Detecting Environmental Hazards through Artificial Intelligence

Deputy Head of Research Department
Dr. Frederic Stahl (frederic_theodor.stahl@dfki.de)

www.dfki.de/map

Marie-Curie-Str. 1
D-26129 Oldenburg

map-info@dfki.de

DFKI – German Research Center for Artificial Intelligence

Carl von Ossietzky Universität Oldenburg

DFKI is one of the leading (applied) AI research centers

DFKI Marine Perception (MAP) → www.dfki.de/map

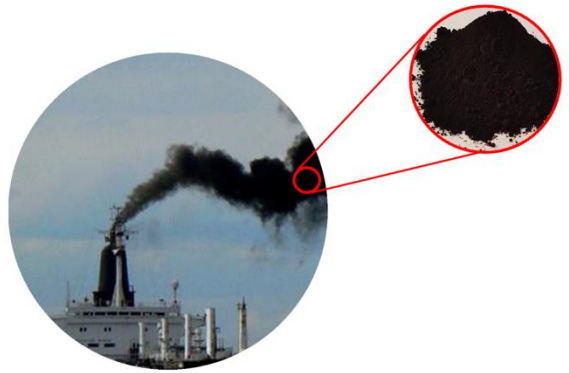
Carl von Ossietzky Universität Oldenburg

Sensing is believing…

- Intelligent sensors and distributed systems for automatic perception and classification in the aquatic environment
- Autonomous analysis of multisensory data using artificial intelligence methods, techniques and tools
- Real-time data stream analysis and integration into a high-dimensional situation picture

➔ **We combine sensor technology and artificial intelligence to evaluate environmental situations and identify options for action**

DFKI Marine Perception (MAP) → www.dfki.de/map



Sensing is believing…

- Intelligent sensors and distributed systems for automatic perception and classification in the aquatic environment
- Autonomous analysis of multisensory data using artificial intelligence methods, techniques and tools
- Real-time data stream analysis and integration into a high-dimensional situation picture

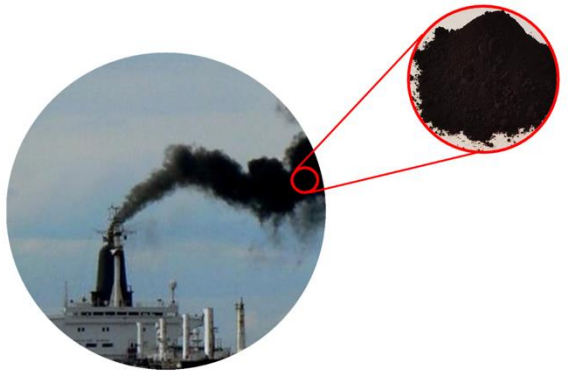
➔ **We combine sensor technology and artificial intelligence to evaluate environmental situations and identify options for action**

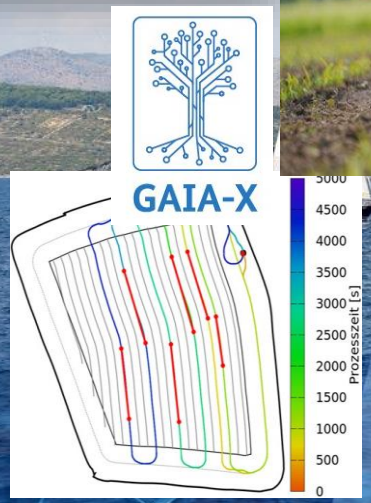
DFKI Marine Perception (MAP) → www.dfki.de/map

Sensing is believing…

- Intelligent sensors and distributed systems for automatic perception and classification in the aquatic environment
- Autonomous analysis of multisensory data using artificial intelligence methods, techniques and tools
- Real-time data stream analysis and integration into a high-dimensional situation picture

➔ **We combine sensor technology and artificial intelligence to evaluate environmental situations and identify options for action**



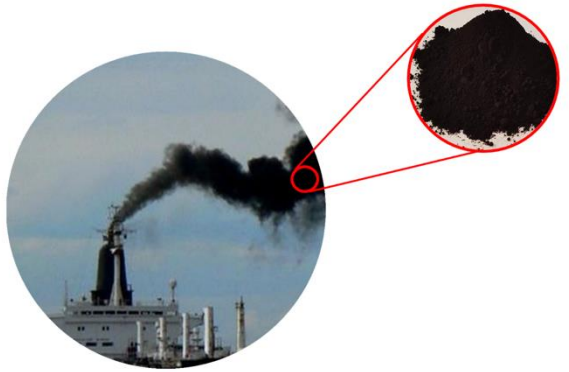


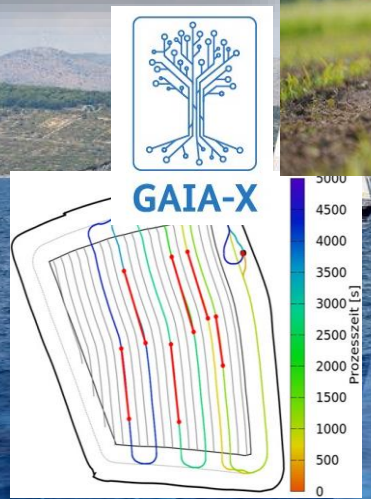
DFKI Marine Perception (MAP) → www.dfki.de/map

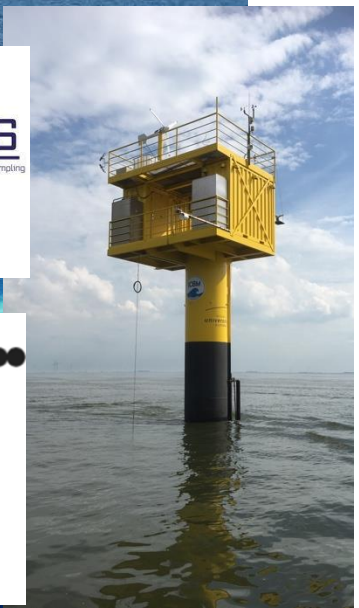
Sensing is believing…

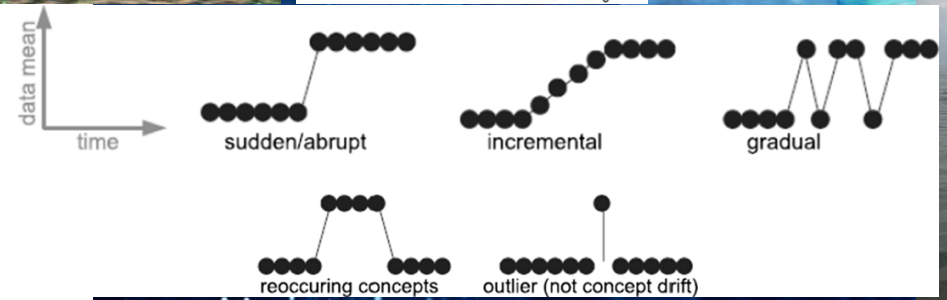
- Intelligent sensors and distributed systems for automatic perception and classification in the aquatic environment
- Autonomous analysis of multisensory data using artificial intelligence methods, techniques and tools
- Real-time data stream analysis and integration into a high-dimensional situation picture

➔ **We combine sensor technology and artificial intelligence to evaluate environmental situations and identify options for action**







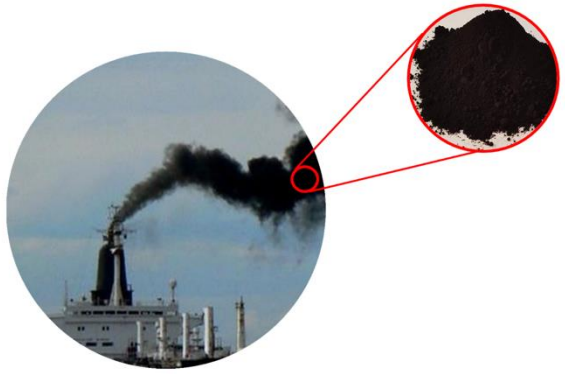


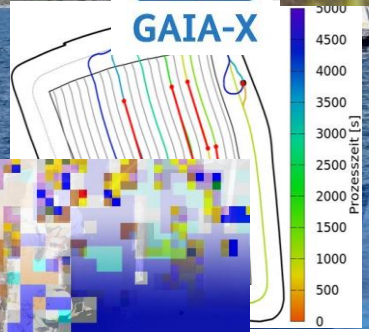
DFKI Marine Perception (MAP) → www.dfki.de/map

