Adaptation to climate change in the coastal zone and operational forecasting

Antonio Navarra, CMCC

NOSTRA Workshop: Tourism and Cultural Heritage

Otranto and Lecce, 10-12 April 2013

About us

Mission

To investigate and model Earth climate system and its interactions with society to provide reliable, rigorous, and timely scientific results to stimulate sustainable growth, protect the environment and to develop science-driven adaptation and mitigation policies in a changing climate.

The Euro-Mediterranean Center on Climate Change is a **non-profit research Institution** established in 2005, with the financial support of the Italian Ministry of Education, University and Research.

CMCC manages and promotes scientific and applied activities in the field of **international climate change research**.

The CMCC **network structure** has offices in Lecce, Bologna, Capua, Milan, Sassari, Venice, Viterbo, and Benevento. It involves and links private and public institutions jointly investigating multidisciplinary topics related to climate science research.
6 consortium members, which constitute the following General Meeting of Shareholders:

- Istituto Nazionale di Geofisica e Vulcanologia (INGV)
- Università del Salento
- Università degli Studi del Sannio
- Centro Italiano di Ricerche Aerospaziali (CIRA S.c.p.a.)
- Università Ca' Foscari Venezia
- Fondazione Eni Enrico Mattei (FEEM)

The research network is distributed among 6 research divisions that share different knowledge and skills in the field of climate science. The administrative premises are in Lecce.

1. **Simulating the climate system** - Numerical Applications and Scenarios **ANS Division**
2. **Translating climate change in economic values** - Climate Impacts and Policies An Economic Assessment **CIP Division**
3. **Focusing on agriculture and ecosystems** - Impacts on Agriculture, Forest, and Natural Ecosystems **IAFENT Division**
4. **Climate risks for soil and coasts** - Impacts on Soil and Coast **ISC Division**
5. **Supercomputing for climate change research** - Scientific Computing and Operations **SCO Division**
6. **Delivering climate science outputs to stakeholders** - Climate Services **SERC Division**

CMCC has submitted so far more than **180 research proposals** under the EU Framework Program or other public funding agencies. At present, its research projects portfolio is composed by

79 national, European and International funded projects

such as: 2 funded projects in FP6 (6th Research Framework Program of the European Union), 24 funded projects in FP7 and 53 funded projects under other EU and international research grants. **CMCC has coordinated about half of these research projects.**

CMCC collaborates with experienced scientists, economists, and technicians, which work together in order to **provide full analyses of climate impacts on various systems** such as agriculture, ecosystems, coasts, water resources, health, and economics. CMCC also **supports policymakers** in setting and assessing costs, mitigation, and adaptation policies.

www.cmcc.it

facebook
CMCC-Climate

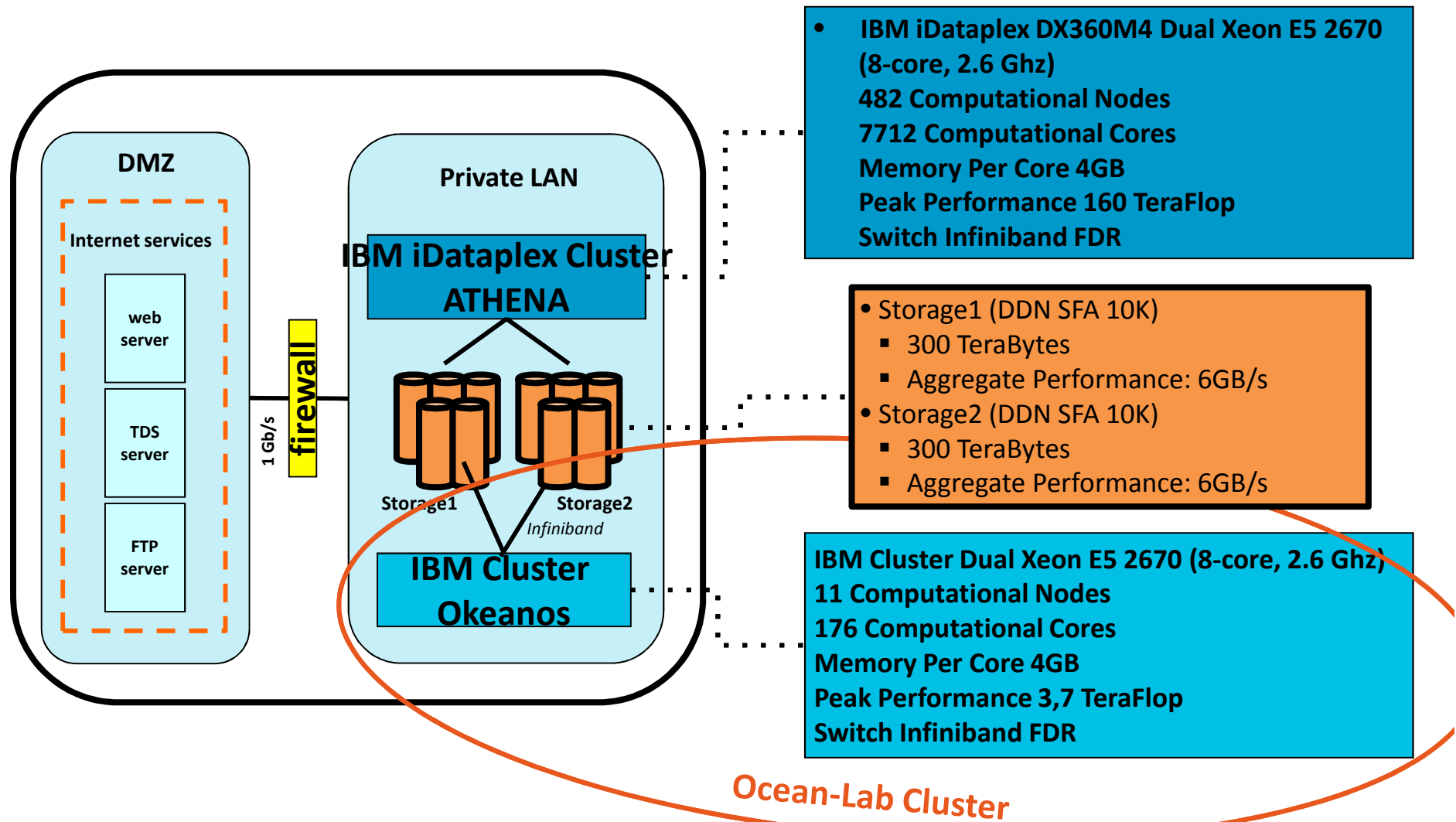**twitter**
@cmccclimate

ClimateScience&Policy

OceanLab – The Mission

- Founded: April 2012
- Part of the "Numerical Applications and Scenarios" Division of CMCC

Mission

- Development and production of short term ocean forecasts;
- Coastal modeling and forecasting;
- Development of applications and services in the field of maritime safety (i.e. sea situational awareness, search and rescue, ship routing, oil spill modeling);
- Estimate climate impacts assessment in the coastal area.
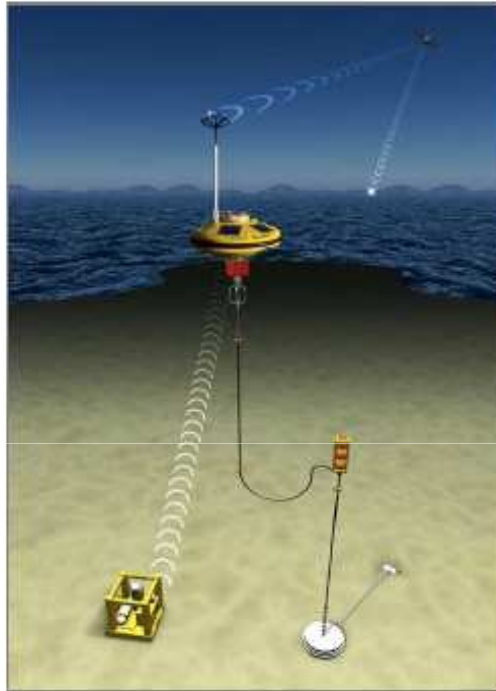
CMCC and OceanLab supercomputing facilities

DMZ

Internet services

web server

TDS server

FTP server

1 Gb/s

firewall

Private LAN

IBM iDataplex Cluster ATHENA

Storage1   Storage2
Infiniband

IBM Cluster Okeanos

- IBM iDataplex DX360M4 Dual Xeon E5 2670 (8-core, 2.6 Ghz)
  482 Computational Nodes
  7712 Computational Cores
  Memory Per Core 4GB
  Peak Performance 160 TeraFlop
  Switch Infiniband FDR

- Storage1 (DDN SFA 10K)
  - 300 TeraBytes
  - Aggregate Performance: 6GB/s
- Storage2 (DDN SFA 10K)
  - 300 TeraBytes
  - Aggregate Performance: 6GB/s

IBM Cluster Dual Xeon E5 2670 (8-core, 2.6 Ghz)
11 Computational Nodes
176 Computational Cores
Memory Per Core 4GB
Peak Performance 3,7 TeraFlop
Switch Infiniband FDR

Ocean-Lab Cluster

TESSA: Target Users and Needs

USERS \ DEMANDS	Ship routing	Early warning for extreme sea conditions	Offshore operations safety	Search and rescue	Safety entry into port	Pollutant dispersion warning	Marine health assessment	Sea conditions forecasting in coastal areas	Support to army and police operations in sea
Maritime transport operators	O	O	O		O			O	
Yachters	O	O					O	O	
Seaside toursists	O	O					O		
Offshore industries		O	O			O	O	O	
Coast Guards	O	O	O	O	O	O	O	O	O
Port Authorities		O		O	O				
Environmental Protection Agencies		O				O	O	O	
Environmental consulting companies		O	O					O	
Authorities for defence and safety		O		O	O	O			O
Ministries	O	O	O	O	O	O	O	O	O

Observations in the Ionian Sea

Ionian existing mooring together with the seabed platform (depth:1 670m). Sensors to be added:
2 CTs
2 dissolved oxygen
2 chlorophyll-a

2 new ARGO floats

BATOS
- P
- T, U
- DD, FF
- SST
- manned (visibility, clouds, sea state ...)

BAROS
- P
- T

- P

IONIO

Observations in the Ionian Sea
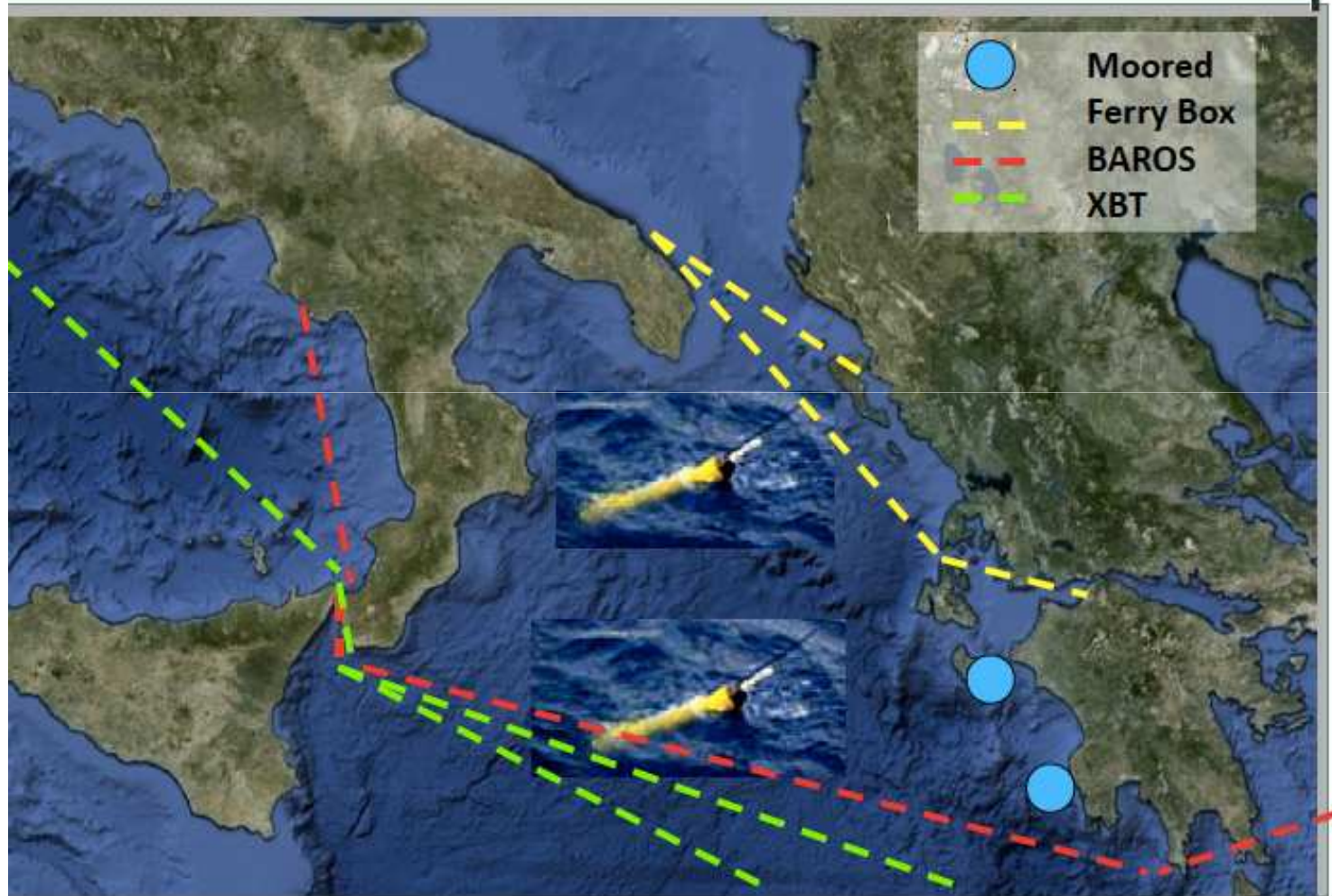
Research and operational activities:
Operational Modelling and Climate Impacts
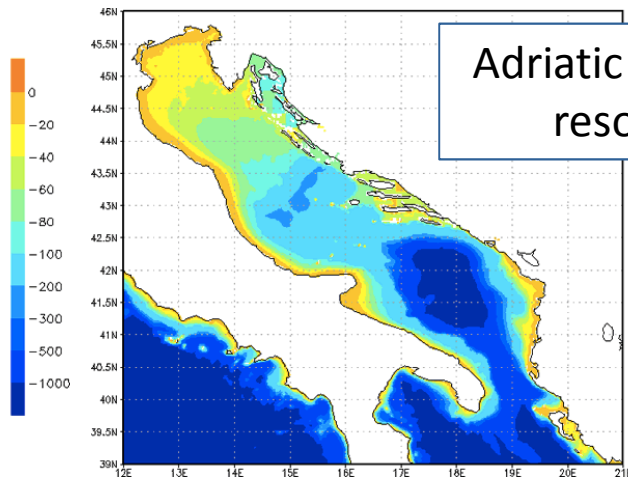
Adriatic Forecasting System (2km resolution) (Operational)

Coastal Puglia-Calabria Model under development (SANI area)

New Adriatic -Ionian Model under development
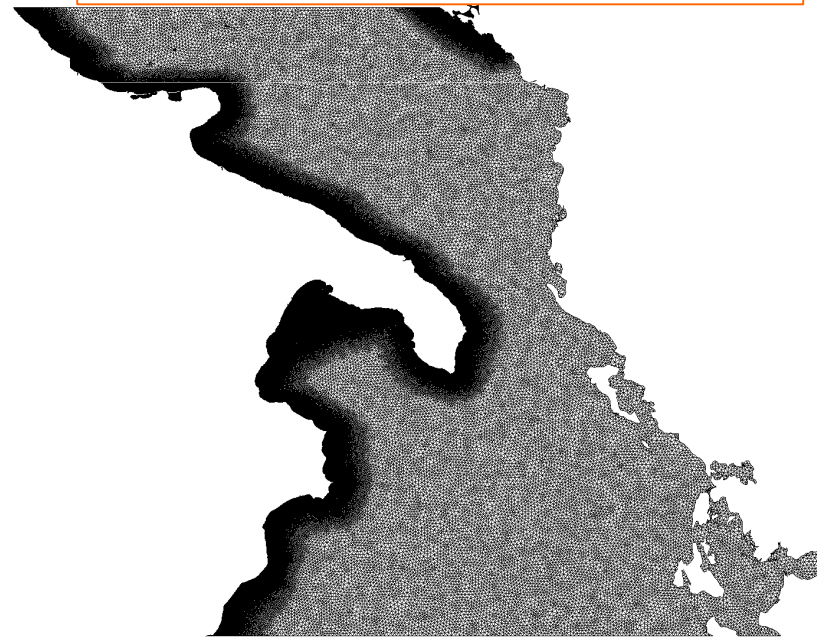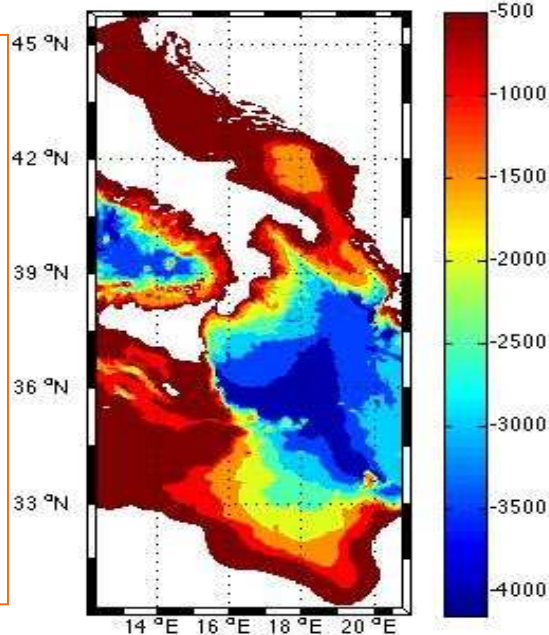
(2km resolution)

