Mapping ecosystem services in the Volta basin using Co$ting Nature ES assessment model

Authors: Mark Mulligan, Arnout van Soesbergen

Scope and objective

Co$ting Nature is a web based tool for natural capital accounting and analysing the ecosystem services provided by natural environments (i.e. nature's benefits), identifying the beneficiaries of these services and assessing the impacts of human interventions. This policy support system is a testbed for the development and implementation of conservation strategies focused on sustaining and improving ecosystem services. It also focused on enabling the intended and unintended consequences of development actions on ecosystem service provision to be tested in silico before they are tested in vivo. The system incorporates detailed spatial datasets at 1-square km and 1 hectare resolution for the entire world, spatial models for biophysical and socio-economic processes along with scenarios for climate and land use. The tool calculates a baseline for current ecosystem service provision and allows a series of interventions (policy options) or scenarios of change to be used to understand their impact on ecosystem service delivery. It does not focus on valuing nature (how much someone is willing to pay for it) but rather costing it (understanding the resource e.g. land area and opportunity cost of nature being protected to produce the ecosystem services that we need and value).

Input data for application of this model anywhere globally (from remote sensing and other global sources) is included in the system. However, users can also use this model with their own datasets. Application with the provided datasets takes only half an hour and requires no GIS capacity. Bringing in your own datasets will take much longer depending on the availability, level of processing, format and consistency of those datasets and also requires GIS capacity.

Typical applications include ecosystem service assessment, conservation prioritization, analysis of co-benefits e.g. for REDD+ and analysis of pressures and threats on carbon and biodiversity in general or for specific planned agricultural, industrial or extractive interventions.

Audience: Conservation and development NGOs, GO and NGO Policy analysts, agriculture and industry (e.g. extractives), education and academic research.

Description and application

To access the tool, go to http://www.policysupport.org/costingnature and click on the relevant link to create a free account which can be used with the scientist user level interface.

After logging in, there are four easy steps to run the tool. All these steps (except step 3) are also documented in training video's. At each step you can find the link for the relevant video.

Step 1: select study area location

Video: here

The model can be run at 1-km and 1-ha resolutions with a tiled extent of 1-degree (~100 km) or 10-degrees (~1000 km). The 1-ha resolution can only be run within the 1-degree tiles. The 1-km resolution can be run within tiles of 10 degrees or at country or large river basin level. To select your study area, you can either move the map until your area is within the highlighted tile (blue for 1-km, 10 degrees and pink for 1-ha, 1 degree) or select a country or basin from the dropdown list (Figure 1, A). Once you have selected your area, you need to give it a name (Figure 1, B) and click on Step 1: Define area.

