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.

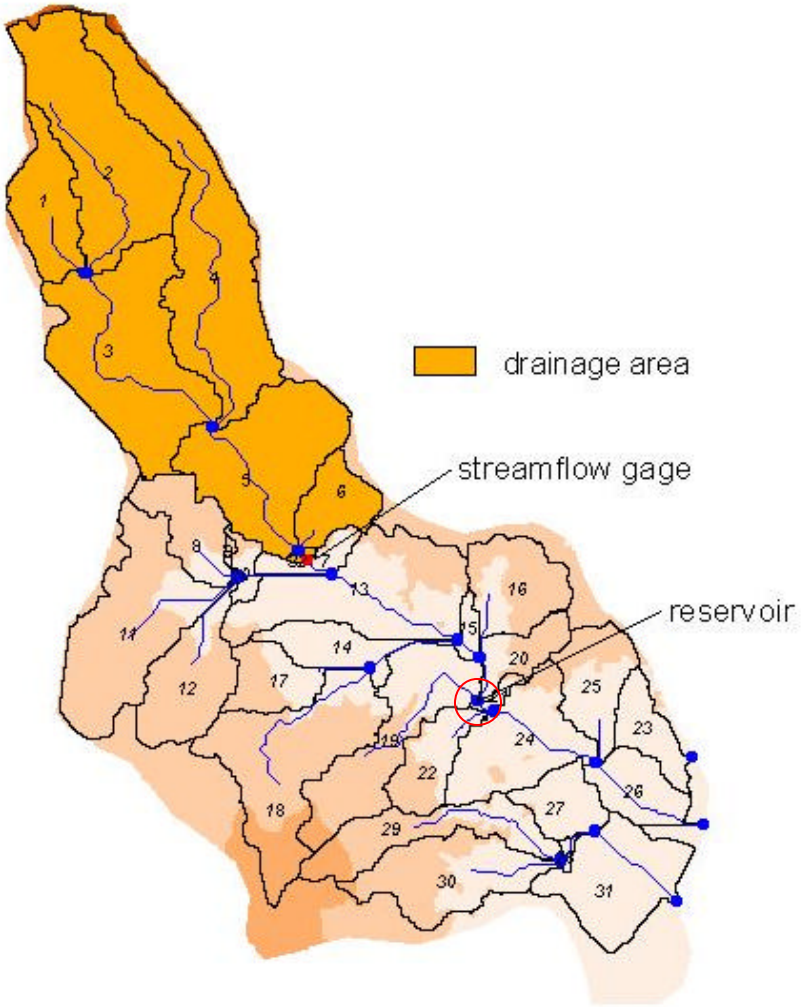
This work:

- *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



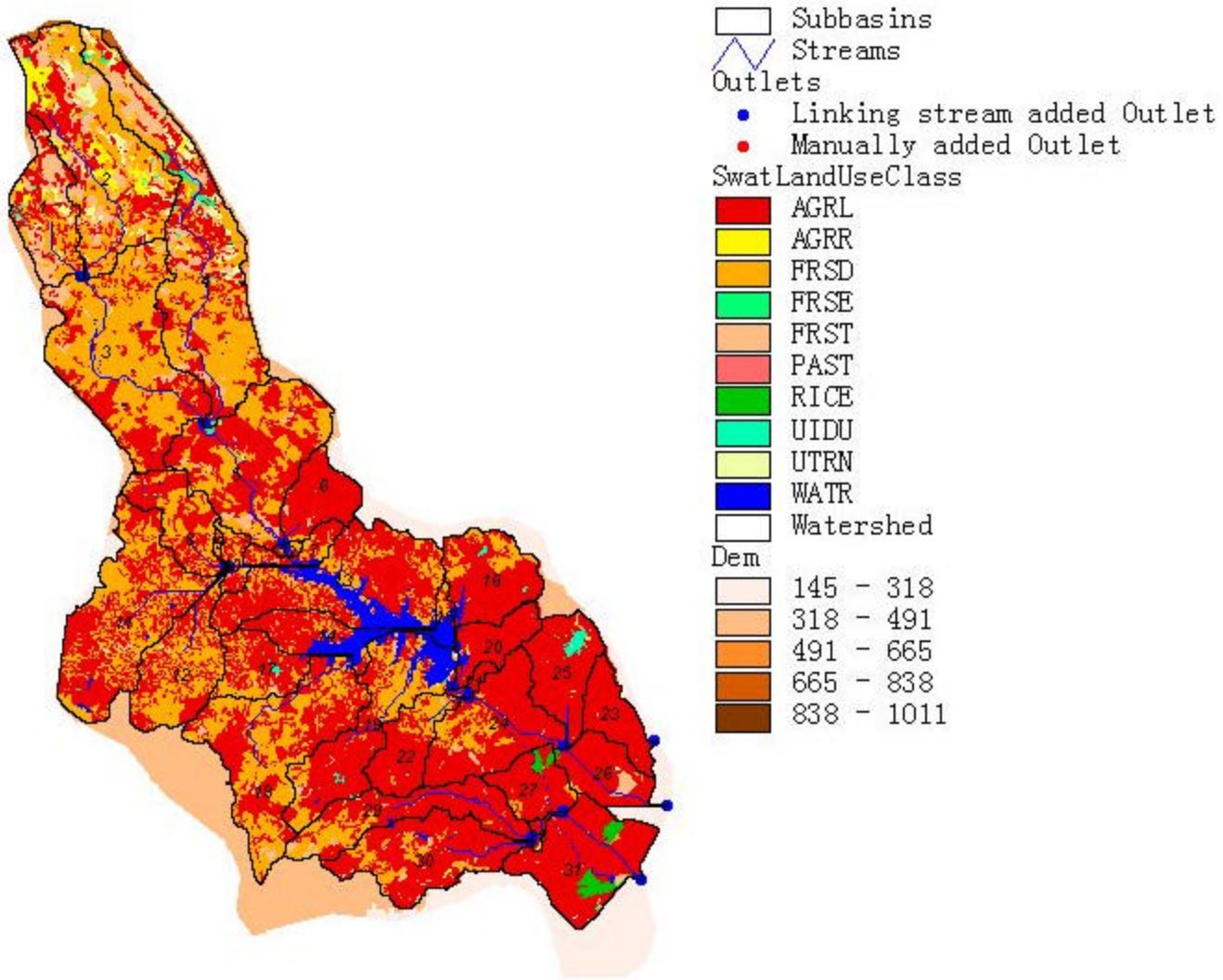
- *DEM (digital elevation model)=100m resolution*
- *Min. elevation=180m*
- *Max. elevation=998m*
- *Area=780km^2*
- *Subbasins=32 (threshold area=11km^2)*

