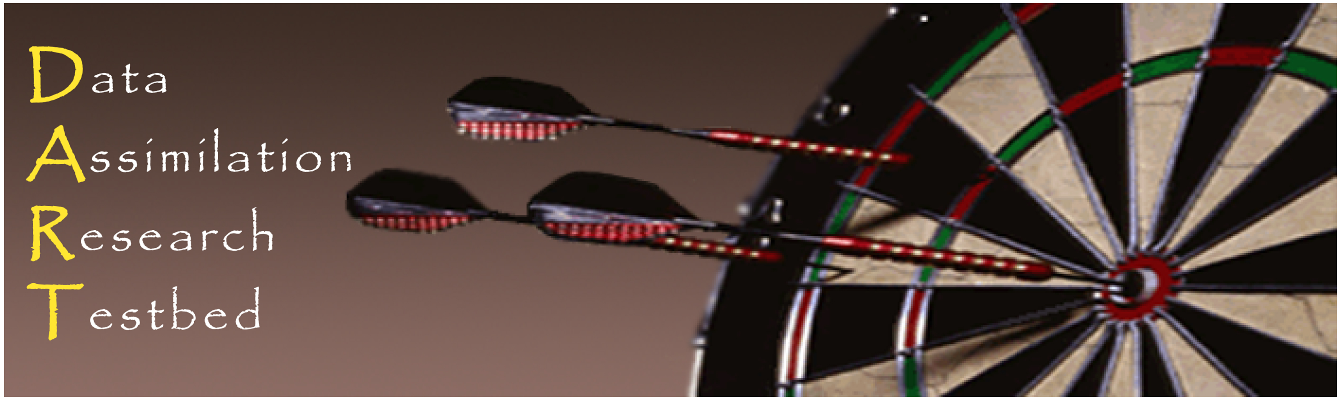
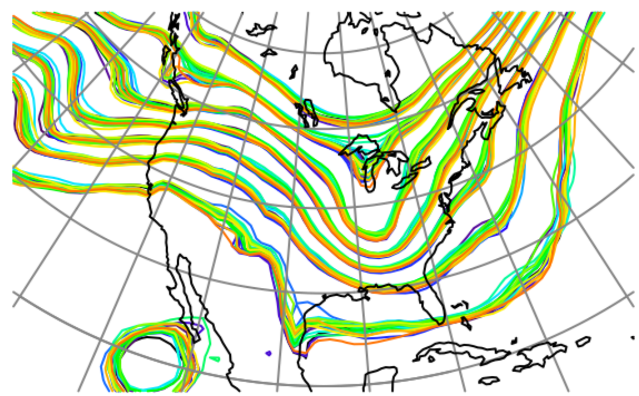


DART Tutorial Section 14:
DART Observation Quality Control



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Observation Sequence Files

DART uses observation sequence files to store information about observations that are available for assimilation.

Default names are:

1. *obs_seq.in* Input to ***perfect_model_obs*** for OSSEs
2. *obs_seq.out* Input to ***filter***, (output from **perfect_model_obs**).
3. *obs_seq.final* Output from ***filter***.

These files contain metadata describing observations, and may include a number of related values (for instance, the actual observation, the prior ensemble estimates, etc.).

Quality control summary

Each observation can have a prior quality control value.

For instance, BUFR files from NCEP contain a prior qc value.

A DART quality control value is added when observation sequences are generated by DART programs. It has metadata *DART quality control.* *obs_seq.final* generated by filter has following DART qc values:

0. Assimilated
1. Evaluated only
2. Assimilated but posterior forward observation operator(s) failed
3. Evaluated only but posterior forward observation operator(s) failed
4. Not used, prior forward observation operator(s) failed
5. Not used because not selected in *obs_kind_nml*
6. Not used, failed prior quality control check
7. Not used, violated outlier threshold

Quality control details

DART provides runtime control over what types of observations in an observation sequence file are assimilated by the filter.

This is done in the `&obs_kind_nml`:

assimilate_these_obs_types is a list of names of observation types to be assimilated.

evaluate_these_obs_types is a list of names of observation types to be evaluated only (withheld observations).

An observation type that is not in either list is ignored.

See *input.nml* in *models/bgrid_solo/work* for an example of an *assimilate_these_obs_types* list.

Quality control details

DART qc values 0 to 3 indicate that the observation was okay

- 0 and 2: observation was assimilated
  - Obs. kind is *assimilate_these_obs_types* in `&obs_kind_nml`
- 1 and 3: Prior observation ensemble computed, not assimilated
  - Obs. kind is *evaluate_these_obs_types* in `&obs_kind_nml`
  - This is withholding an observation to be used for validation
- 2 and 3: one or more posterior forward operators failed
  - Cannot use this observation for posterior diagnostics
  - Can be used for prior diagnostics

DART qc value 5 indicates observation not used at all.

