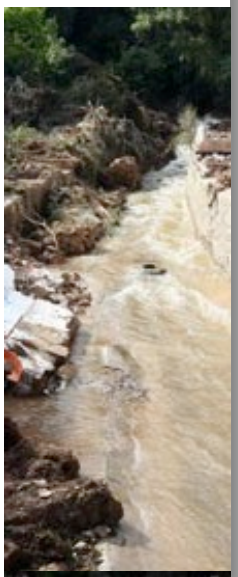


DRIHM

DISTRIBUTED RESEARCH INFRASTRUCTURE
FOR HYDRO-METEOROLOGY

The DRIHM Portal

Daniele D'Agostino

e-infrastructure

DRIHM is co-funded by the EC
under the 7th Framework Programme

Outlook

- Introduction
- Before DRIHM…
- … and with the DRIHM portal
- The DRIHM portal architecture
- Conclusions

Introduction

An HM experiment is implemented as a workflow of heterogeneous HM models that have to be *installed*, *configured* and *executed* somewhere.

How DRIHM can help Mark?

FOCUS ON

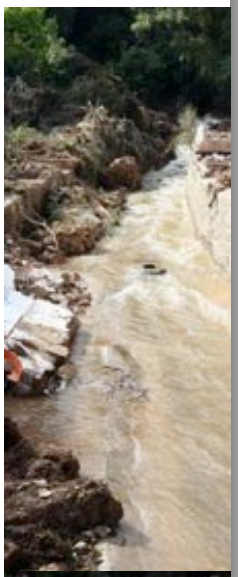
Mark is an Hydro-Meteo Researcher.
He has just designed a modification to his meteo model, but he would like to validate the new model.
There are two tasks required to validate a model:

- compare the prediction computed by the model with measured data
- cross-check the prediction computed by the model, with those computed by other models.

Let's focus on the second task: compare at least two meteo models on the same events, and cross-check the results. Mark already has its new model, but has to fetch, install and use some alternatives.

Required steps are summarized in the following list:

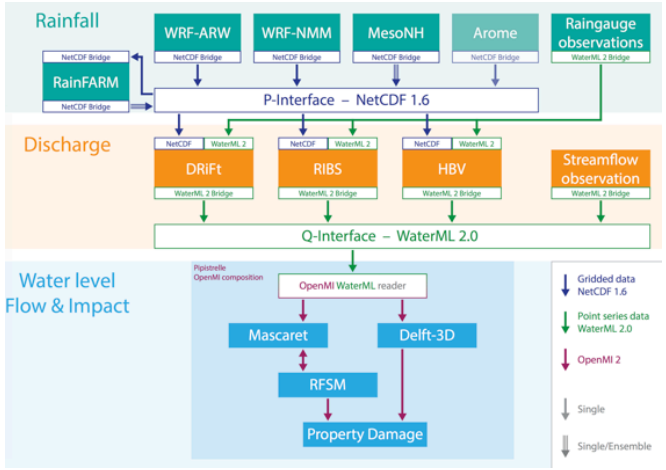
1. Install, compile and optimize the HMR simulation models, possibly developing data converters, connector to further models and visualization tools (hours to days)
2. Find and retrieve input data from other repositories, via ssh, ftp and other command line tools/scripts, learning the process and all the flags (hours)
3. Select and retrieve large data (like static data)
4. Execute convert and pre-process operations on the data (hours)
5. Set execution parameters
6. Select the executable resources
7. Move all the data and ancillary files
8. Launch the execution
9. Monitoring of possible execution faults and re-submit in case of failure
10. Results retrieval
11. Visualization or further processing

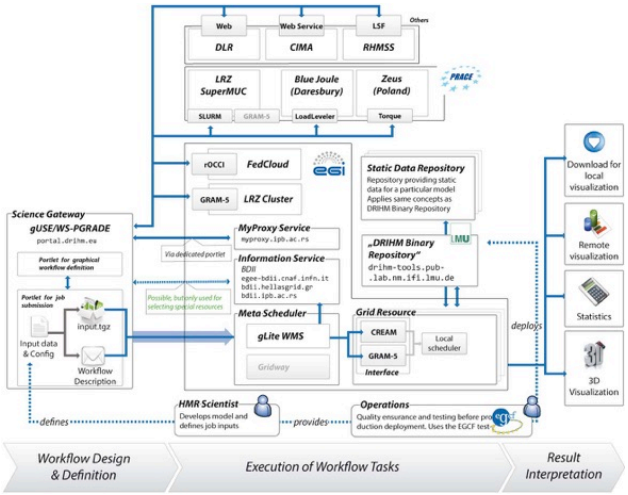


Introduction

- Our analysis identified the need for improvement in executing an HM experiment at the following levels:
  - Model Interfaces
  - User Interfaces
  - Computing Infrastructures
    - Models have different computational requirements
    - Probabilistic forecasts (ensemble)

