

# WG-38 Contributions to FUTURE

## **WG-38: Mesoscale and Submesoscale Processes**

**Nov. 2016 – Oct. 2019**

**Co-chairs:  
Annalisa Bracco (USA)  
Hiromichi Ueno (Japan)**

# WG-38 Contributions to FUTURE

## 2016 Annual Meeting (San Diego)

### **Workshop 8:** *Mesoscale and submesoscale processes in the North Pacific: history and new challenges*

Convenors: KI Chang (Korea), H. Ueno (Japan) and A. Bracco (USA)

Invited speakers: S. Itoh (Japan) N.M. Levine (USA)

**Terms of Reference for new WG were discussed.**

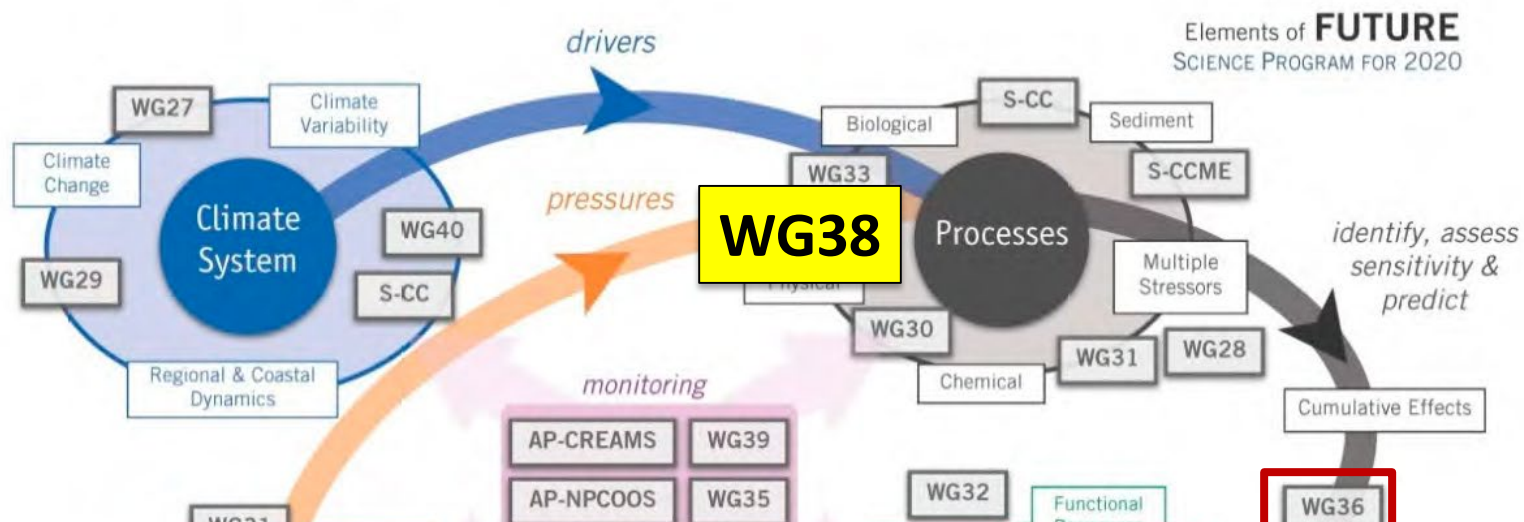


# WG-38 Contributions to FUTURE

## Terms of Reference

1. **Review** and document the current understanding of meso-/submeso-scale processes and their impact in the North Pacific.
2. **Summarize** the detection, observation and modeling methods of meso-/submeso-scale processes.
3. **Classify** meso-/submeso-scale features, and identify their spatio-temporal variations.
4. **Compare** the impacts of meso-/submeso-scale processes on heat/material transport and marine ecosystems between areas in the PICES region.
5. **Convene a session** or workshop on meso-/submeso-scale processes at PICES Annual Meetings.
6. **Publish a final report** summarizing results.

