

Current Application Trends and Data Challenges Regarding the Use of the Soil and Water Assessment Tool (SWAT) in Africa



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Content

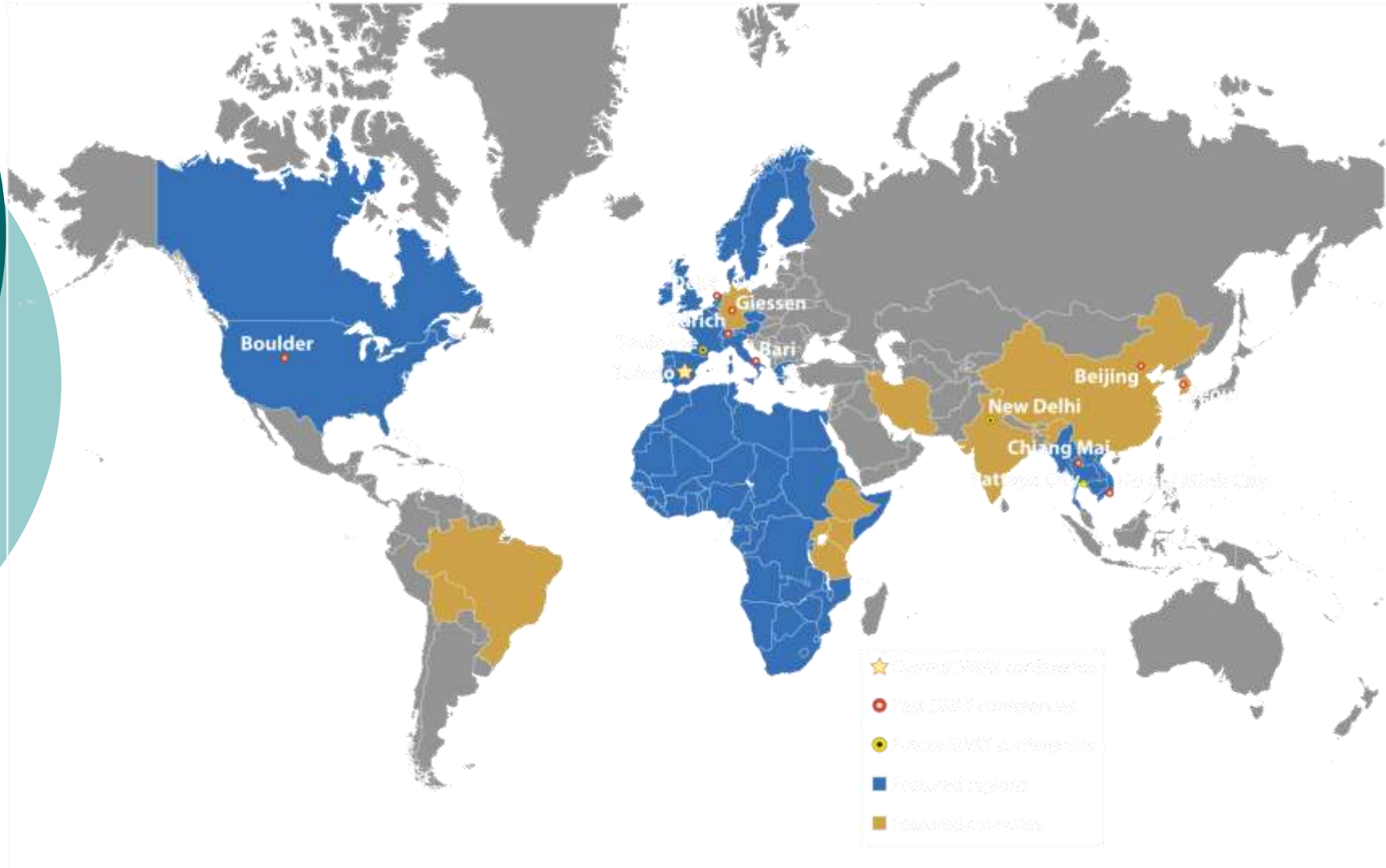
○ Application per region

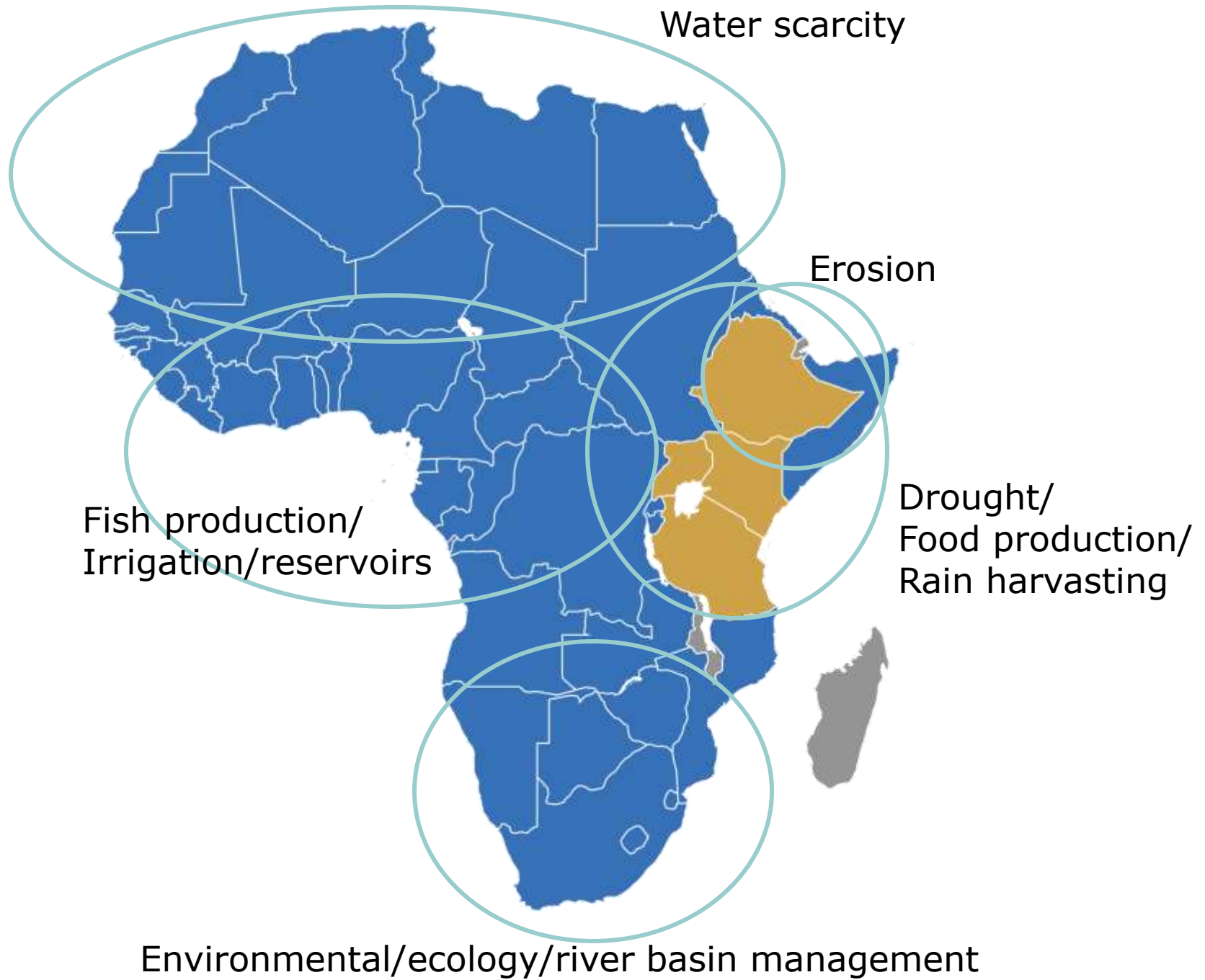
