2020 Ocean Surface Topography Science Team meeting

**Nikolai Maximenko, Jan Hafner, and Per Knudsen**

IPRC/SOEST, University of Hawaii, USA  Denmark Technical University

# Multi-scale interactions in ocean circulation analyzed using satellite and in situ observations and model outputs

Acknowledgements: D. Nechaev, C. Roach, O. Andersen, H. Kamachi, A. MacFadyen, L. Centurioni, V. Hormann

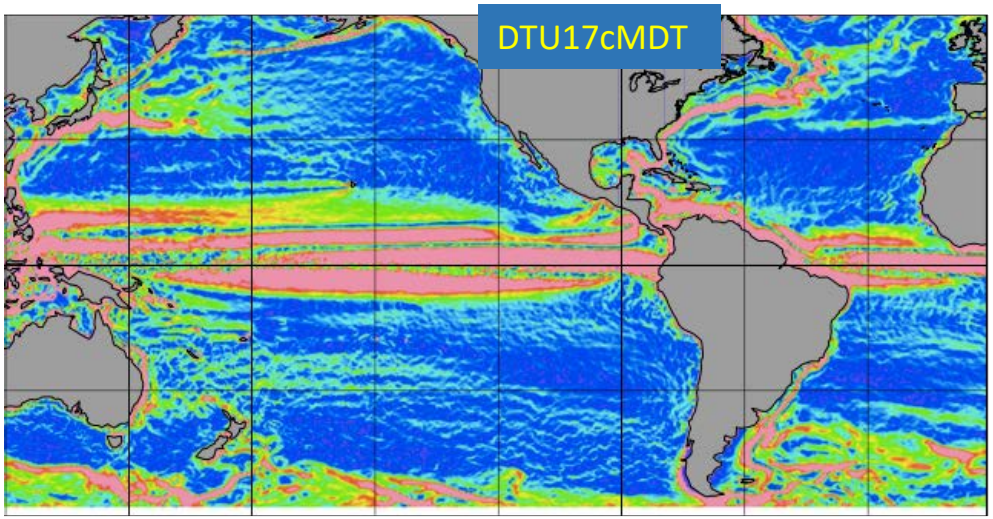
# Enhanced mean dynamic topography (DTU17cMDT)

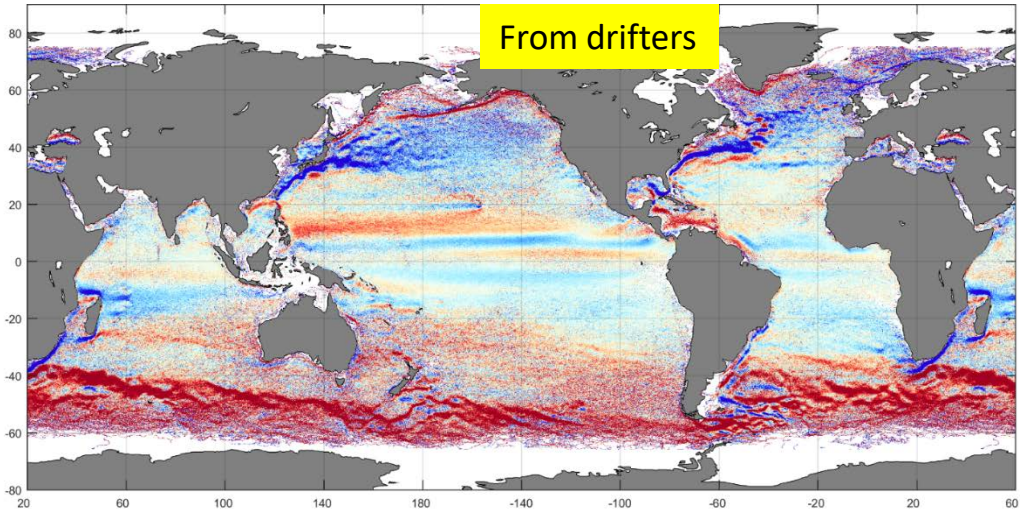
based on:
- GOCE geoid
- improved parameterization of ageostrophic currents
- extended satellite and in situ datasets

RMS MDT gradient signals and differences:
**geodetic**,
**oceanographic**,
**difference.**


