



Water Resources Programme

# Groundwater & Climate in Africa

*an international conference*

Kampala, Uganda  
24 to 28 June 2008

conference programme - final



Federal Institute for Geosciences and Natural Resources



Department for International Development



# CONFERENCE RATIONALE

Current monitoring and assessments of the impacts of climate variability and change on water resources commonly exclude groundwater. This omission is of particular concern in Africa where current usage and future adaptations in response to climate change and rapid population growth, place considerable reliance upon groundwater to meet domestic, agricultural, and industrial water demands. The *Groundwater & Climate in Africa* conference brings together water and climate scientists from research/academic institutions, government departments, and private sector as well as policy makers and representatives from international agencies, donors and consortia in order to share knowledge and expertise, and thereby improve current understanding of the impact of climate and development on groundwater resources in Africa.

# CONFERENCE STRUCTURE

The conference begins with a plenary sessions of opening addresses and keynote presentations that sets the agenda and structure of the conference. Subsequent oral and poster presentations will occur in sessions that contribute to each of the conference's 6 scientific themes. In each session, considerable time is dedicated to open discussion of the technical and policy-related issues that arise from oral and poster presentations. Session chairs and rapporteurs will include experts in both technical and policy issues to distil minuted discussions. To aid in this process, each presenter will be asked to submit, where possible, two key policy and scientific recommendations emanating from their presentation. A synthesis of the technical and policy-related issues raised in each session will be presented on the final day of the conference in advance of two plenary roundtable discussions during which key technical and policy-related recommendations will be debated and adopted. To facilitate this process, roundtable discussions will feature panels of senior water and climate scientists, policy makers, parliamentarians and other stakeholders. Technical recommendations will be published in the conference proceedings, forwarded to key scientific programmes (*e.g.* IPCC AR5, GEWEX, GWSP, GRAPHIC) and distributed widely via popular press (*e.g.* World of Science, EOS) and conference webpage ([www.gwclim.org](http://www.gwclim.org)). Recommendations that assist the formulation of national and international policies related to groundwater and climate will be distributed for consideration by national governments via AMCOW (African Ministerial Committee on Water), regional bodies (*e.g.* SADC, ECOWAS) and international fora (*e.g.* AU Summit 2008, 5<sup>th</sup> WWF in Istanbul 2009, Copenhagen 2009). Finally, the conference will feature three side events that include: (i) building networks of groundwater and climate scientists in Africa, (ii) an invitation for African experts to join a global network of scientists in the UNESCO GRAPHIC Programme, and (iii) a workshop on groundwater monitoring and data management.

The conference will end with a field trip to Jinja, the source of the River Nile, which will include tours of HEP facilities and monitoring stations assessing interactions between groundwater and surface water.

### Groundwater & Climate in Africa Conference - Programme Summary

|               |                                    | Day 1   | Day 2   | Day 3   | Day 4  |  |                        |  |
|---------------|------------------------------------|---|---|---|--|--|------------------------|--|
|               | Monday                             | Tuesday   | Wednesday   | Thursday  | Friday   | Sat.   | Sun.                   |  |
|               | 23 Jun                             | 24 Jun  | 25 Jun  | 26 Jun  | 27 Jun   | 28 Jun   | 29 Jun                 |  |
| 08:00 - 09:00 | arrival of delegates, registration | registration  |   |   |  | field trip to Jinja: 'Source of the Nile', Nalubaale & Bugajali Dams | departure of delegates |  |
| 09:00 - 10:10 |                                    | opening ceremony (Victoria Hall)  | parallel sessions 1 and 2 (con't)   | parallel sessions 3 and 4 (con't)   | parallel sessions 5 and 6 (con't)  |  |                        |  |
| 10:30 - 11:00 |                                    | coffee/tea break  |   |   |  |  |                        |  |
| 11:00 - 13:00 |                                    | opening plenary session (Victoria Hall)   | parallel sessions 1 and 2:<br><i>open discussion of technical and policy-related issues</i>   | parallel sessions 3 and 4:<br><i>open discussion of technical and policy-related issues</i>   | parallel sessions 5 and 6:<br><i>open discussion of technical and policy-related issues</i>                      |  |                        |  |
| 13:00 - 14:00 |                                    | lunch break   |   |   |  |  |                        |  |
| 14:00 - 15:00 |                                    | plenary keynote lectures (Victoria Hall) sessions 1 & 2   | Plenary keynote lectures (Albert Hall) sessions 3 & 4   | plenary keynote lectures (Albert Hall) sessions 5 & 6   | plenary round-table discussions (Albert Hall) <i>technical issues</i>  |  |                        |  |
| 15:00 - 15:30 |                                    | coffee/tea break  |   |   |  |  |                        |  |
| 15:30 - 17:30 |                                    | parallel sessions   | parallel sessions   | parallel sessions   | parallel sessions  |  |                        |  |
|               |                                    | <p><b>session 1 – Victoria Hall:</b><br/>Impact of climate variability and change on groundwater-based livelihoods</p> <p><b>session 2 – Meera Hall:</b><br/>Impact of climate variability and change on groundwater and groundwater-fed ecosystems</p> | <p><b>session 3 – Albert Hall</b><br/>Monitoring and modelling groundwater use and replenishment</p> <p><b>session 4 – Meera Hall</b><br/>Estimation of groundwater resources and demand under a changing climate</p> | <p><b>session 5 – Albert Hall</b><br/><i>Groundwater management in sub-Saharan Africa under climate variability</i></p> <p><b>session 6 – Meera Hall</b><br/><i>Groundwater management in arid and semi-arid Africa</i></p> | <p>coffee/tea Break</p> <p><b>plenary round-table discussions (Albert Hall) <i>policy-related issues</i></b></p> |  |                        |  |
| 18:00 - 19:30 |                                    | special event: <i>Networking African groundwater &amp; climate scientists</i>   | special event: <i>UNESCO GRAPHIC – call for African experts</i>   | special event: <i>Groundwater monitoring &amp; data management workshop</i>   | closing ceremony (Albert Hall) 17:30 – 18:30   |  |                        |  |
| from 19:30    | ice breaker                        | opening reception<br>host: Minister of Water & Environment (Uganda)   |   |   | closing gala dinner from 19:00   |  |                        |  |

