Water balance calculation at the regional-catchment scale using a remotely sensed evapotranspiration: Thur Catchment, Switzerland

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1. Aims and Objectives

Climatic, topographic, and land use/land cover heterogeneities (Fig. 1), pose a significant challenge to managing water resources at the catchment scale. This is further complicated by data limitations.

This project aims to:

- Develop **estimates** of water distribution and storage change in the **unsaturated** zone based on remotely sensed fluxes and runoff data.
- Develop practical **management** schemes based on results.

2. Thur Catchment

The Thur River:

- Longest Swiss river without natural or artificial barriers (~130km).
- Highly dynamic river (discharge ~3 m^3/s to 900 m^3/s).
- Topographically variable catchment (366 ~ 2100m).
- Catchment size ~ 1696 km^2.
- Maximum rainfall ~ 2837 mm.

3. Mass Balance

To determined the basic mass balance equation:

$$P - ET = Q$$

P = Precipitation
ET = Evapotranspiration
Q = Discharge (inflow & outflow)

for the Thur catchment, and its sub-catchments, the following tools were used:

1 Precipitation (Fig. 1).
Spatially interpolated annual precipitation data (Meteoswiss).

2 Evapotranspiration (ETa)
Annual actual evapotranspiration **MOD**erate resolution **I**maging **S**pectrometer (MODIS) composite product (which uses the Penman–Monteith equation)

MODIS composite (Fig. 1):
Land use (Fig. 1), leaf area indices, albedo, radiation, air pressure, temperature and humidity are the primary inputs into the MODIS ETa product..

