Mapping seagrass and water depths using Sentinel-2

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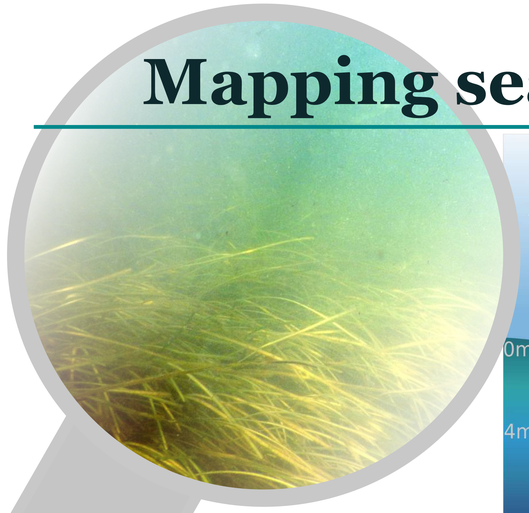
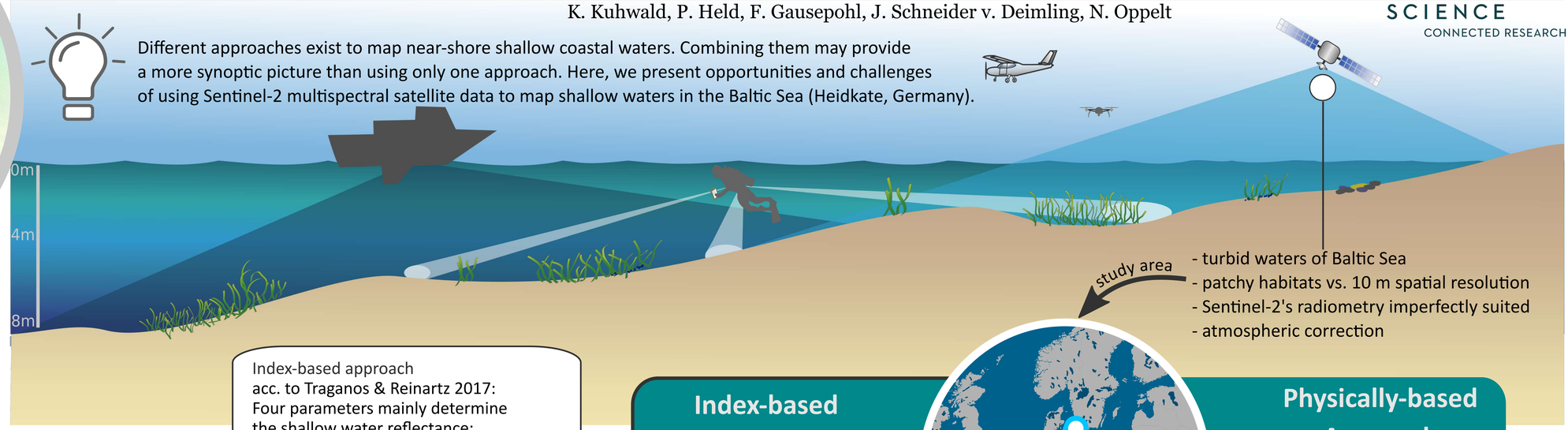
KIEL MARINE SCIENCE
CONNECTED RESEARCH

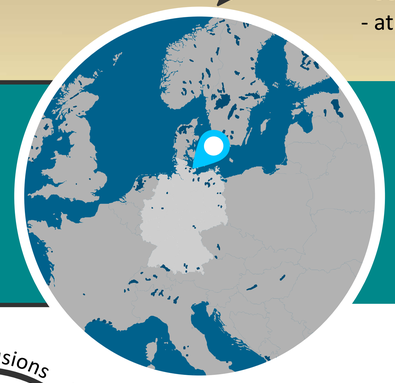


Different approaches exist to map near-shore shallow coastal waters. Combining them may provide a more synoptic picture than using only one approach. Here, we present opportunities and challenges of using Sentinel-2 multispectral satellite data to map shallow waters in the Baltic Sea (Heidkate, Germany).



study area

- turbid waters of Baltic Sea
- patchy habitats vs. 10 m spatial resolution
- Sentinel-2's radiometry imperfectly suited
- atmospheric correction

