

Coordination Meeting Hydro - CH2018

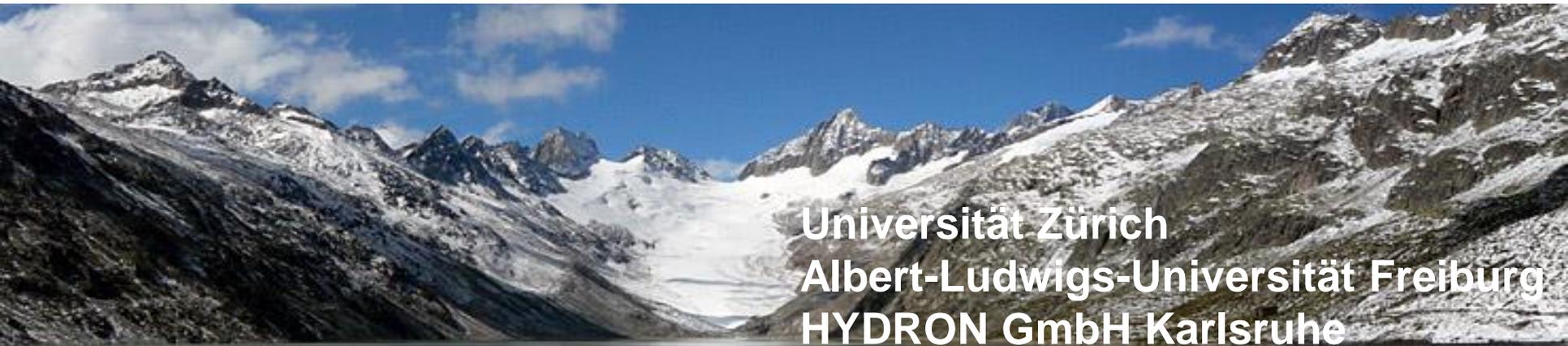
**Contributions of snow and ice to streamflow in  
~~the River Rhine~~ during the ~~past~~ century**

**Switzerland**

**coming**

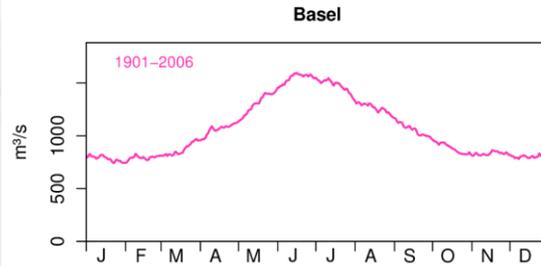
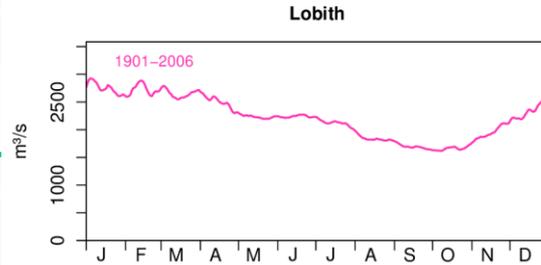
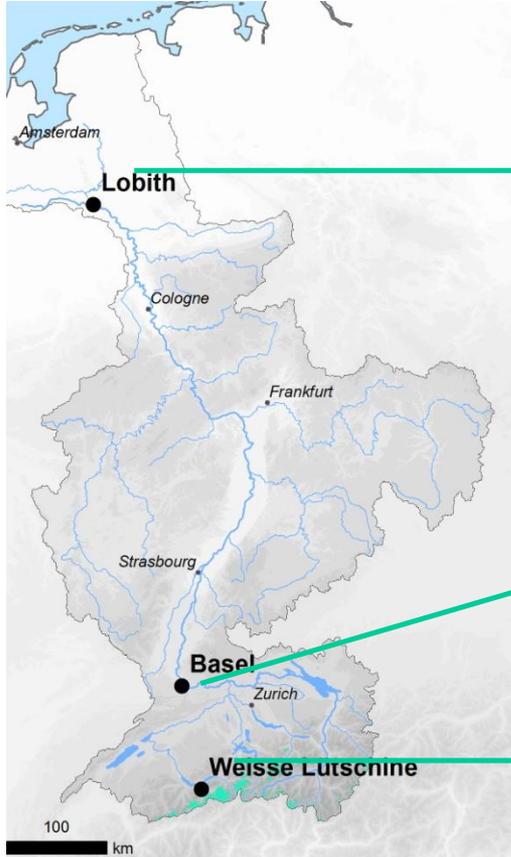
**Jan Seibert**

