



UN-REDD
PROGRAMME



Food and Agriculture
Organization of the
United Nations



Empowered lives.
Resilient nations.



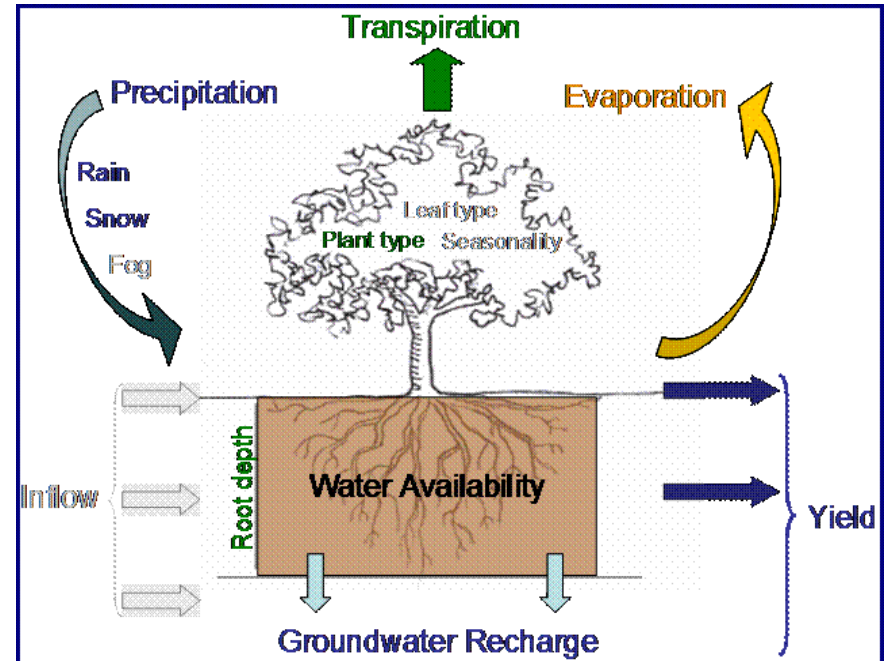
Mapping the importance of forests for water supply and soil erosion control