**Monday 23 June 2008**

14:00 – 20:00 conference registration – Sapphire Hall  
 From 19:30 **Ice breaker – hosted by Conference Secretariat**

**Tuesday 24 June 2008 Day 1**

08:00 – 09:00 Registration – Sapphire Hall

**OPENING CEREMONY (Victoria Hall)**  
*chair: Permanent Secretary, Ministry of Water & Environment (Uganda)*

09:00 – 09:10 Welcome remarks by the **Permanent Secretary, Ministry of Water & Environment** (Uganda)  
 09:10 – 09:20 Introductory remarks by the **Conference Chairs**  
 09:20 – 09:30 Address by the **Minister of Water & Environment** (Uganda)  
 09:30 – 09:40 Address by the **President, African Ministerial Committee on Water** (AMCOW)  
 09:40 – 09:50 Address by the **Danish Ambassador to Uganda**  
 09:50 – 10:00 Address by the **UNESCO Nairobi Director**  
 10:00 – 10:30 Opening address by the **President of Uganda**

10:30 – 10:50 *Coffee/Tea Break – common area (outside halls)*

**OPENING PLENARY SESSION (Victoria Hall)**  
*chair: Joseph Massaquoi (UNESCO, Kenya)*

|               | <i>Speaker</i>            | <i>Organisation/Institution</i>                                | <i>Title of presentation</i>   |
|---------------|---------------------------|--|--|
| 10:50 – 11:20 | <b>Zbyszek Kundzewicz</b> | Polish Academy of Sciences, Poland                             | <i>Will groundwater ease the freshwater stress under climate change?</i>   |
| 11:20 – 11:50 | <b>Laban Ogallo</b>       | IGAD Climate Prediction and Applications Centre, Kenya         | <i>Climate variability and change in Africa and potential impacts on terrestrial water resources</i>                                       |
| 11:50 – 12:10 | <b>Jacob Burke</b>        | Food and Agricultural Organisation (FAO) of the United Nations | <i>Agricultural demand for groundwater services in times of change; prospects for patterns and styles of groundwater use across Africa</i> |

|               |                          |   |   |
|---------------|--------------------------|---|---|
| 12:10 – 12:30 | <b>Makoto Taniguichi</b> | Research Institute for Humanity and Nature, Japan | <i>GRAPHIC: Groundwater resources assessment under the pressures of humanity and climate change</i> |
| 12:30 – 13:00 | <b>AGWC Secretariat</b>  | UNEP/UNESCO/UWC                                   | <i>The AMCOW African Groundwater Commission (AGWC): roadmap &amp; way forward</i>                   |

13:00 – 14:00 *Lunch Break*

**PLENARY KEYNOTE LECTURES – SESSIONS 1 & 2 (Albert Hall)**

*chair: Willi Struckmeier (BGR, Germany)*

|               |  |                              |   |
|---------------|--|------------------------------|---|
| 14:00 – 14:30 | <b>Keynote Session 1:<br/>Richard Carter</b> | Cranfield University, UK     | <i>Climate change, population trends and groundwater in Africa</i>                        |
| 14:30 – 15:00 | <b>Keynote Session 2:<br/>Daniel Olago</b>   | University of Nairobi, Kenya | <i>Holocene palaeohydrology, groundwater and climate change in the Central Kenya Rift</i> |

15:00 – 15:30 *Coffee/Tea Break – common area (outside halls)*

**SESSION 1 (Victoria Hall): *Impact of climate variability and change on groundwater-based livelihoods***

*chair: Richard Carter (Cranfield University, UK)  
rapporteur: Albert Rugumayo (Makerere University, Uganda)*

