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Review

This article is novel in its approach to coping with the difficult problem of separating surface water from (possibly wet) vegetated land in a small catchment of 2770 sq.km in the Prairie Pothole Region in North America. The data to make the scheme feasible was obtained from the orbiting satellite Sentinal-1A, at a resolution of about 20m, sampled during the summer and autumn months, so were not blanketed by snow. The authors developed the tools to obtain valid images to work from.

The text is very well laid out and informative – there are only a few places that need repair and I am glad to say that I read every word so that [perhaps not to the authors' taste] I made some very minor alterations, where I deemed necessary. The math is well set out, but I would like the equations inset from the margins; however that's a minor issue of layout. The Figures are good and easy to understand. Regretfully some of them are placed up to 3 pages away from their first mention, which is irritating. There is however the odd glitch, like Fig. 9, where the caption and label are in in hectares, and the image legends are in sq m!! Fortunately, I could not find any others.

I judge that this paper is worth publishing after repair, so recommend minor corrections. I am returning the version of the paper that I have marked up, attached to this review. In addition, I will import the more substantial of my remarks to be listed below my signature, which is my wont.

Geoff Pegram

18 August 2021

Dear Geoff,

We would like to thank you for your helpful comments. We absolutely agree with the observation that some of the figures and Table 1 are placed too far away from their first mention. This may also be a result of the fact that we may not have fully exploited the Latex options for placing the figures and so much of the placement was actually done automatically. We will change this in the revised version (final version will anyhow have different 2-column layout).

We are responding to your individual comments below in red.

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Comments, line-by-line from the article, followed by # and my suggestions

Abstract. The North American Prairie Pothole Region (PPR) represents a large system of wetlands with great importance for biodiversity, water storage and flood management. Knowledge of seasonal and inter-annual surface water dynamics in the PPR is important for understanding the functionality of these wetland ecosystems and the changing degree of hydrologic connectivity between them.

# Try and make this more interesting so that, although it is informative as an introduction, please make your abstract (or intro) more descriptive - Wiki's description is a good springboard – your paper is not overlong:

“The Prairie Pothole Region (PPR) is an expansive area of the northern Great Plains that contains thousands of shallow wetlands known as potholes. These potholes are the result of glacier activity in the Wisconsin glaciation, which ended about 10,000 years ago. The decaying ice sheet left behind depressions formed by the uneven deposition of till in ground moraines. These depressions are called potholes, glacial potholes, kettles, or kettle lakes. They fill with water in the spring, creating wetlands, which range in duration from temporary to semi-permanent. The region covers an area of about 800,000 sq. km and expands across three Canadian provinces (Saskatchewan, Manitoba, and Alberta) and five U.S. states (Minnesota, Iowa, North and South Dakota, and Montana). The hydrology of the wetlands is variable, which results in long term productivity and biodiversity. The PPR is a prime spot during breeding and nesting season for millions of migrating waterfowl. [Wikipedia]”

Two other reviewers suggested substantial shortening of the abstract but we are happy to use your ideas for the introduction. We suggest to change Line 36 to 40 to the following (changes highlighted in yellow):

“The Prairie Pothole Region (PPR) of North America covers an area of over 780,000 km² in the Great Plains of the Northern USA and Southern Canada. The region is characterised by millions of shallow depressions formed during glacier retreat at the end of the last glacial period, when glacial till was unevenly deposited in ground moraines. These depressions contain ~~open water bodies~~ wetlands whose areas vary between one square metre and several square kilometres. They can store considerable amounts of water during rainfall events, which contributes to flood mitigation in downstream populated areas (Huang et al., 2011b). The wetlands 40 of the region are of great importance for the waterfowl population of North America (Mitsch and Gosselink, 2000).”

In turn, we will remove a repetition of the above in Line 129.

27….. due to the rather low temporal resolution of 12 days over the PPR.

# You make this point later on in the text (lines 97, 155, 451 & 473) but the reader is left unsure as to whether this data is sampled 12 days apart, or averaged over that interval

For this part of the PPR, the Sentinel-1 observation scenario foresees only acquisitions using the second satellite of the pair (Sentinel-1B), hence new imagery is acquired only every 12 days, not every 6 days as would be the case if both satellites were acquiring data. We will change “low temporal resolution” to “long acquisition interval” to clarify this.

90 attention, as co and cross-polarised data

# Unsure what 'co' means. Aha! found it on the web - does it make sense? :- "Co-polarization is the antenna's radiation in your desired directions. Whereas cross-polarization is the antenna's radiation in the unwanted directions, i.e the cross-polar is basically considered as a dissipation in antenna radiation."

