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# A WaterWorld Hydrological Baseline for CAZ

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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\_

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

| run: [CAZ1 \(72 hrs.\)](#) » alternative: baseline » database: baseline » parameter set: default |

Find

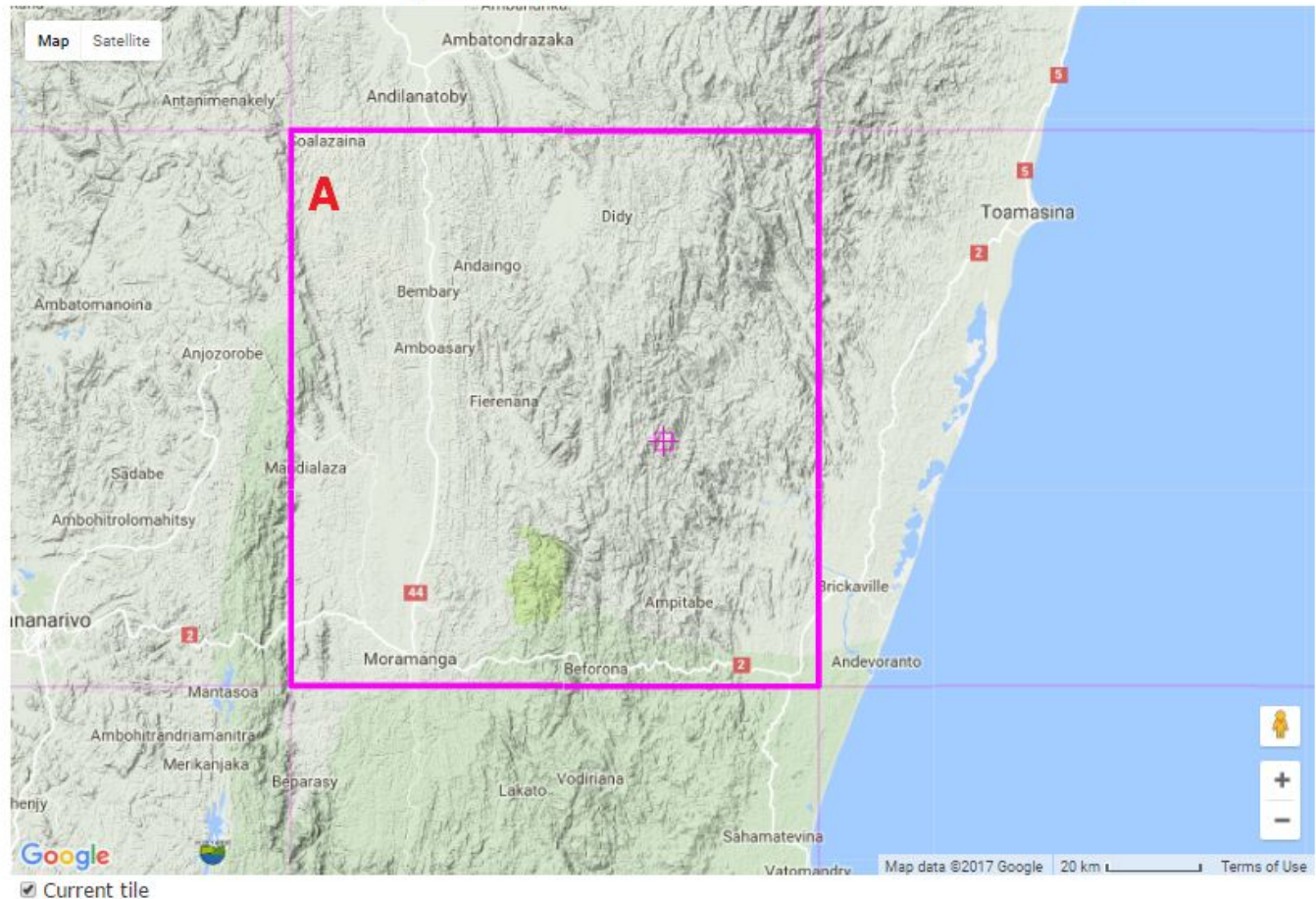
Go >

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'



