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Shallow water UAV based habitat monitoring of seagrass meadows in the Baltic Sea

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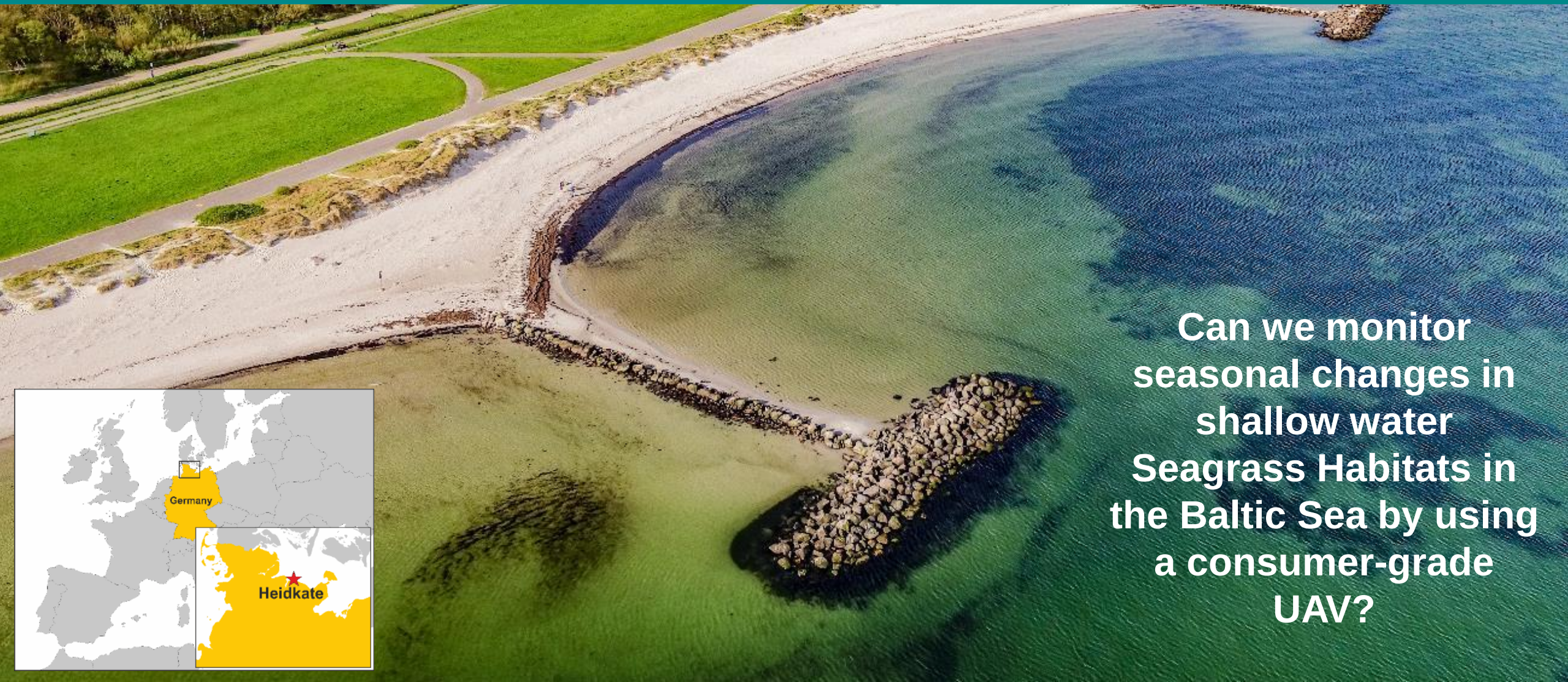

Can we monitor seasonal changes in shallow water Seagrass Habitats in the Baltic Sea by using a consumer-grade UAV?

Why is seagrass so important and what are its stressors?

