

Monitoring climate variables to assess trends in climate change

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Themes

- The need for baseline knowledge and measurements of local climatology
- Data absence issues
- Working with informal data resources
- Considering parameters other than temperature and rainfall

Local climatological baselines

- How well do we know the climatology of the landscapes in which we work?
- Where does this knowledge come from? Is it based on observations or perceptions?
- What baseline observations are available for assessing change?

Automatic weather stations

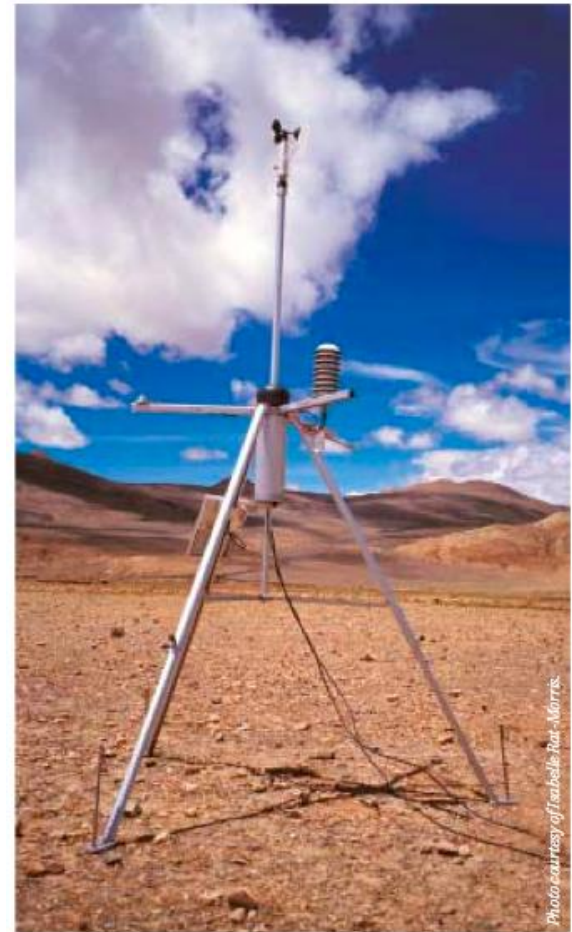
standard tool for observing local climate parameters

A basic configuration records:

- Temperature
- Dew point (→ humidity)
- Wind direction
- Wind speed
- Precipitation amount
- Barometric pressure
- Solar radiation

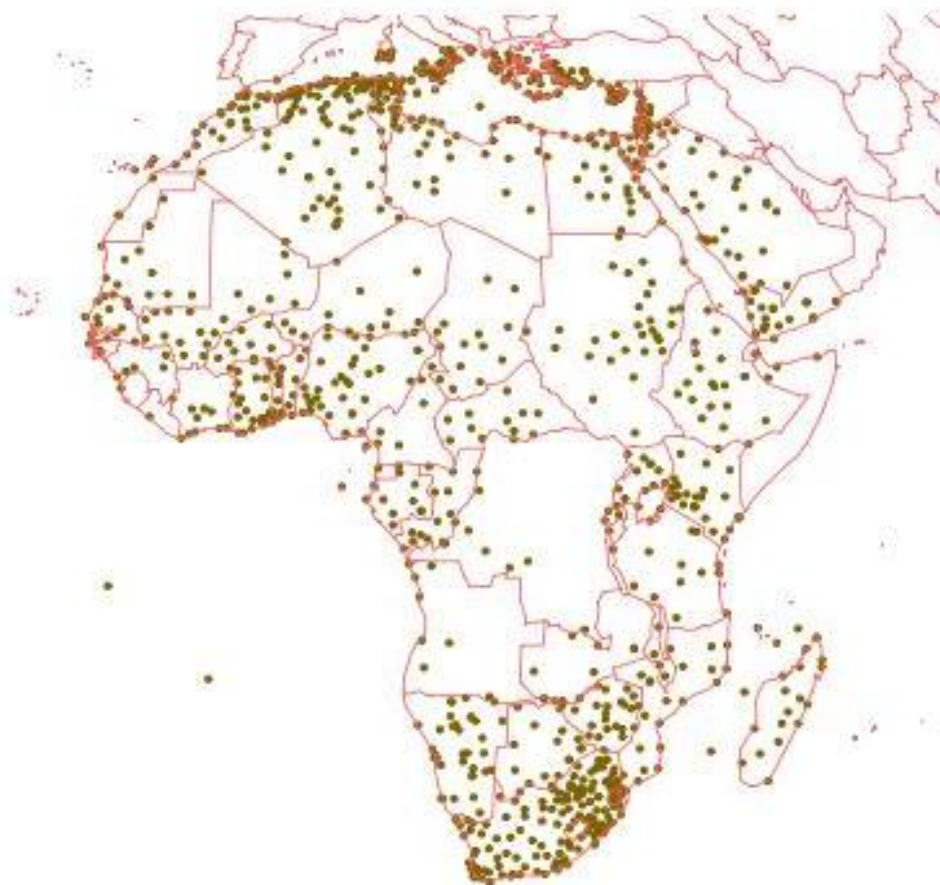
Appropriate station siting is critical

Significant tradeoffs between cost, data accuracy and durability



Present day climatological observation network in Africa as represented on the Global Summary of Day observation listing

Station map AfricaGSOD 2008 - 2009

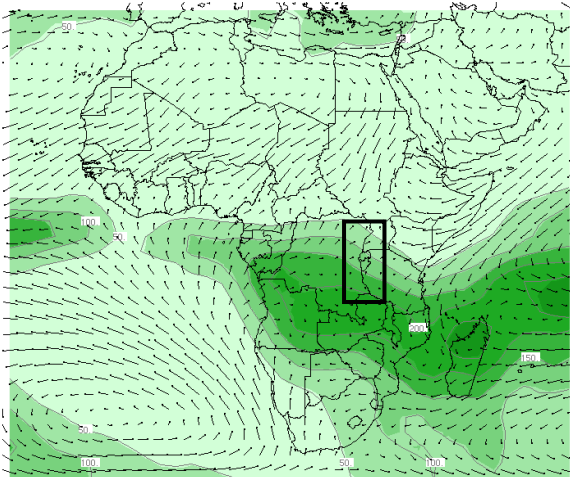


(Source: <http://moyhu.blogspot.com/2010/07/spatial-coverage-of-ghcn-and-gsod.html>)

Climatological records

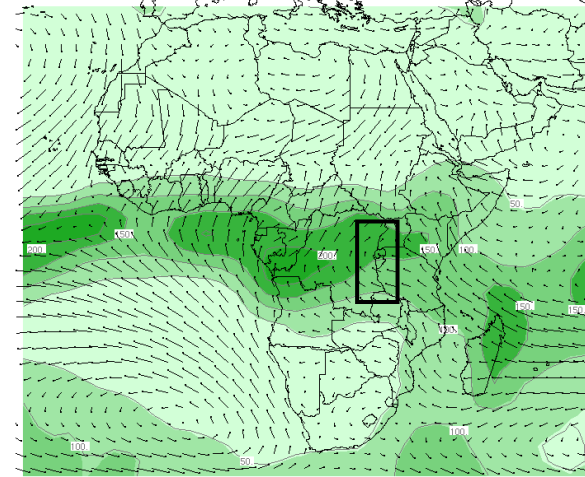
- A 30-year continuous record of climatological observations is the international standard for ascertaining mean conditions, anomalies and trends
- Such records are often unavailable across much of sub-Saharan Africa, and especially so in protected areas away from major population centers
- With caveats, it is possible to work with informal/unofficial data resources

