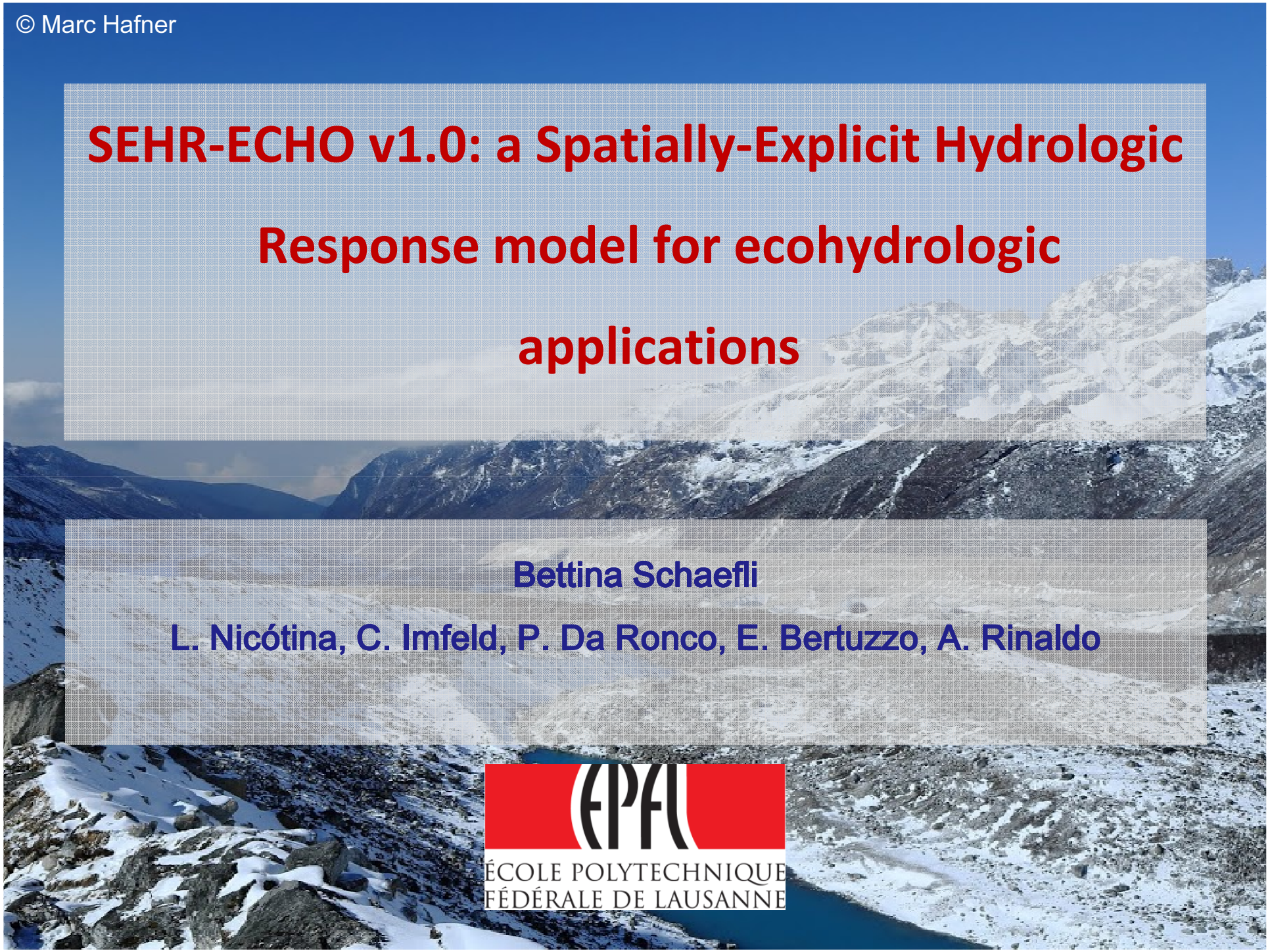


SEHR-ECHO v1.0: a Spatially-Explicit Hydrologic Response model for ecohydrologic applications

Bettina Schaefli

L. Nicótina, C. Imfeld, P. Da Ronco, E. Bertuzzo, A. Rinaldo

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

Motivation - Context

- **Alpine headwater catchments (10-100km^2)**

  → **Water & flood management in downstream areas**

  → **Energy production (energy turn-around)**

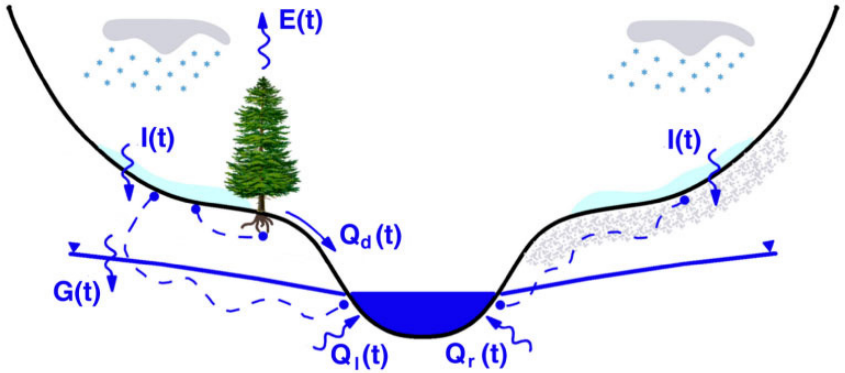
  → **Few undisturbed observed discharge series**

Source Figures:

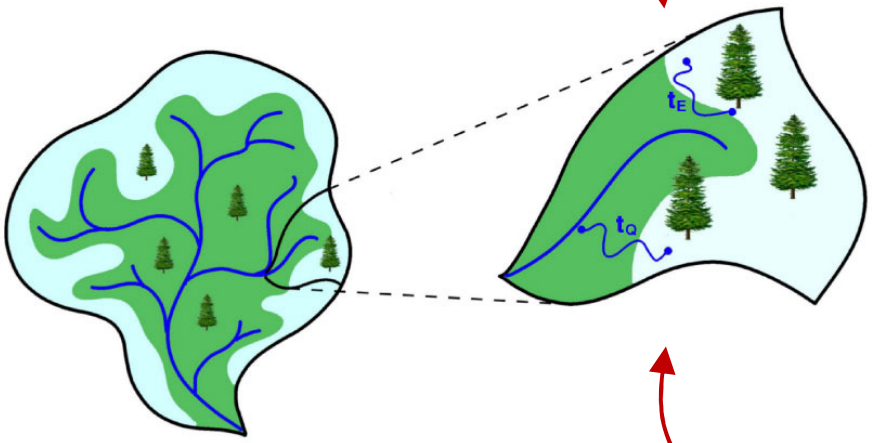
Comola et al., WRR 2015

Reservoir-based runoff transformation

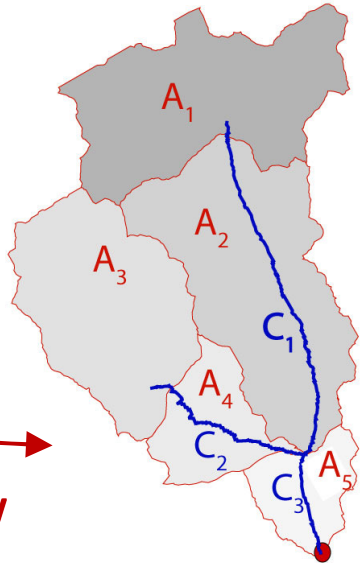
Degree-day snow melt



Runoff simulated at sub-catchment scale



Convolution with flow pathways



Pathways:

$A_1 \rightarrow C_1 \rightarrow C_2$

$A_3 \rightarrow C_2 \rightarrow C_3$

…

Summary

- **Catchment-scale models**

  → Spatially-explicit to account for

    → Input & flow generation patterns

    → Spatial origin of flows & geomorphology

  → Use of geomorphologic information

    → Enhanced spatial transferability of travel time parameters

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END of SUMMARY

Details & Discussion at PICO Screen 3.18 or anytime!

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OUTLINE

- **Precipitation-runoff model structure**
  - Flow generation at the hillslope scale
  - Convolution with river network
- **Application example**
  - Dischma catchment (Swiss Alps)
- **Spatially-explicit: gridded or not gridded?**
- **Summary**
- **Reference - Code**

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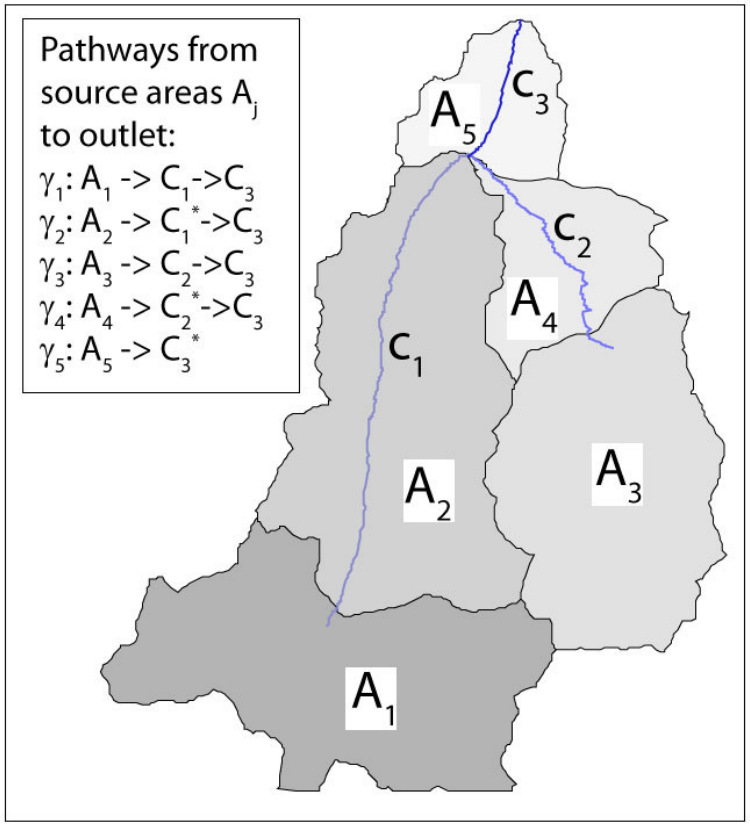
Spatially-Explicit Hydrologic Response model of the Ecohydrology lab (ECHO)



Travel-time distribution approach

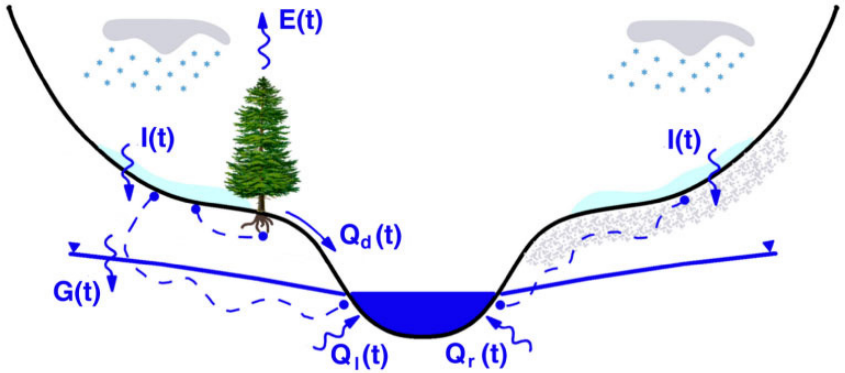
Source: Schaefli et al. Geosci. Model Developm., 2014

Source Figures:

Comola et al., WRR 2015

Reservoir-based runoff transformation

Degree-day snow melt



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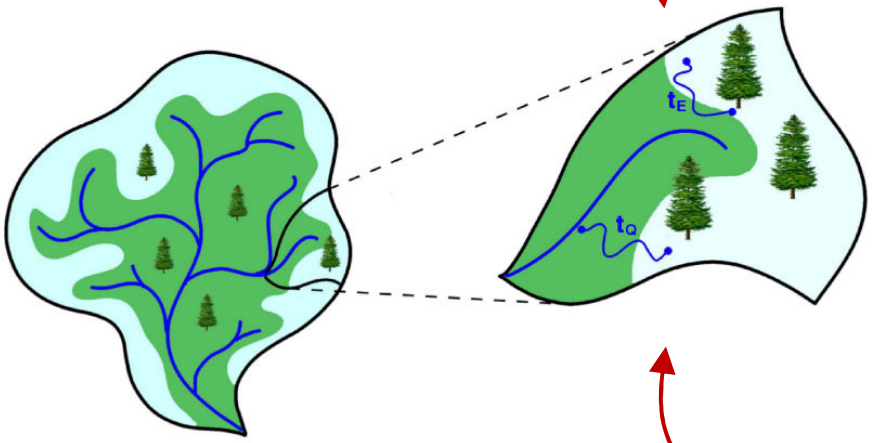
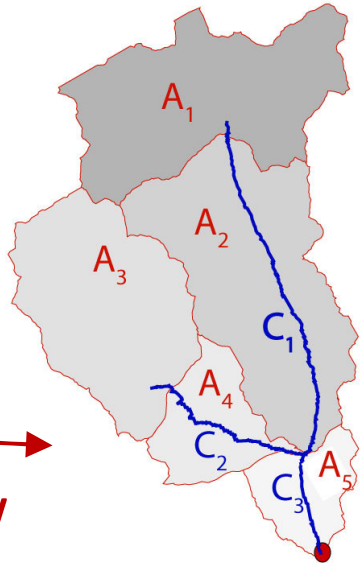


