SENTINEL 2
Mission Performance Centre

esa

European Commission

NEXT UPDATES OF ATMOSPHERIC CORRECTION PROCESSOR SEN2COR

SPIE REMOTE SENSING DIGITAL FORUM

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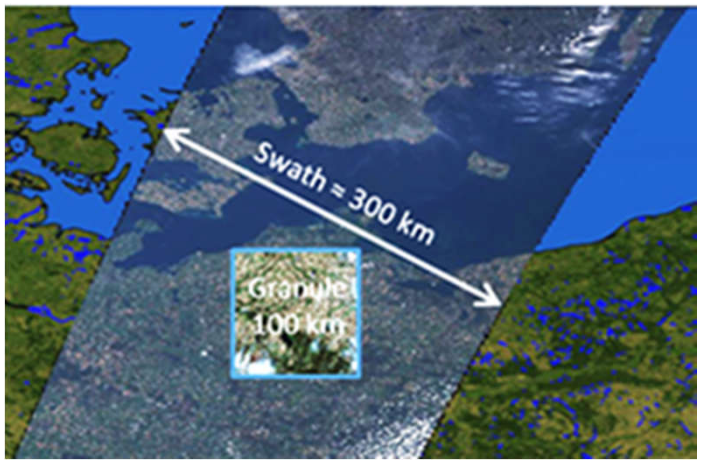
OUTLINE 'NEXT UPDATES OF ATMOSPHERIC CORRECTION PROCESSOR SEN2COR'

1. Sen2Cor – processor overview
2. Sen2Cor history
3. Scene classification
4. AOT and WV retrieval
5. Surface reflectance estimation
6. Conclusions and Recommendations

