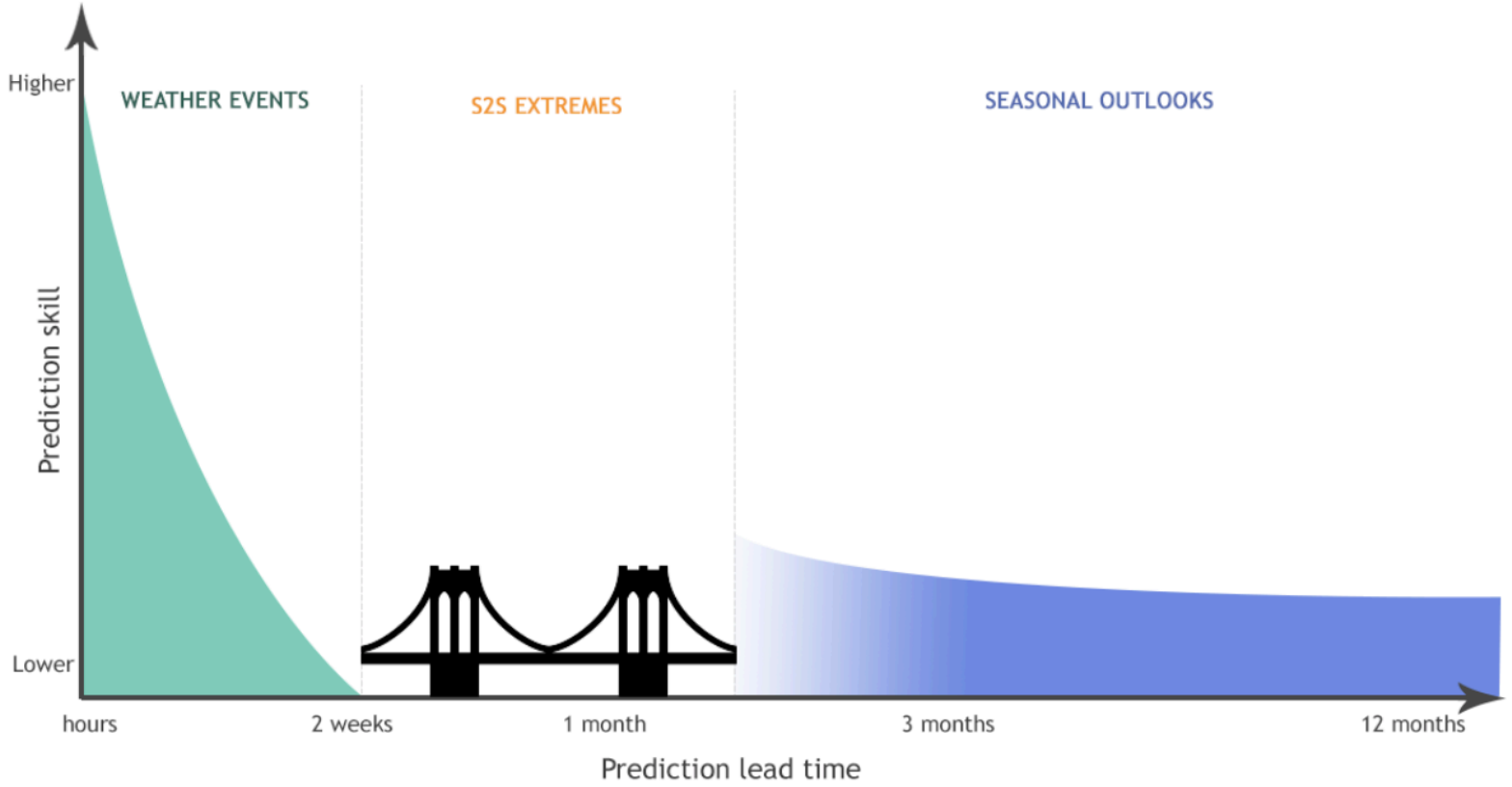
Outline

- Background
  - What came first – the International S2S Prediction Project
- NOAA/MAPP S2S Prediction Effort
  - Task Force
  - Key science questions
  - PIs / Projects
- SubX – North American Subseasonal Experiment
- Summary

