# Large-scale atmospheric drivers of recent hydroclimatic changes in the Horn of Africa: evidence from the Awash Basin terminal lake system, Ethiopia

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## 1 Supplementary material

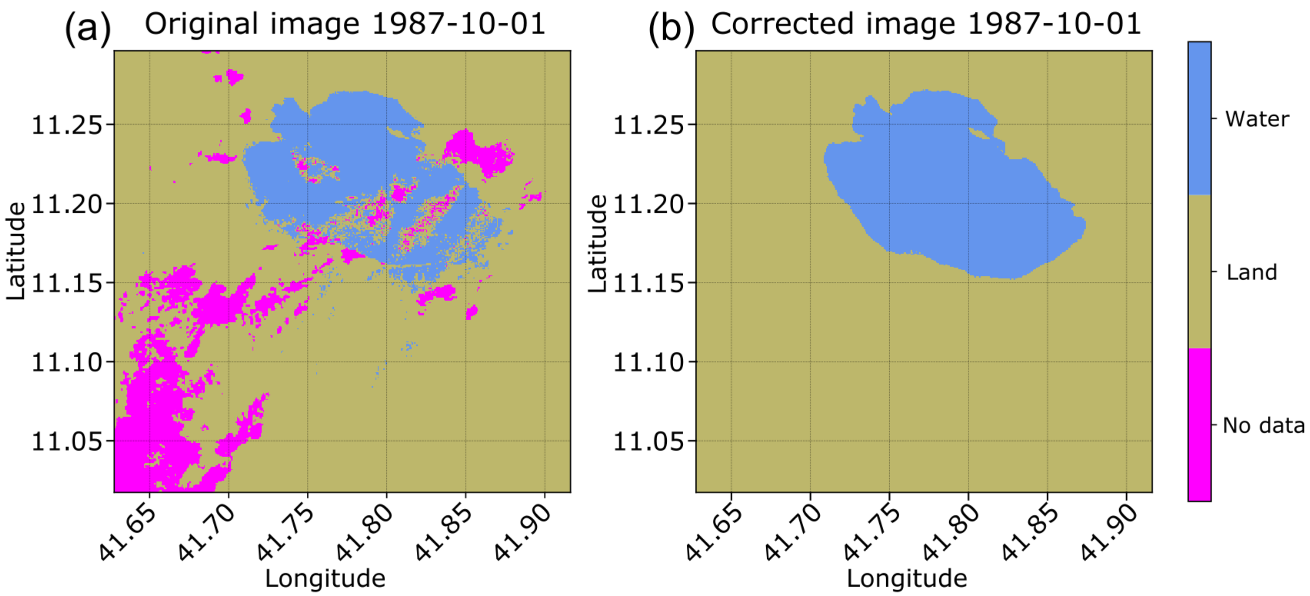


**Figure S1.** Satellite image correction applied to Landsat imagery of Lake Abhe (October 1987) following the methodology of **?**. (a) Uncorrected and (b) corrected images. Source: Global Surface Water Dataset (GSWD; **?**)

