Conference for Wetlands: Monitoring, Modelling and Management
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Modelling Water Balances of Wetlands with controlled Drainage and Sub-irrigation Systems

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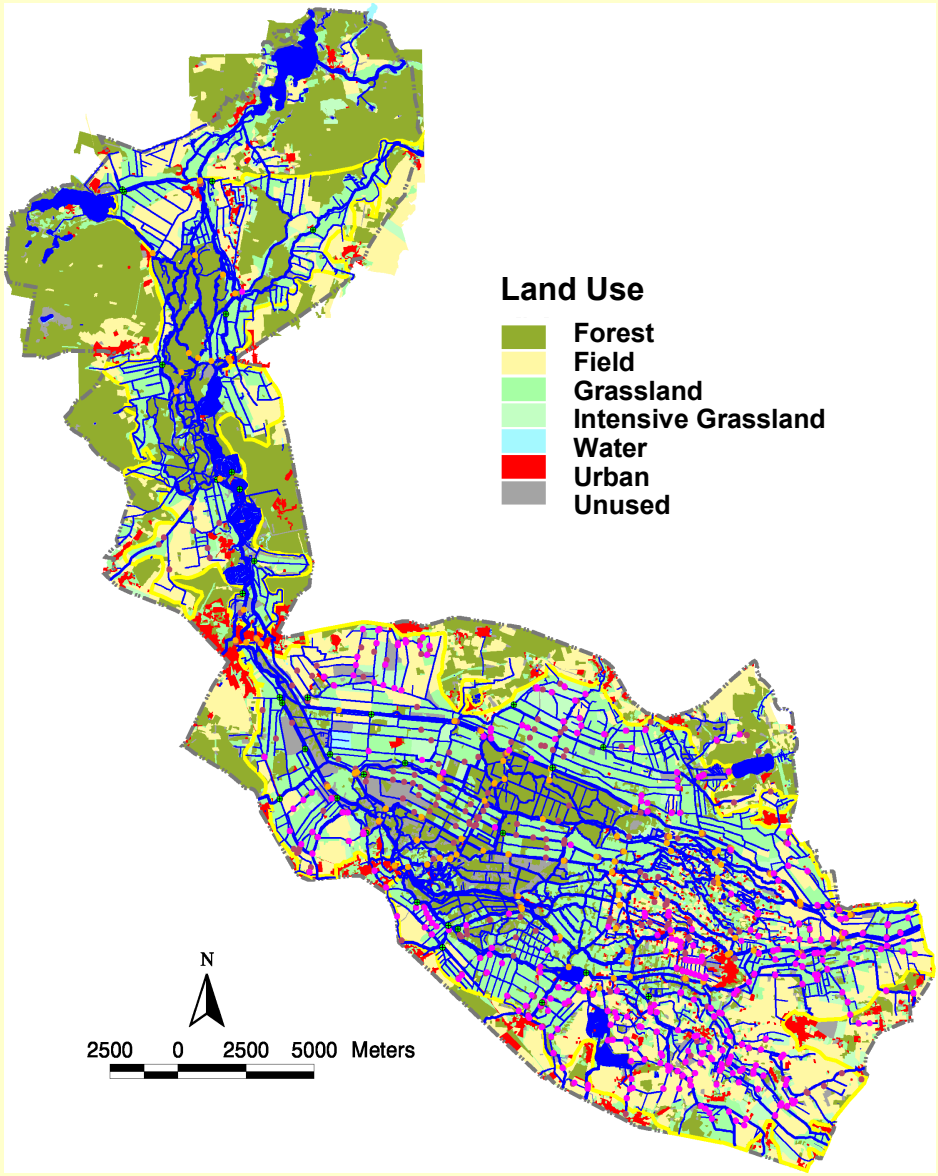
Wetlands in North-Eastern Germany

Wetlands in Elbe-Lowland:

- ~ 20 % of area
- drained for agricultural land use
- low precipitation
- sub-irrigation systems

Investigation Region Spreewald



Land Use und Water Management System of the Spreewald Wetland

Size:

- Biosphere Reserve 475 km²
- Lowland Area 320 km²

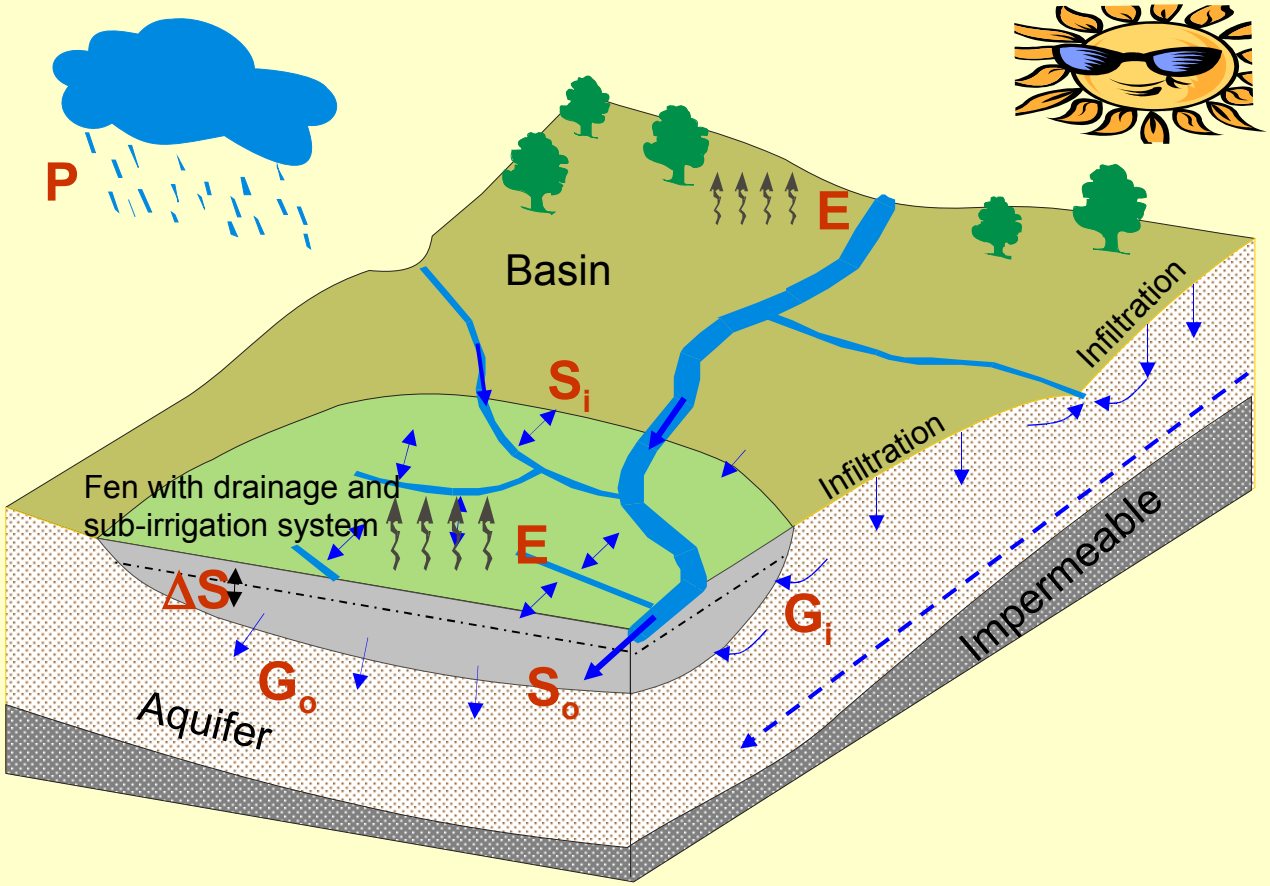
Climatic Characteristics (1961/90):

- Precipitation 530 mm/a
- Air Temperature 9 °C
- pot. Evapotranspiration 610 mm/a

Water Management System:

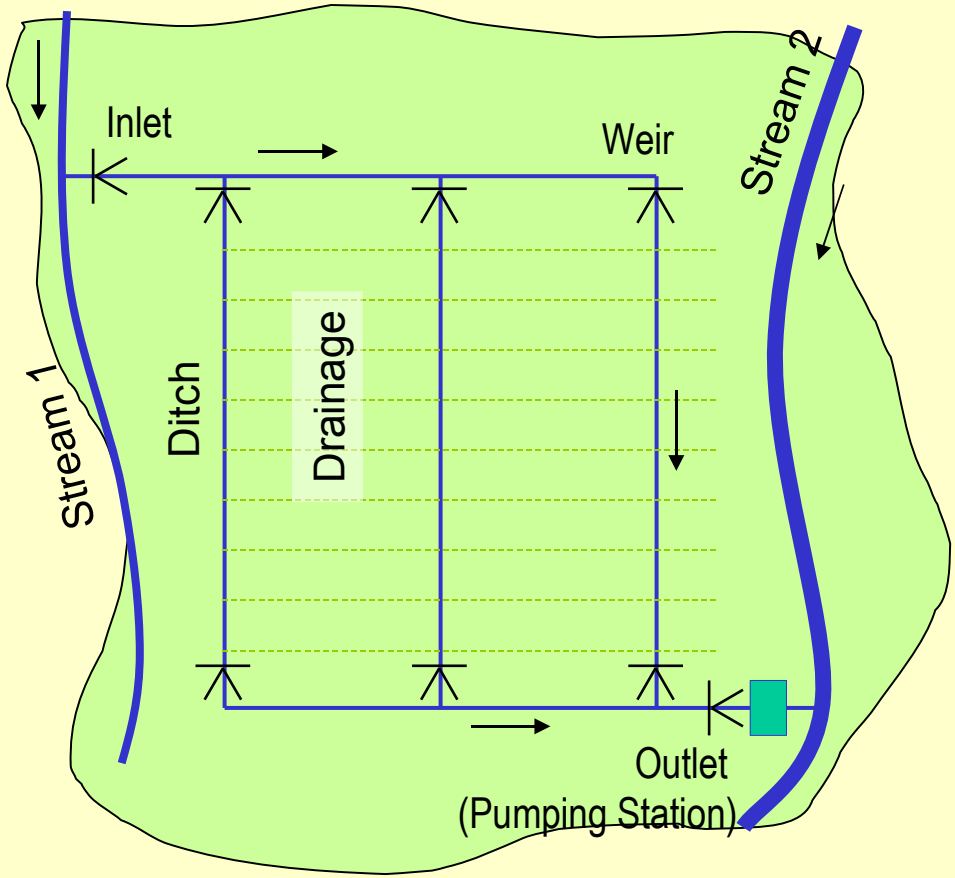
- approx.1600 km Streams and Ditches
- approx.600 Weirs
- Basin (2.500 km²) with open pit mining (problems)

