

# Inter-comparison and assimilations of Remote sensing ET into spatially distributed Hydrological model (SWAT), Upper Blue Nile River Basin

BELAYNEH T. ABEBE, Tadesse A. Abitew, Ann van Griensven

*Vrije Universiteit Brussel, UNESCO-IHE*

SWAT 2015, Sardinia

June 24



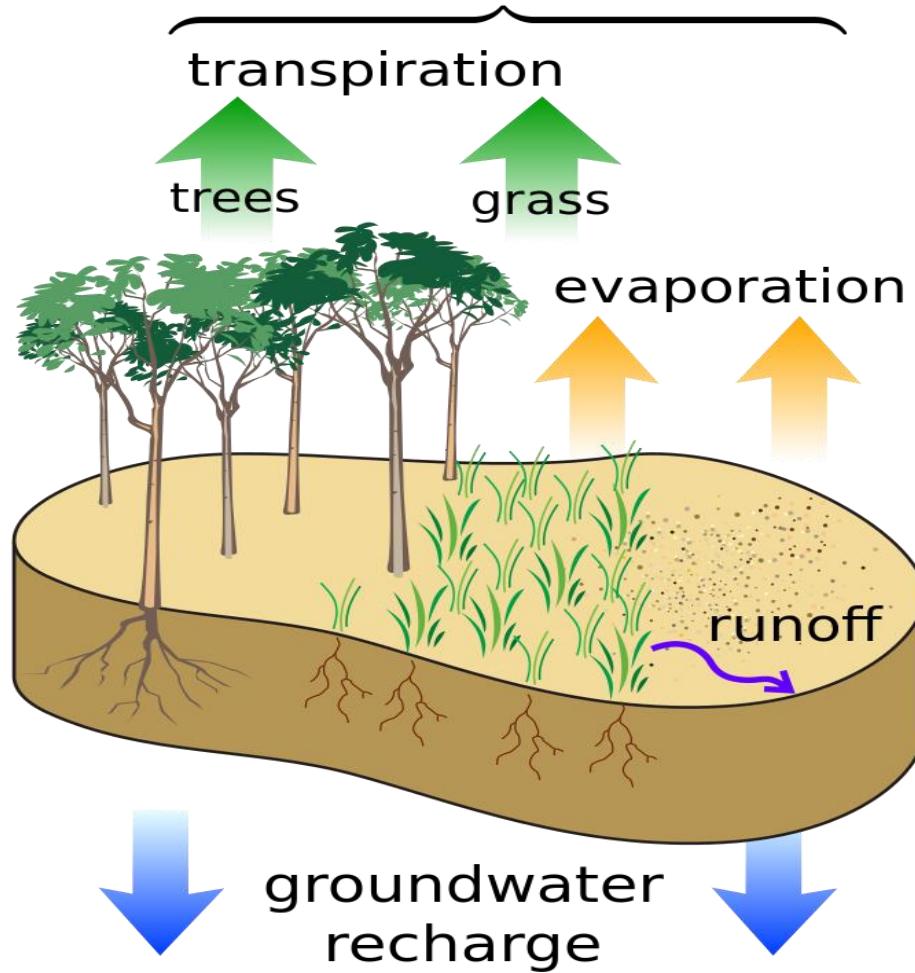
Vrije  
Universiteit  
Brussel

UNESCO-IHE  
Institute for Water Education



evapotranspiration =  
transpiration + evaporation

47-62% of rainfall

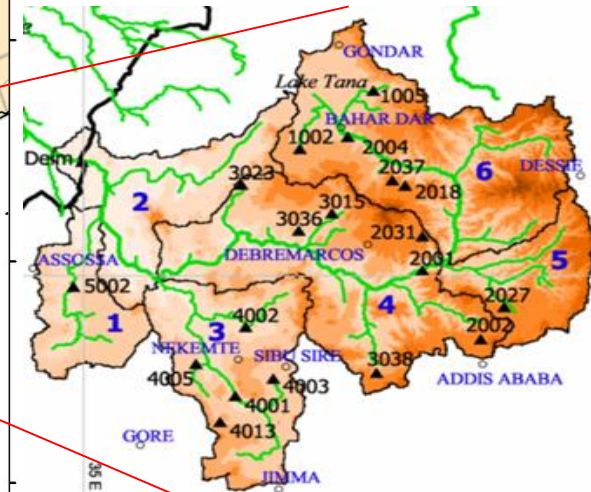
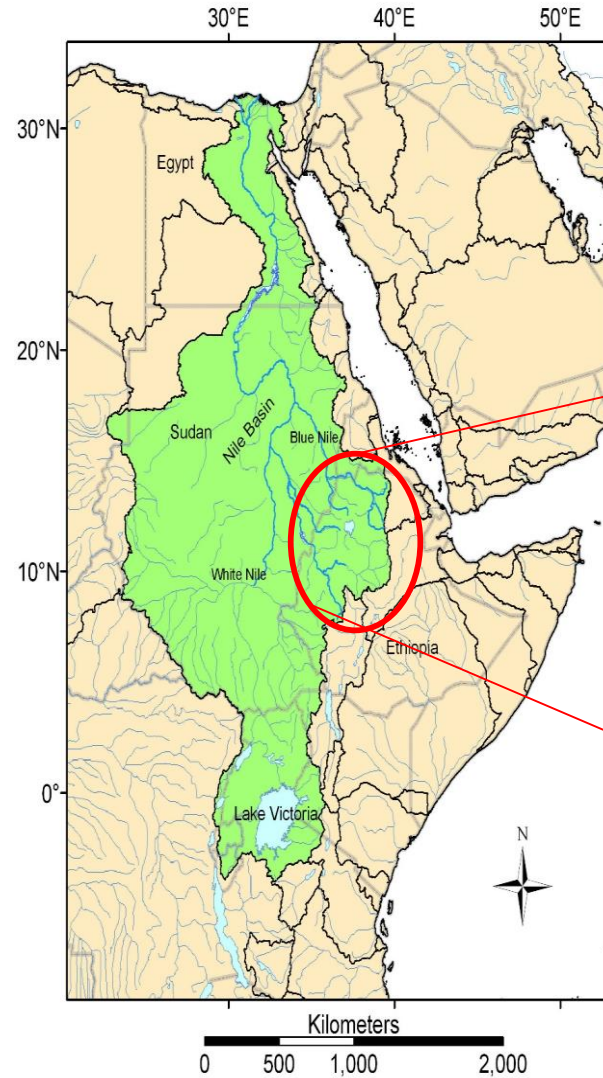