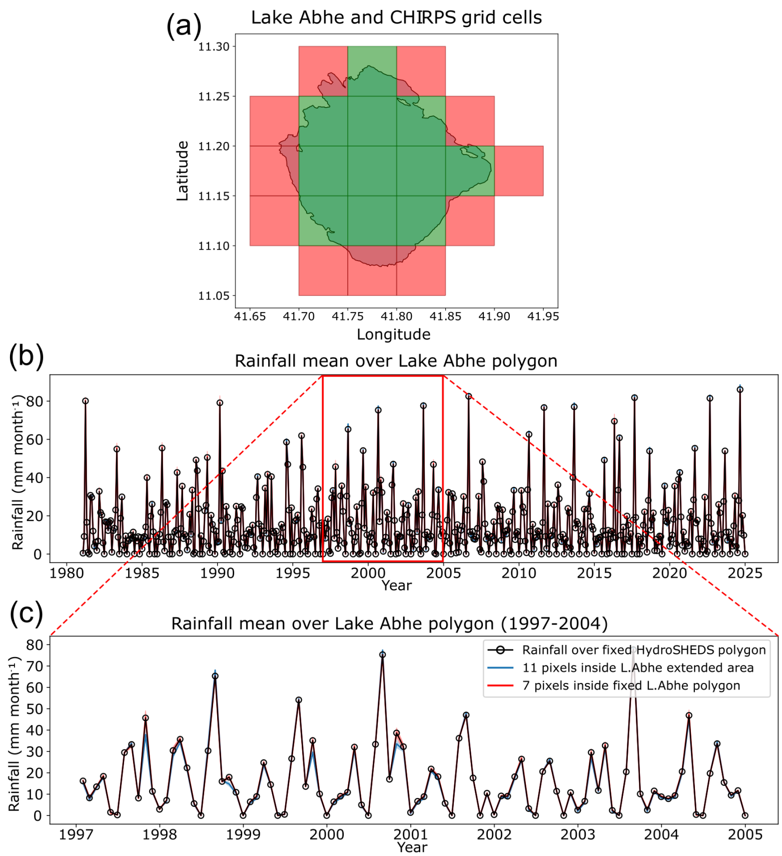


**Figure S2.** (a) CHIRPS v2 pixels falling within Lake Abhe at its maximum (red) and minimum (green) observed extents. (b) Spatially averaged rainfall time series derived from three lake boundary definitions: the fixed reference polygon from HydroLAKES (**?**) , and the polygons corresponding to the maximum and minimum observed lake extents. Shading denotes the spread across 100 Monte Carlo subsamples of pixels within the lake boundary, illustrating the sensitivity of the rainfall estimate to pixel selection. (c) Enlarged view of the 1997–2005 period highlighting the robustness of the rainfall time series to variations in lake extent.

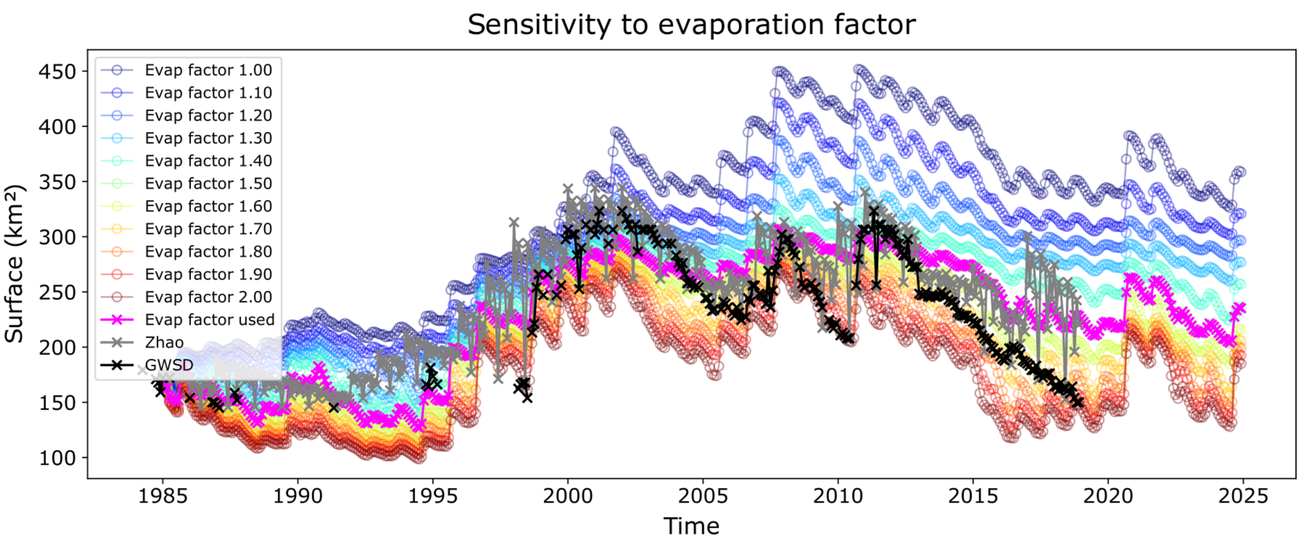


**Figure S3.** Observed (black and gray) and modeled (colored lines) lake surface area ($\mathrm{km}^2$) time series for Lake Abhe over the 1985-2024 period. Modeled time series are shown for direct lake evaporation scaling factors ranging from 1.0 to 2.0 (increment of 0.1), applied to account for uncertainties in open-water evaporation estimates. Observed surface water extent is derived from GSWD and **?** databases.

