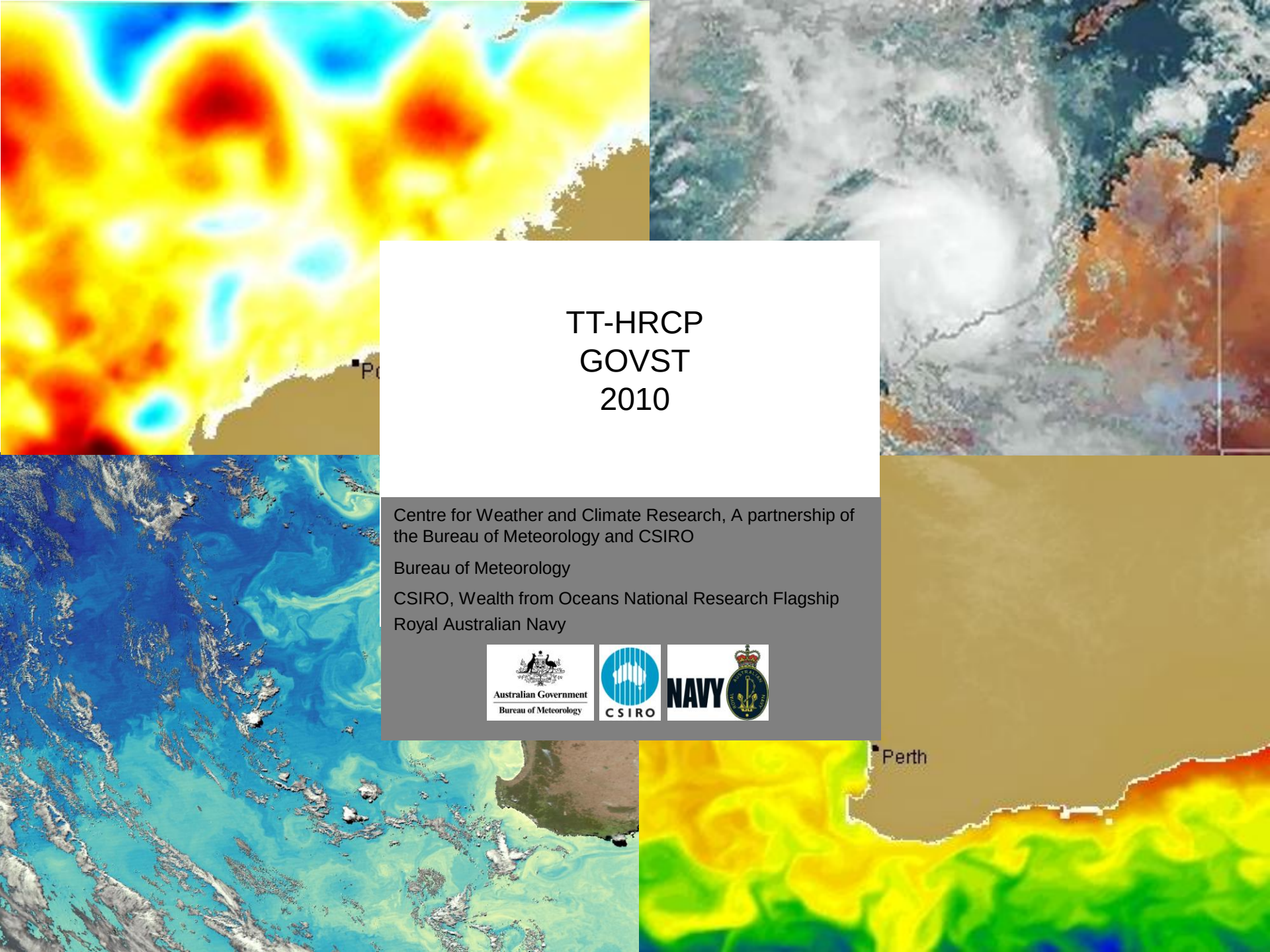


TT-HRCP
GOVST
2010

Centre for Weather and Climate Research, A partnership of the Bureau of Meteorology and CSIRO

Bureau of Meteorology

CSIRO, Wealth from Oceans National Research Flagship

Royal Australian Navy

Australian Government
Bureau of Meteorology

CSIRO

NAVY

Background

Proceedings of the ECMWF Workshop on Atmosphere-Ocean Interaction, 10-12 Nov 2008

