PICES Annual Meeting: S1

The UN Decade of Ocean Science for Sustainable Development and PICES: For the perspective of a predicted ocean

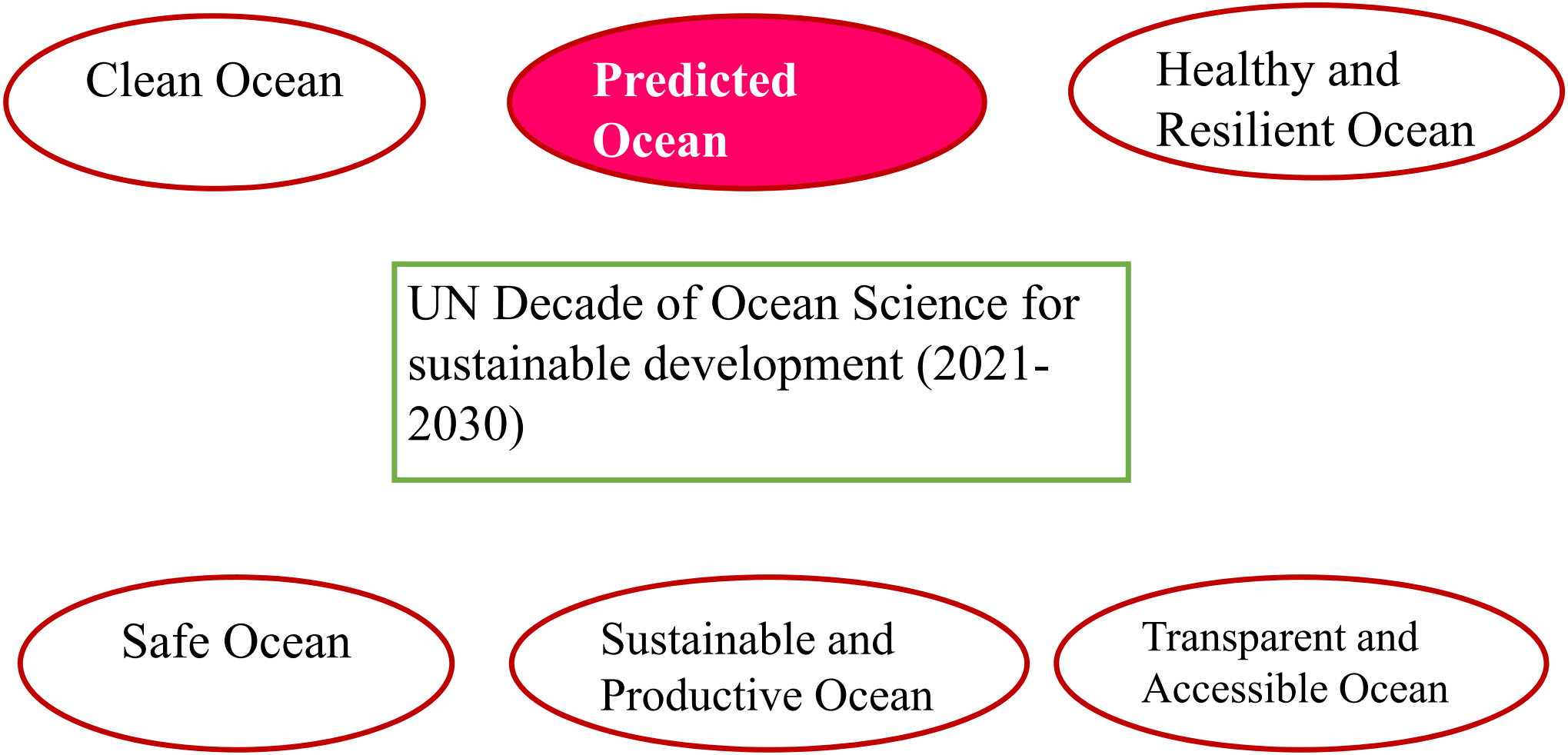
Fangli Qiao

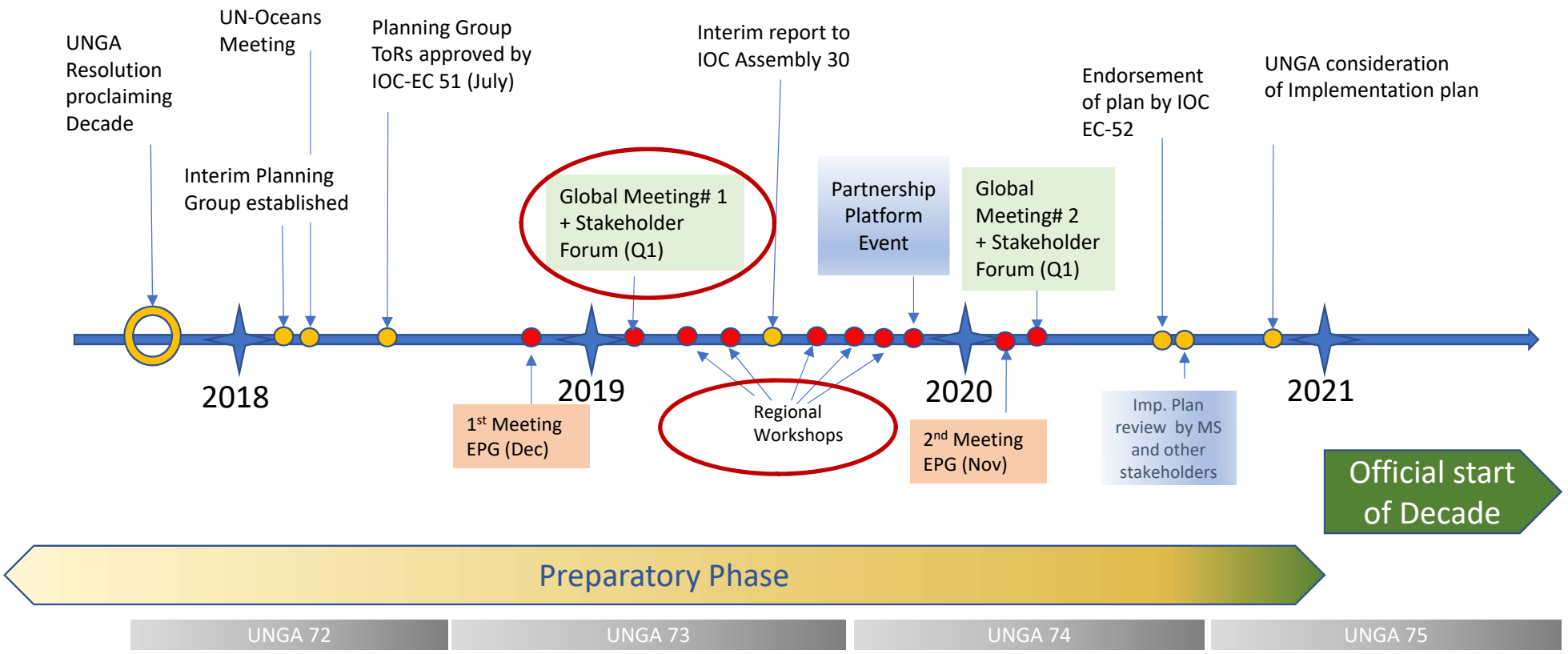
First Institute of Oceanography(FIO), MNR, China

21 Oct, 2019 @ Victoria, Canada

CONTENTS

The UN Decade of Ocean Science (2021-2030) will build upon 60 years of ocean science leadership at the United Nations to create a global process and movement to unlock the body of ocean science and knowledge the world needs to achieve its goals for a healthy and sustainable planet. The decade has 6 social goals including


Clean Ocean
Predicted Ocean
Healthy and Resilient Ocean
UN Decade of Ocean Science for sustainable development (2021-2030)
Safe Ocean
Sustainable and Productive Ocean
Transparent and Accessible Ocean



Preparing for the Decade


ACADEMIA

Outcomes of the First Global Planning Meeting: UN Decade of Ocean Science for Sustainable Development

13-15 May 2019

National Museum of Denmark, Copenhagen

1st Global Planning Meeting: 13-15 May, 2019 in Copenhagen, Denmark

- The meeting informs the preparation phase of the Decade and develops the implementation plan
- More than 200 participants from science, academia, policy, communication and private sector organizations brainstorming on how to achieve the six key Decade outcomes by 2030

United Nations Educational, Scientific and Cultural Organization · Intergovernmental Oceanographic Commission · 2021 2030 United Nations Decade of Ocean Science for Sustainable Development

Guiding the Decade development to success…

- Focusing on central mission: Ocean Science for Sustainable Development, not just ocean science
- Interdisciplinary and Trans-disciplinary approaches with a broad range of stakeholders
- Inclusion of social sciences in early design of the programme and in every societal area.
- Focus on enhanced capacity development, particularly for Small Island Developing States (SIDS) and Least Developed Countries (LDC),
- Ocean Literacy as a priority, for youth, general public, policy makers and business sectors
    - The Decade should create an “Ocean Generation” of informed citizens.
- Focus on New technology and innovations for data sharing and management, observing systems, measurement techniques, communication and visualisation, pollution mitigation, citizen science technologies, and capacity development.
    - The Decade must lead to a data sharing revolution.
- New and innovative partnerships with other stakeholders, particularly the Blue Economy sector and the Insurance sector, are essential
- Importance of involvement of young professional in the design

