EVASPA : EVapotranspiration Assessment from SPAce

Albert Olioso, Belen Gallego-Elvira, Malik Bahir, Gilles Boulet, Marie Weiss, Maria Mira Sarrio, Sergio Reyes Castillo

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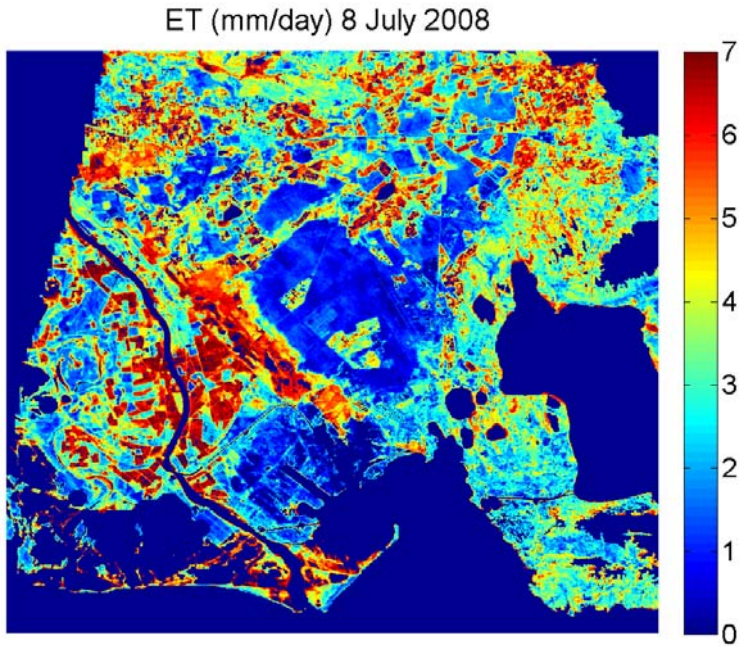

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UMR 1114 INRA - UAPV
Environnement Méditerranéen et
Modélisation des Agro-Hydrosystèmes

CESBIO

Objectives

Provide evapotranspiration **ET** maps at relevant spatial and time scales for agronomical and hydrological purposes

-> watershed hydrological balance

-> water stress and drought monitoring

-> crop water requirements and irrigation management

Account of the improvements in algorithm for mapping land surface variables (LAI, albedo, vegetation fraction cover) and evapotranspiration since the 90's

by combining Earth Observation and thermal infrared remote sensing

NB: Operational Evapotranspiration products are only few and have strong limitations (validity, temporal and spatial resolution)

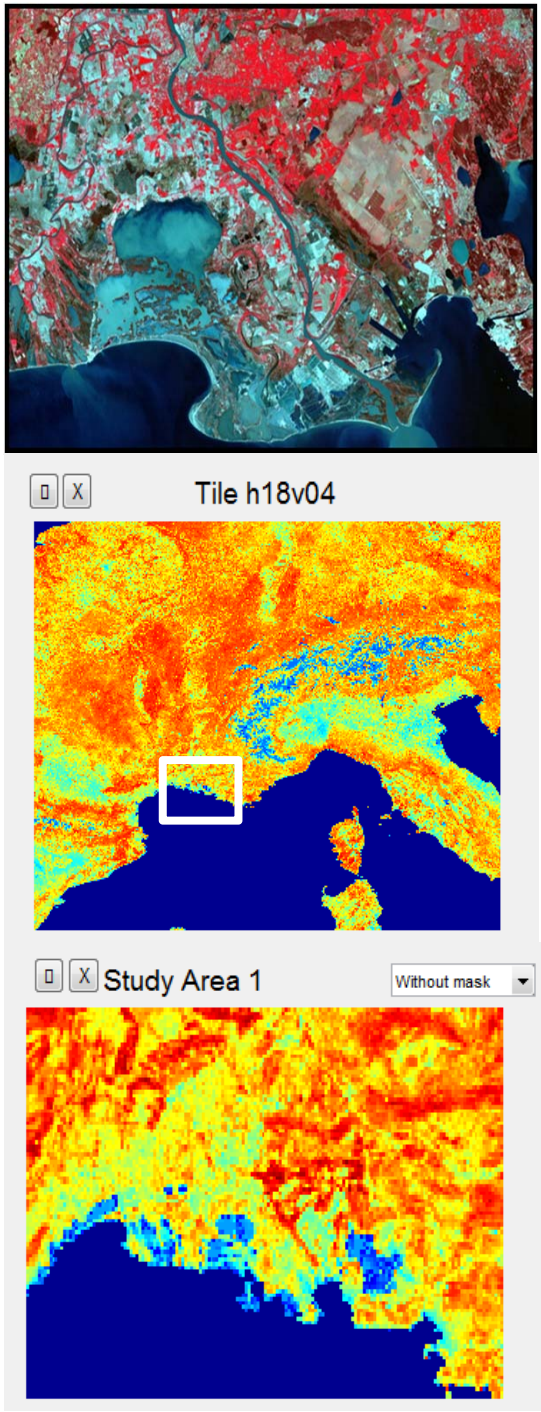
Main features of EVASPA

1) Combination of Evapotranspiration models (ensemble calculation): estimation of uncertainties

2) Integrate data from various remote sensing sensors (Easily adaptable to new sensors)

3) Continuous daily ET maps (interpolation methods)

4) Graphical User Interface (GUI) (MATLAB)



EVASPA.v1 – v2 (first operational versions)

1) MODIS data (TERRA and AQUA)
   Continuous daily ET maps at kilometric spatial resolution

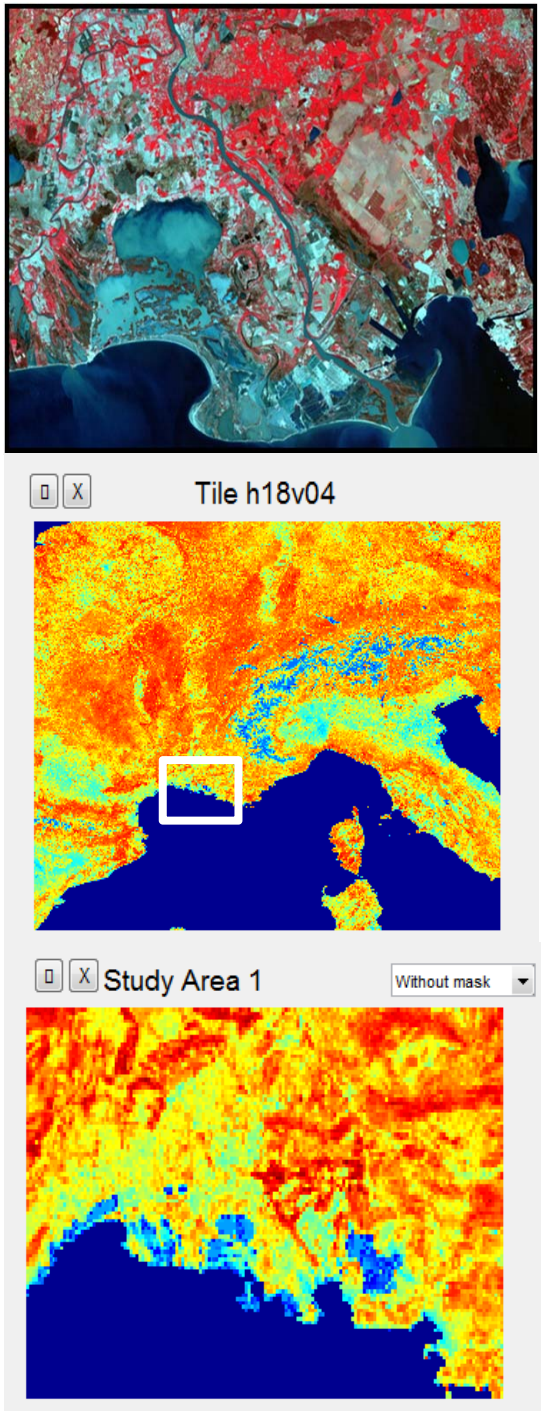
2) Landsat 5 and 7 High resolution ET maps (~hectometric) when images of the study area are available ;

3) extension to any VISIR-IRT sensors

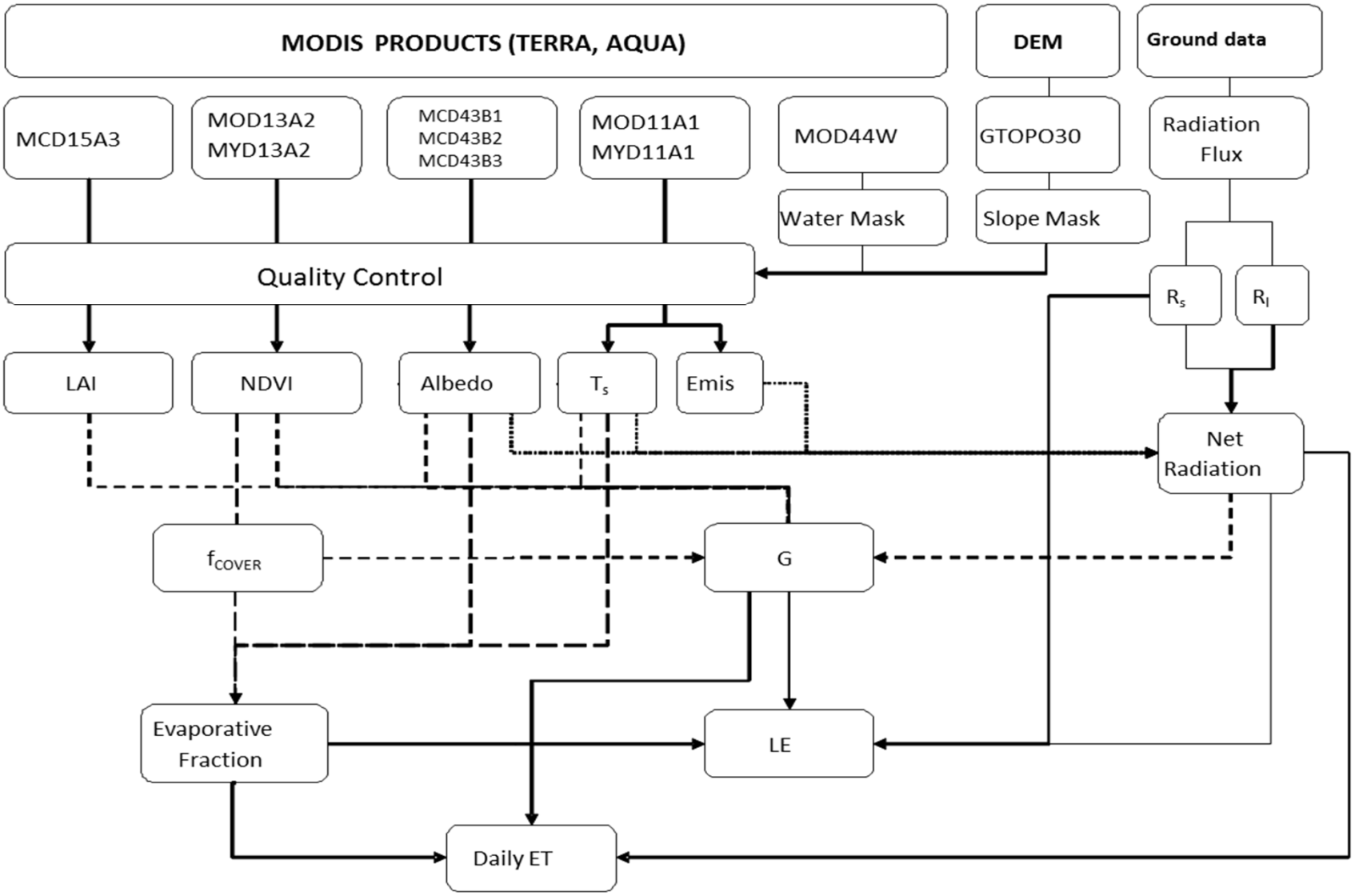
4) Solar radiation from satellite products