- Nile countries
- West Africa
- North Africa
- South Africa
- Africa

○ Applications per topic

- Data scarcity
- Erosion modeling
- Land use studies
- Climate change studies
- Model developments

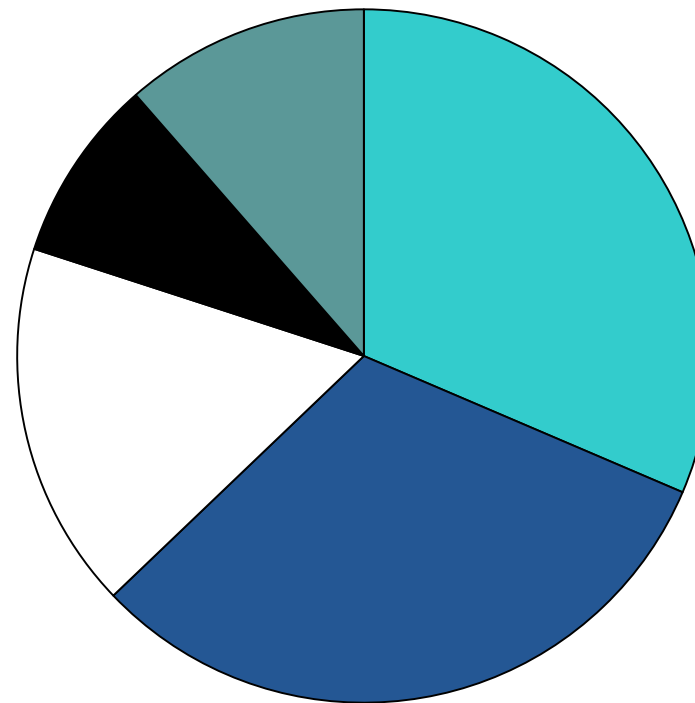
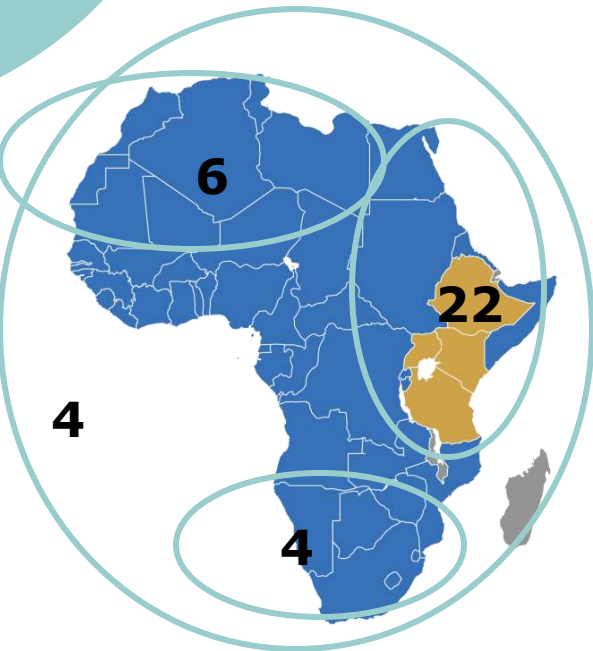
○ Conclusions