UNEP-WCMC

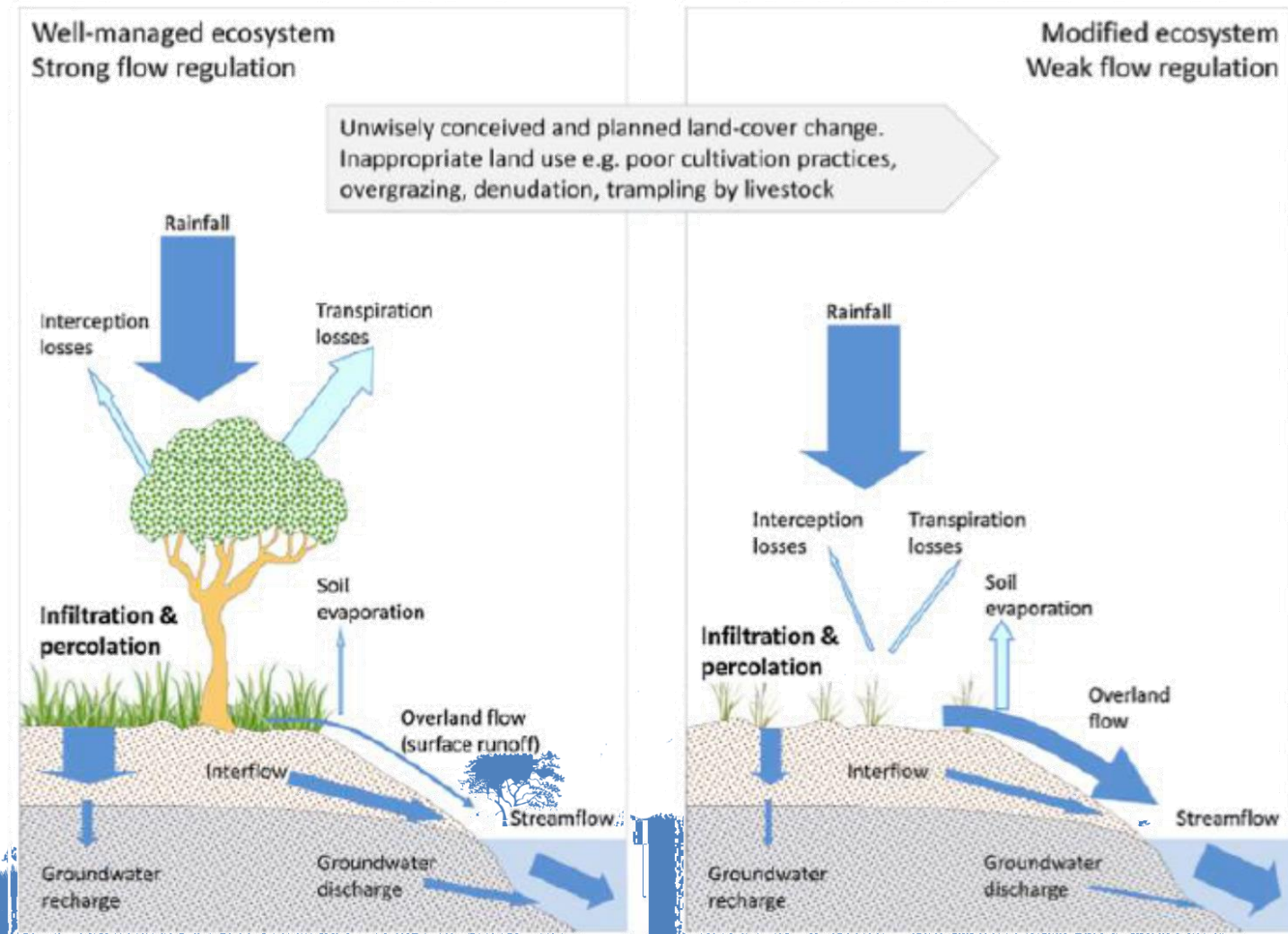
Monrovia, 12-16 February 2018

Hydrological services provided by forests

- Forests use and discharge water:
 - Intercept precipitation, evaporation and transpiration
 - Forest removal can increase downstream yields, which can be used to mitigate drought but may also cause flooding
- Mountain cloud forests provide horizontal precipitation

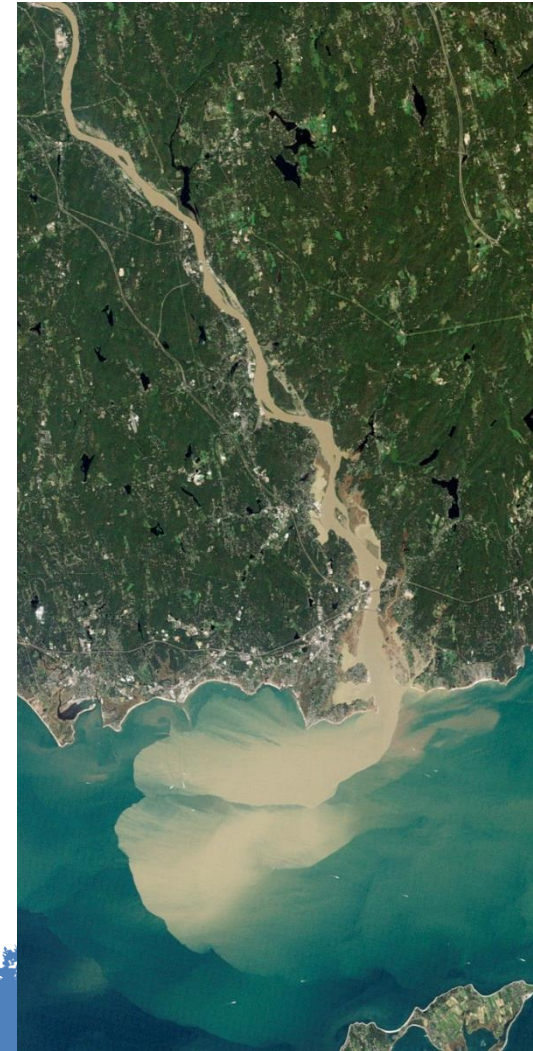


Effects of forest changes on hydrological services



Hydrological services provided by forests

- Reduce soil erosion and reduce sediment loading
 - Stabilization of slopes
 - Roots trap sediments
 - Lower canopy leaves and ground litter reduce splash force from precipitation
- Maintain water quality by trapping nutrient and pollutants



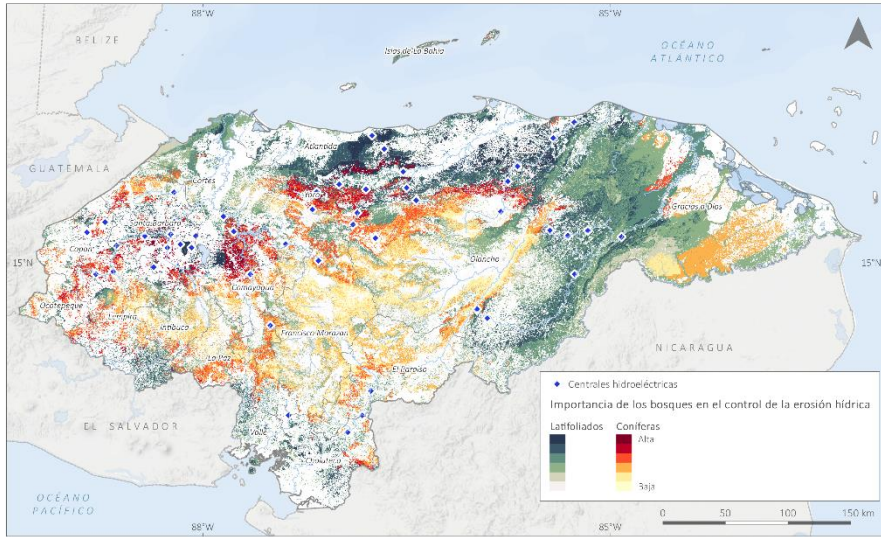
Hydrological services provided by forests



