

U.S. CLIVAR: CLIMATE VARIABILITY AND PREDICTABILITY

U.S. CLIVAR SCIENTIFIC STEERING COMMITTEE REPORT OF THE TENTH MEETING (SSC-10)

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1 Action Items

- Action Item 1.** Develop template for panels and working groups to use for providing Roadmap information (preferably within a month) (SSC-Exec).
- Action Item 2.** SSC members, Panel, and Working Group chairs to provide Roadmap information as described in template (SSC-Exec)
- Action Item 3.** Distribute CD-ROM of CCSP inventory to SSC (Legler)
- Action Item 4.** Develop CCSP framework diagram and (in consultation with program managers and respective scientific advisory groups from other climate science elements, e.g. carbon cycle) submit to CCSP for possible adaptation (Fein/Legler)
- Action Item 5.** Solicit, collate, vette and submit SSC review of CCSP plan (Legler).
- Action Item 6.** Panels and working groups are encouraged to submit their own review of the CCSP plan (Legler to communicate to panels/working groups).
- Action Item 7.** Pacific panel is encouraged to develop further (through a workshop) a science and implementation plan for PUMP, particularly the integration of modeling with observations, and how it will be coordinated with other (e.g. VEPIC, CORC, TAO) studies and activities.
- Action Item 8.** A letter expressing SSC interest in seeing further development of a NAME analysis and modeling component will be sent to the NAME SWG, Mike Patterson, and the Pan American panel (co-chairs).
- Action Item 9.** The SSC is willing to campaign for the use of *Ron Brown* (communicate to NAME SWG). The SSC also encourages further development of plans to address the role of the ocean and include contingency plans to deal with the possible unavailability of the *Ron Brown*. (Legler to communicate to NAME SWG at NAME SWG meeting).
- Action Item 10.** The SSC to write a letter to Mike Johnson and Jim Todd strongly encouraging support of the TAV-STC effort. (Co-chairs; Legler to coordinate).
- Action Item 11.** Encourage EDW experiment to contact KESS to identify common issues and opportunities (Visbeck).
- Action Item 12.** The SSC encourages the AAMWG to pursue model/parameterization improvement of TISO through forecasting/prediction efforts currently gaining momentum. The AAMWG should use the planned workshop on AGCM hindcasts (summer 2003) as an opportunity to discuss the issues raised at SSC-10 and leverage support for a set of activities that address modeling of TISO within climate models (Legler to coordinate feedback).
- Action Item 13.** The SSC will request from the members of the U.S. CLIVAR Inter-Agency Group (IAG) to develop a list of funded TISO and AAM-related activities and to encourage PIs of these activities to participate in the development of an overall AAM strategy lead by the AAMWG and (as appropriate) attend the summer 2003 workshop (Legler to communicate).
- Action Item 14.** During Indoex, soundings at Diego Garcia (and other locations) were taken more frequently. The Indoex follow-on (Asian Brown Cloud project, sponsored by UNEP) will continue some of these observations. These activities may be of interest. (Jay Fein to provide the name of the naval attache who organized this activity to the AAMWG).

- Action Item 15.** Complete and submit to SSC for approval SIMAP TOR and membership (Schopf/Suarez).
- Action Item 16.** U.S. CLIVAR has identified three relevant process studies; NAME, EDW, and DIMES; and one enhanced monitoring activity; TAV-STC, that are ready to proceed. Several other studies are potentially interesting, but more planning is needed. The SSC will communicate its level of interest of all considered studies to the sponsoring agencies and to the panels/working groups (SSC-Exec).
- Action Item 17.** Post a description of the process whereby similar studies can be submitted for U.S. CLIVAR consideration. (Legler).
- Action Item 18.** Panels and working groups are requested to update/consider needs for sustained observing system elements for discussion at SSC-11. Additionally Bruce Wielicki will be tasked on providing an update on remote-sensing issues. (Co-Chairs to communicate).
- Action Item 19.** The SSC is very concerned about the lack of progress in planning for the reanalysis workshop. Additionally, Detlef Stammer's role needs clarification. (Max to communicate to the SSG).
- Action Item 20.** An invitation will be sent to Mike Johnson to make a presentation at SSC-11 on the plans for a U.S. contribution to the climate observations system (Legler to communicate).
- Action Item 21.** The SSC approves the proposed plan for developing the CLIVAR/PAGES abrupt climate change research strategy/roadmap and encourages the CLIVAR/PAGES working group hold its next meeting in Washington, DC.
- Action Item 22.** Recommended CLIVAR/PAGES working group membership be submitted to SSC for approval in advance of working group meeting (Overpeck/Cane to submit to Legler).
- Action Item 23.** The SSC was concerned about the proposed banner on predictability, but felt there were insufficient details (e.g. what is a "banner") to provide a formal response (Legler to communicate to SSG; Legler to coordinate a presentation on the Banner at SSC-11).
- Action Item 24.** The SSC encourages Detlef Stammer to address the issues raised at SSC-10 in the U.S. CLIVAR ocean data assimilation strategic plan.
- Action Item 25.** SSC will review the TAO transition plan once it is made available for comment (Kessler to advise SSC when comments are invited; Legler to coordinate CLIVAR input)
- Action Item 26.** Post the workshop endorsement process on U.S. CLIVAR web site. (Legler)
- Action Item 27.** The SSC endorsed the Coupled Data Assimilation; Pacific Decadal Variability, and Tropical Coupled Model workshops and will communicate endorsement of these workshops to organizers and IAG (Legler)
- Action Item 28.** Send letter to Ming Ji and Ken Mooney expressing concern with proposed merger of CLIVAR Pacific and CLIVAR Atlantic programs and proposed merger of PACS and GAPP (Co-chairs; Gutzler to supply comments on PACS-GAPP).
- Action Item 29.** Panel and working Group changes to be vetted by SSC (Legler to coordinate).
- Action Item 30.** Vetted changes to SSC to be submitted to IAG for approval (Legler)
- Action Item 31.** Identify dates and determine location of SSC-11 (Legler).

2 U.S. CLIVAR Roadmap

Bob Weller (SSC co-chair) introduced the concept of a U.S. CLIVAR Roadmap. In the Roadmap, the CLIVAR could describe how it will reach its goals through the presentation of specific activities, their costs, timing, and sequencing. Such a plan would not consider monetary restrictions, but rather focus on the actual costs of achieving CLIVAR objectives.

The Roadmap would actually be several documents, each with a level of detail tailored to its intended audience. These documents would be based on a set of activity profiles describing a particular activity/need (e.g. empirical studies in the Atlantic region, NAME process study), its costs, relevance, and other information. From these profiles the Roadmap could be developed. For senior research program officials (e.g. James Mahoney, director U.S. Climate Change Science Program - CCSP), a compelling, high-level brief of limited length could lay out CLIVAR's activities critical for Climate Change Research Initiative-CCRI. For program managers, a detailed Roadmap could describe sequencing and costs for budgetary planning. Other groups (e.g. Carbon Cycle Science program; sea floor observatory initiative) have used Roadmaps effectively.

Organizing the Roadmap under the five goals of the U.S. CLIVAR program would help convey how CLIVAR elements interweave to address its objectives. A discussion of the five goals ensued. The first goal "identify and understand the major patterns of climate variability on seasonal and longer time scales and evaluate their predictability" was recognized as perhaps the most important. The last goal "detecting and describing ..." was thought to be somewhat vague and needed clarification.

During the discussion the panel chairs noted that many details are a) available already in the regional implementation plans and b) some elements would be common to more than one panel/working group. Additionally, CLIVAR doesn't have control over some elements (e.g. radiosonde networks), and thus some elements of the Roadmap will indicate CLIVAR's reliance rather than a CLIVAR commitment.

After lengthy discussion, a process for building the Roadmap was proposed and accepted.

- A template for reporting information on costs, phasing, relevance to U.S. CLIVAR goals, etc. will be developed and be provided to the SSC and the panel/working group chairs.
- The SSC decided to assign to SSC members the task of developing Roadmap material for overarching elements (Table 1).
- The panels and working groups will be provided instructions on assembling and submitted road-map information that describes their vision of what is needed to achieve their objectives. Additionally, the chairs were not to consider resource issues but to address costs and needs for achieving goals within their respective panel/working group. These needs should be discretized into 0-5, 5-10, and 10-15 years in the future.

Because of the short time available to influence the FY05 (and perhaps the FY04) budget, and the upcoming opportunity to interface with Dr. Mahoney, the Roadmap should be completed very quickly, preferable within a few months.

Action Item 1. Develop template for panels and working groups to use for providing Roadmap information (preferably within a month) (SSC-Exec).

