SYMPOSIUM 24'

Ocean Predict

In partnership with unesco Intergovernmental Oceanographic Commission

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

A relocatable approach to regional ocean forecast systems:

Applications along South Africa's continental shelf

Giles Fearon[1], Jennifer Veitch[1,2], Zach Smith[3], Nkululeko Memela[1], Gustav Rautenbach[1]

[1] Egagasini Node, South African Environmental Observation Network (SAEON), Cape Town, South Africa.
[2] Nansen-Tutu Centre, Marine Research Institute, University of Cape Town, Department of Oceanography, Cape Town, South Africa.
[3] South African Radio Astronomy Observatory (SARAO).

Forestry, Fisheries and the Environment

Science and Innovation

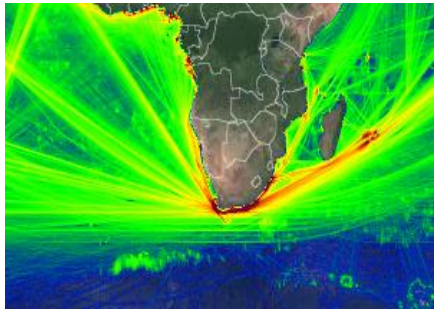
OPERATION PHAKISA planning | implementation | growth

NATIONAL OCIMS

NRF National Research Foundation | SAEON South African Environmental Observation Network

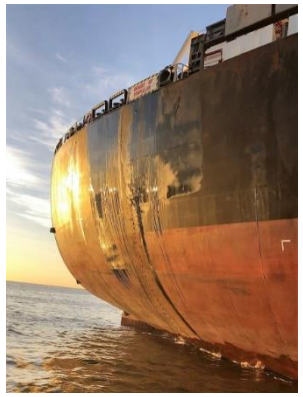
Bunkering operations in Algoa Way

https://blog.samsa.org.za/2019/07/

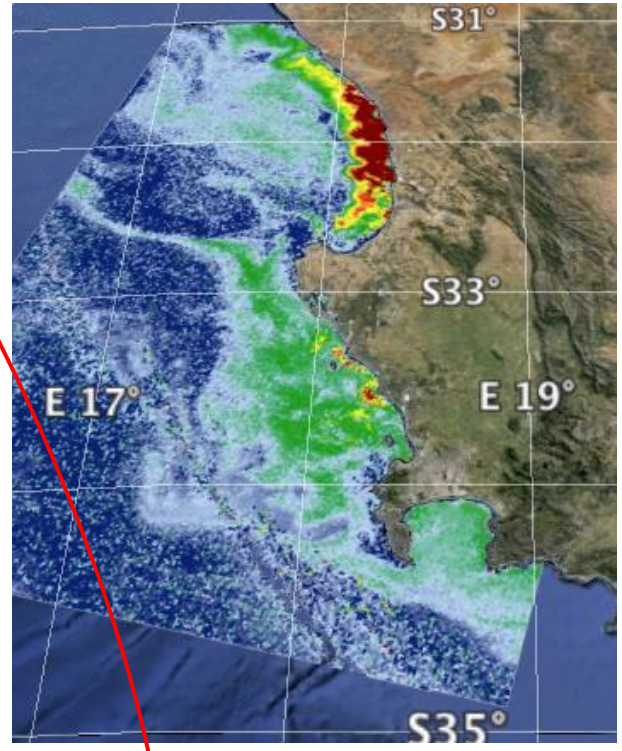


Oil spill on 6 July 2019:

- ~400 litres of oil was spilled
- 120 + seabirds heavily affected (gannets and penguins)



Harmful Algal Blooms



https://www.sowetanlive.co.za/news/2022-03-04-in-pics-dramatic-images-of-cape-rock-lobster-walkout-after-red-tide-on-west-coast/

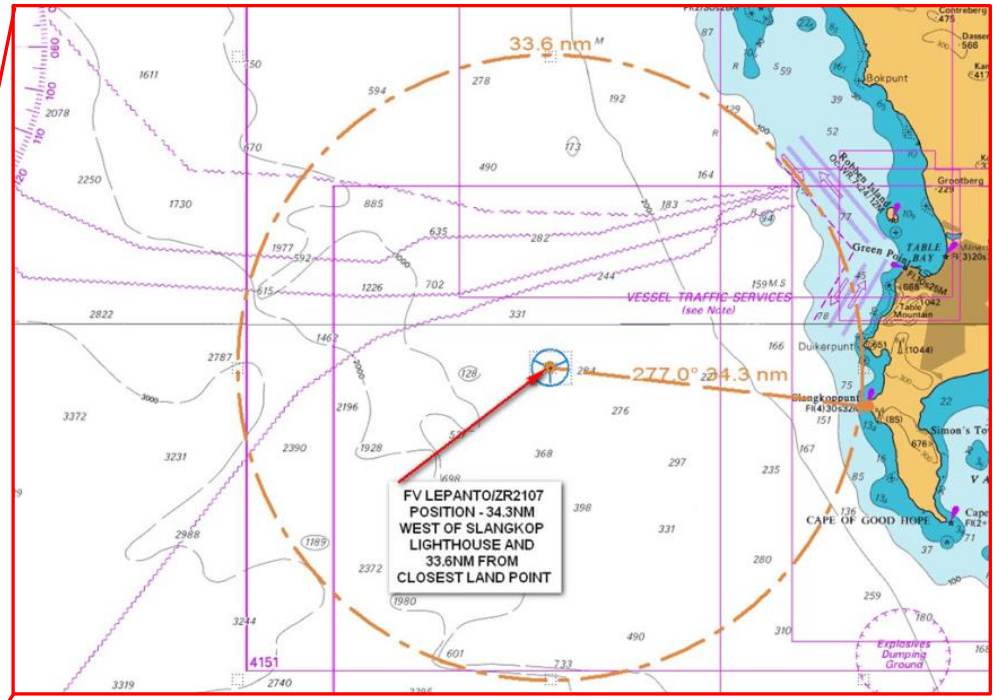
Pitcher, Bernard and Ntuli (2008), "Contrasting bays and red tides in the southern Benguela upwelling system." Oceanography Vol.21, No.3

High Court presumes 11 missing fishermen dead after May 2024 tragedy off Cape Town coast

Noxolo Sibiya

news24

https://blog.samsa.org.za/2024/05/19/search-for-11-missing-fishermen-called-off-incident-investigation-underway-samsa/



