Links between QPF and hydrology

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Introduction

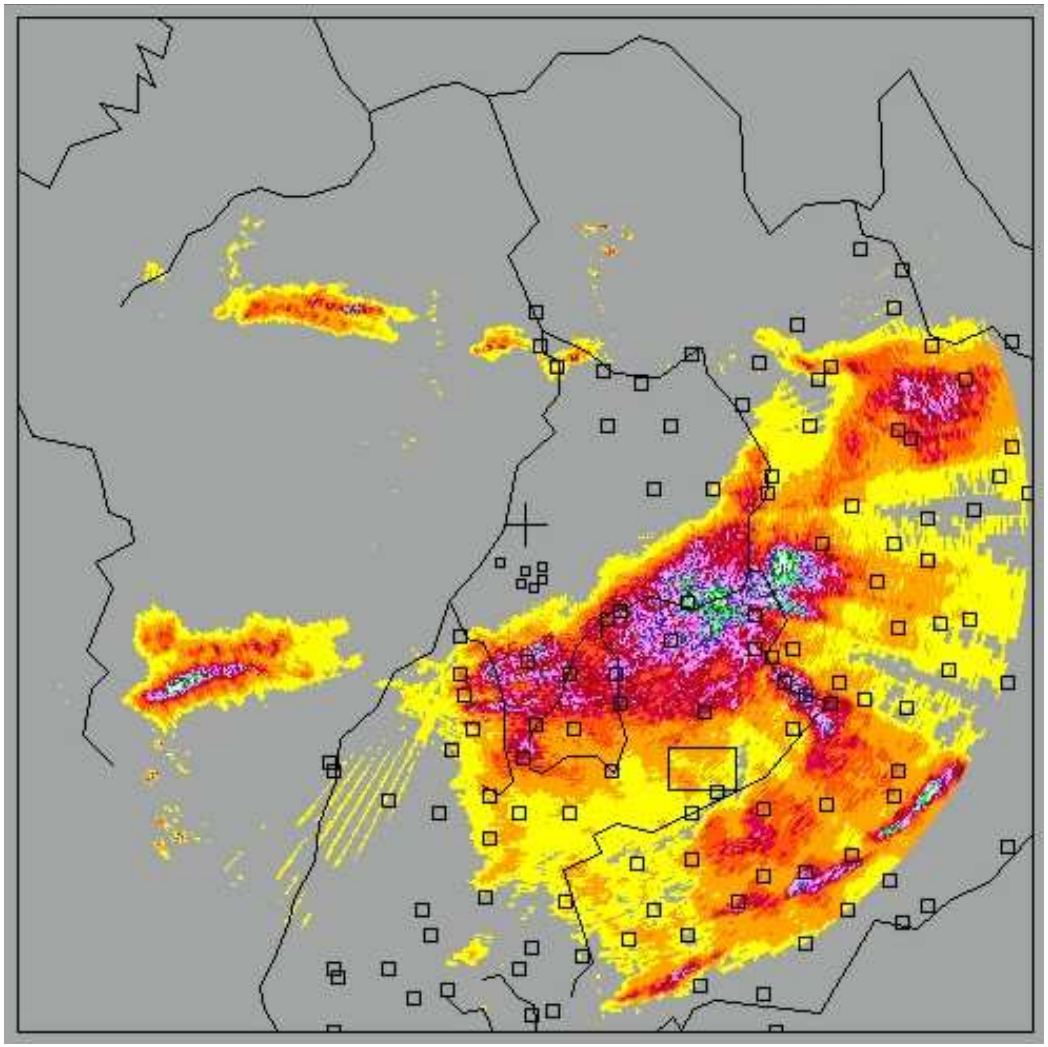
- Rainfall/Runoff process non-linear
- Forecasting of:
  - Amount
  - Timing
  - Spatial distribution
- Uncertainty of the forecast
  - Ensembles
  - Subscale variability

Goals:

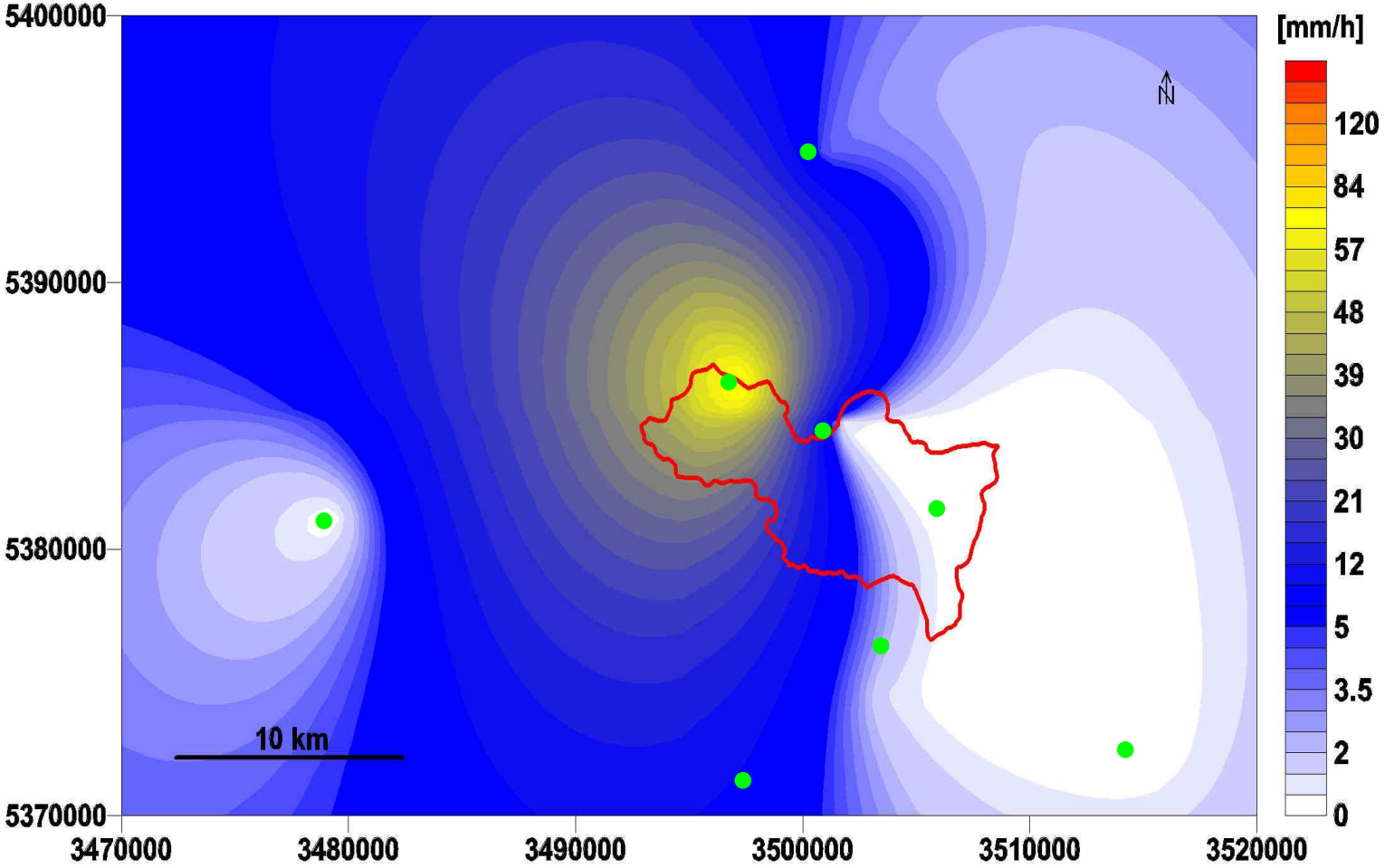
- To quantify the influence of the spatial variability of precipitation
  - To quantify the error variance of predicted discharge
  - To identify a possible bias
  - To see the effect of different model resolutions
  - To see the effect on parameter identification

