ACIX-Land Protocol

WHERE?

All the AERONET sites with available measurements, so to get a complete range of climate zones and land cover types for reaching robust conclusions.

WHAT?

The developers are invited to submit the **Quality flags** as part of their products defining the appropriate ones to be included in the inter-comparison process in their technical note. The analysis will be made initially for the pixels that are considered of good quality by all AC processors. Additional inter-comparison investigation will be performed using the corresponding individual quality mask per processor.

To be Discussed

WHAT?

Aerosol Optical Thickness

Water Vapour

Surface Reflectance

Only the ‘quality approved’ pixels
Will be considered in the comparisons
(Quality flags provided by the participants)

How?

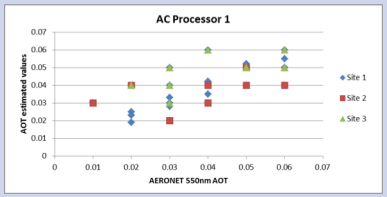
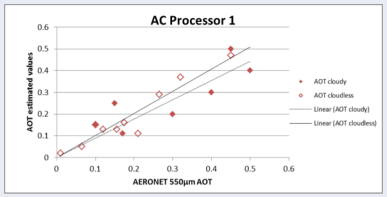
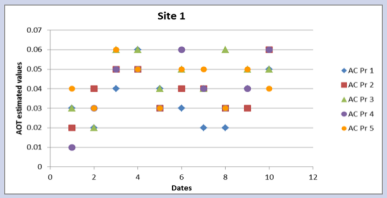
Estimated AOT compared to Level 1.5 (cloud screened) AERONET data

1. Interpolate AERONET values @ λ=550 nm using the Angstrom Exponent
2. Average AERONET values over time period within ±15 min from AOT retrieved values (L-8/S-2 overpass)
3. Average AOT values over an image subset of 9 km x 9 km centred on the AERONET Sunphotometer station

Visualization of Inter-comparison Results

- Scatter plots per date, test site and processor
- Time series plots of the submitted AOT values (y axis) against AERONET (x axis)

How?

Plot	X axis	Y axis	Plot Example
#1: One plot per test site for all the AC processors (including the AERONET value)	Dates	AOT results	
#2: One plot per AC processor & test site, including cloudy and cloudless cases	AERONET measurements	AOT results	
#3: One plot per AC processor for all the test sites	AERONET measurements	AOT results	

How?

The presence of clouds in the image scene will be also taken into consideration, as neighboring cloudy pixels, outside the 9 km x 9 km area of inter-comparison analysis, can affect the AOT and mainly WV retrievals. Therefore, in scatter plot #2 totally clear conditions (<5% cloudiness in the whole image scene) to surrounding cloudy conditions (<65% cloudiness in the whole image scene) will be distinguished

. \ .		AC Processor AOT (20m) - Reference AOT			
	No. of samples	Min	Mean	± rms	Max
Cloudiness	<65%				
Boreal	1	0.035	0.035		0.035
subtropical N	7	0.036	0.226	± 0.140	0.480
Tropical	3	0.016	0.158	± 0.215	0.405
Midlatitude S	3	0.122	0.222	± 0.088	0.282
Total	14	0.016	0.197	± 0.142	0.480
Cloudiness	<5%				
Boreal	1	0.035	0.035		0.035
Tropical	2	0.016	0.034	± 0.026	0.053
Total	3	0.035	0.035	± 0.019	0.053

WHAT?

Aerosol Optical Thickness

Water Vapour

Surface Reflectance

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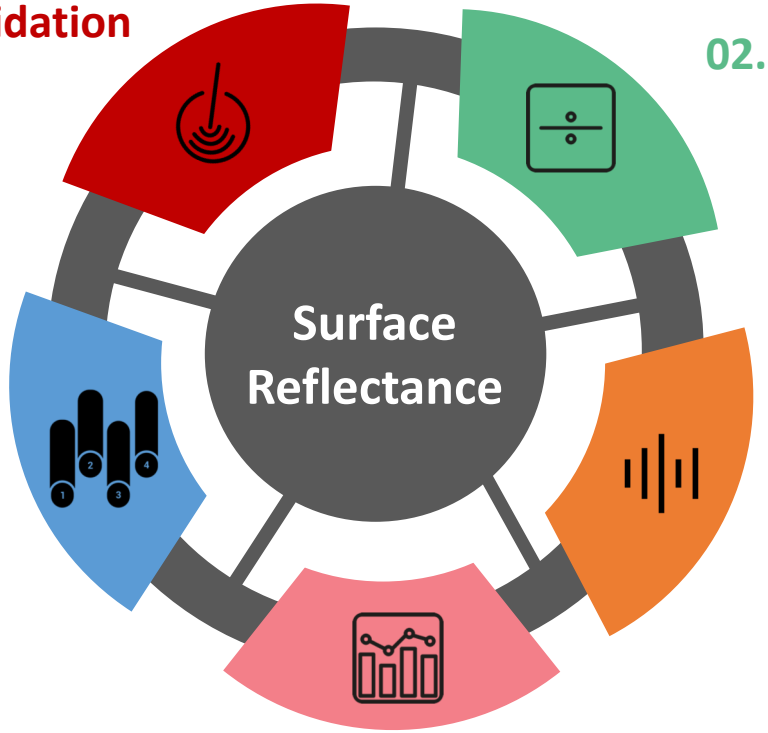
How?

