3-7-17Board Meeting-Item 7
Climate Change
Deadline: 3/3/17 12 noon

RECEIVED
3-3-17
SWRCB Clerk

Deirdre Des Jardins
145 Beel Dr
Santa Cruz, CA 95060
(831) 423-6857
ddj@cah2oresearch.com

March 3, 2017

VIA electronic mail to commentletters@waterboards.ca.gov

Clerk of the Board
State Water Resources Control Board
1001 I Street
Sacramento, California 95814

Deirdre Des Jardins, Principal at California Water Research, provides the following comments on the staff draft Climate Change Resolution for the March 7, 2017 Board meeting.

California Water Research strongly supports the staff's efforts in drafting an expansion of the original 2007 AB 32 resolution, as well as the staff's effort to coordinate climate change efforts across all Board divisions and with other state and federal agencies. However, California Water Research notes that recent developments may create a problem with implementation of the following resolution:

II. Improve Ecosystem Resilience

7. The Executive Director shall engage in dialogue with the United States Environmental Protection Agency (U.S. EPA), and interested stakeholders on how best to address meeting water quality standards given climate change impacts that contribute to or exacerbate degradation of water quality, including but not limited to increased surface water temperatures, decreased surface water flows, changes in water chemistry (such as increases in salinity, bacteria, and nutrient concentrations), hydrology, and ecology.

Yesterday, the Trump administration announced that the funding for the United States Environmental Protection Agency San Francisco Bay Water Quality efforts will be cut by 100%. California Water Research suggests the following additional sentence:

If U.S. EPA staff is not available due to budget cuts, the Executive Director will engage in dialogue with interested stakeholders on these issues.

California Water Research also strongly supports the efforts of the staff to ensure that there are open climate change models and hydrologic data made publicly available through the State Water Board's Office of Information Management and Analysis (OIMA), and to incorporate these models in Board proceedings, as resolved in the following paragraphs of the resolution

II. Improve Ecosystem Resilience

9. To assist with implementation of the co-equal goals for protecting, restoring, and enhancing the Sacramento-San Joaquin Delta (Delta) ecosystem, and providing a more reliable water supply, the Delta Watermaster shall maintain an ongoing consultation with the Delta Stewardship Council, which runs the Delta Science Program. The Delta Watermaster shall coordinate with OIMA to identify and obtain downscaled projections of climate and hydrology changes expected in the Delta.

State Water Board staff shall incorporate effects of climate change when evaluating and approving long-term projects designed to meet the goals or objectives of the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary

IV. Rely on Sound Modeling and Analysis

17. Office of Information Management and Analysis (OIMA) shall work with the California Energy Commission, and the Department of Water Resources to obtain access to relevant climate change data, model outputs and data evaluation services. OIMA and Division of Information Technology shall collaborate on providing these climate change data and model outputs on an open data platform by December 15, 2017.

18. OIMA shall assist State Water Board divisions and offices, and Regional Water Boards in the selection and the use of climate change resources described above, as needed to account for and address impacts of climate change in permits, plans, policies, and decisions.

19. Division of Water Rights shall, by July 1, 2018, identify data needs, and evaluate and make recommendations on regulatory and policy changes regarding the use of models to account for projected impacts of climate change when conducting water availability analyses and shortage analyses.

However, California Water Research notes that additional procedures will be required, including peer review. California Water Research notes that the above paragraphs need to clearly

recognize the difference between an open source model and data set, and standard, peer reviewed models and data sets. The Board needs to be careful to not conflate acquisition and public distribution of model results and code with actual peer review and validation of models for use in water rights or water quality proceedings. Also, when models and data will be used in implementing a regulation, or policy under the Porter-Cologne Water Quality Act, the Board has the statutory obligation under Health and Safety Code § 57004 to obtain peer reviews from "the National Academy of Sciences, the University of California, the California State University, or any similar scientific institution of higher learning, [or] any combination of those entities." Health and Safety Code § 57004 defines a regulation by Government Code § 11342.600:

> 11342.600. Regulation means every rule, regulation, order, or standard of general application or the amendment, supplement, or revision of any rule, regulation, order, or standard adopted by any state agency to implement, interpret, or make specific the law enforced or administered by it, or to govern its procedure.

Given this definition of a regulation, when OIMA acquires climate change models and data for general use in Board proceedings, the Board must ensure that there is a peer review of the climate change models and data. In addition, Health and Safety Code 57004 provides that the developer of the models cannot be part of the peer review:

> (2) Rule 57004 (c) provides that "No person may serve as an external scientific peer reviewer for the scientific portion of a rule if that person participated in the development of the scientific basis or scientific portion of the rule."

