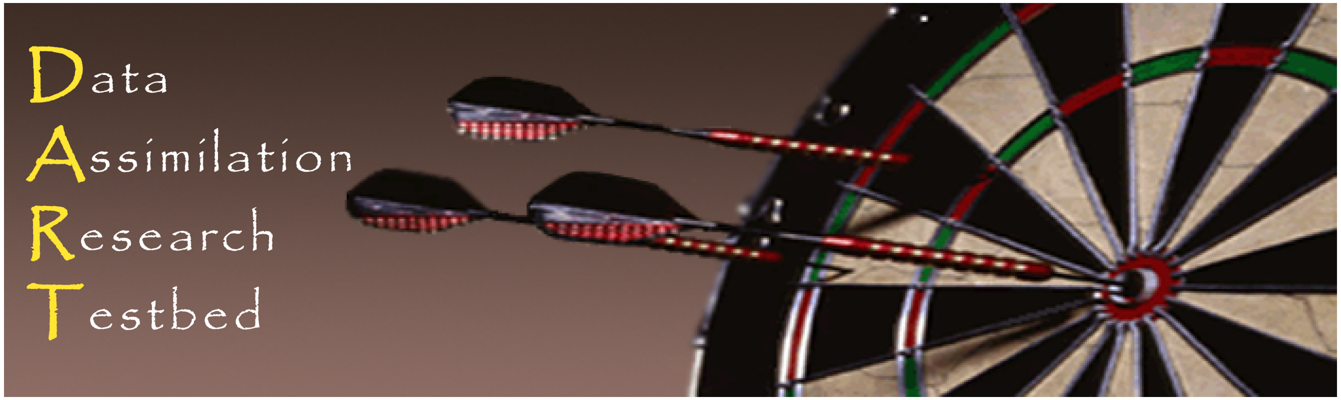
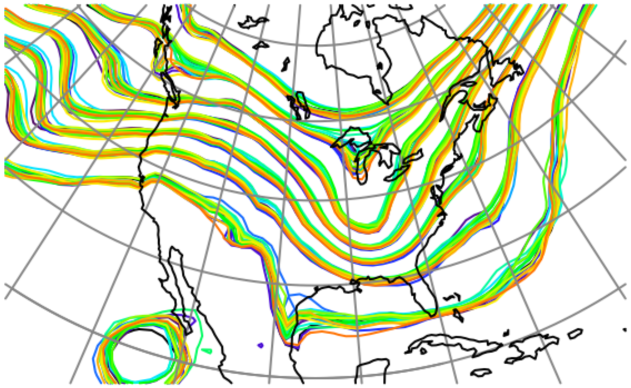


DART Tutorial Section 15: DART Experiments: Control and Design



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DART observation sequence (obs_sequence) files

