

## US CLIVAR Themes

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The concept of US CLIVAR Themes emerged in 2008, and developed over the next several years. Themes are broad areas of climate research that are intended to expand the traditional areas of interest of US CLIVAR during the last 5 years of its existence. Other defining characteristics are that they intersect the interests of at least two Panels and that they are timely, that is, reflect the current interests of the scientific community and funding agencies. (As such, the Themes can be viewed as precursors to research areas in the next Science Plan.)

Four Themes are now active, concerning decadal variability, climate extremes, polar climate, and the interaction between climate and carbon/biogeochemistry.

Each Theme has its own set of defining questions.

- **Decadal variability:** What processes give rise to decadal variations in societally relevant environmental attributes (e.g., precipitation, storms, surface temperature, sea level, ecosystem services)? What is the predictability of decadal climate variations, what processes contribute to this predictability, and what are the skill contributions (if any) from internal versus externally forced conditions? What are the best practices for decadal time-scale outlooks/projections?
- **Climate extremes:** What are the physical processes responsible for extremes, and what is the capability of current models to simulate the statistical properties of extreme climate events? What are the return periods for extreme events of high societal and ecosystem relevance, and are these periods changing? What do we want to say about predictability of extremes? Have there been, and are there likely to be future, changes in the character (location, duration, intensity, etc.) of extremes? What are best practices for assessing predictability of extremes?
- **Polar Climate:** What processes affect sea-ice conditions? For example, what is the role of the ocean in ice-shelf stability? What is the impact on global and lower-latitude climate of polar climate change (e.g., sea ice loss)? What are the large-scale polar/subpolar/subtropical interactions and processes involved in affecting these changes? What processes are involved in the exchange of polar (and subpolar) water masses with lower latitudes?
- **Carbon and climate/biogeochemistry:** How do changes in the physical ocean circulation and heat content affect the magnitudes and distributions of ocean carbon sources and sinks on seasonal-to-centennial time scales? What are the coupled physical/biogeochemical processes and feedbacks that contribute to determining the future state of heat and carbon sources and sinks and ecosystem structure? What will be the future atmospheric concentrations of carbon dioxide, methane, and other carbon-containing greenhouse gases, and how will marine carbon sources and sinks change in response to anthropogenic forcing in the future?

US CLIVAR addresses the Themes through the implementation of Science Teams and limited-lifetime Working Groups. Currently, there are two activities for each Theme. They are:

- **Decadal variability:** AMOC Science Team (2007–present); Decadal Predictability WG (2010–2012).
- **Climate extremes:** Hurricane WG (2011–2013); Extremes WG (2012–2014)
- **Polar climate:** High-Latitude Surface Flux WG (2009–present); Greenland Ice Sheet-Ocean Interactions WG (2011–2013).
- **Climate and carbon/biogeochemistry:** Ocean Carbon Uptake in CMIP5 Models WG (2012–2015); Southern Ocean Heat and Carbon Uptake WG (2012–2015)

Questions for discussion at this year's Summit include: How well do the existing Science Teams and Working Groups cover what needs to be done in each Theme? Are one or more new Themes needed? Should the existing Themes be merged into the new Science Plan?