The response of Bonis Catchment in Calabria - Southern Italy to different management options under climate change scenarios

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Project: INNOMED

Study case: Bonis catchment-Calabria, southern Italy

Objectives: In the INNOMED project in the Bonis catchment are to simulate the water balance of the Bonis catchment under different land use / management scenarios, combined with climate change forcings to quantify the effect of alternative management options on the land-water cycle.
Catchment characterization - Meteorological data

Soil characterization

Hydrological model FEST-WB SET UP

Automatic and Manual Model calibration

Insertion of forest growth module

Simulate different land use / management scenarios coupled with climate change forcing
In May 2003 a tower for the measurement of fluxes with the Eddy covariance technique was installed in a plantation of 44-year old Laricio pines, in Cozzarella – Don Bruno location.

The runoff is measured at the outlet of the watershed using a gauging structure.

Data from 1986 were collected from 3 Meteorological stations:
- **Basin outlet** (Outlet: 975 m a.s.l.)
- **Petrarella**: 1258 m a.s.l.) located in the north-eastern of the catchment
- **(Don Bruno)**: 1175 m a.s.l.) located in the south-western part of the catchment.
We carried out the automatic calibration considering the different landuses of catchment.

Figure results of soil parameters calibration using HydrPSO model.
Results of hydrological simulation

Figure. Contribution of each landuse to surface runoff, infiltration and percolation

Figure. Simulated Vs observed surface runoff

Figure. Soil Moisture variation with landuse

RUNOFF
- Landuse1
- Landuse2
- Landuse3
- Landuse4
- Landuse5
- Landuse6
- Landuse7
- Landuse8
- Landuse9

INfiltration
- Landuse1
- Landuse2
- Landuse3
- Landuse4
- Landuse5
- Landuse6
- Landuse7
- Landuse8
- Landuse9

PERCOLATION
- Landuse1
- Landuse2
- Landuse3
- Landuse4
- Landuse5
- Landuse6
- Landuse7
- Landuse8
- Landuse9
The integration of forest growth modules at FEST-WB
### Sensitivity Analysis

#### Parameters considered for the calibration

<table>
<thead>
<tr>
<th>RankingNmbr</th>
<th>ParameterName</th>
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<tbody>
<tr>
<td>1</td>
<td>wood-density</td>
</tr>
<tr>
<td>2</td>
<td>sprn</td>
</tr>
<tr>
<td>3</td>
<td>fprn</td>
</tr>
<tr>
<td>4</td>
<td>GPP-NPP</td>
</tr>
<tr>
<td>5</td>
<td>alpha</td>
</tr>
<tr>
<td>6</td>
<td>hdmin</td>
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<tr>
<td>7</td>
<td>agemax</td>
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<td>albedo</td>
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<tr>
<td>9</td>
<td>k</td>
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<td>10</td>
<td>fpra</td>
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<td>11</td>
<td>spra</td>
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<tr>
<td>12</td>
<td>phi-theta</td>
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<td>sla</td>
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<td>16</td>
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<td>17</td>
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<td>canopymax</td>
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<td>26</td>
<td>as</td>
</tr>
<tr>
<td>27</td>
<td>ns</td>
</tr>
</tbody>
</table>

- **S.A.** was carried out using the HydroPSO model.
- This later was carried out with regard to the DBH parameter.

#### All required inputs for FEST-FOREST

- Parameters considered for the calibration
- Parameters not considered for the calibration

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**Parameters considered for the calibration**

- wood-density
- sprn
- fprn
- GPP-NPP
- alpha
- hdmin
- agemax
- albedo
- k
- fpra
- spra
- phi-theta
- phi-ea
- hdmx
- sla
- dbhdcmx
- denmax
- tcold-leaf
- canopymax
- laimax
- dbhdcmnin
- denmin
- cra
- crb
- crc
- as
- ns
Historical data from Bonis catchment

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Variables</th>
<th>Values</th>
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<tr>
<td>1986</td>
<td>Plant number (N/ha)</td>
<td>1120</td>
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<tr>
<td></td>
<td>Basal area (m²/ha)</td>
<td>43.2</td>
</tr>
<tr>
<td></td>
<td>DBH (cm)</td>
<td>20.2</td>
</tr>
<tr>
<td>1993*</td>
<td>Plant number (N/ha)</td>
<td>1100</td>
</tr>
<tr>
<td></td>
<td>Basal area (m²/ha)</td>
<td>46.6</td>
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<tr>
<td></td>
<td>DBH (cm)</td>
<td>21.8</td>
</tr>
<tr>
<td>1993**</td>
<td>Plant number (N/ha)</td>
<td>700</td>
</tr>
<tr>
<td></td>
<td>Basal area (m²/ha)</td>
<td>32.4</td>
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<tr>
<td></td>
<td>Diameter (cm)</td>
<td>22.8</td>
</tr>
<tr>
<td>1999</td>
<td>Plant number (N/ha)</td>
<td>690</td>
</tr>
<tr>
<td></td>
<td>Basal area (m²/ha)</td>
<td>45.8</td>
</tr>
<tr>
<td></td>
<td>DBH</td>
<td>27.4</td>
</tr>
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</table>

Historical dendrological analysis. 1993* represents the dendrological measure before the thinning, while 1993** the dendrological data right after the thinning (DBH = diameter at breast height).
Model showed to reproduce satisfactorily the observed patterns for each year for tree height, tree diameter.

Figure. Results of DBH and Height simulations using FEST-WB Vs measurements.
### Climate Change and Management Scenarios Considered in the Simulations

<table>
<thead>
<tr>
<th>Time</th>
<th>Climate Scenario</th>
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<tr>
<td>2006-2095</td>
<td>RCP 4.5</td>
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<tr>
<td>First 30 years</td>
<td>+1°C</td>
</tr>
<tr>
<td>Last 40 years</td>
<td>+2°C</td>
</tr>
</tbody>
</table>

**Management**

- Thinning frequency and density reduction
- Rotational practices
- Different reforestation frequency and density
Considering the projected trends of variation of temperature and precipitations, we are expecting more drought conditions at Bonis catchment, so the management options should take into consideration these projections. Some of the management options that could be taken into consideration by the stockholders to cope with the effects of the climate change, were tested by the different simulations. Each of these management options simulations results are currently under assessment not only on the forest growth and carbon assimilation but also considering the impacts on different components of the water balance namely: surface runoff, and soil moisture.
THANK YOU FOR YOUR ATTENTION
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The authors would like to thank the EU, the Ministerio de Economía, Industria y Competitividad of Spain, the Research Promotion Foundation of Cyprus, the Agence Nationale de la Recherche and the Office national de l'eau et des milieux aquatiques of France, the Ministry for Education, University and Research of Italy, the Center of International Projects of Moldova, and the Foundation for Science and Technology of Portugal for funding, in the frame of the collaborative international Consortium INNOMED financed under the ERA-NET WaterWorks2015 Cofunded Call. This ERA-NET is an integral part of the 2016 Joint Activities developed by the Water Challenges for a Changing World Joint Programme Initiative (Water JPI) as a result of a joint collaborative effort with the Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE JPI).