WRF:
More Runtime Options

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More options

- Have covered basic, nesting runtime options, physics / diffusion options, nudging options..

- More are introduced here:
  - IO options (applies to ARW and NMM)
  - Vertical interpolation options (ARW)
  - SST update (ARW)
  - Adaptive-time step (ARW)
  - Digital filter (ARW)
  - Global runs (ARW)
  - IO quilting (ARW and NMM)

- Time series output (ARW and NMM)

IO Control (1)

History output control in **`&time_control`**

    `history_interval_h`: history output interval in hours

    `history_interval_s`: history output interval in seconds

    `history_begin_h`: history output beginning time in hours

    `history_begin_d`: history output beginning time in days

Complete listing in
  `Registry/registry.io_boilerplate`

IO Control (2)

Optional history output in **&time_control**

1. change Registry.EM and recompile:

```
state integer rainc ij misc 1 - h03 "RAINC" ""
   "ACCUMULATED TOTAL CUMULUS PRECIPITATION"
state integer rainnc ij misc 1 - h03 "RAINC" ""
   "ACCUMULATED TOTAL GRID SCALE PRECIPITATION"
```

2. Edit namelist.input to output these variables:

```
auxhist3_outname = "rainfall_d<domain>"
auxhist3_interval = 10
```

Vertical interpolation options (1)

Program **real** for ARW only, optional, &domains:

use_surface: whether to use surface observations

use_leves_below_ground: whether to use data below the ground

lowest_lev_from_sfc: logical, whether surface data is used to fill the lowest model level values

force_sfc_in_vinterp: number of levels to use surface data, default is 1

extrap_type: how to do extrapolation: 1 - use 2 lowest levels; 2 - constant

t_extrap_type : extrapolation option for temperature: 1 - isothermal; 2 - 6.5 K/km; 3 - adiabatic
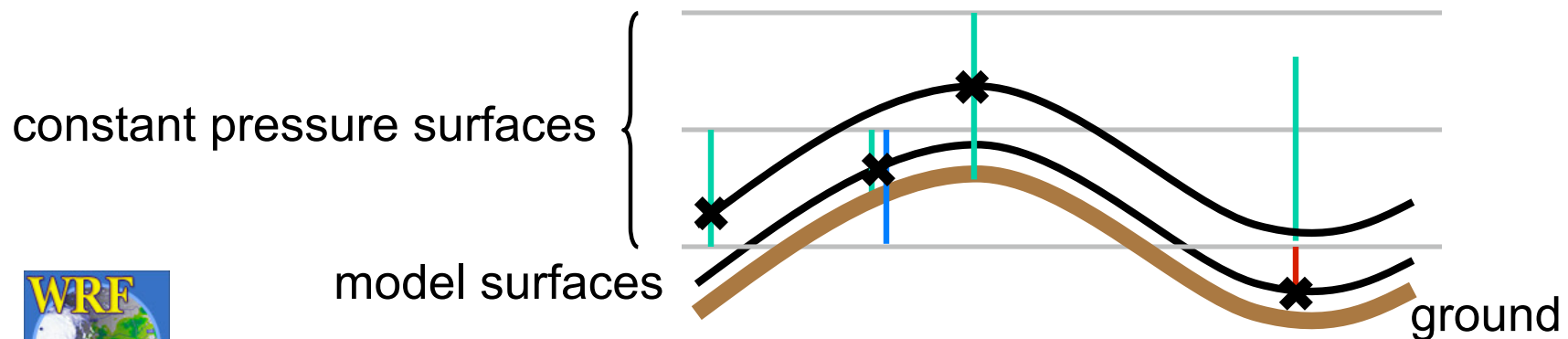
Vertical interpolation options (2)

Program **real** for ARW only, optional:

interp_type: in pressure or log pressure

lagrange_order: linear or quadratic

zap_close_levels: delta p where a non-surface pressure level is removed in vertical interpolation

namelist template: **namelist.input.wps**

constant pressure surfaces

model surfaces

ground

SST update for long simulations (1)

Lower boundary update control: allow SST, seaice, monthly vegetation fraction and albedo to be updated during a model run (ARW only):

`sst_update:` 0 – no SST update

1 – update SST

Set before running `real`, and this will create additional output: wrflowinp_d01, wrflowinp_d02, ..

