

WRF4G project: A framework for executing WRF experiments on distributed infrastructures

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- Motivation
- WRF4G
 - Access to Distributed Computing Infrastructures (DCI)
 - Workflow
 - Experiment types
 - Projects
- Conclusions

WRF experimental setup scen.

Reanalysis/Reforecasts/Hindcast

- High number ($\sim 10^4$) of independent simulations
- High volume of output-data (>TB)
- Requires **scalability**

Regional climate simulation

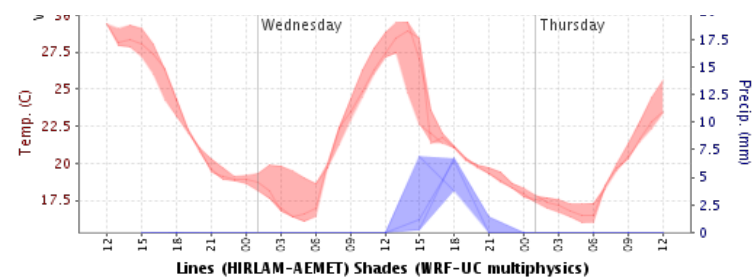
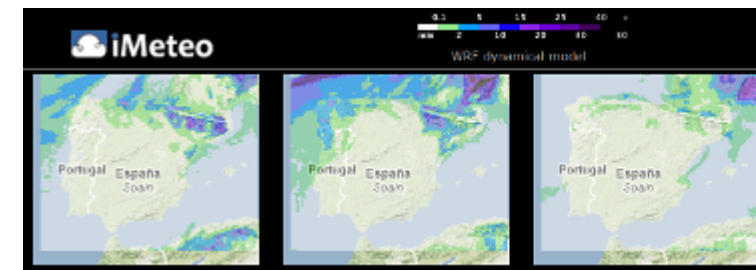
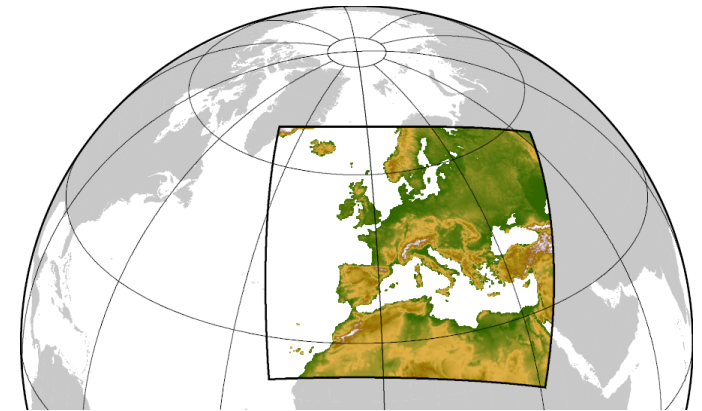
- Long, continuous simulations; weeks of walltime
- High volume of output data (>TB)
- Recovering system for **simulation restart**

Weather Forecasting

- QoS and optimal resources: **deadline for delivery**

Sensitivity/ensemble studies

- Physical schemes, initial conditions and boundary conditions: uncertainty sampling
- Resource demanding experiments composed of many **independent simulations**



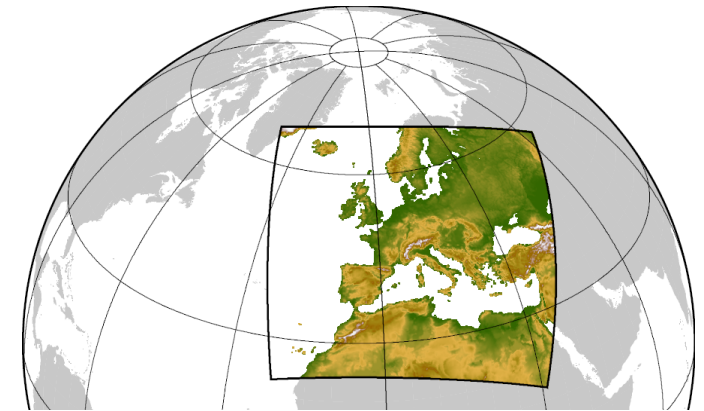
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Examples: Santander MetGroup

Reanalysis/Reforecasts/Hindcast

- SEAWIND project
- 21 years of daily reforecasts (36h each)
- 7,665 independent simulations



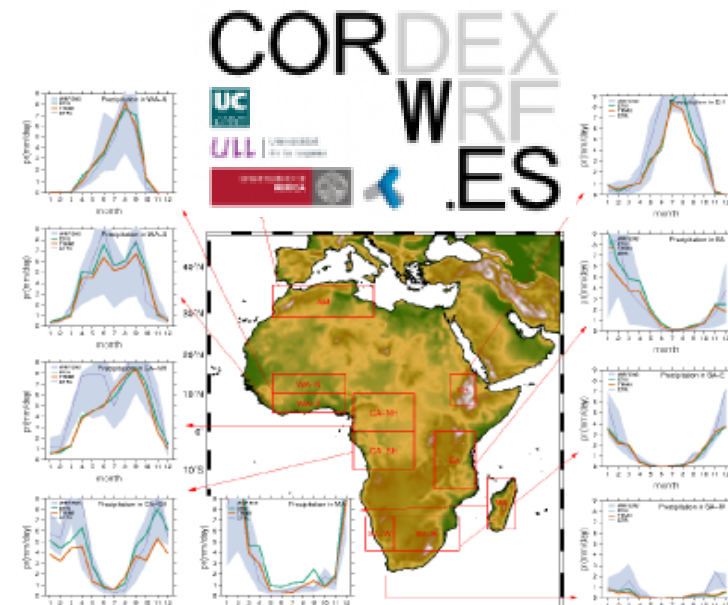
Regional climate simulation

- ESCENA & CORDEX projects
- 50 years (continuous run, 28-day restarts)
- 650 dependent simulations



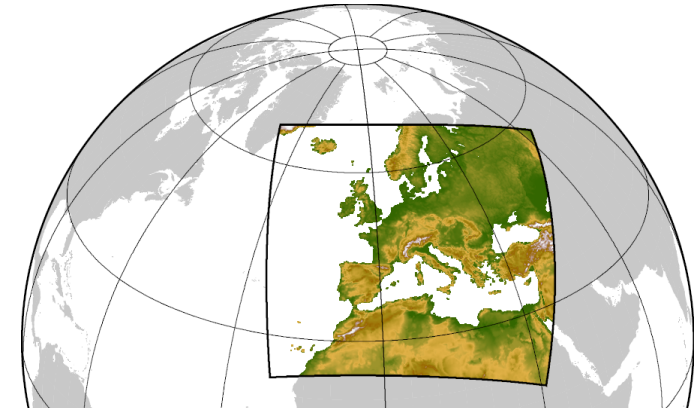
Sensitivity/ensemble studies

- CORWES project
- Physics sensitivity study for CORDEX-Africa
- 8-member ensemble of 5-year continuous simulations
- 8 independent groups of 65 dependent simulations



SEAWIND experiment set: past reforecasts of an improved wind field over Europe for off-shore wind farms.

- Characteristics of each experiment
 - 21 years of daily reforecasts (36h each)
 - 7,665 independent simulations
- Computation cost of each experiment
 - Working Node Architecture
 - CPU: Intel(R) Xeon(R) CPU E5620 @ 2.40GHz 8 Cores
 - RAM Memory: 16 GB
 - Result
 - WALLTIME (MPI job) = 21 x 365 x 70' ~ **2 years**
 - Output = 21 x 365 x 17 GB ~ **130 TB**



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DCI scenarios

Desktop/Laptop (UI)

- Low computational power and storage
- **User interface** to other computer resources



Workstation

- Multi-core, shared memory, moderate storage
- **ssh access**



Local group/institutional cluster

- Multi-node, distributed memory, large storage
- ssh access, **batch system** (PBS, SGE, ...) to submit jobs

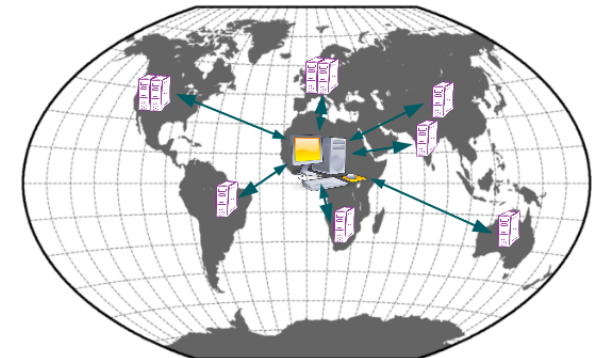


Mainframe/HPC site

- **Different architectures** and memory arrangements
- ssh or kerberos and token based security

Grid infrastructure

- “Cluster of clusters”, geographically distributed
- **Huge amount of computational power** and storage (not trivial to take advantage of it for meteo/climate apps)
- PKI security



DCI scenario

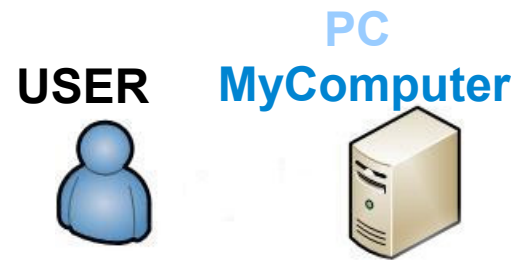
USER



Statement of the problem

DCI scenario

- Different types



Statement of the problem

DCI scenario

- Different types

USER



**PC
MyComputer**



Workstation Oceano



Statement of the problem

DCI scenario

- Different types

USER



**PC
MyComputer**



Workstation Oceano



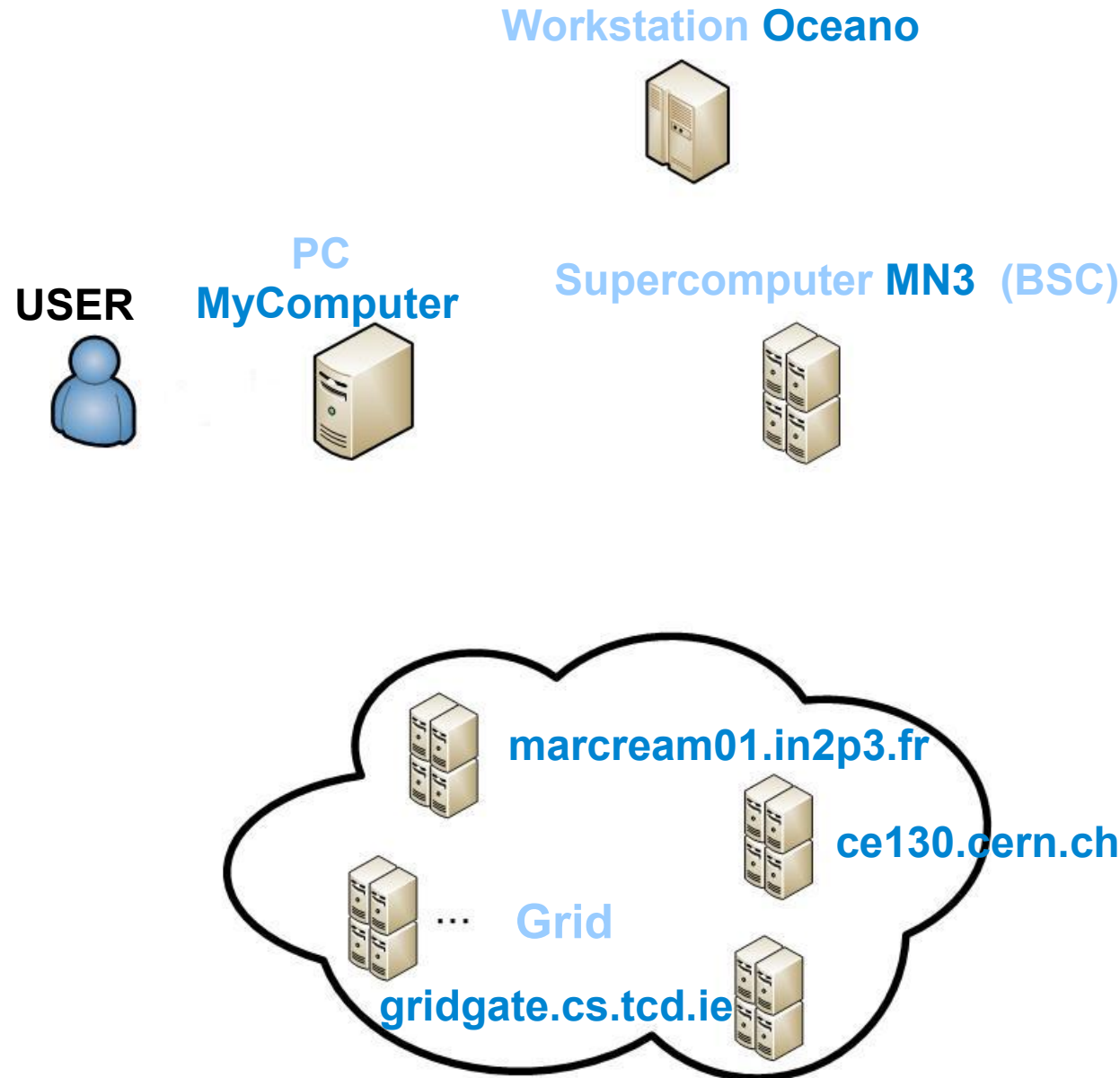
Supercomputer MN3 (BSC)



Statement of the problem

DCI scenario

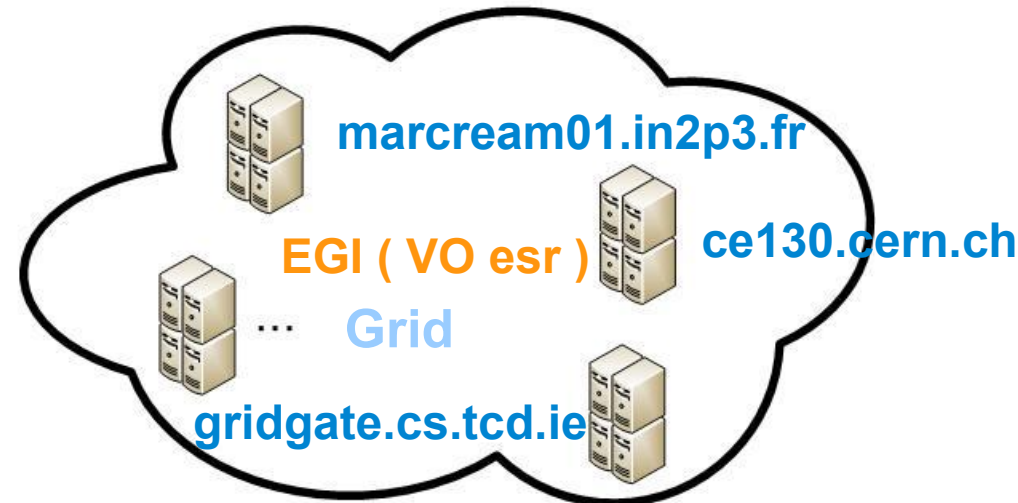
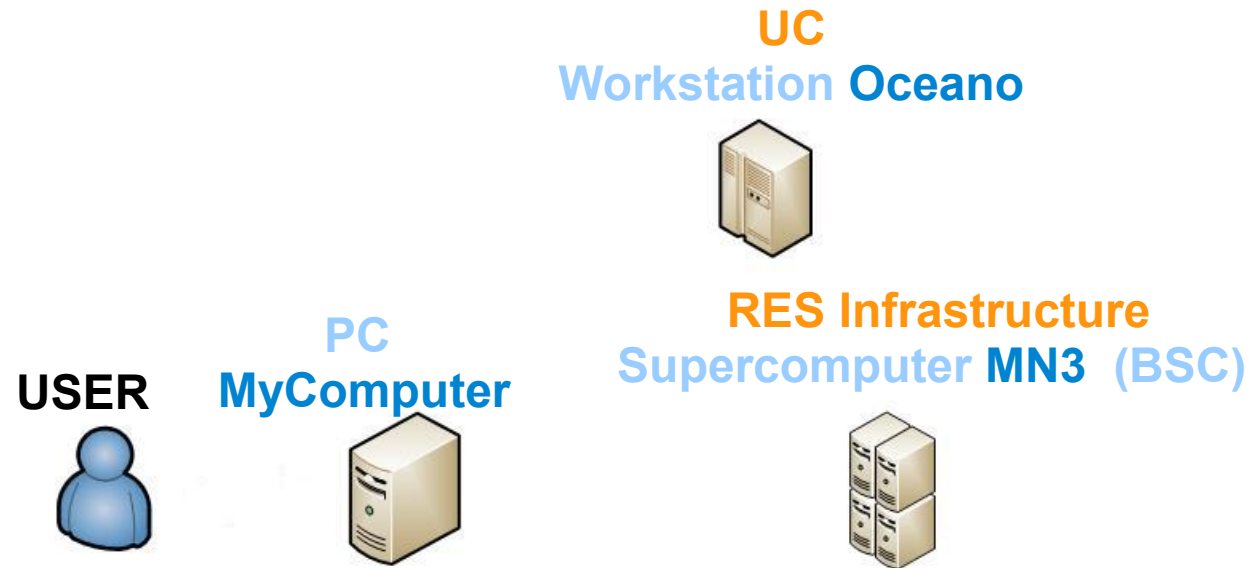
- Different types



Statement of the problem

DCI scenario

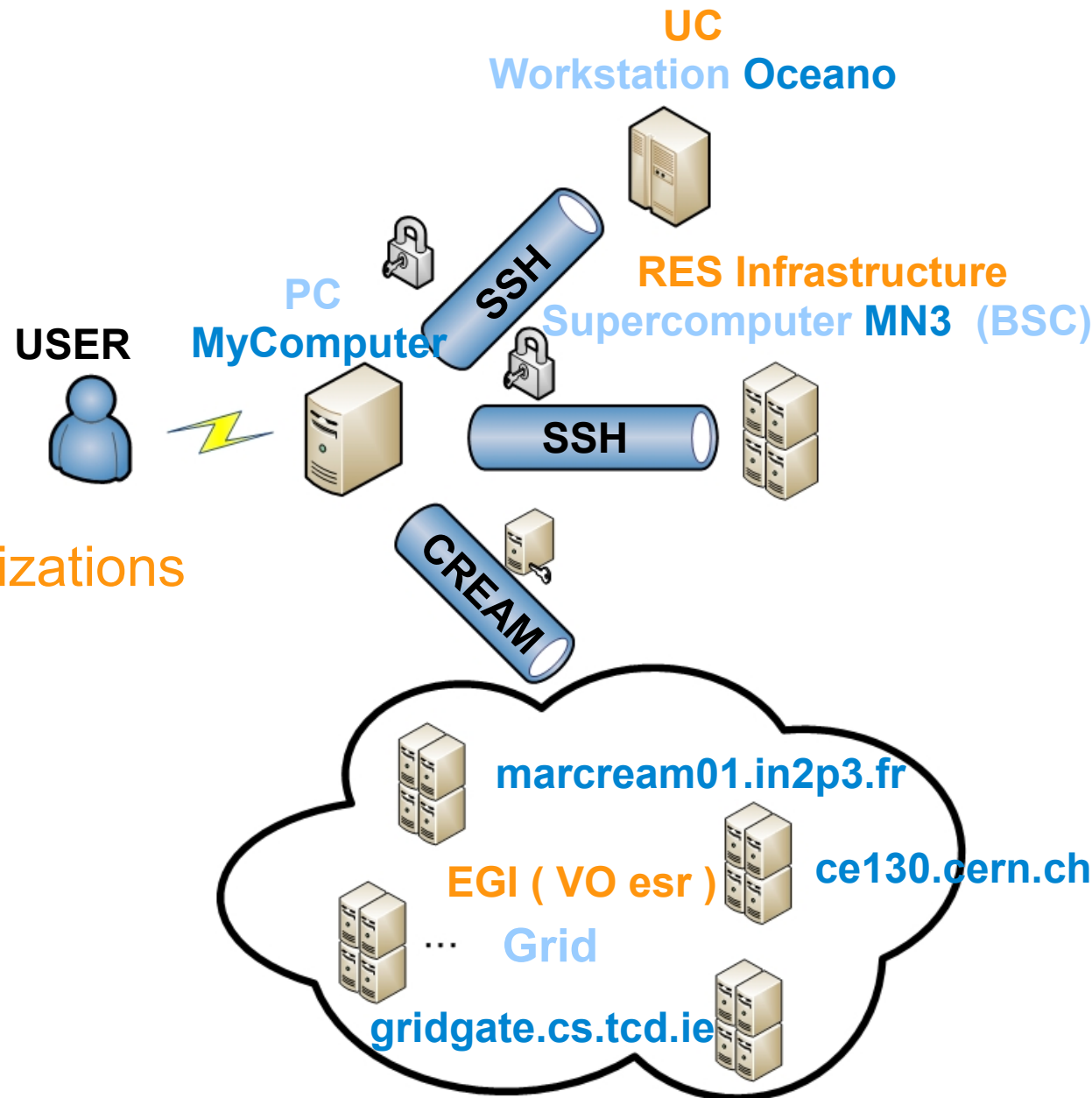
- Different types
- Different institutions/organizations



DCI scenario

- Different types
- Different institutions/organizations
- Different access protocols

Statement of the problem



WRF4G, developed by the Santander Meteorology Group, provides:

- The ability to simulate experiments in heterogeneous distributed computing resources, concurrently, **homogeneously** way and ...
- ... ease to **design**, **execute** and **monitor** WRF experiments

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- ... ease to **design, execute** and **monitor** WRF experiments

WRF4G provides a **Scientific Gateway** based on **command line tools**.