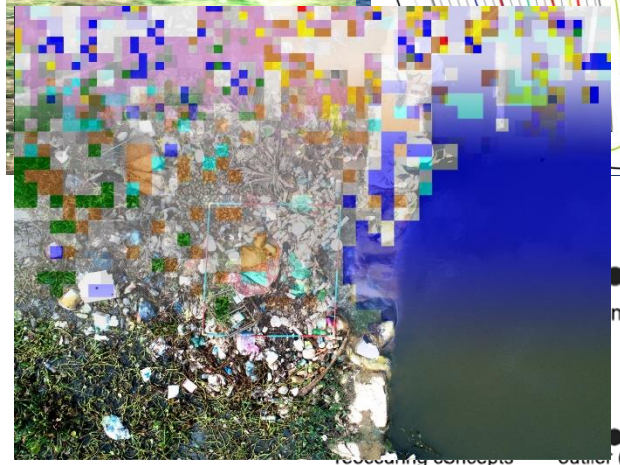
Sensing is believing…

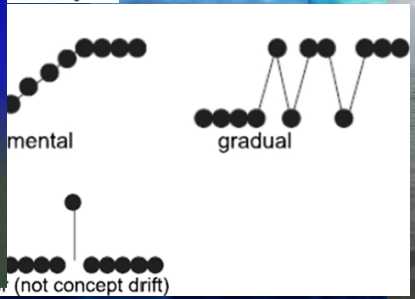
- Intelligent sensors and distributed systems for automatic perception and classification in the aquatic environment
- Autonomous analysis of multisensory data using artificial intelligence methods, techniques and tools
- Real-time data stream analysis and integration into a high-dimensional situation picture

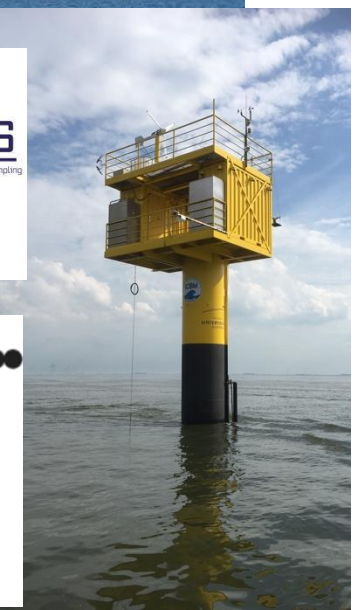
➔ **We combine sensor technology and artificial intelligence to evaluate environmental situations and identify options for action**











What is AI?

Carl von Ossietzky Universität Oldenburg

Term was coined by John McCarthy in 1956 who organised the “Dartmouth Summer Research Conference on Artificial Intelligence”

A branch of computer science that studies how **to endow computers with capabilities of human intelligence**

- to model or replicate human intelligence

Source: Photo by Chuck Painter, credits Stanford University

What is AI?

Carl von Ossietzky Universität Oldenburg

Term was coined by John McCarthy in 1956 who organised the "Dartmouth Summer Research Conference on Artificial Intelligence"

A branch of computer science that studies how **to endow computers with capabilities of human intelligence**

- to model or replicate human intelligence

What is human intelligence? general mental capability that involves the ability to

- reason
- plan
- solve problems
- think in an abstract way
- comprehend complex ideas
- learn from experience

Source: Photo by Chuck Painter, credits Stanford University

What is AI?

Carl von Ossietzky Universität Oldenburg

Term was coined by John McCarthy in 1956 who organised the "Dartmouth Summer Research Conference on Artificial Intelligence"

A branch of computer science that studies how **to endow computers with capabilities of human intelligence**

- to model or replicate human intelligence

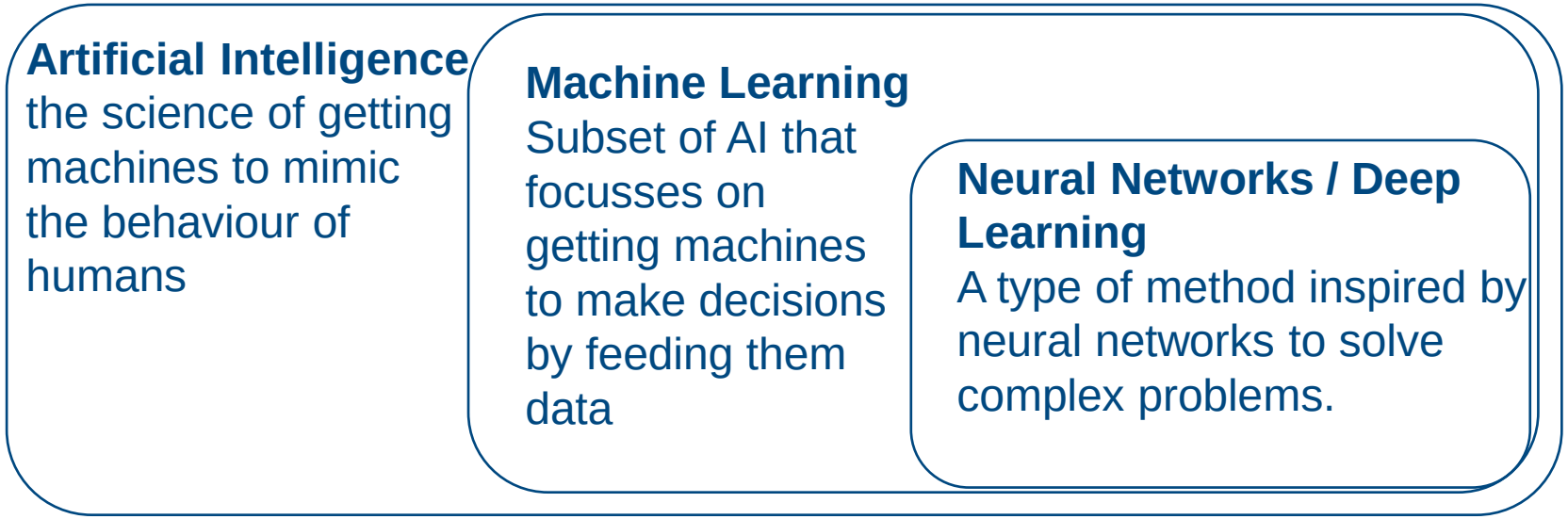
er, credits Stanford University

What is human intelligence? general mental capability that involves the ability to

- reason
- plan
- solve problems
- think in an abstract way
- comprehend complex ideas
- learn from experience

Humans have different degrees of intelligence!

What is AI?



Machine Learning and Deep Learning aid Artificial Intelligence by providing a set of algorithms to solve data driven problems.

What is AI?

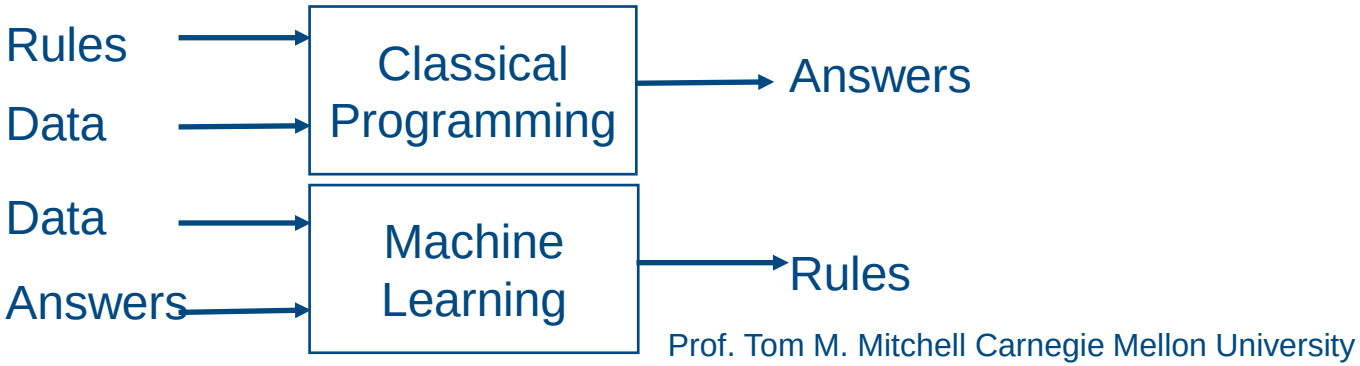
Artificial Intelligence
the science of getting machines to mimic the behaviour of humans

Machine Learning
Subset of AI that focusses on getting machines to make decisions by feeding them data

Neural Networks / Deep Learning
A type of method inspired by neural networks to solve complex problems.

Machine Learning and Deep Learning aid Artificial Intelligence by providing a set of algorithms to solve data driven problems.

Machine Learning is the study of computer algorithms that allow computer programs to automatically improve through experience.



Prof. Tom M. Mitchell Carnegie Mellon University

What is AI?

