



# Was the 2020 Lake Victoria flooding linked to anthropogenic climate change? An event attribution study

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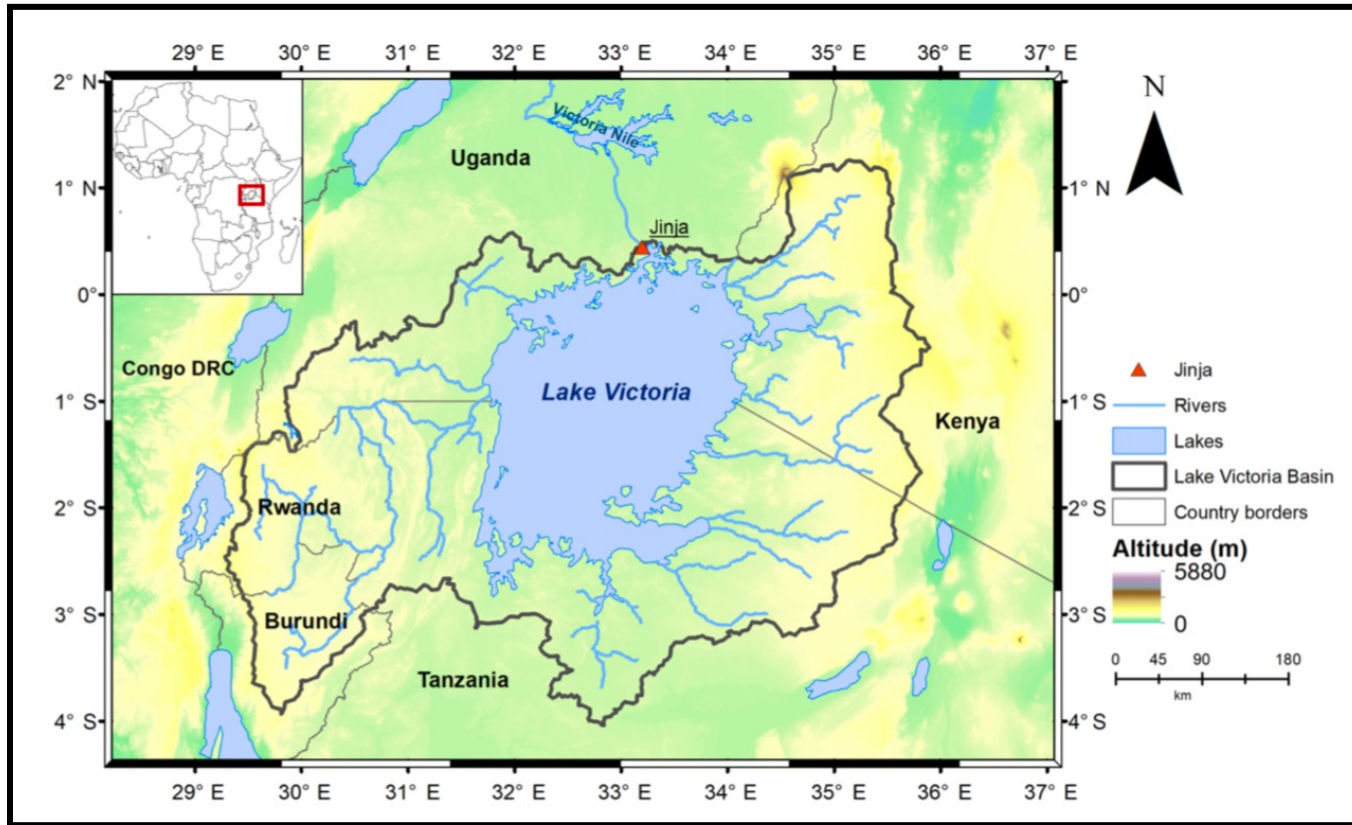
EGU22 session HS2.4.2 - *Understanding and modelling hydrological response  
under climate variability and change*

