GRASS GIS crowdsourcing of the local calibration of ETa models to improve on public domain Global ET products

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Contents

Overview

Evapotranspiration is the largest transiting quantity in the daily hydrological cycle along with rain. It is used by scientists and managers in:

- Irrigation systems performance
- Crop water productivity
- Water accounting
- Wetlands-agriculture interface
- Basin water uses quantification
- Climate change on water cycle & users

Overview

There are several types of evapotranspiration modeling methods:

- Reference ET: Hargreaves, Penman-Monteith
- Potential ET: Priestley-Taylor, astronomical
- Actual ET: Thermodynamic/energy balance (mostly)

Reference & potential ET

Trunk (G7)

- i.evapo.mh: ETo Hargreaves, Modified H., H.-Samani
- i.evapo.pm: ETo Penman-Monteith (PM, 1972)
- i.evapo.pt: ETpot Priestley-Taylor (PT, 1970s)
- i.evapo.potrad: ETpot astronomical (WB, 1995)

Add-ons (G7)

- i.evapo.senay: ET *regional* (Senay, 2007)
- i.evapo.zk: ET *biome* (ZK, 2010)

Actual ET

Actual ET: thermodynamic heat flux modeling

$$\Lambda = \frac{Rn - G - H}{Rn - G} \tag{1}$$

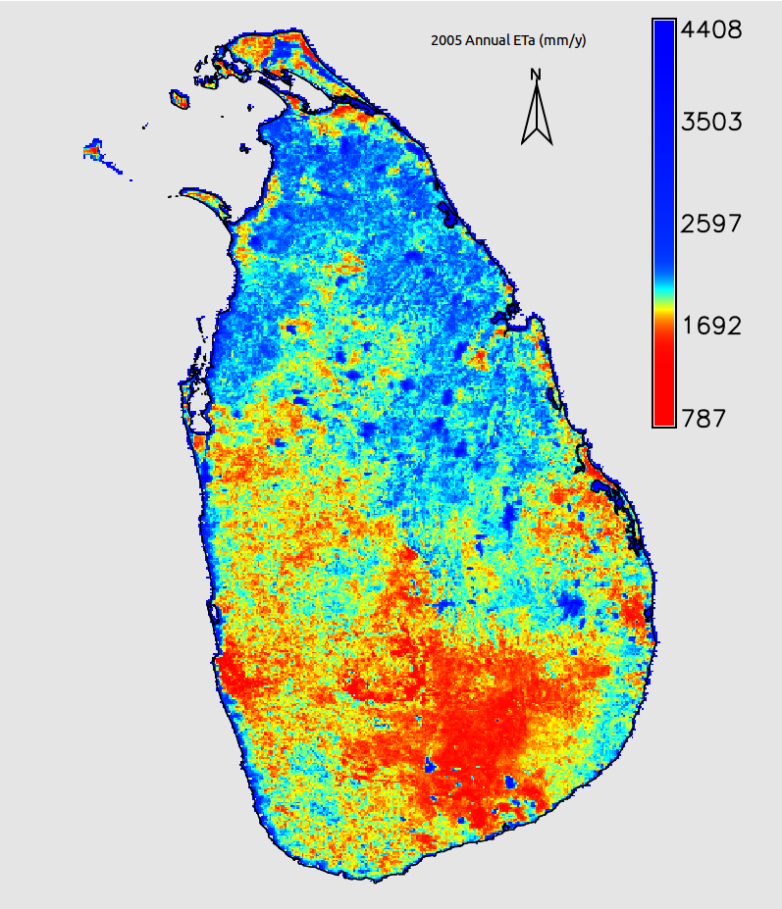
$$ET_a = \Lambda \, ET_{potential} \tag{2}$$

