OceanPredict
Advancing the science of ocean prediction

Coastal Ocean and Shelf Seas Task Team (COSS-TT)

OceanPredict Science Team Meeting, OPST-8, COSS-TT Report

COSS-TT co-chairs:
Villy Kourafalou
Alexander Kurapov
Pierre De Mey-Frémaux

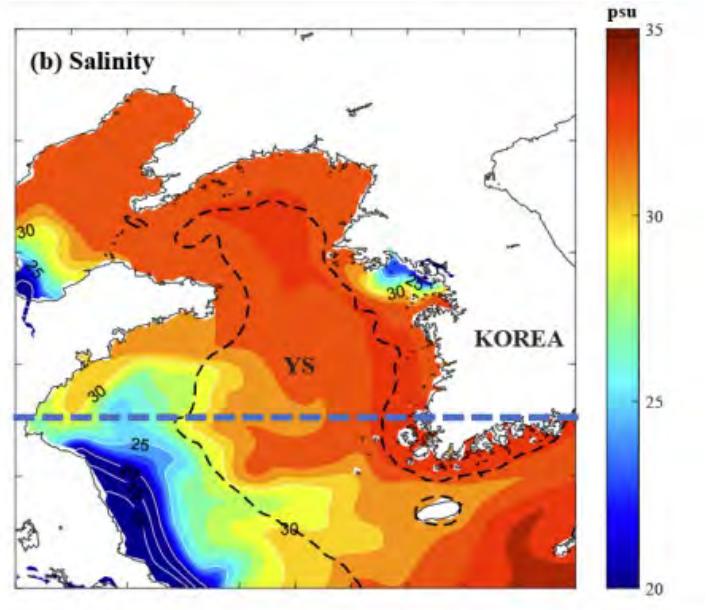
6-10 November 2023, Busan, S. Korea

Coastal Ocean and Shelf Seas Task Team (COSS-TT):

Terms of Reference: *"The main goal and central mission of the COSS-TT is to work within OceanPredict towards the provision of a sound scientific and expert basis for sustainable multidisciplinary downscaling and forecasting activities in the world's regional and coastal oceans"*

Our mission: *International coordination of science, research and development efforts that lead to improvement of regional and shelf-scale ocean forecast systems*

- physical processes
- numerical methods
- test cases
- model-data synergies (including data assimilation)
- model verification
- operational forecast system improvements
- etc.



[Figure: courtesy B-J Choi, Aug 2010 sea surface salinity]

COSS-TT members (updated in May 2023):

Name	Institution	Country
Lucy Bricheno	National Oceanographic Center	UK
Guillaume Charria	Ifremer/ LOPS	France
Byoung-Ju Choi	Chonnam National University	Korea
Mauro Cirano	REMO, Rio de Janeiro	Brazil
Pierre De Mey-Frémaux	CNRS / LEGOS	France
Chris Edwards	UC Santa Cruz	USA
Ivan Federico	CMCC	Italy
Marcos Garcia Sotillo	Puertos del Estado	Canada
Michael Dunphy	DFO	Canada
Mike Herzfeld	CSIO, Hobart	Australia
Naoki Hirose	Kyushu University, Fukuoka	Japan
Lars Hole	Met.no	Norway
Jianping Gan	Hong Kong University of S&T	China
Rob King	Met Office	UK
Villy Kourafalou	U. Miami	USA

Name	Institution	Country
Alexander Kurapov	NOAA National Ocean Service	USA
Bruno Levier	Mercator Ocean	France
Paolo Oddo	U. Bologna	Italy
Nadia Pinardi	U. Bologna	Italy
Marie-Isabelle Pujol	CLS	France
Yeqiang Shu	South China Inst. of Oceanogr.	China
Emil Stanev	HZG	Germany
Joanna Staneva	HZG	Germany
Jennifer Veitch	SAEON	S. Africa
Luyun Wu	NMEFC	China
Peter Zavialov	P.P. Shirshiv Inst. of Oceanology	Russia

COSS-TT Team Geography:

26 members
academia / research and operational centers

+ large coastal ocean modeling community

COSS-TT meetings:

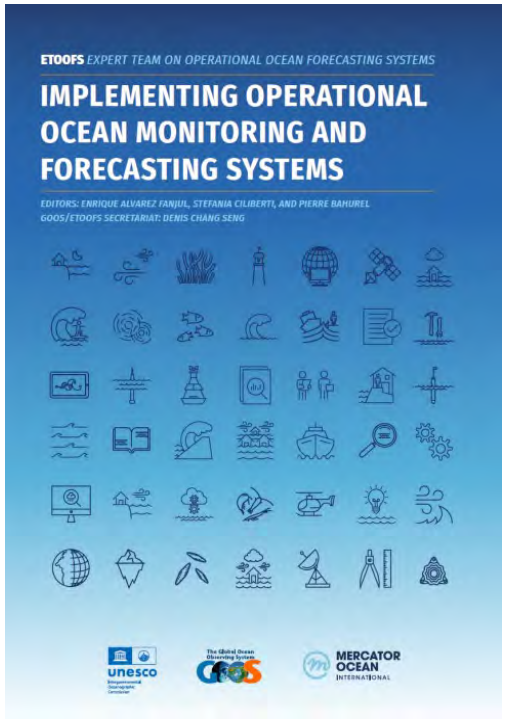
2012: Miami, USA
2013: Lecce, Italy
2014: Rincon, Puerto Rico
2015: Lisbon, Portugal
2017: Cape Town, S. Africa
2018: Madrid, Spain

2021: COSS-TT online meeting
2022: COSS-TT online meeting

2023: Montreal, Canada
(grand merci à Greg Smith, Jean-Philippe Paquin, Environment Canada & McGill U.)

Other activities:

- TT members wrote coastal sections of ET-OOFS “Guide on Operational Ocean Monitoring and Forecasting Systems” The Guide was officially published by UNESCO in June 2022
- Info on the website: Coastal Systems Information Table, paper titles, etc.
- UN Ocean Decade activities
- COSS-TT Special Issue in Oce Dyn.: target 2024
- COSS-TT contribution to the SynObs Decade project special issue: "Assessing the impact of ocean observing assets in coastal and shelf sea environments" by Edwards et al., in preparation for Frontiers (2024).



- Coastal ocean modeling seminar (https://coastaloceanmodels.noaa.gov/seminar/)

- Open to any colleagues
- Email list: NOAA + 200 scientists outside NOAA (US, Canada, EU, Mexico, Brazil, S. Africa, Turkey, Israel, etc.)
- 140 seminars since Dec 2019

21 November, 2023, 1pm US EST
Decomposition of estuarine circulation and residual stratification under land-fast sea ice
Hans Burchard (Leibniz Institute for Baltic Sea Research, Germany)

28 November, 2023, 1pm US EST
Evidence of Langmuir mixing effects in the upper ocean layer during tropical cyclonesusing observations and a coupled wave-ocean model
Xiaohui Zhou (Princeton University)

5 December, 2023, 1pm US EST
Effects of vertical mixing on the Lake Michigan food web: an application of a linked end-to-end Earth System Model Framework
Hongyan Zhang (1), David Cannon (2) (1: Eureka Aquatic Res. LLC, 2: U. Michigan)

Discussion point: Other ways to use online interaction to exchange science?

COSS-TT possible involvement in the Ocean Decade:

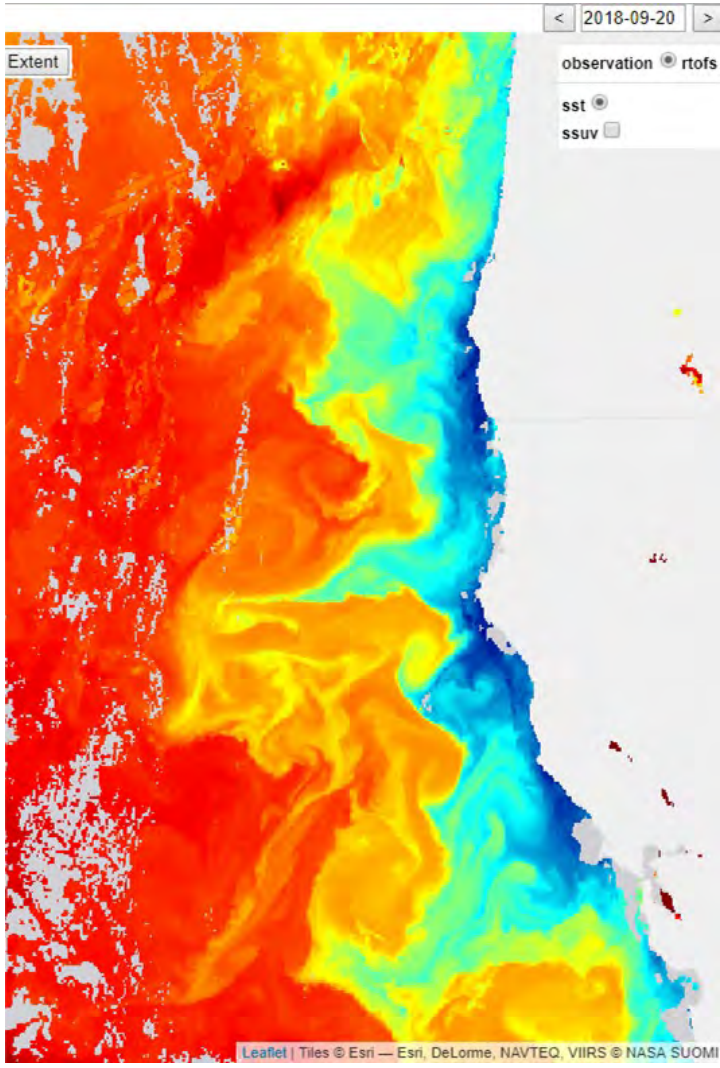
The Landscape:

- DCO (Decade Coordination Office): GOOS (DCO for Ocean Observing)
- DCC's (Decade Collaborative Centers): OceanPrediction, Coastal Resilience, …
- Programs: ForeSea, CoastPredict, *DITTO, Global Estuaries Monitoring (GEM), Mega-Delta, Ocean Cities Network,…*
- Projects: SynObs, PredictOnTime, FLAME,…/ Global Coast

The Challenge: Identify a roadmap towards concrete involvement.

- Presentations/discussions in Montréal: PredictOnTime, FLAME, GlobalCoast, *ForeSea*, DCC-OP
- SynObs/OSEval-TT: ongoing discussions on coastal OSE contributions to flagship OSE (coastal array design and array impact, coastal/shelf extension of ARGO/glider), TT participation in Regional Analysis Group, …
- Coordination/guidance expected at OP level

VIIRS (NPP, NOAA-20, etc.) delivers SST at a 2-km (or better) resolution



COSS-TT vis-à-vis GOOS/CoastPredict

CoastPredict Board
Chair - Nadia Pinardi* | University of Bologna (IT)
Co-chair - Villy Kourafalou* | University of Miami (USA)
Co-chair - Joaquín Tintoré | SOCIB Balearic Islands Coastal Observing and Forecasting System & IMEDEA (CSIC-UIB) (ES)
GOOS liaison: Emma Heslop | Global Ocean Observing System, UNESCO-IOC

** coss-tt members*

The CoastPredict **Global Coastal Ocean Experiment ("GlobalCoast")** is a central framework for the coordination and practical implementation of the CoastPredict Program. Pilot Sites within Regions of the Global Coastal Ocean are being identified, through a comprehensive survey that was recently completed.

COSS-TT members response (focus on regional currents, T, S, waves):

- South African coast (Veitch)
- Elbo Delta: *estuary* (Sotillo)
- Galway Bay "
- Gulf of Biscay "
- Strait of Messina: *nonlinear tides* "
- US West Coast: *upwelling, data assimilation* (Kurapov)
- Bering Sea shelf: *coupled ice-ocean modeling* "
- Rio de Janeiro: *port infrastructure* (Cirano)
- Great Barrier Reef, SE Australia (Hetzfeld)

Discussion of COSS-TT focus areas:

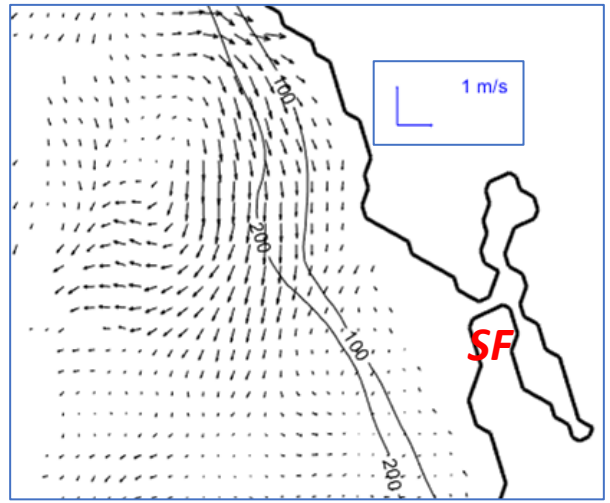
Our “historic” FAs:

- **Science** in support of Coastal Ocean forecasting
- Coastal and Regional (pre-)operational ocean **forecasting systems** and applications
- Seamless **integration** between Coastal and Regional systems (R/COFS under COSS-TT) and Large scale systems (LOFS under OceanPredict)
- Synergy between **altimetry and modelling** in coastal regions

New FAs as agreed in Montreal:

- Observing infrastructure in the coastal seas, integration with models and with forecasting
- COSS modelling and seamless integration with larger-scale estimates
- Land-Ocean Continuum: integration of coastal ocean and estuaries/deltas/wetlands, coastal cities
- Coastal projections & scenarios, coastal vulnerability

