A Similarity Approach for the Regionalization of Hydrological Model Parameter Sets

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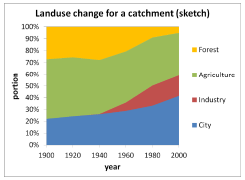
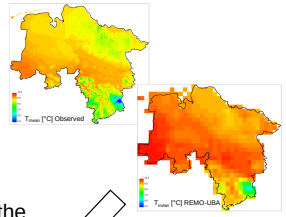
MOTIVATION:
Impact Analysis in Poorly Gauged Catchments

Landuse change studies



Interaction

Climate change studies



How does this affect the hydrological regime?

Hydrological Modelling

Conceptual models require a calibration of their parameters

Therefore reliable observed data (e.g. observed flood flows) are needed at the outlet of the catchments

In practices these data are not everywhere available (Fig.1)

To make statements for poorly gauged catchments any kind of regionalization is required

Here hydrological model parameters were regionalized by using a similarity approach

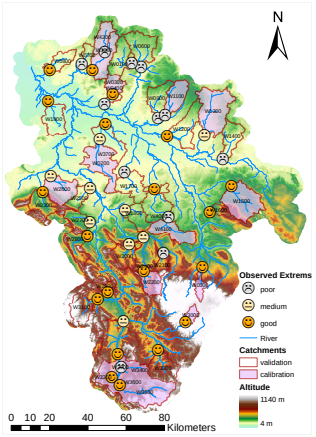


Fig. 1 Aller-Leine-watershed with some of its calibration/validation catchments and gauges

METHODS:
One-Step Similarity Regionalization Approach

Hydrological model:

- Modified lumped version of the HBV-IWS model
- Hourly time steps (3 years calibration; 2 years validation)
- Input data: precipitation, temperature, pot. evaporation

Assumption:

Catchments with similar characteristics have similar model parameters

Self-Organizing Map (SOM):*1)

- Artificial neural network
- Unsupervised learning
- Ordering similar inputs to similar regions in the map

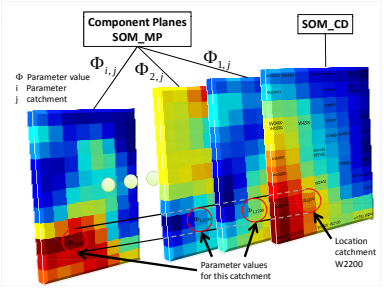
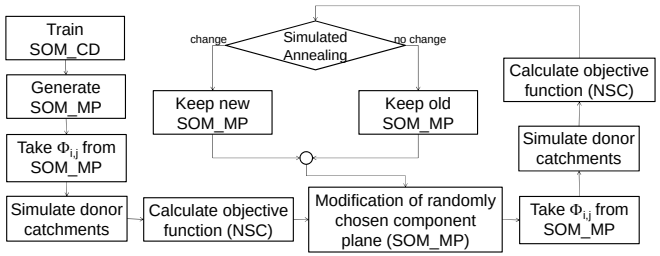


Fig. 2 Systematic of the regionalization approach

One-step regionalization using SOM:

- Two SOMs are needed for this approach (Fig. 2)
- SOM trained by catchment descriptors (SOM_CD); analyzes the similarity between catchments
- Randomly generated SOM to derive model parameters $\Phi_{i,j}$ (SOM_MP); parameters are derived depending on the location of the catchments in the SOM_CD



DATA & AREA:
41 Catchments of the Aller-Leine-River Basin

- 13 donor catchments; 28 validation catchments (Fig. 1)
- 16 catchment descriptors derived from different sources

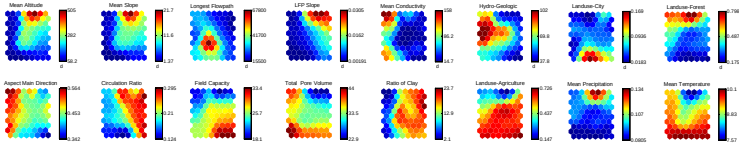
Topographic	Geomorpholigic	Soil/Ground	Landuse	Climate
mean altitude; mean slope; main aspect;	circulation ratio; longest flow path; longest flow path slope;	field capacity; total pore volume; conductivity; ratio clay; hydro-geologic;	ratio of agriculture; city; forest;	mean annual precipitation; temperature;

RESULTS:
Good Performance of Ungauged Catchments with Transferred Parameters

- In most cases the values of the component planes (SOM_MP) are systematically ordered
- Strong relationships between CDs and MPs (e.g. slope↔k0)
- Not all relationships are currently physically interpretable

⇒ Further development (implementation of rules etc.)

Component panels of the catchment descriptors (SOM_CD)



U-matrix of SOM_CD

Component panels of the model parameter (SOM_MP)

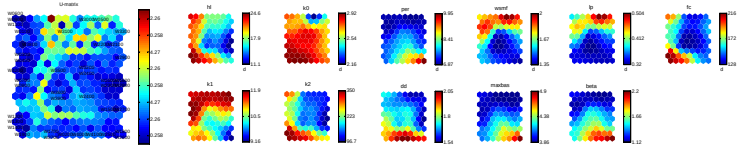


Fig. 3 Component planes of CDs and MPs; Note that the SOM was just trained for CDs

- The performance of the 13 donor catchments with a median NSC of 0.67 is satisfactory
- But the performance of the 28 validation catchments with a median NSC of 0.62 is good

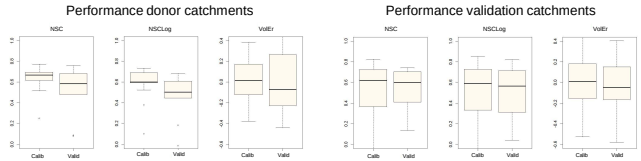


Fig. 4 Performances for calibration/validation period and donor/validation catchments

- First results indicate that the presented method can be a good alternative for the robust estimation of parameters in poorly gauged catchments
- Further investigation is needed to improve the performance

Literature:

*1) Kohonen, T. 1995, Self-Organizing Maps, Springer Series in Information Sciences, ISBN 3-540-58600-8

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