(100-300 m grid resolution at the coasts)

Research and operational activities:
Operational Modelling and Climate Impacts

Brindisi Harbor
and South Brindisi Coast
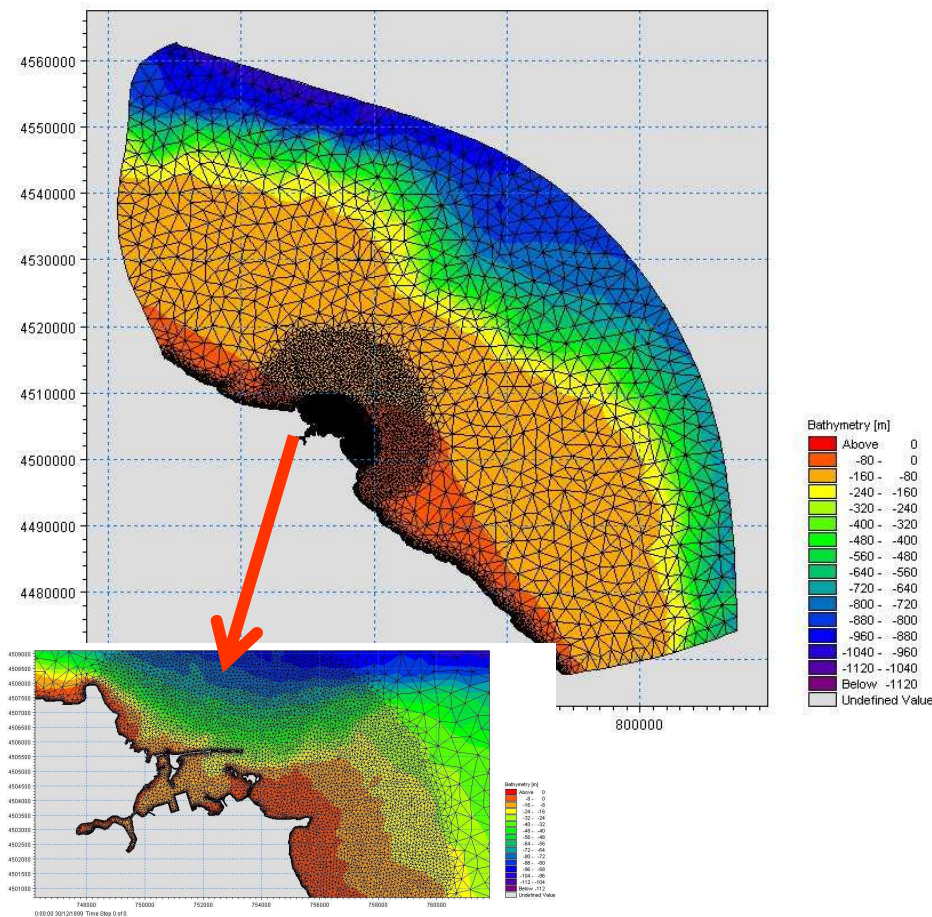
Taranto Harbor
and Porto Cesareo Coast
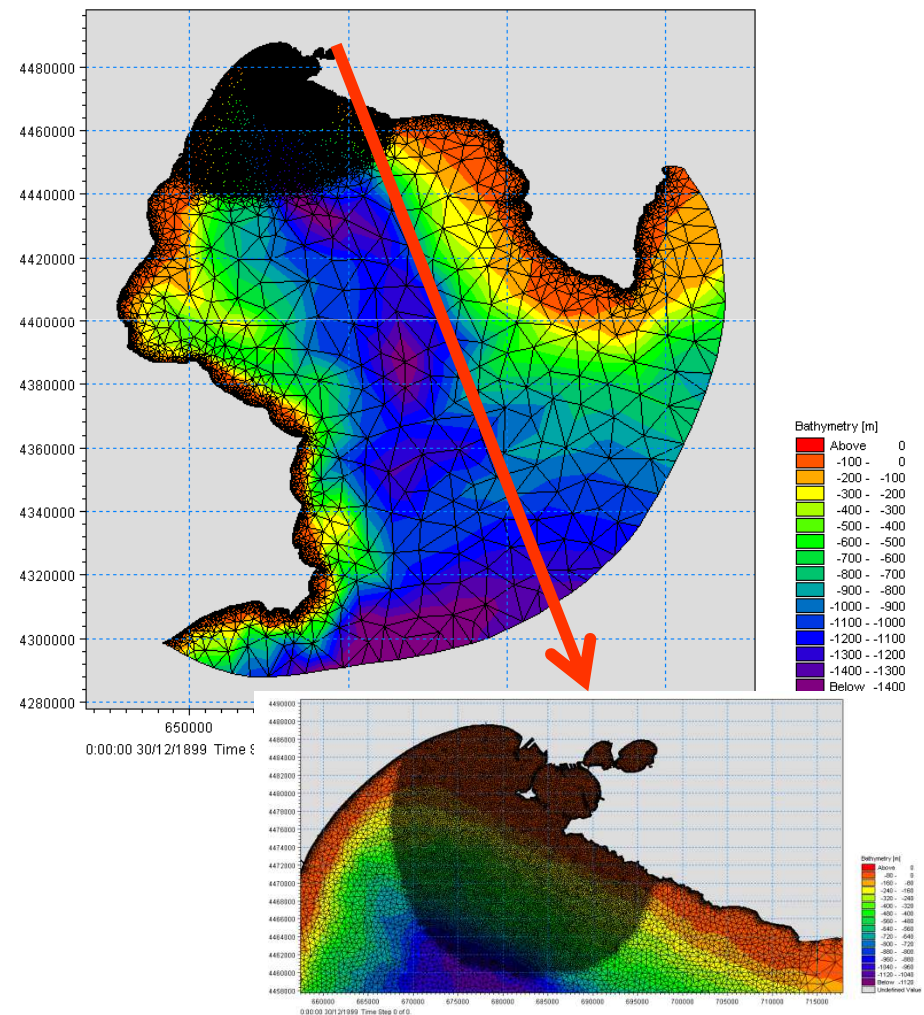
Research and operational activities: Services