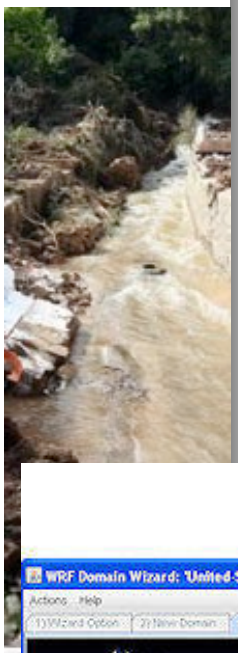
Vertical Integration
for a seamless environment

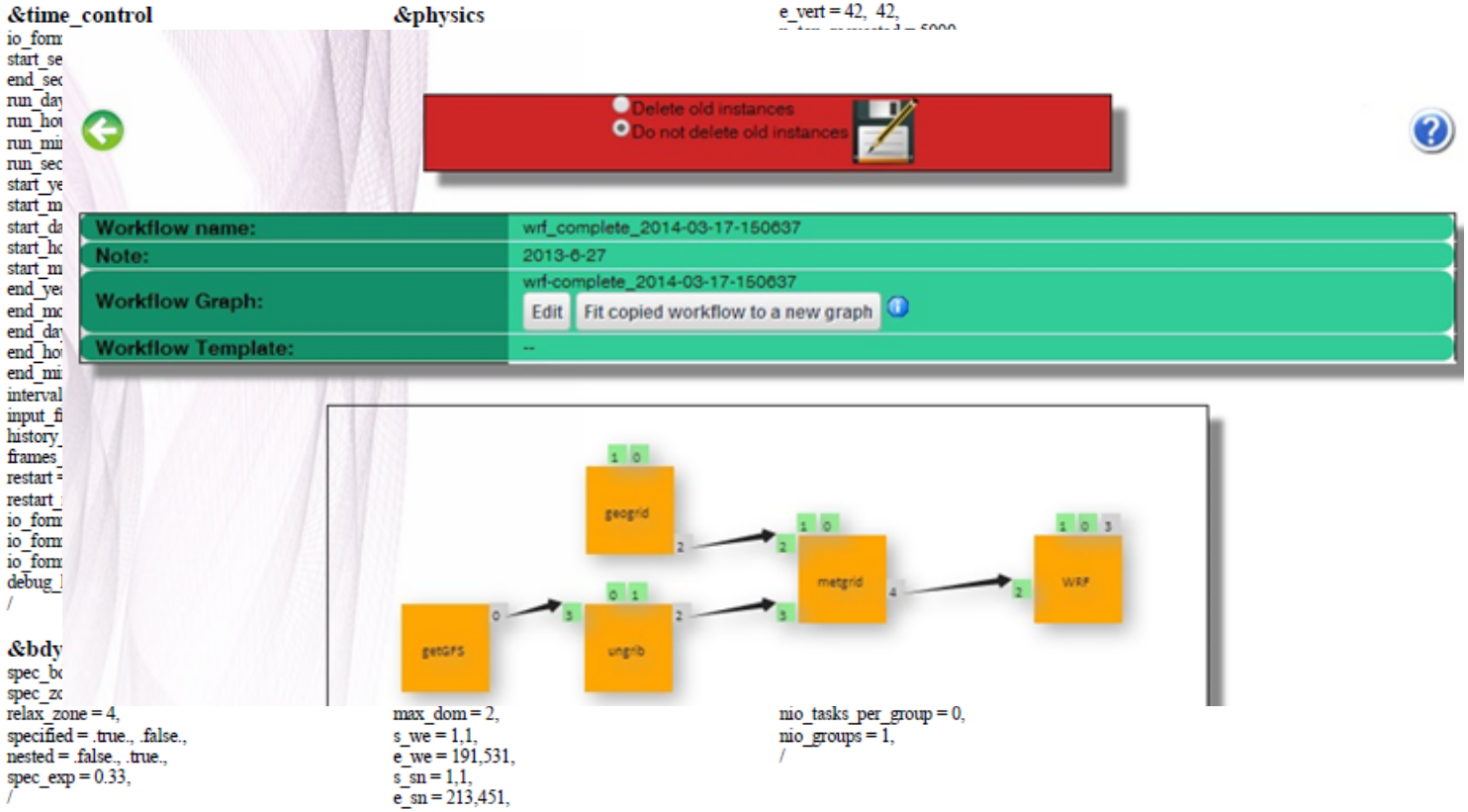




Before DRIHM: User Interfaces

- HM models are usually configured independently and in different ways
- General-purpose workflow management systems provide a minimal support in the definition of experiments

