Climate change or irrigated agriculture – what drives the water level decline of Lake Urmia?

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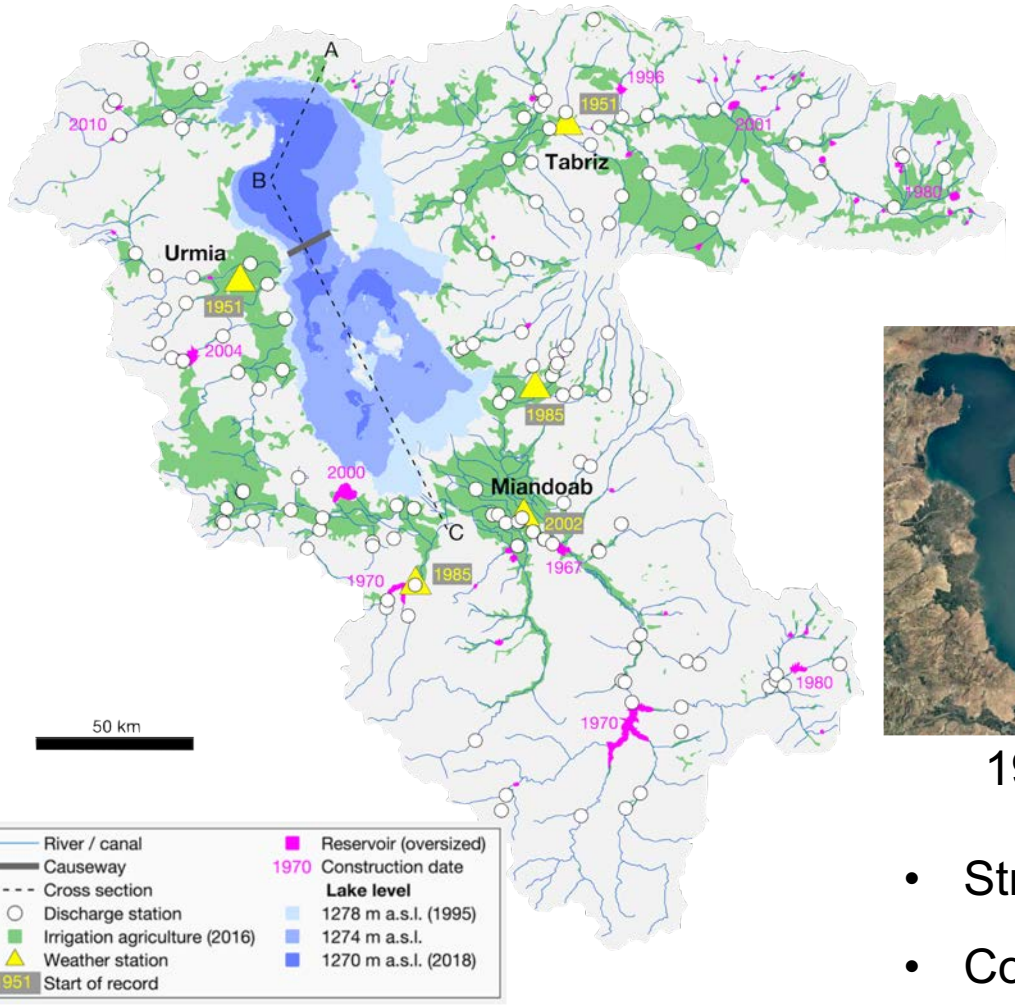
HS2.4.6 – Chat Thu, 07 May, 10:45-12:30
Understanding the links between hydrological variability and internal/natural climate variability

Lake Urmia

- Hypersaline; important ecosystem; area: 5000 km^2
- Intense irrigated agriculture in the catchment



1995 2005 2015

- Strong decline of water level since 1995
- Controversial debate about the reasons

