Societally-Relevant Multi-Year Climate Predictions
US CLIVAR Workshop
March 29, 2022

Assessing multi-year predictability of Colorado River water supply using a drift-free decadal climate prediction system

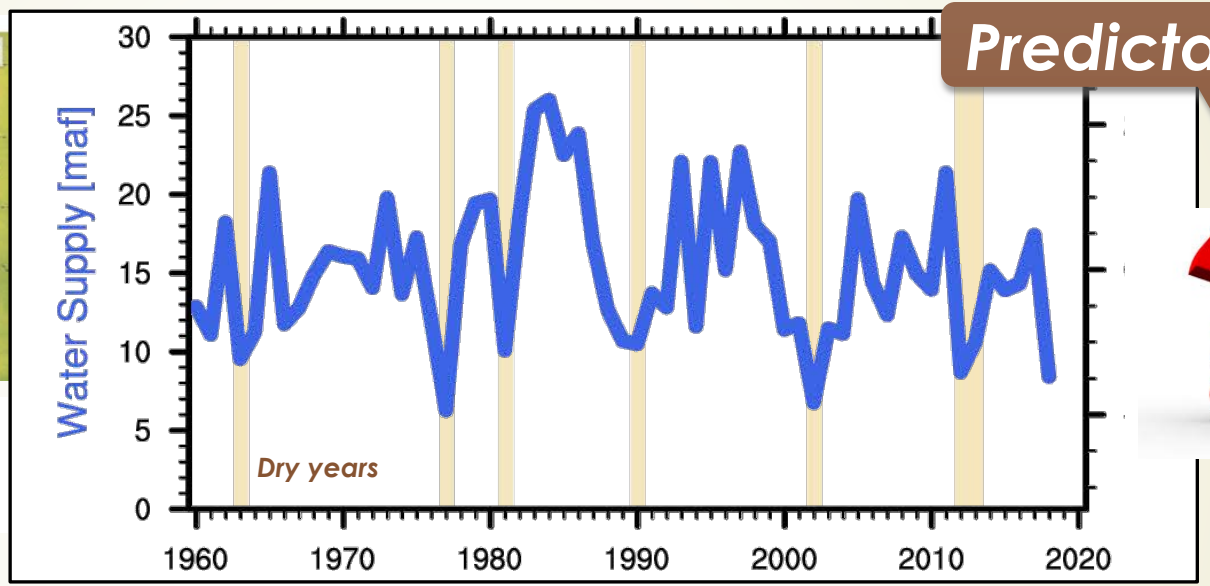
Yoshi Chikamoto[1] (Yoshi.Chikamoto@usu.edu)

Simon Wang[1], Robert Gillies[1,2], Matt Yost[1] & Larissa Yocom[3]

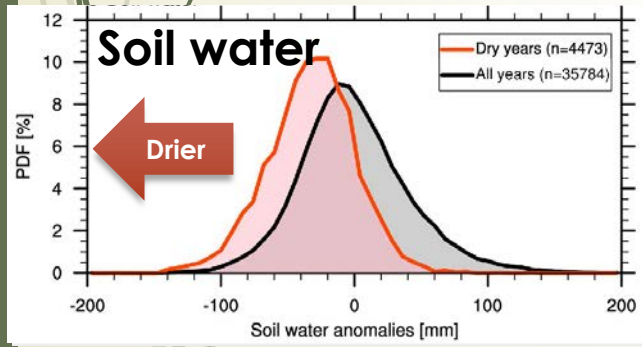
[1]Department of Plants Soils & Climate
[2]Utah Climate Center
[3]Department of Wildland Resources

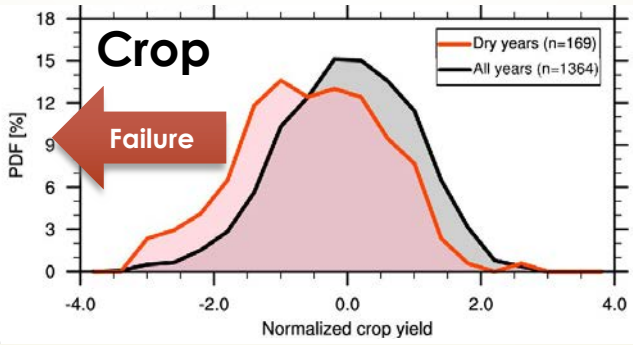
Colorado River water supply

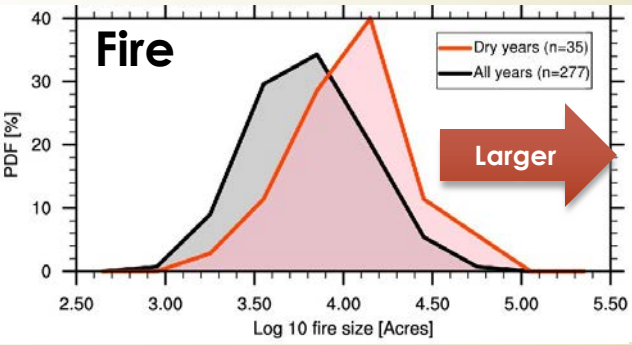
Natural Streamflow at Lees Ferry, AZ



Predictable?

