Notes

Public engagement on first-order results on Climate projections

Elea Becker Lowe (LCI) gives an introduction on the meaningfulness of the Sierra Nevada regional report in the fifth climate assessment of California. The timeline is shown on the screen and it is explained that the complete portfolio will be released sometime around mid next year (2026). The major goal is to support a community-driven process, produce actionable science and process and to help the community here.

Kaeleigh Reynolds introduces Dr. Prakash Kumar Jha, an applied to others who is today's speaker. His work focusses on developing climate resilient policies for agriculture. He is going to present climate projections for Sierra Nevada as per the CMIP6 projections and which would be encapsulated in the regional report.

Dr. Jha starts with the discussion on warming in future depending on emissions of greenhouse gases and aerosols. The basic assumption is through the shared socioeconomic pathways (SSPs). We take a high emission pathway (SSP5-8.5: assumes that there would be no reduction in emissions and the emissions would continue to rise till the end of the century and the extra radiative forcing would be 8.5 W/m2 by the end of the century) and a moderate emission pathway (SSP2-4.5: emissions will peak and then decline around the end of the century; radiative forcing is 4.5 W/m2). In CCA4, RCPs were used. RCP4.5 from last report is same as SSP2-4.5 and RCP8.5 is equivalent to SSP4-8.5. The only difference between SSPs and RCPs is the inclusion of socioeconomic technologic evolution and policy development concepts in SSPs.

An earlier study framework (Krantz et al., 2021) is adoped to choose the GCMs for the climate projections. Based on that, five GCMs (after downscaling to 3km resolution) are chosen which perform the best for California. Results for average maximum temperature for historical (1980-2009), and difference with end of century projections (2071-2100 minus historical period) is shown as per both SSP2-4.5 and SSP4-8.5 pathways. The high emission pathways, increase the Tmax (maximum annual temperature) by a lot more. Dr. Jha discussed the numerical values of the changes as per the emission scenarios. Then he shows the same results, but for minimum annual temperatures (Tmin). Again, there are variations even with the Sierra Nevada region (spatial variations).

Dr. Jha further discussed region-specific temperature increase (N Sierra, NE Sierra, S Sierra, SE Sierra). Compared to historical period, there will be warming in every region consistently (depicted through mean of all climate models considered for this study).

Further, discussion on precipitation is depicted. Future changes in precipitation don't follow the patterns of temperature. The changes in precipitation are comparatively lower

than temperature. There will be a slight increase in precipitation projected by 2070-2099. There would be more precipitation extremes, with prolonged dry periods, followed by intense storms. There are in fact a few other studies which have shown that in the future the atmospheric rivers across California may may precipitation extremes more frequent. Hence, we should be ready to adapt to floods as we as prolonged dry periods. Similar results are shown for the sub-regions of Sierra Nevada.

Similar results are shown for snow water equivalent (for April). Although the precipitation is expected to increase little bit, the snow pack is expected to decline significantly almost across all the projections. It is consistent even in those projections which depict increase in precipitation. Snowpacks are expected to decline by 90% across most of the Sierra Nevada under SSP5-8.5 pathway.

The possible reason behind decline in snowpack might be due to increase in rainfall/snow ratio and increase in snow melting. Furthermore, hydrological simulations are shown which are as per the VIC model. Soil moisture is projected to decline during the summer. During the winter and spring, the changes in soil moisture vary across regions. Lower soil moisture can ultimately reduce evapotranspiration and increase dry fuel loads resulting in increase chance of wildfire.

Runoff plots are further shown (monthly average for historical and future periods). In future, winter and spring runoff will increase but summer runoff will decrease in all the projections. This phenomenon might be due to a combination of factors: earlier snowmelt, increase in rainfall-to-snow ratio, and/or a slight increase in precipitation. Increase in winter and spring runoff may have implications for frequent and severe flooding and less water available during summer. The projected runoff for the emission pathways are further shown in the form of a table. The annual total runoff will increase by 88-121%. Furthermore, snowmelt patterns in the future for the four sub-regions of Sierra Nevada are depicted. The results depict an earlier snowmelting. And in the future, by the beginning of June, most snowpacks would be already melting which is vastly different from the historical period.

The results regarding heatwaves (defined as 99^{th} percentile of historical Tmax; calculated by exceeding this threshold for every grid cell). In the future, every year there would be 10-20 days (as per SSP5-8.5) when the temperature will exceed 99^{th} percentile of historical Tmax resulting in illness, wildfire. Also, freeze days (number of days below 0 degree Celsius) is quantified. Days below 0 degree Celsius will significantly decrease in the future causing implications in snow accumulation and snow melting.

Kaeleigh invites others for Q&A regarding the results shown by Dr. Jha.

Isabella Velicogna: Is there any reason you selected historical data as 1970-2000? (and 1980-2009?)

Dr. Jha: To be consistent with fourth assessment and to have a longer timeline as basement (30-year minimum).

Mike Dettinger: There might be a way of masking 99th percentile maps with public health data? Probably linkage with public health side of issues associated with it?

Dr. Jha: I will definitely look at public health county data and mostly related to heatwave.

Joseph Harvey: You look at different pathways. Is there any hope of SSP2-4.5 or is it all expected to be SSP4-8.5?

Dr. Jha: Depends on the climate mitigation measures globally. Currently we are not heading towards the SSP2 pathway, we are heading towards the worst scenario (SSP4). But we are still very far away from 2100 and we still have time to mitigate and shift to a lesser radiative forcing.

Mike Dettinger: For a long time we were on the SSP4-8.5 path but Covid might have helped in mitigation; probably closer to the 4.5 curve. It takes something like Covid to make difference between the two! We should not conceive 8.5 radiative forcing.

Dr. Jha: We hope for the best but also ready for the worst!

Helene Margolis: When you go from historical to mid-century projections to end of century projections, is it linear relation or non-linear function? From a heat-illness perspective, can we model it as a function of Tmax?

Dr. Jha: It is not linear. It is more exponential. We haven't covered an analysis of trends but it is mostly nonlinear.

Helene: What about projections for average temperature/precipitation in terms of adaptation mid-century? Are there thresholds above which we can have a warning tool for the healthcare system? How the orographic shift in foothills change the groundwater dynamics? Precipitation higher up could lead to water shortage for people living in the foothills.

Dr. Jha: It is hard to include the topographic map in the projections. I can include a topo map and check if the altitude plays a role governing the temperature and/or precipitation dynamics.

Isabella Velicogna: Snowmelt may infact add to the groundwater. So it is not just about precipitation.

Helene: Point taken!

Gulnaz Shalgumbayeva: What are the resolutions of historical data and is there any observation data?
Dr. Jha: The models are downscaled by LOCA2 and are at 3km resolution (available in CalAdapt). And we are not using any observations. The hydrological projections are from the VIC model.

Rick Iger: Can you include some sort of estimates of volcanic eruptions? The greenhouse gases added to the atmosphere may be related to that.

Dr. Jha: I can do that. But volcanic impacts only have a short-term impact on climate. In long-term, they may not have a major impact on the climate.

Kaeleigh thanks everyone to join the presentation and to Dr. Jha for sharing his results. The meeting is concluded!