

## Summary of Activities Achieved under the

### MENA Water Seminar Series

## H<sub>2</sub>KN<sub>0</sub>W: Innovation in the Science, Technology and Economics of Water

### Introduction

The MENA Water Department is pleased to report that it has successfully hosted three learning events under the Seminar Series “H<sub>2</sub>KN<sub>0</sub>W: Innovation in the Science, Technology and Economics of Water”. Through this series, World Bank staff and consultants were given an opportunity to learn about innovations within the water sector worldwide and gain access to cutting edge knowledge on the most up-to-date in water management strategies. More specifically, the sessions covered: (1) potential applications of renewable energy in desalination in MENA, (2) earth observation and remote sensing applications for better water and environment management, and (3) wastewater reuse in the Arab world. A total of 50 + leading experts in academic research, the private sector and US federal government agencies were invited to share their knowledge and inform project work of World Bank staff.

### A Detailed Summary of Seminars

The title of the three sessions are as follows: (1) “Renewable Energy Desalination: An Emerging Solution to Close MENA’s Water Gap” on 26 January 2012; (2) “Using Satellites for Better Water and Environment Management” on 29 February 2012; and “Wastewater Reuse in MENA” on 2 May 2012. A summary of each session is as follows. Full seminar descriptions (with agendas) are included in Annexes 1, 2 and 3 respectively.

#### *Renewable Energy Desalination: An Emerging Solution to Close MENA’s Water Gap (26 January)*

As water scarcity in the MENA region becomes increasingly endemic, new and innovative solutions are required to ensure supply will meet growing demand. In this regard, desalination offers great promise – in addition to necessary conservation and efficiency activities. However, desalination is oftentimes more expensive and energy-intensive, while the environmental implications of the process should not be underestimated. To better understand the potential of desalination for the MENA Region, The World Bank therefore commissioned [a comprehensive study](#) to analyze the scope of desalination and the potential use of renewable energy in desalination processes.

During the event, **Bekele Debele Negewo** (Senior Water Resources Specialist, MNSWA) and **Chandrasekar Govindarajalu** (MNSRE) spoke on the background and overview of the desalination report while **Tom Pankratz** (Editor, *Desalination Report*); **Theophil Laukemann** (Projects Director, Fichtner Consulting Engineers); **Helfried Unger** (Senior Project Economist, Fichtner); **Franz Trieb** (Project Manager, German Aerospace Center); and **Jurgen Kern** (Managing Director, Kernenergien) spoke on a global perspective on desalination; the economics of renewable energy desalination; the role of concentrated solar power (CSP) in the future MENA electricity mix; and a financial and economic analysis of renewable energy applications in desalination respectively. **Jonathan Walters** (Regional Strategy and Programs Director, MNARS) served as the Panel Chair while **Julia Bucknall** (Sector

Manager, TWIWA), **Marcus Wijnen** (Senior Water Resources Specialist, TWIWA), and **Pierre Audinet** (Clean Energy Program Team Leader, ESMAP) served as Discussants.

### *Using Satellites for Better Water and Environment Management (29 February)*

As climate change increasingly affects the regularity of both quantity and quality of water resources in MENA, the value of [earth observation](#) (EO) and [remote sensing](#) (R/S) applications becomes more apparent. The ability to better measure and project rates of precipitation, evapotranspiration and aquifer recharge as well as forecast weather patterns and assess vegetative cover can result in more effective planning and management of water, agriculture, irrigation and environment systems as well as reduce risk associated with drought, flood, famine and other natural disasters. While many developed countries have long used EO and R/S tools, efforts to link this capacity to international development has slowly been emerging in recent years.<sup>1</sup>

H2Know therefore sponsored an event jointly hosted by The World Bank and US Government (USG) titled, *Satellites for Better Water and Environment Management* – as part of the [World Bank-US Government MOU on water](#). Over the course of a day-long session scheduled during the 2012 Sustainable Development Forum, Bank task team leaders and representatives from [NASA](#), [NOAA](#), [USGS](#), [USDA](#) and the [US Army Corps of Engineers](#) discussed and explored potential collaborative opportunities to utilize EO and R/S tools in Bank operations work. Eighteen World Bank and USG presenters spoke on EO and R/S applications in project operations in the morning, followed by an exhibition fair of 30 posters in the afternoon. [Mary Kicza](#) (Assistant Administrator for Satellite and Information Services of NOAA) and **Julia Bucknall** (Sector Manager, TWIWA) gave opening remarks for the event. Contributors who spoke directly on MENA-specific projects include **Ben Zaitchik** (NASA) who presented on the use of remote sensing for climate adaptation work in the Nile Basin and **Shahid Habib** (NASA) who spoke on the NASA Water Information System Platforms for MENA. For a link to all 18 presentations and 30 posters exhibited, [click here](#).



Bob Kuligowski (NOAA) and Nagaraja Rao Harshadeep (World Bank, AFTEN) speak on flash flood forecasting.



James Verdin (USGS) speaking on remote sensing applications to World Bank staff.

<sup>1</sup> In MENA, applications of EO and R/S are currently being piloted in Lebanon, Jordan, Morocco and Tunisia under the Regional Coordination for Improved Water Resources Management and Capacity Building Project ([P117170](#)).

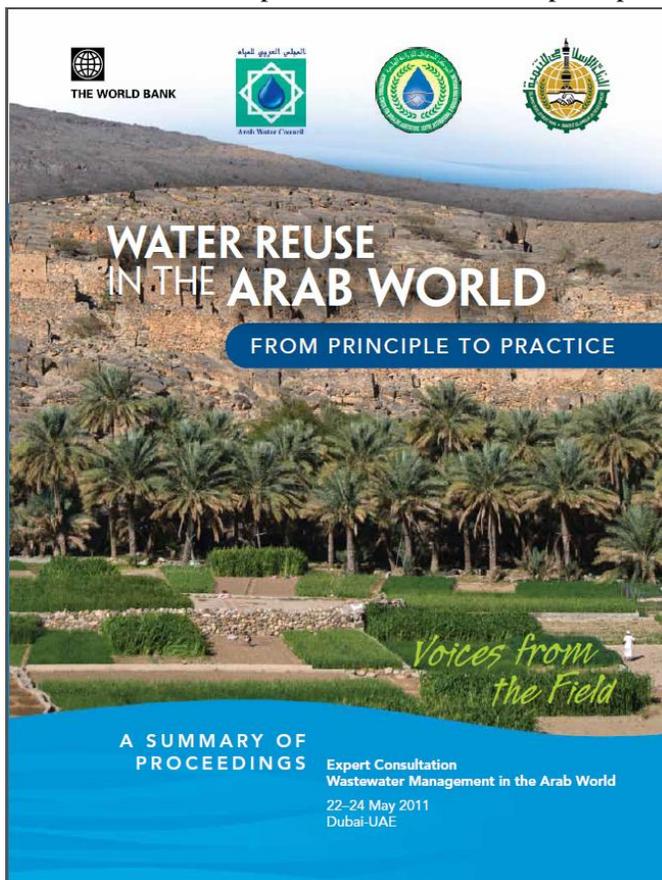
Roughly 30 activities were identified as potential collaborative opportunities during this event – as mentioned by US Secretary of State Hillary Rodham Clinton in her remarks in honor of World Water Day on March 22, 2012. For a link to the speech, [click here](#).