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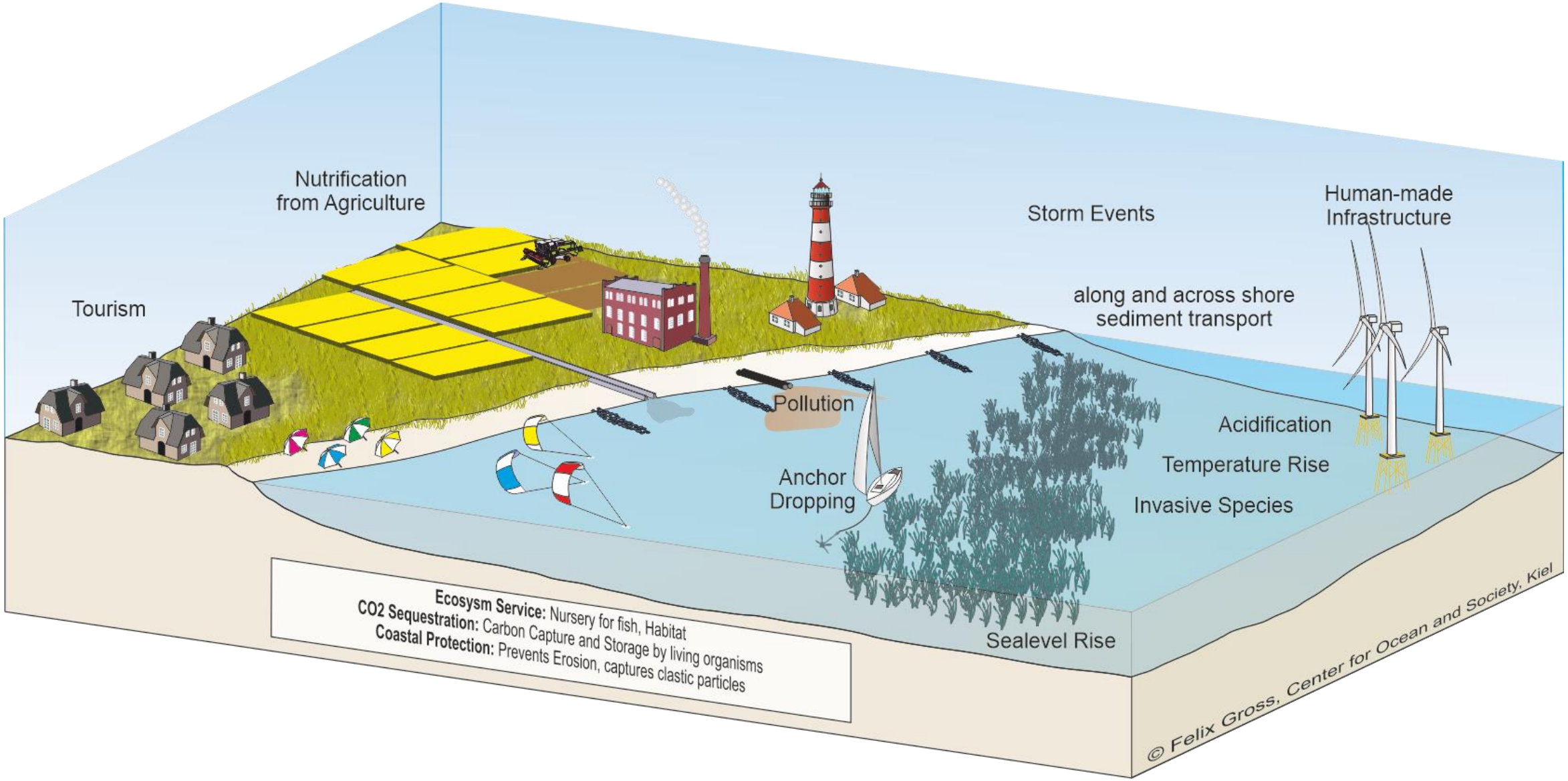
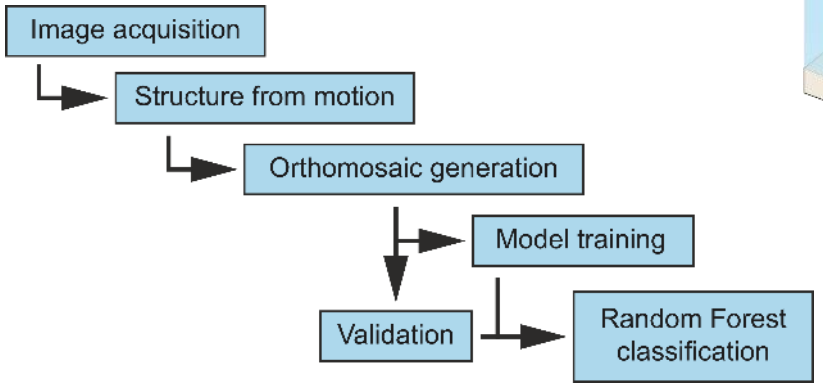


