Global Water Security Center

LAKE CHAD BASIN, 2035: Flooding, Heatwaves, and Drought Can Drive Rebel Recruitment, Terrorism Risk

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BLUF

Government inability to respond to weather extremes, which are projected to increase, leaves people frustrated and more willing to join terrorist organizations.

Background

*Violent extremist organizations (VEOs) like Boko Haram disrupt fisheries, farming, and markets that support the 30 million people who live in the Lake Chad Basin (**Map 1**). Though the lake extent has rebounded in recent decades (see Supplemental), terrorist activity prevents the region from reaching its full livelihood potential.*

WEATHER EXTREMES

A projected 10% increase in average annual rainfall bodes well for the basin, but more floods, heatwaves, and drought could increase vulnerability to recruitment by VEOs (**Figure 1**).

FLOODING: Heavy rain days are projected to triple.

- The 2022 flood, the biggest in 50 years, displaced 1.5 million people in the basin; **such floods could occur once per decade**.

HEATWAVES: 5-day >40°C heatwaves could increase by 35%.

- **More deadly heatwaves like that of April 2024** could drain urban water supplies, overwhelm hospitals, and kill livestock.

DROUGHT: Despite wetter rainy seasons, 5-day >35°C spells with no rain during the rainy season could persist.

- Dry spells could stress water supplies and livestock during the agricultural growing season, which may **increase the risk of farmer-herder conflict**.

Map 1: The Lake Chad Basin stretches over 1 million km² and is shared by seven countries. More than 10 million people (1/3 of pop.) in the basin depend on external food aid to survive.
VEO violence in agricultural areas prevents farmers from maximizing yield and accessing markets even in good years, which amplifies grievance over government inaction.