- Regulate seasonal discharge
 - Reduce flooding from high rainfall
 - Reduce drought from low rainfall
- Reduce flooding at local scales

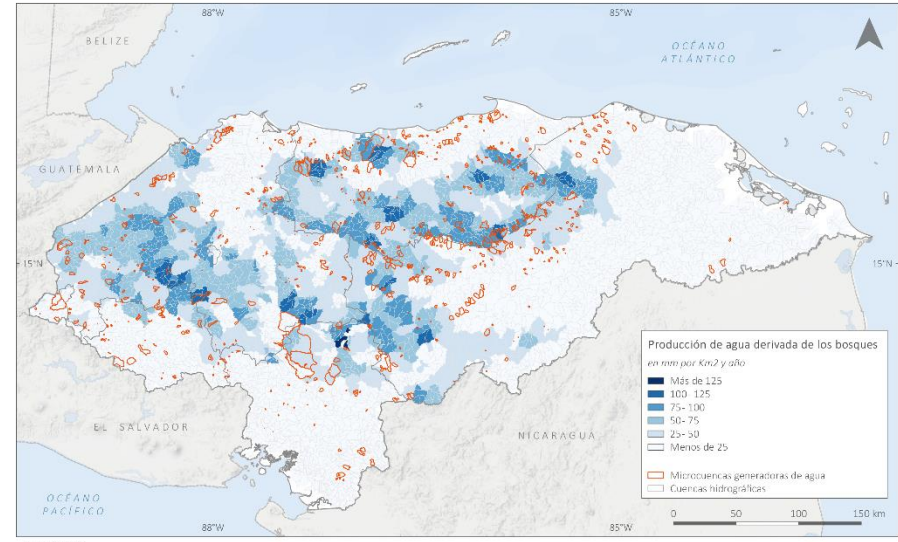


SOIL EROSION CONTROL (Erosion-prone areas)



FUENTES DE DATOS:
 Modelo Digital del Terreno: FAO, 2006; V.F. Barris, A. Dávalos, "Soil spatial hydrology and erosion risk assessment: A data intensive, iterative, GIS-based approach", *International Journal of Geographical Information Science*, 2011.
 Topografía: SRTM30 PLUS, 2010; <http://www.srtm30plus.com/>.
 Localización de centros hidroeléctricos: Sistema de Información Geográfica de la Universidad de Costa Rica, 2017.
 Cuencas generadoras de agua: Información geográfica de la Dirección General de Recursos Hídricos, 2017.
 Cobertura forestal: Instituto Nacional de Conservación y Desarrollo Forestal, Área Planificación y Uso del Suelo (INCD/DF), Área Mapeo y Planificación, Consejo de la Zona Costera, República de Honduras.

WATER PROVISION (Forest water yield)



FUENTES DE DATOS:
 Producción de agua derivada de los bosques: Utilizando el método de estimación de producción de agua derivada de los bosques (Meyer 2012) <http://www.fao.org/3/a/i2560es.pdf>, adaptado de la metodología utilizada por el INCD/DF, 2017, con datos de cobertura forestal y de uso del suelo de la Dirección General de Recursos Hídricos, 2017.
 Cuencas generadoras de agua: Información geográfica de la Dirección General de Recursos Hídricos, 2017.
 Microcuencas generadoras de agua: Información geográfica de la Dirección General de Recursos Hídricos, 2017.
 Cuencas hidrográficas: Información geográfica de la Dirección General de Recursos Hídricos, 2017.



What we want to know?



What we want to know?

- Where are the hydrological ecosystem services produced?
- Who benefits from them?
- What are the land use change effects?
- What will specific policy/management interventions do?
- What will climate change do?
- What will all of these do combined? Who wins/loses?
- What are the data uncertainties and how can these be reduced?