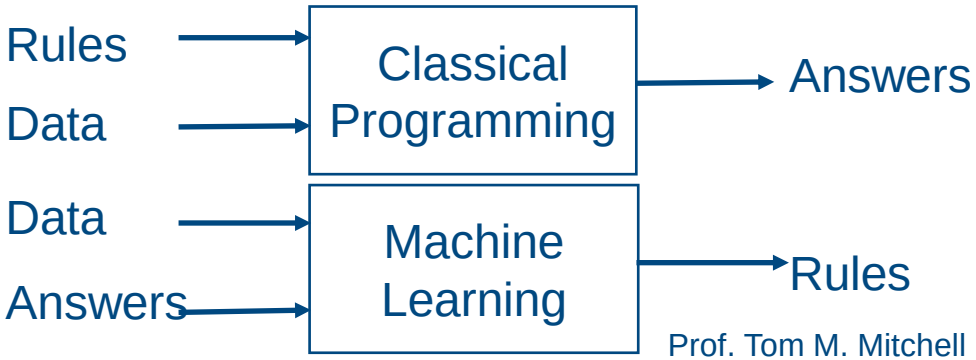
Artificial Intelligence
the science of getting machines to mimic the behaviour of humans

Machine Learning
Subset of AI that focusses on getting machines to make decisions by feeding them data

Neural Networks / Deep Learning
A type of method inspired by neural networks to solve complex problems.

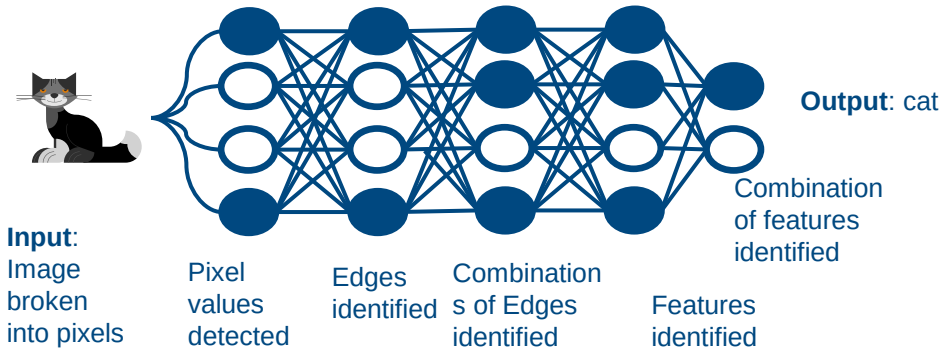
Machine Learning and Deep Learning aid Artificial Intelligence by providing a set of algorithms to solve data driven problems.

Machine Learning is the study of computer algorithms that allow computer programs to automatically improve through experience.



Prof. Tom M. Mitchell Carnegie Mellon University

Deep Learning



Artificial intelligence as a key technology for meeting global challenges

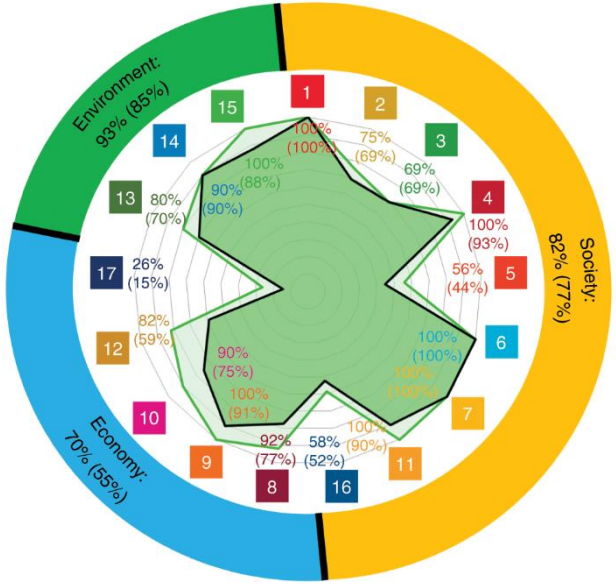
Carl von Ossietzky Universität Oldenburg

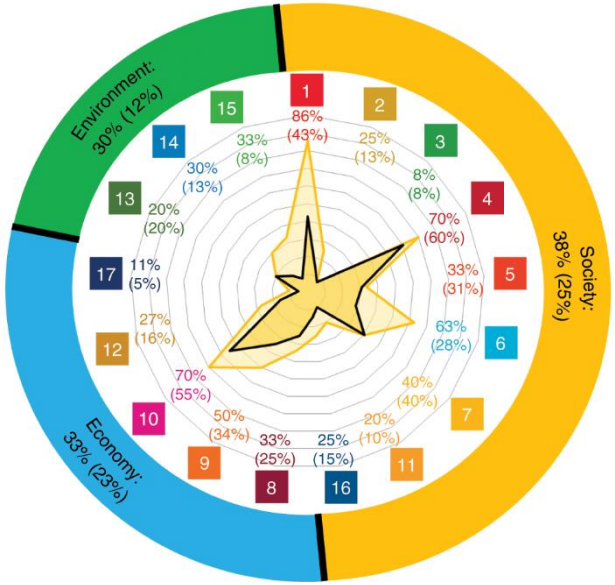
AI and the UN-SDGs (Vinuesa et al, 2020)

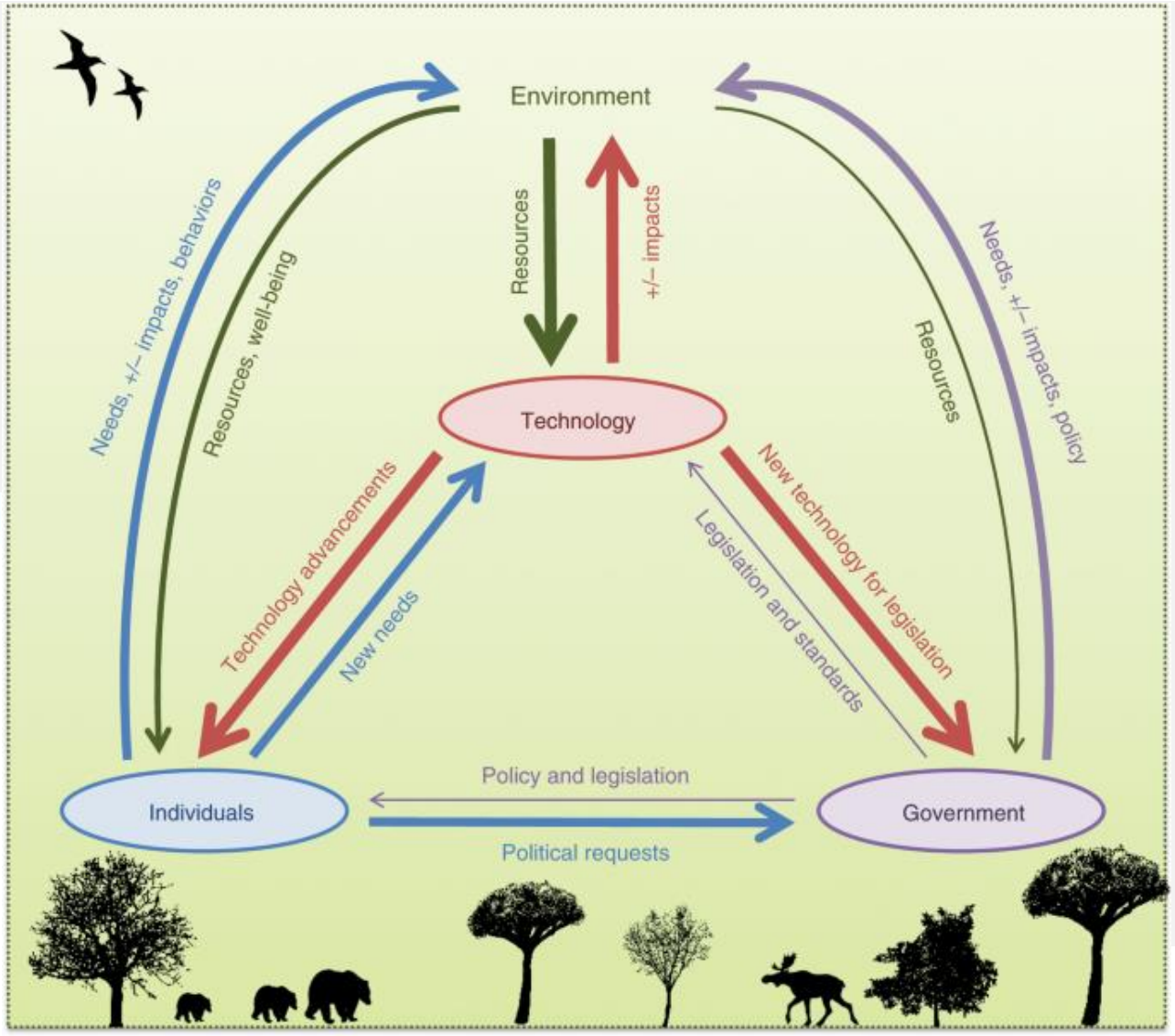
- Many positive potentials for SDG targets, especially in the area of environment
- AI needs societal acceptance and legal frameworks → Real World Laboratories

