

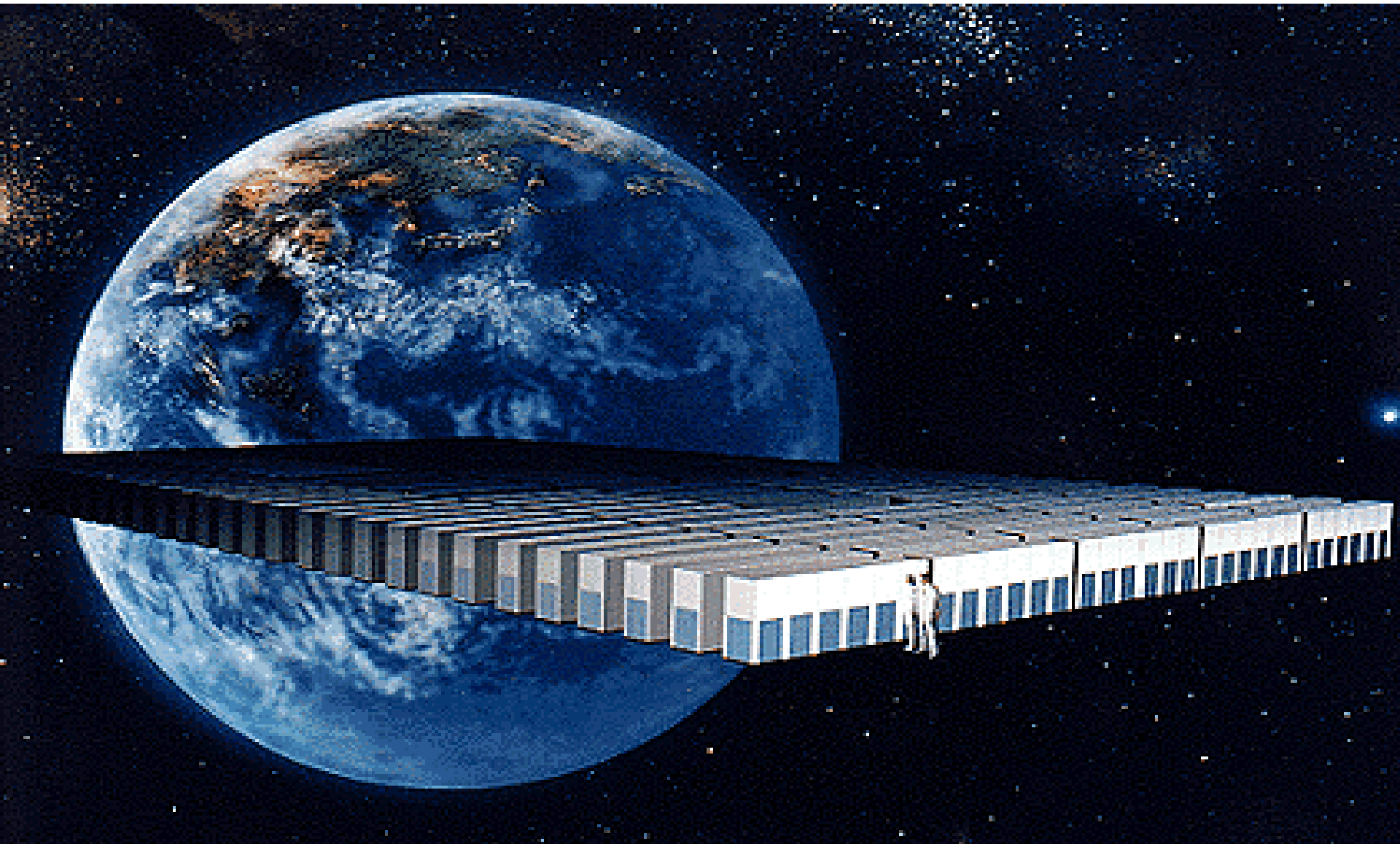
Scientific Computing & Visualization

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www.icesfoundation.org

Yokohama Earth Simulator

Opened March 2002, NEC SX-6

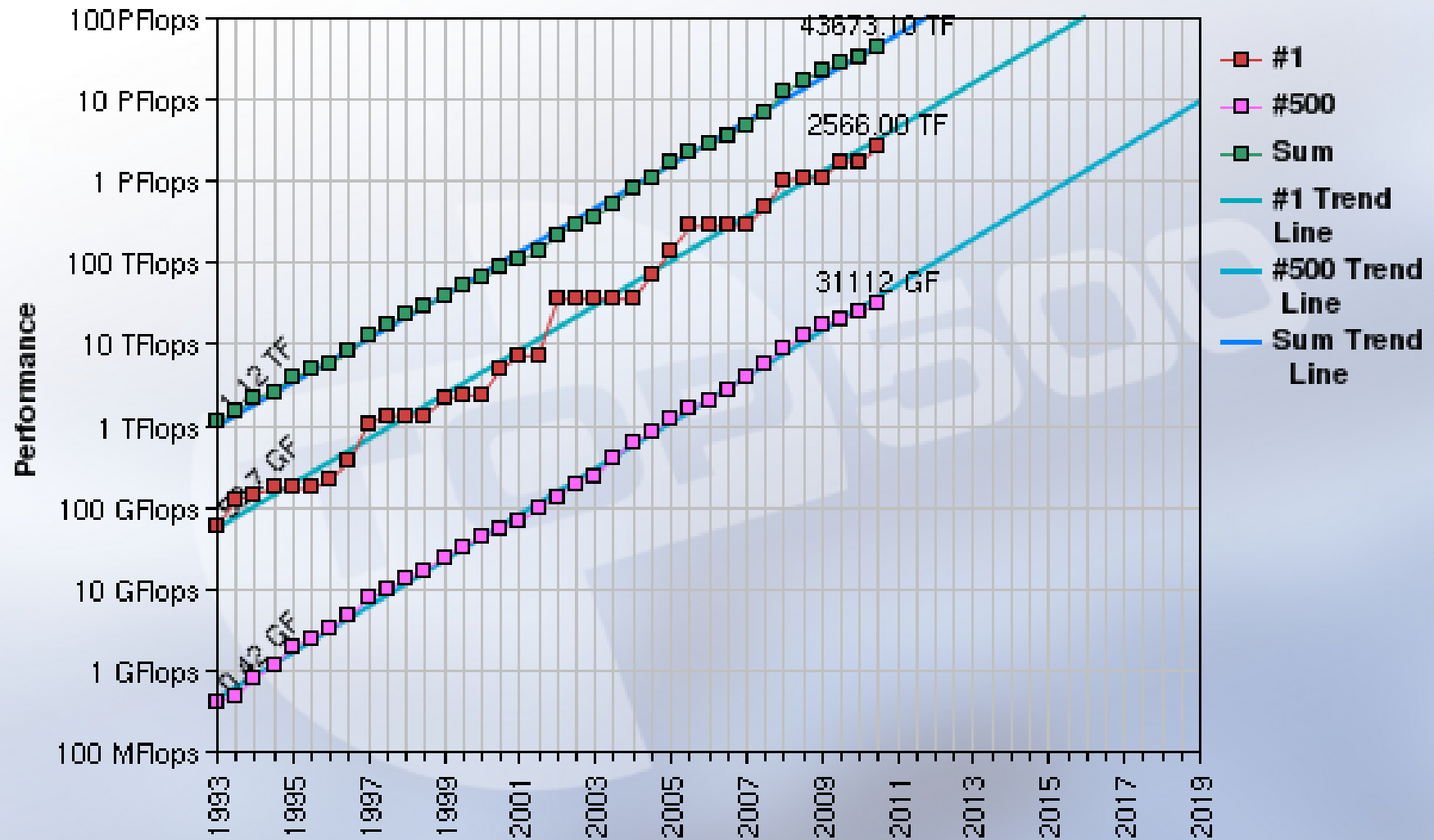


Dedicated Weather-Climate Systems

(TAKEN FROM THE NOVEMBER 2010 LIST OF TOP500 SUPERCOMPUTER SITES)

Worldwide Ranking	Organization	Country	Peak Teraflops	Sustained Teraflops	Supplier
# 19	KMA	Korea	379.01	316.40	CRAY XE6
# 20	KMA	Korea	379.01	316.40	CRAY XE6
# 32	NOAA/ORNL	USA	259.66	194.40	CRAY XT6
# 50	NOAA/ESRL	USA	148.12	126.50	Aspen Cluster
# 56	JAMSTEC	JAPAN	131.07	122.40	NEC SX9
# 57	ECMWF	UK	156.42	115.90	IBM Power 575
# 40	ECMWF	UK	156.42	115.90	IBM Power 575
# 58	DKRZ	GY	151.60	115.90	IBM Power 575
# 81	NAVO	USA	117.14	90.84	CRAY XT5
# 93	NAVO	USA	102.27	78.68	IBM Power 575
#101	NIES	JAPAN	177.12	74.84	HP Cluster
#103	NCEP	USA	93.85	73.06	IBM Power 575
#104	NCEP	USA	93.85	73.06	IBM Power 575
#127	NCAR	USA	76.40	59.68	IBM Power 575

Projected Performance Development



New Trends in Scientific Computing Hardware

- SCALABILITY
- PARALLELISM & COMPLEXITY!
- HETEROGENEOUS ARCHITECTURES

THE MEMORY WALL:

Memory architectures (shared, distributed, smart memory)

THE POWER WALL:

Water cooling; variable chip clock speeds; Green 500 (Mflops/W)

THE GOAL: 1 Petaflop per rack; PUE ratio 1.1

