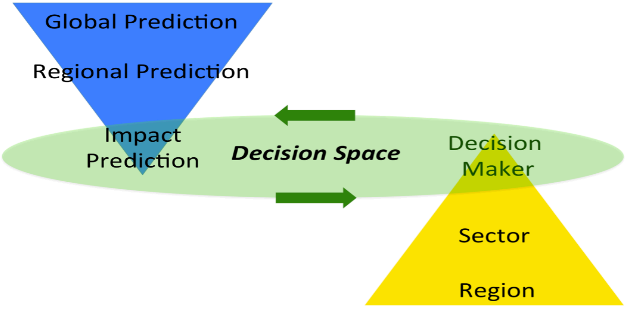

Towards the Application of Decadal Climate Predictions in Water Management

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2017 US CLIVAR Summit
PSMI Panel Breakout
Aug 9, 2017
Remote Webinar to Baltimore, MD

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Goals:

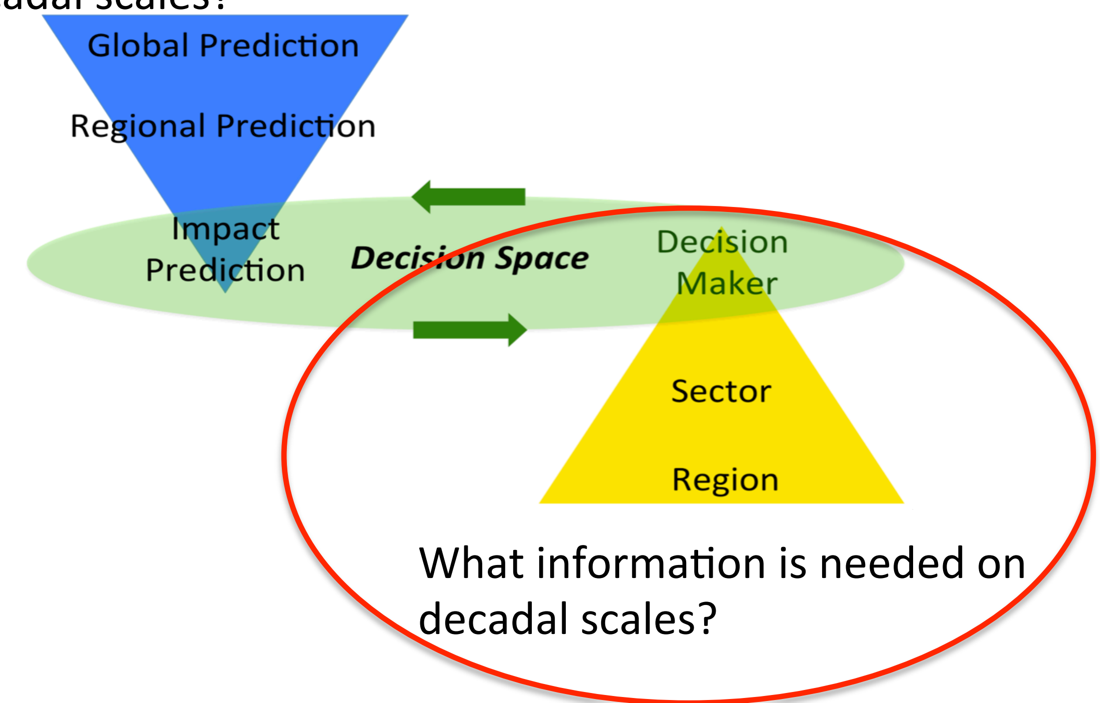
1. Introduce our NSF-funded project on Understanding Decision-Climate Interactions on Decadal Scales (UDECIDE)

2. Present a framework towards the application of decadal climate predictions

Understanding Decision-Climate Interactions on Decadal Scales

UDECIDE aims to understand the role of decadal climate information for water management decisions.

What information is skillful on decadal scales?



What information is needed on decadal scales?

20 interviews with water managers in Colorado to explore potential of decadal information

Interview results corroborate the three criteria needed for climate information to be used by decision makers identified by Cash et al. (2002):

***Saliency* - How relevant the information is to decision makers**

***Credibility* - How authoritative, believable, and trustworthy the data and its source are considered to be by decision makers**

***Legitimacy* - How "fair" an information producing process is and whether it considers appropriate values, concerns, and perspectives of different actors**

(Andrews, Lazrus, Done, 2017 AMS)

Results also indicated two additional criteria: Compatibility and Contextual Acceptability.

***Compatibility* - How well the new data fits with existing processes, mathematical models, decision-making processes, and required activities**

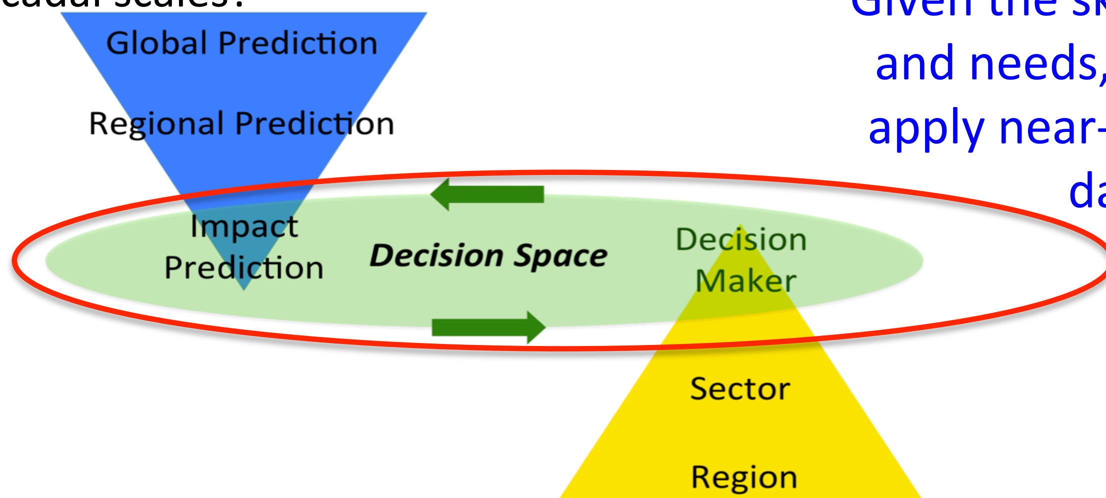
***Contextual Acceptability* - How well the new data fits with existing political, financial, and social forces**

(Andrews, Lazrus, Done, 2017 AMS)

Understanding Decision-Climate Interactions on Decadal Scales

UDECIDE aims to understand the role of decadal climate information for water management decisions.

