

Reply to reviewer 1

Many thanks to Martin Claussen for his kind and useful comments. Please find here below my reply in black.

On line 160 ff., it is stated that Milankovitch used the caloric seasons for the first time in his contribution (Mathematische Klimalehre) to the 1930 Köppen-Wegener Handbook. When going through the book “Die Klimate der geologischen Vorzeit” by Köppen and Wegener in 1924, I already find the concept of caloric seasons described by Milankovitch himself. Actually, Köppen and Wegener invited Milankovitch to contribute a piece of text in which Milankovitch himself cites his paper on “Kalorische Jahreszeiten und deren Anwendung im paläoklimalen Problem” (Ber. D. Königl. Serb. Adad. Bd. 1923). The text is very close to, albeit much shorter than, the text in Milankovitch’s “Kanon der Erdbestrahlung” (1941). The defining figures (Figure 34 in “Die Klimate ...” and Figure 42 in “Kanon ...”) are pretty much the same.

I have cited the 1930 edition of Köppen-Wegener because I thought it was easier to find for the general reader. I have however added the reference 1924 because this edition was recently reproduced and translated into English by Thiede et al., Borntraeger, Stuttgart, 2015.

Köppen, W; and Wegener, A.: Die Klimate der geologischen Vorzeit. Borntraeger Berlin, 1924. Reproduction of the original German edition and complete English translation (The Climates of the Geological past) by Thiede J., Lochte K., Dummermuth ., Translated by Oelkers B., Borntraeger Stuttgart, 2015

I knew the original 1923 paper. It is actually a communication dating from 1922 (vol CVII) and the paper is written in Cyrillic. The original title and its translations in German, English and French are:

Kalorična godišnja doba I njihov primena u paleoklimaskom problemu; Kalorische Jahreszeiten und deren Anwendung im paläoklimalen Problem; Caloric seasons and their application in paleoclimate problem; Les saisons caloriques et leurs applications au problème paléoclimatique. In Separat iz., Glas Sprske kraljevske akademije, 1923, vol CIX, p. 1-30

Regarding style, I would like to suggest rewriting the Abstract. When having read the Abstract, I frankly expected a rather technical paper. But likely, the manuscript is an eye opener for many paleoclimate modelers. Perhaps the two sentences I cited above, or similar sentences, could appear in the Abstract to make sure that everybody will read the paper. And it is a great pleasure to read it.

I follow the suggestion of Martin Claussen and re-write the abstract:

Abstract. The history of the long-term variations of the astronomical elements used in paleoclimate research shows that, contrary to what might be thought, Milutin Milankovitch is not the father of the astronomical theory but he is definitely of paleoclimate modelling. He has not calculated himself these long-term variations but used them extensively for calculating the “secular march” of incoming solar radiation. He has advanced our understanding of Quaternary climate variations by two important and original contributions fully described in his Canon of Insolation. These are the definition and use of caloric seasons and the concept of the

“mathematical climate. How his mathematical model allowed him to give the caloric summer and winter insolation a climatological meaning is illustrated.

Minor comments:

Line 71: Not only the numerical values of the astronomical parameters were reproduced in Köppen and Wegener’s “Die Klimate ...”, but also the insolation during the caloric summer and winter. The famous fold-up figure in “Die Klimate ...” are already the caloric values, if I understood it correctly.

You are right

Line 142: Actually, Milankovitch himself wrote in his contribution to Köppen and Wegener’s “Die Klimate ...” : “Daß die folgende Tabelle sich auf die sommerliche Bestrahlung bezieht, geschieht auf Wunsch der Verfasser vorliegenden Werkes“ (That the following table refers to summer irradiation is at the request of the authors of this work.) Hence, Köppen and Wegener claimed already in 1924 the summer half-year as decisive factor in glaciation – and they explicitly cited this as Penck’s and Brückner’s idea.

Yes I agree that Köppen, Wegener, Penck, Brückner and Milankovitch spread the Murphy’s idea of a cool summer

Typos etc.:

Title: paleoclimate modeling or palaeoclimate modelling? American or British English?

I chose modelling

Line 38: Miskovitch or Miskovic? (In his “Kanon ...”, Milankovitch cited Miskovic as Michkovitch).

I use Michkovitch in this version of this article. In Milankovitch we find indeed *Miškovitch* . My writing was using by mistake ‘s’ instead of ‘š’ and this last character is very difficult to reproduce.

Line 48: 10-4, not 10-4

OK

Line 62: Milankovitch’s own words... taken from which paper or book? (Actually, you can find them in both, “Die Klimate ...” and the “Kanon ...”.)

It is in his main books and contributions. I have added the references 1920 and 1941

Line 80 ff. In the symbol , the should appear as subscript, if Milankovitch’s “Kanon ...” notation is followed, i.e., . Likewise, rather than $\square \square \square \square \square 0 \square \square 0 \square \square$

Done. It was actually well written in my manuscript

Line 105, 107: which paper / book of Milankovitch’s are these quotes taken from?

MM 1941 Pp 264, 269, 270

Line 120: interested in (not ‘by’) obliquity.

Done

Line 144: Brückner instead of Bruckner.

Done

Line 164: 'Canon' or 'Kanon', both quotes appear in the paper. I would harmonize it.

I use Canon except in Kanon der Erdbestrahlung

Line 187: Klimalehre (not Klimalehere), Stefan law (not Sefan law)

Done

Line 188: IR? I guess it's infrared.

Yes I have written explicitly.

Line 205: Which "Köppen table" is meant?

It is the table of the altitude of the snow limit for different latitudes, see Figure 53 p 435 and table xxvii p 437 of MM 1941

Line 208 / 210: which paper / book is this quote taken from?

MM 1941 p 471

Line 239: amounted to 1920 caloric

OK it is canonic units

Line 249: Neue Ergebnisse (not Neue Ergebnissen)

Done

Line 294: Veränderungen der Bahnen der großen Planeten

Done

Line 303: Klimate (not Kliamte)

Done

Line 329: Erforschung der

Done

Line 320: Klimalehre

Done

Line 333: Erdbestrahlung

done