Climate-Aquatics Blog #16: Why the quality of the ski season may ultimately matter for fish

Hi Everyone,
So we're picking up this week with the first blog post on hydrology, which is the second major component of "climate" in streams after the thermal regime. The posts in this module will have a strong focus on studies conducted in the western US because the hydrology of the region is so well studied and is proving to be especially sensitive to climate change. Although glaciers get most of the play as charismatic cold physical features that are disappearing as the climate warms, there's a fluffier, seasonal type of unconsolidated glacier otherwise known as snow that accounts for the large majority of streamflow runoff across most of the western US and is being similarly affected by warmer temperatures.

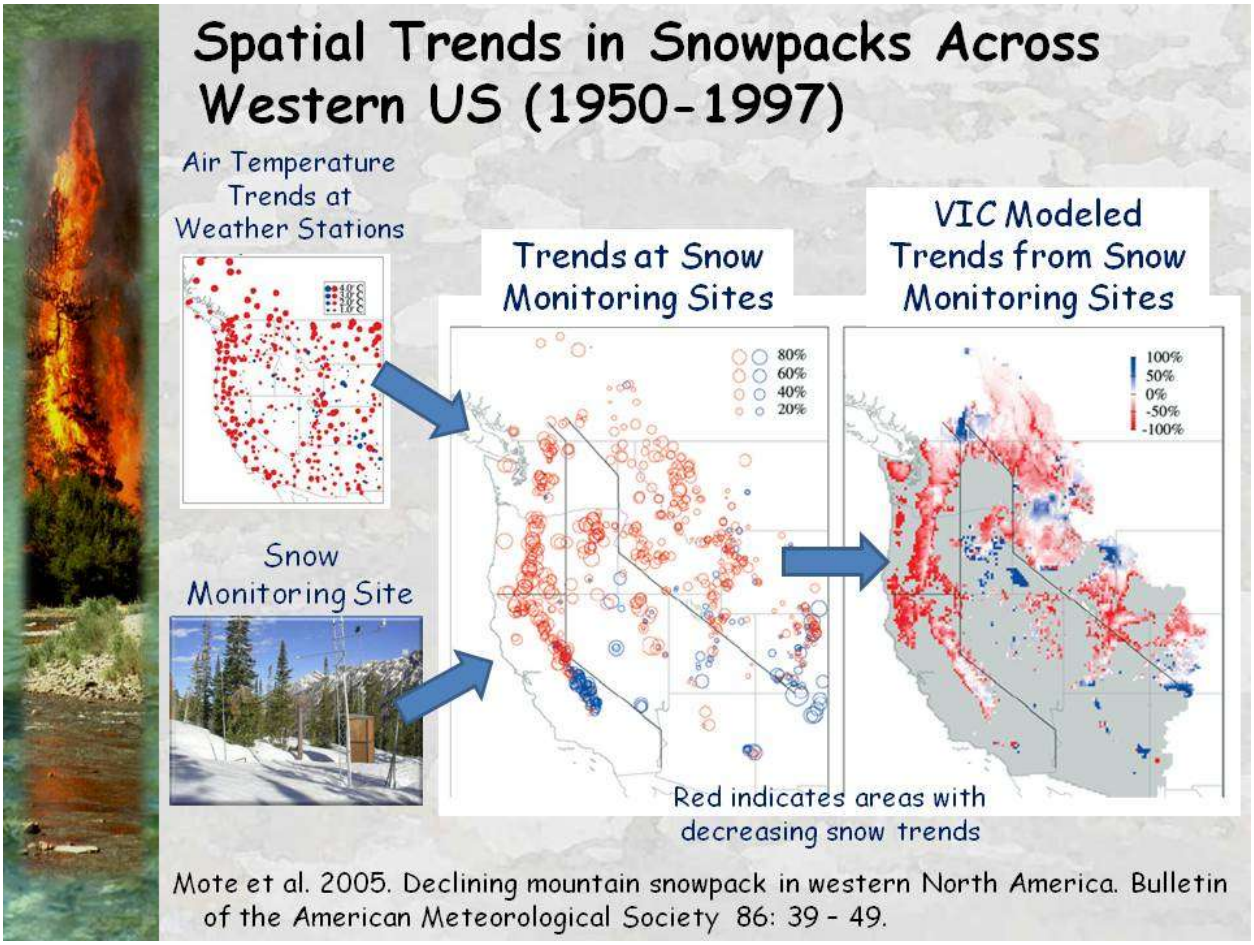
So this week, we'll look at two studies that document historical trends in spring snow accumulations across the west. The first, by Phil Mote & coauthors describes trends in April 1 SWE (Snow Water Equivalent) at more than 800 snow course locations during the latter half of the 20th century (graphic 1). Perhaps not surprisingly, as air temperatures have increased, the amount of snow measured on the ground on April 1st of each year has decreased. Two factors are thought to be primarily responsible. First, warmer air temperatures mean a larger proportion of precipitation falls as rain rather than snow, which tends to run off immediately rather than sticking around in a snowbank. Second, warmer air temperatures are melting more of the snow that does fall by April 1st of each year. In some areas, especially the southern Rockies, these mechanisms have been more than offset by trends toward more overall precipitation (but note that most climate model projections suggest these precipitation trends are likely to be transient in nature). The other interesting thing about the Mote et al. study is the relationship between winter air temperatures and reductions in snowpack (graphic 2). The colder winter temperatures are, either because a site is at high elevation and/or latitude, the less likely it is that snowpacks are decreasing.