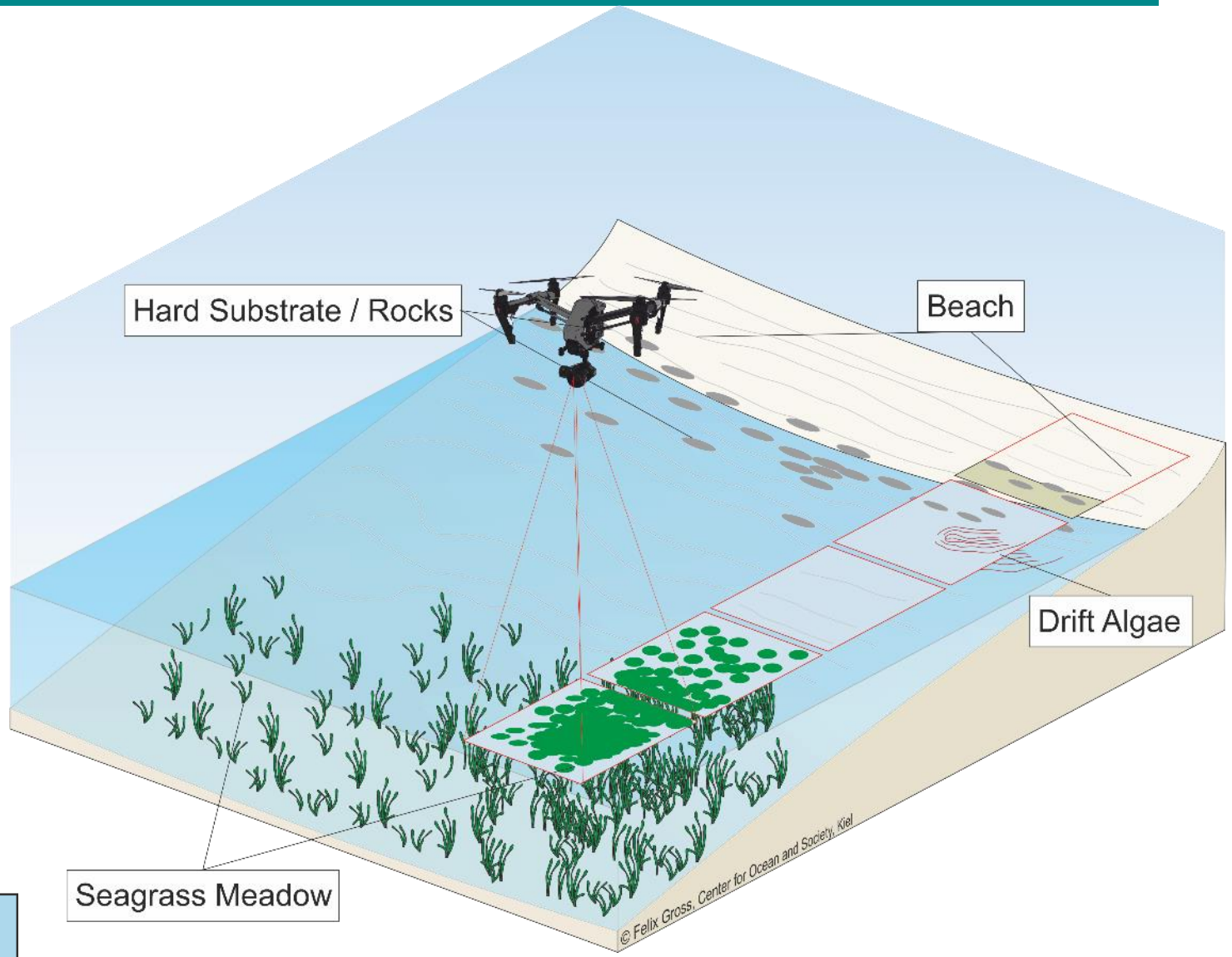
Data Acquisition and Methods

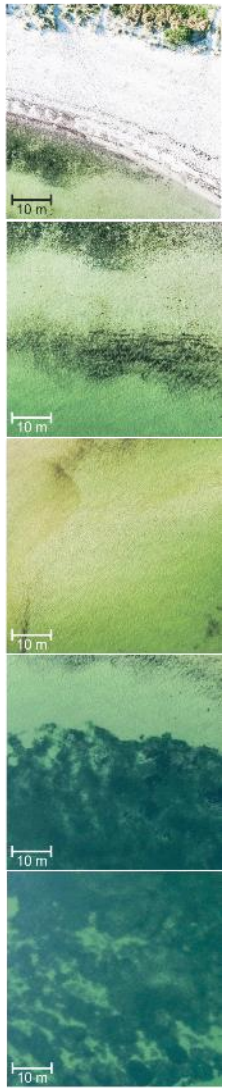
UAV:
DJI Inspire 2
20.8 megapixel Zenmuse X5S 15 mm/ 1.7 ASPH lens with B&W circular polarized filter

