

GEWEX Plans for 2013 and Beyond

At the GEWEX SSG meeting in New Delhi in January 2010, discussion was continued about future plans for GEWEX and WCRP. I believe there is already a draft document "*The GEWEX Contribution Towards WCRP's Future*" [the latest version I saw was one dated Jan 31 2009 with my comments on it]. It included sections with these questions:

- *What will be the key science issues your project aims to address over the coming years to 2013?*
- *What elements of this science do you see as needing to be taken forward beyond next decade?*
- *What new science do you see WCRP needing to address beyond 2013 in the context of your project?*

While we need to plan, much of what happens over the next 3 years is already in place. What happens in the longer term is very much up in the air. And how to transition from one to the other will be concerns over the next few years as well.

At the SSG meeting, discussion took place on the three major components of GEWEX [GEWEX Radiation Panel (GRP), GEWEX Modelling and Prediction Panel (GMPP), and Coordinated Energy and Water Cycle Observations Project (CEOP)] and whether these fitted together. The conclusion was that they do, but perhaps the links have not been adequate. Accordingly, this structure seems likely to remain for now. The main discussion occurred over what it was in GEWEX that *must* be done, "imperatives." Brief discussion occurred over major new horizons, "frontiers." Possibly renaming GEWEX was mooted and received surprisingly little opposition. After all, why is the "EX" in GEWEX? Below a possible new name is put forward, along with an overall mission statement for post 2013, and 11 imperatives. These are intended for the post 2013 era. Some frontiers are mentioned (there are likely more?). Further below, a start is made on fleshing these out by adding sections on partners, and actions.

This version is revised following a number of comments and suggestions, and I thank all of those who responded. The imperatives have been slimmed down and made succinct with more of the description placed underneath under the "actions" in the extended version. It is expected that the fuller description will be further fleshed out at the Pan-GEWEX science meeting in Seattle in August, and that a further, order a page or two, might be written as well. The whole will make a nice document of where GEWEX is headed, and some indication of how we get there. It should feed directly into WCRP plans and also help us with funding agencies. Note that I appended a few comments at the end that are not adequately accounted for at this stage. This list could be added to.

Kevin Trenberth

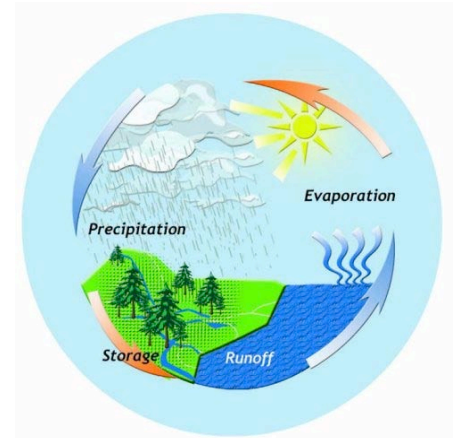
Revised 10 February 2010

Global and Regional Energy and Water project (GREW)

1 [GEWEX grew]

2 **Mission statement**

3 To develop improved observational, diagnostic and modeling
4 capabilities to measure and predict global and regional energy
5 and water variations, trends, and extremes such as heat waves,
6 floods and droughts; and provide the science underpinning
7 climate services.



1 **Imperatives: (post 2013)**

2

3 **DATA**

- 4 • Develop **climate data records** of atmospheric and land variables, complete with metadata and error bars.
- 5 • Provide **descriptions** and analyses of observed variations, trends and extremes in hydrological and energy-related quantities.

8 **ANALYSIS**

- 9 • Develop advanced **diagnostic tools** and identify pathways for model improvement.
- 10 • Increase understanding of energy and water cycle **processes**, quantify their contribution to climate feedbacks, and develop improved hydro-meteorological parameterizations.
- 11 • Develop and exploit methods of dealing with **non-stationarity** of hydrological variables, and especially extremes of floods and droughts, associated with climate and global change.
- 12 • Contribute to building a comprehensive end-to-end pan-WCRP initiative on climate **extremes** addressing the compound and nonlinear nature of extreme events, their ubiquity and risk coping issues.

