A26C-08 - An LES Survey of Cold-Air Outbreaks Spanning ACTIVATE and COMBLE (Invited)

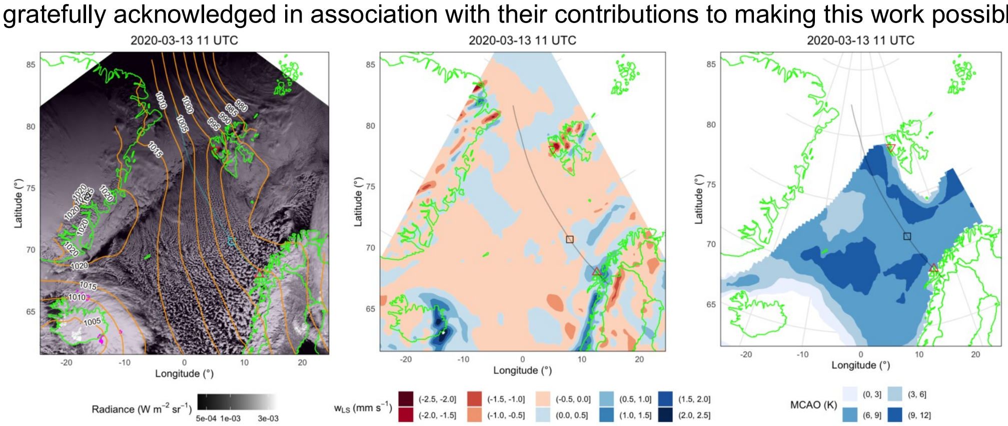
Tuesday, 13 December 2022

18:55 - 19:05

E258 (Lakeside, Level 2, McCormick Place)

Abstract

Two recent field campaigns offer unique new opportunities to survey coupled aerosol and cloud processes operating within cold-air outbreaks (CAOs). NASA's 2019-2023 Aerosol Cloud meTeorology Interactions oVer the western Atlantic Experiment (ACTIVATE) project provided airborne in situ and remote sensing observations in multiple CAOs off the central US Eastern Seaboard. Contemporaneously, DOE's 2019-2020 Cold-air Outbreaks in the Marine Boundary Layer Experiment (COMBLE) provided continuous ground-based in situ and remote sensing measurements during hundreds of hours of CAO conditions at two sites flanking the Norwegian Sea. Here we highlight lessons learned from contrasting sets of aerosol-aware Lagrangian large-eddy simulation case studies derived from each campaign, as well as outstanding uncertainties. Cases simulated include all of the most extensively sampled CAO flights during ACTIVATE, and a wide range of CAO strengths and mesoscale structures during COMBLE. Each case study is also suitable for simulation with large-scale models in single-column model mode or with a limited-domain approach using periodic boundary conditions. We seek to address the central question: what microphysical process pathways control the Lagrangian evolution of surface and top-of-atmosphere radiative fluxes under ACTIVATE and COMBLE conditions? Many science team members, co-investigators, and collaborators will be gratefully acknowledged in association with their contributions to making this work possible.



Plain-language Summary

The widespread, long-lived meteorological conditions associated with cold air flowing from land or ice surfaces onto relatively warm ocean waters are commonly referred to as cold-air outbreaks (CAOs). Because climate models are known to have poor skill in correctly simulating CAO clouds, recent NASA and DOE field campaigns gathered extensive new measurements off the central US east coast and west of Norway, respectively. In this work, we use the field campaign measurements and ancillary data to initialize and evaluate a variety of very high-resolution and detailed large-eddy simulations (LES). We then evaluate what processes are most important for climate models to represent properly in order to improve their simulation of CAO clouds. Our simulation framework is also suitable to directly test the capability of climate model physics schemes to reproduce the detailed LES results under that variety of CAO conditions.

First Author

F

Ann M Fridlind
NASA Goddard Institute for Space Studies

Authors

T

Florian Tornow
NASA Goddard Institute for Space Studies

A

Andrew S Ackerman
NASA Goddard Institute for Space Studies

Scientific Team

ACTIVATE and COMBLE Field Campaign Science Teams

View Related