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Interactive Comment

Interactive comment on "The effects of springtime mid-latitude storms on trace gas composition determined from the MACC reanalysis" *by* K. E. Knowland et al.

Anonymous Referee #1

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The study of Knowland et al. examine the impact of extra-tropical storms in the North Pacific and North Atlantic on springtime O3 and CO distribution. The authors considered the most intense (95th percentile) storms (∼60) in each basin and focused on the period 2003-2012, using MACC reanalysis. By composing the storms, the study quantifies the changes in CO and O3 horizontally and vertically throughout the storm. The analysis is thorough and the manuscript is in general well written. The results are interesting; however, I think the authors should present more analyses related to the implication of their results (see major comment below), before being published in ACP.

Major comment

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Discussion Paper

- Hess and Lamarque (2007) have shown how ozone at the surface is modulated by the Arctic oscillation during the spring months and Pausata et al., (2012) have shown that the NAO is driving ozone variability in large parts of Europe, both at low levels and in the middle-upper troposphere, suggesting that increased baseline ozone over western and northern Europe maybe due to the prolonged NAO phase during the 90s. It would be interesting whether the authors would expand the part related to the implications of their results: For example, better quantifying – together with what has been suggested by Reviewer #2 – the effects of stratospheric ozone transport at the surface and how this could impact the trend seen in the mid-high latitudes of the Northern Hemisphere. It would be interesting to investigate in which phase of the NAO these stronger storms develops and then analyze those that impact western and northern Europe (e.g. Mace Head) and a similar analysis could be done for the pacific storms. The authors show that at the end of the DI there can be O3 anomalies at the surface of 5 ppb. May an increased number of such strong storms (during NAO + ?) have an impact on baseline ozone and influence trends over western and northern Europe.

Minor comments

- I feel the introduction needs some further discussion. For example, the authors state that meteorological conditions play an important role in the intercontinental transport of pollutants citing a viewpoint (Akimoto, 2003) rather than the studies that have shown that. Here below I suggest some studies that would be relevant to discuss (in the last section of the manuscript as well) in relation to the intercontinental transport of pollutants and also in light of my previous comment on NAO.

Long range air pollutant transport in general: Duncan and Bey, 2004;Hess and Mahowald, 2009;Christoudias et al., 2012; Pausata et al., 2013.

Long range Ozone transport specifically: Lelieveld and Dentener, 2000; Creilson et al., 2003; Lamarque and Hess, 2004; Pausata et al., 2012.

See complete list of references below.

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- It is not completely clear to me the definition and the choice of the background averaged conditions. The authors should better clarify it.

- Some figures are too cluttered to be well understood. I would suggest: a) Reducing the number of panels specifically in figures 4, 5 and 6.

b) I would place the O3 in NP close to the O3 in NA and CO in NP close to CO in NA for a better comparison of the two basins.

c) Please fix the colorscale in some figures since one cannot distinguish the contours (e.g., Figs. 8 and 9).

d) In figures 2 and 3, are all 12 levels really necessary? For example, having the O3 concentration at 950-925 and 900 hPa does it add anything to the key message you want to convey?

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 27093, 2014.