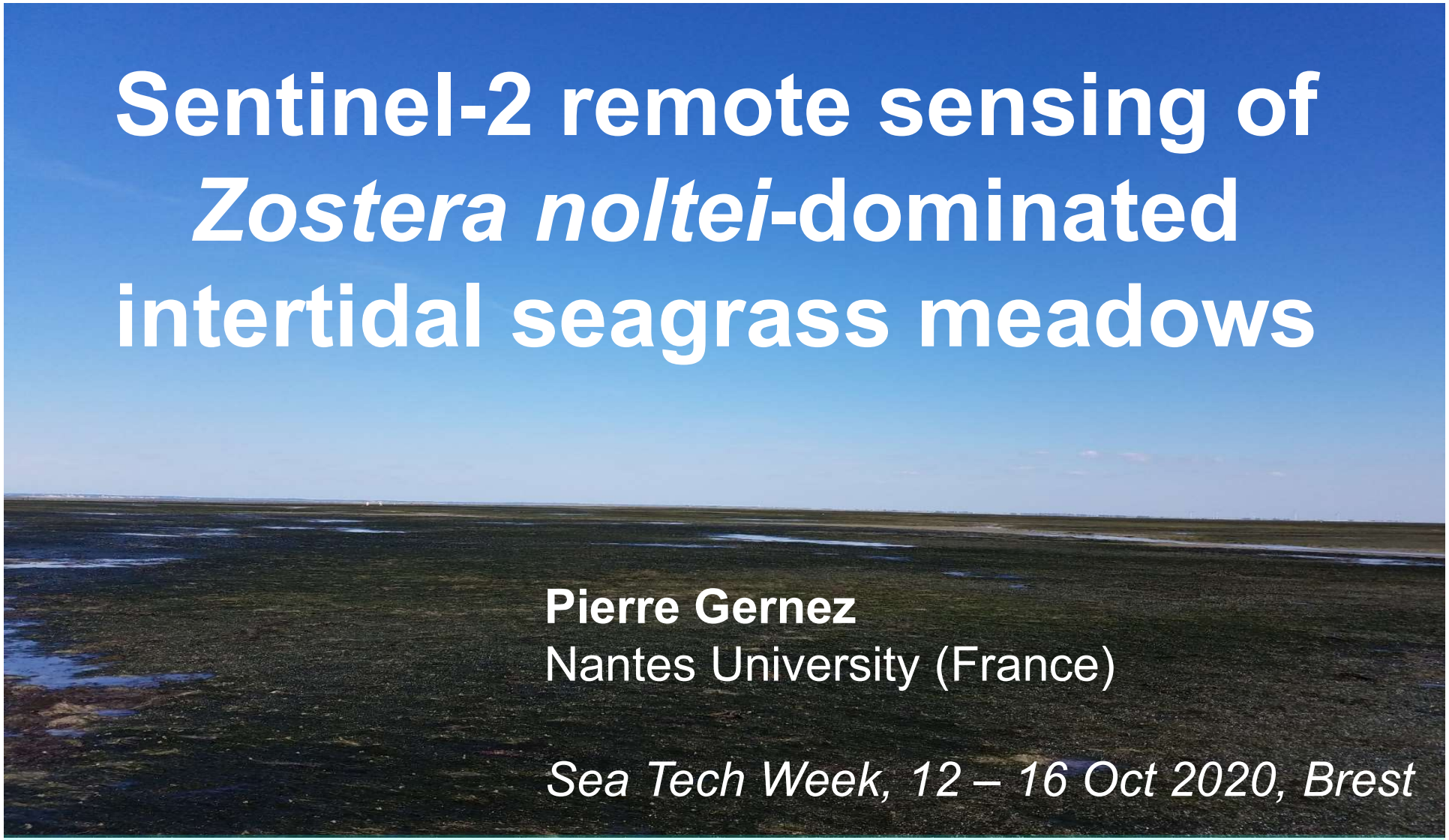
Sentinel-2 remote sensing of *Zostera noltei*-dominated intertidal seagrass meadows



Pierre Gernez
Nantes University (France)

Sea Tech Week, 12 – 16 Oct 2020, Brest

CoastObs

COMMERCIAL SERVICE PLATFORM FOR USER-RELEVANT COASTAL WATER MONITORING SERVICES BASED ON EARTH OBSERVATION

Water Insight · University of Stirling · Consiglio Nazionale delle Ricerche · Université de Nantes · Universidade de Vigo · BioLittoral · GEONARDO

Related publication

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Sentinel-2 remote sensing of *Zostera noltei*-dominated intertidal seagrass meadows

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Seagrass meadows

- Ecosystem services
  - Sequester carbon
  - Protect shoreline
  - Regulate nutrients & turbidity
  - Provide food & habitat

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- Anthropogenic pressures
  - Sea level rise
  - Nearshore development
  - Environment contamination