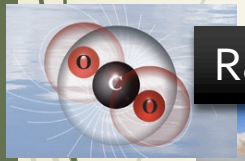






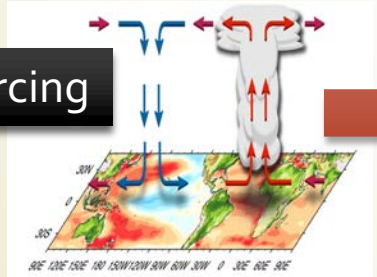
Hypothesis: ocean-land synchronization

Weather disturbance

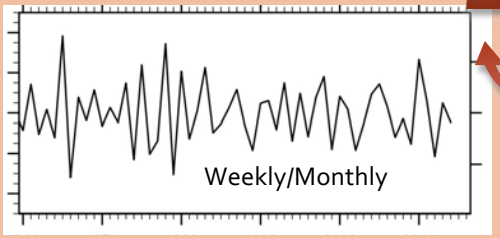


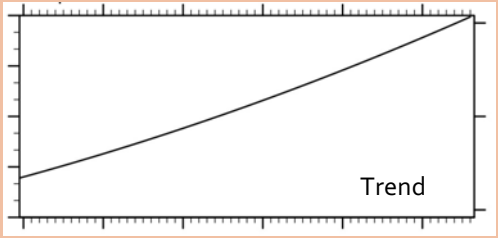
Radiative Forcing

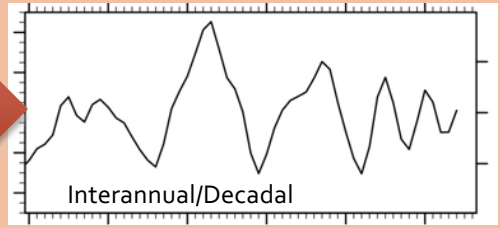
Ocean Forcing



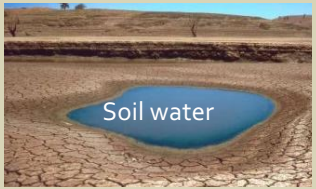
Atmosphere







Land Process



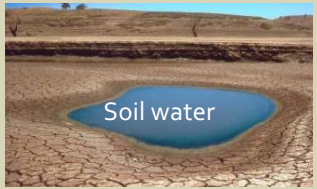
Hypothesis: ocean-land synchronization

Weather d

Radiative Forcing

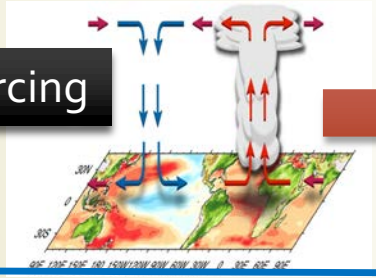
