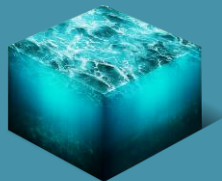


TIMBERS



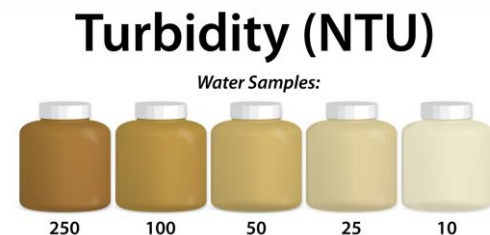
3D Turbidity assessment through Integration of
MultiBeam Echo-sounding and optical Remote Sensing

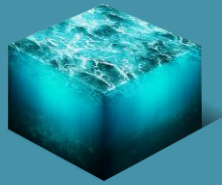
Robrecht Moelans, Liesbeth De Keukelaere, Els Knaeps (VITO)
Nore Praet, Maarten De Rijcke, Thomas Vandorpe (VLIZ)
Heidi Dierssen (University of Connecticut)



Why TIMBERS? (1)

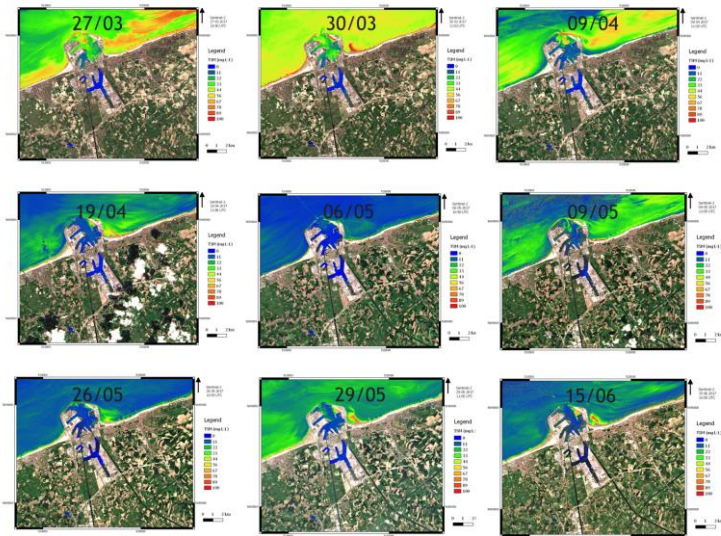
- TIMBERS = 3D Turbidity assessment
- What?
 - Cloudiness of water
 - = optical property (ISO 1999: 90° side-scattering of light at 860nm with respect to Formazin
 - Suspended Particulate Matter (SPM) = mass concentration
- Why?
 - Can have negative effects on aquatic life
 - Can carry contaminants
 - mandatory parameter to be measured in the MSFD
- 3D?
 - MSFD: 3D is recommended (2D not representative for entire water column)
 - 3D is important to understand sediment transport (e.g. Maritime access division)
 - Validation of hydrodynamic models (e.g. Proba4Coast)



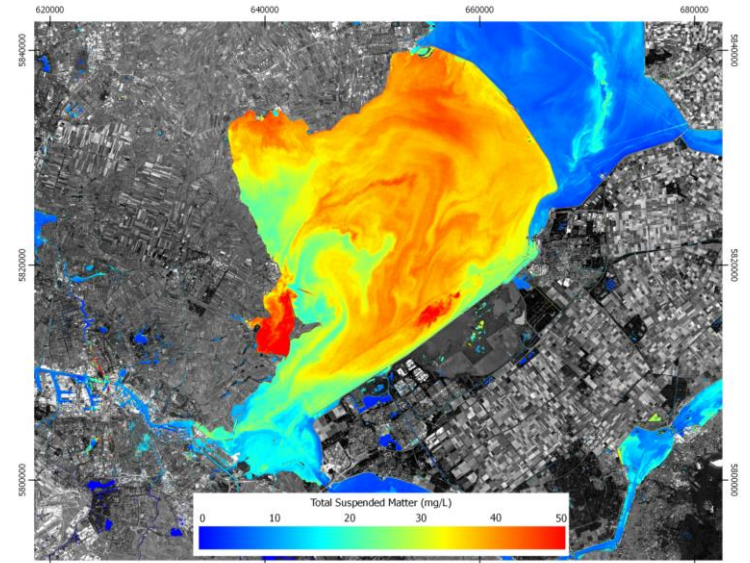


Optical Remote Sensing: 2D Turbidity

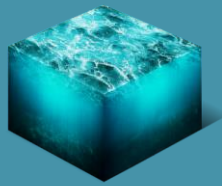
- Used for decades to assess the quality of aquatic systems
- Key parameters: Turbidity and Suspended Particulate Matter (SPM)
- Very limited penetration in many coastal waters: 2D assessment



