AMSU-A Observation Quality Control

by

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Why do we need Quality Control?

We know that the HIRALM 3D-var data assimilation system is optimal if the observations are

- independent,
- have no bias and
- have **Normal (Gaussian) error distribution**.

Unfortunately, "cloud contamination" gives AMSU-A observations a non-Normal error distribution.

The purpose of Quality Control is to reject observations that disagree with the "Normal assumption" *in an optimal manner.*

Bayesian Risk

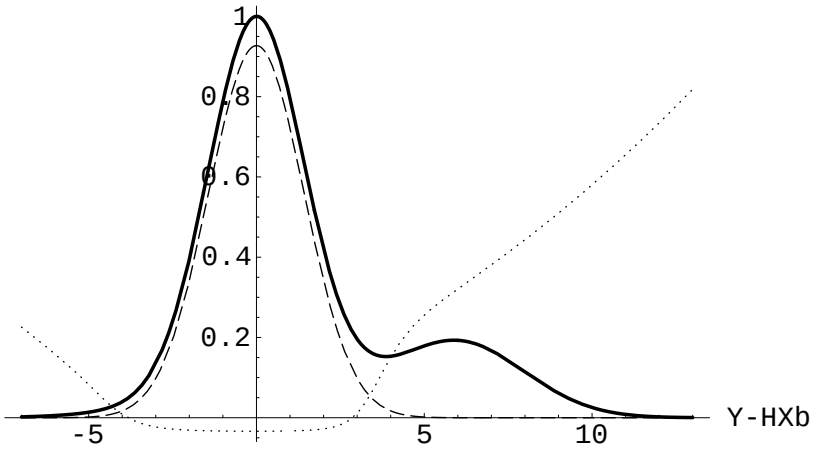
We formulate a **risk** from using an observation with non-Normal error distribution, while the assimilation system assumes it has Normal error distribution.

If the risk is less than zero, the observation has a positive effect on the analysis (i.e. the mean squared error verification score will improve).

Observations should be **rejected** when they have **positive risk**.

The **risk** is formulated as a function of the **innovation**, i.e. the departure between the observation (Y) and the first guess equivalent (HXb).

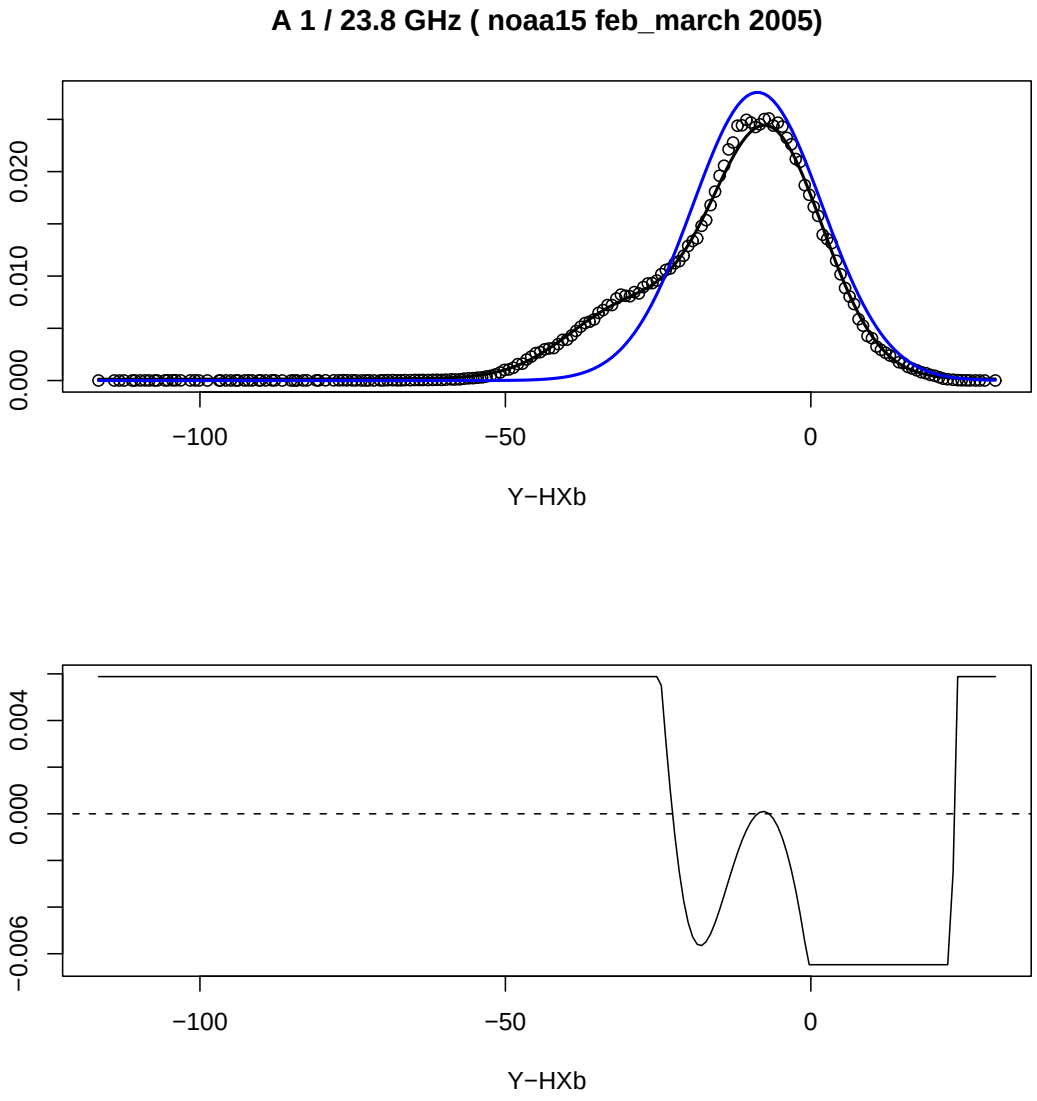
Example:



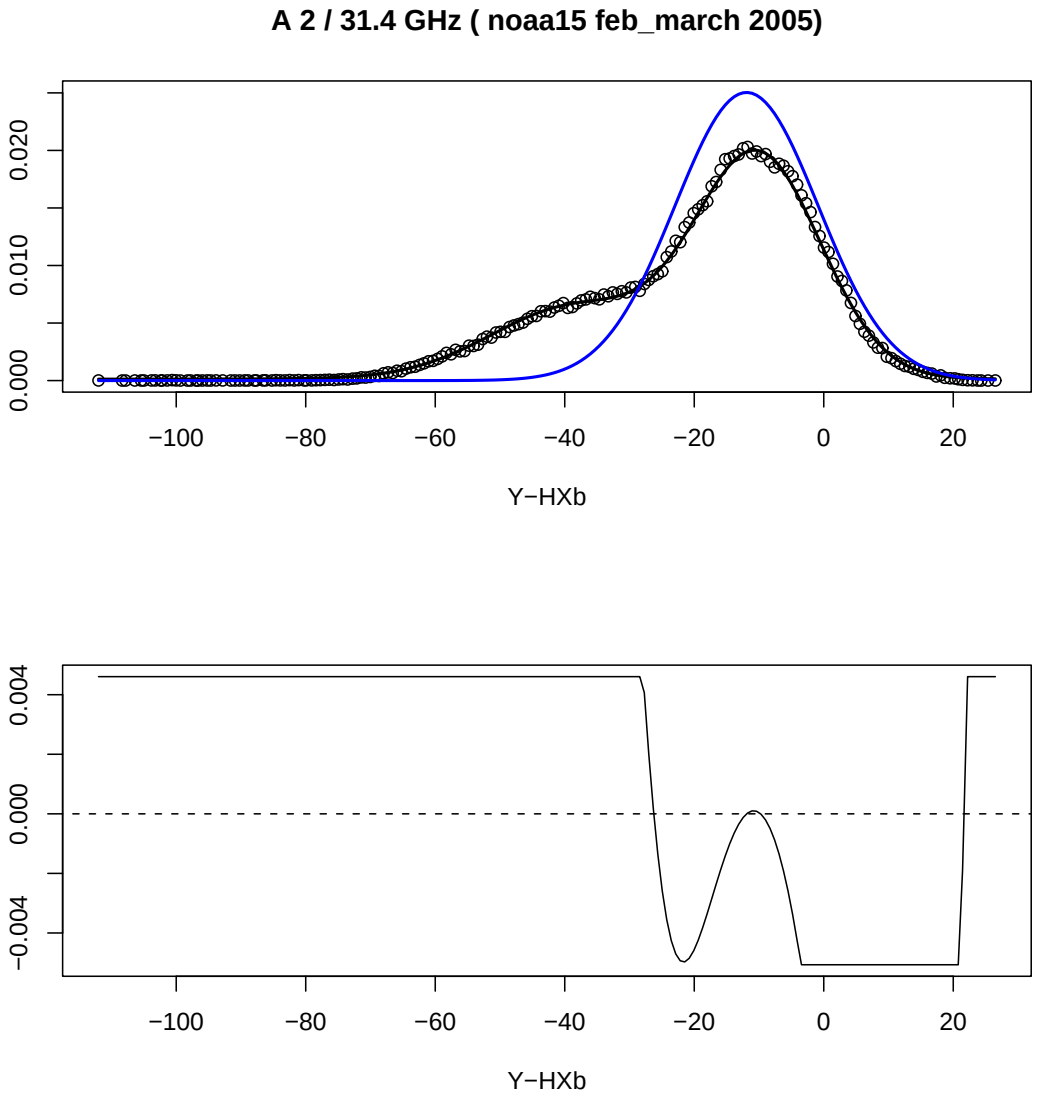
Solid line: actual, non-Normal distribution,
Dashed line: the assumed Normal distribution,
Dotted line: Risk from using observation