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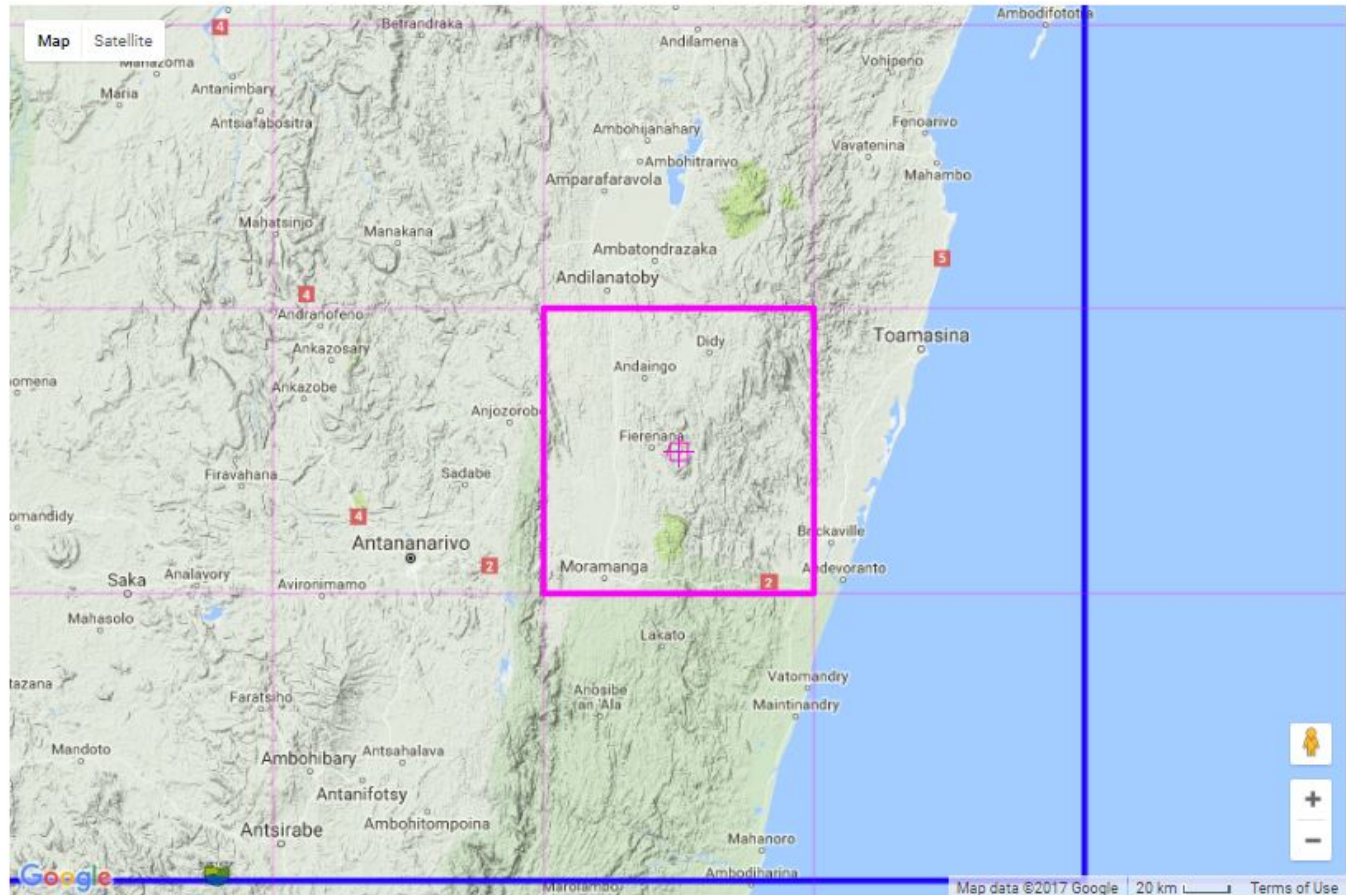
| Disk: u:26 | d:103 GB | Mem: 36 % | Load: 0% |

run: **CAZ1 (72 hrs.)** » alternative: baseline » database: baseline » parameter set: default **A**

Find  
Go >

lat: -18.500 lon: 48.5000 Run name \_Tiled 1km

Step 1: Define area



☒ Current tile

Map data ©2017 Google 20 km Terms of Use

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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explore:

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**Step 2: Prepare data** **A**

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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 Terms of Use

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

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Variable	Unit	Download	Visualise	View by
Wind speed July (UEA) (m/s *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Wind speed August (UEA) (m/s *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Wind speed September (UEA) (m/s *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Wind speed October (UEA) (m/s *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Wind speed November (UEA) (m/s *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Wind speed December (UEA) (m/s *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Cover of bare ground (Landsat 2000) (percentage) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Cover of herb-covered ground (Landsat 2000) (perce.. <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Cover of tree-covered ground (Landsat 2000) (perce.. <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Landsat water mask (Hansen/UMD/Google/USGS/NASA) (.. <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Daily temperature range January (WC) (deg C *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Daily temperature range February (WC) (deg C *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Daily temperature range March (WC) (deg C *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	
Daily temperature range April (WC) (deg C *10) <sup>2</sup>		<a href="#">download+</a>	<a href="#">view by:</a>	

Google Maps

Map data ©2017 Google 20 km

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## Step 2: prepare data

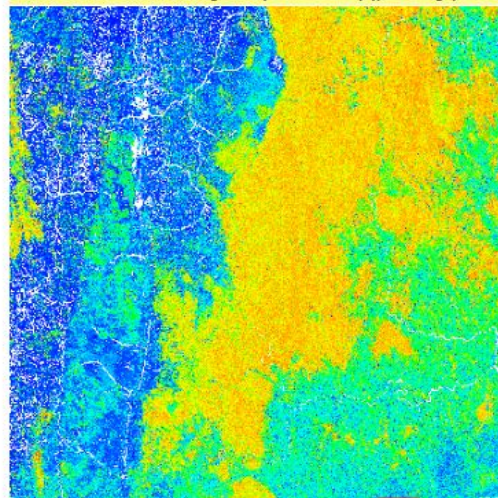
1. The model requires more than 140 maps to run
2. Those that we produce or have license to redistribute can be downloaded in GIS formats (A) and visualised (B, also see next slide) from here
3. Many cannot be redistributed but we are working with data providers to enable at least visualisation of the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



values=class  
base

view by:

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



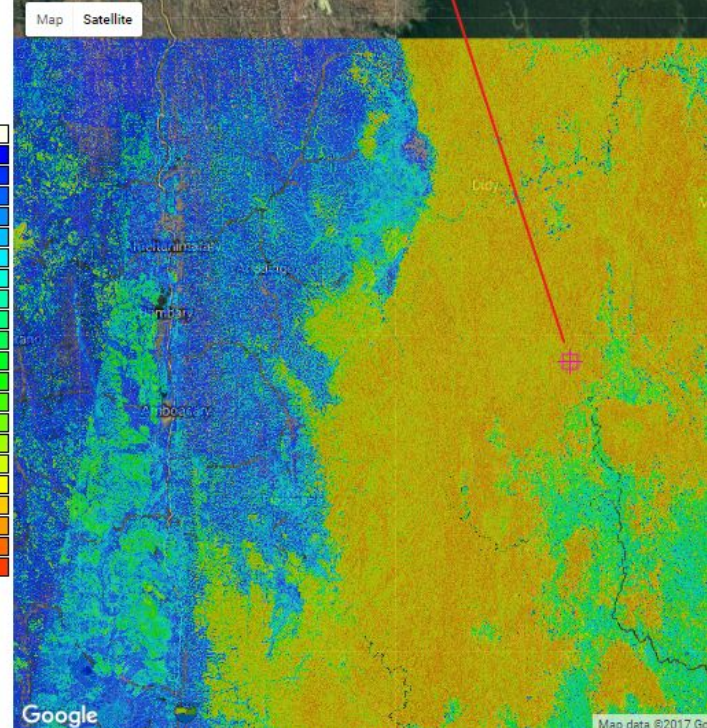
Define regions of interest [ROIs]  
Stats for all active POI sets (none set)

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)

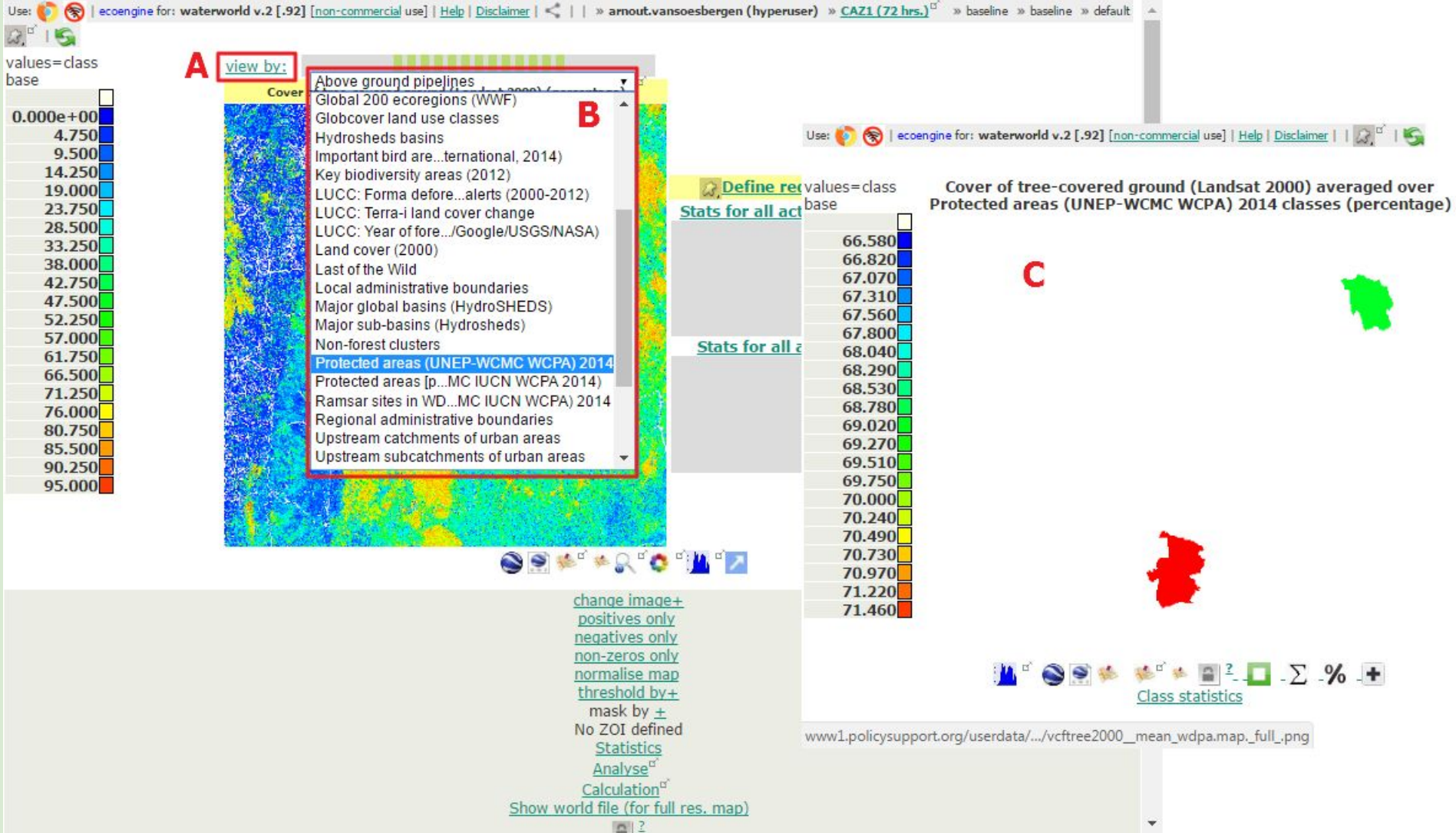
Find Go > lat: -18.3 lon: 48.70 74.0 Query Inputs All



