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Benefits of advanced digital infrastructure for meteorological and oceanographic data collection from connected vessels

September 13th, 2020
WMO, IOC UNESCO, GOOS/OCG
Ship Observations Team Eleventh Session
Virtual Session, 13-16 September 2021

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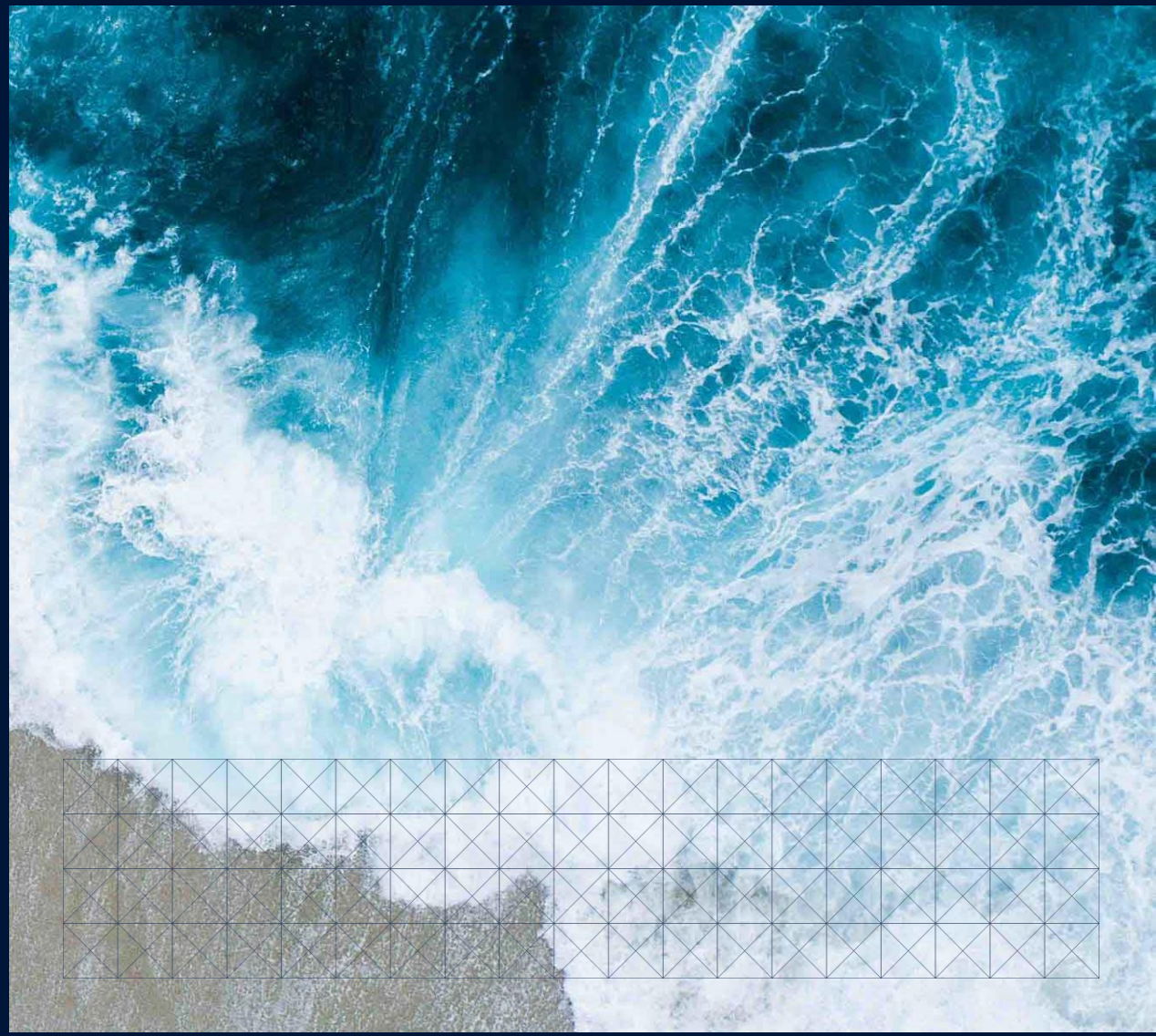

Outline

- The VOS Scheme – Value, Scope and Extend, Motivation
- Digital Transformation of the Maritime Industry – Merchant Fleet Automation
- Cloud Services and Maritime Industry
- Facts and Figures
- **Blue Insight – The Digital Ocean Toolbox**
- **Statsraad Lehmkuhl – Advanced Digital Infrastructure**
- Summary and Outlook

Statsraad Lehmkuhl (picture source)

The Voluntary Observing Ship (VOS) Scheme

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- **Value** – importance of the data
  - **awareness and forecasting of** (extreme) **weather events**
    - numerical weather predictions (NWP) depend on observational data
  - **Increased *safety of life at sea*** for ships (commercial and leisure), their crew and cargo
    - Improved forecasts support better critical decisions and avoidance of extreme weather locations
  - Valuable **data source for climate studies**
    - VOS are the only source of ground truth over much of the oceans for some parameters
- **Scope and Extend** – **Limited number of vessels** collecting and transmitting automatically
  - shipping industry: **participating in VOS helps to improve warnings and forecasts**
    - Involvement as **a standard procedure** emerging
  - Many parameters are measured; already **additional pressure observations** would make a great difference

