European challenges:

- Adapt to and mitigate climate change
- Ensure food- and energy-security
- Preserve biodiversity
- Promote superior alternatives to our fossil-based economies
- Foster economic growth and social prosperity.

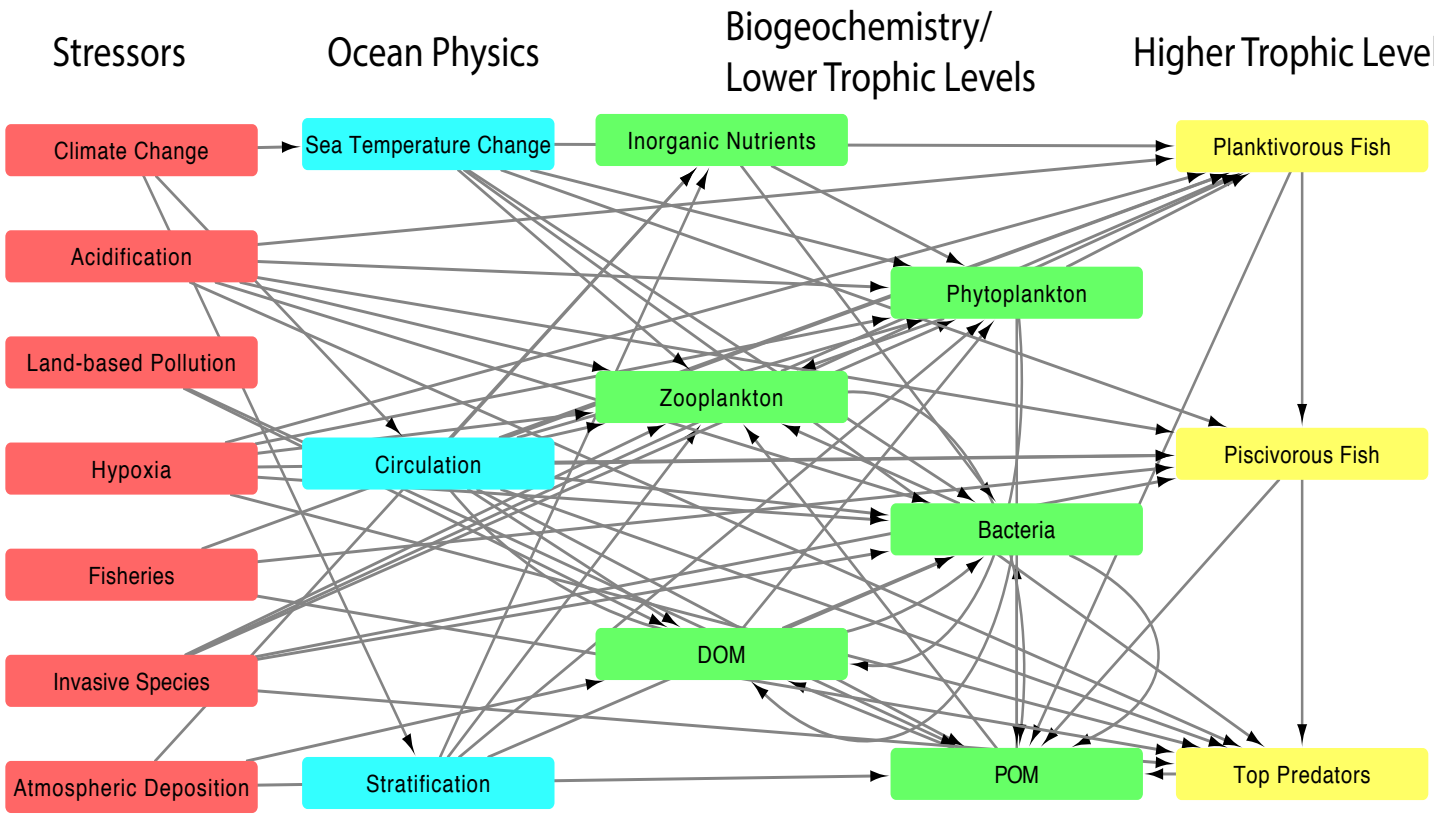
Addressing the challenges
GOAL 1: Understanding the functioning of the Black Sea ecosystem

ACTIONS

- A coordinated network of marine institutes, universities, stations, observatories and companies
- Assess inputs from atmosphere-land-sea and anthropogenic pressures leading to change in marine and coastal ecosystems
- Understanding environmental conditions conductive to invasions, effects on habitats, identifying conditions for ecological resilience
- Assessment of litter, micro- nano-pollutants
- Identifying/disentangling the effect of multiple stressors
- Assessment of climate related risks
- Synoptic surveys/observations
- Long term monitoring

Stressors on ecosystems at the Black Sea system level

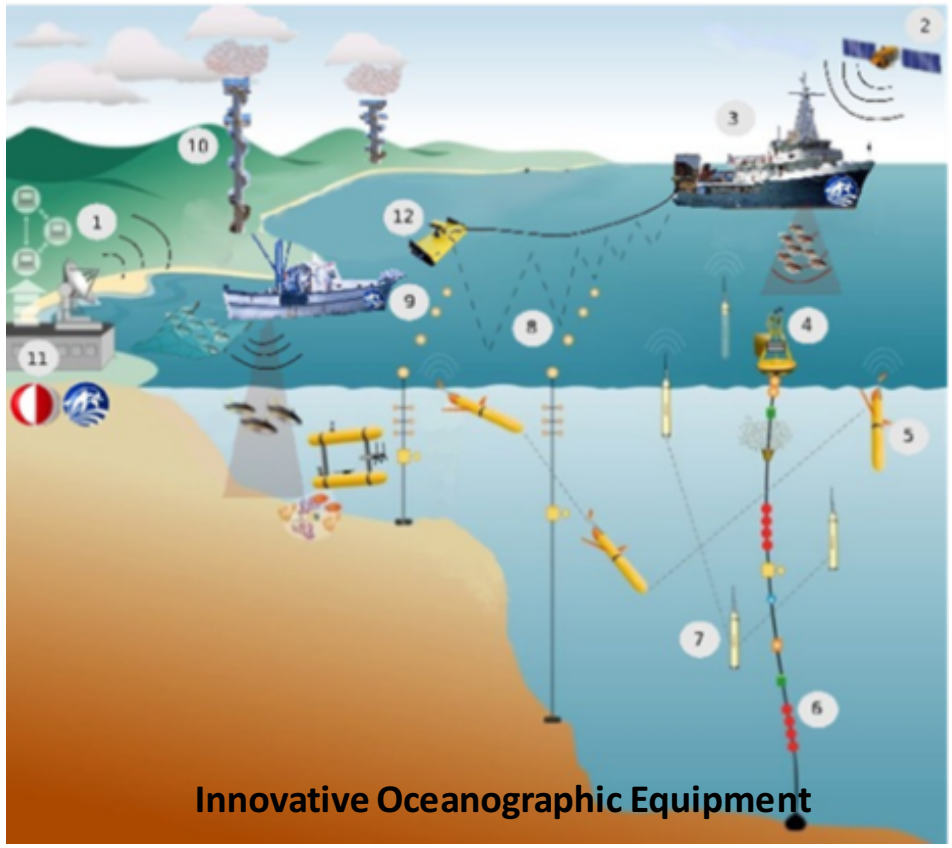
Human activities and natural variability result in a range of stressors that may interact and have greater impacts than expected, compounding direct and indirect effects on different levels of the ecosystems