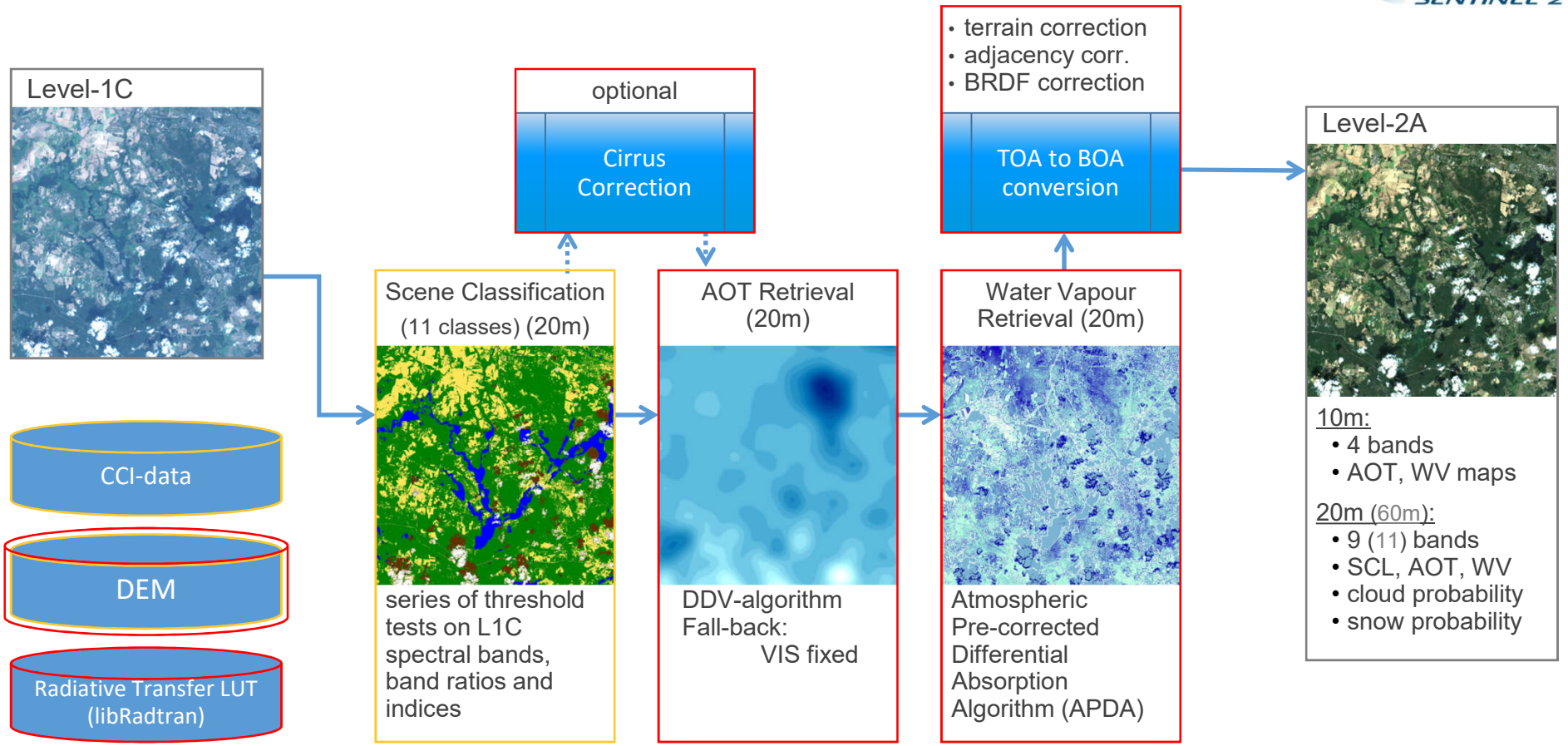
SEN2COR PROCESSOR OVERVIEW

- Atmospheric correction processor for **Sentinel-2 data**
- Atmospheric Correction over **land surface**
- Processing **mono-temporal** orthorectified L1C **granules**



- **ESA-L2A CORE PRODUCT:** L2A-generation performed in the S2-PDGS, (Planet DEM; 10m/30m/90m Copernicus DEM; more frequent updates; product format and generation differs); can be downloaded from OpenHub: https://scihub.copernicus.eu/dhus/#/home.
- **'USER' PRODUCT:** L2A-generation by the user by command line processing or via SNAP Toolbox plugin (SRTM resp. user DEM; 90m Copernicus DEM); Available from: http://step.esa.int/main/third-party-plugins-2/sen2cor

SEN2COR PROCESSING CHAIN



SEN2COR HISTORY

- Scene classification using ESA **CCI** Data package
- Improved AOT estimation
- **Updated LUT** for S2A spectral response v3.0
- Merge with evolutions of core production
- Option to disable terrain correction using a DEM

Nov. 2017 | March 2018 | May 2019

Sen2Cor 2.4.0 → Sen2Cor 2.5.0 → Sen2Cor 2.5.5 → Sen2Cor 2.8.0

'user' production (public versions)

ESA core production for Europe

Sen2Cor 2.4.0 → Sen2Cor 2.5.0 ? → Sen2Cor 2.6.1 … → Sen2Cor 2.6.3 … → Sen2Cor 2.6.6 → Sen2Cor 2.7.x → Sen2Cor 2.8.0

Nov. 2017 | Feb. 2018 | 24. April 2018 | 8. Oct. 2018 | 6. May 2019

- Improved AOT estimation
- Designed for PDGS processing
- **Updated LUT** for S2A spectral response v3.0
- RAM optimization
- Scene classification using ESA **CCI** Data package
- **Blue path radiance** rescaling -> **OFF**
- Topographic correction under clouds disabled
- **PDGS optimizations**

- Source: S2-PDGS-MPC-L2A-SRN-V2.8.pdf;Sentinel-2-L2A-Data-Quality-Report.pdf

SEN2COR 2.8 SCENE CLASSIFICATION PERFORMANCE AND OUTLOOK

- Reference mask for 20 granules:
  (by visual inspection and labelling of pixels or polygons)

	clear	shadows	clouds		UA	CE
clear	287 480	5 080	10 247		94.9%	5.1%
shadows	2 611	13 433	150		83.0%	17.0%
clouds	4 908	165	47 859		90.4%	9.6%
PA	97.5%	71.9%	82.2%		**OA**	
OE	2.5%	28.1%	17.8%		94%	