(http://www.ecmwf.int/publications/library/do/references/list/28022009)

Proceeding of the Ocean Atmosphere Workshop, UK Met Office, 1-2 Dec 2009 (http://www.ncof.co.uk/modules/documents/documents/OAsummary.pdf)

WGNE presentation, GODAE OceanView, Eric Dombrowsky, Nov 2009

Brassington, G. B., 2010: Ocean prediction issues related to weather and climate prediction, CAS XV Vision paper (Agenda item 8.5)

Brunet, G., T. Keenan, J. Onvlee, M. Béland, D. Parsons and Jocelyn Mailhot, 2010: The next generation of regional prediction systems for weather, water and environmental applications, CAS XV Vision paper (Agenda item 8.2)

CAS Presentation

Coupling is the future for ocean prediction

Is coupling the future of weather prediction?

- Coupled dynamics
- Coupled data assimilation

What ocean to couple ?

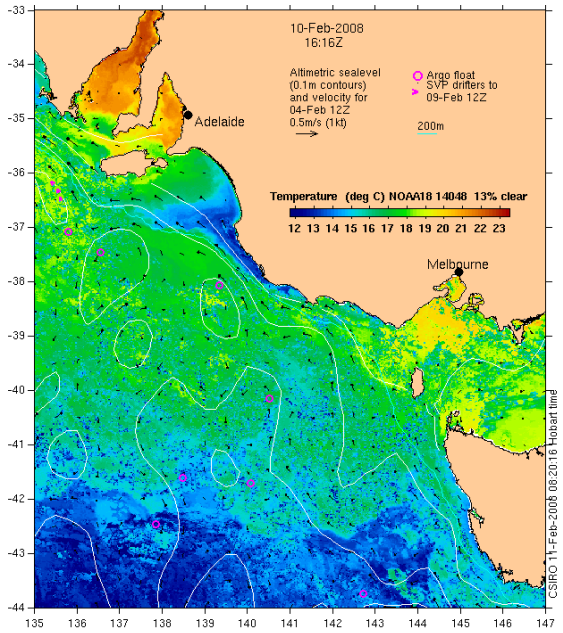
Status of ocean prediction

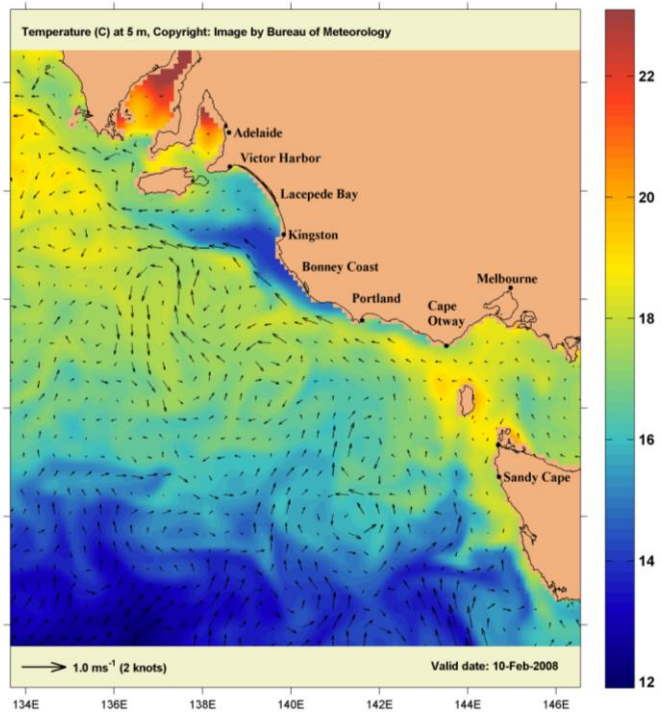
Why not couple with a high resolution ocean now?