Action Item 2. SSC members, Panel, and Working Group chairs to provide Roadmap information as described in template (SSC-Exec)

Table 1. Assignments for U.S. CLIVAR Roadmap

<i>Assignee</i>	<i>Assignment</i>
Stammer	Ocean data assimilation
SIMAP	Coordinated climate (S-I and change) prediction effort
Stammer & Suarez to request input from Houser/Schubert	Historical reanalyses (atm/ocean/land/ice)
Wielicki	Remote Sensing (climate-critical observations/missions; algorithm dev't; calibration)
Schopf	CPTs (model improvement)
Weller	Interfacial fluxes (e.g. air-sea, land-atm)
Legler	Data & product management/access
Observation Systems	
Hurrell/Trenberth	Troposphere observation (new technology, stop degradation of GUAN, assess anticipated changes in obs systems)
Greg Johnson	Repeat deep-ocean msmts
SIMAP	Global soil moisture ...joint with GEWEX

3 CLIVAR's role in U.S. Climate Research

During the planning of the U.S. CLIVAR Roadmap and the CCSP plan review, the SSC discussed CLIVAR's role in the CCSP and how this role would be conceptualized and abbreviated so that the CLIVAR message could be effectively sold and communicated so that budgets would reflect the planning and importance of CLIVAR research. The importance of CLIVAR research for regional impacts (regional downscaling), and carbon sequestration were noted. A few ideas were noted as national needs where CLIVAR could and should play a leadership role; nationally coordinated seasonal-to-interannual prediction effort, and a coordinated modeling effort that spans variability, sensitivity, and change; and a nationally coordinated ocean data assimilation effort.

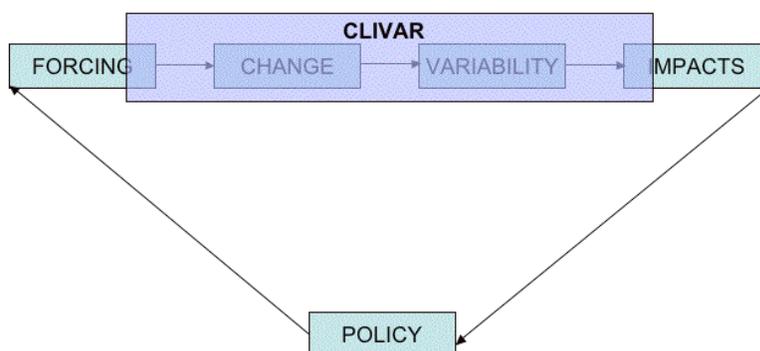
The agency representatives added that often the successful budget initiatives are those that capture the essence of a research program with a few short words that resonate with CCSP, administrative, and legislative officials. For example the terms El Niño, carbon cycle, and water cycle all generate reactions (accurate or not) amongst nearly everyone, but "CLIVAR" does not.

Jay Fein noted there is no interagency group providing advice on climate change science. Several years ago he felt CLIVAR should not (for bureaucratic reasons more so than scientific) address climate change issues, but feels ownership of forcing science is no longer clear. He added that CLIVAR is now poised to serve in an advisory role. Using black soot as an example, Jay Fein noted that the impacts of these aerosols on cloud formation and precipitation regimes makes it difficult (and scientifically questionable) to draw boundaries between CLIVAR and forcing/climate change. Additionally, one can't deal with regional issues of climate change without considering climate variability, thus CLIVAR's role should be more encompassing. Enjoining change and variability would make CLIVAR more holistic and help it develop a more cogent framework motivating its activities. Jay also suggested "uncertainty" as a potential central link between CLIVAR and CCSP. Finally, the CCSP inventory of \$3.8 billion in climate research (available on a CD-ROM) was of interest to many.

During the discussion of the CCSP plan review, Jay Fein suggested a diagram (below) that attempts to establish a framework for CCSP science and highlights the role of U.S. CLIVAR, from forcings to regional impacts. He noted that the products and capabilities that are central to CCSP must rely on CLIVAR. Although many of the other elements (e.g. water cycle) could indicate they too cover a majority of the diagram, it is not clear this is actually the case. The SSC felt this diagram was helpful and concurred with Jay that its development, involving representatives from respective scientific steering groups and respective program managers, should move forward quickly and be presented to the CCSP Office.

- Action Item 3.** **Distribute CD-ROM of CCSP inventory to SSC (Legler)**
- Action Item 4.** **Develop CCSP framework diagram and (in consultation with program managers and respective scientific advisory groups from other climate science elements, e.g. carbon cycle) submit to CCSP for possible adaptation (Fein/Legler)**

CLIMATE CHANGE SCIENCE PROGRAM



4 Review of Climate Variability and Change chapter of CCSP Plan

Jay Fein described the overall process of development of Chapter 6, Climate Variability and Change, of the CCSP plan. The authors, i.e. program managers and a few representative scientists, developed Chapter 6 according to directives/guidance from the CCSP office drawing on a variety of input, including CLIVAR documents. Comments from U.S. CLIVAR SSC are welcome on the higher-order issues (individuals are encouraged to provide comments on details).

The SSC agreed to provide feedback on the CCSP plan. The comments should state who we are and describe CLIVAR’s critical role in implementing the plan. While focusing on the omissions and limitations of Chapter 6, the SSC should also point out those parts of Chapter 6 where CLIVAR clearly leads (much of Chapter 6 IS CLIVAR) and to more explicitly state that CLIVAR will lead much of the research in chapter 6. Finally, the SSC agreed that the priorities listed in chapter 12 should be discussed by CLIVAR.

The following points were suggested as an initial start:

- Part I never mentions the ocean in the way CLIVAR addresses the oceans role in climate, i.e. changes of ocean dynamics may change the response to increasing carbon and heat (Schopf).
- Variability is a central aspect of global change research; the change - variability relationship is not made well enough and should be a highly visible part of this chapter. Perhaps add a sixth question....how does inherent climate variability limit our ability to reduce uncertainty in impacts (part of question 2?). (Battisti)
- While the five questions in chapter 6 are the correct questions, the wording of a few of them (most notably question 1 and 5) need revision to make them clearer (Meehl)
- What is missing is a description of the overall approach...process studies, synthesis frameworks, modeling (and model improvement). Fundamental research needs need to include these as well as an appropriate observing system (G3OS), reanalyses, ocean state estimation, and paleoclimate modeling. (Legler)
- We support the plan's strategy of assigning responsibility and adequate resources for the IPCC assessments to GFDL and NCAR. But climate research and prediction involve much more than IPCC assessments, and the nation's climate research program demands more than a "two-center" strategy. The USGCRP part of the document needs its own research plan and its own modeling

strategy. A more comprehensive national modeling strategy should be laid out in Chapter 12, replacing the woefully inadequate discussion in the second section of that chapter. (Suarez)

- AO/NAO issue is scattered, inconsistent. P73L19...why not do more than ENSO forecasting (e.g. tropical ocean)? (Visbeck)
- In question 5 (weak), it is not clear what infrastructure (IPCC, regional assessments, climate services?) would/could increase communication between users/producers? Two-way communications between stakeholders and producers is critical. Also, the responsiveness of scientific community is lacking. (Overpeck)

Action Item 5. Solicit, collate, vette and submit SSC review of CCSP plan (Legler).

Action Item 6. Panels and working groups are encouraged to submit their own review of the CCSP plan (Legler to communicate to panels/working groups).

5 Pacific Panel

Billy Kessler (co-chair) summarized the Pacific Implementation Panel (PIP) meeting, the first meeting in over a year. Since the panel had many new members and a new co-chair, considerable time was devoted to discussions of panel objectives and briefings on ongoing activities. There was renewed recognition that the Pacific panel must address more (e.g. seasonal cycle and ENSO) than decadal variability. The PIP was pleased to hear KESS (Kuroshio Extension System Study) received funding, but were concerned (in response to a comment from SSC-9) it was narrowly focused on ocean dynamics and should be augmented to address more coupling issues such as the role of the mixed-layer during cold-air outbreaks. The PIP also identified the need for further evaluation of EPIC results before the timing of its follow-on, VEPIC, should be decided. Billy also presented a wish-list for funding:

- Observations (to improve atm reanalyses of the mid-latitude stormtracks);
- OSSEs (to evaluate the importance of reinstating Pacific island rawinsondes and/or THORPEX-type driftsondes);
- MIP and diagnostic studies and workshops aimed at interannual and decadal phenomena such as PDO (the PDV workshop in late February will address these);
- Diagnostic studies using the emerging assimilation products based on Argo floats.
- Technology development/exploration to enable observation of low-latitude western boundary currents (mass / heat / property fluxes and variability);
- Workshop in mid-2003 to plan a Pacific Upwelling and Mixing Physics (PUMP) experiment (see below).
- Workshop in late 2003 to discuss the next steps for a subtropical subduction process study.
- Workshop on understanding errors in climatology and variability of tropical convection in coupled GCMs and AGCMs.

5.1 Pacific Upwelling and Mixing Physics study (PUMP)

Billy described the motivation and initial thoughts on PUMP, a process study to observe equatorial upwelling (i.e. the entire complex of processes, e.g. vertical velocity and diapycnal transport, that connect the thermocline to the surface). From a climate perspective, upwelling's role in determining SST is important. Upwelling is both a response to local winds and a component of the gyre-scale circulation, each affecting SST. In general, the local wind determines the rate of vertical exchange and how deep it extends into the thermocline, while the gyre-scale circulation determines the background stratification and the properties of the water that is upwelled. Indeed, the relation between SST and thermocline depth used in simple ENSO models is shorthand for a complex heat budget in which upwelling temperature transport is the main cooling effect.

MIP experiments have shown that many GCMs still have trouble depicting the annual cycle of SST. There are a variety of reasons why this occurs, but vertical processes in the ocean appear to be a major contribution (Meehl et. al., Climate Dynamics, 2001).

PUMP will not monitor upwelling, but rather provide the observations and interpretation that will let models accurately represent vertical exchange near the equator by improving parameterizations, through more precise observations, and learning how to use sparse sustained observations (assimilated into models), to infer and diagnose upwelling events.

