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A WaterWorld Hydrological Baseline for CAZ

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UNIVERSITY OF TWENTE.





The PSS is a testbed for the development and implementation of land and water related policies globally, enabling intended and unintended consequences to be tested in silico before they are tested in vivo. It incorporates detailed spatial datasets at 1-square km and 1 hectare resolution for the entire World, spatial models for biophysical and socioeconomic processes along with scenarios for climate, land use and economic change. A series of interventions (policy options) are available which can be implemented and their consequences traced through the socio-economic and biophysical systems. The model integrates with a range of geobrowsers for immersive visualisation of outcomes. A series of scenario and interventions tools are provided and the model can be used by policy analysts, scientists and students in Spanish or English. Works best in the Mozilla Firefox browser. Your browser must have Javascript enabled and any pop-up blockers disabled. [What do I do now?](#) or [Quick overview](#). Latest news_

Scientists:

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Password :

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Hyperuser ▾

Language

English ▾

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waterworld was developed with the [//ecoengine](#) framework.



1. Open Firefox or Chrome browser (system does not work with IE).
2. Go to <http://www.policysupport.org/waterworld/training/level-2>
3. Normally you would access using <http://www.policysupport.org/waterworld>
4. Select your assigned training server and click the link. Type your assigned username and password for use today
5. Choose hyperuser
6. Hit the **Login** button