Unsworth et al. (2019)

- Indicator of coastal ocean health
  - Water Framework Directive

NATURA 2000

Monitoring seagrass status

- Global challenges
  - 72 seagrass species in 208 countries
  - Large gaps in seagrass records

Unsworth et al. (2019)

Region	Countries	Continental shelf (km^2)	Coastline (km)	Number of seagrass species	Documented seagrass area (km^2)	Countries lacking polygon data	Countries seagrass records absent
1. Temperate North Atlantic	25	20 015 178	207 997	5	3 430	11	7
2. Tropical Atlantic	64	2 949 362	77 804	10	109 146	17	14
3. Mediterranean	30	1 900 896	48 382	9	25 260	14	6
4. Temperate North Pacific	6	10 557 527	112 130	15	1 675	1	
5. Tropical Indo-Pacific	74	8 741 755	239 163	24	168 488	20	12
6. Temperate Southern Oceans	9	4 291 071	51 134	18	17 179	4	3
GLOBAL	208	48 455 788		72	325 178	67	42

- Harmonize and rationalize seagrass data & indicators

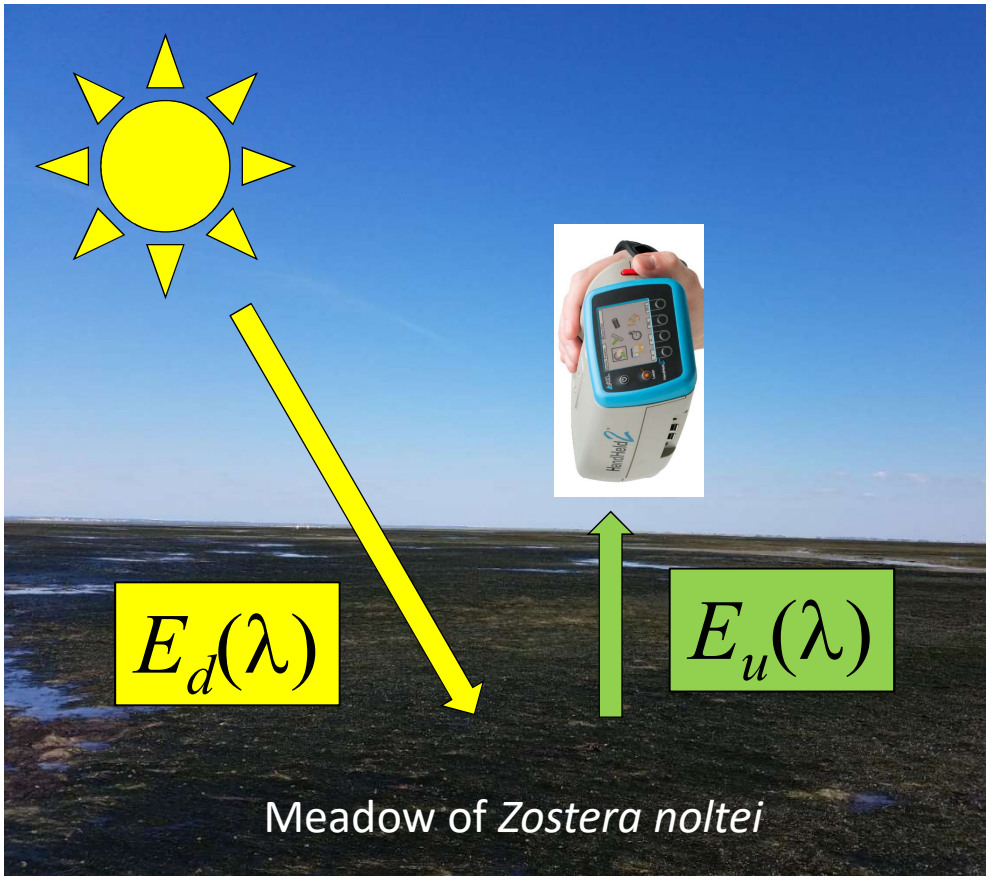
(*Marba et al.* 2013 identified 51 different metrics in EU)

