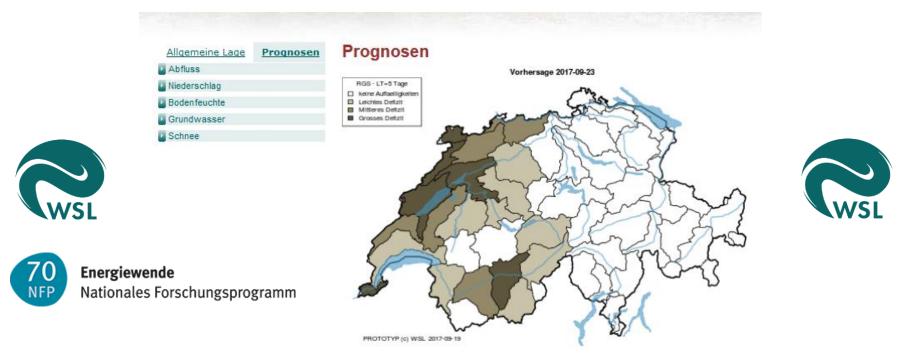
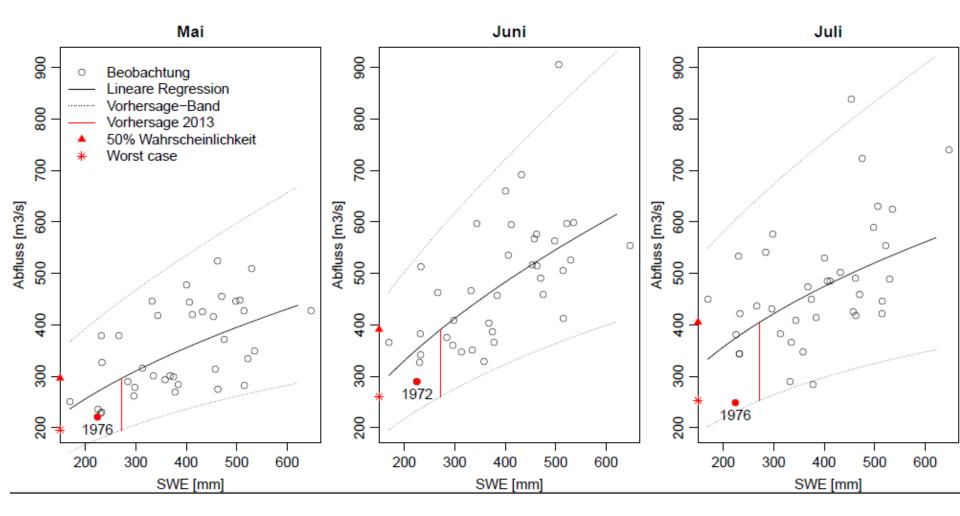
## SOME CURRENT CHALLENGES IN SETTING UP AND OPERATING SUB-SEASONAL TO SEASONAL PREDICTIONS OF LOW FLOWS IN SWITZERLAND



#### M. ZAPPA, S. MONHART, K. BOGNER et al.

Swiss Federal Research Institute WSL.- massimiliano.zappa@wsl.ch

#### REMEMBERING VIKTORSBERG: DATA DRIVEN APPROACHES USING MID-APRIL SWE FOR THE RHINE BASIN UP TO NEUHAUSEN



Jörg-Hess et al., The Cryosphere, 2015

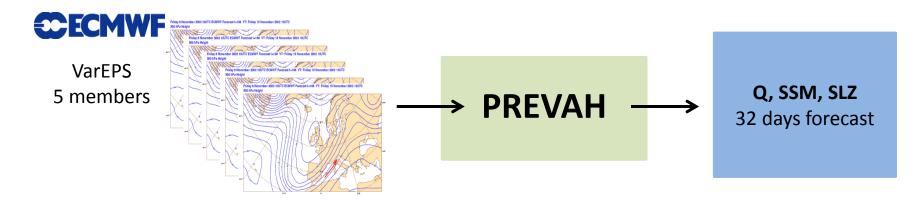
#### SUMMARY VIKTORSBERG

- Challenging conditions in high mountains and small basins
- Low-flow predictions initialized with numerical weather predictions provide skilful forecasts
- The import of SWE observations at initialisation
  - improves the predicted runoff volume
  - improves SWE prediction for lead times up to ~ 20 days
- Good initial conditions help a lot (for low-flows)

