# A FRAMEWORK FOR DYNAMICAL DOWNSCALING OF CMIP6 SIMULATIONS IN THE WESTERN US

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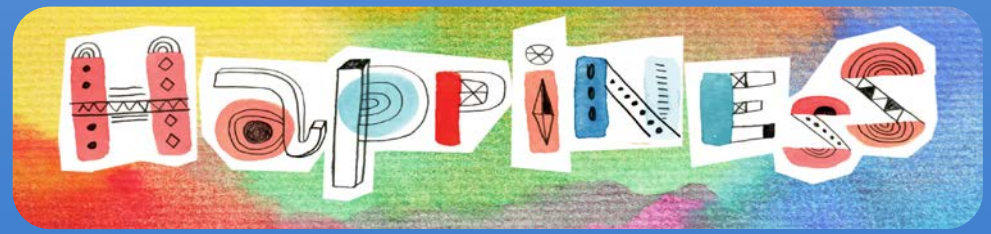


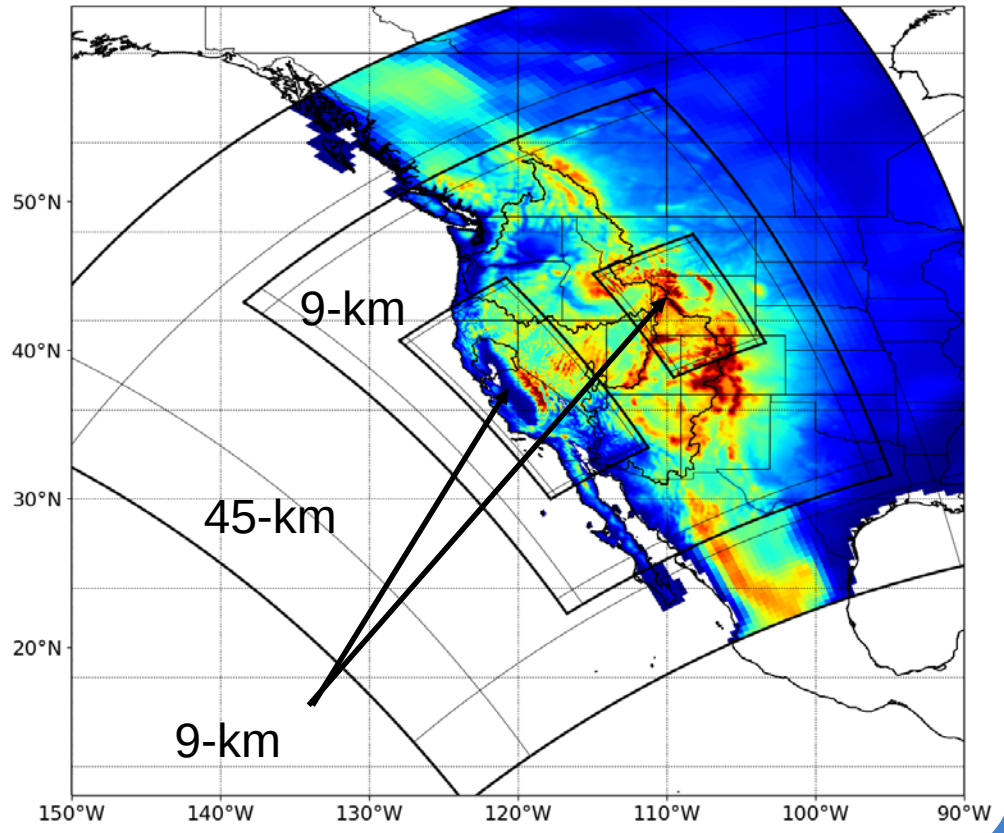
# MOTIVATION

Across the western US (WUS), physically-based sub-10-km resolution climate projections are highly sought after, down to convective-permitting scales….

