Examining Projected Run-off in the South Saskatchewan River Basin in NARCCAP and CCCma RCM Data

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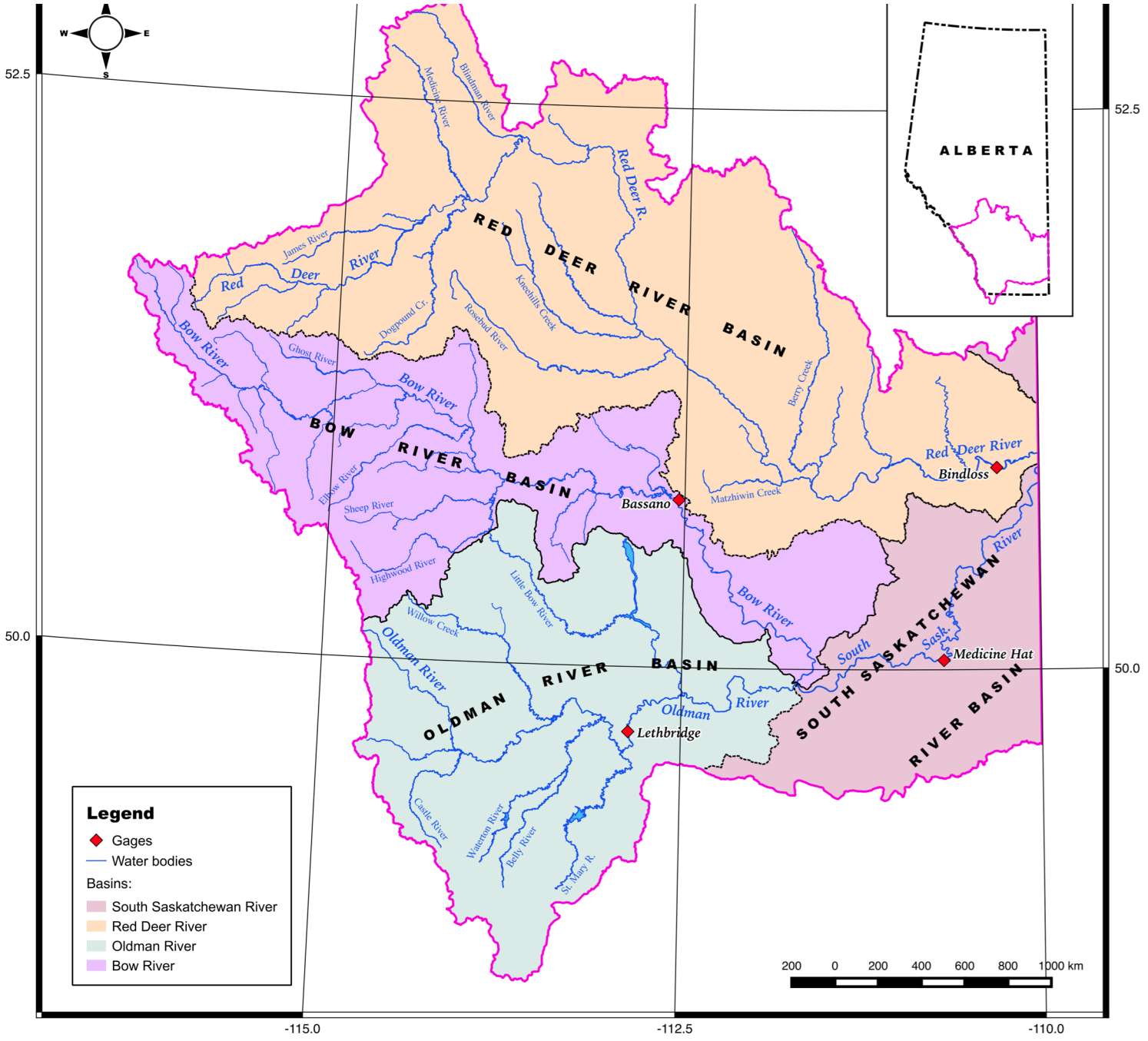
CWRA 2016, Montreal

South Saskatchewan River Basin (SSRB)




Taber
Fincastle
Purple Spr
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Image S. Alberta MD s and Counties

Purpose of Study

What will happen to SSRB riverflow by 2041-2070?

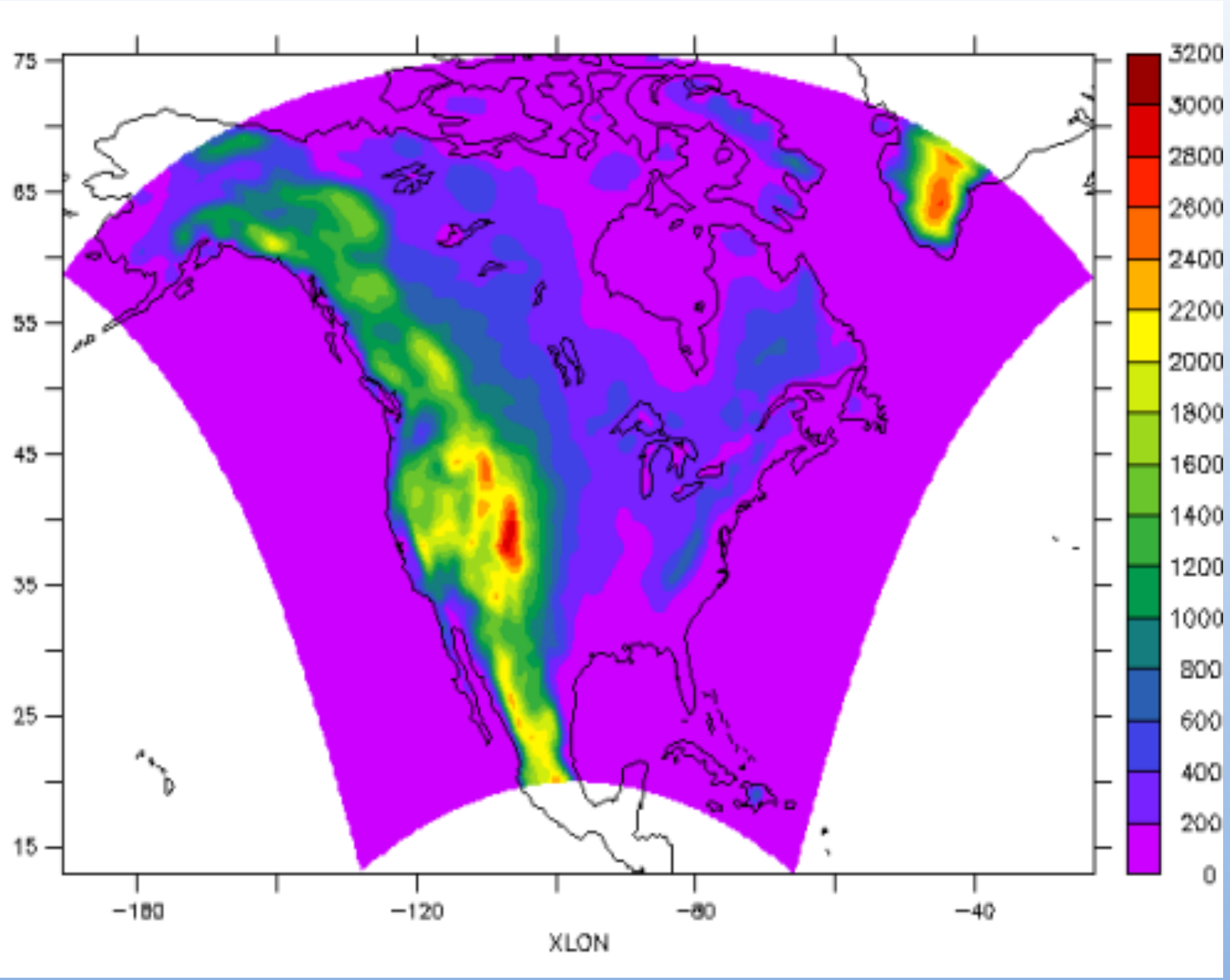
Part of the South Saskatchewan River Basin Adaptation to Climate Variability Project