Center for Marine Ecosystems and Climate Research

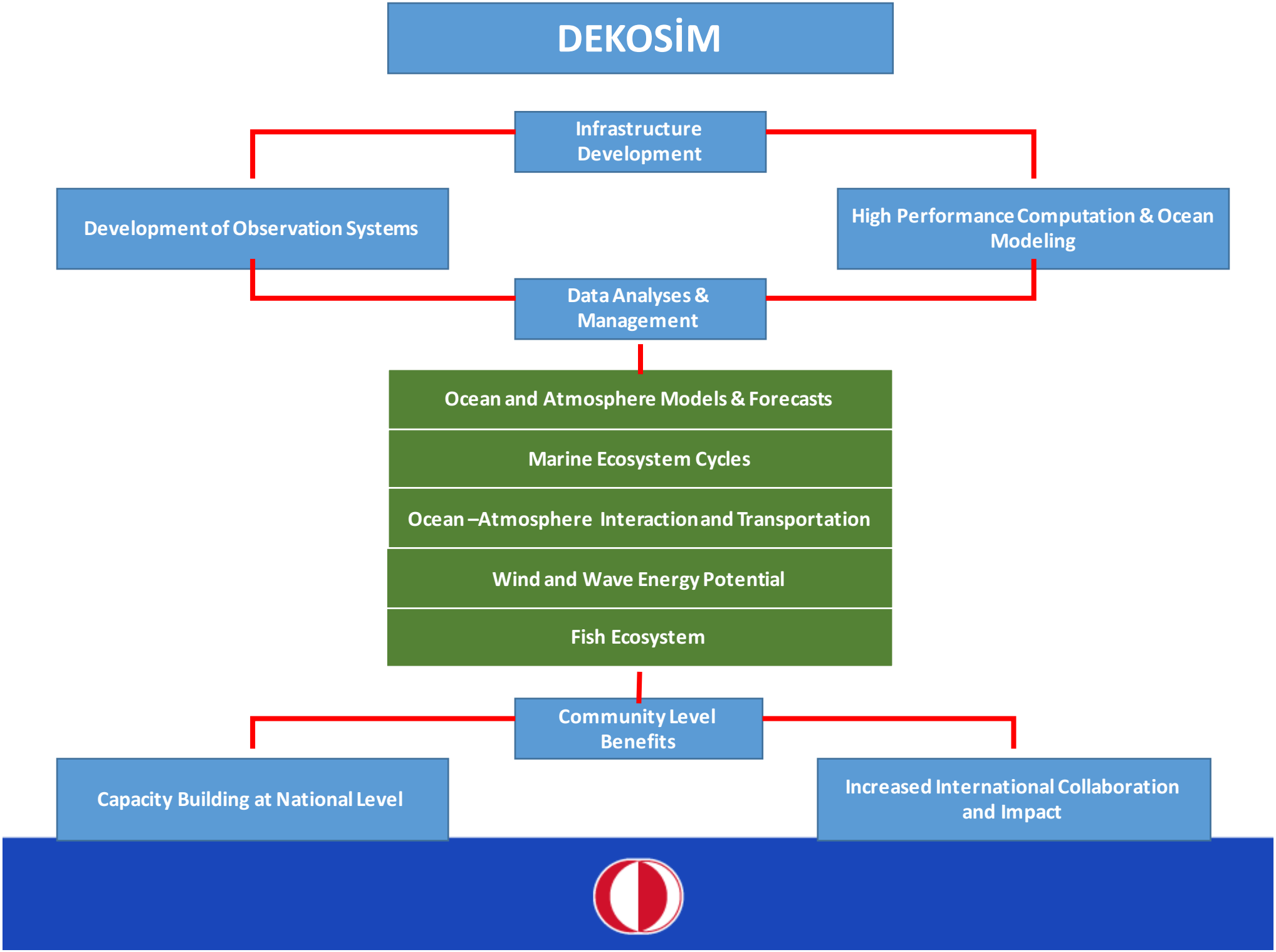
DEKOSİM

Climate related studies with special focus on marine ecosystems as well as atmospheric and geophysical research

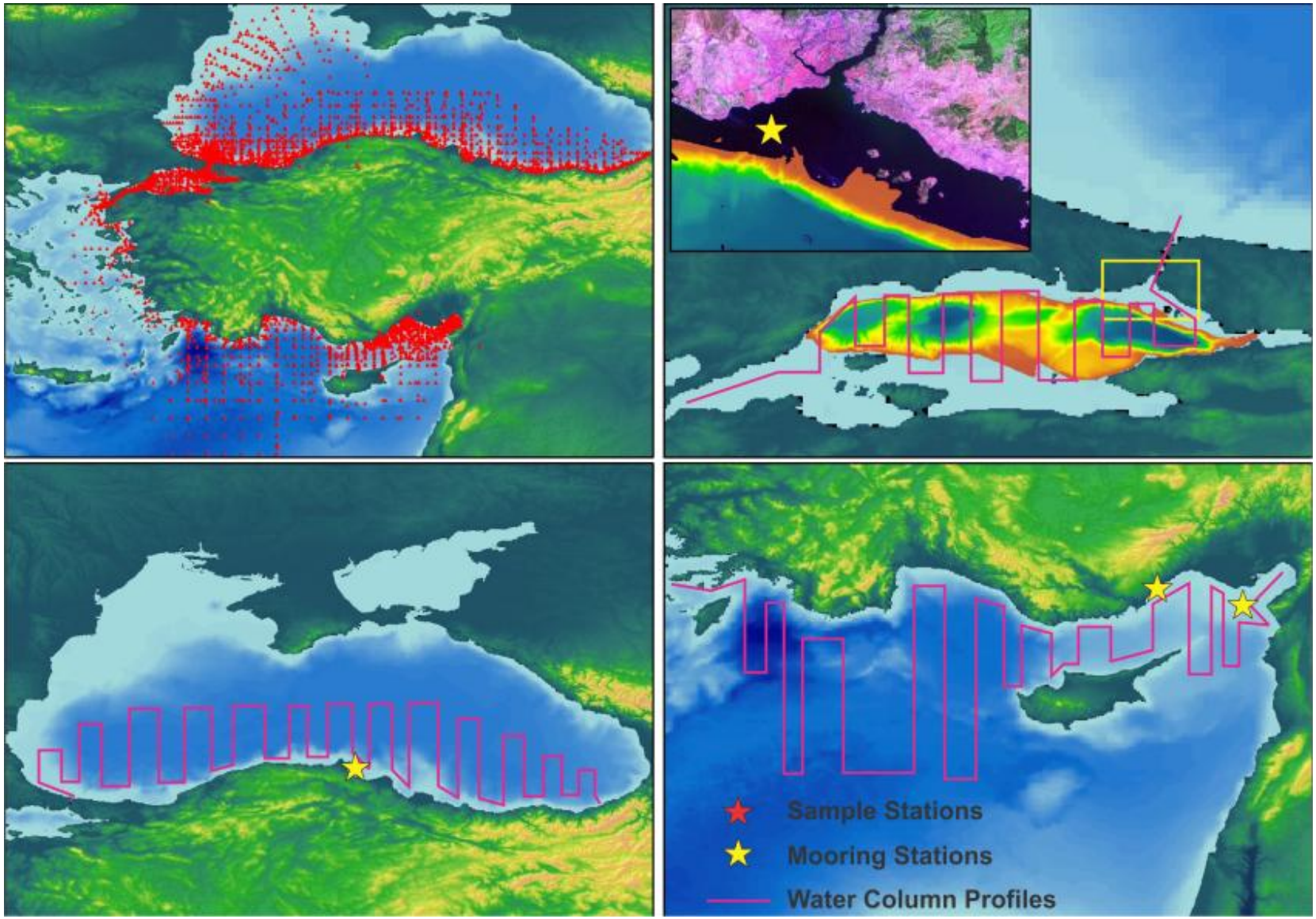


Innovative Oceanographic Equipment

RV Bilim-2

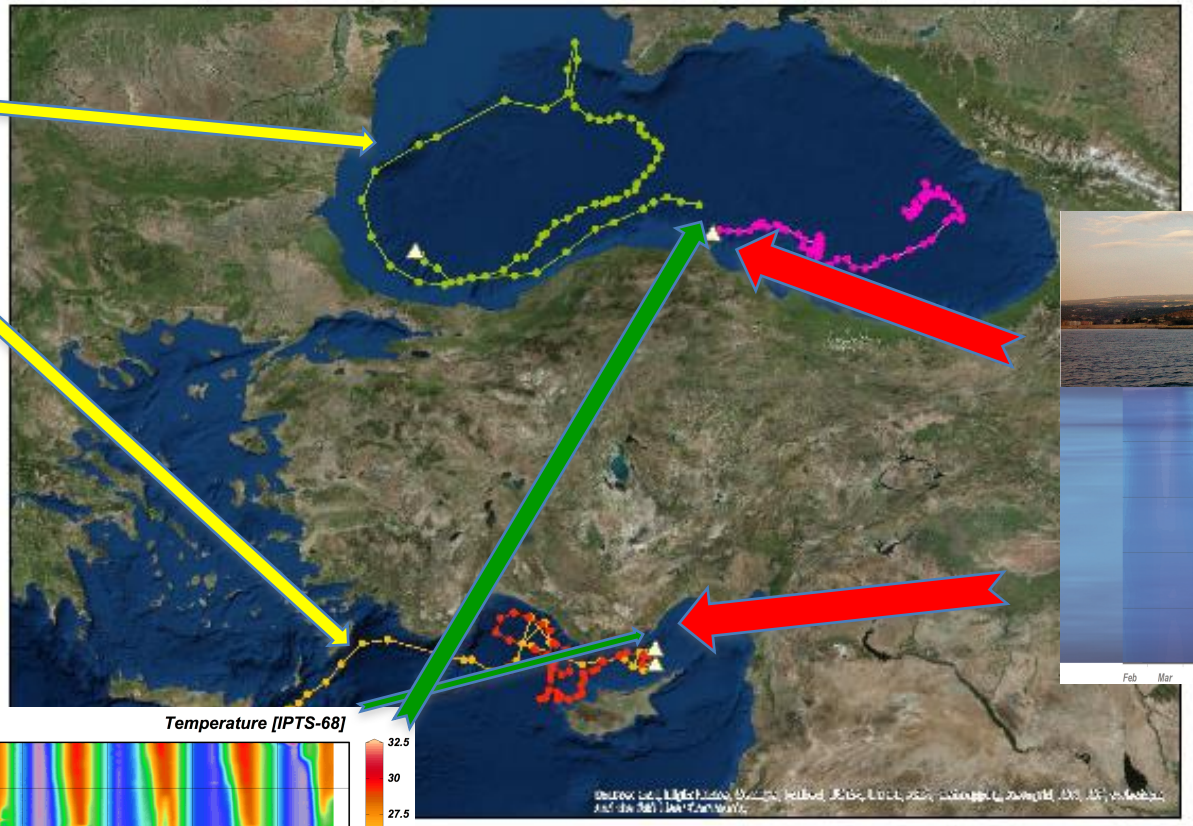

DEKOSİM
Infrastructure Development
Development of Observation Systems
High Performance Computation & Ocean Modeling
Data Analyses & Management
Ocean and Atmosphere Models & Forecasts
Marine Ecosystem Cycles
Ocean –Atmosphere Interaction and Transportation
Wind and Wave Energy Potential
Fish Ecosystem
Community Level Benefits
Capacity Building at National Level
Increased International Collaboration and Impact

