COLLEGE OF THE ENVIRONMENT
UNIVERSITY of WASHINGTON

Climate Impacts Projections

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University of Oregon

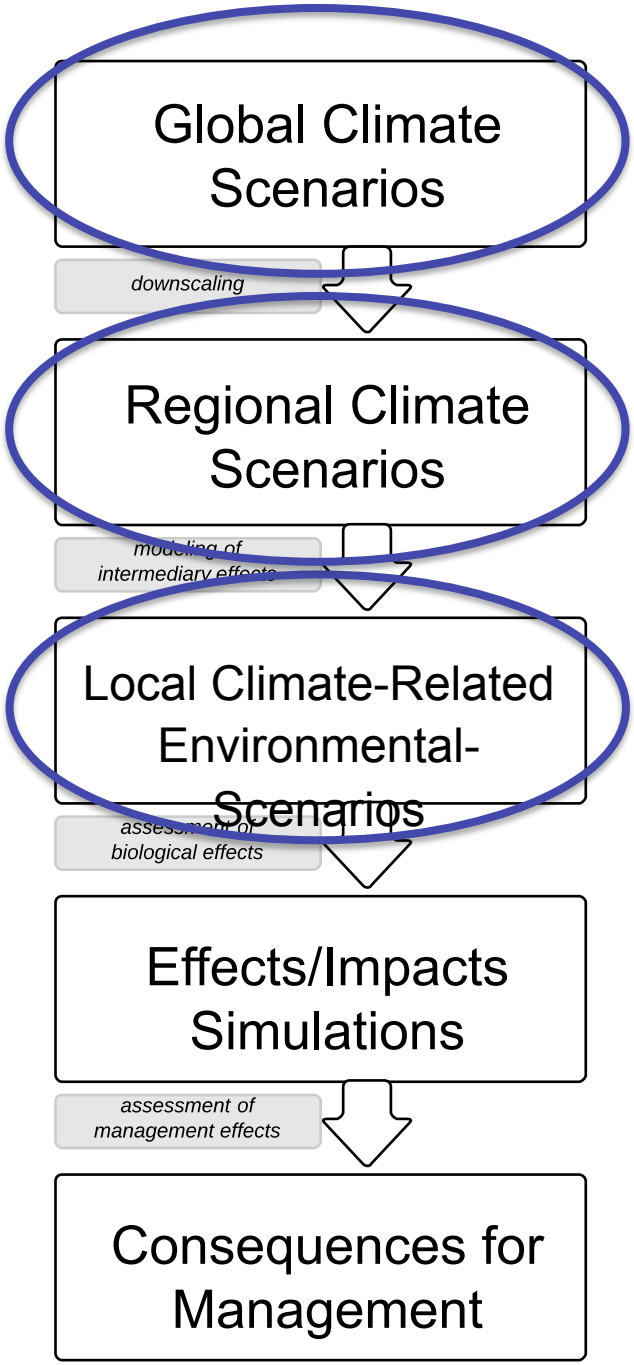
OCCRI

CLIMATE IMPACTS GROUP

Climate Science in the Public Interest

Background:

General Approach to Climate Impacts Assessment



Source: Snover et al., Cons. Bio., 2013

Global Climate Models (GCMs)

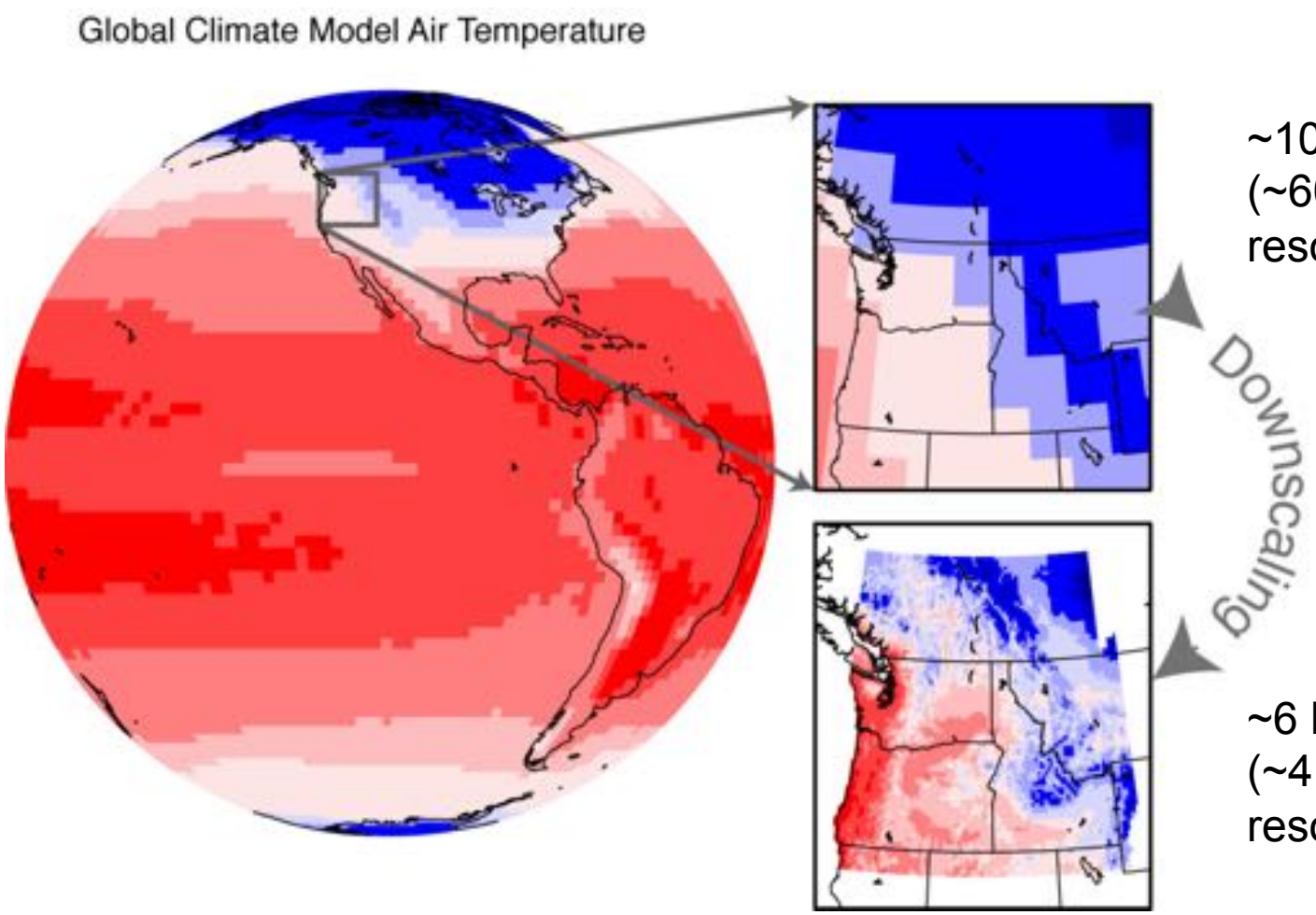
- GCMs have been developed by universities and others throughout the world.
- The Coupled Model Intercomparison Project, or CMIP, defines a set of specific model simulations that allow for apples-to-apples comparisons.
  - CMIP3 (2007): previous dataset
  - CMIP5 (2012): newer dataset

