



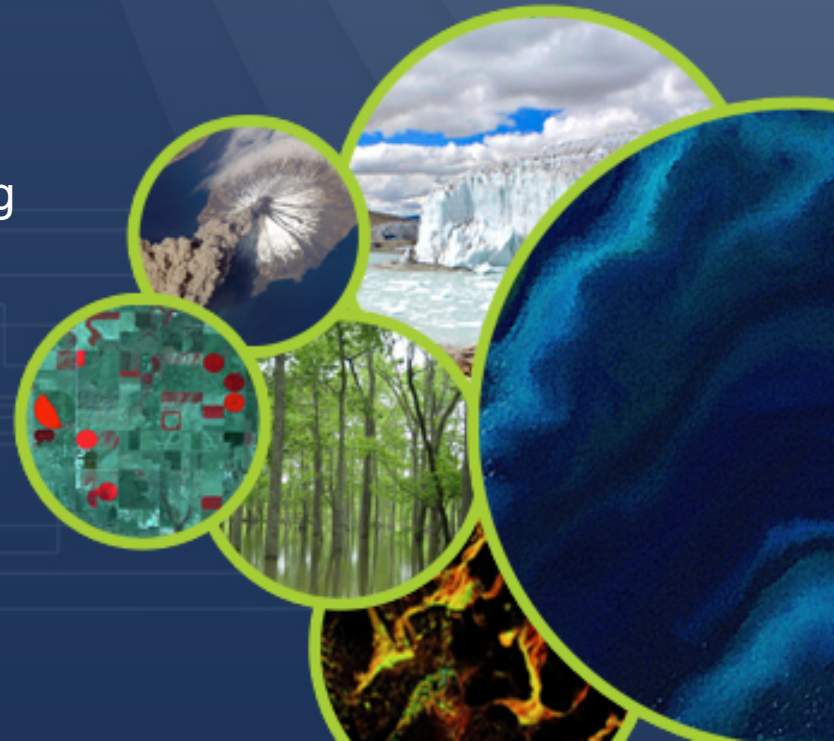
WGCV-47 ESA report

Philippe Goryl

ESA/ESRIN

CEOS WGCV 15 July 2020 – Virtual Meeting

Working Group on Calibration and Validation



ESA-Developed Earth Observation Missions

Overall satellite planning

Recent launches, commissioning status

15 Satellites in operations

Last launch was **Aeolus - Launched 22 Aug. 2018**, Wind Mission, First ever UV LIDAR in Space

. Aeolus achieved a number of important milestones recently. ECMWF has started assimilating Aeolus wind products into their operational forecasting system in Jan 2020, following the evidence of a very positive impact on the forecasts

. Novel bias correction method has been implemented recently → **public data release, planned in May.**

25 satellites are under development

Forthcoming launches:

Copernicus: Sentinel-6 Michael Freilich Mission — formerly Sentinel-6 / Jason-CS : Q4 2020

EarthCARE, BIOMASS planned for 2022, FLEX in 2024, Altius in 2024.

Sentinel-1C: 2022, Sentinel-2C 2022/23, Sentinel-3C 2023, Sentinel-5 2021, Sentinel-4 2022

MTG 2021-2032, MetOp SG 2023-2038

Small Sat: SCOUT , Phi-SAT (in 2021).

Major satellite events

PROBA-V ends its operational phase in June 2020. Experimental Phase will start (Africa 100 m).

