Hydrological Processes within the Drâa Basin (Morocco) and their Future Development under Global Change

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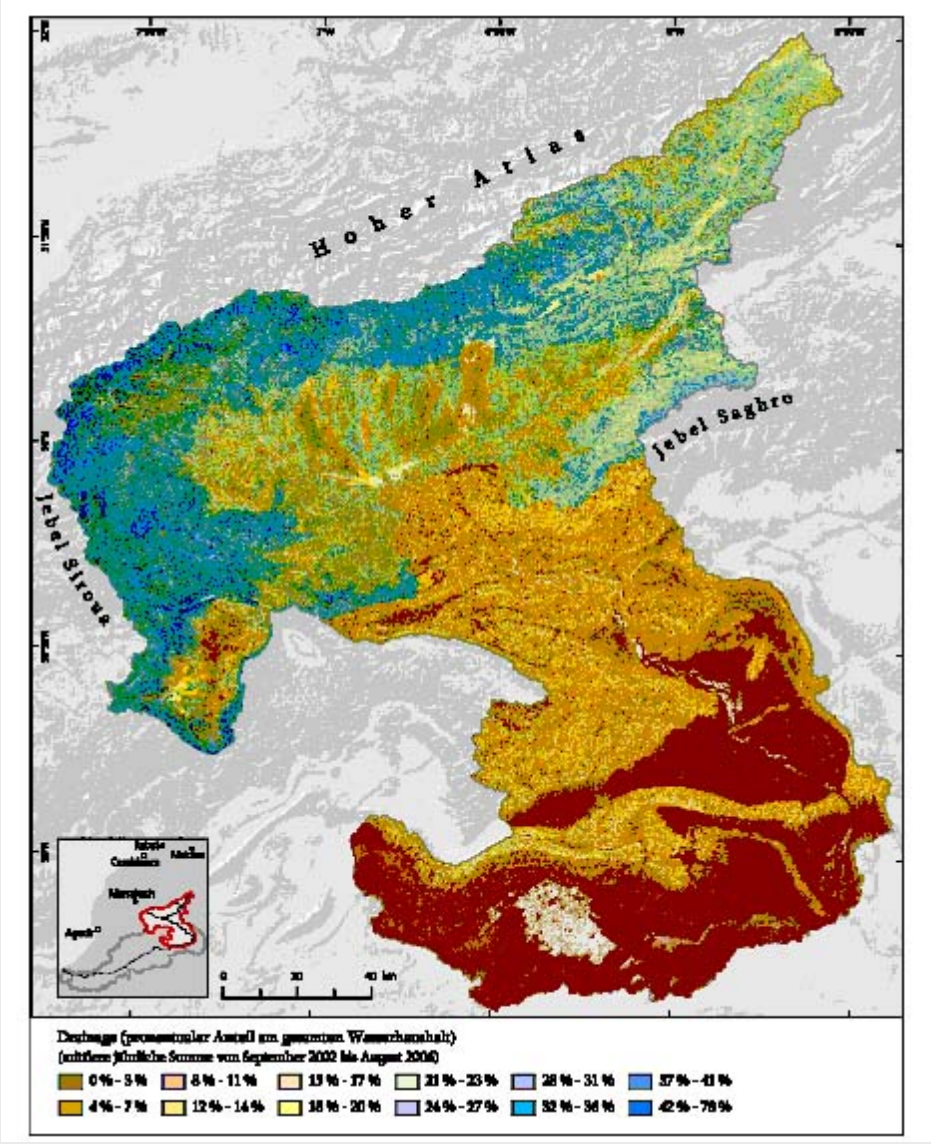
universitätbonn

Outline

- Snow in the High Atlas Mountains
- Hydrological processes in the Upper Drâa basin
- Hydrological processes in the Middle Drâa basin

