

# ***Interactive comment on “Suitability Analysis of Ski Areas in China: An Integrated Study Based on Natural and Socioeconomic Conditions” by Jie Deng et al.***

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This review commentary will build on the insightful comments of Carlo Maria Carmagnola and not repeat the questions and suggested areas of revision previously identified.

The objective of the analysis is clear and builds on a similar type of analysis in a much smaller study area of the United States that is characterized by very different climateology (particularly natural snow resources).

The approach to include both natural conditions and the socioeconomic factors that can influence the feasibility and competitiveness of ski area operations is essential.

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The selection of indicators and how they are operationalized (including data sources) is well explained.

There are two important limitations to the study as currently conducted: First, the equal weighting of the indicators is problematic. The set of indicators are not equal, as some are essential (must be achieved) and others are useful to improve competitiveness or a higher quality ski experience. Consultation with industry stakeholders in China could have been used to determine which indicators are essential to business operations and profitability. Expert weightings could also have been used. For example, without sufficient cold temperatures and water supply for snowmaking, ski operations are not feasible in most of China (which has a dry season in winter and very limited natural snow). Other natural and socio-economic factors cannot overcome the inability to produce and maintain a reliable, quality snowpack at operational depths.

Second, while the range of indicators included is a strength of the study, some of the indicators used are problematic. The study should consult Steiger et al (2017) for a summary of limitations of studies in the literature that result in the mis-representation of climate variability/climate change risks for the ski industry. This study suffers from two of these limitations: (1) the use of inappropriate performance indicators and (2) the lack of an indicator that accurately represents the combined natural-technical snowpack, and therefore does not represent the current operational realities of ski areas in China.

The paper states that, “Therefore, in this study, an SCD [snow cover day] larger than 100 days is taken as the optimal value.” Snow cover days are not a suitable indicator of ski seasons. Snow cover is measured as 1 inch/2.5cm and is not sufficient for ski operations, and therefore provides no meaningful information on whether skiable conditions were present on a day with ‘snow cover’.

The indicator needed to define a ski season is how many days with sufficient snow depth for ski operations (usually a minimum of 30 cm is used in the literature, but this varies based on terrain). In every regional market in the world, this operational depth

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must be calculated as the combined snowpack of natural snow and machine-made snow, because there is no regional market where at least some ski areas / ski terrain utilizes snowmaking. This is particularly the case in China, much of which has a dry winter climate

The study identifies a snow depth threshold that is common in the literature, but provides no measure of how many days this threshold is achieved with natural snow, because “small-scale snow properties ( $\sim 1$  km) cannot be obtained due to the low resolution of passive microwave products.” Furthermore, the study does not physically model the snowpack with snowmaking, but rather uses proxies of potential snowmaking days.

It is not clear what is meant in the statement that, “Therefore, SD is only taken as a reference for the index of snow cover.” However, as indicated, snow cover is not a meaningful indicator for ski area operations and cannot be used as a proxy for operational snow depth. Because the study does not provide a robust and meaningful analysis of snow resources (natural or with the additional capacity of snowmaking) that are fundamental to ski operations, publication cannot be recommended.

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Interactive comment on The Cryosphere Discuss., <https://doi.org/10.5194/tc-2019-43>, 2019.

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