zonal
meridional

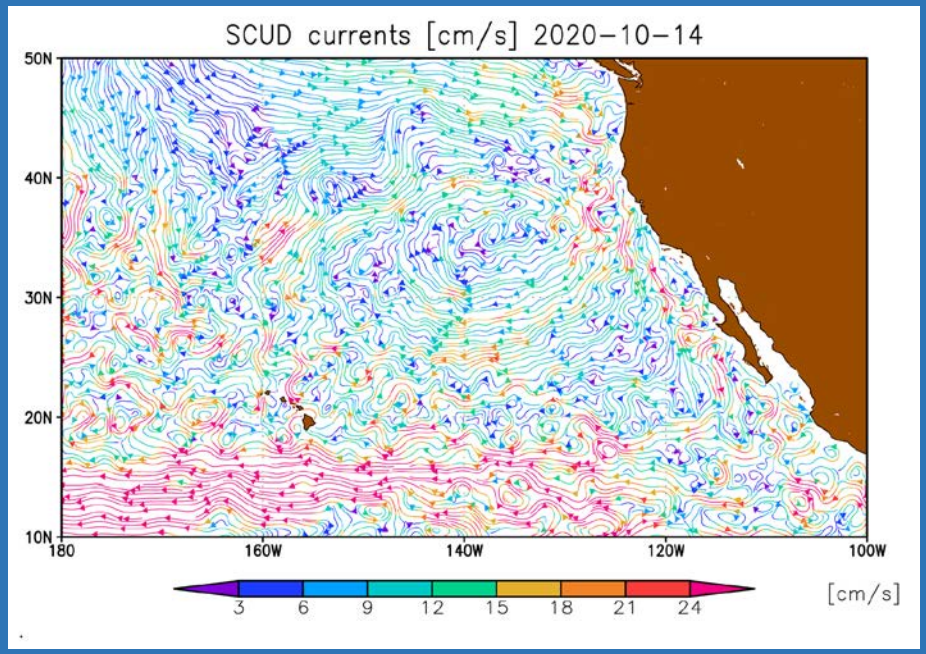
Meridional gradient of MDT



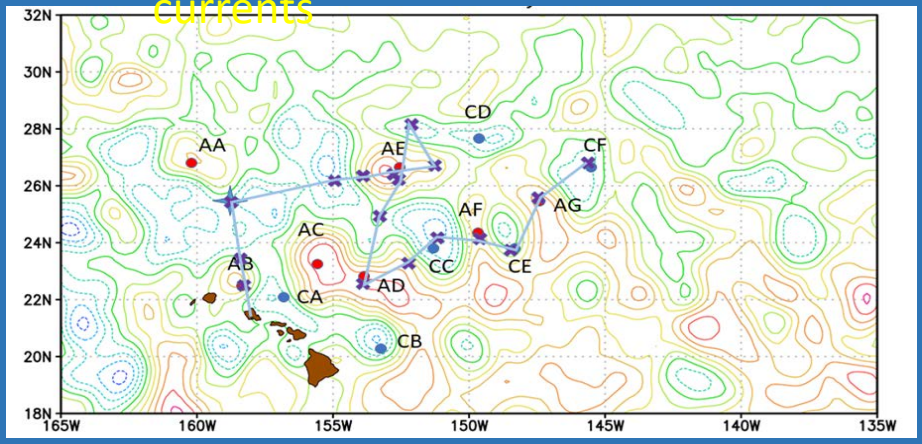




Knudsen et al., 2020, in press

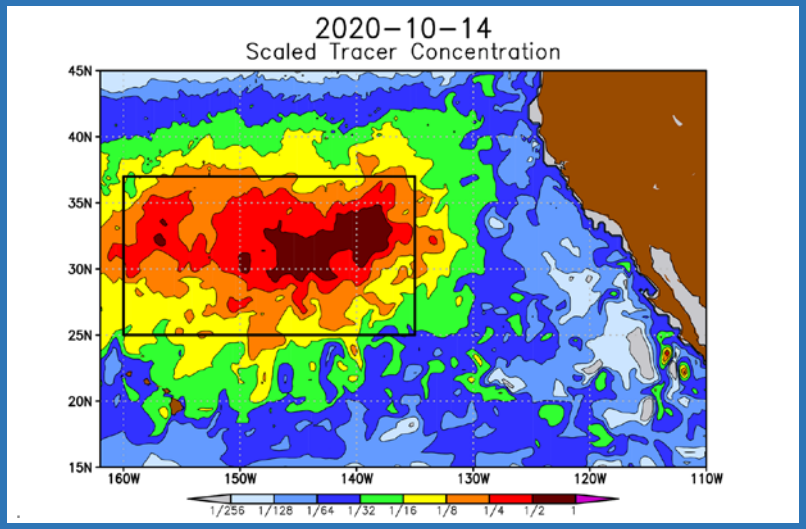
# Applications



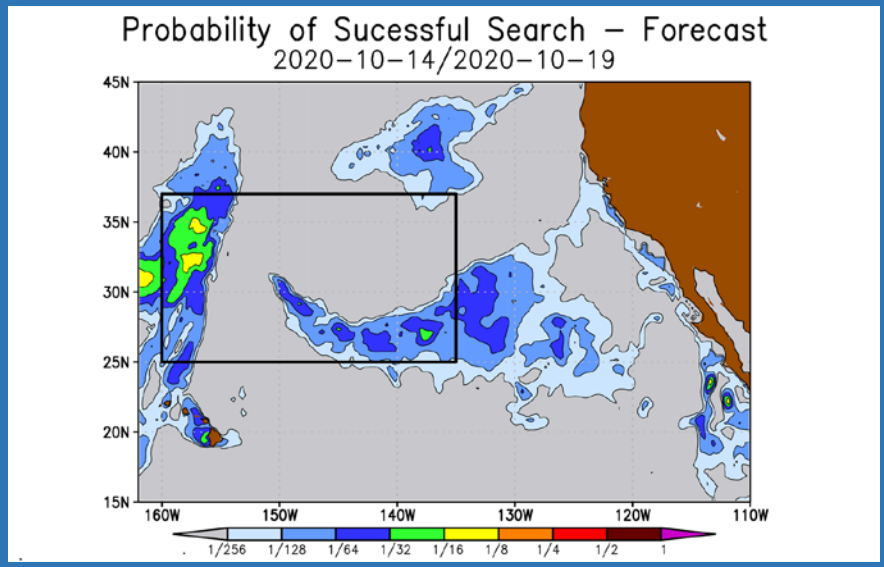

