



The impact of climate change on the skiing tourism industry

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Skiing tourism has been repeatedly identified as an economic sector being highly vulnerable to the impacts of climate change. Skiing is the number one touristic product in the winter season in the research area of the Tyrol (Austria/Italy). Tourists' expenses are approximately € 5 billion per season thus marking skiing tourism as an important economic sector not only on the local but also on the provincial level.

The sector's response to marginal snow seasons especially at the end of the 1980s and in 2006/07 was investing in snowmaking to reduce their business risk. But previous climate change impact studies in Europe so far did not incorporate snowmaking as a potential adaptation strategy thus reducing the validity of the assessments of the future of skiing tourism considering that about 75 % of all ski slopes in the Tyrol are equipped with snowmaking facilities. Increasing temperatures will increase the need for technically produced snow as less natural snow will be available at low and mid altitude. On the other hand, snow production will be hampered as sufficiently cool temperatures will be less frequent in a warmer climate.

In order to assess the sustainability of skiing tourism in a warmer climate, a ski season simulation model "SkiSim 2.0" was developed and applied to 111 ski areas in the Tyrol. Climate change signals of the regional climate model REMO driven by two emission scenarios (B1 and A1B) were downscaled to the climate stations using a stochastic weather generator ("LARS-WG"). SkiSim 2.0 results were produced for each decade from the 2020s to the 2080s. Assuming the current snowmaking technology to remain unchanged, the modelled changes of ski season length were further processed into a snow reliability classification scheme to differentiate between different degrees of impact. Ski areas being the first and most affected are located in the northern and southernmost part of the research area. From an economic point of view this is particularly problematic as a number of large, internationally renowned ski resorts are among the "early losers" and the corresponding municipalities are highly dependent on winter tourism.

But, as a further technical development of snowmaking is likely in the future, the capacity of ski areas to cope with greatly rising snowmaking costs is another important factor besides climatic issues. Economic thresholds of snowmaking might be reached sooner than climatic thresholds, thus a further analysis of the development of snowmaking costs was undertaken.

Snowmaking costs are projected to double in 16 % of the ski areas by 2030 and in 41 % by 2050. At the end of the century 47 % of the ski areas have at least tripled snowmaking costs. Thus the contraction of the skiing industry that has already begun in many parts of Europe and Northern America is likely to have a significant impact on tourism destinations in the Tyrol. By using the snow reliability classification scheme, projected increases of snowmaking costs and the dependency of municipalities on winter tourism, areas where the continuation of skiing tourism is at risk and the need for a restructuring of the tourism product is greatest can be identified.