British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Gateway to the Earth

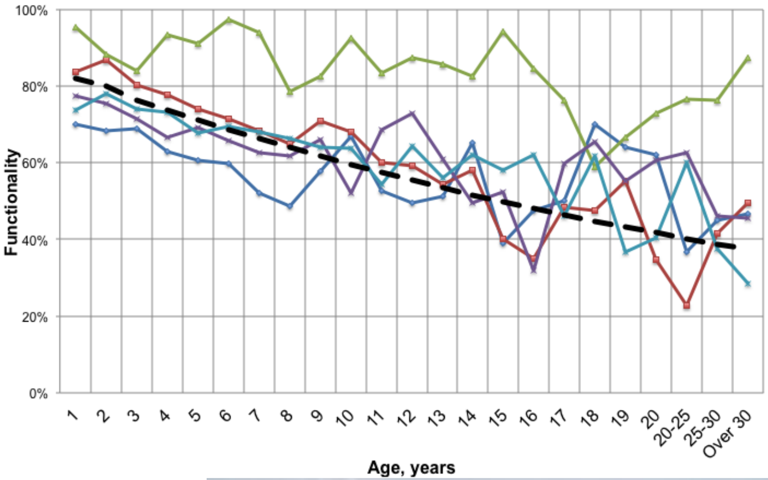
A hidden crisis

unravelling current failures for future success in rural water supply

Alan MacDonald, Frances Cleaver,
Michael Owor, Helen Bonsor, Seifu Kebede, Vincent Casey, Evance Mwathunga, Richard Carter, Geoffrey Chavula, Peter Cook, Roger Calow, Naomi Oates, Dick Fenner. John Chilton

UP Gro Unlocking the Potential of Groundwater for the Poor

What crisis?



- There is mounting evidence that 20 – 40% of rural handpumps are non functional within 2 years.
- Therefore many of the benefits of improved access to water are lost
- Cumulative cost estimated to be $1.2b
- Often hidden – focus on coverage, few incentives, confusion over definitions,

And: there are still 300 million people without any access – and significant investment planned to meet SDGs

Individual reasons cited for failure

Engineering problems

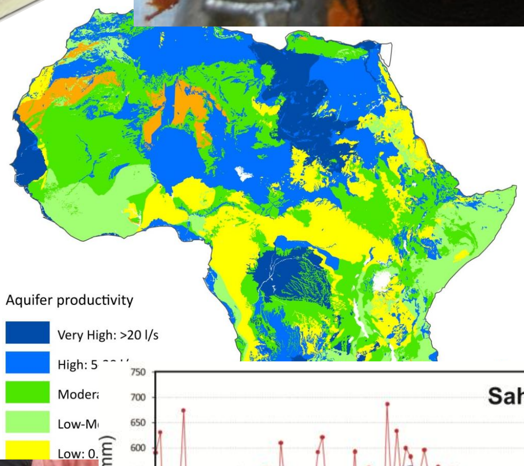
Community management

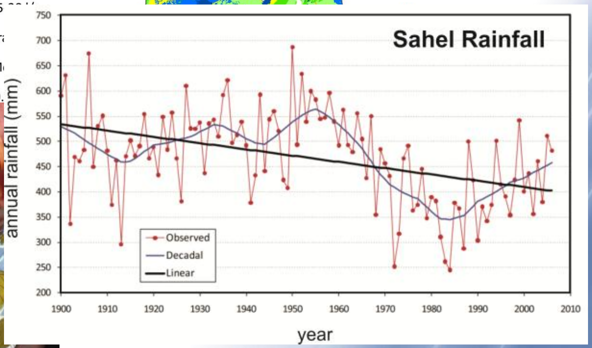
Financing, spare parts, life cycle costs

