

Herbaceous growth by the STEP model over the Gourma region in Mali

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Géosciences Environnement Toulouse (GET)

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Objectives

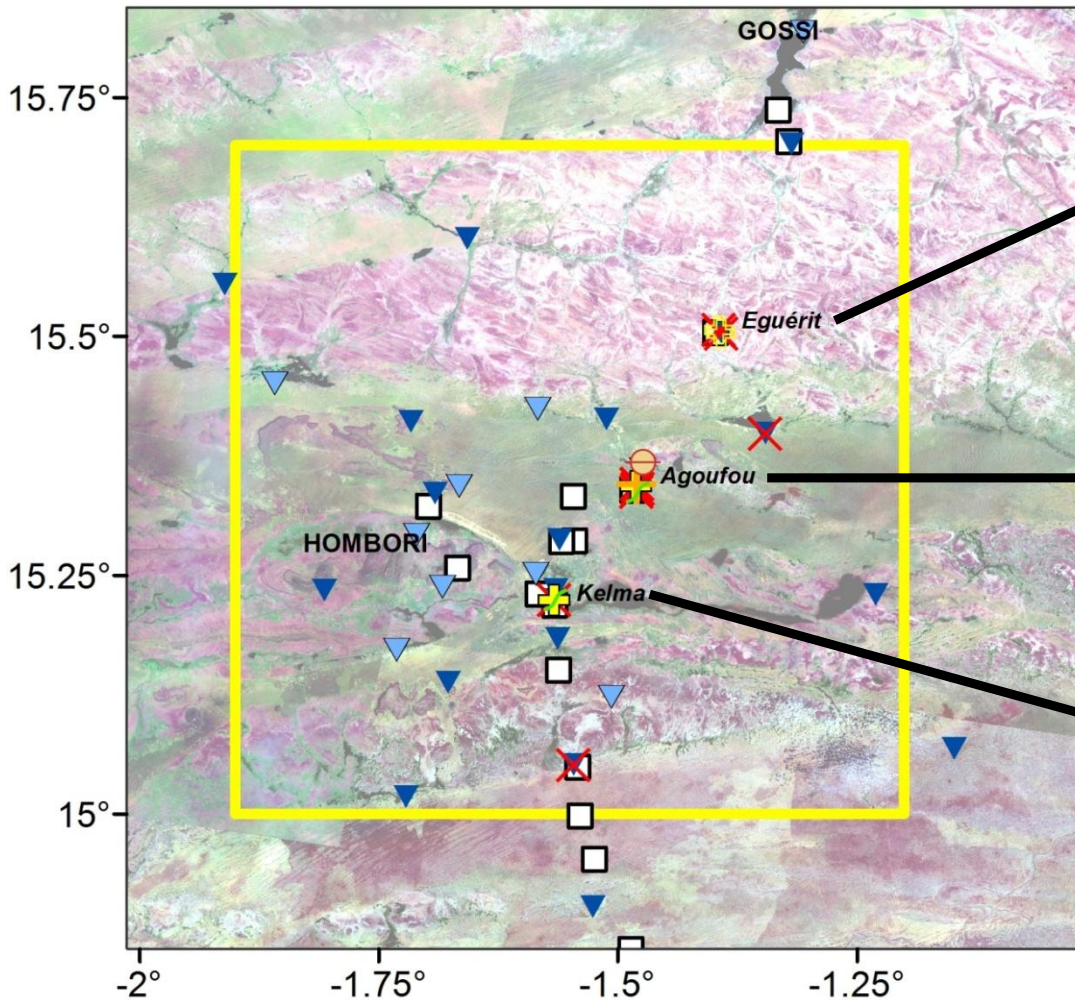
- **Evaluate herbaceous growth and the water balance simulated by STEP in the framework of the ALMIP2 project over the Gourma site in Mali**
 - comparison to in situ measurements at 3 local sites
 - comparison to satellite data at the meso scale
- **Investigate the impact of the meso scale forcing (soil description and the precipitation) on the modelled herbaceous growth**

ALMIP AMMA Land Surface Model
Intercomparison Project



The ALMIP2 Gourma site

Meso scale site



Local sites



Dry season



Wet season



**Shallows soils
generating runoff
→ Ponds**

Eguerit



**Deep sandy soils
endoheric**

Agoufou



**Seasonally flooded
areas**

Kelma

STEP model: Sahelian Transpiration Evaporation and Production model

Meteo data (precipitations, temperature, wind speed, radiation), **Soil** (texture, depth)

Vegetation

Photosynthesis, respiration

Growth and mortality

Litter decomposition

LAI

Water and energy balance

Evapotranspiration from soil
and canopy

Soil water transfers

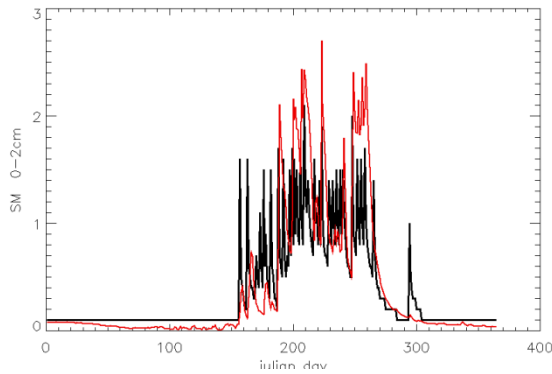
Soil water

LAI, Biomass (green, dry and litter), **Water and energy fluxes**, **Soil water**

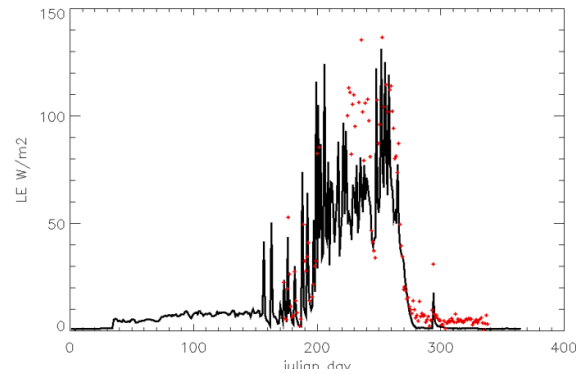
Local scale simulations

Example on sandy soil: Agoufou 2007

Surface SM (mm)



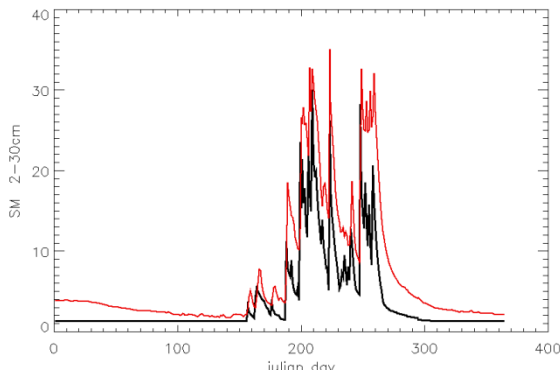
LE flux (W/m^2)



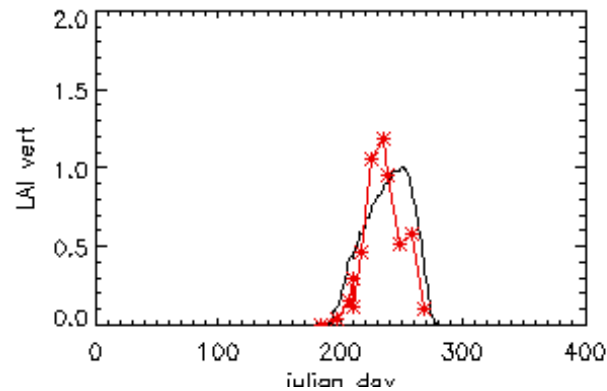
— STEP

— in situ measurements

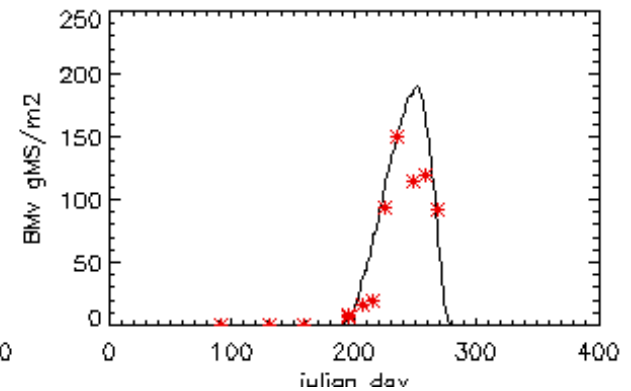
Root layer SM (mm)