Earth Observation

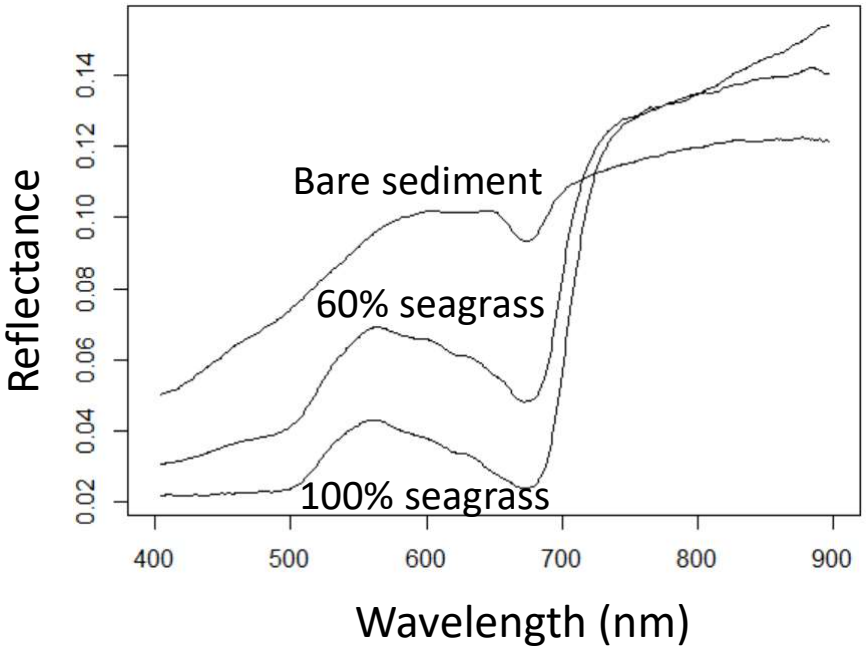
- Long-term time series of satellite images (> 30 years)
  - SPOT & Landsat archives (1980s – present)
  - High spatial resolution (10 – 30 m)

- Sentinel-2
  - Global coverage
  - Spatial resolution 10 m
  - Revisit time 5 days
  - 2015 – present
    (expected end > 2030)

Field radiometry



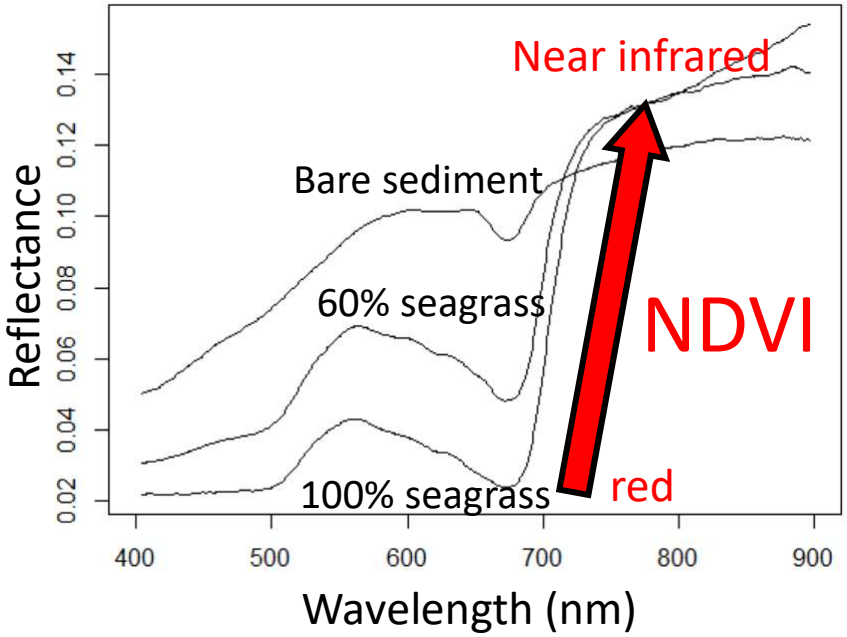
$$R(\lambda) = \frac{E_u(\lambda)}{E_d(\lambda)}$$