Both horizontal divergence and vertical mixing contribute to vertical exchange, and horizontal mixing (which may be partially resolvable) is also essential for the property and momentum balances. Thus measurements of all these will be necessary. But, unlike previous experiments, the process study should integrate its microstructure (turbulence) observations into as full (mesoscale and large) a context as possible (OGCMs are ready to include more sophisticated mixing parameterizations) to avoid the difficulties of interpretation that occurred in the past. While it seems clear that resolving mechanisms and challenging modern models requires finer-scale sampling than the 100-km scales of previous efforts, the need for context and representativeness demands substantial spatial and temporal coverage. The balance between these two goals will determine the shape of the experiment.

A workshop of invited modelers, observationalists, and others is recommended to address:

Sampling requirements (over a three-month period, probably concentrated near 110W):

- Sample an entire annual cycle?

- Strategy for sampling tropical instability waves (introduces aliasing problem but they also a major contribution to mixing)?

- How to make best use of the TAO array?

- Meridional extent of sampling required?

- Location: East Pacific (EPIC follow-on) or central Pacific (simpler)?

Modeling work:

- Internal wave models to diagnose microstructure observations

- High-resolution models to check basin models (and OSSEs?)

- How to sample to effectively compare/challenge/verify models?

The SSC welcomed the report on the activities of the PIP. Much of the discussion focused on PUMP. It was noted that PUMP could address resolution of the diurnal cycle. In response to a question on how the models would improve their estimates of upwelling, Billy responded that modelers would be invited early in PUMP development to participate in planning, and that the observations would be taken on scales that could challenge the models and foster improvement. It was also noted that this experiment would complement the activities of the ocean mixing CPT (The CPT could provide some feedback to PUMP on observational design). It was unclear where PUMP should focus its observations. An eastern location (110W) would help address the difficulties of determining the seasonal cycle and the over-extensive cold tongue as well as being located in an area where mixing parameterizations can be tested, but had the potential disadvantage of being “downstream” of much of the mixing and in an area where models have lots of problems. It was remarked that PUMP would be a nice start to describing the communication between the top of the thermocline and mixed layer (and its spatial structure), a fundamental question for all of oceanography.

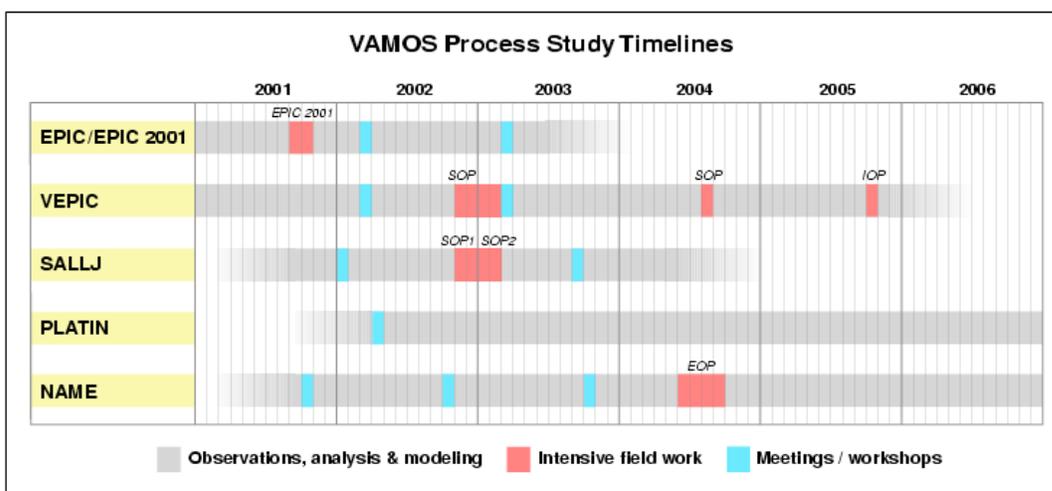
In conclusion, the SSC felt PUMP is highly relevant to U.S. CLIVAR objectives, that it is feasible, that modelers would be interested in incorporating the results, and that a workshop was necessary to develop more details and begin the process of bringing together the observationalists, process expertise, and climate model developers to discuss the details of implementation.

Action Item 7. Pacific panel is encouraged to develop further (through a workshop) a science and implementation plan for PUMP, particularly the integration of modeling with observations, and how it will be coordinated with other (e.g. VEPIC, CORC, TAO) studies and activities.

6 Pan American Panel

Dave Gutzler (chair of the Pan American Panel) reported on changes to the timeline of Pan American process studies (see below). He indicated that analysis of EPIC data would be extended through 2005. The fall 2003 EPIC science meeting will have a modeling focus. A proposal for a VEPIC/SALLJ field campaign to occur in late 2005 will be discussed at the SWG meetings to be held in conjunction with VAMOS meeting in late April. In NAME, a hydrometeorology group has been formed. Dave also noted the NAME SWG will seek ways to accelerate progress on oceanographic aspects at their meeting (immediately following SSC-10) NOTE: following the NAME SWG meeting, a workshop on oceanographic research for NAME was organized for Spring 2003 in Ensenada. Another issue is the availability of the Ron Brown. With regards to modeling in NAME, a proposal for a CPT-like NAME-related global model-based activity was submitted for consideration. [After the NAME SWG meeting, a workshop was organized for June 2003 to advance planning for global and regional modeling and data assimilation in NAME.]

Dave indicated potential interest of the Pan American Panel in their exploring the variability of severe droughts in the southwest over long-time periods. The SSC felt the EPIC results should be carefully examined before the timing of a VEPIC campaign can be decided. The SSC encouraged NAME to continue to strengthen their linkages and focus on continental and global scientific objectives. They specifically encouraged the development of an analysis and modeling strategy that would effectively address the connectivity of the Tier I observation campaign to continental scales and the improvement of climate and prediction models. The SSC also encourages the NAME SWG to call upon the SSC to actively campaign for the use of the Ron Brown for NAME.



Action Item 8. A letter expressing SSC interest in seeing further development of a NAME analysis and modeling component will be sent to the NAME SWG, Mike Patterson, and the Pan American panel (co-chairs).

Action Item 9. The SSC is willing to campaign for the use of *Ron Brown* (communicate to NAME SWG). The SSC also encourages further development of plans to address the role of the ocean and include contingency plans to deal with the possible unavailability of the *Ron Brown*. (Legler to communicate to NAME SWG at NAME SWG meeting).

7 Atlantic Panel

Martin Visbeck (co-chair) reminded the SSC of the objectives and foci of the Atlantic Sector Implementation Panel (ASIP). Since SSC-10, the panel met in Chicago to continue deliberations on relevant process studies. Additionally, there was a U.S. CLIVAR workshop on “The Atlantic ITCZ” in September 2002, and a special session on NAO/NAM at fall AGU. Upcoming activities in 2003 include the CLIVAR/OOPC Workshop on South Atlantic Climate Observing System (Feb 2003 in Brazil). Also under consideration is a US PI meeting late in 2003 or early 2004.

Noting that an “alphabet soup” of process studies have been initiated in the Atlantic, many without sponsorship or coordination under CLIVAR, Martin indicated the ASIP’s approach to assessing process studies was to identify those that showed high relevance to CLIVAR science, realistic in scope, were embedded within a network of sustained observations, targeted improvement of models of climate variability and change, and were well-coordinated with the international community. Thus the ASIP ranked the process studies according to the criteria of readiness, relevance, contribution to model and prediction improvement, and the degree the study could rely on a system of sustained observations. They also provided feedback to each of the process study organizers, but were eager to learn “what next?” from the SSC. The highest-ranked process studies were presented.

7.1 Tropical Atlantic Variability - TAV (TAV-AMI and TAV-SST)

An ITCZ workshop was organized to gauge community interest in, identify activities leading to, and identify/prioritize areas offering the best opportunity to improve understanding of tropical Atlantic climate and its predictability, and contribute to improved predictions. The Atlantic Marine ITCZ (AMI) is an integral part of the Tropical Atlantic Climate system and directly impacts precipitation over W. Africa and NE South America. It also is linked to interannual variability in mineral dust transport (from sub-Saharan Africa), rainfall in Central American/Caribbean region, and Atlantic tropical storm activity. Its interannual variability is also linked to several external influences. Global models display large biases in simulations of the AMI location and intensity and (perhaps as a consequence) predictions are lacking in range and accuracy impacting benefits to society. A draft process study brief describes the motivation, objectives, and potential scope of a proposed AMI study. The study would target the AMI complex while maintaining links to relevant basin efforts and emphasizes collaboration with prediction centers. An AMI effort could complement a planned CPT that addresses convection. A working group is needed to draft a science and implementation plan and coordinate numerous activities. If started in early 2003 this preparation could help bring some intense ITCZ observation elements to the AMMA Gulf of Guinea experiment planned for the African monsoon onset period in Spring 2005. AMMA planning includes ocean measurements (EGGE) and some atmospheric measurements (particularly of the boundary layer flow over the ocean and the atmospheric state along the coast to the north) that will need to be enhanced in order to learn more about the ITCZ. The development of the AMI proposal made considerable progress in the two months prior to SSC–10.