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

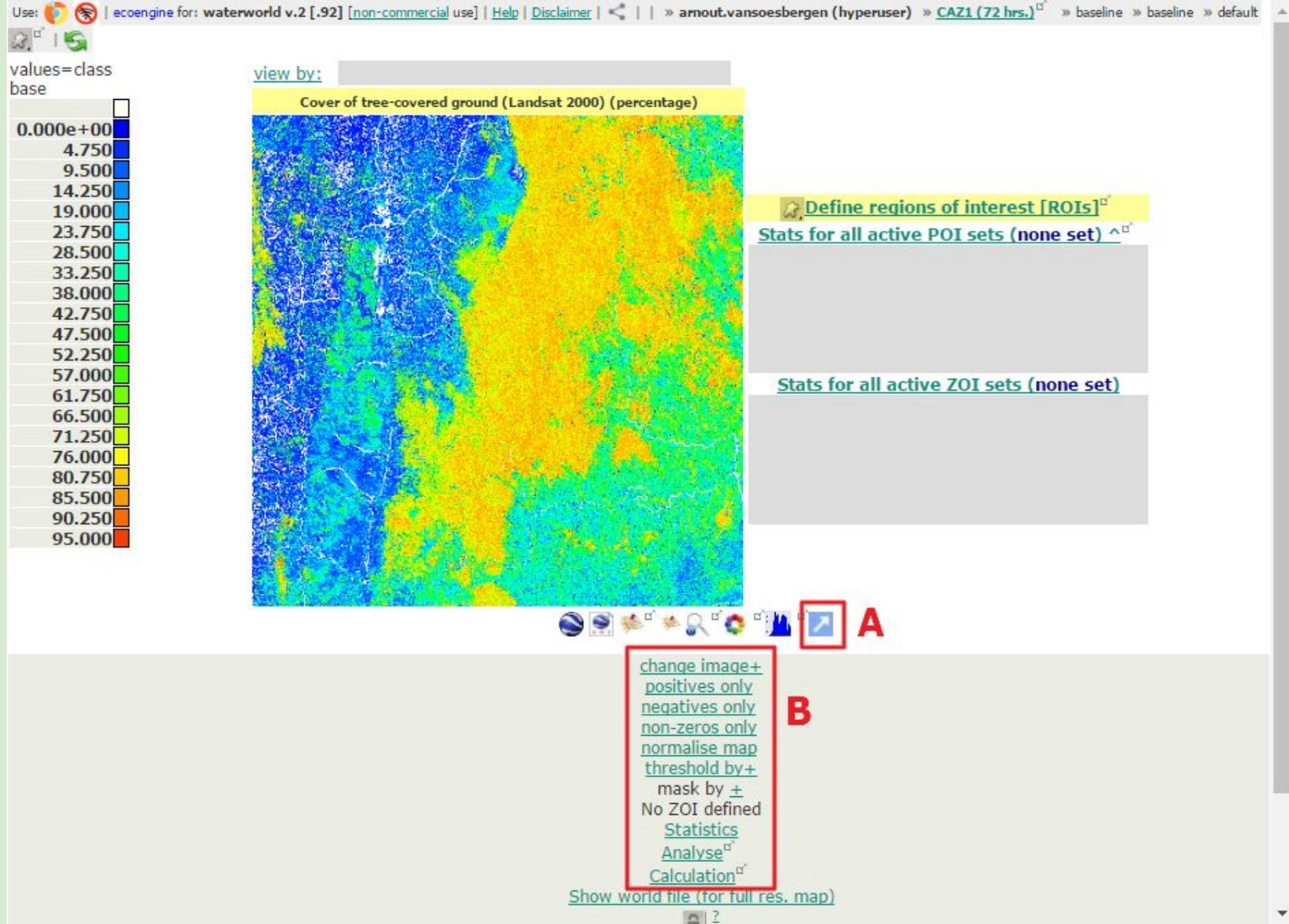
Visualising and comparing data including Google Maps/Earth, even without running the model. No local GIS system or skills required.

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)



- 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)





## 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: for: **waterworld v.2** [.92] [[non-commercial use](#)] | [Help](#) | [Disclaimer](#) | » [arnout.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%5Enaxnmx79xo%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.