17 **MODELING**

- 18 • **Attribute** causes of trends, and determine the **predictability** of energy and water cycles on a global and regional basis in collaboration with the wider WCRP community.
- 19 • Accelerate **developments in models** of the land, atmosphere and entire climate system.
- 20 • Improve capabilities for **predictions** of water and energy cycle variability on all time scales.

22 **APPLICATIONS**

- 23 • Develop observational sites, data processing tools, data management and archival systems, model initialization and synthesis capabilities, and other research outcomes for **transition to operations**.
- 24 • Promote and foster **capacity building** through training of scientists and the user community.

27 **FRONTIERS**

- 28 • Understanding and modeling:
 - 29 ○ anthropogenic influences on land and water use, including urbanization

- 30 ○ effects of climate variability and change on land surface properties and processes
- 31 ○ anthropogenic aerosols
- 32 • Improved representation of hydrological processes in land surface schemes, including
- 33 groundwater
- 34 • Assimilation of local and regional data to constrain global model parameterizations
- 35 • Extremes in water cycle effects on, for example, ecosystems, land forms, food systems, human
- 36 health, ...
- 37 • Linkages with biogeochemical processes, including modeling of water quality and other non
- 38 physical variables
- 39 • Geo-engineering

1 Imperatives Post 2013

3 DATA

- 4 • Develop **climate data records** of atmospheric and land variables, complete with metadata
5 and error bars.
6 **Lead:** GRP, CEOP; **Partners:** SCOPE-CM, CEOS, WOAP
7 **Actions:**
 - 8 ○ Reprocess GEWEX datasets, provide advice on other efforts and lead evaluations.
 - 9 ○ Continue evaluation and refinement of sensor algorithms, influencing next
10 generation space-born platforms and reprocessing.
 - 11 ○ Development of appropriate calibration/validation/evaluation datasets to confront
12 models.
 - 13 ○ Devise robust ways of dealing with the more diverse, complex, higher spatial and
14 temporal resolution, and much greater volumes of data.
 - 15 ○ Build on CEOP experience in data management, archival and access.
- 16 • Provide **descriptions** and analyses of observed variations, trends and extremes in
17 hydrological and energy-related quantities.
18 **Partners:** Rest of WCRP
19 **Actions:**
 - 20 ○ Analyze, evaluate and compare observations, and document results.
 - 21 ○ Work to close moisture and energy budgets, regionally and globally.
 - 22 ○ Determine the geographical and seasonal characteristics of key water and energy
23 cycle variables especially over land areas.
 - 24 ○ Close catchment water budgets.
 - 25 ○ Integrated product assessment, data assimilation into hydrological models.

27 ANALYSIS

- 28 • Develop advanced **diagnostic tools** and identify pathways for model improvement.
29 **Lead:** GRP, GMPP, CEOP; **Partners:** WGNE, CAS
30 **Actions:**
 - 31 ○ Spin up a new joint GRP-GMPP-CEOP effort in advanced diagnostics;
 - 32 ○ Build on GEWEX's combination of observations and modeling capabilities
 - 33 ○ Identify and entrain collaborators from other WCRP and CAS groups
- 34 • Increase understanding of energy and water cycle **processes**, quantify their contribution to
35 climate feedbacks, and develop improved hydro-meteorological parameterizations.
36 **Lead:** GMPP, CEOP
37 **Partners:** CLIVAR, CliC, SPARC, WGCM, WGNE
38 **Actions:**
 - 39 ○ Observations, process studies, field programs
 - 40 ○ Investigate alternative representations of sub-grid processes in Land Surface
41 Schemes;
 - 42 ○ Develop improved understanding of climate variability and change on land surface
43 properties, including soils, vegetation and hydrological processes, and an associated
44 modelling capability;