Developing climate projections is sensitive to:

1. *Region considered*
2. *Physics/chemistry considered*
3. *Complex geography*
4. *Emissions scenario*

**Domain setup**



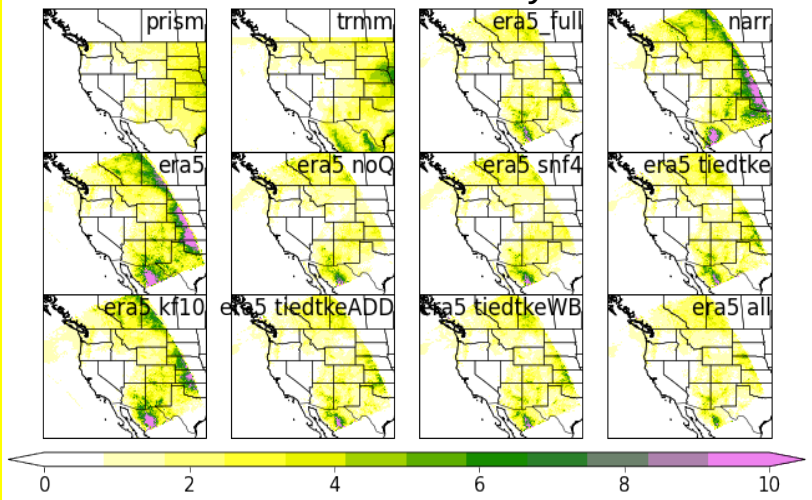
# APPROACH

## We use the Weather Research and Forecasting (WRF) model, version 4

Focusing on a test year, identify optimal model and grid options

- Initial choices based on precedent, experience
- 33-year NARR run completed
- Extreme biases found
- Several dozen test experiment conducted
- Deduction+physics-based bias reduction

Test year 2009




*e.g. precipitation*

Downscale ERA5 onto all grids from 1980-2020

- Spectral nudging of *u, v, T*, Φ on 45-km grid *only*
- Tiedtke Cu physics
- P3 microphysics
- Specific Noah-MP options for radiation, runoff
- 1-D lake model
- One-way nesting
- Year are independent

- Live with the remaining biases
- Select GCMs to be downscaled based on available data and based on where GCM falls in the climate change space

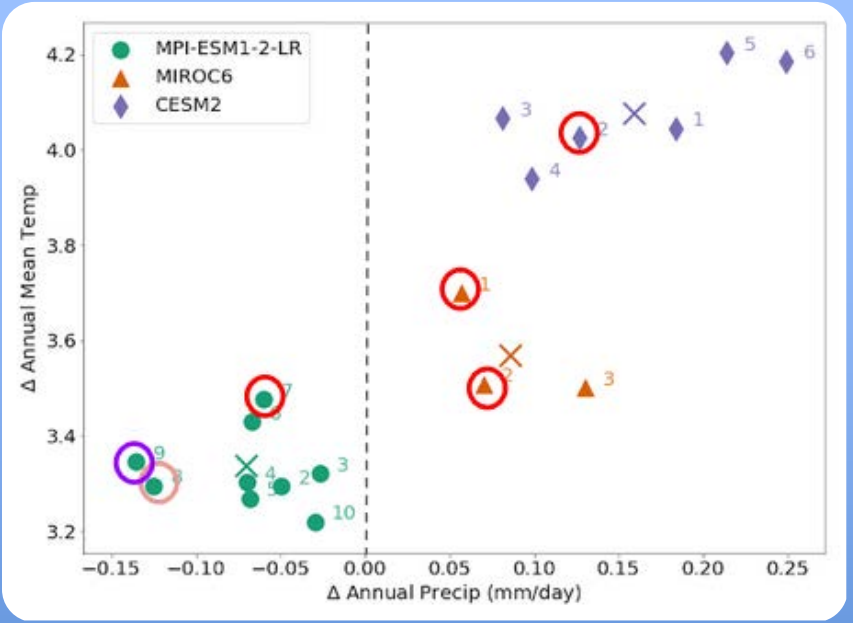
# GCM SELECTION & VISION

**How do we screen & select GCMs?**

1. “Core” SSP: 3-7.0 with accompanying historical simulation
2. What models have 3-D *T, u, v,* & Φ on model levels at 6-h intervals?
3. SSTs, soil moisture & *T* daily
4. How do models perform in simulating historical climate & where do they fall in the climate change space (e.g. are they warm/dry or cool/wet?)