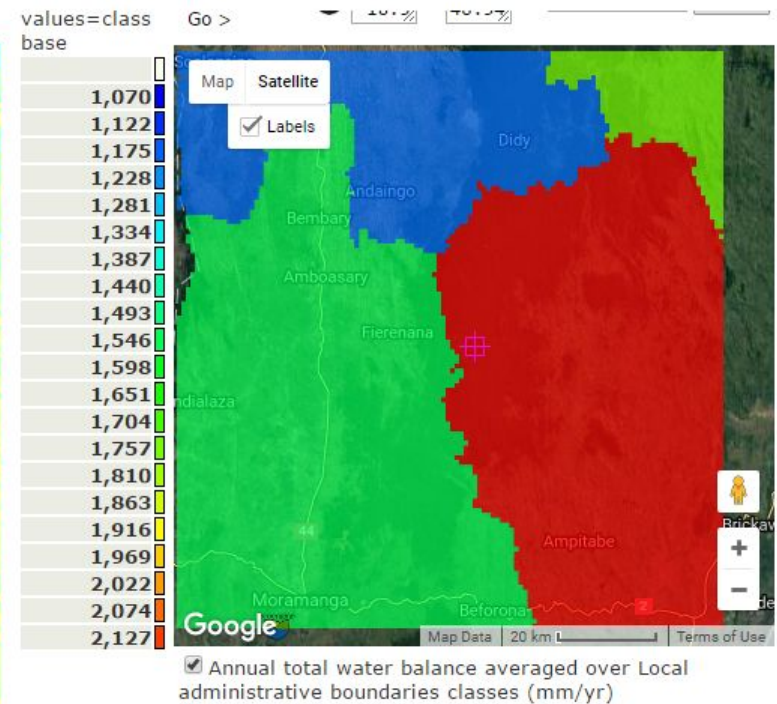
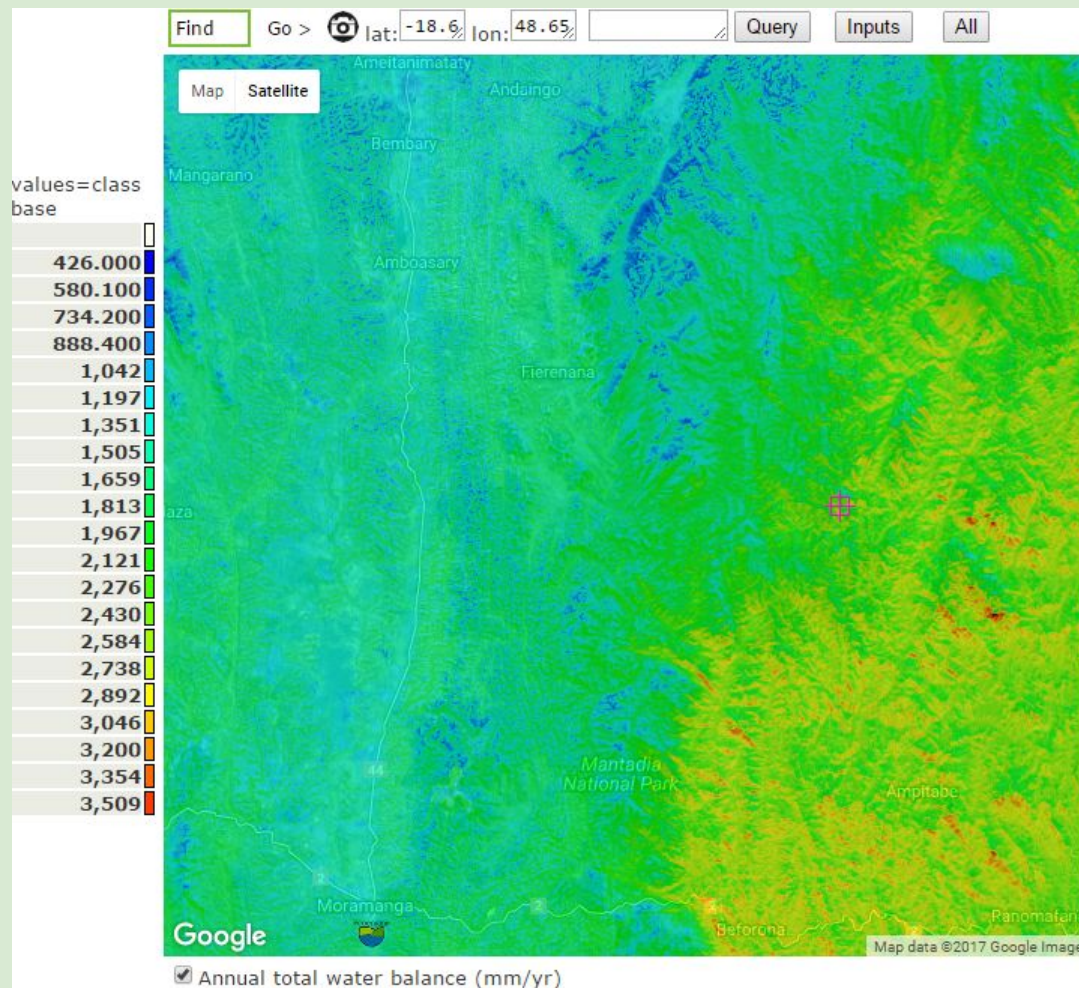
[Analyses, metrics and reporting](#)

- [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>B</b>
Runoff	Total annual runoff (m <sup>3</sup> /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)

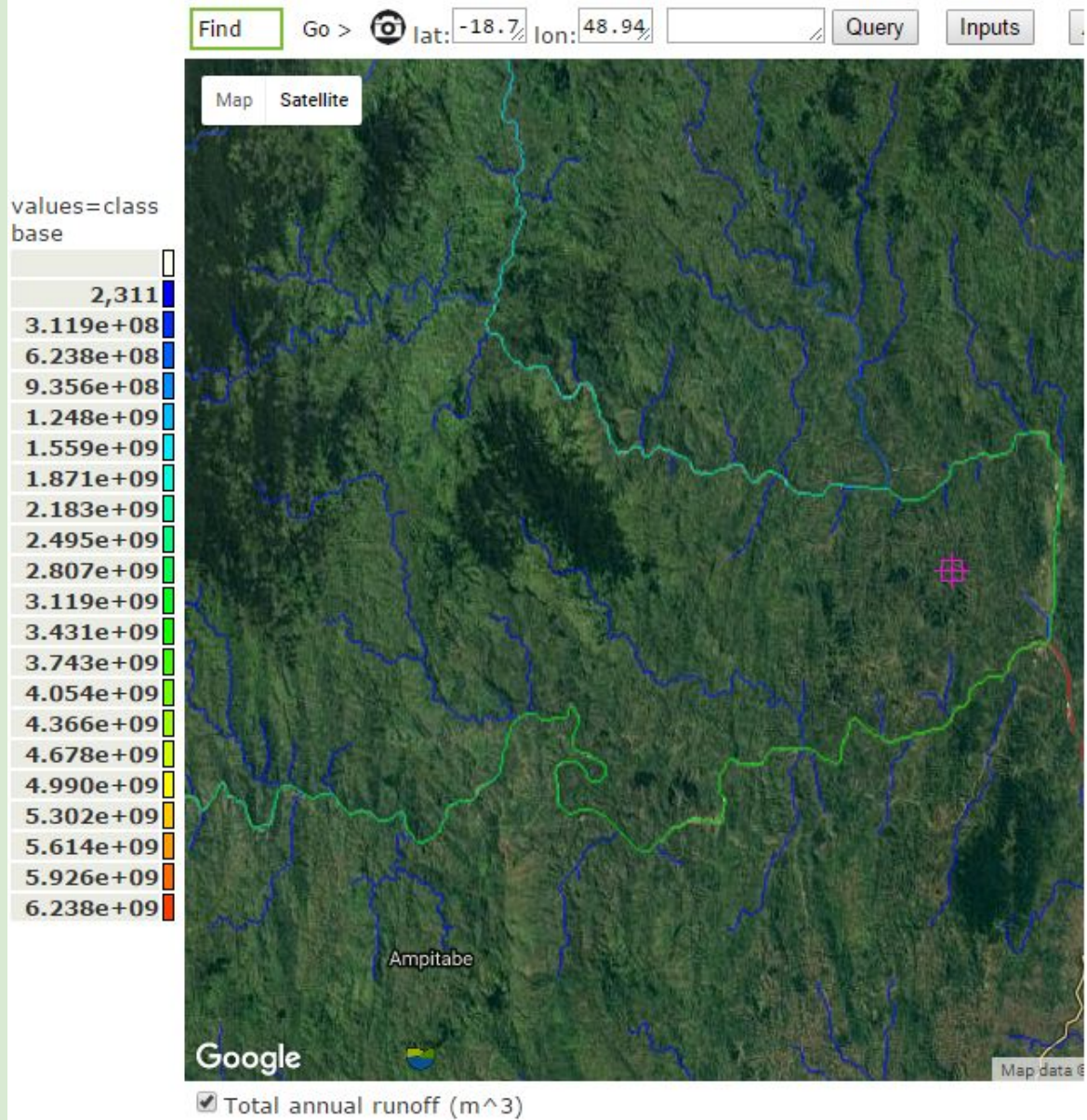


## Water balance (available water)

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 (m<sup>3</sup>).

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 <sup>3</sup> /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**

