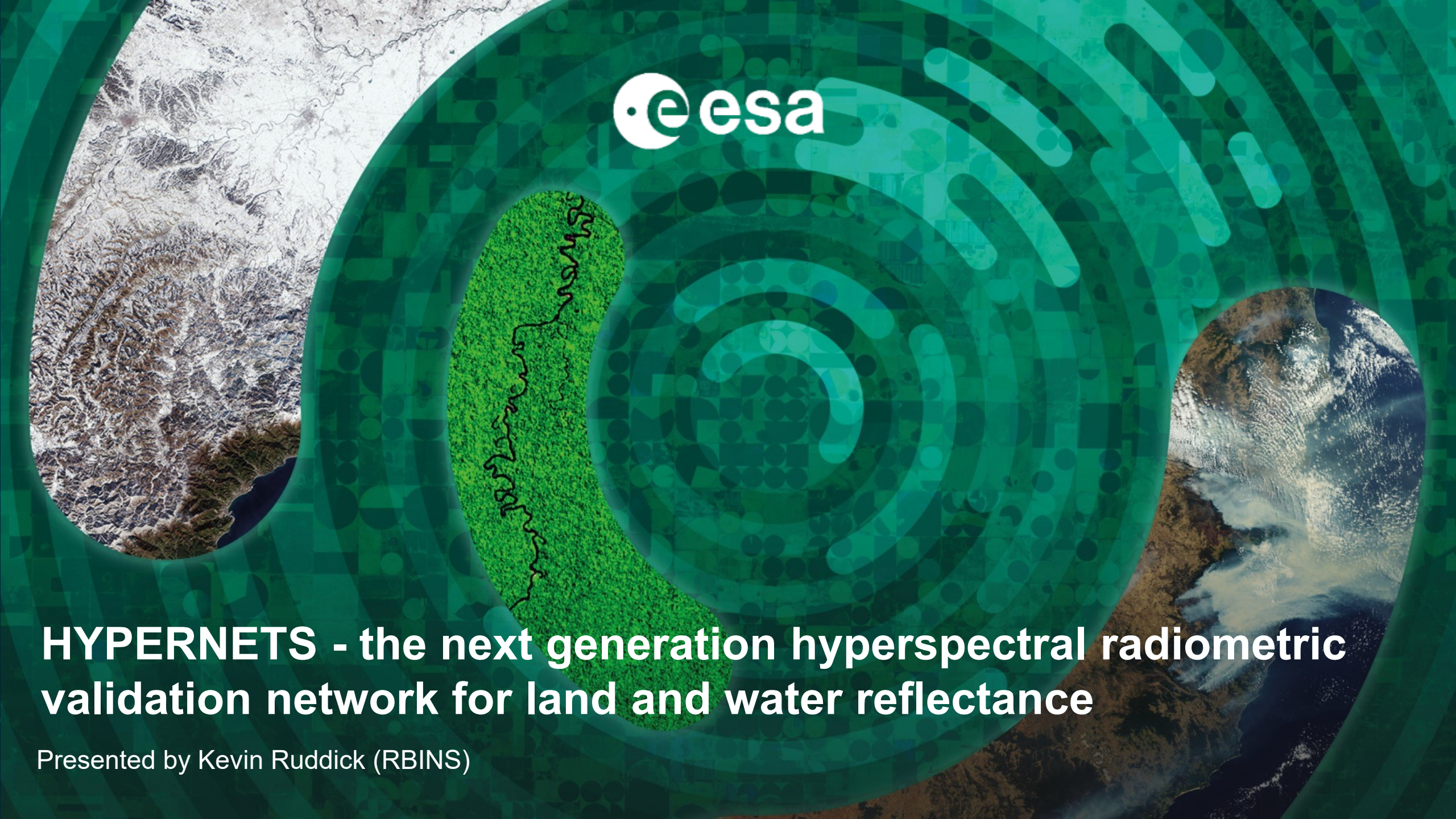


HYPERNETS - the next generation hyperspectral radiometric validation network for land and water reflectance

Presented by Kevin Ruddick (RBINS)

