A Grid Infrastructure for Environmental Computing

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Environmental computing infrastructure: anything that helps us cope with this...

Climate change adaptation
100 year storm every 10 years?

Exposure change (urbanisation,...)
thousands of lives
millions of livelihoods

Environmental Computing

Growing expectations on models
400M€ question, answer next week

Post-Hyogo framework
Inter-governmental mandates, obligations
• Signs of market pull for infrastructure
  • After a decade characterised by “technology push”

• Opportunity to address major issues
  • Fine particulates: 2.1 million deaths annually (3 x times malaria)
  • 10 worst natural disasters in 2014: over 2600 deaths, 46b$ damages

• Pressure
  • Answers need to come faster
  • With more confidence
  • Often there is no “safe option”
  • Questions are more holistic
• Environmental computing
  • Applied environmental modelling
    • New use cases, problem statements
  • Environmental multi-modelling
    • Link several models together to produce more complete scenarios
    • Capture inherently multi-model phenomena, such as flooding

• Grid infrastructure
  • IaaS + … + consulting
What is environmental computing?

• Enhance, combine, complement – don’t replace
  • Meteorology, seismology etc. important components
    • Scaled up – especially “new” specialties
    • Speeded up – urgent computing
  • Developing applied environmental modelling solutions
    • Efficiency
    • Trust
    • Making the results relevant
  • Similar to medical informatics
    • Integration didn’t replace specific disciplines
    • Made them more accessible and visible – and trusted
    • Common body of knowledge

Heikkurinen, Schiffers, Kranzlmüller: Environmental Computing
Current environmental computing service providers (government facing)

- **UNISDR**
  - UN-wide mandate: coordinate disaster risk reduction activities
  - Ongoing collaboration with LMU/LRZ, joint “side event” 15th March at Sendai WCDRR
  - Computational challenge: Global Assessment Report on Risk reduction
    - Global grids ranging from 30km to 1km “edge”
    - “We could have happily spent one more year producing this”
    - Ambition: 100m x 100m grid -> computing requirements thousands to millions times the current ones

- **Others**
  - WHO, UNEP,…
  - EC-ECHO,…
  - National civil protection

- **Approach**: coordinate role, modelling in collaborating institutes
Technical challenge – case UNISDR

- 2 Servers, 24 cores
- 5 week “job” to provide fundamental input to policy documents
- Reaching this stage ~6 months (from single core model)

- Manual “sanity checks” essential
- Country-by-country checks trigger re-execution (impact days)
Another 6 months?
Success stories: DRIHM
(motivated the first steps)
Dr. Christian Pelties, Department of Earth and Environmental Sciences (LMU)
Prof. Michael Bader, Department of Informatics (TUM)

1.42 Petaflop/s on 147,456 Cores of SuperMUC
(44,5 % of Peak Performance)

http://www.uni-muenchen.de/informationen_fuer/presse/presseinformationen/2014/pelties_seisol.html
Leverage on the 5 sided projection installation to enable decision makers to have a swift and yet deep insight into simulated predictions.
Date: 20 May 2012
Magnitude: 5.9
Code: Specfem3D Cartesian
Why these matter

- Part of the shared body of knowledge that we need to build
  - Technical solutions (products, libraries)
  - Approaches used to reach them (reuse in other projects)
  - “Lessons learned”

- Motivation for the model developers
  - “We have a path to SuperMUC” and to major policy documents

- New users for components
  - Individual component vs. component suite
• Requirement gathering crucial
  • May require proof of concept implementations
• Change the wheels while the bus is running
  • High demand for modelling results on the user side
  • Offer man- and computing power, not advice
• Support network needs to be “Grid-like”
  • A lot of the current environmental computing activities are federated
  • Actual computing infrastructure less important?
The big picture – redrawn

**Phenomena**

(Observations, Models)

Seismology

Global Warming

Hydro-Meteorology

**Solution Enabling**

(Services, Tools, Providers, Cooperations)

**Opportunities & Benefits**

(Science, Economy, Ecology, Society)

Disaster Management

Climate Change Responses

Local/Regional Forecasting

Hazard Research

Decision Support

Project Funding Schemes

Centers of Excellence

Transdisciplinary Education

Market Opportunities

Research Agendas

Heikkurinen, Schifflers, Kranzlmüller: Environmental Computing
• More information
  • Envcomp.eu website- launched, more content soon
  • WCDRR side event: http://www.envcomp.eu/?page_id=84

• Events
  • eScience 2015: environmental computing focus day
    • http://escience2015.mnm-team.org/
  • ISGC 2016 workshop on disaster mitigation (TBC)

• Get in touch!
  • Mailing lists being planned – contact heikku@nm.ifi.lmu.de
  • Success stories, interesting problems, use cases etc. also most welcome!
  • Envcomp.eu forum (in beta)