Water Balance of Wetlands



$$\Delta S = P - E + S_i + G_i - S_o - G_o$$

Water Management in Wetlands



- Drainage and sub-irrigation for agricultural land use
- Surplus water from basins, often with reservoirs
- Regulation of ditch and ground water levels by weirs

Requirements for the Water Balance Modelling

Special site conditions of drained/sub-irrigated wetlands		Model requirements
Heterogeneous soils and land use Heterogeneous terrain with varying ground water levels below surface	→	Water balance for groundwater influenced areas
Control of ground water levels in the sub-areas by subirrigation systems	→	Water management in the wetland
Surplus water from sub-basins with water management	→	Connection of wetland + basin

Application of a model combination of WBalMo® + WABI

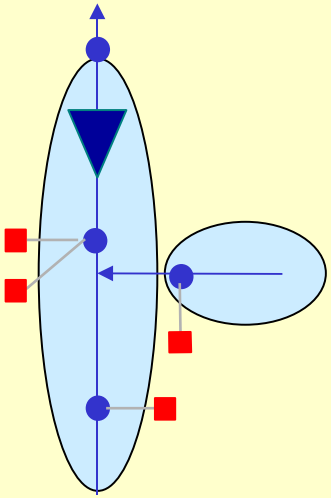
Basic Modells

WBalMo®

- River basins represent by simulation sub-areas, running waters, balance profiles, water users, reservoirs
- Stochastic generated input values (P, ETP, discharge) – Monte-Carlo-Simulation
- Deterministic reproduction of water utilisation processes
- Time step one month
- Statistical analysis of registered events
- Possibility to introduce other models in a WBalMo model

WABI

- Simple water balance model for ground water influenced areas with drainage/sub-irrigation systems (rewetting investigations of fen sites)
- Grid-based
- Investigation site is divided in sub-areas
- Assumption: horizontal ground water level in every sub area
- Time step one month
- Target water levels and inflows in the sub-areas are pretended



