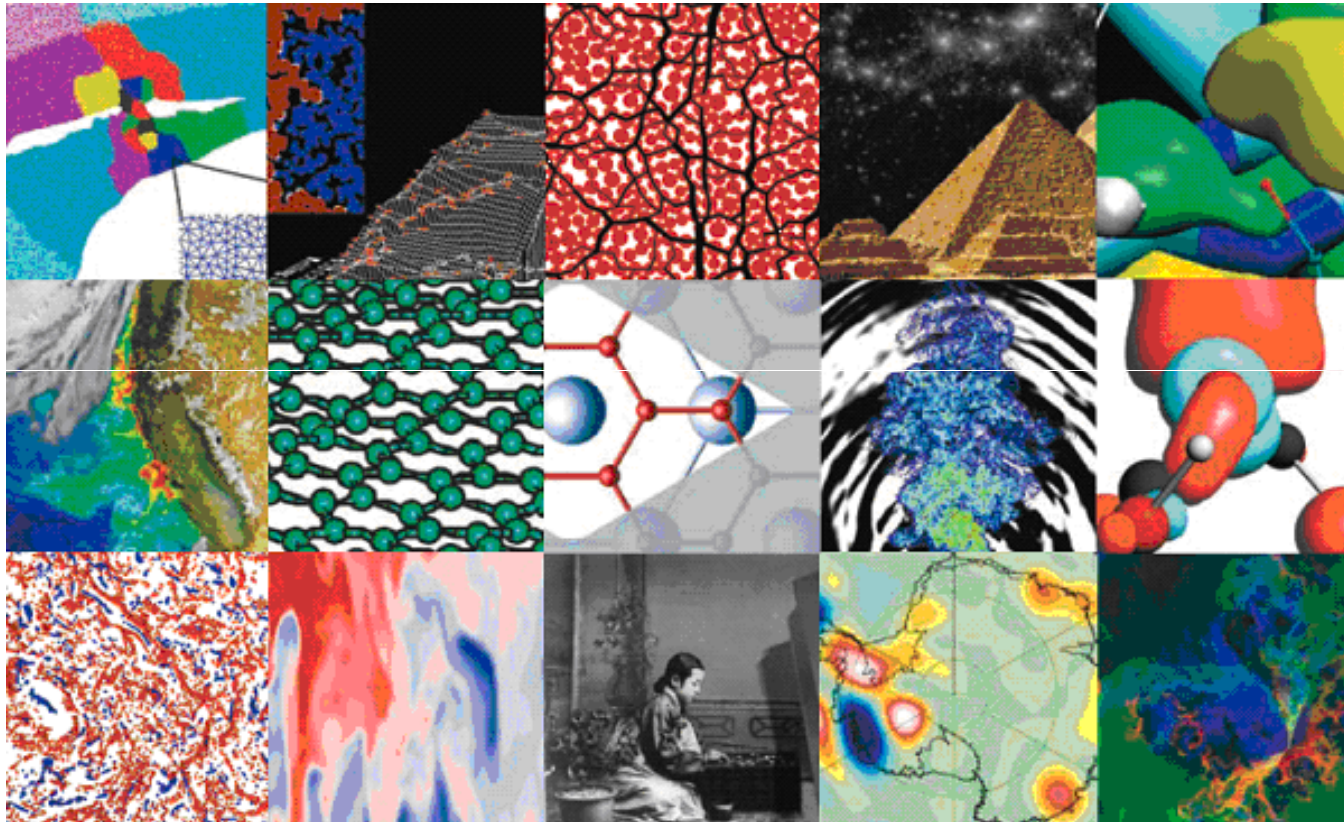




# Overview of HPC in The Netherlands

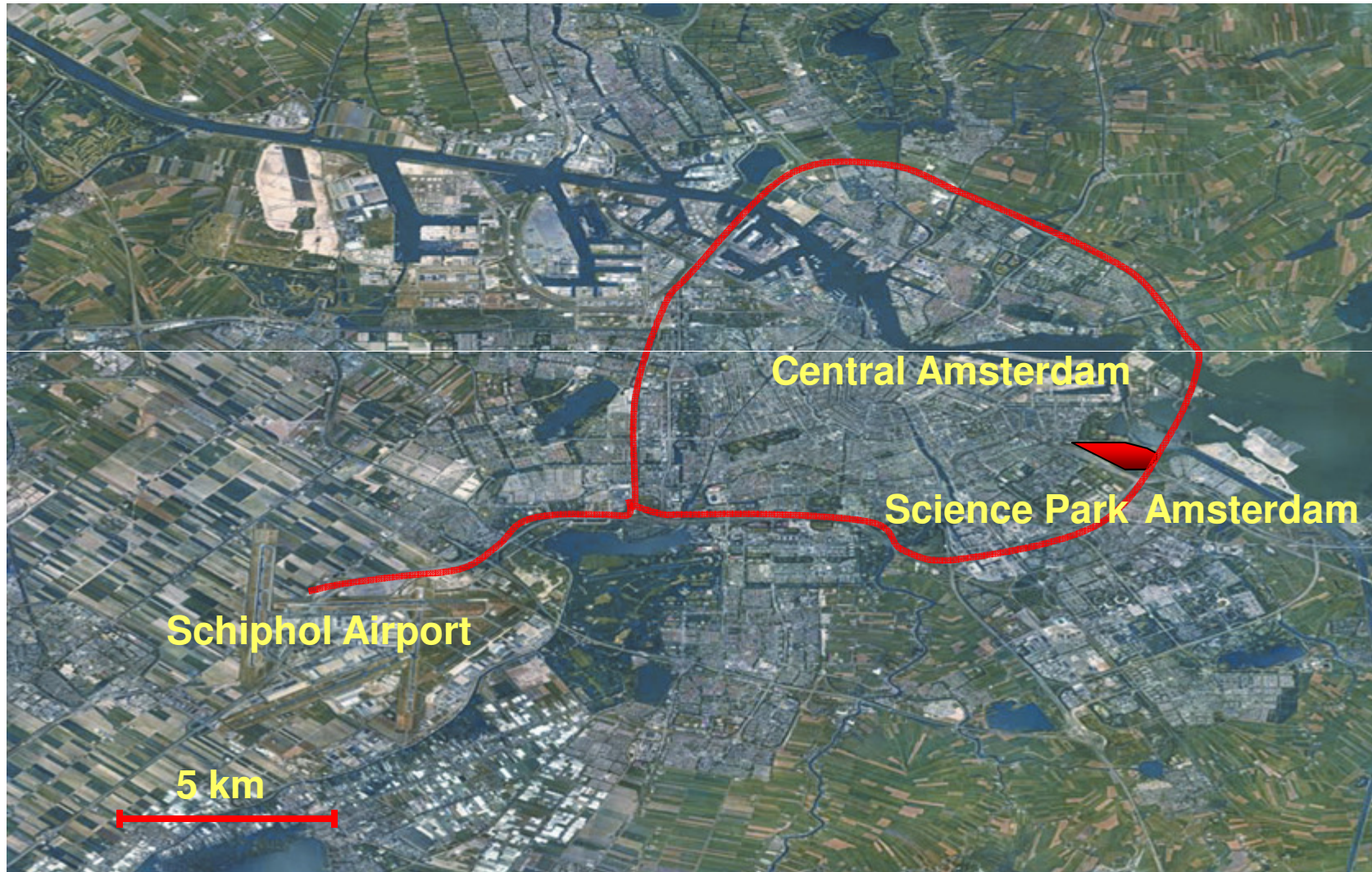


**Anwar Osseyran**  
Managing Director SARA  
11 October 2010





# Welcome to the Science Park Amsterdam







# Science Park Amsterdam

## a world of science in a city of inspiration

- ▶ Faculty of Science of the “Universiteit van Amsterdam”
- ▶ National Institute for Particle and High Energy Physics (NIKHEF)
- ▶ Institute for Atomic and Molecular Physics (AMOLF)
- ▶ National Research Institute for Mathematics and Computer Science (CWI)
- ▶ SARA Computing and Networking Services
- ▶ AMsterdam Internet eXchange (AMS-IX)
- ▶ Matrix Innovation Center, with 80+ innovative companies in life sciences, ICT and other areas





# SARA's Mission: Support Innovation

SARA Foundation is an independent (hybrid) organization with ~140 fte's in 2 locations (Amsterdam and Almere)

The mission of SARA is 2-fold:

1. Supporting research in the Netherlands by providing high-end Providing not-for-profit ICT services to geographically dispersed education and research communities [SARA for Science & Innovation]
2. Offering commercial high-end commodity ICT services based on the expertise built in the high-end activities [Vancis for adVANCed Ict Services]



Amsterdam



Almere

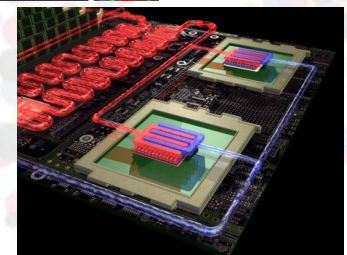
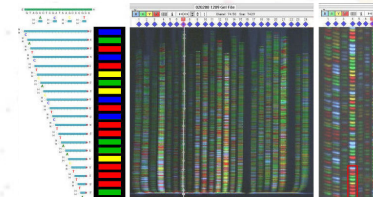




# HPC in The Netherlands

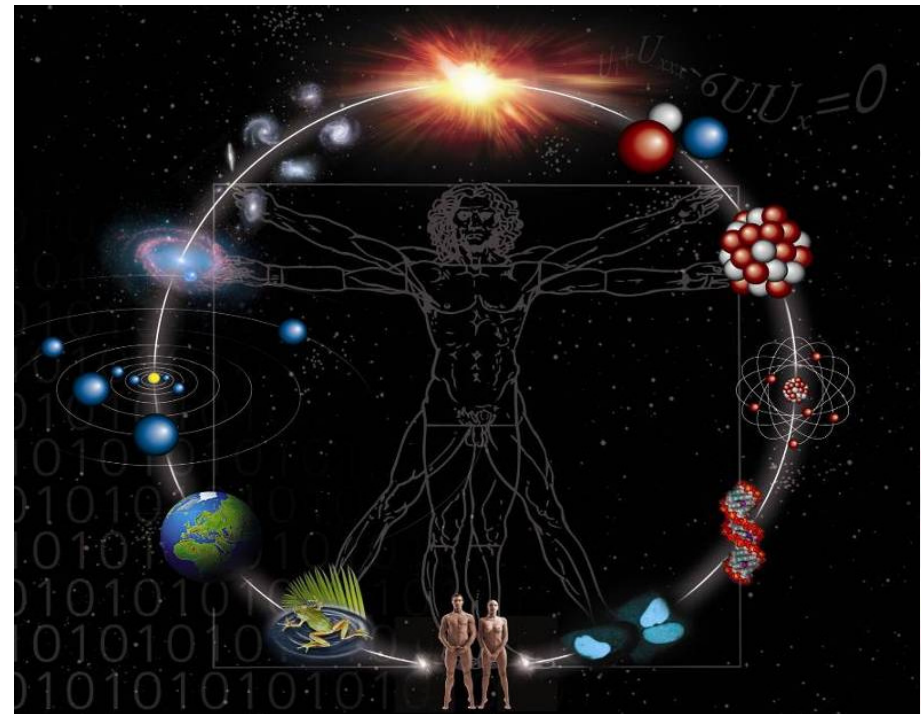
## What's the Challenge?

- Support the astronomer who needs 10.000.000 core hours on a Super computer
- Facilitate the high energy physicist to store and analyze >2 PB a year
- Help the Life Scientist to learn how to handle data from the new automated DNA sequencers
- Enable the scientist to do focus on research (instead of computers)
- Strengthen Dutch industry by facilitating R&D
- Be energy-efficient (for continuity, cost, sustainability and environment)
- ...



# Dutch HPC Challenges

- ▀ From High Energy Physics
- ▀ to atomic and molecular physics (DNA);
- ▀ Life sciences (cell biology);
- ▀ Human interaction (all human sciences from linguistics to even phobia studies);
- ▀ and from the big bang;
- ▀ to astronomy;
- ▀ science of the solar system;
- ▀ earth (climate and geophysics);
- ▀ into life and biodiversity.



*Slide courtesy of prof. F. Linde, Nikhef*



# Dutch Scientists are queuing up

## Computational sciences

Application	Name PI	Affiliation	Discipline	Requested Core-Hours
Bloomo2	F. Toschi	TUE	BioSciences	5.500.000
Rbflow	D. Lohse	UT	Fluid Physics	7.500.000
SofTAR2	R. Bastiaans	TUE	Engineering	1.000.000
PINNACL2	H. Jonker	TUD	Earth Sciences	6.000.000
BVIDG	J. Van der Vegt	UT	Engineering	1.250.000
CSMCA	S. Portegies Zwart	Univ Leiden	Astrophysics	2.150.000
ITAMOC	H. Dijkstra	UU/IMAU	Earth Sciences	4.000.000
LIGHTMAN	A. Polman	AMOLF	Material Sciences	1.400.000
ProKIN	P. Bolhuis	UvA	BioSciences	7.500.000

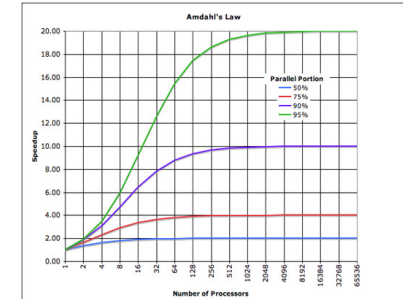
## Experimental sciences

- LHC (PB's)
- LOFAR (PB's)
- Life Sciences (NBIC) (TB-PB's)

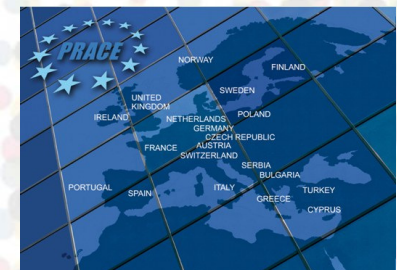


# Strategy for meeting the challenges of future HPC systems

- Use of 100+k cores requires huge optimization effort
- We need to change approach:
  - New paradigms, programming models, algorithms, etc.
- Petascaling of applications requires collaborative effort of users, communities, HPC experts, vendors, algorithm experts
  - Also tied collaboration between SARA, NCF, Big Grid, SURF and others
  - Dutch workshops and Grants Program for parallelization
  - Dutch Compute Challenge Projects
  - Application enabling through DECI (DEISA)
  - Application porting and scaling, tools and new programming languages in PRACE