GCM acronyms are weird

Model	Center
BCC-CSM1-1	Beijing Climate Center, China Meteorological Administration
BCC-CSM1-1-M	Beijing Climate Center, China Meteorological Administration
BNU-ESM	College of Global Change and Earth System Science, Beijing Normal University, China
CanESM2	Canadian Centre for Climate Modeling and Analysis
CCSM4	National Center of Atmospheric Research, USA
CESM1-BGC	Community Earth System Model Contributors
CESM1-CAM5	Community Earth System Model Contributors
CESM1-FASTCHEM	Community Earth System Model Contributors
CESM1-WACCM	Community Earth System Model Contributors
CMCC-CESM	Centro Euro-Mediterraneo per I Cambiamenti Climatici
CMCC-CM	Centro Euro-Mediterraneo per I Cambiamenti Climatici
CMCC-CMS	Centro Euro-Mediterraneo per I Cambiamenti Climatici
CNRM-CM5	National Centre of Meteorological Research, France
CNRM-CM5-2	National Centre of Meteorological Research, France
CSIRO-Mk3-6-0	Commonwealth Scientific and Industrial Research Organization/ Queensland Climate Change Centre of Excellence, Australia
EC-EARTH	EC-EARTH consortium
FGOALS-g2	LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences
FGOALS-s2	LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences
FIO-ESM	The First Institute of Oceanography, SOA, China
GFDL-CM3	NOAA Geophysical Fluid Dynamics Laboratory, USA

Downscaling

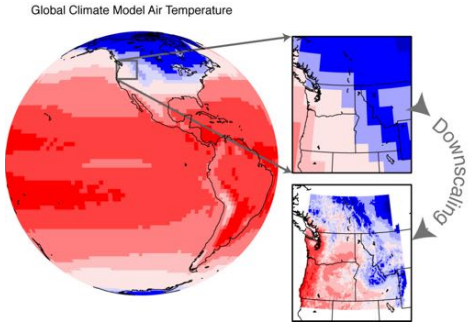
Relates the large to the small



~100-200 km
(~60-120 mi)
resolution

~6 km
(~4 mi)
resolution

Downscaling



Statistical:

Apply changes from global model projection to historical observations

Statistical approach

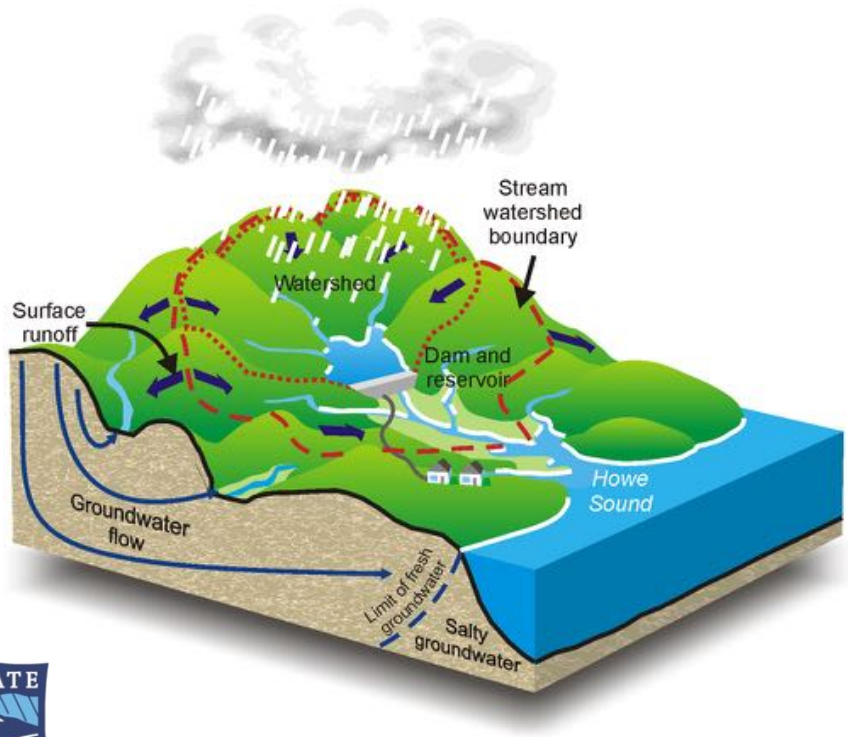
Dynamical:

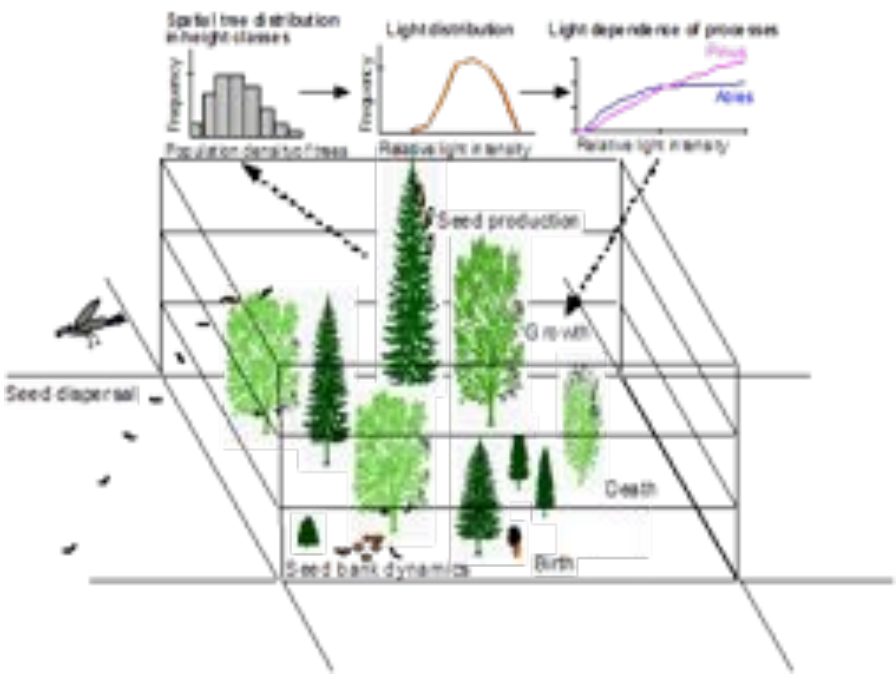
Use global model projections to drive a regional climate model

Physics-based approach

Impacts Modeling

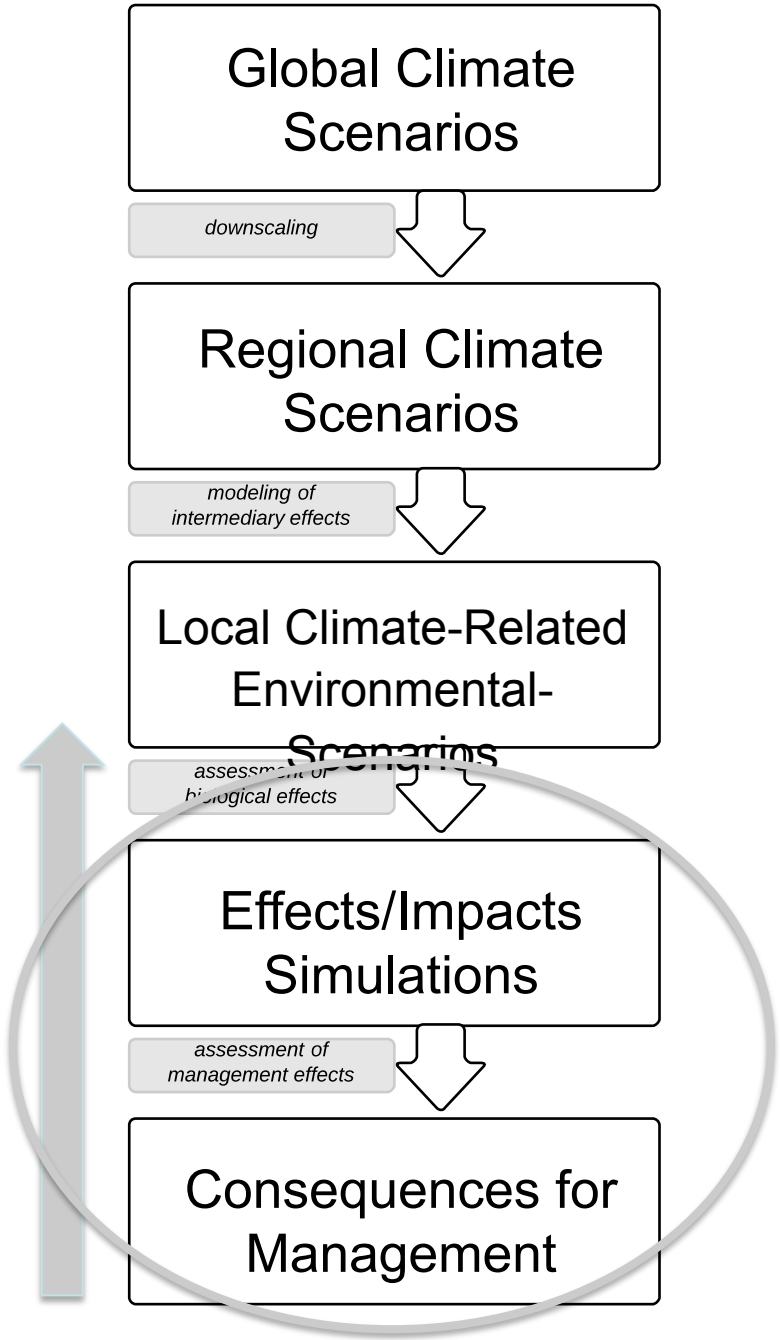
Translation from climate impacts to _____