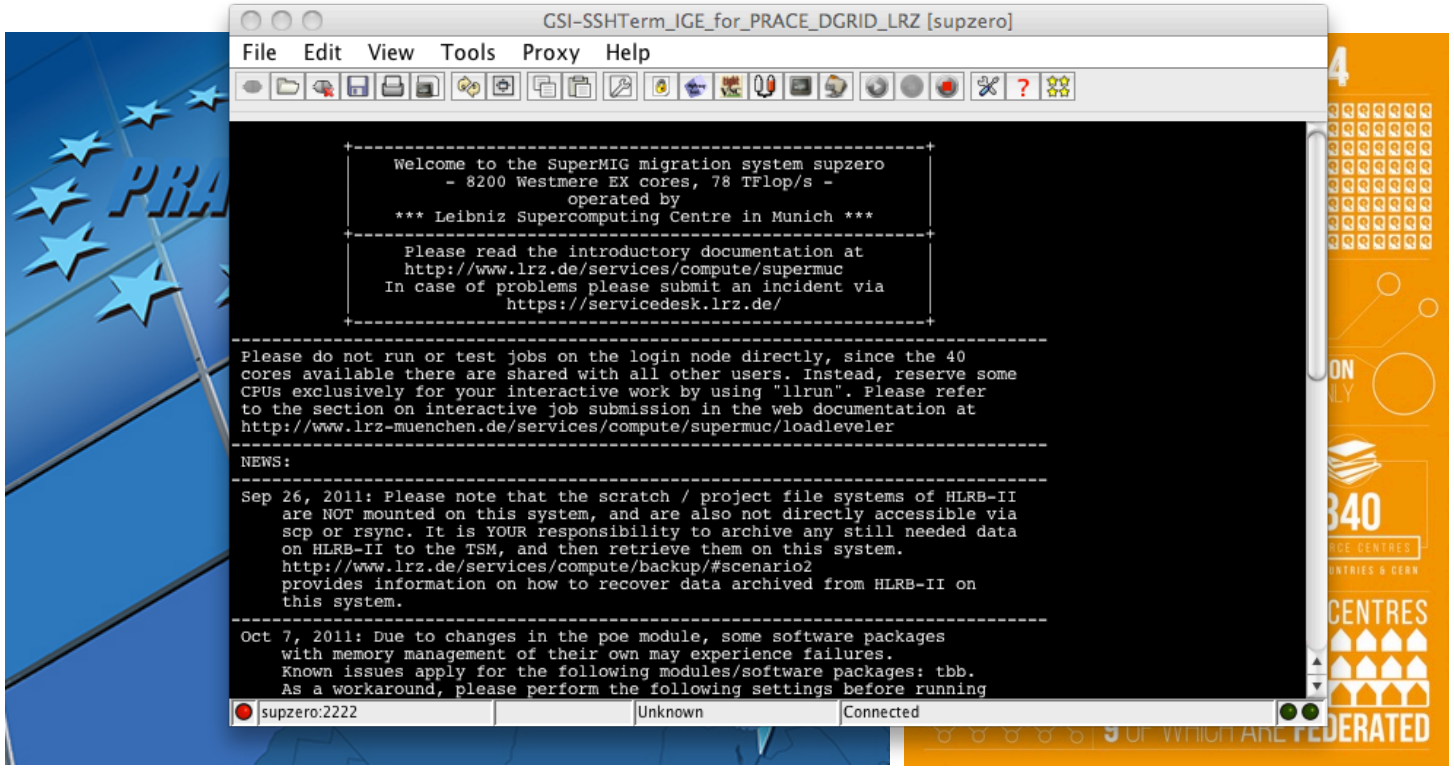




BEFORE DRIHM: DCI

- PRACE + EGI represent the best possible working environment for all European scientists, but they are two independent entities with different access schema
- Cloud Computing
- Dedicated, proprietary resources

A seamless, GUI-based execution environment on this complex DCI is one DRIHM goal



