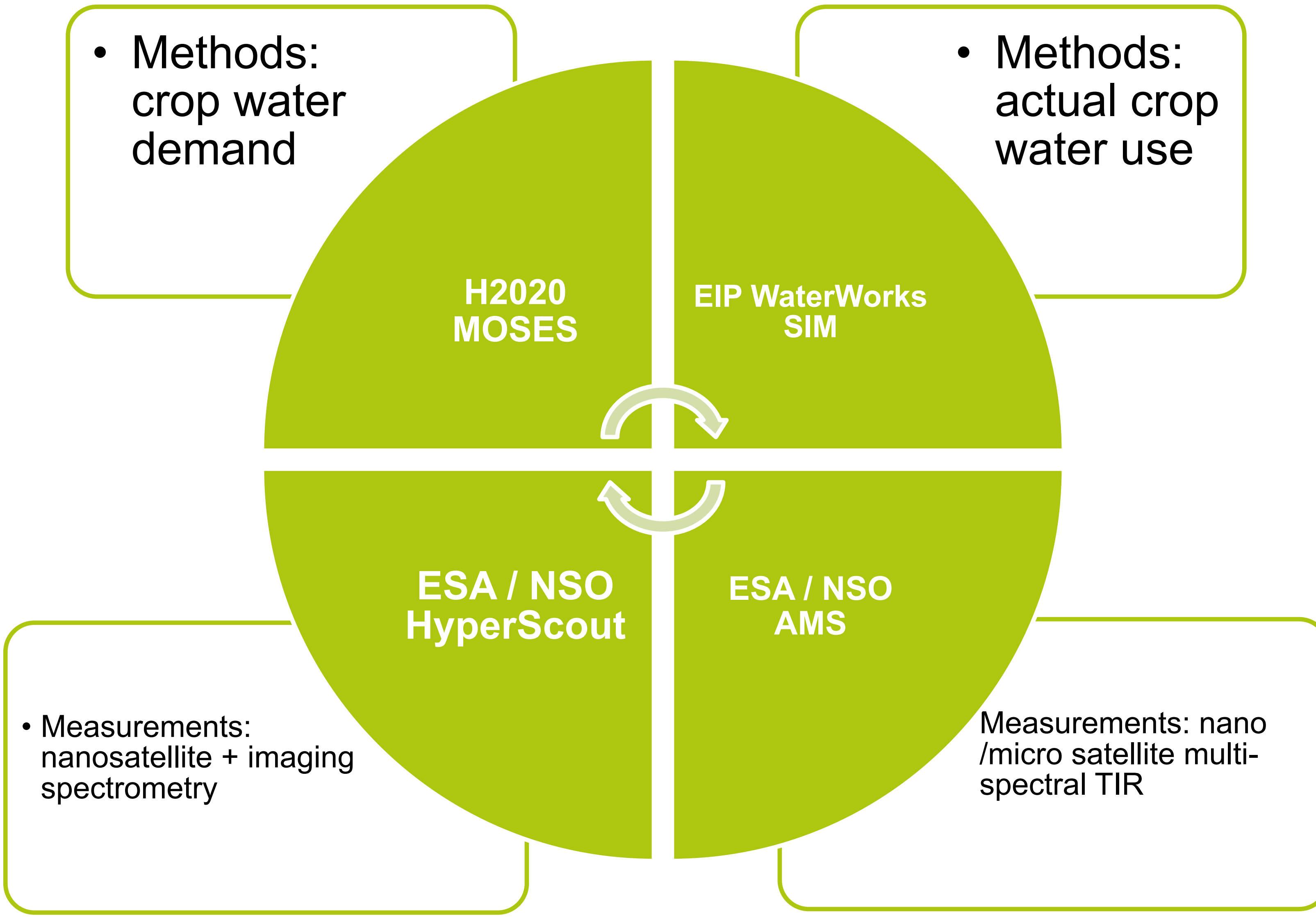
Irrigation water management: remote sensing vs. models.

Massimo Menenti

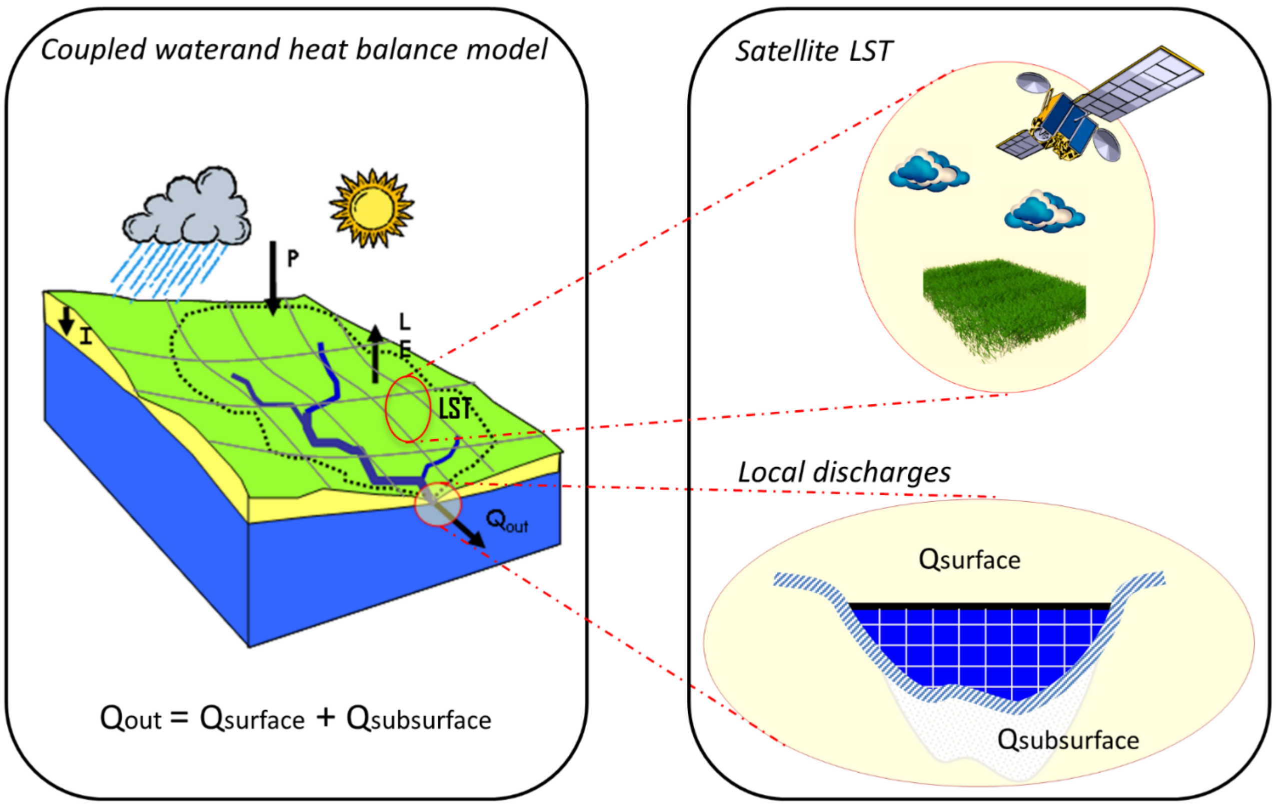
25-06-19

Silvia Alfieri, Ben Gorte, Nadia Akdim, Fatima El Ghandour, Monica Herrero, Susana Laguela, Li Jia, Marco Mancini