e.g.: Hydrology, Vegetation

An important complement:



Best when combined with a bottom-up assessment of information needs

Source: Snover et al., Cons. Bio., 2013

Choosing & Using Scenarios

Conservation Biology

Special Section

Choosing and Using Climate-Change Scenarios for Ecological-Impact Assessments and Conservation Decisions

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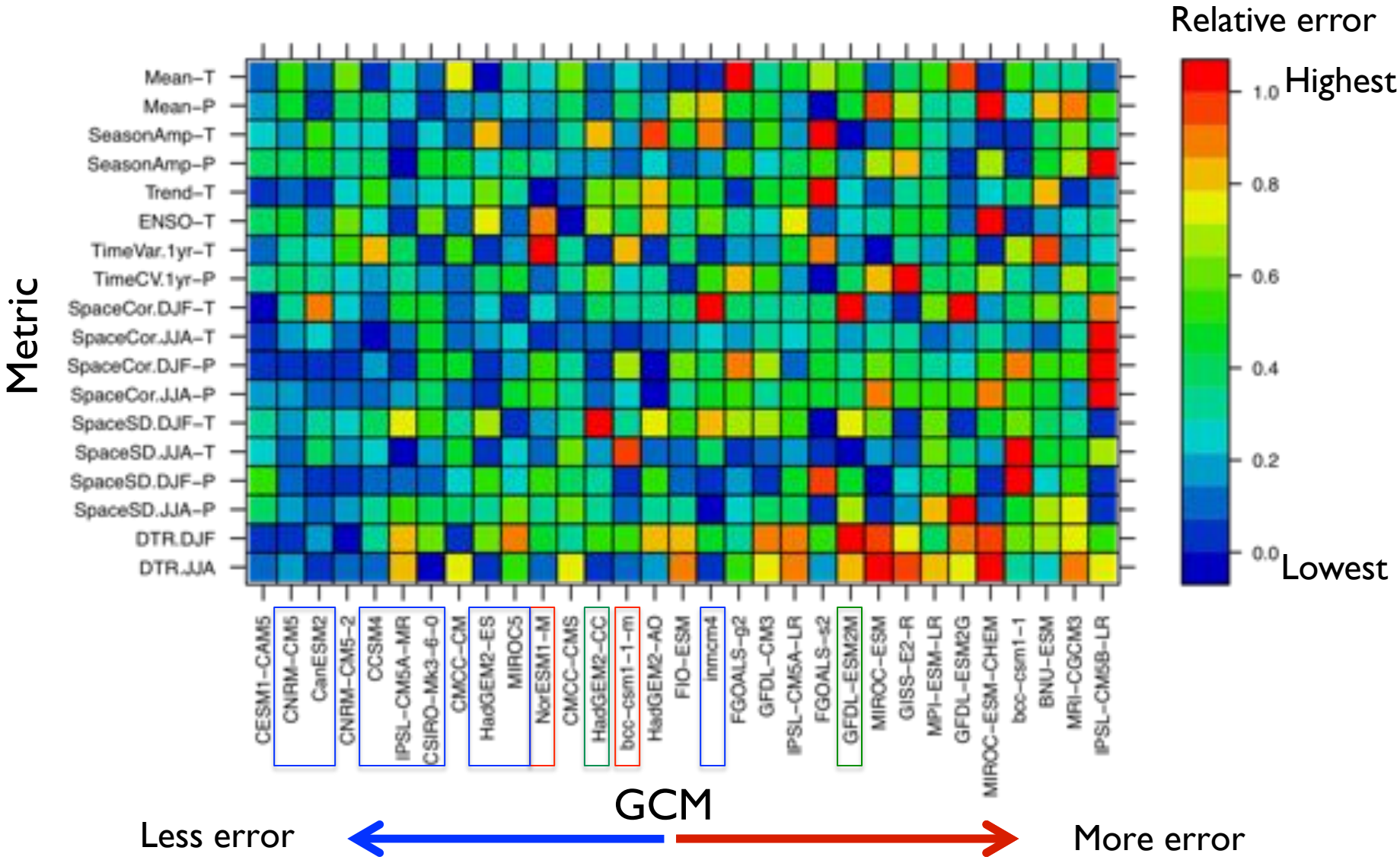
**National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northwest Fisheries Science Center, 2725 Montlake Boulevard East, Seattle, WA 98112, U.S.A.
††School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, NY 11794-5000, U.S.A.

Source: Snover et al., *Cons. Bio., 2013*

The RMJOC-II project:
Climate Projections

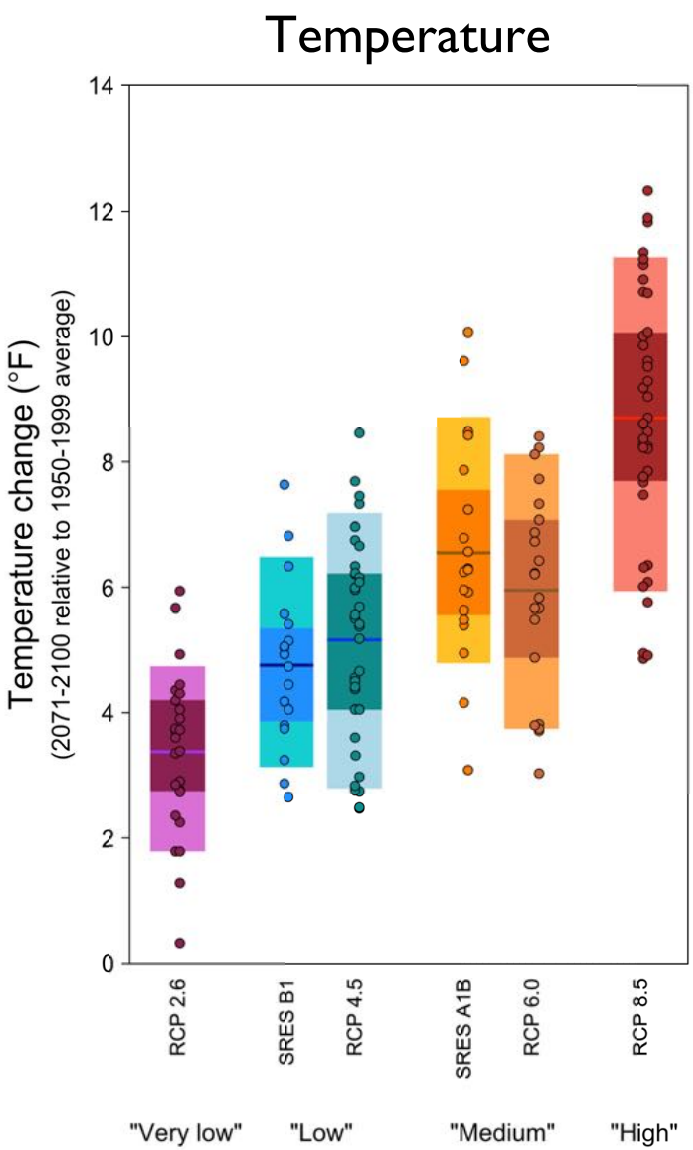
- **Global model selection**
- Statistical Downscaling
- Dynamical Downscaling