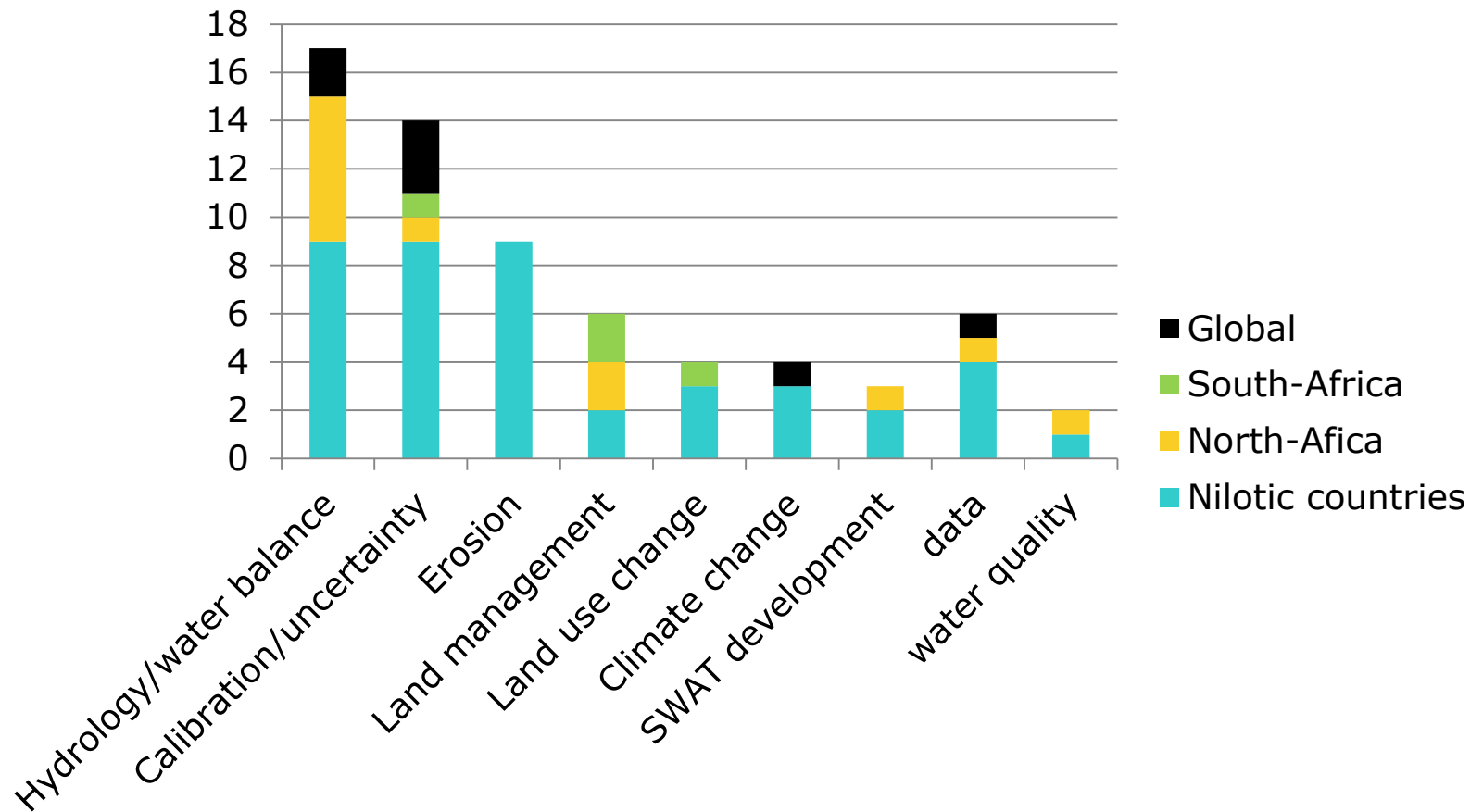
Paper overview per region

35 journal papers



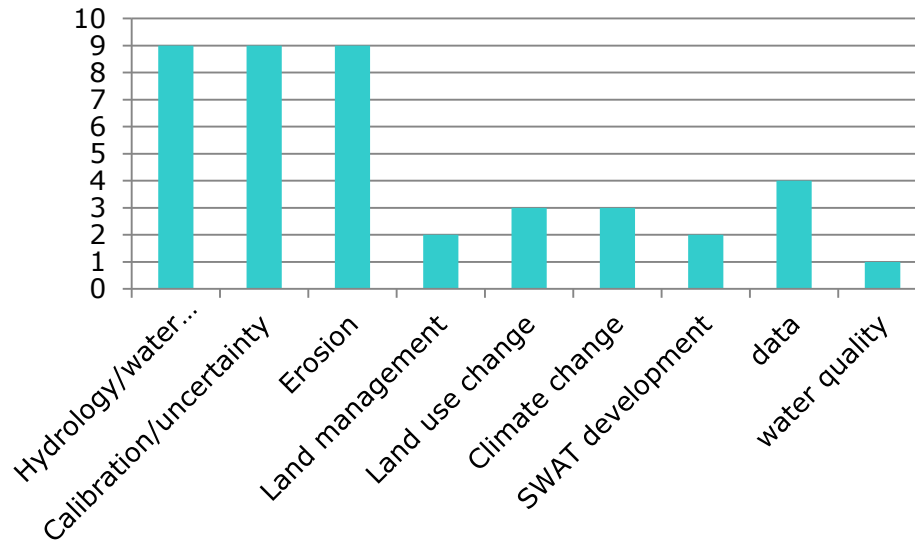
- Nilotic (Ethiopia)
- Nilotic (other)
- North Africa
