

# The Subseasonal Experiment (SubX)

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*Pegion, K. and Co-authors, 2018: The Subseasonal Experiment (SubX): A multi-model subseasonal prediction experiment, to be submitted to BAMS*



**MAPP**  
Modeling, Analysis,  
Predictions, and Projections





- Multi-model
- Monthly
- Re-forecasts & Forecasts
- Research & Predictions (R2O)



- Collection of NOAA MAPP Pls
- Collaboration to understand S2S predictability & prediction
- Uses data from other S2S Projects



- Multi-model
- Subseasonal (weekly)
- Re-forecasts & Forecasts
- Research & Predictions (R2O)



- International project
- Operational models
- Re-forecasts & Forecasts (delayed)
- Research

# What is Unique about SubX?

**Forecasts available in  
real-time**



Supports potential  
use in real-time  
applications

**Research models  
included**



Facilitates model  
development &  
improvements



# SubX BY THE NUMBERS

**7** Global Models

**1+** Years of *Real-time*  
Forecasts

**17** Years of  
*Retrospective* Forecasts

**3-4** week guidance  
for Climate Prediction  
Center Outlooks

# The SubX Team

## CORE TEAM

Ben Kirtman  
Kathy Pegion  
Tim DelSole  
Michael Tippett  
Andy Robertson  
Michael Bell  
Robert Burgman  
Jon Gottschalck  
Dan Collins  
Emerson LaJoie  
Hai Lin

## NCEP-CFSv2

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Eric Sinsky  
Hong Guan

## NASA-GEOS5

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Randy Koster  
Lena Marshak

## ECCC-GEM

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Normand Gagnon

## Navy-ESM

Neil Barton  
Joe Metzger

## NCAR-CCSM4

Ben Kirtman  
Dughong Min  
Kathy Pegion  
Ray Bell

## ESRL-FIM

Shan Sun  
Stan Benjamin  
Ben Green

# SubX Protocol

- Prediction System Details up to Provider
- Real-time and Retrospective Systems Identical
- Reforecast Period: 1999-2015
- At Least 3 Ensemble Members
- Minimum Length: 32 Days
- Real-time Forecast Made Available to CPC  
*Every Thurs by 6am of Every week*
- Data on Uniform 1x1 Grid

# SubX Models

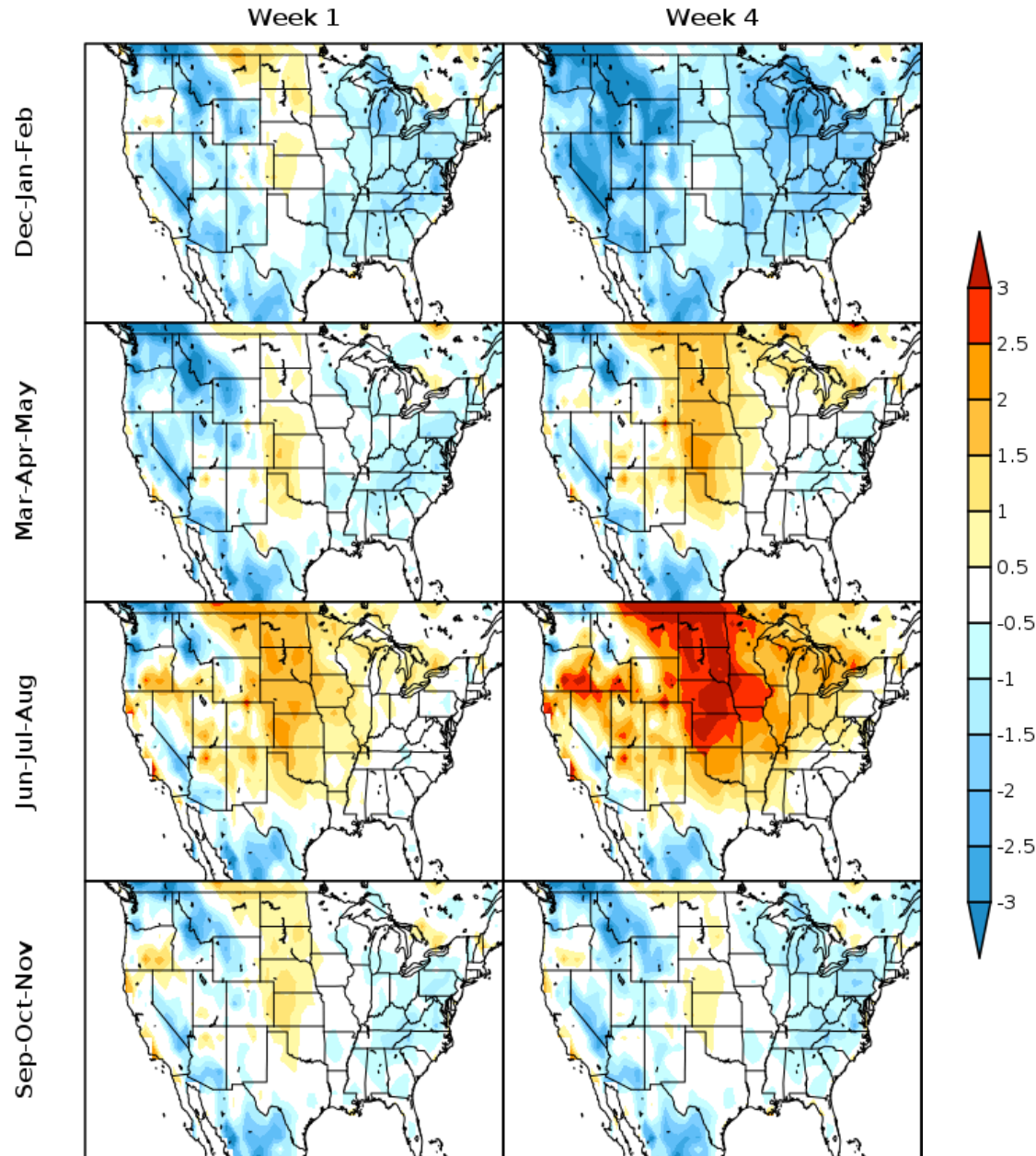
| Model       | Components | Ensemble Members | Length (Days) |
|-------------|------------|------------------|---------------|
| NCEP-CFSv2  | A,O,I,L    | 4                | 45            |
| EMC-GEFS    | A,L        | 11 [21]          | 35            |
| ECCC-GEM    | A,L        | 4 [21]           | 32            |
| GMAO-GEOS5  | A,O,I,L    | 4                | 45            |
| NRL-NESM    | A,O,I,L    | 4                | 45            |
| RSMAS-CCSM4 | A,O,I,L    | 3 [9]            | 45            |
| ESRL-FIM    | A,O,I,L    | 4                | 32            |

