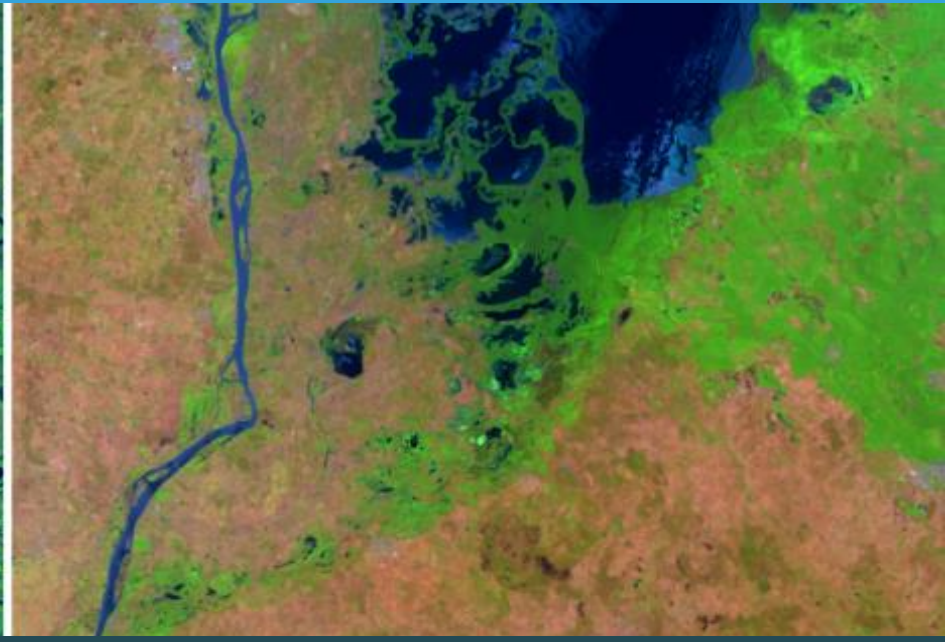


PROBA4COAST - Coastal Turbidity Derived From The PROBA-V Global Vegetation Satellite

Els Knaeps[1], Sindy Sterckx[1] , Liesbeth De Keukelaere[1], Laura Van den Eynde[2], Jaak Monbaliu[2], Erik Toorman[2], Qilong Bi[2], Jonas Royakkers[2], Carole Lebreton[3]

[1] Flemish Institute for Technological Research
[2] KU Leuven, Department of Civil Engineering
[3] Brockmann Consult

belspo

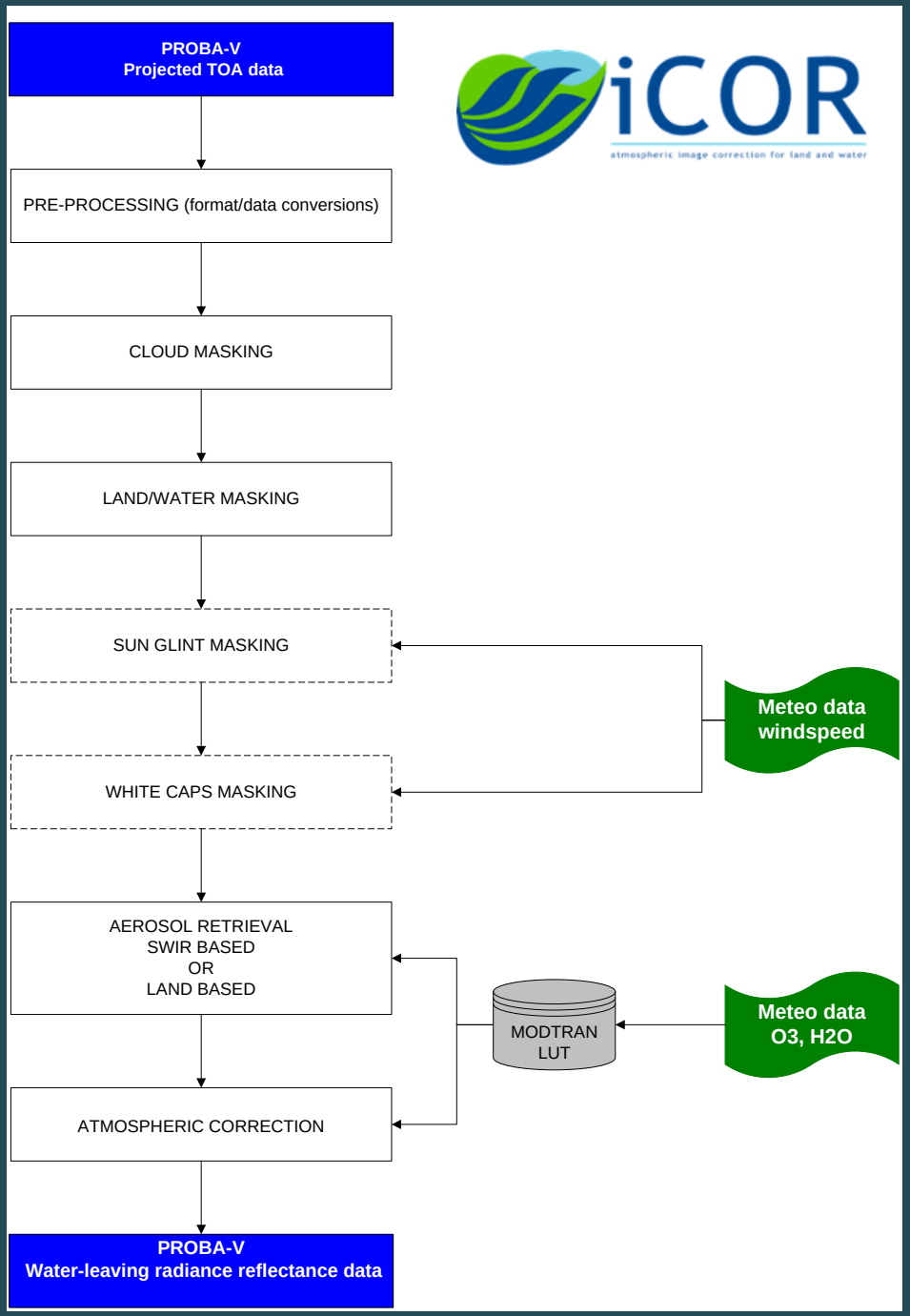
RESEARCH QUESTION AND USER NEEDS

- Can we use Proba-V, a global vegetation mission, for Turbidity/SPM monitoring in coastal areas?
- Is there a need to develop a dedicated marine atmospheric correction?
- How do results compare with MODIS turbidity and can we combine both?
- How do results compare with turbidity derived from modelling and can we use Proba-V for cal/val of the model?

Turbidity =
optical property (ISO, 1999: 90° side-scattering of light at 860 nm with respect to Formazin)

