

IBM p690+ at ECMWF

- ECMWF
- Optimisation & bug finding in IFS
- IFS parallelisation
- Model Resolutions
- Performance of IFS on p690+
- New developments



Deborah Salmond
Research Department
ECMWF

ECMWF

European Centre for Medium-range Weather Forecasts

- Reading, England
- 23 European states
- Founded in 1975
- 10 day Global Weather Forecasts
 - High resolution atmospheric model and data assimilation
- EPS (Ensemble Prediction System)



List for debugging/optimisation

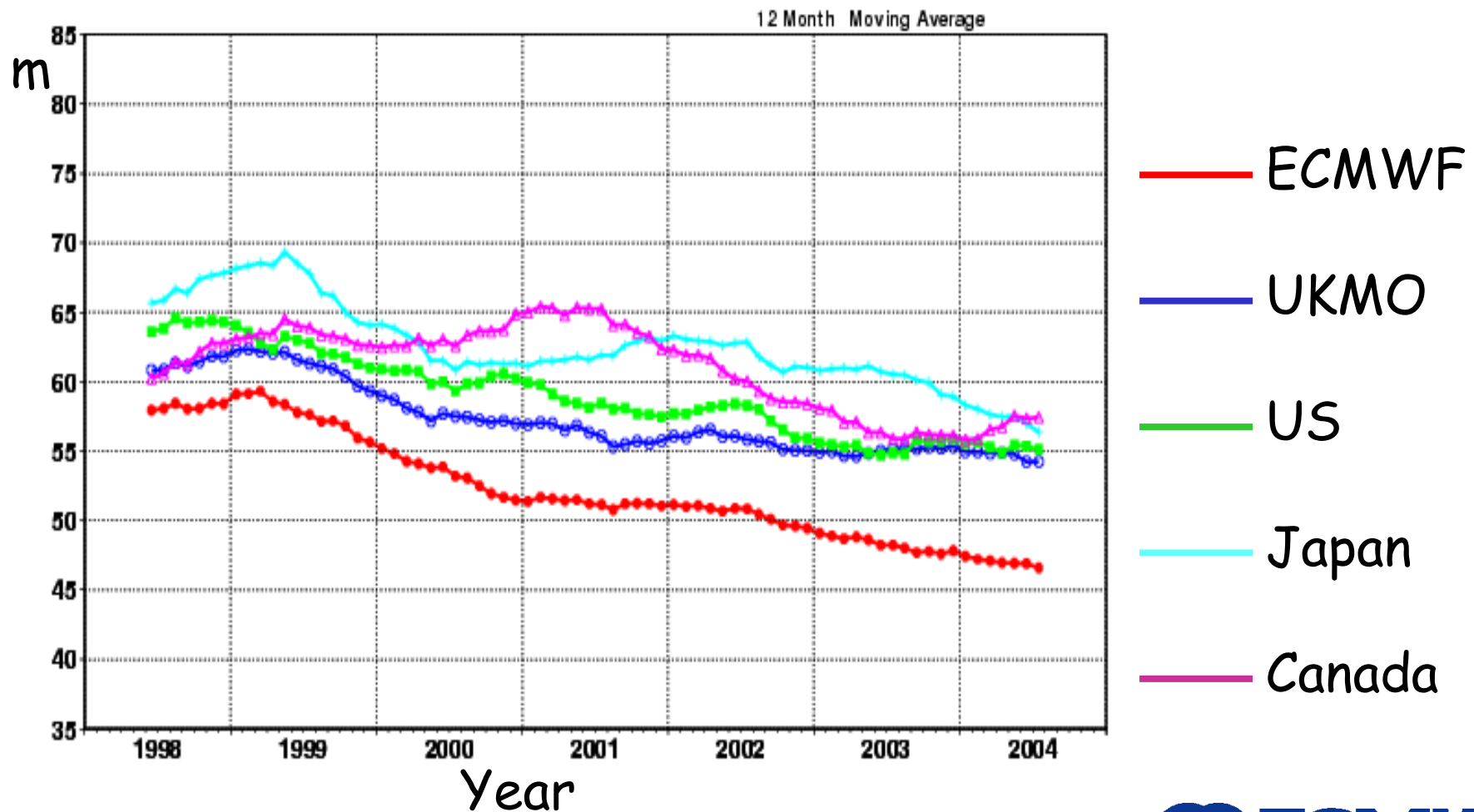
We have introduced:

1. NaNQ detect routine
2. NaNS fill for allocated arrays
3. Signal handling
4. Wall-clock time and memory profiler (Dr.Hook)

We would like:

1. Namelist error → raise signal
2. Allocate/Deallocate error → raise signal
3. Thread number for stderr output – like `MP_LABELIO`
4. Stack too big → detect and raise signal
5. IO-trace by unit number for applications
6. O4 unrolling → same computations for left over part

RMS errors compared with other centres



IFS - parallelisation

-Parallelised using 'mixed' MPI and OpenMP

-MPI

- Transpositions
(spectral model)
- Wide halo exchange
- Long messages

-OpenMP

- Parallelise Loops
(between MPI calls)
- Memory efficient
- 4 threads is best

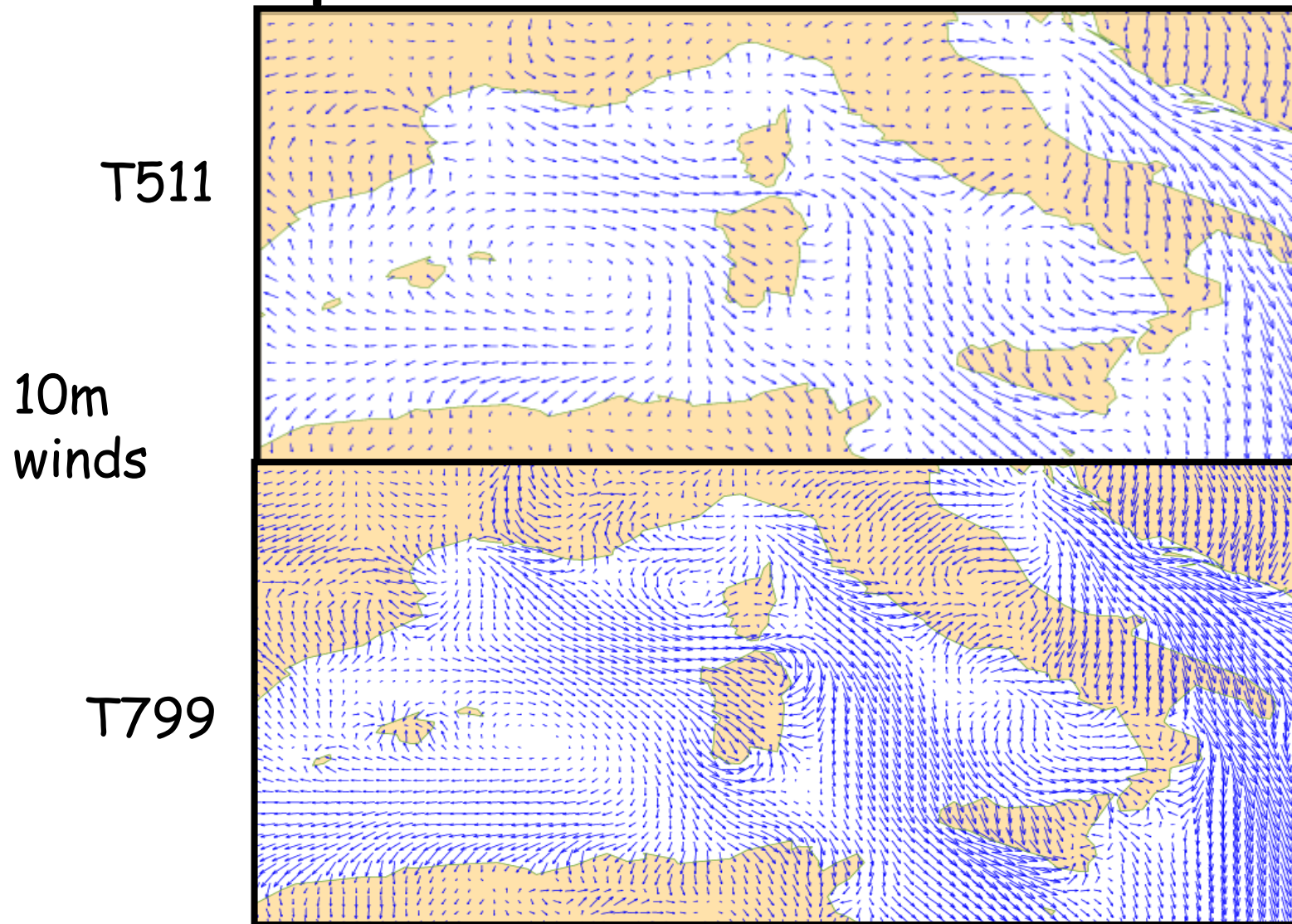
-Now use thread-safe MPI calls inside OpenMP regions