5) Mapping algorithms based on
   - S-SEBI (Roerink 2000)
   - Triangle approach (Jiang and Islam 1999)

6) Several hypotheses in the calculations of albedo, emissivity, ground heat flux, net radiation, evaporative fraction, time interpolation



EVASPA algorithm for mapping ET from MODIS data



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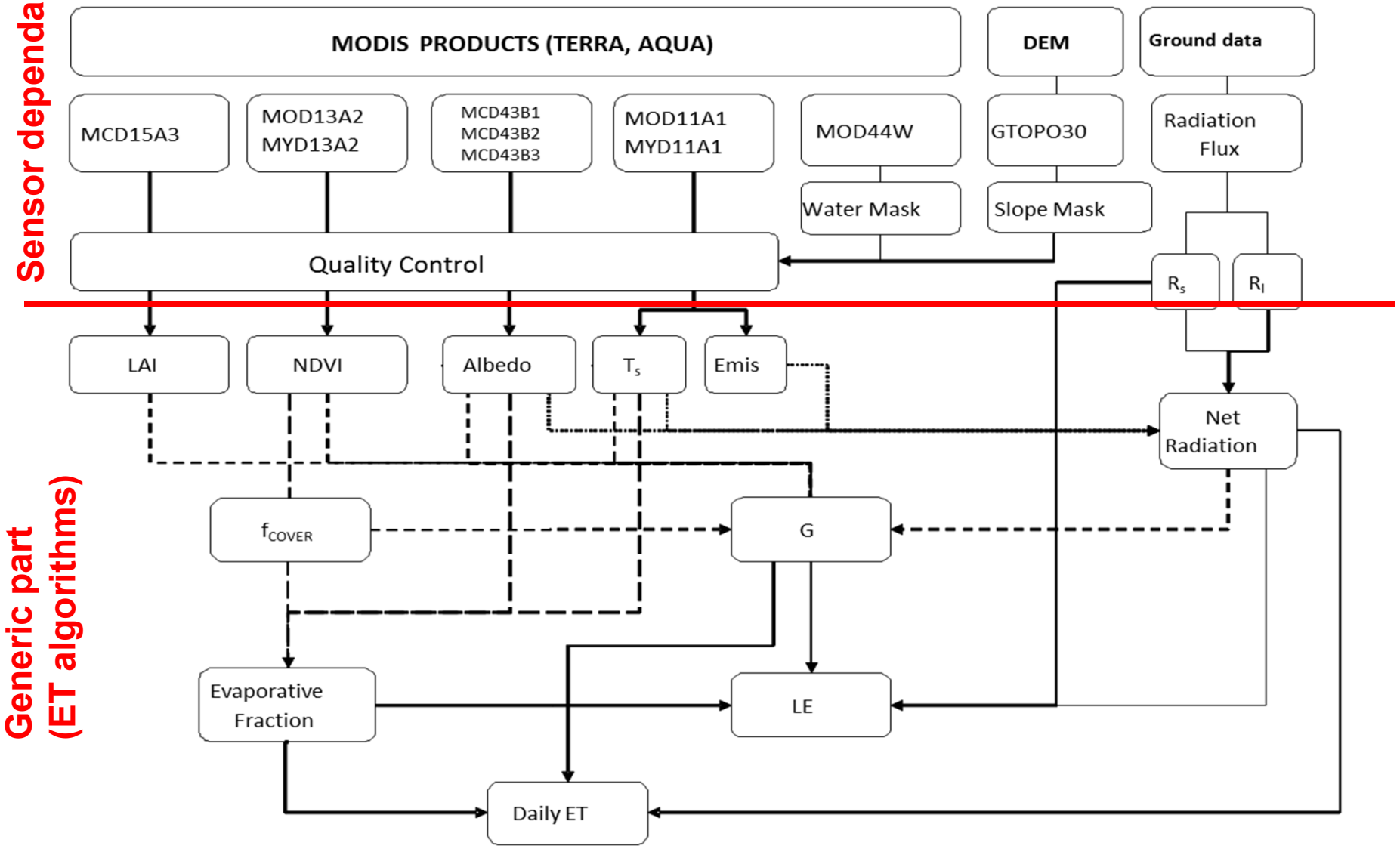
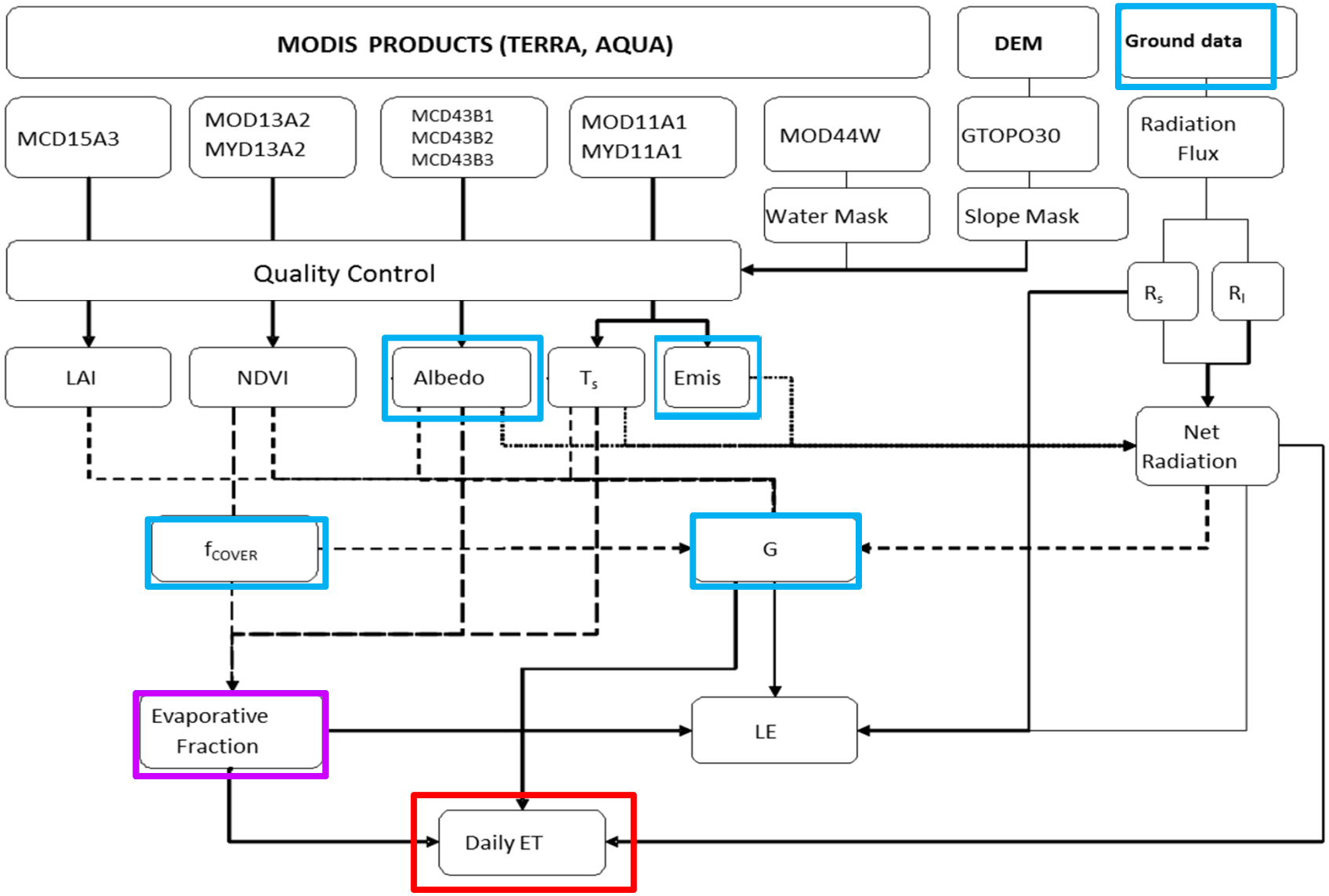
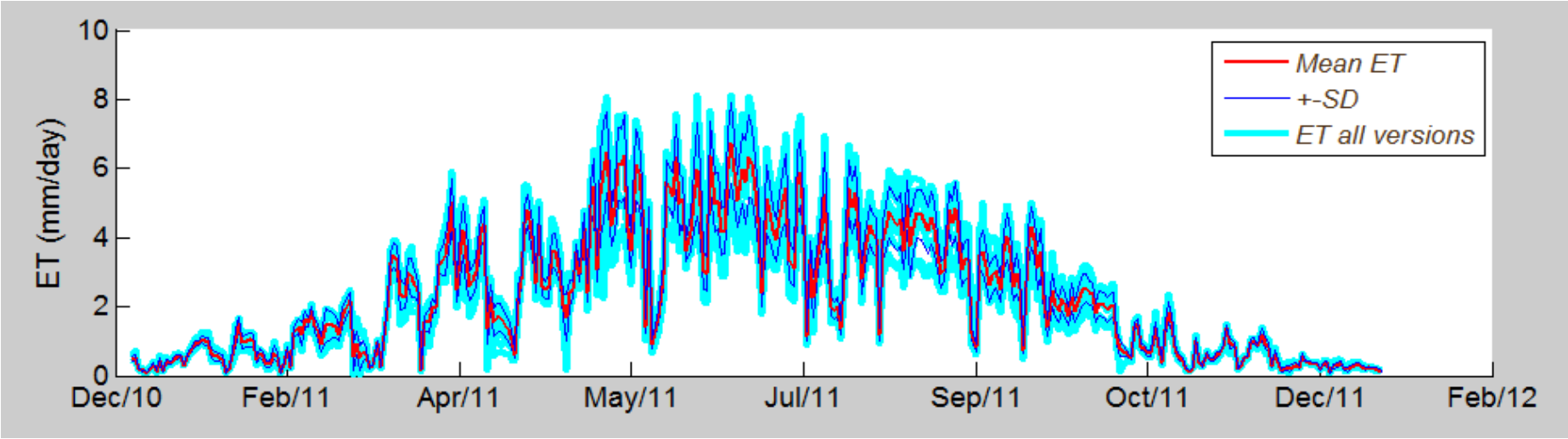
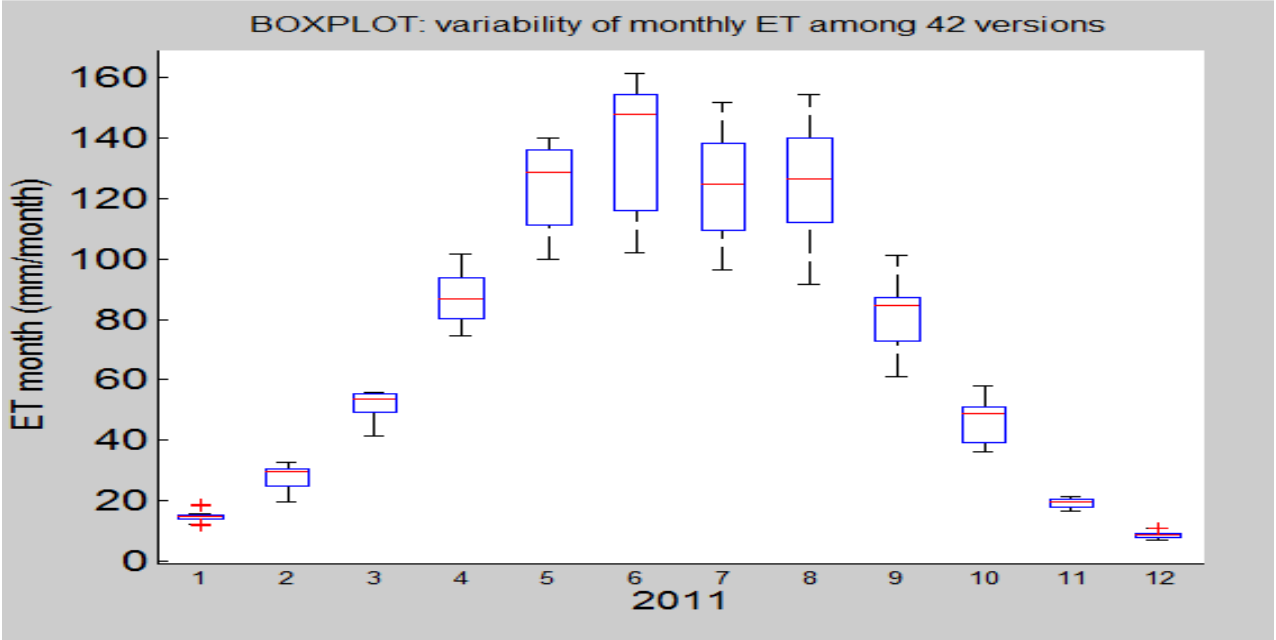