Hydrogeology

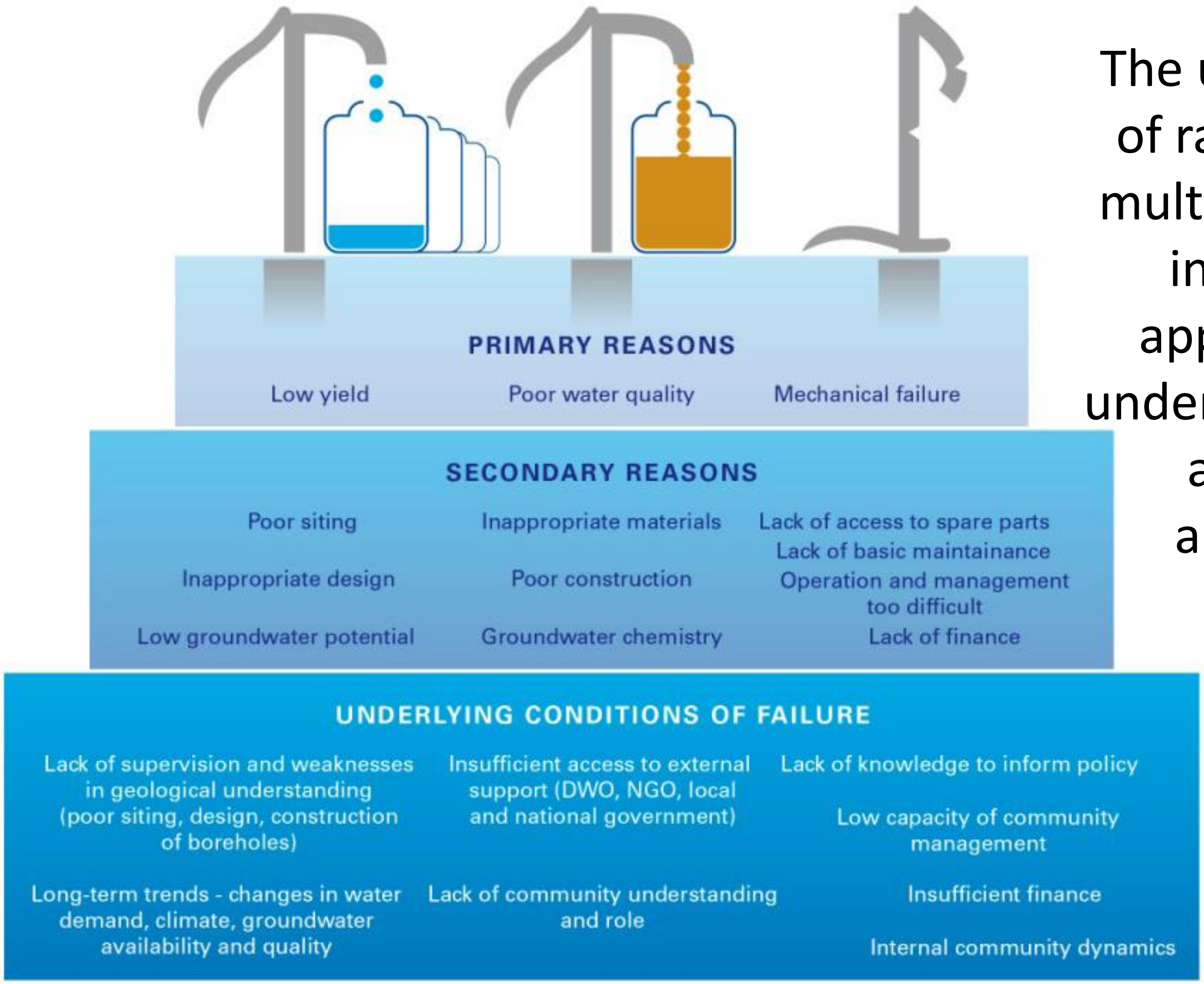
Climate change

Flawed policies





Hypothesis



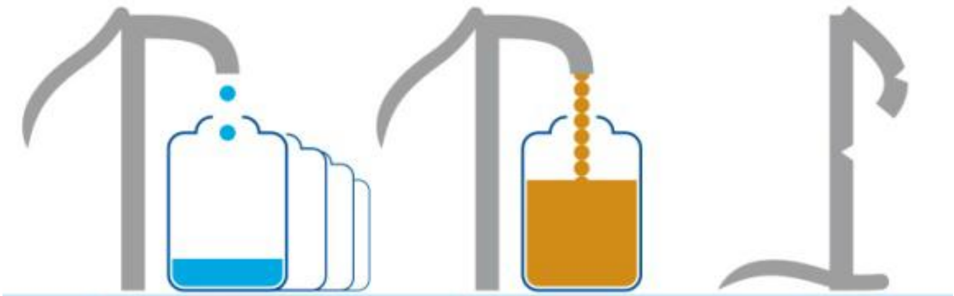
The underlying causes of rapid failure … are multifaceted, but with interdisciplinary approaches can be understood, diagnosed, and ultimately anticipated and mitigated

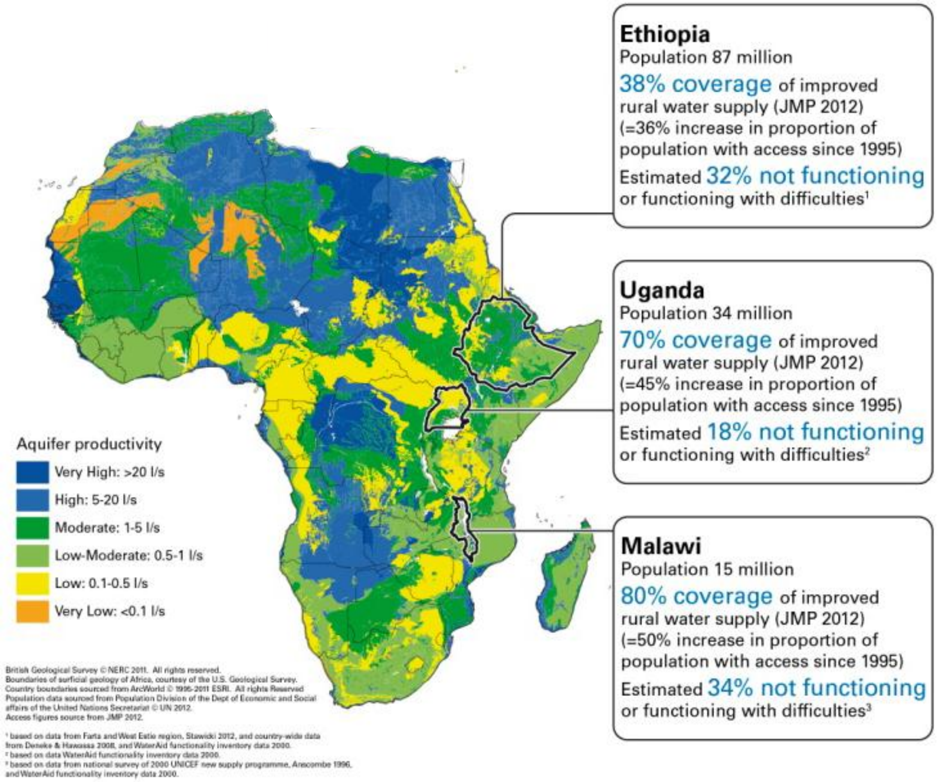
Our team


BGS
KCL
WaterAid
AAU
U of Malawi
Makerere
ODI
Cambridge
U of Flinders

Our research objectives

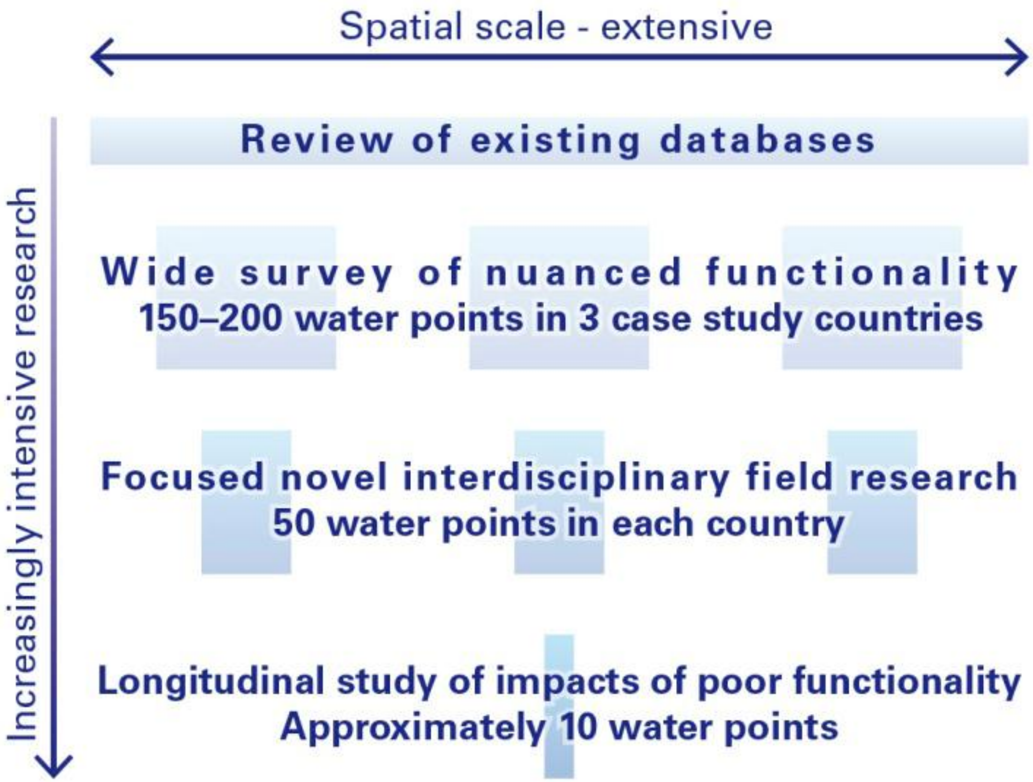
Objective 1: To develop nuanced definitions of the functionality of water points and governance arrangements.