The DRIHM portal: a Science Gateway for HMR

Experiment configuration

Build and run your model chain

Use a predefined critical case

- ○ Yes
- ◉ No

Choose a critical case

Description
No description

Meteorological Models

- ◉ Include Meteorological Model
- ○ No Meteorological Models

Choose meteorological model

LRZ Cluster

- ○ Use Single Output
- ◉ Create Ensemble Output

Rainfarm

Hydrological Models

- ◉ Include Hydrological Model
- ○ No Hydrological Models

RIBS

Hydraulic Models

- ○ Include Hydraulic Model
- ◉ No Hydraulic Models

Choose hydraulic model

☐ Upload namelist

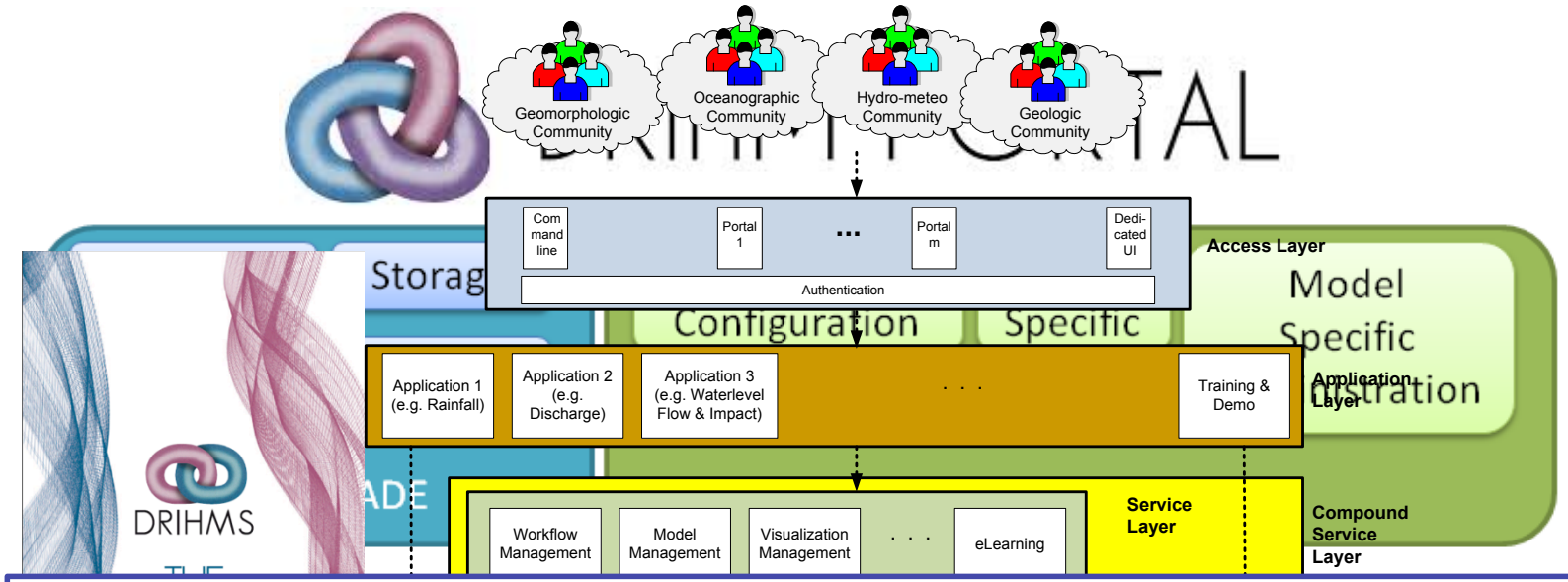
Configure

With the DRIHM portal

DRIHM portal represents the DRIHM HM Science Gateway and it is more than a simple Web interface:

- experiment definition is easier (i.e. domain selection)
- less prone to errors
- users may benefit from expert know-how (i.e. select microphysics combinations)
- for complex, desktop-only GUIs, user can upload experiment configured off-line
- hides low-level DDCI complexities
- manages job submission, result retrieval / visualization, and a repository of the submitted experiments

The Portal Architecture



- Model ***builders*** are able to create model instances
- Model ***users*** are able to run their experiments:
  - Select model(s) with workflow portlet
  - Configure parameters for each model
    - with model portlets
    - uploading pre-configured experiments
  - Execute on DRIHM resources
  - Monitor the execution
  - Retrieve / visualize experiment results and configurations

Workflow Configuration

Use a predefined critical case

- ○ Yes
- ◉ No

Meteorological Models

- ◉ Include Meteorological Model
- ○ No Meteorological Models

- ○ Use Single Output
- ◉ Create Ensemble Output

Hydrological Models

- ◉ Include Hydrological Model
- ○ No Hydrological Models

Hydraulic Models

- ○ Include Hydraulic Model
- ◉ No Hydraulic Models

Build and run your model chain

Choose a critical ca

- ✓ Choose meteorological model
- WRF-ARW
- WRF-NMM
- MesoNH

Choose meteorological

- ✓ Choose ensemble generator
- Rainfarm

Rainfarm

- ✓ Choose hydrological model
- RIBS
- DRIFT
- HBV

RIBS

Choose hydraulic mod

- ✓ Choose hydraulic model
- Mascaret + RFSM
- Delft 3D

Workflow Configuration

Simulated time-range is common to all models in an experiment

Please select the start and the end time for your Workflow

From date: 11/04/2011 and time: 0 00

To date: 11/05/2011 and time: 0 00

Nov 2011

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

DLR imati Deltares

Model Configuration

Current step: WRF-ARW

Previous step: Select Basin

Next step: Rainfarm

Domain | Time Control | Run Option | Physics Option | Diffusion and Dynamics Option | Submit

