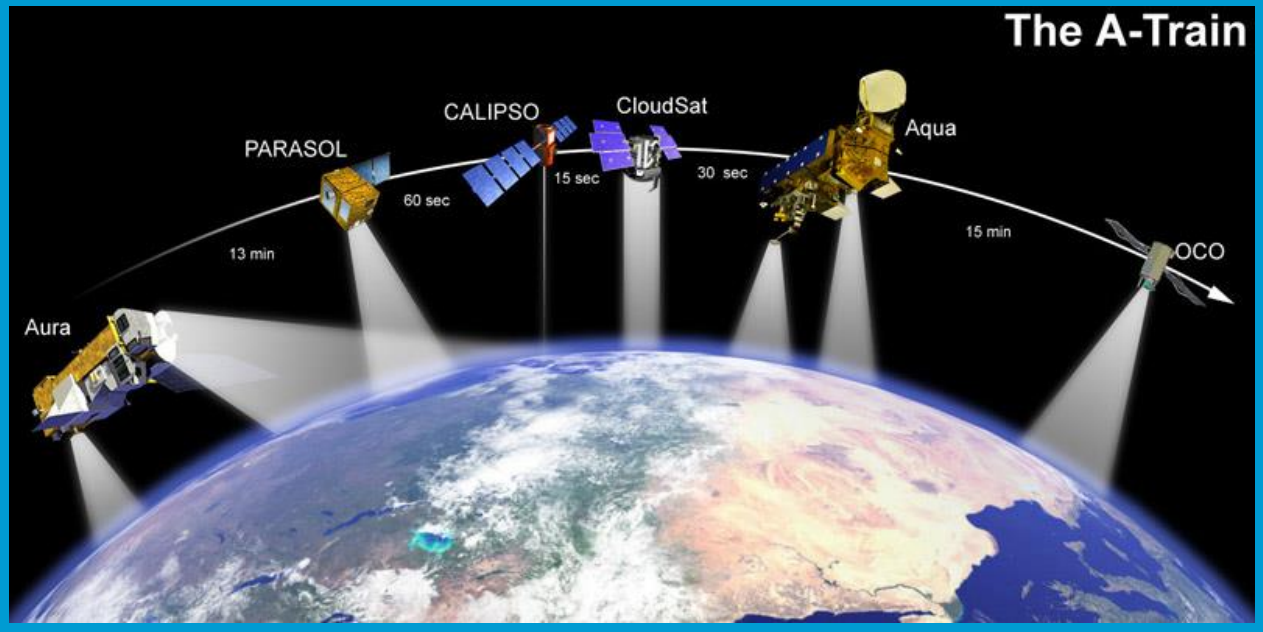
Water Accounting and the Need for Global Ensemble ET Data Products

Wim Bastiaanssen



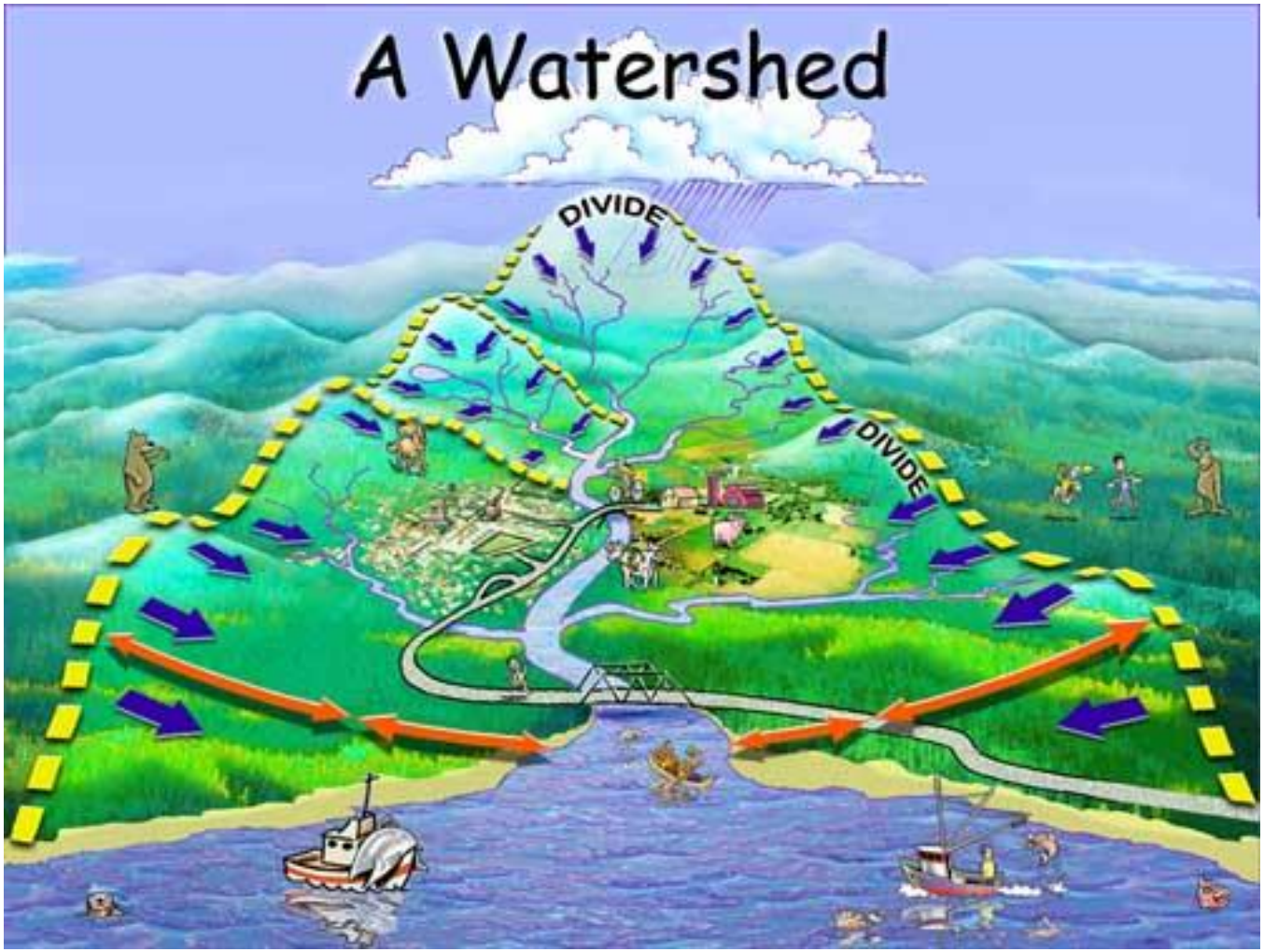
UNESCO-IHE
Institute for Water Education

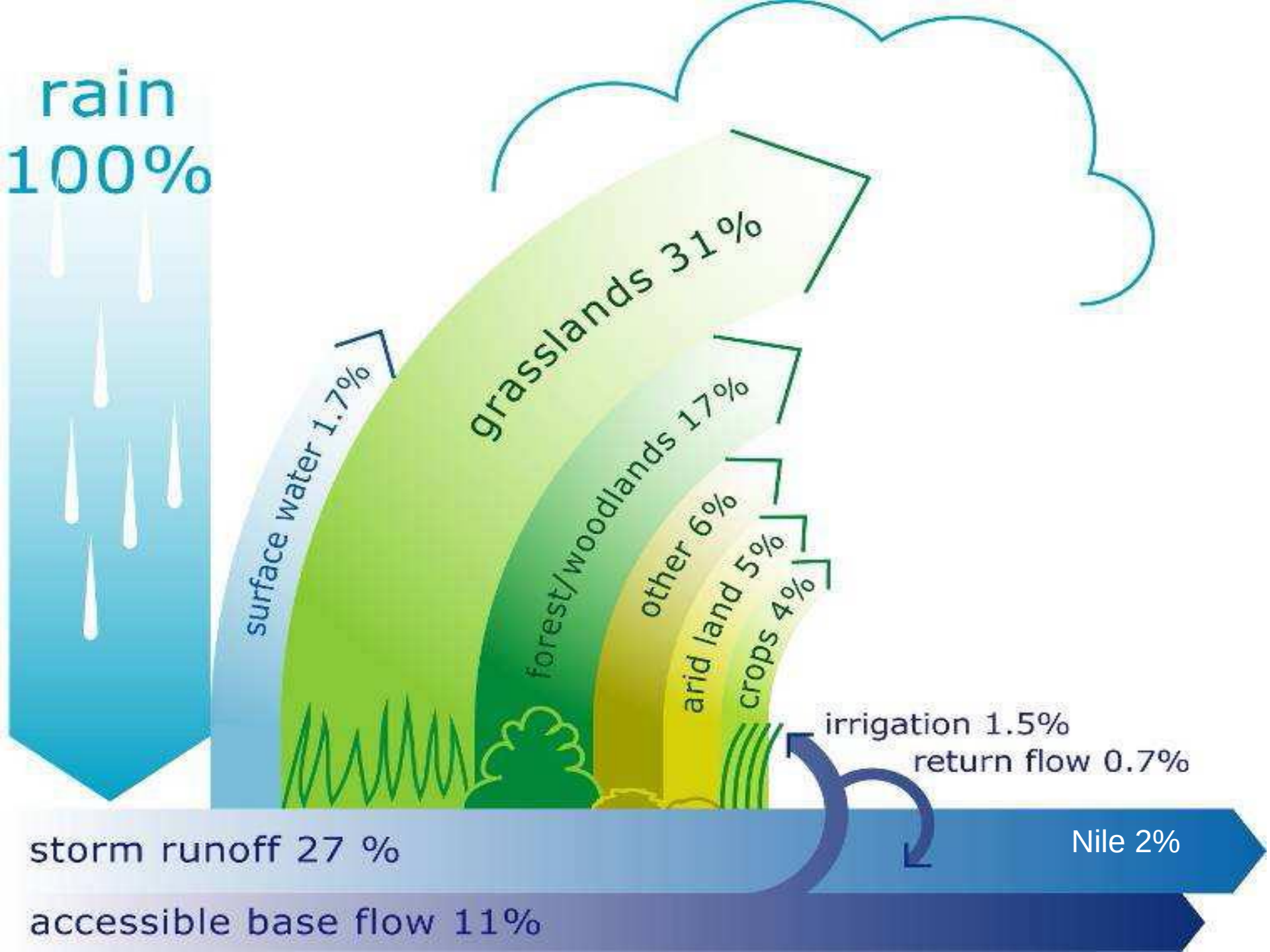
WINROCK INTERNATIONAL
Putting Ideas to Work

