Application of the SWAT model in a decisional framework for the Caia catchment, Portugal

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Motivation and objectives

Caia catchment (southeastern Portugal) water management problems include: equitable distribution of scarce water to different regions and for various uses; irrigation planning; contamination from nutrients.

This work:

- Implement a water balance model as a support tool for a DSS;
- Explore and define the modeling scenarios and I/O transformations that will constitute the interface between model and DSS.

Long-term work:

- Implementation and application of the DSS for the Caia study area, making use of model simulation results where appropriate (e.g., as components of the DSS analysis matrix);
- Tighter integration between the DSS and the hydrological model (SWAT and/or simpler “meta-models”);
- Extension of the water balance model to consideration of water quality aspects as well.
Overview of the watershed

- **DEM (digital elevation model)** = 100m resolution
- **Min. elevation** = 180m
- **Max. elevation** = 998m
- **Area** = 780km$^2$
- **Subbasins** = 32 (threshold area = 11km$^2$)
Land use characterization

- Land use map with a resolution of 100 m

- Prevalent land use classes:
  - 56% agriculture (AGRL)
  - 31% deciduous forest (FRST)
  - 5% mixed forest (FRSD)
  - 3% surface water (WATR)
Soil characterization

- Absence of a map convertible to the classification used by SWAT (USDA)

- One type used for the entire watershed

- Main soil characteristics: C (hydr. group); Clay (10%), Silt (30%), Sand (60%); 100mm/hr (hydr. conductivity)
Climatology of the watershed

- Monthly data set (1960-1990) of precipitation, temperature given for 17 meteo stations in the Caia catchment area

- Daily data set (1960-1990) obtained by meteorological analysis (NCEP-NCAR) for precipitation, temperature and solar radiation
**SWAT modules selected**

- *Surface runoff: SCS-CN method*
- *Potential evapotranspiration: Hargreaves*
- *Routing phase: Variable storage*
Calibration and validation procedures

- Monthly streamflow data given for one gage located within the watershed (1960-1990)
- Average annual conditions
- Model parameters investigated: available soil water capacity, soil depth, curve number
Scenario generation for the DSS

- Non operational reservoir (rainfed farming)
- Operational reservoir combined with the auto-irrigation module (irrigated agricultural production)
30-year averaged soil water distribution

without reservoir

with reservoir + irrigation
SWAT and DSS interaction

- Processing of model-generated spatio-temporal data to extract indicators for the DSS analysis matrix

- The DSS is not spatially or temporally distributed, so for any given indicator a single value must be obtained from any (combination of) model outputs (min, max, weighted average, threshold probability, etc.)
Concluding remarks

- Acquire additional data (soil, irrigation, etc) and assess the quality of the available data (e.g., anomalies in the climate and streamflow time series);

- Improve the hydrological modeling (entire catchment, daily observations)

- Include new scenarios (actual rather than model-generated irrigation program, additional dams/reservoirs?, …)

- Future work as described earlier