**SESSION 2 (Meera Hall): *Impact of climate variability and change on groundwater and groundwater-fed ecosystems***

*chair: Daniel Olago (University of Nairobi, Kenya)  
rapporteur: Philip Gwage (Meteorology Department, Uganda)*

|               |  |   |
|---------------|--|---|
| 15:30 – 15:50 | <i>Socially acceptable distributions of water in rural areas under conditions of climate variability for poverty alleviation: a case for Zambia</i><br><b>Daniel Nkhuwa</b> (University of Zambia, Zambia) | <i>Oases in the apocalypse: the critical role of aquifer dependent ecosystems in mitigating climate change impacts in Southern Africa</i><br><b>Christine Colvin</b> (CSIR, South Africa)                       |
| 15:50 – 16:10 | <i>What effect will climate change have on rural water supplies in Africa?</i><br><b>Alan MacDonald</b> (BGS, UK), R.C. Calow, D.M.J. Macdonald, B. Dochartaigh, W.G. Darling                              | <i>National strategy for adaptation to climate change impacts on water resources in Uganda: status and way forward</i><br><b>Florence Adongo</b> (DWRM, Uganda) and P.M. Gwage (Meteorology Department, Uganda) |
| 16:10 – 16:30 | <i>Climatic implications of groundwater recharge and discharge in parts of the escarpment areas of southern Nigeria</i><br><b>Elisabeth Okoro</b> (Nnamdi Azikiwe University, Nigeria) and B.C.E. Egboka   | <i>Preliminary assessment of the effects of climate change on groundwater resources in Cameroon</i><br><b>T.M. Itie</b> (University of Buea, Cameroon) and V.E. Manga   |

|               |  |  |
|---------------|--|--|
| 16:30 – 16:50 | <i>Groundwater resources mapping in Uganda: experiences and challenges</i><br><b>Caroline Nakalyango</b> (DWRM, Uganda) and C. Tindimugaya   | <i>Climate change, freshwater resources and access to safe water - the global response under the UNFCC</i><br>P.M. Gwage and <b>David Kabasa</b> (Makerere University, Uganda)   |
| 16:50 – 17:10 | <i>Recent improvements of the geological and hydrogeological conceptual model for hard rock aquifers: application to their survey, management, modelling and protection</i><br>P. Lachassagne, Ahmed Sh., <b>Benôit Dewandel</b> (BRGM, France), N. Courtois, J.C. Maréchal, J. Perrin and R. Wyns   | <i>Assessing the impacts of climate change and variability on water resources in Uganda: developing an integrated approach at the sub-regional scale</i><br><b>Charles Basalirwa</b> (Makerere University, Uganda), G. Sabiiti, R. Taylor, A.W. Majugu, C. Tindimugaya |
| 17:10 – 18:00 | Open Discussion of Technical & Policy Issues   | Open Discussion of Technical & Policy Issues   |
| 18:00 – 19:30 | <b>Special event: Networking of African Groundwater and Climate Scientists</b><br><i>discussants: Segun Adelana, Alan MacDonald (IAH), Emmanuel Naah, Yongxin Xu, Tamiru Alemayehu (AMCOW Groundwater Commission)</i><br>This informal session aims to improve networking and communication among African groundwater scientists and managers, and involves the <b>International Association of Hydrogeologists' (IAH) Burdon Network</b> and newly established <b>AMCOW African Groundwater Commission (AGWC)</b> . |  |

|            |   |
|------------|---|
| From 19:30 | <b>Welcome Reception</b><br><i>Host: Hon. Maria Mutagamba, Minister of Water &amp; Environment (Uganda)</i> |
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| <b>Wednesday 25 June 2008</b> | <b>Day 2</b> |
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| <b>SESSION 1 (Albert Hall): Impact of climate variability and change on groundwater-based livelihoods</b><br><i>chair: Patrick Kahangire (African Development Bank)</i><br><i>rapporteur: John Chilton (IAH)</i>   | <b>SESSION 2 (Meera Hall): Impact of climate variability and change on groundwater and groundwater-fed ecosystems</b><br><i>chair: Laban Ogallo (IGAD, Kenya)</i><br><i>rapporteur: Patrick M'mayi (UNEP-DEWA)</i>   |
| 09:00 – 09:20 <i>Land-use impacts on gravity-fed community water supplies in southwestern Uganda</i><br><b>Robert Mutiibwa</b> (FELS Consultants, Uganda)  | <i>The relationships between groundwater and surface water in the upper Niger and Volta basins of West Africa</i><br><b>Gil Mahé</b> (UMR Hydrosociences, France)  |
| 09:20 – 09:40 <i>A survey of the quality of groundwater drawn from boreholes in the Ashanti Region of Ghana</i><br><b>Marian Nkansah</b> (KNUST, Ghana) and J.H. Ephraim   | <i>Preliminary results from recent monitoring of groundwater / surface-water interactions in the Victoria Nile basin of Uganda</i><br><b>Michael Owor</b> (Makerere University, Uganda), R. Taylor, J. Thompson, C. Mukwaya, C. Tindimugaya                  |
| 09:40 – 10:00 <i>Increased risk of diarrhoeal diseases from climate change: evidence from communities supplied by groundwater in Uganda</i><br><b>Richard Taylor</b> (UCL, UK), M. Miret-Gaspa, J. Tumwine, L. Mileham, R. Flynn, G. Howard, R. Kulabako | <i>Groundwater-surface water interaction as a component of the ecohydrology of arid regions</i><br><b>Mohammed Messouli</b> (Sémalia Faculty of Sciences, Morocco), G. Messana, M. Yacoubi-Khebiza, A. El Alami El Filali, A. Ait Boughrou and M. Boulanouar |

10:00 – 10:20 *Spatial and temporal groundwater quality monitoring in rural Benin, West Africa: an example of collaboration with local populations*  
**Stephen Silliman** (University of Notre Dame, USA), P. Crane, M. Boukari, F. Azonsi