Situational Sea Awareness
Data warehouse

- Sea-Conditions
- Oil spill and hazard mapping
- Ship routing
- Search and rescue
- Early warning
- Environ. quality
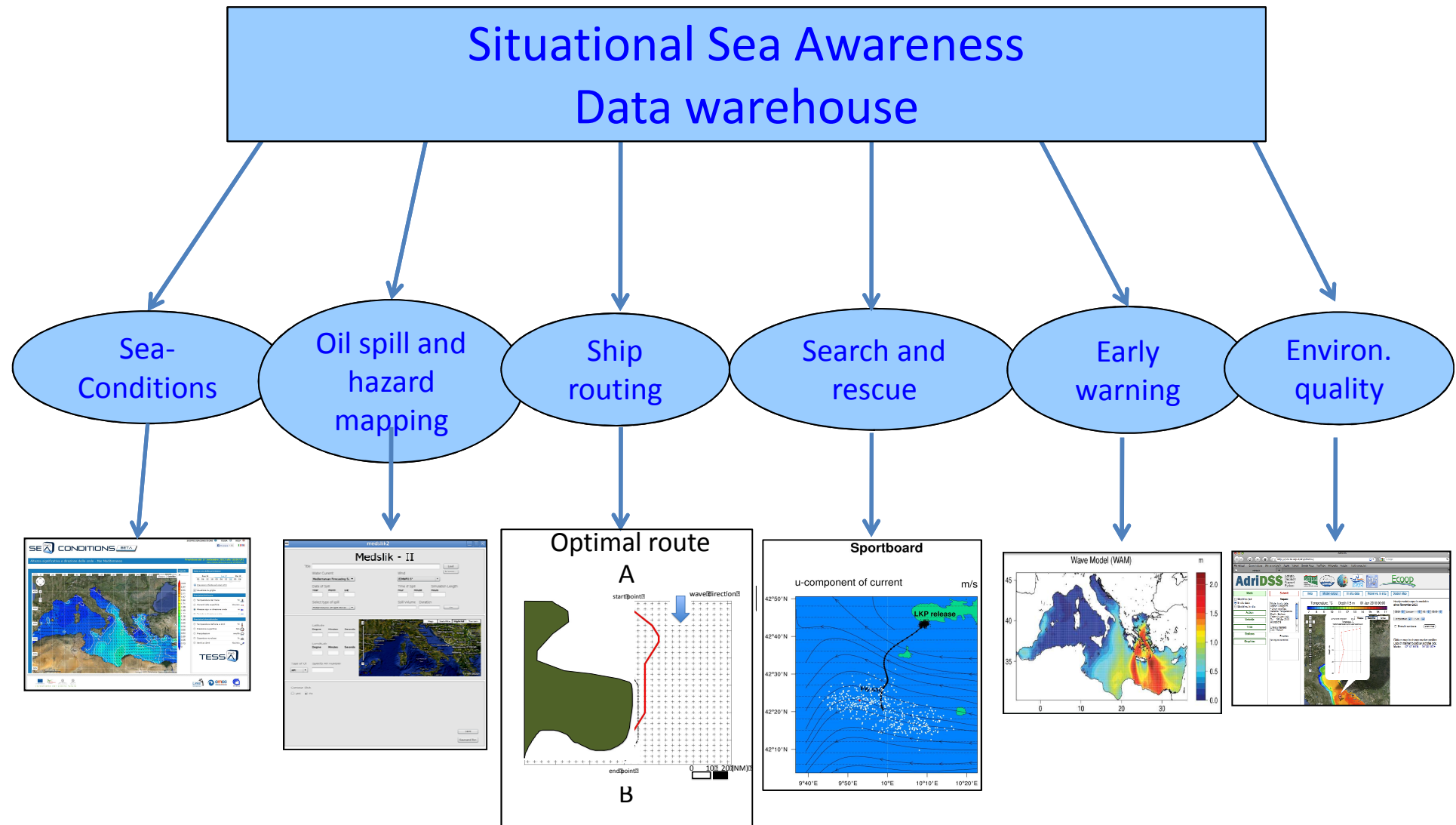
SeaConditions: the web portal
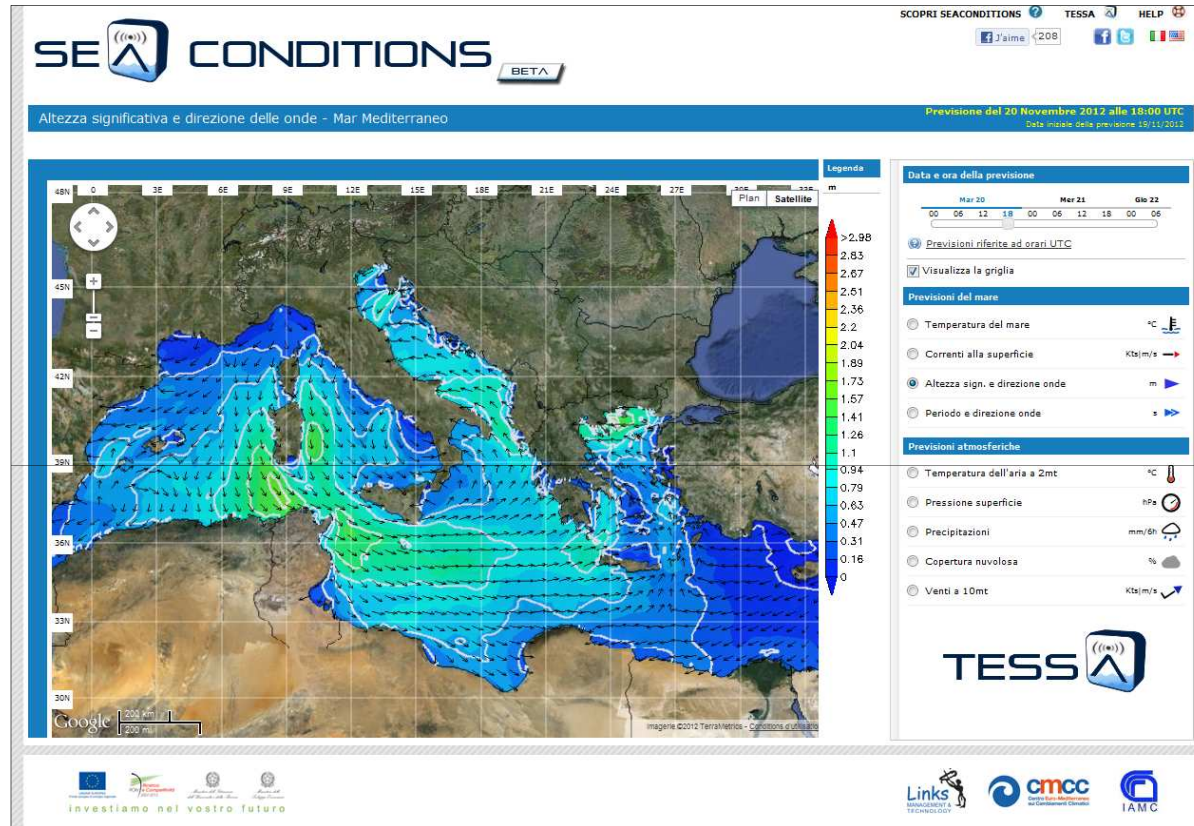
Presented at Genoa, *Salone Nautico 2012*

Free online access to weather and ocean forecasts for the whole Mediterranean Sea

www.sea-conditions.com

Ship routing – computing safe and efficient routes
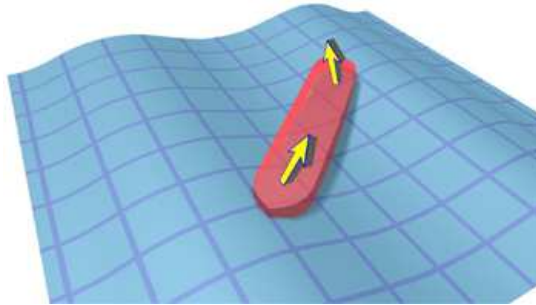
Some combination of sea-state and ship parameters may lead to **dangerous phenomena** (here shown: surf-riding and broaching-to)
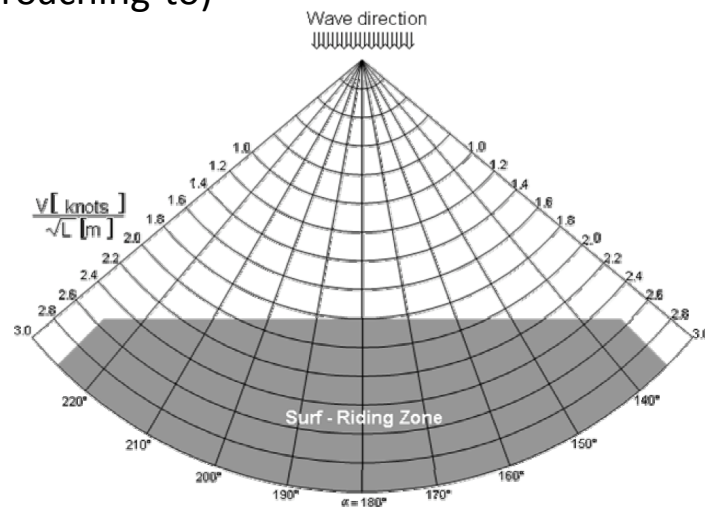
The algorithm computes the route (red line) which is at the same time safe and short (compare to geometrically shortest route which is black).
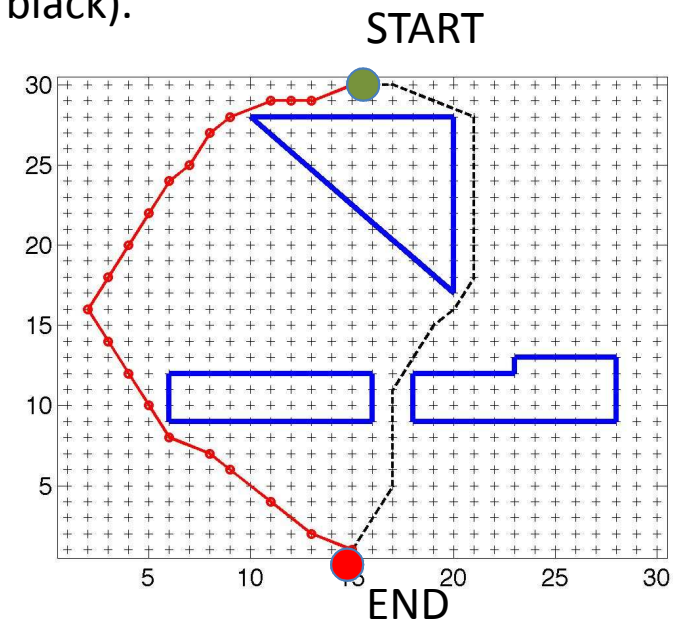
Here: wave moving southwards (peak height: 10ft, vel: 30kn). Ship parameters: (length=100m, vel.=18kn)

G.Mannarini, G.Coppini, P.Oddo, N.Pinardi "A Prototype of Ship Routing Decision Support System for an Operational Oceanographic Service"- TransNav (2013)

