Australian Government
Bureau of Meteorology

The Australian Water Resources Assessment (AWRA) Modelling System Implementation Project

Getting Australia's data and model infrastructure ready for the future

Dr Adam Smith

29 October 2014

Australian Government
Bureau of Meteorology

Why do we need the AWRA Modelling System?

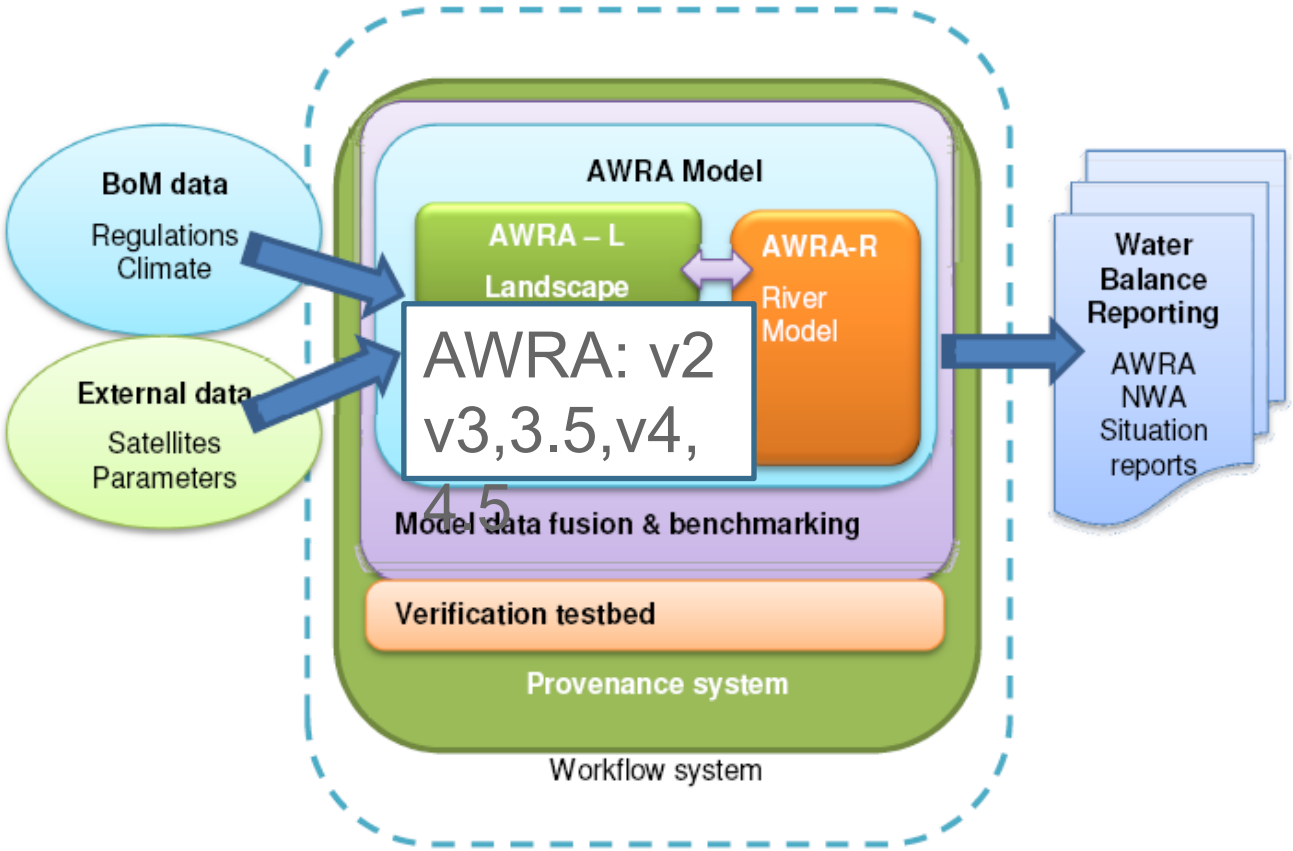
- The Australian Water Resources Assessment (AWRA) Modelling System underpins the Bureau of Meteorology water information services that are federally mandated through the Water Act (2007).

- The AWRA model has been developed for more than six years through the Water Information Research And Development Agreement (WIRADA) collaboration between the Bureau of Meteorology and the Commonwealth Scientific and Industrial Research Organisation (CSIRO).

- While a prototype AWRA Modelling System was developed through WIRADA the AWRA Modelling System has been significantly refactored and enhanced through the Bureau of Meteorology AWRA Modelling System Implementation (AWRAMSI) Project.

Australian Government
Bureau of Meteorology

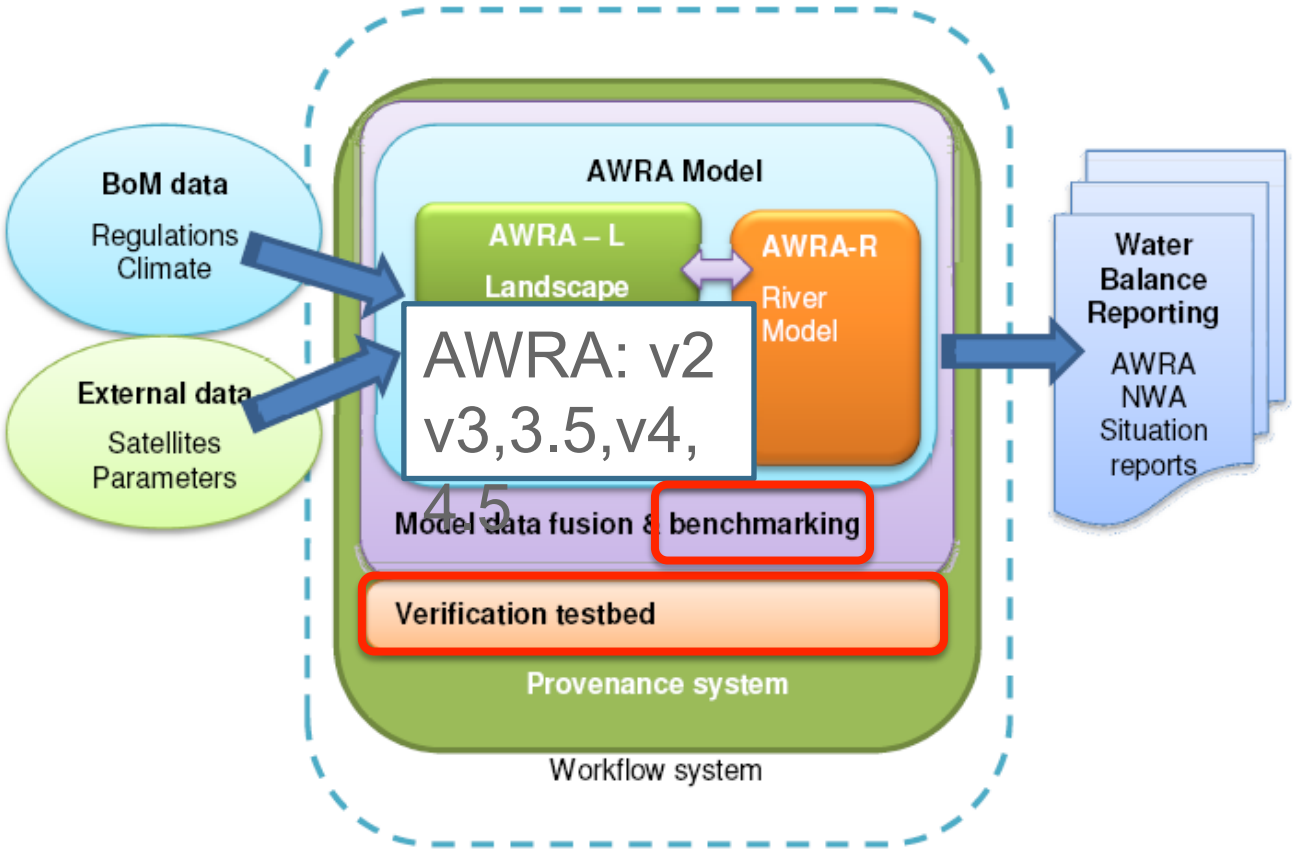
Conceptual diagram of AWRA Modelling System (AWRAMS)



Notes: * verification testbed is an IT verification of code
* model data fusion is calibration of AWRA-L and AWRA-R against observations
* benchmarking is hydrological verification of performance

Australian Government
Bureau of Meteorology

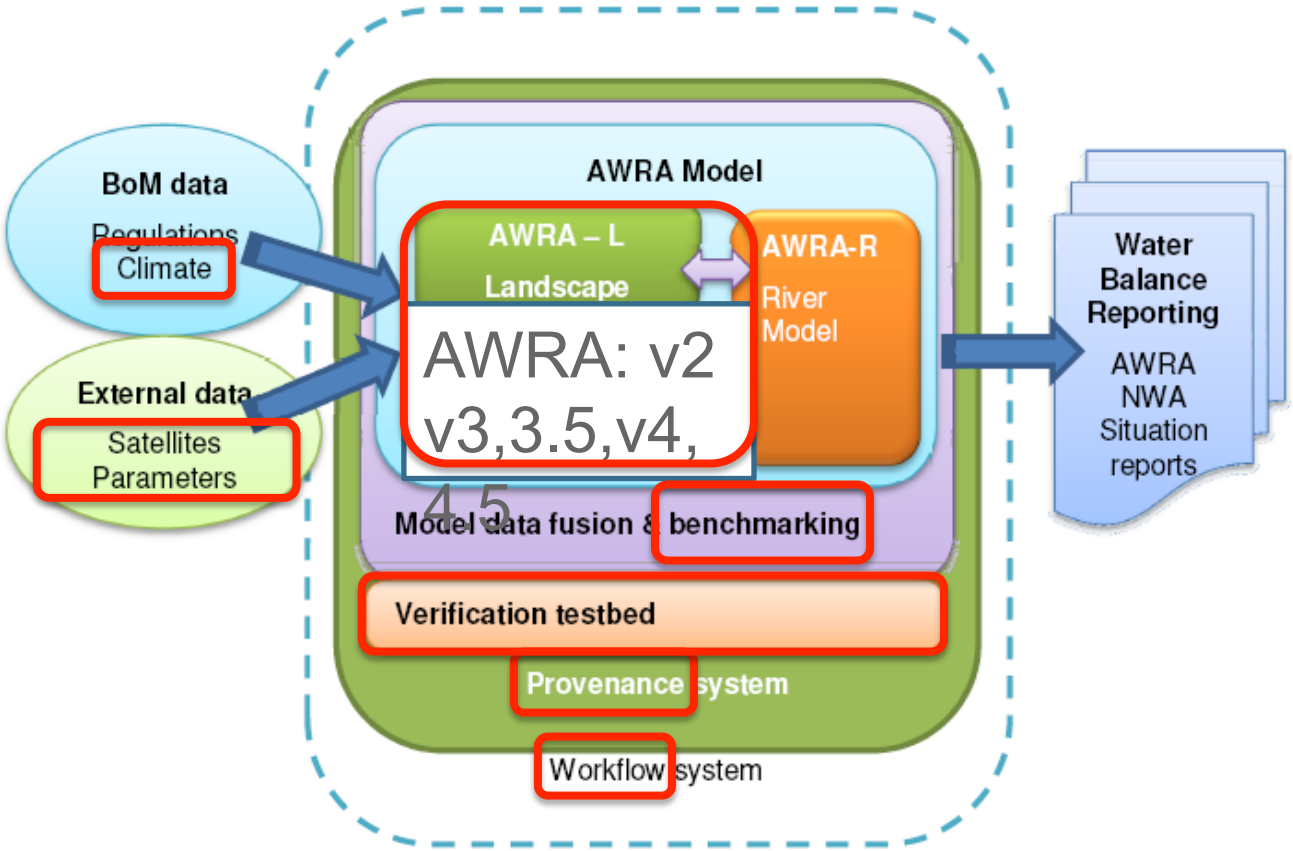
AWRAMSI Quality Assurance – Code Verification & Hydrological Benchmarking