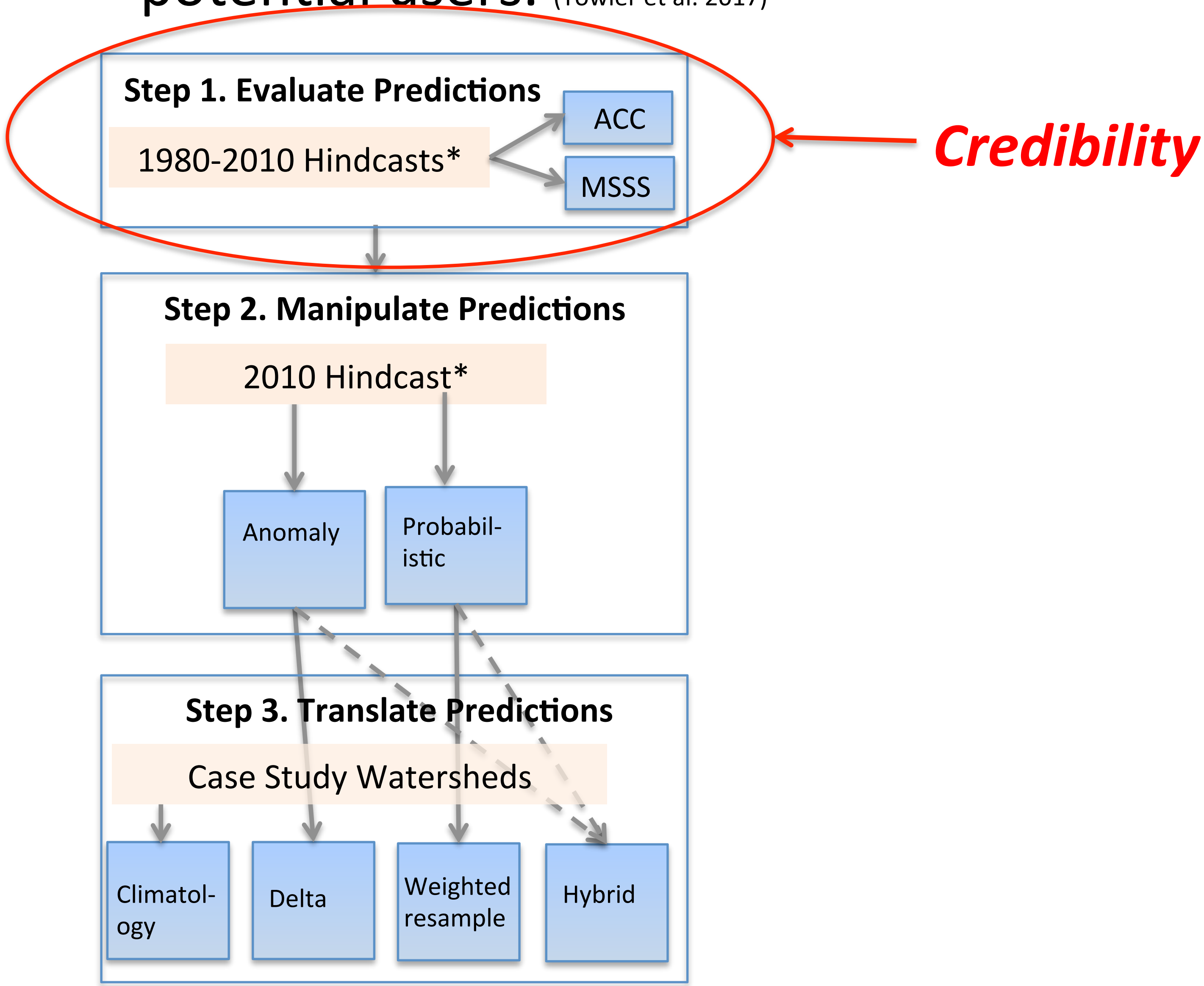
What information is skillful on decadal scales?

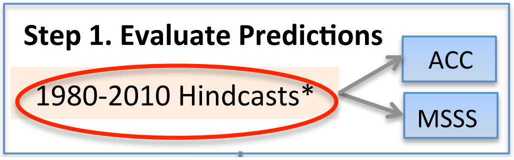


Given the skill, limitations and needs, how can we apply near-term climate data?

What information is needed on decadal scales?

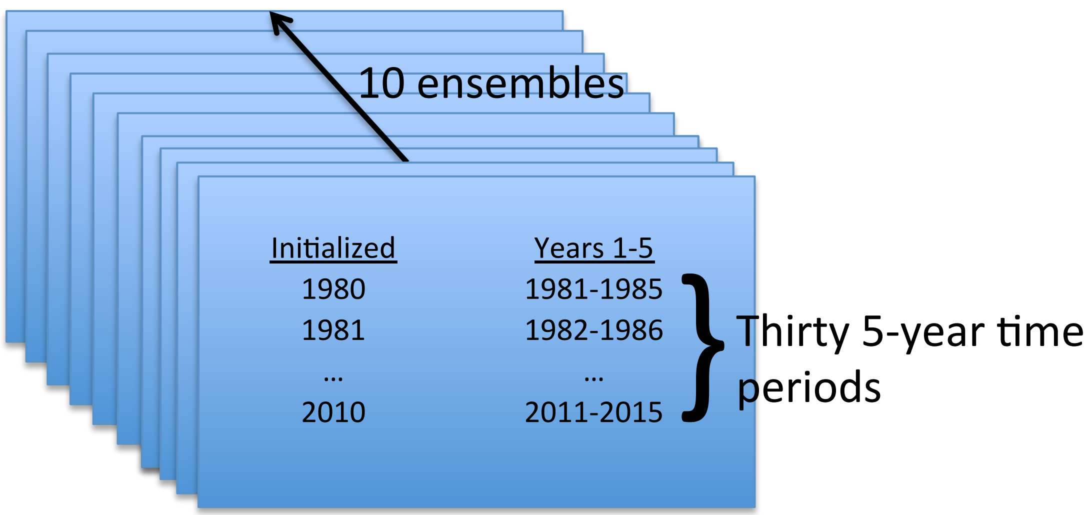
We develop a three-step framework to explore how decadal temperature predictions could be applied by potential users. (Towler et al. 2017)



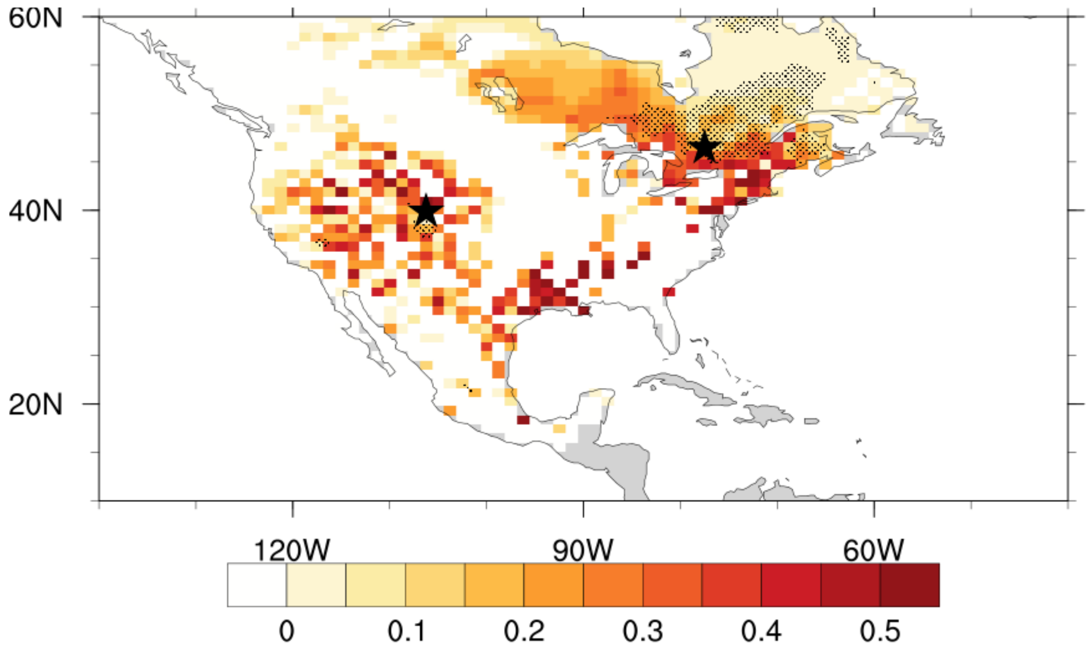


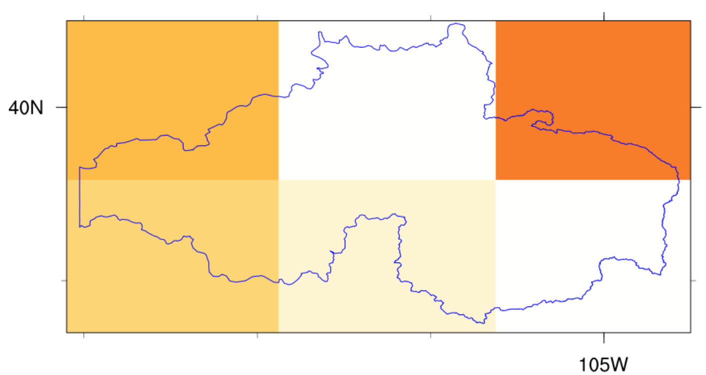
Data:

- NCAR CCSM4 **temperature** hindcasts
  - Initialized every year 1980-2010
  - Examine years 1-5
  - 10 ensembles

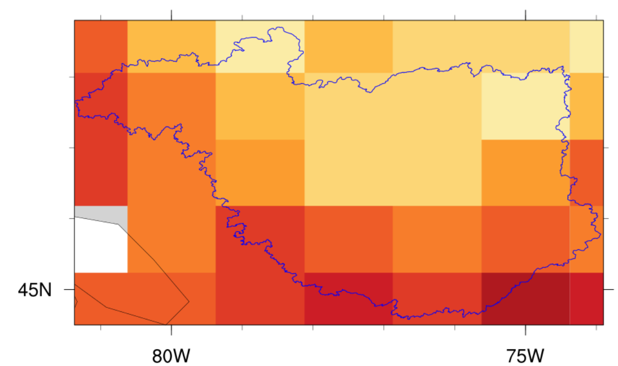


Mean squared skill score (MSSS) is positive where hindcast is more skillful than climatology.