Methods to map hydrological services

Traditional hydrological tools: based on daily-runoff hydrological models at the watershed scale, requiring detailed datasets and expert knowledge

Ecosystem services oriented tools: based on ecosystem services indicators and models across large scales, they are more accessible for non-experts users, and they provide a more integrative picture because it considers the demands for the service

SWAT Soil & Water
Assessment Tool

InVEST
integrated valuation of
ecosystem services
and tradeoffs



ARIES



WaterWorld

- Free spatial modelling tool
- Models hydrology and soil erosion
- All data included
- Runs at 1ha and 1km resolution
- Annual and monthly output maps downloadable in GIS formats
- Runs and compares scenarios of land use change and climate change fast (full analysis in 30 mins)
- Simple to use: chrome or firefox
- Includes free training programme



WaterWorld

supported by:



RESEARCH
PROGRAM ON
Water, Land and
Ecosystems



How to use WaterWorld

KING'S COLLEGE LONDON
Department of Geography

WaterWorld
supported by:

CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems
espa
EUROPEAN UNION
earth2observe

Further credits[®]
Welcome: (hyperuser) corinna.ravilious

Report problem[®]
Logout

Control panel

Want v.12 | Want v.3?

explore:

set-up:
[Step 2: Prepare data](#)

simulation:
[Step 3: Start simulation](#)
[Step 4: Policy exercises](#)
[Manage simulations](#)

results:
[Step 5: Results: maps](#)
[Step 6: Results: stats](#)
[Step 7: Results: narrative](#)

help:
[System documentation](#)
[FAQ](#)
[Change log](#)
[Model documentation](#)

Use: | ecoengine for: **waterworld v.2** [v.92] [non-commercial use] | [Disclaimer](#) | [Help](#) | | Disk:u:33 | d:2 GB | Mem:28 % | Load:0% |

| run: **Liberia1 (72 hrs.)** » alternative: baseline » database: baseline » parameter set: default |

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

Go >

Map Satellite

Bobo-Dioulasso
Kankan
Mamou
Kindia
Conakry
Freetown
Monrovia
San-Pedro
Nzerekore
Man
Yamoussoukro
Korhogo
Tamale
Wa
Kumasi
Accra
Takoradi
Bassam
Cocacoo
Lome
Porto Novo
Ibadan
Lagos
Ogbomoshé
Parakou

Guinea
Sierra Leone
Liberia
Côte d'Ivoire
Ghana
Togo
Benin

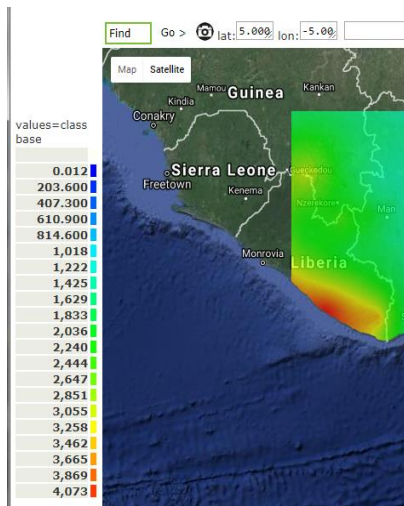
Gulf of Guinea

Google Map data ©2018 Google 100 km Terms of Use

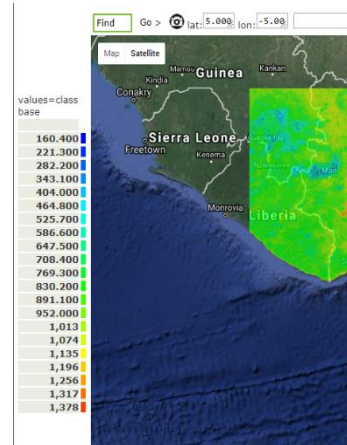
Current tile

Key outputs: Hydrology

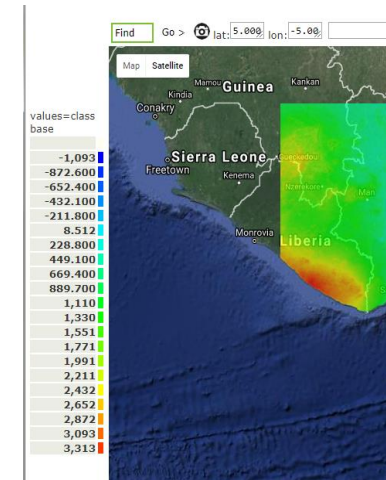
Process based spatial hydrological model



Wind driven precipitation (based on WorldClim)