**Kerstin Stahl, Markus Weiler, Irene Kohn, Daphné Freudiger,  
Marc Vis, Mario Böhm, Kai Gerlinger**

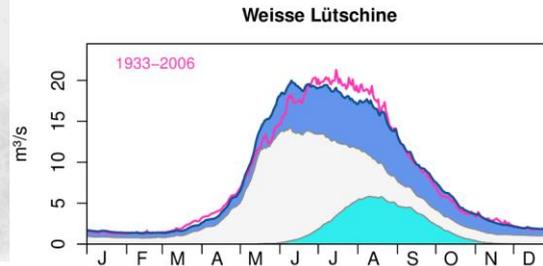
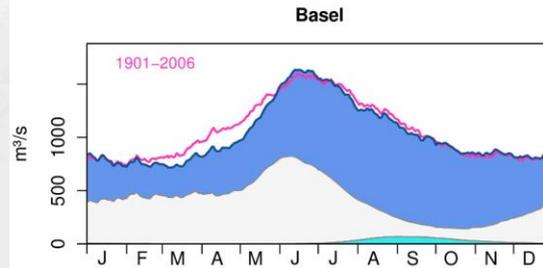
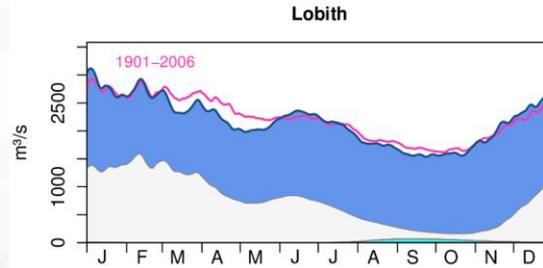
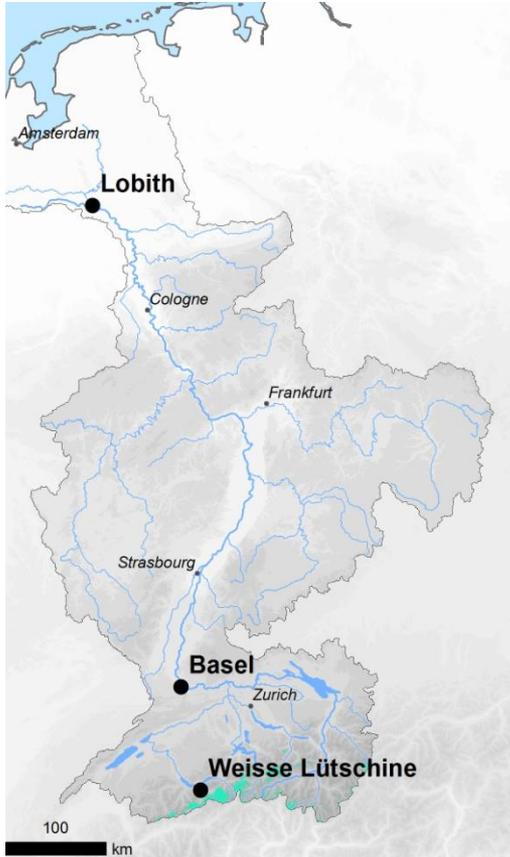


**Universität Zürich  
Albert-Ludwigs-Universität Freiburg  
HYDRON GmbH Karlsruhe**

# Will the Rhine go dry without glaciers?



# Questions about streamflow components



◆ How large are the glacier and snow melt components during summer low flow?

$Q_R$  rain component  
 $Q_S$  snowmelt component  
 $Q_I$  icemelt component

# A century of daily runoff components



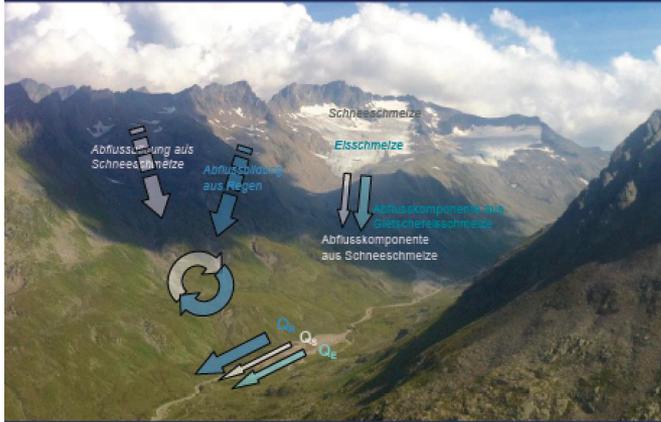
Internationale Kommission für die Hydrologie des Rheingebietes

International Commission for the Hydrology of the Rhine Basin

**Abflussanteile aus Schnee- und Gletscherschmelze im Rhein und seinen Zuflüssen vor dem Hintergrund des Klimawandels**

Synthesebericht

Kerstin Stahl, Markus Weiler, Irene Kohn, Daphné Freudiger, Jan Seibert, Marc Vis, Kai Gerlinger, Mario Böhm



Bericht Nr. I-25 der KHR

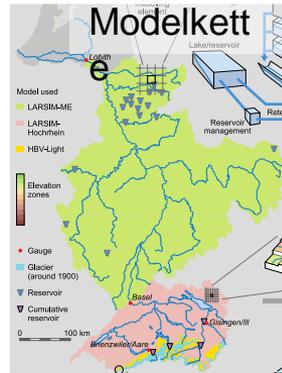
1900

HYRAS-REC (P, T, R)

1951

HYRAS (DWD/BfG) (P, T, R)