DSS early warning for extreme events

Total Water Level Forecasting System (under development)
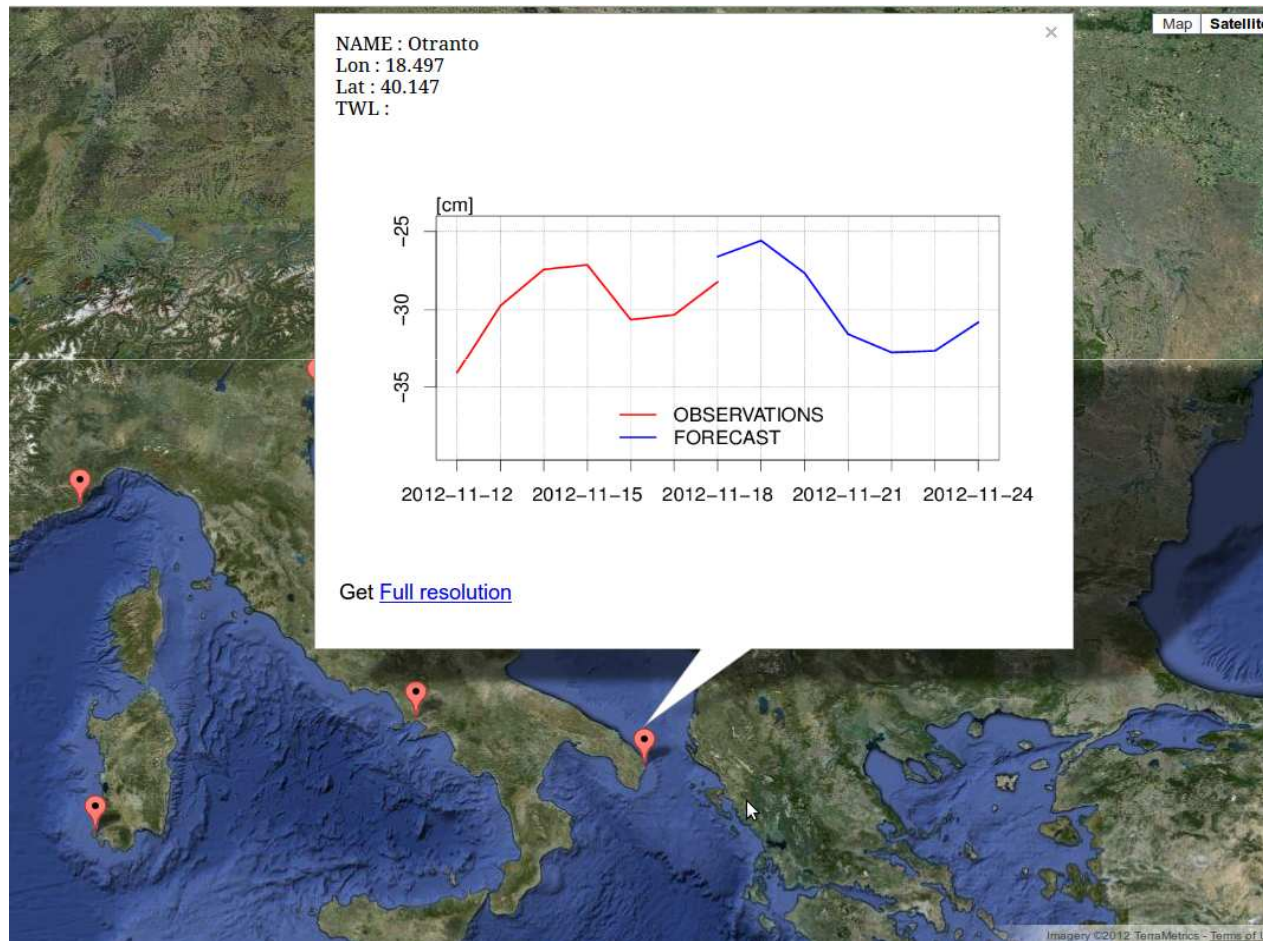
Target Coastal Areas:
ISPRA tide-gauge stations

Time window: 14 days

Frequency: daily mean

System update: daily

Observations: J – 7

Forecast: J + 7

Skill: < 5 cm OBS – FOR

Analysis of climate change – Developed in ADRICOSM STAR and now in ORIENTGATE projects

Set up:

- **Parent model**

SG-X (atmosphere: ECHAM4 @ 1.125°, ocean: OPA @ 2°)

- **Child model**

EBU-POM (atmosphere: EBU@ 0.25°, ocean: POM @ 0.25°)

- **Climate scenario**

IPCC A1B
"Present" time: 2003-2008
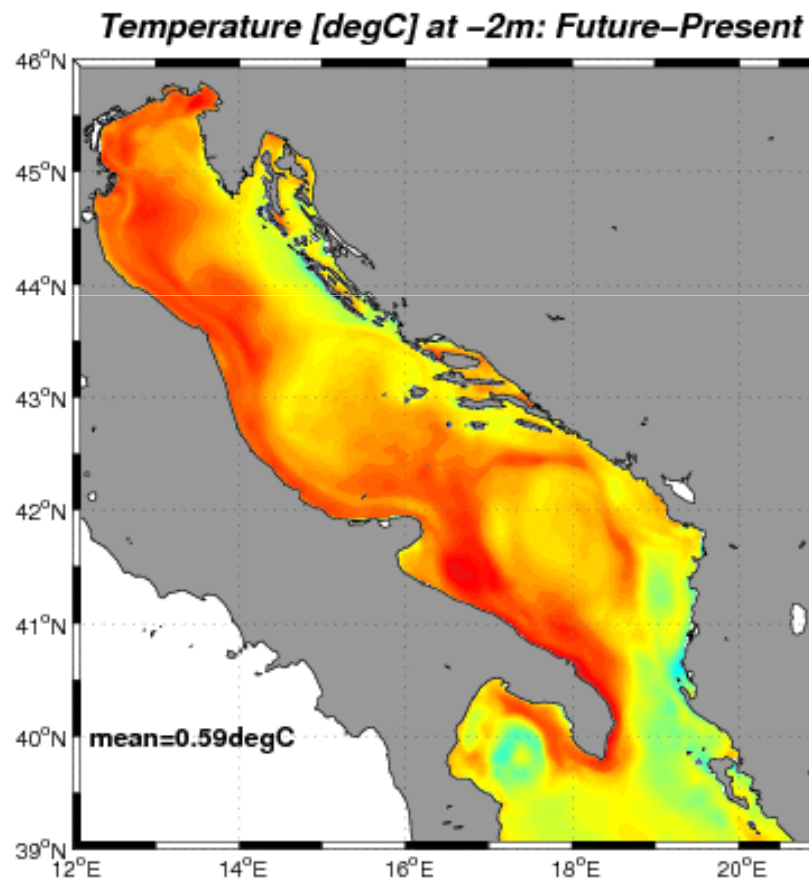"Future" time: 2025-2030