Suspended Particulate Matter (SPM) =
mass concentration

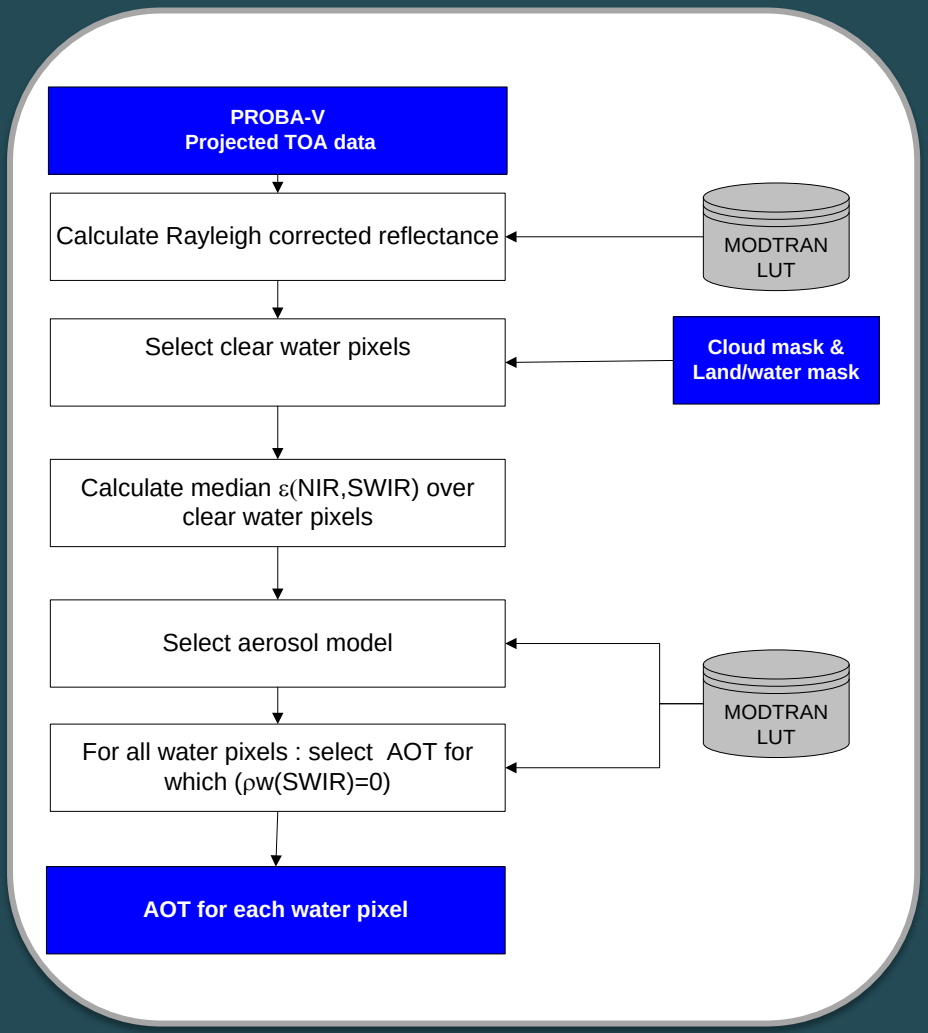
Overall atmopsheric correction workflow



Development of iCOR for Proba-V

De Keukelaere et al., 2018

SWIR-based AOT

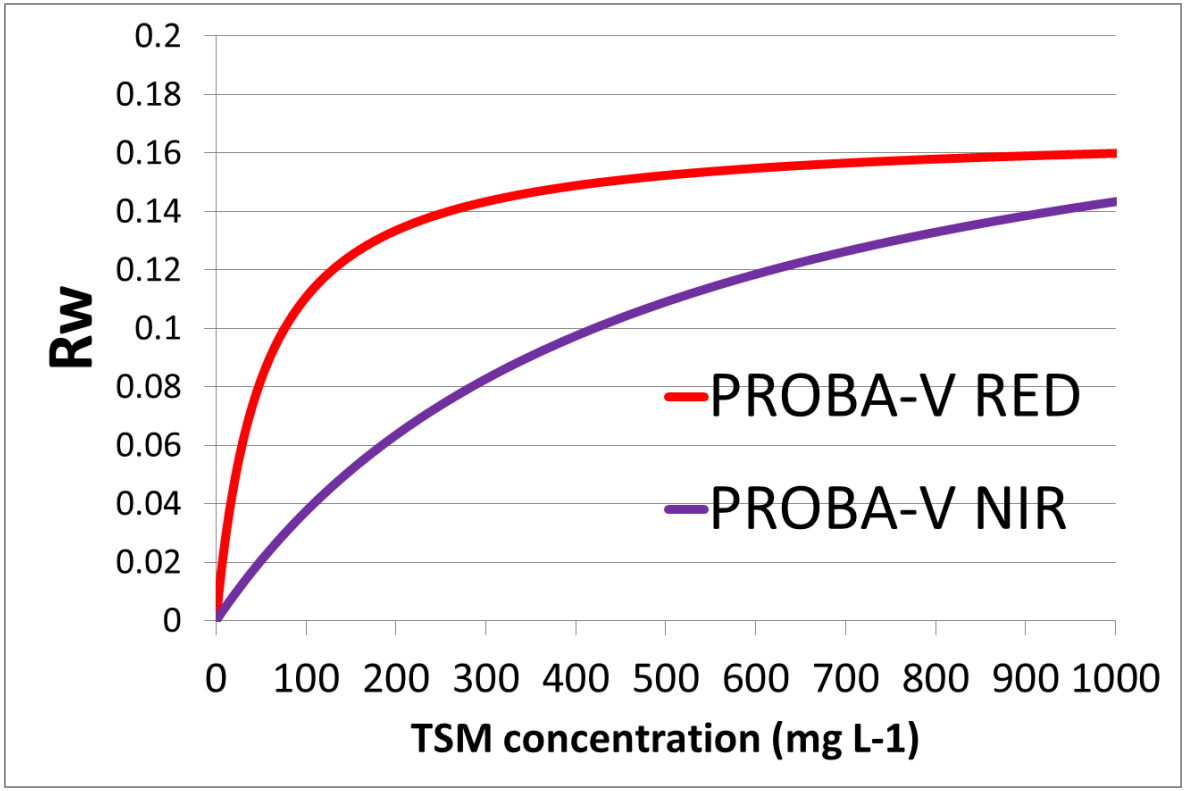


PV-LAC
PROBA-V ATMOSPHERIC CORRECTION & COASTAL PRODUCTS

https://earth.esa.int/web/sppa/activities/instrument-characterization-studies/pv-lac-coast

TSM/TURBIDTY ALGORITHM

$TSM = A^{\rho} R_w(\lambda)/(1-R_w(\lambda)/C^{\rho})$ (Nechad et al., 2010)



Global turbidity algorithm and regional T/TSM calibration (Dogliotti et al., 2015)

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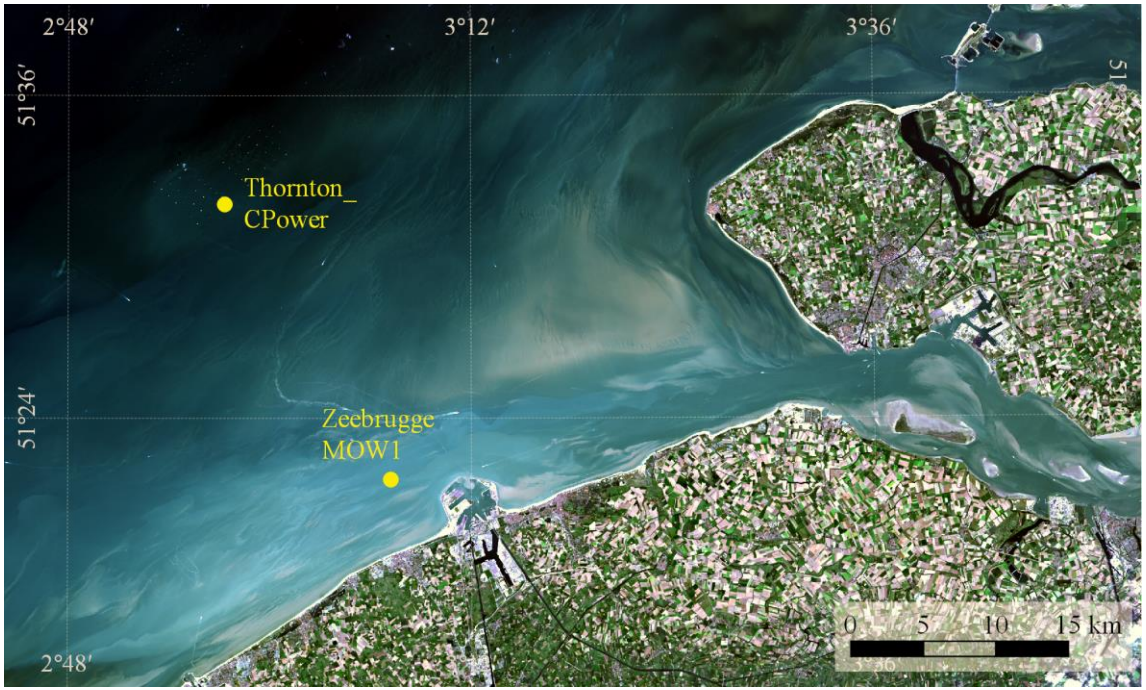
VALIDATION – AOT AND WATER LEAVING REFLECTANCE

Comparision with AERONET stations:

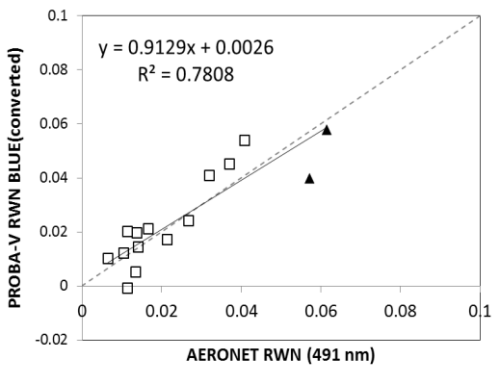
- Zeebrugge MOW1 (51.362° N; 3.120° E)
- Thornton_Cpower (51.533° N; 2.955° E)