 Distributed  
European  
Infrastructure for  
Supercomputing  
Applications







# Dutch HPC infrastructure Supernode @SARA



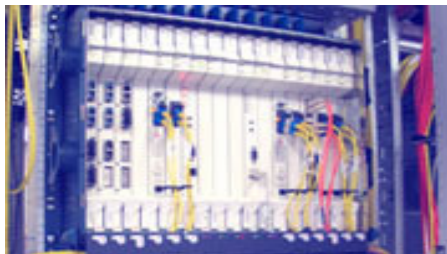
IBM Power6



National Compute Cluster



Disk/tape Storage-on-demand



Netherlight



SURFnet 6

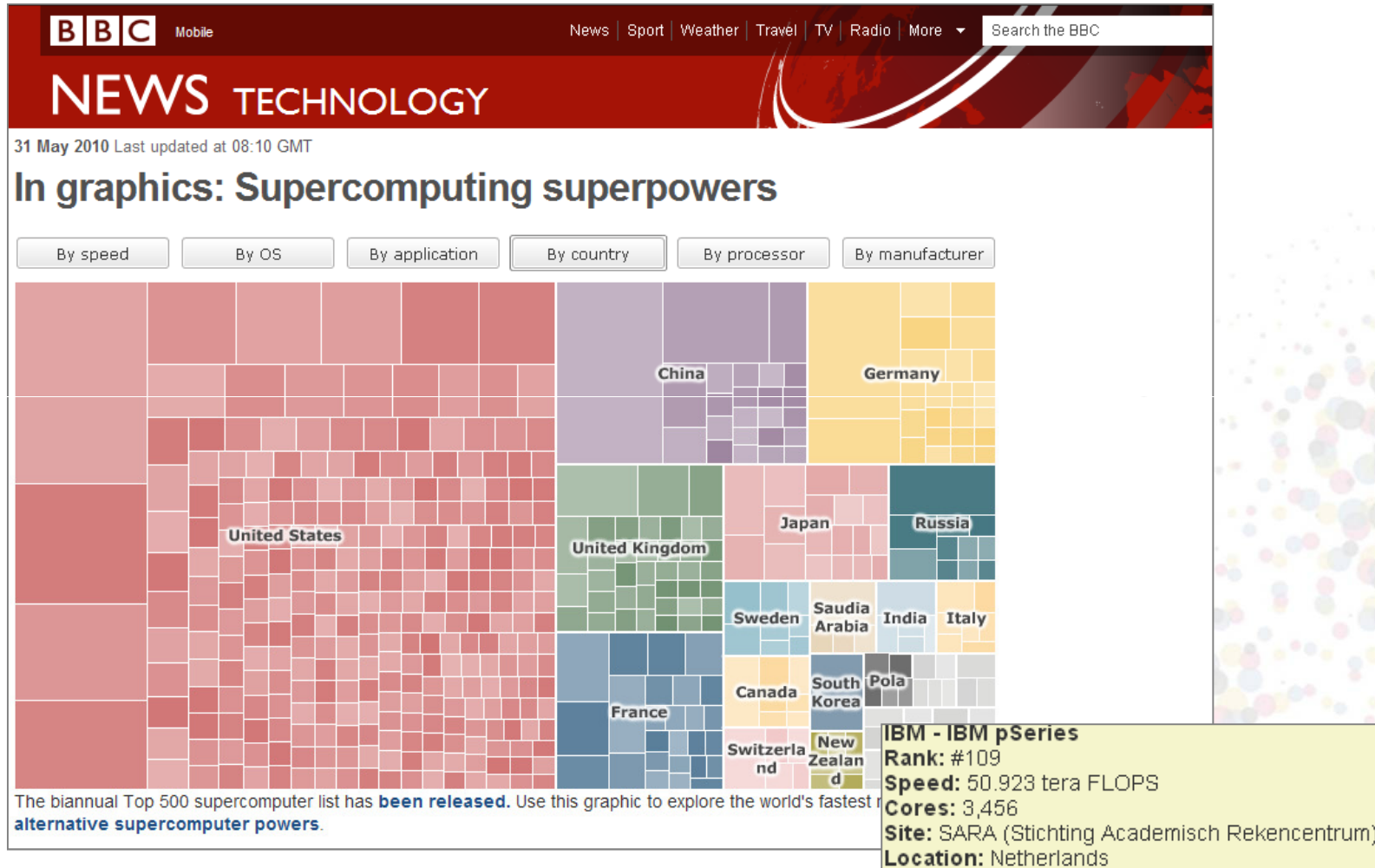


Tiled-panel display



# The HPC landscape (June 2010)

*“We are working on this...”*



<http://www.bbc.co.uk/news/10187248>





# Dutch HPC infrastructure

## Big Grid: The national e-Science Grid

- ▶ 4 sites (SARA, Nikhef, Philips, and the RUG) provide data storage and compute facilities
- ▶ 12 distributed seed clusters for Life Sciences
- ▶ More than 35 research communities
- ▶ All interconnected with high-speed links, with a dedicated optical light path from SURFnet
- ▶ Large scale storage is largely located at SARA, as are the persistent tape stores.
- ▶ Applications include Astronomy, Earth Sciences, Humanities, Life Sciences, Medicine, and Physics.