The High-Frequency Radar derived surface current map, off San Francisco, CA



Picture credit: tidesandcurrents.noaa.gov

COSS modelling and seamless integration with larger-scale estimates

Importance:

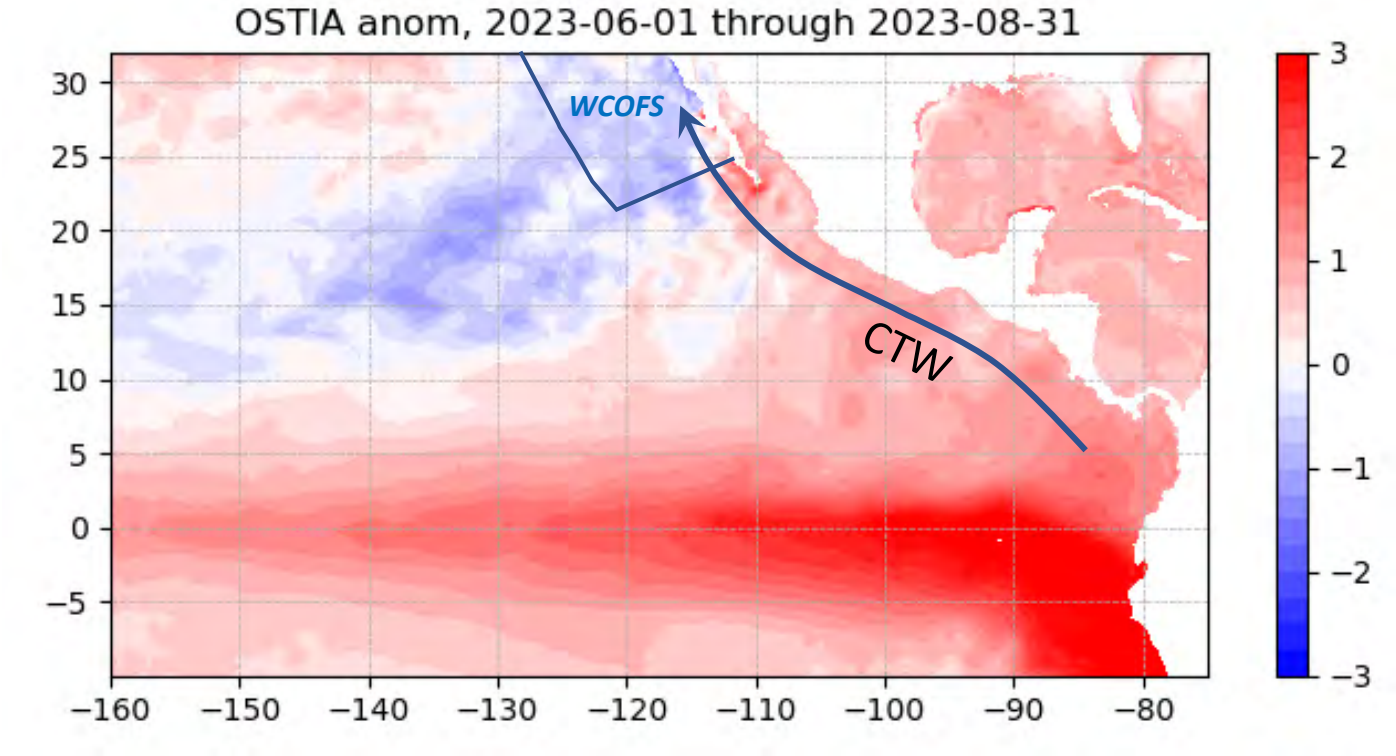
- *basin scale processes influence regional / shelf flows*
- *key to subseasonal to seasonal (S2S) prediction*

Example: 2023 El Niño, promises to be one of the strongest on the record

Coastally trapped waves (CTW) carry the signal across the southern boundary of the West Coast Ocean Forecast System (WCOFS)

