



SMART MONITORING SYSTEMS



Kremena Stefanova

IO-BAS



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under Grant Agreement No:101000240.

SPECIFIC OBJECTIVE

To advance tailored applications of new cost-effective tools for the understanding of ecosystem functioning and rapid biodiversity assessments of high innovation potential

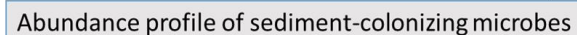
CUTTING-EDGE BIODIVERSITY METHODS

- eDNA metabarcoding → smart, rapid biodiversity monitoring
- Metagenomics → marine enzyme discovery
- Advanced benthic observing systems

EARLY-WARNING DEMONSTRATORS - SENSING PLATFORMS TAILORED FOR SPECIFIC STRESSORS

- Jellyfish bloom monitoring
- Acidification sensing
- Underwater noise detection
- Radioactivity observation

HIGH-INNOVATION PLATFORMS WITH STRONG APPLICATION POTENTIAL!



eDNA - pilot monitoring applications

Gliders - regular cross-border missions

Passive acoustic - non-invasive, constant monitoring

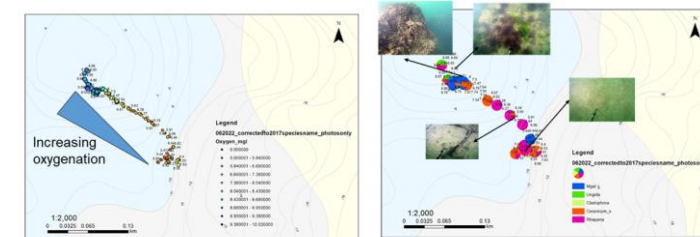
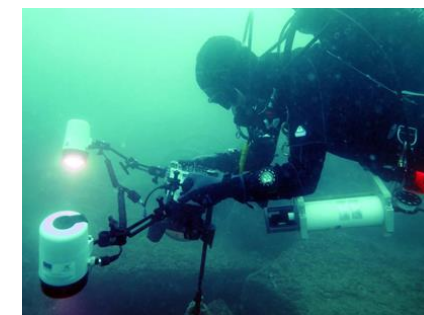
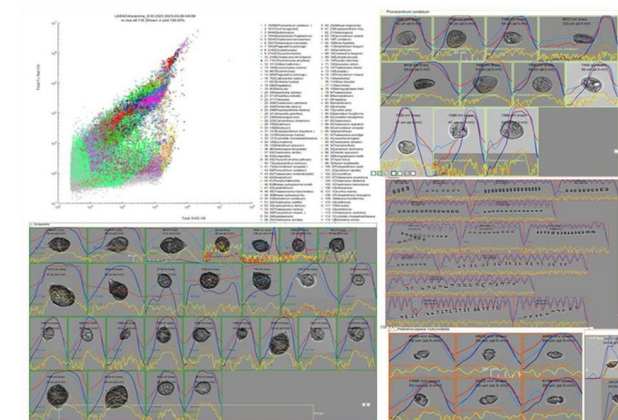
SMART MONITORING

Benthic observatories - tested in real Black Sea conditions

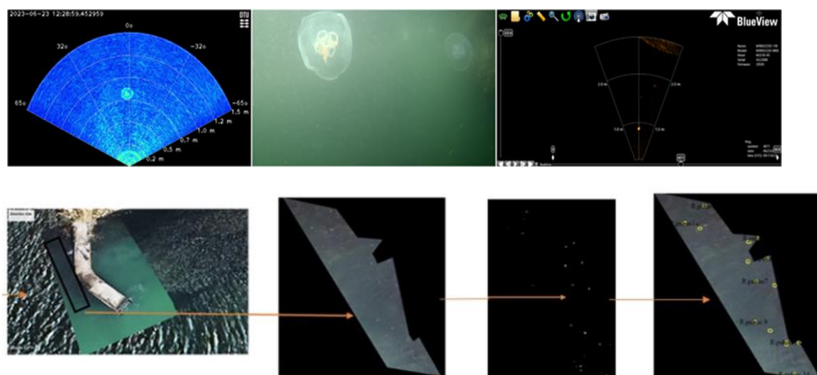
Jellyfish monitoring – alternative methods