Near-real time surface currents




Optimization of expedition plans

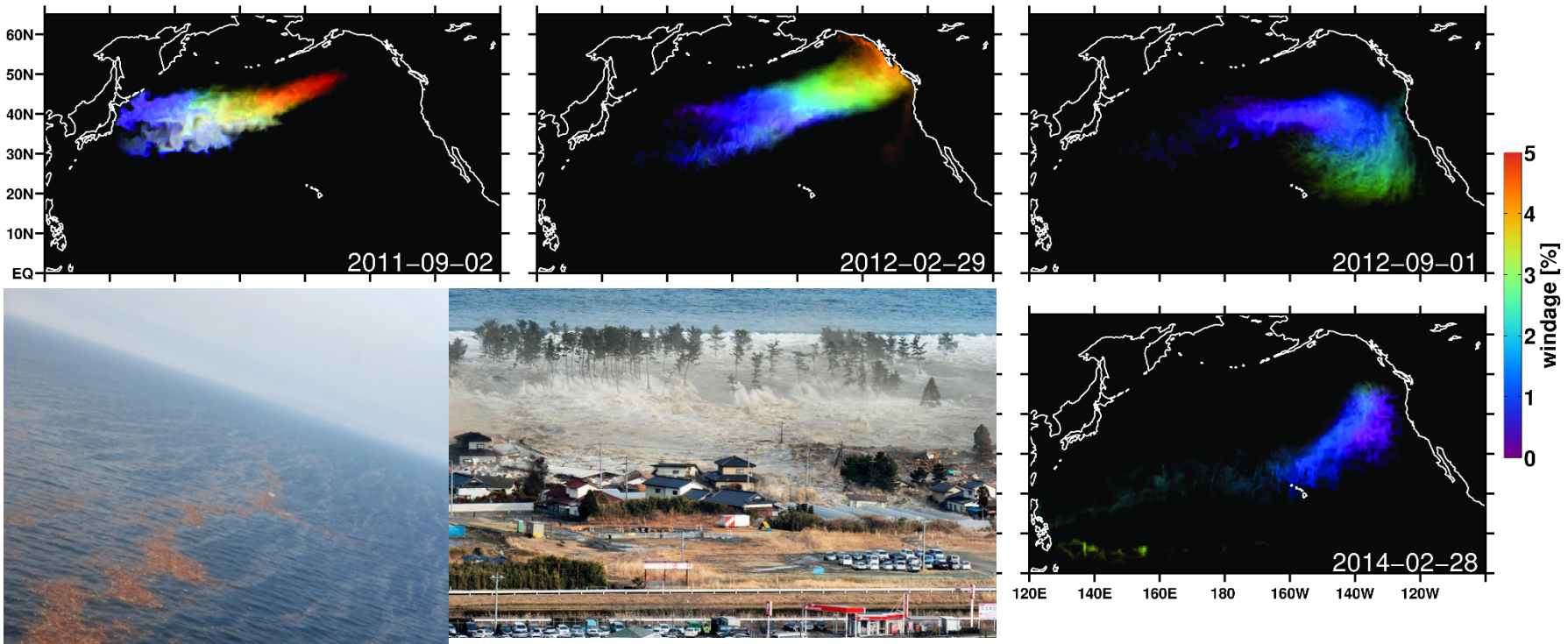



Near-real time model marine debris



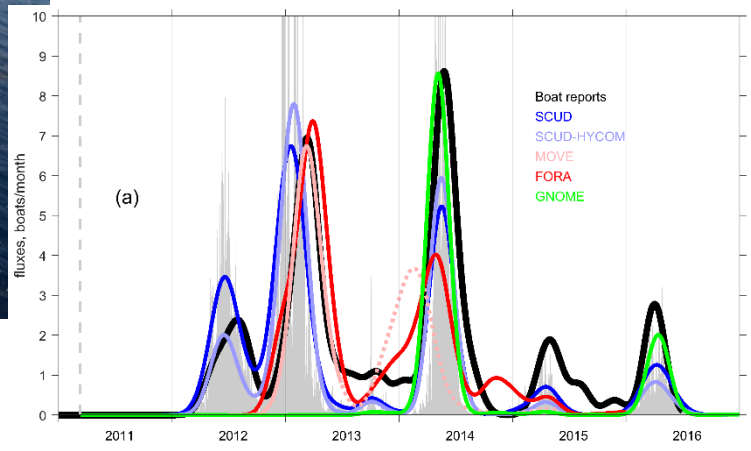

Probability of success -- ocean conditions are accounted for.