Air pressure	Wind	Relative humidity
Waves	Sea ice	Air and Sea temperature
Visibility	Rainfall	Cloud cover

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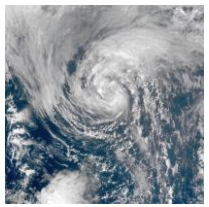
PARTICIPATION IN THE WMO VOLUNTARY OBSERVING SHIPS SCHEME



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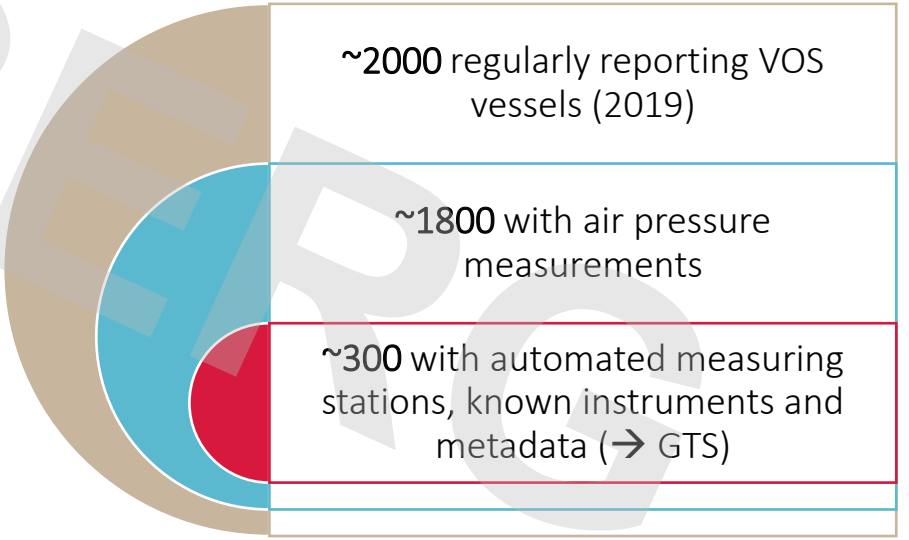
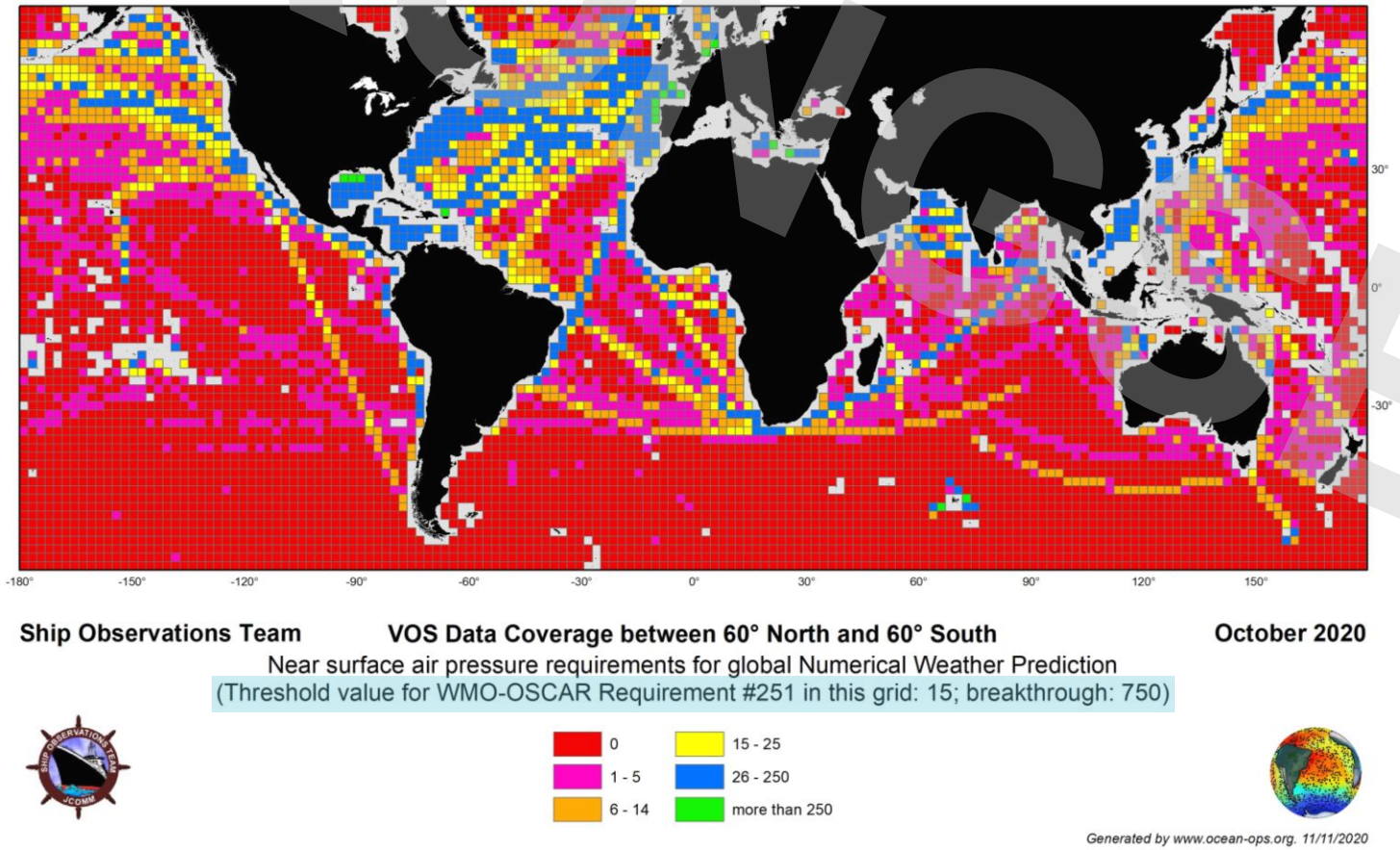


