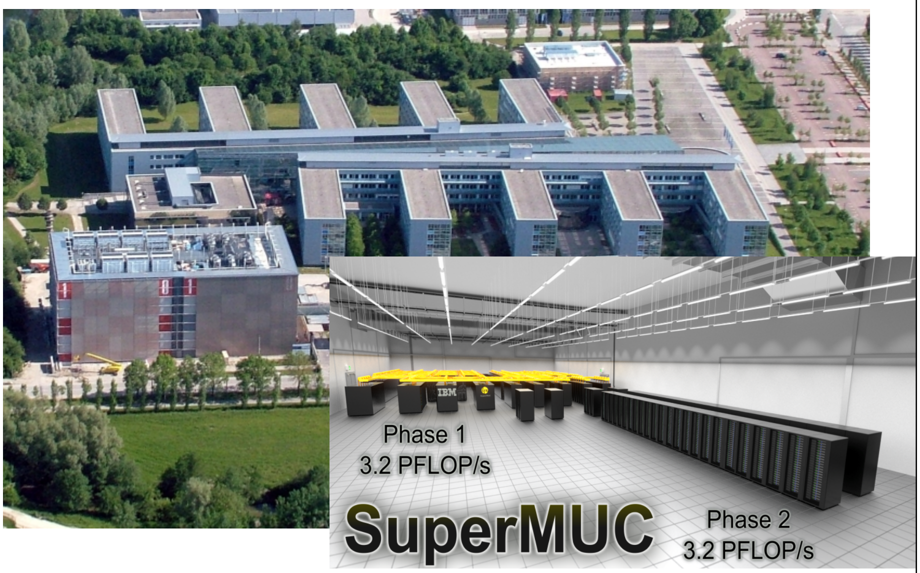
MNM TEAM
Munich Network Management Team

DRIHM and e-Science Support

Dieter Kranzlmüller

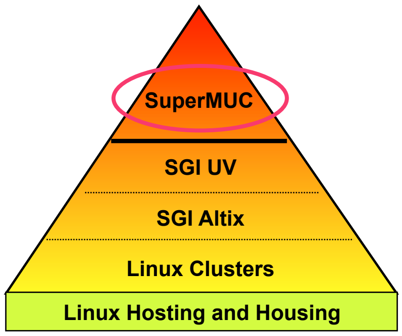
Munich Network Management Team
Ludwig-Maximilians-Universität München (LMU) &
Leibniz Supercomputing Centre (LRZ)
of the Bavarian Academy of Sciences and Humanities

Leibniz Supercomputing Centre
of the Bavarian Academy of Sciences and Humanities



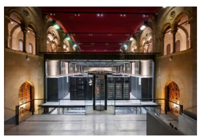
Leibniz Supercomputing Centre
of the Bavarian Academy of Sciences and Humanities

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



PRACE Tier-0 Systems

- **Curie @ GENCI**:
  Bull Cluster, 1.7 PFlop/s
- **FERMI @ CINECA**:
  IBM BG/Q, 2.1 PFlop/s
- **Hermit @ HLRS**:
  Cray XE6, 1 Pflop/s
- **JUQUEEN @ FZJ**:
  IBM Blue Gene/Q, 5.9 PFlop/s
- **MareNostrum @ BSC**:
  IBM System X iDataPlex, 1 PFlop/s
- **SuperMUC @ LRZ**:
  IBM System X iDataPlex, 3.2 PFlop/s


Motivations

- Severe storms, and floods/flash-floods are highly impacting on human society and economical activities

Flood

	2013	2003-2012
Occurence	145	172
Killed	9 545	5 689
Affected	31 350 240	106 139 202
Damage US$ (In US$ billion)	53.90	25.35

Storm

	2013	2003-2012
Occurence	95	99
Killed	9 197	17 527
Affected	48 629 303	30 638 289
Damage (In US$ billion)	47.84	58.90

Earthquake (incl. Tsunami)

	2013	2003-2012
Occurence	27	28
Killed	1 120	67 882
Affected	7 029 162	8 111 667
Damage (In US$ billion)	12.01	46.01

Mass movement wet

	2013	2003-2012
Occurence	11	18
Killed	235	896
Affected	1 031	344 166
Damage (In US$ billion)	—	0.15

Drought

	2013	2003-2012
Occurence	9	15
Killed	—	39
Affected	7 955 904	36 407 747
Damage (In US$ billion)	1.08	4.93

Wild fires

	2013	2003-2012
Occurence	9	10
Killed	34	72
Affected	8 381	211 967
Damage (In US$ billion)	—	2.55

Extreme temperature

	2013	2003-2012
Occurence	15	25
Killed	2 102	14 435
Affected	270 016	9 011 290
Damage (In US$ billion)	—	3.83

Mass movement dry

	2013	2003-2012
Occurence	1	1
Killed	46	23
Affected	2	408
Damage (In US$ billion)	0.048	—

Volcano

	2013	2003-2012
Occurence	3	6
Killed	—	36
Affected	105 106	116 207
Damage (In US$ billion)	—	0.015

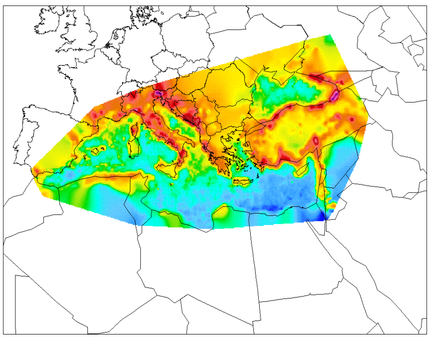
EM-DAT
The International Disaster Database
Centre for Research on the Epidemiology of Disasters - CRED

DRIHM

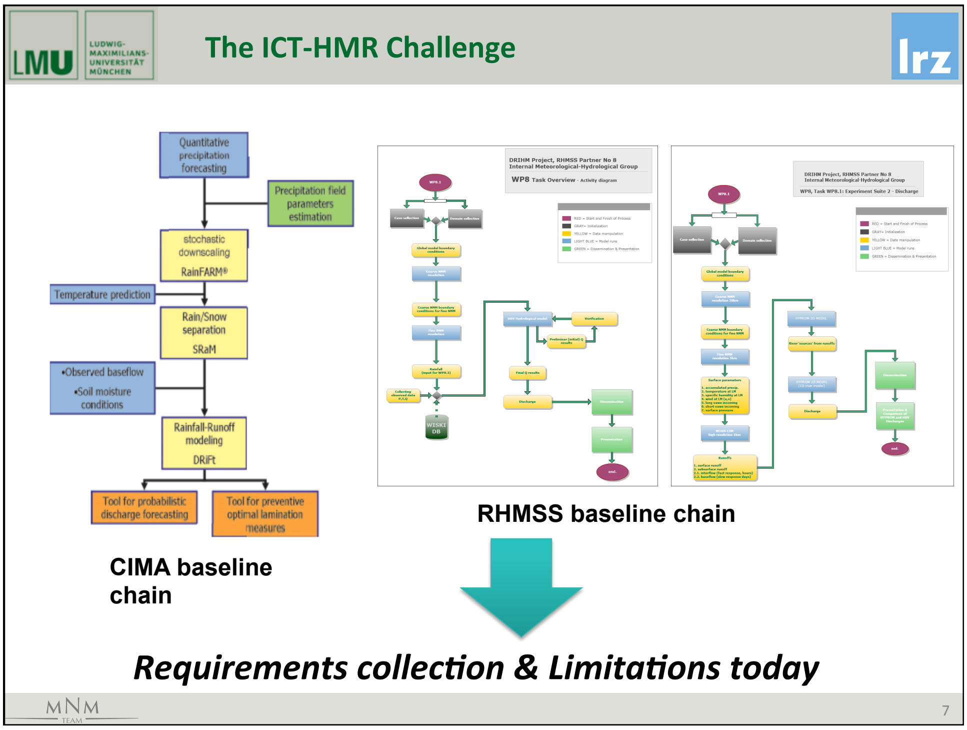
DRIHM2US

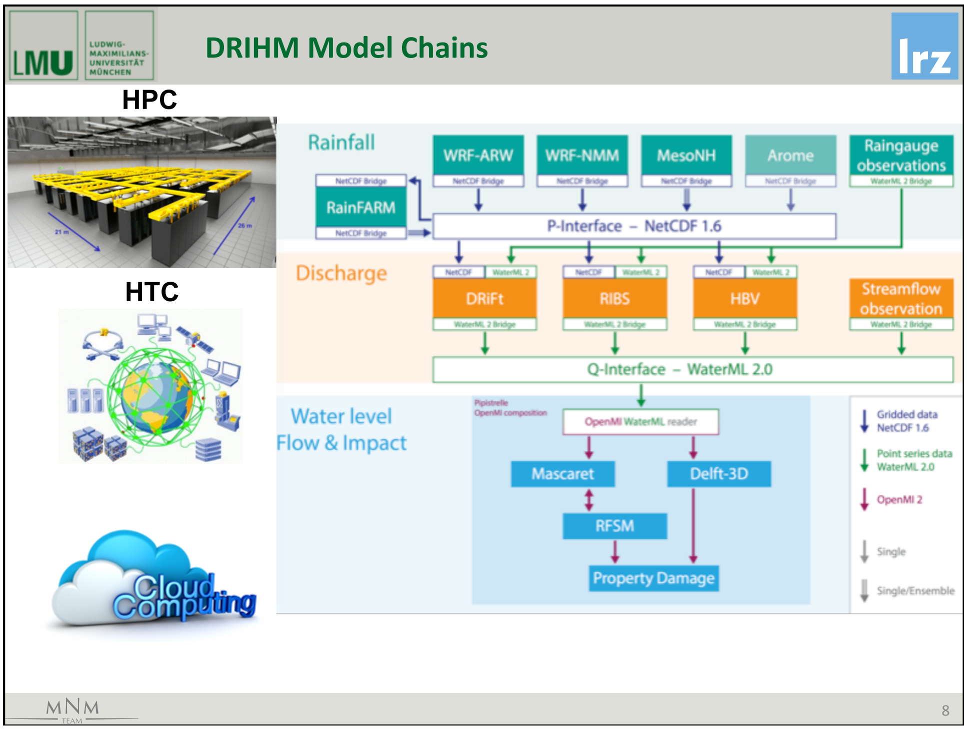
The Mediterranean region

- The FLASH project estimated over 29 billion euros the material damages produced by floods in the Mediterranean region during the 1990-2006 period
- The total number of casualties has been estimated over 4,500, concentrating in the Mediterranean African countries.



SSMI and raingauge observations
1978-1994


LMU
LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
The ICT-HMR Challenge
lrz
Quantitative precipitation forecasting
Precipitation field parameters estimation
stochastic downscaling
RainFARM®
Temperature prediction
Rain/Snow separation
SRaM
•Observed baseflow
•Soil moisture conditions
Rainfall-Runoff modeling
DRiFt
Tool for probabilistic discharge forecasting
Tool for preventive optimal lamination measures
CIMA baseline chain
RHMSS baseline chain
Requirements collection & Limitations today
MNM TEAM
7


LMU
LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN
DRIHM Model Chains
lrz
HPC
HTC
Cloud Computing
Rainfall
WRF-ARW
WRF-NMM
MesoNH
Arome
Raingauge observations
RainFARM
P-Interface – NetCDF 1.6
Discharge
DRiFt
RIBS
HBV
Streamflow observation
Q-Interface – WaterML 2.0
Water level
Flow & Impact
OpenMI WaterML reader
Mascaret
Delft-3D
RFSM
Property Damage
Gridded data NetCDF 1.6
Point series data WaterML 2.0
OpenMI 2
Single
Single/Ensemble
MNM TEAM
8

Data-Intensive Sciences

- Big Data
  - New Big Data: Open datasets, mashups, new discovery tools – Fashion/Hype?
  - Old (really) Big Data: meteo, climate, bio,…
- DRIHM is a perfect example of Data-Intensive Science
- Strong links with practical/operational uses
- e-Infrastructure needs are intrinsic to DRIHM
- General purpose characteristic needs to be adapted to specific needs of DRIHM applications
- "Not just for (single) experts anymore"
  - DRIHM model chain: hard for single individuals to be an expert on all components
  - Link with Civil Protection (time pressure), policy formation (lobbying pressure), Citizen scientists

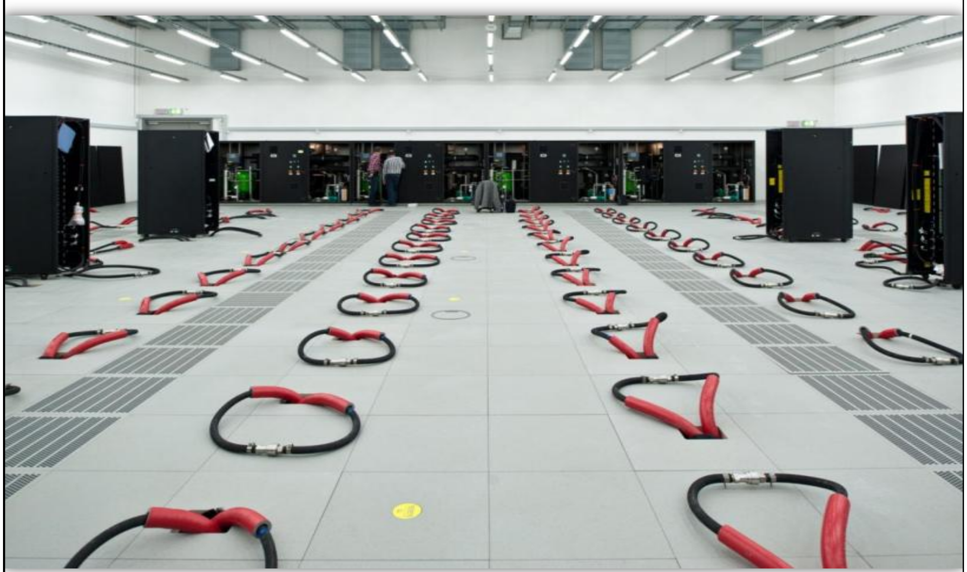
Increasing numbers

Date	System	Flop/s	Cores
2000	HLRB-I	2 Tflop/s	1512
2006	HLRB-II	62 Tflop/s	9728
2012	SuperMUC	3200 Tflop/s	155656
2014	SuperMUC Phase II	3.2 + 3.2 Pflop/s	229960

LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Cooling SuperMUC

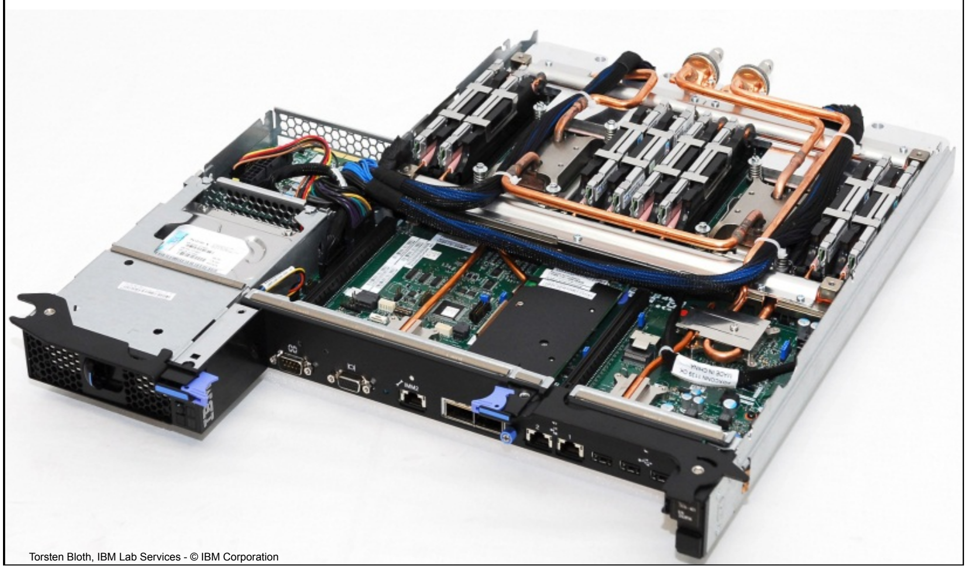
lrz



LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

IBM iDataplex dx360 M4

lrz



Torsten Bloth, IBM Lab Services - © IBM Corporation

Challenges and Opportunities

- Key challenges
  - Understanding e-Infrastructures: scale, complexity
  - Shaping future e-Infrastructures:
    - Expectations from users (interfaces, integration,…)
    - Characteristics from applications
  - Limitations:
    - Budgetary constraints (capital and operational)
    - Capability constraints (hardware features)
    - Scalability constraints (cores, memory, bandwidth)
  - Metrics and incentives need to be adjusted (open data?)
    - Patent vs. well-curated open data?
- Opportunities
  - DRIHM shows: We can do more and better
  - Others to follow: more visible and understandable ➔ more impact

Results from 1st Extreme Scaling WS (Sustained TFlop/s on 128000 cores)

Name	MPI	# cores	Description	TFlop/s/island	TFlop/s max
Linpack	IBM	128000	TOP500	161	2560
Vertex	IBM	128000	Plasma Physics	15	245
GROMACS	IBM, Intel	64000	Molecular Modelling	40	110
Seissol	IBM	64000	Geophysics	31	95
waLBerla	IBM	128000	Lattice Boltzmann	5.6	90
LAMMPS	IBM	128000	Molecular Modelling	5.6	90
APES	IBM	64000	CFD	6	47
BQCD	Intel	128000	Quantum Physics	10	27

Partnership Initiative Computational Sciences πCS

- **Individualized services** for selected scientific groups – flagship role
  - Dedicated point-of-contact
  - Individual support and guidance and targeted training &education
  - Planning dependability for use case specific optimized IT infrastructures
  - Early access to latest IT infrastructure (hard- and software) developments and specification of future requirements
  - Access to IT competence network and expertise at Computer Science and Mathematics departments
- **Partner contribution**
  - Embedding IT experts in user groups
  - Joint research projects (including funding)
  - Scientific partnership – joint publications
- **LRZ benefits**
  - Understanding the (current and future) needs and requirements of the respective scientific domain
  - Developing future services for all user groups

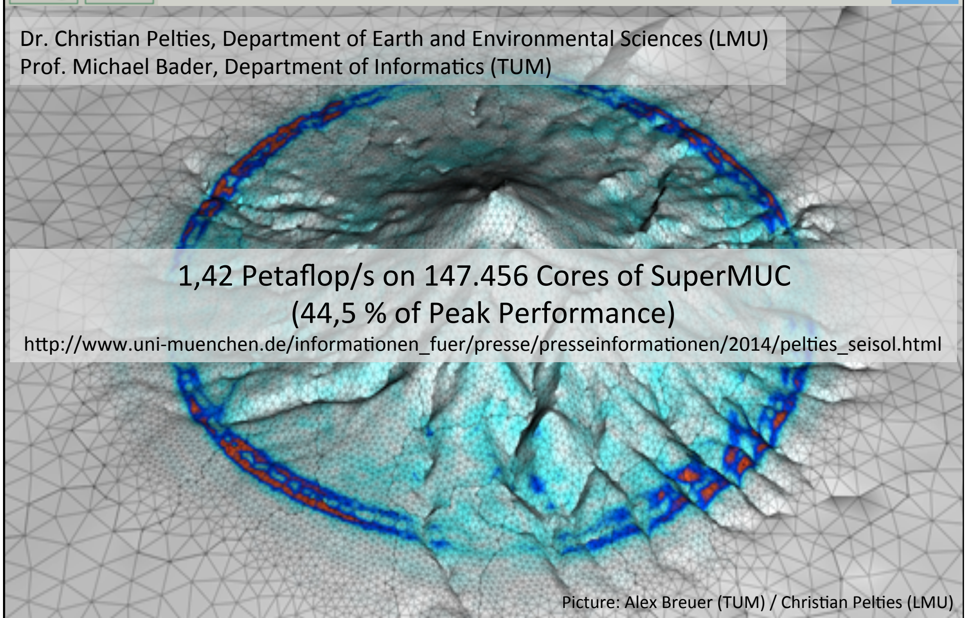
Partnerschaftsinitiative Computational Sciences πCS

Goals for LRZ:

- Thematic focusing – **Environmental Computing**
- Strengthening science through innovative, high performance IT technologies and modern IT infrastructures and IT services
- Interdisciplinary integration (technical and personnel) of scientists and (international) research groups
- Novel requirements and research results at the interface of scientific computing and computer-based sciences
- Increased prospects for attracting research funding through established IT expertise as contribution to application projects
- Outreach and exploitation

SeisSol - Numerical Simulation of Seismic Wave Phenomena

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

Picture: Alex Breuer (TUM) / Christian Pelties (LMU)

D. Kranzlmüller   Trends and Consequences   17

DRIHM and e-Science Support

Dieter Kranzlmüller
kranzlmueller@lrz.de