catchments in the western Czech Republic – comparing SAFE and MAGIC predictions

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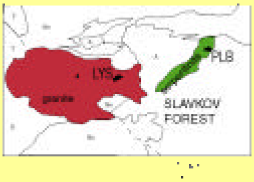
Introduction

The northwestern part of the Czech Republic has experienced exemplary high acidifying deposition in the second half of the 20th century but also radically decreasing acid deposition during the 1990's. While the current chemical status of the ecosystems can be monitored, only dynamic models can provide an assessment of expected future trends of soil and water acidification and recovery from acidification.

The SO_2 emissions in the region declined by 90% compared to the 1980´s, and total deposition of sulfur to the catchments decreased from around 160 meq m^{-2}yr^{-1} in 1990 to roughly 50 meq m^{-2}yr^{-1} in 2000. The model SAFE was calibrated to soil and water chemistry monitoring data of two contrasting sites in the western part of the Czech Republic. Moreover, the results of the SAFE modelling were compared to the results of MAGIC modelling (Hruška et al., 2002).

The **Lysina catchment** is underlain by leucogranite composed mainly of quartz and feldspars. The oxides SiO_2 and Al_2O_3 comprise 87% of the rock by weight. The CaO content of the leucogranite is 0.52%, while MgO content is only 0.11%. Soils in the catchment are brown earths and peaty gleys.

The **Pluhuv Bor catchment** is underlain by serpentinite consisting primarily of antigorite $Mg_3Si_2O_5(OH)_4$. The bedrock is extremly rich in MgO (37%) and only trace quantities of the CaO are present. The dominant soils are eutrophic brown soils and peaty gleys.



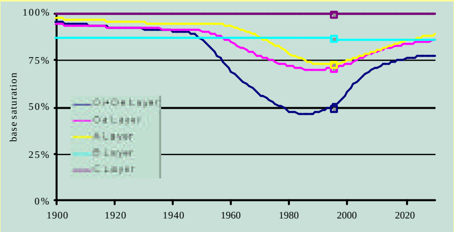
The SAFE model

The SAFE model is a dynamic multi-layer soil chemistry model (Warfving Sverdrup, 1992). The SAFE model includes process-oriented descriptions of cat exchange reactions, chemical weathering of minerals, solution equilibrium reacti involving carbon dioxide, organic acids and Al species and finally leaching a accumulation of dissolved chemical components. The Al concentration in soil solu is simulated using layer-specific apparent gibbsite coefficients. SAFE needs time se of input regarding atmospheric deposition, net uptake of nutrients, litterfall, can exchange, net mineralization and the precipitation flux, as well as input regard physical and chemical soil parameters.

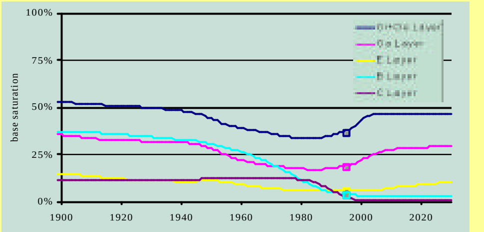
Modeled Catchment	Lysina	Pluhuv Bor
Drainage area (km^2)	0.273	0.220
Altitude (m)	829-949	690-804
Avg. precipitation (mm)	950	850
Avg. runoff (mm)	419	226
Avg. air temperature (°C)	5.0	6.0
Tree species	Norway spruce 100%	Norway spruce 92% Scots pine 8%
Prevailing soils	Podzolic brown earth	Eutrophic brown earth
Glacial deposits	None	None
Bedrock	Leucogranite	Serpentinite

Results

Pluhuv Bor catchment

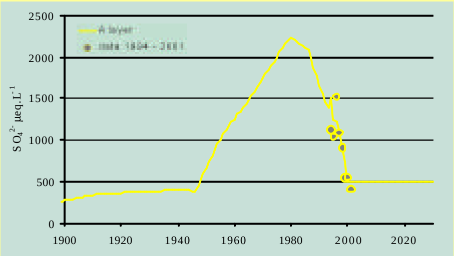


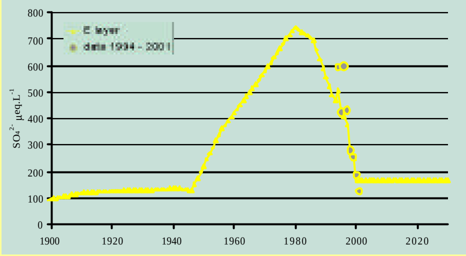
Lysina catchment



Modelled soil base saturation for individual soil horizons

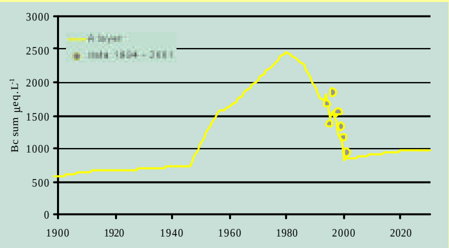
- base saturation of all horizons was impacted at the Lysina catchment
- the increase of base saturation was predicted for the upper layers of the Lysina catchment
- however, the future prediciton for Lysina bottom layers is pesimistic
- the base saturation of the top layers at Pluhuv Bor catchment decreased more significantly in the past but the future prediction promises a significant recovery compared to the Lysina

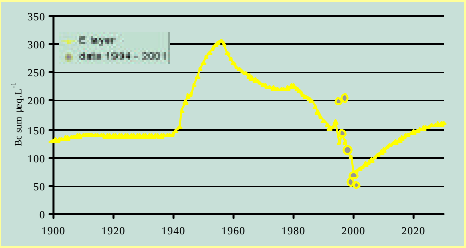




Modeled sulphate concentration in the soilwater from A and E horizons

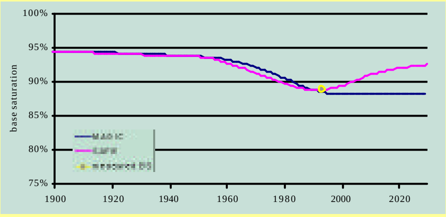
- the modeled data are fitted to the measured data satisfactorily
- the SAFE model does not include the S adsorption parameter
- the Pluhuv Bor soilwater (however from a comparable depth) contains much higher sulphate concentrations due to higher evapotranspiration (lower altitude of the catchment, higher annual temperature)

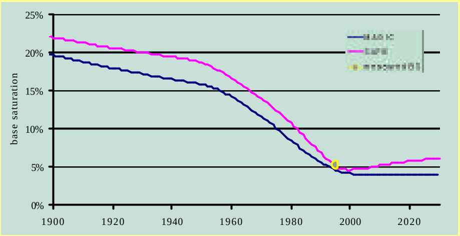




The lumped base cations (Bc = Ca, Mg, K) concentration in the soilwater from A and E layer

- the Lysina catchment soilwater was strongly affected by the uptake in the past





The comparison of the MAGIC and SAFE outputs on soil base saturation (the SAFE data were lumped by weighing to the soil mineral surface area)

- SAFE predicted more recovery for the base saturation when compared to MAGIC in the near future

Comment: