

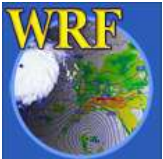


Considerations for Designing an Numerical Experiment

Wei Wang

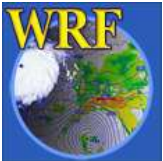
NCAR/NESL/MMM

January 2014

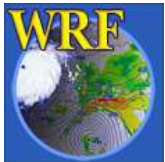
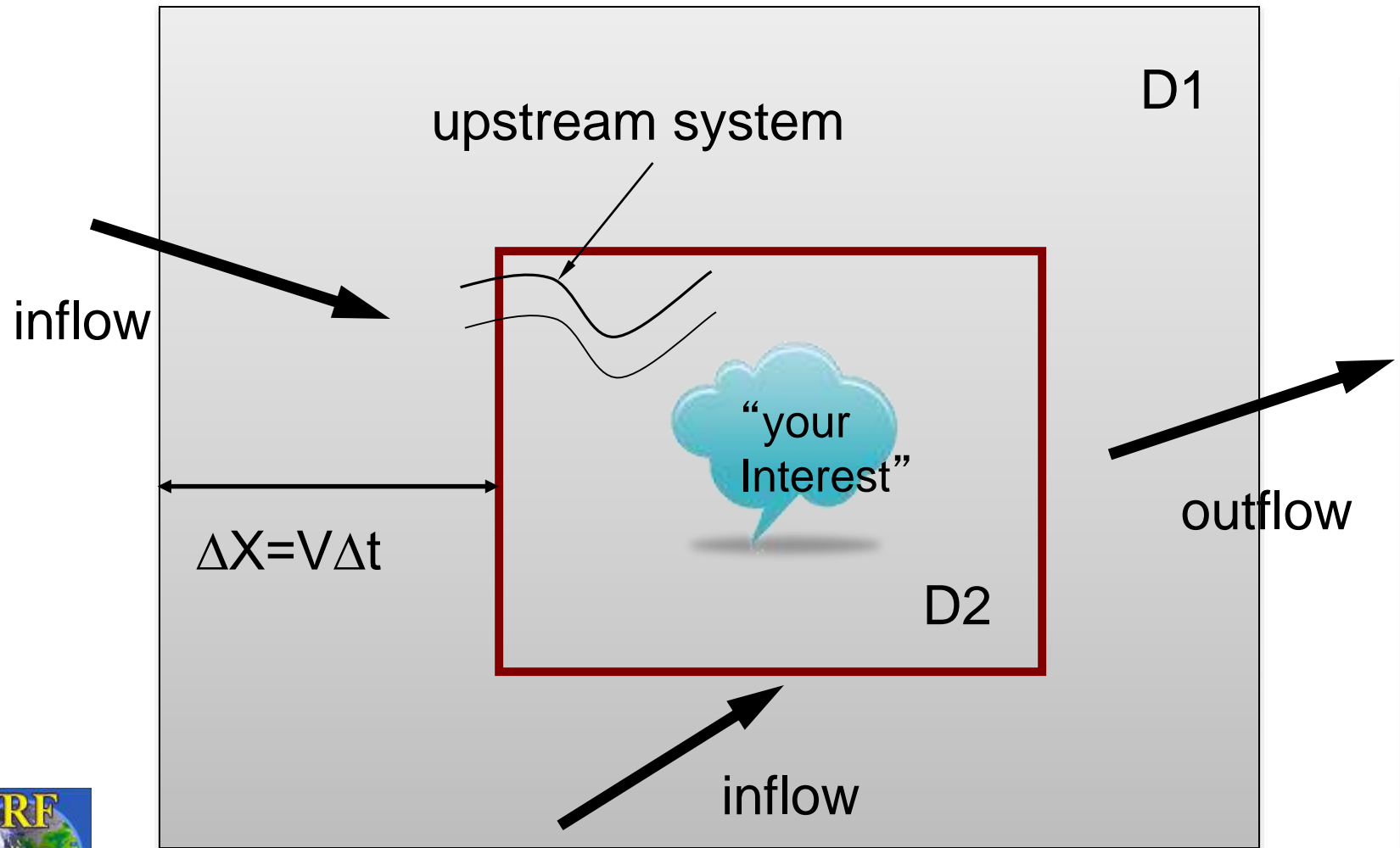


Domains

- In general,
 - IC is more important for simulations of a few days;
 - BC is more important for longer simulations.
- How large do they need to be?
 - Should not be too small, otherwise solution will be determined by forcing data
 - No less than 100x100 (at least 10 grid points are in the boundary zone)
- Where to place my lateral boundaries?
 - Avoid steep topography
 - Away from my interest