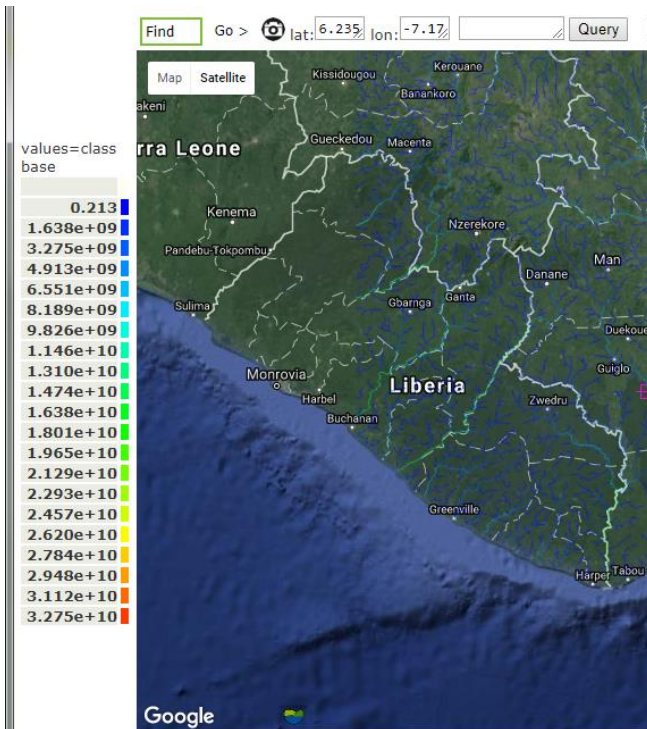
Actual evapotranspiration



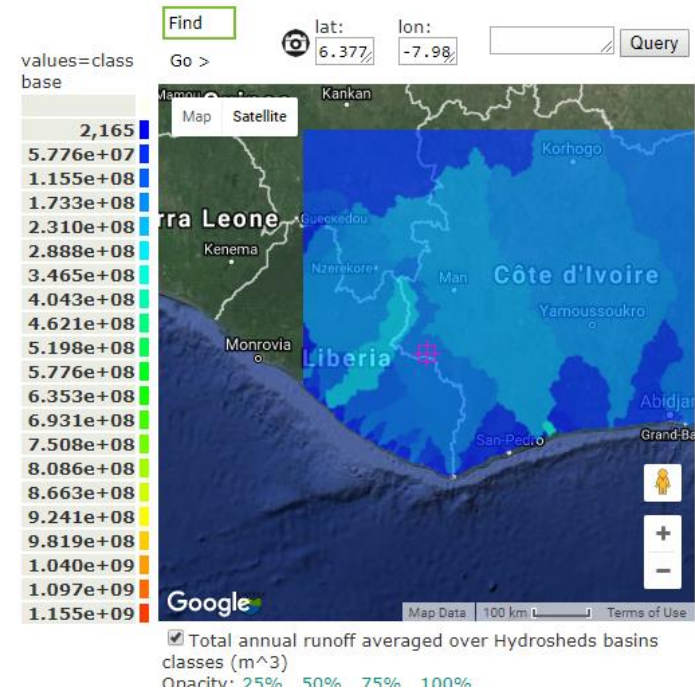
Pixel based water balance (Prec – ActEvap + Fog inputs)



Key outputs: Hydrology



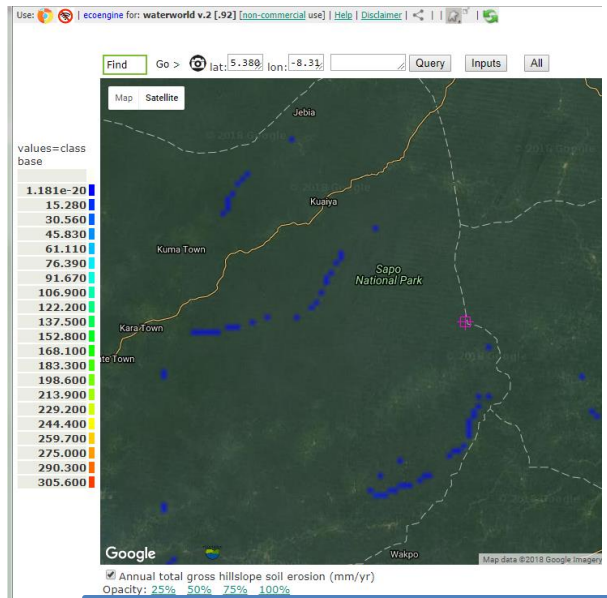
Annual runoff



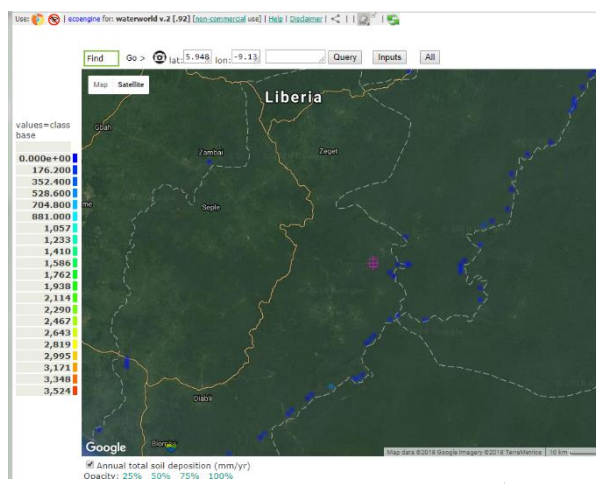
Runoff (water yield) averaged by sub-catchments

