CPC SubX: Progress to date

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More information: http://cola.gmu.edu/kpegion/subx/about.html

What is SubX?

The Subseasonal Experiment (SubX) is a NOAA/Climate Testbed project focused on subseasonal predictability and predictions. Six global models are producing seventeen years of ensemble retrospective forecasts initialized weekly to investigate subseasonal prediction and predictability. Additionally, one-year of real-time predictions will be produced and provided to the NOAA/NWS Climate Prediction Center as additional guidance for their week-3/4 outlooks. The project will test the skill of individual prediction systems as well as multi-model combinations.

The Objectives

- Collecting and serving data both internally at CPC for use by operational forecasters and for the external community via the IRI data library
- Providing a baseline verification particularly for the weeks 3-4 temperature and precipitation probability forecasts
- Evaluating the skill of individual model systems
- Investigating multi-model combinations including selecting suitable models, optimizing the design of the system, and evaluation of the prediction products
- Enhancing communications between operational forecasts and the model forecast producers
- Participation in the NOAA/MAPP S2S Task Force (http://cpo.noaa.gov/Meet-the-Divisions/Earth-System-Science-and-Modeling/MAPP/MAPP-Task-Forces/S2S-Prediction-Task-Force)

The Models and Data

Model	Hindcast Period	# Members	Perturbation Methodology	Lead (days)	Atm	Ocn	Sea Ice	Land
NCEP/CFSv2	1999-2010	4/day	Time-lagged 0,6,12,18Z each day	45	T126L64 ICs CFSR	MOM4L40 0.25 deg EQ, 0.5 deg global ICs CFSR	Same as Ocn	NOAH ICs GLDAS
NCEP/GEFS	1999-2015	20	EnKF & ETR	35	T574L64 for 0-8 day & T382 for 8-35 day ICs Atm DA	N/A	N/A	T574 ICs GDAS
ECCC GEM	1995-2014	4	random isotropic perturbation	32	0.45x0.45 deg; 40 levels; ICs from ERA-Interim	N/A	N/A	Offline SPS forced by ERA-Interim
NASA GEOS-5 AOGCM	1981-2015	10	scaled difference of two consecutive days of analysis	45	GEOS5~1/2 degree horizontal resolution,; 72 vertical layers ICs from MERRA2	MOM5 ~ 1/2 deg horizontal resolution, 40 vertical layers ICs GMAO Ocn Analysis	CICE ICs GMAO Ocn Analysis	Catchement Land Sfc Model ICs MERRA-2 precipitation corrected
Navy Earth System Model	1999-2015	4	time-lagged	45	NAVGEM-T0299L50 ICs atmos DA	HYCOM-0.08 deg; 41 vertical layers ICs from Ocn/Ice reanalysis	CICE4-0.08 deg ICs from Ocn/Ice reanalysis	Inline NAVGEM T0299 ICs from Agrmet
NCAR/CCSM4	1999-2015	3 or 4 per day	time-lagged	45	0.9x1.25deg L26	POP(g0.1deg global with 0.25 lat res in deep tropics	same as ocean	same as atmosphere
NOAA/ESRL FIM HYCOM	1999-2014	4 per week	time-lagged 12Z & 18Z Tues; 00Z & 06Z Wed	32	~30km w/64 vertical layers; ICs from CFSR	N/A	N/A	NOAH land sfc model; ICs from CFSR

CPC Priority 1 variables:

On 500 and 200 hPa levels

Variable	CF Standard Name	Abbrev	Unit	Frequency
Geopotential Height	geopotential_height	zg	m	Average of Instantatneous values at 0,6,12,18Z

On 850 and 200 hPa levels

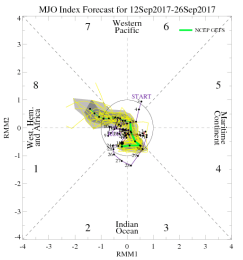
Variable	CF Standard Name	Abbrev	Unit	Frequency
Zonal Velocity	eastward_wind	ua	ms-1	Average of Instantatneous values at 0,6,12,18Z
Meridional Velocity	northward_wind	va	ms-1	Average of Instantatneous values at 0,6,12,18Z