IFS Model Resolutions

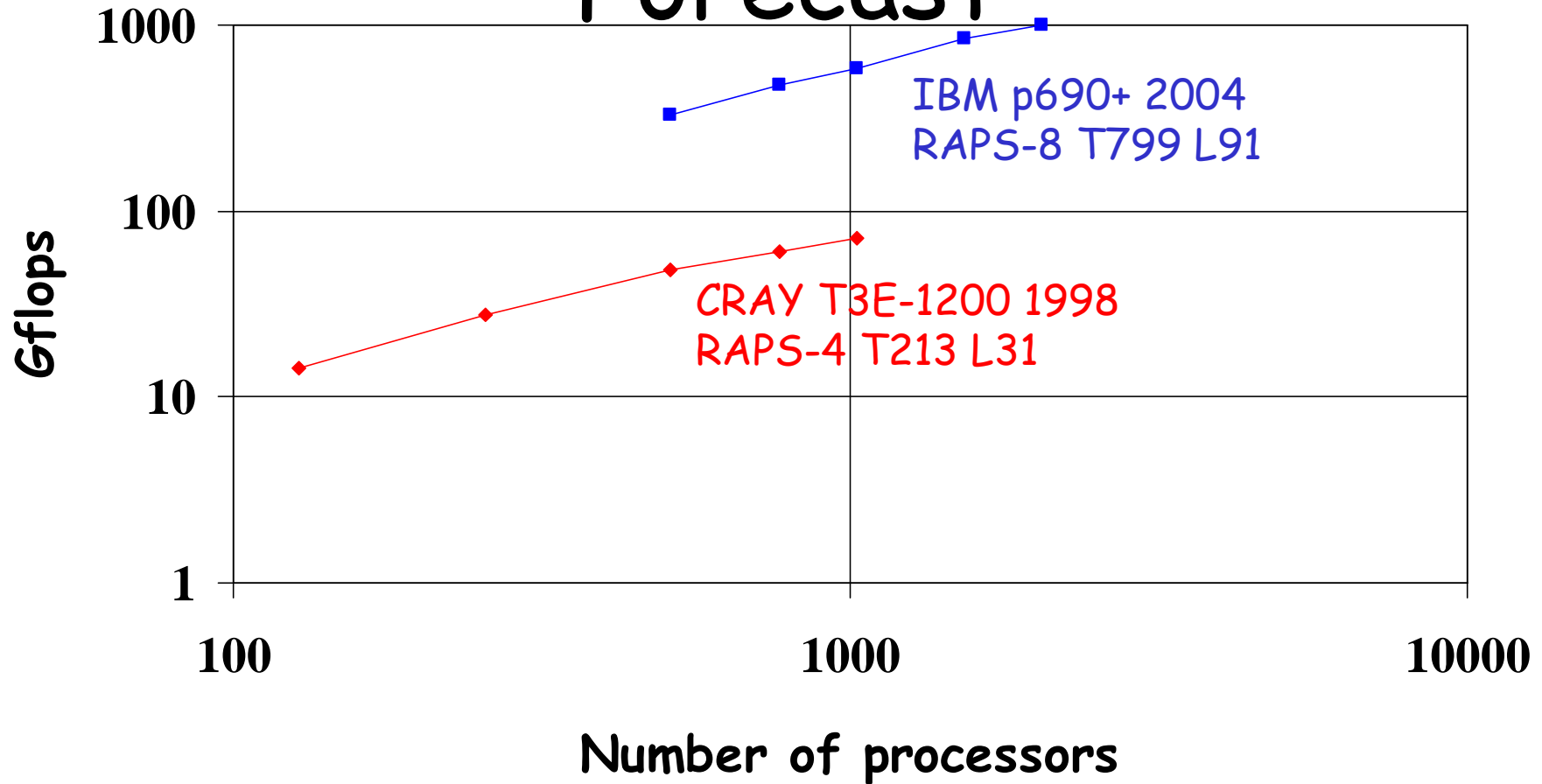
Resolution	Horizontal Grid spacing	Floating –point ops for 10 day forecast	Date in operations	Computer
T511 L60	40km	0.4 Pflop	2000	Fujitsu VPP5000
T799 L91	25km	1.6 Pflop	2005	IBM p690+
T2047 L60	10km	20 Pflop	?	?

