US CLIVAR Working Group on
Air–Sea Interaction
Overview

Mesoscale and Frontal–Scale Ocean–Atmosphere
Interactions and Influence on Large–Scale Climate

Co–Chairs
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US Members
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US CLIVAR Whither the Gulf Stream Workshop
June 16, 2022
Working Group Objectives

Overarching goal: Formulate and coordinate observational and modeling efforts to quantify oceanic mesoscale and frontal–scale air–sea coupled processes and evaluate their integrated impacts on Earth’s climate and hydrological cycle

- Produce a review paper synthesizing current understanding and open questions, and demonstrate influence of this air–sea coupling on a wide variety of high–level processes in Earth’s climate system
  - Large–scale atmospheric circulation, hydrologic cycle, and ocean dynamics and biogeochemistry, among others
- Develop diagnostic frameworks and analyze models and observations using a set of robust metrics
- Identify consensus on uncertainties and directions forward for observing and modeling
  - Guide in situ and satellite observations for optimum sampling strategies
  - Motivate coordinated process–oriented modeling andobservationally–based diagnostic studies
  - Broker community efforts following the previous US CLIVAR Workshops on related topics
Mesoscale air–sea coupling addresses aspects of core CLIVAR research challenges:

- Subseasonal-to-Seasonal Prediction
- Decadal Variability and Predictability
- Climate Change
- Climate and Extreme Events
- Polar Climate Changes
- Climate and Marine Carbon/Biogeochemistry
- Climate at the Coasts

Also: Hydrological cycle (distribution of precipitation and aspects of terrestrial drought); Marine heat waves (coastal and open ocean); ocean ecology (specifies proliferation and distribution)

https://usclivar.org
Recent WG activities

- Submitted review paper to the Journal of Climate
- Bi-monthly research seminars to the working group
- Assist planning of US CLIVAR Gulf Stream workshop
- Hosting a session at the 2022 Fall AGU meeting
- Planning a community workshop for winter/spring 2023
Bi-monthly science seminars

- **Jackie May** (NRL): “Impact of currents and submesoscale ocean resolution on the air–sea interface in a coupled model”
- **Lucas Laurindo** (NCAR): “Role of ocean and atmosphere variability in scale–dependent thermodynamic air–sea interactions”
- **Eduardo Moreno–Chamarro** (Barcelona Supercomputing Center): “Can we trust future projections of European winter precipitation?”
- **Justin Small** (NCAR): “Convergence over the Gulf Stream on Hourly to Annual Timescales: the Role of SST Revisited”
- **Jim Edson** (WHOI): “A Global Array of Surface Flux, Currents and Waves Measurements and the Evolution of the COARE Algorithm”
“Ocean Mesoscale and Frontal–scale Ocean–Atmosphere Interactions and Influence on Large–scale Climate: A Review” Submitted to the Journal of Climate in Dec 2021

Reviewed recent advances in many aspects of the role air–sea coupling on Earth’s large–scale climate

- Focused on coupling processes on scales of 10–1000km and weather to climate timescales
- This is a frontier of observational and modeling and tests the limits of spatial resolution and temporal sampling of observations and models
1) Impacts of air–sea coupling touch on many key aspects of our climate system, including the hydrological cycle, ocean biogeochemical cycles, and climate change

2) Importance of sustained global observations of the oceanic mesoscale from in situ and remote sensing
   - Lack of measurements hampers improvements in weather and climate model predictions

3) Improving surface heat, momentum, and gas flux observations
   - Emerging evidence indicates that surface current measurements are a critical missing piece of the current flux observing system

4) Oceanic submesoscale is being recognized as important for air–sea coupling and large–scale climate
   - Lack of studies (modeling and observations) due to challenges specific to submesoscale

5) Diagnostics for comparing air–sea coupling between models and observations are crucial for improving coupled climate models and understanding key physical processes of air–sea coupling
   - These diagnostics require long observational data records
Activities of working group members

- S-MODE
- US CLIVAR–sponsored workshops on:
  - Gulf Stream in Weather and Climate Workshop
  - Tropical Pacific Observing Needs
- HighResMIP2, PRIMAVERA
- OASIS
- DYAMOND
- WaCM winds/surface currents satellite
- Butterfly satellite mission concept
- DOE wind projects
- HOTSPOT–2
- CASPER–extension
Future Activities

- Community workshop (Spring 2023)
- Continued bi-monthly webinars
- Data repository and evaluation of diagnostic metrics which assess aspects of air–sea coupling in observations and models
- Focus on topics related to:
  - Impacts of surface currents on air–sea fluxes and climate
  - Non–local impacts of air–sea coupling on climate, including representation in climate model projections, Earth’s hydrologic cycle (especially impacts on precipitation, terrestrial drought, etc)
  - Air–sea coupling as a source of predictability for mid–latitude weather and climate
  - Links to marine heat waves
- Anticipate that these activities will lead to a second review–type paper or feed into a white paper
- Continue involvement in current community activities, such as planning of satellite missions (e.g., Odysea) and workshops (e.g., the Gulf Stream workshop)