- South-Africa
- Global application

Topics



Region: Nile basin countries

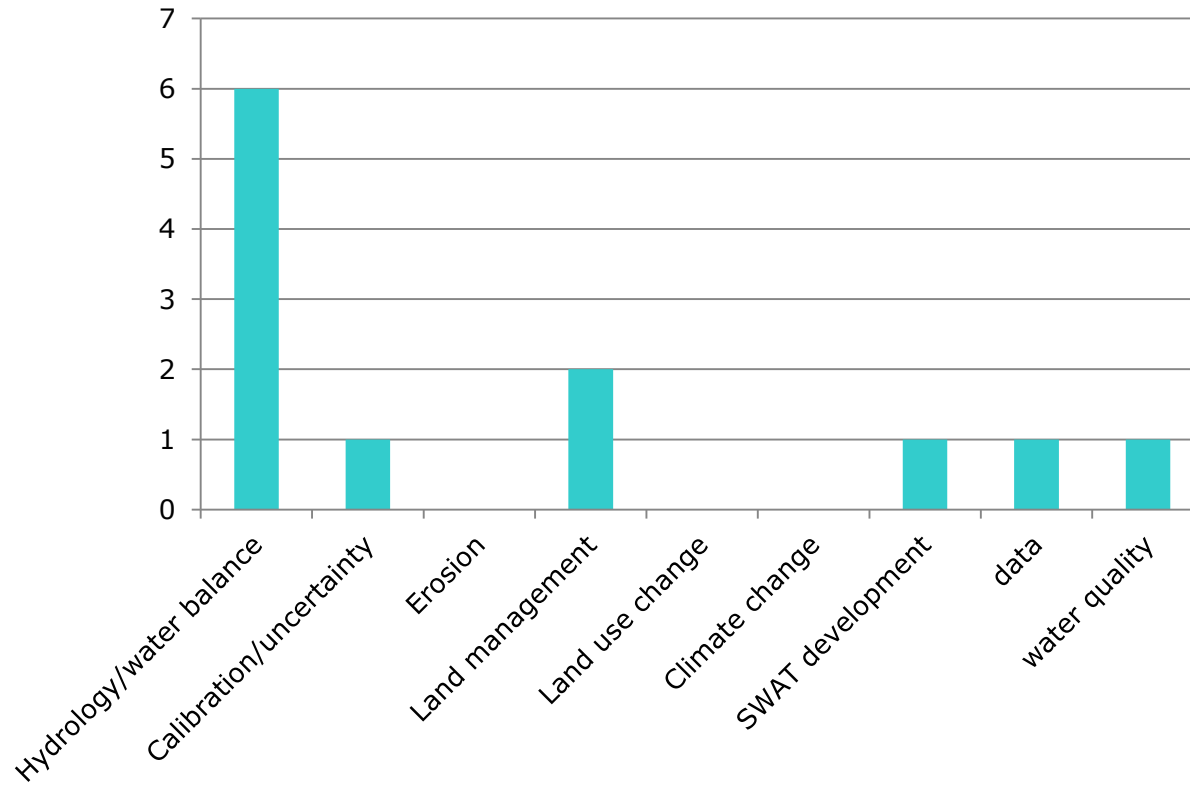
- Concentration of applications in the Nile, more specifically Ethiopia