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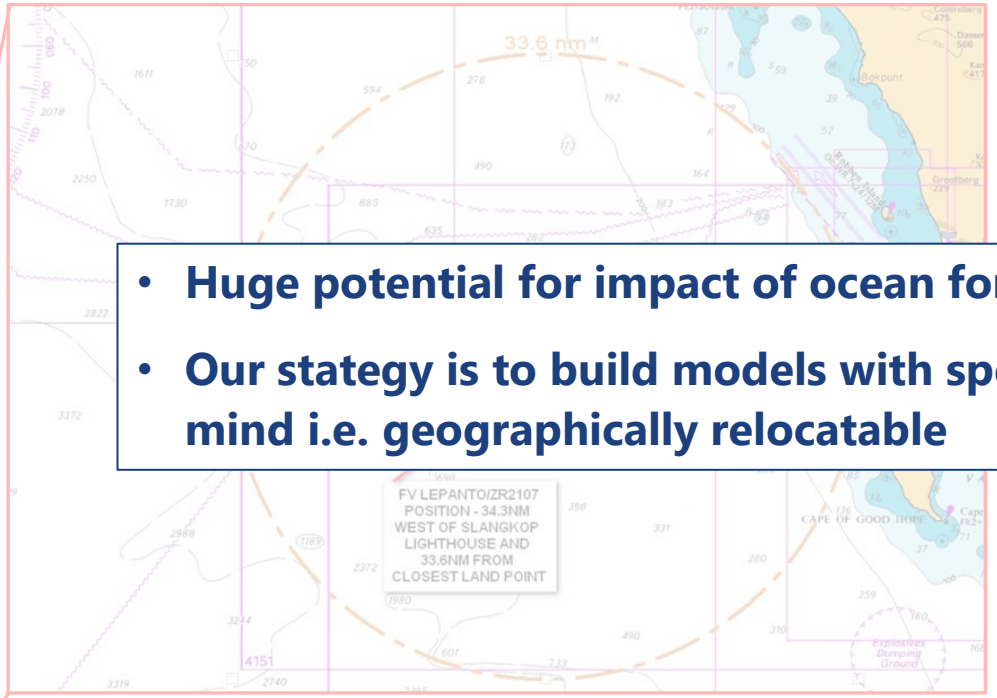


- **Huge potential for impact of ocean forecast systems**
- **Our stategy is to build models with specific use cases in mind i.e. geographically relocatable**

Coastal and Regional Ocean COmmunity model configuration

CROCO
Coastal and Regional Ocean COmmunity model

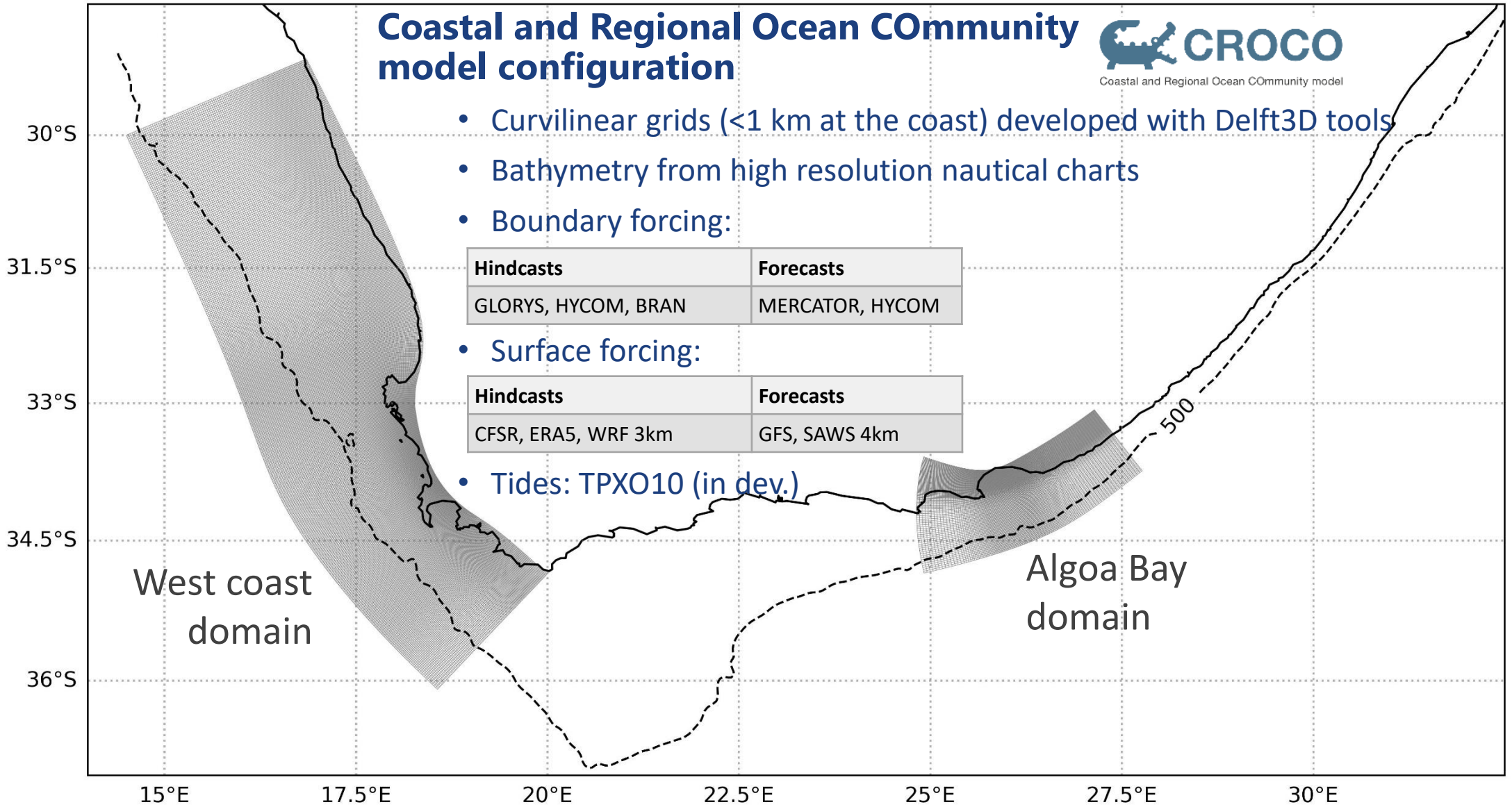
- Curvilinear grids (<1 km at the coast) developed with Delft3D tools
- Bathymetry from high resolution nautical charts
- Boundary forcing:

Hindcasts	Forecasts
GLORYS, HYCOM, BRAN	MERCATOR, HYCOM

- Surface forcing:

Hindcasts	Forecasts
CFSR, ERA5, WRF 3km	GFS, SAWS 4km

- Tides: TPXO10 (in dev.)