## **SubX Current Status & On-going Activities**

- ✓ Re-forecast & real-time forecast database
- ✓ Real-time forecast maps
- ✓ Real-time forecast data to NCEP/CPC
- ✓ Re-forecast Evaluation: probabilistic and deterministic skill, bias
- ✓ Sources of predictability/phenomena: MJO, NAO



# SubX Multi-model Biases 2m Temperature

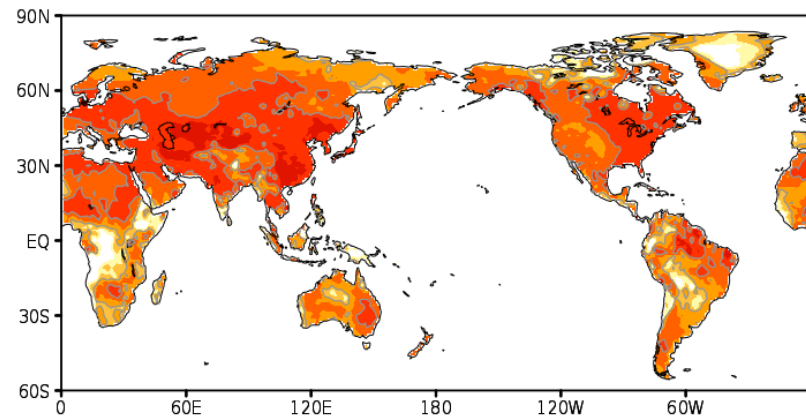


- Bias patterns established in week 1, grow into week 4
- Summer warm/dry bias
- MME bias is smaller than individual models

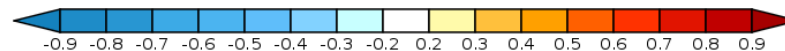
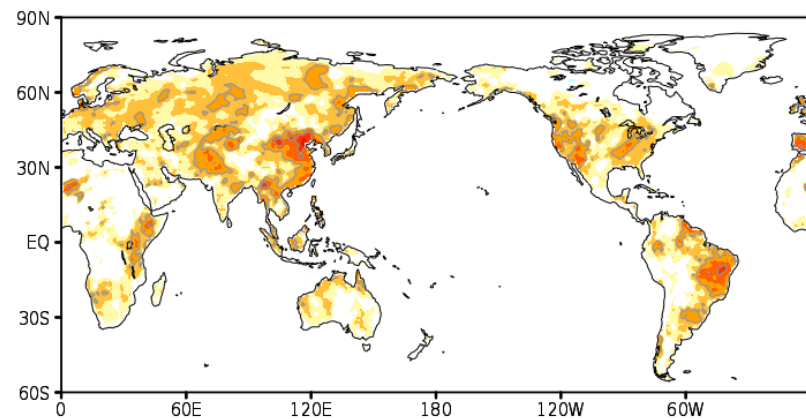
# SubX Multi-model Week 2 Skill