Data scarcity is important issue
Erosion studies

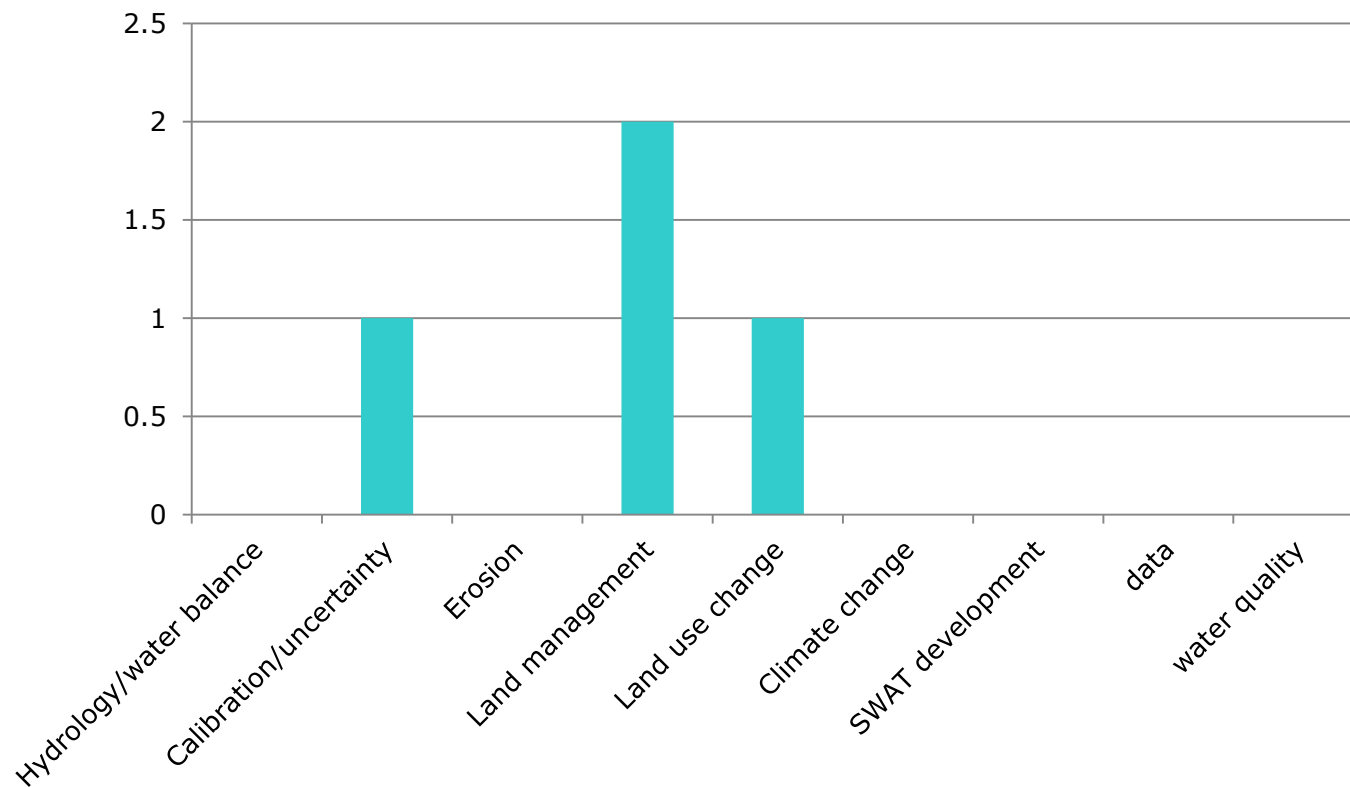
Region: North Africa

- Importance of water resources



Region: South-Africa

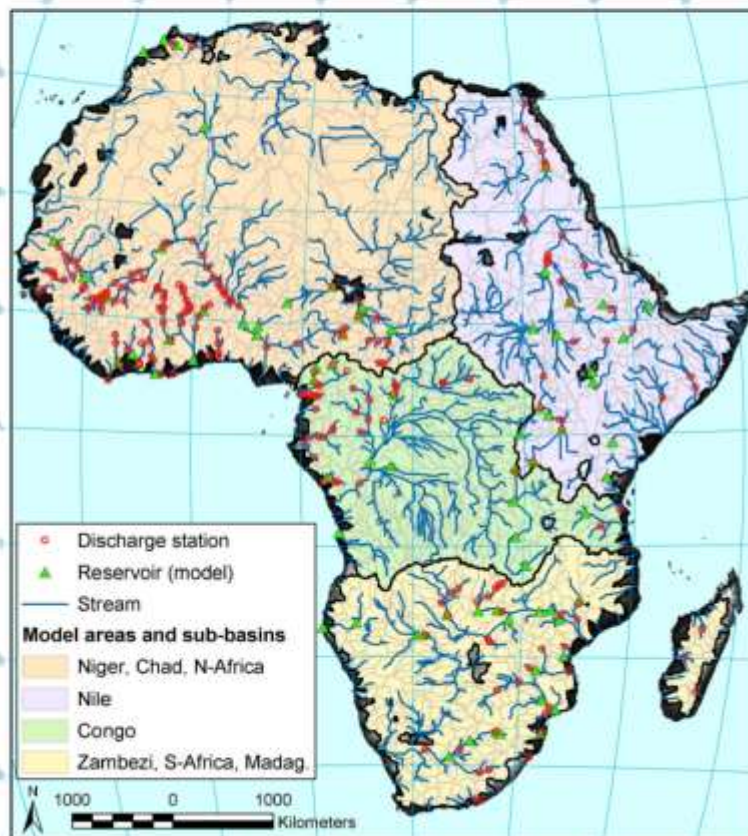
- Interesting papers on crop modeling



Global application for Africa

eawag
aquatic research

The Africa continental model



- ◆ Delineation of Africa into 1496 sub-basins using the **ArcSWAT interface**
- ◆ Use dominant soil, landuse and slope in each subbasin
