MUSICActivities

NCAR ACOM

Newsletter

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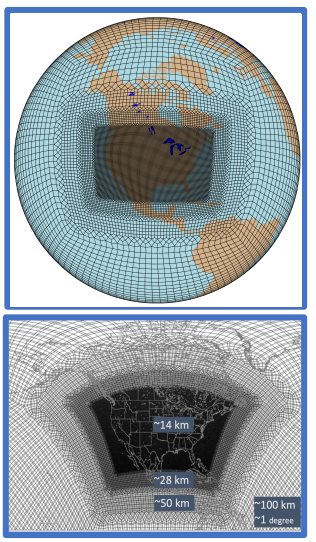
of the Multiscale Infrastructure for Chemistry and Aerosols - MUSICA

MUSICA is a computationally feasible global modeling framework currently in development that allows for the simulation of large-scale atmospheric phenomena, while still resolving chemistry at emission and exposure relevant scales (down to ~4 km). MUSICA will eventually replace and extend the current separate community chemistry modeling efforts at NCAR (e.g., WACCM, CAM-Chem, WRF-Chem) paralleling other activities at NCAR to streamline and unify model developments.

Summary

In this issue of our newsletter you will find information on:

- Links to MUSICA outputs and tutorial lectures
- MUSICA Air Quality simulations during fire events
- CAMP - An integrated multi-phase chemistry model
- Community workshops



MUSICAv0 is an initial configuration based on the CESM Community Atmosphere Model with chemistry (CAM-Chem) using the Spectral Element (SE) with Regional Refinement (RR) dynamical core.

MusicBox is a box model using a model independent chemistry module.

MELODIES is a modular framework to compare model results and observations of atmospheric chemistry.

To contribute to the newsletter, please email alma@ucar.edu

MUSICA Developments

MUSICA Online Tutorial Series

The tutorial series have been completed for various MUSICA tools:

- November 12: How to use MUSICAv0 output
- December 10: How to run MUSICAv0
- January 14: How to create your own variable resolution grid
- March 11: Introduction to the MELODIES MONET software
- April 8: How to use MusicBox

The tutorial videos and presentations are available at:
https://www2.acom.ucar.edu/workshop/musica-tutorial-2021

MUSICAv0 is available for the community

MUSICAv0 has been released as a configuration of CAM-chem in CESM2.2.0, with a refined grid over the continental U.S. Guidance on getting started running MUSICAv0 is available on the MUSICA wiki page:

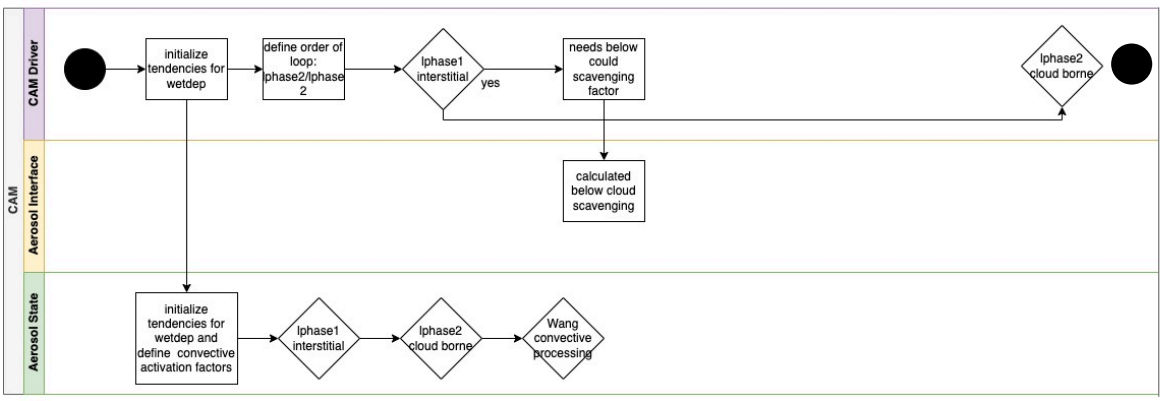
https://wiki.ucar.edu/display/MUSICA/MUSICA+Home