A Predicted Ocean

Working Group 3

Knowledge gaps and research priorities

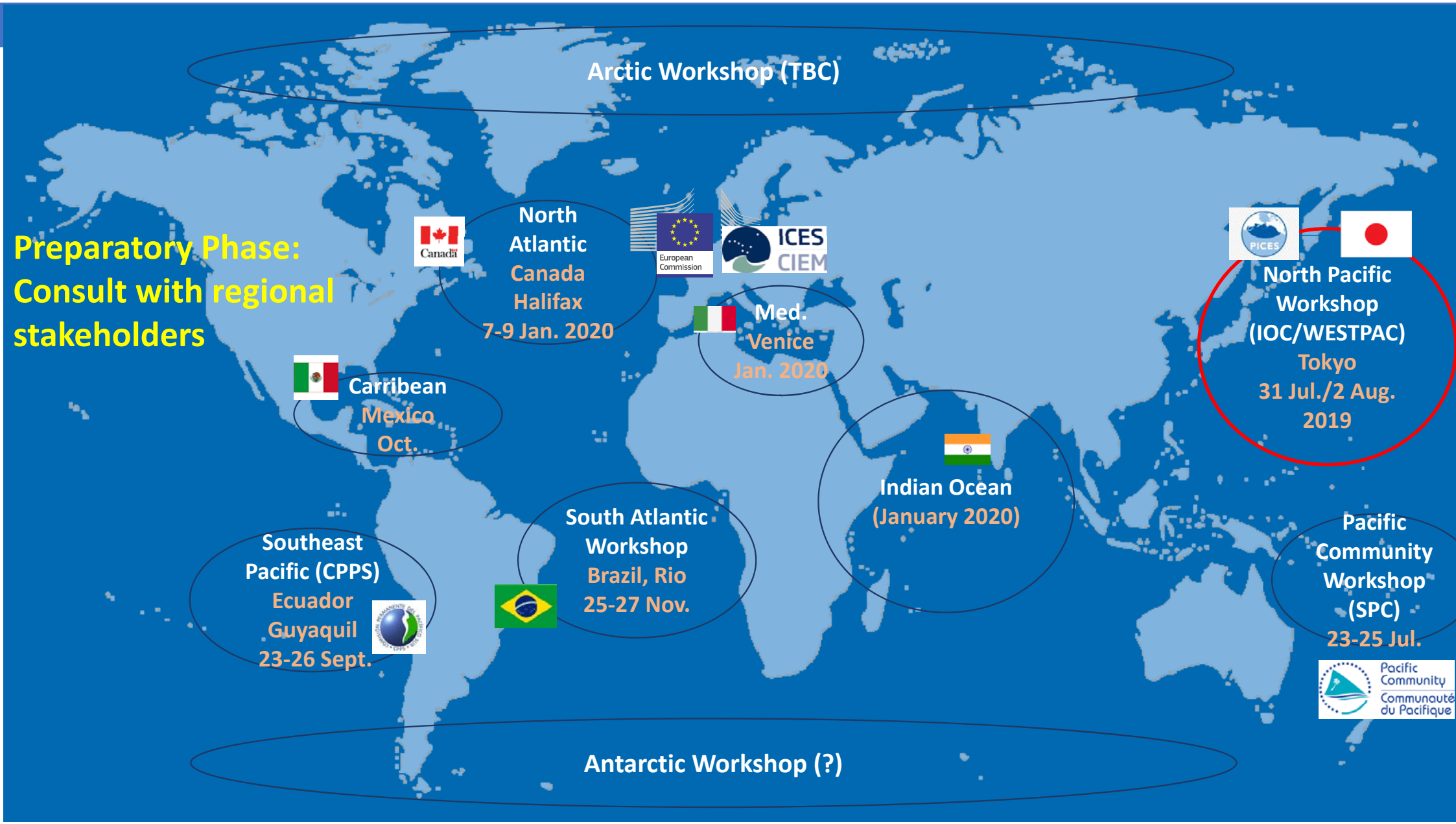
- Scientific understanding of ocean ecosystems is key to prediction
- Focus on deep sea ocean's role in climate and related impacts on carbon cycling and organic matter fates
- Strengthening understanding of deep ocean responses to cumulative human impacts, ecosystem function and services, adaptative capacity, connection between deep ocean to surface and coastal processes,and response to resource extraction
- Science to support management of high-seas areas beyond national jurisdictions
- Observations for weather and climate forecasts at all scales
- Connecting users to ocean prediction system
- Improving modelling through coupled models

Co-chairs: **Fangli Qiao,** MNR of China

Craig McLean, NOAA of US

Recommended activities in support of the Decade

- Monitoring and evaluation of observation and data services, including fostering local uses
- Platform to build partnerships to ensure fit for purpose observing systems
- Observations of ocean biology and ecosystem data
- Increase involvement of private sector in support of Blue Economy
- Mainstreaming discussions on deep ocean
- Development of indicators for measuring societal outcomes
- Encourage large-scale ecosystem model intercomparison project
- Development of indicators for societal outcomes


Arctic Workshop (TBC)
Preparatory Phase:
Consult with regional stakeholders
North Atlantic
Canada
Halifax
7-9 Jan. 2020
Canada
European Commission
ICES
CIEM
Med.
Venice
Jan. 2020
PICES
North Pacific Workshop (IOC/WESTPAC)
Tokyo
31 Jul./2 Aug. 2019
Carribean
Mexico
Oct.
Indian Ocean
(January 2020)
South Atlantic Workshop
Brazil, Rio
25-27 Nov.
Southeast Pacific (CPPS)
Ecuador
Guyaquil
23-26 Sept.
Pacific Community Workshop (SPC)
23-25 Jul.
Pacific Community
Communauté du Pacifique
Antarctic Workshop (?)

PROGRAMME

Regional Planning Workshop for the North Pacific and Western Pacific Marginal Seas

Tokyo, Japan, 31 July 2019 - 2 August 2019

Jointly organized by IOC/WESTPAC and PICES

Hosted by JEMSTEC, Japan

More than 160 experts from 22 countries mainly around the North Pacific

6 workshops, corresponding to the 6 societal outcomes

Conveners of each WG session for regional consultation and planning of the UN Decade

WG1: A Clean Ocean
Co-conveners: Gil Jacinto, Zainal Arifin, Mitsuo Uematsu & Peter S. Ross

WG 2: A Healthy and Resilient Ocean
Co-conveners: Youn-Ho Lee, Binh Thanh Nguyen, Aileen Tan Shau Hwai, Phoebe Woodworth-Jefcoats

WG 3: A Predicted Ocean
Conveners: Fangli Qiao, Vyacheslav Lobanov, Desiree Tommasi
Rapporteur: Molly McCammon and Desiree Tommasi

WG 4: A Safe Ocean
Conveners: Wendong Yu and Teron Moore
Raporture: Gwyn Lintern

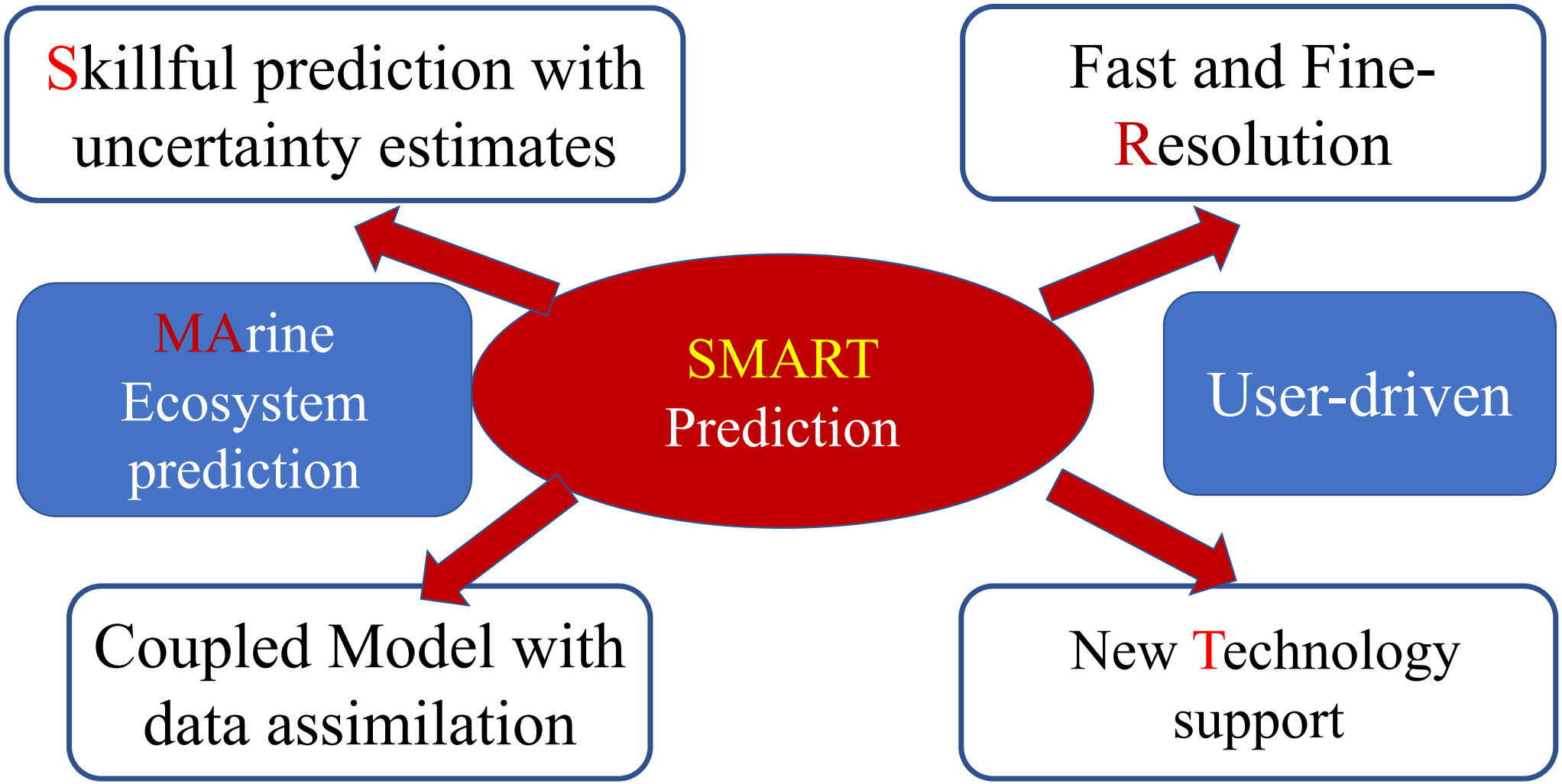
WG 5: A Sustainably Harvested and Productive Ocean
Co-conveners: Hiroaki Saito, Somboon Siriraksophon & Cisco Werner
Rapporteurs: T. Schaefer, S. Bograd, D. Tommasi, P. Woodworth-Jefcoats

WG 6: A Transparent and Accessible Ocean
Co-conveners – Margaret Leinen, Somkiat Khokiattiwong, Kim juniper
& 4 rapporteurs

