Transmuting S2S Forecasts into Applications

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ECMWF, Reading, April 5th, 2019
Outline

1. Introduction

2. A good S2S forecast is a skillful S2S forecast

3. What? Combining seasonal and sub-seasonal forecasts to predict rainfall characteristics?

4. Predictions in flexible format and Forecast-based Financing (FbF)
1. Introduction

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**transmute**  
\verb|trans·mute|  
**Definition of transmute**

**transitive verb**
1 : to change or alter in form, appearance, or nature and especially to a higher form

2 : to subject (something, such as an element) to transmutation

**intransitive verb**
: to undergo transmutation
Introduction

- Generate climate information and knowledge - learn from the past, monitor the present, forecast the future.
- Translate the climate knowledge into information that is relevant to agriculture, public health and other target sectors.
- Transfer the translated information to the appropriate beneficiaries, in formats and media most useful to their operations.
- Put the translated and transferred climate knowledge to use in operational decision processes, policies and plans. Learn what works and what doesn’t.

Vaughan and Dessai (2014); IRI Comms
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The Seasonality of Sub-Seasonal Skill

Muñoz et al. (in prep)

Init: Jan

worse than clim

2AFC

better than clim

Init: Jul
The Seasonality of Sub-Seasonal Skill

Muñoz et al. (in prep)
Why do we need to calibrate?
Why do we need to calibrate?

Conditional Bias (errors in patterns of variability)

Important climate features may be displaced in GCMs relative to observations: *Systematic spatial biases*
PyCPT

Python interface for IRI’s Climate Predictability Tool (CPT), a widely used research and application Model Output Statistics/Prediction toolbox.

Publicly available: GitHub.

Automatically downloads required observations (CHIRPS, TRMM, CPC Unified) and S2S model data from the IRI Data Library (S2S Database and SubX – ECMWF, CFSv2, GEFS, others are being included).

Computes climatologies, anomalies, a variety of skill metrics (uncalibrated and PCR/CCA-calibrated hindcasts) and probabilistic sub-seasonal forecasts.

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- NOAA NA16OAR4310145 (Robertson)
- NOAA NA18OAR4310275 (Muñoz)
- Columbia World Project “ACToday”
CFSv2 Rainfall. Init: ~14 March 2019

NoMOS

PCR

CCA

Turkington et al. (in prep)
Turkington et al. (in prep)

ECMWF Rainfall. Init: 14 March 2019

IIRF Climate and Society

International Research Institute
Earth Institute | Columbia University
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Weather-typing

Several weather-typing codes, in MatLab and Python.

PyWR

Python script to compute weather types/regimes using K-means. Model weather types are projected into the observed ones in the EOF space.

Authors:
James Doss-Gollin (jdoss-gollin@columbia.edu) and Ángel G. Muñoz (agmunoz3@columbia.edu)

Download Data
Download ERA5 and re-forecast data, 5-day running average and native climatology/ anomalies already computed using the PyWR Data Library (see link for details)

Dimension Reduction
We need to choose a percentage of variance explained that we will require:

EOF Retained

Reanalysis Weather Typing
Now we perform the clustering. We will manually specify the number of clusters we want to create and the number of simulations we want to run:

Model Weather Types
Now, for each ensemble member, calculate the weather types by projecting the model geopotential height anomaly fields onto the reanalysis regime and assigning each day of the forecast to the closest centroid in terms of Euclidean distance. The model anomaly fields are first calculated by first taking 5-day running averages and then subtracting the thickened climatology on a daily basis. The anomalies are then projected into the reanalysis EOFs and the distances then calculated in EOF space.
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https://github.com/agmunozs/Weather-typing
We use vCAPE in the yellow box and $k$-means to identify the circulation patterns (a)-(c), with vectors showing wind anomalies at 850mb; (d)-(f) are rainfall anomaly composites. Data: 20thC reanalysis, at daily resolution (1981-2015).

Analysis based on CAPE transport (Muñoz et al., 2016a; Alfaro et al., 2017).
Circulation Regimes: temporal evolution

Muñoz et al (2015; 2016b)
Muñoz, Carvalho and Vecchi (in
Circulation Regimes and Rainfall
Circulation Regimes: predictability

Candidate predictors: $f(\partial_t F, F_{onset})$, $f(\partial_t F, F')$
Predictability of Rainfall Characteristics

Candidate predictors: $f(\partial_t F, F_{onset})$, $f(\partial_t F, F)$
Combining Seasonal and Subseasonal Predictions

Candidate predictors:

Seasonal

Sub-seasonal

Multi-layered S2S forecast system

Candidate predictors: $f(\partial_t F, F, \text{onset})$ $f(\partial_t F, F)$
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Predictions in Flexible Format
Forecast-based Financing Maproom
Forecast-based Financing Maproom

Python Interface for the Data Library Maproom!
Summary

1. A good S2S forecast is a skillful S2S forecast

2. Some benefits in combining seasonal and sub-seasonal forecasts to predict rainfall characteristics

3. Advantages in predictions in flexible format
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