## **Current challenges (not specific to low-flow)**

- Operational deployment of monthly forecasts
- Dealing with systematic errors of meteorological and hydrological forecasts
- Dealing with hydrological predictions adopting preprocessing and post-processing tools
- Extension of forecasts beyond day 32
- Identification of strategies for warnings

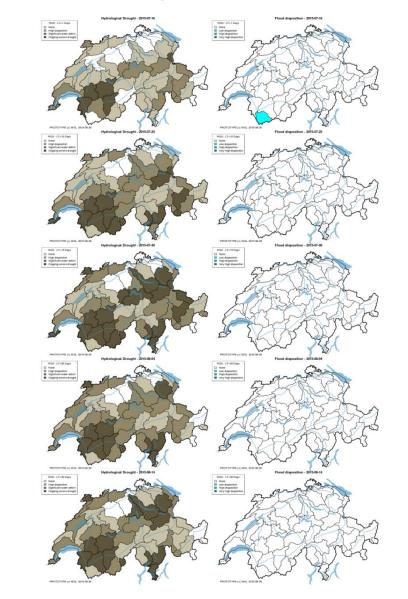
#### USING HEPS FOR MONTHLY ENSEMBLE LOW-FLOW PREDICTIONS SINCE 2015



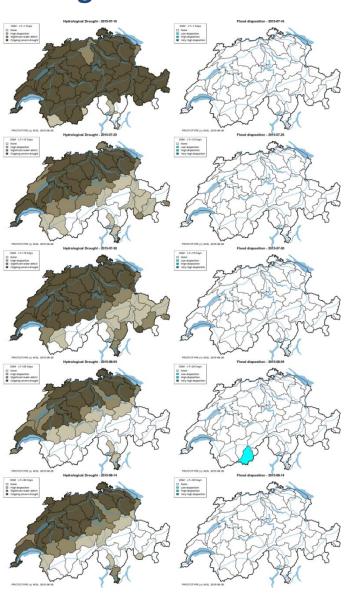
- Quasi operational since April 2015
- Assessment of deviation from climatology
- FOEN Basins (Aggregation to 1000 km2 set)
- Verification against reference run with observed meteorology
- Can be run 5 weeks after day 1



# Forecast on July 16th 2015Runoff anomaliesSoil moisture anomaliesDrought & FloodDrought & Flood



LT



#### Bogner et al., WARM, submitted

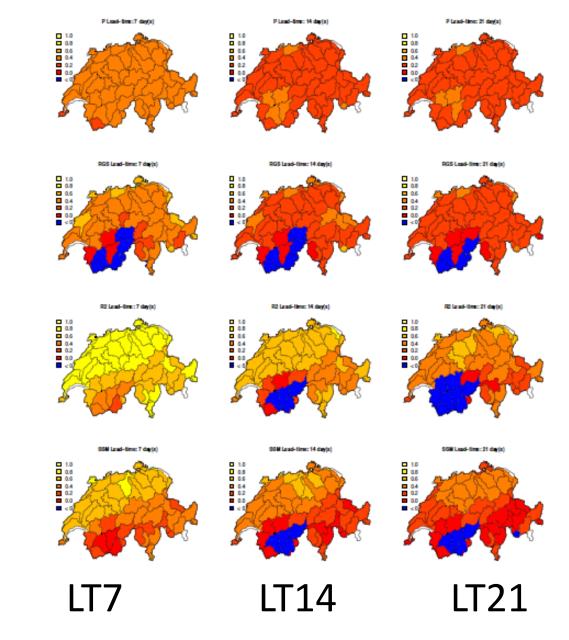
#### Monthly reforecasts 2012-2016

Precipitation

Discharge

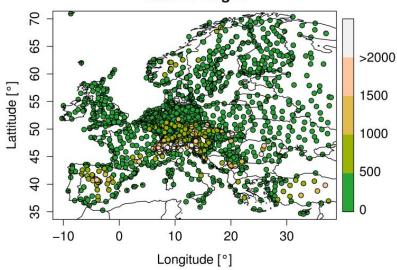
Low-flow

#### Soil moisture



### Dealing with uncertain meteorological forecasts Bias correction

- ECMWF IFS cycle 40r1 (November 13 May 2015):
  - No updates during analysis period (May 2014 March 2015)
  - 20 years of re-forecasts with 5 members
    (hindcasts, 1994-2014)
  - Observational data (1637 sites):
    - European Climate Assessment and Dataset project (ECA&D)<sup>1</sup>
    - Global Summary of Day (GSOD)<sup>2</sup>
    - Swiss national observing system (SwissMetNet)<sup>3</sup>