The VOS Scheme – Motivation

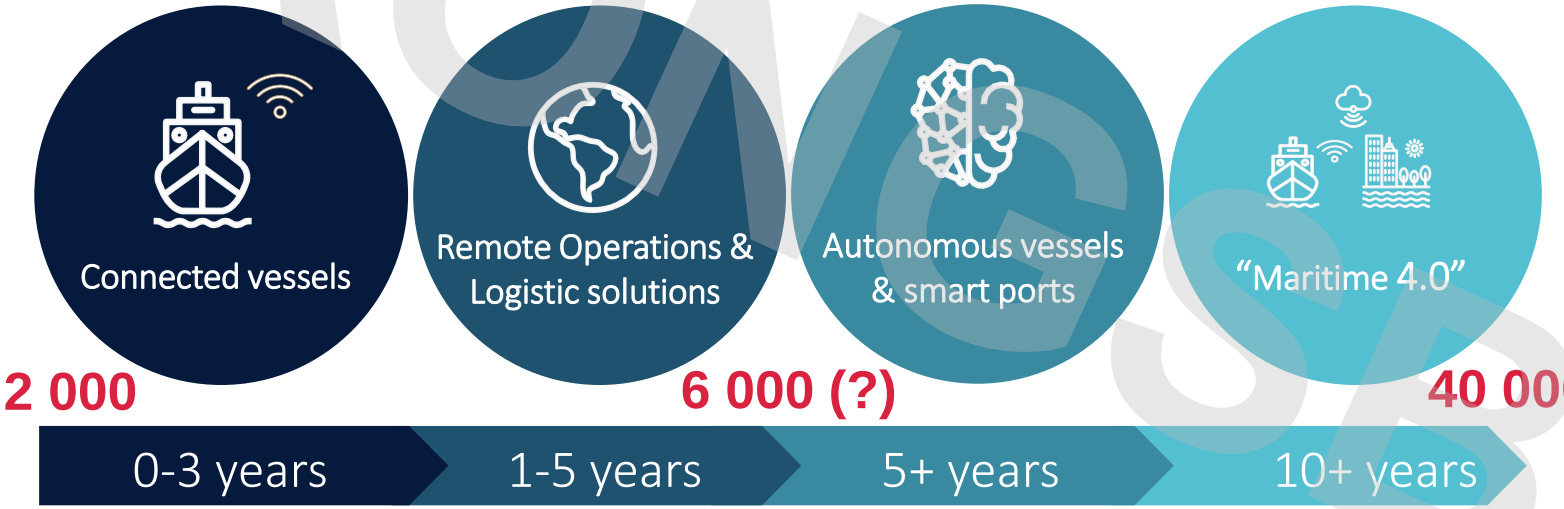
Spatial distribution of air pressure data reveals **observational gaps**

More **measurements** at higher spatial and temporal resolution required

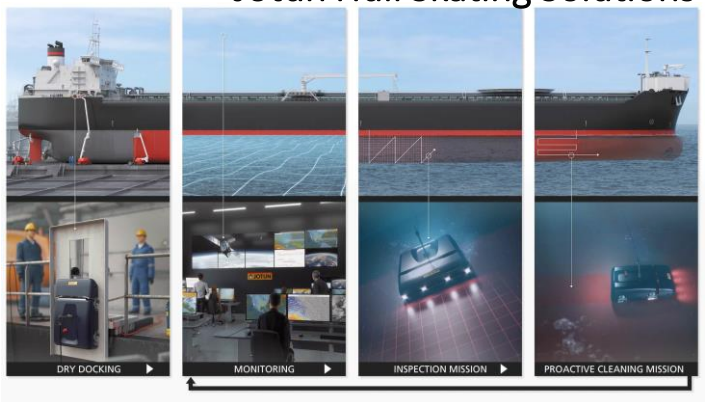


- WMO Observing Systems Capability Analysis and Review Tool (OSCAR) requirements for air pressure measurements for global NWP:
  - **Threshold** condition of observations (achieved for approx. **green, blue, yellow** areas in the map)
    every 500 km every 12 h
  - **Breakthrough** target of observations (approx. **green areas**)
    every 100 km taken every 6 h
  - **Goal** for observations
    every 15 km taken every 60 min
  - For ***high–resolution*** **NWP**, the ambitious breakthrough goal is
    every 10 km taken every 60 min

