Generalized mapping-based precipitation calibration methodology for impacts modelling: a special look at the African regions

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**ECMWF main duty for QWeCI**

To develop a seamless prediction system from medium-range to seasonal scales. Final aim is to provide the best ("unbiased") possible forecast at any lead time independently of the forecast systems (short-range, varEPS /monthly, seasonal)
ECMWF forecasting system
In accessing products from different sources we ideally want .... seamlessly in
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Temperature

short range FC

longer range FC

Time

time

space
Main questions

- What are IFS problems over Africa and do we see them in the short-range, varEPS/monthly and seasonal forecast systems SYS3/SYS4?
- How are the performances of ERA-Interim over Africa?
- In other words, how “seamless” is the ECMWF over Africa?
Precipitation Bias for JAS 2006 from SYS3 Hindcast. Verification against GPCP-2.1

- Rainfall displaced South
- Confirmed by negative bias in TOA IR radiation (lack of stratocumulus clouds?)
The bias is robust, month by month, and year by year. This for the 2006 AMMA IOP.

An amalgamation of day 1 forecasts shows the same southerly shift for operational forecasts of JAS 2006 (recall cycle 31r1)
However, it is seen that the rainfall shifts northwards in the medium range: here at day 5.
However, it is seen that the rainfall shifts northwards in the medium range: here at day 10.

**Note that....**

The shift in rainfall as a function of the short range forecast indicates an imbalance between model climate and its analysis (spin-up/down)
Precip Biases in SYS4 (36R4)

Bias (model minus reference) for ECMWF with 15 ensemble members
Precipitation
Hindcast period 1981-2008 with start in May average over months 2 to 4

Precipitation Bias for JJA 1981-2006. SYS4 against GPCP-2.1 (Courtesy of Laura Ferranti)
Precipitation correction over Africa

Biases in ECMWF systems

The generalised mapping calibration

Conclusions

ERA-Interim over Africa: JJA

from Franco Molteni
ERA-Interim over Africa: June

Precipitation correction over Africa

Biases in ECMWF systems

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Conclusions

from Franco Molteni
ERA-Interim over Africa: July

prec anomaly in sah–1 [-17.5/25 ; 10/20] month = 7
\text{cor}[\text{EPS}, \text{GPCP(red)}/\text{ERA(or)}] = 0.45/0.10, \text{cor}[\text{obs}] = 0.01

\textbf{from Franco Molteni}
The GPCP-merge dataset

\[ G(1.0) = F(r)G'(1.0) \]

where:

\[ r = (E(1.0) + \epsilon)/(E'(1.0) + \epsilon). \]

\[ \epsilon = \max[0.1\langle E'(1.0)\rangle, 0.2\text{mm/day}]. \]

- \( E(1.0) \): ERA-interim at 1° resolution (on daily-GPCP grid)
- \( E(2.5) \): ERA-interim aggregated on 2.5° grid
- \( E'(1.0) \): ERA-interim bi-linear interpolated from 2.5° onto 1.0°
- \( G(2.5) \): GPCP original pentade data on 2.5° grid (original dataset)
- \( G'(1.0) \): GPCP bi-linear interpolated from 2.5° onto 1.0°
- \( G(1.0) \): Merging of GPCP and ERA-interim on 1.0° grid
The inaccuracy of the delivered precipitation estimations needs to be corrected while awaiting for improved models (i.e. physics, availability of new observations, improvements in data assimilation ...)

Biases are different across model cycles and at different lead times. Without any calibration, products could be inconsistent in time.

**Note therefore ....**

The emphasis is on model ensemble mean bias (and its correction for impacts), not on model skill (which for example improved recently with ocean observation network in Atlantic or improvements in the physical package).
The mapped EOFs can also be thought as a spatial "correction" mask.

- Uses a **GPCP-based dataset** as observation dataset but can use any available dataset.
- It is applied to pentad (5 days average) precipitation anomalies.
- It is applied separately to sub-regions “homogeneous” in terms of precipitation synoptic “to maximise” the model skills.
Africa MacroRegions definition

- Each location is represented by a set of 10 coordinates which are the principal components (PCs) of monthly mean rainfall anomalies over Africa from GPCP-2.1 for all months in years 1979-2008.
- The K-means method uses the 10-dimension time-dependent coordinates to define clusters of grid points with coherent time variability,
- There is no constraint in the clustering method about geographical proximity, so the geographical boundaries of the cluster regions are only originated by the 'closeness' of the anomaly time series.
Overview of correction performance

Precipitation correction over Africa

Biases in ECMWF systems

The generalised mapping calibration

Conclusions
The 2009 Ghana Floods
Comparing the climatology with what happened ...
Conclusions

- highlights needs for automated bias correction for impacts applications, especially considering frequent system updates.
- A new generalised mapping technique has been tested to calibrate precipitation over Africa from 1 to 5 pentade lead time (Monthly time scale) and will be extended to be applied to SYS4
- The technique is constructed to reshape the predicted precipitation anomaly to spatially “map” the observed precipitation
- It has to be stressed that the reshaping takes place only if the model possess some predictive skills.
- Instead being based on EOF mapping and not on PC mapping it cannot corrected for time shift.