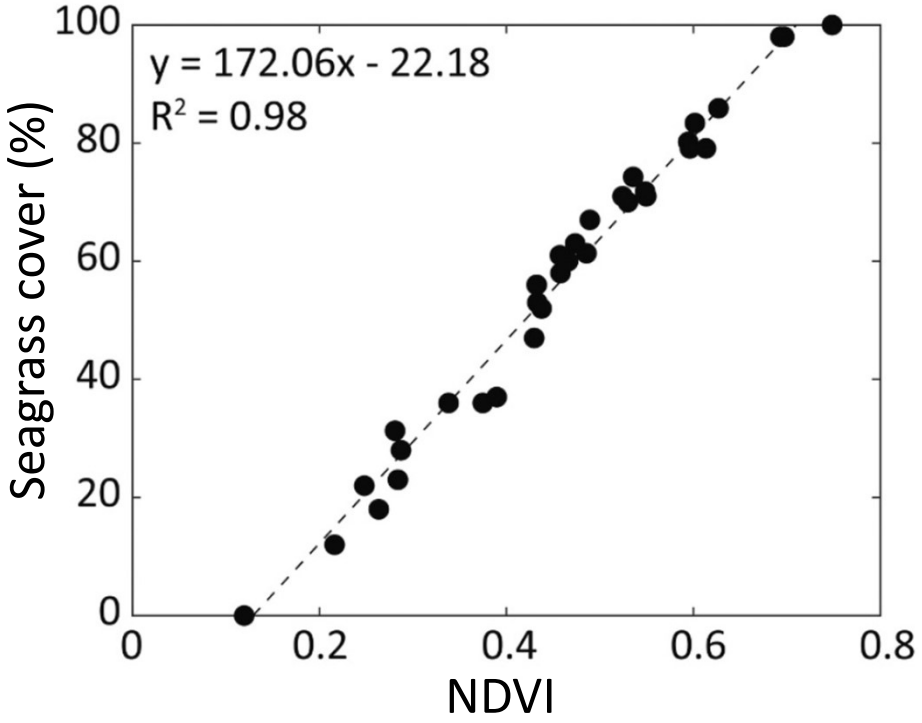


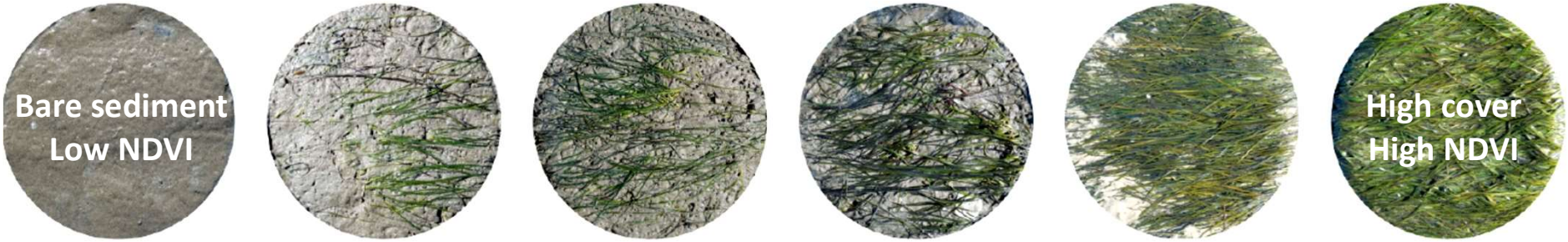
$E_u(\lambda)$ is the upwelling irradiance (W m^{-2} nm^{-1})

$E_d(\lambda)$ is the downwelling irradiance (W m^{-2} nm^{-1})