The panel integrated the TAV process study’s two components; i.e. AMI (Kushnir et al) and TAV-SST (Garzoli et al), even though their readiness and phasing differed. In particular, the goals, stages, observational requirements, and atmospheric PIs need to be developed before a stronger merger between the two studies can be obtained.

The ASIP was positive about the TAV-SST proposal, but felt it covered a wide range of topics, and needed more focusing (one suggestion was to focus on the upwelling branch of the sub-tropical cell) and a strengthened (coupled) modeling component. For the AMI proposal, even though the panel recognized that the study is still in its early stage of development, it shows much promise for a well-

focused process study that can fit nicely with the STC experiment and/or AMMA in about 2005 and encouraged further development.

7.2 Variability of the Western Hemisphere Warm Pool

The ASIP has initiated preliminary talks with the PanAmerican Panel to consider jointly a Western Tropical Atlantic study (Enfield/Wang et al), noting that this study needed more planning before a field phase can be considered.

7.3 Eighteen-Degree Water (EDW)

The NAO-related process study on 18-degree water formation addresses mode-water processes (e.g. formation mechanisms, rates) and large-scale consequences in the dynamically active region of the Gulf Stream. It would examine the interaction of eddies and the mixed-layers; seek to understand and improve parameterizations of air-sea fluxes in a region of relatively large exchanges; and focus on the physics of how mode waters interact with the atmosphere and hence govern the update of heat. This study lent itself very readily to formation of a CPT. This process study was rated very highly by the panel on its relevance to CLIVAR.

7.4 Subpolar Gyre Experiment (SPG)

A Meridional Overturning Circulation (MOC)-targeted process study, the Subpolar Gyre Experiment, focuses on the East Greenland Current in the Irminger Sea to identify and quantify the export of shelf water into the deep Irminger Sea.

The SSC congratulated the ASIP in its excellent efforts narrowing the previous list of numerous studies down to a small portfolio of relevant and maturing studies. The leaders of the individual process studies were also to be commended for their rapid responses to SSC and ASIP comments. The SSC commented that for the EDW experiment, the mode water formation area is a very complex area where mixing parameterizations are the key problem. It wasn't clear how this study would advance knowledge without advances in mixing parameterizations. Noting that in the Pacific the same processes are probably active, some consideration should be given to how KESS (which focused more on the adiabatic processes) and this experiment could better share knowledge and coordinate to address the general issue of subduction. One suggestion was for KESS to add a few observations to see if the process studied in Atlantic is valid in the Pacific region.

The TAV-SST component of the TAV study generated considerable discussion on relevance (e.g. what is the *process* under exploration? How are sub-tropical cells (STCs) relevant to climate?), scope (e.g. does it encompass too much), and feasibility. There was no consensus on the best strategy to effectively address key scientific STC issues (thus lending considerable argument to a need for a measurement campaign), and whether this study should be treated as a process study (its links to modeling needed strengthening) or as an enhanced monitoring activity (that over several years would provide information that leads to better understanding and perhaps motivate a more focused study on STCs and their representation in models). The STC proposal has a considerable history and international support. Noting that a) some international components are ready to proceed, b) this activity is partly exploratory in nature (observe to understand), and c) this effort would be helpful in determining requirements for an observing system, it was decided this proposal should proceed as an enhanced observing effort, thereby leveraging international activities. There did not appear to be any strong evidence that delaying the STC proposal would clarify the scientific issues or offer any advantages. The SSC charged the ASIP to closely monitor the effort and to encourage the STC proposal leaders to coordinate their efforts with the other (e.g. AMI) ASIP activities.

- Action Item 10.** **The SSC to write a letter to Mike Johnson and Jim Todd strongly encouraging support of the TAV-STC effort. (Co–chairs; Legler to coordinate).**
- Action Item 11.** **Encourage EDW experiment to contact KESS to identify common issues and opportunities (Visbeck).**

8 Southern Ocean Working Group

The co-chair of the Southern Ocean Working Group (SOWG), Arnold Gordon, provided the SSC with a synopsis of the first meeting of the SOWG (December 2002 at Lamont). The meeting addressed several issues (a report will be completed in February 2003) and identified several the SOWG felt should be targeted for inclusion in the U.S. CLIVAR implementation plans: climate variability (especially as represented in models and observations); the Southern Ocean MOC (the most unique and climate-relevant part of southern ocean region); sustained atmospheric observations and data rescue; sea ice (observations and model representation); glacial ice (ocean contact; cores as records of climate change); ocean repeat sections; time series stations; underway ocean observations; Argo and surface drifters; satellite observations; modeling (ocean, coupled); and process studies. Arnold then presented three process studies the SOWG felt were ready for consideration by the SSC.

8.1 Diapycnal and Isopycnal Mixing Experiment (DIMES)

Advection (including convection) of surface waters into the subsurface layers of the world ocean is the main means by which heat and carbon dioxide perturbations are transmitted from the atmosphere into the ocean on time scales of more than a year or so. These flows are driven by air sea fluxes of momentum, heat, and fresh water (including ice formation and melting) and they are especially strong and important in the Southern Ocean, because of its large area, strong winds, and low temperatures, which work to expose normally deep water to surface fluxes that modify it and return it to depth. The response and feedback of the ocean to this atmospheric forcing, in particular what upwells and where, depends on the interior dynamics of the ocean, including eddy transport of mass, heat, and potential vorticity along isopycnal surfaces in the ocean interior (important for meridional transport of properties at mid-depths) and diapycnal mixing in the ocean interior (enhanced by the strong topographic flows).

Simple models and theory both indicate that these processes, isopycnal eddy transport and diapycnal diffusion, are of first order importance. The magnitude, the spatial variability, and the dependence of eddy transports and diapycnal diffusivity on the ambient large-scale velocity, hydrographic, and bathymetric fields must be understood in order to understand and predict climate change. The experiment will measure diapycnal diffusivity and isopycnal mixing, stirring and eddy fluxes of potential vorticity and heat in a large sector of the Southern Ocean in the region of the ACC, and the environment in which these occur. The magnitude of the fluxes will be measured and parameterizations of how these fluxes depend on variables accessible to numerical models will be tested and refined. The observational elements of the study are evolving (Arnold noted the tracer release component would run over several years), but the model studies are (currently) ocean-only and process-oriented. The larger context of coupled climate models and numerical center involvement requires further development and DIMES seeks SSC advice on a suitable protocol for involving large centers.

8.2 Subantarctic Mixed Layers, Fluxes & Overturning Circulation (SAMFLOC)

The formation and variation of deep surface mixed layers in the Subantarctic is a circumpolar phenomenon, but greatly enhanced in the eastern Indian and Pacific regions (by northward Ekman transport across the Antarctic circumpolar current (ACC) and buoyancy loss). The northward upper ocean flux feeds directly into the deep mixed layers (Subantarctic Mode Water or SAMW). SST and

hence ocean-atmosphere coupling might be strongly affected by these fluxes and the meridionally varying surface layer depths in which they occur. Variations in SST and the ocean-atmosphere coupling, in turn, can directly impact the rate of anthropogenic CO₂ uptake. The SAMW is exported as Antarctic Intermediate Water and SE Indian SAMW to the subtropics and tropics. This study will explore the balance between (a) northward Ekman advection, (b) buoyancy loss along the circumpolar path north of ACC, and (c) influx of subtropical waters from western boundaries. Its focus of (a) and (b) will be a representative region with most extreme mixed layers and with greatest impact on subtropical and tropical thermoclines, e.g. SE Pacific. Several types (e.g. hydrographic, Argo, moored profilers) of observations were outlined. The modeling component was not as advanced in planning. A proposal is already in preparation for Feb 2003 submission to NSF.

8.3 Southern Ocean air-sea CO₂ exchange (GASEX-SO)

This study would address the particularly acute and large uncertainties in the air-sea flux of CO₂ in the Southern Ocean. These uncertainties prevent accurately quantifying the partitioning of anthropogenic CO₂ between the ocean and the terrestrial biosphere on interannual timescales, and consequently limiting the ability to realistically model future atmospheric CO₂ levels. Uncertainties of ~50% are associated with the current global and regional air-sea flux estimates because of inadequacies in the gas transfer parameterizations. This problem is particularly acute in the Southern Ocean. Some of the uncertainty stems from the paucity of measurements in the Southern Ocean, but some is also attributed to uncertainties in the parameterizations for gas transfer velocity. The work will concentrate on measuring CO₂ fluxes directly in the marine air boundary layer and the elucidation of the physical, chemical, and biological processes controlling the fluxes in order to quantify air-sea CO₂ fluxes over the entire region through use of parameterizations of gas exchange and observed physical forcing (physical forcing includes wind, wave slope, and momentum).

The SSC felt that overall the SOWG had made great progress, particularly in considering these process studies at their first (and only) meeting. It was noted that there were no atmospheric processes under consideration (but did not some atmospheric aspects such as air-sea fluxes in DIMES and GASEX). Lynne Tally added that water mass formation is concentrated under the (atmospheric) dipole mode nodes and thus atmospheric climate dynamics are likely have a link. The discussion drifted to questions regarding the declining number of surface drifters in the southern ocean region. It was noted that models and 4-D var systems are more capable of utilizing satellite data (e.g. raw backscatter information from scatterometers can be assimilated as surrogates for surface pressure observations) for determining the surface analyses. The SSC agreed the impacts of a reduced surface drifter network needed careful and continuous attention, particularly the need for continued calibration and assessment of SLP and SST products.