Digital Transformation of the Maritime Industry – Merchant Fleet Automation



Jotun Hull Skating Solutions



- **OPEX reductions** by digital solutions for the maritime industry related to, e.g.:
  - Fuel and energy management, port charges, insurance, repair, personnel
- Improving existing platforms with new tech and in the long-term autonomous shipping → **more efficient, safer and sustainable operations** (e.g. CO_2 emission reductions)

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VESSEL INSIGHT

The gateway to next generation shipping

Cloud Services and Maritime Industry

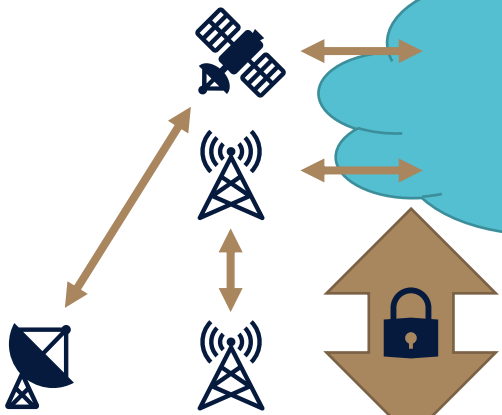
One open digital ecosystem

Kognifai

FUEL OPTIMIZATION	MAINTENANCE	ROUTE OPTIMIZATION	APPLICATIONS SERVICES VISUALIZATION ANALYSIS
LOGISTICS	FLEET MANAGEMENT	ENERGY MANAGEMENT	
WEATHER	SAFETY	DOCUMENT HANDLING	API

MARKETPLACE

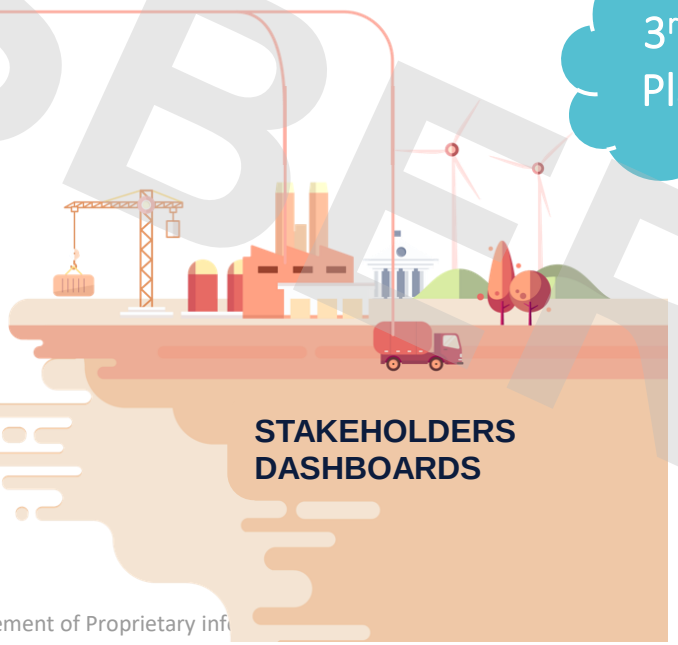
- **Common system** helps stakeholders to scale and grow the market
- **Cyber security** is essential (→ single point of contact)
- One **integrated system** – no data silos
- **Automated**, no manual data gathering
- **Full ownership** and **control** of the **data**



Cloud

Data Transfer
& Cyber Security

3rd Party Platform



STAKEHOLDERS DASHBOARDS

ERDDAP server

National Meteorology and Hydrology Services (NMHS)

WMO's Global Telecomm. System (GTS)

Data collection at the „**edge**“

Facts and Figures

Kongsberg Maritime – The Full Picture - From Bridge to Propeller

- **> 33 000** vessels with KM equipment
- **~ 10 000** vessels with KM automation and control systems (**>30 years** experience)
- **> 10 years** experience with remote sensing, cyber security and information management solutions
- onboard **>11 000** vessels each year; global reach and service

- ***Kognifai*** – open digital ecosystem; 3rd party services
- ***Vessel Insight*** – data collection and in situ/cloud analysis; > 300 developers;
  ~200 vessels now, goal: **2 000 vessels** within **3 years**

Complete solutions for e.g. vessel operation, hull performance and/or applications such as bathymetric measurements

Blue Insight – The Digital Ocean Toolbox

Seamless acquisition, fusion, processing, visualization, contextualization and management of ocean data

Core

- Cloud **framework** & Cyber **security**
- BI **Dashboard**
- **Software** deployment
- Data **storage** & Data **management**
  - Advanced data accessibility and selection based on meta data

Sensor Fusion (onboard)

- Receive data from **sensors & databases**
- **Distribute** to cloud
- **Interface** between sensors and Remote & View

Ocean View

- **Web interface** for visualizing real time and historical sensor data
- **Visualize and navigate** in data from multiple sensors
- Geographical background **maps**
- Variety of **2D & 3D views**