IWMI International Water Management Institute

TU Delft Delft University of Technology

River basin and watersheds as a water resources planning unit




rain
100%
surface water 1.7%
grasslands 31%
forest/woodlands 17%
other 6%
arid land 5%
crops 4%
irrigation 1.5%
return flow 0.7%
storm runoff 27 %
Nile 2%
accessible base flow 11%

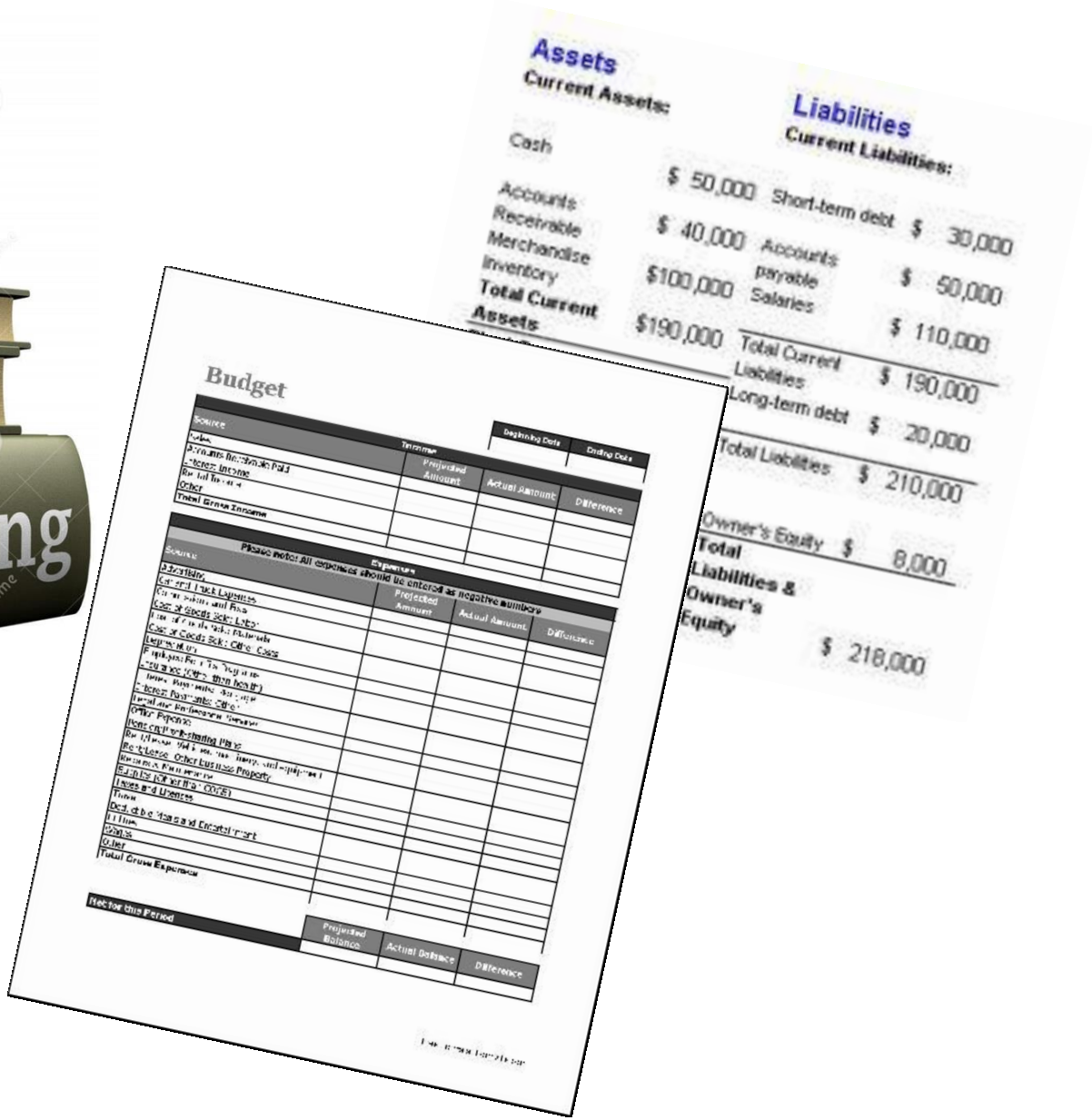
Water Accounting+

independent estimates of water flows, fluxes, stocks, consumption and services

IWMI
International Water Management Institute

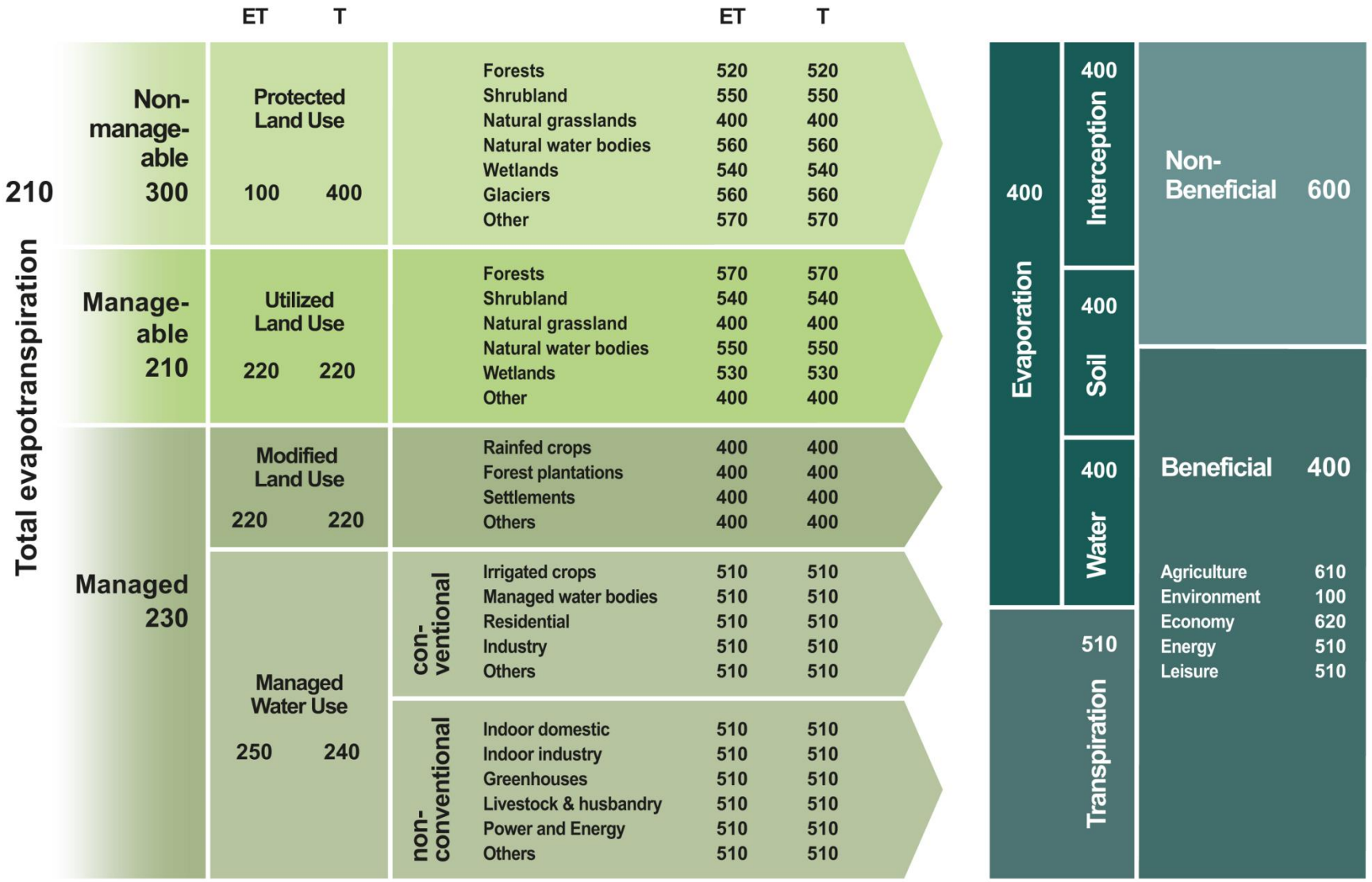
UNESCO-IHE
Institute for Water Education

Accounting sheets



Sheet 2: Evapotranspiration (km³/yr)

Basin:
Period:



Thermal satellites

System	Spatial resolution	Temporal resolution	Operational since
Landsat	100 m x 100 m	16 days	1984
Feng Yung	300 m x 300 m	1 day	2009
VIIRS	375 m x 375 m	1 day	2012
MODIS	1000 m x 1000 m	1 day	1999
MSG / GOES	1000 to 3000 m	30 minutes	1990
EcoStress	50 m x 80 m	3 days (?)	2017 (?)
PROBA-V	100 m x 100 m	3 to days	2018 (?)