Key outputs: Soil erosion

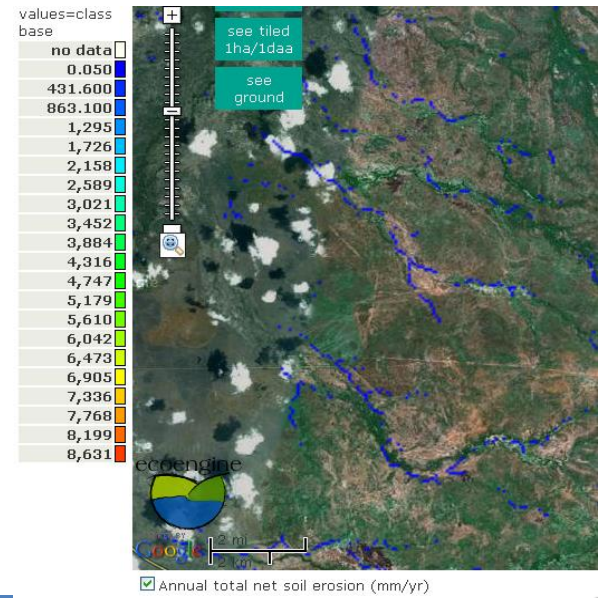
Full wash erosion model



Gross soil erosion:
detachment of soil
based on runoff,
vegetation, slope



Soil deposition:
detached soil that gets
deposited



Net soil erosion:
sedimentation

Scenarios

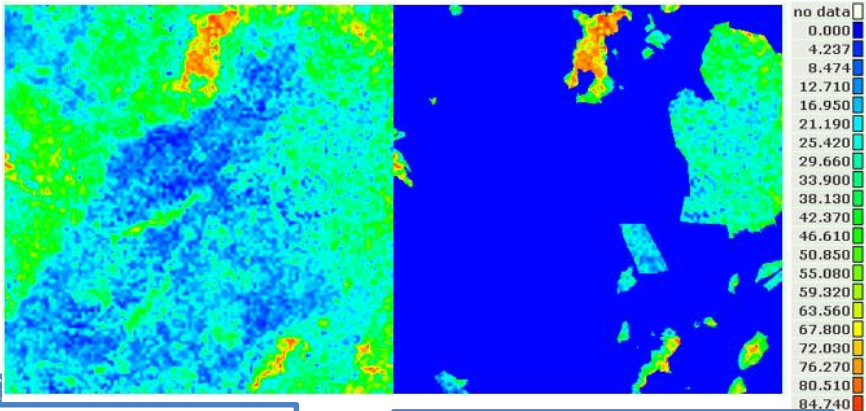
Click the intervention tool you would like to use

- Climate Change : assess impacts of climate change
- Land Cover and Use Change : assess impacts of land use change
- Land and water management : implement land management policy options
- Change input maps : replace one or more of the input maps
- Extractives : examine impacts of mining or oil & gas
- Population : examine impacts of changes in population and demography

Submit choice

Close window

Scenarios for Climate Change and Land cover and use available



Baseline tree cover

Scenario tree cover

Use: | [ecengine for: waterworld v.2 \[92\]](#) | [\[non-commercial use\]](#) | [Help](#) | [Disclaimer](#) | | » [corinna.ravillous \(hyperuser\)](#) » [Liberia1 \(22 hrs.\)](#) » baseline » baseline » default » Working...

LAND USE AND COVER CHANGE: choose the scenario that you wish to apply.

[View recent land use and cover change](#)

FOREST TO HERBACEOUS and HERBACEOUS TO FOREST: Changing forest cover replaces forest (tree cover) with pasture or cropland (herb cover). Changes of between -99% and 99% represent selective deforestation and afforestation respectively. Deforest a given percentage per pool of trees with e.g. -15 or reforest by a given percentage per pool of trees e.g. 15. Specify where and by what percentage (per pixel) deforestation or reforestation should occur.

Use a pre-defined rule: [±](#)
...or define your own rule: [±](#)

CREATE LAND COVER TYPE: For each row that you want to apply, set the corresponding percentage of tree, herb and bare soil functional types (FTs) per pixel to achieve the land cover that you wish, for example pasture might be 10% tree FT, 85% herb FT and 5% bare FT, a crop might be 10% tree FT 50% herb FT and 40% bare FT

Use a pre-defined rule: [±](#)
...or define your own rule: [±](#)

Name for my scenario:

Set/change tree, herb, bare covers: 0 % 100 % for approx: 100 of land, cluster, pixels:

where: Cover of tree-covered ground (MODIS 2010) this value:

other rules: [±](#)

Define converted areas as: Fraction of water exposed to contamination: , or: scale the default for land use.