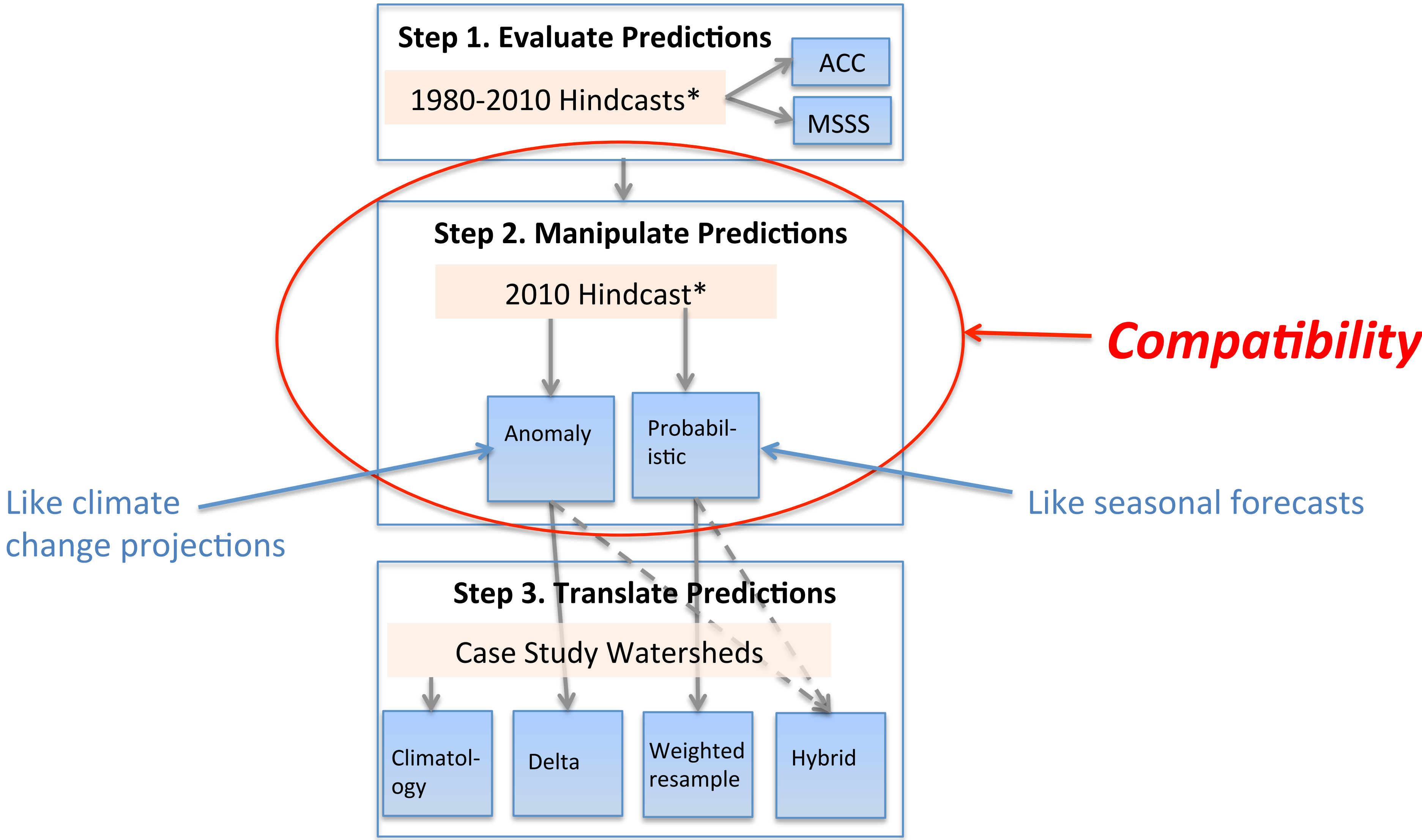


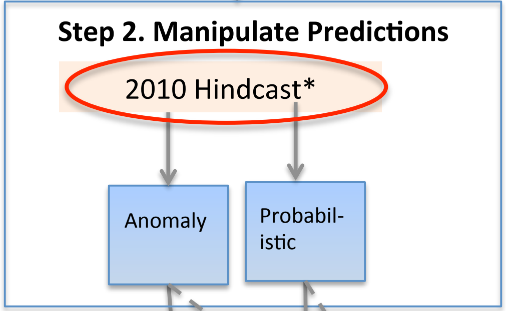
Colorado Watershed
(MSSS = -0.038)



Ottawa Watershed
(MSSS = 0.25)

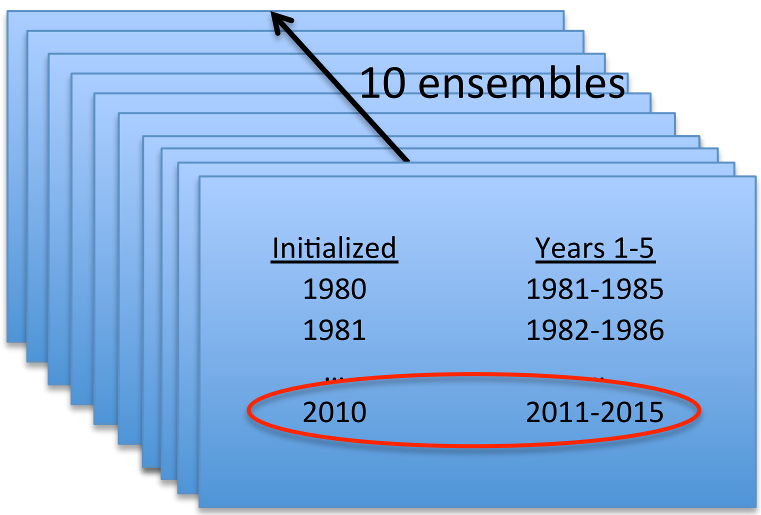
We develop a three-step framework to explore how decadal temperature predictions could be applied by potential users.



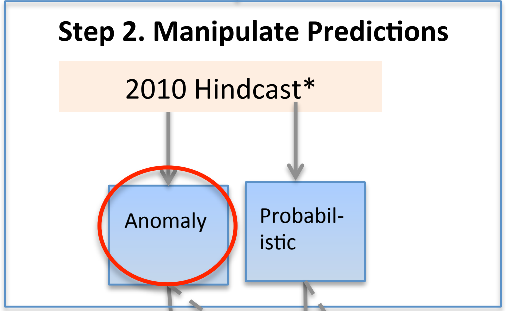


Data:

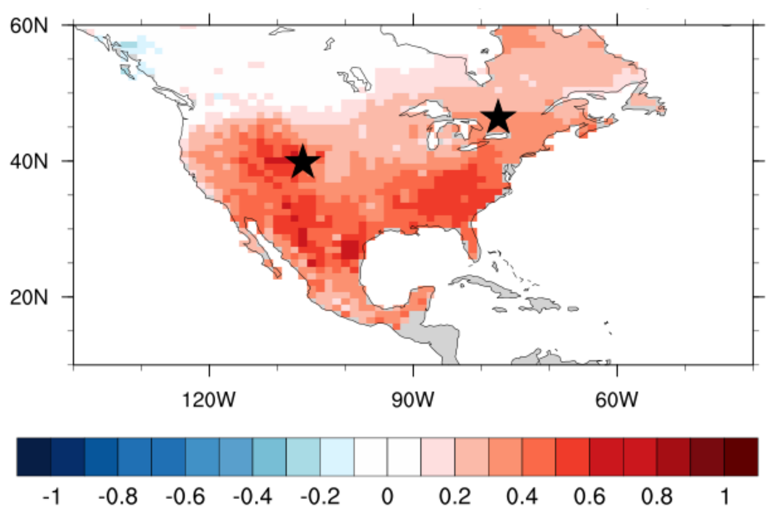
- NCAR CCSM4 **temperature** hindcasts



Examine 2011-2015
prediction period

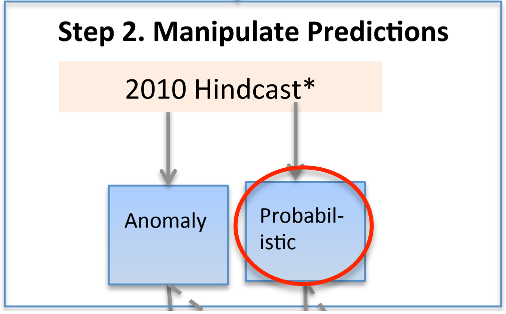


Decadal temperature predictions can be presented like climate change projections (i.e., a delta)