Positive Impacts: 79%

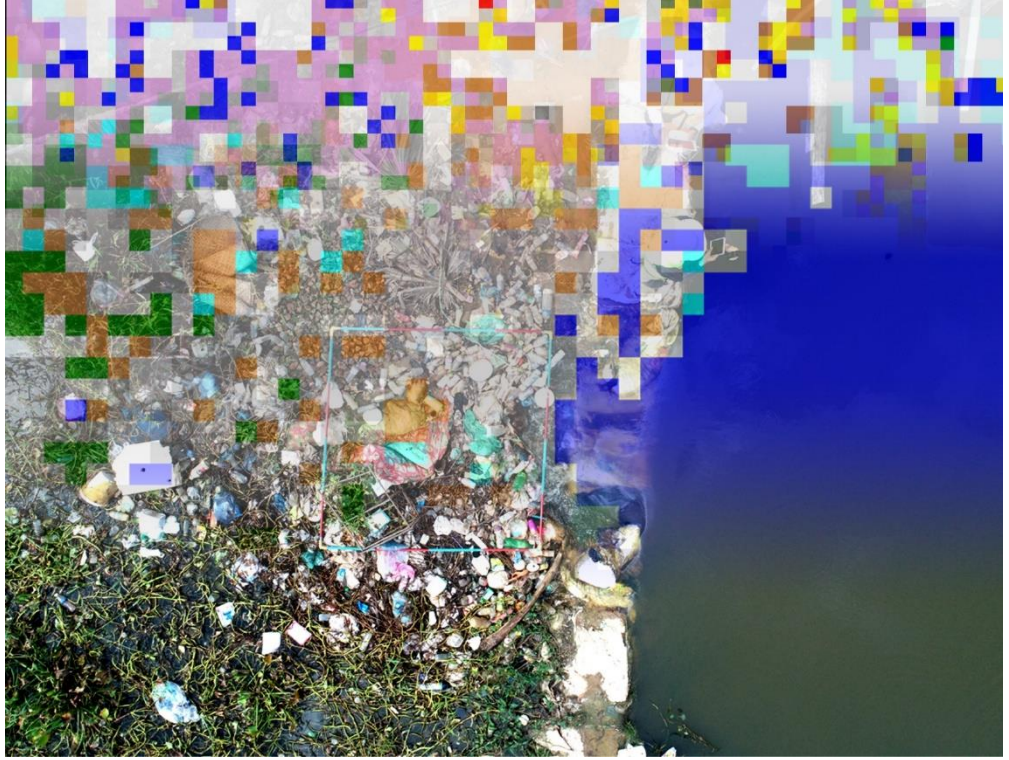
Negative Impacts: 35%







Planetary boundaries



Combating plastic waste

Quantification and classification

Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz

everwave

WORLD BANK GROUP

UN environment programme

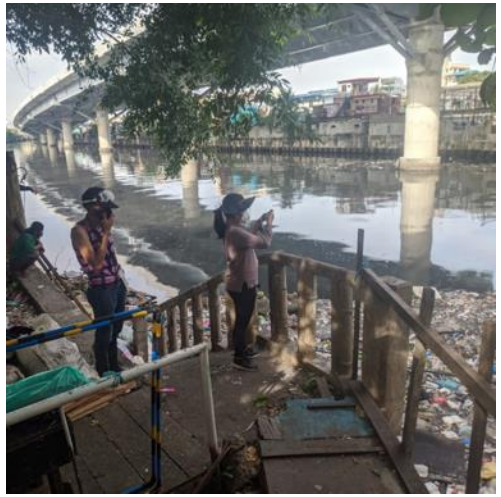
Remote Sensing in Southeast Asia

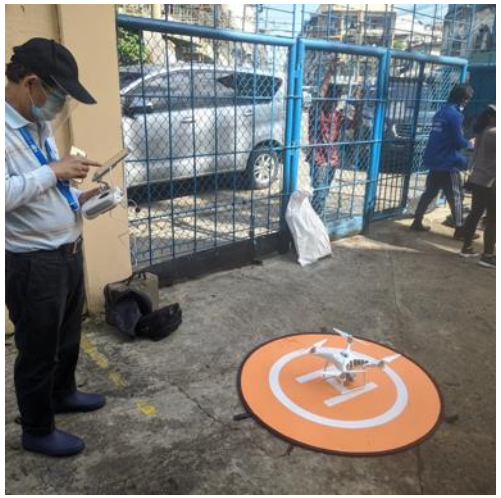
Carl von Ossietzky Universität Oldenburg

Four World Bank projects

- Projects in Cambodia, Myanmar, the Philippines Vietnam and Indonesia
- Field investigations and remote sensing flights by partners on site, concept and data analysis by DFKI Marine Perception
- Impact & Capacity Building: local, regional and national scope

➔ **Easy-to-use methodologies that enable stakeholders to perform assessment and monitoring**





WORLD BANK GROUP

KEMENTERIAN KOORDINATOR BIDANG KEMARITIMAN DAN INVESTASI

PT. LAPI ITB
To Serve for Your Betterment and the Nation

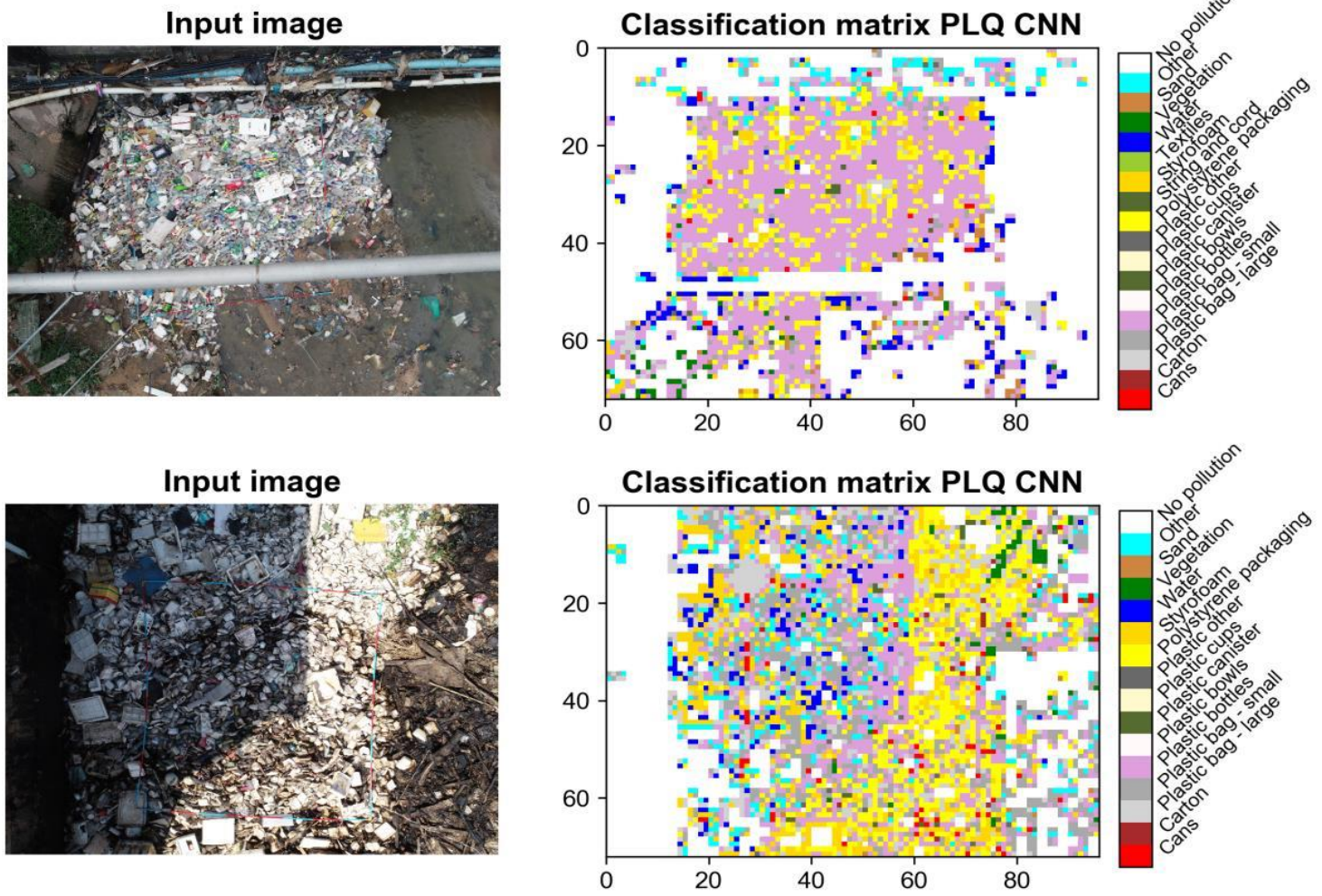
Remote Sensing in Southeast Asia

Carl von Ossietzky Universität Oldenburg

Four World Bank projects

- Projects in Cambodia, Myanmar, the Philippines Vietnam and Indonesia
- Field investigations and remote sensing flights by partners on site, concept and data analysis by DFKI Marine Perception
- Impact & Capacity Building: local, regional and national scope