Notes: * verification testbed is an IT verification of code
* model data fusion is calibration of AWRA-L and AWRA-R against observations
* benchmarking is hydrological verification of performance

Australian Government
Bureau of Meteorology

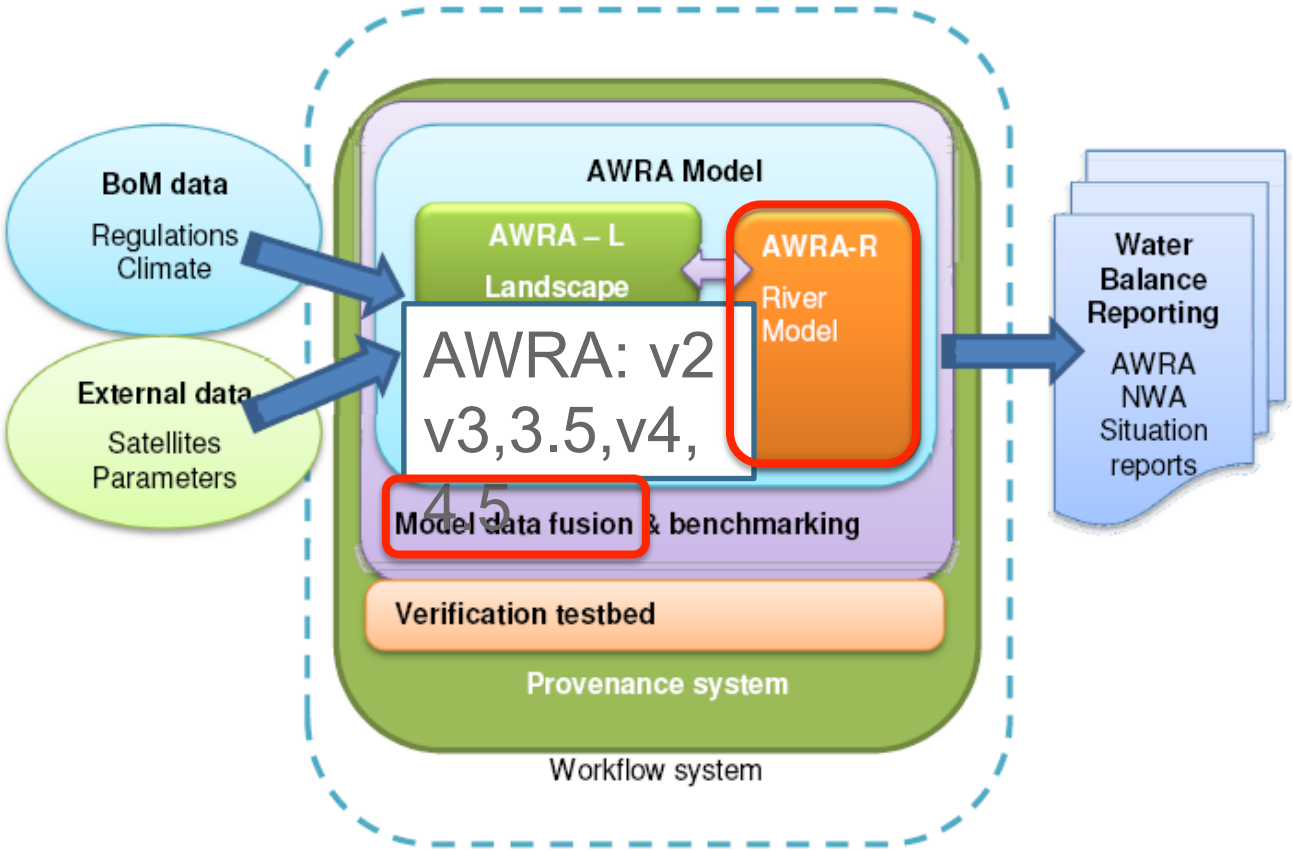
AWRAMSI Work Complete or Nearing Completion



Notes: * verification testbed is an IT verification of code
* model data fusion is calibration of AWRA-L and AWRA-R against observations
* benchmarking is hydrological verification of performance

Australian Government
Bureau of Meteorology

AWRAMSI Work In Progress – Calibration and AWRA-R



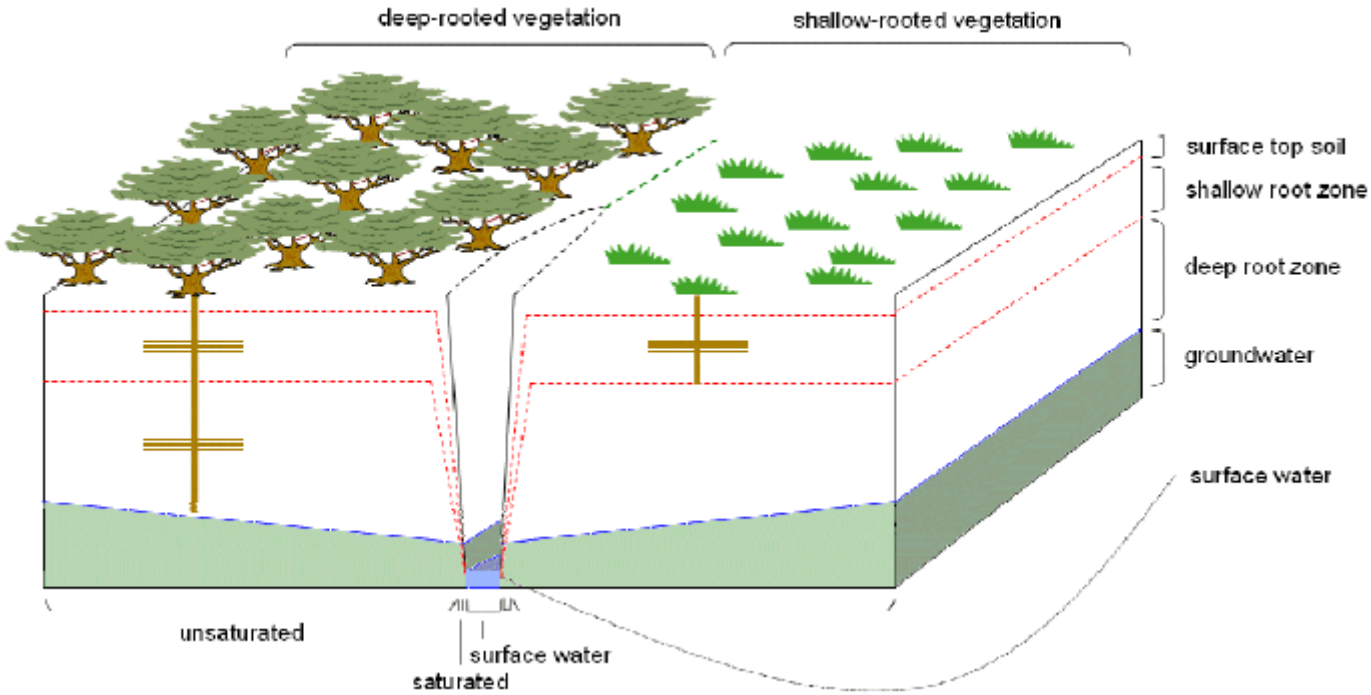
Notes: * verification testbed is an IT verification of code
* model data fusion is calibration of AWRA-L and AWRA-R against observations
* benchmarking is hydrological verification of performance

Australian Government
Bureau of Meteorology

AWRA-L
The AWRA Landscape Model

- Runs for the continent on a 0.05 degree (~5 km) grid
- Runs for the period 1911 to yesterday at daily resolution

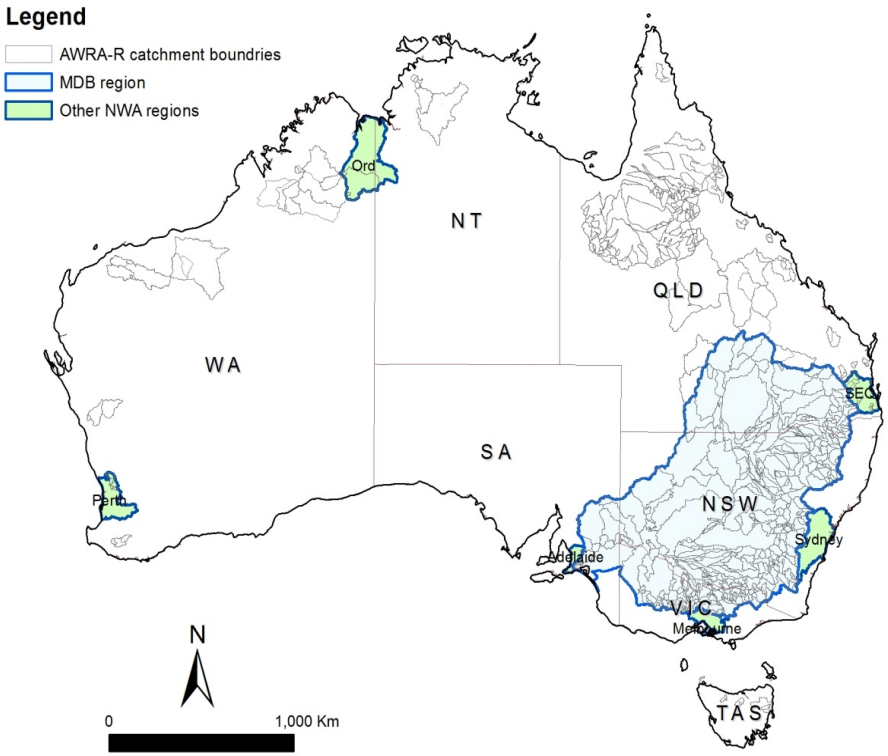
- Consists of two hydrological response units (HRUs)