Radar images

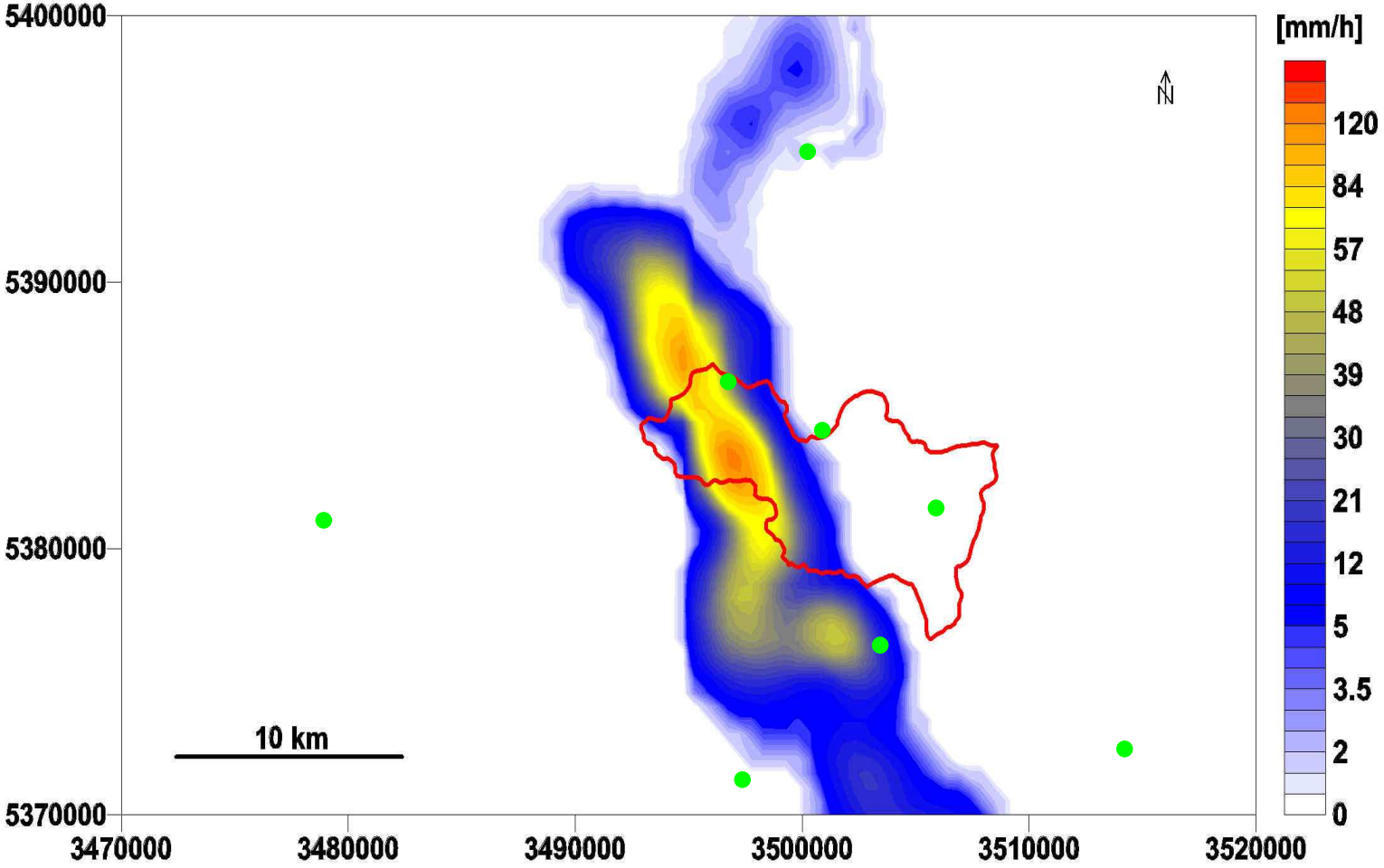
26.02.97 07:30 – 08:50



Gauge interpolation



Radar field


5400000
5390000
5380000
5370000
3470000
3480000
3490000
3500000
3510000
3520000
10 km
[mm/h]
120
84
57
48
39
30
21
12
5
3.5
2
0