Convolution with flow pathways



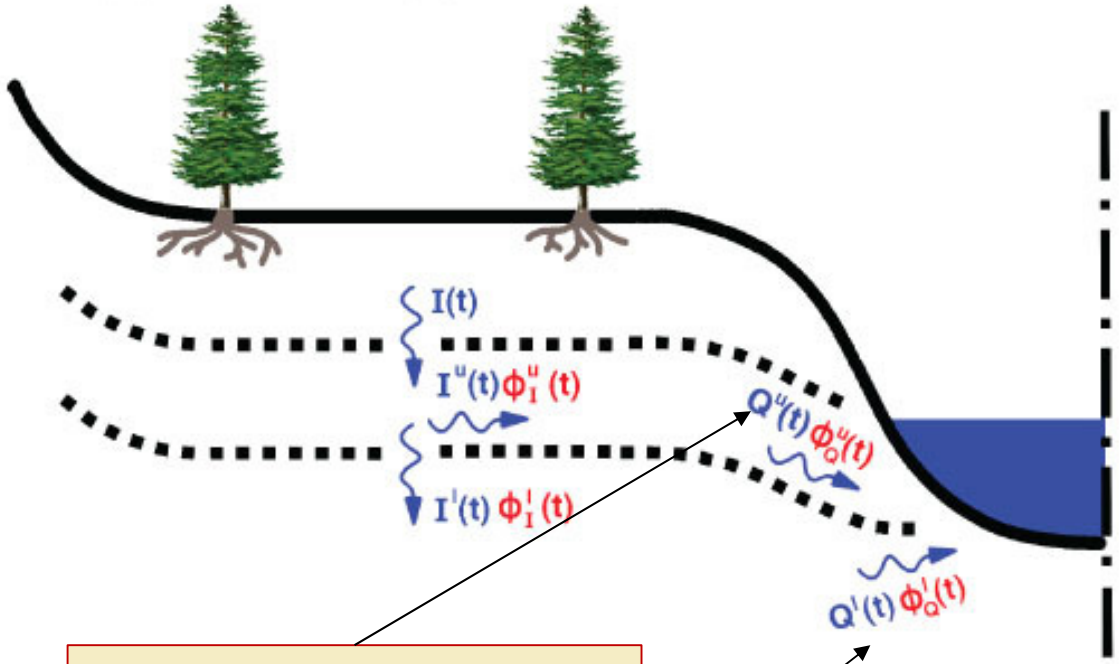
Pathways:

$A_1 \rightarrow C_1 \rightarrow C_2$

$A_3 \rightarrow C_2 \rightarrow C_3$

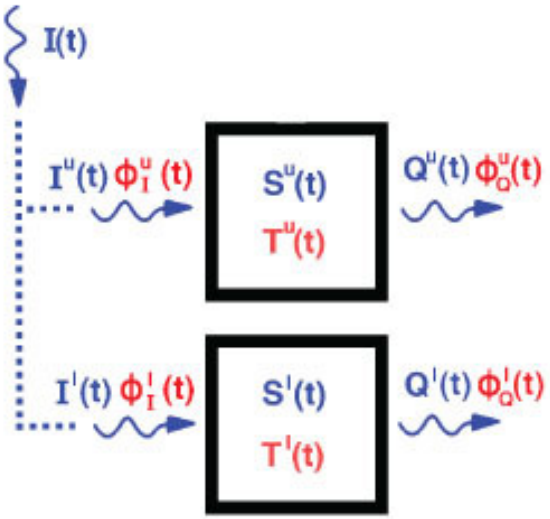
…

Water mobilization simulation at subcatchment scale



Source Figures:

Comola et al., WRR 2015

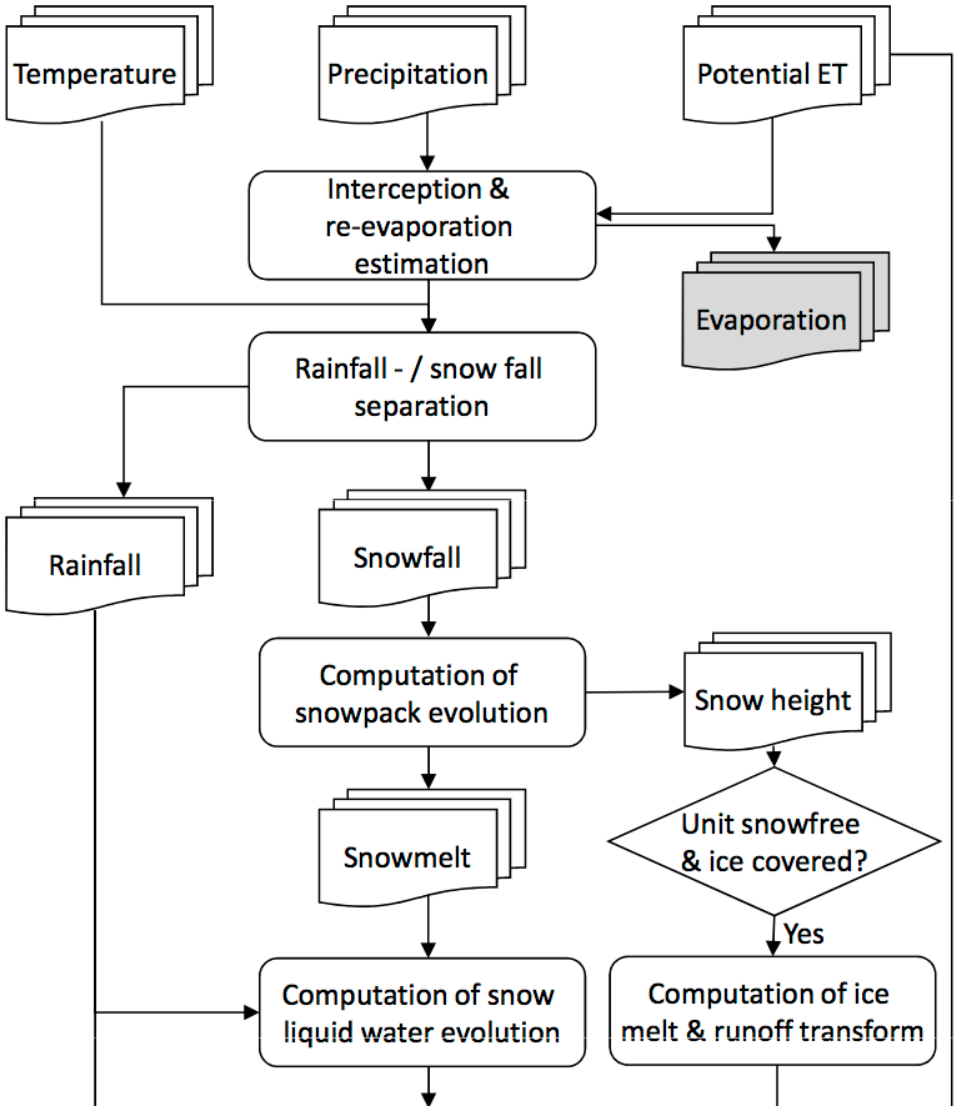


Fast subsurface flow

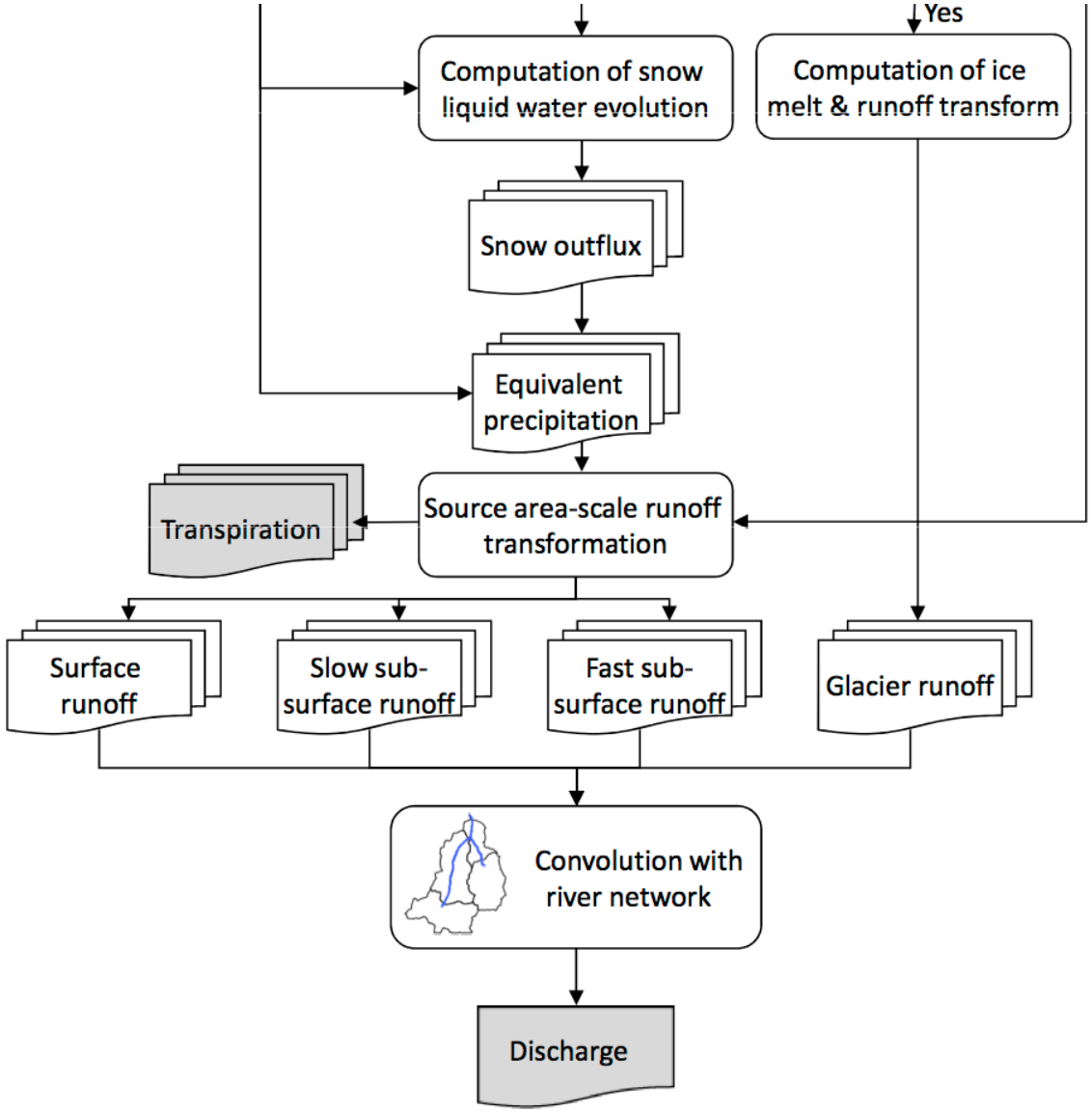
Slow subsurface flow

Source: Comola et al., WRR, 2015

Model structure (1)



Model structure (2)



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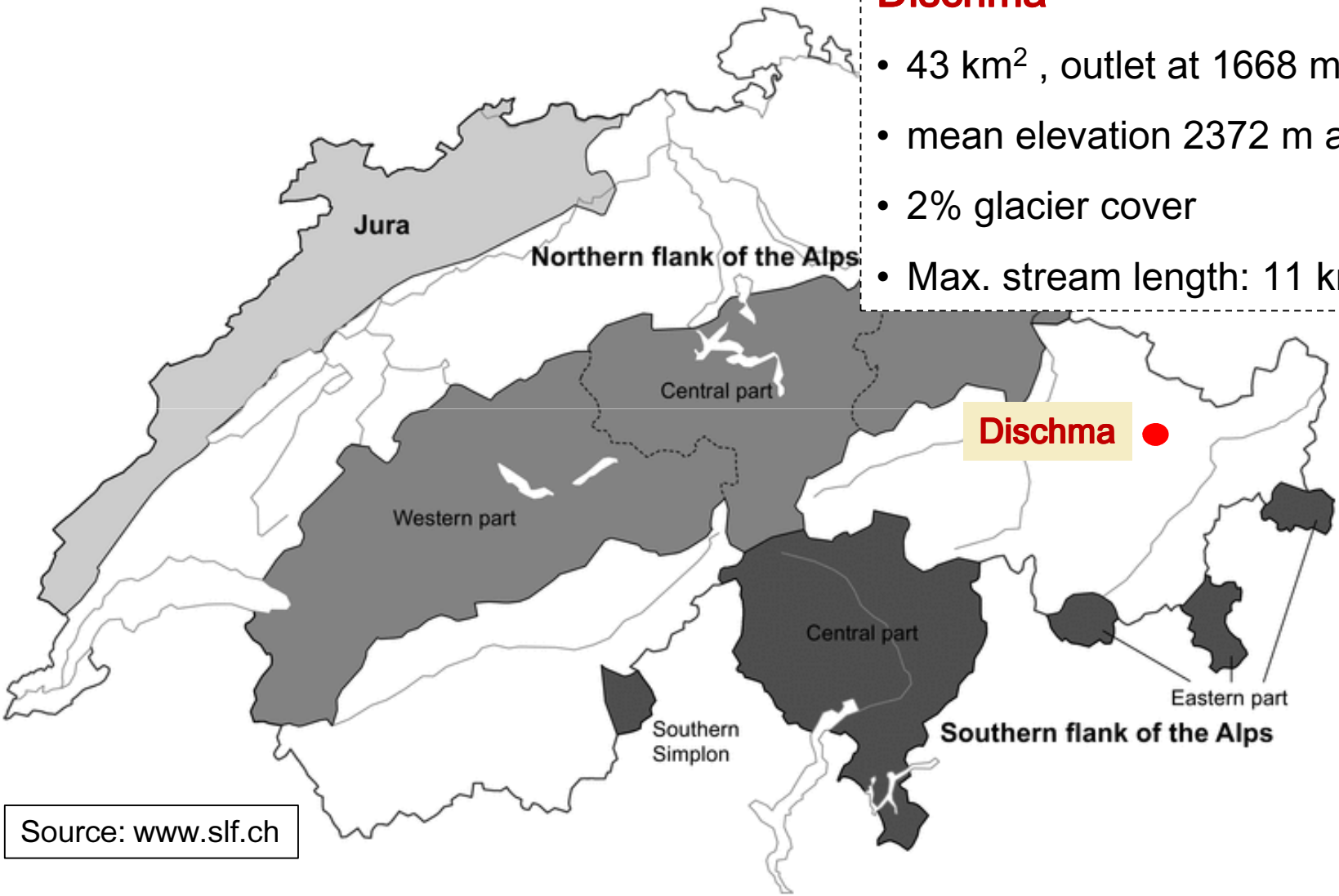
Dischma case study