Current step: WRF-NMM

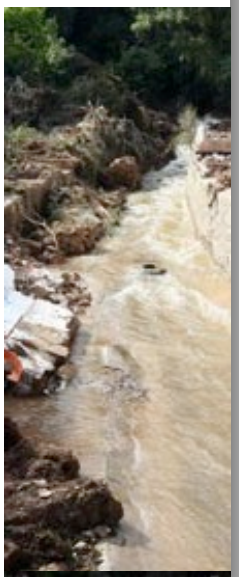
Previous step: Experiment Chain

Next step: Experiment Summary

Domain | Time Control | Run Option | Physics Option | Submit

Microphysics option:	8 - Thompson graupel scheme
Longwave radiation option:	1 - RRTM scheme
Shortwave radiation option:	0 - No shortwave radiation
Surface Layer option:	2 - Monin-Obukhov (Janjic Eta) Similarity scheme
Land Surface Option:	2 - Noah Land-Surface Model
Urban Physics:	No active urban canopy model.
Boundary Layer Option:	2 - Mellor-Yamada-Janjic (Eta) TKE scheme.
Cumulus Option:	2 - Betts-Miller-Janjic scheme
Cumulus options for second domain:	0 - No cumulus
Soil Layers:	4 - Noah

Model Configuration



Current step: Ribs

Previous step: Select Basin

Next step: Experiment Summary

General | Model Specific | Submit

Current step: HBV

Previous step: null

Next step: Experiment Summary

General | Model Specific | Submit

Initial Condition: Select an initial condition...