Objective 2: to apply this new definition to 3 countries, Ethiopia, Uganda and Malawi to provide authoritative evidence about functionality.

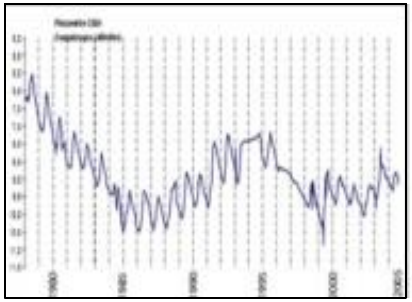
Our research objectives

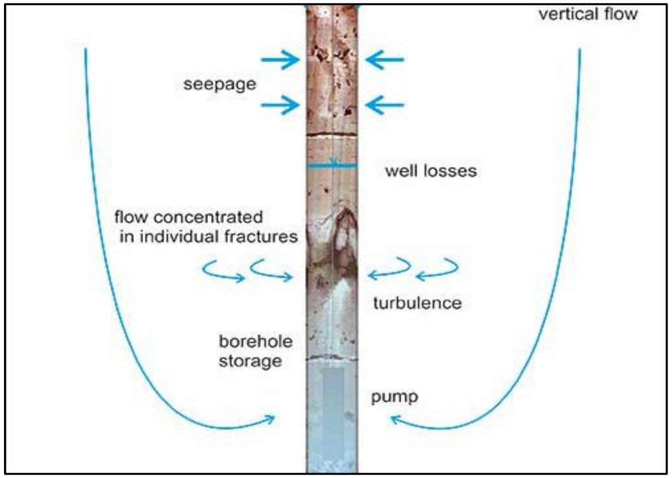


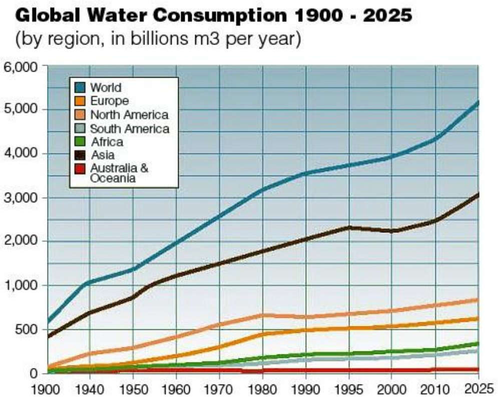
Objective 3: To understand the inter-dependancies between the factors governing source failure and success through detailed novel interdisciplinary science

Examine trajectories

Objective 4: To examine and forecast trajectories and trends given future scenarios: scenario building (recharge, water demand); novel water point modelling



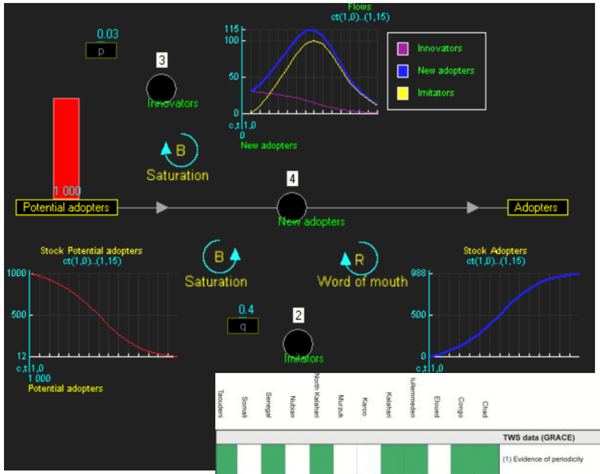


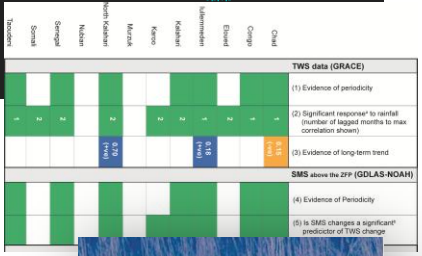


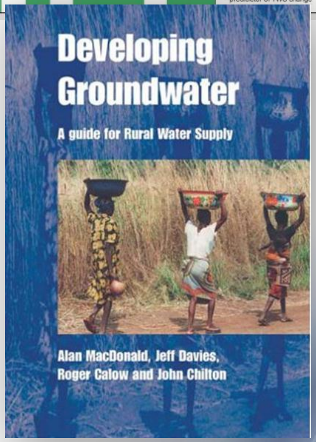
Analysis and uptake

Objective 5: To develop a dynamic approach for building resilience into future rural water supply

- Adaptive interdisciplinary learning
- Multiple analysis tools and methods
- Novel use of system dynamics modelling
- Develop a framework for building resilience into water supply
- Deliver research findings through our multiple pathways

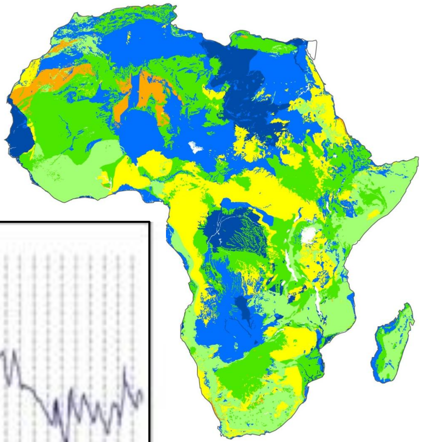


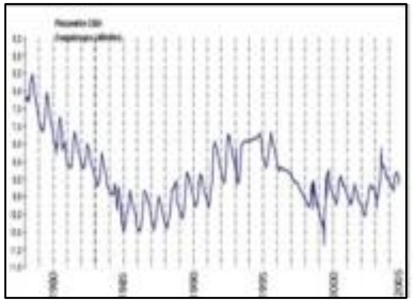




WaterAid

Deliverables





Unique rich datasets at different scales on water governance, groundwater flow and storage, recharge processes, functionality, impact of water access on gender dynamics.