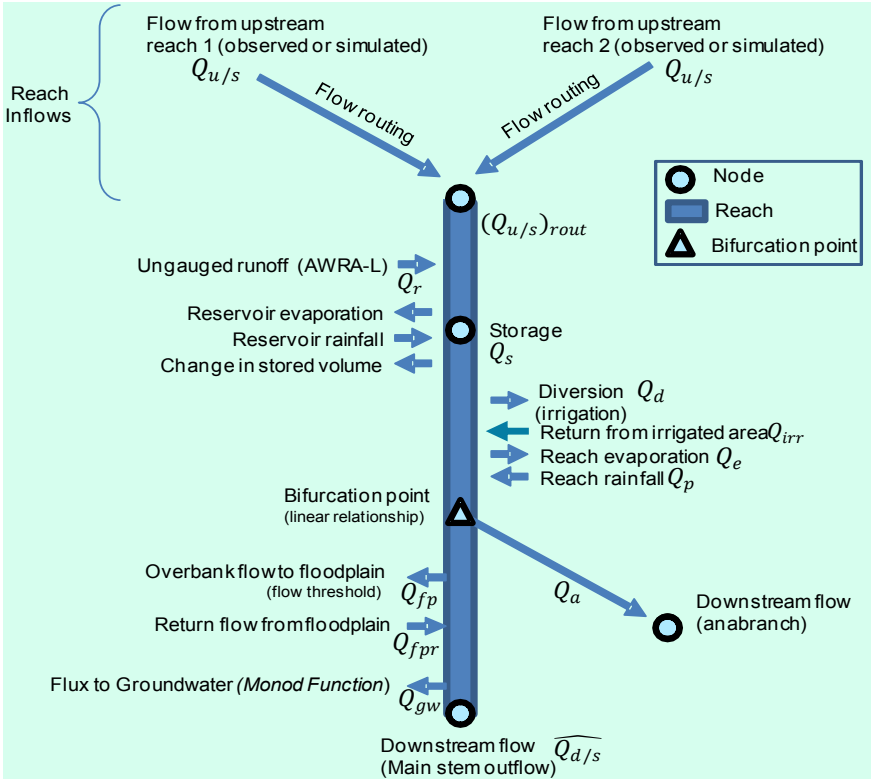


Australian Government
Bureau of Meteorology

AWRA-R
The AWRA River Model

- Runs for river basins around capital cities and the Murray Darling Basin on a node-link network
- Runs for the period 1970 to 2013 at daily resolution





Australian Government
Bureau of Meteorology

AWRA Modelling System
Modes Of Operation

1. Interactive
   - Simulation runs of AWRA-L and AWRA-R over arbitrary regions and time periods with ability to switch outputs, inputs, parameters and initial states
   - Visualisation of maps and timeseries with arbitrary aggregation
   - Benchmarking of AWRA-L and AWRA-R runs against observations

2. Scheduled Run
   - Outputs generated daily for 1 January 1911 to yesterday
   - Shared internally to Bureau of Meteorology via THREDDS
   - Soon shared to external parties and available on NCI via RDSI
   - May soon underpin a Bureau of Meteorology soil moisture website

3. Calibration
   - Fitting AWRA-L and AWRA-R models to observations (streamflow, soil moisture and ET)

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [ ]:
```
import simulation
from simulation import *
from test_support import *
```

In [ ]:
```
#inputs.default()
inputs.fill_gaps_with.climatology()
outputs.destination = test_output_path("_basicRunResults")
outputs.existing_files.overwrite()
parameters.l.default()
parameters.spatial.default()
states.initial.default()
simulation.period = dt.dates("2000","2014/10/22")
extents.select.all()
```

In [ ]:
```
simulation.run()
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/pyt
hon2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time
. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.
py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
2014-10-27 10:45:56,475 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
```

In [ ]:
```
#inputs.default()
inputs.fill_gaps_with.climatology()
outputs.destination = test_output_path("_basicRunResults")
outputs.existing_files.overwrite()
parameters.l.default()
parameters.spatial.default()
states.initial.default()
simulation.period = dt.dates("2000","2014/10/22")
extents.select.all()
```

In [ ]:
```
simulation.run()
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/pyt
hon2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time
. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.
py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
2014-10-27 10:45:56,475 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
```

In [ ]:
```
#inputs.default()
inputs.fill_gaps_with.climatology()
outputs.destination = test_output_path("_basicRunResults")
outputs.existing_files.overwrite()
outputs.existing_files.
```

```
outputs.existing_files.append
outputs.existing_files.overwrite
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5 J.xml for AWRA-L v45
```

```
outputs.select.qtot_avg
outputs.select.s0_avg
outputs.select.s0_dr
outputs.select.s0_sr
outputs.select.s_avg
outputs.select.sd_avg
outputs.select.sd_dr
outputs.select.sd_sr
outputs.select.sg_bal
outputs.select.sr_bal
```

```
ading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.

 Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_

ading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
```

In [ ]:
```
ology()
utput_path("_basicRunResults")
outputs.select.
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
2014-10-27 10:45:56,475 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

In [ ]:
```
#inputs.default()
inputs.fill_gaps_with.climatology()
outputs.destination = test_output_path("_basicRunResults")
outputs.existing_files.overwrite()
parameters.l.default()
parameters.
```

parameters.l
parameters.landscape
parameters.s
parameters.spatial

ult()
)
dates("2000","2014/10/22")

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

```
parameters.l.slope_coeff
parameters.l.tgrow
parameters.l.tsenc
parameters.l.ud0
parameters.l.us0
parameters.l.vc
parameters.l.w0lime
parameters.l.w0ref_alb
parameters.l.wdlimu
parameters.l.wslimu
```

In [ ]:
```
parameters.l.
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/pyt
hon2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time
. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.
py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
2014-10-27 10:45:56,475 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
```

In [ ]:
```
#inputs.default()
inputs.fill_gaps_with.climatology()
outputs.destination = test_output_path("_basicRunResults")
outputs.existing_files.overwrite()
parameters.1.default()
```

extents.select.all
extents.select.bounds
extents.select.catchment
extents.select.cell

```
s("2000","2014/10/22")
extents.select.
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/pyt
hon2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time
. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.
py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
2014-10-27 10:45:56,475 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
```

In [ ]:
```
#inputs.default()
inputs.fill_gaps_with.climatology()
outputs.destination = test_output_path("_basicRunResults")
outputs.existing_files.overwrite()
parameters.l.default()
parameters.spatial.default()
states.initial.default()
simulation.period = dt.dates("2000","2014/10/22")
extents.select.all()
extents.select.catchment.
```

```
extents.select.catchment.by_id
extents.select.catchment.by_name
```

In [ ]:

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
import simulation
from simulation import *
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/pyt
hon2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time
. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-27 10:45:55,005 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.
py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-27 10:45:56,413 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
2014-10-27 10:45:56,475 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
```

In [ ]:

```
extents.select.catchment.by_name.KyeambaCk_BookBook
extents.select.catchment.by_name.KyeambaCk_Ladysmith
extents.select.catchment.by_name.Lachlan_Gunning
extents.select.catchment.by_name.LaidleyCk_Mulgowie2
extents.select.catchment.by_name.LakeAceCk_SpencersFarm
extents.select.catchment.by_name.LakeKingCk_Gardner
extents.select.catchment.by_name.Landsdowne_Landsdowne
extents.select.catchment.by_name.LangLangR_LangLangHeadRd
extents.select.catchment.by_name.LardnerCk_Gellibrand
extents.select.catchment.by_name.Latrobe_HawthornBr
```

```
extents.select.catchment.by_name.
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [2]:
```
#inputs.default()
inputs.fill_gaps_with.climatology()
outputs.destination = test_output_path("_basicRunResults")
outputs.existing_files.overwrite()
parameters.l.default()
parameters.spatial.default()
states.initial.default()
simulation.period = dt.dates("2000","2014/10/22")
extents.select.all()
```

```
2014-10-27 11:51:20,563 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
2014-10-27 11:51:20,666 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
5_J.xml for AWRA-L v45
```

In [ ]:
```
simulation.run()
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [*]:
```
simulation.run()
```

```
INFO:simulation_server:2014-10-27 11:54:36,320 INFO Loading climatology for all months from /data/cwd_awra
_data/AWRAMSI/IWRM_0042_WP3/Technical/Climate/Climatology/Solar/Rad_1990_2009.nc
INFO:simulation_server:2014-10-27 11:54:38,242 INFO Generating MD5 summaries for Spatial Parameters
INFO:simulation_server:2014-10-27 11:54:40,045 INFO Generating MD5 summaries for temp_min_day input files
INFO:simulation_server:2014-10-27 11:54:40,963 INFO Generating MD5 summaries for solar_exposure_day input
files
INFO:simulation_server:2014-10-27 11:54:41,744 INFO Generating MD5 summaries for climatology file /data/cw
d_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Climate/Climatology/Solar/Rad_1990_2009.nc
INFO:simulation_server:2014-10-27 11:54:41,792 INFO Generating MD5 summaries for rain_day input files
INFO:simulation_server:2014-10-27 11:54:42,292 INFO Generating MD5 summaries for temp_max_day input files
INFO:simulation_server:2014-10-27 11:54:43,011 INFO Adding simulation provenance information to all files
INFO:simulation_server:2014-10-27 11:54:48,741 INFO Loading climate data for temp_min_day from /data/cwd_a
wra_data/awra_inputs/climate/tmin/tmin_*.nc

INFO:simulation_server:2014-10-27 11:54:48,746 INFO Loading climate data for solar_exposure_day from /data
/cwd_awra_data/awra_inputs/climate/solar/solar_*.nc

INFO:simulation_server:2014-10-27 11:54:48,748 INFO Loading climate data for rain_day from /data/cwd_awra_
data/awra_inputs/climate/rr/rr_*.nc

INFO:simulation_server:2014-10-27 11:54:48,749 INFO Loading climate data for temp_max_day from /data/cwd_a
wra_data/awra_inputs/climate/tmax/tmax_*.nc

INFO:simulation_server:2014-10-27 11:54:48,763 INFO Loading climatology for all months from /data/cwd_awra
_data/AWRAMSI/IWRM_0042_WP3/Technical/Climate/Climatology/Solar/Rad_1990_2009.nc
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

```
INFO:simulation_server:2014-10-27 11:54:50,782 INFO Applying climatology for solar_exposure_day from /data
/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Climate/Climatology/Solar/Rad_1990_2009.nc

INFO:simulation_server:2014-10-27 11:54:58,781 INFO Running for period: 2000
INFO:simulation_server:2014-10-27 11:54:58,795 INFO Running cell (12, 603) : 0.00% complete
INFO:simulation_server:2014-10-27 11:55:03,622 INFO Running cell (50, 394) : 0.05% complete
INFO:simulation_server:2014-10-27 11:55:05,747 INFO Running cell (62, 603) : 0.10% complete
INFO:simulation_server:2014-10-27 11:55:08,166 INFO Running cell (75, 437) : 0.15% complete
INFO:simulation_server:2014-10-27 11:55:10,248 INFO Running cell (85, 606) : 0.19% complete
INFO:simulation_server:2014-10-27 11:55:12,367 INFO Running cell (94, 455) : 0.24% complete
INFO:simulation_server:2014-10-27 11:55:14,556 INFO Running cell (102, 360) : 0.29% complete
INFO:simulation_server:2014-10-27 11:55:16,849 INFO Running cell (109, 292) : 0.34% complete
INFO:simulation_server:2014-10-27 11:55:18,978 INFO Running cell (115, 388) : 0.39% complete
INFO:simulation_server:2014-10-27 11:55:21,136 INFO Running cell (121, 423) : 0.44% complete
INFO:simulation_server:2014-10-27 11:55:23,241 INFO Running cell (127, 340) : 0.49% complete
INFO:simulation_server:2014-10-27 11:55:25,112 INFO Running cell (132, 479) : 0.54% complete
INFO:simulation_server:2014-10-27 11:55:27,117 INFO Running cell (137, 505) : 0.58% complete
INFO:simulation_server:2014-10-27 11:55:29,267 INFO Running cell (142, 397) : 0.63% complete
INFO:simulation_server:2014-10-27 11:55:31,402 INFO Running cell (147, 214) : 0.68% complete
INFO:simulation_server:2014-10-27 11:55:33,320 INFO Running cell (151, 409) : 0.73% complete
INFO:simulation_server:2014-10-27 11:55:35,382 INFO Running cell (155, 542) : 0.78% complete
INFO:simulation_server:2014-10-27 11:55:37,500 INFO Running cell (159, 636) : 0.83% complete
INFO:simulation_server:2014-10-27 11:55:39,781 INFO Running cell (164, 263) : 0.88% complete
INFO:simulation_server:2014-10-27 11:55:41,850 INFO Running cell (168, 333) : 0.93% complete
INFO:simulation_server:2014-10-27 11:55:43,866 INFO Running cell (172, 370) : 0.97% complete
INFO:simulation_server:2014-10-27 11:55:45,998 INFO Running cell (176, 399) : 1.02% complete
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Simulation Runs

