IASI quality control at KIAPS and preliminary results

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Introduction

Infrared Atmospheric Sounding Interferometer (IASI) covering the spectral interval 645 – 2760 cm-1 at a resolution of 0.5 cm-1 improves forecast impact accuracy in numerical weather prediction (NWP). Satellite observation data need to be converted to model variables to be used in data assimilation and a large spatial correlation compared to other observations data is a challenge. For satellite radiance data, it is essential to develop specialized preprocessing and quality control systems to correct various errors caused by observation environments such as wave length, field of view, and atmospheric conditions. This study is mainly focused on quality control processes at Korea Institute of Atmospheric Prediction Systems (KIAPS) and its preliminary results show reduced processing time and better data accuracy.

Data and methods

IASI measures radiances in 8461 channels covering the spectral interval 645 – 2760 cm-1 at a resolution of 0.5 cm-1. In this study, we used the level 1d BUFR(Binary Universal Form for the Representation of meteorological data) as observation data that are also used as input data for ODB(Observation database) at Korea Meteorological Administration. Surface information and temperature and humidity profiles derived from qwumgla_pp006, which are also used as background of data assimilation in the UM forecast, were used as input to a radiative transfer model, RTTOV(Radiative Transfer for TOVS) version 10.2.
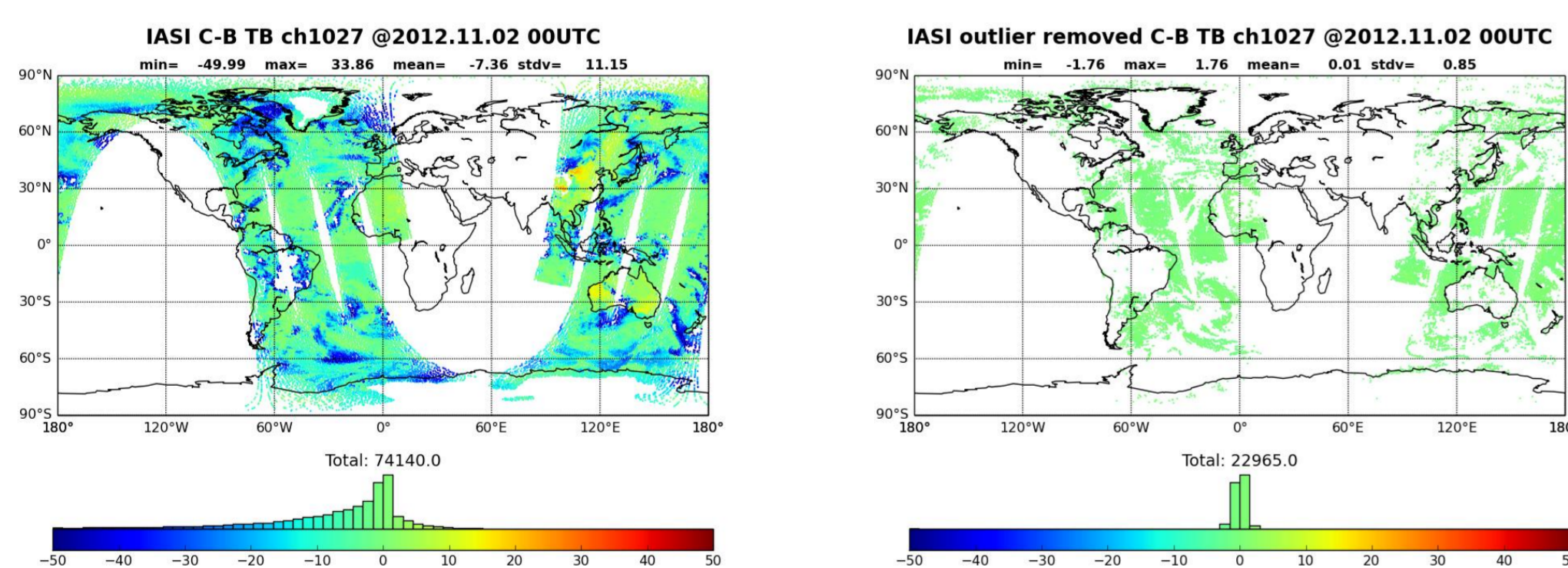
A quality control is conducted in each step in the IASI data processing system and QC flags are designed for data that degrade the data quality.
- Rejection flags: For data with critical errors that might stop the whole program. bits 15 -
- Information flags: For data with factors that can help decide data quality of data. bits 5 - 14
- Quality flags: For actual data quality based on the obtained information from each information flag. bits 0-4