9 Asian-Australian Monsoon Working Group

Duane Waliser presented an update on AAMWG activities. Recapping their efforts targeting a full range of time scales from subseasonal to climate change, he emphasized their strategy of developing components for empirical, modeling and process studies, long-term observations, and data mining. Based on feedback from the SSC as well as considerations of readiness, feasibility and importance, the intraseasonal time scale (namely the Tropical Intraseasonal Oscillation (TISO)) was identified as a key physical process that provides a unifying theme linking the major components of the AAMWG. Duane updated the SSC on each of the five elements of the AAMWG TISO work plan that were reviewed at SSC-10:

Data Mining and Model Intercomparison: There was not much progress or planning, as indications of agency support were needed to proceed. He showed example figures comparing intraseasonal

precipitation variability in several climate models. There were notable deviations from observed values.

TISO predictability and experimental forecasting: A spring 2002 NASA workshop on this topic (Schubert, S., R. Dole, H. van den Dool, M. Suarez, and D. Waliser, 2002: Prospects for improved forecasts of weather and short-term climate variability on subseasonal (2 week to 2 month) time scales. NASA Technical Report Series on Global Modeling and Data Assimilation, 2002-104606, volume 23, 171pp) concluded that evidence strongly suggests predictability beyond two weeks; that predictability was linked to low-frequency, tropical and high-latitude annular modes (PNA, MJO, AO), and that tropical diabatic heating and soil wetness were particularly important on these time scales. The workshop recommended an experimental MJO prediction program and a series of workshops focusing on modeling of the MJO. From the workshop report, the AAMWG work plan, and other initiatives (e.g. CEOP), a TISO Experimental Prediction framework was developed. NOAA/CDC agreed to sponsor the project and act as repository for the forecasts and undertake modest analysis tasks. Several participants (international) have agreed to participate. A follow-up workshop focusing on MJO/TISO modeling is tentatively planned for June 2003 (Sig Schubert lead).

Improvement of theoretical understanding of TISO and model physics parameterization: There were several activities being organized by the international Asian-Australian Monsoon Panel, including a joint CLIVAR-GEWEX monsoon workshop focused on specific processes known to be poorly simulated across a wide range of models.

New and sustained AAM observations: Duane reported that the Indian Ocean GOOS conference (Nov 2002) was very successful and that a multinational effort for observing the Indian Ocean and atmosphere was developing. This effort included the continuation of six ongoing open-ocean moorings and a commitment for a widely dispersed array (India signed up for 40 meteorology/ocean moorings). The AAMWG is also concerned with insuring the continuation of critical upper-air stations (e.g. Diego Garcia).

In summary, Duane indicated that most present-day actively developed AGCMs from major U.S. modeling centers (e.g., NCAR, GFDL, NCEP, NASA/GEOS, COLA) have marginal, poor, and/or *deteriorating* capability to simulate the TISO, and added that developing this capability would have numerous and positive impacts. Noting the apparent lack of agency support, he presented a proposed budget (\$4.2M per year) for TISO activities and asked how the AAMWG should proceed and what role the SSC could play in making progress toward securing funding for the TISO program.

The SSC warmly welcomed Duane and his encompassing and useful report. The progress towards implementing an observing system for the Indian Ocean was particularly good news. The SSC reaffirmed its recommendation to the AAMWG to focus on subseasonal variability and the TISO. The variability of monsoons is strongly dependent on TISO, so climate models will want to simulate TISO. Duane noted that while reanalysis products generally exhibit robust MJO variability this does not necessarily translate into the underlying model's ability to simulate and/or maintain MJO variability that may exist in the initial conditions. In fact, most forecast models (e.g., NCEP) exhibit useful forecast skill for the MJO only out to a few days even though empirical models exhibit skill out to 15-20 days and theoretical predictability studies suggest a limit of predictability out to 20-30 days.

A lengthy discussion ensued around the SSC recommended strategy of focusing on understanding and modeling the TISO (exploring predictability) rather than through experimental forecasting. However, there now appear to be several reasons why the AAMWG may want to consider embracing the experimental forecasting strategy. As the 2002 workshop demonstrated, there is much interest in the forecasting aspects (compiling and comparing forecast products) that could be enlisted to address TISO issues. Furthermore, from a modeling perspective, the representation of TISO variability (as

opposed to the mean climate) is getting worse and perhaps devoting the AAMWG effort towards predictions may be more fruitful if a baseline of (model) failure can be established and the models can be confronted with observations on a routine basis. A consensus began forming that experimental prediction activities can be exploited to gain momentum and improve (climate) model physics. An activity on model physics improvement would complement the prediction effort that is underway. Noting that model intercomparison alone would not be a worthwhile activity (because the models can't be compared if they don't have TISO), the question of how or if a CPT could be formed to systematically address the TISO issue was raised. Perhaps a subset of people from the TISO Experimental Prediction framework could address the TISO climate aspects (the relevance to an anticipated CPT for climate model sensitivity/atmospheric convection was not clear)? The SSC indicated support for the upcoming workshop in hopes it would be helpful in organizing the community in these directions.

On questions of agency support, the agencies indicated that some (not clear how much) resources were being devoted (through competed and sustained support) towards activities in the AAM region. It would be advantageous to obtain from the agencies a list of these activities, determine how they are contributing towards the TISO plan laid out by the AAMWG, and subsequently determine what new resources would be needed. The agencies also indicated that the AAMWG should engage and enlist the broader AAM research community (particularly in the U.S.) in order to build support for AAMWG priorities within the agencies.

- Action Item 12.** **The SSC encourages the AAMWG to pursue model/parameterization improvement of TISO through forecasting/prediction efforts currently gaining momentum. The AAMWG should use the planned workshop on AGCM hindcasts (summer 2003) as an opportunity to discuss the issues raised at SSC-10 and leverage support for a set of activities that address modeling of TISO within climate models (Legler to coordinate feedback).**
- Action Item 13.** **The SSC will request from the members of the U.S. CLIVAR Inter-Agency Group (IAG) to develop a list of funded TISO and AAM-related activities and to encourage PIs of these activities to participate in a the development of an overall AAM strategy lead by the AAMWG and (as appropriate) attend the summer 2003 workshop (Legler to communicate).**
- Action Item 14.** **During Indoex, soundings at Diego Garcia (and other locations) were taken more frequently. The Indoex follow-on (Asian Brown Cloud project, sponsored by UNEP) will continue some of these observations. These activities may be of interest. (Jay Fein to provide the name of the naval attache who organized this activity to the AAMWG).**

10 SIMAP

The Terms of Reference (TOR) of a reconstituted SIMAP were revised slightly and potential members identified. The membership should be able to identify and address common issues in coupled model development across both the seasonal-to-interannual and coupled climate change prediction communities. Lastly, the reconstituted SIMAP should serve as the focal point of coordination and advocacy for S-I variability/predictability within U.S. CLIVAR and CCSP.

- Action Item 15.** **Complete and submit to SSC for approval SIMAP TOR and membership (Schopf/Suarez).**

11 Agency Reports

11.1 NOAA-OGP

Ming Ji indicated that NOAA-OAR is being monitored for performance in several areas (assessments as a means of reducing uncertainty, improved seasonal forecasts, and ocean observing system and its uses). Therefore, OGP science priorities will focus on the development of NOAA Earth System Model and data sets for climate change projections and assessments; improving SI forecasts; development of decision support resources; and development of the in-situ ocean component of the global climate obs system. Furthermore, the activities are loosely organized under the paradigm of process and applied research programs to support operational centers/customers.

Ming also informed the SSC that some internal program realignment is under consideration. OGP is considering merging the PACS and GAPP programs in order to better address the priority on improving S-I forecasts. Additionally, OGP is also considering merging the management of the CLIVAR Pacific and Atlantic programs to focus on tropical oceans and variability on interannual and longer time scales to better address the global change projection and assessment priority. The SSC raised concerns about the proposed mergers drawing into question its scientific motivation. (SSC believes that there wasn't any, it was simply cast as a managerial decision). See Section 20.1 for further comments and SSC response.

11.2 NSF-Climate Dynamics

Jay Fein provided an overview of CLIVAR expenditures by NSF ATM. The total is \$6.7 million per year, 1.0 million at NCAR for process studies and data set development and 5.7 million for CDP grants and administration, e.g., workshops and USCPO and ICPO at about .5 million. The CLIVAR grants account for over 50% of Jay's entire (11M) portfolio. The CDP CLIVAR funds remain from transfer of TOGA monies in the early 90's plus a TOGA COARE increase of about \$1 million and small inflationary increases. Since FY 1995 no increases have been received. Jay also contributes \$1-1.5M in grants to academia for their work in conjunction with CCSM. Finally he noted that NCAR has \$2.5M per year from NSF for Climate Modeling, Analysis and Prediction (CMAP) for improvements in climate-system modeling and prediction.

Jay went on to describe the important role of CLIVAR in influencing how he decides to support process studies. Citing EPIC as an example, Jay's program has supported EPIC (~\$1M/year for three years), and these funds are available for field programs the SSC advises are of high priority (although other programs may also propose). He encouraged the SSC to provide advice on which process studies to support, but noted because EPIC analysis is still ongoing, will not support plans for field campaigns in FY03 and FY04. Jay indicated that support for process studies will not compete with that devoted to CPTs (funds for the pilot phase of CPTs came from a one-time increase in total CDP base) adding that if CPTs were to expand beyond the initial concept, new resources would have to be found for them.