## DJF Anomaly Correlation

2m Temperature



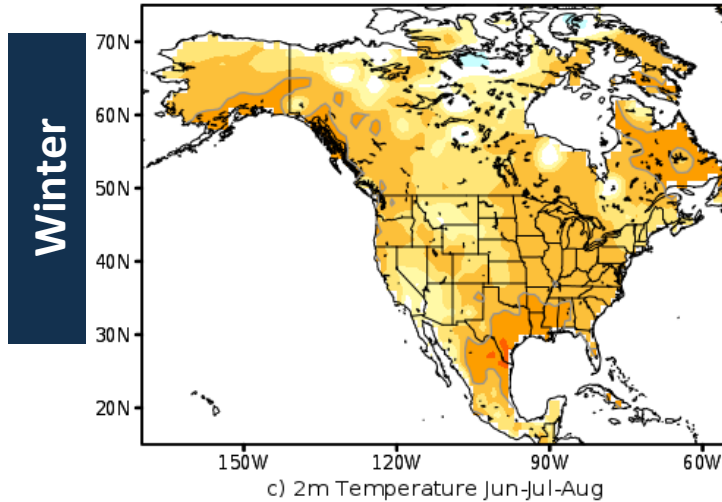
Precipitation



# SubX Multi-model Anomaly Correlation Week 3-4

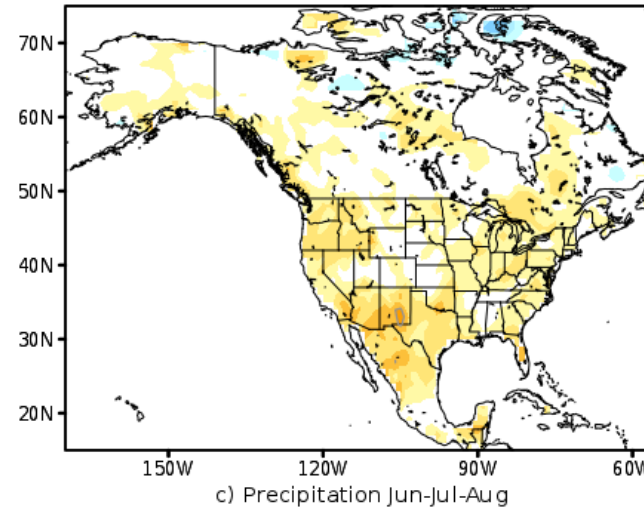
## 2m Temperature

a) 2m Temperature Dec-Jan-Feb

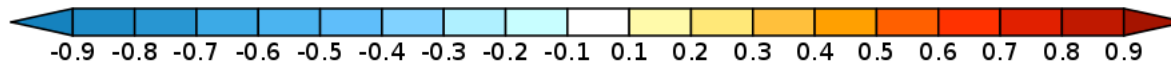
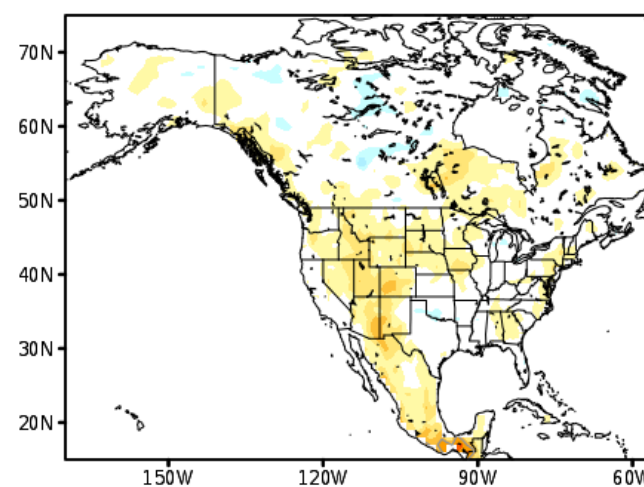
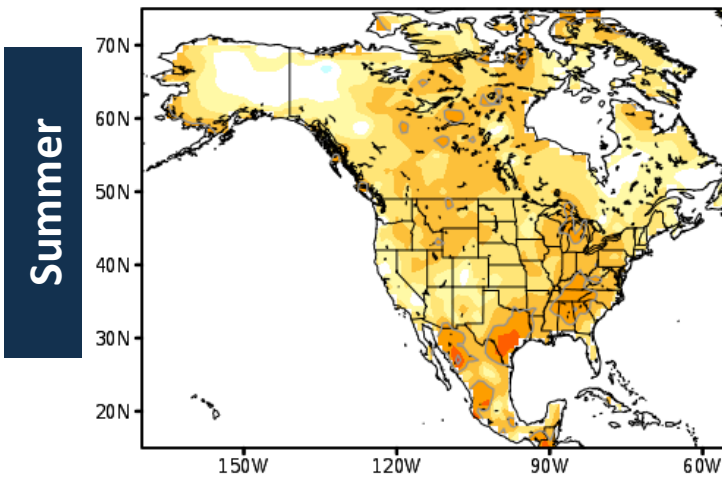