Gradient of the water balance

Discharge in % of rainfall



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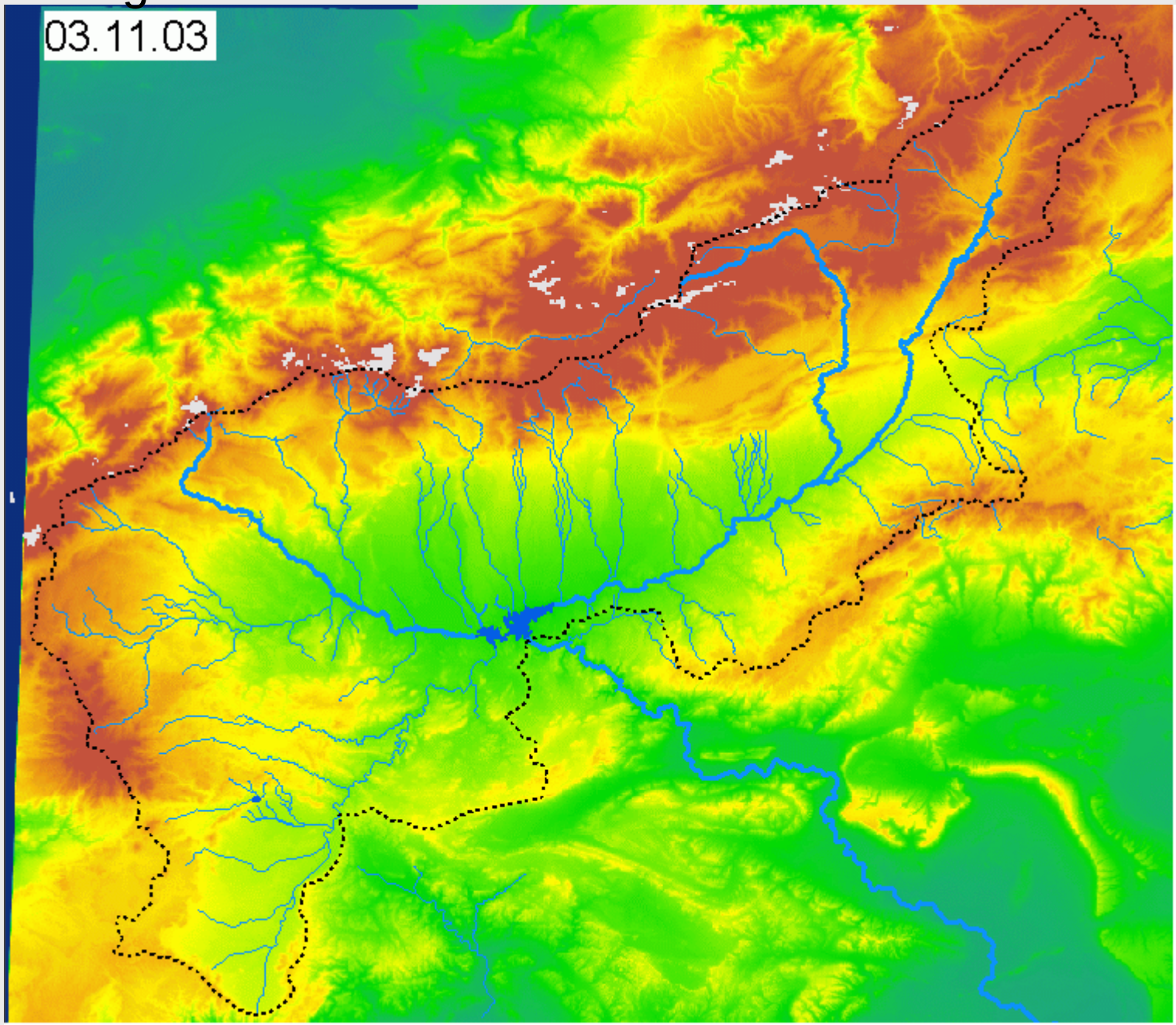
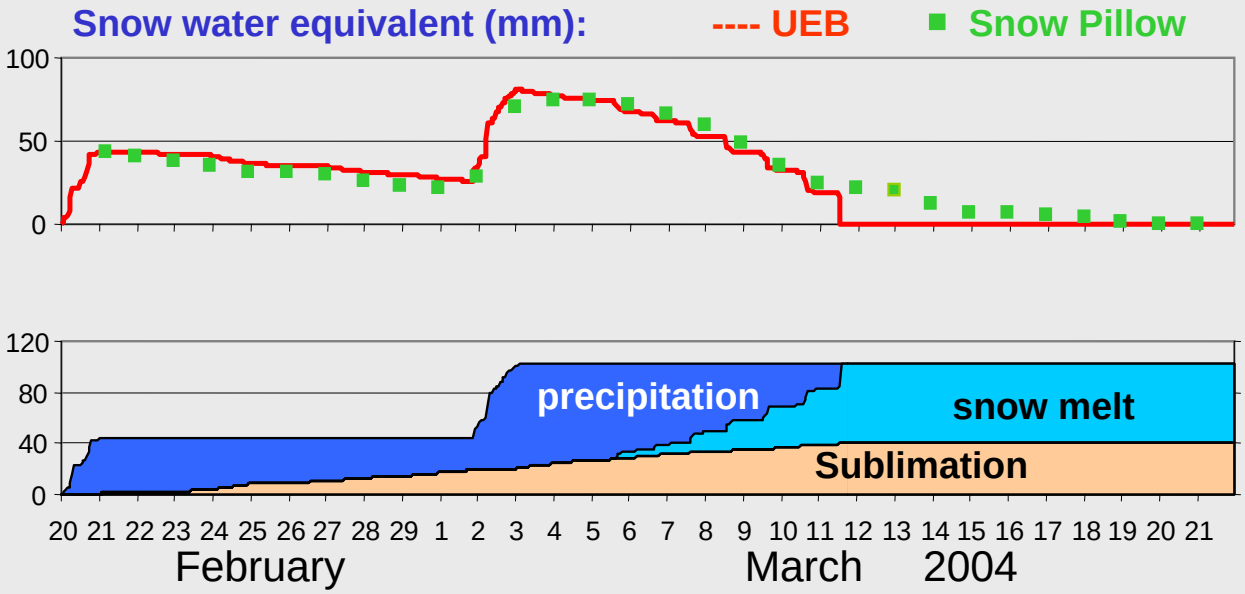
Snow coverage



Modeling snow dynamics at the local scale

Utah Energy Balance Model (UEB) results for the station Tounza/High Atlas (2960m)

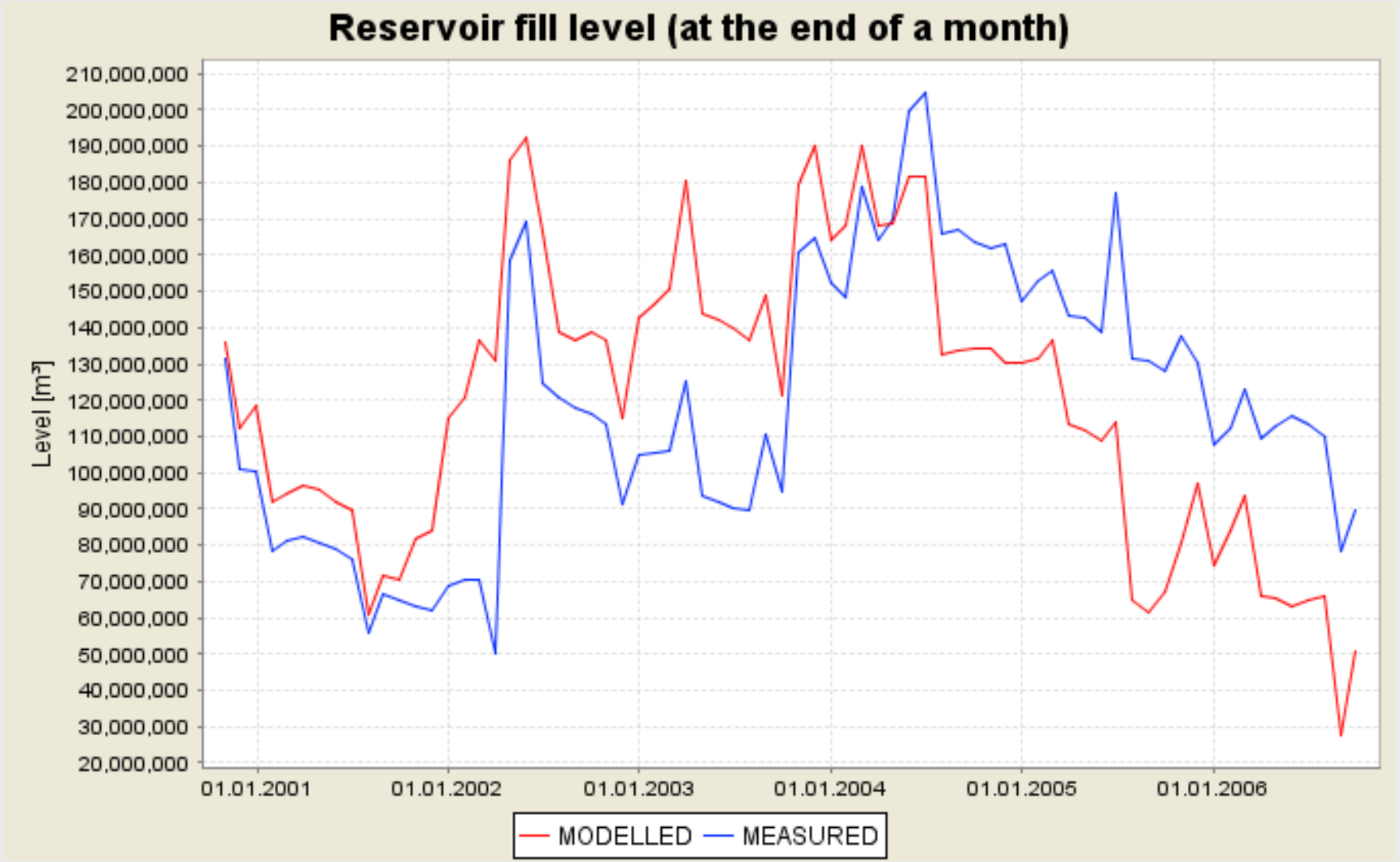
20.2.-21.3.2004



IA: 0,96
ME: 0,9

- sublimation rate 2-3mm/d in elevations above 3000m
- total sublimation losses up to 30% over a whole ablation period