➔ **Easy-to-use methodologies that enable stakeholders to perform assessment and monitoring**



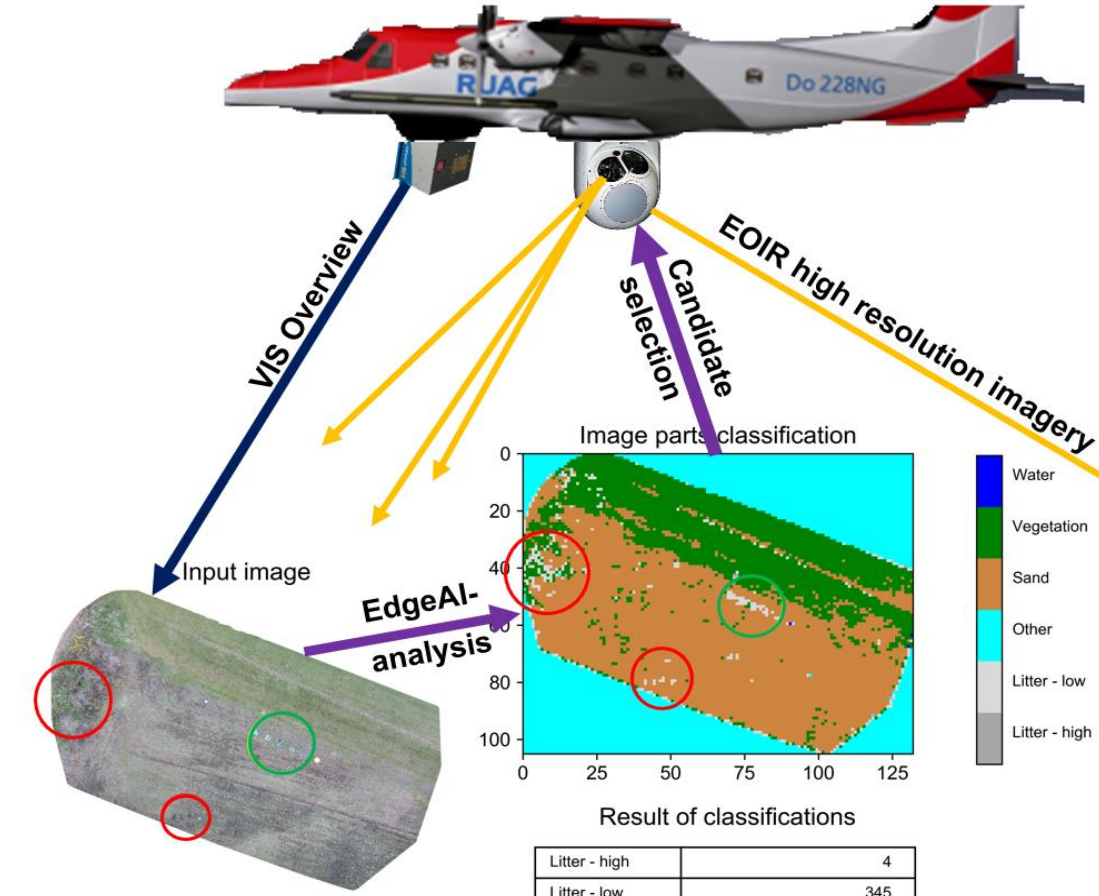
WORLD BANK GROUP

KEMENTERIAN KOORDINATOR BIDANG KEMARITIMAN DAN INVESTASI

PT.LAPITB To Serve for Your Betterment and the Nation

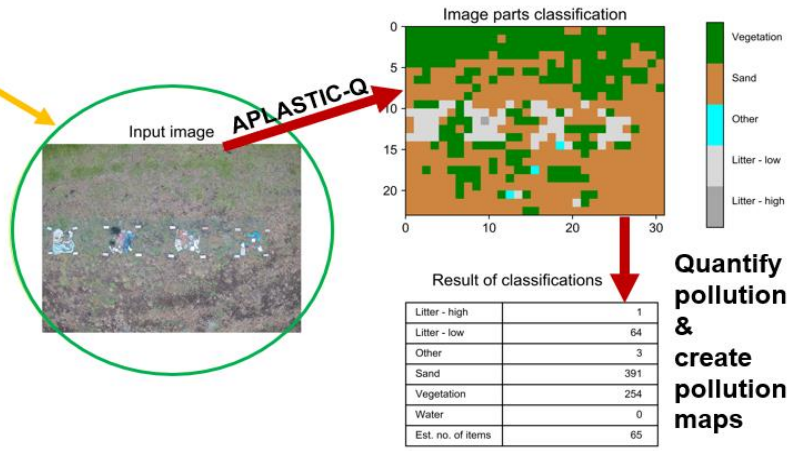
KCC

Airborne Plastic Pollution Control (PlasticObs)



Result of classifications

Litter - high	4
Litter - low	345
Other	4527
Sand	5845
Vegetation	3136
Water	3
Est. no. of items	349



Airborne surveillance with fast **Edge-AI object detection** and subsequent detailed **CNN classification from EO-imager** data.

Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection

Carl von Ossietzky Universität Oldenburg

OPTIMARE

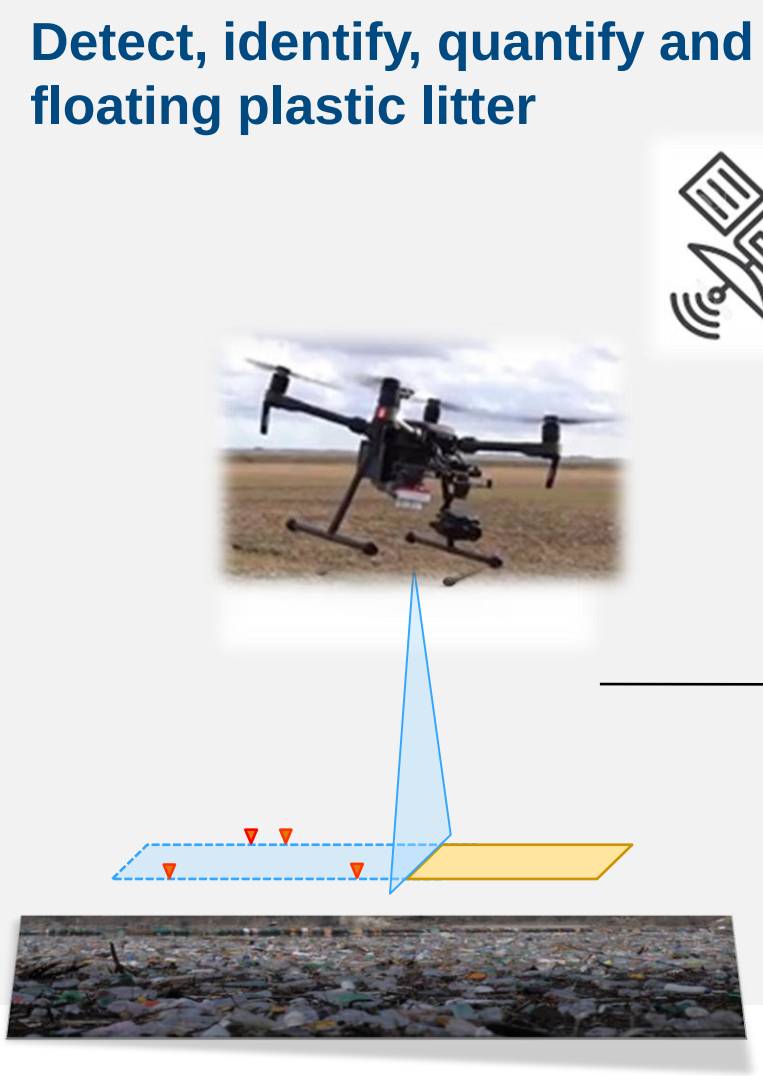
JADEHOCHSCHULE Wilhelmshaven Oldenburg Elsfleth