Data Forwarder

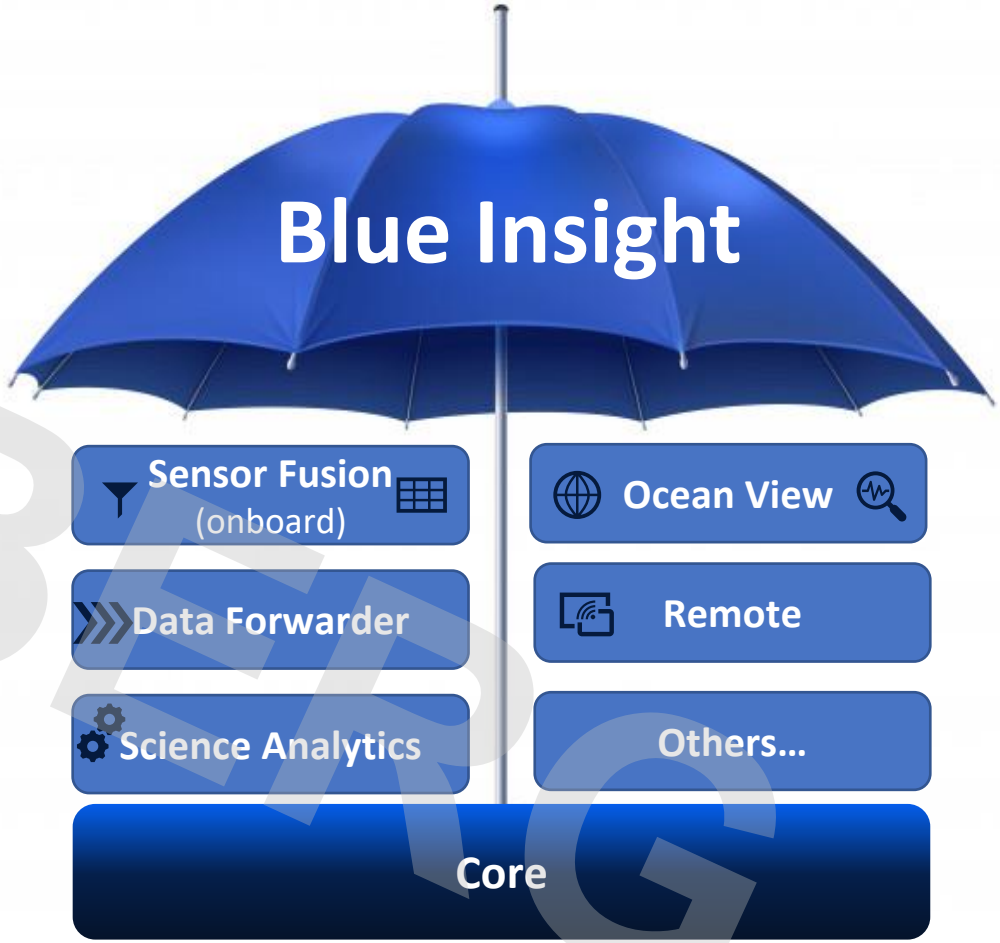
- **Conversion** of data into desired **formats**
- **Automatic forward** selected data to external (cloud) systems and servers or position information to AIS servers

Remote

- Web interface for **remote control** of EK/EM systems
- EK **system status** information

Science Analytics

- Data **QC/QA**
- **Automated** data **analysis**
- **Machine Learning** & AI



First Blue Insight Projects

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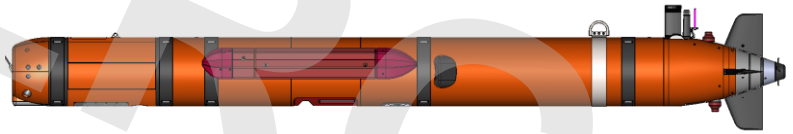
- **One Ocean** (2020+) https://oneoceanexpedition.com/
  - Project focus on science AND visualization/**communication**
  - EK80 was installed, requires (1) sensor fusion, (2) remote, (3) ocean view and (4) data forwarder
  - Covers collection and distribution of KM and 3rd party sensor data

- **Glider II** – lead: **Akvaplan-niva** (2021+) https://www.akvaplan.niva.no/en/projects-networks/glider/
  - Fleet of different platforms: Unmanned Surface Vehicles (USVs), underwater glider AUVs
  - Focus on EK80 and other oceanographic data for ecosystem monitoring, situational awareness, contextualization and decision support
  - Current focus on real time **visualization** improvements (vehicles, data, environment)
  - Further improvements planned ref. **data** flow/quality/handling/sharing

- **CRIMAC** – lead: **IMR** (2021+) https://crimac.no/en/projects/crimac
  - 2 AUV's and 2 USV's + Blue Insight solution
  - Benefits from sensor fusion, **remote**, ocean view and data forwarder functionality
  - Additional functionality required: Automatic **classification** of water column targets (→ machine learning)



Statsraad Lehmkuhl

Blue Insight supports and facilitates an ambitions undertaking

- The One Ocean Circumnavigation (2021-2023)
- Part of the Decade of Ocean Sciences for Sustainable Development
  → **create attention and share knowledge**
- Connected vessel with an **extensive list of measurement parameters** included in the digital infrastructure solution such as:
  - **Meteorological**: air temperature, relative humidity, air pressure, wind
  - **Wave** measurements
  - FerryBox surface water flow-through system with **water temperature**, **oxygen**, **turbidity**, etc.
  - pCO_2 system
  - **Echosounder**, incl. onboard processing for biomass and ecosystem inf.