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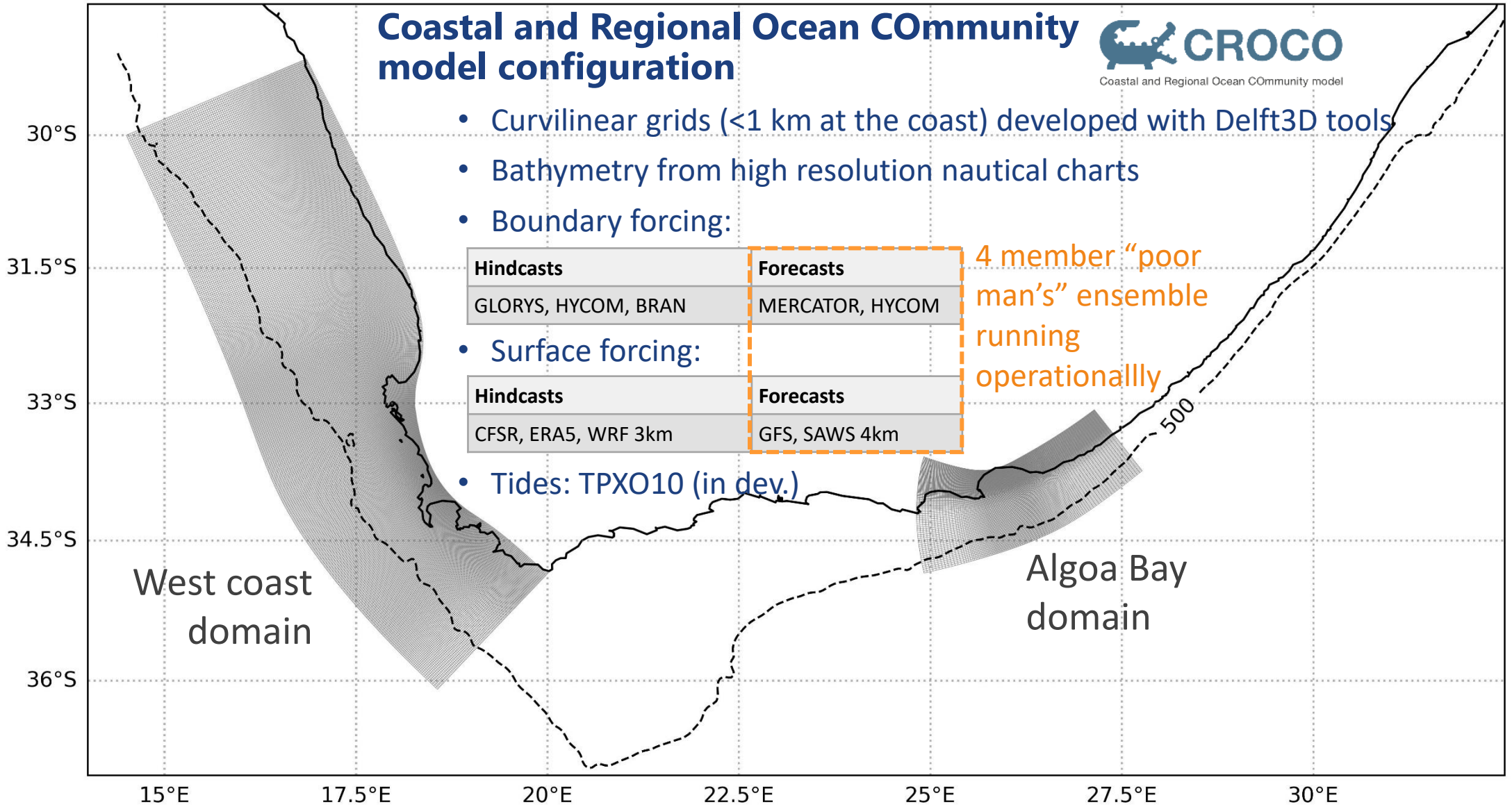
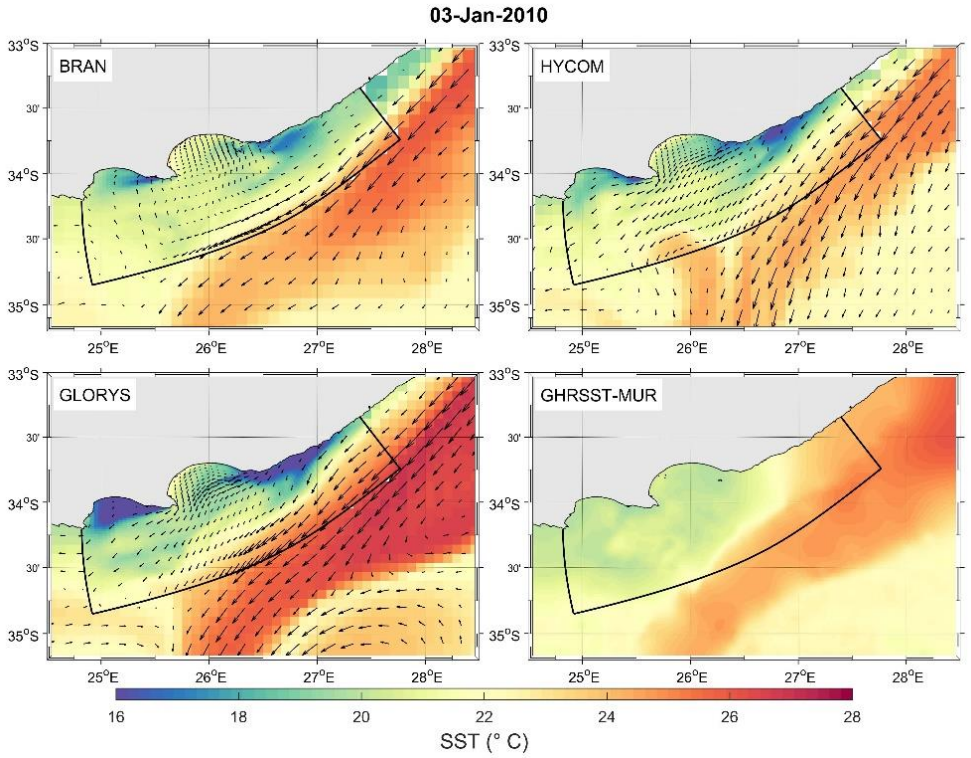
4 member "poor man's" ensemble running operationallly

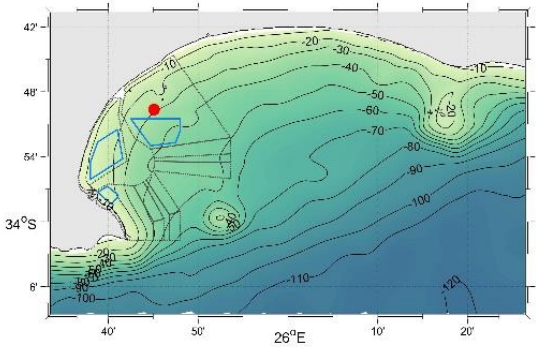


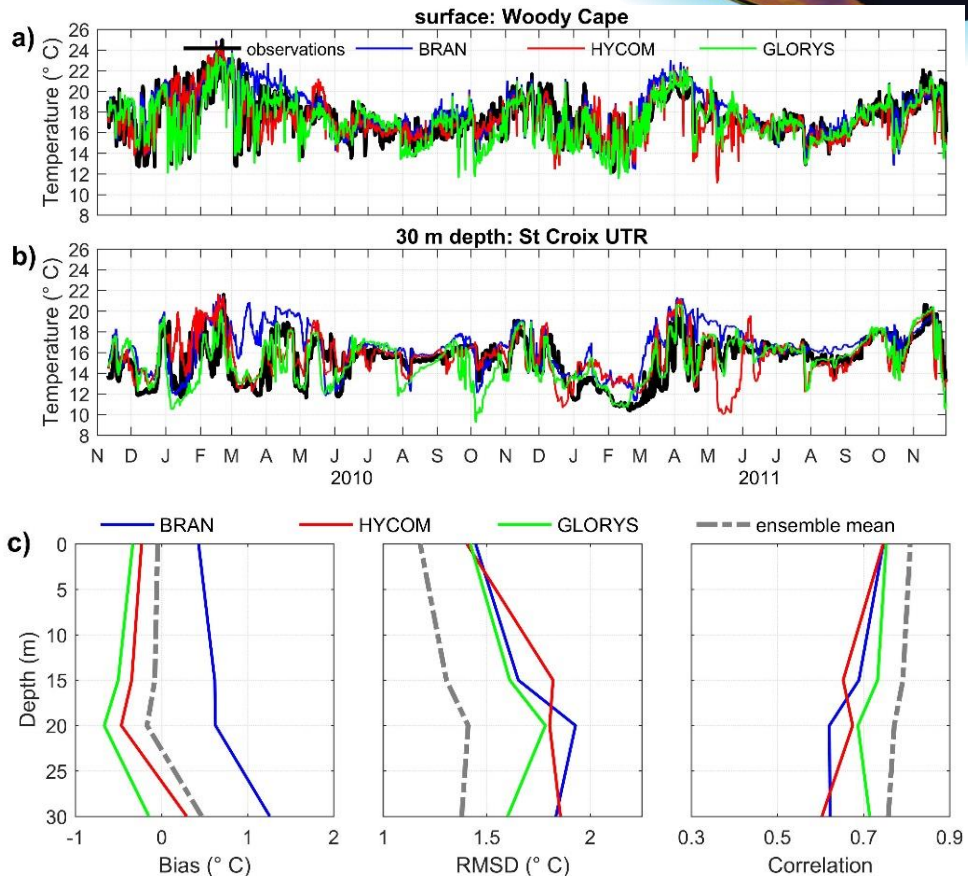
Algoa Bay domain hindcast: Evaluation of temperature