Current step: Drift

Previous step: Select Basin

Next step: Experiment Summary

General | Model Specific | Submit

Additional Input Data

Use also observed data: ☑

Calibration

dCt Value (0.3 - 0.8): 0.5

dCf Value (0.04 - 0.08): 0.08

dSoilHumidity Value (0.15 - 0.7): 0.2

Time Interval

Time Interval Value (3600.0 - 3600.0): 3600.0

Workflow Configuration

Summary of the workflow appears before submission

- Model configuration files can be edited

Summary: 16903

UserId

16903

Session Id

4312

Date

2014-09-23

Weather

WRF-ARW

Stochastic Ensamble

Rainfarm

Hydro

Ribs

Meteo File Name

16903-1411468942805

Edit

Stochastic Ensamble File Name

16903-1411468955905

Edit

Hydro File Name

16903-1411468981041

Edit

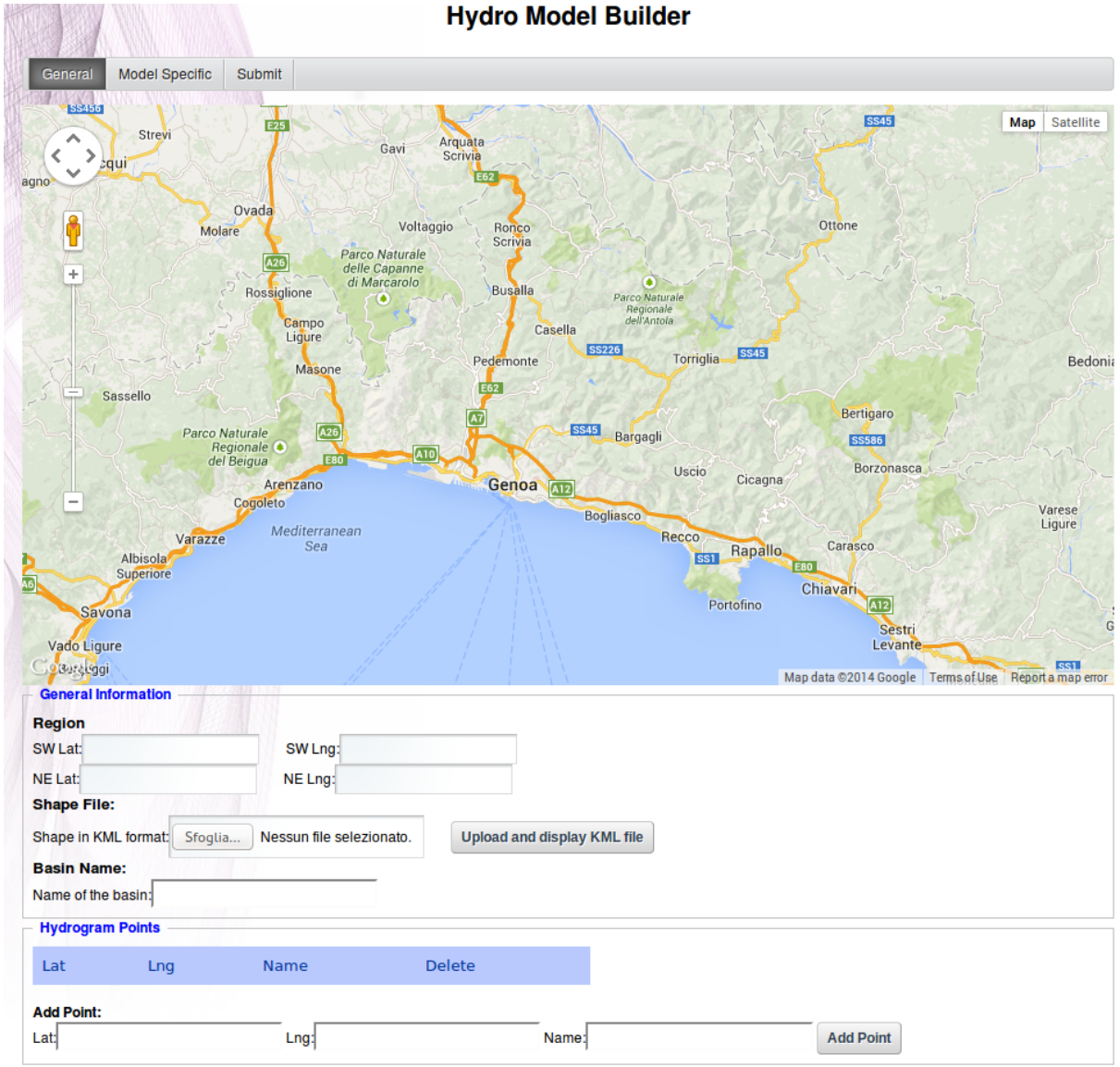
WPS File Name

16903-1411468942943

Edit

Submit

Hydrological Model Builder



Workflow Repository

Showing 23 results.

Items per Page 30 Page 1 of 1 First Previous Next Last

File Id	Description	Type	Modified		
3158	Rainfarm on 5Km WRF-ARW producing 1Km output	rainfarm	2014-09-18 11:29:13.0	Edit	Download
3156	WRF-ARW 5Km	wrf	2014-09-18 11:30:45.0	Edit	Download
3157	WPS file automatically generated for the wrf file 3156	wps	2014-09-18 11:30:54.0	Edit	Download
3141	RIBS from Arome 03	ribs	2014-09-17 21:11:09.0	Edit	Download
3140	RIBS on WRF-NMM - 12 hours	ribs	2014-09-17 20:33:27.0	Edit	Download
3139	RIBS from MesoNH	ribs	2014-09-17 20:30:47.0	Edit	Download
3138	RIBS from WRF-NMM	ribs	2014-09-17 20:29:26.0	Edit	Download
3137					

File:

```
iNEnsemble = 10
iTemporalRatio = 2
iSpatialRatio = 5
dSSl = -9999
dSSt = -9999


sFileNameRef = ''


dGeoXRefMin = 8.92
dGeoYRefMin = 44.388
dGeoXRefMax = 9.125
dGeoYRefMax = 44.489
dGeoXRefStep = 0.0010
dGeoYRefStep = 0.0010



sFileNameSource = {1}
```

Description:

Rainfarm on 5Km WRF-ARW producing 1Km output

Save

Cancel

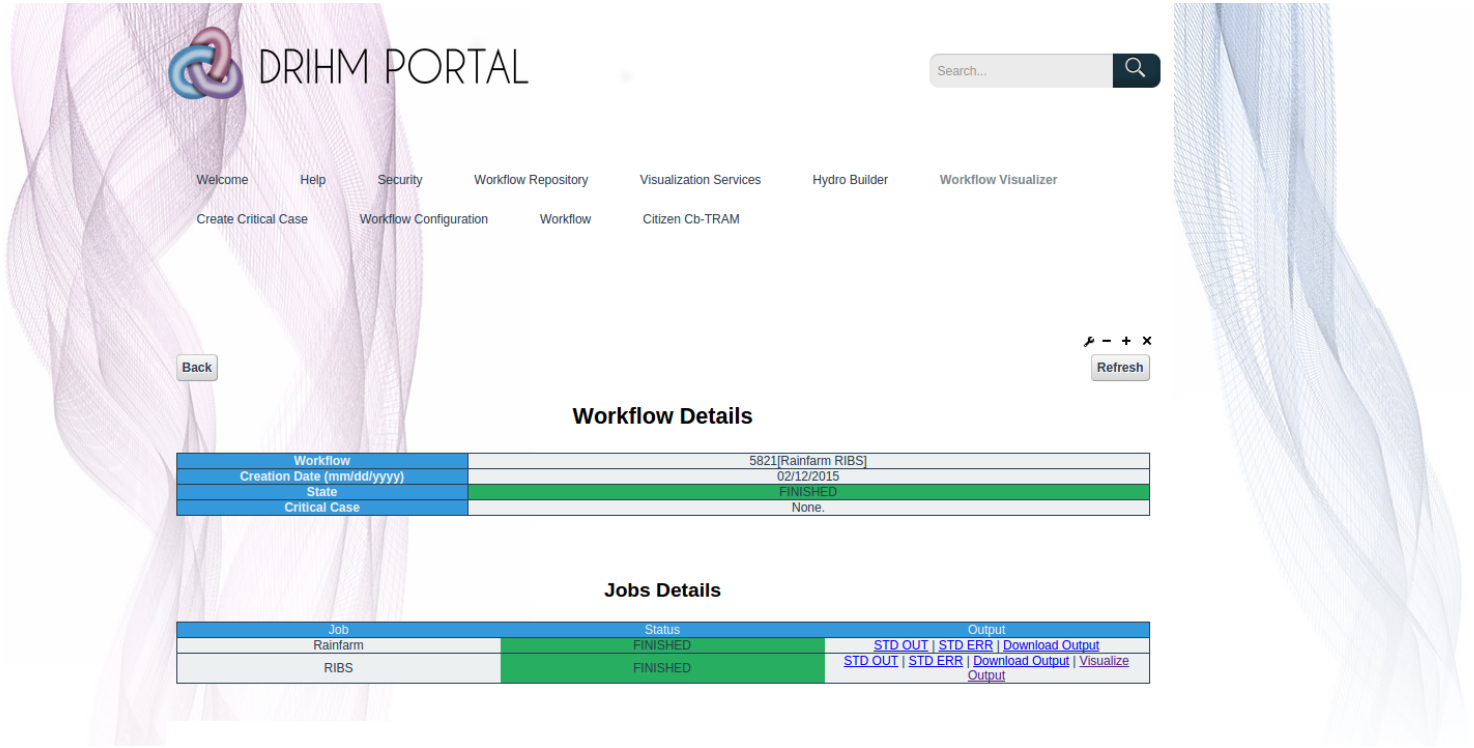
- List all configured experiments
- User can view, download, edit and upload namelists