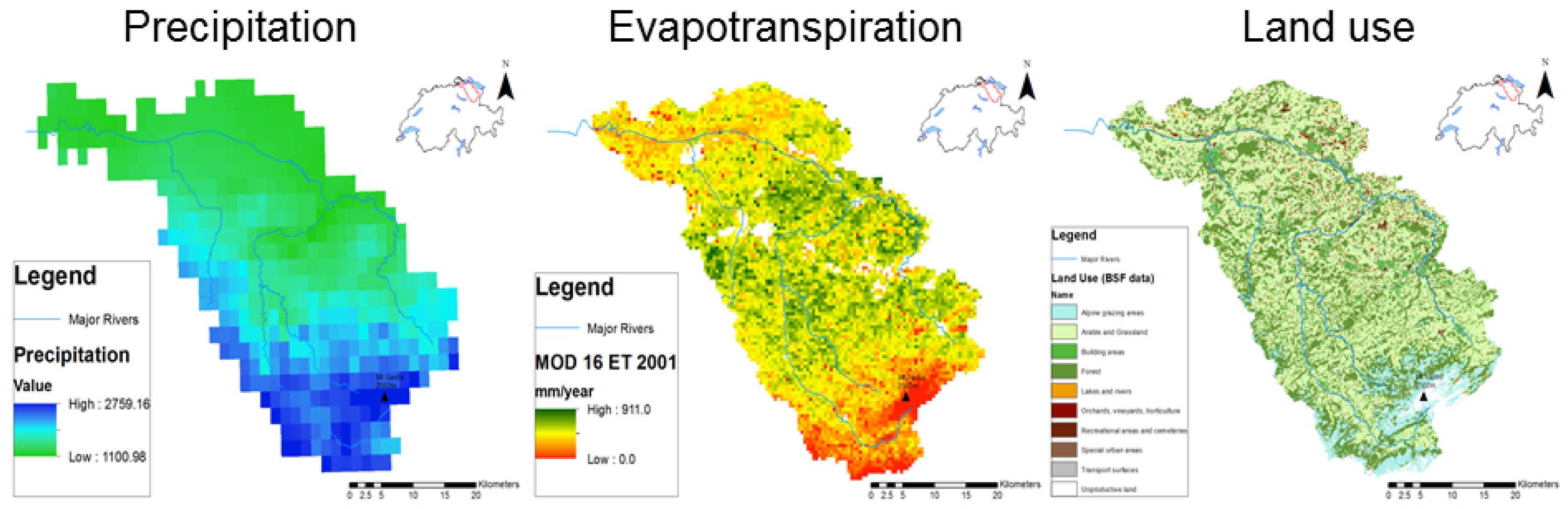
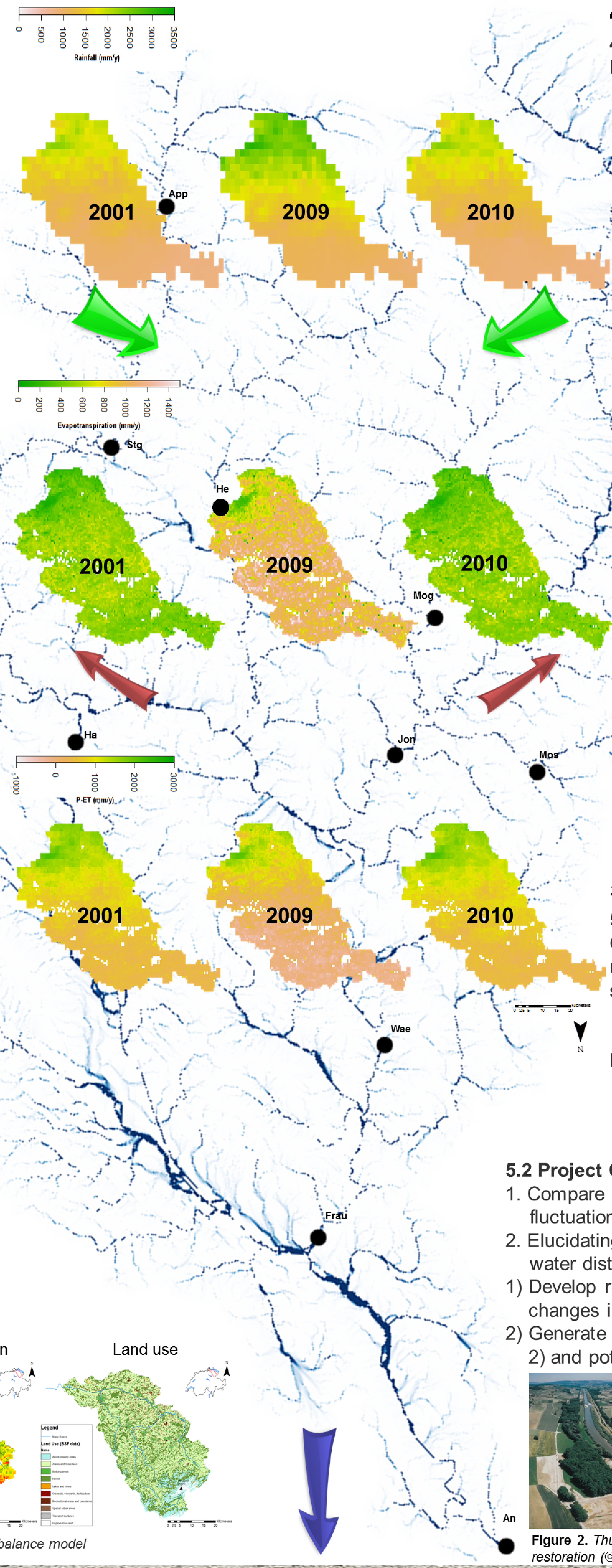