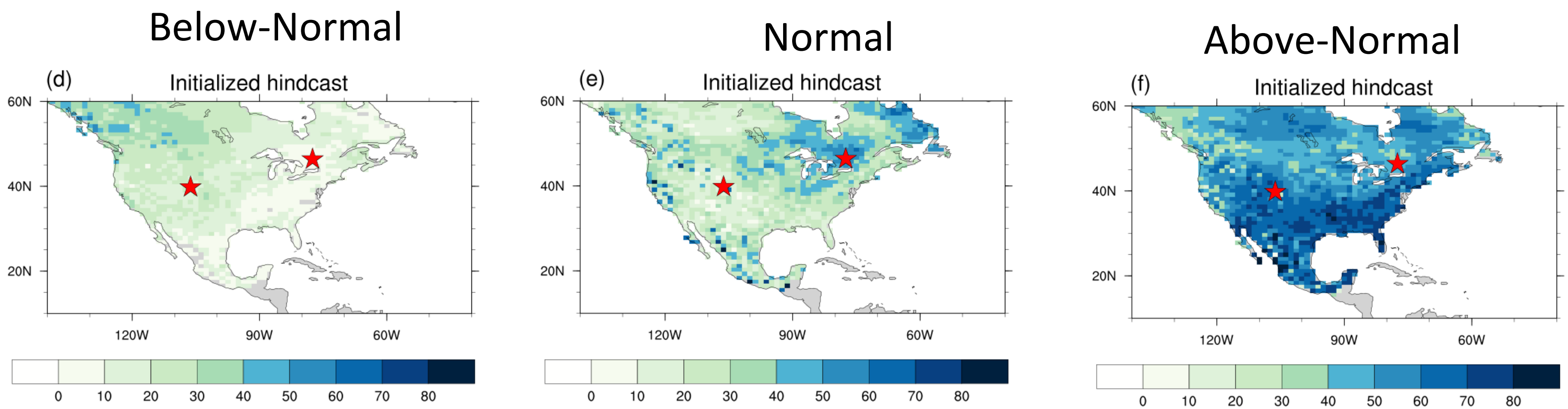


Discrete temperature anomalies (deltas) for 2011-2015 (relative to 1981-2010) shows warming across the US.

	Delta	
	Colorado	Ottawa
Anomaly (C)	**0.9**	**0.2**



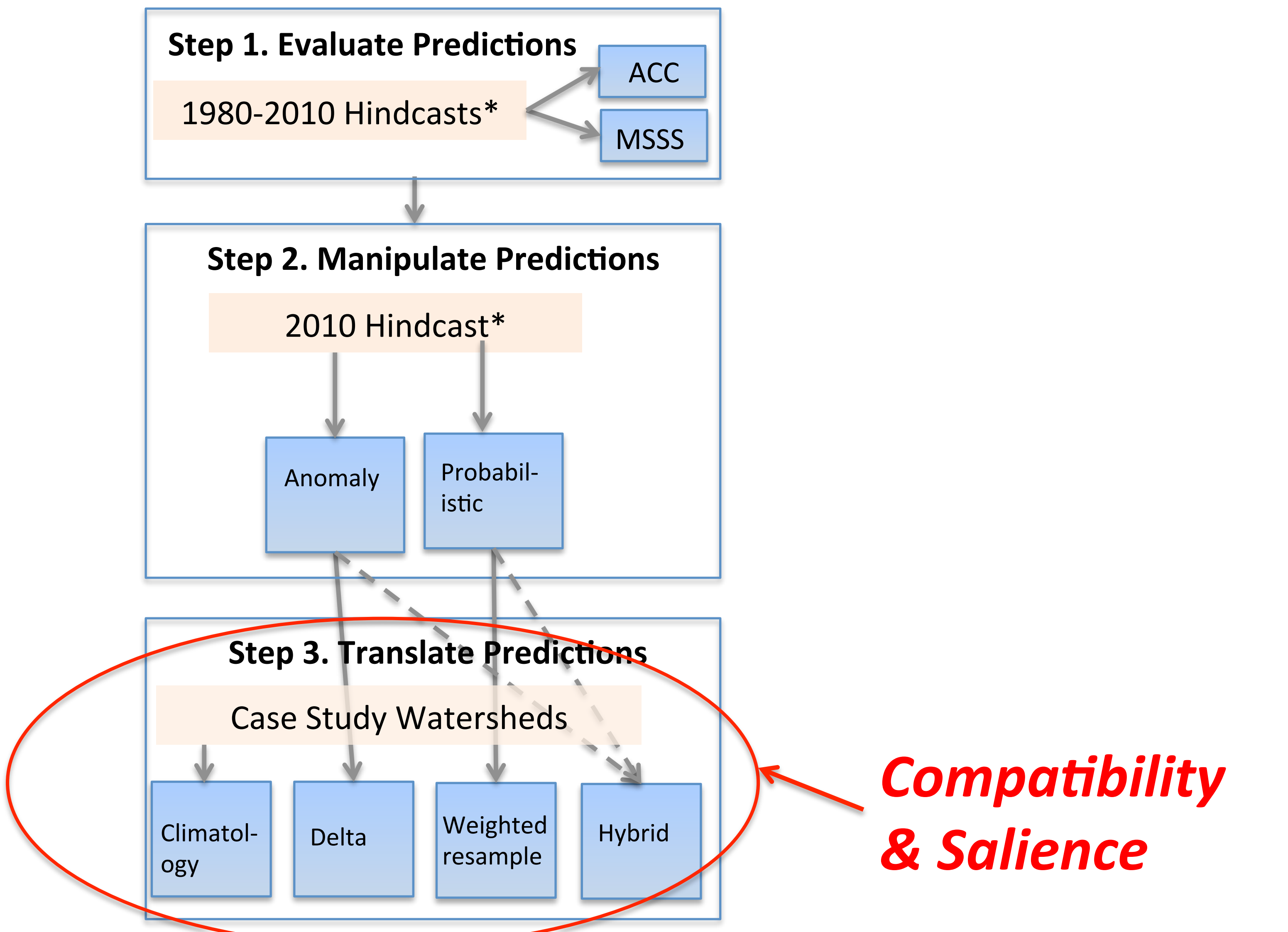
Decadal temperature predictions can be presented like seasonal climate forecasts (i.e., probabilistic)

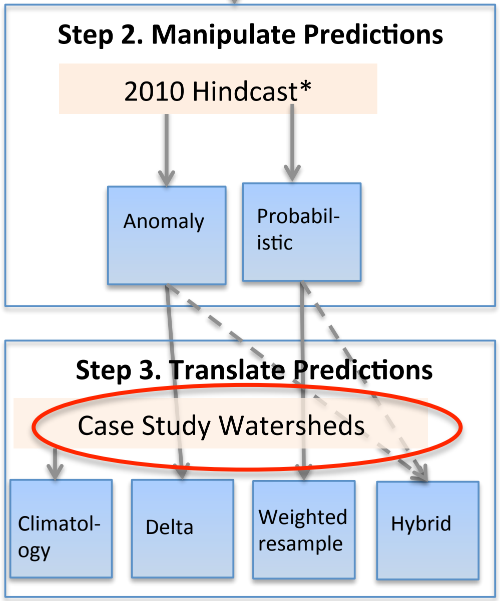


Probabilistic temperature predictions for 2011-2015 tilt towards “Above-normal” category