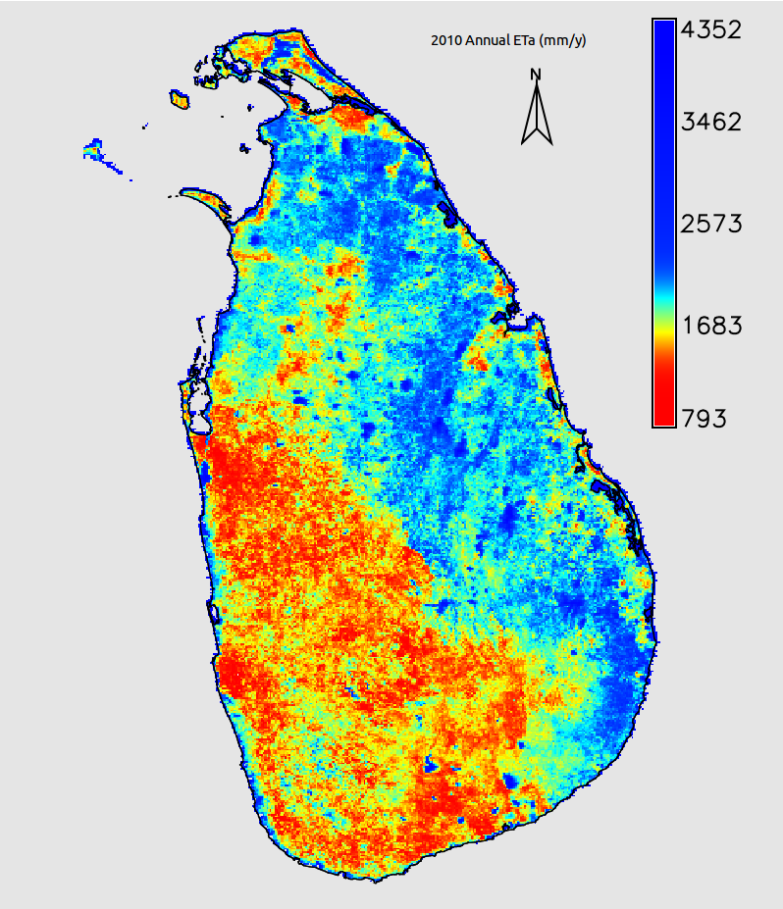
i.eb.* modules (G7 main) using thermodynamic heat flux modeling

- i.eb.netrad: Net radiation (Rn in 1)
- i.eb.h_*: Sensible heat flux (H in 1)
- i.eb.evapfr: Evaporative fraction (Λ in 2)
- i.eb.eta: Evapotranspiration (ETa in 2)

Evapotranspiration @ country level

Actual evapotranspiration
for water resources monitoring & management.