everwave

52north

Overall vision: From perception to action

Detect, identify, quantify and track floating plastic litter



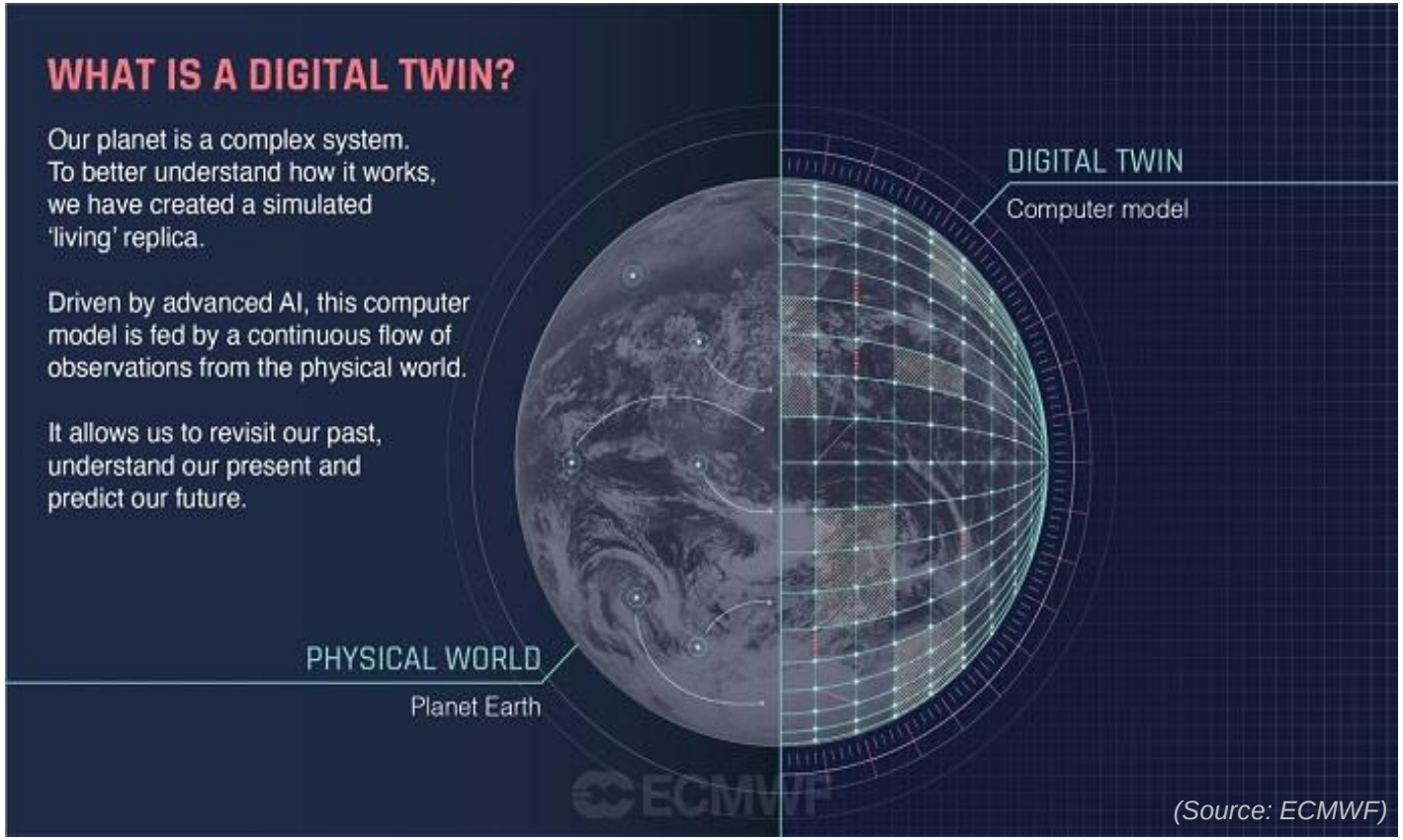
Combining local remote sensing (drones + bridges), **satellite-based information** and **models** in an **AI-enhanced digital twin** providing automated analysis for decision support and near real-time guidance for clean-up activities.

Digital Twins

Modelling Aspects of the Real World to Assess Potential Environmental Impacts

Digital Twin Earth (DTE)

- EU data strategy: "Destination Earth (DestinE)“
- Related to **European Green Deal**
- Example questions/testing scenarios :
  - *"For the EU and for my country, which industrial policy measures lead to 2050 carbon neutrality, which in the opposite direction?“*
  - *"How many trees do we have in Europe and where best to plant for the maximum environment and economic positive impact?“*



(Source: ECMWF)

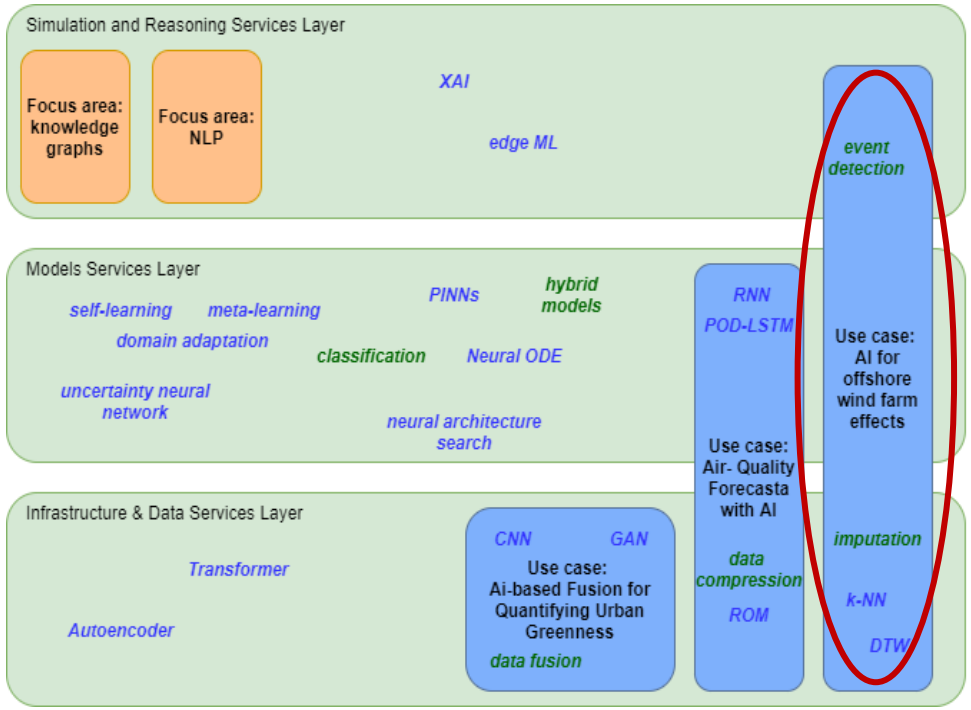
“DTE is an interactive replica of past, present, and future of our planet in the digital domain“

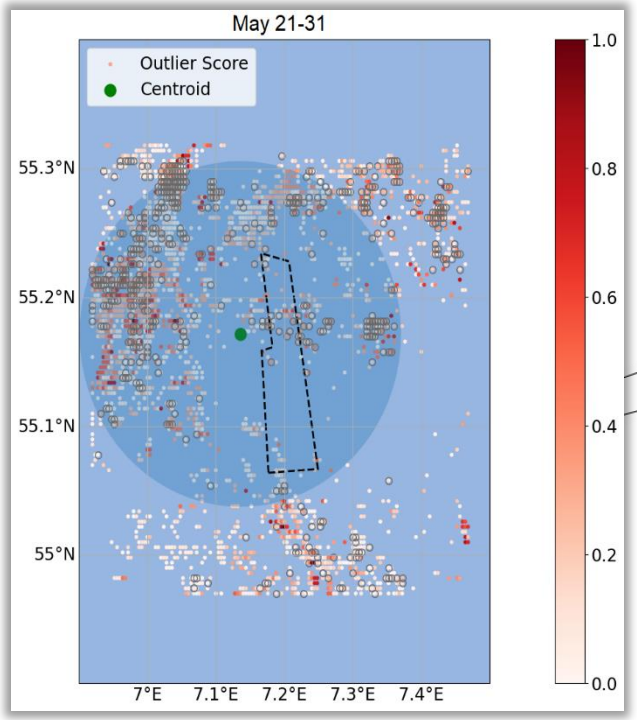
*Bauer, P., Stevens, B. & Hazeleger, W. A digital twin of Earth for the green transition. Nat. Clim. Chang. **11,** 80–83 (2021). https://doi.org/10.1038/s41558-021-00986-y*