Temporal evolution of the water balance

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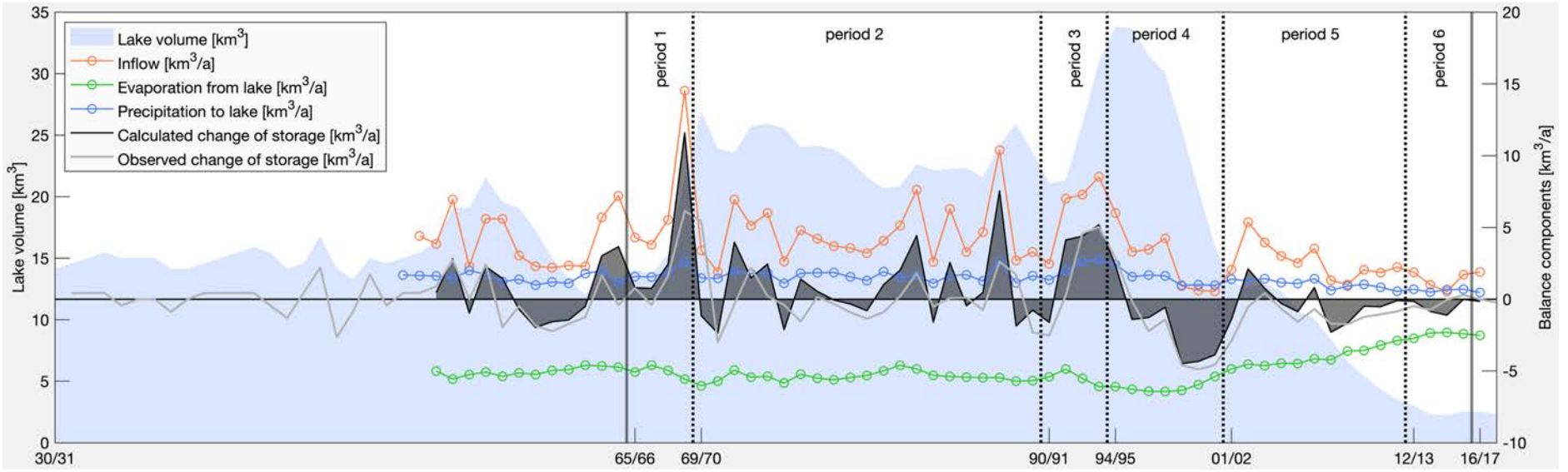
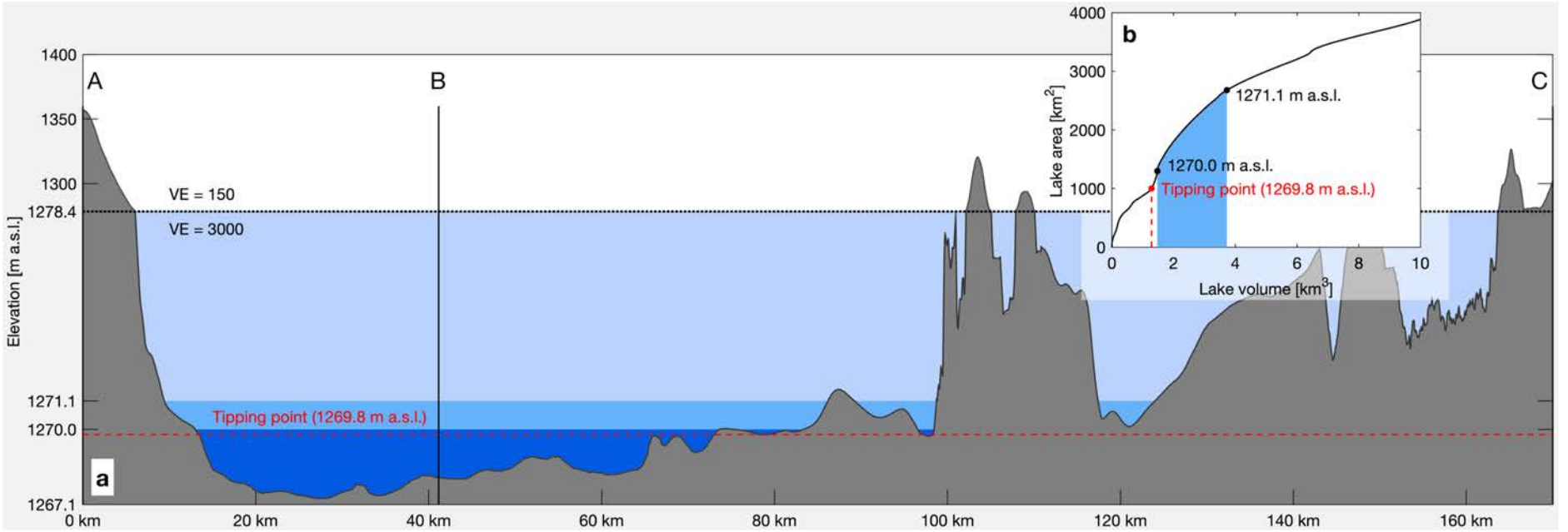


