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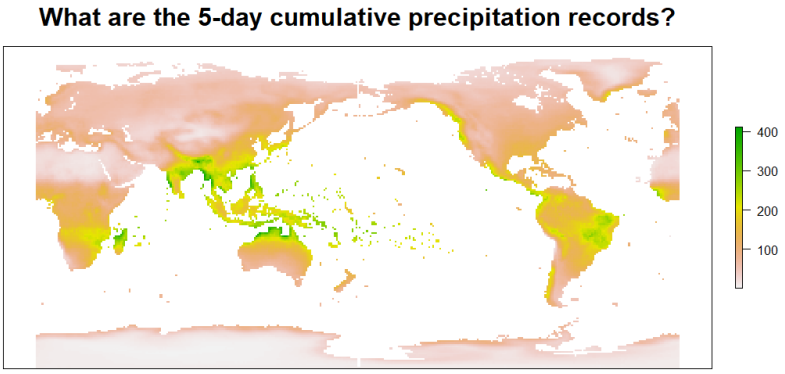
12/3/22

Climate Memo

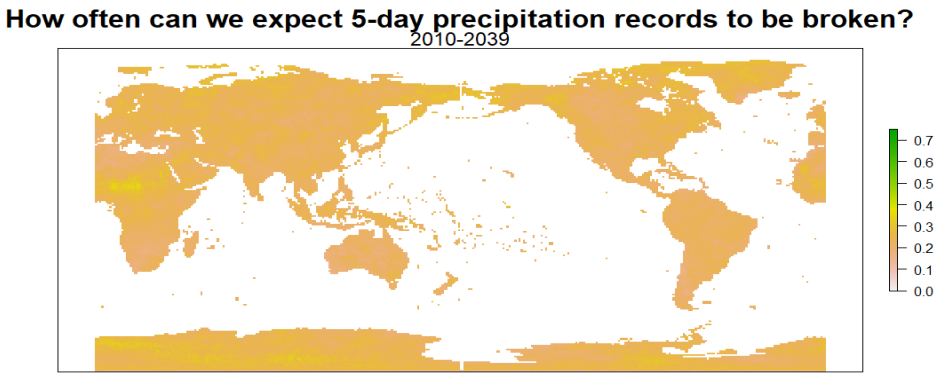
The question I seek to explore is: How often can we expect to surpass historic precipitation events in different parts of the world? How do these expectations change under different scenario assumptions?

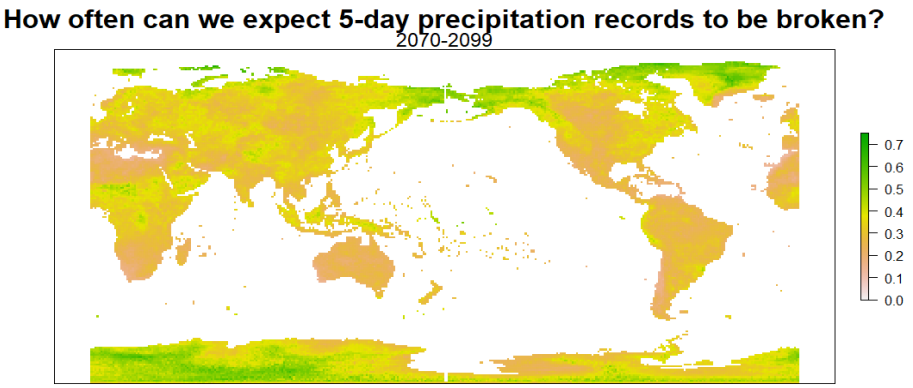
The data used in this analysis comes from the Climate Change Knowledge Portal. All data is from the CMIP6 collection, which involves recording and estimating extremes. It includes initial measures of the largest 5-day cumulative precipitation event in an area's history, which is used as the baseline for all future projections. I started by mapping this data to get an idea of what this baseline looks like in different parts of the world.



The results do not present much surprising information: Areas of heavy historic rainfall include southeastern Asia, Madagascar, western North America, and the Amazon. These are all traditionally wet areas, so it makes sense that their largest 5-day cumulative precipitation events are relatively high.