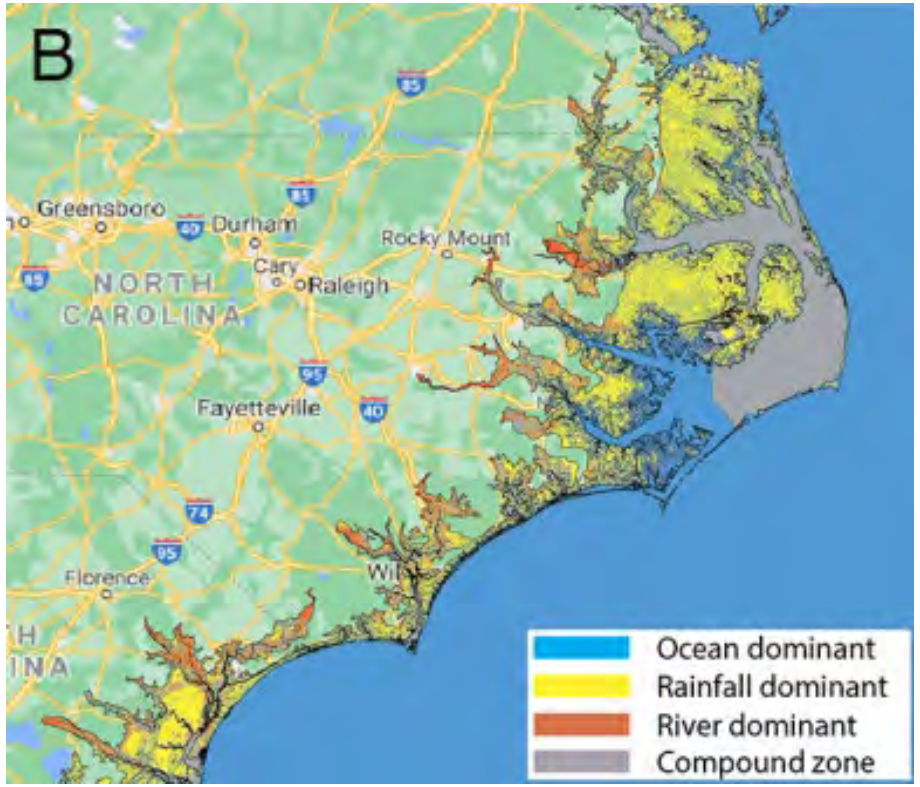
This signal impacts coastal and continental slope oceanic variability as far as in Oregon (45N) (Kurapov et al., JGR 2022, 2023)

Summer 2023 SST anomaly



Land-Ocean Continuum: integration of coastal ocean and estuaries/deltas/wetlands, coastal cities

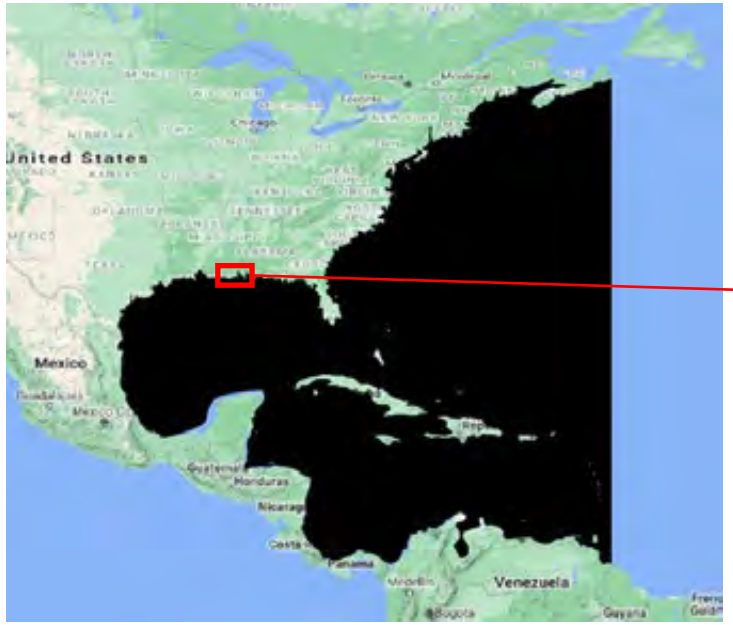
- in estuaries: seafood farming, salt water intrusion
- storm surge, nearshore wave processes: sediment transport, coastal resiliency (beach morphology)
- compound floods (combined effect of the storm surge and terrestrial runoffs, esp. following hurricanes)
- total sea level (for navigation): tides + atm pressure + geostrophic ocean currents + storm surge + waves + terrestrial discharges