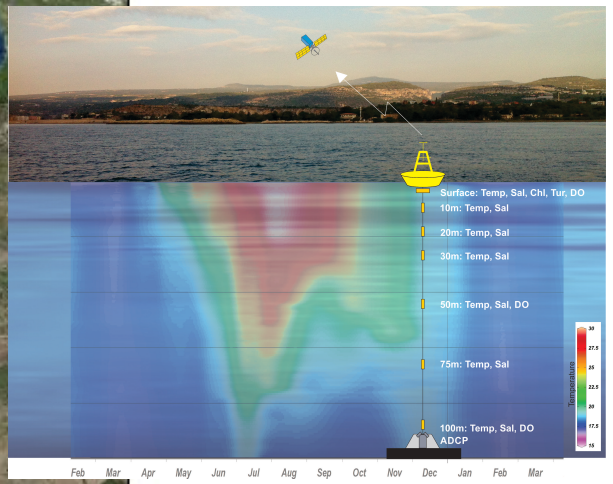
Main Research Areas



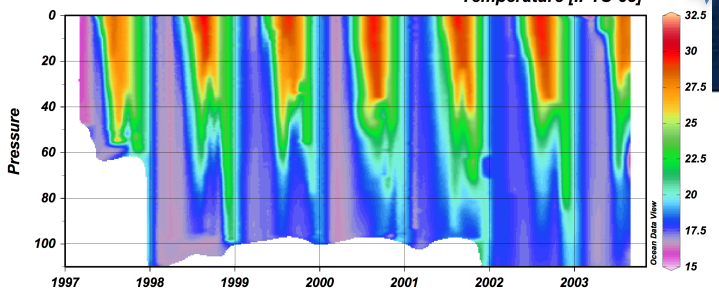
Monitoring Systems

6 Argo floats





2 Mooring systems



Oceanographic Time Series

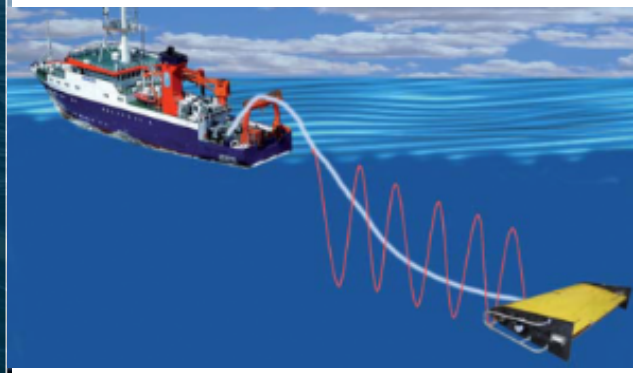
Monitoring Systems

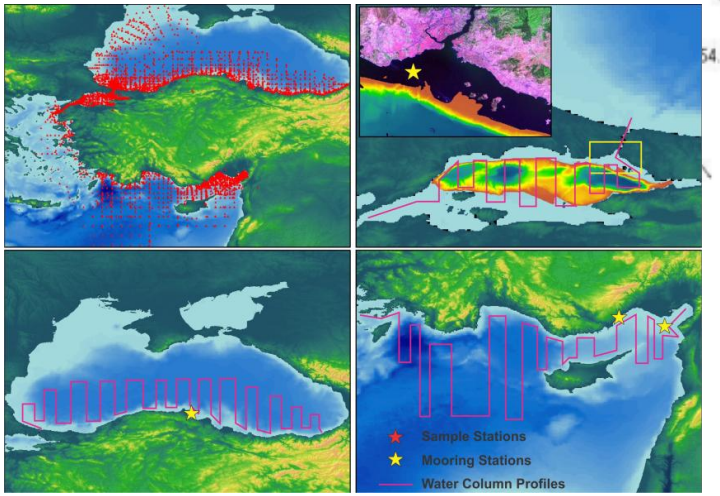
Intelligent anti-collision feature

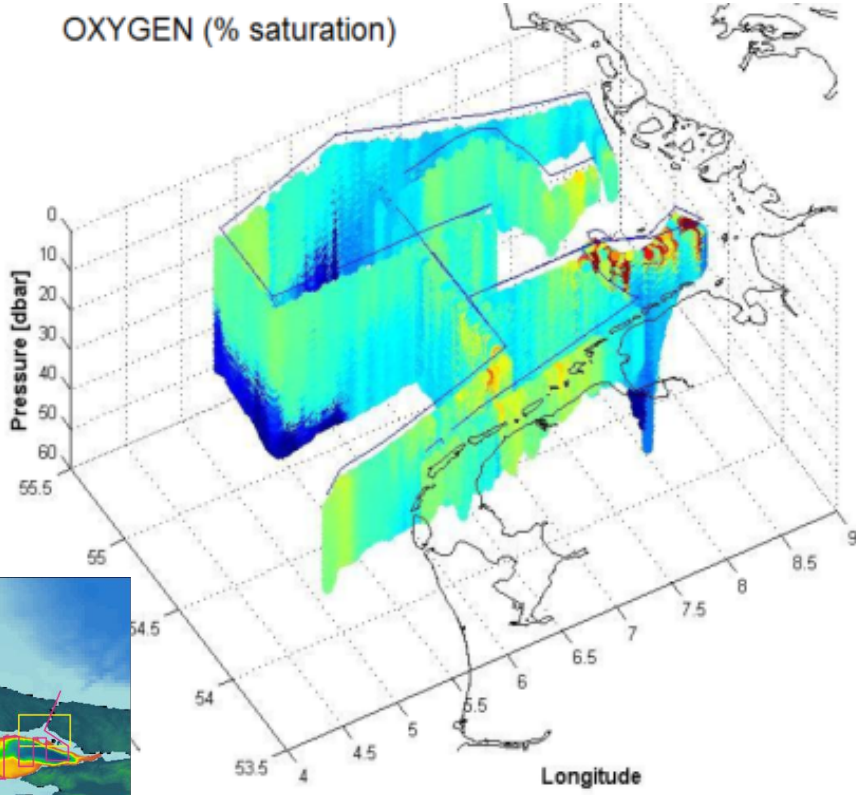
The ScanFish Rocio has an intelligent anti-collision feature which ensures that the ROTV will pitch upwards when detecting obstacles in its path.

Simple to handle and deploy

Due to the practical design, the ScanFish Rocio is easily handled on deck and deployed with an A-frame and winch by only two men. When stored, it takes up a minimum of space.







FP7 PERSEUS BSEX: Black Sea Experiment

Responsible: METU

Participants: GeoEcoMar, SIO-RAS, IO-BAS, IBSS, UoP, NIB, CSIC

SUMMARY

JOINT EXPERIMENTS is carried to fill the gaps that were defined under 3 categories:

- **Eutrophication:** Level of eutrophication and distribution of phytoplankton, zooplankton and impact of gelatinous zooplankton is studied during 2013.

  Inputs for D2, D5, D7. Contributing institutes are METU, SIO-RAS, IO-BAS, IBSS.

- **Invasive ctenophores:** Temporal levels of concentration of invasive ctenophores and their impact on native zooplankton and especially on fish is being studied. Experimental study of invasive ctenophores effect on low trophic web-microzooplantton, phytoplankton and nutrients contents are also investigated.

  *Inputs for D2, D4. **C**ontributing institutes are SIO-RAS, METU, IO-BAS, IBSS.*

- **Anchovy Spawning areas:** Experiments to define where most abundant fish, anchovy, spawn were carried out.

  *Inputs for D3, D4. **C**ontributing institutes are METU, SIO-RAS IO-BAS, IBSS*

- **<u>There are also ongoing activities under specific tasks:</u>**

- **Deep Trends**: In BSEX, past and future trends in the Black Sea related to climate is being studied, **GeoEcoMar**

- **MODEL**- Shelf-deep sea exchange processes is being studied in the NW Black Sea sector (UoP, MHI)

Joint experiments

Main focus:

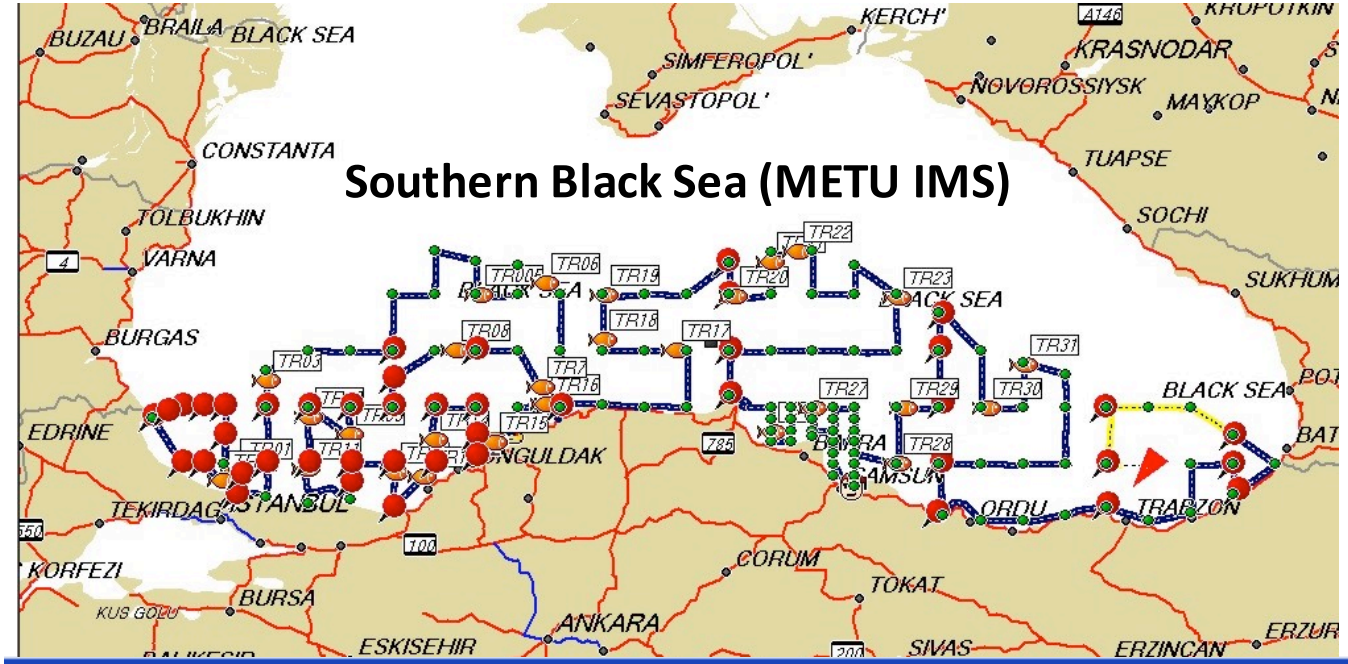
Eutrophication: Level of eutrophication and distribution of phytoplankton, zooplankton and impact of gelatinous zooplankton