- ◆ 64 reservoirs with a volume $>1\text{km}^3$ are included
- ◆ 208 stations with monthly observed river discharge

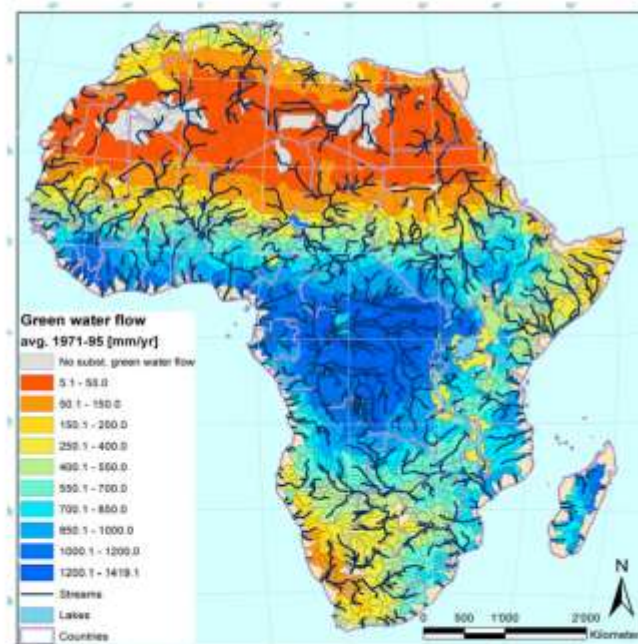
- ◆ Divided the continent into **4 model areas**, which are independently calibrated and validated but within the same model frame

Global application for Africa

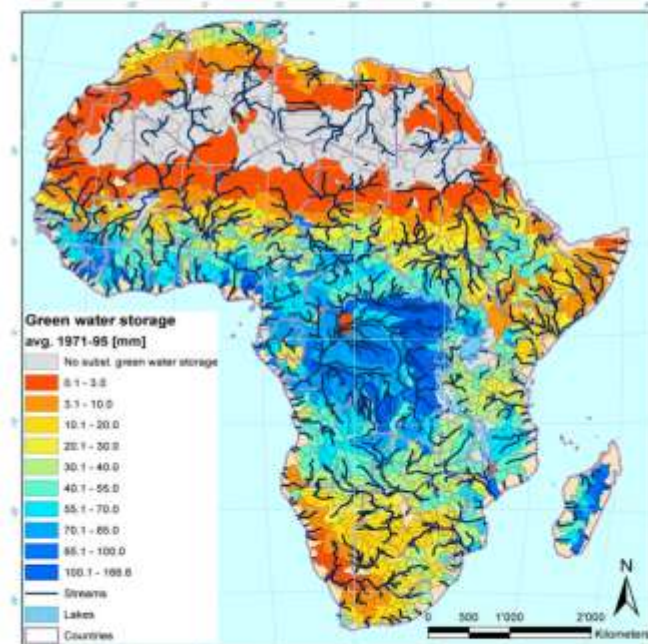
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The continental picture: Green water