To use the files in `wrf`, in `&time_control`, add

`auxinput4_inname` = "wrflowinp_d<domain>"
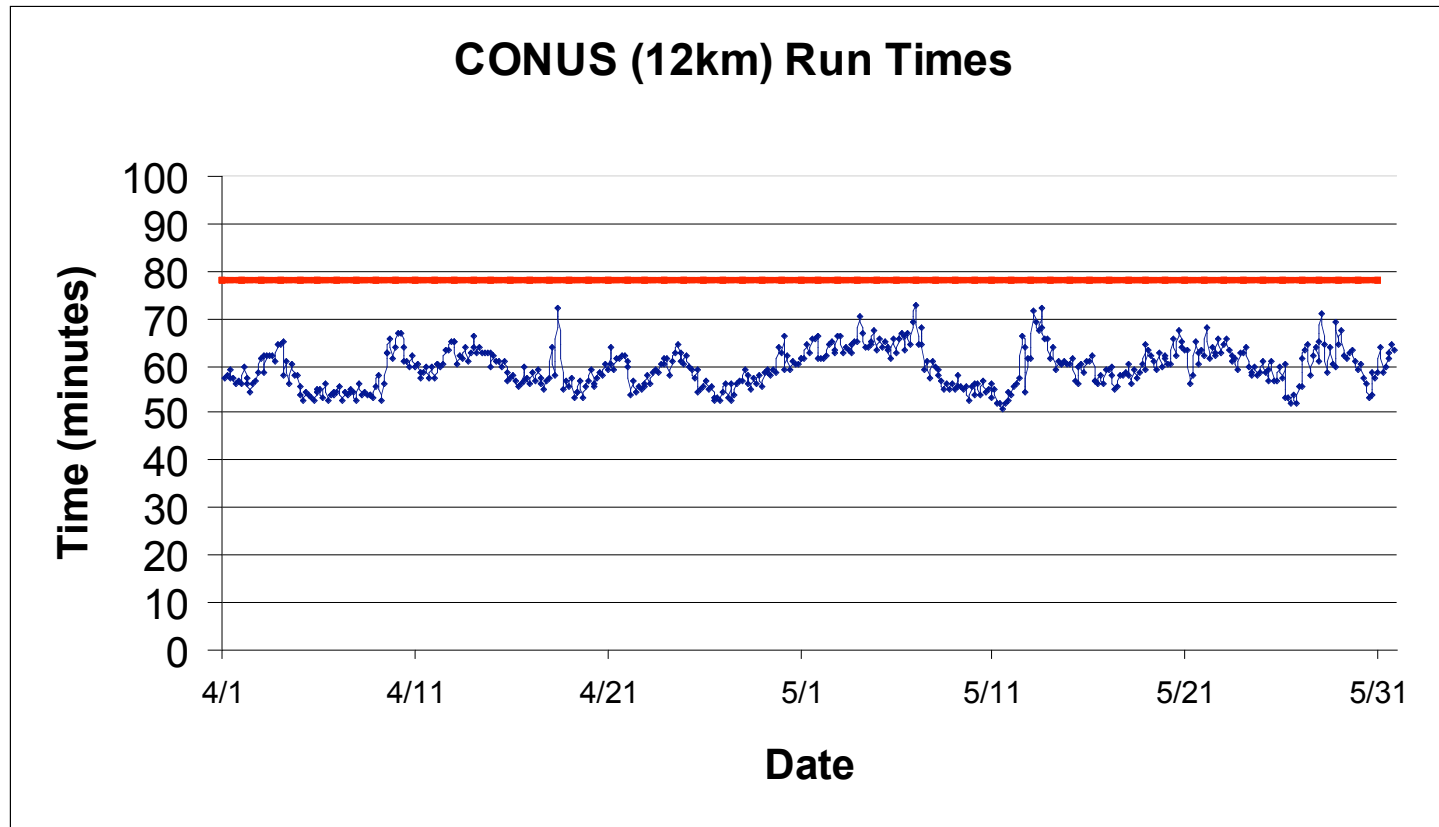
`auxinput4_interval` = 360

Adaptive time steps (1)

- Adaptive-time-step is a way to maximize the model time step while keeping the model numerically stable

- New in V3. Works well for single domain. Good to use for real-time run
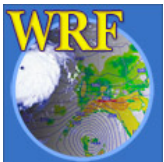
Adaptive time steps (2): an example

On average, forecasts finish in 60 min (50-73min) as compared to 79 min standard runtime

Adaptive time steps (3)

Namelist control: `&domains`

> `use_adaptive_time_step` : logical switch
>
> `step_to_output_time`: whether to write at exact history output times
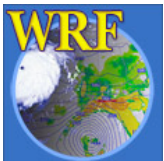>
> `target_cfl`: maximum cfl allowed (1.2)
>
> `max_step_increase_pct`: percentage of time step increase each time
>
> `starting_time_step`: in seconds; -1: 6*DX;
>
> `max_time_step`: in seconds; -1: 3*starting step
>
> `min_time_step`: in seconds; -1: 0.5*starting step
>
> * USE WITH GREAT CARE

Digital filter initialization (1)

Digital filter initialization is a simple way to remove initial model imbalance:

- – May be introduced by simple interpolation, or by objective analysis, or data assimilation
- – It may generate spurious gravity waves in the early simulation hours, which could cause erroneous precipitation, numerical instability and degrade subsequent data assimilation
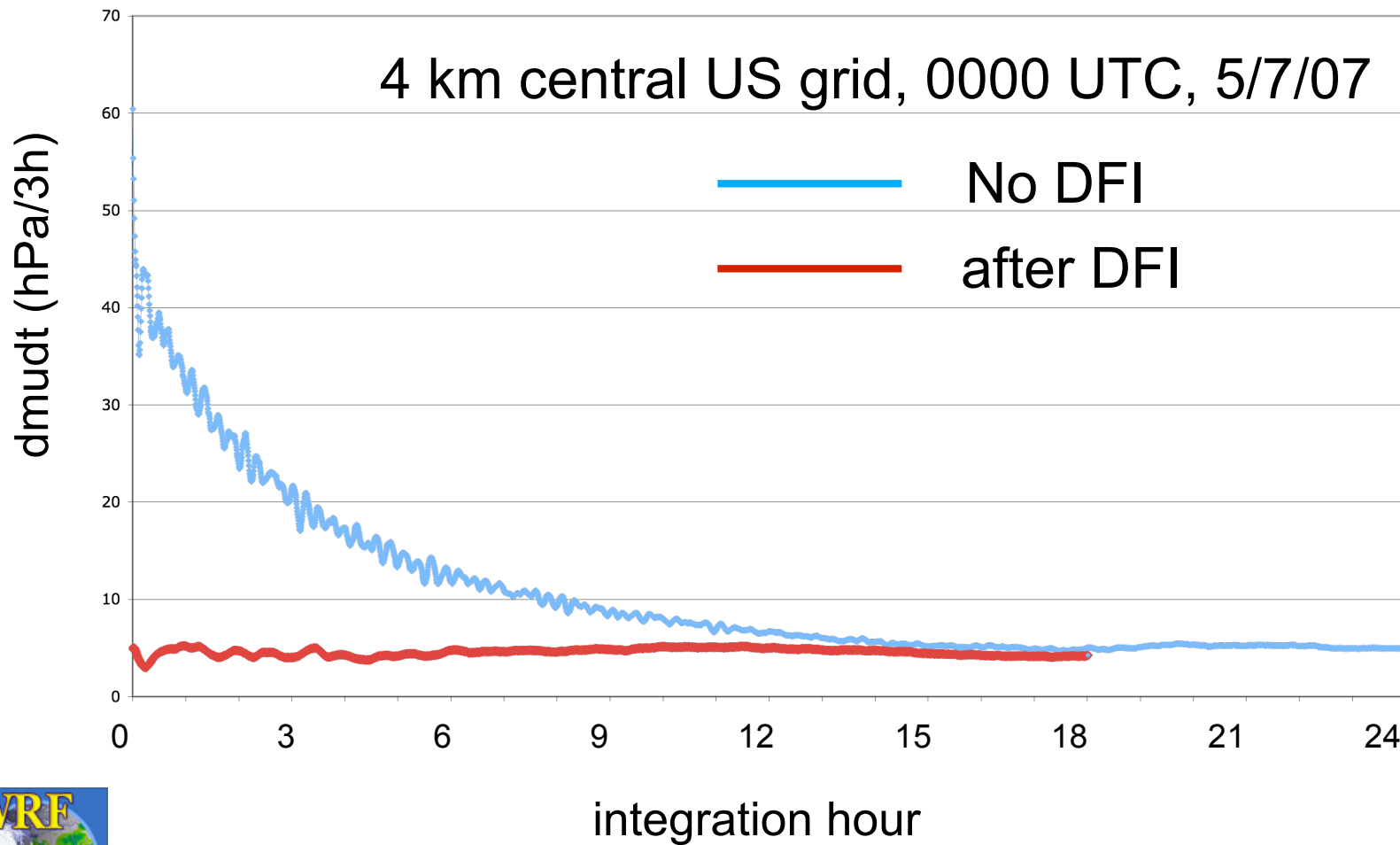
Digital filter initialization (2)

Using DFI

– can construct consistent model fields which do not
exist in the initial conditions, e.g. vertical motion,
cloud variables

