May 29, 2012

NWP Systems and Use of ATOVS/AIRS/IASI (2012 SURVEY)

Table 1: Overview

STATUS at Jan 1, 2012 wrt 2010	Institute	Data Assimilation System		Radiative Transfer Model	ATOVS assimilated			Bias Correction Scheme	Monitoring Web Page
		Global	Regional or Km Scale		Radiances	Retrievals	RARS		
Updated	**EC**	4DVAR & EnKF	3DVAR	RTTOV8.7	YES	NO	NO	off-line	YES
Updated	**ECMWF**	Hybrid 4DVAR+Ens		RTTOV10.1	YES	NO	YES	VAR	YES
Updated	**NMI**		3DVAR	RTTOV7	YES	NO	YES	off-line	NO
Updated	**US-FNMOC/NRL**	4DVAR	3DVAR	CRTM	YES	YES (RD)	YES	off-line	YES
Updated	**DWD**	3DVAR	nudging	RTTOV7	YES	NO	YES	off-line	YES
Updated	**Met Office**	Hybrid-4DVAR+Ens	4DVAR	RTTOV7	YES	NO	YES	off-line	YES
Not Updated	**DMI**		3DVAR	RTTOV8.5	YES	NO	YES	off-line	YES
Updated	**JMA**	4DVAR	4DVAR	RTTOV9.3	YES	NO	YES	VAR	YES
Updated	**Meteo-France**	4DVAR+Ens	3DVAR	RTTOV9.2	YES	NO	YES	VAR	YES
Updated	**US-NCEP**	3D-VAR	3D-VAR	CRTM	YES	NO	YES	VAR	YES
Updated	**BoM**	4DVAR	4DVAR	RTTOV7	YES	NO	NO	off-line	NO
Updated	**CPTEC/INPE**	3DVAR	3DVAR	CRTM	YES	NO	YES	N/A	NO
NEW	**SMHI**		4DVAR	RTTOV 7	YES			off-line	NO
NEW	**CNMCA**		LETKF	RTTOV10.2	YES	NO(monitoring)	YES	off-line	NO
NEW	**KMA**	4DVAR	4DVAR	RTTOV7	YES	NO	YES	off-line	NO
NEW	**NCMRWF**	3DVAR		CRTM	YES	NO	NO	VAR	YES

G global

Table prepared by ITWG/NWP WG

R regional

GD global deterministic
RD regional deterministic

Table 2: NWP Systems and Use of ATOVS

Table prepared by ITWG/NWP WG

Institute	Global		Regional		Data Assimilation	Radiative Transfer Model	ATOVS Radiance Assim (Level)	ATOVS Retrievals Assim	RARS
	Deterministic	Ensemble	Deterministic	Ensemble					
EC (Canada)	35 km L80 (10d)	66 km L40 (20m) (16d)	15 km L80 (2d) 2.5 km L58 (1d)	35 km L28 (3d)	GD: 4D-Var T108 L80 GE: EnKF 100 km L58 (192m) RD : 3D-Var T200 L80	RTTOV 8.7	Level 1b processed to 1c with AAPP	NO	NO
ECMWF (Europe)	T1279 L91 (10d)	T639 up to 10d/ T319 d10-15, L62 51m			12-hour 4D-Var at T1279 L91 with T255 final inner loop	RTTOV 10.1	Level 1c (after antenna pattern correction)	NO	EARS AP-RARS
NMI (Norway)			8 km L60 (2.75d) 12 km L60		3D-Var "	RTTOV 7 "	Level 1c "	NO "	EARS + locally received data "
FNMOC/NRL (USA)	T319 L42 (7.5d)	T119 L30 (24m) (10d)	70 areas, most are 45/15/5km L30, some 45/15/5/1.67km L30		GD: 4D-Var-AR T119 L42 GE: 4D-Var-AR T119 L30 RD: 3D-Var 27/9/ 3 km	CRTM	Level 1b processed to 1c with AAPP	YES (RD)	YES
DWD (Germany)	20 km L60 (7d)		7 km L40 2.8 km L50	2.8km (20m) (21h)	GD: 3D-Var RD: nudging	RTTOV 7	Level 1b	NO	YES (G)
Met Office (UK)	25 km L70 (6d)	60 km L70 (24m) (3d)	12 km L38 1.5 km L70	18 km (24m) (2d)	G: 4D-Var 60 km L70 R12km: 4D-Var 24 km R1.5km: 3D-Var + Latent Heat nudging 1.5 km	RTTOV 7	Level 1b/1c	NO	EARS AP-RARS SA-RARS
DMI (Denmark)			0.15 deg (16 km) L40 0.09 deg (10 km) L40 0.03 deg (3.3 km) L40 0.05 deg (5.6 km) L40		3D-Var 0.15 deg L40 3D-Var 0.09 deg L40 3D-Var 0.09 deg L40 incremental	RTTOV 8.5	Level 1c from AAPP	NO	EARS
JMA (Japan)	T959 L60 (9d)	T319 L60 (51m) (9d)	5 km L50	T319 L60 (11m) (5d)	G: 4D-Var T319 L60 R: 4D-Var 15 km	RTTOV 9.3	Level 1c	NO	EARS AP-RARS SP-RARS
Météo France (France)	T798C2.4 L70 (4d)	T538C2.4 L65 (35m)	2.5 km L60	25 km (35m) (4d)	G: 4D-Var+ens T323C1 L70 R: 3D-Var 2.5 km	RTTOV 9.2	Level 1c	NO	EARS AP-RARS