10 day forecast has to run in ~1 hour

Comparison of T511 and T799

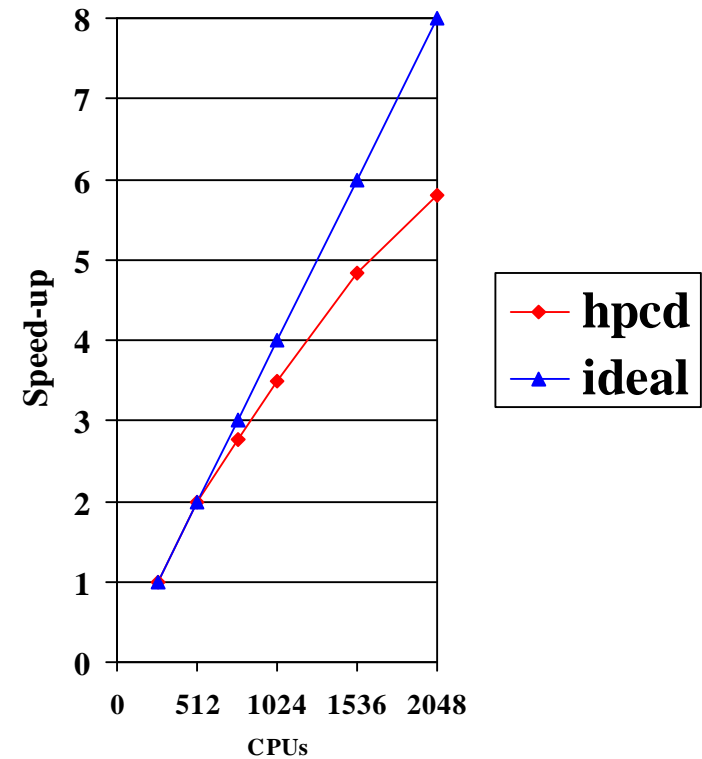


Performance of IFS Forecast



RAPS-8: T799 L91 10 day forecast on p690+

MPI x OpenMP	Wall (secs)	Gflops
64x4	8850	193
128 x 4	4410	369
192 x 4	3187	509
256 x 4	2534	644
384 x 4	1830	886
256 x 8	1523	1073