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Find

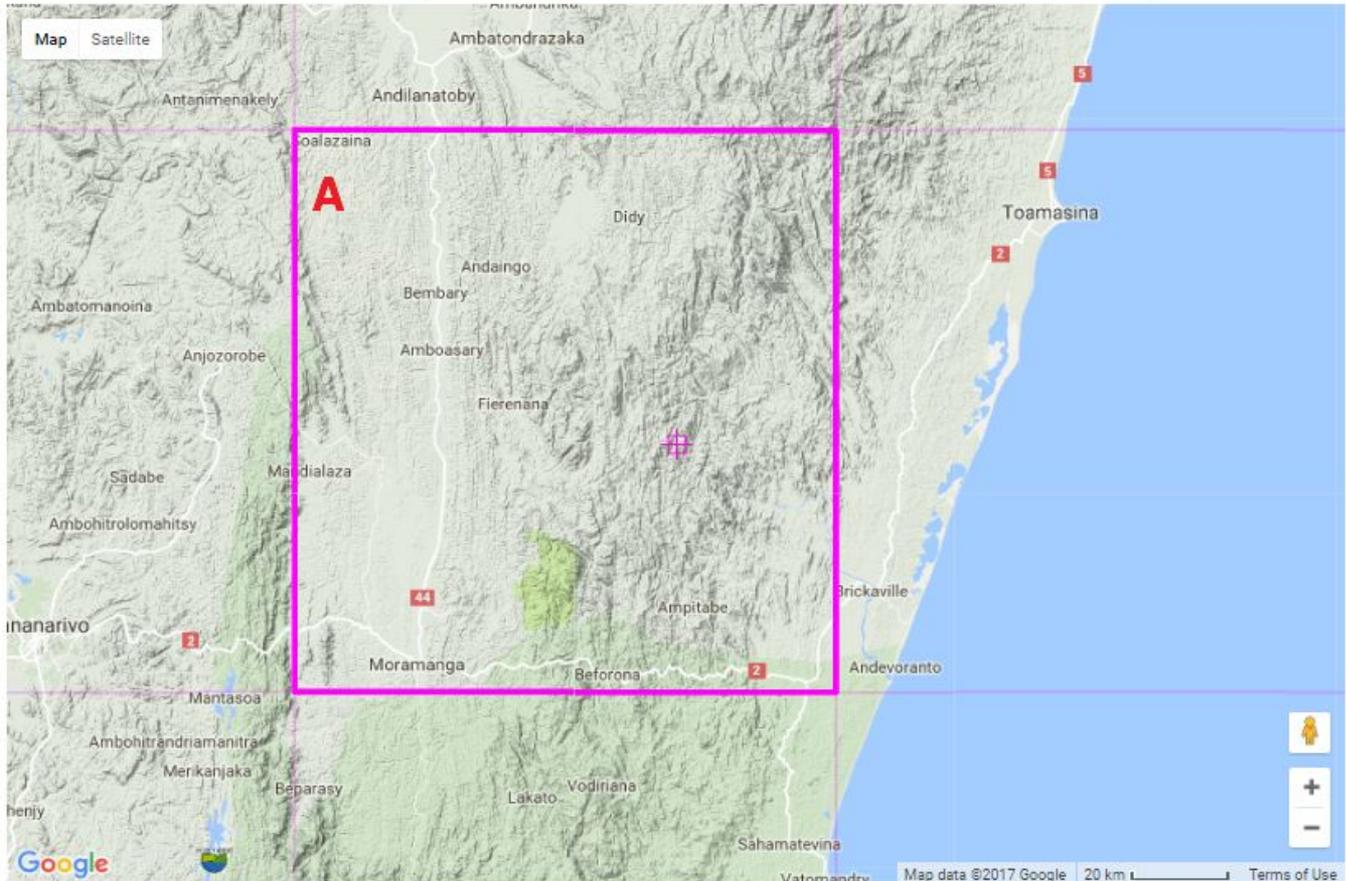
Go >

lat: -18.558 lon: 48.7038

CAZ1

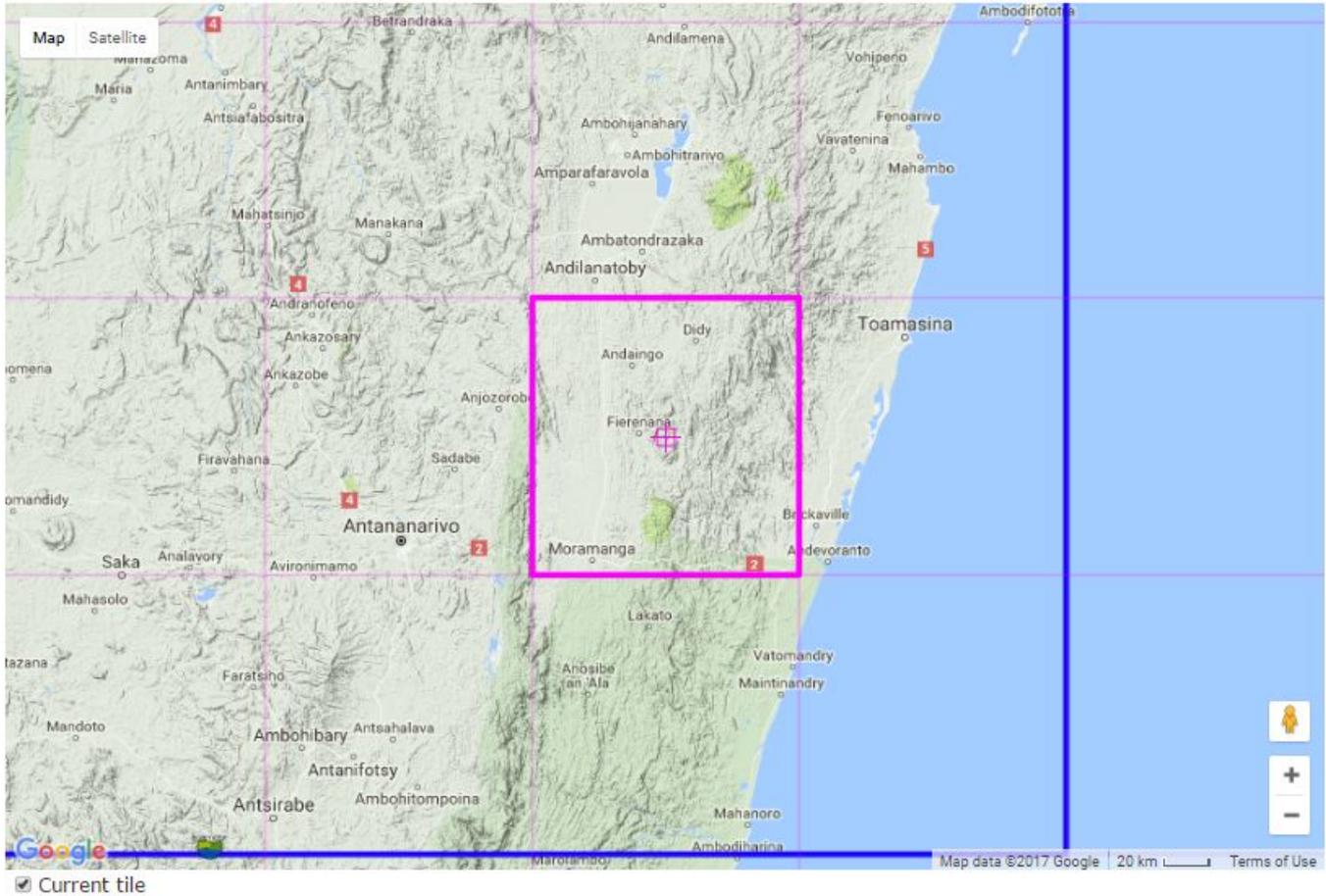
Tiled 1ha

Step 1: Define area



1. Step 1: select the region of interest by moving the map within the highlighted purple tile (A)
2. At (B) give the run a name (e.g. CAZ1)
3. Use the dropdown list at (C) to select 'Tiled 1ha' to select 1-ha resolution
4. Click on 'Step 1: Define area'

Find lat: lon: Run name Step 1: Define area



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1. The map will re-center on your area of interest (if it does not, click the green refresh button at **(A)**).
2. Your run name will change. Click to see a window with details of the run **(B)**



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Input data - Google Chrome

www1.policysupport.org/cgi-bin/simterra/v1/simterra/pss/controls.cgi?model=ecoengine&username=xyz07oalp%A360o%5Enaxnmx

Use: ecoengine for: waterworld v.2 [.92] [non-commercial use] | Help | Disclaimer | » arnout.vansoesbergen (hyperuser) » CAZ1 (72 hrs.) » baseline » baseline » default

Here are the modules and data available for project **waterworld**, model run **CAZ1**.

To use your own datasets choose copy data to workspace below and then go back to step 2 (prepare data), choose list workspace data and choose "upload your own data" on the next page. To compare results with your data with waterworld default data go through the prepare data step, run the simulation with waterworld data and then choose policy options->change input data from the main menu to run again with your data.

Maps in simterra database+
[Use alternative SIMTERRA input maps licensed, megauser](#)

Define WEAP control points+

Copy data directly to your workspace **B**

List baseline workspace data

Close window

Copy to workspace - Google Chrome

www1.policysupport.org/cgi-bin/simterra/v1/simterra/util/file_mgt.cgi?model=ecoengine&username=xyz07oalp%A360o%5Enaxnmx

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Data ready.

show workspace data+ **C**

Close window

Antsirabe Ambohitompoina Mahanoro Ambodiharina

Map data ©2017 Google 20 km

Current tile

Step 2: prepare data

1. Click on the **Step 2: Prepare data button (A)**

2. In the window that opens, click on '**Copy data to your workspace**' (**B**). The system will now take a few minutes to gather and copy the necessary data to your workspace on the servers. Do not refresh the page or it will start again. When the data is ready you can see the inputs by clicking the **+** (**C**)



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Copy to workspace - Google Chrome

www1.policysupport.org/cgi-bin/simterra/v1/simterra/util/file_mgt.cgi?model=ecoengine&username=xyz07oalp%A360o%5Er

Use: ecoengine for: waterworld v.2 [.92] [non-commercial use] | [Help](#) | [Disclaimer](#) | amout.vansoesbergen (hyperuser) » CAZ1 (72 hrs.)

baseline » baseline » default					
Wind speed July (UEA) (m/s *10) ²			Σ		view by:
Wind speed August (UEA) (m/s *10) ²			Σ		view by:
Wind speed September (UEA) (m/s *10) ²			Σ		view by:
Wind speed October (UEA) (m/s *10) ²			Σ		view by:
Wind speed November (UEA) (m/s *10) ²			Σ		view by:
Wind speed December (UEA) (m/s *10) ²			Σ		view by:
Cover of bare ground (Landsat 2000) (percentage) ²			Σ		view by:
Cover of herb-covered ground (Landsat 2000) (perce.. ²			Σ		view by:
Cover of tree-covered ground (Landsat 2000) (perce.. ²			Σ		view by:
Landsat water mask (Hansen/UMD/Google/USGS/NASA) (.. ²			Σ		view by:
Daily temperature range January (WC) (deg C * 10) ²			Σ		view by:
Daily temperature range February (WC) (deg C * 10) ²			Σ		view by:
Daily temperature range March (WC) (deg C * 10) ²			Σ		view by:
Daily temperature range April (WC) (deg C * 10) ²			Σ		view by:

Map data ©2017 Google | 20 km | Terms of U

A

[download+](#)