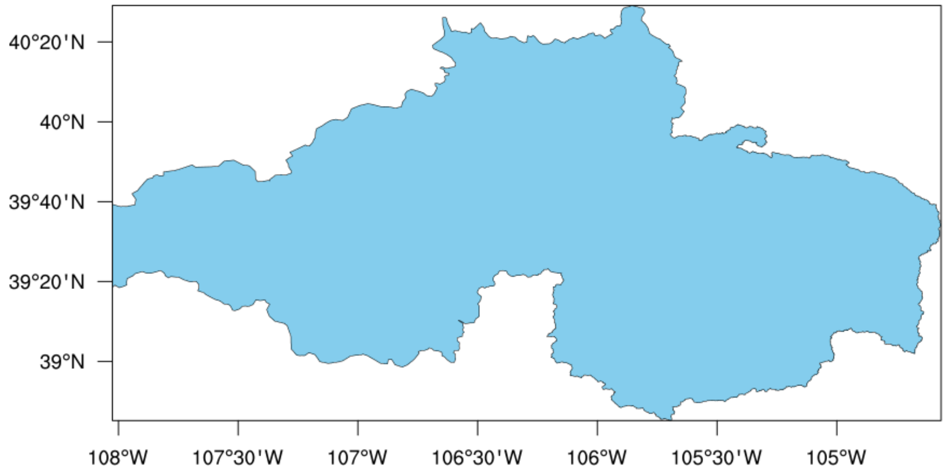
		Colorado	Ottawa
Probability (%)	Below-Normal	**0**	**27**
	Normal	**27**	**30**
	Above-Normal	**73**	**43**

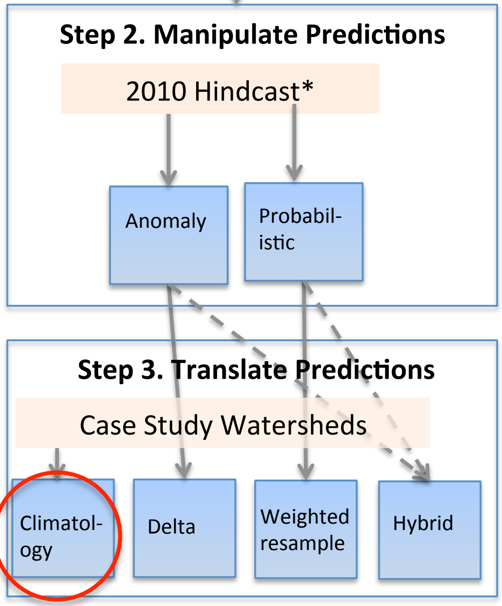
We develop a three-step framework to explore how decadal temperature predictions could be applied by potential users.



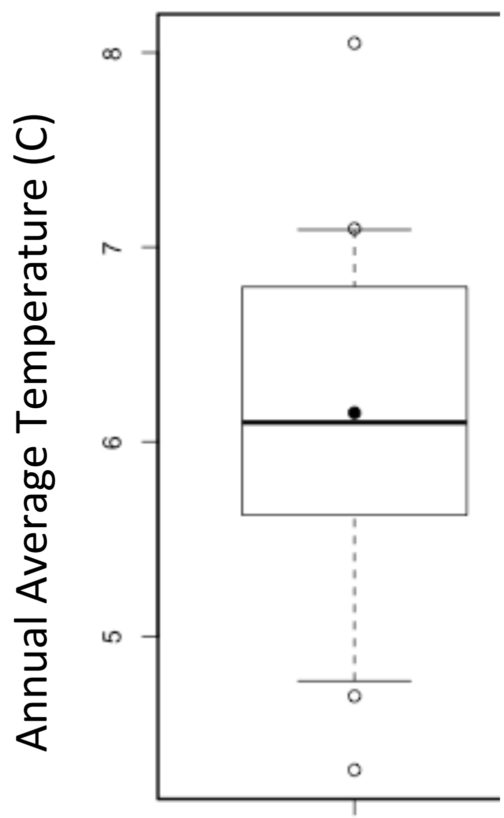


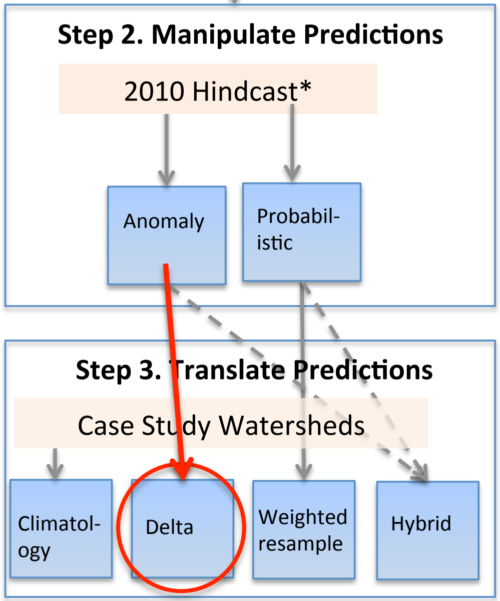
Only look at **Colorado watershed results…**



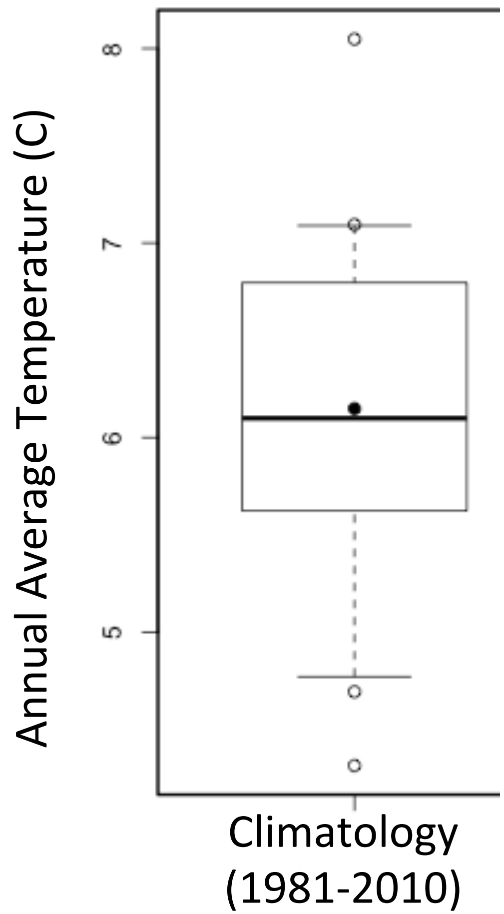


Climatology is the observed average temperatures over the watershed from 1981-2010 (=30 years).

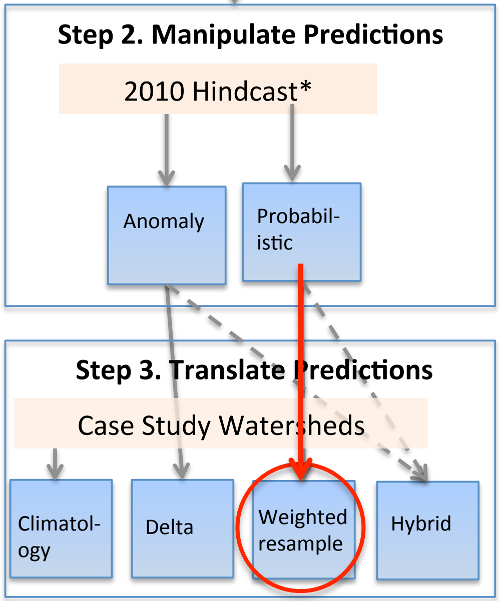




The **Delta** adds the average temperature **anomaly**

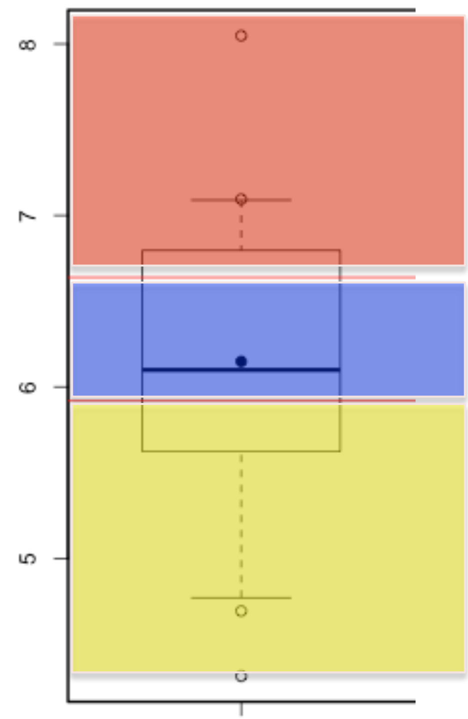


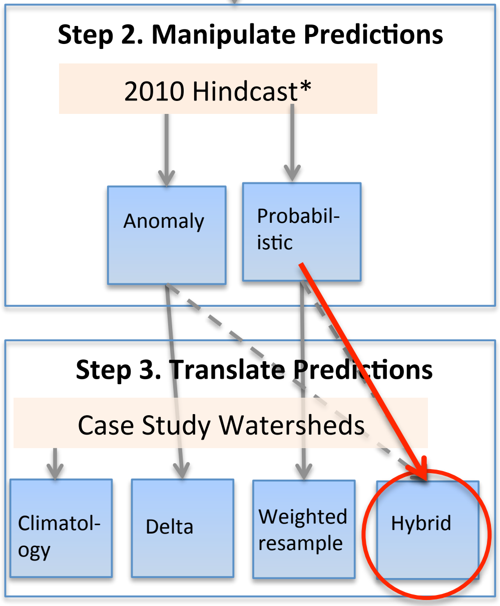
+ Delta (0.9C)



