Contribution ID: **23** Type: **Poster**

How does microphysical phase relate to cloud morphology transition speed within cold-air outbreaks over the northwest Atlantic?

Tuesday, 17 May 2022 12:33 (2 minutes)

Cold-air outbreaks off of the eastern US seaboard provide dramatic visual examples of cloud morphological transitions from closed-cell to more open-celled circulations. Space-based lidar and radar indicate the transitions typically involve mixed-phase clouds and precipitation, but may also remain liquid-only at times. Because the air flow moves over the Gulf Stream, significant surface turbulent fluxes also contribute to cloud deepening encouraging cloud break-up through entrainment. Cloud condensation nuclei (CCN) concentrations can also vary depending on an anthropogenic pollution loading, encouraging aerosol indirect effects on liquid-bearing clouds and perhaps affecting differences in ice production. Previous work on subtropical stratocumulus indicates high cloud LWPs support morphological transitions by encouraging precipitation and CCN depletion. Mixed-phase processes add further complexity to these mid-latitude transitions, for example larger droplets are typically thought to glaciate more quickly. The importance of mixed-phase processes relative to liquid-only processes remain uncertain.

Here we make use of recent aircraft measurements over the northwest Atlantic to make detailed fetch-dependent characterizations of five cold-air outbreaks as a function of distance from the cold edge of the Gulf Stream. The leading question is to determine which of the influences on the cloud transition are dominant, and, if so, if the parameters determining whether a transition is fast versus slow can be identified. The five cold-air outbreaks were sampled in March 2020 and January-March of 2021 by the NASA ACTIVATE campaign. The flight strategy is to fly two planes in tandem, with a lower plane making in-situ microphysical measurements and an upper plane making remote measurements using a lidar and imager and deploying dropsondes. The five cases encompass a representative phase space of conditions. The plane fully sampled two fast transition cases (determined subjectively) with different stratiform cloud liquid water paths (LWPs), and a third in which the (fast) transition region was beyond the reach of the plane. Two slower transition cases also differed in their stratiform cloud LWPs. We will ascertain the range of variability in the in-situ cloud and precipitation microphysics of the five examples. Of interest is how mixed-phase characteristics relate to the cloud LWP, if observed variability in upwind CCN concentrations can be distinguished from macrophysical (LWP) controls on the transition speed, and if ice production related to droplet size can affect the transition speed.

Primary authors: ZUIDEMA, Paquita (University of Miami); Dr CHELLAPPAN, Seethala (University of Miami)

Co-authors: THE ACTIVATE SCIENCE TEAM; KIRSCHLER, Simon (DLR)

Presenters: ZUIDEMA, Paquita (University of Miami); Dr CHELLAPPAN, Seethala (University of Miami); THE ACTIVATE SCIENCE TEAM; KIRSCHLER, Simon (DLR)

Session Classification: Poster pitches