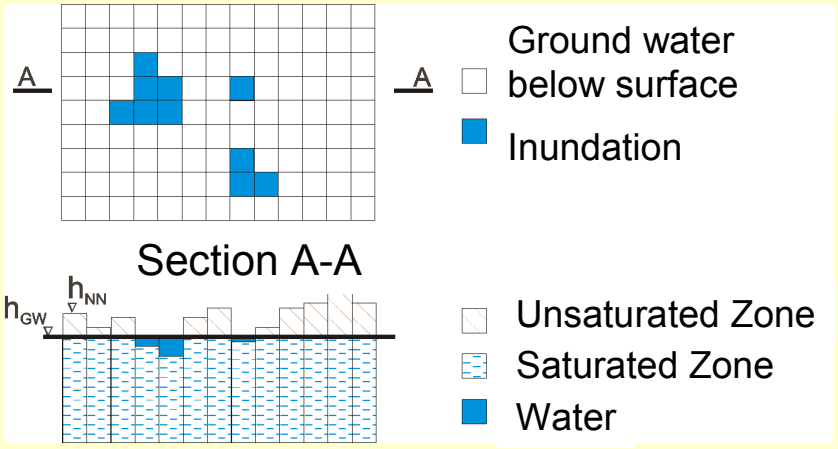
Simulation sub-area

Running waters with balance profile

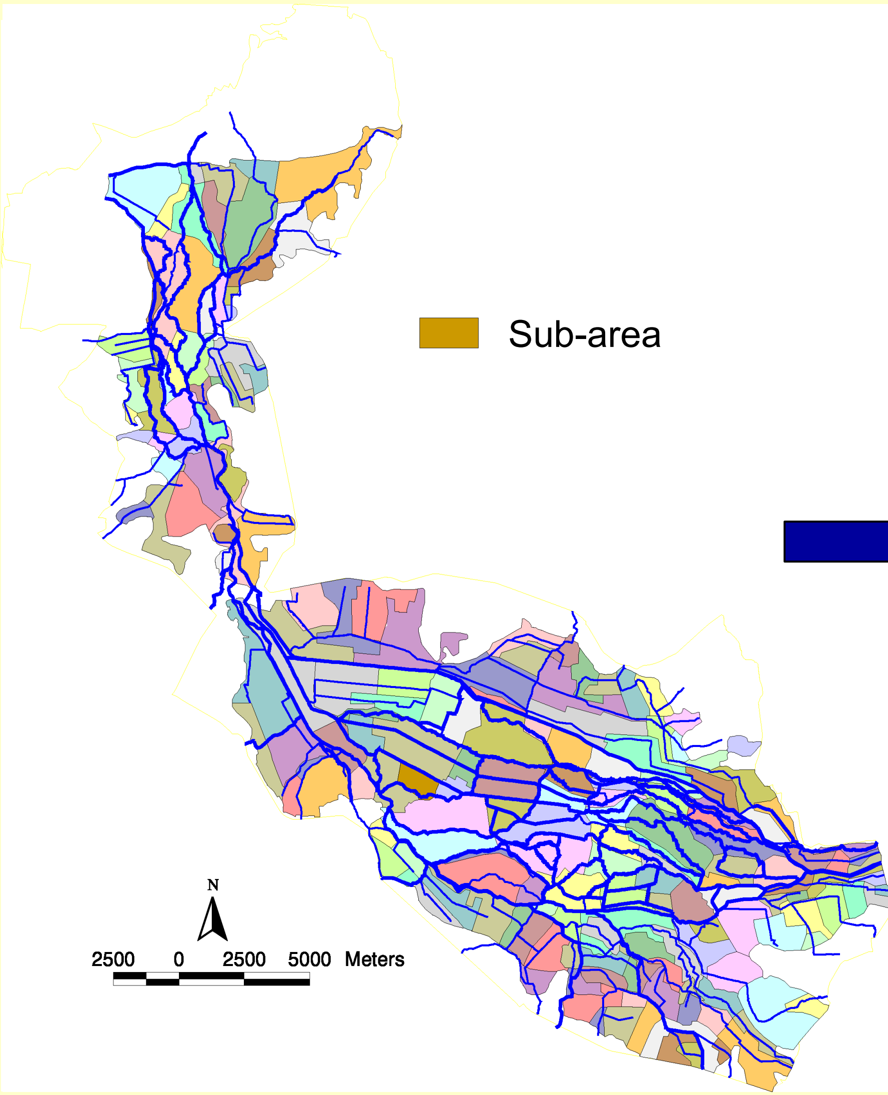
Reservoir

Water user

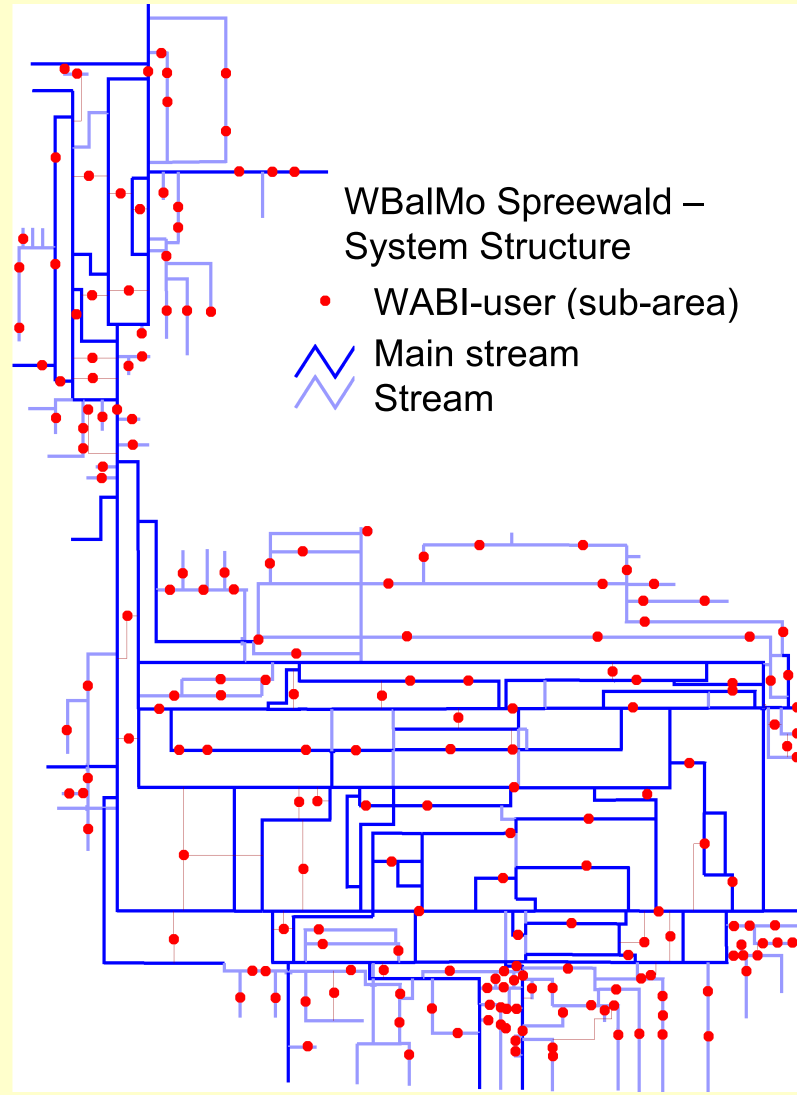
WABI sub-area = water user in WBalMo



WBalMo Spreewald

