Update on the Integrated Global Water Cycle Observation (IGWCO) COP

Rick Lawford
GEO User Engagement Session
Beijing, China
November 2, 2010
In 2008, the IGWCO became the IGWCO Community of Practice within the GEO framework.
IGWCO COP supports three water tasks in the 2009-2011 Work Plan

*Water Cycle Target:* By 2015, produce comprehensive sets of data, and information products and services to support decision-making for efficient management of the world's water resources, based on coordinated, sustained observations of the water cycle on multiple scales.

- **Task WA-06-02** addresses the use of these data for assessments and early warning.
- **Task WA-08-01** stimulates the development of new WC products.
- **Task WA-06-07** disseminates data products and decisions support systems to the world.

Feedback arrows connect each task, illustrating the iterative nature of the process and the exchange of information and insights.
WA-08-01: Integrated Products for Water Resource Management and Research: Improvements and expansion of in-situ networks, combined with new and existing satellite missions and emerging assimilation and prediction capabilities, are opening the door to a new era in global water-cycle management.

a) Soil Moisture  
b) Runoff  
c) Groundwater  
d) Precipitation  
e) Water Cycle Data Integration  
f) Pilot Projects for Improved Water Discovery and Quality Assessments  
g) Global Water Quality Monitoring
<table>
<thead>
<tr>
<th>Variable</th>
<th>Ranking in the Cross-SBA List in US-09-01a</th>
<th>Status of Observations</th>
<th>Possible Follow-on</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precipitation</td>
<td>#1</td>
<td>In good shape in most areas</td>
<td>GPM needs support IGWCO happy to help with US-09-01a follow-on</td>
</tr>
<tr>
<td>Soil Moisture</td>
<td>#2</td>
<td>SMOS &amp; SMAP beneficial. Surface obs need help</td>
<td></td>
</tr>
<tr>
<td>Surface Humidity U. Air Humidity</td>
<td>#6 #17</td>
<td>IGWCO has looked to GEWEX to lead</td>
<td>Intercomparison of products.</td>
</tr>
<tr>
<td>Vegetation Cover (Evapo-transpiration)</td>
<td>#7</td>
<td>ET is not included as an GCOS ECV</td>
<td>ET workshop planned</td>
</tr>
<tr>
<td>River flow Observations</td>
<td>#19</td>
<td>WMO has advanced HARON proposal</td>
<td>CNES has a mission proposal under development</td>
</tr>
</tbody>
</table>
Priority Measurements: Precipitation

Microwave sensors in low orbit (best estimates) provide one snapshot over ~ 80% of the Earth every three hours.

Gauges are confined to land areas, and provide the densest coverage only at the monthly scale. Gauge data are important for anchoring the satellite estimates.

Climate observations: coarse resolution, long-term records
Instantaneous records: combine satellite and gauge data in different ways to produce high-resolution data.

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Algorithm</th>
<th>Lead Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>CMORPH</td>
<td>Morphing</td>
<td>NOAA/NWS/CPC</td>
</tr>
<tr>
<td>GSMaP</td>
<td>Morphing</td>
<td>JAXA</td>
</tr>
<tr>
<td>NRL MW/IR</td>
<td>Microwave-calibrated infrared</td>
<td>U.S. Naval Research Lab</td>
</tr>
<tr>
<td>PERSIANN</td>
<td>Neural network</td>
<td>Univ. of California at Irvine</td>
</tr>
<tr>
<td>TMPA</td>
<td>Merger, with gauge</td>
<td>NASA/GSFC</td>
</tr>
</tbody>
</table>
Soil Moisture Mapping

SMOS and SMAP are dedicated soil moisture missions.

ESA launched SMOS in 2009.

NASA fly an active / passive microwave soil moisture mission in 2012-2013.

SMAP extends soil moisture to deeper depths with improved spatial resolution

In-situ observations are needed to validate these new satellite products. Standards and coverage are major challenges.