**Our initial set of GCMs**

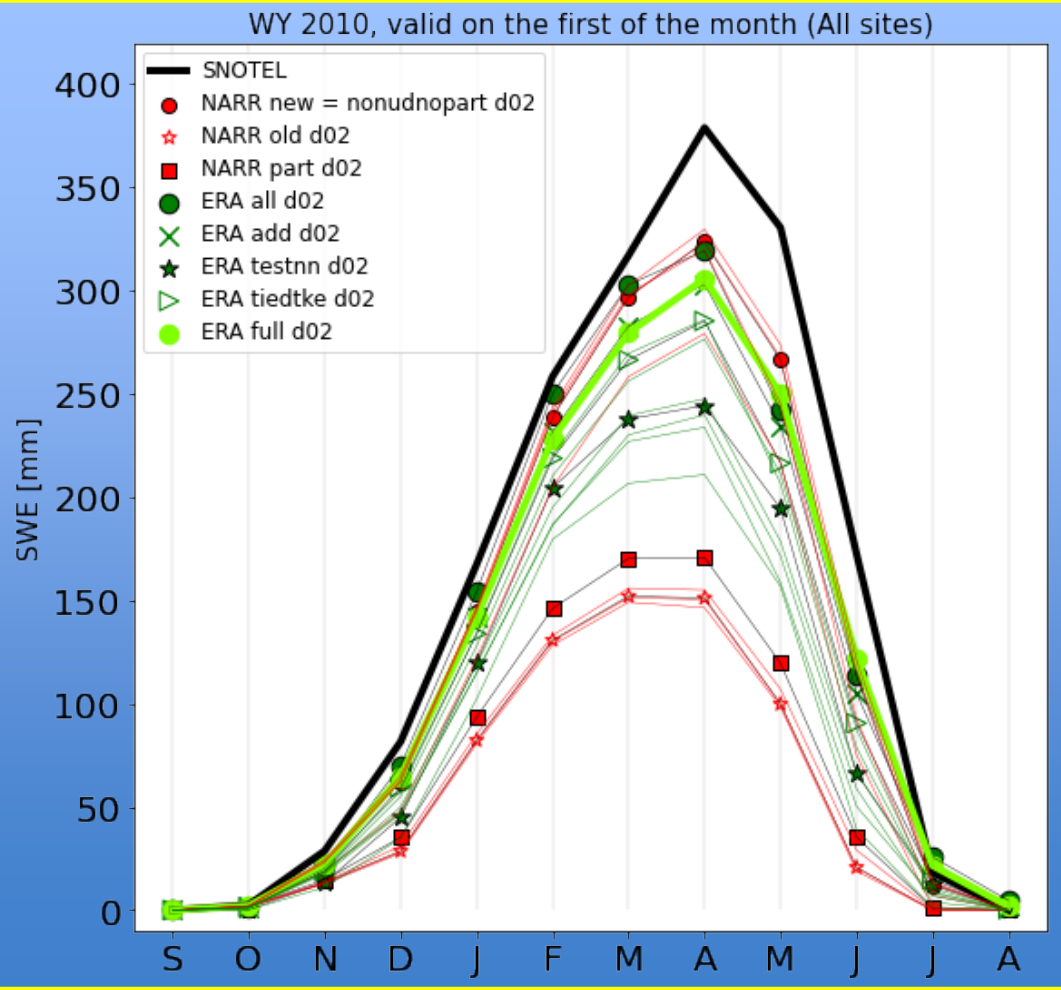
1. MPI-ESM1-2-LR (r7i1p1f1, r8i1p1f1)
2. CESM2 (r11i1p1f1) for SSPs 2-4.5, 3-7.0, and 5-8.5