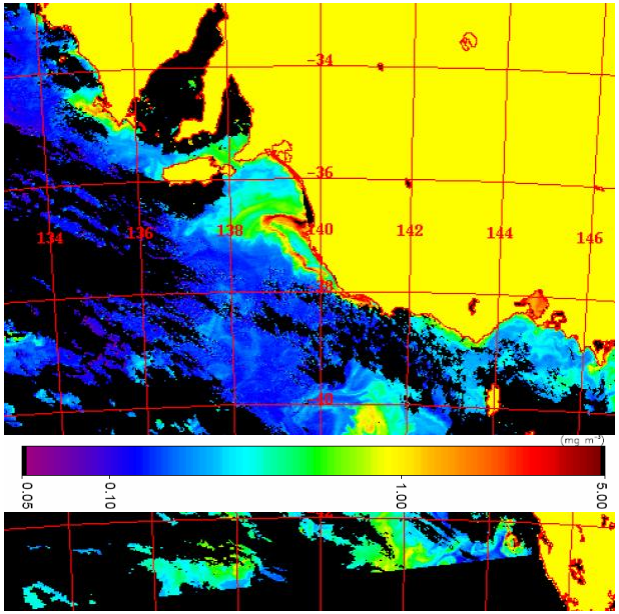
Pathway for high resolution coupling?

