Growing the African land surface air temperature record: by assimilation of short-segment time series

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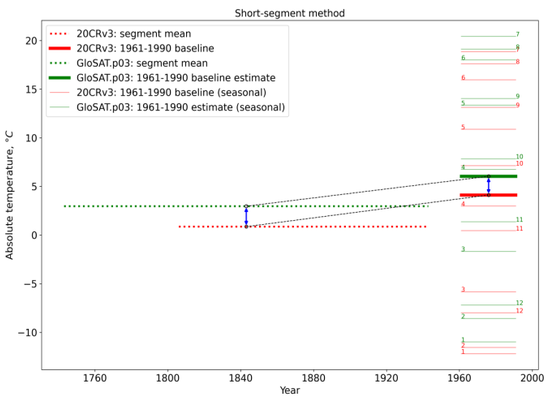
INTRODUCTION

- Africa is a climate-sensitive continent impacted by anthropogenic global warming. Its instrumental record helps provide important spatial coverage for NWP validation and the monitoring of climate change.
- However, CLIMAT reports of surface temperature observations from Africa suggest only ~50% of those expected are being incorporated in some global temperature databases. One main reason is short-segments that do not span the 1961-1990 baseline needed to calculate anomaly time series.
- To allow for the immediate incorporation of short-segment data we develop a method that refers to historic trends in 20th Century Reanalysis (20CRv3) to estimate the baseline.
- We evaluate the impact of inclusion of the 'missing' stations on the continent's temperature anomaly record.

SHORT-SEGMENT MODEL

1. We calculate the linear change in reanalysis from the short-segment period to the 1961-1990 baseline,
2. This is used to shift the segment mean temperature and estimate the 1961-1990 normal for each month of the year:

Station Normal (1961-1990) = Station Mean (segment)
– 20CRv3 Mean (segment)
+ 20CRv3 Normal (1961-1990)

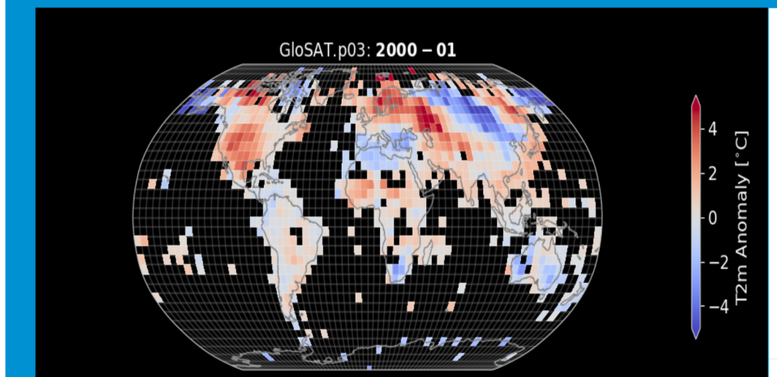


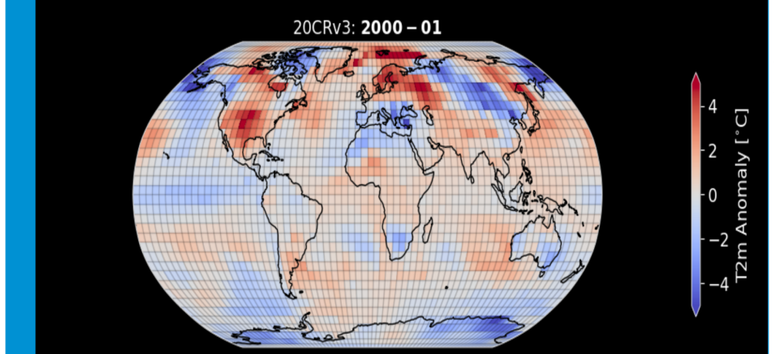
VALIDATION

Tests have been performed with segments taken from long and well documented time series including CET, Armagh Observatory and Adelaide. One caveat is that in early 20CRv3 the reanalysis is being driven mainly by SST extrapolation and is reflected by larger ensemble noise.