Time steps and scales

	Daily	Monthly
Field scale		√
Regional scale	√	√

Different near-operational global scale remote sensing ET products

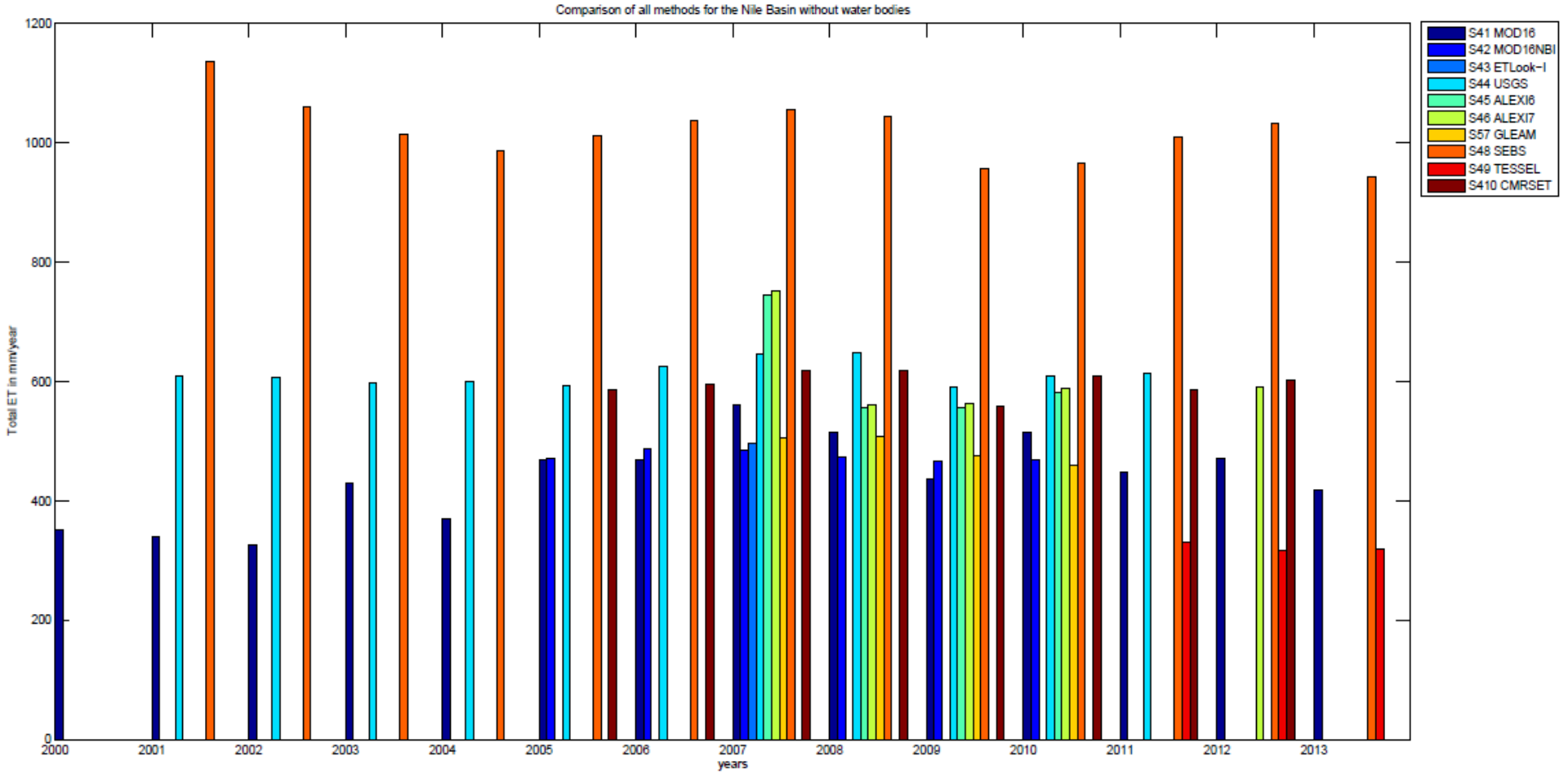
• ALEXI	USDA	Anderson et al.
• SSEBop	USGS	Senay et al.
• MOD16	NASA	Mu et al.
• SEBS	ITC	Su et al.
• CMRSET	CSIRO	Guerschman et al.
• ETMonitor	CAS	Li Jia et al.

True RS

• LSA-SAF	ECMWF	van der Hurk et al.
• GLEAM	FU-AMS	Mirales et al.