Filtering Effect

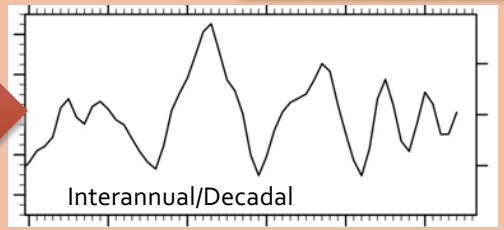
Land Process



Ocean memory

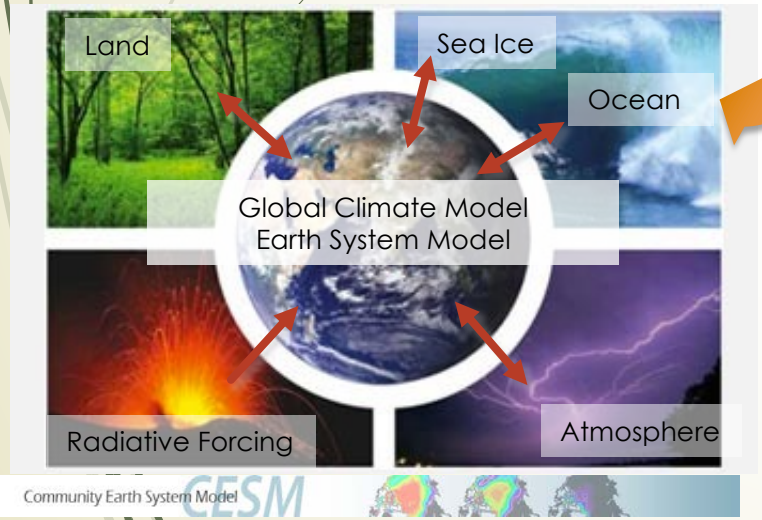
Ocean Forcing

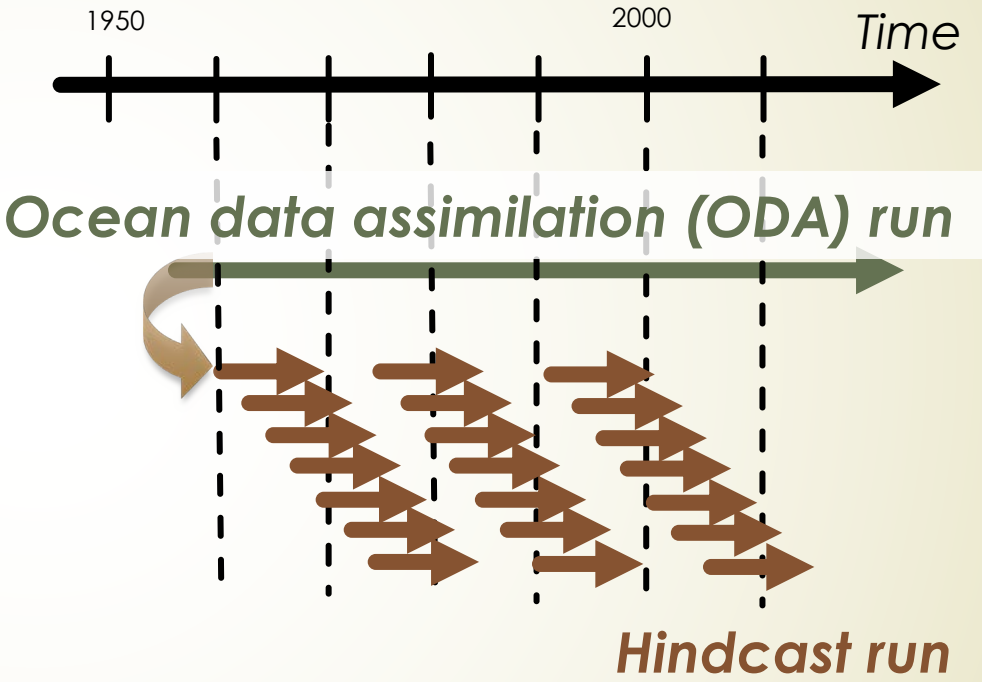




Decadal climate prediction approach

Ocean data Assimilation



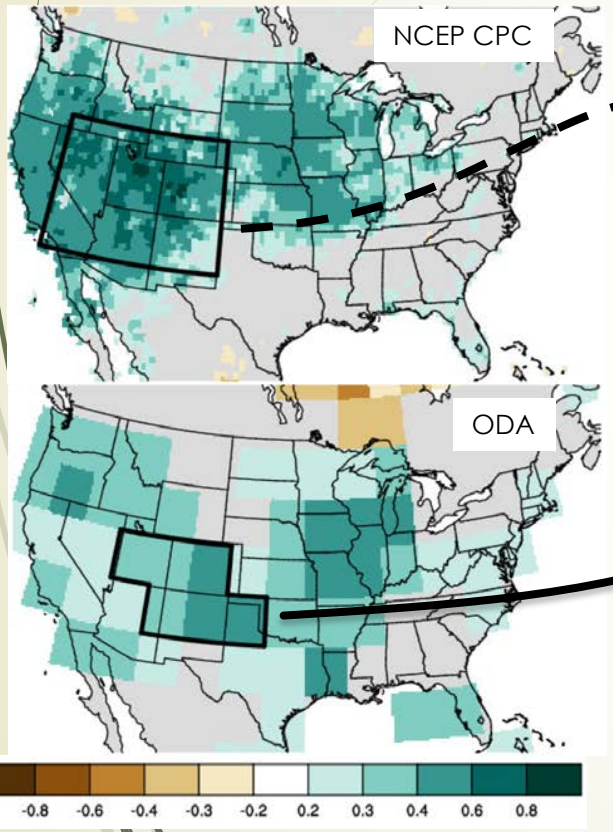


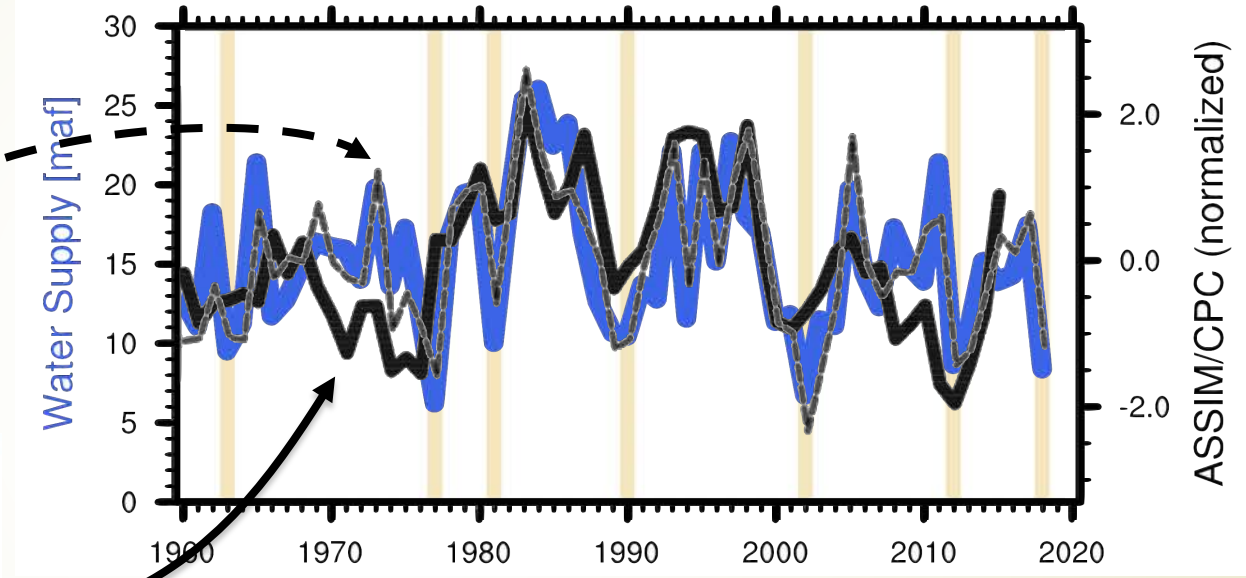
Each experiment has 10-member ensemble.

Chikamoto et al., (2019): A drift-free decadal climate prediction system for the Community Earth System Model, *J. Climate*.