01. Ground based validation

02. Indices



03. Noise Estimation

04. AERONET corrected data

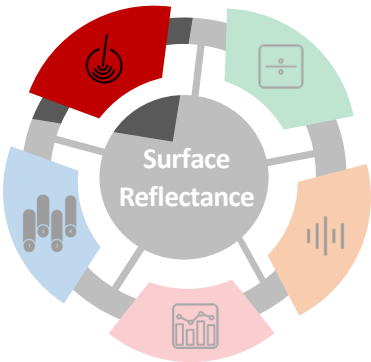
05. SR inter-comparison

How?

01. Ground based validation

Based on **RadCalNet, La Crau (France)** and **Gobabeb (Namibia)**, directional reflectance measurements and the bidirectional reflectance distribution function the SR will be estimated in the same angular conditions as Landsat-8, Sentinel-2A and -2B. Similar to the work done by CNES

Rouquié, B.; Hagolle, O.; Bréon, F.-M.; Boucher, O.; Desjardins, C.; Rémy, S. Using Copernicus Atmosphere Monitoring Service Products to Constrain the Aerosol Type in the Atmospheric Correction Processor MAJA. *Remote Sens.* **2017**, *9*, 1230.



How?

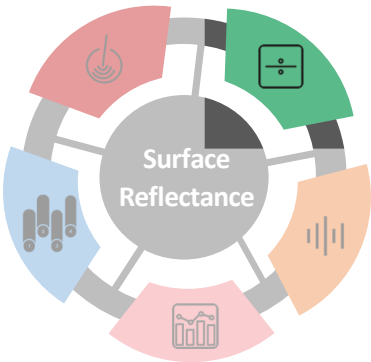
02. Indices

NDVI, NDWI and EVI will be calculated based on the SR products. Similar directional effects are in the visible and near infrared bands, and therefore by estimating their ratio the effect will be reduced.

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

$$NDWI = \frac{NIR - SWIR}{NIR + SWIR}$$

$$EVI = \frac{2.5 * (NIR - Red)}{NIR + 6 * Red + 7.5 * Blue + 1}$$



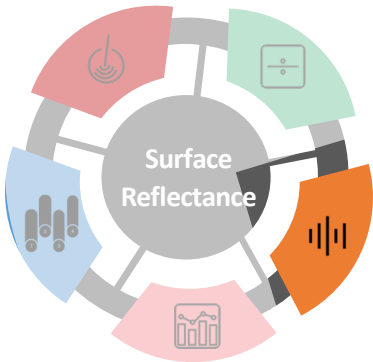
How?

03. Noise Estimation

This estimate assumes that there is a linear SR variation between two consecutive acquisition days. So, for three successive observations, the statistical difference between the center measurement and the linear interpolation between the two extremes quantifies the “noise” :

$$Noise(y) = \sqrt{\frac{\sum_{i=1}^{n-2} \left(y_{i+1} - \frac{y_{i+2} - y_i}{d_{i+2} - d_i} \ (d_{i+1} - d_i) - y_i \right)^2}{N - 2}}$$

Vermote, E. F., Justice, C. and Breon, F.-M. Towards a generalized approach for correction of the BRDF effect in MODIS directional reflectance. IEEE Trans. Geosci. Rem. Sens. 47, 898–908 (2009).



How?

04. AERONET corrected data

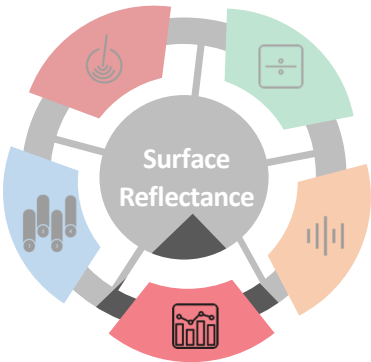
AC data generated by 6S radiative transfer model using AERONET data. AOT, aerosol model and column water vapour will be derived from AERONET sunphotometer measurements and will be used in the radiative transfer model in order to perform the AC of TOA reflectance.