2006



LARSIM-ME: from Basel

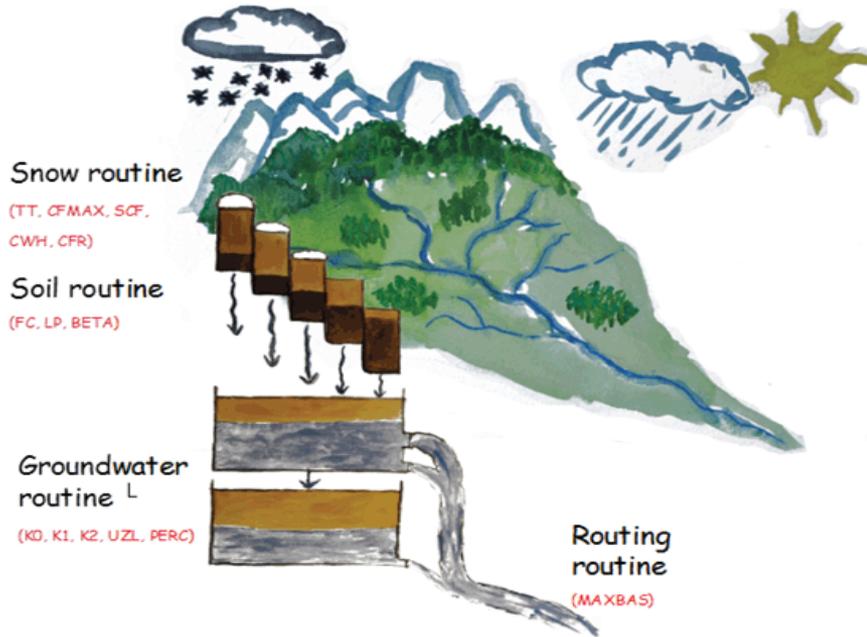
LARSIM-Hochrhein: until Basel

HBV-light: Glaciers & headwaters

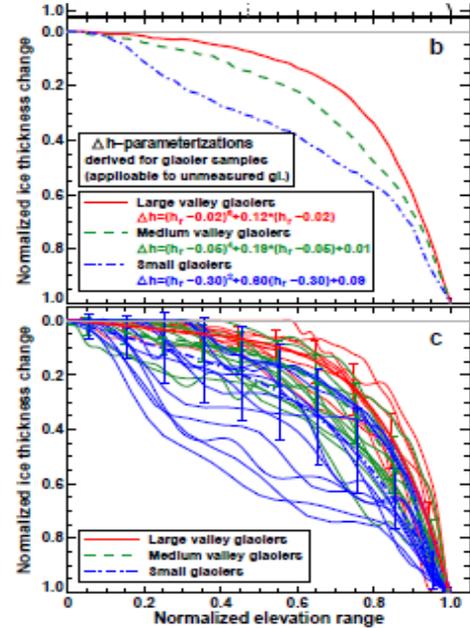
Daily simulations of runoff components  $Q_R$ ,  $Q_S$ ,  $Q_E$

- Runoff: NSE, Vol., saisonal
- Snow: SCA, SWE - 1km Raster 1971-2006
- Glacier: Volume at 4 points in time