### ***The Promise of Water Reuse in MENA (2 May)***

Arab nations have played a lead role in the development of innovative water solutions – with noteworthy achievements in desalination, dam infrastructure and drip irrigation. Nonetheless, as Arab water supplies require further augmentation to feed growing demand and adapt to climate change, other non-conventional water production strategies are actively being pursued. Water reuse is increasingly generating traction within MENA, which until recently was largely centered around the protection of public health and the environment. Today, water reuse is regarded by most Arab nations to have great potential in significantly increasing available water resources; Arab states produce an estimated 10.8 km<sup>3</sup> / year of wastewater, of which approximately 55% and 15% are reported to be respectively treated and reused in agriculture, landscape irrigation, industrial cooling and environmental protection.

To highlight some of these successes in water reuse, The World Bank hosted a formal launch of a publication, “Water Reuse in the Arab World: From Principle to Practice” which summarizes proceedings from the “Expert Consultation Meeting on Wastewater Management in the Arab World” held in Dubai in May 2011, hosted by the Arab Water Council, International Center for Biosaline Agriculture and Islamic Development Bank. The publication (and the meeting more generally) is meant to better quantify the status and lessons learned on water reuse in the Arab world. The report further summarizes principal messages and priorities on water reuse as communicated by Arab water experts in papers and presentations prepared for the Consultation and provides an overview of the current status and future potential of water reuse across the Arab region, as described by local experts and institutions.

The book launch included a panel chaired by **Param Iyer** (Sr. Water and Sanitation Specialist, MNSWA) who provided openings and introductions. **Claire Kfour** (Sr. Water and Sanitation Specialist) provided a background on the report and highlighted key messages while **Susanne Scheierling** (Sr. Irrigation Water Economist) spoke on the economics of water reuse both in MENA and globally. **Jamie Bartram** (Director, The Water Institute) and **Joseph LoBuglio** (Research Manager, The Water Institute) spoke on the science and technology of water reuse – with special attention paid to the relevance of wastewater reuse to the region.



**Annex 1: Agenda and Full Summary of “Renewable Energy Desalination: An Emerging Solution to Close MENA’s Water Gap”**



**MENA Regional Water Outlook to 2050**

**A Flagship Report on**

**“Renewable Energy Desalination:  
An Emerging Solution To Close MENA’s Water Gap”**



**PANEL DISCUSSION**  
**26 January 2012**  
**11:30 AM – 3:00 PM**  
**MC C2-131**

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## ABSTRACT

The Middle East and North Africa (MENA) region is the world's most water scarce region. Per capita water renewable water resources have declined from over 3,000 m<sup>3</sup>/yr in 1950s to around 715 m<sup>3</sup>/yr in 2011. This figure is below the WHO's water poverty threshold of 1,000 m<sup>3</sup>/yr per capita renewable water resources. Future projections are even dimmer. The projected climate change impacts on the region's water availability are unfavorable at best, with some countries expected to experience up to 40 percent decreases in precipitation and runoff by the end of the 21st century. Ever-increasing water demand – coupled with rapid population and economic growth – will likely add to the region's water stress and pose serious challenges to the region's future development prospects.

While significant opportunities exist to promote the conservation and more efficient use of water resources, the region nevertheless requires augmentation of water supply. Desalination offers great promise for MENA in this regard, with desalinated water already comprising a significant portion of MENA countries' water supply portfolios. Yet, desalination is oftentimes more expensive and energy-intensive, while the environmental implications of the process should not be underestimated. For example, the Kingdom of Saudi Arabia currently uses approximately 1.5 million barrels per day of crude oil for desalination, and the estimate is that domestic fossil-based fuel demand is on a pace to reach over 8 million bbl/d (oil equivalent) by 2030 if current trends continued. The economic and social repercussions of such trends are clear.

The World Bank embarked on a two-year endeavor and commissioned a comprehensive study to assess water availability and demand projection as well as implications of climate change impacts on MENA's water availability up to 2050. The study also analyzed the scope of desalination and the use of renewable energy in desalination processes. Financing modalities that are both available and can be made available for desalination with renewable energy are also identified. More specifically, two major background reports (summarized in the MENA Flagship report) cover the following topics:

- i. Water availability and demand assessment, including implications of climate change impacts on both resources and demands;
- ii. Assessment of options to close MENA's water gap, including scope of regional desalination needs;
- iii. Energy needs assessment of desalination and the potential for utilizing renewable energy (primarily Concentrated Solar Power (CSP), and;
- iv. Concentrate management—Environmental implications of desalination and mitigations especially in fragile eco-systems such as the Gulf of Arabia.

Together, these reports are meant to provide MENA's decision makers with the much-needed analysis and tools to better ensure long-term water and energy securities in the region.

## AGENDA

**Purpose:** To share the findings of the two-year study “Assessing the viability of renewable energy desalination in the MENA region and associated challenges.” The workshop will bring together international experts in the field of desalination and renewable energy to debate the viability of these two technologies for MENA’s energy and water security, and hence its sustainability.