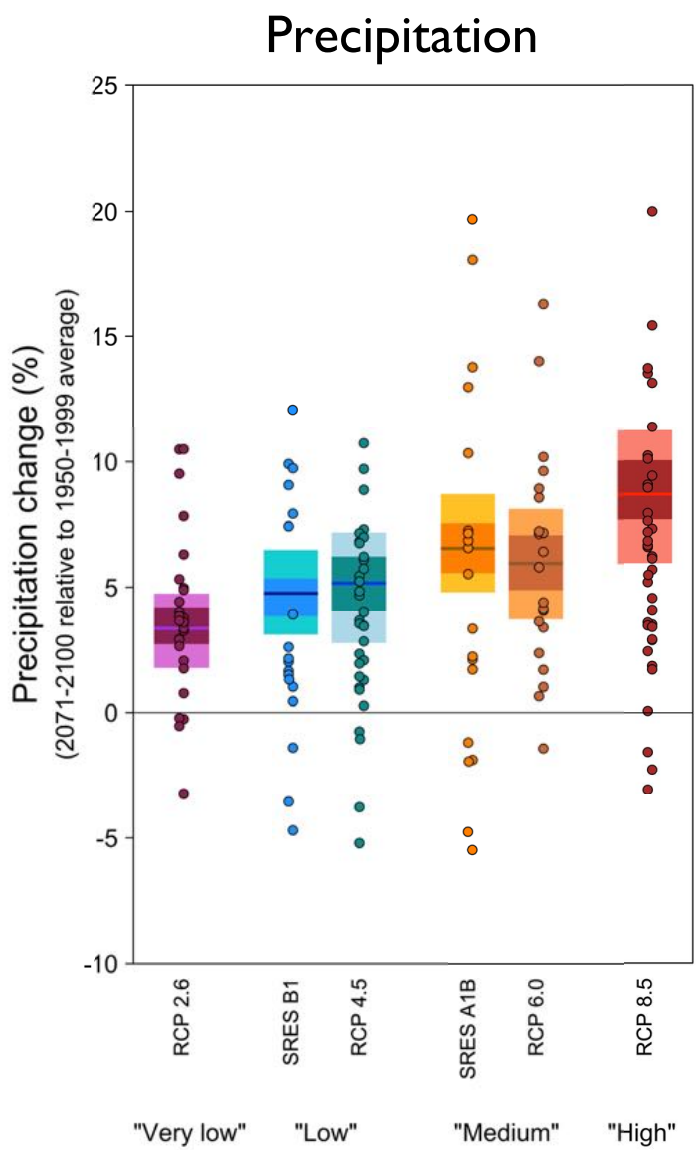
GCM Evaluation: the "Quilt"



(Ordered by sum total of relative errors. All metrics treated equally.)

New projections closely resemble previous ones





(2070-2099 relative to 1970-1999)

The RMJOC-II project:
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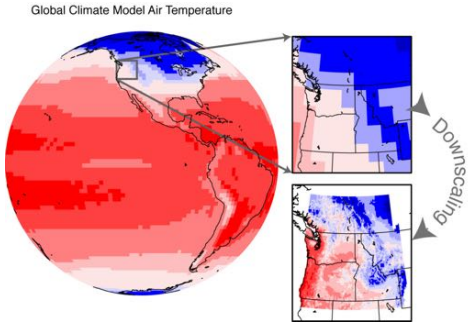
- **Downscaling Approaches**
- Downscaling Comparison

Downscaling



Statistical:

Apply changes from global model projection to historical observations

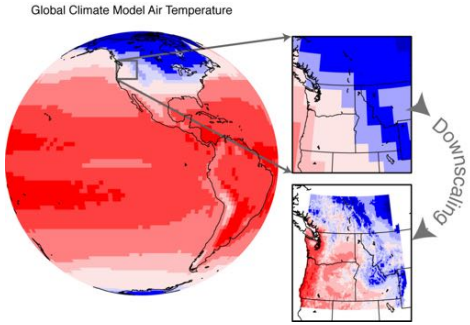
Statistical approach

Dynamical:

Use global model projections to drive a regional climate model

Physics-based approach

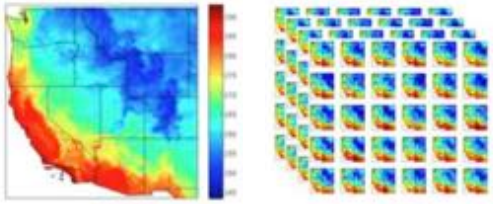
Downscaling



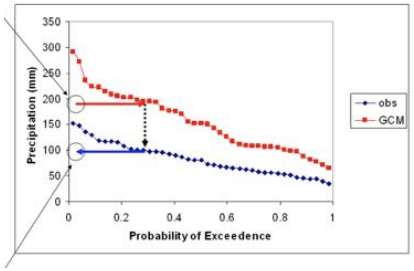
Statistical:

Two methods:

MACA



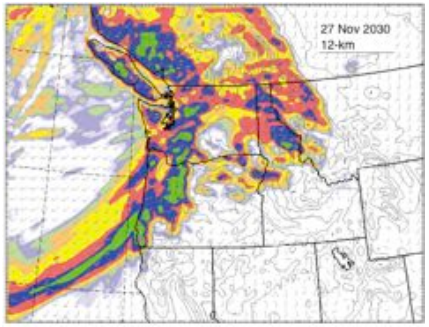
BCSD
(monthly)



Dynamical:

One approach:

RegCM4



(1966-2005, 2011-2050;
RCP 8.5 only)