+ High OA (94%), low omission (2.5%) and commission (5.1%) of clear pixels

– 10 000 cloud pixels classified as clear

– 17% commission of shadows
('dark features' mapped to shadows)

– 28% omission of shadows
(cloud shadow; generic cloud top height distribution)

➢ cloud/cloud shadow/snow dilation; bright isolated pixels identification

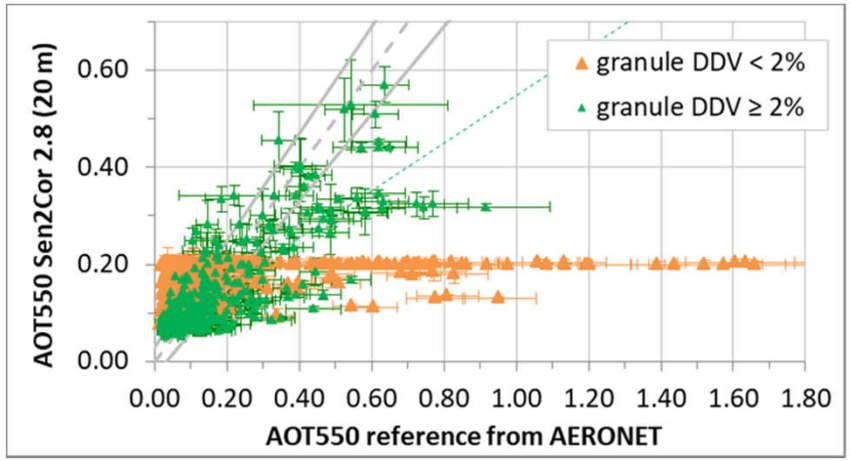
➢ Reduction of class 'dark features' to topographic shadows

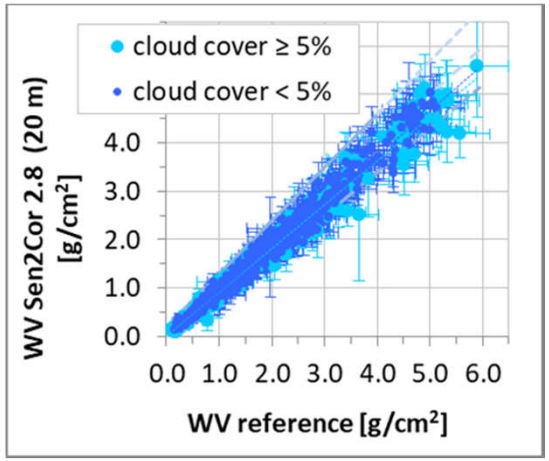
➢ Update of cloud shadow algorithm with cloud top height estimation

SEN2COR 2.8 AOT AND WV RETRIEVAL PERFORMANCE

- Reference: sunphotometer measurements of AERONET sites
  (AERONET: interpolated to 550 nm; time averaged over ±15 min to overpass time)
  (Sen2Cor: spatially averaged over 9x9 km2 area; only clear land surface pixels)

› **Green triangles**: Results for **DDV**-algorithm
› **Orange triangles**: **fall-back** processing
› **solid lines**: Specification $|\Delta AOT550| \leq 0.1*AOT550_{ref}+0.03$
› **Dashed line**: Sen2Cor_output = Reference
› Linear trend lines for DDV and fall-back





› **Blue Circles**: Results for **cloud cover <5%**
› **Cyan circles**: Results for **cloud cover ≥ 5%**
› **solid lines**: Specification $|\Delta WV| \leq 0.1*WV_{ref}+0.2$
› **Dashed line**: Sen2Cor_output = Reference
› Linear trend line