- 11:30**            **Introduction by the Chair**  
*Jonathan Walters, Director, Regional Programs and Partnerships*
- 11:35**            **Background and Overview of the Flagship Desalination Report**  
*Bekele Debele Negewo, Senior Water Resources Specialist, MNSWA*  
*Chandrasekar Govindarajalu, Senior Energy Specialist, MNSRE*
- 11:55**            **A Global Perspective on Desalination**  
*Tom Pankratz*  
*Editor, Desalination Report*
- 12:10**            **The Scope of Desalination in MENA**  
*Theophil Laukemann*  
*Fichtner Consulting Engineers Limited*
- 12:30**            **Q&A (light lunch will be provided - working lunch)**
- 12:35**            **The Economics of Renewable Energy Desalination**  
*Helfried Unger*  
*Fichtner Consulting Engineers Limited*
- 12:50**            **The Role of CSP in the Future MENA Electricity Mix**  
*Franz Trieb*  
*DLR, German Aerospace Center*
- 1:15**             **A Financial and Economic Analysis of Renewable Energy Applications in Desalination**  
*Jurgen Kern*  
*Kernenergien*
- 1:30**             **Discussants (7 minutes each)**  
*Julia Bucknall, Sector Manager, TWI*  
*Marcus Wijnen, Senior Water Resources Management Specialist, TWIWA*  
*Pierre Audinet, Clean Energy Program Team Leader, ESMAP*
- 1:50**             **Q&A**
- 2:00**             **Open Discussion (Q&A)**
- 3:00**             **Close**

## Presentation Descriptions and Bios

### Background of the Flagship Desalination Report

**Mr. Bekele Debele Negewo** will provide an overview of the *MENA Regional Desalination and Renewable Energy Nexus Study*. The study involves the 21 MENA countries and has been ongoing for the last two years in two phases.

Mr. Debele is a Senior Water Resources Specialist in the MENA Region of The World Bank. Bekele has over 15-years of experience working on subjects ranging from water resources management, water supply and sanitation, irrigation, desalination and renewable energy to climate change impacts. Bekele has published extensively in peer-reviewed journals in similar subjects.



Before joining the World Bank, Bekele had been working in academia and private sector in Ethiopia, Ireland and the US. While at the Bank, Bekele has worked on and led many technical and policy oriented studies and projects in AFR, MENA, SAR and LAC regions. Bekele is currently leading a MENA wide regional desalination and renewable energy nexus study. Bekele holds PhD in water resources engineering from Cornell University, US.

**Dr. Chandrasekar Govindarajalu** will also speak on the rationale and importance of renewable energies in the MENA region and its promise for being linked to desalination in the region. Dr. Govindarajalu is Senior Energy Specialist at the World Bank working in the MENA region. Prior to working in energy, Dr. Govindarajalu was a Senior Environmental Specialist at the World Bank. His expertise includes clean technologies, climate change mitigation, renewable energy and energy efficiency financing. He holds a PhD in Energy and Environmental Policy from the University of Delaware.



### A Global Perspective on Desalination

**Mr. Tom Pankratz** will offer a global overview of desalination by mapping technological and capacity trends across regions and over time. Special attention will be paid to technological innovations as well as changes in costs associated with desalination. Examples of 'best practice' will be offered drawing from examples within and outside the MENA region, with discussion on what exactly enabled such success (i.e. technology choices, financing, policy / regulations, etc). The presentation will close with discussion on how desalination can become a solution not only for wealthy nations but also for developing countries.



Mr. Pankratz is Editor of the *Water Desalination Report*, the most up-to-date news source for the desalination sector. Mr. Pankratz is responsible for evaluating and writing on the most innovative and cutting-edge in desalination technology. Mr. Pankratz has extensive work and speaking experience in the MENA region – particularly the Gulf – including a number of training courses on desalination with

the Middle East Desalination Research Center in Muscat and the Global Water Intelligence Center in Jeddah.

### **The Scope of Desalination in MENA**

**Mr. Theophil Laukemann** will speak on the state of desalination across MENA, while highlighting the reasons desalination is a viable solution to close the region's growing water gap. Mr. Laukemann will provide a brief background on how desalination works (especially with relation to energy demand) while noting the limitations of the process.



Mr. Laukemann is Projects Director of the Fichtner Desalination Department. Mr. Laukemann holds a degree in chemical engineering and extensive experience in desalination processes, thermodynamic processes and heat transfer. Over the last 8 years, Mr. Laukemann has worked on various desalination-energy cogeneration projects in the Middle East, Europe, Australia and Africa. He has advised a number of governments on technical matters related to the development of large-scale desalination and power plants as well as provided training on energy-efficient desalination.

### **The Economics of Renewable Energy Desalination**

**Dr. Helfried Unger** will speak on the potential of using solar energy for desalination, focusing on concentrated solar power (CSP) and other renewable energy alternatives. The costs and affordability of such projects will be discussed as well as factors which determine viability of combined renewable energy - desalination projects. Special attention will be paid to financial and economic analysis. An Algerian desalination plant powered by photovoltaic, wind and CSP energy will be highlighted.



Dr. Unger is Senior Project Economist in the Fichtner Consulting Department. Dr. Unger holds a degree in economics and has worked extensively on cash flow analysis for projects in developing countries, restructuring projects and conducting tariff studies. He has worked on projects in the Middle East, Africa, Asia, Europe and CIS countries involving (amongst many topics) electricity generation, waste management and wastewater. Dr. Unger specializes in cost and budget control and has extensive experience working with international donor agencies on tendering, bid evaluations and contract negotiations.

### **The Role of CSP in the Future MENA Electricity Mix**

**Dr. Franz Trieb** will speak on the promise of concentrating solar power (CSP) and its applications to desalination. Dr. Trieb is a research associate and Project Manager of the Department of Systems Analysis and Technology Assessment at the German Aerospace Center (DLR) where he has successfully managed over 20 major projects. He has worked in the field of renewable energies since 1983, focusing on renewable energy resource assessment and modelling, market strategies for CSP and long-term scenarios for electricity supply. He is a leading author of studies on MED-CSP, TRANS-CSP and AQUA-CSP that have led to the DESERTEC Initiative. Dr. Trieb is a mechanical engineer by training. His doctoral thesis was written on the implementation of a hydrogen storage facility for an autonomous renewable energy system. **With**



teaching experience on renewable energies in Peru, Austria, and Germany, Dr. Trieb has also published over 100 scientific articles, keynotes and presentations in international journals, books, conferences and seminars.