Continental scale precipitation seasonality



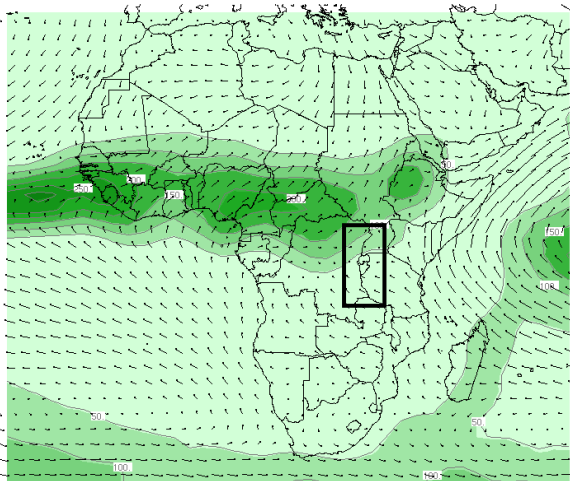
January

Time Jan Pressure 925. mb



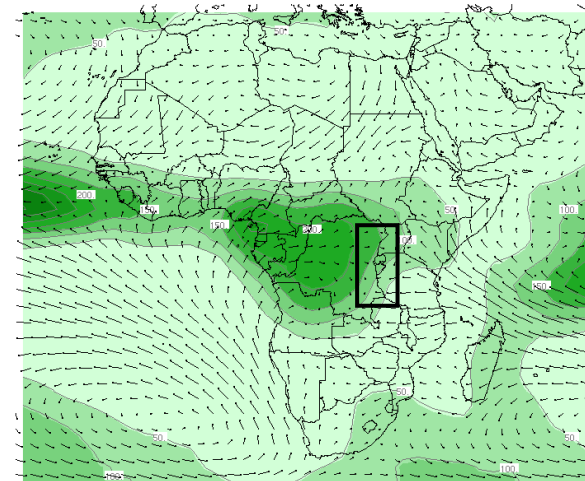
April

Time Apr Pressure 925. mb



July

Time Jul Pressure 925. mb

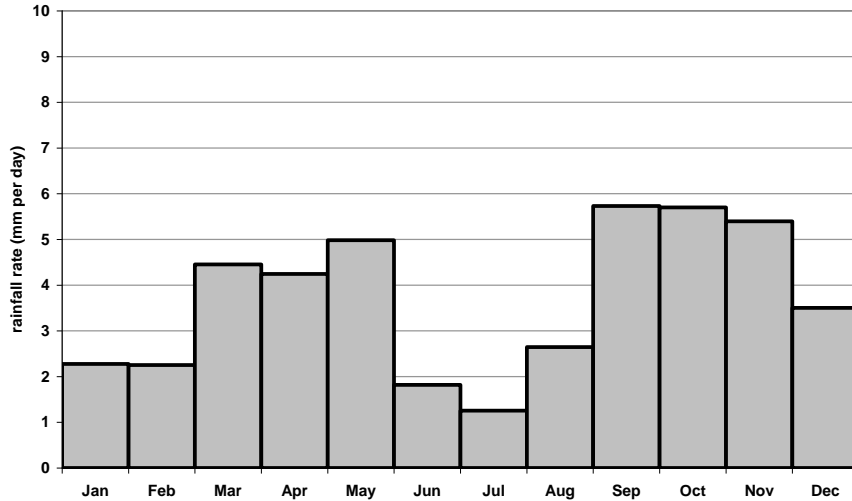


October

Time Oct Pressure 925. mb

Annual rainfall climatology at Bwindi National Park, Uganda

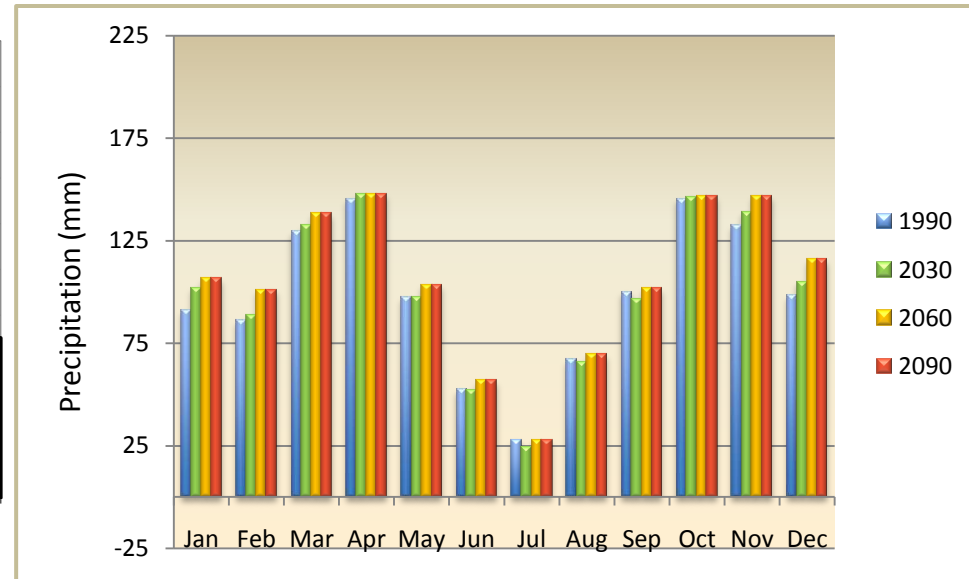
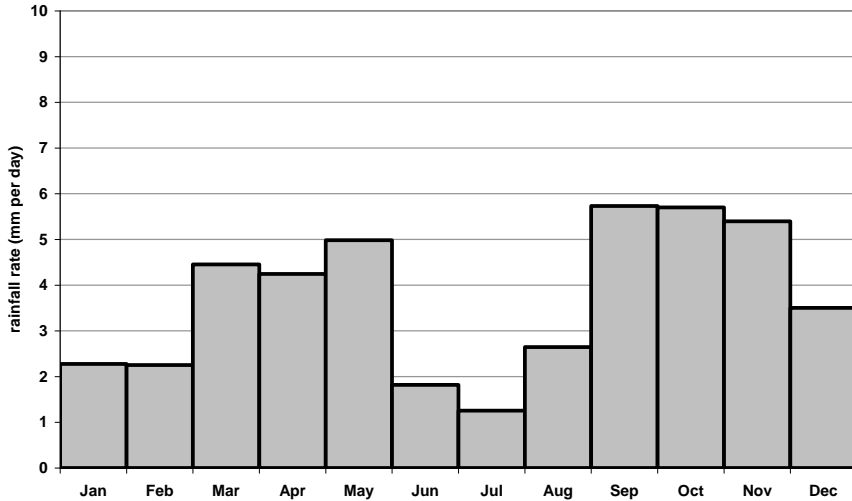
Bwindi-Ruhija monthly mean rainfall rates
(annual 3.7 mm/day = 1,348 mm total)