## Case study:

- Area = 175, 000 km<sup>2</sup>
- Tributary of Nile river
- contribute about 60% to river Nile
- Agriculture (74.37%) & forest (25.63 %)

## Objective

- To inter compare & assimilate RS ET into SWAT model for Blue Nile river basin.

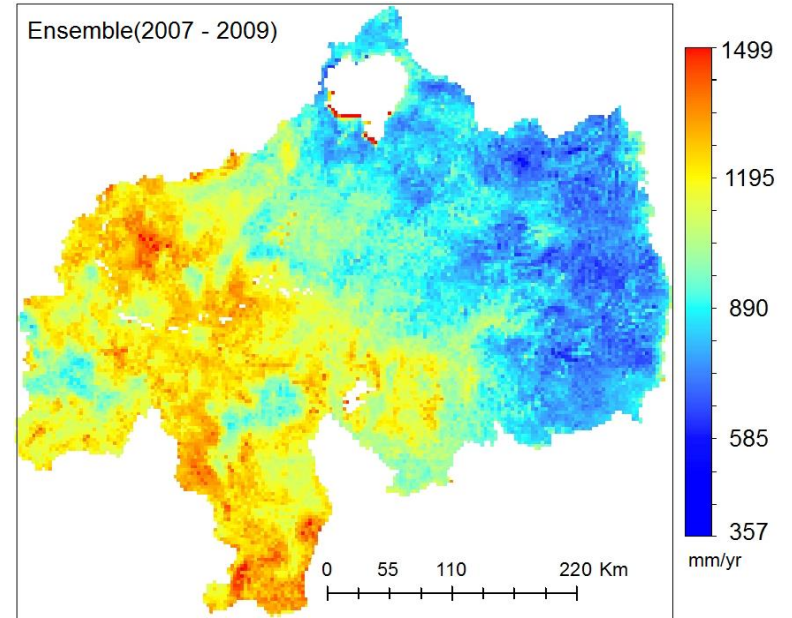
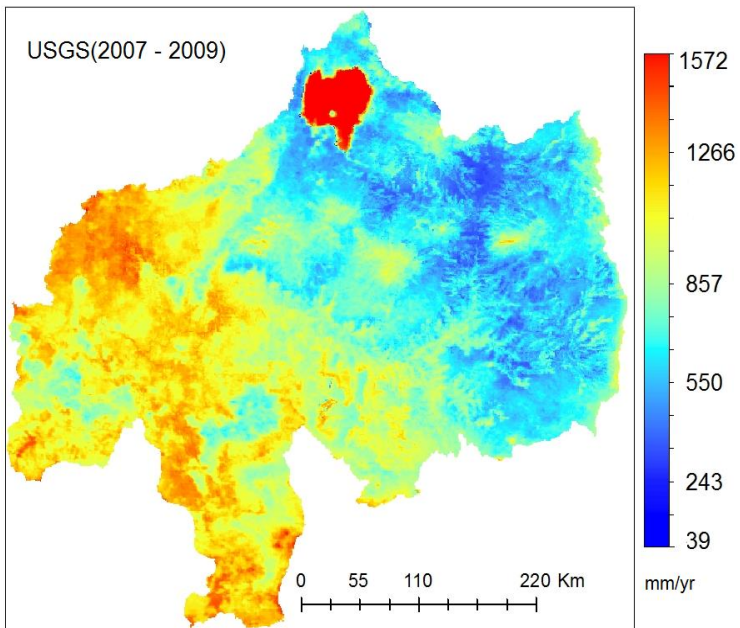
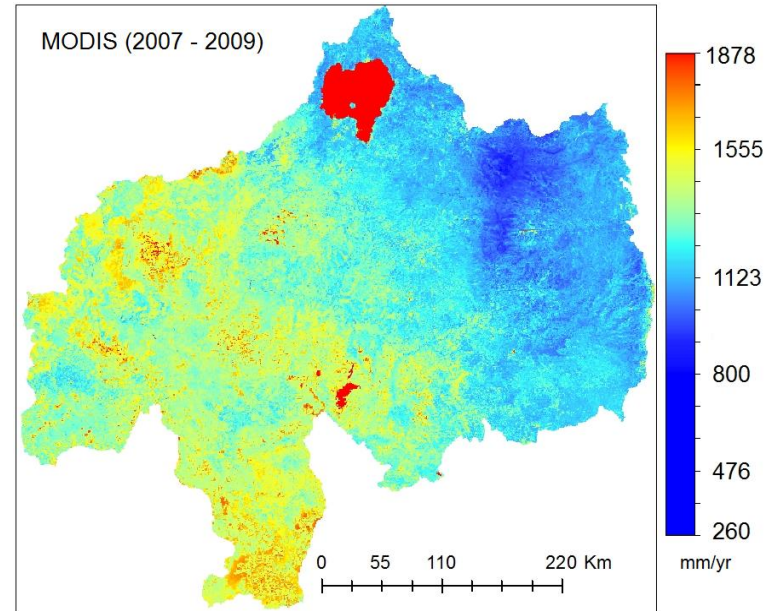
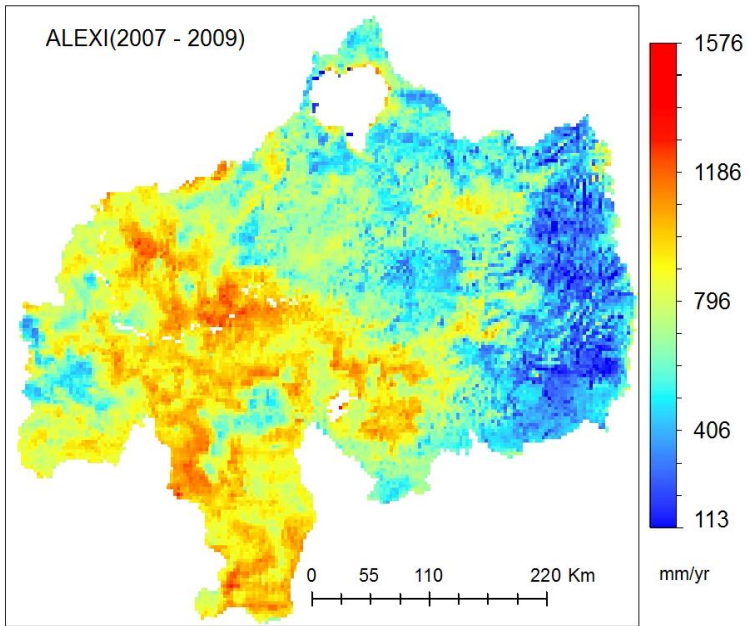


source: Kim and Kaluarachchi, 200

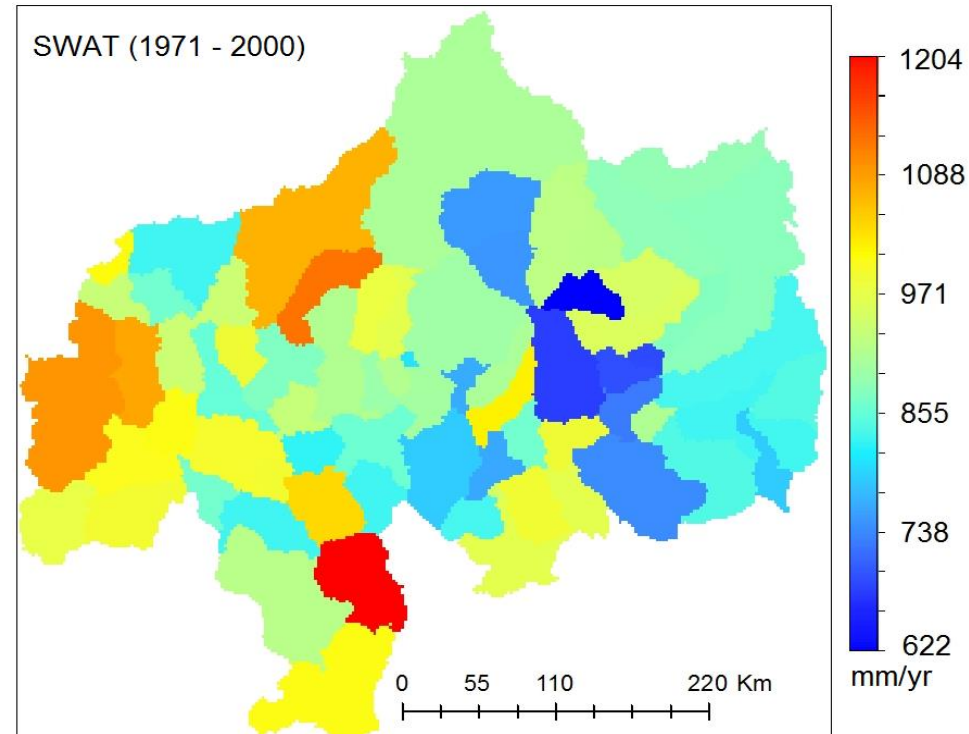
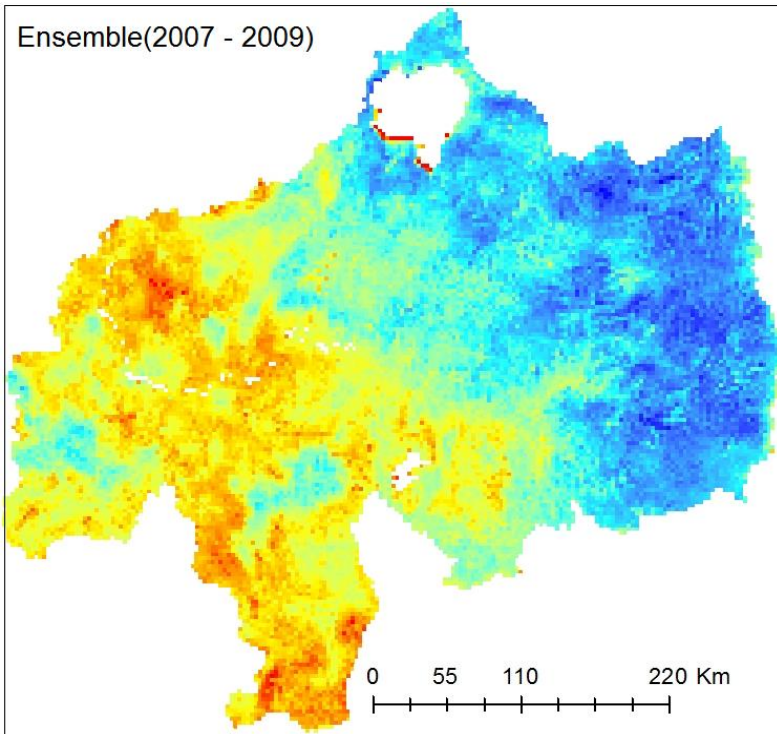
# ① Inter – comparison of ET:

1. Basin, sub-basin scale; -> Spatial
2. Monthly -> Temporal
3. Based on Landuse classes

# ② Integration into SWAT Model

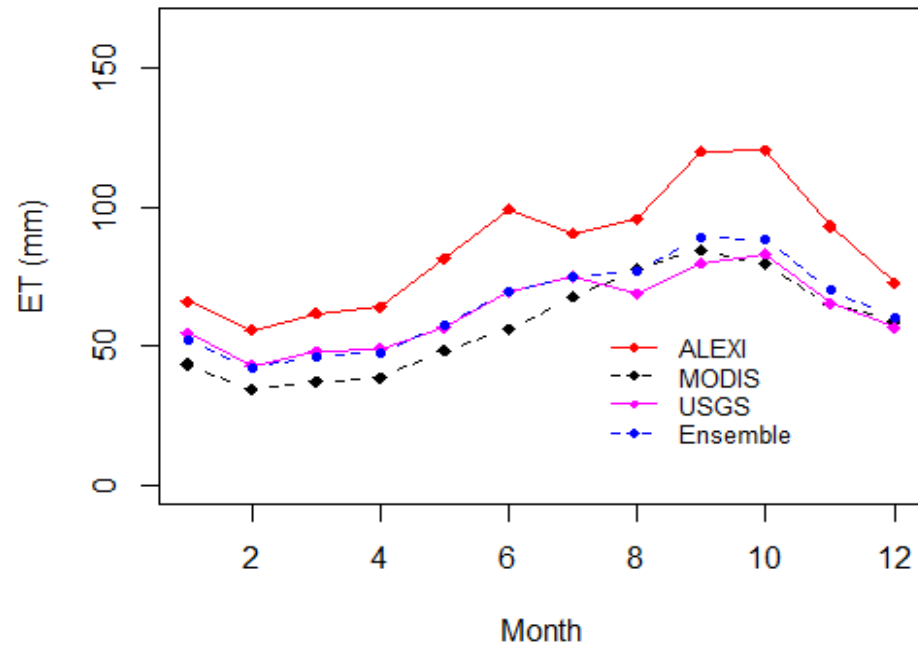


# Hydrological Model ET versus ensemble mean

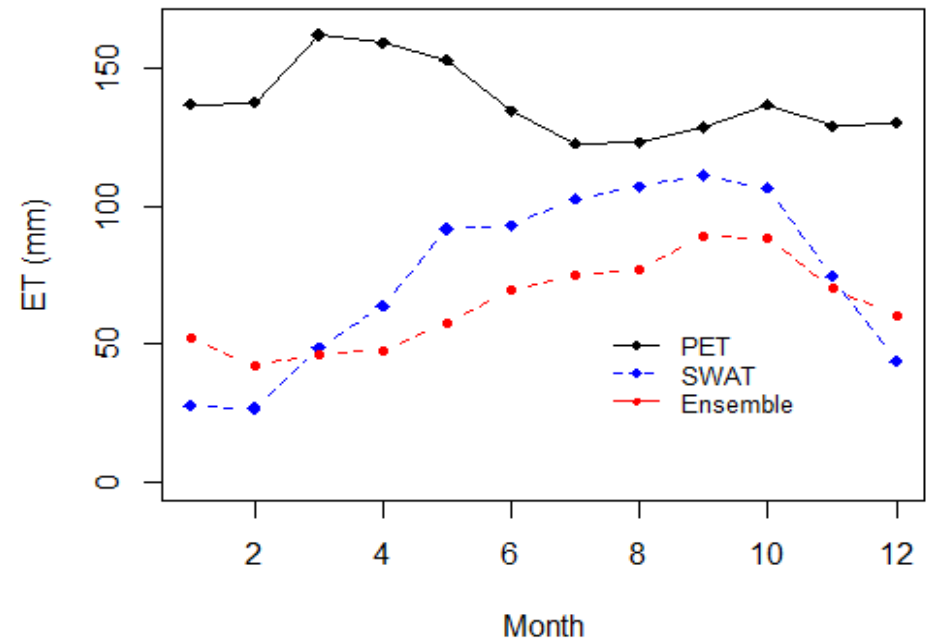


# Comparison of ET at watershed Scale

## Remote sensing Seasonal ET



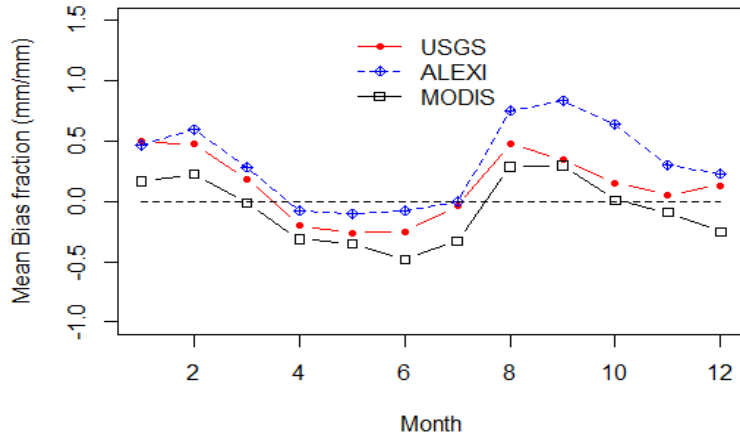
## Seasonal PET & ET (SWAT & Ensemble)



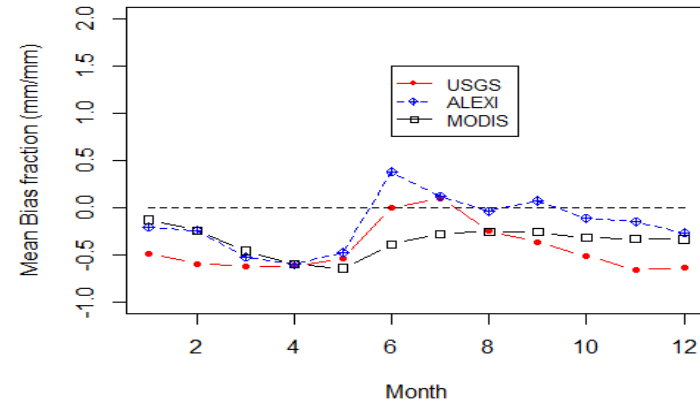