A Predicted Ocean

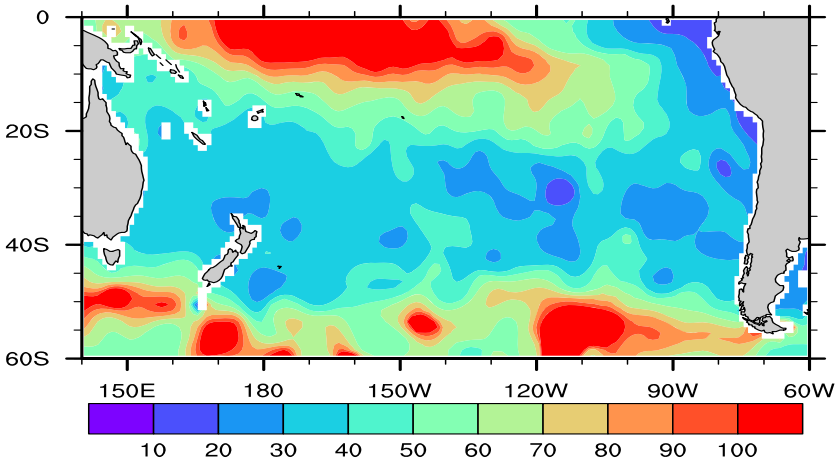
- Ocean Prediction
- Marine Hazards Prediction
- Role of the Ocean in Climate Prediction
- Marine Ecosystems Predictions

Model development is the core for “A Predicted Ocean”

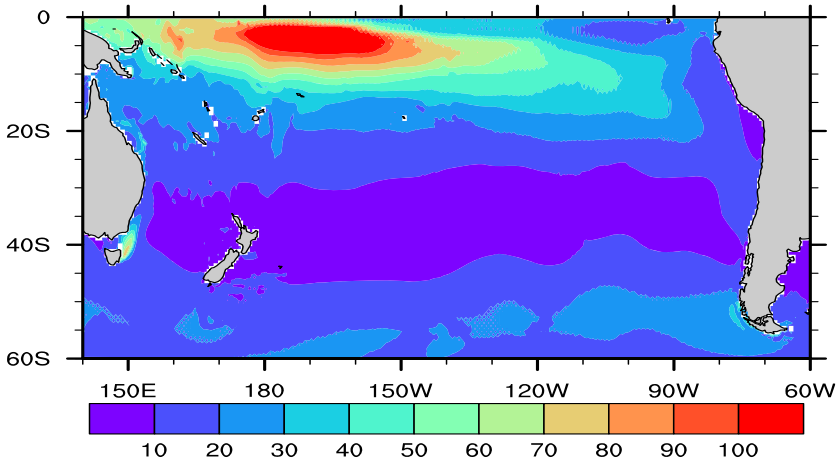

Skillful prediction with uncertainty estimates
Fast and Fine-Resolution
MArine Ecosystem prediction
SMART Prediction
User-driven
Coupled Model with data assimilation
New Technology support

CONTENTS

Long-standing challenges for Ocean General Circulation Models: Simulated SST is overheating in summertime, and mixed layer depth is too shallow (Martin 1985; Kantha 1994; Ezer 2000; Mellor 2003; Qiao etal, 2016).



✓ Observed Mixed Layer Depth



✓ Modeled Mixed Layer Depth

Non-breaking wave-induced vertical mixing

$$B_V = \alpha \iint_k E\left(\vec{k}\right) \exp\{2kz\}\, d\vec{k}\, \frac{\partial}{\partial z}\left(\iint_k \omega^2 E\left(\vec{k}\right) \exp\{2kz\}\, d\vec{k} \right)^{1/2}$$

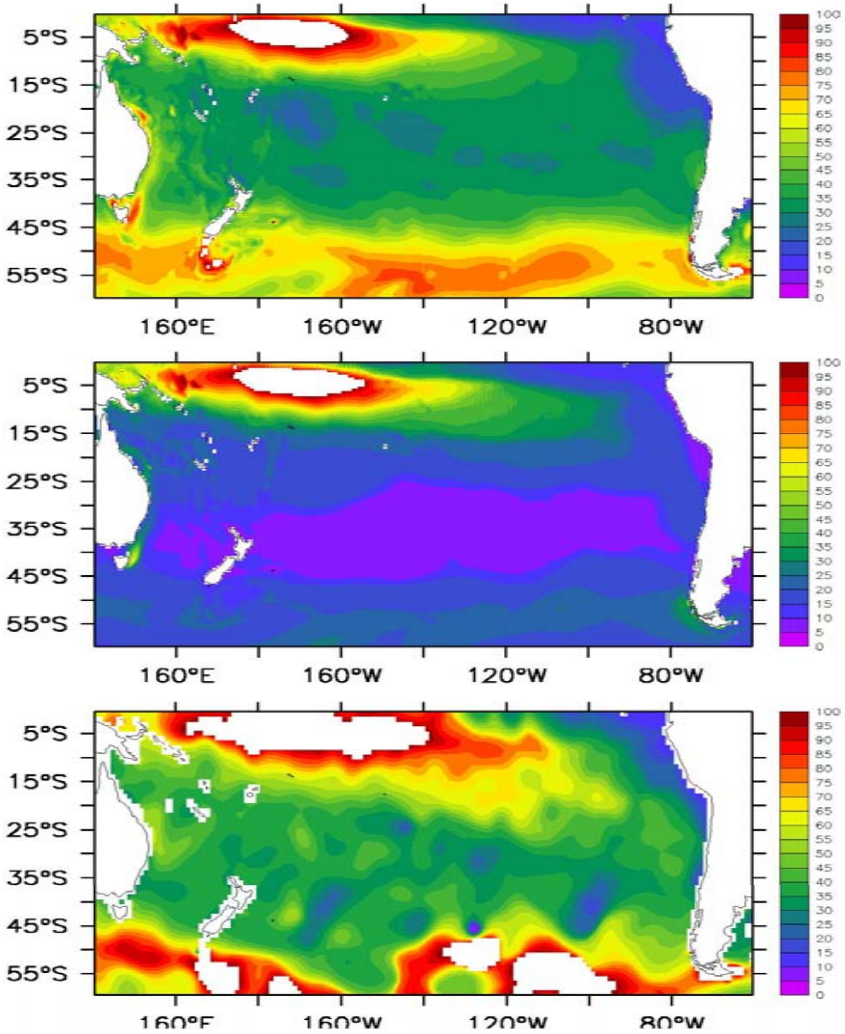
As the mixing process is essentially an energy balance problem, waves, as the most energetic motions at the ocean surface, should play a controlling role. Surface wave: 60 TW, Circulation: 4 TW

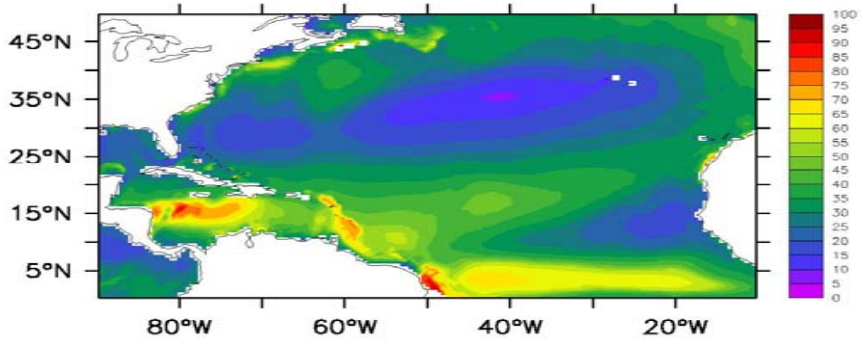
Qiao et al, GRL, 2004; OD, 2010; RS, 2016

Wave effects: MLD in summer (Qiao et al, OD, 2010)

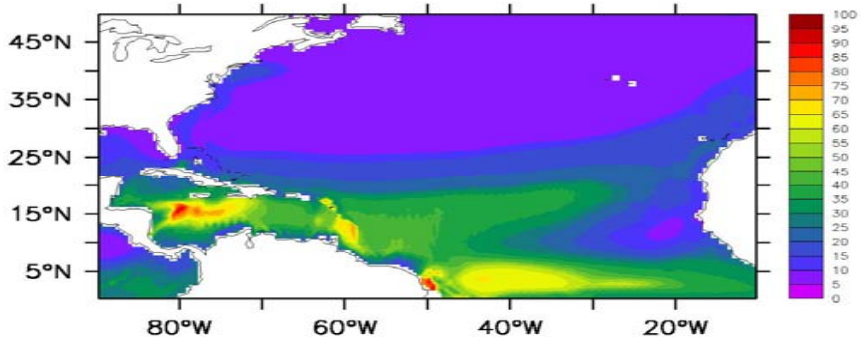
MLD of the Southern Pacific in Feb.

MLD of the Northern Atlantic in Aug.