# WG-36 Contributions to FUTURE



More detailed understanding of meso-/submeso-scale processes would contribute to FUTURE, e.g.

ToR1.1. What are the important physical, chemical and biological processes that underlie the structure and function of ecosystems?

ToR1.2. How might changing physical, chemical and biological processes cause alterations to ecosystem structure and function?

# WG-38 Contributions to FUTURE

## 2017 Annual Meeting (Vladivostok) First business meeting

It was decided to

- focus activities on the seasonal to interannual changes in meso-/submeso-scale processes
- publish a synthesis review paper with a regional characterization of meso-/submeso-scale processes and their impact on marine ecosystem in the North Pacific
- invite two or possibly three members with a modeling focus that will cover both the physical and the biogeochemical realm.
  - Y. Sasai, I. Rypina and Y. Zhong became new members in 2018



# WG-38 Contributions to FUTURE

## **2017 Annual Meeting (Vladivostok) Session 9**

*Meso-/submeso-scale processes and their role in marine ecosystems*

Convenors: H. Ueno (Japan), M.D. Iglesias-Rodriguez (USA), S. Itoh (Japan), E. Ustinova (Russia)

Invited Speakers: S.V. Prants (Russia) R.M. Suryan (USA)

## **2018 Annual Meeting (Yokohama) Session 5**

*Seasonal to interannual variations of meso-/submeso-scale processes in the North Pacific*

Convenors: A. Bracco (USA), S. Itoh (Japan), E. Ustinova (Russia)

Invited Speakers: YL Eda (Japan) B Qiu (USA)

# WG-38 Contributions to FUTURE

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## **2018 Annual Meeting (Yokohama) Session 8**

Internal tides, nonlinear internal waves, and their impacts on biogeochemistry, climate and marine ecosystems via ocean turbulent mixing processes (Co-Sponsor OMIX)

Convenors: Shin-ichi Ito (Japan), SungHyun Nam (Korea), John Barth (USA), Annalisa Bracco (USA)

Invited Speakers: K Davis (USA), Y Noh (Korea), I Yasuda (Japan)

# WG-38 Products Related to FUTURE

## Anticipated activities:

- **Publish a synthesis review paper** with a regional characterization of meso-/submeso-scale processes and their impact on marine ecosystem focusing on seasonal to interannual variation (WG38 ToR 1-4).
- **Convene a session or workshop** on meso-/submeso-scale processes at PICES Annual Meetings (WG38 ToR 5).
- **Publish a final report** summarizing results (WG38 ToR 6).

### FUTURE Terms of Reference

1.1. What are the important physical, chemical and biological processes that underlie the structure and function of ecosystems?

1.2. How might changing physical, chemical and biological processes cause alterations to ecosystem structure and function?



# WG-38 Products Related to FUTURE

## Completed Activities:

- **Topic Session** (2017 annual meeting) *Meso-/submeso-scale processes and their role in marine ecosystems*
- **1-day business meeting** (2017 annual meeting): focused WG activities on the seasonal to interannual changes in meso-/submeso-scale processes (2017 business meeting)
- **Topic Session** (2018 PICES Annual Meeting) *Seasonal to interannual variations of meso-/submeso-scale processes in the North Pacific*
- **1-day business meeting** (2018 PICES Annual Meeting)

## Ongoing activities:

- **Working towards a synthesis review paper** with a regional characterization of meso-/submeso-scale processes and their impact on marine ecosystem in the North Pacific, focusing on seasonal to interannual variation.