WRF and third-party tools are **deployed dynamically in the computing resources by the framework**. (on-site software *can be configured*)

The **input/output and log files are centralized** as a single repository

Broken **experiments** (due to a temporal disruptions) are automatically **handled by the framework**: only the non-completed simulations are re-submitted from their last **restart** point.

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- The ability to simulate experiments in heterogeneous distributed computing resources, concurrently, **homogeneously** way and ...
- ... ease to **design, execute** and **monitor** WRF experiments

WRF4G **software** features:

- Components: WRFV3, MySQL, GridWay, CDO and NCO
- Binaries for x86_64 Linux, are provided (OpenMPI). You only need to download and run: tested on Ubuntu 10.04, 11.04 and 12.04; CentOS 5 and 6; Fedora 18 and 19; Debian 6.0 and openSuse 12 and 13
- Third-party dependencies like the **middleware for accessing Grid** resources:
 - gLite (old)
 - UMD3 (new)
 - Globus toolkit (GT2, GT4 and GT5)

WRF4G, developed by the Santander Meteorology Group, provides:

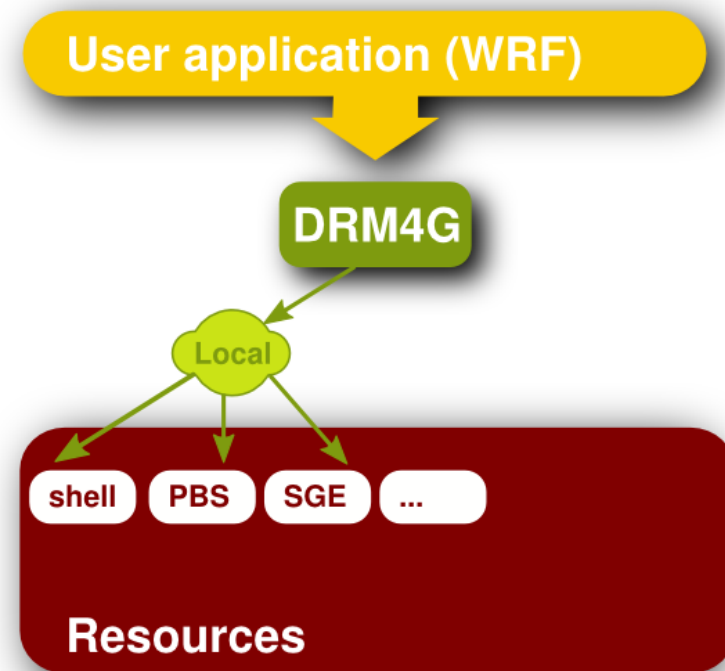
- The ability to simulate experiments in heterogeneous distributed computing resources, concurrently, **homogeneously** way and ...
- ... ease to **design**, **execute** and **monitor** WRF experiments

DCI access: the controller

DRM4G (Distributed Resource Manager) allows the user to **merge different computing resources** at hand in a homegenous way:

Local resources (UI)

- Directly in a shell session
- Interacting with LRMS
 - PBS
 - SGE
 - SLURM
 - ...

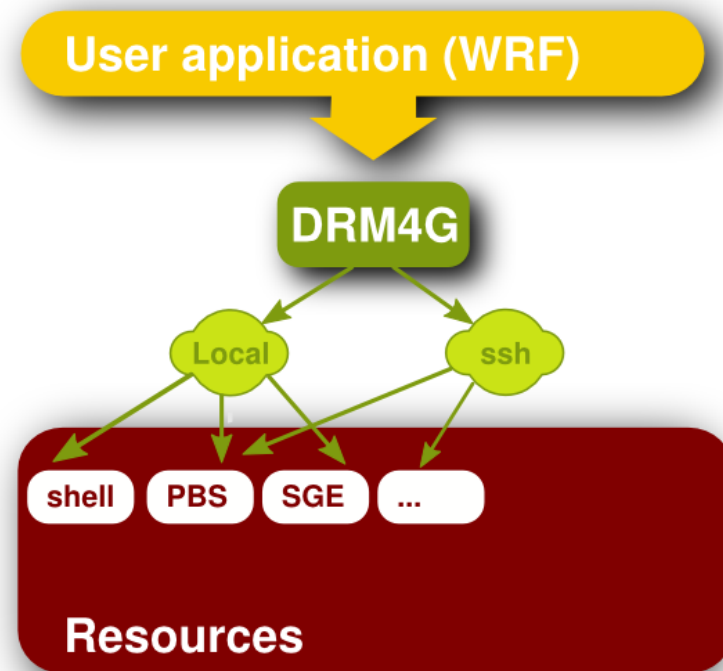


DRM4G (Distributed Resource Manager) allows the user to **merge different computing resources** at hand in a transparent way:

Local resources (UI)

Remote resources (ssh)

- Directly in a shell session
- Interacting with LRMS
 - PBS
 - SGE
 - SLURM
 - ...



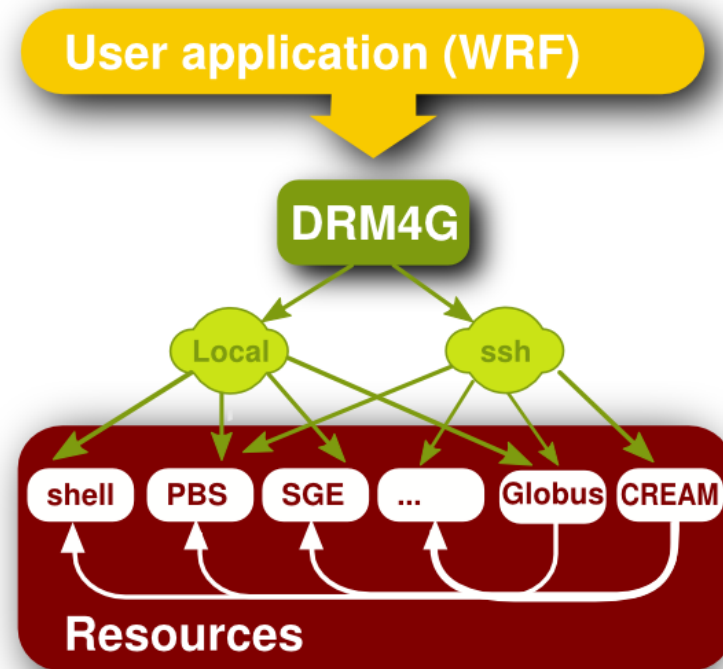
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Local resources (UI)

Remote resources (ssh)

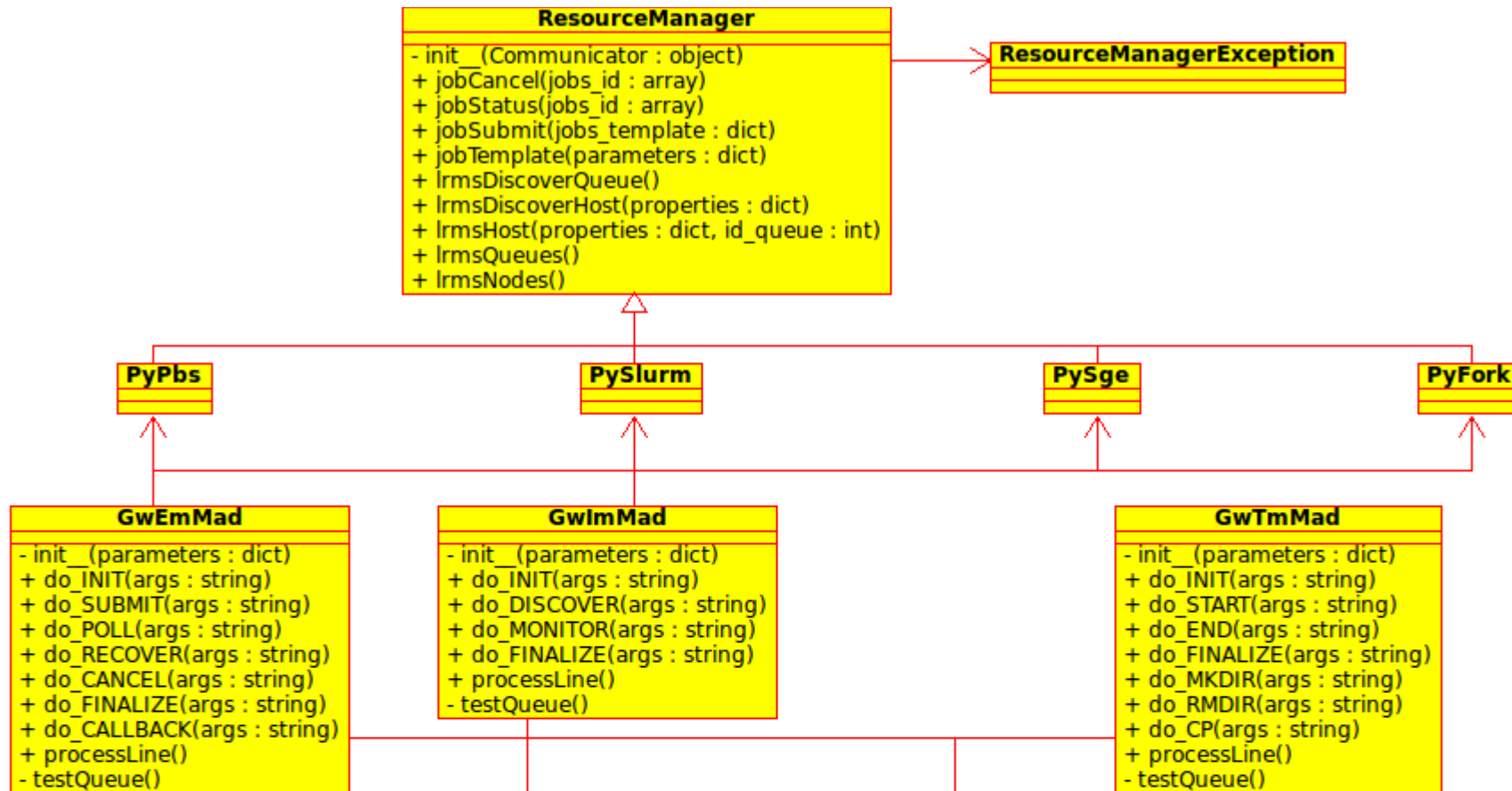
Grid infrastructures (Globus , CREAM)

- Directly in a shell session
- Interacting with LRMS
 - PBS
 - SGE
 - SLURM
 - ...



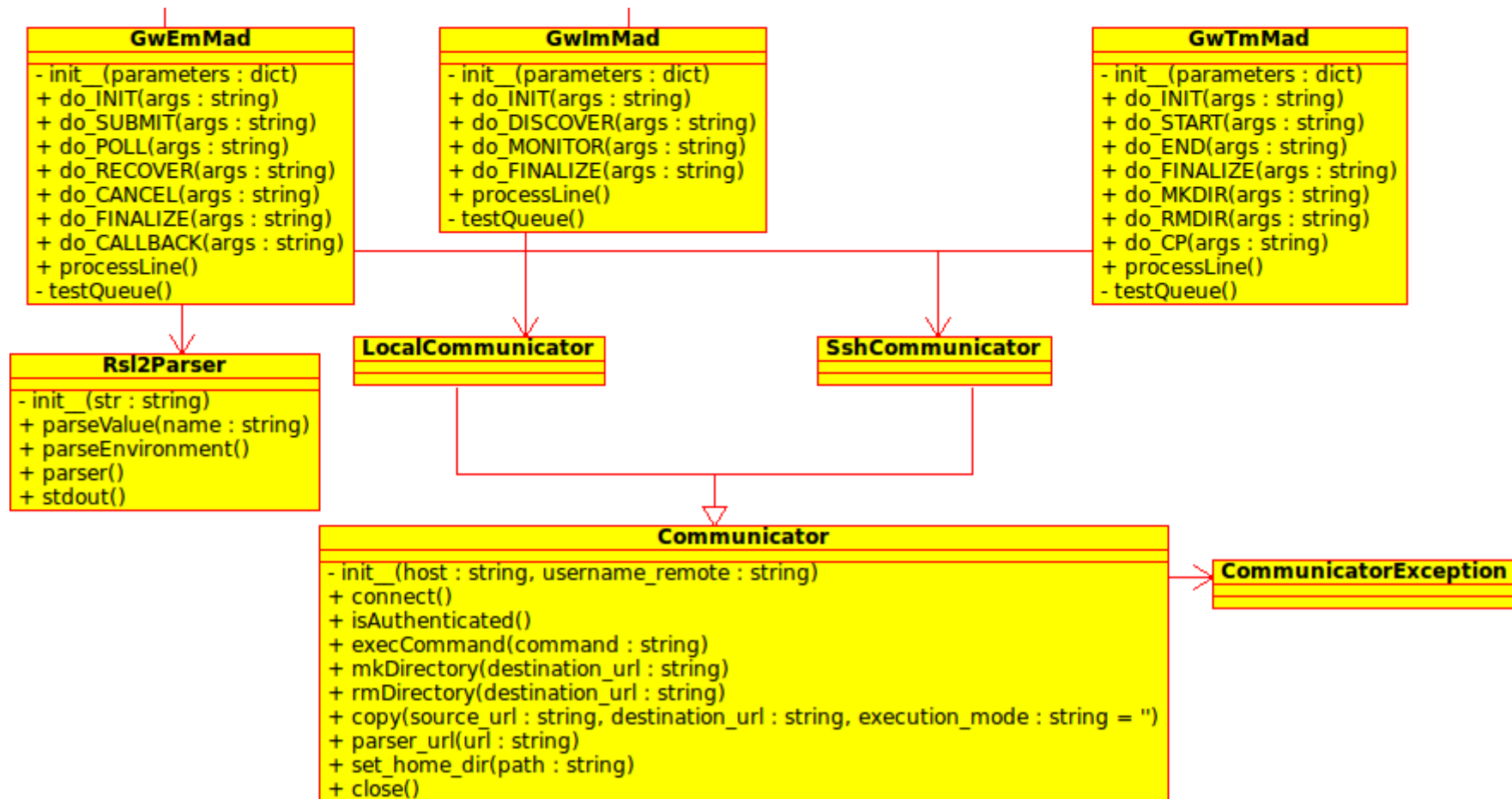
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```
$ wget http://meteo.unican.es/work/WRF4G-1.5.2.tar.gz
$ tar xzvf WRF4G-1.5.2.tar.gz
$ export PATH=$PWD/WRF4G/bin:$PATH
$ wrf4g framework start
```

```
Creating a WRF4G local configuration in '~/wrf4g'
Creating '~/wrf4g/etc' directory
Creating '~/wrf4g/var/log' directory
Creating '~/wrf4g/var/submission' directory
Creating '~/wrf4g/var/mysql' directory
Creating '~/wrf4g/opt/var' directory
Creating '~/wrf4g/opt/gw_drm4g/var' directory
Starting DRM4G .... OK
Starting WRF4G_DB (MySQL) ... OK
```

```
$ wrf4g framework status
```

```
DRM4G (GridWay) is running
WRF4G_DB (MySQL) is running
```

```
$ wrf4g resources edit
```

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Configuration files

resources.conf

```
[DEFAULT] # default values
enable      = True
communicator = local
frontend    = localhost
lrms        = fork # or none

[resource:mycomputer] # BAD IDEA!!!!
ncores      = 1

[resource:es-ngi] # EGI VO local UI
lrms        = cream
vo          = earth.vo.ibergrid.eu

[resource:esr] # EGI VO remote UI
communicator = ssh
username     = blancojc
frontend     = ce02.macc.unican.es
lrms        = cream
vo          = esr

[resource:meteo] # local PBS cluster
lrms        = pbs
queue       = estadistica
```



Resource Configuration I

resources.conf

```
[DEFAULT] # default values
enable      = True
communicator = local
frontend    = localhost
lrms        = fork # or none

[mycomputer] # BAD IDEA !!!!!
ncores      = 1

[meteo] # my cluster with a batch system
communicator = ssh
username     = blancojc
frontend     = ui.macc.unican.es
auth         = private_key | ~/.ssh/id_rsa
Lrms         = pbs
queue        = estadistica
```



Resource Configuration II

resources.conf

```
[mn3] # MareNostrun HPC
communicator = ssh
username     = ecm3292929
frontend    = mn3.bsc.es
auth        = ssh-agent | ~/.ssh/id_dsa
lrms        = lsf
queue       = mic
ncores      = 400

[esr] # GRID Virtual Organization (EGI)
communicator = ssh
username     = carlos
frontend    = ui.macc.unican.es
auth        = private_key | ~/.ssh/id_rsa
lrms        = cream
vo          = esr
```



Resource Configuration II

resources.conf

```
[es-ngi] # GRID VO (Spanish Grid Infra.)  
communicator = ssh  
username     = carlos  
frontend     = ce02.macc.unican.es  
auth         = private_key | ~/.ssh/id_rsa  
lrms         = cream  
vo           = earth.vo.ibergrid.eu
```



```
$ ssh-keygen -q -t rsa -N ""
```

```
Enter file in which to save the key (/home/carlos/.ssh/id_rsa):
```

```
$ wrf4g resource oceano copy-ssh-key
```

```
Introduce your password to log into blancojc@oceno.unican.es : *****
```

```
~/.ssh/id_rsa.pub added to blancojc@oceno.unican.es:~/.ssh/authorized_keys file
```

```
$ ssh-agent
```

```
SSH_AUTH_SOCK=/tmp/ssh-qOXSm1sQaPFB/agent.2292; export SSH_AUTH_SOCK;  
SSH_AGENT_PID=2293; export SSH_AGENT_PID;  
echo Agent pid 2293;
```

```
$ ssh-keygen -q -t dsa -N "RES2014"
```

```
Enter file in which to save the key (/home/carlos/.ssh/id_dsa):
```

```
$ wrf4g resource mn3 add-ssh-key
```

```
Introduce your password for ~/.ssh/id_dsa : *****
```

```
~/.ssh/id_dsa added to the authentication agent
```

```
$ wrf4g resource mn3 copy-ssh-key
```

```
Introduce your password to log into ecm3292929@mn3.bsc.es : *****
```

```
~/.ssh/id_dsa.pub added to ecm3292929@mn3.bsc.es:~/.ssh/authorized_keys file
```

```
$ wrf4g resource esr copy-ssh-key
```

```
Introduce your password to log into carlos@ui.macc.unican.es : *****
```

```
~/.ssh/id_rsa.pub added to carlos@ui.macc.unican.es:~/.ssh/authorized_keys file
```

```
$ wrf4g resource esr create-proxy
```

```
Logging into carlos@ui.macc.unican.es ...
```

```
Insert your Grid certificate password: *****
```

```
Insert your MyProxy password: *****
```

```
Your identity: /DC=es/DC=irisgrid/O=unican/CN=josecarlos.blanco
```

```
Creating proxy ..... Done
```

```
Proxy Verify OK
```

```
Your proxy is valid until: Wed May 7 10:22:42 2014
```

```
A proxy valid for 168 hours (7.0 days) for user carlos  
now exists on px.grid.sara.nl.
```

WARNING!!!: WRF4G assumes well known user's frontend configuration: i.e. Personal X509 certificates are available on frontends.

```
$ wrf4g resource es-ngi copy-ssh-key
Introduce your password to log into carlos@ce02.macc.unican.es : *****

~/.ssh/id_rsa.pub added to carlos@ce02.macc.unican.es:~/.ssh/authorized_keys file

$ wrf4g resource es-ngi create-proxy
Logging into carlos@ce02.macc.unican.es ...
Insert your Grid certificate password: *****
Insert your MyProxy password: *****
  Your identity: /DC=es/DC=irisgrid/O=unican/CN=josecarlos.blanco
  Creating proxy ..... Done
  Proxy Verify OK
  Your proxy is valid until: Wed May  7 10:22:42 2014
  A proxy valid for 168 hours (7.0 days) for user carlos
    now exists on cesga.egi.cesga.es.
```

WARNING!!!: WRF4G assumes well known user's frontend configuration: i.e. Personal X509 certificates are available on frontends.

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Resources

```
$ wrf4g resources edit
```

The resources.conf is edited and loaded dynamically by the framework

```
$ wrf4g resource list
```

Name	State
es-ngi	enabled
esr	enabled
mycomputer	enabled
mn3	enabled
oceano	enabled

```
$ wrf4g resource check
```

The check has passed with flying colors

```
$ wrf4g resource check-frontends
```

```
--> Resource 'es-ngi' ...  
    The front-end ui.macc.unican.es is accessible  
--> Resource 'esr' ...  
    The front-end ce02.macc.unican.es is accessible  
--> Resource 'mn3' ...  
    The front-end mn3.bsc.es is accessible  
--> Resource 'oceano' ...  
    The front-end oceano.unican.es is accessible
```


Santander Meteorology Group*A multidisciplinary approach for weather & climate***Hosts****\$ wrf4g host list**

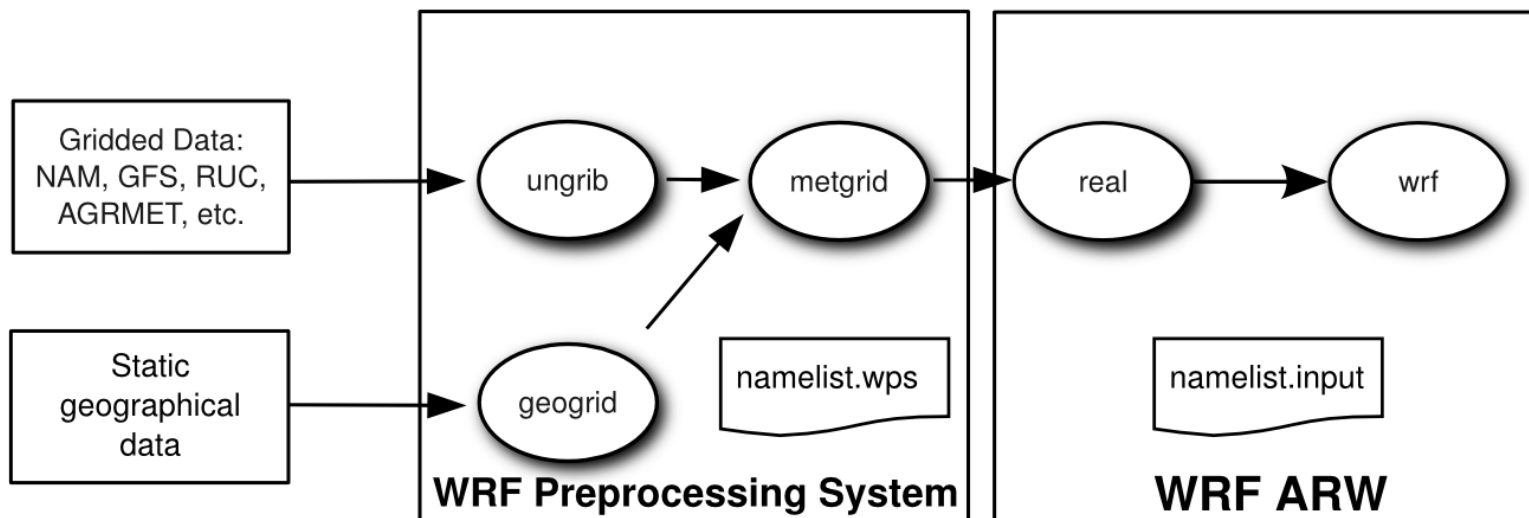
HID	ARCH	CORES (U/F/T)	LRMS	HOSTNAME
0	x86_64	0/1/1	fork	mymachine
1	x86_64	0/400/400	lsf	mn3
2	x86_64	0/120/360	pbs	meteo
3	x86_64	0/633/684	cream-pbs	es-ngi_ce01.macc.unican.es
4	x86_64	0/523/784	cream-pbs	es-ngi_ce03.ific.uv.es
5	x86_64	0/127/408	cream-sge	es-ngi_ce.ceta-ciemat.es
6	x86_64	0/48/48	cream-pbs	es-ngi_ce02.ific.uv.es
7	x86_64	0/94/72	cream-sge	es-ngi_cream.egi.cesga.es
8	x86_64	0/117/200	cream-pbs	es-ngi_ngiescream.i3m.upv.es
9	x86_64	0/26/96	cream-pbs	es-ngi_cream01-tic.ciemat.es
...				
20	x86_64	0/23/1948	cream-pbs	esr_sbgce2.in2p3.fr
21	x86_64	0/103/358	cream-pbs	esr_cream.afroditi.hellasgrid.gr
22	x86_64	0/17/114	cream-pbs	esr_cream-ce01.marie.hellasgrid.gr
23	x86_64	0/4/4	cream-pbs	esr_cream-ce02.marie.hellasgrid.gr
24	x86_64	0/26/168	cream-pbs	esr_snf-458754.vm.okeanos.grnet.gr
25	x86_64	0/14/212	cream-pbs	esr_cream-ce01.hellasgrid.gr
26	x86_64	0/464/1374	cream-pbs	esr_hepgrid6.ph.liv.ac.uk
27	x86_64	0/477/1374	cream-pbs	esr_hepgrid5.ph.liv.ac.uk
28	x86_64	0/5/55	cream-pbs	esr_snf.vm.okeanos.grnet.gr
...				

WRF4G, developed by the Santander Meteorology Group, provides:

- The ability to run these experiments on different computing resources concurrently in a **transparent** way and ...
- ... ease to **design**, **execute** and **monitor** WRF experiments

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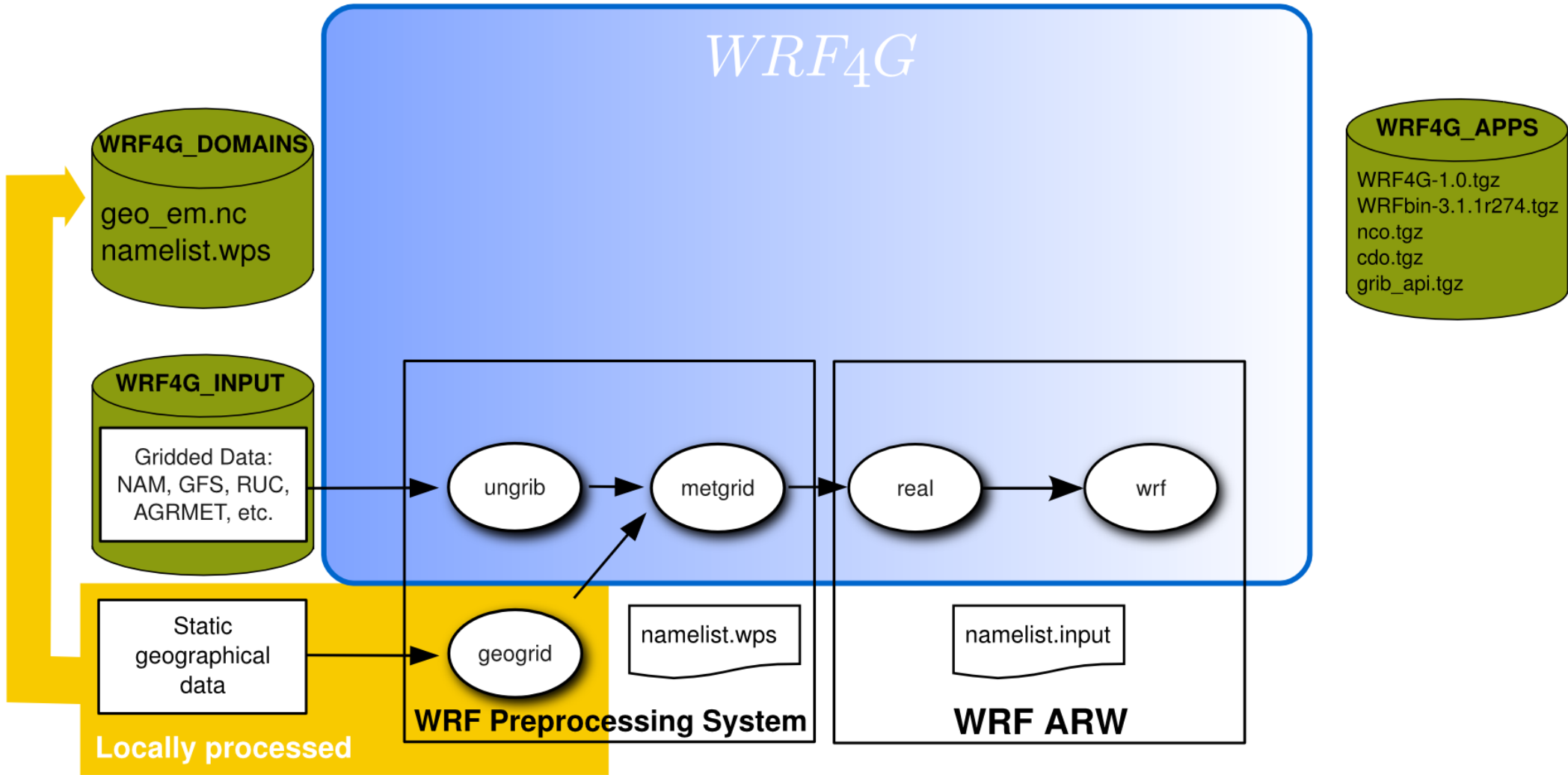
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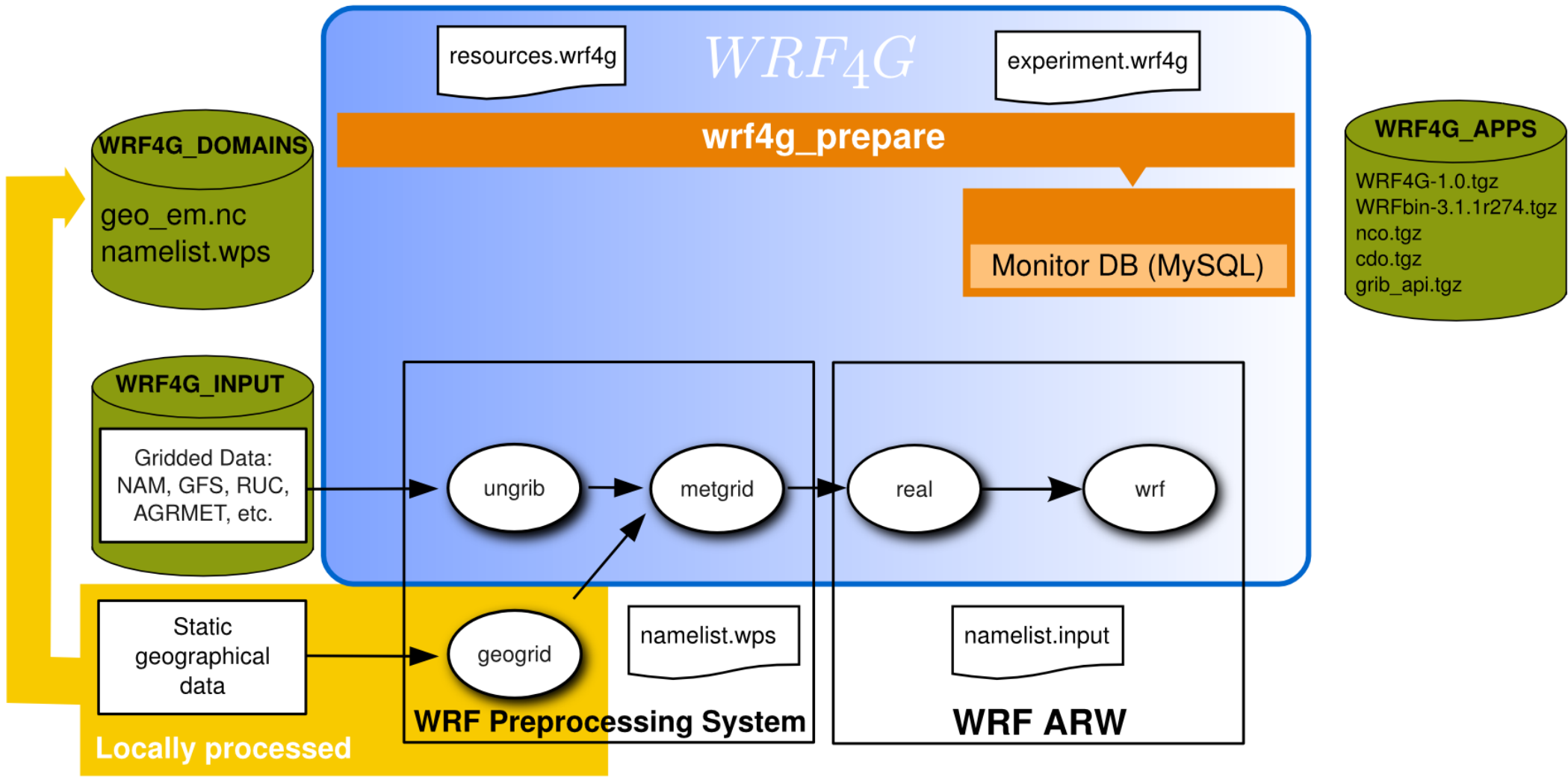
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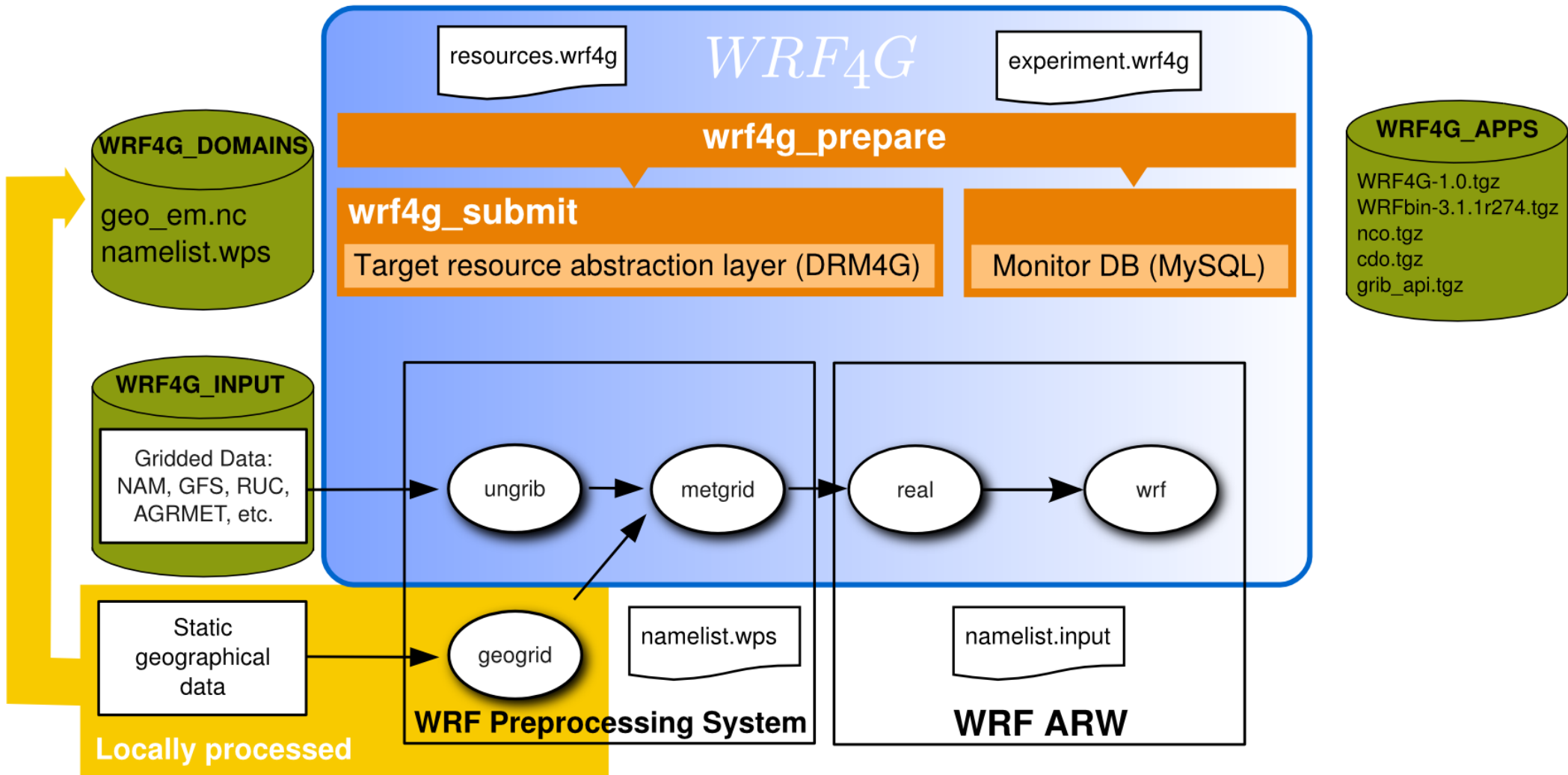
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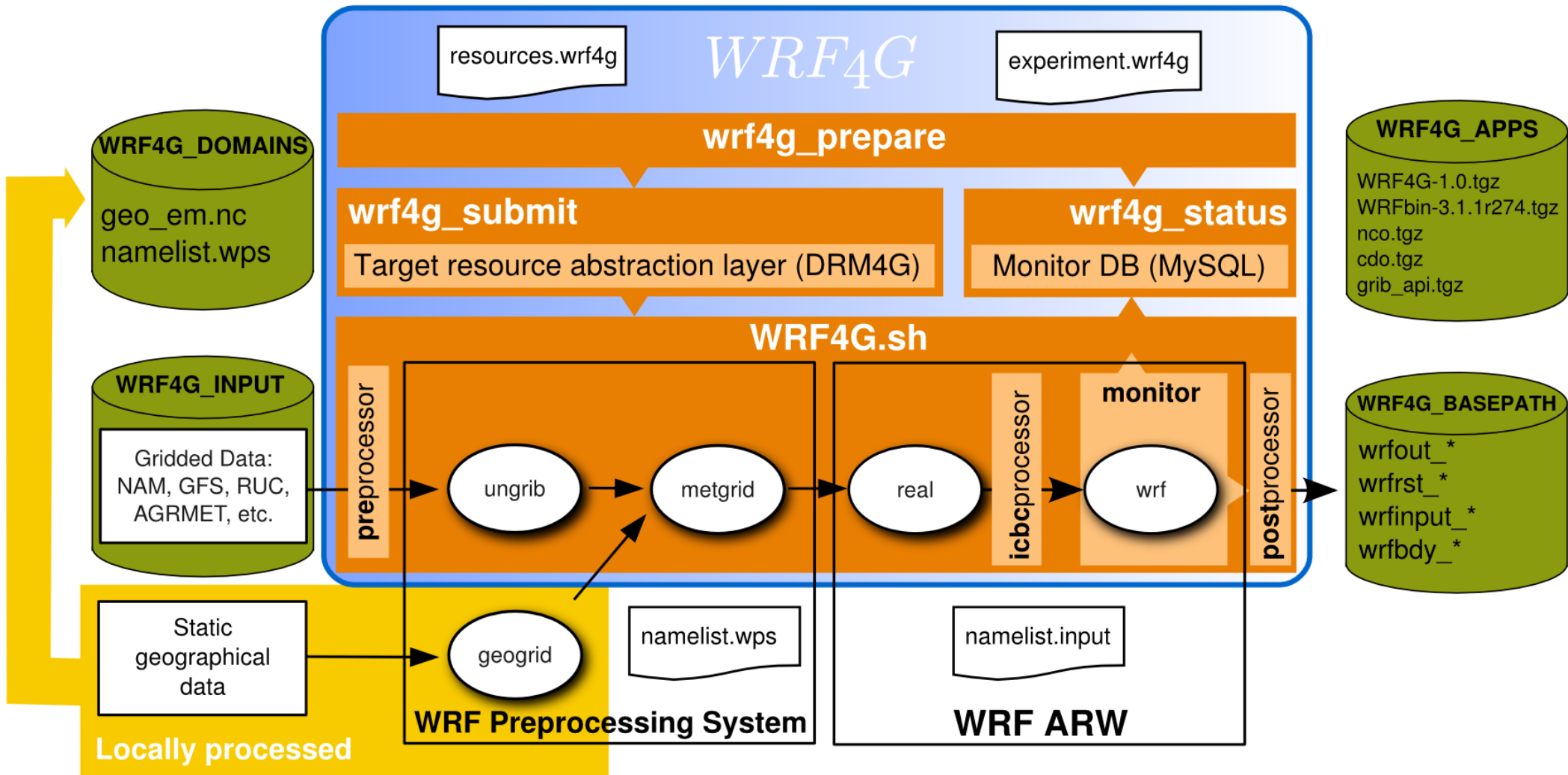
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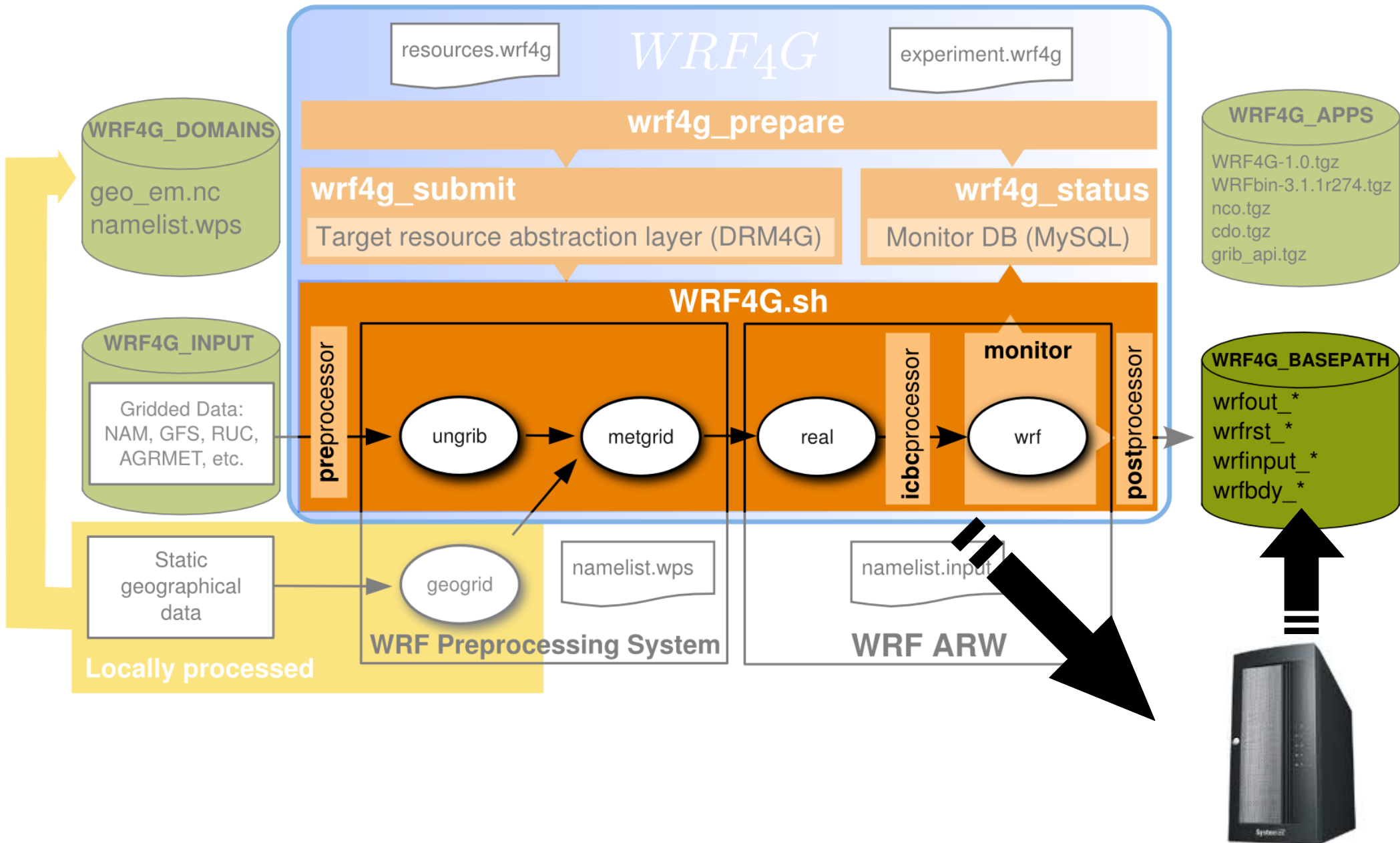
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Experiment preparation and submission

```
$ wrf4g experiment demo1 setup --template=single
```

```
$ ls demo1
```

```
experiment.wrf4g  input_files  output  resources.wrf4g
```

`resources.conf`

`wrf4g.conf`

```
[DEFAULT] #WRF4G default configuration for ALL resource unless is overloaded
# WRF4G repository structure
WRF4G_REPOS_ROOT = #THIS IS EMPTY BY DEFAULT!!! (see below)
WRF4G_BASEPATH   = ${WRF4G_REPOS_ROOT}/home/user/output
WRF4G_DOMAINPATH = ${WRF4G_REPOS_ROOT}/home/user/repository/domains
WRF4G_INPUT      = ${WRF4G_REPOS_ROOT}/home/user/repository/input
WRF4G_APPS       = ${WRF4G_REPOS_ROOT}/home/user/repository/apps

# WRF4G software
WRF4G_WRF        = ${WRF4G_APPS}/WRF/WRFbin-3.3.1_r1184INTEL_OMPI.tar.gz
WRF4G_NETCDF     = ${WRF4G_APPS}/netcdf/netcdf-4.1.1.tar.gz
WRF4G_NCO        = ${WRF4G_APPS}/nco/nco-4.0.9.tar.gz
WRF4G_CDO        = ${WRF4G_APPS}/cdo/cdo-1.3.0.tar.gz

# WRF4G job submission options
NP = 8
REQUIREMENTS = 'ARCH="x86_64"'
```

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Configuration files

resources.conf

wrf4g.conf

```
[DEFAULT] #WRF4G default configuration for ALL resource unless is overloaded
# WRF4G repository structure
WRF4G_REPOS_ROOT = #THIS IS EMPTY BY DEFAULT!!! (see below)
WRF4G_BASEPATH   = ${WRF4G_REPOS_ROOT}/home/user/output
WRF4G_DOMAINPATH = ${WRF4G_REPOS_ROOT}/home/user/repository/domains
WRF4G_INPUT      = ${WRF4G_REPOS_ROOT}/home/user/repository/input
WRF4G_APPS       = ${WRF4G_REPOS_ROOT}/home/user/repository/apps

# WRF4G software
WRF4G_WRF        = ${WRF4G_APPS}/WRF/WRFbin-3.3.1_r1184INTEL_OMPI.tar.gz
WRF4G_NETCDF     = ${WRF4G_APPS}/netcdf/netcdf-4.1.1.tar.gz
WRF4G_NCO        = ${WRF4G_APPS}/nco/nco-4.0.9.tar.gz
WRF4G_CDO        = ${WRF4G_APPS}/cdo/cdo-1.3.0.tar.gz

# WRF4G job submission options
NP = 8
REQUIREMENTS = 'ARCH="x86_64"'

[resource:esr] #Overloading variables by resource
WRF4G_REPOS_ROOT = gsiftp://ce02.macc.unican.es

[resource:meteo] #Overloading variables by resource
WRF4G_REPOS_ROOT = rsync://ui.macc.unican.es/wrf4g
```

- WRF4G splits a regular WRF simulation **experiment** into:
 - **realizations**
 - A **realization** is any **independent WRF simulation**, each simulation is one of the `multiple_dates` and `multiple_parameters`
 - **chunks**
 - For convenience, a WRF **realization** are split-ed into **chunks**. By definition, a **chunk** is a **dependent partial simulation** and requires the previous **chunk** to start.
 - **Chunks** depend on **computing resource limitations**: `WALLTIME`, `RESOURCE DISK QUOTA`, ...
 - **Chunks** allow **fine tuning** of the size of the input files (boundary and initial conditions).

Climate simulation (continuous)

Simulation Dates

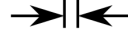
Realizations



start_date

end_date

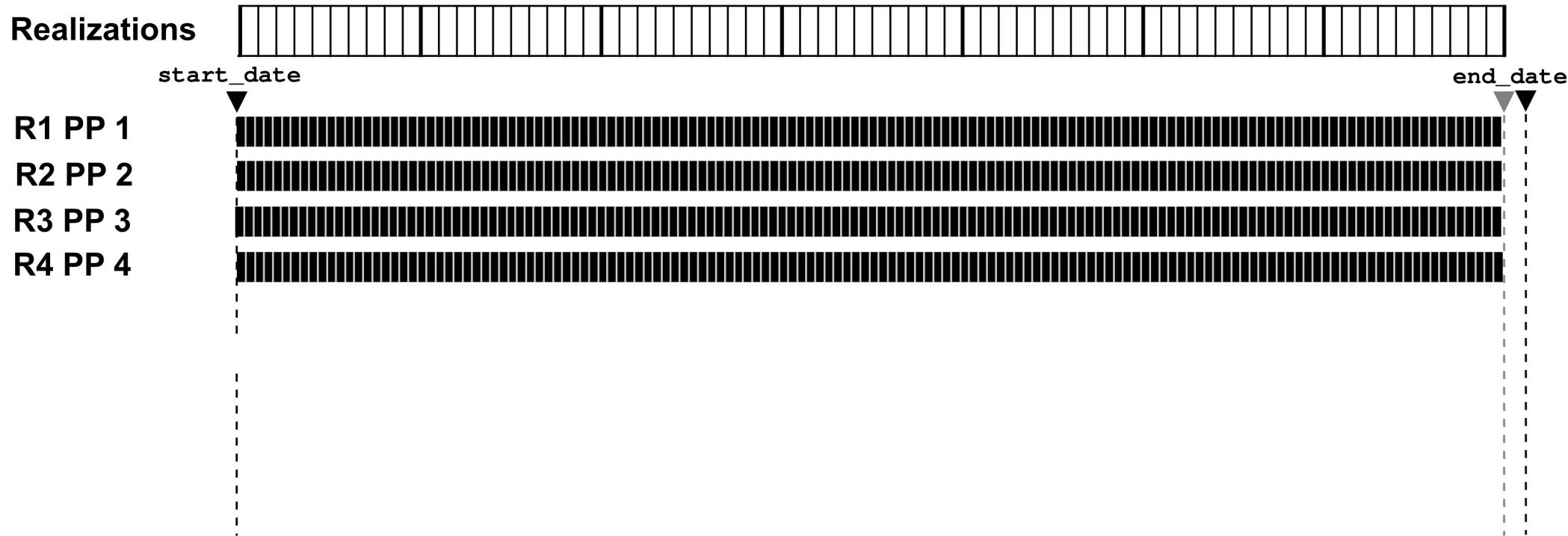
R1



chunk_size_h



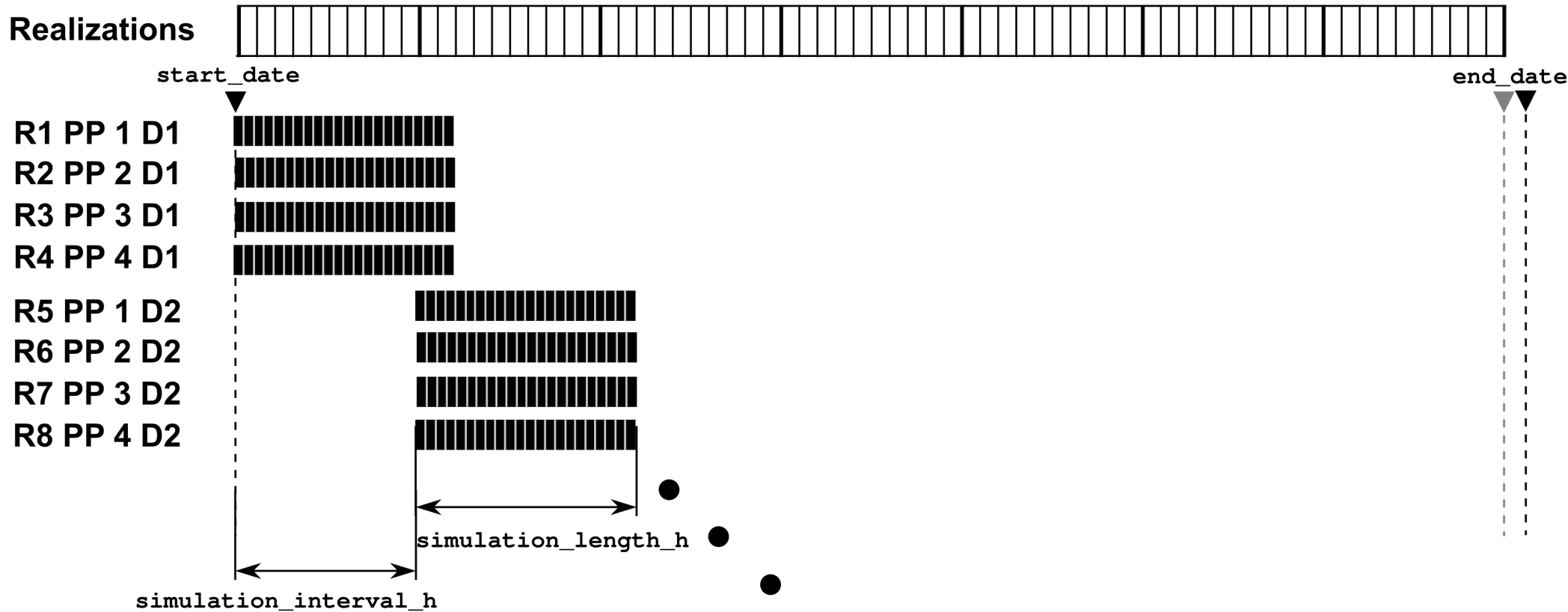
Simulation Dates



```
[multiple_parameters]
multiparams_variables = mp_physics,cu_physics,e_vert
multiparams_combinations = 3,1,28 / 3,3,28 / 4,1,36 / 3,1,36
multiparams_labels = WSM3_KF_L28/WSM3_GD_L28/WSM5_KF_L36/WSM3_KF_L36
```

Multi-Parameter & Multi-Date

Simulation Dates



[multiple_parameters]

`multiparams_variables` = `mp_physics,cu_physics,e_vert`

`multiparams_combinations` = `3,1,28 / 3,3,28 / 4,1,36 / 3,1,36`

`multiparams_labels` = `WSM3_KF_L28/WSM3_GD_L28/WSM5_KF_L36/WSM3_KF_L36`

[multiple_dates]

Experiment preparation and submission

```
$ wrf4g experiment demo1 setup --template=single
```

```
$ ls demo1
```

```
experiment.wrf4g  input_files  output  resources.wrf4g
```


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Configuration files

resources.conf**wrf4g.conf****experiment.conf**

```
[main]
experiment_name      = demo1

[domain]
domain_name         = Europe15km
max_dom             = 2

[input_data]
vtable              = ECMWF    # Vtables must exist as Vtable.[input_extdata]
path                = ${WRF4G_DATA}/ECMWF/INTERIM
interval           = 21600    # Seconds between global analysis input times

[processors]
pre_processor       = ECMWF
post_processor      = SEAWIND2

[time_experiment]
start_date          = 1989-01-01_06:00:00
end_date            = 2001-01-02_00:00:00
chunk_size_h        = 36