Domain EBU-POM

light blue – Eta / dark blue – POM
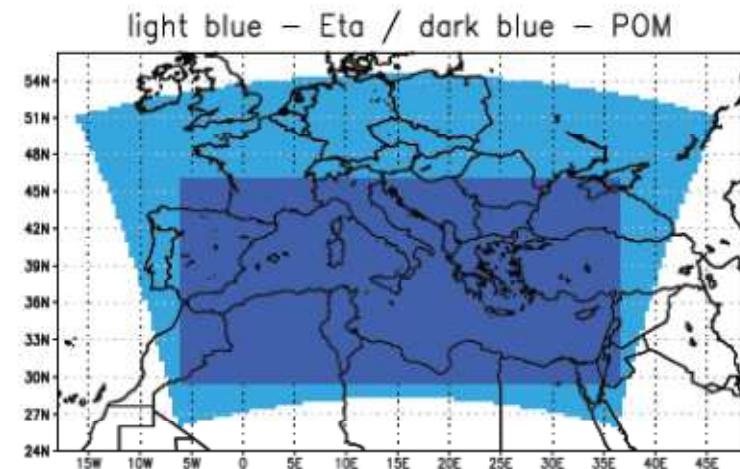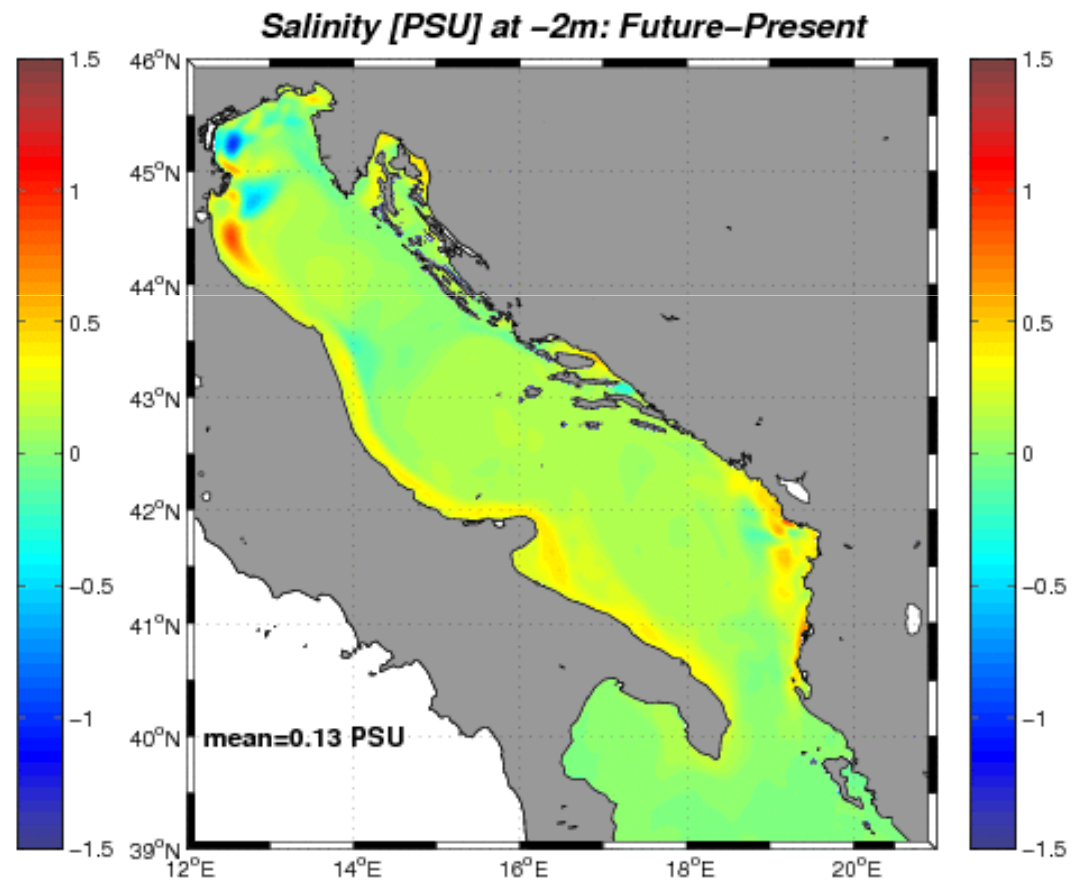
IPCC Climate Change Scenarios
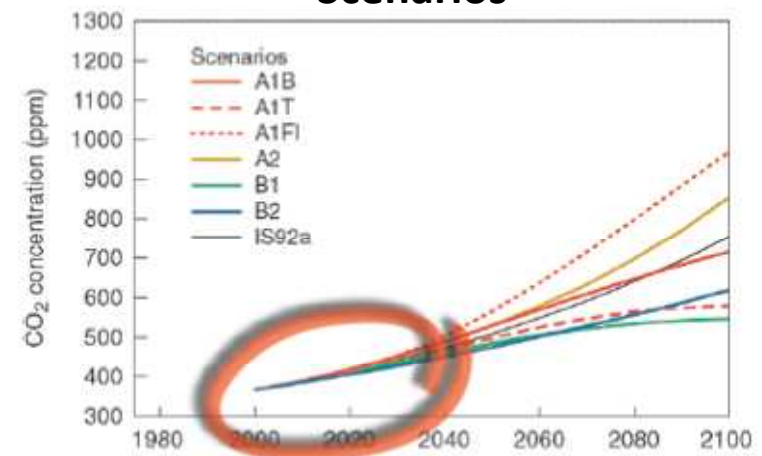
Results: (Spring) Temperature and Salinity difference
Present: average over 2003-2008 and Future average over 2025-2030
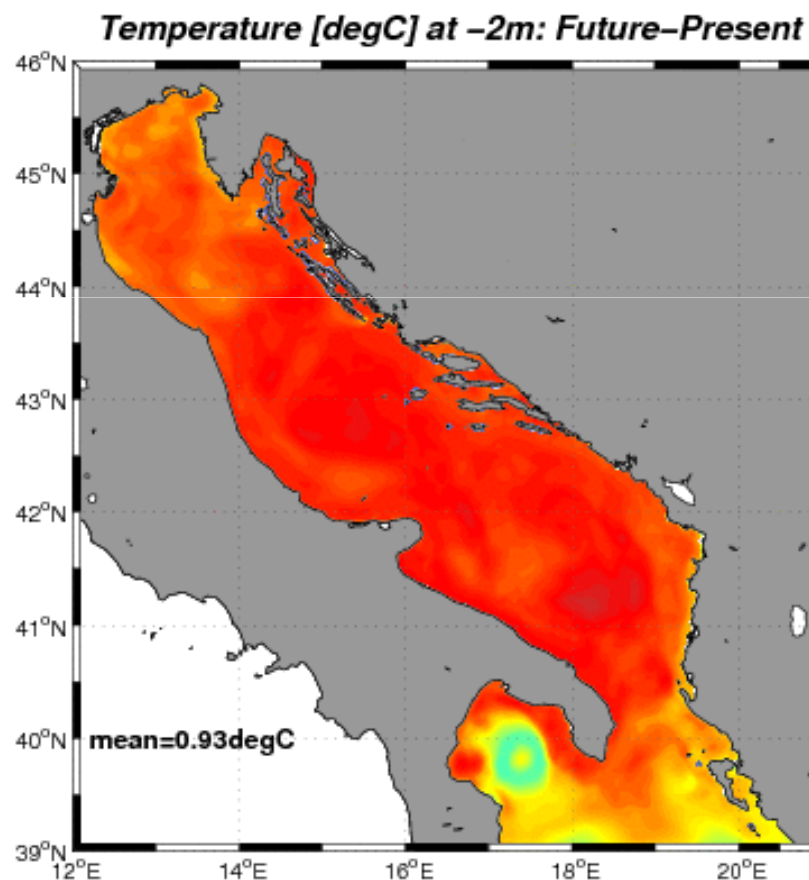
T Diff
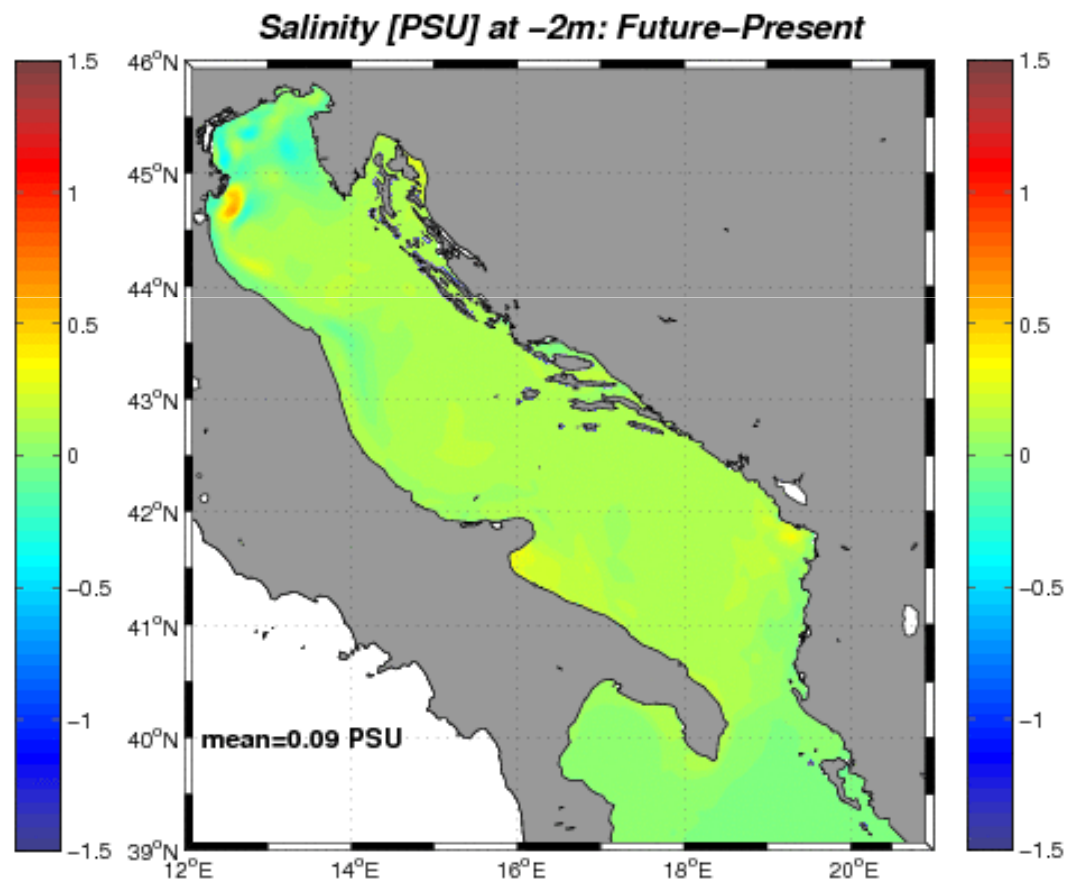## (Future-Present)

S Diff
(Future-Present)

Temperature [degC] at −2m: Future−Present

mean=0.59degC

Salinity [PSU] at −2m: Future−Present

mean=0.13 PSU

Results: (Summer) Temperature and Salinity difference

T Diff
(Future-Present)

S Diff
(Future-Present)

