# The Coastal Ocean and Shelf Seas Task Team

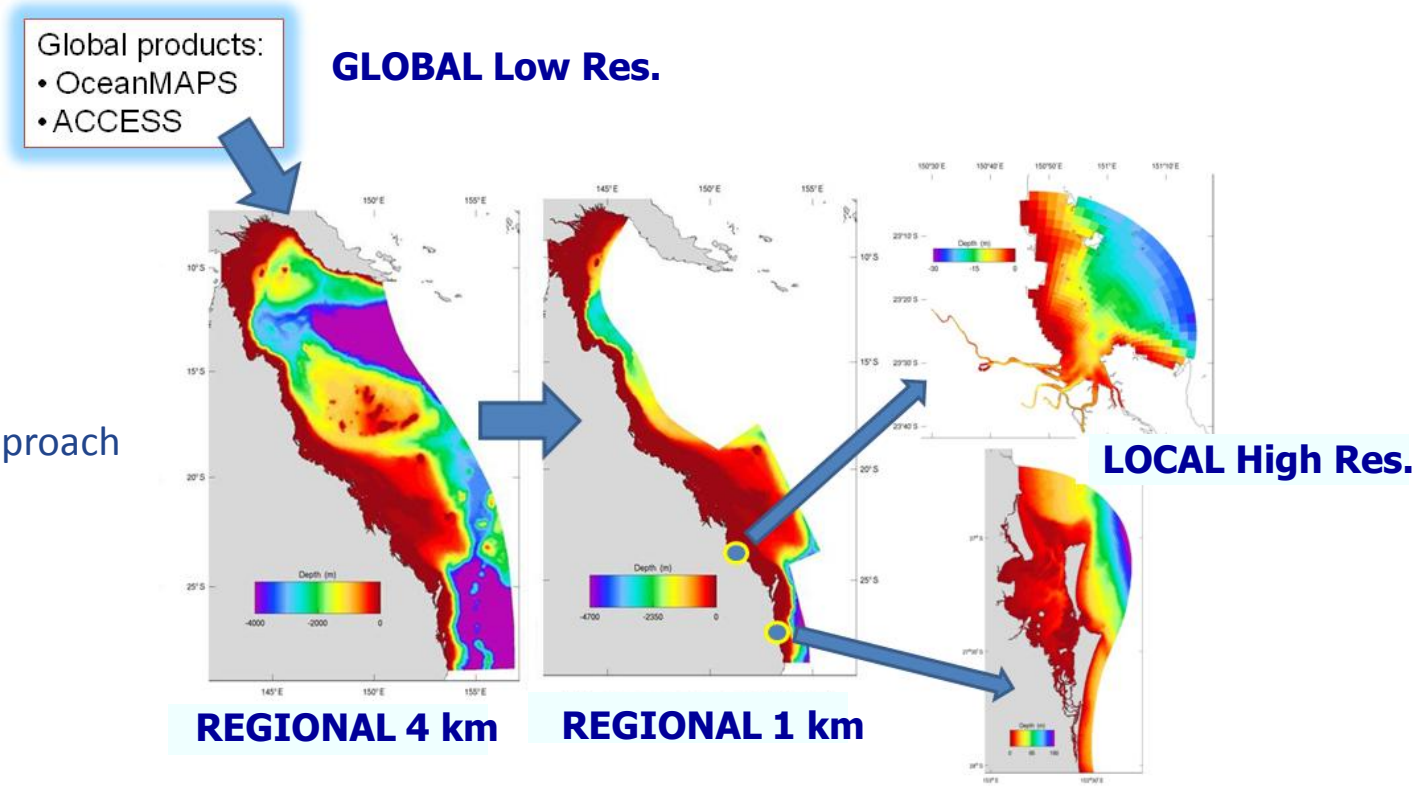
Villy Kourafalou - RSMAS/U. Miami

Pierre De Mey - LEGOS/U. Toulouse

# Mission and goals

- The main goal of the TT is to work in coordination with the GOV-ST and GOOS towards the provision of a sound scientific basis for sustainable multi-disciplinary downscaling and forecasting activities in the world coastal oceans.
- The strategic goal of the TT is to help achieve a seamless framework from the global to the coastal/littoral scale.

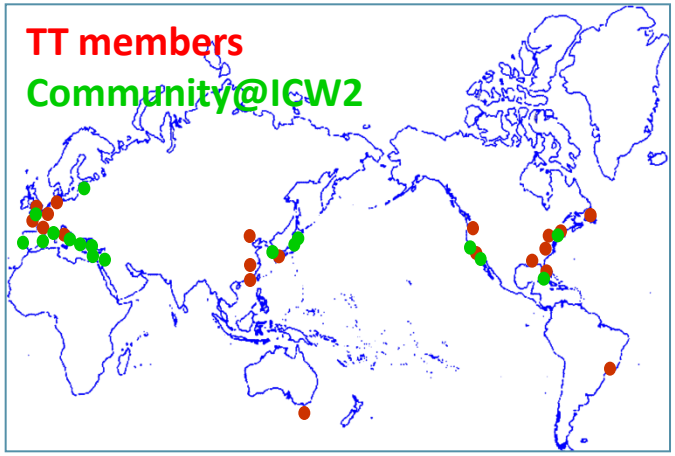
➢ Multi-nesting downscaling approach




*Provided by M. Herzfeld, CSIRO, Australia*

# TT members as of Feb, 2013 + Community attending ICW2

| Name | Institution, City | Country |
|---|---|---|
| Aikman, Frank | NOAA | USA |
| Barth, Alexander | U. Liège | Belgium |
| Chao, Yi | RSS and UCLA, Los Angeles, CA | USA |
| Chassé, Joël | DFO, Mont-Joli, QC | Canada |
| Cirano, Mauro | REMO, Rio de Janeiro | Brazil |
| Craig, Peter | CSIRO, Hobart | Australia |
| De Mey, Pierre | CNRS / LEGOS, Toulouse | France |
| Dumas, Franck | IFREMER / Previmer, Brest | France |
| He, Ruoying | NCSU, Raleigh, NC | USA |
| Herzfeld, Mike | CSIRO, Hobart | Australia |
| Hirose, Naoki | Kyushu U., Fukuoka | Japan |
| Jianping, Gan | Hong Kong U. of S&T | China |
| Kourafalou, Villy | U. Miami / RSMAS, Miami, FL | USA |
| Kurapov, Alexander | Oregon State U. / COAS, Corvallis, OR | USA |
| Liu, Guimei | NMEFC, Beijing | China |
| O'Dea, Enda | UK Met Office, Exeter | UK |
| Oddo, Paolo | INGV, Bologna | Italy |
| Oey, Leo | U. Princeton, NJ | USA |
| Patchen, Richard | NOAA / NOS, Silver Spring, MD | USA |
| Pinardi, Nadia | U. Bologna | Italy |
| Richman, Jim | NRL, Stennis Space Ctr., MS | USA |
| Stanev, Emil | HZG, Hamburg | Germany |
| Zhu, Jiang | IAP, Shenzhen | China |




- COSS-TT is engaging the international Coastal Ocean and Shelf Seas modeling/forecasting community (COSS-COMM)
- International Coordination Workshops: open to the COSS-COMM
- > 100 people in COSS-COMM mailing list at the moment

# Actitivies and achievements

- The Task Team represents the interests of the international Coastal Ocean Forecasting community in GODAE OceanView.
- Three International Coordination Workshops have been organized and have been successfully embraced by the community as a much needed forum to discuss latest scientific advances, promote international networking and update strategic planning.
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ICW2, Lecce, Feb 2013

- Pilot affiliated regional working groups are being created, and are expected to serve as a model for further regional initiatives.
- Links have been established with other active international communities, such as the Coastal Altimetry community, and more links are planned.