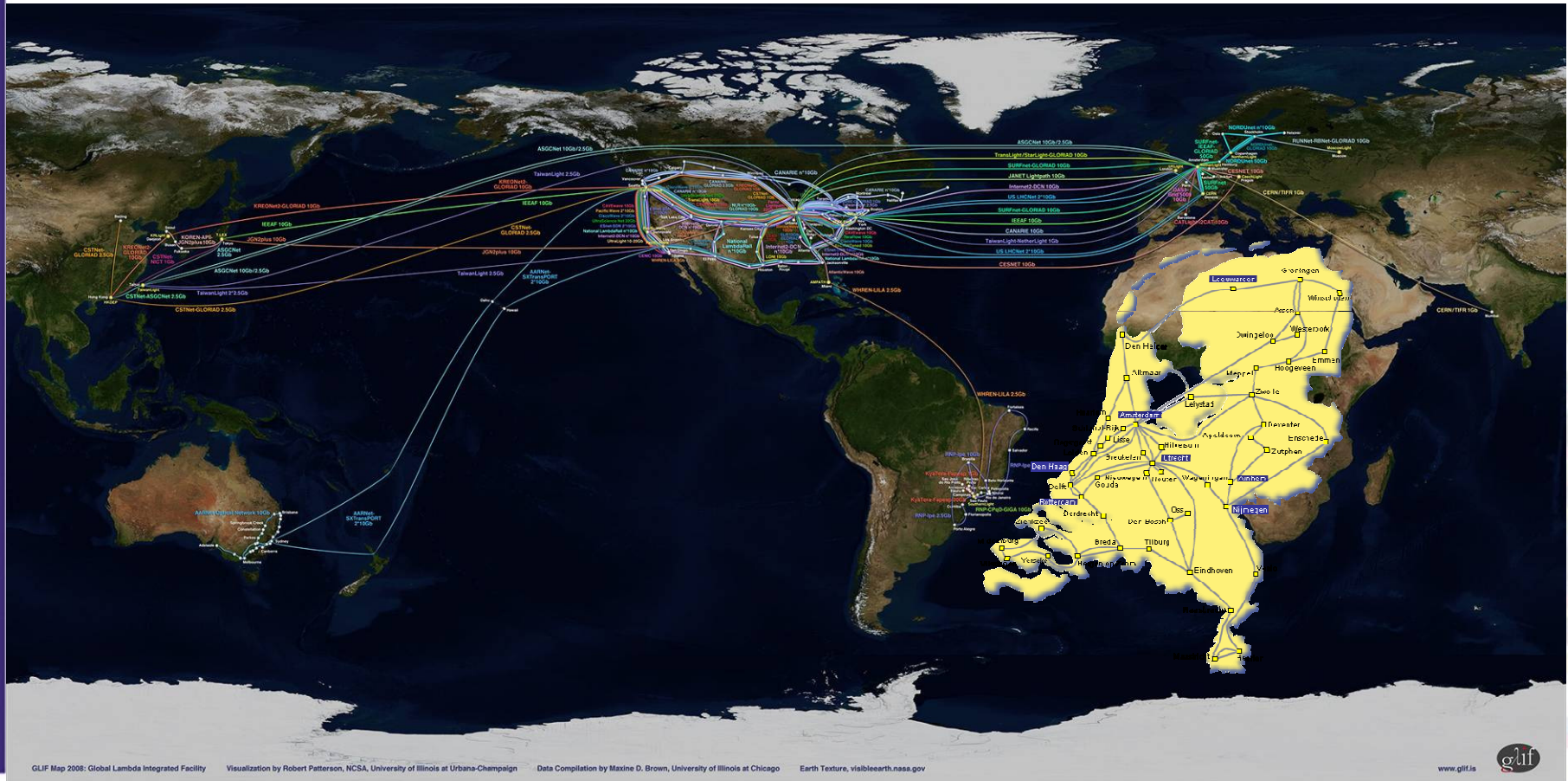
The BiG Grid logo is positioned in the lower right area of the slide. It consists of a cluster of colorful, irregular shapes in shades of blue, green, yellow, and pink, resembling a molecular or network structure. Below this graphic, the text "BiG Grid" is written in a bold, black, sans-serif font.

**BiG Grid**



# Connectivity is key

## SURFnet connected to networks participating in GLIF







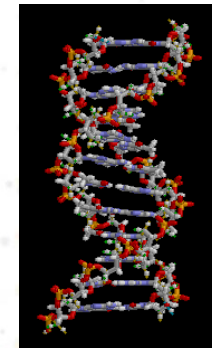
# Dutch OptIPortal

*“A Picture is worth a million words”*

## ■ SAGE\* is used in the Netherlands:

- ❑ By the Climate Research Group at IMAU Utrecht:
  - ▶ Supercomputing Challenge data rendered at SARA
  - ▶ Light path from SARA to Utrecht (35 Km)
  - ▶ Tiled Panel Display at IMAU
- ❑ By the e-Biolab (Genomics, University of Amsterdam) to visualize high-resolution images of DNA-arrays
- ❑ By the University of Amsterdam and SARA in the CineGrid project for video streaming of high definition (4K) movies
- ❑ By SARA to display (ultra) high resolution scientific data (>40 Mpixel images and movies)

(\*)SAGE is developed by EVL in Chicago with NSF grant (OptIPuter)