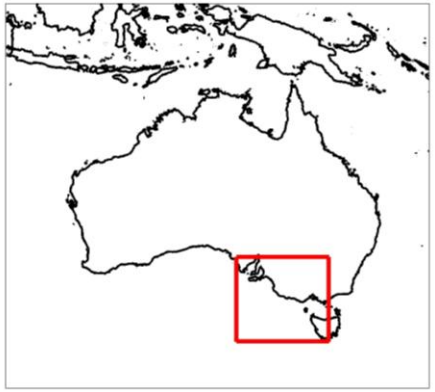
Making progress

Bonney coast upwelling – stable boundary layer



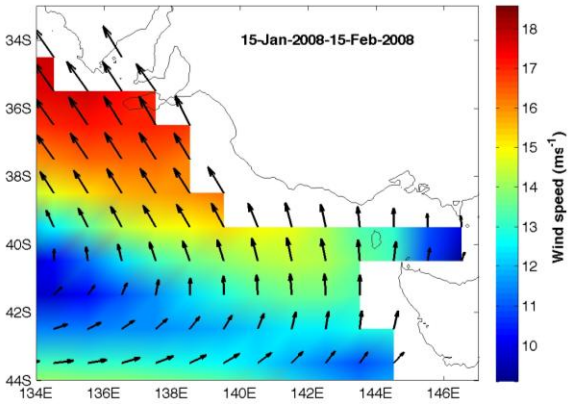




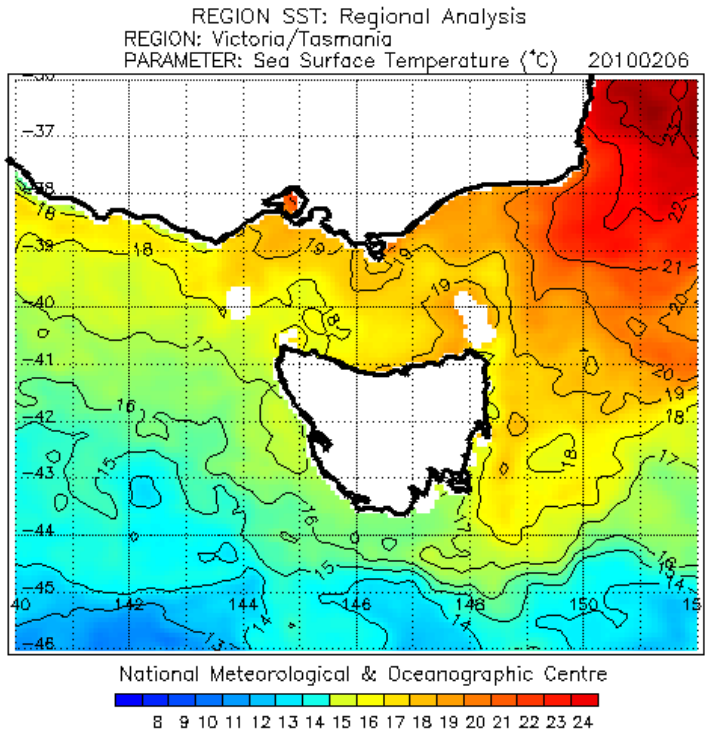


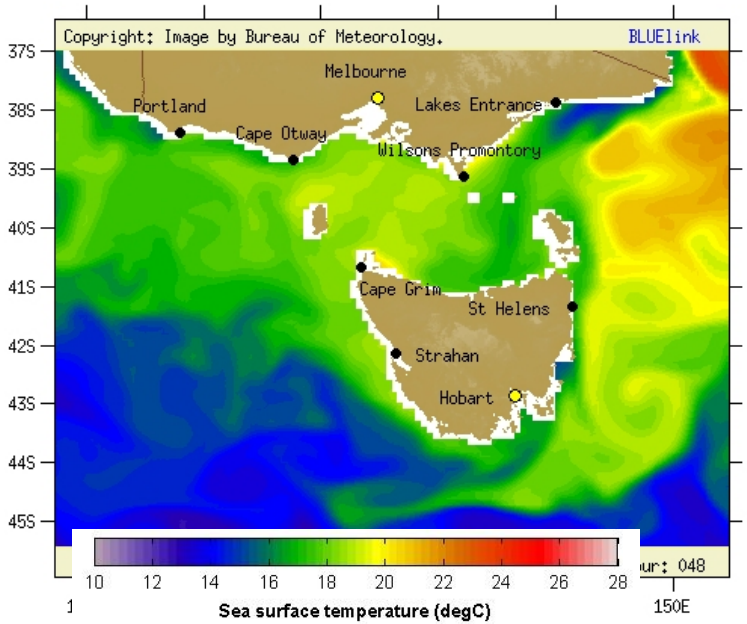
Bonney coast off South Australia is a location of frequent coastal upwelling

The upwelling in Feb 2008 was one of the largest events ever recorded



Sea fog – eastern Bass Strait





Persistent easterlies (upwelling favorable winds) observed off eastern Bass Strait

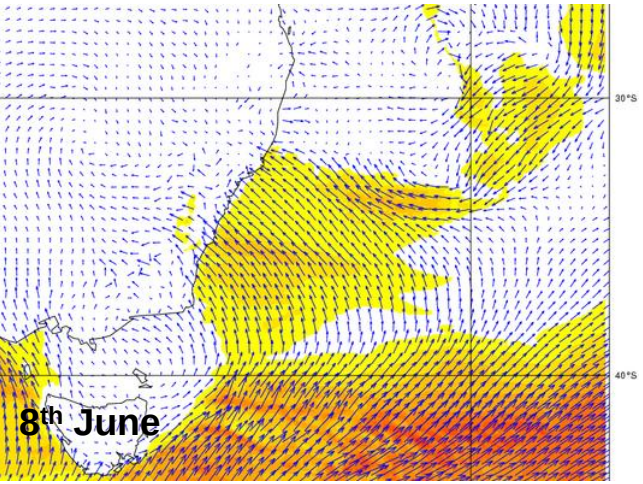
8th Feb 2010, VICRO forecaster noted discrepancy between RAMSSA (left) and BLUElink (right)

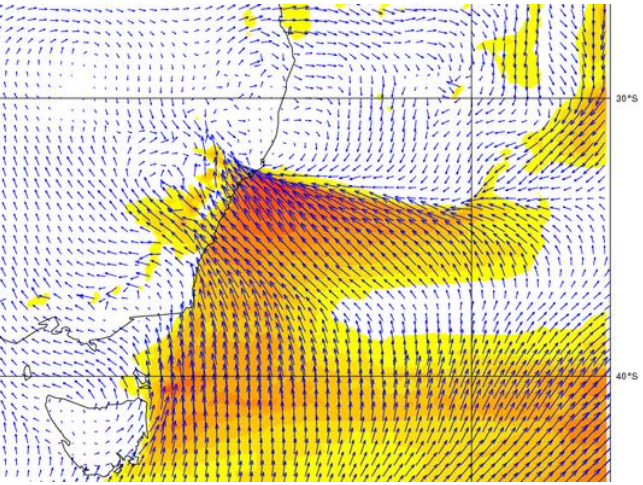
Dew points were estimated to be 17-19 °C

RAMSSA exhibits 18-19 °C (i.e., no fog) while BLUElink 14-15 °C (i.e., sea fog)