Satellites

25 under development

15 in operation

2025

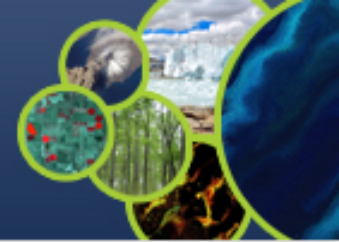
2030

Science

Copernicus

Meteorology

EUMETSAT



Over 11 new Satellites at *Space19* 



Earth Explorer 9

FORUM

Far-infrared-Outgoing-Radiation
Understanding and Monitoring

Small Missions

1-2 SCOUTS
and
2-4 Φ -sats



Copernicus

6 ESA-funded Sentinels
(+ 6/7 EU-funded recurrent)



TRUTHS

Phase A/B1

ARCTIC WEATHER

ALTIUS

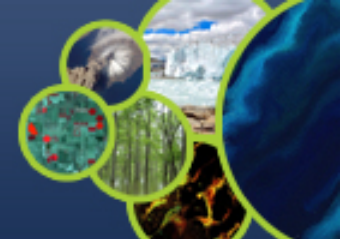
Phase E

Proba-V

Exploitation + 2 Smallsat

Prepare future Missions

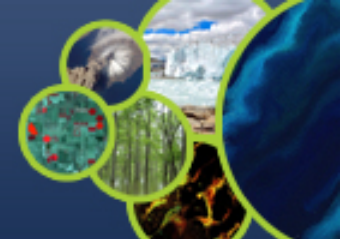
Sentinels NG Phase AB1 in FutureEO
Aeolus follow-on, Earth Explorer-10,
Next Generation Gravity Mission with NASA



Copernicus: 6 HPCM and Status



Mission	RFP Publication	Status
CHIME	24 July 2019	Closed on 13 Jan. 2020
LSTM	24 July 2019	Closed on 13 Jan. 2020
CRISTAL	4 Oct. 2019	Issued (closing 2 March 2020)
CO2M	4 Oct. 2019	Issued (closing 3 March 2020)
CIMR	18 Oct. 2019	Issued (closing 16 March 2020)
ROSE-L	1 Nov. 2019	Issued (closing 16 March 2020)
TEB		mid May 2020
PB-EO		19-20 May 2020
Joint CC-PBEO		June 2020 (tbc)
IPC		17-18 June 2020



Product	Status	Comments	
Sentinel-3 SLSTR	1st official coefficients	Technical Note under review/approval	

4 different analysis of SLSTR top-of-atmosphere radiances over stable reference sites.

The analyses show good agreement within the reported uncertainties.

Combined weighted → provide vicarious adjustment factors to align SLSTR reflectances to MERIS and MODIS Aqua L1 calibrations. **This is on the basis that MERIS and MODIS calibrations have been assessed over many years and are considered as reference sensors in the VIS/SWIR.**

- RAL Space for the MPC comparisons with AATSR and MODIS-A over desert sites.
- CNES assessment using the SADE/MUSCLE vicarious calibration system.
- Radiative Transfer Modelling of the Libya-4 desert site by Rayference .
- University of Arizona comparisons against in-situ field measurements of the Railroad Valley Playa RadCalNet site.

Technical Note: Assessment of Visible and Short Wavelength Radiometric Calibration using Vicarious Calibration Methods, MPC, 2020