# New glacier routine in HBV light



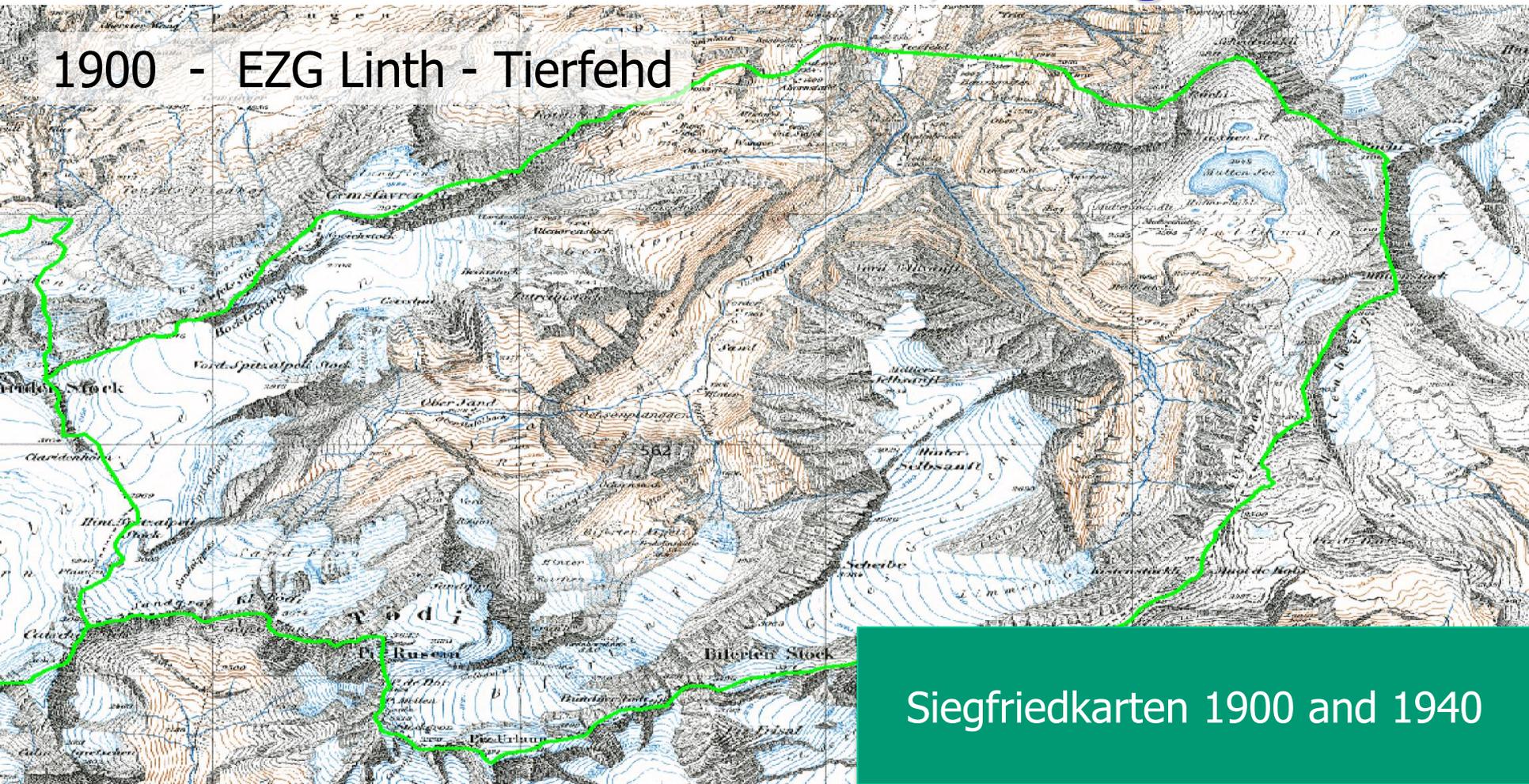
Seibert et al., 2017, HESS-D,  
in review



Huss, M., Juvet, G., Farinotti, D., Bauder, A., 2010. Future high-mountain hydrology: a new parameterization of glacier retreat. Hydrol. Earth Syst. Sci. 14, 815–829.

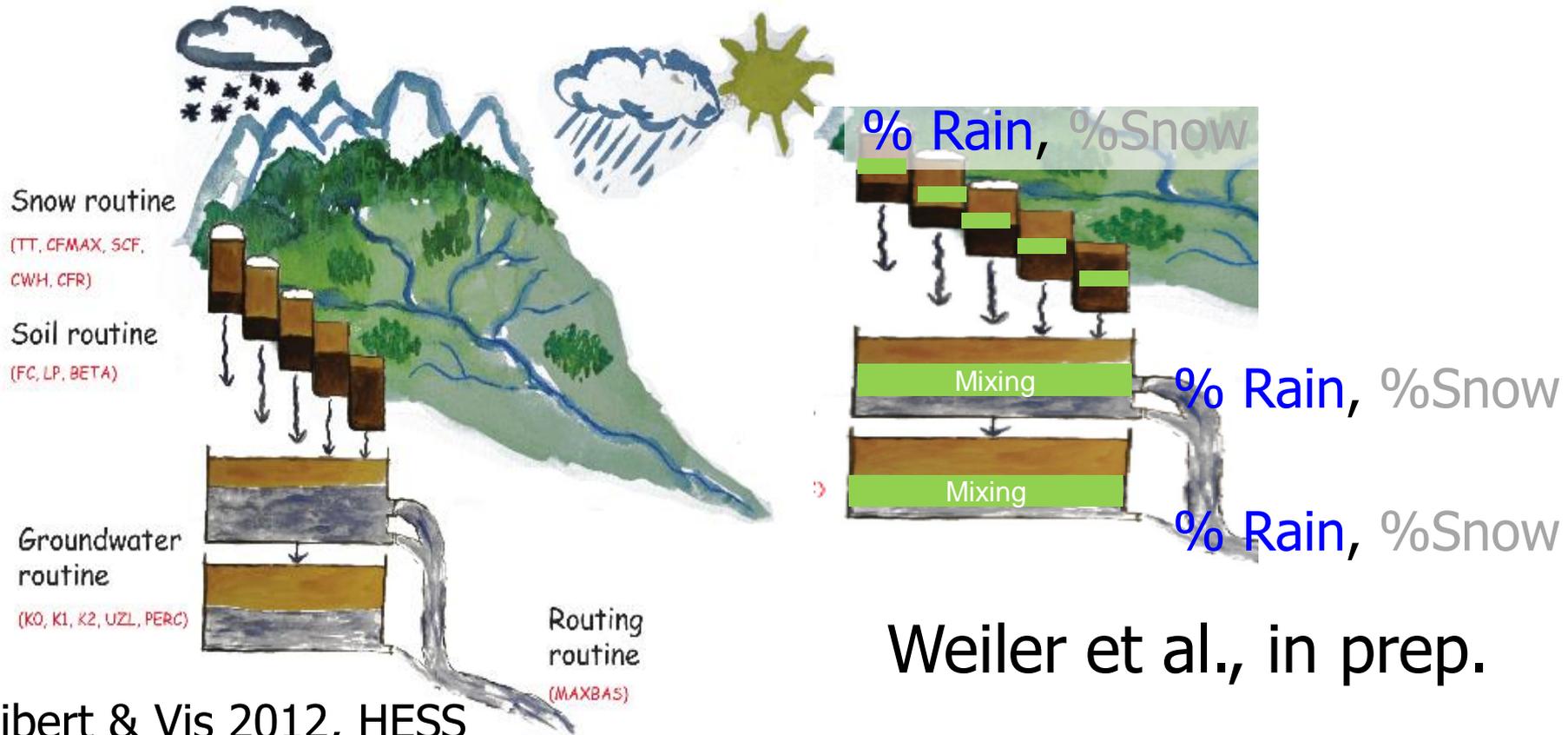
# Glacier extend at 1900 and 1940, new digitalization