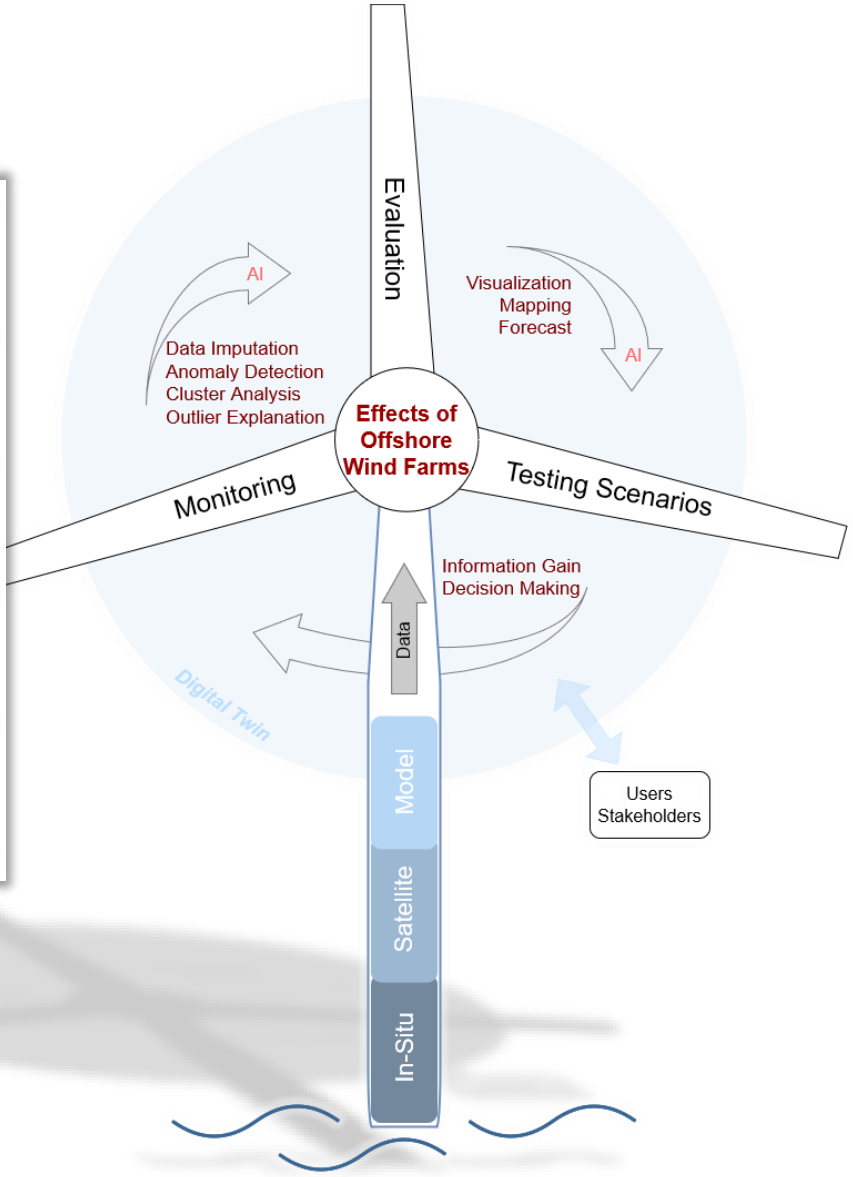
AI4DTE

Artificial Intelligence (AI) Enhanced Earth Observation (EO) for on Digital Twin Earth (DTE)

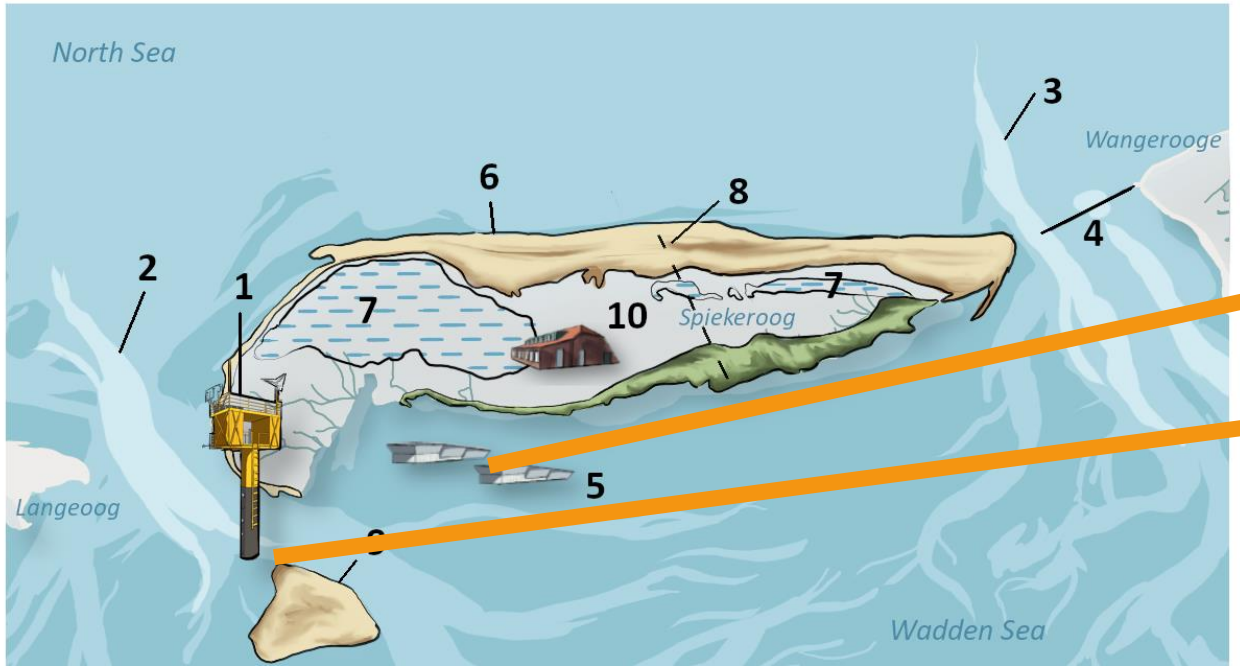
- The goal of the activity is to **identify those elements of artificial intelligence** that will aid the **development of DTEs**

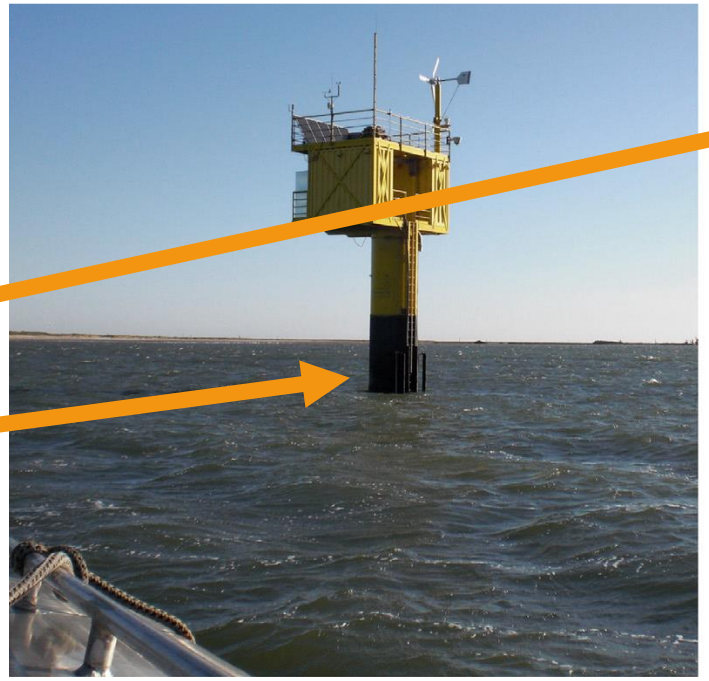






→ Provides method to monitor and evaluate wind farm effects, providing stakeholders with information for informed decision making on future maritime energy infrastructures