Seagrass detection



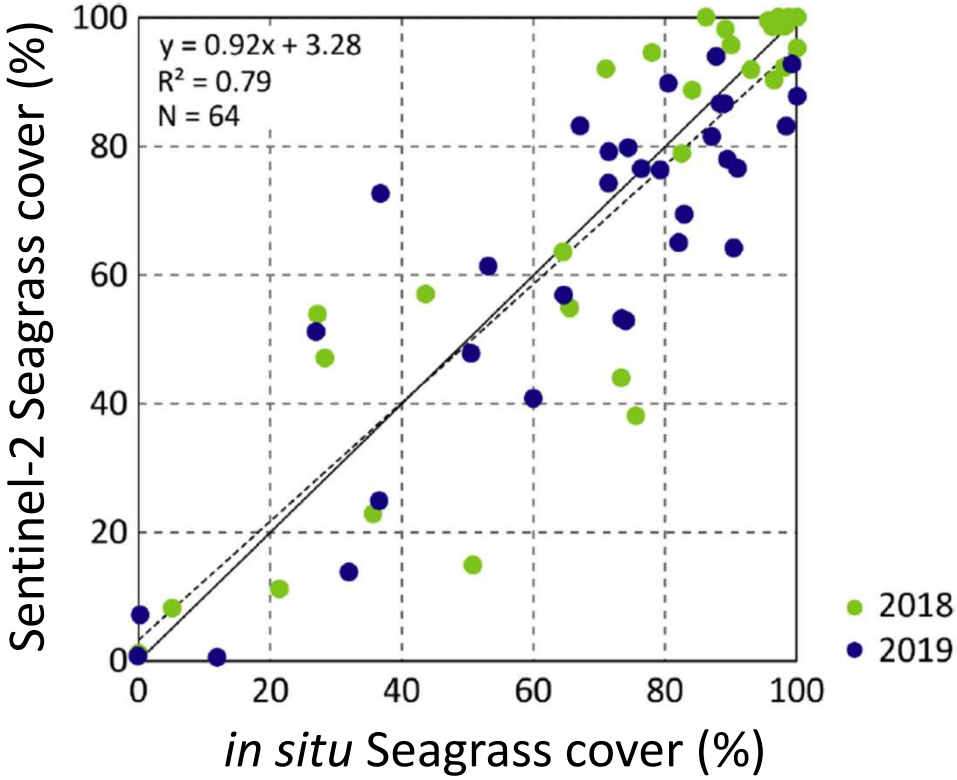




Algorithm calibration & validation

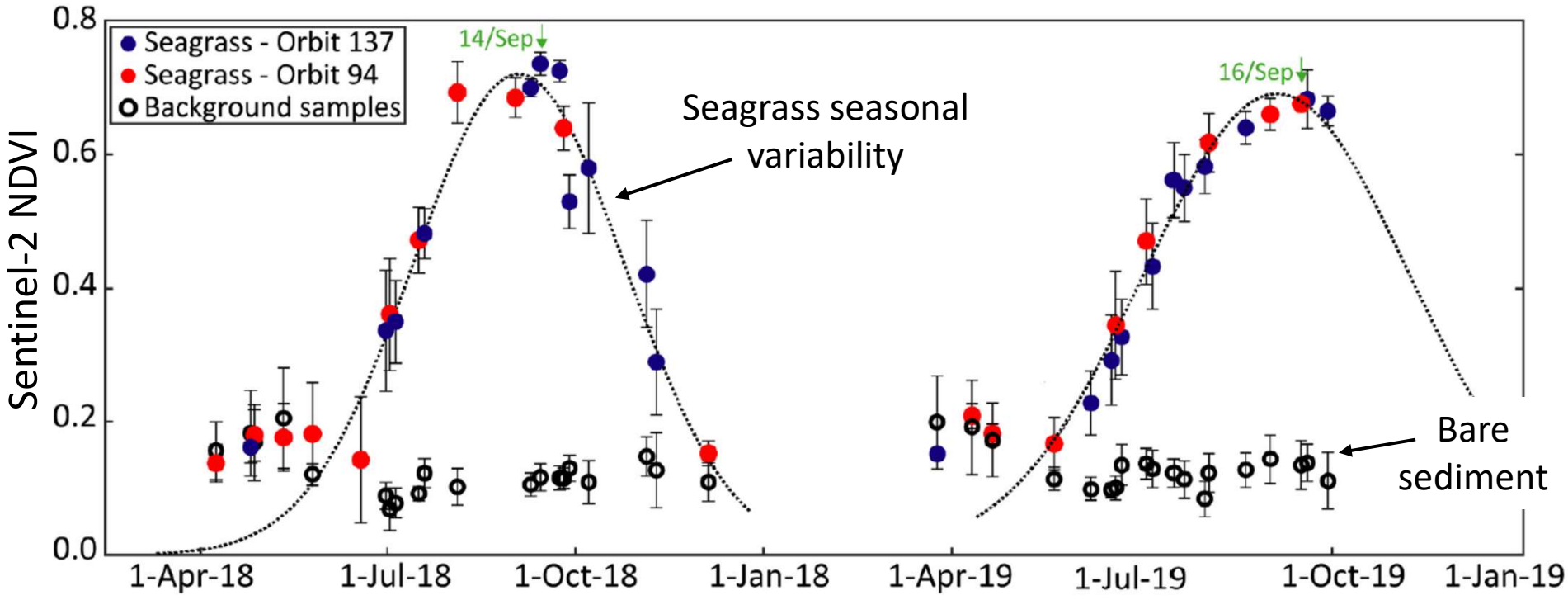
- *in situ* calibration in several sites in Europe
  - Bourgneuf, Marennes-Oléron, and Cadiz (Spain)
  - Emerged *Z. noltei* meadows

- Map validation
  - 320 individual quadrats
  - 1 point = averaged 5 meas.
  - RMSE 14%