Risk plots for AMSU-A

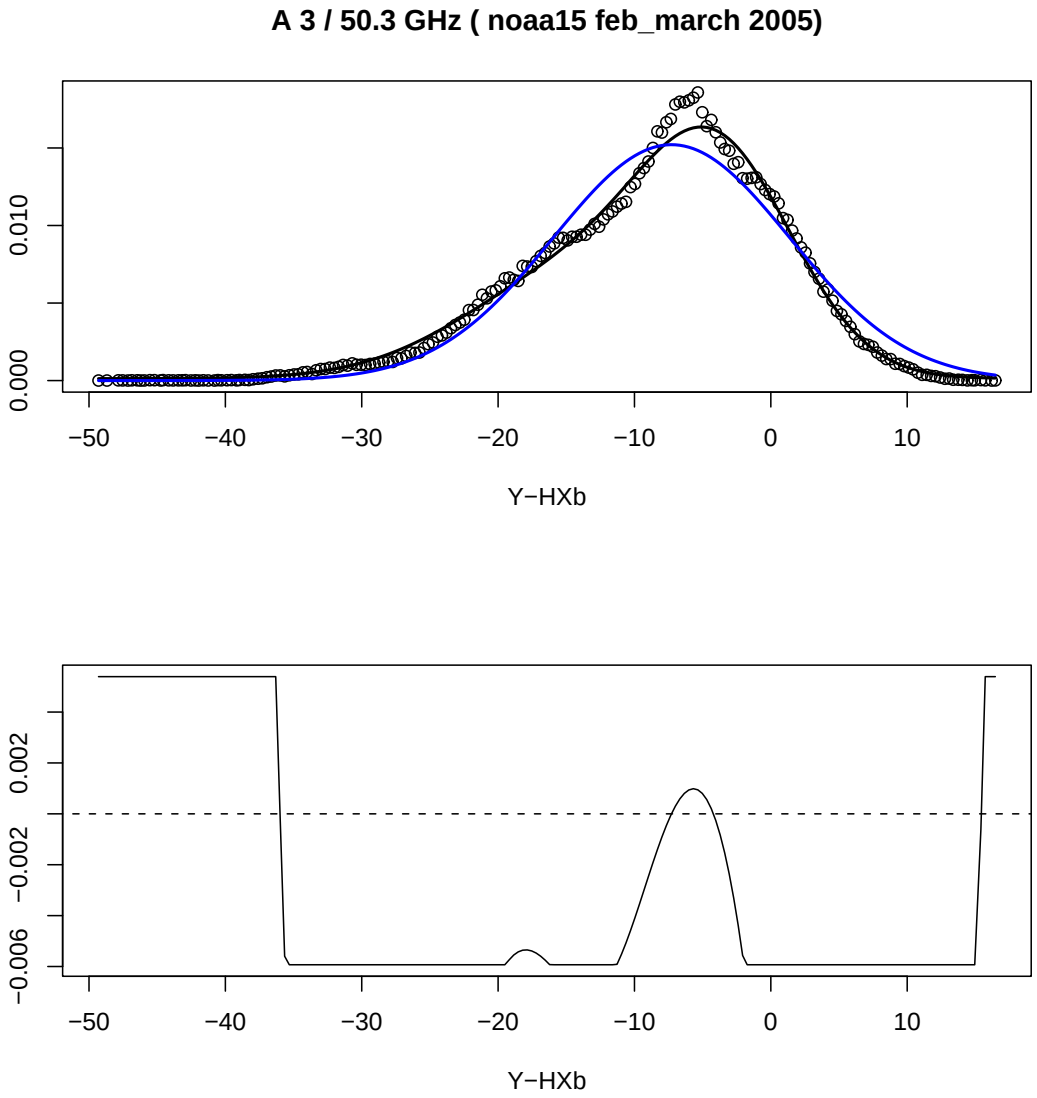
Satellite:	Noaa-15 (Channel 1)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk* (chopped)
Valid range:	-22.65159 K to 23.66040 K



