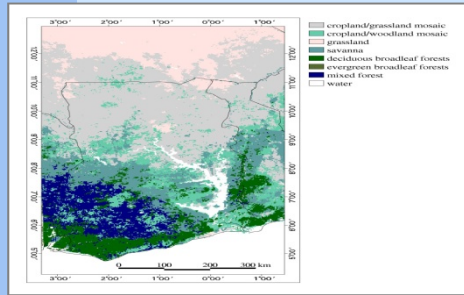


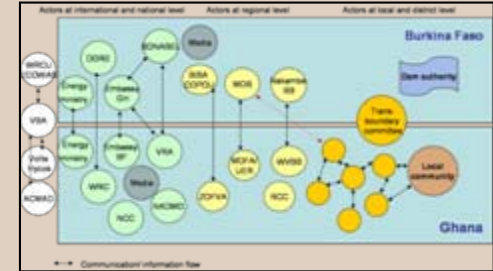


## Climate, Land Use, Hydrology

## Economics, Institutions, Stakeholders



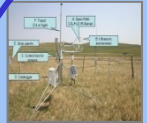
Field Investigations



Processes of decision making and information flows

### Land Conversion

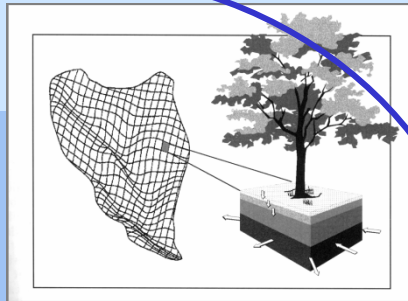
### Remote Sensing



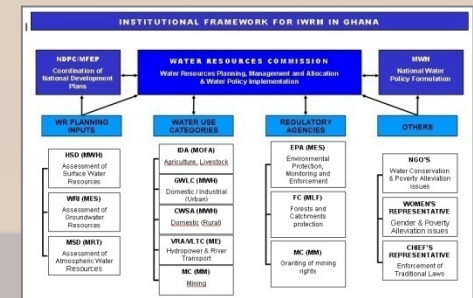
