The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC2
https://doi.org/10.5194/tc-2021-163-RC2, 2021

Comment on tc-2021-163

Charles Fierz (Referee)

Referee comment on "Review article: Performance assessment of radiation-based field sensors for monitoring the water equivalent of snow cover (SWE)" by Alain Royer et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-163-RC2, 2021

General comments

This paper presents an assessment of methods to measure autonomously and continuously the water equivalent of snow cover. The presented data (one winter each on two sites) are augmented by a wealth of already published data, including own ones. This allows for a thorough analysis of pros and cons of these instruments that are increasingly used worldwide. Furthermore, an emerging, truly low-cost method based on FMCW radar is presented. These two last points form the major strength of the paper while I cannot really call it a 'review'.

On the other hand, it is sometimes difficult to find out whether the authors speak about their own data or data taken from the literature. This ambiguity is one of the major drawback of this contribution, that also reflects itself in a poor structure of Section 3 (see comments below). Another major problem is the 'classification' of the Cosmic Ray Neutron Probe as an 'electromagnetic wave-based field sensor'. With that respect the authors are required to make necessary corrections throughout the text. Furthermore, the author should eliminate quite a number of weaknesses I address below and in the manuscript. This to make the paper less ambiguous and easier to read, thereby increasing its value for the community.

In summary I recommend accepting the paper after the authors addressed the issues below and consider the revisions as suggested in the annotated manuscript.

Specific comments

- Title:
  In view of my general comments and because CRNP is not based on EM waves, I would suggest to change the title to, "**Performance of autonomous field sensors for continuously monitoring the water equivalent of snow cover (SWE)**"
- Line 25: '*relatively low cost'*
  In Table 3, cost is named as a drawback for at least three instruments! I would also argue it is a matter of appreciation whether one considers USD 10 000.- to be '*low-cost*'. I would thus propose to drop this argument, at least in the abstract, the introduction, and the conclusions.
- Line 40: '*kg* m^{-2}*, or in mm*'
  You nicely define water equivalent of snow cover as 'its mass per unit area'. Why then use mm as a unit? I would prefer by much seeing only kg m^{-2} throughout the paper.
- Line 50: '*reliable and automatic instrument alternatives exist*'
  This is questionable. At least I could not find corresponding evidences in the references provided.
- Section 4:
  Consider shortening the last paragraph (lines 367-376) or moving it to the introduction as it is not further considered in the paper.
- Lines 533-534: '*winter period, uncertainty can be introduced by well-known local SWE spatial variability that can occur at fine scales around the sensors.*'
  I would argue this variability is less present in bulk snow density. Thus a comparison of SWE recomputed with regard to one reference snow depth may have been beneficial.
- Line 653:
  clearly, in your own words, CRNP is NOT EM wave!

Comments on structure

- Section 3 is quite difficult to follow and not free of ambiguities. I'd suggest the following to improve its readability:
  Rename Section 3 as '*Results*' and start with a description of both sites (Sub-section 3.1). Adding a figure showing the location of the instruments at each site as well as a summarizing table would extremely helpful.
  Then Section 3.2 would become '*Validation of measurements*' with separate sub-sections on SIRENE and Neige-FM. 3.3 '*Uncertainty of measurements*' would end Section 3.

Comments on terminology

- *'snow water equivalent'*:
  Consider switching to "**water equivalent of snow cover**" as defined by WMO (for example, see WMO 2018): Guide to instruments and methods of observation: Volume II - Measurement of Cryospheric Variables, 2018th ed., edited by: WMO, World Meteorological Organization, Geneva, Switzerland, 52 pp., 2018.)
- '*accuracy*':
  Consider switching to "**uncertainty**", see the VIM https://jcgm.bipm.org/vim/en/index.html or https://jcgm.bipm.org/vim/fr/index.html

- 'CNRP' (see line 23):
  Please correct to "**CRNP**" throughout the text.
- 'GNSS' (used 16 times) vs 'GNSSR' (used 34 times):
  The distinction between 'GNSS', that is the satellite system, and 'GNSSR', that is the instrument used, is sometimes misleading in the text. Also note that GNSSR can easily be misunderstood as GNSS reflectometry. Thus I'd suggest the following: on lines 24-25 and 67 write, "**Global Navigation Satellite System receiver(s) (GNSSr)**". Using GNSS alone later should then be clear too.

Please also note the supplement to this comment:
https://tc.copernicus.org/preprints/tc-2021-163/tc-2021-163-RC2-supplement.pdf