1900 - EZG Linth - Tierfehd



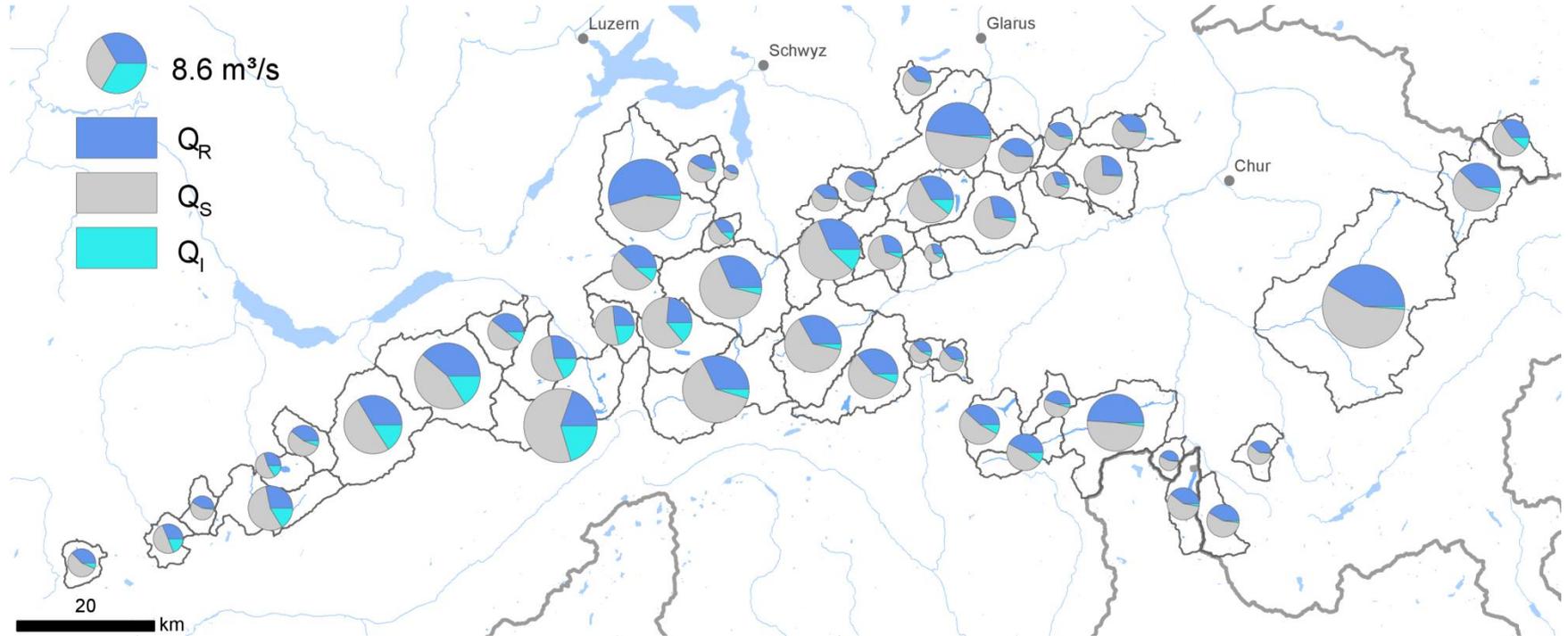
Siegfriedkarten 1900 and 1940

# Tracing simulated