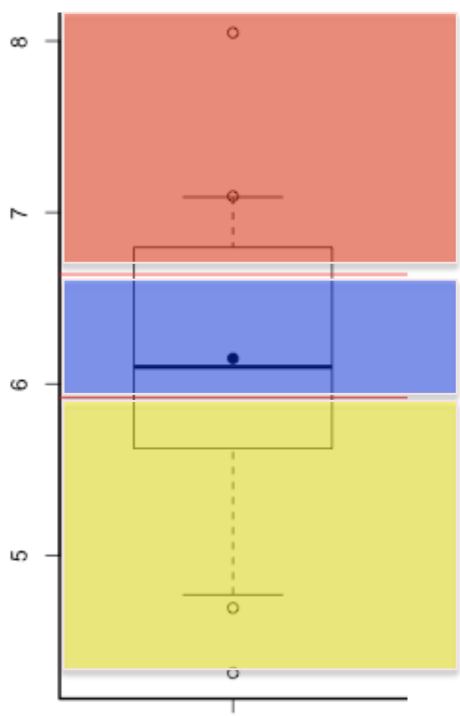
The **Weighted Resample** resamples average temperatures over the watershed to reflect the **probabilistic hindcast**

		Colorado
Probability (%)	Above-Normal	73%
	Normal	27%
	Below-Normal	0%



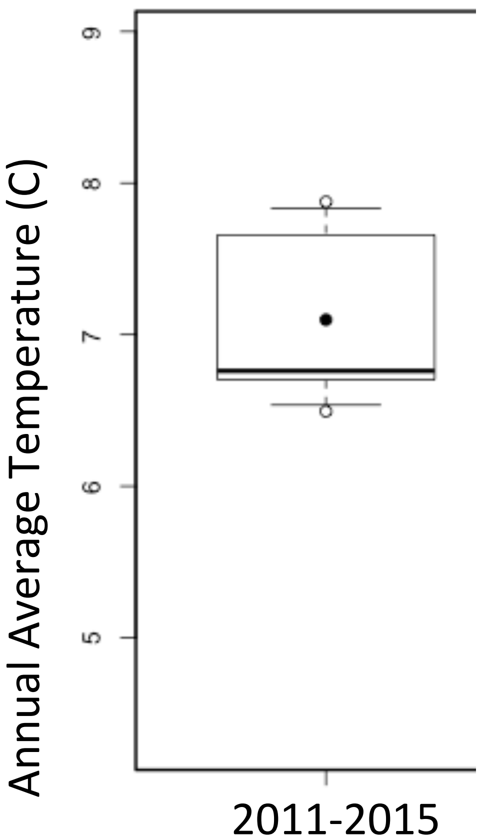


The **Hybrid** re-centers the weighted resample over climatology, then adds the delta.

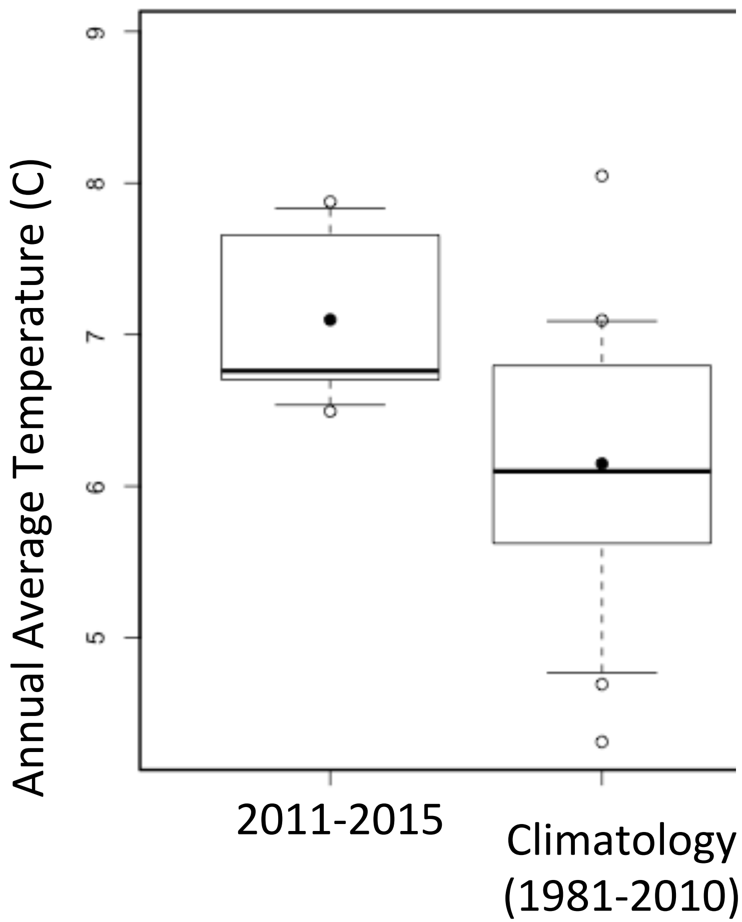


$$- \quad (\mathrm{Resamp}_{Avg} - \mathrm{Clim}_{Avg}) \quad + \quad \text{Delta (0.9C)}$$