Green water flow



Green water storage

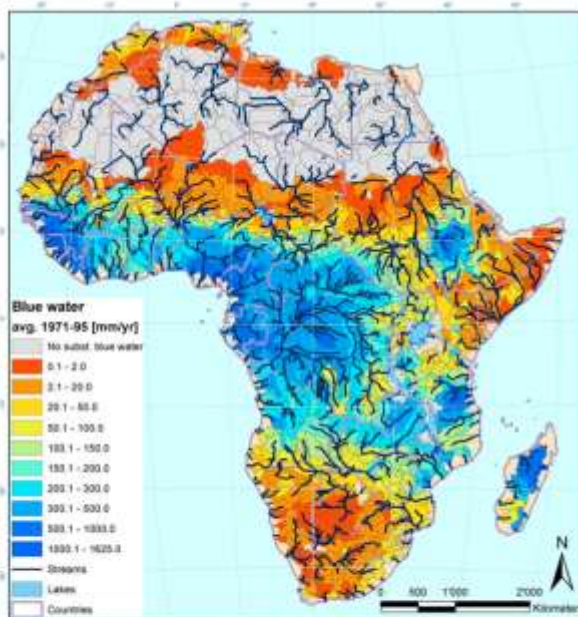


Global application for Africa

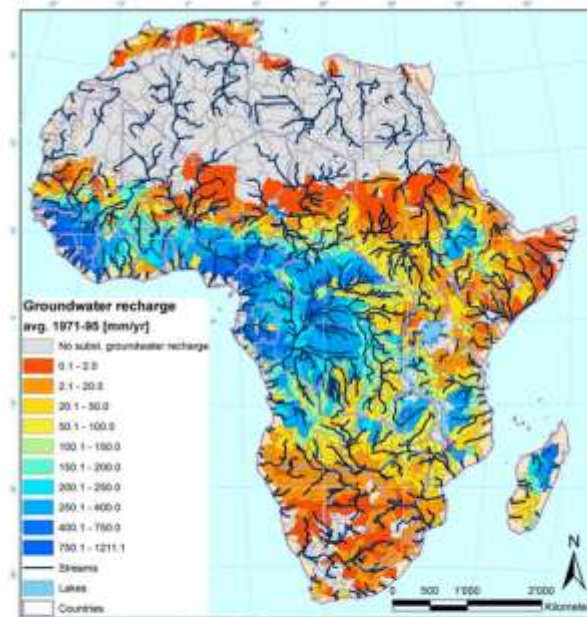
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The continental picture: Blue water

Blue water flow



Groundwater recharge



Global application for Africa

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aquatic research logo

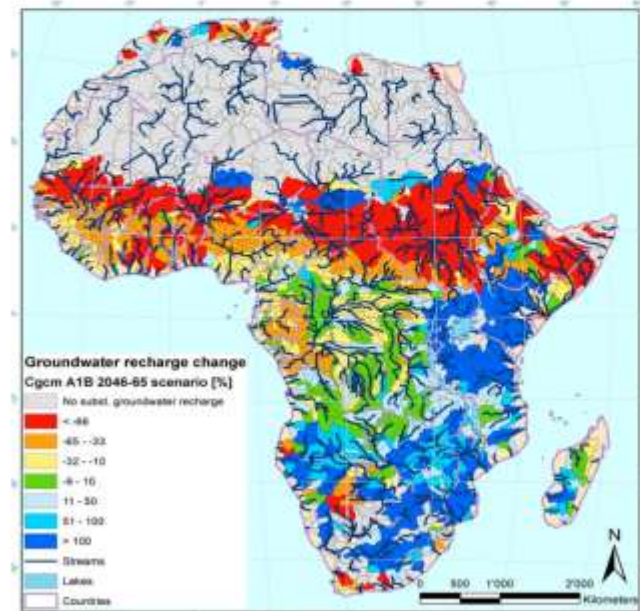
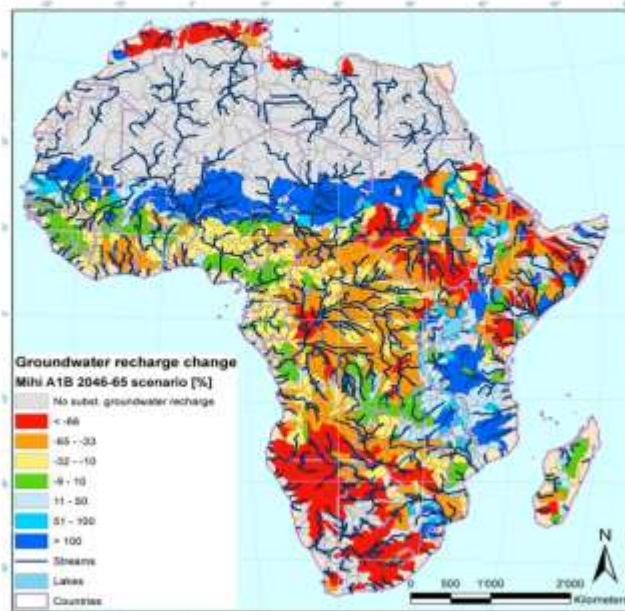
Changes in groundwater recharge

A1B emission scenario

MIROC3.2(hires)

2046-2065

CGCM3.1(T63)



Content

- Application per region

- Nile countries
- West Africa
- North Africa
- South Africa
- Africa

- **Applications per topic**

- **Hydrology/water resources/calibration**
- **Erosion modeling**
- **Land use studies**
- **Climate change studies**
- **Model developments**

- Conclusions

Hydrological processes/water resources/calibration

- Water balance component often not reported
- Parameter values often not reported
 - CN are often lowered
- Monthly higher NS than daily
- Daily NS-efficiencies typical ranges
 - Ethiopia 0.5-0.8
 - Lake Victoria 0.3-0.7
- Data problems, especially rainfall

Erosion

- Most application in Ethiopia
- Calibrations often on single gage
- NSE values are OK
- Very high erosion in Ethiopia (>150 T/ha)



