Sensitivity of Parameterized Dust Emissions to Model Resolution
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Abstract
Wind-blown dust from the Sahara desert has the potential to propagate over the Atlantic Ocean as part of the Sahara Air Layer (SAL). The dry, warm, and dusty SAL can interact with tropical storms, and thus may be an important factor in tropical cyclone genesis. Dust emission parameterizations are important to model simulation/forecast results and are dependent on model-predicted wind speeds, which are influenced by model resolution. Therefore, the primary objective of the study is to improve emission schemes in a Weather Research and Forecasting (WRF) tracer model. To isolate the influence of model resolutions on dust emission, assimilation of observations, including COSMIC RO data, will be performed in order to improve model initial

Emission Parameters

- Several different emission schemes will be used (not all shown).
- They each parameterize the vertical dust flux differently.
- Emission schemes have dependence on different variables.

Ackerley et. al.

\[ F = Q_0 \times 10^{13.6F_0 \cdot 10^{-6}} \times S_{me} \times GT \]

\[ Q_0 = \frac{2.61 \times 10^{-10} \cdot \rho_{cl} \cdot \rho_{s}}{s} \left( 1 + \frac{s}{U_{fr}} \right) \left( 1 - \frac{U_{hi}}{U_{fr}} \right)^{1/2} \]

Shao et. al.

\[ F = \int_{0}^{\infty} \int_{0}^{\infty} F(D, DS, u) \, p(D) \, p(DS) \, dD \, dDS \]

\[ u_{ef} = \frac{N}{g} \int_{0}^{\infty} \left( \frac{g \cdot DS}{\mu_{c}} \right) F(D, DS, u) \, dD \]

Validation of Results

The Moderate Resolution Imaging Spectrometer aboard Terra and Aqua satellites, provides retrievals of aerosol optical depth (Figure 2). These retrievals can provide information about the spatial distribution of dust, as well as the concentration of dust. This will allow for assessment of model performance. Additionally, data from the NASA African Monsoon Multidisciplinary Analysis field experiment will be used to validate the model dust production.

Tracer Model and Experiment Design

WRF has been modified to include dust as an interactive tracer; The model includes dust-radiation interactions, as well as dust-microphysics interactions. Correctly calculating the magnitude and location of dust emission fluxes is essential in studying the impacts of dust on mesoscale phenomena (e.g. tropical cyclones), as well as in other applications such as climate research. Different combinations of model resolutions and emissions parameterizations will be tested to examine the dependence of the dust emission flux on model resolution. Cases will be chosen to examine the effectiveness of emission parameterizations for different weather phenomena.

Data Assimilation of RO

Retrievals of refractivity profiles, as well as other satellite data, will be assimilated to improve model-predicted wind fields and instability. These will allow more accurate prediction of the emission and transport of dust. Locations of refractivity profiles are shown for August 19th, 2006 (Figure 1).

References