Forecast Gap between Weather & Climate



Adapted from: iri.columbia.edu/news/qa-subseasonal-prediction-project

NOAA CPO image

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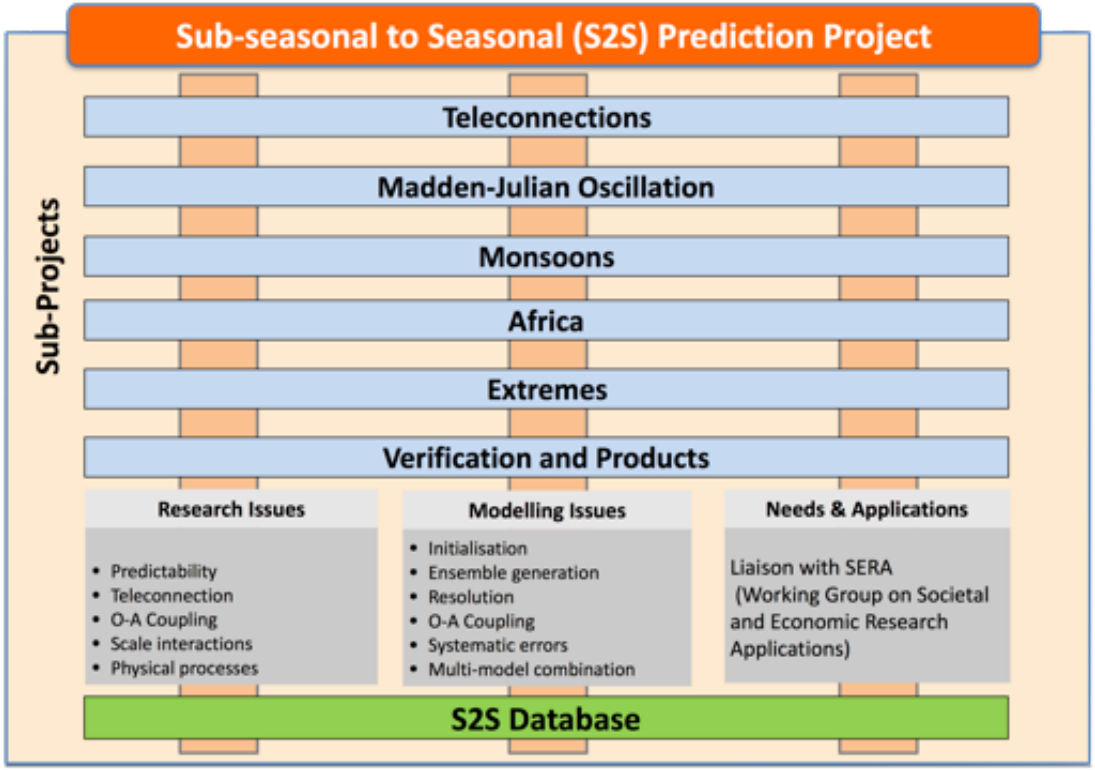
Subseasonal-to-Seasonal (S2S)

- International S2S Prediction Project: http://s2sprediction.net/
  - Operational forecast centers (11) participate, provide ensemble historical re-forecasts and near-real-time forecasts – all currently have data online.
  - Each center follows its own operational protocols, output data are supposed to meet S2S standards (mandatory variables, units, etc.)
  - Data re-distributed by ECMWF (primary) and CMA (secondary); IRI (limited subset); primarily daily means, multiple ensemble members, out to 30-60 days; forecasts initialized 1-28 times per week.
  - Coming to end of original 5-year mandate, preparing a proposal for another 5 years; want to standardize more between modeling centers, expand list of output variables, new sub-projects, enhance infrastructure and user applications…

S2S Subprojects

- Teleconnections is a new subproject, just started in 2016.
- Others are ongoing.
- All represent specific scientific applications of S2S data.



- Each has leadership / membership, a science plan and a Wiki page at s2sprediction.net
- Liaise with elements of WWRP, WCRP, other regional S2S efforts.

NOAA/MAPP S2S Prediction Project

- Program Manager: Heather Archambault – Climate Prediction Office (CPO); Modeling, Analysis, Predictions and Projections (MAPP) project
- 14 funded projects (2016-2019) were selected from proposals to a targeted NOAA funding opportunity in 2015
- Mission: "…to advance NOAA's and the Nation's capability to model and predict sources of S2S predictability. The ultimate goal of this initiative is to help close the gap in prediction skill and products between traditional weather and seasonal lead times."