- Hindcasts using three different boundary forcings:
  - HYCOM
  - GLORYS
  - BRAN



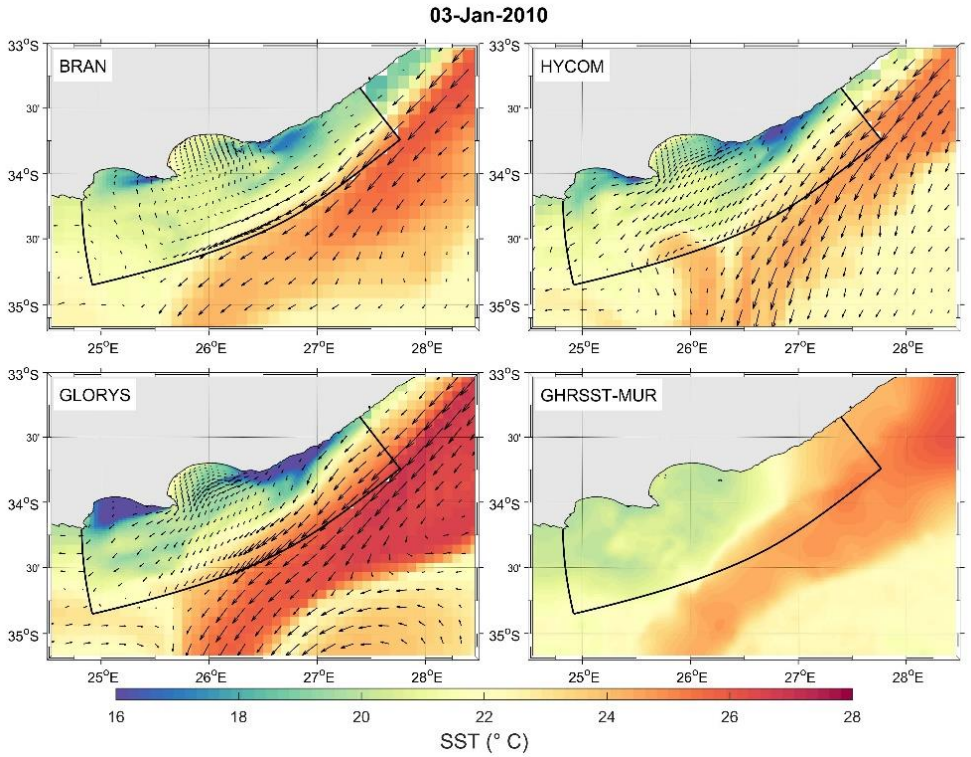
3 member ensemble mean outperforms any individual run





Algoa Bay domain hindcast: Evaluation of currents

- Hindcasts using three different boundary forcings:
  - HYCOM
  - GLORYS
  - BRAN