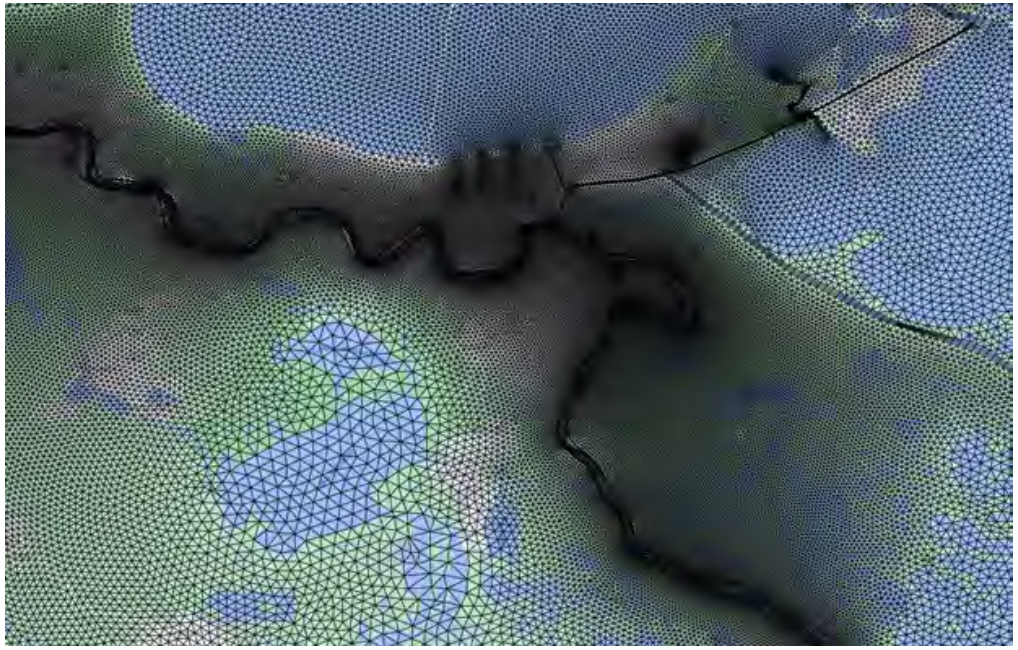
Individual flood drivers were dominantly responsible for the vast majority of flooding in some regions (blue, yellow, red) along the coast of the Carolinas during Hurricane Florence, whereas multiple factors were significant in other areas (gray). [Credit: Wei Huang, adopted from Moghimi et al. EOS, 2021]

Approaches include: unstructured mesh models

Storm and Tide Operational Forecast System: STOFS-Atlantic (2D, 3D)



