

The Cryosphere Discuss., referee comment RC2
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Comment on tc-2021-369

Anonymous Referee #2

Referee comment on "A Novel Global Freeze-Thaw State Detection Algorithm Based on Passive L-Band Microwave Remote Sensing" by Shaoning Lv et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-369-RC2>, 2022

Review on A novel global freeze-thaw state detection algorithm based on passive L-band microwave remote sensing, by Lv et al., (tc-2021-369).

This paper used Diurnal Amplitude Variation (DAV) to detect the landscape FT status over Northern hemisphere using SMAP L-band H-pol brightness temperatures. The performance of the FT classification was assessed using ERA5 2m air temperature and other global SMAP FT data records. The paper covers a topic that is suitable to readers of The Cryosphere and should be of particular interest to those interested in FT classification algorithm development and FT dynamics under climate change. However, the manuscript has concluded with lack of detail in describing method and FT classification algorithm, and insufficient FT agreement assessment. Additional analysis on relationship between L-band signal and soil temperature should be added to improve the conclusion (See "line 329-331" below). The suggested major revisions are as follows:

- Major concern is FT agreement assessment. Authors used air and skin temperatures, and soil temperatures at several depths from a single site (Xilinhot). Agreement assessment from only one site is not enough for global scale FT validation. FT sensitivity to L-band Tb signal varies on land cover type and climate regions.

- In the accuracy agreement at global domain, ERA5 is a model reanalysis data with uncertainty as well. Authors should include additional global FT agreement assessment instead of using only ERA5 data.

- Additional analysis on relationship between L-band signal (FT dynamics as well) and soil temperature should be added to improve the conclusion. That would be the possible reason why L-band microwave remote sensing can be used for better penetration depth

monitoring.

- Although this study provided better overall FT classification accuracy, it is not clear that what factors (or which land cover type?) contribute to improve FT classification accuracy or degrade. Other landscape factors affect FT classification accuracy. The factors include sub-grid open water fraction, terrain heterogeneity, tree cover, precipitation and snowmelt and on. To improve the quality of the paper, additional analysis and discussion on this should be required.

Additional edits are noted below:

Line 66: Are the limitations not clearly described? Authors should include what the limitations are in more details.

Line 72-74: This is not clear to me. Author should clarify it.

Line 87: Authors should justify why you used 36km instead of 9km brightness temperature (Tb) data records. Indeed, SMAP data are provided at both 36-km and 9-km spatial resolution. The 9-km spatial resolution is closer to 0.1 degree ERA5.

Line 89: This study used older version of SMAP data.

Line 92, 98: ERA5 data provide hourly. What time did authors use for agreement assessment? Is it 6PM or 6AM? Authors should include data source (e.g., web link).

Line 118-123: The relevant citation should be included (Xu?, Derksen? Kim?).

Line 134: Surface air temperature from global weather stations were used for landscape FT classification accuracy assessment, not for validation. Authors should check and revise it.

Line 165: Why did you use H-pol? Is there any justification?

Line 178-179: Is this your assumption?

Line 212: Authors should include in-situ data description in Data sections (e.g., relevant references, data source (web site)).

Line 222: Figure 4 does not show soil moisture variations. How did you provide the influence of soil moisture on Tb? If it is soil moisture influence, how much variation in soil moisture?

Line 263: The geographic location of Xilinhot site should be provided to check if this site is within a domain applied to SCV algorithm in SMAP FT Prpdocuts.

Line 286: SMAP FT sate products were compared new FT data. Authors should provide more details on SMAP FT state products used in this validation. Which overpass time did you use? (e.g., 6am or 6pm?).

Line 293: Authors compared two FT state data with different spatial resolution. You should include how to reproject one data from another in method sections. Is it from 0.1 degree to 36km?

Line 296: Why was it worse in latitudes above 60N and low latitudes below 30N? Is it false frozen or thawing? What if you use skin or/and soil temperature? Could it be a better agreement?

Line 324: Some studies reported the results on FT accuracy assessment with soil temperature derived FT state. Authors should discuss the results from previous studies.

Line 329-331: Because you did not use soil temperature (indeed, soil temperature from one site only), this statement is not clear conclusion.

Line338: Is spatial resolution of ERA5 1degree? In data section, the resolution is 0.1 degree.

Figure 1: It would be great to include the latitude/longitude of Xilinhot site.

Figure 3: It is too complicated. Author could remove unnecessary time-series lines.

Figure 4: Where (or what) is Maqu?

Figure 5: Authors should describe study domain in details. E.g., how to define your domain?