station height

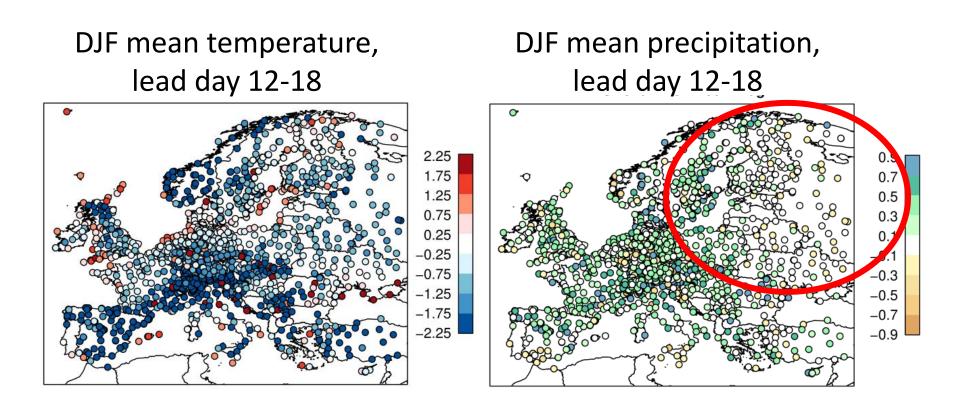
<sup>1</sup>www.ecad.eu, Klein Tank, et al., 2002. Daily dataset of 20<sup>th</sup>-century surface air temperature,. *International Journal of Climatology*, 1453, pp.1441–1453.

<sup>2</sup>https://data.noaa.gov/dataset/global-surface-summary-of-the-day-gsod

<sup>3</sup> http://www.meteoschweiz.admin.ch/home/mess-und-

prognosesysteme/bodenstationen/automatisches-messnetz.html

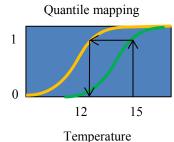
### Dealing with uncertain meteorological forecasts Bias of the direct model output

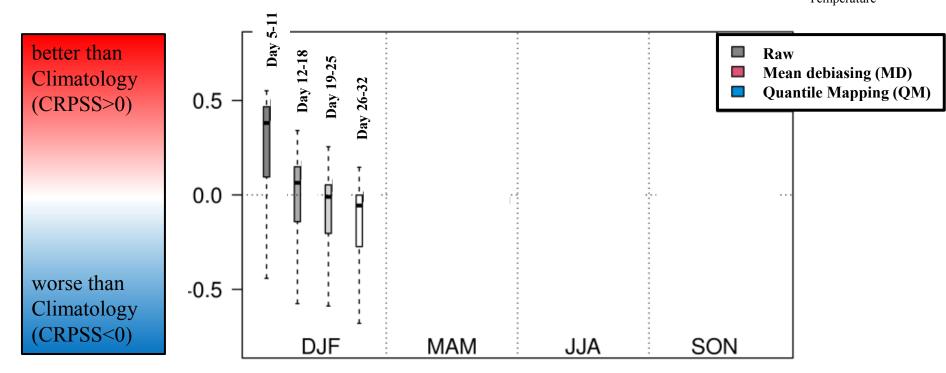


Monhart et al., JGR-atm, to be submitted

## Dealing with uncertain meteorological forecasts Bias correction

- Bias correction methods for **daily corrections**:
  - Mean debiasing (MD)
  - Quantile mapping (QM)