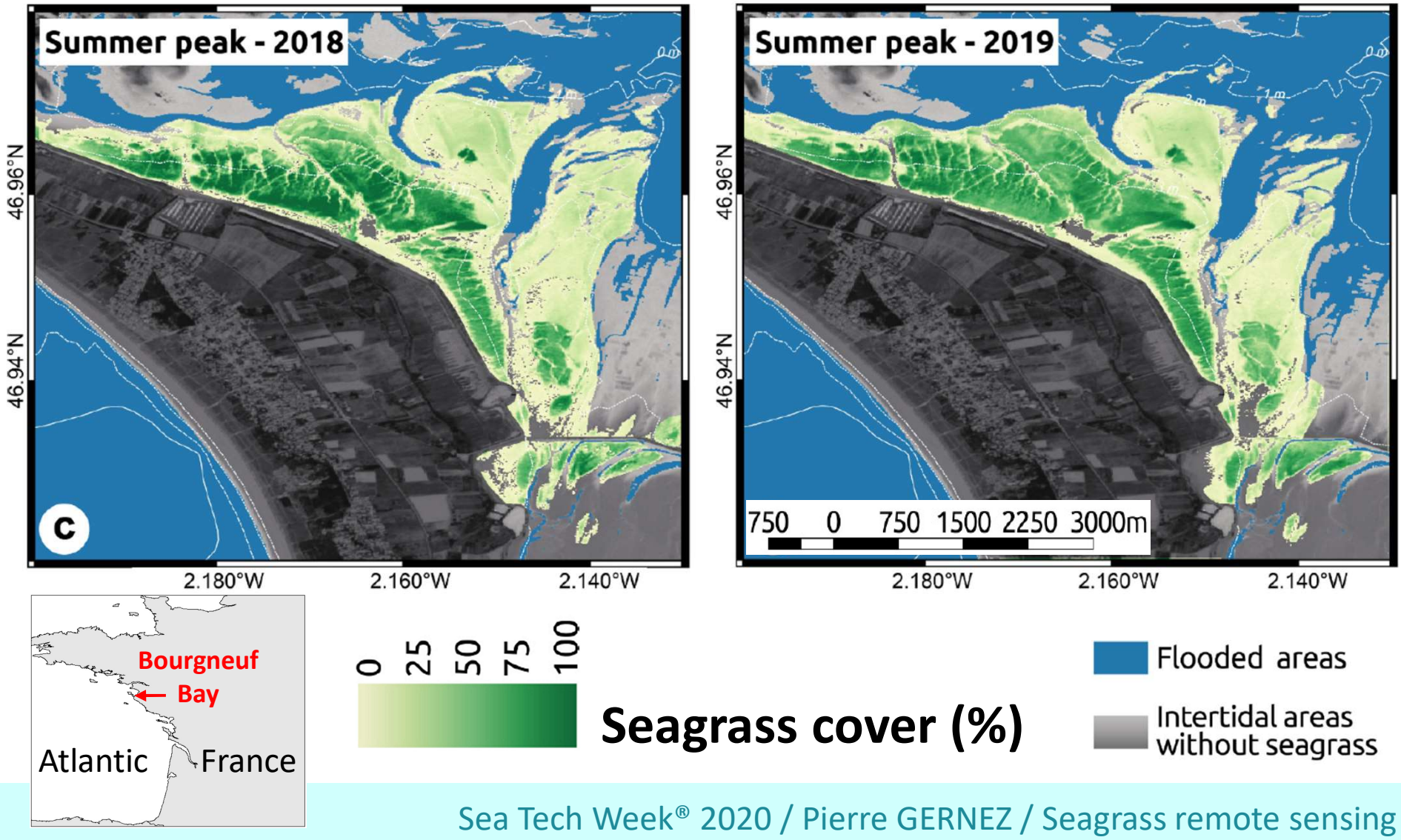


Seagrass seasonal cycle by satellite

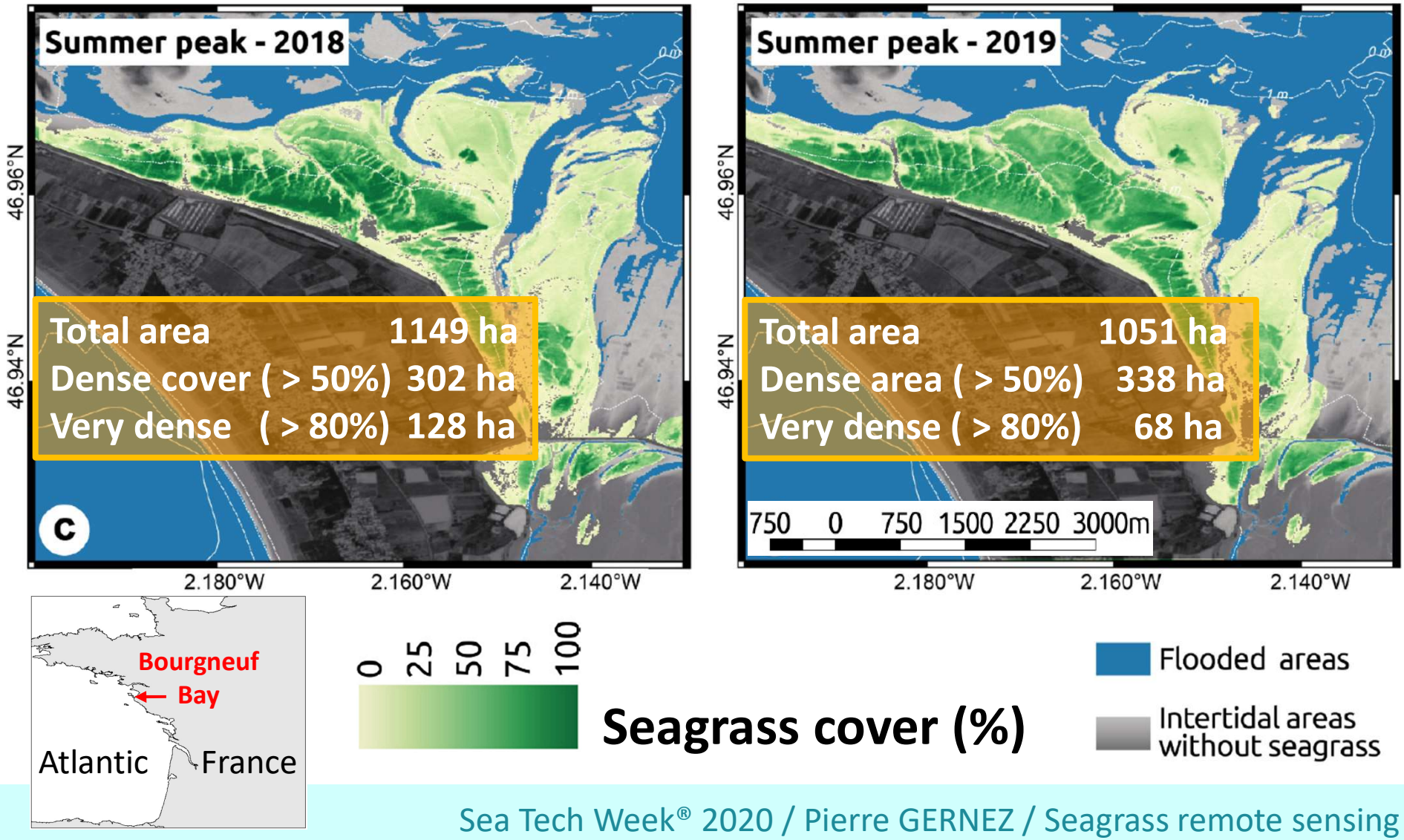
- 42 clear sky & low tide images in 2018 – 2019
  - Gaussian fit to characterize seasonal variability
  - Seasonal cycle: late summer