# Model simulations of debris drift from the 2011 tsunami in Japan







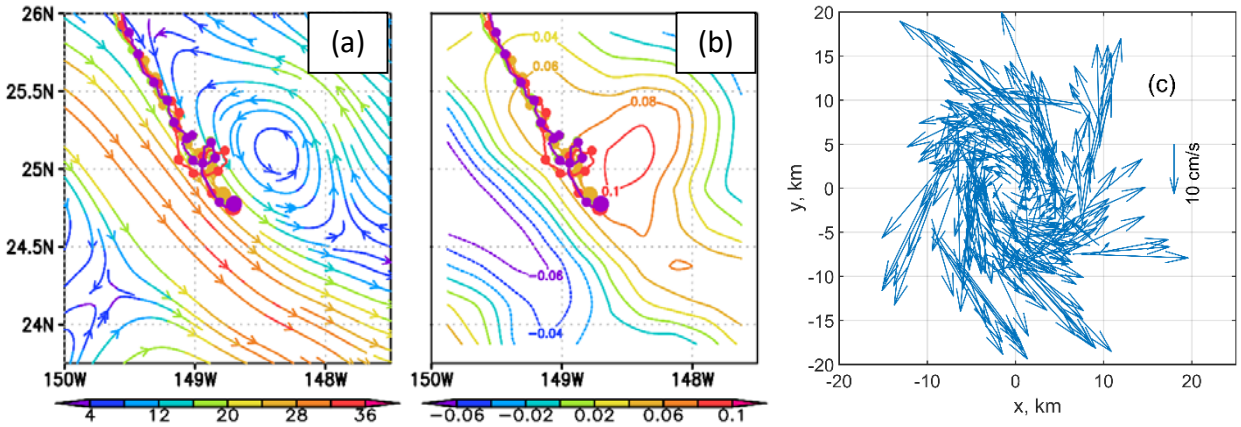




Simulations revealed significant differences between pathways of different windages suggesting that different areas were affected by different types of JTMD and at different times.

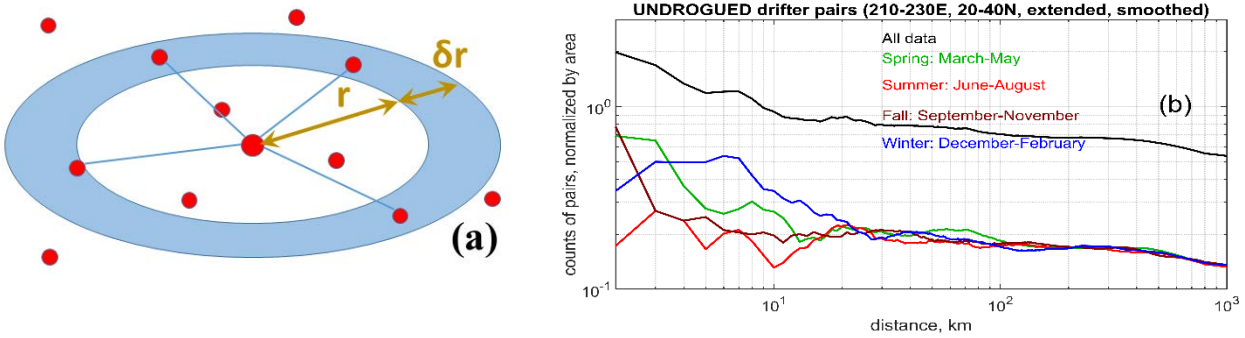
SCUD modeling explained all peaks, observed on the US/Canada west coast.

