Comment

1. Plot the air temperature (ground surface temperature) for different regions for the last 125k years. As I understand there is a temperature zonation factor involved. What is it? How does the air temperature differ between various regions, subzones?

Response

The article presents graphs of mean annual ground temperatures over the past 125 thousand years depending on paleogeographic events (shelf drying, flooding, glaciation, etc.)according to latitudinal zoning and meridional sectorality (Fig. 4,5,7). When specifying latitudinal zonality during periods of shelf drying, the authors followed differences in ground temperatures reflected on the Russian Geocryological Map (Yershov ed., 1991). The mean annual ground temperature is 4-6 °C lower in the NE of the region (north of Taimyr) adjacent to the Kara coast, than as for the SW (south-west of Yamal). When zoning the shelf (Table 1, Fig. 3), the southwest (68-71 ° N) and north-eastern (72-77 ° N) areas were distinguished. During the periods of drainage in the periglacial part of the shelf in MIS-2, the following values for the ground temperature were taken: -19 ° C for the north-eastern area, and -15 °C for the south-western one .

Reference:

Yershov E.D. (Ed.): Geocryological Map of the USSR, scale 1:2 500 000. Moscow State University, Moscow, 1991 (in Russian).

Comment

2. It is stated that “about 50-75ky bp the sea level was the same as present”. Unfortunately, the paper lacks the sea level dynamics,I think it was used in the scenario building, but not explicitly shown. Please supplement Figure 4 with a plot of the relative sea level curve with respect to the present-day conditions for the last 125k years.

Response

The paper claims that the sea level was the same as current 50-25 Ka BP (not 50-75, Lines 207-208). This is shown at Fig. 6 based on the marine sediments dating (50-25 Ka BP) on the islands, shelf and the sea coast . We will add the Figure showing fluctuations of the sea level during the modeling period of 125-15 Ka BP.

Comment

3. Make a series of maps to show which areas were flooded, glaciated or exposed to air 10, 20, 40, 55, 70, 80 ky bp. It will help a reader. It is okay to take different times, e.g. middle of the MIS periods. The goal is to help future researchers to understand when a certain part of the shelf was exposed to the air. Right now, it is not clear. Also, change the y-labels in Figure 4 to "Sea level with respect to the present-day datum, m". Make values in Figure 4a negative. '

Response

The authors totally agree with the reviewer: the relevant illustrative material will help the reader to understand the content of the article. Therefore, the change in surface conditions will be illustrated by a series of cartographic schemes for the following moments: MIS- 5e (130-120 ka BP); MIS -5d (117-110 ka BP); MIS- 5c (110-105 Ka BP); MIS -5b (100-75 Ka BP).

As for the Figure 4, we will change y-label for «Sea level with respect to the present-day, m », but it seems more convenient not to make changes in values in Figure 4a, because they are depth's values, not altitude as in Figure 4b.

Comment

4. How are the effects of salts taken into the account? Does the salt lower the freezing point depression? Do you take into the account unfrozen liquid pore water while freezing the saline water? How are the salt effects parameterized in the model? Explain and clarify in the paper.

Response

The freezing temperature equal to the freezing temperature of sea water (- 1,8°C) was set for all types of soils for the modeling. This assumption was made due to the fact that all the marine sediments composing the Yamal Peninsula have the close values of the salinity to a depth of 300 m and more (Chuvilin et al., 2007).Very high degree of averaging over the properties was used for the modeling caused by the lack of data on the water area. The rare drilling data showed the salinization of sediments through the entire drilling depth. So there was not possible to take into account the salt diffusion, and the salinity did not vary with the depth. Because the modeling has evaluative nature a scheme with complete freezing (thawing) of moisture in the ground at the moving front of phase transitions was used. The content of unfrozen water in the sediments was taken into account by reducing the volumetric heat of phase

transitions in the model by the value corresponding to the average content of unfrozen water in different types of rocks at negative temperatures typical of the process under study.

We will add the next text after the sentence « All rocks and sediments were assumed to be saline from top to bottom of the modeling domain» Line 82 : «All reference rocks and sediments were considered saline; the concentration of pore saline solution corresponding to that of sea water (23 ‰) was used. The freezing temperature equal to the freezing temperature of sea water (-1,8℃) was set for all types of soils for the modeling. Thermophysical properties, the content of unfrozen water and the heat of the phase transitions of water in the pores, the freezing point of the deposits were set taking into account the indicated salinization.

Reference:

Chuvilin E.M., Perlova E.V., Baranov Yu.B., Kondakov V.V., Osokin A.B., Yakushev V.S. The structure and properties of cryolithozone sediments of the southern part of the Bovanenkovo gas condensate field. M.:"Geos", 2007, p.20

Comment

5. The paper goes into the discussion of various ground layers (sand, clay,etc) and heat flux values. I suggest moving this analysis into a separate section, e.g.“Sensitivity analysis”. Do you do sensitivity analysis with respect to salt concentration?

Response

Actually we have a related comment from the first reviewer about lack of information on the influence of control factors of permafrost dynamics (section 4.2). Therefore, it seems to be more convenient to expand that section with four figures showing the dynamics of the Kara shelf permafrost (top and base) for the past 125 Kyr. The results obtained during modeling for the following aspects for the southwestern and northeastern areas will be presented: 1) different deposit temperatures within the same sea depths, lithology, heat flux etc. (eg. in cryochrons (for example, MIS-2) in the NE it's 11 degrees lower than in the SW) 2) the same for the different sea depths (120 and 5 m), 3) different heat flux, 4) different lithology (eg. sand and clay silt).

As for the salinization, the modeling was provided for the uniform salt concentrations as we described in the response to the previous comment.

Comment

6. The manuscript is understandable, but terminology is used unconventionally

Response

Thank you, we will moderate the language focusing on precision and word choice. The paper would be proof-readed by a native-speaker with background in the topic.

Some obvious changes: «cold» will be changed to «cryotic»; we would replace the «rock» for the «ground» (i.e. soil and rock) or «deposits» wherever it is necessary.