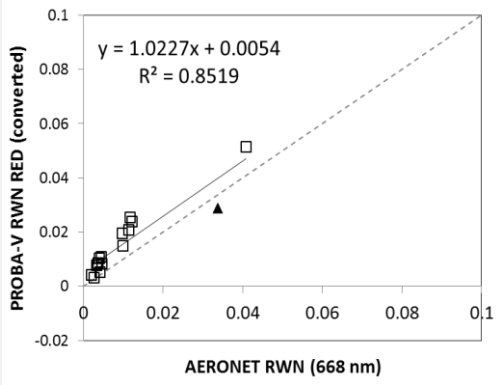
VALIDATION – WATER LEAVING REFLECTANCE

SWIR-based

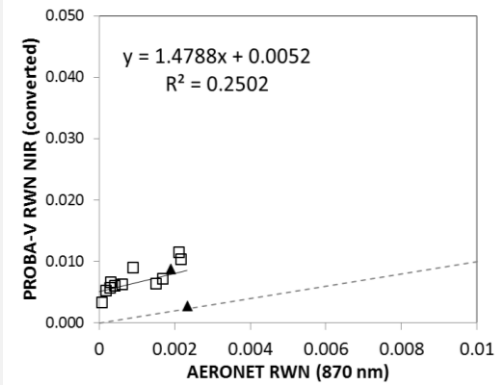
BLUE



RED



NIR



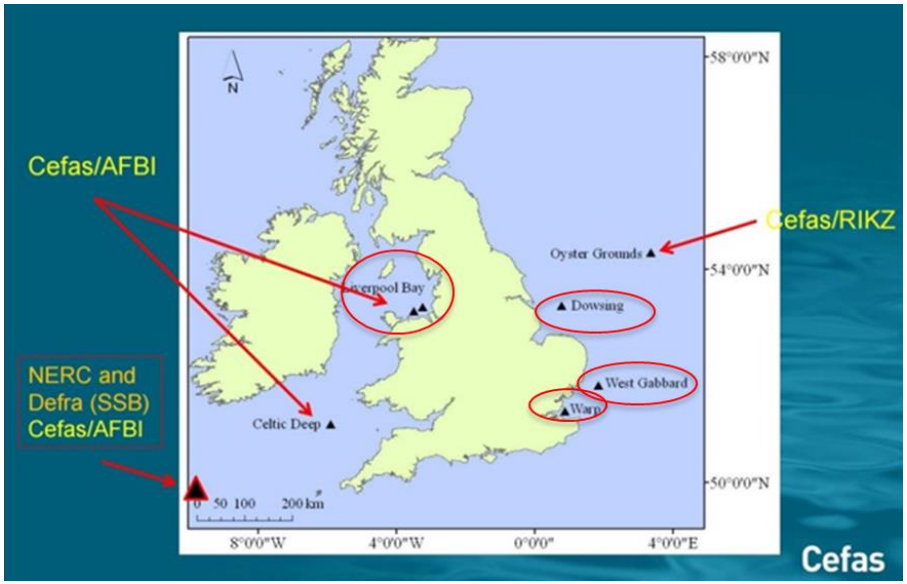
TURBIDITY VALIDATION

CEFAS Smartbuoys

- Autonomous systems
- Turbidity typically collected every 30 minutes at 1m depth
- Data is freely available

SmartBuoy

Location CEFAS smartbuoys



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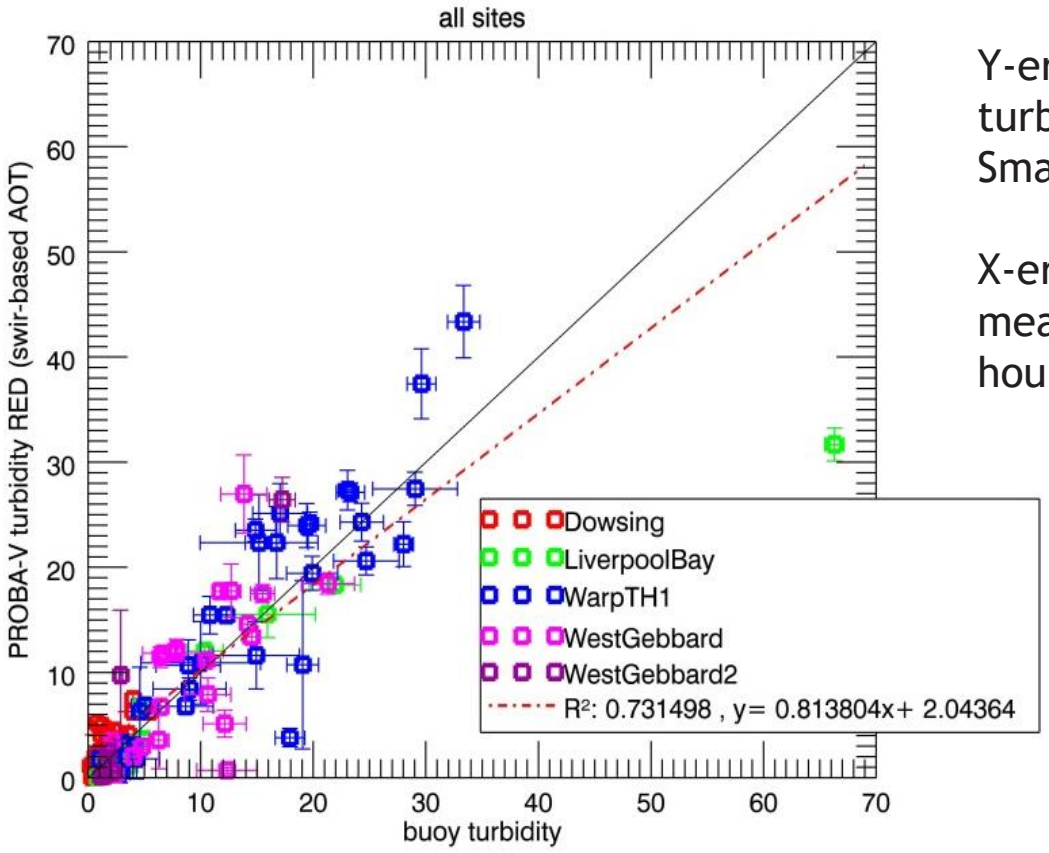
TURBIDITY VALIDATION



Scatterplot Proba-V vs buoy turbidity

Y-error bars: std of Proba-V derived turbidity within 1kmx1km around Smartbuoy location

X-error bar: std of buoy turbidity measurements performed within 1 hour of the PROBA-V acquisition

May-2014 till Dec 2016
Proba-V 100m

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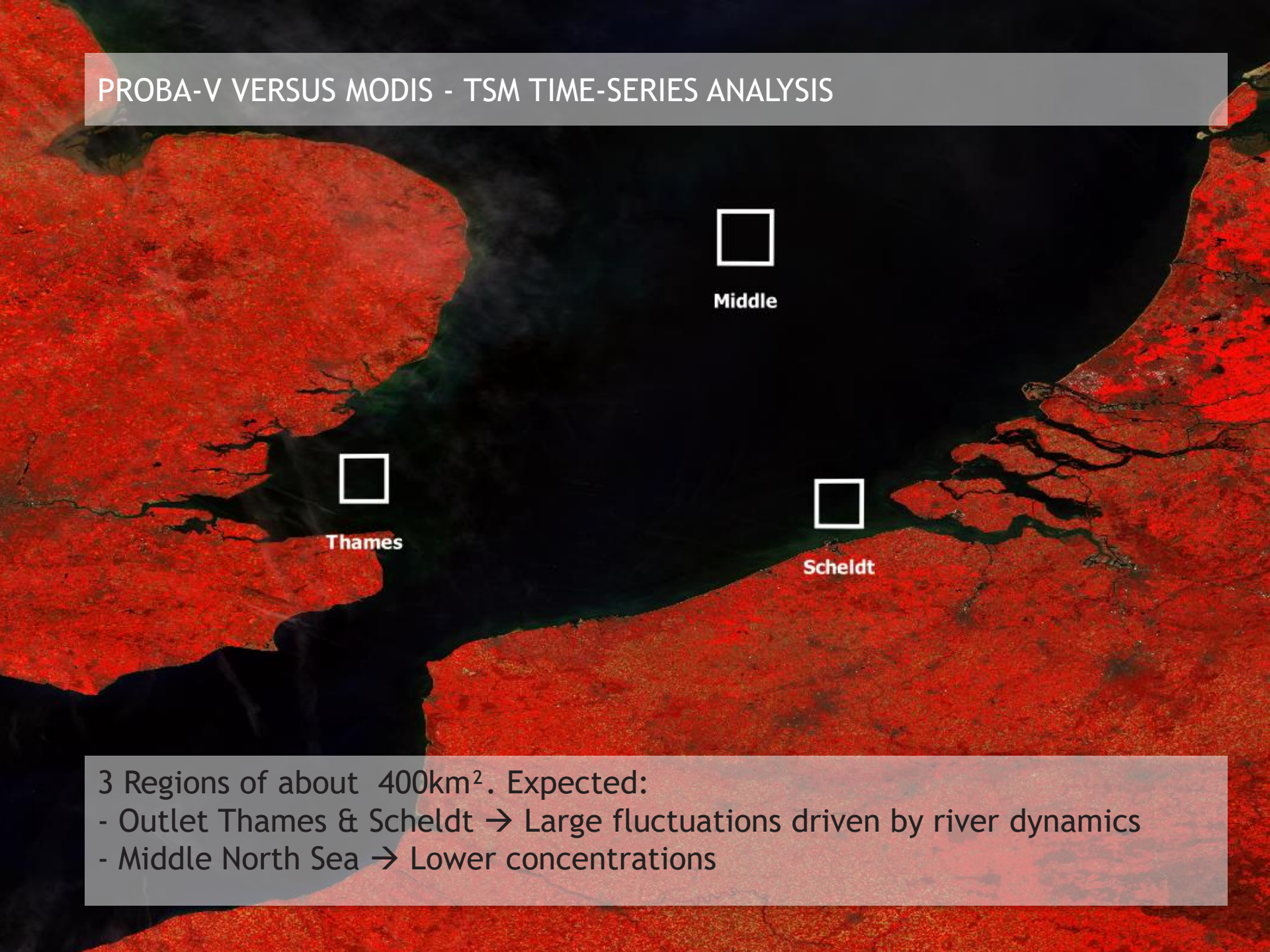
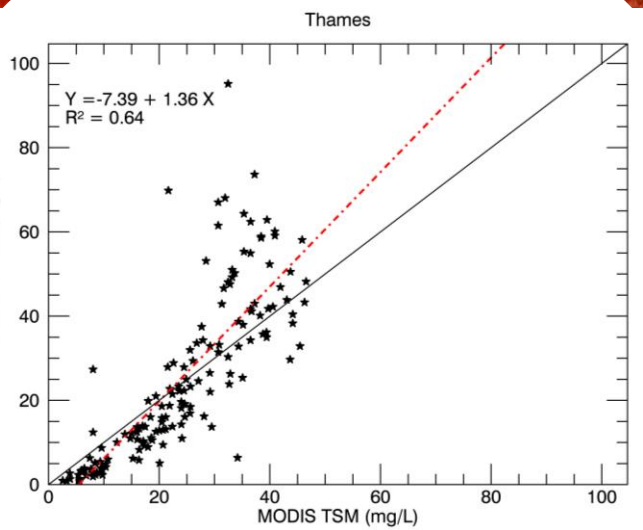
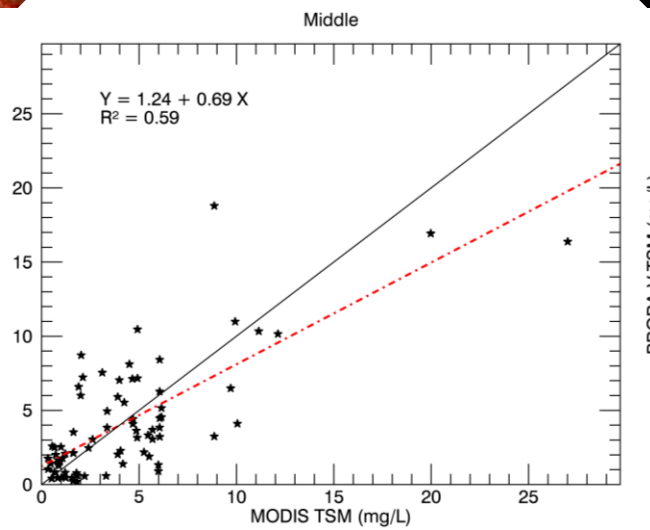
PROBA-V VERSUS MODIS - TSM TIME-SERIES ANALYSIS