*Impact of simulated extreme hydroclimatic conditions on groundwater resources*  
**Richard Anyah** (Rutgers University, USA), G. Miguez-Macho, Y. Fan and A. Robock

10:20 – 10:45

poster sessions – common area (outside halls)

**POSTER SESSION 1: *Impact of climate variability and change on groundwater-based livelihoods***

*Reliability of interview data for monitoring and mapping groundwater*  
**Dale Lightfoot** (Oklahoma State University, USA) N. Mavlyanov, D. Begimkulov and J. Comer

*The challenge of climate variability and change to the sustainability of shallow groundwater supplies: a case study from Kabubbu Village, Uganda*  
**Ronald Musiige** (DWRM, Uganda)

*The overburden aquifer and its potential contribution to reaching MDG targets of safe water coverage in northern Uganda*  
C. Mulder and **Ron Sloots** (WE Consult, Uganda)

*Enhancing private sector participation in rural water supply*  
P. Baur, M. Woodhouse and **Richard Boak** (Water Management Consultants, UK)

*The influence of hydrochemistry on the distribution of pathogenic strains of Escherichia coli in urban groundwater of Yaounde*  
**Mireille Ebiane Nougang** (University of Yaoundé, Cameroon), M. Nola, T. Njine, S. Hubert Z. Togouet, M. Djaouda and M. Djah

*Correlations between hydrochemistry and faecal bacteria counts in urban groundwater underlying Ago-Iwoye, southwestern Nigeria*  
**Olusola Fasunwon** (Olabisi Onabanjo University, Nigeria), J. Olowofela, O. Akinyemi and O. Akintokun

**POSTER SESSION 2: *Impact of climate variability and change on groundwater and groundwater-fed ecosystems***

*Variations in the intensity of the monsoon-like flow from the tropical Atlantic and summer rainfall over equatorial and tropical southern Africa*  
**Nicholas Vigaud** (UCT, South Africa), Y. Richard, M. Rouault, N. Fauchereau

*Simulation of Ethiopian Kiremt (summer) rainfall using NCEP Coupled Forecast System*  
**Girmaw Bogale** (National Meteorological Agency, Ethiopia) and W. Thiaw

*Climate change impacts on groundwater recharge in Draa watershed, Morocco*  
**Mohammed Messouli** (Sémmlalia Faculty of Sciences, Morocco), M. Yacoubi-Khebiza, A. El Alami El Filali, L. Bouarab, B. Ghallabi, S. Rochdane, A. Ben Salem and F. E. Hammadi

*Isotopic study and relationship between surface water and groundwater in the Souss-Massa basin of southwestern Morocco*  
**Lhoussaine Bouchaou** (Ibn Zohr University, Morocco), T. Tagma, Y. Hsissou, M. Ikenne, S. Boutaleb, L. Bouragba and J. Mudry

*Isotope techniques for the assessment of interactions between surface water, groundwater and wetlands in Uganda*  
**Christine Mukwaya** (DWRM, Uganda) and C. Tindimugaya

*Detection of inhomogeneities in the national climate dataset (1902-2003) of Uganda*  
**Lubega Fortunata** (Meteorology Department, Uganda)

10:45 – 11:15 *Coffee/Tea Break - extension of poster sessions*

|               |  |  |
|---------------|--|--|
| 11:15 – 11:45 | Session 1 Open Discussion of Technical Issues<br><i>chair: <b>Abou Amani</b> (UNESCO)</i>  | Session 2 Open Discussion of Technical Issues<br><i>chair: <b>Charles Basalirwa</b> (Makerere University, Uganda)</i>                        |
| 11:45 – 12:30 | Session 1 Open Discussion of Policy Issues<br><i>chair: <b>Patrick Kahangire</b> (African Development Bank)</i>  | Session 2 Open Discussion of Policy Issues<br><i>chair: <b>Patrick M'mayi</b> (UNEP-DEWA)</i>  |
| 12:30 – 13:00 | Session 1 Summary of Technical and Policy Issues<br><i>rapporteurs: <b>Abou Amani</b> (UNESCO) &amp; <b>Patrick Kahangire</b> (African Development Bank)</i> | Session 2 Summary of Technical and Policy Issues<br><i>rapporteurs: <b>Laban Ogallo</b> (IGAD, Kenya) &amp; <b>Patrick M'mayi</b> (UNEP)</i> |

13:00 – 14:00 *Lunch Break*

**PLENARY KEYNOTE LECTURES - SESSIONS 3 & 4 (Albert Hall)**

*chair: Professor Stephen Foster, IAH President*

|               |  |                                   |   |
|---------------|--|-----------------------------------|---|
| 14:00 – 14:30 | <b>Keynote Session 3:</b><br><b>Ken Howard</b> and A. Griffith | University of Toronto (Canada)    | <i>Using transient models to confront the impacts of climate change on groundwater reserves in sub-Saharan Africa</i> |
| 14:30 – 15:00 | <b>Keynote Session 4:</b><br><b>Petra Döll</b> and K. Berkhoff | University of Frankfurt (Germany) | <i>Diffuse groundwater recharge and groundwater withdrawals in Africa as estimated by global-scale water models</i>   |