The RMJOC-II project:
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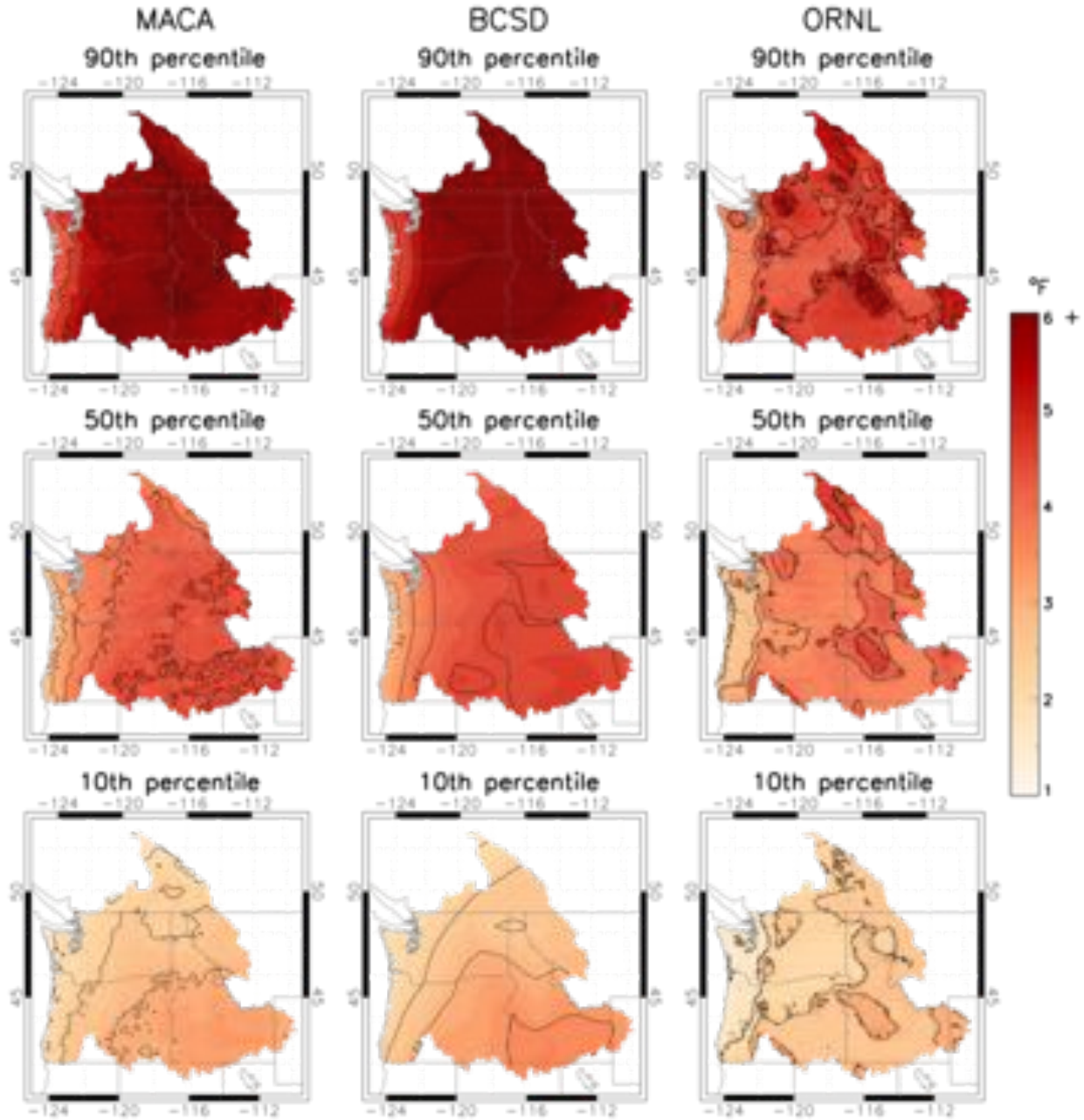
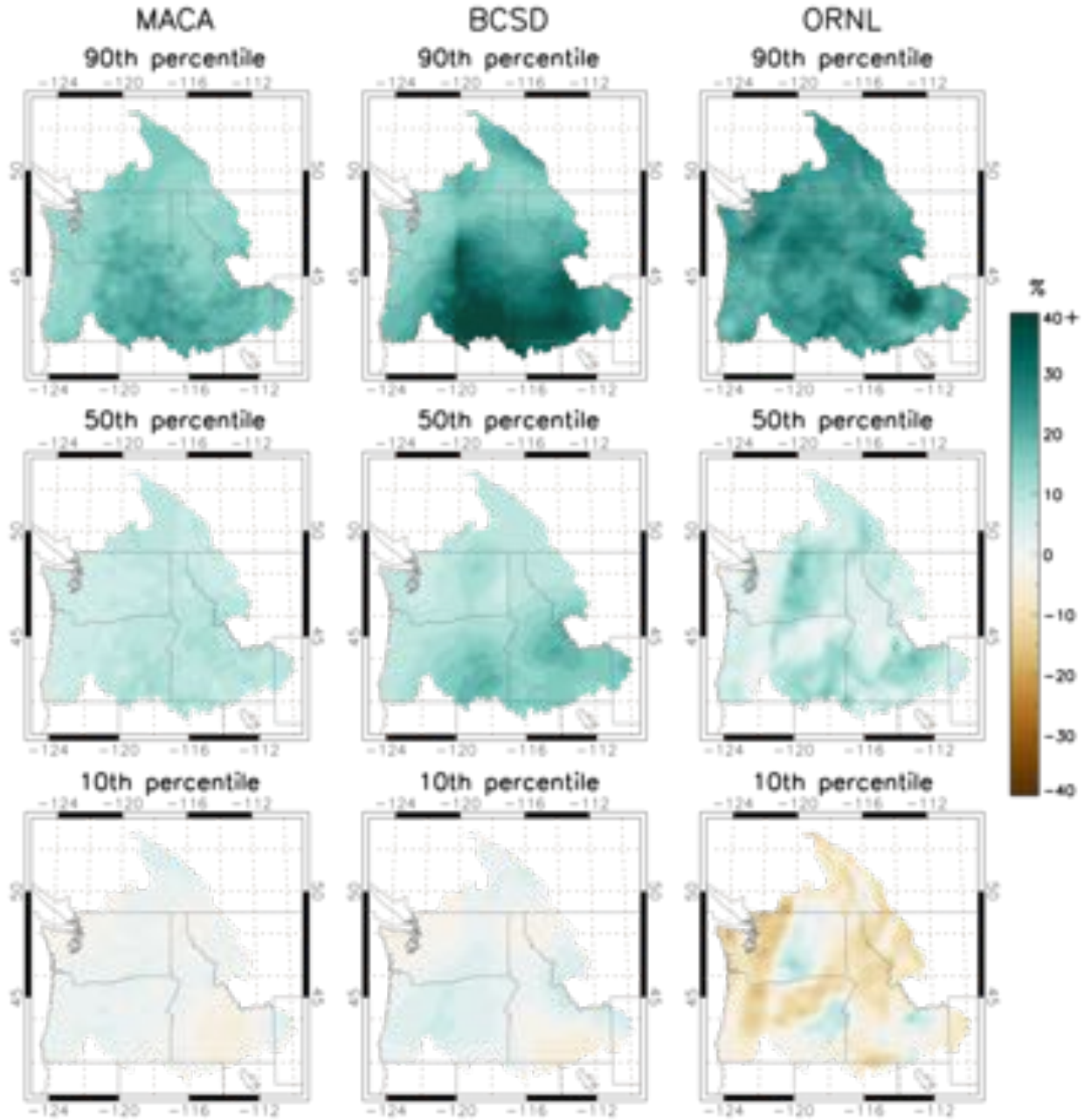
- Downscaling Approaches
- **Downscaling Comparison**