## Enhanced Particulate Organic Carbon Export at Eddy the Oligotrophic Western North Pacific Ocean

Yung-Yen Shih, Chin-Chang Hung , Gwo-Ching Gong, Wan-Chen Chung, Yu-Huai Wang, I-Huan Lee, Kuo-Chuang-Yi Ho

## Mesoscale eddy effects on temporal variability of surface chlorophyll *a* in the Kuroshio Extension

### Interannual Variability of the North Pacific Subtropical Countercurrent and Its Associated Mesoscale Eddy Features

Shinya Kouketsu , Hitoshi Kaneko, Takeshi Okunishi, Kosei Sasaoka, Sachihiko Itoh, Ryuichiro Inoue, Hiromichi Ueno

Bo Qiu and Shuiming Chen  
*Department of Oceanography, University of Hawaii at Manoa, Honolulu, Hawaii*

## Physical and biological roles of mesoscale eddies in Japanese eel larvae dispersal in the western North Pacific Ocean

## Krill space: A comparative assessment of mesoscale structuring in polar and temperate marine ecosystems

August 2012 · ICES Journal of Marine Science 69(7)

DOI: 10.1093/icesims/fss048

## Simulating the Oceanic Migration of Silver Japanese Eels

Yu-Lin Chang , Yasumasa Miyazawa, Mélanie Béguer-Pon

Published: March 16, 2016 • <https://doi.org/10.1371/journal.pone.0150187>

K. Chang , Yasumasa Miyazawa, Mélanie Béguer-Pon, Yu-San Han, Kyoko Ohashi & Jinyu

### Mesoscale to Submesoscale Transition in the California Current System. Part I: Flow Structure, Eddy Flux, and Observational Tests

X. Capet, J. C. McWilliams, M. J. Molemaker, and A. F. Shchepetkin  
*Institute of Geophysics and Planetary Physics, University of California, Los Angeles, Los Angeles, California*



[rspb.royalsocietypublishing.org](http://rspb.royalsocietypublishing.org)



## Review Alaskan Stream flow in the eastern subarctic Pacific and the eastern Bering Sea and its impact on biological productivity

Sergey Prants, Andrey Andreev, Michael Uleysky, and Maxim Budyansky  
Seasonal and Mesoscale Variability of the Kuroshio Near Its Origin

## The tropicalization of temperate marine ecosystems: climate-mediated changes in herbivory and community phase shift

Adriana Vergés<sup>1,2,5</sup>, Peter D. Steinberg<sup>1,5,6</sup>, Mark E. Hay<sup>7</sup>, Alistair G. B. Poore<sup>1</sup>, Alexandra H. Campbell<sup>1,2,5</sup>, Enric Ballesteros<sup>8</sup>, Kenneth L. Heck Jr<sup>9</sup>, David J. Booth<sup>5,10</sup>, Melinda A. Coleman<sup>11</sup>, David A. Feary<sup>5,10</sup>, Will Figueira<sup>5</sup>, Tim Langlois<sup>13</sup>, Ezequiel M. Marzinelli<sup>1,5</sup>, Toni Mizerek<sup>5,14</sup>, Peter J. Mumby<sup>1</sup>, Yohei Nakamura<sup>16</sup>, Moninya Roughan<sup>3,5</sup>, Erik van Sebille<sup>4</sup>, Alex Sen Gupta<sup>4</sup>, Ian K. Wilson<sup>1</sup>

### Anticyclonic Eddies in the Alaskan Stream

Hiromichi Ueno and Kanako Sato  
*Institute of Observational Research for Global Change, Japan Agency for Marine-Earth Science and Technology, Yokosuka, Kanagawa, Japan*