### Instrumentation

# Water Supply

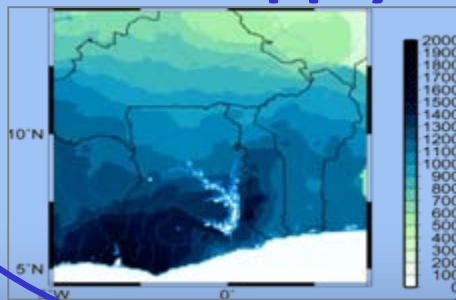
### Hydrology



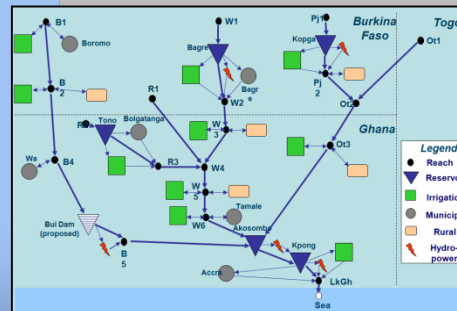
# Decision Support



Institutional Analysis

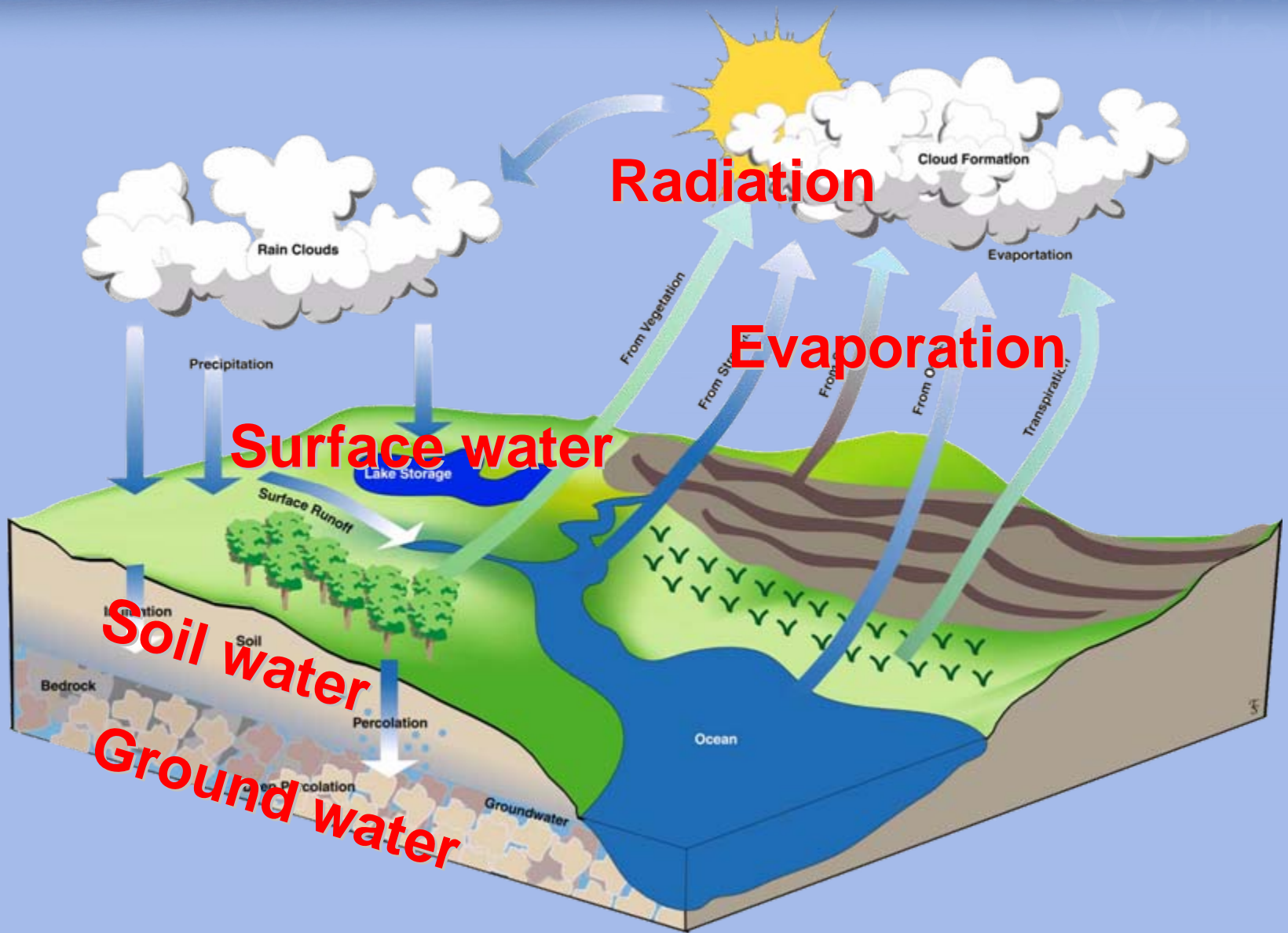


Mesoscale Climate

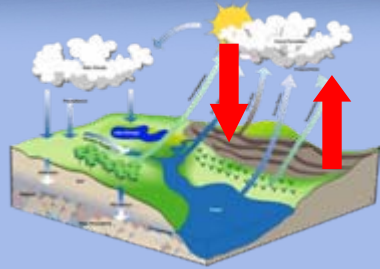


Integrated Basin Model

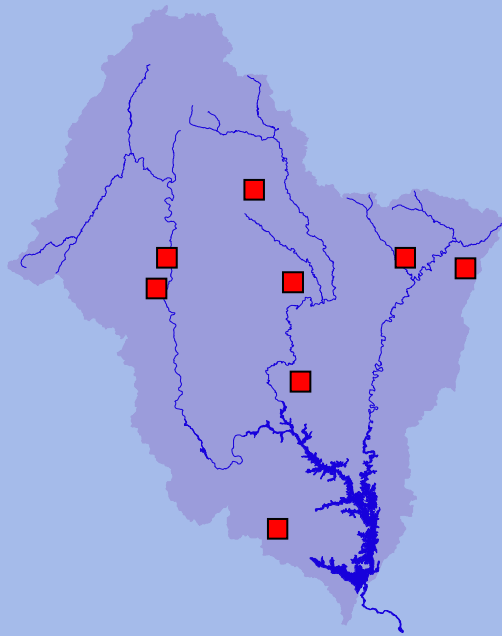




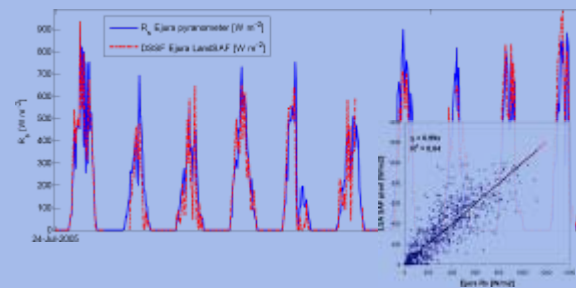
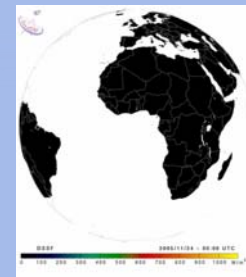
## Climate