NSERC CRSNG

ALBERTA waterSMART Water Management Solutions

HYDROLOGICS Advancing the management of water resources

What do NARCCAP RCMs project?

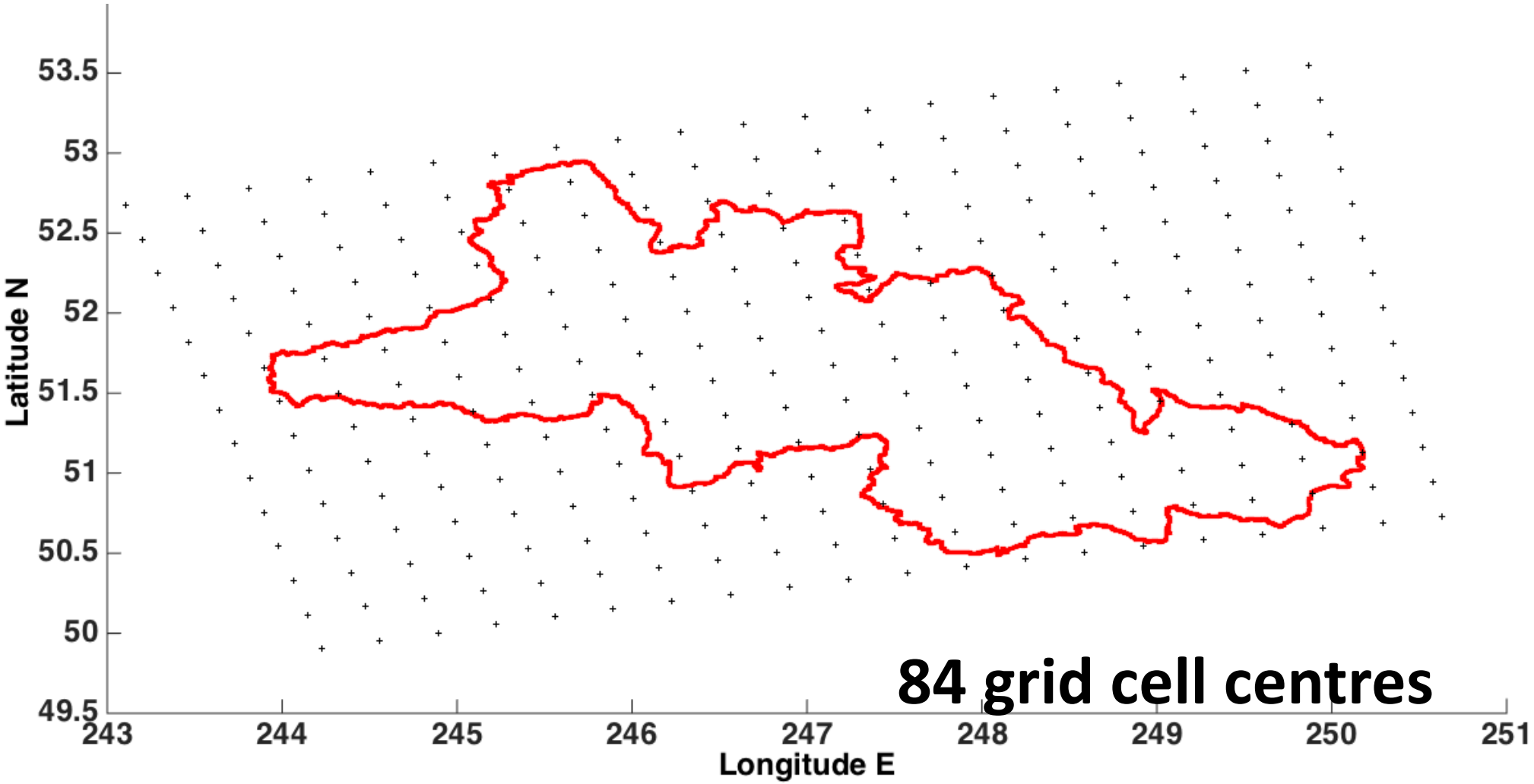


10 RCMs used

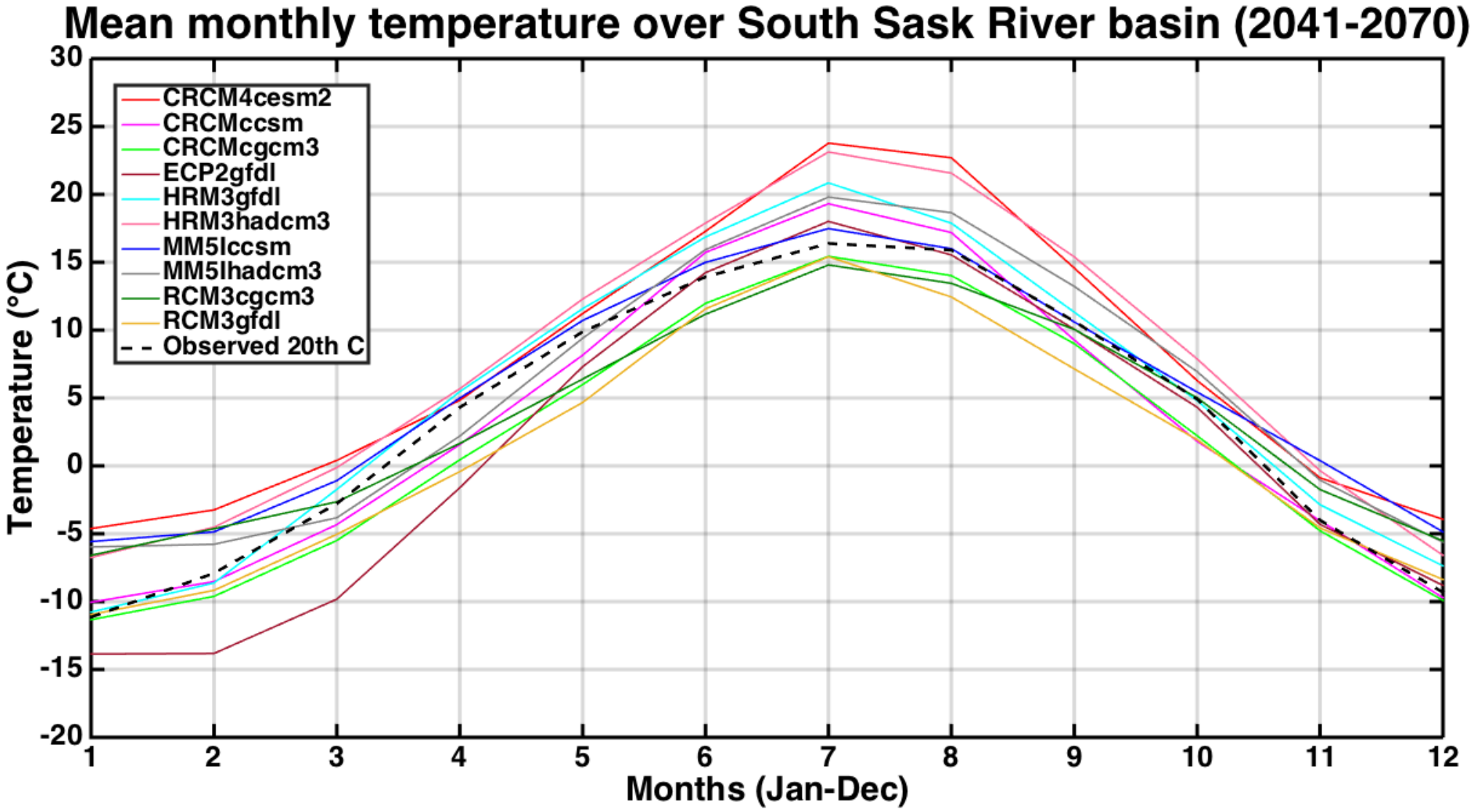