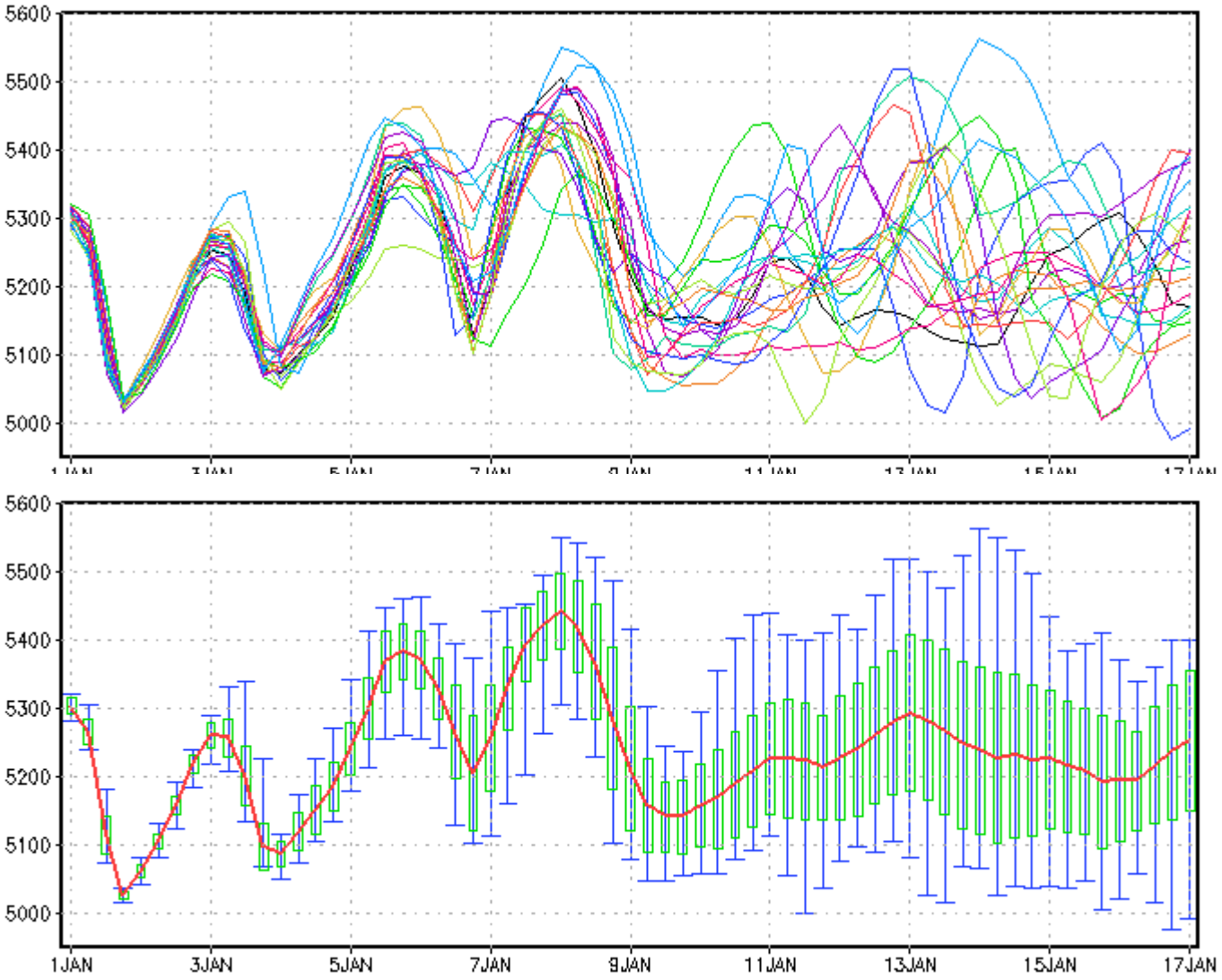
RS + LSM

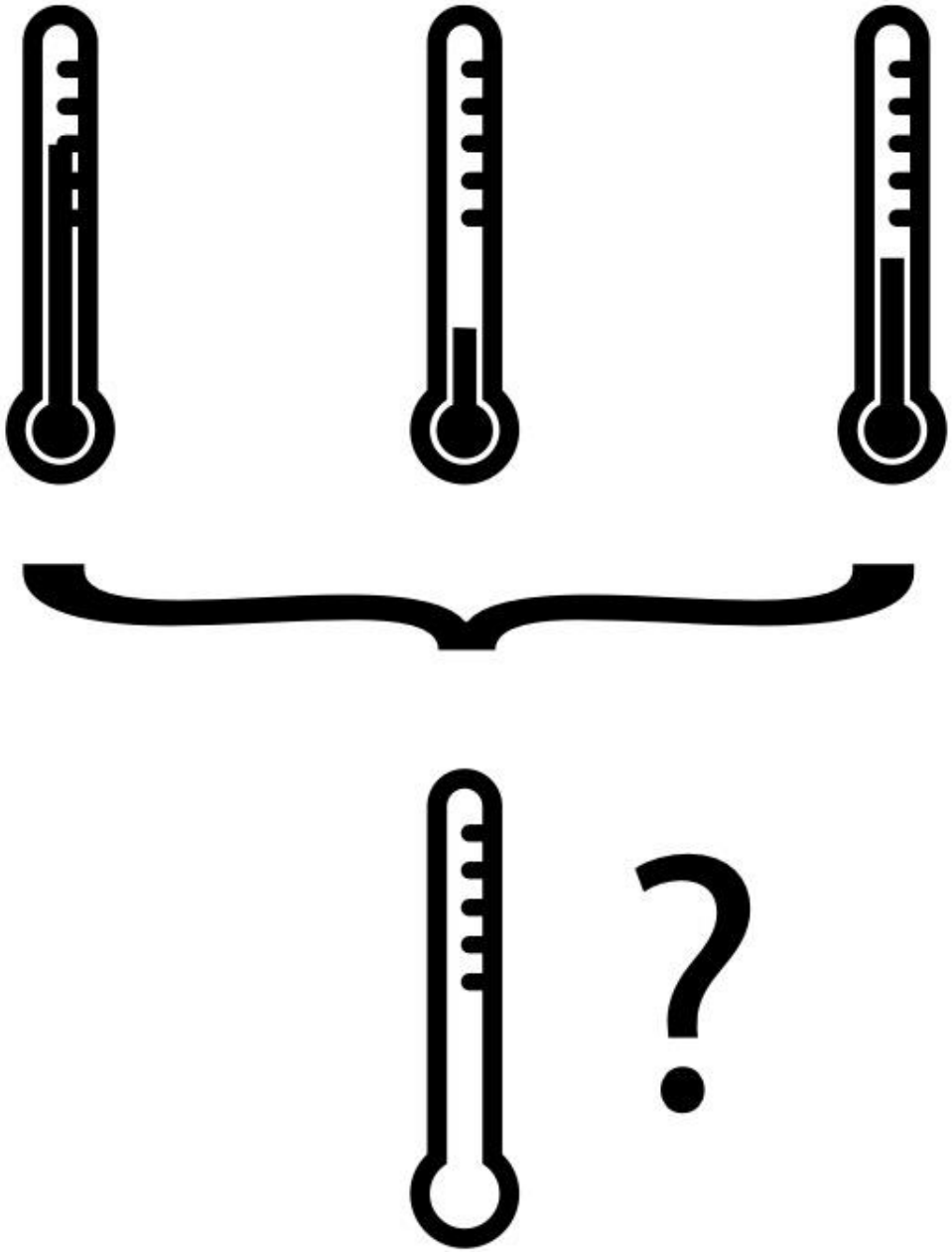
Nile basin ET from different RS algorithms



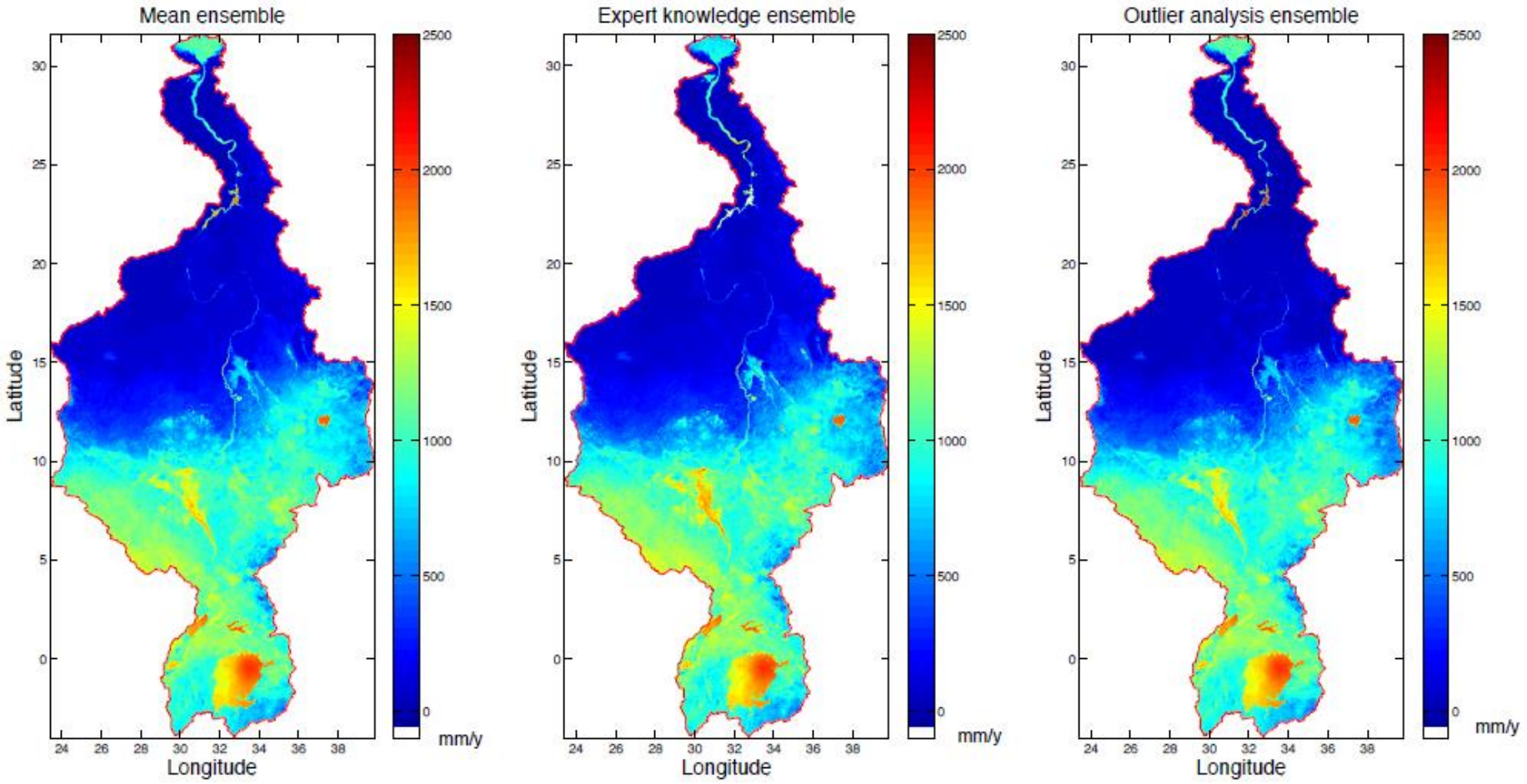
Long term rainfall: 624 mm/yr and ET 616 mm/yr

