Motivation

- Common practice to use deterministic models for prediction of runoff in hydrology
- Stochastic models have been used for regionalisation of model parameters
  - We suggest a geostatistical interpolation method for runoff taking into account:
    - Runoff from neighbouring catchments
    - True catchment boundaries
    - Network structure

Data

- Interpolation of 17 stations from Innviertel, Austria
  - Marked with black circles, numbered C1-C17
- Yearly runoff relatively homogeneous (small green numbers)
- Also other neighbouring catchments used for interpolation

Results

- Two interpolated runoff hydrographs as examples
  - Hourly runoff 1998 interpolated
  - Only showing 35 day period
  - Nash-Sutcliffe for all catchments: 0.75-0.97
- Hydrographs from some of the neighbours used for interpolation

The influence of support on interpolation

A spatial example - Four neighbour blocks with equal centre-to-centre distance

- Largest catchment will get largest kriging weight
- Smallest catchment get smallest weight
- Size of interpolated block does not come into account in symmetric case

Block Kriging

- Gamma value in kriging matrix calculated separately for each pair
  of catchments
- Kriging matrix solved as normally
- The kriging matrix is only solved once for each ungauged catchment.

\[
\begin{align*}
\gamma_h(i,j) &= \frac{1}{A} \sum_{i=1}^{4} \sum_{j=1}^{4} \gamma(h_i, h_j) \mathbb{1}(i \neq j) + \gamma_h - c_d \delta_{ij} \mathbb{1}(i = j) - 1 \mathbb{1}(i = j) \\
0.5 \frac{1}{A} \sum_{i=1}^{4} \sum_{j=1}^{4} \gamma(h_i, h_j) \mathbb{1}(i \neq j) + \frac{1}{A} \sum_{i=1}^{4} \sum_{j=1}^{4} \gamma(h_i, h_j) \mathbb{1}(i = j) \\
\end{align*}
\]

Regularisation of a point variogram in space and time:

- Variance between catchments
- The average of point variances
- Variances dependent on spatial and temporal distances
- Regularisation

Back-calculation of a point variogram:

Spatio-temporal sample variogram of runoff
- Variogram cloud of the catchment pairs
- Binned temporal distances
  - Point variogram found by point fitting of the spatio-temporal variances between catchments

Spatio-temporal point variogram of runoff

Conclusion

Spatio-temporal geostatistical interpolation offers an alternative to regionalisation of rainfall-runoff model parameters for ungauged catchments (PUB)

- Method uses real catchment boundaries
- No information in addition to runoff data and catchment boundaries needed
- To do:
  - Consider other aggregation schemes
  - Preserve variance in a better way