B

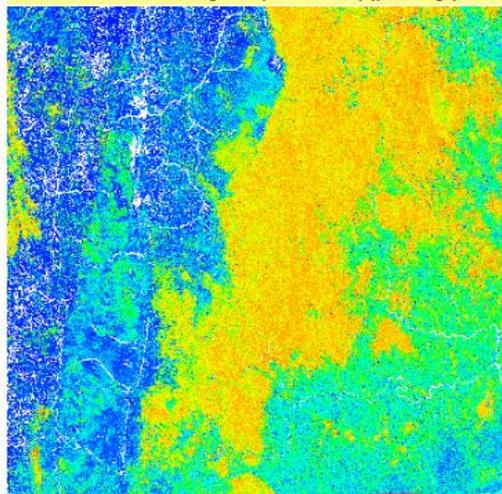
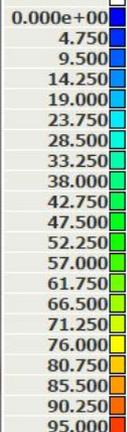
Step 2: prepare data

1. The model requires more than 140 maps to run
2. Those that we produce or have license to redistribute can be downloaded in GIS formats (A) and visualised (B, also see next slide) from here
3. Many cannot be redistributed but we are working with data providers to enable at least visualisation of the input datasets

values=class
base

view by:

Cover of tree-covered ground (Landsat 2000) (percentage)



Define regions of interest [ROIs]

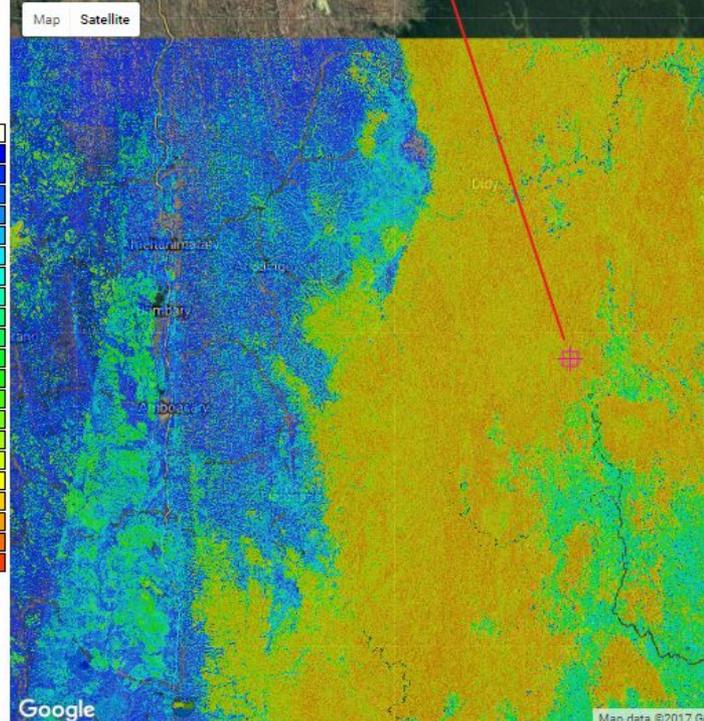
Stats for all active POI sets (none set)

Stats for all active ZOI sets (none set)



- change image+
- positives only
- negatives only
- non-zeros only
- normalise map
- threshold by+
- mask by ±
- No ZOI defined
- Statistics
- Analyse
- Calculation
- Show world file (for full res. map)

Find Go > lat: -18.3 lon: 48.70 74.0 Query Inputs All



Google
Cover of tree-covered ground (Landsat 2000) (percentage)
Opacity: 25% 50% 75% 100%

Visualising and comparing data including Google Maps/Earth, even without running the model. No local GIS system or skills required.

1. Select to view the **Cover of tree-covered ground** map (see previous slide). This will open up the map view window (left)
2. To view the map in Google maps click on the maps icon (**A**) this will open up a new window (right)
3. You can query any pixel in the map. Move the map until the crosshair is on the desired pixel and click '**Query**' (**B**) This will give the value (% of tree cover)

Use: ecoengine for: waterworld v.2 [.92] [non-commercial use] | Help | Disclaimer | amout.vansoesbergen (hyperuser) » CAZI (72 hrs.) » baseline » baseline » default

values=class base

A view by:

Cover

B

Above ground pipelines
Global 200 ecoregions (WWF)
Globcover land use classes
Hydrosheds basins
Important bird are...ternational, 2014)
Key biodiversity areas (2012)
LUCC: Forma defore...alerts (2000-2012)
LUCC: Terra-i land cover change
LUCC: Year of fore.../Google/USGS/NASA)
Land cover (2000)
Last of the Wild
Local administrative boundaries
Major global basins (HydroSHEDS)
Major sub-basins (Hydrosheds)
Non-forest clusters
Protected areas (UNEP-WCMC WCPA) 2014
Protected areas [p...MC IUCN WCPA 2014)
Ramsar sites in WD...MC IUCN WCPA 2014
Regional administrative boundaries
Upstream catchments of urban areas
Upstream subcatchments of urban areas

Define re... values=class base

Stats for all act...

Stats for all e...

Cover of tree-covered ground (Landsat 2000) averaged over Protected areas (UNEP-WCMC WCPA) 2014 classes (percentage)

C

66.580
66.820
67.070
67.310
67.560
67.800
68.040
68.290
68.530
68.780
69.020
69.270
69.510
69.750
70.000
70.240
70.490
70.730
70.970
71.220
71.460

change image+
positives only
negatives only
non-zeros only
normalise map
threshold by+
mask by ±
No ZOI defined
Statistics
Analyse
Calculation
Show world file (for full res. map)

Class statistics

www1.policysupport.org/userdata/.../vcftree2000_mean_wdpa.map_full.png

Aggregate maps by areas (eg mean or sum of map for a protected area):

1. Click on 'View by' (A)
2. This will open up a dropdown list (B). Select Protected areas in this list
3. This opens up map (C) with mean tree cover percentages for the two PAs in the tile (here based on 2014 WDPA, you can upload your own protected areas file if needed)

Use: | ecoengine for: waterworld v.2 [.92] [non-commercial use] | Help | Disclaimer | | » amrou.vansoesbergen (hyperuser) » CAZ1 (72 hrs.) » baseline » baseline » default

values=class
base

0.000e+00	█
4.750	█
9.500	█
14.250	█
19.000	█
23.750	█
28.500	█
33.250	█
38.000	█
42.750	█
47.500	█
52.250	█
57.000	█
61.750	█
66.500	█
71.250	█
76.000	█
80.750	█
85.500	█
90.250	█
95.000	█

view by:

Cover of tree-covered ground (Landsat 2000) (percentage)

[Define regions of interest \[ROIs\]](#)

[Stats for all active POI sets \(none set\)](#)

[Stats for all active ZOI sets \(none set\)](#)

A

B

- [change image+](#)
- [positives only](#)
- [negatives only](#)
- [non-zeros only](#)
- [normalise map](#)
- [threshold by+](#)
- [mask by ±](#)
- No ZOI defined
- [Statistics](#)
- [Analyse](#)
- [Calculation](#)