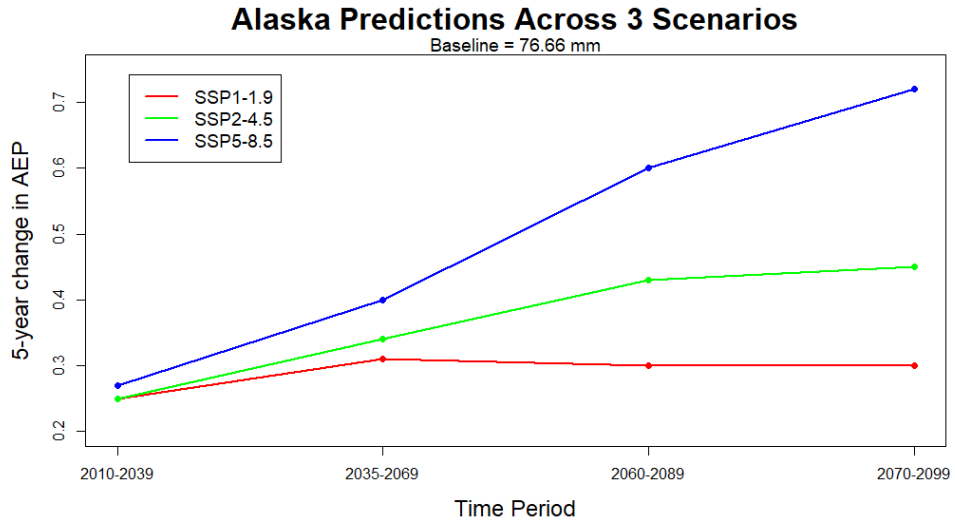
Next, we can examine the annual exceedance probability for each of these areas, or the AEP. AEP measures the likelihood that in any given year, the historic precipitation event will be exceeded (i.e., the area will experience an amount of precipitation over a 5-day period in excess of its greatest historic 5-day event). Specifically, the maps below show the *change* (increase) in AEP across a 5-year period for the timeframe listed. These predictions operate under the SSP2-4.5 assumption, where SSP2.5 is middle of road, and 4.5 is a target for radiative forcing by 2100 that is considered practical. For brevity, only two figures are shown below.

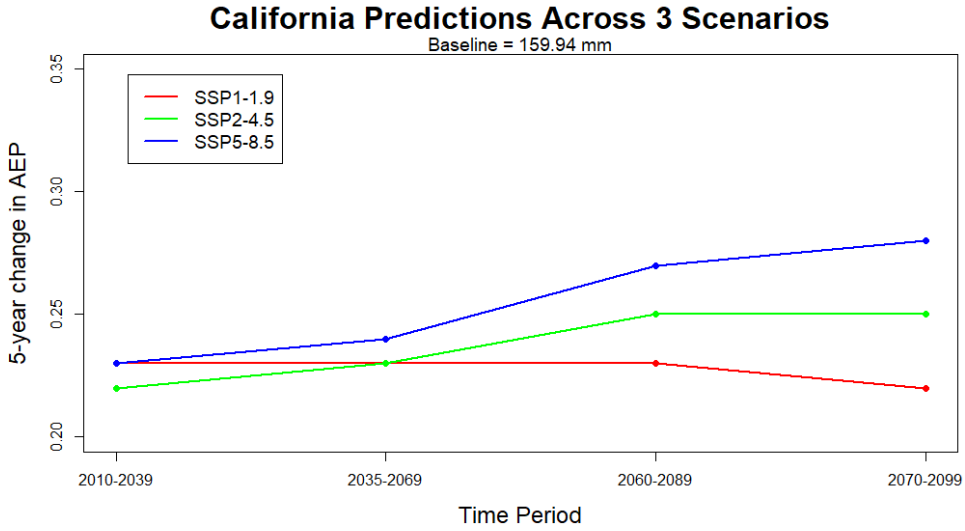




The results in the figures show that the AEP for many areas across the world is expected to increase at a sharp rate over the next 75 years. Although some of this increase occurs in the historically wet regions, a number of the areas expected to see a high increase in AEP are areas that have had low amounts of precipitation in their historic events. This makes sense, as the historic baseline that needs to be surpassed in these areas is lower than in the wet areas. In particular, areas like Antarctica, Russia, Greenland, and Alaska are expected to see their historic baseline surpassed multiple times within a one year period by 2089.