Change in JJA temperature between 1970-1999 and 2020-2049, RCP8.5



Change in DJF precipitation between 1970-1999 and 2020-2049, RCP8.5



The RMJOC-II project:
Climate Projections

- Global model selection
- Downscaling Approaches
- Downscaling Comparison

Thank you

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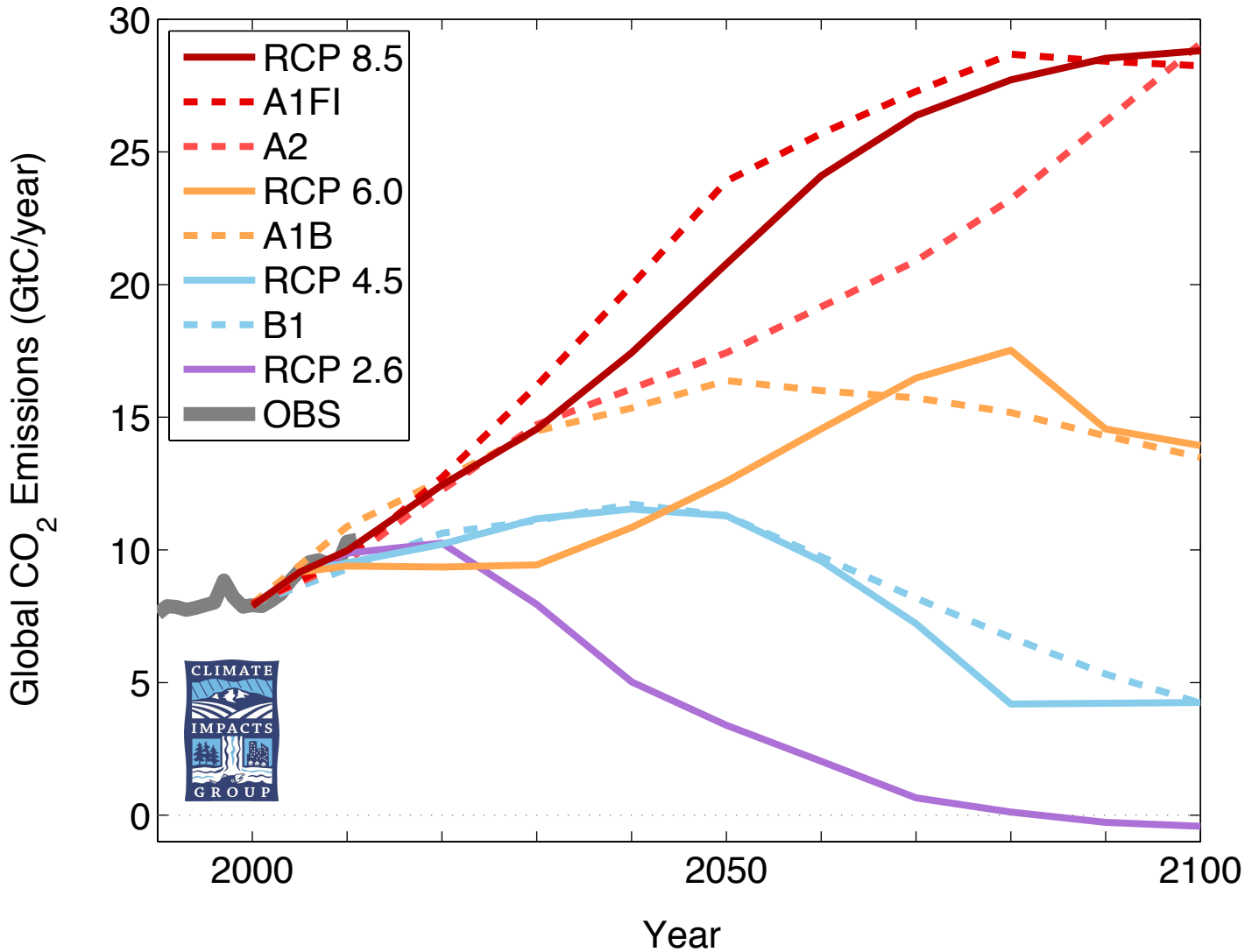
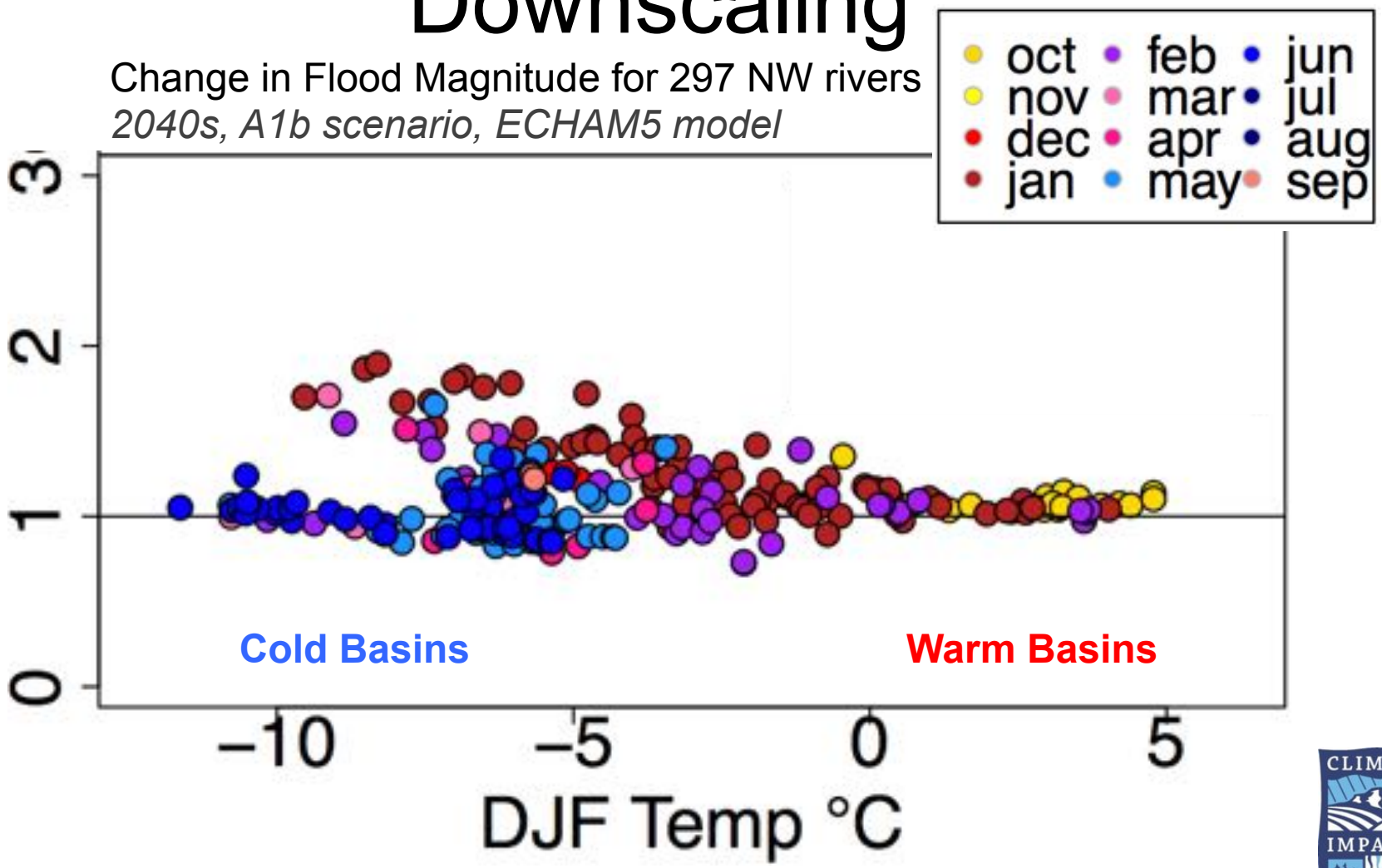
Greenhouse Gas Scenarios