- Strong decline since the mid-1990s
- Despite persistently low inflows, the volume seems to stabilize on a low level
- Endorheic basin → evaporation acts as a buffer

Impact of lake morphology



- Due to the lake's morphology, the area decreases less at a certain point as the volume decreases → evaporation buffer will become less effective
- Fluctuations in recent years were only just above this tipping point

Impact of climate

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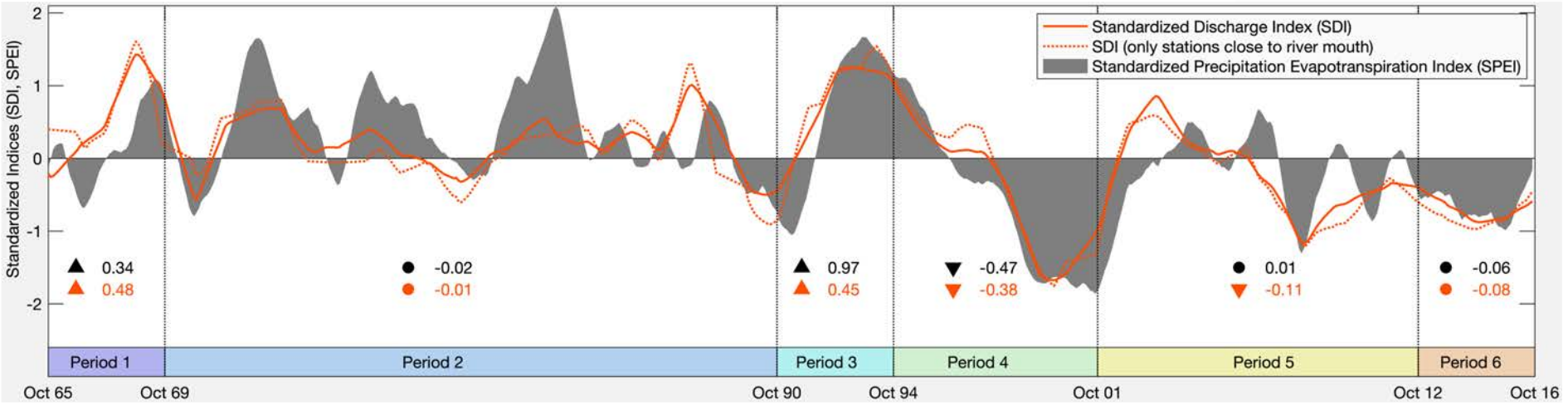
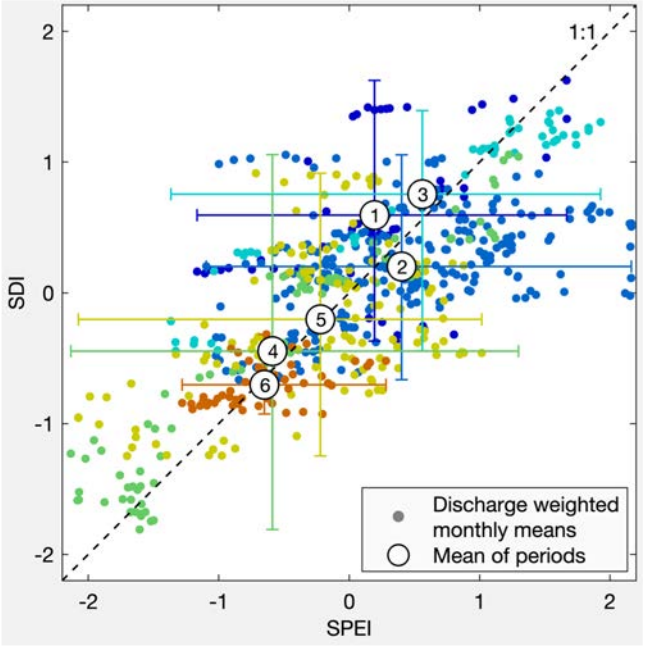
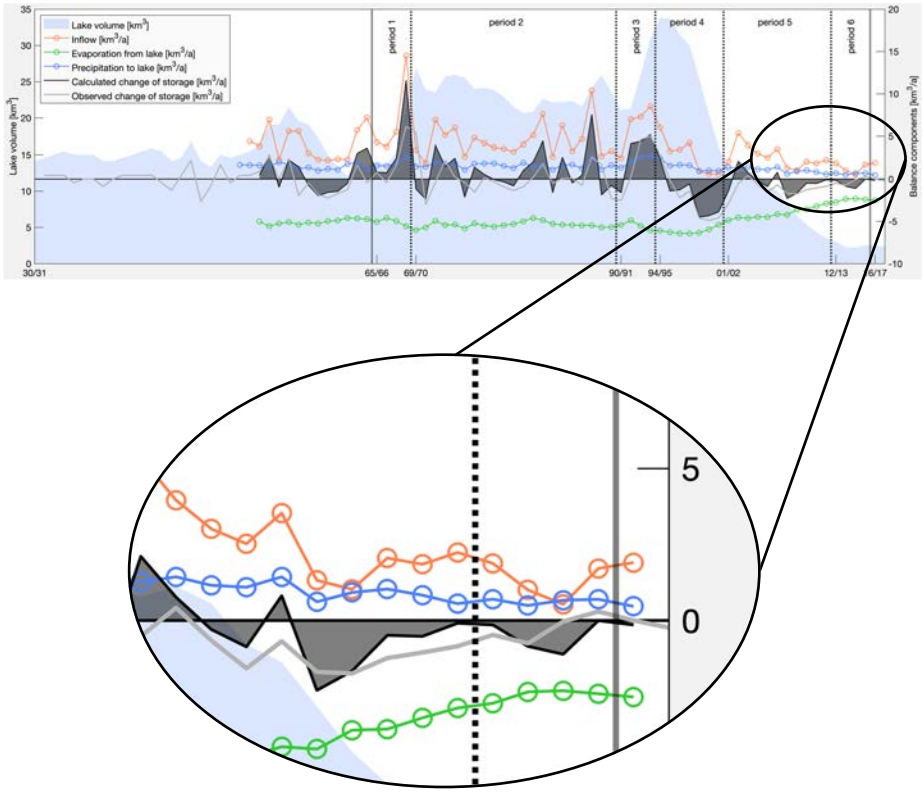
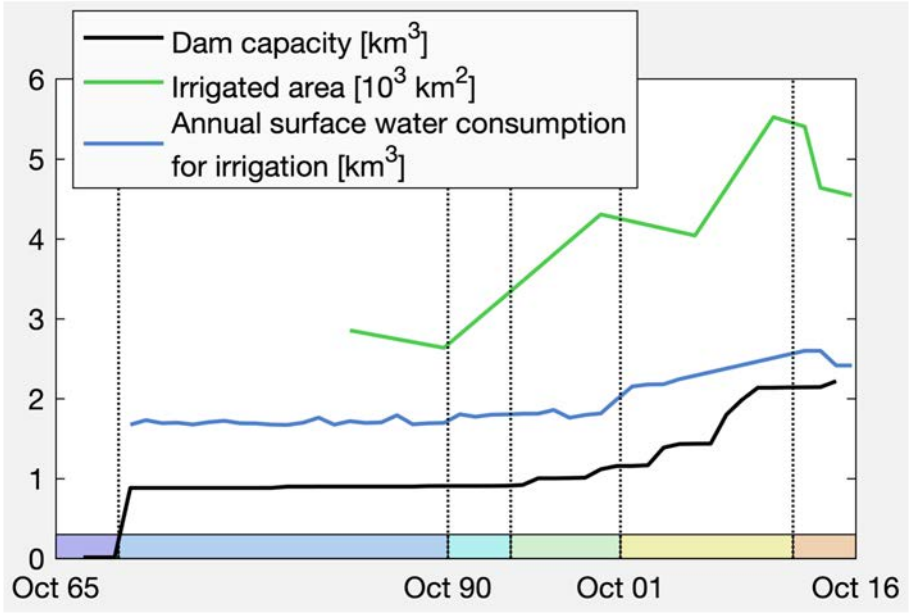




- Inflow to the lake (SDI) follows the trend of climatic boundary conditions (SPEI)
- Even at times when the water level of the lake falls sharply (e.g. period 4), there is no disproportionate decrease in inflow (SDI) relative to SPEI