# “Science in support of coastal forecasting”: drivers

1. Coastal ocean climate and long-term monitoring of physical, geochemical and biological parameters in coastal regions
2. Fine-scale coastal ocean modeling
3. Coastal-scale atmosphere-waves-ocean couplings
4. Downscaling the ocean estimation problem from large-scale to coastal-scale models, data and forcings
5. Probabilistic approaches and risk assessment in the coastal ocean, including extreme events

# “Science in support of coastal forecasting”: thematic sessions

**Science drivers** have been used to define **thematic sessions** at Miami, Lecce and Puerto Rico workshops:

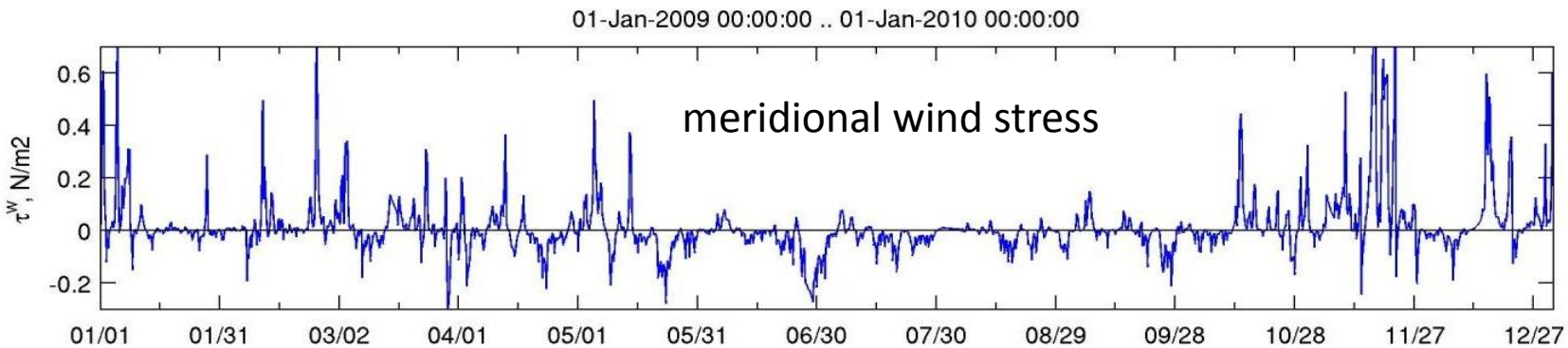
- Advances in integrated coastal **observations**
- **Data assimilation** in coastal systems
- Advances in **downscaling**
- **Upper-ocean processes**, waves-current-atmosphere interactions and couplings
- Impact and signature of **climate change** in the coastal oceans
- **Predictability** in the coastal oceans
- **Probabilistic approaches** and **risk assessment** in the COSS, science in support of the mitigation of coastal hazards
- **Training/Education/Outreach** initiatives in the coastal oceans

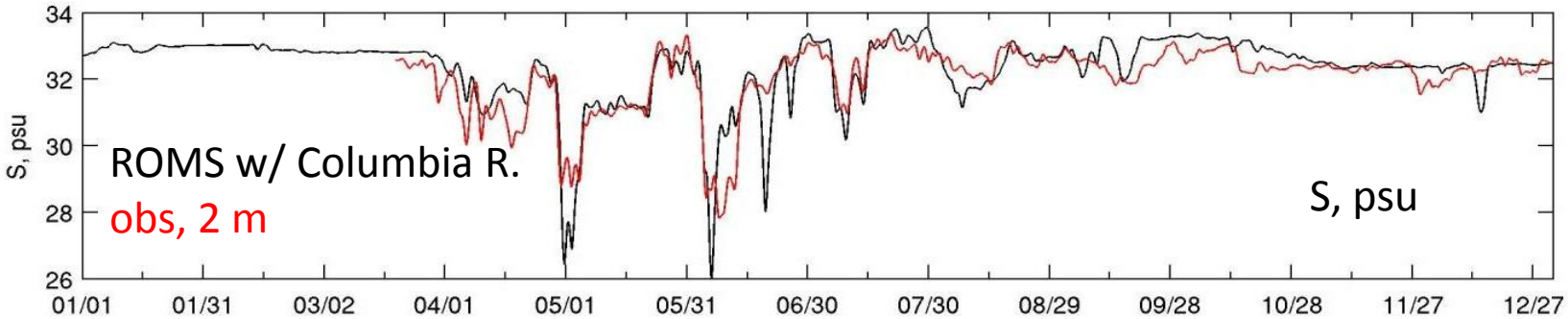
Science driver 1:

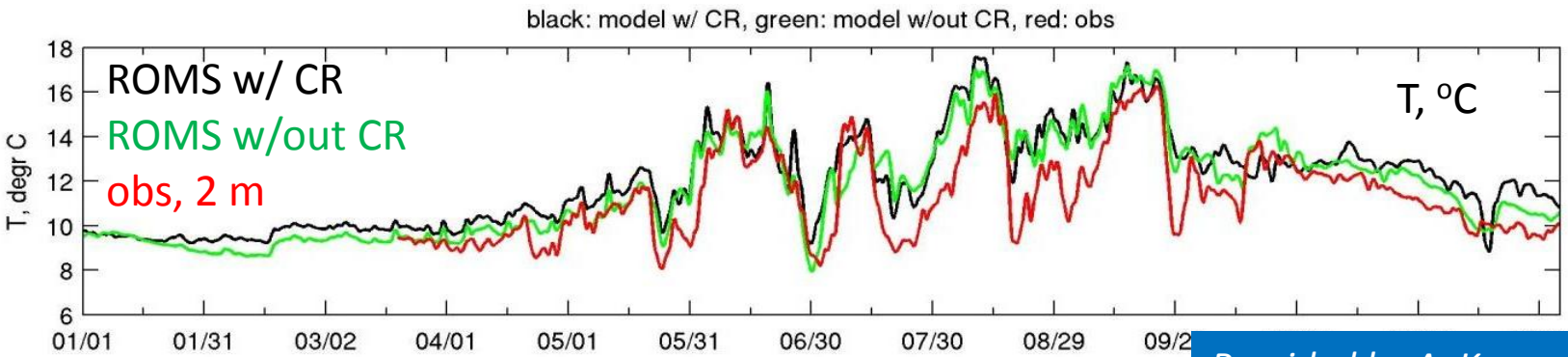
# Coastal ocean climate and long-term monitoring

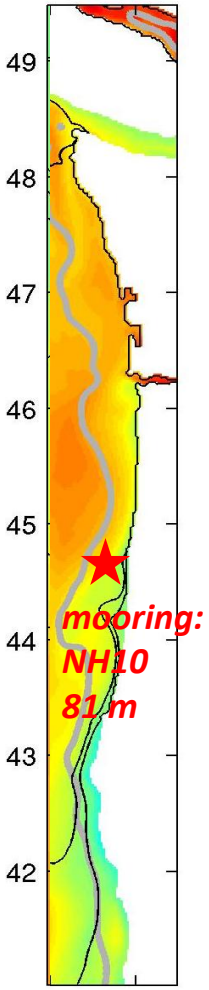
- coastal networks & observatories
- array design methods
- indices of “good environmental status”

**Model-mooring data comparisons:** temporal variability in near-surface T and S is reproduced by the model



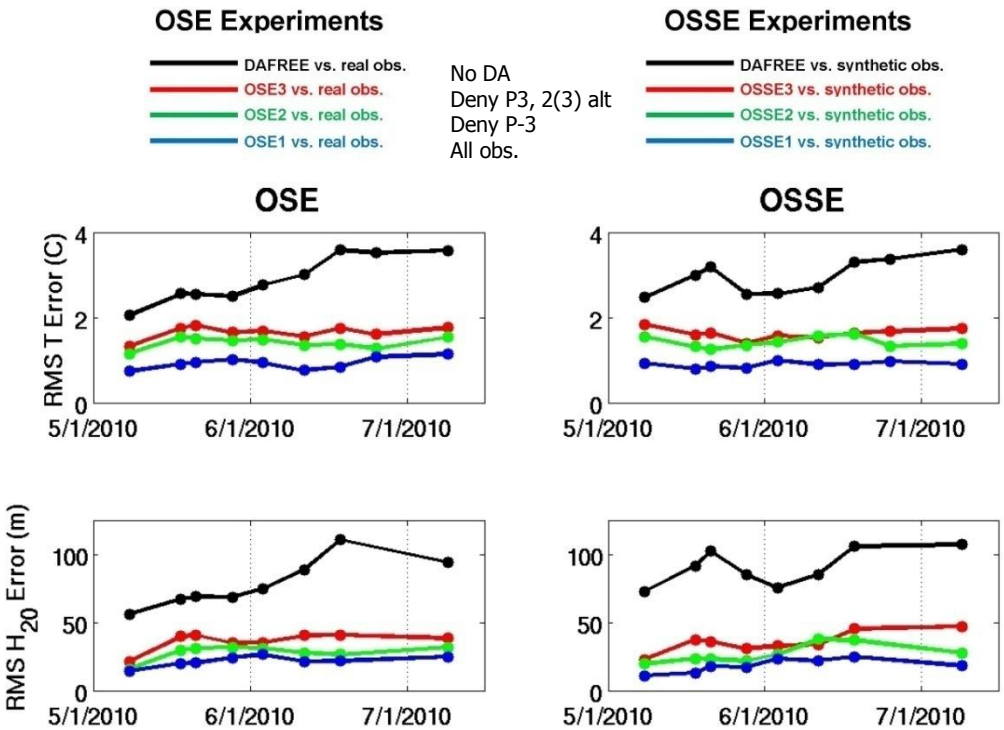

*Provided by A. Kurapov, COAS/OSU, U.S.A*

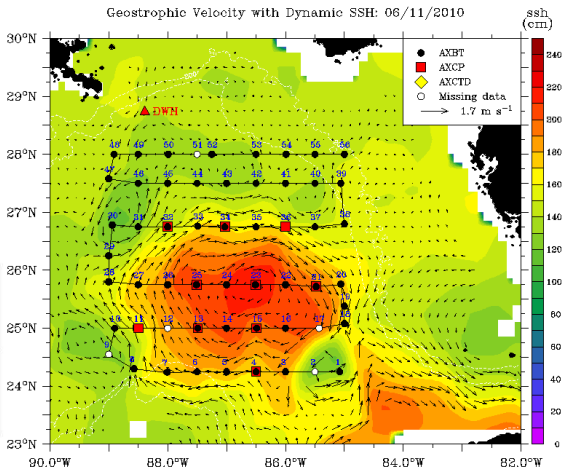
# OSSE Evaluation of Rapid Airborne Ocean Observing Strategies in the Gulf of Mexico - G. Halliwell, V. Kourafalou, M. Le Hénaff, R. Atlas

➢use various altimetry and in situ observation scenarios ***(NOAA-AOML/U.Miami-RSMAS)***

➢validate along temperature profiles

POSTER, *Halliwell et al.*




Typical sampling pattern ($0.5^0$) of the WP-3D hurricane research aircraft during the DWH oil spill *(dropping AXBTs, AXCTDs AXCPs)* ***(Observations collected by N. Shay and colleagues at UM/RSMAS)***

➢Comparison of OSE/OSSE pairs demonstrates that the **prototype Gulf of Mexico OSSE system** will produce **unbiased** impact assessments

1. Nature Run (NR) model: reproduce both the climatology and variability of ocean phenomena of interest within pre-specified error limits
2. Errors between the DA and NR models *(models must be different)*: similar magnitude and properties as errors between the best available ocean models and the true ocean
3. OSSE system errors and biases: evaluated by comparing OSSEs to reference OSEs

Science driver 2:

# Fine-scale coastal ocean modelling

- validation using coastal networks & observatories
- support the development of new HR sensors (such as SWOT)

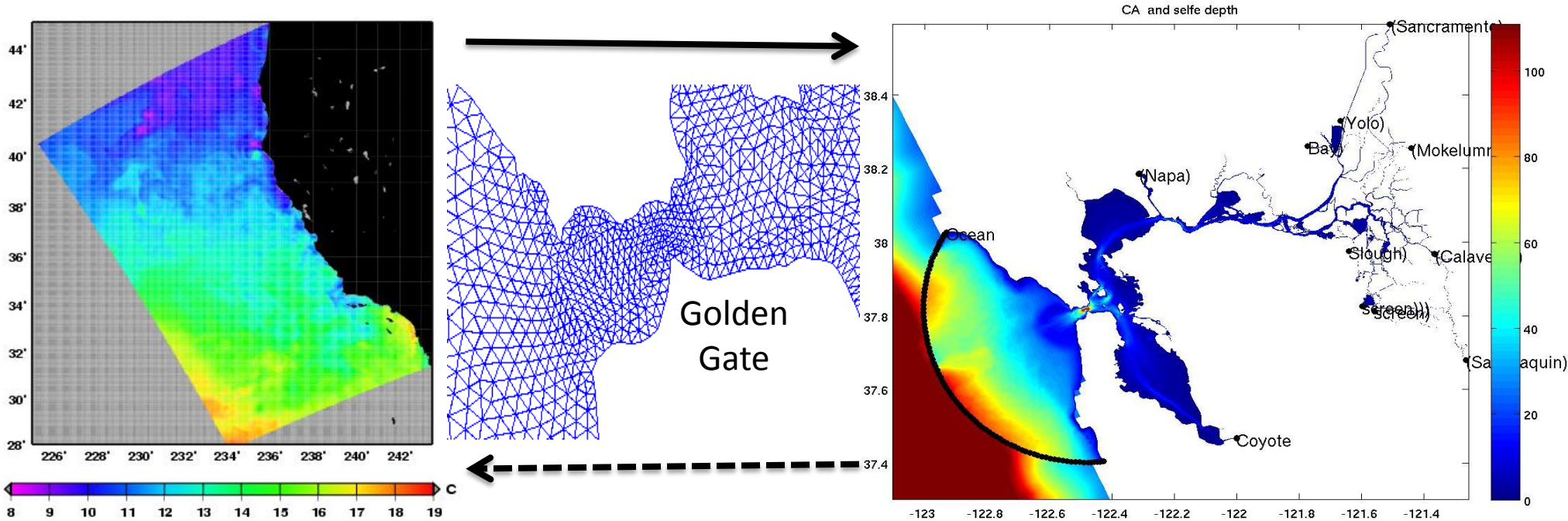
# Downscaling from Pacific Ocean to California Coast and San Francisco Bay/ Estuary to Enable Real-Time Forecasting

POSTER, *Chao et al.*

Yi Chao, John Farrara, Hongchun Zhang
University of California at Los Angeles

## Objective

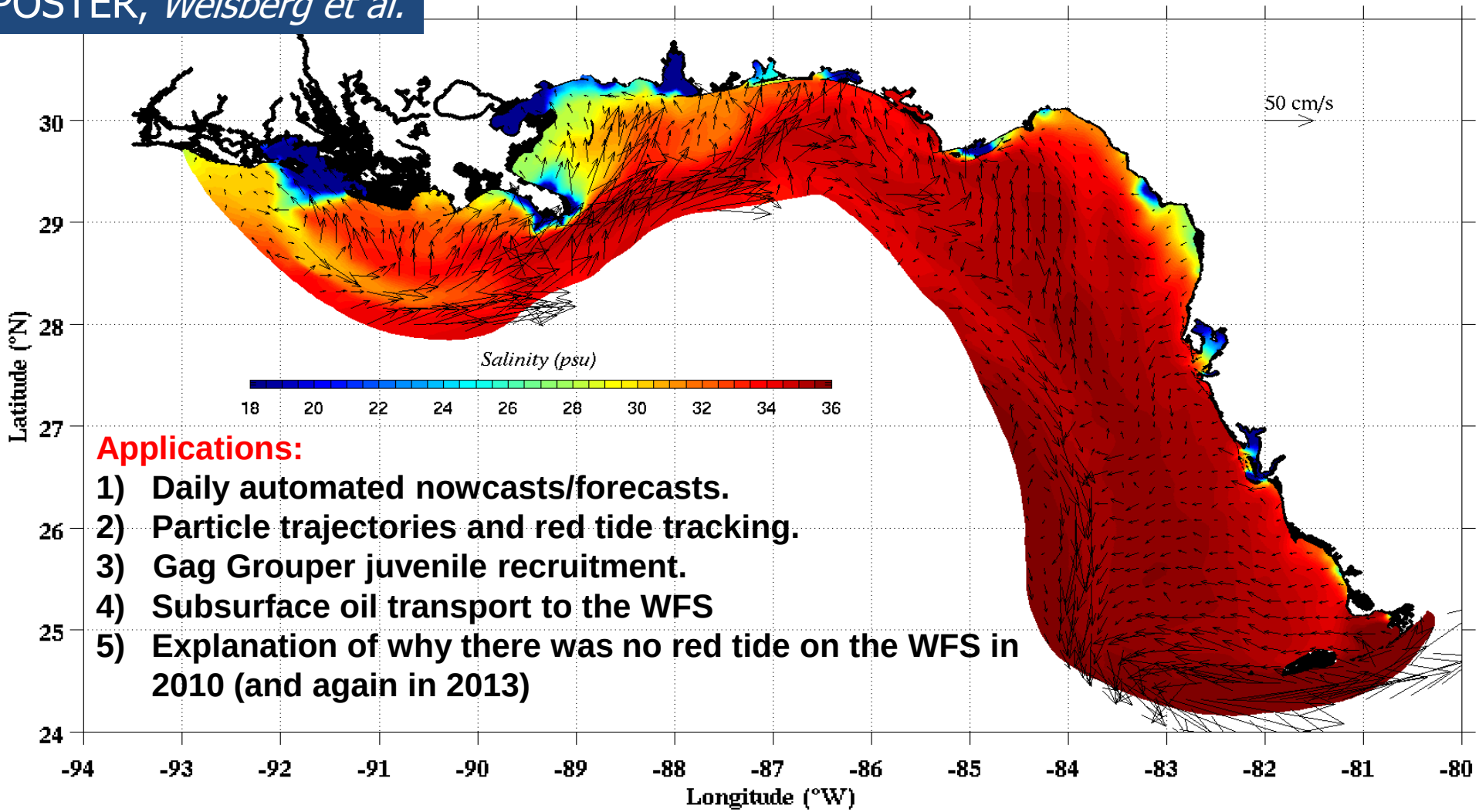
Develop an unstructured grid model (i.e., SELFE) for the San Francisco Bay/Estuary and lower Sacramento River that can be coupled to the California coastal ocean model (i.e., ROMS) to enable hindcast/nowcase/forecast.



# Importance of in situ observations for the accuracy of nesting an inner shelf coastal model into a global model

R.H. Weisberg, L. Zheng and Y. Liu, U. South Florida

POSTER, *Weisberg et al.*




**Applications:**

1) Daily automated nowcasts/forecasts.
2) Particle trajectories and red tide tracking.
3) Gag Grouper juvenile recruitment.
4) Subsurface oil transport to the WFS
5) Explanation of why there was no red tide on the WFS in 2010 (and again in 2013)

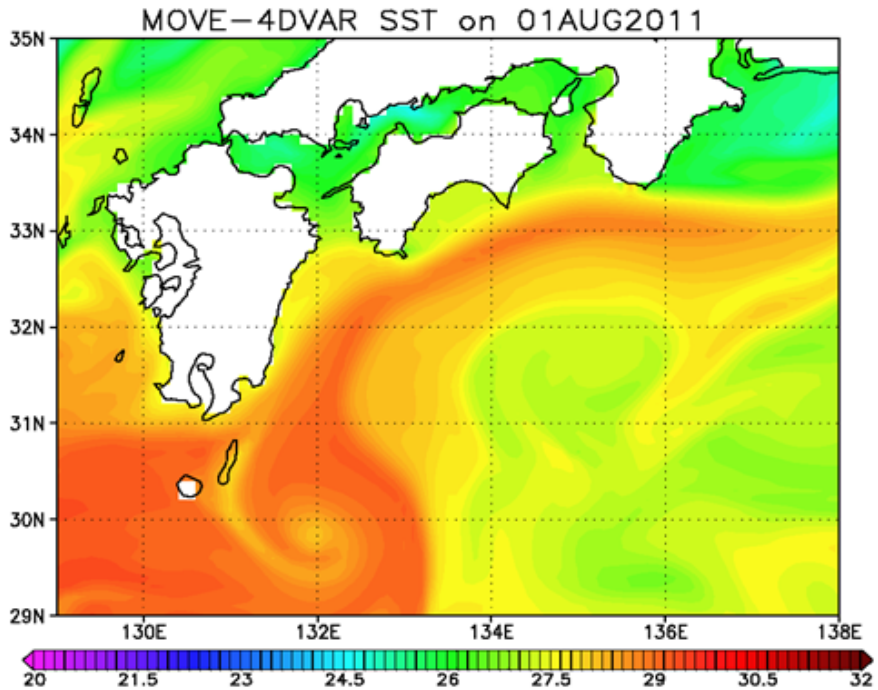
**Model simulated surface velocity and salinity on 6/23/13 when the eastward movement of DWH surface oil ceased near Cape San Blas and surface oil retreated back to the west.**

# Development of a coastal monitoring and forecasting system around the Seto Inland Sea, Japan

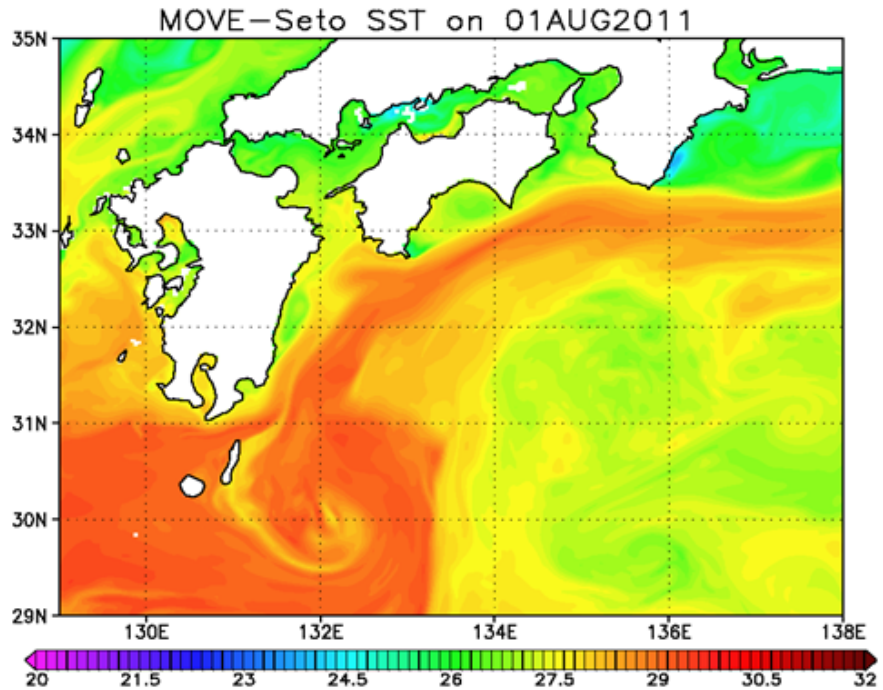
- N. Usui, K. Sakamoto, Y. Fujii, K. Ogawa, T. Kuragano, and M. Kamachi, *Japan Meteorological Agency*

POSTER *Usui et al.*

**Analysis model - Western N. Pacific (MOVE-4DVAR; 10km )**




**Forecast model - Japanese coastal region (MOVE-Seto; 2km )**




- ✓ Mesoscale features in the analysis model results such as the Kuroshio current pattern and mesoscale eddies are well represented in the 2km forecast results.
  - → The initialization scheme for the forecast model works well.
- ✓ Small-scale features such as Kuroshio frontal fluctuations and submesoscale phenomena are much enhanced in the forecast model.