Ensemble predicted weather forecast



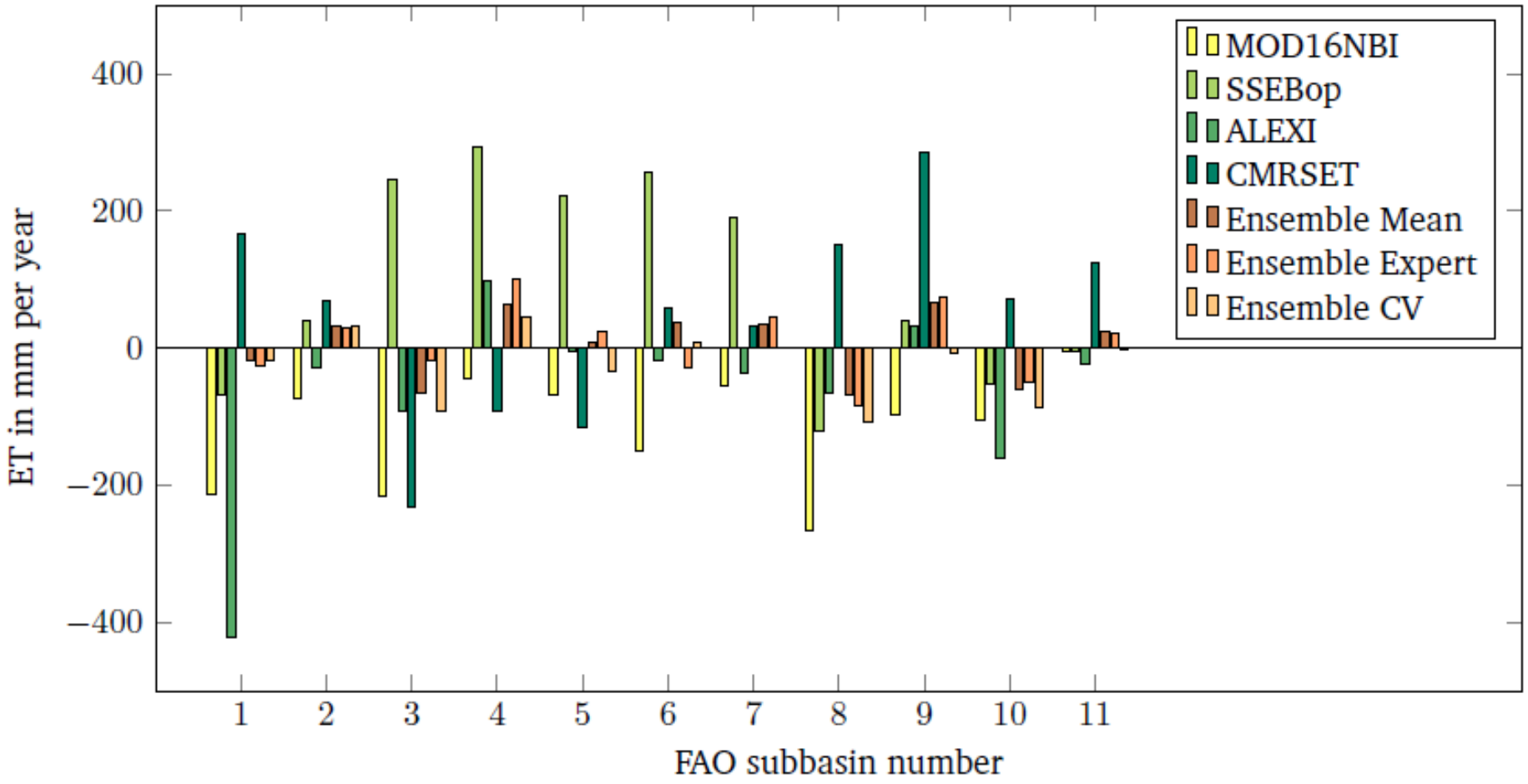


Ensemble based on 4 ET models (0.027 degrees)



Source: Rutger Hofste, M.Sc. Thesis TU Delft

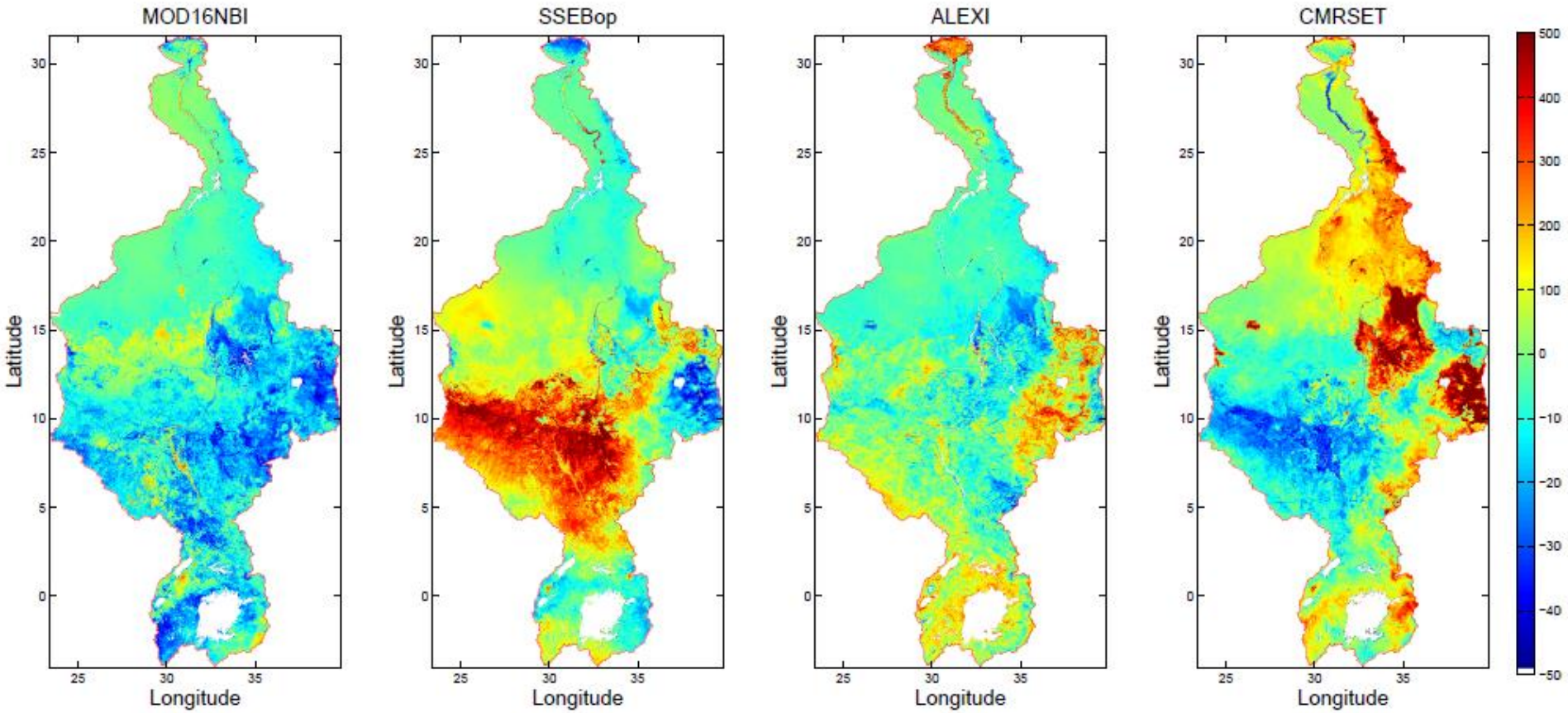
Single ET model vs Ensemble ET model



September 28, 2015

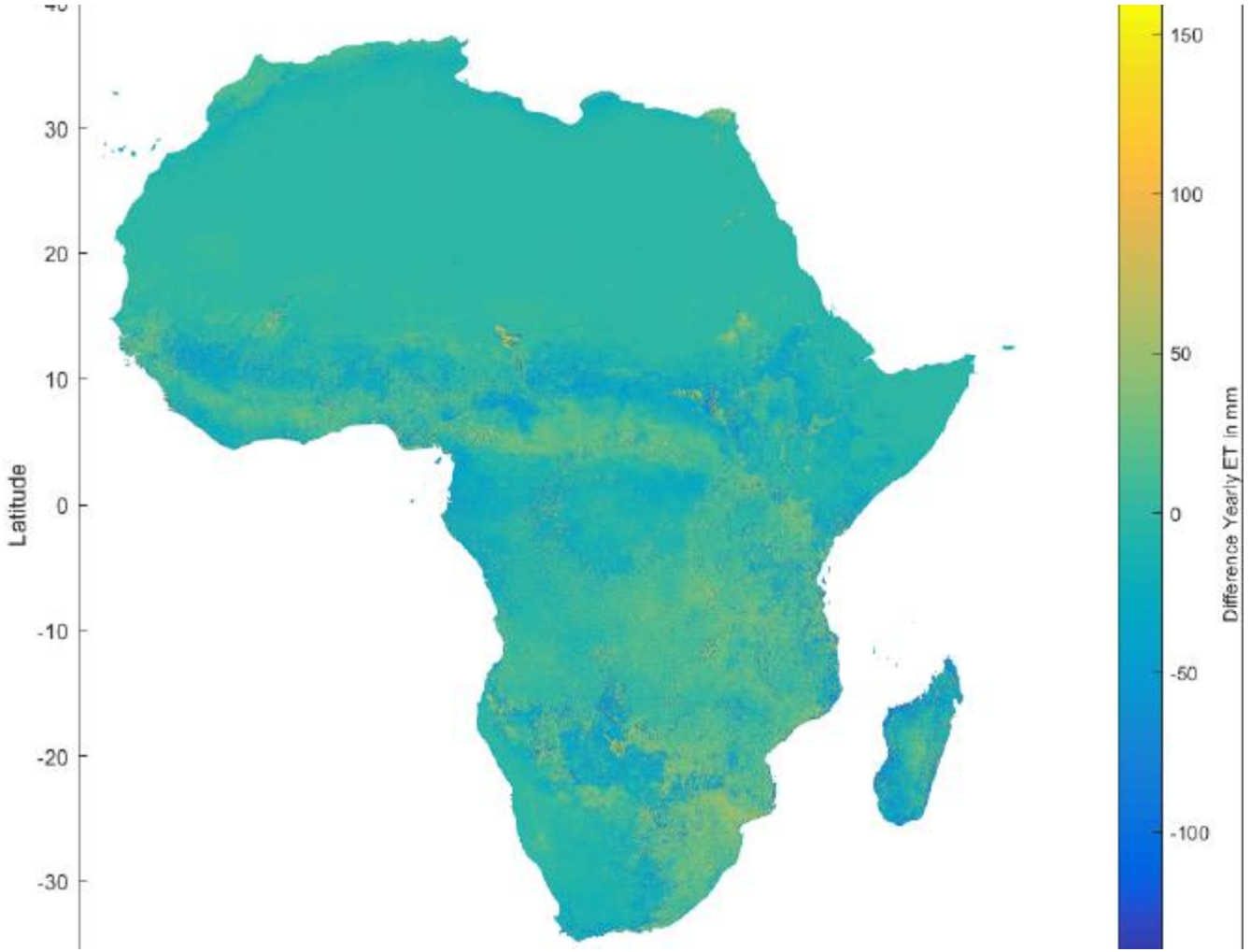
Source: Rutger Hofste, M.Sc. Thesis TU Delft

