ADRIAN
and
SUPERCOMPUTING

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TIMELINE

UoR

Head of Numerical Aspects Section

1978

Head of Model/Data Division

1992/1995

GEMS

macc
Monitoring atmospheric composition & climate

2007

CONTROL DATA

CRAY RESEARCH, INC.

FUJITSU

IBM
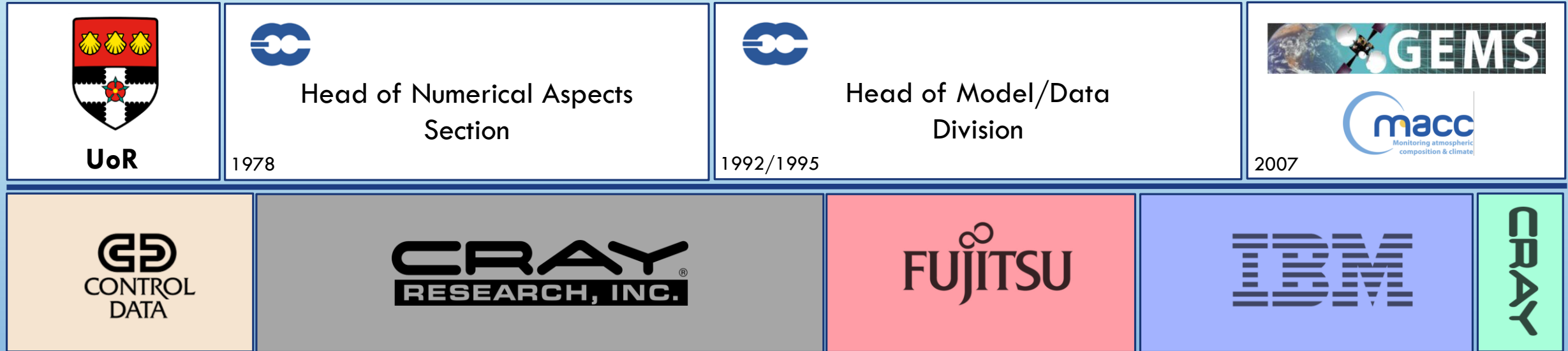
CRAY

1972 - 1978

- CDC 6600 – designed by S. Cray

- Simplified instruction set

- Move from Germanium to Silicon

- Freon cooling

- Term "supercomputer" was coined

- Reading University group used the CDC 6600/6700 at the University of London

- Adrian was assessing the performance of spectral versus grid point models