Total change in population for changed land uses (persons per sq. km.):

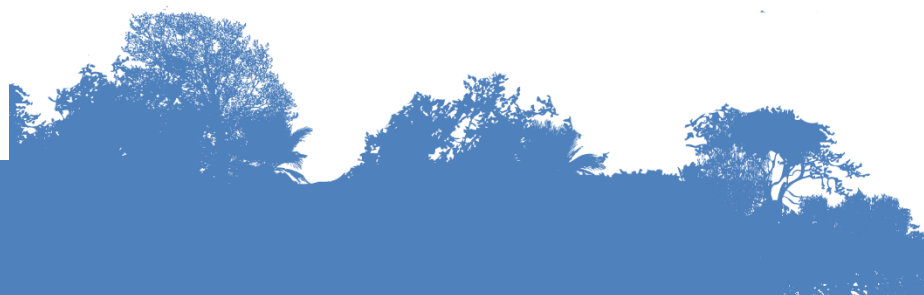
Mean conversion cost (USD per ha.):

Check and Submit

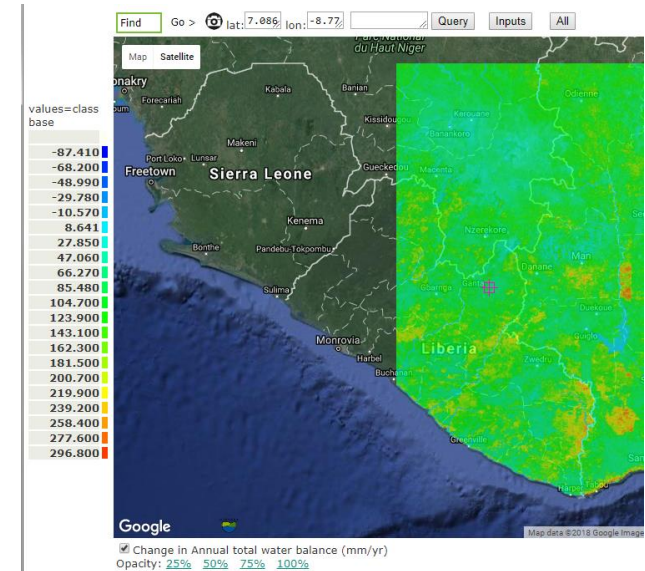
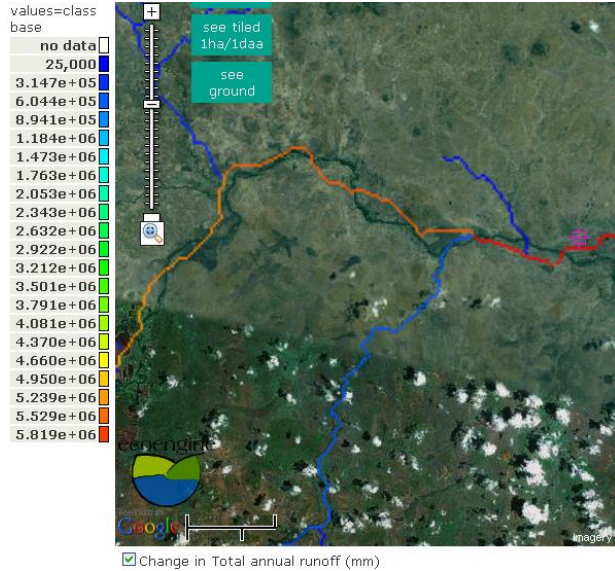
...or copy your own maps: [±](#)
...or upload your own maps: [±](#)
...or run QUICKLUC (v2.1) land use change model: [±](#)
...or define from a land use or cover classification: [±](#)

[List baseline workspace data](#)