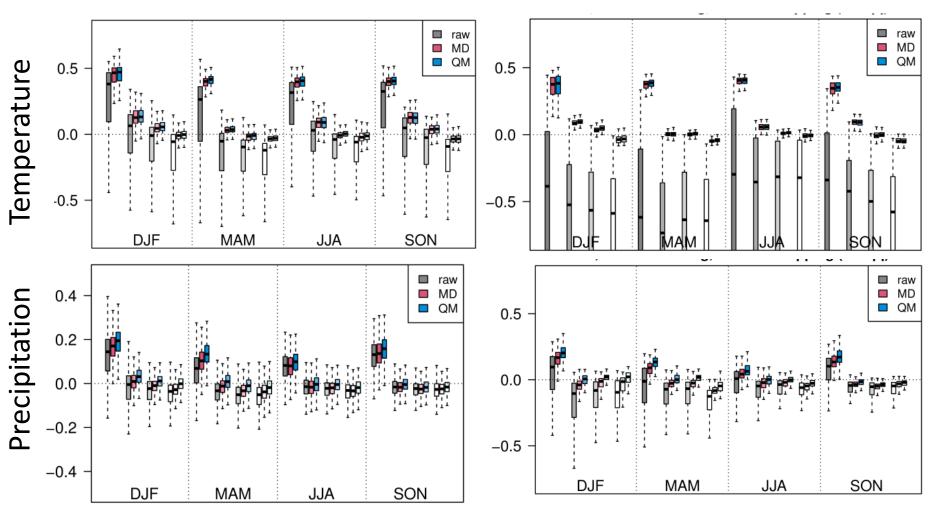




#### **Comparison all stations vs. alpine only**

All stations

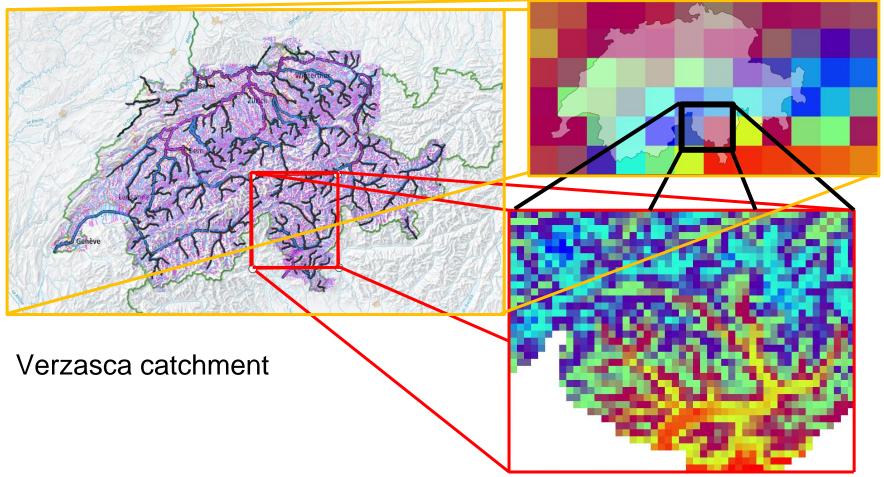
Alpine only



Monhart et al., JGR-atm, to be submitted

## PREVAH forced with post-processed meteorological forecasts

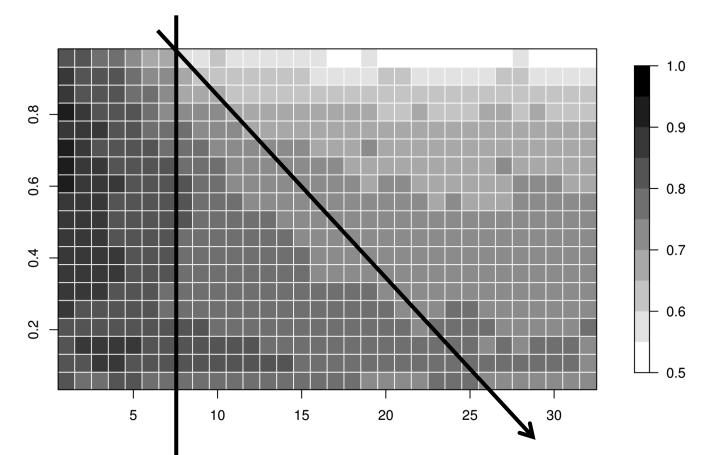
• Post-processing based on MCH 2km gridded observations