Reconstruction of Colorado River water supply

Soil water anomalies





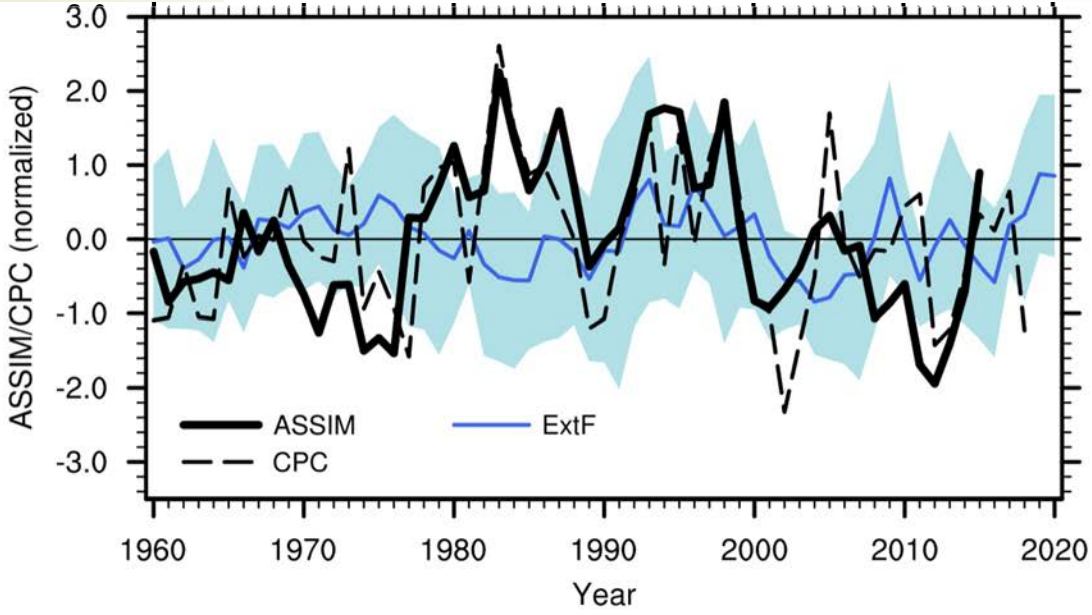
R (Water supp vs CPC) = 0.88

R (Water supp vs ODA) = 0.43

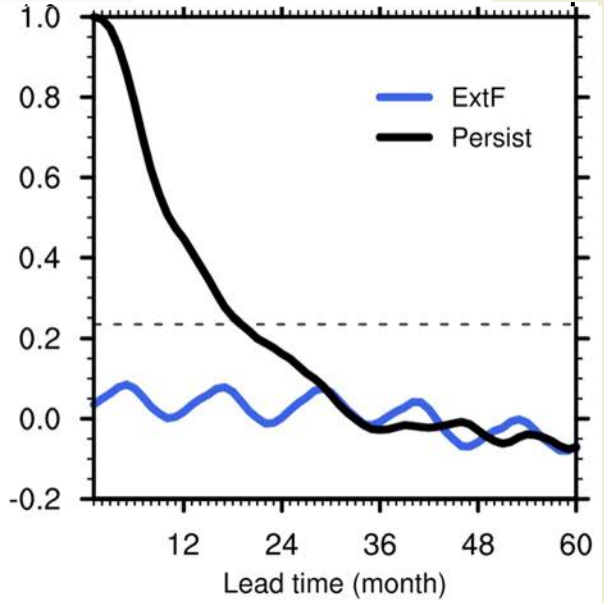
Ocean drives low-frequency streamflow variability

Predictability of Colorado River water supply

Reconstructed water supply



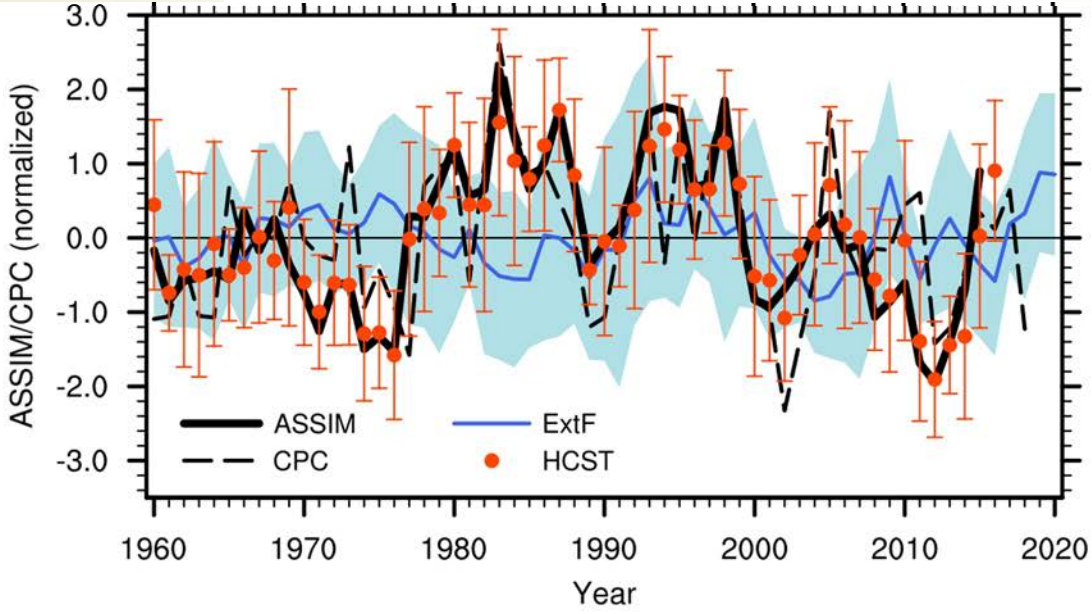
Predictive skill



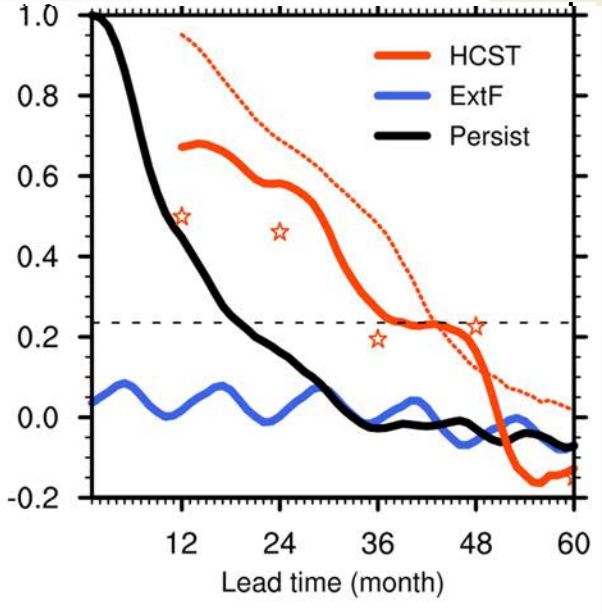
The global warming component is negligible for interannual-to-decadal water supply predictability

