WRF: Overview and Capabilities for Dispersion Modeling Applications

Paul E. Bieringer and Daniel F. Steinhoff

Research Applications Laboratory, National Center for Atmospheric Research, Boulder, CO 80301

ATMOSPHERIC MODELING

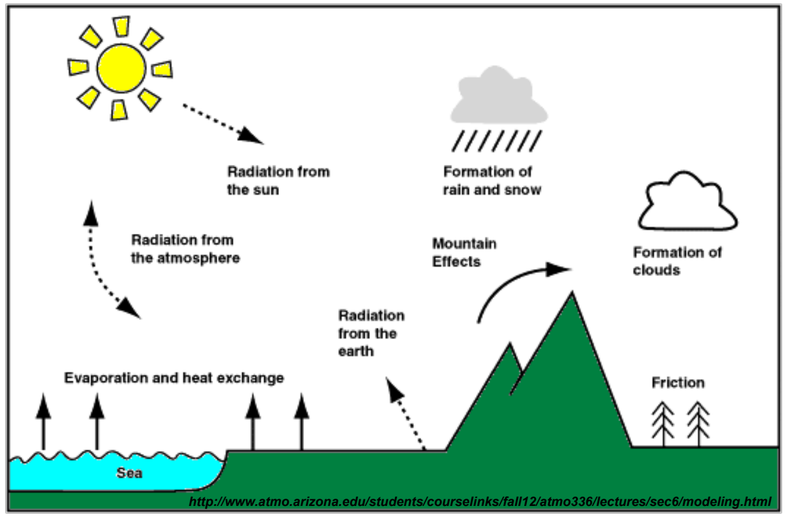
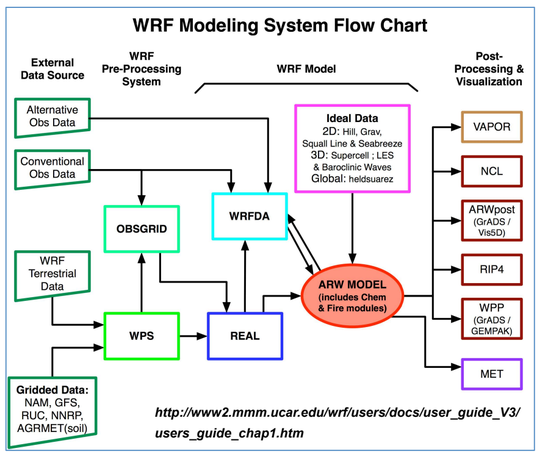


Figure 1. Some of the interactions in an atmospheric model

- **Atmospheric models are based on fundamental mathematical relationships that describe the dynamics and the physics of the atmosphere**

WEATHER RESEARCH AND FORECASTING MODEL (WRF)

- **WRF is a state-of-the-art atmospheric model that can be used for research and forecasting applications**
- **Both real-world and idealized simulations possible, on a wide range of spatial scales**
- **Several options for *physical parameterization* of processes that are either too small or too complex to be explicitly simulated**



http://www2.mmm.ucar.edu/wrf/users/docs/user_guide_V3/users_guide_chap1.htm

Figure 2. Schematic diagram of the WRF modeling system

DATA ASSIMILATION

- **Data assimilation is an analysis method where information from observations is accumulated over a period of time into a model state**
- **The goal is to produce the best possible initial conditions using available observations and background state**