RCM/GCM	GFDL	CGCM3	HADCM3	CCSM
CRCM		x		x
ECP2	x			
HRM3	x		x	
MM5I			x	x
RCM3	x	x		

Plus 1 run from CRCM4 - a CORDEX run

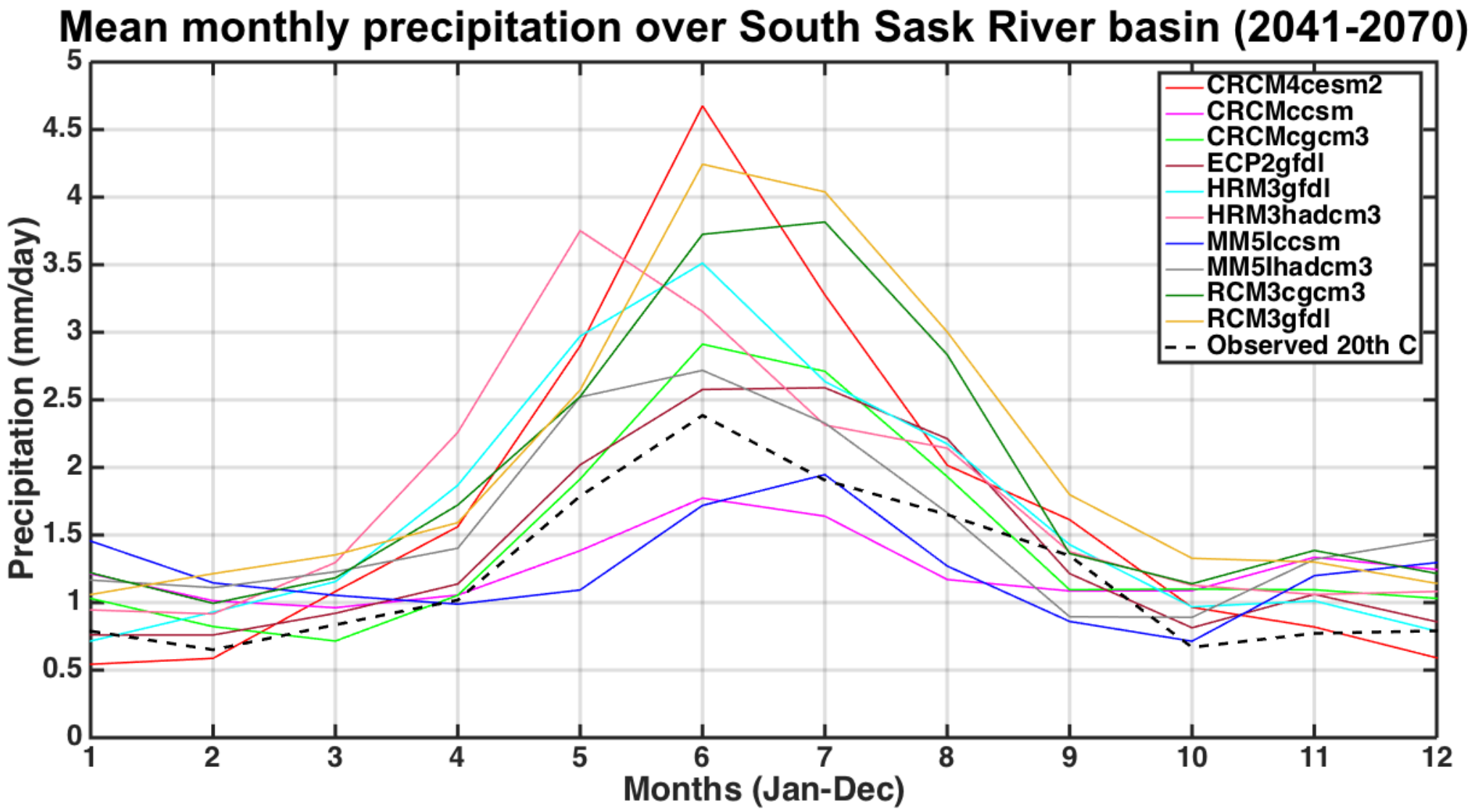
Red Deer River Basin with grid cell centres from CRCM4