NCEP **(USA)**	T574 L64 (7.5d) T190 L64 (16d)	T254L42 (84m)(1-8d) T190L42 (84m)(8-16d)	12 km L60 4 km L50	16 km L35 (21m) (3.6d)	G: 3D-Var T574 L64 R: 3D-Var 12 km	CRTM	Level 1b	NO	YES (G)
BoM **(Australia)**	80 km L 50 (10d)		37.5 km L50		G: 4D-Var 100 km L50 R: 4D-Var 75 km L50	RTTOV 7	Level-1d from AAPP from Met Office	NO	NO
CPTEC/INPE **(Brazil)**	45 km L64 (7d)	100 km L28 (40m) (15d)	15 km L50	20 km (21m) (10d)	G: 3DVAR 40 km R: 3DVAR 15 km	CRTM	YES	NO	YES
SMHI **(Sweden)**			10 km L60		4dvar	RTTOV 7	YES	NO	EARS
CNMCA **(Italy)**			7 km L40 2.8 km L50	*(perhaps in 2013)*	R:LETKF 10 km	RTTOV9.2	Level 1c	NO(monitoring)	EARS
KMA **(Korea)**	25 km L70 (10.5d)	40 km L70 (10d)	12 km L70 1.5 km L70		G: 4D-Var 75 km L70 R12km: 4D-Var 36 km L70 R1.5km: 3D-Var + FGAT	RTTOV 7	Level-1d from AAPP from Met Office	NO	AP-RARS EARS SA-RARS
NCMRWF **(INDIA)**	T574L64				3DVAR	CRTM	Level 1b	NO	NO

CODES

G global
R regional
GD global deterministic
RD regional deterministic
GE global ensemble
RE regional ensemble
T*n* truncation wavenumber
L*n* number of levels
(*n* d) number of days
(*n* m) number of members