Predictability of Colorado River water supply

Reconstructed water supply

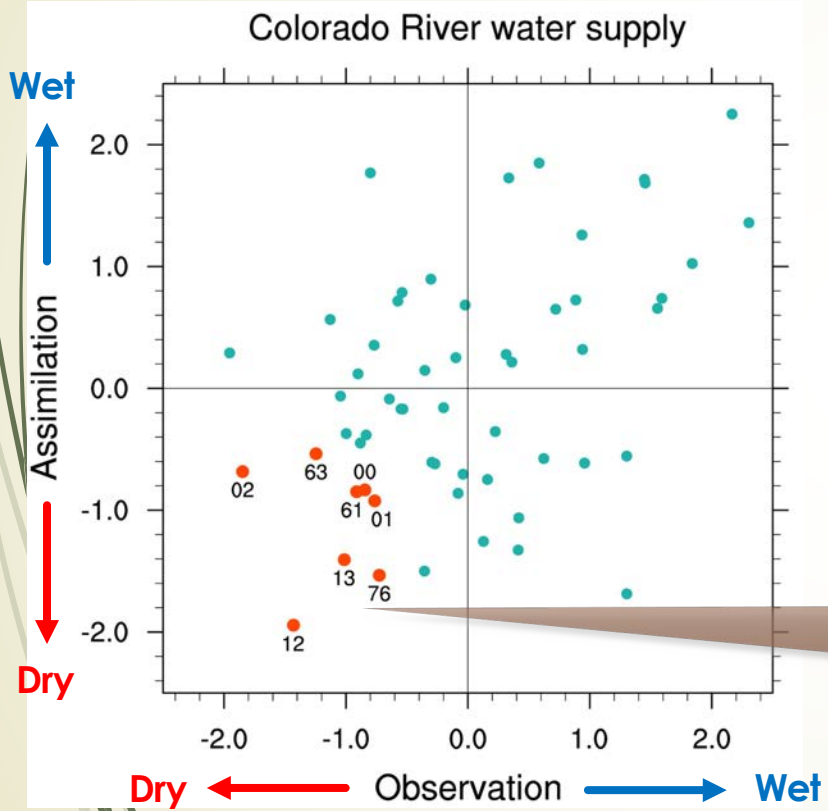


Predictive skill



The Colorado River water supply is predictable for several years!