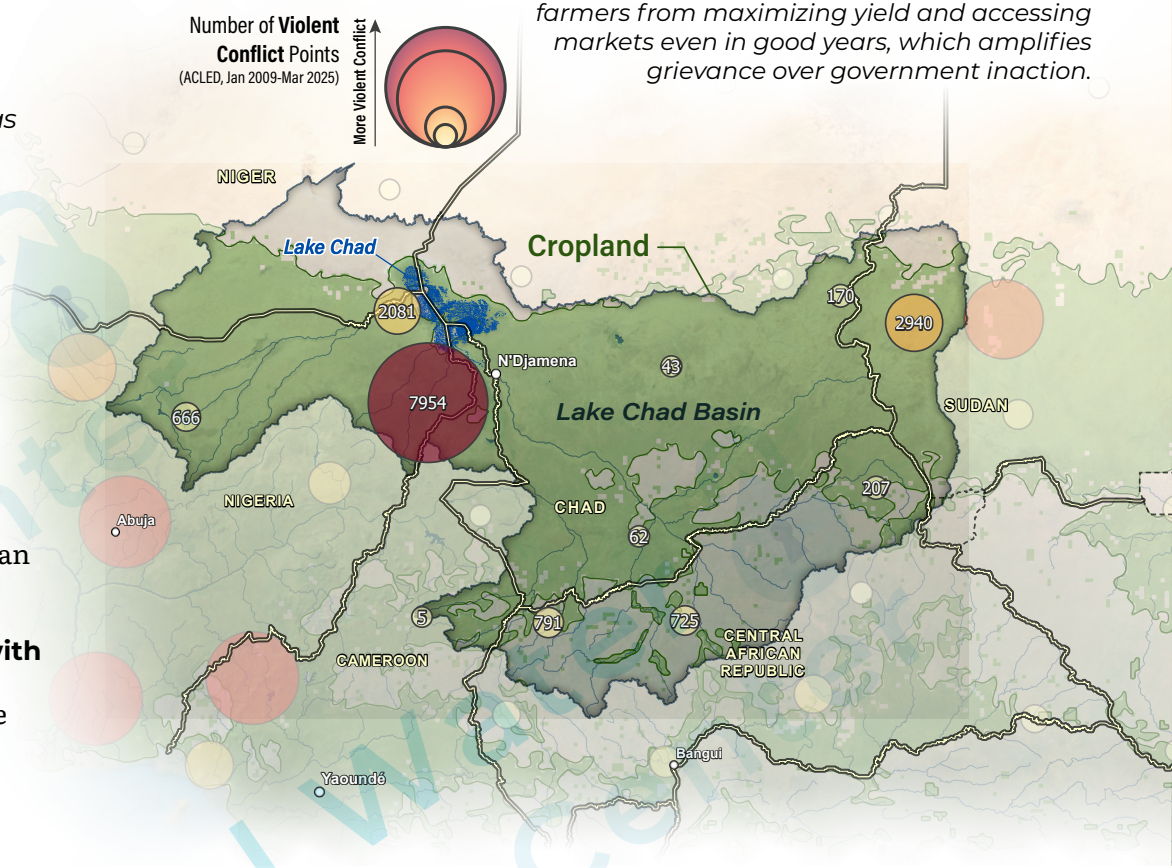

Figure 1: Pathways to Instability—VEOs leverage grievance over government inaction to recruit new members.
Youth left frustrated by a lack of effective government response join VEOs who promise solutions, retribution.

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Map Sources:

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Made with Natural Earth. Free vector and raster map data @ naturalearthdata.com.

Data Analysis Methods:

DATASETS: Historical Weather Data from ERA5 [1950-2024] - daily values for precipitation, average temperature, maximum temperature, and minimum temperature . Future Weather Data from CMIP6 downscaled by NASA Earth Exchange Global Daily Downscaled Projection (NEX-GDDP-CMIP6). Scenario: SSP245 and/or SSP585 [2025 – 2045 & 2050-2070]. Historical [1975 - 1995 & 2000 - 2020]. 17 models: ACCESS-ESM1-5, BCC-CSM2-MR, CanESM5,CMCC-ESM2, FGOALS-g3, GISS-E2-1-G, MIROC-ES2L, MPI-ESM1-2-HR, MRI-ESM2-0, NESM3, NorESM2-MM, CNRM-ESM2-1, EC-Earth3-Veg-LR, GFDL-ESM4, INM-CM5-0, IPSL-CM6A-LR, KIOST-ESM.

CALCULATIONS: Baseline (sometimes called "normal") and representative future values for each year of interest are calculated using 21-year time intervals around the date of interest. Our historic normal periods are based on the years 1985 (1975 – 1995) and 2010 (2000 - 2020) using ERA5 data. To bias correct future values, we calculate the difference or ratio between NEX-GDDP-CMIP6 modeled future [2035 (2025-2045) and/or 2060 (2050-2070)] and modeled historic [2010 (2000-2020)] values and apply this difference to the 2010 historic baseline value for each metric of interest. All calculations are spatially distributed (quarter-degree grid cells) and aggregated as the final step.

Important note: Values reported are median values based on the 17 model outputs. Error bars are the 95% confidence interval around the median. IPSL-CM6A-LR was an outlier for mean annual precipitation and was not included in the final calculations for this metric or mean annual temperature.

Precipitation
Mean Annual Precipitation: The sum of the total daily precipitation for each year, averaged over the time period of interest.
Heavy Rain Days: The number of days reaching the 95th percentile of historic daily precipitation events, excluding days with less than 1 mm of precipitation.

Temperature
Mean Annual Temperature: The mean of the daily average temperature for each year, averaged over the time period of interest. Also referred to as the "normal temperature" for the time period of interest.
Heatwaves: The number of times in a year that there were 5 days in a row where the maximum temperature reached or exceeded 40°C.

Precipitation and Temperature
Hot and Dry Days: The number of times in a year that there were 5 or more days in a row where the maximum temperature reached or exceeded 35 and received less than 1mm of rain.

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Supplemental Materials: Lake Chad Basin

