The 2018 drought in BW from a drought hazard perspective

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Introduction

- Drought, defined as below normal water availability, is a complex natural hazard that can occur in many regions of the world and can manifest itself in every domain of the hydrological cycle.
- The drought that developed over the summer of 2018 provides an important test case for the DRIeR projects aims to visualize, analyse and explain the natural hazard and its impacts

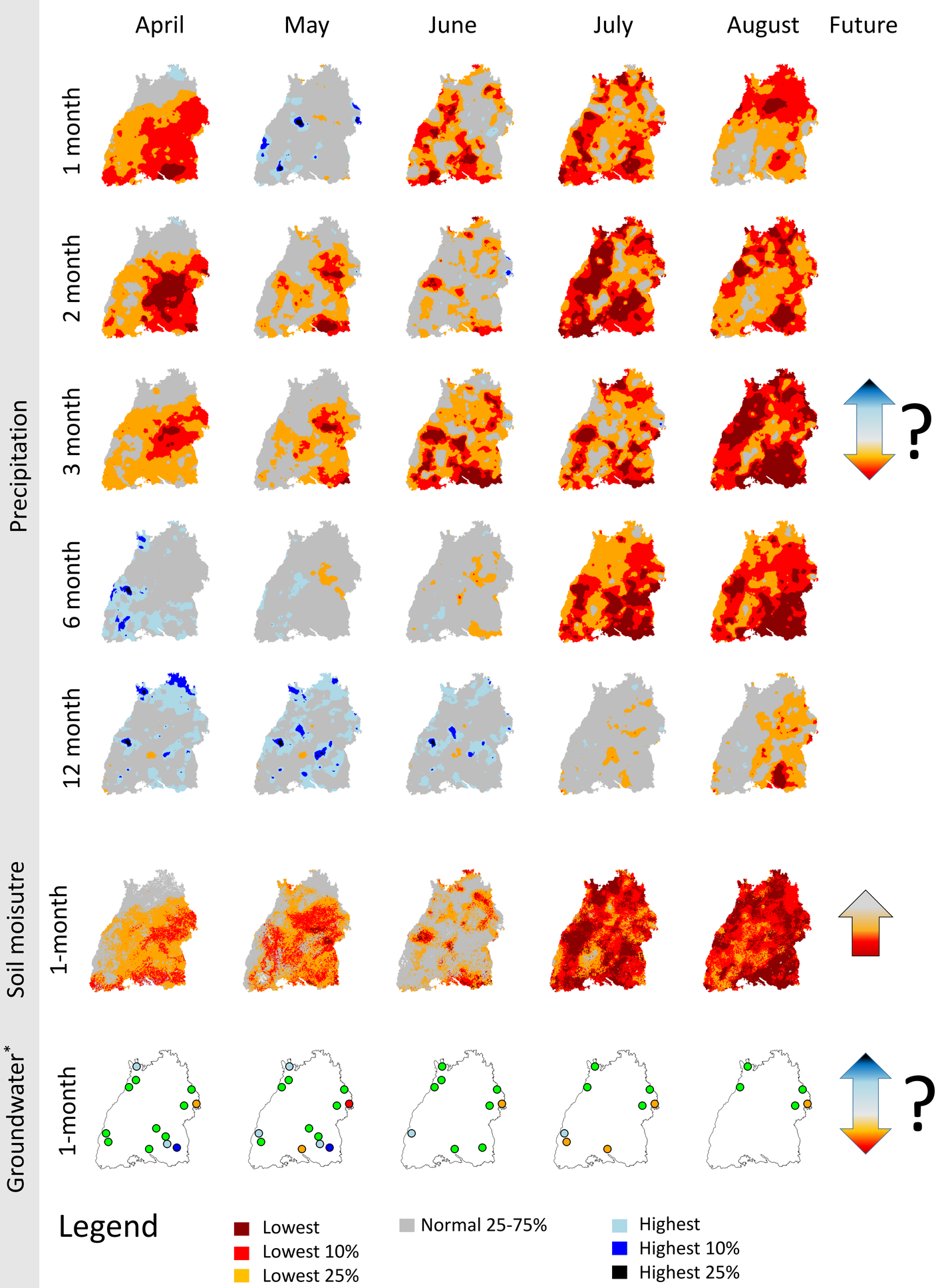
- **This study aims to:**
  1. Analyze and describe the **temporal development and propagation of drought** through the hydrological cycle.
  2. To give **a preliminary assessment of the severity** compared to previous events - preliminary because the drought is not yet over in some part of the hydrological cycle.
  3. Test different ways of **communicating** the drought hazard.