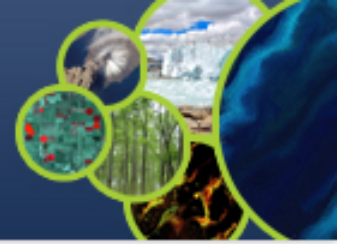
18-19 May 2020

Nadir View

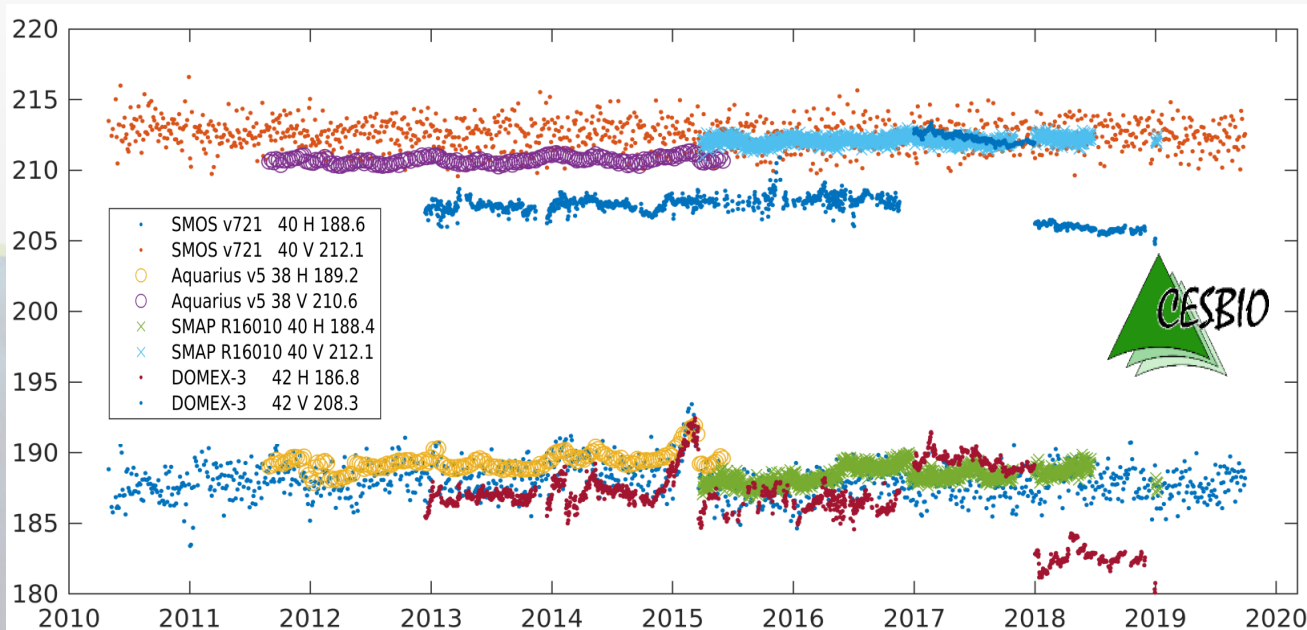
	S1	S2	S3	S5	S6
Correction	0.97	0.98	0.98	1.11	1.13
Uncertainty	0.03	0.02	0.02	0.02	0.02
Input Analysis	UoAz Rayference CNES	UoAz MPC (RAL) Rayference CNES	UoAz MPC (RAL) Rayference CNES	UoAz MPC (RAL) Rayference CNES	UoAz MPC (RAL) Rayference CNES

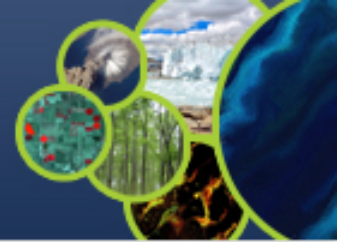
Oblique View

	S1	S2	S3	S5	S6
Correction	0.94	0.95	0.95	1.04	1.07
Uncertainty	0.05	0.03	0.03	0.03	0.05
Input Analysis	Rayference CNES	MPC (RAL) Rayference CNES	MPC (RAL) Rayference CNES	MPC (RAL) Rayference CNES	Rayference CNES

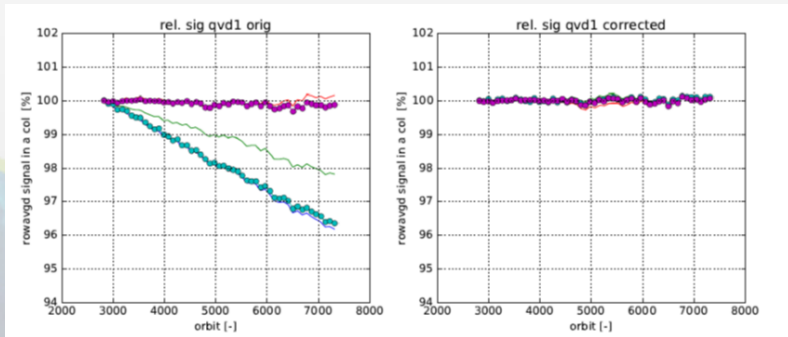


- **Aquarius, SMAP and SMOS L-band Brightness Temperature measurements are inter-compered with in situ dataset over Dome-C station in Antarctica (DOMEX3 experiment) and from on-going MOSAIC expedition.**