LAI

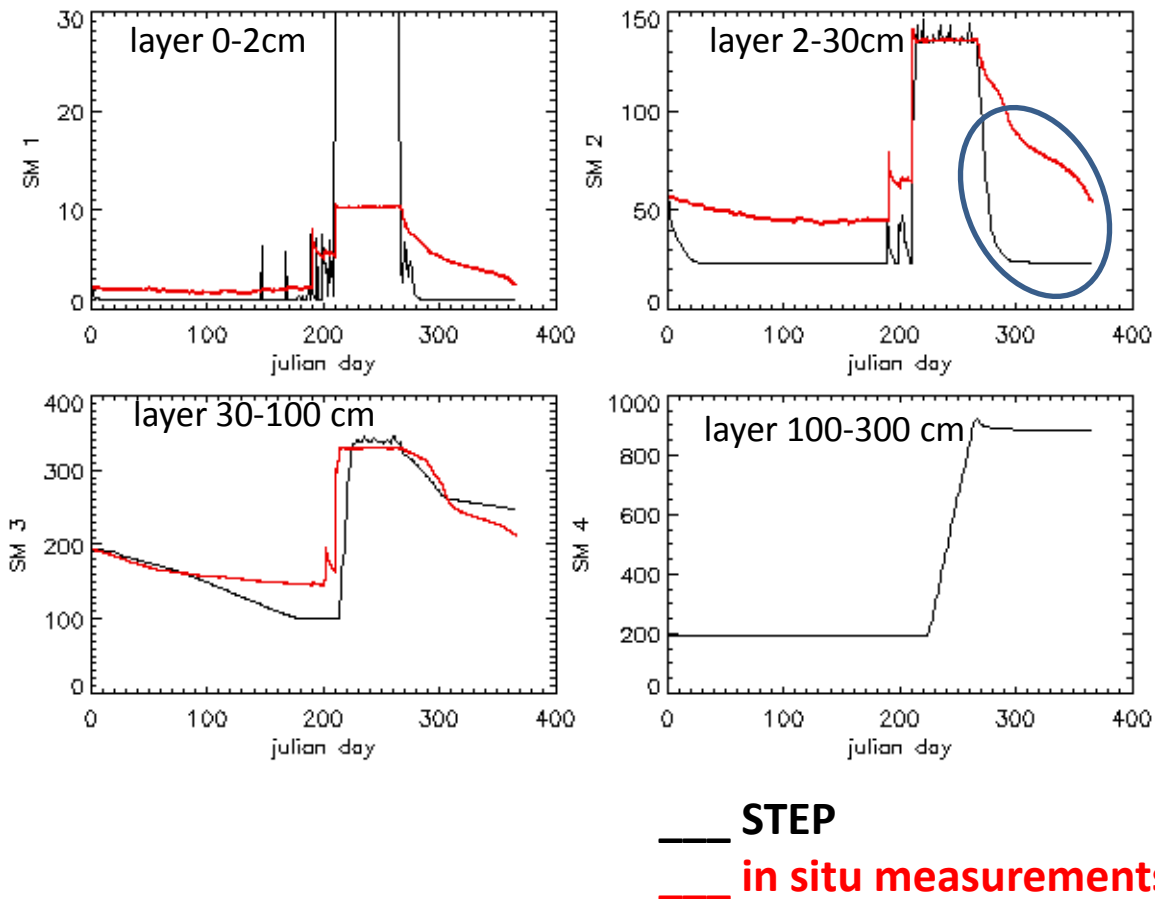


Green biomass ($\text{g DM}/\text{m}^2$)



Example on seasonally flooded clayed soil: Kelma 2006

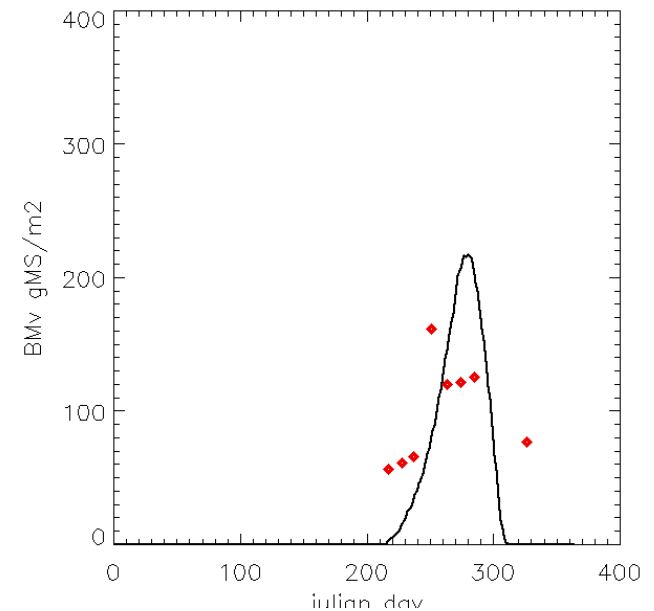
SM (mm)



Trees not taken into account!



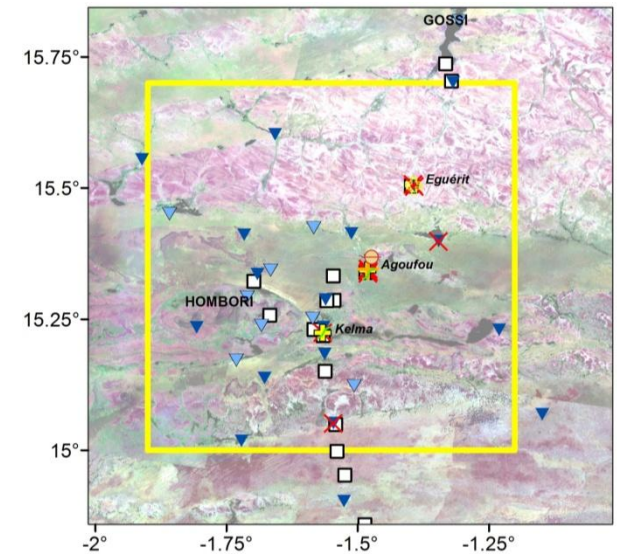
Green biomass (g MS/m²)



Vegetation does not develop
without flood description

Meso scale simulations

Evaluate STEP at the meso scale and investigate the impact of different soil descriptions (texture and depth) and different methods for kriging precipitation



0.05°x0.05°, daily

Soil description

12 Soil type classes derived by LANDSAT classification and field knowledge

(Hiernaux et Cheula 2007)

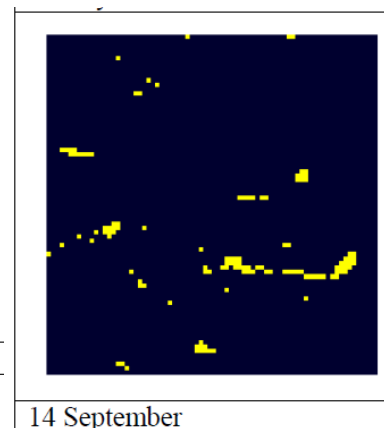
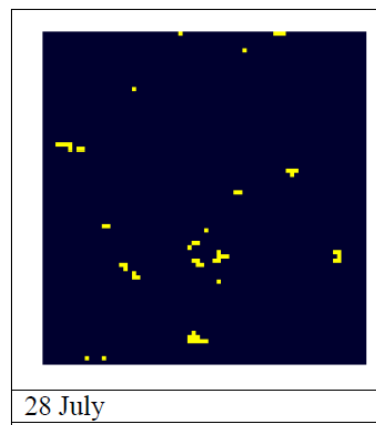
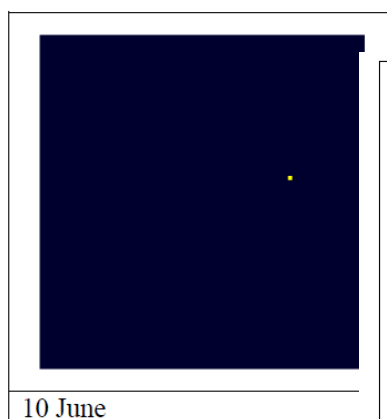


Dominant classes

Name	Texture grossière (%)			Texture fine (%)			Prof (cm)
	C	G	F	S	L	A	
Affleurement de cuirasse et grès	100	0	0	0	0	0	0
Sol limoneux	10	10	80	55	30	15	50
Ensablement de surface	0	0	100	85	10	5	30
Dune	0	0	100	90	6	4	> 300
Interdune	0	0	100	85	10	5	>300
Sable vif	0	0	100	95	3	2	>300
Sol Argileux	0	0	100	35	20	45	> 150
Eau de surface	0	0	100	35	25	40	>150

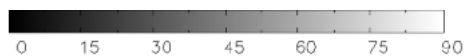
Flood progression in 2007 derived by MODIS NDPI (MIR and blue reflectances)

→ subgrid description



Gourma

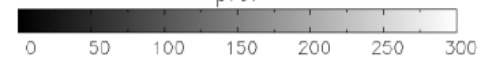
Sand %



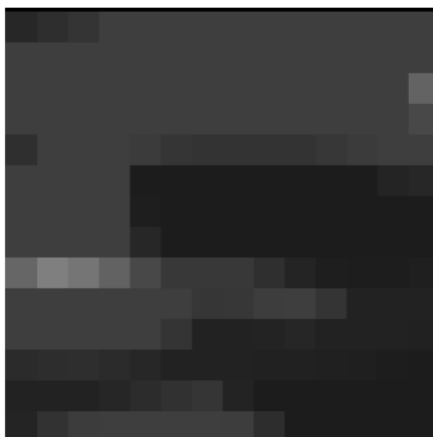
Clay %



Depth (cm)