Data and methods

- Meteorological variables from the DWD (precipitation, temperature, relative humidity, windspeed and radiation) were interpolated over BW to 1km resolution grids using the INTERMED software. Additionally, DWD REGNIE and groundwater data were sourced from resp. the DWD and LUBW website.
- The interpolated meteorological variables were used as forcing for the TRAIN model to compute rootzone soil moisture over the whole of BW.
- Precipitation (accumulated over different periods), modeled soil moisture and groundwater levels of the most recent 30 years (1989-2018) were transformed to anomaly timeseries (percentiles).
- Alternatively, Standardized Drought indices could have been used: See interactive screen: how to communicate (the 2018) drought.

Development of the 2018 drought

Percentile maps



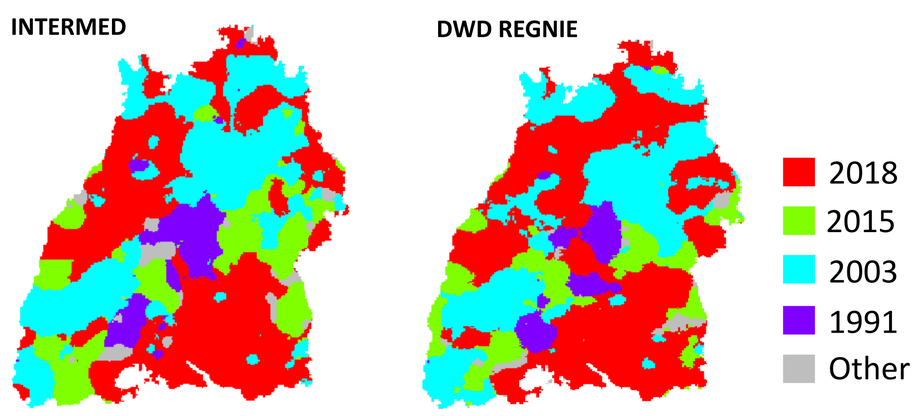
- **Precipitation** in the winter (year) preceding April 2018 was normal to relatively wet throughout BW.
- Precipitation in April was below normal, but extended dry conditions were interrupted by (local) rainfall events in the second half of May and beginning of June.
- Intense (flash) drought conditions started from there on, with very low precipitation in the second half of June, July and August.
- The precipitation deficit propagated to anomalously low **soil moisture** contents as early as April. How fast available soil moisture content (%) declined depended on properties of the root zone (see interactive screen).
- **Groundwater levels** declined over the summer, but did not fall (much) below normal conditions (yet) in most regions. The larger groundwater systems are as of yet less sensitive to the more short term precipitation deficits.
- **For the future:** soil moisture very likely to return back to normal conditions (field capacity) towards the end of the year. Uncertain for hydrological conditions → depending on meteorological conditions of the upcoming winter.
- ➢ **The flashy development of the drought of 2018 was comparable to the drought of 2003** (and to a lesser extent to the 2015 drought) but different from the less intense but more long-term droughts in 1976 and the early 90s. More info: see interactive screen.