Table 3: Use of ATOVS Radiances in NWP

Table prepared by ITWG/NWP WG

Institute	NWP Systems using ATOVS	Thinning	Bias Corr.	Other Preproc	AMSU-A										AMSU-B/MHS									HIRS								
					Satellites							Channels			Satellites							Channels			Satellites							Channels		
					N15	N16	N17	N18	N19	AQ	MO	land/sea	sea/lo topo	sea	15	16	17	18	19	AQ	MO	land/sea	sea/lo topo	sea	15	16	17	18	19	AQ	MO	land/sea	sea/lo topo	sea
EC (Canada)	GD, RD, GE	GD,RD=150 GE=250 km[1]	HK off-line dynamic[2]	screen for CLW and precip.	X	X		X	X	X	X	7-14	6	4-5		X		X	X		X	3-4		2,5									
ECMWF (Europe)	GD, GE	125 km	variational[13]		X			X	X	X	X	7-14	5-6					X	X		X		3-4	5					X		X		12	4-7, 11, 14, 15
NMI (Norway)	RD (HIRLAM)	50 km	before assim.	cloud-clearing	X	X		X						4-10																			
FNMOC/NRL (USA)	GD, GE	140 km[4]	HK off-line dynamic[5]	screen for high CLW	X	X		X	X	X	X	6-14		4-5				X	X		X			4-5									
DWD (Germany)	GD	200 km	off-line static[6]	screen for CLW and precip.	X			X	X		X			5-14																			
Met Office (UK)	GD, RD, GE	G=125/154 km R=80 km	off-line	Calibration. Remap to HIRS	X			X	X		X	6-14		4-5	X			X	X		X			3-5					G		G			4-7, 11, 12, 15
DMI (Denmark)	RD (HIRLAM)	0.9 deg (100 km)	HK off-line static		X	X		X	X		X			4-10[7]				X	X		X			3-5									
JMA (Japan)	GD, GE	G= AMSUA250km AMSUB180km R=45km	off-line for scan bias, remainder with variational	cloud/rain classification	X	X		X	X	X	X	8-13	6-7	4-5				X	X		X			3-5									
Météo France (France)	GD, RD	125 km 80 km IASI RD	variational		X	X		X	X	X	X	5-13[8,9]	5-13	5-13				X			X	3-5	3-5	3-5				X		X			12	4-7, 11, 14, 15
NCEP (USA)	GD, RD	G=145 km R=120 km IR, 60 km MW	variational	See Note 10	X			X	X	X	X	1-13, 15						X	G		X	1-5							X		X	2-15		
BoM (Australia)	GD, RD	G=154 km R=80 km	HK off-line[11]	See Note 12		X		X	X		X	7-14	6	4-5				X			X			3-5			X	X		X			4-7, 11, 12, 15
CPTEC/INPE	GD	145 km			X			X	X		X				X			X			X						X		X			

(Brazil)	RD																													
SMHI	RD (HIRLAM)	0.9 deg	HK off-line static		X	X							5-10																	
CNMCA (Italy)	RD	R=120 km	off-line dynamic	screen for CLW and precip.		X		X	X		X	7-10	5-6	5-10	See Note 3						3-4	5								
KMA (Korea)	GD, RD, GE	G=154 km R=80 km	off-line	See Note 12	X		X	X	X		X	7-14		4-14	X			X	X			3-5			X		X			2-8, 10-15,
NCMRWF (INDIA)	GD		variational		X			X	X	X	X	1-10 12,13,			X			X	X		1-5				X		X		2-15		

NOTE: All centers reject some channels from certain satellites for which the radiance data are known to be bad. These details are not provided here.

CODES

G global
R regional
GD global deterministic
RD regional deterministic
GE global ensemble
RE regional ensemble

Nxx, xx NOAA xx
MO Metop-A
AQ Aqua

off-line dynamic	bias corrections updated and applied to data before each analysis
variational	e.g. VarBC where bias corrections are computed during variational analysis as part of minimization
HK	Harris Kelly type bias correction (thickness predictors)
sea/lo topo	assimilated over ocean and low topography land
CLW	cloud liquid water

NOTES

1 Thinning to be reduced to 150 km (currently being tested)
2 Bias correction is off-line static for AMSU-A channels 11-14
3 AMSU-B/MHS assimilation is being tested
4 Start with taking every 4th point along scan, from every other scan line (skipping pattern to sample every scan point), then further reduce to approximately 140 km.
5 VarBC code developed, awaiting transition
6 Switch to an online bias correction scheme soon
7 Channels 4-5 not assimilated over sea ice

8 AMSU-A ch. 5-6 not assimilated over sea ice
9 AMSU-A channels in range 5-13 not assimilated: N15 (6,11) N16 (5-10,12) AQ (5-7) MO (7)
10 Calibration and for RARS data removal of antenna correction (G), Calibration (R)
11 Bias correction soon to become offline adaptive
12 Cailibration and pre-processing via AAPP at Met Office. Cloud detection, land/sea/ice determination in OPS pre-processor as part of Met Office UM suite.
13 AMSU-A channel 14 used without bias correction