Temperature [degC] at −2m: Future−Present

Salinity [PSU] at −2m: Future−Present

Results: (Autumn) Temperature and Salinity difference
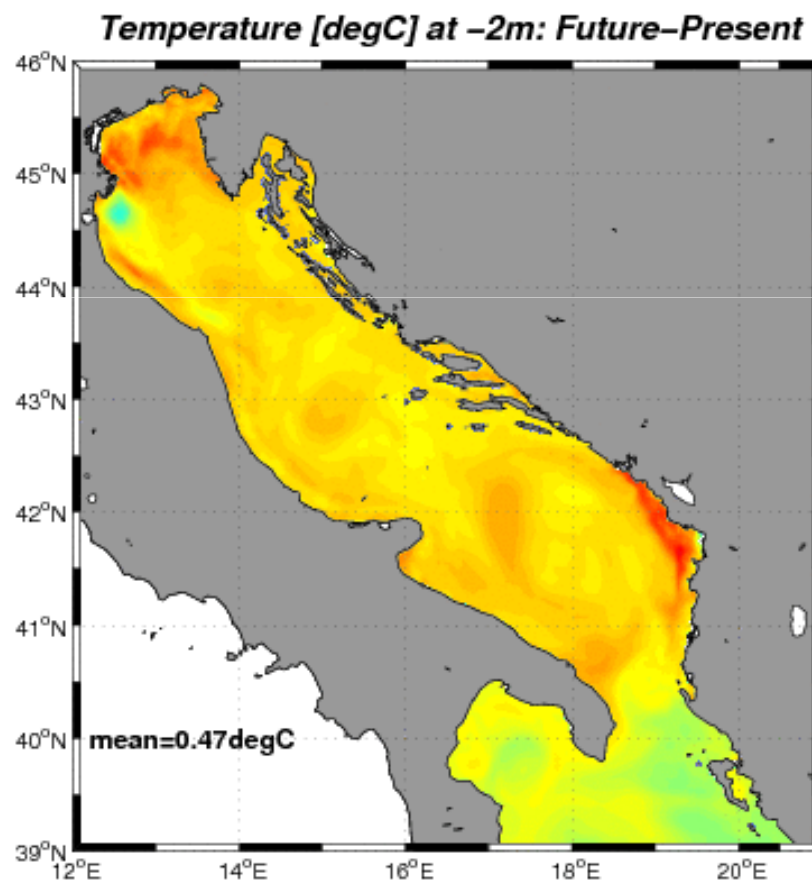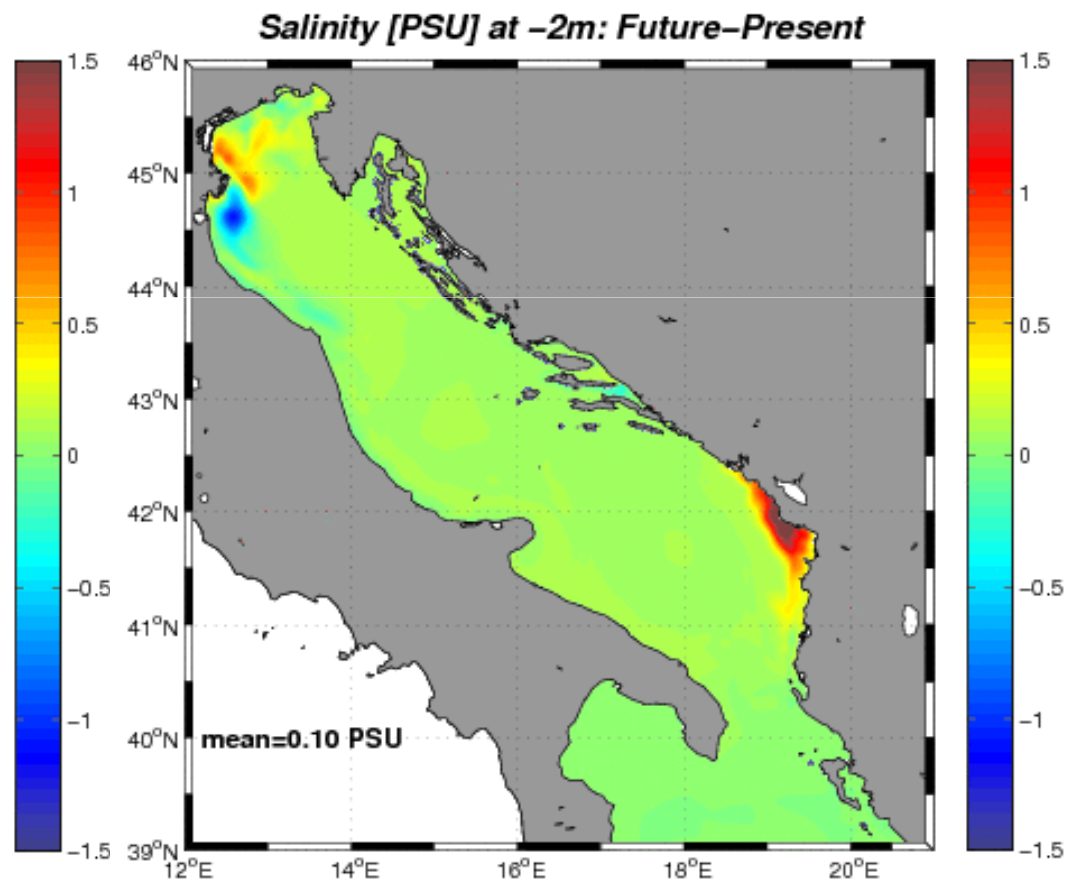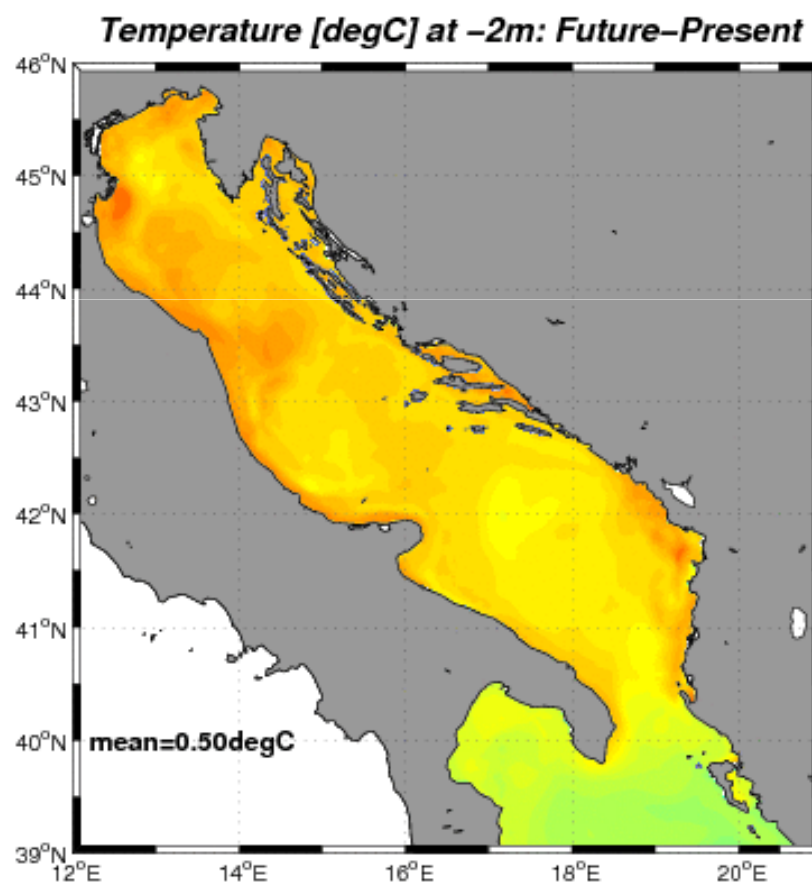
T Diff
(Future-Present)
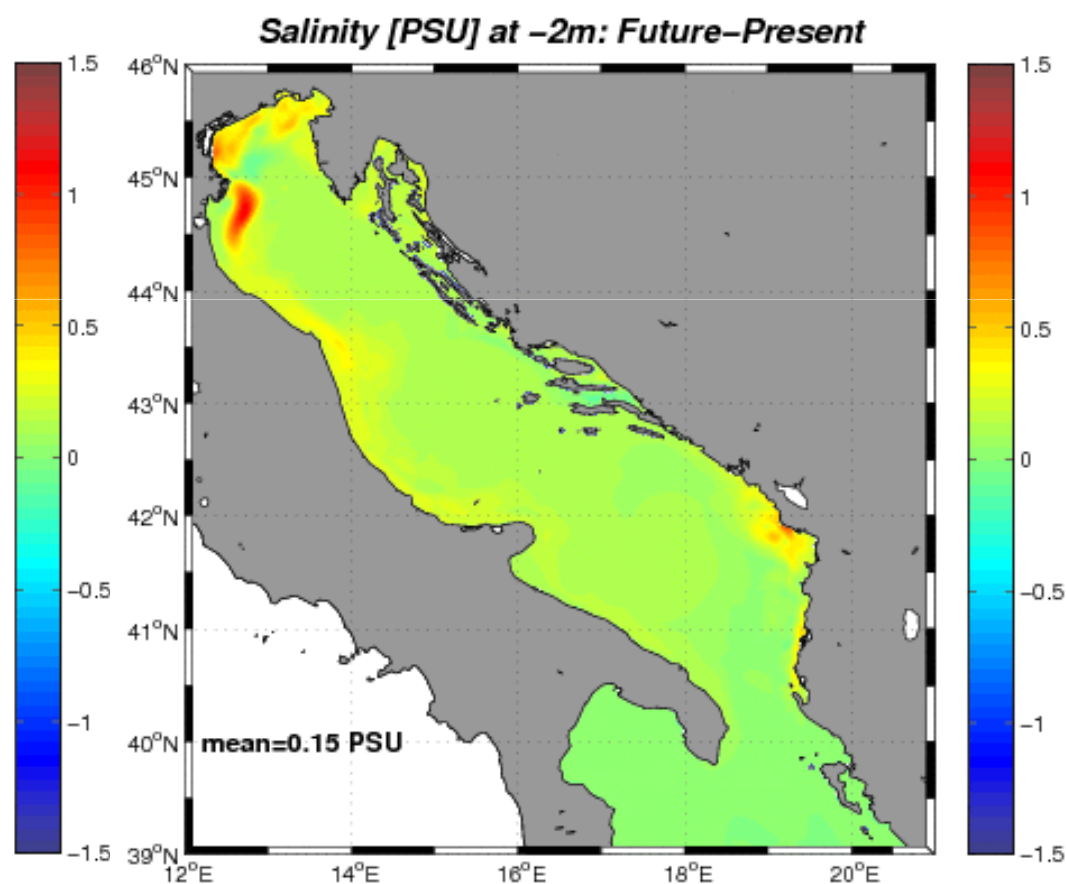
S Diff
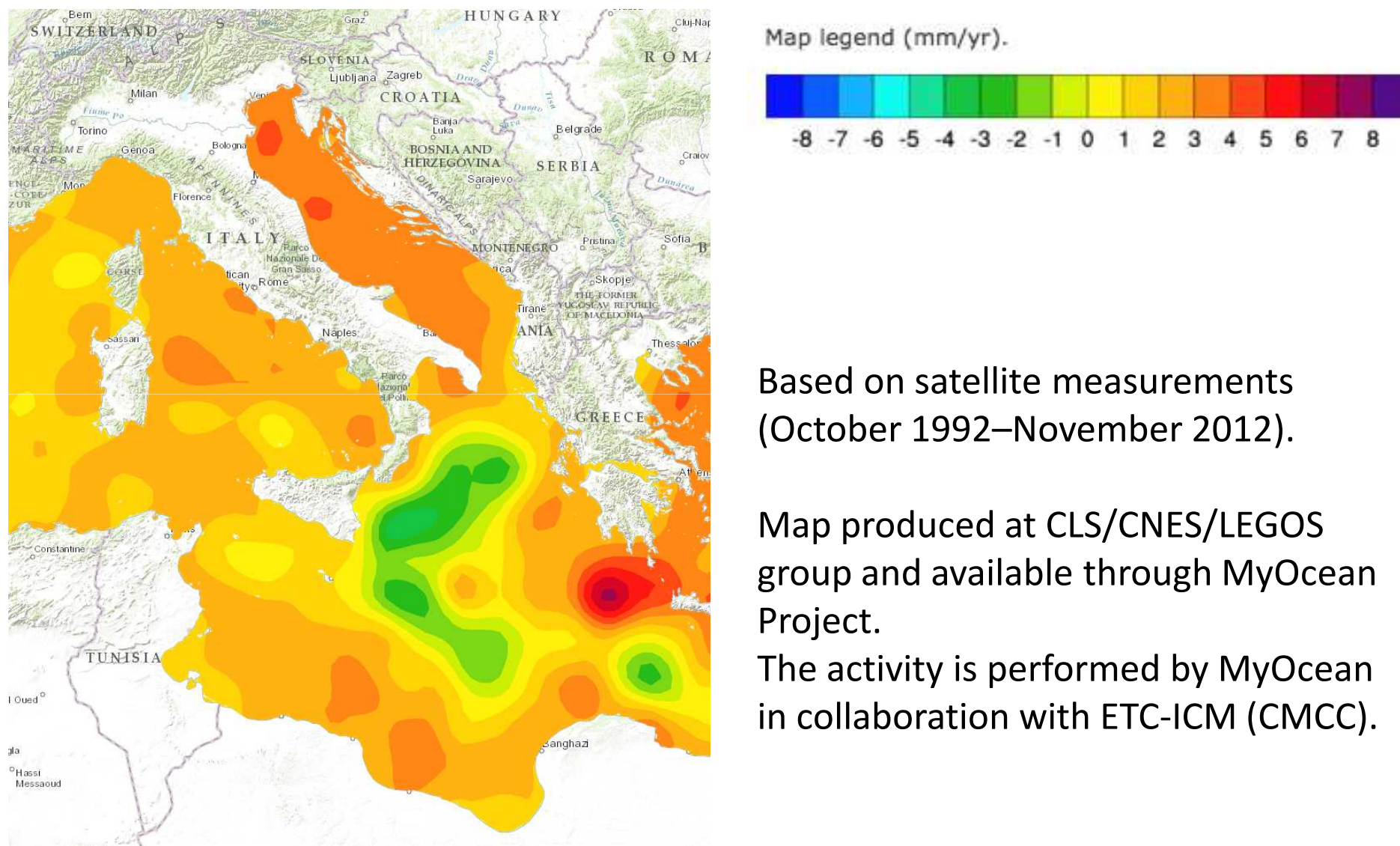### (Future-Present)