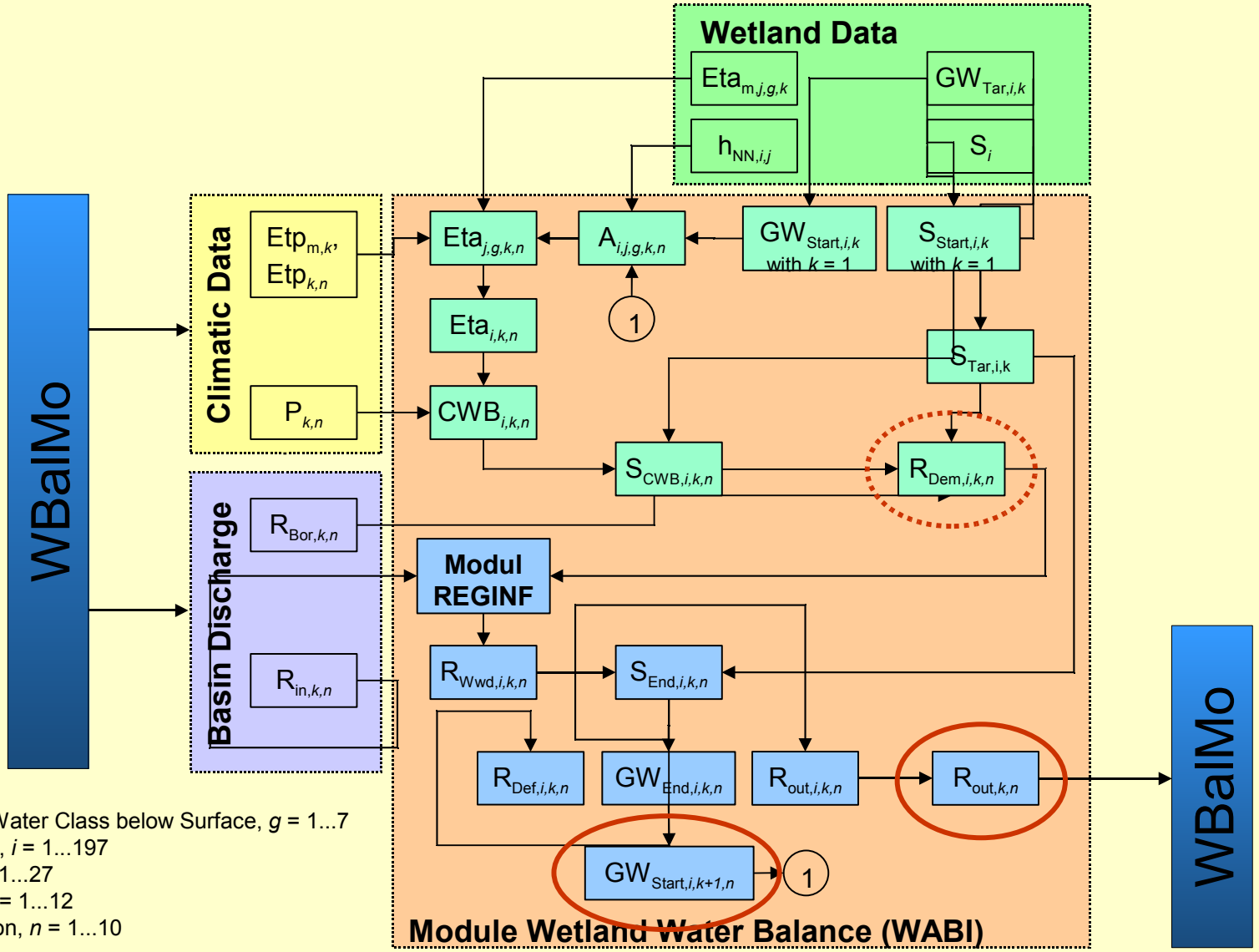


Sub-areas
Stream system



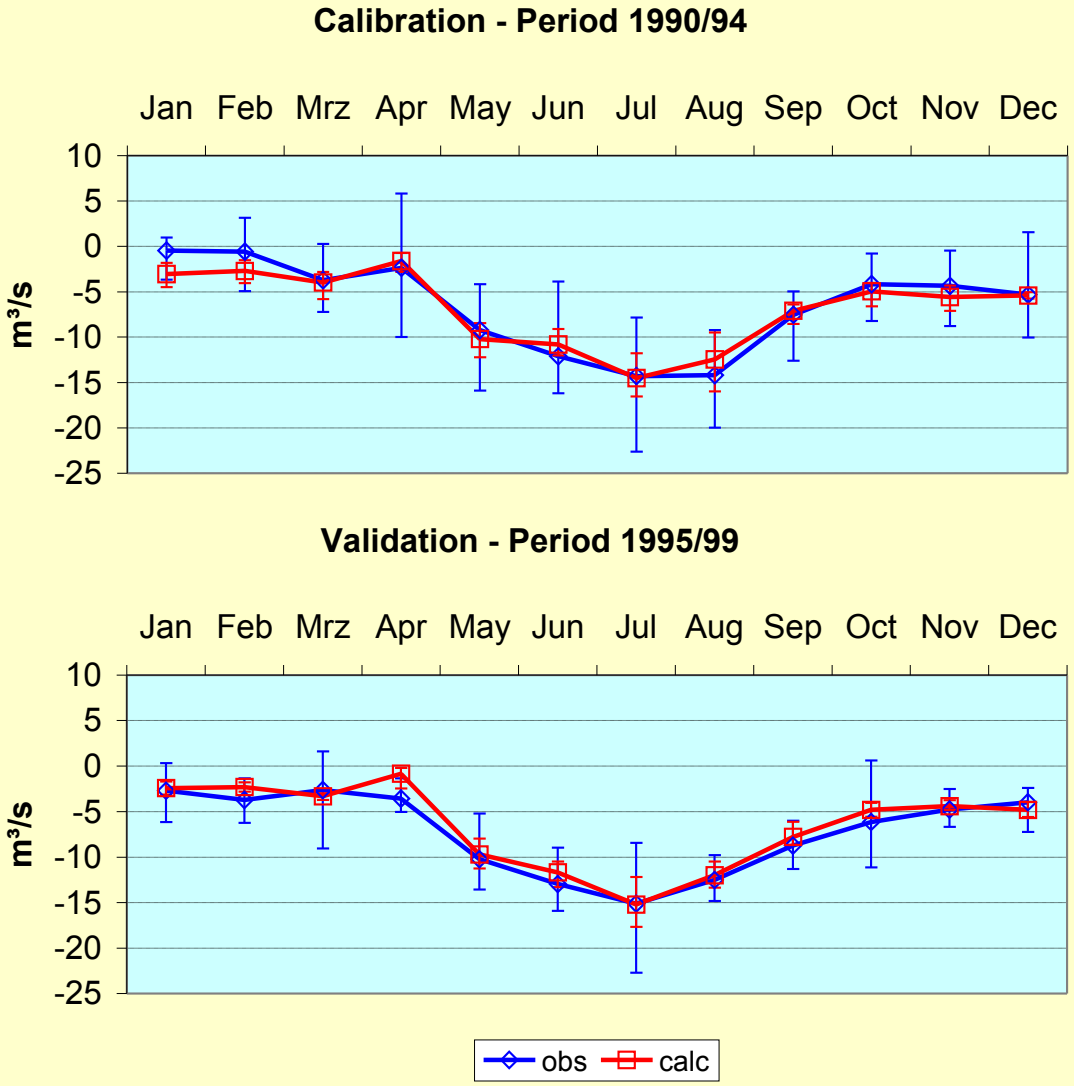
WABI-user
System structure

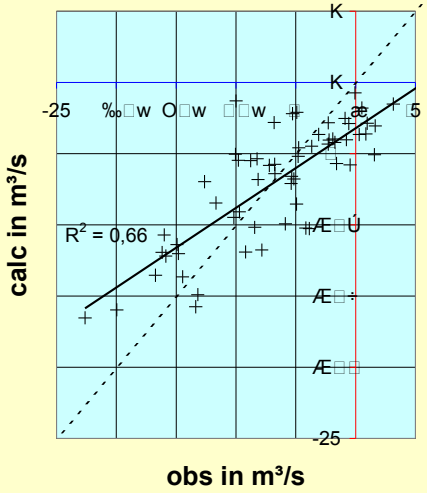
Module WABI within WBalMo

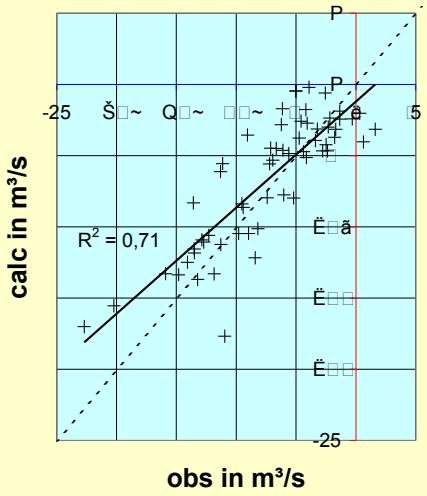