Implementation at TUD

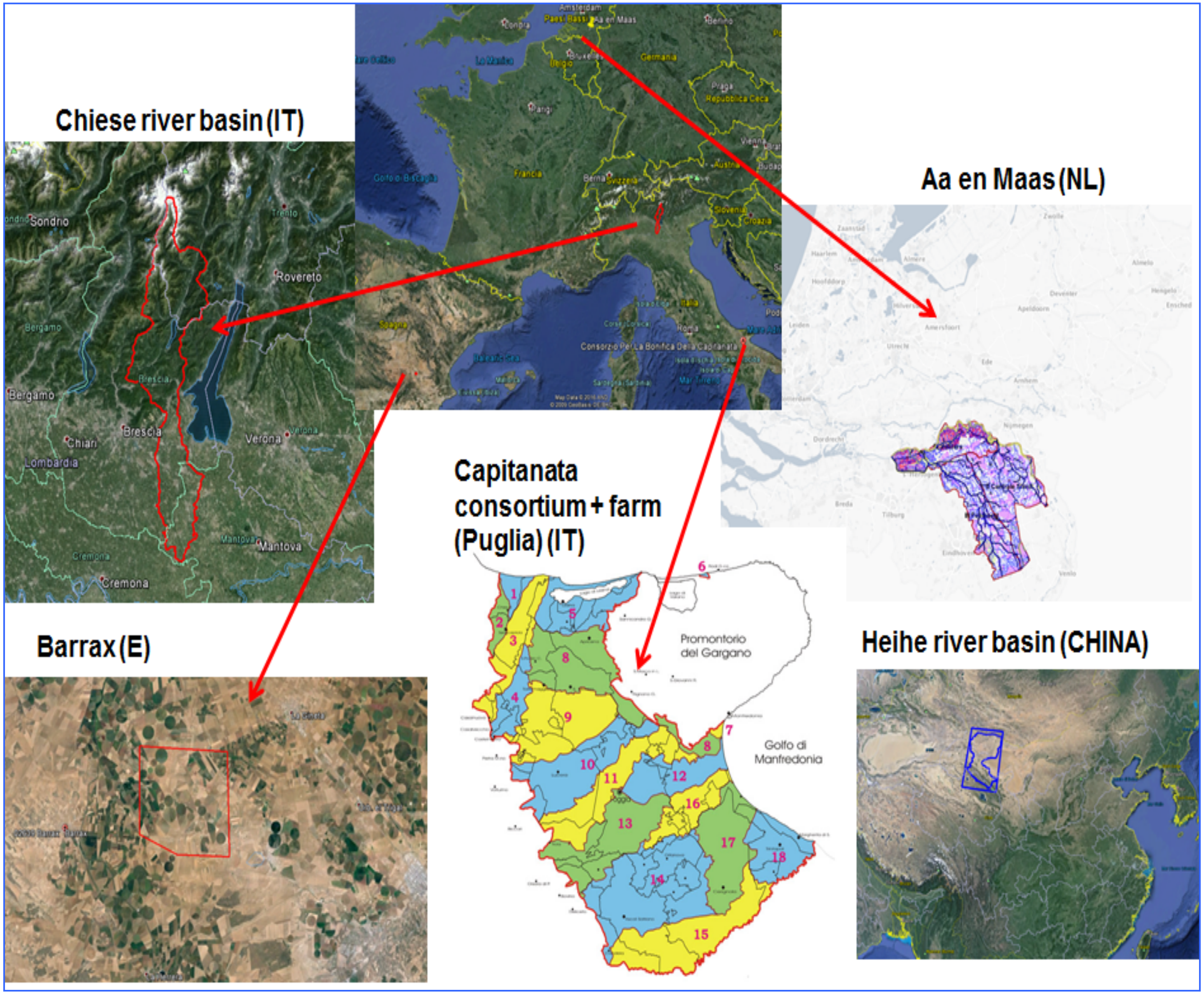


Application



Conceptual approach to the calibration of a coupled water and heat balance model using observations of LST

Case studies



Assess benefit of HR LST

Case studies TU Delft

Site	focus	year	
Capitanata	Irrigation on demand	Spring – summer 2016	
Aa & Maas	Drought and irrigation	Spring - summer 2018	
HeiHe	Irrigation system specific indicators	Spring – summer 2016	

Collaboration

Site	Partner	Team
Aa & Maas (NL)	Water Board Aa & Maas	Hydrology: F.v.d. Bolt and J. Moorman
HeiHe (China)	CAS RADI	Li Jia and EOWater Team

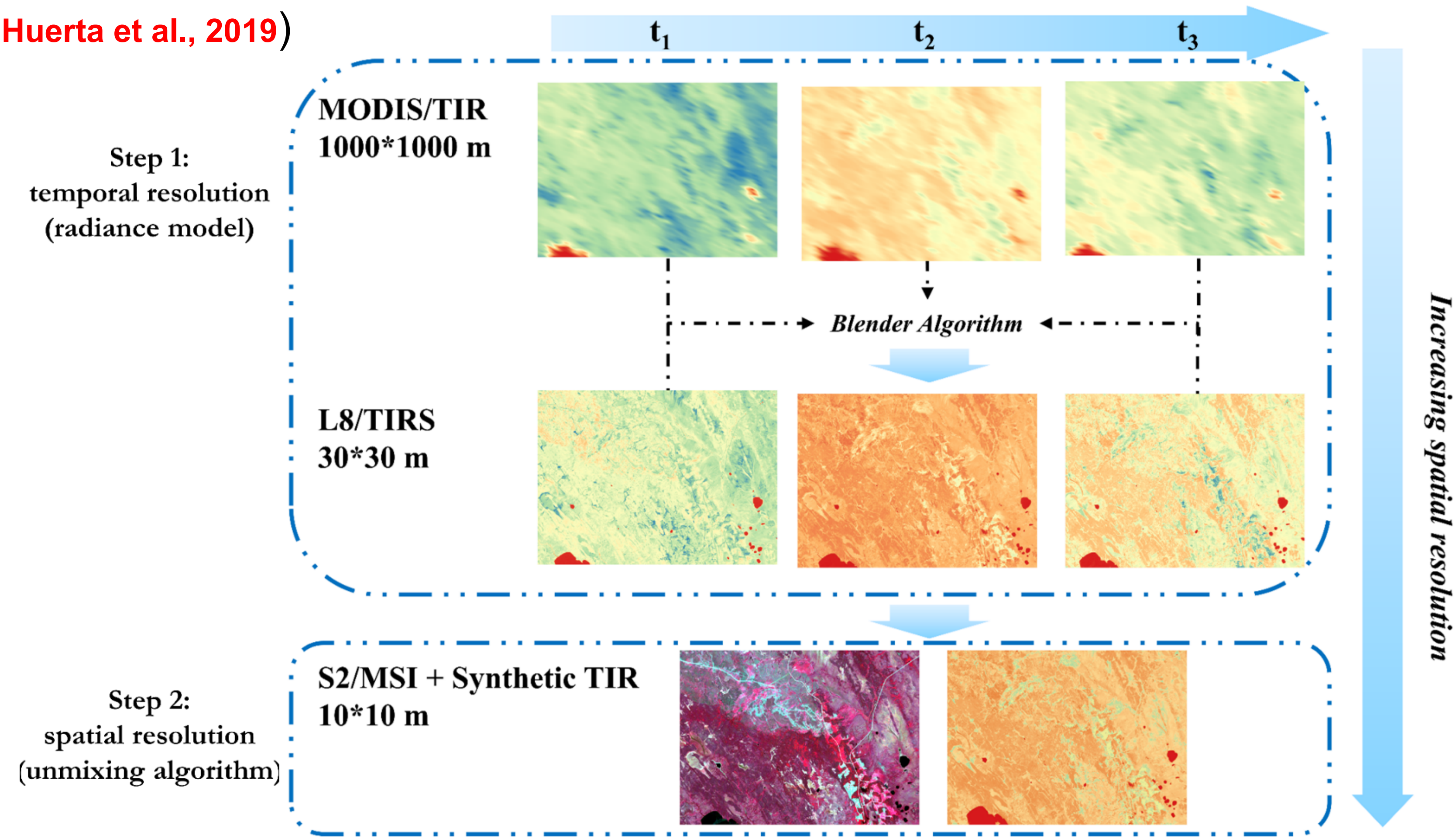
TU Delft Delft University of Technology

GENERATING HIGH-TEMPORAL AND SPATIAL RESOLUTION TIR IMAGE DATA

M. Herrero-Huerta
S. Lagüela
S. M. Alfieri
M. Menenti

Methodology

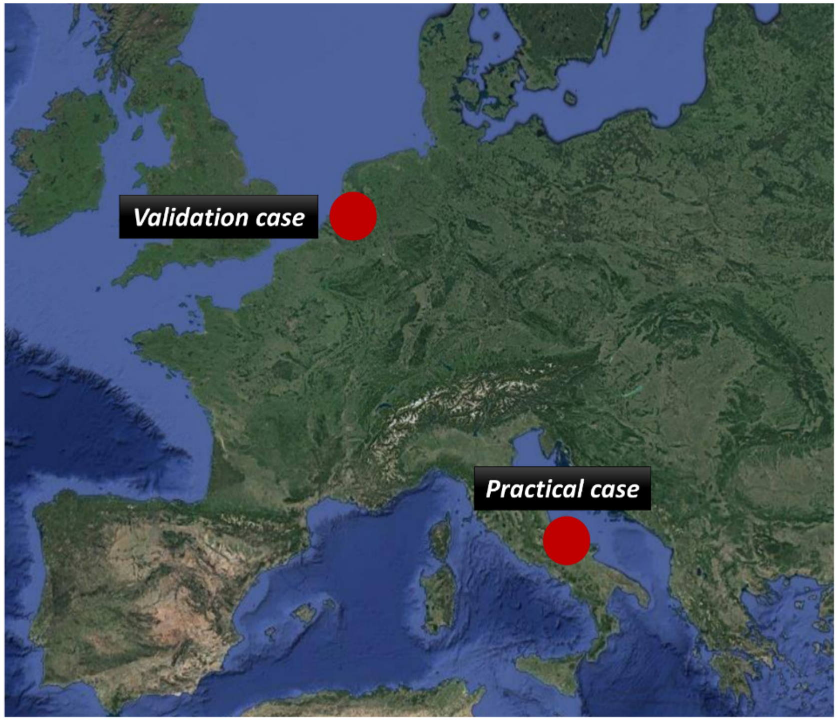
(Herrero – Huerta et al., 2019)