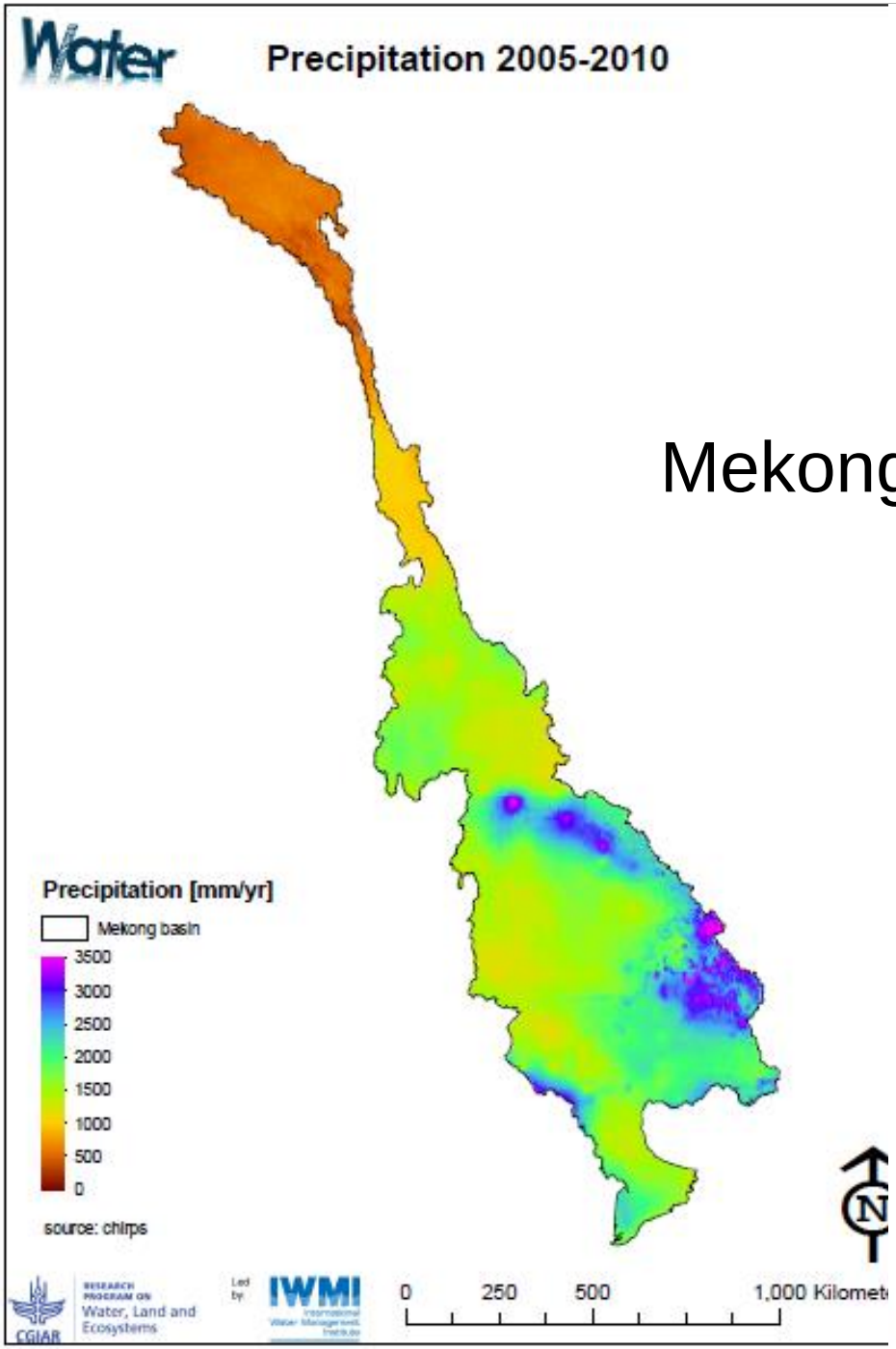
Annual ET spatial differences from ensemble mean value



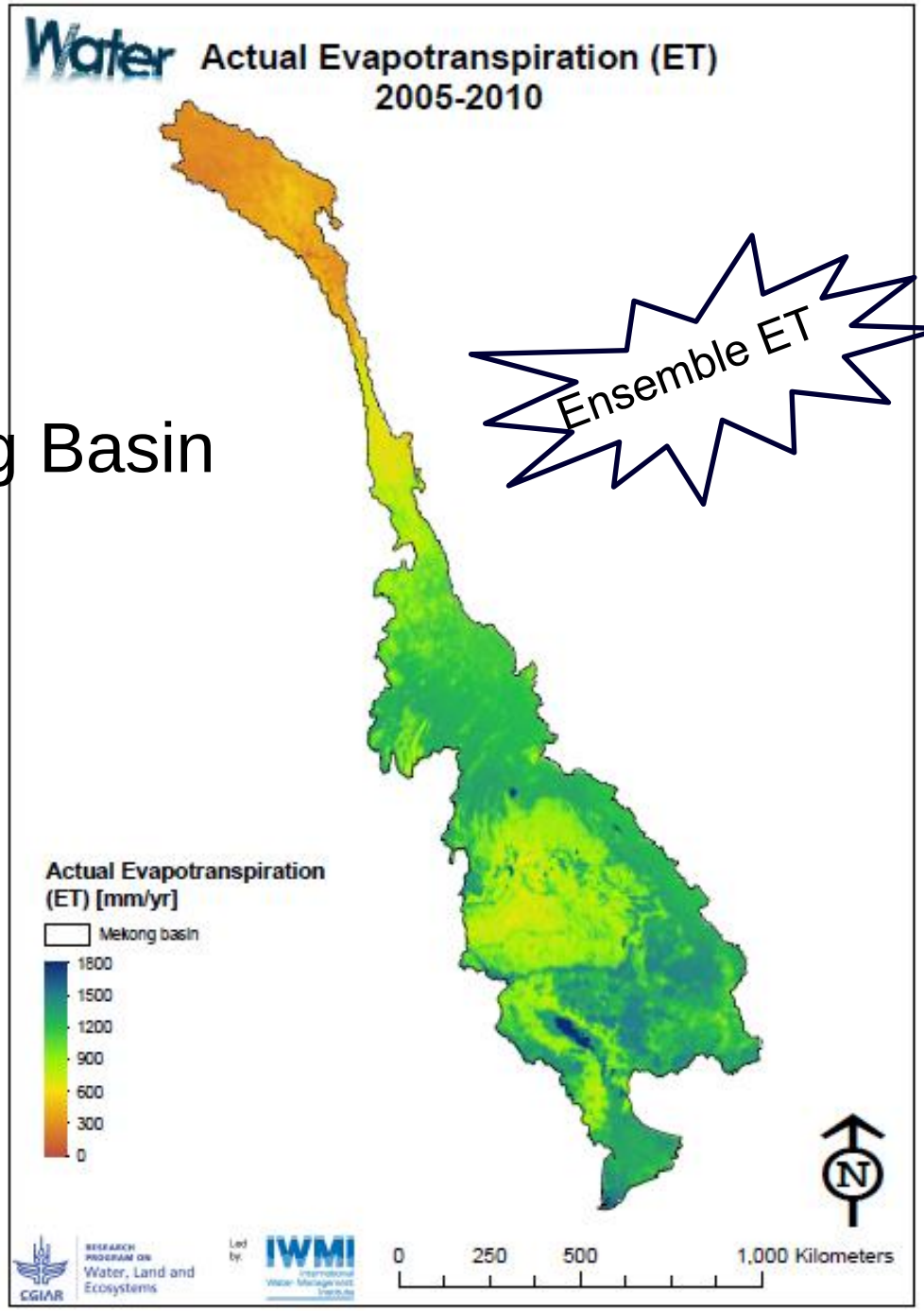
Source: Rutger Hofste, M.Sc. Thesis TU Delft