GCP (Ground Control Points):
Measured and leveled with a Leica RTK system, lateral resolution of ~2 cm.

Processing of orthomosaic images and DEM/DSM:
Agisoft PhotoScan™/ Metashape™
Pix4D™







Examples of Orthomosaics off Heidkate, Germany

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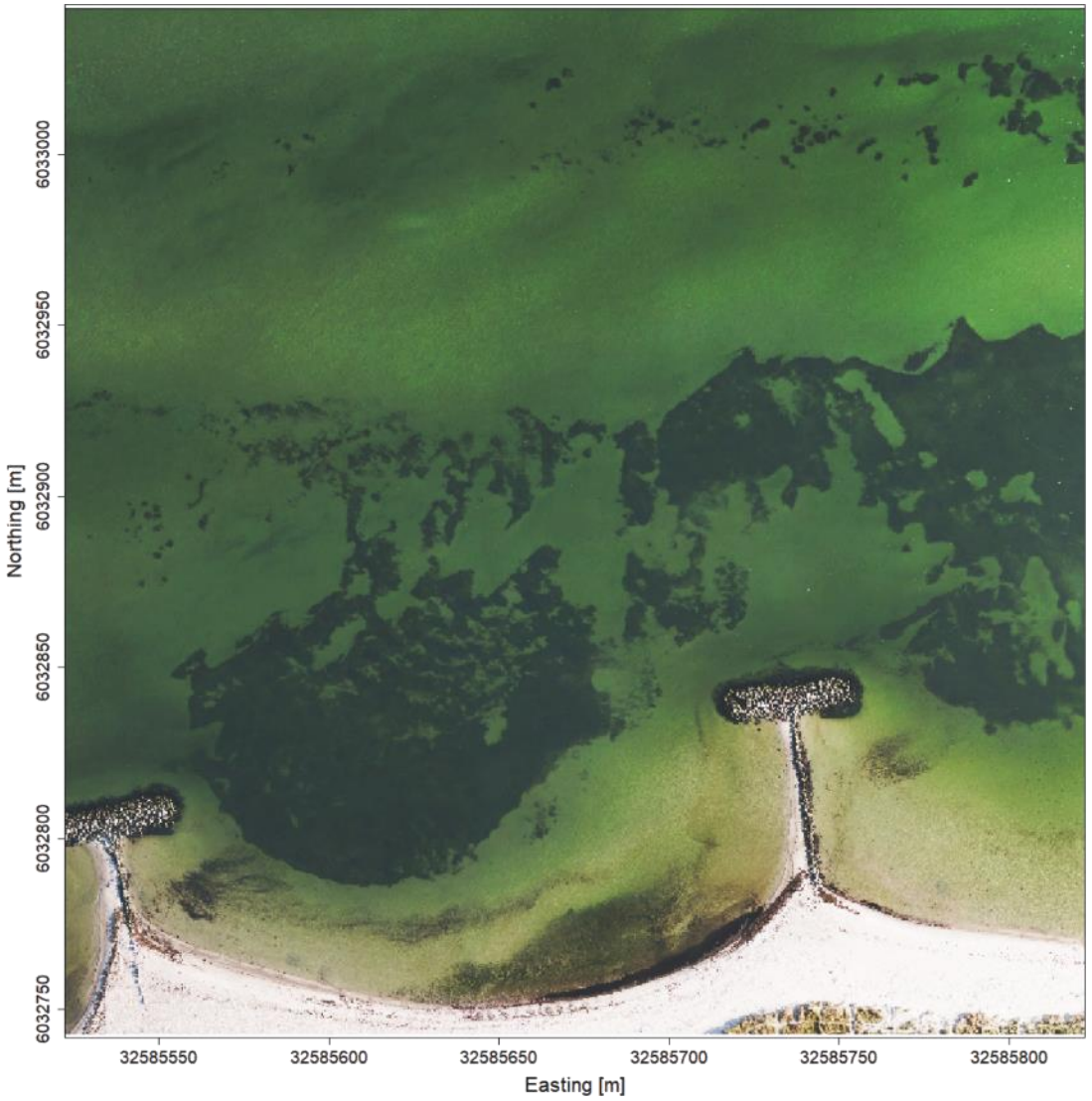
Orthomosaic 04.05.2018