Conceptual workflow of the proposed temporal and spatial data fusion algorithm

Overview | Methodology | Results and discussion | Conclusions

Results



Data sets 10 m LST bi-weekly:

- **Capitanata (IT): 6/4/2016 - 10/10/2016**
- **Aa & Maas (NL): 4/4/2018 - 30/10/2018**
- **HeiHe (PRC): 4/2016 – 10/2016**

Location of the two case studies carried out in Europe: validation in The Netherlands and demonstration in Italy

Results

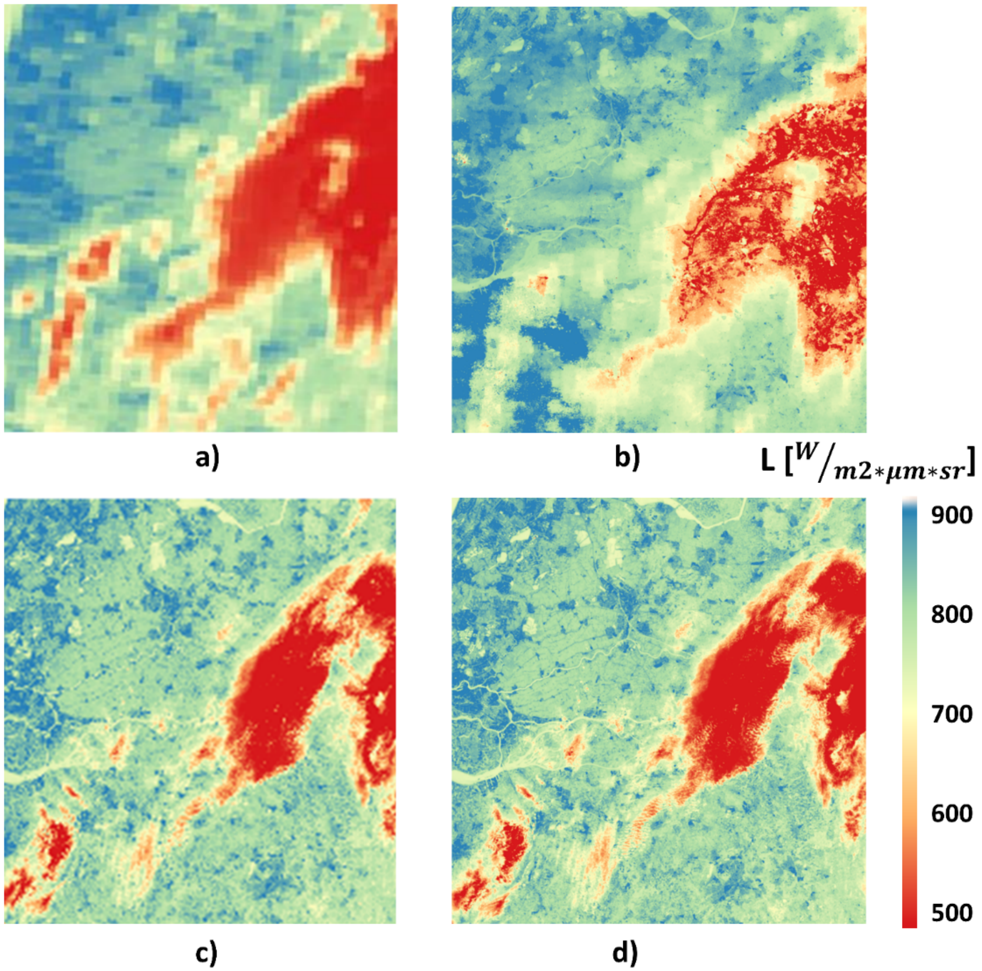
The Netherlands

a) MODIS/TIR at 1000-m resolution;

b) synthetic L8/TIRS at 30-m resolution;

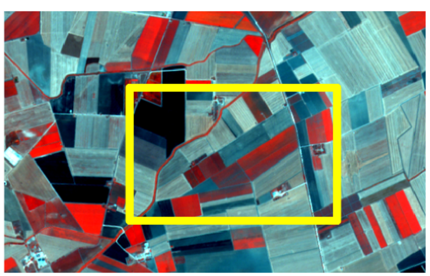
c) actual L8/TIRS at 30-m resolution and

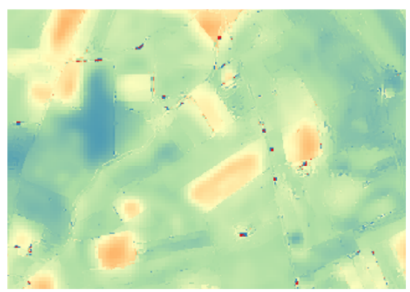
d) synthetic TIR image data at 10-m resolution;



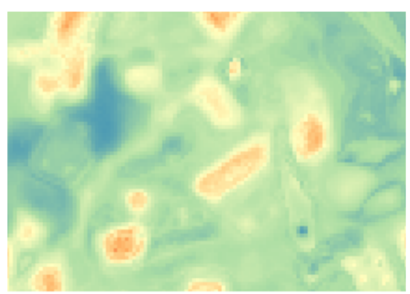
Results

High spatial resolution improvements in crop differentiation and delineation of irrigation channels (Northern Puglia, Italy)

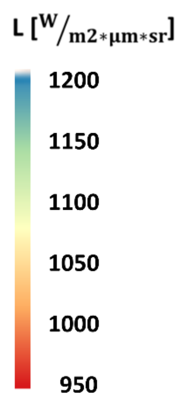


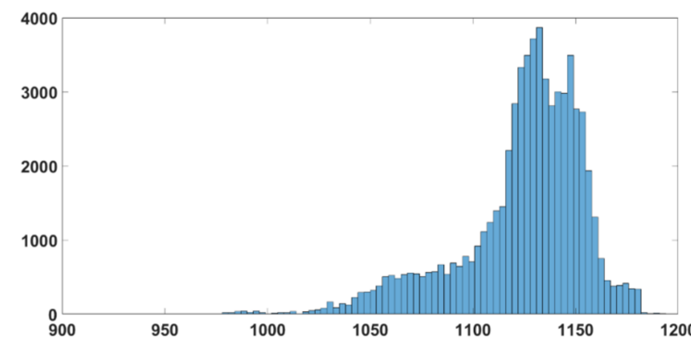


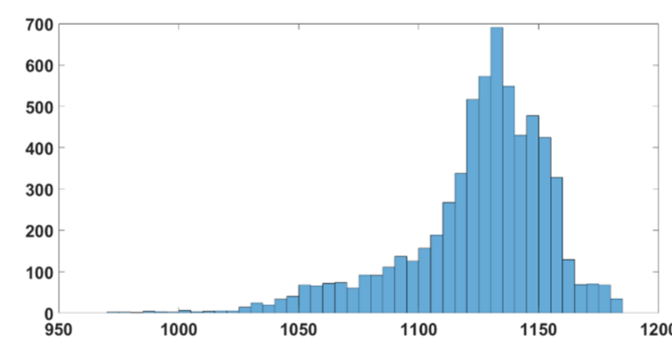
a) HR image (10-m)



b) Synthetic image (100-m)