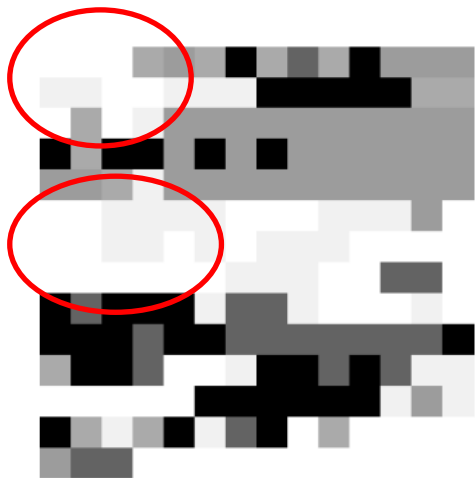
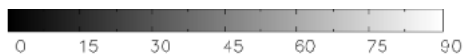


ECOCLIMAP2

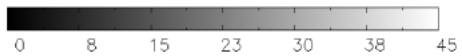


Gourma

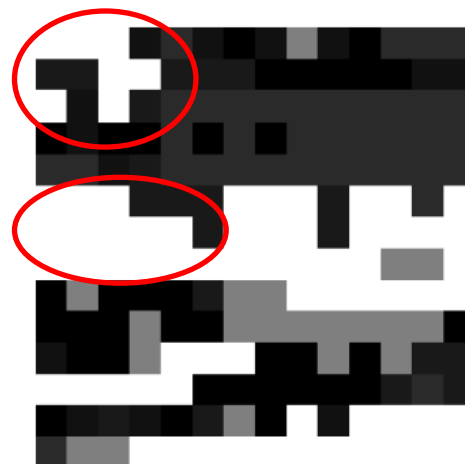
Sand %



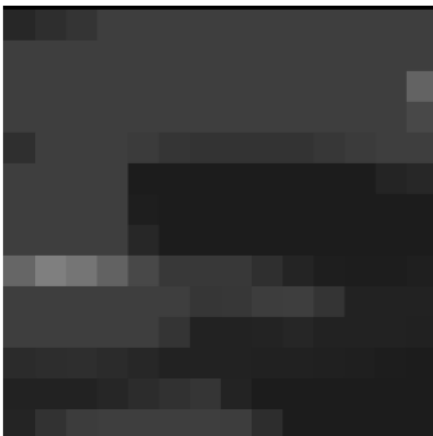
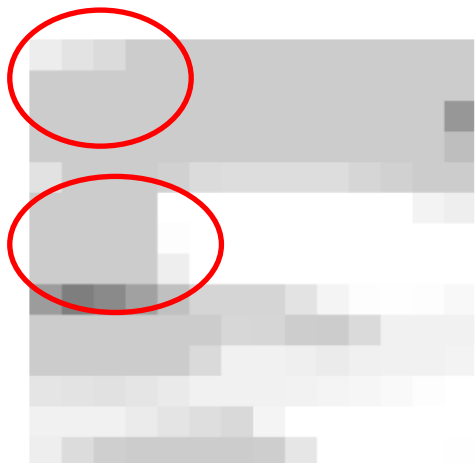
Clay %



Depth (cm)

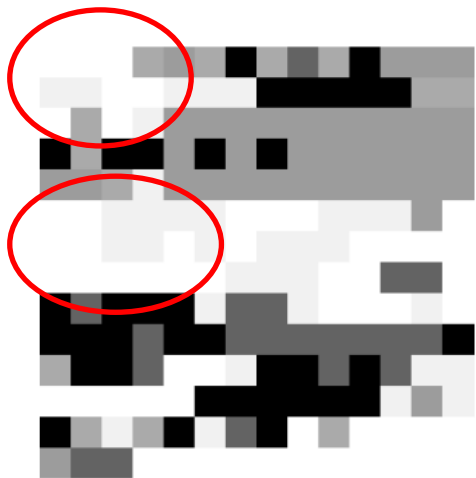
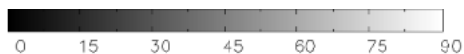


ECOCLIMAP2

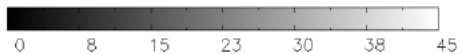


Gourma

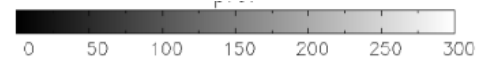
Sand %



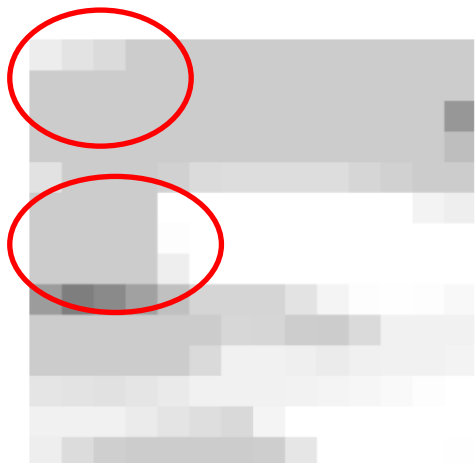
Clay %



Depth (cm)



ECOCLIMAP2

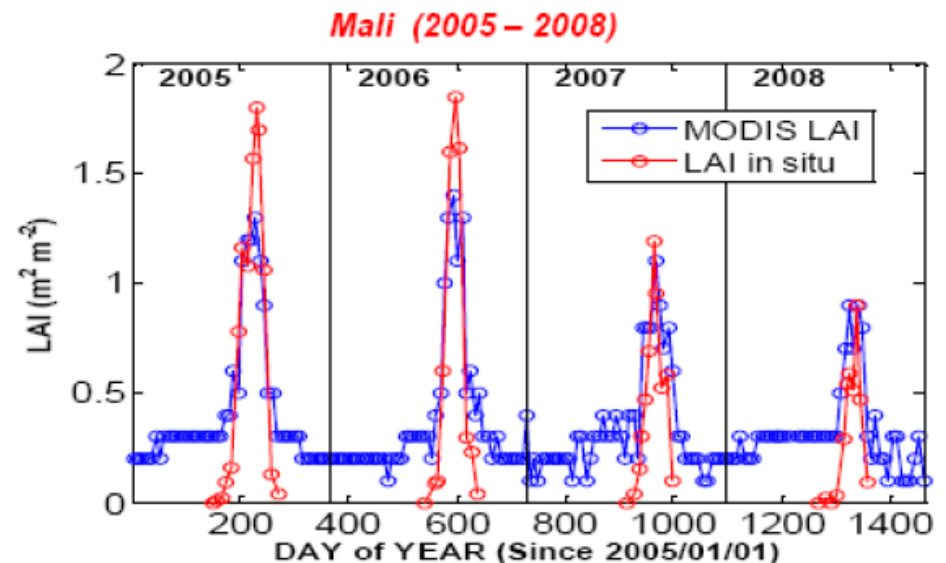


Meso runs

Soil type maps (texture and depth):

- ECOCLIMAP2
- Gourma soil texture classification
 - dominant class
 - subgrid approach (flooded area)