[Show world file \(for full res. map\)](#)

Geobrowse data. Other options

As well as view in Google maps, you can also view in Google Earth or pop out a map for comparison with other maps (**A**)

1. A number of other options are available, such as changing the colour scheme, view only positives or negatives (if relevant), normalise, threshold and mask maps and calculate statistics (**B**). If download is available, there will be a download link

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Current simulation - Google Chrome

www1.policysupport.org/cgi-bin/simterra/v1/simterra/pss/controls.cgi?model=ecoengine&username=xyz07oalp%A360o%5En

Use: | ecoengine for: waterworld v.2 [.92] [non-commercial use] | [Help](#) | [Disclaimer](#) | » amout.vansoesbergen (hyperuser) » CAZ1 (73 hrs.) » baseline » baseline » default

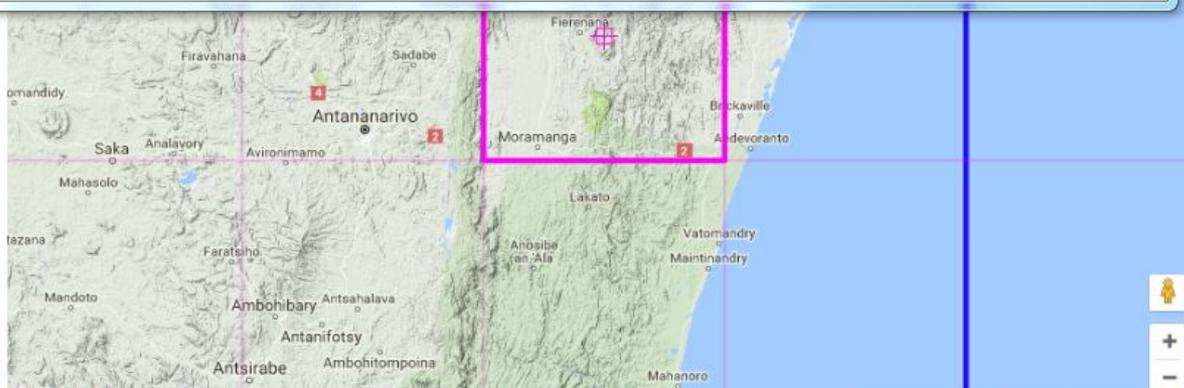
Currently set to NOT write maps every timestep (faster, less disk space used). [Write maps.](#)
Use the following button(s) to control the simulation:

B

(You may close this window, break your connection or switch off the computer. The simulation will continue).
(If the refresh button does not refresh the progress bar, click Start simulation again on the main menu to refresh this window).

0 %

activity : waiting | timestep: 0 of 48



Step 3: Start simulation

1. Click **Step 3: start simulation (A)**

2. Click Start (**B**). A simulation will take around 15 minutes to run a sophisticated hydrological baseline. If the area has never been run before by anyone else, this can take 24 hours (because of preprocessing) but once started, window or computer can be switched off. Will complete without user interaction.

Time for discussion or take a break now




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Results maps - Google Chrome

www1.policysupport.org/cgi-bin/simterra/v1/simterra/pss/controls.cgi?model=ecoengine&username=xyz07oalp%A360o%5Enaxmx79xo%5E4u5%A30u%A314f

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The output datasets that appear on this list depend upon your licensed user level and whether or not you are using the commercial-use version of this system.

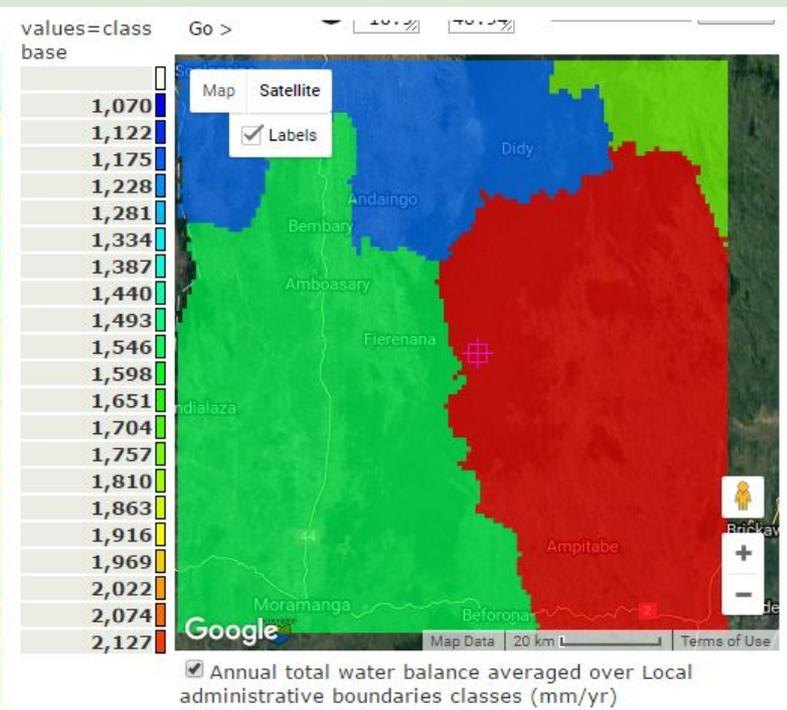
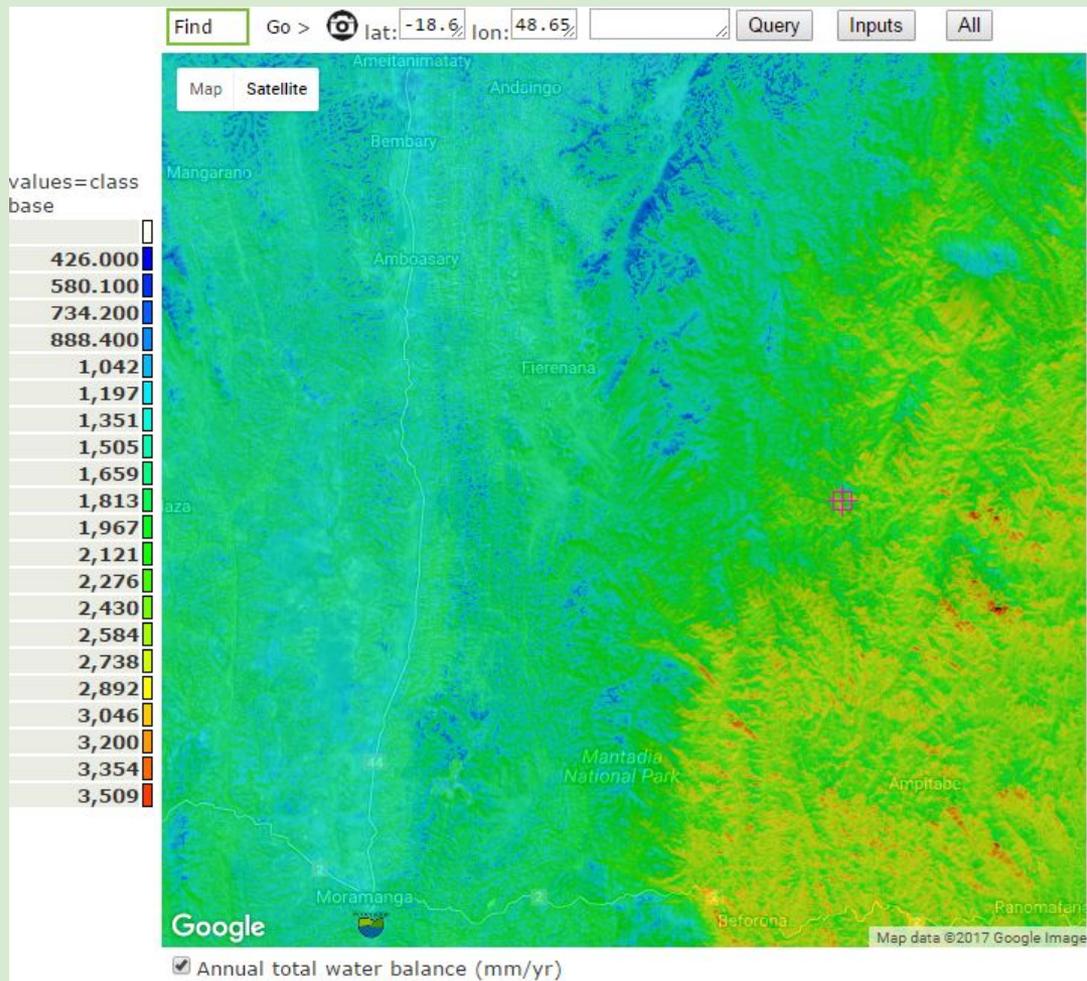
[Analyses, metrics and reporting](#)