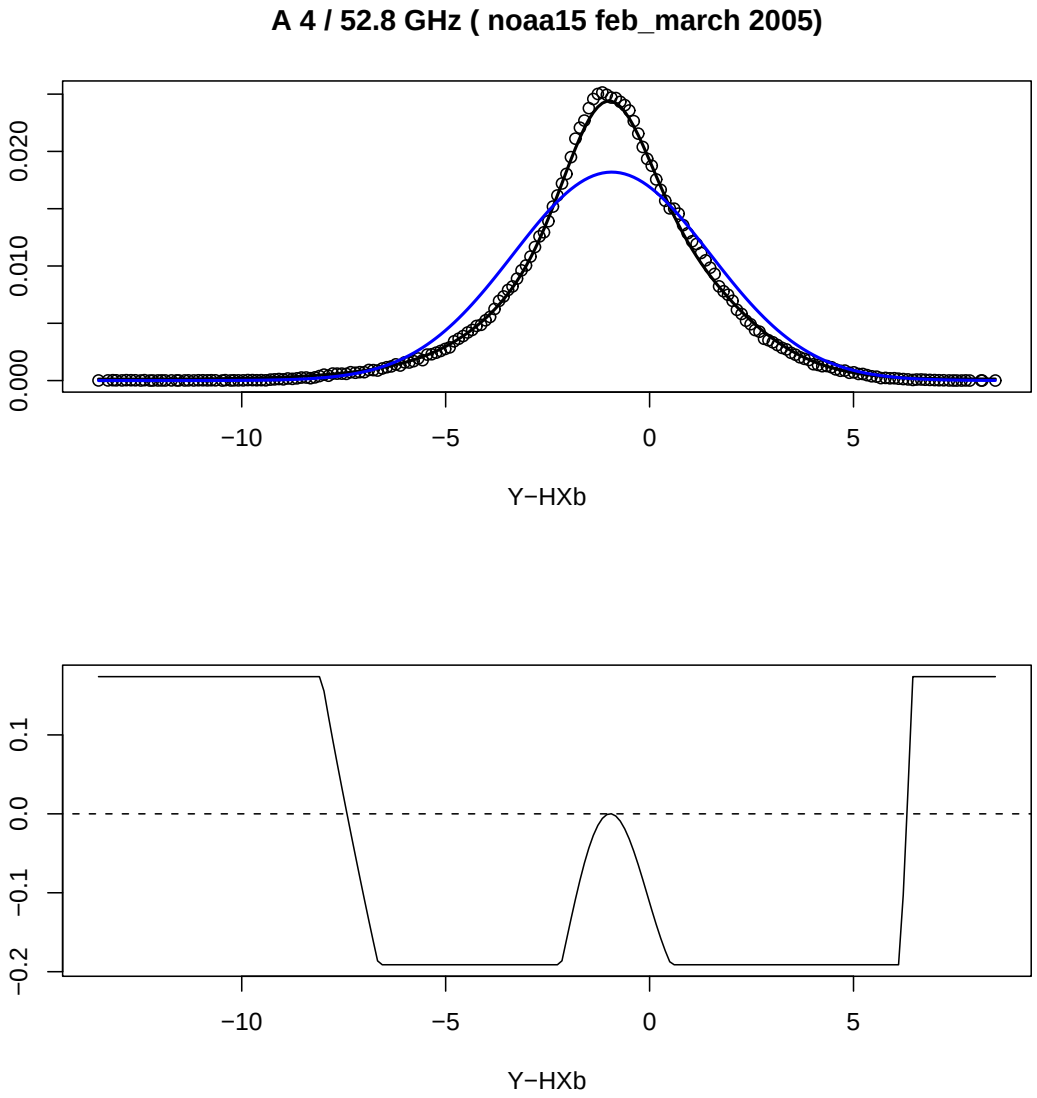
Satellite:	Noaa-15 (Channel 2)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-26.67881 K to 21.83006 K



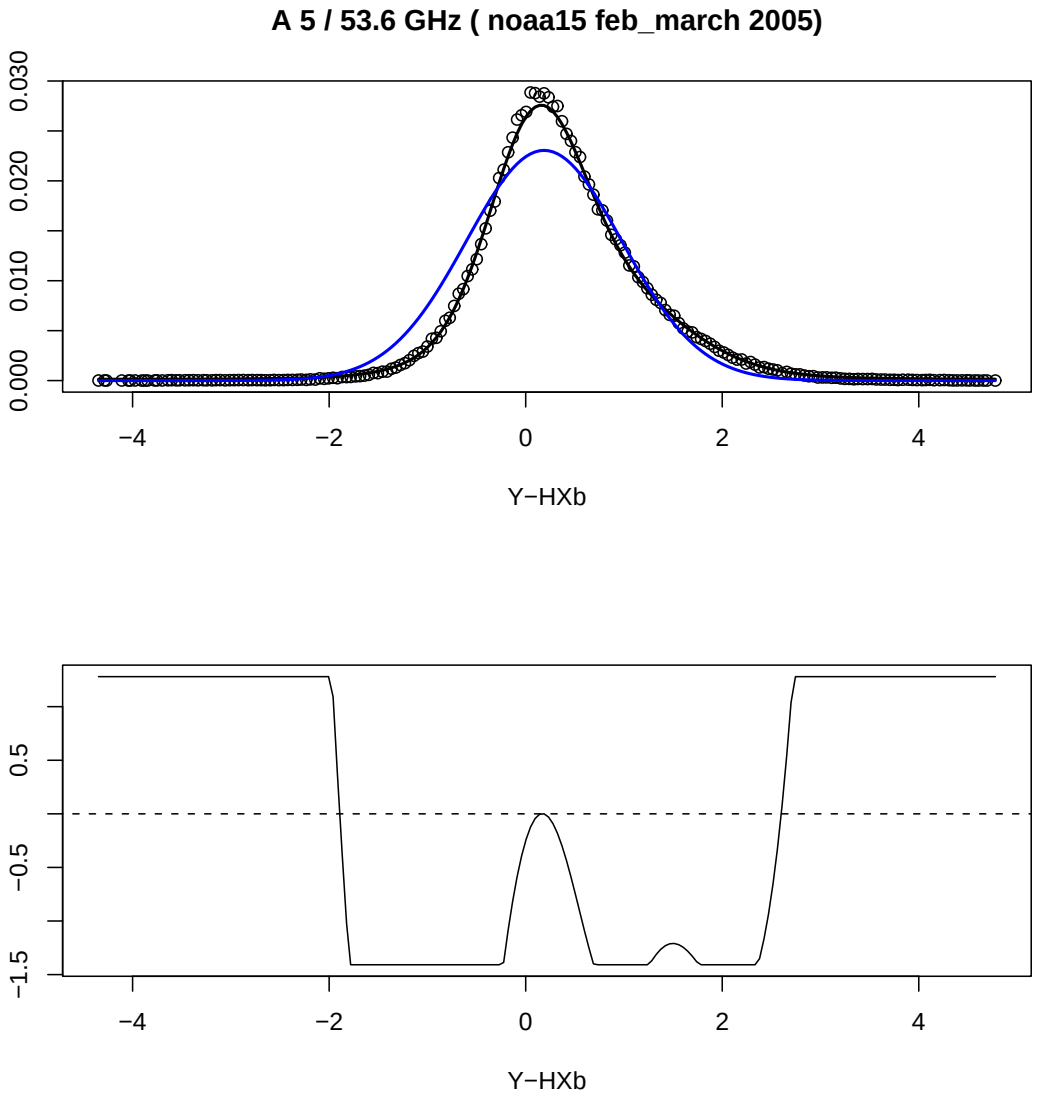
Satellite:	Noaa-15 (Channel 3)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-36.14119 K to 15.56422 K



