GestAqua .AdaPT | ADAPTATION WATER RESOURCES CLIMATE CHANGE

Water management adaptation strategies in a Mediterranean river basin

TASK REPORT - HYDROLOGICAL SCENARIOS

SUMMARY

This report briefly presents the hydrological scenarios generated by GestAqua.AdaPT. The SWAT ecohydrological model was applied to simulate the response of vegetation, hydrological processes and phosphorus exports of the watersheds draining to the Monte Novo and Vigia reservoirs. The calibrated model was then applied with two future climate scenarios between 2010 and 2100, and used to forecast changes to water and phosphates flows into the reservoirs, as well as the evolution of water requirements for the main irrigated crops in the region.

METHODS

The Soil and Water Assessment Tool (SWAT) model was applied for a study area comprising the drainage areas of the Monte Novo and Vigia reservoirs, as well as an area immediately downstream. This area was simulated as 19 sub-basins, divided into hydrological response units according to land use, soil properties and topography. SWAT was successfully calibrated for the period between 1994 and 2005, using existing data and estimates for reservoir inflows, volume, water extractions, and phosphorus inflows.

The model was then applied for the period between 1970 and 2100 using data for two Regional Climate Models: RACMO22E and RCA4, using data generated in the climate scenarios task. Two CO_2 concentration scenarios were used: RCP 4.5 and 8.5. SWAT produced daily results for streamflow, phosphorus flow, and irrigation requirements for the two reservoirs, which were analyzed in monthly and annual summaries for four periods: 1970-2000 (control period), 2010-2040, 2040-2070 and 2070-2100. Results were analyzed as anomalies between the control and each future period.

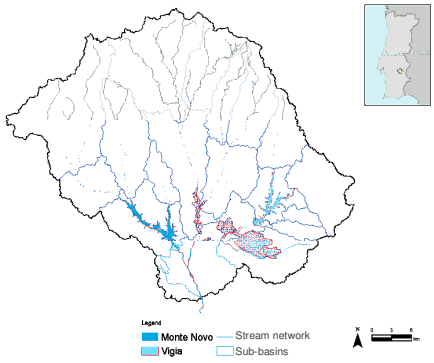

Figure 1. Model application area and sub-divisions

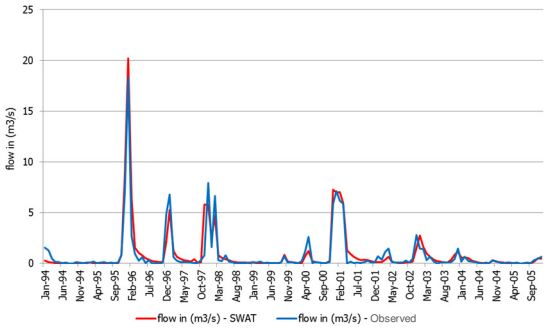

Figure 2. Model calibration for inflow to the Monte Novo reservoir

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RESULTS

Model results for water inflow were highly variable and resulted from the combination of two different trends: (i) a general decrease in rainfall, leading to lower inflow; (ii) a concentration of rainfall in winter, leading to higher inflow, as soils are unable to retain excess water. This resulted in trends of increased inflow for the RCP 4.5 scenarios, and of lower inflow for the RCP 8.5 scenarios.

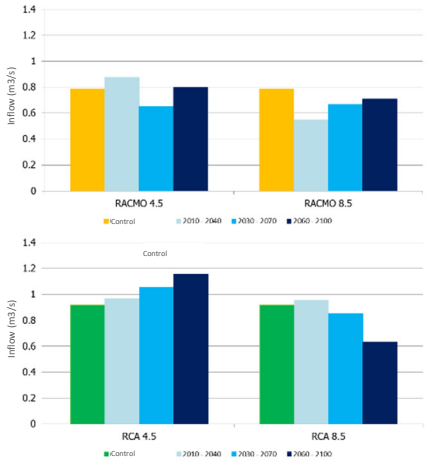

Figure 3. Inflow at Monte Novo for the RACMO (top) and RCA (bottom) regional climate models

In contrast, model results for irrigation water requirements were relatively constant, and reflected an increase in demands proportional to the overall decrease in rainfall. Model results for phosphate inflows were in between these two trends: relatively variable, and resulting from a combination of (i) a general increase due to higher winter rainfall, and (ii) a variability matching that of inflow, due to changes in phosphorus transport by water. The result was a trend for slight increases in scenario RCP 4.5 and moderate increases in RCP 8.5.

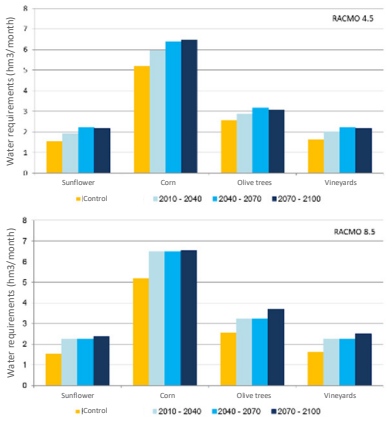

Figure 4. Irrigation requirements for the RACMO model in scenario RCP 4.5 (top) and 8.5 (bottom)

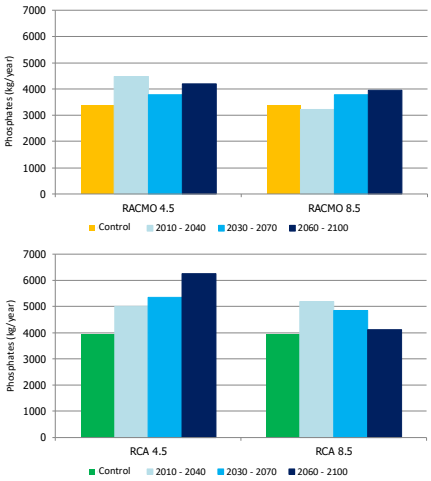

Figure 5. Phosphate inflow at Monte Novo for the RACMO (top) and RCA (bottom) climate models