- Costs mapping+
- Benefits mapping+
- Water quality mapping+
- Key output maps-

Name	Explanation	Show
Rainfall	Total annual (wind-driven) rainfall (mm/yr)	
Water balance	Local water balance (mm/yr) (rainfall+fog+snowmelt minus actual evapotranspiration (AET). Where water balance is negative local AET is supported by upstream sources of water and/or groundwater	 B
Runoff	Total annual runoff (m ³ /yr). Calculated as water balance cumulated downstream. Negative water balance (AET>precipitation) in a cell consumes runoff from upstream.	
Hillslope net erosion	Hillslope net erosion (mm/yr). Net erosion (erosion minus deposition) on hillslopes	
Total net erosion	Total net erosion (mm/yr). Net erosion (erosion minus deposition) from hillslopes and channels (streams/rivers)	
Mean annual human footprint on water	Mean percentage of water that may be polluted (human footprint index)	

Step 5: Results maps (A)

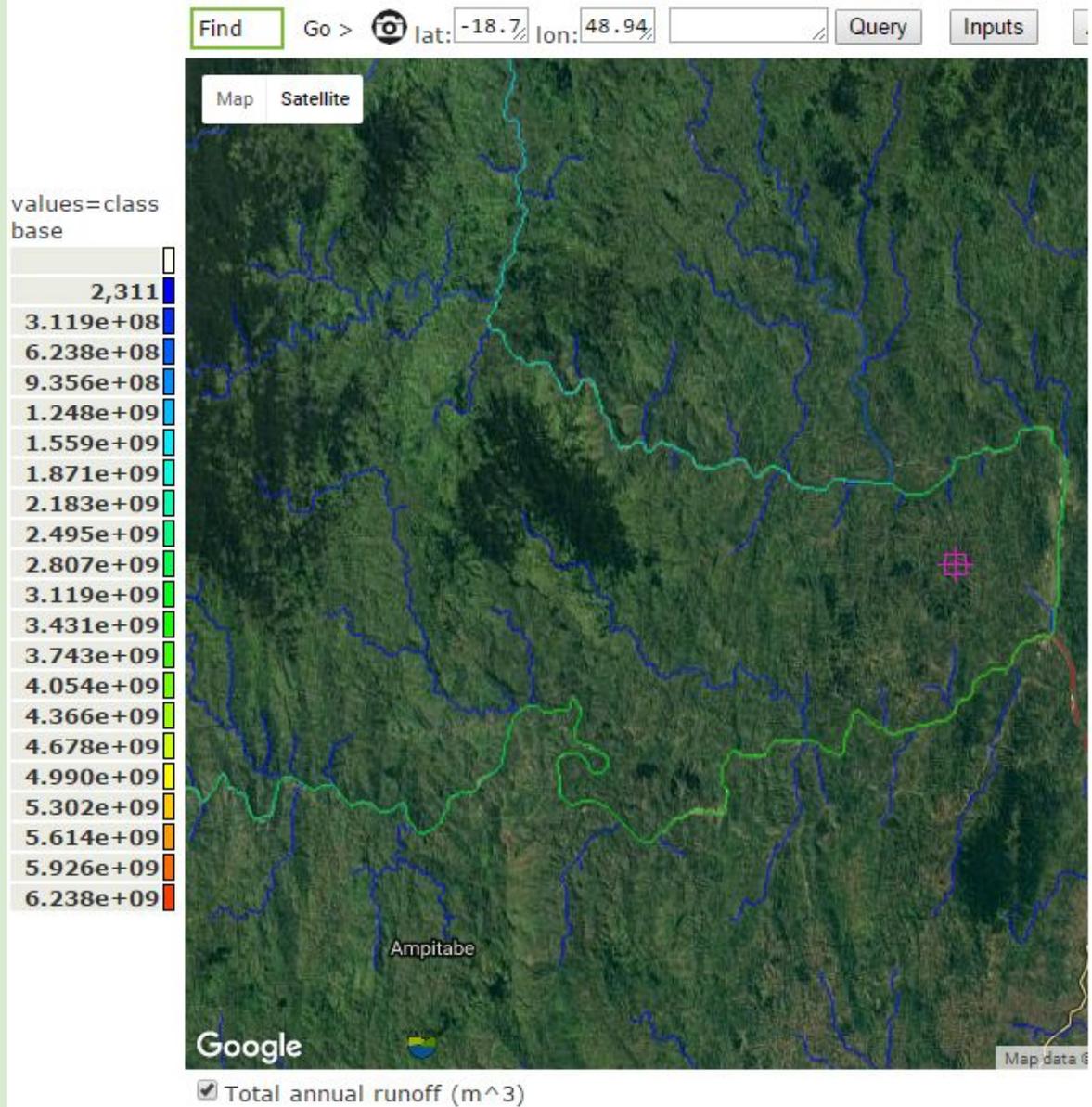
1. We are skipping Step 4 as we want to look at the baseline results before running an alternative
2. Key results are presented
3. To view them, click the 'Show link'. Do so for the map water balance (B)



Water balance (available water)

The pixel based water balance (in Google map view) ranges from around 420 mm/year to more than 3500 mm/year (left). Wind driven rain means that topographic exposure is important to rainfall receipt. The west is clearly in rain shadow.