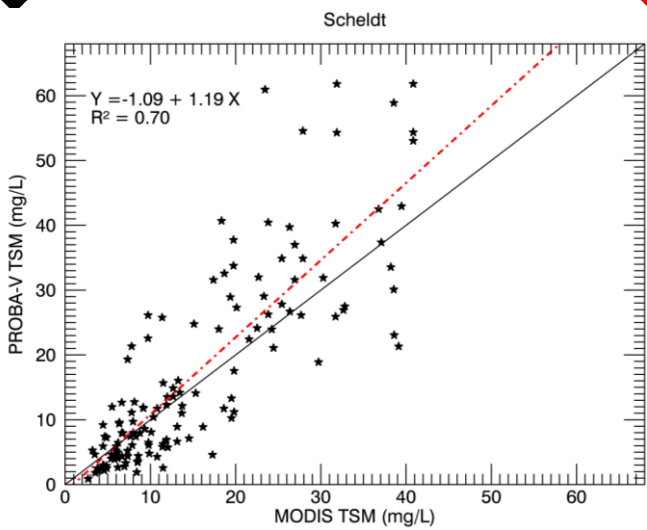


3 Regions of about 400km^2. Expected:
- Outlet Thames & Scheldt → Large fluctuations driven by river dynamics
- Middle North Sea → Lower concentrations