15:00 – 15:30 *Coffee/Tea Break – common area (outside halls)*

**SESSION 3 (Albert Hall): Monitoring and modelling groundwater use and replenishment**

*chair: Ken Howard (University of Toronto, Canada)  
rapporteur: Emmanuel Naah (UNESCO)*

**SESSION 4 (Meera Hall): Estimation of groundwater resources and demand under a changing climate**

*chair: Petra Döll (University of Frankfurt, Germany)  
rapporteur: Nebert Wobusobozi (DWRM, Uganda)*

|               |   |  |
|---------------|---|--|
| 15:30 – 15:50 | <i>Monitoring and modelling groundwater use in sub-Saharan Africa: issues and challenges</i><br><b>Segun Adelana</b> (University of Ilorin, Nigeria)                                      | <i>The impact of climate change on groundwater recharge: a case study from the Ethiopian Rift</i><br><b>Tamiru Alemayehu</b> (Wits University, South Africa)   |
| 15:50 – 16:10 | <i>The impact of climate change on groundwater recharge and runoff in a humid, equatorial catchment of Uganda</i><br><b>Lucinda Mileham</b> (UCL, UK), R. Taylor, M. Todd, C. Tindimugaya | <i>Impacts of climate variability and change on groundwater in the humid tropics: a case study from the Ivory Coast</i><br><b>B.T.A. Goula</b> (University of Abobo-Adjame, Ivory Coast), F.W. Kouassi, V. Fadika, K. E. Koff, B. Gnamien, K. Koffi, K. Bamory, D. Inza, I. Savane |

|               |  |  |
|---------------|--|--|
| 16:10 – 16:30 | <i>Estimating the effect of climate change on the hydrology of River Ssezibwa catchment, Uganda</i><br><b>Philip Nyenje</b> (Katholieke Universiteit Leuven, Belgium) and O. Batelaan  | <i>Global analogues of climate change effects on agriculture and groundwater between hydrologically similar regions of the world</i><br><b>Timothy Green</b> (USDA-ARS, USA), B. Bates, S. Charles and E. Fathelrahman |
| 16:30 – 16:50 | <i>Application of a semi-distributed SWAT model to an Upper Nile catchment: implications for groundwater resources</i><br><b>Max Kigobe</b> (Makerere University, Uganda)  | <i>Modelling the freshwater availability in Africa with special attention to the current and future groundwater recharge</i><br><b>Jürgen Schuol</b> (EAWAG, Switzerland), K. Abbaspour and H. Yang                    |
| 16:50 – 17:30 | Session 3 Open Discussion of Technical & Policy Issues   | Session 4 Open Discussion of Technical & Policy Issues   |
| 18:00 – 19:30 | <b>Special event: UNESCO GRAPHIC (Groundwater Assessment under the Pressures of Humanity and Climate Change) Programme – call for African experts</b><br><i>discussants: Makoto Taniguchi (UNESCO GRAPHIC), Richard Taylor (UCL, UK), Tim Green (USDA, USA), Kevin Hiscock (UEA, UK)</i><br><i>moderators: Alice Aureli, Holger Treidel (UNESCO-IHP)</i><br>This evening meeting will feature a brief overview of the UNESCO's GRAPHIC programme and an open invitation to African water scientists and managers to engage in this global initiative assessing the impacts of development and climate change on groundwater. |  |

**Thursday 26 June 2008**

**Day 3**

|   |   |  |   |
|---|---|--|---|
| <b>SESSION 3 (Albert Hall): Monitoring and modelling groundwater use and replenishment</b><br><i>chair: Yongxin Xu (UWC, South Africa)</i><br><i>rapporteur: Cheikh Bécaye Gaye (University of Cheikh Anta Diop, Senegal)</i> |   | <b>SESSION 4 (Meera Hall): Estimation of groundwater resources and demand under a changing climate</b><br><i>chair: Engineer Mugisha Shillingi (DWRM, Uganda)</i><br><i>rapporteur: Daniel Nkhuwa (University of Zambia, Zambia)</i> |   |
| 09:00 – 09:20   | <i>Groundwater recharge and flow in a small mountain catchment in northern Ethiopia</i><br><b>Kristine Walraevens</b> (Ghent University, Belgium), I. Vandecasteele, K. Martens, J. Nyssen, W. Clymans, J. Moeyersons, T. Gebreyohannes, F. De Smedt, J. Deckers, M. Van Camp | 09:00 – 09:20  | <i>Systematic approach for groundwater management, under climate change in Benin, West-Africa</i><br><b>Antoine Kocher</b> (University of Bonn, Germany) and B. Reicher       |
| 09:20 – 09:40   | <i>Assessing changes in terrestrial water storage in Africa using GRACE satellite gravity data and JLG terrestrial water storage model</i><br><b>Keiko Yamamoto</b> (Kyoto University, Japan), T. Nakaegawa, T. Hasegawa, Y. Fukuda and M. Taniguchi                          | 09:20 – 09:40  | <i>Climate variability and its impact on the Table Mountain Group aquifer in South Africa</i><br><b>Anthony Duah</b> , (UWC, South Africa) and Y. Xu                          |
| 09:40 – 10:00   | <i>Design of a national groundwater monitoring network in Uganda</i><br><b>Deborah Mwesigwa</b> (DWRM, Uganda) and C. Tindimugaya   | 09:40 – 10:00  | <i>Groundwater recharge and salinization in coastal areas of Senegal: impacts of climate change</i><br><b>Serigne Faye</b> (University Cheikh Anta Diop, Senegal) and A. Faye |