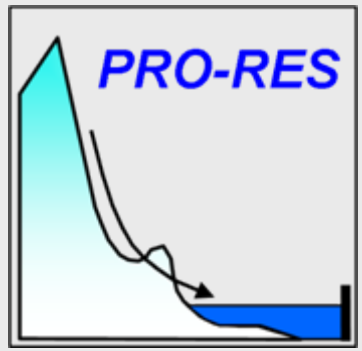
Modelling of reservoir volume with PRO-RES
SRM – Snowmelt Runoff Model



Conclusions: Snow in the High Atlas Mountains

- Snow melt plays a major role for baseflow of perennial rivers in the north-eastern part of the Drâa basin, and therefore
- Snow melt delivers the annual minimum of inflow to the reservoir Mansour Eddahbi
- Snow melt occasionally augments direct runoff in late spring due to rapidly rising temperatures within a few days after snow fall.
- Seasonal forecast of snow melt is difficult but possible with limited accuracy

- Test the Monitoring Tool ProRes



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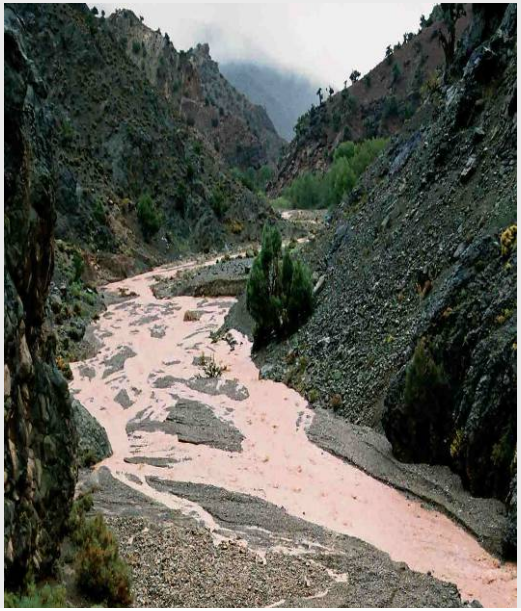
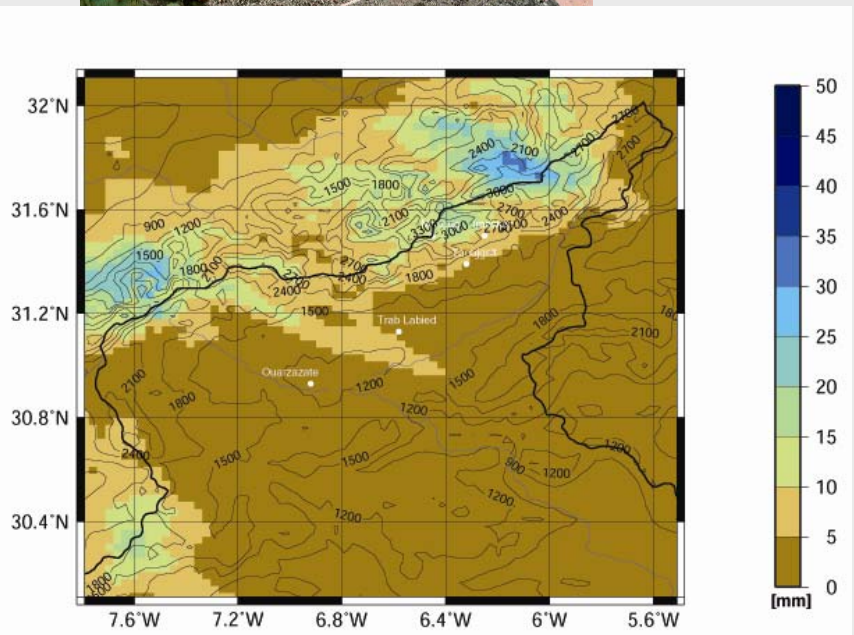
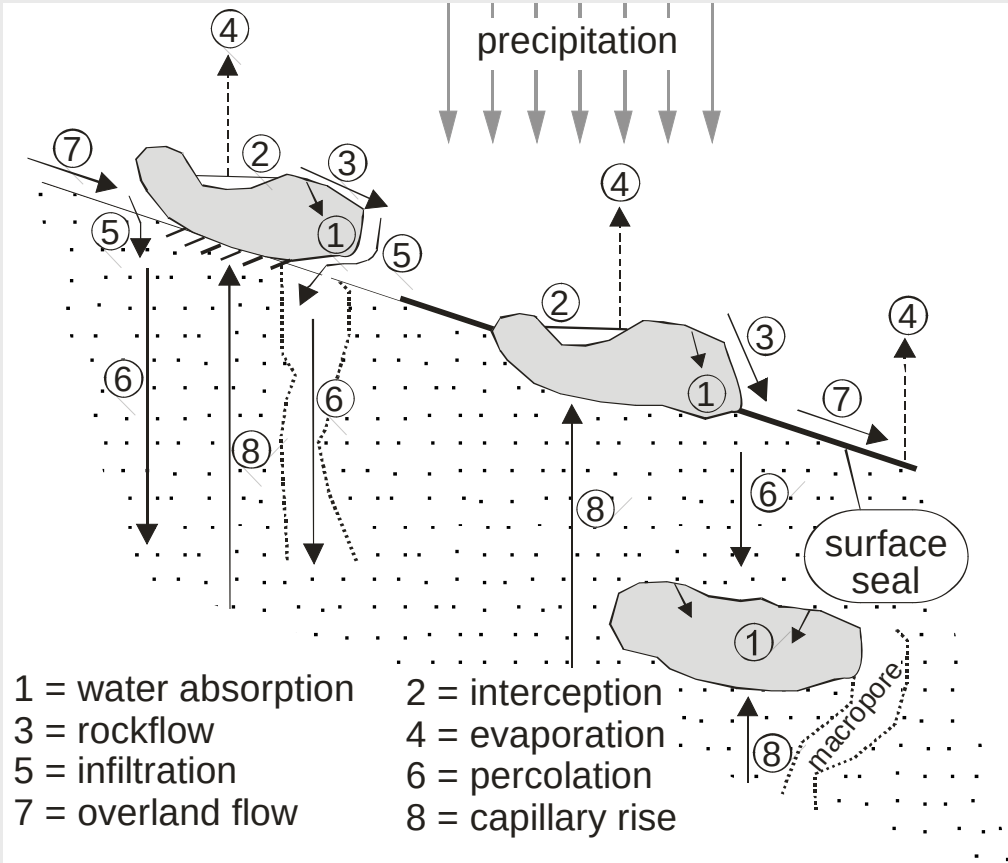
Problems in modeling semi-arid regions