runoff components

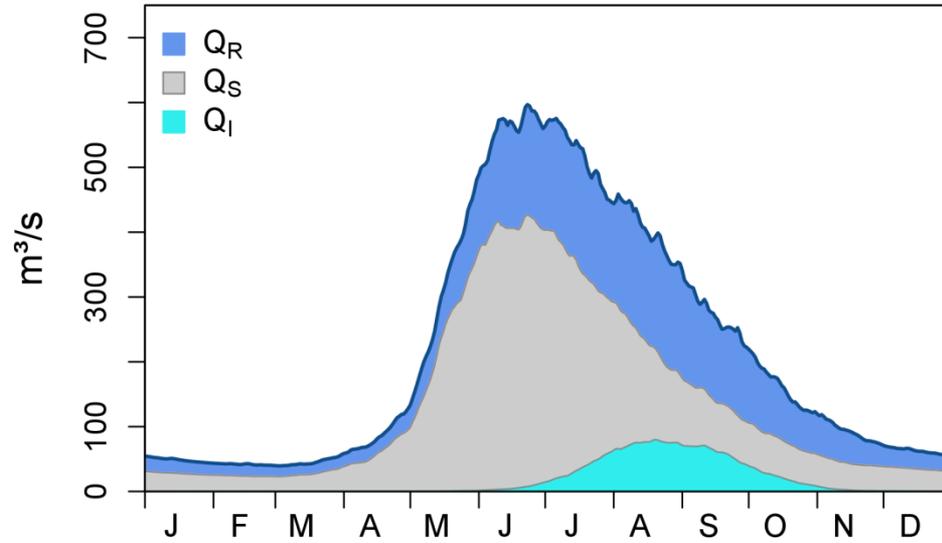


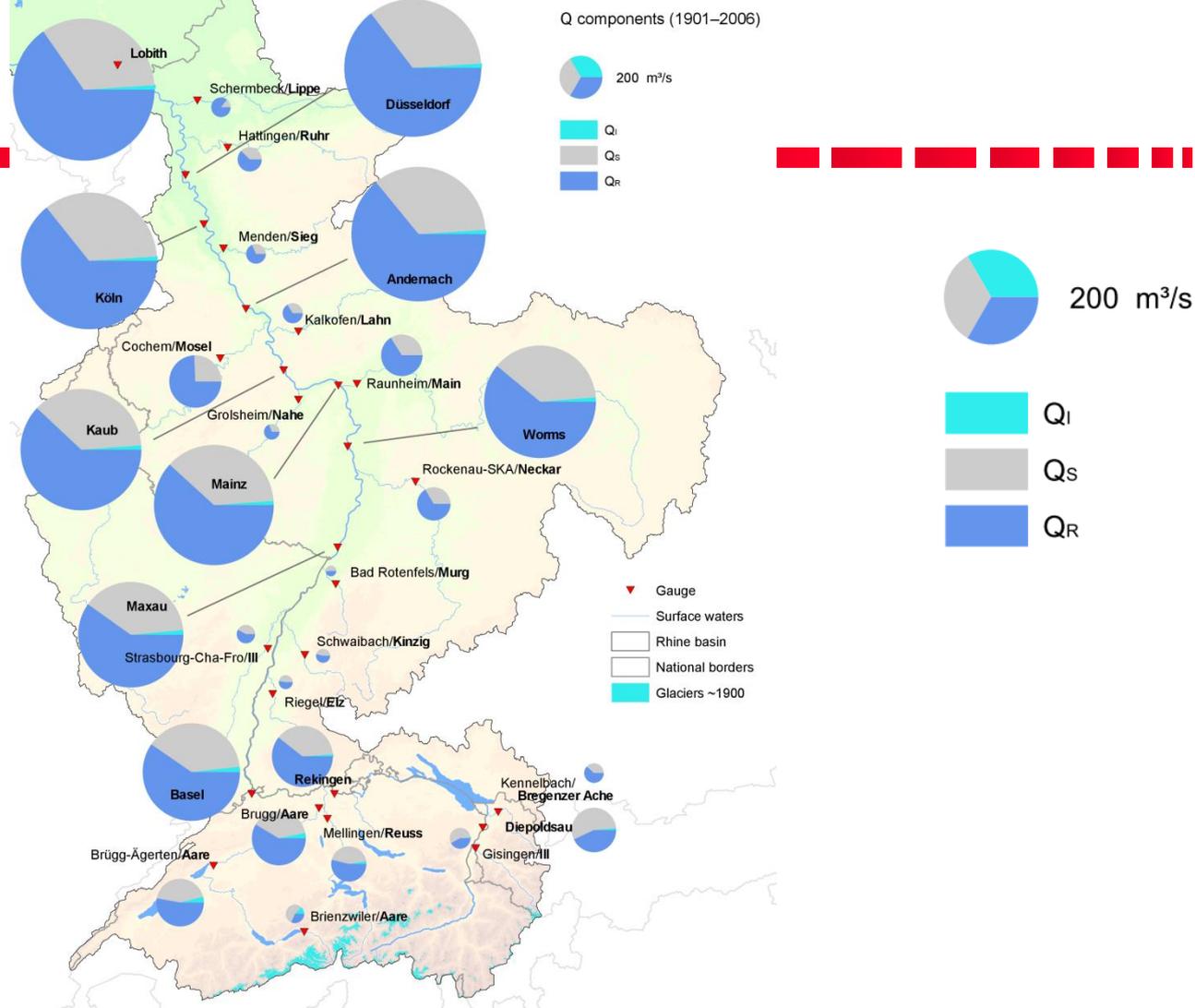
Weiler et al., in prep.