- 45 ○ Investigate the scope for development of next generation land surface models with
46 improved representation of subsurface hydrology, including groundwater processes;
47 identify suitable areas for their evaluation.
- 48 ○ Develop more modular Land Surface Models and components for use in Earth system
49 models.
- 50 • Develop and exploit methods of dealing with **non-stationarity** of hydrological variables, and
51 especially extremes of floods and droughts, associated with climate and global change.
52 **Partners:** CLIVAR; IHDP (Global Water System Project, GWSP),
53 ○ UNESCO (International Hydrological Programme, IHP)
54 ○ Hydrological community
55 **Actions:**
56 ○ Define requirements for data types, sampling and resolution.
57 ○ Develop new statistical methods for planning for extremes.
58 ○ Develop new generation methodologies for quantification and prediction of
59 extremes.
- 60 • Contribute to building a comprehensive end-to-end pan-WCRP initiative on climate **extremes**
61 such as heat waves, floods and droughts, addressing the compound nature of extreme
62 events, their ubiquity and risk coping issues.
63 **Partners:** WCRP (CLIVAR, CliC), Hydrological community, IRDR (Integrated Research
64 on Disaster Risk)
65 **Actions:**
66 ○ Define requirements for data types, sampling and resolution.
67 ○ Model development, focused on extremes, and definitions consistent with
68 observations (upscaling and downscaling).
69 ○ Characterize the entire pdf and especially the characteristics of precipitation
70 (frequency, intensity, amount, type, duration).
71 ○ Assist in reducing vulnerability and planning for adaptation to and coping with
72 changes.

73 **MODELING**

- 74 • **Attribute** causes of trends, and determine the **predictability** of energy and water cycles on a
75 global and regional basis in collaboration with the wider WCRP community.
76 **Partners:** WCRP projects and WGs; IPCC
77 **Actions:**
78 ○ Develop links between global, regional and local scales.
79 ○ Model detection and attribution studies.
80 ○ Coordinate data set generation, process studies and modeling.
- 81 • Accelerate **developments in models** of the land, atmosphere and entire climate system.
82 **Lead** GMPP, CEOP; **Partners:** WGNE, WGCM
83 **Actions:**
84 ○ Strengthen the model improvement activities within GMPP.
85 ○ Strengthen collaboration with the modeling centers.
86 ○ Consider how the components interact and make up a complete system through
87 improved understanding of coupling and feedbacks.
88

- 89 ○ Continue evaluation of developing earth system model products.
90 ○ Develop archives to support model development and intercomparison.
91 ○ Develop forecasting algorithms including ensemble techniques.
92 ○ Promote regional application and evaluation studies;
93 ○ Improve representation of hydrological processes – lakes, wetlands, groundwater,
94 river routing.
95 ○ Improve the representation of the atmospheric energy and water cycle, in particular
96 clouds and precipitation.
97 ○ Improve representation of non-stationarity in land surface properties under global
98 change.
- 99 • Improve capabilities **predictions** of water and energy cycle variability on all time scales.
100 **Partners:** CLIVAR, CLiC, WGSIP, WGCM; UNESCO (International Hydrological
101 Programme, IHP); International Association of Hydrogeologists (IAH)
102 **Actions:**
103 ○ Diagnose model errors and exploit GEWEX datasets and focused process studies
104

105 APPLICATIONS

- 106 • Develop observational sites, data processing tools, data management and archival systems,
107 model initialization and synthesis capabilities, and other research outcomes for **transition to**
108 **operations**.
109 **Partners:** pan-WCRP, IGBP, hydro-meteorological and climate services
110 **Actions:**
111 ○ CEOP reference sites heritage;
112 ○ Undertake joint activities with operational hydro-meteorological and climate
113 services, and hydrological research programs to demonstrate the value of the
114 capabilities, data sets, technology, tools, and information products that address
115 societal needs.
116 ○ Promote collaboration among climate system science, engineering **hydrology and**
117 **socio-economic sciences**.
118 ○ Demonstrate a prototype of an end-to-end fully collaborative study.
119 ○ Work with operational agencies to transition new capabilities
- 120 • Promote and foster **capacity building** through training of scientists and the user community.
121 **Partners:** ESSP, START
122 **Actions:**
123 ○ Publish results and lessons learned
124 ○ Collaborate on observations
125 ○ Participate in outreach and workshops
126 ○ Provide tools for diagnoses and analysis
127
128

Other suggestions:

Ron Stewart:

Global to Local Energy and Water (GLEW) . Likes update of name idea

I still feel that GEWEX itself should take stock of the many things it has accomplished and summarize this in a BAMS-type article.