Science driver 3:

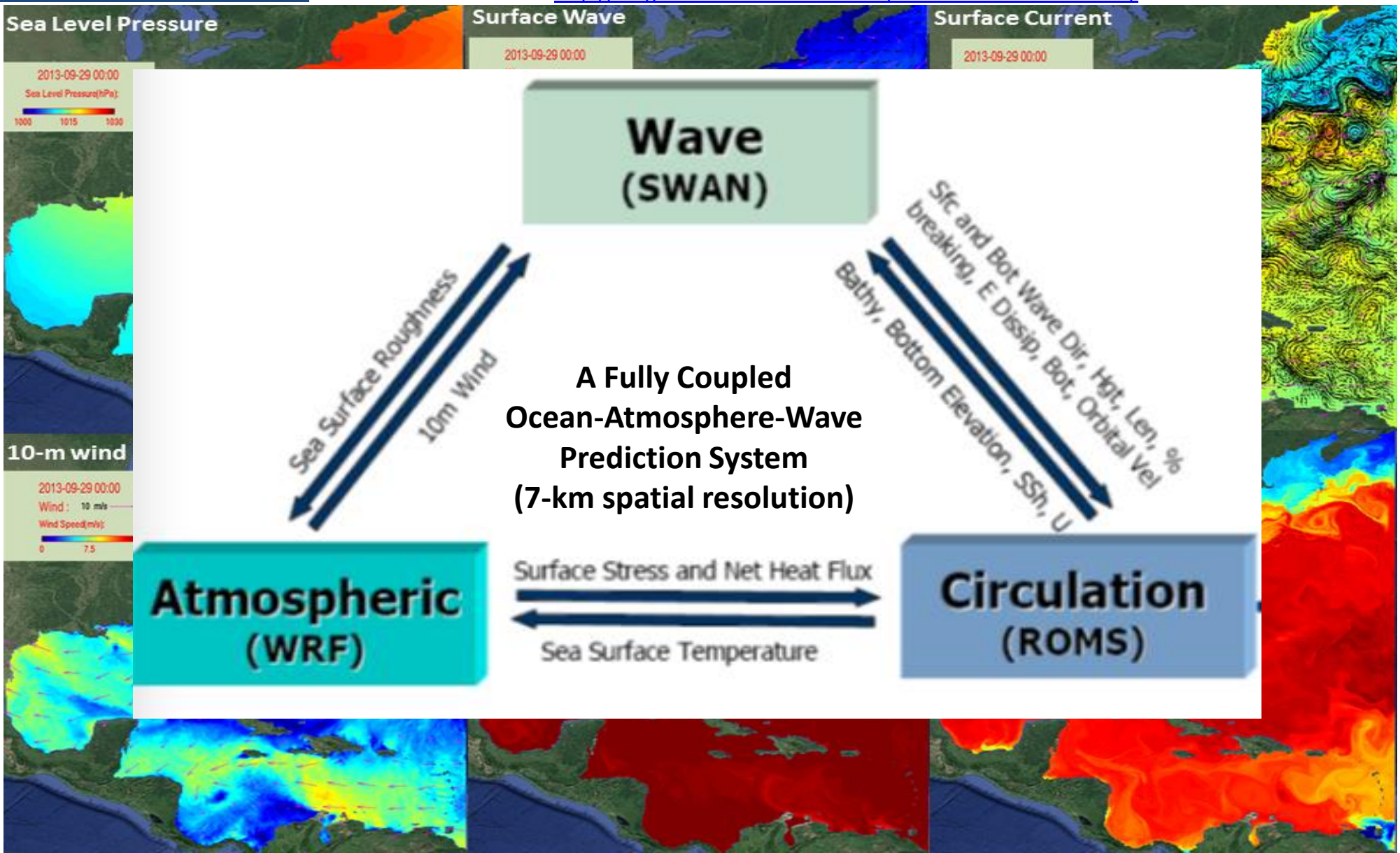
# Coastal scale atmosphere-waves-ocean couplings

# An integrated Ocean Circulation, Wave, Atmosphere and Marine Ecosystem Prediction System for the South Atlantic Bight and Gulf of Mexico

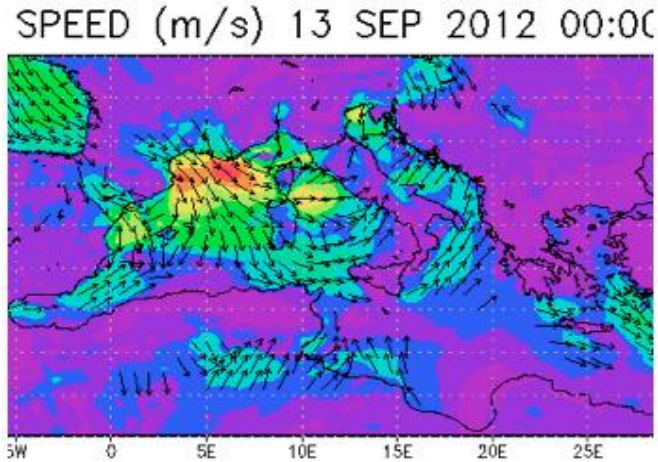
POSTER, *He et al.*

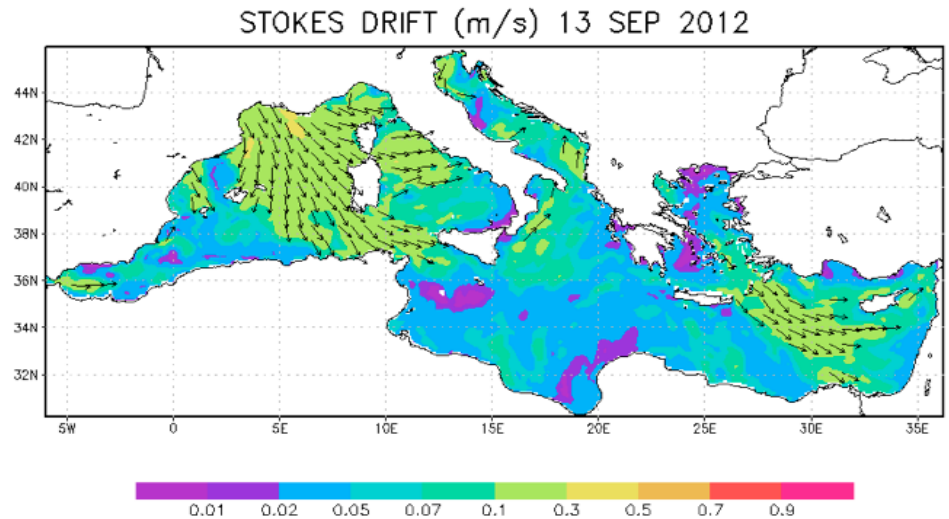
**Ruoying He, Gorge Xue and Joseph Zambon**, ***North Carolina State University, USA***