A new robust, replicable methodology for the research community

4 benchmark papers, + 5-10 methods or case study papers

A team of interdisciplinary skilled researchers

A set of tools delivered through a manual, policy briefs and social media

A change in practice in the WASH community

Quantitative maps of groundwater resources in Africa

A M MacDonald[1], H C Bonsor[1], B É Ó Dochartaigh[1] and R G Taylor[2]

nature climate change

LETTERS

Evidence of the dependence of groundwater resources on extreme rainfall in East Africa

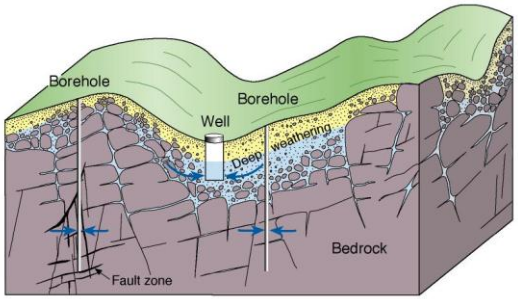
Simplified workplan

	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Objective 1a To develop nuanced definitions of functionality and governance arrangements																
Develop principles of water service governance functionality																
Development of a set of measurable indicators																
Objective 2 Apply definitions to a representative subset in each country and undertake country analysis																
Rapid survey of 150 - 200 sources and water committees per country																
Investigate the PE of the wider service delivery chain																
Assess the regional hydrogeological and climate context																
Objective 3 To produce focused innovative fieldwork on multifaceted factors governing source failure and success																
Identify a representative subset (approx 50) in each country																
Deteiled interdisciplinary research at each source																
In depth longitudinal survey of small sub sample																
Objective 4 - To examine trajectories of change																
Instrument boreholes to measure gwls in target areas																
Develop future possible scenarios																
Source functioning modelling for different scenarios																
Model impact of future functionality on SDG																
Objective 5 - develop an approach for developing resilient access to water, and publish manuals																
Interdisciplinary analysis of data collected in objective 3																
Apply Systems Dynamic Modelling																
Construct dynamic framework for building resilience into WASH																
Developing pathways to impact																

Key events next 12 months

Setup meetings Malawi, Uganda, Ethiopia May 28 – June 8th

Appoint PDRAs, set up project management systems Jul-Sep

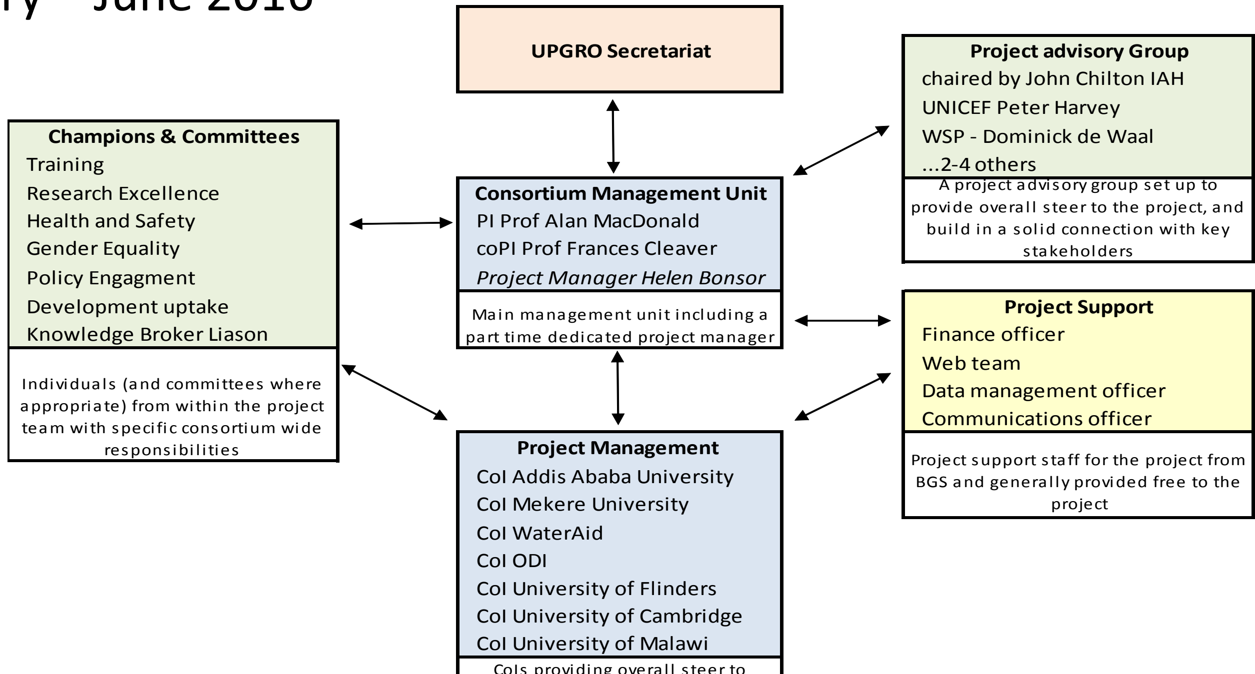


Review of PE and hydrogeology each country

Workshop – Addis September 8 – 11th

Training and sample strategy November – February 2016

Functionality survey February – June 2016



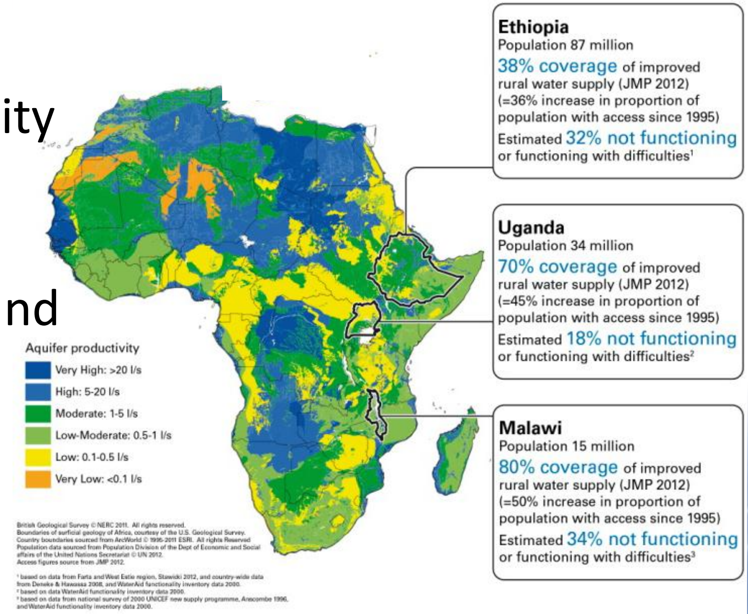
Summary

*to move **from anecdote to evidence***

Truly interdisciplinary with an adaptive learning approach

Five main objectives:

1. Define nuanced understanding of functionality
2. Apply to Uganda, Ethiopia and Malawi
3. Detailed analysis of subset in each country and a focussed longitudinal study
4. Analysis –interdisciplinary approaches
5. Use to test scenarios



Impact and delivery: Publications, book, tools, working through WaterAid and others globally and in each country

UPGro Unlocking the Potential of Groundwater for the Poor

Additional slides

How will the research be delivered ?