A major sea fog event took place in this case

East coast cyclone – Pasha Bulker

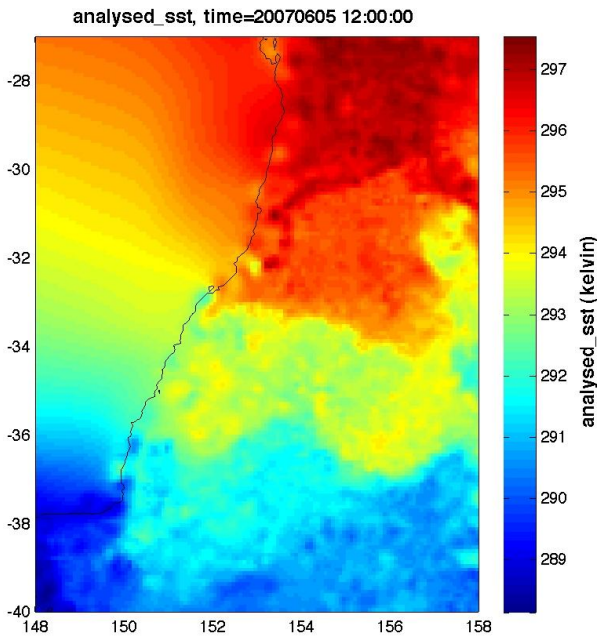


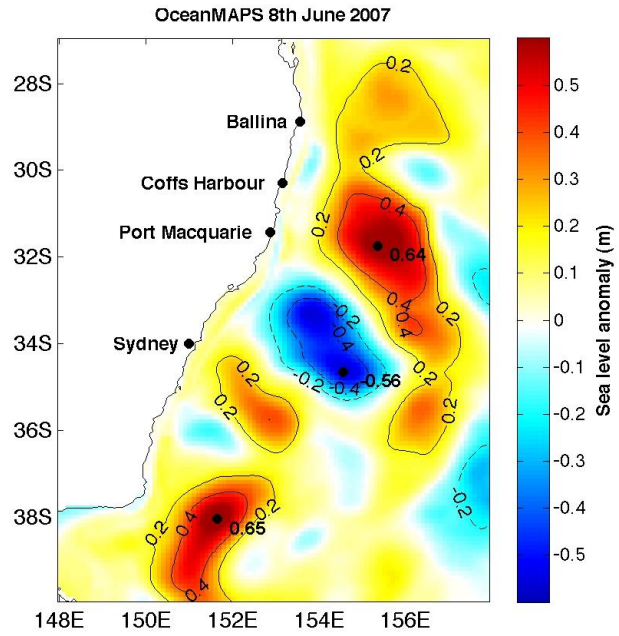


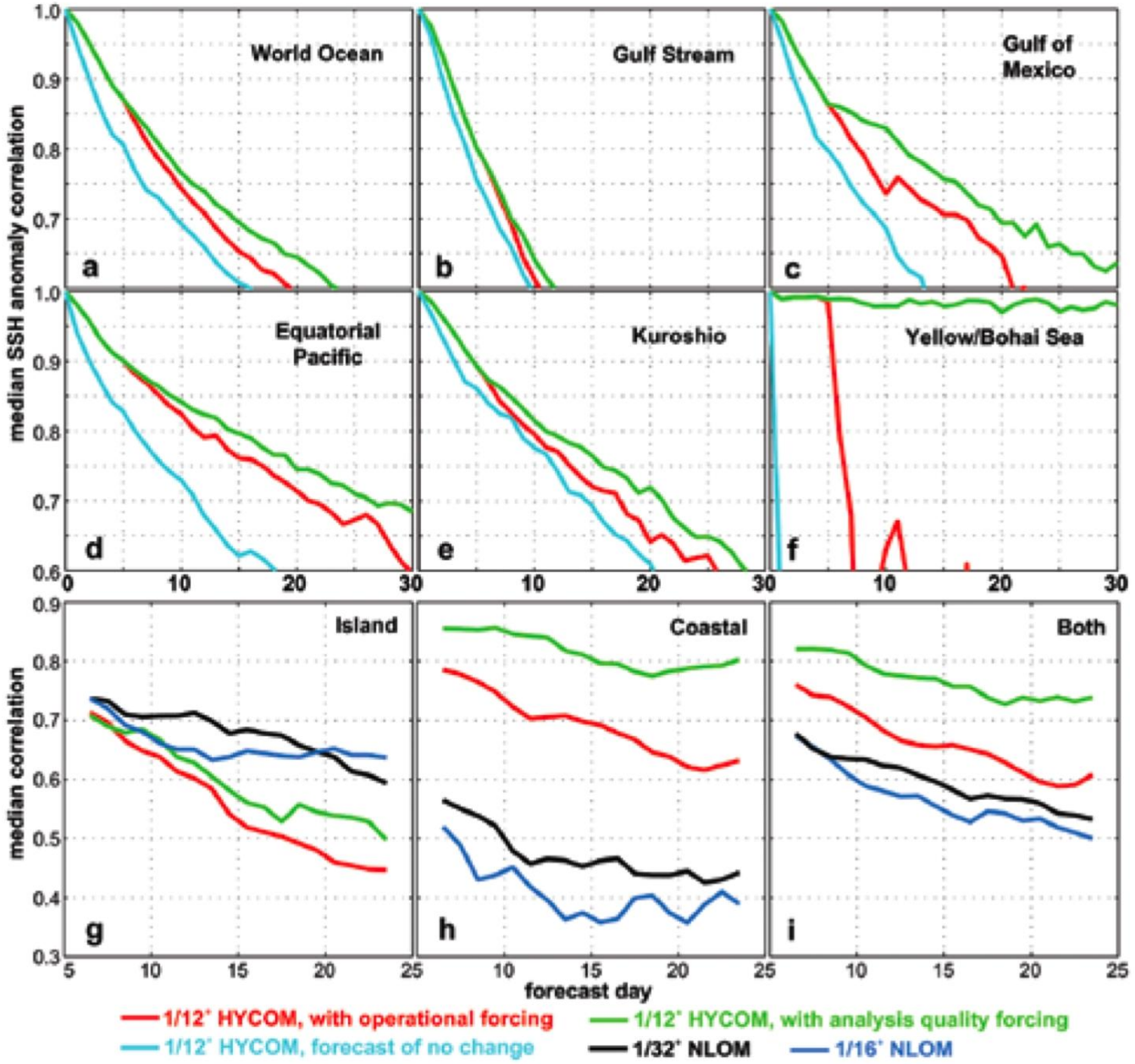
7th June 2007

Rapid storm development aligned with the SST front, 8th June 2007
Flash flooding resulting in deaths and grounding of Pasha Bulker

SST front sustained by deep core eddies and heat content







Hurlburt et al., 2009

National efforts

1. UK MetOffice
    1. Forming working groups
    2. Global coupled prediction
2. NRL
    1. COAMPS => ITOP and HFIB
    2. Coupled DA effort Craig Bishop/Jim Cummings