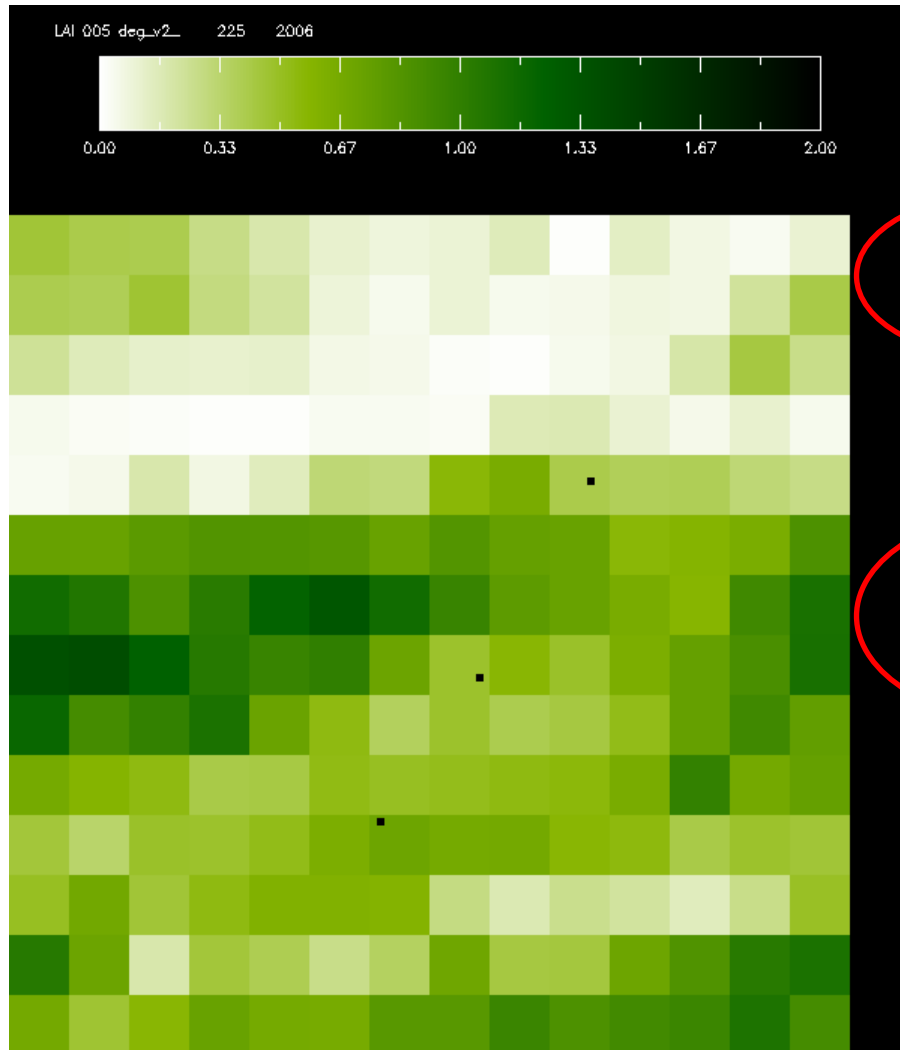
Comparison to LAI derived by MODIS



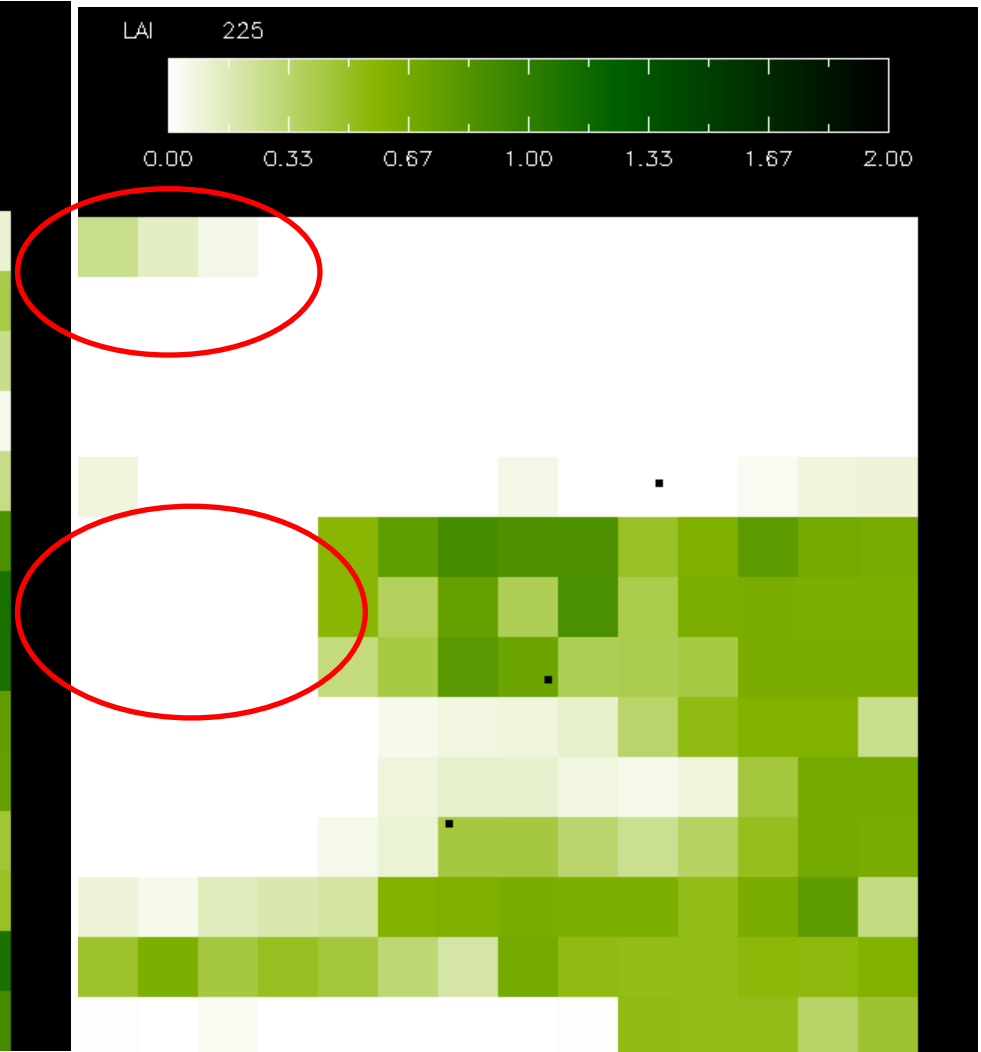
Mougin et al. in preparation

Example 13 08 2006

MODIS



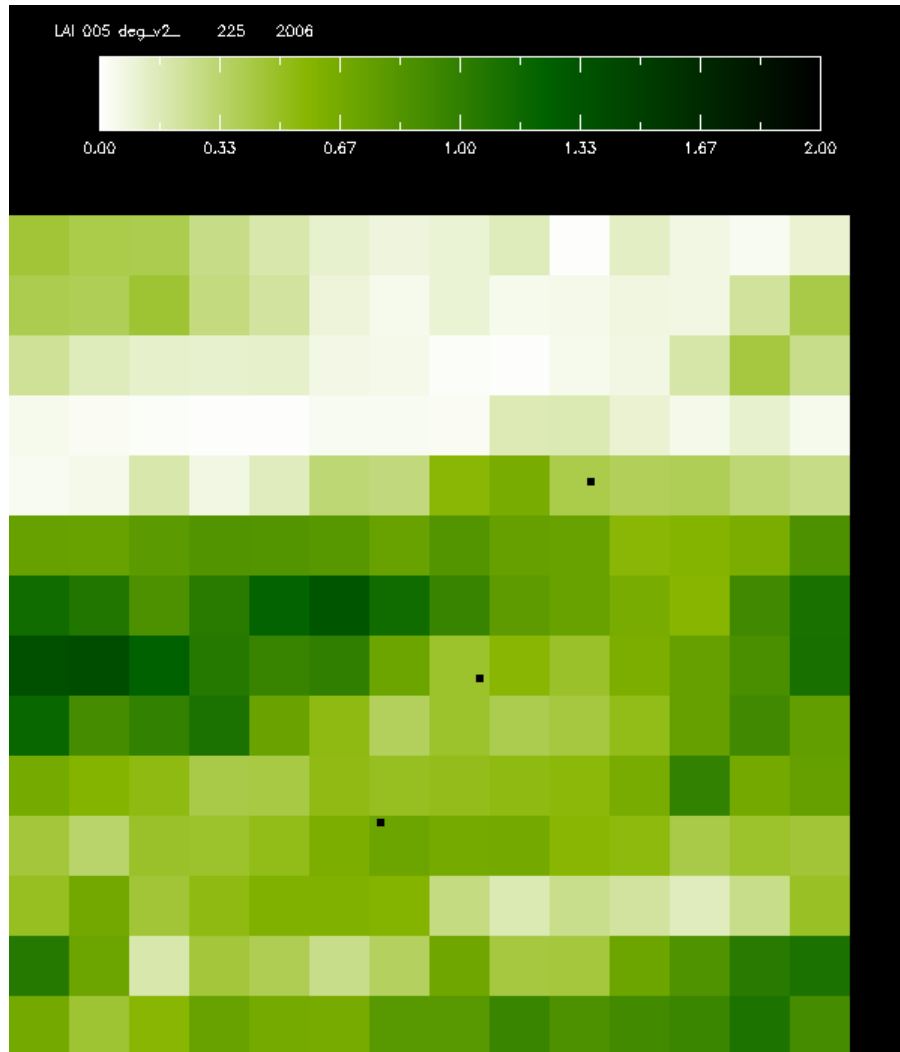
STEP ECOCLIMAP2



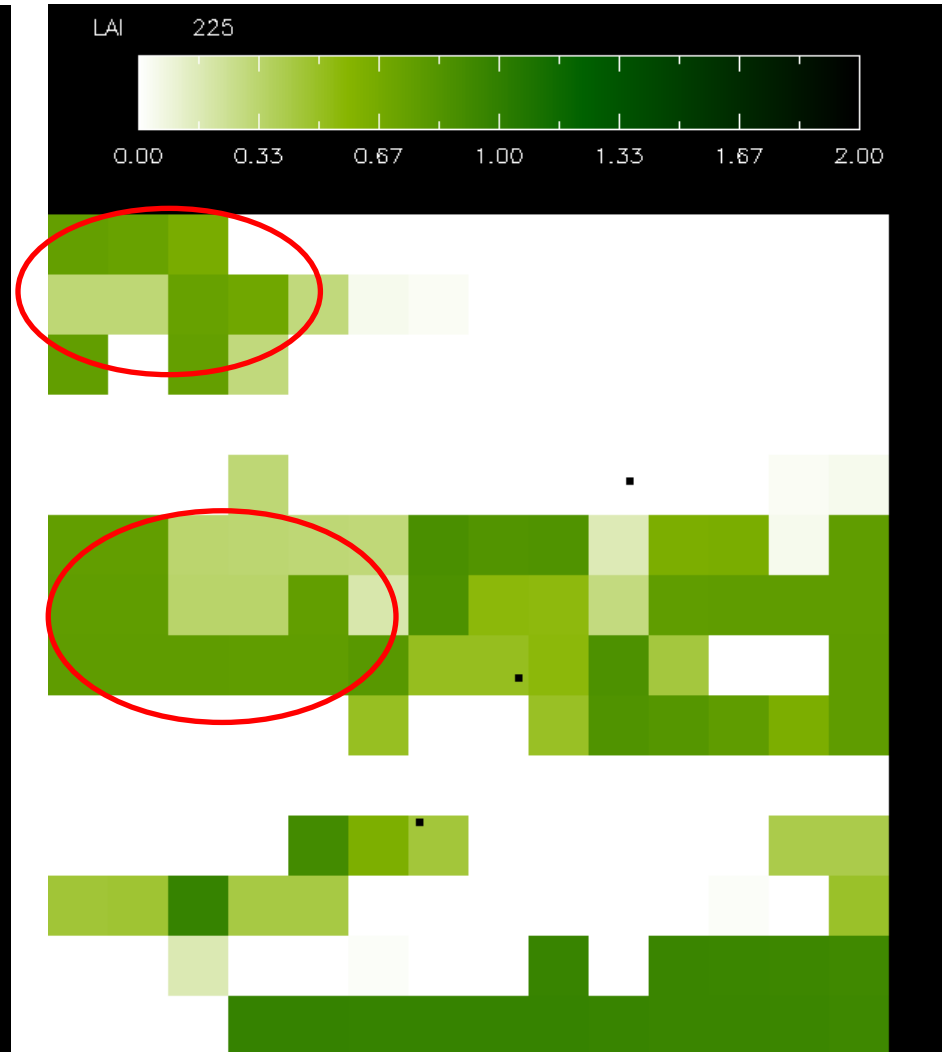
Correlation LAI MODIS vs STEP ECOCLIMAP = **0.40**