New Trends in Scientific Computing Hardware

- Multi-core processor chips (2, 4, 6, 8, 10, 12, 16,128)
- Accelerators: GPUs (Nvidia, AMD, IBM, Intel); FPGAs, ASICs
- Interconnect: Infiniband, GbEthernet, Fibre Channel, Photonics
- Storage systems: SSD, Flash, Tape
- Topologies: cluster, hypercube, 3D torus, fat tree

New Trends in Scientific Computing Software

- Multi-core programming languages & libraries: r, Cilk, Matlab, PGAS
- Heterogeneous development languages: CUDA, OpenCL
- Message Passing: MPI, OpenMP, SHMEM
- File Management: GPSS, Panasas, Lustre
- In-memory data bases: TimesTen, TM1
- OS: Linux, Windows HPC Server 2008
- Virtualization: VMware, Hyper-V
- File & Data de-duplication
- SaaS, Cloud Computing
- Hard/Soft co-design

New Trends in Visualization

- Interactive
- Immersive
- Panoramic
- Remote Viz
- Stereographic
- Glasses free
- Computational steering
- Analysis and data visualization

PUTTING THE 'SCIENTIST IN THE LOOP'

What's needed to improve MET productivity:

- APIs
- Standards
- Modularity
- Inter-operability
- Inter-changeability
- Workflow
- Benchmarks
- Best Practices
- Parallelism methods
- Service-Oriented Architecture

What is emerging from the bottom up:

- Twitter
- Facebook
- Google Earth
- Smart phones
- Wolfram Alpha
- Citizen science
- Crowd sourcing
- Sensor networks
- Internet of Things (IoT)

International Centre for Earth Simulation