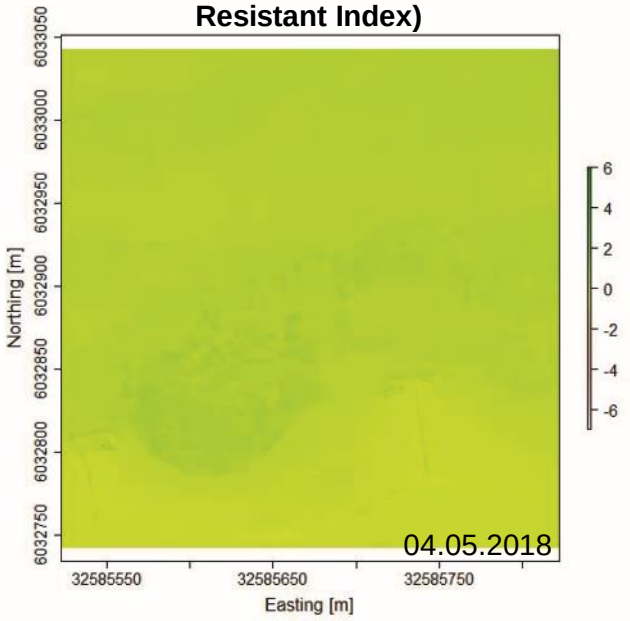


Orthomosaic 18.02.2019

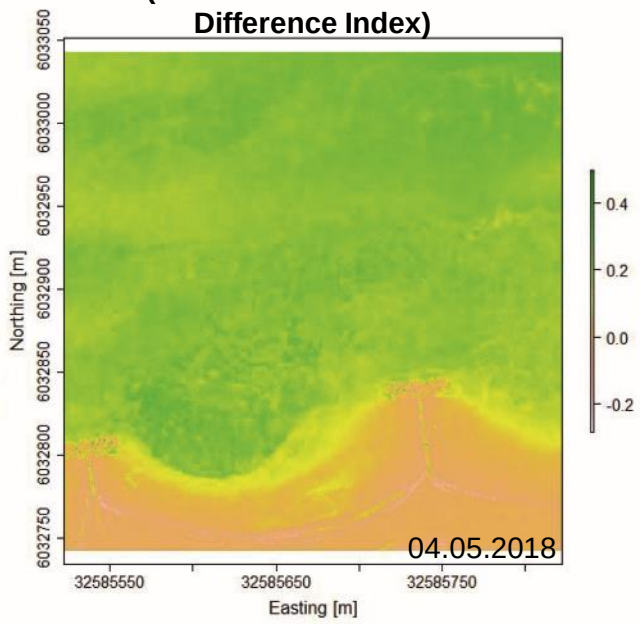
RGB based Vegetation Indices (VI)

The four selected **Vegetation Indices** (VI) for the visual spectrum, VARI, NGRDI, GLI and TGI were calculated for the orthomosaic. Both, the RGB-bands of the orthomosaic and the VIs were **aggregated into a single 7-band raster**.

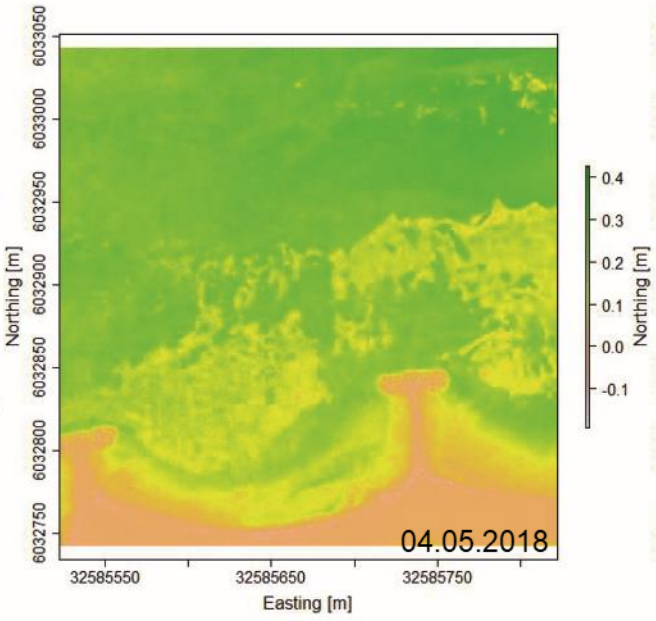
VARI
(Visible Atmospherically Resistant Index)