10:00 – 10:20 *Improving groundwater monitoring networks in Africa: developing integrated approaches to the assessment of the impacts of climate and socio-economic change on groundwater resources in Africa*  
M.T.H. van Vliet and **Neno Kukuric** (IGRAC, Netherlands)

*Impact of climate change on the renewal of groundwater resources in the Chélif-Zahrez basin of Algeria*  
**Mohamed Meddi** (University of Khemis Miliana, Algeria) and A. Boucefiane

10:20 – 10:45

poster sessions – common area (outside halls)

**POSTER SESSION 3: Monitoring and modelling groundwater use and replenishment**

*Using satellite-based solar insolation for estimating long-term regional evapotranspiration*

**Simon Paech** (University of Alabama, USA), J.R. Mecikalski, D.M. Sumner and J.M. Jacobs

*Climate change impacts on groundwater recharge in northeastern Uganda and the potential role of groundwater development in livelihood adaptation and peace building*

J. Gavigan, **Mark Cuthbert** (CHIPS, UK) and R. Mackay

*Groundwater recharge mechanisms and water management in a coastal sedimentary basin of Benin*

**Henri Totin** (University of Abomey-Calavi, Benin), M. Boukari and M. Boko

*An assessment of the response time of groundwater levels to climate change and abstraction*

**Robert Mutiibwa** (FELS Consultants, Uganda)

*Ground water resources seasonal variability and vulnerability of rural communities in the middle Nzoia River catchment, Kenya*

**Gelas Simiyu** (Moi University, Kenya), T. A. Esipila and D.D. Adams

*Groundwater quality and the sustainability of abstraction from weathered and fractured granite aquifers in the Lake Kyoga Basin of Uganda*

J. Nyende, F. Hodgson and **Albert Rugumayo** (Makerere University, Uganda)

*Fluoride hydrochemistry of regional crystalline rock aquifers: a case study from southern Sri Lanka*

**Kevin Hiscock** (UEA, UK), L.D. Rajasooriyar and E. Boelee

*Hydrogeochemistry of fluoride and salinisation of groundwater in Singida, central Tanzania*

**Hudson Nkotagu** (University of Dar es Salaam, Tanzania)

**POSTER SESSION 4: Estimation of groundwater resources and demand under a changing climate**

*Episodic recharge to the Quelo-Luanda aquifer: anticipating the impacts of climate change*

G. Miguel, L. Rebollo and **Miguel Martín-Loeches** (University of Alcalá, Spain)

*Quantifying the impact of predicted climate change on groundwater recharge to fractured rock aquifers*

**Emmanuel Appiah-Adjei** (KNUST, Ghana) and D. Allen

*The movement and occurrence of groundwater in the Ethiopian volcanic terrain: implications for exploration and development*

**Tenalem Ayenew** (Addis Ababa University, Ethiopia)

|  |   |   |   |
|--|---|---|---|
| 10:45 – 11:15  | <i>Coffee/Tea Break - extension of poster sessions</i>  |   |   |
| 11:15 – 11:45  | Session 3 Open Discussion of Technical Issues<br><i>chair: Ken Howard (University of Toronto, Canada)</i>   |   | Session 4 Open Discussion of Technical Issues<br><i>chair: Didier Pennequin (BRGM)</i>  |
| 11:45 – 12:30  | Session 3 Open Discussion of Policy Issues<br><i>chair: Science &amp; Technology Committee (Uganda)</i>   |   | Session 4 Open Discussion of Policy Issues<br><i>chair: SADC Parliamentary Forum</i>  |
| 12:30 – 13:00  | Session 3 Summary of Technical and Policy Issues<br><i>rapporteurs: Ken Howard (University of Toronto, Canada) &amp; Disan Ssozi (DWRM, Uganda)</i>     |   | Session 4 Summary of Technical and Policy Issues<br><i>rapporteur: Daniel Nkhuwa (University of Zambia, Zambia) &amp; Sam Mutono (World Bank)</i>   |
| 13:00 – 14:00  | <i>Lunch Break</i>  |   |   |
| <b>PLENARY KEYNOTE LECTURES - SESSIONS 5 &amp; 6 (Albert Hall)</b><br><i>chair: H.E. Ato Asfaw (Ministry of Water Resources, Ethiopia)</i>   |   |   |   |
| 14:00 – 14:10  | <b>Vahid Alavian</b>  | World Bank  | <i>Opening Address</i>  |
| 14:10 – 14:30  | <b>KEYNOTE SESSION 5:<br/>Stephen Foster</b>  | World Bank GW/MATE & IAH  | <i>Urban water-supply security in sub-Saharan Africa: making the best use of groundwater</i>  |
| 14:30 – 15:00  | <b>KEYNOTE - SESSION 6:<br/>Youba Sokona</b>  | OSS (Tunisia)   | <i>Transboundary groundwater management and climate nexus in the Circum-Sahara</i>  |
| 15:00 – 15:30  | <i>Coffee/Tea Break – common area (outside halls)</i>   |   |   |
| <b>SESSION 5 (Albert Hall): Groundwater management in the humid tropics of sub-Saharan Africa under variable climates</b><br><i>chair: Segun Adelana (IAH/University of Ilorin, Nigeria)</i><br><i>rapporteur: Lister Kongola (Ministry of Water and Irrigation, Tanzania)</i> |   | <b>SESSION 6 (Meera Hall): Groundwater management in arid and semi-arid Africa under variable climates</b><br><i>chair: Youba Sokona (OSS, Tunisia)</i><br><i>rapporteur: Mohammed Messouli (Semlalia Faculty of Sciences, Morocco)</i> |   |
| 15:30 – 15:50  | <i>Impact of climate variability on groundwater in Dar es Salaam, Tanzania</i><br><b>Praxeda Kalugendo</b> (Ministry of Water and Irrigation, Tanzania) |   | <i>Palaeohydrogeology of the Okavango Basin and Makgadikgadi Pan (Botswana) in the light of climate change and regional tectonics</i><br>J. Meier, <b>Thomas Himmelsbach</b> (BGR, Germany) and J. Böttcher |
| 15:50 – 16:10  | <i>Rationale and strategies for groundwater management in urban areas of Uganda</i><br><b>Callist Tindimugaya</b> (DWRM, Uganda)                        |   | <i>Sustainable groundwater management in the East African Rift – the MAWARI Project experience</i><br><b>Cheikh Bécaye Gaye</b> (University of Cheikh Anta Diop, Senegal), S. Kebede, F. Pinard             |