Table 4: Use of ATOVS Retrievals

Table prepared by ITWG/NWP WG

Institute	ATOVS Retrievals								
	Used in radiance assimilation (e.g. QC)	Assimilated	NWP System	Scheme / Product	Variable(s)	Vertical Resolution	Horizontal Sampling	Excluded	Bias Correction
EC (Canada)	NO	NO							
ECMWF (Europe)	NO	NO							
NMI (Norway)	NO	NO							
FNMOC/NRL (USA)	NO	YES	RD (COAMPS, NAVDAS)	NESDIS	Temperature	Full to 10 mb	1.5 degrees (167 km)	over land	NO
DWD (Germany)	NO	NO							
Met Office (UK)	**YES**[1]	NO							
DMI (Denmark)	NO	NO							
JMA (Japan)	NO	NO							
Météo France (France)	NO	NO							
NCEP (USA)	NO	NO							
BoM (Australia)	**YES**[2]	NO							
CPTEC/INPE (Brazil)	NO	NO							
SMHI									
CNMCA (Italy)	NO	NO(monitoring)	RD	EUMETSAT	Temperature	Up to 10hPa			
KMA (Korea)	**YES**	NO							
NCMRWF	NO	NO							

(INDIA)

NOTES

1 Run 1D-var prior to assimilation which analyses skin temperature and for advanced IR sounders cloud cover and emissivity which are used in the forward calculations in 4D-Var.
2 1D-Var

Table 5: Use of AIRS AND IASI Radiances in NWP

Table prepared by ITWG/NWP WG

Institute	AIRS								IASI							
	Number of Channels Assimilated								Number of Channels Assimilated							
	15 microns		Window + O3		H2O		Short Wave		15 microns		Window + O3		H2O		Short Wave	
	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean	Land	Ocean
EC (Canada)	4	19	0	10	26	33	0	24	14	43	0	19	0	0	0	0
ECMWF (Europe)	47	81	0	33	0	7	0	19	0	153	0	28	0	9	0	1
NMI (Norway)																
FNMOC/NRL (USA)	31	51						13	25	51						
DWD (Germany)																
Met Office (UK)	46	75	0	19	0	47	0	0	87	87	14	21	30	30	0	0
DMI (Denmark)																
JMA (Japan)																
Météo France (France)	0	54	0	0	0	0	0	0	50	64	0	4	9	9	0	0
NCEP (USA)	75	75	11	11	20	20	14	14	116	116	45	45	4	4		
BoM (Australia)		20		12		16		14								
CPTEC/INPE (Brazil)																
SMHI																

CNMCA																
KMA (Korea)	**0**	**20**	**0**	**11**	**0**	**16**	**0**	**0**	**95**	**124**	**0**	**29**	**24**	**30**	**0**	**0**
NCMRWF INDIA	75		11		20		14		116		45		4			

Instructions: Please enter the number of channels assimilated in each band. Bands are defined as follows:

15 microns: [650 cm-1 - 770 cm-1]
window + ozone: [770 cm-1 - 1210 cm-1]
H2O [1210 cm-1 - 2000 cm-1]
Short-wave [2000 cm-1 - 2700 cm-1]

You are also encouraged to send in attachements describing actual channel numbers and observational errors used.

Table 6: Assimilation of cloudy RADIANCES in NWP

Institute	IASI	AIRS	CrIS	AMSU-A	AMSU-B/MHS	ATMS	HIRS
EC (Canada)	IC	IC		IC	IC		n/a
ECMWF (Europe)	IC, SV	IC, SV		IC	IC		IC, SV
NMI (Norway)							
FNMOC/NRL (USA)	IC	IC	IC planned	IC	IC	IC planned	n/a
DWD (Germany)				HH			
Met Office (UK)	SV (1)	SV (1)		AC	IC		HH
DMI (Denmark)							
JMA (Japan)				IC	IC		
Météo France (France)	IC, SV	IC, SV		IC	IC		IC
NCEP (USA)	IC	IC	IC	IC	IC	IC	IC
BoM (Australia)		HH		IC	IC		HH
CPTEC/INPE (Brazil)							
SHMI							
KMA (Korea)	IC	IC					
NCMRWF INDIA							

Table prepared by ITWG/NWP WG

HH	**hole hunting:** search for clear FOVS and only assimilate clear sky radiances
IC	**Insensitive channels :** not sensitive to clouds but clouds can be present at altitudes lower than where the radiance is sensitive
CC	**cloud clearing:** method to transform potentially cloud affected radiances to clear, then assimilate modified radiances
SV	**sink variable:**the cloud is retrieved/analysed as a sink variable in 1D/3D/4DVar but is not actually assimilated.

AC **assimilate clouds:** assimilation of cloud affected radiances **** Please feel free to provide more information on assimilation technique that is used***

Notes:

1 with dynamic selection of weakly cloud-affected channels