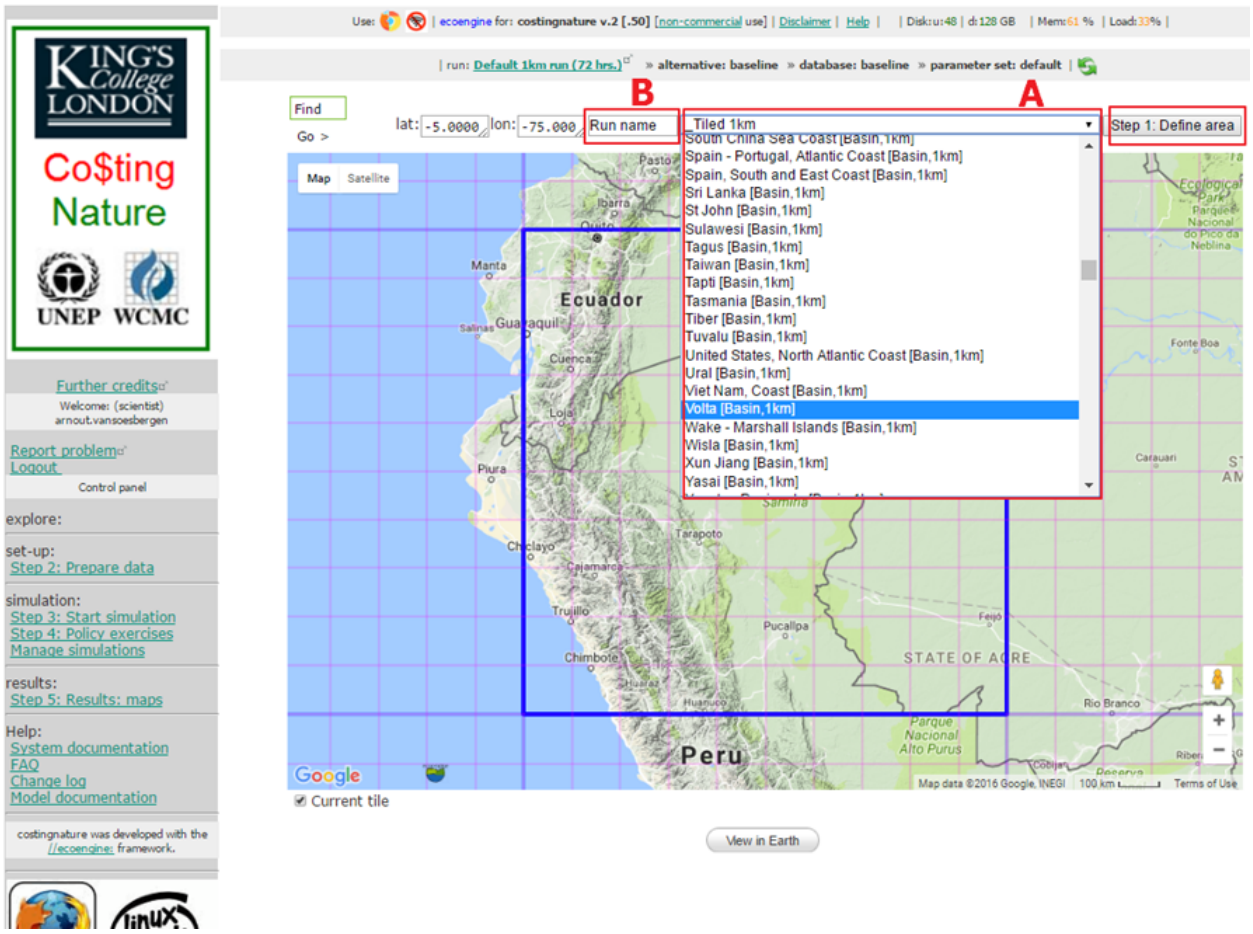


Figure 1 Step 1 in defining study area for running the model

Step 2: Prepare data

Video: here

Step 2 is about preparing the data. Co$ting Nature comes with all necessary data included to run the model. For each model run however, data will have to be prepared and copied to your personal workspace (linked to your account). To set up data for a model run, click on Step 2: Prepare data (Figure 2, A). This will then open up a window where you can view the list of data (list baseline workspace data) or Copy data to your workspace (Figure 2, B) which is required to run the model. When clicking on this,

the system will take a few minutes to gather and copy the necessary data to your workspace on the servers. When the data is ready you can view the workspace data by clicking on the +/- next to show workspace data (Figure 2, C).