Index: *g* – Ground Water Class below Surface, *g* = 1...7
i – Sub-area, *i* = 1...197
j – HRU, *j* = 1...27
k – Month, *k* = 1...12
n – Realisation, *n* = 1...10

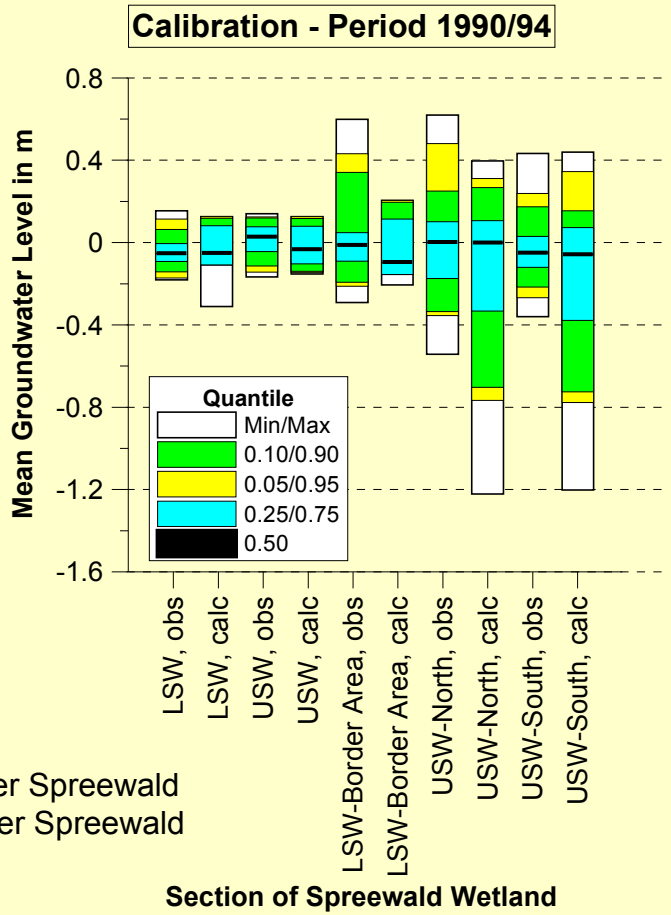
Validation - Water Balance of the Wetland in total (S_o – (S_i + G_i + P))