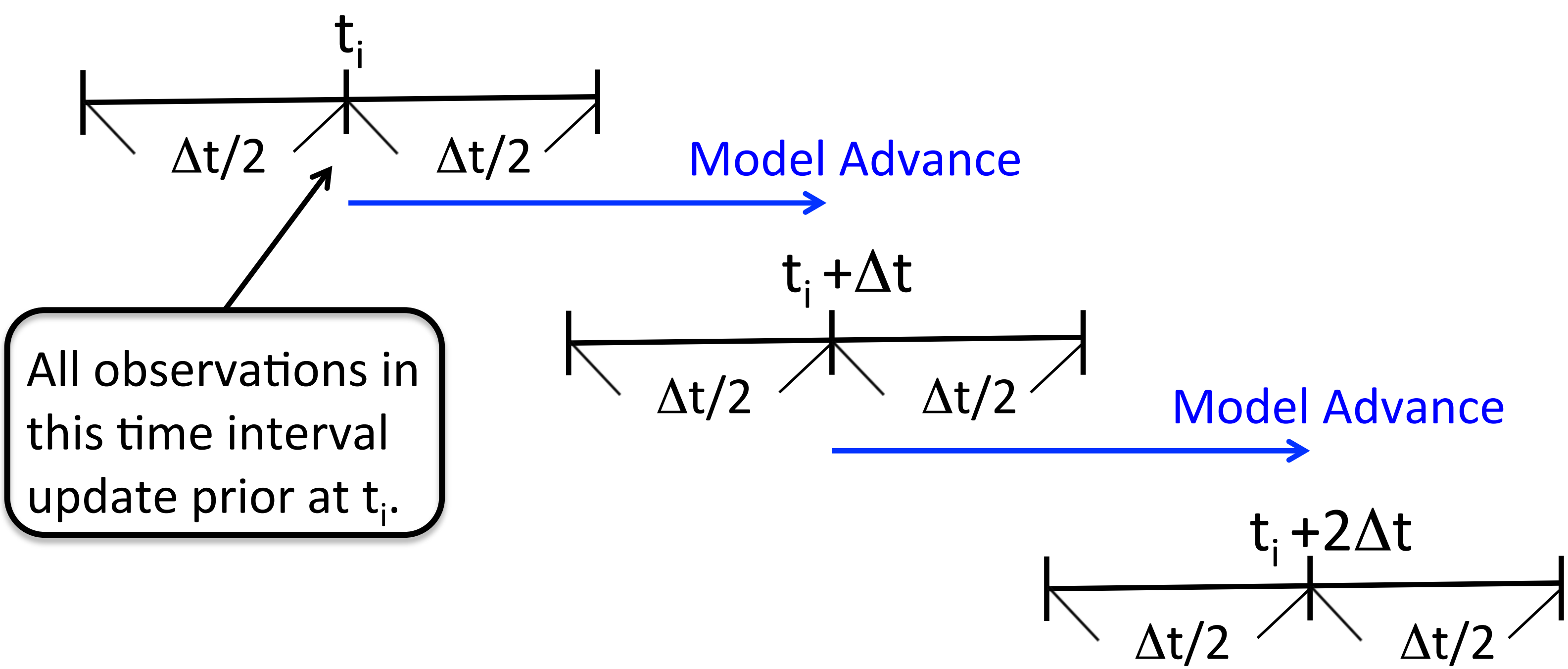
Contain a *time-ordered* list of observation definitions:
1. Type of observation (radiosonde temperature, radar reflectivity),
2. Location of observation,
3. Time of observation,
4. Observation error variance,
5. Additional stuff for complex observation types,
6. Quality control values.

When driving ***filter*** assimilation, also contain observed values.

(An observation sequence can have 0 or more values associated with each observation; section 17).

DART experiments are driven by input observation sequences

model_mod defines a *shortest_time_between_assimilations*, Δt.
Initial time of ensemble (from input file or namelist) is t_i.