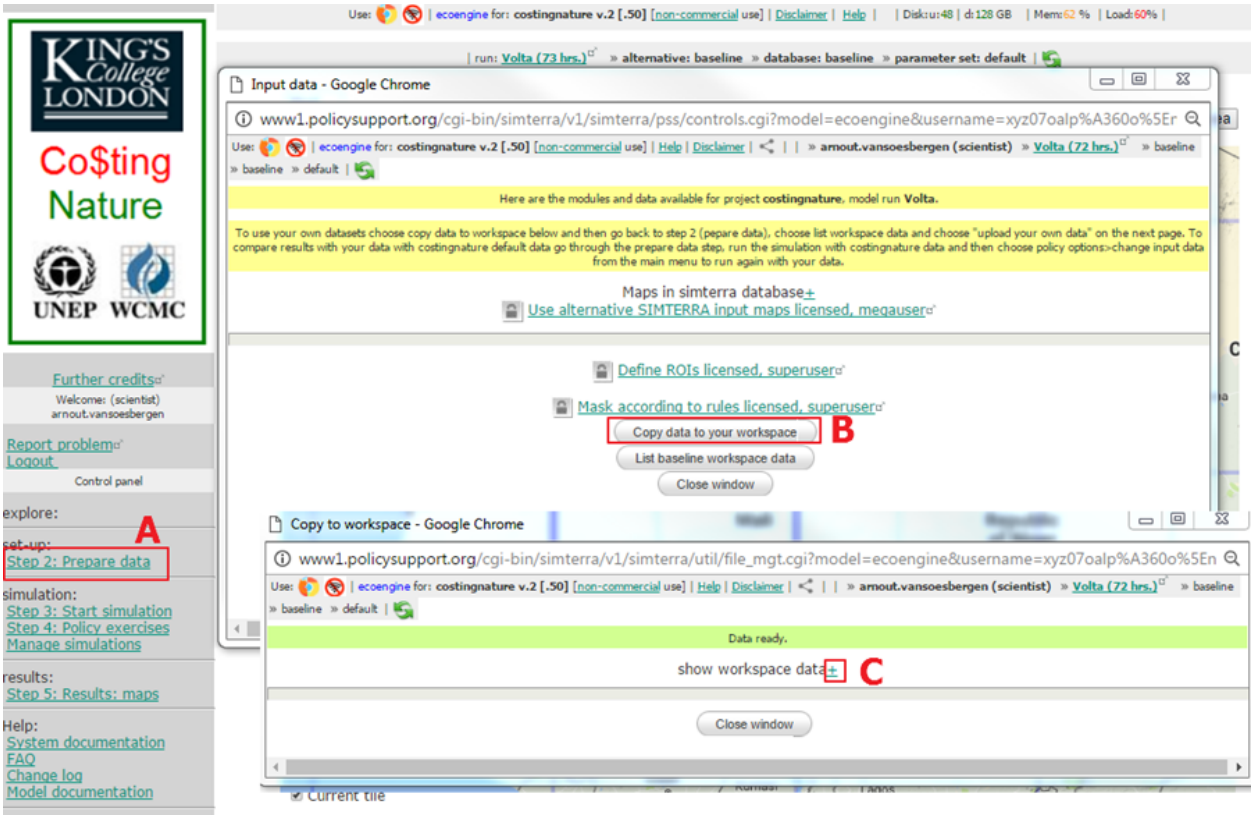


Figure 2: Prepare data for running the model

Visualising data

Opening up the list of workspace data (Figure 2, C) will show the list of all datasets necessary to run the model. Around 140 spatial datasets are required for a run. Maps that have a license to redistribute can be downloaded in a variety of GIS formats (Figure 3, A), or can be viewed (Figure 3, B), depending on the license.

