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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice-nucleating particle versus ice crystal number concentration in altocumulus and cirrus embedded in Saharan dust: A closure study" *by* A. Ansmann et al.

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One of the case studies in this manuscript compelled me to offer some informal comments. A small group of scientists have been studying what we're calling dust-infused baroclinic storms (DIBS). What we found has been published in two papers.

https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016GL071801

https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2017JD027848

The DIBS phenomenon, I believe, bears directly on one of Ansmann et al.'s case study of 17 March 2015. In particular, the back trajectory from the dusty cirrus layer reveals

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Discussion paper

some critical aspects of the air mass history that may alter the paper's interpretation of the cloud and aerosol observed over Cyprus. The back trajectory indicates dramatic warm conveyor belt uplift prior to some hours of relatively level transport. We find in our cases that the RH along such trajectories also suggests cloud formation (RH increasing to >80%). When combined with geostationary and polar orbiting visible and IR imagery we were able to show that the ascending dust essentially entered the cloud base of the baroclinic storm, flowed through the storm cloud from its lowest (liquid) levels up to ice-only temperatures, infusing the cloud wth nucleation sites. The storm itself exhibits lots of peculiar physical and microphysical signals consistent with dust infusion all the way to the cloud top. The 17 March cirrus observation case is preceded by the "classic"DIBS signatures laid out in the above-referenced papers. E.g. the DIBS cirrus deck has a peculiar cellular texture (for reasons we still are trying to understand). Here's a view of the MODIS brightness temperature showing the cellular DIBS cloud north of Libya on 16 March, right along the Figure 11 back trajectory.

https://go.nasa.gov/2EjHvBL

By 17 March the residual DIBS cloud had expanded over southern Europe, all the way to Cyprus.

https://go.nasa.gov/2Eld9yy

My guess is that SEVIRI visible and IR imagery would enable a full reconstruction of that DIBS from formation on ∼15 March to the time of the 17 March observations. And unless I am letting my eyes fool me, I think I can discern a cellular nature in the lidar time series in Figure 5e-f (especially the depolarization ratio). We've seen the cellular structure in other lidar/radar depictions of DIBS. Here is an example:

https://www.eumetsat.int/website/home/Images/ImageLibrary/DAT_IL_10_02_11.html

The characterization in Ansmann et al. of this as a "long-lasting" cirrus cloud is consistent with the synoptic view of this DIBS cloud. According to the back trajectory (Fig.

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11), it might be argued that one is seeing an air mass involving ice and dust that traces back more than a day, when the air was flowing through the WCB and inside clouds of liquid and then ice.

One of the aspects of DIBS that the EUMETSAT folks have been documenting is a cloud lifetime effect of these "dusty cirrus."

https://www.eumetsat.int/website/home/Images/ImageLibrary/DAT_3008816.html

Maybe the long-lasting dusty cirrus over Cyprus on 17 March 2015 was also holding on longer than expected? I'd be curious to get the authors' thoughts on the DIBS perspective and whether it further informs their understanding of the ice-

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