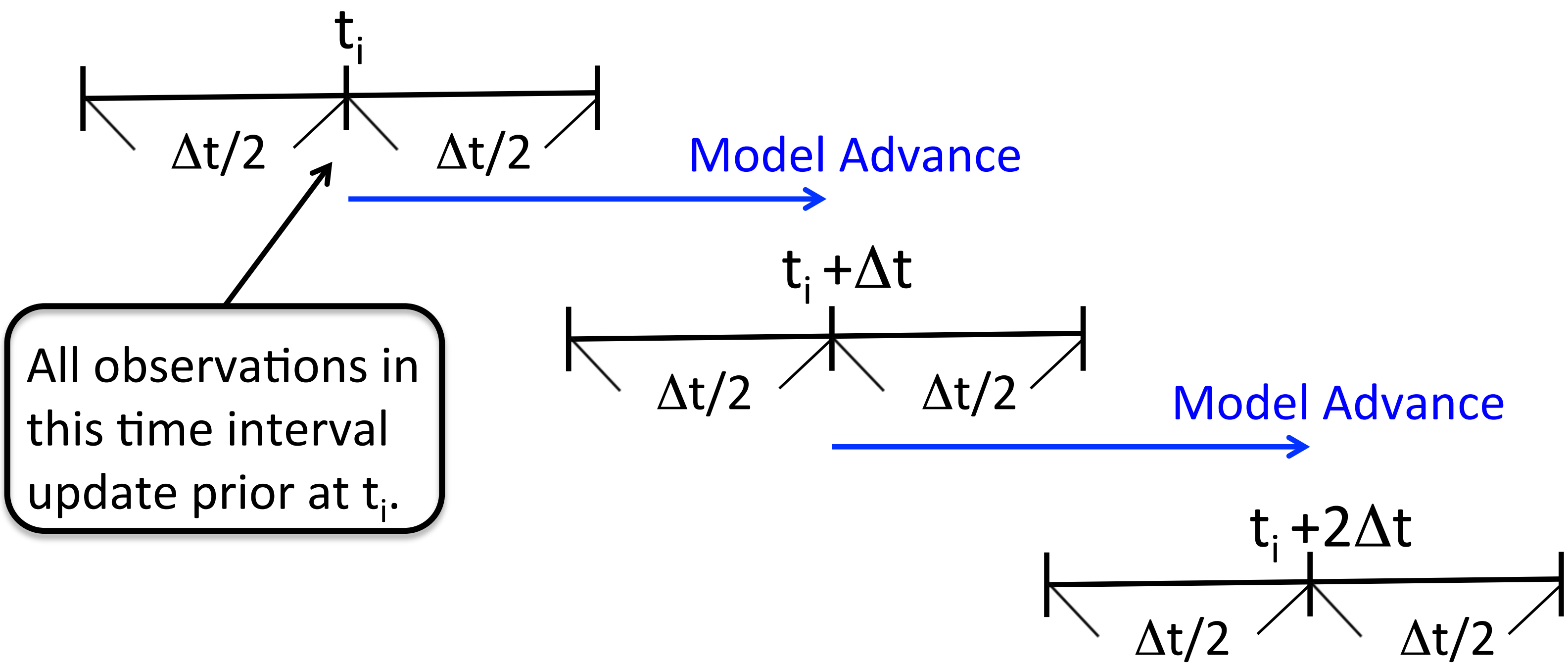


Filter continues until all observations in sequence have been used.
First observation can NOT be earlier than first 'window'.
If a 'window' has no observations, no assimilation is done.

DART experiments are driven by input observation sequences

This capability is too limited: Would like to allow:

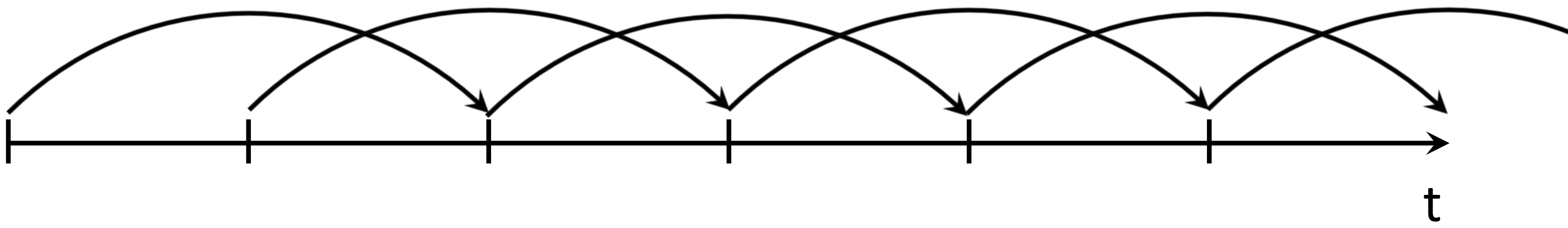
1. Dynamically adjusting model Δt for models with this capability;
2. Window widths that could be less than Δt;