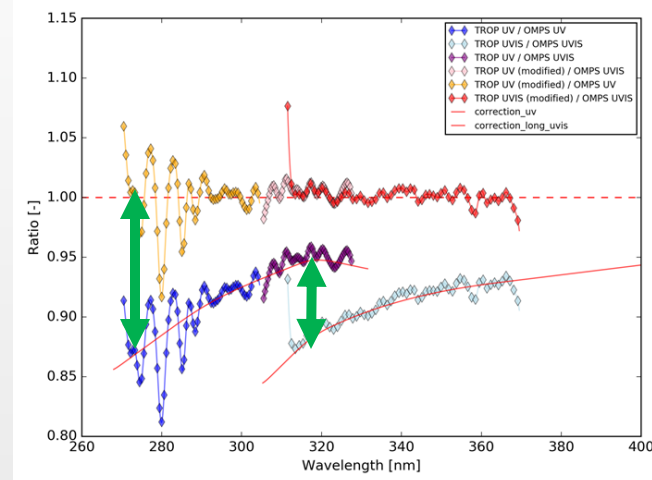


- Sentinel-5P : TROPOMI L1b processor status:
 - Current version of the L1b is 01.00.00 since end E1 Phase (30 Apr 2018)
 - **New release 02.00.00 ready to be implemented**
 - Includes **new algorithms to address degradation** (+ some minor bugfixes, code cleanup)
 - New version also includes updates to Calibration Key Data (CKD)



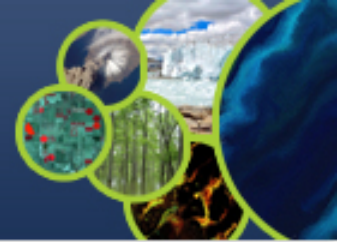
Degradation of the Irradiance in UV

Left: without degradation correction in the L01b Processor. Right: with the degradation correction enabled in the L01b Processor

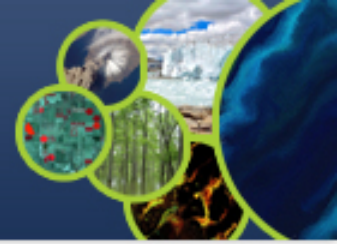


Sun radiometric adjustment needed for bands 1-4 with OMPS

- TROPOMI Solar Spectral Irradiance (SSI) deviates with respect to comparable SSI from other missions (left green arrow)
- In spectrally overlapping regions of bands 2 & 3, ratio is not the same (right green arrow)



- **The ESA moon calibration project** is closed. Final data package is being compiled.
 - *A continuation activity is in negotiation with NPL/VITO/Univ. Valladolid: for 4 years → maintain the lunar photometer in operation and update the model + hopefully one more calibration at NPL.*
 - *Participation to Lunar WS. participation to the GSICS intercomparison of model planned for the next lunar calibration workshop this year under discussion.*
 - *Discussion for improving the model.. The objectives: 1) Improve the spectral resolution/sampling of the current lunar irradiance model by making new ground based hyperspectral measurements 2) Develop a spatially resolved lunar radiance/reflectance model using ground based telescope measurements*
- **Eradiate project:** → providing the Earth observation community with a flexible, modern, open-source 3D radiative transfer model based on the Monte Carlo ray tracing technique.
 - *the first beta release of Eradiate scheduled for MTR in October 2020.*
 - *Eradiate workshop : 12 - 13 November at ESRIN (tbc).*
- **The ESA atmospheric Validation Data Center (EVDC)** has been updated, introducing new tools and upgrading existing functionalities. The renewed portal is online since 11st March 2020. GSICS community is invited to explore the website:
<http://calvalportal.ceos.org/>



WATERHYPERNET (long-term activity brand) HYPERNET-VN = phase 2 ESA project

water (ocean, coastal, lakes)

A Hyperspectral network for ocean colour validation

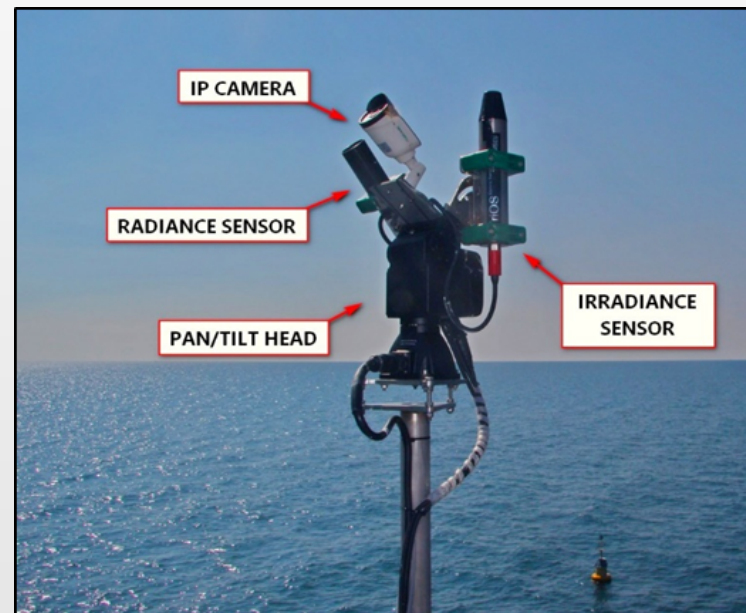
Kevin Ruddick,
Royal Belgian Institute for Natural
Sciences (RBINS)

