Clim. Past Discuss., 2, S774–S778, 2007
www.clim-past-discuss.net/2/S774/2007/

Climate of the Past Discussions

Interactive comment on "Simulated northern hemispheric storm tracks of the Eemian interglacial and the last glacial inception" *by* F. Kaspar et al.

Anonymous Referee #1

Received and published: 8 January 2007

General comments

This manuscript describes the changes in mid-latitude storm activity in a Last Interglacial and a Last Glacial Inception coupled atmosphere-ocean simulations. It is important to study storm activity because in the mid-latitudes in winter, it is one of the main causes of precipitation. Since storms are also responsible for an important part of the meridional heat transport, they are also a key component to understand mid-latitude climatic changes. So, even if this parameter is not often studied in palaeoclimate simulations because it cannot easily be compared to palaeodata, it is important to understand a given paleoclimate. The simulations presented here are also a way

to test our understanding of storm activity in climate different from the present climate and future climate.

The authors have chosen to focus on two periods: the first one at the maximum of the last interglacial (125 ky ago); which was warmer than today; the second one is the beginning of the last glaciation (115 ky ago), for which they indeed obtain perennial snow at high latitudes. These periods are interesting because they represent, to first order, symmetrical changes w.r.t. present conditions: the former has a warmer Arctic (Fig 1), the latter a cooler one. This results in a weakened/strengthened (respectively) meridional temperature gradient, which is a key factor in determining mid-latitude storm activity. The land surface conditions are not very different from today (i.e. no large additional ice-sheets to Greenland over the northern continents), which makes these experiments valuable in understanding our present and future warm climates.

The authors use a coupled atmosphere-ocean model, which is an appropriate tool for this type of study, and which allows them to compute the sea surface temperatures rather than prescribing them to an atmosphere-only model. The resolution of the atmospheric model (T30) is somewhat on the low side for atmospheric storminess, but the results obtained for the preindustrial climate (Figures 3 and 4) show that the storm-track representation is rather good. The main forcing for these two periods is the change in the orbital parameters which leads to important seasonal changes in the insolation received by the Earth from the Sun. These have appropriately been changed in the simulations presented here. Trace gas concentrations have also been modified taking into account ice-core measurements. The experimental design is simple and well described.

The authors first show the temperature response, before describing storminess changes from the point of view of the high-pass (2.5-6 days) variability and extremes in wind speed. Indeed, they mainly ascribe the storminess changes to changes in meridional temperature gradients, since these are the main source of mid-latitude storms according to the baroclinic instability theory. Then they study the relationship between

CPD
2, S774–S778, 2007

EGU

storminess and precipitation changes.

In my opinion the manuscript is clearly written and the figures are well chosen. However, I am not always convinced about the comments of the authors on these figures. For instance, the claim that most changes in storminess are related to changes in meridional temperature gradients is, in my opinion, too simple. For instance, for the 115ky BP simulation, the increase in storm track activity off the American East Coast (Fig 7) cannot easily related to changes in the meridonal temperature gradient (Fig 2). More to the East, the strengthening of the storm track activity off the European Coasts are located south of the gradient change that can be inferred from Fig 2. While I agree that most storm track activity changes can be related to changes in the meridional temperature gradients, I think that the authors should not oversimplify the presentation of the model responses and underline other potentially important factors, such as latent heat or the storm-track feedback on the mean flow. Similarly, Fig 9 and 10 show that the description of storm changes in terms of frequency of storm days is not always consistent with the description based on high passed variability from Fig 5 to 7. Showing these different diagnostics is a strength of the manuscript, but this potential could be better used.

In the same way, the relationship between changes in precipitation and changes in storm activity is not discussed as much as needed. The authors should emphasize that in some locations/cases, the relationship is simply very poor. For instance, in the Eemian case, storminess increases over the North Atlantic between 50 and 70°N but precipitation only increases to the East of this region.

As a conclusion, I think the results shown in this work are interesting and merit being published, but that the analyses and discussion should be more rigorous and critical w.r.t to the simple message "mid latitude winter precipitation changes are related to storms changes, which are related to meridional temperature gradient changes".

Specific comments

CPD
2, S774–S778, 2007

EGU

P1251, l22. "the changes orbital configuration would lead to distinct changes in the seasonal cycle of temperature, especially over land". Please explain why especially over land.

P1252 l17. Here, the authors could add a few sentences explaining why the study of storm tracks for the Eemian and Last Glacial Inception is particulary interesting, by referring to earlier work, such as Vettoretti and Peltier's "cryospheric pump" or Khodri et al's transports at the Last Glacial Inception. More generally, the introduction gives good account of storm track studies for other periods but lacks references to earlier modelling/storm-track work both on the Eemian and the Last Glacial Inception.

P1253, last sentence before section 2.2. Which experiments are the authors referring to? The sentence needs to be completed.

P1254, section 3.1, first paragraph. Since the authors refer to a publication in a book which is not easy to get, it would be better if they included a short summary of their results here.

P1256/1257 section 3.3. This discussion would be easier to follow if the authors chose to describe the changes for EEM and GI in the same order (in terms of regions). In the present state of the manuscript, the discussion is a little messy.

P1259 before beginning of section 4: the discussion of the GI relationship between storms and precipitation is very slim. It would be good to expand this paragraph and give some ideas as to why the relationship does not always work.

P1260, conclusions. For the sake of clarity, the authors should stress that if some storm activity changes may appear to be similar for the EEM and future situations, this is not because the forcings are similar, but rather because these different forcings (insolation vs greenhouse gas concentration increase) have similar consequences on the meridional temperature gradients (and other potential factors), which in turn yield similar changes in storminess.

CPD

2, S774–S778, 2007

Technical comments

P1251 l27. Replace "high frequent variability" by "high frequency variability" P1252 l11. Differences in sea surface temperaturesĚ and sea ice cover. P1254 l16. "relativEly" instead of "relativly" P1257 l 25 : some references would be good to illustrate this assertion. P1258 l19 : "In THE case of" instead of "In case of" P1258 l20 : "consistent with" instead of "in consistency with" P1258 l25 : "ratios" instead of "ration" and add "precipitation" at the end of this sentence. P1258 l 28 : "ThIS region" instead of "The region" Reference section : some problems with the alphabetical order of the references, Blackmon being placed before Bengtsson. P1261 l 13 : "decadAl" instead of "decadel"

Interactive comment on Clim. Past Discuss., 2, 1249, 2006.