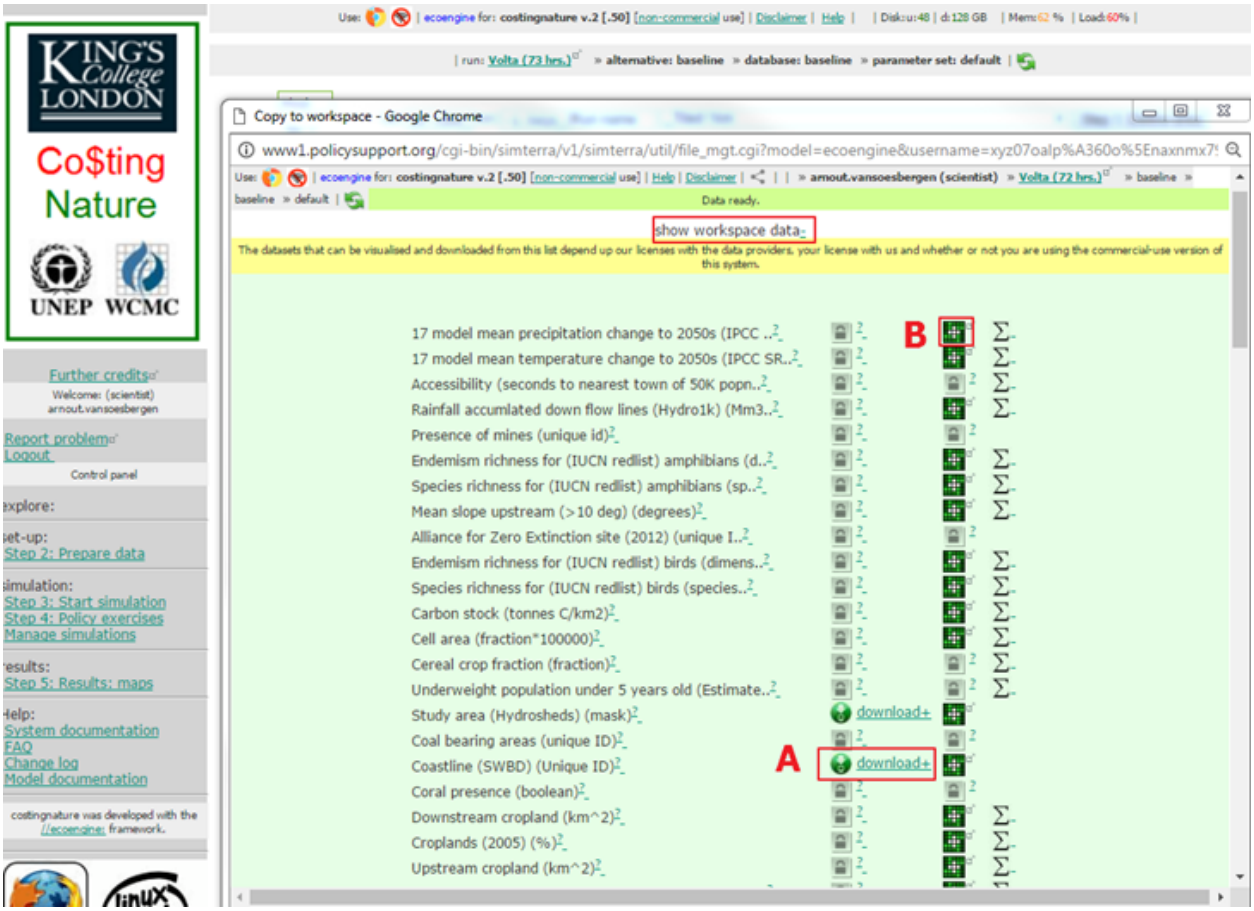


Figure 3 Download or visualise maps in workspace

Clicking on the green view map icon (Figure 3, B) will open up a map viewer window with a number of options similar to those in a GIS. Any map (input or output) can be overlaid on Google Earth or Google maps. Some of the options are shown in Figure 4, showing a pixel based map of recent deforestation (A), an elevation map overlaid on Google Maps (B) for which you can query individual pixel values by moving the map until the crosshair overlays your pixel of interest and clicking on **Query**. Maps can also be aggregated over other maps by selecting a map from the **View by** dropdown above the main map, e.g. select protected areas (C) to view the mean deforestation in protected areas (D)