Aggregated over local administrative boundaries (View by -> local admin boundaries) provides a clearer view of the regional differences.



The water balance cumulated downstream represents the runoff, shown here in Google maps mode as total annual runoff (m³).

If you have points where measurements have been taken, these can be compared with the model by setting points of interest and reading the values for those points from the map.

Name	Explanation	Show
Rainfall	Total annual (wind-driven) rainfall (mm/yr)	
Water balance	Local water balance (mm/yr) (rainfall+fog+snowmelt minus actual evapotranspiration (AET). Where water balance is negative local AET is supported by upstream sources of water and/or groundwater	
Runoff	Total annual runoff (m ³ /yr). Calculated as water balance cumulated downstream. Negative water balance (AET>precipitation) in a cell consumes runoff from upstream.	
Hillslope net erosion	Hillslope net erosion (mm/yr). Net erosion (erosion minus deposition) on hillslopes	
Total net erosion	Total net erosion (mm/yr). Net erosion (erosion minus deposition) from hillslopes and channels (streams/rivers)	
Mean annual human footprint on water quality (pollution)	Mean percentage of water that may be polluted (human footprint index)	

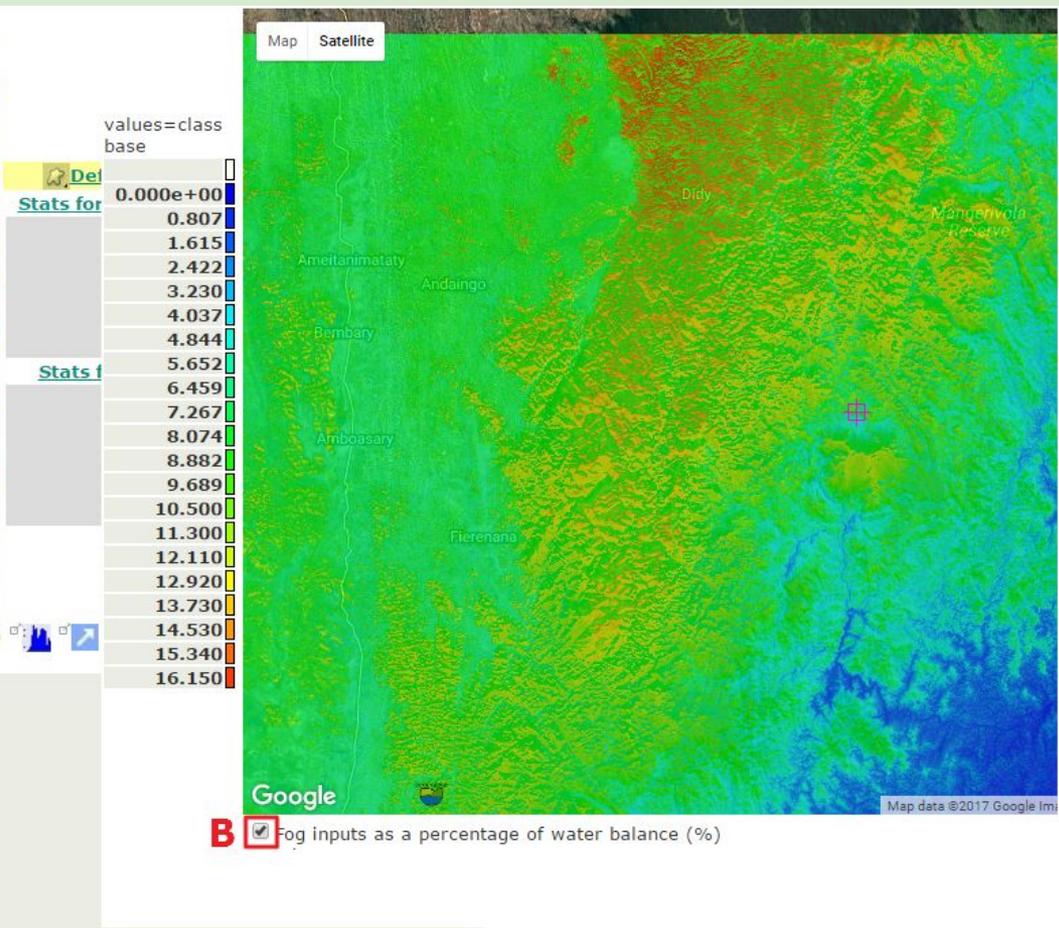
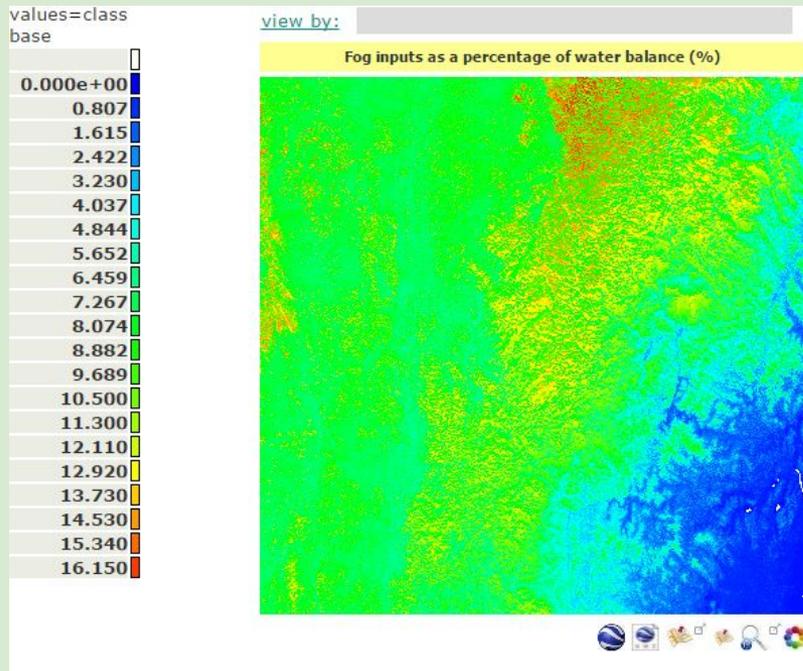
All maps **A**