IP[y]: Notebook BasicRun Last Checkpoint: Oct 23 14:23 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

```
INFO:simulation_server:2014-10-27 13:18:12,978 INFO ModelRunner_2 (26443):
INFO:simulation_server:2014-10-27 13:18:12,984 INFO Total Runtime: 1h23m13.
INFO:simulation_server:2014-10-27 13:18:12,986 INFO Breakdown
INFO:simulation_server:2014-10-27 13:18:12,987 INFO run_model : 56.88
INFO:simulation_server:2014-10-27 13:18:12,988 INFO climate_input_mapping : 16.24
INFO:simulation_server:2014-10-27 13:18:12,989 INFO waiting : 11.65
INFO:simulation_server:2014-10-27 13:18:12,990 INFO other : 8.02
INFO:simulation_server:2014-10-27 13:18:12,990 INFO spatial_mapping : 6.20
INFO:simulation_server:2014-10-27 13:18:12,991 INFO initial_states : 1.00
INFO:simulation_server:2014-10-27 13:18:12,992 INFO 88.35% occupancy
INFO:simulation_server:2014-10-27 13:18:12,993 INFO OutputWriter (26440):
INFO:simulation_server:2014-10-27 13:18:12,994 INFO Total Runtime: 1h23m24.
INFO:simulation_server:2014-10-27 13:18:12,995 INFO Breakdown
INFO:simulation_server:2014-10-27 13:18:12,996 INFO waiting : 100.00
INFO:simulation_server:2014-10-27 13:18:12,996 INFO other : 0.00
INFO:simulation_server:2014-10-27 13:18:12,997 INFO 0.00% occupancy
INFO:simulation_server:2014-10-27 13:18:13,030 INFO SimulationServer (26362):
INFO:simulation_server:2014-10-27 13:18:13,033 INFO Total Runtime: 1h23m37.
INFO:simulation_server:2014-10-27 13:18:13,035 INFO Breakdown
INFO:simulation_server:2014-10-27 13:18:13,036 INFO waiting : 74.82
INFO:simulation_server:2014-10-27 13:18:13,037 INFO retrieve_inputs : 14.07
INFO:simulation_server:2014-10-27 13:18:13,041 INFO other : 10.82
INFO:simulation_server:2014-10-27 13:18:13,043 INFO provenance : 0.14
INFO:simulation_server:2014-10-27 13:18:13,045 INFO setup : 0.11
INFO:simulation_server:2014-10-27 13:18:13,047 INFO terminate_workers : 0.04
INFO:simulation_server:2014-10-27 13:18:13,047 INFO create_files : 0.00
INFO:simulation_server:2014-10-27 13:18:13,048 INFO 25.18% occupancy
INFO:simulation_server:2014-10-27 13:18:13,049 INFO 823.66 cell years/second
INFO:simulation_server:2014-10-27 13:18:13,049 INFO Finished simulation
```

```
{'message': 'sim_server_terminated'}
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Visualisation

IP[y]: Notebook Visualisation Last Checkpoint: Oct 23 14:19 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

In [1]:
```
from Simulation import results
from Visualisation import vis
from test_support import *

import Interaction.datetools as dt
from Interaction import extents
from Interaction.catchments import CatchmentDB

catchments = CatchmentDB()
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/pyt
hon2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time
. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-25 08:08:03,773 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.
py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-25 08:08:05,565 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_
v4.02.xml for AWRA-L v4
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.
02.xml for AWRA-L v4
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Visualisation

IP[y]: Notebook Visualisation Last Checkpoint: Oct 23 14:19 (autosaved)

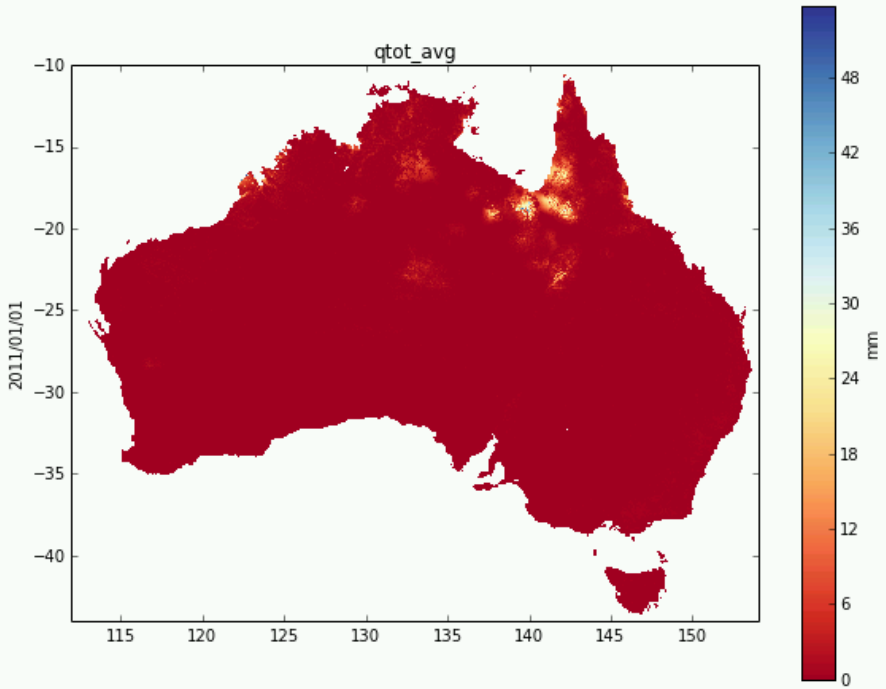
File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

Specify the path to an existing model run and load the results

```
In [2]: res = results.load_results(test_output_path("_basicRunResults"))

In [3]: vis.spatial(res.variables,dt.dates('jan 1 2011'),res.extent)
```



Australian Government
Bureau of Meteorology

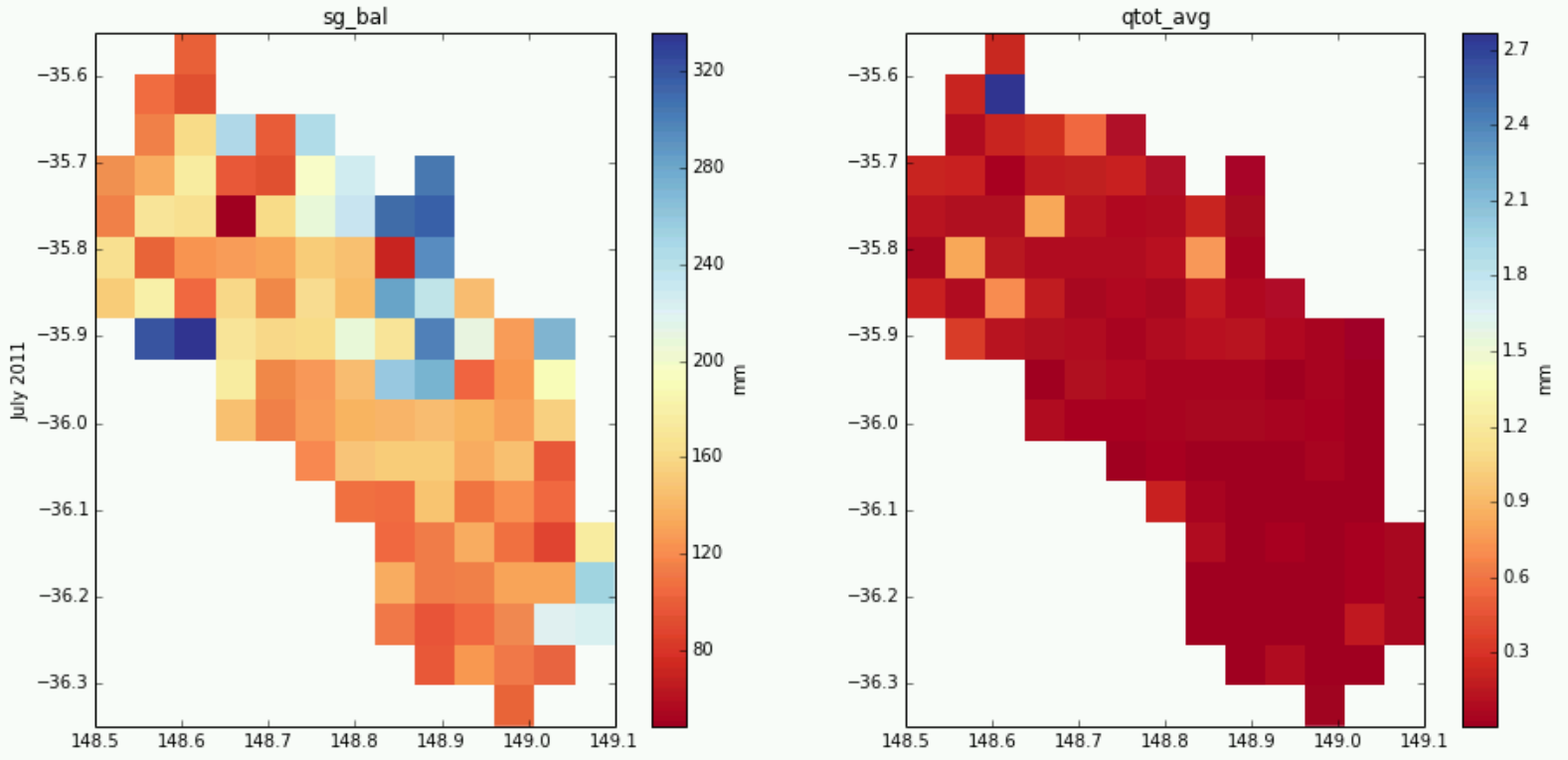
AWRA Modelling System
Interactive Visualisation

IP[y]: Notebook **Visualisation** Last Checkpoint: Oct 23 14:19 (autosaved)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

```
In [11]: vis.spatial(res.variables,dt.dates('jul 2011'),catchments.by_name.MurrumbidgeeMittagangCrossing())
```