- Meteorological observation network
- Spatio-temporal rainfall patterns
- Validation of satellite radiation products



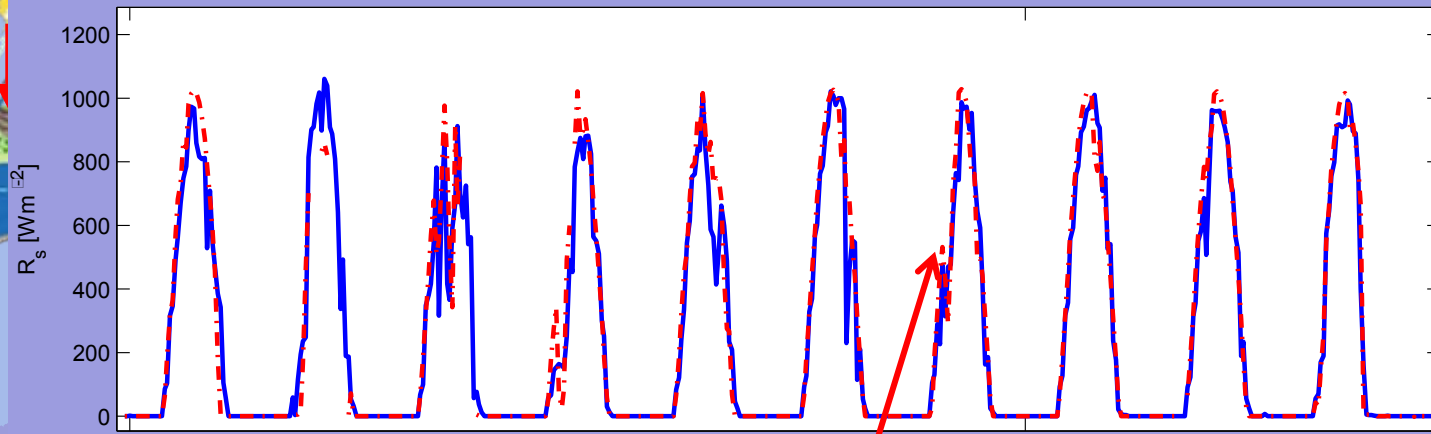
Network of field observation stations



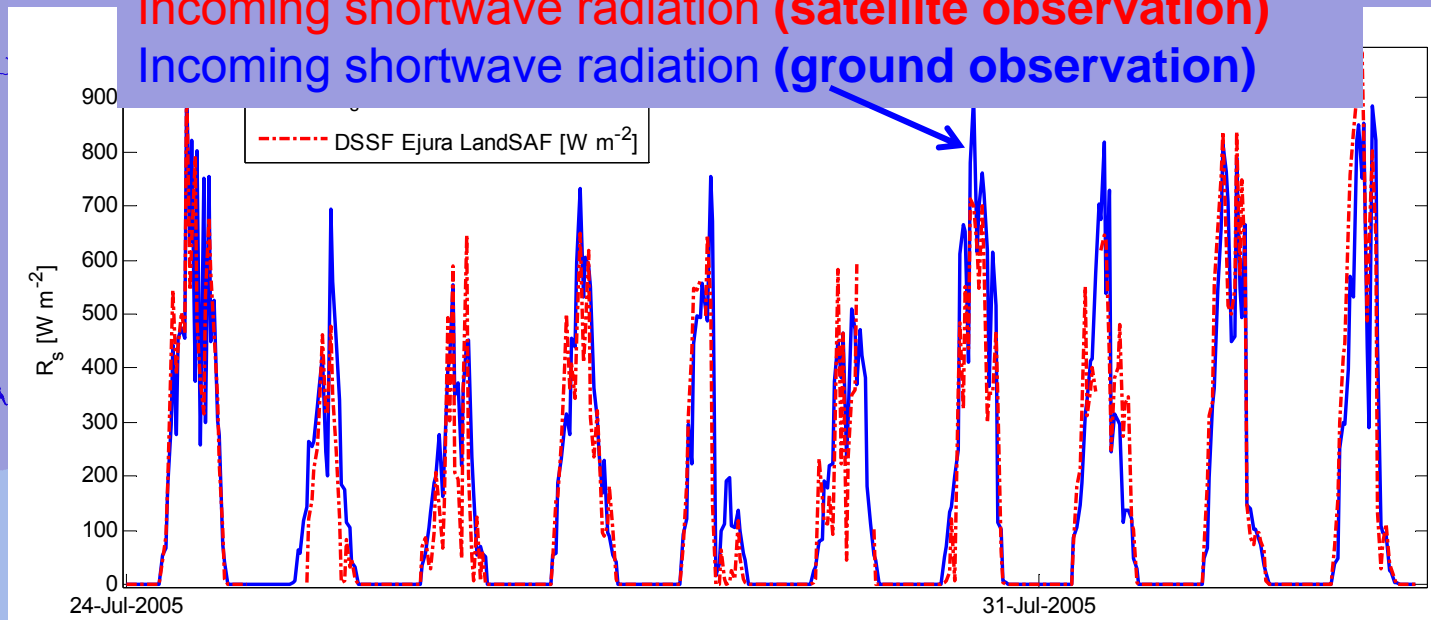
Validated radiation product from LSA SAF