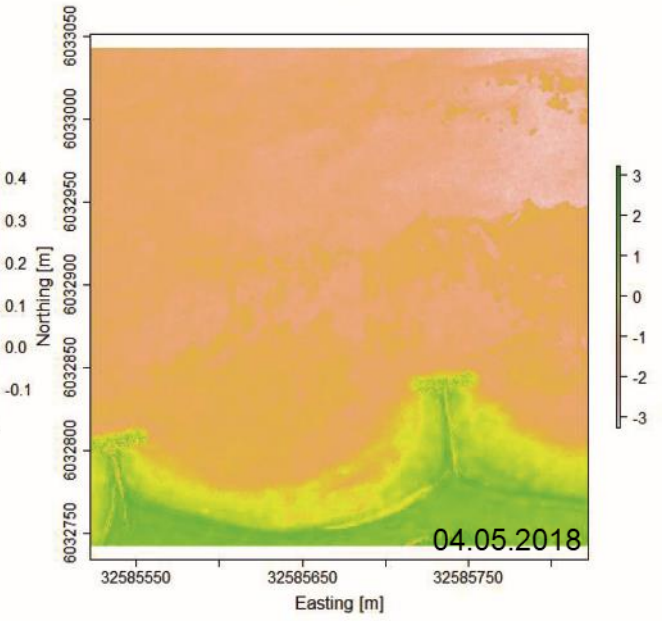
NGRDI
(Normalized Green–Red Difference Index)



GLI
(Greean Leaf Index)



TGI
(Triangular Greenness Index)



The **Random Forest Model** was trained on a dataset of **50000 randomly selected points**. It was ascertained that the class distribution of the training set represented the distribution of classes within the whole dataset. A **maximum deviation of 5%** per class was allowed. The forest was planted with **500 decision trees** and an **unlimited node depth**. NA-values were omitted before modelling.

Changes in Seagrass Abundance between two Scenes

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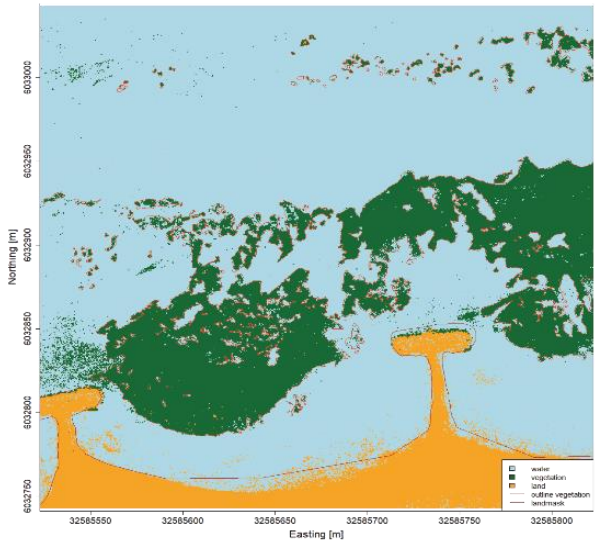
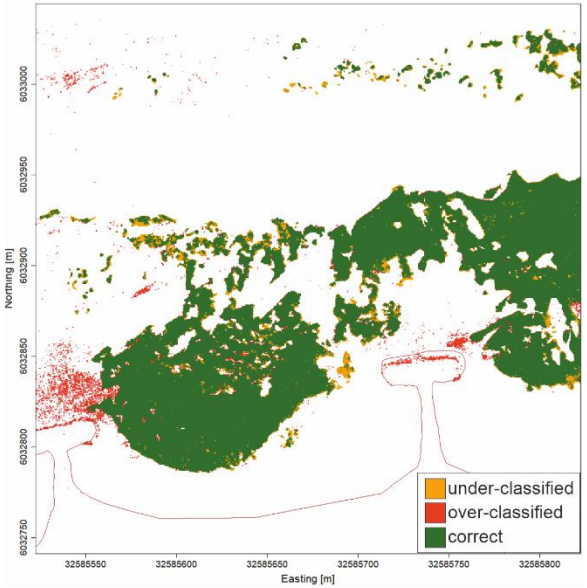
Random Forrest Classification 04.05.2018