### **A Financial and Economic Analysis of Renewable Energy Applications in Desalination**

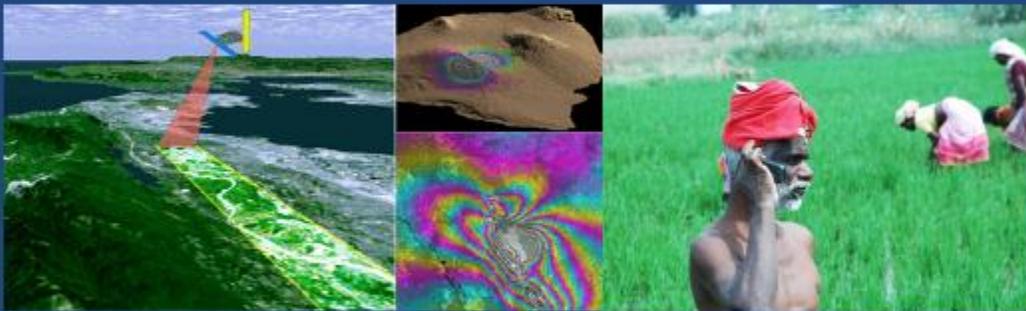
**Mr. Jurgen Kern** will speak on how renewable energy applications in desalination can be both financially and economically viable. Mr. Kern is Owner and Managing Director of Kenergien – a solar company based in Germany. He has worked extensively in MENA, with experience in assessing the technical and economic potentials of solar power for energy generation and desalination in the Mediterranean region (Italy, Morocco, Cyprus, Egypt and Palestine). He has also participated in the Aqua-CSP study, which analyses the potential of concentrating solar thermal power technology for seawater desalination in MENA. Mr. Kern's specializations include renewable energy, solar energy, concentrating solar power (CSP) and seawater desalination.



Annex 2: Agenda and List of Presenters of “Satellites for Better Water and Environment Management”

# Satellites for Better Water and Environment Management

A Training Session Jointly Hosted by  
The World Bank and US Government Agencies  
Working in Remote Sensing



With Opening Remarks by  
Ms. Mary Kicza  
Assistant Administrator of NOAA

29 February 2012  
MC C2-131

10:00 am - 12:00 pm (15 short talks - 4 minutes each!)  
12:30 pm - 4:00 pm (Exhibition Fair)



# AGENDA

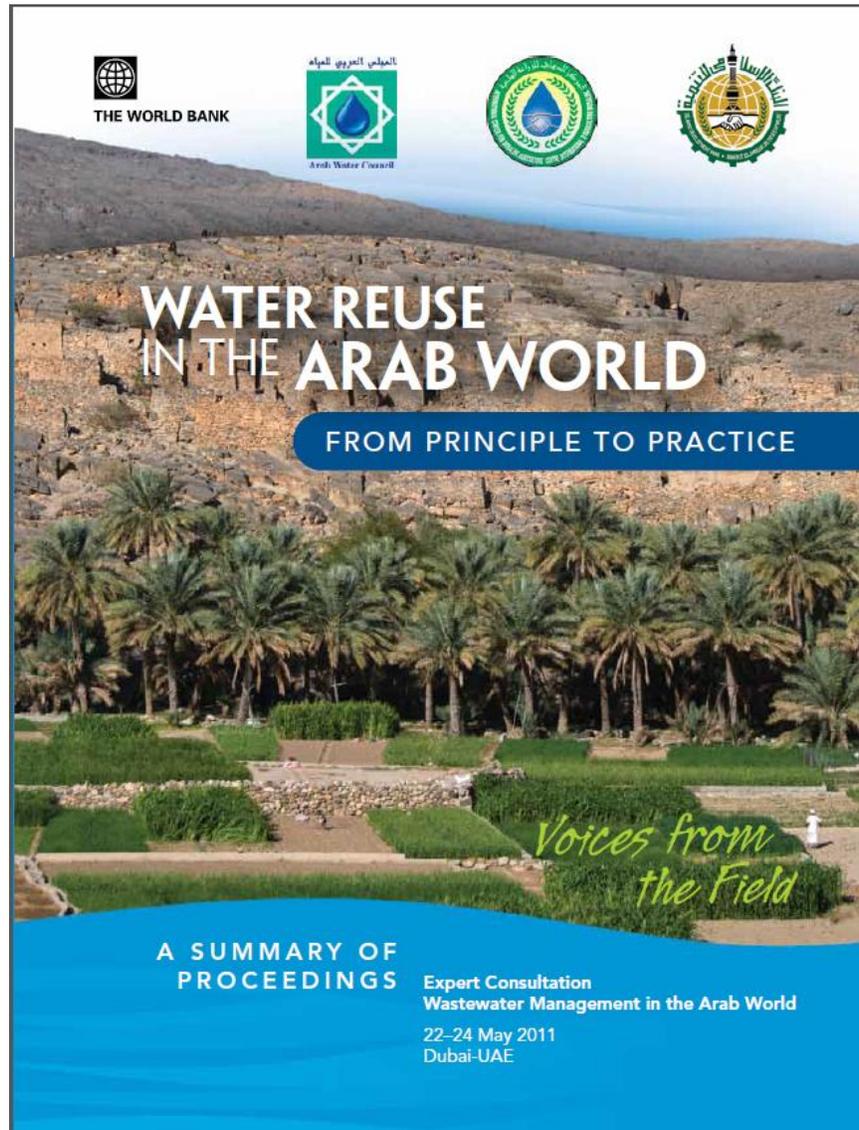
<b>10:00 - 10:15</b>			<b>Welcome</b>
Julia Bucknall	World Bank Water Anchor	Opening Remarks	
Mary Kicza	NOAA	Opening Remarks	
<b>10:15 - 10:35</b>			<b>World Bank Perspectives (5 minutes each)</b>
Claire Kfourri	World Bank MNSWA	Remote Sensing in WB MENA Projects	
Nagaraja Rao Harshadeep	World Bank AFTEN	Remote Sensing in WB Africa Projects	
Winston Yu	World Bank SASDA	Remote Sensing in WB South Asia Projects	
Erwin De Nys	World Bank LCSEN	Remote Sensing in WB LAC Projects	
<b>10:40 - 11:50</b>			<b>US Government Ignite Presentations (5 minutes each)</b>
Robert Tetrault & Otto Gonzalez	USDA/FAS	USDA Foreign Agricultural Service Capacity Building and Drought Analysis	
Martha Anderson	USDA/ARS	Monitoring Water Use and Drought at Field to Regional Scales Using Satellite Remote Sensing	
Wade Crow	USDA/ARS	Prospects for Improving Global Agricultural Drought Monitoring Using Microwave Remote Sensing	
James Verdin	USGS	Detection and Monitoring of Agricultural Drought for Famine Early Warning	
Jean Parcher & Prasad Thenabail	USGS	Remote Sensing of Global Croplands and their Water Use for Food Security in the 21st Century	
Christa Peters-Lidard	NASA/GSFC	Using the NASA Land Information System for Improved Water Management	
James Verdin	USGS	A GIS Tool for Flood Inundation Mapping	
Bob Kuligowski	NOAA	Central American Flash Flood Guidance System (CAFFG)	
Andrew Bruzewicz	US Army Corps of Engineers	A Turnkey Approach to Inundation Modeling and Mapping	
Robert Adler, F. Policelli & D. Kirschbaum	NASA and UMd	Flood and Landslide Monitoring, Prediction & Mapping	
Paul Seymour	NOAA	GeoNetCast Americas	
John Bolten	NASA	Using NASA GRACE, Satellite and Modeling for Groundwater and Water Availability	
Dan Irwin, Nancy Searby & Ashutosh Limaye	NASA/HQ & MSFC	The NASA SERVIR Program Providing Hydrologic Modeling and Remote Sensing Tools	
Ben Zaitchik & Jose Molina	NASA and Johns Hopkins	Using Remote Sensing and Modeling for Adapting to Climate Change and Improved Water Management	
<b>11:50 - 12:30</b>			<b>Q &amp; A and Discussion</b>
<b>12:30 - 1:00</b>			<b>Lunch</b>
<b>1:00 - 4:00</b>			<b>Open Reception / Network Event / Exhibition Fair</b>