Preparation of Next Generation Hyperspectral Radiometric Validation Networks for Water and Land Surface Reflectance - the HYPERNETS project

presented by Kevin Ruddick (RBINS)

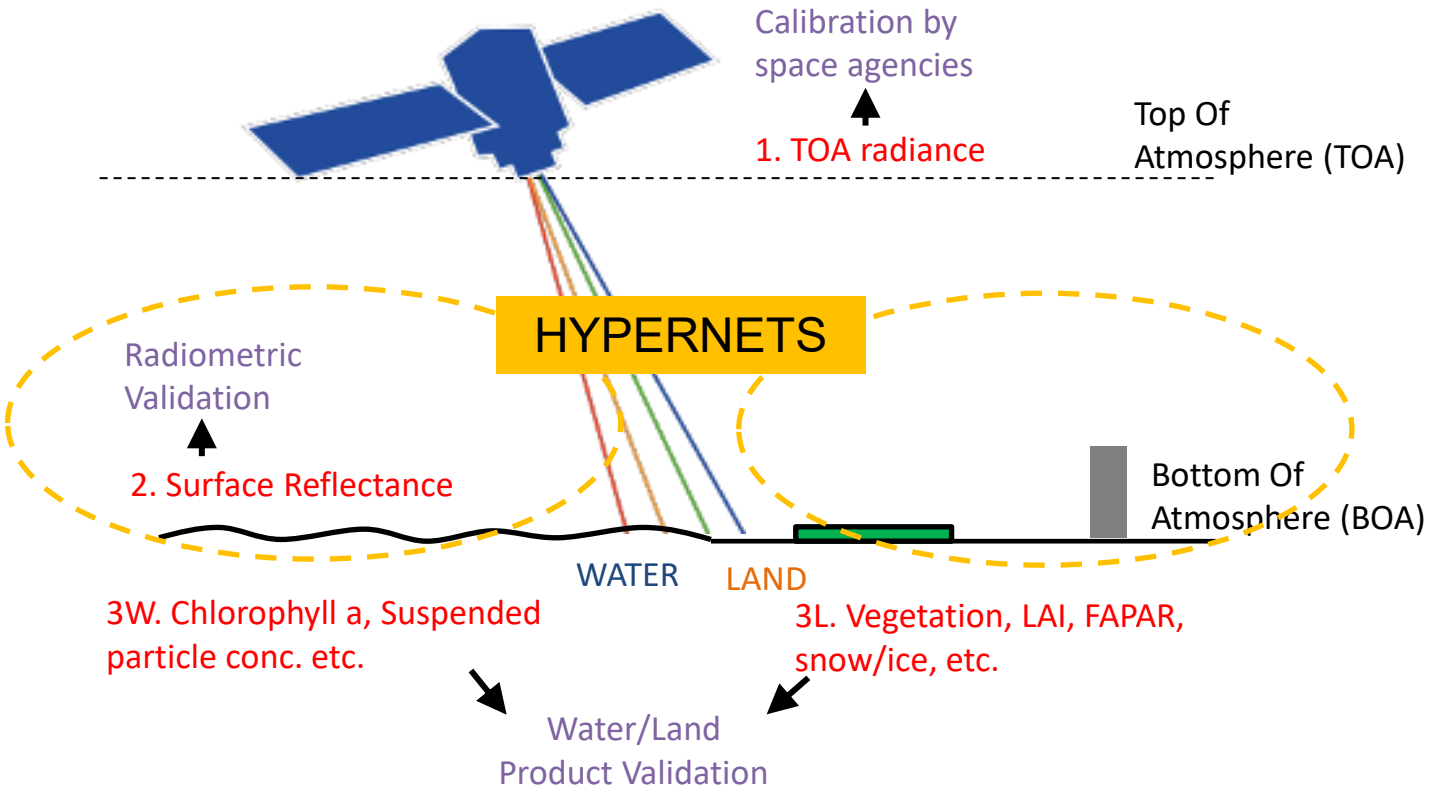
H2020/HYPERNETS

Joel Kuusk, Agnieszka Bialek, Vittorio Brando,, Alexandre Corizzi, Pieter de Vis, Ana Dogliotti, David Doxaran, Kim Duong, Ken Flight, Anabel Gammaru, Luis Gonzales Vilas, Clémence Goyens, Sam Hunt, Kaspars Laizans, Harry Morris, Pablo Perna, Estefania Piegari, Lucas Rubinstein, Mehdi Saberioon, Morven Sinclair, Daniel Spengler, Quinten Vanhellemont

The HYPERNETS project is funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 775983.
This communication represents only the authors' views. The European Union is not liable for any use that may be made of the information contained therein.

