Hydroclimate insights from the warm Pliocene, Miocene, and Eocene

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A warmer atmosphere holds more water vapor supporting an amplified hydrological cycle with both more intense precipitation events and droughts. Yet future climate projections are uncertain when it comes to predicting climatological changes in regional hydroclimate, particularly for subtropical and Mediterranean climates. Past warm climates in Earth's history offer an opportunity to learn how regional hydroclimate responds to global warming. Here we review insights from several studies that model and reconstruct hydroclimate during the warm climates of the Pliocene, Miocene and Eocene. A common finding is the importance of correctly predicting warming patterns and their impact on large-scale circulation, leading to circulation driven changes in climatological moisture convergence. Most notably, climate models that simulate the largest reduction in equator-to-pole temperature gradients are characterized by a reduction in subtropical moisture divergence, leading to an increase in mean annual precipitation and better agreement with proxy reconstructions.

Biosketch: Dr. Burls received her PhD in Physical Oceanography from the University of Cape Town in 2010. From 2011 to 2014, she worked as a postdoctoral associate in the Department of Geology and Geophysics at Yale University. She joined George Mason in January 2015. Dr. Burls' research is focused on improving our understanding of the key processes determining Earth’s climate and climate variability on a variety of timescales ranging from seasonal, to decadal, to much longer geological scales. In particular, she is interested in the climatic role of ocean general circulation, ocean-atmosphere interaction, and cloud dynamics in determining Earth’s climate sensitivity. Her research efforts acknowledge that, to fully understand, model and predict changes in climate characteristics that have a significant impact on society (especially temperature and precipitation patterns), a fully coupled ocean-atmosphere perspective is needed – one that accounts for changes in important variables such as the thermal structure of the slowly-adjusting ocean. Complementing observations with theory, she endeavors to accompany complex simulations of climate phenomena with simple models capturing the essential dynamics required to explain unanswered questions within climate science. Dr. Burls has a large collaborative network both nationally and internationally, with particularly strong connections in her home country of South Africa. Dr. Burls has a strong external funding record which includes receiving a prestigious NSF CAREER award. Dr. Burls has extensive experience in education at all levels. She has advised several Postdocs, PhD, MS, undergraduate, as well as over 30 high school students, through successful research projects. Dr Burls currently serves as co-chair of the international CLIVAR climate dynamics panel. CLIVAR (Climate and Ocean: Variability, Predictability and Change) is one of the six core projects of the World Climate Research Program (WCRP). Dr Burls is a member of the National Center for Atmospheric Research (NCAR) Climate and Global Dynamics (CGD) Advisory Panel and has served on panels for numerous institutions including the National Academies of Sciences, Engineering, and Medicine.