3. Bureau of Meteorology
    1. CLAM, CLAM-TC
4. ECMWF
    1. Coupled atmosphere-wave
5. Mercator
    1. Proposal for coupled system for TC’s in Indian Ocean
6. JMA
    1. Developments of coupled Typhoon prediction
    2. Research in general weather coupling
7. Canada
    1. Coupled ocean-sea-ice-weather

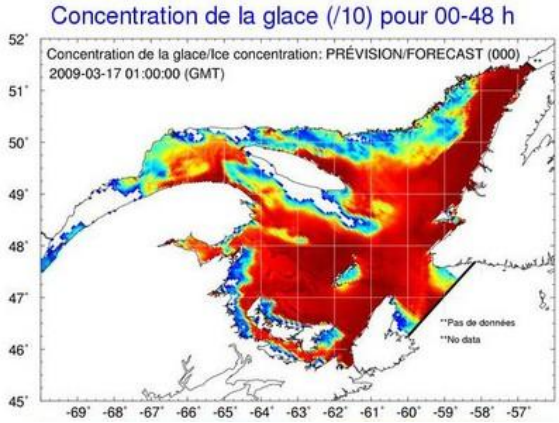
Canadian High Resolution Coupled Prediction

Fisheries and Oceans Canada | Pêches et Océans Canada | Environment Canada | Environnement Canada | National Defence | Défense nationale

Development of the Canadian Coupled Atmosphere-Ice-Ocean Forecast System for the Gulf of St. Lawrence