On a single level

Variable	CF Standard Name	Abbrev	Unit	Frequency
2m Temperature	air_temperature	tas	K	Daily Average
Precipitation	precipitation_flux	pr	kgm-2s-1	Accumulated every 24hrs
Surface Temperature (SST+Land)	surface_temperature	ts	K	Daily Average
Outgoing Longwave Radiation at top of Atm	toa_outgoing_longwave_flux	rlut	Wm-2	Accumulated every 24hrs

Future CPC Products

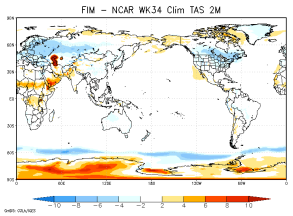
- Probabilistic forecasts (eg, Week 3-4 Outlooks)
- Probability of Exceedence (POE) forecasts and extremes
- MJO forecasts (see example right), possible teleconnections
- Evaluation of the hindcasts
  - Deterministic: Correlation, MSE
  - Probabilistic: Brier Skill Score, Heidke Skill Score, Reliability, Rank Probability Skill Scores
- Evaluation of realtime pseudo-operational forecasts
- Calibration of probabilities; ensemble regression as a baseline

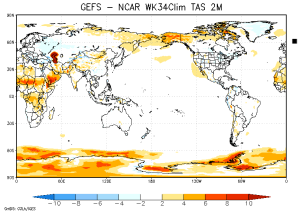


Climatologies and Figures – Harvey and Irma

We anticipate future work on estimating climatologies (see Science Questions), however as an initial approach we generally followed these steps for each model:

- Average across lead days for n members initialized on the same day
- Average across years in the hindcast for each available date
- Smooth with a 31-day triangular weighted moving average

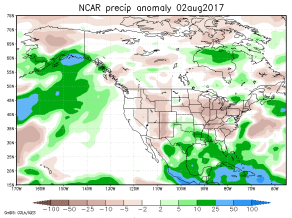


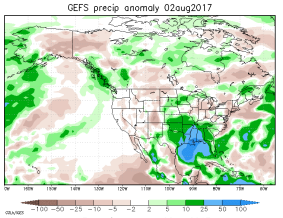


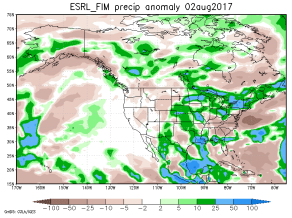
On the left:

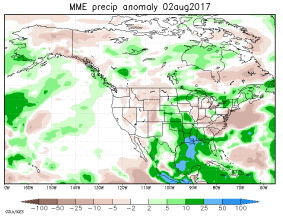
Difference in weeks 3-4 climatology for July 12 initializations:

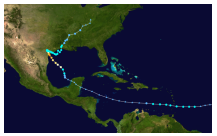
- **ESRL minus NCAR (left, top)**
- **GEFS minus NCAR (left, bottom)**



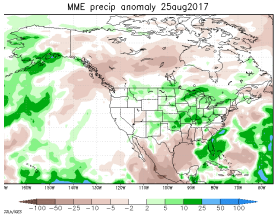








Harvey Storm track (above, wikipedia)
Weeks 3-4 ahead of Harvey (left)
Weeks 3-4 ahead of Irma (below)



Science Questions

- Bias correction and probability calibration
- Consolidating of the MME
  - Accounting for varying skill of models and model weighting
  - Possibly Bayesian Model Averaging
- Skill-spread relationships (spread within individual model ensembles and spread between models)
- Non-stationarity of model skill and bias (possibly related to climate change and/or ENSO/internal variability)