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| 16:10 – 16:30 | <i>Simulating groundwater level fluctuations in the Quaternary aquifer of Bamako, Mali</i><br><b>Hamadoun Bokar</b> (Ecole Nationale d'Ingenieurs, Mali)   | <i>A decision support tool for sustainable groundwater management in semi-arid, hard-rock regions</i><br><b>Benoit Dewandel</b> (BRGM, France), J. Perrin, S. Ahmed, S. Aulong, Z. Hrkal, P. Lachassagne, M. Samad, S. Massuel, A. Mukherji |
| 16:30 – 16:50 | <i>Groundwater exploitation and recharge rate estimation of a quaternary sand aquifer in Dar es Salaam, Tanzania</i><br><b>Ibrahimu Chikira Mjemah</b> (Sokoine University of Agriculture, Tanzania), M. Van Camp and K. Walraevens  | <i>Cooperation, conflict and adaptation to climate change in transboundary river basins in Africa</i><br><b>Marisa Goulden</b> (UEA, UK) and Declan Conway  |
| 16:50 – 17:30 | Session 5 Open Discussion of Technical & Policy Issues   | Session 6 Open Discussion of Technical & Policy Issues  |
| 18:00 – 19:30 | <b>Special event: Groundwater monitoring and data management</b><br><i>chairs: Segun Adelana (Nigeria), Callist Tindimugaya (Uganda), Lister Kongola (Tanzania) &amp; Neno Kukuric (Netherlands)</i><br><i>This evening session will focus on the development of groundwater monitoring networks and management of hydrogeological data and feature discussions involving senior water managers from around Africa who will discuss formally or informally case studies highlighting best practice in the design, construction and maintenance of monitoring networks.</i> |   |

**Friday 27 June 2008 Day 4**

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| <b>SESSION 5 (Albert Hall): Groundwater management in the humid tropics of sub-Saharan Africa under variable climates</b><br><i>chair: Phera Ramoeli (SADC)</i><br><i>rapporteur: Rafik Hirji (World Bank)</i> | <b>SESSION 6 (Meera Hall): Groundwater management in arid and semi-arid Africa under variable climates</b><br><i>chair: Ralf Klingbeil (BGR, Germany)</i><br><i>rapporteur: Alex Magarigakis (UNESCO)</i>                      |
| 09:00 – 09:20<br><i>Groundwater management in non-urban areas under changes in climate variability</i><br><b>Albert Tuinhof</b> (World Bank GW/MATE)   | <i>Conceptualising transboundary groundwater management</i><br><b>Waltina Scheumann</b> (DIE, Germany), E. Herrfahrdt and M. Alker   |
| 09:20 – 09:40<br><i>Groundwater management in rural Ethiopia</i><br><b>H.E. Ato Asfaw</b> (Ministry of Water Resources, Ethiopia)  | <i>Water and food security in the Nile Basin: taking account of water resources beyond the river and the basin</i><br><b>Tony Allan</b> (Kings College London, UK)   |
| 09:40 – 10:00<br><i>Groundwater management in rural sub-Saharan Africa under conditions of climate variability</i><br><b>Lister Kongola</b> (Ministry of Water and Irrigation, Tanzania)                       | <i>Tradeoff analysis between economic development and climate change adaptation strategies for the Nile river basin</i><br><b>Eihab Fathelrahman</b> (USDA, USA), M. Babiker, K. Strzepek, J. Ascough II, and T. Green         |
| 10:00 – 10:20<br><i>Groundwater management and drought preparedness in the SADC region</i><br><b>Phera Ramoeli</b> (SADC)  | <i>The role of parliamentarians in developing groundwater management policies under conditions of climate change</i><br><b>SADC Parliamentary Forum</b><br><b>Science &amp; Technology Committee of the Ugandan Parliament</b> |

10:20 – 10:45

poster sessions – common area (outside halls)