**web:** http://omgsrv1.meas.ncsu.edu:8080/ocean-circulation-useast2/



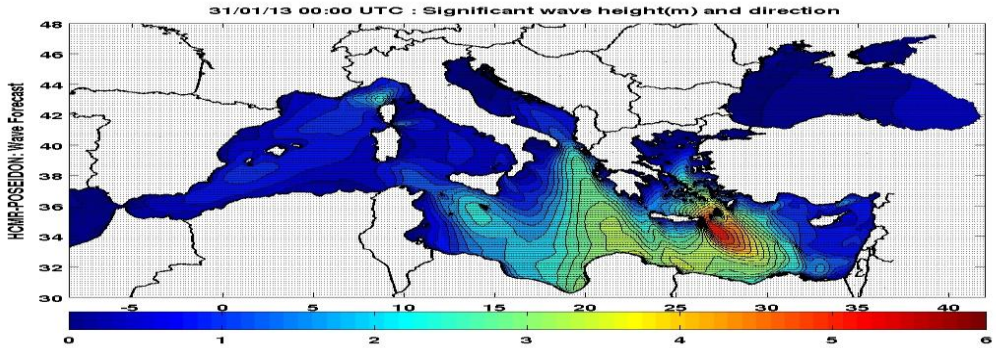
# MyOcean wave derived products



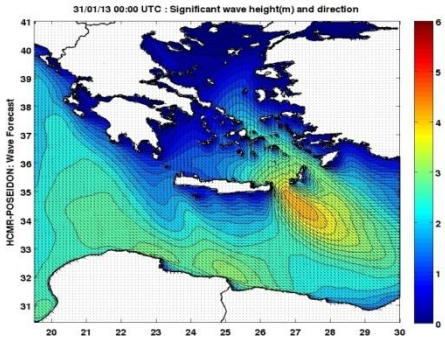




*Provided by M. Tonani, INGV, Italy*

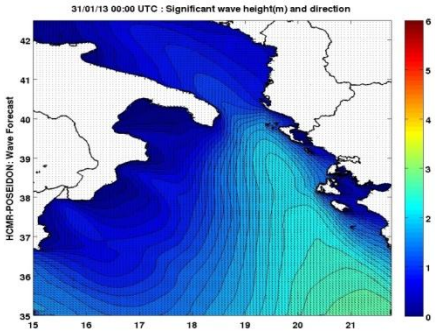
*WAVE SYSTEM BASED ON WAVEWATCH-III: MED + BLACK SEA 1/20 x 1/20*




**1/30 x 1/30**




**1/50 x 1/50**




*Provided by M. Korres, HCMR, Greece*

Science driver 4:

# Downscaling the ocean estimation problem from large-scale models, data and forcings to the coastal scale

- Includes assimilation of locally available data

# PREVIMER

POSTER, *Lecornu et al.*

# A coastal operational oceanography system coupled to the Copernicus Marine Service

PREVIMER

COASTAL OBSERVATIONS & FORECASTS

F. Lecornu, L. Pineau-Guillou, F. Dumas, P-Y. Le Traon, F. Gohin, A. Menesguen, IFREMER

- Partnership between IFREMER (French Research Institute for Exploitation of the Sea), SHOM (French Hydrographic Office) and several major French institutions, providing coastal observations, analyses and 4 days forecasts for the French coasts

Currents / Waves / Sea level / Temperature & salinity / Primary production

Ifremer SHOM METEO FRANCE Toujours un temps d'avance

Project supported by the European Union in partnership with Ifremer, SHOM and Météo-France

# Data Assimilative Modeling of the U.S. Mid Atlantic Bight Shelf

**John Wilkin, Julia Levin, Javier Zavala-Garay**

POSTER, *Wilkin et al.*

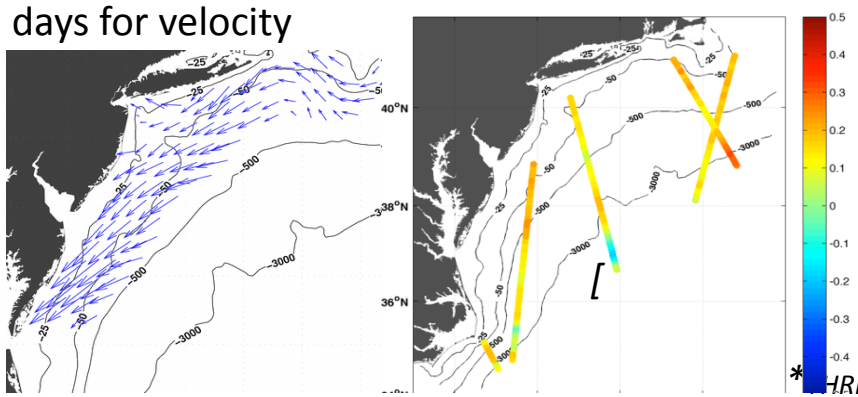
***Rutgers University*** ROMS 4DVAR uses all available data from a modern coastal observing system

- multi-satellites, *in situ* obs., HF-radar, climatology
- more and diverse data is better (need all of T, S, **u**, sea level)
- bias correction to coastal MDT and OBC is essential

**Useful subsurface skill for real-time applications:**

- 4 days for temperature and salinity;
- 1-2 days for velocity

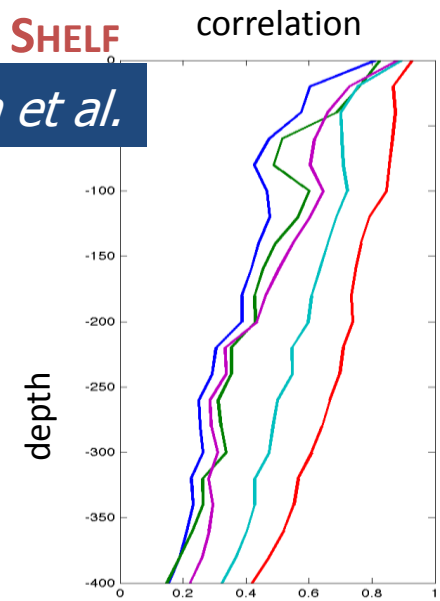
*Data used*




*[ … real-time SOURCE]*

*HREDDS Data Server

- 72-hour met forecast NAM 0Z cycle *[NCEP NOMADS]*
- Rutgers regional CODAR hourly: 4-hr delay *[RU TDS*]*
- MARACOOS.org glider T,S (~ 1 hr delay) *[RU TDS]*
- USGS daily average flow available 11:00 EST *[USGS waterdata]*
- AVHRR IR passes 6-8 per day (~ 2 hour delay) *[MARACOOS TDS]*
- REMSS MW+IR blended SST daily average *[NASA PO-DAAC]*
- HYCOM NCODA 7-day forecast updated daily *[NRL]*
- Jason-2, CryoSat, AltiKa along-track altimeter OGDR *[RADS.nl]*
- SOOP XBT/CTD, Argo floats on GTS *[NOAA OSMC ERDDAP]*




**Subsurface temperature skill**

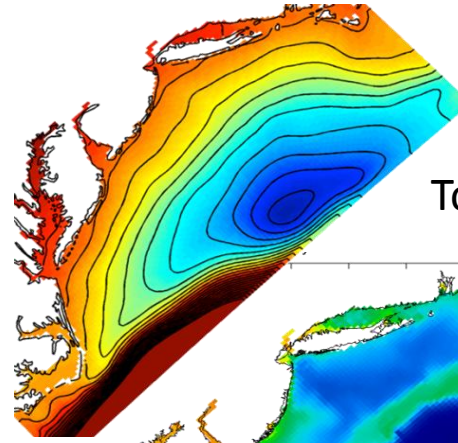
**Forward model**

**Forward model after bias removal**

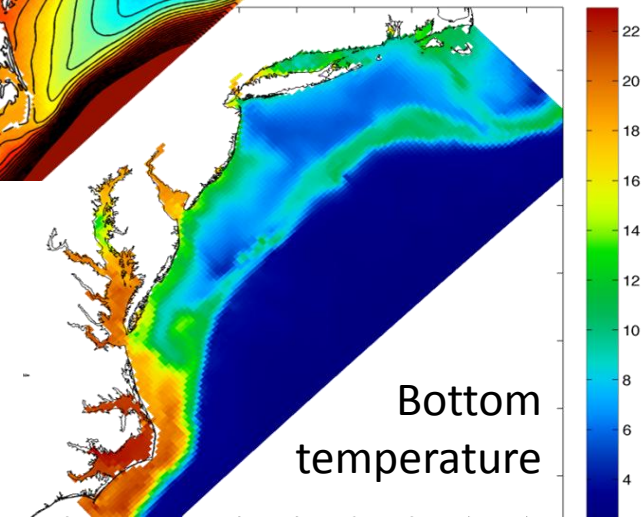
**Data assimilation analysis/hindcast**

**2-day forecast**

**4-day forecast**



Mean Dynamic Topography




Bottom temperature

Science driver 5:

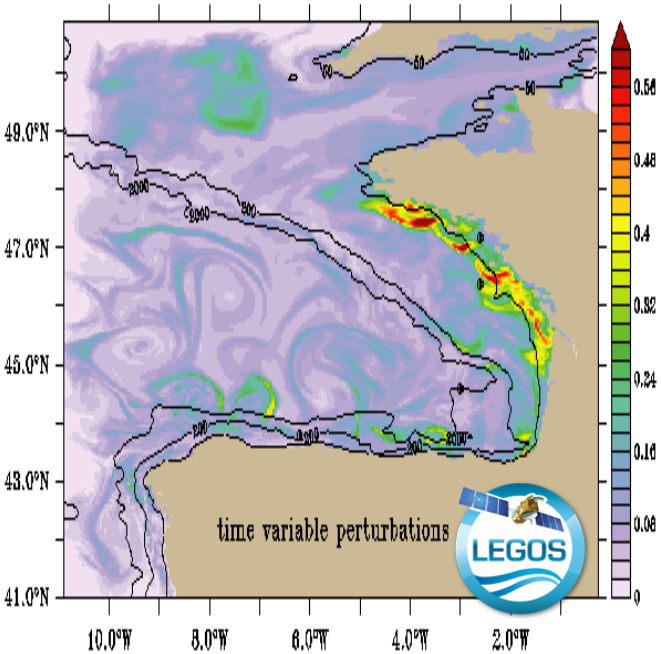
## Probabilistic approaches and risk assessment in the coastal ocean

- Includes extreme events

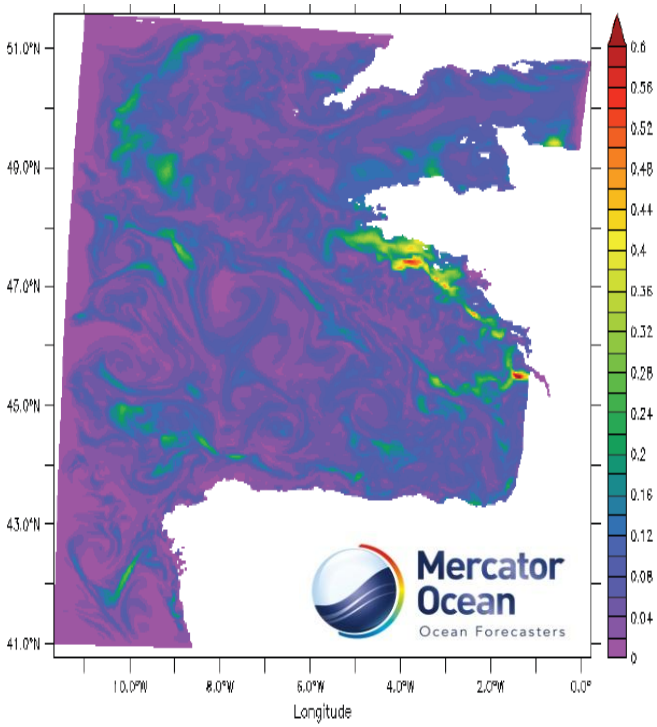
# Community assessment of regional Ensembles in the Bay of Biscay

SST Ensemble stdev(°C) in response to wind uncertainties

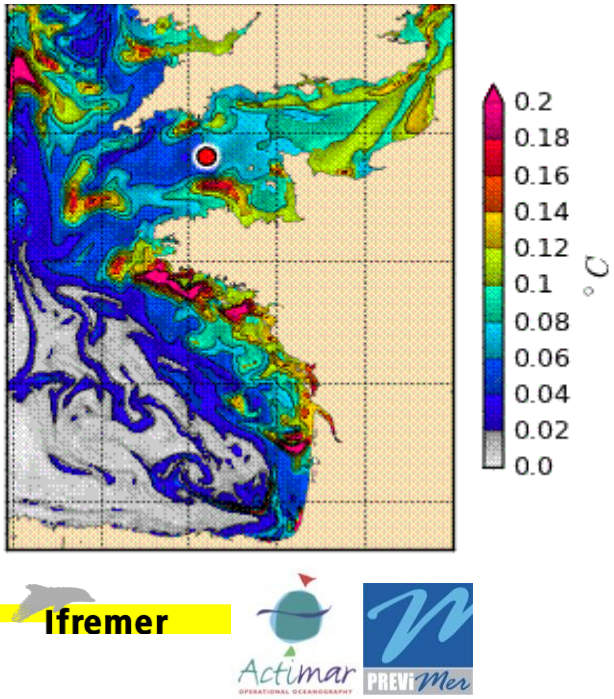
BOB-REG1 21/01/2008
(Ayoub et al., LEGOS)




NEMO/BISCAY 21/01/2008
(Quattrocchi et al., MERCATOR)




MANGA 15/01/2008
(Heyraud et al., Actimar/IFREMER)