*A more comprehensive few on the groundwater situation can be found on the LUBW website: https://guq.lubw.baden-wuerttemberg.de/

Which year was driest? → Hard to say

Depends on precipitation variability and interpolation method…

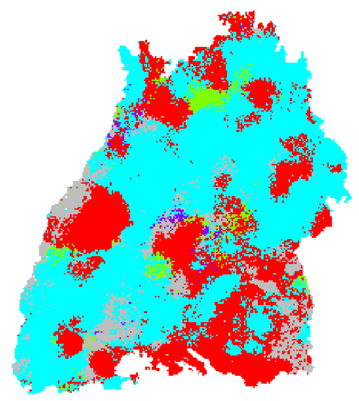
Total precipitation (JJA)



- **Local precipitation variability** plays an important role. One (minor) rainfall event in summer can make a difference.
- **Interpolation method** used in gridded products (slightly) matters.

Soil properties and variability in other meteorological variables…

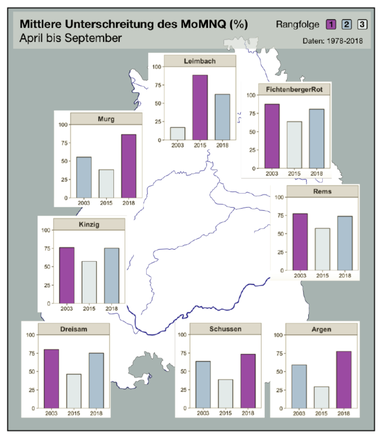
Average Soil moisture (JJA)



- Average modelled summer soil moisture mostly shows a more consistent spatial pattern with mostly 2003 and 2018 as the driest years.
- Reasons include the stronger spatial homogeneity of the dry weather period in 2003 and 2018 and other meteorological conditions that favoured increased evapotranspiration in these years.
- Some regions are less homogeneous, i.e., those with varying root zone soil properties.
- Irrigation is not considered: see poster Kraft & Menzel how this affects soil moisture.

Catchment propperties…

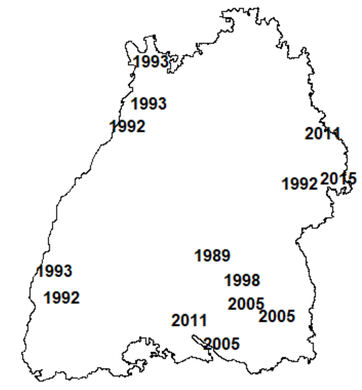
Minimum flow (AMJJAS)



- Figure shows average deviation (%) from the average monthly minimum flow (credit figure: Michael Stölzle).
- 2003 and 2018 were (up to now) often more or less comparable in terms of streamflow drought severity.
- The streamflow drought of 2018 was (up to now) the most severe drought in the South-East and North-West of the region, i.e., those regions with the most persistent dry conditions.
- The streamflow drought situation in 2015 was less severe for most catchments, besides for the Leimbach.

Aquifer properties

Minimum groundwater



- Groundwater shows a completely different picture in timing of minimum groundwater levels.
- Larger groundwater systems are often less responsive and more sensitive to long term multi-year water deficits such as those that occurred in the early nineties.
- BUT: the drought of 2018 is not over yet. GW drought lags behind meteorological and soil moisture drought
- More info on the groundwater droughts in BW? See poster Maurer & Menzel

Conclusion

- This poster shows a preliminary assessment of the drought during the summer of 2018 in Baden-Württemberg from a drought hazard perspective (see Poster by Blauhut et al. for an impact perspective).
- This drought was characterized by intense meteorological drought conditions, resulting in a fast decline in rootzone soil moisture, especially for the shallower rootzones with low water holding capacities.
- Low flow conditions have and still are pronounced throughout the state and need to be further analyzed.
- Groundwater levels are less sensitive to shorter and intense dry conditions as in 2018, and often decline and recover much slower, especially in the larger aquifer systems.
- Consequently, the drought from a hydrological and groundwater perspective is not yet over and a full assessment of the event can only be given after recovery.

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