#	Person	Agency	Title	Speakers / Afternoon Exhibitors	Topic	Contact
1	Robert Tetrault & Otto Gonzalez	USDA/FAS	USDA Foreign Agricultural Service Capacity Building and Drought Analysis	<ul style="list-style-type: none"> <li>Global, web-based, open access drought information updated 3 times per month—both weather and vegetation rainfall, temperature, and soil moisture (modeled) from WMO and US Air Force</li> <li>Vegetation assessment using NASA-MODIS and ESA-SPOT-Veg</li> <li>Twice daily NASA-MODIS views</li> </ul>	Agriculture & Drought	<a href="mailto:Robert.Tetrault@fas.usda.gov">Robert.Tetrault@fas.usda.gov</a>
2	Martha Anderson	USDA/ARS	Monitoring Water Use and Drought at Field to Regional Scales Using Satellite Remote Sensing	<ul style="list-style-type: none"> <li>Using remote sensing tools to estimate consumptive water loss through evapotranspiration of agriculture and non-agriculture systems.</li> <li>Approach can be run regionally and customized for local applications</li> </ul>	Agriculture & Drought	<a href="mailto:martha.anderson@ars.usda.gov">martha.anderson@ars.usda.gov</a>
3	Wade Crow	USDA/ARS	Prospects for improving global drought monitoring using microwave remote sensing	<ul style="list-style-type: none"> <li>Lack of root-zone soil water availability is the key early indicator for impending agricultural drought.</li> <li>Existing global soil moisture monitoring systems have clear shortcomings – especially in regions of the world prone to food insecurity.</li> <li>These shortcomings can be effectively mitigated using remote sensing and data assimilation approaches.</li> </ul>	Agriculture & Drought	<a href="mailto:wade.crow@ars.usda.gov">wade.crow@ars.usda.gov</a>
4	James Verdin	USGS	Detection and Monitoring of Agricultural Drought for Famine Early Warning	<ul style="list-style-type: none"> <li>USGS has supported USAID/FEWS NET with remote sensing for monitoring agricultural drought since 1988</li> <li>Vegetation indices, satellite rainfall estimates, and land surface temperatures provide the basis for a convergence of evidence</li> <li>Field scientists in Africa and Central America assist food security analysts in applying remote sensing to their assessments</li> </ul>	Agriculture & Drought	<a href="mailto:verdin@usgs.gov">verdin@usgs.gov</a>
5	Jean Parcher and Prasad Thankabail	USGS	Remote Sensing of Global Croplands and their Water use for Food Security in the Twenty-first Century	<ul style="list-style-type: none"> <li>USGS currently has a global working group on "Remote Sensing of Global Croplands and their Water use for Food Security in the Twenty-first Century"</li> <li><a href="http://powercenter.usgs.gov/current_projects.php#GlobalCroplandsAbstract">http://powercenter.usgs.gov/current_projects.php#GlobalCroplandsAbstract</a></li> <li>Thankabail, USGS, PI for first remote sensing global irrigated croplands areas</li> <li><a href="http://www.iwmgiam.org">http://www.iwmgiam.org</a></li> <li>USGS currently developing automated cropland classification (Uzbekistan)</li> </ul>	Agriculture & Irrigation	<a href="mailto:jparcher@usgs.gov">jparcher@usgs.gov</a>
6	Christa Peters-Lidard	NASA/GSFC	Using the NASA Land Information System for Improved Water Management	<ul style="list-style-type: none"> <li>Uses multi-model approach in a data integration and assimilation scheme with an emphasis on satellite data to provide water availability information</li> <li>Water information can be provided regionally to less than 1 km resolution to regional and global to less than 1 hour time steps.</li> <li>May be used for near real time, historical and future (weekly to decadal) with hourly time steps</li> </ul>	Disaster Risk Management & Water Availability	<a href="mailto:christa.d.peterslidard@nasa.gov">christa.d.peterslidard@nasa.gov</a>
7	James Verdin	USGS	A GIS Tool for Flood Inundation Mapping	<ul style="list-style-type: none"> <li>Many developing countries lack flood mapping to support mitigation and response planning</li> <li>The tool can produce an initial estimate of flood inundation hazard virtually anywhere in the world, taking advantage of publicly available digital elevation models. It is useful in settings that lack the field surveys and hydraulic modelling studies required for detailed flood hazard mapping.</li> <li>Successful training sessions have been completed in Kenya and Ethiopia</li> </ul>	Disaster Risk Management & Flooding	<a href="mailto:verdin@usgs.gov">verdin@usgs.gov</a>
8	Bob Kuligowski	NOAA	Central American Flash Flood Guidance System (CAFFG)	<ul style="list-style-type: none"> <li>Flash floods are among the most costly natural disasters worldwide.</li> <li>Satellites can be used to monitor rainfall throughout the globe in real time—a critical tool for identifying flash flood-producing heavy rainfall.</li> <li>NOAA has partnered with the Hydrologic Research Center (HRC) to provide a Flash Flood Guidance product that identifies regions of flash flood risk using satellite rainfall.</li> <li>This product is used by weather services in many countries in Central America, Africa, and Asia.</li> </ul>	Disaster Risk Management & Flooding	<a href="mailto:Bob.kuligowski@noaa.gov">Bob.kuligowski@noaa.gov</a>
9	Andrew Bruzewicz	US Army Corps Engineers	A Turnkey Approach to Inundation Modeling and Mapping	<ul style="list-style-type: none"> <li>Lidar or other elevation data</li> <li>Hydraulic and hydrologic modeling and maps using the US Army Corps of Engineers Hydrologic Engineering Center models</li> <li>Training including members of local colleges and universities and table top exercise</li> </ul>	Disaster Risk Management & Flooding	<a href="mailto:andrew.i.bruzewicz@usace.army.mil">andrew.i.bruzewicz@usace.army.mil</a>
10	Robert Adler, F. Policelli & D. Kirschbaum	NASA and UMD	Flood and Landslide Monitoring, Prediction & Mapping	<ul style="list-style-type: none"> <li>Real-time global estimation of floods and landslides through use of satellite rainfall and hydrological models and algorithms—running routinely</li> <li>Same day mapping of flooded areas through automated analysis of MODIS data</li> <li>Potential for improvement in products through improved precipitation estimation through coming GPM mission, improved models and use of additional remotely sensed data.</li> <li>Information can be used for damage/impact assessment and mitigation planning and education/training</li> </ul>	Disaster Risk Management & Flooding	<a href="mailto:radler@umd.edu">radler@umd.edu</a>
11	Paul Seymour	NOAA	GeoNetCast Americas	<ul style="list-style-type: none"> <li>GeoNetCast is a satellite dissemination system</li> <li>It features comparably inexpensive, stand-alone user receive stations not requiring an internet connection</li> <li>It is especially applicable for areas of limited internet bandwidth or those prone to disasters or internet interruptions</li> </ul>	Disaster Risk Management & Weather	<a href="mailto:paul.seymour@noaa.gov">paul.seymour@noaa.gov</a>
12	John Bolten	NASA	Using NASA Satellite and Modeling Resources for Monitoring Groundwater Availability and Variability	<ul style="list-style-type: none"> <li>Identifying areas of water stress from satellite-based groundwater storage anomalies.</li> <li>Quantifying groundwater depletion using observations from the Gravity Recovery and Climate Experiment (GRACE)</li> </ul>	Environment & Aquifers	<a href="mailto:john.bolten@nasa.gov">john.bolten@nasa.gov</a>
13	Dan Irwin, Nancy Seabry and Ashutosh Limaye	NASA/HQ & MSFC	The NASA SERVIR Program Providing Hydrologic Modeling and Remote Sensing Tools	<ul style="list-style-type: none"> <li>SERVIR is a joint NASA-USAID project, enabling countries in SERVIR regions to use NASA data for environmental decision-making. SERVIR has two active Hubs, in East Africa and in Himalaya. A hub in Mesoamerica was in operation from 2005-2011, and initiated by several partners, including the World Bank.</li> <li>SERVIR-East Africa is running a distributed hydrologic model (CREST) in near real time to compute streamflow using NASA TRMM rainfall data in close collaboration with the Kenya Meteorological Department. SERVIR-East Africa has also run the CREST model for the TRMM historical archives. SERVIR-East Africa plans to engage water resources departments in neighboring countries in a similar fashion.</li> <li>SERVIR-Himalaya ran CREST to quantify the impacts of climate change in Wangchu watershed in Bhutan, which provides water to an economically important hydroelectric power plant. The Bhutan Ministry of Water Resources provided historic rainfall and streamflow data.</li> </ul>	Environment & Climate Change	<a href="mailto:dancy.d.seabry@nasa.gov">dancy.d.seabry@nasa.gov</a>