- Achievable – well supported coIs and dedicated management
- 2 UK based post docs, 6 based in Africa
- Significant capacity building
- Interdisciplinary process – with adaptive learning approach
- Leveraging £160k of support

UPGRO Secretariat

Champions & Committees
Training
Research Excellence
Health and Safety
Gender Equality
Policy Engagment
Development uptake
Knowledge Broker Liason

Individuals (and committees where appropriate) from within the project team with specific consortium wide responsibilities

Consortium Management Unit
PI Prof Alan MacDonald
coPI Prof Frances Cleaver
Project Manager Helen Bonsor

Main management unit including a part time dedicated project manager

Project Management
CoI Addis Ababa University
CoI Mekere University
CoI WaterAid
CoI ODI
CoI University of Flinders
CoI University of Cambridge
CoI University of Malawi

CoIs providing overall steer to direction of project in targeted workshops and virtual meetings and also managing specific activites within workpackages

Project advisory Group
chaired by John Chilton IAH
UNICEF Peter Harvey
WSP - Dominick de Waal
...2-4 others

A project advisory group set up to provide overall steer to the project, and build in a solid connection with key stakeholders

Project Support
Finance officer
Web team
Data management officer
Communications officer

Project support staff for the project from BGS and generally provided free to the project

Major research outcomes

A step change in the understanding of borehole functionality and its implication for WASH coverage figures

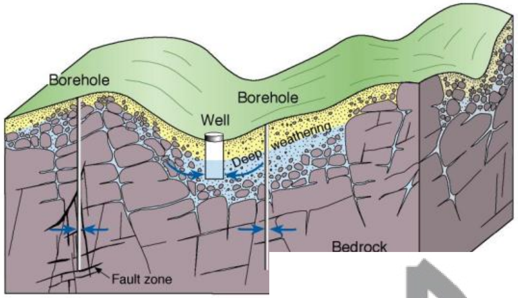
Deep understanding on the viability of the community management model for WASH

Quantitative evidence of groundwater storage, flow and recharge for key hydrogeological environments

Analysis of the contribution of environmental change to water supply functionality

An authoritative analysis of the main predictors of borehole functionality

Defendable forecasts of future functionality and therefore RWS coverage given plausible future trajectories.



Partners and pathway to impact

To provide tools for problem diagnosis and see these adopted

To present clear evidence and see it disseminated

To contribute to practices that can effect change

Approach

WaterAid and partners are integral to the research

Make use of existing in country channels and research

UNICEF, WSP, RWSN and IAH all involved.

Link to other initiatives

Develop the voice of the rural communities

Play a major role within wider UPGro community

Work Plan – next 12 months

	YEAR 1				YEAR 2				YEAR 3				YEAR 4			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Objective 1a To develop nuanced definitions of functionality and governance arrangements																
Systematic Literature Review		■	■													
Develop principles of water service functionality	■	■														
Develop principles of local governance funtionality	■	■														
Development of a set of measurable indicators			■													
Objective 2 Apply definitions to a representative subset in each country and undertake country analysis																
Review existing country databases and VfM studies		■	■													
Develop a robust stratified sampling strategy			■													
Rapid survey of 150 - 200 sources and water committees			■	■	■											
Training of community members for seasonal repeats				■	■											
Investigate the PE of the wider service delivery chain		■	■	■	■											
Assess the regional hydrogeological and climate context		■	■	■	■											
Use subset to reinterpret existing functionality and coverage data					■	■	■									