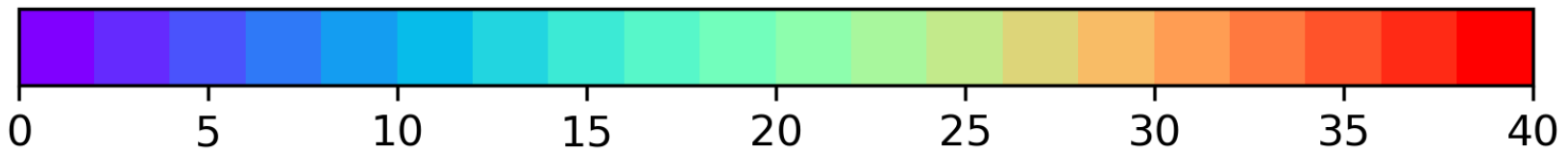
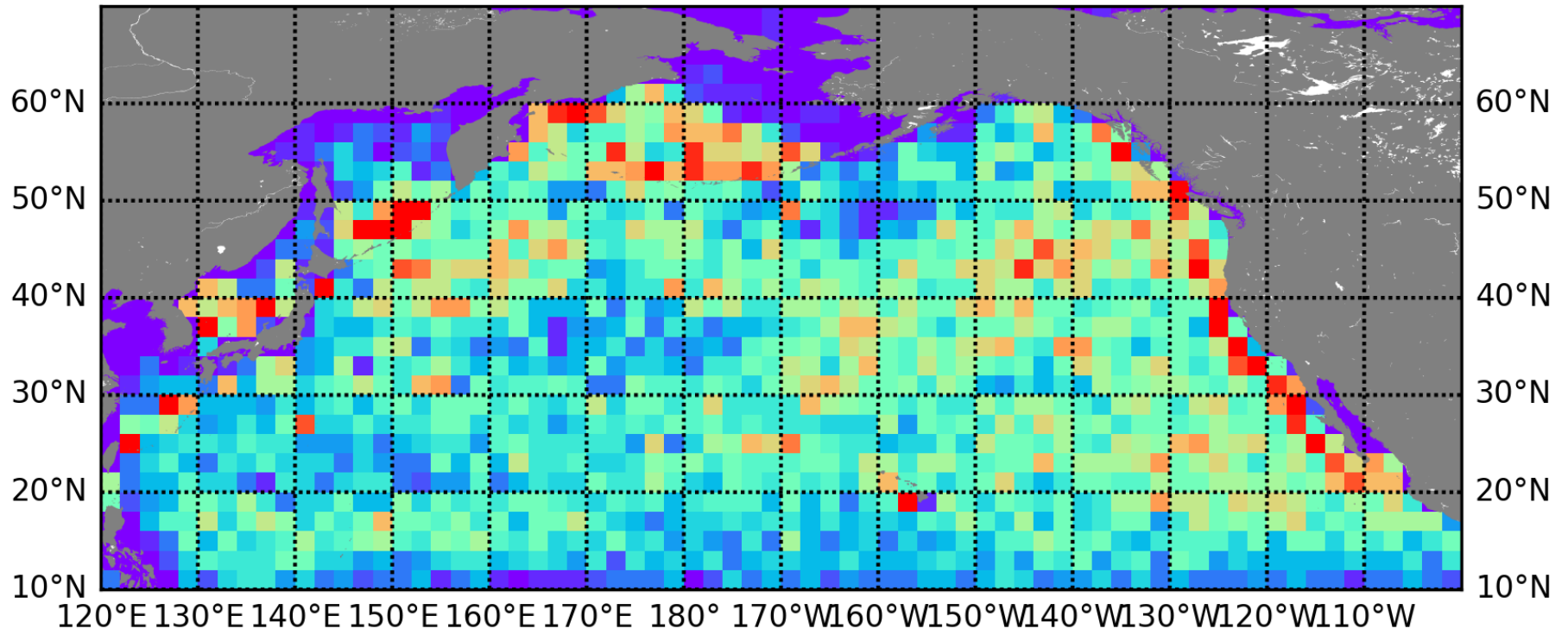
### Regionality and seasonality of submesoscale and mesoscale turbulence in the North Pacific Ocean

Hideharu Sasaki<sup>1</sup>  • Patrice Klein<sup>2</sup> • Yoshikazu Sasai<sup>3</sup> • Bo Qiu<sup>4</sup>