The CAL/VAL place for HYPERNETS

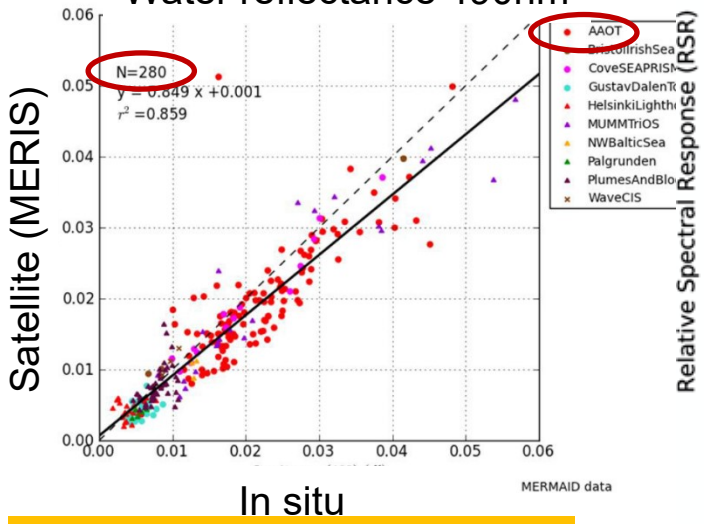
MOTIVATION =
Automated measurements for validation of water and land surface reflectance
at all VIS/NIR spectral bands (380-1700 nm, @3 nm FWHM to 1020 nm)
...2300 nm? ... 2500 nm??



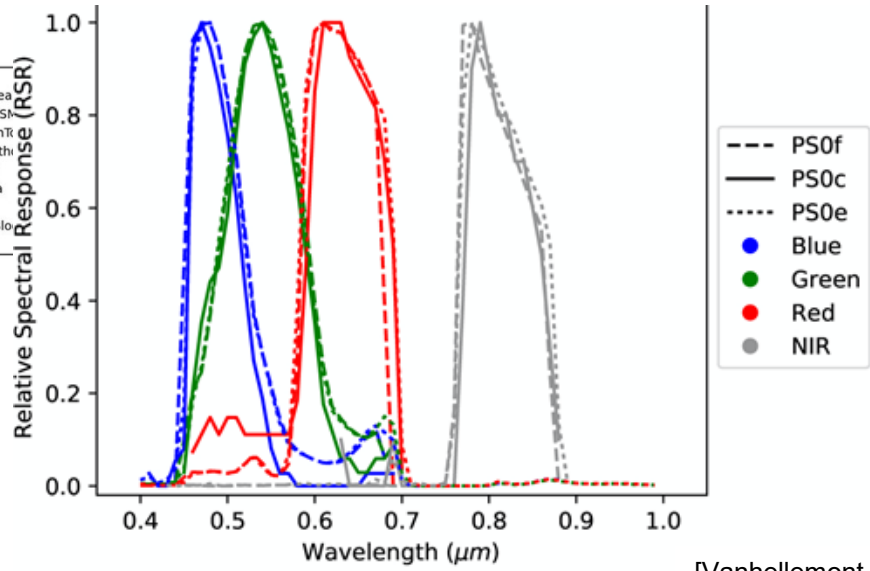
Why automated hyperspectral?

10 years of MERIS water reflectance validation, including a few years of AERONET-OC…

Water reflectance 490nm



Planetscope spectral response



+ new generation of hyperspectrals (EnMAP, PRISMA, EMIT ... PACE ... CHIME, SBG, GLIMR and cubesats?)