Statsraad Lehmkuhl (picture source)

Statsraad Lehmkuhl

Advanced Digital Infrastructure – from *onboard processing* to *smart data forwarding*

Configuration
Remote control
Algorithms

Raw and Processed data

Models
Prepared algorithms

Raw and Processed data

Vessel

Measurements

Pos., Autom., Ship systems
Met Sensors
Echosounder
FerryBox, pCO_2, Waves

Onboard **processing**

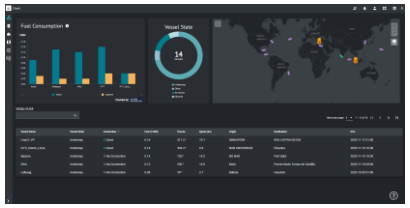
Visualization

Cloud

Processing

Visualization

Sensor **control**



Datacenters

Automated **distribution**
e.g. with met.no (json format)
and
Storage at various data centers
e.g. NMDC

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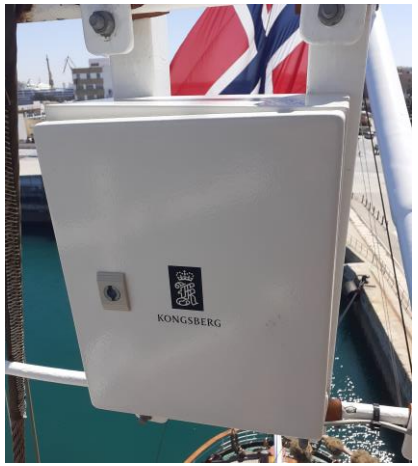
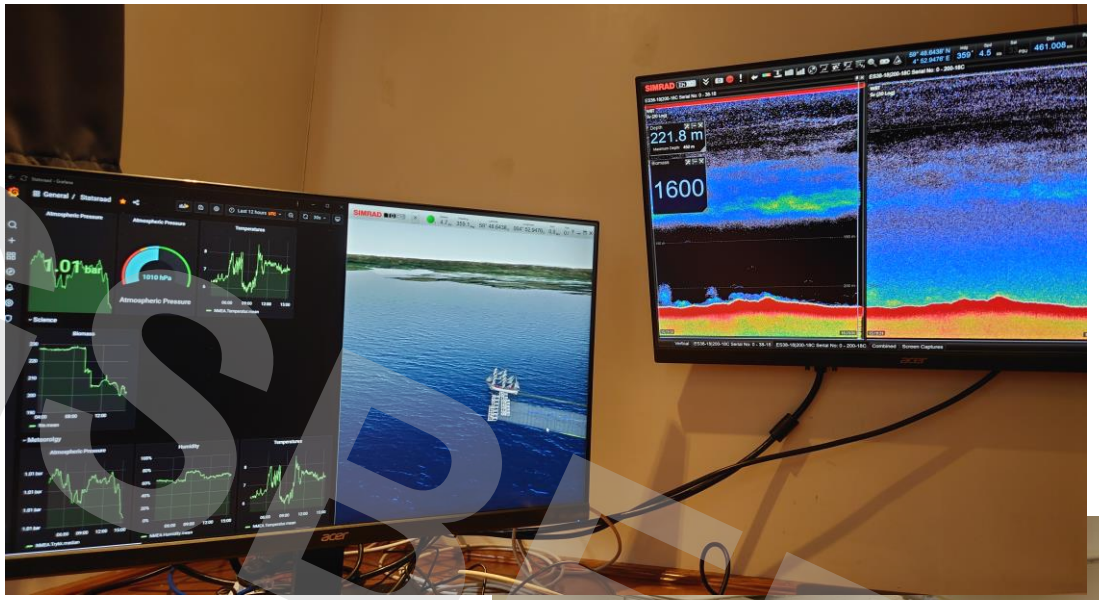
Onboard impressions





