Background

- The Southeast Atlantic Ocean is characterized by a marine stratocumulus cloud system that interacts with plumes of biomass burning aerosol from southern Africa
- Models, including GEOS, struggle to accurately represent this complex regime
- NASA’s Observations of Aerosols above Clouds and their interactions (ORACLES) campaign provided an opportunity to sample the environment and evaluate the meteorology and aerosols within GEOS

A modified version of the QG-omega equation is used to isolate model processes that may contribute to the excessive subsidence

\[ \frac{\partial}{\partial t} \left( \nabla^2 + f^2 \frac{\partial^2}{\partial \phi \partial \theta} \right) \omega = \frac{f_0}{\sigma} \frac{\partial}{\partial \theta} \left[ v_g \cdot \nabla (\zeta_g + f) \right] + \frac{1}{\sigma} \nabla^2 v_g \cdot \nabla \left( -\frac{\partial \Phi}{\partial \theta} \right) + \text{IAU} \]

vorticity advection + thermal advection + heating + "nudging"

- Please see the corresponding iPoster for a more detailed analysis and conclusions

Diabatic Heating Due to Biomass Burning Aerosol

- Metrology was free-running in two ensembles of 24 simulations using GEOS v10.22.0 in which a control ensemble was compared to an ensemble with radiatively inactive black and brown carbon
- Aerosol emissions included biomass burning emissions from QFED v2.5r1 and anthropogenic emissions from CEDS v2021_04_21

Heating due to biomass burning aerosol reduces upward vertical motion, and reduces the subsidence rate of the aerosol plume, over the Southeast Atlantic Ocean. There is no statistically significant change to horizontal winds.

"Replaying" Meteorology to Reanalyses

- A version of GEOS with updated model physics relative to MERRA-2 was run with meteorology "replayed" to MERRA-2 and ERAS.
- ERAS has previously been shown to agree well with observations of specific humidity from ORACLES (Pistone et al., 2021).
- Comparisons are made to aircraft data collected as part of ORACLES-1 in 2016

An anomalous circulation is present in MERRA-2 along the coastline of Angola such that upward motion is too strong over land and downward motion is too strong over the ocean.

This is coupled with temperature biases.

References

