INSTITUTE OF MARINE SCIENCES (Barcelona)

* It is the largest public marine R&D centre in Spain

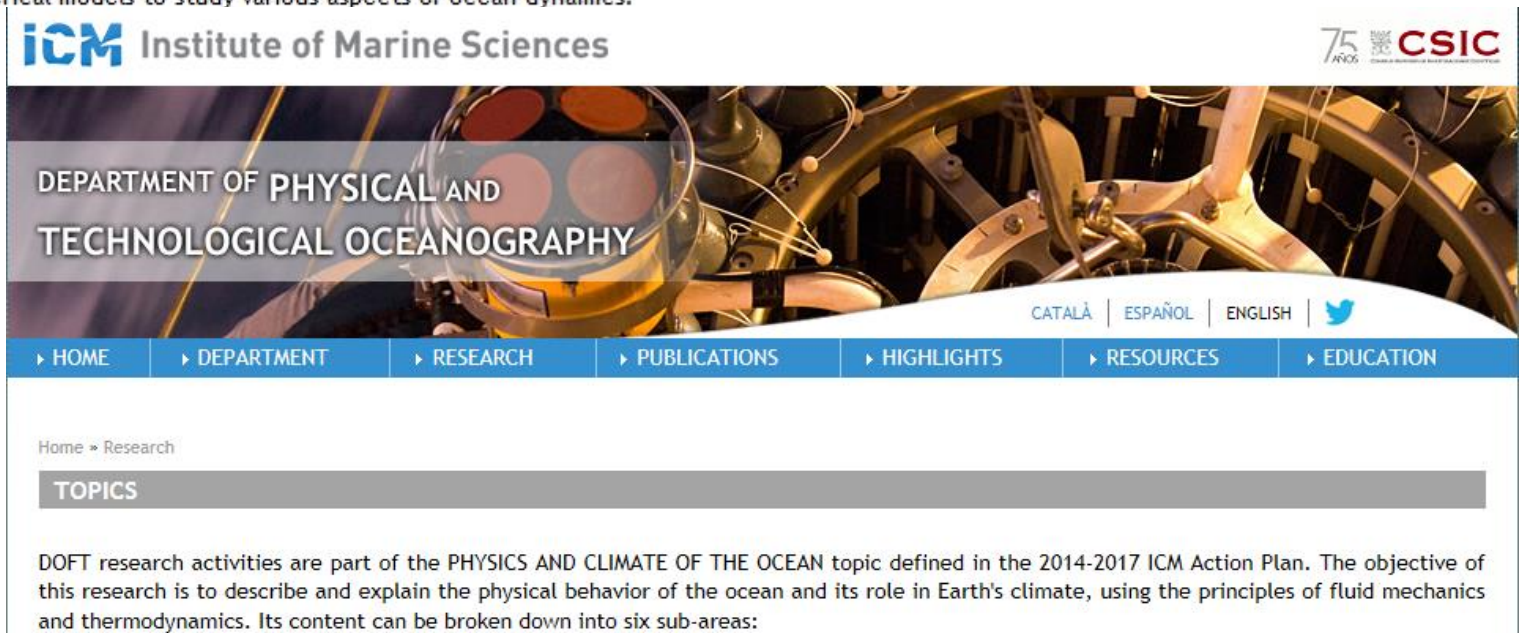
- 1951: Foundation as “Institute of Fisheries Research”
- 1987: Inclusion of Geology and Physics Departments. Name change to ICM
- 2001: New building/location
- Four departments:
  - Marine biology and oceanography
  - Renewable marine resources
  - Marine geosciences
  - Physical and technological oceanography
- Staff numbers: 300-350
  - Scientists: 80-120
  - PhD students: 75-120
  - Scientific support personnel: 75-100
- 40-50 Research Projects
- 20-30 Contracts with companies and Administration
- 250-300 research papers ISI per year

www.icm.csic.es

Physical and Technological Oceanography Department (DOFT)

http://www.icm.csic.es/oce/en

Physical and Technological Oceanography Department focuses on the description and explanation of the physical behavior of the ocean and its role in the climate of the Earth, using the principles of fluid mechanics and thermodynamics. The observation and analysis of water movement (waves and currents), the transfer of energy and momentum between the ocean and atmosphere, and the special properties of seawater, such as the propagation of electromagnetic energy, serve to improve the knowledge about the physical processes in the ocean, from the microstructure to global scale climatic phenomena. The Department is also working on new techniques for analysis of data obtained from space and oceanographic instrumentation design and development of advanced numerical models to study various aspects of ocean dynamics.



