Aerosol impacts for convective parameterizations: Recent changes to the Grell-Freitas Convective Parameterization

Hannah Barnes\textsuperscript{1,2}, Georg Grell\textsuperscript{2}, Saulo Freitas\textsuperscript{3,4}, Haiqin Li\textsuperscript{1,2}, Judy Henderson\textsuperscript{2}, and Shan Sun\textsuperscript{2}

\textsuperscript{1}University of Colorado - Boulder, Cooperative Institute for Research in Environmental Sciences at the University of Colorado Boulder, Boulder, United States of America
\textsuperscript{2}NOAA Global Systems Laboratory, Boulder, United States of America
\textsuperscript{3}Universities Space Research Association, Washington, D.C., United States of America
\textsuperscript{4}NASA/GSFC Global Modeling and Assimilation Branch, Washington, D.C., United States of America

The Grell-Freitas (GF) cumulus parameterization is an aerosol-aware, scale-aware convective parameterization. This presentation will focus on one of the several developmental activities ongoing in GF: the continued development of its aerosol-aware capabilities and the impact in global forecast models.

Previous versions of GF initialized aerosols based on an assumed value of aerosol-optical depth (AOD) that was applied uniformly across the entire globe. Observations of AOD indicate that AOD varies substantially across the globe. Recently, the constant AOD value assumed in GF has been replaced by global AOD data from NASA's MERRA2 reanalysis. Thus, the distribution of aerosols at initialization more physically reasonable and geographically appropriate. This is important since the treatment of aerosols in GF should be most sensitive in regions with either very high or very low AOD. This method is extremely efficient, but can be adapted so that other aerosol and AOD products can be used in GF. Other products that could be used for initialization include the aerosol climatology used by the Thompson Aerosol-Aware Microphysical Parameterization or predicted aerosols using NOAA's aerosol prediction model, which is currently one ensemble in the Global Ensemble Forecast System – Aerosols (GEFS-Aerosols).

GF includes three aerosol related cloud processes: aerosol-influenced evaporation, aerosol-influenced auto-conversion of cloud water to rain water, and aerosol wet scavenging based on memory. As in Wang (2013) the treatment of wet scavenging has been modified so that the aerosol wet scavenging efficiency is proportional to precipitation efficiency. Additionally, aerosols in GF are now allowed to slowly return to their original concentrations during precipitation-free periods. These changes are important since they allow the aerosols in GF to evolve over time in a physically realistic manner.

The impact of these changes to GF will be shown in a version of NOAA's operational global prediction model.