Output from a simulation of MUSICAv0 is available for 2012-2013 at:

https://sima.ucar.edu/simulations/chemistry/

Swimlane diagrams to interface aerosol modules with the dynamical core of CAM

An example of swimlane for aerosol wet deposition



MUSICA Science

Effects of fire diurnal variation and plume rise on U.S. air quality during FIREX-AQ and WE-CAN based on the Multi-Scale Infrastructure for Chemistry and Aerosols (MUSICAv0)

Contributed by **Wenfu Tang** *(wenfut@ucar.edu)*
NCAR/ACOM, Boulder, CO
Submitted to Journal of Geophysical Research: Atmospheres, Feb 2022

In short

This paper explores the impact of the diurnal cycle and vertical distribution of fire emissions using MUSICAv0, which is configured with 14-km horizontal resolution over the contiguous U.S. and 1-degree resolution over the rest of the world. Results from MUSICAv0 are evaluated with satellite products, U.S. EPA Air Quality System surface measurements, and aircraft observations taken during the NASA FIREX-AQ and NSF WE-CAN field campaigns, which took place during the summer of 2019 and 2018, respectively.

Wenfu Tang

Wenfu graduated from the University of Arizona in 2019. She came to NCAR as an ASP postdoc and is now a Project Scientist I.

Wenfu's research focuses on understanding fire and anthropogenic emissions, and their impacts on atmospheric composition, using satellite retrievals, field measurements, models, and data assimilation. She has a particular research interest in the Africa domain.

Findings

The study shows that including both the diurnal cycle of fire emissions and a plume-rise parameterization improved the MUSICAv0 predictions of surface PM2.5 and mid-troposphere CO and NOx. The impact of including a plume-rise parameterization is larger than the impact of the diurnal cycle of fire emissions. Besides affecting air quality in fire impacted regions, both the diurnal cycle of fire emissions and plume-rise parameterization impacted local-to-regional meteorology and chemical reaction rates and the plume-rise parameterization greatly enhanced modeled long-range transport of fire-emitted pollutants.

Presented at the AGU 2021 Fall Meeting
https://agu.confex.com/agu/fm21/meetingapp.cgi/Paper/960318

MUSICA-related community developments

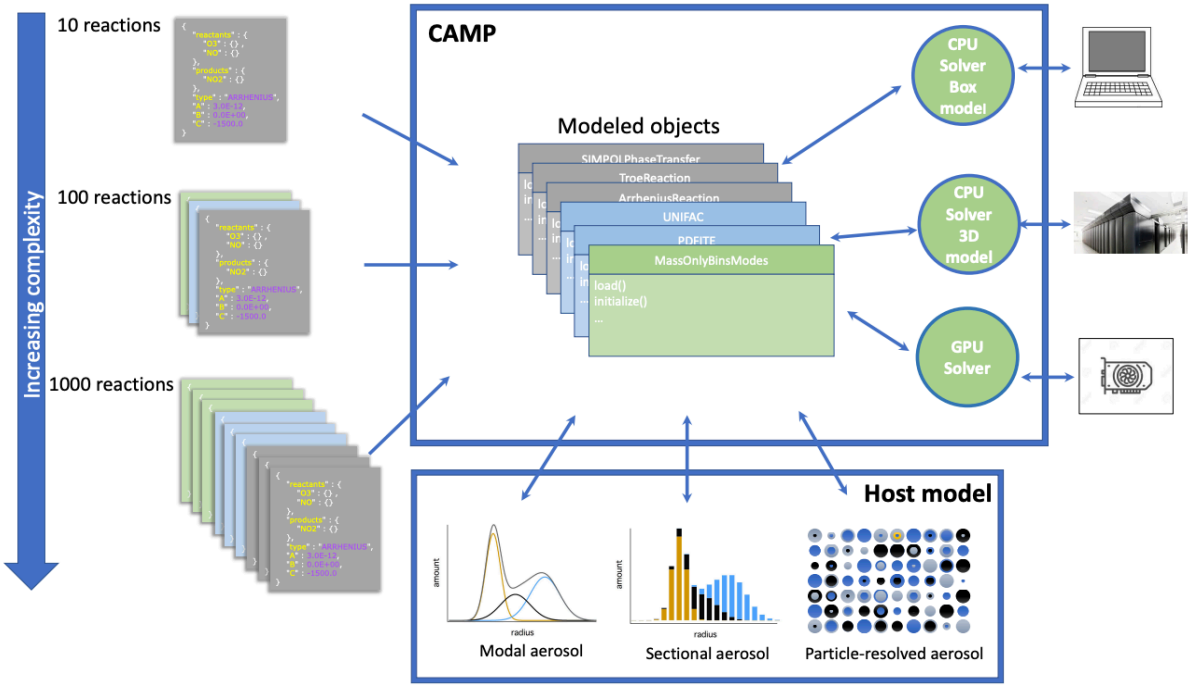
Chemistry Across Multiple Phases (CAMP) version 1.0: An integrated multi-phase chemistry model