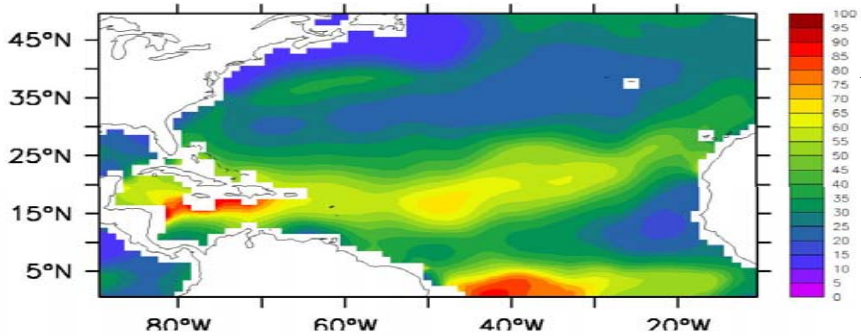




With wave-induce mixing



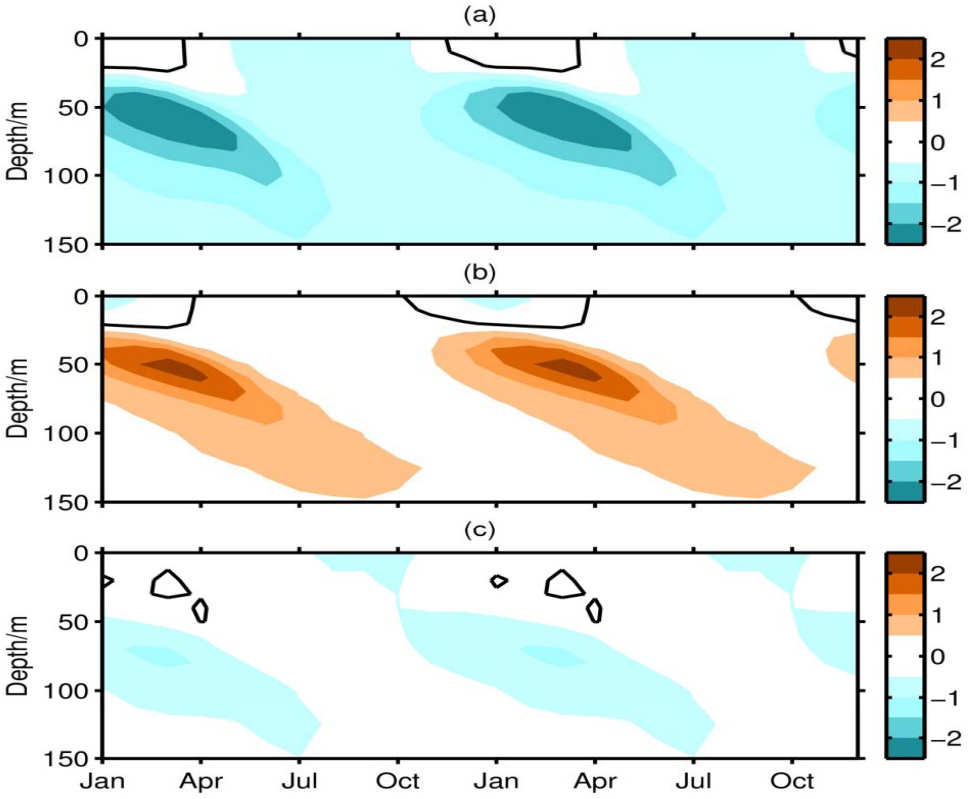
Without wave-induce mixing



World Ocean Atlas

Temperature differences: cooperated with Prof G Lohmann of AWI, Germany

Temperature Difference of 30S



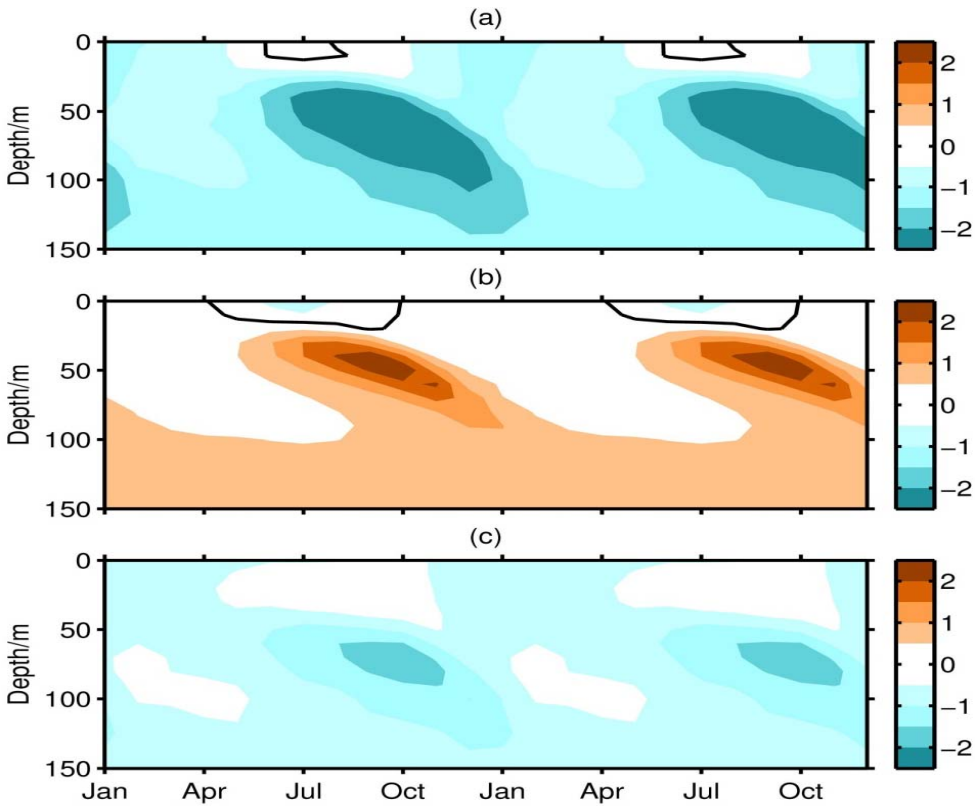
(a) without Bv - WOA09

(b) with Bv - without Bv

(c) with Bv - WOA09

black line - zero line

Temperature Difference of 30N



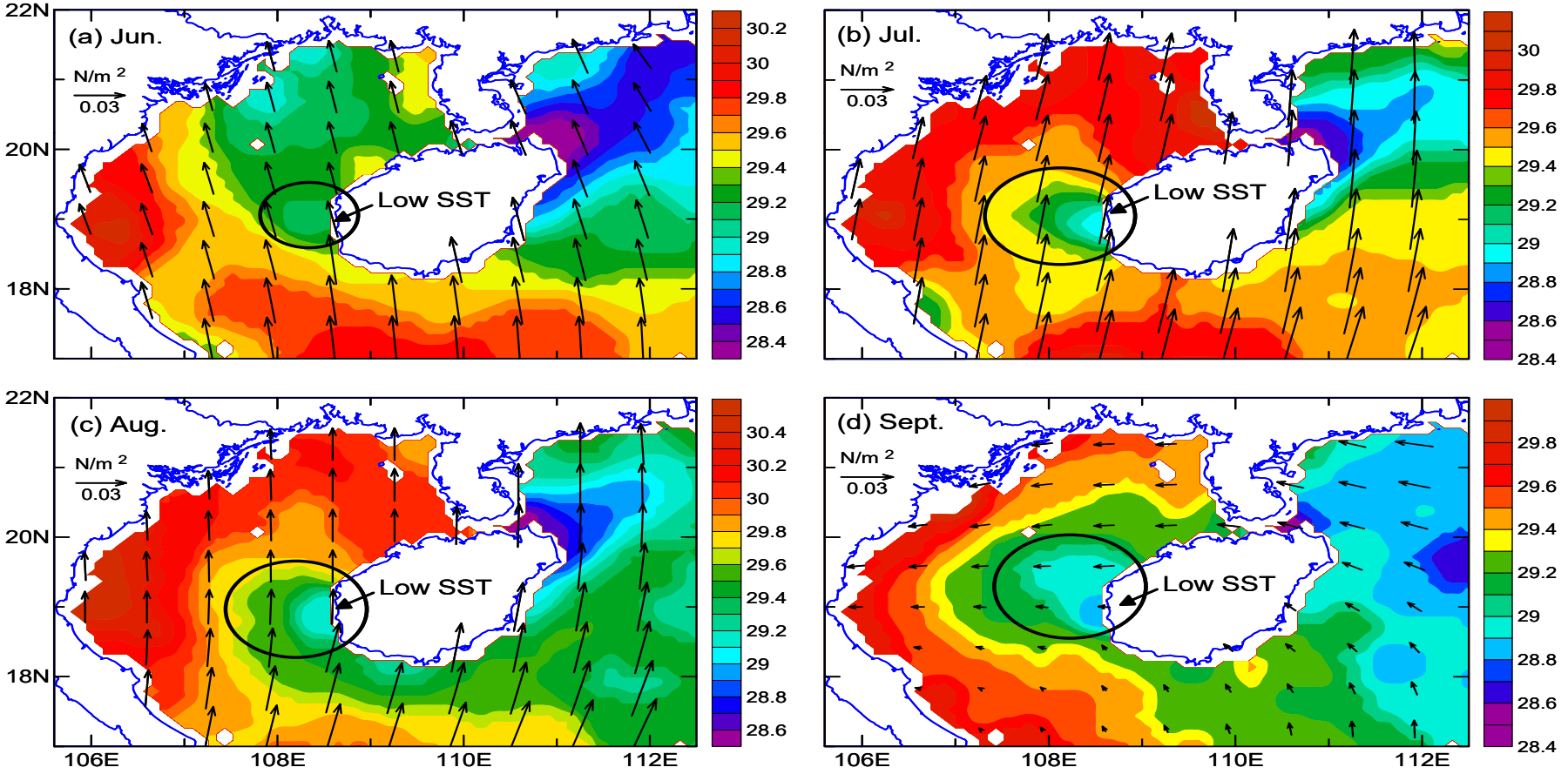
(a) without Bv - WOA09

(b) with Bv - without Bv

(c) with Bv - WOA09

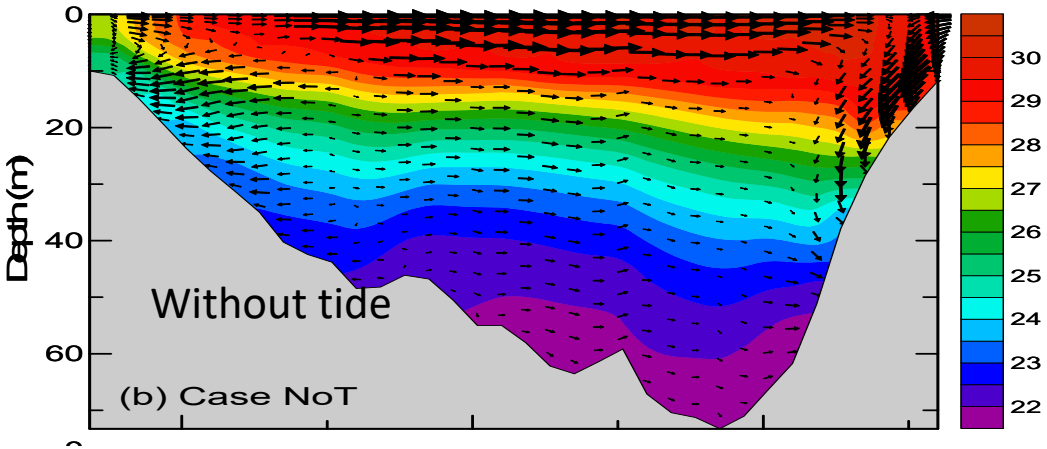