14	Ben Zaitchik & Jose Molina	NASA and Johns Hopkins U.	Using Remote Sensing and Modeling for Adapting to Climate Change and Improved Water Management <ul style="list-style-type: none"> <li>Project Nile leverages multiple independent satellite and modeling methodologies to evaluate climate variability, water resources, and agricultural.</li> <li>In the Nile basin--and elsewhere--satellite and in situ observations can be applied to climate model evaluation and to generate high resolution climate projections with regionally-specific uncertainty estimates.</li> </ul>	Environment, Climate Change, & River Basins	<a href="mailto:zaitchik@jhu.edu">zaitchik@jhu.edu</a>
<b>Additional Afternoon Exhibitors</b>					
1	Inbal Becher Reshef and Chris Justice	USDA-FAS w/ Univ MD	Using Remote Sensing for Drought and Agriculture Assessment <ul style="list-style-type: none"> <li>Extending the Global Agriculture Monitoring (GLAM) for agriculture, drought and environmental information</li> <li>Strong emphasis on using NASA MODIS data, including in near-real time data for WB environmental applications</li> </ul>	Agriculture & Drought	<a href="mailto:Justice@hermes.eseoq.umd.edu">Justice@hermes.eseoq.umd.edu</a>
2	Megan Lang	USDA/ARS	Improving Resilience to Climate Change through the Enhanced Monitoring of Aquatic Ecosystems <ul style="list-style-type: none"> <li>Remotely sensed data including synthetic aperture radar (SAR), the Landsat time series, and various elevation datasets (e.g., LIDAR and interferometric SAR) can be used to monitor fluctuations in wetlands.</li> <li>Products include maps of wetlands and wetland hydroperiod at key time intervals, as well as maps of historic wetlands that could be prioritized for restoration.</li> </ul>	Environment & Climate Change	<a href="mailto:Megan.Lang@ARS.USDA.GOV">Megan.Lang@ARS.USDA.GOV</a>
3	Felix Kogan	NOAA/NESDIS/STAR	Space Observations for Early Detection and Analysis of Global Drought Dynamics in a Changing Climate <ul style="list-style-type: none"> <li>NOAA has developed and applied new technology for monitoring drought from space by monitoring vegetation health weekly at 4 km x 4 km resolution.</li> <li>This technology can detect drought 4-6 week earlier than surface temperature and rainfall records and can track the drought's area, intensity, duration, &amp; impacts on crops.</li> <li>These vegetation health products are available in real time via the internet for 190 countries.</li> <li>Vegetation health can also be used to analyze changes in land cover and climate.</li> </ul>	Environment, Drought, & Climate Change	<a href="mailto:felix.kogan@noaa.gov">felix.kogan@noaa.gov</a>
4	Shahid Habib	NASA/GSFC	The NASA Water Information System Platforms for the MENA <ul style="list-style-type: none"> <li>Providing remote sensing based platforms for water managers to Morocco, Tunisia, Jordan, Lebanon and Egypt.</li> <li>Developing tools for water availability, agriculture, drought, floods, ground water and climate change with an emphasis on semi-arid to arid systems that can be transported to other areas of the world</li> </ul>	Environment, Water Mgmt & Agriculture	<a href="mailto:shahid.habib@nasa.gov">shahid.habib@nasa.gov</a>
5	Brad Doorn & David Toll	NASA/HQ	The NASA Water Resources Program International Activities <ul style="list-style-type: none"> <li>Within the NASA Applied Sciences Program to accelerate the use of NASA and other Earth science products to benefit decision making.</li> <li>Program provides a range of national and international projects promoting the free and open exchange of water information over five thematic areas: 1) drought; 2) streamflow; 3) water quality; 4) consumptive water loss through evapotranspiration; and 5) climate impacts on water resources</li> </ul>	Environment, Water Mgmt, Ag & Climate	<a href="mailto:dave.toll@nasa.gov">dave.toll@nasa.gov</a>