Example 13 08 2006

MODIS



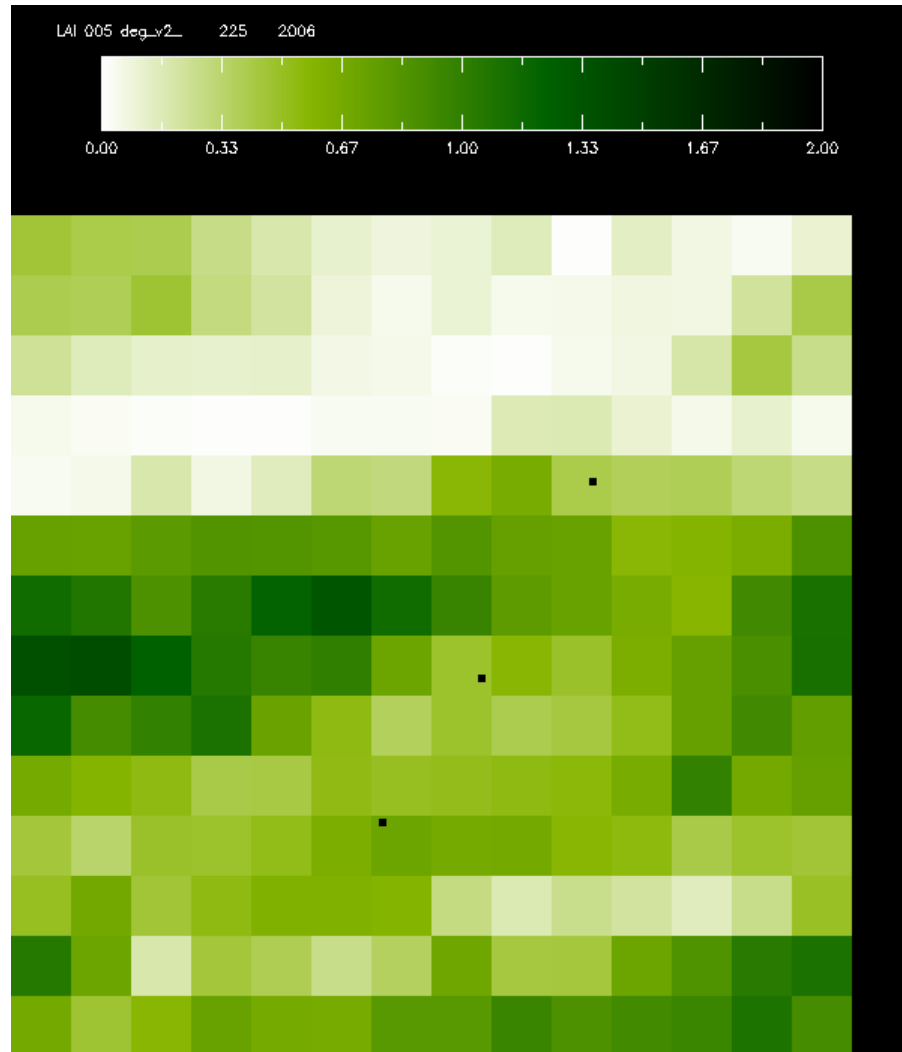
STEP Gourma



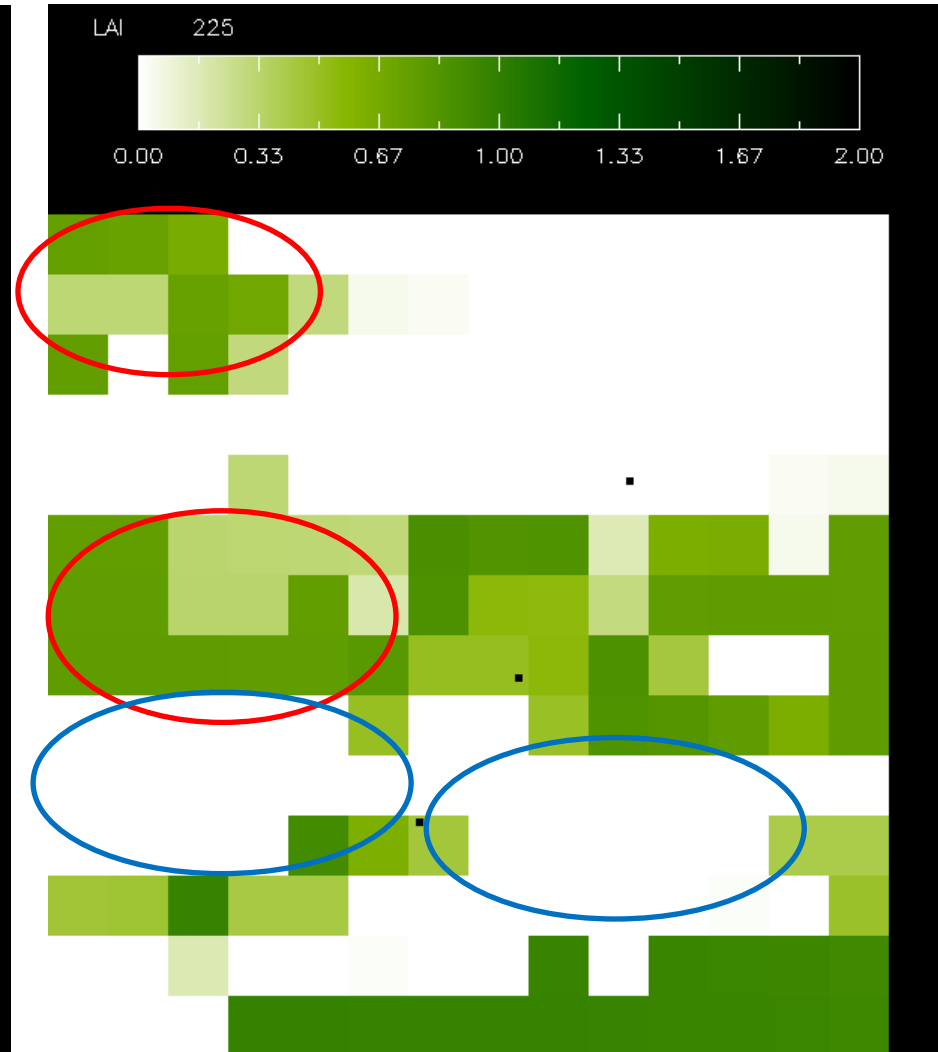
Correlation LAI MODIS vs STEP Gourma = **0.56**