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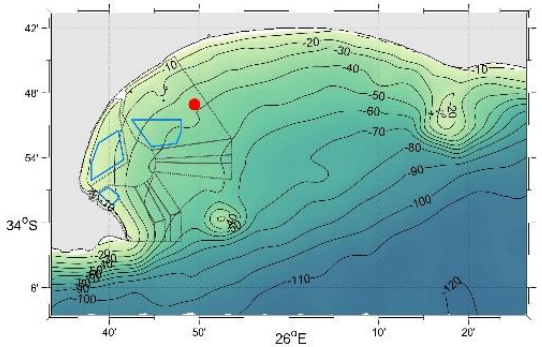
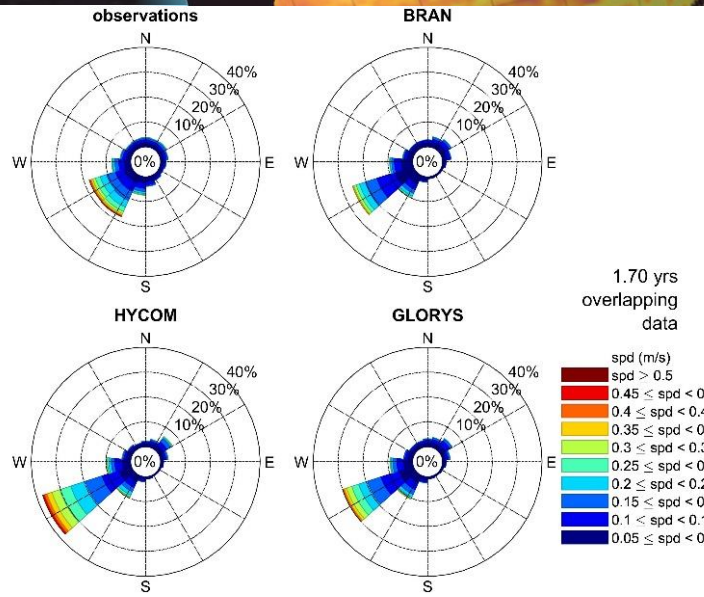
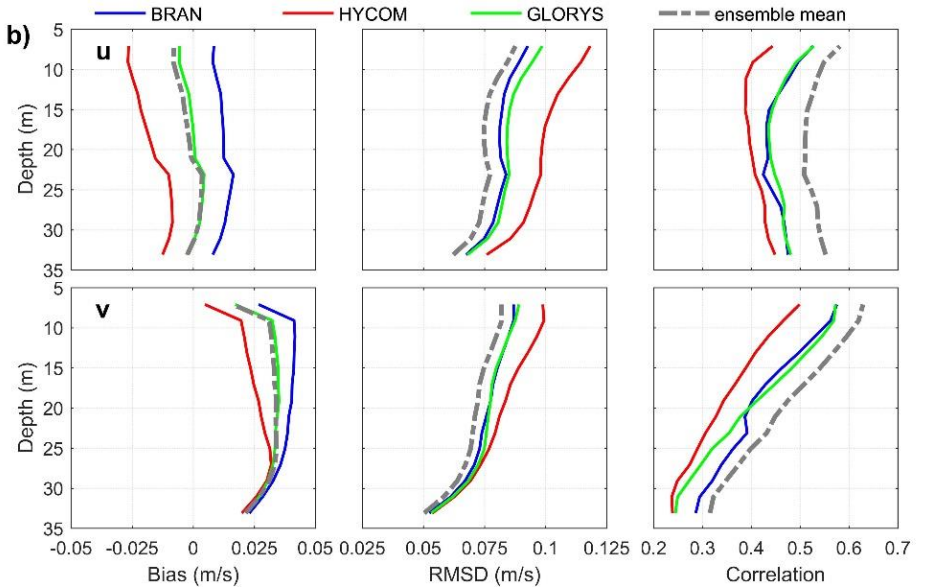
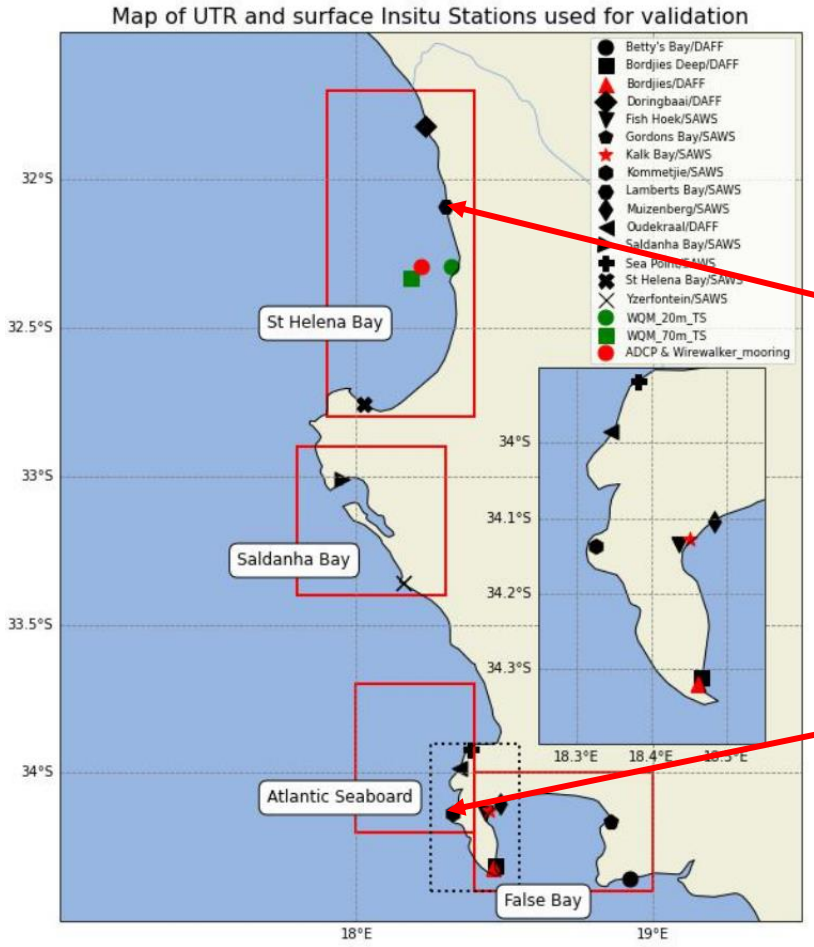




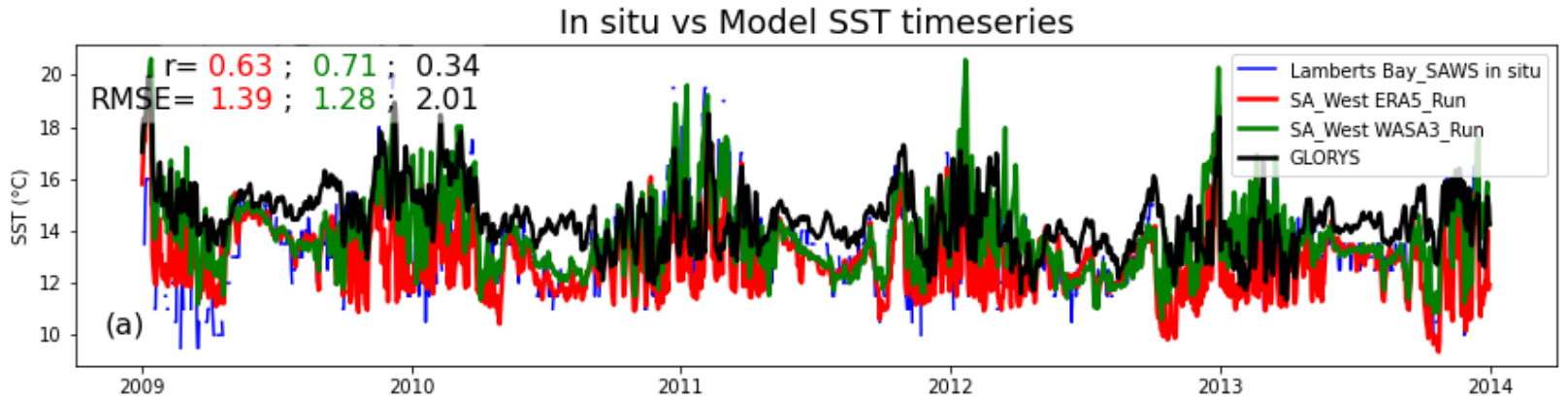


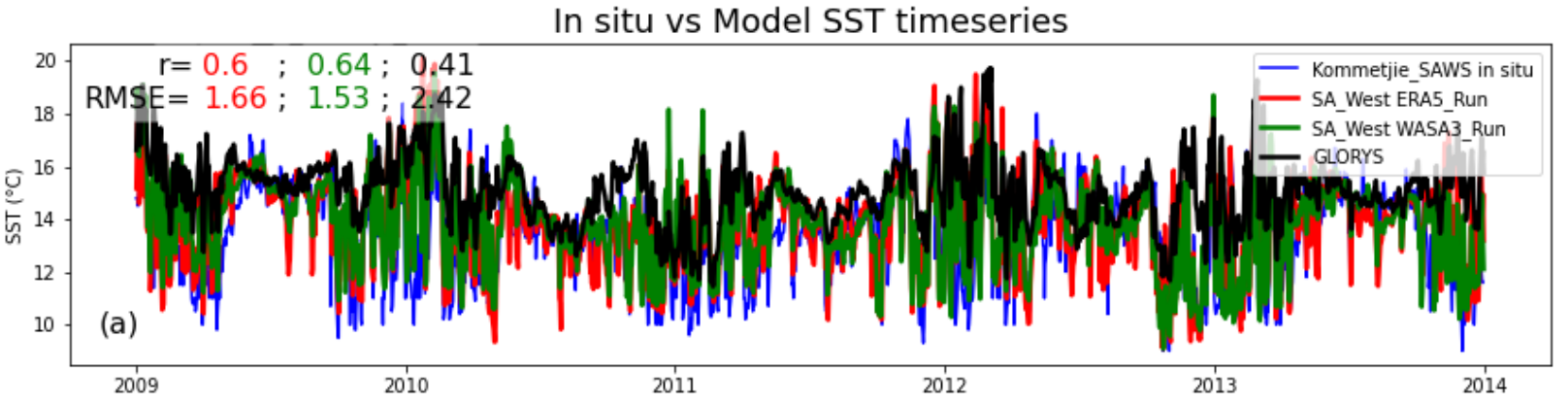
West coast domain: Evaluation of temperature

