Sub-seasonal rainfall predictability types over South Asia and the global tropics

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Outline

- 1. Hypothesis: Low week 3-4 skill in monsoonal precipitation over tropical land areas can be understood in terms of observed daily rainfall characteristics, in particular their small spatial scales and high intensities.
 - We analyze ECMWF model reforecasts of week 3-4 precipitation from the S2S database, together with observed GPCP rainfall.
- 2. SubX Real-Time Calibrated MME Maproom product for weekly and biweekly precipitation and temperature forecasts.

Examples over South Asia.



Methods & Data **S2S Tropical Rainfall Predictability Types**

- Observed daily gridded rainfall amounts: GPCP-1DD product $(1^{\circ} \times 1^{\circ}, daily, version 1.3)$ from 1 October 1996 to 31 December 2017 [blends satellite estimates and rain-gauges].
- S2S reforecasts of Weeks 3–4 (days 15–28) accumulated rainfall from the ECMWF model $(1.5^{\circ} \times 1.5^{\circ}; 11$ -members, 105 twice-weekly start dates each year 1998–2017).
- Week 3–4 Skill: Spearman correlation of ECMWF ensemble mean vs GPCP-1DD on 1.5° grid.
- **Potential Predictability:** mean Spearman correlation between anomalies of each run vs the ensemble mean.
- **Rainfall Predictability Types:** K-means clustering of land gridpoints according to 7 observed daily rainfall characteristics (including spatial scales & filtered temporal variances).





S2S Weeks 3–4 Model Skill and Potential Predictability



Dry seasons excluded: Calendar weeks where the reforecast week 3-4 climatological mean <1mm/day are omitted.

- Skill generally low over land, incl. S Asia
- Pot. Pred. exceeds skill
- pattern correlation over land = 0.72





Spatial Scales of Biweekly Observed Rainfall

Size of area around each grid point with Spearman spatial correlation exceeding 0.37 (1/e)



Moron & Robertson (2020, npj)

• Spatial scale of biweekly observed rainfall anomalies are generally much lower over land than ocean. • Patterns of observed rainfall scale and model skill are strongly associated.





Observed Daily Rainfall Characteristics





2.3 2.7 3.3 4.2 7.6 1.6 1.9 31 .9 1.3 0



4 11

33

35

37

30



Moron & Robertson (2020, npj)

115 124 220 83 89 95 102 108 77

Intraseasonal (20-90 days) Variance (%) 24 35 18 19 22 14 15 21



41

43

47

55

78

 (\mathbf{IRI})

39

Over S Asia:

- **High intensities** and large subweekly variability
- **Daily wet patch** size relatively large
- Substantial subseasonal variance





Rainfall Predictability Types over Land Six clusters of land points according to 7 <u>observed</u> rainfall characteristics





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SubX Real-Time Calibrated MME Maproom Precipitation Example: Aug 7, 2020



map shows a verification of the forecast as the observed tercile values according to the 1999-2014 training period of the calibration of the forecast.

http://iridl.ldeo.columbia.edu/maproom/Global/ForecastsS2S/

Issued every Friday **Based on 3 NOAA** models: CFSv2, GEFS, **ESRL-FIM Calibrated using** extended logistic regression



Precipitation Hindcast Skill: August Ranked Probability Skill Score (RPSS)



Over S Asia, some skill at weeks 2–3 but little at weeks 3-4

Skill is somewhat higher in June-July













Summary

- - prospects for skillful prediction during strong ISO events.

[Moron, V., and A.W. Robertson, 2020: npj Climate and Atmospheric Science; https://doi.org/10.1038/ <u>s41612-020-0107-3</u>]

- Friday, based on three SubX models, in a tercile-category probability format.
 - Calibrated using extended logistic regression.
 - Past and current forecasts can be browsed.
 - forecasts of opportunity.

http://iridl.ldeo.columbia.edu/maproom/Global/ForecastsS2S/

1. Low week 3-4 skill in monsoonal precipitation over land can be understood in terms of the observed characteristics of rainfall variations, and in particular their small spatial scales and high intensities.

• Over South Asia, S2S reforecast skill is relatively low, while potential predictability is moderate. Observed spatial scales are comparable to other land areas but daily intensities are very high.

• However the ISO variance band is relatively strong, especially in the 7-20 day range, elevating the

2. IRI issues multi-model real-time forecasts of weekly and biweekly precipitation and temperatures every

• Successful forecast cases are highlighted which provide a basis for further analysis to identify skillful