Workflow Visualizer

Workflow	Creation Date (mm/dd/yyyy)	State	Critical Case	Details
4212[DRIFt]	09/19/2014	FINISHED	None.	Details
4211[Rainfarm RIBS]	09/19/2014	FINISHED	None.	Details
4210[Rainfarm RIBS]	09/19/2014	FINISHED	None.	Details
3444[WRF-ARW Rainfarm DRIFt]	09/18/2014	SUBMITTED	None.	Details
3435[RIBS]	09/17/2014	FINISHED	None.	Details
3434[RIBS]	09/17/2014	FINISHED	None.	Details
3433[RIBS]	09/17/2014	FINISHED	None.	Details
3431[RIBS]	09/17/2014	FINISHED	None.	Details
3430[DRIFt]	09/17/2014	FINISHED	None.	Details

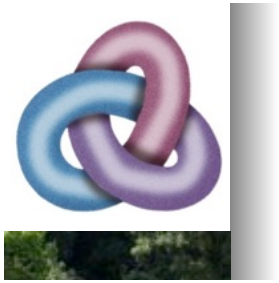
- List of all submitted user experiments
  - Workflow composition
  - Experiment date
  - Jobs status

Workflow Visualizer



- Status of each job composing a chain
- When job is completed (or failed)
  - Possibility to download job output or error messages
  - Possibility to visualize the results

Remote Visualization



Auto-zoom on select Refresh

Overlay opacity: 100%

- My ncWMS server
  - WRF
    - specific_humidity
    - air_temperature
    - northward_wind
    - eastward_wind
    - lwe_thickness_of_stratiform_precipitation_amc
    - lwe_thickness_of_precipitation_amount
    - surface_net_downward_shortwave_flux
    - lwe_thickness_of_convective_precipitation_amc
    - surface_air_pressure
    - surface_net_downward_longwave_flux
    - land_binary_mask
    - altitude
    - wind