Figure 1. *Catchment characteristics as input data to a water balance model*



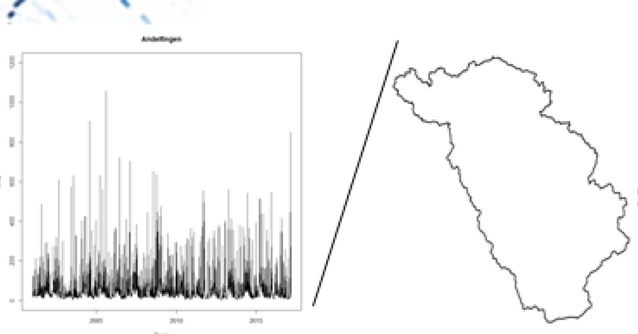
4. Soil Moisture

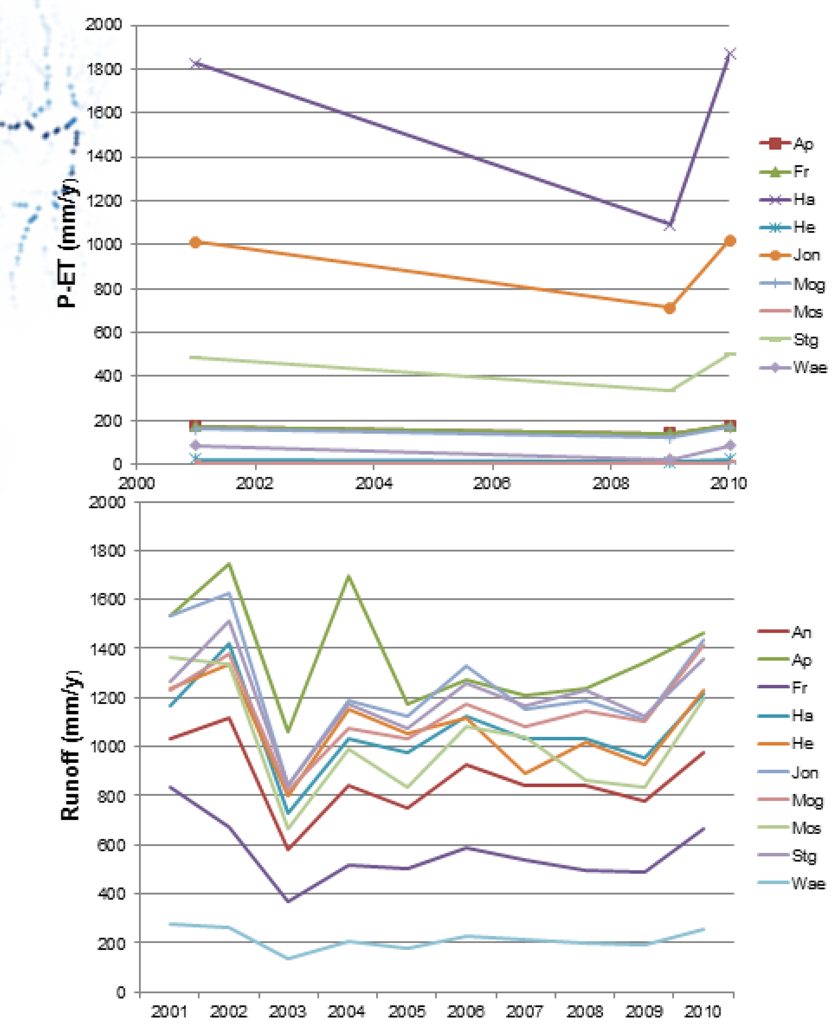
4.1 Soil moisture balance

P-ET ≈ Q, but change in groundwater storage is not accounted for here. Differences between runoff (m^3/s) and P-ET should account for excess water available for recharge and subsequent storage change.

4.2 Runoff

Since 1974, 10 active monitoring stations have been measuring runoff along the Thur catchment





5. Discussion

5.1 Preliminary Interpretations

Over large time intervals, changes in recharge potential could infer changes in saturated aquifer volume storage (ΔS).

$$(P - ET - Q)/\Delta t = \pm \Delta S$$

Note: Δt = 1 year

Problem: Discharge measurements include all additional inputs!

5.2 Project Outlook

1. Compare results with actual groundwater fluctuations,
2. Elucidating the catchment-wide spatiotemporal water distribution and budget.

1) Develop reliable simulations of water **quality** changes in the Thur aquifer.
2) Generate guidelines on **river restoration** (eg. Fig. 2) and potential **retention areas**..

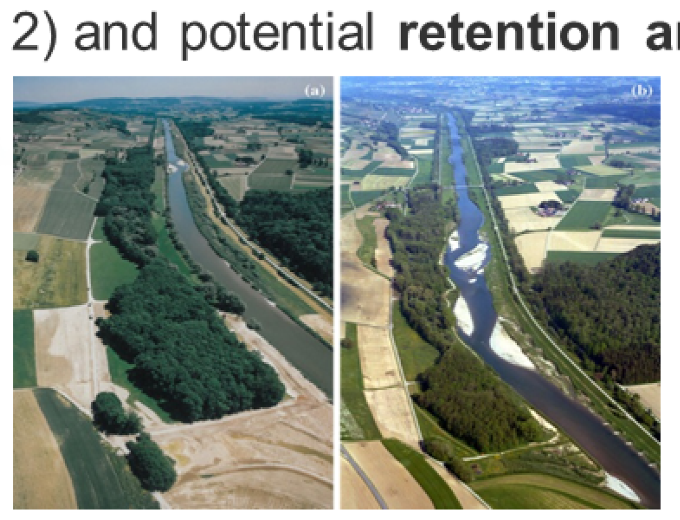


Figure 2. *Thur before (a) and after (b) restoration (© BHAteam, Frauenfeld).*

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