# Few Examples of Dutch Grand Challenge Applications

- ▶ GBBP: The Gravitational Billion Body Problem  
(Prof. Simon Portegies Zwart  
Leiden University Observatory)
- ▶ Research to answer the question: why does the sky have the structure it has, size, formation observed structure of galaxies.
- ▶ Simulation of a billion bodies and tracking each individual one.
- ▶ Run simultaneously on Super-Computers in Amsterdam, Tokyo, Helsinki and Edinburgh.
- ▶ 1.100.000 Core-hour on Huygens (IBM Power6)
- ▶ 14 days half the system (1664 cores)
- ▶ > 100 TB of data



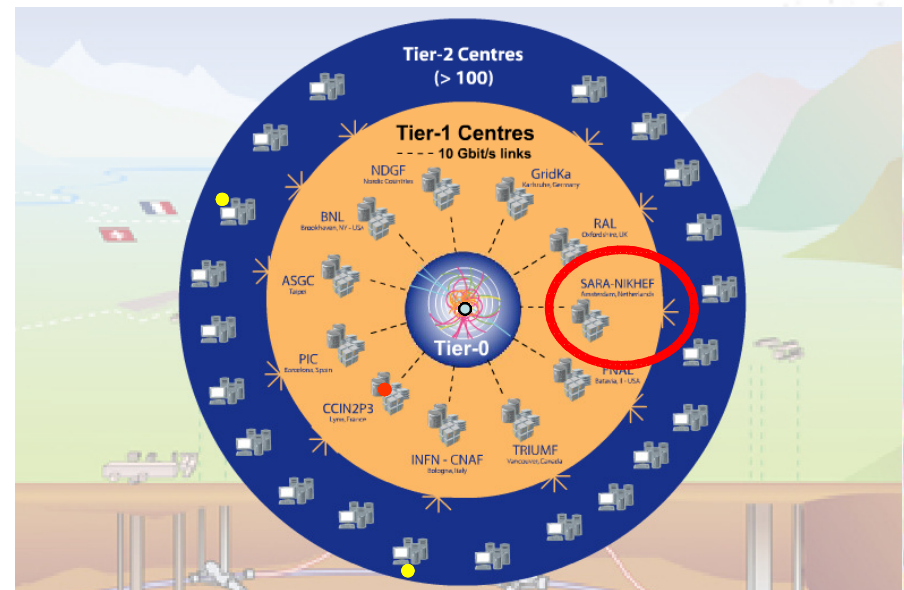




# Dutch LHC Tier-1

stores and analyses 10% of all LHC data

- ▶ Dutch Tier-1 (SARA and Nikhef ) is one of ~10 Tier-1 centers connected with dedicated networks to CERN
- ▶ Copies of data stored/archived and analyzed.
- ▶ There are 4 PB disk storage, 2 PB tape archive storage and 4000 core of compute power in NL.
- ▶ Resulting data products are then shipped to ~100 Tier-2 for the scientist to work with.



# Problem Solving Environments: FlySafe: development of bird avoidance models



Koninklijke Luchtmacht



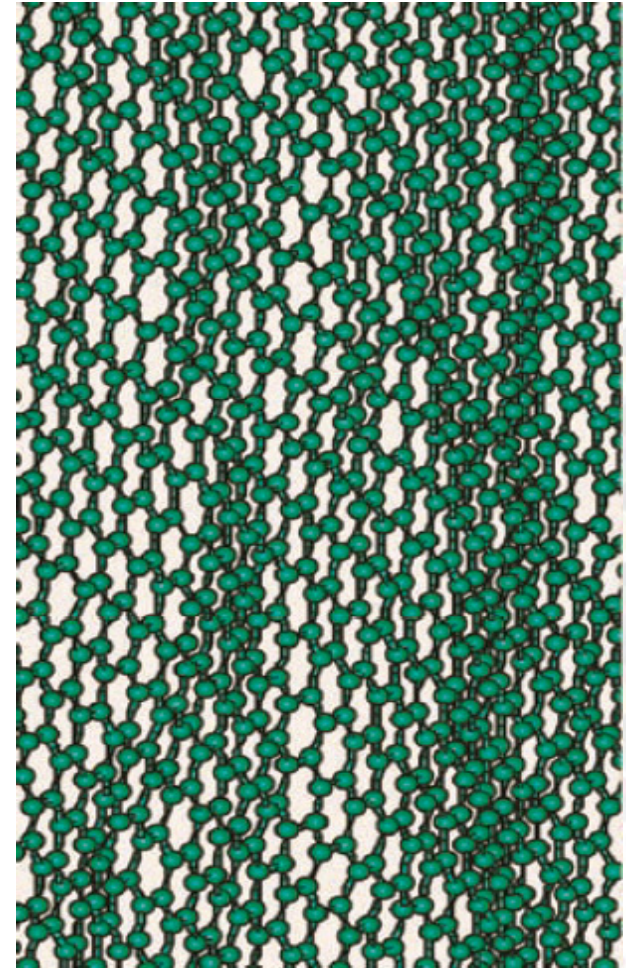
Institut für Vogelforschung  
"Vogelwarte Helgoland"