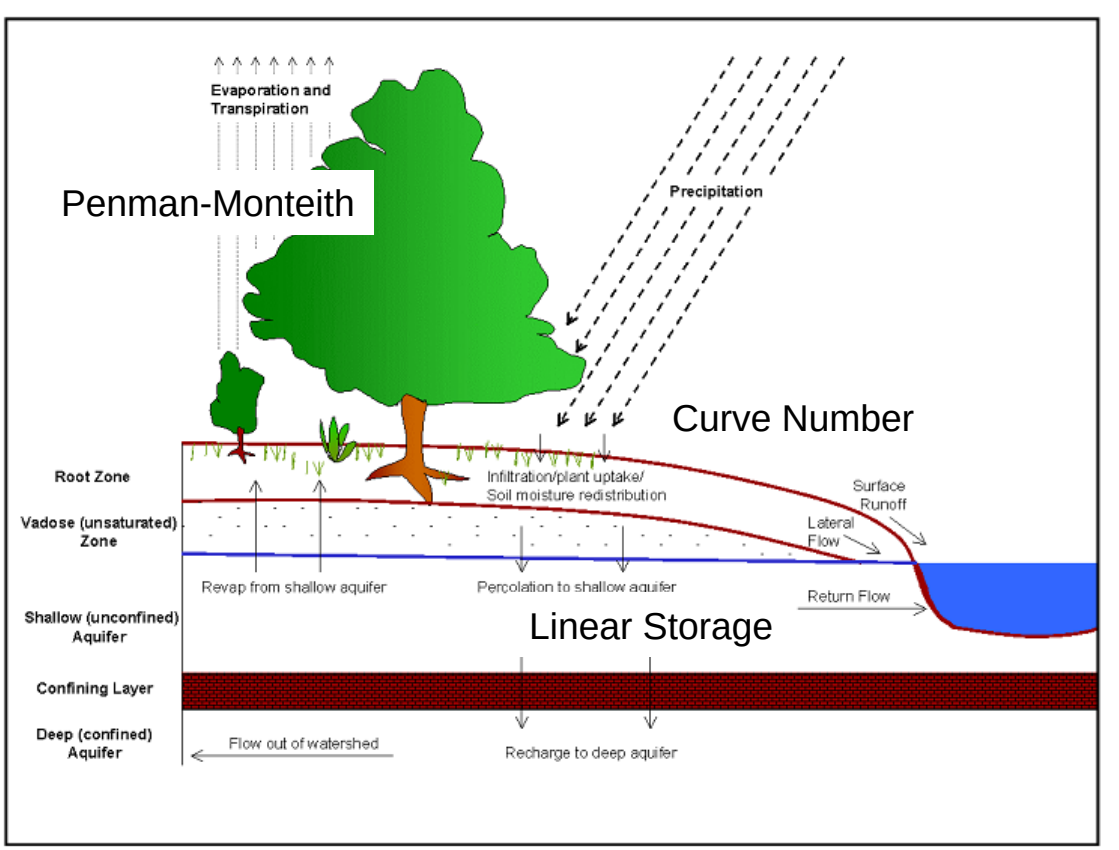


- Uncertain boundary condition due to small scale heterogeneity of precipitation processes
- Uncertain discharge measurements due to sediment transport and variable river bed
- Uncertain soil properties due to small scale heterogeneity





Modeling at the regional scale

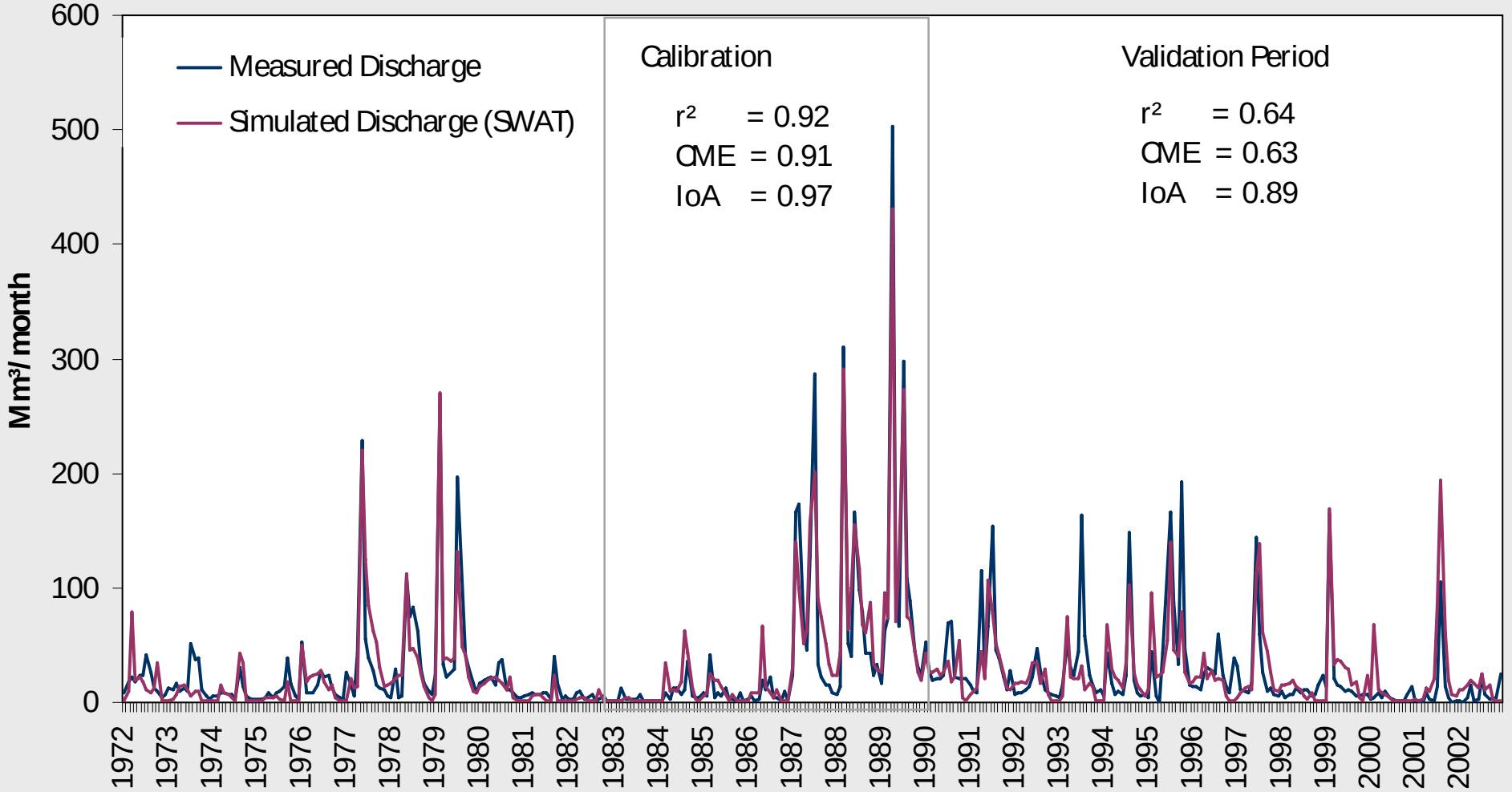


Soil & Water Assessment Tool | SWAT

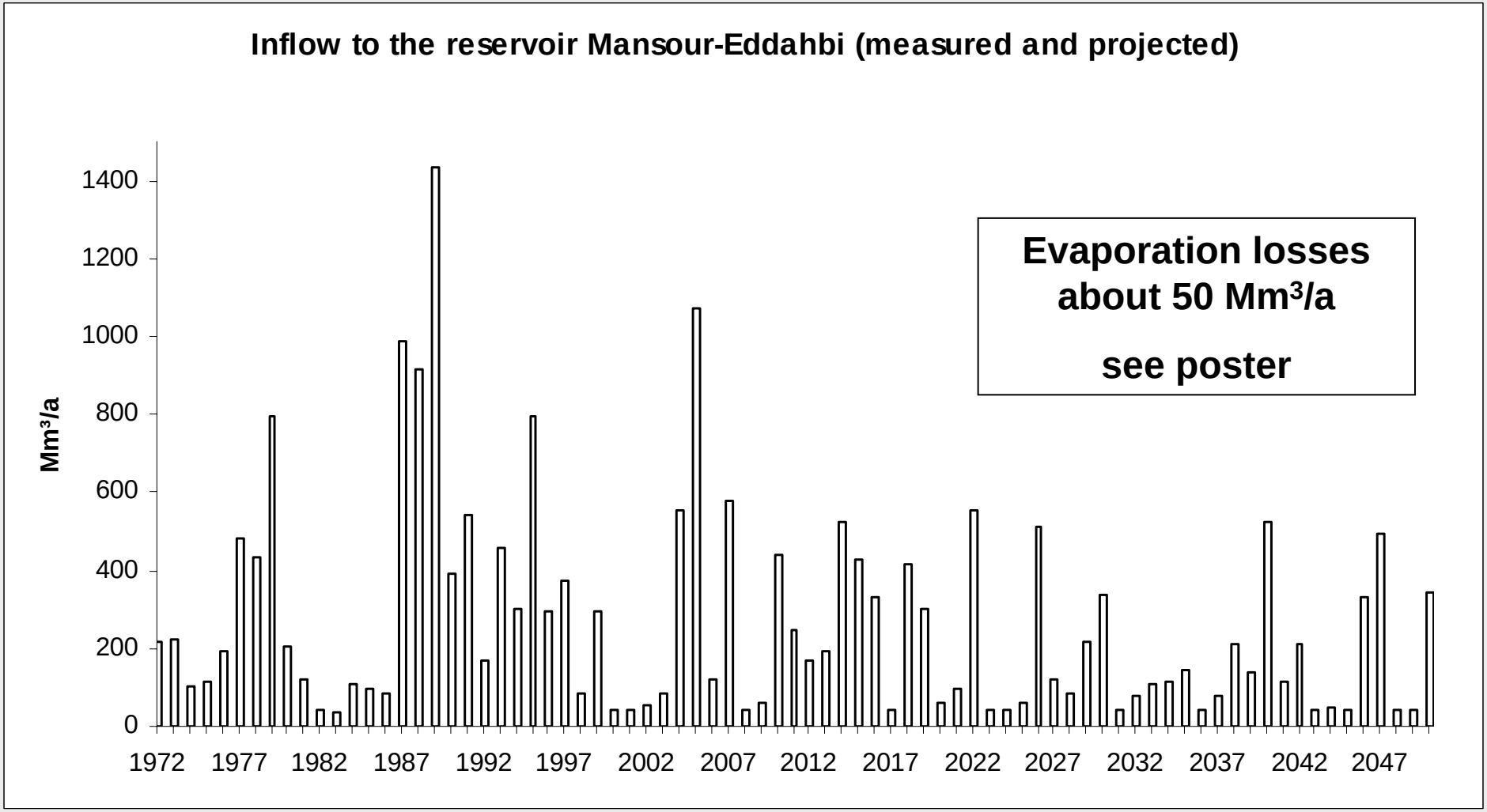
- Daily time step
- Spatial discretization
  - 11 Subwatersheds
  - 219 HRUs (Soil/LULC)
- Altitudinal discretization
  - 500m
- Weather data
  - 7 precipitation gages
  - 2 climate stations

SWAT model results

Discharge into the reservoir Mansour-Eddahbi (1972-2003)



Scenario calculations



Conclusions: Hydrological processes in the Upper Drâa basin

- Due to small scale heterogeneity, transfer of local scale process knowledge to regional scale not possible
- Rainfall amount and spatio-temporal pattern are most important for hydrological simulation
- Validated models are available which couple snow storage, regional water fluxes with the river system and oases
- Scenario calculations reveal the importance of snow for future reservoir filling
- Test the Spatial Decision Support System

