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# Influence of snow melting surrounding an RFID tag

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Passive RFID tags are increasingly used outdoor, for example for geoscience monitoring applications [1]. In temperate areas, tags must simply deal with variations of snow cover and temperature [2]. But in cold areas, tags can end up buried under a snowpack or simply be covered with a layer of snow. The snowpack can reduce the ability to read the tags [3], to localize tags [5], or to use tags as contactless snow sensors [4]. A deeper understanding of the snow influence is required to enable reliable usage of RFID tags in snowy areas.

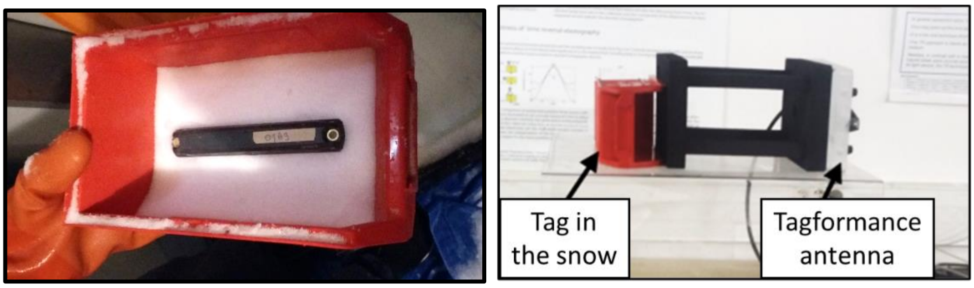


Figure 1. (a) tag placed on the dry snow before being covered; (b) picture of setup with the tag in the snow interrogated by the Tagformance system;

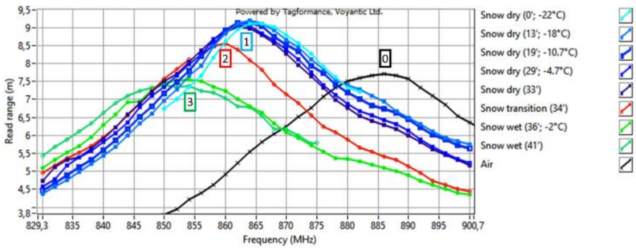


**Figure 2.** Estimated read range of the tag depending on the frequency in different materials. (0, in black) the tag is in the box without snow. (1, in blue) the snow remains dry; (2, in red) the snow operates a rapid transition; (3, in green) the snow becomes wet.

A battery-assisted passive RFID tag is placed in a box of dry snow which progressively melts. The experiment consists in placing a tag in a box containing dry snow (initially at -30°C), and to let the snow progressively melts, heated by the room (at 20°C). Meanwhile, every two minutes, the tagformance system sweeped between different transmit power and frequencies (800–900 MHz). A standard reader (Impinj SR420) also read the tag's temperature sensor every 10 minutes.

As a result, we observe a detuning of –20 MHz and –35 MHz respectively in dry (500kg/m$^3$ density) and wet snow (5% volume liquid water content), compared to the tag in the air.

## References

[1] M. Le Breton, F. Liébault, L. Baillet, A. Charléty, É. Larose, and S. Tedjini, “Dense and long-term monitoring of earth surface processes with passive RFID — a review,” Earth-Science Reviews, vol. 234, p. 104225, Nov. 2022, doi: 10.1016/j.earscirev.2022.104225.

[2] M. Le Breton et al., “Outdoor UHF RFID: Phase Stabilization for Real-World Applications,” IEEE Journal of Radio Frequency Identification, vol. 1, no. 4, pp. 279–290, Dec. 2017, doi: 10.1109/JRFID.2017.2786745.

[3] J. Nummela, L. Ukkonen, and L. Sydänheimo, “Passive UHF RFID tags in arctic environment,” International Journal of Communications, vol. 2, no. 1, pp. 135–142, 2008.

[4] M. Le Breton, É. Larose, L. Baillet, Y. Lejeune, and A. van Herwijnen, “Monitoring snowpack SWE and temperature using RFID tags as wireless sensors.” EGUSphere, Aug. 22, 2022. doi: 10.5194/egusphere-2022-761.

[5] M. Le Breton et al., “Passive radio-frequency identification ranging, a dense and weather-robust technique for landslide displacement monitoring,” Engineering Geology, vol. 250, pp. 1–10, Feb. 2019, doi: 10.1016/j.enggeo.2018.12.027.