Szarzynski, J., et al. (2005), Networking in West Africa: The Biophysical Observation Network (BON) operated by GLOWA Volta, BIOTA West Africa, and INERA. International Conference on Integrated Assessment of Water Resources and Global Change: A North-South Analysis, Bonn, Germany.

Winsemius, H. C., et al. (2006), Radiation and land surface temperature from Meteosat second generation, in *European Geosciences Union (EGU) General Assembly*, Vienna, Austria.



Incoming shortwave radiation (satellite observation)  
 Incoming shortwave radiation (ground observation)



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 SAF

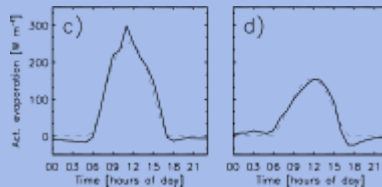
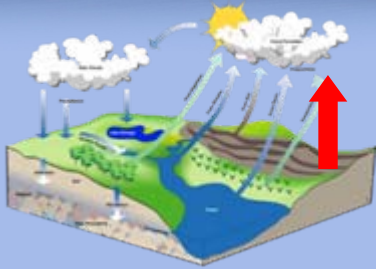
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Szarzynski, J., et al. (2001) ... operated by GLOWA Volta, ... Assessment of Water Resources and Global Change: A North-South Analysis, Bonn, Germany.

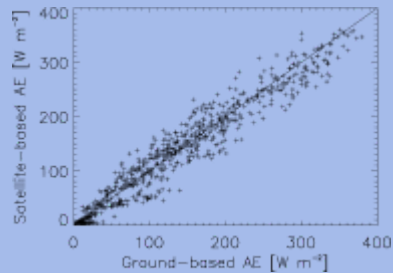
... generation, in European Geosciences Union (EGU) General Assembly, Vienna, Austria.

## Evaporation

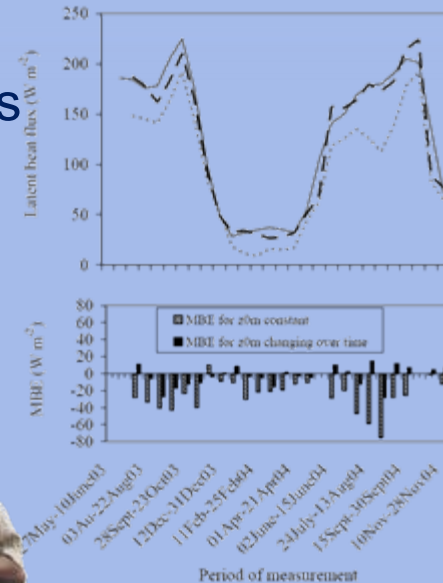
- Evaporation measurements through Eddy correlation and Large Aperture Scintillometry
- Open water evaporation through automated floating evaporation pan and wind field analysis



## LAS observations & evaporation modeling



## EC observations



Bagayoko, F., et al. (2006a), Effect of seasonal dynamics of vegetation cover on land surface models: A case study of NOAA LSM over a savanna farm land in eastern Burkina Faso, West Africa, *Hydrology and Earth System Sciences Discussions*, 3(5), 2757-2788.