In-situ: [http://www.ipf.tuwien.ac.at/insitu](http://www.ipf.tuwien.ac.at/insitu)
NASA's Gravity Recovery and Climate Experiment (GRACE) twin satellites (2002 – present)

GRACE is unique in its ability to sense terrestrial water stored at all levels (groundwater, soil moisture, surface water, snow and ice, and biomass)
Anthropogenic Stressors
- Low and high flow volumes (minimum flow requirements)
- Eutrophication
- Thermal Discharges
- Diffuse pollution (Urban and Rural)
- Mining discharge (Hard rock gold mining/cyanide)
- Pathogens

User Groups with Water Quality Concerns
- Municipal drinking and sanitation utilities
- Agriculture
- Recreation
- Industry
- Ecological needs biological integrity

TROPHIC STATUS IMAGES FOR WATER BODIES NEAR EAGAN, MN FROM IKONOS DATA (FROM S. GREB)
INTEGRATION IN THE IGWCO THEME

WORK IS DIRECTED AT INTEGRATED PRODUCTS FOR SPECIFIC WATER CYCLE VARIABLES INCLUDING PRECIPITATION AND SOIL MOISTURE.

(HIGH RESOLUTION PRODUCTS FROM THE PERSIANN SYSTEM)

INTEGRATION IS ALSO DIRECTED AT THE DEVELOPMENT OF SYSTEMS FOR COMBINING DIFFERENT TYPES OF DATA. TOOLS INCLUDE DATA ASSIMILATION, DATA MERGING AND GEOGRAPHICAL INFORMATION SYSTEMS.
### Assessment of the status of data integration activities

<table>
<thead>
<tr>
<th></th>
<th><strong>In-situ</strong></th>
<th><strong>Satellite</strong></th>
<th><strong>Integration</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Moisture</td>
<td>ISMWG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precipitation</td>
<td>IPWG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Runoff</td>
<td>WMO Lead</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td>GWWG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water Quality</td>
<td>WQWG</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Possible New Products**

- **Evapotranspiration**
- Water Vapour
- Skin Temperature

**Legend**

- **Success**
- **Good Progress**
- **More effort needed**
Translation of Landsat ET to MODIS ET for Local to Regional Applications (R. Allen)

One of Two NASA MODIS & Related Products in Near Real Time towards a Global ET. U Wash. Continental US 2001-2009. (to 1-km)

Right – USDA-ARS ‘Alexi-DisAlexi’ for Regional to Local ET. Applied to Nile. {30m – 25km}

Normalized Evaporative Stress Index
USDA/ARS

NASA ET Satellite Data w/ Real-Time with Local to Global &Applications
WA-06-02: Droughts, Floods and Water Resource Management
Address decision-making challenges related to the management of hydrometeorological extremes and the sustainable use of water.

a) Forecasting and Early Warning Systems for Droughts and Floods *
b) Impacts from Drought *
c) ACQWA (Assessing Climatic change and impacts on the Quantity and quality of WAter)
d) Drought Monitoring * WA-06-02: Droughts, Floods and Water Resource Management
Global Drought Monitoring: Linking Earth Observations to Societal Benefits

Is more generation capacity needed?

(Girling)

(Girling)

Is more generation capacity needed?

Surface Measurements

GRACE Satellite

Surface Storage

Surface Storage

Snelgrove

Drought

GRACE Satellite

Surface Storage

Selnogrove

Drought
Regional drought impacts and their relationship to climatological indicators

Statistically significant Drought Index correlations with wheat protein by category

(from Paul Bullock)

<table>
<thead>
<tr>
<th></th>
<th>AC Barrie</th>
<th>Superb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Supply Indices</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Water Demand Indices</td>
<td>19</td>
<td>24</td>
</tr>
<tr>
<td>Water Balance Indices</td>
<td>14</td>
<td>18</td>
</tr>
<tr>
<td>Water Use Indices</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

Evapotranspiration provides a more accurate estimate of wheat yield and quality than precipitation indicies and should be utilized for assessment of agricultural drought.
One plan for integrating regional drought monitoring products into a global drought monitor.
WA-06-07: Capacity Building for Water Resource Management

Initiate capacity building programs in support of water management, to show the value of, and develop tools for, Earth observation data.

a) Latin and Caribbean America (Communidad para la Informacion Espacial e Hidrologica en Latinoamerica y el Caribe (CIELHYC))

b) Asia (Asian Water Cycle Inititaive (AWCI))

c) Africa (Africa Water Cycle Coordination Initiative (AfWCCI))
Priority Issues (L&C Americas):
- Floods
- Adaptation to Impacts of Climate Change (Receding Tropical Glaciers)
- Droughts
- Water Quality Issues