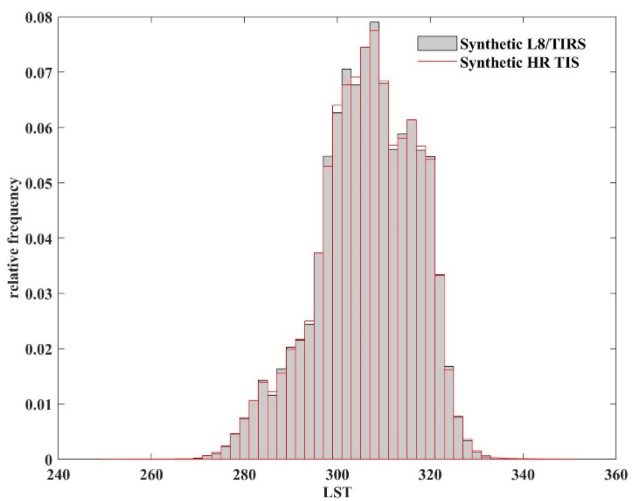


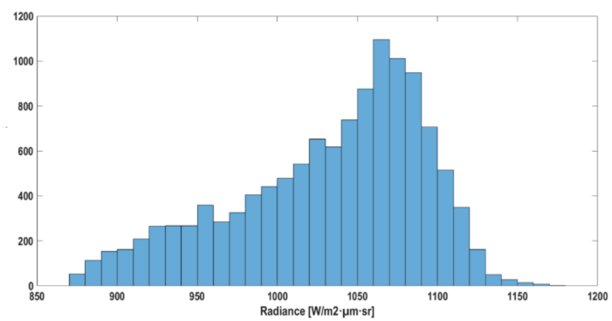




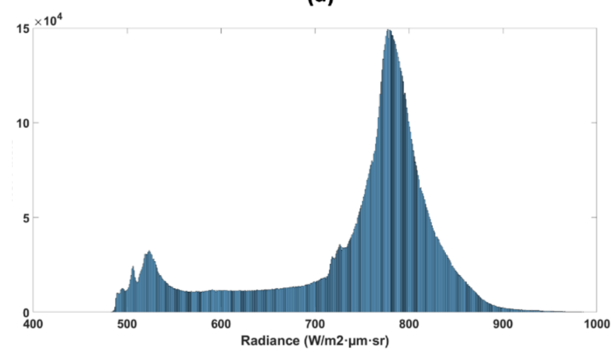
Results

Capitanata



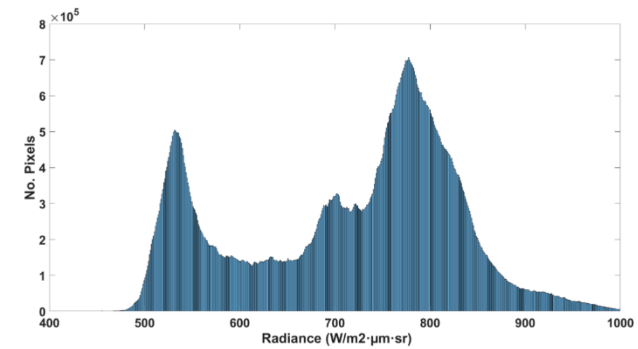


(a)



(b)

The Netherlands

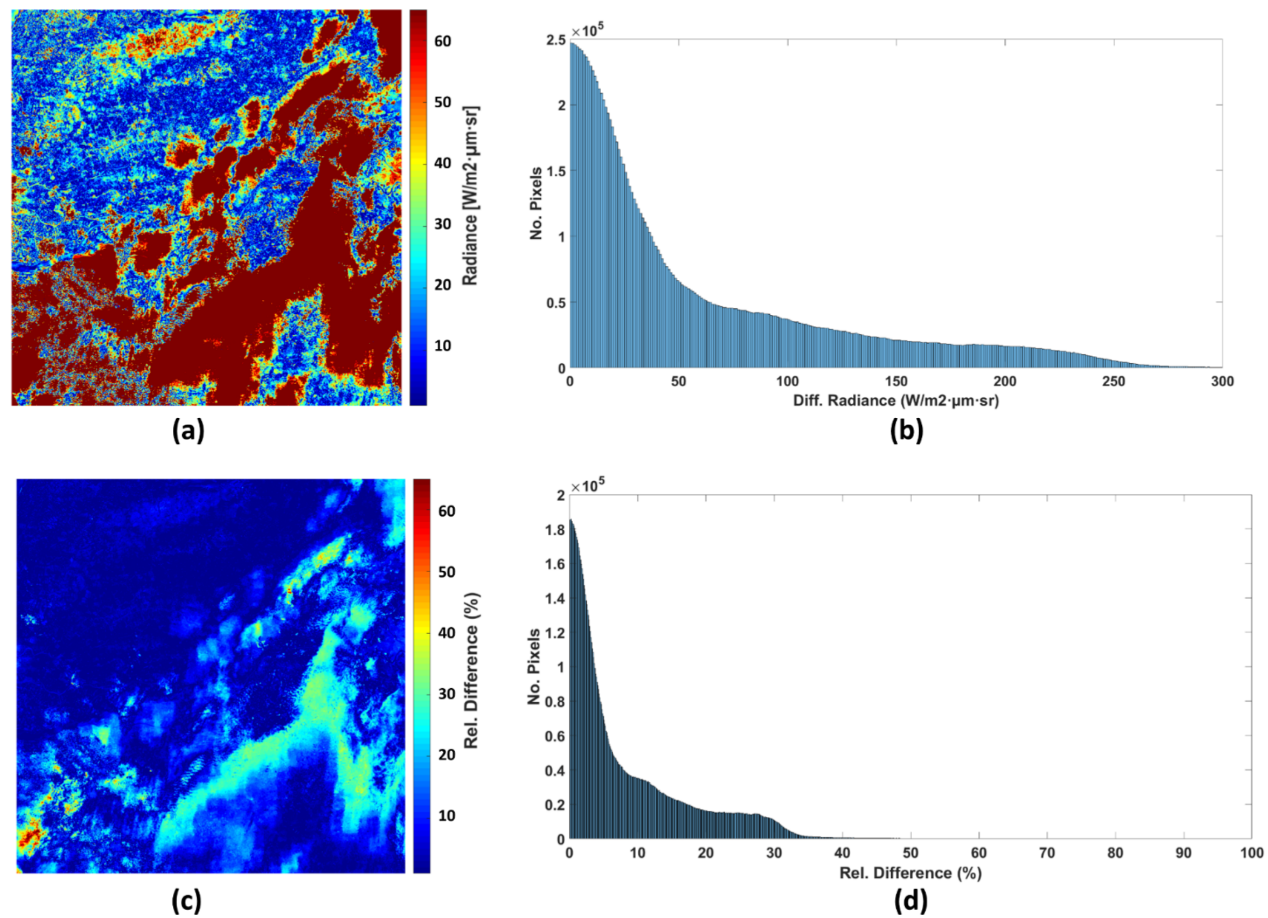


(c)

Histogram of the observed MODIS/TIR band (a), of the observed L8/TIRS band-10 (b) and of the synthetic HR TIR image (10-m) (c) on the selected date (May 1st, 2016).

Results

The Netherlands



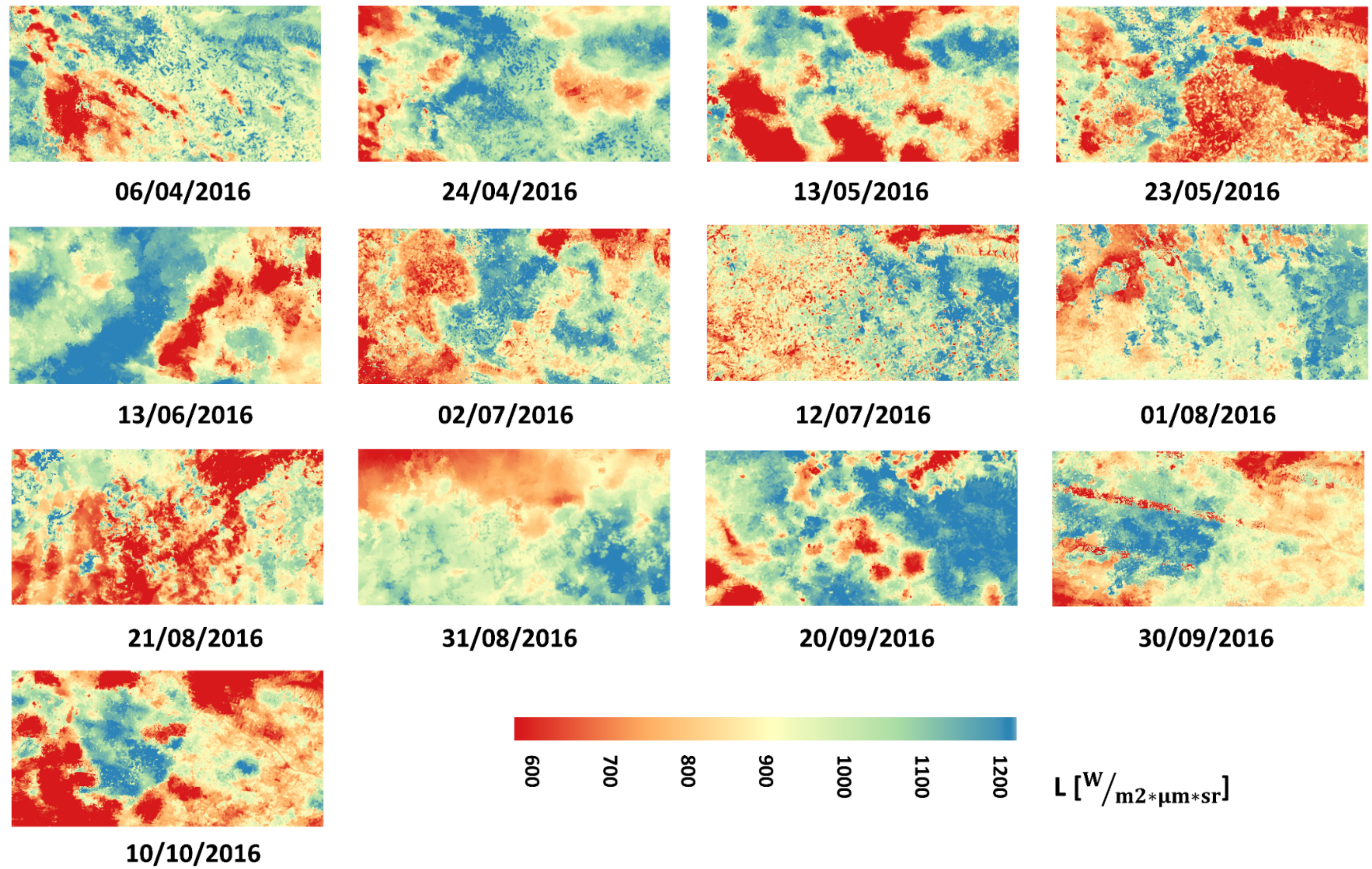
Absolute difference radiance image in radiance values of the observed L8/TIRS image and the synthetic one (30-m) (a); histogram of absolute difference image (b); relative difference image (c); histogram of relative difference image (d).