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)*

Land Use


Subbasins
Streams
Outlets
Linking stream added Outlet
Manually added Outlet
SwatLandUseClass
AGRL
AGRR
FRSD
FRSE
FRST
PAST
RICE
UIDU
UTRN
WATR
Watershed
Dem
145 - 318
318 - 491
491 - 665
665 - 838
838 - 1011

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*


1200
964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
Precip_observed
Precip_generated
Precip_meteo

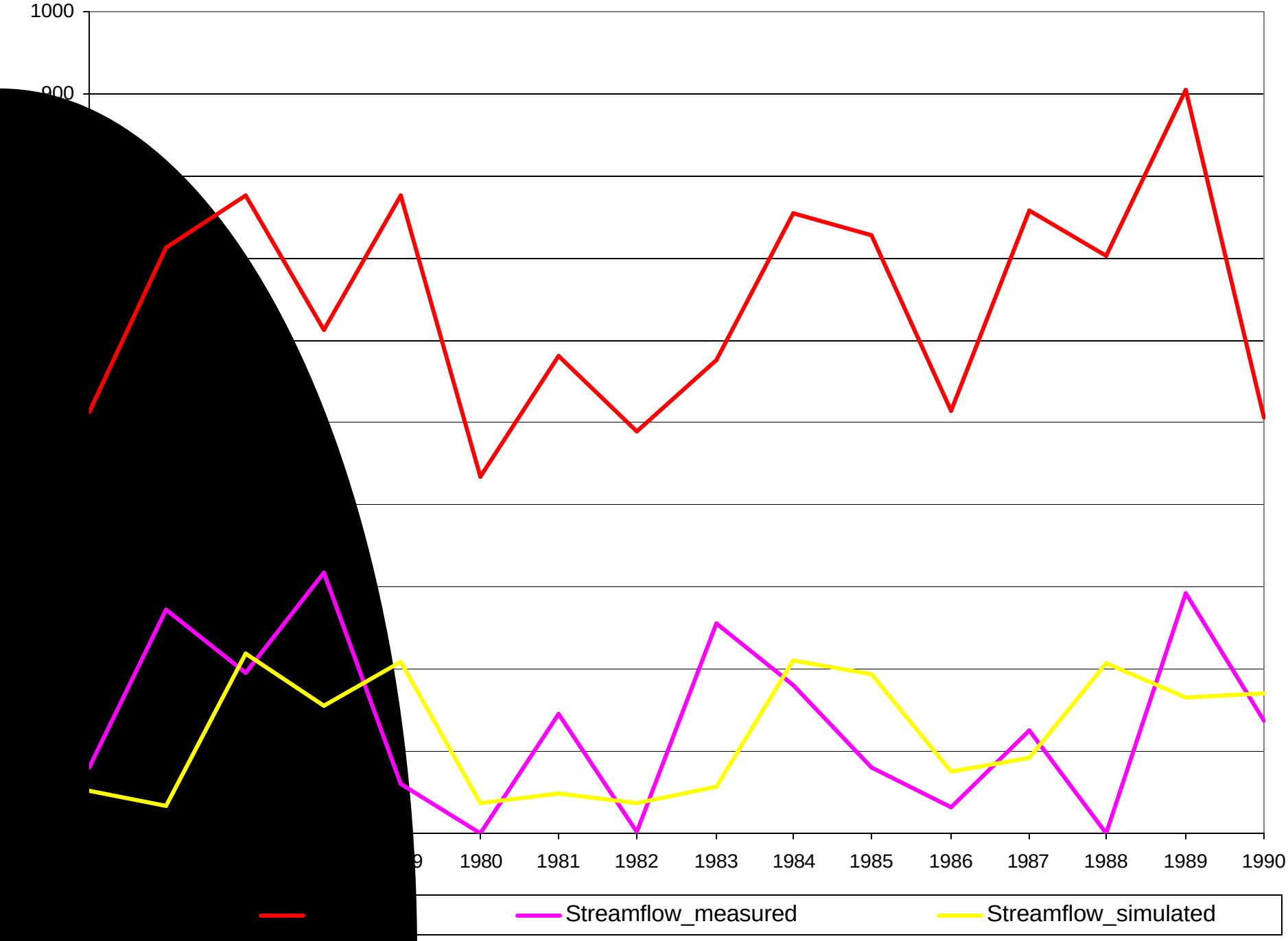
SWAT modules selected

- *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*