## A rare and extensive summer bloom enhanced by ocean eddies in the oligotrophic western North Pacific Subtropical Gyre

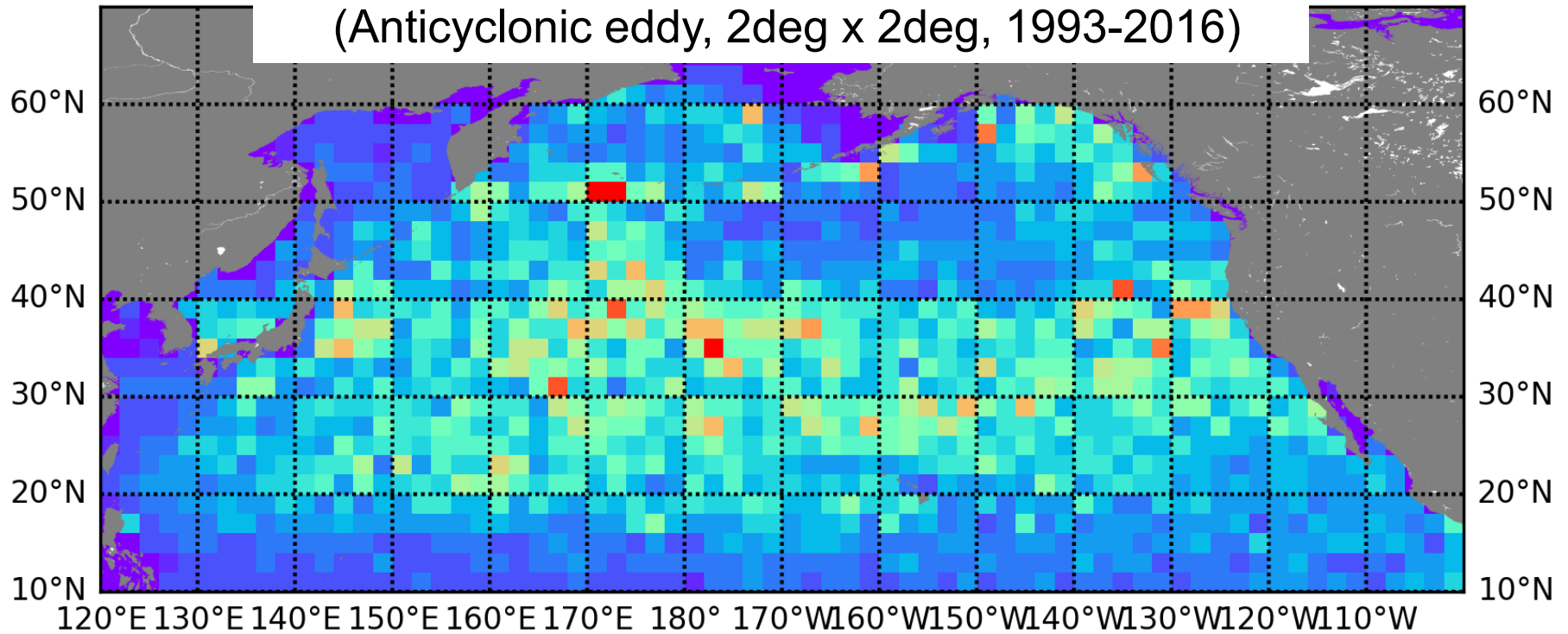
Chun Hoe Chow , Wee Cheah & Jen-Hua Tai

Number of Anticyclonic eddy formation (2deg x 2deg, 1993-2016)



Eddies are formed intensively along the coast

Lifetime (day) averaged within the formation area  
(Anticyclonic eddy, 2deg x 2deg, 1993-2016)



- long-lived-eddy formation area is different from the area eddies form frequently.
- Long lived eddies form e.g. at 30-40N and south of Aleutian Is.