black line - zero line

●AVHRR SST Climatology

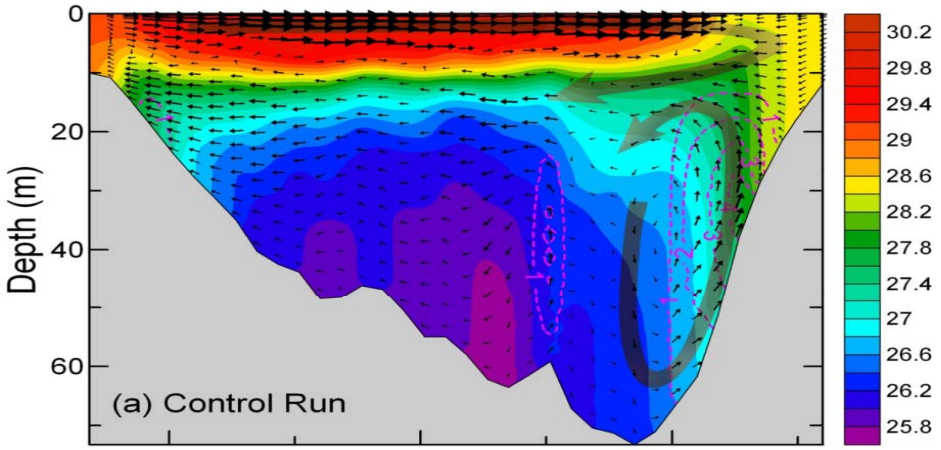


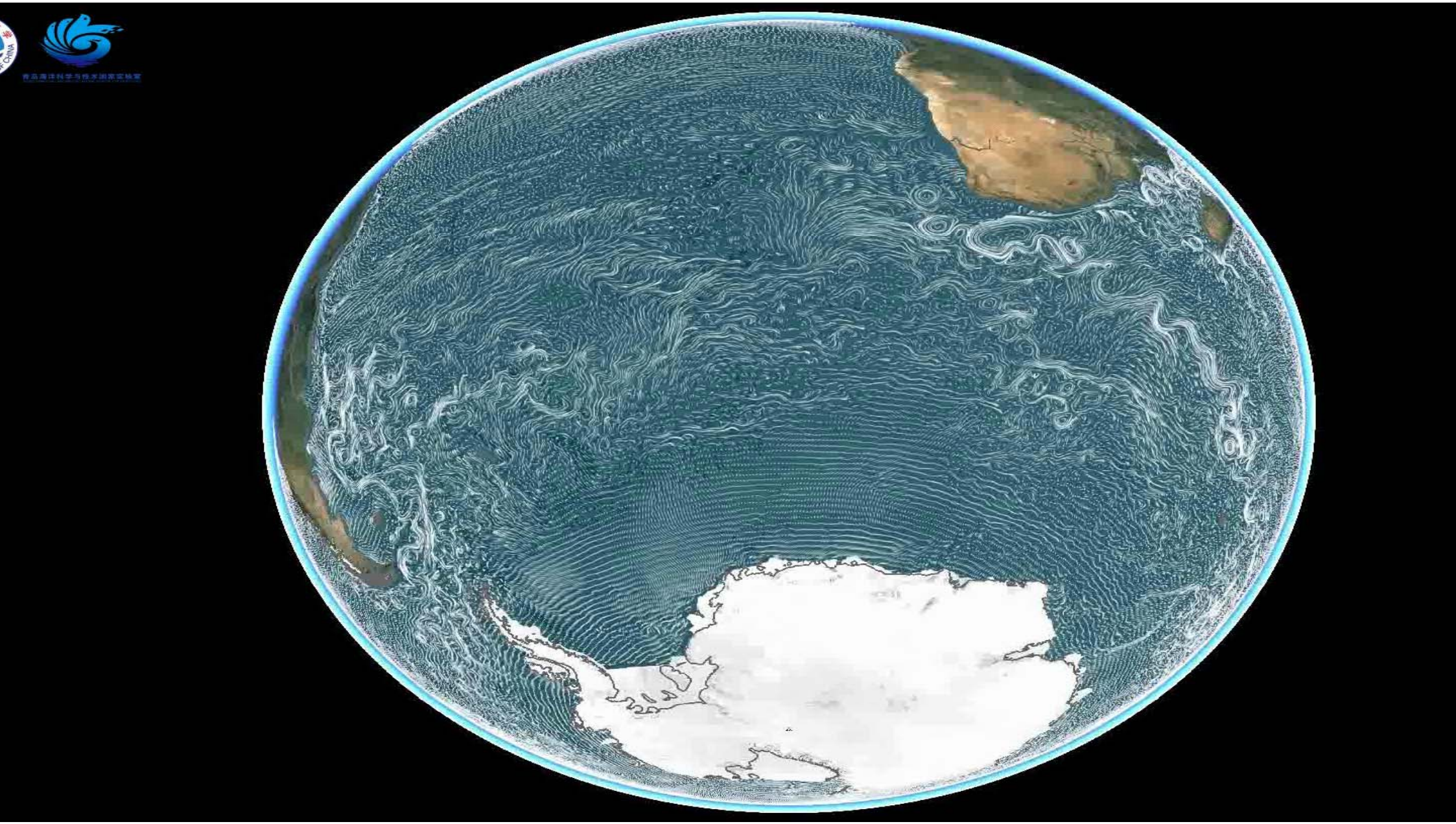
AVHRR Pathfinder SST monthly climatology over 13 years [*Casey and Cornillon*, 1999, JC]

Numerical experiment w/o tidal current



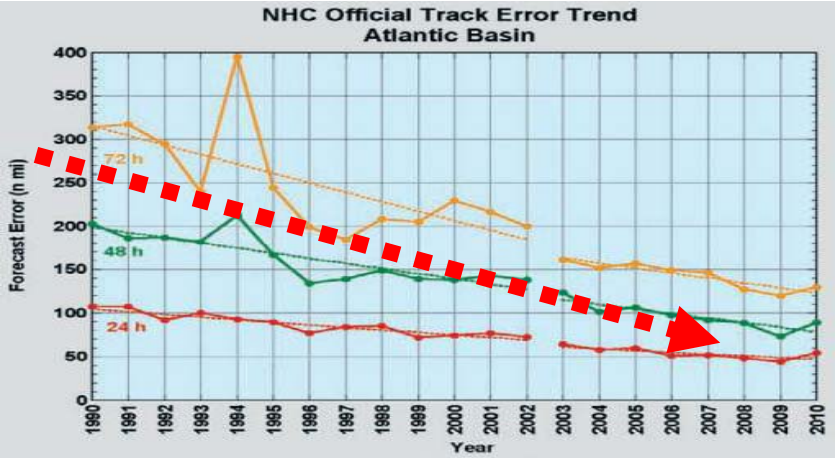
From coupled model

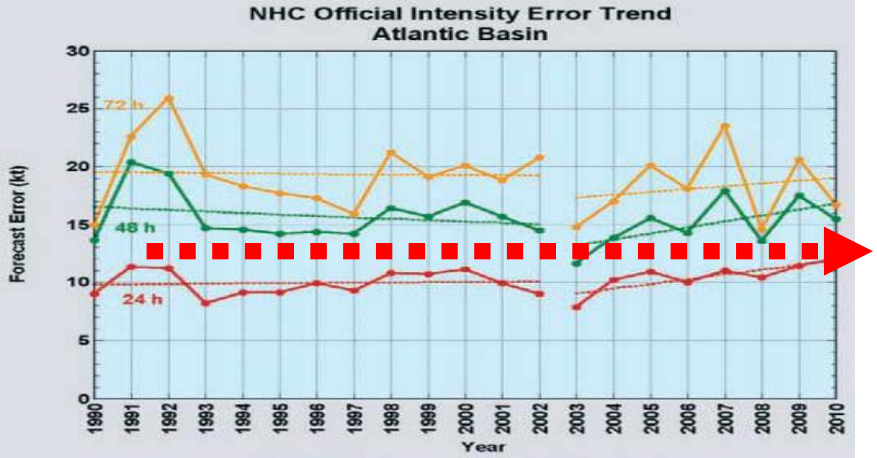




CONTENTS

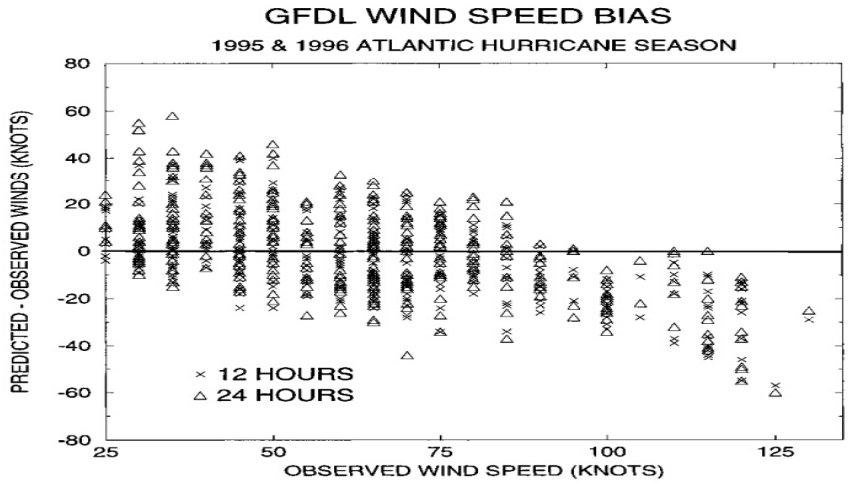
Challenge for Typhoon models for several decades: The forecasted typhoon track getting better and better, while the forecasted intensity has had no any progress