1200
964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
Streamflow_measured
Streamflow_simulated

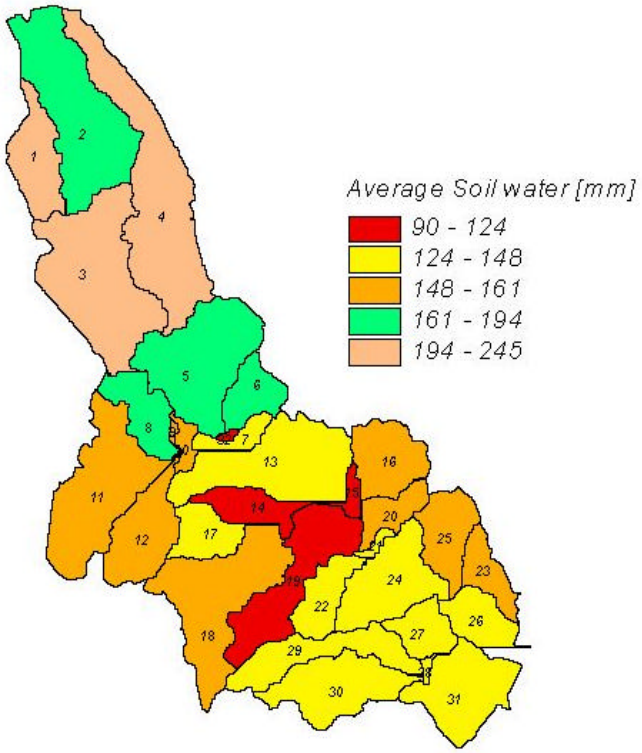

1000
900
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
Streamflow_measured
Streamflow_simulated

Scenario generation for the DSS

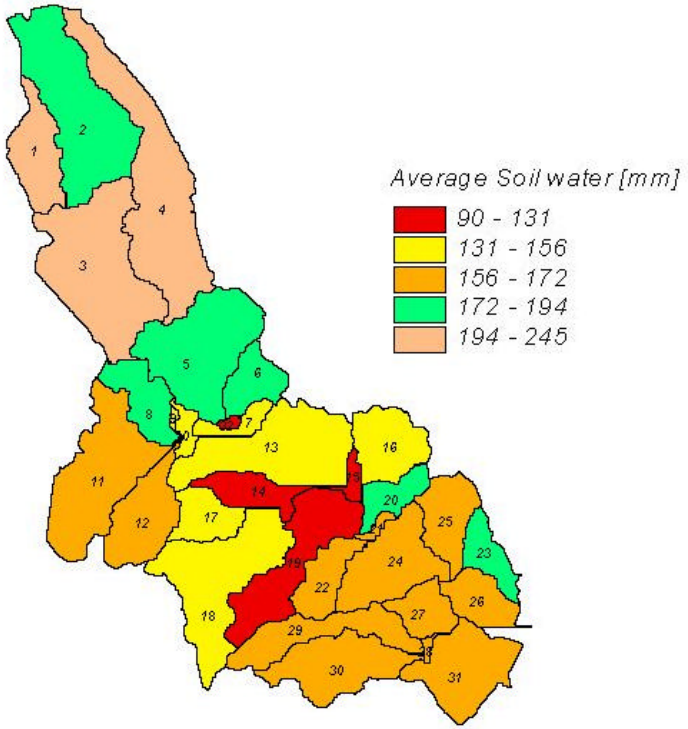
- *Non operational reservoir (rainfed farming)*
- *Operational reservoir combined with the auto-irrigation module (irrigated agricultural production)*

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*