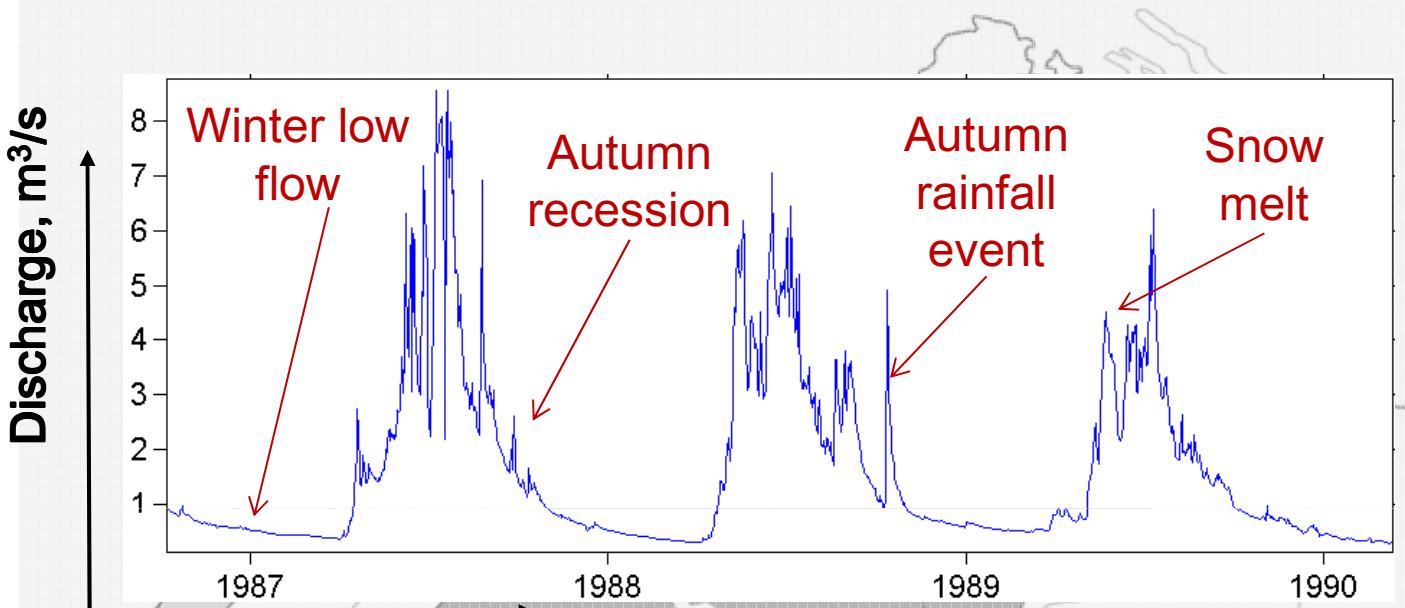
Dischma

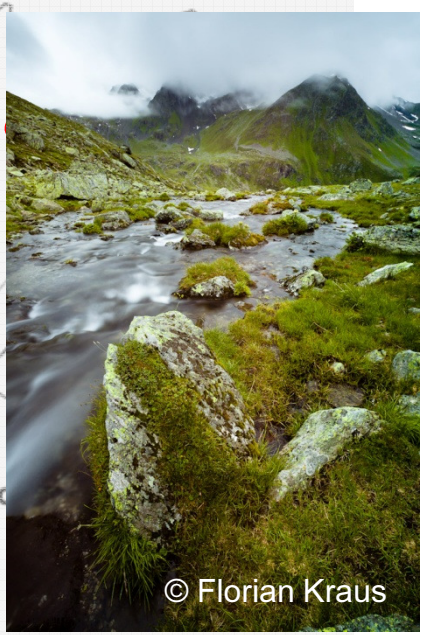
- 43 km^2 , outlet at 1668 m asl.
- mean elevation 2372 m asl.
- 2% glacier cover
- Max. stream length: 11 km