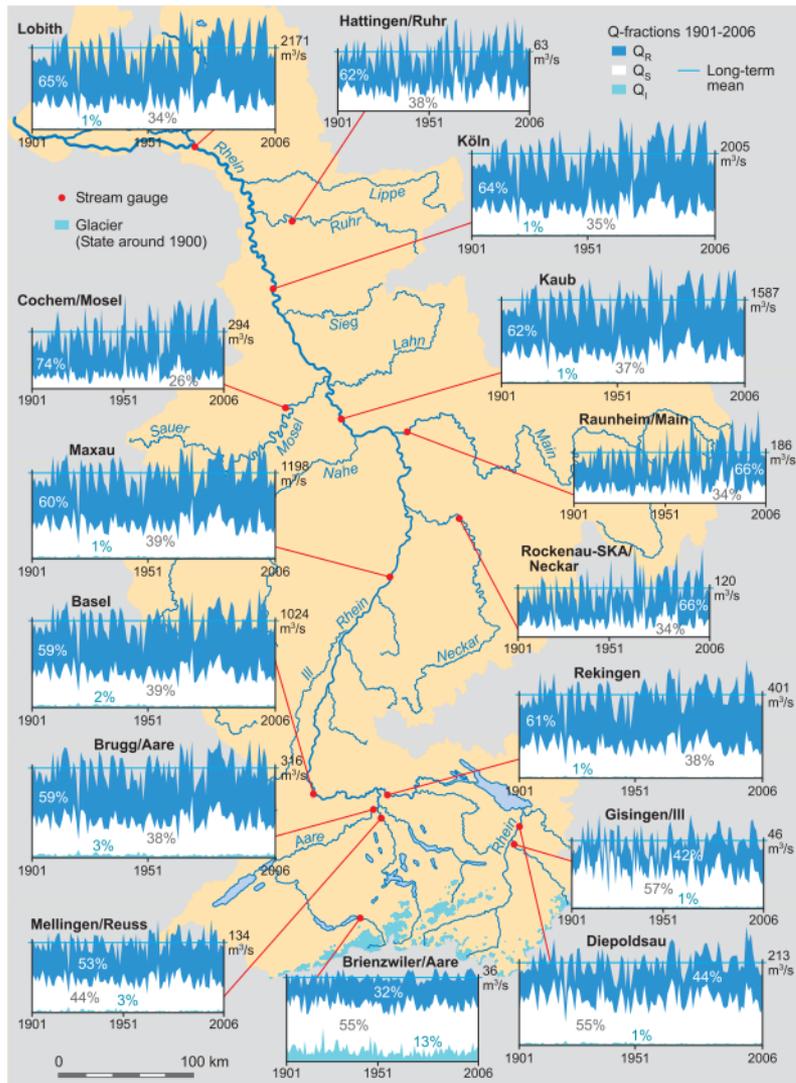
# Runoff components 1900-2006



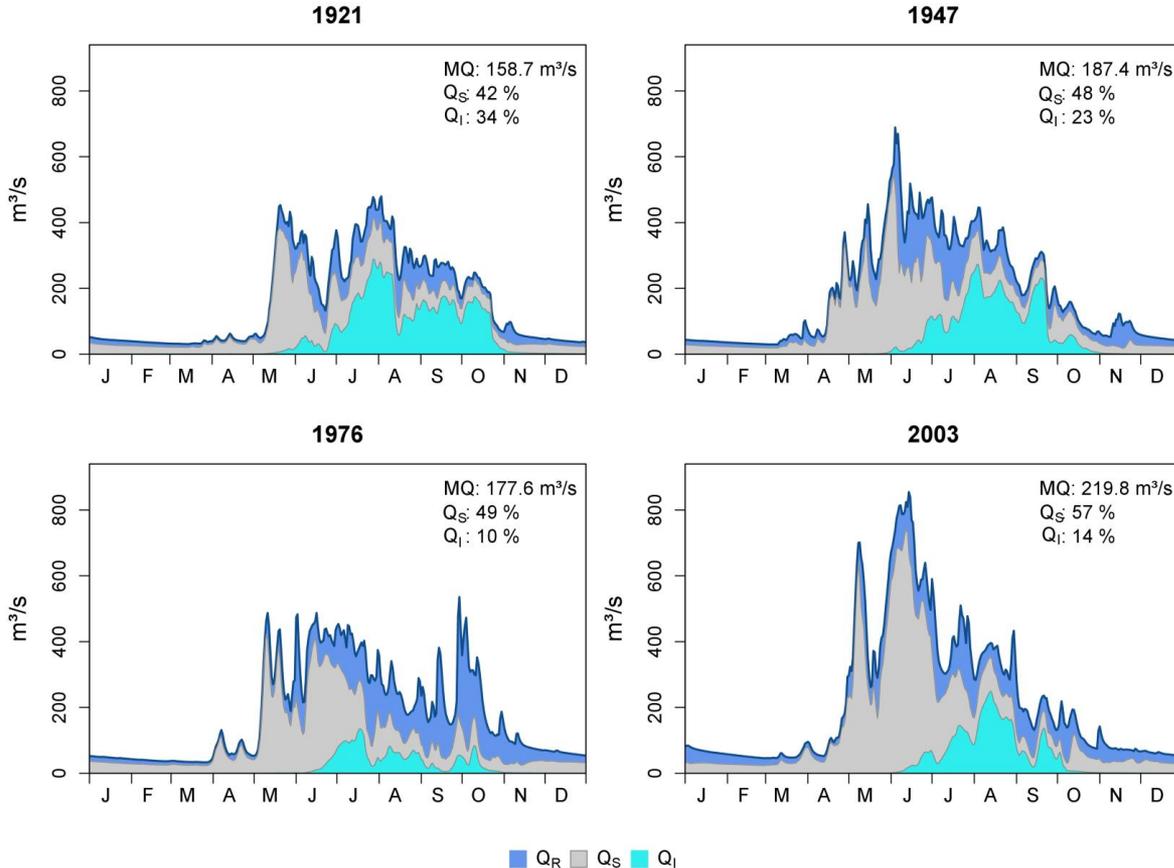
# Runoff from the glaciated headwater catchments