## Precipitation

a) Precipitation Dec-Jan-Feb

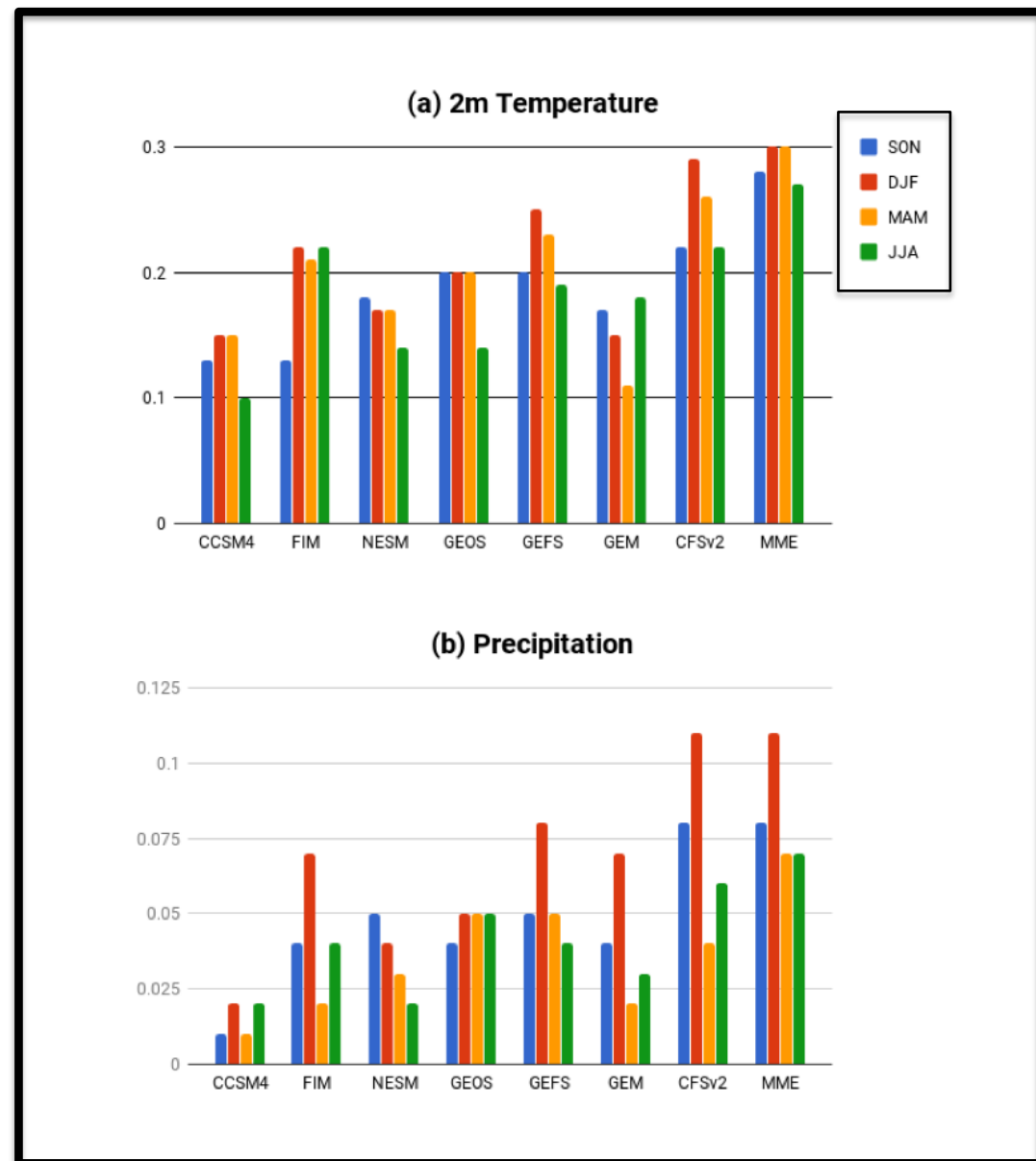


- Skill is positive
- There is skill for some regions and seasons



# SubX Average Anomaly Correlation North America Week 3-4

- MME more skillful than individual models in all seasons
- No stratification of skill by model configuration



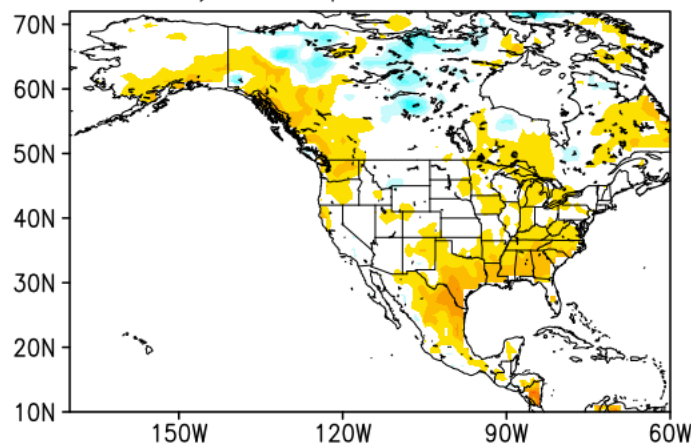
# SubX Multi-model RPSS Week 3-4

## 2m Temperature

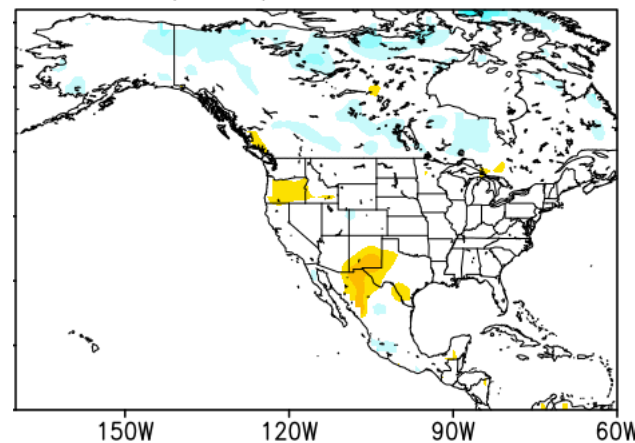
## Precipitation

Winter

a) 2m Temperature Dec–Jan–Feb

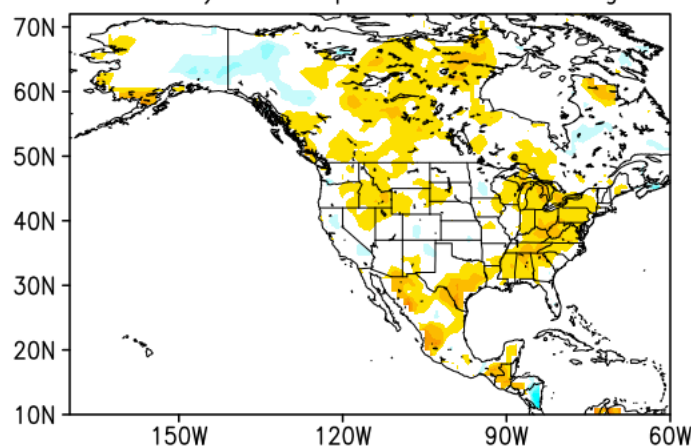


a) Precipitation Dec–Jan–Feb

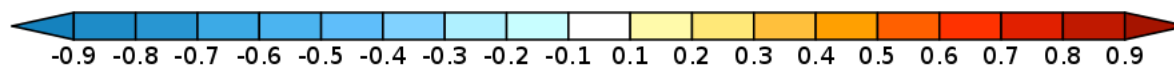
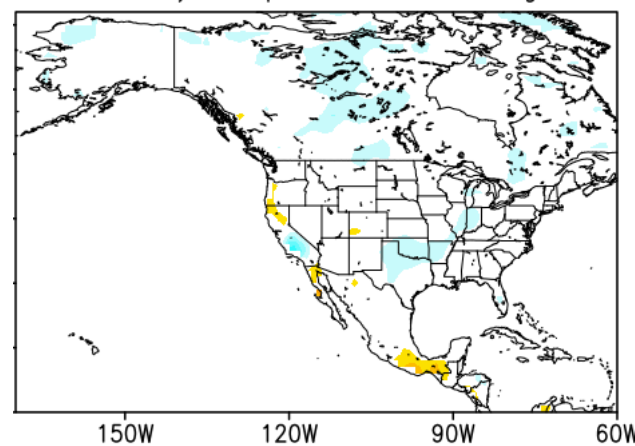