For example deforest all land

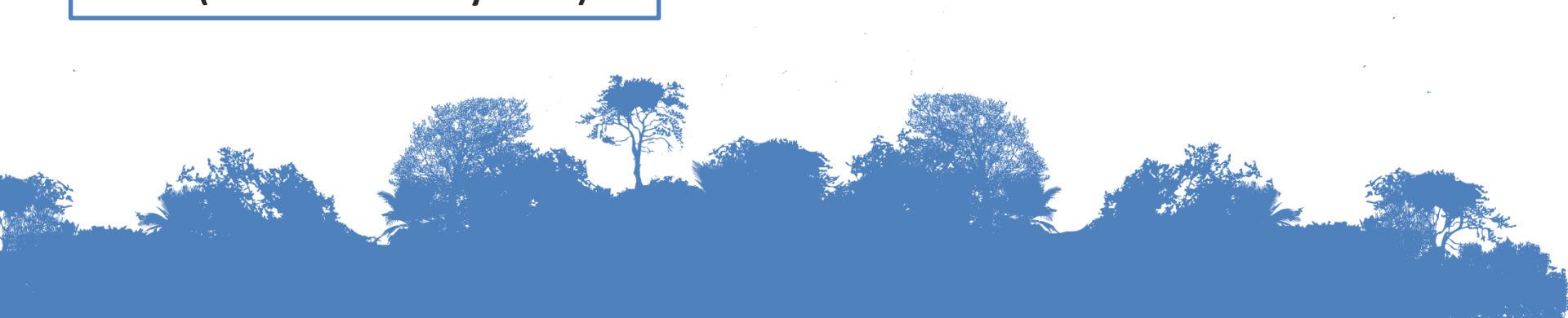


Run scenarios

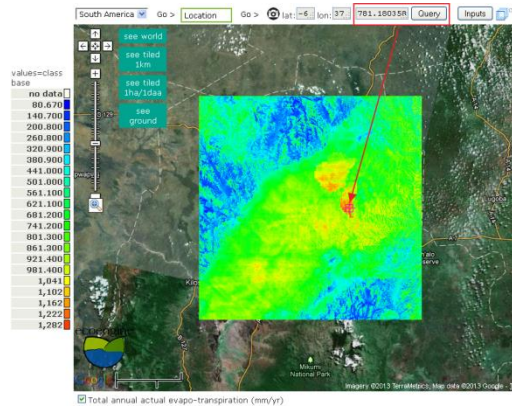


Deforestation leads to increased runoff (less water use by trees)

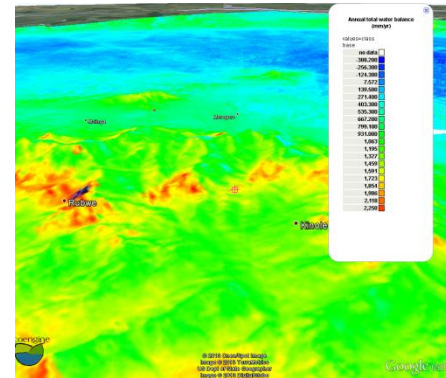
Changes to annual water balance



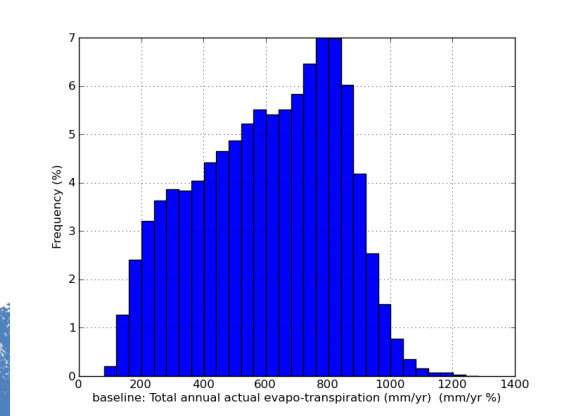
Analyse, visualise and/or download GIS maps



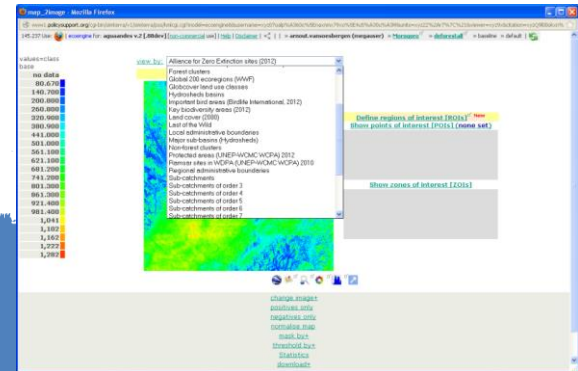
View in Google maps and query map at points



Overlay in Google Earth



Analyse map histogram



Mask by regions from other maps, zones of interest or get values for points

Remember to think about

- ❖ Needed skills are web browsing and basic hydrological knowledge and some GIS skills for your own data. Update your skills using the free training programme and resources (<http://../training-course-schedule>)
- ❖ All data is supplied but you are able to use your own data
- ❖ Different scales:
 - Local is 100km x 100km tile at 1ha resolution
 - National is 1000km x 1000km tile at 1km² resolution
- ❖ Latest features cost money



Limitations

- Global datasets are coarse for local needs
- If your catchment crosses two tiles you need to run both separately and stitch using WW's Google Earth integration or in GIS
- You run on WaterWorld's servers so only a limited number of simulations can be stored. ***Download results and delete simulation to start a new one***





Thank you!

