Sebastian,

I appreciate your detailed and thoughtful response to my earlier review, and I think that the issue of rain signals has now been much better addressed. However, as I read the paper again, I find the term "space-for-time" to be very confusing throughout, and I believe the paper will have a much better impact on the community if it is easier to read and follow. I recommend that you drop the terminology "space-for-time" and instead explain clearly what you are doing in the regressions. As I understand it, you are fitting regressions to watershed temperature and precipitation and other variables across multiple sites and then using data from warmer sites to predict future changes in currently colder sites. If this is not what you're doing, then my personal confusion is just an example of how the paper might be confusing, and please clarify what you are doing. If that's part of it, and there's more to it, please also explain that. This is particularly critical in the abstract and the introduction because I could not figure out what the main goal of the paper is after reading the abstract and Section 1. When I'm reading papers in general (not as an assigned reviewer), I'm very likely to stop reading if I can't figure out the objectives by that point. If you want to use the term "space-for-time", please make sure that it is clearly defined both in the abstract (if used there) and in the first section of the paper. I would be happy to read this again after you have rewritten for clarity. I think there's a lot of interesting analysis here, but without making the paper clearer, that analysis will be not be useful to the scientific community.

Thank you, Jessica Lundquist

Dear Professor Jessica Lundquist,
We appreciate your previous comment about the issues related to the rain signal and we are happy that our response was satisfactory.
Your interpretation of our method is correct, but given the lack of clarity following your comment, we have decided to drop the term space-for-time (which we thought was better established in the community than it is). Instead, we now call it an "empirical diel streamflow-based model" everywhere in the text. As you correctly interpreted, this model is based on the stepwise multiple linear regression that uses 4 climate variables (precipitation, temperature, humidity, and solar radiation; predictors) to predict the DOS20 metric. We then use those DOS20 predictions and the linear regression between DOS20 and DOQ25 and DO50 to project changes in streamflow volume timing. Ultimately, this is an empirical model, which explains our name of choice. We emphasize and clarify this in section 2.3 now called "The empirical diel-streamflow based model".

Regarding the main goal of the paper, we agree that it wasn't clear and we have changed both the abstract and the introduction to be as clear as possible, for which we have added the following sentences to the abstract (lines 15-20):

"Quantifying how sensitive is streamflow timing to climate change, and in which places it is the most sensitive, remains a key question. Physically based hydrological models are often used for this purpose; however, they have embedded assumptions that translate into uncertain hydrological projections. Such uncertainties need to be quantified and constrained (as possible) to provide reliable projections. The purpose of this study is to evaluate differences in projected changes to streamflow volume timing by the end of the century between a new empirical model based on diel (daily) streamflow cycles and regional land-surface simulations across the mountainous western US."

Additionally, we have added the following to the Introduction section (lines 106-110):

"However, it remains unknown whether information embedded in the diel streamflow response following snowmelt events can be used to inform streamflow predictions due to climate change, and whether such projections are consistent with current land-surface simulations. The purpose of this research is to evaluate potential differences in projected changes to streamflow volume timing by the end of the century between a new empirical diel streamflow-based model and regional land-surface simulations across mountainous western US headwater catchments"

We believe that clarifies the main purpose of the study.

Minor details:
Abstract should be stand alone and understandable by someone who has not read the whole paper. This is not true right now. Please, for greater impact, rewrite the abstract.

We have changed the abstract significantly to make both the main goal and methods clearer.

line 23: space-for-time substitution used in abstract but not defined — please clarify what you mean by this. I recommend not even using that term but instead just write out what specifically you are trying to do.

As suggested, we are dropping the term space-for-time and now using "empirical diel streamflow-based model".

Line 66 on: explanation of space for time is still confusing. Here, what is space and what is time. I think you mean that you assume that warmer locations today represent currently cooler locations tomorrow, is that right? Please clarify.

That is correct, and we have changed the sentence to read as followed (lines 73-80) to avoid further confusions:

"Empirical models assume that long-term and often site-to-site statistical relationships among predicting variables (e.g., precipitation and air temperature) and water fluxes (e.g., evapotranspiration and streamflow) can be used to understand and model their likely changes over time or space. Empirical models used to predict changes over time (sometimes referred to space-for-time substitutions) have been used in fields such as hydrology (Goulden and Bales, 2014; Jepsen et al., 2018; Sivapalan et al., 2011), biodiversity (Blois et al., 2013) and tree growth (Klesse et al., 2020) to predict responses to climate change. Such models use information from different places ("space"), typically spanning a wide range of conditions (e.g., climate gradient), to predict changes over time. For example, observed characteristics from warm regions maybe used to infer future changes in cold regions due to global warming."

line 93: "driven by either snow or ice melt and evapotranspiration " I think you need to switch the "or" and the "and" in that sentence.

We have changed the "or" to "and" as suggested by the reviewer.

Line 188: still very confusing use of space for time. Just say what part of the regression equation you're changing. The temperature and precip inputs? Something else?

We have dropped the space-for-time terminology and clarify what we mean about or DOS20 predictions. Please see changes in lines 194-195, where we specify that:

"The MLR model is the basis of our empirical diel streamflow-based model, which is used to assess changes in DOS20 due to climate change (i.e., changes in x1, x2, x3 and x4 in Eq. (1))."

References:

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