Such peer review would also be in accord with the recommendations of the Board's 2012 independent scientific and technical panel on Analytical Tools for Evaluating Water Supply, Hydrodynamic and Hydropower Effects in the Bay Delta Plan. The panel recommended independent review of hydrologic models and data used in Board proceedings, as well as provision of appropriate calibration, testing, and validation information. This recommendation should be implemented, and should apply to both hydrologic models and to climate change projections of changes in precipitation and runoff, which are inputs to the models.

To fund the peer review of the climate change modeling data, California Water Research recommends that the Board revisit the fee schedule for processing water right petitions and changes to address the cost of incorporating climate change.

With respect to Section IV, paragraph 18, regarding the OIMA assisting the State Water Board and Regional Water Board in the selection and use of climate change resources, California Water Research observes *English v. City of Long Beach (1950) 35 Cal.2d 155* requires that OIMA testify about the selection and use of climate change models and data at a hearing of which parties had notice and were present.

> Administrative tribunals which are required to make a determination after a hearing cannot act upon their own information, and nothing can be considered as evidence that was not introduced at a hearing of which the parties had notice or at which they were present. (United States v. Abilene & So. Ry. Co., 265 U.S. 274 [44 S.Ct. 565, 68 L.Ed.

> 1016]; Interstate Commerce Com. v. Louisville & Nashville R. R. Co., 227 U.S. 88 [33 S.Ct. 185, 57 L.Ed. 431]; La Prade v. Department of Water & Power, supra; Bandini Estate Co. v. Los Angeles County, supra; Carstens v. Pillsbury, supra.) The fact that there may be substantial and properly introduced evidence which supports the board's ruling is immaterial. (Cf., Ohio Bell Tel. Co. v. Public Utilities Com., 301 U.S. 292 [57 S.Ct. [35 Cal.2d 159] 724, 81 L.Ed. 1093].) (*Id*. at 157-165)

The Board should also recognize that the science of climate change and climate change modeling is rapidly evolving. Provision of standard models and data sets by the Board cannot override the rights of parties to evaluate scientific and technical information used in a Board hearing and to submit evidence that could inform the prospective use of the models. In making a decision, the Board will need to consider any relevant peer-reviewed scientific literature, scientific testimony, or alternative model results produced by parties and party's experts that could inform the decision. Thus California Water Research also recommends that where climate change is expected to be a significant component of a Board decision, a special workshop be held before the hearing.

With respect to Section IV, paragraph 18, regarding the OIMA identifying data needs, California Water Research recommends that staff identify standard information used by climate change researchers in evaluating climate change projections:

a. Information on the uncertainty of model projections. For ensemble models, this includes the range of projections of the ensemble as well as the central tendency.

b. Information on the unforced model fit (without bias correction) to regional climate data. This allows assessment of how well the model captures the regional climate. This output may be particularly important for California since global climate change models and model ensembles are significantly wetter than the climate in Western North America. (See Appendix.) Our unique climate is heavily influenced by the El Nino / Southern Oscillation and Pacific Decadal Oscillation.

c. Information on the downscaling method (and any bias correction) should also be provided.

In addition, the Board and the Office of Information Management should recognize the recommendations of the Department of Water Resources' Climate Change technical advisory group (CCTAG), available at http://www.water.ca.gov/climatechange/cctag.cfm. This group of leading scientists was convened by the Department of Water Resources to give recommendations on future climate modeling. The technical advisory group recommends selecting a subset of global climate models Daniel Cayan, who oversaw the modeling for the state of California Climate Change Assessment, would be an appropriate independent scientist to advise OIMA and the Board on the use of climate change modeling for California.

Sea Level Rise

With respect to sea level rise, the draft resolution provides as follows:

III. Respond to Climate Change Impacts

> 16. When making recommendations on permits and other decisions to protect coastal infrastructure, wetlands, and other near-shore ecosystems, all State Water Board staff shall, and all Regional Water Boards are encouraged to refer to projections of sea level rise as directed in the most recent Ocean Protection Council Sea-level Rise Guidance Document, the most current data available through Cal-Adapt, and the California Coastal Commission's Sea Level Rise Policy Guidance, and shall consult with the Ocean Protection Council, the Coastal Commission, Bay Conservation and Development Commission, State Lands Commission, and other relevant agencies.

California Water Research strongly supports the staff's recommendation to consider sea level rise "when making recommendations on permits and other decisions to protect coastal infrastructure, wetlands, and other near-shore ecosystems." However, to comply fully with the Governor's executive order, estuaries should be added to the list. California Water Research also requests that the resolution be amended to include recent federal recommendations on sea level rise which incorporate new science.