11.3 NSF-Physical Oceanography

Eric Itsweire reported on his expenditures for CLIVAR. As WOCE funds are freed, more resources are anticipated to be available for CLIVAR priorities. In FY03 for example, Eric indicated that \$9.2M would be labeled as CLIVAR. This included 2.2M for KESS, 2M for MOC paleo and monitoring activities (joint with the NERC); 1.6M for the global ocean surveys; 1.1M for other sustained and large-scale observations; and the balance for individual projects, development, and infrastructure. This total is anticipated to increase to cover support of an ocean mixing CPT and other additional individual CLIVAR research projects. The maximum allocation to CLIVAR is anticipated to go to

\$15M per year in the future. Other (non-CLIVAR) funds (250K in FY02) go to NOPP in support of ocean data assimilation.

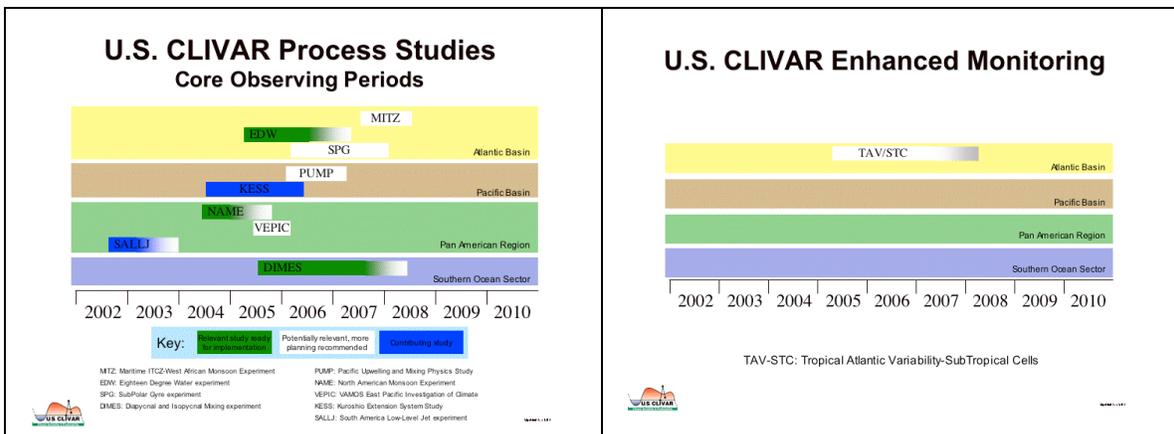
During the discussion, the process of how to encourage/phase process studies deemed as most relevant was raised. Noting that smaller studies can come under the general OCE announcement, Eric discouraged a first-come, first-serve approach. Noting that the OCE budget would be capable of supporting a few new process studies/experiments in the FY04 and FY05 time frame, he encouraged the SSC to identify one-to-two studies ready to go now, and a few that could begin in a few years. It was not clear from the discussions how proposals for these studies should be submitted to OCE (e.g. special CLIVAR announcement) nor if a special review process would be utilized.

12 Process Study Feedback to Panels/Working Groups

In executive session, the SSC acknowledged several proposed process studies that were relevant to U.S. CLIVAR objectives and are ready to proceed with implementation: NAME, EDW, and DIMES. Additionally, several other process studies were identified as potentially relevant, but where additional planning is required before SSC consideration could be given: PUMP, VEPIC, SPG, and MITZ. The SSC felt that two process studies, GASEX and SAMFLOC, were not sufficiently relevant to CLIVAR to consider. Finally, the SSC felt the science/observation study of Atlantic TAV/STC is a valuable enhanced monitoring effort required to understand STCs. The SSC decided that it will send a letter to the agencies, most notably NOAA (Mike Johnson and Jim Todd), in strong support of this activity - and given the ongoing international activities that would contribute to this effort, urge for its implementation as soon as possible indicating that the extended monitoring of the STCs in the Atlantic would likely lead to results of value to CLIVAR.

Specific comments on each of the process studies will be forwarded to the panels (IAG wishes to vet the feedback to panels).

The SSC further recommended the panels continue to encourage advanced planning of the identified relevant process studies and provide an update on their status in a year. Additional process studies the panels and working groups feel would be highly relevant to U.S. CLIVAR will also be reviewed at that time.



Action Item 16. U.S. CLIVAR has identified three relevant process studies; NAME, EDW, and DIMES; and one enhanced monitoring activity; TAV-STC, that are ready to proceed. Several other studies are potentially interesting, but more planning is needed. The SSC will communicate its level of interest of all considered studies to the sponsoring agencies and to the panels/working groups (SSC-Exec).

Action Item 17. Post a description of the process whereby similar studies can be submitted for U.S. CLIVAR consideration. (Legler).

As part of the process to develop its roadmap and the basin-specific elements of the sustained observing system, the panels are asked to update their sustained observing system element needs and prepare input to a focused discussion at SSC-11 (co-chairs to communicate to panels). Remote-sensing issues (continuation of high-quality remote sensing into NPOESS era, cross-mission calibrations, etc) will also be discussed (Bruce Wielicki).

Action Item 18. Panels and working groups are requested to update/consider needs for sustained observing system elements for discussion at SSC-11. Additionally Bruce Wielicki will be tasked on providing an update on remote-sensing issues. (Co-Chairs to communicate).

13 Climate Process Modeling and Science Teams (CPTs)

David Legler updated the SSC on the availability of the two CPT whitepapers on the web site and his plans to distribute hardcopies and a CPT brochure. Jay Fein indicated OGP and NSF is preparing a joint announcement for CPTs using the SSC input as guidance. He estimated ~\$2M would be available and that letters of intent would be requested in advance of proposals.

In further discussions, Jay indicated that these pilot CPTs were intended to address high-priority issues of coupled climate modeling where there is a good chance of demonstrable progress in a few years. He emphasized that CLIVAR should continue to address important issues and that any process studies it advocates ought to address and demonstrate an active role by modeling centers, i.e. modeling (or synthesis, algorithm development, etc.) interest should be represented in the planning stages of the process study. If the pilot phase CPTs are a success (as assessed in a year or two) then he felt we could then seek preferential treatment from Dr. Mahoney (CCSP).

Jay also indicated that if a group of investigators wished to request a workshop or other small item to help develop a CPT, this request could be submitted to the usual NOAA or NSF programs, independent of the CPT announcement. Further, Jay indicated that while the current pilot phase will be closely prescribed, the concept of CPTs is general, and CPTs associated with process studies or panel activities may be submitted under future (general of CPT specific) announcements. Ming Ji added that if good (small) ideas come in under the pilot-phase announcement, NOAA would consider funding development.

14 U.S. CLIVAR's role in developing observation system

David Legler provided an update on discussions with International CLIVAR since a letter was sent to the SSG expressing concern over the plan to deactivate the CLIVAR Ocean Observations Panel (COOP). The discussions have been inconclusive. The SSC agreed with the premise that the COOP and OOPC (Ocean Observations Panel for Climate) should not overlap, however, there appears to be sufficient tasks and issues (especially addressing *research* issues) to warrant a CLIVAR panel on observations. It was noted that both Dean and Detlef had volunteered to lead COOP, but have not received a response to their offer.

The planned workshop on reanalysis still has no date or active organizer (there appears to be some confusion about the workshop organization – what is Detlef's role on the organizing committee?). If the workshop is to stimulate activities in preparation for the 2004 CLIVAR conference, it should be scheduled very soon.

Additionally, the SSC felt it important that the SSC review and provide feedback to U.S. plans for a sustained observation system. Noting that Mike Johnson has not briefed the SSC on the latest plan, he should be invited to make a presentation.

Action Item 19. **The SSC is very concerned about the lack of progress in planning for the reanalysis workshop. Additionally, Detlef Stammer's role needs clarification. (Max to communicate to the SSG).**

Action Item 20. **An invitation will be sent to Mike Johnson to make a presentation at SSC-11 on the plans for a U.S. contribution to the climate observations system (Legler to communicate).**

15 CLIVAR/PAGES Working Group

Jonathon Overpeck (co-chair) briefed the SSC on the plans for the CLIVAR-PAGES working group to develop a national research strategy and accompanying roadmap that scopes activities addressing abrupt climate change. Building on the abrupt climate change report from the National Academy, the CLIVAR-PAGES WG will concentrate on the physical climate system (establishing links to ecological and impacts communities through IGBP) with a special focus on a) hydrologic extremes, including the full range of variability, especially in drought and megadrought, but also including tropical storms and flood regimes, and the role of the tropics, e.g. tropical storm frequency (to complement extensive extra tropical research) and b) the last century in the context of the last 1000-2000 years. The overarching question is how will natural and human-induced forcing/variability interact to affect the probability of abrupt climate change (e.g., abrupt ocean circulation shifts; megadroughts and/or more frequent droughts; increase in flood and/or tropical storm frequency; abrupt sea-level rise). Alternatively, the question may be cast as: is there a threshold beyond which there is an unacceptable probability of a *dangerous* abrupt climate change.

