Considerations for Designing an Numerical Experiment

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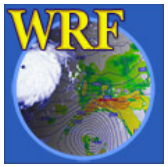
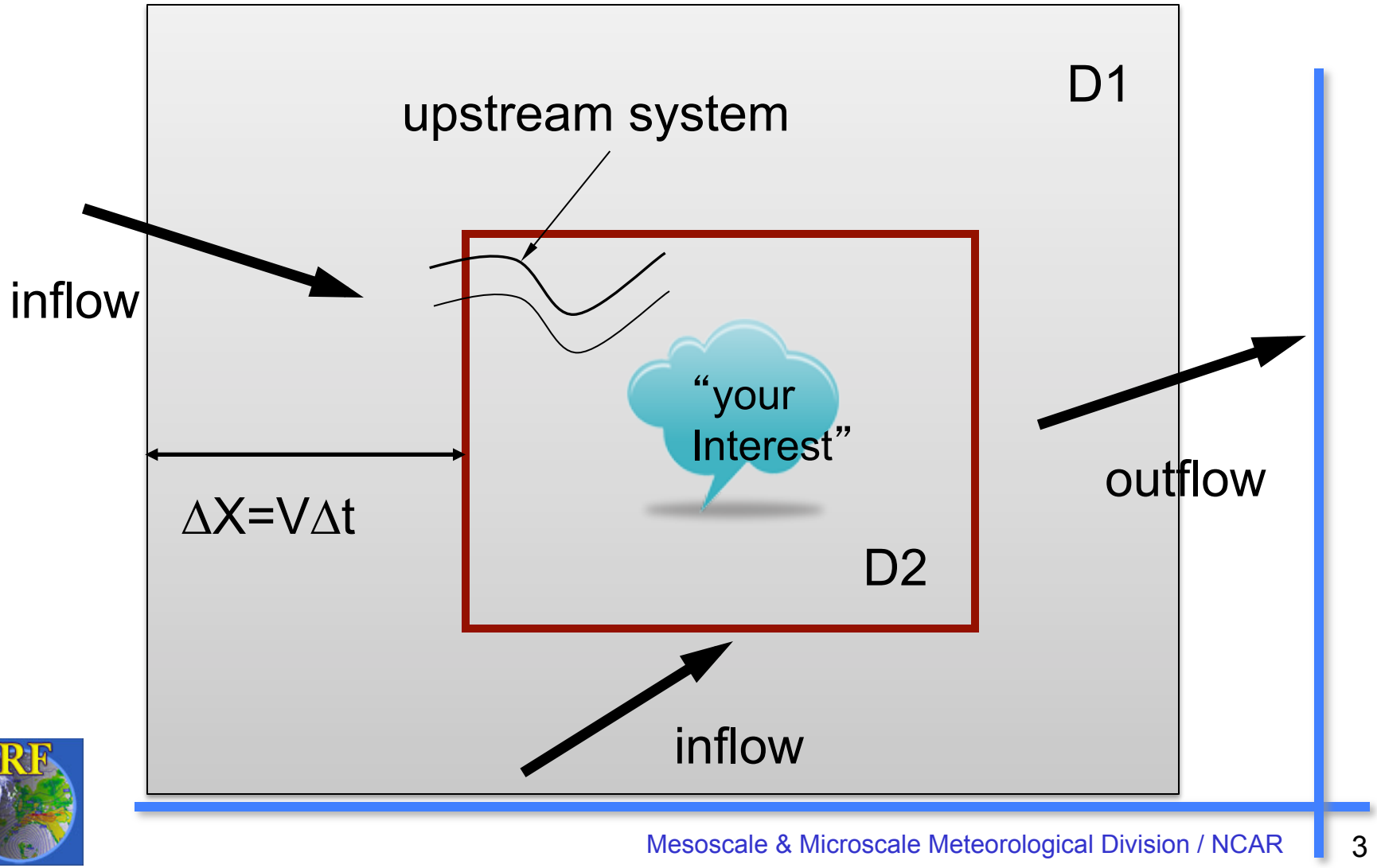
Domains

- How large do they need to be?
  - Depending on applications
    - Simulations for a few days: IC
    - Simulations for a few months, or years: BC
  - Domain sizes should not be too small: no less than 100x100
- Where to place my lateral boundaries?
  - Avoid steep topography
  - Away from my interest