Australian Government
Bureau of Meteorology

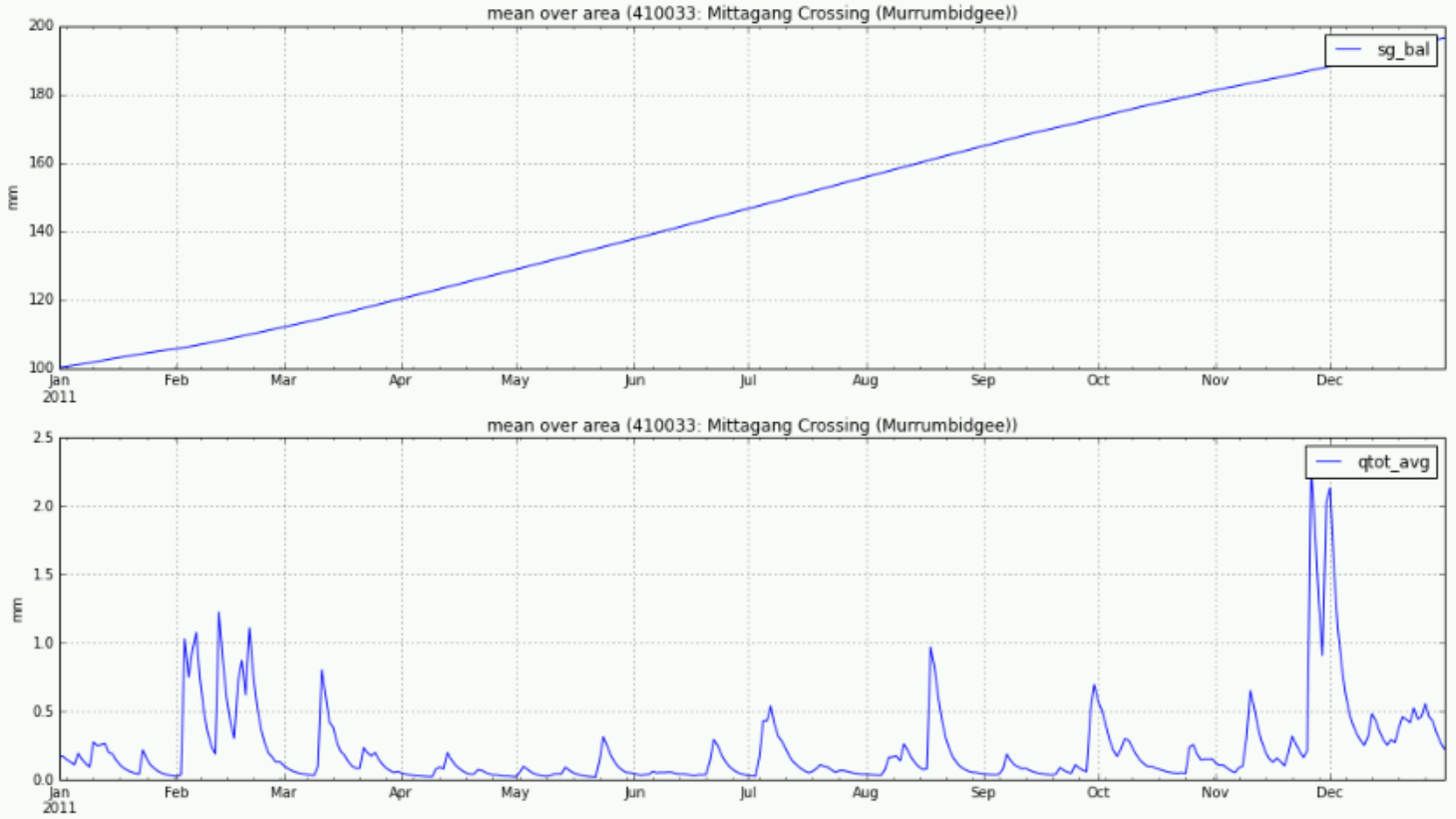
AWRA Modelling System
Interactive Visualisation

IP[y]: Notebook Visualisation Last Checkpoint: Oct 23 14:19 (autosaved)

File Edit View Insert Cell Kernel Help

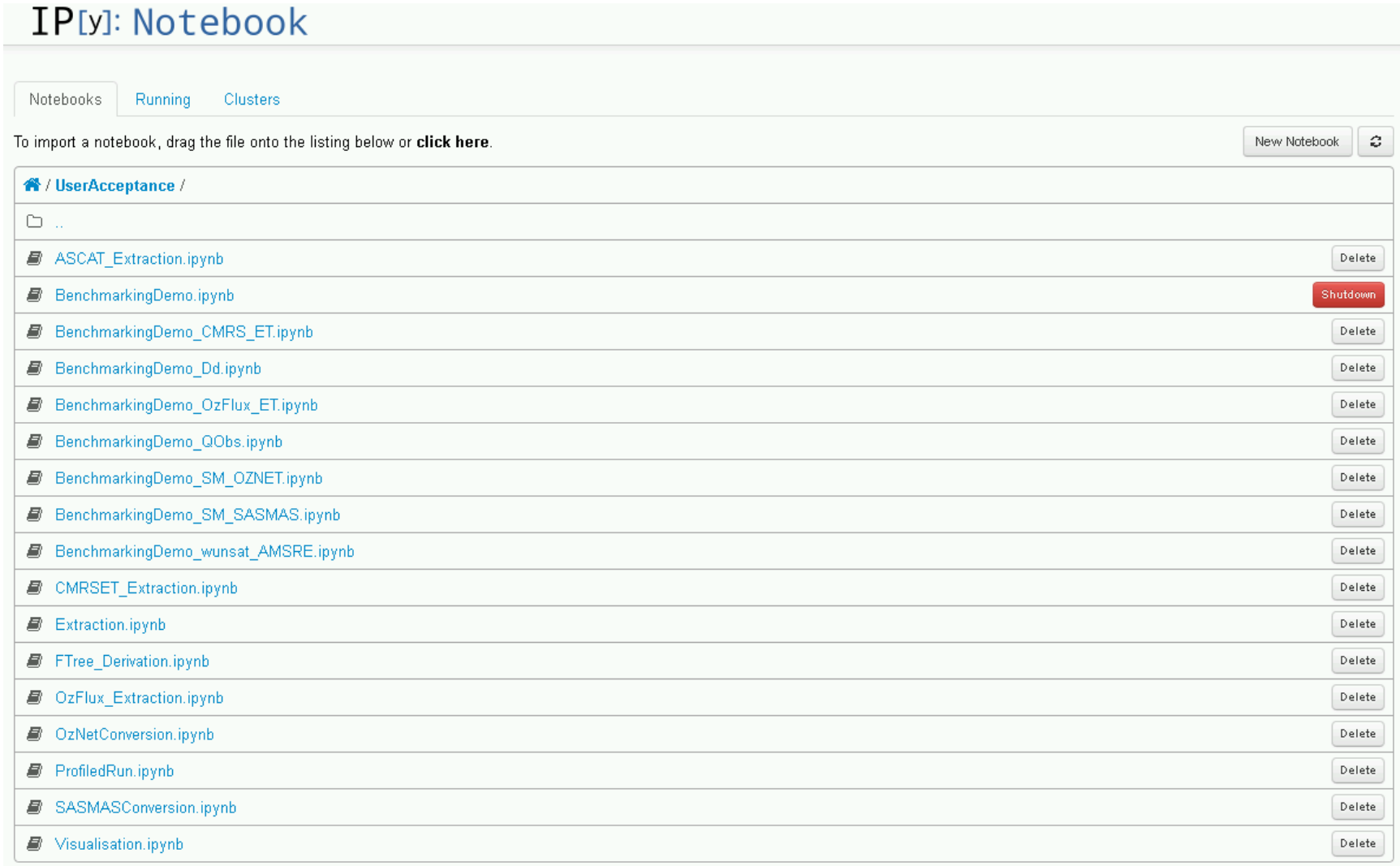
Code Cell Toolbar: None

```
In [13]: vis.timeseries(res.variables,dt.dates(2011),catchments.by_name.MurrumbidgeeMittagangCrossing())
```



Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Benchmarking



Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Benchmarking

IP[y]: Notebook BenchmarkingDemo (autosaved)

File Edit View Insert Cell Kernel Help

Markdown Cell Toolbar: None

Demonstrates benchmarking functionality

In [1]:
```
from Processing.benchmarking import *
from test_support import test_input_path
```

```
2014-08-14 02:33:48,267 INFO Using settings file from /home/dshipman/GIT/awral/Config/dshipman.py
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-08-14 02:33:48,267 INFO Using settings file from /home/dshipman/GIT/awral/Config/dshipman.py
INFO:awrams.awra:Using settings file from /home/dshipman/GIT/awral/Config/dshipman.py
2014-08-14 02:33:49,419 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.02.xml for AWRA-L v4
2014-08-14 02:33:49,419 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.02.xml for AWRA-L v4
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.02.xml for AWRA-L v4
```

Set up required input data

The benchmarking suite takes Pandas DataFrame objects as input (using dates as an index, and columns labelled with site names)

In [2]:
```
oznet_data_fn = test_input_path("benchmarking/oznet/s0.csv")
model_outputs_path = "/data/cdc_cwd_wra/awra/wra_share_01/Benchmarking/Model_Outputs/"

_SITE_IDX = '/data/cdc_cwd_wra/awra/wra_share_01/Post_Processors/Aggregator/SiteLocationsWithIndex.csv'

oznet_df = pd.DataFrame.from_csv(oznet_data_fn)

site_idx = pd.DataFrame.from_csv(_SITE_IDX)

comparison_sites = oznet_df.columns

set_name = 'Oznet Soilmoisture'

awra355s0_df = pd.DataFrame.from_csv(os.path.join(model_outputs_path,'AWRA3.5_griddedsims/AWRA_v3.5.5_L_S0_Allsites.csv'))
awra20_s0_df = pd.DataFrame.from_csv(os.path.join(model_outputs_path,'AWRA2.0_griddedsims/AWRA_v2.0_S0_Allsites.csv'))
a355_comp = extract_sites_wirada(awra355s0_df,oznet_df.columns,set_name,site_idx)
a2_comp = extract_sites_wirada(awra20_s0_df,oznet_df.columns,set_name,site_idx)
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/core/frame.py:1712: UserWarning: Boolean Series key will be reindexed to match DataFrame index.
  "DataFrame index.", UserWarning)
```

Set up comparison

The basic object for generated benchmarking states is the 'ComparisonSet'