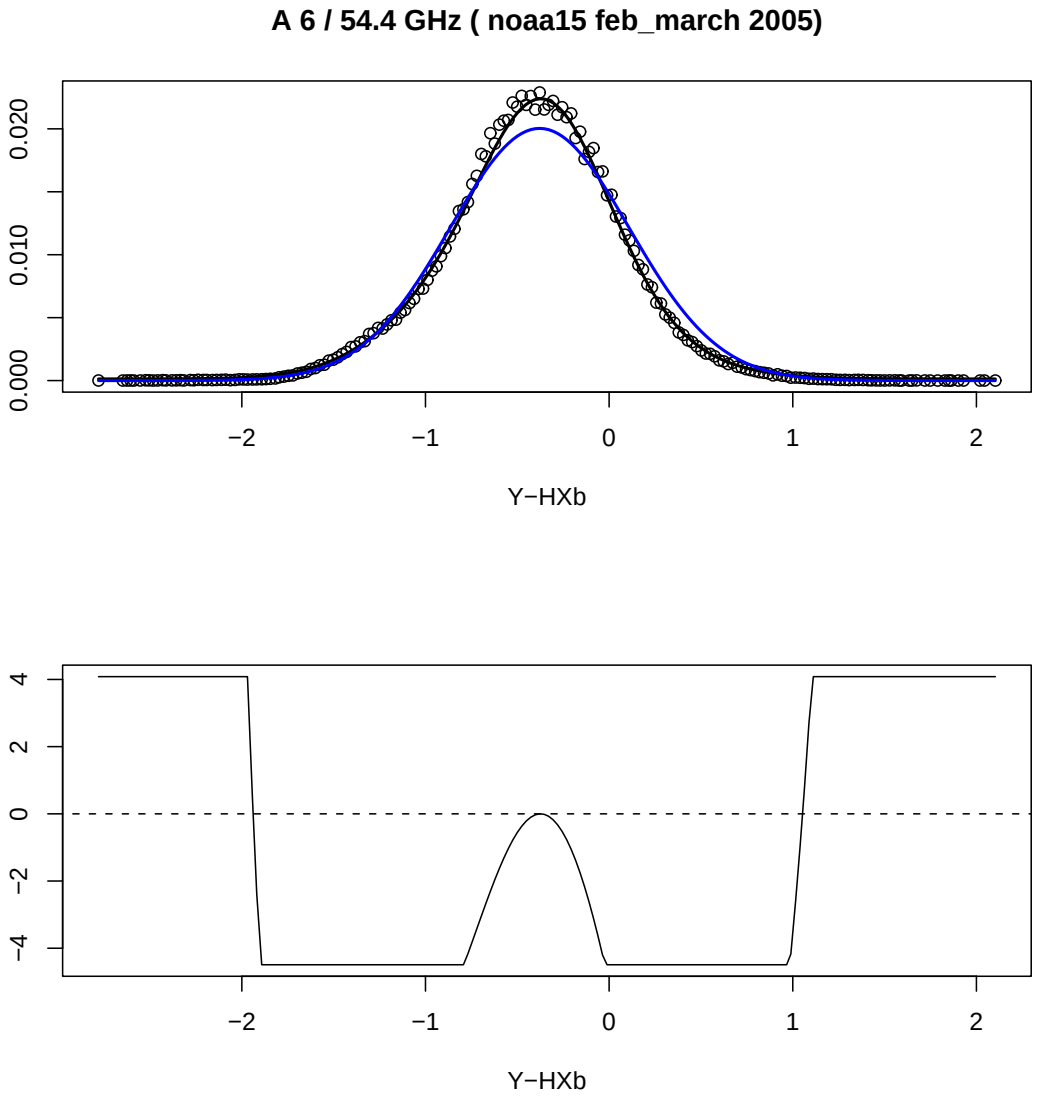
Satellite:	Noaa-15 (Channel 4)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-7.38239 K to 6.27787 K



