LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

MNM TEAM
MUNICH NETWORK MANAGEMENT TEAM

An ICT architecture for environmental computing applications

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Environmental computing – working definition

Common characteristics

- Involves advanced modelling of environmental phenomena
  - Multi-model, multi-scale
  - New phenomena, new approaches
  - Inter- or transdisciplinary nature
- Aiming at producing ***actionable knowledge***
  - Problem oriented: hazard analysis, risk management and reduction, operational disaster response
- With robust management and sustainability approaches
  - Ambition towards infrastructure-like services
  - Availability and reproducibility of results – beyond lifetimes or projects and research careers

Demand for environmental computing

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.

GAR – Global Assessment Report on Disaster Risk Reduction 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

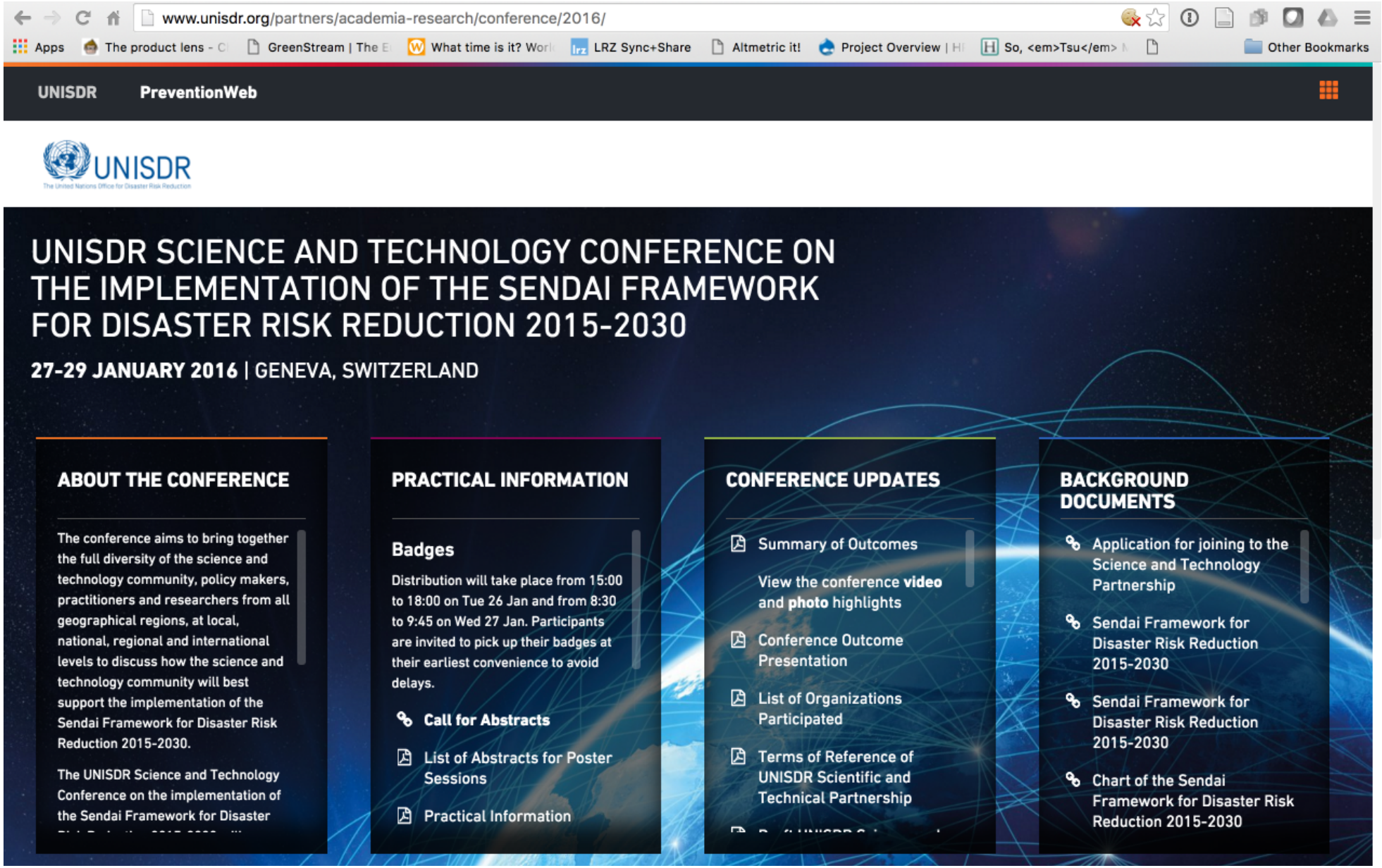
Foreword | At a glance | Preface | Introduction | Part I | Part II | Part III | Backmatter

Most disasters that could happen have not happened yet.

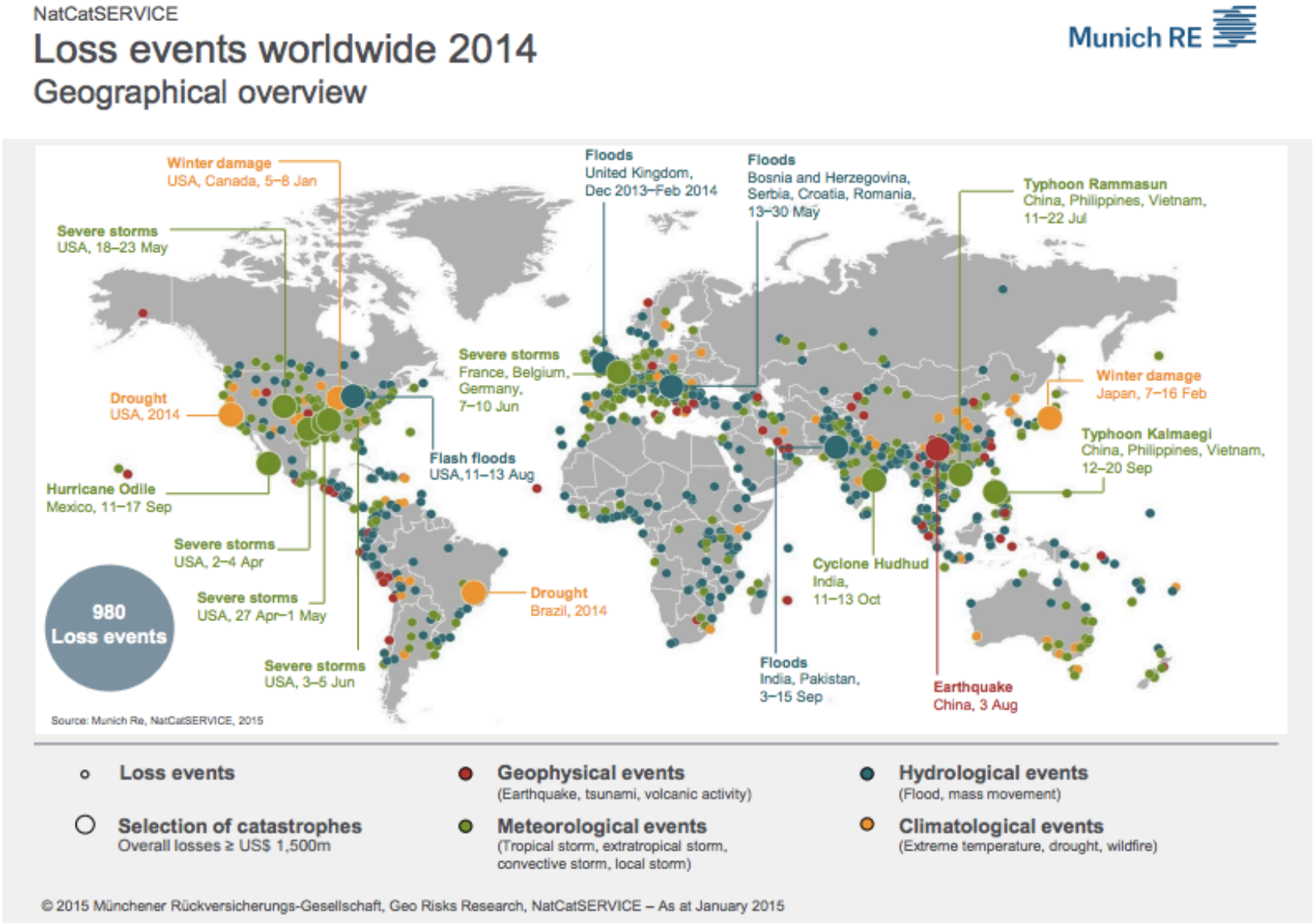
Economic losses from disasters such as earthquakes, tsunamis, cyclones and flooding are now reaching an average of US$250 billion to US$300 billion each year. **Future losses** (expected annual losses) are now estimated at US$314 billion in the built environment alone. **This is the amount that countries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