Monthly resolution:
Typical representation
of rainfall climatology
in observations, model
projections

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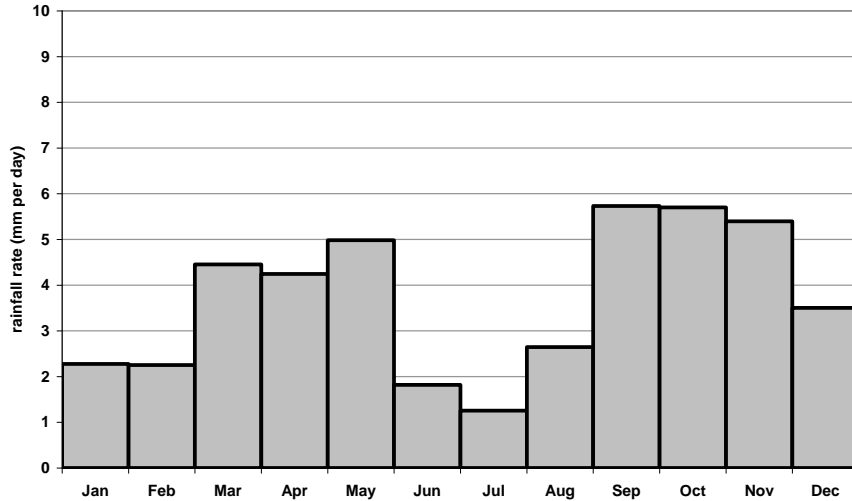


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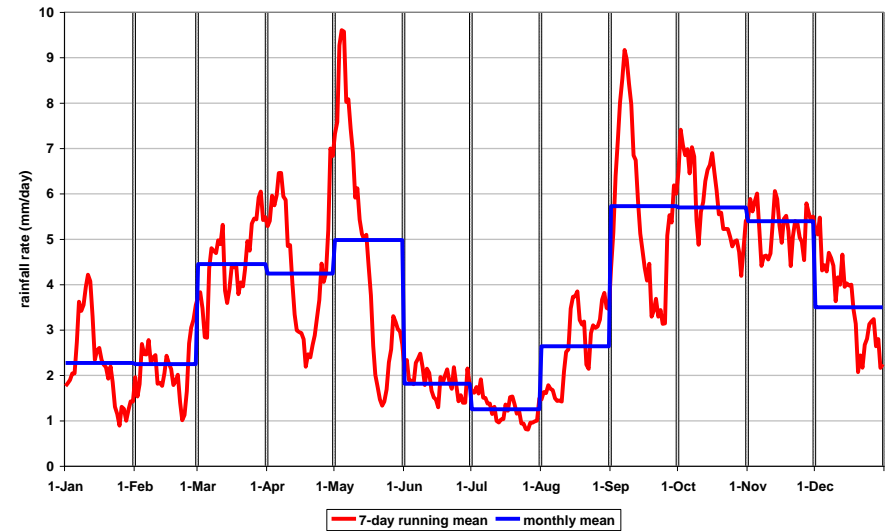
Monthly resolution:
Downscaled IPCC models for
the mountain gorilla domain
including Bwindi

Annual rainfall climatology at Bwindi National Park, Uganda

Bwindi-Ruhija monthly mean rainfall rates
(annual 3.7 mm/day = 1,348 mm total)

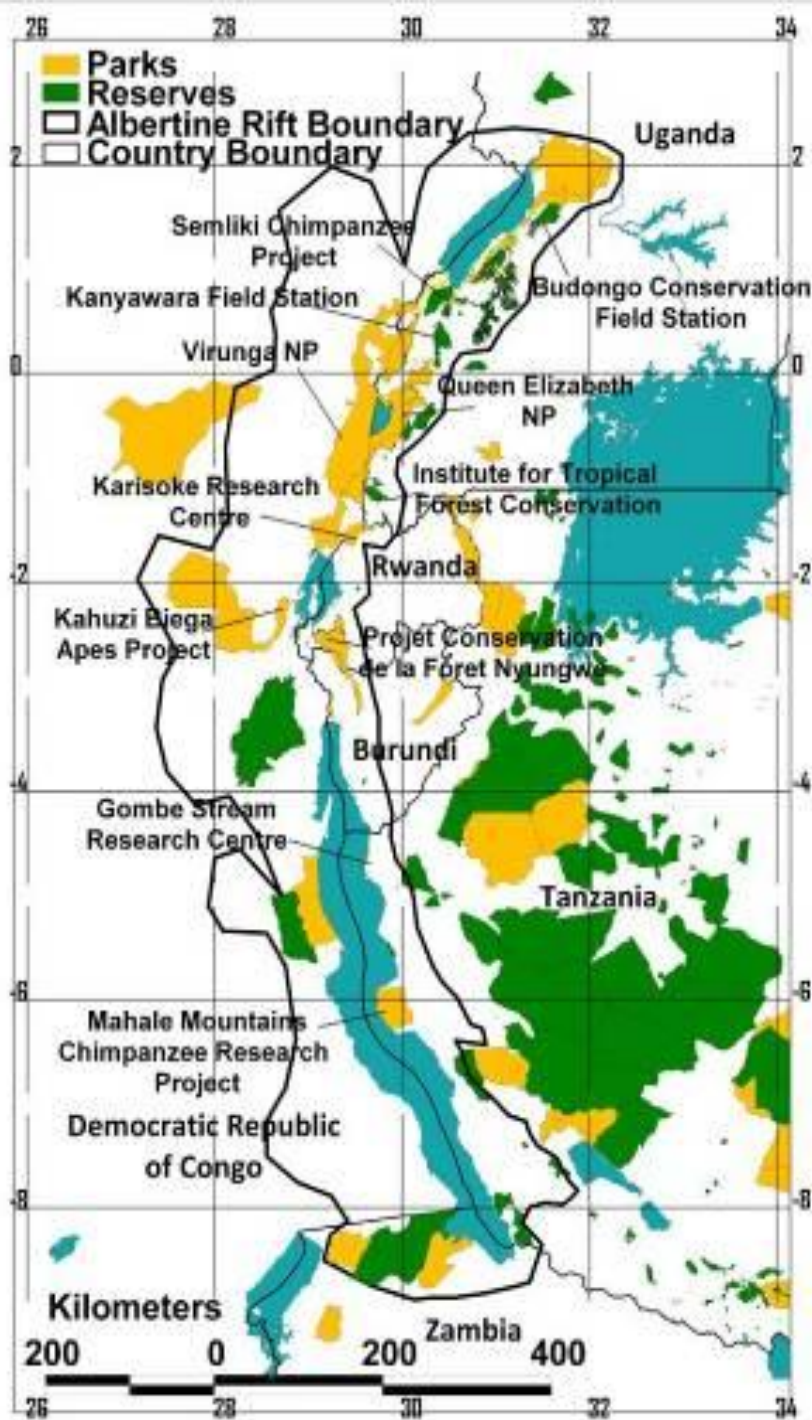


Bwindi-Ruhija precipitation rate
based on daily data from 1991-2006



Monthly resolution:
Typical representation
of rainfall climatology
in observations, model
projections

Daily resolution: high
frequency patterns
suggest much greater
complexity, potential
ecological significance.