EVASPA algorithm for mapping ET from MODIS data



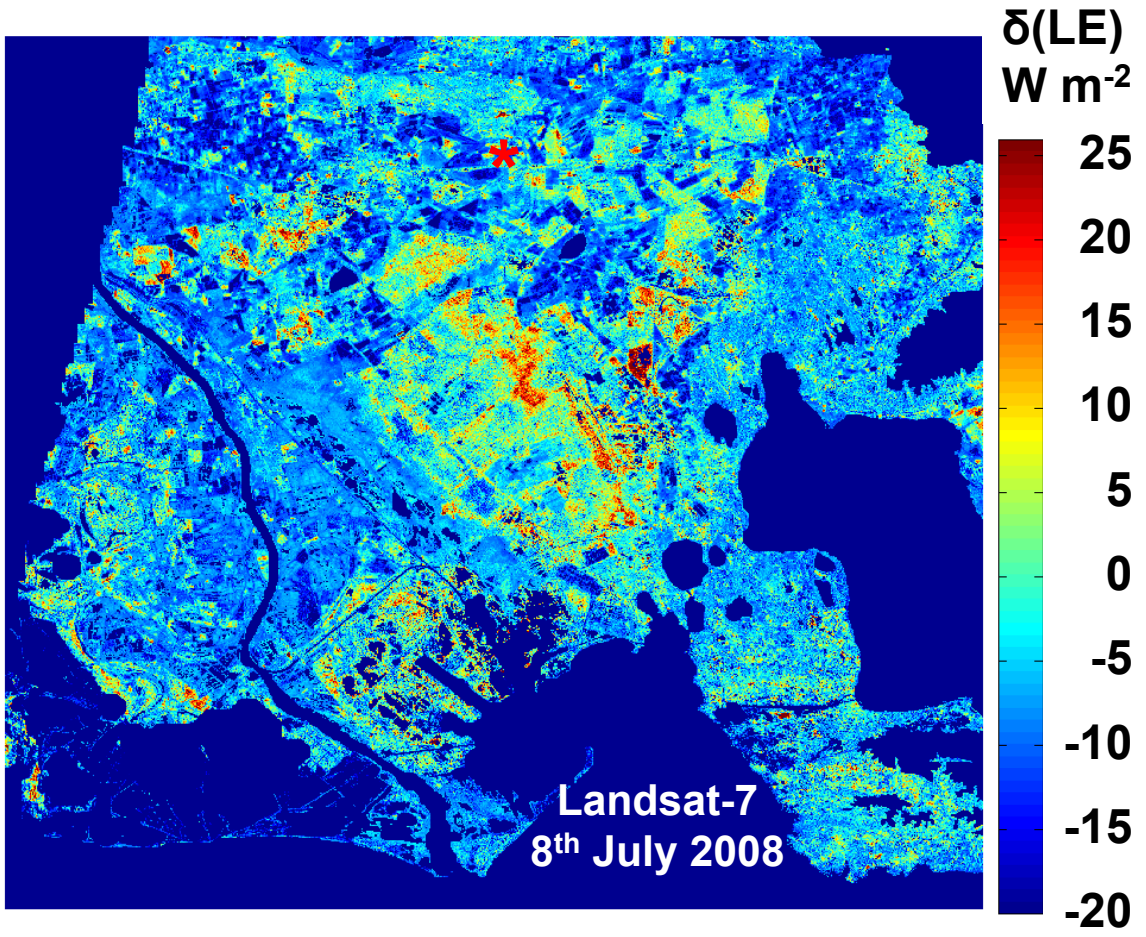
Example : continuous daily evapotranspiration from MODIS