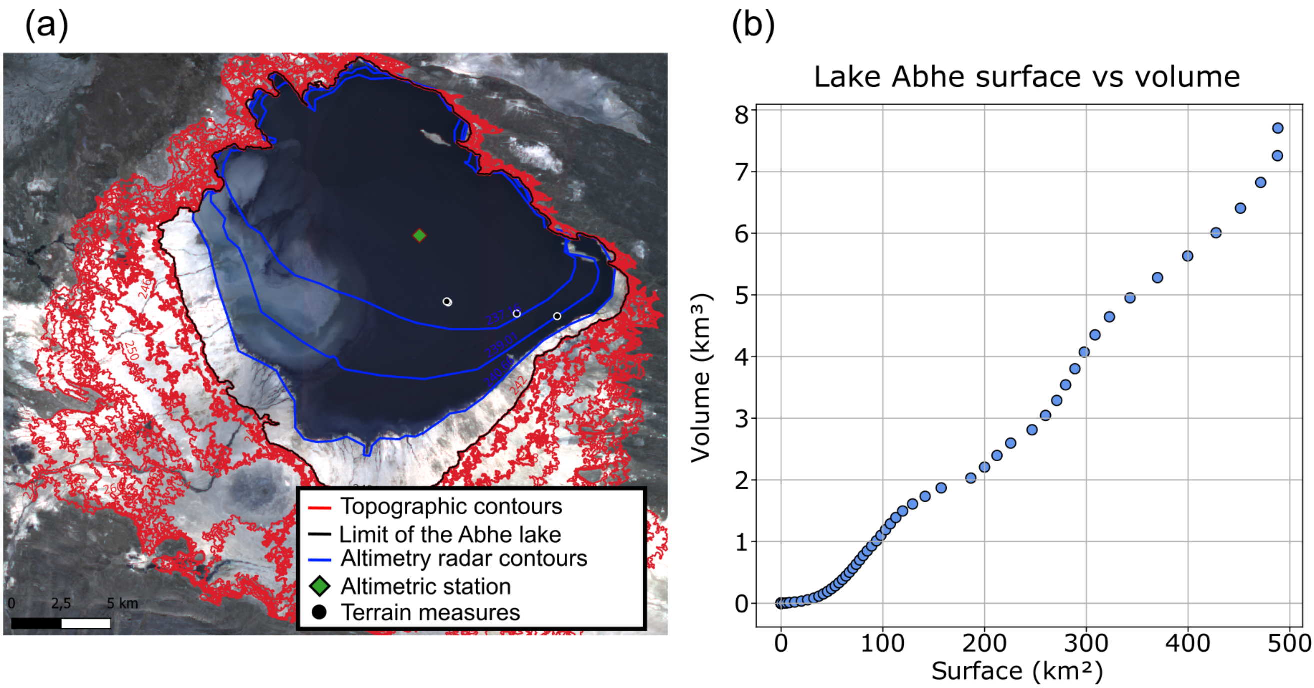


**Figure S4.** (a) Map of Lake Abhe showing SRTM elevation contours (red **?**), the lake boundary from HydroLAKES (black), shoreline contours derived from satellite imagery (blue), the HydroWeb radar altimetry station (green dot), and in situ bathymetric survey points collected during the NILAFAR field campaign (black dots). The satellite-derived shoreline contours and bathymetric measurements were jointly used to construct the hypsometric curve shown in (b). (b) Hypsometric curve of Lake Abhe relating lake surface area ($km^2$) to water volume ($\mathrm{km}^3$), derived from SRTM topographic data, satellite-derived shoreline contours, and in situ bathymetric measurements.

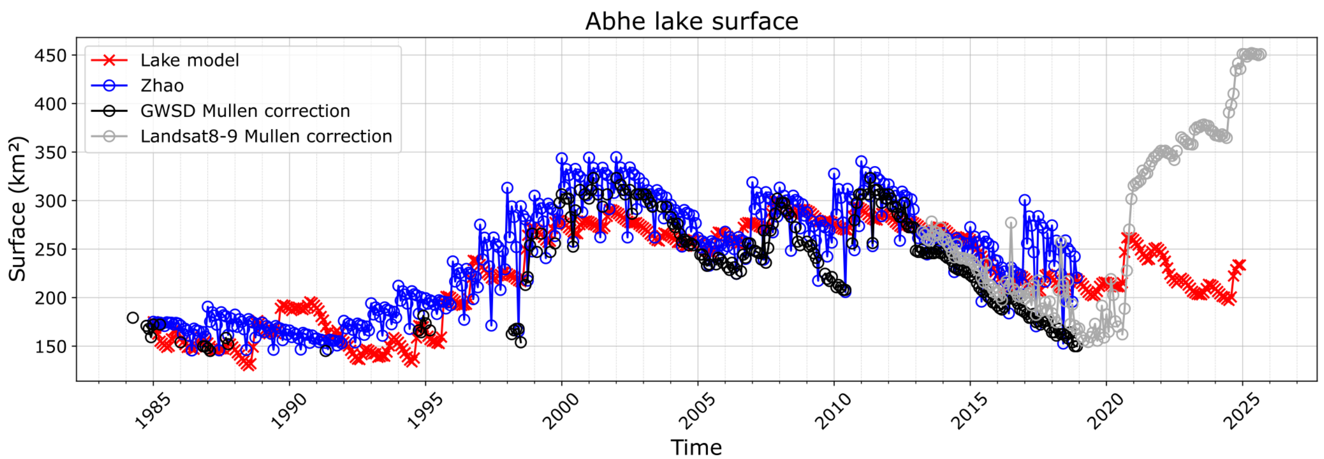


**Figure S5.** (a) Combined surface area of the Afambo–Gemeri–Abhe lake system derived from the corrected Global Surface Water Dataset (GSWD), extended to 2025 using Landsat 8–9 imagery, the reconstruction of **?**, and GR2M-lake model simulations.

## References


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