[multiple_dates]
simulation_interval_h = 24
simulation_length_h  = ${chunk_size_h}

[multiple_parameters]
multiple_variables  = mp_physics,cu_physics,e_vert
multiple_items      = ${max_dom},${max_dom},${max_dom}
multiple_combinations = 3,1,28 / 3,3,28 / 4,1,36 / 3,1,36
multiple_labels     = WSM3_KF_L28/WSM3_GD_L28/WSM5_KF_L36/WSM3_KF_L36

[namelist] # Override namelist.input variables
NI_restart_interval = 2880 # minutes
NI_spec_bdy_width   = 10
NI_spec_zone        = 1
NI_relax_zone       = 9
NI_sst_update_physics = 1
...

```

```
$ wrf4g framework start
Starting DRM4G ... OK
Starting WRF4G_DB ... OK

$ wrf4g framework status
DRM4G is running
WRF4G_DB is running

$ wrf4g framework stop
Stopping DRM4G ... OK
Stopping WRF4G_DB ... OK
```

WRF4G framework is composed by **DRM4G**, **DB** and **CLI** (MVC). DRM4G is managing jobs, DB stores all the information about the experiments and the CLI is for user interaction.

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Resources

```
$ wrf4g resources edit
```

```
The resources.conf is edited and loaded dynamically by the framework
```

```
$ wrf4g resource list
```

Name	State
es-ngi	enabled
esr	enabled
mycomputer	enabled
mn3	enabled
oceano	enabled

```
$ wrf4g resource check
```

```
The check has passed with flying colors
```

```
$ wrf4g resource check-frontends
```

```
--> Resource 'es-ngi' ...  
    The front-end ui.macc.unican.es is accessible  
--> Resource 'esr' ...  
    The front-end ce02.macc.unican.es is accessible  
--> Resource 'mn3' ...  
    The front-end mn3.bsc.es is accessible  
--> Resource 'oceano' ...  
    The front-end oceano.unican.es is accessible
```

Santander Meteorology Group*A multidisciplinary approach for weather & climate***Hosts****\$ wrf4g host list**

HID	ARCH	CORES (U/F/T)	LRMS	HOSTNAME
0	x86_64	0/1/1	fork	mymachine
1	x86_64	0/400/400	lsf	mn3
2	x86_64	0/120/360	pbs	meteo
3	x86_64	0/633/684	cream-pbs	es-ngi_ce01.macc.unican.es
4	x86_64	0/523/784	cream-pbs	es-ngi_ce03.ific.uv.es
5	x86_64	0/127/408	cream-sge	es-ngi_ce.ceta-ciemat.es
6	x86_64	0/48/48	cream-pbs	es-ngi_ce02.ific.uv.es
7	x86_64	0/94/72	cream-sge	es-ngi_cream.egi.cesga.es
8	x86_64	0/117/200	cream-pbs	es-ngi_ngiescream.i3m.upv.es
9	x86_64	0/26/96	cream-pbs	es-ngi_cream01-tic.ciemat.es
...				
20	x86_64	0/23/1948	cream-pbs	esr_sbgce2.in2p3.fr
21	x86_64	0/103/358	cream-pbs	esr_cream.afroditi.hellasgrid.gr
22	x86_64	0/17/114	cream-pbs	esr_cream-ce01.marie.hellasgrid.gr
23	x86_64	0/4/4	cream-pbs	esr_cream-ce02.marie.hellasgrid.gr
24	x86_64	0/26/168	cream-pbs	esr_snf-458754.vm.okeanos.grnet.gr
25	x86_64	0/14/212	cream-pbs	esr_cream-ce01.hellasgrid.gr
26	x86_64	0/464/1374	cream-pbs	esr_hepgrid6.ph.liv.ac.uk
27	x86_64	0/477/1374	cream-pbs	esr_hepgrid5.ph.liv.ac.uk
28	x86_64	0/5/55	cream-pbs	esr_snf.vm.okeanos.grnet.gr
...				

Experiment preparation and submission

```
$ wrf4g experiment demo1 setup --template=single

$ ls demo1
experiment.wrf4g  input_files  output  resources.wrf4g

$ wrf4g experiment demo1 start
Preparing namelist...
WRF Check Warning: CAM radiation selected ...
WRF Check Warning: radt is shorter than dx (0.500000)

---> Single params run
---> Continuous run
    ---> cycle_chunks: real 2011-08-28_12:00:00 2011-08-30_00:00:00
        ---> chunks 1: real 2011-08-28_12:00:00 2011-08-29_00:00:00
        ---> chunks 2: real 2011-08-29_00:00:00 2011-08-29_12:00:00
        ---> chunks 3: real 2011-08-29_12:00:00 2011-08-30_00:00:00

$ wrf4g experiment demo1 submit
Submitting realization: "real"
    Submitting Chunk 1: 2011-08-28_12:00:00 2011-08-29_00:00:00
    Submitting Chunk 2: 2011-08-29_00:00:00 2011-08-29_12:00:00
    Submitting Chunk 3: 2011-08-29_12:00:00 2011-08-30_00:00:00
```

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Monitoring

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	1/3	esr_cccrea	ccwsge0107	Down. Bin.	-	0.00

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	1/3	esr_cccrea	ccwsge0107	ungrib	-	0.00

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	1/3	esr_cccrea	ccwsge0107	metgrid	-	0.00

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	1/3	esr_cccrea	ccwsge0107	real	-	0.00

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	1/3	esr_cccrea	ccwsge0107	WRF	-	0.00

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Monitoring

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	2/3	esr_cccrea	ccwsge0269	Down. Bound.	-	33.33

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	3/3	-	-	Submitted	-	66.67

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	3/3	-	-	Submitted	-	66.67

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	3/3	esr_cccrea	ccwsge0232	Down. Bound.	-	66.67

```
$ wrf4g experiment demo1 status --long
```

Realization	Stat	Chunks	Host	WN	Run.Sta	ext	%
real	W	3/3	esr_cccrea	ccwsge0232	WRF	-	100.00

```
$ wrf4g realization demo1 list_output real  
wrfout_d01_20110828T120000Z_20110829T000000Z.nc  
wrfout_d01_20110829T000000Z_20110829T120000Z.nc  
wrfout_d01_20110829T120000Z_20110830T000000Z.nc
```

```
$ wrf4g realization demo1 list_log real  
log_1.tar.gz  
log_2.tar.gz  
log_3.tar.gz
```

```
$ wrf4g realization demo1 get_log real ./
```

```
$ ls  
log_1.tar.gz
```


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Output

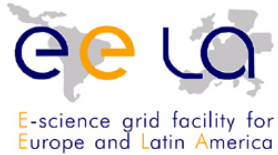
```
$ tree output/demo1/real/
|-- db.conf
|-- experiment.wrf4g
|-- log
|   |-- log_1_1.tar.gz
|   |-- log_2_2.tar.gz
|   `-- log_3_3.tar.gz
|-- namelist.input
|-- output
|   |-- wrfout_d01_20110828T120000Z.nc
|   |-- wrfout_d01_20110828T210000Z.nc
|   |-- wrfout_d01_20110829T000000Z.nc
|   |-- wrfout_d01_20110829T090000Z.nc
|   |-- wrfout_d01_20110829T120000Z.nc
|   |-- wrfout_d01_20110829T210000Z.nc
|   ...
|-- reload
|-- resources.wrf4g
`-- restart
    |-- wrfrst_d01_20110829T000000Z.nc
    |-- wrfrst_d01_20110829T120000Z.nc
    `-- wrfrst_d01_20110830T000000Z.nc
```

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Projects

Community :



EELA2: E-science grid facility for Europe and Latin America

Partners: 52 institutions in Latin America and Europe



GISELA Project (Grid Initiatives for e-Science virtual communities in Europe and Latin America)

Partners: 19 partners in Latin America and Europe

Infrastructure :



EGI: European Grid Infrastructure (ES-NGI and ESR)

WRF4G : <http://appdb.egi.eu/store/software/wrf>



RES: Spanish Supercomputing Network

Altamira and the Barcelona Supercomputing Center. Using binaries compiled for these infrastructures

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Projects

Scientific :



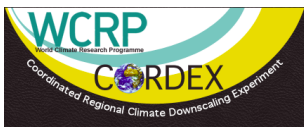
WRF model port to Grid infrastructures and proof-of-concept for a high-resolution wind hindcast over Europe

Universidad de Cantabria



Coordinated regional climate downscaling experiment using WRF: a contribution to the CORDEX initiative by the Spanish WRF community

Partners: 3 Spanish universities and a supercomputing center



CORDEX - Coordinated Regional Climate Downscaling Experiment : a WCRP-sponsored program to produce regional climate change scenarios globally

- The WRF user community usually:
 - designs experiments where several (many or huge ?) simulations are required
 - has several distributed computer resources available for running simulations
- WRF4G simplifies the design, execution and monitoring of WRF on several computer resources as an homogenous meta-computer.
- WRF4G is freely available for use. By, share-alike and non-commercial license scheme

www.meteo.unican.es/software/wrf4g

Thank you!

Contact: antonio.cofino@unican.es

More info: “wrf4g” → [I'm Feeling Lucky](#)



Aknowledgments: This work is funded by the Spanish PLAN NACIONAL de I+D+i 2008-2011 (Ref.# CGL2011-28864, WRF4G) and ERDF

Backup Slides

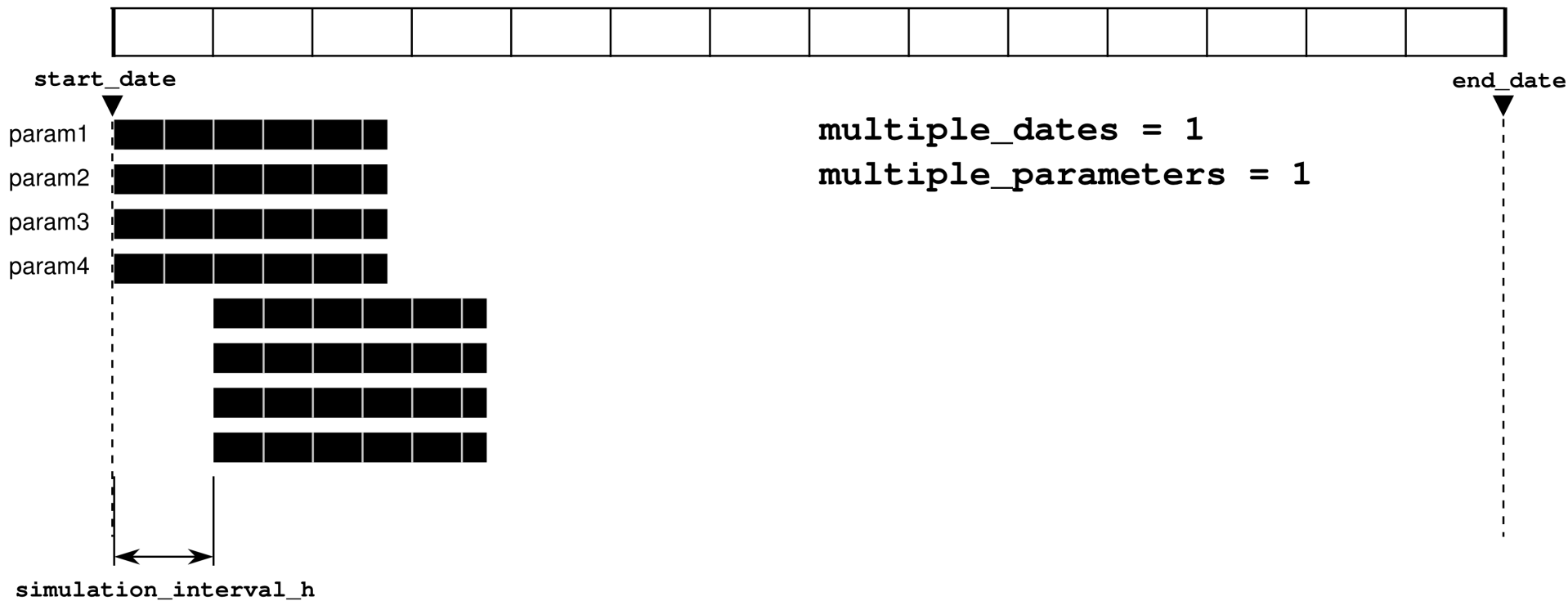
Useful tools developed

- **fortnml**
 - Fortran namelist
 - Provides Fortran namelist manipulation from the command line along with some WRF namelist checks.
 - E.g:

```
fortnml -f namelist.input
fortnml --wrf -f namelist.input
fortnml -f namelist.input -s variable value
fortnml -f namelist.input -s variable value1 value2 value3 ...
fortnml -f namelist.input -s variable@record value
```

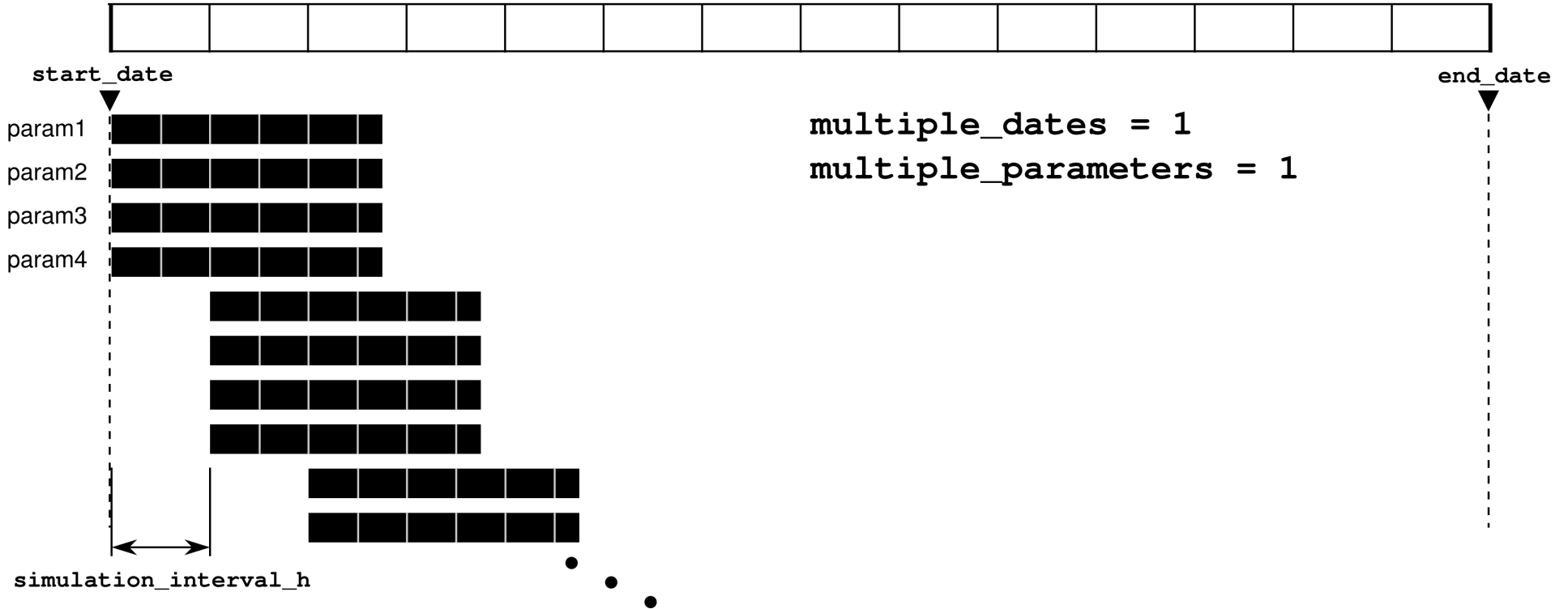
Multi-parameter & multi-date

Months



Multi-parameter & multi-date

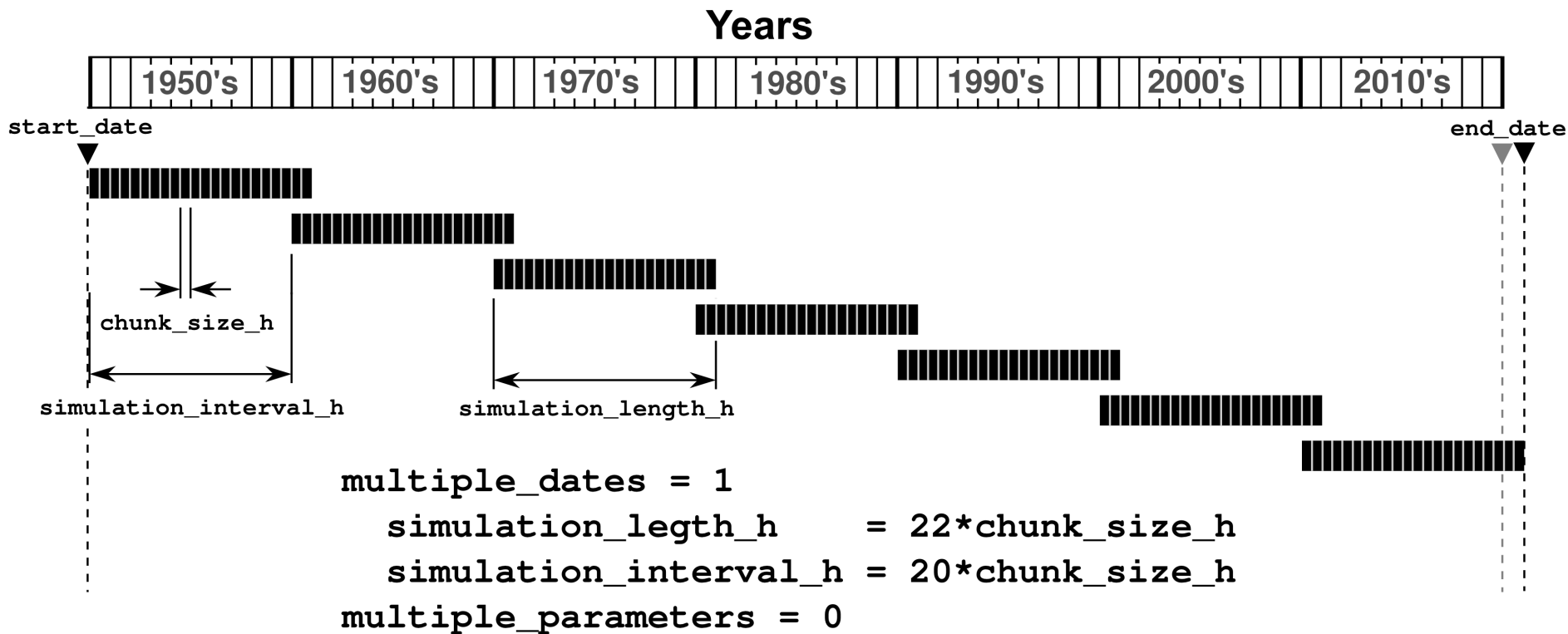
Months



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Climate simulation (split)

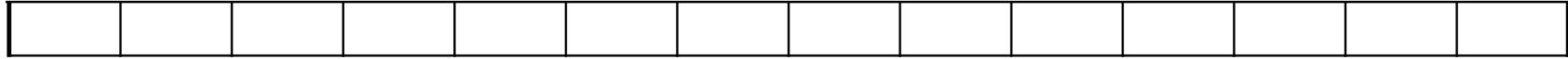


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Experiment definition

Days



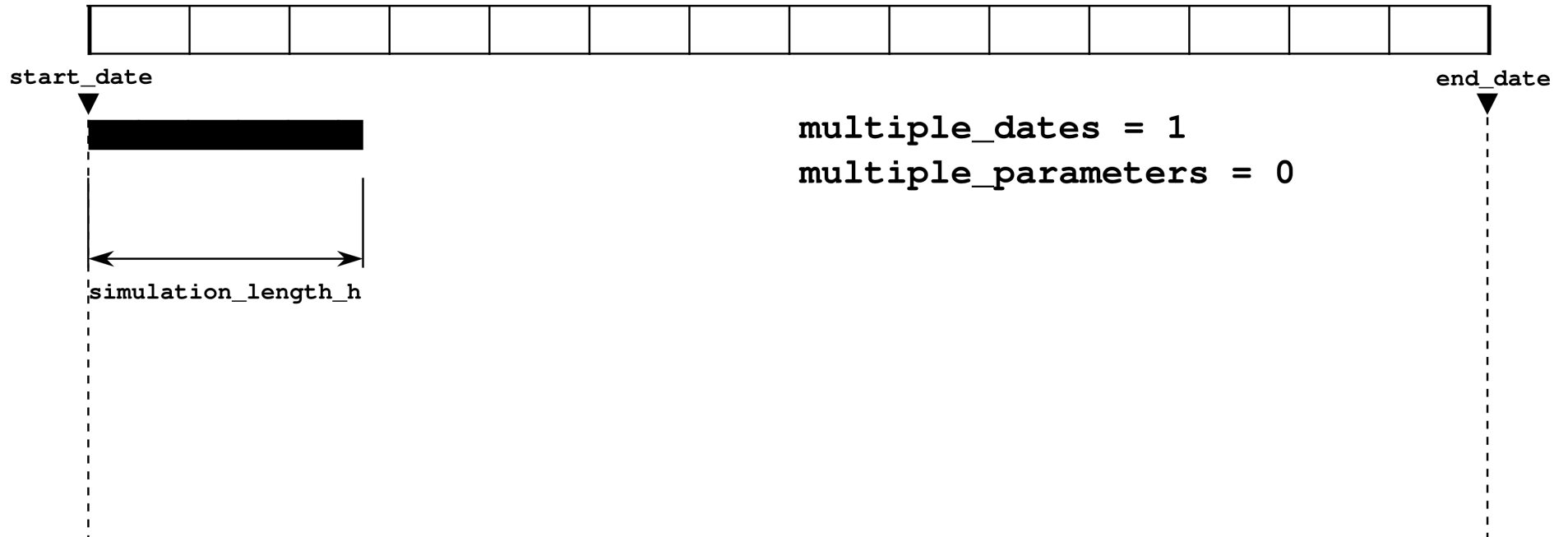
start_date

end_date