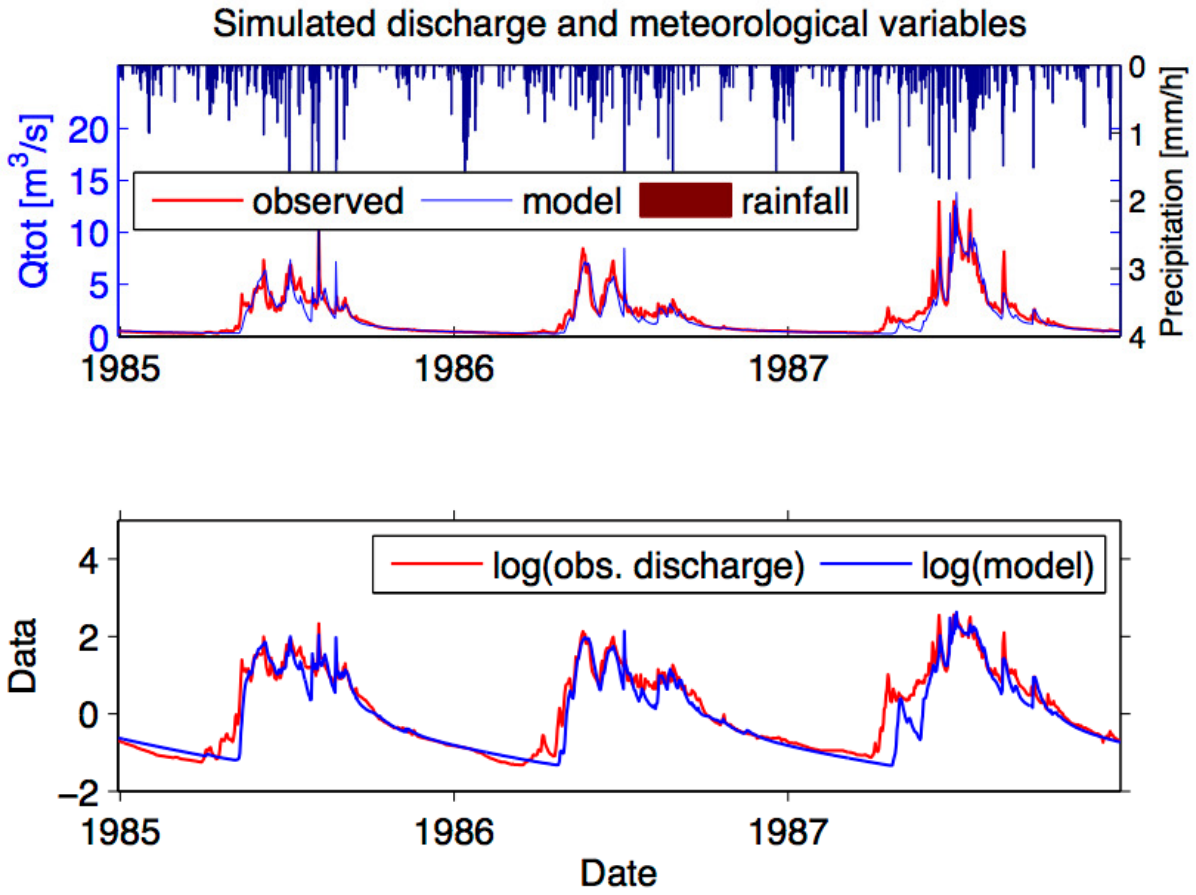
Source: www.slf.ch

Dischma case study

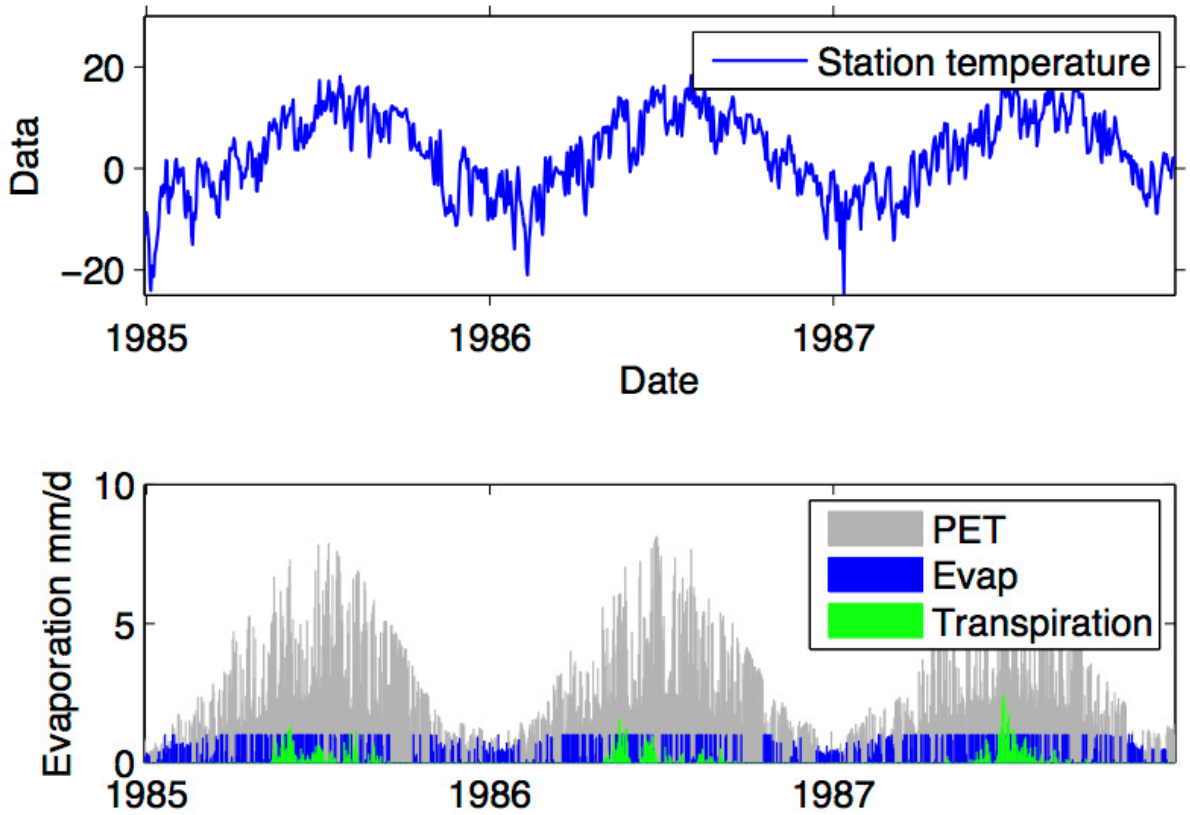




Dischma case study



Dischma case study



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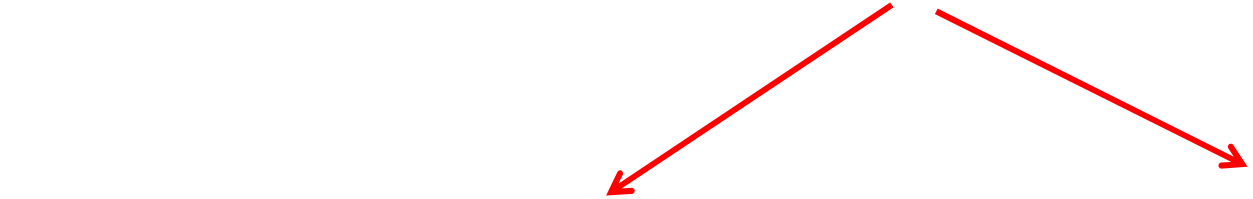
Spatially-explicit modeling

➔ **Hydrologic response =** **Precipitation (+melt) pattern**

+

Dominant hydrologic process patterns



Flow generation at hillslope scale

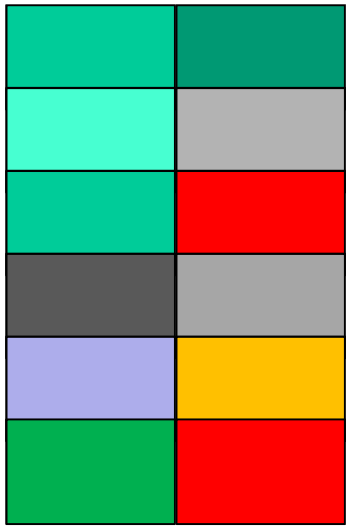
Channeled transport

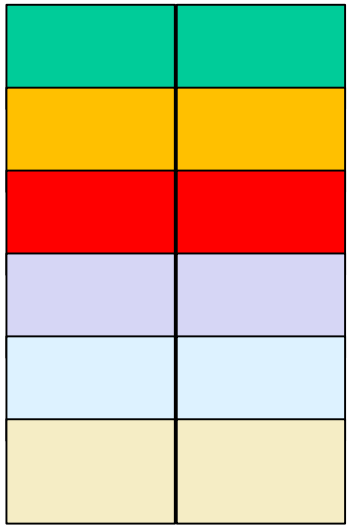
➔ **Combines physics-based / mechanistic parameterizations**

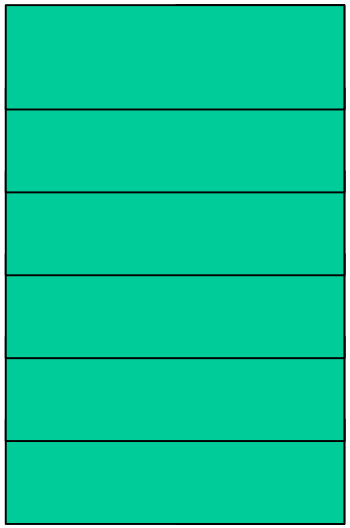
➔ **Overcomes traditional dichotomy lumped vs distributed**

- **Spatially-explicit hydrologic prediction**
  - Lumped
  - Semi-lumped
  - Semi-distributed
  - Distributed