Early papers

- Reading University group developed spectral model

- Model was unstable with "high" (16-level) vertical resolution on CDC 7600

- Solution developed applied also to the new ECMWF model

Stability of the Semi-Implicit Method of Time Integration

A. J. SIMMONS AND B. J. HOSKINS

*U.K. Universities' Atmospheric Modelling Group, Department of Meteorology,
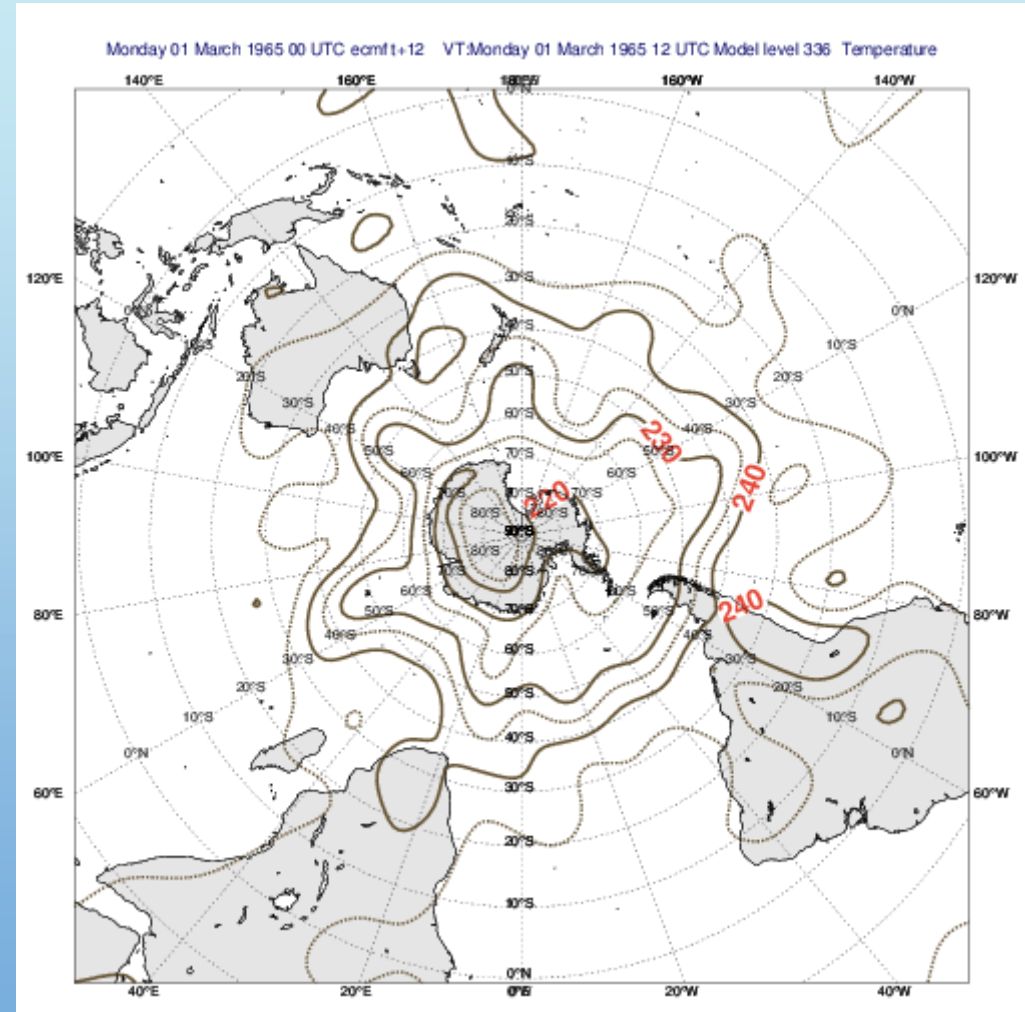University of Reading, Reading RG6 2AU, U.K.*
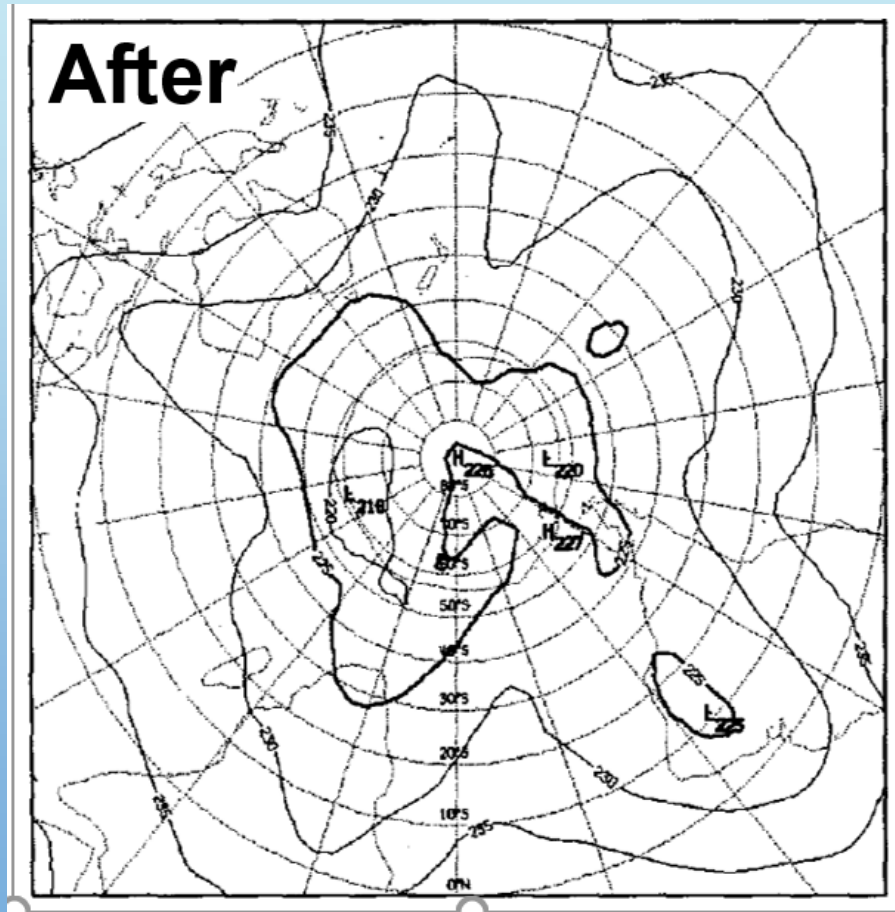
D. M. BURRIDGE

European Centre for Medium Range Weather Forecasts, Fitzwilliam House, Bracknell, Berks RG12 1LQ, U.K.

