LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

MNM TEAM
MUNICH NETWORK MANAGEMENT TEAM

lrz

Introduction to the Environmental Computing Workshop @ ISGC 2016

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Flash Flood Genoa, Italy, 2011

http://www.drihm.eu/images/video/DRIHM_final.mp4

Flash Floods

- Form swiftly due to (extremely) high rainfall rates
- Little or no prior warning
- Devastating consequences (casualties, economic losses, ...)

UNISDR – The United Nations Office for Disaster Risk Reduction

UNISDR
The United Nations Office for Disaster Risk Reduction

Search GO

Connect and convince to reduce disaster impacts

WHO WE ARE | WHAT WE DO | WHERE WE WORK | WHO WE WORK WITH

HOME > WHAT WE DO > WE INFORM > GLOBAL ASSESSMENT REPORT

Global Assessment Report

MAKING DEVELOPMENT SUSTAINABLE: THE FUTURE OF DISASTER RISK MANAGEMENT

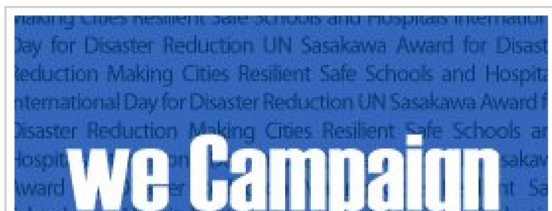
The GAR is a comprehensive review and analysis of disaster risk and risk management. It is published every two years. GAR15 was launched in March 2015, it looks at how to make development sustainable.

Visit the GAR15 website →

"World threatened by dangerous and unacceptable levels of risk from disasters."
-- Ban Ki-moon, United Nations Secretary-General, 2015

The Global Assessment Report on Disaster Risk Reduction (GAR) is a biennial global assessment of disaster risk reduction and comprehensive review and analysis of the natural hazards that are affecting humanity. The GAR contributes to achieving the Hyogo Framework of Action (HFA) through monitoring risk patterns and trends and progress in disaster risk reduction while providing strategic policy

The Third World Conference on Disaster Risk Reduction took place in 2015.



https://www.unisdr.org/

GAR – Global Assessment Report on Disaster Risk Reduktion 2015

Global Assessment Report on Disaster Risk Reduction 2015

Making development sustainable: The future of disaster risk management

Home Pocket GAR **GAR 2015 Main Report** Documents Data Download Press

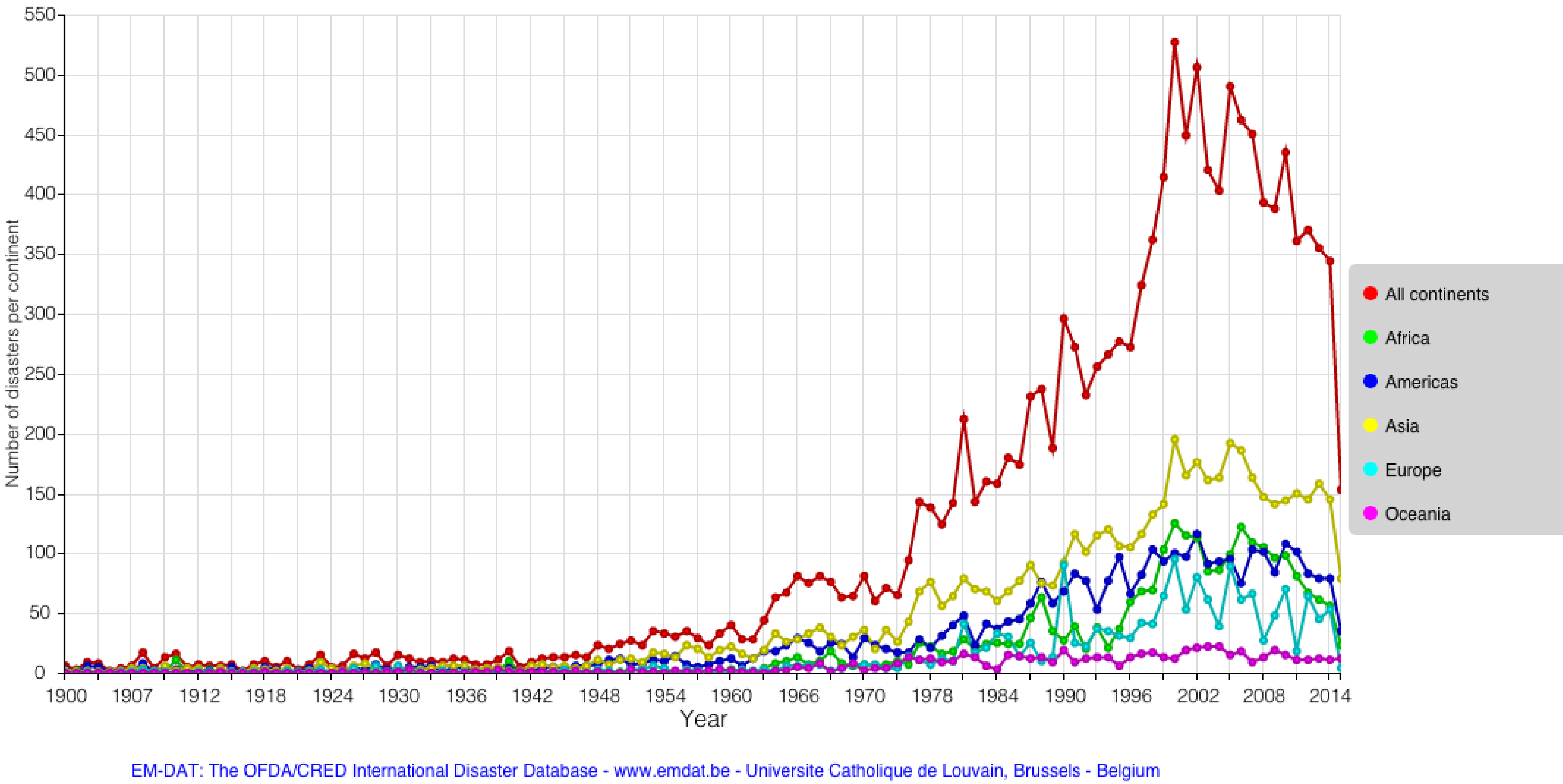
Foreword At a glance Preface Introduction Part I Part II Part III Backmatter

Most disasters that could happen have not happened yet.

Economic losses from disasters such as earthquakes, tsunamis, cyclones and flooding are now reaching an average of US$250 billion to US$300 billion each year. **Future losses** (expected annual losses) are now estimated at US$314 billion in the built environment alone. **This is the amount that countries should set aside each year to cover future disaster losses.** (→ Chapter 3)

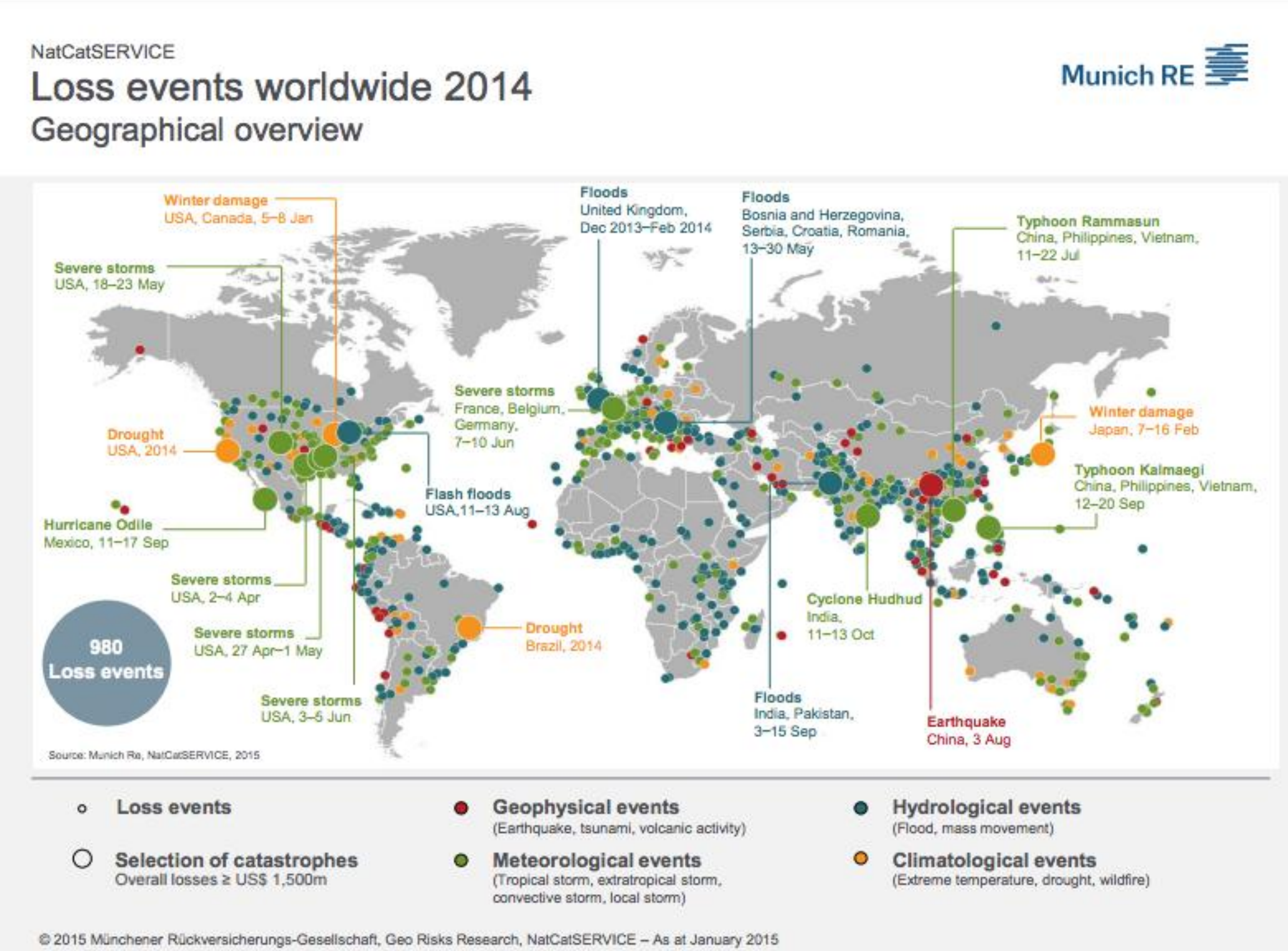
http://www.preventionweb.net/english/hyogo/gar/2015/en/home/GAR_2015/GAR_2015_6.html

Number of Disasters per Region



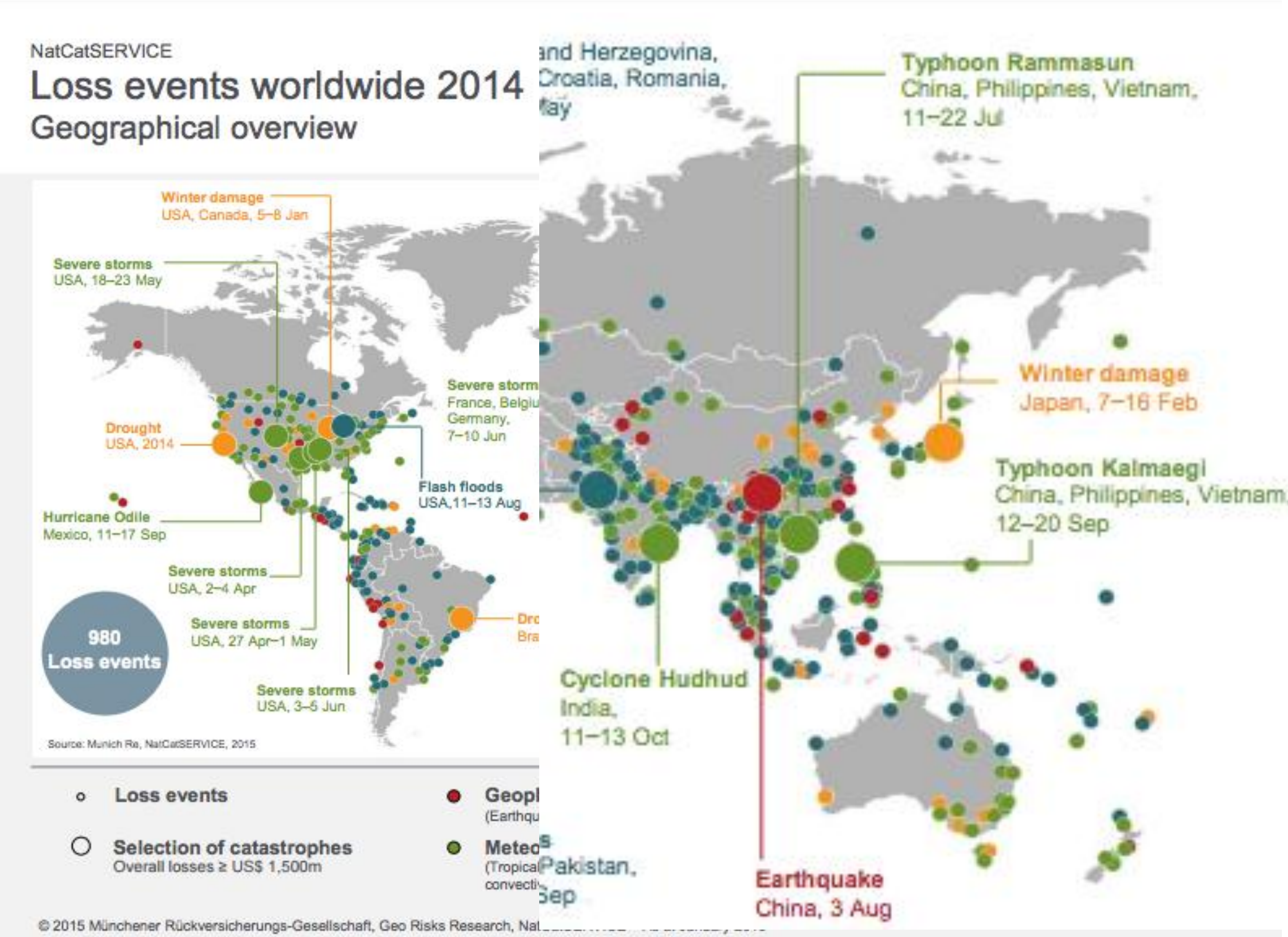
http://www.emdat.be/disaster_trends/index.html

Munich Re – Loss Events Worldwide 2014



http://www.preventionweb.net/files/41773_munichreworldmapnaturalcatastrophes.pdf

Munich Re – Loss Events Worldwide 2014



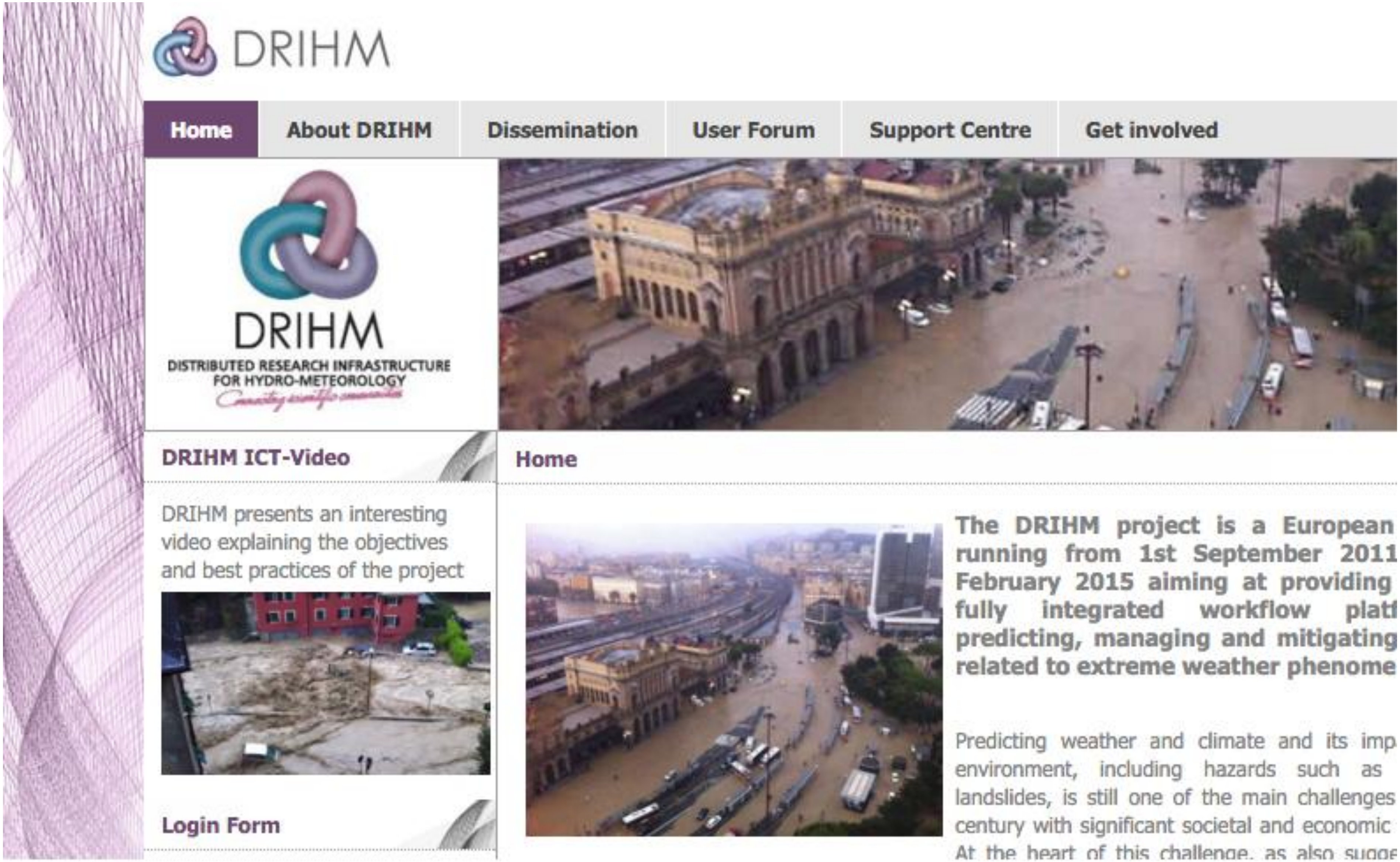
http://www.preventionweb.net/files/41773_munichreworldmapnaturalcatastrophes.pdf

Flash Floods

- Form swiftly due to (extremely) high rainfall rates
- Little or no prior warning
- Devastating consequences (casualties, economic losses, ...)
- Monitoring and forecasting of floods:
  – European Flood Awareness System (EFAS)
  – Global Flood Detection System (GFDS)
  – Global Flood Awareness System (GloFAS)
- Problem: spatial resolution 50-100 km

  ➔ Flash floods remain undetected

The EU Project Series DRIHM*



Possible Solution – Environmental Computing

- Combine meteorology, hydrology, hydraulics through computer science
- Increase spatial and temporal resolution (data quality)
  - Regional Climate Models (RCM)
- Compute ensembles of forecasts to cover all potential outcomes
- Start and finish computation in time to provide lead time for evacuation measures

→ **Simulate ensembles of forecasts**
with high-resolution on
high-performance computing (HPC) infrastructures
on demand when triggered by increased rainfall rates

Agenda of Environmental Computing Workshop

Session I
- Introduction to the Workshop (Dieter Kranzlmüller)
- Keynote: Research Center for Environmental Changes (Huang-Hsiung Hsu)

Session II
- The Big Picture (Matti Heikkurinen)
- DMCC (Eric Yen)
- Mekong Delta (Nam Thoai)
- Environmental Exascale Computing (Dieter Kranzlmüller)

Session III
- Land Use Development Simulation Systems (Feng-Tyan Lin)
- Application of numerical model on extreme weather and environmental studies (Chuan-Yao Lin)
- The Applications of Advanced Numerical Simulation on the Tsunami and Flooding Hazard Mitigation (Tso-Ren Wu)

Session IV

Panel and Discussion

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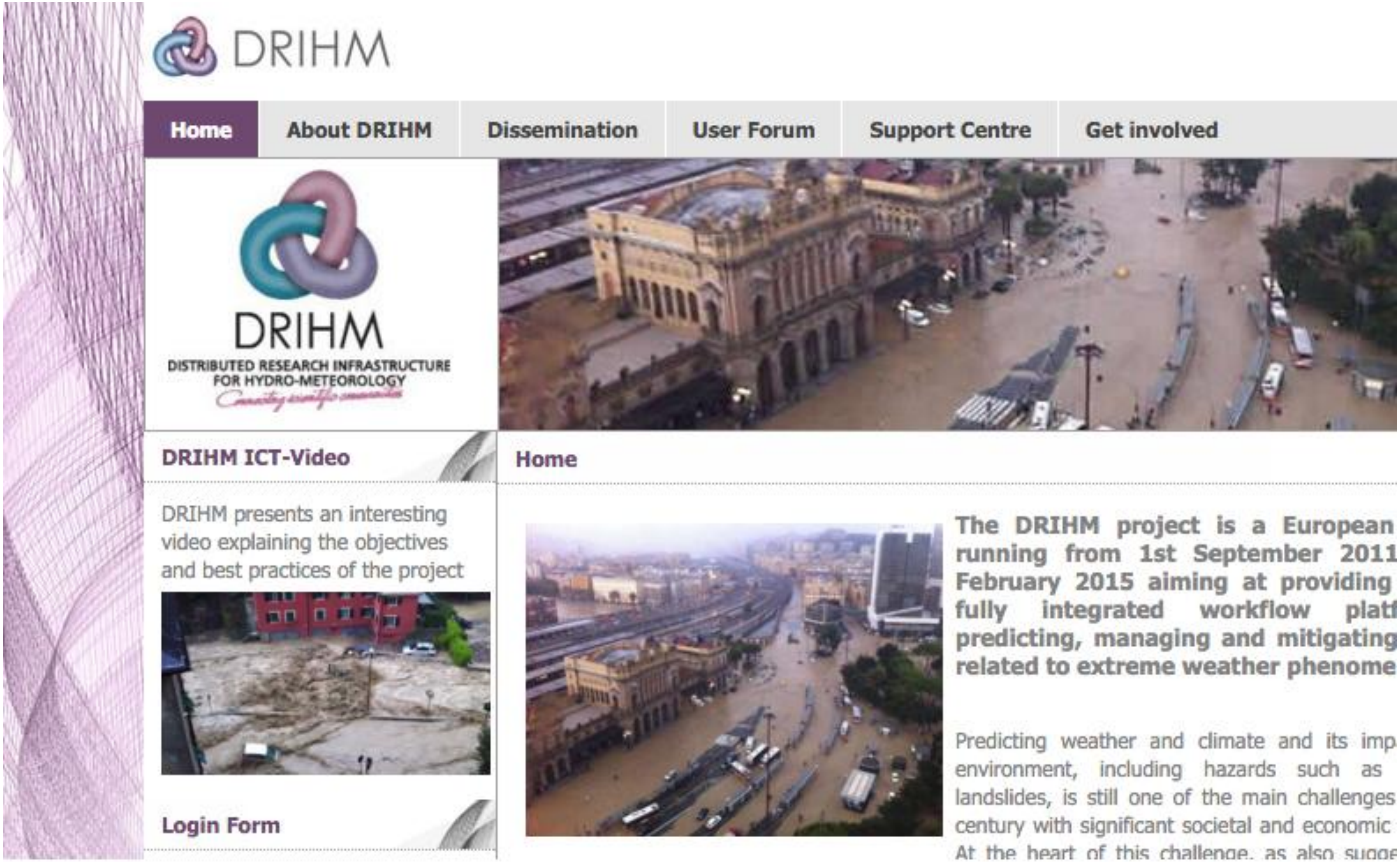

Leibniz Supercomputing Centre
of the Bavarian Academy of Sciences and Humanities

With approx. 230 employees
for more than 100.000 students and
for more than 30.000 employees
including 8.500 scientists

- European Supercomputing Centre
- National Supercomputing Centre
- Regional Computer Centre for all Bavarian Universities
- Computer Centre for all Munich Universities

Photo: Ernst Graf

- European Supercomputing Centre
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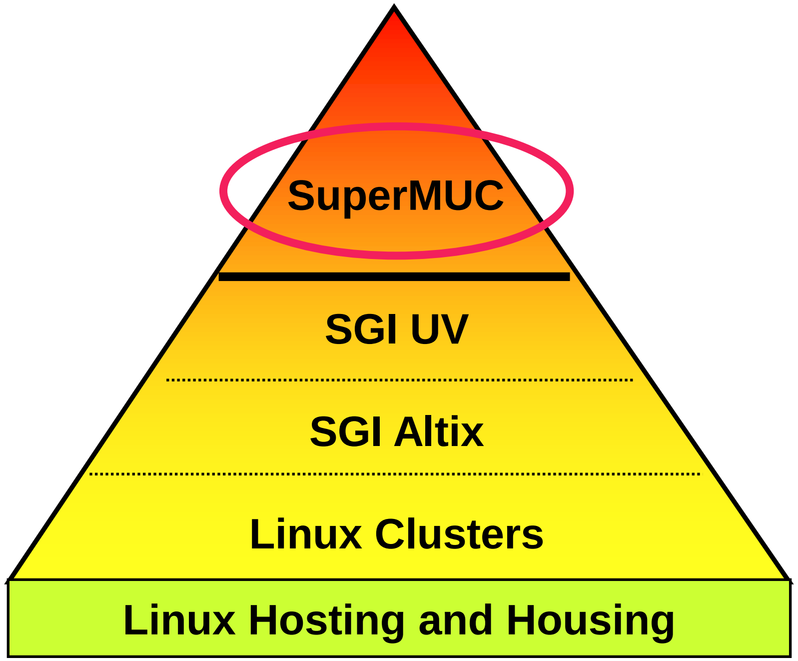


SuperMUC @ LRZ

Video: **SuperMUC rendered on SuperMUC by LRZ**

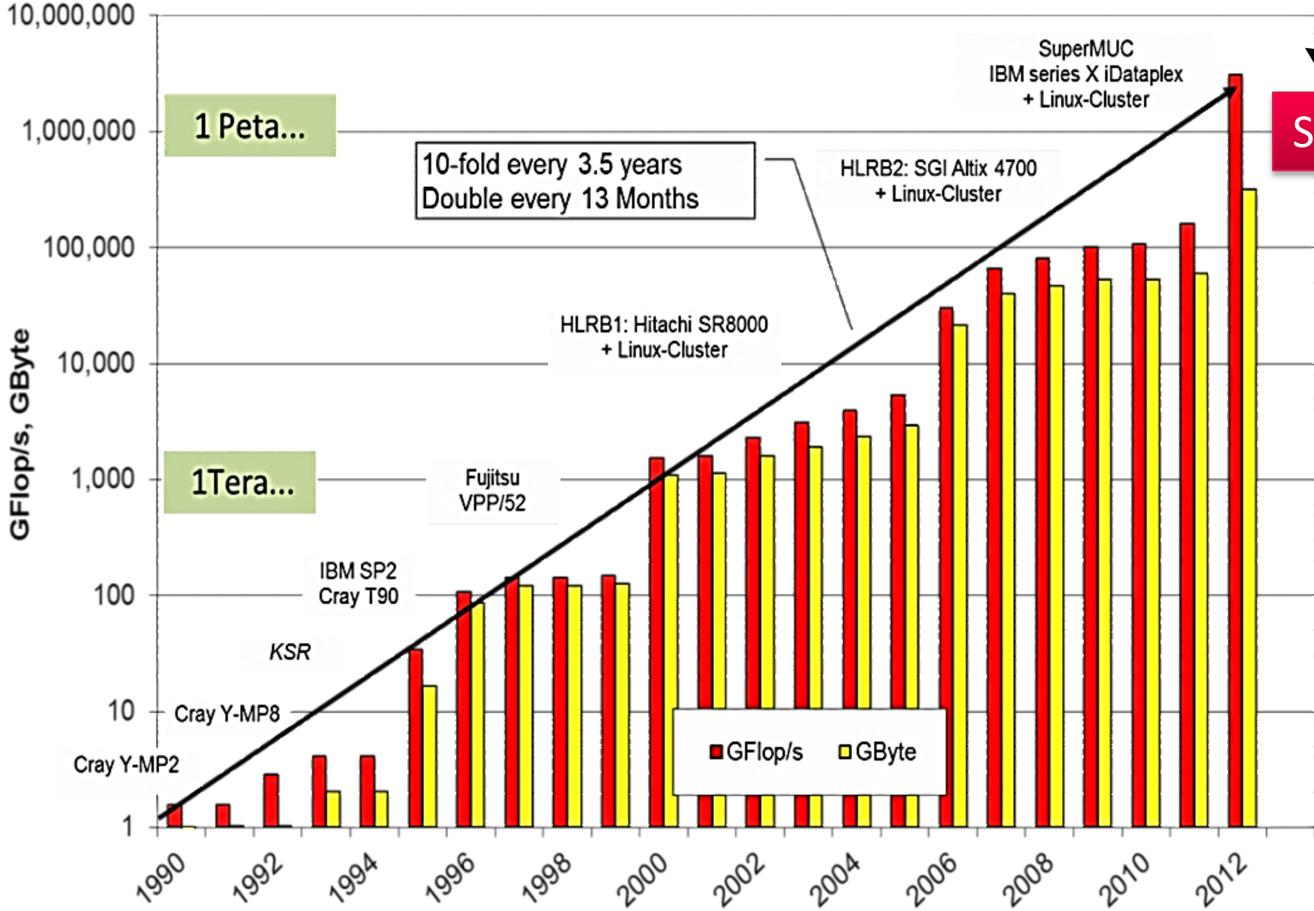
http://youtu.be/OlAS6iiqWrQ

Top 500 Supercomputer List (June 2012)

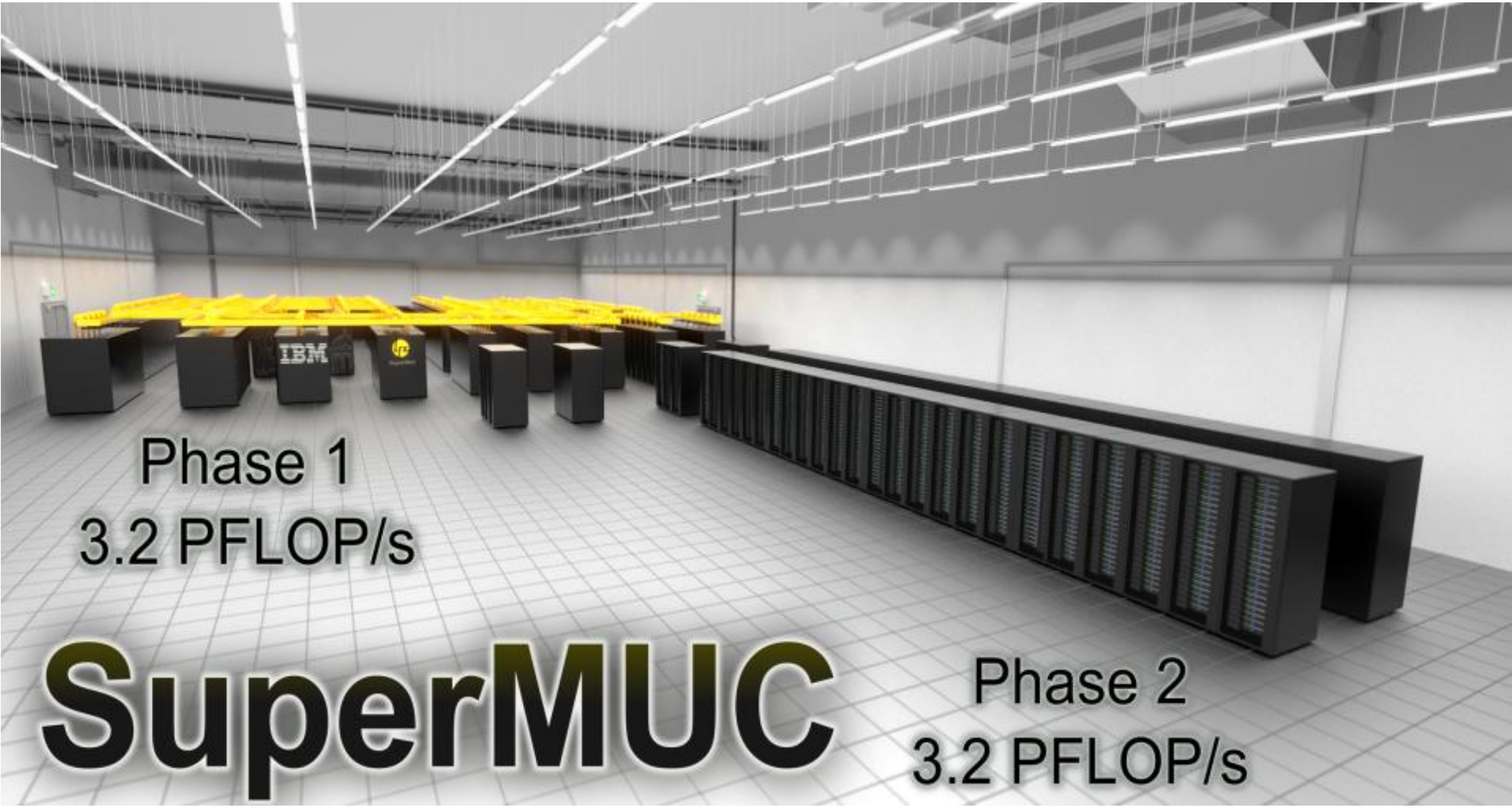
Rank	Site	Computer/Year Vendor	Cores	R_{max}	R_{peak}	Power
1	DOE/NNSA/LLNL United States	**Sequoia** - BlueGene/Q, Power BQC 16C 1.60 GHz, Custom / 2011 IBM	1572864	16324.75	20132.66	7890.0
2	RIKEN Advanced Institute for Computational Science (AICS) Japan	K computer, SPARC64 VIIIfx 2.0GHz, Tofu interconnect / 2011 Fujitsu	705024	10510.00	11280.38	12659.9
3	DOE/SC/Argonne National Laboratory United States	**Mira** - BlueGene/Q, Power BQC 16C 1.60GHz, Custom / 2012 IBM	786432	8162.38	10066.33	3945.0
4	Leibniz Rechenzentrum Germany	**SuperMUC** - iDataPlex DX360M4, Xeon E5-2680 8C 2.70GHz, Infiniband FDR / 2012 IBM	147456	2897.00	3185.05	3422.7
5	National Supercomputing Center in Tianjin China	**Tianhe-1A** - NUDT YH MPP, Xeon X5670 6C 2.93 GHz, NVIDIA 2050 / 2010 NUDT	186368	2566.00	4701.00	4040.0
6	DOE/SC/Oak Ridge National Laboratory United States	**Jaguar** - Cray XK6, Opteron 6274 16C 2.200GHz, Cray Gemini interconnect, NVIDIA 2090 / 2009 Cray Inc.	298592	1941.00	2627.61	5142.0
7	CINECA Italy	**Fermi** - BlueGene/Q, Power BQC 16C 1.60GHz, Custom / 2012 IBM	163840	1725.49	2097.15	821.9
8	Forschungszentrum Juelich (FZJ) Germany	**JuQUEEN** - BlueGene/Q, Power BQC 16C 1.60GHz, Custom / 2012 IBM	131072	1380.39	1677.72	657.5
9	CEA/TGCC-GENCI France	**Curie thin nodes** - Bullx B510, Xeon E5-2680 8C 2.700GHz, Infiniband QDR / 2012 Bull	77184	1359.00	1667.17	2251.0
10	National Supercomputing Centre in Shenzhen (NSCS) China	**Nebulae** - Dawning TC3600 Blade System, Xeon X5650 6C 2.66GHz, Infiniband QDR, NVIDIA 2050 / 2010 Dawning	120640	1271.00	2984.30	2580.0

www.top500.org

LRZ Supercomputers



SuperMUC Phase II


IBM
Phase 1
3.2 PFLOP/s
SuperMUC
Phase 2
3.2 PFLOP/s

SuperMUC System @ LRZ

Phase 1 (IBM System x iDataPlex):

- 3.2 PFlops peak performance
- 9216 IBM iDataPlex dx360M4 nodes in 18 compute node islands
- 2 Intel Xeon E5-2680 processors and 32 GB of memory per compute node
- 147,456 compute cores
- Network Infiniband FDR10 (fat tree)

Phase 2 (Lenovo NeXtScale WCT):

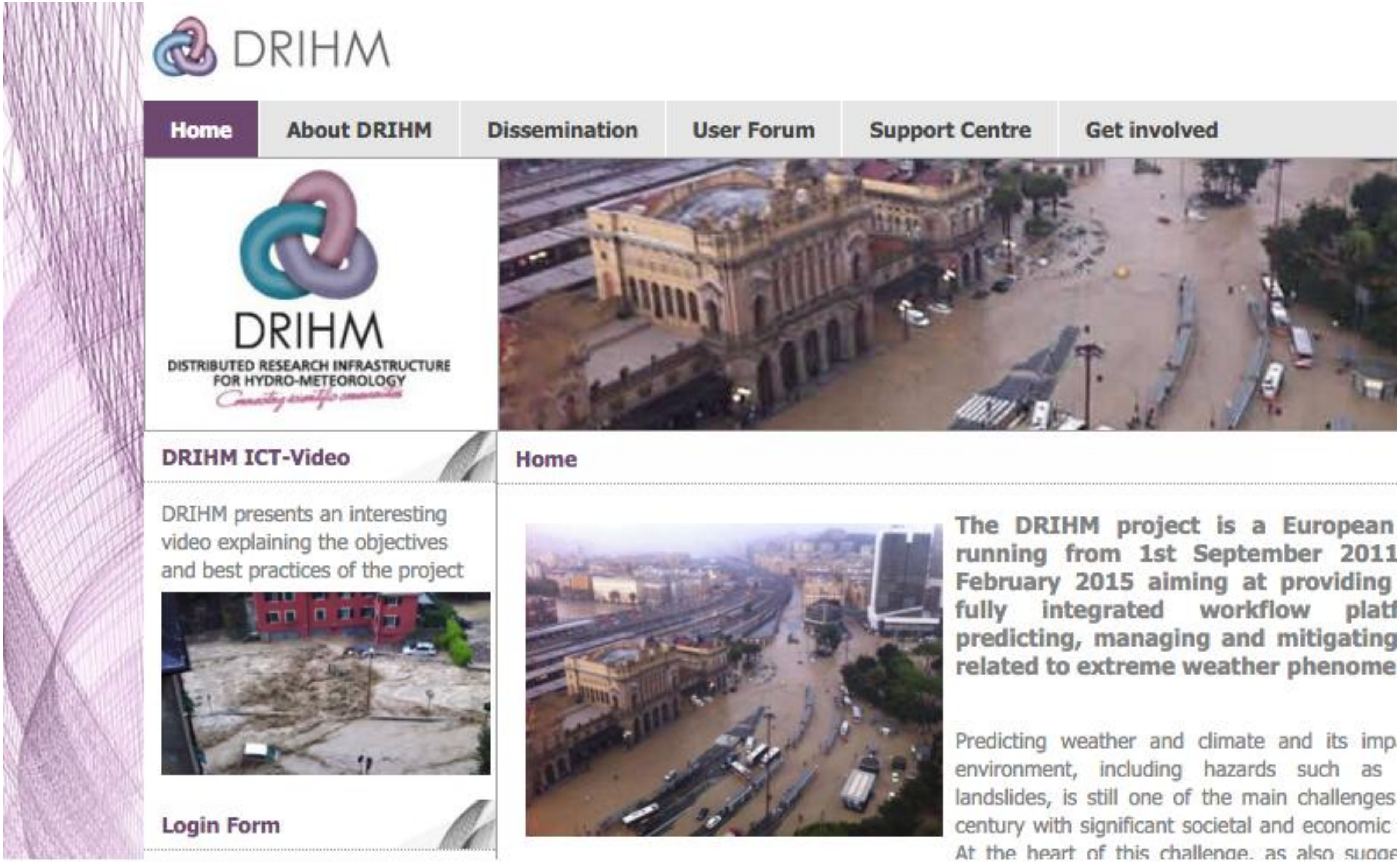
- 3.6 PFlops peak performance
- 3072 Lenovo NeXtScale nx360M5 WCT nodes in 6 compute node islands
- 2 Intel Xeon E5-2697v3 processors and 64 GB of memory per compute node
- 86,016 compute cores
- Network Infiniband FDR14 (fat tree)

Common GPFS file systems with 10 PB and 5 PB usable storage size respectively
Common programming environment
Direct warm-water cooled system technology

LRZ Application Mix

- Computational Fluid Dynamics: Optimisation of turbines and wings, noise reduction, air conditioning in trains
- Fusion: Plasma in a future fusion reactor (ITER)
- Astrophysics: Origin and evolution of stars and galaxies
- Solid State Physics: Superconductivity, surface properties
- Geophysics: Earth quake scenarios
- Material Science: Semiconductors
- Chemistry: Catalytic reactions
- Medicine and Medical Engineering: Blood flow, aneurysms, air conditioning of operating theatres
- Biophysics: Properties of viruses, genome analysis
- Climate research: Currents in oceans

The EU Project Series DRIHM*



Key Gaps

(as observed during the DRIHM project)

- Technical interoperability and portability
  - Models
  - Data formats
  - Execution environments
  - Metadata describing them
- Semantics
- Workflows linking all of the above together
  - Pre-DRIHM hydrometeorological model chain would have taken weeks of manual integration work
  - Despite the fact that webservices and science gateways are available

Actionable Knowledge

How we could have used the information
if it was available beforehand?

How could we utilize the outcomes of environmental computing for societey?

- Links with civil protection

- Risks due to a disaster with a certain probability vs. certain risks related to evacuation
  - False alarms? We don't want to be the "computer that cried flood"
  - There are rules regarding how much of a lead-time warning the population needs (30 minutes before would just trigger chaos, make society more vulnerable

Communicating the Results

How can non-scientists use the information?

- Civil protection model probably fairly well-established ("client" is used to data with certain uncertainty built in)
- Risk reduction: need to answer questions related to long-term infrastructure development projects and policy formation
  - Injecting uncertain data into political process!!
  - Dealing with financial interests unavoidable: protection infrastructure in itself, impact on development:
    - No building permits on flood-prone areas, housing developers not happy
    - Re-classifying existing housing, house owners not happy (lose flood insurance or increase in premiums)

Analyze Simulation Results

Environmental Computing @ LRZ

Summary

- We are talking about an issue with considerable socioeconomic importance
- UNISDR data re. costs of disasters
- Disaster risk reduction is not cheap either
(UK data regarding need for flood defences)
- There will be growing demand for environmental computing, e.g. through Sendai Framework, development, any initiative working on societal resilience
- We focused on flooding as starting point, but there are other risks

Wrap-Up and Goal of Workshop

There are many activities addressing some of the gaps identified, but we are not aware of efforts to look into all of them in a coherent manner

The goal of this workshop is to try to capture, structure and conceptualise this very broad scope in a way that we all can work together and communicate joint results more efficiently

Environmental Computing Workshop @ ISGC 2016

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Photo:Karl Behler

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