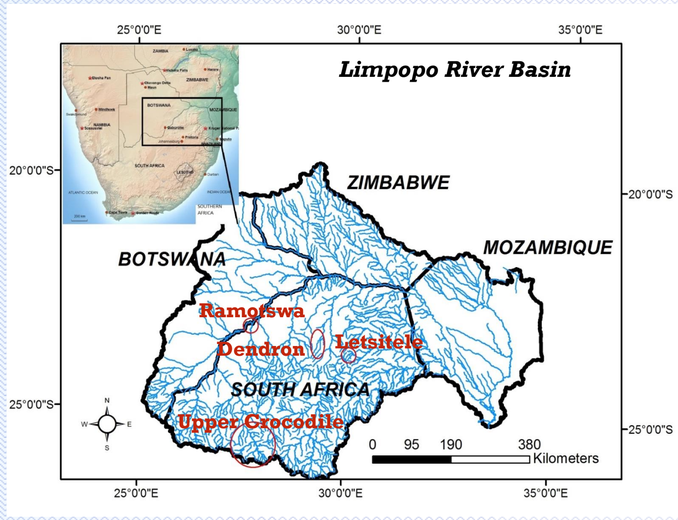
GROUNDWATER RECHARGE IN THE LIMPOPO RIVER BASIN, SOUTHERN AFRICA (GRECHLIM)

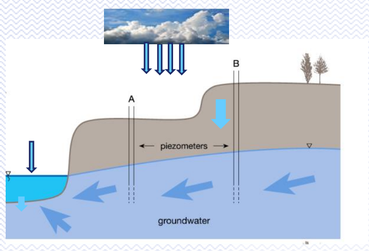
Introduction

* The Limpopo River Basin (LRB) (408,000 km^2, 18 million inhabitants), shared between Botswana, South Africa, Zimbabwe and Mozambique.
* The key development impact of the GRECHLIM Project is to increase the capacity of young scientists as well as local and national authorities to assess groundwater recharge.
* It was also aimed to strengthen the strategic partnerships with stakeholders and entities involved in water resources management in the LRB.
* Involves water authorities, farmers, donors and university researchers for the integrated development of groundwater resource in the basin.

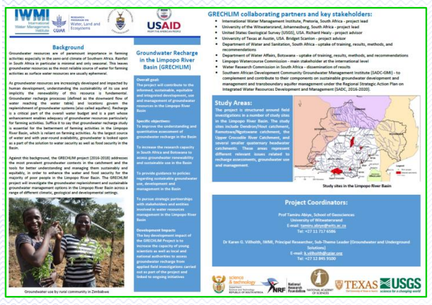
Research Areas



Recharge process



Information for public



Objectives of the project

- To improve the understanding and quantitative assessment of groundwater recharge in the Limpopo River Basin.
- To increase the research capacity in order to assess groundwater renewability and sustainable use of groundwater.
- To provide guidance to policy makers and users on sustainable groundwater use, development and management of groundwater.

Use of groundwater in semi arid region of Southern Africa

Groundwater pumping for irrigation in Dendron

Groundwater for cattle in Ramotswa

Methods used:

Infiltration capacity
Hydrograph Separation
Water Table Fluctuation
Stable Isotopes (^{18}O, ^{2}H, ^{13}C)
Radiogenic Isotopes (^{3}H, ^{14}C)
Catchment Water Balance
Piezometer monitoring

WTF: $R\ (mm) = S_y\ (\Delta H/\Delta t)$

CMB: $R\ (mm) = P\ (Cl_{rain}/Cl_{gw})$

SMB: $I = P - (ET+R)$

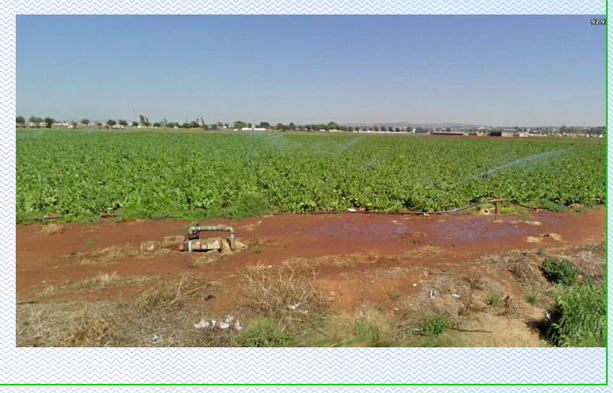
CWB: $Rec = \Delta S_{gw} + BF + ET_{gw} + G_{in} - G_{out}$

CWB: $(P + S_{in} + G_{in}) - (ET + S_{out} + G_{out} + W) = \Delta S$

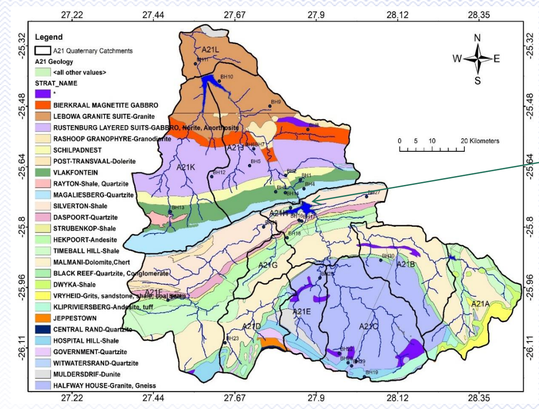
MRT with ^{3}H: $t\ (years) = -17.93 \ln (a_t{}^{3}H / a_0{}^{3}H)$