HYDRAA

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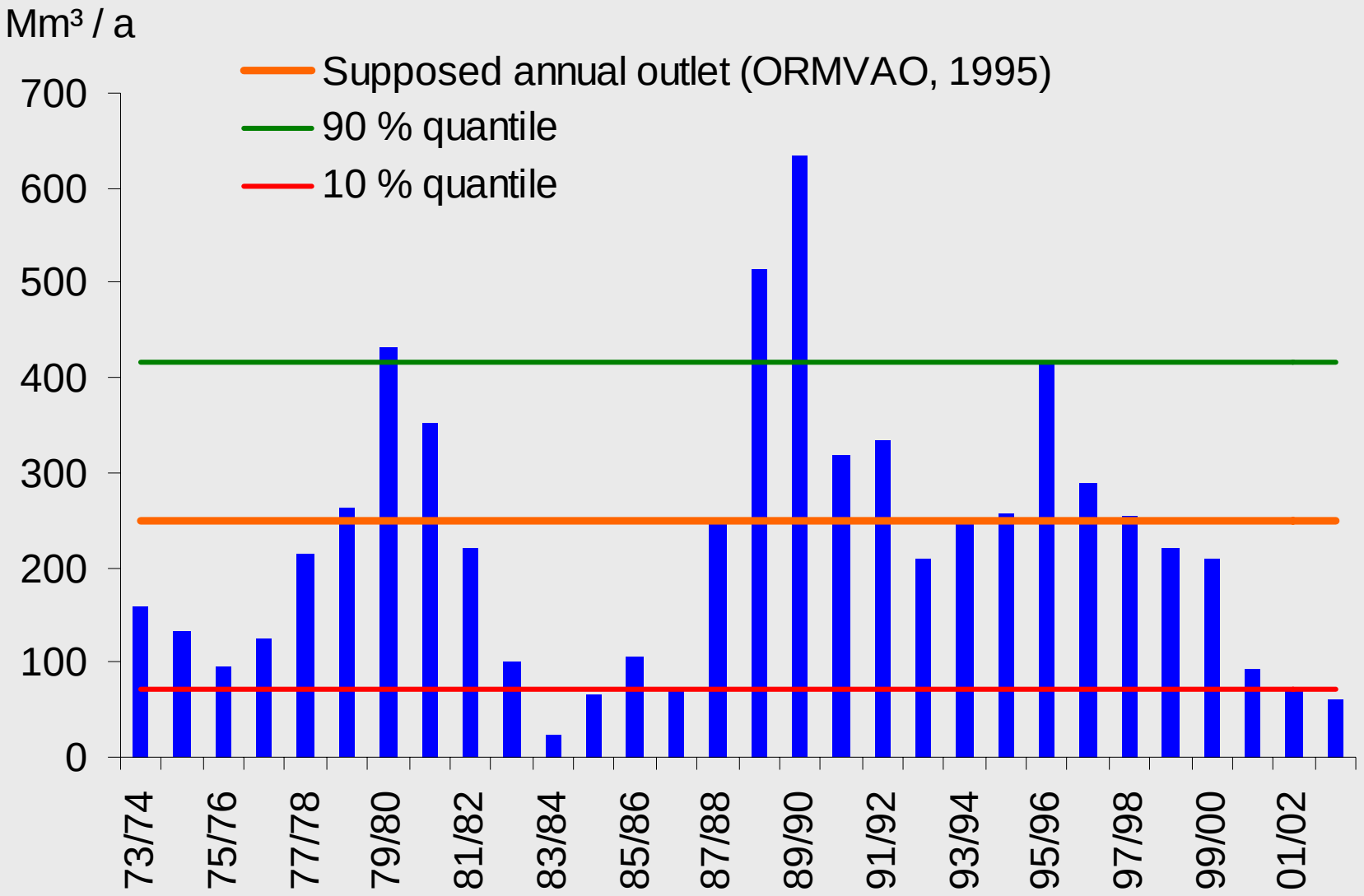
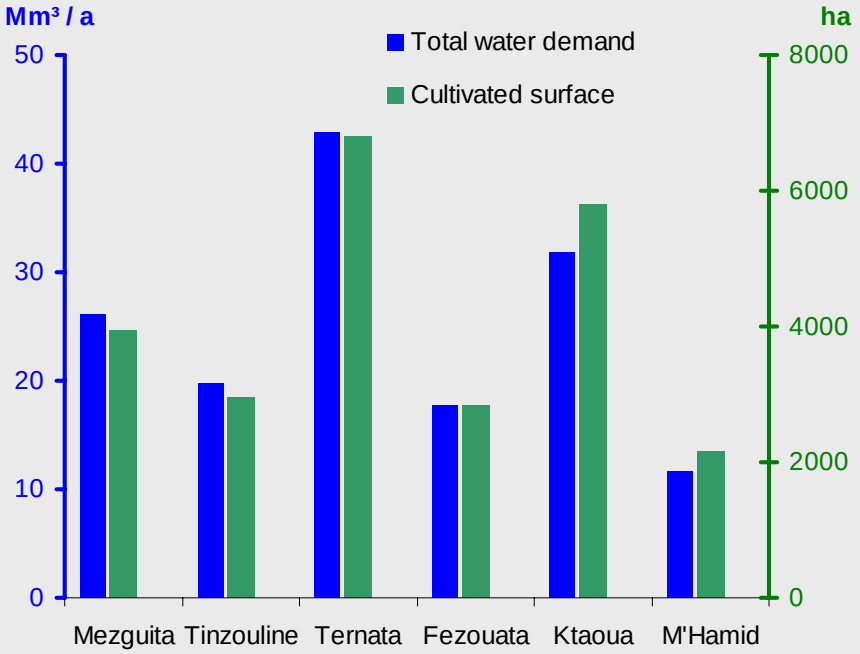
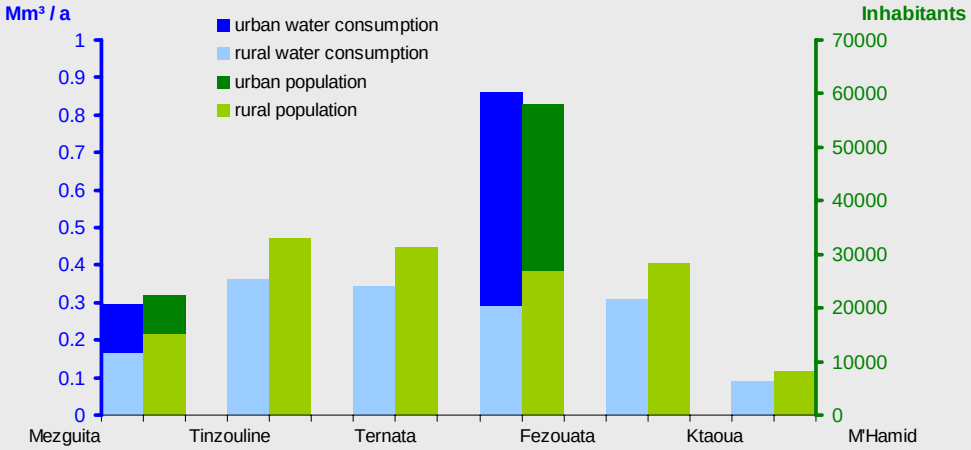
Current water availability: water release from reservoir