The statistical metrics accuracy, precision and uncertainty will be then estimated:

Accuracy (A): $A = \frac{1}{n_\lambda}\left(\sum_{i=1}^{n_\lambda} \Delta\rho_{i,\lambda}^{SR}\right)$

Precision (P): $P = \sqrt{\frac{1}{(n_\lambda - 1)}\left(\sum_{i=1}^{n_\lambda} \Delta\rho_{i,\lambda}^{SR} - A\right)^2}$

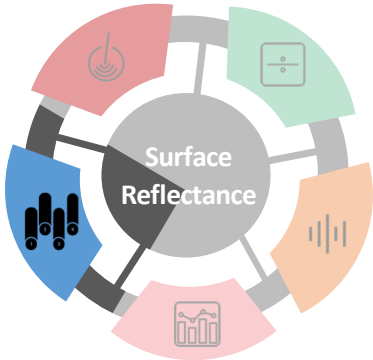
Uncertainty (U): $U = \sqrt{\frac{1}{n_\lambda}\sum_{i=1}^{n_\lambda}(\Delta\rho_{i,\lambda}^{SR})^2}$



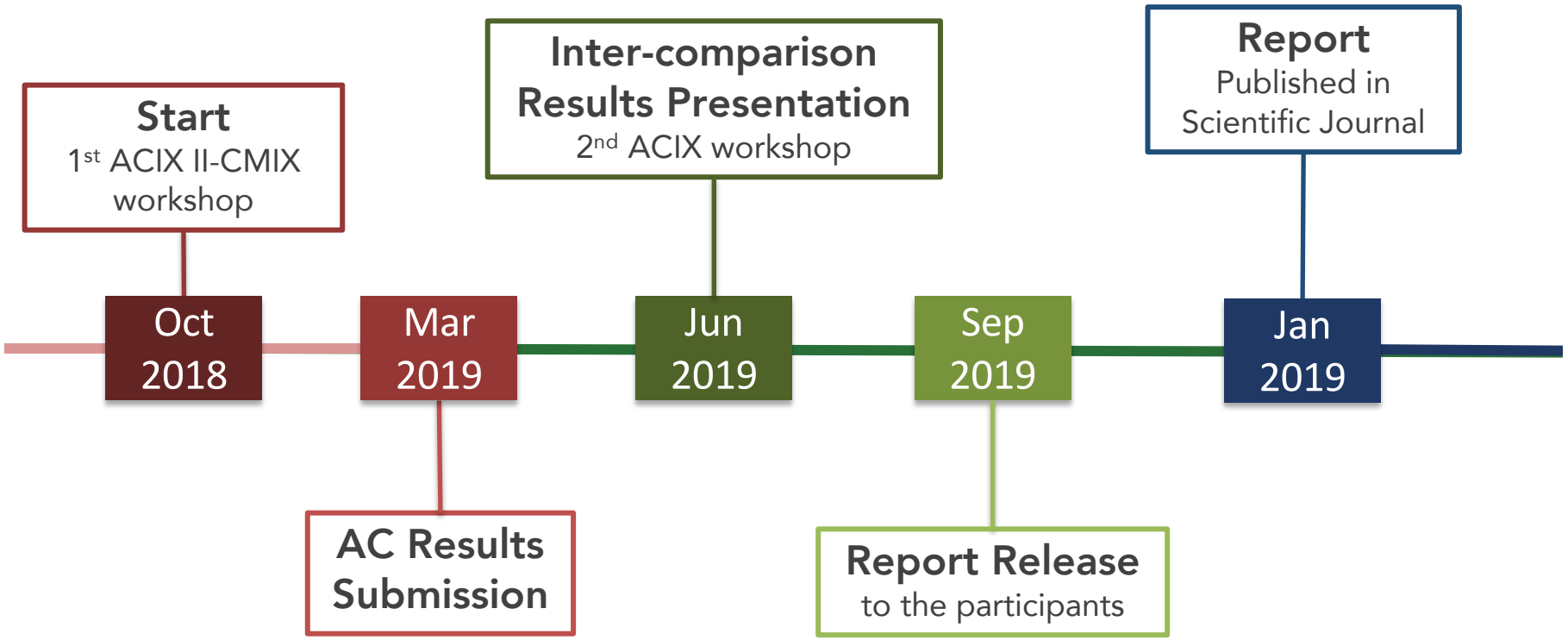
How?

05. SR inter-comparison

Plotting the SR time series per date, band and AC approach. A distance N x N matrix will be also created, where N is the number of AC processors. The rows and the columns headings will be the names of the participating models. The elements of the matrix will be the normalized distances between the resulting BOA values of a 9 km x 9 km subset (same as in §5.1) averaged over the available dates.



When?


Start
1st ACIX II-CMIX workshop
Oct 2018
Mar 2019
AC Results Submission
Inter-comparison Results Presentation
2nd ACIX workshop
Jun 2019
Sep 2019
Report Release
to the participants
Report
Published in Scientific Journal
Jan 2019

Thank you very much!

https://earth.esa.int/web/sppa/meetings-workshops/hosted-and-co-sponsored-meetings/acix-ii-cmix