In [3]:
```
cs = ComparisonSet(oznet_df,'OzNet','S0',dt.dates(2002,2010))
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Benchmarking

IP[y]: Notebook BenchmarkingDemo (autosaved)

File Edit View Insert Cell Kernel Help

Markdown Cell Toolbar: None

Add models

Any number of models can be simulataneously compared

In [4]:
```
cs.add_model(a355_comp,'AWRAv355')
cs.add_model(a2_comp,'AWRAv20')
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/computation/expressions.py:184: UserWarning: evaluating in Python space because the '+' operator is not supported by numexpr for the
bool dtype, use '|' instead
  unsupported[op_str]))
```

View some statistics

Summary percentiles can be printed out by specifying a statistic to the 'stat_percentiles' function
The timeframe defaults to monthly, but can be specified

In [5]:
```
cs.stat_percentiles('bias')
```

Out[5]:

	0%	5%	25%	Median	75%	95%	100%
AWRAv355	-10.672695	-7.626217	-4.741206	-3.430496	-0.633385	1.123612	2.921998
AWRAv20	-1.255768	1.427128	3.874239	4.762280	6.849103	9.735465	10.047411

In [6]:
```
cs.stat_percentiles('nse','daily')
```

Out[6]:

	0%	5%	25%	Median	75%	95%	100%
AWRAv355	-3.228327	-1.139456	-0.106757	0.126331	0.518142	0.698423	0.769616
AWRAv20	-19.371571	-11.472690	-2.091684	-0.595401	0.066074	0.507756	0.693793

Percentiles for the data can also be viewed

In [7]:
```
cs.data_percentiles()
```

Out[7]:

	0%	5%	25%	Median	75%	95%	100%
OzNet	-99.900000	3.353296	7.992827	11.624304	16.790151	26.993152	49.519885
AWRAv355	0.062084	1.281254	4.844398	9.444264	14.057304	17.797211	20.960334
AWRAv20	0.117300	2.368452	8.626343	17.493994	26.151869	38.018642	47.069807

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Benchmarking

IP[y]: Notebook BenchmarkingDemo (autosaved)

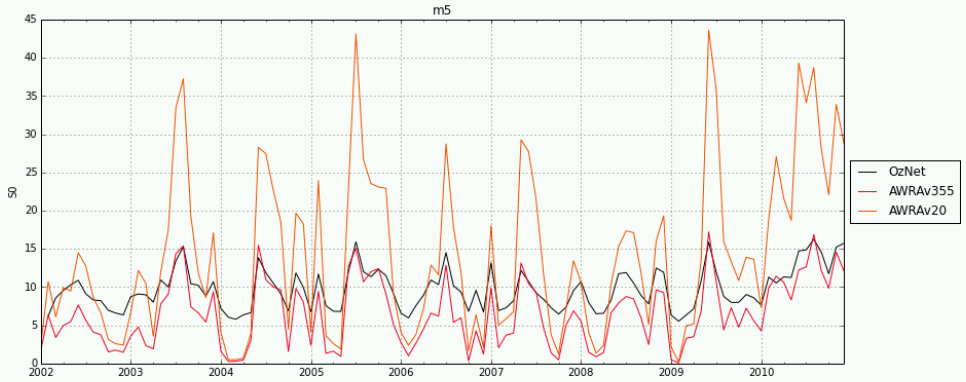
File Edit View Insert Cell Kernel Help

Markdown Cell Toolbar: None

Plotting

Per-site timeseries and regression plots are available

In [9]:
```
cs.plot_timeseries('m5')
```



In [10]:
```
cs.plot_regression('a1')
```

Australian Government
Bureau of Meteorology

AWRA Modelling System
Interactive Benchmarking

IP[y]: Notebook BenchmarkingDemo (autosaved)

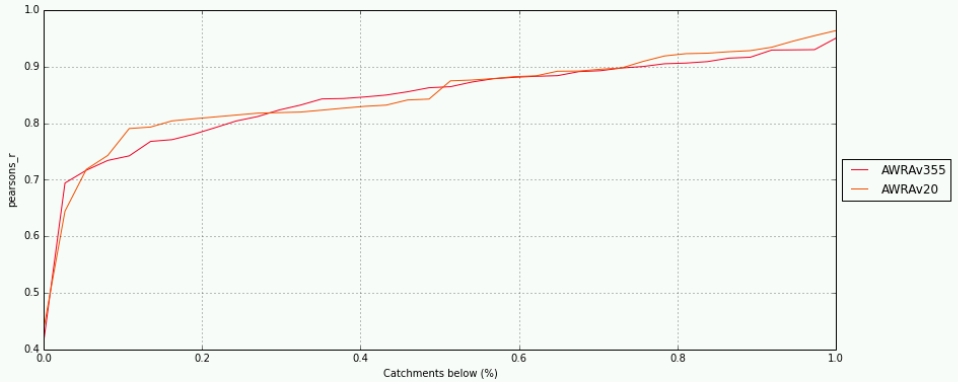
File Edit View Insert Cell Kernel Help

Markdown Cell Toolbar: None

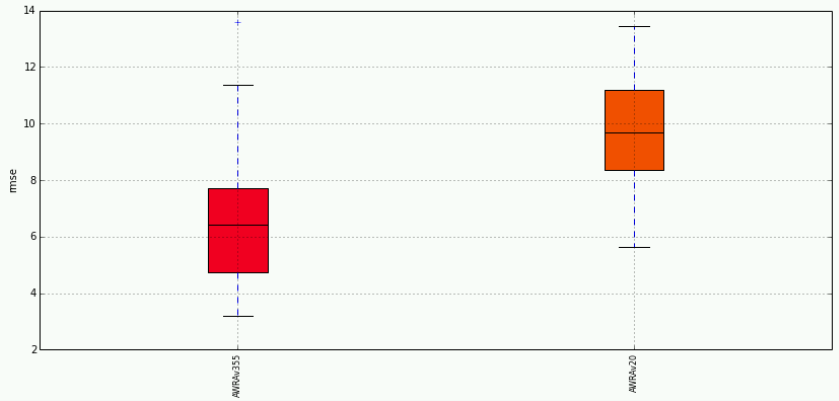
Stats plotting

As well as CDF and box-plots of the statistics

In [11]:
```
cs.plot_cdf('pearsons_r')
```



In [12]:
```
cs.plot_box('rmse','daily')
```



Australian Government
Bureau of Meteorology

AWRAMSI Software Development Principles

- Integrated Modelling Environment (IPython Notebook)
- Agile (test driven) development
- PRINCE2 project management
- Open source technology stack
  - Predominantly Python
  - Fortran (for AWRA-L grid cell)
  - C (for AWRA-R river reach)
  - Git version control
  - Gnu compiler with Linux OS

Australian Government
Bureau of Meteorology

Software Version Control – Git Commits

git://murray.bom.gov.au / awral.git / shortlog — git

summary | shortlog | log | commit | commitdiff | tree
first · prev · next

commit search: re

awral.git

4 hours ago	joel	Added port forwarding to vagrant config master	commit | commitdiff | tree | snapshot
4 hours ago	joel	Updated config for vagrant	commit | commitdiff | tree | snapshot
4 hours ago	joel	Basic config file for Vagrant	commit | commitdiff | tree | snapshot
5 hours ago	Douglas Leng	AWRAMSI-499: Record scheduled run finish time, incase...	commit | commitdiff | tree | snapshot
6 hours ago	joel	Vagrant update hostname	commit | commitdiff | tree | snapshot
6 hours ago	joel	Updates to vagrant provisioning to build shareable box	commit | commitdiff | tree | snapshot
7 hours ago	David Shipman	More jenkins attempts...	commit | commitdiff | tree | snapshot
7 hours ago	David Shipman	Again	commit | commitdiff | tree | snapshot
9 hours ago	David Shipman	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
9 hours ago	David Shipman	Try again...	commit | commitdiff | tree | snapshot
9 hours ago	Stuart Baron-Hay	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
9 hours ago	Stuart Baron-Hay	AWRAMSI-136 tidy-up and notebook updates	commit | commitdiff | tree | snapshot
9 hours ago	David Shipman	Fix logging propogation	commit | commitdiff | tree | snapshot
10 hours ago	David Shipman	Support non-notebook logger tests	commit | commitdiff | tree | snapshot
10 hours ago	David Shipman	Another logging/test fix attempt	commit | commitdiff | tree | snapshot
2 days ago	joel	Fix virtualenv activation in vagrant provisioning	commit | commitdiff | tree | snapshot
3 days ago	joel	Update for build script to make ATLAS detection for...	commit | commitdiff | tree | snapshot
3 days ago	David Shipman	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
3 days ago	David Shipman	Another attempt	commit | commitdiff | tree | snapshot
3 days ago	joel	Vagrant setup now activates virtualenv on startup	commit | commitdiff | tree | snapshot