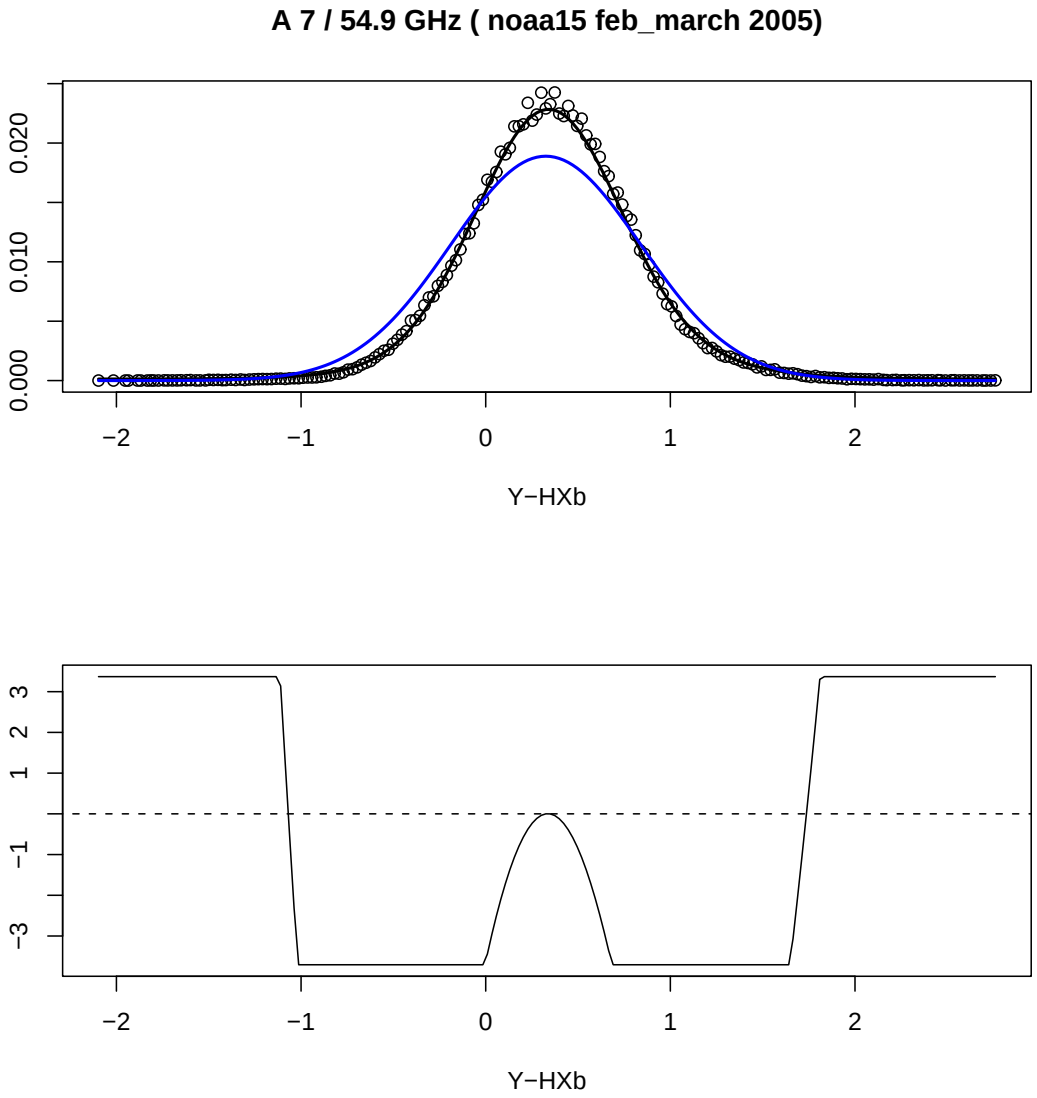
Satellite:	Noaa-15 (Channel 5)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-1.89188 K to 2.58500 K



