensor geometric compatibility
  - Inter-sensor radiometric calibration
- Pixel Identification
  - Efficient cloud screening, cloud shadow & reliable land, water and snow discrimination
- Atmospheric Correction
  - Atmospheric conditions
  - Auxiliary data
  - Surface reflectance retrieval
- Uncertainties
- Temporal aggregation and projection
  - BRDF effects
  - Temporal cloud screening

IdePix-Presentation
Jan Wevers
(Brockmann Consult GmbH/Germany)



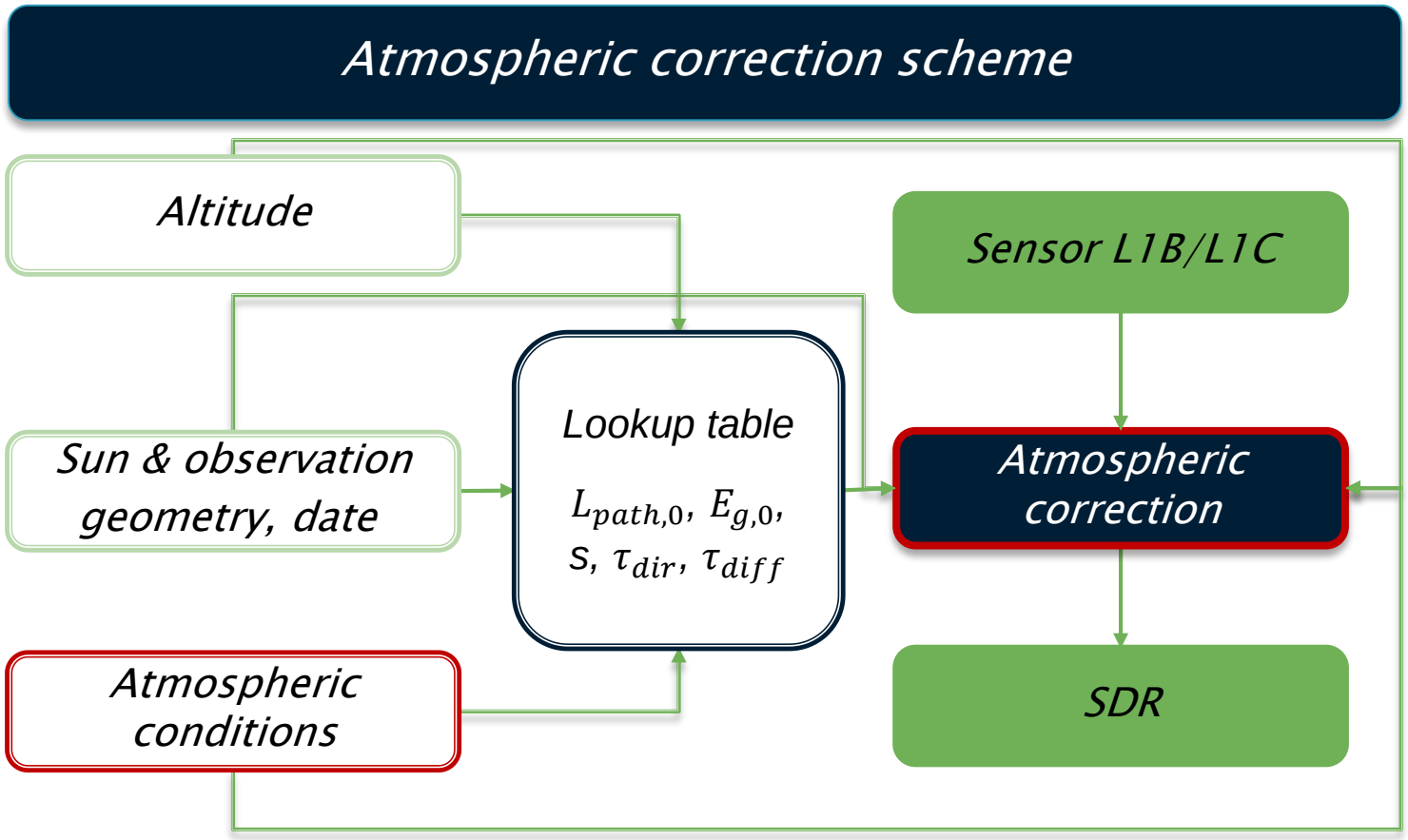
http://2016africalandcover20m.esrin.esa.int/viewer.php