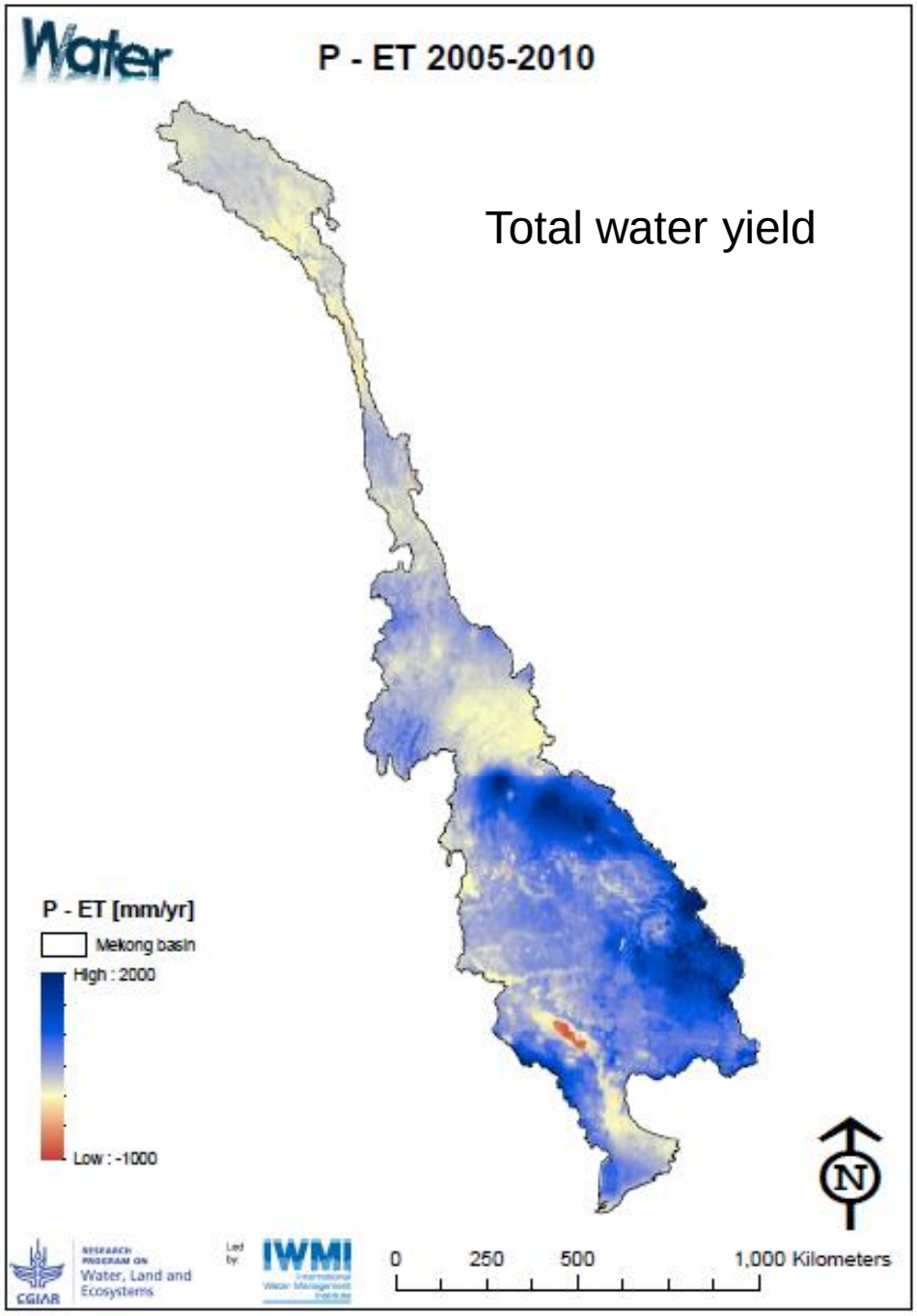
ETMonitor – Ensemble Mean ET Value for Africa (2010)