Terms of Reference

- S2S Prediction Task Force (S2STF) coordinates activities, fosters collaboration among PIs and external efforts.
- Lead: Elizabeth Barnes; Co-leads: Paul Dirmeyer, Edmund Chang, Andrea Lang, Kathy Pegion
- MAPP Program management oversees Task Force activities, working with the leads.
- PIs supported through the MAPP FY16 S2S research competition participate in the Task Force, as described in their proposals. Otherwise, participation in S2STF is by invitation.
- Most S2STF work is conducted remotely via monthly telecons, virtual meetings, or leveraging meetings of opportunity.

S2STF – Key Questions

Key Questions: Processes and Physics

- What are the dominant physical sources of S2S predictability, and how well are these sources simulated and predicted?
- How do tropical/extra-tropical and stratosphere/troposphere connections influence S2S prediction?

Key Questions: Approaches to S2S Prediction

- What indices/metrics best describe extreme weather phenomena relevant to S2S prediction given the limitations in available model and observed variables?
- How can we seamlessly treat the transition from an atmospheric initial value forecast problem to a boundary value forecast problem across subseasonal (1-4 week) timescales, in terms of forecast products and their validation?
- To what extent can S2S prediction skill be enhanced by statistical post-processing (i.e., model output statistics) for various applications?
- How can single- and multi-model ensembles be best exploited for S2S prediction?

Key Questions: Evaluating and Improving Models for S2S Prediction

- What is the relative importance of model resolution, physics parameterizations and forecast initialization for prediction skill of phenomena on S2S timescales?
- How well do models represent interactions between the tropics and extratropics, troposphere and stratosphere, ocean and atmosphere, land and atmosphere, and between S2S and other timescales?
- What are the main sources of model systematic errors on S2S timescales?

S2S Prediction Task Force

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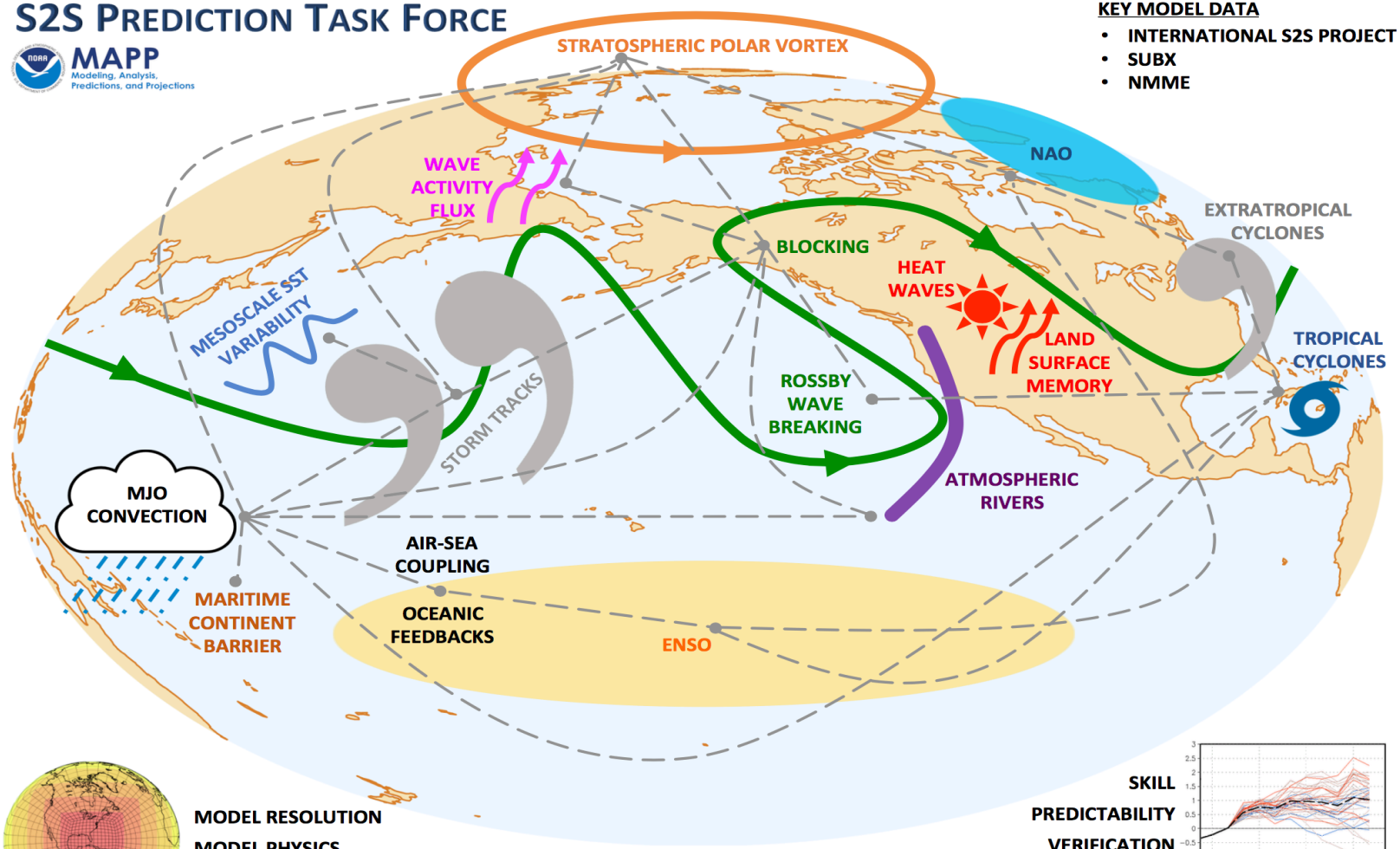
KEY MODEL DATA