Results: (Winter) Temperature and Salinity difference

**T Diff
(Future-Present)**

**S Diff
(Future-Present)**

Trends in sea level during last 20 years

Map legend (mm/yr).

-8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 8

Based on satellite measurements (October 1992–November 2012).

Map produced at CLS/CNES/LEGOS group and available through MyOcean Project.
The activity is performed by MyOcean in collaboration with ETC-ICM (CMCC).

TESSA: Training Course "OTTIMA"
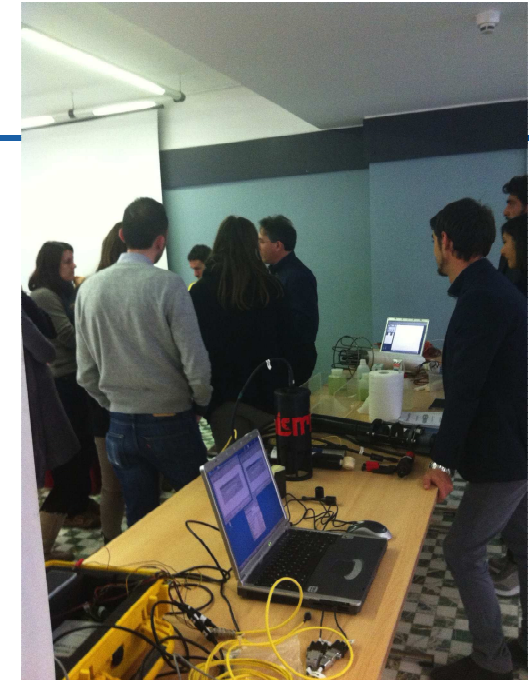
- 2 Courses per year (5 months each) in Naples and Lecce:
    - *Information Technology for Maritime Safety*
    - *Operational Oceanography and Safety*
- stages at companies and research institutions (5 months)
- oceanographic field campaign (1 week)
- final workshops (December 2013 and 2014)

www.cmcc.it/ottima/

Ocean-Lab Funding Projects

Sviluppo di TEcnologie per la 'Situational Sea Awareness' http://tessa.linksmt.it/

IONian Integrated marine Observatory
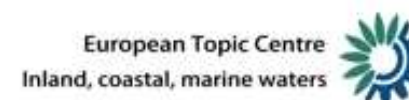http://www.ionioproject.eu/

ADRICOSM-STAR II (ADRICOSM INTEGRATED RIVER BASIN AND COASTAL ZONE MANAGEMENT SYSTEM: Montenegro coaSTal ARea and Bojana river catchment-II) Starting in June 2013 (3 years)

Training course on Oceanografia operativa e Tecnologie Informatiche per la sicurezza Marittima) http://www.cmcc.it/ottima/

European Topic Centre on Inland, Coastal and Marine waters
http://icm.eionet.europa.eu/

MyOcean2: OCEAN MONITORING AND FORECASTING
www.myocean.eu

ORIENTGATE: a network for the integration of climate knowledge into policy and planning
http://orientgate.rec.org/

Future Developments

- Improve the monitoring and forecasting system for coastal zone for the following services:
  - Monitoring quality of marine environment;
  - Management of marine pollution;
  - Development hdro-meteo-oceanographic integrated modeling (lagoons, coastal area, waste water);
  - Monitoring and forecasting extreme events (i.e. flooding);
  - Monitoring erosion and develop scenarios;
  - Evaluate climate impacts;
  - Develop specific delivery systems for the service uptake by public administration and private sector;
- Develop services for development of leisure and tourism activities;
- Improve harbour modeling (Brindisi, Bari, Taranto) and services for maritime safety.

Thanks