So are these trends in snow accumulation a big deal or not? As we discussed earlier (blog post #12), climate cycles come & go and a multi-decadal cycle could be part of what's driving the snow trends. For a broader historical context, therefore, a recently published study by Greg Pederson & co-authors is useful to examine. In this work, tree cores were obtained from across the Rocky Mountains and used to reconstruct snowpack accumulations dating back almost 1,000 years (graphic 3). The time series confirm the patterns documented in the latter half of the 20th century by Mote, in that significant snow declines are seen in the Northern Rockies and Greater Yellowstone regions, with the upper Colorado Region (southern Rockies) not showing much of a response. In the former two regions, the 20th century anomalies suggest snowpacks that have been, on average, lower than any other period in the previous thousand years.

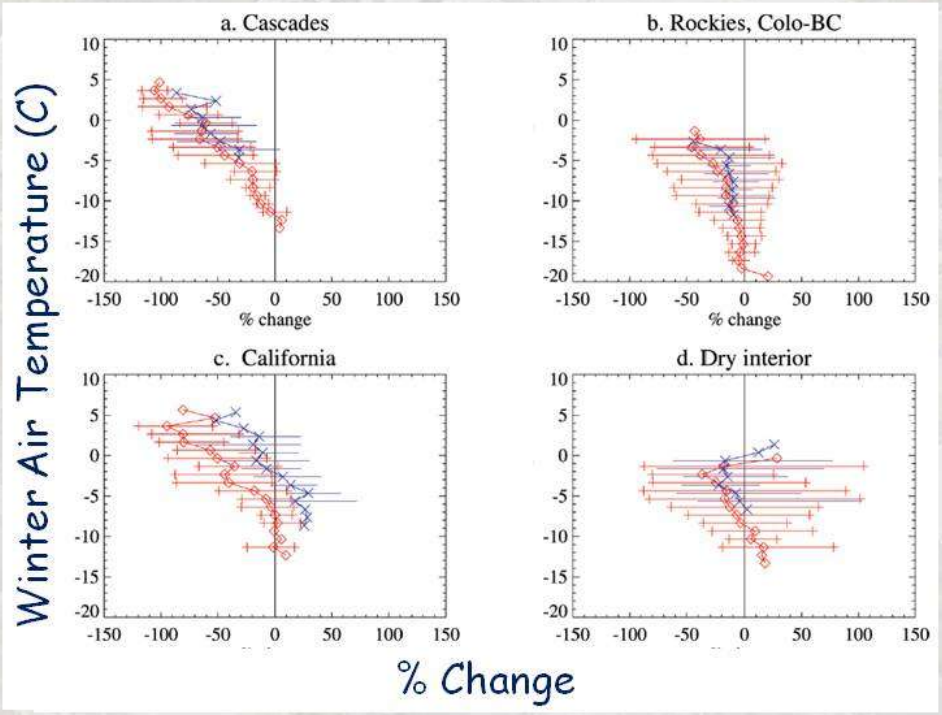
Perhaps even more sobering is that both studies highlighted today examine trends in snowpacks through the end of 20th century & neither factors in changes that likely occurred during the last decade, which was the warmest in the earth's instrumental record going back 130 or so years.

Next time out, we'll start to take a closer look at how these trends in regional snowpacks are altering the timing and magnitude of stream flows across the western U.S.

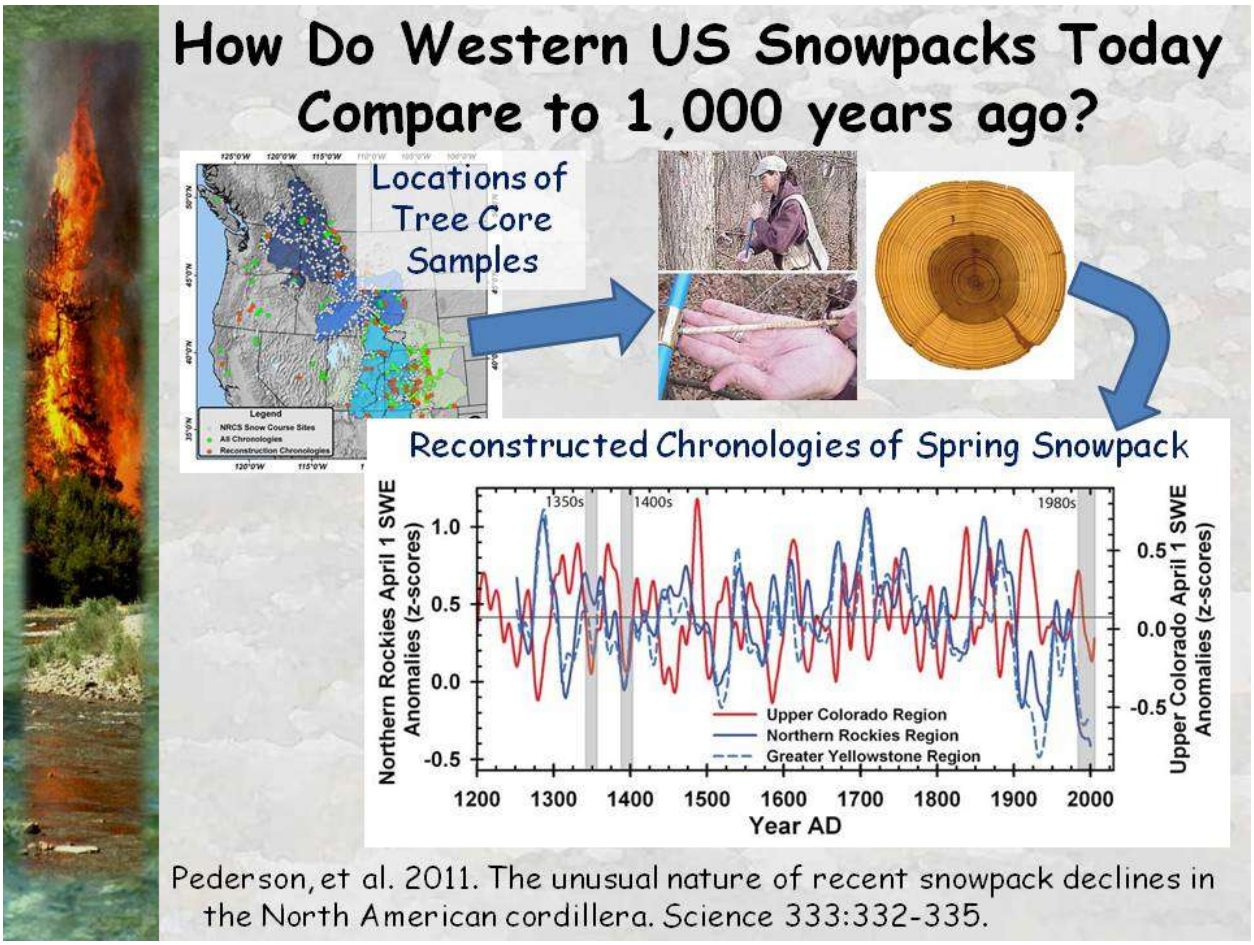
Until next time, best regards,
Dan



Snowpack Trends Across the Western US (1950-1997) Relative to Winter Temperatures



Mote et al. 2005. Declining mountain snowpack in western North America. Bulletin of the American Meteorological Society 86:39 - 49.



Previous Posts

Climate-Aquatics Overviews

Blog #1: Climate-aquatics workshop science presentations available online

Blog #2: A new climate-aquatics synthesis report

Climate-Aquatics Thermal Module

Blog #3: Underwater epoxy technique for full-year stream temperature monitoring

Blog #4: A GoogleMap tool for interagency coordination of regional stream temperature monitoring

Blog #5: Massive air & stream sensor networks for ecologically relevant climate downscaling

Blog #6: Thoughts on monitoring air temperatures in complex, forested terrain

Blog #7: Accurate downscaling of climate change effects on river network temperatures through use of inter-agency temperature databases and application of new spatial statistical stream models

Blog #8: Thoughts on monitoring designs for temperature sensor networks across river and stream basins

Blog #9: Assessing climate sensitivity of aquatic habitats by direct measurement of stream & air temperatures

Blog #10: Long-term monitoring shows climate change effects on river & stream temperatures

Blog #11: Long-term monitoring shows climate change effects on lake temperatures

Blog #12: Climate trends & climate cycles & weather weirdness
Blog #13: Tools for visualizing local historical climate trends
Blog#14: Leveraging short-term stream temperature records to describe long-term trends
Blog#15: Wildfire & riparian vegetation change as the wildcards in climate warming of streams

Climate-Aquatics Hydrology Module

Future topics…
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How to join the group discussion: After clicking on the link, you should be able to see the discussion thread text, but to post comments & read those of others you'll first have to join the Climate-Aquatics Group (you'll only have to do this the first time). To join, follow these steps: 1) on the right side of the page, click on "Join this group" 2) Create your account information with Google user name & password, 3) Add your "nickname", 4) Pick one of the four available options for how you'll read this group (I'd advise against the bottom one that sends a new email every time a comment is added to a discussion thread), 5) Select "Join this group" at the bottom of the page, and 6) Click on the discussion topic hyperlink and you should now be able to post comments to the discussion thread.

The intent of the discussion group is to provide a means for the 1,900 (& growing) field biologists, hydrologists, students, managers, and researchers currently on this mailing list across North America, Europe, and Asia to more broadly and rapidly discuss topical issues associated with aquatic ecosystems and climate change. Messages periodically posted to this blog will highlight new peer-reviewed research and science tools that may be useful in addressing this global phenomenon. Admittedly, many of the ideas for future postings have their roots in studies I and my colleagues have been a part of in the Rocky Mountain region, but attempts will be made to present topics & tools in ways that highlight their broader, global relevance. Moreover, I acknowledge that the studies, tools, and techniques highlighted in future missives are by no means the only, or perhaps even the best, science products in existence on particular topics, so the hope is that this discussion group engages others doing, or interested in, similar work and that healthy debates & information exchanges will occur to facilitate the rapid dissemination of knowledge among those most passionate about climate change and its effects on aquatic ecosystems.

If you know of others interested in climate change and aquatic ecosystems, please forward this message and their names can be added to the mailing list for notification regarding additional science products on this topic. If you do not want to be contacted regarding future such notifications, please reply to that effect and you will be removed from this mailing list.