```
multiple_dates = 1  
multiple_parameters = 0
```

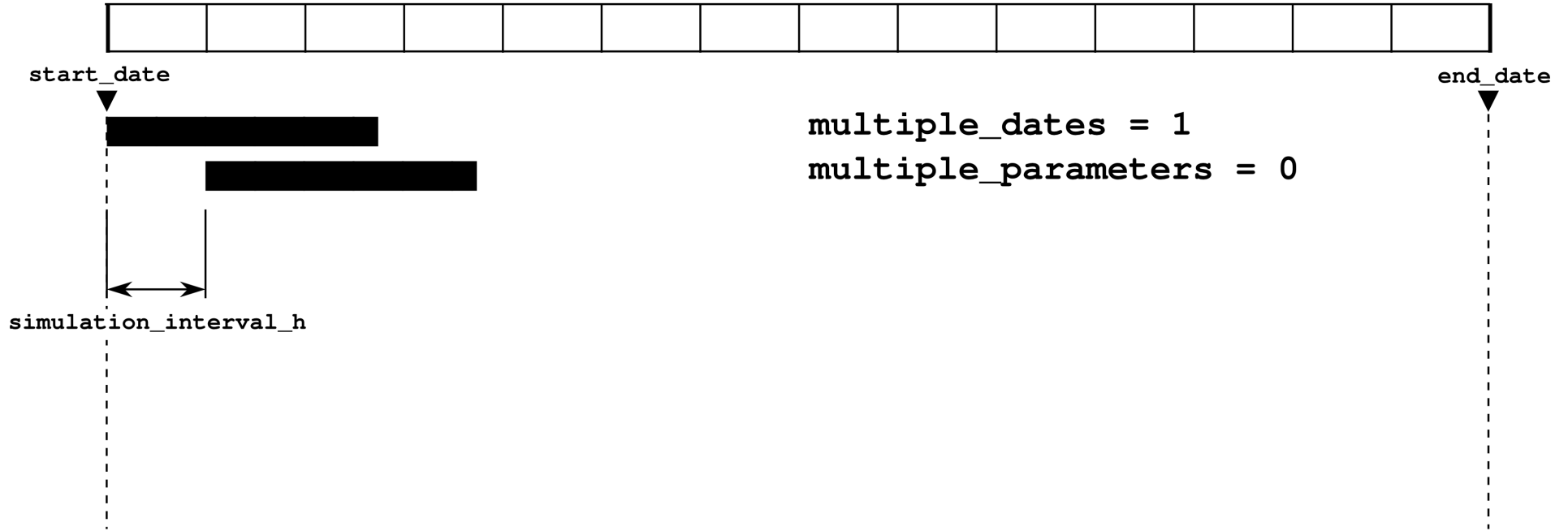
Experiment definition

Days



Experiment definition

Days

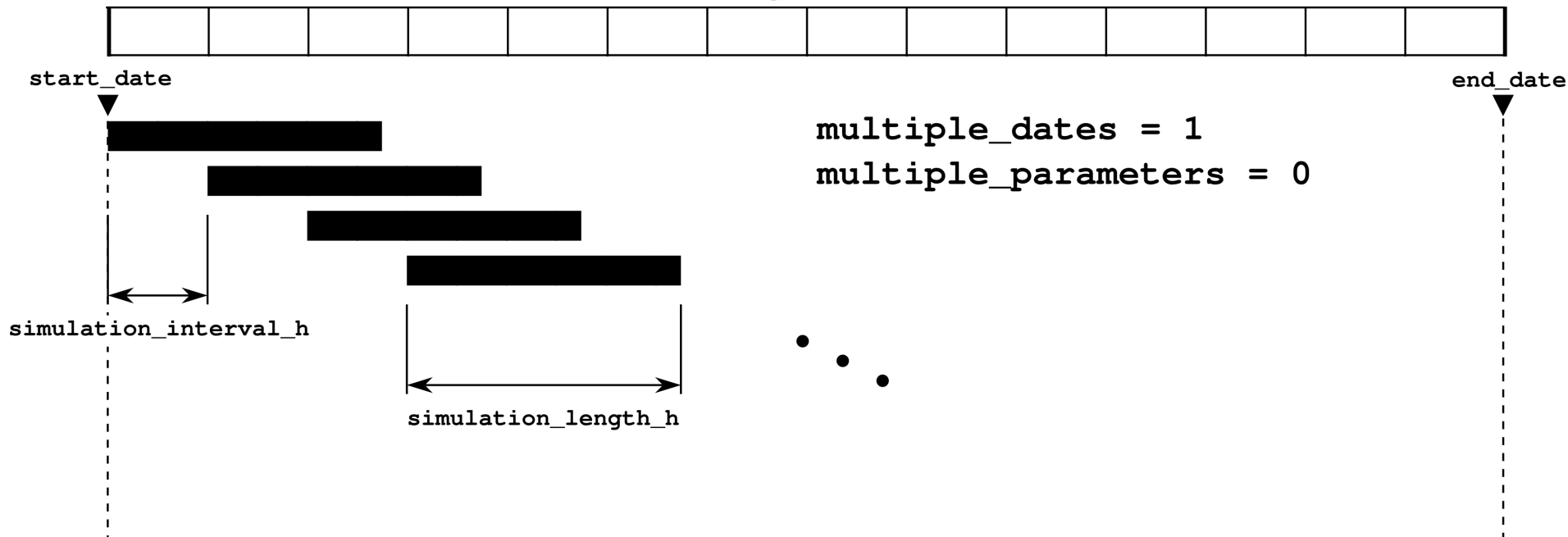


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Experiment definition

Days

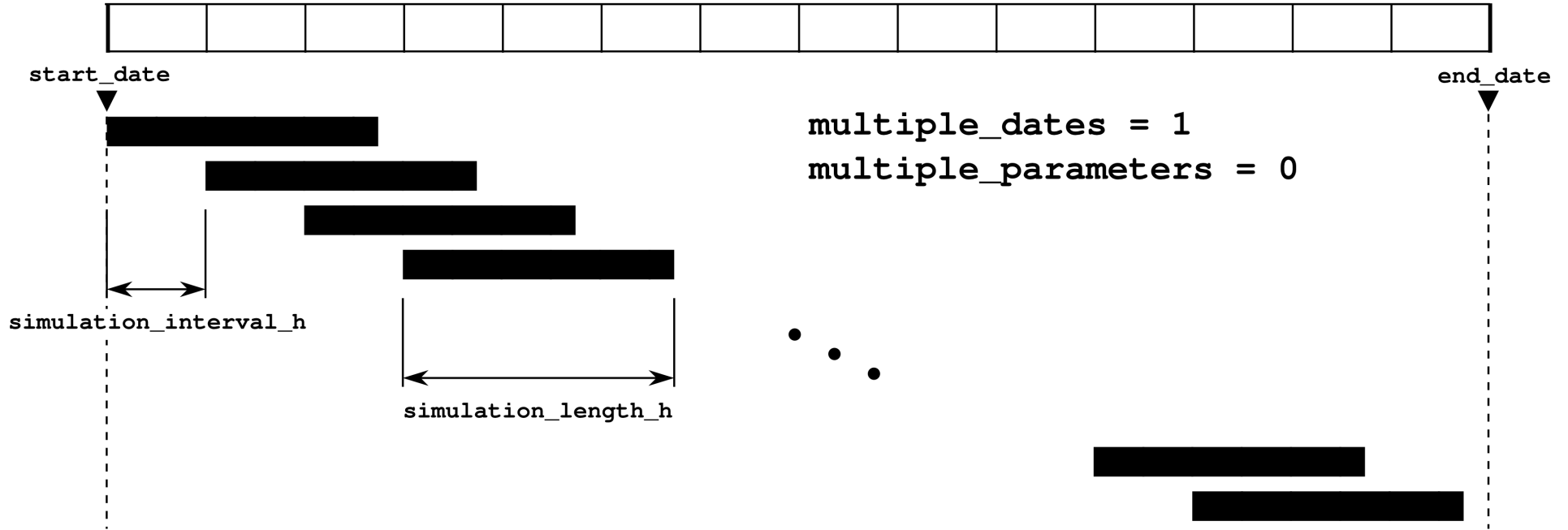


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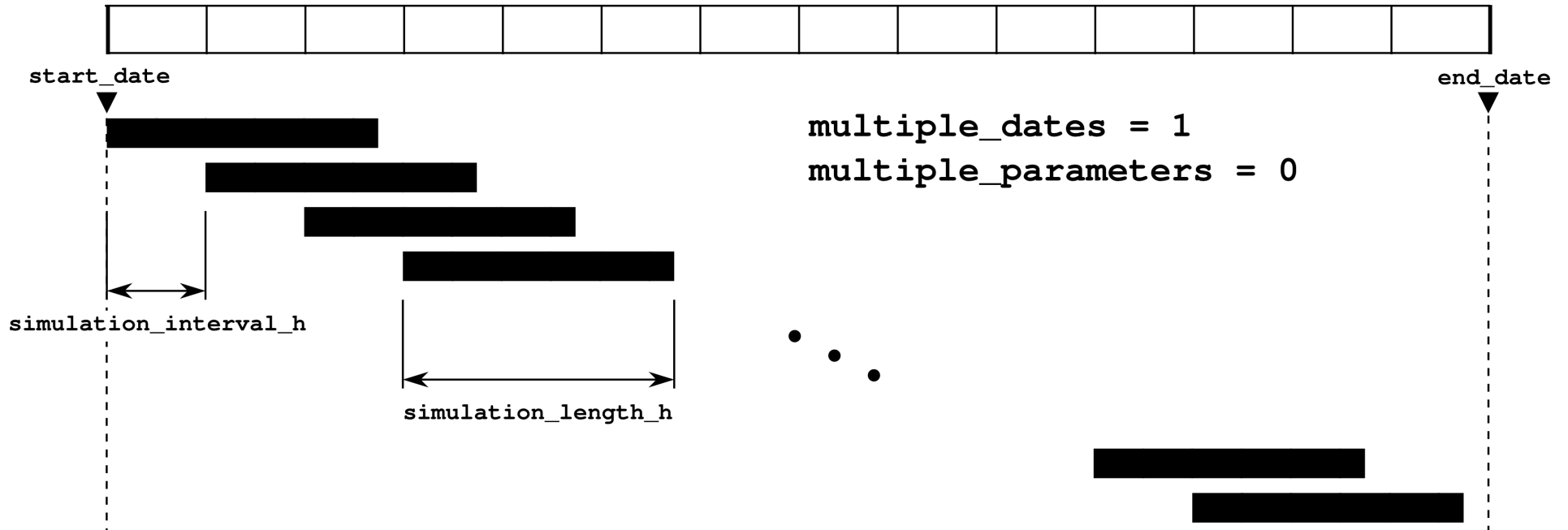
Experiment definition

Days



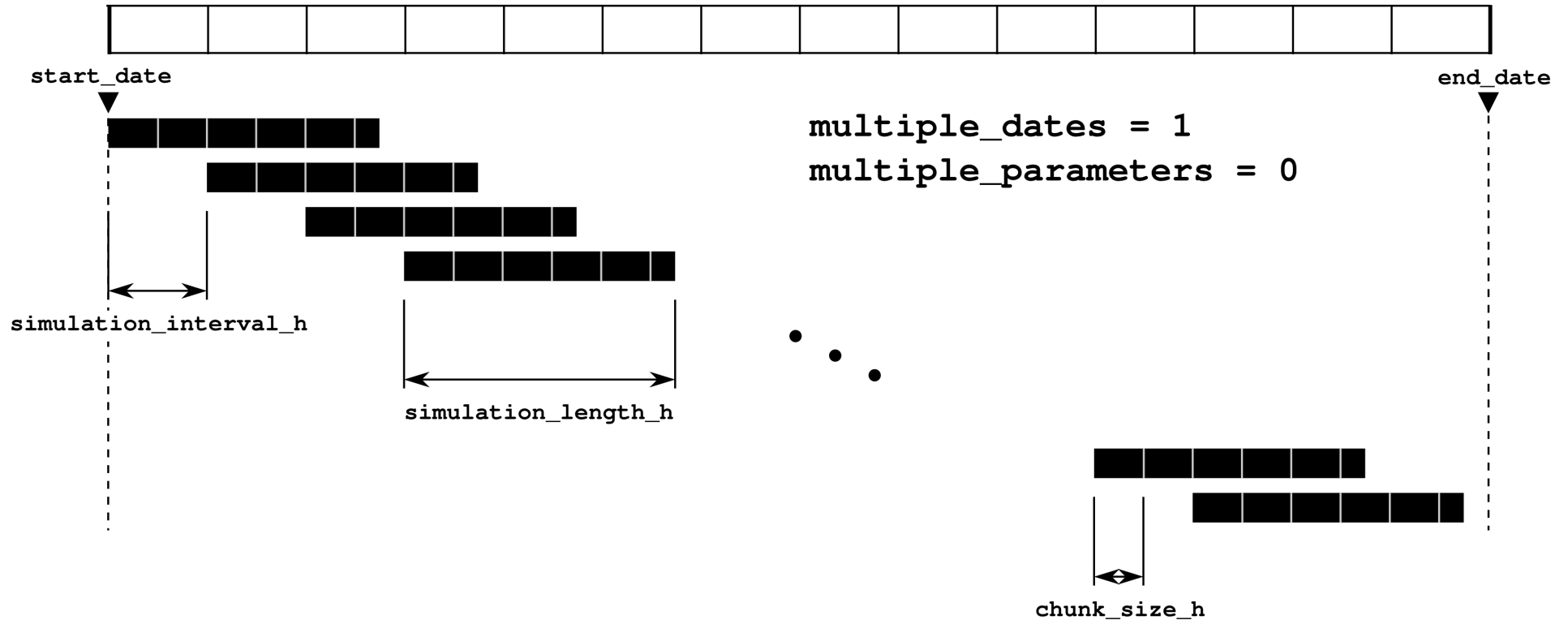
Experiment definition

Months



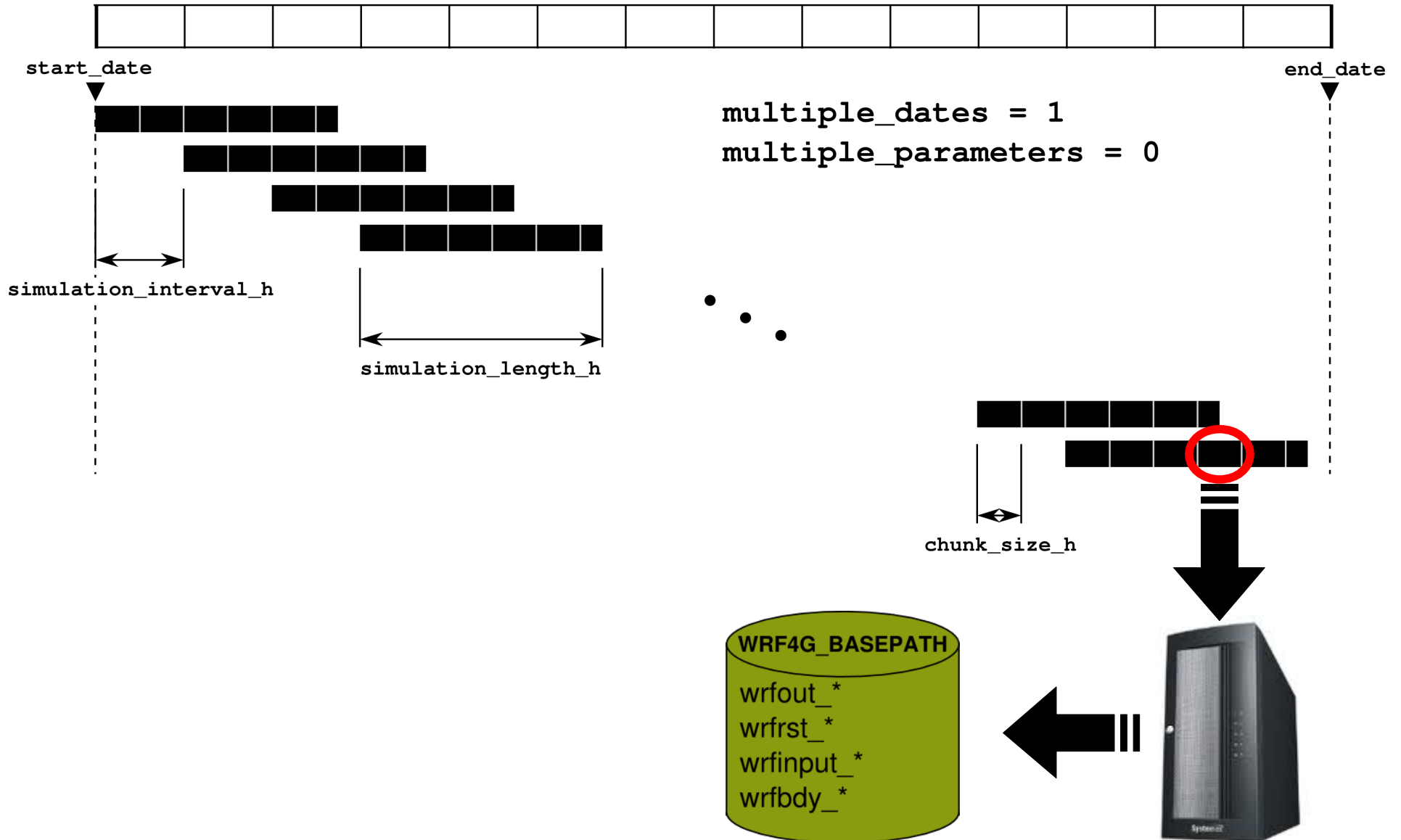
Experiment definition

Months

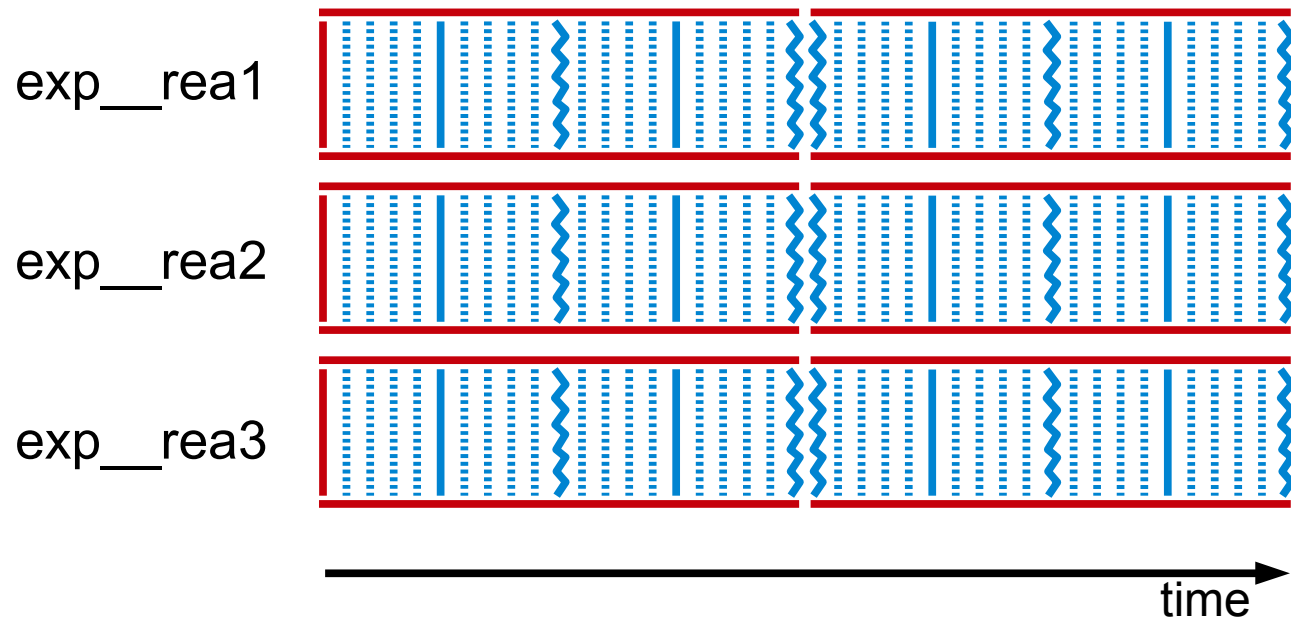


Experiment definition

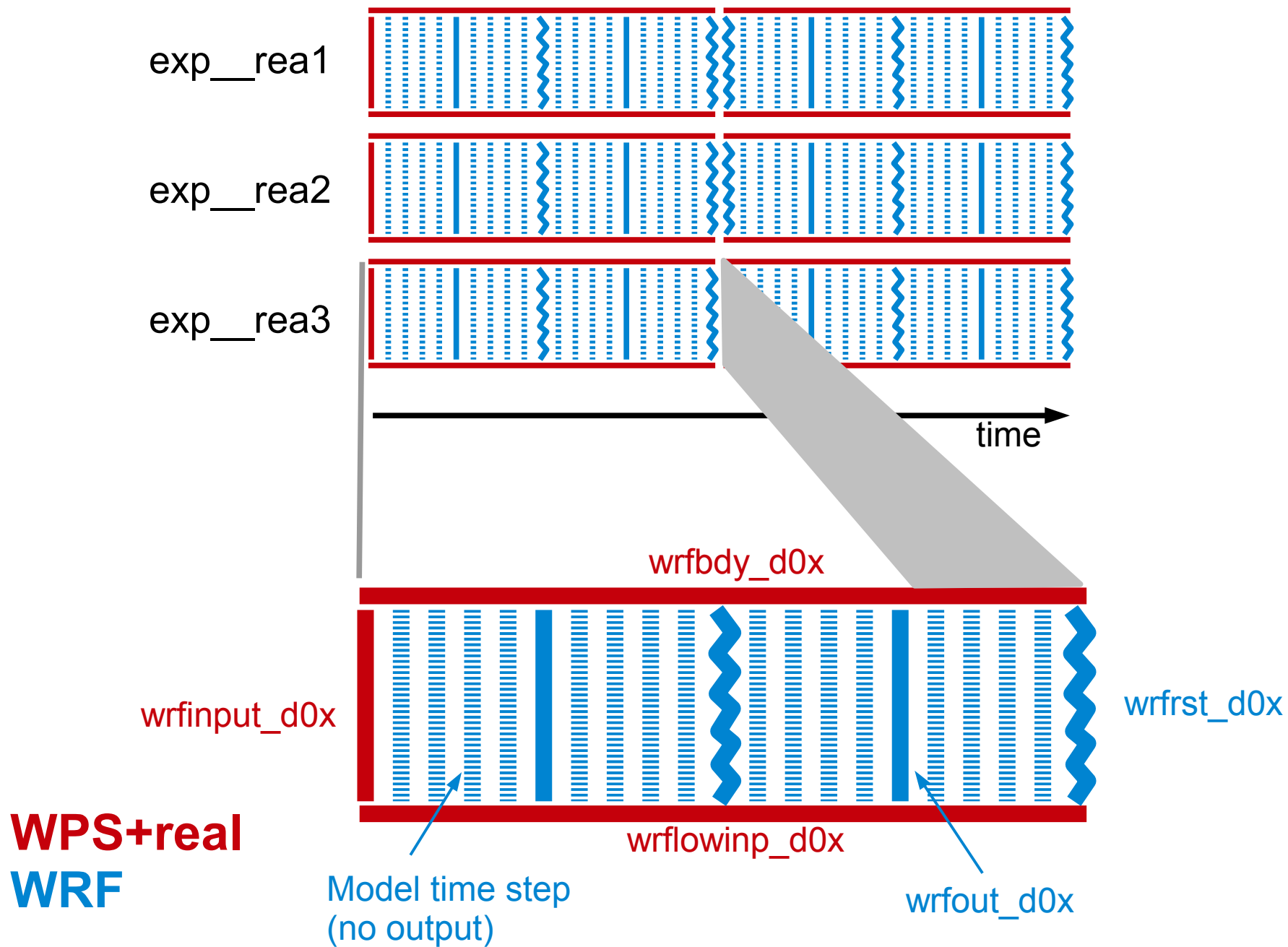
Months



Three realizations split into two chunks each:



Three realizations split into two chunks each:

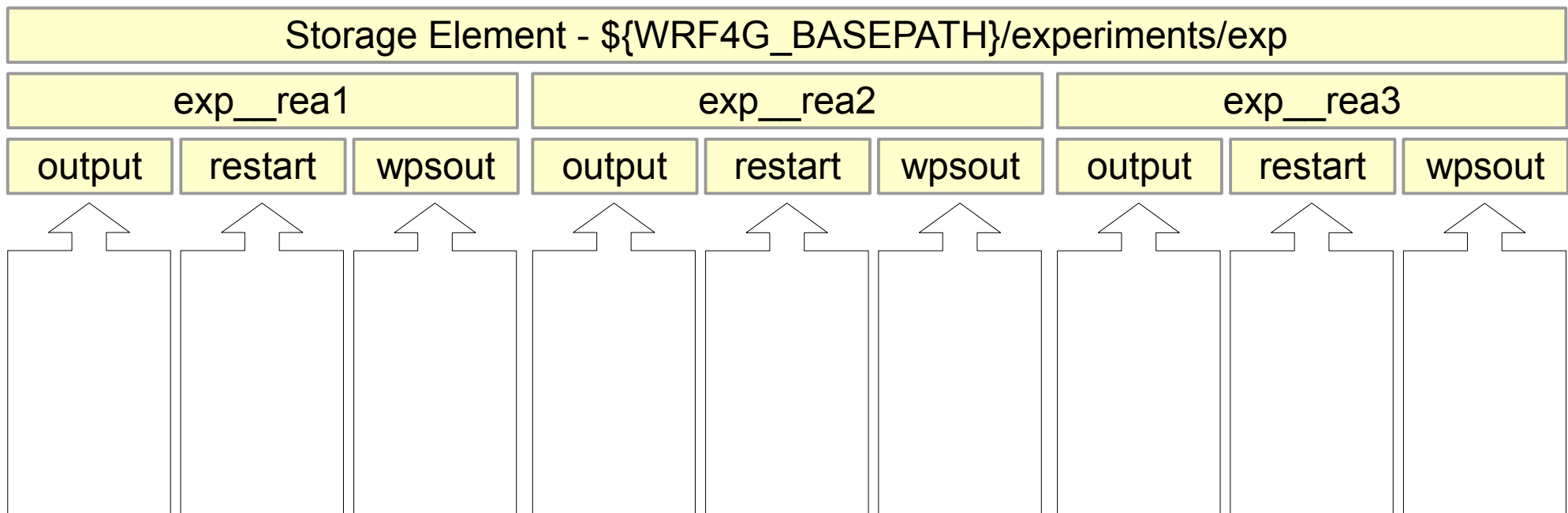
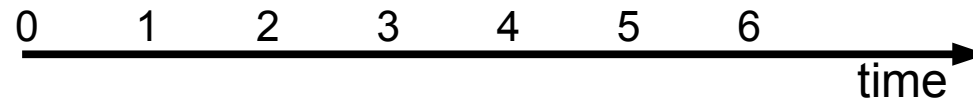


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

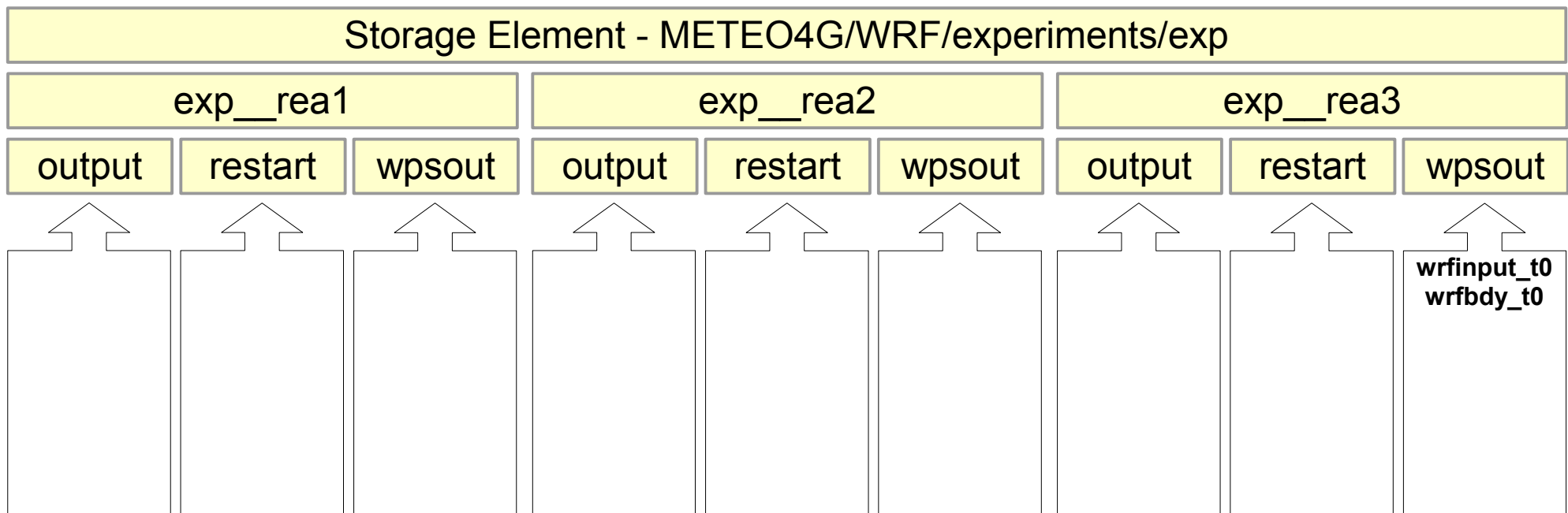
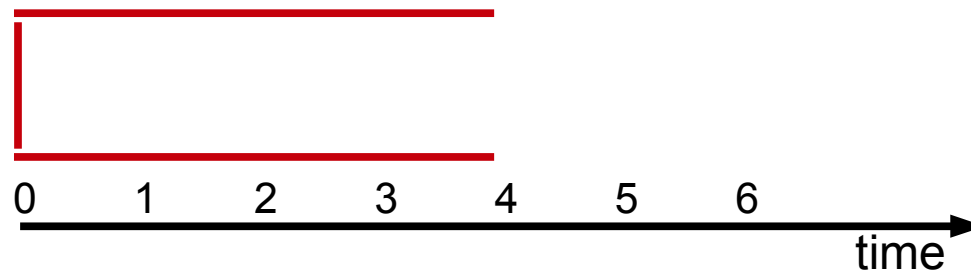


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

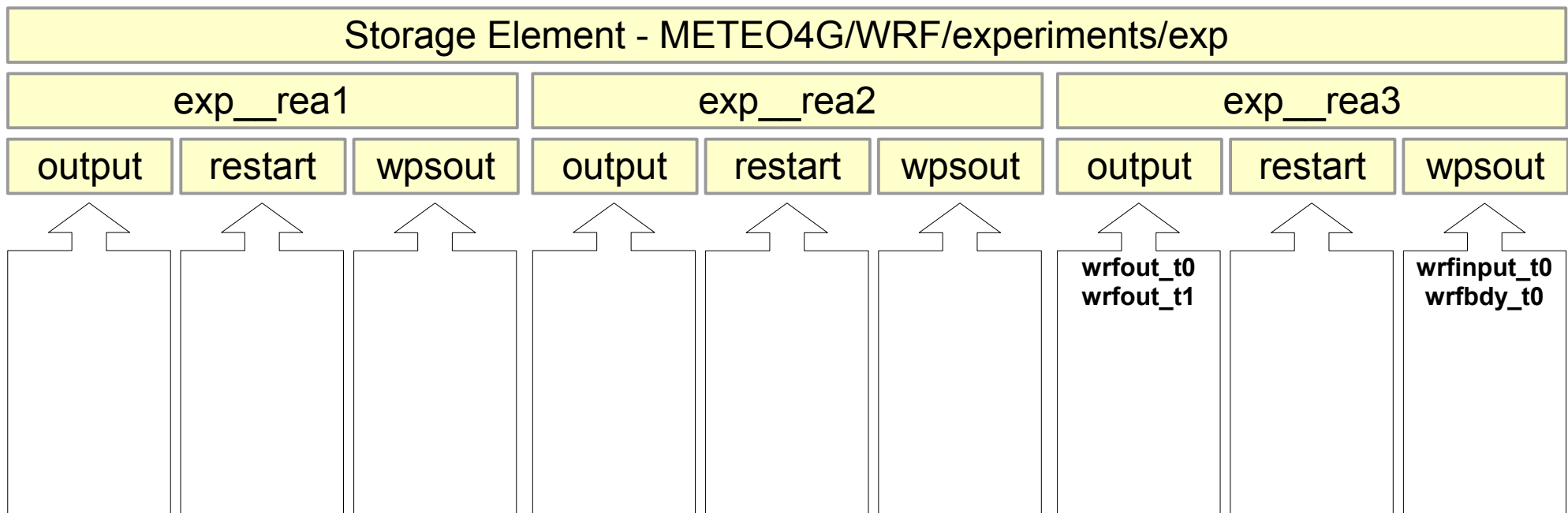
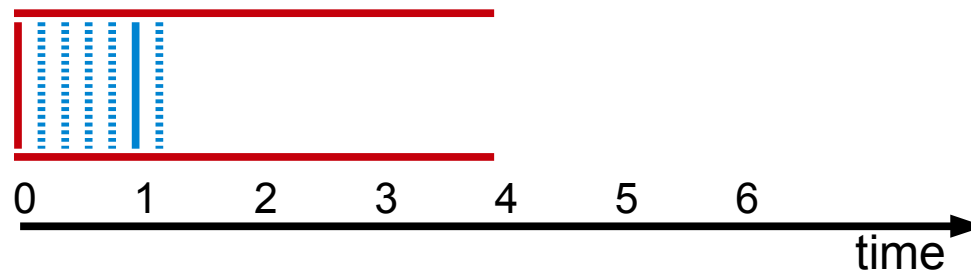


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

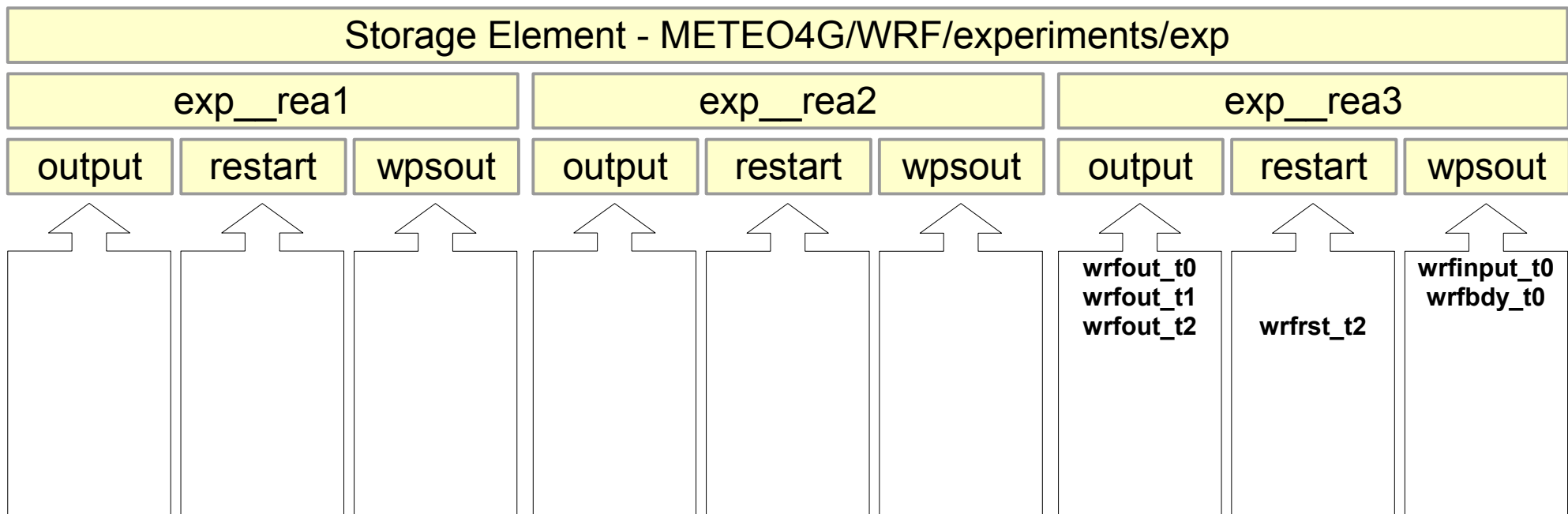
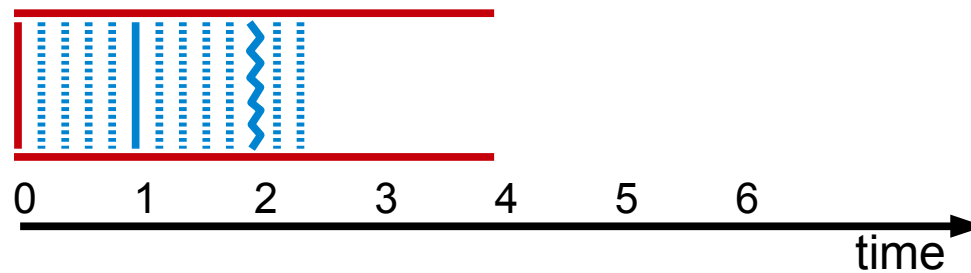


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

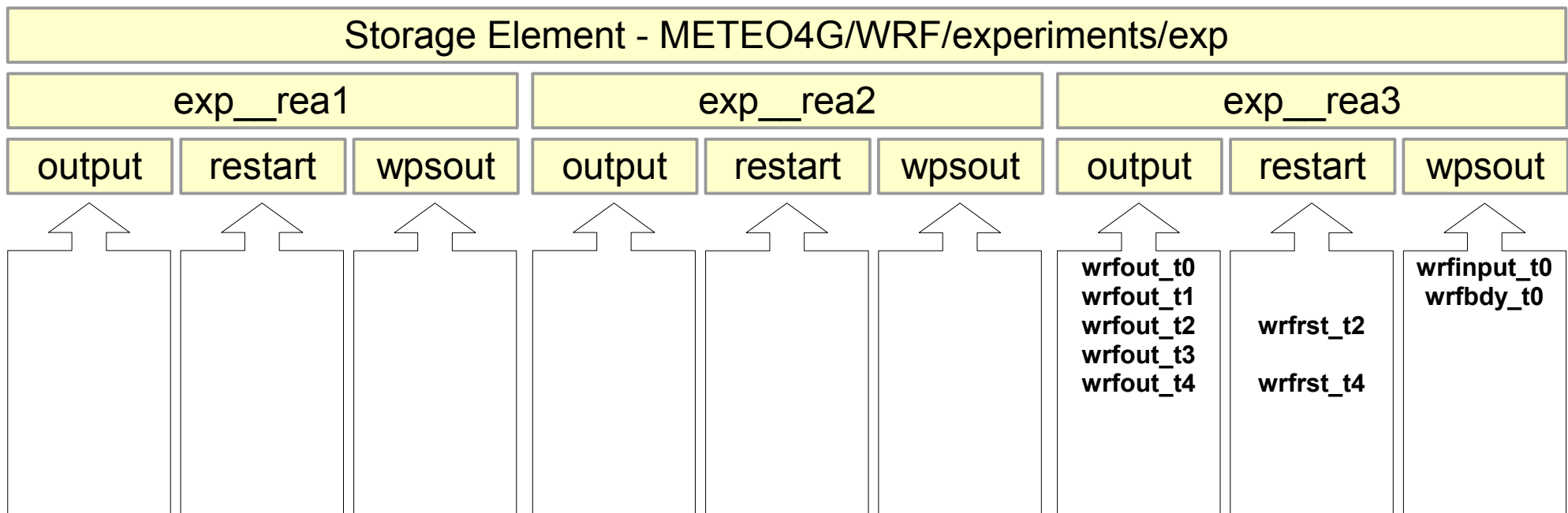