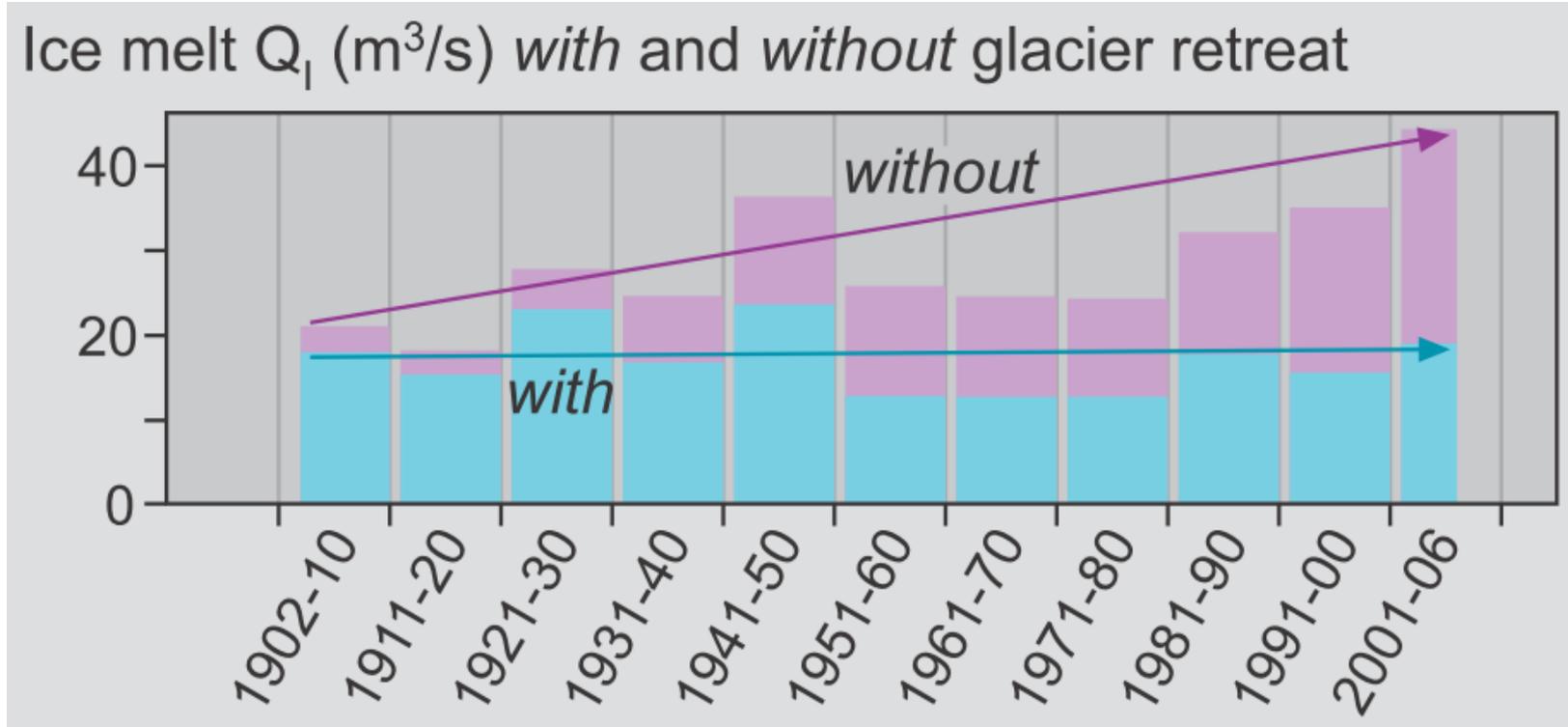




# Selected years



# Effect of changing glacier area



Runoff from the glaciated headwater catchments

# ASG2 - Runoff components in CH2018

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- ❖ Extension from Rhine to Switzerland
- ❖ MeteoSwiss instead of HYRAS
- ❖ Future scenarios