SSRB Projected Temperature



SSRB Projected Precipitation



"Uncalibrated" Runoff Projection

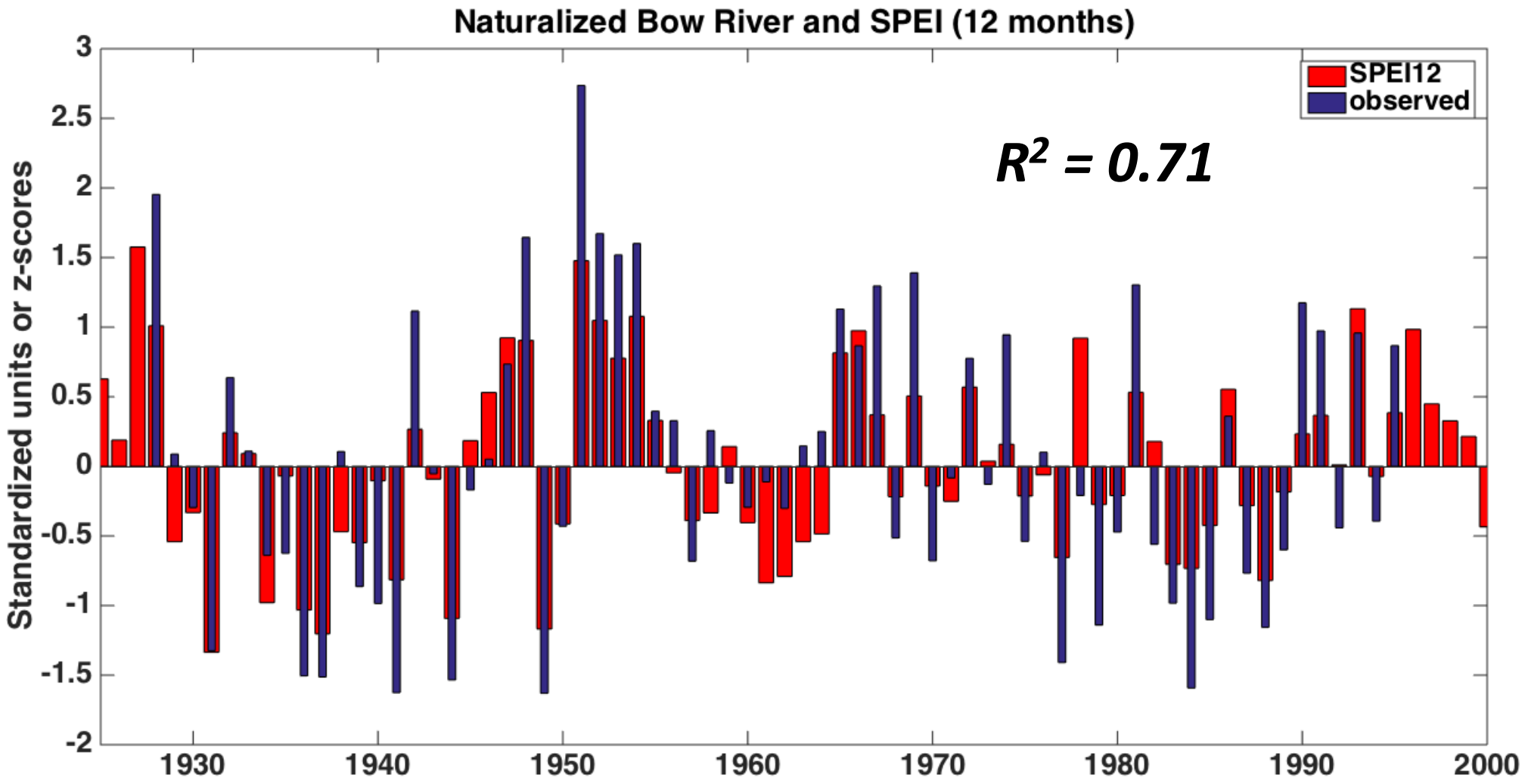
- total runoff (***mrro***)
- surface runoff (***mrros***)
- 4 functional forms of the **aridity index**

$$R \approx P - ET = P(1 - ET/P) \approx P(1 - F(\varphi))$$

Name	Functional form $F(\varphi)$
Schreiber (1904)	$1 - e^{-\varphi}$
Ol'dekop (1911)	$\varphi \tanh(\varphi^{-1})$
Budyko (1948)	$[\varphi \tanh(\varphi^{-1}) (1 - e^{-\varphi})]^{0.5}$
Turc (1954) - **Pike** (1964)	$1/\sqrt{(0.9 + (1/\varphi)^2)}$