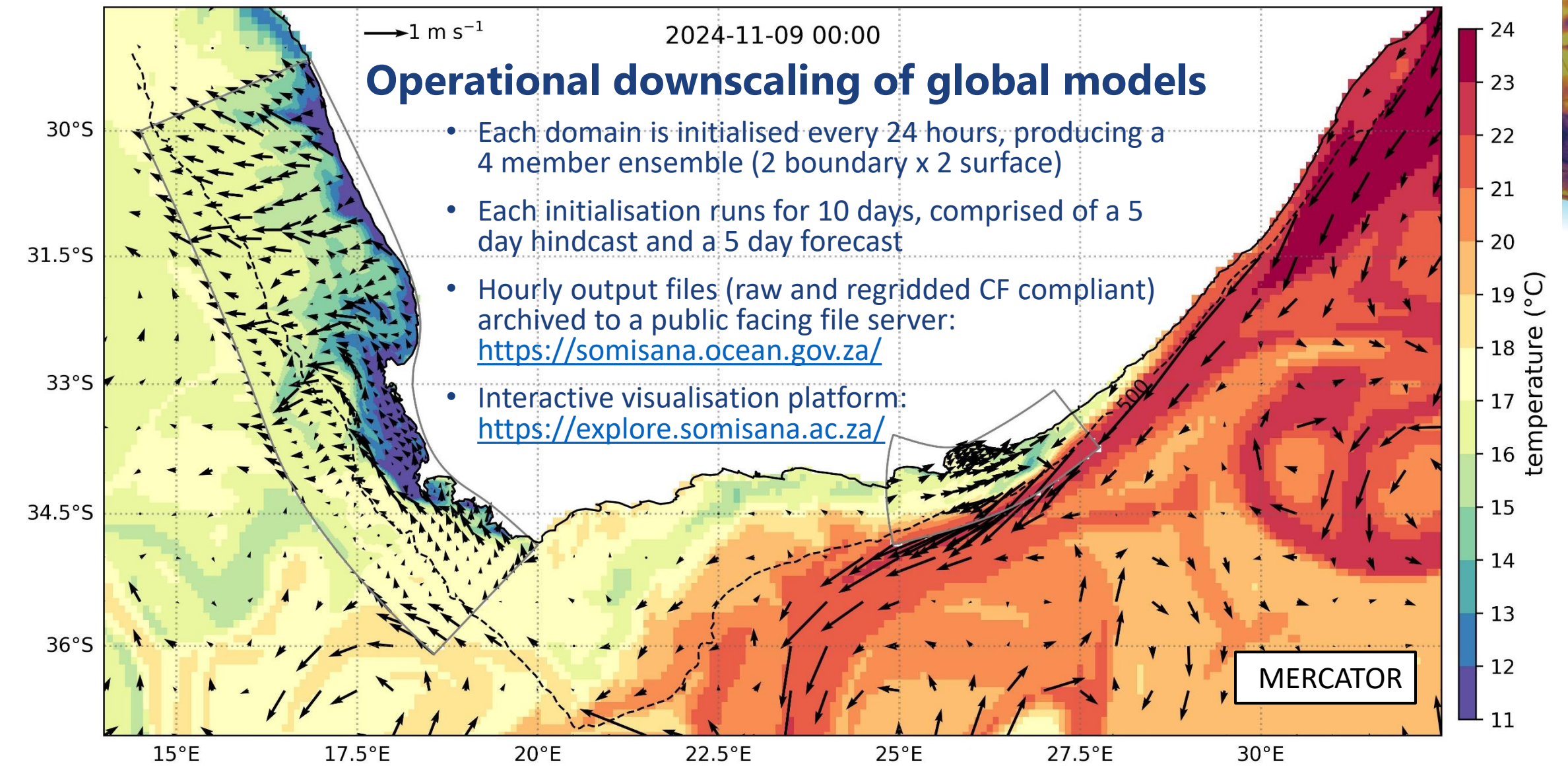
- Boundaries: GLORYS
- Surface: ERA5 and WRF 3km



Downscaled solution outperforms the global solution







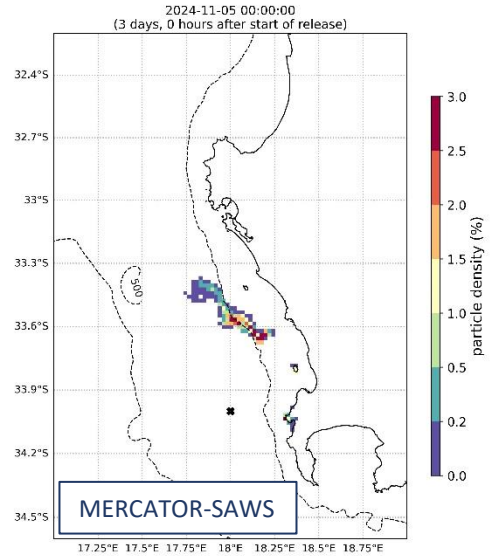
Operational downscaling of global models

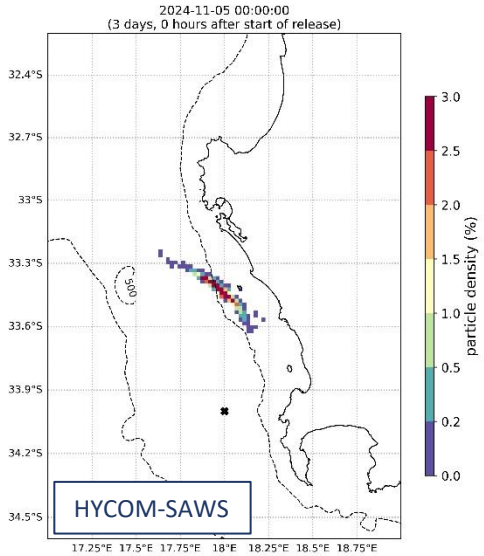
- Each domain is initialised every 24 hours, producing a 4 member ensemble (2 boundary x 2 surface)
- Each initialisation runs for 10 days, comprised of a 5 day hindcast and a 5 day forecast
- Hourly output files (raw and regridded CF compliant) archived to a public facing file server: https://somisana.ocean.gov.za/
- Interactive visualisation platform: https://explore.somisana.ac.za/