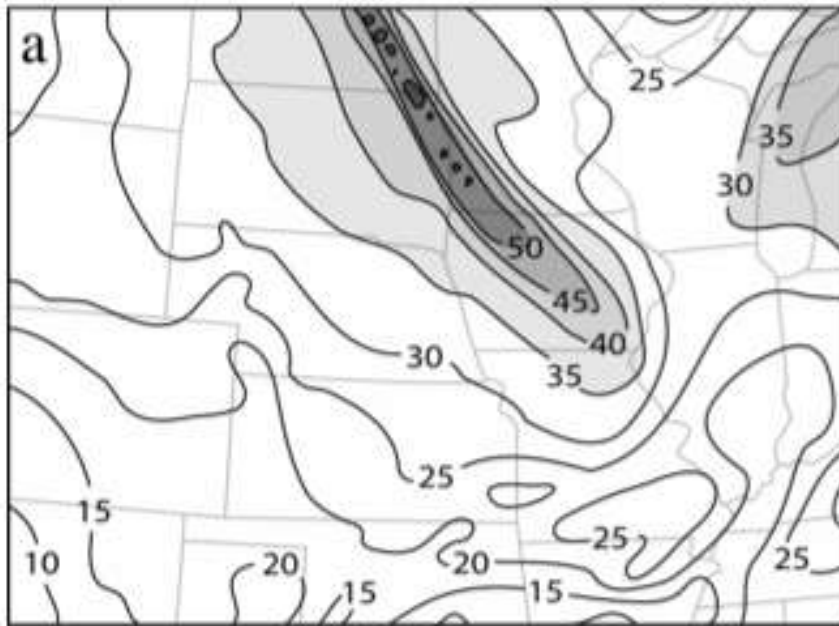


Note on Configuring Domains: Horizontal

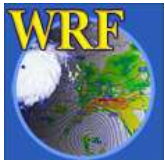
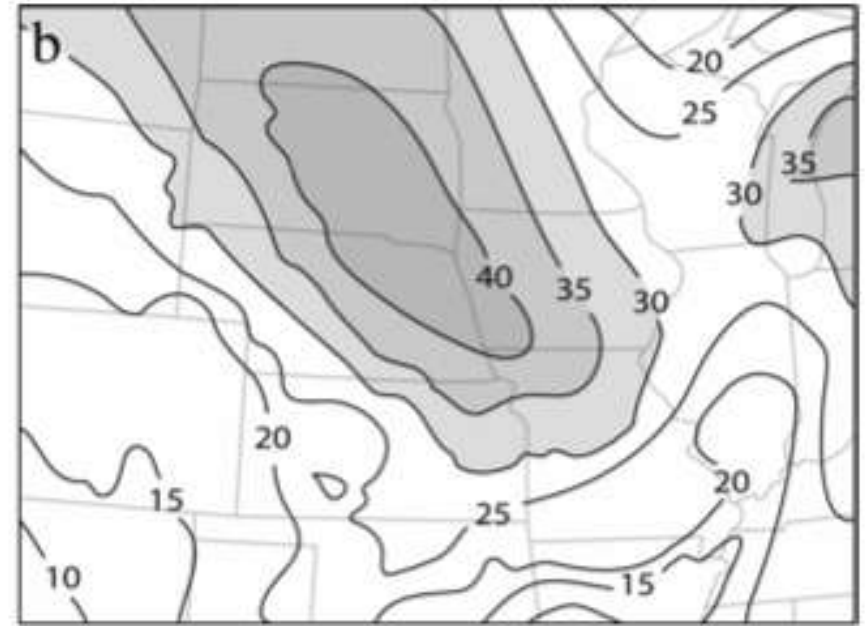