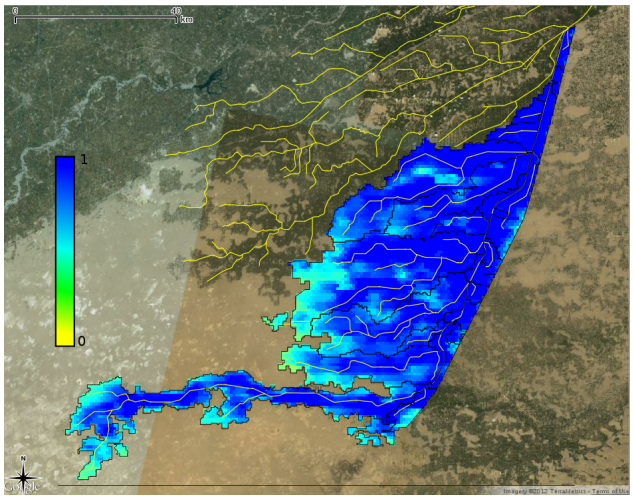


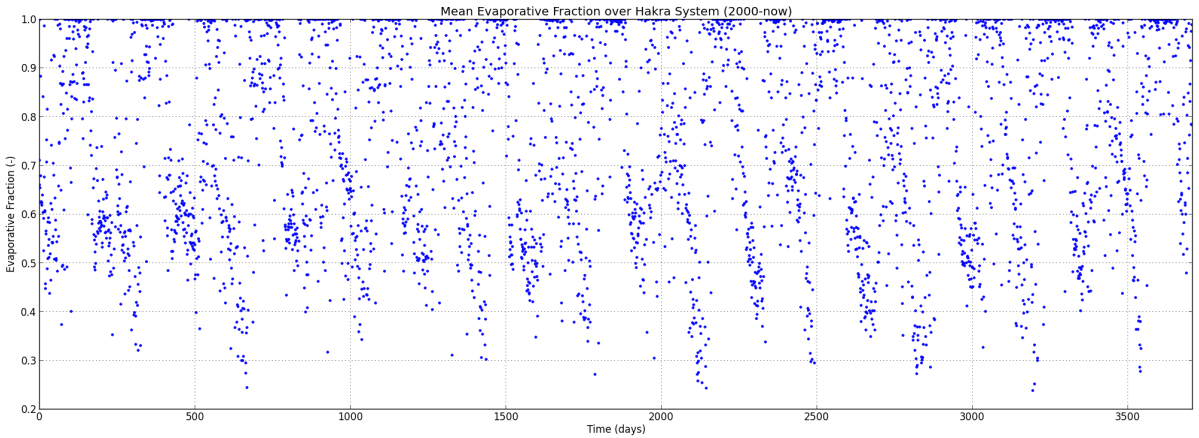


Equity of water use in irrigation systems

Irrigation water monitoring & management

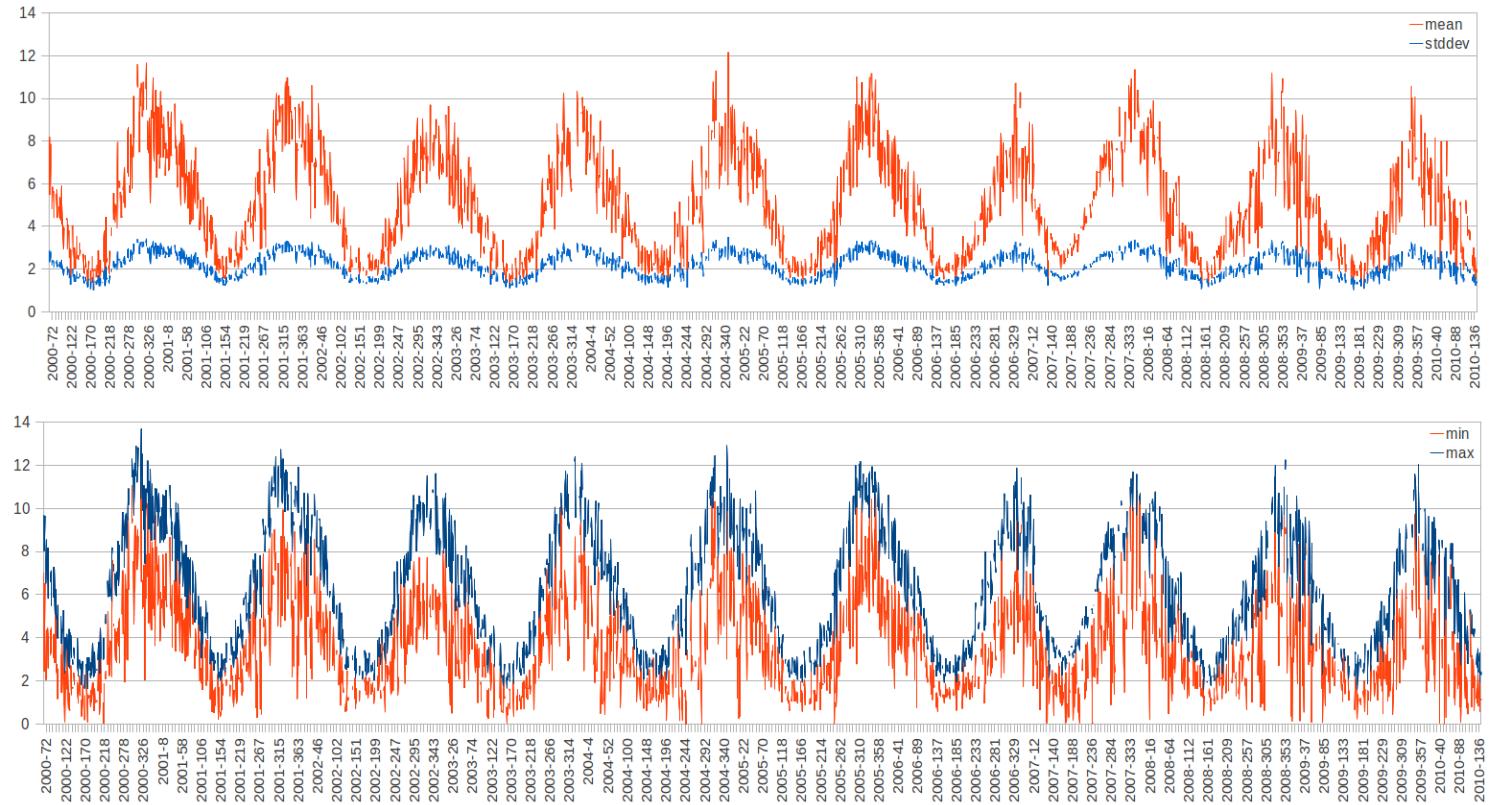
- Map: Uniform colour is equity of water distribution
- Graph: irrigation system equity in time (daily, 12 years)





Crop water consumption in irrigation systems

Actual evapotranspiration (mm/d)
for agricultural water performance management.