Invasive ctenophores: Updated temporal levels in the concentration of invasive ctenophores

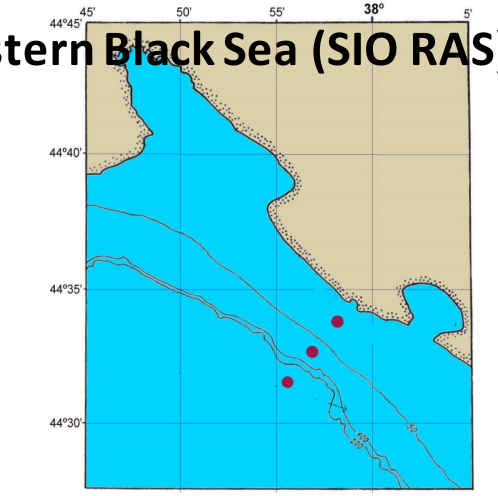
Anchovy Spawning areas: To define where most abundant fish, anchovy, spawn

JUNE-AUGUST 2013, 2014 CRUISES

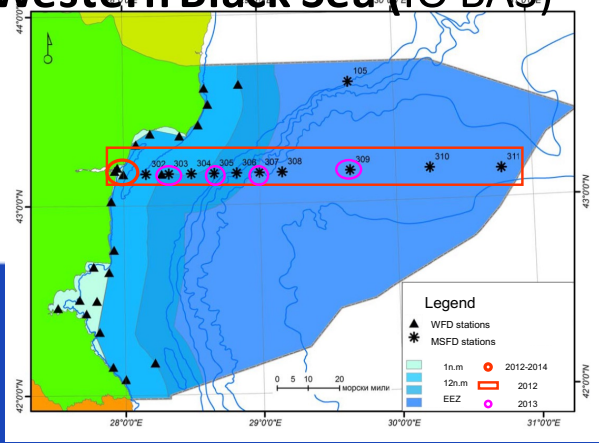
Southern Black Sea (METU IMS)



North Eastern Black Sea (SIO RAS)



Western Black Sea (IO BAS)



Adressing the challenges

GOALS 2, 3, 4:

- Promoting sustainable exploitation of biotic sources
- Preparing to climate change
- Ecosystem based management

ACTIONS

- Develop optimal strategies, technologies and practices for sustainable exploitation of biological resources; take account of socioeconomic and ecosystem considerations, in line with the Common Fisheries Policy and the GFCM
- Provide numerical modelling, forecasting, indicators and trends defining in the Black Sea environmental conditions along with long-term monitoring
- Make a comprehensive assessment of climate related risks in the Black Sea region

New generation end-to-end models to analyse the environmental status of the Black Sea and the ways forward

Dr.Baris Salihoglu

Dr. Bettina A. Fach, Dr. Sinan Arkin, Dr. Valeria Ibello, Dr. Ekin Akoglu, Dr. Olgaç Güven, Dr. Temel Oguz, Volodymyr Myroshnychenko







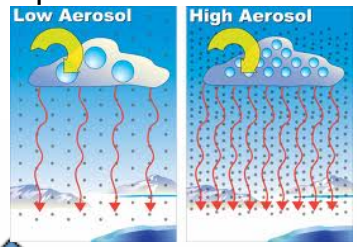
Msc Students: Elif Yılmaz, Selin Küçükavşar, Carina Linder, Deniz Dişa, Umay Güz, Onur Karakus

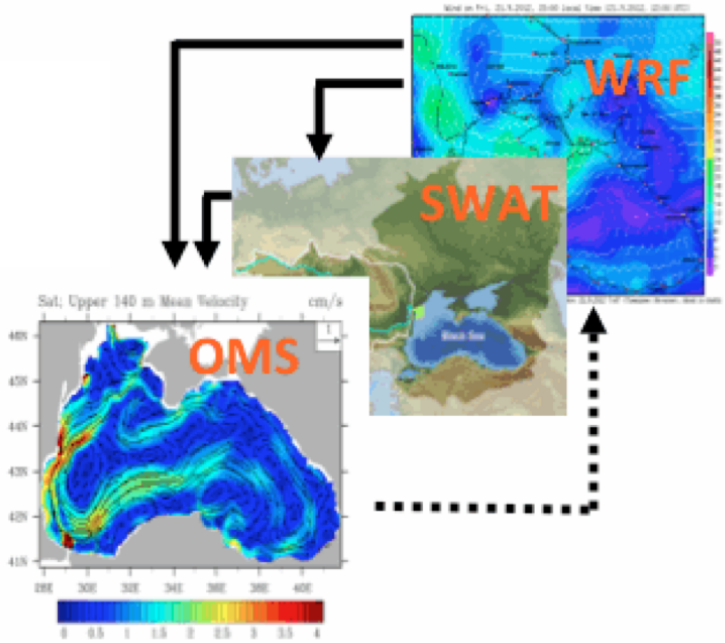
PhD students: Anıl Akpınar, Caglar Yumruktepe, Nusret Sevinç, Ayşe Gazihan, Ehsan Sadigrai, Ceren Güraslan

METU Ecosystem Modelling Group

Black Sea Protection and Prediction System (BSPPS) Structure

Atmospheric Model (AM) +
Atmospheric Loads





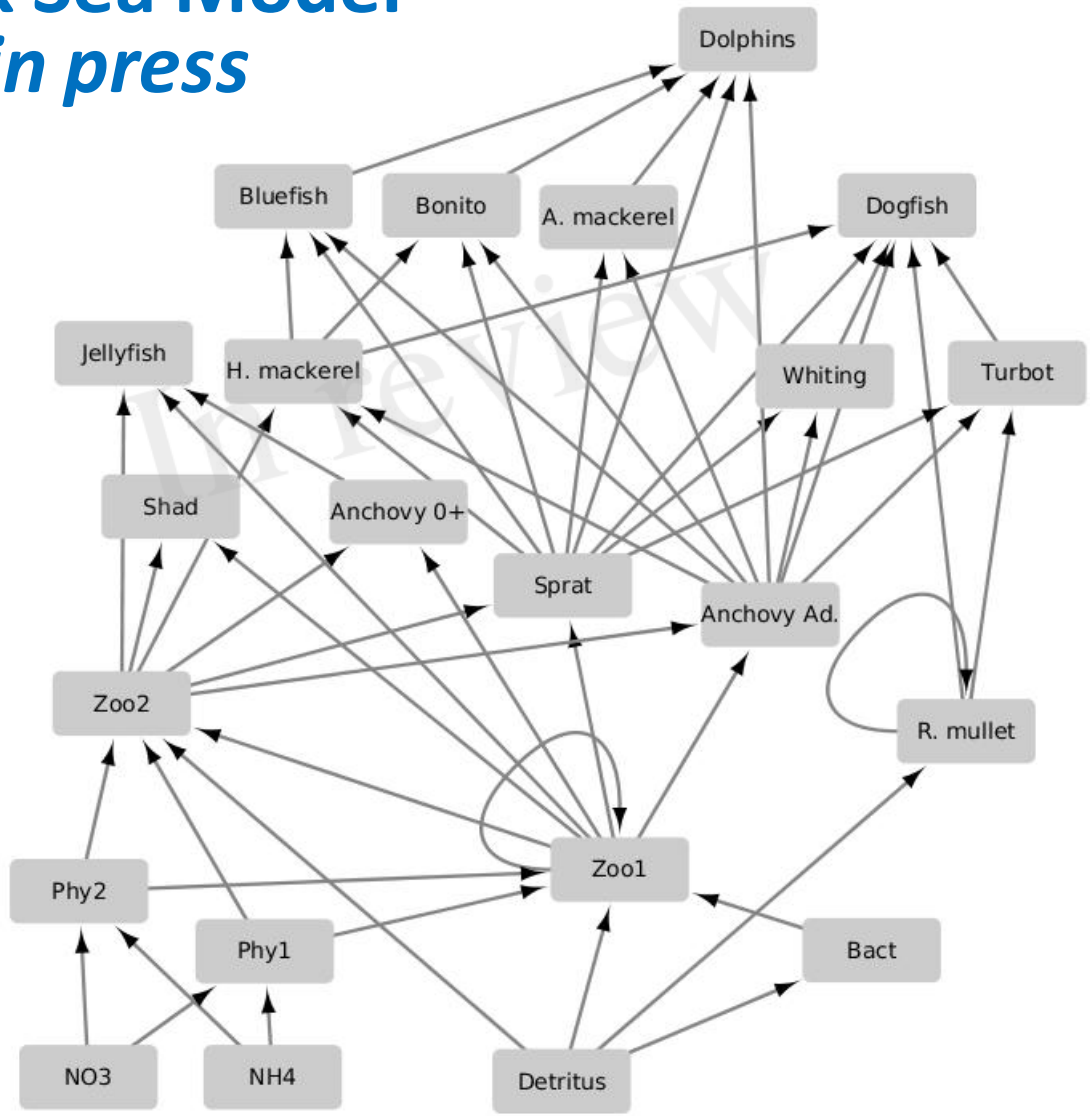
Soil and Water Assessment Tool
(SWAT)