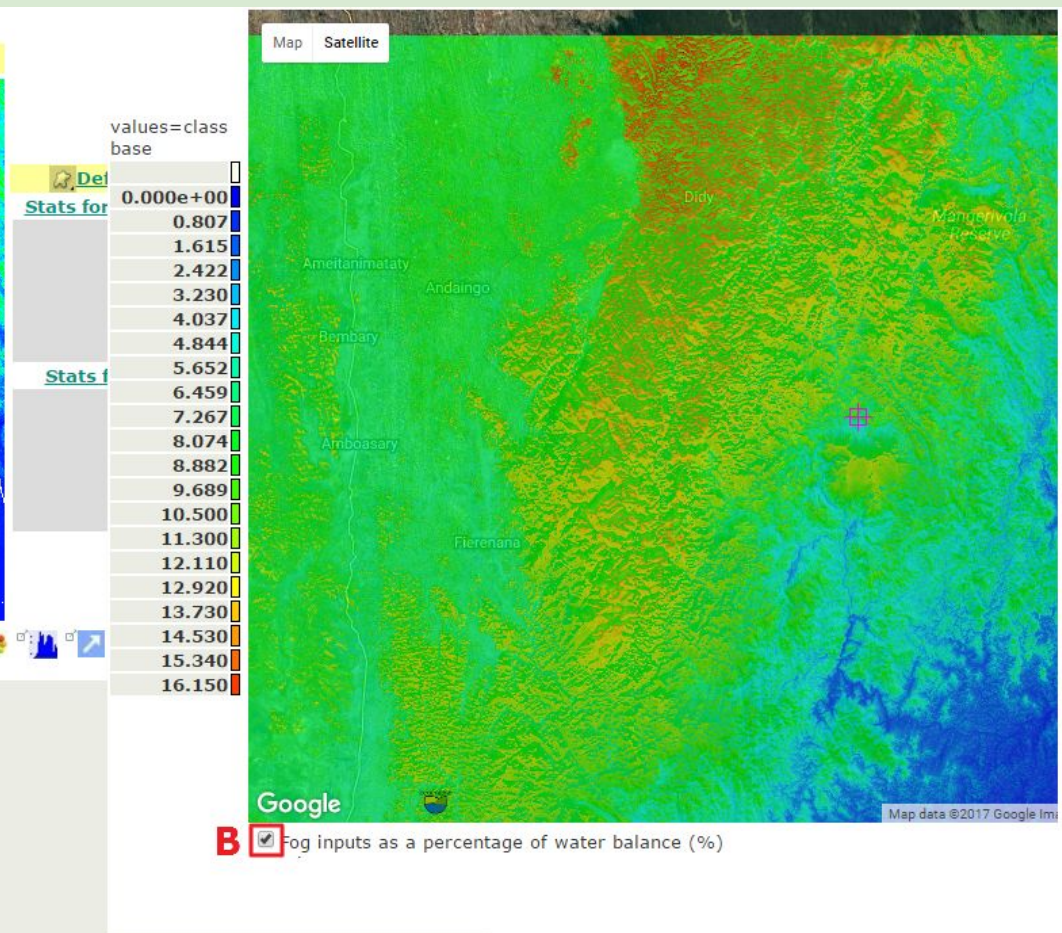
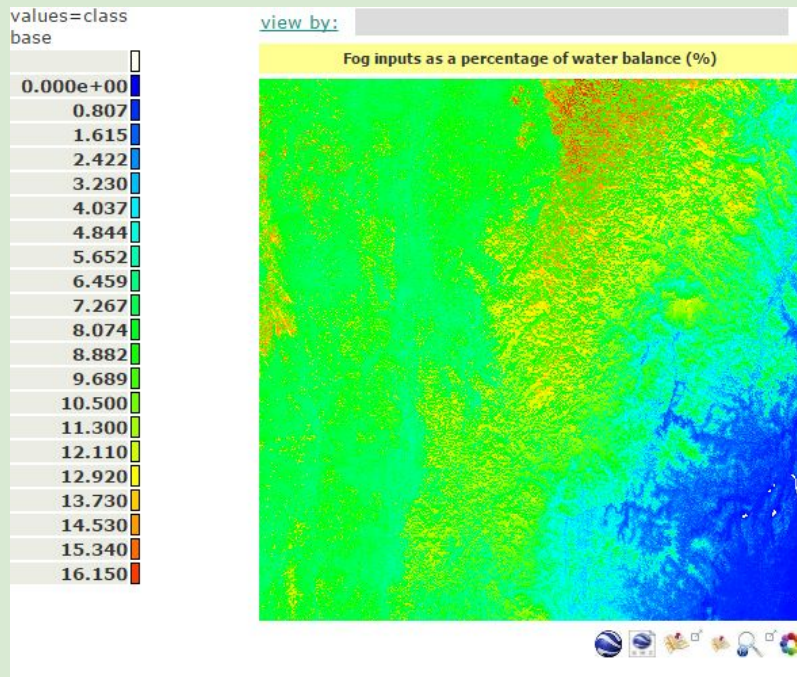
Total annual actual evapo-transpiration (mm/yr) <sup>2</sup>	 <a href="#">download+</a>  
Annual total water balance (mm/yr) <sup>2</sup>	 <a href="#">download+</a>  
Annual total soil deposition (mm/yr) <sup>2</sup>	 <a href="#">download+</a>  
Total fog deposition (mm/yr) <sup>2</sup>	 <a href="#">download+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