data from ORMVAO

Current water demand



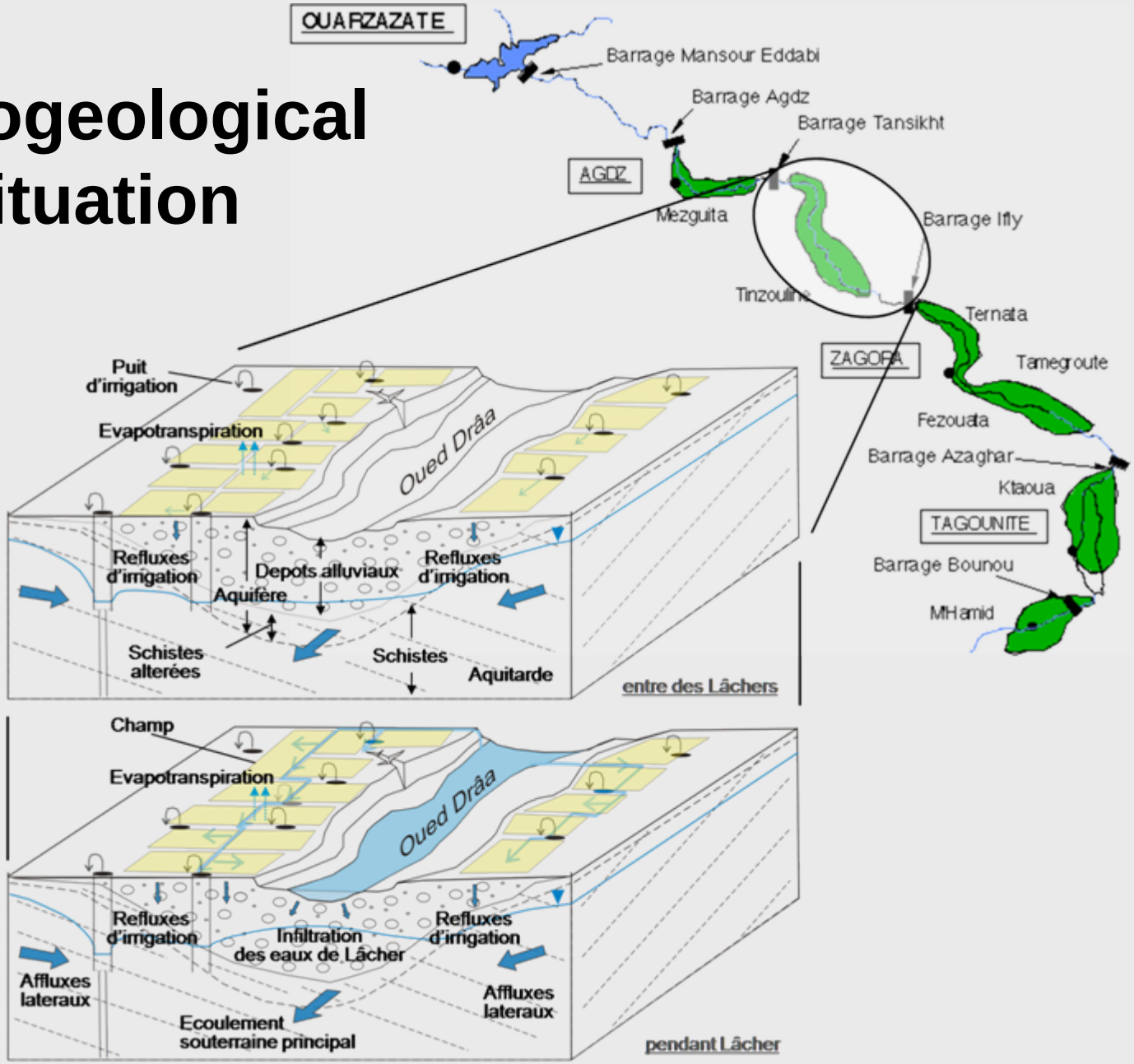


- Water from reservoir is often not sufficient for irrigation agricultural
- Domestic water use of minor importance but locally scarce (e.g. due to tourism)

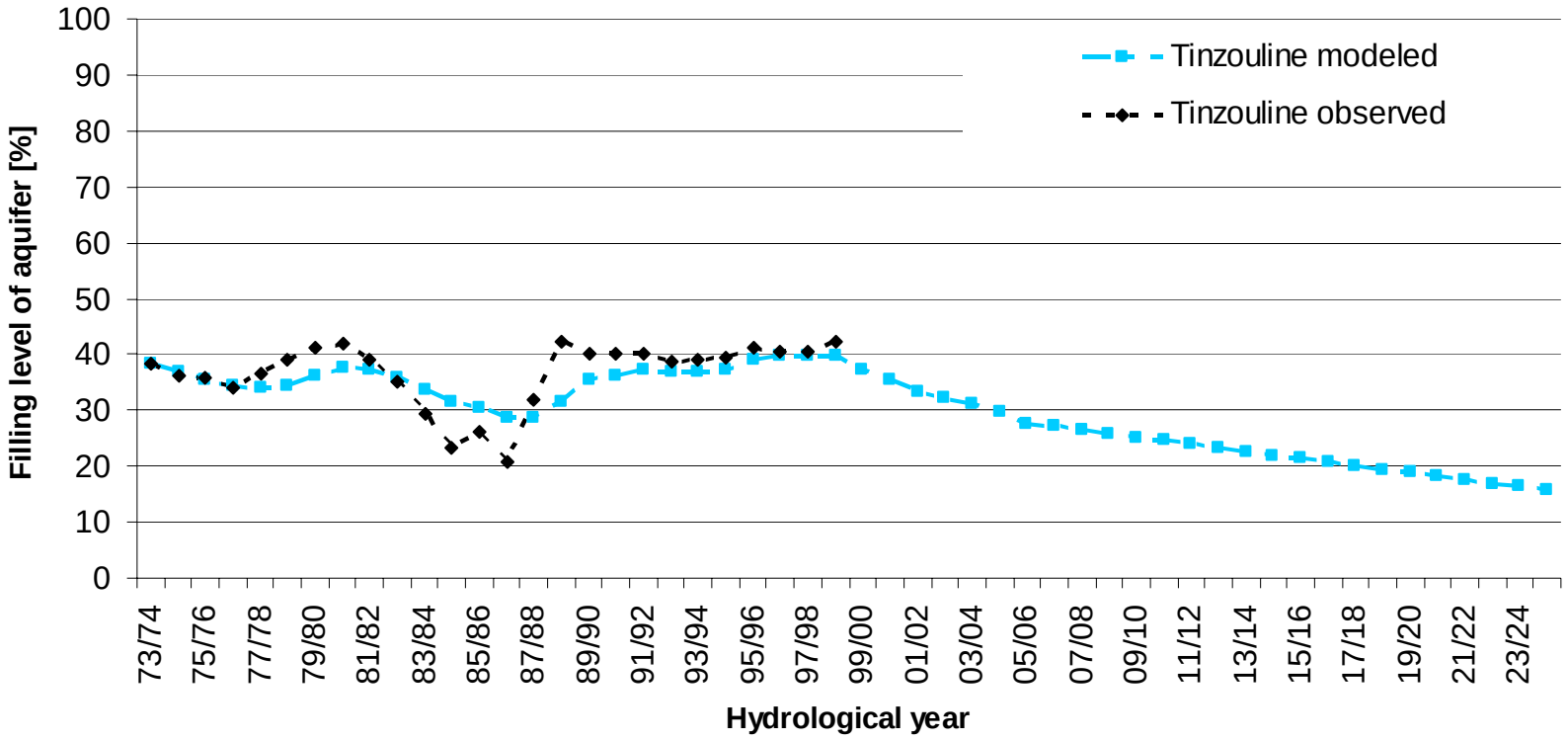
Consequence

- Increasing groundwater use

Hydrogeological situation



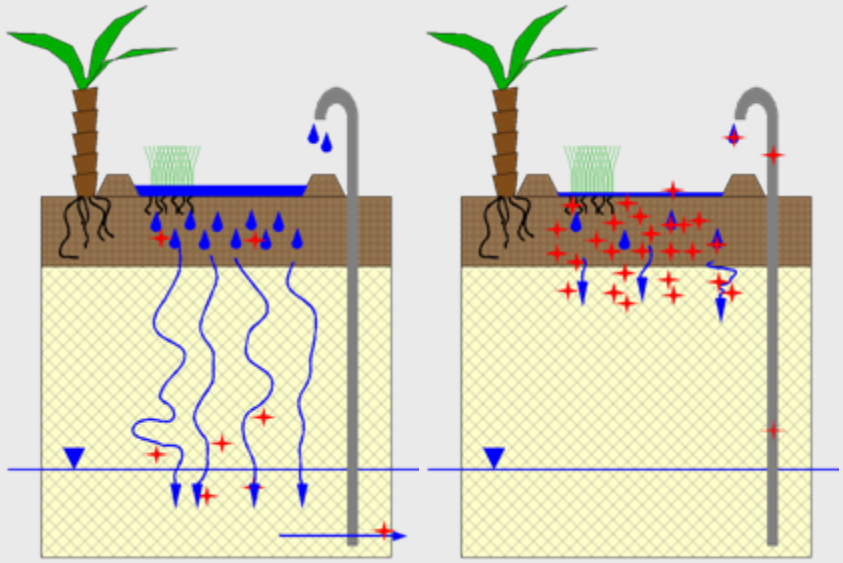
Groundwater availability at the oasis of Tinzouline



Modelled filling level of the aquifer of Tinzouline from 1973 to 1998 and scenario calculation until 2025

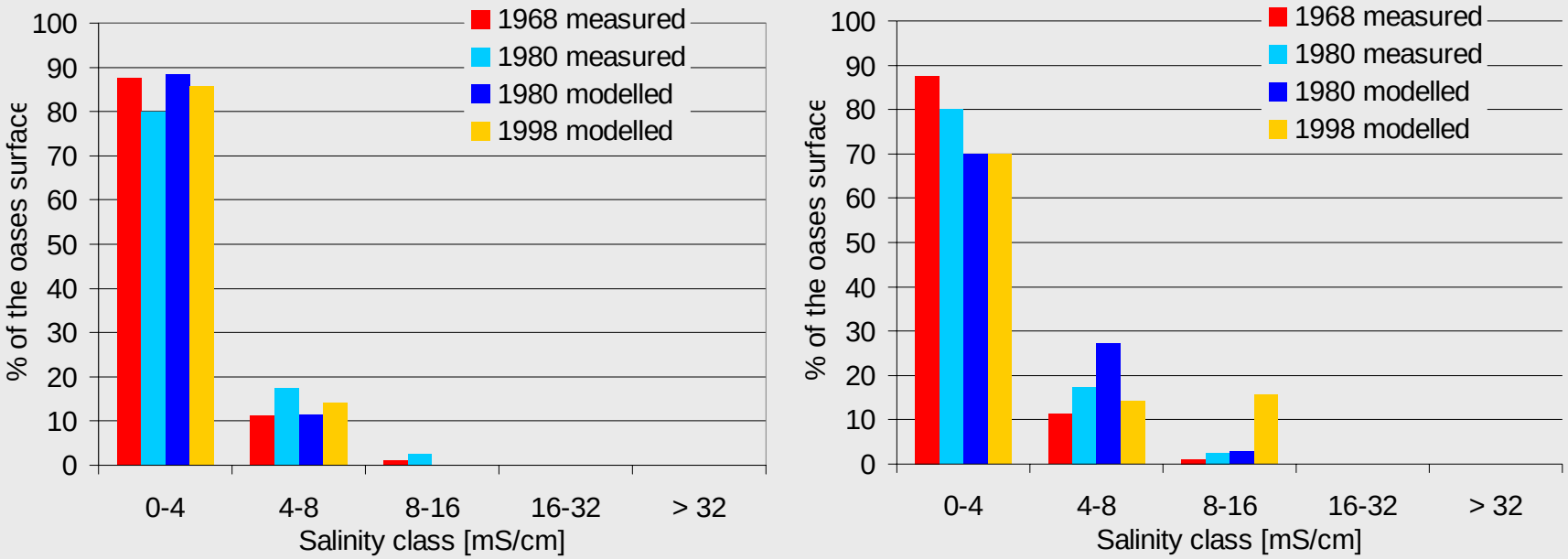
Soil quality

- Decreasing soil quality and decreasing yield due to increasing soil salinity
- Decreasing groundwater quality due to increasing evaporation losses
- Problem will increase in future due to decreasing surface water availability



Modeling long-term soil salinity

- Soil salinity was simulated using the quasi-3d model SahysMod
- As drip irrigation is a technique actually facilitated in the Drâa oasis, a scenario of soil salinity assuming drip irrigation was calculated
- Critical values for agricultural production starts at 4 mS/cm for sensitive plants (for details see the poster of Heidecke et al. and the presentation of Goldbach et al.)



Comparison of simulated and observed soil salinity of the oases Mezguita using flood irrigation (left) and a scenario using drip irrigation (right)

Conclusion: Hydrological processes in the Middle Drâa basin

- The Middle Drâa valley is characterized by high water demand at the oases scale and low regional water recharge
- Overexploitation of groundwater resources due to limited surface water availability causes significant problems
- Soil and groundwater salinity will become the major problem in near future due to limited water quantity and quality
- Test the Spatial Decision Support System

IWEGS

Conclusion

- Surface water availability is the key for agricultural use in the Drâa valley
- Simulations and scenario calculations show that water availability may decrease in future
- Yield reduction due to increase in soil salinity is very likely
- Based on the interdisciplinary modeling approach a number of Spatial Decision Support Systems and Monitoring Tools have been developed which links knowledge gained at different scales with scenario development
- Please visit the poster session and test our SDSS

Thank you for your attention