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Climate of the Past Discussions

Interactive comment on "Miocene–Pliocene stepwise intensification of the Benguela upwelling over the Walvis Ridge off Namibia" *by* S. Hoetzel et al.

Anonymous Referee #2

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This paper is an interesting study to elucidate the evolution of the northern part of the Benguela upwelling system along the west coast of Africa since the Miocene. In the present climate the Benguela system is a major region of upwelling in the Atlantic Ocean, where mostly cold and nutrient rich water comes to the surface and hence influences surface water conditions. The authors produced a new record from ODP site 1081 on organic-walled dinoflagellate cysts, and infer past surface water conditions from the varying distribution of several species and the total organic carbon content. The paper is very well written and methods are clearly explained. I cannot fully judge how complete the interpretation of the record is based on all available literature, as my expertise lies mostly in ocean and climate modeling, but I had similar concerns as ref-

eree 1 as to the interpretation of the data seems somewhat narrow. My major concern, however, lies one step further in the interpretation of the data: Throughout the paper statements are made that in fact are a mix of what the data really say (which is mostly based in nutrient availability) and what that might imply for the conditions and circulation in the (global) ocean and atmosphere. The latter sort of statements should be substantiated by referring to either present-day oceanographic data/simulations and/or past climate model studies. This is an important issue, which needs to addressed and sorted out more elaborately before final publication.

Specific comments

1. It is mentioned in the introduction that the Benguela upwelling system is thought to have initiated in the Late Miocene. I think this is a too general statement. Large-scale ocean upwelling systems exist because of the general distribution of wind patterns in the atmosphere, and so does the BUS. It is difficult to imagine a completely absent BUS in a situation where Africa is at about the same position as today and trade winds and westerlies at mid-latitudes exist. What can vary, is the strength of the upwelling (depending on wind strength) and the properties of the upwelled waters (depending on the global ocean circulation, in particular deep sea conditions). The winds are the main reason for upwelling in the ocean, and while the wind pattern of course is related to meridional temperature gradients this is not a simple relationship. Interpreting the dinoflagellate cyst distributions in terms of meridional temperature gradients appears too far going in my view.
2. In the interpretation of the data a clear distinction should be made between the above mentioned two processes: Is this a consequence of stronger/weaker upwelling or rather different water properties upwelled? The distinction might not be unique at all times, but at least an attempt should be made.
3. Section 5.1 should contain much more information on how dinoflagellates are distributed in the present BUS.

4. I cannot believe the Benguela Nino conditions to be directly related to the appearance of certain dinoflagellate species. Again, there should be steps in between to substantiate this interpretation.

Interactive comment on Clim. Past Discuss., 11, 1913, 2015.