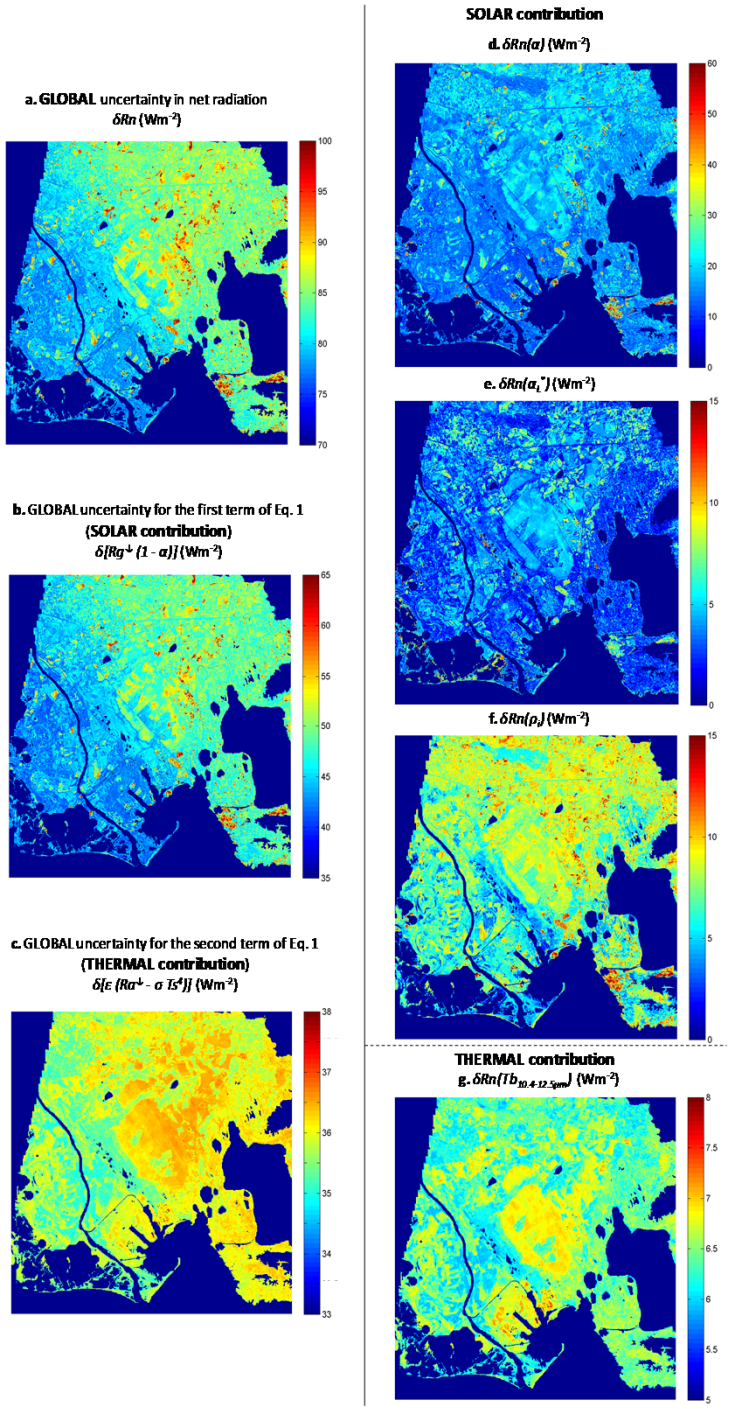


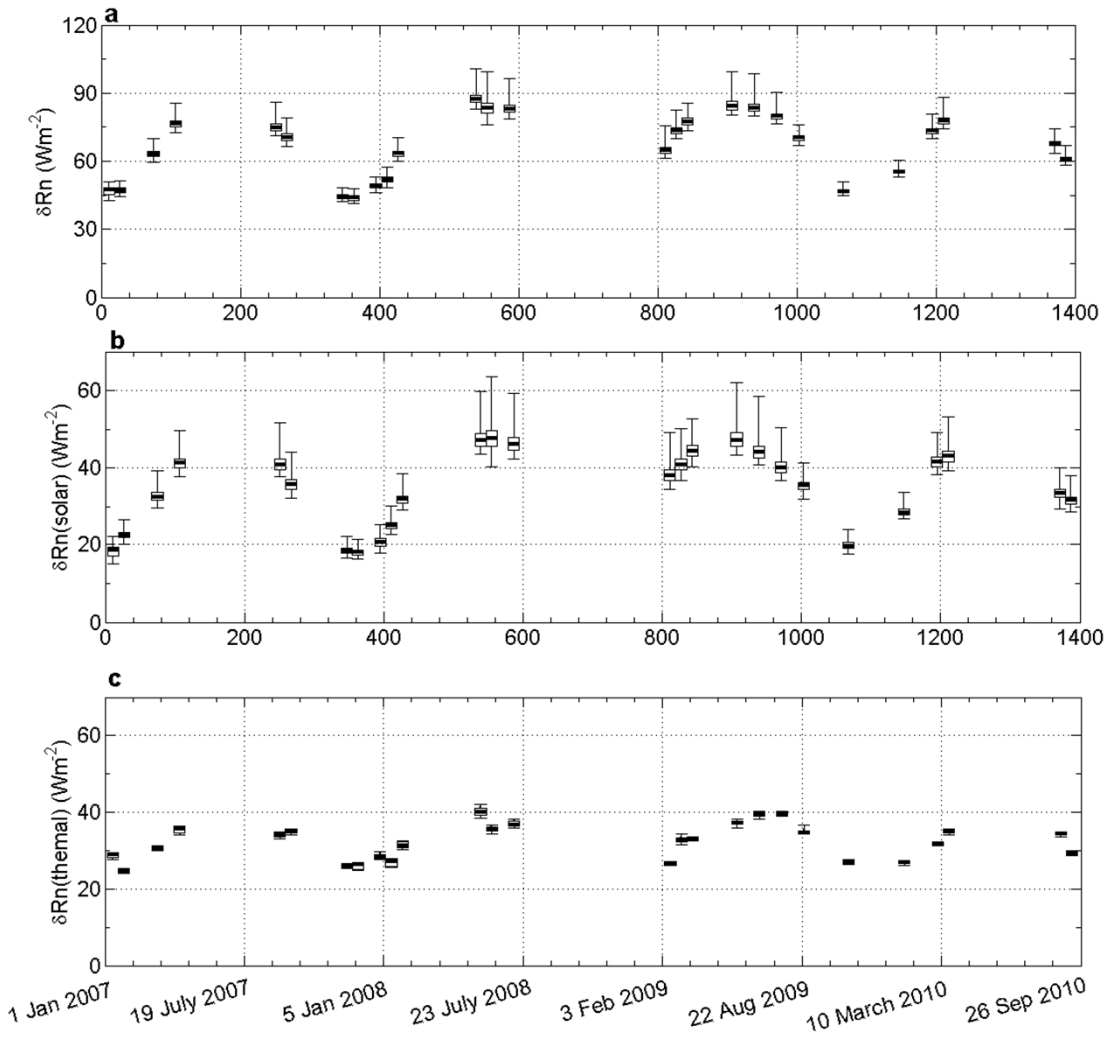
Uncertainties in latent heat flux (LE)

$$\delta(LE) = LE(\alpha_{best\ model}) - LE(\alpha_{worst\ model})$$



Instantaneous latent heat flux (LE) estimates at high spatial resolution using EVASPA tool (S-SEBI algorithm, LANDSAT 7)

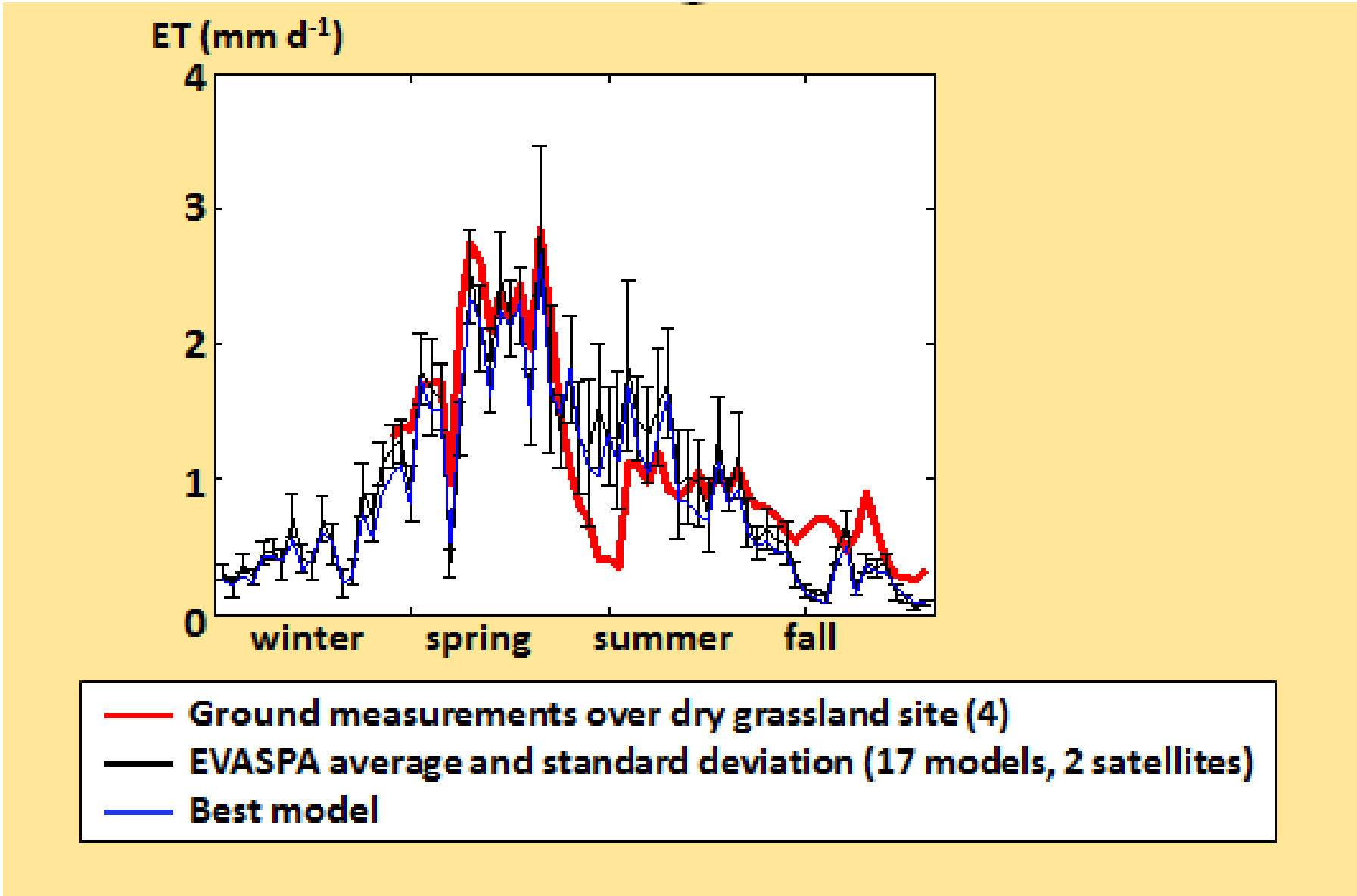




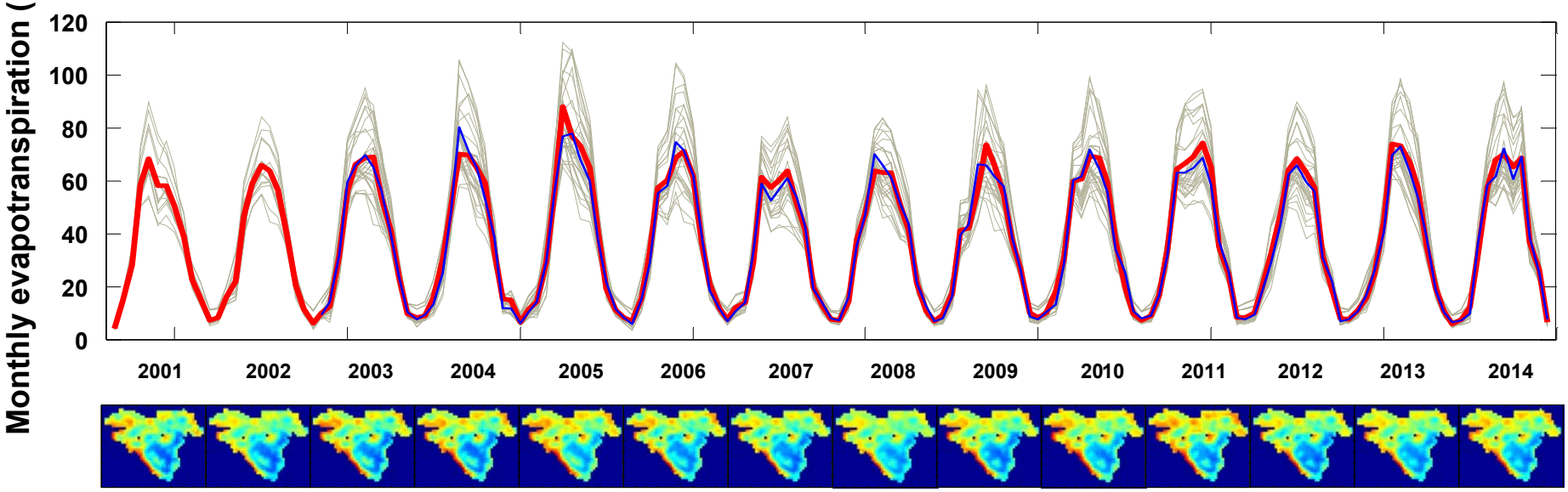
Uncertainty assessment of surface net radiation derived from Landsat