Bagayoko, F., et al. (2007), Energy partitioning over the West African savanna: Multi-year evaporation and surface conductance measurements in Eastern Burkina Faso, *Journal Of Hydrology*, 334(3-4), 545-559.

## Runoff & Surface water



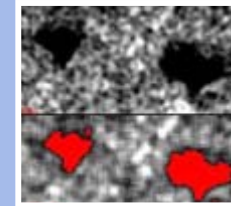
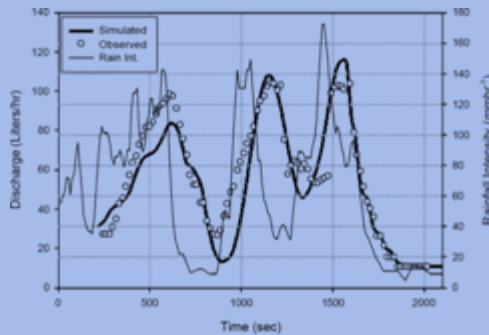
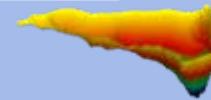
- Surface runoff generation & processes
- Area-volume relation for small reservoirs
- Small reservoirs as regional runoff gages



Runoff generation processes & hydrograph separation



Estimation of surface water storage through small reservoirs



Ajayi, A. E., et al. (2008), A numerical model for simulating Hortonian overland flow on tropical hillslopes with vegetation elements, *Hydrological Processes*, 22(8), 1107-1118.

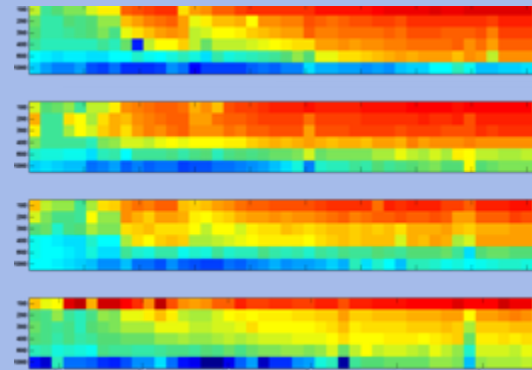
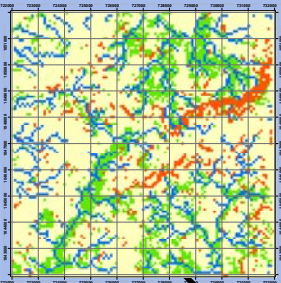
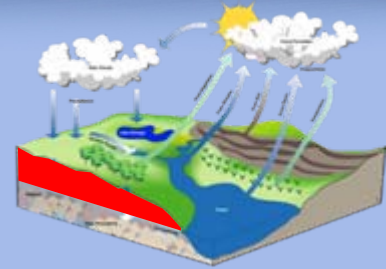
Bagayoko, F. (2006), Impact of land-use intensity on evaporation and surface runoff. Process and parameters for eastern Burkina Faso, West Africa. Doctoral Thesis. University of Bonn, Bonn, Germany.

Liebe, J., et al. (2005), Estimation of small reservoir storage capacities in a semi-arid environment, *Physics and Chemistry of the Earth*, 30(6-7 SPEC. ISS.), 448-454.

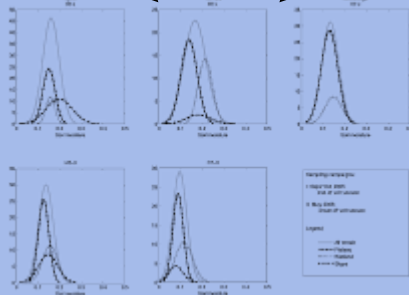
Liebe, J., et al. (forthcoming), The use of remotely sensed small reservoirs as runoff gauges to determine the watershed response in data poor environments.