	Uncertainty
• AOT complete set	±0.24
• AOT DDV subset	±0.11
○ AOT fall-back subset	±0.29

➢ New fall-back solution

	Uncertainty
• WV	±0.24 g/cm²

+ Difference between ESA L2A core product and 'user' product not significant

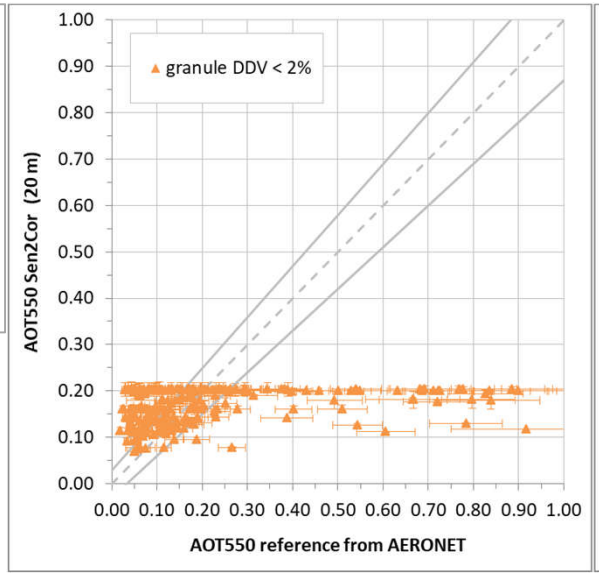
SEN2COR: NEW FALL-BACK SOLUTION FOR AOT RETRIEVAL

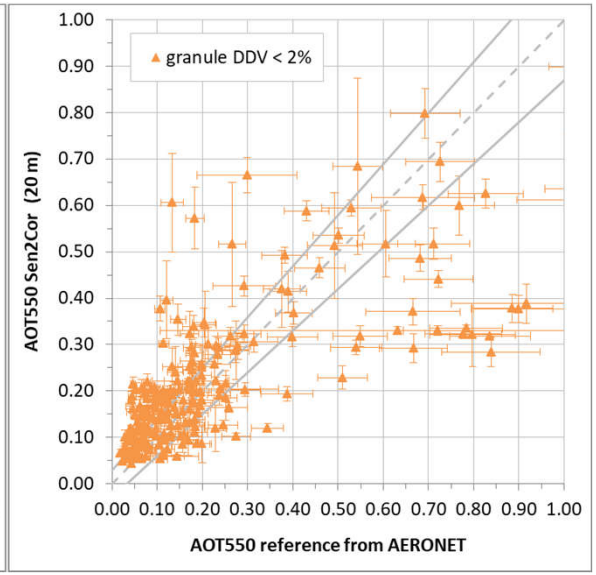
- Reference: sunphotometer measurements of AERONET sites
  (AERONET: interpolated to 550 nm; time averaged over ±15 min to overpass time)
  (Sen2Cor: spatially averaged over 9x9 km2 area; only clear land surface pixels)

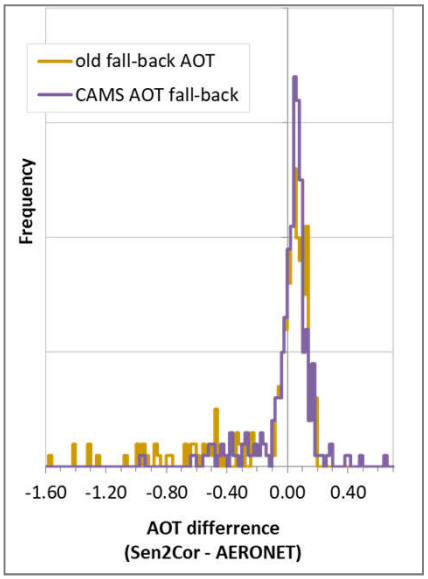
Current fall-back:
fixed, pre-defined AOT (0.2 at sea level)