Summer

c) 2m Temperature Jun–Jul–Aug

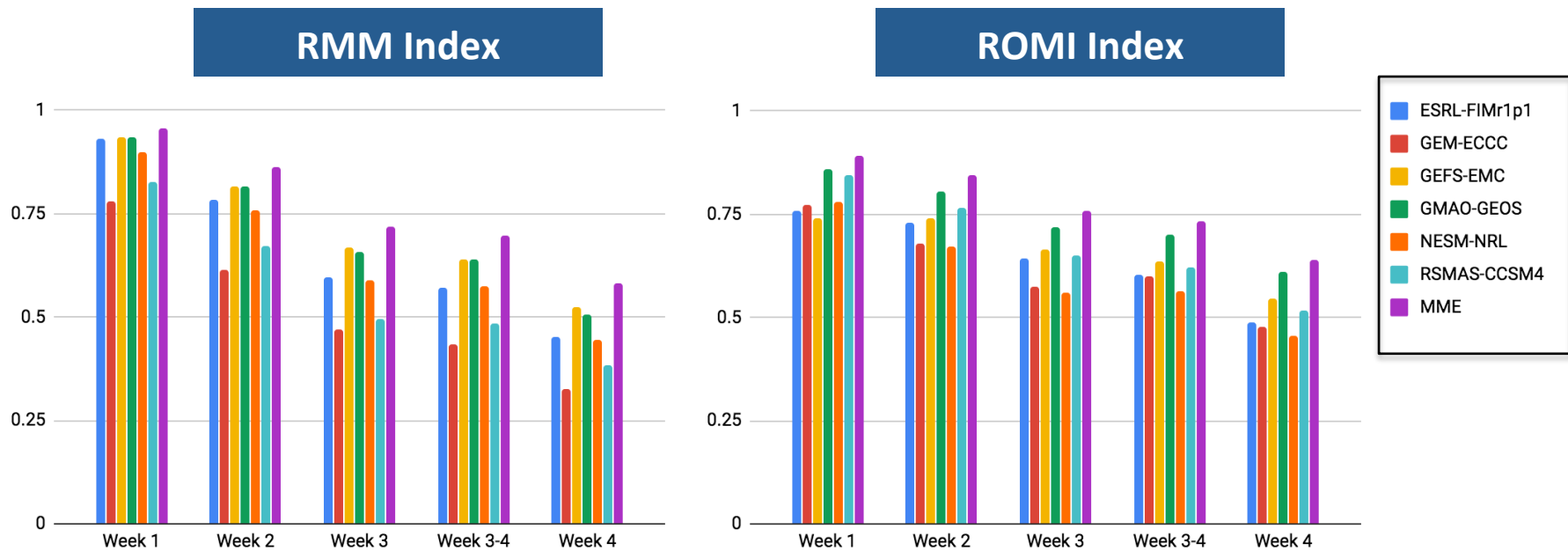


c) Precipitation Jun–Jul–Aug



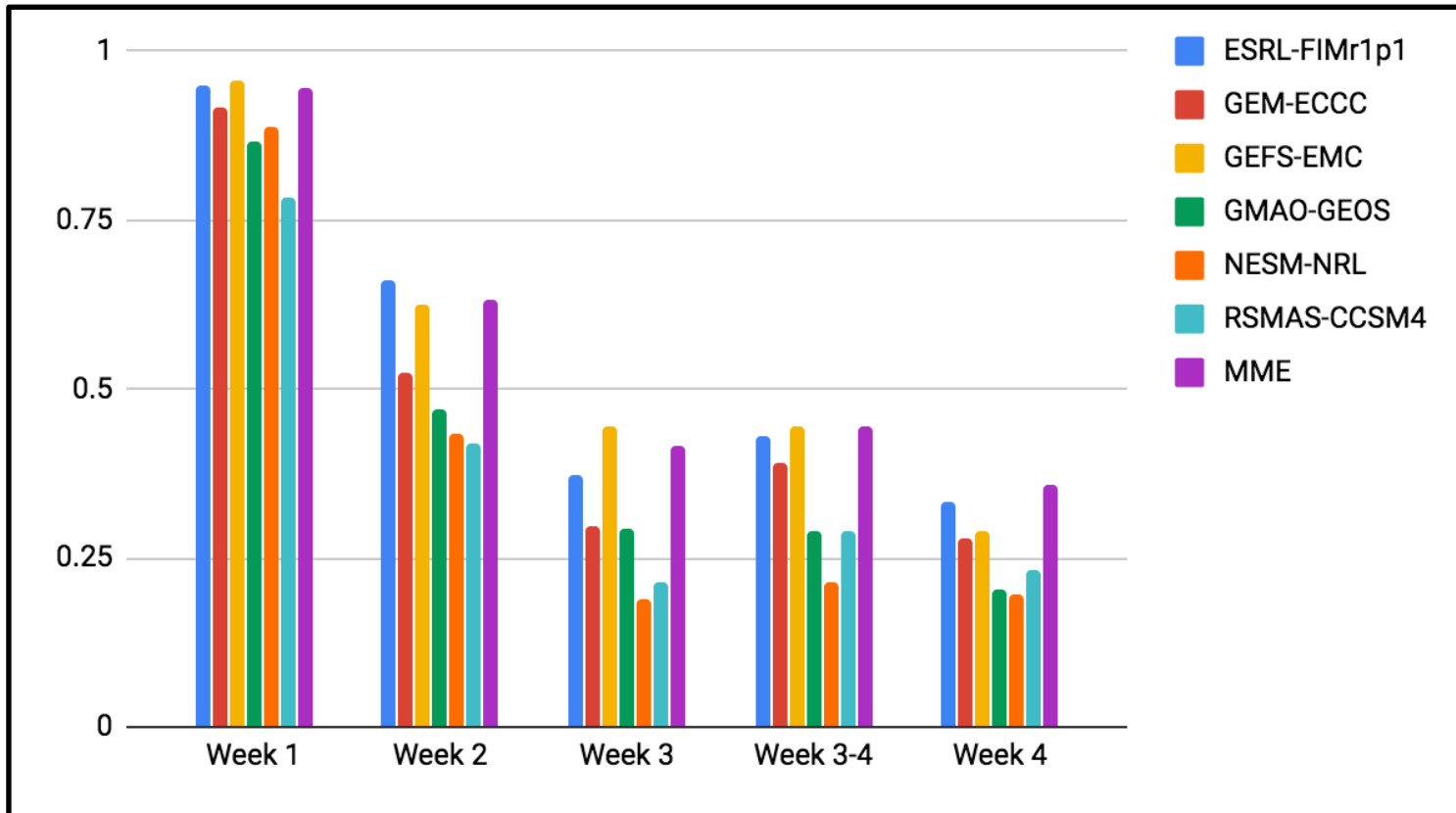
- Consistent with ACC
- There is skill for T2M
- Little skill for precip