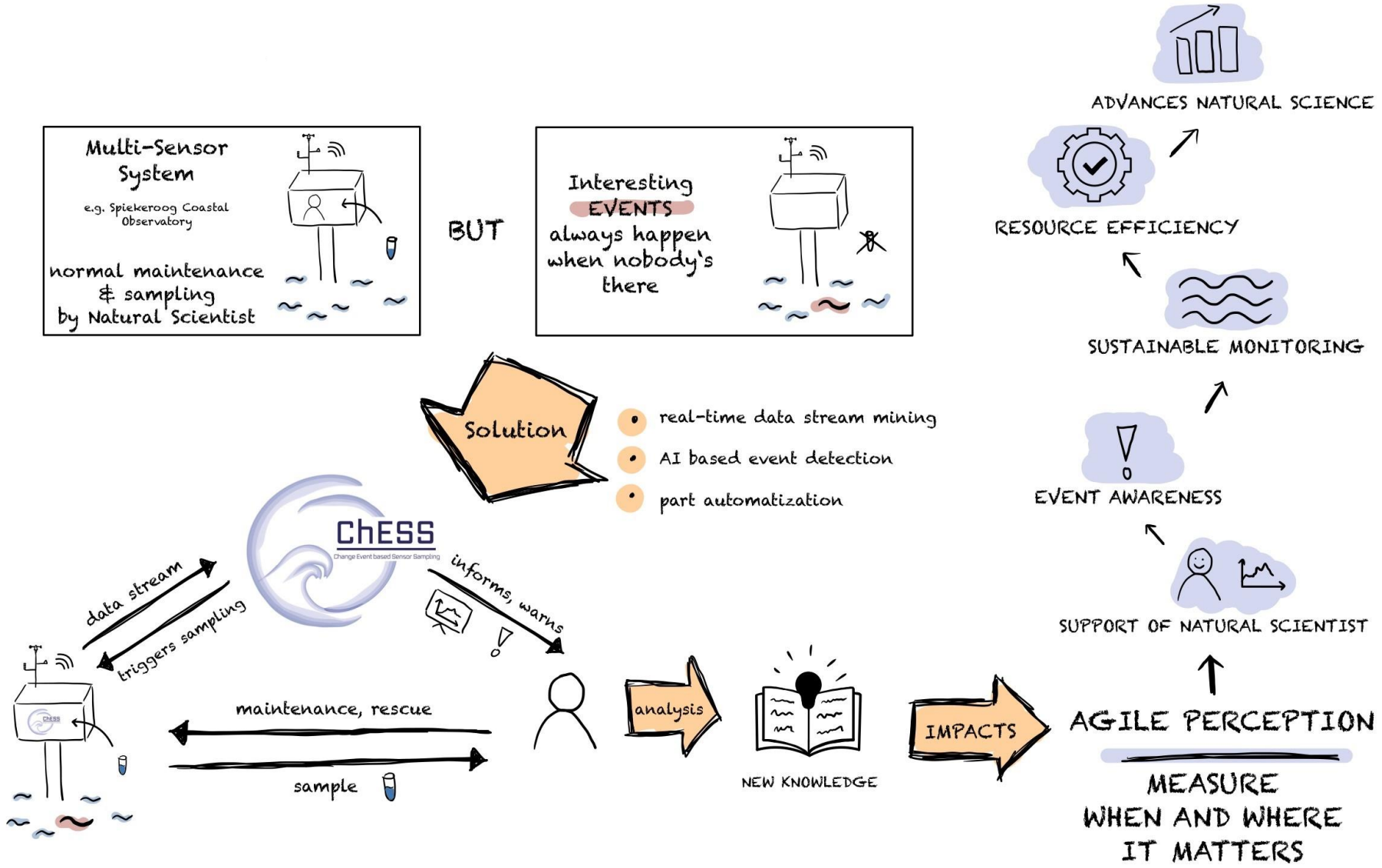




Real-Time Event Detection

Environmental Monitoring and Predictive Maintenance of Observation Stations

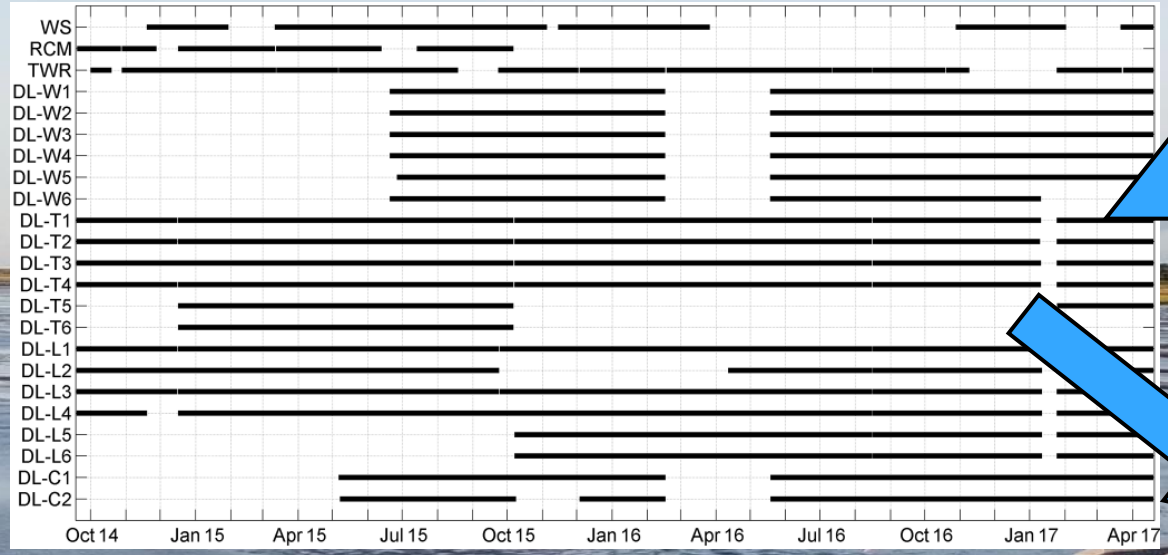
ChESS: Change Event based Sensor Sampling

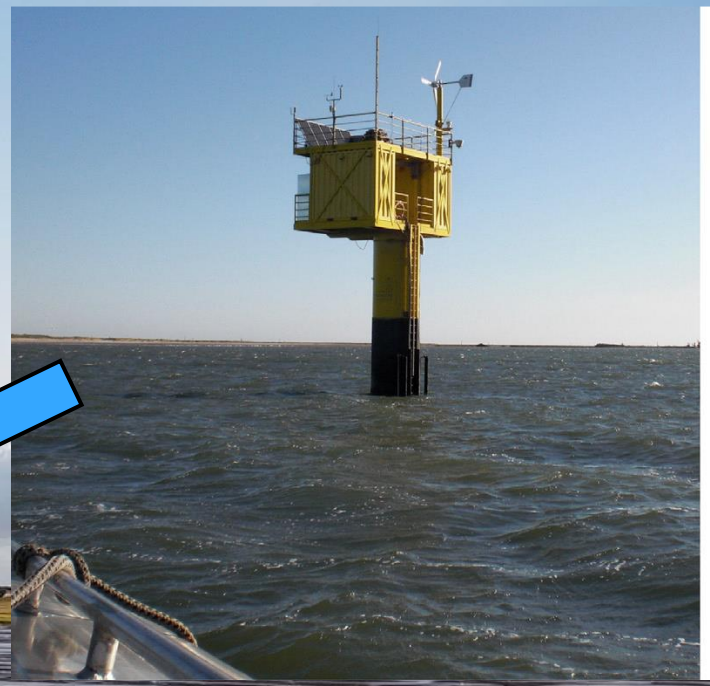


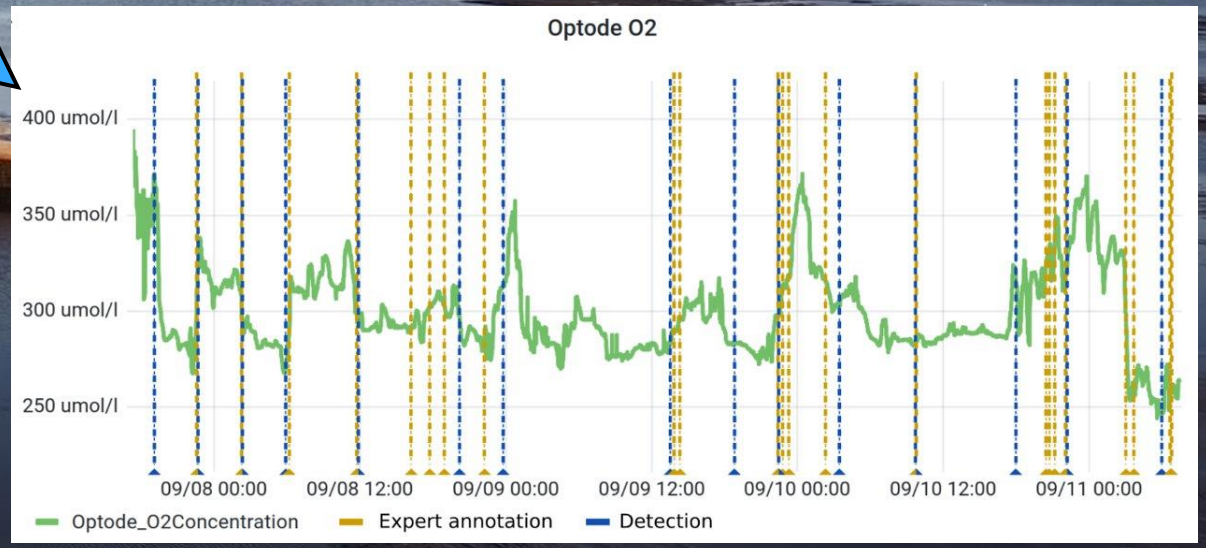
VolkswagenStiftung
Niedersächsisches Ministerium für Wissenschaft und Kultur

Support observational systems

Gap imputation and anomaly detection







SCO
Spiekeroog Coastal Observatory
ICBM

Sustainable AI for Sustainablity

DFKI 4PLANET

- AI offers enormous opportunities for (marine) environmental applications and sustainability goals
- Think and implement AI sustainably in itself
- Societal acceptance is key to achieve impact

AI as an enabler for the sustainability transformation

→ www.dfki.de/dfki4planet

Thank you
for your interest,
I’m happy to
discuss areas of
collaborations

Gefördert durch:
Niedersächsisches Ministerium
für Wissenschaft und Kultur
Niedersachsen Vorab (ZN3480)

Email: frederic_theodor.stahl@dfki.de