1. LARGE-SCALE OCEAN CIRCULATION

To understand the mechanisms that control ocean circulation at large scale, particularly the transfer of properties through the ocean-atmosphere interface, the thermocline, and the deep ocean, and its role from seasonal to inter-decadal time scales. Areas of study include ENSO, NAO, the equatorial and tropical Atlantic Ocean, oxygen minimum zones, boundary currents and upwelling systems, and dense water formation.

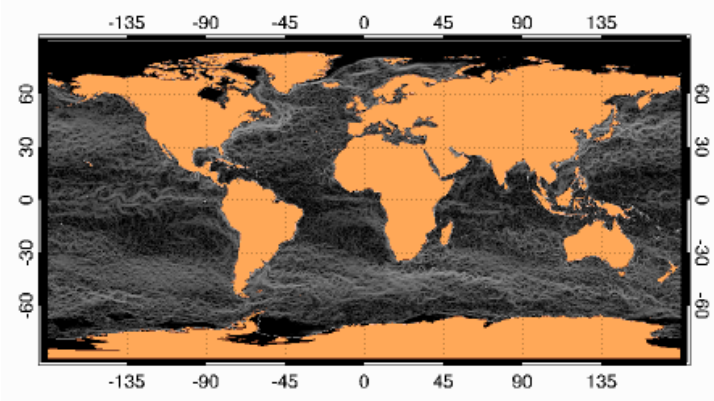
2. CLIMATE CHANGE

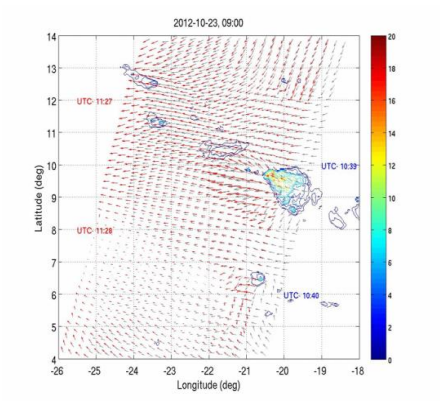
The analysis of time series from both observations and numerical simulations allows investigating past (glacial-interglacial oscillations) and future ocean changes and their potential impact on the Earth system. We are evaluating statistical changes in these time series and analyzing various processes that control the Earth's climate such as the buffering role of biogeochemical interactions and the influence of regional processes such as the Mediterranean outflow.

3. MESOSCALE AND SMALL-SCALE OCEAN PROCESSES

To understand the interactions between mesoscale structures, inertial-gravitational waves, and the distribution of nutrients, phytoplankton, and zooplankton. We use high-resolution non-hydrostatic models and ecological models. New analysis tools are being applied to the data from numerical simulations and fieldwork to characterize mesoscale horizontal mixing to help improve ocean tracer dispersion models, and to understand the interaction of physical and biological processes at small scale.

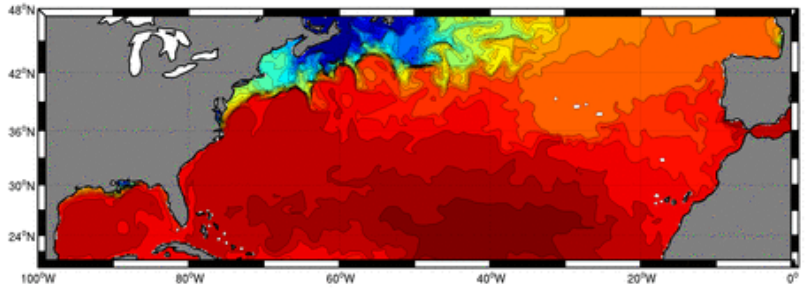
4. ADVANCED OCEANOGRAPHIC DATA PROCESSING METHODS





To obtain new and/or enhanced geophysical information from satellite and in-situ measurements for use in a wide variety of applications such as turbulence modeling and ocean-atmosphere interaction. Research activities include satellite data calibration, error measurement characterization, forward modeling, non-linear inversion of geophysical parameters, quality control, spatio-temporal averaging, mapping, and data fusion, with special focus on the European Space Agency SMOS satellite mission.