- INTERNATIONAL S2S PROJECT
- SUBX
- NMME



MODEL RESOLUTION
MODEL PHYSICS
MODEL FORECAST SETUP
MULTI-MODEL STRATEGY

SKILL
PREDICTABILITY
VERIFICATION
PRODUCTS
LINEAR INVERSE MODEL

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PIs / Projects

		co-Is	Title	Lead Inst.
1	Barnes, Libby	Eric Maloney	Forecasting North Pacific Blocking and Atmospheric River Probabilities: Sensitivity to Model Physics and the MJO	CSU
2	Camargo, Suzana	Adam Sobel (Columbia), Cha-Ying Lee (IRI)	The relationship of tropical cyclones to MJO and ENSO in the S2S database	LDEO
3	Chang, Edmund	Minghua Zhang, Hyemi Kim, Wanqiu Wang (CPC)	Understanding the Sources of Subseasonal Predictability of Extratropical Cyclone Activity and Improving Their Representation in Forecast Systems	Stony Brook
4	DeMott, Charlotte	Nick Klingaman (Reading)	Collaborative Research: Assessing Oceanic Predictability Sources for MJO Propagation	CSU
5	Ford, Trent	Paul Dirmeyer (GMU)	North American Heat Wave Predictability: Assessing the Role of Land Surface Initialization on S2S and NMME Model Forecasts	SIU
6	Furtado, Jason	Michele L-Heureux, Adam Allgood (CPC), Libby Barnes (CSU)	Investigating the Underlying Mechanisms and Predictability of the MJO/NAM Linkage in the NMME Phase-2 Models	Oklahoma
7	Guo, Zhichang	Paul Dirmeyer	Improving subseasonal to seasonal forecast skill of North American precipitation and surface air temperature using a multi-model strategy	GMU

PIs / Projects (cont'd)

8	Hoover, Brent	Matt Newman (ESRL)	Prediction, Sensitivity, and Dynamics of Subseasonal To Seasonal Phenomena Diagnosed Through Linear Inverse Models, Their Adjoints, and Numerical Weather Prediction Models	Wisconsin
9	Kumar, Arun	Wanqiu Wang, Jieshun Zhu	Exploring Pathways to improve MJO Predictions	CPC
10	Andrea Lang (co-lead)		A categorical assessment of forecast skill, uncertainty and biases in extended-range ensemble forecasts of stratospheric regime changes	Albany
11	Perlwitz, Judy	Jadwiga Richter (NCAR), Lantao Sun (CIRES), Julio Bacmeister (NCAR)	Role of stratospheric processes in predicting ENSO-NAO connections on subseasonal time scale	ESRL
12	Szunyogh, Istvan		Investigation of the Effects of Oceanic Mesoscale Eddies on the Midlatitude Storm Tracks and Their Predictability	Texas A&M
13	Wang, Shuguang	Adam Sobel, Michael Tippett	Madden Julian Oscillation -- the Maritime Continent barrier and seamless verification	Columbia
14	Wang, Zhuo	Melinda Peng (NRL), Stan Benjamin (ESRL)	Variability of Rossby Wave Breaking and its Impacts on the Large-scale Circulation and Extreme Weather: Implications for S2S Prediction and Predictability	Illinois