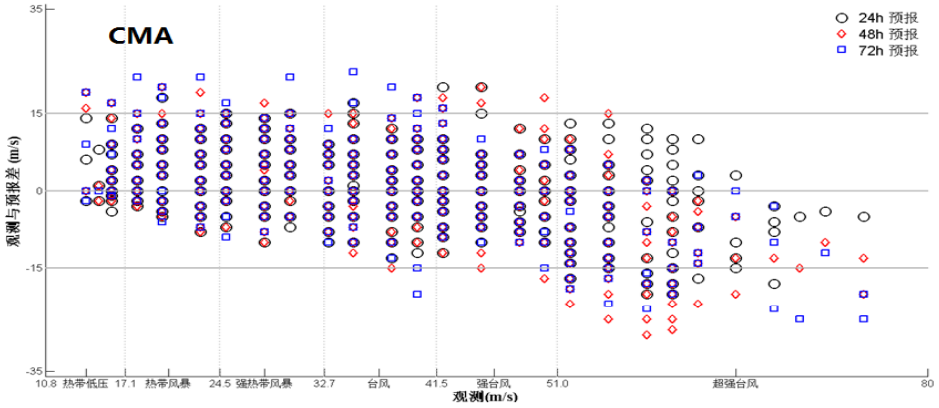


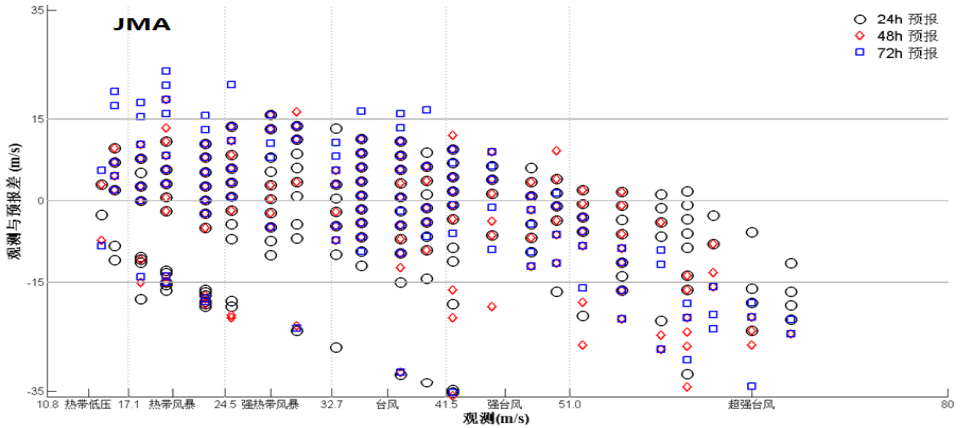


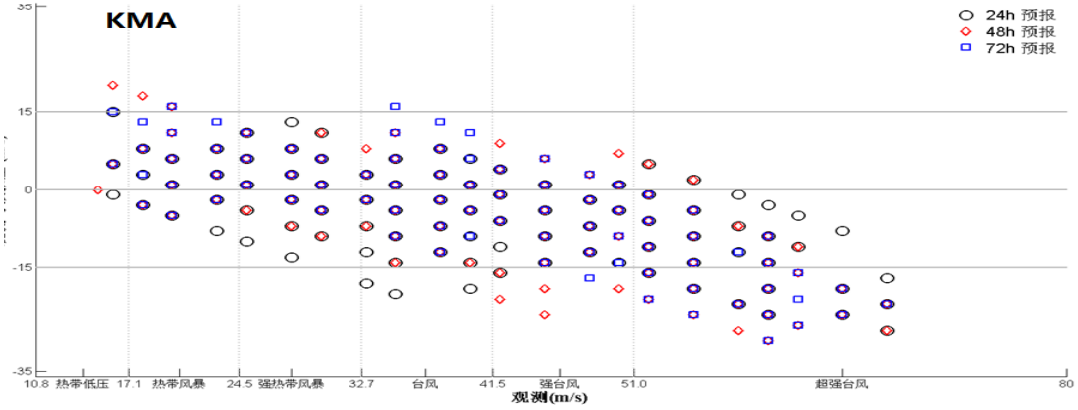
[Rappaport et al., 2012, BAMS]

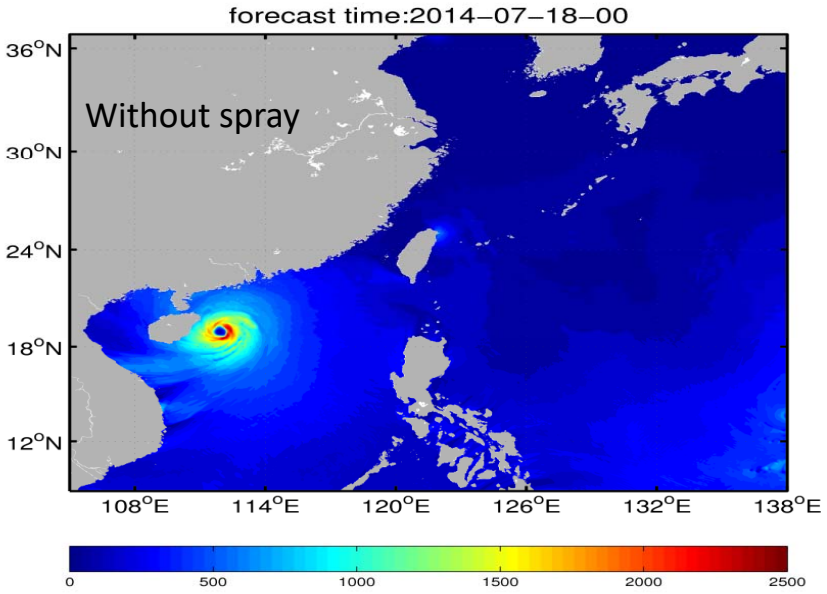
Typhoon intensity

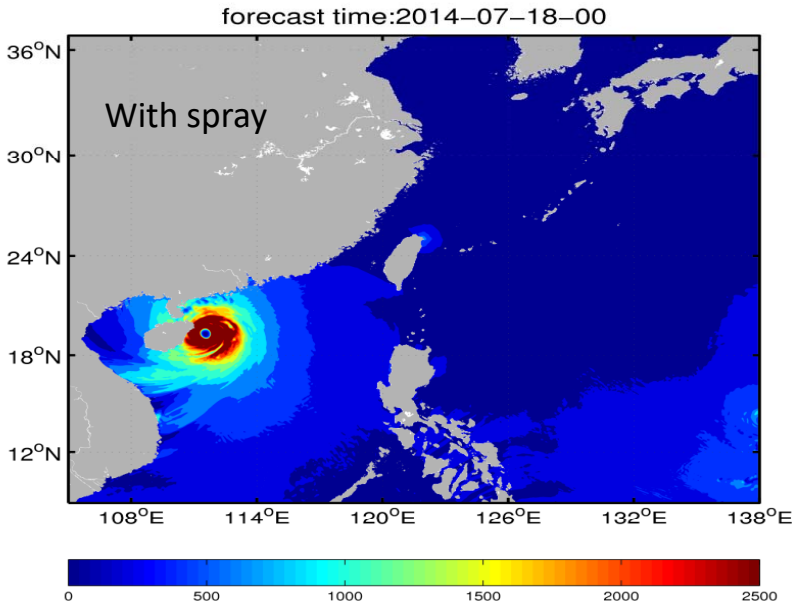




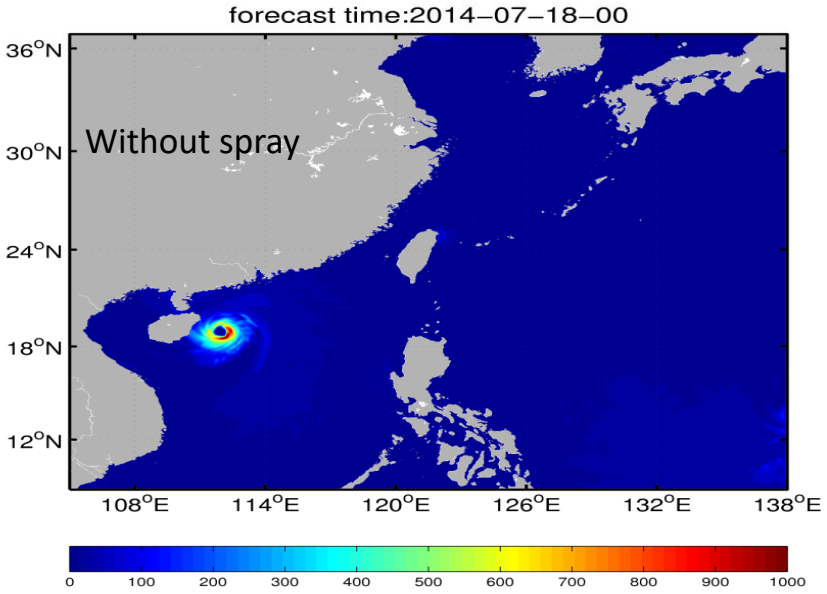


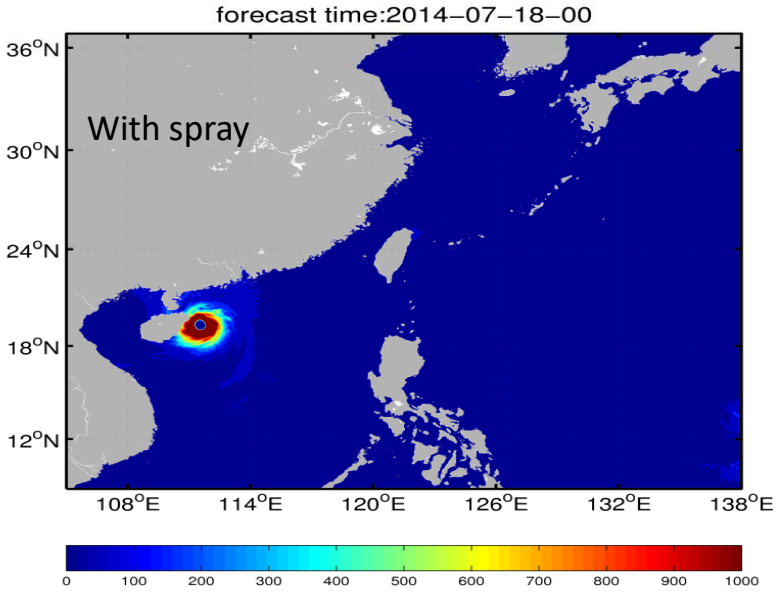



forecast time:2014–07–18–00
Without spray
36°N
30°N
24°N
18°N
12°N
108°E
114°E
120°E
126°E
132°E
138°E
0
500
1000
1500
2000
2500


forecast time:2014–07–18–00
With spray
36°N
30°N
24°N
18°N
12°N
108°E
114°E
120°E
126°E
132°E
138°E
0
500
1000
1500
2000
2500