Peru (12/09)

Priority Issues (Asia):
- Floods and Landslides
- Drought and Water Resources
- Water Pollution and ecosystem degradation
- Climate Impacts on Water

Priority Issues (Africa):
- Integrated Water Resources Management
- Adaptation to Climate Change
- Droughts
- Floods

Tunisia (01/09)

Japan (02/09)
GEOSS Asian Water Cycle Initiative (AWCI)

19 Member Countries
18 River Basins for Initial Demonstration
Some Workshop Outcomes:

1) A dynamic web site has been developed for listing of data sets & services, project summaries with interactive capabilities.

2) Launched a “Coalición para la Información Espacial e Hidrológica en Latinoamérica y el Caribe” (‘CIEHLYC’). Includes reps from Argentina, Mexico, Columbia, Haiti, Brazil, USA & Canada. Petition to GEO in the Americas to be a formal Working Group.

3) A ‘Water Cycle Federation of America’ to help integrate existing projects and develop new projects and initiatives. Issues identified including floods, droughts, glacier retreat & climate impacts.
IEEE “Water for the World” Program

- Developing country focus
- In the field within one year
  - Sustainable
  - Scalable
  - Reusable
  - Fundable

Food Security: Water and Sustainable Agriculture - India

Urban Water - Ghana
The focus is on developing a common data base across the border. Soil moisture field campaigns undertaken in 2010.
USER NEEDS SURVEY FOR WATER CYCLE DATA

- GEO (IGWCO CoP) and NASA have completed a report on the data needs of water resource managers for US-09-01a.
- This report summarizes the findings of earlier reports on a wide range of variables related to:
  1. Surface Waters, Fluxes, and Processes:
  2. Ground Water (Including Recharge/Discharge & Regolith Processes)
  3. Forcing Elements (e.g., Surface Meteorology, Surface Radiation Budgets and Clouds)
  4. Water Quality and Water Use
A recent survey of Data Centres has led to a basis for establishing data centers alliances.

First experimental alliance

- NASA/GIOVANI
- ESA/GENESI
- NSIDC/WDCG
- CAREERI/WDCGG
- MPI/WDCC
- GRDC
- UofT DIAS
- NCDC/GOSIC
November/ December 2009

GEO Water Cycle Capacity Building Workshop – Lima, Peru (draft report available in English). This workshop has launched Coalición para la Información Espacial e Hidrológica en Latinoamérica y el Caribe (CIEHLYC)

Data integration in water cycle variables, especially GEO Task WA-08-01

Asian Water Cycle Initiative Workshop in Tokyo

IEEE/IGWCO Workshop on the use of water cycle information (San Francisco) clarified links of Earth Observations to California’s water needs.
January to March 2010

IGWCO COP Planning Meeting in New York launched a list of activities to be pursued in making links with various decision making groups. This has launched efforts to promote better sharing between data systems (CEOP/DIAS/GTN-H/National systems).

Water Workshop at the Asia Pacific GEO Symposium clarified needs of many Central Asian countries for Earth Observations related to the water cycle.
April to June 2010

DRI (Drought Research Initiative) – GEO Meeting on drought in Winnipeg, Manitoba recommended greater interaction between Water Cycle and Agriculture SBA activities in the area of drought and soil moisture.

NOAA/GEO workshop in Asheville, NC to assess approaches for global drought monitoring.

GEO Work plan review and the STC review of GEO Water Tasks in Pretoria.

Presentation of CIEHLYC to the US UNESCO IHP to support greater UNESCO commitment.
July to October 2010

August: Town Hall meeting on IGWCO at the AGU Meeting of the Americas in Brazil emphasized the need for better communication between governments and universities.

September: Participation in the workshop on metrics and methodologies of estimation of extreme climate events in Paris emphasized the need for better data sets to support the analysis of extremes.

October: IPWG discussion of next steps in precipitation integration and GPM
Planned Meetings for 2011

February 2011 – African Water Cycle Coordination Initiative (Ethiopia)

March 2011 – IGWCO COP Planning Meeting

April 2011 – Workshop on Evapotranspiration (NASA/ USDA)

April 2011 – Workshop on Global Drought Monitoring (NASA)

Others:
IEEE Water Quality and Health workshop
Single variable meetings.