**Radioactivity
observation
tool (near)
real-time
monitoring**

Automated data and classification pipeline test



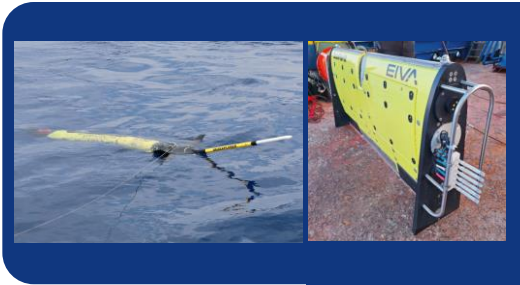
Benthic observatories



Jellyfish monitoring



eDNA & metagenomics for faster, non-invasive biodiversity monitoring



Smart observing (Gliders, Scanfish, benthic observatories) for high-resolution data

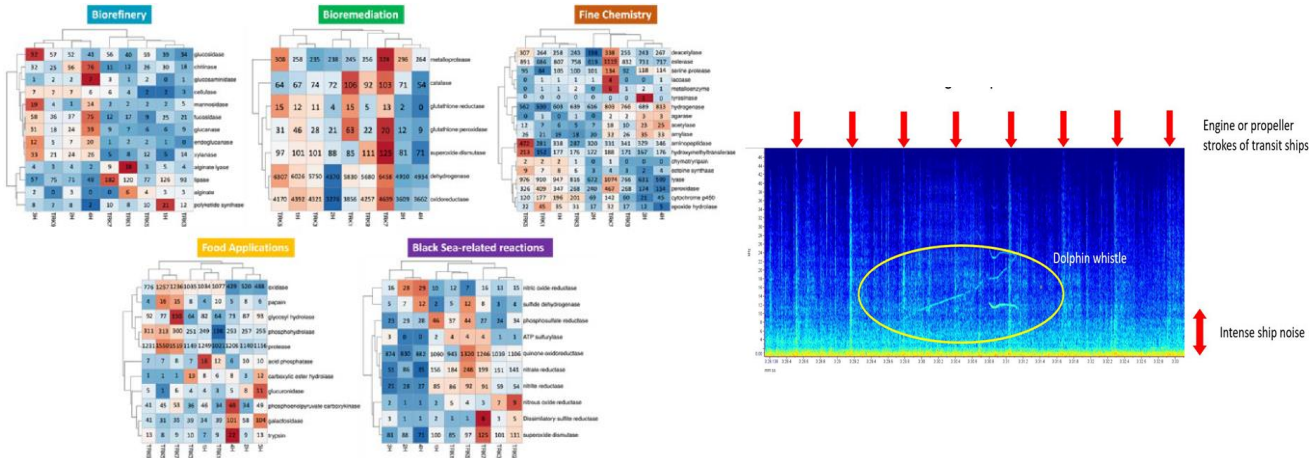
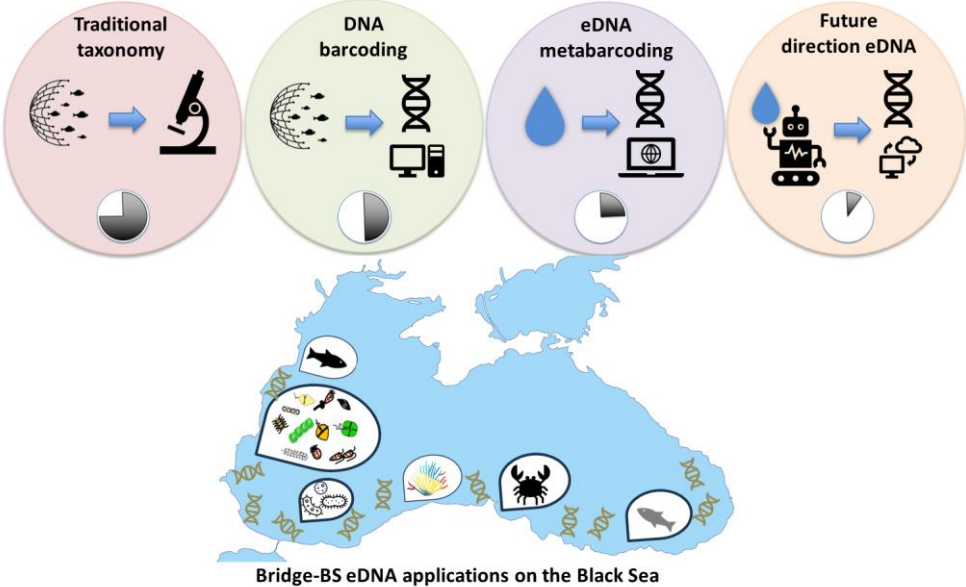