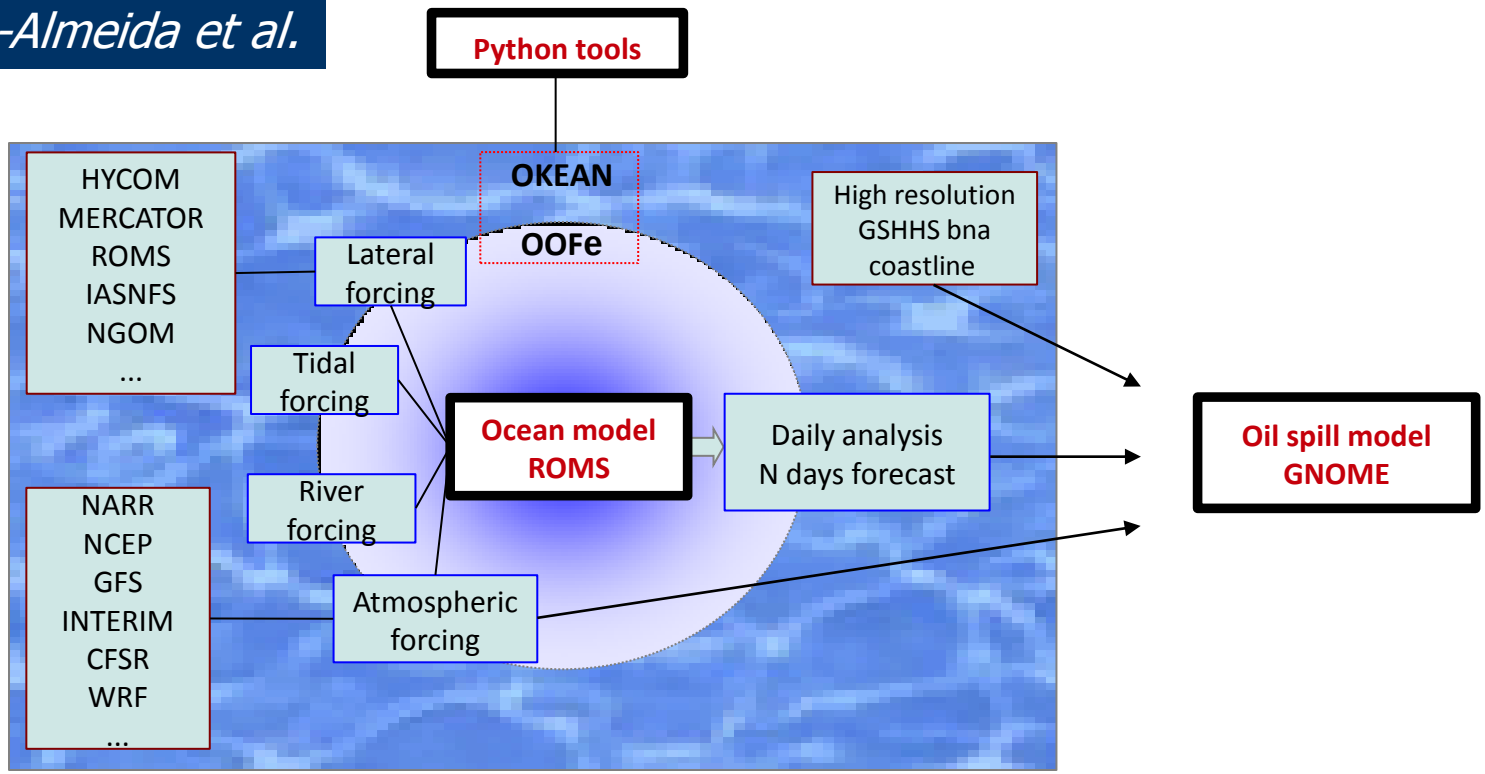

- Specific response on the shelf (intense, faster, small-scale patches)
- Specific response over the abyssal plain (weaker, slower, filament-like)
- Use ensembles for **probabilistic array design** in the Bay of Biscay

*Provided by De Mey et al., LEGOS/MERCATOR Ocean/Ifremer/Actimar, France*

# Efficient Tools for Marine Operational Forecast and Oil Spill Tracking

**M Marta-Almeida M Ruiz-Villarreal J Pereira P Otero M Cirano X Zhang R D Hetland**

## POSTER, *Marta-Almeida et al.*



# Additional posters – session 3.4

**Forecasting coastal to offshore interactions in the Florida Straits: can a marathon swimmer cross the Florida Current?**

***V. Kourafalou, H. Kang and M. Le Hénaff – U. Miami***

**Impact of boundary conditions on high-resolution simulations in a western boundary current region: the Gulf of Mexico example**

***M. Le Hénaff, V. Kourafalou, G. Halliwell, R. Atlas – U. Miami/NOAA-AOML***

**Operational Ocean Forecasting Capacity in the ASEAN region : the INDESO system**

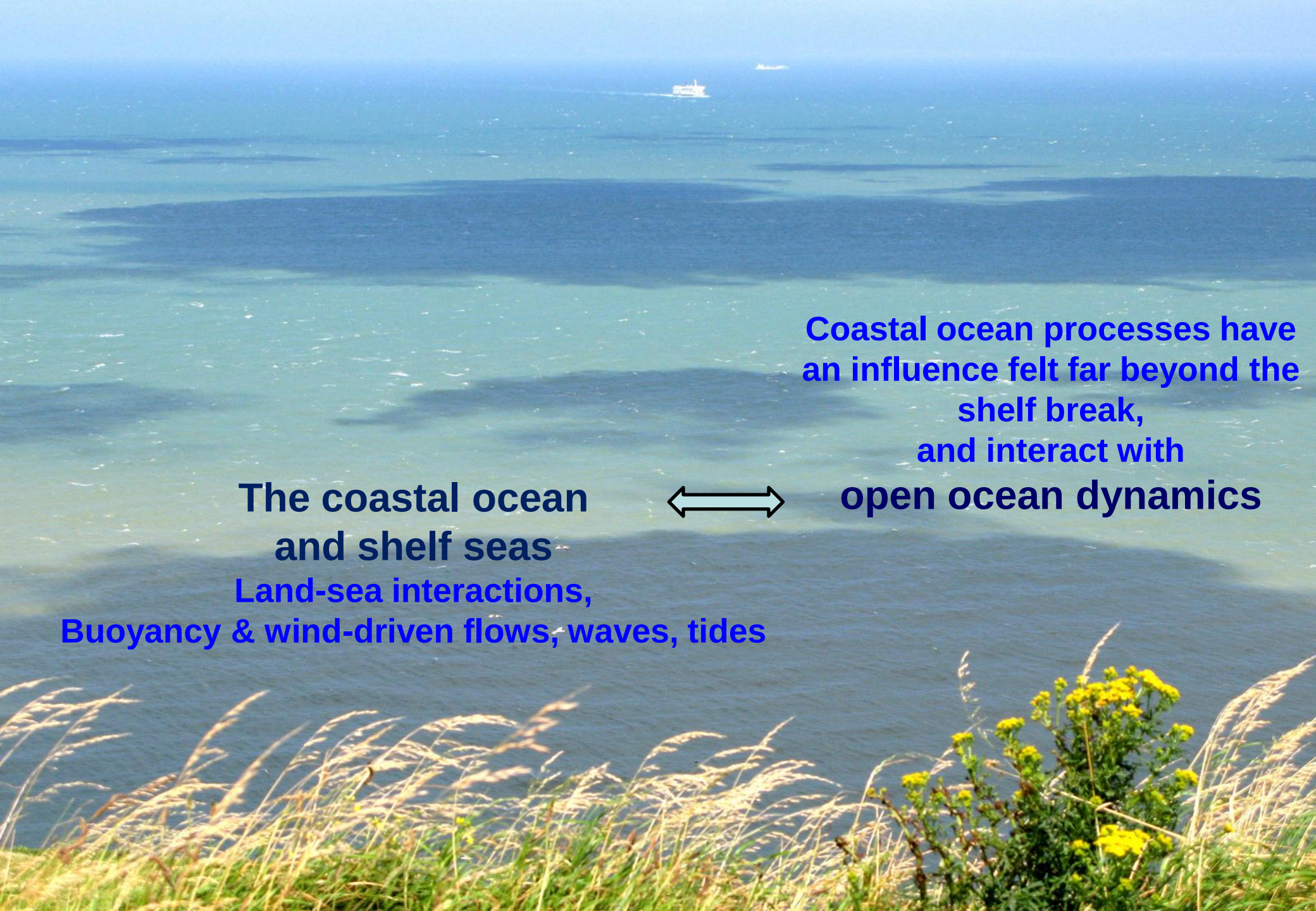
***B. Tranchant, E. Greiner, P. Gaspar, S. Giraud, S. Guinehut, G. Reffray, E. Gutknecht, Y. Drillet, M. Gehlen, A. Koch-Larrouy – CLS, MERCATOR, LCSE, LEGOS***

# Outlook (1/2)

- The coastal oceans are a **new frontier** for ocean forecasting science, as well as for applications
- The GOV/COSS-TT aims at advancing **science in support of coastal ocean forecasting** engaging and helping to consolidate the **international Coastal Ocean and Shelf Seas modeling/forecasting community (COSS-COMM)**
- The COSS-COMM is very diverse and active in many countries of the world, facing diverse but similar **challenges**

# Outlook (2/2)

- COSS-TT International Coordination Workshops are excellent opportunities to exchange information, identify good practices and update strategy
  (also: regional/thematic activities, such as: "International Workshop for Operational Oceanography in Developing Countries", Bejing, Sept. 2013; sponsored by the Chinese Academy of Sciences)
- The COSS-TT promotes ways to work together more closely to address the outstanding challenges of coastal forecasting
  - White Papers: clarify science drivers & share expertise
  - Pilot Projects: showcase international cooperation
- Next workshop in Puerto Rico, Jan 21-24, 2013 – Registration open
  - Workshop registration via www.godae-oceanview.org, "Workshops and Meetings"


Coastal ocean processes have
an influence felt far beyond the
shelf break,
and interact with
open ocean dynamics
The coastal ocean
and shelf seas
Land-sea interactions,
Buoyancy & wind-driven flows, waves, tides