2018 Coupled Ocean Surface Variables Workshop summary
Draft 4 (23 July 2018)

Theme 1: Ocean mixing

Major goals:

- Understand the spatial and temporal variability of mixing on time and space scales that can be observed with satellite (days to months, $O(1 \text{ to } 100)$ km).
- Determine links between mixing processes and the state of the larger-scale ocean, and which mixing processes are key for accurately representing variability at larger scales.
- Improve model parameterizations by better understanding the physics of small-scale mixing.
- Leverage *in situ* measurements, in conjunction with satellite data, to improve our understanding of small-scale mixing and its consequences.

Specific Questions:

1. What processes modulate mixed-layer depth (MLD) and mixing layer depth in the global ocean?
    - Develop strategies to determine MLD, mixing layer depth, and near-surface stratification from space-based measurements (e.g., through parameterizations), on <50 km to 100 km space scales and sub-daily to monthly time scales.
    - Create a high-resolution validated MLD product using satellite-based sensors, in situ measurements, and modeling/state estimation
2. What are the contributions of tides, winds, and bottom bathymetry to global internal wave-driven ocean mixing?
    - Where, when, and why is energy for ocean mixing generated, propagated, and dissipated?
    - What are the impacts of these processes on larger-scale ocean dynamics and heat budgets?
3. What is the impact of submesoscale (<25 km) mixing processes on air-sea exchanges of momentum, heat, freshwater, and gases?
    - How do submesoscale fronts and eddies govern mixing?
    - What role does atmospheric variability play in governing submesoscale mixing processes?
4. To what extent can we use space-based measurements to identify mixing and mixing processes within the ocean, such as deep convection, submesoscale instability, wind-driven mixing, and internal waves?
    - What types of mixing dominates in what seasons and what regions?
    - How can this information be used to develop better parameterizations?
5. What do observations during periods with little mixing reveal about air-sea fluxes when boundary layers are stable?

Strategies

- Use the global database of microstructure measurements to connect in situ and satellite observations of mixing.
- Identify a global model that can connect the various projects of the ocean mixing team that are deriving mixing from surface variables.

Theme 2: Air-sea interaction

Specific Goals:

- Quantify the dependence of forcing, response, and two-way ocean-atmosphere coupling (including air-sea fluxes) on the background/large-scale ocean and atmosphere states, for temporal scales of hours to seasons and spatial scales of submesoscale to regional.
- Understand the relationship between state variables within the mixed layer and at the sea surface, and investigate how this relationship is affected by physical processes at the air-sea interface (such as buoyancy forcing, wind, waves).
- Evaluate whether fluxes can be inferred directly from remotely sensed observations (rather than bulk parameterizations).
- Improve parameterization of processes that affect air-sea fluxes such as wind-current interactions, sea state, clouds, and processes that affect mixed-layer temperature.

Strategies:

- Improve usage of existing data for analysis and data assimilation to improve our knowledge of key processes in air-sea coupling.
- Determine the surface expression (e.g., SST, SSH) of mixed-layer and atmospheric boundary-layer processes.
- Use satellite data for regional validation of coupled models.
- Exploit SAR data to qualitatively identify submesoscale features in wind speed.
- Use ship-based meteorological and sea surface observations to get at submesoscale (subpixel) variability in SST and the impact on air-sea fluxes.
- Use space-based wave estimates (along with other observations) to understand the effect of waves on air-sea interactions.

Theme 3: Submesoscale

Specific goals:

- Determine how to separate the geostrophically balanced motions from the internal wave field, which is challenging due to the poor temporal and spatial sampling of satellite observations.
- Diagnose the magnitude of submesoscale variability, including its seasonality and regional variability, and what we miss given the resolution of current satellite observations.

Strategies:

- Use existing high-resolution satellite data (SST/color/SAR) to identify regions of large vertical velocities and active internal waves in order to explore techniques for separating geostrophically balanced and wave motions.
- Use NASA airborne sensors (e.g., DopplerScatt) and Earth Venture Suborbital missions to study air-sea interaction and submesoscale variability in regions where satellite measurements are difficult (e.g., Arctic, Maritime Continent, coastal).
- Use high resolution, internal-wave-resolving models to explore the synergy between existing satellite/in-situ data and data from future NASA mission such as SWOT.