Total Pflop = 1.6



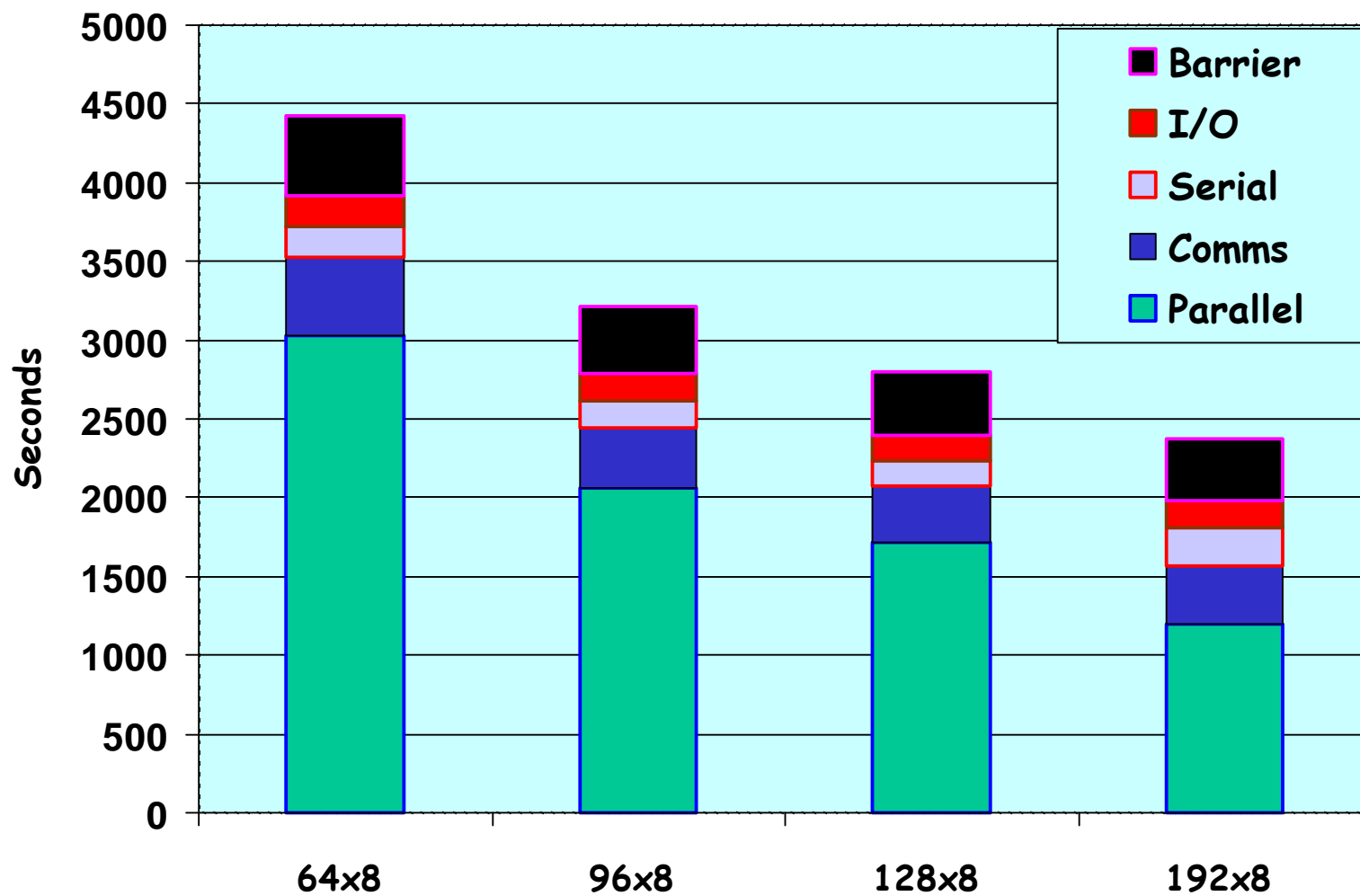
RAPS-8: T799 L91 10 day forecast on p690+

MPI x OpenMP	Wall (secs)	Gflops	% of peak	% comms
64x4	8850	193	10.0%	5.2%
128 x 4	4410	369	9.5%	5.8%
192 x 4	3187	509	8.7%	8.3%
256 x 4	2534	644	8.2%	9.0%
384 x 4	1830	886	7.6%	10.5%
256 x 8	1523	1000	6.9%	13.2%