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**Abstract:**

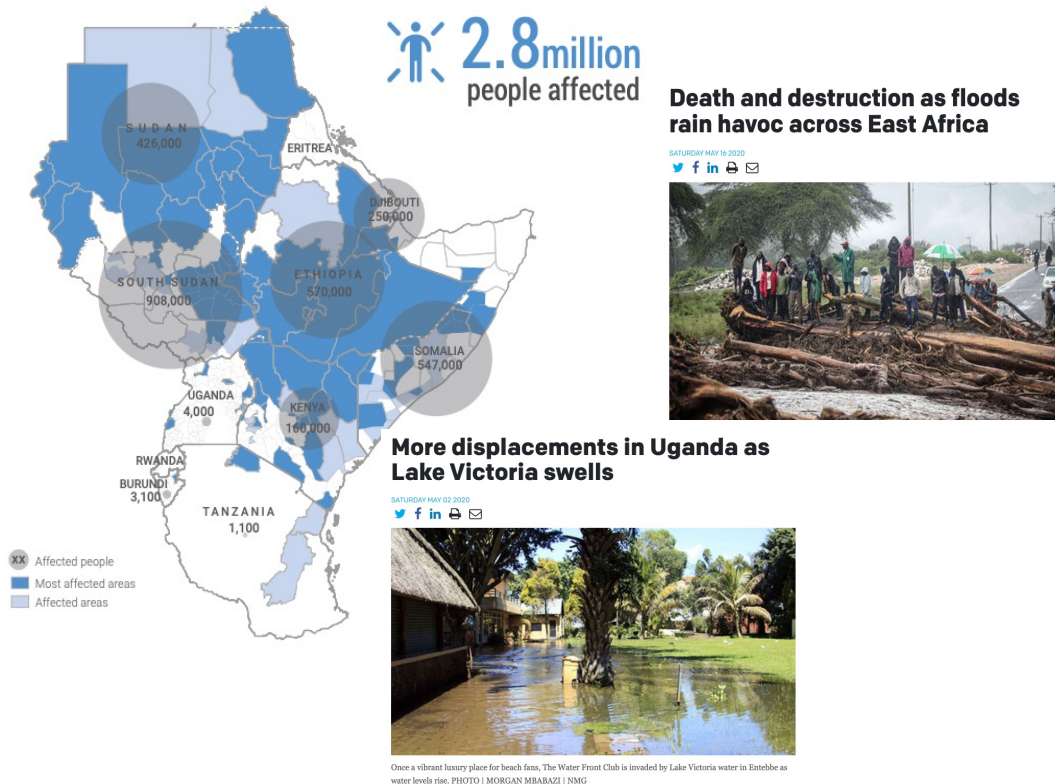


# Study area and event context



- Numerous flooding events in East Africa between late-2019 and mid-2020
- In **May 2020** Lake Victoria reached **record-breaking levels**
- Shoreline and tributary rivers flooded

## FLOOD-AFFECTED AREAS



# Probabilistic extreme event attribution protocol

(Philip et al., 2020)