New fall-back:
AOT from CAMS product

- **Orange triangles**: **fall-back** processing
- **solid lines**: Specification $|\Delta AOT550| \leq 0.1*AOT550_{ref}+0.03$
- **Dashed line**: Sen2Cor_output = Reference
- Linear trend lines for DDV and fall-back





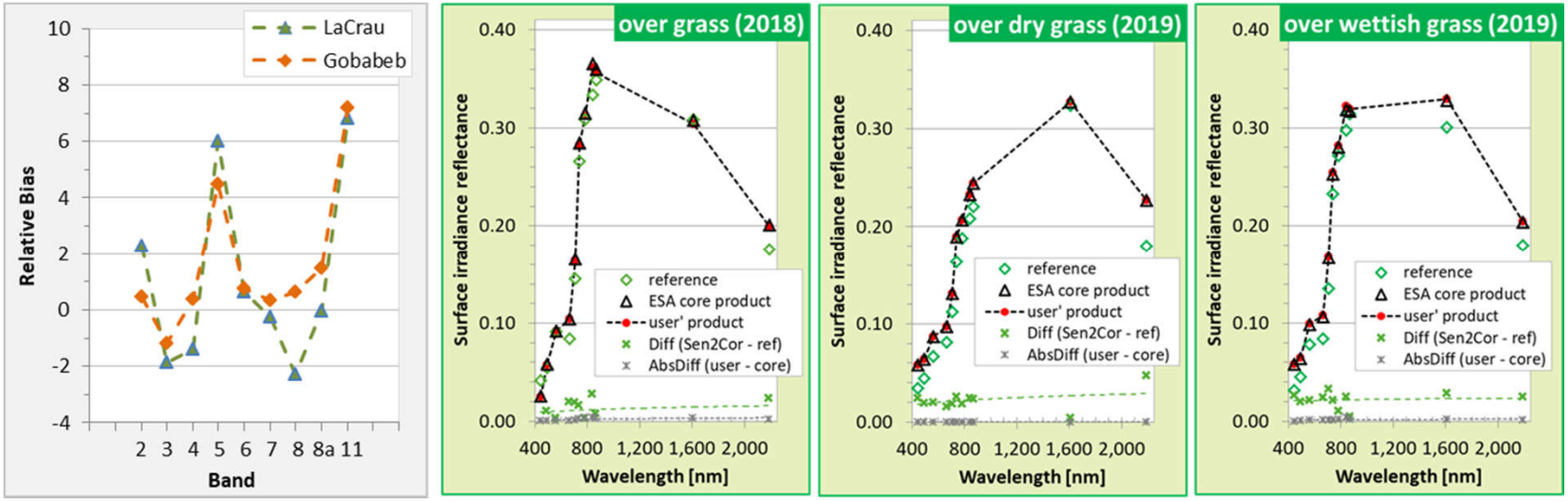


Uncertainty ±0.35

Uncertainty ±0.19

SEN2COR 2.8 SURFACE REFLECTANCE ESTIMATION

- Reference: SR measurements at RADCALNET sites LaCrau and Gobabeb
  own measurements for vegetated sites [copy from ACIX-2]