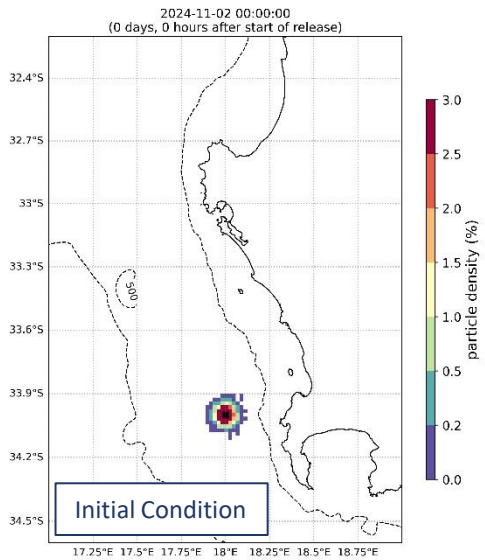
Operational particle tracking

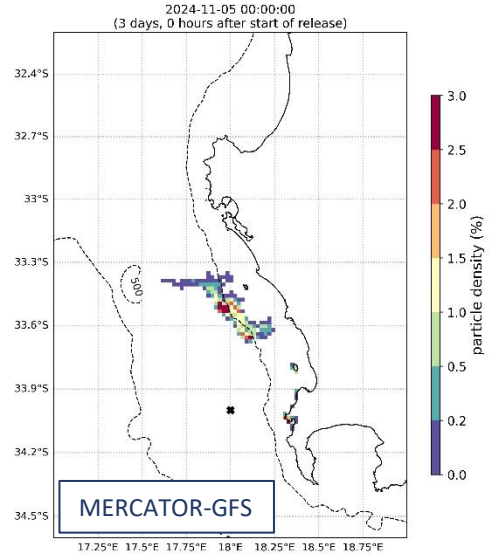
OpenDrift

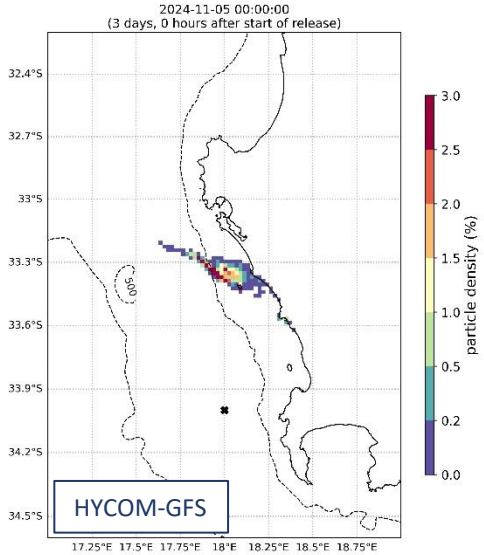
- OceanDrift
- OpenOil
- Leeway

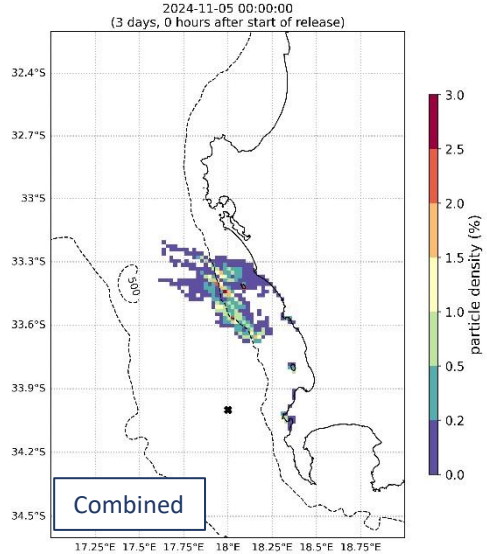












SYMPOSIUM OP'24

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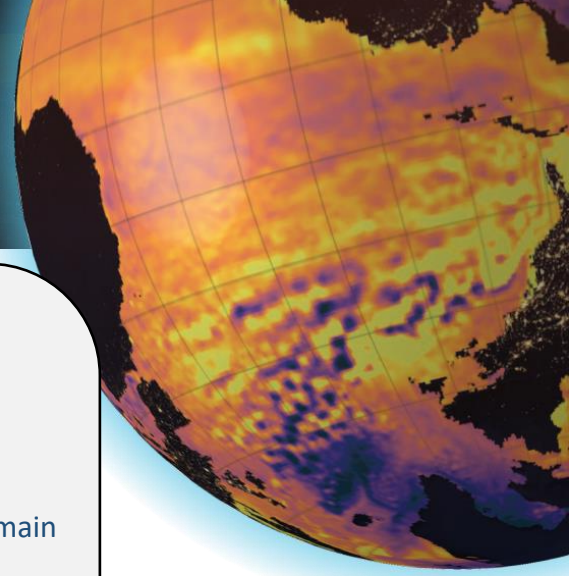

Github Actions workflow

https://github.com/SAEON/somisana-croco

ghcr.io/saeon/somisana-croco_run_main

ghcr.io/saeon/somisana-croco_cli_main

ghcr.io/saeon/somisana-croco_cli_main

download data and prepare forcing files

Compile code, run CROCO on both domains

CROCO

Coastal and Regional Ocean COmmunity model

Postprocess output files

Upstream data providers

OGCMs:
- HYCOM 1/12°
- MERCATOR 1/12°

Atmospherics:
- GFS 1/4°
- SAWS 4 km

Tides:
- TPXO10

Data for downstream services

public facing file server

https://somisana.ocean.gov.za/

ghcr.io/saeon/somisana-opendrift_main

OpenDrift

run OpenDrift on all combinations of forcing data

Github Actions workflow

https://github.com/SAEON/somisana-opendrift

Github Actions workflow
https://github.com/SAEON/somisana-croco

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Tides:
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- **A relocatable system, both in terms of the geographical domain and the infrastructure on which it runs**
- **The workflow could be adapted by other developing countries with their own use cases in mind**