Mira, Olioso, Gallego et al., en révision (mineure) dans RSE

Comparaison des estimation d'évapotranspiration par rapport aux mesures de terrain sur les coussouls de Crau



Application: bilan hydrique de l'aquifère de Crau (550 km²)

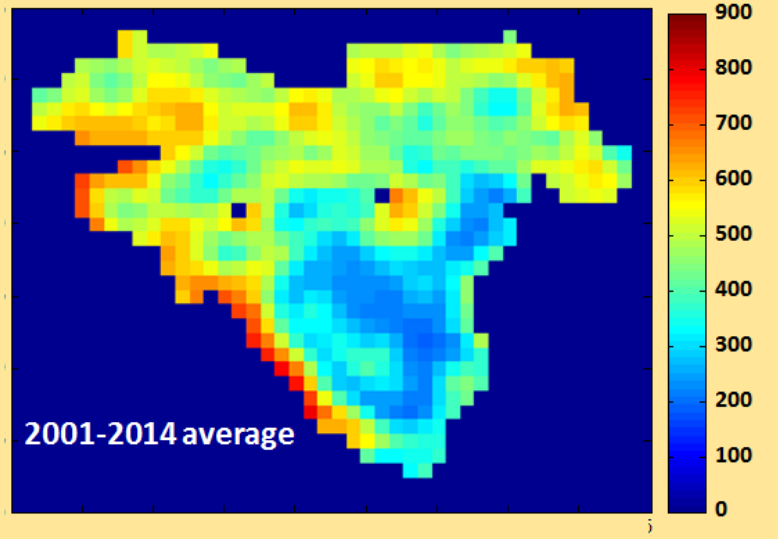


MODIS TERRA model average
MODIS AQUA model average
All models

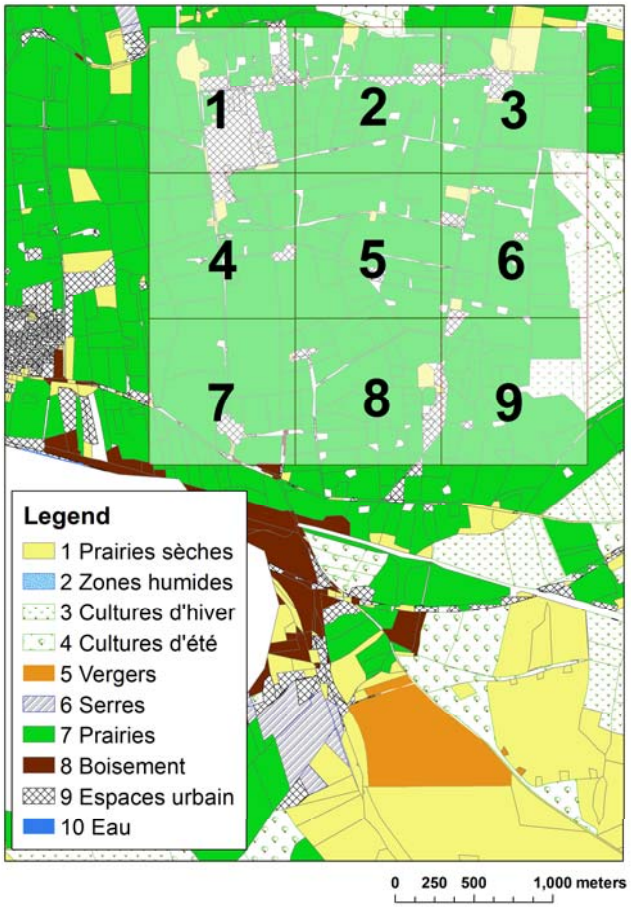
Water balance of the Crau aquifer area

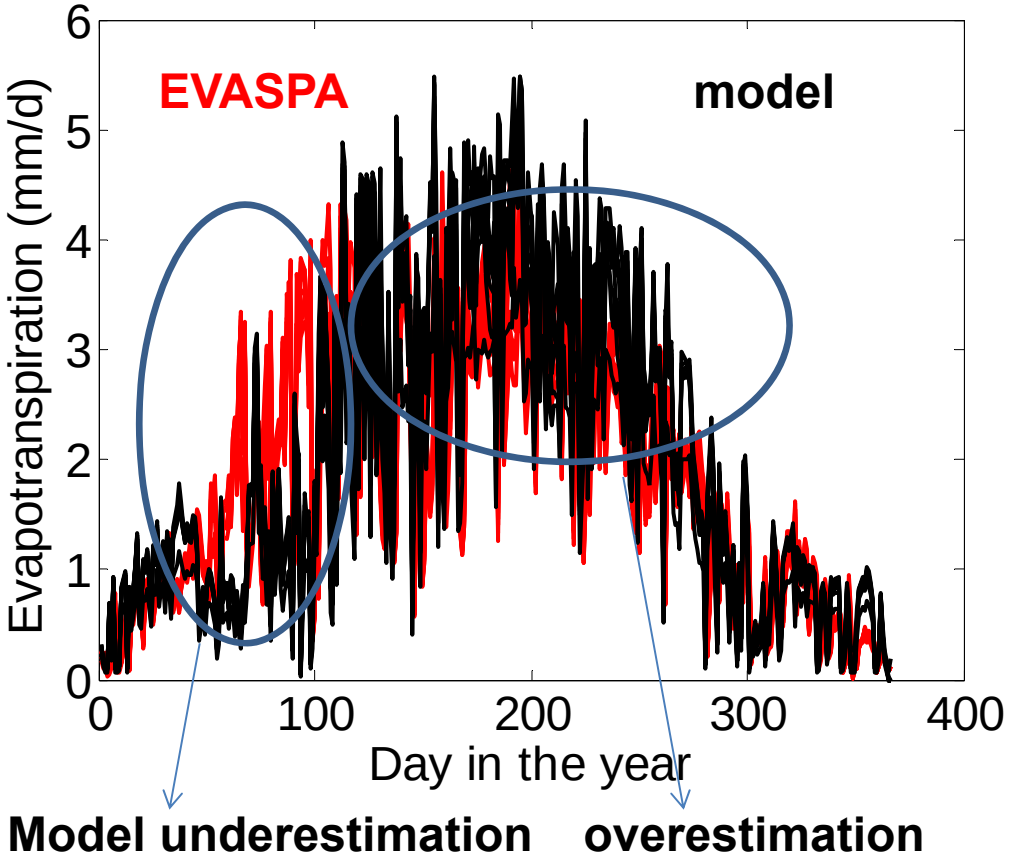
EVASPA		Olioso et al. (2013)	
Rain (Salon)	299 hm³	Rain (SAFRAN)	294 hm³
Rain (Istres)	260 hm³		
ET	239 hm³ [224 -261 hm³]	ET (surface models)	321 hm³
		Irrigation	297 hm³
		Drainage	277 hm³

Annual evapotranspiration (mm y⁻¹)