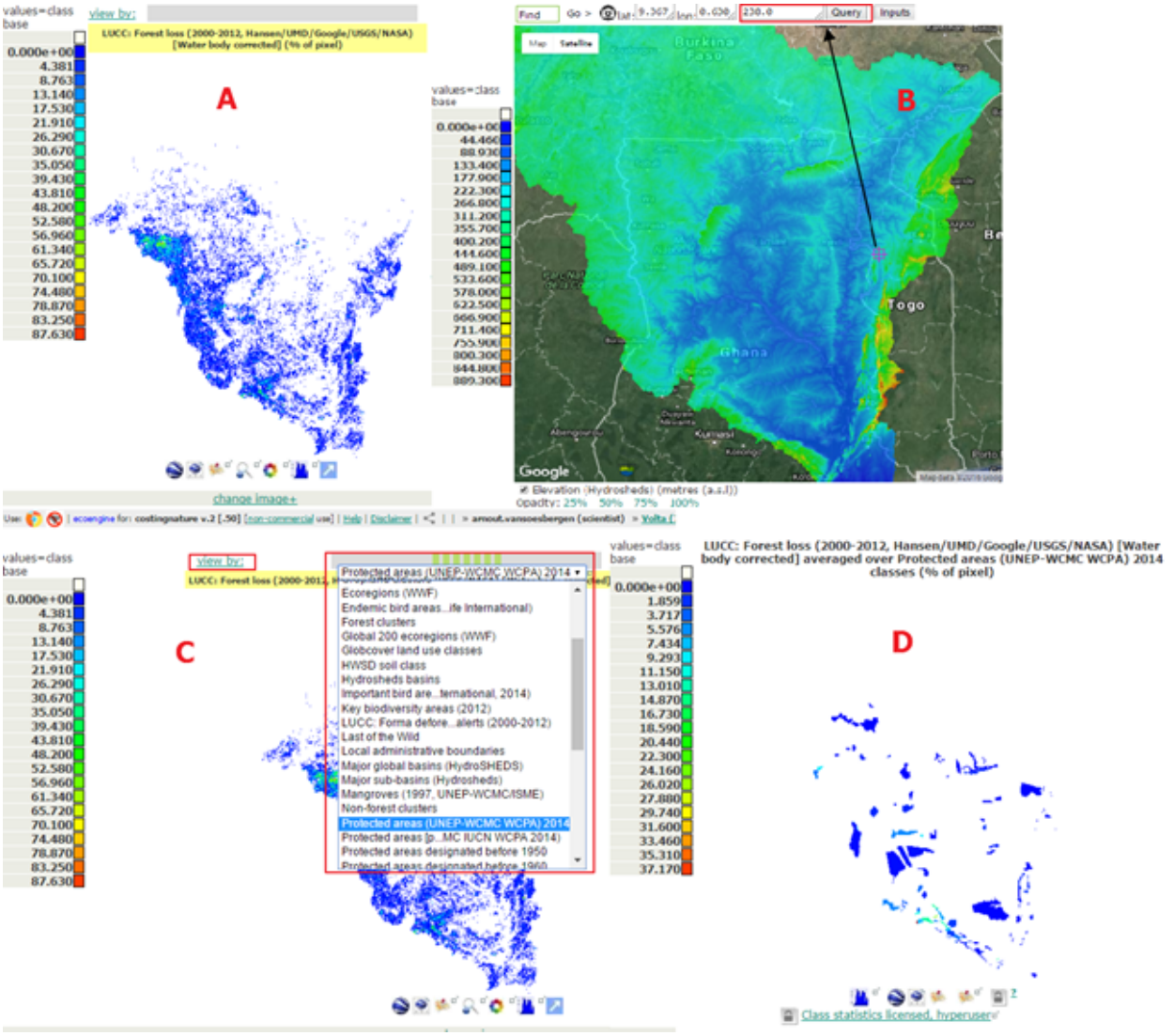


Figure 4: visualising input and output maps

Step 3: Start simulation

Once all data has been copied over to your workspace, you can start the simulation by clicking on **Step 3: start simulation** in the left hand control panel on the main page (Figure 4, A). This will then open a simulation window. In this window you can choose whether you want the output maps to be indexed globally (i.e. for comparing your study area with anywhere else in the world) or locally (which will index all values between 0 and 1 within your study area) (Figure 4, B). The default setting is globally. Note that Co$ting Nature only produces indexed output maps, i.e. all maps will always scale between 0 and 1. Once you have made your selection, click on Start (C) to set the simulation running. Runs only take a few minutes to complete.

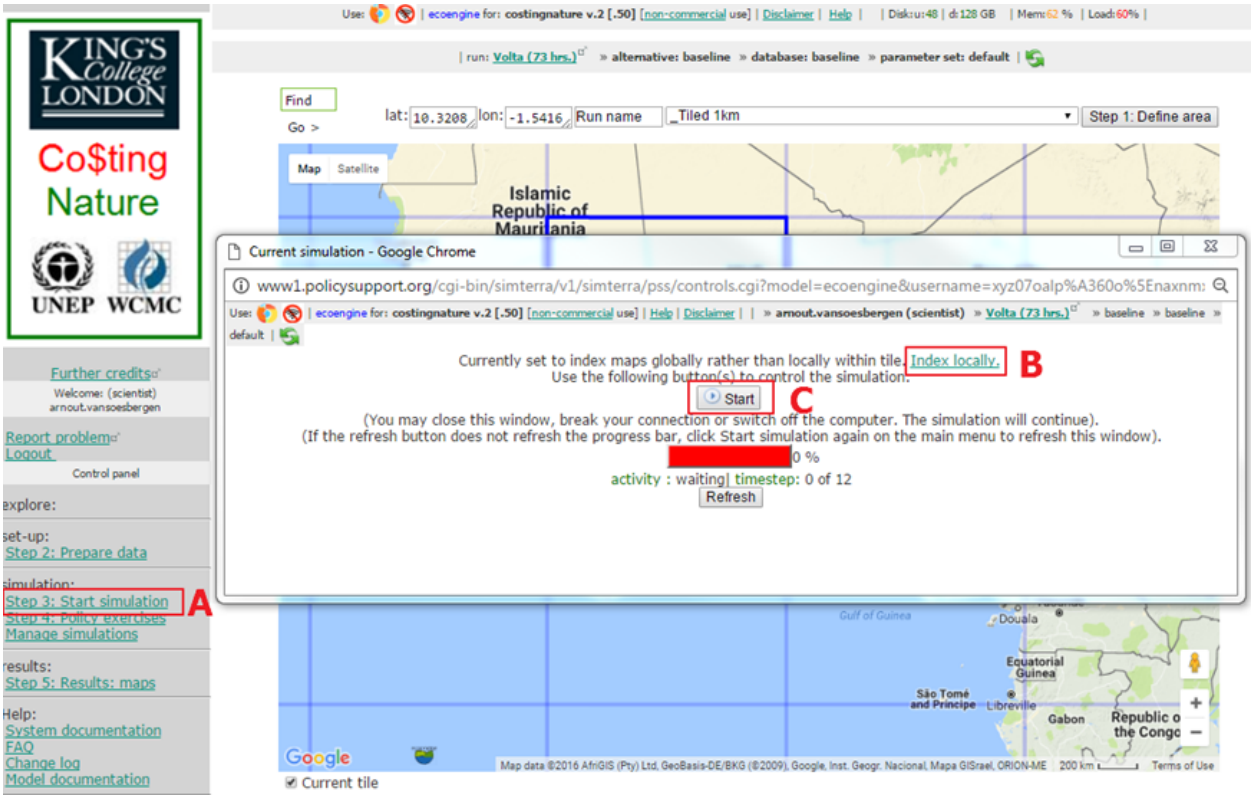


Figure 5: step 3: start simulation

Step 5: Results maps

Video: here

Once the simulation has finished you can look at the results by clicking on **Step 5: results maps** in the left control panel on the main page. Step 4 is skipped as that step is for scenario simulations which can only be run after a baseline run has been done. Map outputs from all runs (baseline and scenario) are always in step 5. This will open up a new window showing all the map results as shown in Figure 5. You can view and interrogate the output maps by clicking on the green view map icon (A) which gives you all the options to view and analyse the maps as discussed in the previous section.