S2S Subprojects

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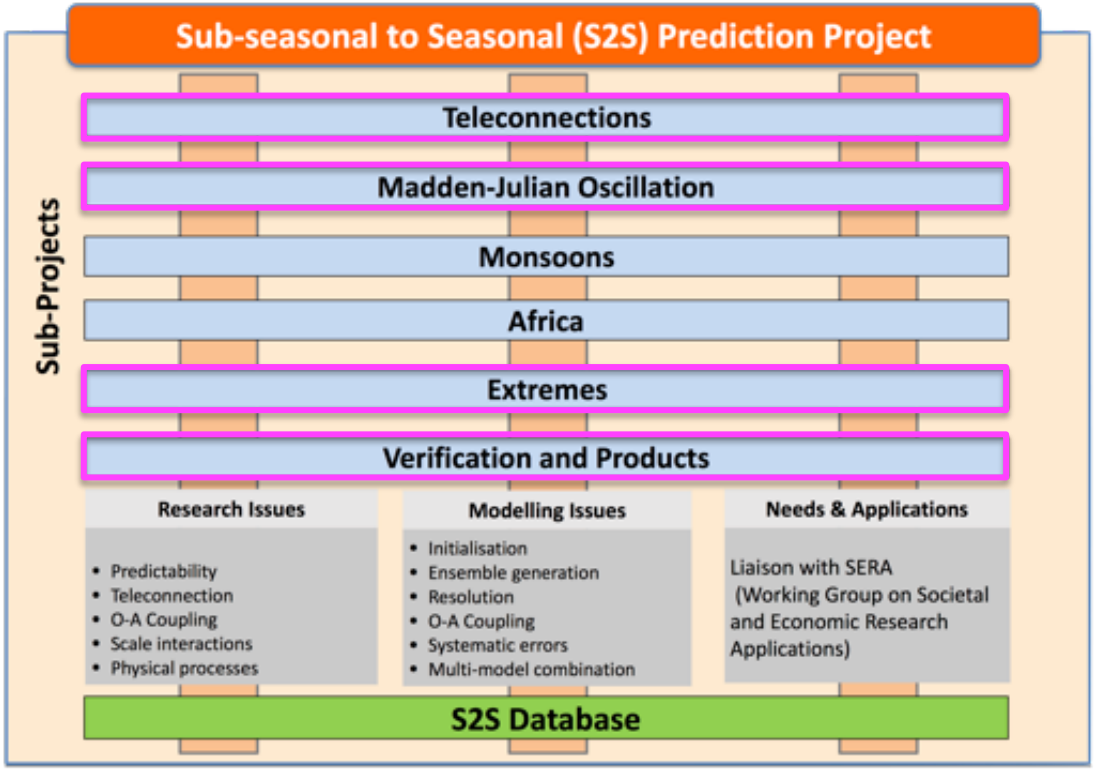


- Each has leadership / membership, a science plan and a Wiki page at s2sprediction.net
- Represent another point for GLASS interests to interface with S2S.

S2STF – Kickoff Meeting

- Early December 2016 at IRI/LDEO in conjunction with a workshop on S2S predictability of extremes and Int'l S2S SG meeting http://iri.columbia.edu/s2s-extremes-workshop-2016/.
- S2STF information at CPO: https://tinyurl.com/s2stf-mapp
- Also a private Wiki for S2STF members

Others involved in S2STF

- Climate Test Bed (CTB) "SubX" (Subseasonal eXperiment) PIs (also 3-year projects)
  - Ben Kirtman & Kathy Pegion lead
  - Parallels International S2S in many ways but NA models only, synchronized IC dates, more staunch about output variables.
- International S2S Prediction Project leadership (F. Vitart, A. Robertson)
- WWRP (Paolo Ruti) & WCRP (Michel Rixen)

N.Am. Subseasonal Experiment (SubX)

- SubX is also a sub-seasonal forecast/hindcast experiment http://cola.gmu.edu/subx/. Differs from S2S in the following ways:
- Evolved from the seasonal prediction predecessor: NMME (North American Multi-Model Ensemble) – focus remains on multi–model ensemble techniques
- Only North American models involved, includes research models
- All models synchronize IC dates (weekly), output data grid (1^{o}), land/sea mask, period of hindcasts
- No time embargo on real-time forecasts
- Hindcasts should be completed by end of 2017; real-time forecasts during 2018-2019.