Ex: INRA: EVAPOTRANSPIRATION

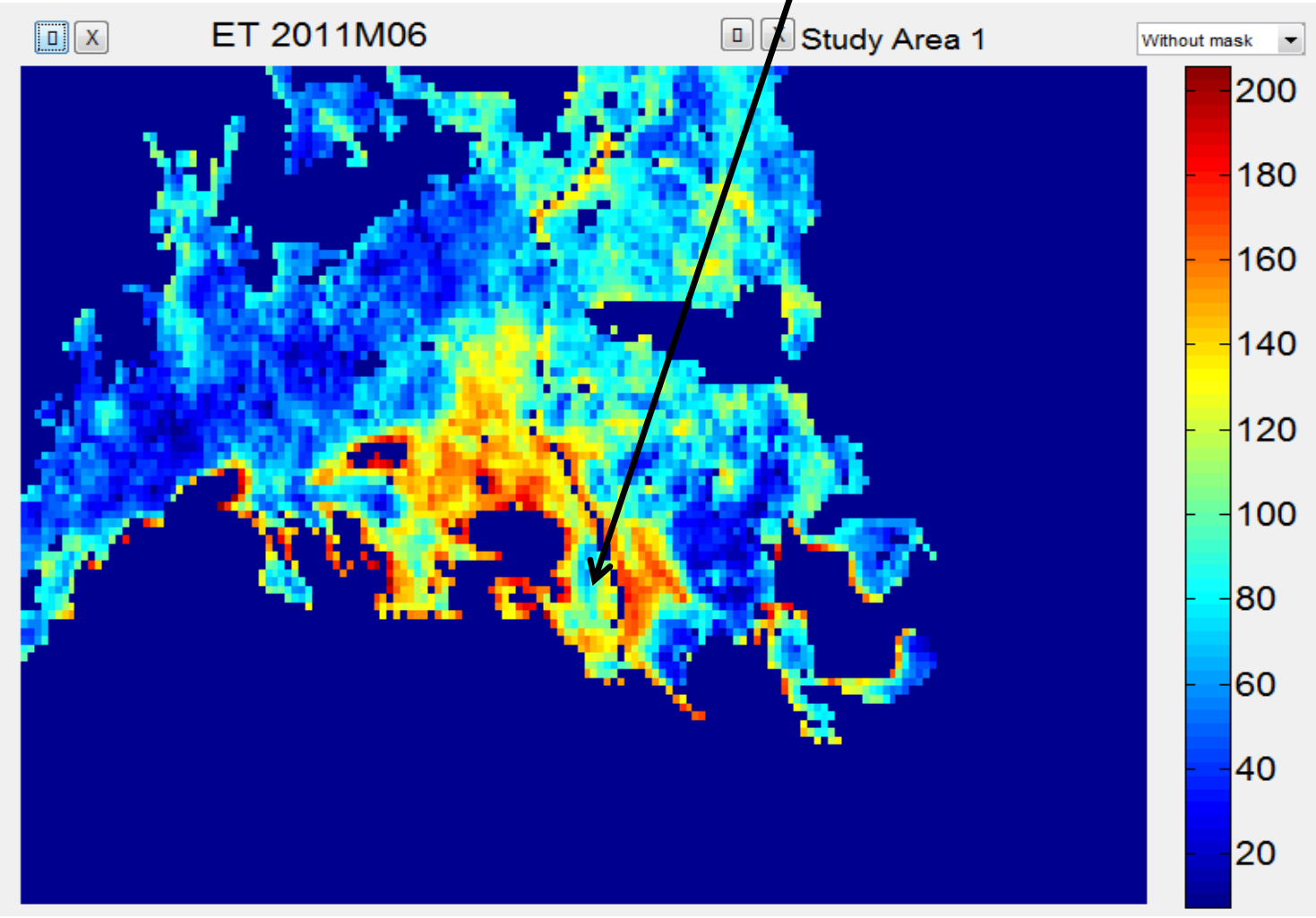




Tour du Valat – Camargue – France

MODIS data against ground station

and water table fluctuations

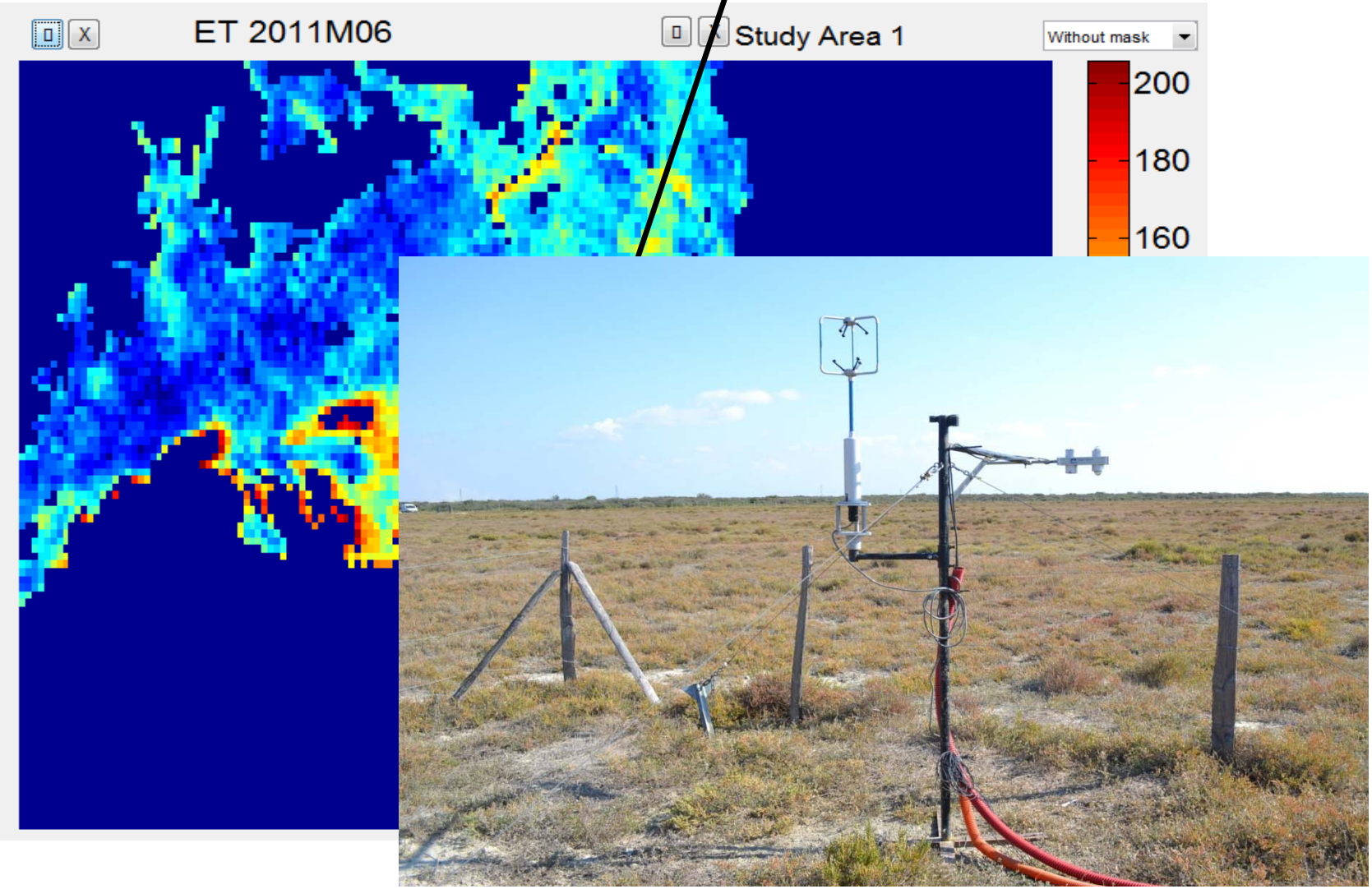


saltmarsh scrubs

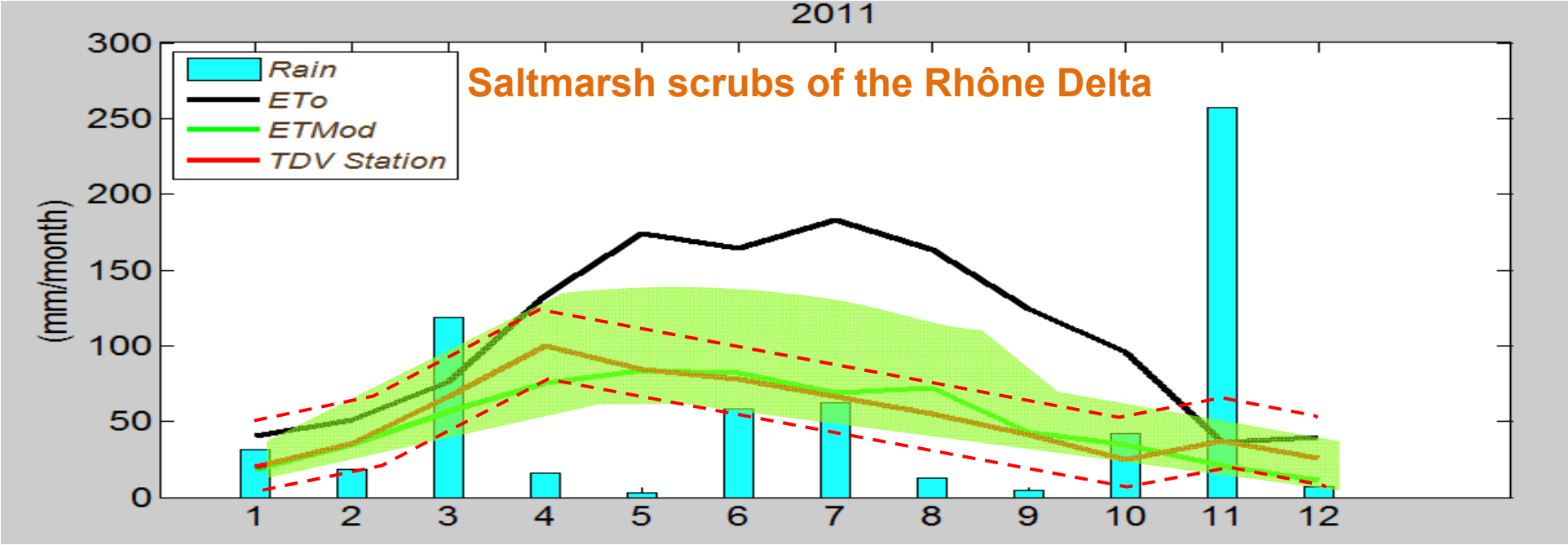
Tour du Valat – Camargue – France

MODIS data

saltmarsh scrubs



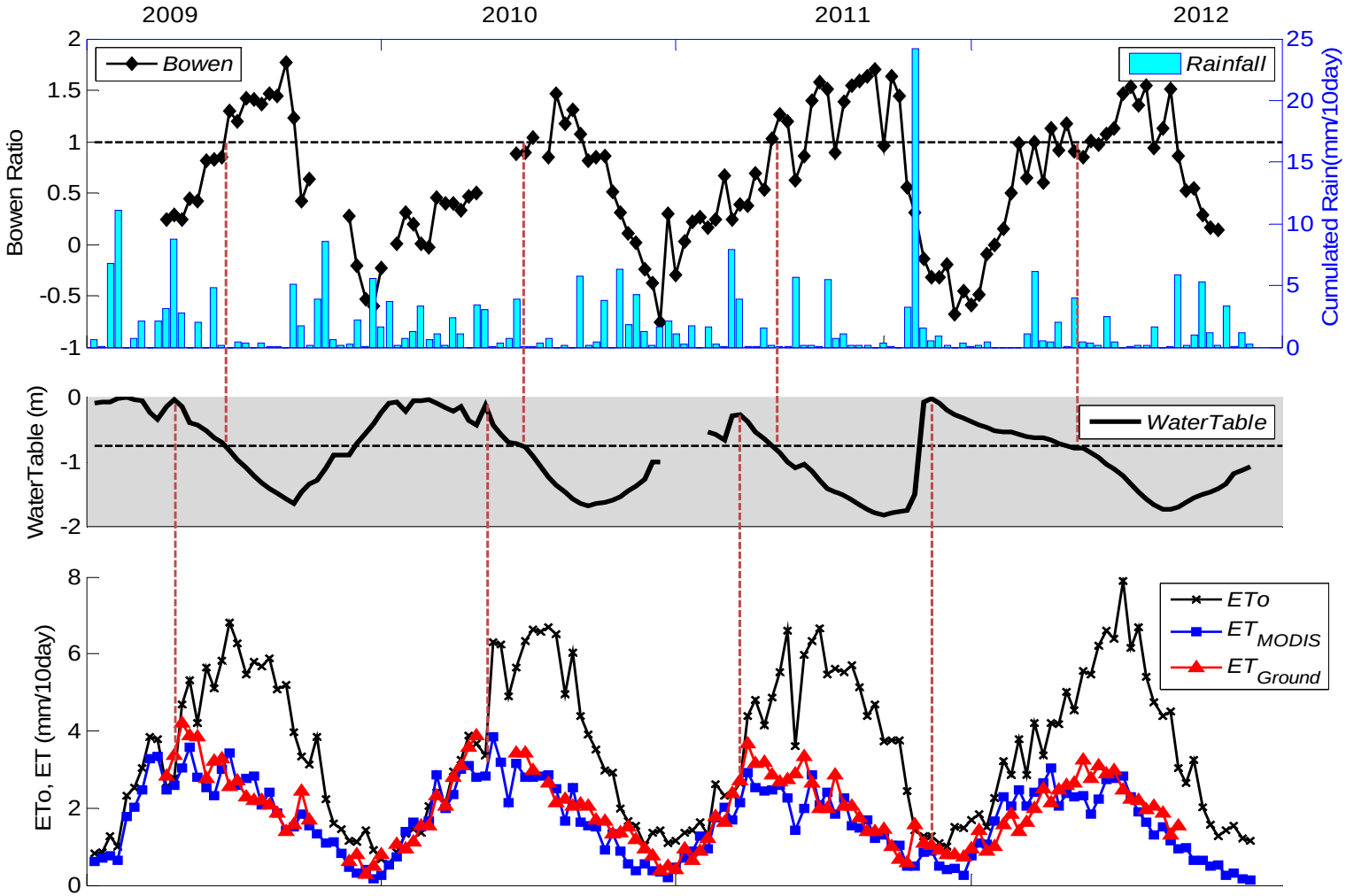
EVASPA ET estimations vs. ground stations