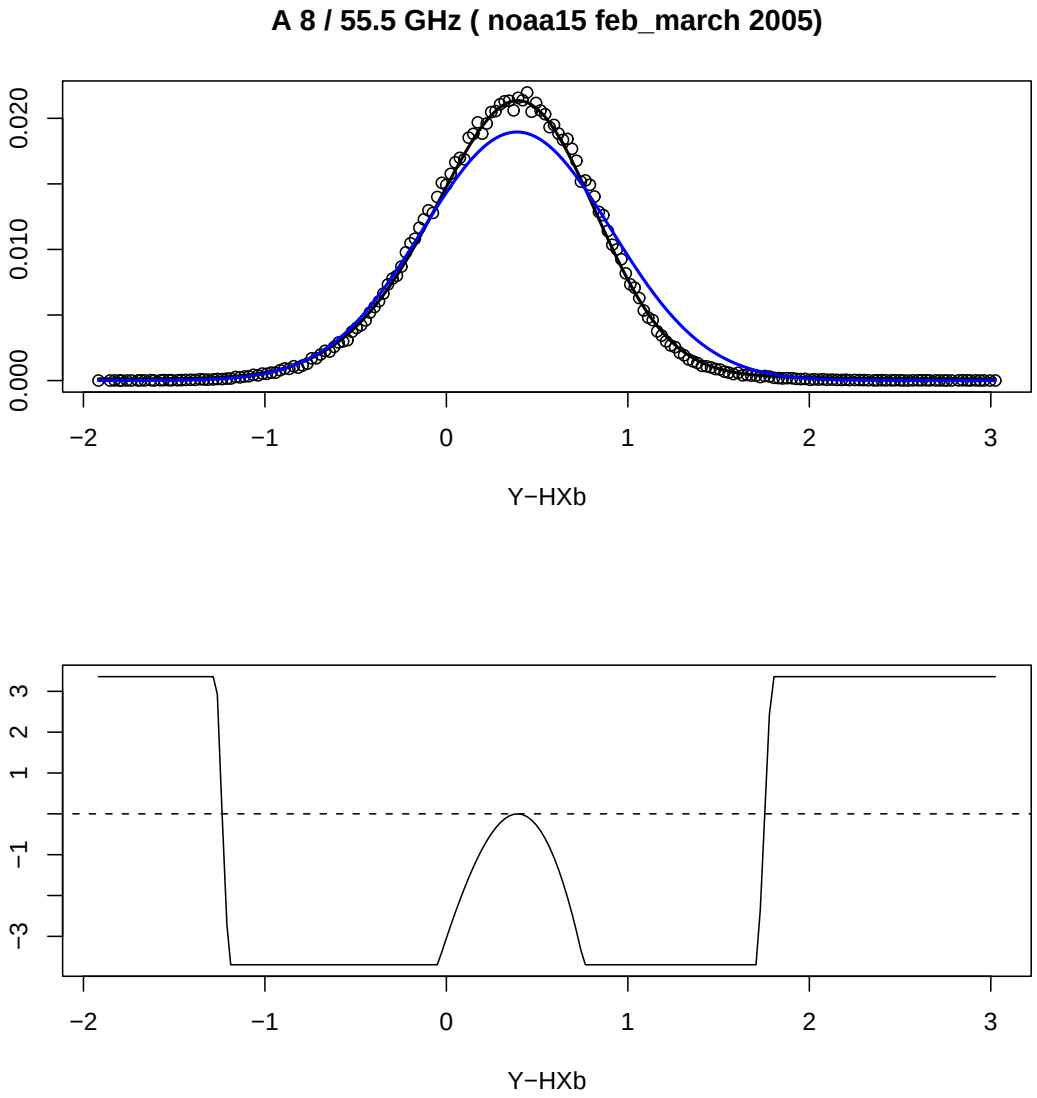
Satellite:	Noaa-15 (Channel 6)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-1.93033 K to 1.05184 K



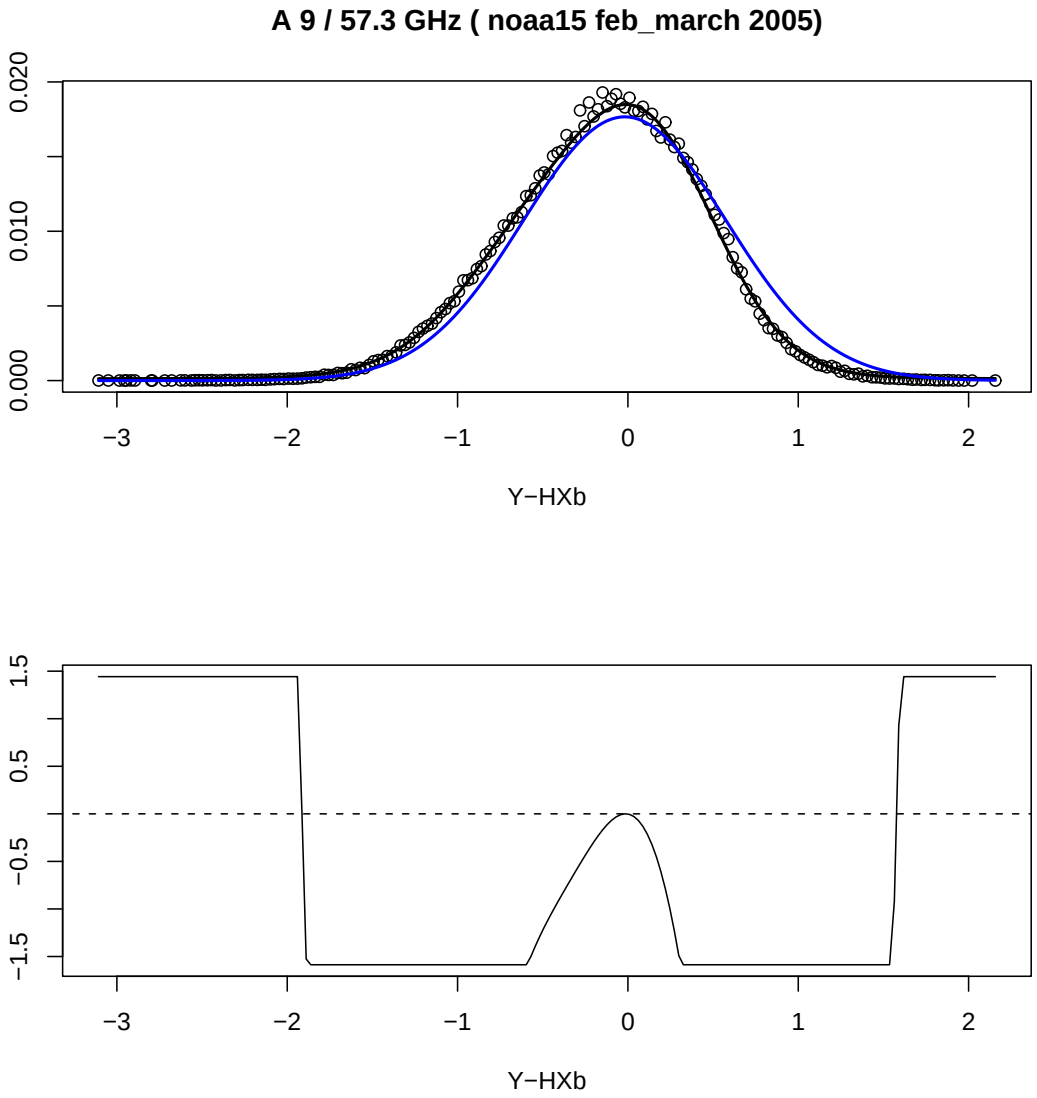
Satellite:	Noaa-15 (Channel 7)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-1.07438 K to 1.72510 K