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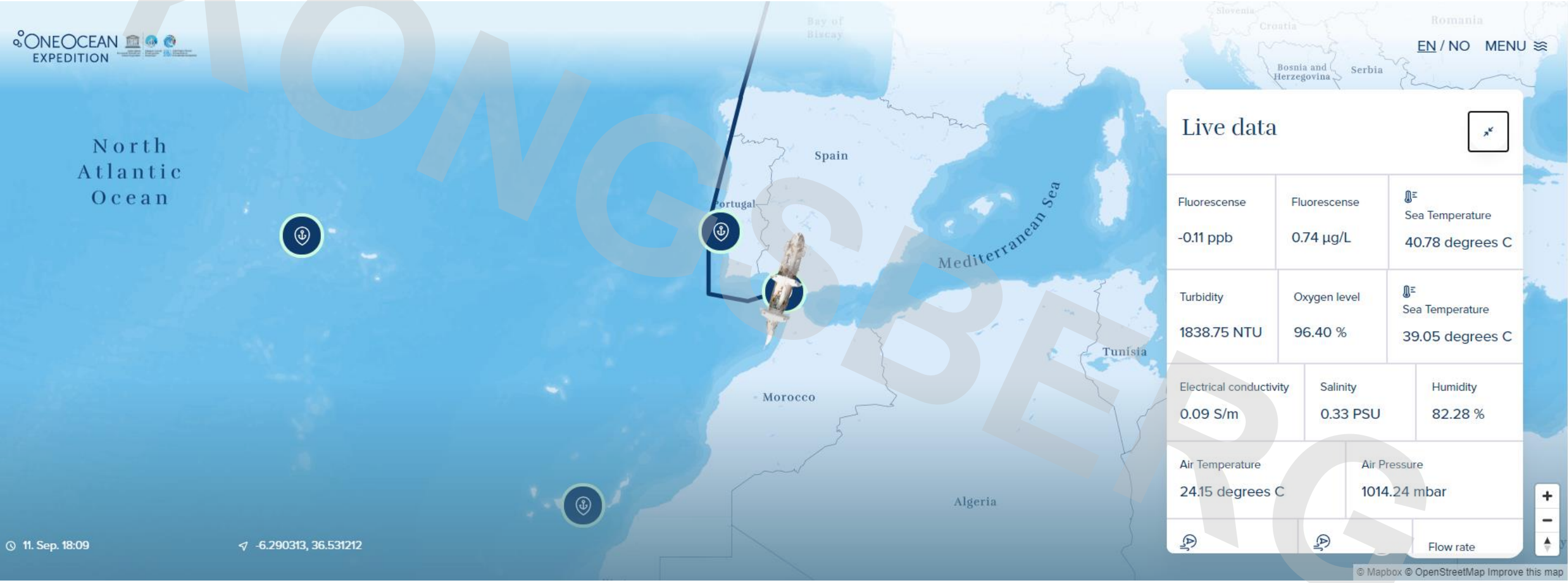
Real-time, online data