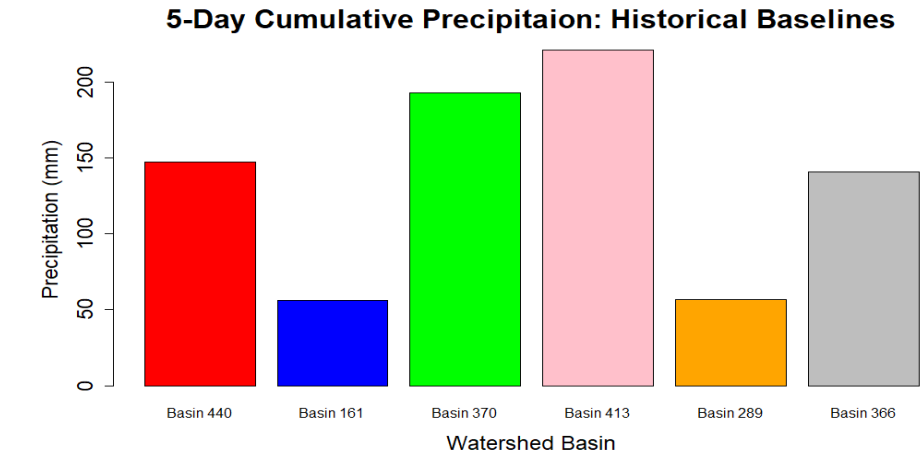
We can dive further into these models by changing the area of analysis, as well as the scenario assumptions.

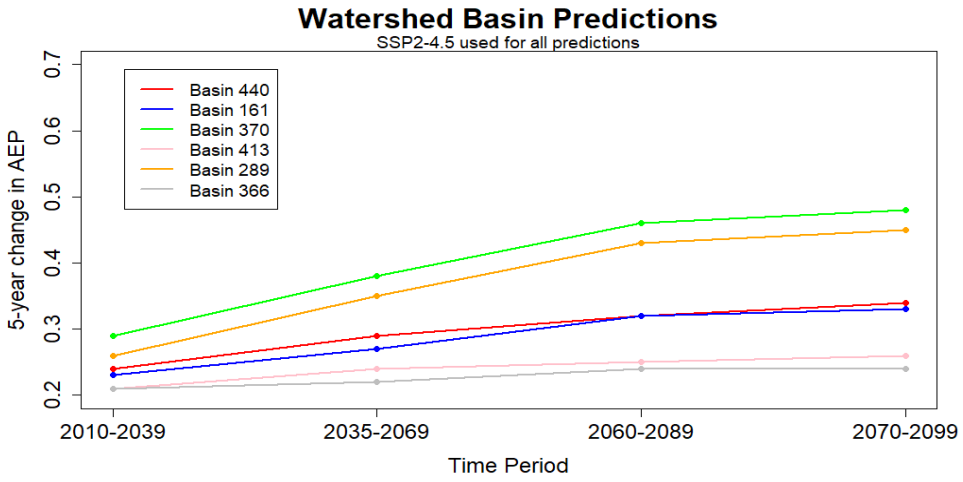




The above plots compare Alaska, which sits at the high end of AEP change within the USA, versus California, which sits at the low end. The three lines on each plot show the three different scenario assumptions, with SSP1-1.9 on the low end of climate catastrophe, and SSP5-8.5 on the high end. As is expected, the more aggressive models result in higher amounts of change in AEP, though this change is far more pronounced under the severe model in Alaska, rather than California.

Finally, many of the datasets on the Climate Change Knowledge Portal divide the world up into watershed basins, based on major rivers. We can analyze the differences in AEP across these basins, and see how they compare to those basins' historical baselines.





Notably, the basin with the highest change in AEP is Basin 370, which has one of the higher historical baselines. This means that Basin 370 is an area that has historically experienced very wet extreme events, and those extremes are expected to continue to get wetter at a high rate of change. On the other hand, Basin 413 is another area with a high historical baseline, but comes in closer to the bottom of expected change in AEP. It is an area with historically wet extremes, but will not get much wetter at a fast rate of change. Finally, we note that Basin 289 has had historical precipitation events that are not very wet, but it is expected to get wetter at a high rate of change, due to its high values on the AEP change graph.

Overall, extreme precipitation events are expected to increase into the future, even though the overall climate of many areas of the world may become drier. Areas all across the world need to be ready to deal with these extreme weather events that are currently once-in-a-30-year events, but in the future are likely to occur multiple times per year. It’s inevitable that historic events will soon become commonplace; how well humans adapt to climate change will determine the rate of change at which we will begin to see more and more of these events.