RTTOV v11 Performance Tests

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Change record			
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0.1	25/04/13	David Rundle	Original draft
1.0	16/05/13	David Rundle	Respond to DRI comments

This document describes the tests performed to compare the performance of RTTOV v11 with that of RTTOV v10.2.

Tests were performed on IBM and Intel architectures. Calculations were performed for AMSU-A (all channels) and IASI (183 channels). Runs were carried out both with and without interpolation, for one profile at a time and for several profiles at a time (for AMSU-A only).

For AMSU-A, the FASTEM-5 surface emissivity model was used in both RTTOV v10.2 and v11. The ISEM emissivity model was used for IASI. The tests were set up identically for both versions with the same options being selected for each and the same 54 level coefficient files being used in both cases.

Tests 1-18 used a 54-level clear-sky profile and 54-level, version 7 predictor coefficient files or a 101-level, version 7 predictor coefficient file. Tests 19-21 used a 101-level input profile which included cloud and aerosol profiles, and 100/101-level version 9 predictor coefficient files. Tests 22-27 used a 101-level input profile, a 101-level, version 9 predictor coefficient file and corresponding PC coefficient file.

The following table lists the clear-sky tests:

Test Number	Platform	Sensor	Coefs pred/levels	nchannels	nprofiles per call	Interp?	Model
1	noaa	amsua	v7, 54	15	1	N	direct
2	noaa	amsua	v7, 54	15	10	N	direct
3	noaa	amsua	v7, 101	15	1	Y	direct
4	noaa	amsua	v7, 101	15	10	Y	direct
5	noaa	amsua	v7, 54	15	1	N	K
6	noaa	amsua	v7, 54	15	10	N	K
7	noaa	amsua	v7, 101	15	1	Y	K
8	noaa	amsua	v7, 101	15	10	Y	K
9	noaa	amsua	v7, 54	15	1	N	TL/AD
10	noaa	amsua	v7, 54	15	10	N	TL/AD
11	noaa	amsua	v7, 101	15	1	Y	TL/AD
12	noaa	amsua	v7, 101	15	10	Y	TL/AD
13	metop	iasi	v7, 54	183	1	N	direct
14	metop	iasi	v7, 101	183	1	Y	direct
15	metop	iasi	v7, 54	183	1	N	K
16	metop	iasi	v7, 101	183	1	Y	K
17	metop	iasi	v7, 54	183	1	N	TL/AD
18	metop	iasi	v7, 101	183	1	Y	TL/AD

The following table lists the cloud and aerosol-affected tests:

Test Number	Platform	Sensor	Coefs pred/levels	nchannels	nprofiles per call	Interp?	Model
19	metop	iasi	v9, 100/101	183	1	N	direct
20	metop	iasi	v9, 100/101	183	1	N	K
21	metop	iasi	v9, 100/101	183	1	N	TL/AD

The following table lists the Principle Component tests:

Test Number	Platform	Sensor	Coefs pred/levels	channels/ pcscores	nprofiles per call	Reconstructed radiances/jacobians	Model
22	metop	iasi	v9, 100/101	300/100	1	N	direct
23	metop	iasi	v9, 100/101	300/100	1	N	K
24	metop	iasi	v9, 100/101	300/100	1	N	TL/AD
25	metop	iasi	v9, 100/101	300/100	1	Y	direct
26	metop	iasi	v9, 100/101	300/100	1	Y	K
27	metop	iasi	v9, 100/101	300/100	1	Y	TL/AD

Each test was run for a large number of profiles. The total number of profiles processed in each test is given in the following tables:

Tests 1-18:

AMSU-A direct only	1000000 profiles
AMSU-A direct/TL/AD/K	100000
IASI direct only	100000
IASI TL/AD & K	10000

Tests 19-21:

IASI direct only	1000 profiles
IASI TL/AD & K	100

Tests 22-27:

IASI direct only	10000 profiles
IASI TL/AD & K	1000

The timing results are shown in the table on the following page; all times given are times *per profile* in ms. Notes on results:

- All timings were taken from the RTTOV test suite.

- ifort version 12.0.4 and gfortran 4.4.6 (distributed with RHEL 6.3) was used on the Intel platform and XLF 14.1 was used on an IBM POWER7 supercomputer. Compiler flags used in testing were similar for both platforms where only floating point safe optimisations were used (-O3 -fp-model source and -O3 -qstrict).

- For clear-sky simulations (Tests 1-18) RTTOV v11 generally runs as fast or faster than RTTOV v10.2. There is a marked improvement in performance for the K code on all platforms, whereas performance in improvements in the direct and TL/AD codes is more modest.

- For cloud and aerosol-affected simulations, the RTTOV v11 code is somewhat slower than RTTOV v10.2.

- Tests that are at least 10% faster for RTTOV 11 vs 10.2 are highlighted in green and those that are 10% slower are highlighted in red.

Test Number	Intel gfortran v10.2	Intel gfortran v11	Intel gfortran v11:v10.2	Intel ifort v10.2	Intel ifort v11	Intel ifort v11:v10.2	IBM v10.2	IBM v11	IBM v11:v10.2
1	0.26	0.27	101.25	0.19	0.19	103.04	0.09	0.09	98.85
2	0.23	0.24	101.6	0.16	0.15	98.26	0.07	0.07	97.77
3	0.45	0.46	102.97	0.31	0.29	95.56	0.13	0.14	106.2
4	0.37	0.38	101.73	0.24	0.24	98.84	0.13	0.12	84.27
5	1.22	0.7	57.44	0.92	0.60	64.86	0.40	0.30	75.69
6	1.19	0.64	53.69	0.9	0.52	58.00	0.51	0.34	67.13
7	2.07	1.24	59.72	1.33	0.87	65.07	0.59	0.52	88.89
8	1.96	1.09	55.43	1.27	0.76	59.59	0.69	0.56	81.24
9	0.98	0.97	98.88	0.81	0.75	92.84	0.38	0.37	97.11
10	0.84	0.84	100.24	0.638	0.6	94.04	0.33	0.30	91.38
11	1.70	1.66	98.11	1.232	1.17	94.72	0.56	0.62	111.51
12	1.39	1.37	98.41	0.97	0.95	97.73	0.57	0.53	93.85
13	2.61	2.75	105.34	1.74	1.67	96.5	1.07	0.85	78.93
14	4.27	4.53	105.87	2.74	2.66	97.19	1.86	1.37	73.44
15	18.34	8.25	45.01	13.04	7.01	53.77	9.40	5.70	60.45
16	28.24	14.22	50.34	17.72	9.94	56.08	14.08	6.94	49.24
17	8.96	9.35	104.33	6.94	6.63	95.6	4.28	4.44	103.83
18	14.75	15.69	106.39	10.73	10.59	98.74	7.38	6.31	85.49
19				114.48	117.74	102.85	75.24	68.03	90.42
20				355.50	312.7	87.96	319	238.9	74.89
21				538.0	523.3	97.27	438.8	321.3	73.25
22	Tests not performed on this platform			8.61	8.45	98.23	5.11	4.22	82.61
23				2570.4	2552.4	99.3	1083.5	1015.9	93.76
24				360.1	373.6	103.75	226.5	204.4	90.24
25				8.61	8.55	99.27	5.27	4.40	83.46
26				5209.9	5146.9	98.79	1908.0	1848.9	96.90
27				362.5	361.1	99.61	22.91	20.95	91.4