The 2013 Ocean Protection Council's Sea-level Rise Guidance Document uses the 2012 projections of the National Research Council, which projected maximum sea level rise of 5.48 feet by 2100. However, our scientific understanding of sea level rise has changed greatly since 2012, informed by the recent dramatic melting of the ice sheets in Greenland and West Antarctica. In December 2014, the American Geophysical Union accepted a paper by Tyler Sutterly and colleagues at University of California, Irvine and NASA's Jet Propulsion Laboratory which showed that the acceleration of mass loss (net melting) in West Antartica had tripled in the last decade. [1] Sutterley's analysis was comprehensive and authoritative as it evaluated and reconciled data using four different measurement techniques over 21 years. Similar accelerations are being seen in Greenland.

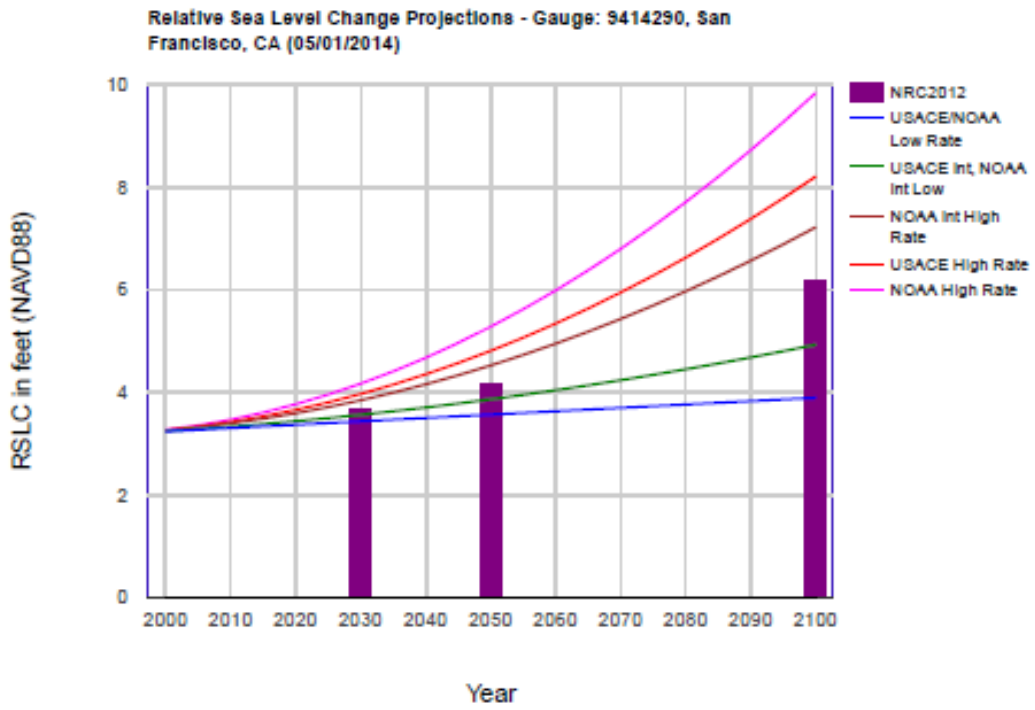
As of February, 2017 projections by the U.S. Army Corps of Engineers are as high as 8.2 feet by 2100 at the Golden Gate in San Francisco Bay, relative to the year 2000. The Climate Change Program Office of the National Oceanic and Atmospheric Association projects up to 9.9 feet. The graph and table on the next page are from the Army Corps of Engineers' sea level change curve calculator, available at http://www.corpsclimate.us/ccaceslcurves.cfm. NOAA provides some estimate of probabilities of sea level rise in the 2017 guidance document.

California Water Research suggests the following additional sentence in the resolution:

> Current NOAA sea level rise guidance documents shall be considered, if available, as well as projections of the U.S. Army Corps of Engineers sea level change calculator.