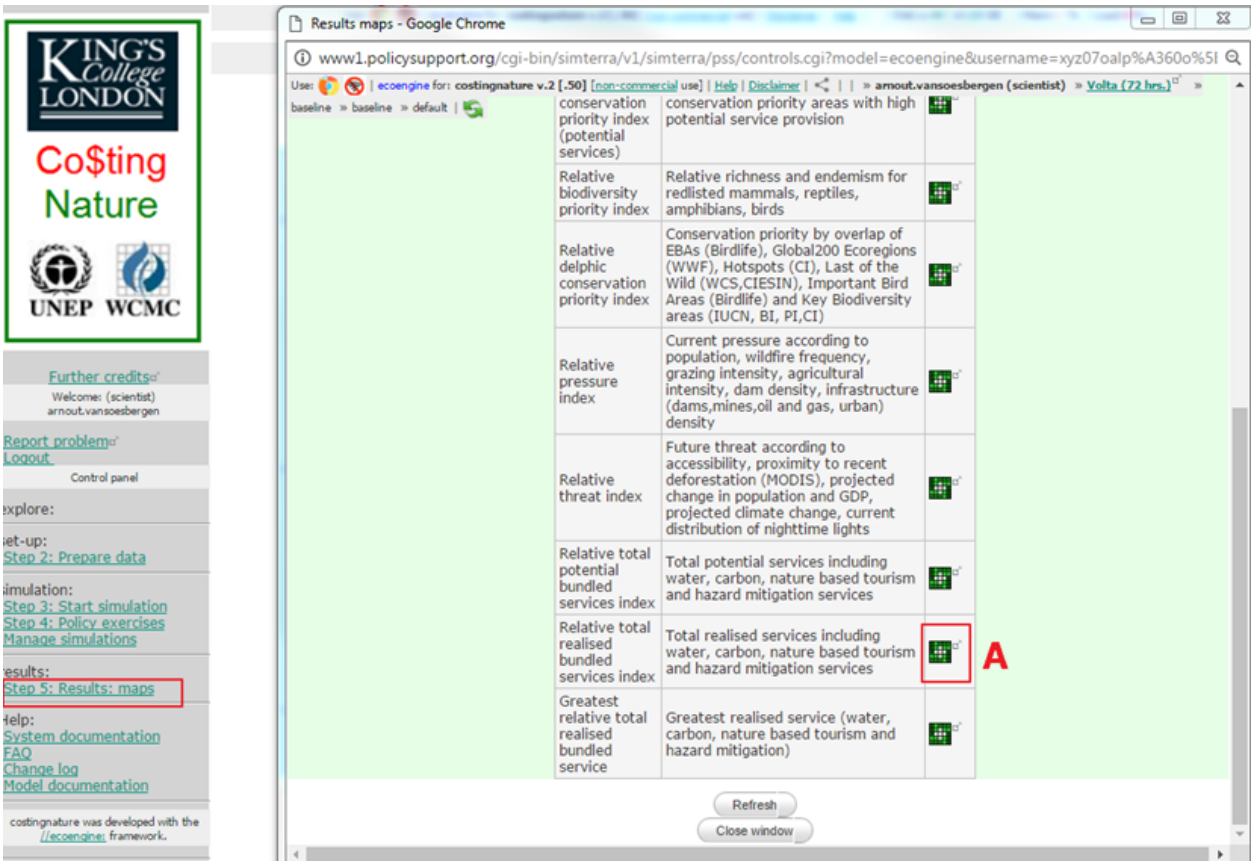
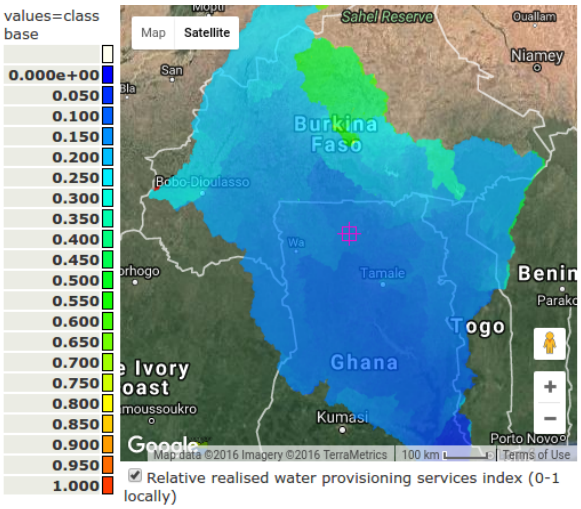
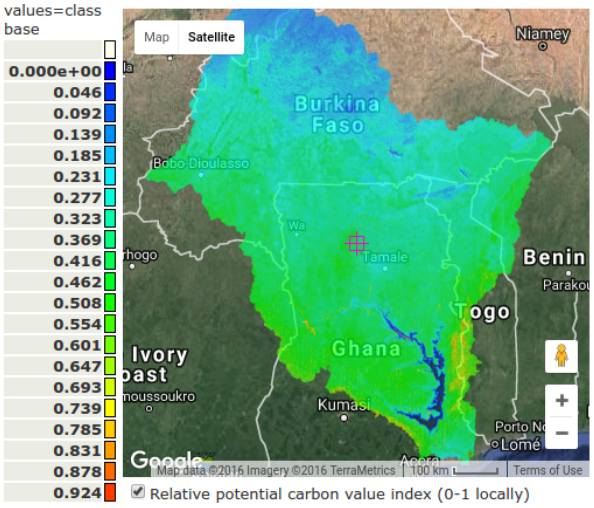
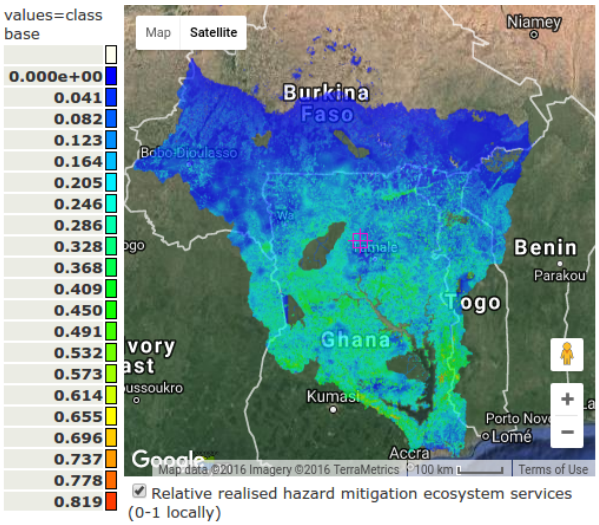