**RQ : Were the mid-2020 high Lake Victoria levels and floods made more likely by anthropogenic climate change?**

Step 1 : Analysis trigger

Step 2 : Event definition

Step 3 : Observed probability and trend

Step 4 : Model evaluation

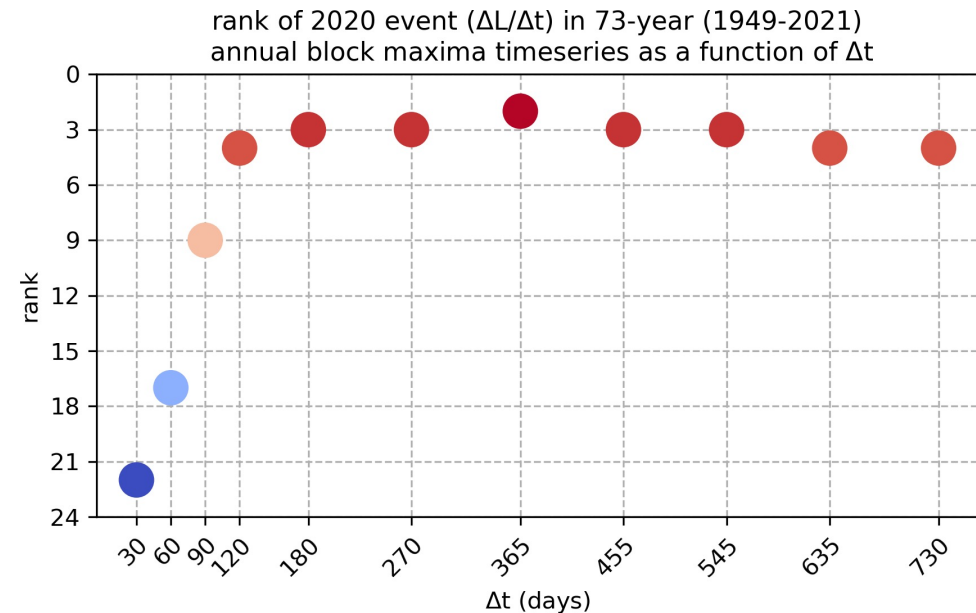
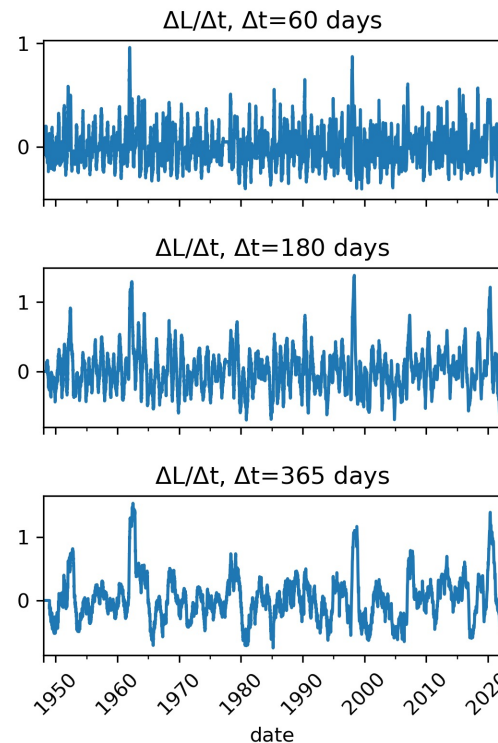
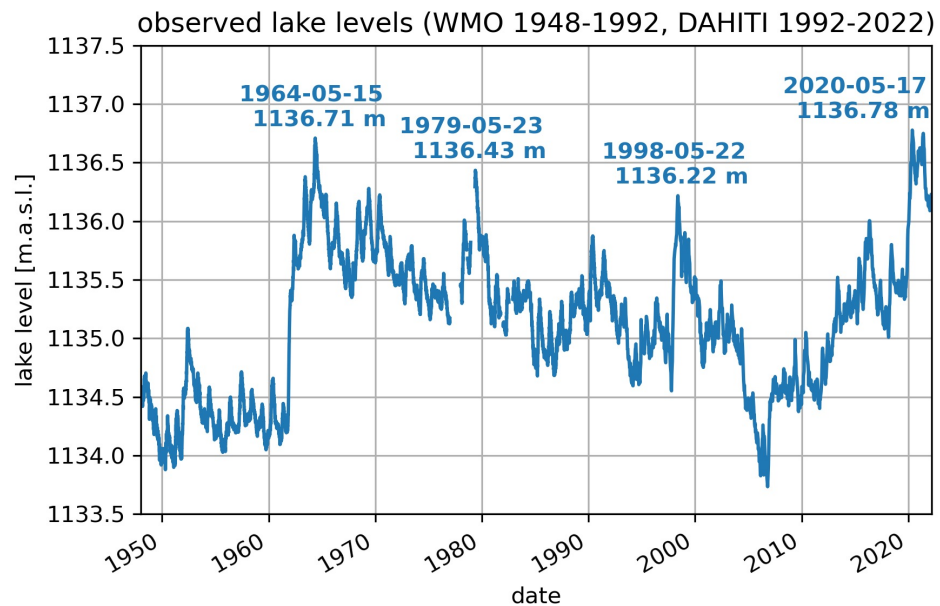
Step 5 : Multi-method multi-model attribution