# BIAS calculations

SWAT perform very well during cropping season & agricultural Landuse.

Mean Monthly Bias Fraction (sub 81, Agriculture)

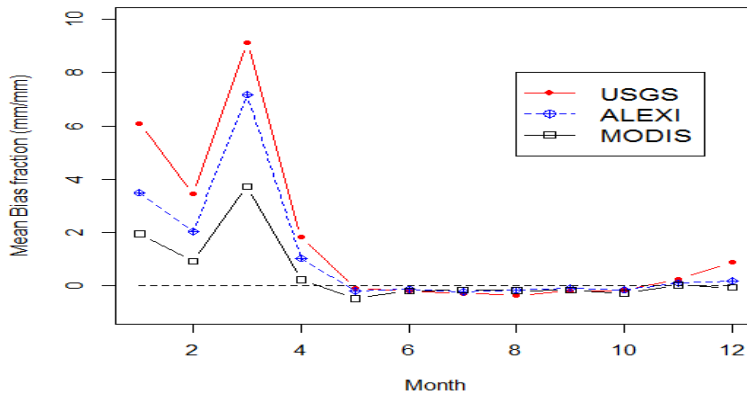


Mean Bias Fraction (sub 38, Agriculture)

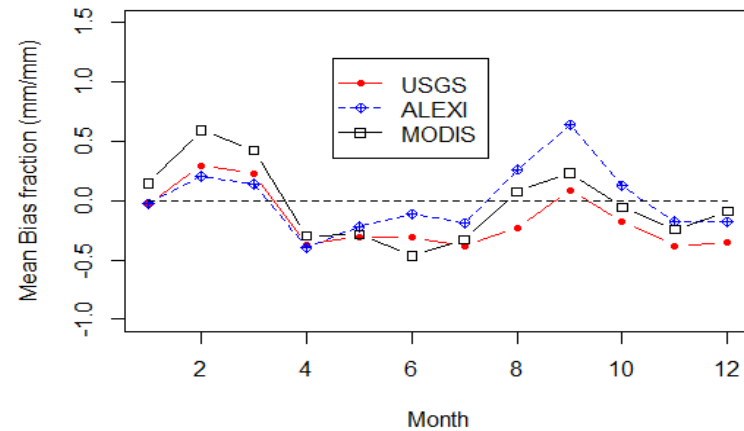


SWAT strongly underestimate ET for forest Landuse (<<max up to 900%)

Mean Monthly Bias Fr (sub 11, Forest)



Mean Bias Fraction (Lake Tana)