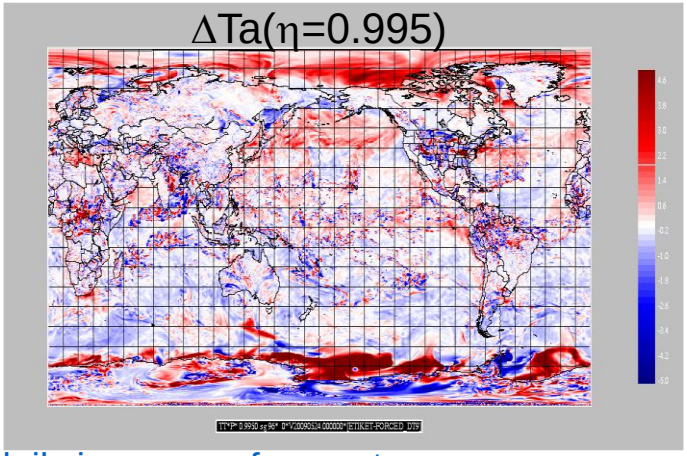
Summary:

- Initiated 14 years ago by the Maurice Lamontagne Institute (DFO) and Recherche en Prévision Numérique (EC)
- EC and DFO have successfully developed a fully-interactive coupled atmosphere-ice-ocean forecasting system for the Gulf of St. Lawrence (GSL)
- This system will become fully operational at the Canadian Meteorological Centre (CMC)
- Results during the past 2 years have demonstrated that the coupled system produces improved weather forecasts in and around the GSL during all seasons
  - Shows that atmosphere-ice-ocean interactions are indeed important even for short-term Canadian weather forecasts
  - Great potential for improved ice-ocean components and global systems
- This has important implications for coupled modelling and data assimilation partnerships.



Status of coupling work

- Current:
  - Prototype GEM-NEMO coupled model
    - GEM (0.3degL58) and NEMO (0.25degL50)
    - Preliminary tests look promising
    - Further development and testing underway
    - Test in long-range forecasts (monthly)
- This fall:
  - Routine production of global ice-ocean forecasts
  - Installation of NW Atlantic system at Dorval to produce daily ice-ocean forecasts
- Planned for 2011 onwards:
  - Development of REGLAM-NEMO NW Atlantic
    - C-NOOFS, F. Davidson, DFO
  - Extend NW Atlantic system to Arctic
    - Y. Lu, DFO
  - Development of GEM-NEMO Great lakes
    - V. Fortin, RPN-E
  - Develop low-res global system for monthly-to-seasonal forecasting
    - RPN in collaboration with CCCma



Impact of coupling + SST I.C. on 96H T forecast

HRCP Objectives – high level

1. Focus on linking GODAE systems to the coupling problem
    1. Ocean prediction (coastal/open ocean)
    2. Ocean data assimilation (mesoscale, altimetry)
2. Form a community to share/discuss national efforts
3. Identify obstacles to progress

4. Determine the impact of coupling on ocean prediction (short-medium)
    1. Provide guidance on the limitations
5. Aid discovery of impact of the mesoscale ocean on other systems

6. Links to seasonal/climate
    1. Next generation systems

Objectives

1. Coordinate and extend capacity within the meteorological and oceanographic community for coupled high resolution prediction systems
2. Develop a community, from within the current meteorological and oceanographic communities, that will target high resolution coupled prediction systems to facilitate the exchange of methods for accelerated development in this application
3. Exploit high resolution coupled prediction systems to evaluate the impact to atmospheric, wave and ocean prediction, assess the gains relative to less computationally intensive alternatives.
4. To compile results from numerical experiments and observations regarding the impact of explicit representation of high resolution air/sea interaction on the prediction of various atmosphere and ocean phenomena at different time scales.
5. Propose and undertake or exploit/enhance existing observational experiments to facilitate the evaluation of the impact of observations on high resolution coupled initialisation and coupled data assimilation.

Task team membership

Gary Brassington,	Bureau of Meteorology (acting lead)
Paul Sandery,	Bureau of Meteorology
James Cummings,	Naval Research Lab.
Matthew Martin,	UK MetOffice
Isaac Ginis,	Univ. of Rhode Island
Hendrik Tolman,	NOAA, NCEP
Magdalena Balmaseda,	ECMWF
Michele Rienecker,	NASA Goddard Space Flight Center
Laurent Bertino,	Nansen Research Center
Harold Ritchie,	Environment Canada
Nicolas Ferry,	Mercator Océan
Hans Bonekamp,	EUMetSAT
Yukei Takaya,	JMA

Timelines

2009: Present the task team workplan to the wider community for comment and survey current capability and research plans to determine potential common objectives amongst the participants. Survey questions:

- provide a description of what they are doing now in coupled modeling
- describe what capabilities are in place for experimentation (along the lines of the work plan elements)
- describe the short term and long term goals for their coupled system(s)
- list any past or future observational experiments that have or will be used to evaluate their coupled systems (we have access to several observation data sets from coupled boundary layer process studies that could be made available).