3 days ago	joel	Build scripts updated to work with Vagrant / clean VMs	commit | commitdiff | tree | snapshot
3 days ago	joel	Changed build script to use /mnt/awramsi_test_data...	commit | commitdiff | tree | snapshot
3 days ago	joel	Make ATLAS build conditional on not finding it. To...	commit | commitdiff | tree | snapshot
3 days ago	joel	First cut Vagrant configuration including reworking...	commit | commitdiff | tree | snapshot
3 days ago	David Shipman	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
3 days ago	David Shipman	Another logging fix attempt...	commit | commitdiff | tree | snapshot
3 days ago	Max Monahan	AWRAMSI-407: Implement multi-variable multi-period...	commit | commitdiff | tree | snapshot

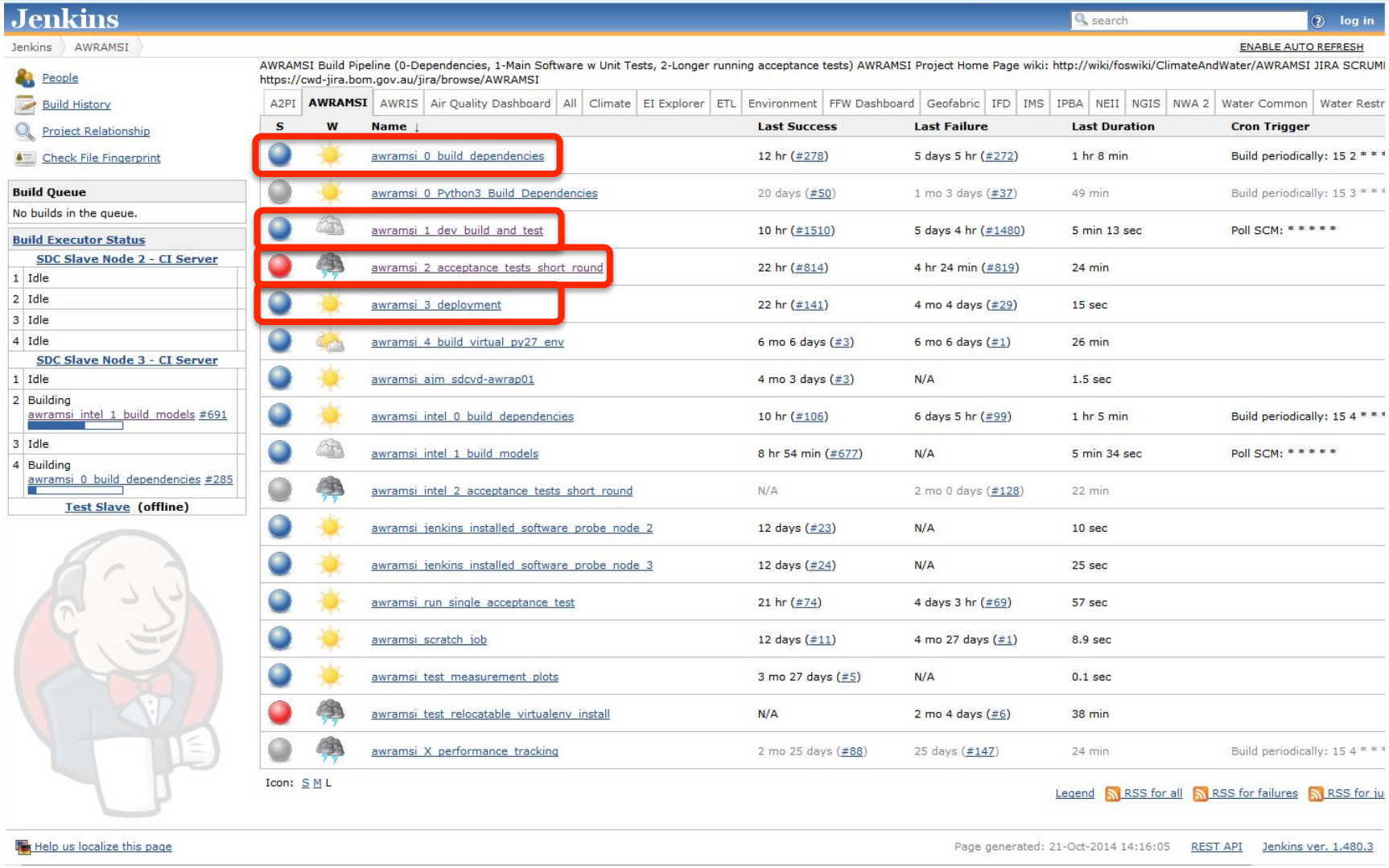
Australian Government
Bureau of Meteorology

Software Version Control – Git Commits

4 days ago	David Shipman	Missed a spot...	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Refactored test logging	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Testing jenkins fix	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Typo in simulation	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Revert subprocess32 change (temp jenkins tests)	commit | commitdiff | tree | snapshot
4 days ago	Stuart Baron-Hay	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
4 days ago	Stuart Baron-Hay	scheduled run updates	commit | commitdiff | tree | snapshot
4 days ago	Stuart Baron-Hay	AWRAMSI-473 added notebook for CMRSET derivation	commit | commitdiff | tree | snapshot
4 days ago	Stuart Baron-Hay	AWRAMSI-136 added Dd benchmarking notebook	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Attempting to fix broken FD bug	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Visualistion notebook demo	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Adding subprocess32 to dependencies (attempted jenkins...	commit | commitdiff | tree | snapshot
4 days ago	Robert Pipunic	AWRAMSI-463: Not sure if I need to commit/push 'Calibra...	commit | commitdiff | tree | snapshot
4 days ago	Robert Pipunic	AWRAMSI-463: Updates of modules for testing AWRAMSI...	commit | commitdiff | tree | snapshot
4 days ago	David Shipman	Attempt to fix leaky file descriptors bug	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Trying to solve nosetests segfault	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Logging/hanging fixes, updated tests	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Removed giant files...	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Improve logging on exceptions, fix potential hang condition	commit | commitdiff | tree | snapshot
5 days ago	Robert Pipunic	AWRAMSI-463: Updating all cal. work (pathnames in code...	commit | commitdiff | tree | snapshot
5 days ago	Robert Pipunic	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
5 days ago	Robert Pipunic	AWRAMSI-463: Minor alteration take 2... removed for...	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Typo bugfix...	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Fixing ack for row_complete	commit | commitdiff | tree | snapshot
5 days ago	David Shipman	Deleting troublesome acceptance test	commit | commitdiff | tree | snapshot
6 days ago	Robert Pipunic	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
6 days ago	Robert Pipunic	AWRAMSI-463: Minor refactoring... removed some for...	commit | commitdiff | tree | snapshot
6 days ago	David Shipman	Fixing unit test	commit | commitdiff | tree | snapshot
6 days ago	David Shipman	Merge branch 'master' of ssh://murray.bom.gov.au/awral	commit | commitdiff | tree | snapshot
6 days ago	David Shipman	AWRAMSI-464: Readers only open on demand	commit | commitdiff | tree | snapshot
7 days ago	Robert Pipunic	AWRAMSI-463: Update to calibration modules - 'run_cal_t...	commit | commitdiff | tree | snapshot

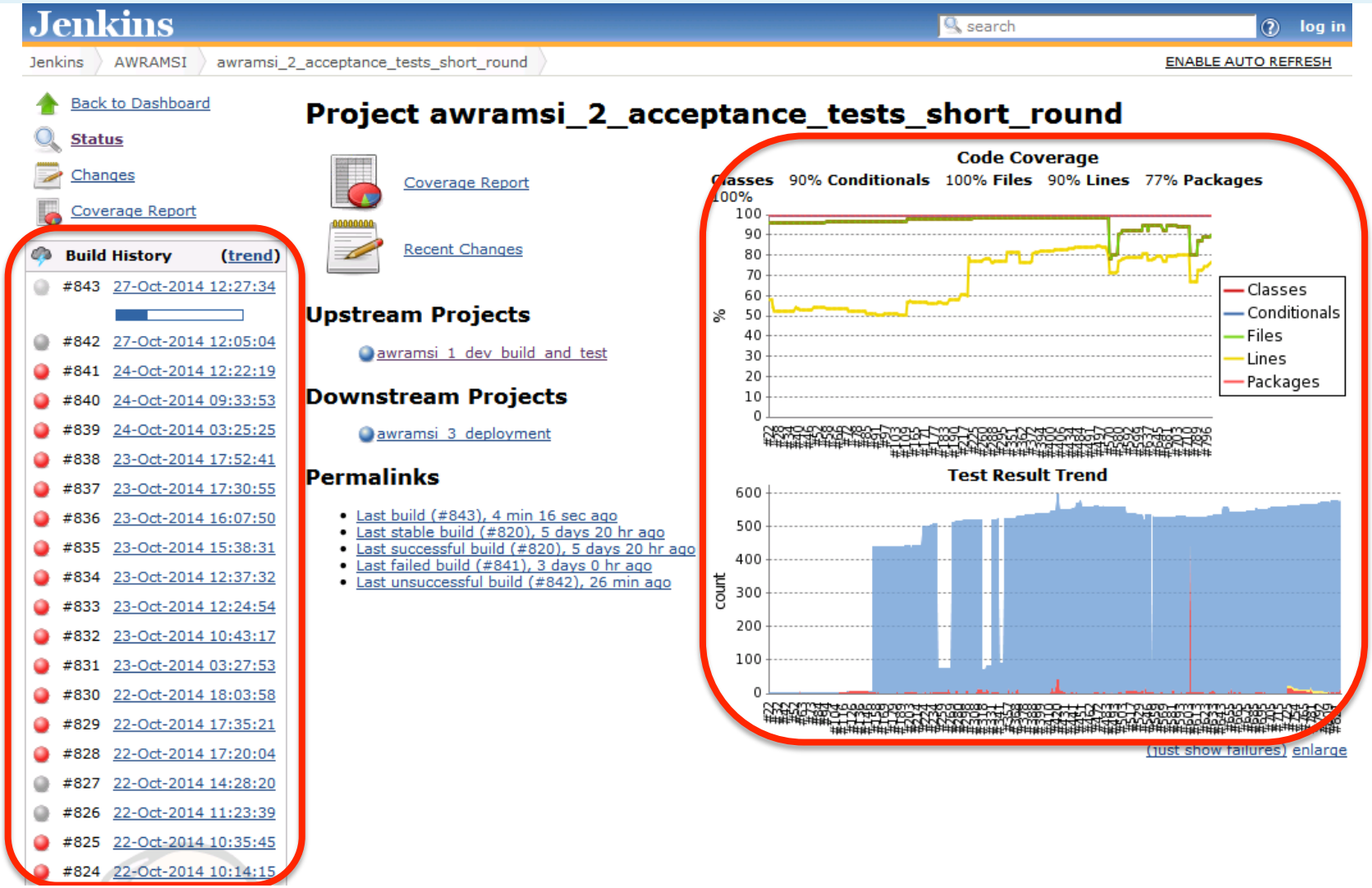
Australian Government
Bureau of Meteorology

Test Driven Development – Continuous Integration



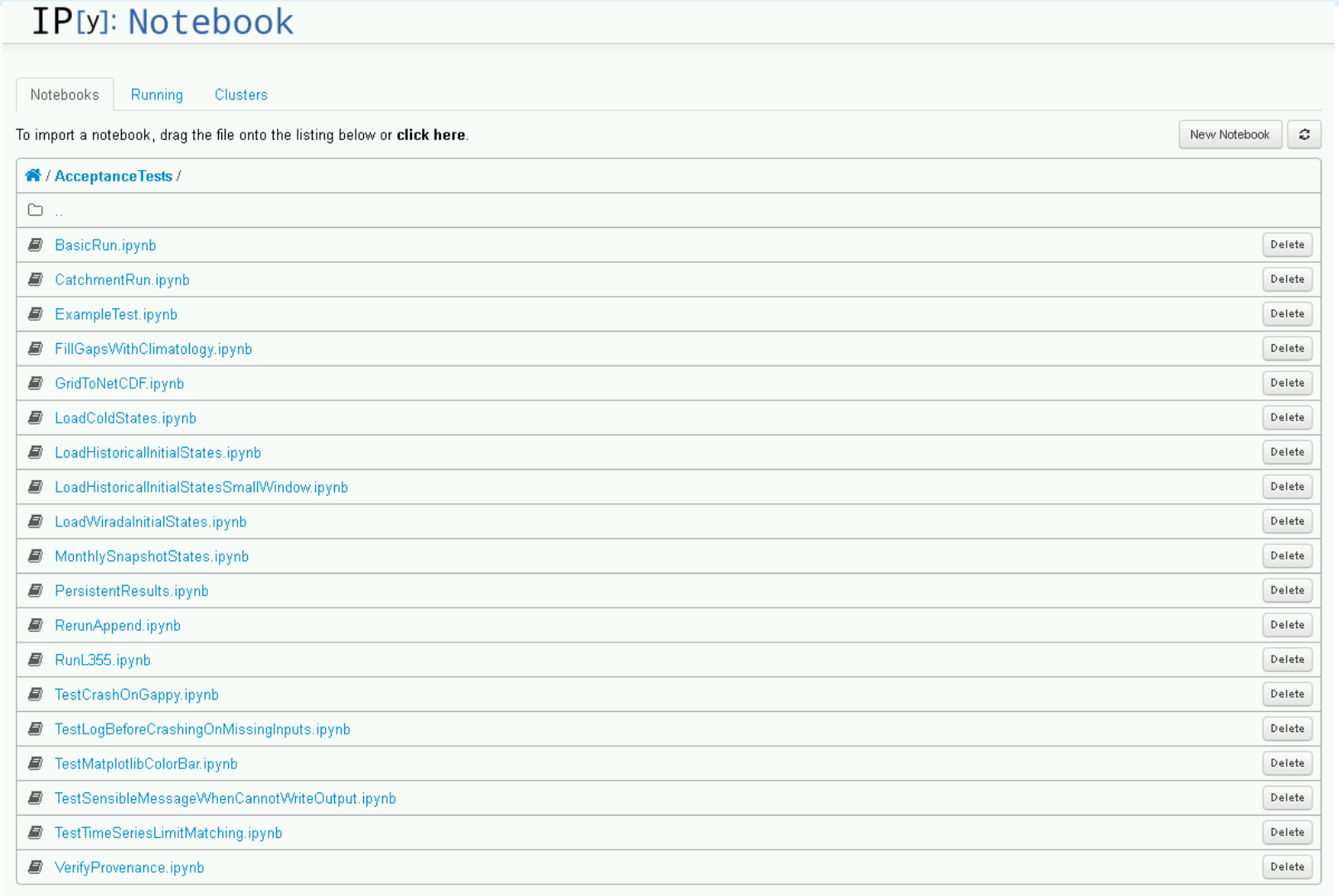
Australian Government
Bureau of Meteorology

Test Driven Development – Continuous Integration



Australian Government
Bureau of Meteorology

Test Driven Development – Acceptance Tests



Australian Government
Bureau of Meteorology

Test Driven Development

IP[y]: Notebook ExampleTest (autosaved)

File Edit View Insert Cell Kernel Help

Markdown Cell Toolbar: None

Building Acceptance Tests for the AWRAMSI Project

Acceptance tests are built in the IPython notebook and committed to git in the AcceptanceTests directory

Notes Don't leave any IPython magics in place when you save and commit. It messes with the conversion to .py scripts

Start by importing everything from test support

In [1]:
```
from test_support import *
```

Then, use the expects object (.<tab> to see what's available)

In [2]:
```
#expects.should.log.critical.exactly_once("Bad Kitty")
expects.should.fail.with_a(ZeroDivisionError)
```

Then do something!

In [3]:
```
1/0
```