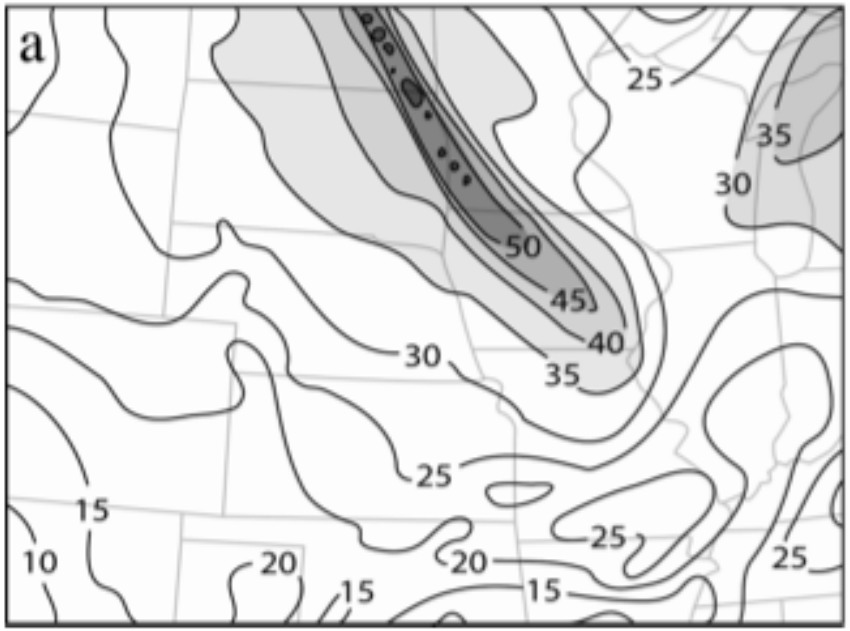


Note on Configuring Domains: Horizontal

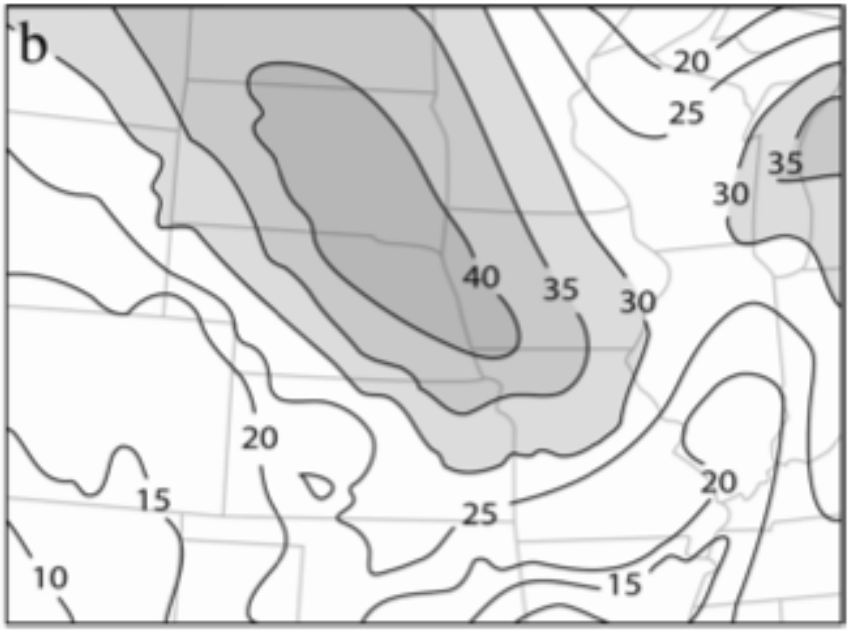


Note on Configuring Domains: Horizontal