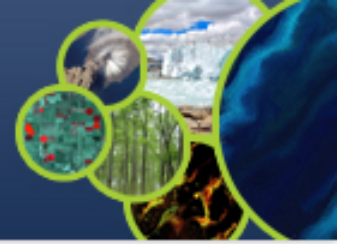
New WATERHYPERNET measurement system

Existing TRIOS radiometer (2000)

New "PANTHYR" system (2018)

350-900nm 10nm FWHM





HYPERNET An international network for validation
of water reflectance for all VIS/NIR spectral bands of Sentinel-3AB...CD

And MODIS-TERRA/AQUA

And Sentinel-2ABCD

And Landsat-8/9/10

And Pléiades

And PACE

And CHRIS-PROBA1 and PRISMA

And MODIS-AQUA

And all other ocean colour sensors

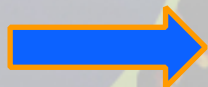
And SEVIRI ... and And VIIRS
MTG

And all future hyperspectral sensors
(inc "Sentinel-10/CHIME", Hypsiri, ...)

And PROBA-V And all future optical nanosatellites (Planetscope, etc.)

And GOCI-1&2

WATERHYPERNET will provide water reflectance data for validation of **all VIS/NIR bands of all optical imaging missions**



Potential for LAND PRODUCT VALIDATION

Working Group on Calibration and Validation

Planned deployments 2020-21



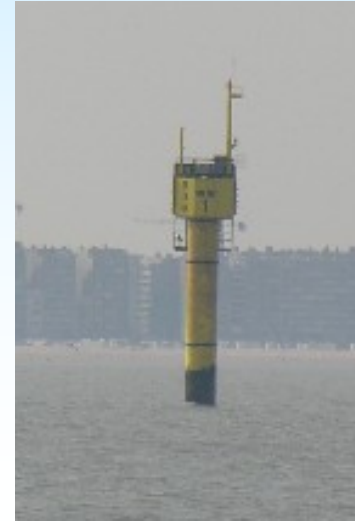
Blue Innovation
platform outside
Oostende harbor, BE
[VLIZ]

Since Dec2019



Blankaart Reservoir,
BE (~800m diameter)
[RBINS]

Tested Sep2019



MOW1/Zeebrugge
AERONET-OC
[RBINS]



CPOWER/Thornton
AERONET-OC
[RBINS]

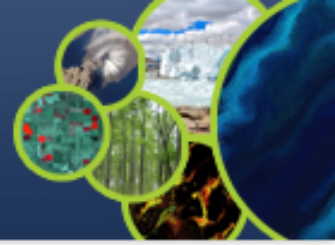


And/or
Aqua Alta
[CNR collaboration]

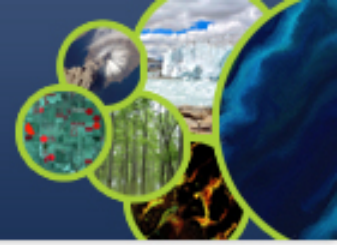
Since Sep2019

And/or
Mesurho (Rhone)
[LOV
collaboration]





- Rayleigh intercomparison activities with GSICS – could it be CEOS coordinated ?
- New Sun Irradiance (SI) dataset from the NASA's Total and Spectral Solar Irradiance Sensor, TSIS-1. The TSIS-1 SI was presented during the GSICS VIS/NIR web meeting part 2 by Odele Coddington of University of Colorado (Boulder). The most important features of this new dataset, are the unprecedented level of accuracy and the extremely high spectral resolution. **The relevance of this new dataset, if its quality will be confirmed, could important.** Ex: the use of this new SI could drastically improve the quality of PGN O3 and SO2 retrievals!