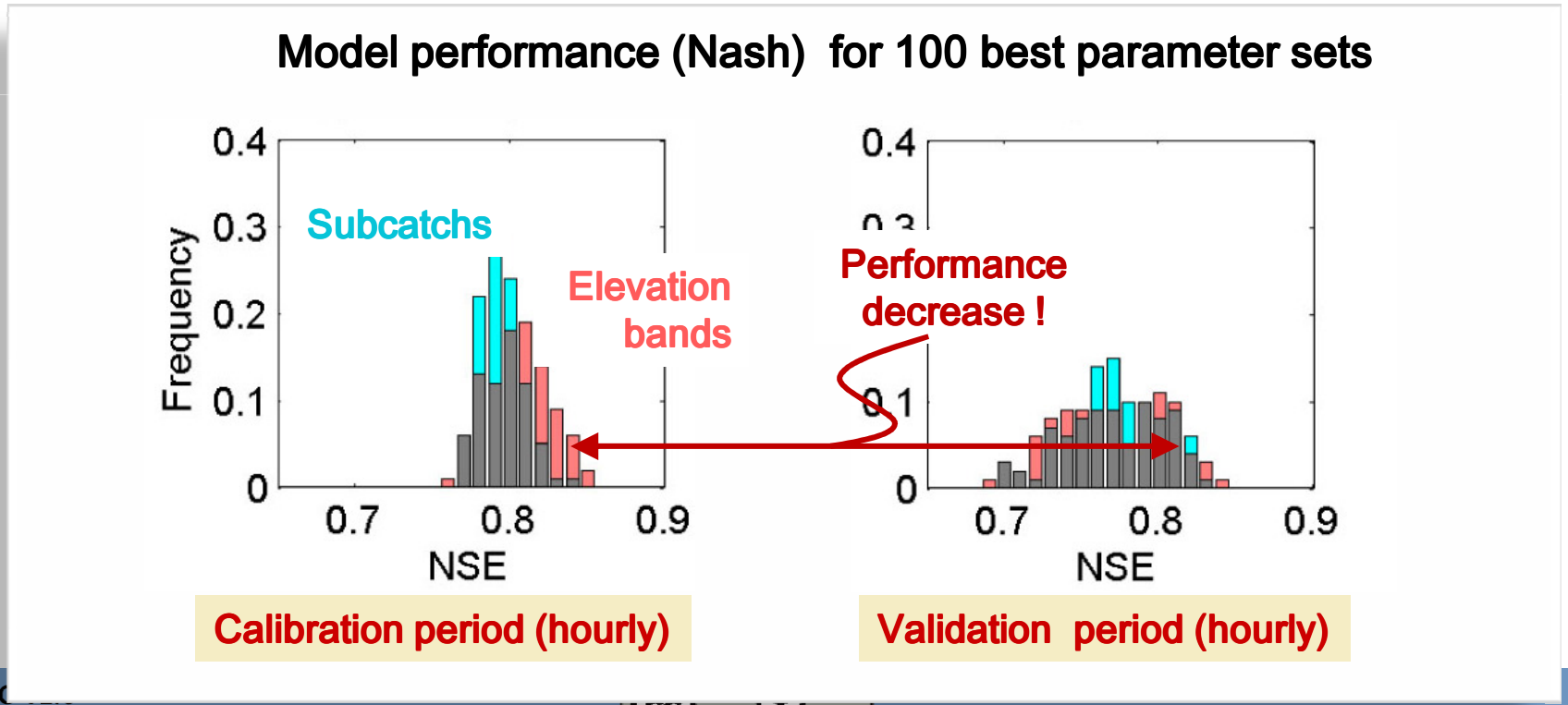
Spatially-explicit



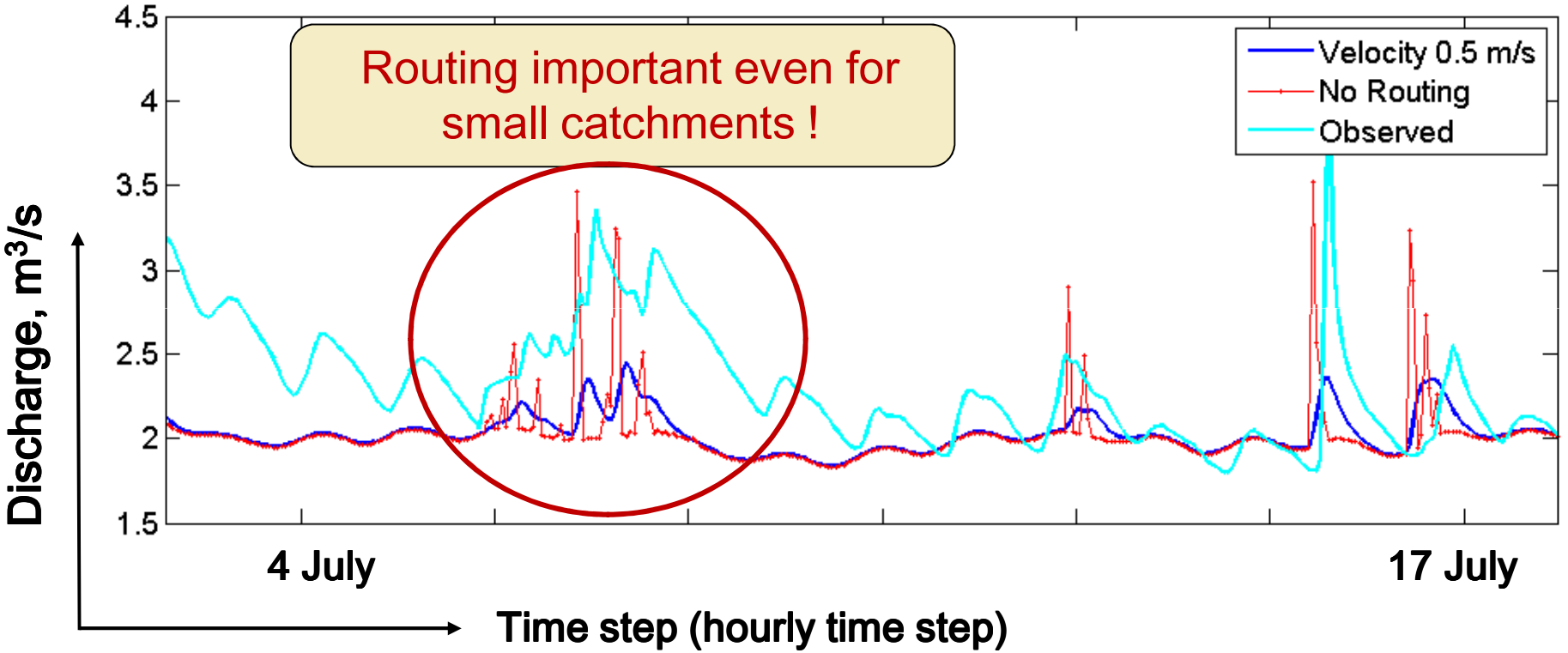




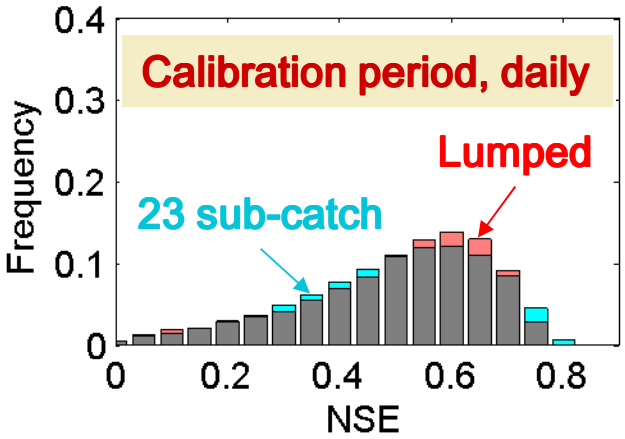
- **Test: different model structure calibrations**
  - **Subcatchments** → Better travel time description
  - **Elevation bands** → Better snowmelt description