	Flag Value		Description	
Rejection (Bits 15 -)	23	QC_BadSatID	Unidentified satellite id	**IASI 1d data**
	22	QC_BadChanInfo	Error identifying which channels from bufr and module	
	21	QC_PreQC	AAPP preprocessor flag	
	20	QC_Domain	Outside of area domain	**Gross QC**
	19	QC_BadScanPos	Unusable scan position	
	18	QC_BadObsTB	Obs TB outside the limits	
	17	QC_BadBkgProf	Background outside the limits	**Background**
	16	QC_BadBCPred	Unusable bias corrected data	**Bias Correction**
	15	QC_BadRTTOV	Error in forward model(Bkg. TB)	**Background TB**
Information (Bits 5 -14)	8	QC_ThinOut	Thinned out	**Thinning**
	7	QC_HighLand	Highland area	**Background**
	6	QC_ScanEdge	Scan position edge	**Gross QC**
	5	QC_MisSfcType	Conflicting surface type	

Quality
(Bits 0-4)

When the difference between corrected observed TB(Brightness Temperature) and background TB, i.e. C – B, is too large, we regard it as an outlier and flag with an outlier removal flag.
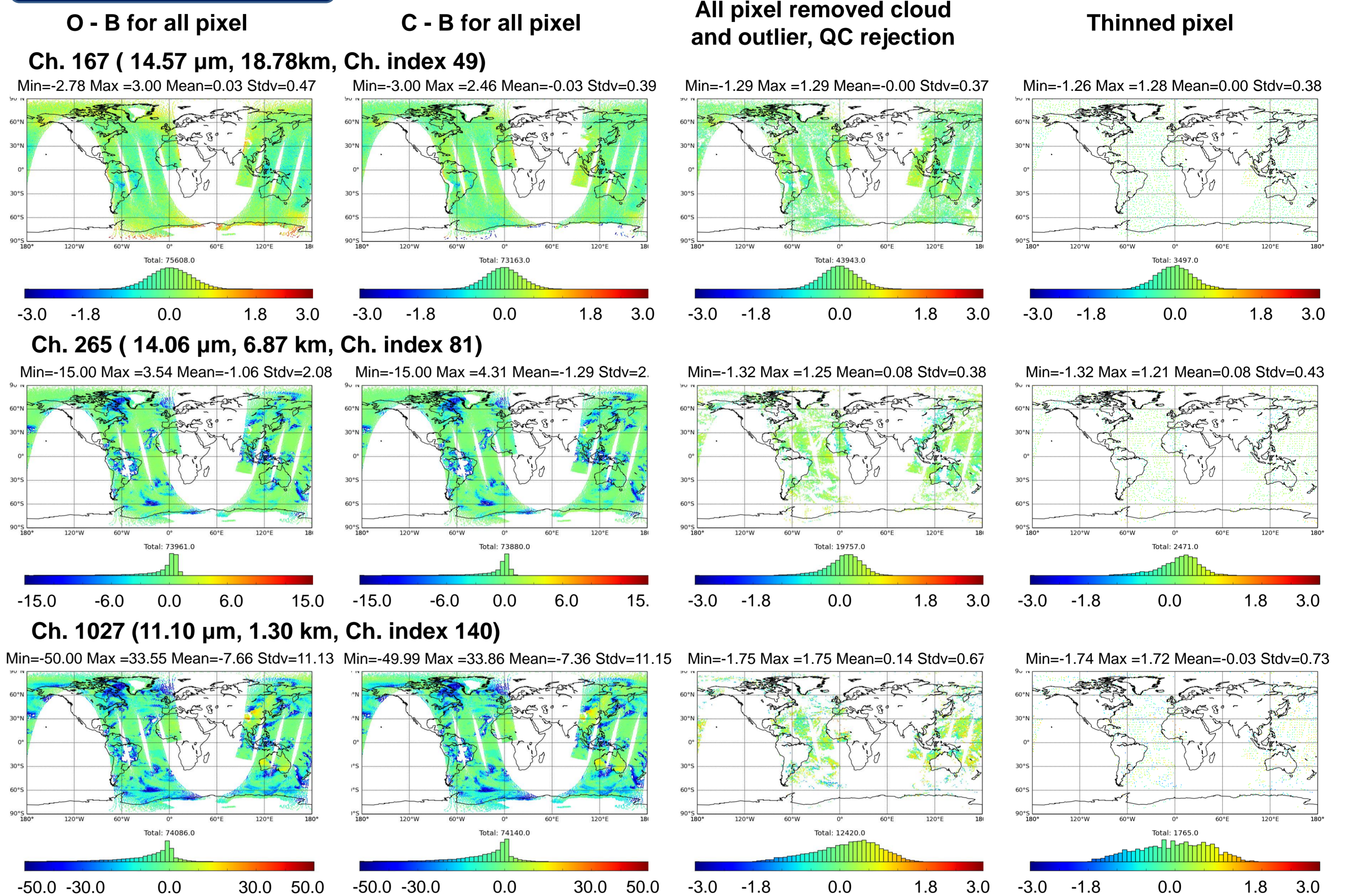
$$Threshold = 1mon \ \sigma_{C-B} * 3$$