– may reduce the spin-up problem in early simulation
hours

DFI is done after program `real`, or data-
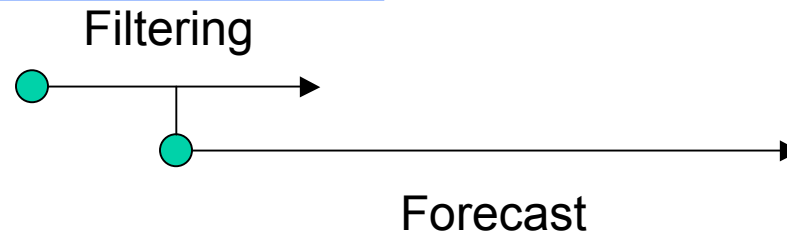assimilation step, just before model integration
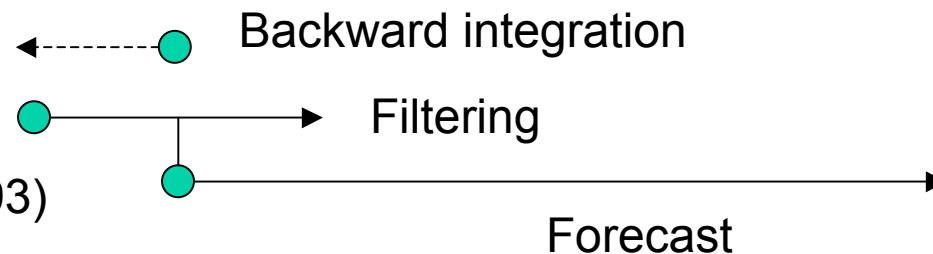
Digital filter initialization (3)

4 km central US grid, 0000 UTC, 5/7/07

— No DFI
— after DFI

y-axis: dmudt (hPa/3h)
x-axis: integration hour

Digital filter initialization (4)

DFL:
(Lynch and Huang, 1994)

Filtering

Forecast

DDFI:
(Huang and Lynch, 1993)

Backward integration

Filtering

Forecast

TDFI:
(Lynch and Huang, 1994)

Backward integration

Filtering

Forecast
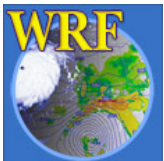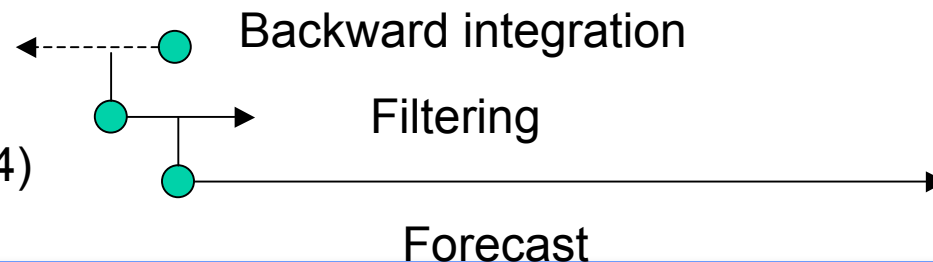
Digital filter inilialization (5)

Namelist control: **&dfi**

  dfi_opt: dfi options: 0: no DFI; 1: DFL; 2: DDFI; 3: TDFI

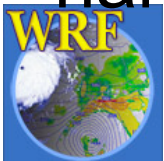 **dfi_nfilter**: filter options 0 - 8, recommended 7

  dfi_cutoff_seconds : cutoff period

  dfi_write_filtered_input : logical

  dfi_bckstop_* : stop time for backward integration

  dfi_fwdstop_* : stop time for forward integration

namelist template: **namelist.input.dfi**

Global application

Setup mostly done in WPS:

`map_proj = 'lat-lon'`

`e_we, e_sn:` **geogrid** will compute dx, dy

See template `'namelist.wps.global'`

In the model stage:

`fft_filter_lat:` default value is 45 degrees

Caution: some options do not work, or have been tested with global domain. Start with template `'namelist.input.global'`

IO quilting: &namelist_quilt

Parallel I/O control:

`nio_tasks_per_group` **`(>0):`** allow IO to be done on separate processors. Performance improvement for large domain runs. A value of 2 to 4 works well.

`io_groups` **`(>1):`** number of I/O streams that the quilting applies.

Time Series Output (1)

- It is a special output in text format with file name like

  ***prefix*.d<domain>.TS**

- It outputs 14 surface variables at every time step:

  e.g. 10 m u/v, 2 m T/qv, precipitation, radiation

- One file per location/weather station

Time Series Output (2)

- Not a namelist option
- Depends the presence of a file called '**tslist**' (a sample of the file is available in **WRFV3/run/**)

```
#-------------------------------------------------#
# 24 characters for name | pfx |  LAT  |   LON  |
#-------------------------------------------------#
Cape Hallett                 hallt -72.330  170.250
McMurdo Station              mcm   -77.851  166.713
```

- This file provides a list of locations where you would like to output time series
- More information in run/README.tslist and User's Guide, Chapter 5
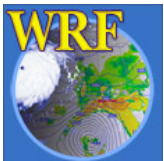
Recommended

Start with the namelist template in a particular test directory, and the options specified in them, and make modifications.

For more information on global extension, DFI and adaptive time step, read ARW Tech Note, and User's Guide.