Annex

**Despite COVID-19 situation
All ESA EO missions remain
operational**



ESA Third Party Missions (Earthnet programme)

Easter in Saint Peter square, Vatican City, Rome

Easter 2011



GeoEye satellite image

©GeoEye 2011

Easter 2020



Pléiades satellite image

©CNES 2020, Distribution Airbus DS



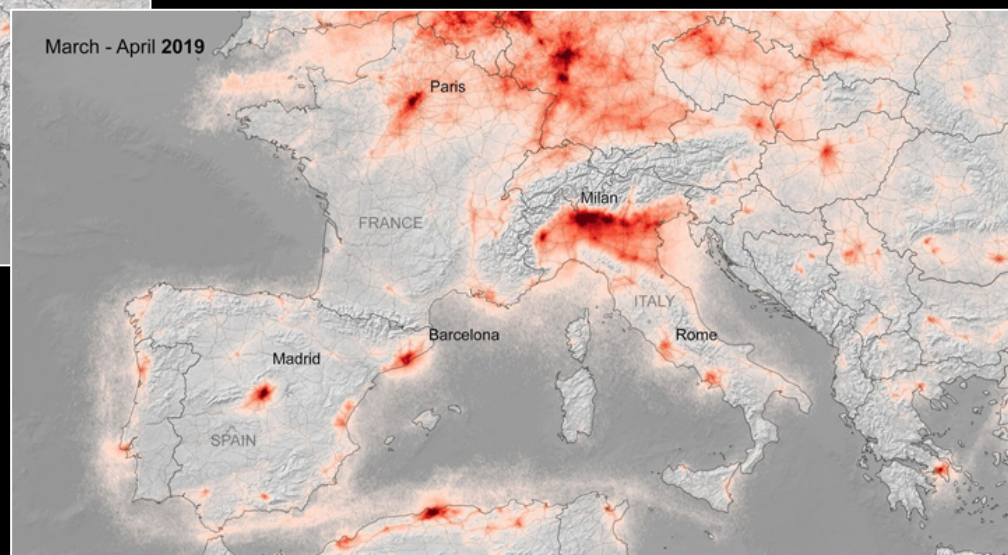
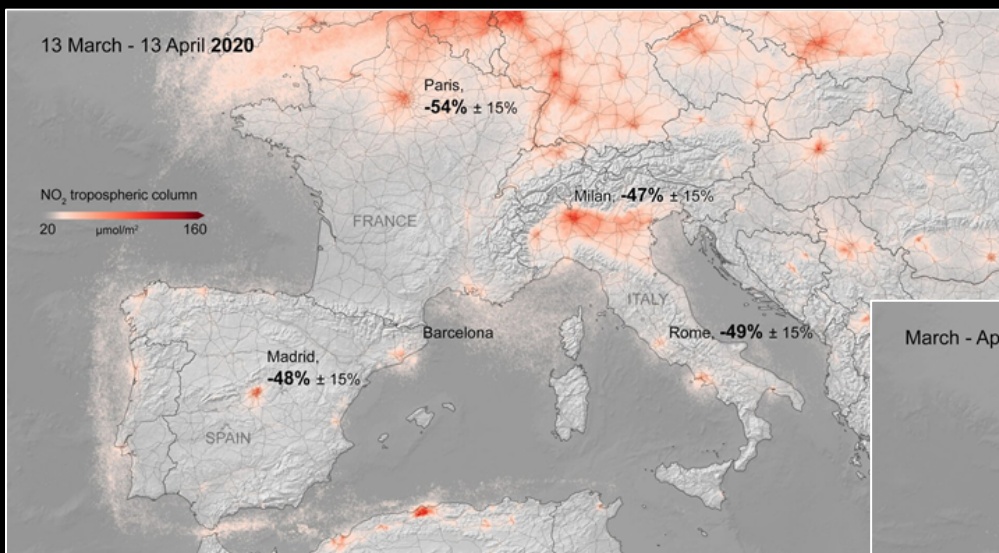
European Space Agency