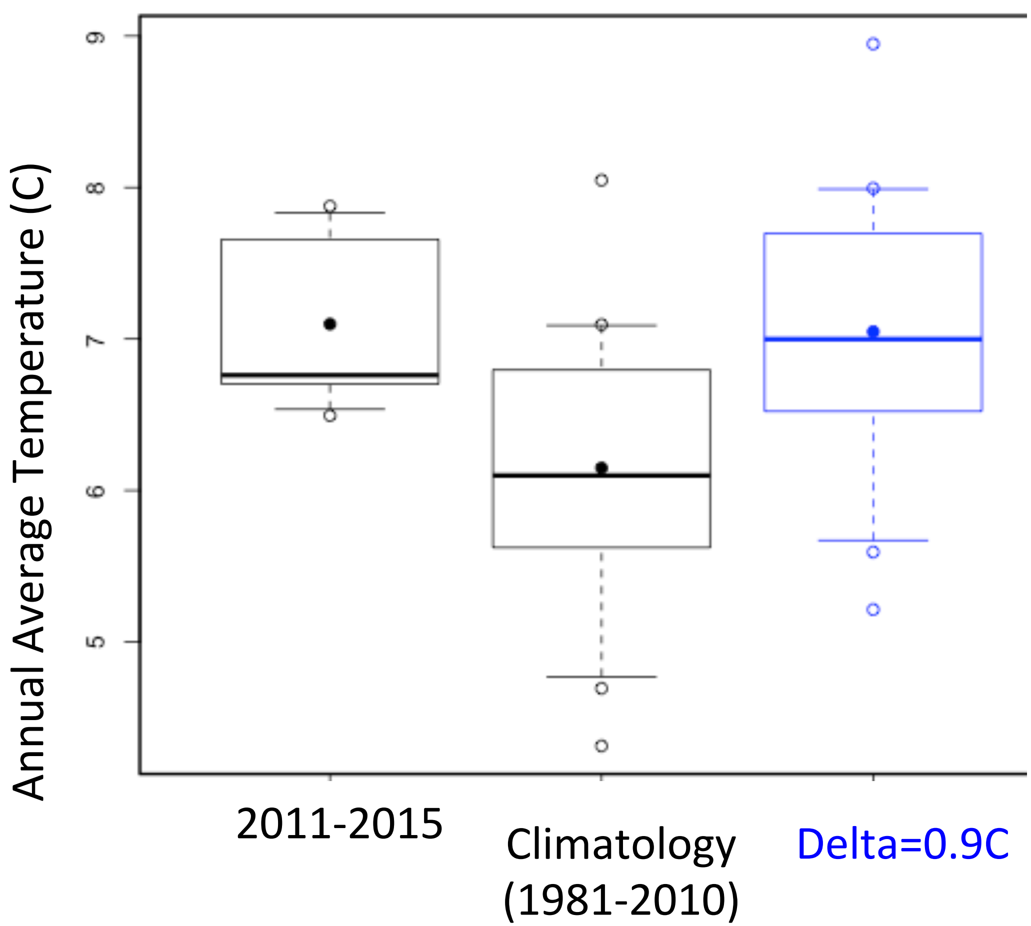
Colorado Watershed



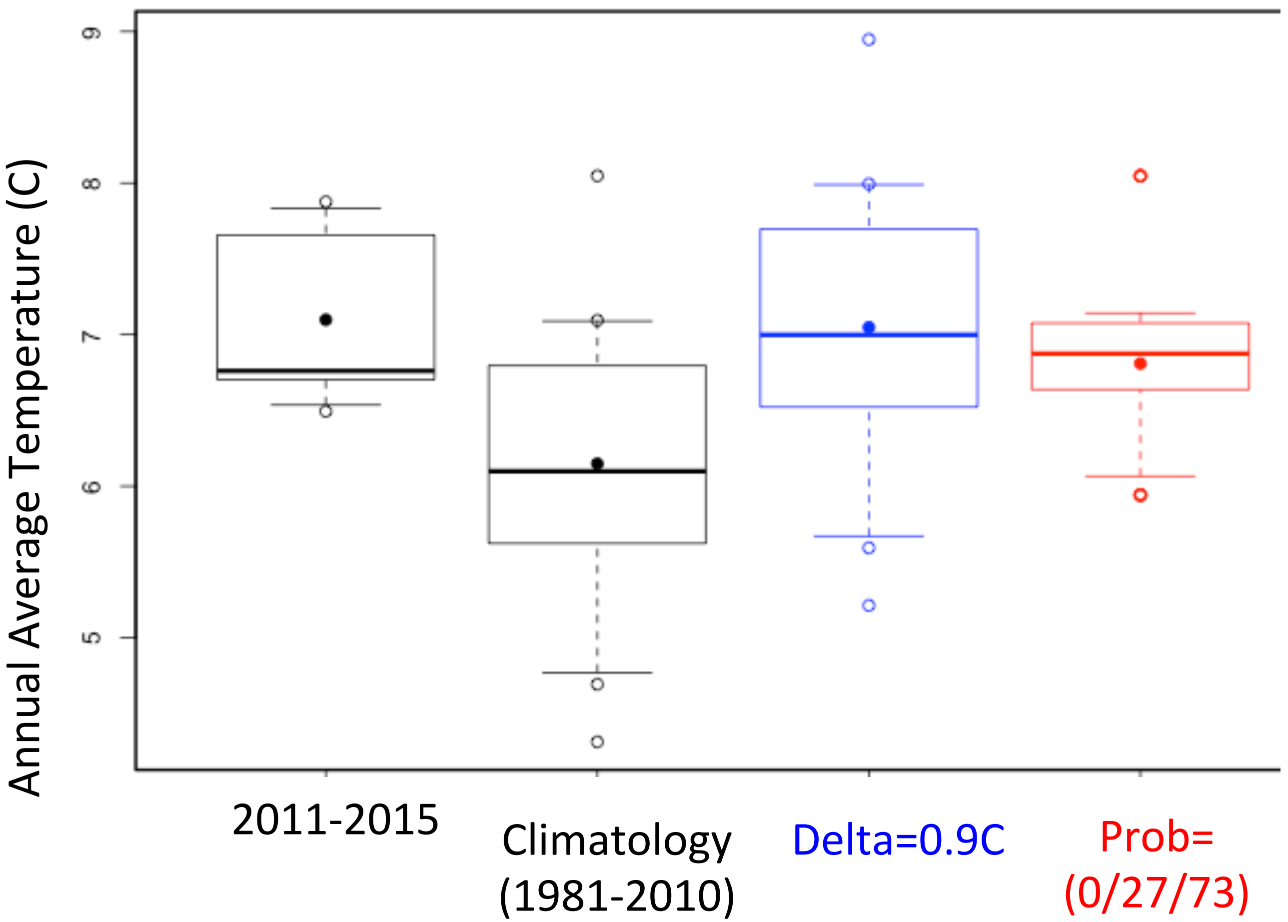
Colorado Watershed: There is a distinct increase in average temperature from 1981-2010 to 2011-2015.



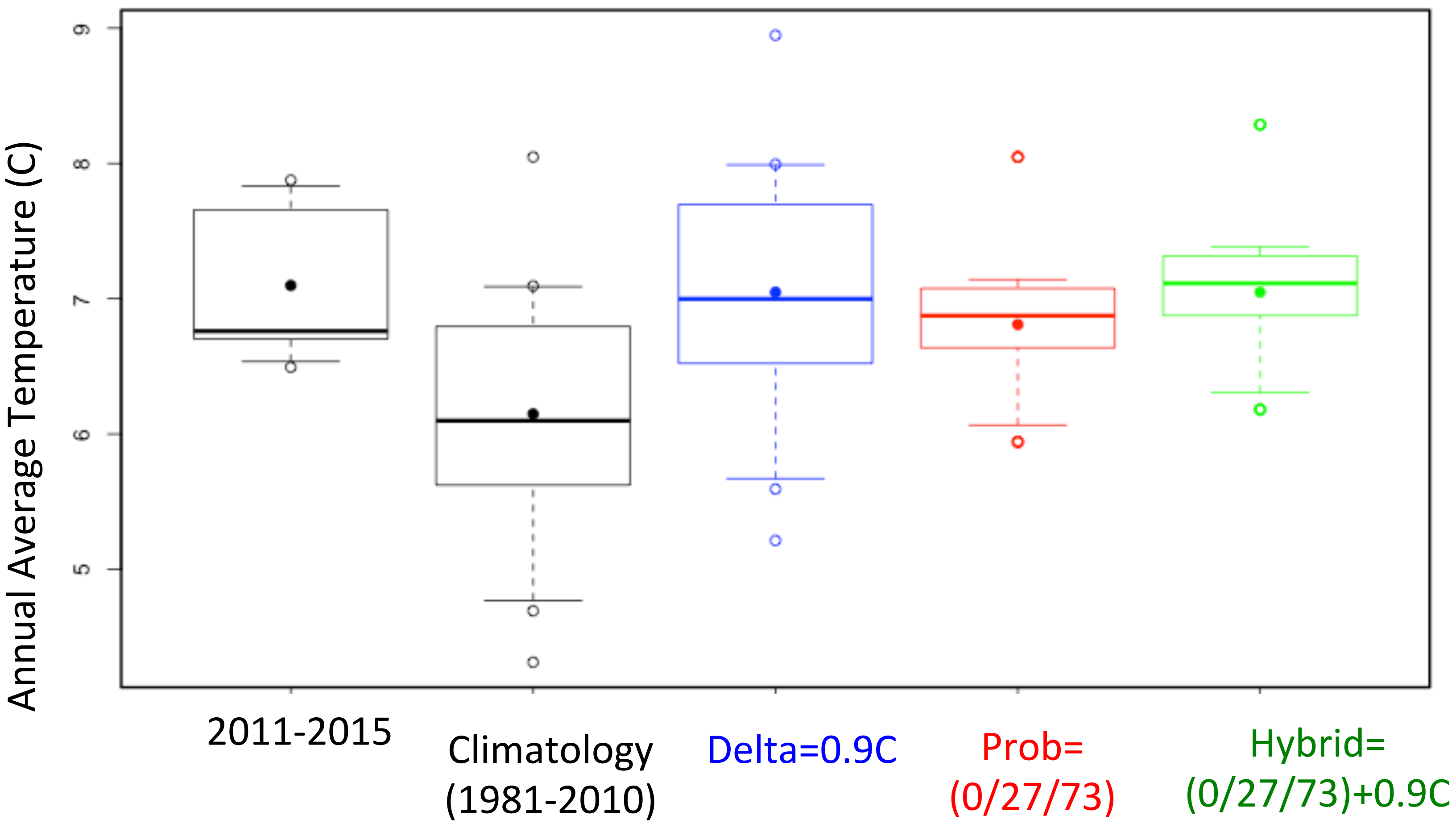
Colorado Watershed: Delta adds 0.9C to climatology & distribution shape stays the same.