Example 13 08 2006

MODIS

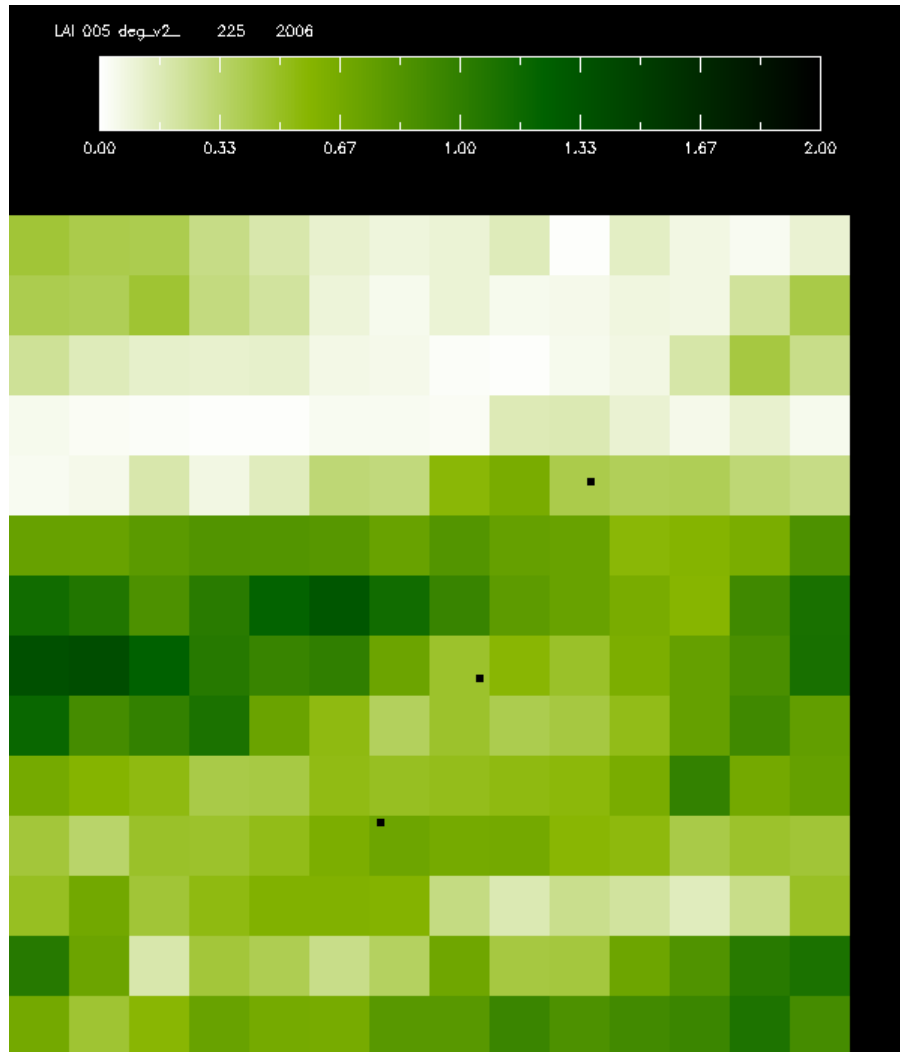


STEP Gourma dominant

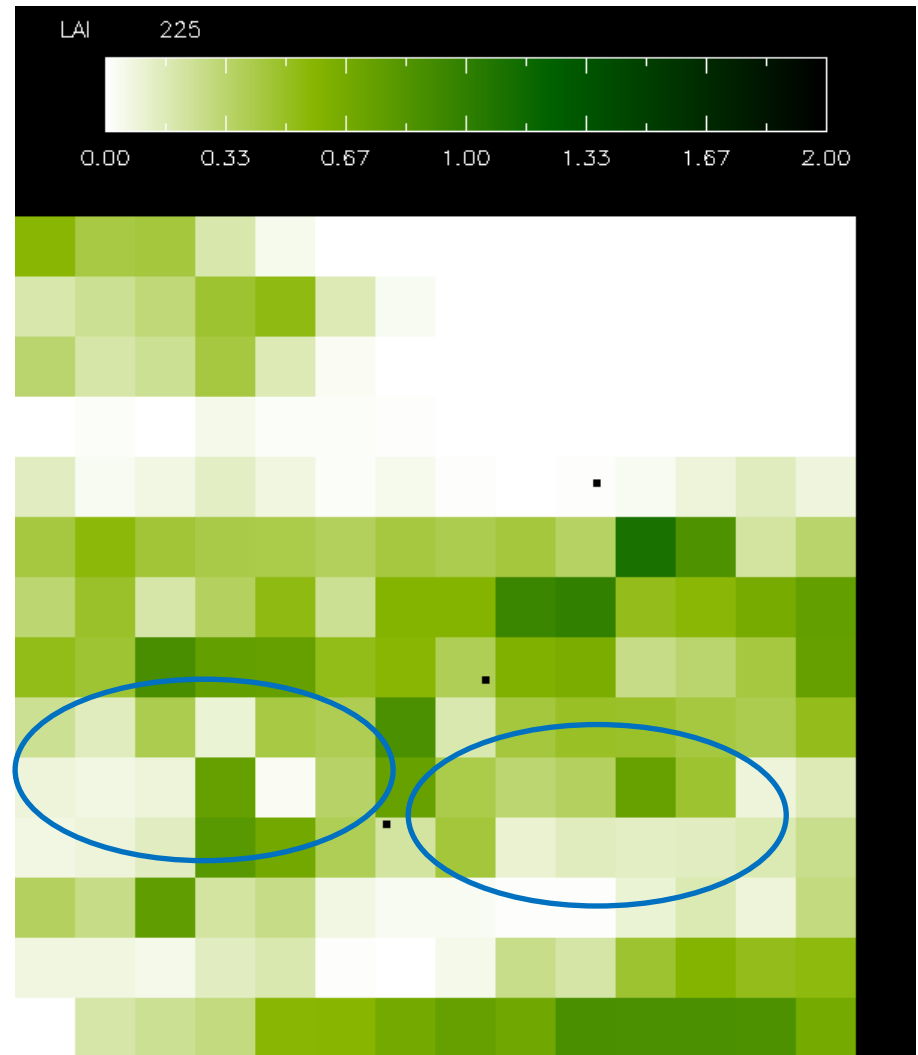


Correlation LAI MODIS vs STEP Gourma = **0.56**

Example 13 08 2006
MODIS

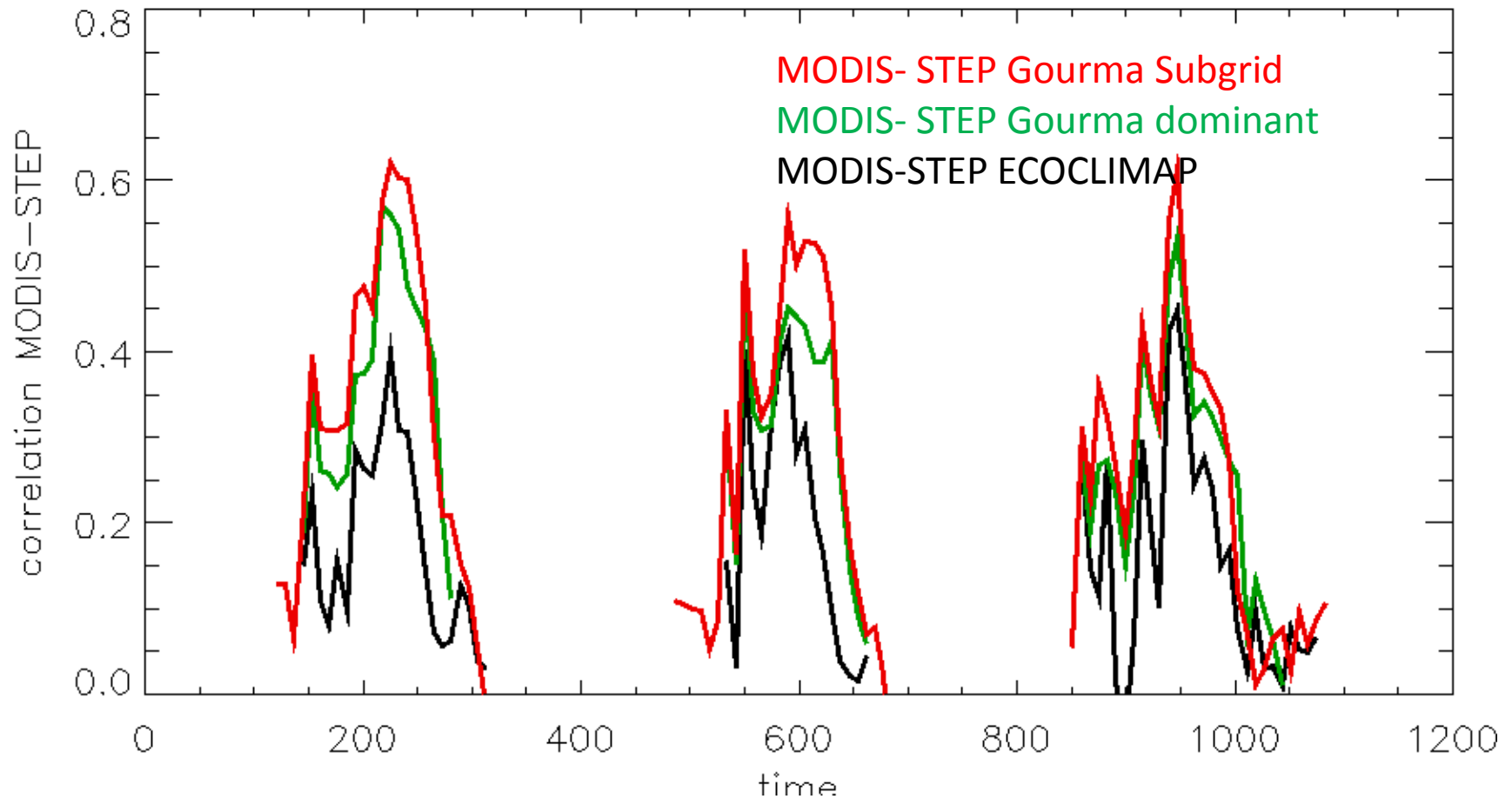


STEP Gourma subgrid



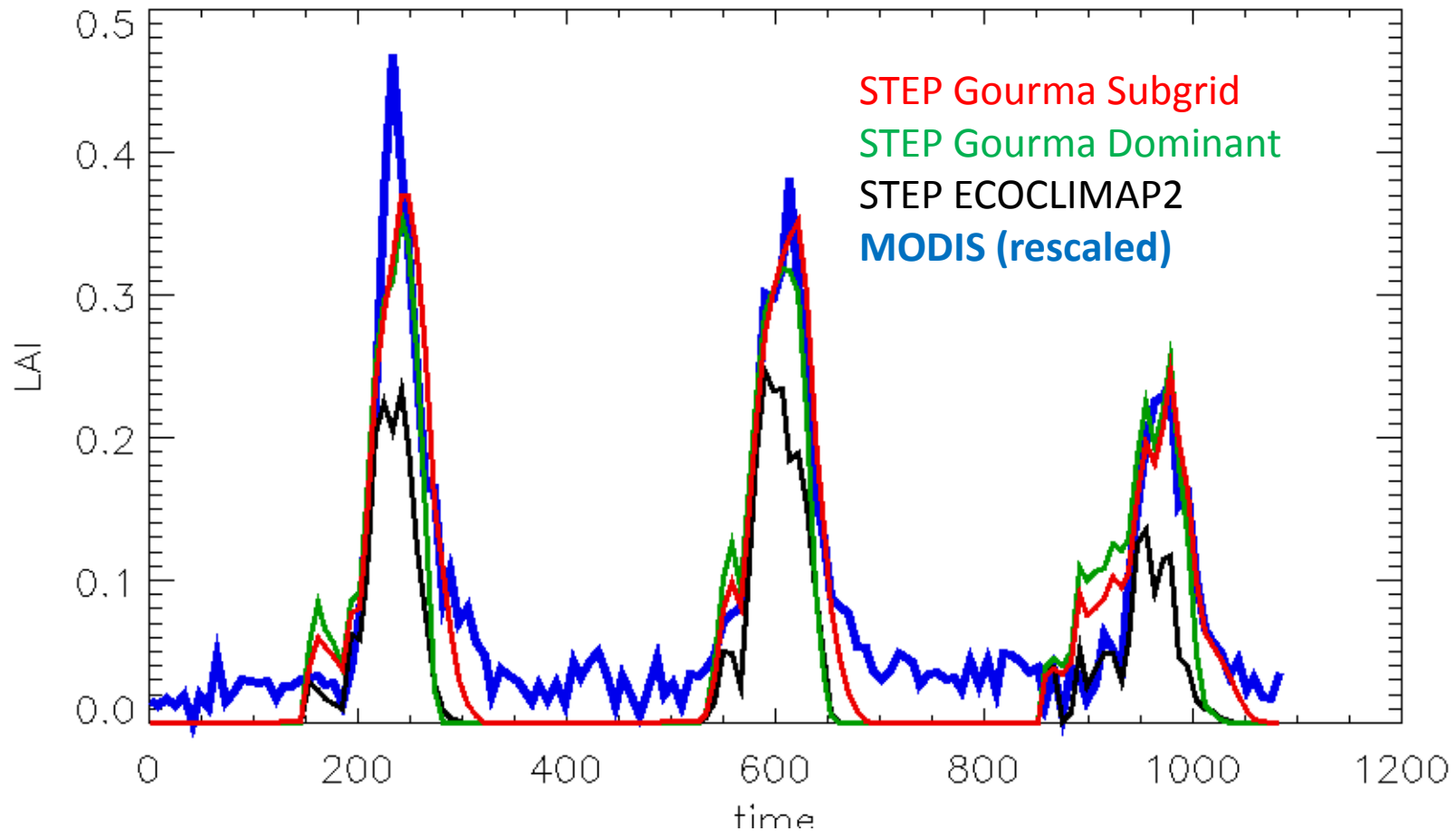
Correlation LAI MODIS vs STEP Gourma subgrid= **0.62**