## Soil water

- Regionalization of Pedo-transfer functions
- Long-time soil moisture profiles
- Large-scale soil moisture averaging



Temporal soil moisture profiles

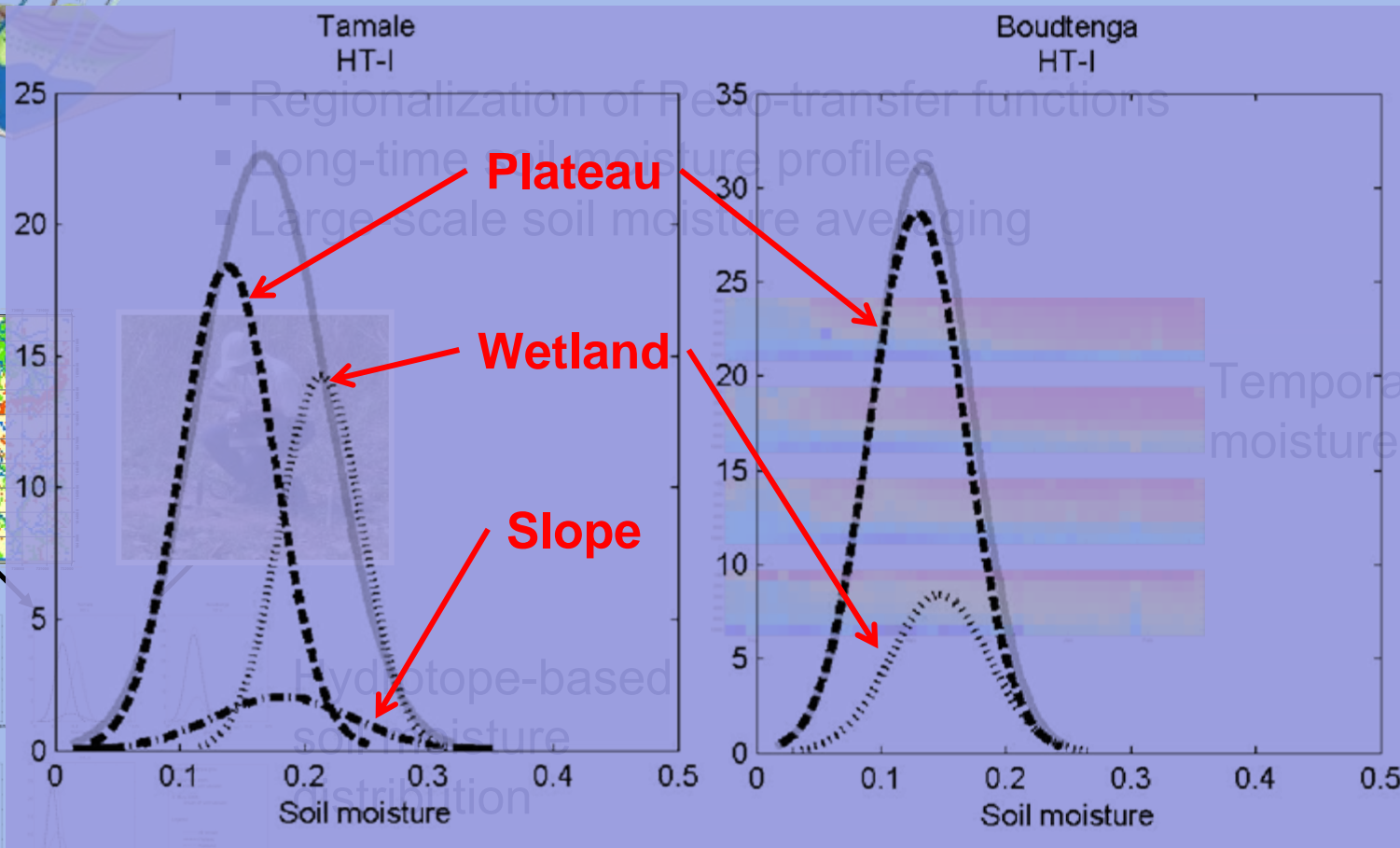
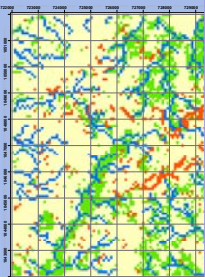
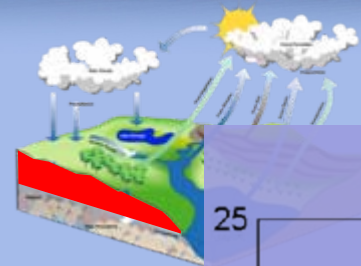


Hydrotope-based soil moisture distribution

Friesen, J., et al. (2008), Hydrotope-based protocol to determine average soil moisture over large areas for satellite calibration and validation with results from an observation campaign in the Volta Basin, West Africa, *IEEE Transactions On Geoscience And Remote Sensing*, 46(7), 1995-2004.