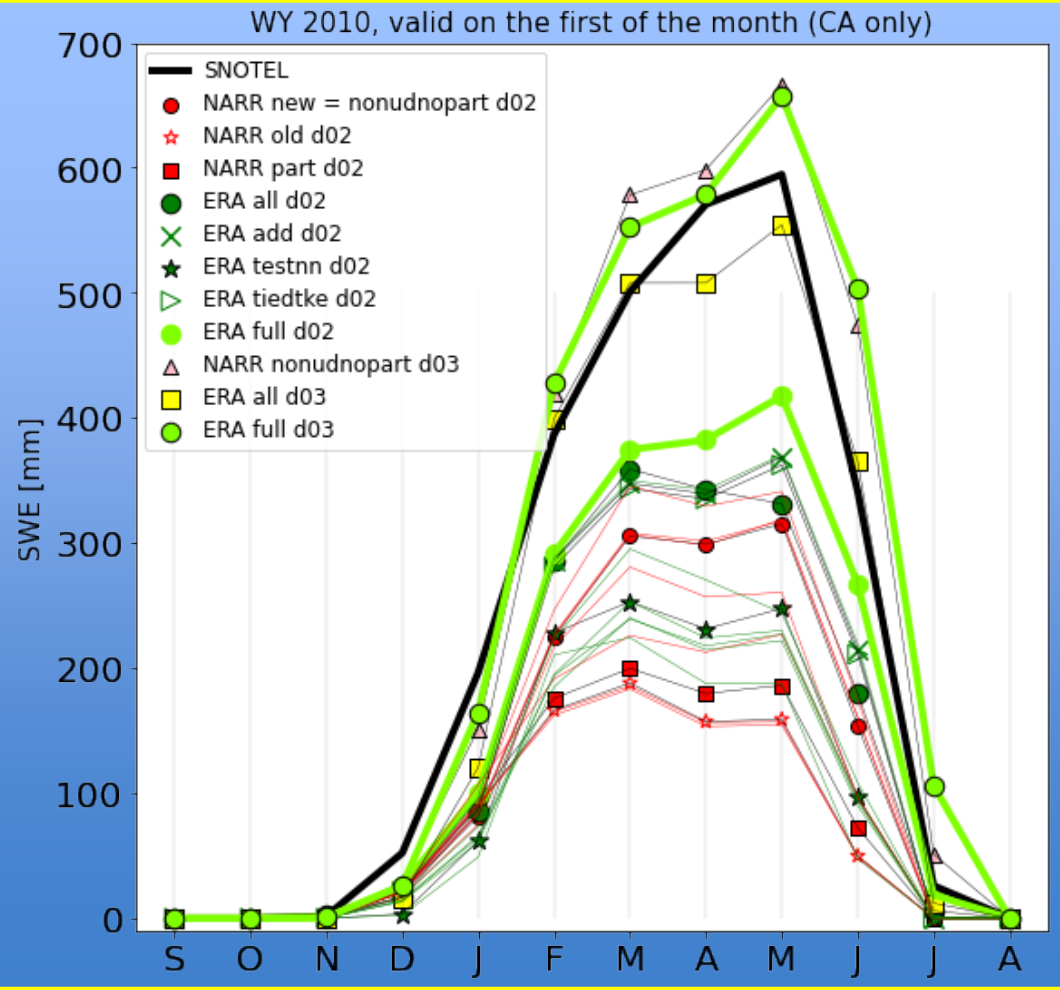



**Vision & products**

- These data are generated with **community usability** in mind, & we want them to be use (i.e. data democratization)
- Full 6-h WRF datastream will be saved for others to downscale to higher resolution grids. Auxiliary 1-h datastream containing 21 variables required to drive hydrological/LSMs offline provided
- 31 daily averaged variables post-processed

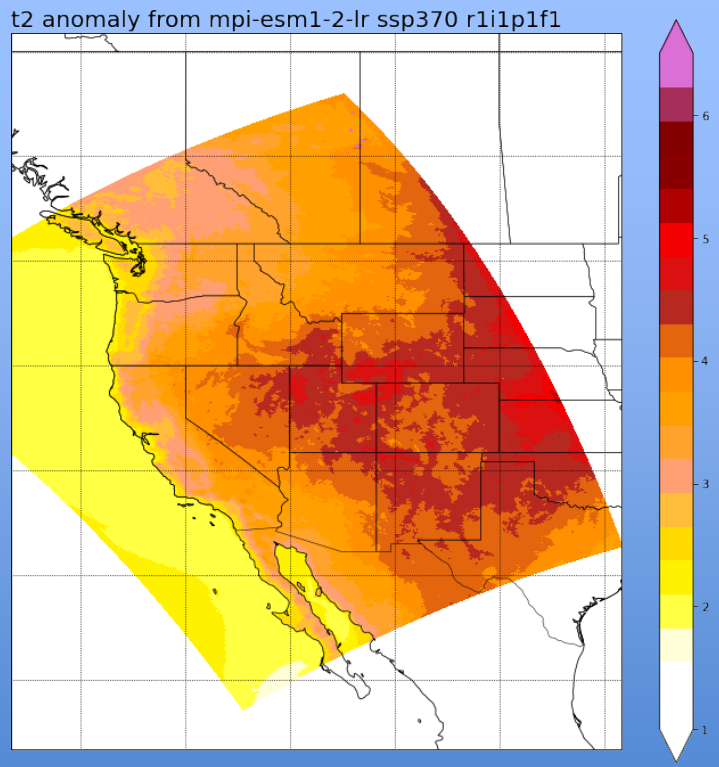
# BE WARY OF BIASES, BUT DON'T BE SUFFOCATED BY THEM….