Data for downstream services

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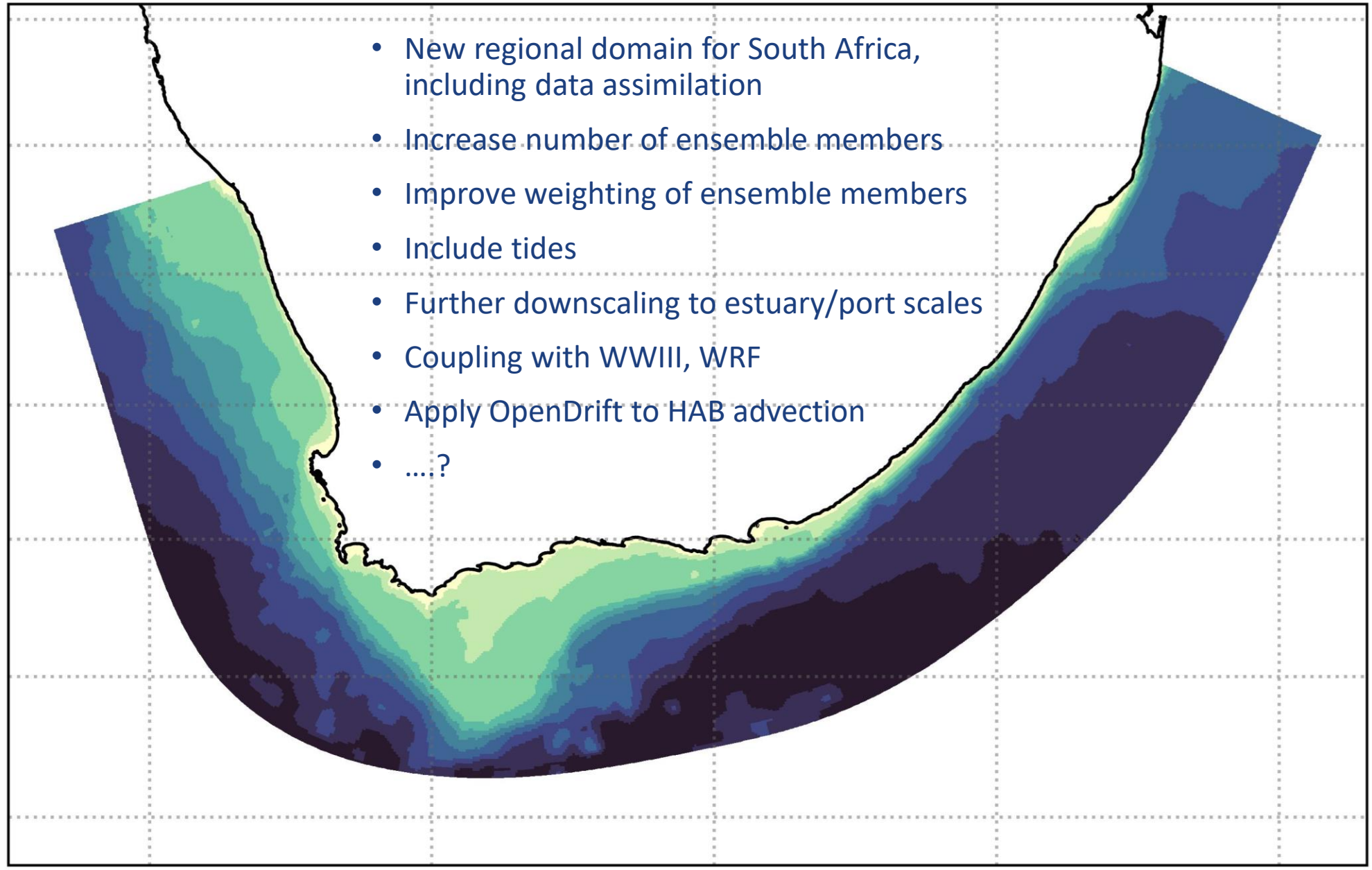
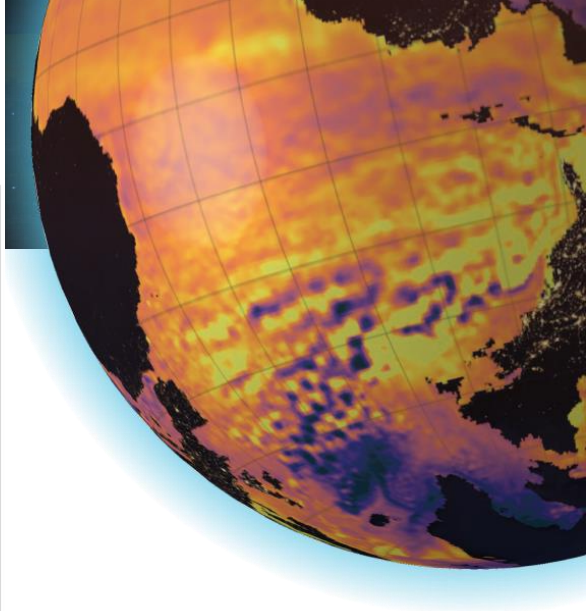
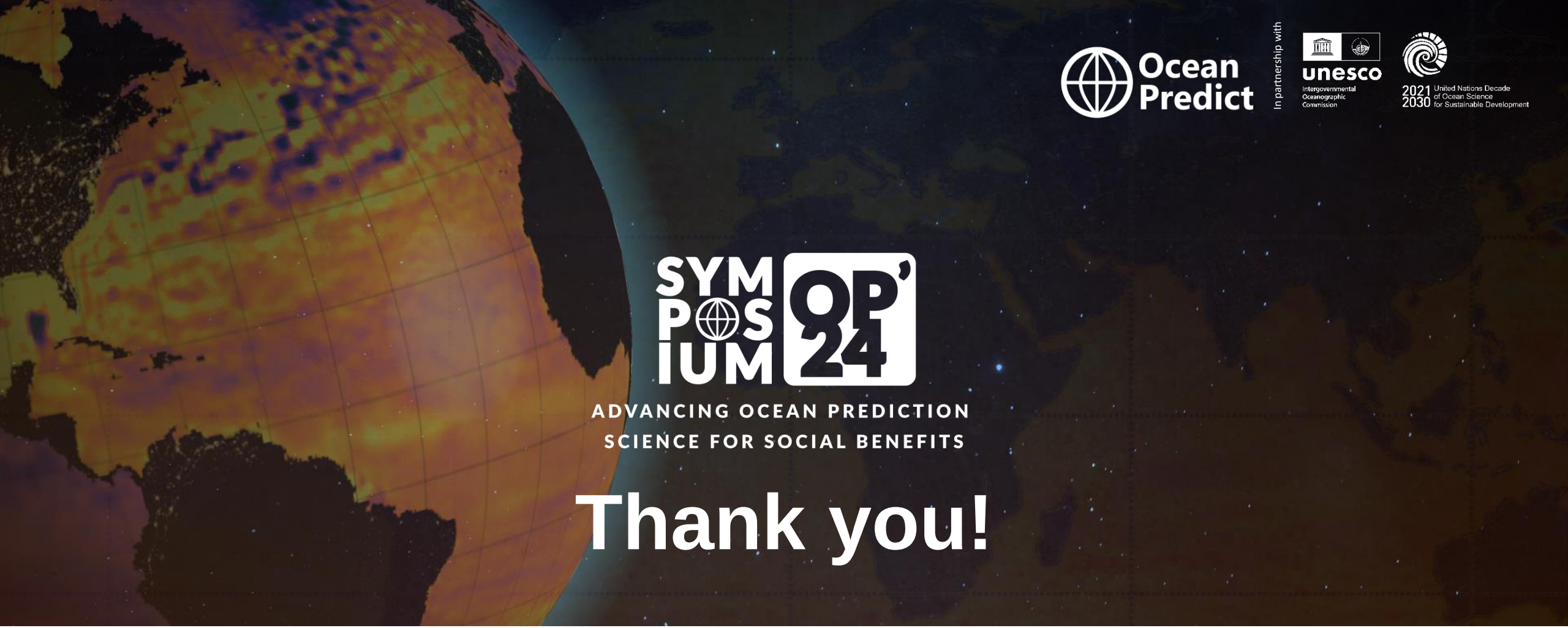
Where to from here?



- New regional domain for South Africa, including data assimilation
- Increase number of ensemble members
- Improve weighting of ensemble members
- Include tides
- Further downscaling to estuary/port scales
- Coupling with WWIII, WRF
- Apply OpenDrift to HAB advection
- …?





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Intergovernmental Oceanographic Commission

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SYMPOSIUM OP'24

ADVANCING OCEAN PREDICTION
SCIENCE FOR SOCIAL BENEFITS

Thank you!

European Commission

Copernicus Marine Service

EU4oceanobs
INTERNATIONAL OCEAN GOVERNANCE
EU COMPONENT TO GLOBAL OCEAN OBSERVATIONS

esa

cnes
CENTRE NATIONAL D'ÉTUDES SPATIALES

Met Office

NERSC

MERCATOR OCEAN INTERNATIONAL

Australian Government
Bureau of Meteorology

Canada