Step 6 : Synthesis, attribution statement

- Impact-focused attribution and event definition
- GCM data bias-adjusted for impact studies
- Smaller GCM model ensemble (for now)

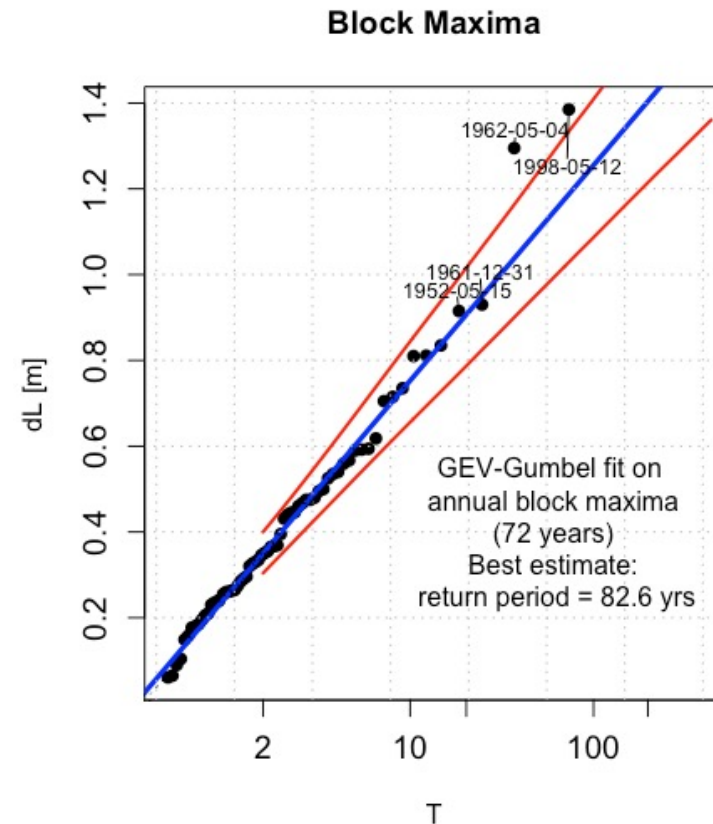
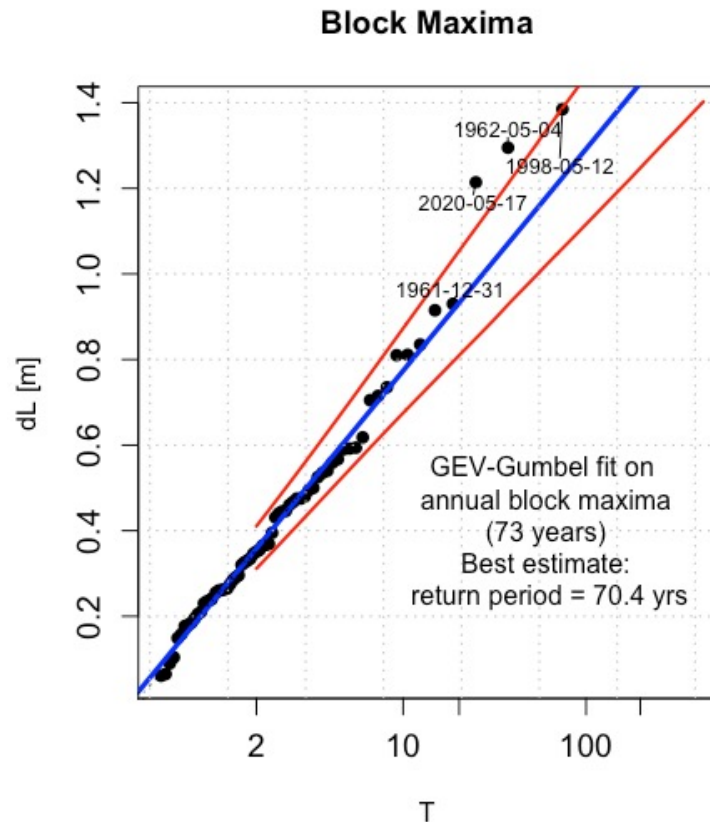
# Event definition