A close-up on the Mississippi Delta: the grid is extended onshore

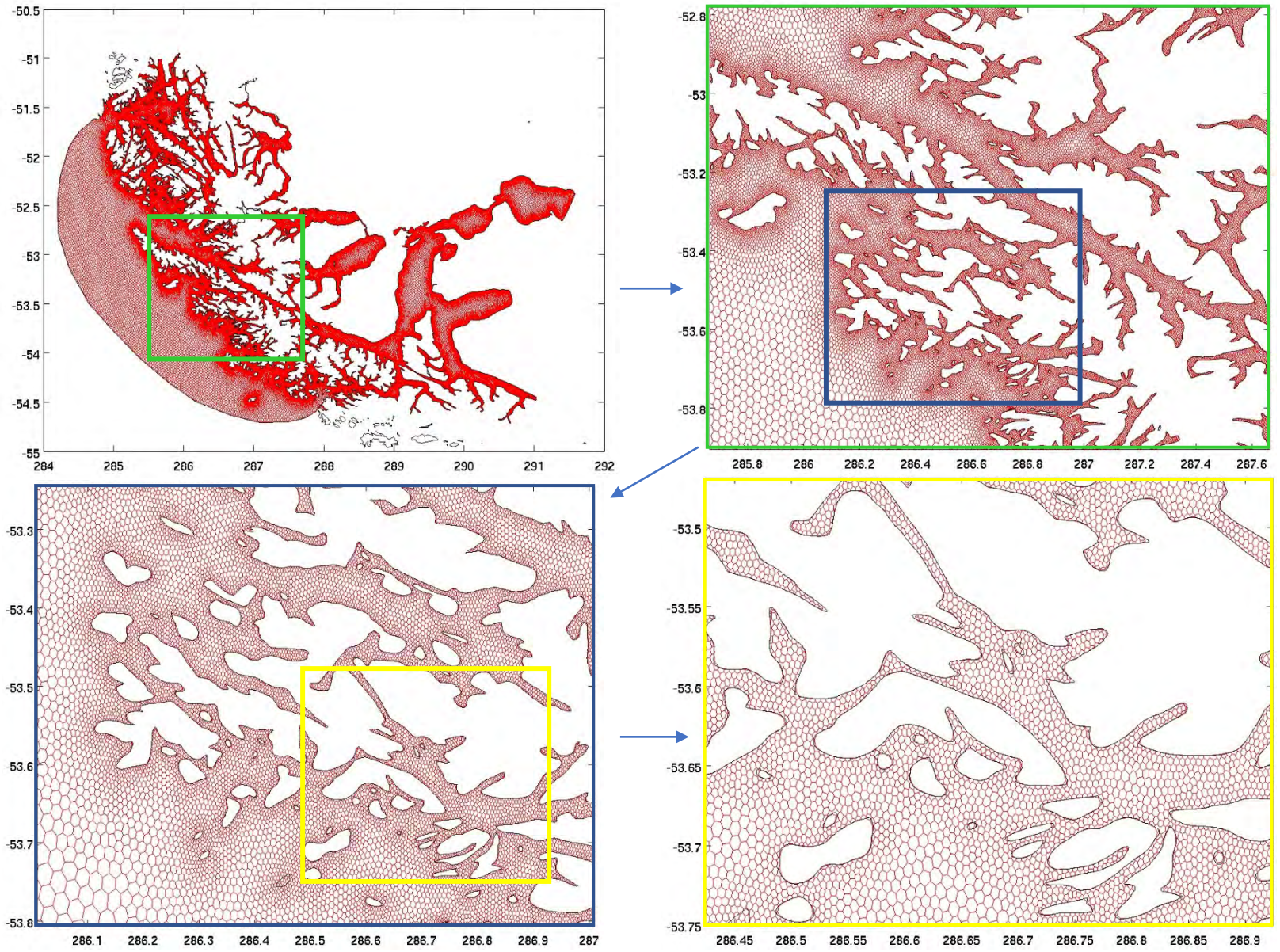


Credit: NOAA Storm Surge Team (Moghimi et al.)

New approaches to modeling: using hexagon meshes for improved numerics

Courtesy: Mark Hetzfeld (SCIRO, Australia)

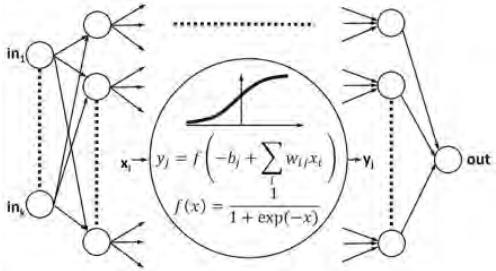
Example of resolution transition in Region XII, Patagonia, Chile