# MJO Skill: Anomaly Correlation



- Skill  $>0.5$  at week 3-4
- Skill is similar to WWRP/WCRP S2S Models
- Two most skillful models have very different configurations
- MME has higher skill than individual models

# NAO Skill: Anomaly Correlation

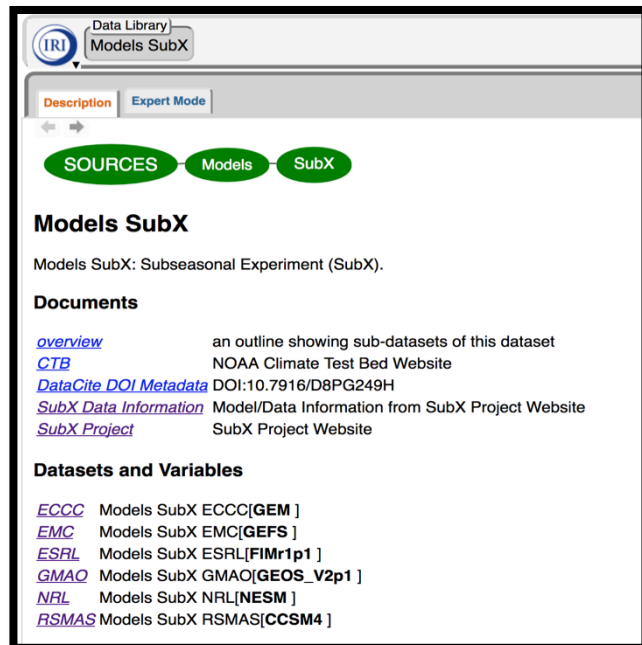


- Skill below 0.5 after week 2
- MME has similar skill to best models
- Two best models have some similarities in configuration



# Real-time Forecasts

- CPC processes for their week 3-4 outlooks
- SubX Team processes for publicly available forecast plots
- All data are publicly available