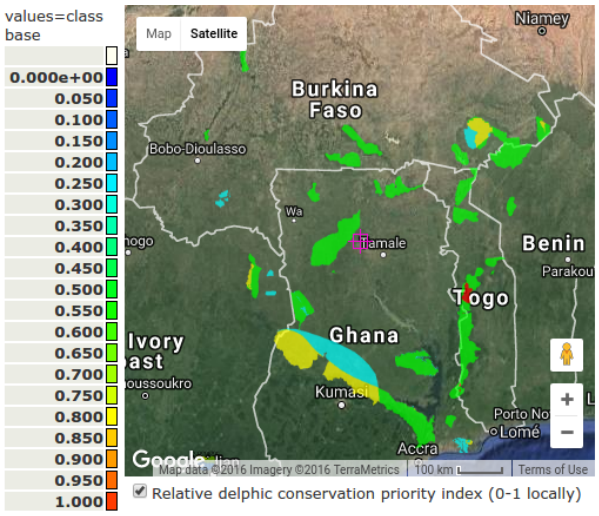
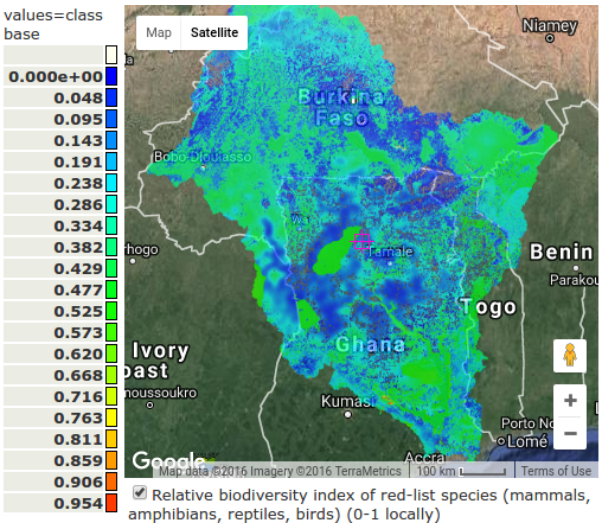
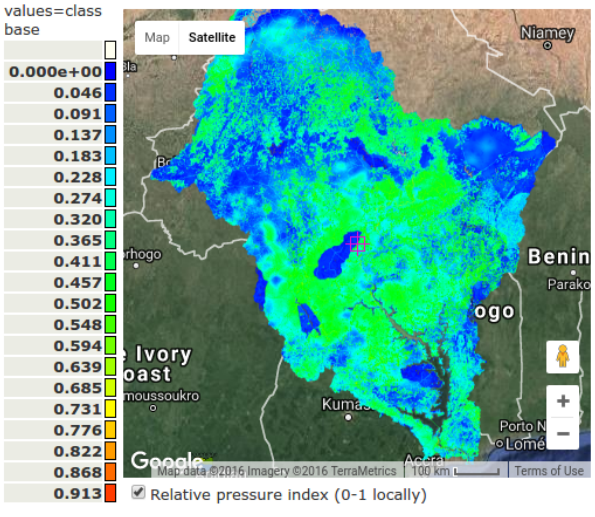
Figure 6: Step 5: results: maps