Setup meetings Malawi, Uganda, Ethiopia May 28 – June 8th

Appoint PDRAs, set up project management systems Jul-Sep

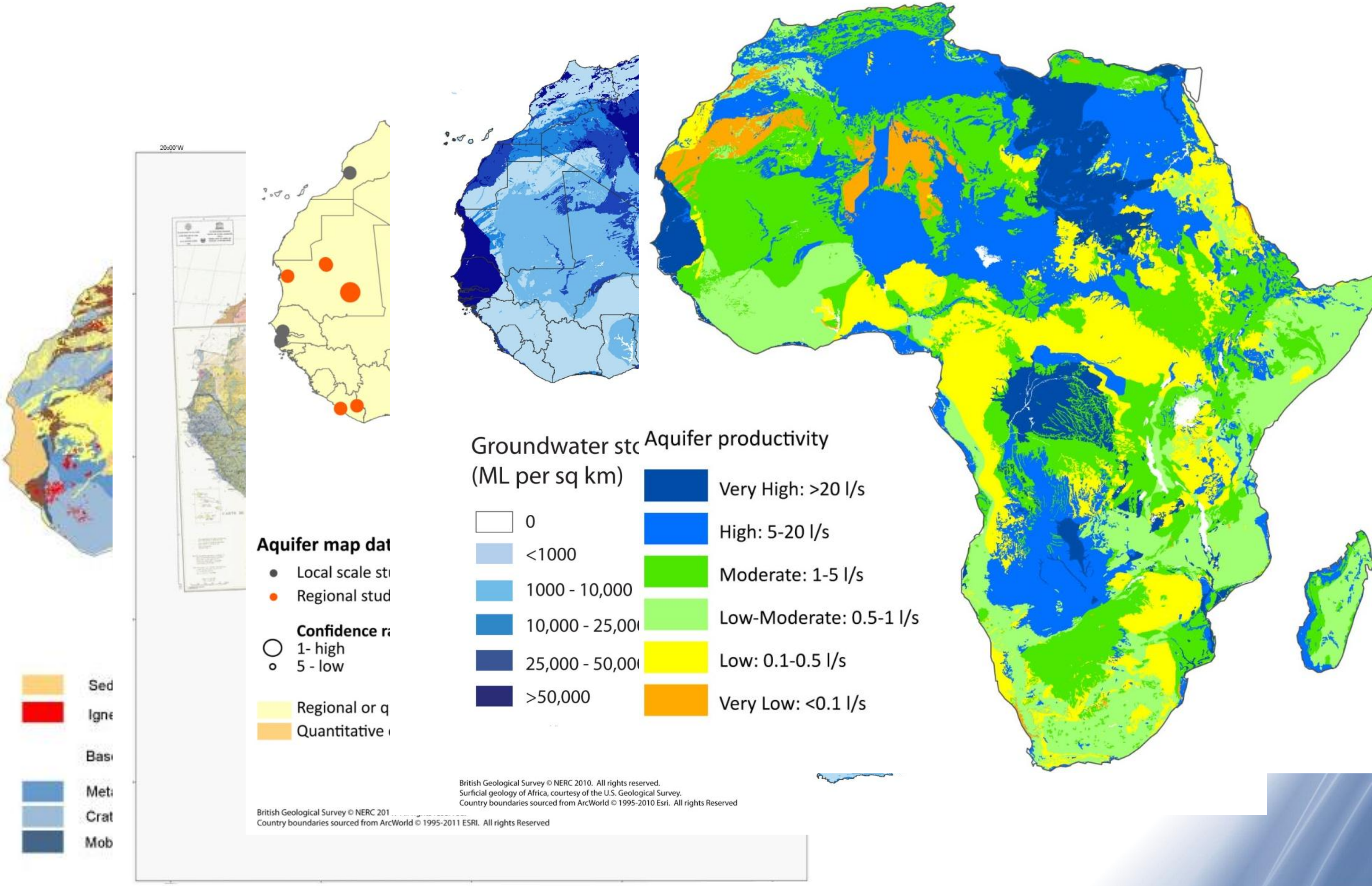
Workshop – Addis September 8 – 11th

Training and sample strategy November – February 2016

Functionality field survey February – June 2016

Work plan - Management

Management, meetings and reporting															
Arrange contracts and MoUs and advertise and interview PDRAs															
Set up file sharing system															
Develop H&S strategy for project															
AIIM and PEA surveys to help with pathways to impact															
Main project Workshops															
Monthly skype meetings															
Three monthly project updates and progress reports															
In country stakeholder meetings															
Steering committee															
Researcher exchanges															
Conferences and KE events (1 - 2 per Co-I)															
NERC reporting															
Website															
Key papers (other country papers and also published)															
Defining source functionality and the implication on WASH coverage figures															
The role of environmental change on water source failure in Africa															
Institutional arrangemgents for community WASH - myth and reality															
Identifying the root causes of source success and failure.															
Published Book with Practical Action- Building resilience into WASH															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Aquifer map dat
Local scale st
Regional stud
Confidence r
1- high
5 - low
Regional or q
Quantitative
Groundwater st
(ML per sq km)
0
<1000
1000 - 10,000
10,000 - 25,00
25,000 - 50,00
>50,000
Aquifer productivity
Very High: >20 l/s
High: 5-20 l/s
Moderate: 1-5 l/s
Low-Moderate: 0.5-1 l/s
Low: 0.1-0.5 l/s
Very Low: <0.1 l/s
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Sed
Igne
Bas
Met
Crat
Mob

Results: African groundwater S and K

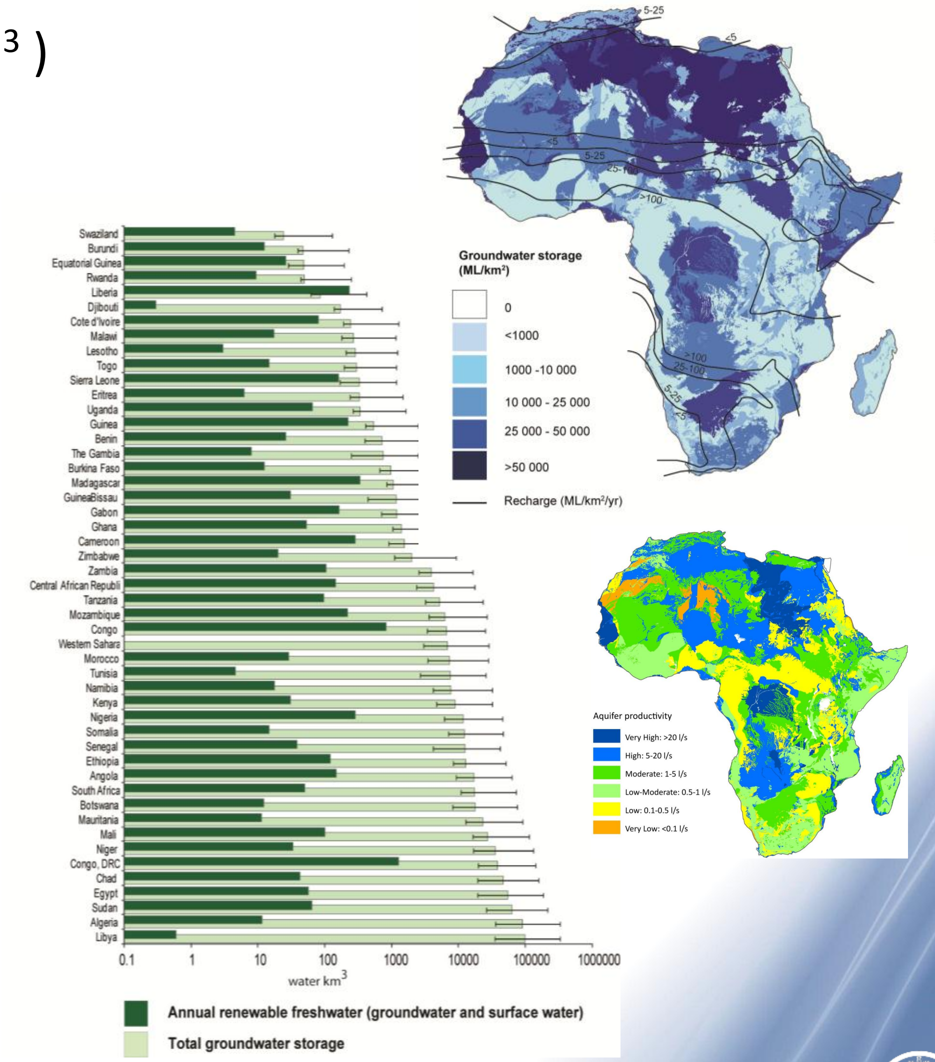
Found that storage was high (0.5 M km^3)
100 x the estimated annual renewable freshwater

Areas often seen as water scarce have large groundwater resources

Even in low storage areas – usually enough for several years supply to a handpump

High spatial variation in permeability – meaning large scale irrigation rarely feasible

If there is so much water – why do sources fail?



