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Water losses during technical snow production

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These days, the production of technical snow can be seen as a prerequisite for winter tourism. Huge amounts of water are used for technical snow production by ski resorts, especially in the beginning of the winter season. The aim is to guarantee an appropriate amount of snow to reliably provide optimal ski runs until the date of season opening in early December. Technical snow is generated by pumping pressurized water through the nozzles of a snow machine and dispersing the resulting spray of small water droplets which freeze during their travel to the ground. Cooling and freezing of the droplets can only happen if energy is emitted to the air mass surrounding the droplets. This heat transfer is happening through convective cooling and though evaporation and sublimation of water droplets and ice particles. This means that also mass is lost from the droplets and added in form of vapor to the air. It is important to note that not all water that is pumped through the snow machine is converted to snow distributed on the ground. Significant amounts of water are lost due to wind drift, sublimation and evaporation while droplets are traveling through the air or to draining of water which is not fully frozen when arriving at the ground. Studies addressing this question are sparse and the quantity of the water losses is still unclear. In order to assess this question in more detail, we obtained several systematic field observations at a test site near Davos, Switzerland. About a dozen of snow making tests had been performed during the last winter seasons. We compare the amount of water measured at the intake of the snow machine with the amount of snow accumulating at the ground during a night of snow production. The snow mass was calculated from highly detailed repeated terrestrial laser scanning measurements in combination with manually gathered snow densities. In addition a meteorological station had been set up in the vicinity observing all relevant meteorological parameters. Results indicate water losses in the range of 15 to 40% which is similar as found during observations in France. We also try to link water losses to weather conditions and machine settings. This data set can finally help to improve the understanding of mass and heat transfer of technical snow making and could be used to validate snow making models.