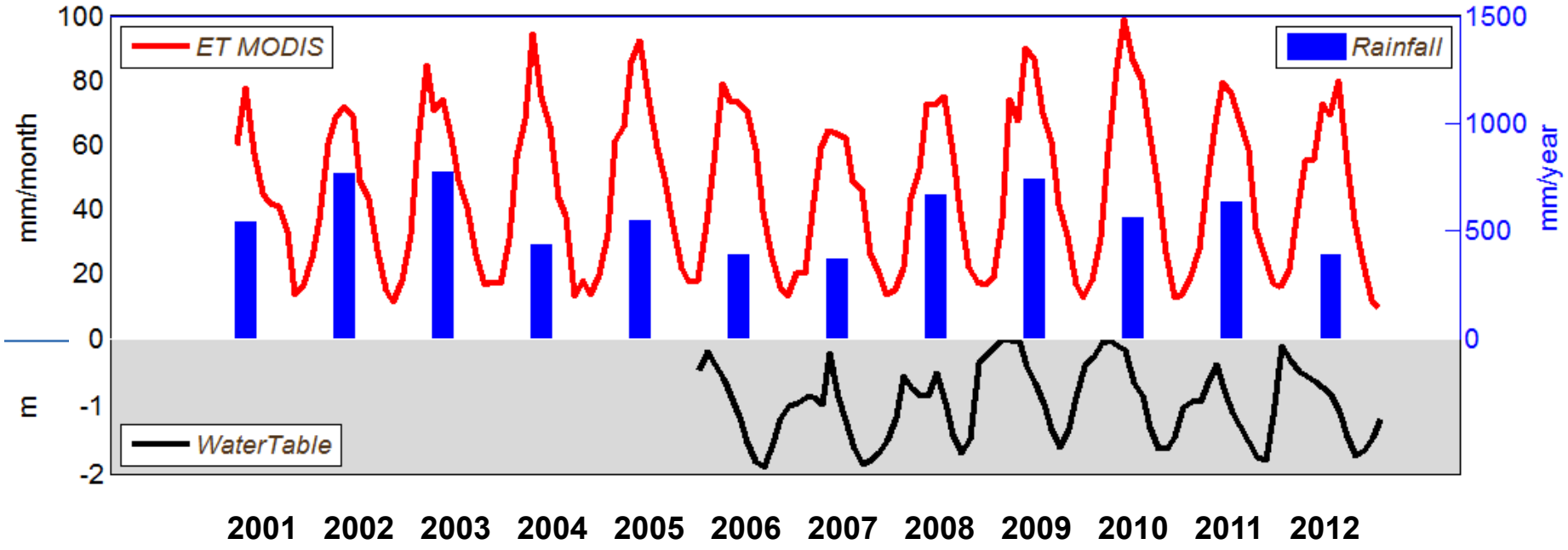
Identification of best performance methods for different surfaces and water stress conditions

EVASPA TOOL

Evapotranspiration in the saltmarsh scrubs and its relationship with water table



Evolution of evapotranspiration, rain and water table



Ground measurements period -> « training »

Application of EVASPA from MODIS data
-> extrapolation of evapotranspiration measurements

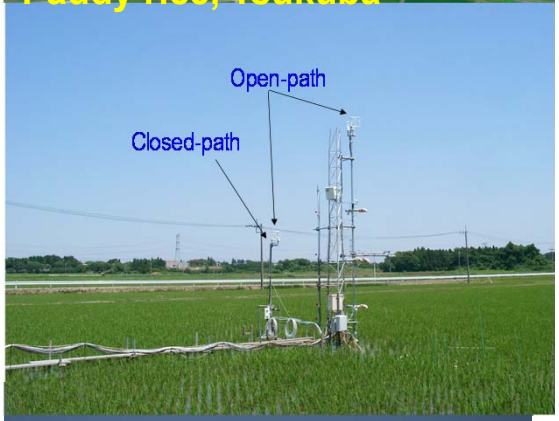
Final remarks

EVASPA integrates

- several methods to derive ET
- data from several remote sensing sensors

Work in progress

- performance assessment in several laboratories and over various types of landscapes
- identify the most suitable and reliable methods for different surfaces and water stress conditions
- uncertainty assessment
- evaluation of land surface models (LSM, SVAT, Crop Models) against evapostranspiration chronicles from EVASPA
- inclusion of new sensors and new models



EVASPA V3.0

Projet TOSCA AO 2015

Coord. A.Olioso, coll. CESBIO (coord. G. Boulet), NASA-JPL (P. Guillevic)

Objectifs:

- **Implémenter les nouveaux algorithmes dans EVASPA2.0 = EVASPA 3.0 (modèles SEBS, TSEB et SEB-4S)**
- **Intégrer les données des nouveaux capteurs ou produits: VIIRS, LANDSAT8, MASTER et MODIS v6**
- **Produire une estimation d'ensemble de l'ETR élaborée à l'aide de la combinaison des algorithmes**
- **Elaborer une méthode de réduction de l'ensemble basée sur une présélection des algorithmes à l'aide de données observées (calibration) ou par analogie (paysages)**
- **Amélioration des procédures d'interpolation / extrapolation temporelle pour passer de l'échelle « instantanée » à l'échelle journalière et pour combler l'absence de données.**

+ proposition d'un premier algorithme dans le CES Evapotranspiration du pole THEIA

THANK YOU FOR YOUR ATTENTION

Supports

⇒ CNES (TOSCA calls) in the frame of the thermal infrared satellite mission project **MISTIGRI**

⇒ Application to water balance of irrigated Mediterranean catchments in the frame of the SIRRIMED FP7 project and SICMED

⇒ Fundacion Ramon Areces (Spanish program for post-doc fellowships)