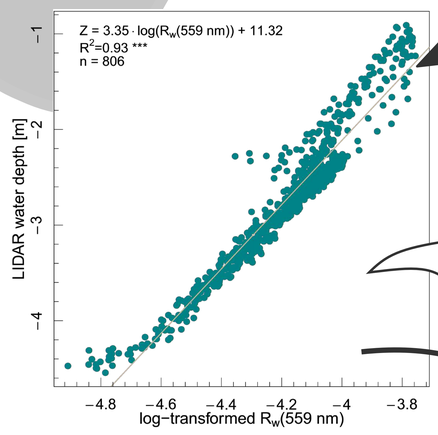


Index-based approach
acc. to Traganos & Reinartz 2017:
Four parameters mainly determine the shallow water reflectance:
1) water depth
2) water and optically active constituents
3) attenutation by water
4) reflectance of sea bottom

Determine parameters 1 (Fig. 1 and 2) to 3 to calculate the sea bottom reflectance from the atmospherically corrected Sentinel-2 data. Classify the sea bottom reflectance into the bottom types using a supervised approach (Fig. 3).

Index-based Approach
− static water column
− hardly transferable
+ easy to use

Physically-based Approach
+ dynamic water column
+ transferable
− complex to use



develop empric water depth model

Fig. 1: empirical model for estimating water depth at Heidkate. Data basis: Sentinel-2 atm. corrected (ACOLITE) green reflectance R_w and LiDAR water depth.

apply model

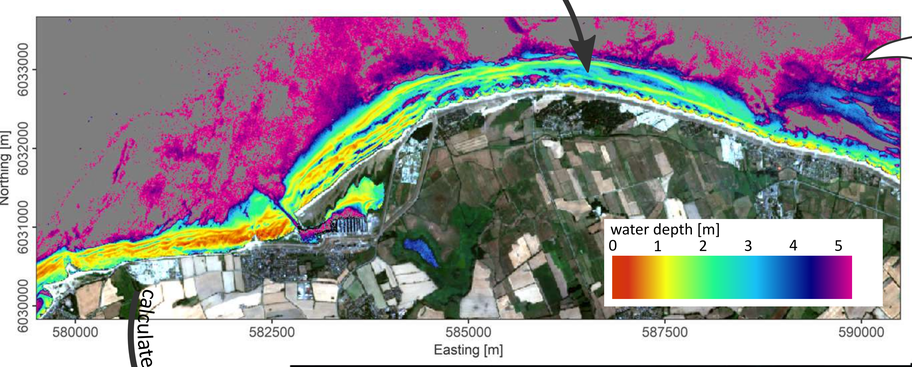
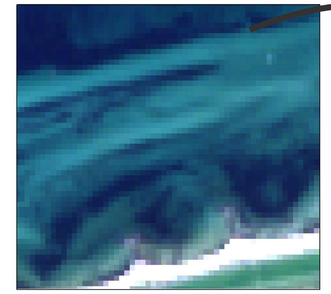


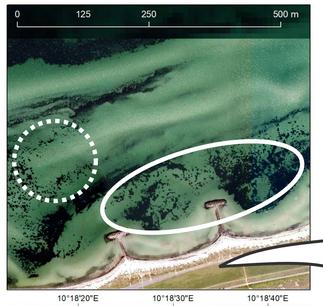
Fig. 2: calculated water depths applying the empiric model (Fig. 1) to a Sentinel-B scene of 23 Aug 2017.

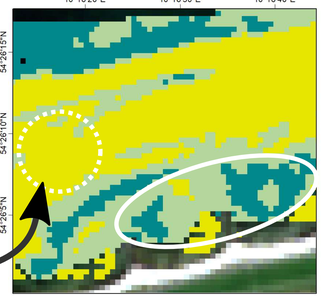
calculate bottom reflectance and classify

Fig. 3: Classified sea bottom based on Sentinel-2B bottom reflectance (23 Aug 2017). The intermediate steps to retrieve bottom reflectance are not shown here.

validate







conclusions

We can look down to appr. 4 m in the Baltic Sea using Sentinel-2.

We can differentiate between seagrass covered, mixed and bare sand.

The index-based approach only works for the trained scene

Kuhwald et al. in prep.

"How does the choice of atmospheric correction influence water depth retrieval with physically-based models?"

Water depths vary between a few cm up to 3 m. Atmospheric correction is very important.

Fig.4: Qualitative comparison with aerial imagery acquired in summer 2016. Large conntected seagrass patches were detected (solid circle), highly reflecting sand outshined dispersed, small seagrass stands (dashed circle).

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ECO MAP

EOM Earth Observation and Modelling

CAU Christian-Albrechts-Universität zu Kiel

References:

Traganos & Reinartz (2017): Mapping Mediterranean seagrasses with Sentinel-2 imagery. Mar. Pollut. Bull.
Vanhellemont (2019): Adaptation of the dark spectrum fitting atmospheric correction for aquatic applications of the Landsat and Sentinel-2 archives. Rem. Sens. Env.