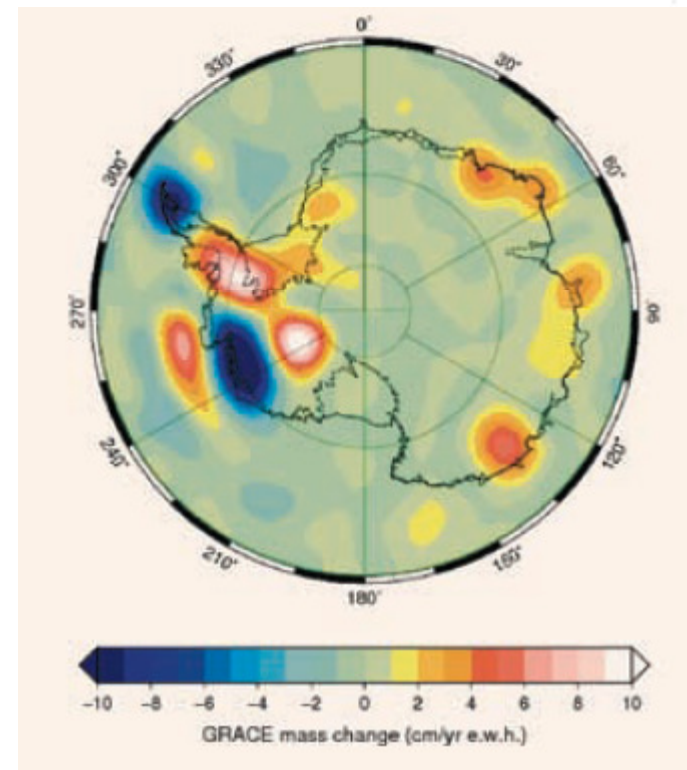


# Research on Graphene

- ▶ Simulations of the mechanical, thermal and structural properties of Graphene
- ▶ Radboud University of Nijmegen (2010 Nobel Price winning group)
- ▶ Objective is to derive 2-dimensional materials with certain desired properties
- ▶ Parallel codes for both fundamental calculations of electronic structure and calculations based on of atomistic Monte Carlo techniques and molecular dynamics.



- ▶ Prof. Klees at TUD
- ▶ Quantification of climate relevant processes
- ▶ Data from multiple Satellite sensors are processed.
- ▶ High demands in terms of spatial and temporal resolution, reliability and complexity of the underlying physical processes
- ▶ require the use of powerful supercomputer facilities





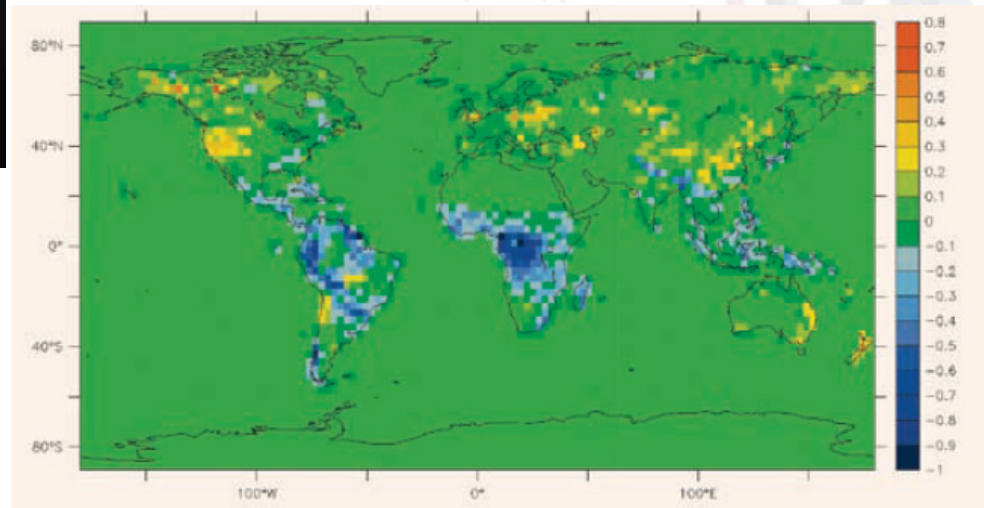
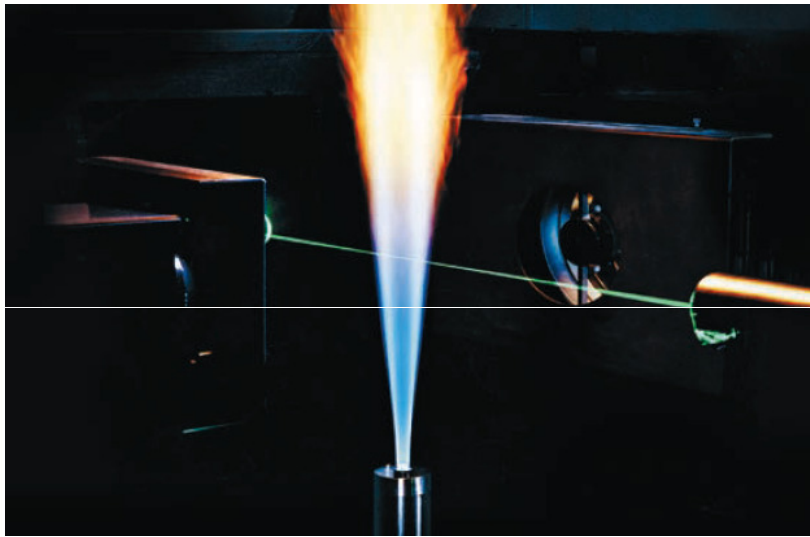
# 42 Dutch Grand Challenge Applications Bundled