---

[1] Sutterley, T. C., I. Velicogna, E. Rignot, J. Mouginot, T. Flament, M. R. van den Broeke, J. M. van Wessem, and C. H. Reijmer, *Mass loss of the Amundsen Sea Embayment of West Antarctica from four independent techniques*, 41 Geophys. Res. Lett. 8421–8428, doi:10.1002/2014GL061940, *available at http://dx.doi.org/10.1002/2014GL061940*



Year	USACE Low NOAA Low	USACE Int NOAA Int Low	NOAA Int High	USACE High	NOAA High	NRC2012
2000	3.2	3.2	3.3	3.3	3.3	
2005	3.3	3.3	3.3	3.3	3.4	
2010	3.3	3.3	3.4	3.4	3.5	
2015	3.3	3.4	3.5	3.5	3.6	
2020	3.4	3.4	3.6	3.7	3.8	
2025	3.4	3.5	3.7	3.8	4.0	
2030	3.4	3.6	3.8	4.0	4.2	3.7
2035	3.5	3.6	4.0	4.1	4.4	
2040	3.5	3.7	4.2	4.4	4.7	
2045	3.5	3.8	4.3	4.6	5.0	
2050	3.6	3.9	4.5	4.8	5.3	4.2
2055	3.6	3.9	4.7	5.1	5.6	
2060	3.6	4.0	5.0	5.3	6.0	
2065	3.7	4.1	5.2	5.6	6.4	
2070	3.7	4.2	5.4	6.0	6.8	
2075	3.7	4.3	5.7	6.3	7.2	
2080	3.8	4.4	6.0	6.6	7.7	
2085	3.8	4.6	6.3	7.0	8.2	
2090	3.8	4.7	6.6	7.4	8.7	
2095	3.9	4.8	6.9	7.8	9.3	
2100	3.9	4.9	7.2	8.2	9.9	6.2

In sum, California Water Research applauds the efforts of the Board and the staff to ensure that climate change is addressed in future Board decisions. This is critically important for both mitigation and adaptation.

However, climate change and sea level rise projections are area of evolving scientific understanding. California Water Research respectfully submits these recommendations to ensure that the best available, peer-reviewed climate science is used in Board permits and Board decisions.

Sincerely,

Deirdre Des Jardins
Principal, California Water Research

REGIONAL BIAS IN CMIP3 and CMIP5 ENSEMBLE OF GLOBAL CLIMATE MODELS

From Flato, G., J. Marotzke, B. Abiodun, P. Braconnot, S.C. Chou, W. Collins, P. Cox, F. Driouech, S. Emori, V. Eyring, C. Forest, P. Gleckler, E. Guilyardi, C. Jakob, V. Kattsov, C. Reason and M. Rummukainen, Evaluation of Climate Models. In: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 2013. Cambridge University Press, Cambridge, United Kingdom and New York, NY, US.