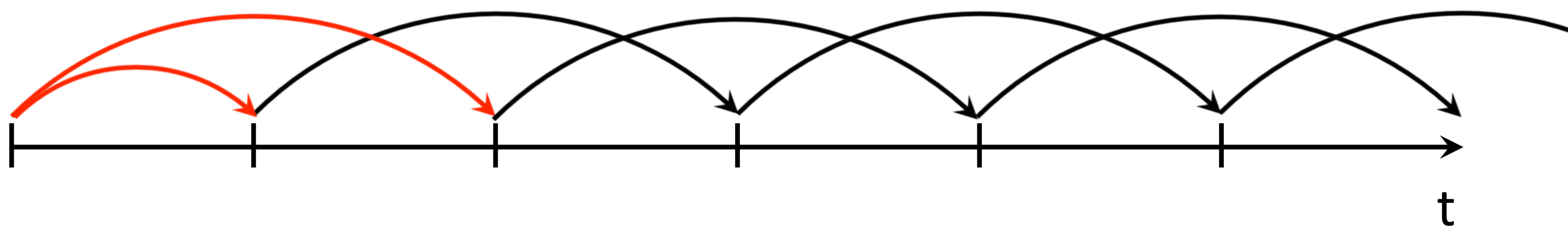
3. Time interpolation forward operators.

Dealing with models with multi-level time differencing

Example: Leapfrog



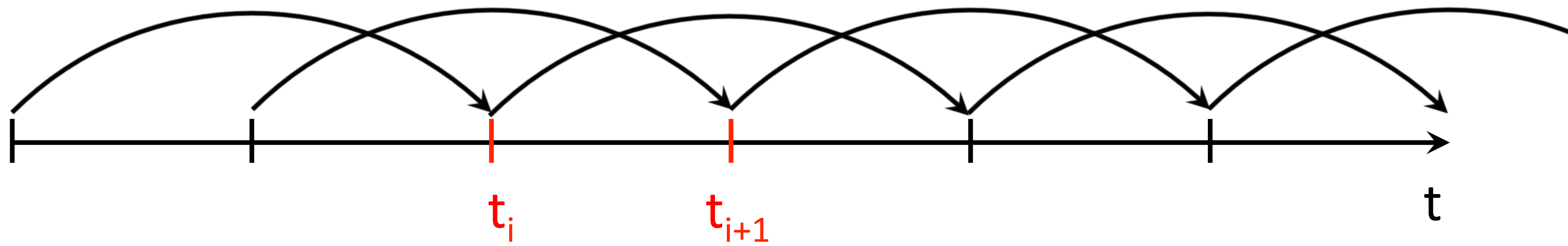
1. Can just 'restart' from single time-level after each assimilation.



This can lead to numerical instability if 'restarts' too frequent.
Limit of dense observations in time, becomes forward differencing..

Dealing with models with multi-level time differencing

Example: Leapfrog



2. Can expand definition of model state to include multiple times.

State vector includes times t_i and t_{i+1} for observations with times in this interval.

This can improve performance.

Also permits easy time interpolation forward operators.

Works in current implementation if *model_mod* interface is modified.

Most models do not implement this capability.

Experiment types

1. Real data filtering assimilations: observations from instruments.

2. Observing System Simulation Experiments (OSSEs):
   Observations are synthetic.
   Model integration substitutes for truth.
   Forward operator for each observation applied to truth state.
   Random sample from $N(0, \sigma_{obs})$ added in.
   σ_{obs} from observation sequence file.

3. Observing System Experiments (OSEs):
   Use real observations, but withhold some with purpose.

Experiment types

4. Mixed OSEs/OSSEs:
   Add synthetic observations to real observations.
   'Truth' for synthetic comes from model integration from last assimilated state estimate.

5. Observation targeting:
   Given OSE or OSSE,
   Add observations in future to improve future performance,
   Already done operationally for weather prediction.
   Where should a plane fly to get most valuable observations?

6. <u>Smoothing: not currently supported in DART Manhattan</u>
   Use observations in future to improve state estimate,
   Can be turned on with `&smoother_nml`: *num_lags*.

DART Tutorial Index to Sections