Large regional domain

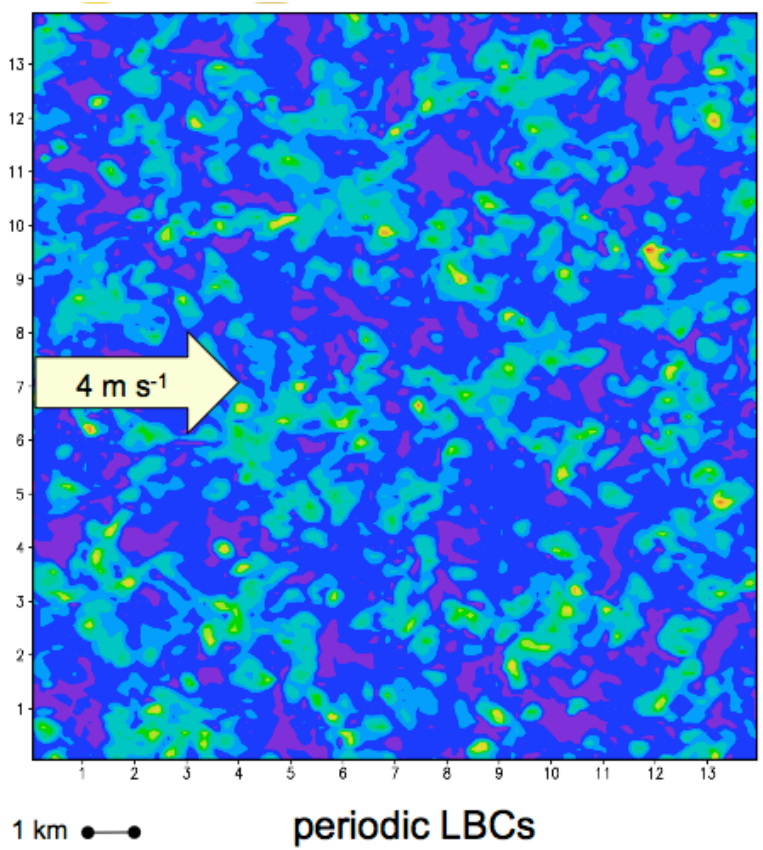


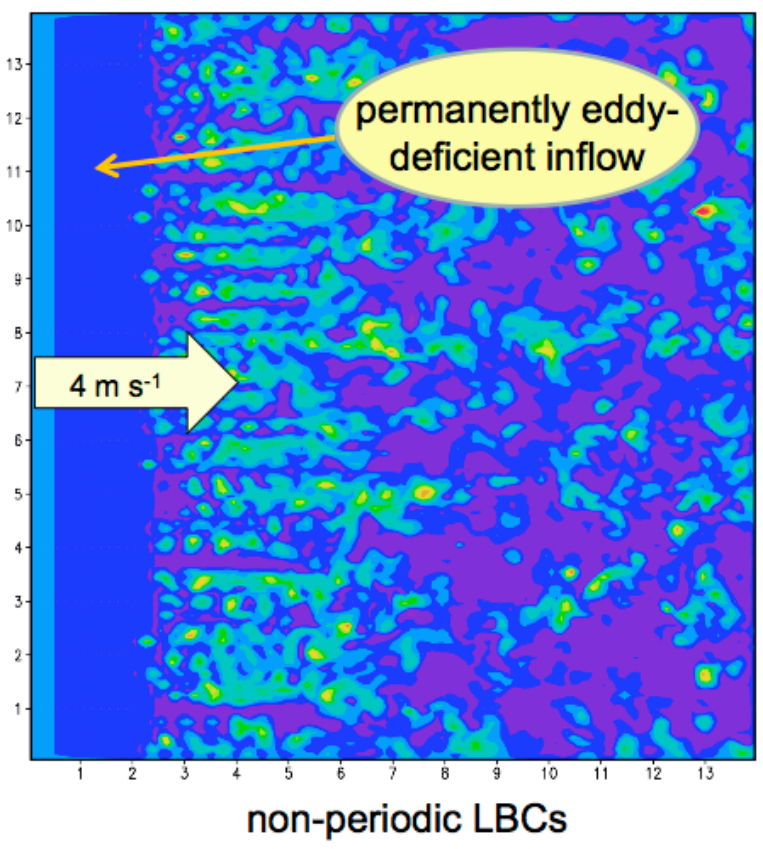
Smaller regional domain



(From Warner, 2011)