Contributed by **Matthew L. Dawson** (mattdawson@ucar.edu)
Work performed under Dr. Jorba at the Barcelona Supercomputing Center, Barcelona, Spain
Accepted in the Journal of Geoscientific Model Development in February 2022
https://gmd.copernicus.org/preprints/gmd-2021-370/gmd-2021-370.pdf

About the author: Matthew L. Dawson

Matthew joined NCAR as a Software Engineer in 2020, after completing his Postdoc at the Barcelona Supercomputing Center. Matthew graduated from UC Irvine in 2015. He is playing a key role in developing MICM and MusicBox and is now leading the project management of the MUSICA technical model development.

In short: Progress in identifying complex, mixed-phase physicochemical processes has resulted in an advanced understanding of the evolution of atmospheric systems but has also introduced a level of complexity that few atmospheric models were designed to handle. This study presents a novel flexible treatment for multi-phase chemical processes for models of diverse scale, from 0d box to 3D global models. This enables users to build a customized multiphase mechanism that is accessible to a much wider community. This framework is illustrated below.



Community workshops

GIANT: Generallzed Aerosol/chemistry iNTerface

- Natalie Mahowald (Cornell U.), Alma Hodzic (NCAR), and several others are organizing community activities to develop a general set of requirements for aerosol-chemistry interfaces within weather and climate models, so that we can more easily move modules from one atmospheric model to another.
- The first virtual workshop was held on February 16. About 70 participants discussed processes to be considered for this interface, its complexity and requirements.
- The next steps will consist in developing software engineering solutions. A synchronous and asynchronous HACKATHON will take place on **April 29 and May 6 from 1-3pm ET.** If you are interested in attending or contributing to, please register here and answer these questions:

  https://docs.google.com/forms/d/e/1FAIpQLScMV_CJplXRbyvoBUJSP8nNjZ7dIBC99fEPCAJBwMTaiM56QQ/viewform?usp=sf_link

Workshop on Ozone Dry Deposition

- Olivia Clifton (NASA GISS), Arlene Fiore (MIT) and Louisa Emmons (NCAR) held a virtual workshop on ozone dry deposition on **March 28 & 30**. The participants worked on :

  1) identifying recent advances in incorporating process understanding of ozone dry deposition into local-to-global models

  2) establishing future priorities for multi-scale modeling ozone dry deposition.

- A workshop summary is being prepared. Please contact Olivia, Arlene or Louisa if you are interested in learning more about the workshop and participating in future model development and science studies.

2022 CESM workshop will take place June 13-16, 2022

For registration refer to: https://www.cesm.ucar.edu/events/workshops/2022/

More information can be found at the MUSICA web page:
https://www2.acom.ucar.edu/sections/multi-scale-chemistry-modeling-musica