Albertine Rift Research Stations

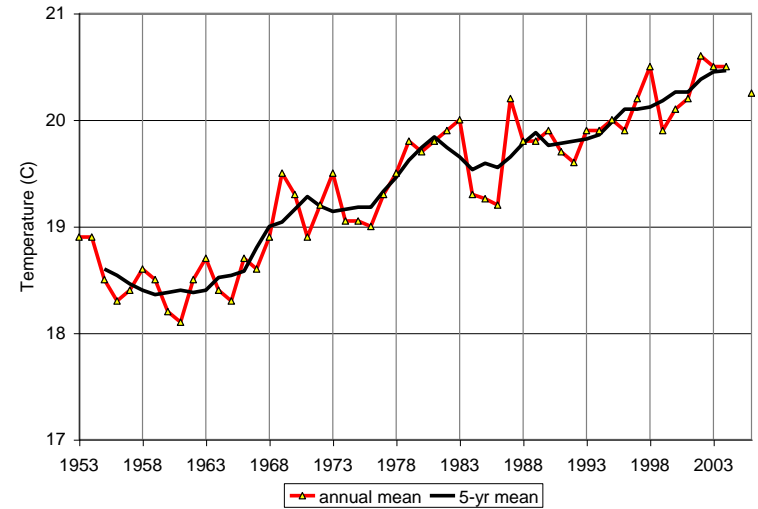
- Research back to the 1950s
- Long term climate data
- Vegetation changes
- Wildlife population changes
- Changes in Fruiting and Flowering
- Socioeconomic changes

Courtesy of Andy Plumptre, WCS

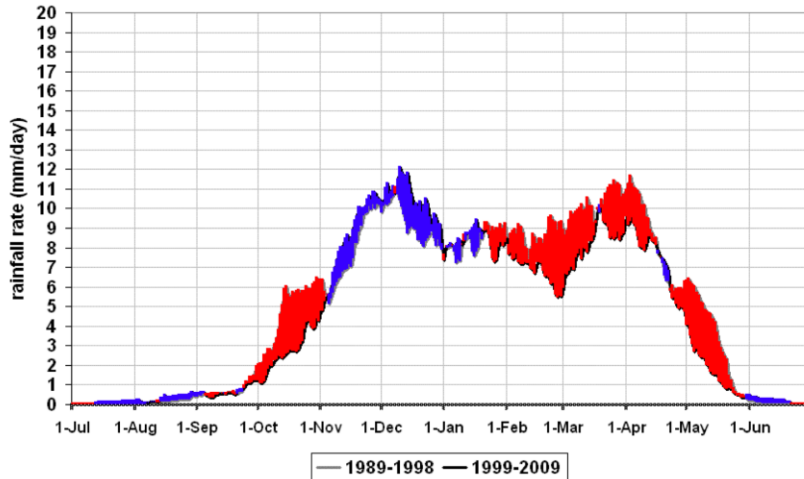
Building local climate data baselines

Often requires data mining of unconventional climate data from research stations, protected area managers etc.

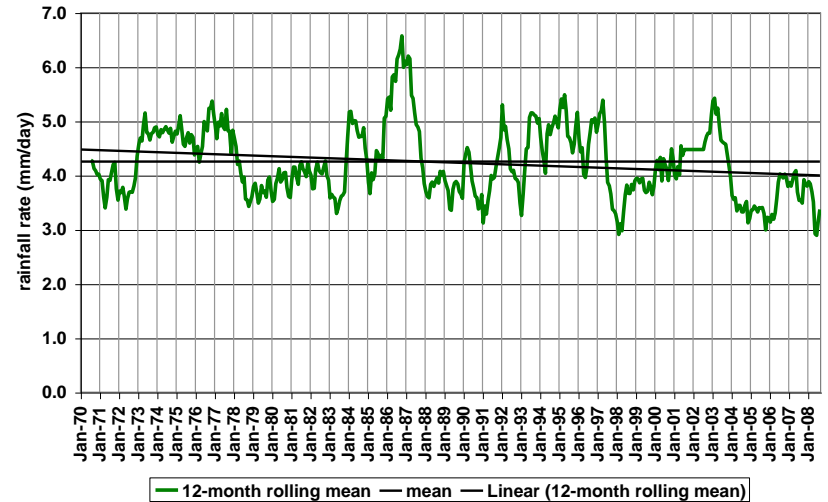
Lwiro, Congo annual mean temperature 1953-1007



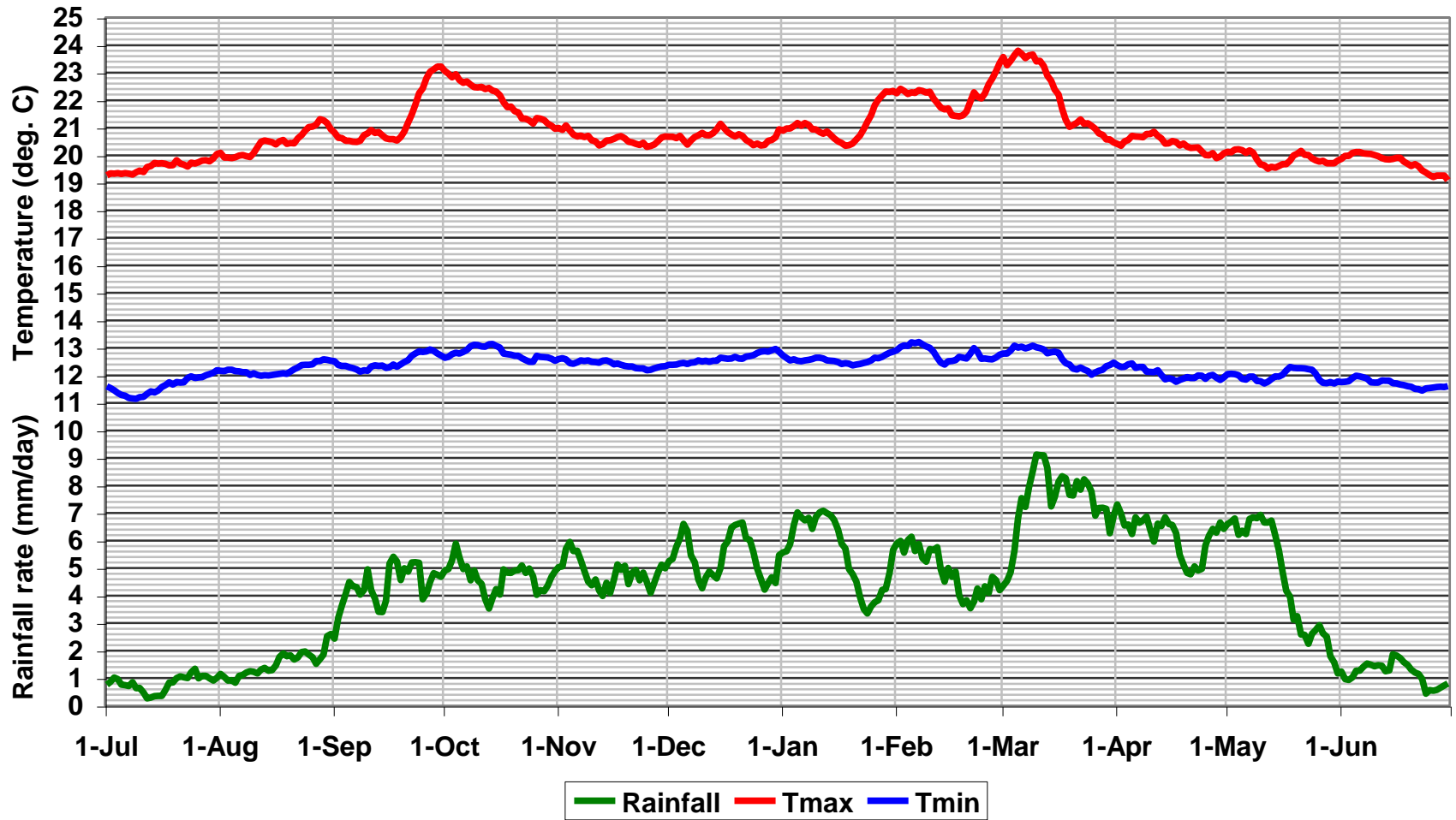
Mahale, Tanzania hydrological year rainfall rate 1989-1998 vs. 1999-2008