5. OCEAN MODELLING AND DATA ASSIMILATION



To design, adapt, and implement numerical simulations to analyze ocean processes at different scales, from large-scale interactions and climate evolution to mesoscale and small-scale phenomena, both in the open ocean and in coastal regions. To define and implement robust data assimilation approaches, with special interest in salinity maps from SMOS and other satellite-based ocean forcing products.

6. NEW TECHNOLOGIES FOR OCEANIC, COASTAL, AND SEA ICE OBSERVATIONS

To develop ad hoc autonomous platforms and sensors for specific oceanographic monitoring purposes. To improve and enhance current instrument designs for near-surface and small-scale observations. To develop polar instrumentation, devise novel satellite methods, design seamless methods to in-situ and satellite data combination, and use geophysical models for an improved understanding of the rapidly changing Arctic climate system.

The Barcelona Expert Center, today

Defined as **a cooperation agreement** among ICM, UPC and IEEC - a will of working together in subjects of common interest, with no specific funding.

Main goals:

- **Research and development in EO**, with special focus on microwave RS and more specifically on SMOS and follow-on missions.
- **Support to European Space Agency** through ESL contracts.
- Continuous generation and distribution of **high-level RS products**.
- **Geophysical exploitation** of dedicated RS data, with special interest in scientific applications.
- **Fostering the use of BEC RS data** among academia, enterprises and stakeholders.

Headquarters:

CSIC Institute of Marine Sciences, Barcelona

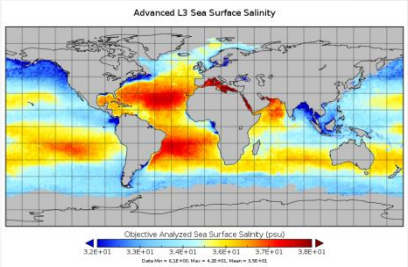
High-value assets:

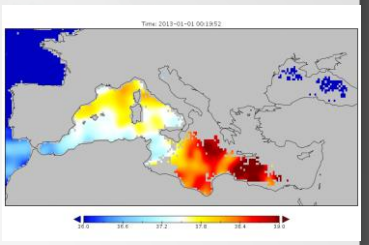
- A dynamic, highly motivated, **inter-disciplinary team**, covering all processing levels.
- Close **support and scientific exchange** with ICM and UPC scientists.
- Own **computation cluster** (20 processors, 160 cores, high speed connectivity).
- Good **internationalization**.

The Barcelona Expert Center, products: ocean

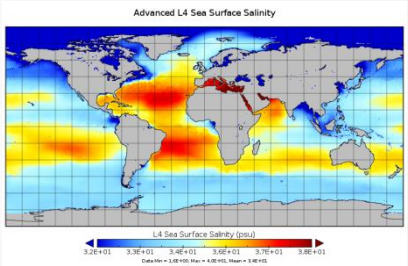
Ocean salinity:

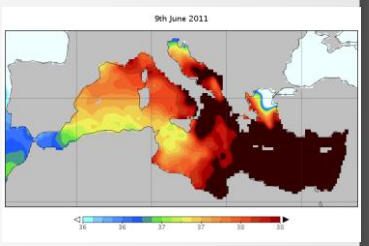
Advanced L3: 6 years of 9-day, 0.25º OA maps



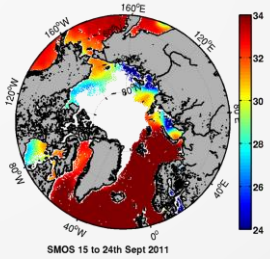


Advanced L4: 6 years of daily, 0.05º fused maps



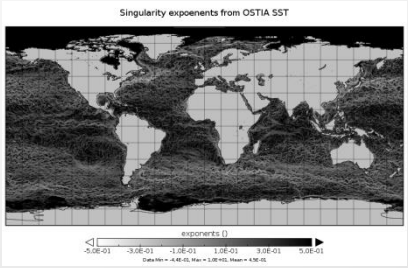


Advanced: 3 years of Arctic, 25-km, 9-day OA maps



Singularity exponents:

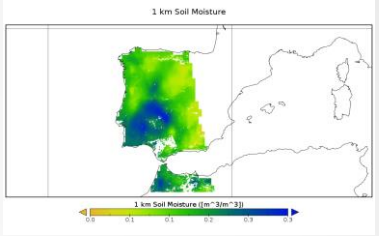
Daily maps of SE derived from OSTIA SST,0.25º



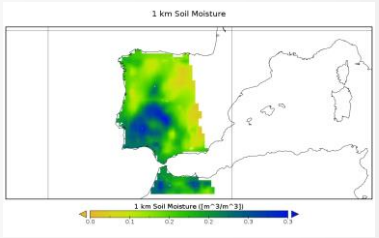
The Barcelona Expert Center, products: land

Soil moisture

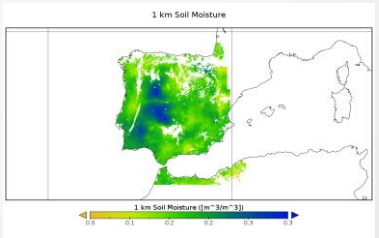
Operational L4: daily, MODIS-fused at 1-km resolution, Iberian peninsula, Ghana and South Africa



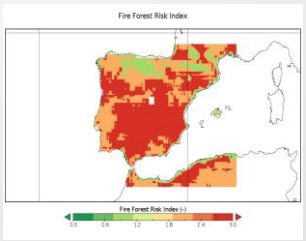
Operational L4: daily, all-weather at 1-km resolution, Iberian peninsula, Ghana and South Africa



NRT L4: daily, MODIS-fused at 1-km resolution, Iberian peninsula



NTR L4: daily fire risk index at 1-km resolution, Iberian peninsula

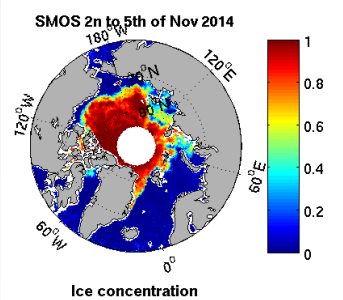


The Barcelona Expert Center, products: forthcoming

Cryosphere: Sea ice concentration:

Initial phase of production.

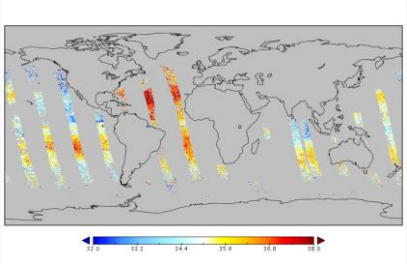
3-day, 25 km, polar projection



Land & ocean: Brightness temperature L3:

Development.

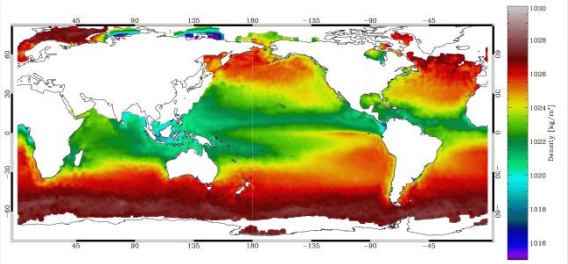
1 to 3-day, 0.25º, nodal sampled



Ocean: Sea surface density:

Under validation.

Same resolutions as SSS products



The Barcelona Expert Center, R&D: ocean salinity

Lead: **Antonio Turiel**

BEC team invested many years and effort to develop our own inner **SMOS SSS processing chain**, starting from L0 up to L4.

With the help of this processing chain, we are now able to propose new processing algorithms at any level and **test their impact at the final products**.