Data acquisition must be AUTOMATED

Instrument must be HYPERSPECTRAL

[Vanhellemont & Ruddick (2018) https://doi.org/10.1016/j.rse.2018.07.015 Atmospheric correction of metre-scale optical satellite data for inland and coastal water applications]

[MERIS 3rd reprocessing data validation report, ACRI, 2012]
Data courtesy of PIs (D. McKee, K. Ruddick, D. Siegel, S. Kratzer) and AERONET-OC PIs (G. Zibordi, G. Schuster, S. Kratzer, B. Gibson), matchup using MERMAID

Sites should be NETWORKED

HYPERNETS in a single slide

2023-2027

INSTRUMENTS

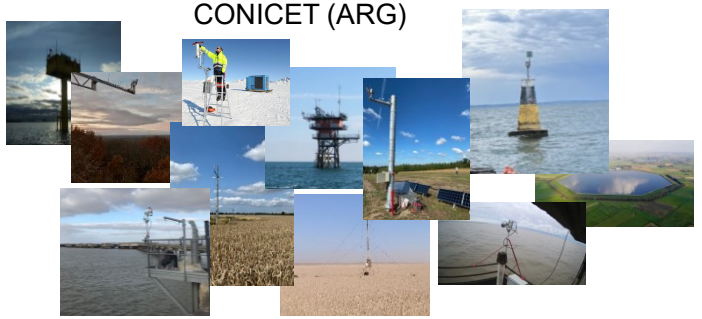
Automated hyperspectral measurements

PANTHYR system
[Vansteenwegen et al, 2019]
400-900nm, 10nm FWHM

HYPSTAR® system
[https://hypstar.eu/]
380-1700nm, 3-10nm FWHM

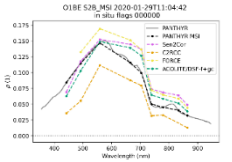
NETWORK

RBINS (BE, coordinator)
+ VLIZ (BE), CNR (IT), LOV (FR),
NPL (UK), GFZ (D), TARTU (ES),
CONICET (ARG)

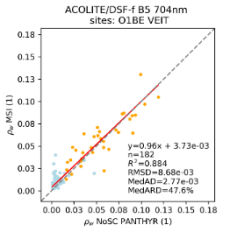


10 water and 10 land sites operating/ed
Many international requests to join in 2023 ...

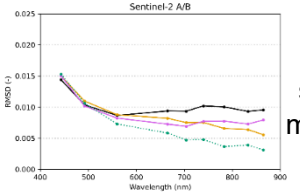
DATA PROCESSING and ANALYSIS



e.g. one matchup



one band (S2/704nm), many matchups



spectral stats, many matchups

Prototype network has provided validation data and information to:

Sentinel-2A&B, Sentinel-3A&B/OLCI, Landsat-8&9, Planetscope Doves and Superdoves, PRISMA, Pléiades, ENMAP, MODIS-A&T, VIIRS-1&2,...

OBJECTIVE: To validate **all** VIS/NIR spectral bands (400-1700nm, @3-10nm FWHM) for **all** satellite missions measuring water or land surface reflectance