2010: Meet to exchange ideas and refine and commit to the work plan

2010-2012: Carry out the workplan and report progress to GODAE OceanView

1. *Regional high resolution coupled modelling*

Regional modelling is considered essential to reduce the computational cost for high resolution modelling. Regional coupled models have been established by a number of centres, COAMPS (NRL), CLAM (Bureau of Meteorology), Coupled hurricane prediction (URI). Other centres will be encouraged to develop similar capacity to strengthen the community participating in the proposed activities. The task team will aim to share experiences in nesting methodologies, air-sea parameterisations, coupled initialisation etc. Regional coupled models will be encouraged to include options for course resolution ocean models and mixed layer models to address specific questions relating to the impact of high resolution coupled modelling.

2. *Coupled assimilation and initialisation*

Initialisation of a coupled regional model will initially exploit the available ocean-atmosphere state from the global/regional ocean and atmospheric models. The task team will focus on the best methodologies for initialising the coupled model with minimal loss of information. Coupled data assimilation has been identified as offering the greatest potential gain for the short timescale prediction. Coupled data assimilation will be considered within the high resolution regional model context. The complexity of the data assimilation procedure in two different media (atmosphere and ocean) may require an incremental or iterative approach, as may be expected from the intialization of systems with different time scales and different data distributions.

3. *Intercomparison of high resolution coupled forecasts*

Global re-analyses are available for both the atmosphere (ERA-Interi, NCEP-2 and MERRA) and the high resolution ocean (BRAN, Schiller et al., 2008; Mercator). Specific intercomparison periods would be proposed within different air-sea regimes (e.g., high-wind conditions, tropical, sub-tropical, western boundary, etc.). Intercomparisons would be likely to initially focus on the optimal configuration for the components of the system and subsequently be extended to explore the impact on forecast skill. Depending on the resources, the intercomparison may consist either of a “centralized” assessment, or on a compilation of results from the individual groups. Intercomparisons periods and objectives will be coordinated with other communities to maximise the potential analysis and identify the robust elements from the various results.

4. *Ensemble approaches*

An advantage of regional coupled prediction is the ability to explore ensemble approaches for assessment of forecast uncertainty as well as ensemble methods for data assimilation. Progress could be made on the best approaches to generate ensembles that provide a representative statistical sample of the maximum forecast error growth.

5. *Coupled air-wave-ice-sea integrated experimental campaigns*

Seek opportunities to collaborate and enhance existing observational experiments targeting air-sea observational campaigns to facilitate the development coupled parameterisations and evaluation of the impact of observations on high resolution coupled initialisation and coupled data assimilation. An important outcome from the task team will be to evaluate the observational requirements for high resolution coupled prediction systems.

6. *High resolution coupled regional reanalysis*

The production of a series of high resolution reanalyses would provide a useful data set from which to evaluate the statistical properties of the coupled system and the impact of the observations on the analysis. A regional analysis could be achieved through nesting within global atmospheric and ocean analysis products.

Meeting – Wednesday 5pm

Discuss/finalise workplan
Collate the information on national efforts
Next steps
GODAE-WGNE workshop

Jim, Matt, Nicolas, Hal, Yukei, Gary, Hendrik?
Open meeting

Venue:
Hotel Villa Fontaine
5.30pm

GODAE-WGNE workshop

WGNE in general support this activity
Christian Jacob – elevated this as an action item in WGNE
Struggling to get a WGNE champion
Gary Dietachmeyer – informal backup (international leader desirable)
WGNE to meet in November (expect progress by then)

Agenda
Forming a joint working group
Why, Who, When, How, What
Passive - collecting/synergy of national activities
Active - develop a collaborative science plan

Patrons
Consider funding to support GODAE participation and hosting of first workshop
Guidance on development of workplans
Opportunities for integrated observing campaigns