ICM: current developments in HPC area

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HPC in Poland: 2014 update

- Funding 2008-2014: $200M+
- Objectives:
  - Capacity infrastructure:
    - Cracow (Cyfronet)
    - Poznan (PSNC)
    - Gdansk (TASK)
    - Wroclaw (WNSC)
    - Governmental site (energy)
  - Capability facility:
    - Warsaw (ICM)

Coordinated concept: competence centers

- High Performance Networking: PSNC
- Capacity services: Cyfronet
- Capability and data-driven services: ICM

- Concerted POWIEW and PL-GRID R&D programs:
  - Complementary computing infrastructures
  - Joint job allocation concept
  - National services
- Current aggregated capacity:
  - Cyfronet: .5 PF (2+ PF coming)
  - PSNC: 150 TF (subject expansion)
  - ICM: .5 PF (2-3 PF coming)
  - In addition, TASK & WNSC: each appr. 100 TF

ICM: integrated OCEAN concept

- Distributed location:
  - Current site – future back-up facility
  - New site:
    - Under construction
    - Operations: Q3, 2015
    - Total floor: 5000+ sq.m
    - Power supply: 4MW (10MW pending)
  - Concept:
    - Data storage services: initial 30+ PB fast storage
    - HP Data Analytics: 850 GTeps
    - Capability computing: 2-3 PF

OCEAN: program

- National data infrastructures:
  - Research: INFONA integrated platform
  - Government: CRIP public information platform
- HighPerformance data analytics:
  - large-scale data-sets
  - time-critical dependable services
  - development of specialized solutions and infrastructure for big-data analytics
- Capability computing:
  - time-critical applications
  - data-driven computing
  - development of specialized solutions for big-data driven computing

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ICM: computational infrastructure

- As of July, 2014:
  - x86-based compu-clusters: appr. 20K cores
  - Blue Gene Q: 16K cores
  - Power 775: ….
  - Blue Gene P: 4K cores (development & education)
- 2014 (pending):
  - Capacity compu-server: .2-.3 PF
- 2015 (pending):
  - HighPerformance data analytics system
  - Capability computing system
  - HighPerformance data storage

OCEAN R&D program

- Concept:
  - Centre for data science and data-driven services
  - Duality set-up:
    - research-oriented profile
    - governmental services

- Core areas:
  - large operational neworks
  - interactive populations
  - energy, transportation, logistics, medicine

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OCEAN: selected reference areas

Large-scale visual data processing and analysis

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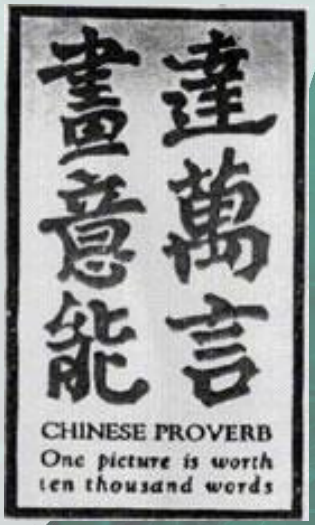
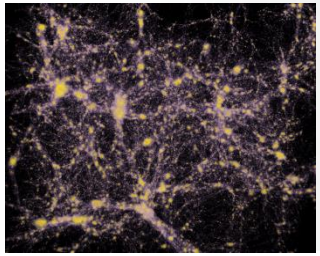
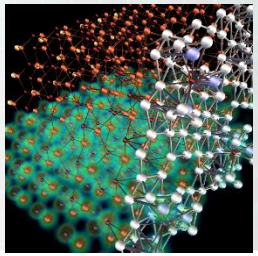
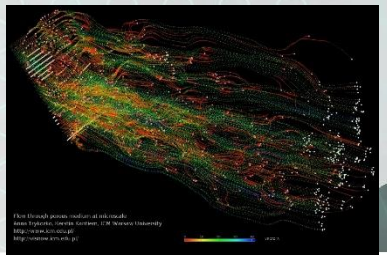
Visualization and Visual Analysis

- **Visualization**
  - Translation from data to image
  - Natural and parallel information interpreted by human
  - Information presentation
  - More comprehensive overview of data
  - Key role in data interpretation
- **Visual Analysis**
  - Enables key information extraction
  - Reveals the unexpected information
  - Supports model building
  - Allows interactive analysis









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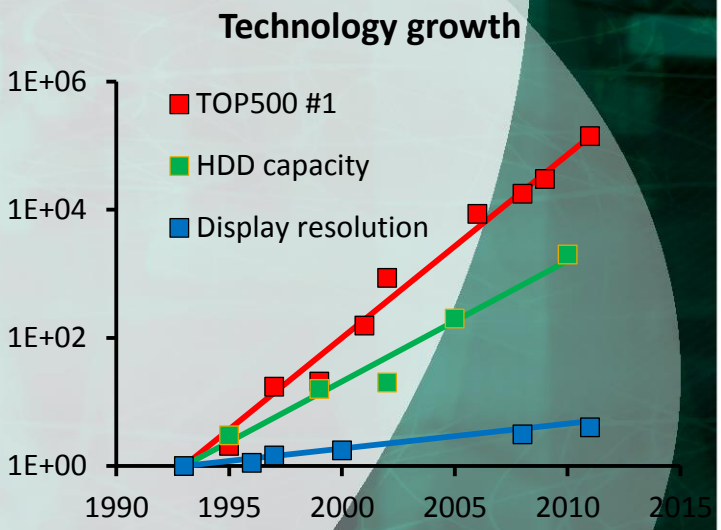
Large scale visualization in HPC