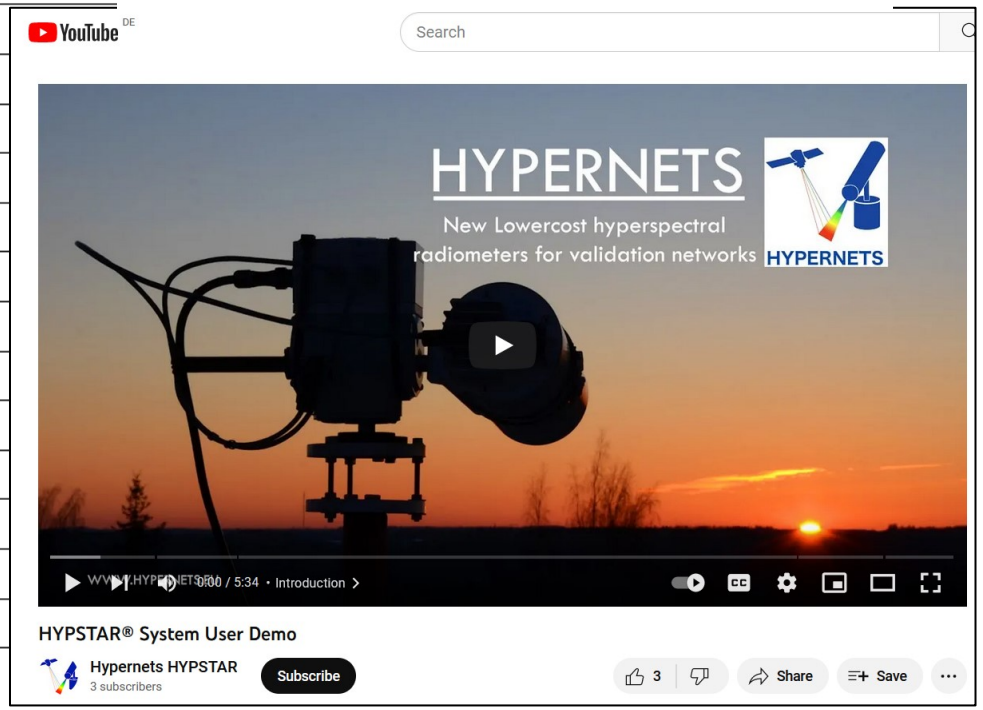
and preparing for:

ACIX, DESIS, MTG and SEVIRI, EMIT, CHIME, LSTM, PACE, GLIMR, SBG, PROBAV-CC, GOCI, SABIAMAR, various Newspace, ... (national hyperspectral imagers from Canada, Norway, Australia, ...)

HYPSTAR® instrument spec (XR=land version)

Parameter	HYPSTAR-XR radiometer
Measured quantity	Radiance and irradiance (multiplexed)
Field of view	5° (radiance), 180° (irradiance)
Detector array	2048 px Si, 256 px InGaAs
Spectral range	380 ... 1700 nm
Spectral sampling interval	0.5 nm (VNIR), 3 nm (SWIR)
Spectral resolution	3 nm (VNIR), 10 nm (SWIR)
ADC resolution	16 bit
Integration time	1...65535 ms
Shutter	Internal
Target camera	5 Mpx, RGB
Communication interface	RS485, half duplex, 115.2 ... 8000 kbps
Housing material	Anodised marine grade aluminium
Dimensions (DxL)	ø110.3 x 434 mm
Weight	3 kg
Power supply	8 ... 18 V DC, 2 A
Environmental protection	IP67
Operating temperature	-25 ... +45 °C
Storage temperature	-35 ... +70 °C

User demo video
https://www.youtube.com/watch?v=dfUAPYxg5Cc



[www.hypstar.eu]

SR=water version
VISNIR (380-1020nm),
2° FOV

Typically measuring every 30 mins during daytime for a year before recalibration

Prototype LANDHYPERNET validation sites

See Poster 37 LANDHYPERNET [Bialek et al]

Land sites currently/recently running

NPL: Wytham

GFZ: ATB

CONICET: IFEVA

RBINS: PEAntarctica (Dec-Jan)

TARTU: Järvselja

RBINS: Lonzee

GFZ: DEMMIN

NPL: Gobabeb

NPL/RBINS: Barrax (Jul 2022)

TARTU: Soontaga

+

CNR: Jolanda di Savoia 2023 ...

+ ...

esa will support 5 land sites to 2027

Data processing and distribution - status

HYPSTAR®:

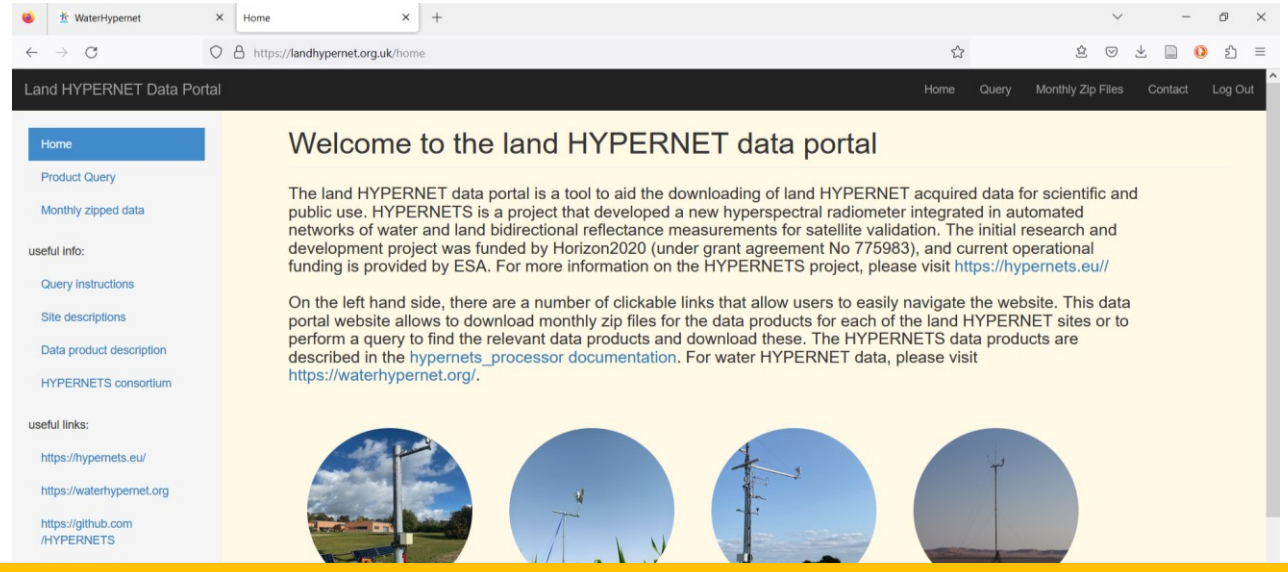
Prototype data to be released ZENODO June 2023

Reprocessing expected by Dec 2023 (improved QC, spectral weighting, etc.)

SHORT TERM

LATER 2023

In prep: LANDHYPERNET data portals



FOLLOW US on https://twitter.com/Hypernets_H2020 !

Conclusions

Surface reflectance data is essential for water and land product validation

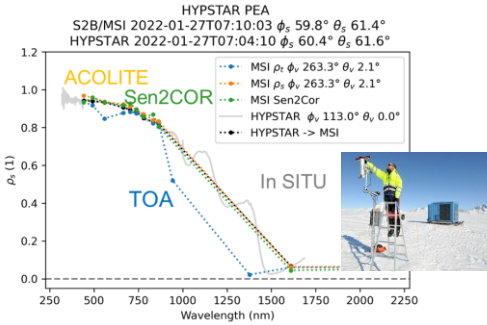
Autonomous hyperspectral network is most cost-effective (multi-mission context)

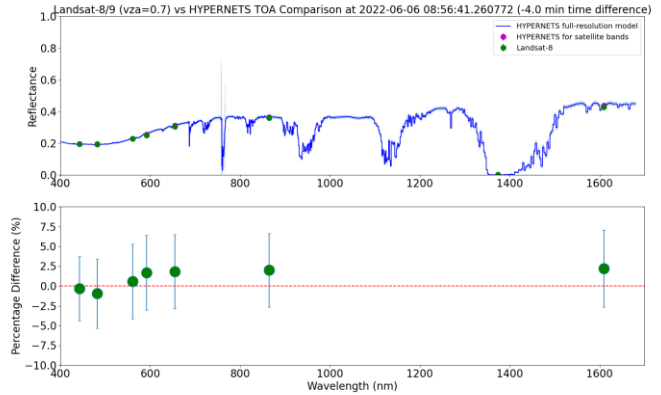
Zenith- and azimuth-pointing enables full HRDF for land and extra scenarios for water (as well as "parking" to protect)

Useful for other applications (not just sat val) ...

Early prototype HYPSTAR® data looks very useful ...

Diverse water and land HYPERNETS validation sites should provide good basis for validation of S2A&B, L8&9, S3A&B, EnMAP, PRISMA, Planetscope, ... PACE ... CHIME, SBG, GLIMR ... and NewSpace and ...





Questions? Comments?