(Manuscript received 13 September 1977, in final form 23 November 1977)

- First published paper that shows an output of the ECMWF model

Before

After
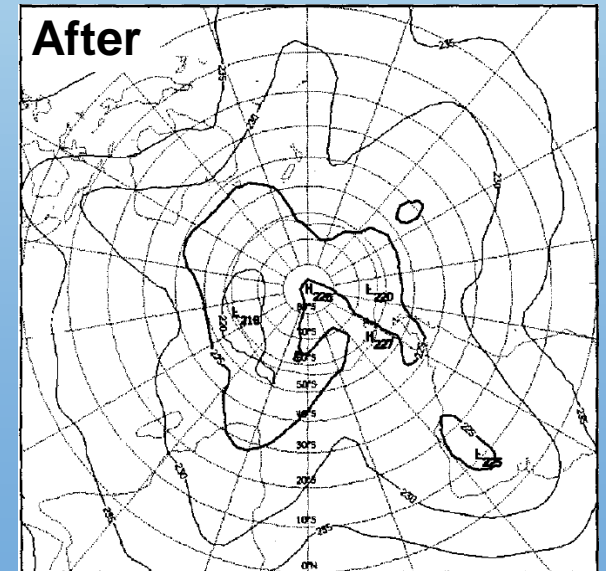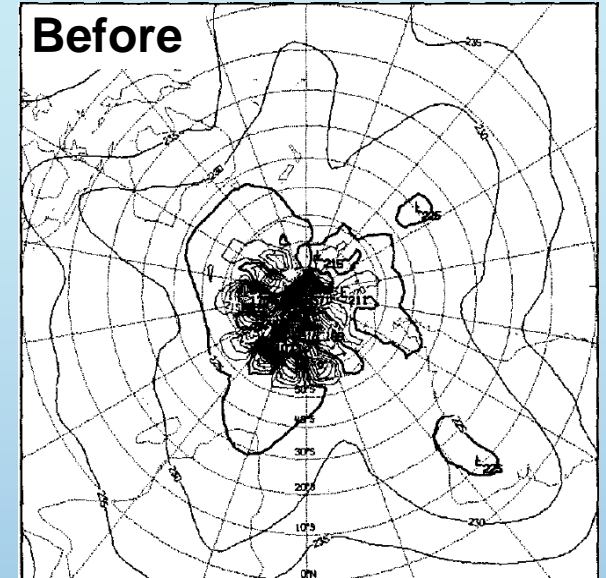
Same date – 40 years later – ERA5, T369, 4D-Var (T21 plot)

Produced by Hans Hersbach and Per Dahlgren

1978 - 1996

- CRAY-1A (serial 9) in October 1978

- X-MP/22, X-MP/48, Y-MP/8, C90 [and T3D]

- Vector processors

- Shared memory, modestly parallel

- Adrian was working on the parallelization

  - X-MP/22 was mainly a N/S hemispheric split

  - X-MP/48 a more general approach was implemented

  - Involved a rewrite of the spectral model code

18 years with CRAY Research

- Runs in Minneapolis on a large memory XMP/464
  - Doubling of the horizontal resolution was tested (T106 to T213) – implemented 5 years later
  - Just managed to run a 10-day forecast

- Visits to other user sites, e.g. Indian Met Department

- Increasingly involved in HPC procurements and market surveys – trips round the world to visit the manufacturers of HPC systems

- Vendors had full control over their technology

FUJITSU   1996 - 2002

- VPP700/116, VPP700E/48, VPP5000/100

- Vector processors

- Distributed memory, moderately parallel

- First NWP centre to run operations on a distributed memory machine

- Adrian's first big management task: Cray to Fujitsu migration
  - Required both technical and scientific work – the original data analysis code was not migrated
  - From the CY15R1change note (September 1996)