- At Level 1, we have proposed **new image reconstruction** algorithms, characterized **systematic errors** and tested **new calibrations**.
- At Level 2, we have proposed **new debiasing** schemes
- At Level 3, we have created a **completely new product** (**debiased non-Bayesian**), which provides SSS in previously inaccessible areas and corrects many of the known systematic biases.
- At Level 4, we have developed a synergistic approach that simply **blends information from different ocean variables**, even with other L-band vars.

With the gained knowledge, we have started to study the impact of L1 improvements on land and ice caps, and also intercallibrate SMOS with other L-band radiometers.

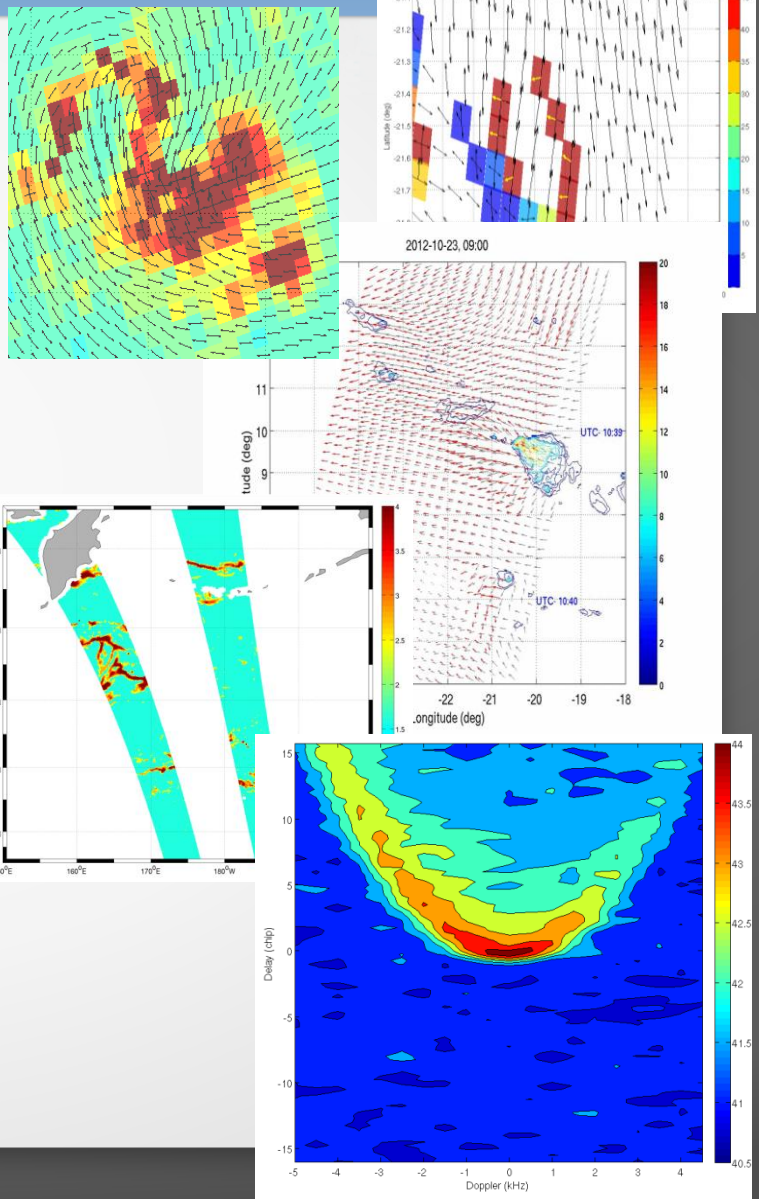
The Barcelona Expert Center, R&D: ocean winds

Lead: **Marcos Portabella**

Expertise in scatterometry, microwave radiometry, and more recently in SAR and GNSS-R.