Monhart et al., in preparation

## PREVAH forced with post-processed meteorological forecasts

2-alternative forced choice Score (2AFC)

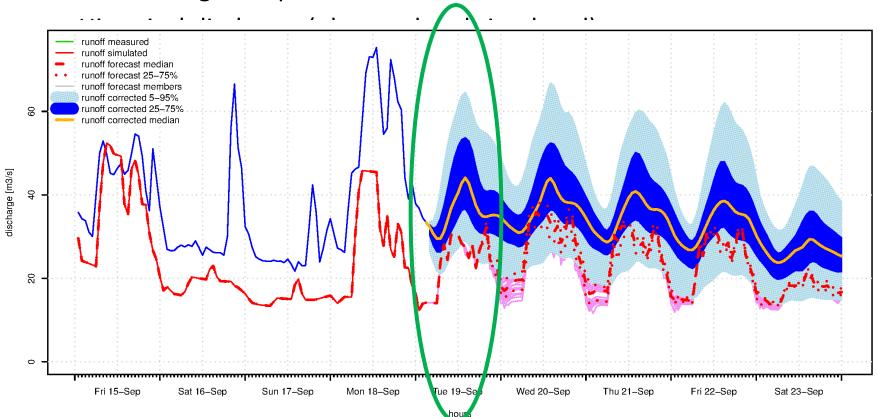


Monhart et al., in preparation

#### **Hydrological Post-processing**

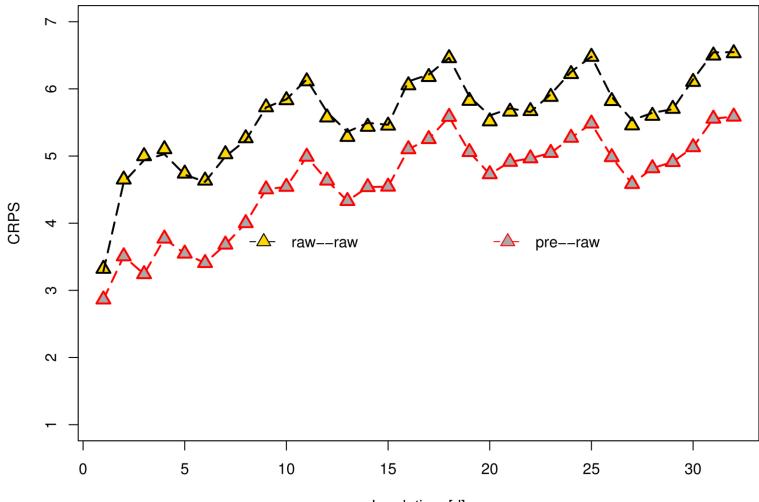
#### Data

Streamflow forecasts based on the raw and pre-processed meteorological input



#### **Pre- and Post-processing**

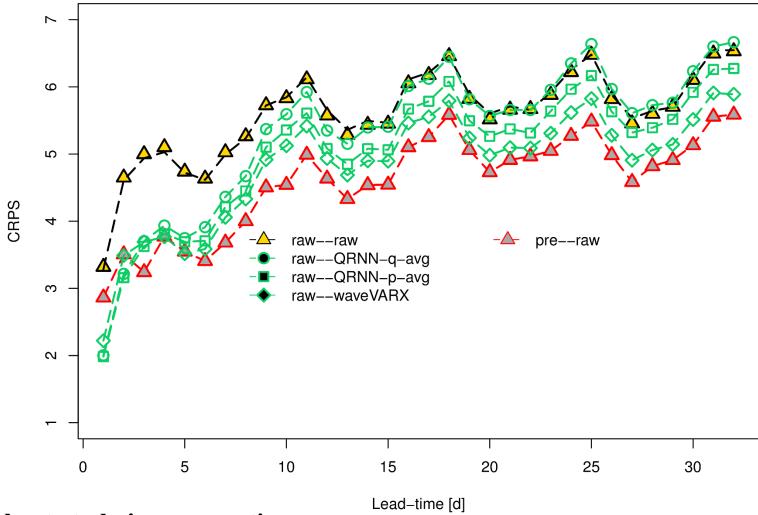
#### Comparison of the effect from pre-and post-processing



Lead-time [d]