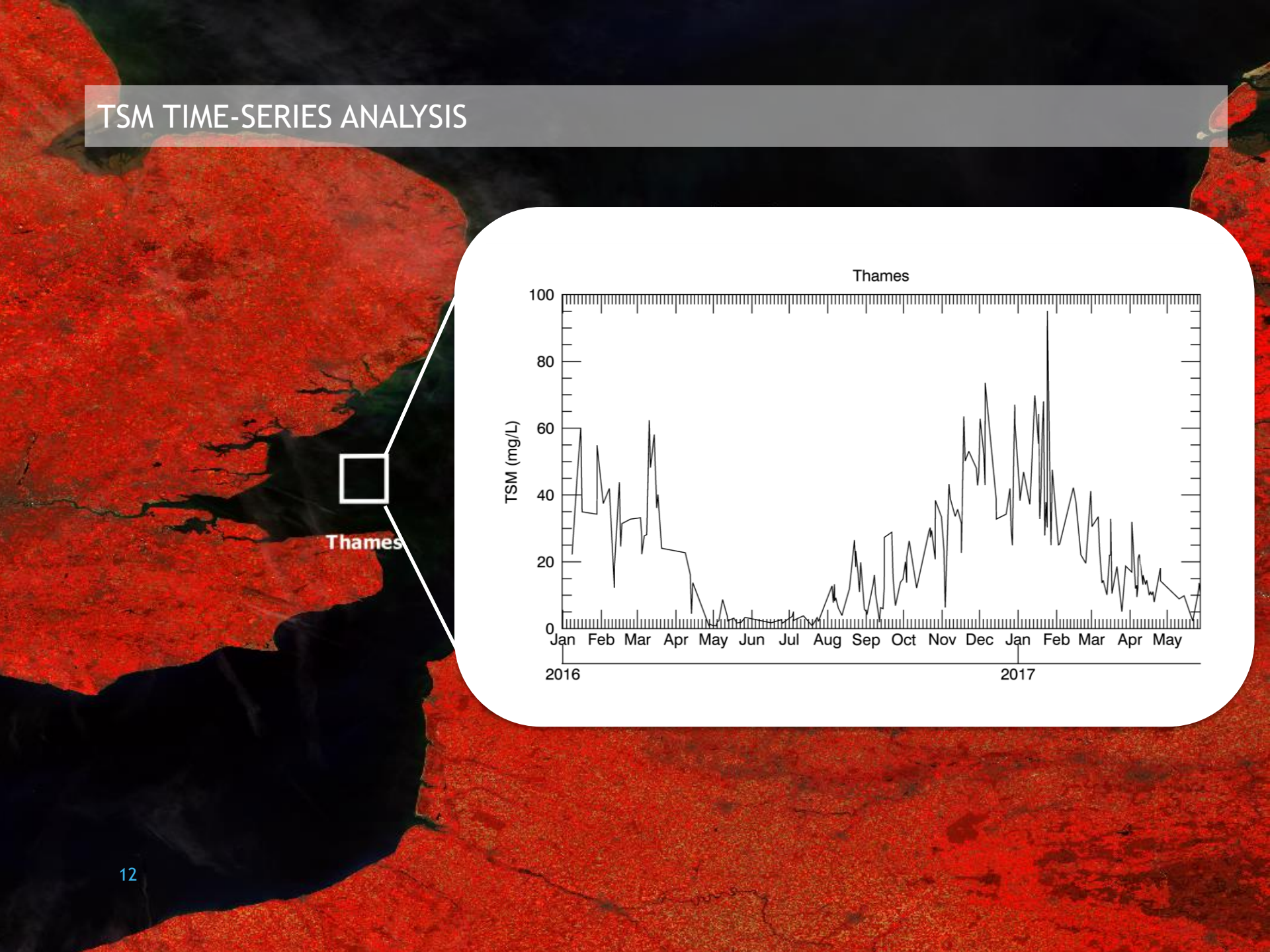
TSM SCATTERPLOTS



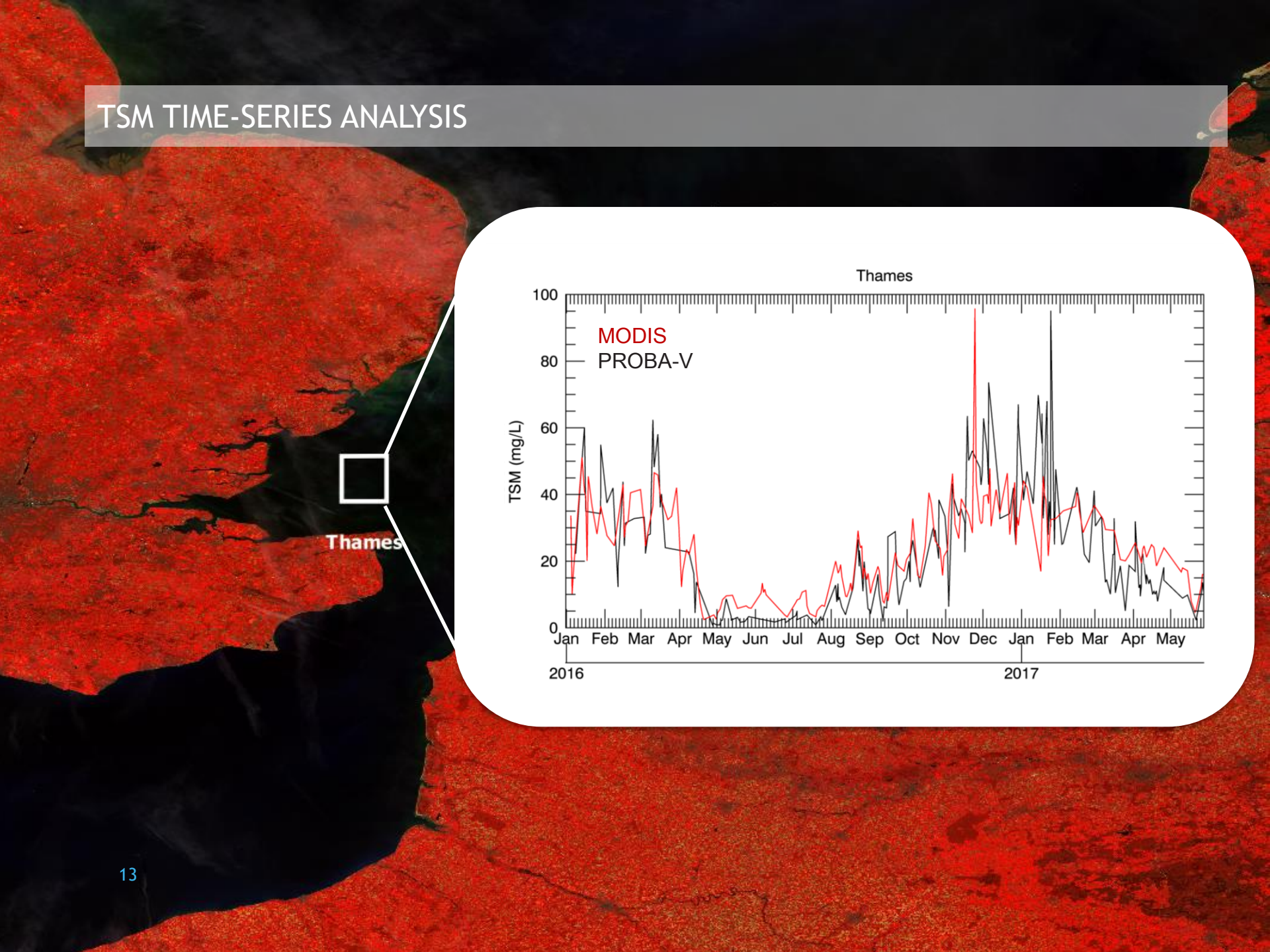




TSM TIME-SERIES ANALYSIS



TSM TIME-SERIES ANALYSIS



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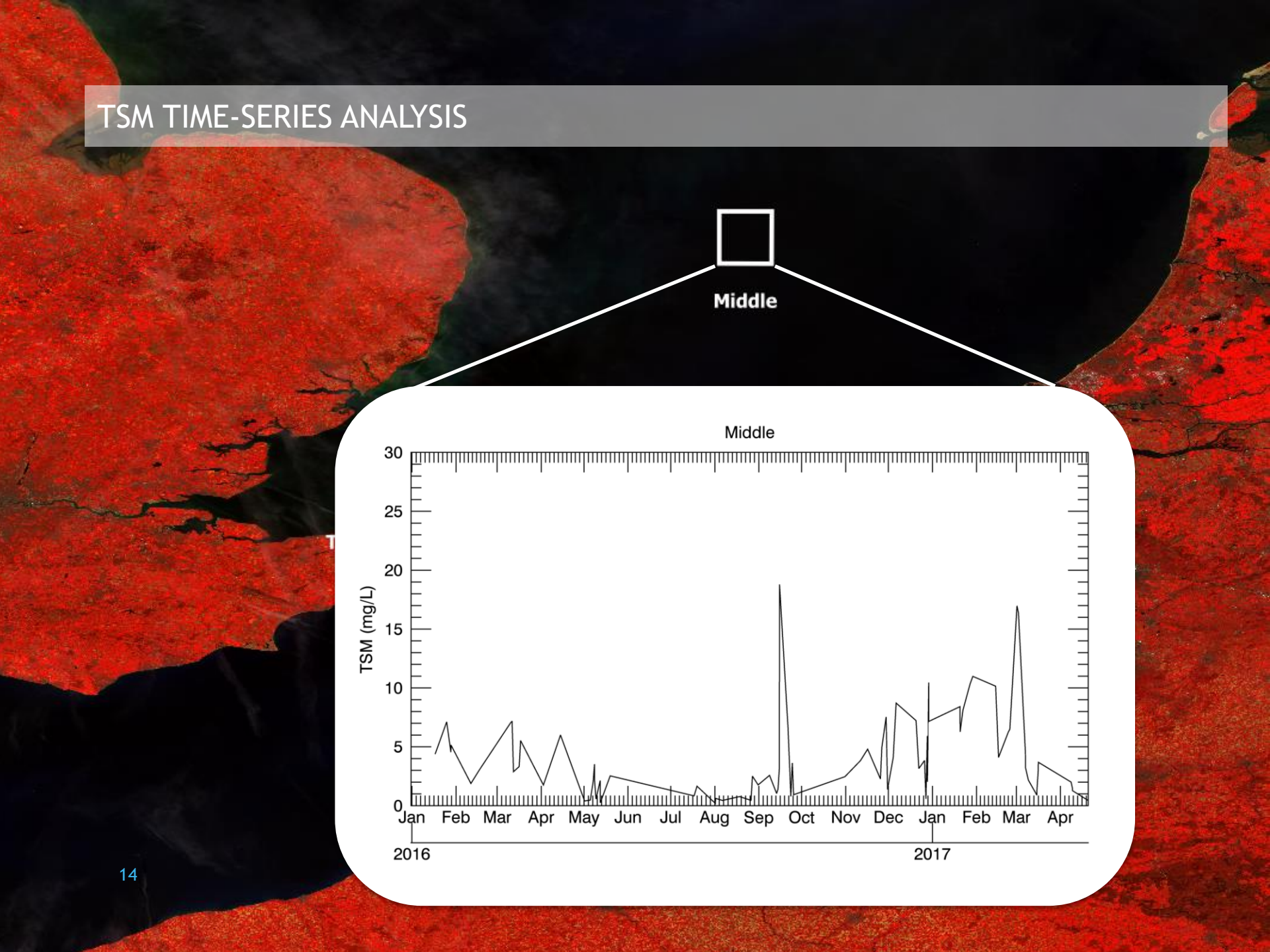