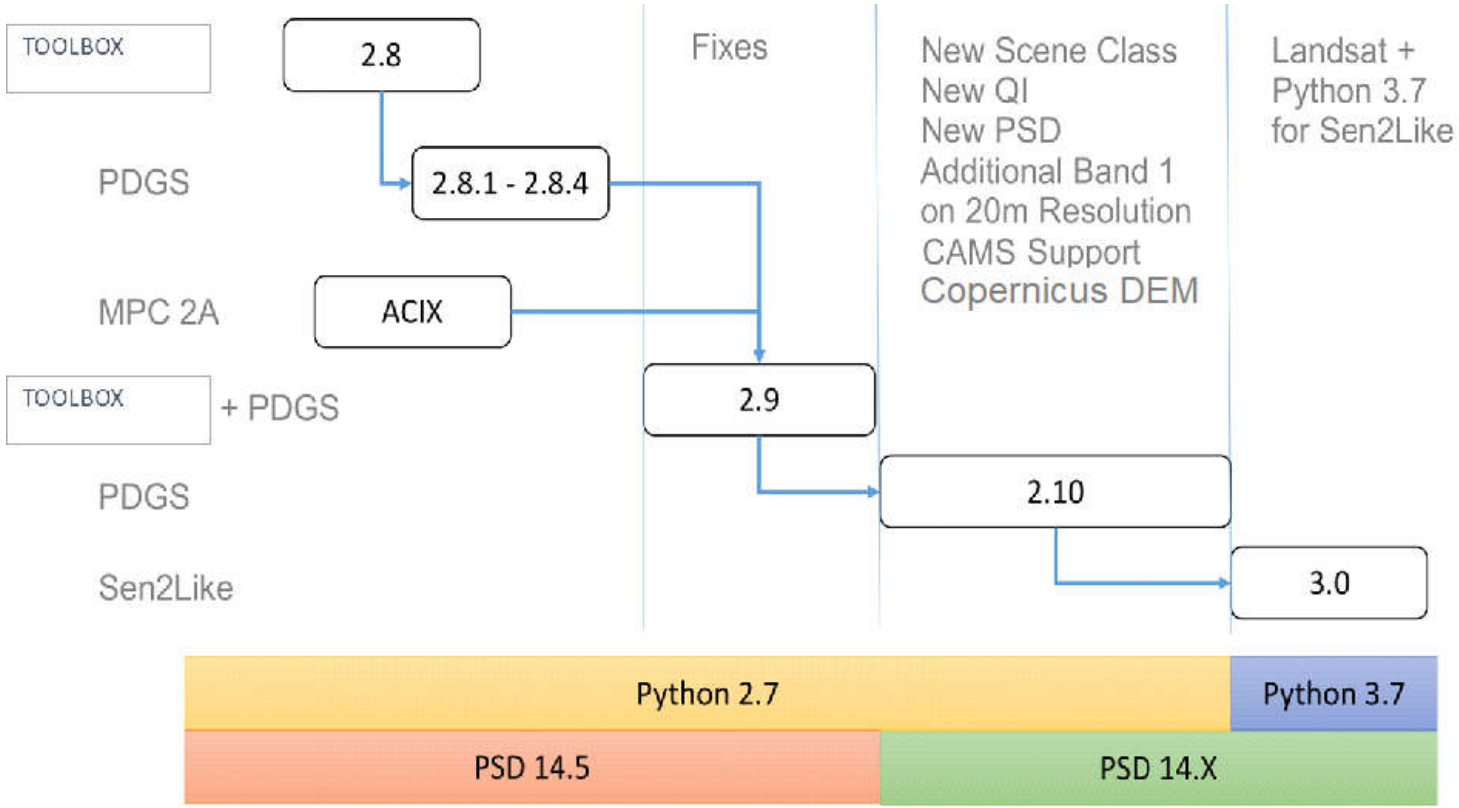


+ almost within ±2% of measured reference data
− except bands 5 and 11

+ Shape of spectra (Pearson correlation >0.99)
± Little undercorrection of SR (0.015 < RMSD < 0.025)
? Bands 5 and 11 not worse

+ ESA L2A core product and 'user' product give equivalent SR spectra

L2A Products Evolution Outline



CONCLUSIONS AND RECOMMENDATIONS

- good performance of Sen2Cor for all of scene classification, WV retrieval and SR estimation
- Several updates of the processor on the way

- ESA L2A core product gives equivalent results to 'user' products
- core product:
  - easiest way to get L2A-products
  - based on a default configuration
- 'user' product
  - opportunity to process with non-default configuration.
  - Can be used to generate a homogenous time series for an area of interest.

- Monthly L2A data quality report:
  https://earth.esa.int/web/sentinel/user-guides/sentinel-2-msi/document-library/

THANK YOU!
BYE BYE!

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