- Not listed in `&obs_kind_nml`.
- Not used in either prior or posterior diagnostics.

Quality control details

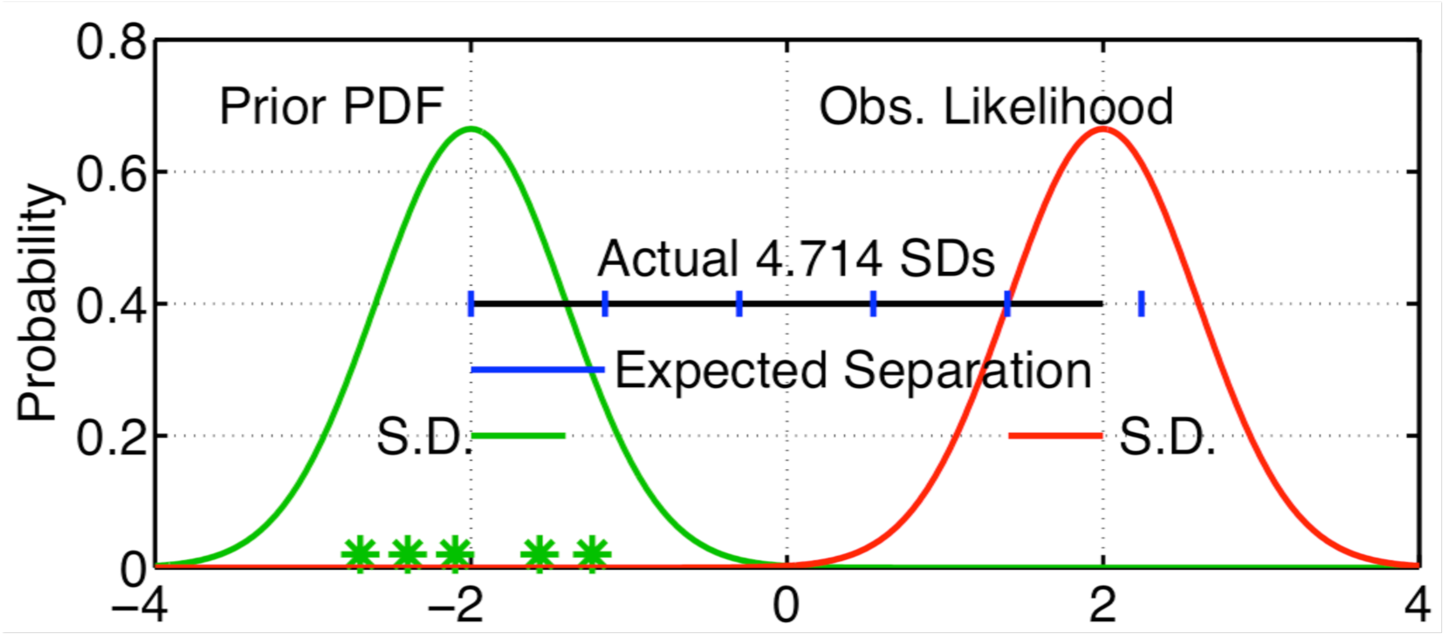
DART qc value 6 indicates that the prior qc value was too large.
Threshold set by `&quality_control_nml`: *input_qc_threshold*

If prior qc of observation is greater than threshold, then...
  Observation is not assimilated.
  Not used in either prior or posterior diagnostics.

NOTE: BUFR qc values larger than 3 means observation is suspect.
Most people assimilating observations from BUFR use an *input_qc_threshold* of 3 which is the default value in DART *input.nml*'s.

Quality control details

DART qc value 7 indicates outlier threshold exceeded



Expected(prior mean - observation) = $\sqrt{\sigma^2_{prior} + \sigma^2_{obs}}$.
Reject if (prior_mean - observation) > T times expected value.
T is set by *outlier_threshold* in *&quality_control_nml*.
outlier_threshold < 0 means no outlier check.

Outlier threshold quality control

Designed to discard observations that are inconsistent with prior.

Low-order models have the *outlier_threshhold* check turned off by default, set to -1.

Large models have *outlier_threshold* set to 3 standard deviations.

Setup a successful lorenz_96 or lorenz_63 assimilation case.
Set *outlier_threshold* to 2.0, or 1.5.
Examine what happens to assimilation quality.

Outlier threshold qc has a significant impact when using BUFR observations.

DART Tutorial Index to Sections