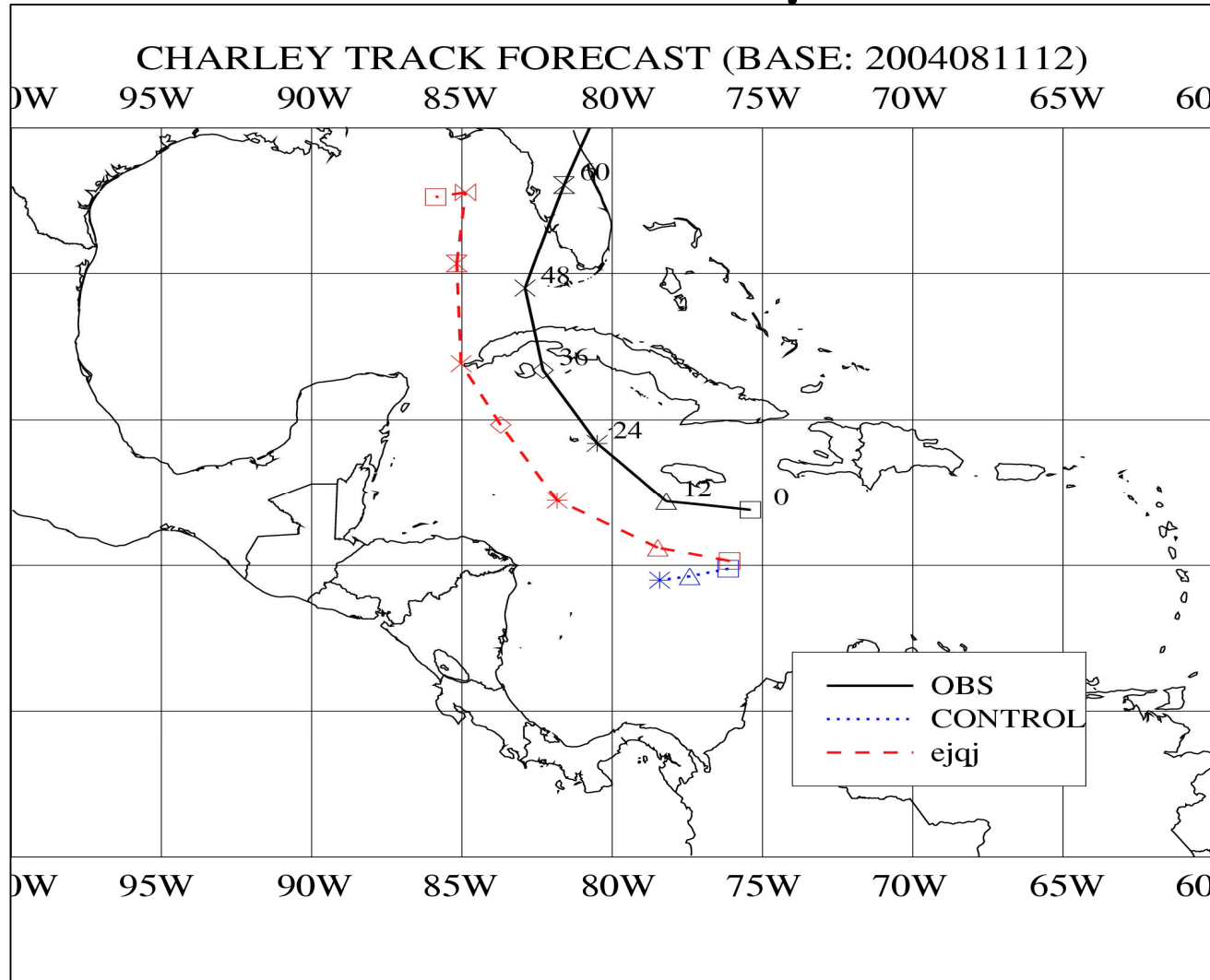
Total Pflop = 1.6



4D-Var - Data Assimilation T799/T95/T255 L91 on p690+



Assimilation of Rainy Radiances



Microwave radiance data coverage

29/APR/2004; 12 UTC

Total number of obs = 18567