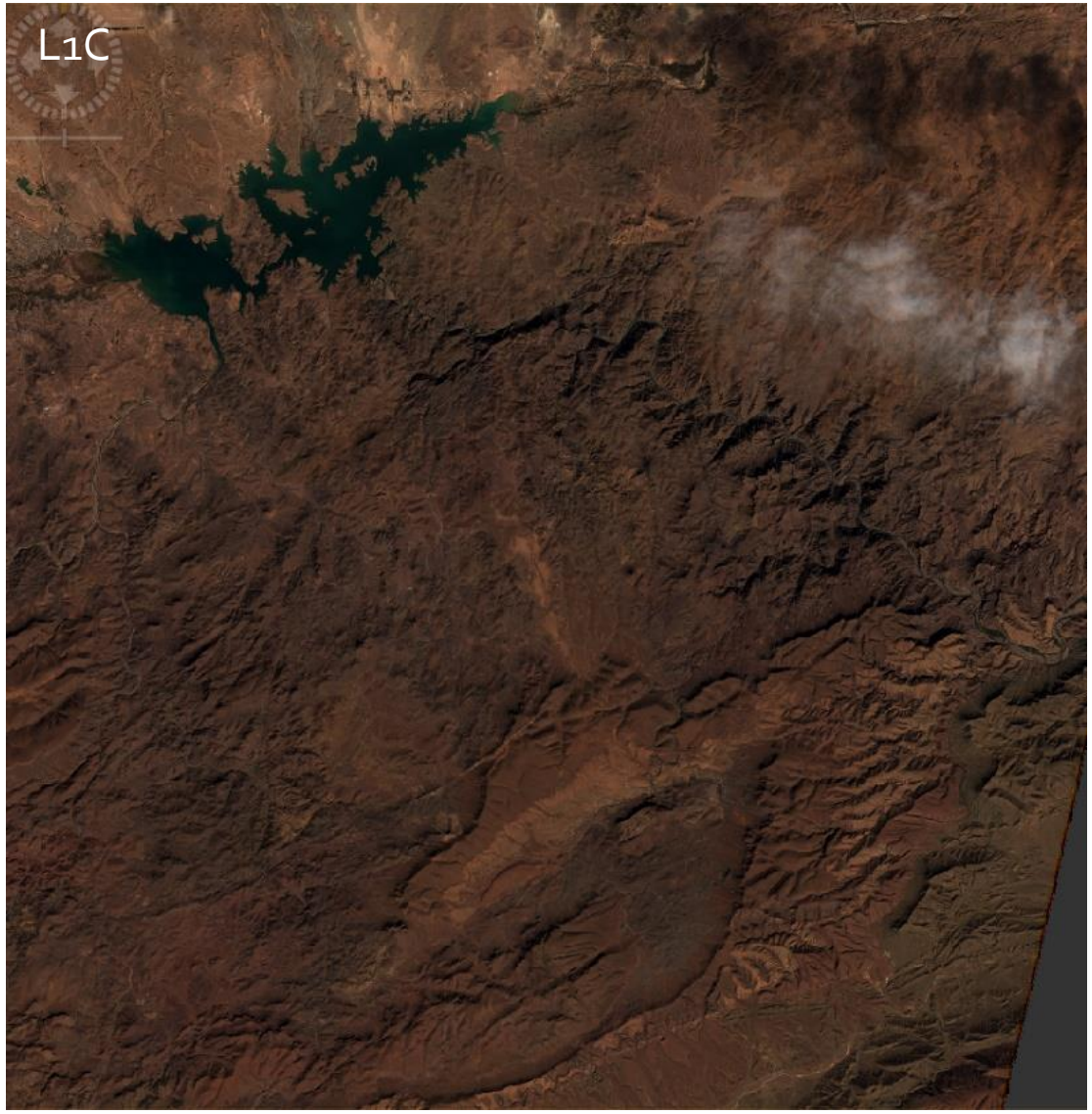
Atmospheric correction over Land

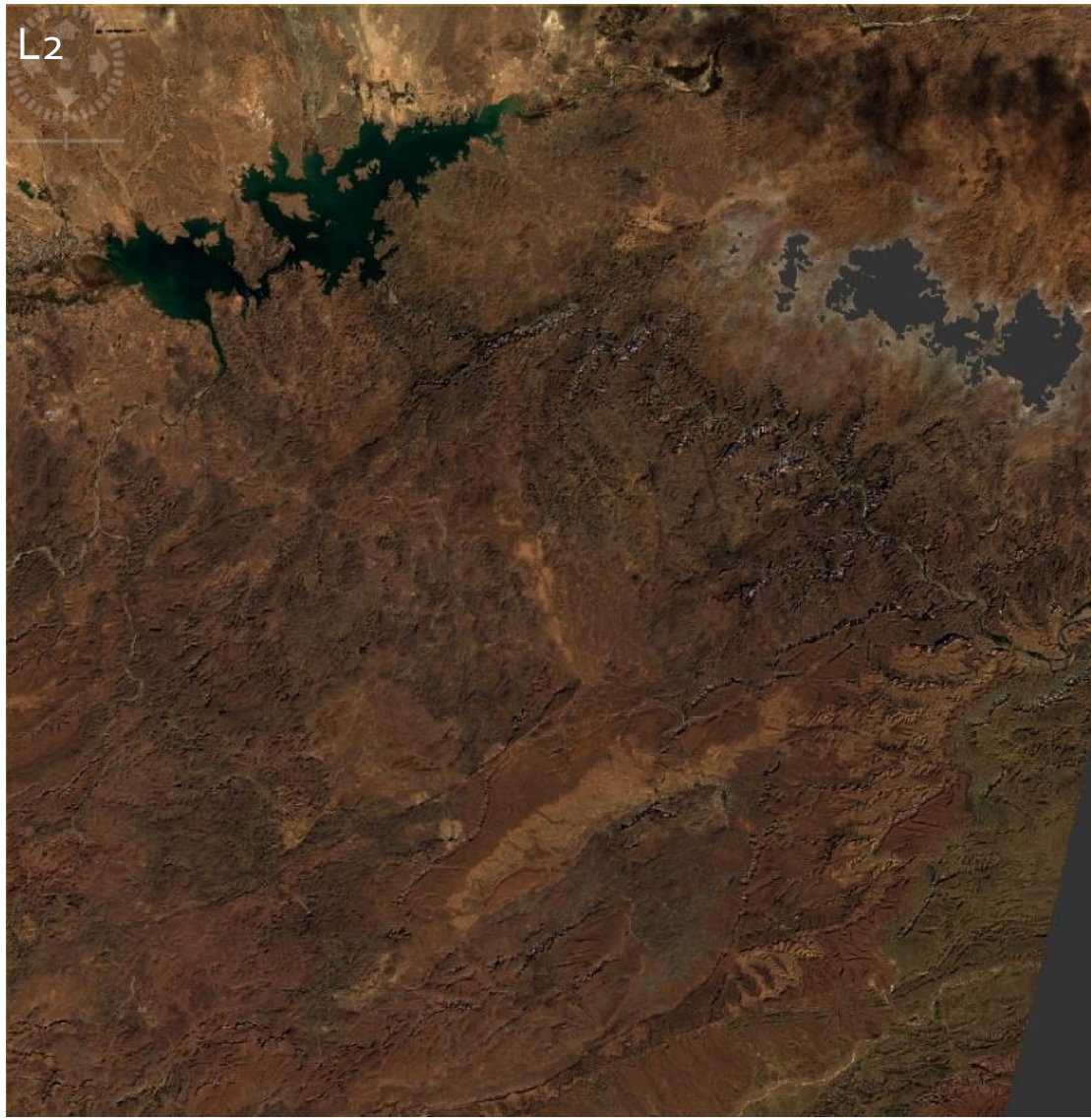
Atmospheric state characterisation & explicit solution of the RT equation

- Medium resolution baseline:
  - Radiative transfer for Lambertian flat homogeneous surface
- High Resolution baseline:
  - Heterogeneous surface, rugged terrain, Lambertian
- Atmospheric conditions
  - Retrieved from sensor observation
  - Auxiliary data set, ERA5, CAMS
  - Aerosol and water vapour retrieval module
- Uncertainty estimation



SENTINEL 2 – SURFACE REFLECTANCE – T29RQQ – QUARZATE LAKE CITY

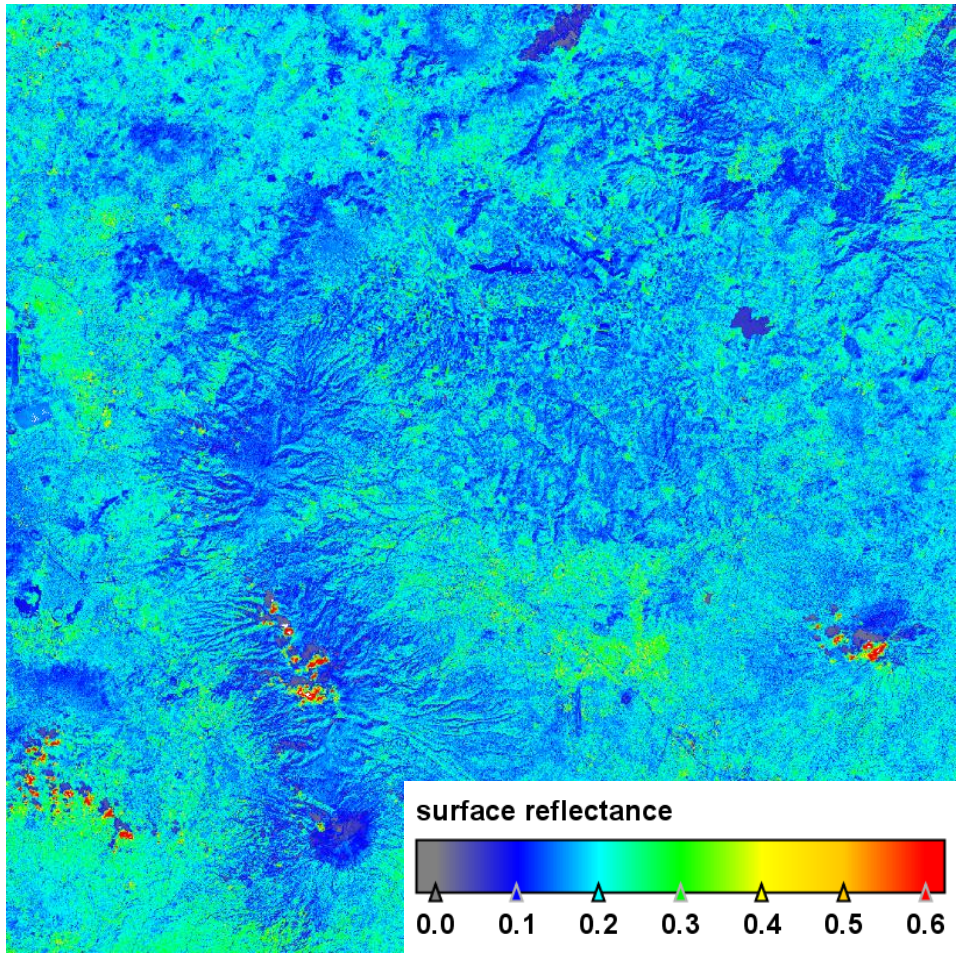




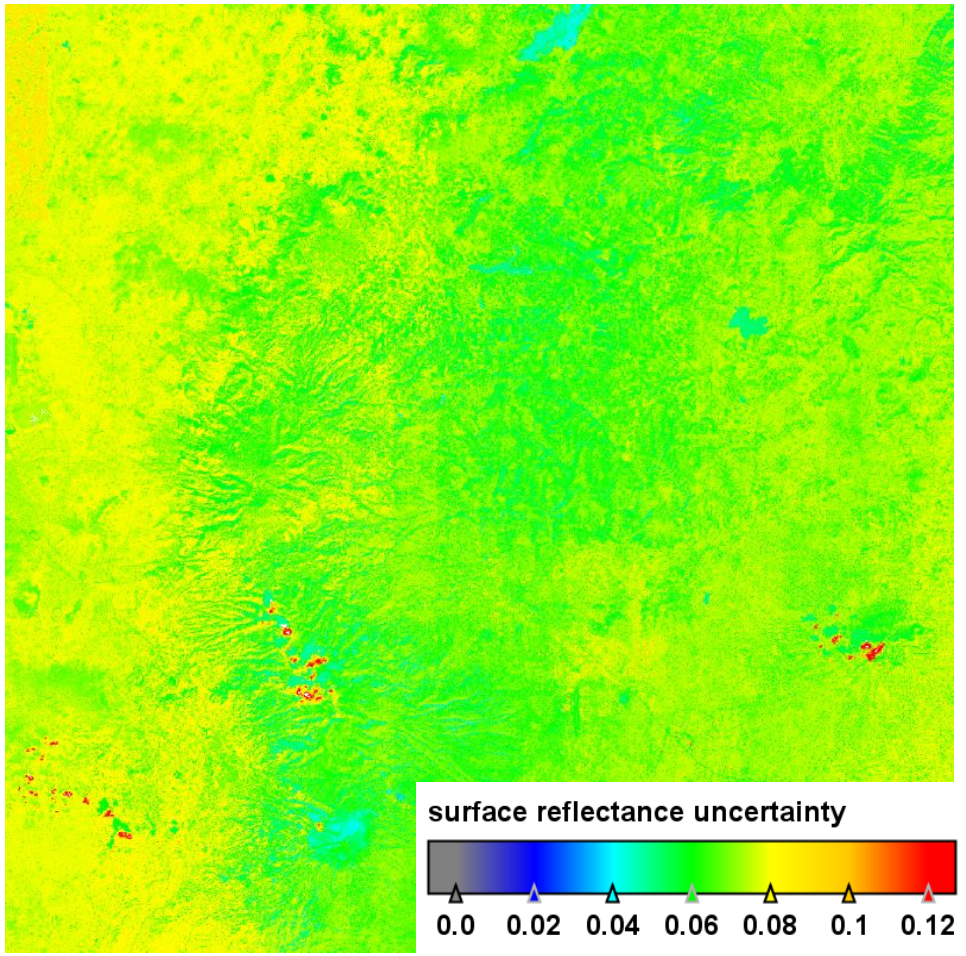
S2A_OPER_PRD_MSIL1C_PDMC_20160204T165714_R094_V20160204T111022_20160204T111022_T29RQQ