Chain processing

Chain processing has a fundamental impact on remote sensing work:

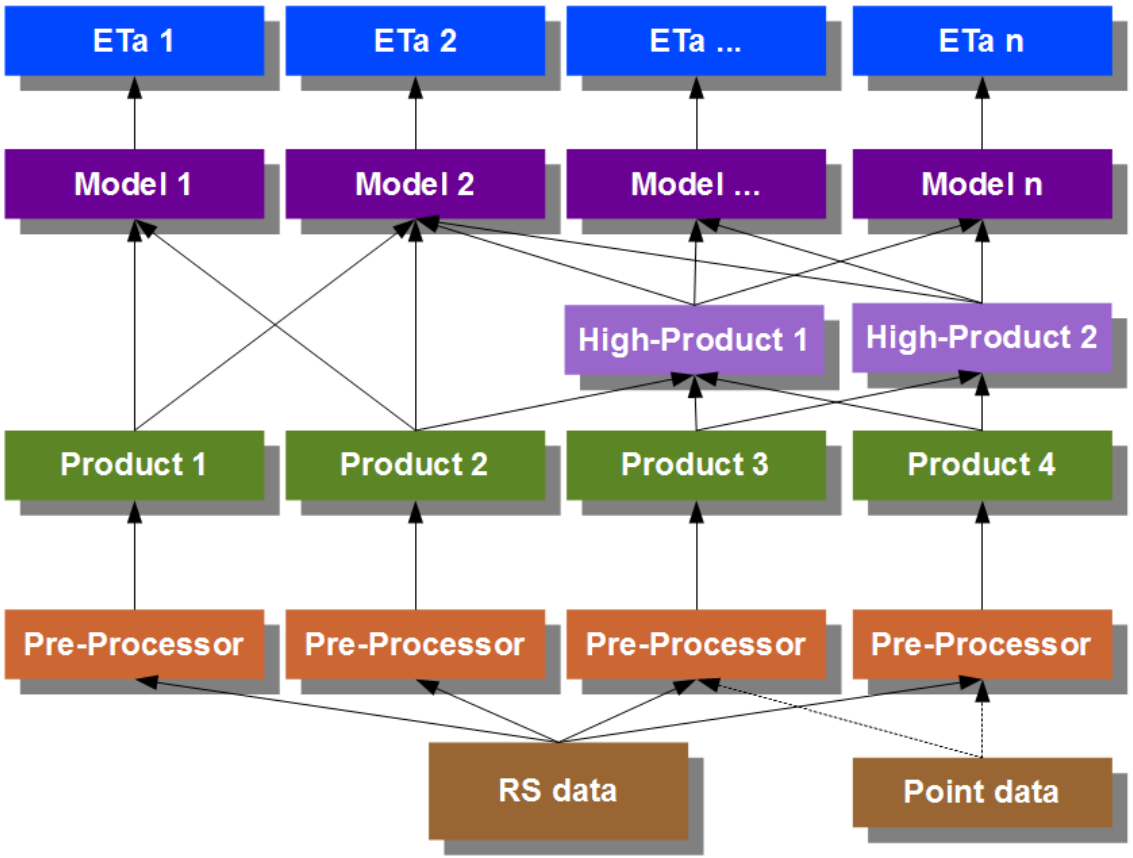
- Standardization limits bugs
- Less prone to human error
- Simpler parameterization access
- Permits to apply any number of modules to all target images
- Ensures maximum quality of generated images

Concept

- META Module, a module using modules
- Prototype, shell script, then grass.script
- Actually moving to pygrass (Genoa CS2013)

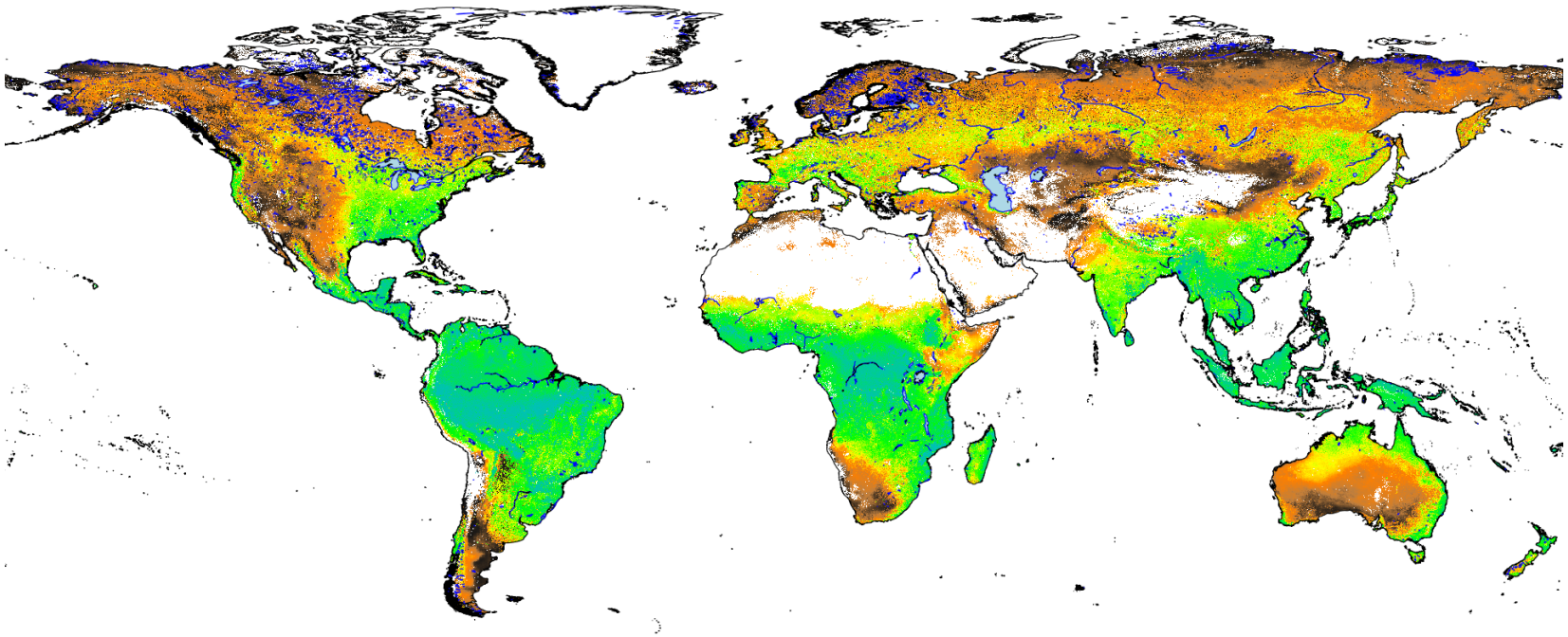
Chain processing

The development of pyGRASS is maturing,
META Modules arise from vertical integration.



MOD16 MODIS product

Global monthly (MOD16A2) and yearly (MOD16A3) dataset



8km parameterization, validated on Fluxnet data.
Not validated daily.

Rationale for crowdsourcing

Local parameterization of ET models is necessary

because the end-user is:

- in a better position for QC in/out
- interested in both upstream/downstream

but the constraints are:

- using ET models
- using GIS, FOSSGIS

set up for year 1: Kick the geek

Scientists on all continents

- Background in RS/ET/FOSS (pick any to all)
- Interested to publish their calibration of ET models
- Willing to be trained on GRASS GIS v7

Year 1 Goals

- Training a core of interested scientists
- GRASS GIS modules for ET modeling taken over by users

set up for year 2: Bring the bee

Any interested person on all continents

- Background in science
- Interested to learn that knowledge
- Willing to be trained on GRASS GIS
- Interested in simple GRASS GIS raster programming

Year 2 Goals

- Year 1 articles in press, local calibration in svn
- HPC FOSS source code online
- GRASS GIS ET modules used by Year 2 community

set up for year 3: Ubergeek upgrade

Any intensely interested person on all continents

- Background in C programming, ET models
- Interested to process all MODIS archives
- Willing to learn and contribute distributed modeling

Year 3 Goals

- Year 1/2 articles in press
- Local calibration in svn
- HPC FOSS source code taken over by community

Conclusions

One for all

- Crowdsourcing of science should be possible
- But needs supporting efforts in terms of training
- Realizing this makes the science uptake more robust

All for all

- Returning local parameterization from local to svn
- Permits local QC improvement of global ET data generation
- Anybody can model ET anywhere/anywhen they want

Thank You