The proposed process whereby the working group would develop this plan involved working group meeting in the spring 2003, after which a draft white paper would be developed. During the fall 2003, up to three focused workshops (drought/megadrought – joint with IPCC; paleoclimate variability of the tropics; and climate predictability using paleoclimate data) would be used to solicit feedback on the plan. Finally, in winter 03/04, there would be a CLIVAR/PAGES community workshop to review/vette abrupt climate change white paper.

The issues raised (to the SSC and IAG) where: what is the right balance between science vs implementation? How best to involve/coordinate-with agencies to ensure product is of maximum use? How best to coordinate with non-physical climate communities (ecological, human dimensions)? Is the preparation timeframe acceptable (noting the tradeoff between the quality of the plan vs timing)? Finally, is the overall development plan acceptable?

The question was raised on how to best entrain stakeholders into answering the question of what are the acceptable/safe conditions under which they could live? Their input is critical; however, it was recognized this issue may take longer to resolve and thus perhaps a parallel process for stakeholders to address this question should be initiated.

The SSC responded favorably to the proposed plan and felt given the importance of the issue and the opportunity to raise this priority within the CCSP, encouraged the working group to proceed as quickly as possible. It was suggested the working group meet in D.C. to engage the federal research agency program managers not represented in CLIVAR (e.g. Earth System History – NSF-ESH). Lastly, the membership of the working group needed review and the co-chairs were requested to submit for consideration by the SSC, before the working group meeting, a membership suited to address the issues at hand.

- Action Item 21.** The SSC approves the proposed plan for developing the CLIVAR/PAGES abrupt climate change research strategy/roadmap and encourages the CLIVAR/PAGES working group hold its next meeting in Washington, DC.
- Action Item 22.** Recommended CLIVAR/PAGES working group membership be submitted to SSC for approval in advance of working group meeting (Overpeck/Cane to submit to Legler).

16 WCRP Banner on Predictability

David Legler briefed the SSC on the proposed “Banner” on predictability. Although the objective of this banner is to “...develop prototype prediction systems for climate on time scales from weeks to century”, it was not clear what the "banner" is, nor its implications. It was not entirely certain that a WCRP reorganization/restructuring would alter the current U.S. CLIVAR committee structure. The importance of improving "predictions" (on time scales of seasonal *and longer*) was recognized as one of the overall goals of WCRP and is a central objective of CLIVAR. Agreeing to a new predictability banner would not necessarily lead to a more effective (i.e. than current WCRP structures) means of improving predictions or the observing system.

Rather than address the banner proposal directly, the SSC felt it best for U.S. CLIVAR to develop a clearer message of what CLIVAR is (see elsewhere in the meeting report) in the context of overall climate research (from forcings to regional impacts). Pending the outcome of pending discussions with the CCSP (particularly in light of the "diagram", see section 2), the SSC felt it would need more information on the Banner proposal and suggested a more thorough presentation of this idea at SSC-11.

- Action Item 23.** The SSC was concerned about the proposed banner on predictability, but felt there were insufficient details (e.g. what is a “banner”) to provide a formal response (Legler to communicate to SSG; Legler to coordinate a presentation on the Banner at SSC-11).

17 Ocean Data Assimilation Report

Detlef Stammer reviewed the progress towards completing the report to the SSC on the status of ocean data assimilation activities in the US and requested more specific guidance on the scope of the document (e.g. should it be a plan?). Detlef indicated that the ocean synthesis activity he has been leading (ECCO) costs approximately 2M per year. Other activities (e.g. data collection and preparation) outside of ECCO are currently being funded by several programs and are not reflected in this total. It was noted that the ODA for S-I forecasting project (ODASI – funded through the NOAA Climate Dynamics program, but includes participation by several non-NOAA groups) is comparing some products.

The SSC recognized the critical role ocean data assimilation (ODA) activities play in synthesizing observations and models to produce value-added data products and predictions and in designing the climate observing system. The SSC felt the report should be expanded into more of a strategic plan that addresses several issues:

- Synthesis, seasonal-to-interannual, and nowcasting (mesoscale) ODA activities have much in common, but were not coordinated terribly well and the merging of ODA products is uncertain. For example, would a 10-yr ocean reanalysis/synthesis be used as initial conditions for S-I forecasting? How are the various ODA products being tested?
- While there continues to be some support being directed to ODA, there is no plan or vision for long-term (inter-agency/coordinated) support of ODA activities. What is the plan for supporting ocean syntheses after 2004 (projected end of funding) and what should CLIVAR encourage as targets for improvement (better models, higher resolution, more resources for production of products; more centralized and cost-efficient collection and preparation of data)? What is the

timeline for development of data assimilation efforts at GFDL and how do they intersect with these plans?

- Additionally, there are a number of datasets from the various ODA projects that are of potential interest to CLIVAR (a list of these products is available in the latest GODAE report). ODA projects are looking for input on what products the community desires. How should CLIVAR provide feedback to ocean data assimilators on its needs?
- The use of ODA products in coupled models was recognized to be job of significant size and scope, how should CLIVAR encourage progress in this area?

Action Item 24. The SSC encourages Detlef Stammer to address the issues raised at SSC-10 in the U.S. CLIVAR ocean data assimilation strategic plan.

18 Review of TAO Transition Plans

Plans for transition of the TAO array from PMEL to NDBC were submitted Nov 15 to NOAA. The submitted transition plan indicated significant additional resources may be needed in addition to an extensive training effort (over 4 years) and that a Chief Scientist should be appointed by NDBC to act as the contact for ancillary projects. If the plan is approved (and there was some suggestion that the presently-proposed transition may be modified), the transition would begin in FY04 with training of NDBC staffers in Seattle.

The NOAA Executive Council will meet in late January to decide on the transition plans after which the SSC will have an opportunity to provide comment. That decision will be public and comment will be sought. Comments have been quite influential in the process so far. The issues for CLIVAR input include: assuring transition is fully funded; appointment of a Chief Scientist office at NDBC; an understanding of "operational", assurances support for TAO would be sustained; technology evolution (climate observations are not like weather observations); developing a global observing system is still a research subject; role of international partners (Japan, France, Brazil) especially in light of the more international nature of other systems (e.g. Argo). Finally, the SSC suggested one way to insulate against difficulties in assuring ancillary programs (add-on projects to cruise and moorings) would continue is to formalize the process of approval for ancillary programs.

Action Item 25. SSC will review the TAO transition plan once it is made available for comment (Kessler to advise SSC when comments are invited; Legler to coordinate CLIVAR input)

19 Science Workshop/Meeting Endorsement

The SSC approved the process for workshop/meeting organizers to seek U.S. CLIVAR scientific endorsement. It was understood that program managers, when determining workshop financial support, would consider such an endorsement. Endorsement also means organizers would have responsibility to report findings to the SSC.

The SSC endorsed the following workshops:

Coupled Data Assimilation Workshop (April 03)

Pacific Decadal Variability Workshop (Feb 03)

Tropical Coupled Model Workshop (June 03)

Action Item 26. Post the workshop endorsement process on U.S. CLIVAR web site. (Legler)

Action Item 27. The SSC endorsed the Coupled Data Assimilation; Pacific Decadal Variability, and Tropical Coupled Model workshops and will communicate endorsement of these workshops to organizers and IAG (Legler)

20 EXECUTIVE SESSION

20.1 NOAA-OGP

The SSC and panel-chairs agreed the proposed merging of Atlantic and Pacific programs in NOAA-OGP would be detrimental to the Atlantic and Pacific communities. Moreover, any advantages of such a merger were not evident. Now that the roadmap for CLIVAR and the sequencing of process studies is becoming clearer, the SSC encourages OGP to consider a response to the process studies it deems more relevant and ready for implementation under the current management structure. Additionally, the Pan American panel has concerns regarding the merging of the PACS and GAPP programs.

Action Item 28. Send letter to Ming Ji and Ken Mooney expressing concern with proposed merger of CLIVAR Pacific and CLIVAR Atlantic programs and proposed merger of PACS and GAPP (Co-chairs; Gutzler to supply comments on PACS-GAPP).

20.2 Membership

The SSC considered membership on all panels and working groups as well as the SSC. The proposed changes are indicated in tables (appendix). A rotation schedule for the AAMWG was determined, three members will be asked to end their terms effective immediately. The AAMWG will be asked to submit suggestions for three new members. One suggestion was Chris Thorncroft who has been actively leading efforts within the US for African Monsoon research. Also, the CLIVAR-PAGES working group will determine who is ready to continue and submit suggestions for new members (see CLIVAR/PAGES action item).

Action Item 29. Panel and working Group changes to be vetted by SSC (Legler to coordinate).

Action Item 30. Vetted changes to SSC to be submitted to IAG for approval (Legler)

20.3 Next Meeting

The completion of many action items is urgent. The next SSC meeting is targeted to be Sept 2003. Lamont/IRI has indicated an interest in hosting the meeting.

Action Item 31. Identify dates and determine location of SSC-11 (Legler).