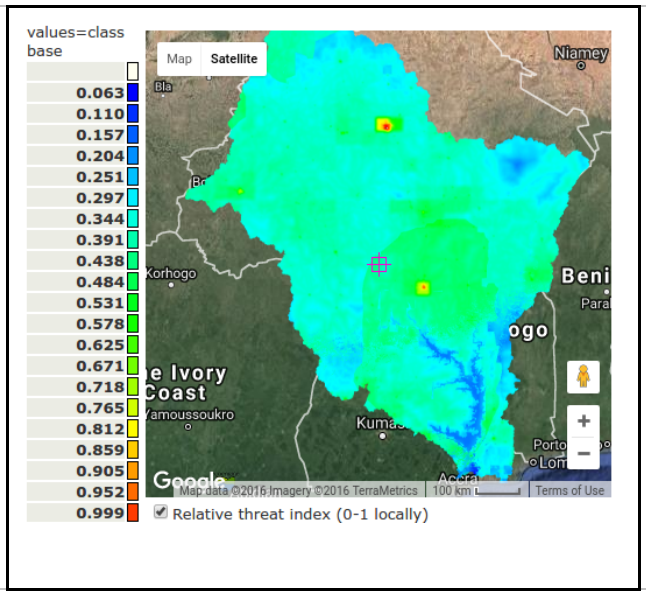
Baseline results

Aside from ecosystem services, Co$ting Nature also maps conservation priorities, current pressures and future threats. The following table provides these output maps for the Volta basin and describes the metrics. The results indicate very different geographical distributions of key ecosystem services and thus the clear tradeoffs between protection of services, biodiversity and delphic conservation priority and pressures and threats to those services, including agriculture

Table 1: Co$ting Nature outputs for the Volta basin

Name	Whole Volta map	Explanation
Relative realised water provisioning services index		Relative volume of clean (not human impacted) water available to downstream people and dams
Relative potential and realised carbon services index		Relative carbon sequestration and relative carbon stock (from living plant biomass and soil) services (all potential is realised)
Relative realised natural hazard mitigation index		Relative hazard mitigation services for flood/drought, landslide/erosion, inundation/tsunami/cyclone according to relative risk protected against

Relative delphic conservation priority index		Conservation priority by overlap of EBAs (Birdlife), Global200 Ecoregions (WWF), Hotspots (CI), Last of the Wild (WCS,CIESIN), Important Bird Areas (Birdlife) and Key Biodiversity areas (IUCN, BI, PI,CI)
Relative biodiversity priority index		Relative richness and endemism for redlisted mammals, reptiles, amphibians, birds
Relative pressure index		Current pressure according to population, wildfire frequency, grazing intensity, agricultural intensity, dam density, infrastructure (dams,mines,oil and gas, urban) density

Relative threat index		Future threat according to accessibility, proximity to recent deforestation (MODIS), projected change in population and GDP, projected climate change, current distribution of nighttime lights

Documentation and further reading:

Model and data documentation can be found here and system (interface and functionality) documentation here. A presentation on the science behind the PSS can be found here (English) and here (Spanish) [opens in Google docs viewer]. Download: (EN, ES). A powerpoint demo of the system functionality is here (English) and here (Spanish) [opens in Google docs viewer]. Download: (EN, ES)

Key references:

Mulligan, M. (2015) Trading off agriculture with nature's other benefits, spatially in Zolin, C.A and Rodrigues, R de A.R. (eds) Impact of Climate Change on Water Resources in Agriculture. CRC Press ISBN 9781498706148

Mulligan, M. A. Guerry, K. Arkema, K. Bagstad and F. Villa (2010) Capturing and quantifying the flow of ecosystem services in Silvestri S., Kershaw F., (eds.). Framing the flow: Innovative Approaches to Understand, Protect and Value Ecosystem Services Across Linked Habitats. UNEP World Conservation Monitoring Centre, Cambridge, UK. ISBN 978-92-807-3065-4. [available here]

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