JOANNEUM RESEARCH

Low flow characteristics – the influence of geological conditions

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Objectives

- Analysis of geological influence on low flow characteristics (groundwater flow) in catchments
  - runoff components
  - water storage capacities
  - recession characteristics
  - subsurface drainage systems
    hydrographic vs. orographic catchment

- Case studies in catchments with comparable climatic conditions
  → Similarities and differences in runoff characteristics

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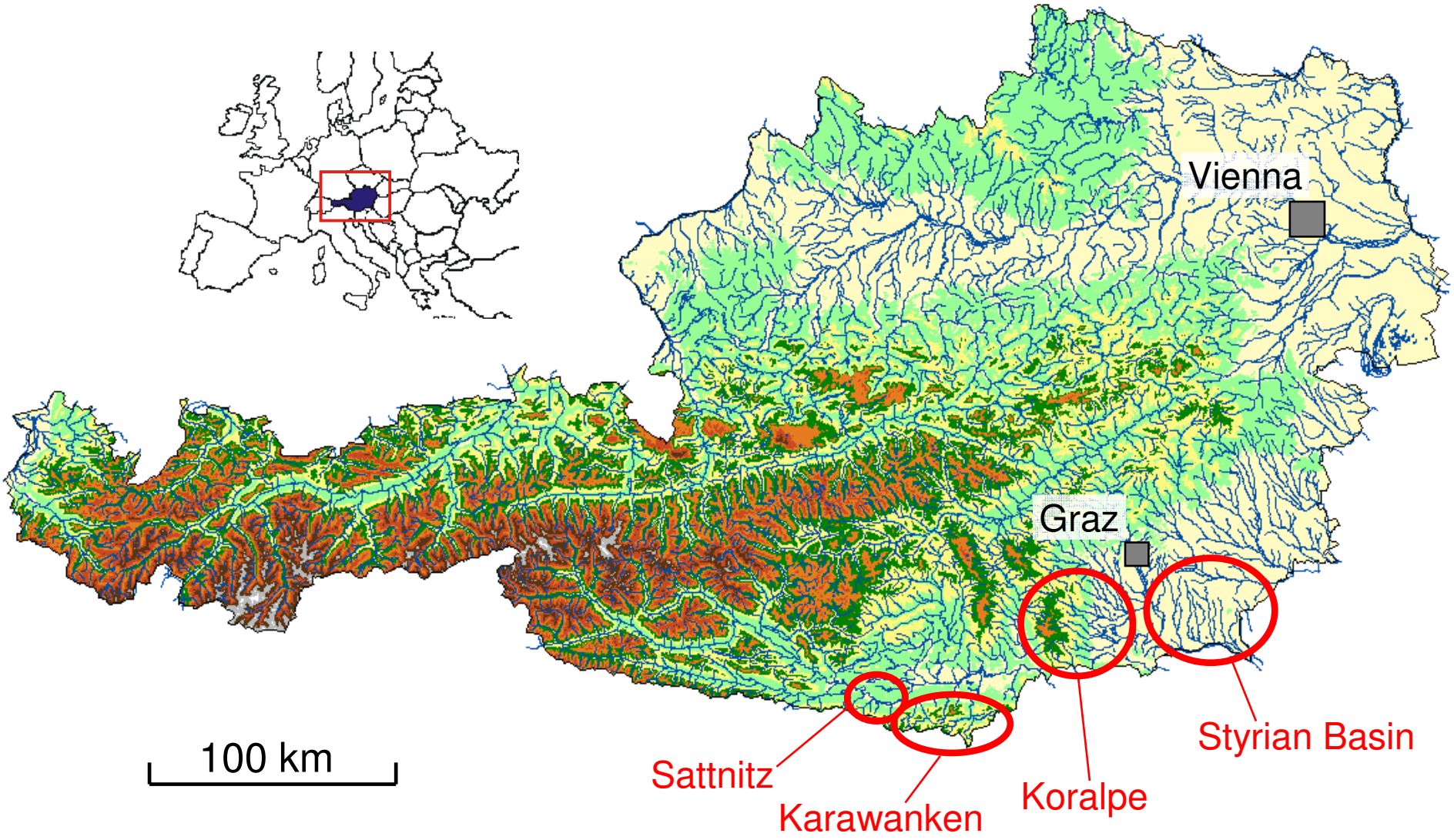
- Case studies in catchments with comparable climatic conditions
  → Similarities and differences in runoff characteristics

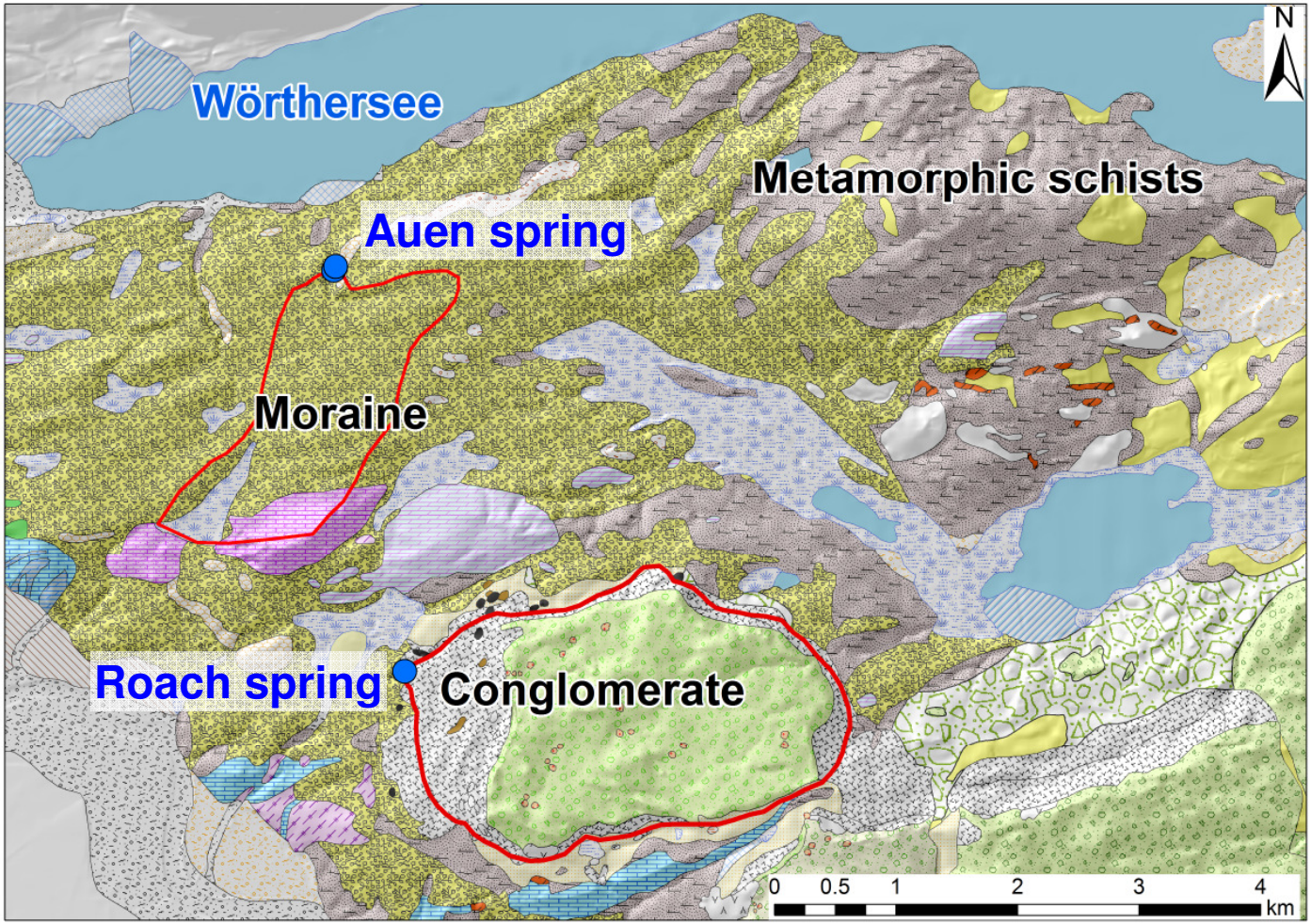
- Analysis assists in:
  → Evaluation of sensitivity of basins to dry climate conditions
  → Regionalisation
  → Modelling: structure and parameter identification

Case studies



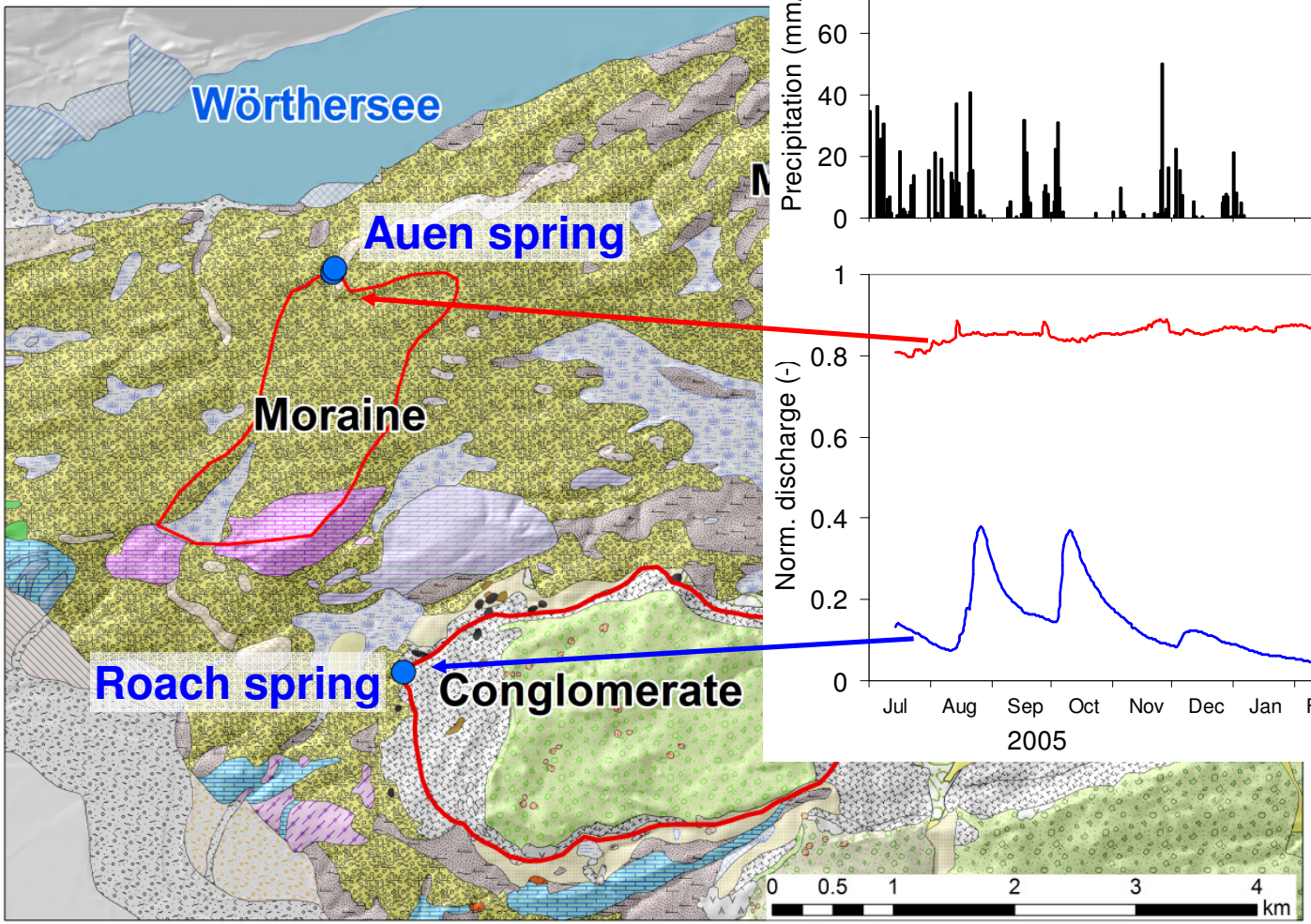

Graz

Sattnitz


Wörthersee
Auen spring
Metamorphic schists
Moraine
Roach spring
Conglomerate
N
0 0.5 1 2 3 4
km

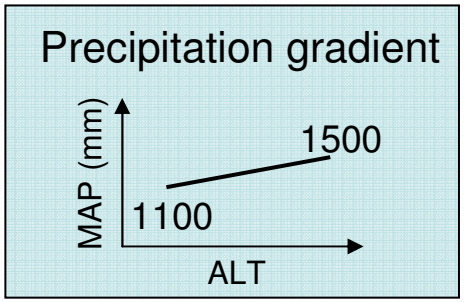

Graz

Sattnitz


Wörthersee
Auen spring
Moraine
Roach spring
Conglomerate
0 0.5 1 2 3 4
km

Precipitation (mm/d)
80
60
40
20
0
Norm. discharge (-)
1
0.8
0.6
0.4
0.2
0
Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
2005
2006

Koralpe



Summit zone included in catchment (Schwanberg gauge)

Weathered, fractured gneiss

„Kare“ (cirques, alpine bowls)

≤ 150m

very large storage

Springs

Lower catchment (Hörmsdorf gauge)

large storage

Steep slopes

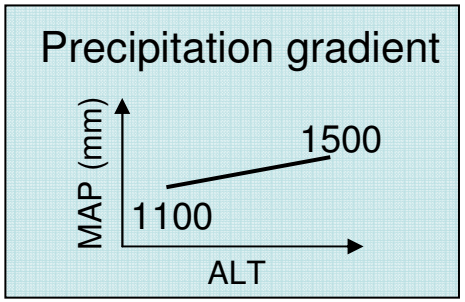
Catchment at foothills (Zehndorf gauge)

Gauges

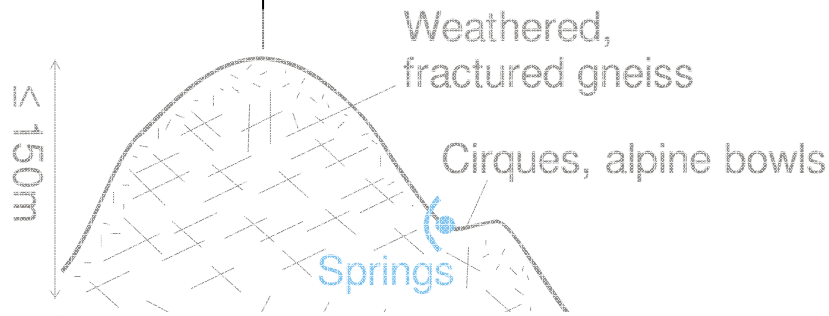
Cristalline (gneiss)
low storage

Tertiary material
very low storage

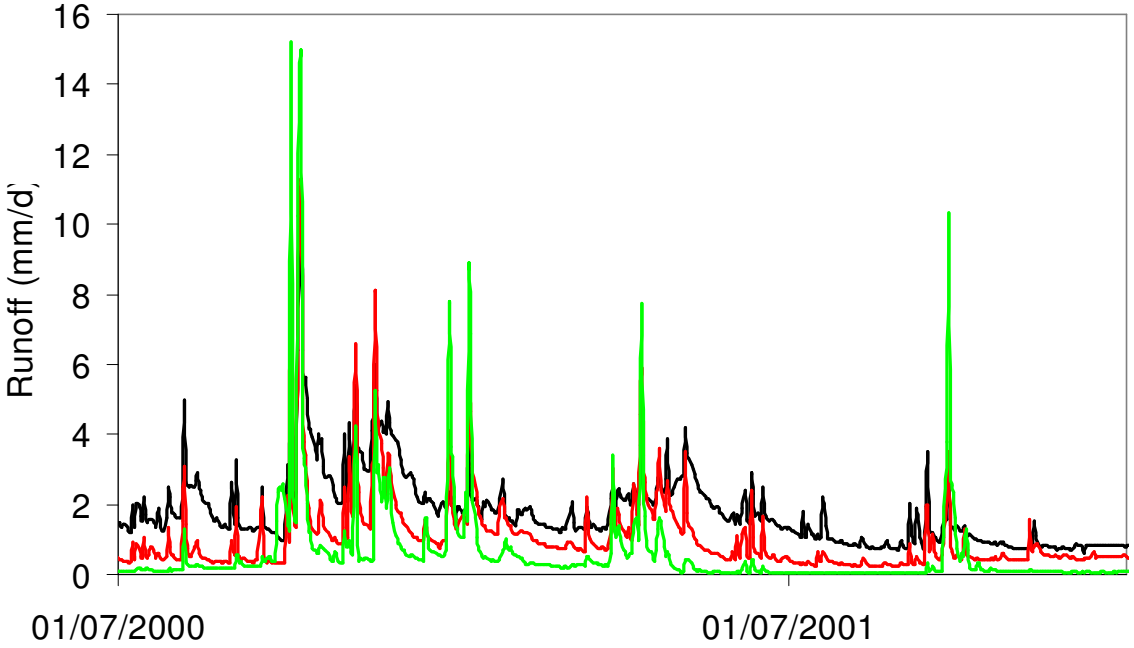
Koralpe

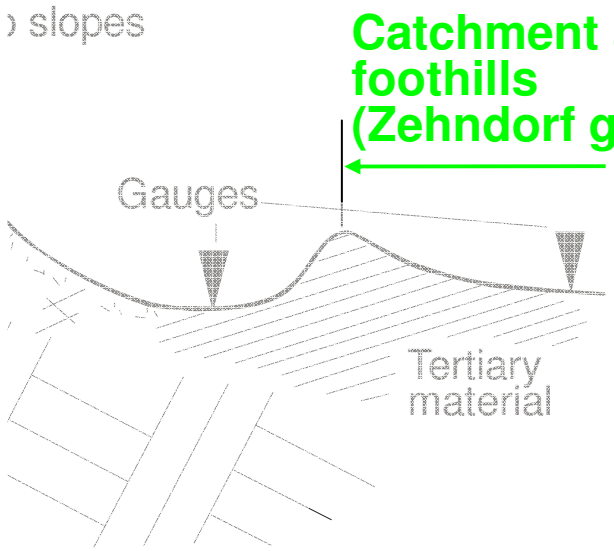


Summit zone included in catchment (Schwanberg gauge)



Lower catchment (Hörmsdorf gauge)

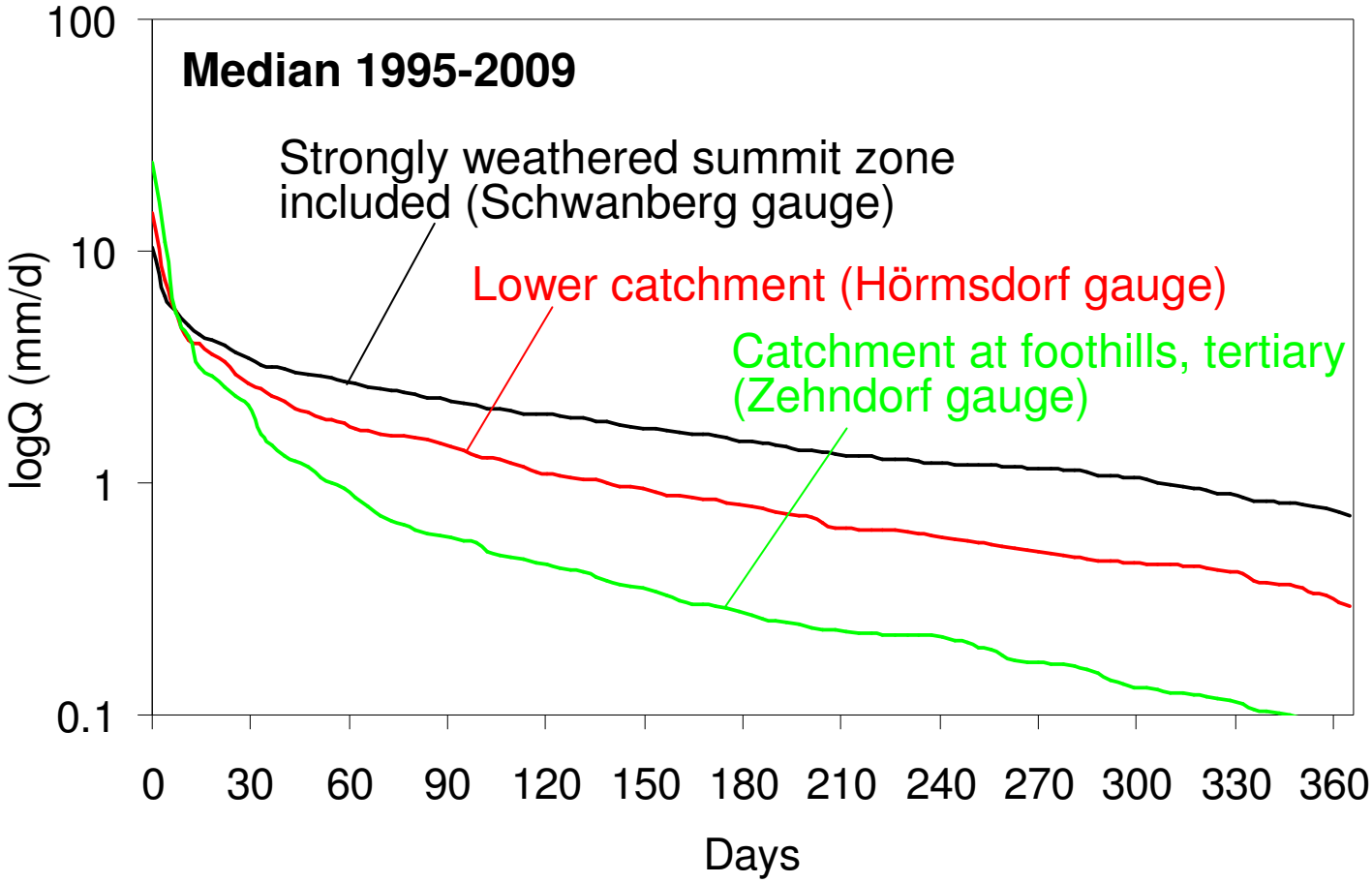




Catchment at foothills (Zehndorf gauge)

Koralpe

Duration curves

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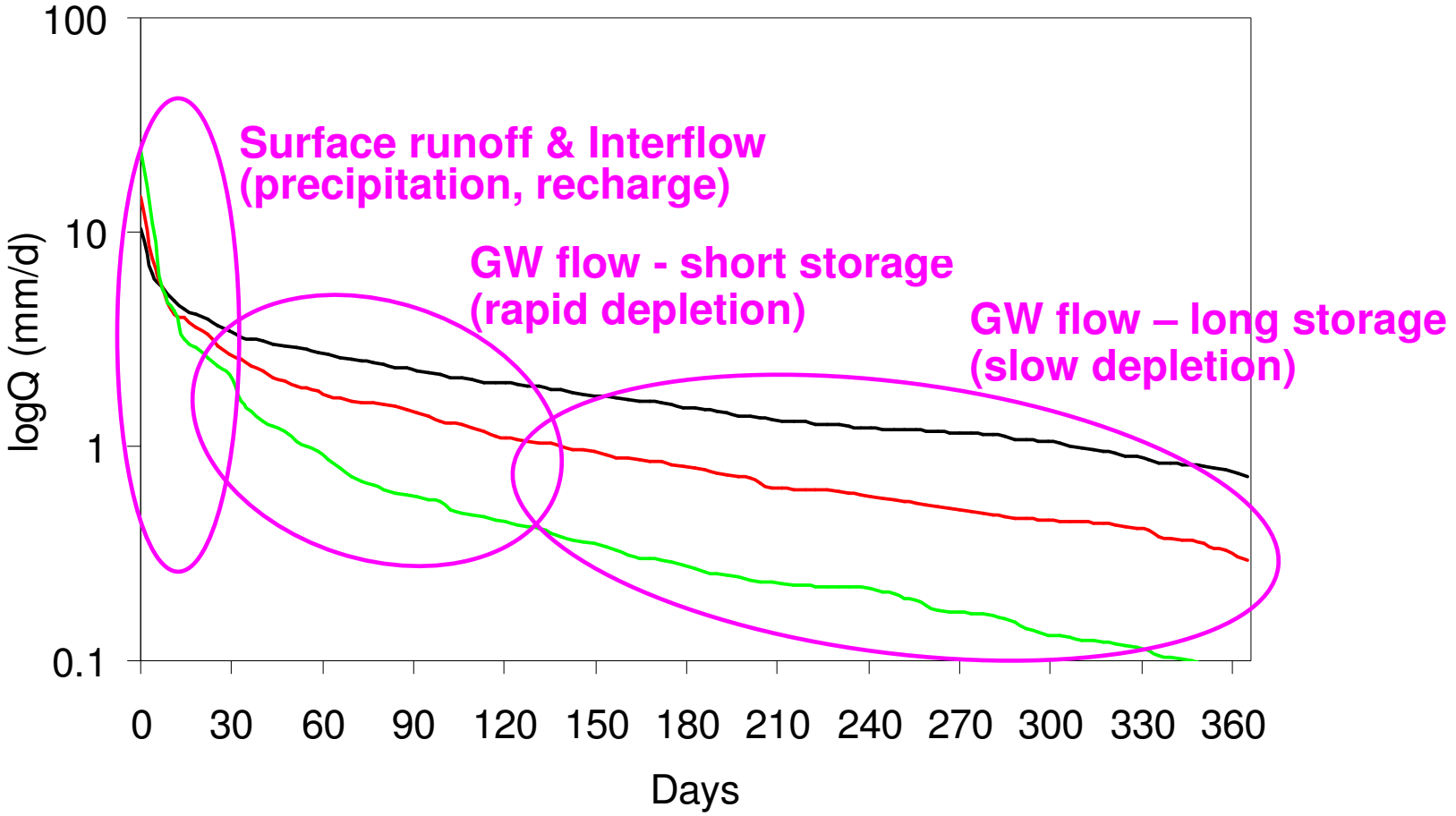
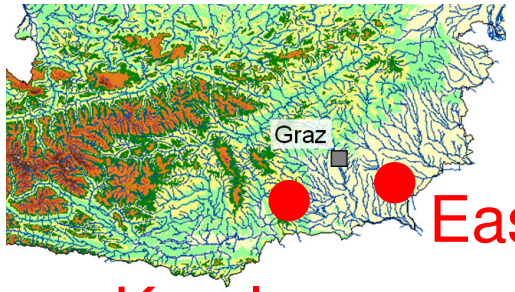
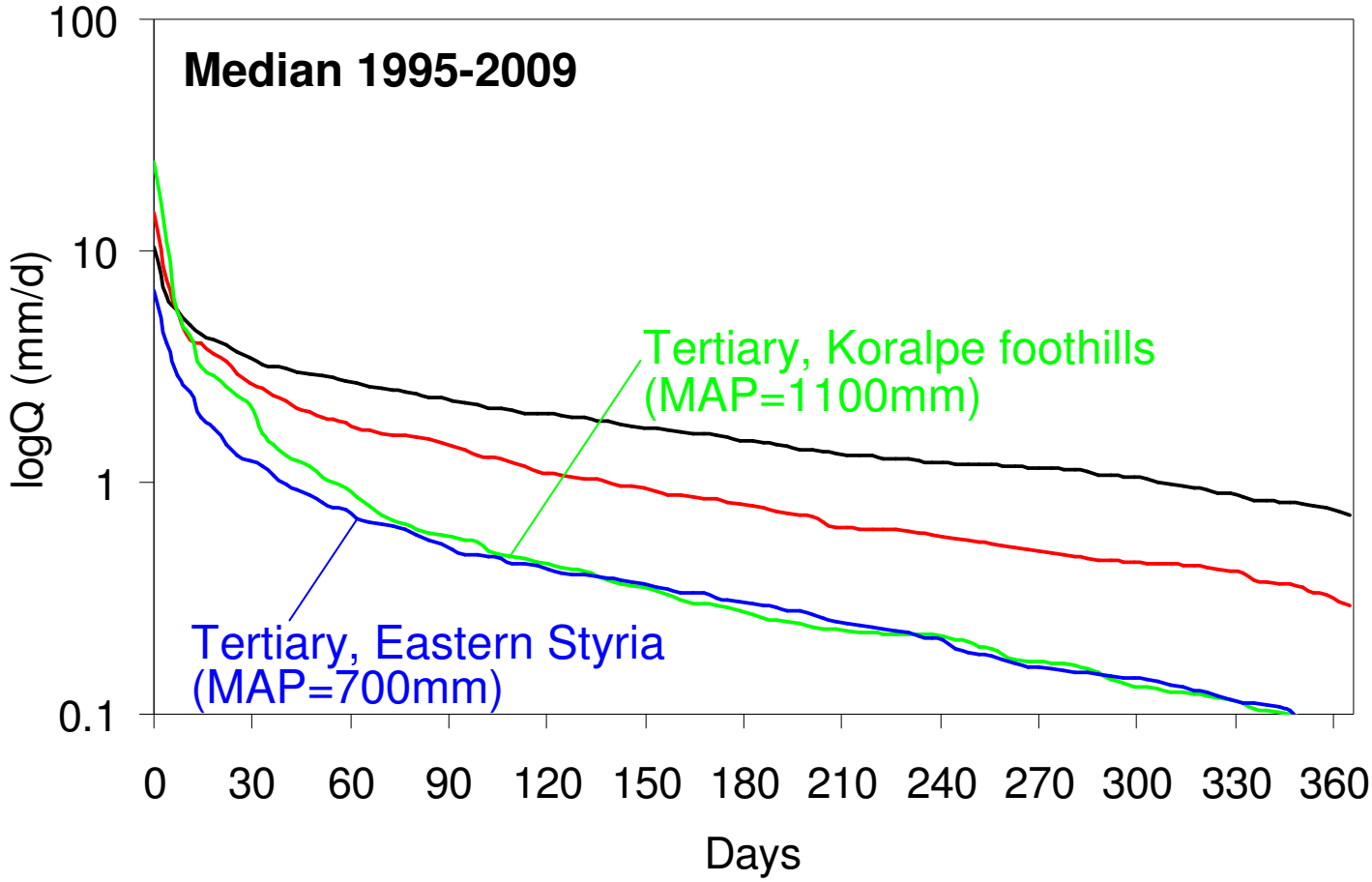
Koralpe


100
10
1
0.1
logQ (mm/d)
0
30
60
90
120
150
180
210
240
270
300
330
360
Days
Surface runoff & Interflow
(precipitation, recharge)
GW flow - short storage
(rapid depletion)
GW flow – long storage
(slow depletion)



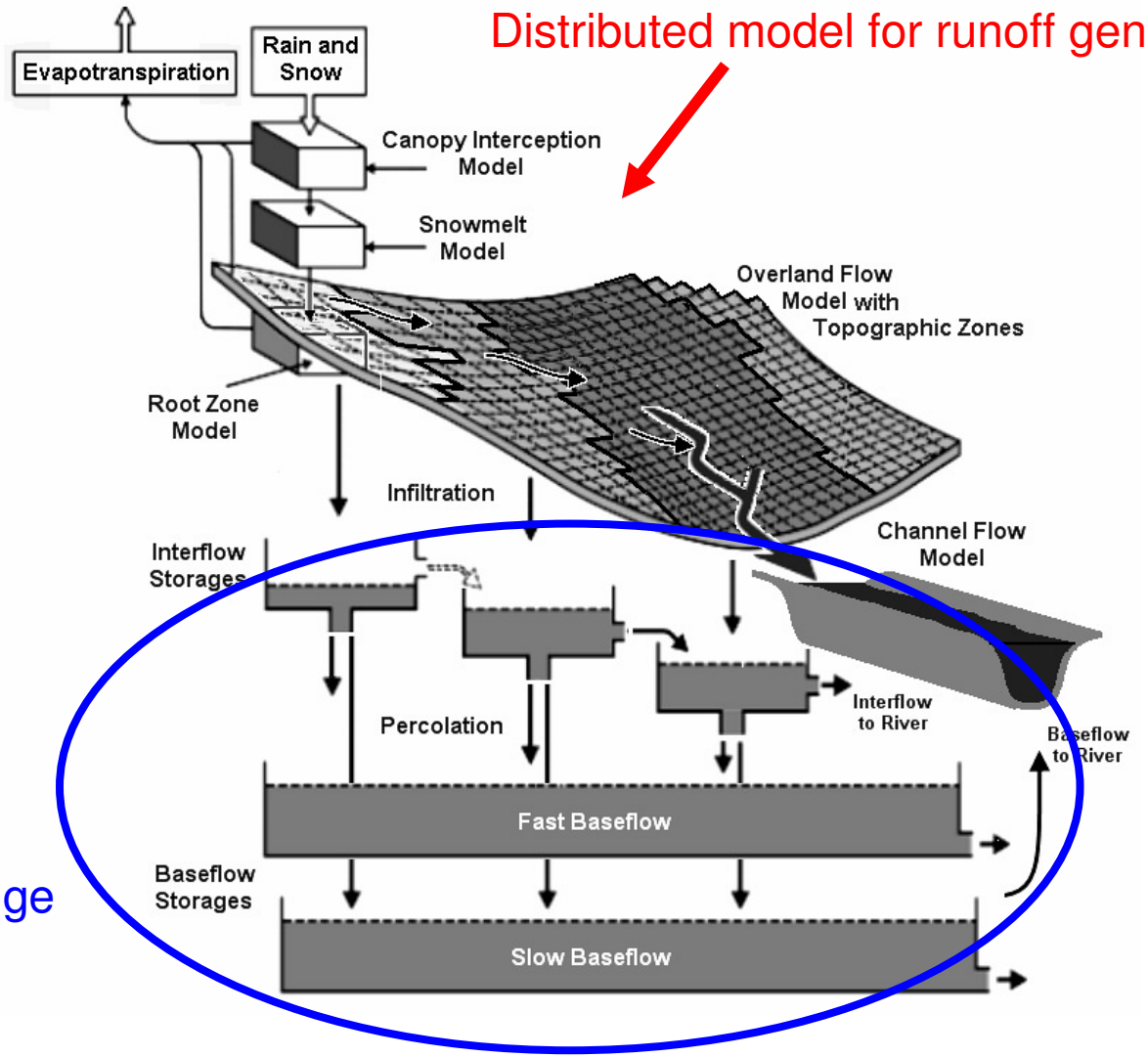
Eastern Styria (Fluttendorf gauge)

Koralpe

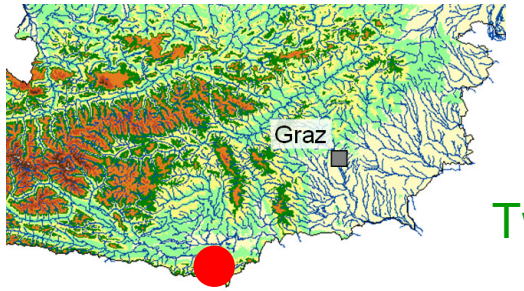


Modelling

MIKE-SHE
(DHI)



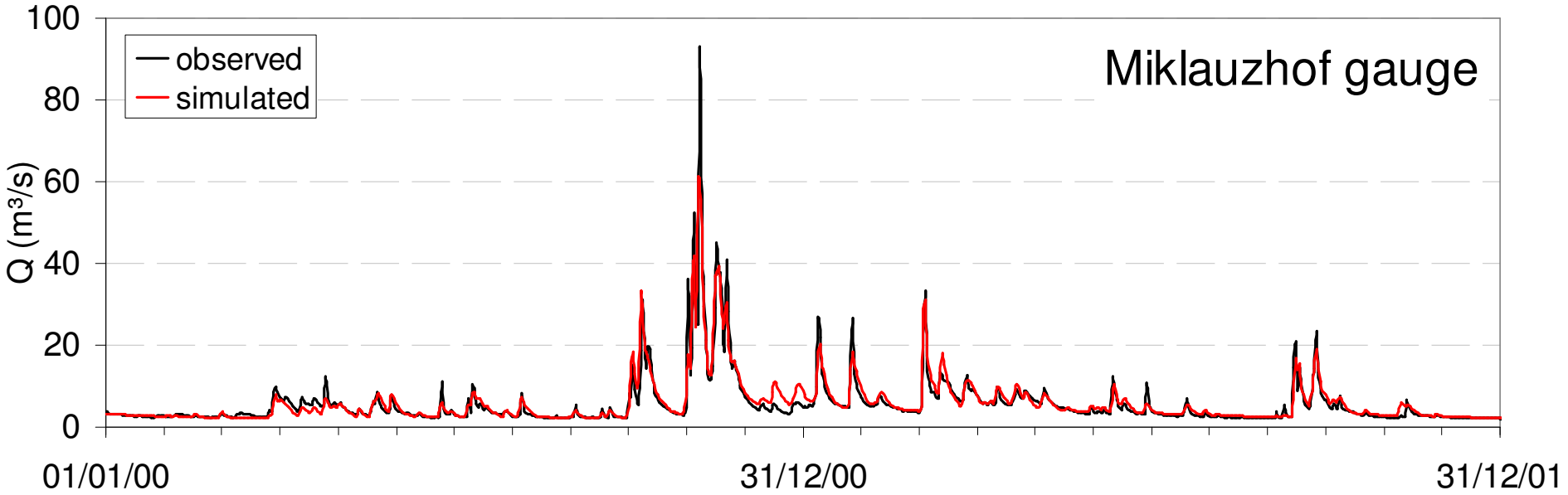
conceptual approach (system of linear reservoirs)
→ parameters: time constants and exchange rates

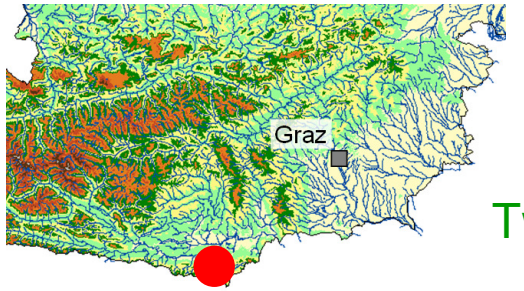


Example Karawanken

Two neighbouring gauged catchments with differences in geology

Calibration





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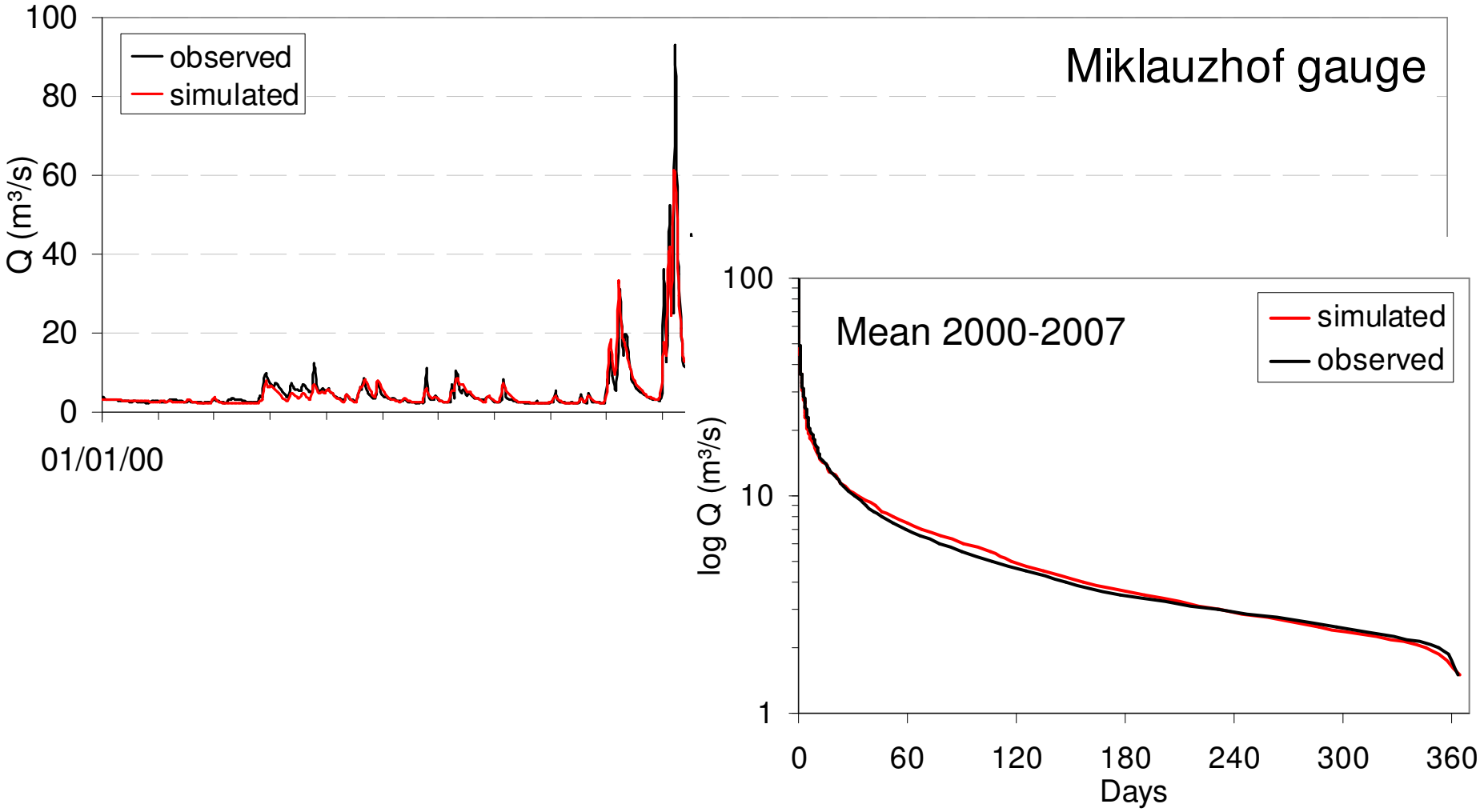
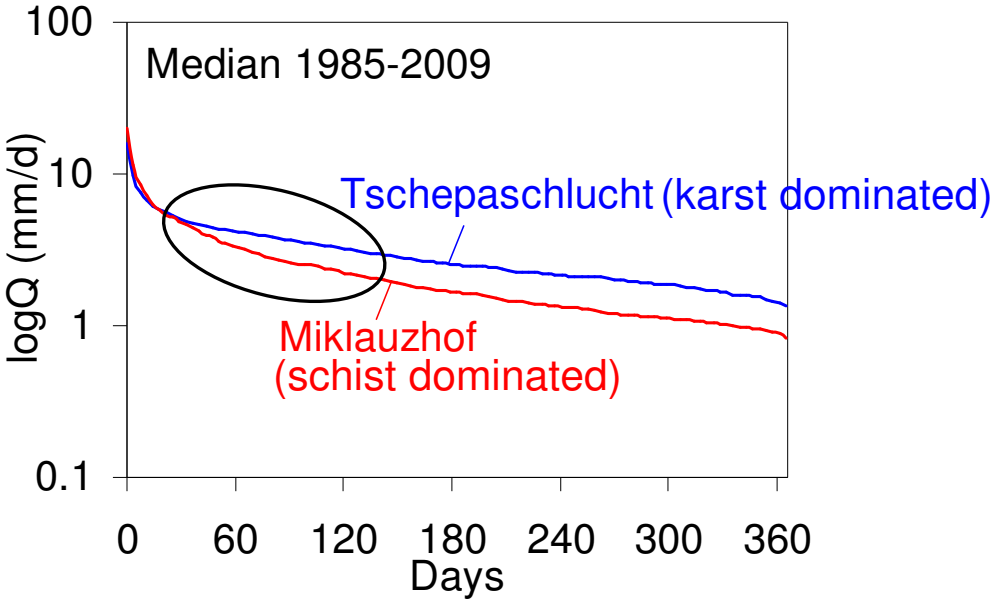
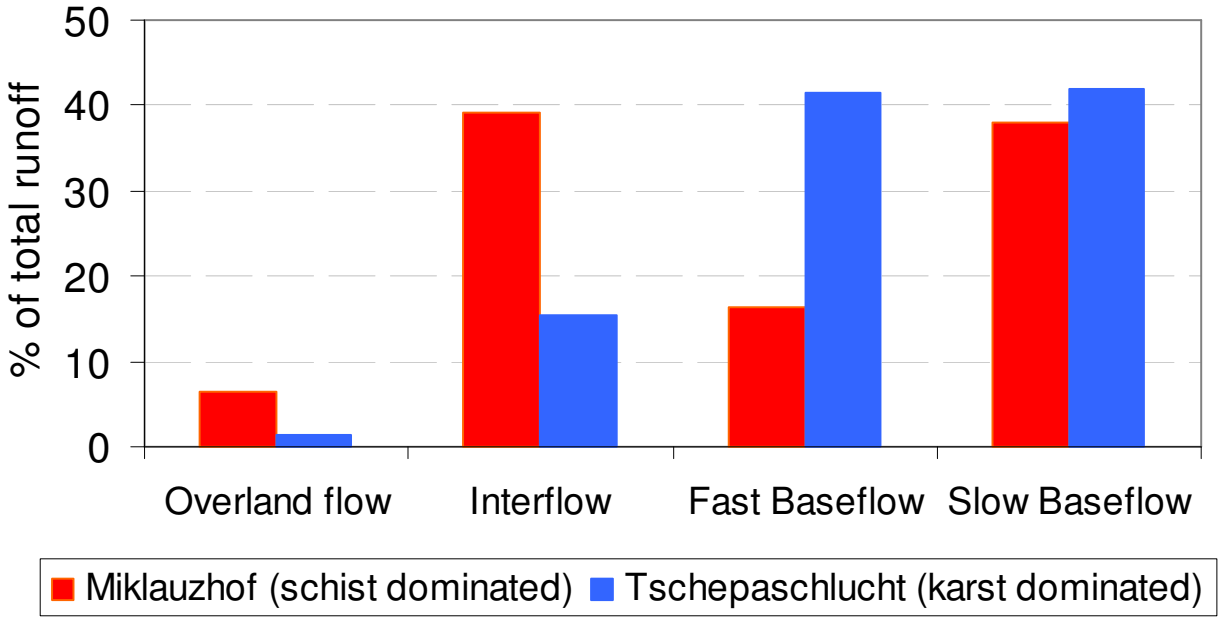


Karawanken

Observed duration curves



Simulated runoff components
(average 1985-2009)



Conclusions

Analysis of geological influence on low flow characteristics

→ Evaluation of sensitivity to dry periods

- long term water storage and GW recession:
  weathered/fissured zones, karst, tectonics, geomorphology …
  (in combination with seasonality of recharge, e.g. snow melt,
  autumn/winter rain storms → shift due to climate change)
- large surface runoff intensifies vulnerability:
  limited recharge, e.g. in tertiary regions

→ Definition of hydrogeologically “homogenous” zones
for regionalisation of low flow characteristics

- small scale heterogeneity in alpine region
- data availability (monitoring network)

→ Modelling: combined hydrological and geological analysis
assists in parameter identification and verification (plausibility
check) -> runoff components

Open research questions

- Local (small) scale → regional (large) scale:
  - → regionalisation of low flow characteristics
    - → hydrogeological unit subdivision: trade off
- Change of near surface weathering processes due to climate change:
  - →soil
  - →change of infiltration conditions
  - →different vegetation
  - →change in land use
  - →…

THANK YOU

Acknowledgements

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  Provincial governments of Carinthia and Styria

Photo: R. Benischke