The 3D-Var code has been generalised to allow it to be run on parallel, distributed-memory computers using message passing. A new parallel code is used for observation pre-processing and screening. Quality control and the calculation of background error variances are now based on the variational analysis rather than the earlier OI approach. Objective verification indicates little overall sensitivity of forecast performance to these changes.
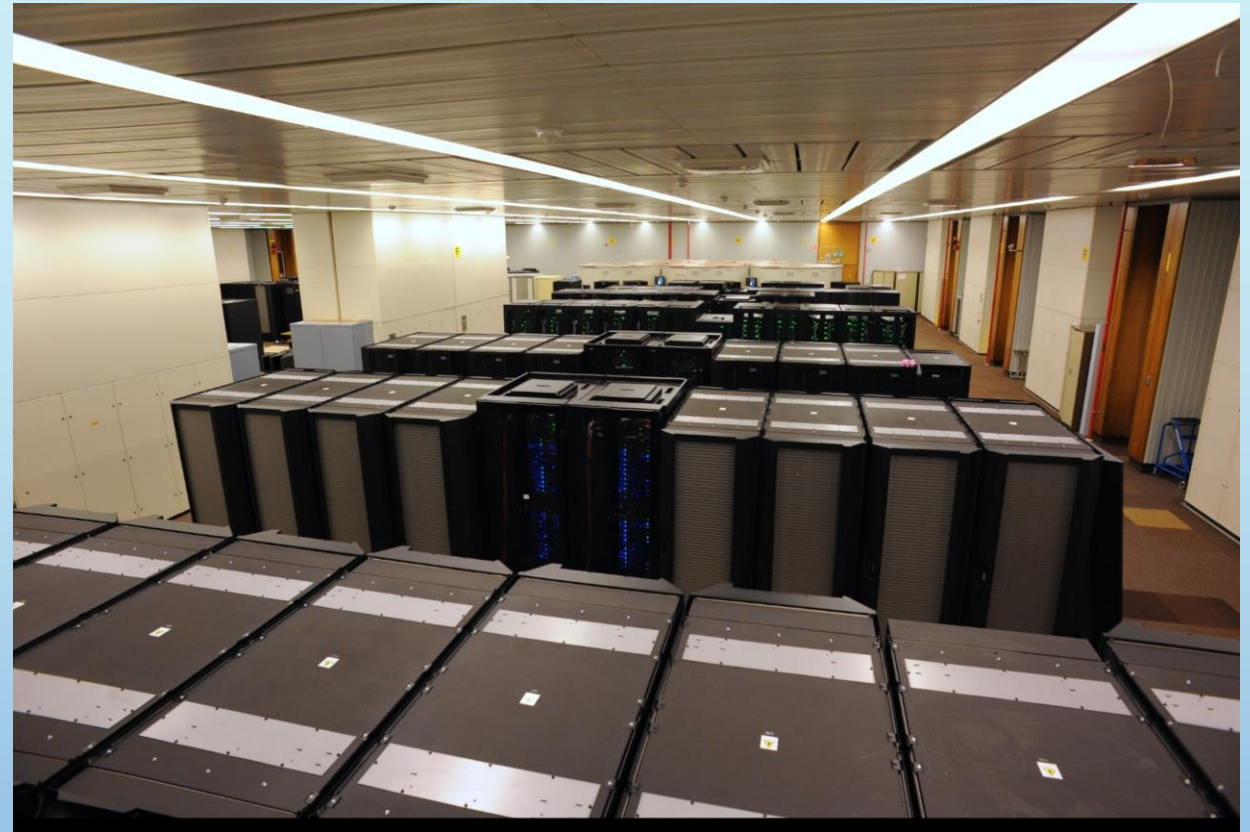
# Numazu Railway Station - Fujitsu factory

2003 - 2014

- Series of two identical clusters

- POWER4, 4+, 5, 6, 7 built by IBM

- Microprocessors, distributed memory

- Highly parallel, POWER6 ran at 4.7 GHz

- Several generations of interconnects

Personal tribute to Adrian

- 10-year period of very close cooperation

- Adrian represented RD in all HPC matters

- In-depth understanding of computing systems

- Amazingly broad knowledge: model, data assimilation, atmospheric composition, HPC