For each Regions

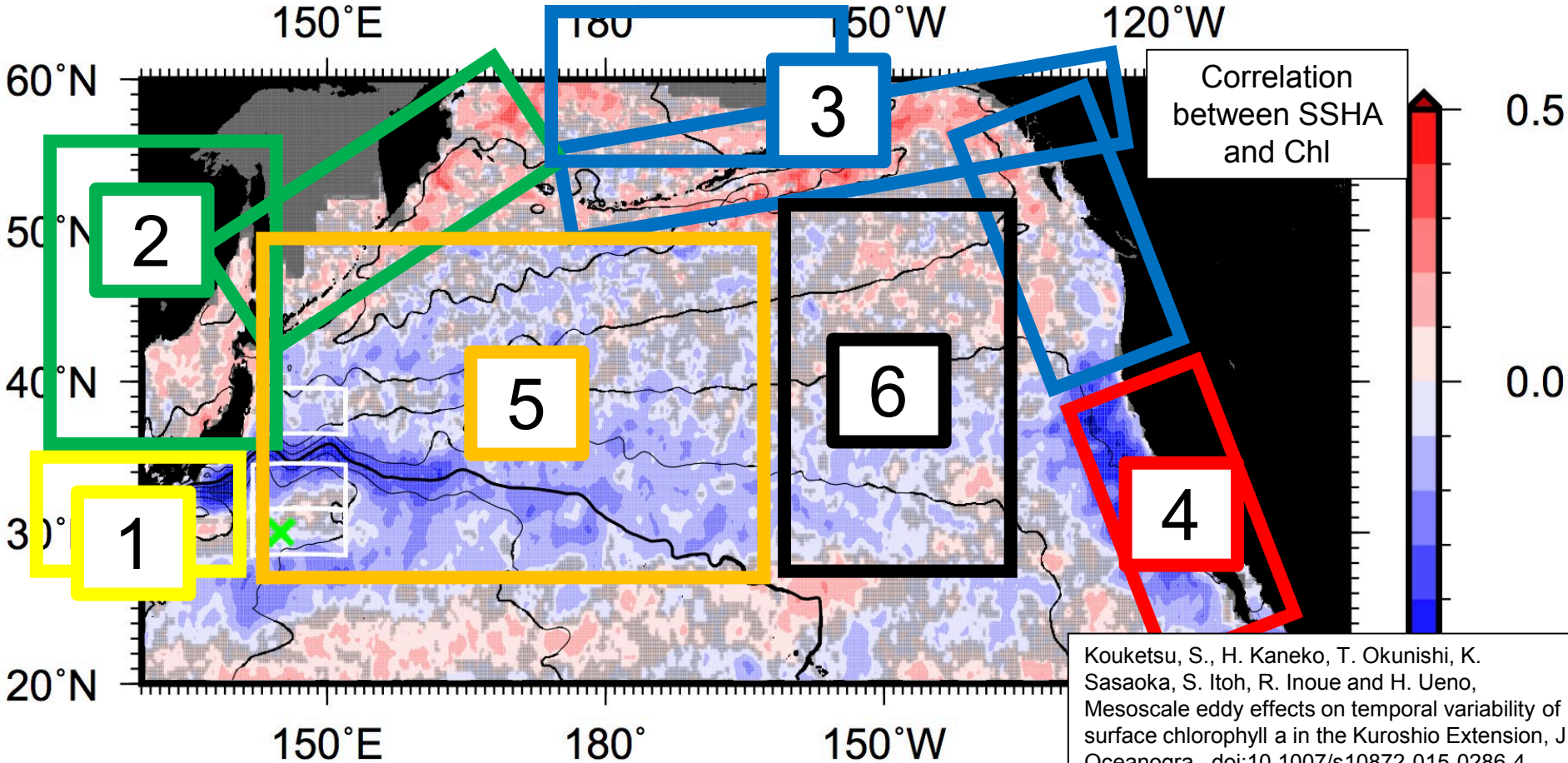
- Timescales
  1. Mean state
  2. Trends
  3. Interannual
  4. Seasonal