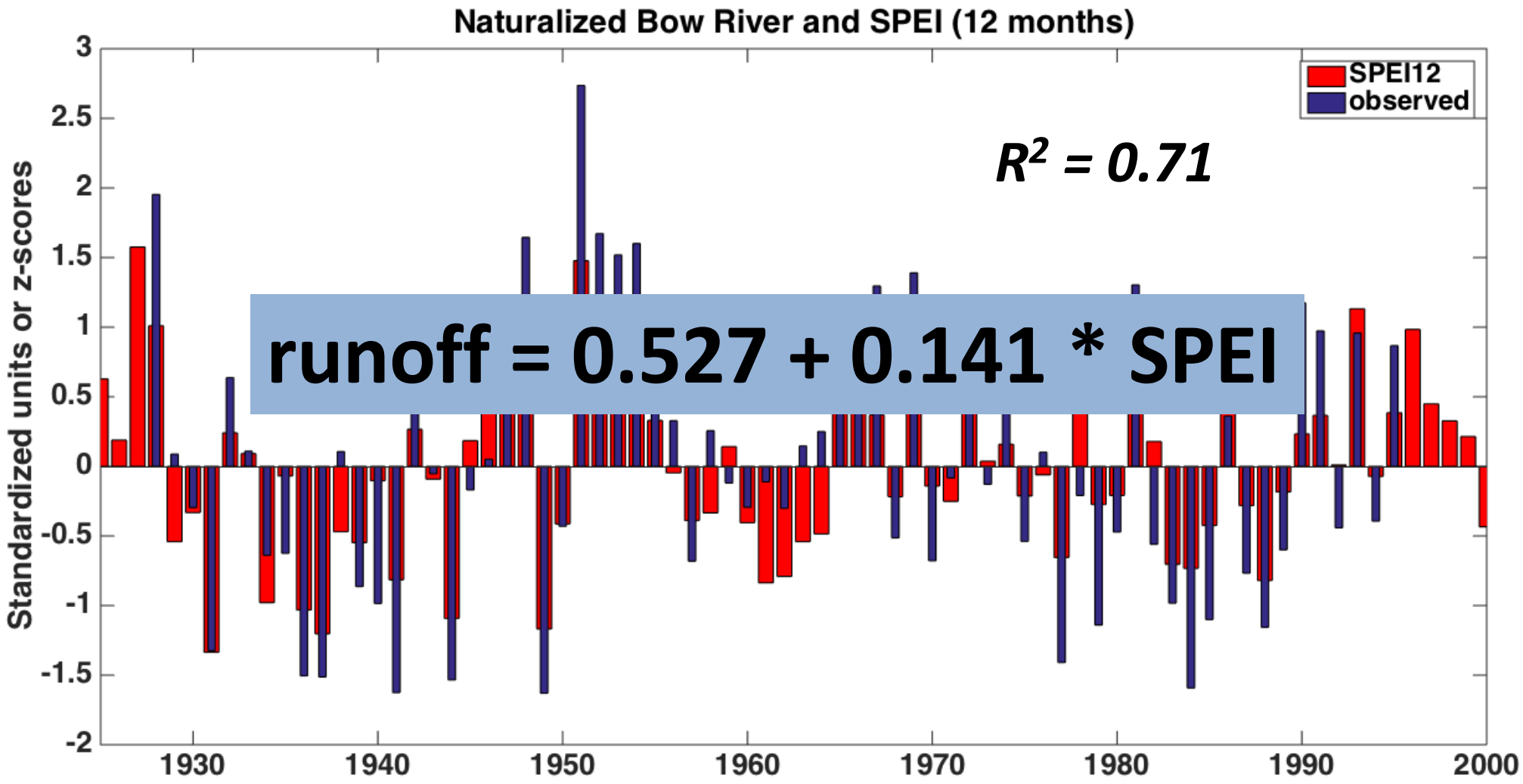
following Arora (2002) and González-Zeas *et al*. (2012)

“Calibrated” SPEI-based Downscaling



SPEI – Vicente-Serrano *et al.* (2010)

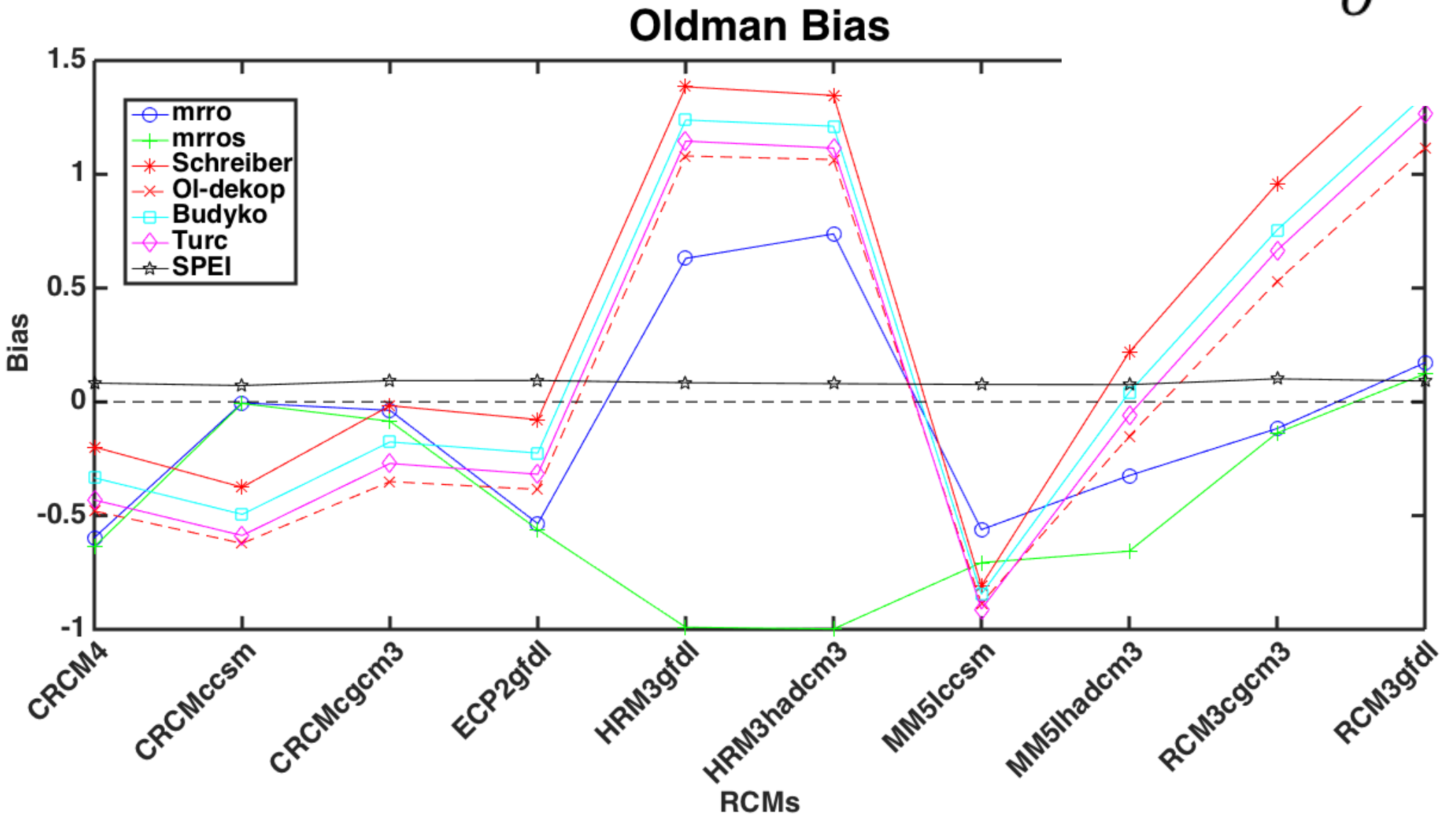
“Calibrated” SPEI-based Downscaling



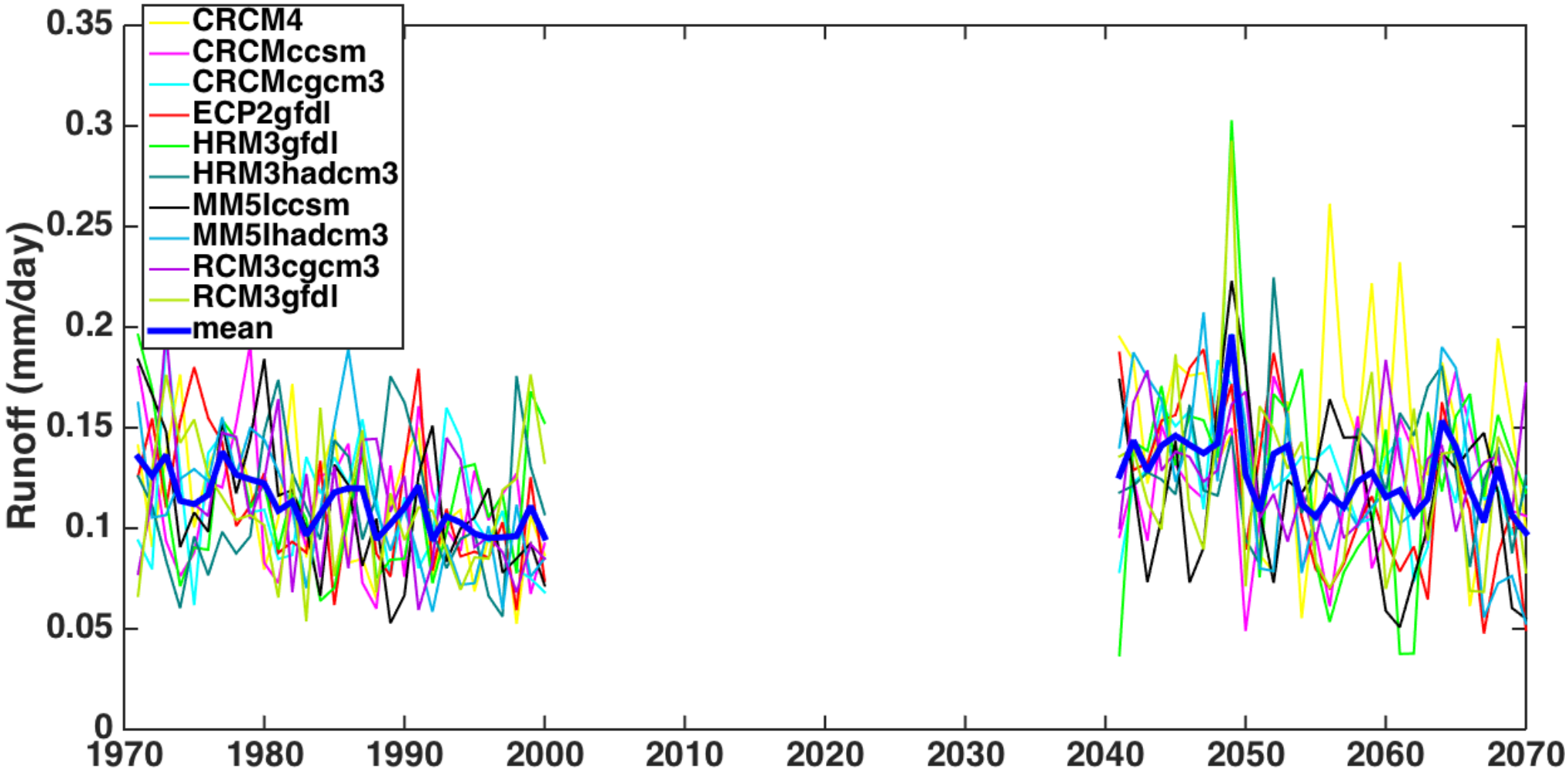
SPEI – Vicente-Serrano *et al.* (2010)

mrro works best

$$\text{Bias} = \frac{\bar{s} - \bar{o}}{\bar{o}}$$

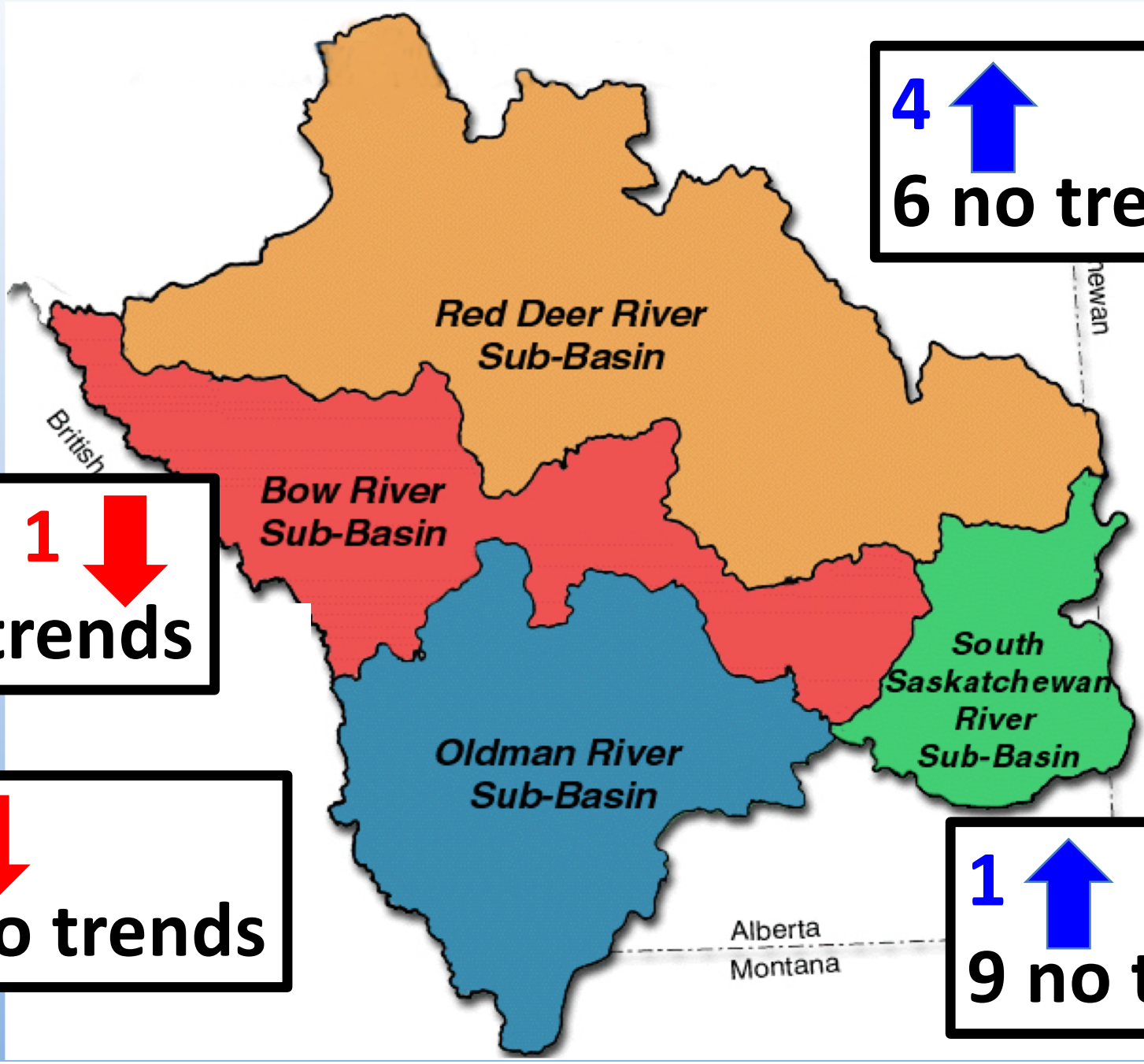


mrro results for Red Deer



quantile-quantile mapping bias correction used

mrro-based projection results



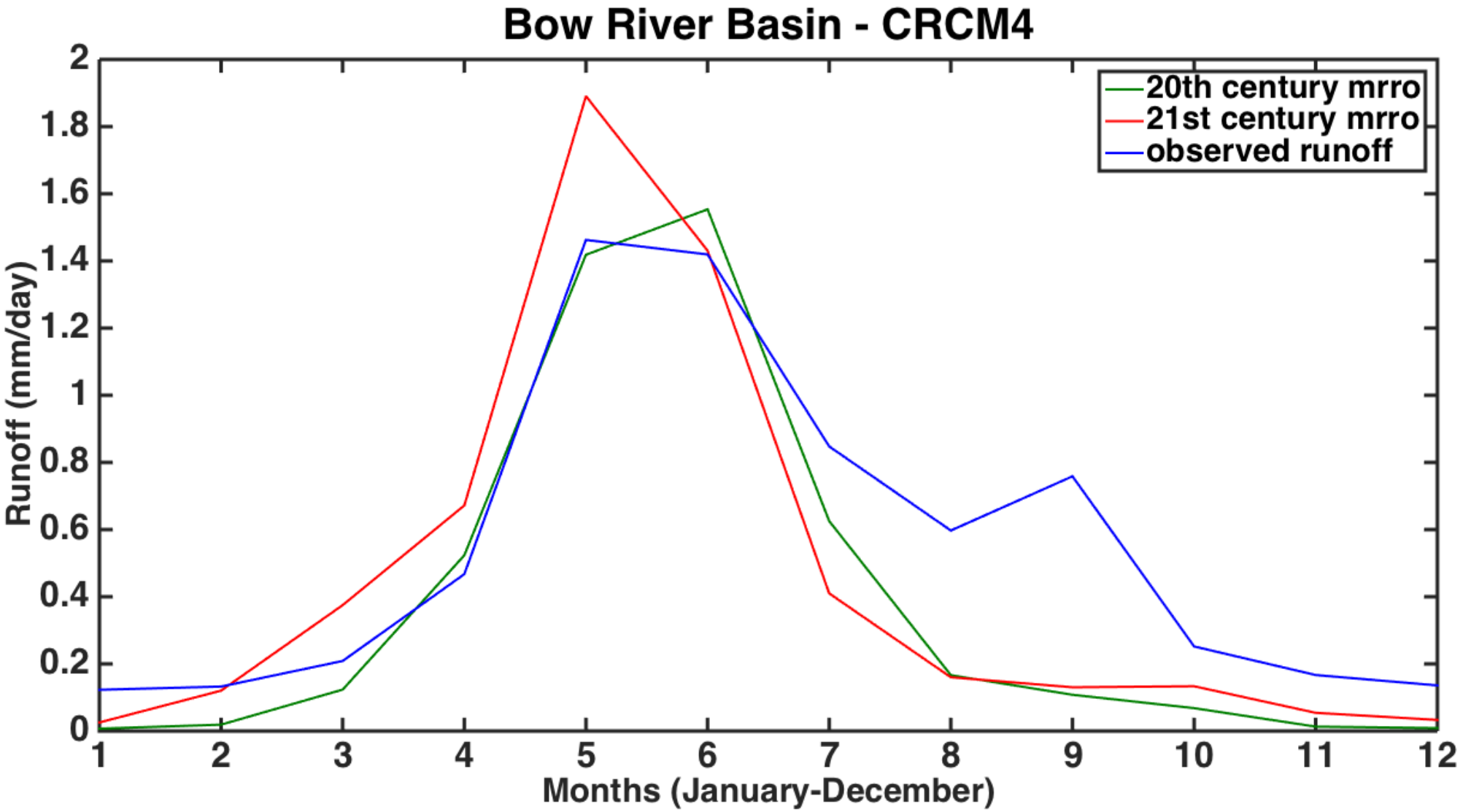
4 ↑
6 no trends

1 ↑, 1 ↓
8 no trends

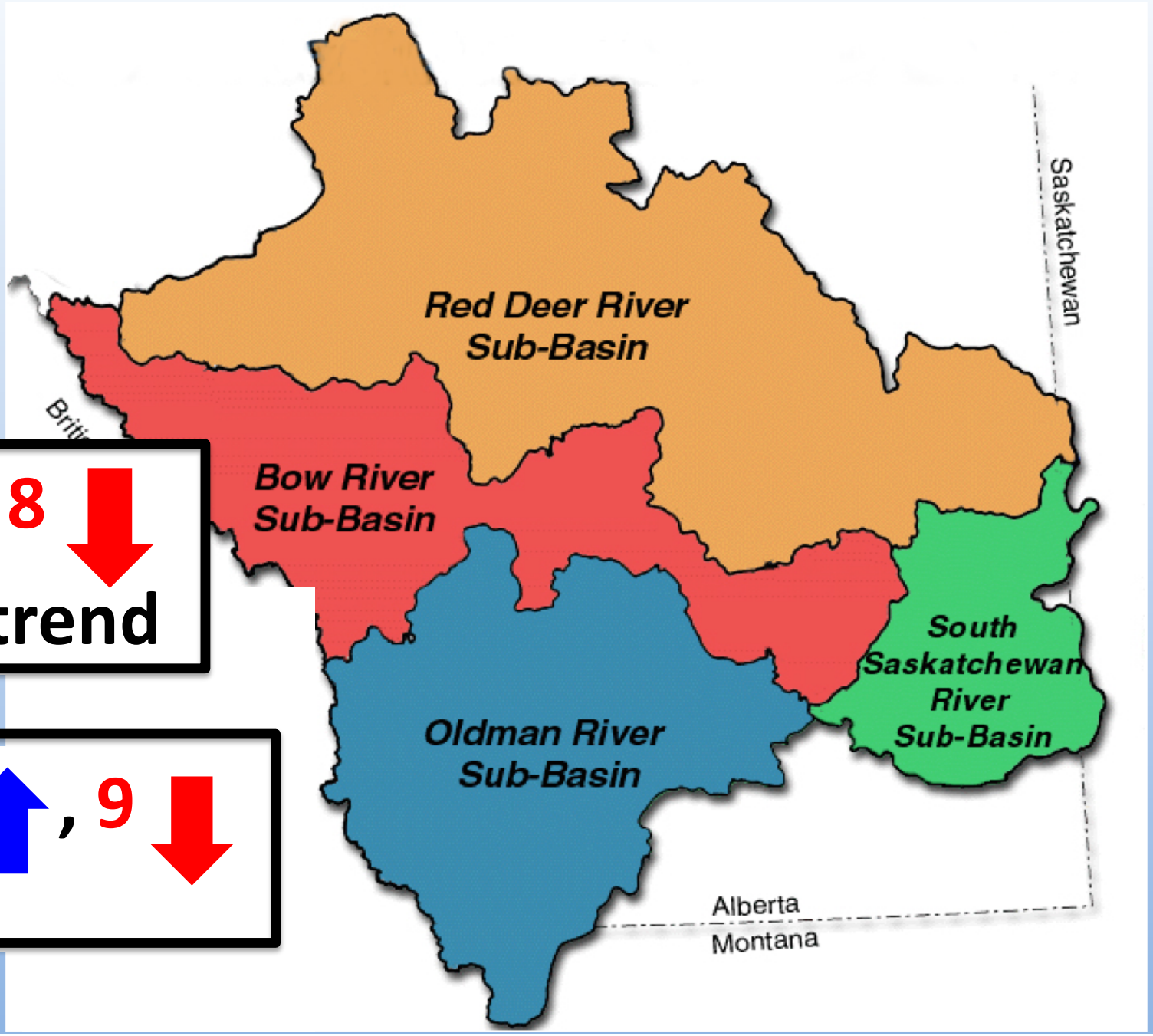
1 ↓
9 no trends

1 ↑
9 no trends

mrro hydrograph advances



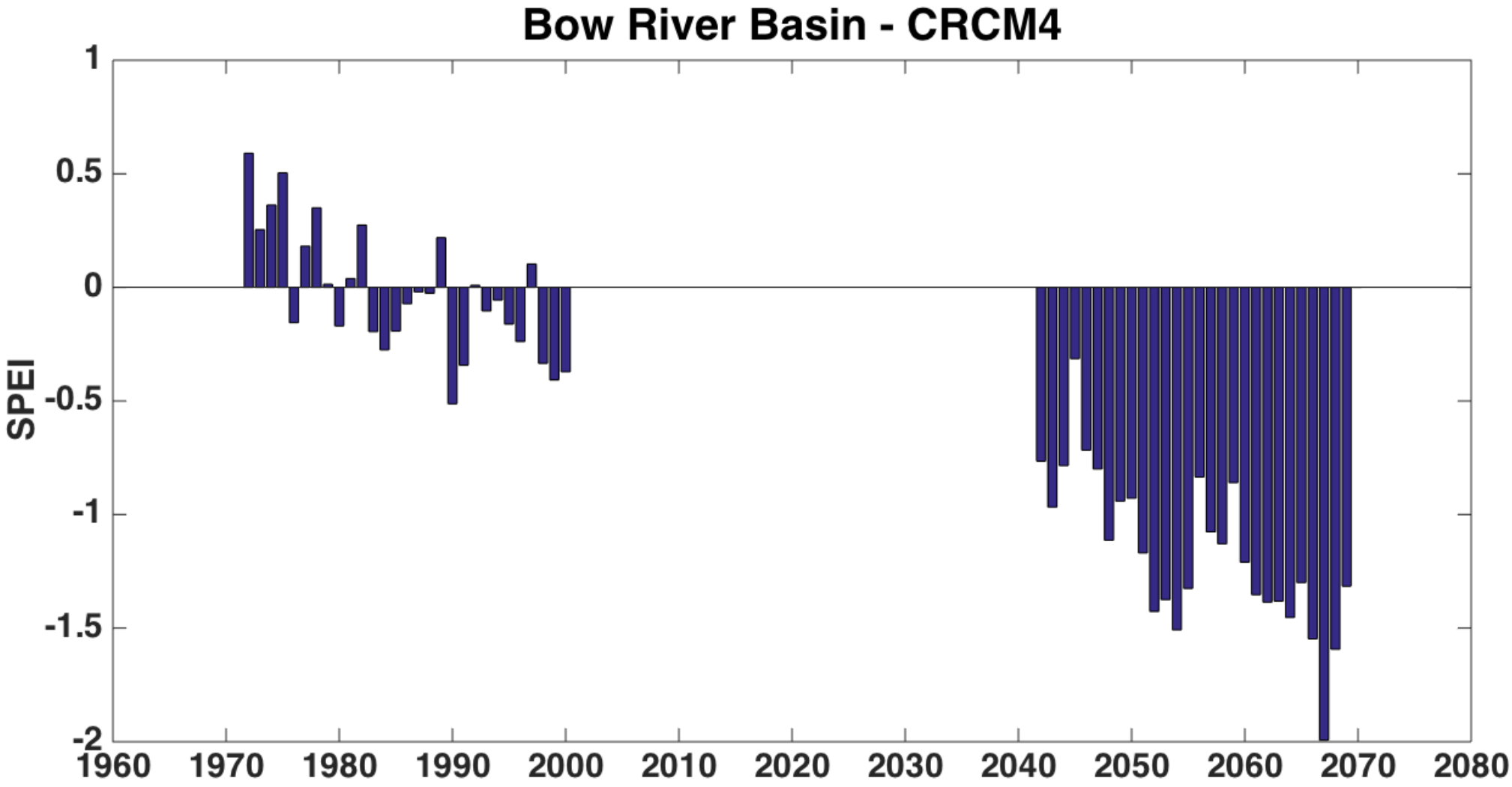
SPEI-based projection results



1 ↑, 8 ↓
1 no trend

1 ↑, 9 ↓

Why SPEI-based downscaling so extreme



Conclusions

mrro **projects a subtle pattern across SSRB**

- **Oldman shows most drying**
- **Red Deer shows increased moisture**
- **Peak flow shifts to earlier in season**

Preliminary SPEI-based downscaling shows much more extreme drying in SSRB

Regardless, SSRB will experience climate change adaptation challenges