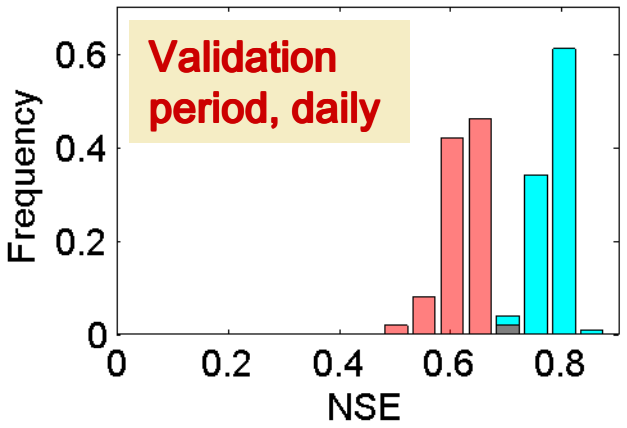


- **Role of in-stream routing**

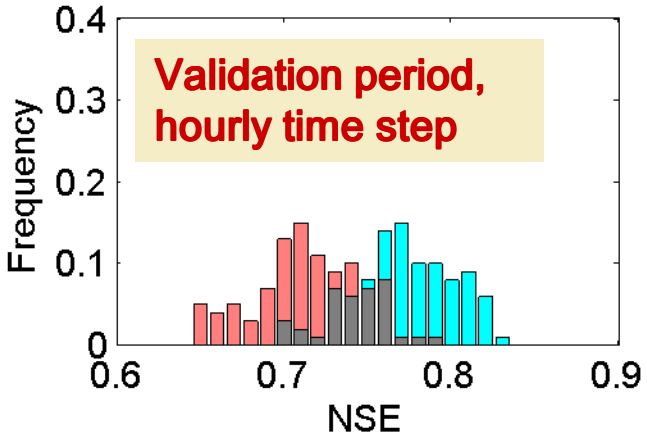


Is lumped model sufficient, at least at daily time step?





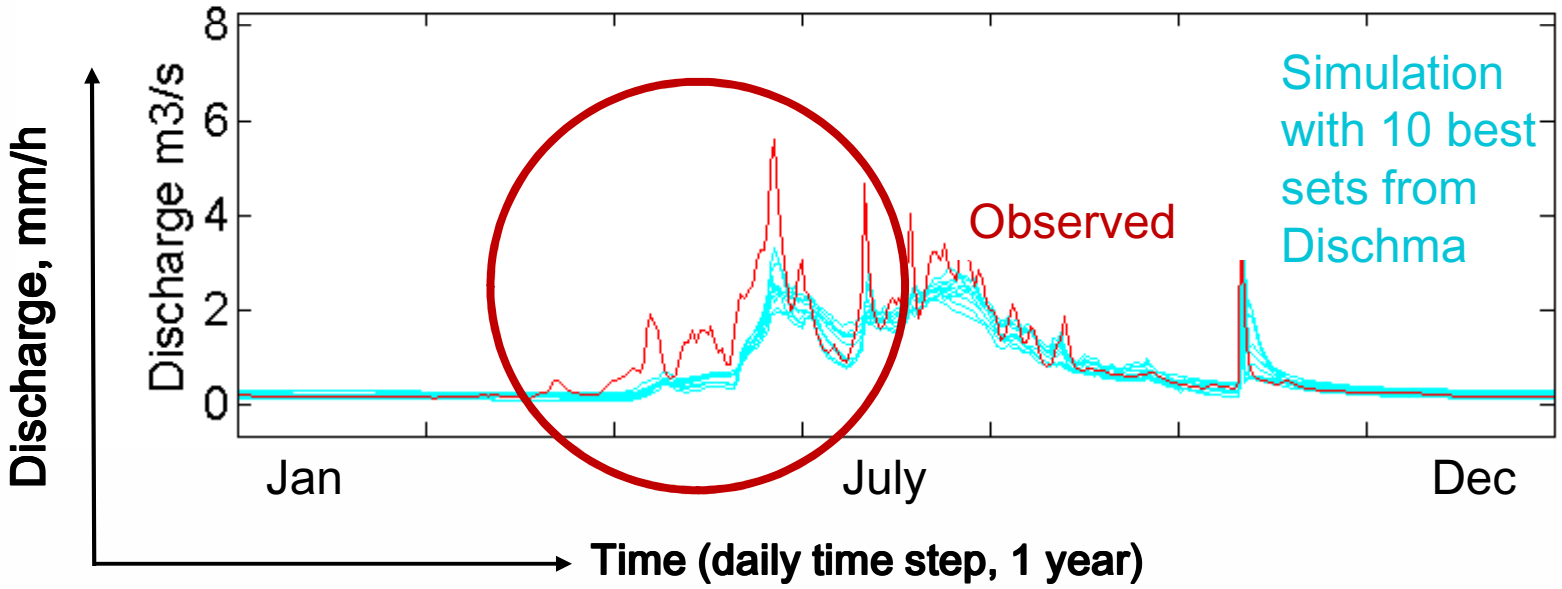
- Monte Carlo simulations for lumped & subcatchment setup
- Performance of best 100 parameter sets (Nash-Sutcliffe) for validation period



- **Role of spatial input patterns: no spatial transferability of calibrated melt input**

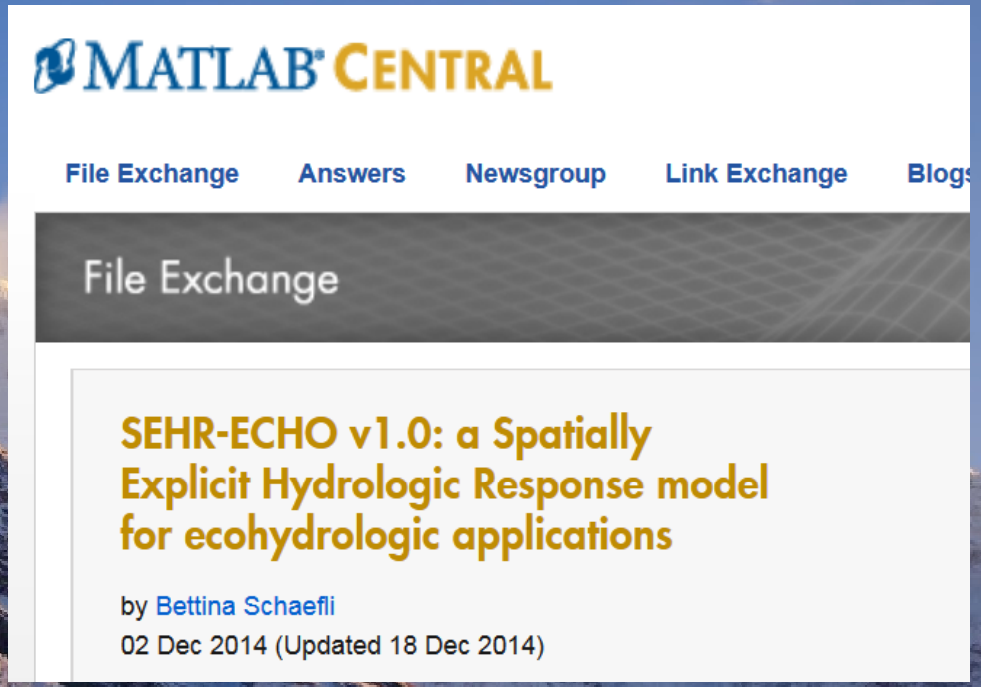
Direct parameter transfer from Dischma to Ova de Cluozza

(similar size & glacier cover, different valley)

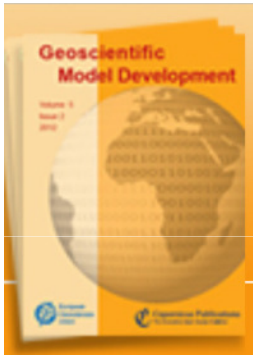


Code

- **Matlab code**
  - Stream network extracted with Taudem
  - Available modules: interception, PET, snow/glacier melt, soil water mobilization, routing
  - Complete test case
  - Not available: precipitation interpolation



- **Paper: Schaefli et al., 2014**



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