Large scale water quality modeling in Lithuania: parameterization, calibration and validation using PAIC-SWAT tool

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Problem statement

- All members states need to implement the Water Framework Directive to get good status in all water bodies.
- Lithuanian Environmental Protection Agency (AAA) has to elaborate river basin districts management plans and programs of measures for all catchments in Lithuania.
- Models should be open source, reproducible and flexible (at any moment changes/adaptations can be done without redoing the whole work).
Input data
PAIC-SWAT model

- Soil and Water Assessment Tool (SWAT)
- a Python workflow by the Center of Processes Analysis and Research (PAIC).

>1000 sub-basin

HRU originally 1,400,000, after elimination <5ha – 200,000
Calibration strategy

- Daily Flow data:
  - 62 stations
  - 1997-2012.

- Water quality data
  - 500 stations
  - 135 data-rich
  - 1997-2012.

- A regionalization strategy for 13 hydrological regions.
- Automated and manual calibration for selected catchment
- Dividing data to 3 parts first and last 1/3 for calibration and 1/3 in the middle for validation
- Transfer to other catchments in hydrological region
Evaluation criteria for hydrology

<table>
<thead>
<tr>
<th>Action</th>
<th>NSE threshold</th>
<th>PBIAS threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration</td>
<td>NSE &gt; 0.5</td>
<td>PBIAS &lt; 20%</td>
</tr>
<tr>
<td>Validation</td>
<td>NSE &gt; 0.4</td>
<td>PBIAS &lt; 25%</td>
</tr>
<tr>
<td>Extrapolation (transfer)</td>
<td>NSE &gt; 0.3</td>
<td>PBIAS &lt; 30%</td>
</tr>
</tbody>
</table>

Observation vs. Simulation

Station Nevežis-Panevežis

Moriaisi et al., 2007
Evaluation criteria for water quality

<table>
<thead>
<tr>
<th>Action</th>
<th>R² threshold, N-NO₃, N-tot</th>
<th>PBIAS threshold, all parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration</td>
<td>R² &gt; 0.5</td>
<td>PBIAS &lt; 40%</td>
</tr>
<tr>
<td>Validation</td>
<td>R² &gt; 0.4</td>
<td>PBIAS &lt; 70%</td>
</tr>
<tr>
<td>Extrapolation (transfer)</td>
<td>R² &gt; 0.3</td>
<td>PBIAS &lt; 70%</td>
</tr>
</tbody>
</table>

NO₃-N: Šeimena - žemiau Vilkaviškio.

PO₄-P: Šeimena - žemiau Vilkaviškio.
Evaluation of mass balance
Results of hydrology
Results of water quality

Number of station

Number of station
Results of in-stream NO3-N
Results of in-stream PO4-P
Conclusion

• For hydrology: > 90% OK
• For water quality: >95% OK

• Data errors mainly cause of problems

• Parameterization, calibration, validation and extrapolation of flow and water quality parameters was successful.
Thanks for your attention