Torokahuna Tea Estate 1970-2008

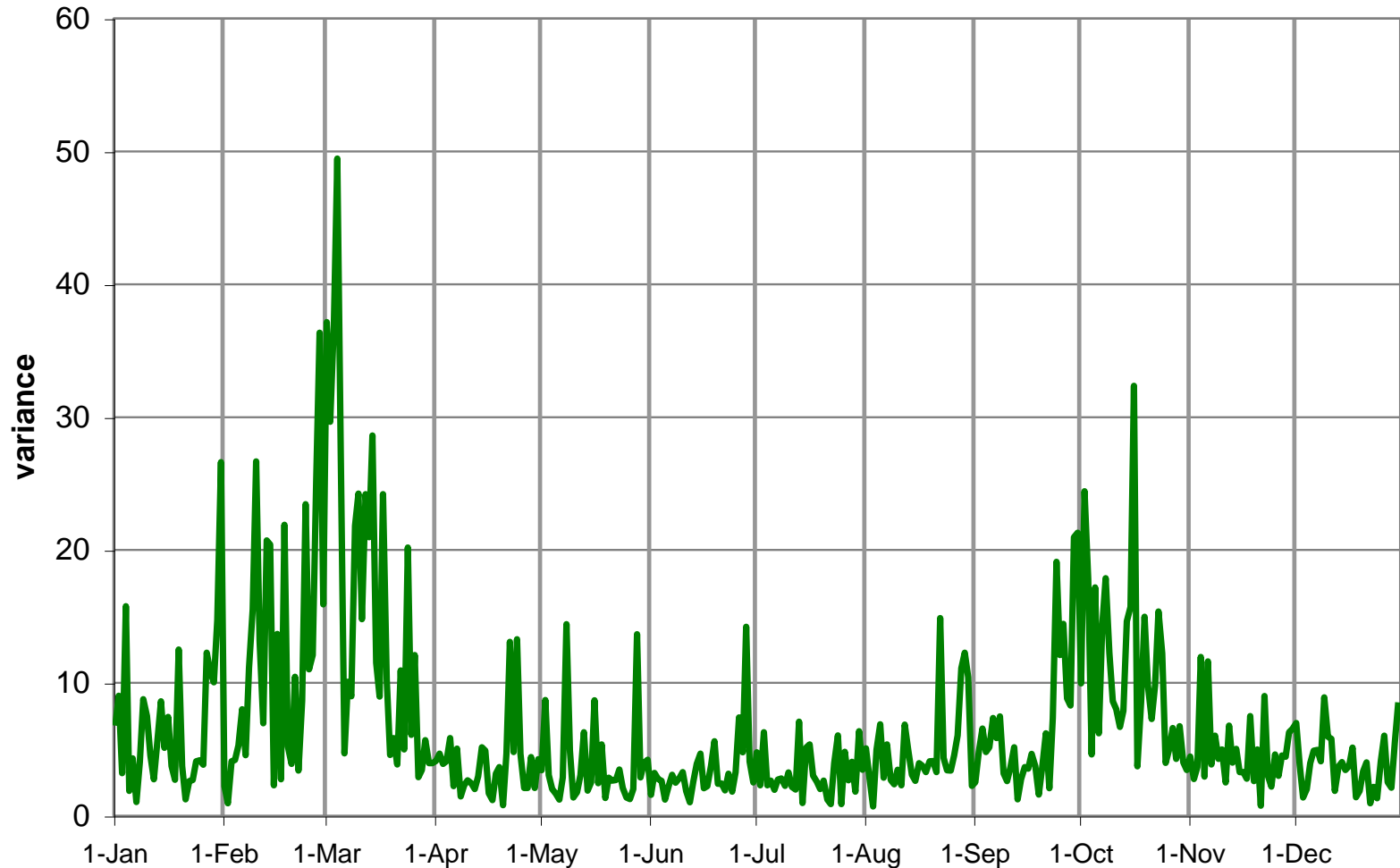


Nyungwe, Rwanda: hydrological year Tmax, Tmin and Rainfall rate 1996-2007
(9-day running means)