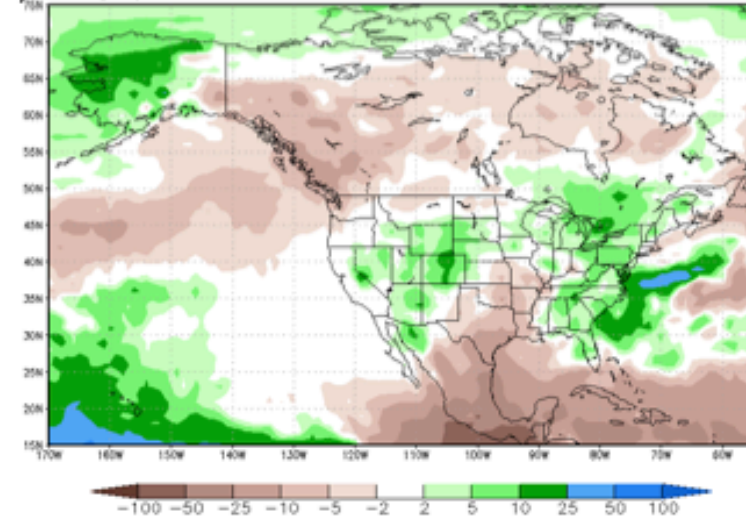


<http://iridl.ldeo.columbia.edu/SOURCES/.Models/.SubX/>

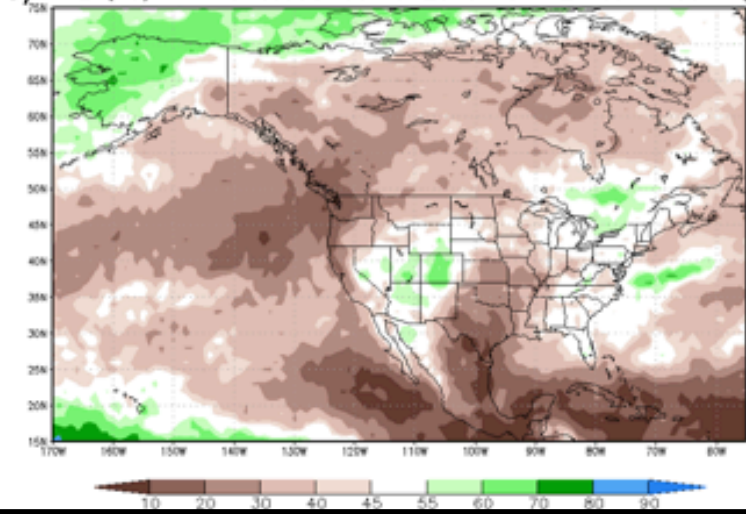


# Example SubX Forecast Guidance & CPC Outlook

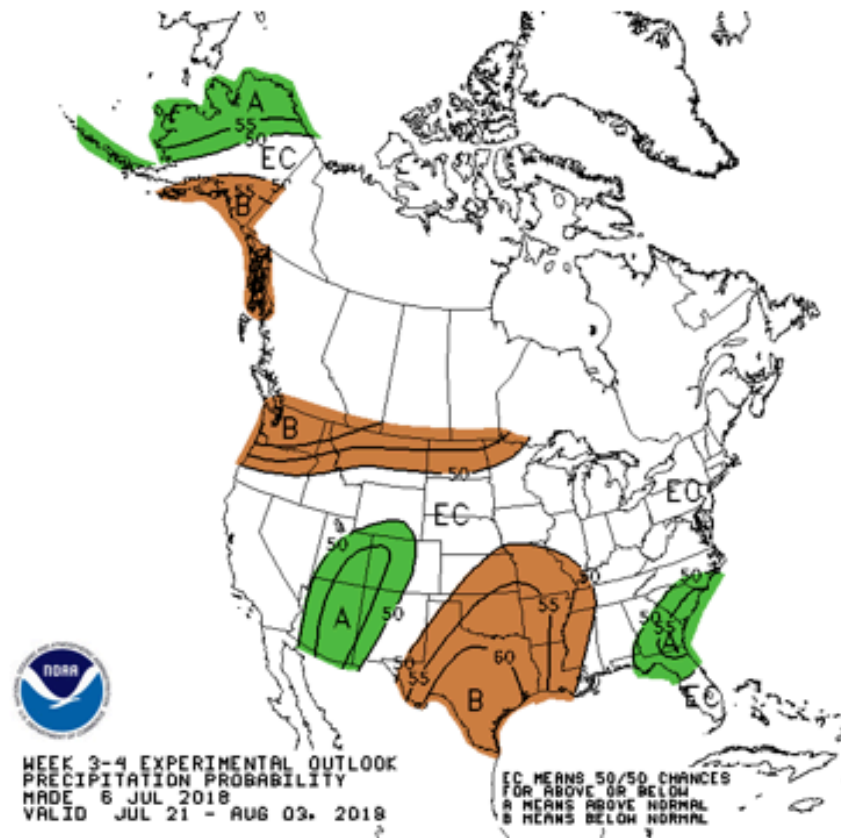
d) MME (79) P anom Issued: 06 Jul 2018 Valid: 21 Jul – 03 Aug



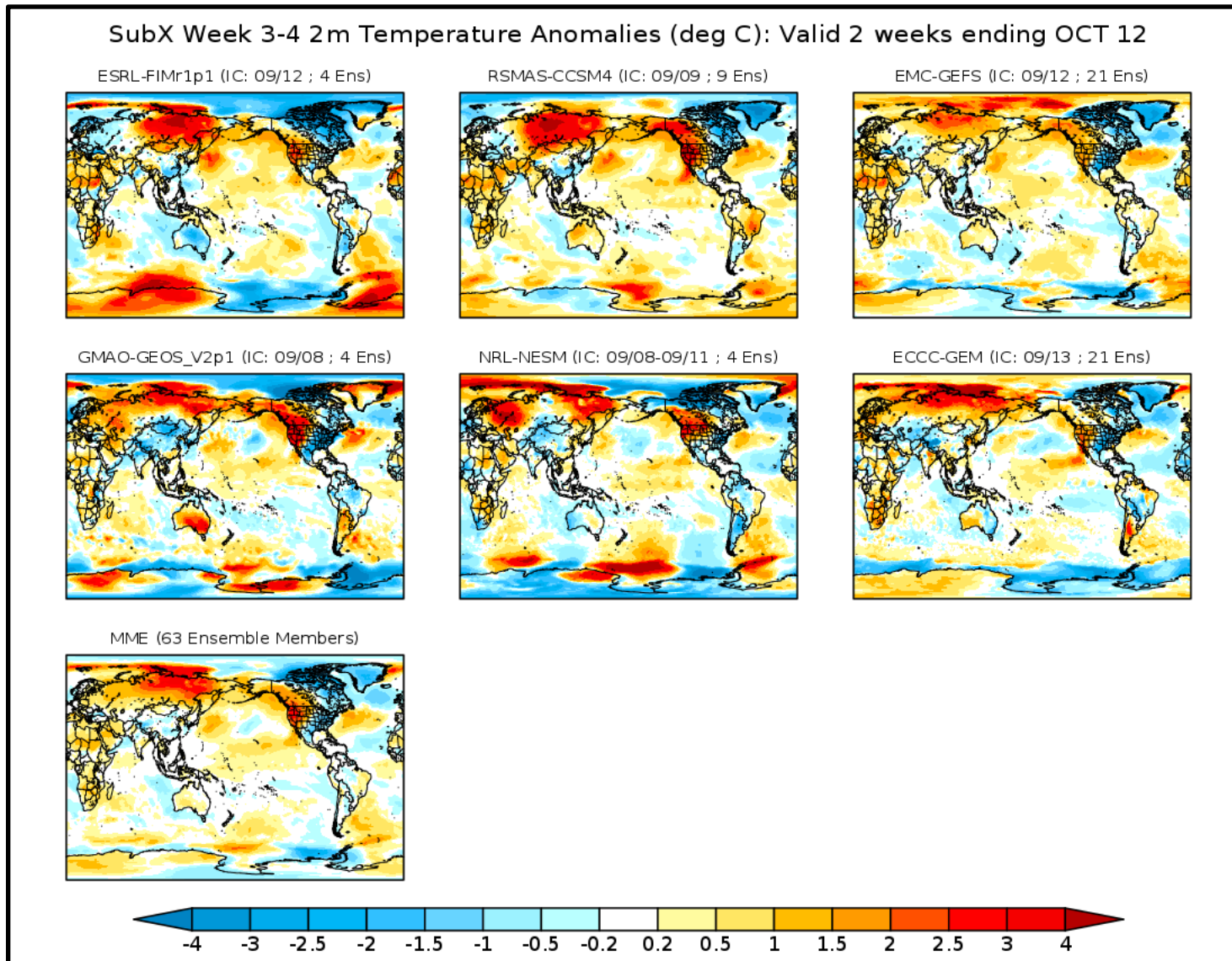
e) MME (79) P Prob Issued: 06 Jul 2018 Valid: 21 Jul – 03 Aug