LAI STEP – MODIS: Spatial correlation



LAI STEP – MODIS: Mean values

Spatially averaged values over the meso site



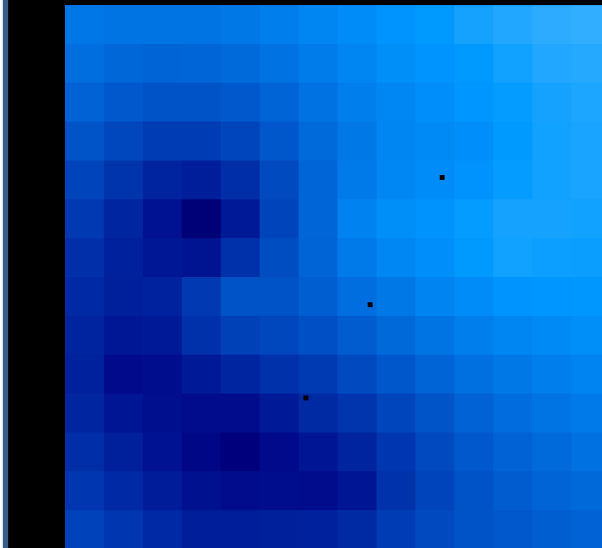
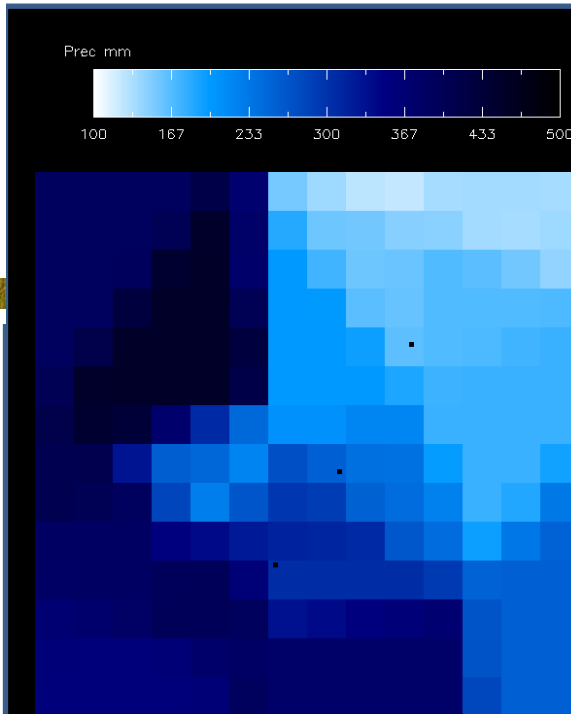
Sensitivity to precipitation kriging



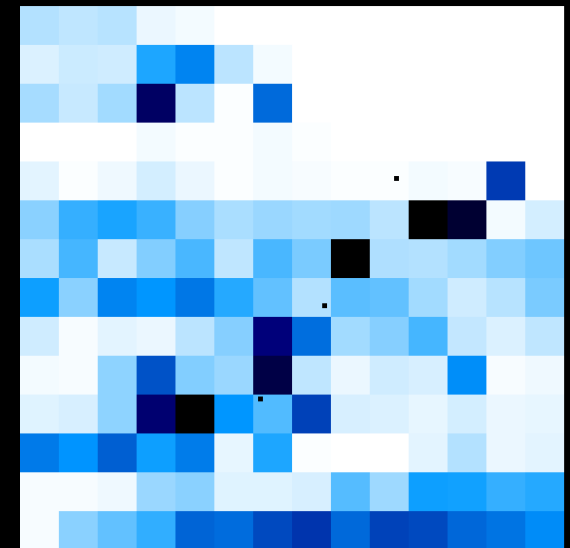
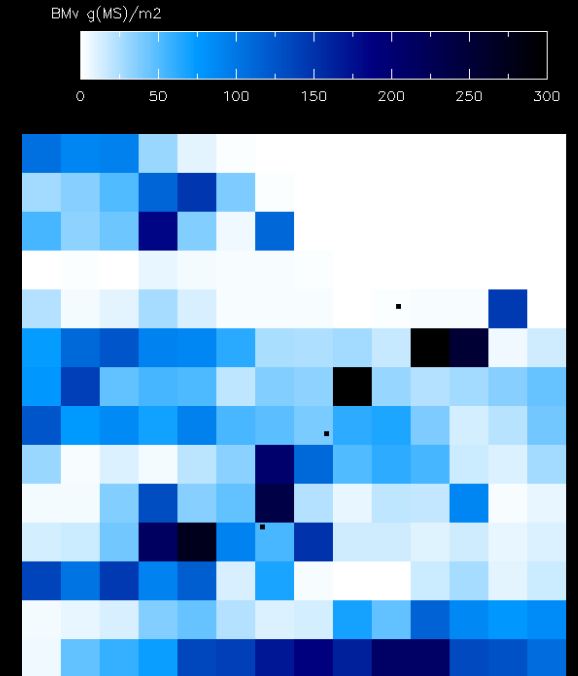
Thiessen