Rutten, M. et al. (forthcoming), Using temporal scales of observed soil moisture profiles to validate satellite-based soil moisture estimates.

## Soil water



- Regionalization of Peds-transfer functions
- long-time soil moisture profiles
- Large scale soil moisture averaging

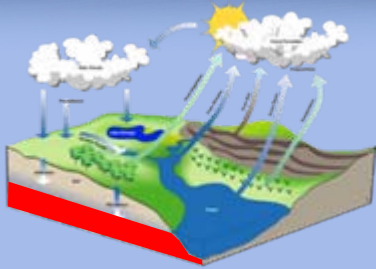
Hydrotpe-based soil moisture distribution

Temporal soil moisture profiles

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Rutten, M. et al. (forthcoming), Using temporal scales of observed soil moisture profiles to validate satellite-based soil moisture estimates.

## Groundwater



- 5-6 % of annual precipitation recharge the groundwater reservoir
- Basin-wide groundwater potential & borehole distribution



Groundwater potential in the Volta Basin



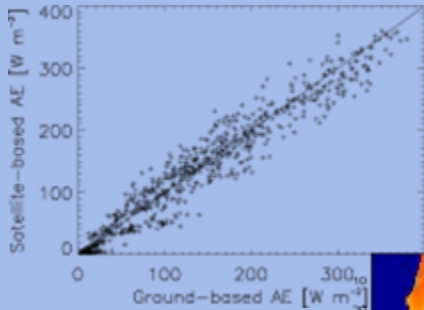
Groundwater observations



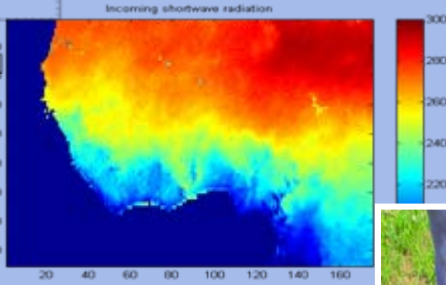
Martin, N., and N. Van De Giesen (2005), Spatial distribution of groundwater production and development potential in the Volta River basin of Ghana and Burkina Faso, *Water International*, 30(2), 239-249.

Sandwidi, J.-P.W. (2007). Groundwater potential to supply population demand within the Kompienga dam basin in Burkina Faso. Doctoral thesis. University of Bonn, Bonn, Germany.

