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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Deriving surface soil moisture from reflected GNSS signal observations from a grassland site in southwestern France" *by* Sibo Zhang et al.

Anonymous Referee #1

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General comments: The authors utilize a geodetic-quality GNSS antenna (AR10 type) in a meadow to test out a soil moisture retrieval algorithm under different stages of natural grass cover growth. They find that their retrieval algorithm performs well and retrieves soil moisture compared to in situ with an RMSE less than 0.04 cm3 cm-3. They compare their results to a 'benchmark' algorithm and find that their algorithm performs better. They also vary the height of the antenna to see if antenna height affects their results, and they also look at the effects from changing the sampling rate. They find that antenna height does not affect their retrievals, but sampling rate does.

Overall, there are two major short comings of this study that must be addressed: *First,

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the 'benchmark' algorithm that the authors compare their own retrievals to should NOT be used for this type of antenna. The benchmark algorithm developed in Chew et al. (2016) was created solely for the antennas used in the Plate Boundary Observatory network (Trimble antennas). It is well known that the algorithm would need to be calibrated for use with a different antenna type. The authors should remove the portion of the paper (figures and text) that compare their algorithm to that from Chew et al. (2016). This is a significant portion of the text and dicussion that should be removed, but the paper is still worthwhile without it. *Second, the fact that the authors' retrieval algorithm requires having in situ observations of maximum and minimum soil moisture (Eq. 3) detracts significantly from the usefulness of the algorithm. Of course their algorithm produces soil moisture retrievals within the bounds of the in situ probes–it is effectively scaled by the in situ observations. Furthermore, the authors state that they need min/max in situ observations from both vegetation growth and senescence periods, which then means that they need ancillary vegetation information in order for their algorithm to work. If you need vegetation data and in situ soil moisture probes in order for your algorithm to work, why use GNSS-IR at all? The authors should spend some time re-working their algorithm so that they don't need in situ soil moisture information.

If the authors can address the above two comments, then the paper will be technically correct and will make a more worthwhile contribution to the field of GNSS-IR in general. I know that these are harsh criticisms, and I don't want the authors/editors to think that I don't like the paper–overall, I enjoyed reading it. It is well organized and clearly written. I think reporting their retrieval results is worthwhile, and removing the comparison with the benchmark algorithm will not detract from the paper.

Specific comments: Page 2, line 5: You should make it clear that GNSS-IR is not used for spaceborne applications, as you reference in the Camps et al. (2008) paper. The spaceborne technique is very different from GNSS-IR.

Page 8, line 9: Isn't another way of saying this, is that the sensing depth of GNSS-IR is less than 5 cm? This has been found in previous studies for GNSS-IR (Chew et al.,

2014) and for L-band microwave remote sensing in general (Shellito et al., 2016, GRL).

The comparison with the land surface model is a bit rushed and perhaps not needed. As you know, there are a variety of different land surface models, each with their own parameterizations of the land surface. There aren't enough details provided about the land surface model for readers to understand its advantages and shortcomings. Was it parameterized for this particular field? What is the spatial resolution of the model? The authors do not spend much time with comparing their results to the model output, so it would be easy to remove this part of the paper.

With regards to the sampling rate discussion–are you not just exploring effects of sampling lower than the required Nyquist sampling frequency for a given antenna height?

Technical corrections: Figure 2 needs a second y-axis for Anorm. I understand they are scaled between 0-1 just like you have your biomass values, but it's a bit confusing without an extra label.

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