Given that the imperatives will inevitably become the focal points, the present organizational structure probably needs some updating, although perhaps not much. One issue that needs invigorating is the regional climate activity. Several of the RHPs are ending soon and it is a good opportunity to think through how best to address regional issues in the future. Lots of largely unrealized potential. My work on extremes in the different regions is a small indication of this.

To some degree, below is what we have now. Maybe this is still a first-cut for the future:

Integrated Global Datasets and Analyses

Regional Climate Studies

Model Parameterizations

Applications

Cross-cuts may be best organized by having clear actions with sunsets. They shouldn't be allowed to grow too large. (Something like Extremes could end up being huge otherwise! Is this wise?)

With its diverse group of researchers, GEWEX is actually addressing several elements of Earth System Models. As well, GEWEX is in a position to comment what such a model MUST possess in order to capture the key processes and interactions. We could even now 'describe' what such a model must possess or capture.

Matt McCabe

A statement along the lines of "Seek closure of the water and energy budgets through observations (remote and in-situ) at global and regional scales". This is a grand challenge in remote sensing of the hydrological cycle, but also at the catchment scale through in-situ measurement. Not being able to attain closure in our 'observations' necessarily limits faith in models. This is something that CEOP should be driving. Frontier - "Water and energy balance closure through remote and in-situ observation at regional scales" (i.e. the basin or catchment). I see it listed under "Determine the geographical and seasonal characteristics of key..." but I wonder whether it isn't a separate topic i.e. detection and attribution is separate from closure of the water cycle.

Water quality is a huge area (and problem). What can GEWEX (GREW) really offer to this field? Water quality problems are generally local in scale, not regional or global. I think this is a tangent that will naturally develop (and benefit) from improvements in water (and energy) cycle characterization – not a core GEWEX activity – nor something we should be devoting primary effort to. Not clear to me what is meant by non-physical variables?

NEXT ACTIONS

(To be taken up by the three GEWEX Panels and the SSG at the August 2010 Pan-GEWEX Science Meeting in Seattle, Washington)

Given the imperatives, how do we evolve the GEWEX Panels and their projects and working groups to ensure that these topics are addressed? We must build on what we have done, wrap up some things, and go beyond. What enabling infrastructure is necessary and how do we get it? How do we deal with the cross cutting themes?

For instance, with increased attention to seasonal to decadal prediction as an initial value problem, how do we build on new observational capabilities from space (such as SMOS) and the heritage from CEOP to develop robust (not model dependent) current descriptions of the state of the land surface (including soil moisture), its vegetation, and water levels? How is this information used to initialize models? How can WCRP contribute to building Earth System Models?

Draft Agenda for the Pan-GEWEX Meeting:

- Half day for WCRP/GEWEX presentations—focus on the future of GEWEX science and activities
- Half day for sponsor presentations—NASA, ESA, JAXA, NOAA, EUMETSAT
- One day for each panel to meet alone and discuss their future (including climate services) and discuss panel science
- One day for panel interaction science sessions (RHP science interactions)
- One day for science interactions with other WCRP programs (crosscutting issues; hot topics such as polar climate, ocean fluxes/acidification, etc.)
- Two-day meeting of the GEWEX SSG after the Pan-GEWEX Meeting.

1. It is suggested that each GEWEX Panel answer a set of strategic questions at an early stage of the Pan-GEWEX meeting, such as the following:

- What are their 3-5 priority areas (imperatives) for 2013 and beyond, within the scope of their panel.
- What can their panel contribute: a) over the next 3 years, and b) beyond 2013 to the other panels
- What would they most like to be able to obtain from a sister panel.

2. As a joint exercise, in breakout groups, each taking a different CEOP Regional Hydroclimate Project (RHP) as an exemplar, examine what could be achieved by cross-panel collaboration and integrated analysis and modeling with: a) existing data, b) an expanded monitoring program.

3. Each of the RHPs should provide a statement summarizing their key science deliverables, what they have learned about integrated monitoring that is transferable, and a list of their strategic goals and the required timescale to achieve these.

Strategically, if the above work well, it would be good to follow-up items 2 and 3 at a later date with an exemplar cross panel workshop focused on a selection of RHPs.