## From local observation to regional parameters

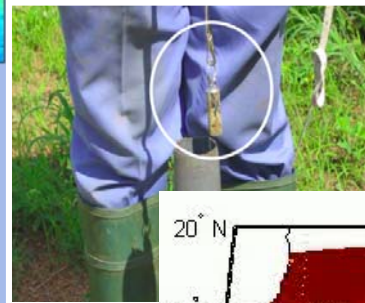


Locally validated evaporation algorithms

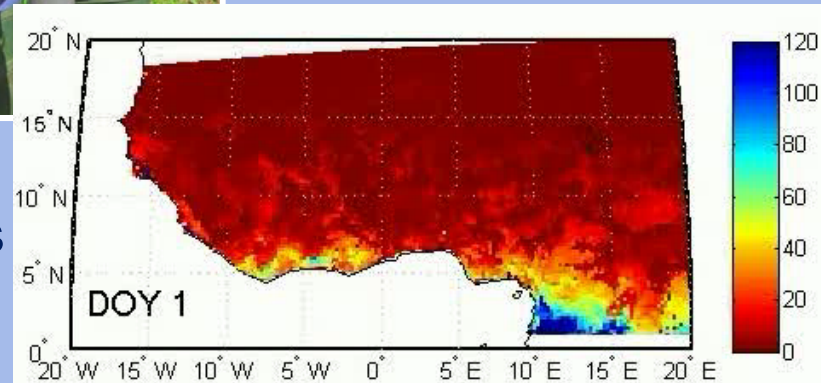


Regional satellite data

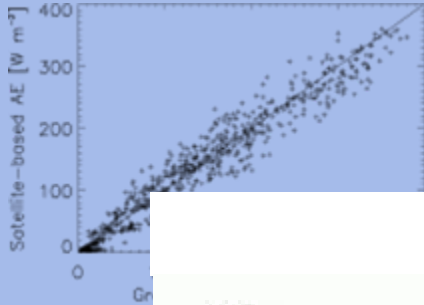
Update modeling concepts



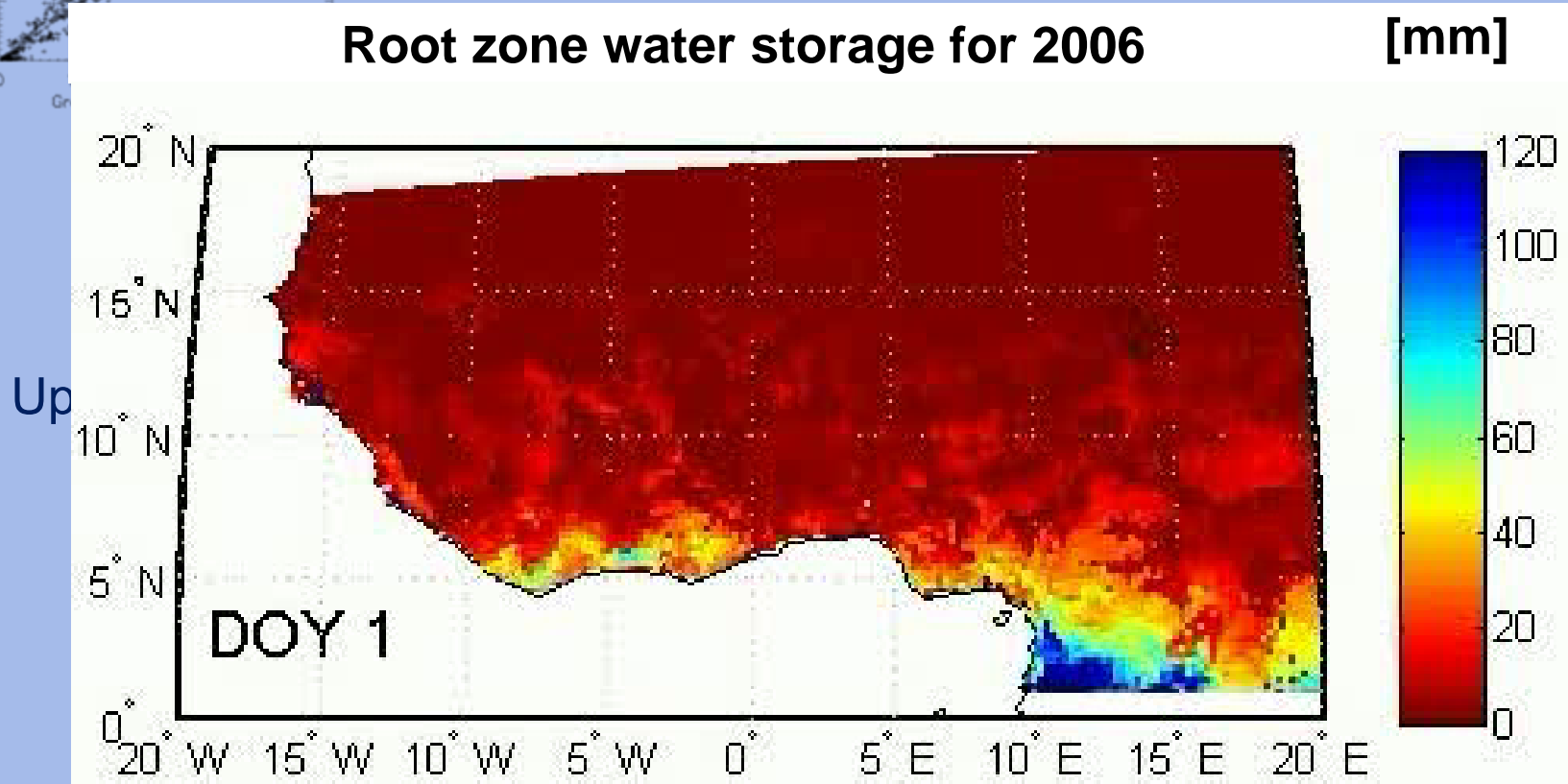
Regional soil moisture models



## From local observation to regional parameters



Locally validated evaporation algorithms



- **Local observations to estimate regionally available water resources**
  - Measure selected parameters
  - Measure at representative locations and times
  - Use measurements to derive models that fit available data