f) NOAA/CPC Precipitation Outlook



# Example: Real-time forecast maps on SubX Website



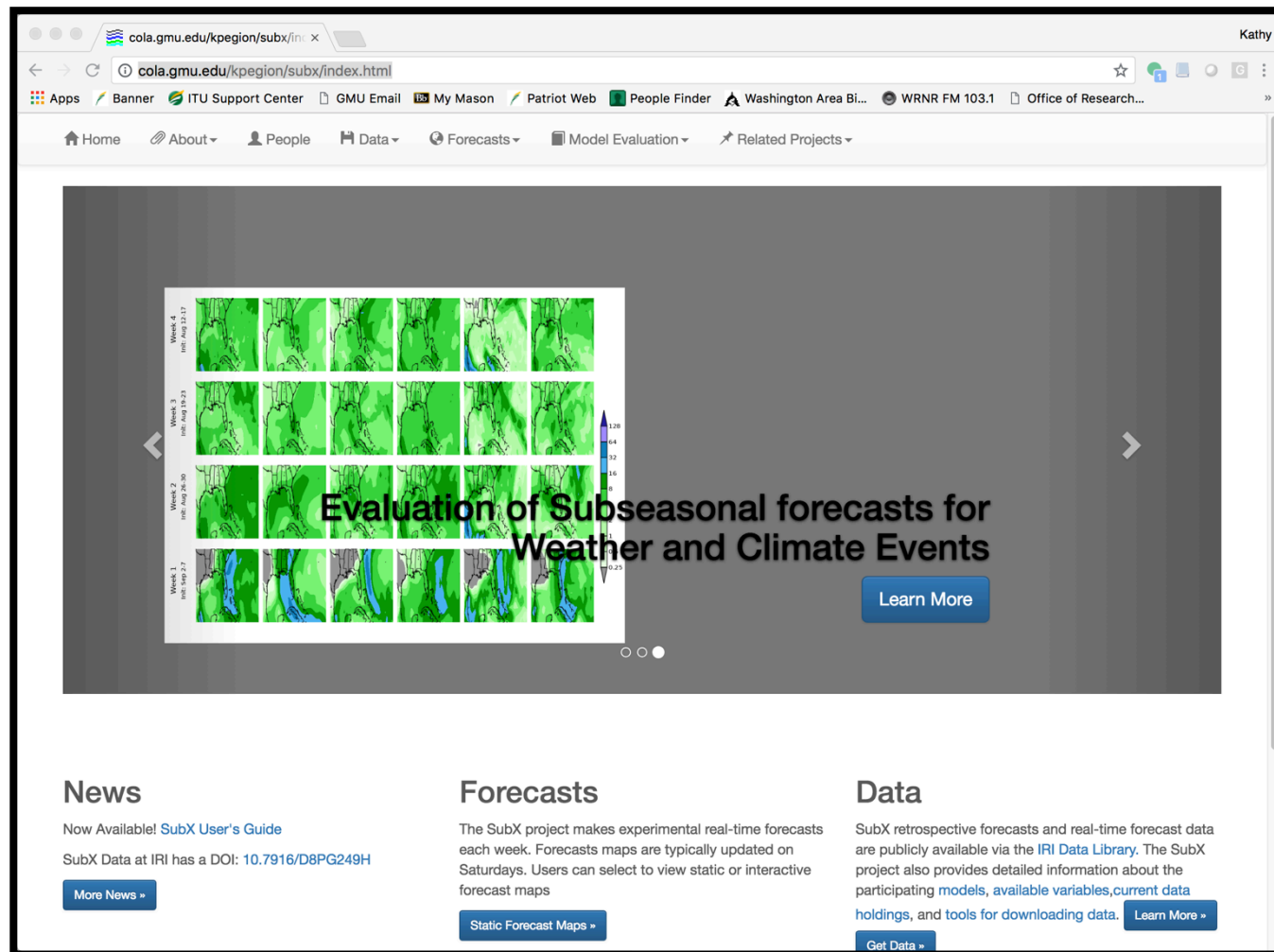
<http://cola.gmu.edu/kpregion/subx/forecasts/forecasts.html>

# Summary

- 1) SubX provides a publicly available re-forecast and real-time forecast database for S2S research, operations, and applications.
- 2) SubX Complimentary to other S2S efforts:
  - real-time forecasts
  - research models
- 3) Evaluation of model biases, skill, sources of predictability demonstrate skill at subseasonal timescales in specific regions and seasons and benefit of MME
  - Much more to be done...
- 4) SubX provides useful contributions to operational week 3-4 forecast guidance at NCEP/CPC
- 5) SubX is an ideal framework for testing model improvements

Where to find more information: <http://cola.gmu.edu/kpegion/subx/>

**NEW**



- SubX Data Users Guide
- Codes for Downloading and processing data
- Model Evaluation Plots
- Real-time Forecast Plots