Maximenko et al., 2018

# Close-range interactions between Lagrangian drifters

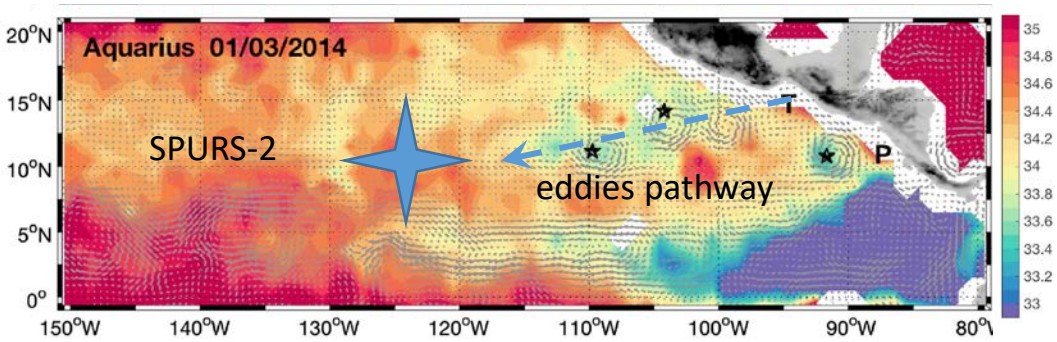


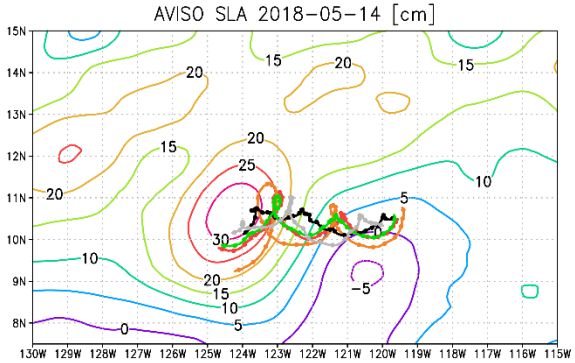

(a,b) Trajectories of four drifters, deployed in the FloatEco experiment, captured in November 2018 – February 2019 in a small submesoscale cyclonic eddy. Background in (a) is streamlines of geostrophic surface currents and in (b) contours of geostrophic vorticity, normalized by the local Coriolis parameter, for December 4, 2018. (c) Composite of eddy velocities relative to its center, calculated for the period November 21 – December 11, 2018.

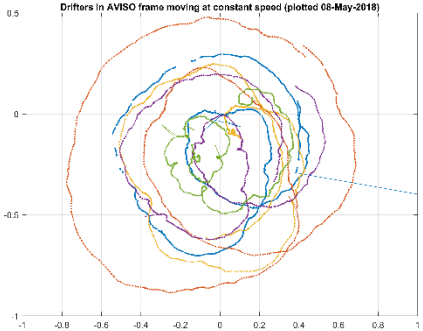



(a) Schematic, illustrating calculations of the statistics of distances between pairs of particles. (b) Seasonal and full PDF's of distances between pairs of historical drifters in the subtropical North Pacific.

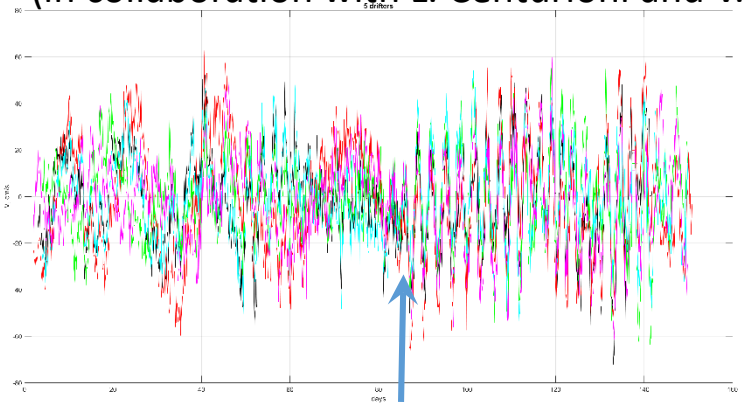
# Dynamics of mesoscale eddies, generated off of Mexico and reaching SPURS-2 area



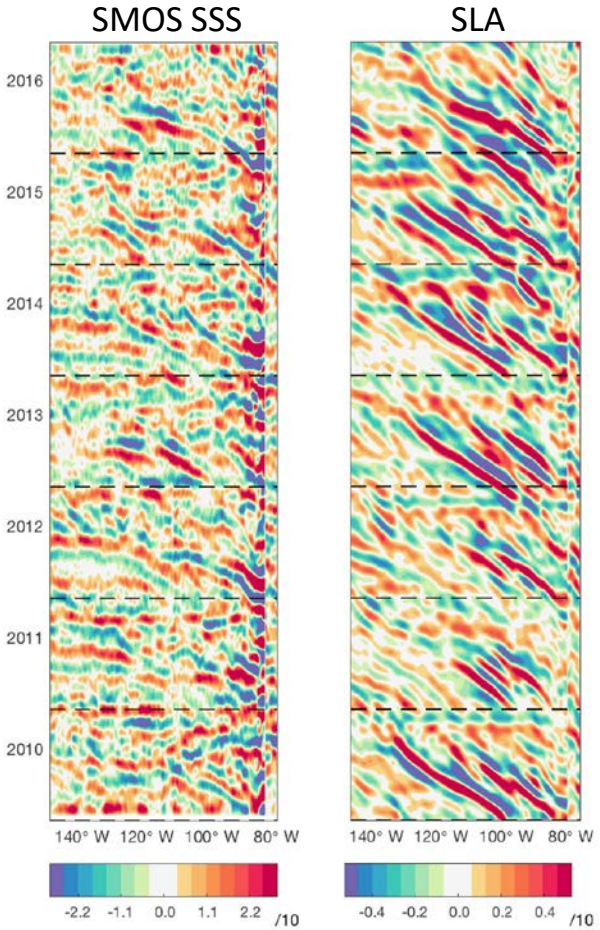




Five drifters deployed in the "Mexican" eddy during SPURS-2.
(in collaboration with L. Centurioni and V. Hormann)