- Many trips together: market surveys, procurements and trouble shooting

- Many nightly emails exchanged during strategic planning

- Adrian was never showy – just got on with whatever was thrown at him
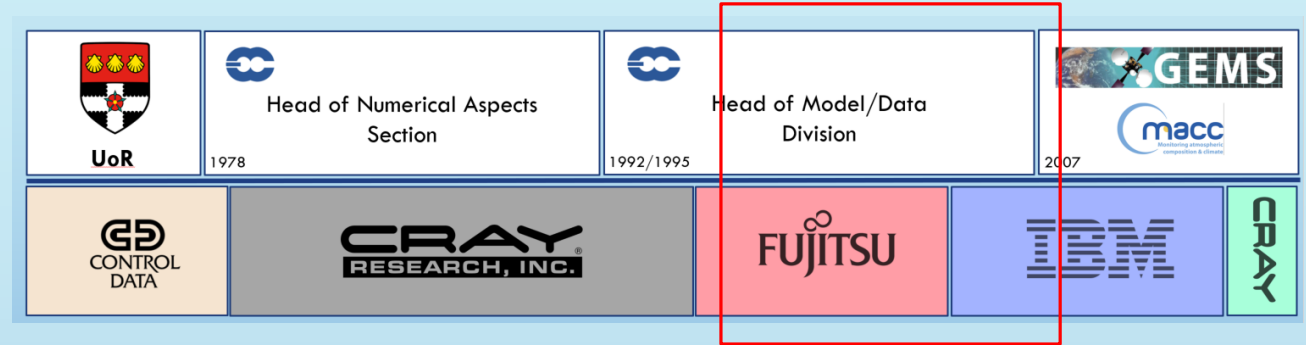
Chippewa Falls, Wisconsin, 2004

… but it ended in a long swim back
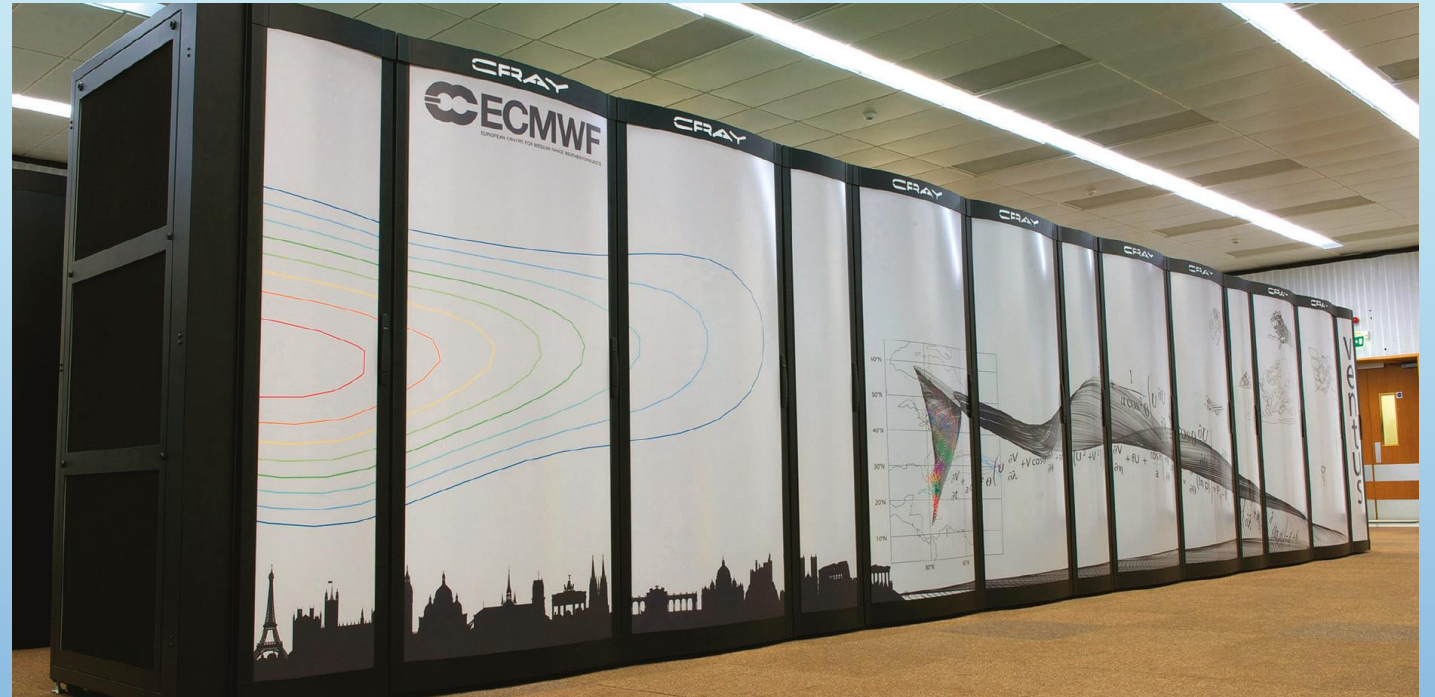
Competitive spirit was high …