SWAT model performances

Variables	Performance indicators	Time step	Study cases				
			NYM	SIMIYU	KOKA	KAGERA	ANJENI
Runoff	Calibration, CE (%)	Daily	54.6	38	68	-	-
		Monthly	65	82	-	50	-
	Validation, CE (%)	Daily	68	30	63	-	-
		Monthly	77.4	81	-	37	-
Sediment yield rate	Calibration, CE (%)	Daily	56	24	66	-	-
		Monthly	-	83	-	43	81
	Validation, CE (%)	Daily	-	16	68	-	-
		Monthly	-	80	-	-	79
	Calibration, BIAS (%)	Monthly	-	-	-	-	28
	Validation, BIAS (%)	Monthly	-	-	-	-	30

Parameters

SWAT sediment parameters sensitivity results in different study cases

SN	Parameter	Description of parameter	NYM Rank	SIMIYU Rank	KOKA Rank	ANJENI Rank
1.	Csp	Linear re-entrainment parameter for channel sediment routing	1	2	1	1
2.	CCH	Channel cover factor	2	5	2	2
3.	P_USLE	USLE support practice factor	3	3	3	4
4.	KCH	Channel erodibility factor [cm/h/Pa]	4	6	4	3
5.	spexp	Exponential re-entrainment parameter for channel sediment routing	5	4	5	5
6.	C_USLE	Minimum USLE cover factor	6	7	6	6
7.	BIOMIX	Biological mixing efficiency.	7	1	7	-
8.	K_USLE	USLE soil erodibility factor [t.ha.h./(ha.MJ.mm)]	10	10	10	-
9.	RSDIN	Initial residue cover [kg/ha]	10	10	10	-

Land use change modeling

- Most application around lake Victoria
- Little attention for processes/parameters/balances at HRU level



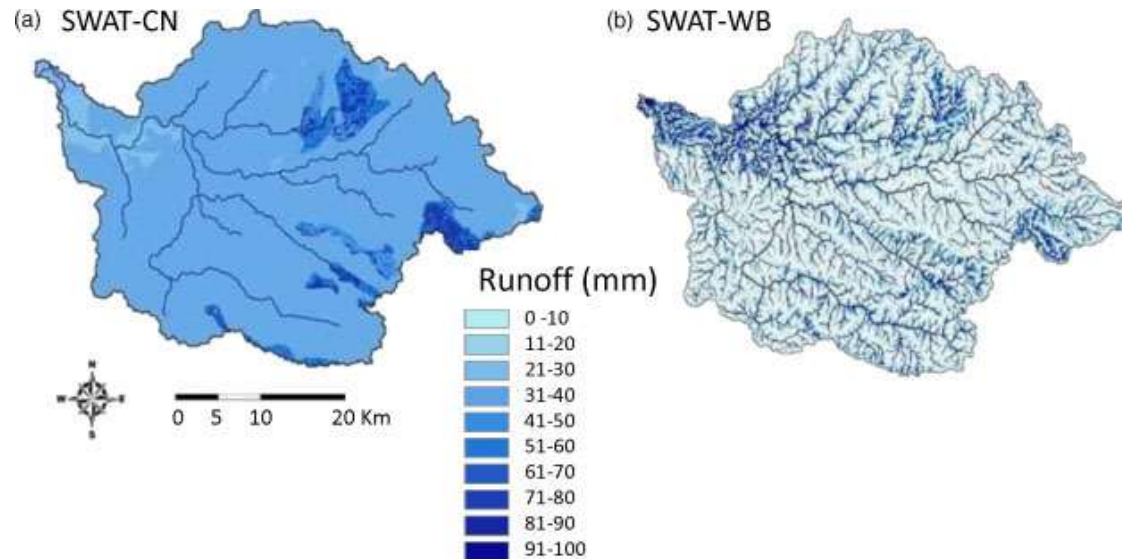
Climate change modeling

- Applications in the Nile basin
+ global application
- High sensitivity to climate change



SWAT developments

- SWAT-WB: new concept, Ethiopia
 - Easton et al. (2010) White et al. (2011)



- SWAT-RH: Rain harvesting, Tunisia
 - Ouesser et al. (2009)

**5-day SWAT Workshop at the ICRAF Campus in Nairobi, Kenya;
participants: 8-Kenya, 2-Tanzania, 2-Uganda**



http://gisweb.ciat.cgiar.org/wcp/swat_training_workshop.htm

**Other workshops have been conducted including one in
S. Africa in April 2011 and several led by me**

UNESCO/FRIEND Nile project:

SWAT workshops in 2007/2008/2009/2011



Conclusion



- Regional imbalance: many applications in East-Africa, little work in West-Africa
- Many applications on erosion (especially in Ethiopia and other Nile countries), little work reported on water quality
- Data scarcity often reported as issue
 - Large use of global datasets (many thanks to EAWAG)
 - No applications using remote sensing for model validation
- Little attention for crop model (except SA)
- No applications on drought