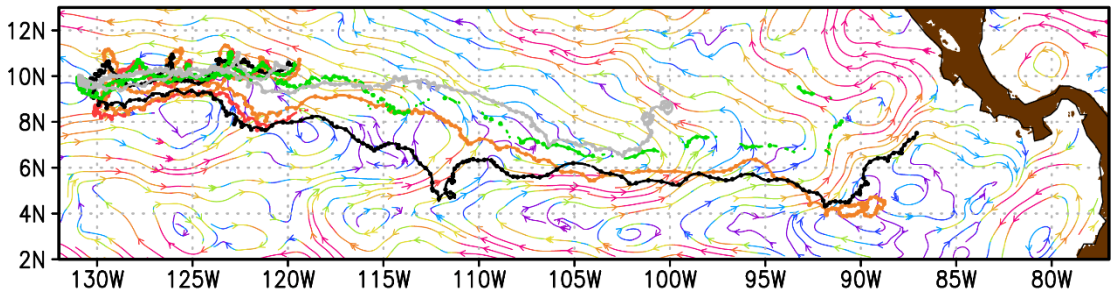


Sudden death of the eddy with generation of strong monochromatic inertial oscillations

Hasson et al. (2019)

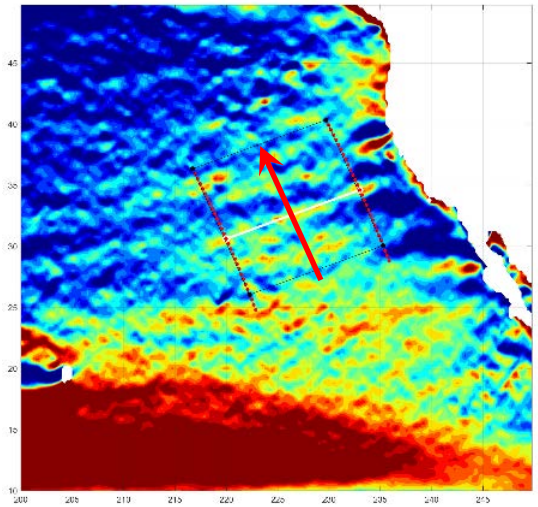


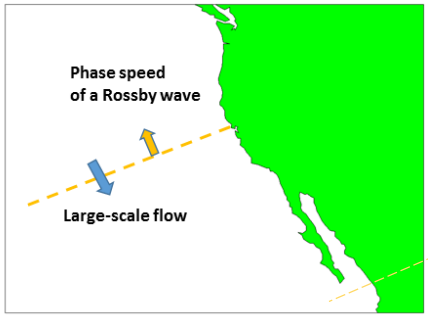

Lagrangian gyre in the eastern Tropical Pacific

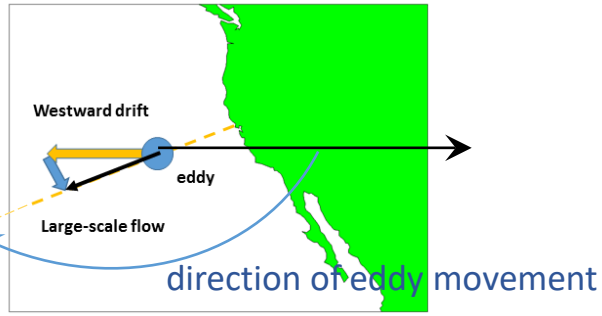


# Ongoing research: eddy response to variations of large-scale flow

(application to striations and beta-plumes)