- Physical Metrics

1. Temperature/salinity profiles -- stratification
2. Eddy kinetic energy/SSH
3. Eddy lifetime
4. Formation regions vs transit regions

- Ecosystem metrics

1. Nutrients
2. Chlorophyll
3. Higher trophic levels: Zooplankton/fish/marine mammals/seabirds



Kouketsu, S., H. Kaneko, T. Okunishi, K. Sasaoka, S. Itoh, R. Inoue and H. Ueno, Mesoscale eddy effects on temporal variability of surface chlorophyll a in the Kuroshio Extension, J. Oceanogra., doi:10.1007/s10872-015-0286-4 (2015)

# WG-38 Products Related to FUTURE

**Planned Activities (in 2017):** Characterization of meso/submesoscale circulations in a submesoscale-permitting model solution (MITgcm, 2 km resolution).

**Challenges:** Delayed outside WG control. Now possible to using a 3 km resolution OFES solution (WG would need extension to complete analysis and manuscript)

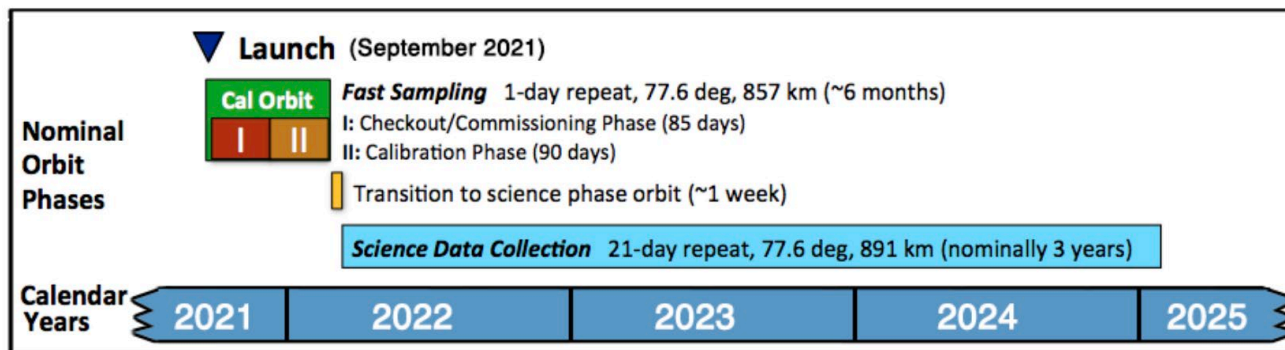
**Planned activity:** 2019 POC Topic Session proposal  
*Impacts of meso-/submeso- scale processes on heat/material transport and on marine ecosystems*

Conveners: Tetjana Ross (Canada), Hiromichi Ueno (Japan), Olga O. Trusenkova (Russia)



# WG-38: What next for FUTURE?

- Submesoscale observations: SWOT mission (launch planned for 2021)



- Already available: Envisat MERIS, Sentinel-2 MSI, and Landsat TM/ETM+/OLI, high-frequency radar measurements, gliders... (limited in time/spatial coverage but very useful for coastal/regional studies)
- CMIP6 will include OMIP, Biogeochem OMIP and HighResMIP experiments. All great resources for mesoscale variability studies ([https://www.wcrp-climate.org/images/modelling/WGCM/WGCM20/documents/3a\\_Eyring\\_CMIP6-EndorsedMIPs\\_Overview\\_WGCM\\_161101\\_FINAL.pdf](https://www.wcrp-climate.org/images/modelling/WGCM/WGCM20/documents/3a_Eyring_CMIP6-EndorsedMIPs_Overview_WGCM_161101_FINAL.pdf))
- New ocean reanalysis at 10 km resolution are being produced

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Thank you  
спасибо  
谢谢  
고맙습니다  
ありがとうございました!