2014 onwards

- Two identical clusters

- XC30 followed by XC40

- Distributed memory

- Highly parallel

- Intel microprocessors

- 259,920 processor cores (in total)

Progress (HPC++) during Adrian's career at ECMWF

- Adrian started on a single CPU machine … made the model work on 2 CPUs …
  - 40 years ago, when discussing 4 or even 8 CPUs, if someone would have mentioned a quarter of a million CPUs at ECMWF …

- Some of the progress was less eye catching

- What would you have said is least likely to be true by the time you have your retirement party?
  - Supercomputers with huge numbers of miniature processors
  - Spectral model still going strongly
  - FORTRAN being used for the bulk of the model code
  - Fuel consumption of your car having gone down by just 50% or so

TOP500

- List being issued twice per year since 1993

- 50 issues so far and ECMWF had three times a machine in the top 10 worldwide

(A)	(B)	(C)	(D)
C90	C90	VPP700/46	POWER6
POWER6	VPP5000/100	VPP700/116	POWER7
POWER7	POWER6	POWER4+	XC40

ANSWER: (C)
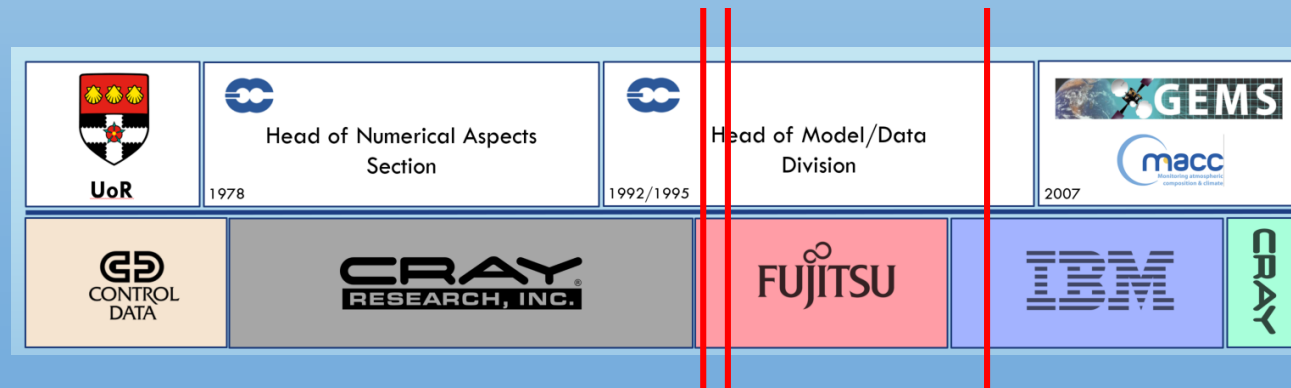
- Visited COMPAQ in Boston – building a very large system for CEA

- EV7 and EV8 processors

ADRIAN to the water taxi driver:

"no, we are not in computing, we are in weather forecasting"

US East Coast in 2000 – Part 2 of 3 – Guest of honour

- Visited IBM factory in upstate New York – Colony and Federation switches

- On Sunday, walked a forest trail along the Hudson river near the Roosevelt estate

- 25th anniversary of the purchase by the Hudson Valley Railroad Society

- King George VI and Queen Elisabeth used the station in 1939 – for the "hot dog" summit

- Had invited the Queen Mother for the anniversary - Adrian became guest of honour

US East Coast in 2000 – Part 3 – Full denial

- After the railway station party, storm clouds started to gather

- Adrian's group walked on and got absolutely drenched

- Were allowed to use a phone in the Roosevelt estate

- Taxi arrived, driver had a look and almost sped away

ADRIAN to the taxi driver:

"we are in computing"

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