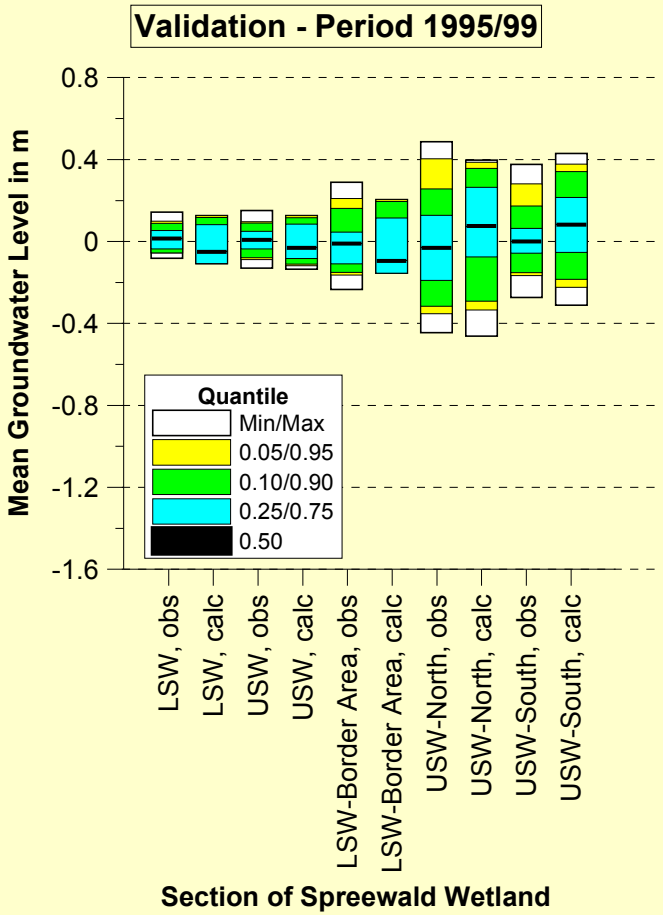






Validation - Ground Water Level

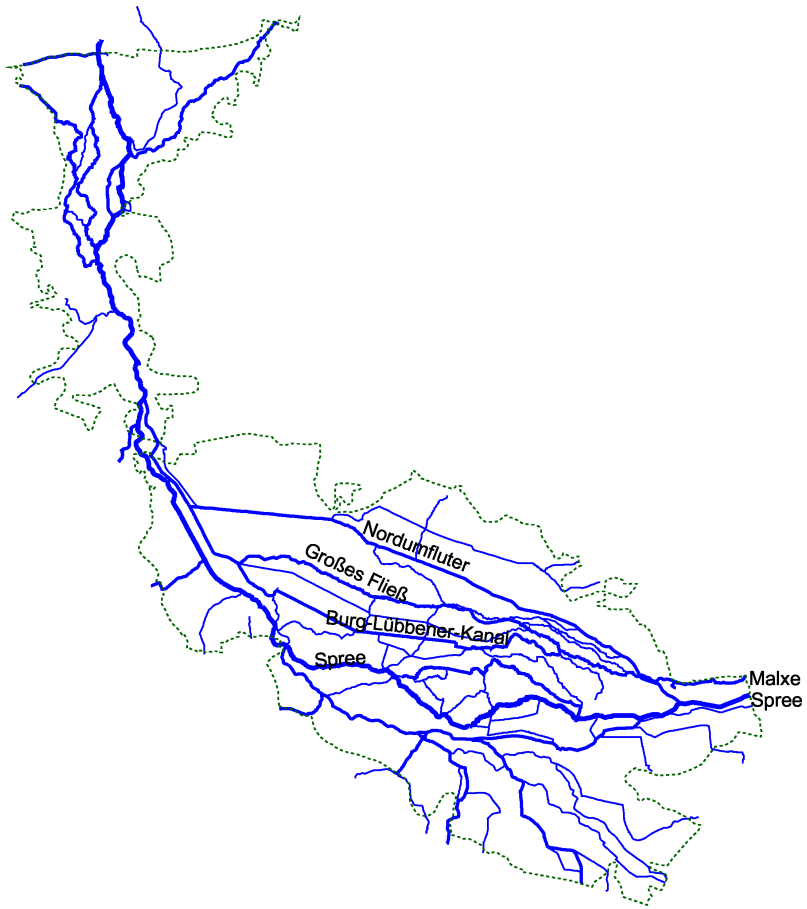




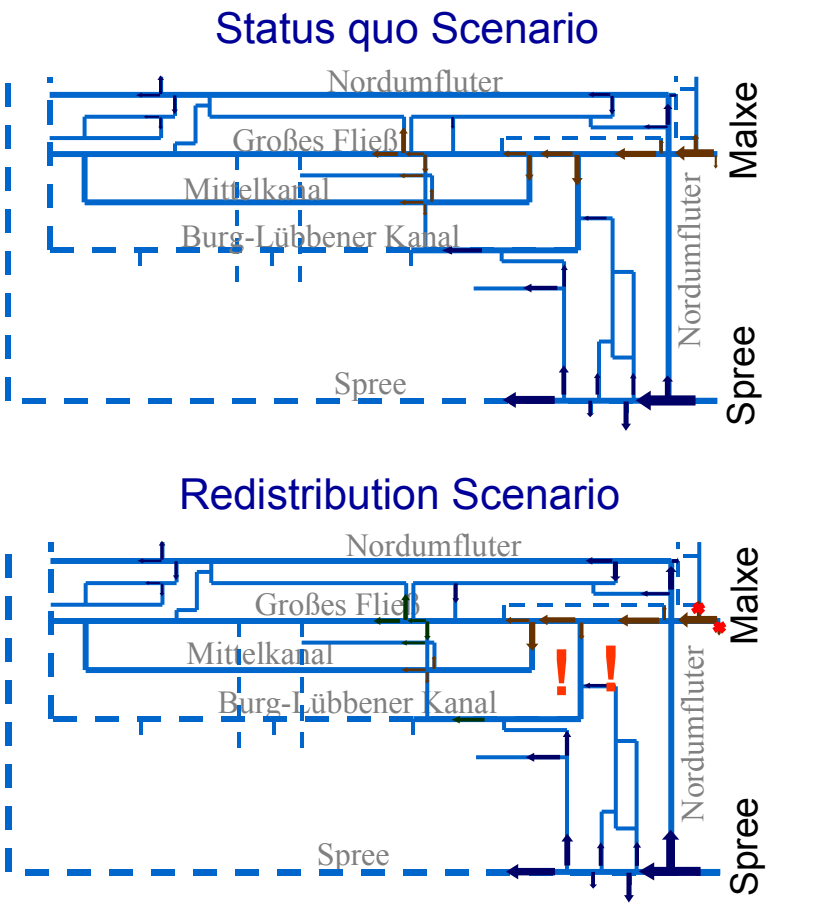
LSW – Lower Spreewald
USW – Upper Spreewald