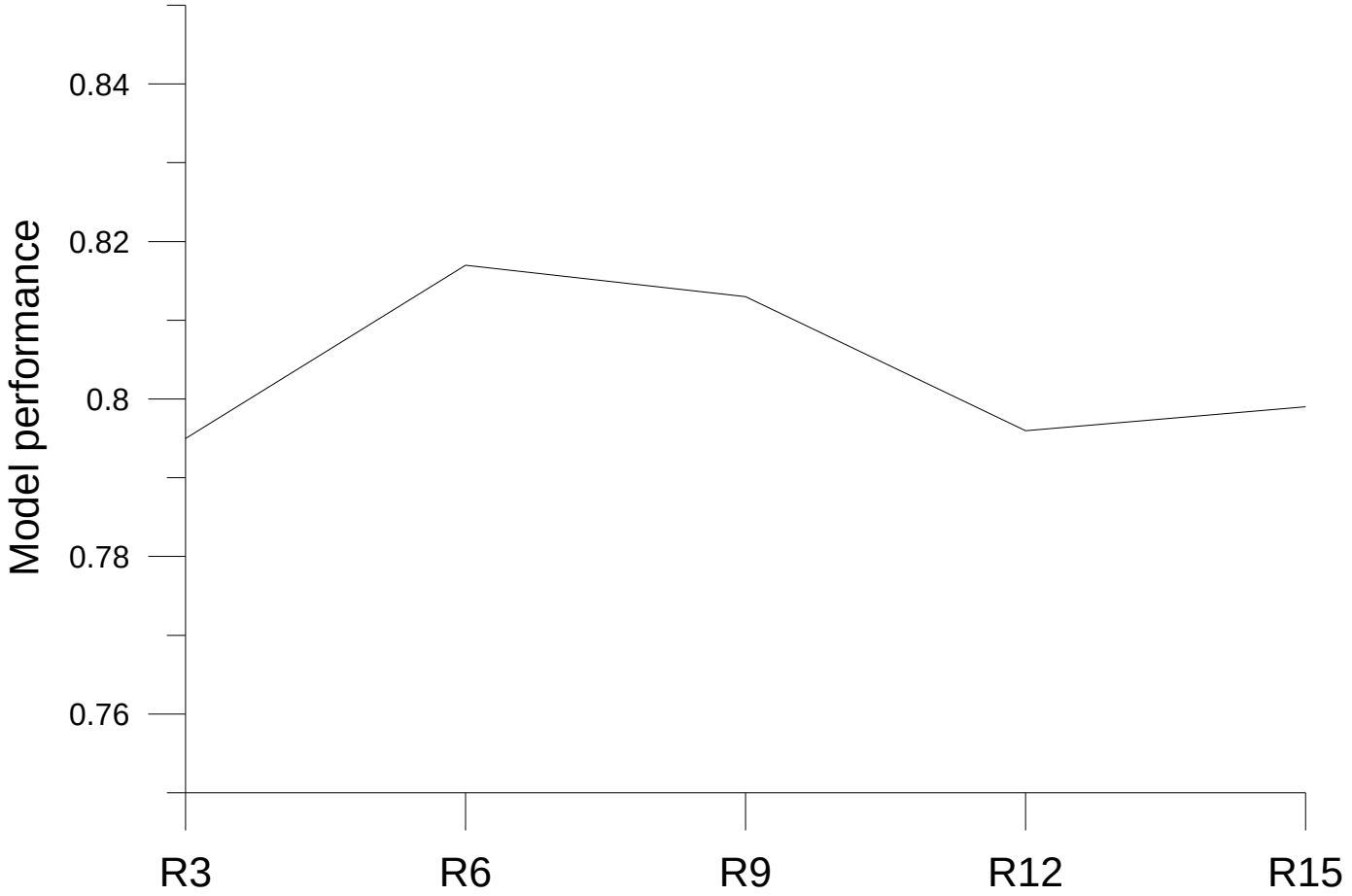
Methodology 1

- 30 years daily precipitation at 288 locations (1961-1990)
- Geostatistical analysis
  - Interpolation using EDK 1 km^2 resolution
- 3 catchments 454 , 693 and 1114 km^2
- Hydrological modelling
  - Modified HBV – (snow, soil, evapotranspiration)
  - 5 different spatial resolutions
  - Multiobjective calibration
    - Multiple time scales and weighting for maxima
    - Using interpolated precipitation
    - Period 1961-1970

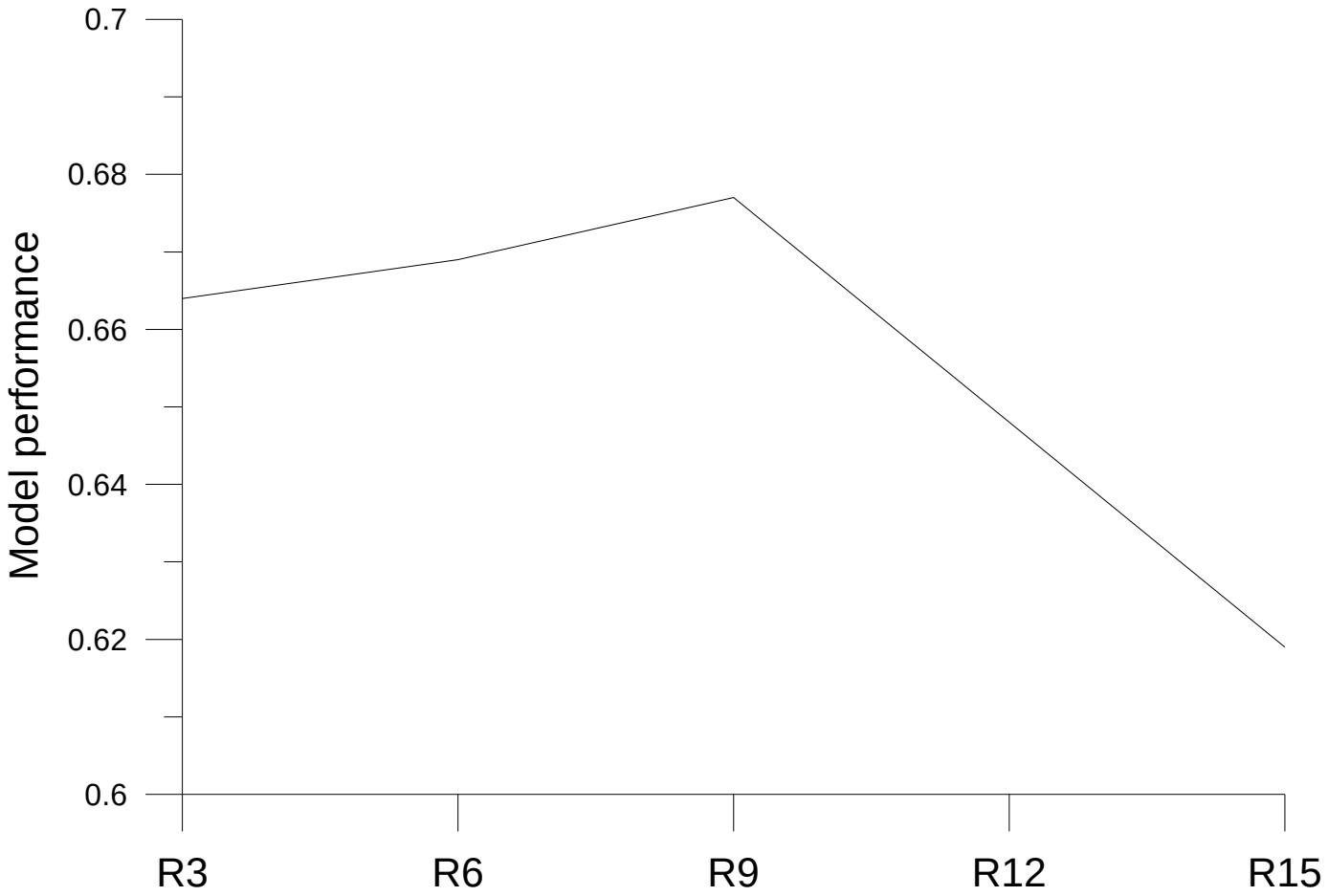
Model resolution

Resolution	Average Block size (km^2)
R3	5.6
R6	19.2
R9	28.6
R12	55.7
R15	69.6

Effect of model resolution
(Validation C3)

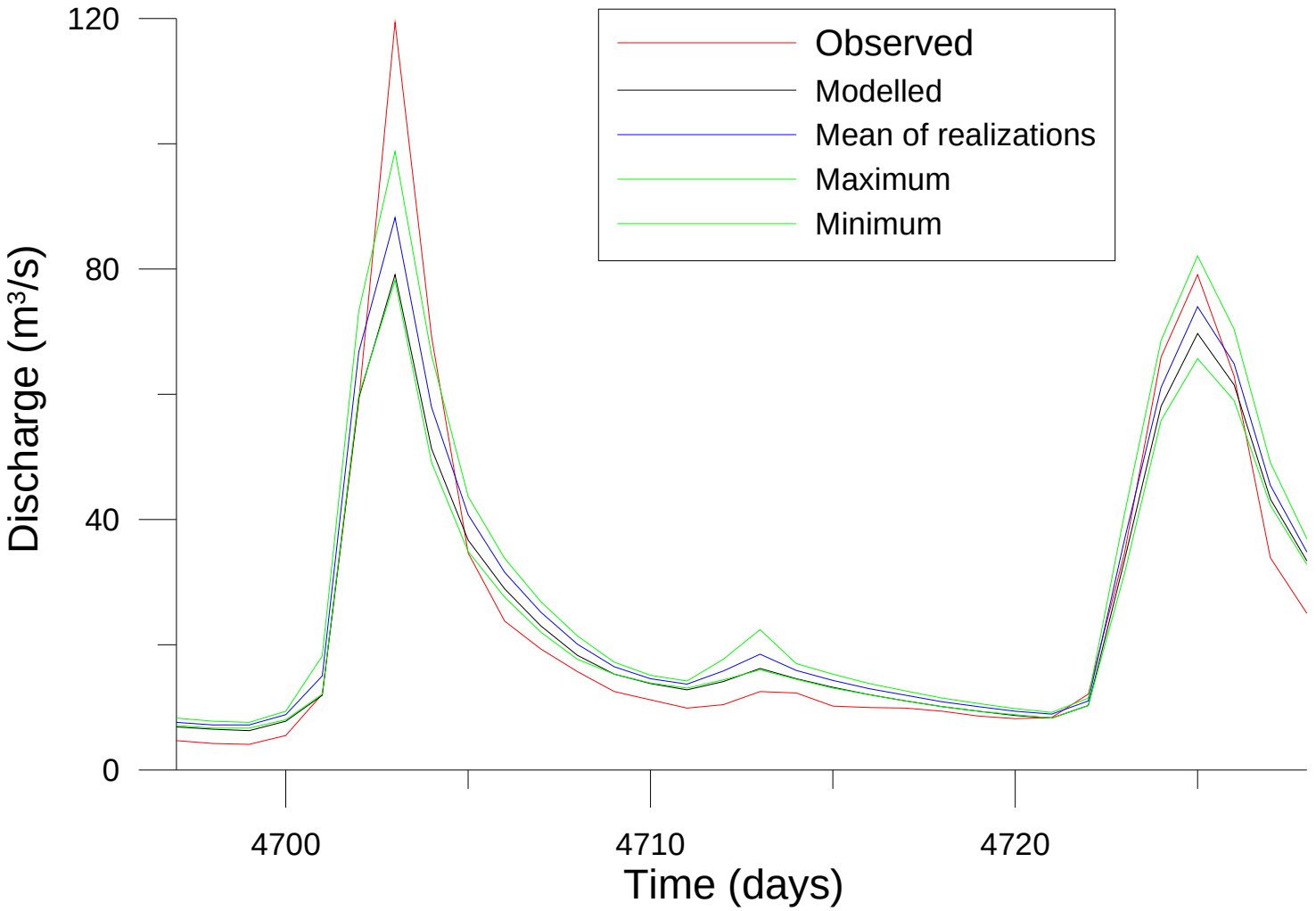


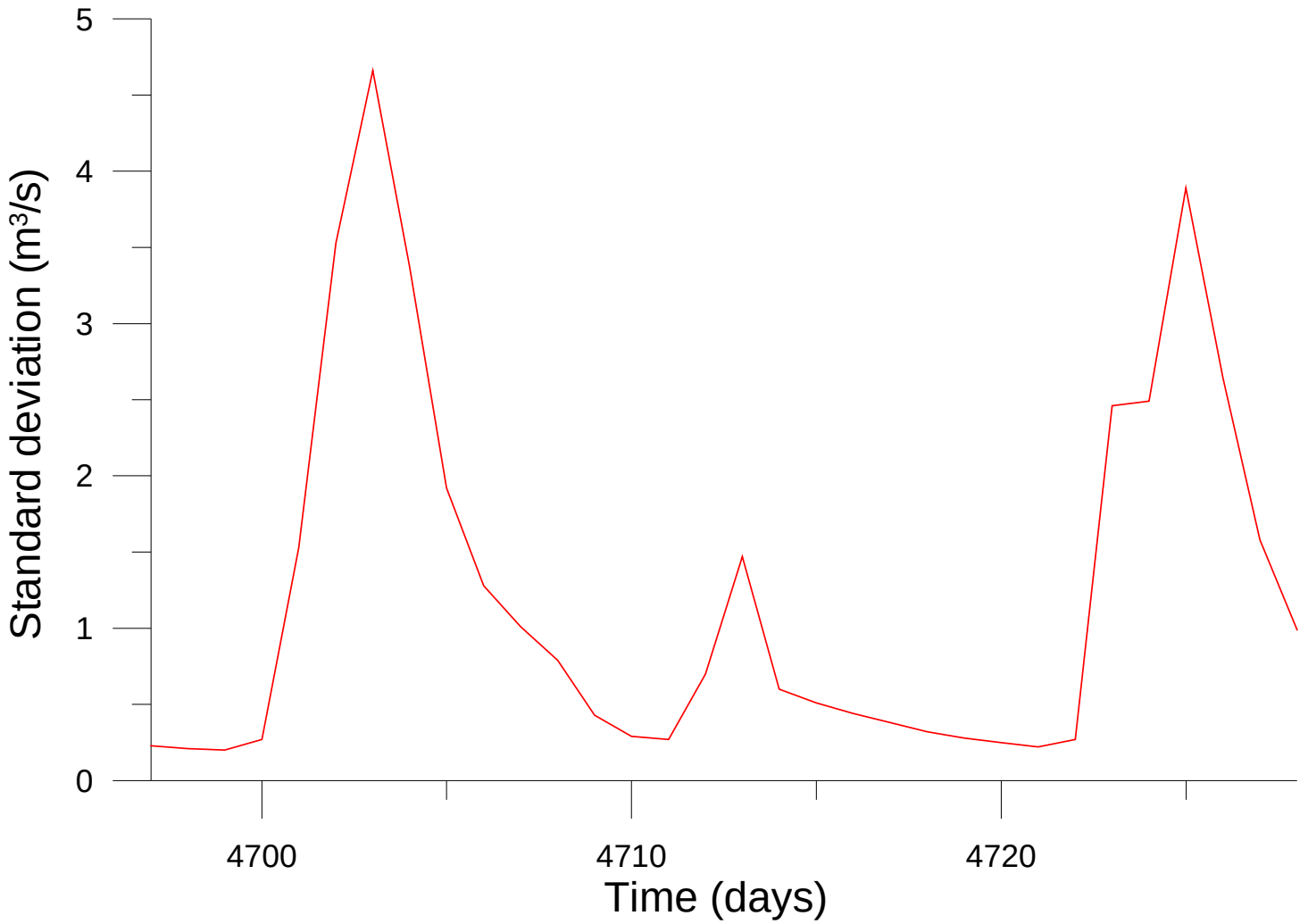
Effect of model resolution
(Validation C1)



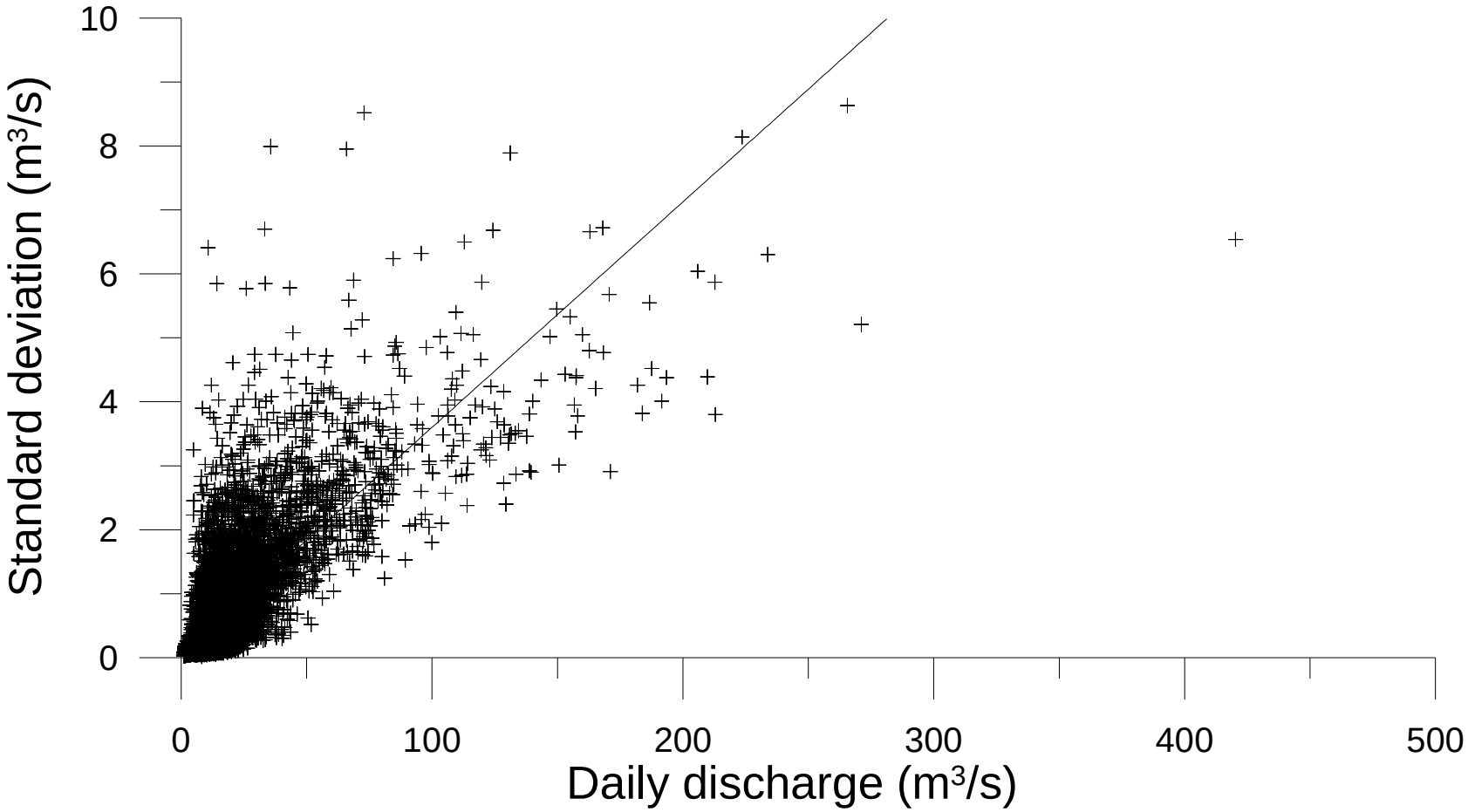
Methodology 2

- 30 years daily precipitation at 288 locations (1961-1990)
- Geostatistical simulation
  - Variogramm estimation – for each day
    - Monotonisation algorithm (PAVA)
    - Automatic model fitting and validation (CR)
  - Conditional simulation of the EDK residuals using Turning Bands
  - Integration according to the selected resolution

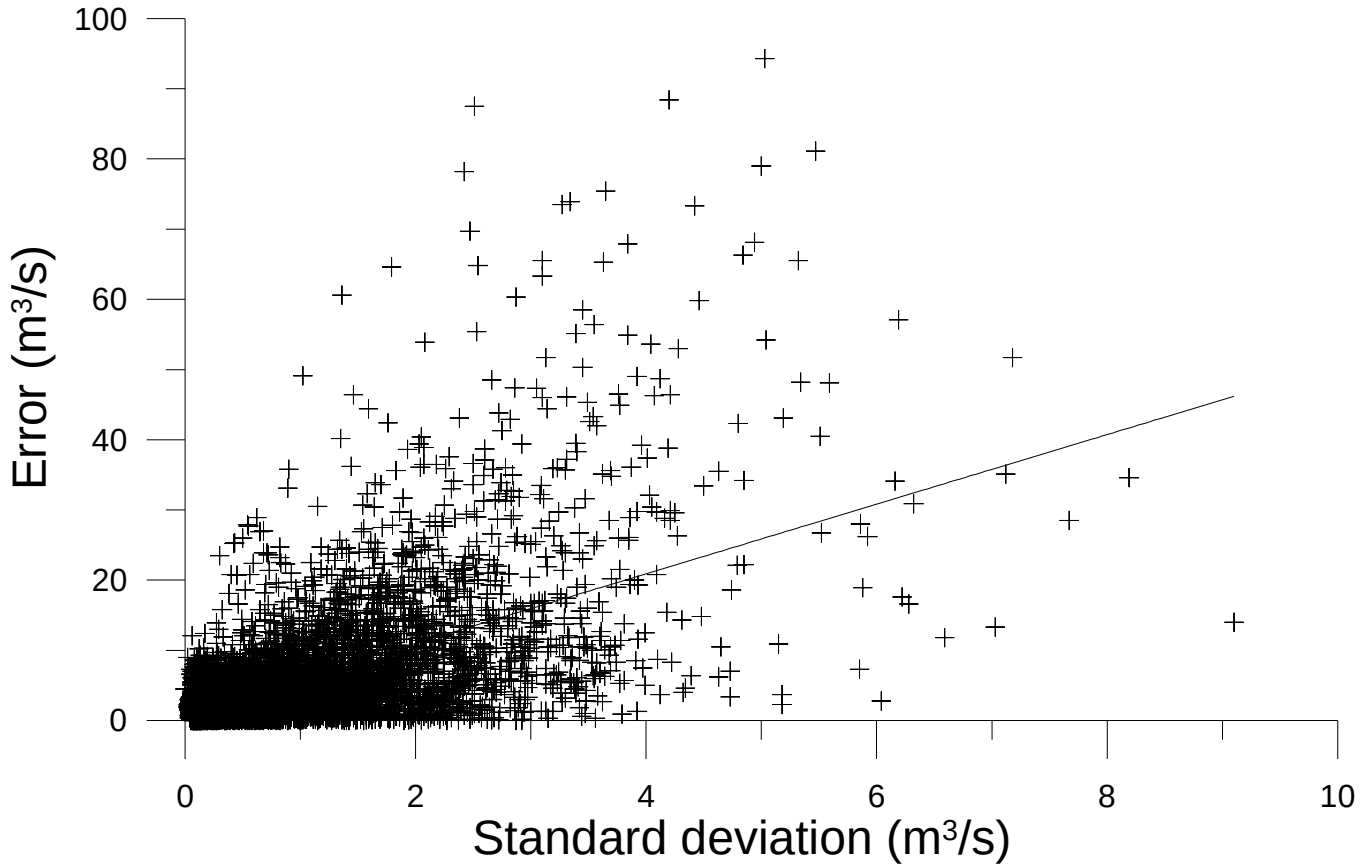

Observed
Modelled
Mean of realizations
Maximum
Minimum
Discharge (m³/s)
120
80
40
0
4700
4710
4720
Time (days)