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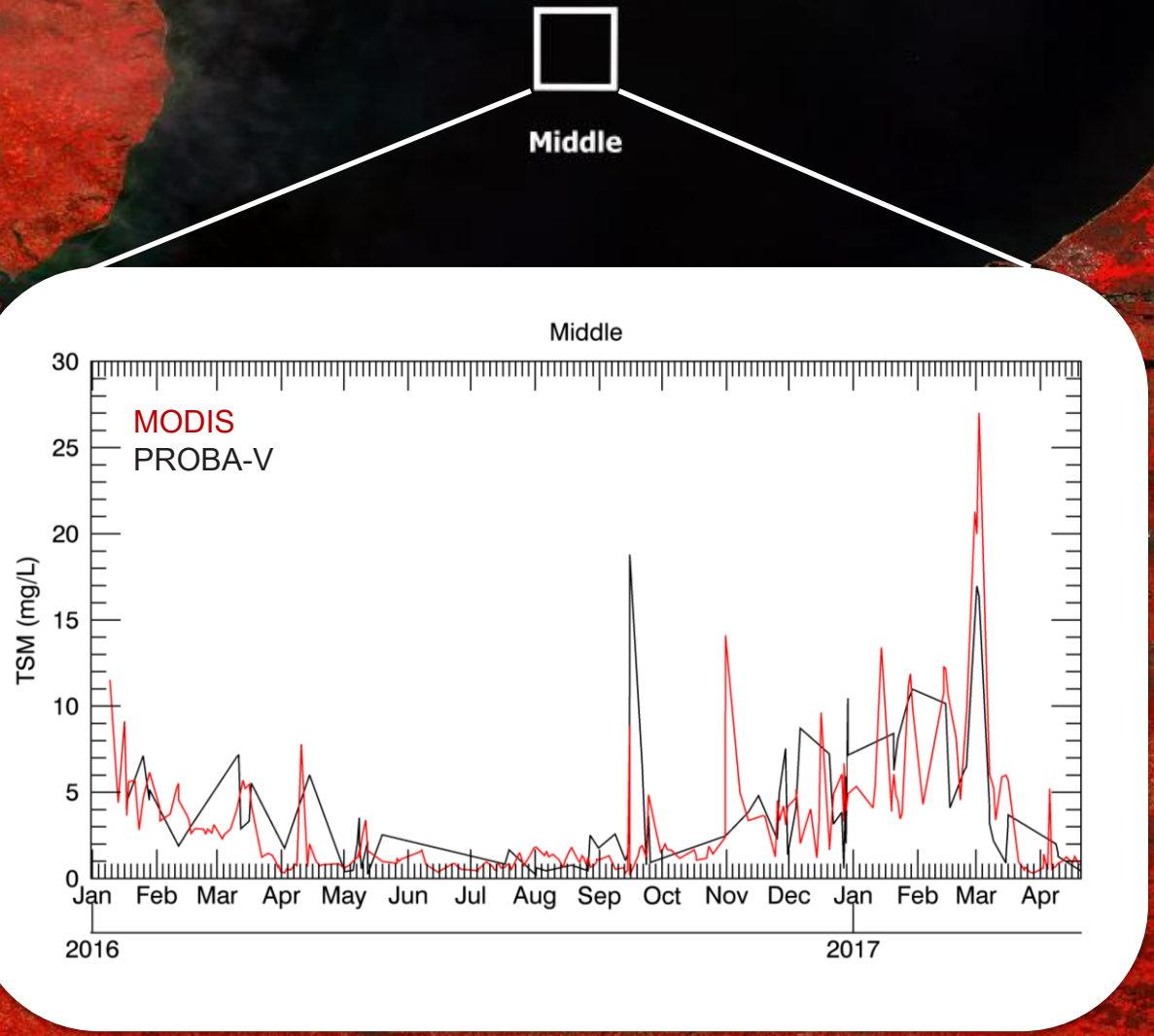

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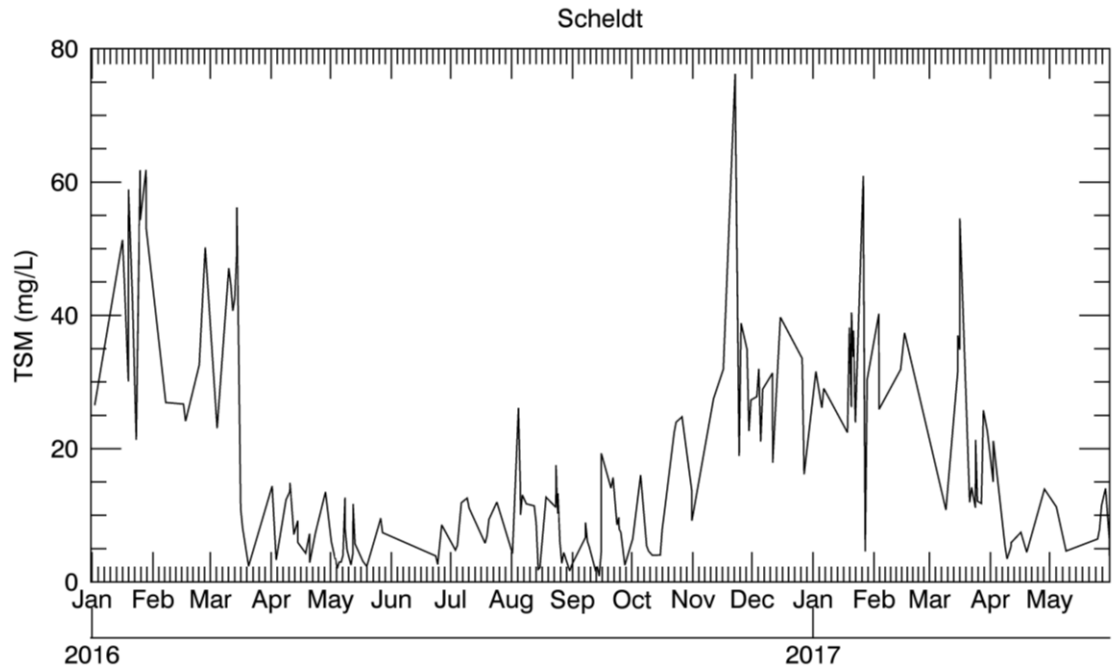
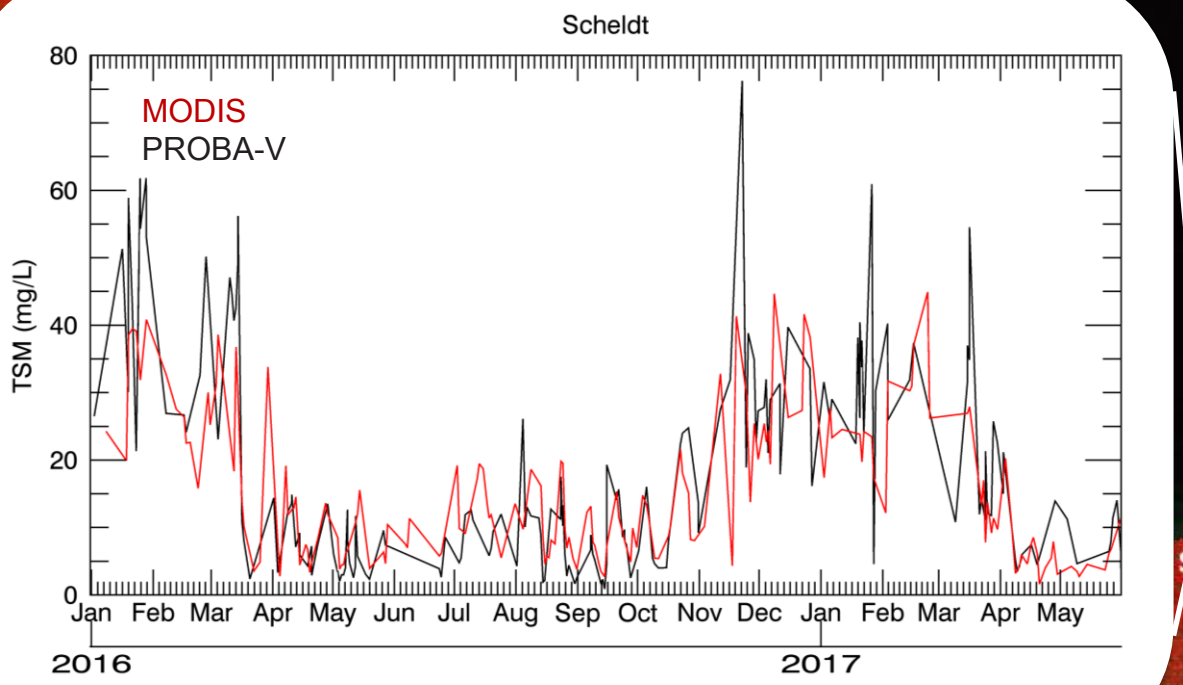


Scheldt

TSM TIME-SERIES ANALYSIS



Scheldt

TURBIDITY / TOTAL SUSPENDED MATTER - CONCLUSIONS

- Turbidity shows good correlation with CEFAS turbidity buoys
  (R^2 = 0.73; Slope = 0.81; Offset = 2 mg/L)

- Proba-V and MODIS show good agreement
  - Similar patterns in the water
  - Time series comparable
  - Good regression coefficients
    (R^2 = 0.59 – 0.7; Slope = 0.69 – 1.36; Offset = -7 – 1.24 mg/L)

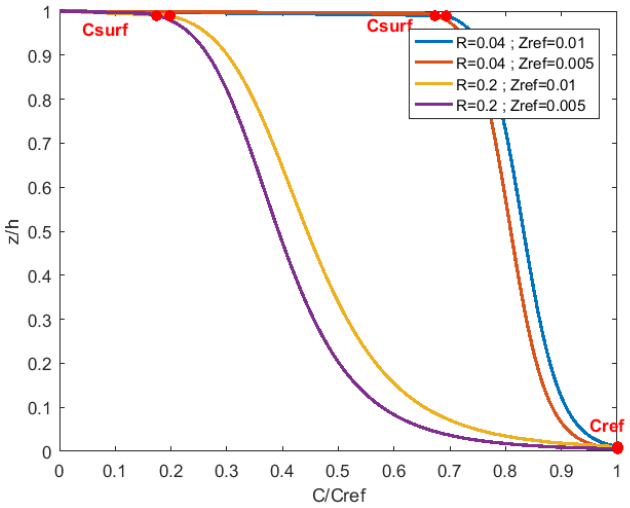
TELEMAC-MASCARET

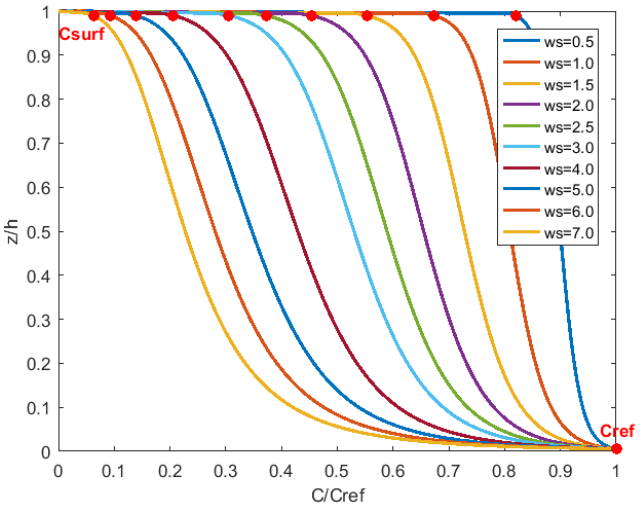
- Telemac-2D: two-dimensional flows
  → Flow velocities + water level
- Tomawac: wave propagation
  → Wave energy + characteristics (wave height,direction, period)
- Sisyphe: morphodynamics and sediment transport
  → Depth-averaged sediment concentrations + sediment fluxes + bed evolution

Conversion to surface concentrations!

Modification of reference height, settling velocity

Calibration period = April 2015





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Validation period = March to July 2016

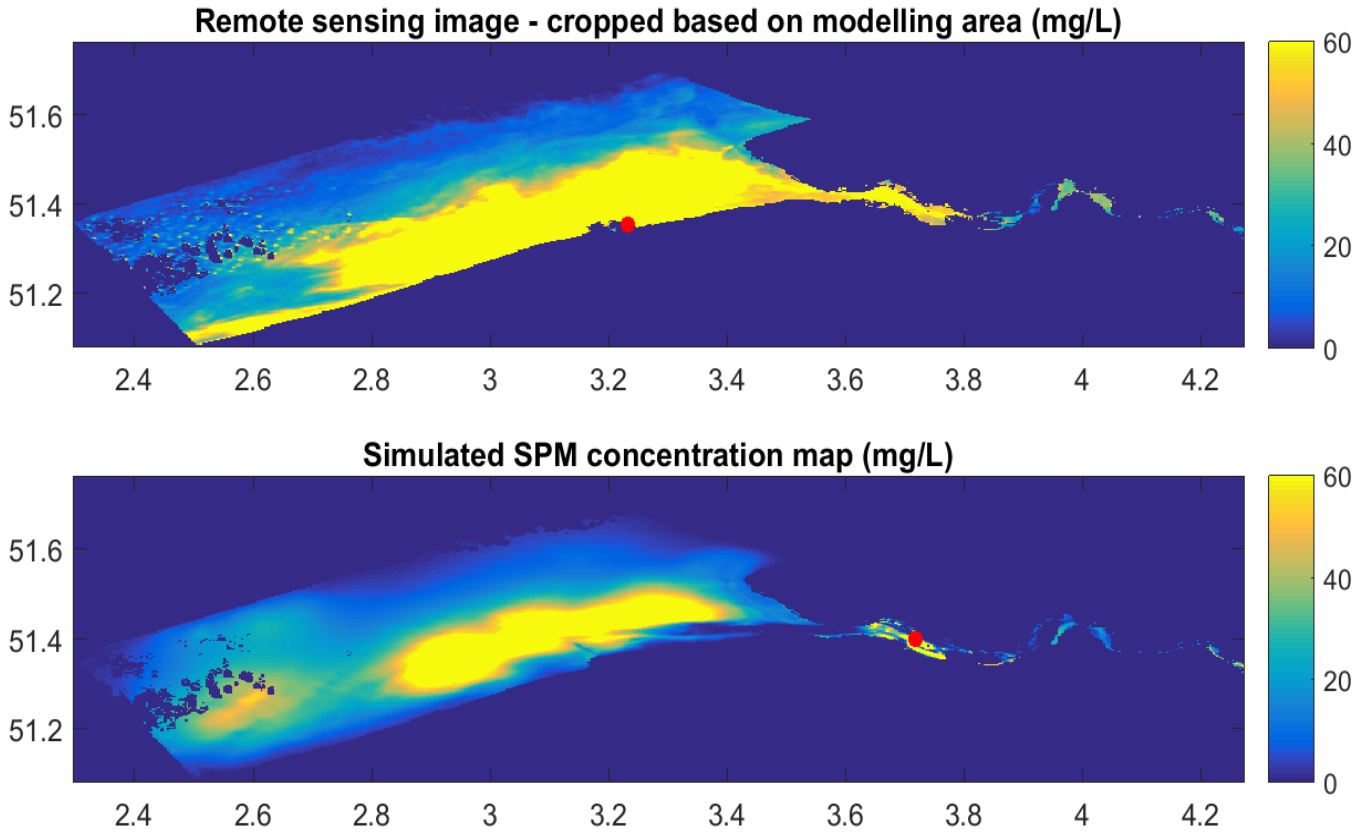


Image 5: 14/03/2016 12:10:00

Visual comparison (3)

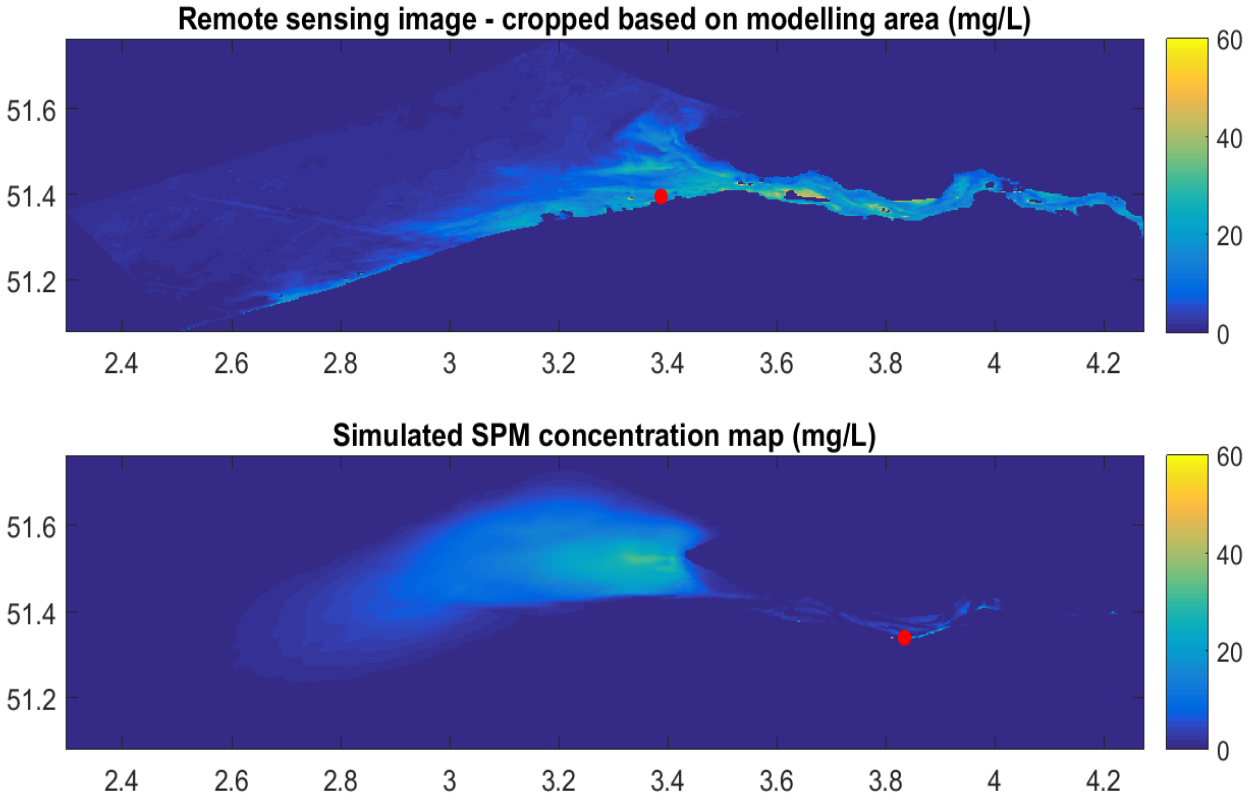


Image 9: 03/04/2016 11:20:00

Visual comparison (5)