Average nitrogen dioxide (NO₂) concentrations

13 March – 13 April 2020

vs March-April 2019



[https://www.esa.int/Applications/Observing the Earth/Copernicus/Sentinel5P/Air pollution remains low as Europeans stay at home](https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel5P/Air_pollution_remains_low_as_Europeans_stay_at_home)

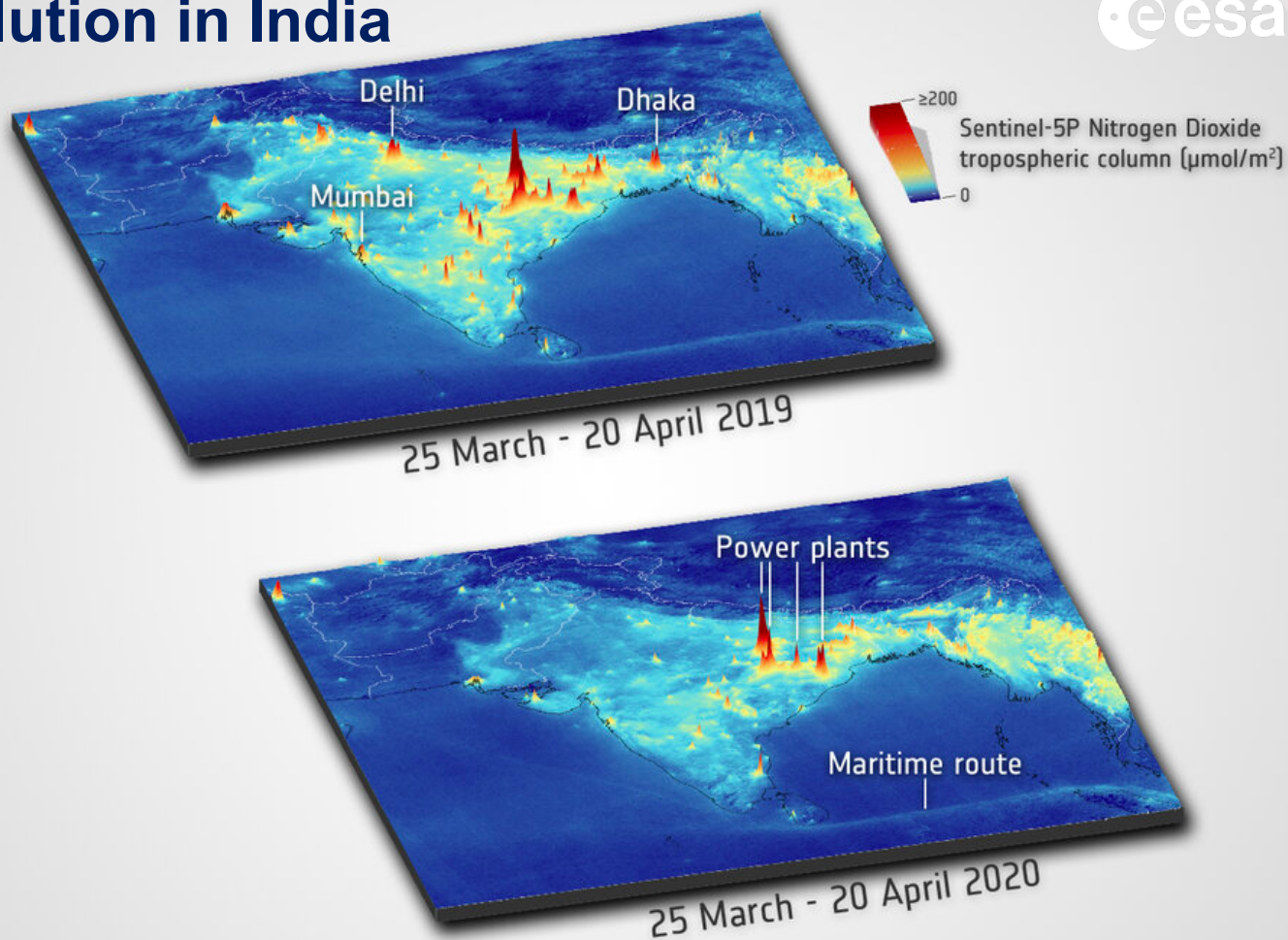
Copyright: Contains modified Copernicus Sentinel data (2019-20) / processed by KNMI/ESA