Results from Statistical Downscaling

Change in Flood Magnitude for 297 NW rivers

2040s, A1b scenario, ECHAM5 model

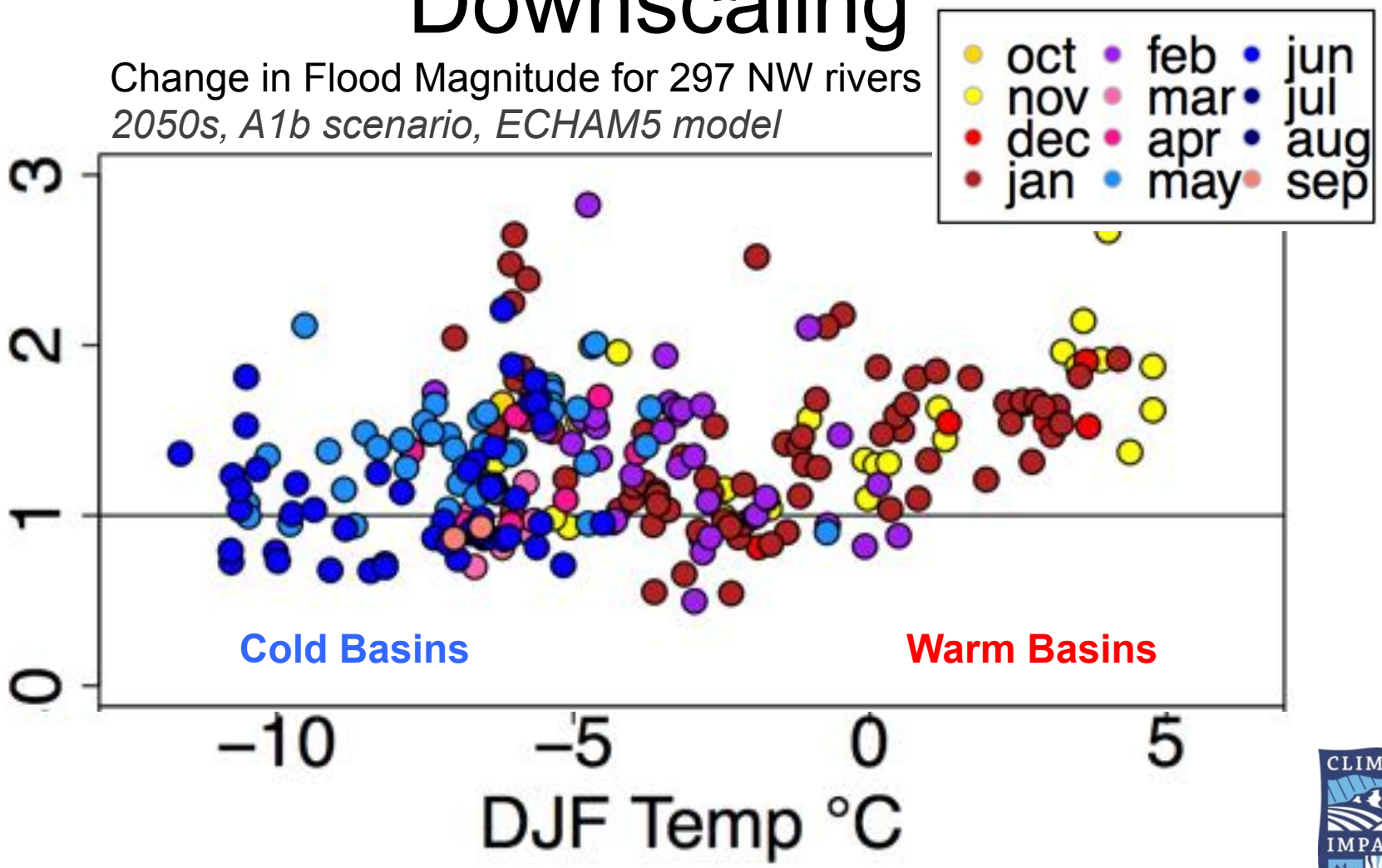


Source: Salathé et al 2014

Results from Dynamical Downscaling

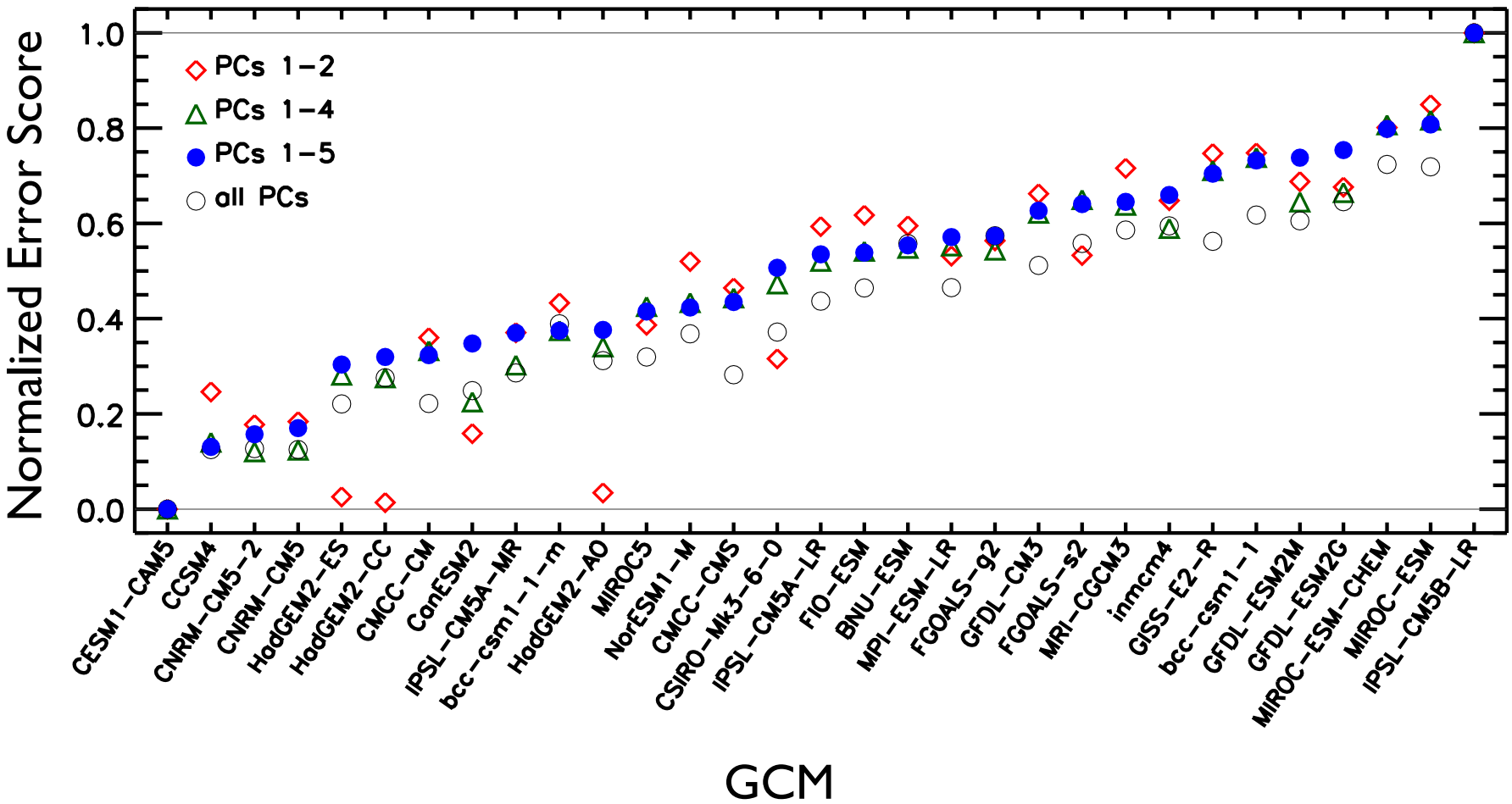
Change in Flood Magnitude for 297 NW rivers