p. 812

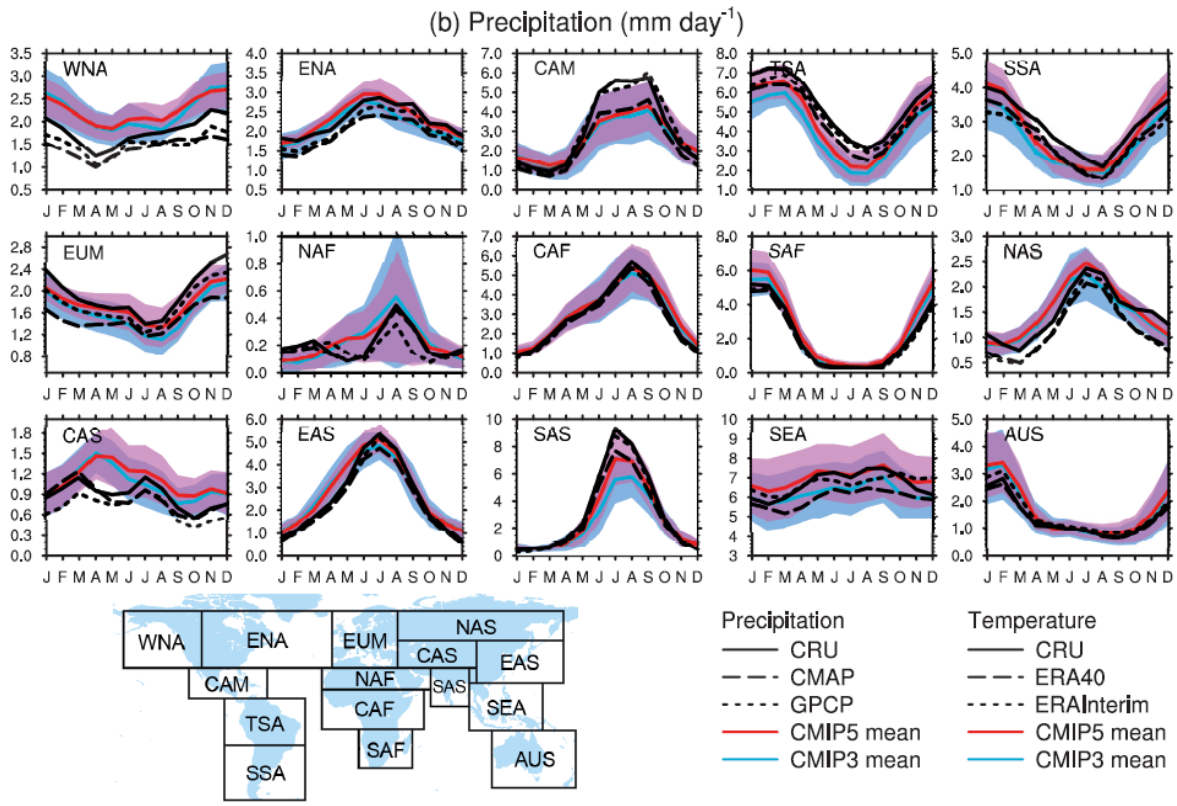
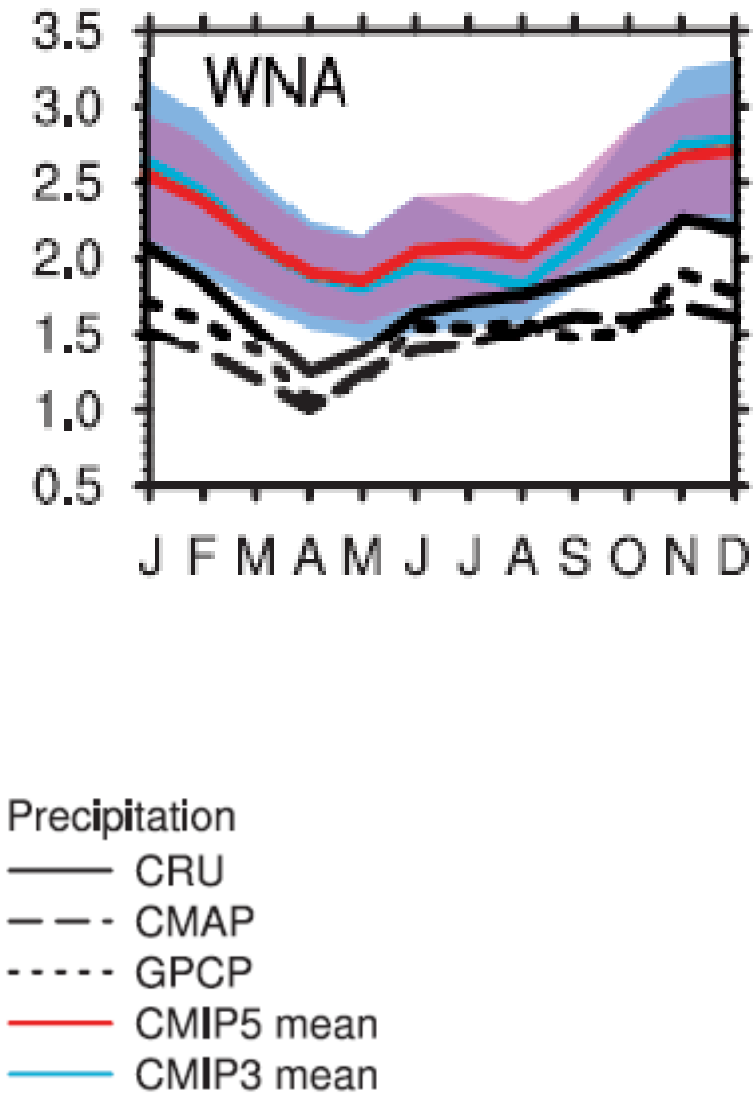


Figure 9.38 | Mean seasonal cycle of (a) temperature (°C) and (b) precipitation (mm day^{-1}). The average is taken over land areas within the indicated regions, and over the period 1980–1999. The red line is the average over 45 CMIP5 models; the blue line is the average over 22 CMIP3 models. The standard deviation of the respective data set is indicated with shading. The different line styles in black refer to observational and reanalysis data: Climatic Research Unit (CRU) TS3.10, ECMWF 40-year reanalysis (ERA40) and ERA-Interim for temperature; CRU TS3.10.1, Global Precipitation Climatology Project (GPCP), and CPC Merged Analysis of Precipitation (CMAP) for precipitation. Note the different axis-ranges for some of the sub-plots. The 15 regions shown are: Western North America (WNA), Eastern North America (ENA), Central America (CAM), Tropical South America (TSA), Southern South America (SSA), Europe and Mediterranean (EUM), North Africa (NAF), Central Africa (CAF), South Africa (SAF), North Asia (NAS), Central Asia (CAS), East Asia (EAS), South Asia (SAS), Southeast Asia (SEA) and Australia (AUS).