```
---------------------------------------------------------------------------
ZeroDivisionError                         Traceback (most recent call last)
<ipython-input-3-05c9758a9c21> in <module>()
----> 1 1/0

ZeroDivisionError: integer division or modulo by zero
```

Call ~evaluate()~ to check the result. Should be silent if everything is good. Note: When running on Jenkins, this gets called for you anyway (especially for cases where execution ends with an exception)

In [4]:
```
evaluate()
```

Don't forget to save and commit

Australian Government
Bureau of Meteorology

Test Driven Development

IP[y]: Notebook ExampleTest (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

Building Acceptance Tests for the AWRAMSI Project

Acceptance tests are built in the IPython notebook and committed to git in the AcceptanceTests directory

Notes Don't leave any IPython magics in place when you save and commit. It messes with the conversion to .py scripts

Start by importing everything from test support

In [1]:
```
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-25 11:10:13,548 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-25 11:10:14,694 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
2014-10-25 11:10:14,755 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

Then, use the expects object (.<tab> to see what's available)

In [2]:
```
#expects.should.log.critical.exactly_once("Bad Kitty")
expects.should.fail.with_a(ZeroDivisionError)
expects.
```

expects.should
expects.should_not

In [3]:
```
1/0
```

```
---------------------------------------------------------------------------
ZeroDivisionError                         Traceback (most recent call last)
<ipython-input-3-05c9758a9c21> in <module>()
----> 1 1/0

ZeroDivisionError: integer division or modulo by zero
```

Call ~evaluate()~ to check the result. Should be silent if everything is good. Note: When running on Jenkins, this gets called for you anyway (especially for cases where execution ends with an exception)

In [4]:
```
evaluate()
```

Don't forget to save and commit

Australian Government
Bureau of Meteorology

Test Driven Development

IP[y]: Notebook ExampleTest Last Checkpoint: Oct 22 17:52 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

Building Acceptance Tests for the AWRAMSI Project

Acceptance tests are built in the IPython notebook and committed to git in the AcceptanceTests directory

Notes Don't leave any IPython magics in place when you save and commit. It messes with the conversion to .py scripts

Start by importing everything from test support

In [1]:
```
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-25 11:10:13,548 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-25 11:10:14,694 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
2014-10-25 11:10:14,755 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

Then, use the expects object (.<tab> to see what's available)

In [2]:
```
#expects.should.log.critical.exactly_once("Bad Kitty")
expects.should.fail.with_a(ZeroDivisionError)
expects.should.
```

```
expects.should.fail
expects.should.log
expects.should.match_results
```

In [3]:
```
1/0
```

```
---------------------------------------------------------------------------
ZeroDivisionError                         Traceback (most recent call last)
<ipython-input-3-05c9758a9c21> in <module>()
----> 1 1/0

ZeroDivisionError: integer division or modulo by zero
```

Call ~evaluate()~ to check the result. Should be silent if everything is good. Note: When running on Jenkins, this gets called for you anyway (especially for cases where execution ends with an exception)

In [4]:
```
evaluate()
```

Don't forget to save and commit

Australian Government
Bureau of Meteorology

Test Driven Development

IP[y]: Notebook ExampleTest Last Checkpoint: Oct 22 17:52 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

Building Acceptance Tests for the AWRAMSI Project

Acceptance tests are built in the IPython notebook and committed to git in the AcceptanceTests directory

Notes Don't leave any IPython magics in place when you save and commit. It messes with the conversion to .py scripts

Start by importing everything from test support

In [1]:
```
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-25 11:10:13,548 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-25 11:10:14,694 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
2014-10-25 11:10:14,755 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

Then, use the expects object (.<tab> to see what's available)

In [2]:
```
#expects.should.log.critical.exactly_once("Bad Kitty")
expects.should.fail.with_a(ZeroDivisionError)
expects.should.fail.with_a()
```

```
ArithmeticError
AssertionError
AttributeError
BaseException
BasicRun.ipynb
BufferError
BytesWarning
CatchmentRun.ipynb
DeprecationWarning
EOFError
```

Then do something!

In [3]:
```
1/0
```

```
---------------------------
ZeroDivisionError
<ipython-input-3-05c9758a9c
----> 1 1/0

ZeroDivisionError: integer division or modulo by zero
```

Call ~evaluate()~ to check the result. Should be silent if everything is good. Note: When running on Jenkins, this gets called for you anyway (especially for cases where execution ends with an exception)

In [4]:
```
evaluate()
```

Don't forget to save and commit

Australian Government
Bureau of Meteorology

Test Driven Development

IP[y]: Notebook ExampleTest Last Checkpoint: Oct 22 17:52 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

Building Acceptance Tests for the AWRAMSI Project

Acceptance tests are built in the IPython notebook and committed to git in the AcceptanceTests directory

Notes Don't leave any IPython magics in place when you save and commit. It messes with the conversion to .py scripts

Start by importing everything from test support

In [1]:
```
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-25 11:10:13,548 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-25 11:10:14,694 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
2014-10-25 11:10:14,755 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

Then, use the expects object (.<tab> to see what's available)

In [2]:
```
#expects.should.log.critical.exactly_once("Bad Kitty")
expects.should.fail.with_a(ZeroDivisionError)
expects.should.log.
```

```
expects.should.log.critical
expects.should.log.error
expects.should.log.info
expects.should.log.warning
```

In [3]:
```
1/0
```

```
---------------------------------------------------------------------------
ZeroDivisionError                         Traceback (most recent call last)
<ipython-input-3-05c9758a9c21> in <module>()
----> 1 1/0

ZeroDivisionError: integer division or modulo by zero
```

Call ~evaluate()~ to check the result. Should be silent if everything is good. Note: When running on Jenkins, this gets called for you anyway (especially for cases where execution ends with an exception)

In [4]:
```
evaluate()
```

Don't forget to save and commit

Australian Government
Bureau of Meteorology

Test Driven Development

IP[y]: Notebook ExampleTest Last Checkpoint: Oct 22 17:52 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

Building Acceptance Tests for the AWRAMSI Project

Acceptance tests are built in the IPython notebook and committed to git in the AcceptanceTests directory

Notes Don't leave any IPython magics in place when you save and commit. It messes with the conversion to .py scripts

Start by importing everything from test support

In [1]:
```
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-25 11:10:13,548 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-25 11:10:14,694 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
2014-10-25 11:10:14,755 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

Then, use the expects object (.<tab> to see what's available)

In [2]:
```
#expects.should.log.critical.exactly_once("Bad Kitty")
expects.should.fail.with_a(ZeroDivisionError)
expects.should.log.critical.
```

```
expects.should.log.critical.at_least_once
expects.should.log.critical.exactly
expects.should.log.critical.exactly_once
```

In [3]:
```
1/0
```

```
---------------------------------------------------------------------------
ZeroDivisionError                         Traceback (most recent call last)
<ipython-input-3-05c9758a9c21> in <module>()
----> 1 1/0

ZeroDivisionError: integer division or modulo by zero
```

Call ~evaluate()~ to check the result. Should be silent if everything is good. Note: When running on Jenkins, this gets called for you anyway (especially for cases where execution ends with an exception)

In [4]:
```
evaluate()
```

Don't forget to save and commit

Australian Government
Bureau of Meteorology

Test Driven Development

IP[y]: Notebook ExampleTest Last Checkpoint: Oct 22 17:52 (unsaved changes)

File Edit View Insert Cell Kernel Help

Code Cell Toolbar: None

Building Acceptance Tests for the AWRAMSI Project

Acceptance tests are built in the IPython notebook and committed to git in the AcceptanceTests directory

Notes Don't leave any IPython magics in place when you save and commit. It messes with the conversion to .py scripts

Start by importing everything from test support

In [1]:
```
from test_support import *
```

```
/data/cwd_awra_data/AWRAMSI/IWRM_0042_WP3/Technical/Common/awramsi/sharedvirtual/.pyenv/virtualenv/lib/python2.7/site-packages/pandas
/io/excel.py:626: UserWarning: Installed openpyxl is not supported at this time. Use >=1.6.1 and <2.0.0.
  .format(openpyxl_compat.start_ver, openpyxl_compat.stop_ver))
2014-10-25 11:10:13,548 INFO Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
INFO:awrams.awra:Using settings file from /home/asmith/new/awral/Config/default_user_settings.py
2014-10-25 11:10:14,694 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
2014-10-25 11:10:14,755 INFO Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
INFO:awrams.awral_helpers:Loading parameter set from /mnt/awramsi_test_data/ParameterSets/BestParamSet_v4.5_J.xml for AWRA-L v45
```

Then, use the expects object (.<tab> to see what's available)

In [2]:
```
#expects.should.log.critical.exactly_once("Bad Kitty")
expects.should.fail.with_a(ZeroDivisionError)
expects.should.match_results.
```

```
expects.should.match_results.lai_avg
expects.should.match_results.loaded_from
expects.should.match_results.mbal_avg
expects.should.match_results.mleaf_dr
expects.should.match_results.mleaf_sr
expects.should.match_results.qgtot_avg
expects.should.match_results.qiftot_avg
expects.should.match_results.qrtot_avg
expects.should.match_results.qtot_avg
expects.should.match_results.s0_avg
```

In [3]:
```
---------------------------------
raceback (most recent call last)

ZeroDivisionError: integer division or modulo by zero
```

Call ~evaluate()~ to check the result. Should be silent if everything is good. Note: When running on Jenkins, this gets called for you anyway (especially for cases where execution ends with an exception)

In [4]:
```
evaluate()
```

Don't forget to save and commit

Australian Government
Bureau of Meteorology

AWRA Modelling System
Modes Of Operation

1. Interactive
   - Simulation runs of AWRA-L and AWRA-R over arbitrary regions and time periods with ability to switch outputs, inputs, parameters and initial states
   - Visualisation of maps and timeseries with arbitrary aggregation
   - Benchmarking of AWRA-L and AWRA-R runs against observations

2. Scheduled Run
   - Outputs generated daily for 1 January 1911 to yesterday
   - Shared internally to Bureau of Meteorology via THREDDS
   - Soon shared to external parties and available on NCI via RDSI
   - May soon underpin a Bureau of Meteorology soil moisture website

3. Calibration
   - Fitting AWRA-L and AWRA-R models to observations (streamflow, soil moisture and ET)

Australian Government
Bureau of Meteorology

Thank you…

Adam Smith
03 9669 4606
Adam.Smith@bom.gov.au