Nyungwe: Variance analysis suggests solar effects biasing TMax

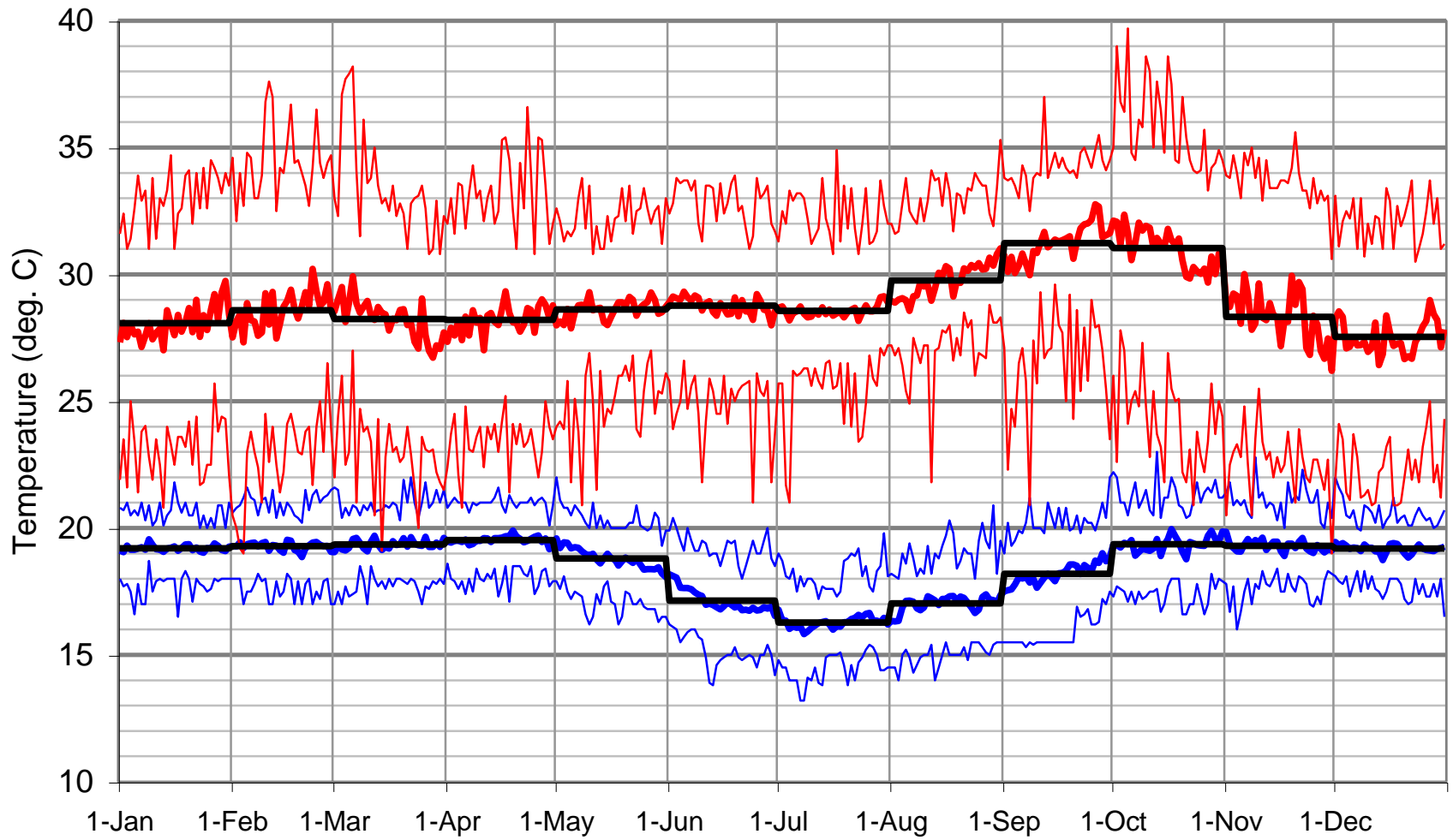
Nyungwe, Rwanda Variance of Daily Maximum Temperature



Working with informal data resources – an example from Mahale Mountains National Park, Tanzania

- 20-year daily climate records collected by Kyoto University Chimpanzee Research Project

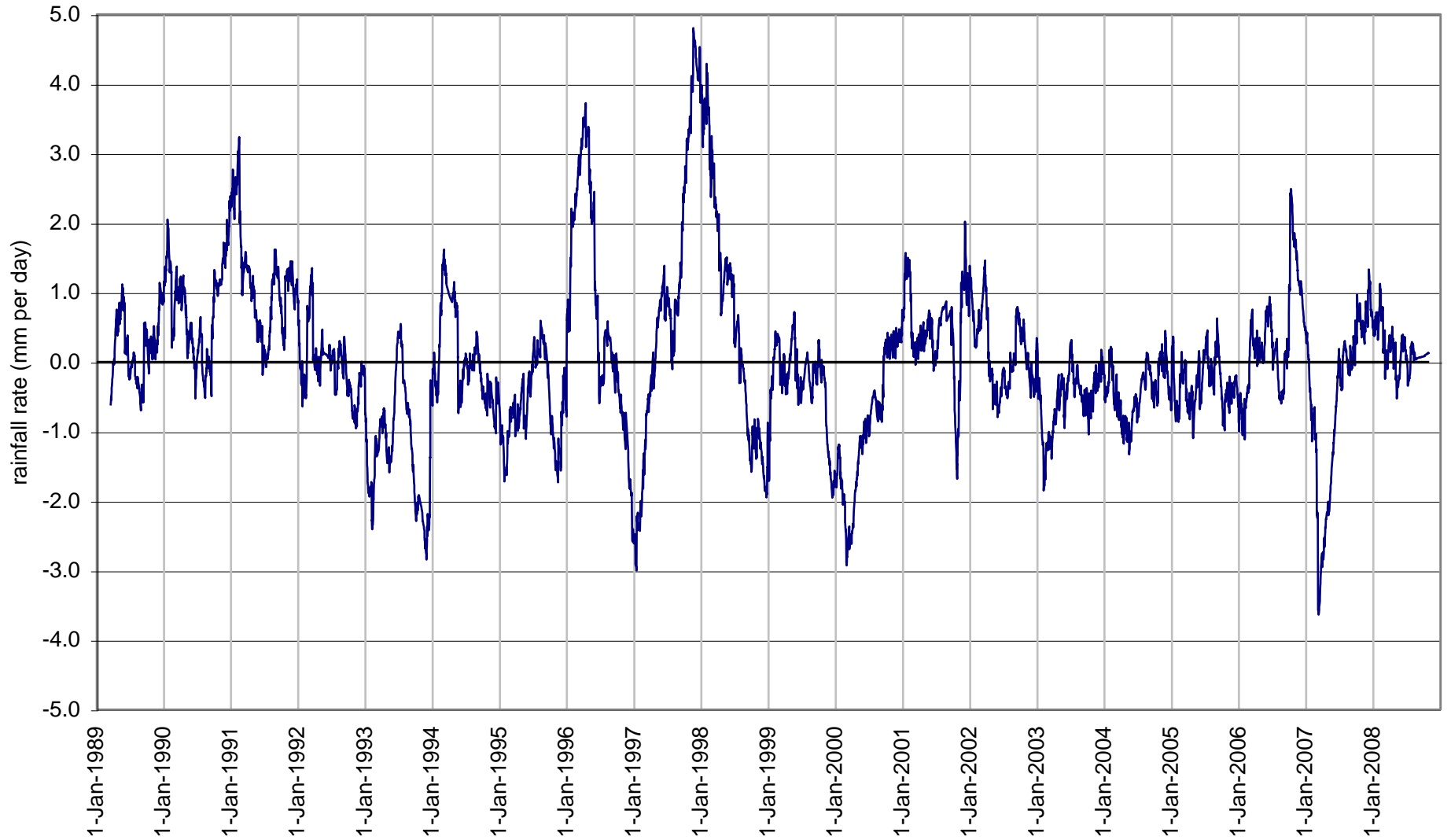
Mahale, Tanzania daily temperature climatology 1989-2008