SPM near the harbor of Zeebrugge, Belgium (Sentinel-2)

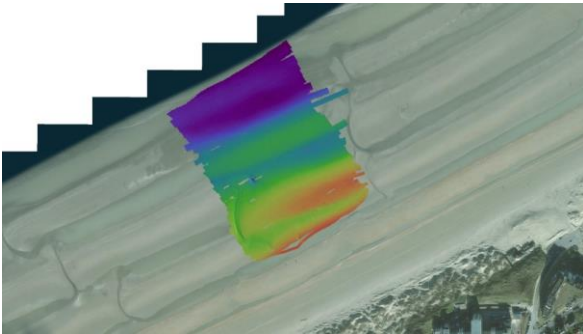


SPM on 07/01/2015 in Markermeer, the Netherlands (Landsat-8)

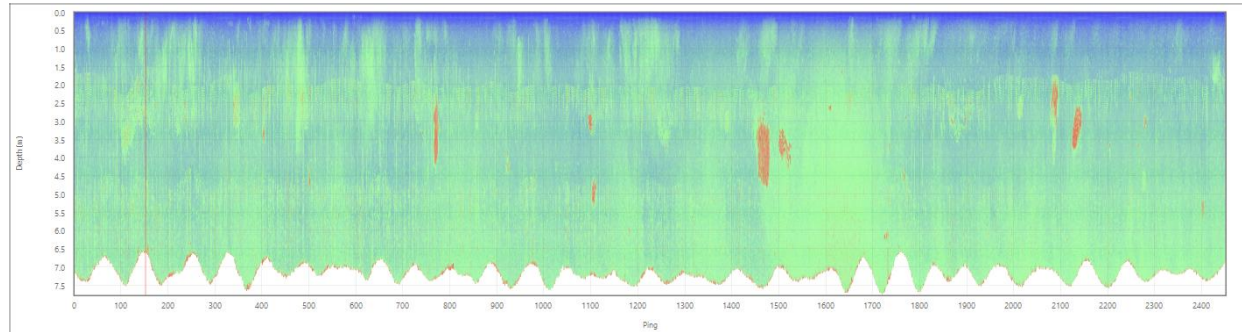


Multibeam Echo-Sounding: Bathymetry

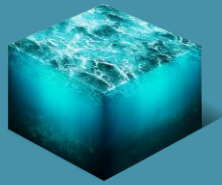
- Used for decades to assess the water depth in high resolution (bathymetry)
- Scattering of acoustic signals in water column = 'Noise'
 - But! contains a wealth of information on density of particles in water column
 - 'Noise' => 3D Turbidity?



Norbit bathymetry data from the intertidal area at Groenendijk, acquired with the RIB 'Zeekat'



Water column data from the BCP acquired with the EM2040 installed on the RV 'Simon Stevin'



TIMBERS: Research Hypothesis



Optical Remote Sensing

Passive / Electromagnetics waves

-

2D Turbidity at water surface



Multibeam Echo-Sounding

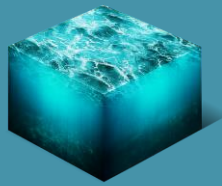
Active / Mechanical waves

-

Acoustic 'Noise' => 3D Turbidity?
(excl. water surface)

Integration?

Goal: Full 3D Turbidity profiles



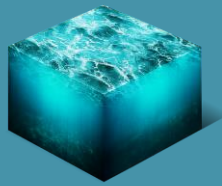
Why TIMBERS? (2)

Satellite-derived Water Quality parameters are already investigated thoroughly but often lacking a large validation dataset & only providing information at the very top layer of the water column.