MISTRALS

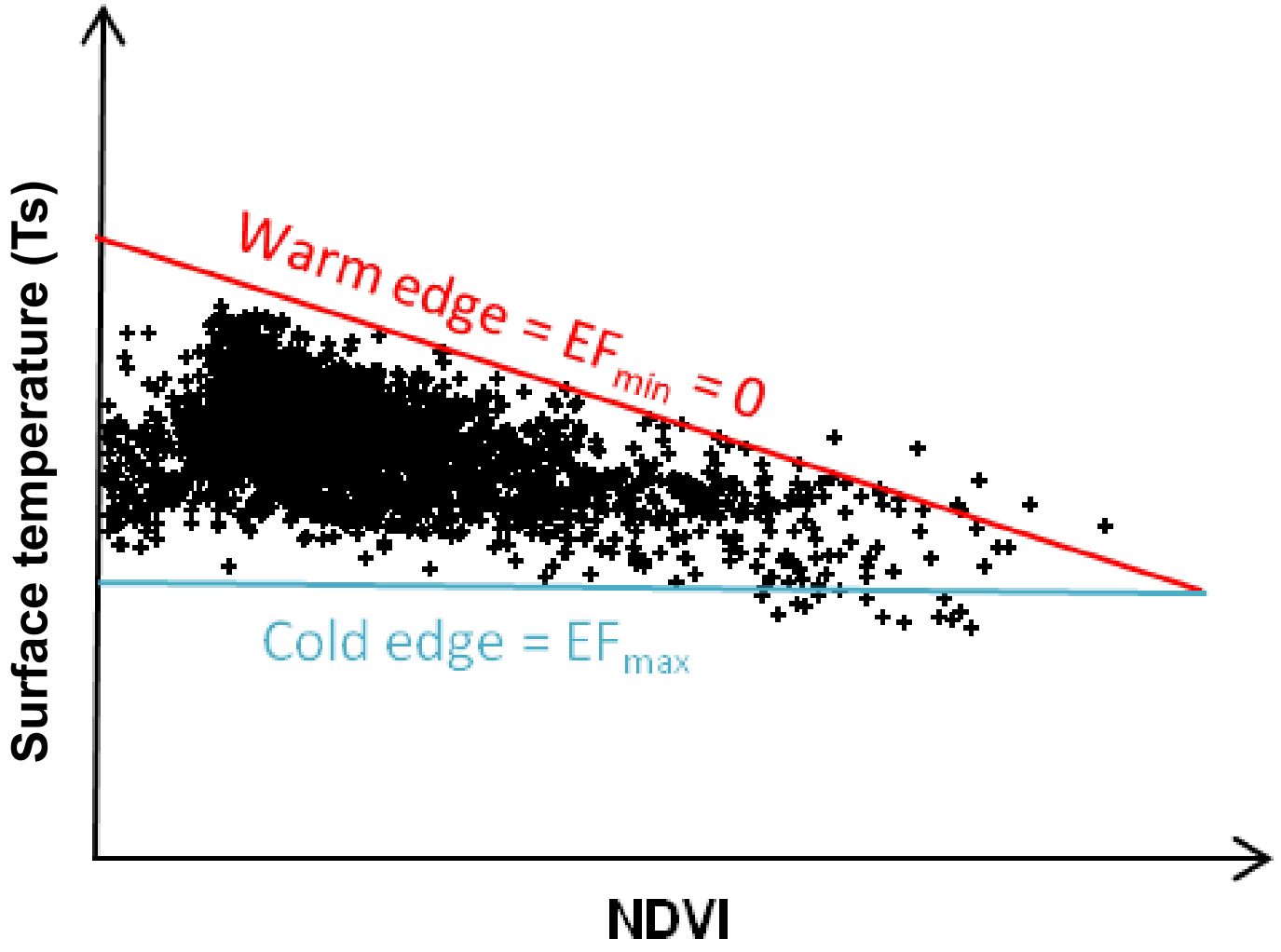
Mediterranean I

at Regional A

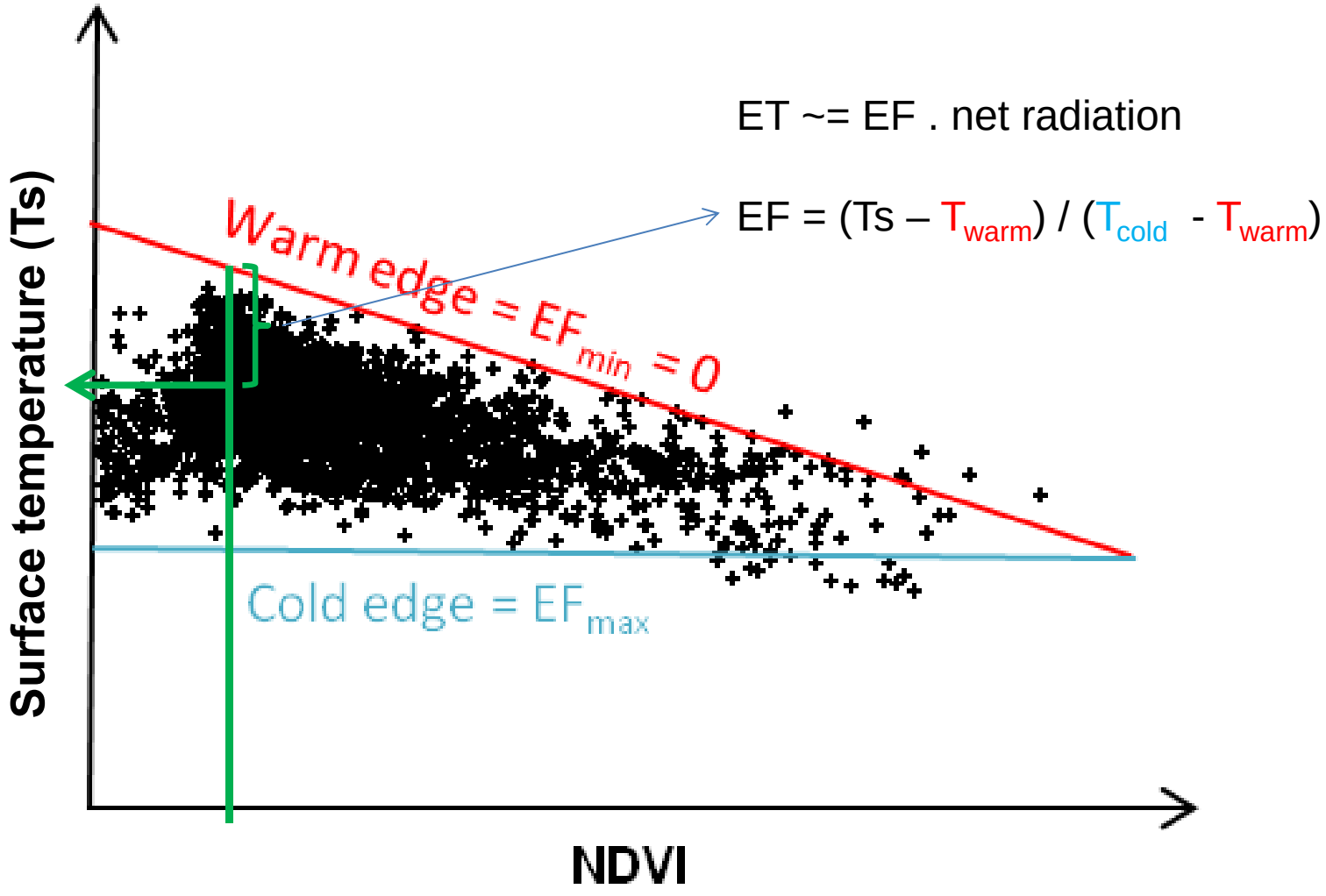
SIRRIMED

SUSTAINABLE USE OF IRRIGATION WATER IN THE MEDITERRANEAN REGION

Triangle method:
Evaporative Fraction (EF)

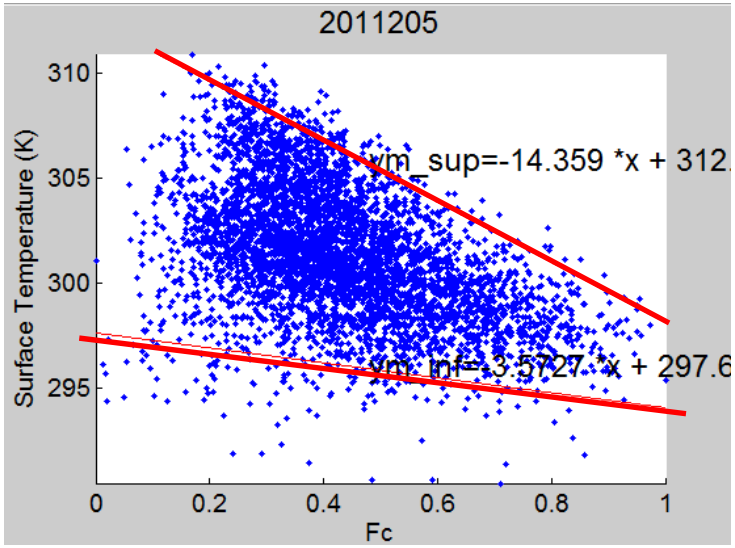


Triangle method:
Evaporative Fraction (EF)

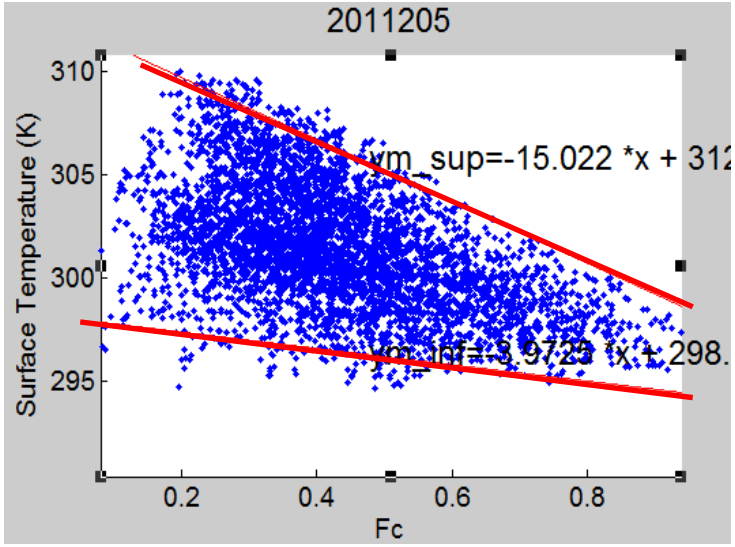


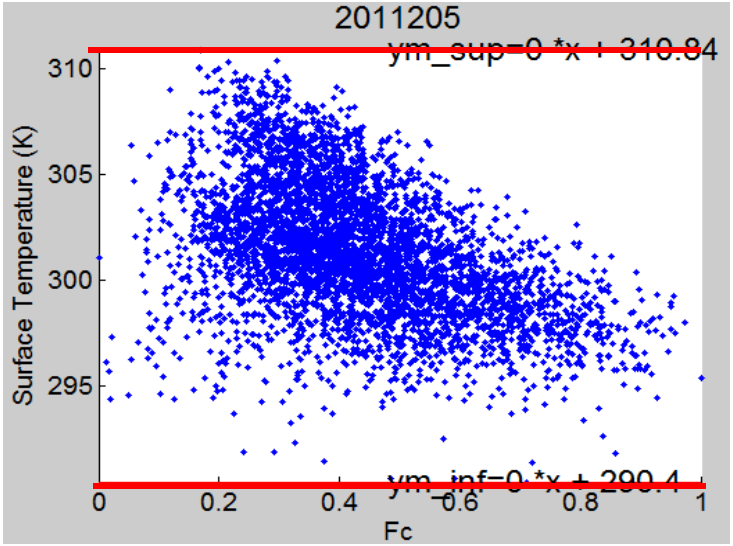
Triangle method:
Evaporative Fraction (EF)

EF1

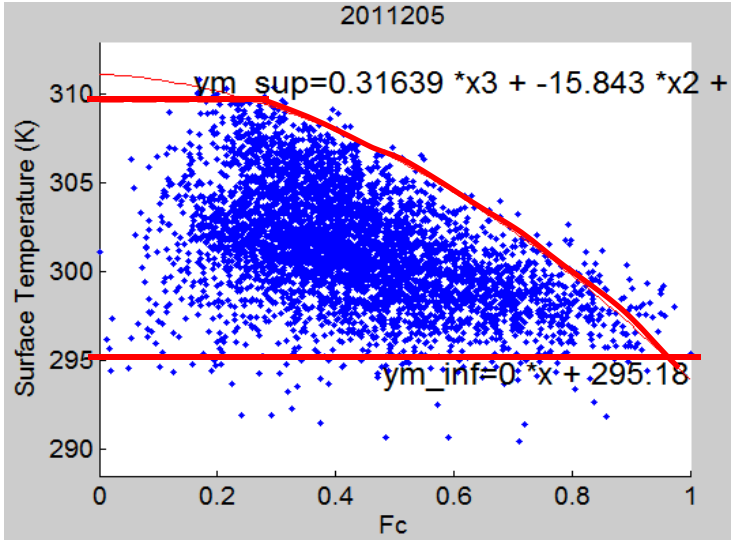


EF2





EF3



EF4