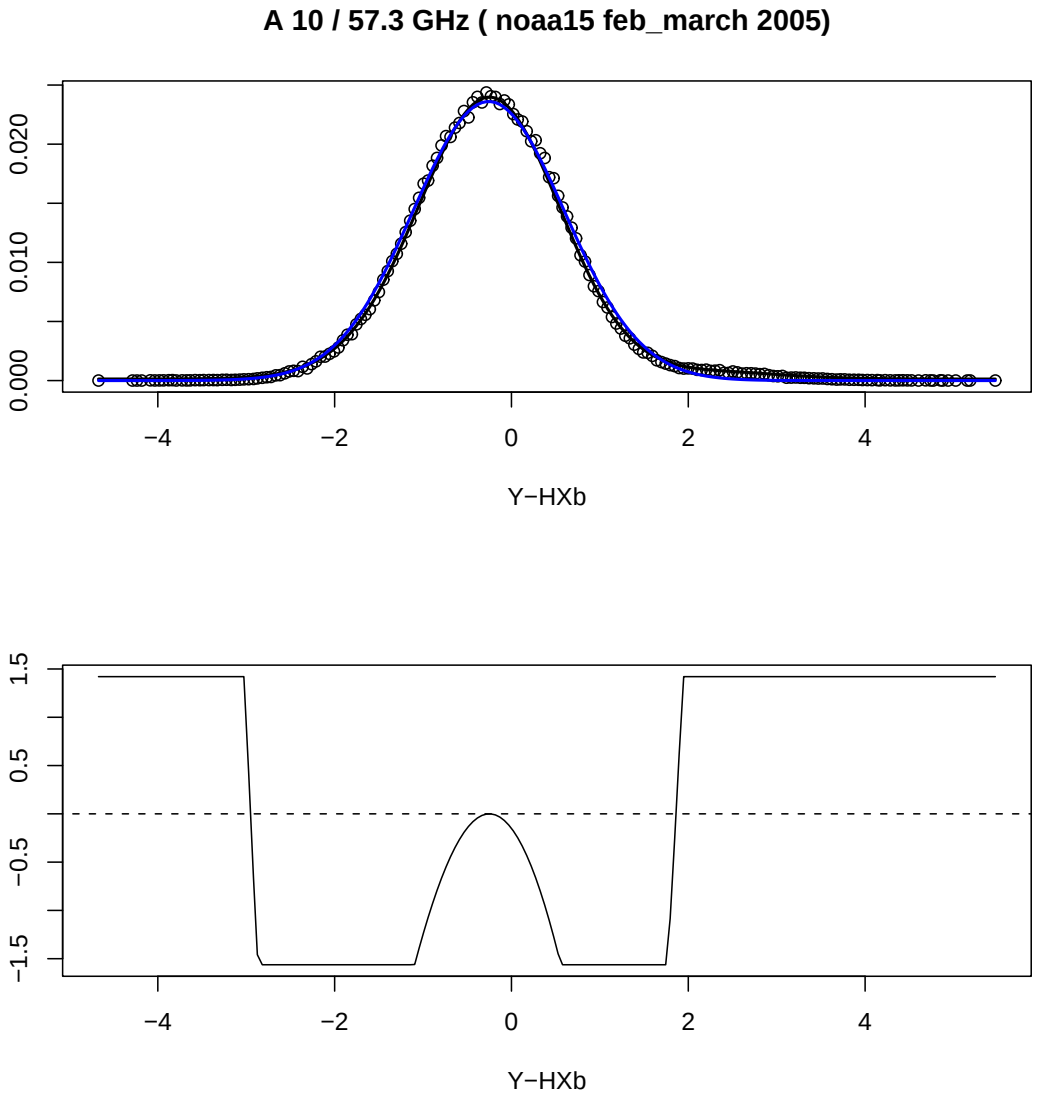
Satellite:	Noaa-15 (Channel 8)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-1.24914 K to 1.74230 K



Satellite:	Noaa-15 (Channel 9)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-1.90122 K to 1.57715 K



Satellite:	Noaa-15 (Channel 10)
Top Panel:	*Innovation probability and optimal Gaussian approximation,*
Lower Panel:	*Risk*
Valid range:	-2.94538 K to 1.87141 K



Summary

- A Bayesian Risk from using an observation with non-Normal error distribution in an assimilation system that assumes Normal error distribution, can be formulated.
- The most optimal Normal approximation can be estimated, and thresholds for this approximation can be found.
- The optimal Normal approximation tends to include as much data as possible, at the expense of using a larger observation error.