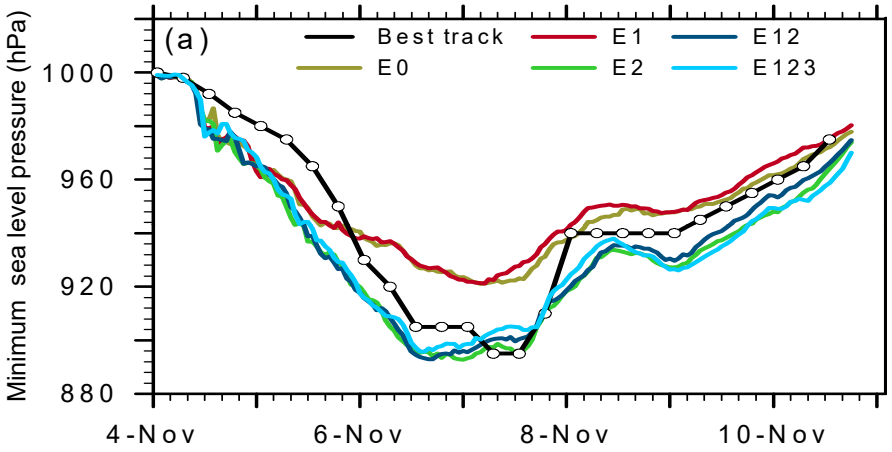
L-HF


forecast time:2014–07–18–00
Without spray
36°N
30°N
24°N
18°N
12°N
108°E
114°E
120°E
126°E
132°E
138°E
0
100
200
300
400
500
600
700
800
900
1000

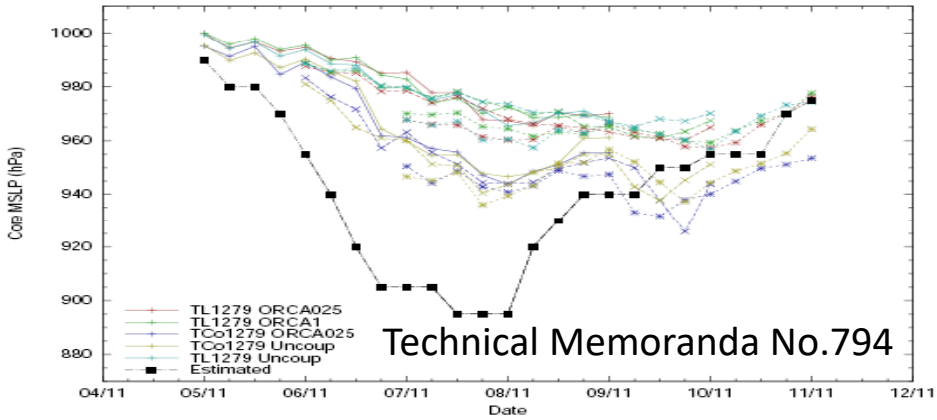

forecast time:2014–07–18–00
With spray
36°N
30°N
24°N
18°N
12°N
108°E
114°E
120°E
126°E
132°E
138°E
0
100
200
300
400
500
600
700
800
900
1000

S-HF

FIO-AOW



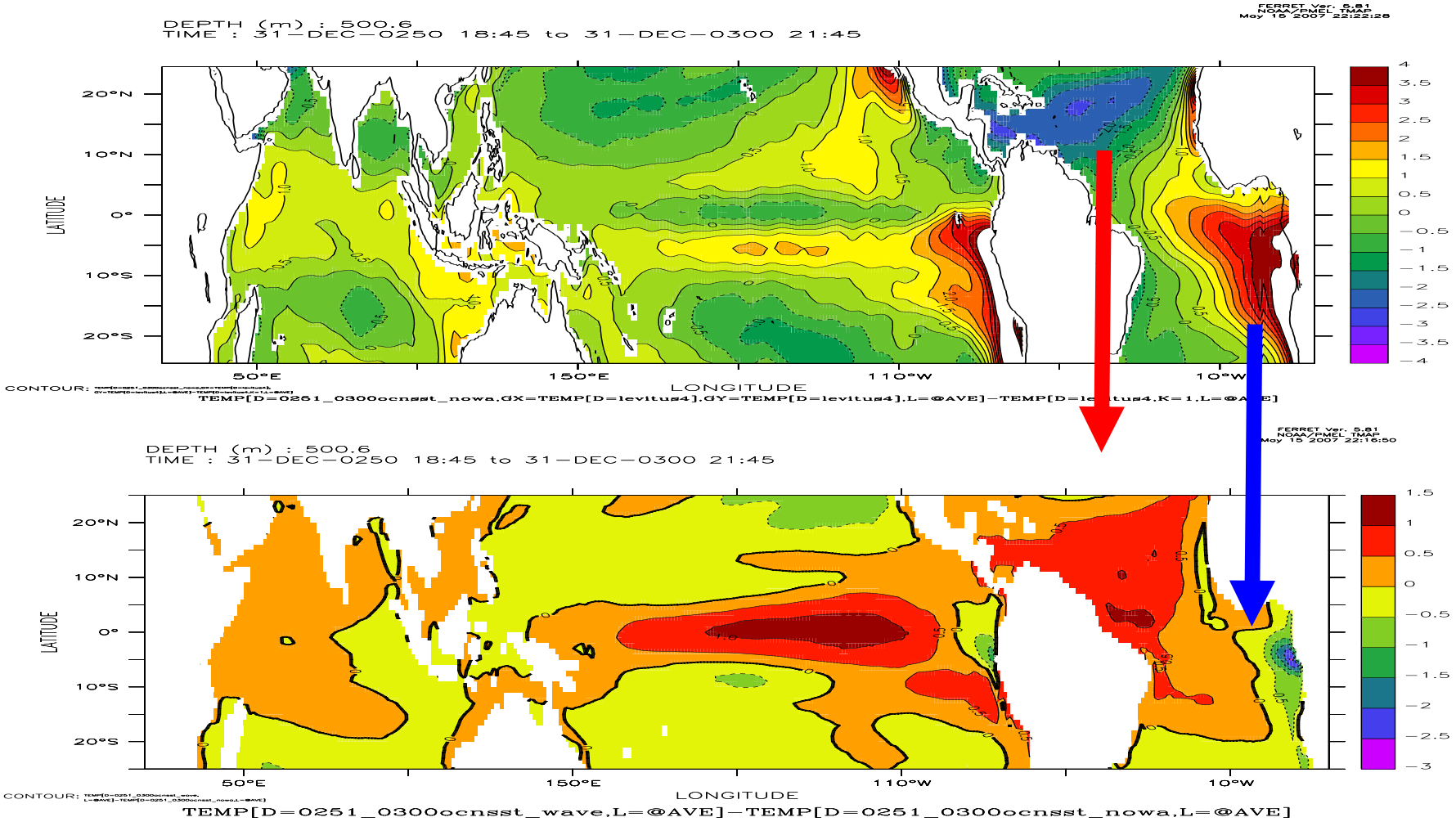
ECMWF coupled model



Technical Memoranda No.794

Unpublished Results

CONTENTS

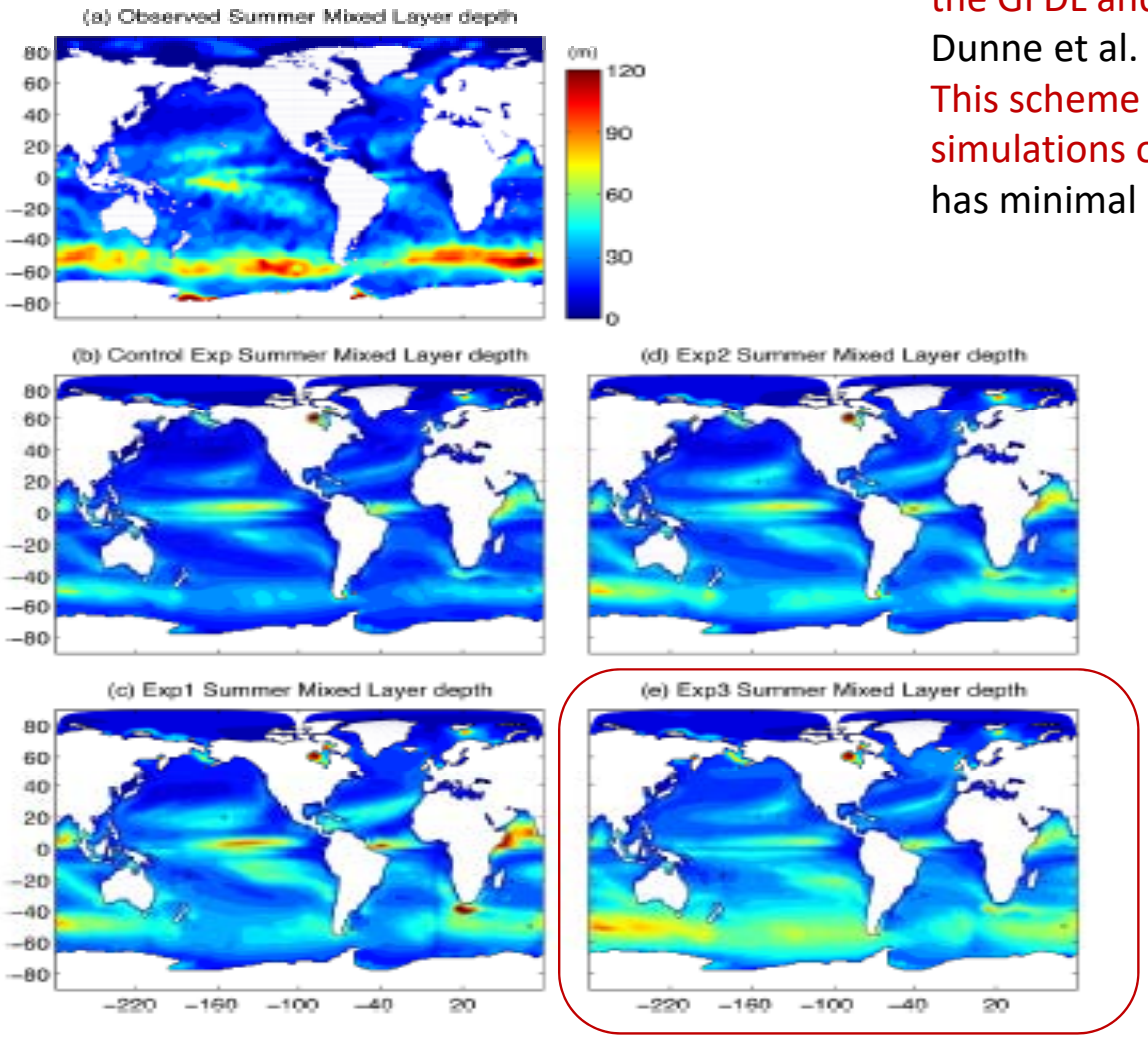


50a averaged SST (251-300a).

Up: Exp1-Levitus, Down: Exp2-Exp1

Exp1: CCSM3 without Bv

Exp2: with Bv



Summertime oceanic mixed layers are biased shallow in both the GFDL and NCAR climate models (Bates et al. 2012; Dunne et al. 2012, 2013).

This scheme (Qiao et al., 2004) has most impact in our simulations on deepening the summertime mixed layers, yet it has minimal impact on wintertime mixed layers.

Yalin Fan, and Stephen M. Griffies, 2014, JC

Hindcasted SST Results

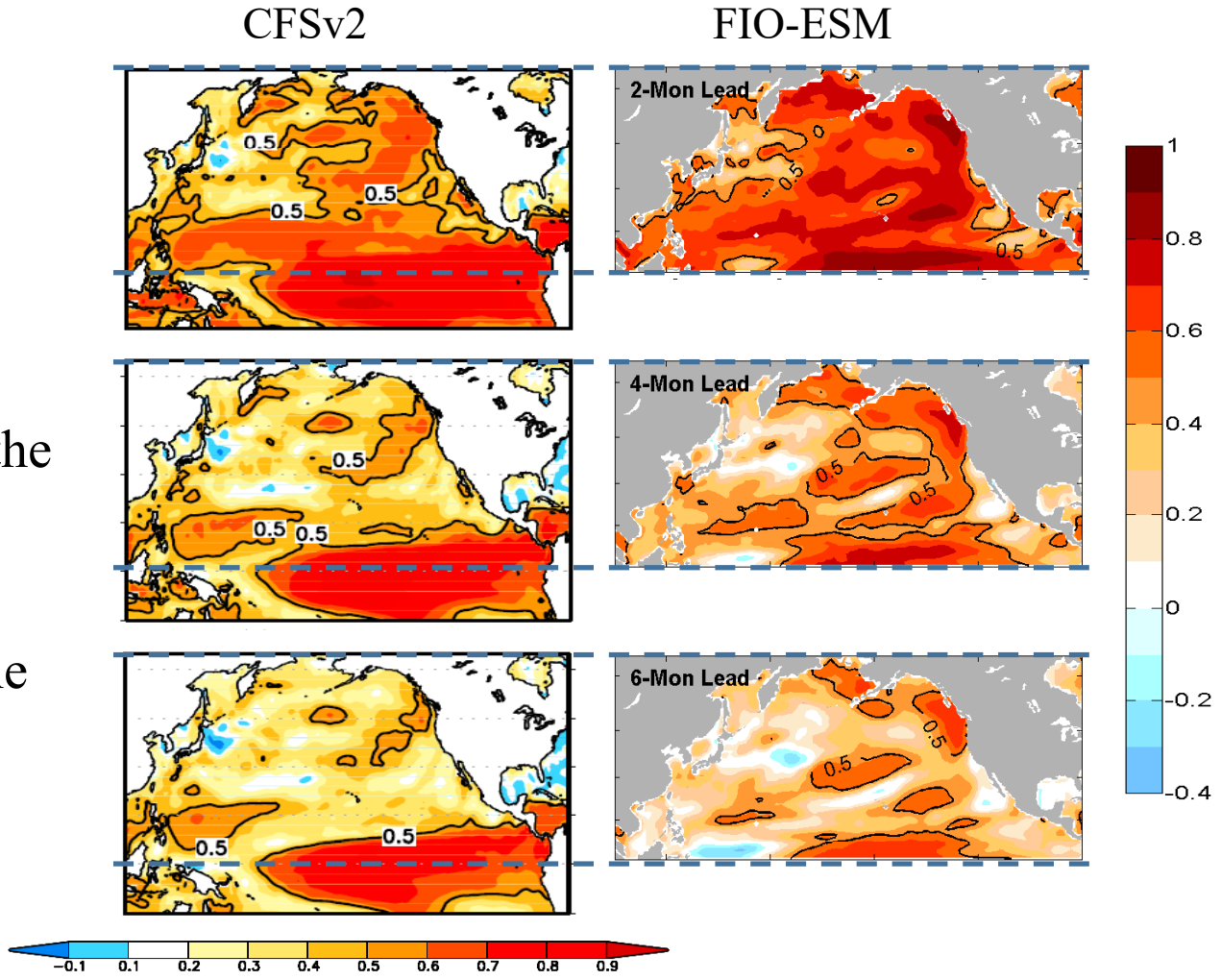
Anomaly correlation coefficient(ACC):

$$ACC_{i,j} = \frac{\mathrm{cov}(F_t, O_t)}{\sigma_F \sigma_O}$$

$\mathrm{cov}(F_t,O_t)$: the covariance of the simulated and observational anomaly

σ : the standard deviation of the variable

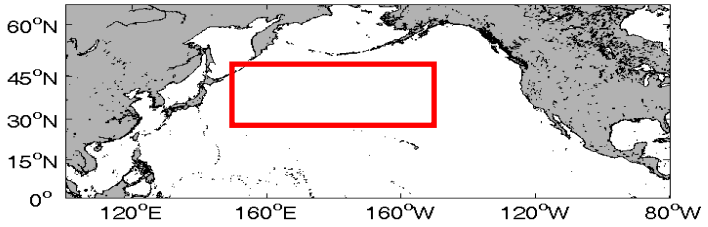
(Hu et al., 2014, J. Climate)



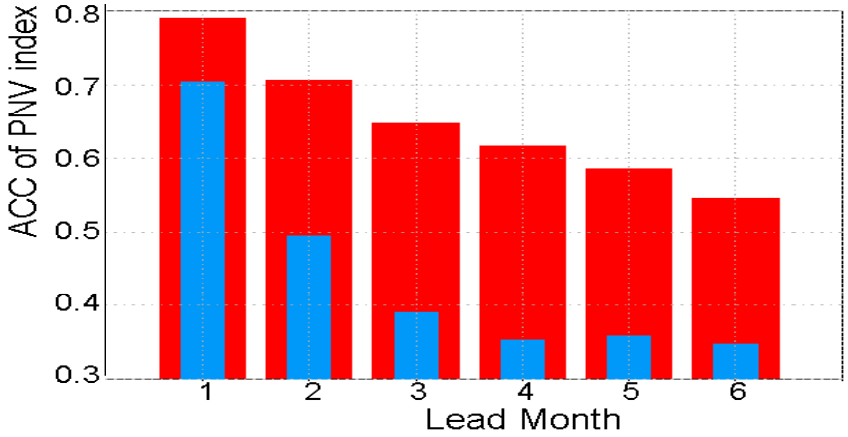
Hindcast Results

NPV: (30°-50°N, 150°-150°W) SSTA

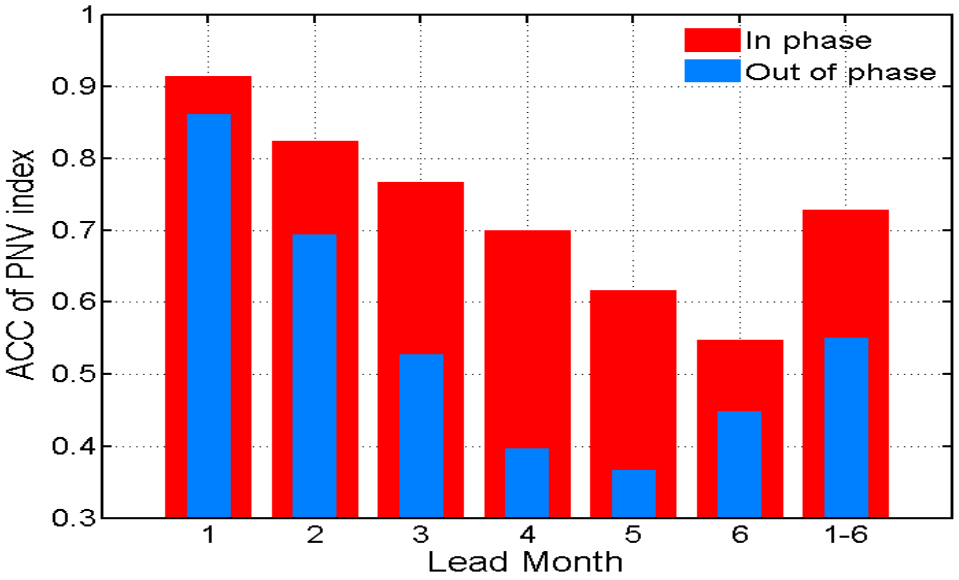
North Pacific Variability (NPV) in or out of phase with ENSO



CFSv2



FIO-ESM



- In phase : ↑ 11.6% ⟶ ENSO teleconnection
- Out of phase : ↑ 23.6% ⟶ local variability

PICES/CLIVAR WG-40 workshop on "Towards an integrated approach to understanding ecosystem predictability in the North Pacific"

Chaired by Ryan Rykaczewski, Antonietta Capotondi, Masami Nonaka and Fangli Qiao

June 20-21, 2019 in Qingdao, China

As the goal of FUTURE is to Understand the Predictability and Sustainability of the Social-Ecological-Environmental System, WG40 decided to provide seasonal prediction for PICES from physical parameters, bio-geo-chemical parameters to fisheries.

Summary

- UN Decade should be the main stream of ocean science to serve sustainable development. PICES, as the most important regional international organizations in the north Pacific, should plays key role in the Decade.
- As indicated in the 1st Global Planning Meeting and Regional n Denmark and the Regional Planning Workshop in Japan, to develop coupled models especially considering the surface wave can dramatically improve our simulation and forecasting ability for ocean, Typhoon and climate.
- Seasonal prediction products for PICES will be available within months through the efforts of Working Group 40.


Thank you for your attention
Observing the Ocean, Predicting its Future