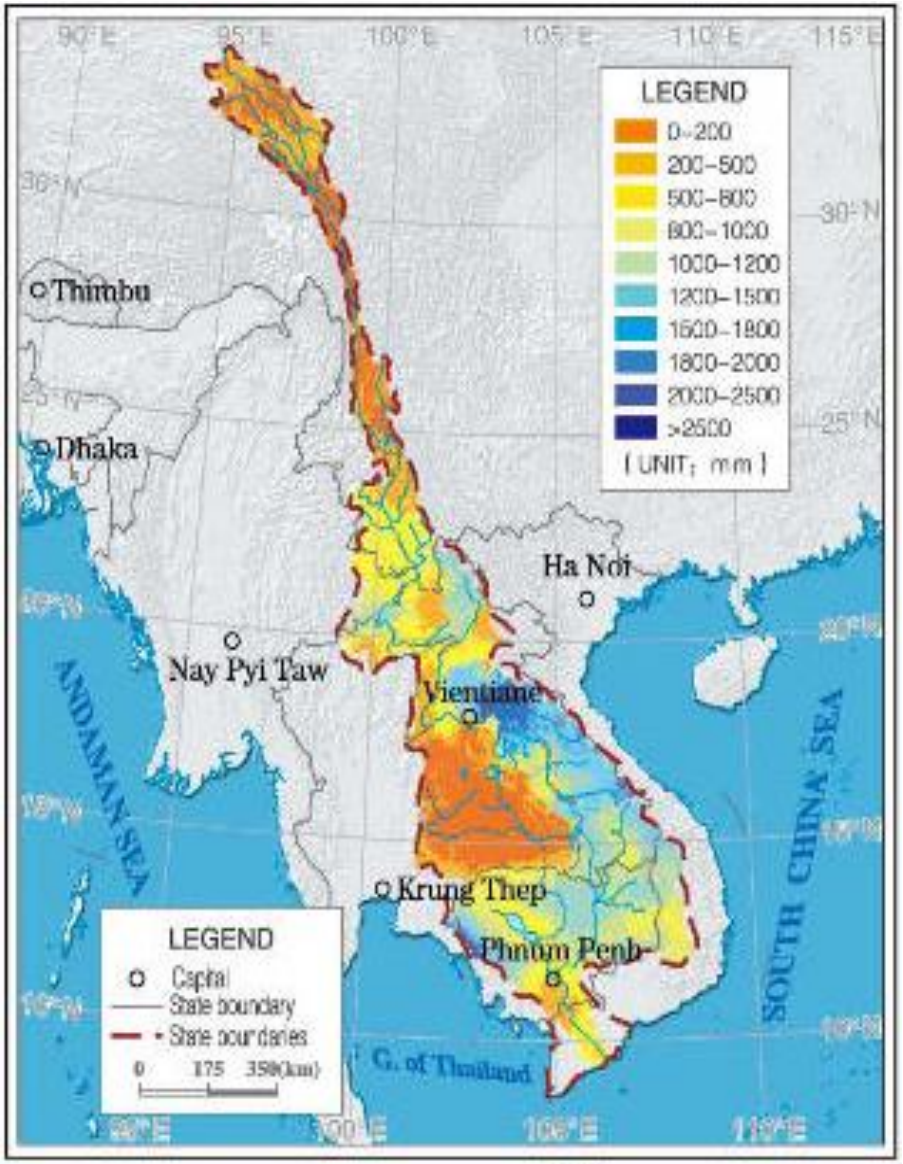




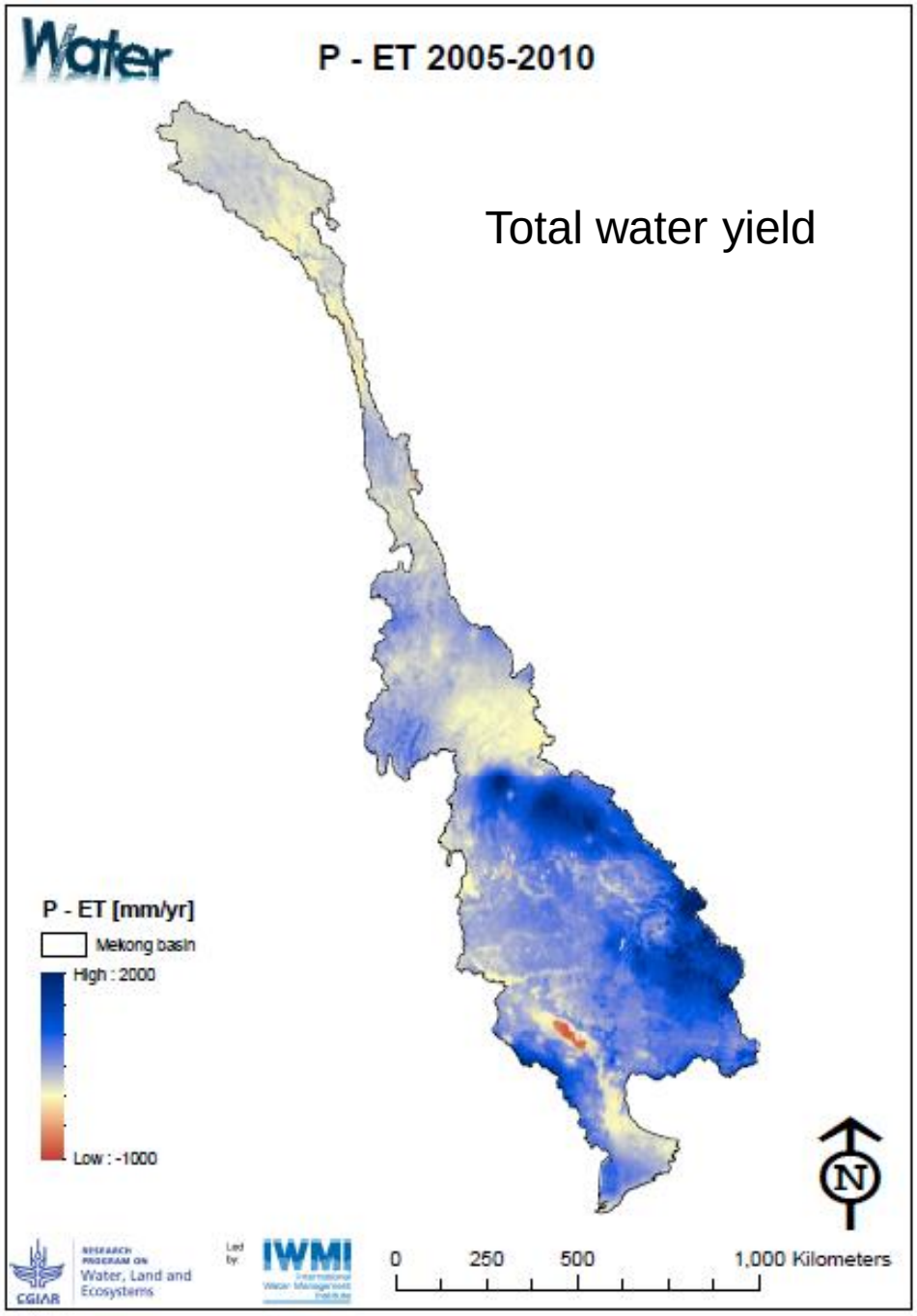
Mekong Basin

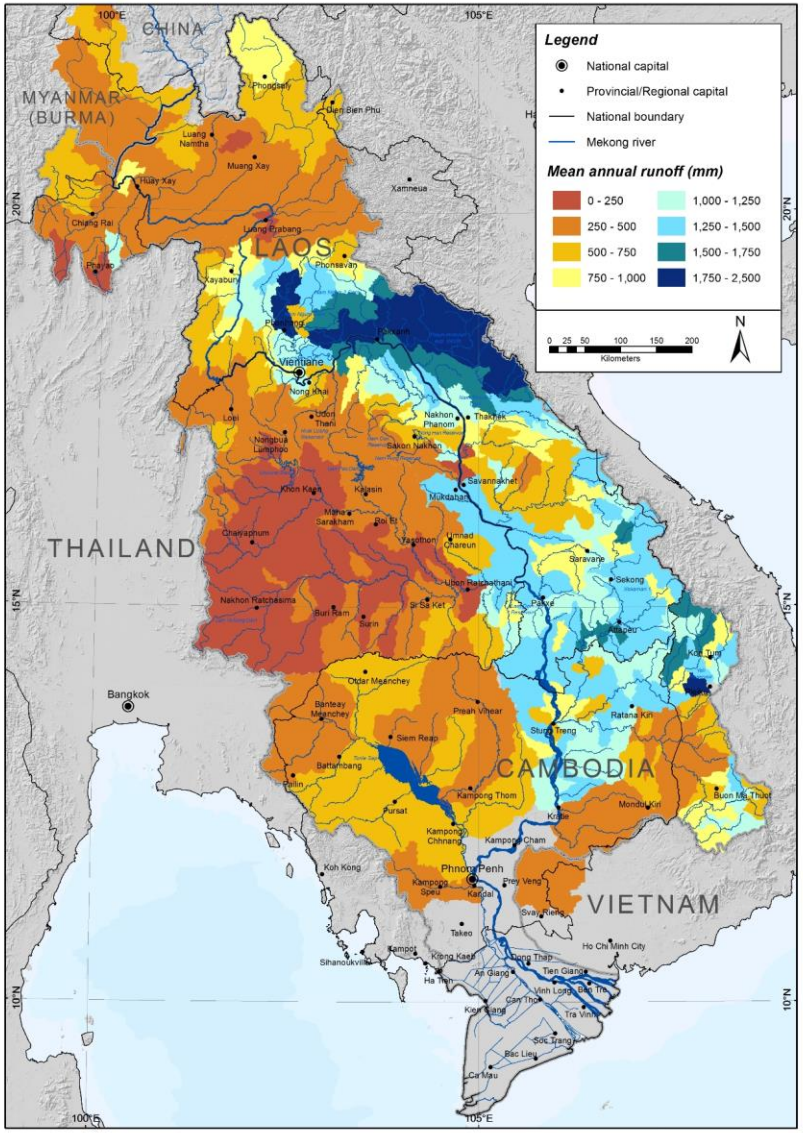



Water
P - ET 2005-2010
Total water yield
P - ET [mm/yr]
Mekong basin
High : 2000
Low : -1000
N
CGIAR
RESEARCH PROGRAM ON Water, Land and Ecosystems
Led by: IWMI
0 250 500 1,000 Kilometers


LEGEND
0-200
200-500
500-800
800-1000
1000-1200
1200-1500
1500-1800
1800-2000
2000-2500
>2500
(UNIT: mm)
Thimbu
Dhaka
Ha Noi
Nay Pyi Taw
Vientiane
Krung Thep
Phnom Penh
ANDAMAN SEA
SOUTH CHINA SEA
G. of Thailand
LEGEND
Capital
State boundary
State boundaries
0 175 350(km)


NASCC
The National Remote Sensing Center of China
Supply Situation of Maize,Rice,Wheat and Soybean
Large Area Wetlands of International Importance
Africa Land Cover
China-ASEAN Ecological And Environmental Conditions

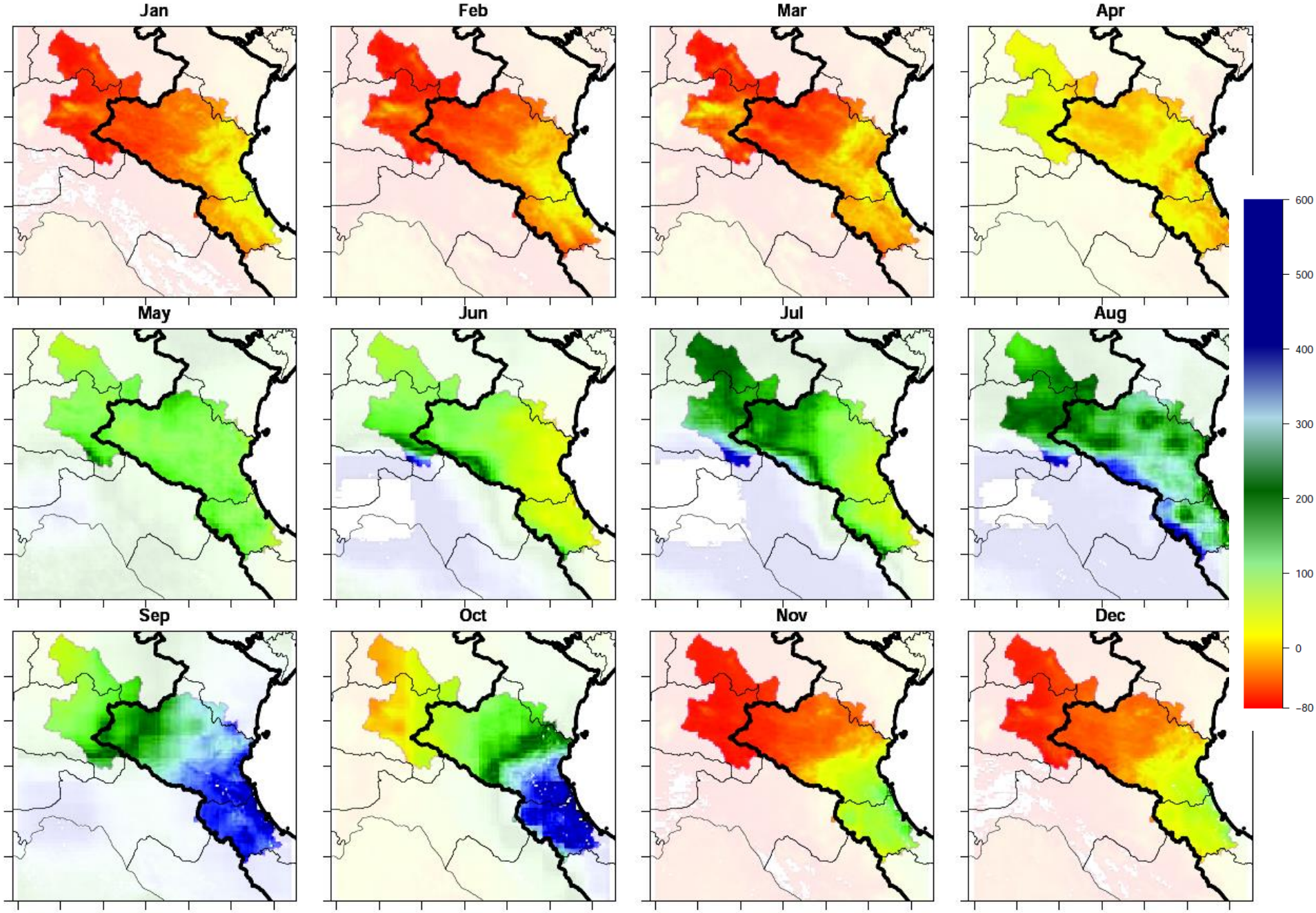




Mekong River Commission
For Sustainable Development

WINROCK INTERNATIONAL

Monthly water yields Ca basin (mm/month) based on ensemble ET values



Conclusions

- Global ET models have diverging parameterizations and spectral input requirements. There is something to choose from !
- ALEXI, SSEBop, CMRSET and ET-Monitor are performing well under a wide range of environmental conditions (despite different levels of complexity)
- The performance is land use dependent
- The ensemble mean errors are very acceptable: 6 out of 10 basins have an error less than 5%
- Averaging should be done land use dependently and optimized using known water balances of sub-basins and flux towers (machine learning). This is future research
- Water accounting is a standard reporting system by means of sheets, tables and maps. Easy to understand for policy makers
- Focus on consumptive use, benefits and services; more than just water flows
- Accuracy of water accounting depends on - free of charge - global ET data sets
- Let's OPERARTIONALIZE it !