#### **Pre- and Post-processing**

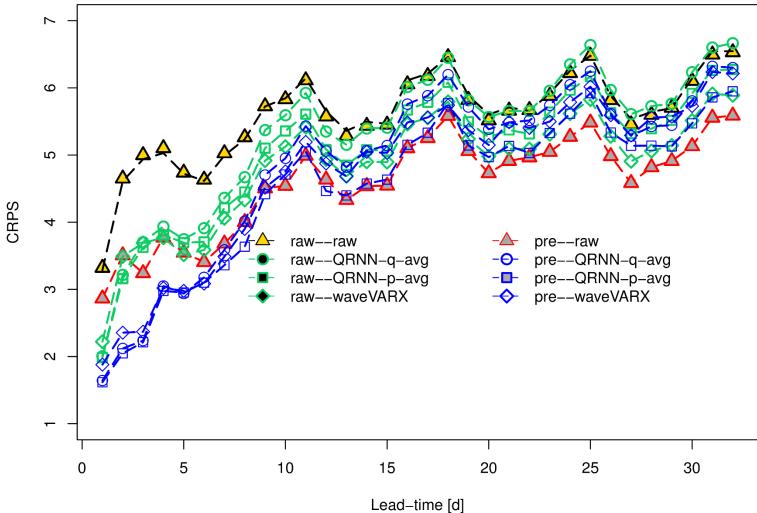
#### Comparison of the effect from pre-and post-processing



Monhart et al., in preparation

#### **Pre- and Post-processing**

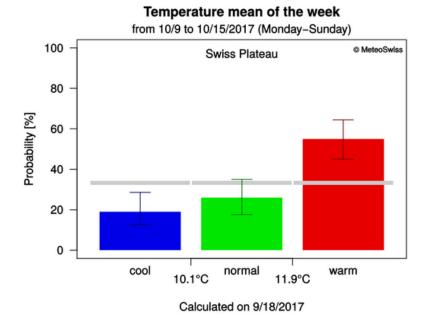
#### Comparison of the effect from pre-and post-processing

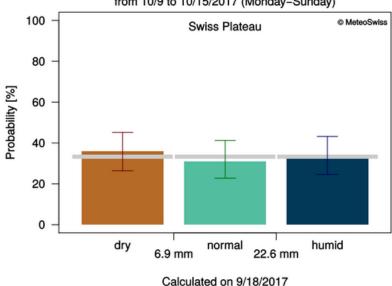


Monhart et al., in preparation

#### Beyond day 32, MeteoSwiss monthly outlook







#### Precipitation sum of the week

from 10/9 to 10/15/2017 (Monday-Sunday)

## It is an hard way ahead!

#### Should seasonal rainfall forecasts be used for flood preparedness?

Erin Coughlan de Perez<sup>1,3,4</sup>, Elisabeth Stephens<sup>2</sup>, Konstantinos Bischiniotis<sup>3</sup>, Maarten van Aalst<sup>1,4</sup>, Bart van den Hurk<sup>5</sup>, Simon Mason<sup>4</sup>, Hannah Nissan<sup>4</sup>, and Florian Pappenberger<sup>6</sup> <sup>1</sup>Red Cross Red Crescent Climate Centre, The Hague, 2521 CV, the Netherlands <sup>2</sup>School of Archaeology, Geography and Environmental Science, University of Reading, Reading, RG6 6AH, UK <sup>3</sup>Institute for Environmental Studies, VU University Amsterdam, 1081 HV, the Netherlands <sup>4</sup>International Research Institute for Climate and Society, Columbia University, New York, 10964, USA <sup>5</sup>Royal Netherlands Meteorological Institute (KNMI), De Bilt, 3731 GA, the Netherlands <sup>6</sup>European Centre for Medium-Range Weather Forecasts, Reading, RG2 9AX, UK

