Agency Guidance

U.S. CLIVAR Summit
2012
Building on our CESD mission:

To advance a robust predictive understanding of Earth’s climate and environmental systems and to inform the development of sustainable solutions to the Nation’s energy and environmental challenges.

Greenhouse gases are emitted during energy production... and climate change will impact energy production.
 Relevant Agency Missions/ Goals

1. Synthesize new process knowledge and innovative computational methods advancing next generation, integrated models of the human-earth system.

2. Develop, test and simulate process-level understanding of atmospheric systems and of terrestrial ecosystems extending from bedrock to the top of the vegetative canopy.

3. Advance fundamental understanding of coupled biogeochemical processes in complex subsurface environments to enable systems-level prediction and decision support.

4. Enhance the unique capabilities and impacts of the ARM and EMSL scientific user facilities and other BER community resources to advance the frontiers of climate and environmental science.

5. Identify and address science gaps that limit translation of CESD fundamental science into solutions for DOE’s most pressing energy and environmental challenges.
Supported US CLIVAR Activities Over the Past 3-4 Years

• Model diagnostics and analyses through
  – solicitations focusing on **modes of climate variability, extremes, understanding uncertainties and feedbacks within the climate system**
  – PCMDI at LLNL and through joint support of NCAR’s CGD with NSF

• CMIP5 support through support of CESM, PCMDI, ESGF

• Model development activities [Fund the CESM/CCSM jointly with NSF]

• Support the development of ocean models: **POP and MPAS ocean models**

• Support of the Ice components: **CICE, and Land-ice models**

• ARM infrastructure and process research support of **VOCALS, DYNAMO (AMIE)**
Long-range (5-10 years) climate research areas of interest that intersect with US CLIVAR

- Develop a new generation high and variable resolution Earth system models based on advancing and testing scale-aware schemes for oceanic, cryospheric, terrestrial, and atmospheric systems
  - Improve understanding and predictability of dynamical processes governing sea level rise.
  - Cloud-climate interactions, to reduce largest climate response uncertainty, and to improve precipitation and hydrology
- Establish advanced model metrics to guide model development and to guide selection of experimental sites
  - Detect and attribute sources of climate change discern evolving patterns of extremes within a changing climate
  - Refine analytical methods to distinguish climate feedbacks
- Develop more sophisticated frameworks and software for model and measurement analysis, comparison, and visualization for the community through mechanisms such as the Earth System Grid Federation
Long-range (5-10 years) climate research areas of interest that intersect with US CLIVAR

- Support integrated studies of key processes driving aerosol-cloud-precipitation-radiation interactions
- Advance ARM capabilities and aggressively exploit the unique DOE facilities to understand cloud, aerosol, and radiative properties over land, sea, and ice
- Continue investigations into dominant atmospheric processes in tropical, marine and arctic environments
  - AMIE, VOCALS
- Exploit existing and new ARM facilities and recently procured ARRA 2009 instrumentation to provide high-resolution, 3-dimensional documentation of evolving cloud, aerosol and precipitation characteristics in climatically sensitive regions.
  - A new site in the Azores
  - An extended duration deployment of a new mobile facility at Oliktok, AK
  - TCAP (two columns: Cape Cod and in the Atlantic)
  - GoAmazon tropical and MAGIC marine campaign
Intangibles - How to Engage and Provide Value

– Coordination/ Collaboration for
  • ocean model development through interagency expertise in ocean process understanding
  • land and sea-ice model development
  • for data dissemination of models and observations through ESGF
– Development of the next generation of visualization tools
– Examining processes in a comprehensive and integrated earth system
– Collaboration for ARM and ASR programs like GoAmazon
– Inform us of publications as soon as they are accepted so that we can highlight them to our management.
Thank You
Relevant Agency Mission or Goals

• While not supporting a formal global change research mission, the US Navy continues a history of interest in USGCRP and USCLIVAR through sponsored research in underlying environmental physical processes that concurrently satisfy maritime and expeditionary national security requirements as well as USCLIVAR goals.

• The Navy Task Force Climate Change (TFCC) was established in May 2009 at the direction of the Chief of Naval Operations (CNO) and includes extended range forecast needs.