Early-warning tools for stressors (jellyfish, pH/pCO₂, noise, radioactivity)



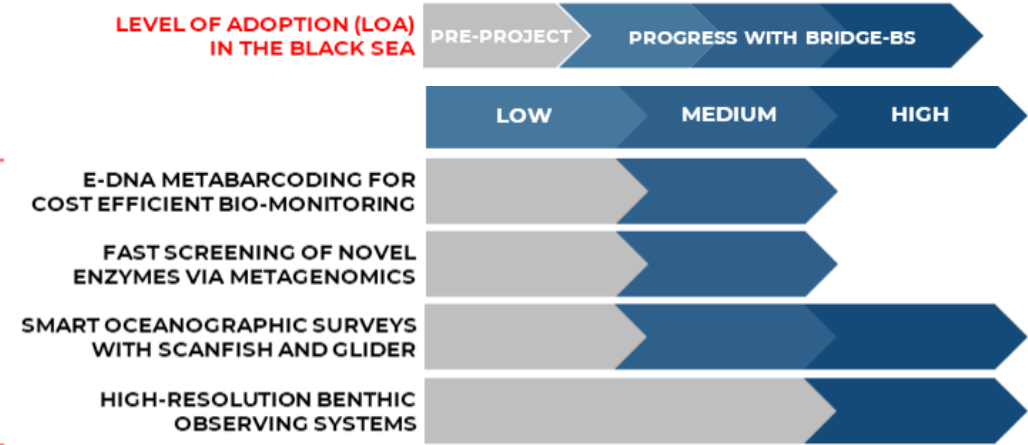
Phytoplankton imaging library enabling rapid HAB assessments

NEXT-GENERATION MONITORING SOLUTIONS INTRODUCED UNDER BRIDGE-BS



NEXT STEPS / LEGACY:

SMART MONITORING SYSTEMS



Four monitoring systems studied in BRIDGE-BS and their level of adoption analysis.

To fully integrate advanced biodiversity monitoring systems and technologies into operational marine observation programs, it is critical to advance the technology beyond initial prototypes and proof-of-concept demonstrations.

Efforts should focus on reaching High level of adoption or Technology Readiness Levels 6-7 and more, where technologies are demonstrated in relevant environments and validated under operational conditions.

NEW SENSORS AND TOOLS



Technology components (new sensors, tools or digital resources) developed under BRIDGE-BS.