Ocean Modeling System (OMS)
POM/NEMO/GETM+ECO/ERSEM

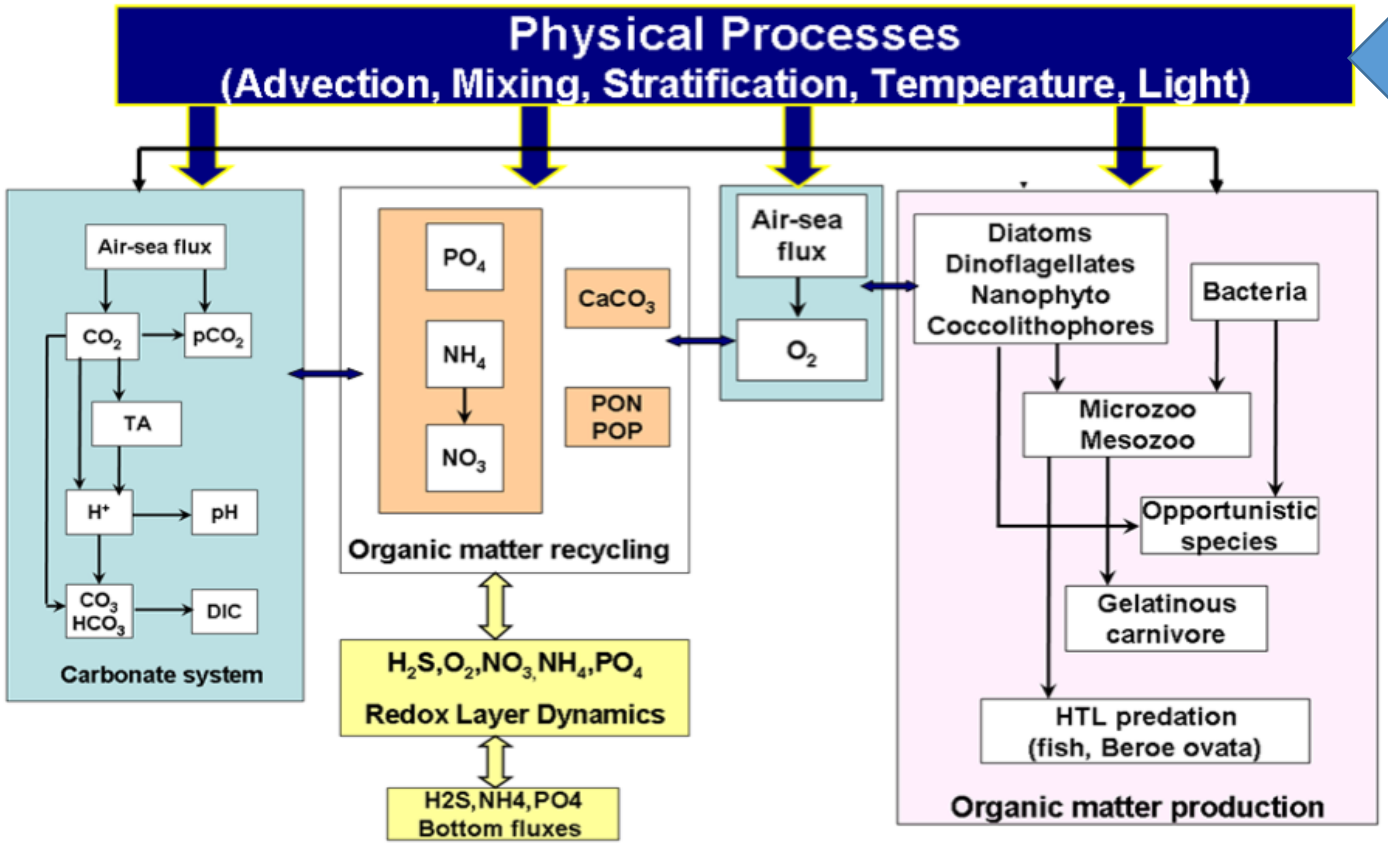
FISH Models

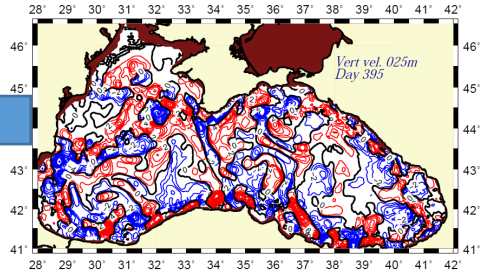
The end-to-end Black Sea Model

Salihoglu et al., in press



Updated Lower Trophic Level Model (BIMS_ECO2)

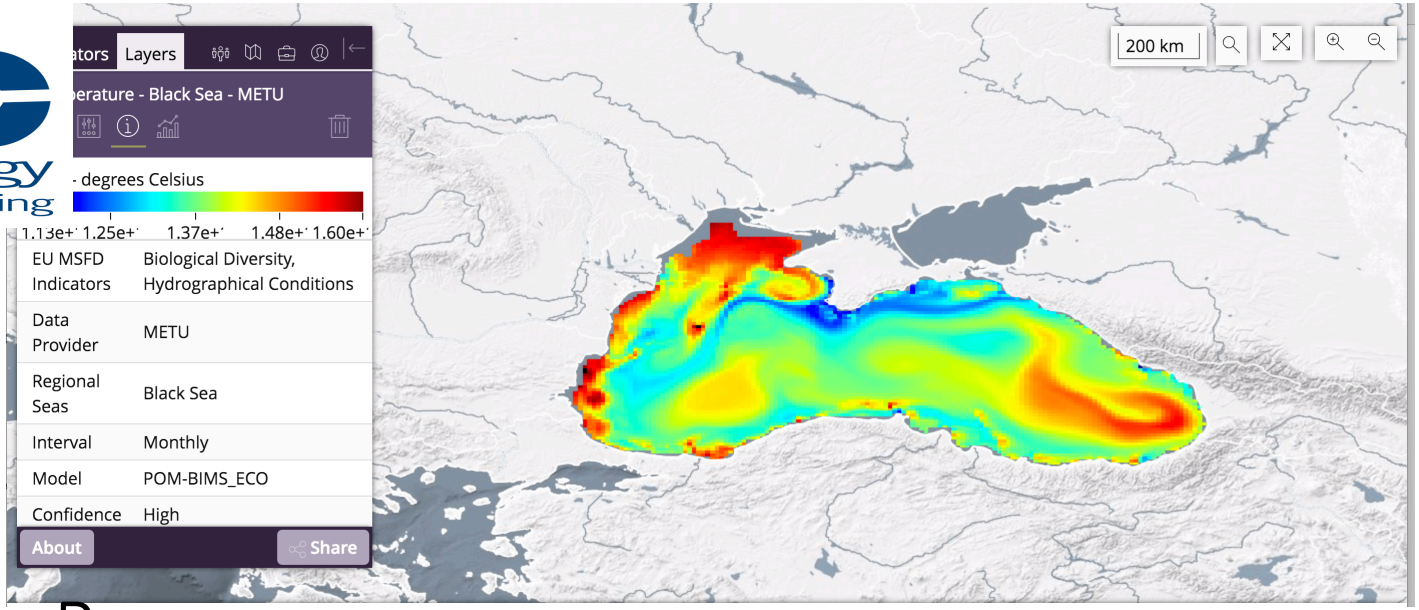




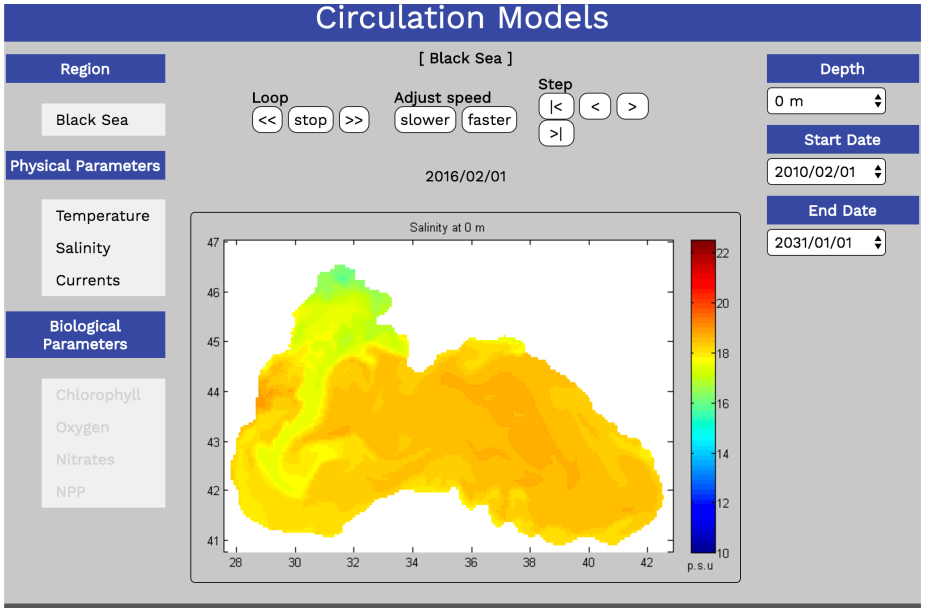
Ocean Circulation Model BIMS vs BIMS version 2

- Princeton Ocean Model (POM)
- and GETM
- POM 5km horizontal resolution
- GETM 3 km
- 40 vertical levels
- Domain includes all of Black Sea except Azov Sea
- Includes water discharges from 9 large rivers
- DMI HIRHAM atmospheric mode
- Able to resolve mesoscale dynamics and the associated ageostrophic features
- Salinity relaxation to climatology with a low relaxation rate

Operational Ecology
Marine Ecosystem Forecasting



DEKOSİM Data Base



ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

Scientific Challenge 1

- New scientific understanding on coastal and shelf observations and modeling
- Methodologies for integrated models

&

Scientific Challenge 2 & 3

- Projecting Future States
- Delivering the Knowledge to Managers and Industry

Dr. Barış Salihoğlu
Institute of Marine Sciences

Grand challenge of our time

- The challenge now is to enhance our understanding of fundamental processes and to develop observational and modelling frameworks that will allow an **integrated assessment of the interconnected ocean ecosystem-environment-human system** (Schulz et al., 2015).