Colorado Watershed: Weighted resample samples 0% from below-normal, 27% from normal, and 73% from above-normal climatology distribution; distribution shape changes



Colorado Watershed: Hybrid re-centers weighted resample to climatological average, then adds the delta.



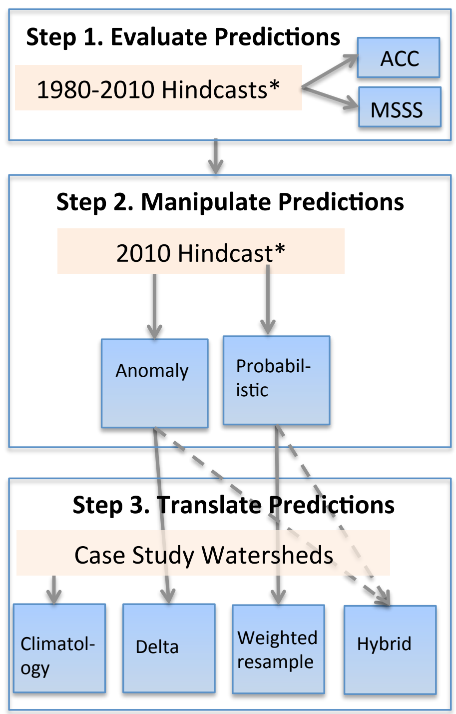
All three translation methods do better than climatology.

Average absolute % error (across selected quantiles) for 2011-2015 prediction

		Avg Abs % Error
Colorado	**Clim**	18%
	Delta	4%
	Weighted	5%
	Hybrid	4%

Conclusions

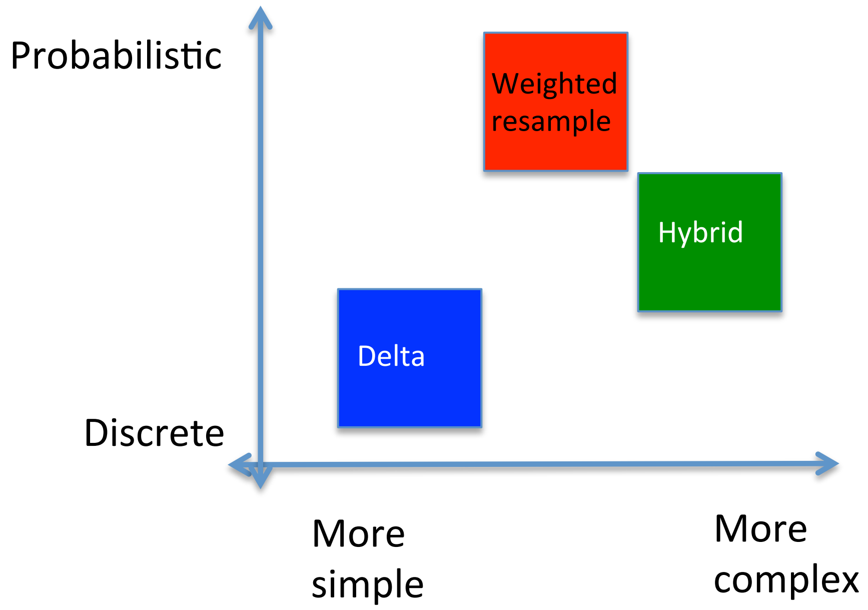
- Decadal predictions are still experimental, but framework provides water managers with **systematic alternatives** to using climatology.



Conclusions

- Decadal predictions are still experimental, but these approaches give water managers **systematic alternatives** to using climatology.

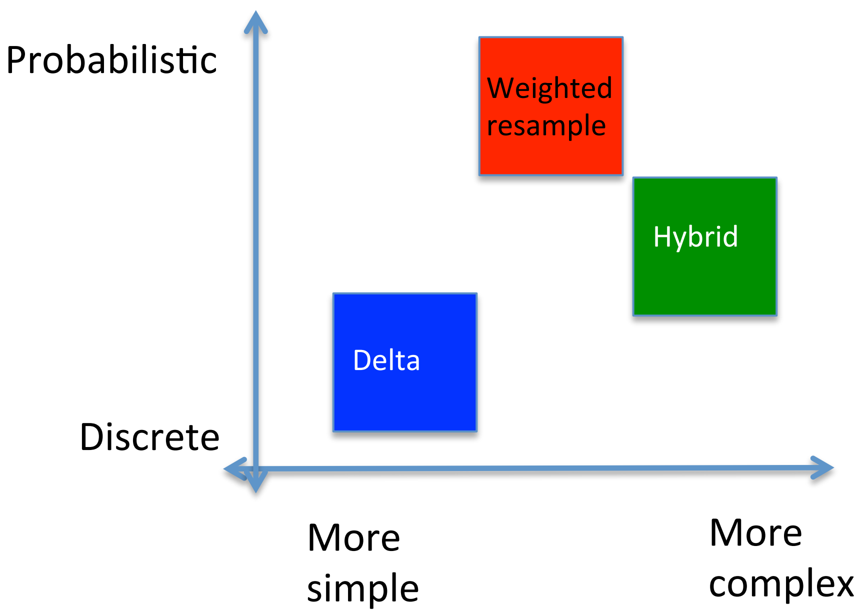
- Translations have pros/cons



Conclusions

- Decadal predictions are still experimental, but these approaches give water managers **systematic alternatives** to using climatology.

- Translations have pros/cons & depend on user needs

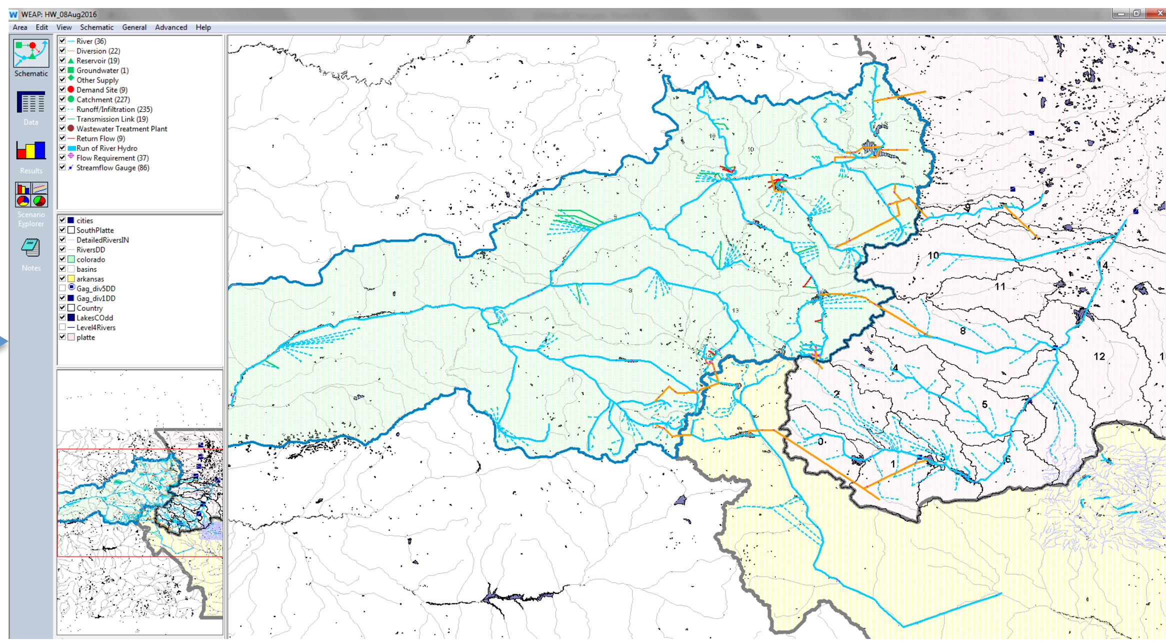


Weighted resample	Most conservative
Delta	Most straightforward
Hybrid	Tailored for decadal predictions

Current Work:

Use hydrologic model to make predictions more relevant to water managers

Temp & Precip



Reservoir inflows

Management

WEAP Application (Hydrologic model)
Courtesy David Yates, NCAR

Thank you!

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Towler E, PaiMazumder D, Done J (2017), "Towards the application of decadal climate predictions," Submitted to the Journal of Applied Meteorology and Climatology (AMS).