Overview | Methodology | **Results and discussion** | Conclusions

Results

Italy (Puglia) :

Time series

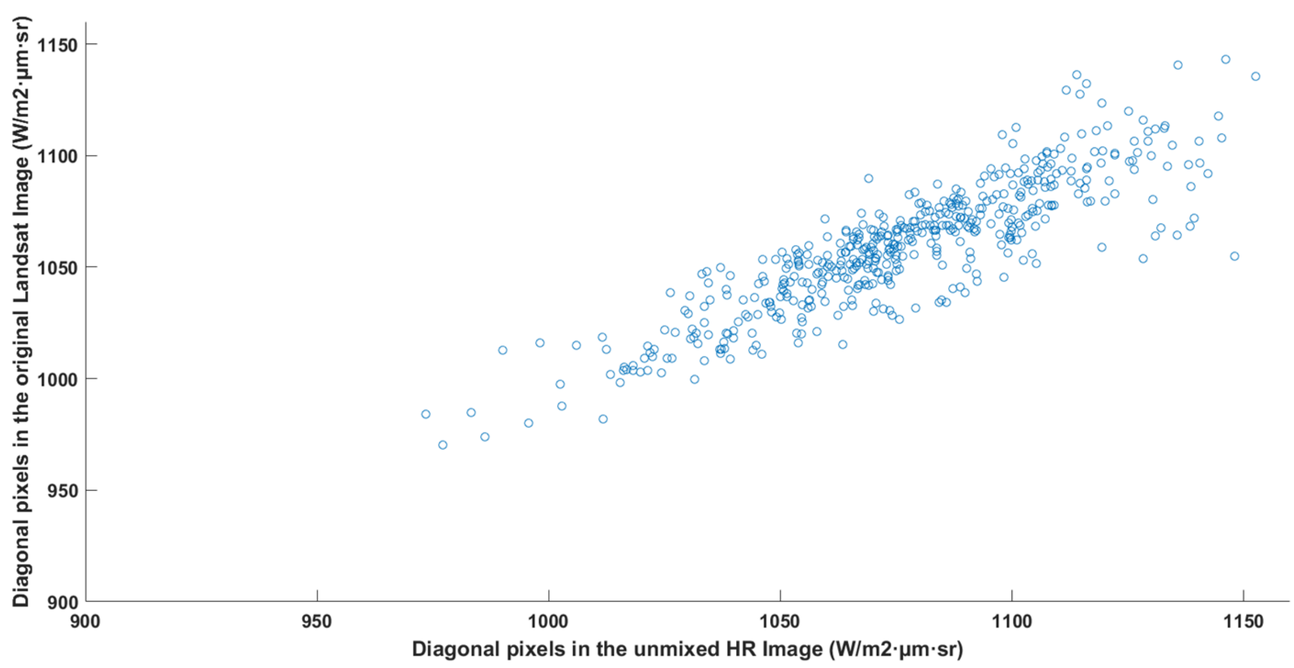


Overview | Methodology | **Results and discussion** | Conclusions

Results

Italy (Puglia) :

Scatter plot of the diagonal pixels (Lower Left to Upper Right) in the original L8/TIRS image against the diagonal pixels in the synthetic HR TIR image.



SIM Project Final Meeting

Evapotranspiration from ETMonitor: Cases in Heihe Basin of China and Chiese Basin of Italy

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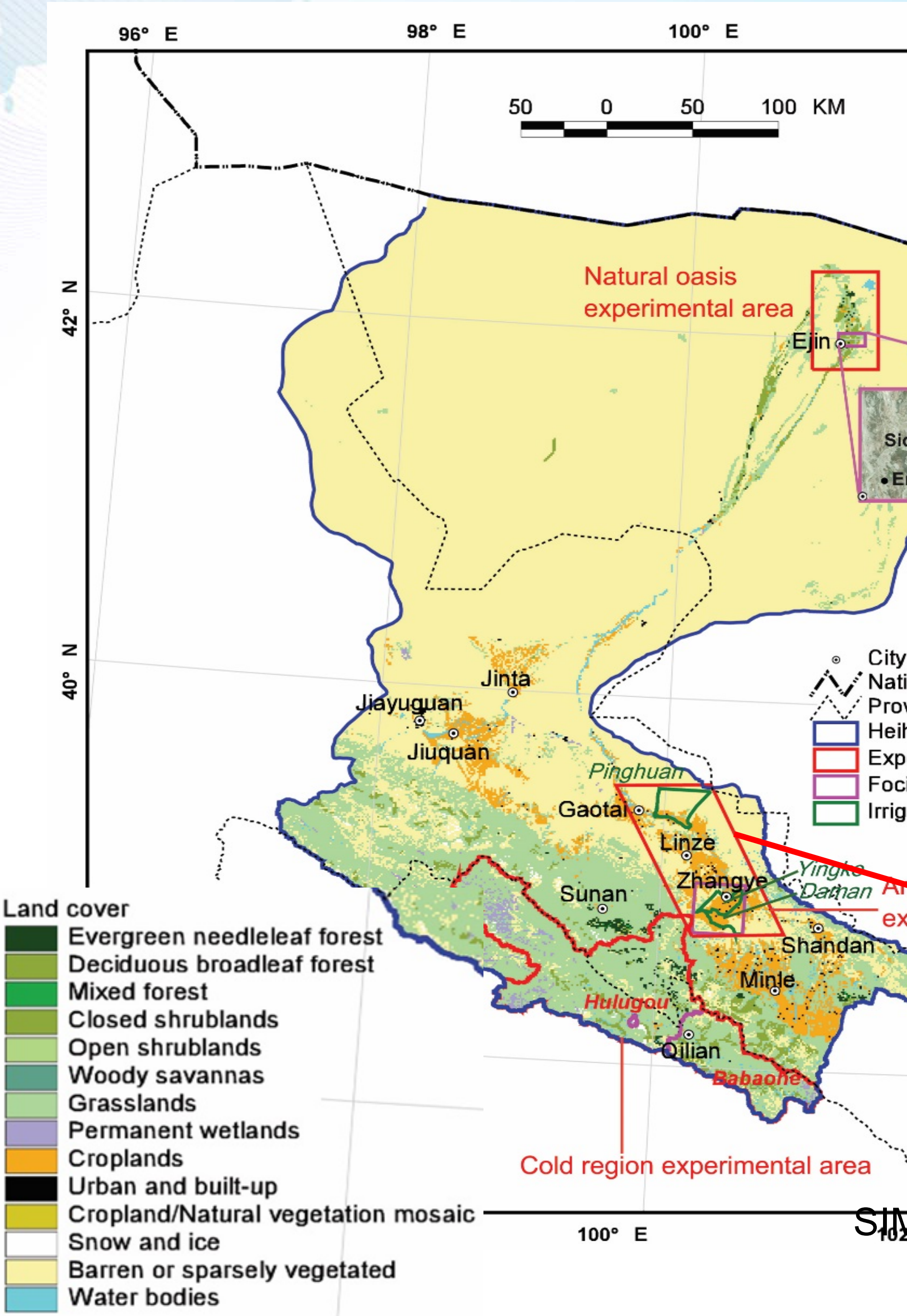
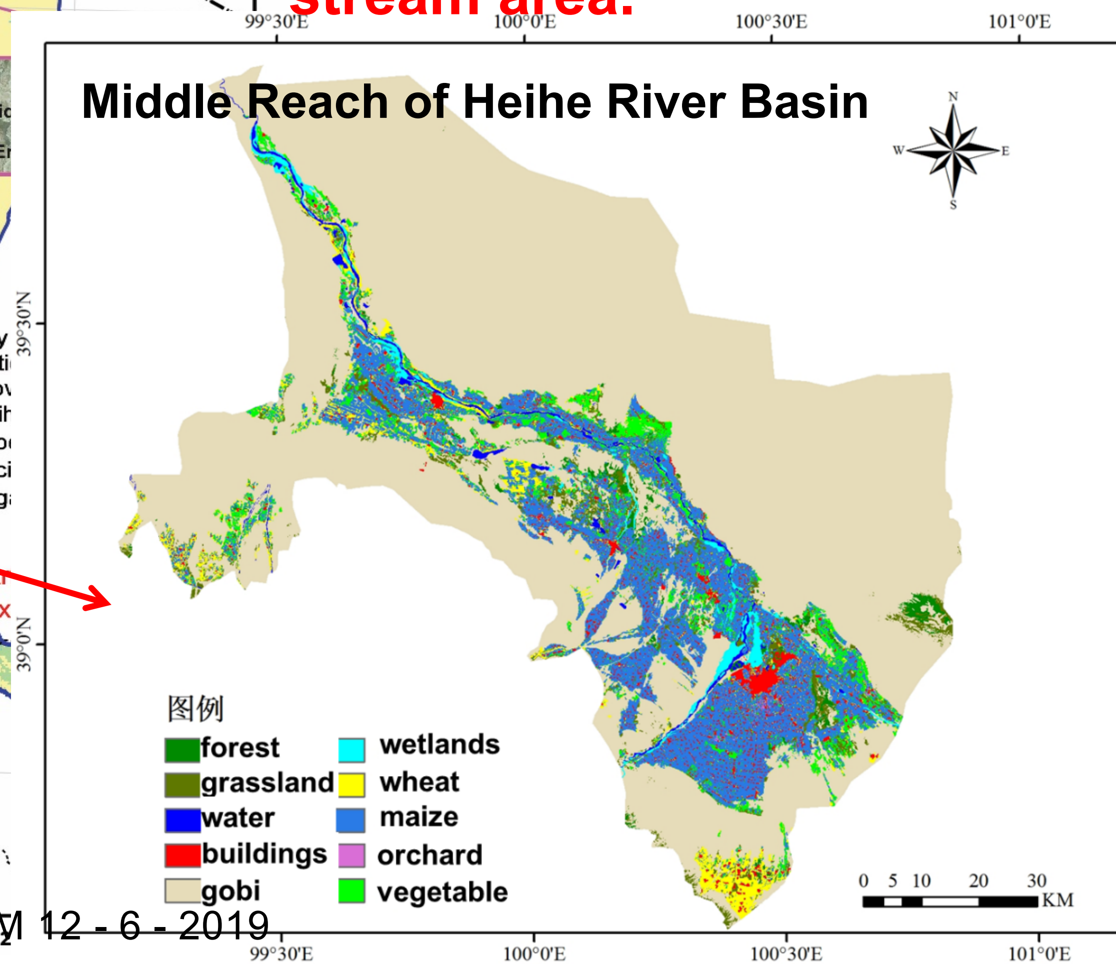
Guangcheng Hu, Chaolei Zheng, Jie Zhou, Qiting Chen