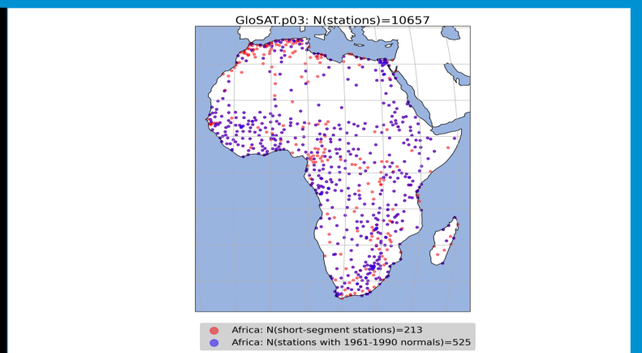
GloSAT
Global Surface Air Temperature

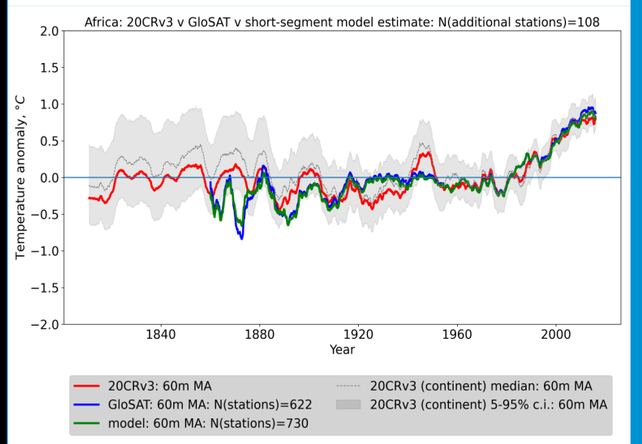
Reanalysis coupled with a **linear model** allows estimation of the 1961-1990 baseline for inclusion of many key short-segment **African land temperature** anomaly time series





GloSAT 2m temperature anomalies (from 1961-1990) and 20CRv3 gridded at 5°x5°





https://glosat.org

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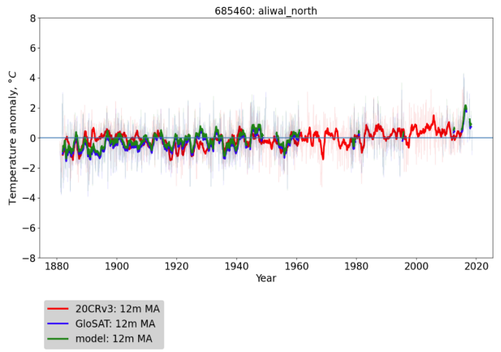
ANALYSIS

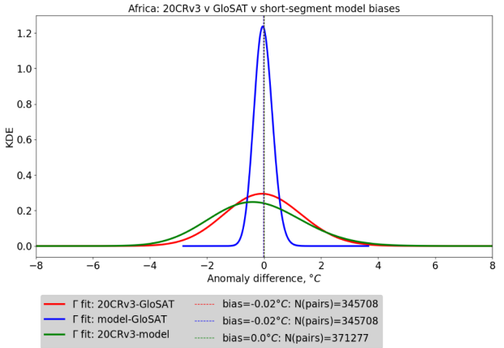
We use stations with 1961-1990 normals and full series anomalies as 'truth' (blue) to evaluate the model (green):



These additional short-segment anomalies help assess early segments of the reanalysis with African instrumental data.

RESULTS

The method allows calculation of anomalies for short-segments overlapping the start or end of 20CRv3 reanalysis (1806-2015). Continent wide short-segment bias is < 0.1 °C:



The African mean anomaly time series comparison (*central panel*) between gridcell extracted 20CRv3 and station data suggests that incorporation of short-segments gives recent trends warming faster than reanalysis, but that spatial sampling is still not sufficient to match the continental background reanalysis level. We also find significant divergence from reanalysis during 1890-1950 possibly due to exposure bias. Africa also has a number of islands in the Atlantic and Indian Ocean not included here because they are not in the reanalysis.

FUTURE WORK

- Application to the other continents in the global record.
- Assessment of potential impact on updating early reanalysis.
- Comparison with other methods using short-segment series.

Credits:
Reanalysis data: 20CRv3 via NCAR
Observations: GloSAT stations (CRU/UEA)