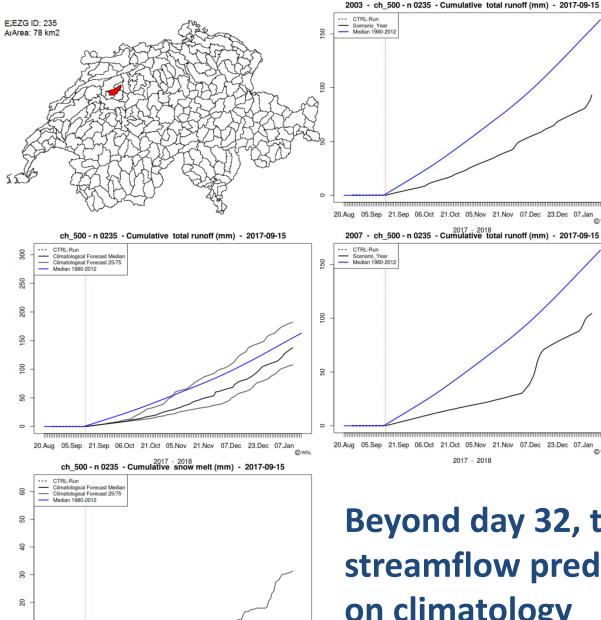
> Received: 24 Jan 2017 – Discussion started: 10 Feb 2017 Reviead: 14 Jul 2017 - Accented: 20 Jul 2017 - Published: 11 Sep 2017

Abstract. In light o seasonal rainfall fo of flooding at the s reanalysis rainfall i some regions of w highest correlation Floodiness in wette intensity of season across the continer flooding." preparedness and

'... even a perfect tercile forecast of seasonal total rainfall would would provide little provide little to no indication of regions in southerr the seasonal likelihood of

question whether e primary indicators input bias-corrected ionstrate that in asonal total rainfall ason shows the odiness in arid easonal total rainfall. neasures of the sonal floodiness ation for flood

Citation: Coughlan de Perez, E., Stephens, E., Bischiniotis, K., van Aalst, M., van den Hurk, B., Mason, S., Nissan, H., and Pappenberger, F.: Should seasonal rainfall forecasts be used for flood preparedness?, Hydrol. Earth Syst. Sci., 21, 4517-4524, https://doi.org/10.5194 /hess-21-4517-2017, 2017.



. © WSL

## Beyond day 32, the ensemble streamflow predictions (ESP) based on climatology **Operational for <u>www.drought.ch</u> since April 2017**

Ows

© WSL

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#### State of the art!



**Identification of strategies** for warnings

NZZ: 2. January 2017

Tricky: (seamless) combination of past information and extended range forecasts

Flood: Event is ahead

**Drought/Low-Flow:** event is ongoing



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#### **Bund warnt neu auch** vor Trockenheit

Wissenschafter wollen extreme Trockenphasen früher vorhersagen

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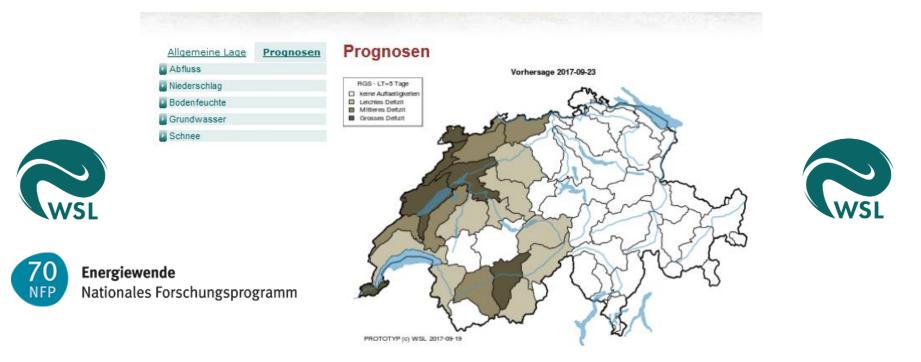
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#### SUMMARY RELOADED

- Challenging conditions in high mountains and small basins -> Pre- and Post-processing HEPS helps
- Low-flow predictions initialized with numerical weather predictions provide skilful forecasts - > confirmed
- Going beyond day 32 is close to gambling. "What if ...? scenarios might be more useful for early awareness"
- Operational deployment of low-flow & drought monitoring system ongoing. Some new thinking needed to define levels of alert.

## SOME CURRENT CHALLENGES IN SETTING UP AND OPERATING SUB-SEASONAL TO SEASONAL PREDICTIONS OF LOW FLOWS IN SWITZERLAND



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#### TOWARDS MONTHLY AND SEASONAL FORECASTS OF WATER RESOURCES IN SWITZERLAND





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