Lagrangian

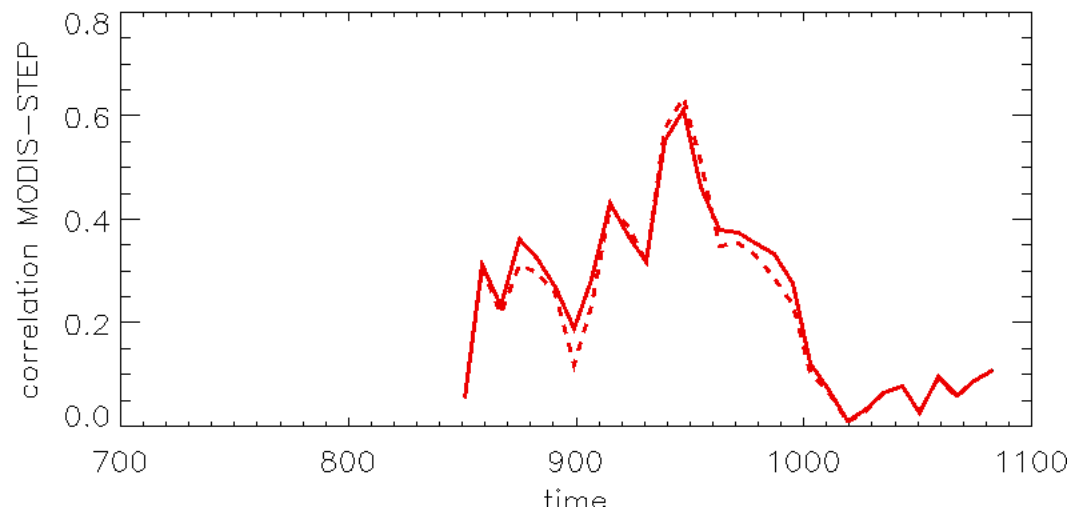
Tot Precipitation 2008



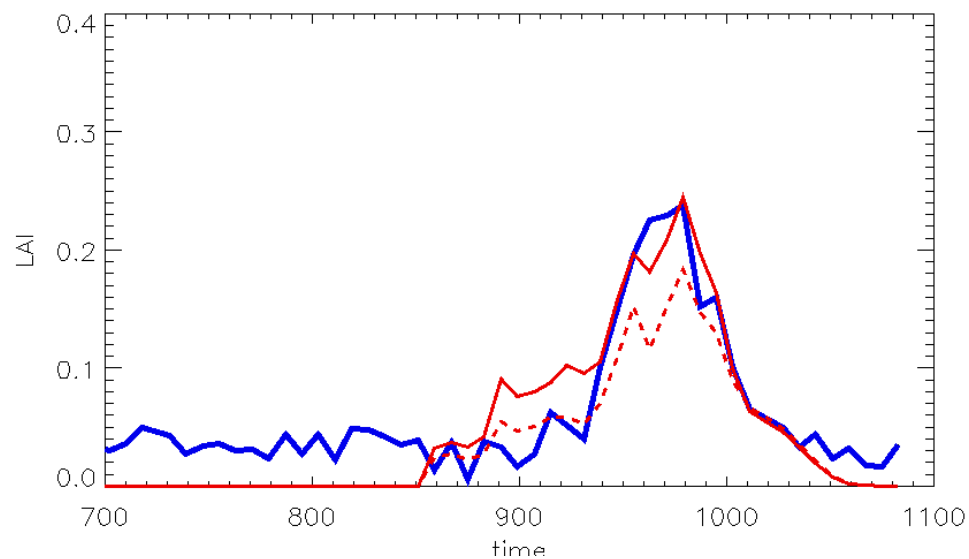
Max biomass 2008,
STEP Gourma subgrid



LAI STEP – MODIS: sensitivity to precipitation



— STEP Subgrid Thiessen
.... STEP Subgrid Lagrangian
— MODIS (rescaled)



Preliminary conclusions

Local scale:

Good agreement between STEP and in situ measurements (soil water, LE fluxes and vegetation) at Agoufou and Kelma

Meso scale:

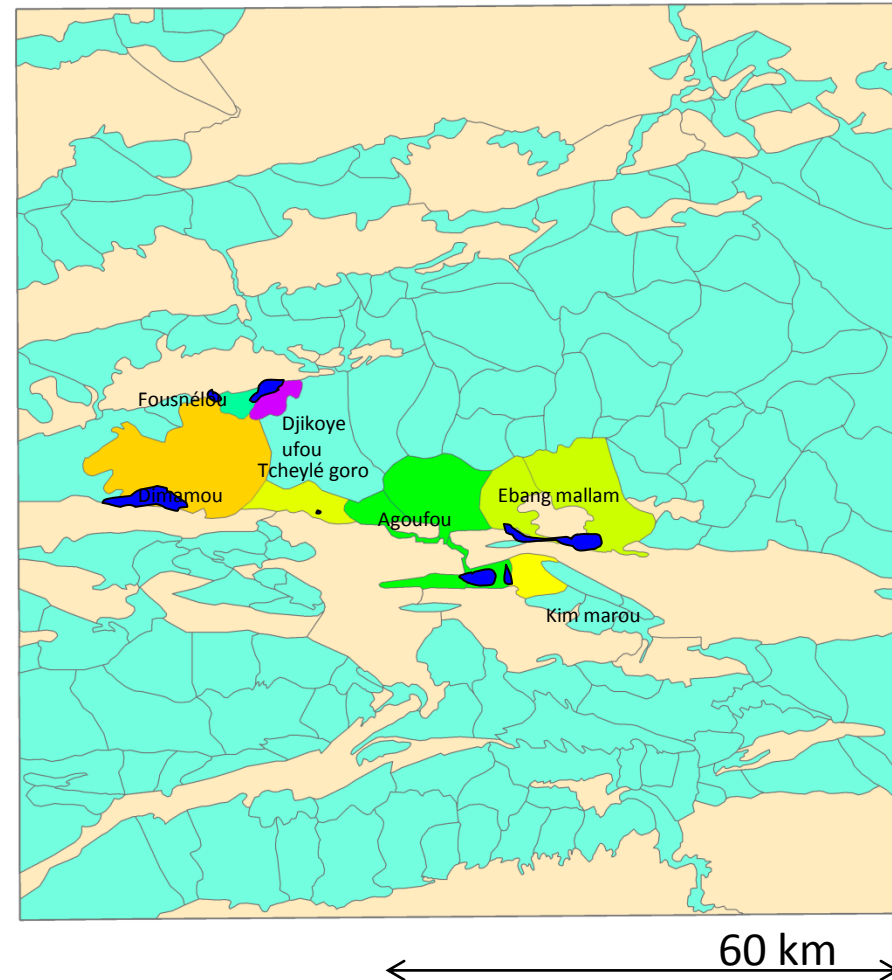
Soil texture and depth is the primary factor accounting for vegetation distribution.

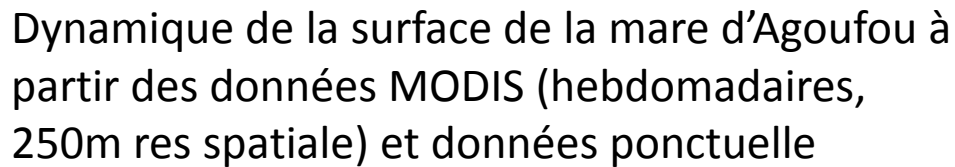
Water re-distribution at subgrid scale is also important (flood on clayed soil)

Rain gauge interpolation method has an impact on the absolute LAI values but not a significant impact on the spatial distribution of vegetation

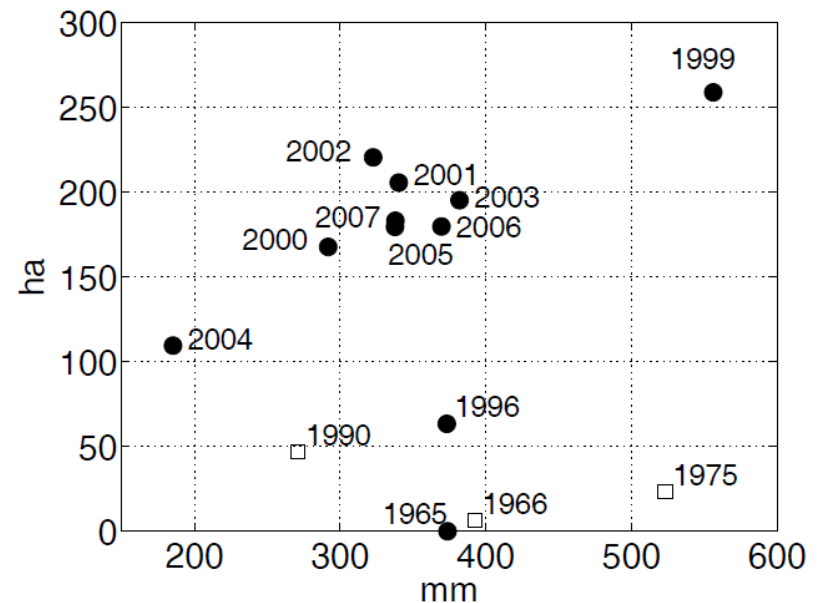
Lots of work still ahead...

- **Water balance evaluation at meso scale:**
watersheds of Agoufou and Bangui Mallam
- **Models intercomparison** over the Gourma meso site (ALMIP2)





Surface de la mare en Octobre vs précipitation annuelle à Hombori



Comparison LAI STEP – MODIS, Sensitivity to precipitation