SubX – Models:

Model	Resolution	LSM	Length	Ens. Size
NCEP CFSv2	A:T126, O:¼° to ½°	Noah	45d	4/day
NCEP GEFS	T574 to T382	Noah	35d	20
ECCC GEM	0.45°	CLASS	32d	4
NASA GEOS5	A:½°, O:½°	Catchment	45d	10
Navy ESM	A:T359, O:0.08°	Bucket	45d	4
NCAR CCSM4	A:~1°, O:1° to ¼°	CLM3	45d	3-4/day
ESRL* FIM HYCOM	30km	Noah	32d	4

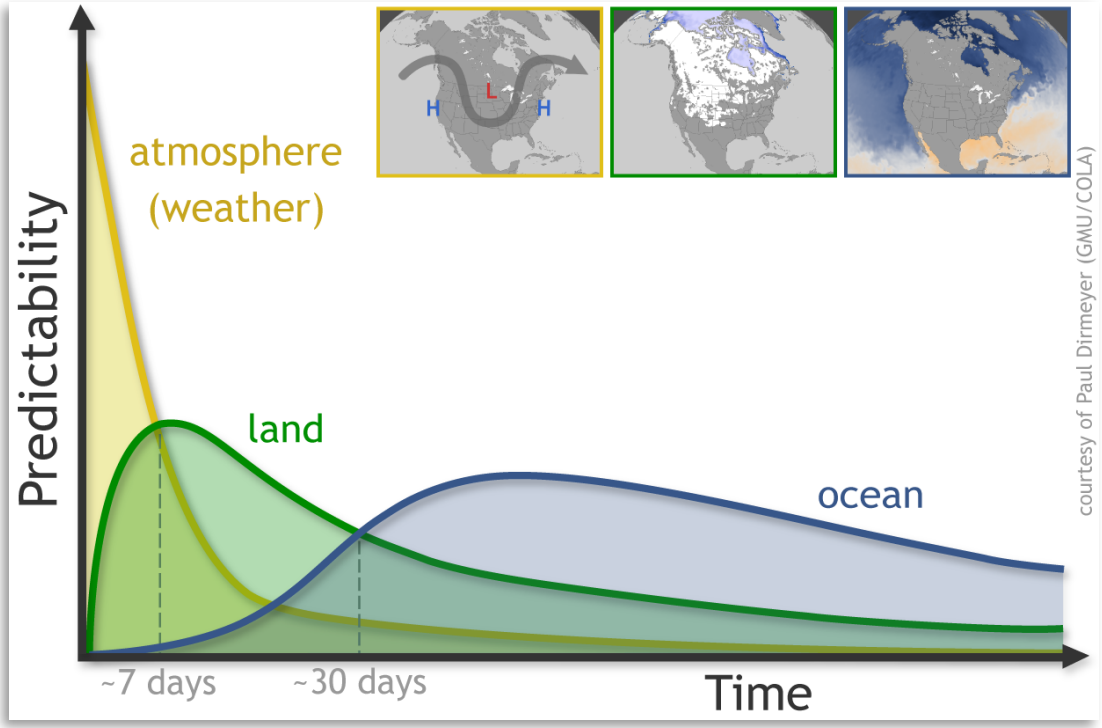
**Partner*

SubX – Core Team

- Ben Kirtman, University of Miami, RSMAS, CIMAS
- Kathy Pegion, George Mason University, COLA
  - Tim DelSole, George Mason University, COLA
  - Michael Tippett, Columbia University
  - Andy Robertson, IRI, Columbia University
  - Robert Burgman, Florida International University
  - Hai Lin, Environment Canada
  - Jon Gottschalck, NOAA/NCEP/Climate Prediction Center
  - Dan Collins, NOAA/NCEP/Climate Prediction Center

S2STF Summary

- MJO, stratosphere, ENSO, NAO/NAM, storm tracks, blocking, Rossby wave breaking, atmospheric rivers, land-atmosphere interactions, ocean eddies – all may contribute to predictable extremes on S2S time scales.



- S2STF facilitates scientific collaboration and coordinates communication between interested researchers, including related international efforts.

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