REGIONAL BIAS IN CMIP3 AND CMIP5 ENSEMBLE OF GLOBAL CLIMATE MODELS

Figure 8. From Flato et. al., Evaluation of Climate Models, p. 812, close-up of Western North America (WNA).



REGIONAL BIAS IN CMIP3 AND CMIP5 ENSEMBLE OF GLOBAL CLIMATE MODELS

Regional Temperature and Precipitation Bias. From Flato et. al., Evaluation of Climate Models, p. 813

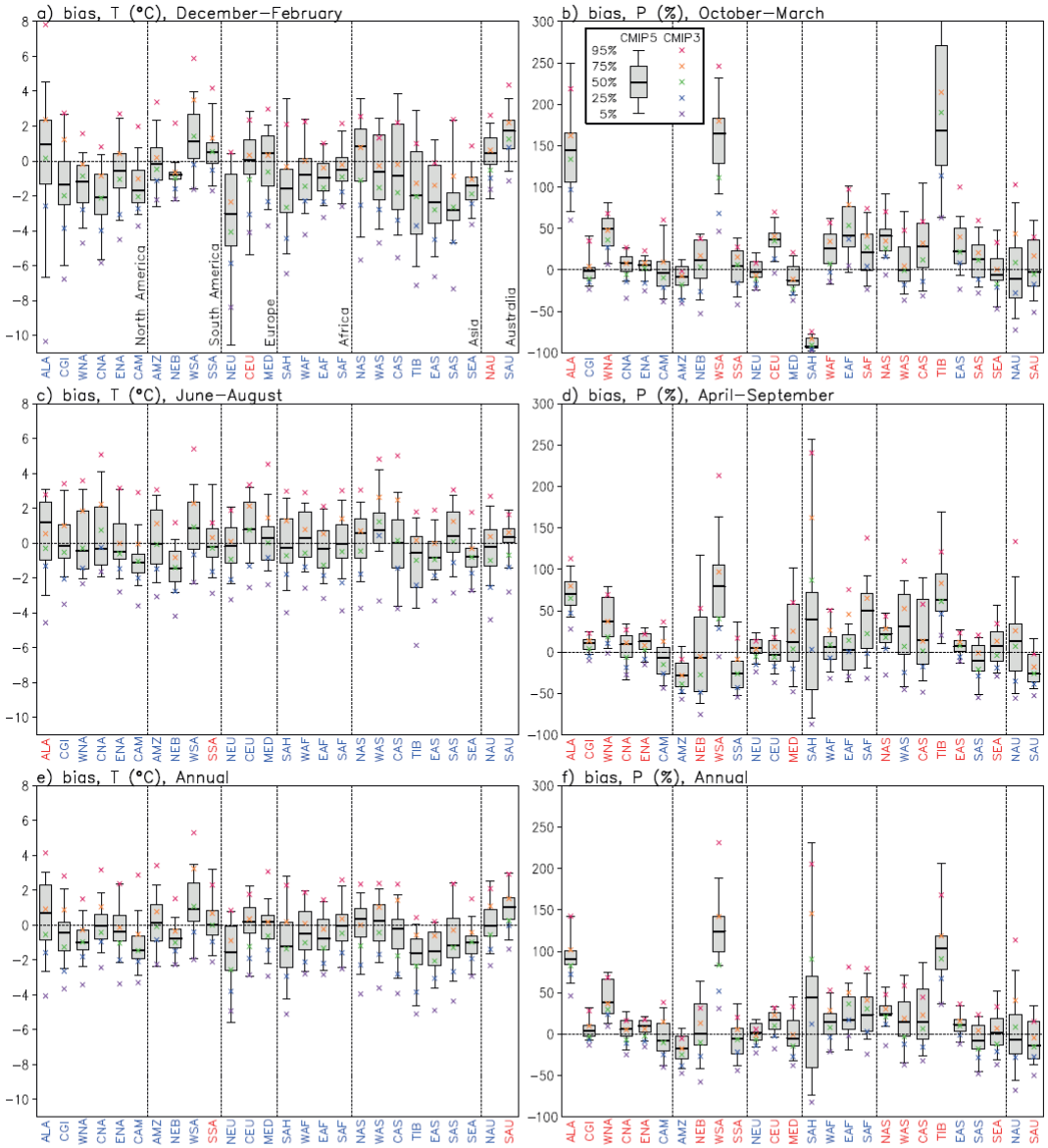
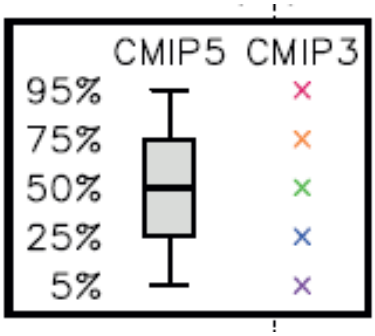