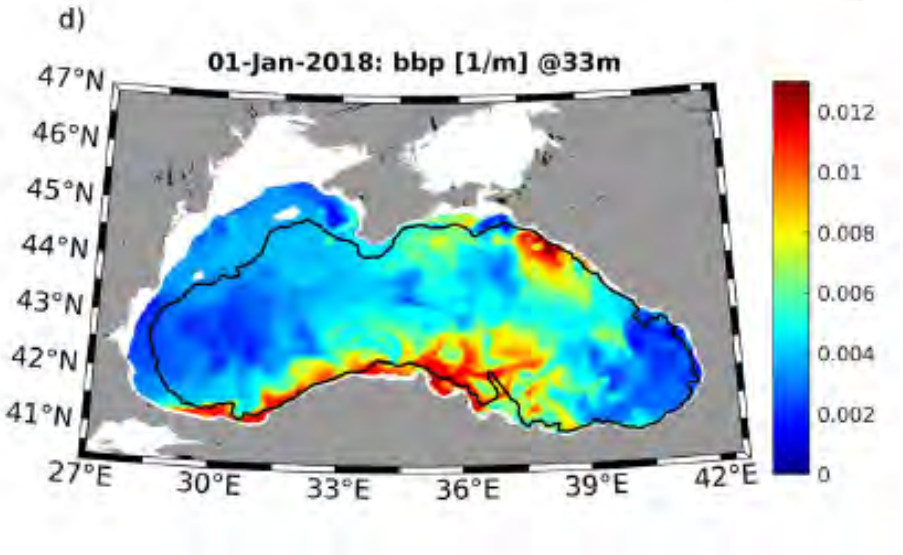


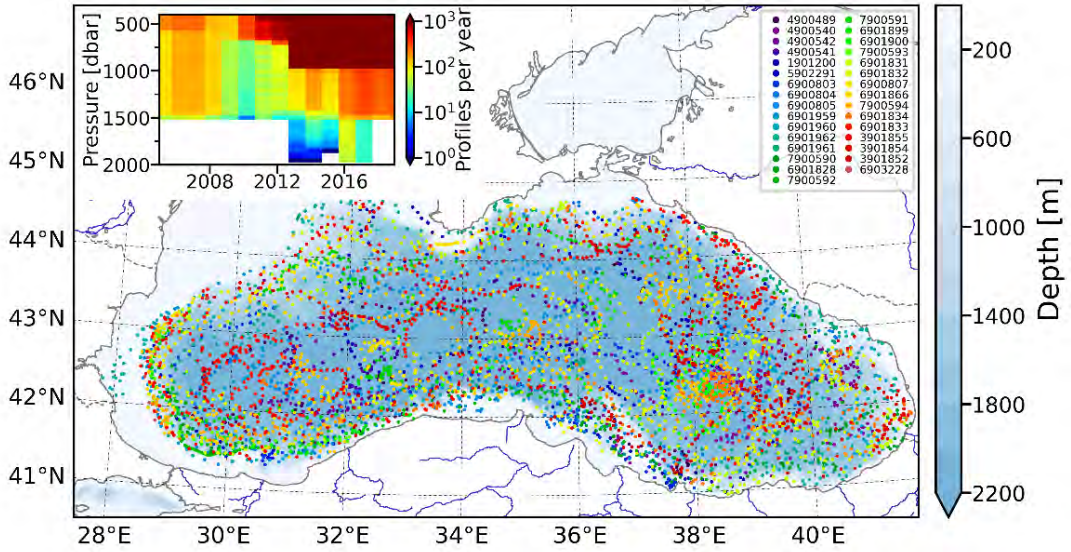
Machine Learning (ML) applications for coastal ocean forecasting

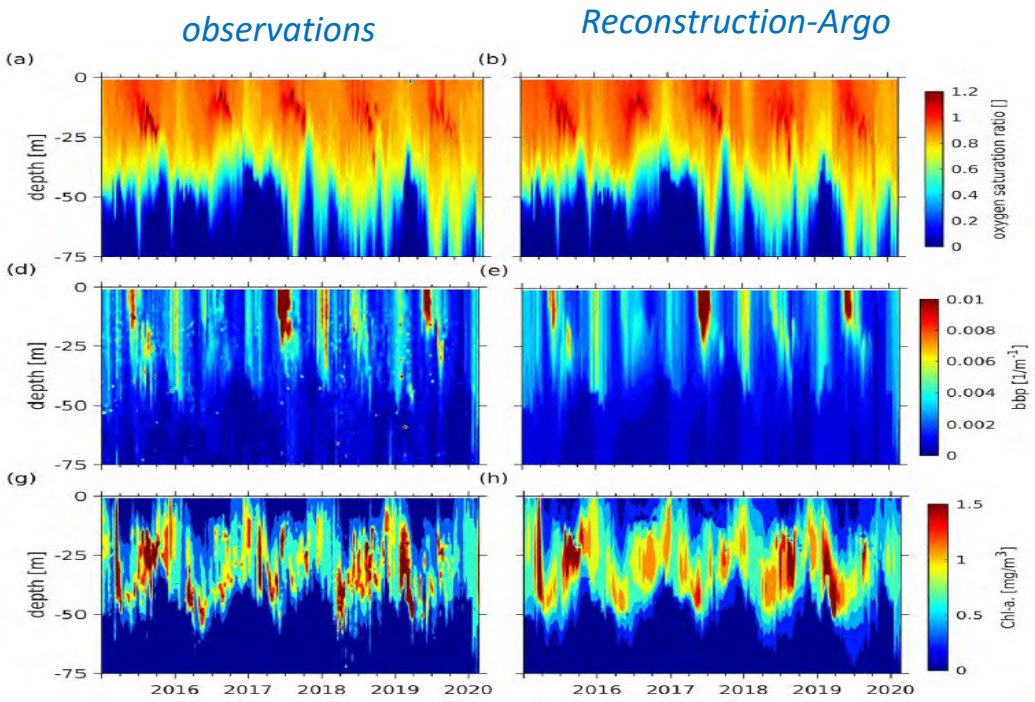
Example: *Stanev et al. JGR 2022*

- Use Argo bio-geo-chemical (BGC) + T&S profiles to train an AI model
- Use this to fill gaps in BGC data using model or observed T&S information









SUMMARY and DISCUSSION POINTS:

- new ways to communicate

- new challenges and areas:
  - ocean continuum: large-scale ↔ regional ↔ shelf ↔ nearshore ↔ inland*
  - the scope of essential processes is expanded (marine heat waves - MHW, surface waves, floods, physical-bio-geochemical interactions)
  - new numerical model approaches, coupling (atm ↔ ocean ↔ ice ↔ wave ↔ hydrology)
  - Machine learning / Artificial Intelligence
  - Coastal climate projections is still TBD with TT and OP: coordinate with CP/FLAME ?
  - synergy with other TT: data assimilation, BGC, CalVal etc.

* inland: includes urban environments. It is a new challenge with many efforts backing it up (including an IOC initiative on "cities by the ocean" that will be launched next April during the Ocean Decade conference in Barcelona)