- **Big calculations, Big data, Big challenges**
  - Technology growth rate – computing power and storage size outrank display resolution
  - Rapidly growing size of computational problems in HPC
  - Data amounts exceeding full analysis possibilities
  - Duality of Big Data
    - **Small number of large data sets**
    - **Large number of small data sets**
- **Solution – Large scale visualization**
  - **HPC** infrastructure based
  - **Distributed** and **parallel** processing
  - Adequate **new programming paradigms**
  - **Information extraction** and data simplification methods
  - Suitable **software tools** and services



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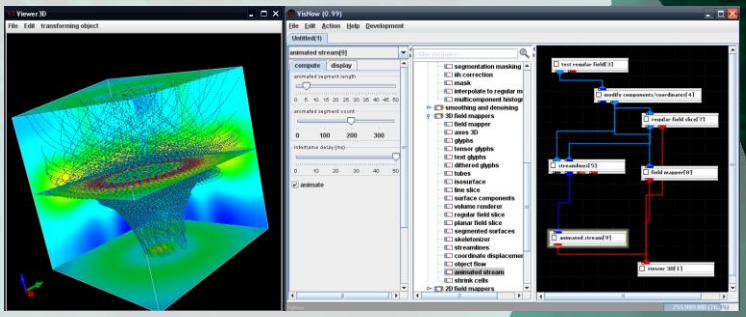
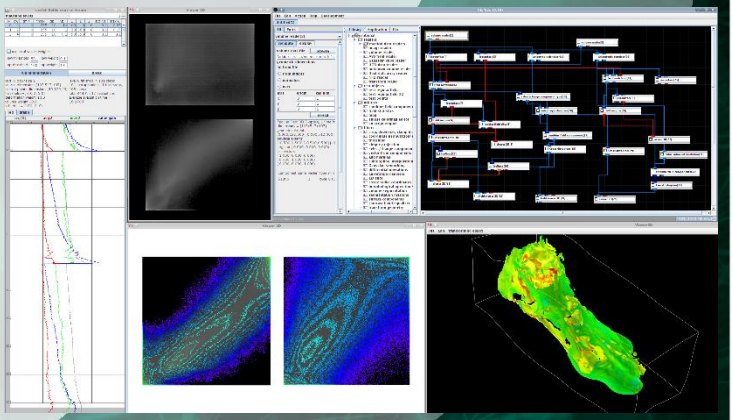
HPC visualization software

- **VisNow** http://visnow.icm.edu.pl
  - Generic **visualization and visual analysis platform**
  - Developed in **Java** at ICM UW
  - **Open Source**
  - **Features**
    - Modular
    - Data flow driven
    - Pluggable
  - **Philosophy**
    - Read-And-Watch – instant visualization
    - Multifunctional modules
    - Module-object-interface connection
    - Reasonable default values
  - **Work in progress**
    - Large datasets support
    - Distributed resources
    - Batch processing





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Numerical weather forecasting and dependent services

- Multi-model multi-grid processing
- Top horizontal resolution in development 1km
- Vertical resolution: 70+ layers

- Services:
  - Severe weather warning systems
  - Energy sector
  - Transportation and logistics
  - Agriculture
- R&D:
  - Energy smart grids
  - Precise agriculture
  - Airspace management

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Personalized medicine and healthcare

- Cardiac interventions:
  - Non-invasive diagnostics
  - Cardio-intervention design
  - Remote monitoring
- Cellular scale computational modeling

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Some facts on ICM

- founded in 1993, shortly after system transformation of Poland, as a centre for:
  - HPC infrastructure: operations and development programs on national scale
  - national information infrastructure
  - research in computational and information sciences

- one of key contributing institutions to the national research ICT infrastructure development in Poland
- ICM has initiated a whole spectrum of diverse programs and activities:
  - national academic applications software system (1996)
  - national research database accessibility (1997)
  - national w3caching program (1996)
  - open-access multi-scale numerical weather prediction system (1997)
  - national virtual library of science (1998)
  - a group of leading-edge experimental labs (2005), extended into a university centre for new technology (2012)

  and also
  - annual festivals of science (from 1997)

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Some of the ICM contributions to large-scale research infrastructures and their development

- national networked HPC infrastructure: applications software, capability computing
- national virtual library of science: content, software system
- unified national academic information infrastructure: integrated system
- Polish Research Bibliography and Polish Citation Index
- EU: DRIVER and OpenAIRE open repository infrastructures
- EU: EuDML (European Digital Mathematics Library)
- EU: UNICORE – grid infrastructure (security functionalities)

ICM: an evolution of the concept

- Centre for computational sciences (1993+):
  - Mathematical modelling
  - Foundations: physics, chemistry, biology, …
- Promotion and implementation of open publishing models (2004+) – Poland and Europe:
  - software
  - Publishing and scholarly communication
  - Research data
  - e-infrastructures
- Data Science and data-driven sciences centre (2013+)

continuously: interdisciplinarity

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e-Infrastructure development

- Numerical Weather Prediction for critical DSS
- Intelligent energy networks (*smart grids*)
- Intelligent city (Warszawa)
- Biobanks (in development)
- Central Repository of Public Information (for government and public administration-created data and information
  - Prototype ready, operations pending
- **Infona** e-infrastructure (research information):
  - Prospective core of national e-infrastructure
- CRPD (Central dissertations repository – in development)
- PBN (Polish Scientific Bibliography) and Pol-Index system

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Virtual Library of Science

- Covering all academic institutions
- Single central license, single contract:
  - Perpetual: content on ICM's servers
  - ICM's access platform: unified search engine, common metadata
  - VPNs admitted
  - Key international publishers – full collections: journals, books
  - Countrywide Open Access publishing, now with Springer, others pending
  - Data analytics facilitated

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