— minimum — maximum — Series3 — Series4

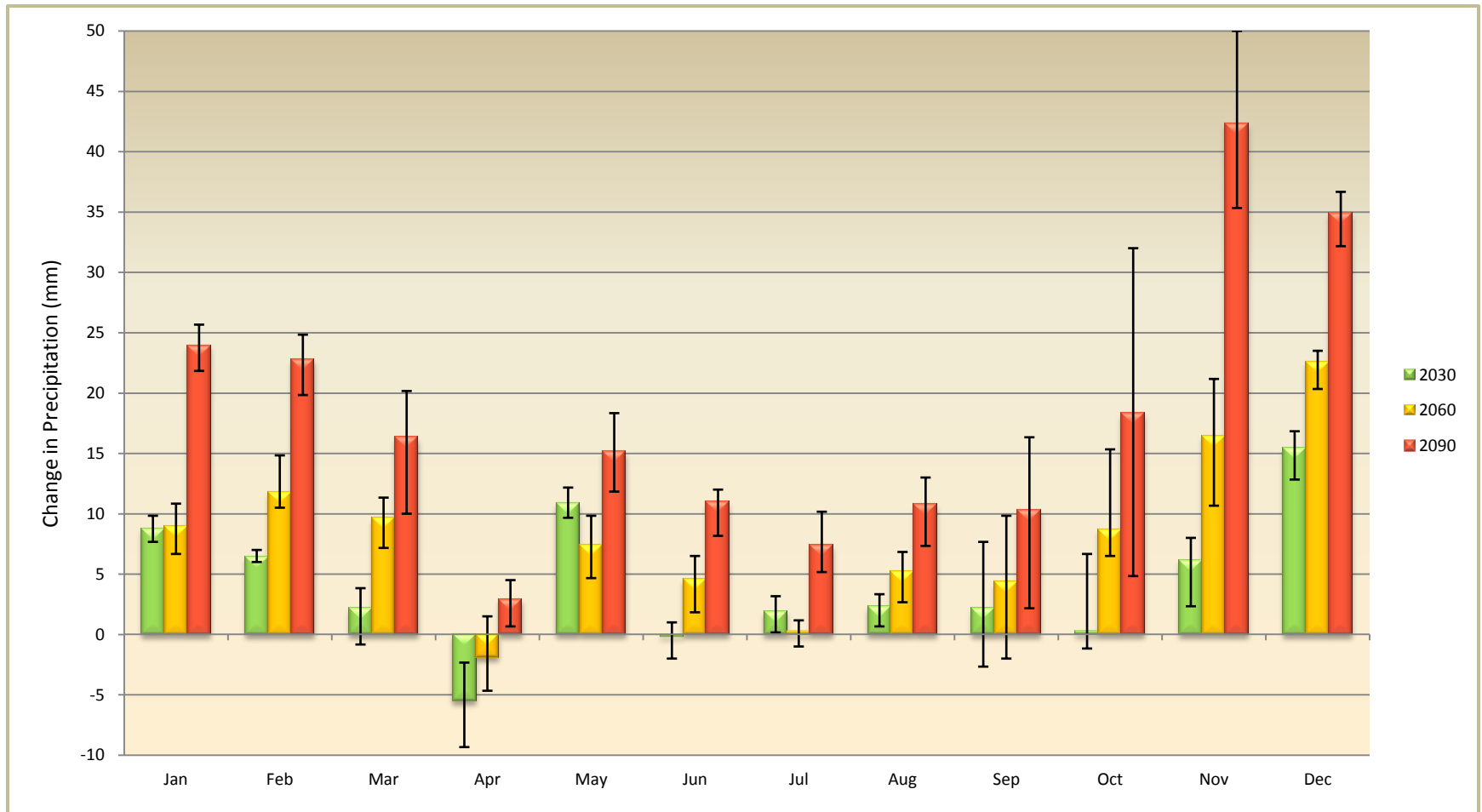
Mahale, Tanzania daily precipitation anomaly 1989-2008