Ocean memory for drought prediction

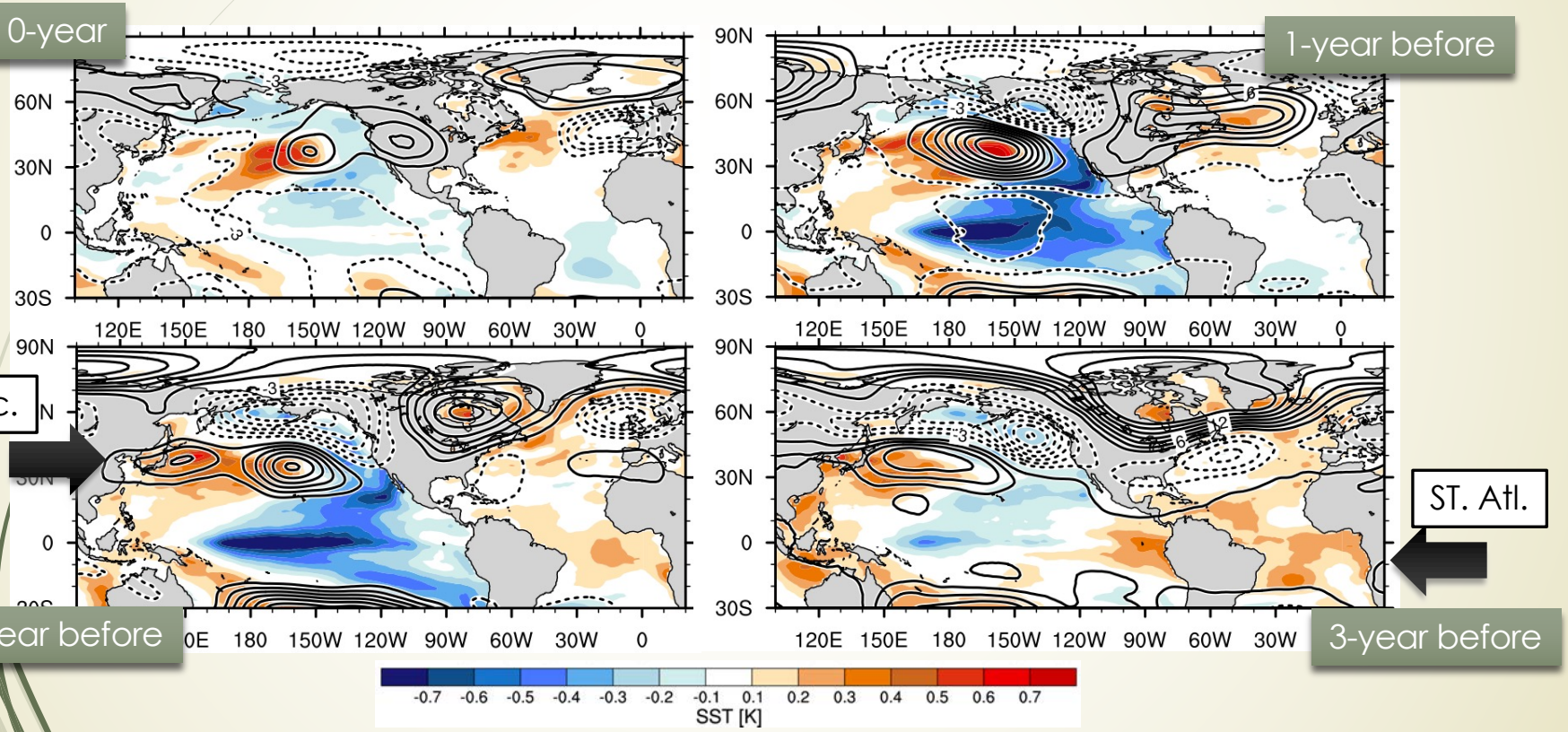


What ocean precursors are important to predict shortage of Colorado River water supply?