- **Event definition:** rate of increase in lake levels over 6 months ( $\Delta L/\Delta t$  for  $\Delta t =$  previous 180 days) as extreme as that observed in 2020 ( $\Delta L_{2020} = +1.214$  m)
- **Rationale:**
  - Impact-relevant variable
  - Maximises hydro-meteorological extremity of event while avoiding low-frequency and interannual trends that violate iid assumption for EV statistics



# Observed probability

- Annual block maxima estimation of return period of the observed event, fitting block maxima to a GEV-Gumbel distribution
- Including v. excluding 2020 event :

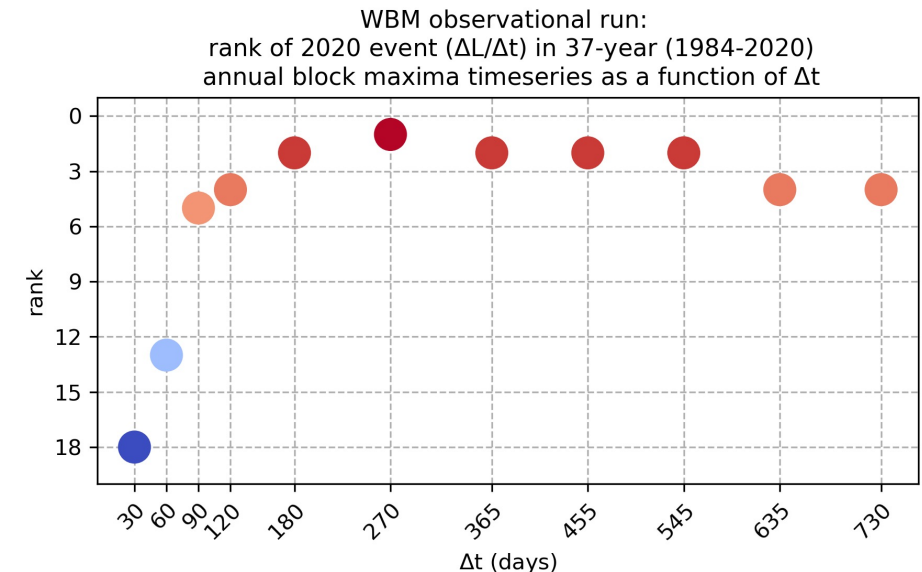
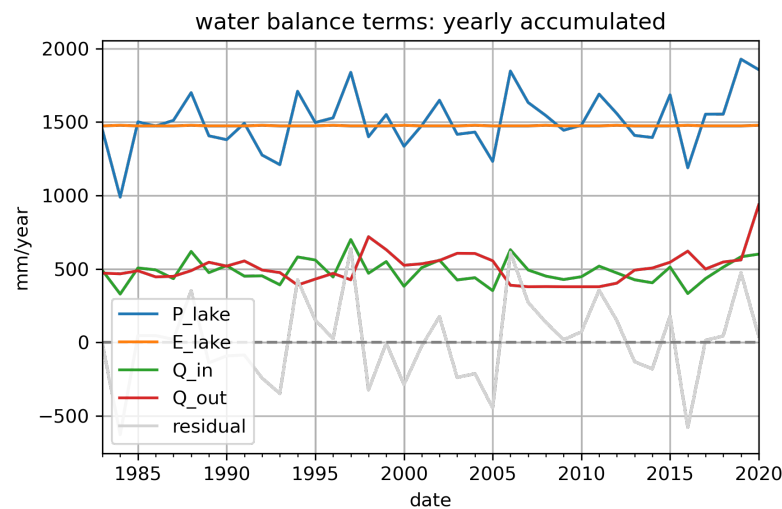
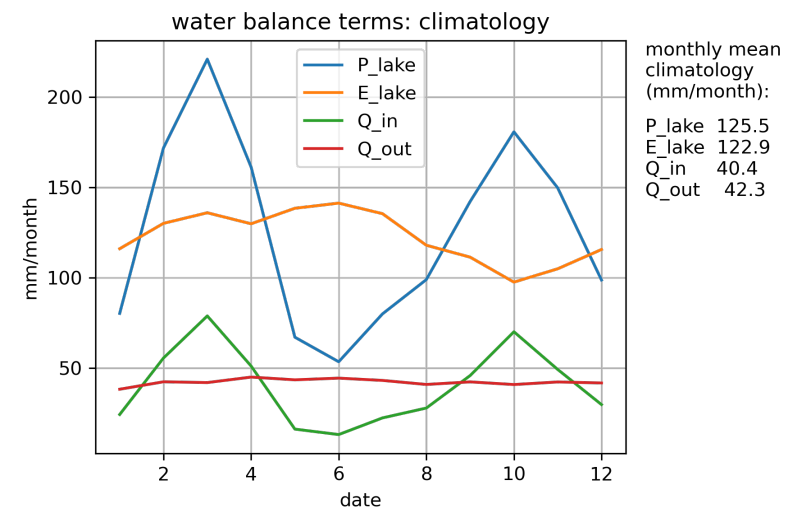
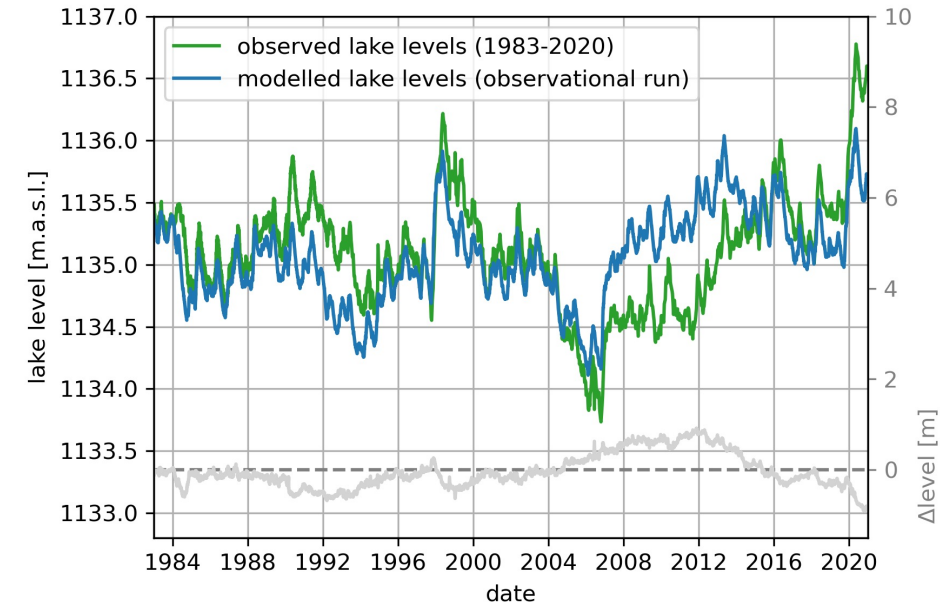