Note on Configuring Domains: Horizontal

Large regional domain

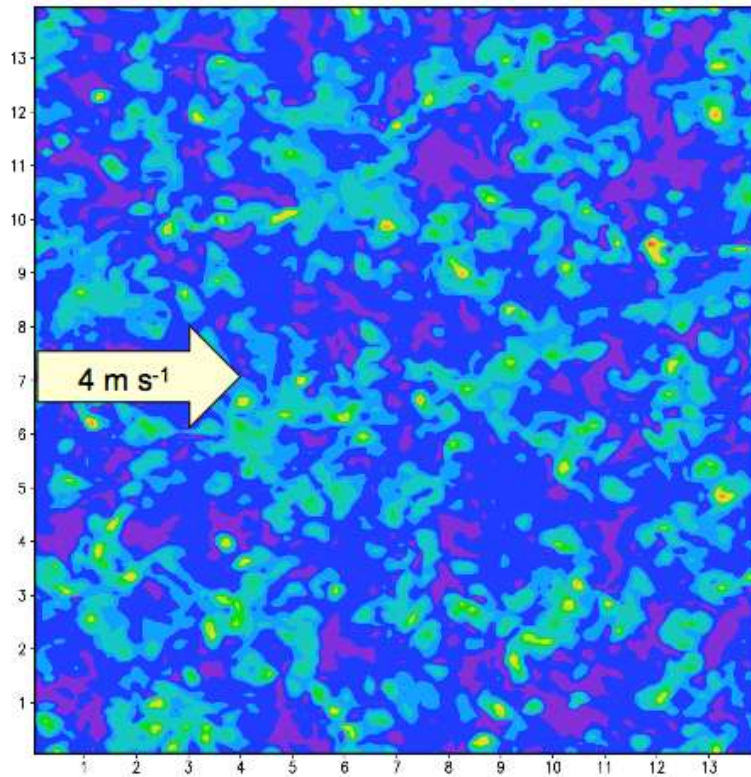


Smaller regional domain



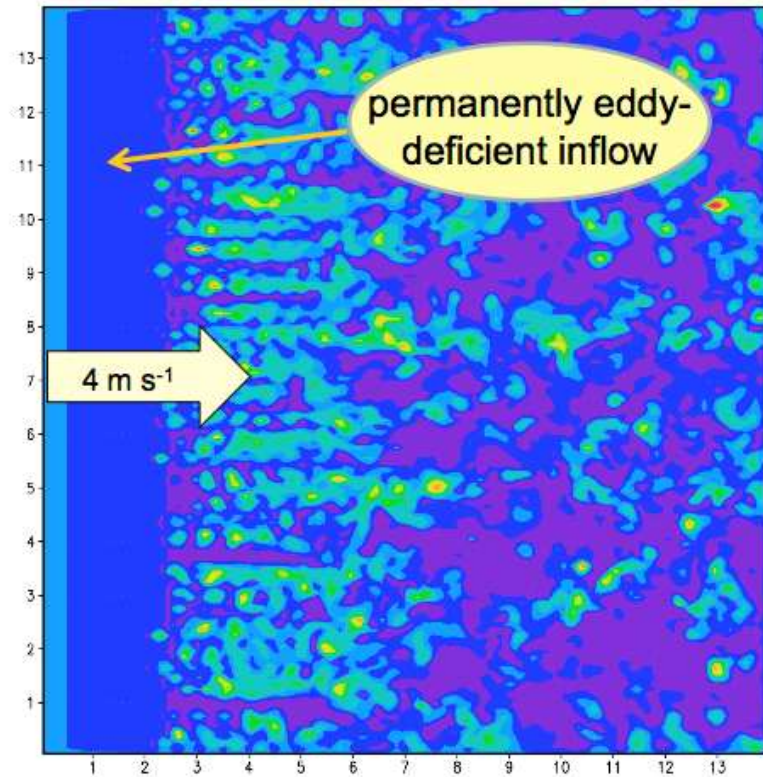
(From Warner, 2011)