Link: https://oneoceanexpedition.com/?dashboard=true

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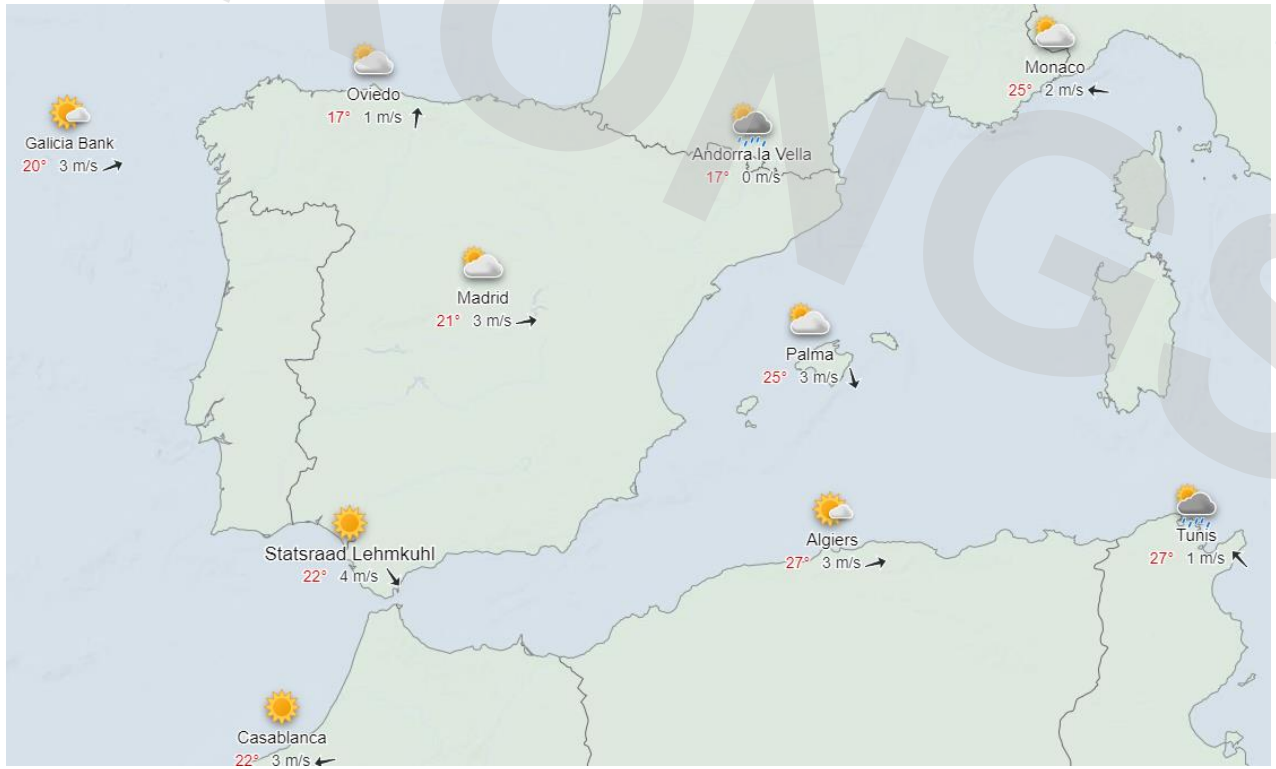
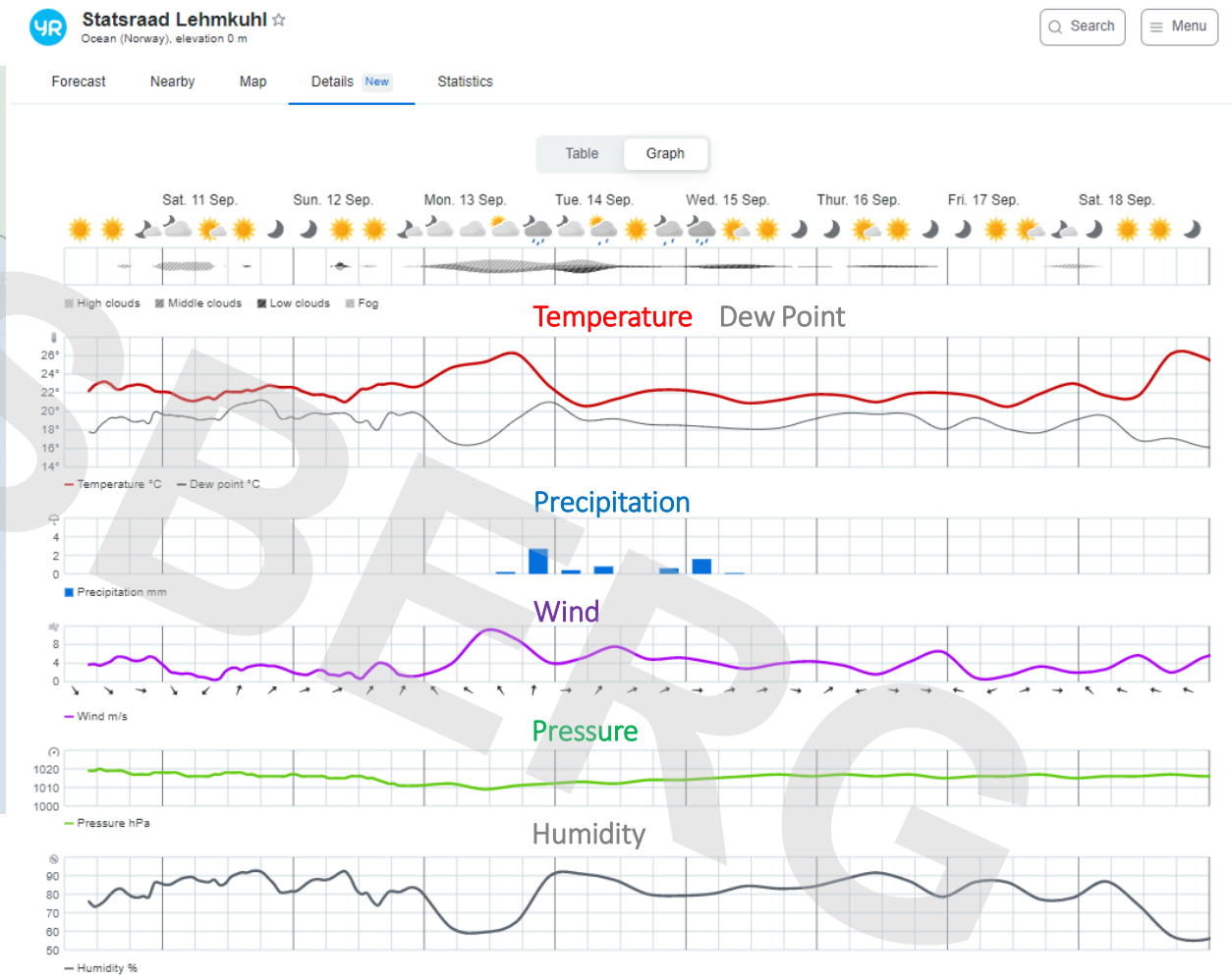
Meteorological online data and forecasting





Link: https://www.yr.no/en/forecast/daily-table/5-20931/Norway/Ocean/Statsraad%20Lehmkuhl

Summary and Outlook

- The favorable ecosystem of **connected vessels** (*Kognifai*, *Vessel Insight*) is evolving and growing
- Simplifies and provides good conditions for **scalable, cost-efficient and effective data collection**

- New **digital toolbox, Blue Insight,** focuses on **all activities related to oceanographic and meteorological data**
- Open for different platforms and parameters such as **standard metocean** (e.g. air pressure – little effort/large effect) to more sophisticated **ocean observing** incl. in situ/cloud data processing (e.g. echosounders)

- Metocean data collection on connected vessels can **meet the Automated Weather Station (AWS) demands** (quality, protocols, etc.) while **benefitting from**, e.g.:
  - synergetic use of vessel systems already connected (GPS, navigation parameters, comm. devices, storage, etc.)
  - automated processing and analysis in the cloud

- **KM's** global **market presence** (thousands of vessels) and **established technology** (full solution) can play a key role in **significantly enlarging VOS scheme data collection**

Open and ready to discuss ambitious **demonstration project** ideas, i.e., connecting existing VOSs to Blue Insight or accessing new VOSs with installation/equipment/BI

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Thank you

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