Multibeam Echo-Sounding (MBES) is one of the most available tools around the globe adopted for both scientific and industrial marine applications. Mainly used for bathymetry but influenced by sediment in the water column (noise). Can we use this “noise” signal to quantify sediment distribution in the water column over a large and continuous area (\leftrightarrow discrete locations like buoys)?

=> new opportunities of creating big datasets for **validation purposes of optical RS.**

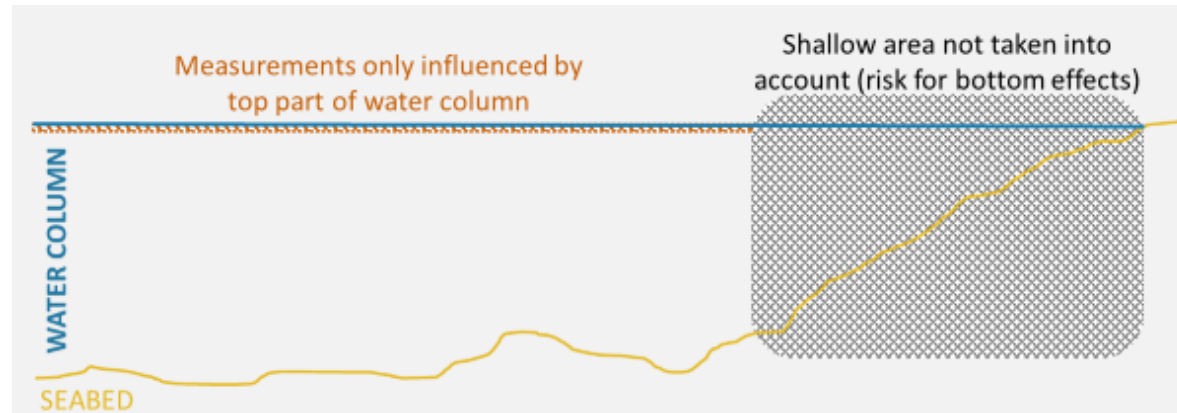
at least 115 research vessels (www.researchvessels.org) as well as commercial or government survey vessels are equipped with multibeam echo-sounders!



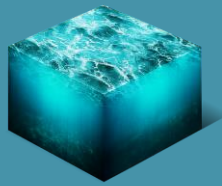
Methodology – Optical Remote Sensing

Summary

- Parameter: water-leaving reflectance => turbidity / SPM
- Only very top layer of the water column
- Attention!
 - Low sea state (≤ 3)
 - No sun glint
 - Avoid shallow areas (influence of seabed)



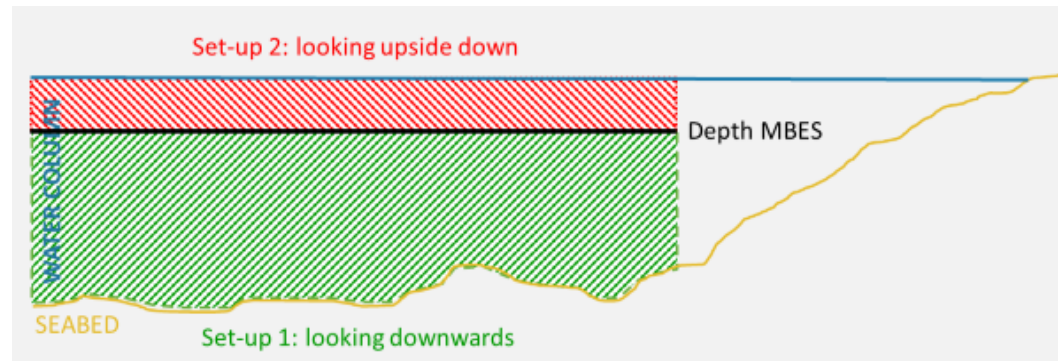
Schematic representation of optical remote sensing results



Methodology – Multibeam Echo-Sounding (MBES)

Summary

- Parameter: acoustic backscatter in water column ('Noise') => turbidity
- Two set-ups to be tested
- Attention!
 - No additional turbulence in the water column (engines off)
 - Time synchronisation + log sheets



Schematic representation of multibeam echo-sounding results



THANK YOU