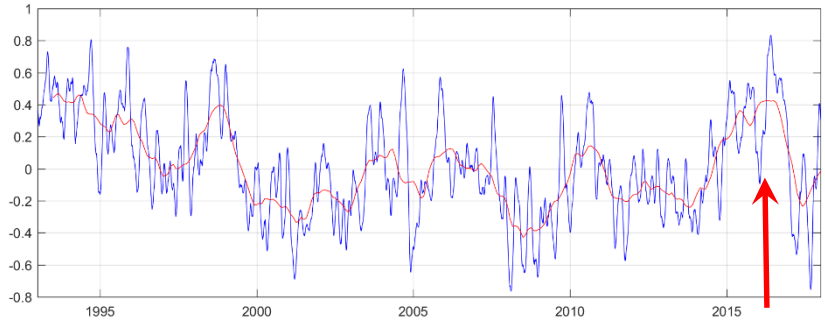




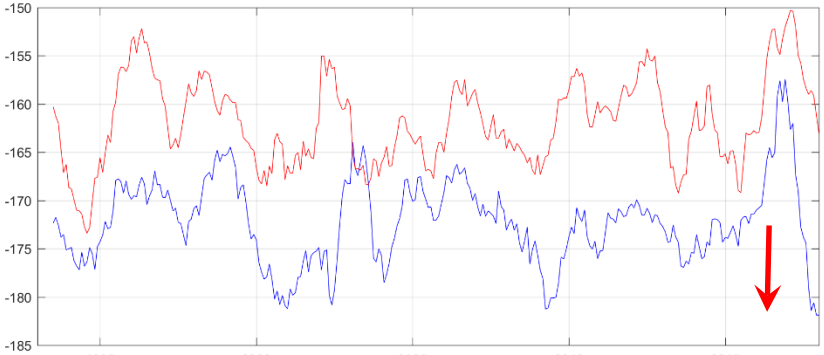




Eddy velocities

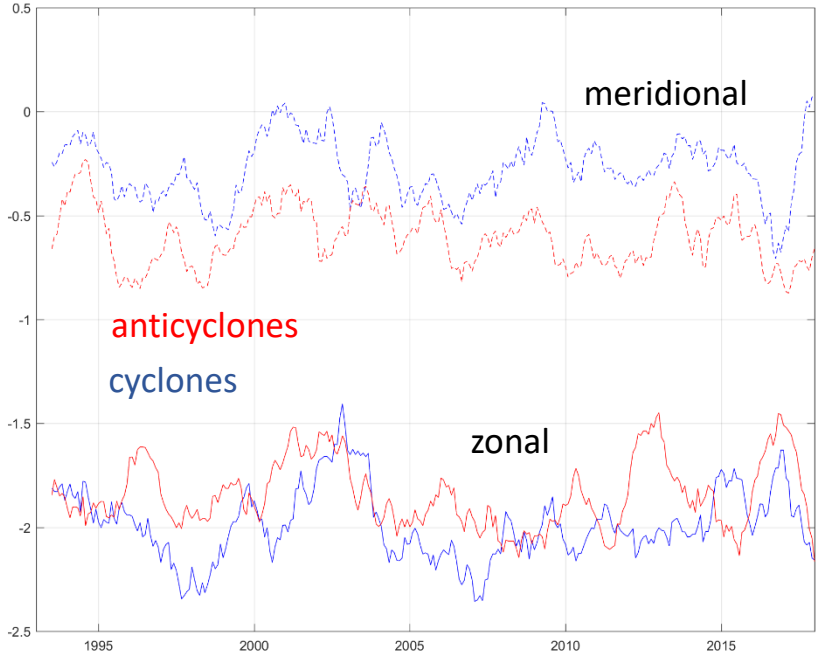
large-scale flow




direction of eddy movement




year

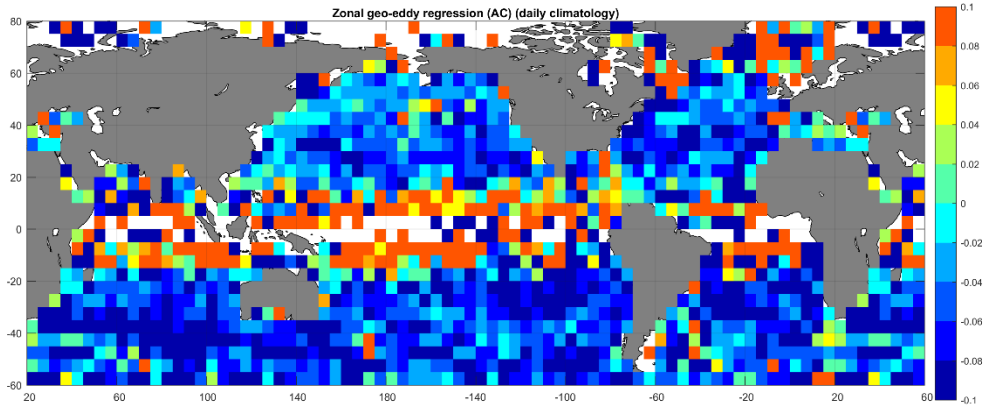



year

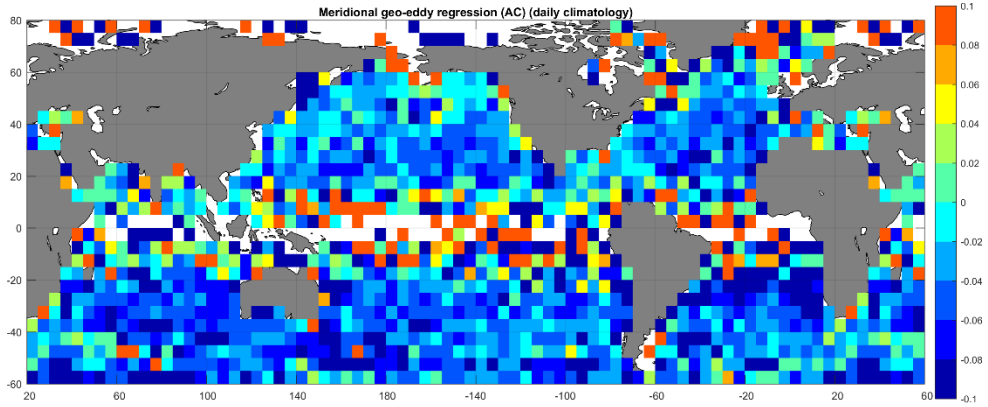
# Ongoing research: eddy response to variations of large-scale flow
(big picture)

Regression coefficients between monthly-averaged zonal and meridional components of velocities of mesoscale eddy and large-scale currents