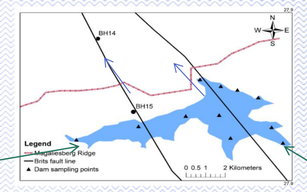
MRT with ^{14}C: $t\ (years) = -8267 \ln (a_t{}^{14}C / a_0{}^{14}C)$

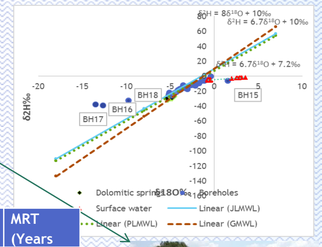
Irrigation with groundwater: main driver for GDP in the Limpopo River Basin



Upper Crocodile River Basin







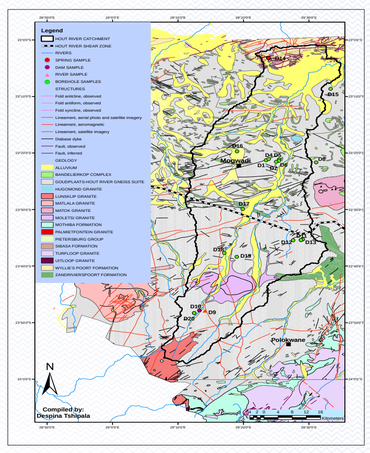
BH No.	$\delta^{13}C$ (‰)	^{14}C (pMC)	error±	MRT (Years
BH14	-12.31	104.4	±2.7	0
BH16	-17.35	88.2	±2.5	1038
BH19	-15.22	95.7	±2.6	363
BH23	-8.41	84.4	±2.5	1402
BH24	-15.38	99.6	±2.6	33
BH25	-15.3	95.1	±2.6	415
SP1	-6.05	82.0	±2.5	1641
SP2	-5.64	79.9	±2.5	1855

Stream carrying treated wastewater 720 million m^3/yr

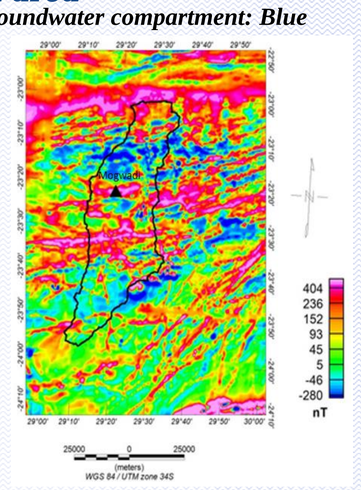
Present to old recharge-over millennia

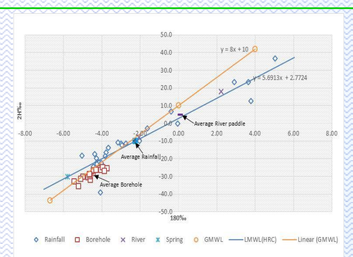
Dendron area

Structural control



Groundwater compartment: Blue





Code	14 C (pMC)	13C (‰)	MRT (years)
D7	85.40±2.5	-12.63	1304.73
D8	93.40±2.6	-11.10	564.46
D12	84.30±2.5	-11.42	1411.91
D15	102.30±2.6	-13.81	0
D16	110.30±2.7	-9.76	0
D17	92.90±2.6	-11.57	608.84
D18	88.10±2.5	-9.41	1047.41
D20	87.70±2.5	-10.67	1085.03

Letsitele area: measurements and pump test on piezometer

Ramotswa transboundary groundwater management training: Feb 2016

Groundwater recharge training Nov 2016 Wits-Johannesburg

Activities

-Collection of rainfall, groundwater, river water and spring samples on regular basis
-Aquifer characterization
-Water balance determination
-Recharge estimation
-Piezometer installation and monitoring
-Surface and ground water interaction monitoring
-PRMS modelling
-Groundwater vulnerability to pollution mapping
-Trainings

RESEARCHERS INVOLVED IN THE PROJECT

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Dr. Girma Ibrahim (Researcher)
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Publication Output

*Abiye, T., Masindi, K., Mengistu, H. Demlie, M. (2018) Understanding the groundwater-level fluctuations for better management of groundwater resource: a case in the Johannesburg region. *Journal of Groundwater for Sustainable Development.7 :1-7*

*Leketa, K., Abiye, A., Butler, M. (Accepted). Characterisation of groundwater recharge conditions and flow mechanisms in the crystalline aquifers of the Johannesburg area, South Africa. *Journal of Environmental Earth Sciences*.

*Leketa, K., Abiye, T., Villholth, K., Zondi, S., Davis, A., Butler M. (Accepted) Assessing groundwater recharge in crystalline aquifers of the Upper Crocodile River Basin, Johannesburg, South Africa. *Journal of Groundwater for Sustainable Development*.

*Leketa, K., Abiye, T., Villholth, K., Zondi, S., Davis, A. (Accepted) Characterising groundwater recharge in crystalline aquifer: a case study of upper Crocodile River Basin, Johannesburg, South Africa. *Journal of African Earth Sciences*.

*Baqa, S., Magombeyi, M., Villholth, K., Abiye T., Butler, M. (Ready for submission). Groundwater in the Ramotswa Dolomitic Aquifer: From Quantifying Recharge Rates to Understanding Flow Pathways. *Journal of Groundwater for Sustainable Development*.

*Leketa, K., Abiye, T. (Ready for submission). Groundwater recharge from PRMS modelling in the Limpopo River Basin.

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PROJECT TIME: 2016-2018