2050s, A1b scenario, ECHAM5 model



Source: Salathé et al 2014

GCM ranking for the PNW

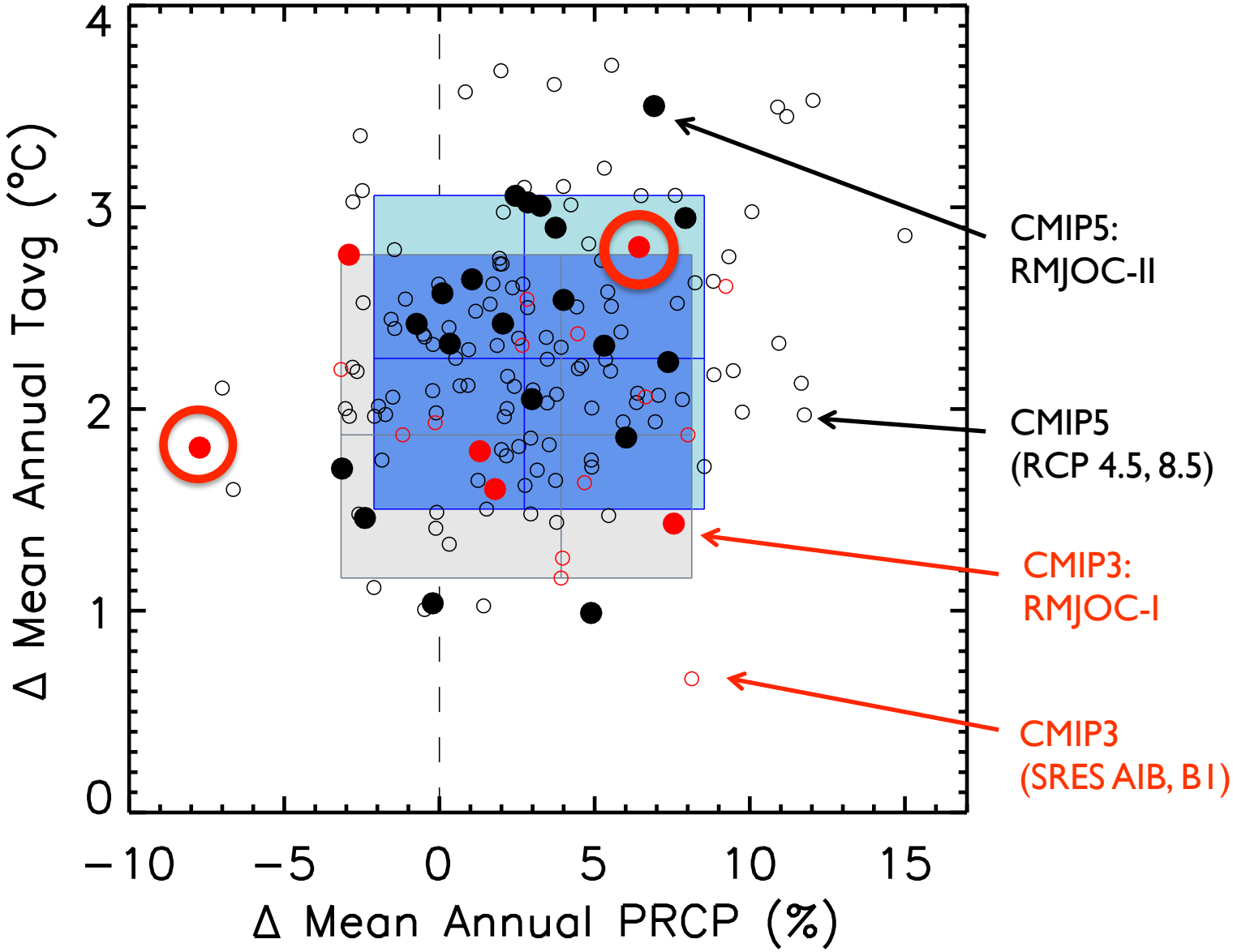


GCM

Less error ⟷ More error

Climate Projections for the Columbia River Basin*

1970–1999 to 2030–2059



*Above The Dalles

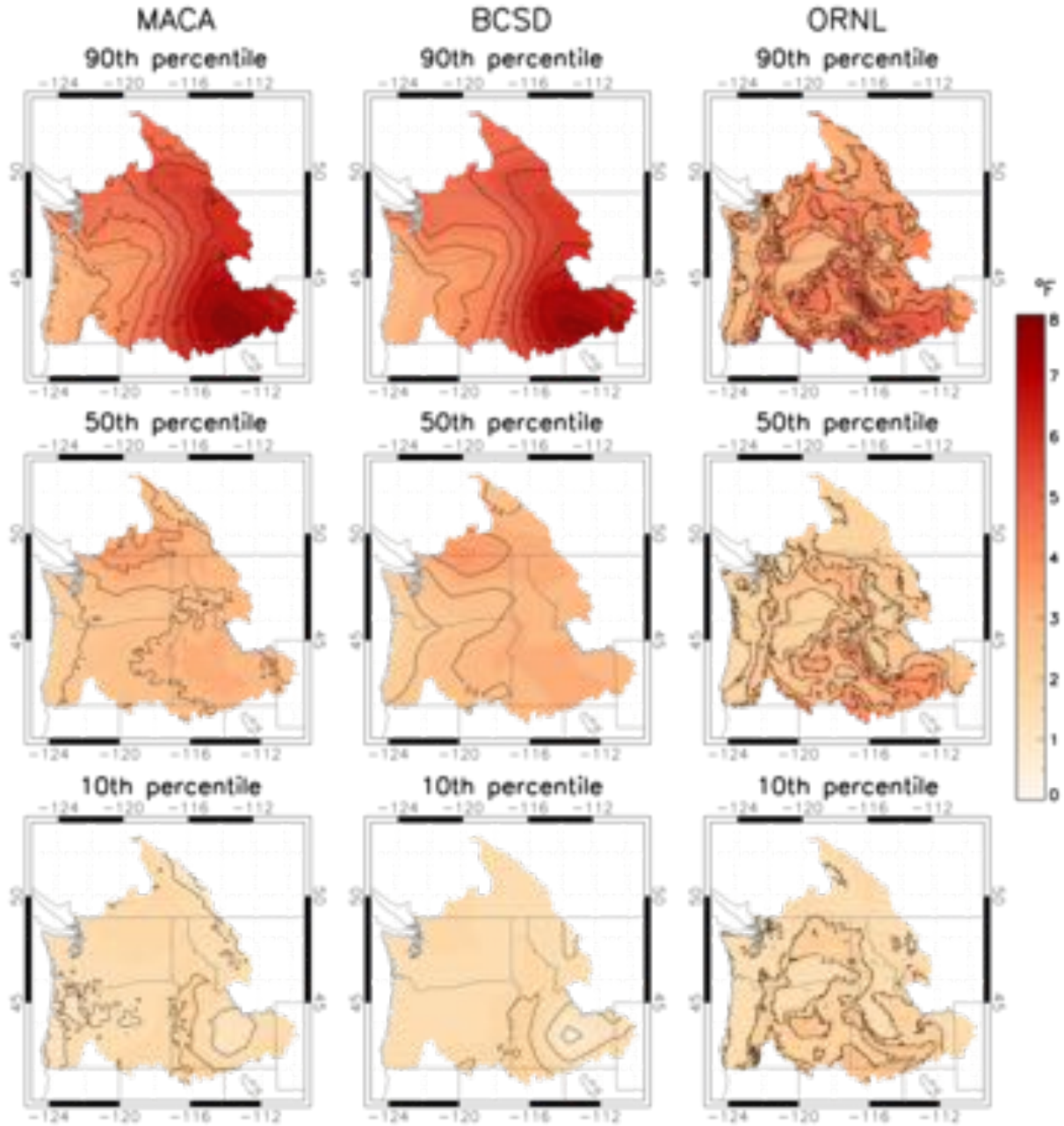
10%-90% percentiles

Gray: CMIP3

Light blue: CMIP5

Blue: overlap

Change in MAM temperature between 1970-1999 and 2020-2049, RCP8.5



Change in JJA precipitation between 1970-1999 and 2020-2049, RCP8.5