Sub-seasonal and seasonal predictions of monsoon variability in the ECMWF ensemble forecast systems

F. Molteni, L. Magnusson, F. Vitart, L. Ferranti
European Centre for Medium-Range Weather Forecasts
Outline

• Predictions of monthly mean values of rainfall over India and the Sahel in the June-September season from ECMWF System-4 for the first and second month of integration

• Impact of errors in the amplitude of anomalies on seasonal skill for the early part of the Indian monsoon season

• Model biases for the JJA season in recent ECMWF model cycles and sensitivity to a new aerosol climatology

**System-4**: ECMWF operational seasonal forecast system since Nov. 2011:

- Seasonal re-forecasts with IFS-36r4 T255 (~80 km) + NEMO v3.1 (1-deg), 30 years, IC from 1st day of each month, 15 members (extended to 51 members for Feb, May, Aug, Nov IC)
All-India rainfall: anomalies for AIR = 1 sd (GPCP2.2)
All-India rainfall, June & July: Sys-4, fc. month 1

June
ac = 0.57

cov (air, prec)

July
ac = 0.57

cov (air, prec)
All-India rainfall, June & July: Sys-4, fc. month 2

June

ac = 0.38

cov (air, prec)

July

ac = 0.30

cov (air, prec)
All-India rainfall, Aug & Sept: Sys-4, fc. month 1

August
ac = 0.48
cov (air, prec)

Sept
ac = 0.65
cov (air, prec)
All-India rainfall, Aug & Sept: Sys-4, fc. month 2

August
ac = 0.29

Sept
ac = 0.51

Predictions of monsoon variability, S2S Monsoon Workshop, June 2015
Sahel rainfall: anomalies for AIR = 1 sd (GPCP2.2)
Sahel rainfall, July: Sys-4, fc. month 1 and 2

\[ \text{ac} = 0.68 \]
\[ \text{cov} \ (\text{sah, prec}) \]

\[ \text{ac} = 0.50 \]
\[ \text{cov} \ (\text{sah, prec}) \]
Sahel rainfall, August: Sys-4, fc. month 1 and 2

\[ \text{ac} = 0.89 \]
\[ \text{cov (sah, prec)} \]

\[ \text{ac} = 0.39 \]
\[ \text{cov (sah, prec)} \]
Sahel rainfall, September: Sys-4, fc. month 1 and 2

\[
\text{ac} = 0.81
\]

\[
\text{ac} = 0.49
\]
### Skill (AC) of Sys-4 forecasts from 1 May

<table>
<thead>
<tr>
<th></th>
<th>June</th>
<th>July-Aug</th>
<th>Jun-Jul-Aug</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>AIR</strong></td>
<td>0.38</td>
<td>0.30</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Sahel</strong></td>
<td>0.63</td>
<td>0.61</td>
<td>0.60</td>
</tr>
</tbody>
</table>

**No AC gain from 3-month averaging!**
U 850 U-wind bias in Sys-4 and recent IFS cycles
Impact of new aerosol climatology on JJA rainfall bias

from A. Bozzo, P. Bechtold, L. Magnusson

Bias, current aerosol clim

New clim (from MACC) – current clim
Summary

- The ECMWF System-4 shows considerable skill in the predictions of the West African monsoon, both in terms of monthly means in the first two months, and for the whole summer season. Skill for the Indian monsoon is significantly lower, although useful skill is present in the first month of the forecast and for September.

- System-4 overestimates rainfall interannual variability over India in June, while variability in July and August is lower than observed. As a consequence, June anomalies get too much weight in JJA-means of All India rainfall.

- For predictions started on 1 May, looking at June and July-August rainfall separately provides more skill than using JJA averages, especially over India.

- Tropical wind biases in recent ECMWF model cycles remain comparable to those in System-4. However, recent experiments with an updated aerosol climatology show significant improvements in wind and rainfall bias over South Asia.