RTTOV v10 Performance Tests

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Change record			
Version	Date	Author / changed by	Remarks
0.1	29/11/10	James Hocking	Original draft
1.0	30/11/10	James Hocking	Added results from PB.
1.1	09/12/10	James Hocking	Response to DRI comments
1.2	13/01/11	James Hocking	Update cloud/aerosol test results after code improvements.

This document describes the tests performed to compare the performance of RTTOV v10 with that of RTTOV v9.3.

Tests were performed on IBM, NEC 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, the FASTEM-3 surface emissivity model was used in RTTOV v9.3 while FASTEM-4 was used in RTTOV v10. (Note that the surface emissivity calculation takes a very small fraction of the total execution time so the use of different models does not compromise the comparison). The ISEM emissivity model was used for IASI.

Tests 1-16 used a 43/44-level clear-sky profile and 43/44-level, version 7 predictor coefficient files. Tests 17-24 used a 100/101-level input profile which included cloud and aerosol profiles, and 100/101-level version 9 predictor coefficient files.

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, 43/44	15	1	N	direct
2	noaa	amsua	v7, 43/44	15	50	N	direct
3	noaa	amsua	v7, 43/44	15	1	Y	direct
4	noaa	amsua	v7, 43/44	15	50	Y	direct
5	noaa	amsua	v7, 43/44	15	1	N	direct/TL/AD/K
6	noaa	amsua	v7, 43/44	15	50	N	direct/TL/AD/K
7	noaa	amsua	v7, 43/44	15	1	Y	direct/TL/AD/K
8	noaa	amsua	v7, 43/44	15	50	Y	direct/TL/AD/K
9	metop	iasi	v7, 43/44	183	1	N	direct
10	metop	iasi	v7, 43/44	183	50	N	direct
11	metop	iasi	v7, 43/44	183	1	Y	direct
12	metop	iasi	v7, 43/44	183	50	Y	direct
13	metop	iasi	v7, 43/44	183	1	N	direct/TL/AD/K
14	metop	iasi	v7, 43/44	183	50	N	direct/TL/AD/K
15	metop	iasi	v7, 43/44	183	1	Y	direct/TL/AD/K
16	metop	iasi	v7, 43/44	183	50	Y	direct/TL/AD/K

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

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

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 1-16:

	Intel	**IBM**	**NEC**
AMSU-A direct only	100000 profiles	500000	N/A
AMSU-A direct/TL/AD/K	10000	50000	10000
IASI direct only	10000	50000	N/A
IASI direct/TL/AD/K	1000	5000	1000

Tests 17-24:

	Intel	**IBM**
IASI direct only	800 profiles	4000
IASI direct/TL/AD/K	100	400

The timing results are shown in the table on the following page. Notes on results:

- All clear-sky tests were run using 44 level coefficient files (rather than the new 51 level files) to make the comparisons between v9 and v10 fair.

- The Intel gfortran and NEC timings were obtained with DrHook while the Intel ifort and IBM timings were taken from the RTTOV v10 test suite. DrHook timings should be more accurate, but the timings from the test suite nevertheless provide a useful indication for the purposes of comparison.

- For clear-sky simulations (Tests 1-16) RTTOV v10 generally runs as fast or faster than RTTOV v9.3. On the NEC one routine (rttov_integrate_ad) cannot currently be compiled with optimisations which reduces the performance of RTTOV v10 relative to RTTOV v9.3.

- For cloud and aerosol-affected simulations, the RTTOV v10 direct code is somewhat slower than RTTOV v9.3, in particular on the IBM. This is a known issue which will be addressed in the future.

Test Number	Intel gfortran v9	Intel gfortran v10	Intel gfortran v10:v9	Intel ifort v9	Intel ifort v10	Intel ifort v10:v9	IBM v9	IBM v10	IBM v10:v9	NEC SX8 v9	NEC SX8 v10	NEC SX8 v10:v9	NEC SX9 v9	NEC SX9 v10	NEC SX9 v10:v9
1	-	-	-	72.50	65.45	90.28%	124.32	126.01	101.36%	-	-	-	-	-	-
2	-	-	-	67.86	57.45	84.66%	111.79	112.51	100.64%	-	-	-	-	-	-
3	-	-	-	77.24	69.92	90.52%	146.01	150.17	102.85%	-	-	-	-	-	-
4	-	-	-	70.95	61.98	87.36%	121.20	117.53	96.97%	-	-	-	-	-	-
5	36.87	27.91	75.70%	93.87	81.71	87.05%	128.49	126.69	98.60%	291.64	253.92	87.07%	556.34	369.20	66.36%
6	41.35	36.45	88.15%	90.67	78.20	86.25%	134.07	124.59	92.93%	37.73	38.91	103.13%	60.20	39.20	65.12%
7	42.56	36.48	85.71%	96.57	90.31	93.52%	160.97	163.50	101.57%	362.00	312.00	86.19%	666.00	470.80	70.69%
8	42.27	39.49	93.42%	91.56	84.67	92.47%	153.34	151.59	98.86%	61.97	55.33	89.29%	101.96	67.61	66.31%
9	-	-	-	83.03	72.71	87.57%	109.65	111.83	101.99%	-	-	-	-	-	-
10	-	-	-	83.66	72.45	86.60%	121.00	121.68	100.56%	-	-	-	-	-	-
11	-	-	-	86.79	76.87	88.57%	117.44	120.77	102.84%	-	-	-	-	-	-
12	-	-	-	86.85	76.52	88.11%	127.98	128.60	100.48%	-	-	-	-	-	-
13	51.63	47.61	92.21%	115.34	106.83	92.62%	150.43	145.13	96.48%	37.56	39.49	105.14%	60.79	52.56	86.46%
14	55.73	51.83	93.00%	118.90	109.46	92.06%	214.12	196.82	91.92%	14.21	19.02	133.85%	17.51	20.39	116.45%
15	50.31	51.14	101.65%	118.31	115.79	97.87%	178.95	172.04	96.14%	61.05	62.28	102.01%	101.97	87.74	86.04%
16	56.64	56.49	99.74%	121.62	118.22	97.20%	235.70	221.36	93.92%	34.70	36.88	106.28%	46.70	48.40	103.64%
17	-	-	-	90.40	81.44	90.09%	115.06	124.99	108.63%	-	-	-	-	-	-
18	-	-	-	89.89	83.85	93.28%	139.40	147.97	106.15%	-	-	-	-	-	-
19	-	-	-	90.27	82.54	91.44%	116.45	125.73	107.97%	-	-	-	-	-	-
20	-	-	-	91.41	84.33	92.25%	140.65	149.28	106.14%	-	-	-	-	-	-
21	-	-	-	178.43	159.34	89.30%	153.89	144.07	93.62%	-	-	-	-	-	-
22	-	-	-	179.71	162.11	90.21%	174.17	160.48	92.14%	-	-	-	-	-	-
23	-	-	-	179.11	162.47	90.71%	158.48	150.12	94.72%	-	-	-	-	-	-
24	-	-	-	181.84	164.26	90.33%	178.37	166.94	93.59%	-	-	-	-	-	-