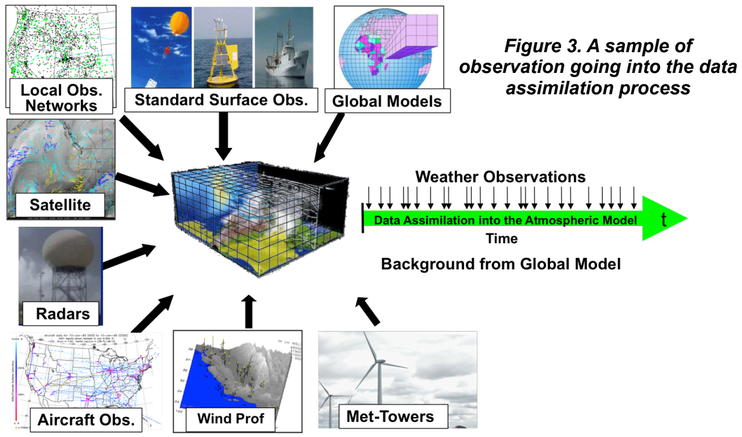
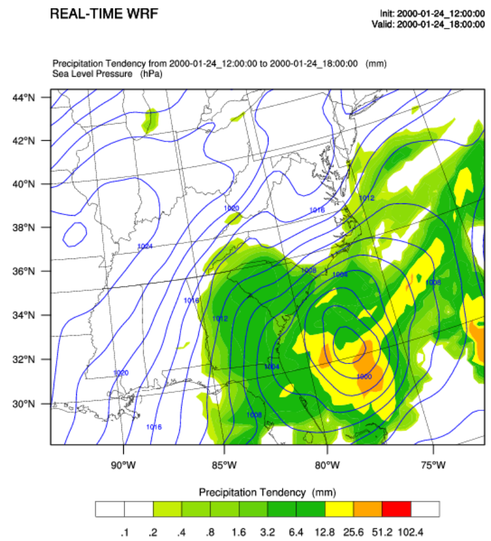


Figure 3. A sample of observation going into the data assimilation process

OPERATIONAL APPLICATIONS

- **WRF is used for real-time operational forecasting applications by groups around the world**

Figure 4. An example of output from a real-time WRF simulation



http://www2.mmm.ucar.edu/wrf/OnLineTutorial/Graphics/NCL/Examples/PRECIP/wrf_Precip.htm

LARGE EDDY SIMULATION (LES)

- **LES appropriate for local scale modeling (~ 50 m), to better model near-surface flow and surface fluxes**
- **With LES, large turbulent eddies (those with substantial energy and fluxes) are explicitly resolved. Smaller eddies are parameterized**
- **For real-world applications, one approach is to nest LES in a mesoscale simulation, to provide realistic lateral boundary conditions**

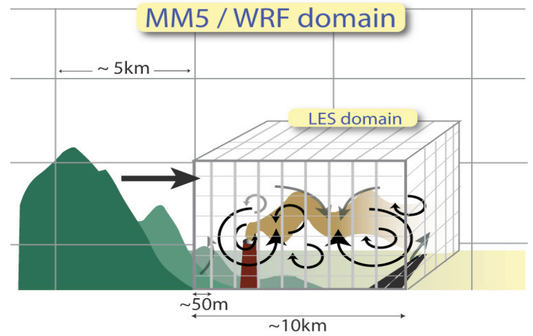


Figure 5. Nesting of an LES domain in a mesoscale domain

http://www2.mmm.ucar.edu/wrf/users/workshops/WS2011/Power%20Points%202011/Monday-LES-Moeng.pdf

WRF-LES DISPERSION MODELING

- **Modifications have been made by NCAR to add highly configurable passive tracers (location, time, concentration) for T&D modeling applications. Representative source term concentrations can be implemented into the model**

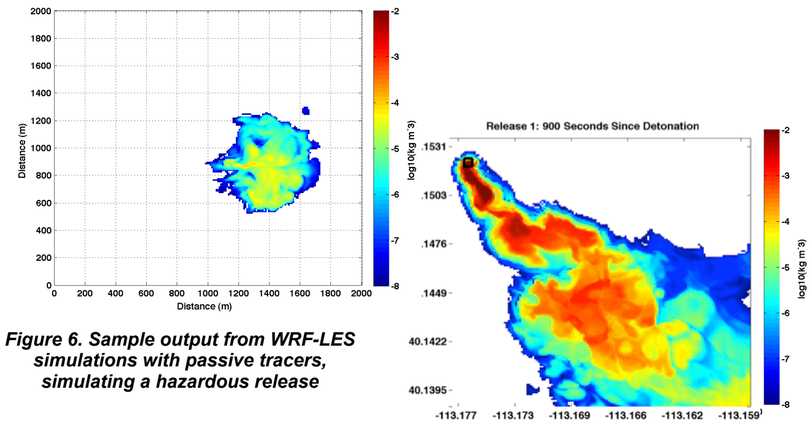


Figure 6. Sample output from WRF-LES simulations with passive tracers, simulating a hazardous release