European Space Agency



Dropping Air Pollution in India



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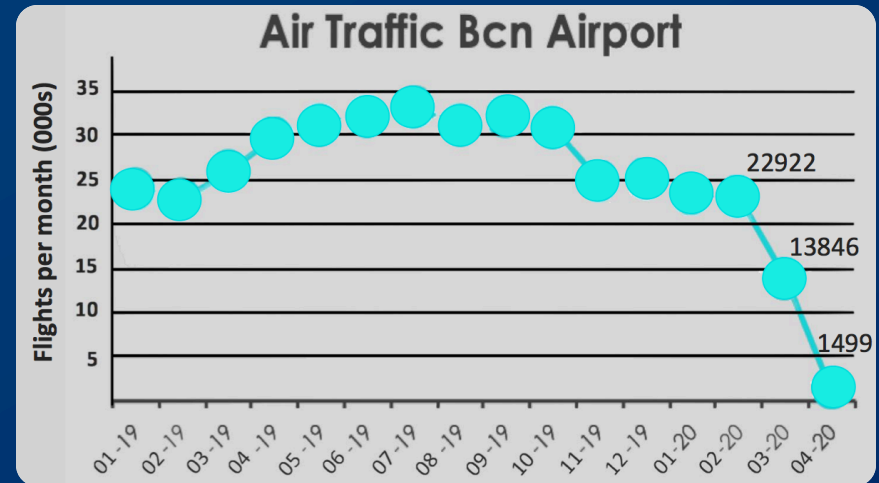
European Space Agency



Economic Indicator Monitoring: AI based analytics



Barcelona Airport (Pleiades and Sentinel-2)



Automated detection/count of parked aircraft to characterise:

- Impact on airlines (number of unused aircraft)
- Impact on air traffic levels

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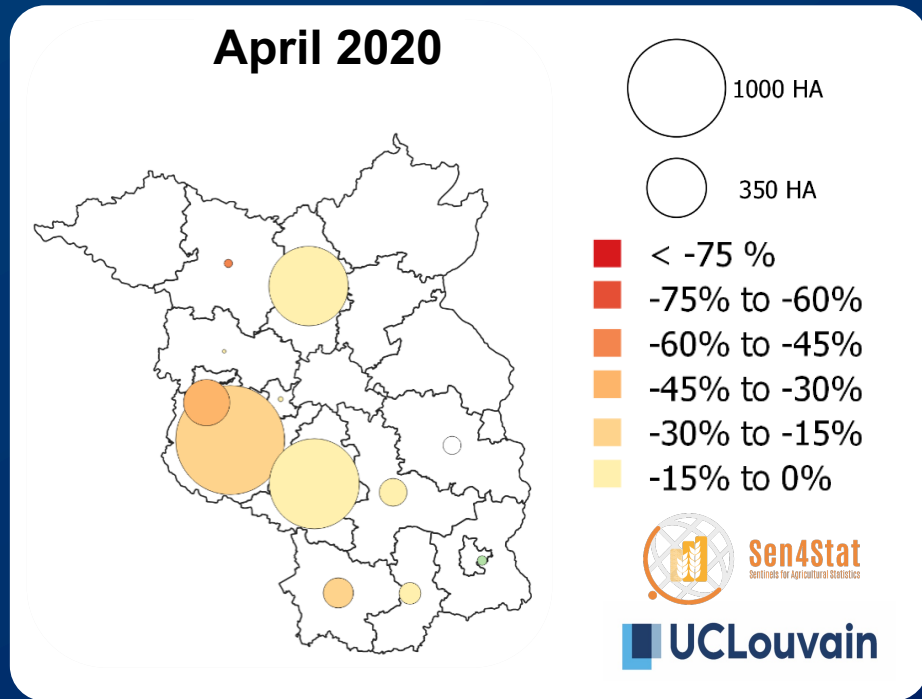


European Space Agency



Agriculture – productivity is impacted

22 to 30% reduction of labour-intensive asparagus production in Brandenburg, Germany, due to border closure impact on the labour market



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