# Dutch HPC and sustainability: Clean and efficient Combustion And Better Climate modeling With HPC



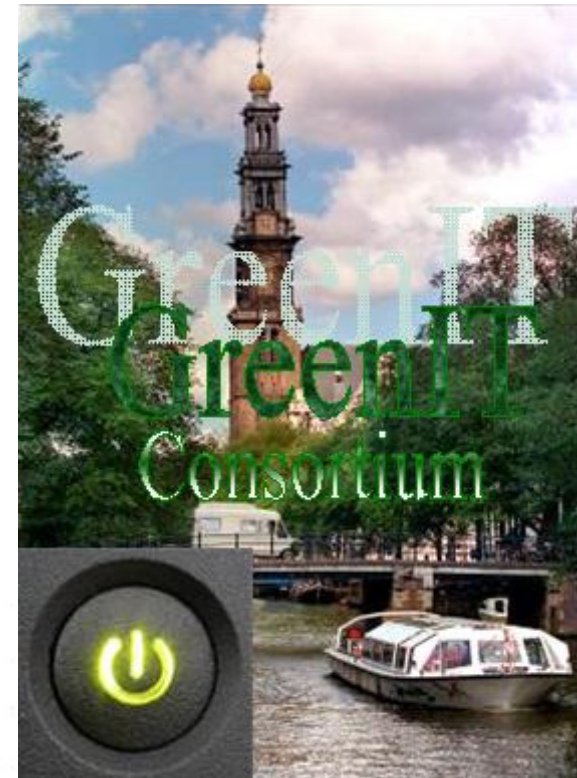
# To finish with: Green IT Consortium Amsterdam

## Collaboration between:

- Energy providers
- Installation equipment manufacturers
- Data Center designers and service providers
- IT equipment suppliers
- Application developers
- Policy makers

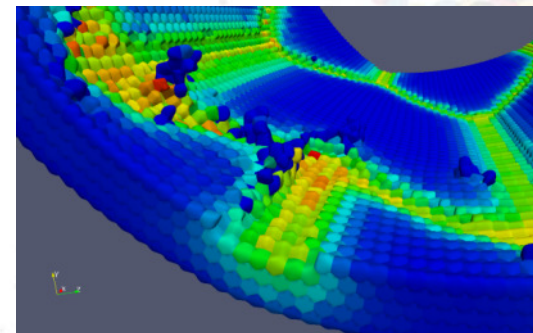
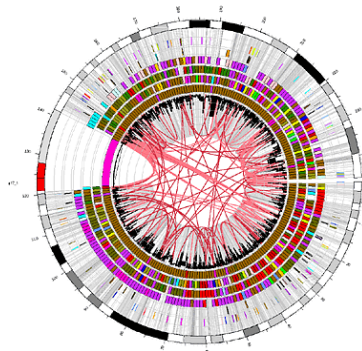
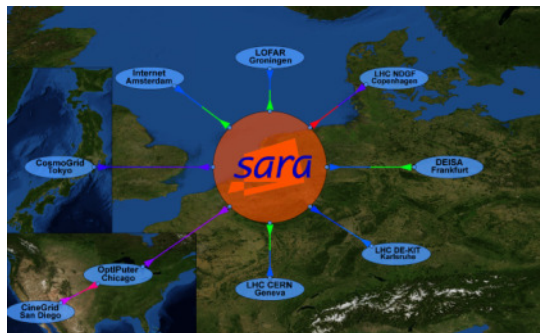
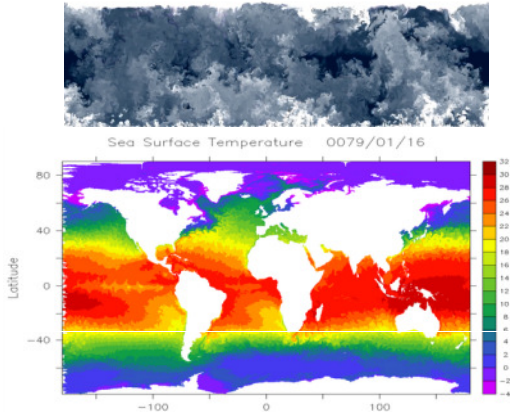
Aimed at Greening the datacenters and deploying ICT and HPC to boost the “Greening by IT”.

Supercomputing and broadband will also help decrease the CO<sub>2</sub> footprint of other sectors





# HPC at SARA: Providing highly competitive integrated ICT services for the research community



Axel Berg, SARA

IDC HPC User Forum, Amsterdam October 11, 2010

Overview of HPC in NL - IDC HPC User Forum 101011