Height (m): 2

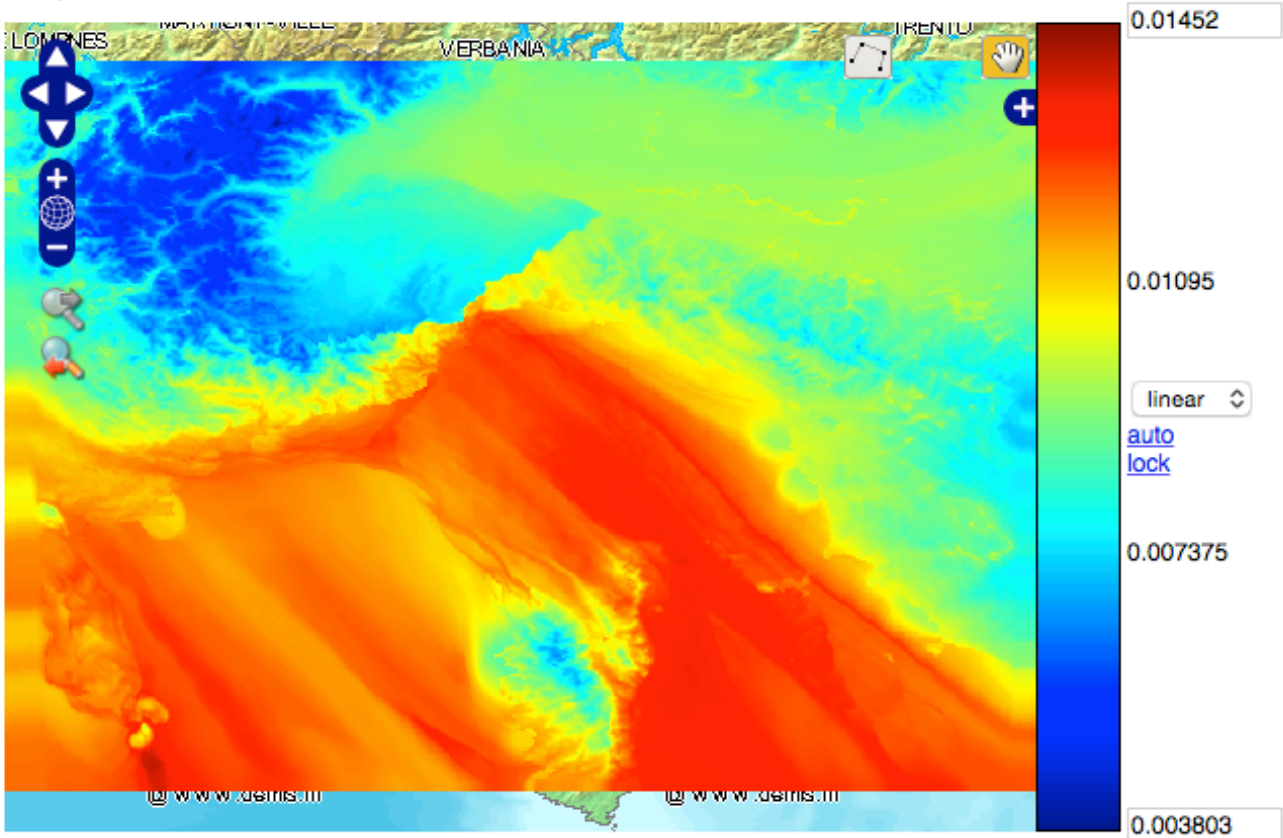
UTC first frame last frame

Create animation from 2011-11-04T01:00:00.000Z to 2011-11-05T00:00:00.000Z

?	November, 2011					
«	‹	Today			›	»
Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

Select date

Fit layer to window



From baseline to advanced HM experiment suites

Rain source	Description	Ensemble members	Resolution (km)	DRiFt and HBV runs	RIBS runs
Observations	Raingauge measurements	1		1	31
WRF-NMM	IC & BC: IFS	1	1.3	1	31
WRF-ARW	IC & BC: IFS	1	1.0	1	31
Arome	IC AEARO; BC: PEARP	8	2.5	8	248
Meso-NH	IC & BC: Arpege	10	0.5	10	310
Meso-NH	IC & BC: IFS	10	0.5	10	310
RainFARM	Downscaling of WRF-ARW	20	0.7	20	620
Total		51		51	1581

About 1700 jobs executed
by defyining only a few experiments!

Conclusions

FOCUS ON

How DRIHM can help Mark?

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He has just designed a modification to his meteo model, but he would like to validate the new model.
There are two tasks required to validate a model:

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4 Execute convert and pre-process operations on the data (hours)
5 Set execution parameters
6 Select the executable resources
7 Move all the data and ancillary files
8 Launch the execution
9 Monitoring of possible execution faults and re-submit in case of failure
10 Results retrieval
11 Visualization or further processing

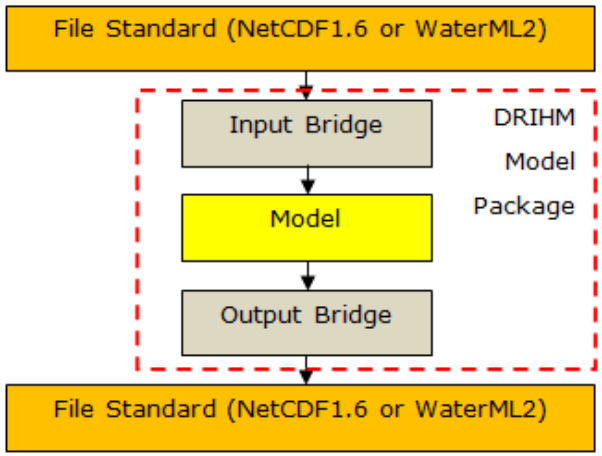
4 Select the conversion and pre-processing
5 Set execution parameters
6 --
7 --
8 Launch the execution (the system will take care of selecting the resources, moving converting and pre-processing the data, re-submit in case of failure)
9 --
10 --
11 Visualization or further processing (the system will take care of results retrieval)

Now Mark can squeeze (from days to minutes) the time required to run a simulation on an alternative model, and can focus on improving the new Hydro-Meteo model and accurately validate it.

Conclusion

The DRIHM portal is a good example of flexible, extensible and interoperable framework for HM research

- Flexible: users are free to define their experiments
- Extensible: its modular GUI allows to add new models by adding dedicated portlet(s)
- Interoperable: the DRIHM2US experience;
  the portal can be used in operational settings based on heterogeneous public/private Clouds



DRIHM Model MAP