# Water balance model: observational run

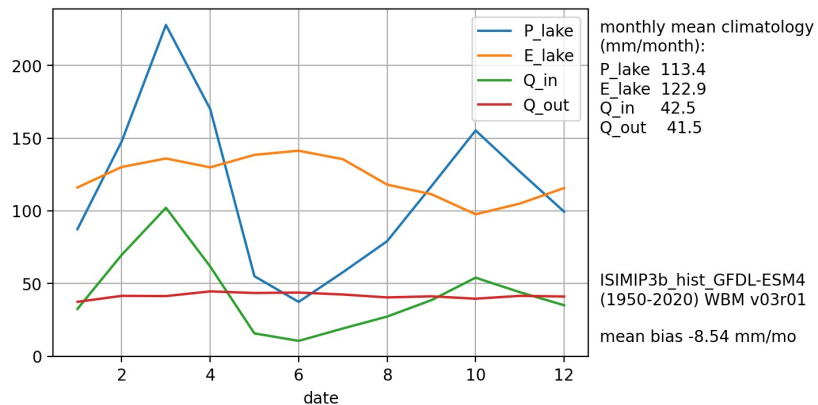
- WBM forced with satellite-derived precipitation data (PERSIANN-CDR, 1983-2020)
- Modelled 2020 event:  $\Delta L = +0.94$  m over 6 months
- Driven by high accumulated over-lake precipitation in 2019

(cfr. Wainwright et al. 2020)

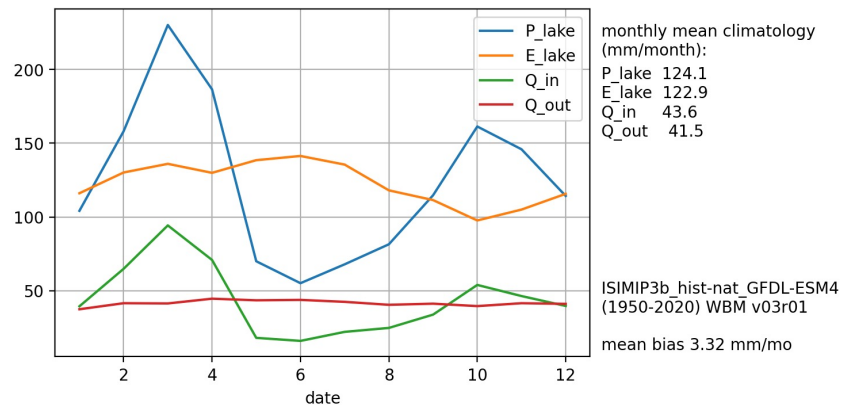


# Water balance model: GCM runs historical and hist-nat

- **WBM forced with ISIMIP3b bias-adjusted precipitation data from six CMIP6-GCMs**
  - Models: CanESM5, CNRM-CM6-1, GFDL-ESM4, IPSL-CM6A-LR, MIROC6, MRI-ESM2-0 (one ensemble member each, see ISIMIP3b climate forcing datasets: <https://protocol.isimip.org/>)
  - **hist** 1850-2014 + ssp3-rcp7 2014-2020 = « factual, new »
  - **hist-nat** 1850-2020 = « counterfactual, ref »
- Trends and biases (wetting or drying) might need to be removed when analysing WBM results forced by GCMs and comparing hist and hist-nat event distributions



e.g. hist GFDL-ESM4 shows drying trend (1950-2020)



e.g. hist-nat GFDL-ESM4 wetting trend (1950-2020)

**Probability ratio:**

$$PR = P_{\text{new}} / P_{\text{ref}}$$

Where  $P_{\text{ref}} = P_{\text{obs}}$   
to determine threshold  
in model runs

# Thank you! Questions, comments, suggestions?

## References:

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## Images:

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