IASI C-B TB ch1027 @2012.11.02 00UTC
min= -49.99 max= 33.86 mean= -7.36 stdv= 11.15

IASI outlier removed C-B TB ch1027 @2012.11.02 00UTC
min= -1.76 max= 1.76 mean= 0.01 stdv= 0.85

Total: 74140.0

Total: 22965.0

Results

O - B for all pixel | C - B for all pixel | All pixel removed cloud and outlier, QC rejection | Thinned pixel

Ch. 167 (14.57 μm, 18.78km, Ch. index 49)
Min=-2.78 Max =3.00 Mean=0.03 Stdv=0.47 | Min=-3.00 Max =2.46 Mean=-0.03 Stdv=0.39 | Min=-1.29 Max =1.29 Mean=-0.00 Stdv=0.37 | Min=-1.26 Max =1.28 Mean=0.00 Stdv=0.38

Total: 75608.0 | Total: 73163.0 | Total: 43943.0 | Total: 3497.0

Ch. 265 (14.06 μm, 6.87 km, Ch. index 81)
Min=-15.00 Max =3.54 Mean=-1.06 Stdv=2.08 | Min=-15.00 Max =4.31 Mean=-1.29 Stdv=2 | Min=-1.32 Max =1.25 Mean=0.08 Stdv=0.38 | Min=-1.32 Max =1.21 Mean=0.08 Stdv=0.43

Total: 73962.0 | Total: 73880.0 | Total: 19757.0 | Total: 2471.0

Ch. 1027 (11.10 μm, 1.30 km, Ch. index 140)
Min=-50.00 Max =33.55 Mean=-7.66 Stdv=11.13 | Min=-49.99 Max =33.86 Mean=-7.36 Stdv=11.15 | Min=-1.75 Max =1.75 Mean=0.14 Stdv=0.67 | Min=-1.74 Max =1.72 Mean=-0.03 Stdv=0.73

Total: 74086.0 | Total: 74140.0 | Total: 12420.0 | Total: 1765.0

The spatial coverage of observation minus background(O – B) innovations, corrected observation minus background(C – B) innovations, and C – B conducted cloud screening and outlier removal, quality control, and thinned C – B at 00UTC in 2nd Nov. 2012 are presented at ch.167, ch.265, ch.1027 which are upper, middle, and lower temperature. It tends to have similar means and standard deviations for O – B and C – B at three channels, but bias are lower for C – B. After processing cloud screening and outlier removal, quality control, means and standard deviations improved. While means and standard deviations have almost equivalent values before and after thinning which is select most clear pixel from set area(in this study, 3 ° x 3 °), there is significant difference in mean at ch.1027. This pattern is only at ch.1027 which is lower temperature, therefore it is seemed to related with clouds. For this reason, it can be inferred that the bias affected by clouds were overcorrected to positive.

Following table shows data number used each processing for 00 UTC in 2nd. Nov. 2012 .

	O - B	C - B	Cloud	Outlier	Quality control	Thinning
Data num.	75705 (93.46 %)	75705 (93.46%)	12607 (15.56 %)	22965 (28.35 %)	70987 (87.64 %)	1765 (2.18 %)

The results presented here are based on data for 1 month period Nov. 2012. To analyze O – B and C – B, C – B processed each steps for temperature sounding, means and standard deviations and data number used each steps are shown.

O – B for QC rejection flags applied pixel

All pixel removed cloud and outlier, QC rejection

C – B for QC rejection flags applied pixel

Thinned pixel

Summary

Quality control for IASI temperature sounding channels have been assessed and the preliminary results are presented. Using QC rejection flags, data were rejected about 10%. While the data were eliminated about 20% at upper atmosphere temperature channels and 80% at lower atmosphere temperature channels of all data, the monthly means for C – B evenly centered around 0.0 K.
In this study, we only use QC rejection flags from QC flags but it is needed to evaluate QC information flags and QC quality flags.