6	Ana Prados	NASA/JIMBC	Building Capacity to Integrate NASA Earth Science into Water Resources Management Applications <ul style="list-style-type: none"> <li>The NASA Applied Remote Sensing Training program works directly with end-user agencies to develop hands-on and online workshops on access, visualization, and application of NASA remote sensing and model products, applicable to flood, drought, agriculture and climate change.</li> <li>The program develops training modules and Case Studies tailored to individual countries and environmental management priorities. All materials are publicly accessible at <a href="http://water.gsfc.nasa.gov">http://water.gsfc.nasa.gov</a></li> <li>Past and present topics: Rain and snow cover monitoring in Latin America available in English and Spanish. Also applicable to other countries. Future Topics : Evapotranspiration, vegetation, ground water.</li> </ul>	Environment, Water Mgmt & Capacity building	<a href="mailto:ana.i.prados@nasa.gov">ana.i.prados@nasa.gov</a>
7	Ted Engman	NASA/SAIC	Using Remote Sensing for Water Quality <ul style="list-style-type: none"> <li>Free data, well developed technology</li> <li>Can go back in time – look at long term changes</li> <li>Synoptic indicator – limited parameters</li> </ul>	Environment & Water Quality	<a href="mailto:jireta@mms.com">jireta@mms.com</a>
8	Molly Brown	NASA/GSFC	NASA Project Himalaya: Remote Sensing and Modeling for Snowpack & Glacier Change on Water Resources <ul style="list-style-type: none"> <li>Using NASA remote sensing and modeling for assessing snow and icepack to water resources</li> <li>Assess climate change on Himalayan snow and ice pack for long term water availability</li> </ul>	Disaster Risk, Climate Change & Water	<a href="mailto:molly.e.brown@nasa.gov">molly.e.brown@nasa.gov</a>
9	Charon Birkett	NASA & Umd	Monitoring Global Water-level Status for Flood, Drought and Water Resources Applications <ul style="list-style-type: none"> <li>Stage/Elevation information for ungauged or poorly gauged basins</li> <li>Techniques applicable to lakes, reservoirs, water holdings/tanks, wetlands, and rivers</li> <li>collaboration via grant assistance to University of Maryland for researchers and contractors.</li> </ul>	Environment, Agriculture & Drought	<a href="mailto:cbirkett@umd.edu">cbirkett@umd.edu</a>
10	Mutlu Ozdogan (POC D. Toll)	Wisconsin/NASA	Agriculture Productivity, Irrigated Mapping and LUIC <ul style="list-style-type: none"> <li>Using remote sensing and modeling for estimating agricultural productivity</li> <li>Mapping irrigated agriculture and land use land cover using remote sensing</li> <li>Assess climate impacts on water resources</li> </ul>	Environment, Water Mgmt & Agriculture	<a href="mailto:ozdogan@wisc.edu">ozdogan@wisc.edu</a>
11	Mike Hayes (POC D. Toll)	NDMRC w/NASA	International Drought Monitoring <ul style="list-style-type: none"> <li>Hybrid remote sensing tools for monitoring and predicting vegetation conditions: an integration remote sensing, climate, and environmental data</li> <li>Bridging the gap between the remote sensing and drought sciences: improving our understanding of drought through satellite observations</li> </ul>	Agriculture & Drought	<a href="mailto:mihayes@unimotes.unl.edu">mihayes@unimotes.unl.edu</a>
12	Amir Aghakouchak (POC D. Toll)	UC Irvine	G-WADI & Climate Impacts on Water Resources <ul style="list-style-type: none"> <li>Leverage World Bank Climate Change Impacts on Water and consumptive water loss (ET) for other WB regions.</li> <li>Extend satellite precipitation and other measurements for water availability and drought assessment</li> </ul>	Environment, Climate Change & Drought	<a href="mailto:amiraa@gmail.com">amiraa@gmail.com</a>
13	Eric Wood (POC D. Toll)	Princeton U. w/ NASA	African Drought Monitor <ul style="list-style-type: none"> <li>Our African drought monitor has been installed in Niamey, Niger (Feb 1 2012.) at AGRHYMET</li> <li>We plan on adding weather and seasonal hydrological forecasting over the next 6 months.)</li> <li>We plan on adding SMOS-based soil moisture through collaboration with CE3BIO and crop water requirements and actual ET over the next 6 months. We would like research support to help with these, especially implementing them in the African centers.</li> </ul>	Agriculture & Drought	<a href="mailto:ewood@princeton.edu">ewood@princeton.edu</a>
14	Molly Brown & Jared Entin	NASA	NASA's Soil Moisture Mission - 'SMAP' <ul style="list-style-type: none"> <li>Emphasis of poster is on the new NASA Soil Moisture Mission, 'SMAP'</li> <li>Looking for global early adopters and work with WB staff to validate SMAP data with collaborations with NASA scientists</li> </ul>	Environment, Disaster Risk, NASA Water Missions	<a href="mailto:molly.e.brown@nasa.gov">molly.e.brown@nasa.gov</a>