# ① Inter – comparison of ET:

1. Basin, sub-basin scale; -> Spatial
2. Monthly -> Temporal
3. Based on Landuse classes

# ② Integration into SWAT Model

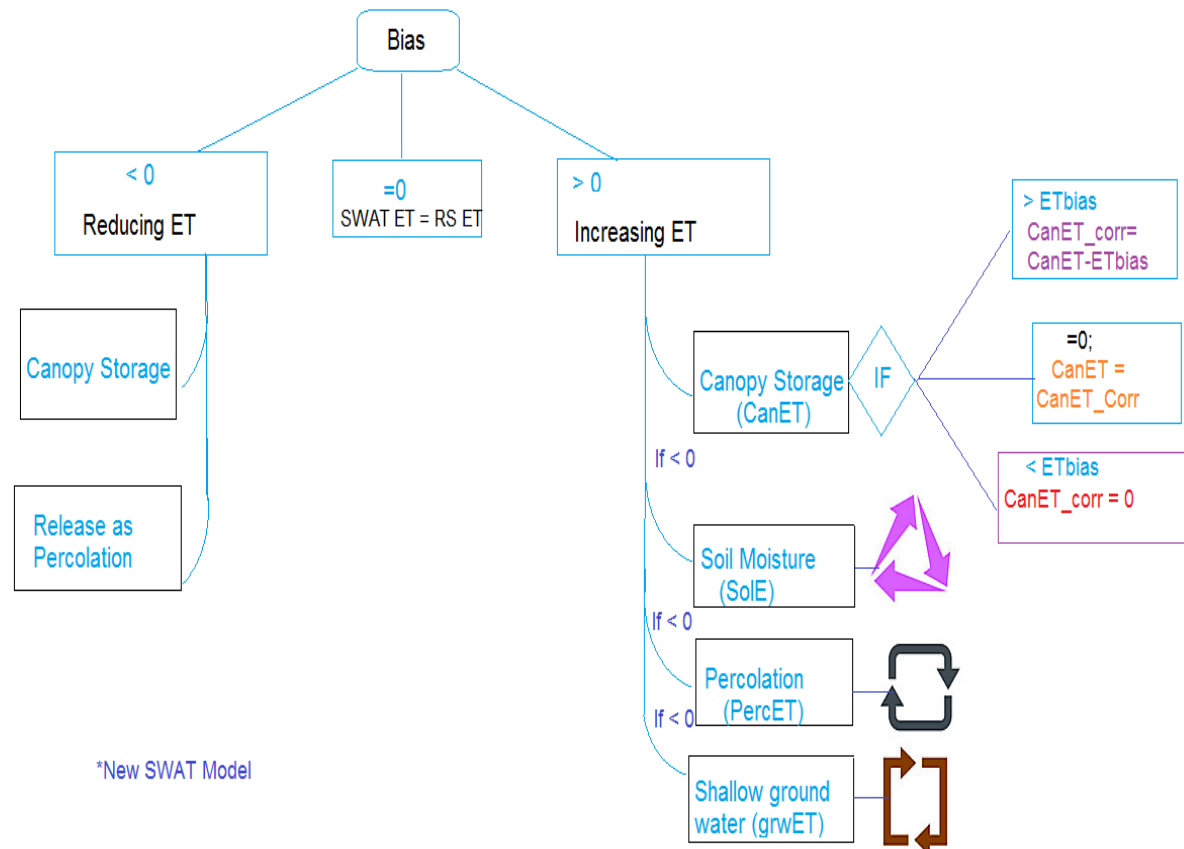
- ❖ STEP 1: Mean Monthly bias of ensemble is calculated
- ❖ STEP 2: bias-correction on daily ET simulation
- ❖ Direct integration **# impossible**  
**Because** ET is a process!!!
- ❖ Or what....



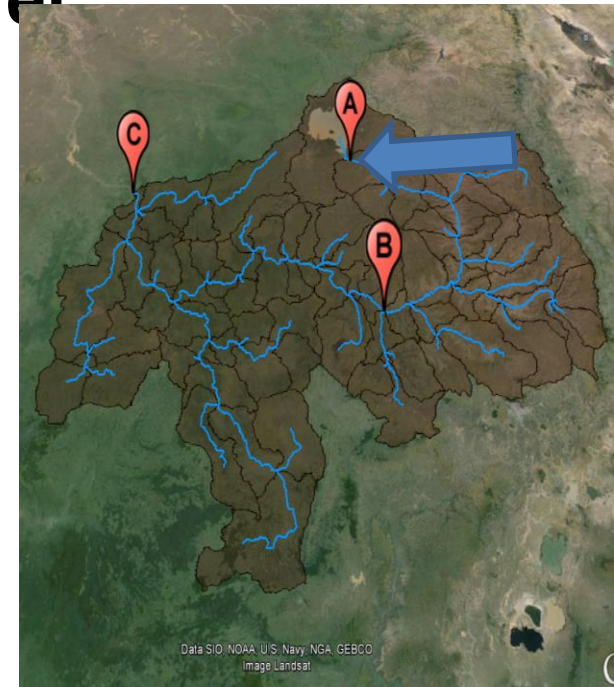
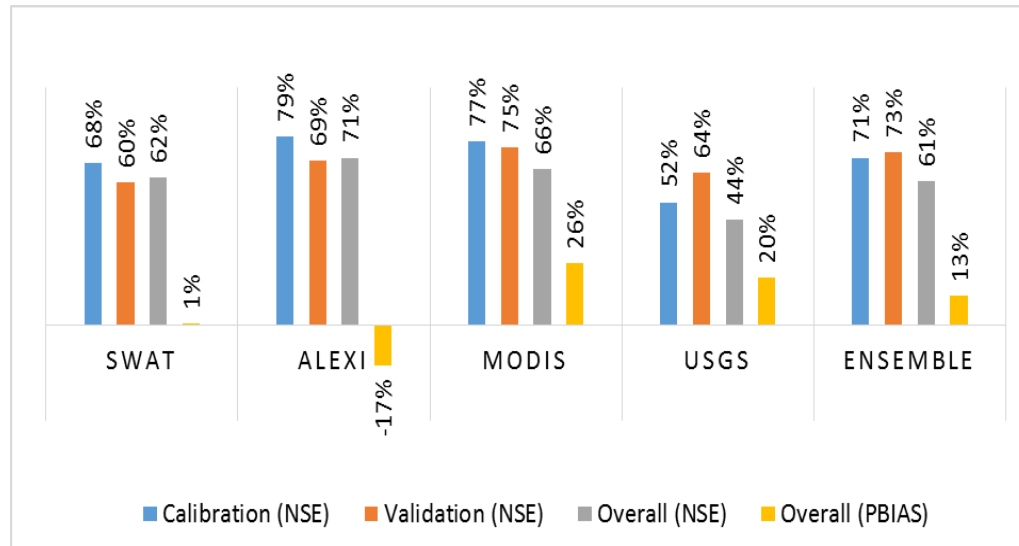
# Integration Approach:

## 1. Bias Analysis

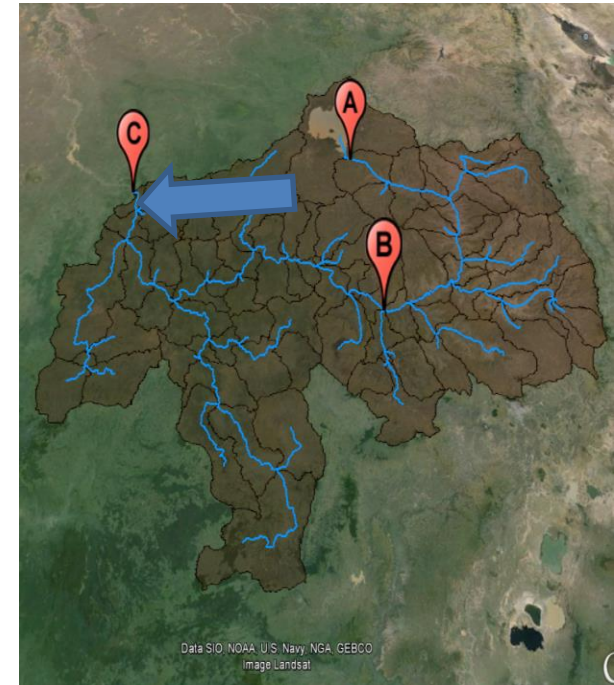
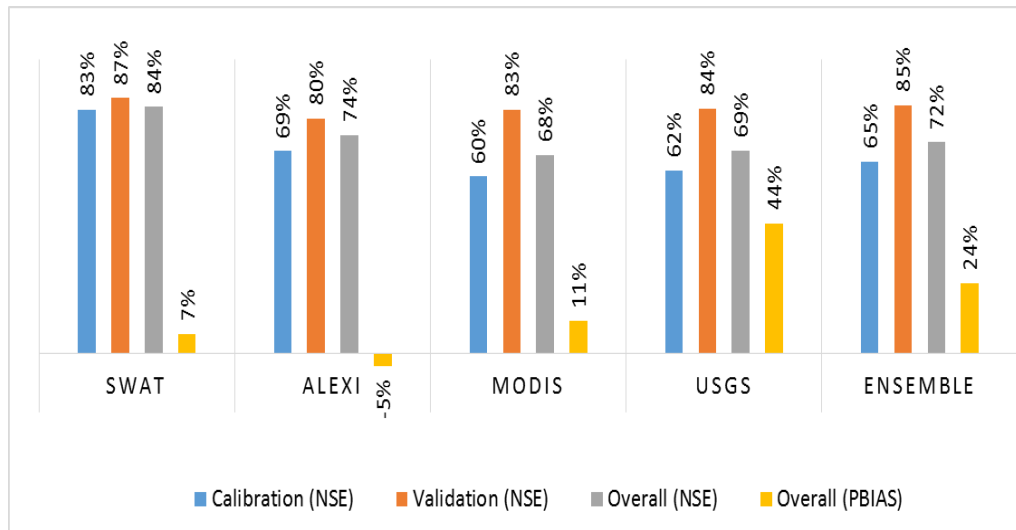
## 2. Developing New algorithm (SWAT-RS)



# Integration into the new SWAT model



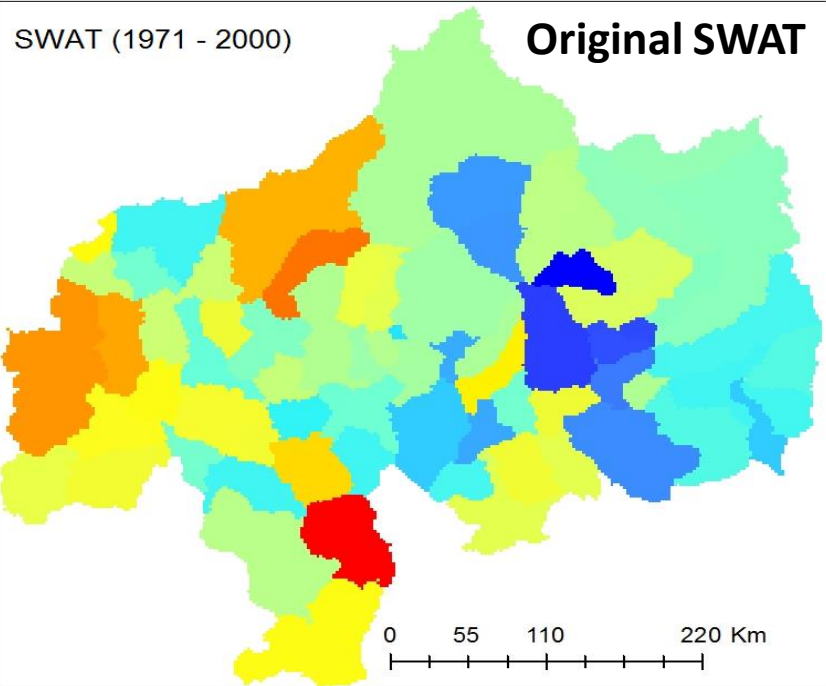
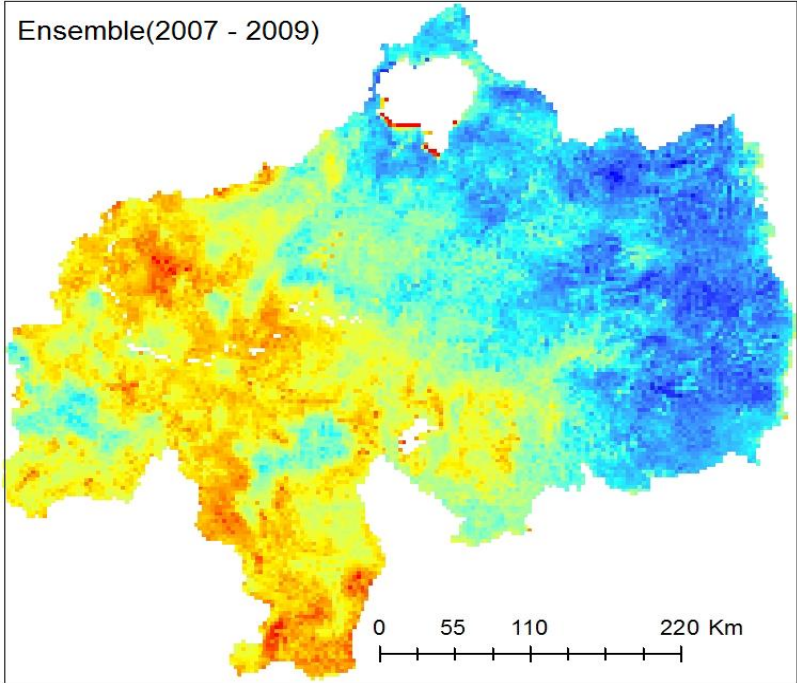
# Results for flow (C: Sudan border)



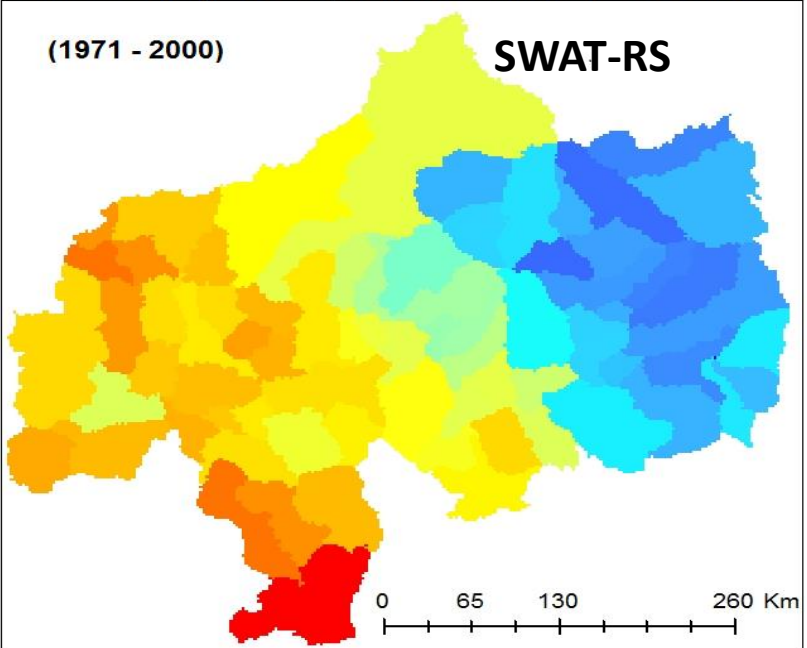
# Improved spatial pattern

## Remote sensing ensemble

Ensemble(2007 - 2009)



Annual ET Map After Integration of Ensemble ET into SWAT



# Conclusion

- High difference and bias within different ET products
- BUT: often similar trends and spatial patterns
- SWAT is strongly underestimating the ET of forest
- After bias-correction with ensemble mean, we obtained better spatial patterns for the SWAT-RS model



# Welcome at the OpenWater symposium!!

*September 16-17, Addis Ababa, Ethiopia*



RESEARCH PROGRAM ON Water, Land and Ecosystems



Vrije Universiteit Brussel

## Already Built Models:

	ET Products			
	ALEXI	MODIS	USGS (SSEBop)	SWAT
General	Land surface Temperature (LST)	Based on Leaf Area Index	LST	Mass balance (continuity equation)
Spatial Resolution	0.027 Deg	0.0083 Deg	0.009 Deg	81 SUB & HRUS WATCH climate data (Daily)
Temporal resolution	Monthly	Monthly	Monthly	
Availability	2007 - 2011	2002 - 2011	2001 - 2011	1965 - 2000
Format	.tif	.tif	.tif	.out
Publicity	Under development	Public	public (Senay et al., 2011)	World wide used
References	(Anderson et al., 2011)	(Mu et al., 2009)		(Allen et al., 2011)

- NB:
- ALEXI = Atmosphere Land Exchange Inverse
- MODIS = MODerate-resolution Imaging Spectroradiometer
- SSEBop = Simplified Surface Energy Balance Operational
- USGS = The United States Geological Survey