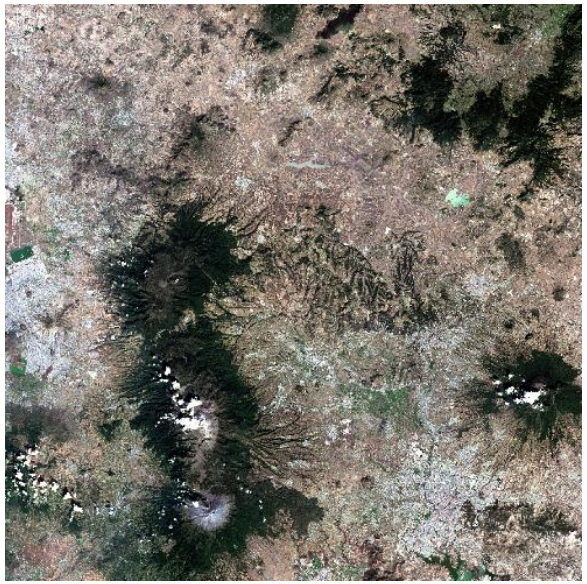
SENTINEL 2 – SURFACE REFLECTANCE & UNCERTAINTY – T14QNG - POPOCATÉPETL

Band 8 surface reflectance



uncertainty





Input: S2A_MSIL1C_20161228T170712_N0204_R069_T14QNG_20161228T171337.SAFE

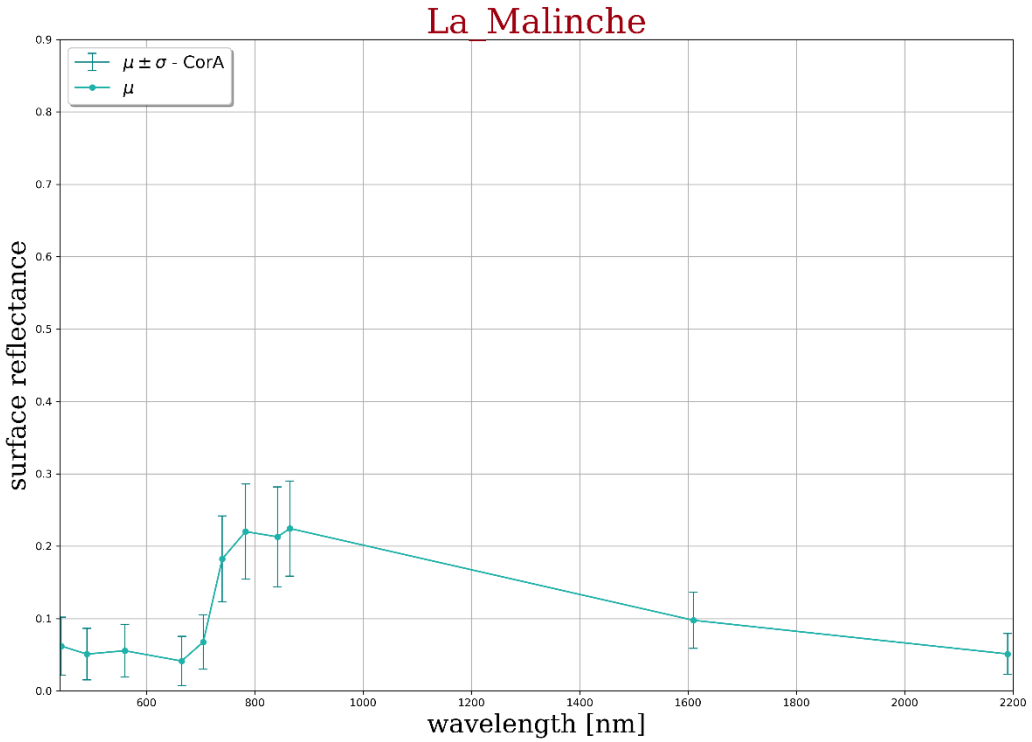
PRODUCT VALIDATION & INTER-COMPARISON

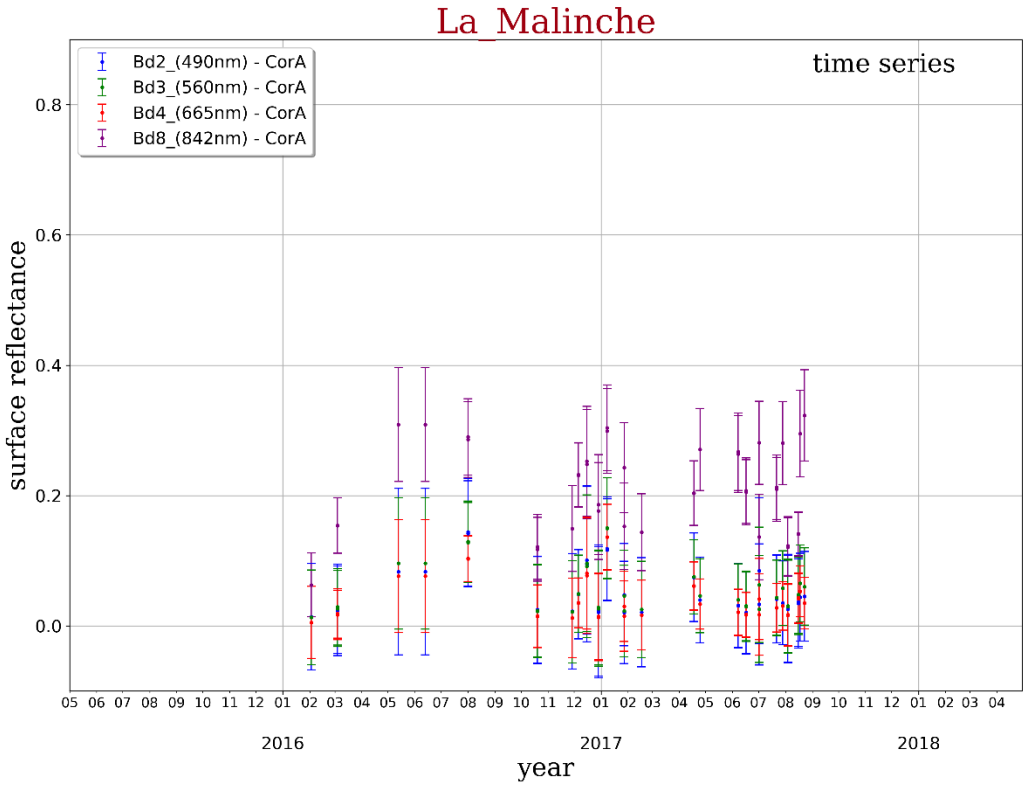
- Products accuracy assessment
  - Temporal variance at the pixel level
  - Local variance within a LC class and across LC classes
  - Intra- and inter-annual reflectance dynamics
  - Validation against in-situ data → RADCALNET
- Visual quality assessment
- Products inter-comparison → CMIX & ACIX
  - Comparison with the Landsat 8 products
  - Inter-comparison with other S2 products

http://www.esa.int/var/esa/storage/images/esa_multimedia/images/2015/03/sentinel-2/15292661-1-eng-GB/Sentinel-2_node_full_image_2.jpg

https://www.radcalnet.org/#!/

VALIDATION OF THE SURFACE REFLECTANCE





Forest - La_Malinche: -98.015,19.254

VALIDATION OF THE UNCERTAINTIES

Approach:

$$\frac{x_{retrieval} - x_{reference}}{\sqrt{\sigma^2_{retrieval} + \sigma^2_{reference} + \sigma^2_{method}}} \approx N(0,1)$$