5-month running average

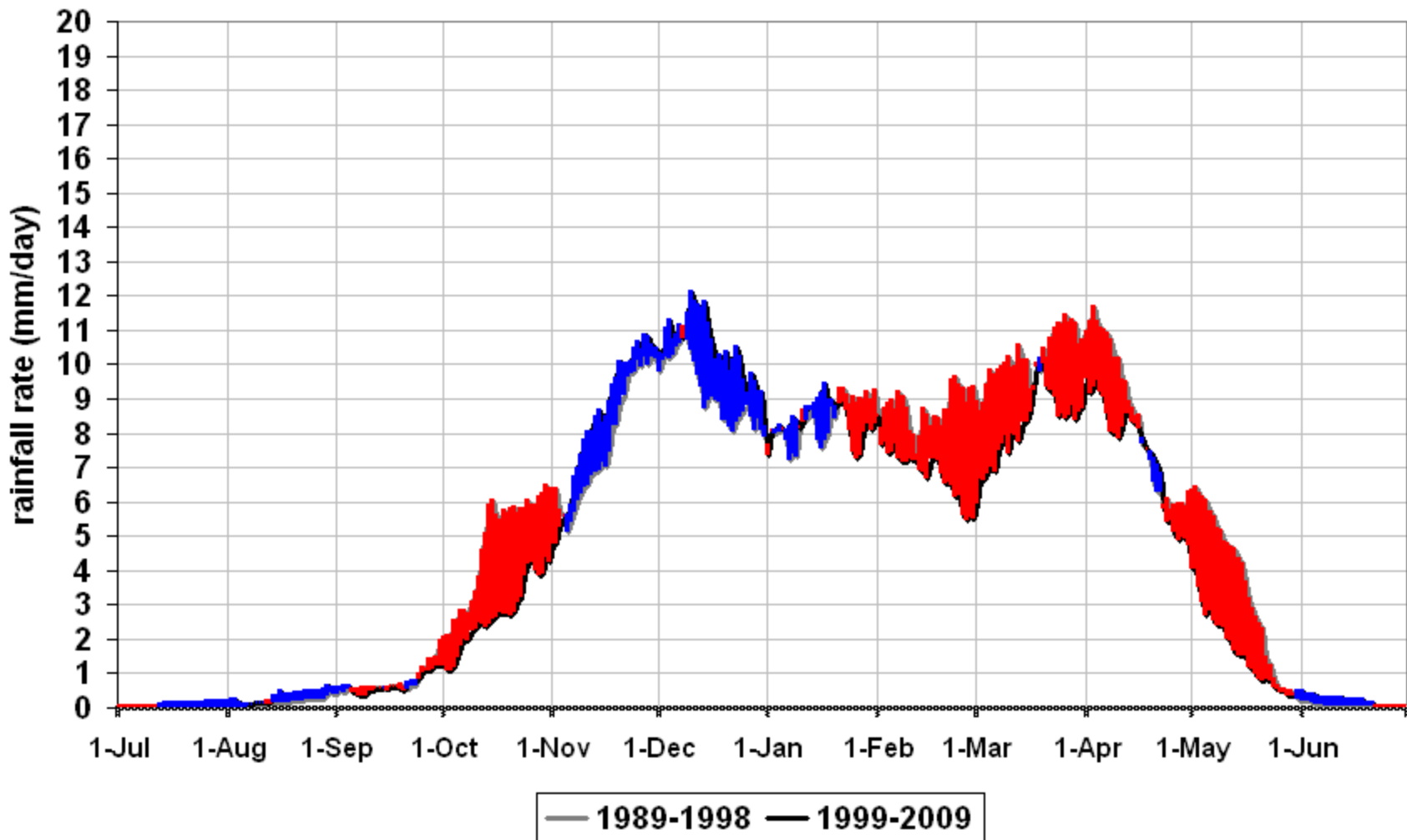


Mahale region precipitation change relative to 1990 baseline conditions

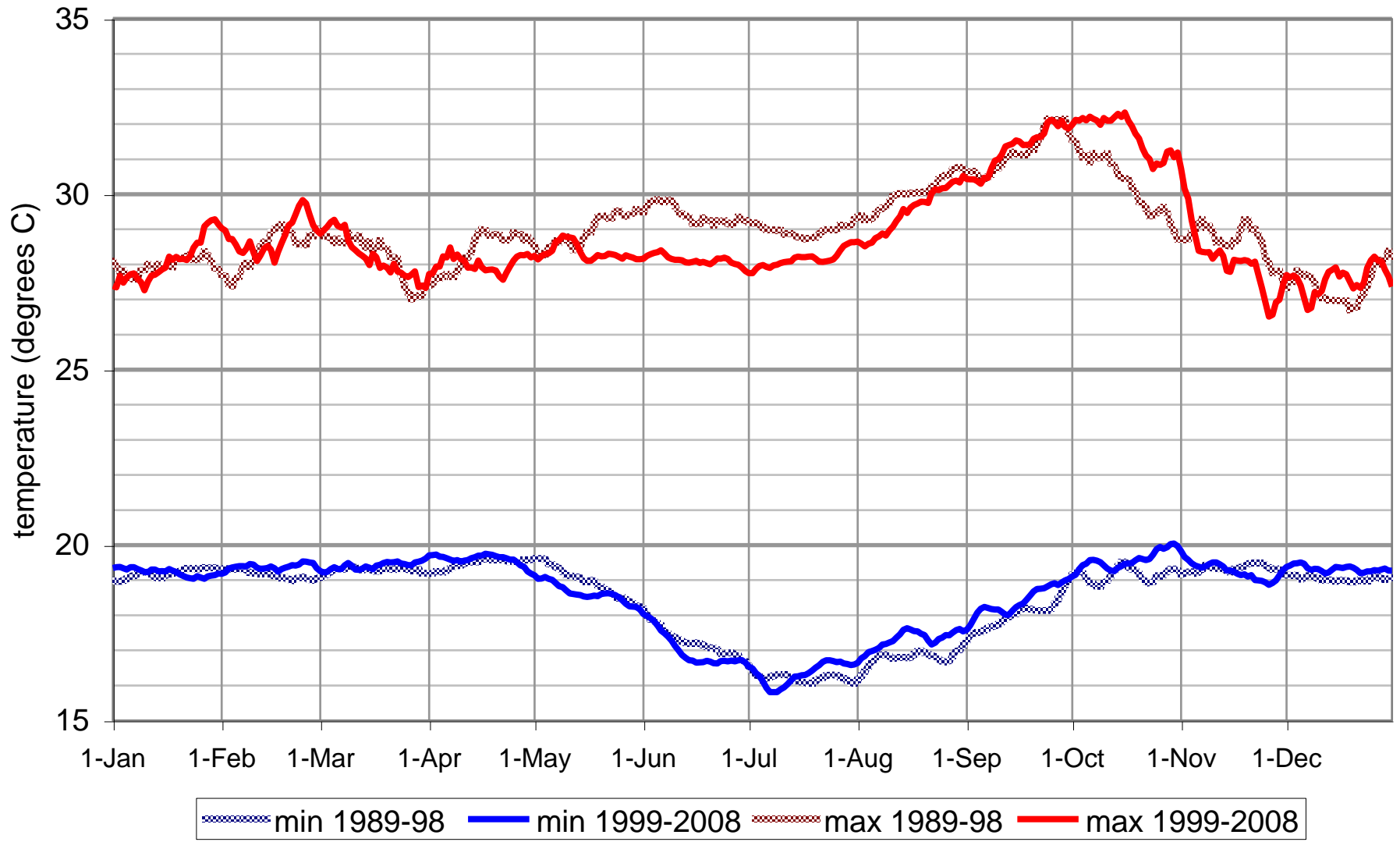
Output from the WCS Climate Assessment



Mahale, Tanzania hydrological year rainfall rate 1989-1998 vs. 1999-2008



Mahale, Tanzania - Split time series comparing daily temperature means
for 1989-1998 and 1999-2008



Climate is more than temperature and precipitation!

Sunshine/cloud cover variability – an example from South America

Cusco, Peru 42-year data shows strong seasonal and decadal variability

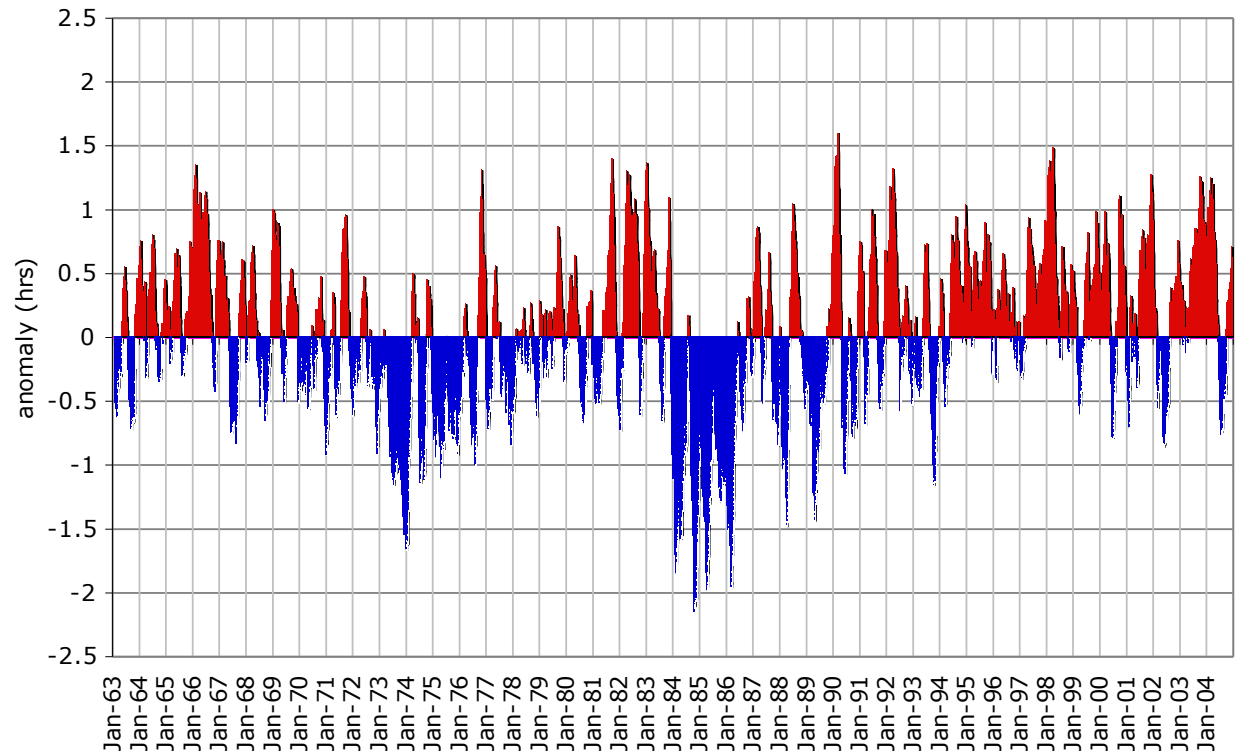
Very high amplitude: 3.5 hr per day difference between peaks

Almost totally unrecognized in literature

Major hydrological and ecological significance

Ecological significance?

...but is the signal real or biased by sampling error?



Cusco daily sunshine
hours compared to
long-term means 1942-
2004
90-day running mean

Lake Titicaca annual rise vs. summer sunshine hours in Cusco (inverted), 196
 $R=-0.84$