21 Agenda

Day 1 – January 7, 2003 - Tuesday

0830-1030:	SSC private session
1030-1100:	Coffee break
1100-1115:	Welcome -- introduction and logistics
1115-1125:	Meeting preview and objectives – (Legler/Weller)
1125-1230:	Developing the Roadmap for U.S. CLIVAR
1230-1345:	Lunch
1345-1430:	Roadmap (continued)
1430-1530:	Review of Climate Variability and Change element of U.S. CCSP Plan
1530-1600:	Break
1600-1630:	Review (continued)
1630-1700:	Climate Process Teams (update) DOCS: Whitepaper-Concept, Whitepaper-Implementation
1700-1730:	CLIVAR-Pages Working Group report
1730-1745:	Input on ocean data assimilation whitepaper
1800:	SSC Dinner at SIO

Day 2 – January 8, 2003 - Wednesday

U.S. CLIVAR Regional panels/working groups present reports on progress since SSC-9.

0830-0930:	Pacific Implementation Panel presentation (20-min) and discussion (Kessler) DOCS: Upwelling process study brief
0930-1030:	Atlantic Implementation Panel presentation and discussion (20-min) and discussion (Visbeck) DOCS: 18-deg water study: summary, description DOCS: TAV study: summary, description DOCS: Atlantic Marine ITCZ study: summary, description DOCS: Sub Polar Gyre Experiment: response to SSC, description
1030-1100:	Break
1100-1215:	Southern Ocean Working Group presentation (25-min) and discussion (Gordon) DOCS: Diapycnal/isopycnal mixing study: description DOCS: GASEX: description
1215-1330:	Lunch

1330-1430: Pan American Implementation Panel presentation (20-min) and discussion (Gutzler)

1430-1515: Asian-Australian Monsoon Working Group presentation (20-min) and discussion (Waliser)

1515-1545: Break

1545-1615: Agency Reports (NOAA-OGP)

1615-1635: Agency Reports (NSF-ATM)

1635-1655: Agency Reports (NSF-OCE)

1700: End of public session

1705-1745: SSC Private Session

Day 3 – January 9, 2003 - Thursday

0830-0900: Review Roadmap strategy

0900-0930: TAO Transition (update/prepare to review plan) (Kessler)
Lautenbacher response

0930-1000: WCRP Banner on *Prediction*

1000-1100: CLIVAR Ocean Observations Panel (COOP) – update on discussions
Scientific workshop endorsements (a new process):
DOCS: Coupled Data Assimilation workshop brief
DOCS: Pacific Decadal Variability workshop brief
Input on ocean data assimilation whitepaper

1100-1115: Break

1115-1215: TBD

1215: Adjourn

22 Attendance

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23 U.S. CLIVAR Committees

Updated 12/31/02. Years indicate last year of service.

U.S. CLIVAR SCIENTIFIC STEERING COMMITTEE (SSC)

<i>Name</i>	<i>Affiliation</i>	2002	2003	2004	2005	2006
David Battisti (co-chair)	University of Washington	✓				
Robert Dickinson	Georgia Institute of Technology	✓				
Isaac Held	NOAA Geophysical Fluid Dynamics Laboratory			✓		
James Hurrell	NCAR		✓			
William Kessler	NOAA Pacific Marine Environmental Laboratory	✓				
Jerry Meehl	NCAR			✓		
Dean Roemmich	Scripps Institution of Oceanography			✓		
Paul Schopf	COLA/George Mason University			✓		
Detlef Stammer	Scripps Institution of Oceanography			✓		
Max Suarez	NASA-Goddard Space Flight Center			✓		
Bruce Wielicki	NASA Langley Research Center		✓			
Robert Weller (co-chair)	Woods Hole Oceanographic Institution		✓			

PACIFIC SECTOR IMPLEMENTATION PANEL

<i>Name</i>	<i>Affiliation</i>	2002	2003	2004	2005	2006
Chris Bretherton (co-chair)	University of Washington		✓			
Greg Johnson	NOAA - Pacific Marine Environmental Laboratory	✓				
William Kessler (co-chair)	NOAA - Pacific Marine Environmental Laboratory		✓			
George Kiladis	NOAA - Climate Diagnostics Center	✓				
Roger Lukas	University of Hawaii	✓				
Art Miller	Scripps Institution of Oceanography			✓		
Sumant Nigam	University of Maryland/NSF			✓		
Paul Robbins	Scripps Institution of Oceanography			✓		
Dan Rudnick	Scripps Institution of Oceanography			✓		
Paul Schopf	COLA/George Mason University		✓			
Max Suarez	NASA - Goddard Space Flight Center			✓		

PAN-AMERICAN SECTOR IMPLEMENTATION PANEL

<i>Name</i>	<i>Affiliation</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>
Bruce Albrecht	RSMAS/University of Miami	✓				
Meghan Cronin	NOAA Pacific Marine Environmental Laboratory			✓		
Robert Dickinson (co-chair)	Georgia Institute of Technology		✓			
Paul Dirmeyer	COLA		✓			
David Gutzler (co-chair)	University of New Mexico			✓		
Wayne Higgins	CPC/NCEP/NWS/NOAA		✓			
C. Roberto Mechoso	University of California, Los Angeles	✓				
George Philander	Princeton University	✓				
Shuyi Chen	RSMAS/University of Miami			✓		
Mingfang Ting	University of Illinois at Urbana-Champaign			✓		
Shang-Ping Xie	University of Hawaii			✓		

ATLANTIC SECTOR IMPLEMENTATION PANEL

<i>Name</i>	<i>Affiliation</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>
Ping Chang	Texas A&M University			✓		
Edward Cook	Lamont-Doherty Earth Observatory of Columbia University	✓				
James Hurrell (co-chair)	NCAR		✓			
Kristina Katsaros	NOAA - Atlantic Oceanographic and Meteorological Laboratory	✓				
John Marshall	Massachusetts Inst. of Technology (MIT)	✓				
Julia Paegle	University of Utah		✓			
Walter Robinson	University of Illinois at Urbana-Champaign			✓		
Mark Serreze	University of Colorado			✓		
Detlef Stammer	Scripps Institution of Oceanography		✓			
Martin Visbeck (co-chair)	Lamont-Doherty Earth Observatory of Columbia University			✓		

ASIAN-AUSTRALIAN MONSOON WORKING GROUP

<i>Name</i>	<i>Affiliation</i>	<i>2002</i>	<i>2003</i>	<i>2004</i>	<i>2005</i>	<i>2006</i>
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Ben Kirtman	COLA					
T. N. Krishnamurti	Florida State University					
William Lau (co-chair)	NASA - Goddard Space Flight Center					
Roger Lukas	University of Hawaii					
Julian McCreary	University of Hawaii					
Jagadesh Shukla	COLA					
Jim Shuttleworth	University of Arizona					
Duane Waliser	SUNY					
Peter Webster	University of Colorado					

SOUTHERN OCEAN WORKING GROUP

<i>Name</i>	<i>Affiliation</i>	2002	2003	2004	2005	2006
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Arnold L. Gordon (Chair)	Lamont-Doherty Earth Observatory of Columbia University					
Alex Hall	University of California, Los Angeles					
Richard E. Moritz	University of Washington -- Applied Physics Laboratory					
David H. Rind	NASA - Goddard Institute for Space Studies					
Christopher L. Sabine	NOAA - Pacific Marine Environmental Laboratory					
William M. Smethie, Jr.	Lamont-Doherty Earth Observatory System of Columbia University					
Kevin Speer	Florida State University					
Achim Stoessel	Texas A&M University					
Stephen G. Warren	University of Washington					

CLIVAR-PAGES WORKING GROUP

<i>Name</i>	<i>Affiliation</i>	2002	2003	2004	2005	2006
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David Battisti	University of Washington					
Mark Cane (co-chair)	Lamont-Doherty Earth Observatory of Columbia University					
Ping Chang	Texas A&M University					
Ed Cook	Columbia University					
John Kutzbach	University of Wisconsin					
Jonathan Overpeck (co-chair)	University of Arizona					
Dan Schrag	Harvard University					
Karl Taylor	Lawrence Livermore					

SEASONAL-TO-INTERANNUAL MODELING & PREDICTION (SIMAP) WORKING GROUP

<i>Name</i>	<i>Affiliation</i>	2002	2003	2004	2005	2006
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Andrew Bennett	Oregon State University					
Ping Chang	Texas A&M University					
Ming Ji	NOAA Office of Global Programs					
Randy Koster	NASA - Goddard Space Flight Center					
Ed Schneider	COLA					
Paul Schopf	COLA/George Mason University					
Max Suarez	NASA - Goddard Space Flight Center					
Joe Tribbia	NCAR					
Steve Zebiak (chair)	International Research Institute (IRI) for Climate Prediction, LDEO					

CLIVAR-SEARCH WORKING GROUP

<i>Name</i>	<i>Affiliation</i>	2002	2003	2004	2005	2006
CLIVAR						
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Cecilie Mauritzen	Woods Hole Oceanographic Institution					
David Rind	NASA - Goddard Institute for Space Studies					
Richard Moritz	Applied Physics Laboratory - University of Washington					
SEARCH						
Peter Schlosser (chair)	Lamont-Doherty Earth Observatory of Columbia University					
Mark Serreze	University of Colorado					
Jamie Morison	University of Washington - Applied Physics Laboratory					
Jim Overland	NOAA - Pacific Marine Environmental Laboratory					

U.S. CLIVAR Reports

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U.S. CLIVAR Office, 2003: Report of the tenth meeting of the U.S. CLIVAR Scientific Steering Committee, SSC-10. U.S. CLIVAR Report 2003-1, U.S. CLIVAR Office, Washington, DC, 20006, 31pp.

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