Total annual actual evapo-transpiration (mm/yr) ²	download+	\sum
Annual total water balance (mm/yr) ²	download+	\sum
Annual total soil deposition (mm/yr) ²	download+	\sum
Total fog deposition (mm/yr) ²	download+	\sum
Annual total gross soil erosion (mm/yr) ²	download+	\sum
Fog inputs as a percentage of water balance (%) ²	download+	\sum
Fog inputs as a percentage of total precipitation .. ²	download+	\sum
Total annual fog runoff (m ³) ²	download+	\sum
Total annual fog runoff (mm/yr) ²	download+	\sum
Total fog inputs (mm/yr) ²	download+	\sum
Annual total gross hillslope soil erosion (mm/yr) ²	download+	\sum
Annual total hillslope net soil erosion (mm/yr) ²	download+	\sum
Total annual hillslope runoff (m ³) ²	download+	\sum
Total fog impaction (mm/yr) ²	download+	\sum
Human footprint on water quality (diarrhoea-releva.. ²	download+	\sum
Human footprint on water quality (% contamination).. ²	download+	\sum
Mean annual air temperature (deg. C) ²	download+	\sum
Annual snow-melt generated runoff (m ³ /s) ²	download+	\sum
Annual total net soil erosion (mm/yr) ²	download+	\sum
Annual % of runoff generated by fog (%) ²	download+	\sum
Annual % of runoff generated by snow-melt (%) ²	download+	\sum
Runoff ratio by subcatchment (fraction) ²	download+	\sum
Total annual runoff (m ³ /s) ²	download+	\sum
Total annual runoff (m ³) ²	download+	\sum

Further results

Click on the **+** next to All maps under the main output maps (**A**). This will show a range of output maps.

Click to view the map Fog inputs as percentage of water balance (%) (**B**)

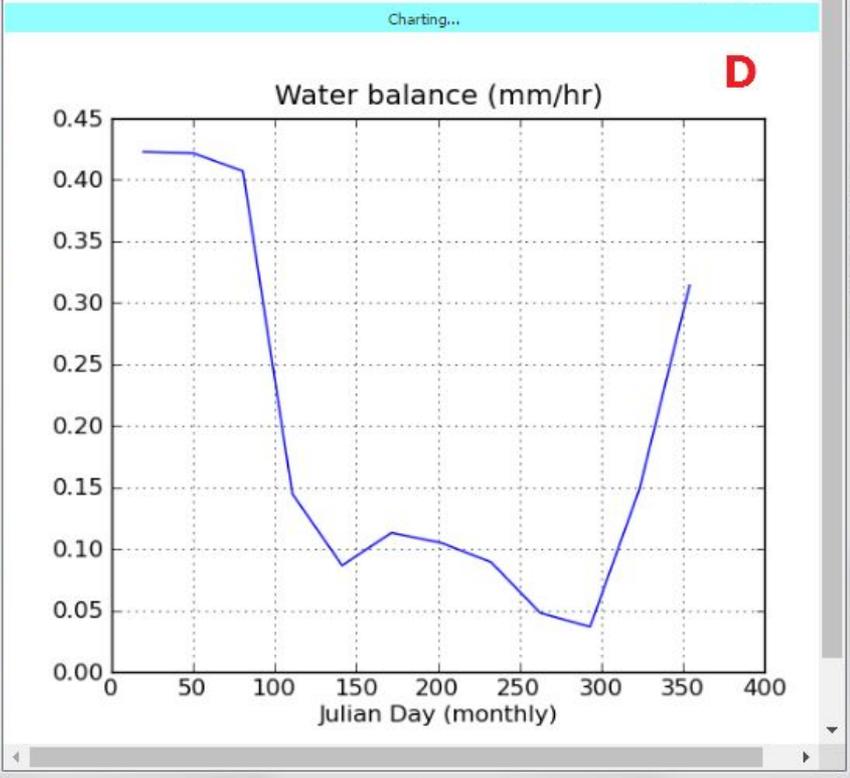


[change image+](#)
[positives only](#)
[negatives only](#)
[non-zeros only](#)
[normalise map](#)
[threshold by+](#)
 mask by ±
 No ZOI defined
A Statistics

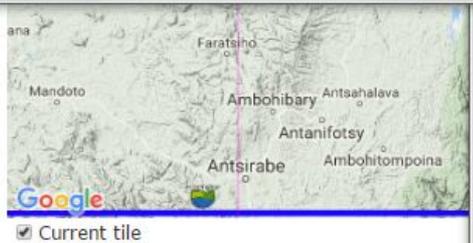
Areas	Min	Max	Sum	Count	Mean	SD	CoV	Area Fraction
All	0.0	16.9470214844	10274903.0	1440000.0	7.13534930556	2.99580238742	41.9853641234	1.0
Zero	0.0	0.0	0.0	420.0	0.0	0.0	nan	0.000291666666667
Non-zero	0.0961439535022	16.9470214844	10274903.0	1439580.0	7.13743105628	2.9937513941	41.9443826566	0.999708333333
Positives	0.0961439535022	16.9470214844	10274903.0	1439580.0	7.13743105628	2.9937513941	41.9443826566	0.999708333333

Annual fog contributions to the water balance are up to nearly 17% in some forested areas. Click on **Statistics** underneath the map to see the stats (A). This contribution of water would be lost with deforestation

In Google maps view, you can toggle the map on and off to see the underlying satellite imagery showing the location of forests by ticking the box (B).



- All timeseries_
- Mean snow pack water equivalent²
 - Precipitation²
 - Meltwater contribution to runoff²
 - Mean melt water production²
 - Fog inputs as a percentage of precipitation²
 - Net soil erosion²
 - Actual Evapo-transpiration²
 - Water storage capacity²
 - Fog contribution to runoff²
 - Water storage²
 - Soil deposition²
 - Runoff ratio²
 - Gross soil erosion²
 - Fog Impaction²
 - Fog inputs as a percentage of water balance²
 - Water balance²**
 - Fog Interception²
 - Mean snowfall²
 - Mean snow cover²
 - Fog Deposition²



Current tile

Step 6: Results: stats

Access to time series results for download (Excel) and online visualisation.