Note on Configuring Domains: Horizontal

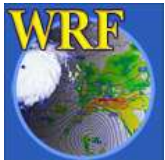


1 km ●—●

periodic LBCs



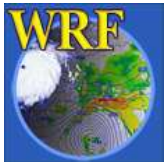
non-periodic LBCs



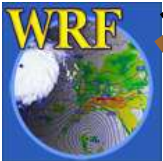
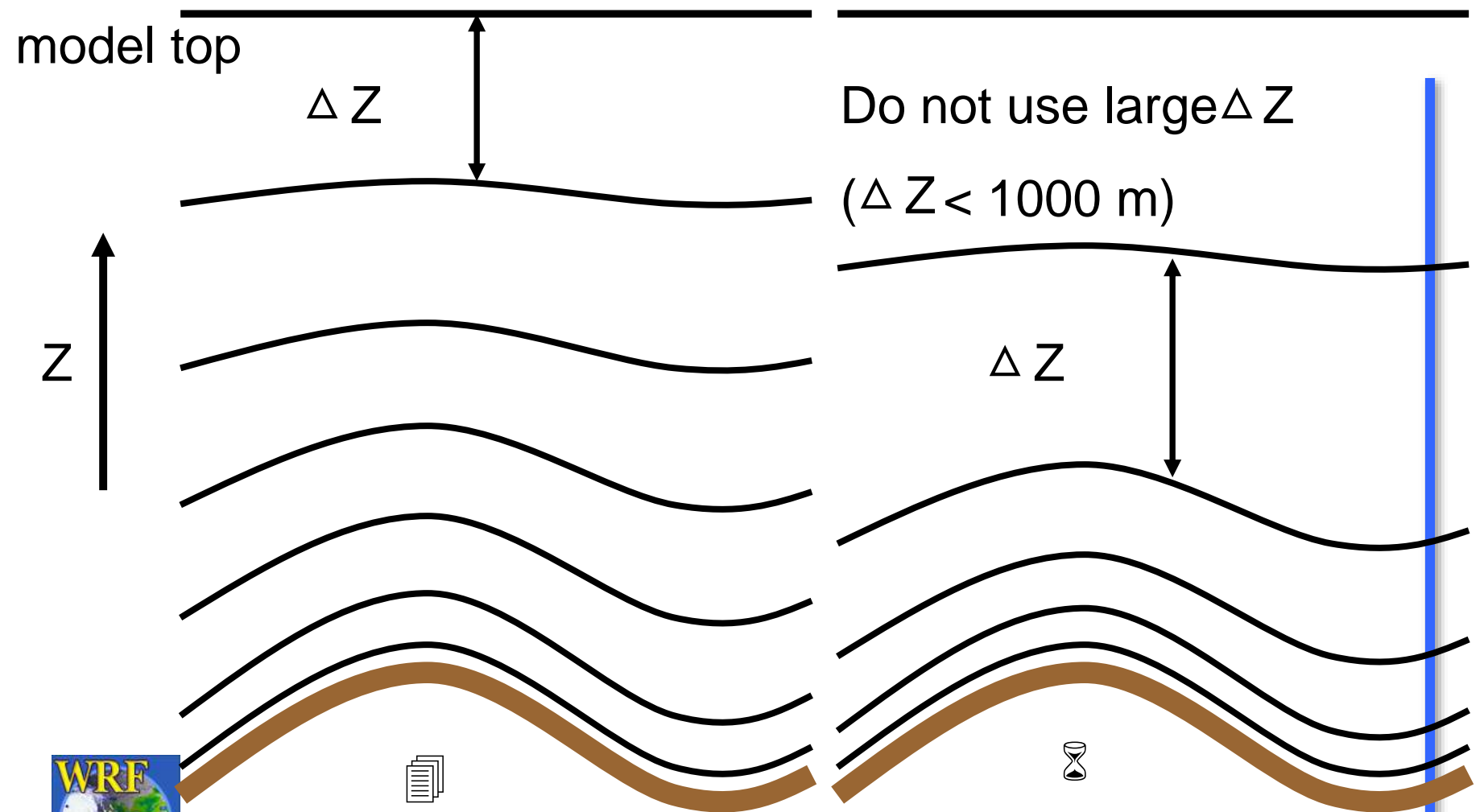
From Gaudet et al. WRF Users' Workshop 2012, talk 3.5

Domains

- How many vertical levels should I use?
 - At least 30 or more levels
 - Vertical grid distance should not be larger than 1000 m:
 - Radiation, microphysics, less accurate lateral BDY
 - Related to horizontal grid size too: if finer horizontal grid size is used, consider adding a few more levels in the vertical

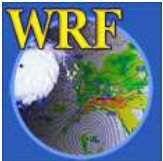


Note on Configuring Domains: Vertical



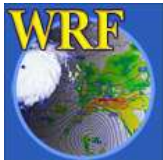
Nests:

- When should I use nests?
Some of the reasons may be:
 - Input data resolution is too coarse
 - Input data may not be adequate as LBC
 - There isn't sufficient computing resources
- Nest domain sizes should not be too small;
- Nest boundary should be kept away from coarse domain boundary, and steep topography.



Input Data

- Check land data:
 - e.g. landuse: *does it represent my area well?*
- Know about the data: *how good are the data?*
 - Forecast data
 - Reanalysis data
 - Climate model data
- How frequent do I need to have boundary conditions?
 - More frequent is better

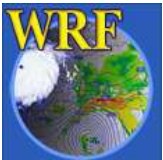


Model Options

- What do I start with?
 - What other people have success with?
 - References, papers
 - Simple options first:

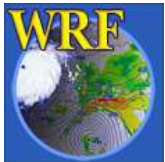
For example,

 - Graupel may not be important if $dx \gg 10$ km
 - mixed layer ocean model may not be needed if the modeled track isn't correct
 - Use analyses from weather centers before trying to create your own (via either *obsgrid* or DA) for both initial and lateral boundary conditions



Bottomline..

- Model results can be affected by many choices:
 - Domain configuration, both horizontal and vertical;
 - Input data;
 - Lateral boundary conditions.
- Model has limitations:
 - Physics: biases, may not handle certain process well, etc.
- Always check the output from each program



References:

Numerical Weather and Climate Prediction, 2011. By Thomas Warner, *Cambridge University Press*.

Warner, T., 2011. Quality assurance in atmospheric modeling. *Bull. Amer. Met. Soc. Dec. issue, p1601 – 1611.*

Stensrud, D., 2007. Parameterization Schemes: Keys to Understanding Numerical Weather Prediction Models. *Cambridge University Press*.

Haltiner G. and R. Williams, 1980. Numerical Prediction and Dynamic Meteorology. *Wiley*.