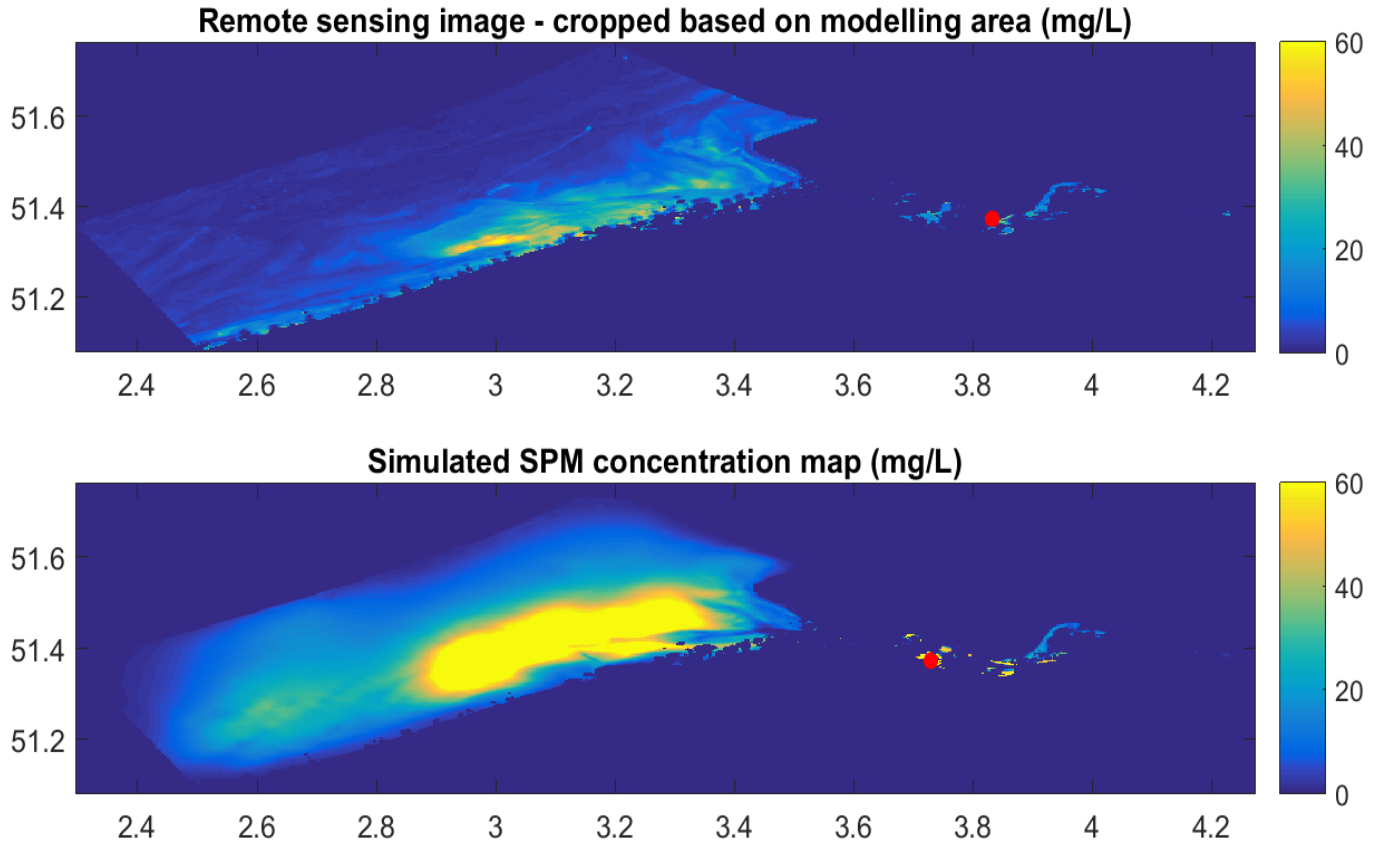
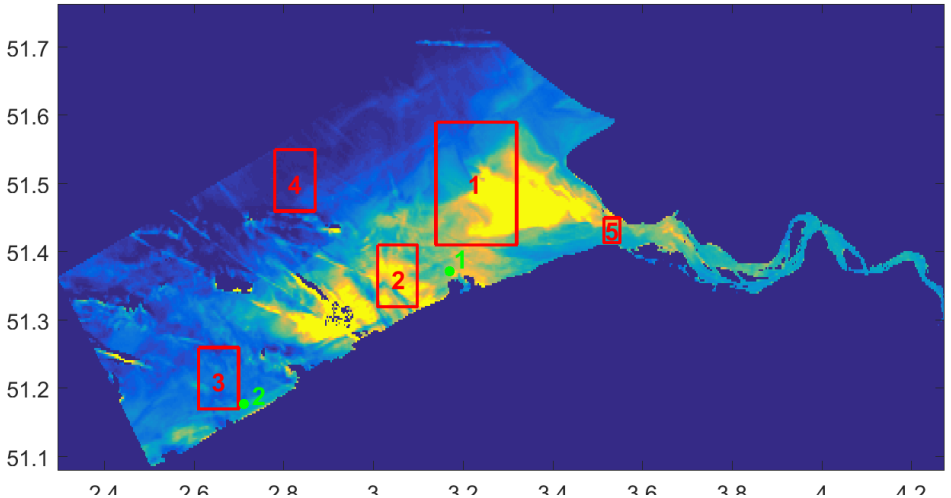
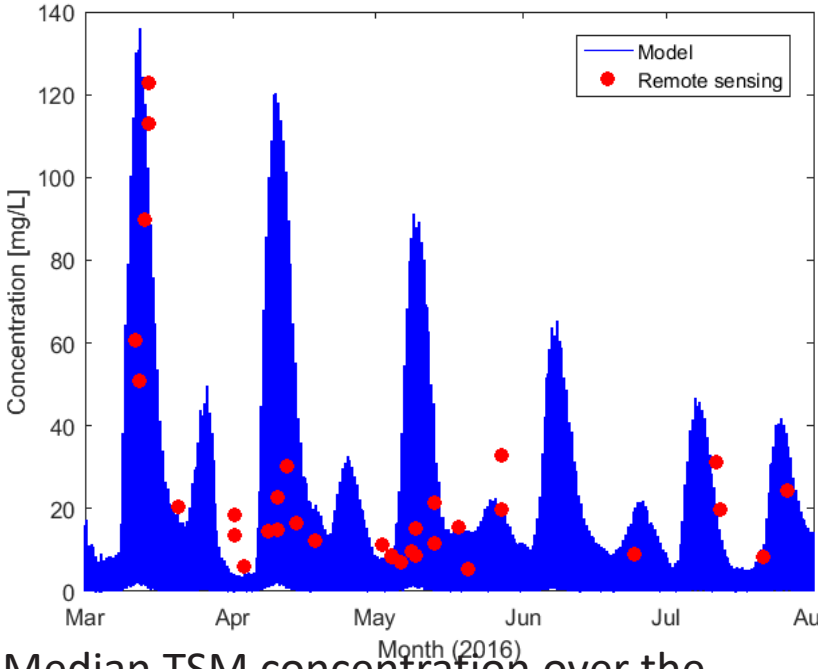
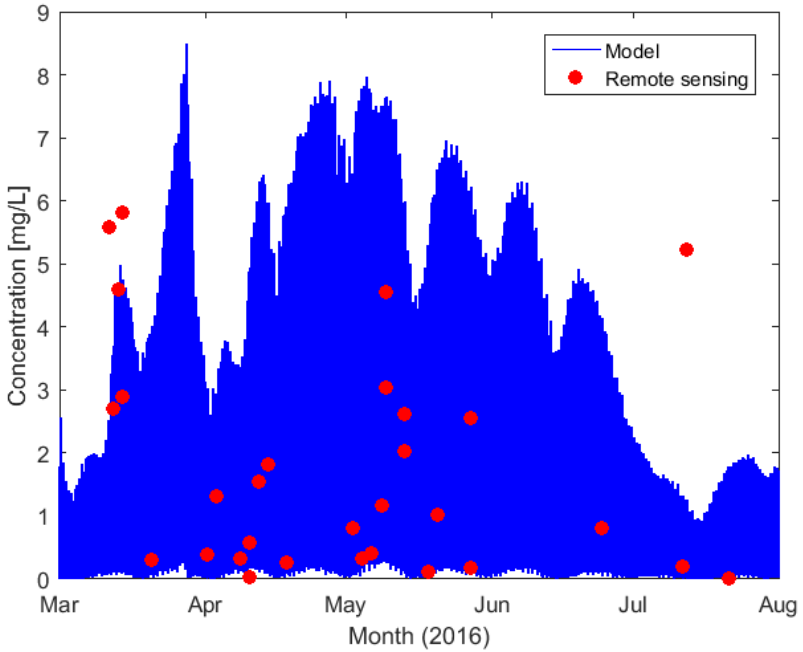


Image 13: 12/04/2016 11:20:00





Median TSM concentration over the window of Zeebrugge for the remote sensing data (red) and the modelling results (blue).



Median TSM concentration offshore (4) for the remote sensing data (red) and the modelling results (blue).

MODEL- CONCLUSIONS

- The pragmatic approach to convert depth averaged to surface concentration for SPM seems to work well in a first approach.

- SPM concentrations retrieved from remote sensing are very valuable for model calibration. This will undoubtedly lead to improvements in model process formulations.

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