Impact of irrigated agriculture





- Still, the agricultural extraction is high and roughly corresponds to the residual amount flowing into the lake → cannot be neglected
- The statistical analysis accounts for variability, but less for a constant high influence

Scenario analysis

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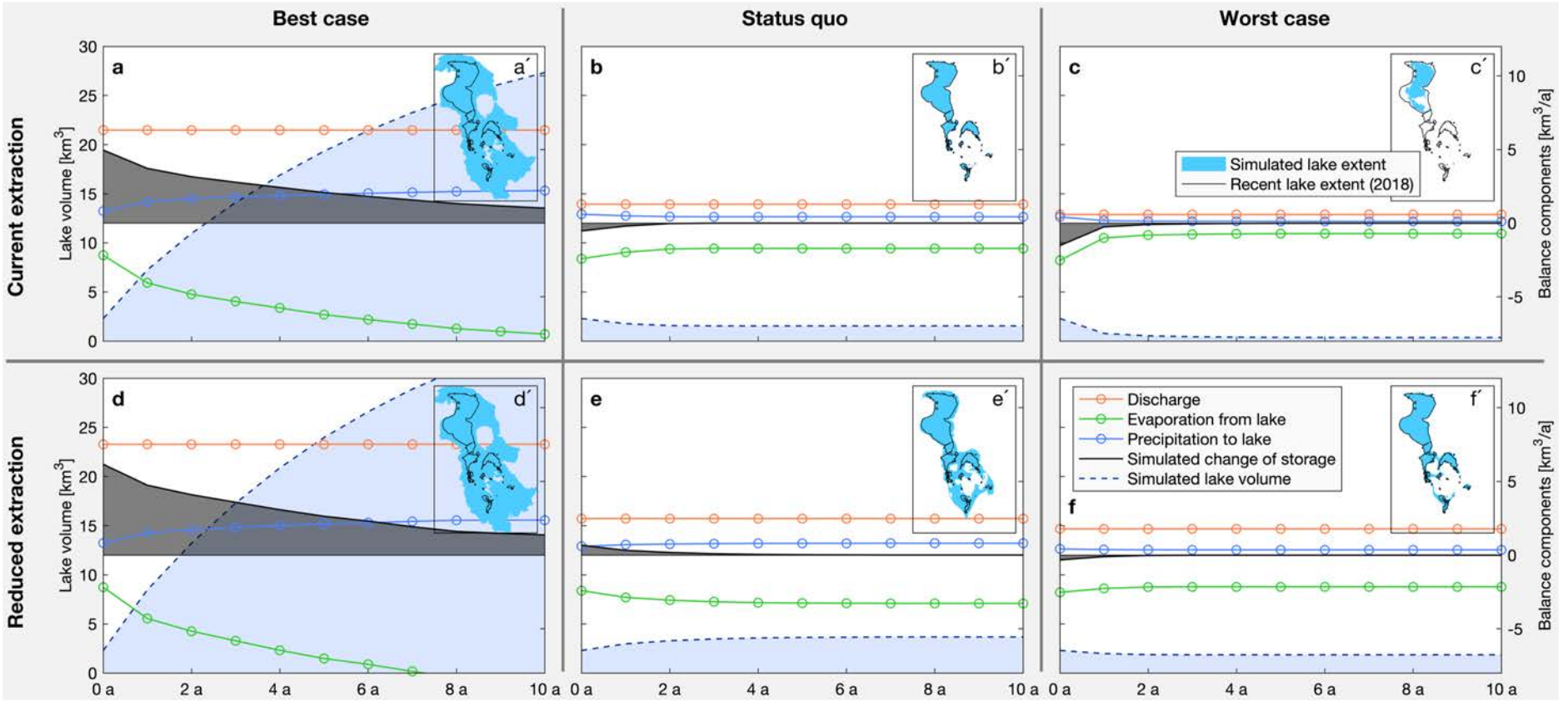

- Reduction of agricultural extraction is a very effective tool to counteract negative consequences of meteorological drought

Conclusions

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- Fluctuations of the inflow and thus also of the lake volume can be explained well by fluctuations of the climatic boundary conditions
- However, constantly high extraction rates have reduced the lake's natural resilience to meteorological drought / climatic change
- Adaptation in agriculture is a very effective measure to improve the state of the lake
- Agriculture could also be seen as an opportunity rather than the bad guy (better argument to convince people)

https://www.nature.com/articles/s41598-019-57150-y