The group provides support to:

- EUMETSAT OSI & NWP SAFs on **scatterometer level 2 processing and related applications**
- EUMETSAT NWC SAF on **validation of AMVs**
- Copernicus on **development of L4 ocean forcing**
- ECMWF on **ASCAT data assimilation**
- ESA on **GNSS-R wind retrieval & ERS/ASCAT climate data records**
- SOA/NSOAS on HY-2A & 2B **scatterometer data processing and NRT plans**)
- International working groups (wind stress, coastal, extreme winds)
- Science teams (NASA IOVWST, ESA/EUMETSAT SCA SAG, NSOAS Ocean Salinity Mission)



The Barcelona Expert Center, R&D: cryosphere

Lead: **Carolina Gabarró**

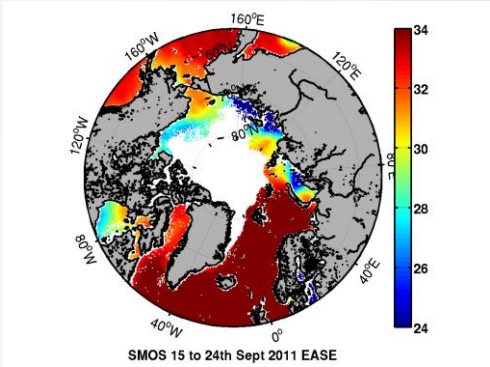
Specialists in passive microwave radiometry, starting activities on sea ice.

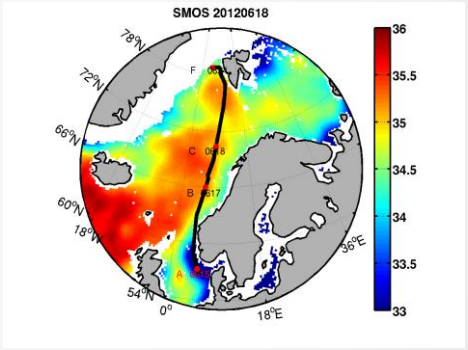
Activities include the design of high-sensitivity **Sea Ice Concentration** maps, the analysis of sea ice thickness, the assessment of the impact of **fresh water fluxes** on sea ice formation, and the definition of **new radiometers for sea ice**.

Involvement in the forthcoming **MOSAIC** campaign.

Participation in **IASC as Spanish Representative**.

Collaboration with **EUMETSAT OSI SAF**.





The Barcelona Expert Center, R&D: ocean currents

Lead: **Jordi Isern-Fontanet**

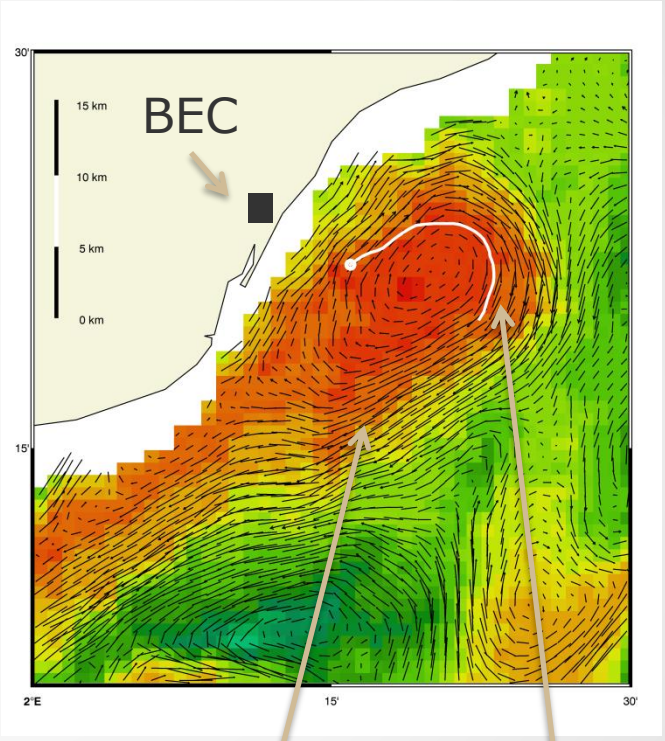
Specialist in upper ocean dynamics and remote sensing (altimetry and infrared radiometry)

Retrieval of surface currents with a special interest in the Mediterranean Sea:

- **High-resolution surface currents** from IR SST (10 times higher than altimetric maps)
- **Surface currents from SMOS** measurements
- New approaches to the processing of **along-track altimetric data in SAR-mode** (AltPy)

New approaches to retrieve **climate** relevant **variables** from long time series of remotely sensing data (SST)

- Mixed Layer Depth
- Ocean stratification



Thank you for your attention

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