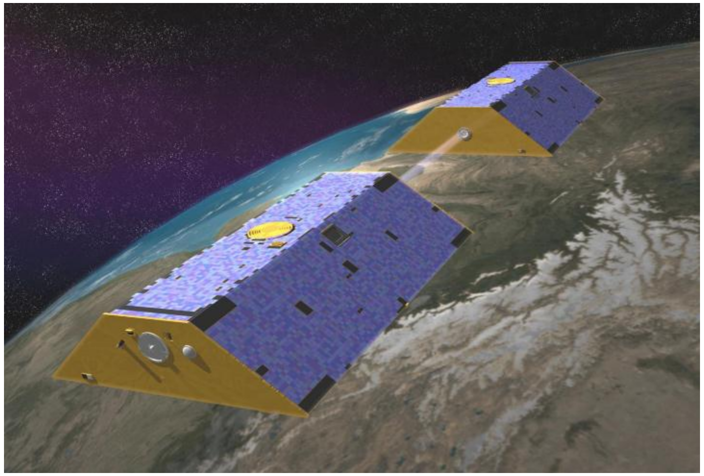
Source MacDonald et al. 2012

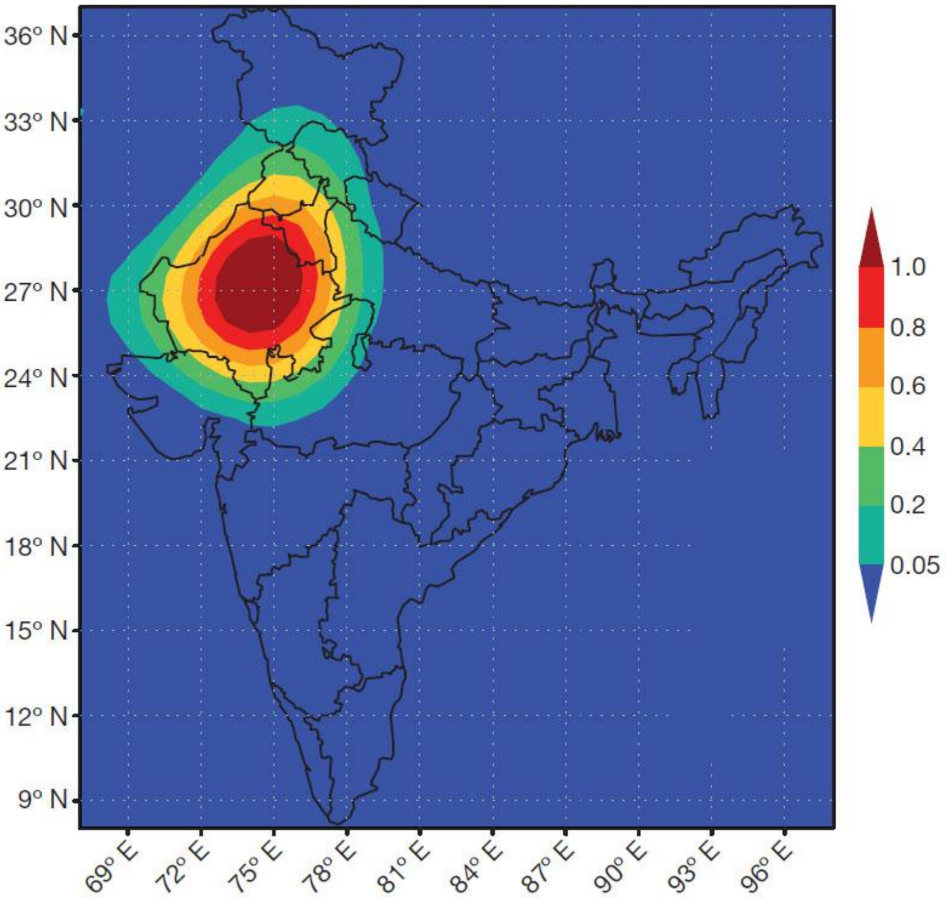
Sustainability: changes in storage: GRACE

Monthly estimates of changes in terrestrial water storage

Resolution – approx 5 mm

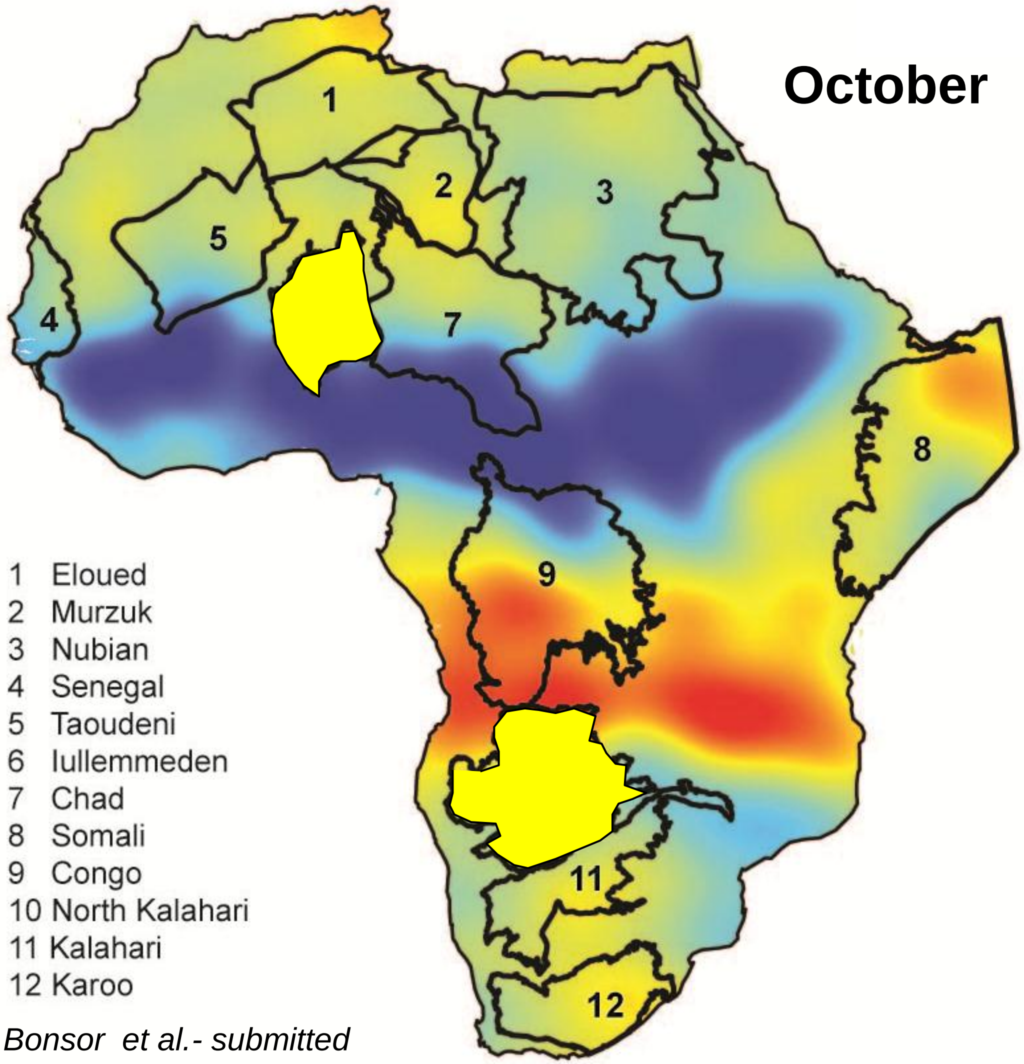
Large footprint (400 x 400 km)





