



EGUsphere, referee comment RC1
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Comment on egusphere-2022-1186

Anonymous Referee #1

Referee comment on "Simulated hydrological effects of grooming and snowmaking in a ski resort on the local water balance" by Samuel Morin et al., EGU Sphere,
<https://doi.org/10.5194/egusphere-2022-1186-RC1>, 2022

General comments:

The paper addresses a relevant scientific question which is within the scope of HESS. It is attempted to quantify the effect of grooming and technical snow production on the water balance components in a Northern French skiing area by means of a combined physically based modelling experiment. In this comparably narrow scientific field the study is probably the first of its type and it does present novel ideas and data.

In general, this is a very valuable and novel contribution in this field. It could however profit from a sound explanation of the choice of the presented methodology.

The original approach of the coupled models has obviously been developed for large scale applications, but is applied here at the local scale of a single ski resort. This resulting scale gap requires several regionalization steps and assumptions which might be the cause for manifold uncertainties. A sound argumentation should be presented why concepts are chosen like „gravitational envelopes“, „Ski resorts Representative Units“ or „SAFRAN altitude bands ...“ (and adopted from the Vanoise massif, some distance away). The spatial units are „intersected“ by the ski pistes with or without their snowmaking equipment (requiring water fluxes scaling afterwards), and/or „crossed“ by the slopes. Even though the original literature where these concepts are described is presented, it mostly remains unclear why the given set of methods is appropriate, and why not a method is applied which uses local measurements and reproduces the water fluxes at the local scale.

The results indicate that the hydrological effect of grooming/snowmaking is small. To which degree are these results caused by uncertainties of the CROCUS simulations? This question arises since for the latter a set of assumptions is applied which significantly might affect the magnitude and timing of the computed water fluxes (mainly with regard to

snowmaking practice, initial water loss and available water amount). Another source of uncertainty is probably the model forcing at the SRU scale, since the chosen method does not account for the conditions at the location of the snow guns and lances. Ski resorts applying technical snowmaking usually monitor and save the available water storage volume and fluxes used for the snow production, so this data should be available.

Two catchments are introduced, one of which is ungauged and requires a spatial transfer method, and generally „information on hydrology is rather sparse“. Hence, several simplifying hypotheses are formulated. Is it possible to evaluate the effect of these hypotheses at the local scale where measurements are available? If the approach remains „purely empirical“: could it be replaced by a much simpler, but easier to understand estimation?

The overall presentation of the paper is well structured and the authors give proper credits to related work. The abstract would benefit from a more complete presentation of the most important results. The choice and number of references is adequate.

Specific comments:

- some terms used are not very common in hydrology (e.g. „disturbances“, „disruption“, „behaviour“, „alteration“). I recommend to change the title accordingly, and also choose other terms in the text

- the analysis of the climate change effects is of limited explanatory power, since only climate is considered. However, many other influencing factors - hard to predict, though - will change and develop in parallel to the climate. It is not so clear if the conciseness of the paper profits from this section

- „water reaching the soil“: to which degree is this a suitable hydrological variable for hydrological change? It can affect streamflow amount and timing at the catchment outlet in very different ways, depending on the hydrological characteristics of the catchment. Maybe one could still add a simple consideration to relate water amounts to streamflow regime, as announced in the text?

- is mechanical stress caused by the skiers and its effect on the snow surface considered in the simulations?

- does SAFRAN provide humidity? How is wet bulb temperature derived?

- technical snow is rather different than natural snow. On the slopes with snowmaking, a mixture of the two develops over the season with varying composition and hence changing physical properties at the surface. Does CROCUS account for that?

Technical corrections:

- figures should be larger

- the English language could profit from correction by a native speaker (mainly: uses of articles, and singular/plural)

- better explain the basic functioning of HydroDem explicitly, rather than referencing another software (TauDem)

Congratulation to this work and valuable contribution! I hope my comments support the further improvement of the manuscript.