• Quadrennial Defense Review (QDR, 2010): “Climate change, energy security, and economic security are inextricably linked”. “DOD will work to foster efforts to assess, adapt to, and mitigate the impacts of climate change”

• Naval S&T Strategic Plan (2011): “Match Environmental Predictive Capabilities to Naval Planning Requirements - Fully coupled (ocean-atmosphere-wave-ice) global, regional and local prediction for operational planning at tactical, strategic and climate scales.”
Supported US CLIVAR-Related Activities Over the Past 3-4 Years

- Selected Departmental Research Initiatives (5-year efforts)
  - Arctic Waves (2013)
  - Bay of Bengal (2013)
  - Arctic Sea Ice (2012)
  - Seasonal Prediction (2012)
  - Unified Parameterizations (2011)
  - Origins of the Kuroshio and Mindanao Current (2011)
  - LASP/DYNAMO (MJO) (2010)
  - ITOP (TC Air-Ocean) (2008)
  - TCS-08/T-PARC (TC genesis, intensification, ET) (2008)

- CMIP5 Analysis support
- Irreducible Uncertainty BRC (2010)
- Extended-Range Environmental Prediction MURI (2012)
Long-range (~5-10 years) research areas that intersect with CLIVAR interests

- Predictability of the earth system on various time and space scales
- Studies of physical processes relevant to Marine Meteorology, Physical Oceanography, Arctic, and Littoral Geosciences
- New observing techniques and technologies
- Quantification of forecast uncertainty
- Diagnostics and model improvement and evaluation (Component and coupled models)
- Unified modeling approach: ocean/ weather/ ice/ space on appropriate time and spatial scales
Long-range research areas of interest that intersect with CLIVAR

• **Integrated Global Prediction**
  – Fully-integrated coupled ocean-wave-ice-atmosphere-stratosphere model systems (towards seamless goal).
  – Provide improved short-term (< 7 days) predictions of the physical environment in support of safe, efficient, and effective naval operations
  – Provide extended-range predictions (sub-seasonal to annual) for Navy strategic resource decisions
  – Understand relevant physical processes and sources of predictability to inform longer (decadal+) predictions

• Define the limits of predictability for different maritime physical variables and processes
Top five long-range research areas of interest that intersect with CLIVAR

• Arctic Prediction
  – Improved basic understanding of the physical environment and processes in the Arctic region
  – Development of new Arctic system models for improved prediction in high-latitudes at longer lead times
  – Utilization of satellite SAR data for assimilation into integrated models
  – Exploration of new technologies (platforms, sensors, communications) that will be required for persistent observation and operation in the harsh Arctic environment
Top five long-range research areas of interest that intersect with CLIVAR

- **Earth System Prediction Capability (ESPC)**
- Major partner with NOAA, NASA, DoE, NSF in coordinated Demonstrations
  - Extreme Weather Events: Predictability of Blocking Events and High Impact Weather at Lead Times of 1-6 Weeks
  - Seasonal Tropical Cyclone Threat: Predictability of Tropical Cyclone Likelihood, Mean Track, and Intensity from Weekly to Seasonal Timescales
  - Arctic Sea Ice Extent and Seasonal Ice Free Dates: Predictability from Weekly to Seasonal Timescales
  - Coastal Seas: Predictability of Circulation, Hypoxia, and Harmful Algal Blooms at Lead Times of 1-6 Weeks
  - Open Ocean: Predictability of the Atlantic Meridional Overturning Circulation (AMOC) from Monthly to Decadal Timescales for Improved Weather and Climate Forecasts
Intangibles - How to Engage and Provide Value

• Connection with ONR-sponsored Principal Investigators to CLIVAR WGs and TFs (e.g. MJO diagnostics)

• Identification of critically important scientific questions, especially in maritime process studies and applications, and the facilities and research required to address them.

• Observation and prediction activities, such as common observational tools, datasets, modeling architectures, and coupling standards (e.g. ESMF) that enhance the productivity of investigators

• Providing information and fostering interactions that lead to the submission of stronger research proposals

• Unified taxonomy across related disciplines at the climate/weather interface