Institute of Remote Sensing and Digital Earth (RADI), Chinese Academy of Sciences

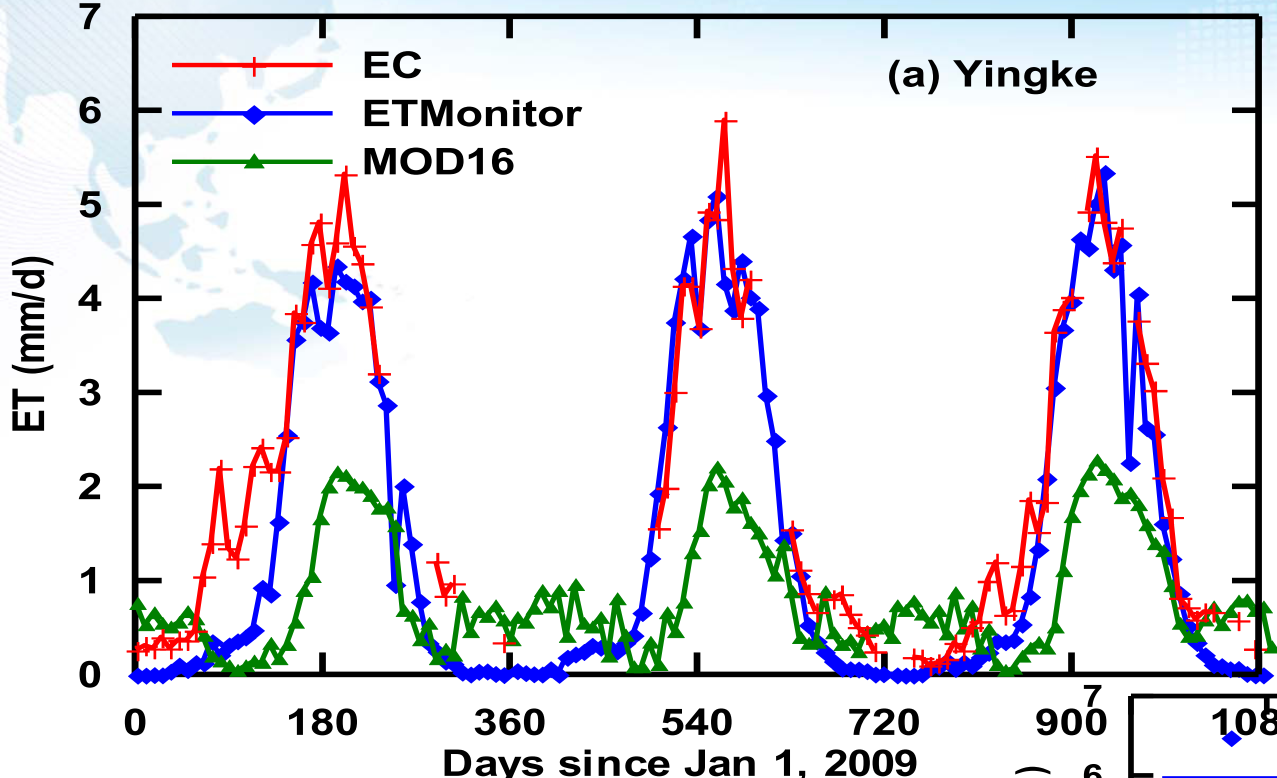
Heihe River Basin

Conflicts in water demand between middle reach agricultural land and the need for nature reserve in the down stream area.