Demand for environmental computing

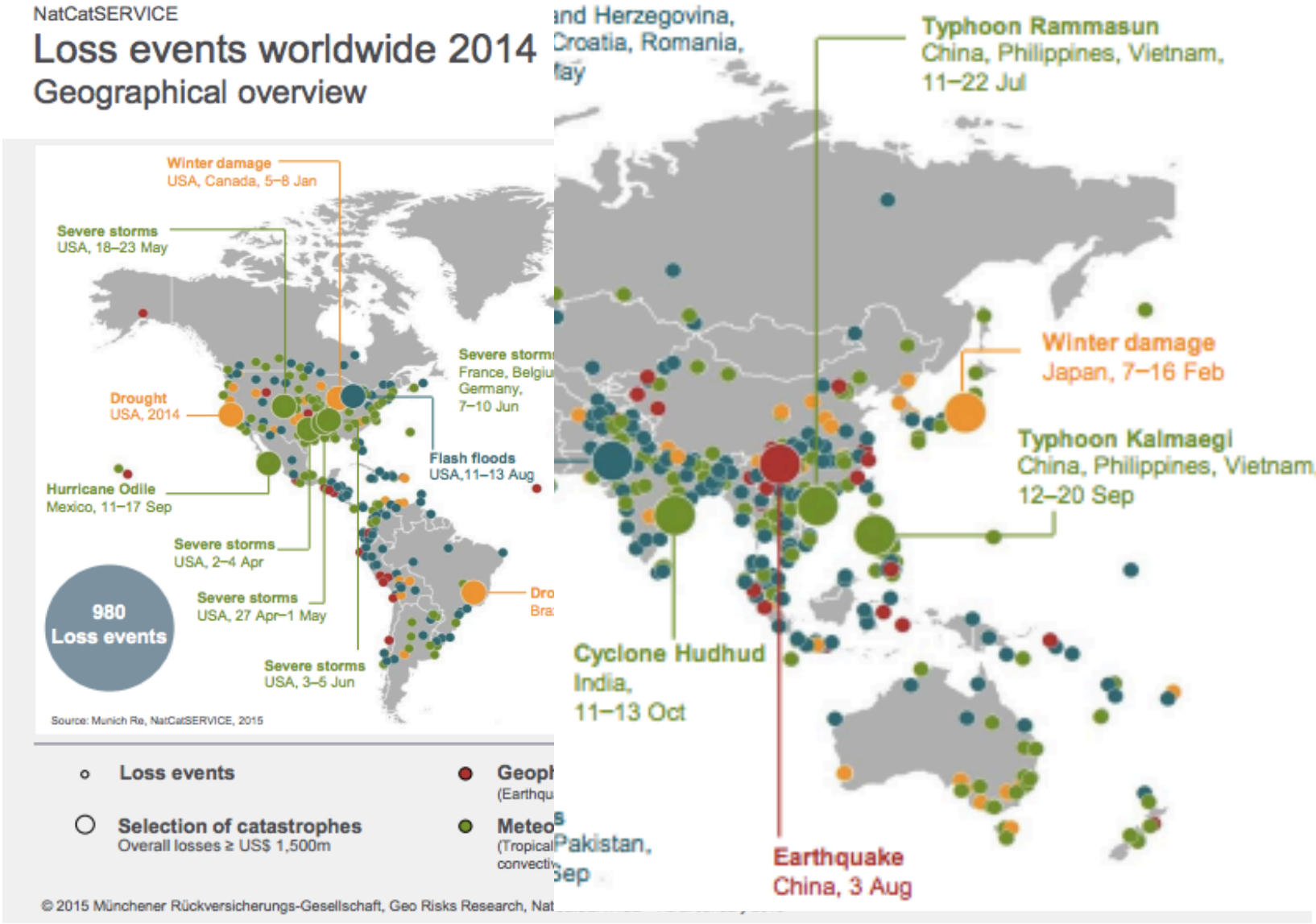


Munich Re – Loss Events Worldwide 2014



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

Munich Re – Loss Events Worldwide 2014



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

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 warning might make society more vulnerable)

Communicating the Results

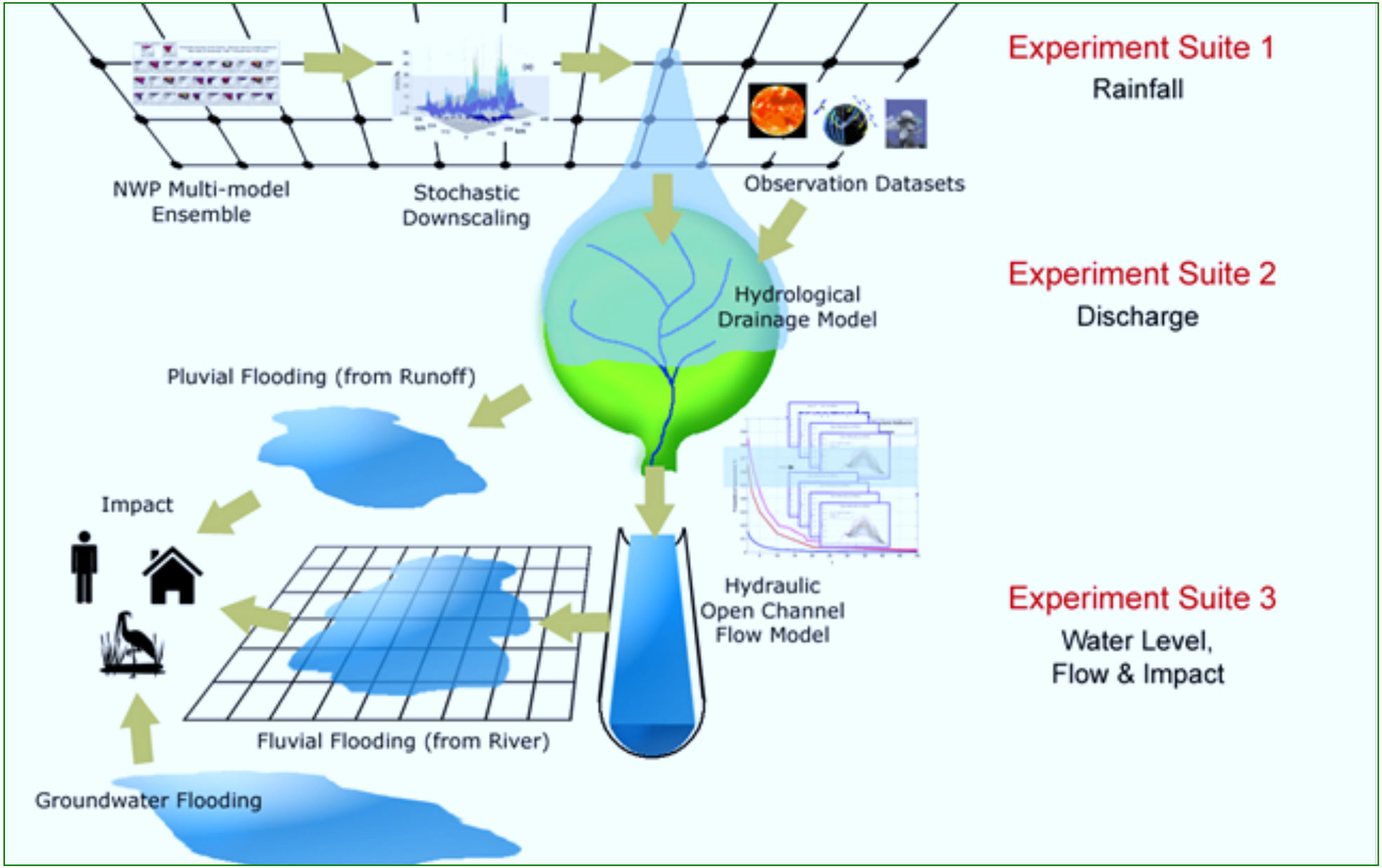
How can non-scientists use the information?

- 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)

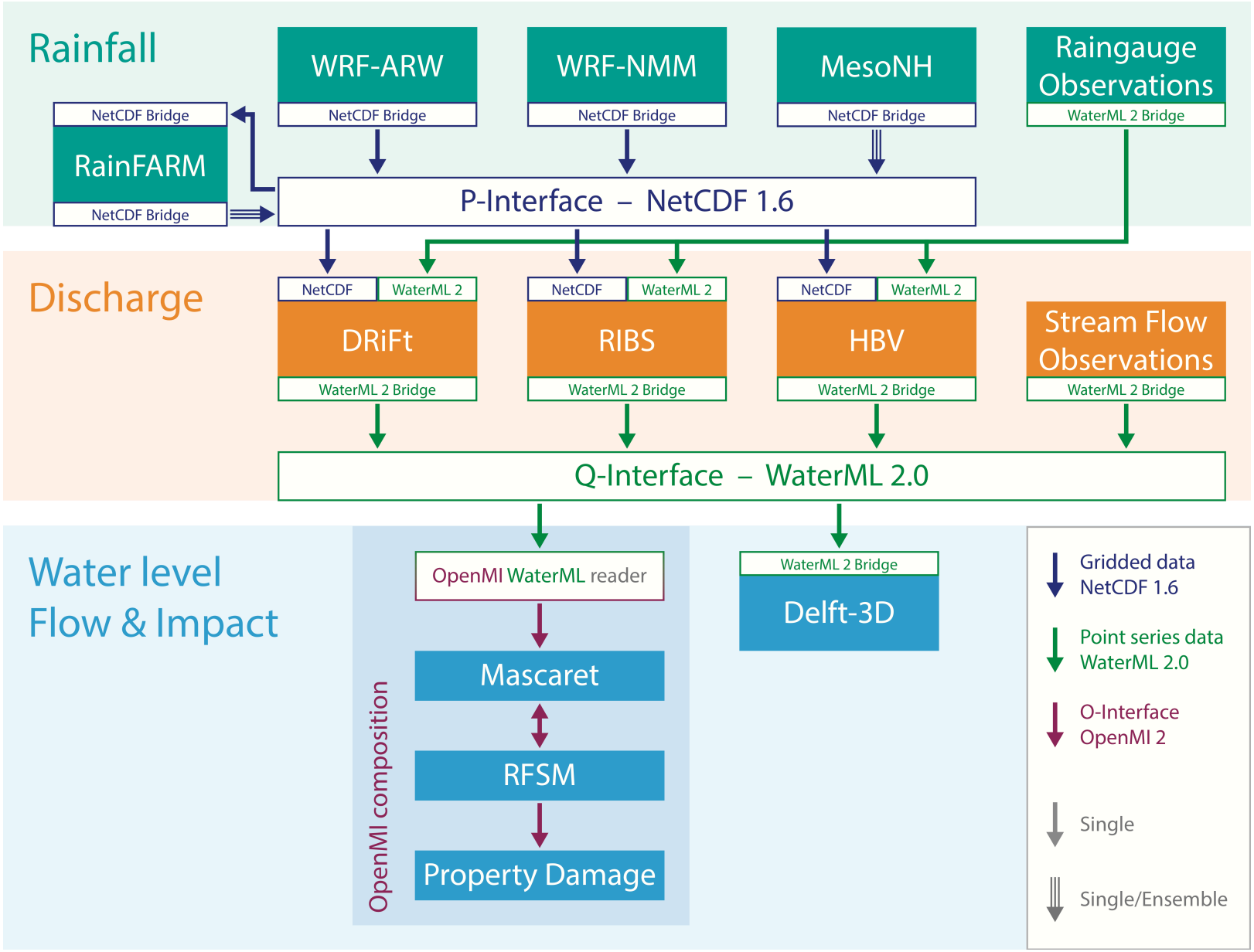
How to address the technology-related challenges?

- Case: HMR model chains

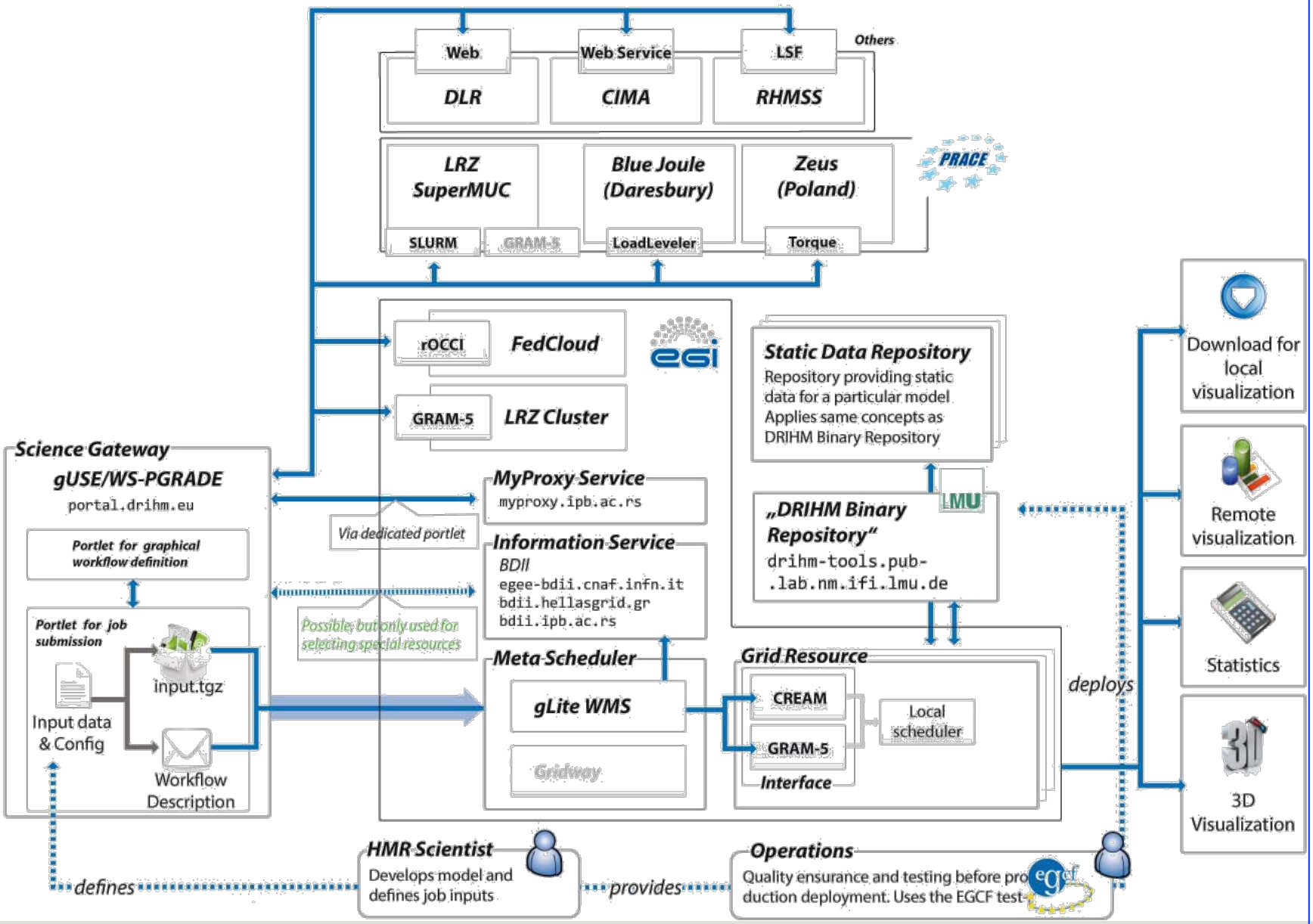
HMR model chain - conceptual



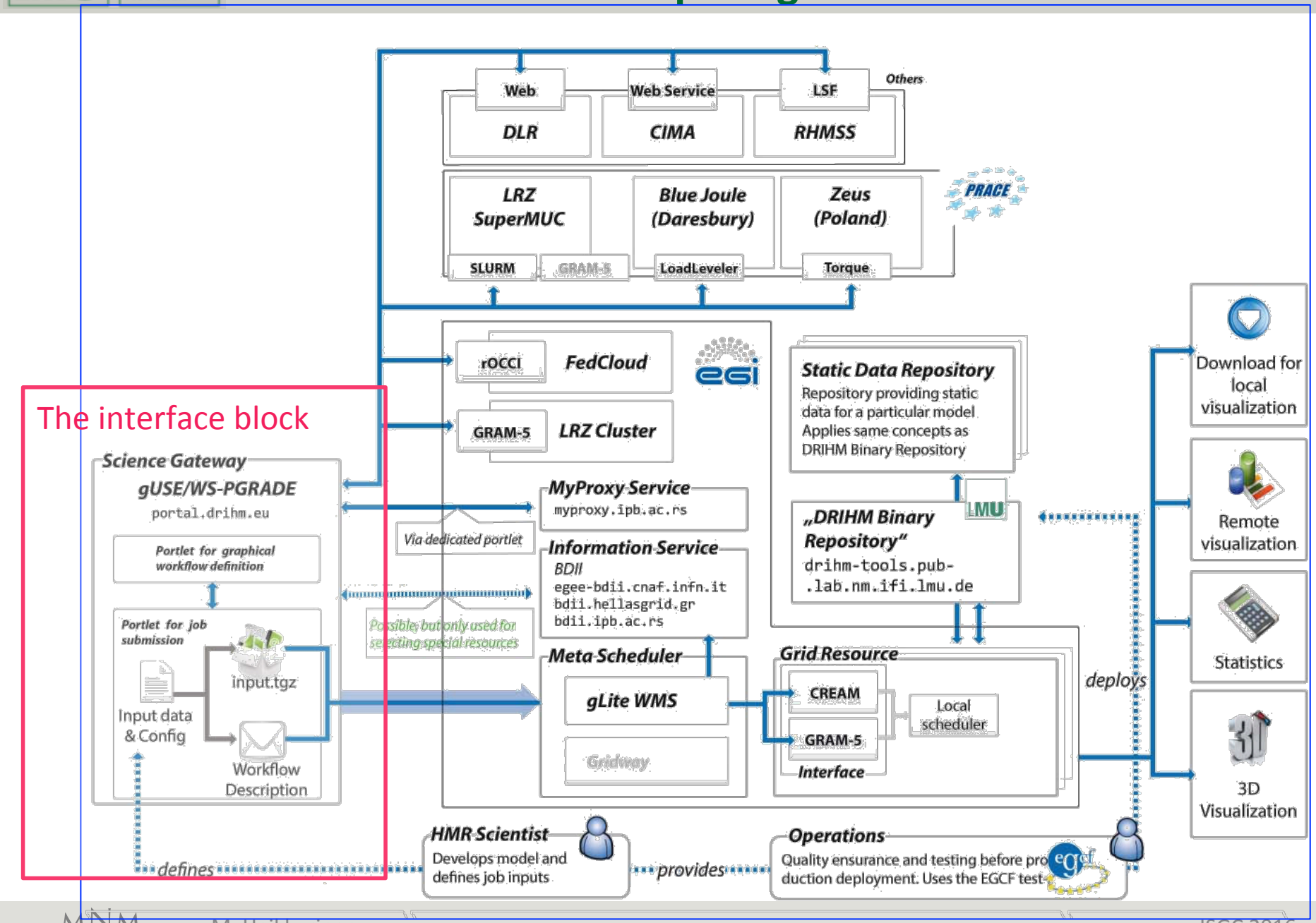
Initial DRIHM HMR model chain components



eScience infrastructure to support HMR models



eScience infrastructure to support environmental computing



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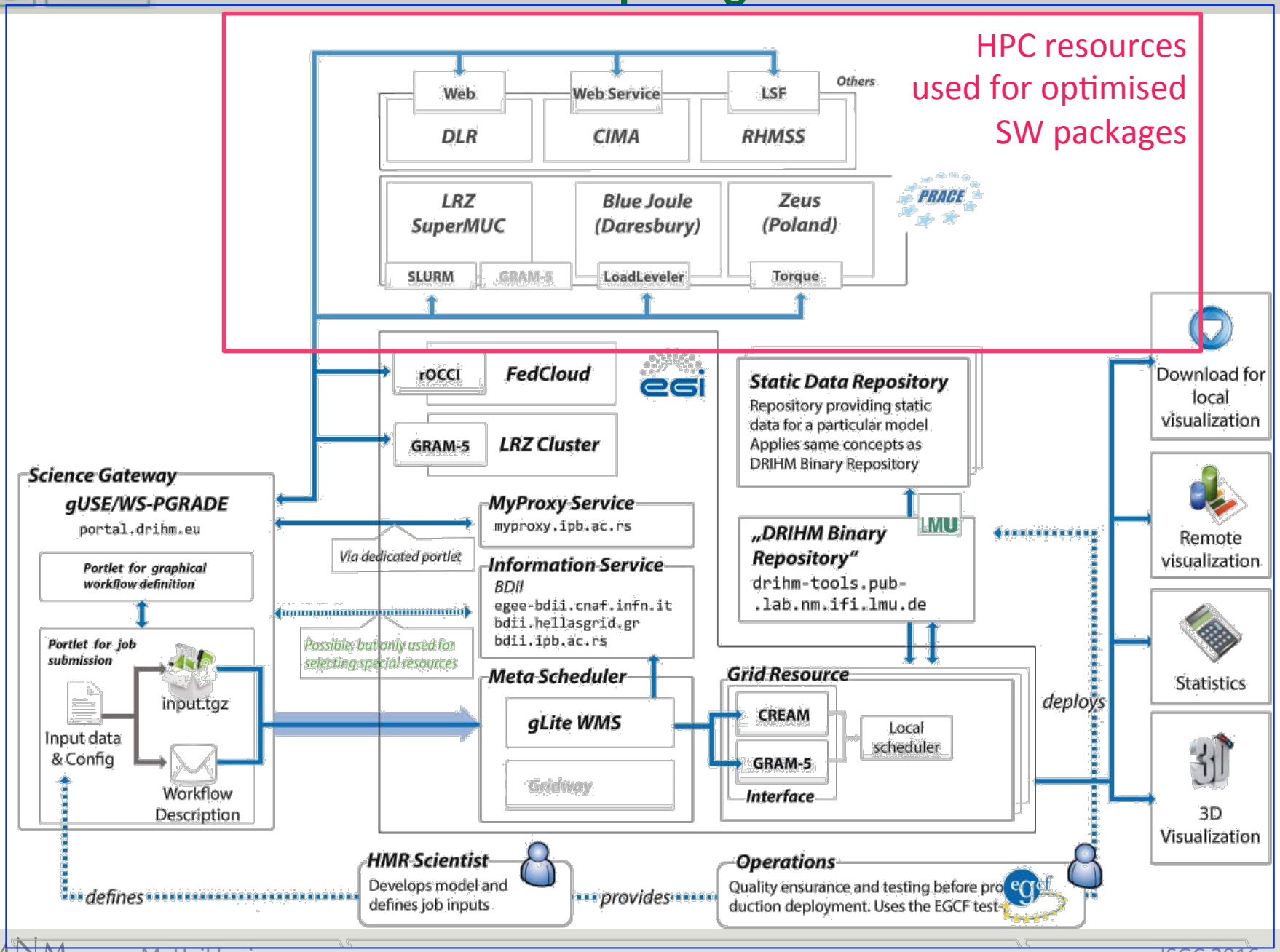

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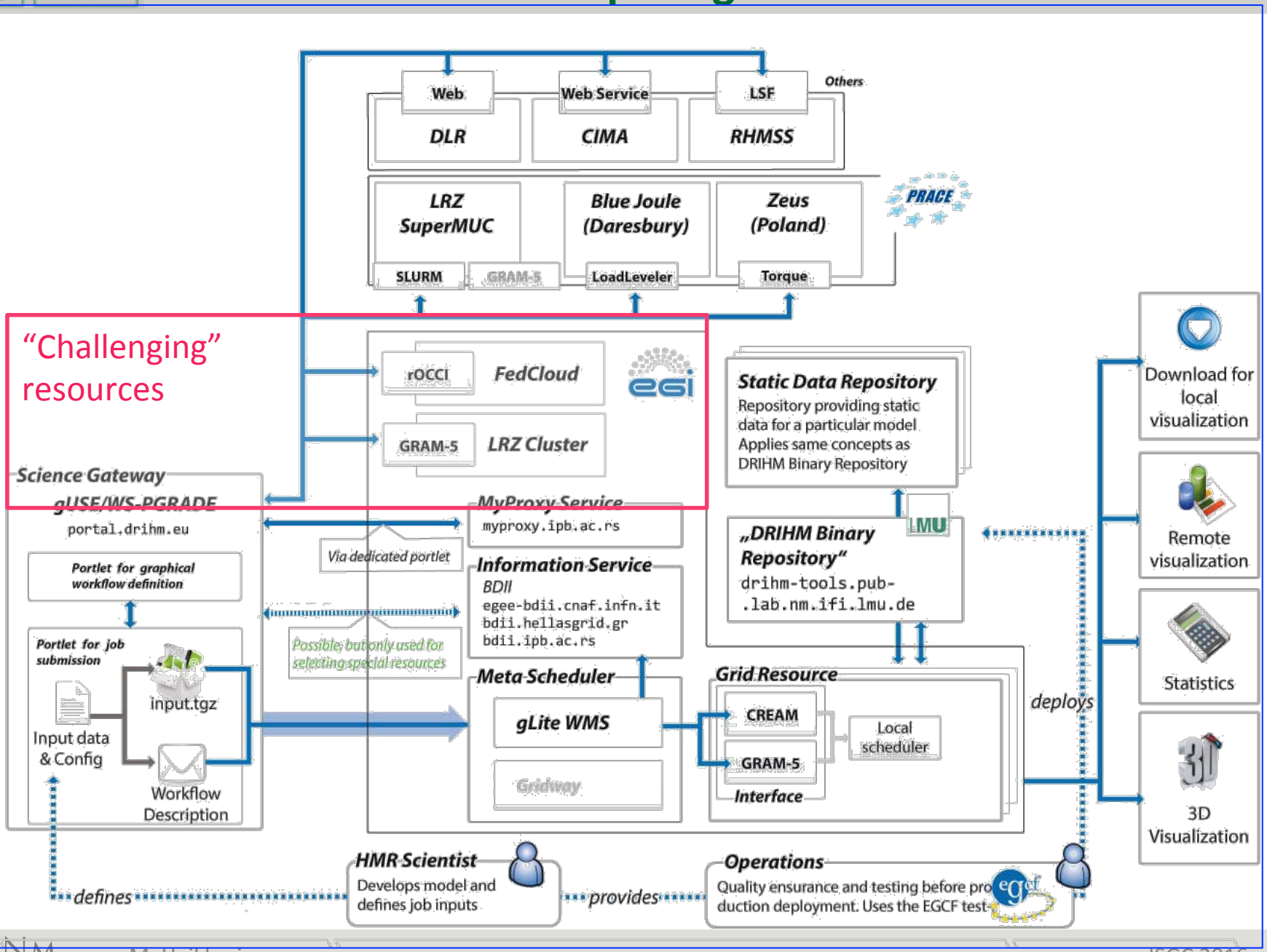

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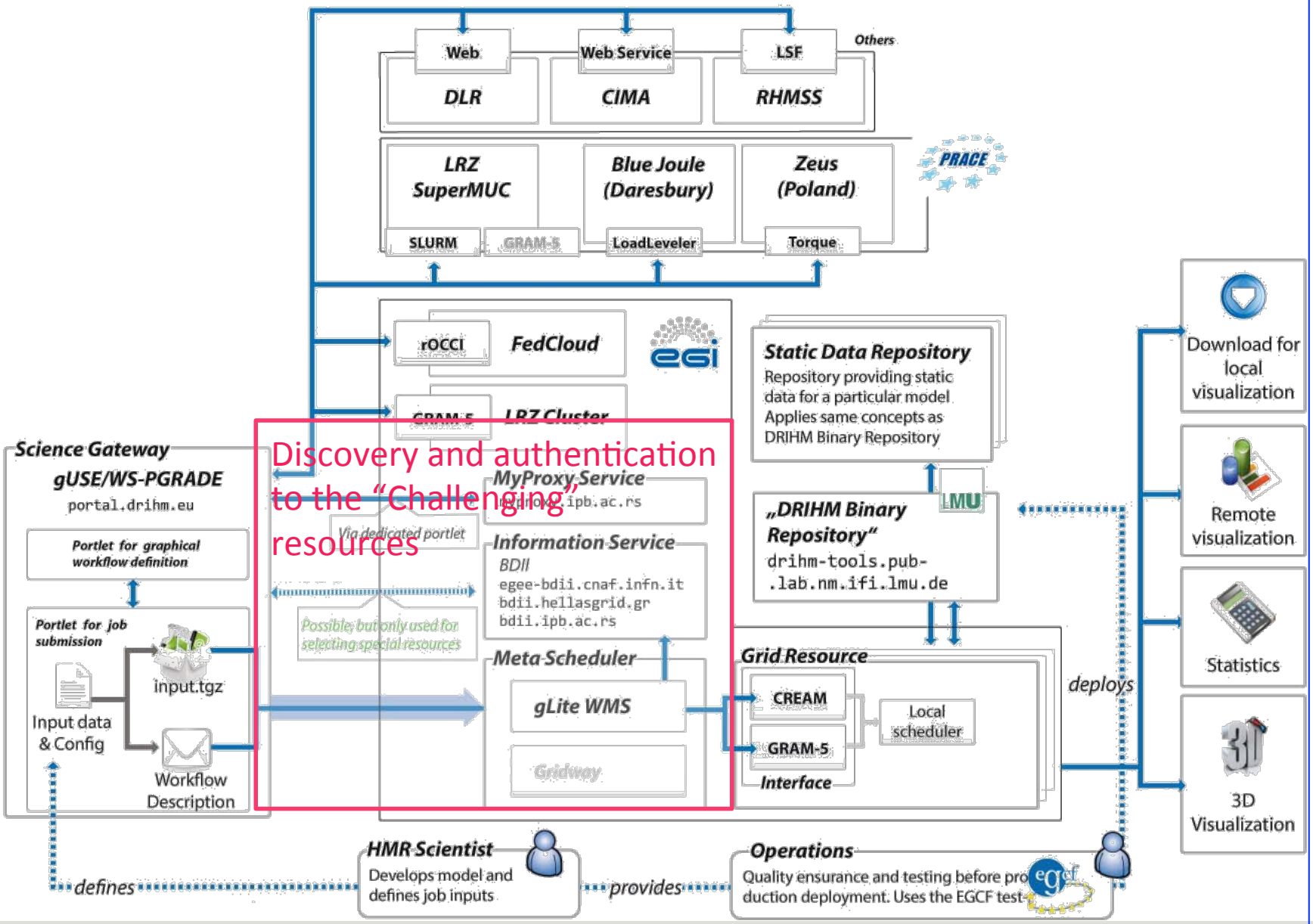

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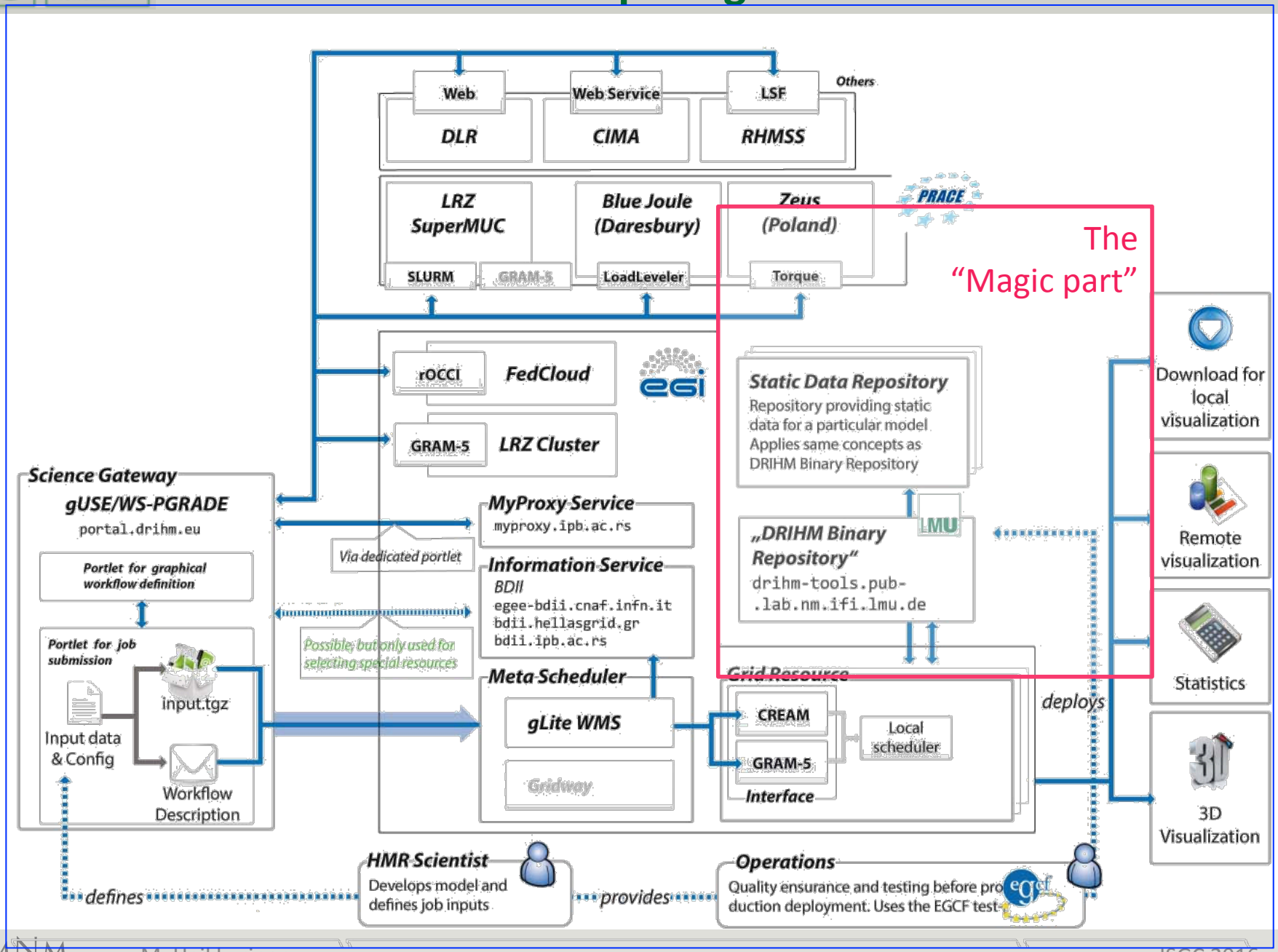
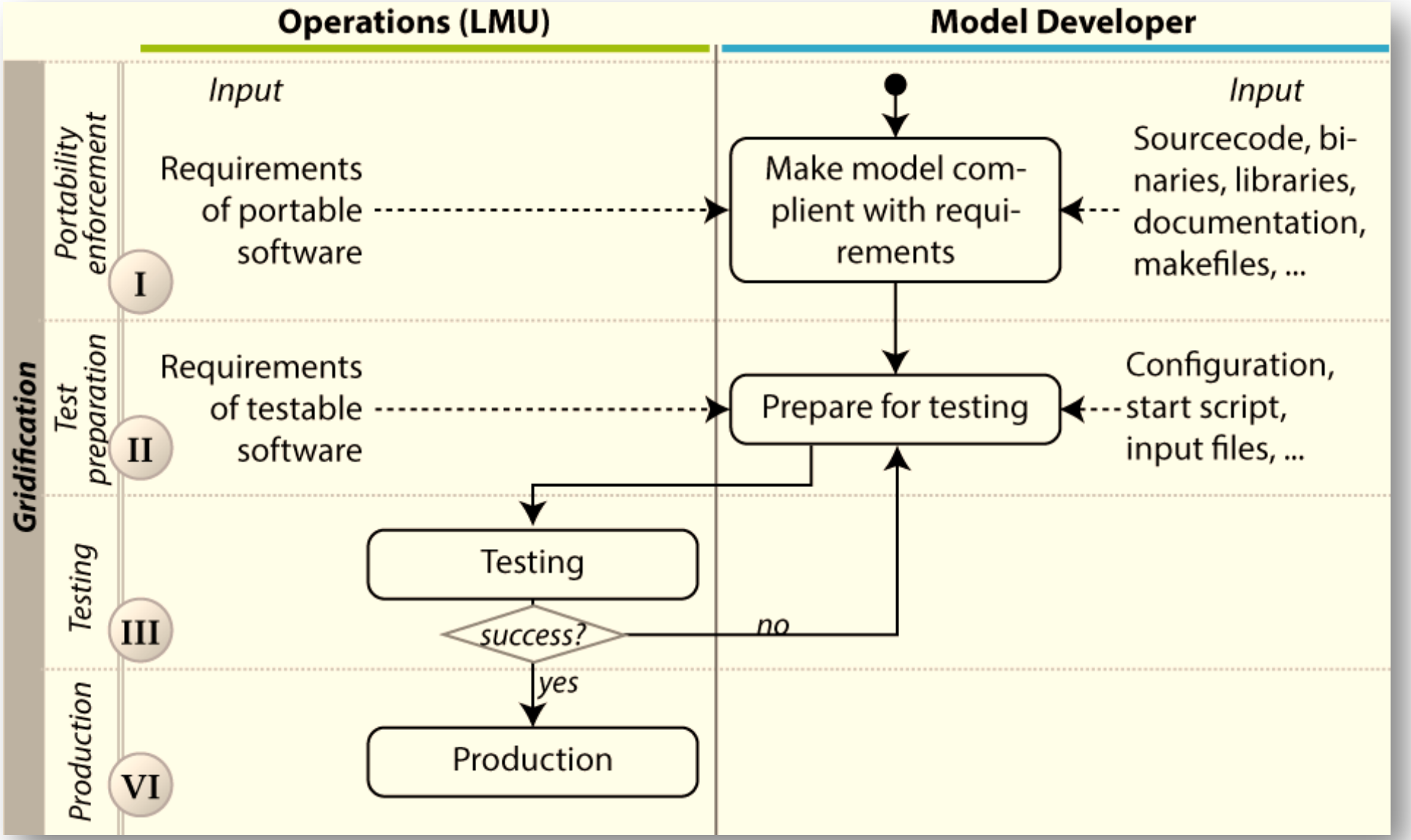


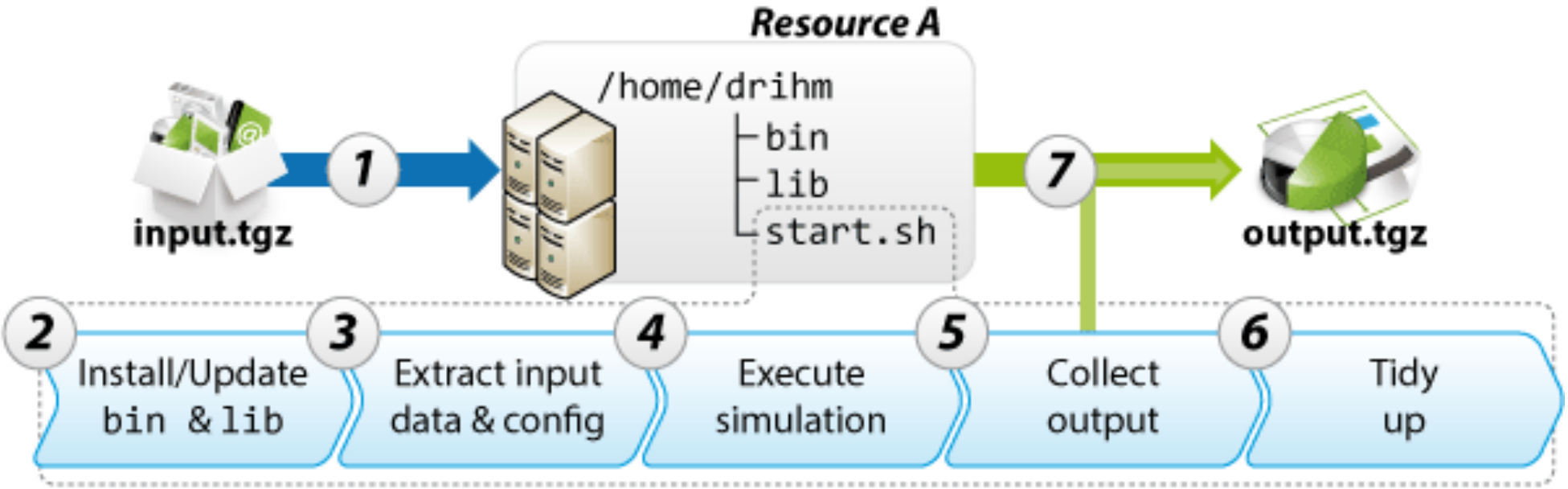
Making "The Magic"



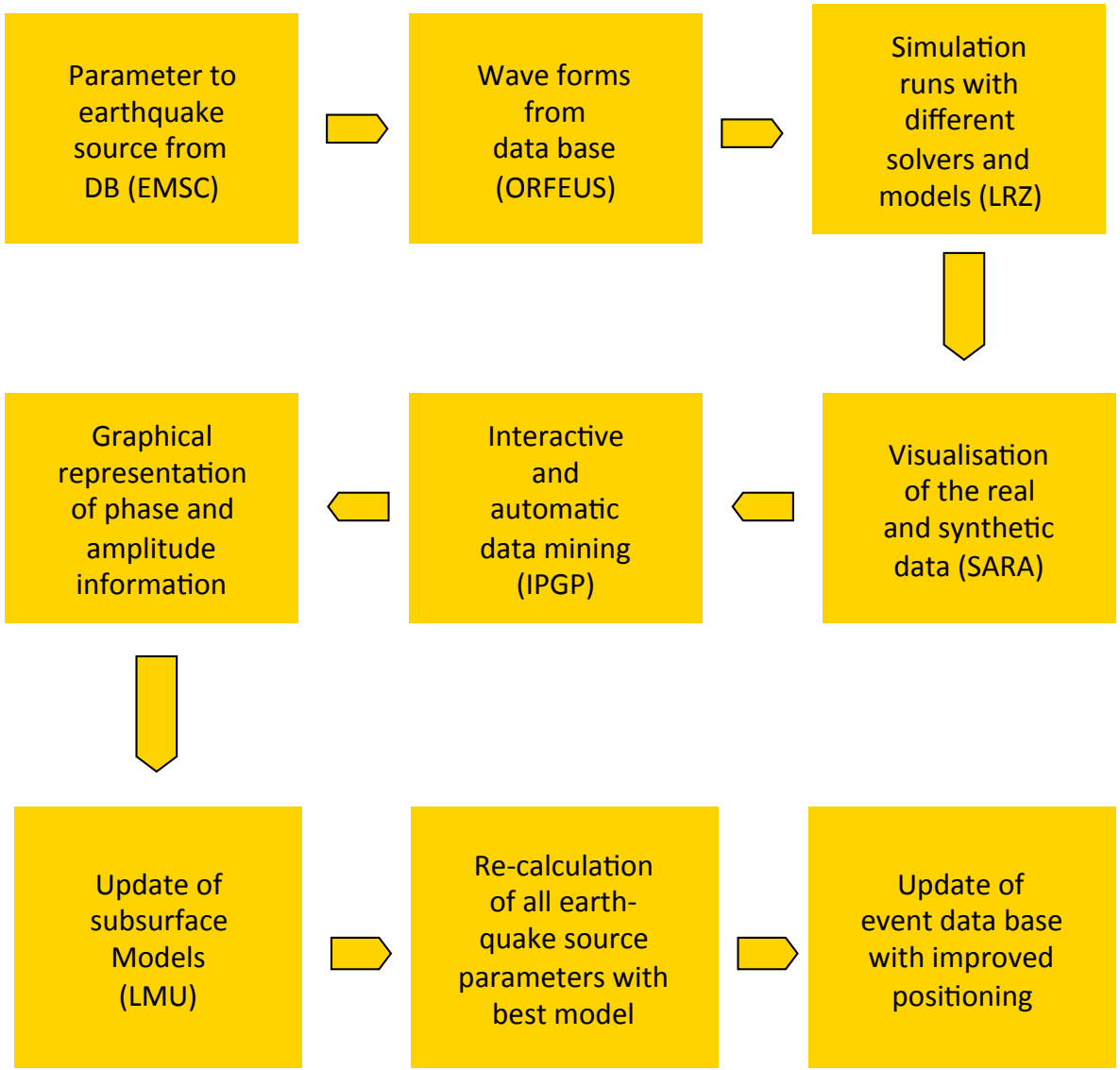
Model metadata snippet

Basic Metadata
Citation **Title:** RIBS Bisagno **Creation Date:** 2011-05-04
Abstract: RIBS version 2.5. The Real-time Interactive Basin Simulator (RIBS) model is a distributed hydrological rainfall–runoff model that simulates the basin response to an event of spatially-distributed rainfall. This model was designed for real-time application in medium-size basins. The model follows the structure of the grid of a digital terrain model in a matrix form. The data are stored in layers of raster-type information, which are combined to obtain the model parameters. This instance covers part of the Bisagno catchment to study the Genoa flash flood of Nov 2011.
Point of Contact **Custodian Organisation Name:** Technical University of Madrid **Custodian Online Resource:** www.upm.es **Responsible Individual** **Name:** Luis Garrote **Organisation:** Technical University of Madrid **Position:** Full Professor **Address and Email:** l.garrote@upm.es
Descriptive Keywords: Rainfall, Runoff, Model
Topic Category Code: Geoscientific Information
Date Stamp: 2011-12-02T12:11:08
urn:ogc:def:crs:EPSG::4326
Extent: 8.88,44.37; 8.88,44.50; 9.09,44.50; 9.09,44.37
Technical Metadata
Programming Language: C++
Supported Platforms: Linux

Running the model



Workflow from other domain – similar use case



Prof. Igel, LMU

Could you just use Cloud or containers?

- Yes, but you'd still need to:
  - Port applications (in most cases) or bridge between different clouds
  - Bridge between different Cloud systems
  - Have functions similar to static data & binary repositories
  - Accept some performance penalty
  - Find mechanisms to maintain libraries in the VMs (versioning)
  - And most importantly: collect the model metadata(!)
- Will all the resources have a Cloud or container interface
  - We are starting to lean towards "eventually yes", but are we certain?
- Conceptual framework and many of the components should be reusable
  - "Export to VMs" functionality for the binary/static data repository?

Conclusions

- It is possible to take software components not originally intended for distributed environments turn them into DCI services
- The model metadata approach, execution environment ("start.sh process") and supporting processes protect against errors that could otherwise be hard to detect
  - E.g. slightly different behaviour of pre-installed libraries
  - Crucial in a system that contains model chains that are potentially executed automatically
- The process of building and testing the "user space" execution scripts:
  - structured the collaboration
  - recorded tacit information about the model and its behaviour
    - E.g. the environmental dependencies included in the metadata

Conclusions 2

- The model could easily be extended
  - To other scientific disciplines
  - To use container-based resources or arbitrary cloud services
- The dedicated effort is mostly related to (technical) model descriptions
  - The approach leverages development efforts in both DCI and broader Un*x community
  - The model description overhead should be seen largely as an investment in the model developer/operations relationship
- The portability of the model was tested during the DRIHM2US project
  - Adding XSEDE resources didn't require any changes in the SW(!)

For more information

- Environmental computing
  - www.envcomp.eu
  - info@envcomp.eu
- DRIHM framework
  - Nils gentschen Felde (felde@nm.ifi.lmu.de)
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    www.mnm-team.org