Note on Configuring Domains: Horizontal

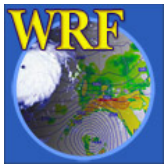




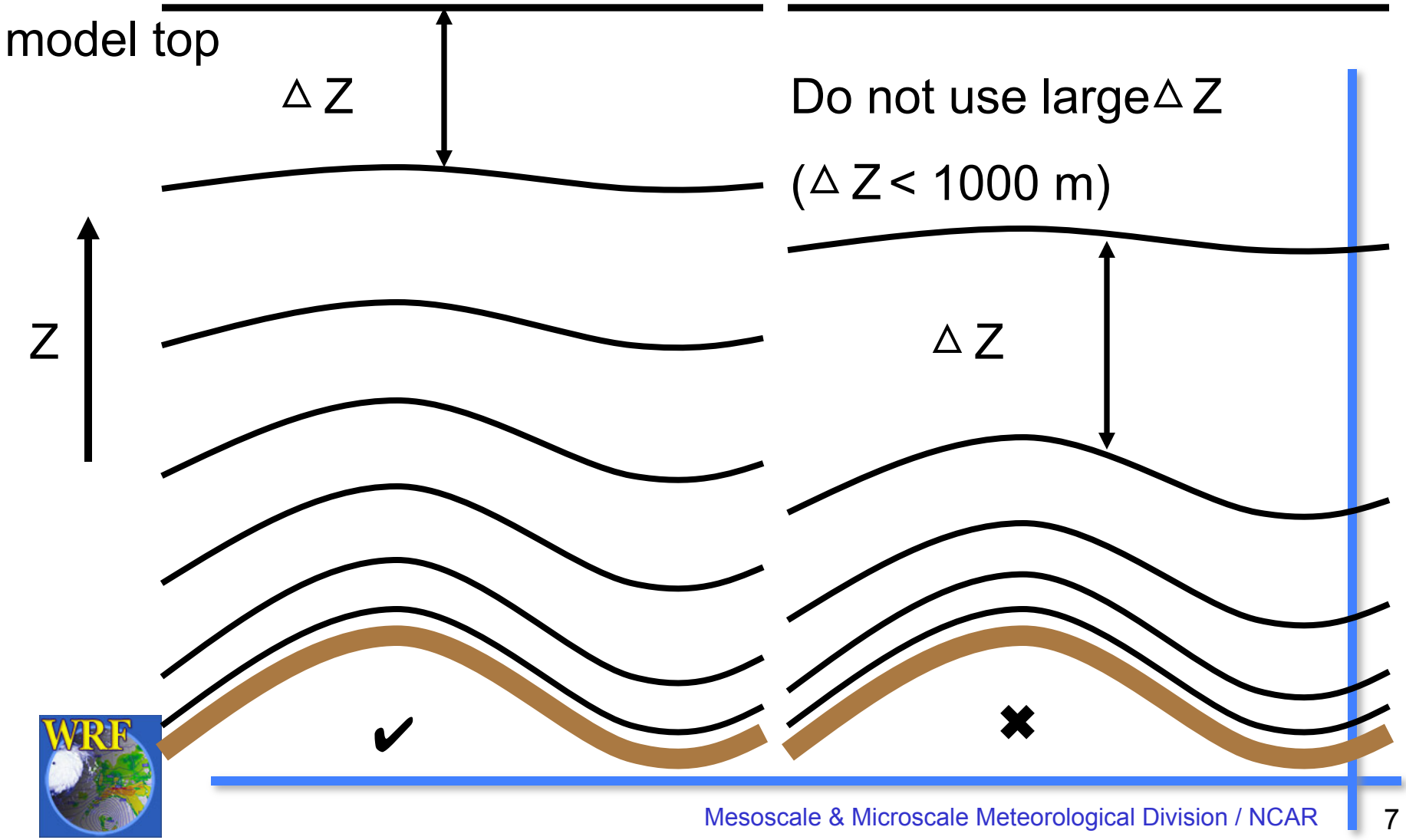
From Gaudet et al. WRF Users' Workshop 2012, talk 3.5

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?

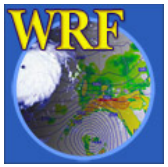
  Some of the reasons may be:

  – Input data resolution is too coarse

  – Input data may not be adequate as LBC

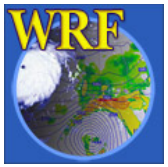
  – There isn't sufficient computing resources

- Nest domain sizes should not be too small;
- Nest boundary should be kept away from coarse domain boundary, and steep topography.



Input Data

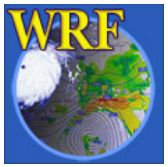
- Check land data:
  e.g. landuse: *does it represent my area well?*
- Know about the data: *how good are the data?*
  - Forecast data
  - Reanalysis data
  - Climate model data
- How frequent do I need to have boundary conditions?
  - More frequent is better



Model Options

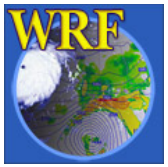
- What do I start with?
  - What other people have success with?
    - References, papers
  - Simple options first:

    For example,
    - Graupel may not be important if dx >> 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*.