Seagrass map (Bourgneuf Bay, France)



Spatial-rich information



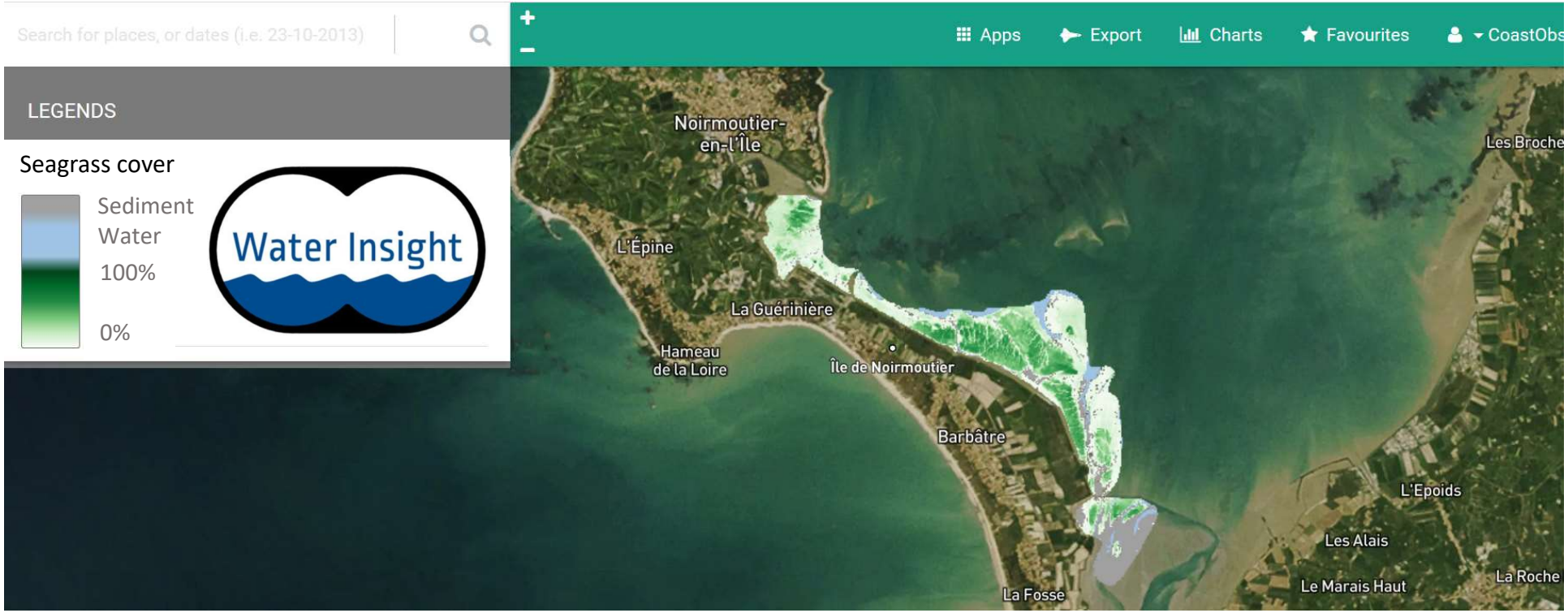
Products & users

- Delivered seagrass products
  - Google Earth (*.kmz)
  - GIS (*.GeoTIFF)
  - Shapefiles

- Positive feedbacks

- 1 user signed contract to buy the 2020 seagrass product

Web portal (Water Insight)