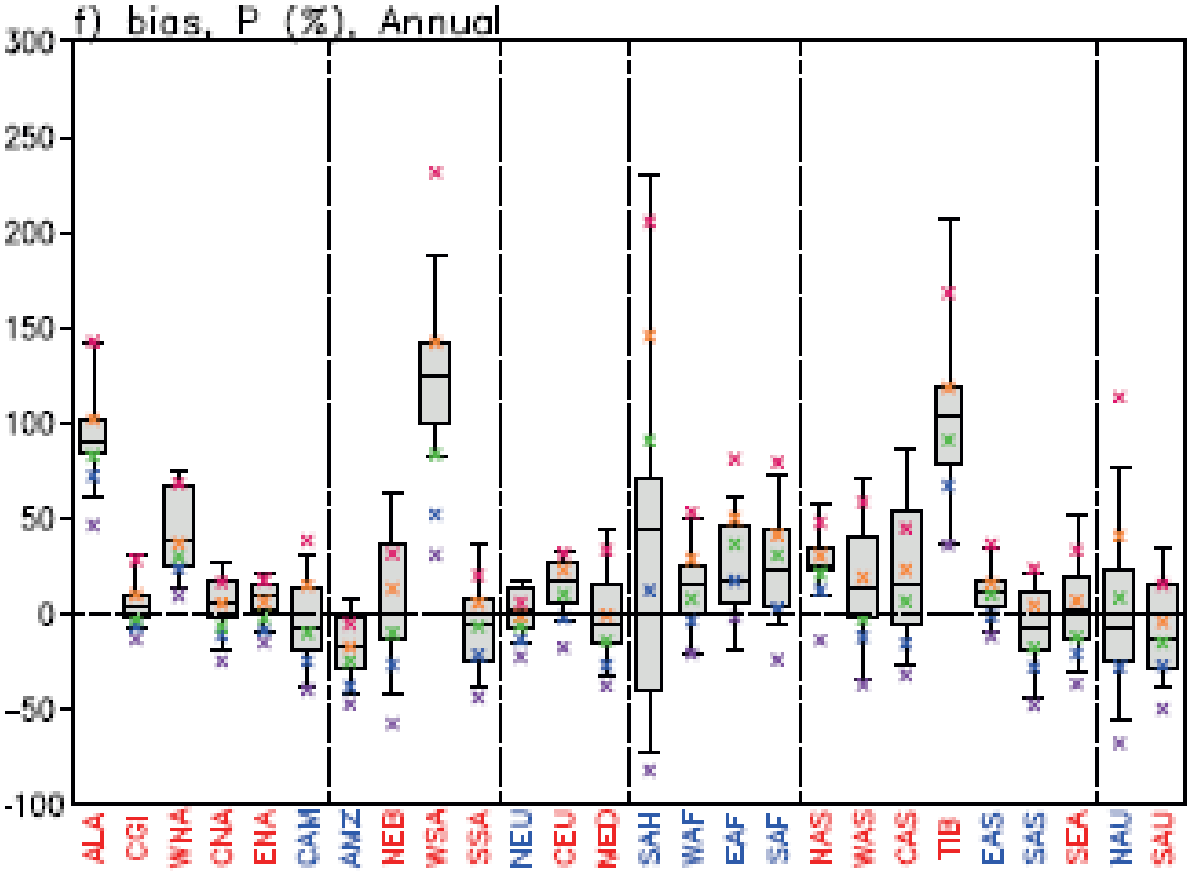
Figure 9.39 | Seasonal- and annual mean biases of (left) temperature (°C) and (right) precipitation (%) in the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) land regions (cf. Seneviratne et al., 2012, p. 12. The region's coordinates can be found from their online Appendix 3.A). The 5th, 25th, 50th, 75th and 95th percentiles of the biases in 42 CMIP5 models are shown in box-and-whisker format, and corresponding values for 23 CMIP3 models with crosses. The CMIP3 20C3M simulations are complemented with the corresponding A1B runs for the 2001–2005 period. The biases are calculated over 1986–2005, using Climatic Research Unit (CRU) T3.10 as the reference for temperature and CRU TS 3.10.01 for precipitation. The regions are labelled with red when the root-mean-square error for the individual CMIP5 models is larger than that for CMIP3 and blue when it is smaller. The regions are: Alaska/NW Canada (ALA), Eastern Canada/Greenland/Iceland (CGI), Western North America (WNA), Central North America (CNA), Eastern North America (ENA), Central America/Mexico (CAM), Amazon (AMZ), NE Brazil (NEB), West Coast South America (WSA), South-Eastern South America (SSA), Northern Europe (NEU), Central Europe (CEU), Southern Europe/the Mediterranean (MED), Sahara (SAH), Western Africa (WAF), Eastern Africa (EAF), Southern Africa (SAF), Northern Asia (NAS), Western Asia (WAS), Central Asia (CAS), Tibetan Plateau (TIB), Eastern Asia (EAS), Southern Asia (SAS), Southeast Asia (SEA), Northern Australia (NAS) and Southern Australia/New Zealand (SAU). Note that the region WSA is poorly resolved in the models.

