## Subseasonal-to-Seasonal (S2S) Research and Experimental Forecasting for FIRO

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#### **Talk Overview**

**Introduction** - Where S2S fits in the chain of forecasts, outlooks, and projections

**Applications** - S2S target predictands and experimental products

Next Steps - Wants, Knows, Possibilities, and Tradeoffs







## Overlapping Science and Decision Space





### The Tool Box - Pushing out from Weather Scales





#### The Tool Box - From the Climate Scale In

Climate Change Projections

Decadal Variability

Interannual Variability

Intra-annual to Seasonal Variability

Seasonal Variability

Sub-Seasonal Variability







#### S2S Quantities, Methods, and Lead Times Investigated

Lead times investigated for S2S predictability of ARs, ridges/blocking, or precipitation/floods			Machine Learning		
		А	В	С	
	<b>6-12 months</b> (water year/annual)		Х		Δ
	<b>3-6 months</b> (seasonal)	Х	Х	Х	B C
	<b>4-12 weeks</b> (long-range subseasonal)	Х	Х	Х	
	<b>2-4 weeks</b> (short-range subseasonal)	Х	Х		

S2S Methods

#### **S2S Methods**

 a = dynamical ensemble methods
b = statistical/traditional methods
c = neural network/deep learning methods

S2S quantities of interest (top label) and which S2S methods are used to investigate them (bottom label)



Slide Credit: Mike DeFlorio and F. Martin Ralph

#### **CW3E S2S Process Pipeline**

S2S research projects at CW3E are initiated based on advances in relevant sciences, and on stakeholder needs, and include direct input at initiation from stakeholders on project methodology and experimental product display.

#### All projects are presented to CW3E/JPL S2S Advisory Panel

Co-chairs: F. Martin Ralph (CW3E) & Duane E. Waliser (JPL)

Members: Daniel R. Cayan (SIO), Bruce D. Cornuelle (SIO), Arthur J. Miller (SIO)

**Purpose:** 1) Provide feedback and suggestions on each S2S research project and its accompanying experimental product development, in order to ensure both scientific credibility and responsiveness to stakeholder needs; 2) Vote on the transition of S2S forecast products from internal → public CW3E website.

Assessment of S2S tools and forecast metrics evaluated in peer-reviewed literature framework.



#### **Example: CW3E Subseasonal Forecast Product**

Subseasonal AR Occurrence Outlooks now public!

https://cw3e.ucsd.edu/iwv-and-ivtforecasts/#S2S

Skill assessment provided in DeFlorio et al. 2019b

Forecast Anomaly

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### **Example: CW3E Seasonal Forecast Product**

#### CW3E January-March 2020 Experimental Seasonal Precipitation Forecast based on October SST (issued: 5 Nov 2020)



Good agreement between observed JFM precipitation and CW3E October forecast for JFM precipitation.

Provided by: Sasha Gershunov and Tamara Shulgina







# Next Steps - Collecting Wants, Knows, and Possibilities

- FIRO is about extracting meaningful information from our knowledge of the dynamic evolution of the atmosphere/land/ocean/ice system and connecting it to decision points in water management
- At the S2S time scale, we need to examine the decision points, information available, potential updating, and possible paths forward given different decision trees
- This space offers great opportunity for collaboration between science and operation but requires some learning on both sides which takes time and commitment







#### Tradeoffs

- Waiting for certainty versus the time needed for planning and implementation of the decision space
- Indexes are helpful but don't explain the physics; complimentary information may be needed
- Guidance information helps define choice of decision space that ultimately avoids hazard and maximizes benefit; This information may be different and have different levels of detail at different lead times







## **Summarizing Thoughts**

S2S Forecast product development for water management is a fertile ground for collaborative research and development

The effort can be pursued from climate scales in and from weather scales out. To the extent the two directions can offer different products for different purposes opens doors to different funding sources

Stay tuned - more to be done...







# Questions?

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