Standard deviation (m³/s)
5
4
3
2
1
0
4700
4710
4720
Time (days)

Daily discharge vs.
Standard deviation due to spatial uncertainty

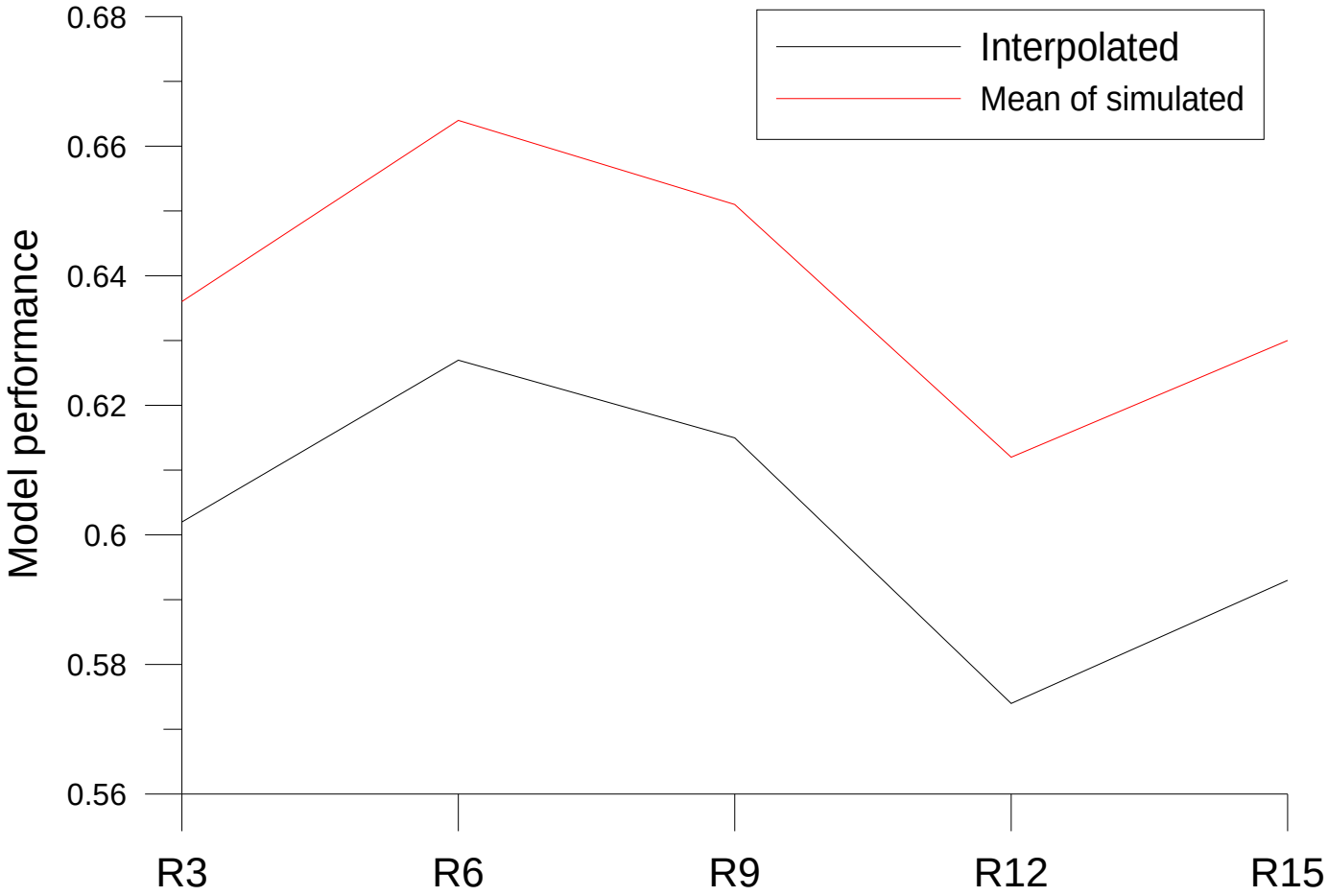


Estimation error vs,
Standard deviation due to spatial uncertainty



Modelling peak discharge

(SC 3)



Results

- Models calibrated using interpolated rainfall yield
  - Biased estimator if used with spatially variable rainfall
    - 7%-10% in the mean
    - 5% for the maxima
  - The mean of the simulations is
    - worse if the whole period is considered
    - better if only floods are considered

  than the model using interpolated rainfall

Conclusions

- Model resolution corresponding to
  - Processes
  - Available information (precipitation)
- Spatial variability of rainfall is partly responsible
  - for modelling errors
  - Problems in parameter estimation
- Spatial simulation is reasonable for flood forecasting
- Forecasting of spatial variability is very important