TRL 3–5
Prototypes & Demonstrators

TRL 6–7
Tested in Real Environments

TRL 8–9
Operational Integration

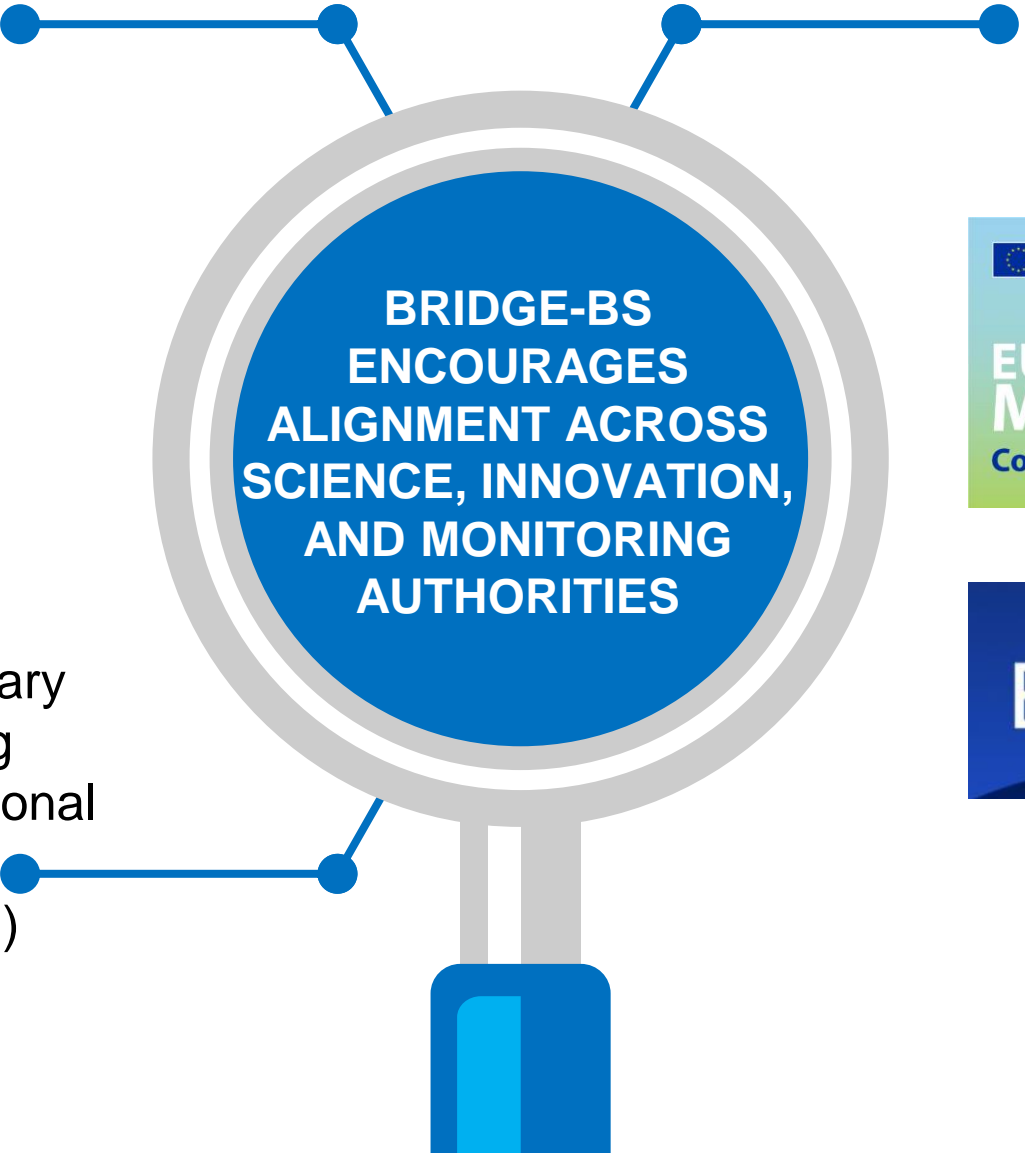
From Observation → Innovation → Legacy

FROM OBSERVATION TO INNOVATION –
BRIDGE-BS IS TRANSFORMING
MARINE MONITORING.

Better supports **MSFD**
Good Environmental
Status (GES)
assessments



Enhances cost-efficiency,
harmonization, and transboundary
observation. Creates a strong
foundation for future EU and regional
investment
(Horizon EMFAF, Interreg....)



Contributes to **EU**
Mission Ocean and the
EU Digital Twin of the
Ocean





Smart observations play a crucial role in safe, sustainable and innovative Blue Growth.



Tools such as eDNA, acoustics, UAV/ROVs, imaging flow cytometry, and radioactivity sensors provide faster, more accurate, and non-invasive data collection.



These innovations strengthen early-warning capabilities, support evidence-based management, and create opportunities for new services in the Blue Economy.



Integrating advanced tools with traditional methods ensures more reliable ecosystem assessments and better-informed decisions.



By combining technology, science, and collaboration, it could detect risks earlier, act faster, and manage marine resources more responsibly.

**BRIDGE-BS DELIVERED HIGH-IMPACT, SCALABLE SOLUTIONS
ALIGNED WITH EU PRIORITIES**

THANK YOU!

STAY TUNED!

bridgeblacksea.org



@BRIDGE_BlackSea



BRIDGE Black Sea



@BRIDGEBlackSea



BRIDGE Black Sea



BRIDGE-BS