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Atmospheric Measurement Techniques Discussions

Interactive comment on "Aerosol optical depth retrievals at the Izaña Atmospheric Observatory from 1941 to 2013 by using artificial neural networks" *by* R. D. García et al.

Anonymous Referee #2

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This paper presents the reconstruction of the 73 year time series of the aerosol optical depth (AOD) at 500nm at the Izaña Atmospheric Observatory (IZO) located in Tenerife (Canary Islands, Spain). They reconstructed AOD records cover the period 1941 to 2001 using artificial neural networks (ANNs). This record was validated against more recent measures of radiation. The authors conclude that "... the reconstructed AOD time series captures well the AOD variations and dust-laden Saharan air mass outbreaks at short-term and long-term time scales and, thus, it is suitable to be used in climate analysis."

This paper addresses an important issue, the changes in dust transport over long time

periods and how these changes might be linked to climate. The paper is well organized and clearly written.

The general approach used in this paper seems reasonable. However I cannot properly comment on the appropriate use (or misuse) of ANN in this study. Nonetheless the testing of the results against direct measures of AOD seems to yield reasonable results.

The main product of this effort is encapsulated in Figure 6 - in particular 6c: Time series of the ANN AOD monthly medians.in July in the period 1941–2009. This figure suggests that there were great changes in column dust concentration over the record. Four periods are particularly interesting because of the high values of monthly median ANN AOD: a) 1941 to about 1950; b) 1968 to 1971; c) 1971 to 1976; d) 1981 to about 1990. This record should be assessed in terms of changes of dust emission and transport from North Africa. There is considerable evidence that dust emissions are linked to rainfall, among other factors. Thus one could ask how this record relates to rainfall records in Africa. Unfortunately the only long term records are for the Sahel region. See for example the Sahel Precipitation Index (SPI) from the Univ. of Washington Joint Institute for the Study of the Atmosphere and Ocean. http://www.jisao.washington.edu/data_sets/sahel/

Drought began abruptly in the late 1960 with one intense period in the early 1970. The second period in the 1980s was particularly strong and long lasting with devastating consequences for the population. Since the late 19980s rainfall has increased and drought has ameliorated although rainfall is still less than the long term means.

The high values observed in Figure 6 during periods c) and d) are consistent with the SPI index. Also the peak values of ANN AOD during c) and d) are consistent with the general knowledge of dust transport variability to the tropical Atlantic. But if these two periods are consistent with links to rainfall, then it is difficult to explain the causes of period a) and b). Indeed the years between about 1950 to the late 1960s were quite "wet". In Figure 6, the 1950s were characterized by some of the lowest ANN AOD

values in the record. But in 1967 AOD increases sharply to the high AOD in the record and remains high until 1971.

The high values during period a) are also puzzling. They are comparable to those seen during the peak of the drought in the 1980s. Yet the SPI was mostly average or above during that period. One might argue that WW2 was going on during the early part of this period. I recall reading reports that increased dust was observed in the Caribbean after intense tank battle in North Africa. This would only explain the first couple years, but one might argue that the soils were destabilized for some time after the battles ended.

In conclusion, the paper presents some interesting technique that could provide new data that is of importance to climate studies, in particular the variability of dust with climate. But as the paper stands, it really does not address that possible relationship or our general expectations. It could be that our expectations are wrong in which case they would be very wrong indeed. Also it could be argued that this paper is about "measurement techniques" which fits the general nature of the journal. My own cursory observations in this regard raises some puzzling questions which would seem to question the validity of the technique. I would not expect the authors to fully explain these contradictions, but they should at least address them to some degree. What shortcomings in their procedure might lead to such a finding? Are there any direct meteorological observations at IZO that could support the increased occurrence of increased dust events during the wet phases in Africa. What would Figure 6c look like with a plot of ANN AOD with visibility alone and coupled with wind sector partitioning? With observations of suspended dust? Etc.

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