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Climate of the Past Discussions

Interactive comment on "Paleometeorology: visualizing mid-latitude dynamics at the synoptic level during the Last Glacial Maximum" *by* M. B. Unterman et al.

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General comments: This paper takes a different approach to paleo-meteorology than the typical atmospheric dynamics paper. It largely forgoes many of the normal dynamical approaches in favor of a large animation (supplemented by static, lagrangian analyses). The main innovations are fine atmospheric general circulation model resolution (spectral resolution, T170) and the use of animations to present the results. I doubt that the high resolution makes much of a difference in terms of the interpretation of the author's results (I have performed T170 runs of paleoclimate as well and found that while storm track EKE increases dramatically–because of the lower diffusion/viscosity–

the qualitative storm track aspects are very much the same as at T42). The authors have missed an opportunity that make a convincing case that T170 improves anything by making a formal comparison to the same results at T42. This would take only a day or two of their time, presumably, to run the simulation. On the other hand, the animation is potentially more interesting because it allows certain kinds of information that are intuitively important from a synoptic point of view, which are usually lost in Eulerian static diagnostics, and often even in Lagrangian static diagnostics. This is one of the main advantages that more sophisticated scientific diagnostics can play in science, although limitations in print media have largely limited this avenue of inquiry. Since this kind of utilization of animations and presentation of raw diagnostics via e-media is still not widely practiced in our discipline it seems necessary to set some ground rules, otherwise the field could devolve entirely into pure 'run-and-show' papers which present results in innovative ways but reveal nothing more scientifically.

So to be clear, the criteria by which I will judge a paper like this is the degree to which scientific questions are answered and also the quality, as compared to other examples of scientific visualization, of the presentation (of course, ideally the two are related).

Specific comments: Scientific question being answered: In this paper, the displacement of N. Pacific storms into Alaska is the main interesting result, in conjunction with the lessening of N. Atlantic storm activity. Both features have been noted before, but the visual treatment here presents the general pattern better. The authors are potentially unaware of the paper in press (J. Clim web site) by Donahoe and Battisti that extended the Li and Battisti (cited) analysis and 'explained' why N. Atlantic storm activity was diminished. Those authors suggest (show) that the most likely reason is a reduction in 'seeding' of N. Atlantic storms. That seems like something that could potentially be addressed by Unterman et al., in this paper. Do they see (present) evidence of less seeding?

Appropriateness of methodology: The Lagrangian storm track analysis has been well proven, so I will focus instead on the animation. One should ask if the variables presented (Surface U,V,TS, convective precip) are the right choice to solve the interesting dynamic questions or to develop a paleo-meteorological characterization. Certainly they are one part of a good characterization, but SLP would also help, U,V,GZ at 500mb or some appropriate level would also be commonplace. For that matter, vorticity would be helplful, as would the Eady stability parameter. The authors state that they analyzed SLP and vorticity anyway (p. 1887) for the Lagrangian analysis, so why not show an animation?

From a PV-theta point of view it would be useful to see an animation of potential vorticity on the 315K isentropic surface. Such an animation would provide a direct link between the blocking over the ice sheet and the heat/water transport diagnostics previously studied. The authors have an exciting opportunity here, they should take it and run with it, and make this a seminal paper in the field.

Technical comments:

The authors clearly went to a lot of effort to get the graphics to look just the way they wanted, "Animations comprised of frames from hourly saves were rendered from a custom built software package built to handle the large data sets and to accurately compile 5 high resolution, 256 color images from high resolution outputs. We felt that pre-built packages, such as the Grid Analysis and Display System (GrADS), would not accurately portray certain climatological parameters and surface features at the T170 level as they are generally limited in their colour profile."

But it is not clear to me that the final result is particularly revealing or that it would be difficult to do much better. Leaving aside 3-D volume rendering for a moment, since that can be computationally intensive, an animation such as this one, http://oceans11.lanl.gov/COSIMdownloads/POP_Vorticity.mov , provides far more information about flow (both it's coherent structures and variability) than the animation included as supplement in this paper. It is simply not difficult to perform this kind of visualization, with off the shelf software, and in fact to do a better job.

Once the data is generated and subsetted one would only need to go here : http://www.ncl.ucar.edu/Applications/Scripts/unique_4.ncl to generate figures comparable to (but arguably more informative than) those in this paper (http://www.ncl.ucar.edu/Applications/Images/unique_4_3_lg.png) (http://www.ncl.ucar.edu/Applications/Images/unique_4.gif) . And vorticity and isentropic surfaces are also easily calculable with off the shelf software (http://www.ncl.ucar.edu/Applications/vort.shtml) . Other scientists I'm sure have their own favorites, but there is a field of scientific visualization for meteorological and oceanographic sciences and there are excellent off the shelf products, the authors of this study should avail themselves of existing tools and techniques.

In my experience, using off the shelf operators (such as nco's ncks, or using the cdo package, and ncl or related interpreted languages) the total amount of coding necessary to do this analysis is about 30 lines in a C-shell script, and it can run and generate a movie in less than 1 day on a linux box (including postscript->quicktime conversion). So, while the amount of disk space required is enormous, it is not technically difficult to generate animations such as in this paper, and consequently there should be more of them and they should be better tailored to answering the scientific questions important for LGM. In essence, I recommend that the authors should include more animations in this paper and that those animations should plot up more dynamically interesting and relevant variables in a more informative way than they currently do.

Interactive comment on Clim. Past Discuss., 5, 1883, 2009.