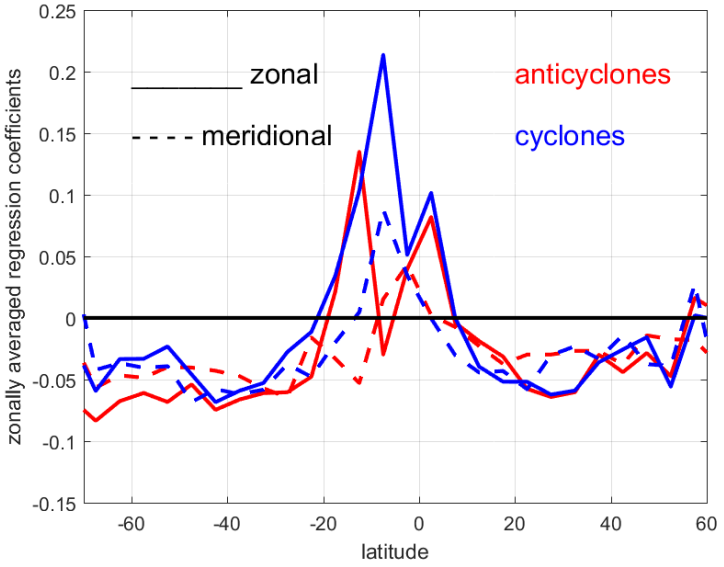
Anticyclones: zonal



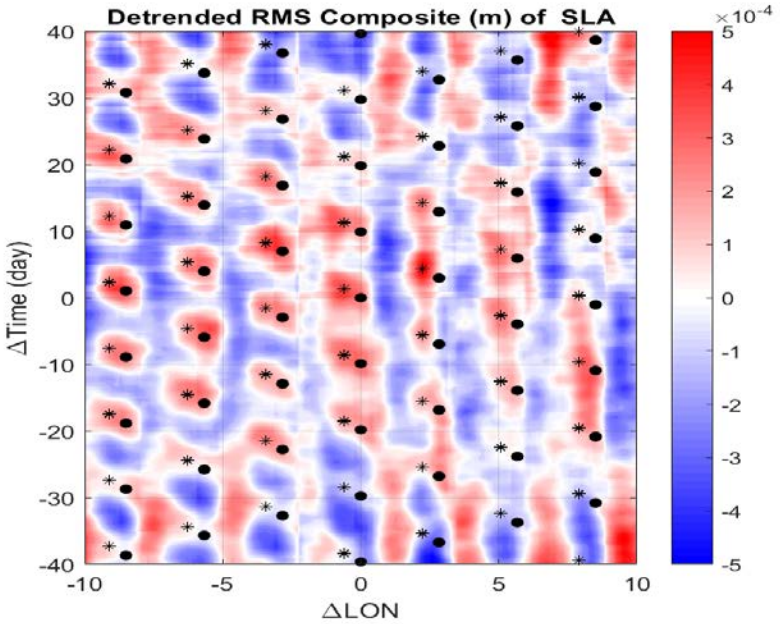

Anticyclones: meridional

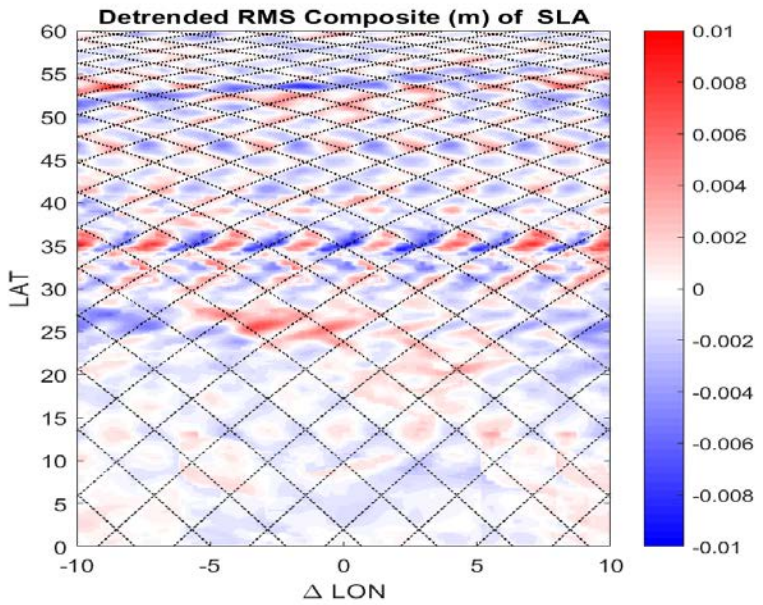



Regression coefficients averaged zonally



# Distortion of mesoscale eddy signal in gridded altimetry products




Current gridded AVISO SLA, based on short time-space correlations has higher energy on satellite tracks and passing times.

Technique of interpolation over large gaps needs to be improved.

Improved coverage in future satellite missions (SWOT) may help to do this.

Roach and Maximenko, OSTST 2017 poster