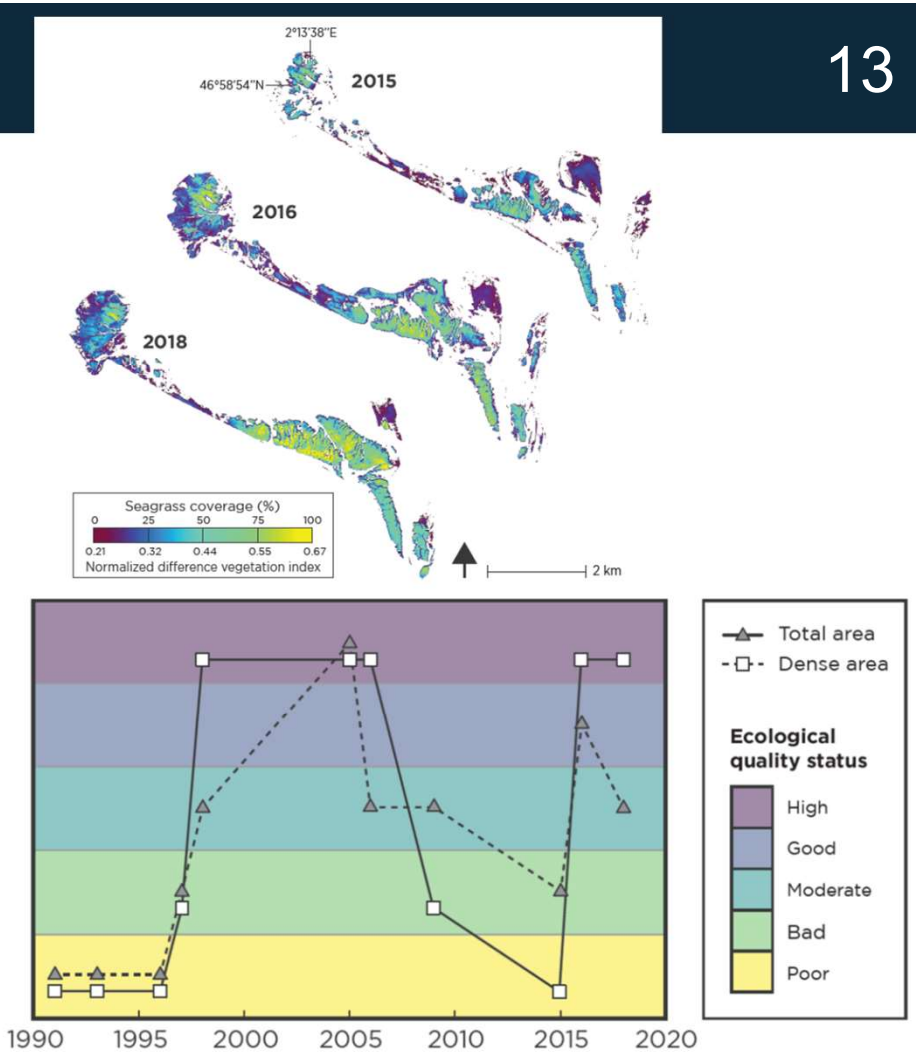
https://coastobs.lizard.net/favourites/cad9297f-1d6f-4573-b60f-c084d81edc22

WFD White Paper

Satellite-assisted monitoring of water quality to support the implementation of the Water Framework Directive

Eleni Papathanasopoulou, Stefan Simis*, Krista Alikas, Ave Ansper, Saku Anttila, Jenni Attila, Anne-Laure Barillé, Laurent Barillé, Vittorio Brando, Mariano Bresciani, Martynas Bučas, Pierre Gernez, Claudia Giardino, Nicolas Harin, Annelies Hommersom, Kersti Kangro, Pirkko Kauppila, Sampsa Koponen, Marnix Laanen, Claire Neil, Dimitrios Papadakis, Steef Peters, Sandra Poikane, Kathrin Poser, Miguel Dionisio Pires, Caitlin Riddick, Evangelos Spyrakos, Andrew Tyler, Diana Vaičiūtė, Mark Warren, Maria Laura Zoffoli

*communicating author: stsi@pml.ac.uk



Satellite-based time-series (1990 – 2018) of seagrass indicator (extent metric)

Conclusion

- Sentinel-2 remote sensing of intertidal seagrass cover
  - Validated maps of *Zostera noltei* (RMSE 14%)
  - Spatial information representative of meadow status
  - From seasonal to long-term interannual monitoring
  - From local to pan-European scale
- Scientific publications
  - White Paper (2019)
  - Zoffoli et al. (2020)
- Product commercially available

- WFD indicator
  - Synoptic maps of percent cover
  - Extent metric of whole, dense, and very dense meadow

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UNIVERSITÉ DE NANTES

THANK YOU!

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