REGIONAL BIAS IN CMIP3 AND CMIP5 ENSEMBLE OF GLOBAL CLIMATE MODELS

Figure 10. Close-up of Western North America (WNA) annual precipitation bias,

From Flato et. al., Evaluation of Climate Models, p. 813



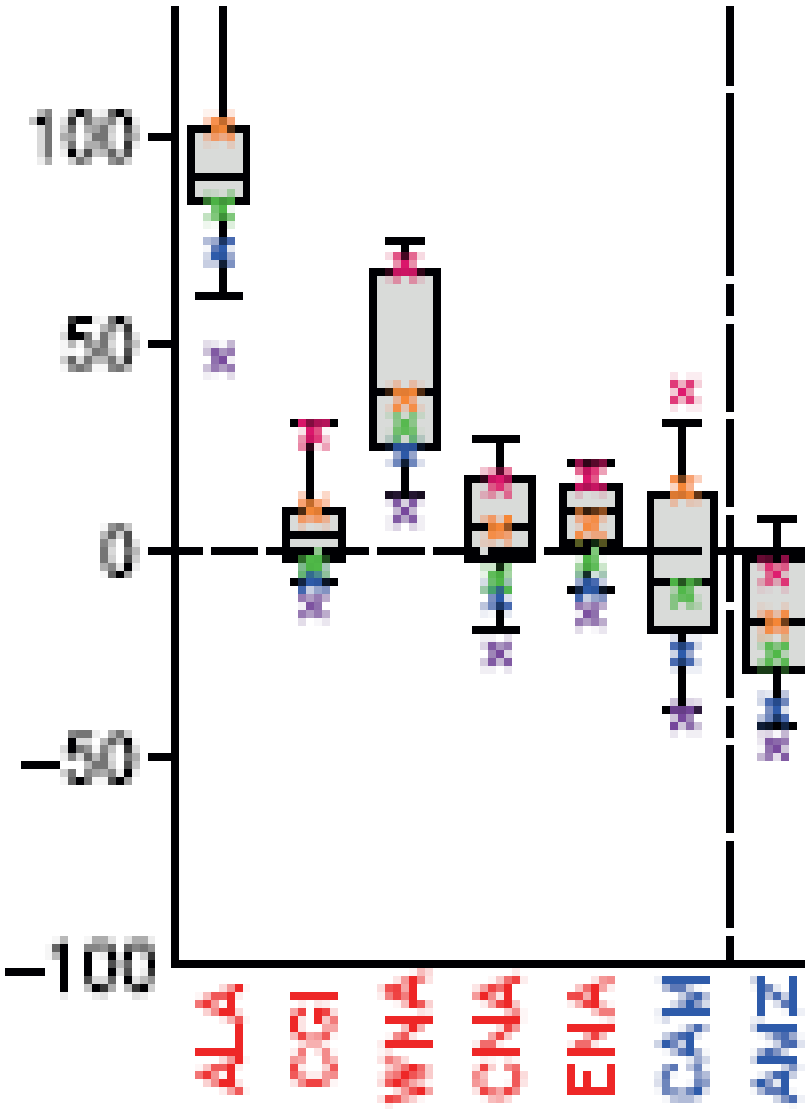


^

REGIONAL BIAS IN CMIP3 AND CMIP5 ENSEMBLE OF GLOBAL CLIMATE MODELS

Figure 11. Expanded close-up of Western North America (WNA) annual precipitation bias,

From Flato et. al., Evaluation of Climate Models, p. 813



SELECTING GLOBAL CLIMATE MODELS

Recommendations of DWR's Climate Change Technical Advisory Group, From Perspectives and Guidance for Climate Change Analysis, p.43.

Figure 2-1 Three-Step Process for Selecting Global Climate Models to Use for California Water Resources