Predictable dry years

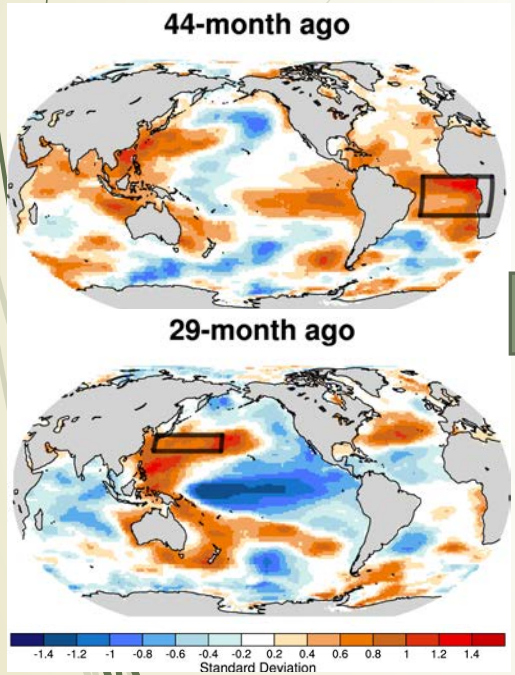
Ocean-induced dry year composites

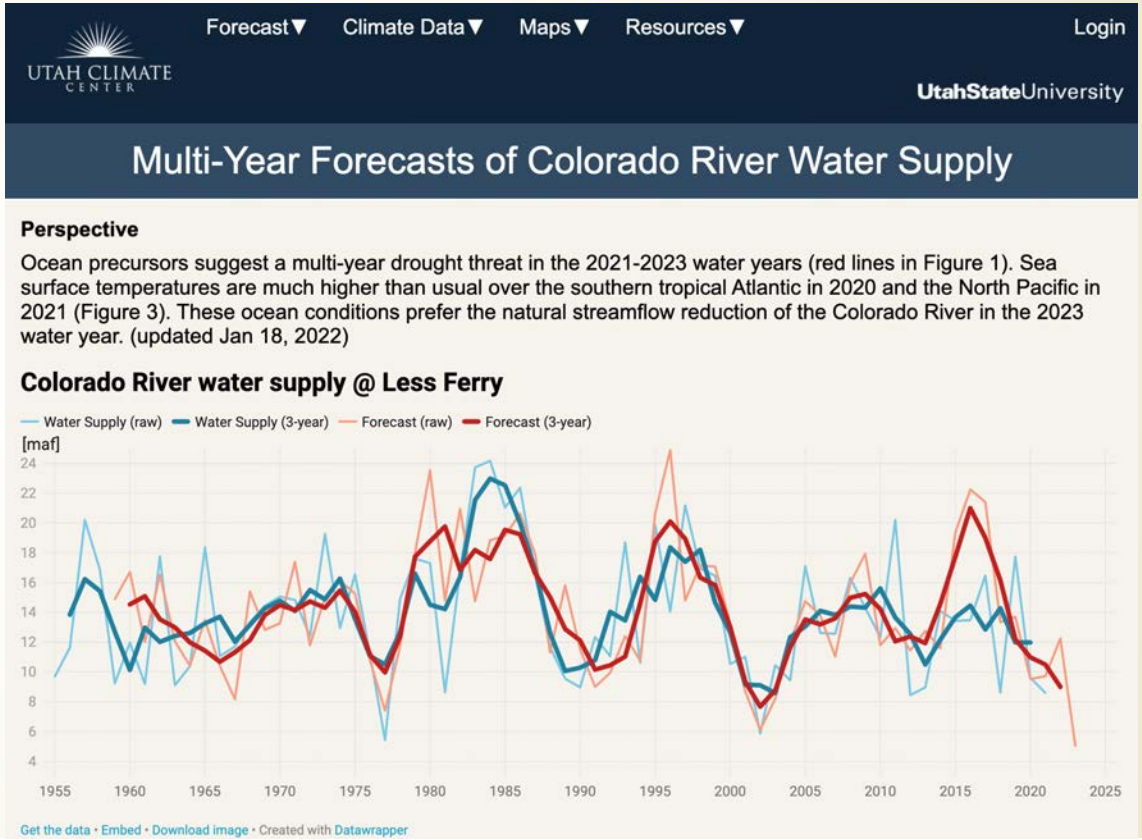
SST (shade) & Z500 anomalies (contour)