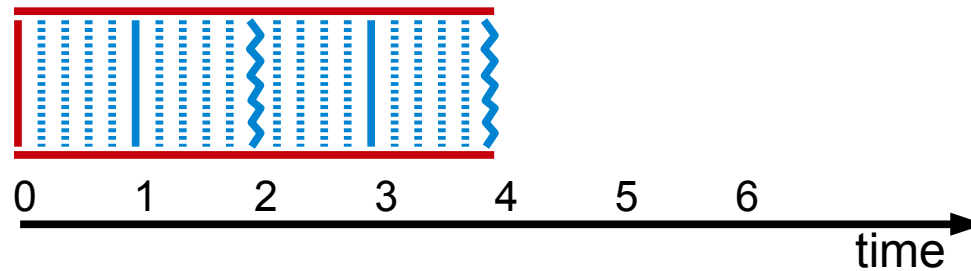


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

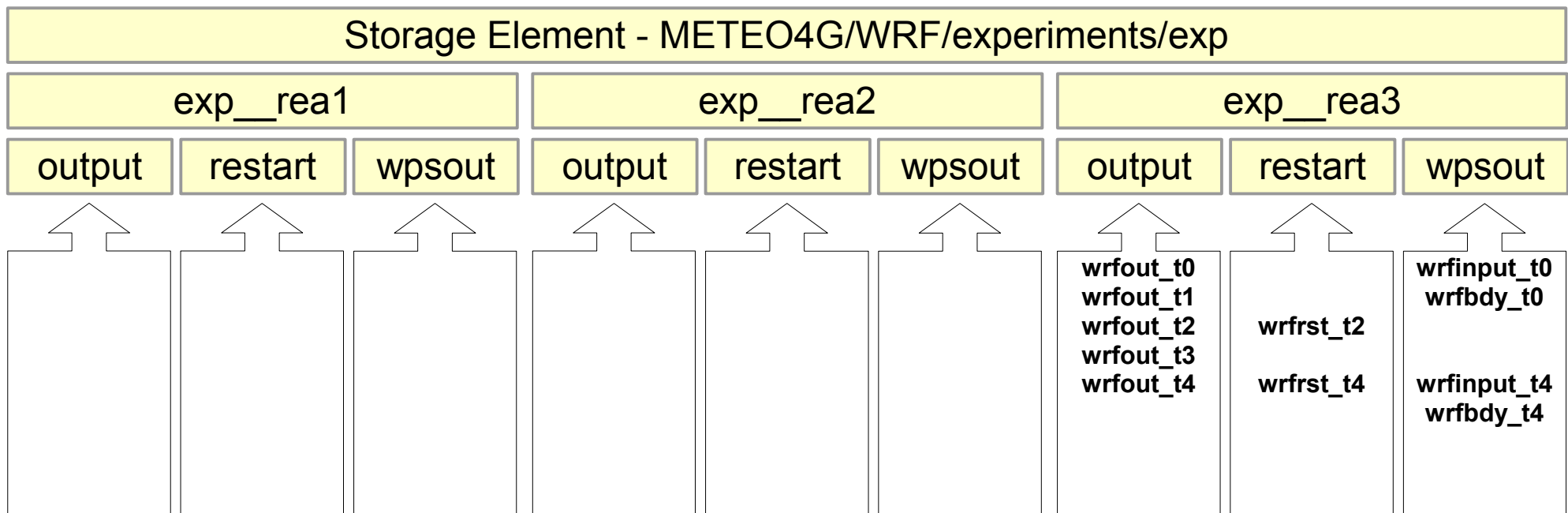
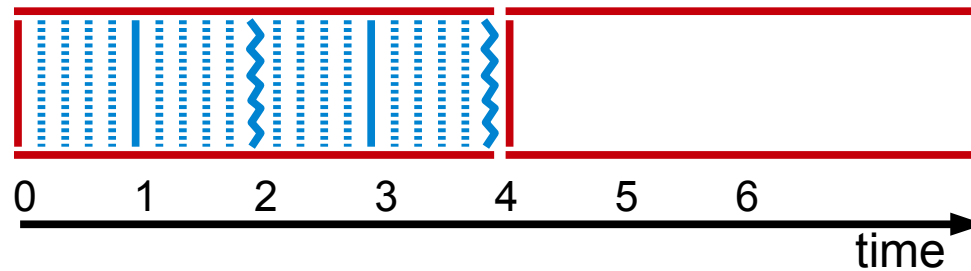


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

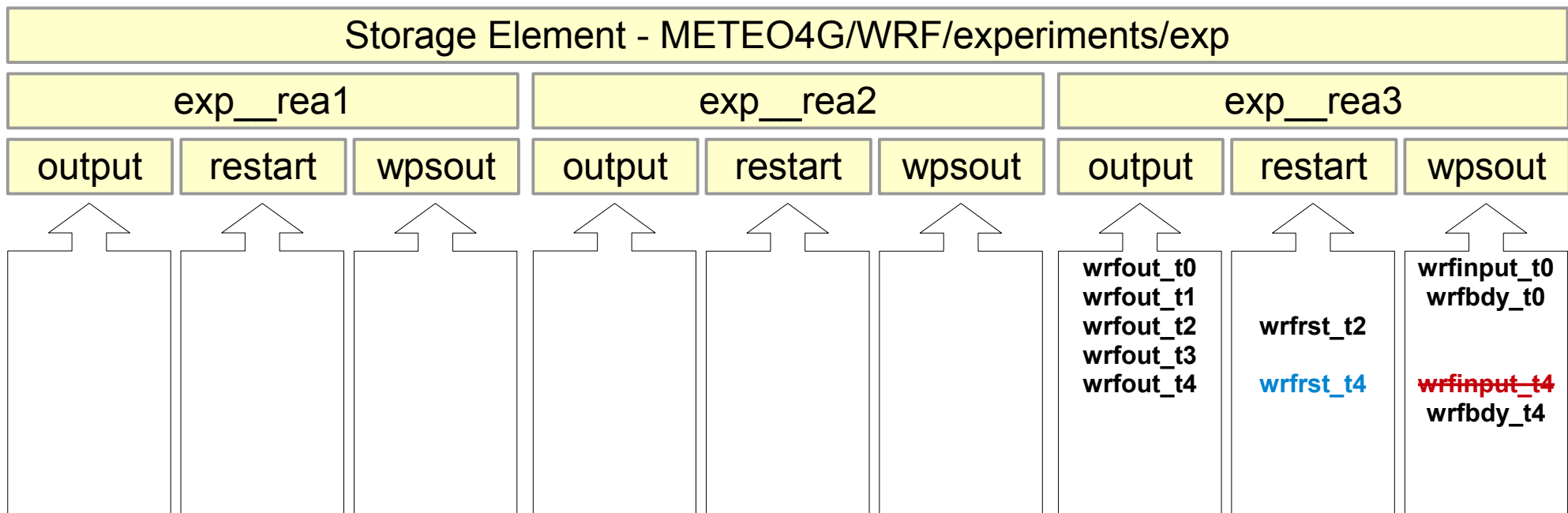
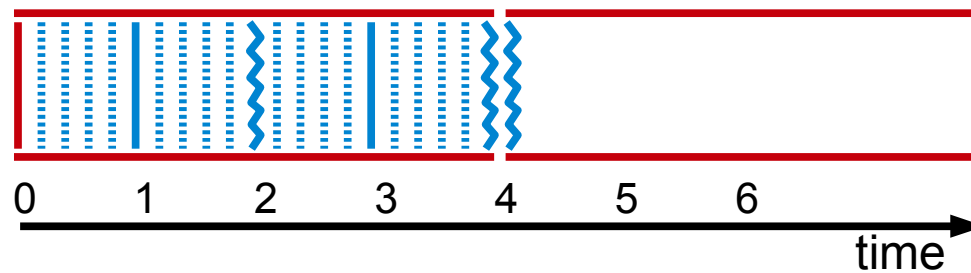


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

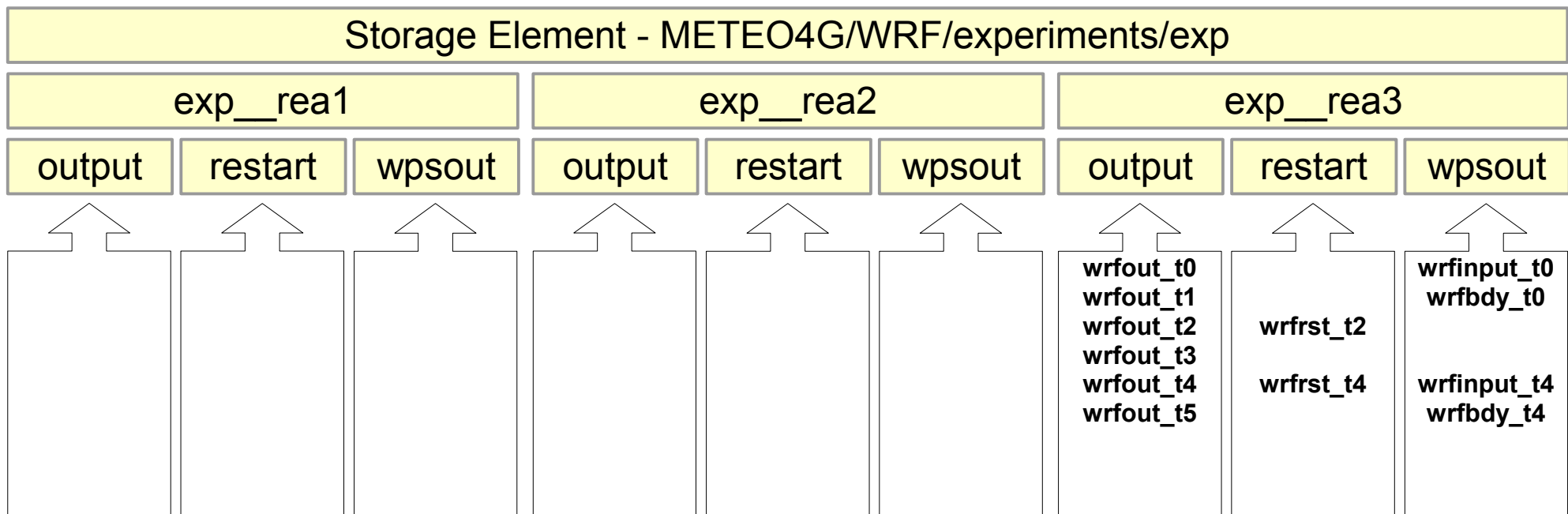
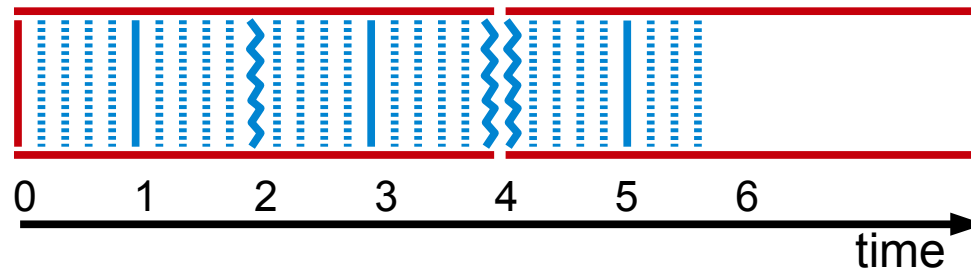


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3

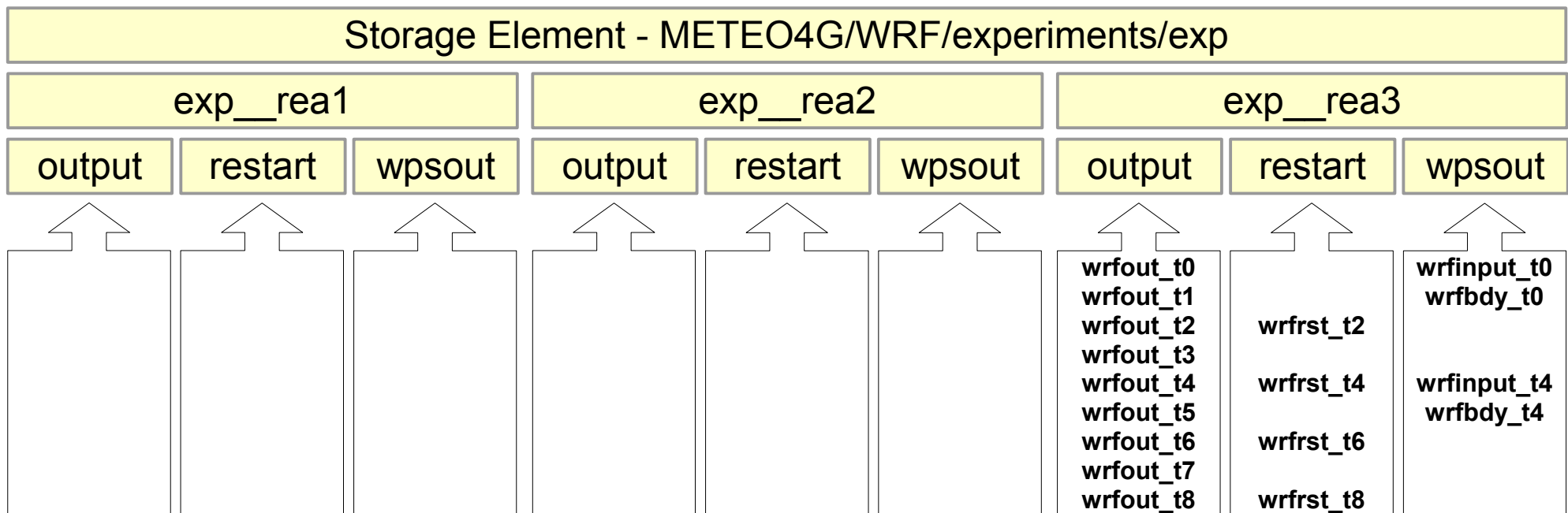
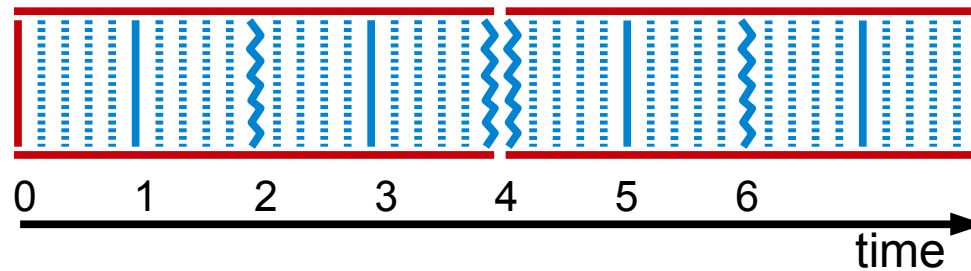


Three realizations split into two chunks each:

exp__rea1

exp__rea2

exp__rea3



Three realizations split into two chunks each:

