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Discussions

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Interactive comment on "Future Snow? A Spatial-Probabilistic Assessment of the Extraordinarily Low Snowpacks of 2014 and 2015 in the Oregon Cascades" *by* E. A. Sproles et al.

Anonymous Referee #1

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This paper is an interesting and detailed look, using modeling, at the snow volume in two recent years in a small (3000 km2) river basin in the western Oregon Cascade mountain range. The most interesting finding may be that there was virtually no snow below about 1300m in 2015, yet this finding is buried in the discussion. It should be highlighted in the abstract.

big picture issues

1) Selecting 2014, 2015, and a notional year that is 2°C warmer than a 30-year "normal" presents a muddled message. In some places, 2014 is presented as being exceptional (e.g. page 1 lines 23-24); but in other places, it does not seem so exceptional (e.g. page 7 line 2 and the caption of Figure 3). It is a little puzzling why the EP would

be shown (Fig 3) for the +2°C world but not the 30-year normal. I don't know how to un-muddle this message.

2) The paper is fairly rife with unsubstantiated assertions. I mention several below.

3) spatial domain. much of the introduction refers to western US or PNW, and only on page 4 do we learn that the study area is actually a small (∼3000 km2) sub-watershed of the Willamette River Basin, and it is there asserted (without evidence) that the McKenzie River Basin is 'characteristic for maritime snow in the Pacific Northwest'. The abstract should make clear where the study was conducted, and either the attempts to relate this to the PNW should be dropped or some additional analysis should be conducted. I'm not suggesting repeating the full detailed analysis on a wider domain, but the interesting finding that there was essentially no snow below 1300m in 2015 should be easy to check with SNOTEL sites throughout the Cascades (perhaps with a latitude-elevation adjustment).

minutia:

word choice: snow volume is variously called snow water storage, snowpack storage, and just snowpack. I suggest picking a single term and using it consistently.

page 2 lines 7-9: assertions about impacts need references.

page 2 line 16 no definition of 'critical' fits this usage - the word is often, as here, misused in place of 'critically important' or just 'important'.

page 3 lines 2-3 why not? do you have evidence to back up this assertion?

page 3 lines 11-13 i don't follow the argument here. these deterministic approaches can also be (and have been) used to simulte past and future. the sentence seems to be arguing that "not analogous" is a weakness, but it's not clear why that's a weakness. likewise, the last sentence in the paragraph returns to the notion of limitations but it's not clear why. and in lines 22-23 again, it's not clear whether this assertion is also a criticism of the deterministic approach (i.e. "Only an analog approach...) I

suggest retooling the paragraphs on lines 9-29 (and possibly the next paragraph too) to better set up the strengths and weaknesses of deterministic modeling and analog approaches. Or just drop entirely.

page 3 line 34 - again, not clear whether this paragraph is describing strengths and weaknesses. the first two sentences are about analogs, but are the models referenced on line 34 the standard deterministic distributed models? Given the last 1+ page of the introduction, I was surprised to find that the paper uses a physically based snow hydrology model instead of analogs.

page 4 lines 13-14: another unsubstantiated assertion.

Page 4 line 28 "most SWE" clarify "per unit area" if that is what's meant

page 4 lines 30-32 these are really valuable and interesting comparisons. Need a source for the reservoir storage statement.

page 5 line 20-22: just call it a sensitivity test. Mote & Salathé is dated (CMIP3 vs CMIP5; see e.g. Dalton et al., Island Press 2013) and the link to IPCC is dubious, since the number discussed in the 2013 IPCC report was not exactly a "threshold set" and moreover is a global number not regional.

page 6 lines 3-10 no rationale is given for this re-dimensionalizing. Perhaps if the meaning of "spatial exceedance probability" was clear.

page 6 lines 4-5 number agreement "dimensions...has" - maybe just delete "the dimensions of"

page 7 line 11 - "is greatest" for the +2°C case. Figs 4 and 5 - these are a crucial point of the paper and perhaps its main contribution. can you comment on the strengths and weaknesses of the observing network in this elevation band? is it adequate? is there evidence that these findings apply outside MRB?

page 7 line 19 - what does "subsequent runoff" mean? wouldn't snowfall also produce

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"subsequent runoff" - just much later? is the subtext that snowmelt contributes more to groundwater recharge than rainfall does?

page 7 line 22 "below until an elevation" - perhaps an extra word in here?

page 7 lines 25-26 and possibly elsewhere: "From February-May" an em dash should not stand in for the preposition "to"

page 7 lines 29-30 - again, make it clear that this is only for the MRB. "the region" should be clarified. Without further analysis outside MRB, it's mere speculation to extend these results to a wider region like the Cascades or the Northwest.

page 8 line 5 "below normal compared with historical average conditions" - could just say "below historical average conditions" unless normal means something other than historical averages, in which case specify

Figures

Figure 2 - bar charts are a difficult way to present this kind of information, and using cumulative precipitation pegs the y-axis at large values, rendering the monthly values harder to distinguish. I suggest replacing the bar charts with something more intuitive like connected line segments with symbols, and also reporting the N-M and DJF values with monthly means instead of cumulative.

Figure 3 - add the EP for the normal. Also I'm not a big fan of the format, showing the 2014 and 2015 values as horizontal lines - it's a lot of ink to convey very little information. I suggest showing just one panel with the EP curves (+0 and +2°C, perhaps for April), and replace the 6 panels with another time series showing the 2014 and 2015 snowpack, and the EP percentiles.

Figures 3, 4, 6 - are these monthly averages or first-of-month?

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