Operational forecast using ocean precursors

Monitoring





https://climate.usu.edu/service/droughtPredictionPages/coloradoRiverWaterSupply.php

Decadal climate prediction efforts

	CESM-DPLE/SMYLE	Our study
Model config	~1° x 1° , 40 members	~3° x 3°, 10 members
Observation	Full field	Anomaly field (& ExtF adjustment)
Atmosphere	Uninitialized run	No observation (from ODA)
Land	Uninitialized run	No observation (from ODA)
Ocean	FOSI (wind stress & heat flux)	3D T&S in ORAS4 (from ODA)
Sea-ice	FOSI (wind stress & heat flux)	No observation (from ODA)

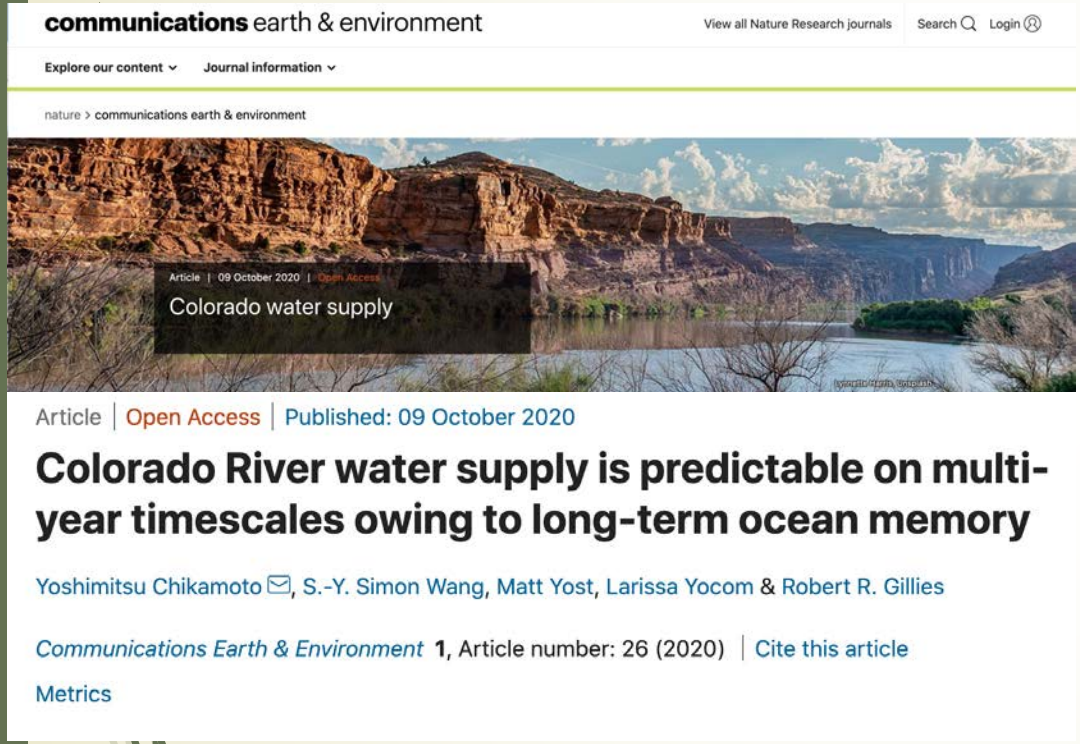
Model drift
Initialization shocks

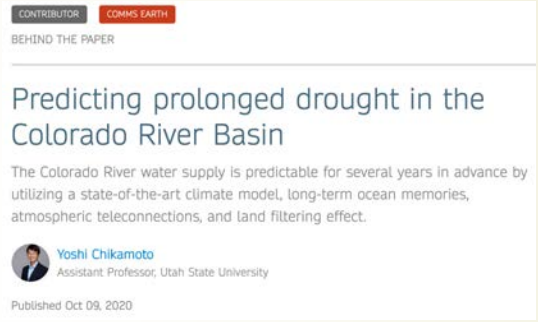
They may have less impact for seasonal predictability but larger for decadal

There are many other factors!

FOSI: Forced Ocean Sea ice simulations
ODA: Ocean data assimilation run

Thank you for your attention!





Yoshi Chikamoto

(Yoshi.Chikamoto@usu.edu)