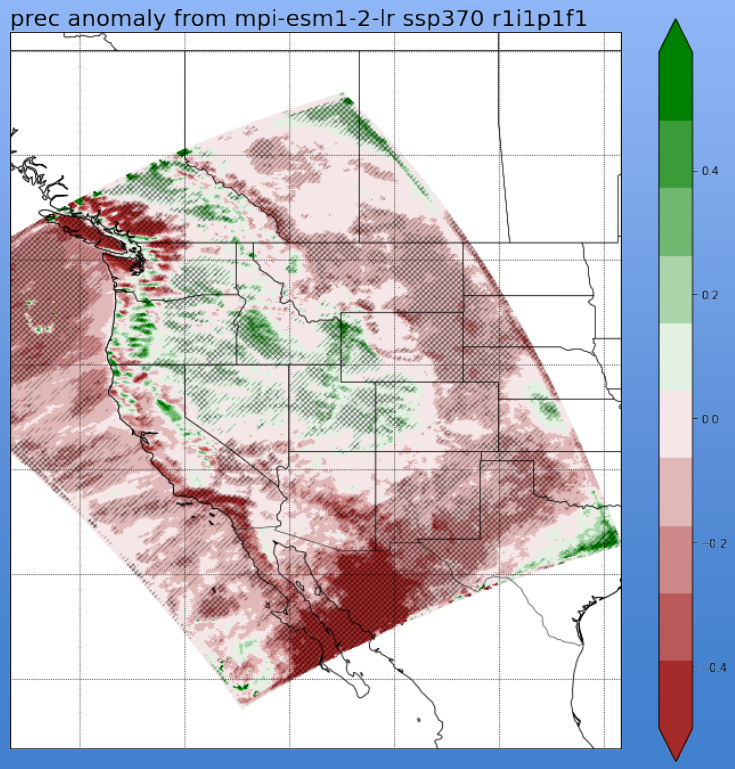


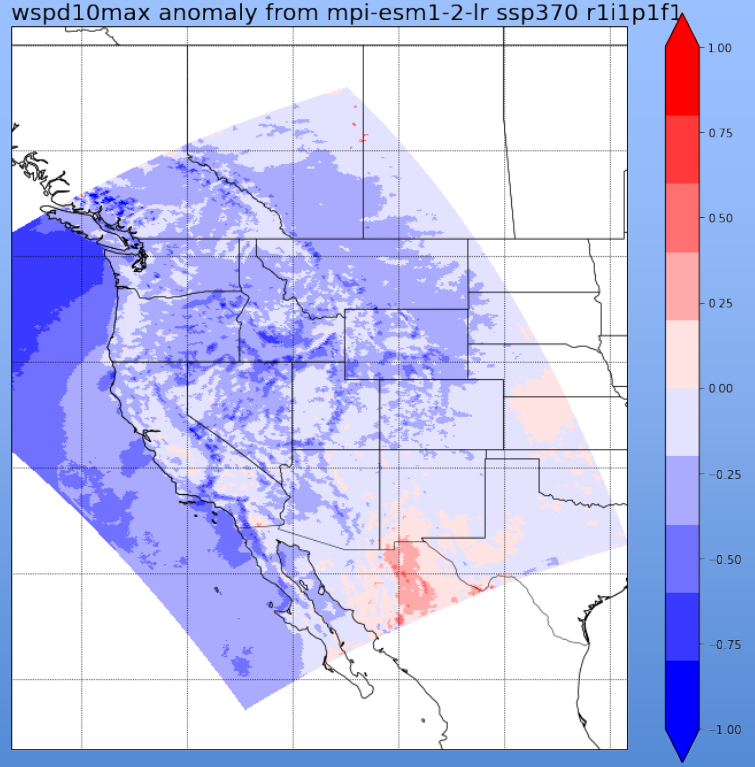



# SOME “EYE CANDY”

From 9-km “WRF MPI-ESM1-2-LR” EC-PD anomalies in 2-m temp. [K], precip [mm/d], & 10-m max windspeed [m/s]

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