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Interactive comment on "Growth of a young pingo in the Canadian Arctic observed by RADARSAT-2 interferometric satellite radar" *by* S. V. Samsonov et al.,

Anonymous Referee #2

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Samsonvov et al. reported surface uplift at a growing pingo on the Arctic coast of the Canadian NW Territories. This paper is innovative in three aspects: being the very first InSAR study of pingo uplift, using a flexure model to fit and explain the InSAR-observed uplift rates, and using a permafrost thermal dynamics model (i.e., NEST) to simulate permafrost aggradation and pingo growth. But the clarity of this paper should be improved before published on The Cryospere.

Major comments:
1. More detailed information about the InSAR data and methods are needed. Where is the reference point?

Consider to present the ascending and descending interferograms in two perpendicular-baseline vs. time plots, from which readers can tell what Radarsat-2 scenes used, temporal and spatial baseline of each interferogram.
Also explain the MSBAS approach, how this is different from the conventional SBAS approach?
It appears that the authors upsampled interferograms from 20 m to 10 m in this MSBAS processing (page 6400, line 19). How reliable are the 10-m results, since they are derived from 20-m interferograms?

2. Time series model
In the result section, it appears that the authors used a time series model consists of a linear plus 'harmonic functions' (page 6402, line 11). Due to a lack of clear definition and description, I found it very hard to understand this model and the time series results. Is it different from linear-trend uplift model stated in the method section (page 6400, lines 22-25). If so, the authors should revise relevant text in the method section to point out that two different time series models are used. What exactly are these 'harmonic functions'? Why they are used and capable of describing the seasonal changes of uplift rate? Add a modelled uplift curve by interpreting the uplift rate curve, so that we can directly compare the model with the InSAR-observed uplift.
Seasonal settlement and heave due to thawing/freezing of active layer could occur (page 6408, line 2; and Liu et al 2014, Seasonal thaw settlement at drained thermokarst lake basins, Arctic Alaska, The Cryosphere, doi:10.5194/tc-8-815-2014). How would this influence the interpretation of measured surface uplift and its seasonal changes?

3. InSAR results
It appears (not stated explicitly) that standard deviation of deformation rates from the entire study area is used to represent the precision of InSAR-measured rates (Page 6401, line 22, line 26). This only works if the deformation rates are expected to be zero. But surface deformation of various types (e.g. thaw settlement, thermokarst) could also occur in this arctic lowland region. How the non-zero deformation affect the

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use of standard deviation to quantify precision?
InSAR maps on Fig 6 and 7 include residual ponds, which should show no InSAR coherence. How areas of low coherence are treated in MSBAS? It looks they are masked out on Fig 5 (again, not explicated explained what are the white areas within InSAR coverage). But why they are not masked out on Fig 6 or 7?
The first SAR image was taken in June 2011. Then why the Fig 6 time series starts from August 2011?

4. Elastic loading model
I like this simple flexure model described in section 4, but I don't have the expertise to judge how appropriate this can be used to describe pingo growth and if the assumed parameter values (page 6403 lines 18-20). The physics makes sense to me though. I think it would be helpful to include a simple diagram to show the geometry and symbols used in equation 1. And it seems theta refers to the azimuth angle from the North direction in the geodetic system, instead of 'tilt angle' (page 6403, line 8)
The authors should state the purpose of this modelling effort at the beginning of section 4. It took me a while to figure out they want to solve for the centre location, size, direction, and delta q/D, from the InSAR data. And discuss why these values are important.

5. Permafrost modelling of pingo scenarios
It is unclear to me how the authors used the same strategy, i.e. saturated 99And another related question: why permafrost thickness and deepening of freezing front (as predicted by NEST) can be used to present pingo uplift, which is driven by expelled pore water? The linkage remains unclear to me. Maybe I have missed something fundamentally.

6. DEMs Several DEM products have been used and presented in this study, e.g. the ones made from air photos (section 2.1), the 20-m one used in InSAR (section 2.2), the 90-m one shown on Figure 2. A brief summary of these may help to reduce confusion. And more importantly, what is the height accuracy for each DEM products? This info is

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essential to assess the accuracy of the differential DEM results shown on Figure 4.

Minor comments:
Abstract, line 9. The conclusion that this pingo is the largest in the region is not supported by the model result.
Abstract, line 24 (and in conclusion): delete sentences about InSAR can study martian pingos, which is not supported by this study.
Page 6400, line 16 and line 20: change software to algorithm
Page 6401, title of section 3: delete [0] at the end
Page 6401, line 10: move definition of the acronym DEM to its first appearance in section 2.1 (I think).
Page 6405, line 15: remove the dot after 33Page 6409, line 18-20: elaborate more on how the processing method caused the failure to resolve known growing pingos.
Fig 4 caption: add 2014 and date of the background radar image.

Interactive comment on The Cryosphere Discuss., 9, 6395, 2015.