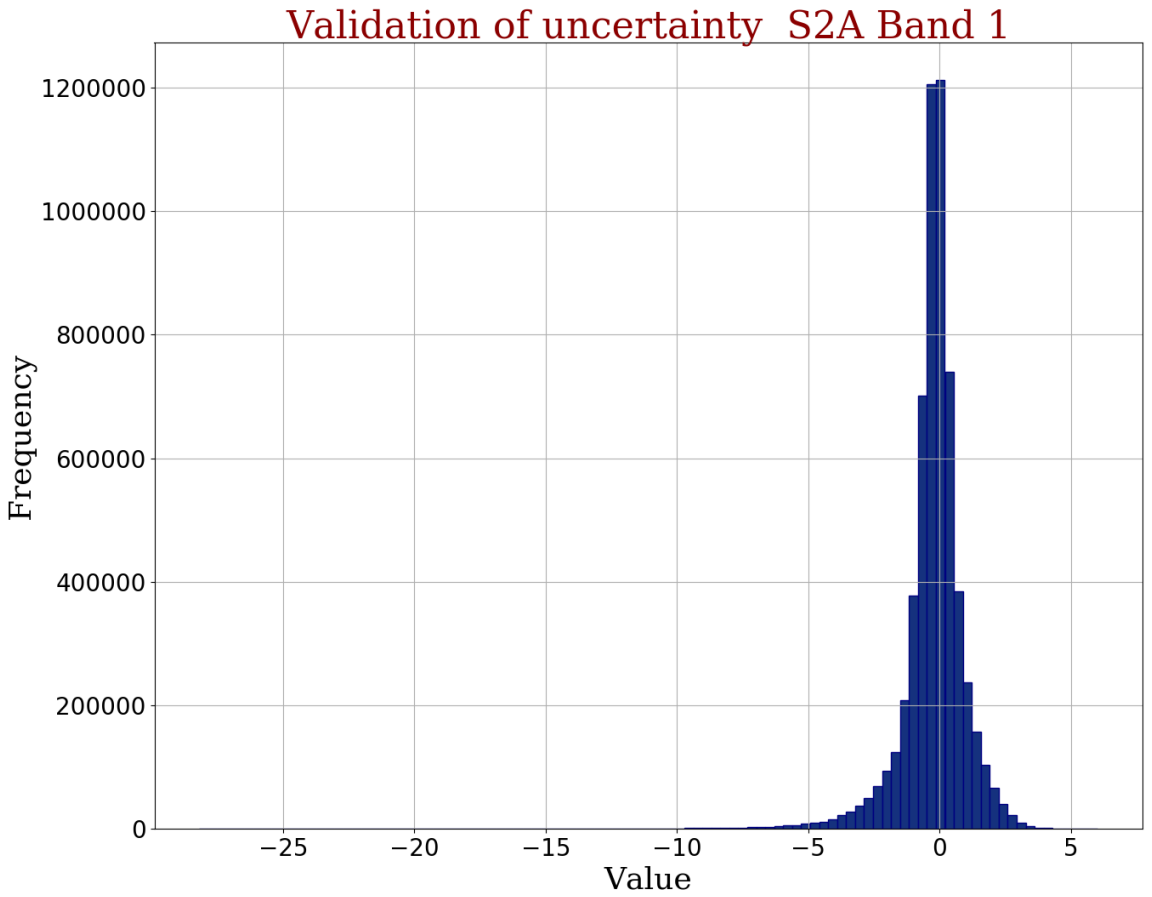
$$N(0,1) = \frac{1}{\sqrt{2\Pi}} e^{-\frac{1}{2}x^2} \quad \text{standard normal distribution}$$

Realisation:

based on simulations, for n cases:

1. SR systematically varied
2. Ensemble of m TOA simulations (MODTRAN) with random variations of atmospheric conditions, geometry, elevation
3. AC

→ n · m couples of true SR and retrieved SR (n · m = ~ 5 970 000)



SUMMARY & CONCLUSION

- **Source data – S2-L1C**
  - Sentinel-2A data quality followed closely
    - ESA Web reports
    - Own QA necessary
- **Careful Pixel Classification - IdePix**
- **AC including aerosol retrieval, terrain and neighbourhood correction**
  - RT Modelling approach using LUTs
  - MODTRAN RT simulations
  - Aerosol & water vapour retrieval from S2 bands and ERA5 & CAMS
- **Uncertainty**
  - Monte-Carlo-Approach
- **Auxiliary data: DEM & Land/water mask**
  - Terrain slope& L/W mask required at 5m spatial resolution
  - no DEM or L/W available to us; fall-back use coarser resolution data
- **Landsat 8**
  - Pre-processing chain is identified as applicable to Landsat 8 with some adaptions

http://www.esa.int/var/esa/storage/images/esa_multimedia/images/2015/03/sentinel-2/15292661-1-eng-GB/Sentinel-2_node_full_image_2.jpg

Thank You For Your Attention!