Precipitation Maps

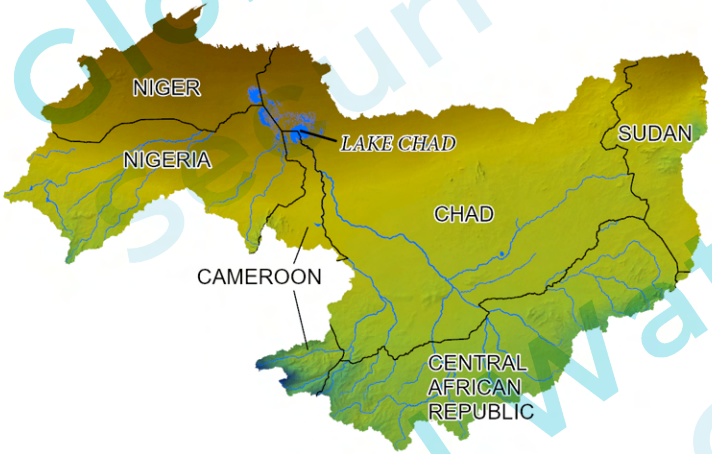
Change in precipitation (averaged across 16 CMIP6 models) in 2035 and 2060 according to SSP245 and SSP585.

0 — 80%

Mean annual precipitation 2010 (mm)
(reference period 2000-2020)

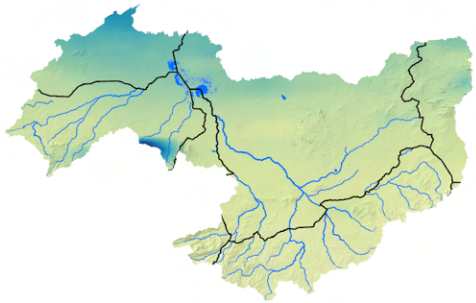
25mm — 2000mm

2010



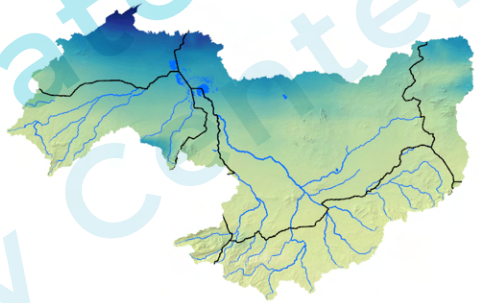
2035 SSP245

2035 SSP585



2060 SSP245

2060 SSP585



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Supplemental Materials: Lake Chad Basin

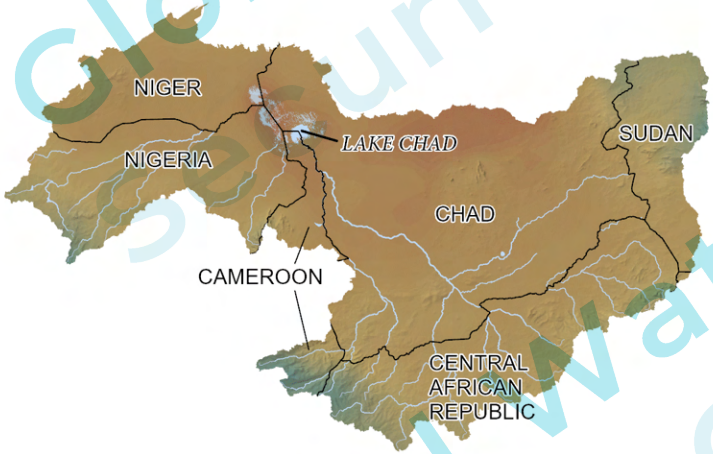
Temperature Maps

Mean annual temperature 2010 (°C)
(reference period 2000-2020)

-10°C — 40°C

22°C ⟷ 30°C
Visible Data Range

2010



Change in temperature (averaged across 16 CMIP6 models) in 2035 and 2060 according to SSP245 and SSP585.

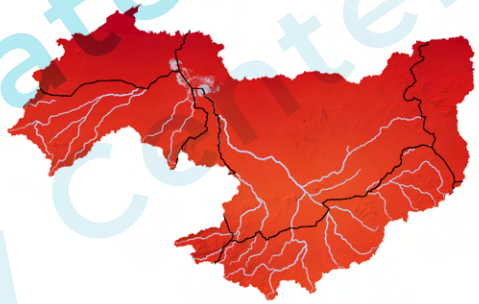
0°C — +3°C

2035 SSP245

2035 SSP585

2060 SSP245

2060 SSP585



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Supplemental Materials: Lake Chad Basin

Lake Chad's Slow Recovery May Continue

Though the lake has not returned to its 1950s maximum, the lake extent showed a modest rebound through the late 1990s and has been growing since 2012. A projected 10% increase in rainfall may grow the lake further.