We suggest to change this sentence as follows to explain these terms: “In particular, the analysis of polarimetric SAR data has received attention as data acquired using different polarisations for sending and receiving (cross-polarised data) respond differently to scattering mechanisms, such as surface and volume scattering, than co-polarised data (same polarisation used for sending and receiving).“

184: composites of the images are shown in Appendix A (Fig. A1).

# Fig. A1 is lonely in an appendix, but informative - I recommend your replanting it about here; there's enough room for it in this medium sized paper

Our idea behind placing this figure in the appendix was due to a) the paper already has 10 figures in the main text, and b) in our opinion, the exact distribution of the sample dots over the images does not add much information that the reader needs to understand the approach. As an alternative to placing the entire figure in the main text, we could show the footprints of the aerial images in Figure 2 and add a reference to it in section 2.2.4. In response to the comment of another reviewer, we suggested adding another figure to the Appendix, so A1 would not be lonely any longer…

225: …… D = p2|µ1 −µ2| _2 1 +_2 2 ,……. (1)

# For easier readability, please indent your 7 equations at both ends

We agree but the text was set using the HESS Latex template which we followed so I don't think we have much choice here. I checked some other preprints and found the same style without indentation there.

313 water extent (Table 1).

# Too far ahead on page 16

We will change the placement so that it appears on the same page as the first mention.

Figure 5. Map of predicted p(W). Scales are in UTM (zone 14) coordinates.

# Please tell us a bit more about this interesting figure in the caption which should be expanded. The caption should redefine the acronyms and symbols (p(W) and UTM).

This suggestion applies to all figure captions. It helps the first quick scan for the tentative reader. I had to make a list of acronyms before I started reading through critically, as I can't retain them in all my head!

We suggest to change the caption as follows: "Map of prior water probabilities p(W) predicted from Eq. 7. Scales show coordinates in the Universal Transverse Mercator system (UTM zone 14)."

329: … HAND….

# How do you measure HAND, and to what precision? I see that you mention it in subsection 2.2.2 Topographical data, but you don't elaborate.

HAND is determined by first computing the drainage direction for each DTM raster cell. For each cell, the algorithm follows the drainage direction raster until a cell belonging to the drainage network is reached. In this case we used both the drainage raster output by r.watershed (GRASS GIS; https://grass.osgeo.org/grass78/manuals/r.watershed.html) and the potholes as drainage pixels. Then the height difference between the original cell and the associated nearest drainage pixel is

taken as HAND value and assigned to the original cell from which the algorithm has started. Further details are given by Rennó et al. (2018). We will add a more extensive explanation to 2.2.2. (Line 169-170): “HAND is defined as the difference in elevation between a given DTM cell and the nearest cell pertaining to the drainage network (Rennó et al., 2018). For this purpose, the flow direction was determined using the D8 method. The algorithm then followed the flow direction raster until reaching a cell pertaining to the drainage network and computed the height difference between the drainage cell and the original starting cell.”

Figure 7. Backscatter in a) VV and b) VH polarisation and derived water bodies on 12 October 2019

# That's pretty smart

365 Fig.8a

# Please rearrange Figs 8 & 9 closer to first mention - they are up to 2 pages distant - I have to split the document to follow text.  Not good if it's a printed copy ...

We will change the placement of the figs. so that they appear on the same page or the page following the first mention.

398: Fig. 10

# 3 pages ahead ... and I have to expand the figure to 300% to find the tiny yellow patches; can't you take a small clip and park it on the empty space like I've done?

We will change the placement. The suggestion to zoom into a subset with yellow patches sounds very good. We will also change the colour from yellow to a colour with more contrast to the background.

Fig. 9

# The caption and label are in hectares, the image legends are in sq m!! That’s confusing - please fix

The y axis labels show hectares. The figure shows the sum of the areas of all water bodies belonging to each size class. This is what we mean by “Total water area” in the caption. We can change it to “Summed areas of water bodies in size classes a) > 8 ha …".

447-460

# That last paragraph is a good summary

475 … programme

# there is a choice here – what about ‘program’?

'In American English, program is the correct spelling. In Australian and Canadian English, program is the more common spelling. In British English, programme is the preferred spelling, although program is often used in computing contexts.' [Grammarly]

We went with the spelling that the “Copernicus Programme” uses, of which Sentinel-1 is a part. They refer to themselves as programme (e.g. 1st sentence here: https://www.copernicus.eu/en/about-copernicus).

476 Author contributions

# I like this list of the contributions of the team. Nice job.

Thank you

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https://hess.copernicus.org/preprints/hess-2021-330#RC2

References:

Rennó, C. D., Nobre, A. D., Cuartas, L. A., Soares, J. V., Hodnett, M. G., Tomasella, J., and Waterloo, M. J.: HAND, a new terrain descriptor using SRTM-DEM: Mapping terra-firme rainforest environments in Amazonia, Remote Sensing of Environment, 112, 3469–3481, 2008.