Annex 3: Agenda and Full Summary of “Water Reuse in the Arab World: From Principle to Practice”

# Water Reuse in the Arab World: From Principle to Practice



## PANEL DISCUSSION

2 May 2012

10:00 AM – 12:00 PM

J10 – 160

## ABSTRACT

Arab nations have historically played a lead role in the development of innovative water solutions with noteworthy achievements including global leadership in desalination, dam infrastructure and drip irrigation. Nonetheless, the challenge of optimizing water management remains an important priority across the Arab world. Until recently, planned wastewater management in the Arab region focused on the conventional objectives of protecting public health and the environment. Pervasive water scarcity, urbanization and the increasingly obvious impacts of climate change however led to a shift in local perceptions of the importance of properly capturing and using reclaimed water.

Today, water reuse is regarded by most Arab nations to have great potential in significantly increasing available water resources. Arab states currently produce an estimated 10.8 km<sup>3</sup>/year of wastewater, of which approximately 55% and 15% are reported to be respectively treated and reused in agriculture, landscape irrigation, industrial cooling and environmental protection. In some countries, water reuse in groundwater recharge is further used to protect freshwater.

In May 2011, the Arab Water Council, International Center for Biosaline Agriculture and Islamic Development Bank convened the “Expert Consultation Meeting on Wastewater Management in the Arab World”. The objective of the meeting was to better quantify the status and lessons learned on water reuse in the Arab world. Guided by the mission to maximize the economic, social and environmental benefits from water reuse in Arab countries, the Consultation provided a platform for dialogue among Arab water experts on priorities and synergies for advancing water reuse management in the Arab region.

This report thus: (i) summarizes principal messages and priorities on water reuse as communicated by Arab water experts in papers and presentations prepared for the Consultation and (ii) provides an overview of the current status and future potential of water reuse across the Arab region, as described by local experts and institutions.

Far from being an exhaustive treaty of the complex subject of water reuse, this short report was compiled—in partnership with the World Bank—in an effort to distill, summarize and convey the Arab experience with water reuse to date, as described by local practitioners. The report is thus structured around the following six common topics and will guide the panel discussion on moving from principle to practice in water reuse:

- Current status of water in the Arab world;
- Basic economic considerations of water reuse;
- Infrastructure investments to enable sustainable reuse;
- Benefits of reuse in agriculture;
- Sustainable cost recovery models and
- Elements of a successful national water reuse strategy.

## AGENDA

**Purpose:** To share key themes expressed by Arab experts on the successes and challenges of wastewater reuse in the MENA region. The workshop will bring together international experts in the field of water reuse and public health to discuss the promise of water reuse for MENA's water security.

- 10:00**            **Introduction by the Chair**  
*Param Iyer, Senior Water and Sanitation Specialist, MNSWA*
- 10:10**            **Background and Overview of the Water Reuse Report**  
*Claire Kfouri, Senior Water and Sanitation Specialist, MNSWA*
- 10:20**            **Toward Improved Water Reuse in MENA Countries**  
*Susanne Scheierling, Senior Irrigation Water Economist, TWIWA*
- 10:40**            **Water Reuse across the Globe: Lessons Learned for the MENA Region**  
*Jamie Bartram, Director of The Water Institute @ UNC*  
*Joseph LoBuglio, Associate Director for Research of The Water Institute @ UNC*
- 11:10**            **Q & A and Discussion**
- 12:00**            **Close**

## Bios

### Introductions on the State of Water Reuse in the Arab Region

**Param Iyer** is a Senior Water and Sanitation Specialist in the MENA Water Department and holds World Bank project experience in Afghanistan, China, Egypt, India, Lebanon, Morocco, and Sri Lanka, amongst other countries. Prior to joining The World Bank, Mr. Iyer served as Director of the Swajal Project, a state-wide, demand-driven rural water supply and sanitation scheme in Uttar Pradesh; Special Secretary of the Department of Rural Development of Uttar Pradesh; and General Manager of the Uttar Pradesh Road Corporation. Mr. Iyer holds an MBA from the National Management Program of India and an MA in Public Administration from the University of Madras.



### Background and Overview of the Water Reuse Report

**Claire Kfouri** is a Senior Water and Sanitation Specialist in the MENA Water Department. Prior to joining The World Bank, Ms. Kfouri was a Senior Process Engineer for Black and Veatch, Ltd and a Water Resources Engineer for the Massachusetts Water Resources Authority. Ms. Kfouri holds an M.Eng in Environmental Engineering and Water Quality from the Massachusetts Institute of Technology.



### Toward Improved Water Reuse in MENA Countries

**Susanne Scheierling** is Senior Irrigation Water Economist in the Water Anchor. Her work focuses on the economic aspects of agricultural water management. Before joining the Water Anchor in 2007, she worked for the Asian Development Bank, Colorado State University, the International Water Management Institute, the International Institute for Applied Systems Analysis, and the German Technical Cooperation. Ms. Scheierling holds a Ph.D. in agricultural and resource economics from Colorado State University.



#### **Water Reuse across the Globe: Lessons Learned for the MENA Region**

Having worked in over 50 countries globally, **Jamie Bartram**'s professional experiences include serving as Chair of UN-Water as well as Coordinator of Assessing and Managing Environmental Risks to Health, Coordinator of Water Sanitation and Health and Regional Advisor on Water and Wastes at the World Health Organization (WHO). Currently, Dr. Bartram is Professor of Environmental Sciences and Engineering and Director of The Water Institute at the University of North Carolina – Chapel Hill.



**Joseph LoBuglio** is Associate Director for Research at the Water Institute at UNC and has over ten years experience in environmental management, water supply planning, drinking water quality as well as uncertainty analysis and modeling. Professional experiences include leading the drinking water analysis for the National Strategy for Environmental Health (United Arab Emirates) and helping develop processes for obtaining, managing, and reporting on river and marine water quality data associated with the Boston Harbor Cleanup Project.

