US CLIVAR Themes

Definition

- Guided by a set of questions that will be addressed/assessed as a **concluding theme action by US CLIVAR**
- Concern a **broad topical area** of compelling coupled climate scientific research
- Intersect activities and interests of **two or more Panels** (all three panels…from obs-modeling-predictability/prediction-application?)
- Remain a theme for a **minimum of 3–5 years** (sufficient time to allow Working Groups and new activities to bear fruit?)
- Reflect **readiness of community** to address/answer to those questions through new and existing activities
- Reflect **readiness of multiple funding agency programs** to support new activities in this area or for already funded activities to be leveraged/coordinated
- Strategic plans (motivation, scope, overview of strategic directions) are encapsulated in a **5–10 page brief**

° Decadal Variability

I. Science Questions

- 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?

II. Overarching Challenges

- **Attribution:** Distinguishing internal variability from anthropogenic change signals.
- **Mitigation:** Global climate sensitivity to greenhouse gas emissions.

° Climate extremes

I. Science Questions

- 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 climate events** of high societal and ecosystem relevance, and are these periods changing?
- What do we say about **predictability** of extremes? Have there been, and are there likely to be **future changes** in the character (e.g., location, duration, intensity) of extremes? What are **best practices** for assessing predictability of extremes?

II. Overarching Challenges

- **Attribution:** Linking local extremes to global climate variability and change.
- **Monitoring:** High quality climate observing systems, reconstructions of past climates/extreme events.

° Polar Climate

I. Science Questions

- 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**?

II. Overarching Challenges

- **Attribution:** Distinguish natural variability from anthropogenic forcing in polar regions.
- **Monitoring:** Ocean currents and ocean transports in polar regions, ocean-sea ice-atmosphere fluxes, surface energy balance.

° Climate and Carbon/Biogeochemistry

I. Science Questions

- 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**?

II. Overarching Challenges

- **Attribution:** Determine impacts of overturning circulation and mode-water formation on heat transport, ecosystem processes and anthropogenic ocean carbon uptake.
- **Monitoring:** Ocean currents and transports, ocean-atmosphere fluxes, surface energy balance; basin-scale distributions of metals, isotopes and chemical tracers.

Theme-related Activities

US CLIVAR is addressing its themes (**decadal variability**, **polar climate**, **climate extremes**, **climate and carbon/biogeochemistry**, and **tropical predictability**) through the implementation of **Science Teams** and limited-lifetime **Working Groups**.

Current theme-related activities are:

- **AMOC Science Team (2007–present)**
- **Decadal Predictability WG (2010–2012)**
- **High-Latitude Surface Flux WG (2009–present)**
- **Greenland Ice Sheet-Ocean Interactions WG (2011–2013)**
- **Hurricane WG (2011–2013)**
- **Extremes WG (2012–2014)**
- **Ocean Carbon Uptake in CMIP5 Models WG (2012–2015)**
- **Southern Ocean Heat and Carbon Uptake WG (2012–2015)**
- **ENSO Diversity WG (2012–2014)**
- **Eastern Tropical Ocean Synthesis WG (2012–2014)**

Questions and issues

- How well do the current Science Teams and Working Groups **cover what needs to be done** in each Theme?
- Are one or **more new Themes** needed?
- Can (should) the existing Themes be **included in the new Science Plan**?