## 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**)

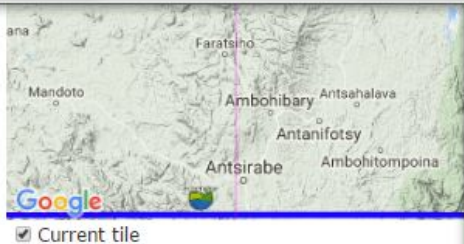
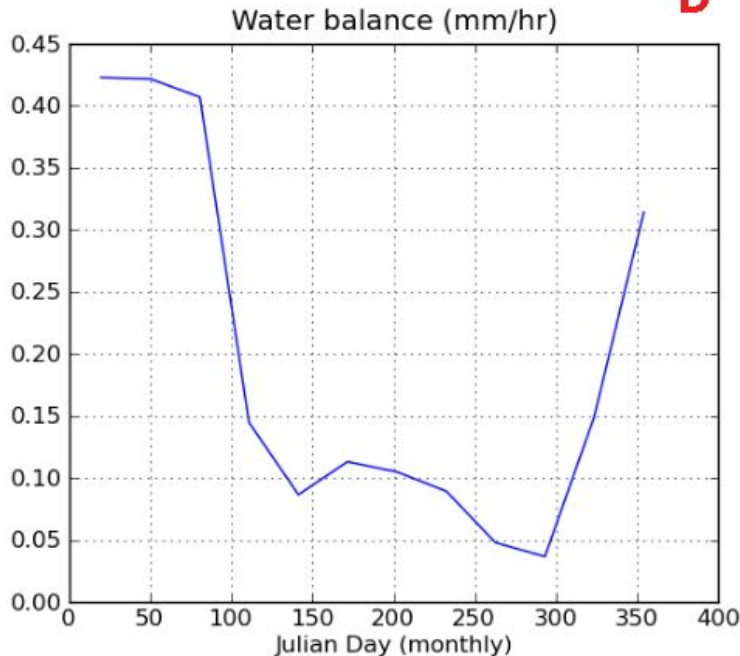




Areas	Min	Max	Sum	Count	Mean	SD	CoV	Area Fraction
All	0.0	16.9470214844	10274903.0	1440000.0	7.13534930556	2.99580238742	41.9853641234	1.0
Zero	0.0	0.0	0.0	420.0	0.0	0.0	nan	0.000291666666667
Non-zero	0.0961439535022	16.9470214844	10274903.0	1439580.0	7.13743105628	2.9937513941	41.9443826566	0.999708333333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



- ☐ Mean snow pack water equivalent<sup>2</sup>
- ☐ Precipitation<sup>2</sup>
- ☐ Meltwater contribution to runoff<sup>2</sup>
- ☐ Mean melt water production<sup>2</sup>
- ☐ Fog inputs as a percentage of precipitation<sup>2</sup>
- ☐ Net soil erosion<sup>2</sup>
- ☐ Actual Evapo-transpiration<sup>2</sup>
- ☐ Water storage capacity<sup>2</sup>
- ☐ Fog contribution to runoff<sup>2</sup>
- ☐ Water storage<sup>2</sup>
- ☐ Soil deposition<sup>2</sup>
- ☐ Runoff ratio<sup>2</sup>
- ☐ Gross soil erosion<sup>2</sup>
- ☐ Fog Impactation<sup>2</sup>
- ☐ Fog inputs as a percentage of water balance<sup>2</sup>
- ☒ Water balance<sup>2</sup>
- ☐ Fog Interception<sup>2</sup>
- ☐ Mean snowfall<sup>2</sup>
- ☐ Mean snow cover<sup>2</sup>
- ☐ Fog Deposition<sup>2</sup>

## 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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[Manage simulations](#)

results:  
[Step 5: Results: maps](#)  
[Step 6: Results: stats](#)  
[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%5Enaxnm79xo%5E4u](#)

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





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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

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» 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](#)

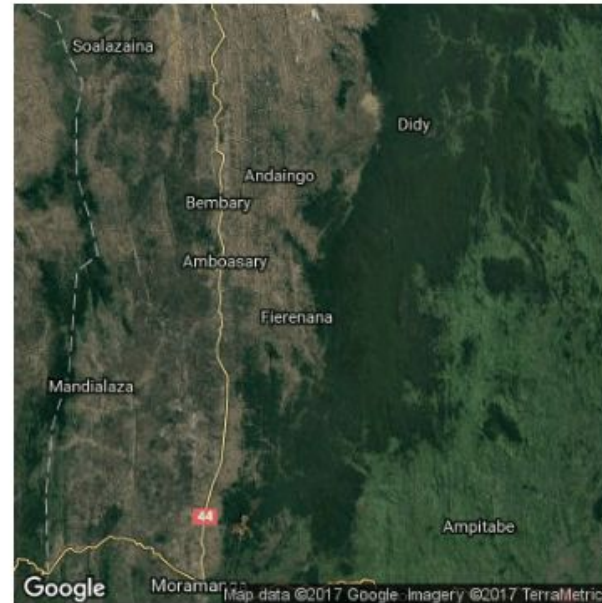


Map data ©2017 AfriGIS (Pty) Ltd, Google, ORION-ME 200 km  Terms of Use

## 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_soesterbergen_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



Centre coordinates: -18.5,48.5

**A**

[Choose this baseline](#)  
[Delete this baseline \(and associated alternatives\)](#)

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

**B**

Alternatives for CAZ1:  
[Compare alternatives](#)

**C**

View run details	Choose run	Run status	Delete run
<a href="#">bau</a>	<a href="#">Choose this run</a>	completed	<a href="#">Delete this run</a>

## 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**)





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\*\*\*\*\*

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Superuser ▼

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WaterWorld is a web based policy support system for understanding hydrological systems and human impacts upon them.

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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