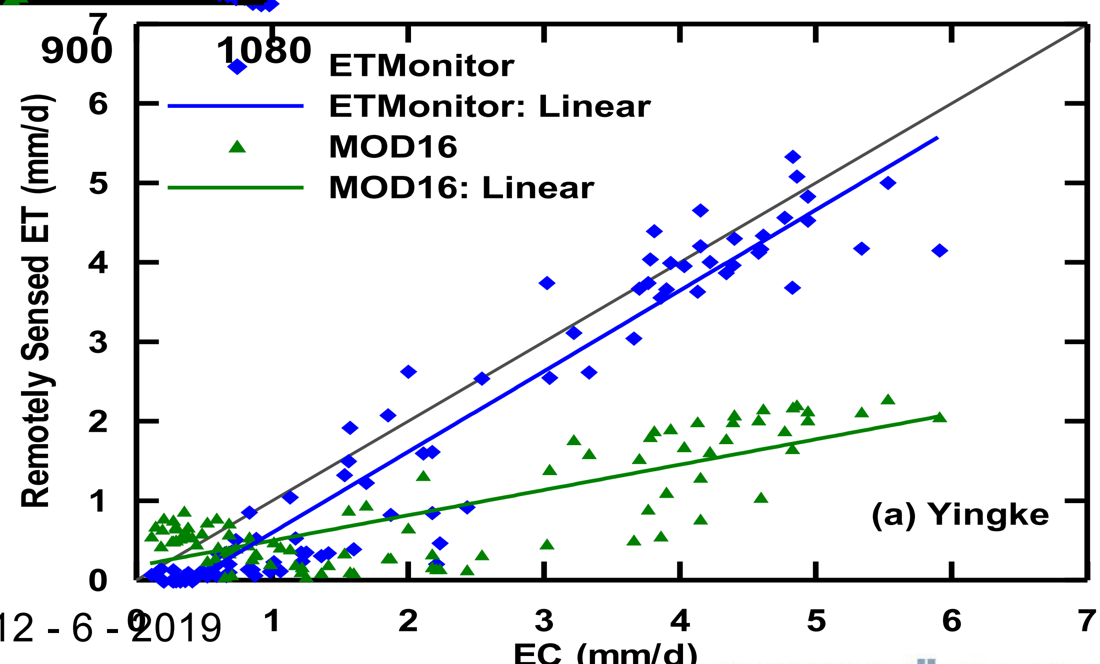


ET in Heihe



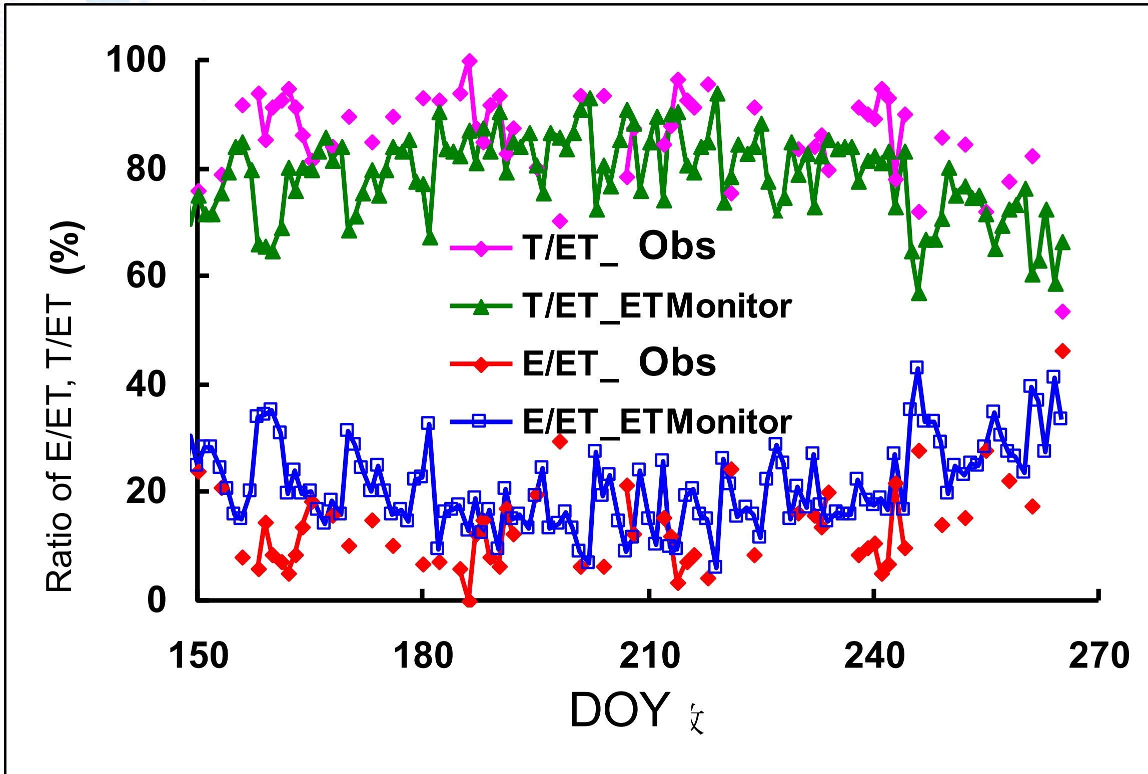
Comparison with EC measurements

Middle Reach of Heihe,
Maize
2009–2011

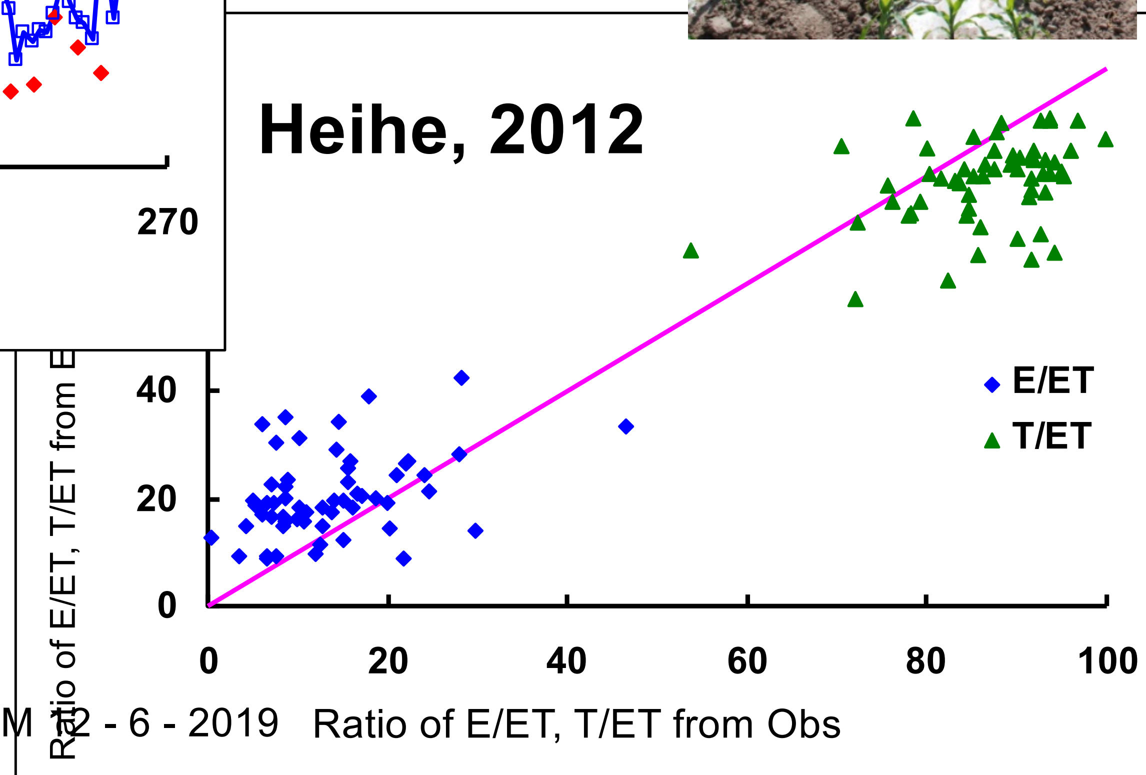


ET in Heihe

Separation between E and T



Stable Isotope Observation of E and T



Middle Reach of Heihe,
Maize
Growing Season in 2012

Irrigation Water Use Efficiency

Irrigation Water Use Efficiency in Middle Reach of Heihe, 2012

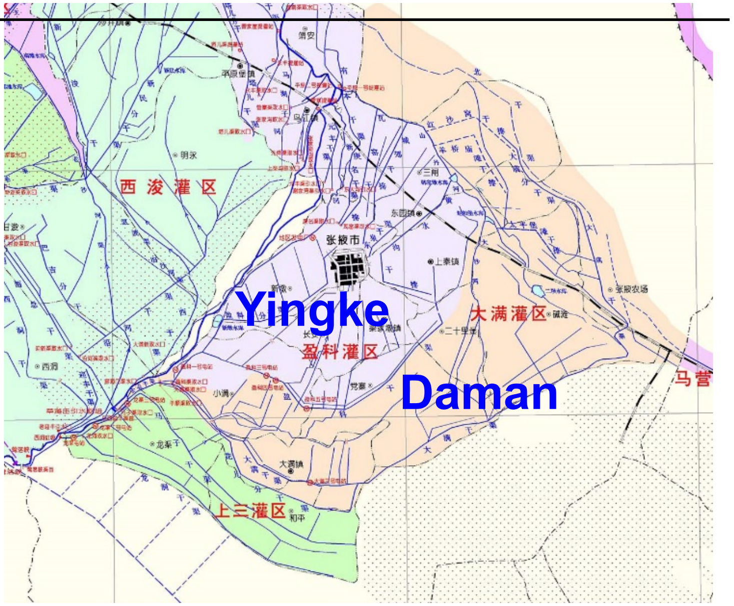
- **The estimation of ET on the oases can be used to evaluate water use efficiency so as to reasonably allocate water resources**

Water Use Efficiency: $$\frac{ET}{Irrigation + P}$$

Irrigation Water Use Efficiency: $$\frac{ET - P}{Irrigation}$$

Irrigation District	Farm (km^2)	Ground-water (10^8 m^3)	Surface Water (10^8 m^3)	Irrigation Water (10^8 m^3)	P (10^8 m^3)	ET (10^8m^3)	Water Use Efficiency	Irrigation Water Use Efficiency
Yingke	**182**	**0.66**	**0.81**	**1.47**	**0.22**	**1.06**	**0.63**	**0.57**
Daman	**377**	**1.04**	**1.23**	**2.27**	**0.55**	**2.16**	**0.77**	**0.71**