**POSTER SESSION 5: Groundwater management in sub-Saharan Africa under variable climates**

*Challenges in enforcing water laws in water resources management in Uganda*

**Grace Namanda-Ssali** (P.K. Hydroexperts Limited, Uganda)

*Experimental GIS hydrogeological mapping of hard rock aquifers in Burkina Faso, to help groundwater management and planning*

**Nathalie Courtois** (BRGM, France), R. Blanchin, P. Lachassagne, R. Wyns, F.D. Bougaïré, S. Somé and A. Tapsoba

*Relict river channels in Uganda: potential corridors of preferential groundwater flow and storage*

**Graham Bradley** (UCL, UK), C. Tindimugaya and R. Taylor

*Geoelectrical characterization of aquifers in the basement complex / sedimentary transition zone around Ishara, southwestern Nigeria*

**Stephen Ariyo** (Olabisi Onabanjo University, Nigeria) and G.O. Adeyemi

*Groundwater governance in Asia: an innovative approach and platform for capacity building, research, and knowledge sharing on groundwater management*

**Karen Villholth** (GEUS, Denmark), A. Mukherji, B.R. Sharma and J. Wang

**POSTER SESSION 6: Groundwater management in arid and semi-arid Africa under variable climates**

*Carbon-14, chlorine-36 and noble gases in deep groundwaters from the NE Sahara (Algeria) and their palaeoclimatic implications*

**Abdelhamid Guendouz** (Blida University, Algeria), A.S.Moulla and J.L.Michelot

*Compared analysis of variabilities and climatic changes impacts on the surface water and groundwater resources in Saharo-Sahelian zones*

**Youba Sokona** (OSS, Tunisia), A. Dodo and M. Baba Sy

*Climat et ressources en eau au Maghreb: tendances et impacts du changement global*

**Moulay Idriss Hassani** (Université d'Oran, Algeria)

*Conceptual model of basement aquifers in Limpopo province, South Africa*

K.T. Witthüser, M. Dippenaar, **Theo Rossouw** (University of Pretoria, South Africa), M. Holland

*Groundwater geochemical variations under a changing climate in the East African rift*

**Seifu Kebede** (Addis Ababa University, Ethiopia)

10:45 – 11:15

Coffee/Tea Break – extension of poster sessions

11:15 – 12:30

Session 5 Open Discussion of Technical & Policy Issues  
chairs: **Segun Adelana** (IAH) & **Richard Carter** (Cranfield University, UK)

Session 6 Open Discussion of Technical & Policy Issues  
chairs: **Youba Sokona** (OSS, Tunisia) & **Ralf Klingbeil** (BGR, Germany)

12:30 – 13:00

Session 5 Summary of Technical and Policy Issues  
chair: **Vahid Alavian** (World Bank)

Session 6 Summary of Technical and Policy Issues  
chairs: **Mohammed Messouli** (Morocco) & **Ralf Klingbeil** (BGR)

13:00 – 14:00

Lunch Break

## PLENARY ROUND-TABLE DISCUSSIONS I (Albert Hall)

*Chair: Patrick Kahangire (ADB)*

14:00 – 14:30 **Synthesis of technical and policy issues from conference sessions**

*discussants: Richard Taylor (UK) / Callist Tindimugaya (Uganda) / Alice Aureli (UNESCO-IHP)*

14:30 – 15:30 **Discussion of technical issues leading to specific outcomes and recommendations**

*provisional panel: Zbyszek Kundzewicz (IPCC), Daniel Olago (Kenya), Youba Sokona (Tunisia), Philip Gwage/Stephen Magezi (Uganda), Didier Pennequin (BRGM), Willy Struckmeier (BGR), Brent Newman (IAEA), Patrick M'mayi (UNEP), DANIDA representative*

*potential foci:*

- How does climate variability and change affect groundwater resources?
- What are the current constraints to improving our understanding of the relationship between groundwater and climate?

15:30 – 16:00

*Coffee/Tea Break*

## PLENARY ROUND-TABLE DISCUSSIONS II (Albert Hall)

*Chair: Hon. Maria Mutagamba (MWE, Uganda)*

16:00 – 17:30 **Discussion of policy issues and recommendations for national and international policy formulations**

*provisional panel: H.E. Ato Asfaw (MWR, Ethiopia), Hon. Jennifer Namuyangu (MWE, Uganda), Aryamanya Mugisha (NEMA, Uganda), Simon Thuo (NBI), SADC Parliamentary Forum, Science & Technology Committee (Uganda), Stephen Foster (World Bank, IAH), Manfred Konukiewicz (BMZ), Janot Mendler de Suarez (UNDP-GEF), Peter Akari (ADB/AWF), Tony Allan (KCL, UK)*

*potential foci:*

- How can groundwater help communities in Africa mitigate or adapt to the impacts of climate change and increasing water demand?
- How can we best manage and regulate groundwater development to ensure long-term sustainability?

17:30 – 18:30

### **Closing Ceremony**

*Chair: Permanent Secretary, Ministry of Water and Environment*

from 19:30

### **CLOSING GALA DINNER**

## **Saturday 28 June 2008**

09:00 – 18:00

### **FIELD VISIT – Jinja**

*Transboundary theme:*

*(1) Bujagali & Nalubale/Kira Dams; (2) Jinja groundwater / surface water monitoring facility; (3) 'Source of the River Nile'*