Manuscript: cpd-7-1647-2011: Present and LGM permafrost from climate simulations: contribution of statistical

Major remarks

The authors derived permafrost distributions from climate model output for today's climate and LGM climate conditions. They used different statistical downscaling methods and compared the methods to each other and to observations/reconstructions.

The kappa statistic is described in the results section 3.2.2 where it is misplaced. It should be either part of the method section or put into an appendix. The whole part of applying the kappa statistic in Sect. 3.2.2 (p. 1661/1662) is very difficult to follow. Around line 16 on p. 1661 I got lost and I was still lost in the beginning of p. 1662. It seems that many complicated measures (based on the Kappa statistic) are needed to show that one method is better than the other. On one hand I think this may be achieved with less or less complicated measures. On the other hand it should be possible to show this in a way, which is easier to understand for a reader who is not familiar with the statistical background.

According to the abstract and general outline, the value of two methods shall be compared, GAM-RV and ML-GAM. This is followed, e.g., in Fig. 3 and 4, where both methods are also compared to the simple bilinear interpolation with RV conditions that is used as a reference. But in the main text this is only partially followed. In sect. 4, suddenly MLR is also introduced and compared to GAM-RV in Fig. 6. But for the latter, no comparison to ML-GAM is done. Also later on, MLR is partially regarded, e.g. in Table 2 and 3. In Fig. 5, three columns are shown (no ML-GAM, but MLR instead), but in the figure caption 4 columns are mentioned in lines 3-4. This is very confusing. Here, the paper is lacking some structure. Either it should be made clear (and followed thoroughly) that three methods are compared to the reference method, or the MLR stuff should be completely removed. In order to avoid an unnecessary lengthening of the paper, it seems that the latter may be the preferable choice.

In general the English needs some improvement, as some sentences are somewhat difficult to read (e.g. p. 1650, lines 4-7, p. 1999, lines 11-14, …). In addition, the use of 'the' and 'a' may be enhanced. It is 'in the period', not 'at the period' or 'on the period'. The same is valid for 'in the climate'. I recommend proof reading of a native English speaker.

In summary the paper may be accepted for publication after major revisions are conducted.

Minor Comments

In the following suggestions for editorial corrections are marked in *Italic*.

Abstract – Par. 2 - page 1648 - line 14
…with non-*systematic* improvements …

Abstract – Par. 3 - page 1648 - line 20
It is written:
… we measure a global agreement by kappa statistic of 0.80 with CTRL permafrost data, against 0.68 …

This sentence is rather technical and requires that the reader knows about Kappa statistic. Consequently, it is not very suitable for an abstract.

Abstract – last Par. - page 1649 - line 5
It is written:
… and depend on several other factors deserving further studies.

This is a very unspecific statement. You should specify these factors if you mention them in the abstract.

Section 1 – Par. 1 - page 1649 - line 12
… and *is* currently …

Section 1 – Par. 5 - page 1650 - line 20
… (or the *inter-model variability*), especially …

Section 1 – Par. 6 - page 1651 - line 20
It is written:
… but compels to fix the relationship between temperature and permafrost.

I don't understand. Please clarify!

Section 3.1 – Par. 1 - page 1654 - line 8-9
It is written:
… and more with preindustrial simulations from climate models.

I don't understand. Please clarify!

Section 3.1 – last Par. - page 1655 - line 1
… regions *for* the type …

Section 3.2.1 – Par. 2 - page 1657 - line 3-6
It is described that the global mean temperature difference to CRU data over land is added to each model grid box to account for the different time period of the PMIP2 simulations and the CRU data. Given the well known fact that under the recent global warming, the temperature increase over the high latitudes (that is where permafrost is located) is stronger than in the global mean, this approach does not seem to be valid!

Section 3.2.1 – Par. 3 - page 1657 - line 21
… can be *attributed* to …

Section 3.2.1 – Par. 3 - page 1657 - line 22
What is the definition of 'very remote from any ocean'?

Section 3.2.1 – Par. 3 - page 1658 - line 1-5
ACO is only vaguely described. Why do you hide how it is exactly defined? In this way, the reader cannot really follow what has been done.

Section 3.2.2 – Par. 3 - page 1659 - line 14
…, we *consider* their …

Section 3.2.2 – Par. 3 - page 1659 - line 27
The *results for* these two climate ….

Section 3.2.2 – Par. 4 - page 1660 - line 13
It is written:
….confusion/matching matrix …

This confuses me. Obviously, too much prior knowledge is required to understand what this kind of matrix is.

Section 3.2.2 – Par. 5 - page 1661 - line 2
… "N" *correspond* to …

Section 3.2.2 – Par. 6 - page 1661 - line 22
… increases *by* 14% ….

Section 3.2.2 – Par. 6 - page 1662 - line 3
It is written:
… in better agreement …

Better than what?

Section 3.2.2 – Par. 7 - page 1662 - line 4
It is written:
Despite heterogeneous contributions ….

What do you mean with heterogeneous contributions?

Section 3.2.2 – Par. 7 - page 1662 - line 6
It is written:
… obtained a percentage of explained variance …

In which respect?

Section 3.2.2 – Par. 7 - page 1662 - line 7
… climatology *by* improving …

Section 4 – title - page 1662 – line 19
… logistic *model*.

Section 4 – Par. 1 - page 1662 - line 23
… more *information.*

Section 4 – Par. 3 - page 1663 - line 27
…predictand *is* estimated …

Section 4 – Par. 5 - page 1664 - line 26
… clearly *appear* with …

Section 4.1 – Par. 2 - page 1665 - line 28
… IPA/FGDC *to* 1.4 …

Section 4.1 – Par. 2 - page 1666 - line 2
In Fig. 5a, …

Section 4.1 – Par. 4 - page 1666 - line 12-18
With regard to this kappa paragraph: What is the information that should be provided which has not already been transmitted before?

This remark relates to my major remark about the kappa application.

Section 4.1 – Par. 5 - page 1666 - line 21
…. (2009) *who* showed …

Section 4.1 – Par. 5 - page 1666 - line 28
… to *derive* a high-resolution permafrost *distribution*.

Section 5 – Par. 1 - page 1667 - line 15
… with *GCM* outputs …

Section 5 – Par. 5 - page 1668 - line 28-29
… whatever *SDM is used*, the … … more *pronounced* than *in the* CTRL period.

Section 5 – Par. 5 - page 1669 - line 1
… still *underestimated* and …

Section 5 – Par. 5 - page 1669 - line 4
… than *in the* CTRL period …

Section 5 – Par. 8 - page 1670 - line 1
The SDMs *include a* strong …

Section 6 – Par. 1 - page 1671 - line 23
It is written:
… study at a local-scale needs more physics about permafrost.

What do you exactly mean?

Figure caption 1
Figure 1 is referred to in the text before abbreviation RV is defined. Thus, abbreviation RV is not defined for Figure 1. Please correct!

Figures 3, 4, 5, 6, 7, 8
Panel subtitles, axis descriptions and colour legend descriptions are too small.

Figures caption 3, 4, 7, 8 – line 6
… letters *show* the …

Figures 6

The figure caption describes a grey area, but I don’t see any grey area in the plots, only bluish ones.

Figures caption 8 – line 4
…. Index by *ML*-GAM.