- The current irrigation water system is irrational, especially for the irrigation district of Yingke
- An improved irrigation water allocation system according to actual ET requirement is needed to increase irrigation efficiency per cubic meter water resource



SIM 12 - 6 - 2019

Losses by evaporation of irrigation water during sprinkling and interception

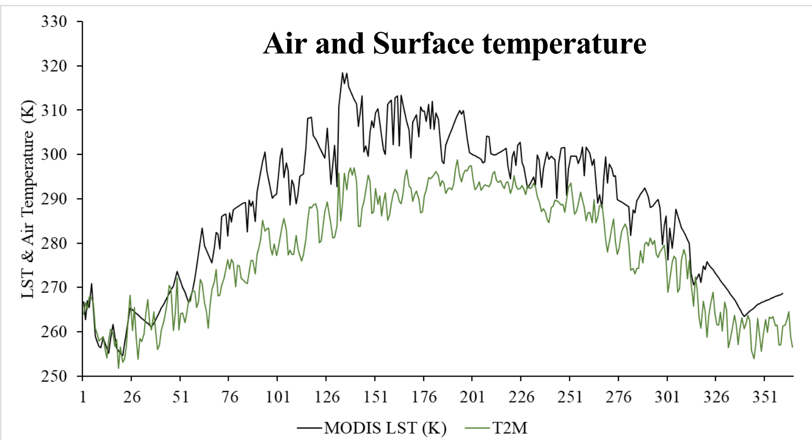
June-2019

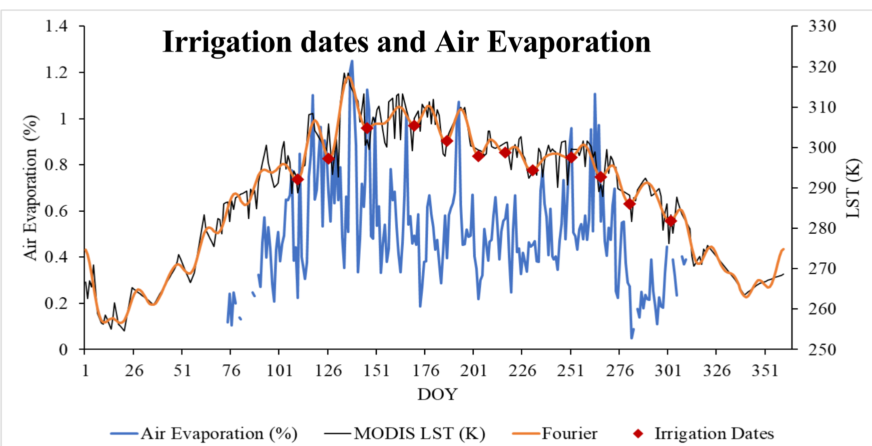
Student: Peejush Pani
Supervisor: Prof. Massimo Menenti
Co-supervisor: Prof. Li Jia

Irrigation type and Components (C_{22})

I_1 Furrow/ Surface	C_{11} Canal/Furrow Infiltration	C_{12} Water Surface Evaporation	C_{13} Soil Evaporation	C_{14} Plant Transpiration
I_2 Sprinkler	C_{21} Interception	C_{22} Evaporation Past Sprinkler	C_{23} Soil Evaporation	C_{24} Plant Transpiration
I_3 Drip	C_{31} Soil Evaporation	C_{31} Plant Transpiration		

Irrigations During Growing Season





Difference between Air Temperature and Surface temperature is minimum during the irrigation dates

red dots: dates of irrigation

Blue: fraction of sprinkler discharge evaporated past the sprinkler under local weather conditions

SIM 12 - 6 - 2019

Interception loss from Sprinkler per Irrigation

$$I = FVC.D_s \; for \; (D_s < D_s')$$
$$I = FVC.D_s' + (FVC.E_v)(D_s - D_s') \; for \; (D_s > D_s')$$

Where,

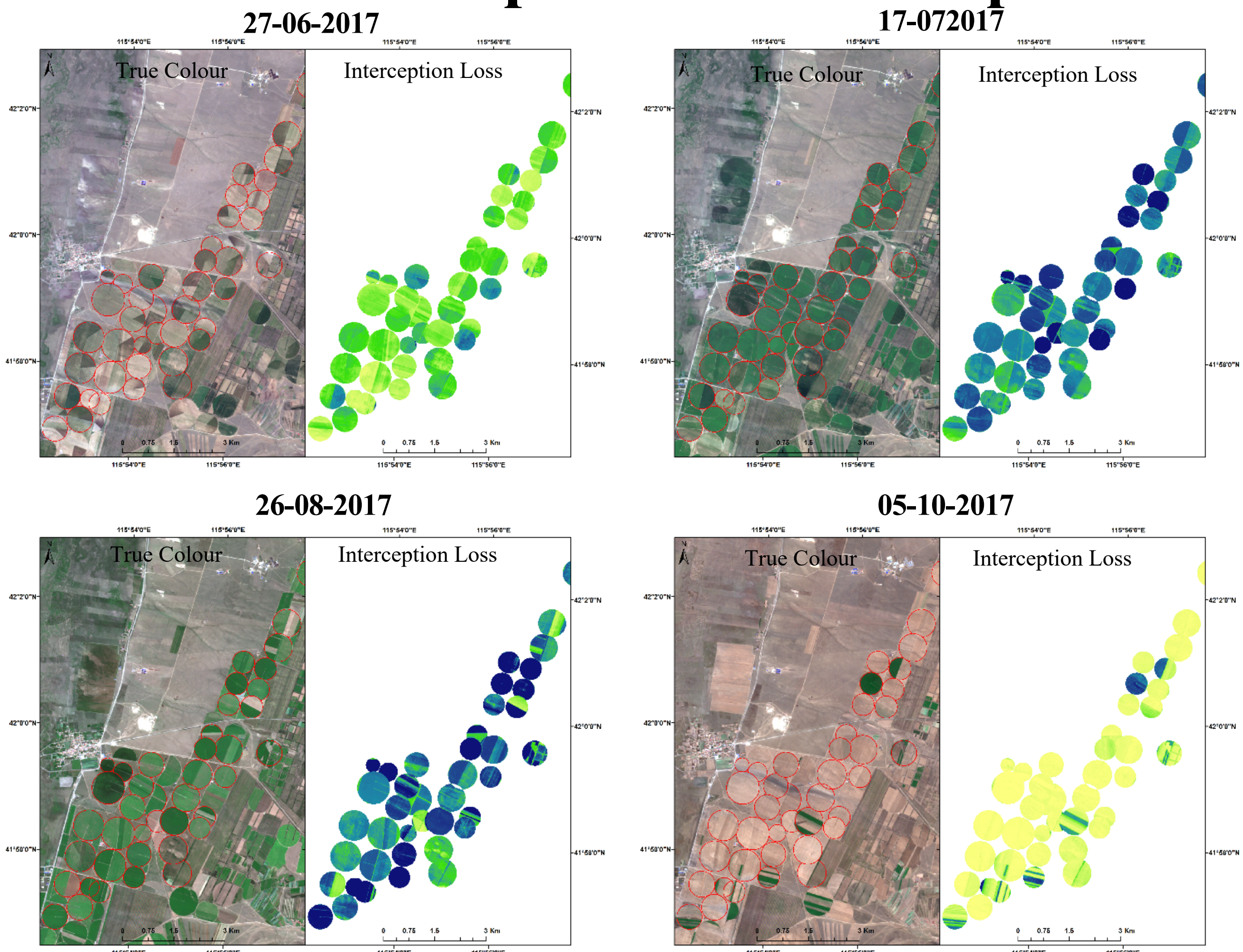
E_v (mm/h) is the evaporation rate per unit vegetation coverage area from saturated crop surfaces, including evaporation rate from canopy and stem;

FVC is the Fractional Vegetation Cover;

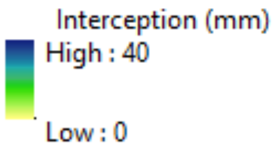
D_s (mm) is the gross water discharge from sprinkler per unit area;

D_s' (mm) is the threshold value of discharge required to saturate the vegetation

Interception loss from Sprinkler per Irrigation



Depending upon the size of each field, volume of discharge per irrigation and the fractional vegetation cover the interception loss per unit area has been estimated



Conclusions & Outlook

TIR data

- High spatial & temporal resolution
- Further studies: filling cloud values

Water requirements and irrigation performance indicators

- Separation E and T → drip irrigation
- Extreme event summer 2018 → control phreatic water table
- Evaporation and interception losses → sprinkler irrigation

Energy and water balance modeling

- Three case – studies under different irrigation systems

Thanks!!

Any questions??