Goodness of Classification 04.05.2018



Starting in May 2018 we produced high resolution UAV-bourne Imagery of the study area in Heidkate, Germany. Over the course of one year we acquired six Orthomosaics, of which three were used for classification

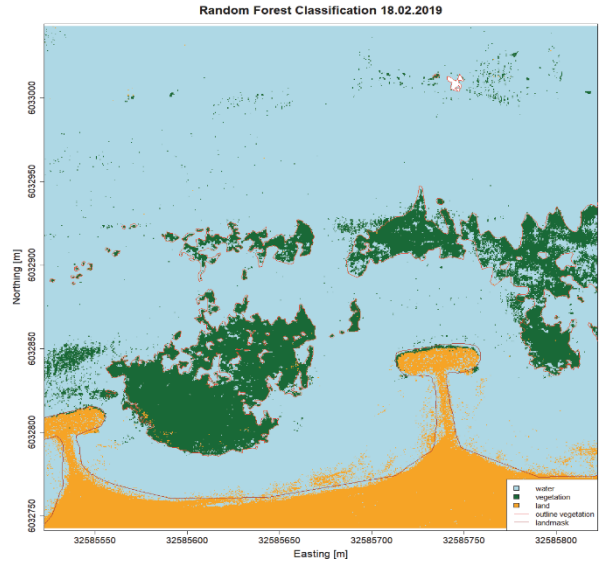
Top: Orthomosaics of the study area, acquired on 04.05.2018 (left) and 18.02.2019 (right)

Bottom: RF classification of the respective Orthomosaics into three classes (water / substrate, submerged aquatic vegetation and Land surface)

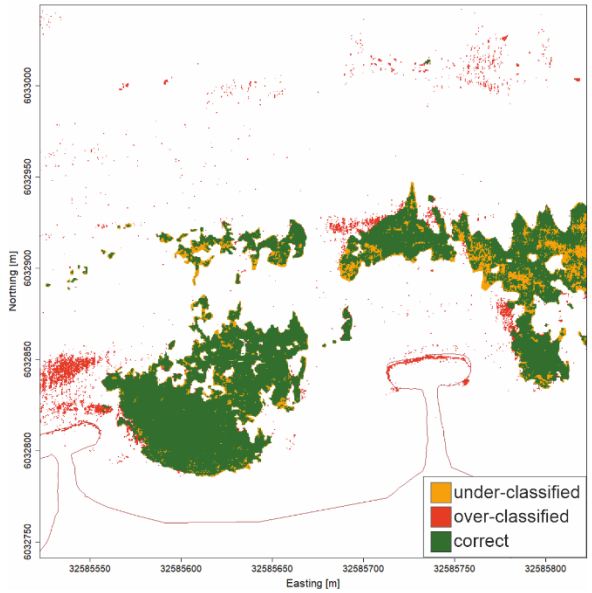
The table below shows the changes in classified areas over the 10 month survey period

	04. May 2018		18. Feb 2019	
Class	**area [m²]**	**%**	**area [m²]**	**%**
Water	61905.36	68.75%	69584.30	77.33%
Vegetation	18299.51	20.32%	10368.06	11.52%
Land	9834325	10.92%	10027.98	11.14%

With this UAV-based method and a semi-automated random forest classifier we were able to observe a loss of around 43% of the extent of the seagrass meadow in our study area between May 2018 and Feb. 2019.



Random Forrest Classification 18.02.2019



Goodness of Classification 18.02.2019

Take Home Message

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Can we monitor seasonal changes in shallow water Seagrass Habitats in the Baltic Sea by using a consumer-grade UAV?

This is just the start of a long-term monitoring framework

The surveys show, that it is possible to use UAVs for repeated monitoring of seagrass meadows in the Baltic Sea. In order to better understand the cyclicity as well as the underlying processes governing the decline of the seagrass habitat further data collection over a longer period is necessary.

Until now, we collected 9 scenes from May 2018 until February 2020

Thank you for your time and feel free to contact us!

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