Source Rodell: Nature 2009

Some evidence from satellites: GRACE



Source Bonsor et al.- submitted

Only long term trend (2002-2012) is groundwater *accumulation* in two basins

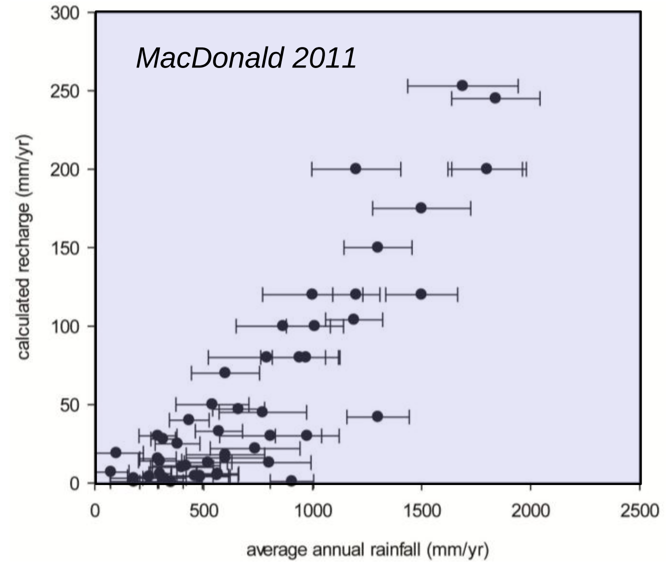
But still baseline conditions

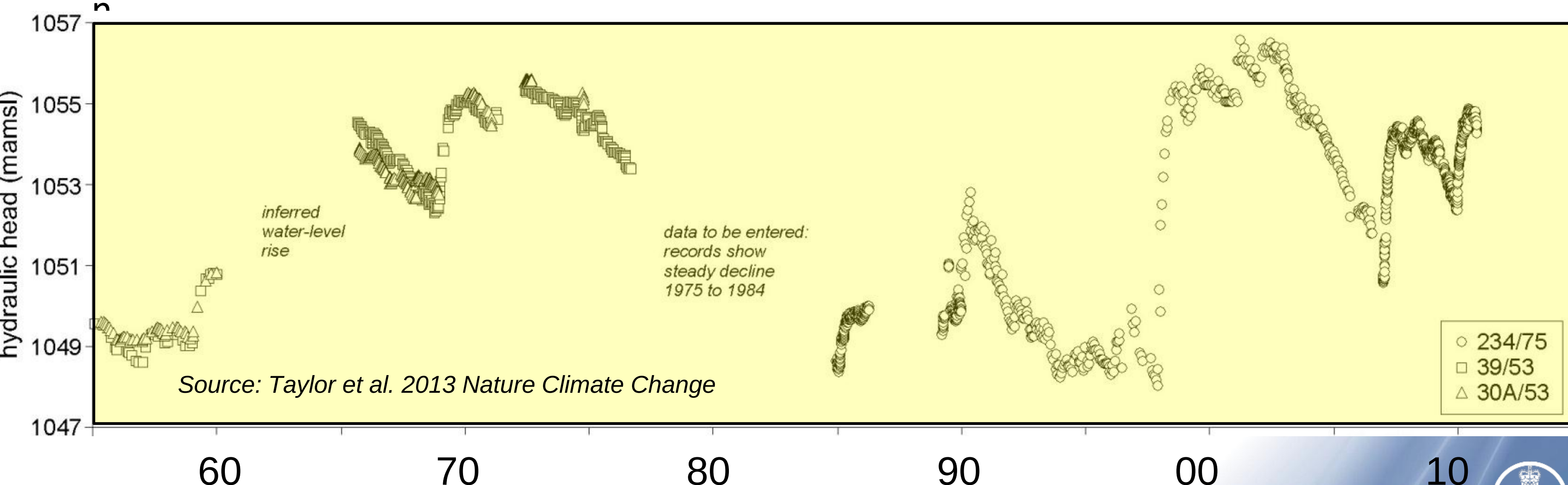
Groundwater recharge: linked to intensity

Investigate relationship of recharge to rainfall within tropics of Africa

Found evidence that groundwater recharge was non-linear when rainfall <750 mm

Strong evidence that groundwater recharge for a site in Tanzania linked to ENSO





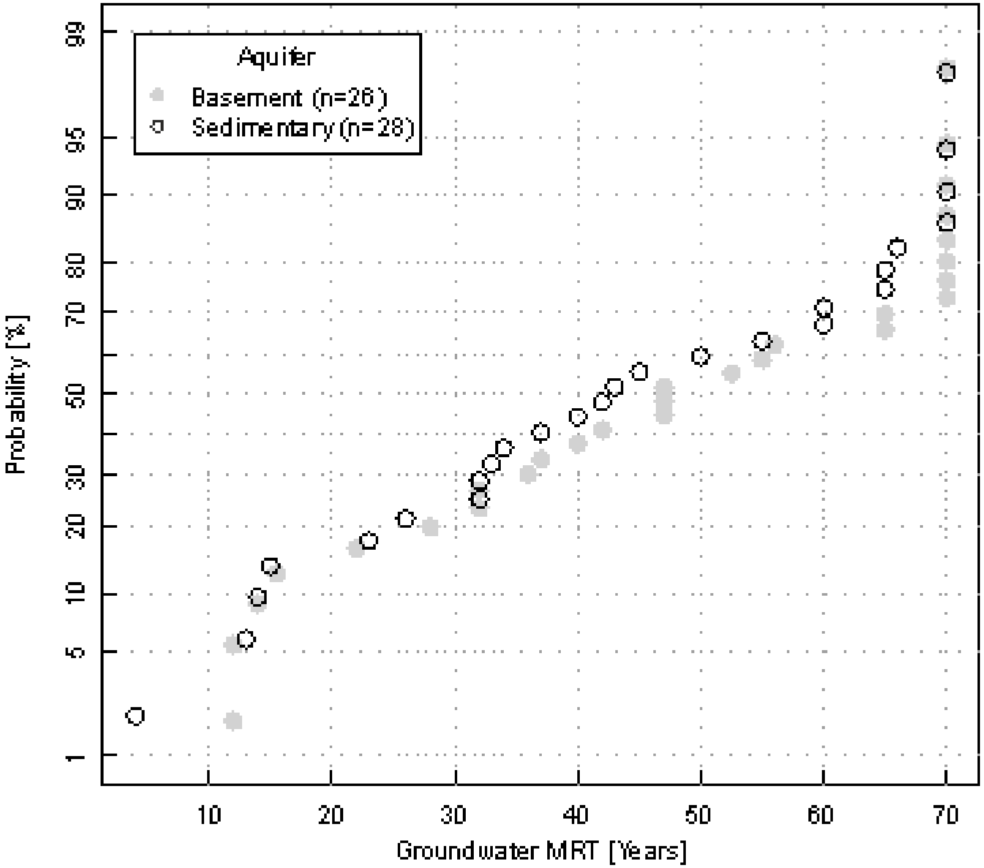
Estimating GW residence times

chemistry, stable isotopes

noble gases

CFC-11, CFC-12 SF6, tritium

West African transect



Lapworth et al. 2013

Shallow GW 30 – 60 years

Even in low rainfall Sahel (400 mm) mean annual recharge 20 -40 mm

High storage, low storage similar residence times