Range and quantiles of observed and calculated ground water levels in different parts of the Spreewald Wetland

Water Management Options



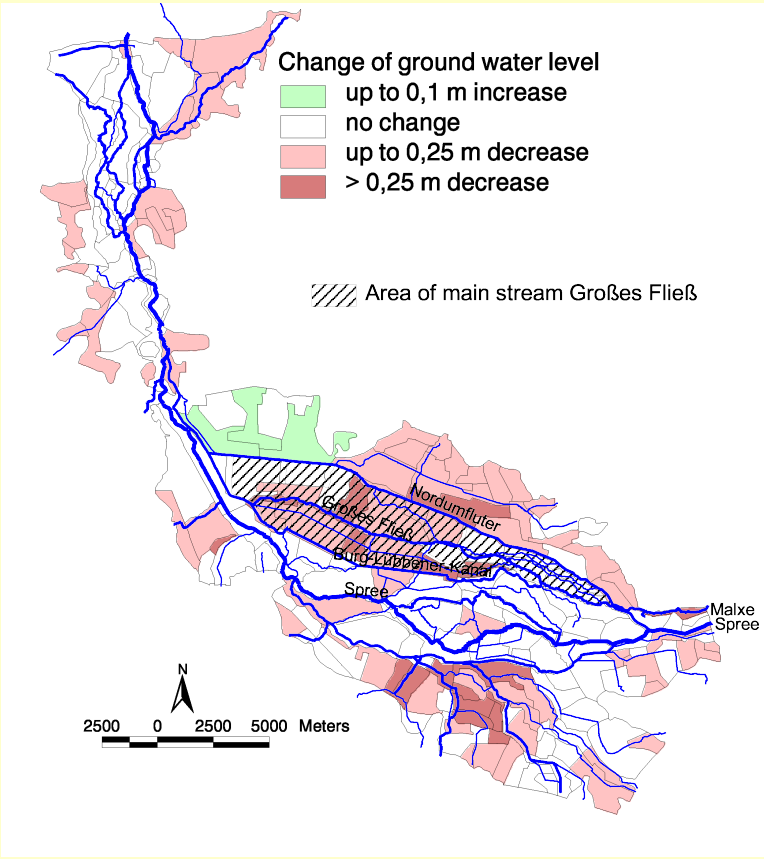
Main rivers and streams for water supply and drainage in the Spreewald Wetland



Changes in water management between status quo and redistribution scenario

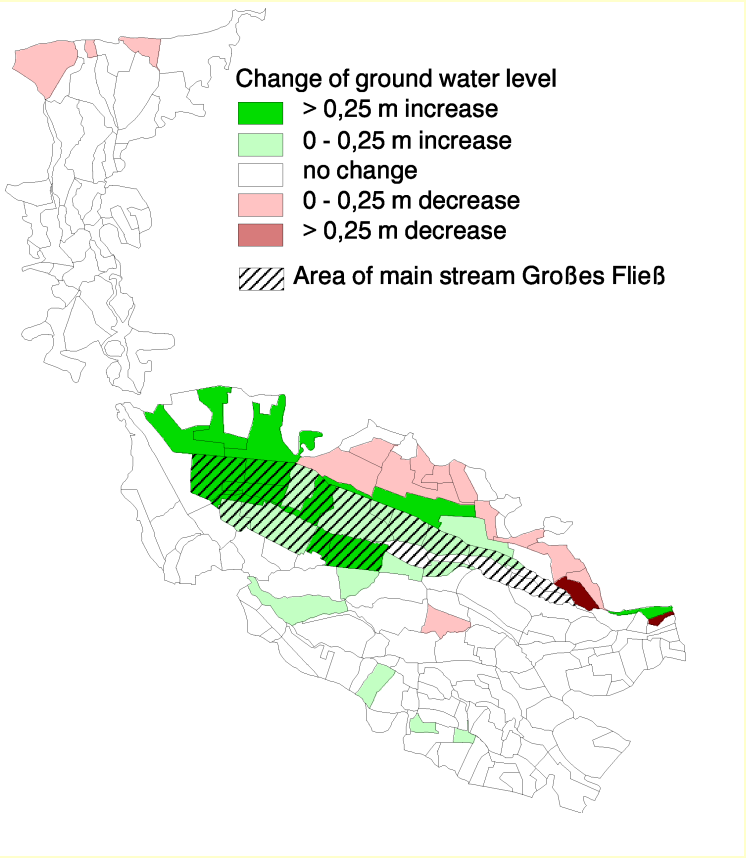
Effects of Water Management

Status quo Scenario



Comparison of the July ground levels of status quo scenario 2048/52 (50. percentile) with the levels of the status quo scenario 2003/07

Redistribution Scenario



Comparison of the July ground levels of the redistribution scenario 2048/52 (50. percentile) with the the status quo scenario 2048/52

Summary

- Water balance of many wetlands is influenced by water resources management systems in wetlands and basins
- Integration of water resources management in water balance modelling for planning of development (restoration, WFD, global change) of wetlands is necessary
- Combination of the models WBalMo and WABI shows one example
- Results show, how the possibilities of water resources management can be used for aims of wetland protection


Thank You