1. Close the results: maps windows and click **Step 6: Results: stats** (A) from the main page to see (B).

2. Click (C) to display the water balance time-series (D) and (E) to download as Excel file.

This is an average across the study tile. The dry season is very clear



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[Step 7: Results: narrative](#) **A**

Help:
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Use: | | ecoengine for: waterworld v.2 [.92] [non-commercial use] | [Disclaimer](#) | [Help](#) | | Disk: u:26 | d:103 GB | Mem: 36 % | Load: 0% |

Results narrative - Google Chrome

[www1.policysupport.org/cgi-bin/simterra/v1/simterra/pss/controls.cgi?model=ecoengine&username=xyz07oalp%A360o%5Enaxnmx79xo%5E4u](#)

Use: | | ecoengine for: waterworld v.2 [.92] [non-commercial use] | [Help](#) | [Disclaimer](#) | | » [arnout.vansoesbergen \(hyperuser\)](#) » [CAZ1 \(70 hrs.\)](#) » [baseline](#) » [baselineWorking...](#)

This simulation is for the tile with boundaries -18.0 (to the N), -19.0 (to the S), 48.0 (to the E and) 49.0 (to the W), named CAZ1 and run at tiled/1-hectare resolution.

The simulation is a baseline simulation with baseline database and default parameter set and was carried out by arnout.van_soesbergen_kcl.ac.uk

The main results indicate:

[For this baseline run-](#)

Water balance (mm/yr) for the area was on average 1,700 with a 25th percentile of 1,300 and a 75th percentile of 2,100 ,an absolute minimum of 360 and maximum of 3,700 . This reflects an area average precipitation (mm/yr) of 1,900 with an absolute minimum of 1,000 and maximum of 3,700 . Actual evapo-transpiration (mm/yr) ranges from 55 to 1,000 with a mean of 310 .Fog inputs are low in relation to precipitation at [show](#) % on average, amounting to [show](#) mm/yr on average but ranging from [show](#) to [show](#) mm/yr.

B [Show all](#)

Current tile

Step 7: Results: narrative

A written summary of the simulation results

1. Click **Step 7: Results narrative** from the main menu (**A**)
2. Click on individual 'show' links or the **Show all** button (**B**) to fill in the results



supported by:



Further credits

Welcome: (hyperuser)
arnout.vansoesbergen

Report problem
Logout

Control panel

Want v.12 | Want v.32

explore:

set-up:

[Step 2: Prepare data](#)

simulation:

[Step 3: Start simulation](#)

[Step 4: Policy exercises](#)

[Manage simulations](#) **A**

results:

[Step 5: Results: maps](#)

[Step 6: Results: stats](#)

[Step 7: Results: narrative](#)

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Prior simulations - Google Chrome

www1.policysupport.org/cgi-bin/simterra/v1/simterra/pss/controls.cgi?model=ecoengine&username=xyz07oalp%A360o%5Enaxmx79xo%5E4u5%A

Use: | ecoengine for: waterworld v.2 [.92] [non-commercial use] | Help | Disclaimer | | » arnout.vansoesbergen (hyperuser) » Madagascar (69 hrs.) » deforest

» baseline » default

Choose the type of simulation:

- All types
- 10 degree tile (1km resolution, global coverage)
- 1 degree tile (1 hectare resolution, near global)
- My simulation
- Community simulation
- Present runs as list

B

Prior simulations - Google Chrome

www1.policysupport.org/cgi-bin/simterra/v1/simterra/pss/kmlcgi.cgi?viewer=ge&username=arnout.van_soesbergen_kcl.ac.uk&model=ecoengine&lan

Use: | ecoengine for: waterworld v.2 [.92] [non-commercial use] | Help | Disclaimer | < | | » arnout.vansoesbergen (hyperuser) » Madagascar (69 hrs.) » deforest

» baseline » default

C

You are storing a total of 6 runs (baselines and alternatives) at different spatial resolutions across all PSS from a maximum of 10

If you are experiencing problems with the system then delete all old runs using the next link as some may no longer be compatible with the system

[Delete runs older than 1 day old from all PSS](#)

[Delete runs older than 1 week old from all PSS](#)

[Delete all but current baseline and associated alternatives](#)

Map data ©2017 Afrigis (Pty) Ltd, Google, ORION-ME | 200 km | Terms of Use

Manage simulations 1:

All runs take up considerable amount of space on the servers and thus you are only allowed to store a limited number of runs. To delete old runs and to see which ones are in your workspace, click on **Manage simulations** (**A**). This will open up a new window. Leave to default and click Submit (**B**) which will open another window (**C**) where you can view and delete old runs

username :	arnout.van_soesbergen_kcl.ac.uk
runname :	CAZ1
model_version :	2.[.92]
runtype :	tilled/1-hectare
bbox_north :	-18.0
bbox_south :	-19.0
bbox_west :	48.0
bbox_east :	49.0
date_created :	(2017, 1, 5)
run_period_begin :	
run_period_end :	
run_status :	completed
alternative :	baseline
database :	baseline
paramset :	default
data :	prepared
archive_status :	
write_timestep_maps :	0
current_moi :	
current_aois :	
current_zoi :	
customisations :	False



This simulation is subject to deletion in: 67 hrs. Simulations past their consume by date are deleted automatically as disk space is required.

A [Choose this baseline](#)
[Delete this baseline \(and associated alternatives\)](#) Centre coordinates: -18.5,48.5

B **Alternatives for CAZ1:**
[Compare alternatives](#) **C**

View run details	Choose run	Run status	Delete run
bau	Choose this run	completed	Delete this run

Manage simulations 2:

The manage simulations window will show all model runs and alternatives. You can select runs (e.g. switching between baselines) or delete baseline *and* alternatives (**A**) or select individual runs (**B**) or delete individual runs (**C**)



The PSS is a testbed for the development and implementation of land and water related policies globally, enabling intended and unintended consequences to be tested in silico before they are tested in vivo. It incorporates detailed spatial datasets at 1-square km and 1 hectare resolution for the entire World, spatial models for biophysical and socioeconomic processes along with scenarios for climate, land use and economic change. A series of interventions (policy options) are available which can be implemented and their consequences traced through the socio-economic and biophysical systems. The model integrates with a range of geobrowsers for immersive visualisation of outcomes. A series of scenario and interventions tools are provided and the model can be used by policy analysts, scientists and students in Spanish or English. Works best in the Mozilla Firefox browser. Your browser must have Javascript enabled and any pop-up blockers disabled. [What do I do now?](#) or [Quick overview](#). Latest news:

Scientists:

[Model documentation](#)

supported by:



POLICY SUPPORT user feedback

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Superuser

Language

English

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Create account: ON PUBLIC SERVER [HERE](#) Define institutional email, username and password for this system [do not use passwords you use on other sites], wait for e-mail, click link in e-mail, check in spam folder if e-mail not received within a few minutes) . **Sign in as scientist. If you do not have an institutional email address create account [here](#)**