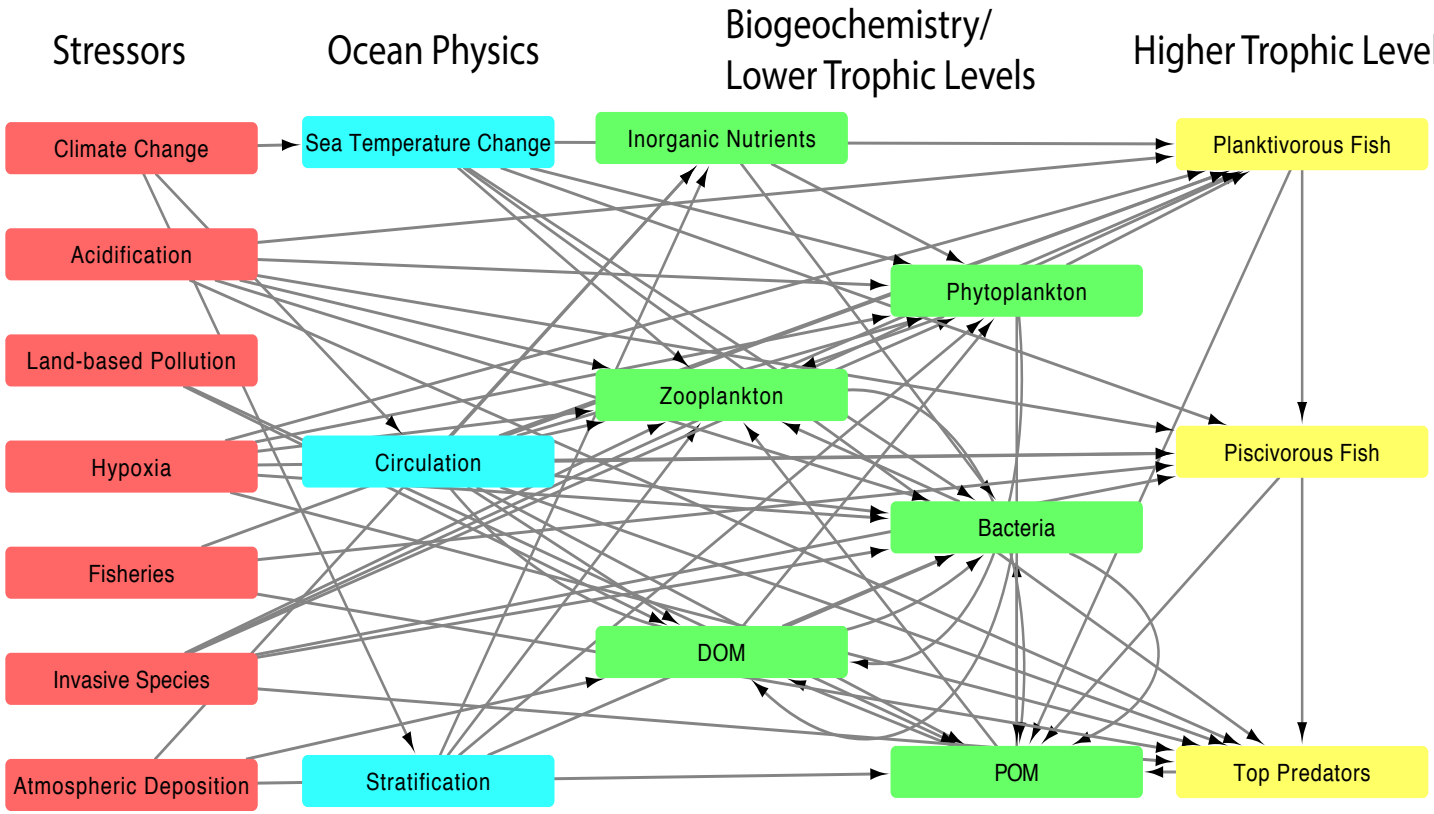
- We hypothesize that **assessment of biodiversity at different levels** is the key towards understanding the state of the entire ecosystem. The variety of genes, species, or functional traits in an ecosystem has an impact on the functioning of that ecosystem and, in turn, the services that the ecosystem provides to humanity.

- Smart, and targeted (tailored for the purpose) observations and models that resolve **biodiversity at each ecosystem level** and across these levels would pose a groundbreaking approach that would form the optimum framework today for the assessment of the marine ecosystem as a whole.

CHALLENGES	OUR APPROACH
1: Develop observational and modelling frameworks that will allow an integrated assessment of the interconnected ocean ecosystem-environment-human system	Fully integrated models of the Atmosphere-land-ocean.
2: Observing and modelling the biodiversity at all levels of the ecosystem as well as across different levels	Smart observations that provide knowledge on ecosystem traits, trade-off. Biodiversity resolving, evolutionary models of all levels of the marine ecosystem (microbes to fish).
3: Understanding resolving and disentangling the effects of stressors on the ecosystem	Beyond the state-of the art statistical tools, such as Bayesian models.

Stressors on ecosystems at the local system level

Human activities and natural variability result in a range of stressors that may interact and have greater impacts than expected, compounding direct and indirect effects on different levels of the ecosystems



New approaches: data and model output analyses

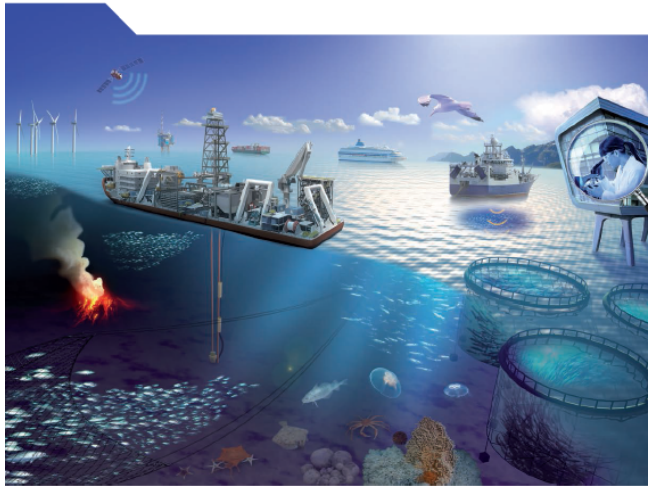
- State-of-the-art statistical approaches (e.g. ANNs, BNs, etc.) will be used to identify stressor-impact pathways. These approaches will help us quantify the intensity of the stressor (independent variable, e.g. physical) - state (response, i.e. dependent variable) interactions in the ecosystem.
- By this way, they will help us discern emerging causal relationships in the ecosystem so that we can focus our attention to explore the ecosystem responses linked to the cumulative impacts of different combinations of multiple stressors (frontal processes, atmospheric input, riverine flow, fisheries and climate) that govern the ecosystem.

Impact

Use of complex models in support of marine policy, management or operations

Ocean Economy

The Ocean Economy in 2030



OECD

Organization for Economic Co-operation and Development

Figure 1.1. **The concept of the ocean economy**

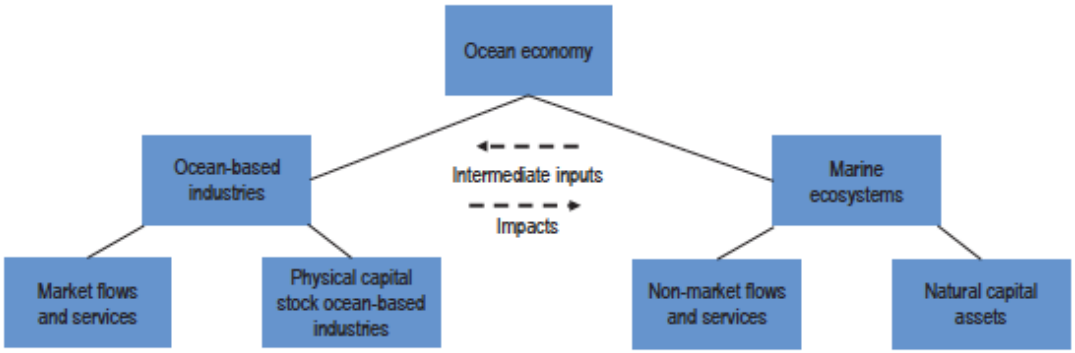


Table 1.1. **Established and emerging ocean-based industries**

Established	Emerging
Capture fisheries	Marine aquaculture
Seafood processing	Deep- and ultra-deep water oil and gas
Shipping	Offshore wind energy
Ports	Ocean renewable energy
Shipbuilding and repair	Marine and seabed mining
Offshore oil and gas (shallow water)	Maritime safety and surveillance
Marine manufacturing and construction	Marine biotechnology
Maritime and coastal tourism	High-tech marine products and services
Marine business services	Others
Marine R&D and education	
Dredging	

Ocean Economy

"The long-term potential for innovation, employment creation and economic growth offered by these sectors is impressive."

Table 1.2. **Overview of estimates of industry-specific growth rates in value added and employment between 2010 and 2030**

Industry	Compound annual growth rate for GVA between 2010 and 2030	Total change in GVA between 2010 and 2030	Total change in employment between 2010 and 2030
Industrial marine aquaculture	5.69%	303%	152%
Industrial capture fisheries	4.10%	223%	94%
Fish processing	6.26%	337%	206%
Maritime and coastal tourism	3.51%	199%	122%
Offshore oil and gas	1.17%	126%	126%
Offshore wind	24.52%	8 037%	1 257%
Port activities	4.58%	245%	245%
Shipbuilding and repair	2.93%	178%	124%
Maritime equipment	2.93%	178%	124%
Shipping	1.80%	143%	130%
Average of the total ocean-based industries	3.45%	197%	130%
Global economy between 2010 and 2030	3.64%	204%	120%[1]

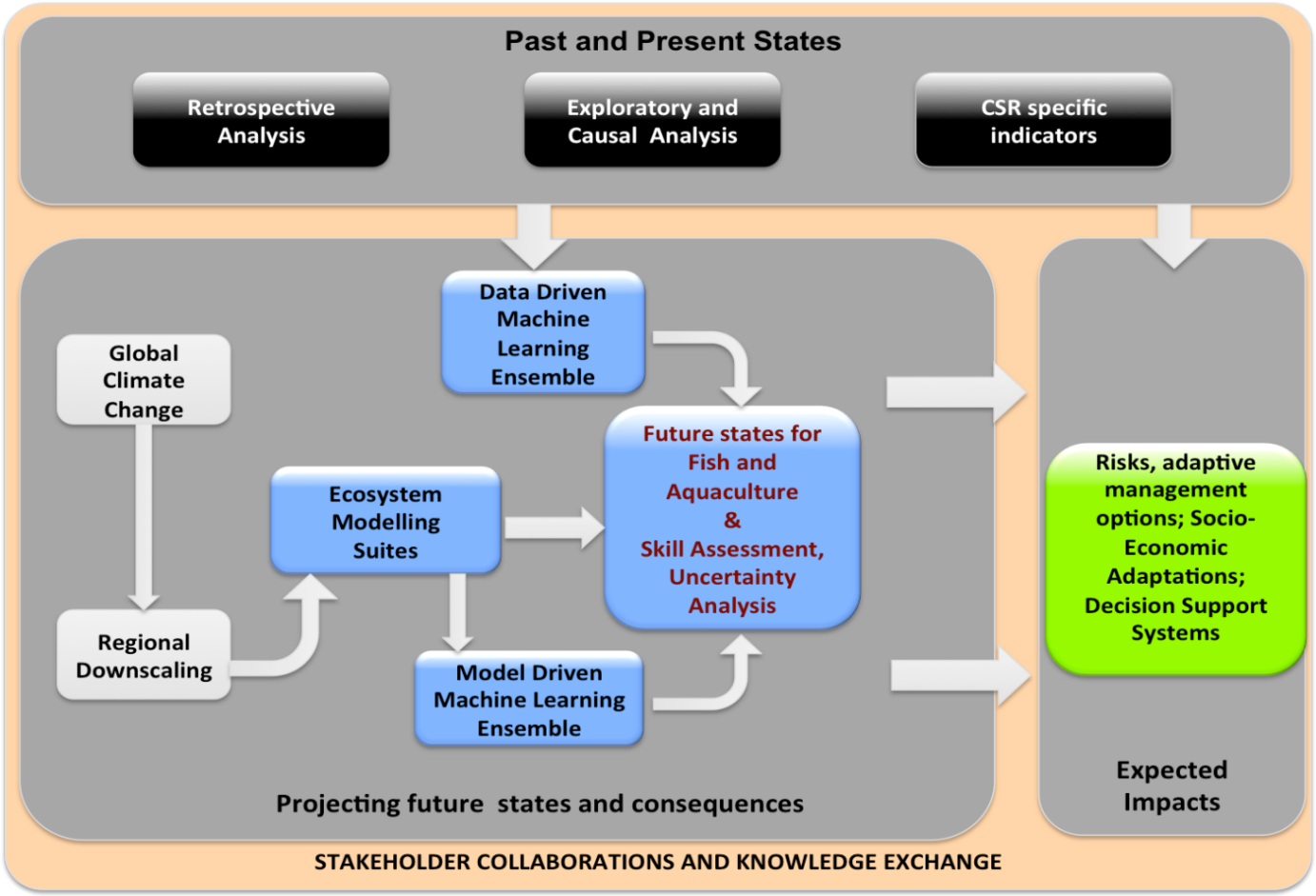
1. Based on projections of the global workforce, extrapolated with the UN medium fertility rate.

Source: Authors' calculations based on OECD STAN, UNIDO INDSTAT, UNSD; Lloyd's Register (2014; 2013); World Bank (2013); IEA (2014); FAO (2015).

Circular, Climate Resilient Economy

- Circular, climate-resilient economy **in sync with the natural environment**, thereby contributing to achieving smart, sustainable and inclusive growth.
- Enhancing understanding and supporting the development and **use of nature-based solutions**, green infrastructure and ecosystem-based approaches to climate change adaptation and mitigation, while enhancing natural capital.
- Providing robust assessments on the impacts of climate change on vulnerable areas/hot-spots such as oceans and polar regions and associated planetary feedbacks, as well as developing solutions for adaptation and sustainable development.

New holistic approaches



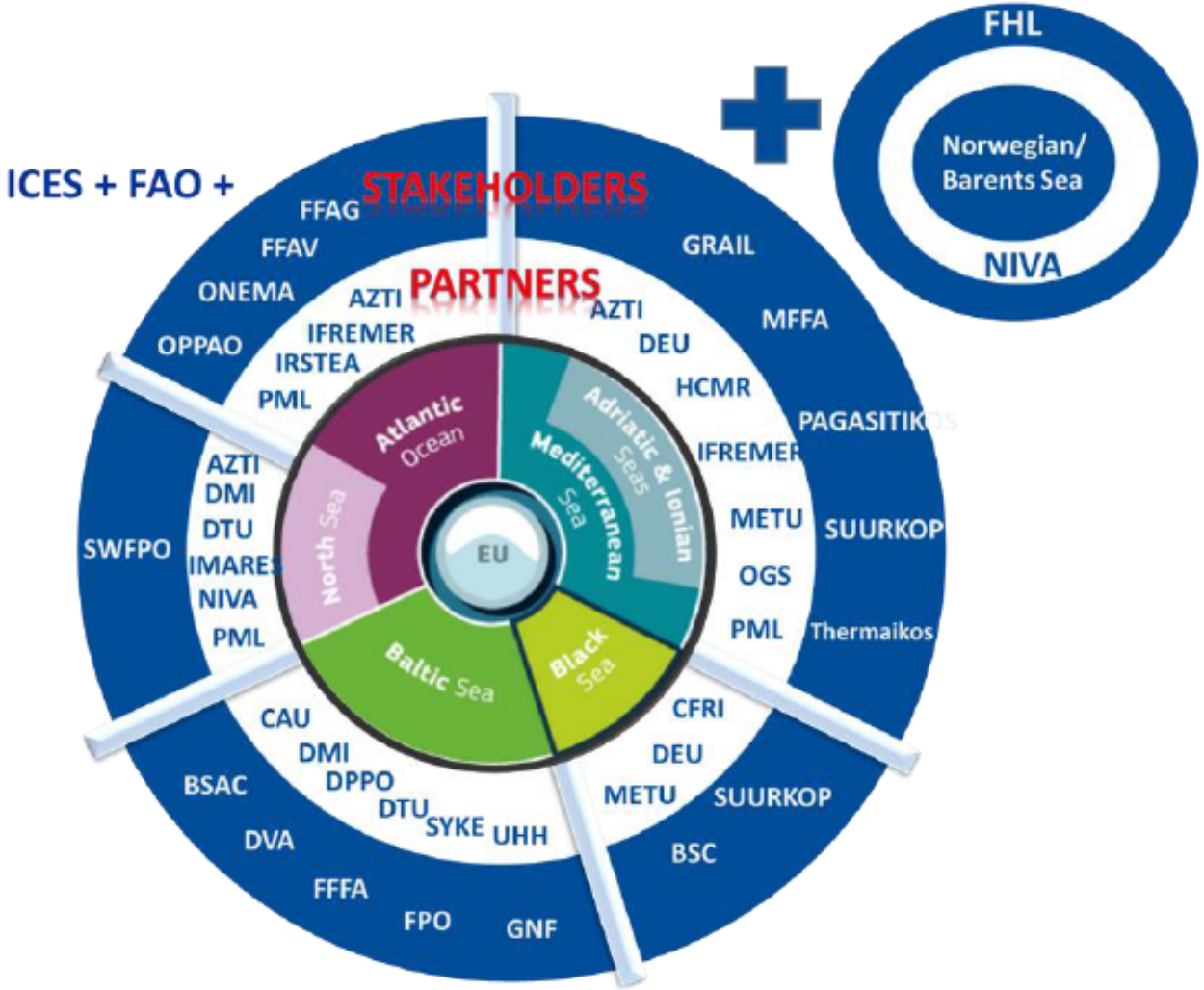
*The **SEAFACTS'** two complementary holistic approaches to generating knowledge base for risk assessment and model prediction and decision support framework*

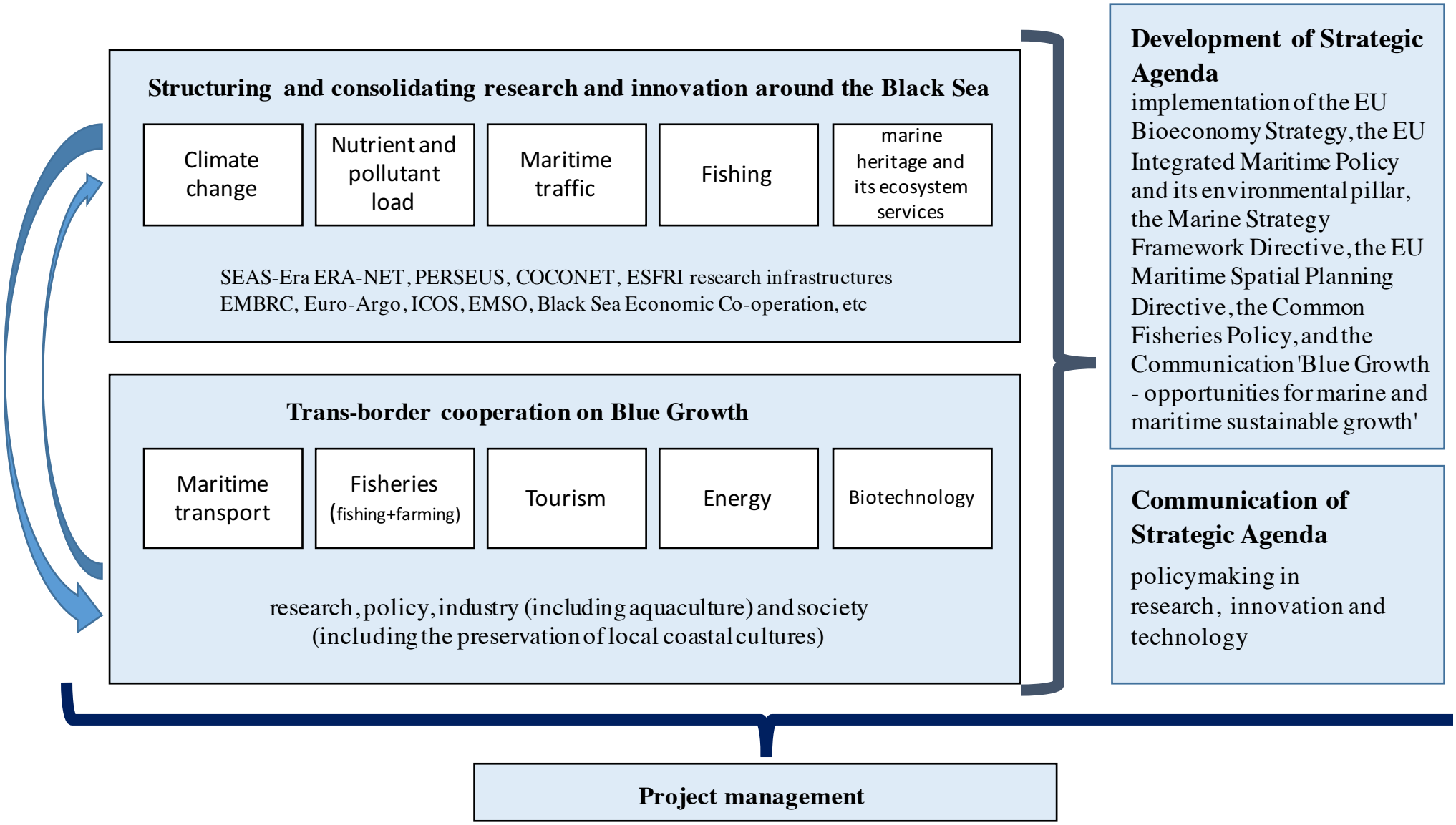
Dissemination and exploitation of results

Impact of the scientific products will be achieved through the implementation knowledge by:

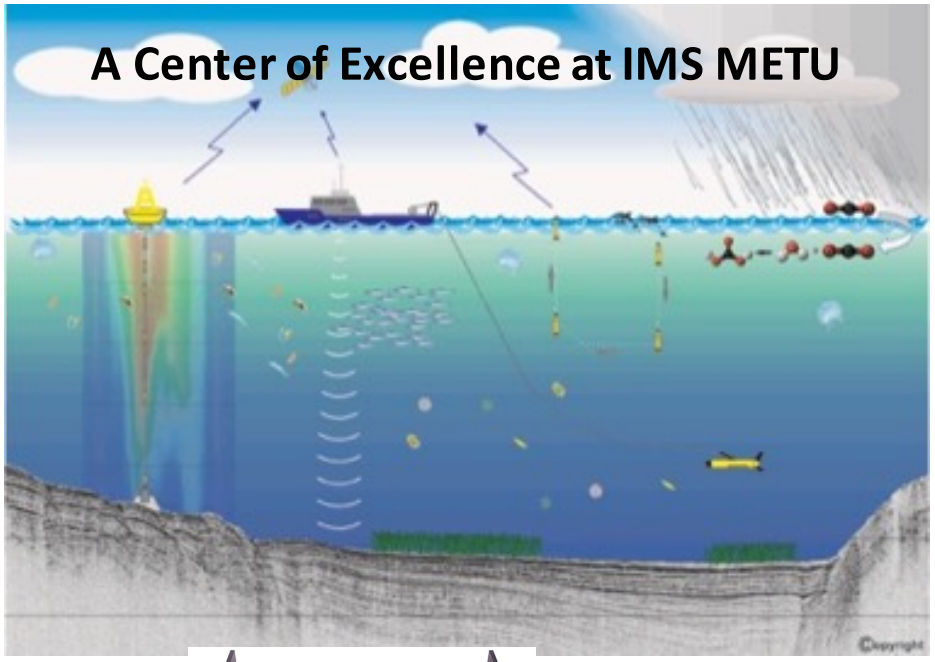
1) **raising awareness of issues that are currently not in the focus of international advice giving bodies,**
2) **implementing the application of new knowledge in existing international advice giving bodies,**
3) **making new knowledge and model tools available to interested stakeholders (Fig) and the general public,**
4) **intellectual development: training of the next generation of researchers.**

European level




Structuring and consolidating research and innovation around the Black Sea
Climate change
Nutrient and pollutant load
Maritime traffic
Fishing
marine heritage and its ecosystem services
SEAS-Era ERA-NET, PERSEUS, COCONET, ESFRI research infrastructures
EMBRC, Euro-Argo, ICOS, EMSO, Black Sea Economic Co-operation, etc
Trans-border cooperation on Blue Growth
Maritime transport
Fisheries (fishing+farming)
Tourism
Energy
Biotechnology
research, policy, industry (including aquaculture) and society
(including the preservation of local coastal cultures)
Development of Strategic Agenda
implementation of the EU Bioeconomy Strategy, the EU Integrated Maritime Policy and its environmental pillar, the Marine Strategy Framework Directive, the EU Maritime Spatial Planning Directive, the Common Fisheries Policy, and the Communication 'Blue Growth - opportunities for marine and maritime sustainable growth'
Communication of Strategic Agenda
policymaking in research, innovation and technology
Project management

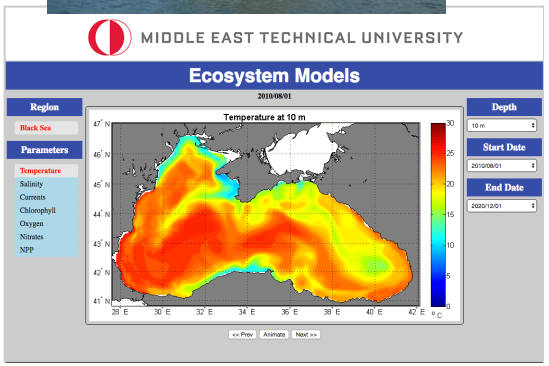
Strong regional expertise in the Southern Black Sea (marine science institutes, universities, fisheries institutes)

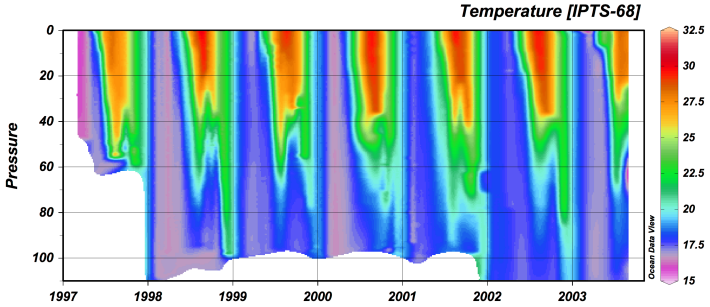


Scanfish

Time Series

RV Sürat





Specific partnership actions that bring together all stakeholders in the field such as a Technology Platform can be an effective way.

Non-EU Black Sea countries should be well informed and included as part of the initiative otherwise plans and achievements be partial and regional.

Regional approach for the Black Sea towards partnership

Connecting knowledge to provide real services and that address citizen's needs

EUROPEAN TALENT POOL

Process-based field experiments

Instrument development

Operational Modelling and Forecasts

Long term/real time observations

Integration of disciplines

INNOVATIVE RESEARCH SPACES

Platform 1
Earth, Marine Biogeochemistry, Ecology and Biodiversity Observations, Science and Applications

Platform 2
Integrated, Atmosphere-Watershed-Marine Modelling and Predictions

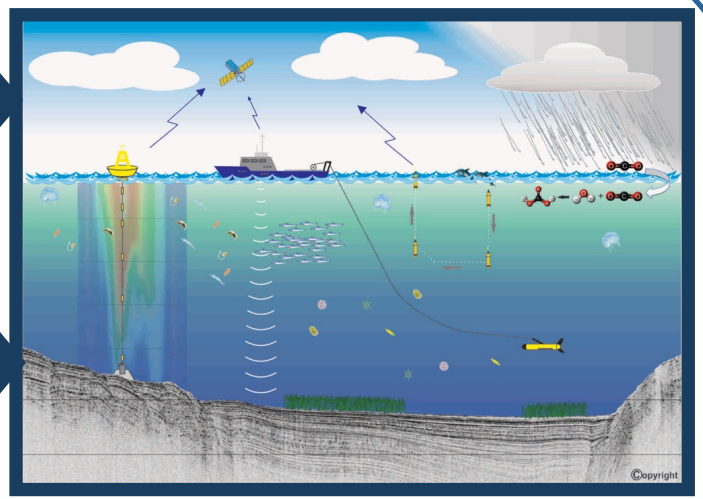
Platform 3
Socio-economics, environment and human health, resource management and services

Interactive integration with end-users

Decision support units

Strategies for economic growth

→Enable the innovative multi-sectoral growth built on newly developed capabilities



→ Sufficient competence to engage nations and regions
→ Holding a competitive position in the global value chains

National, regional and EU level strategies
BLUE GROWTH, CFP, WFD, MSFD, MSP, IMS, TUDAS

New Regional Vision for the Black Sea

Development of products with high economic (along the whole value chains) and by guaranteeing environmental benefits