Validating satellite-derived *land surface temperature* over mountainous area with in situ measurements

Imlil Valley (High Atlas) - Morocco

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Merlin O., Gascoin S., Gastellu J.P., Mattar, C. Olivera L., Khabba S., Jarlan L.

http://rec.isardsat.com

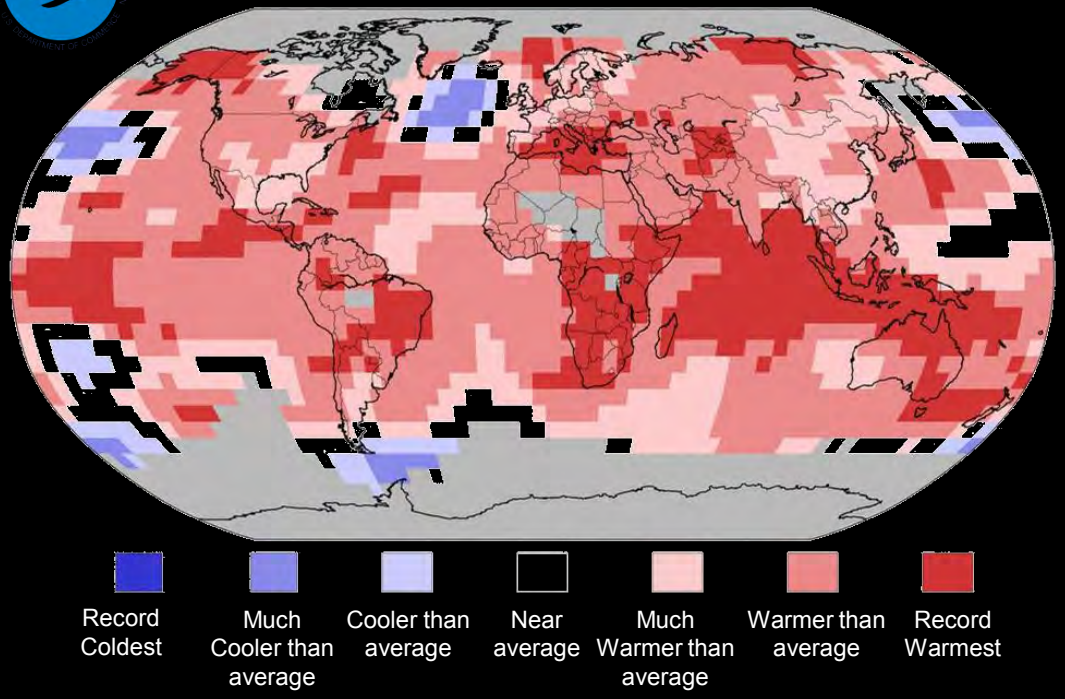
Temperature of Earth's lands during the daytime

April 2016 marks 12th consecutive month of record warmth for globe (NOAA)

Land & Ocean temperature Percentiles Jan-April 2016

NOAA's National centers for Environmental Information

Data Source: GHCN-M version 3.3.0 & ERSST version 4.0.0



Over land and ocean: **+1.11°C**

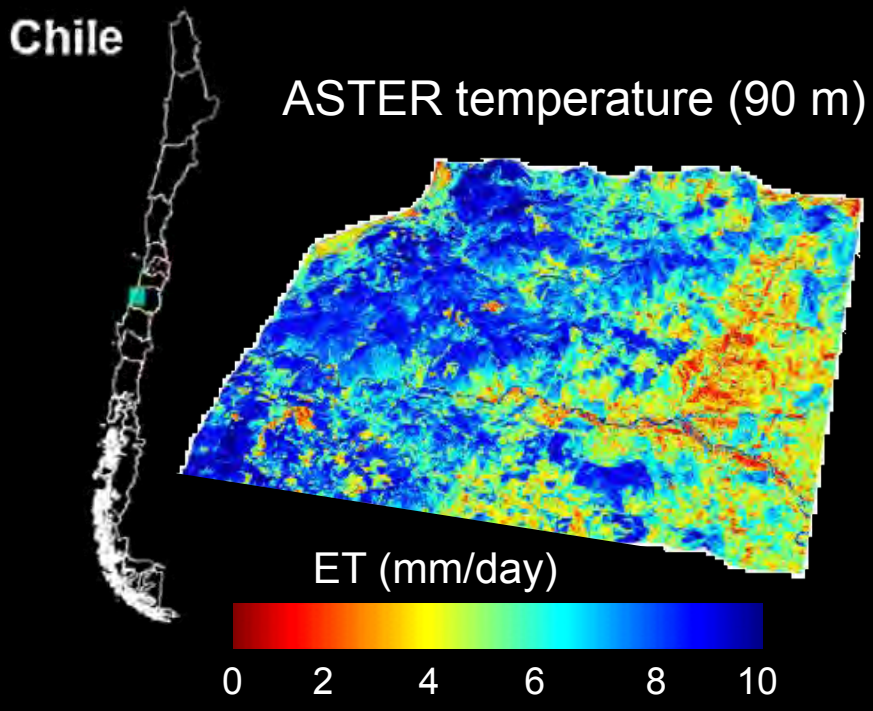
Over land: **+2.33°C**

above the 20th century average

Climatic scale

Land surface temperature for agriculture….

Evapotranspiration estimation / Soil moisture downscaling amongst of others…



Olivera-Guerra L. et al. (2014)

Regional and parcel scale

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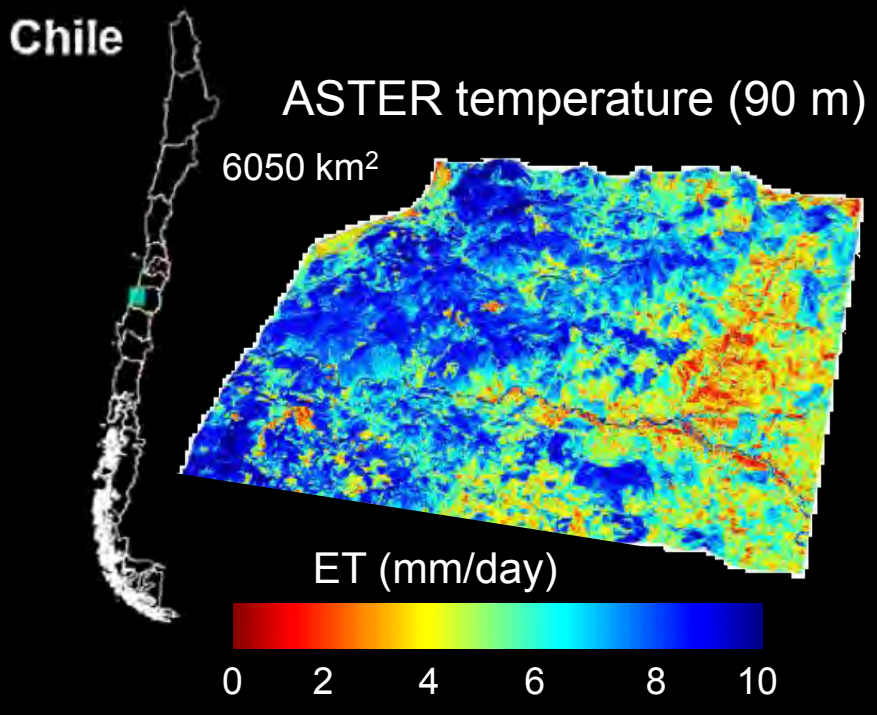

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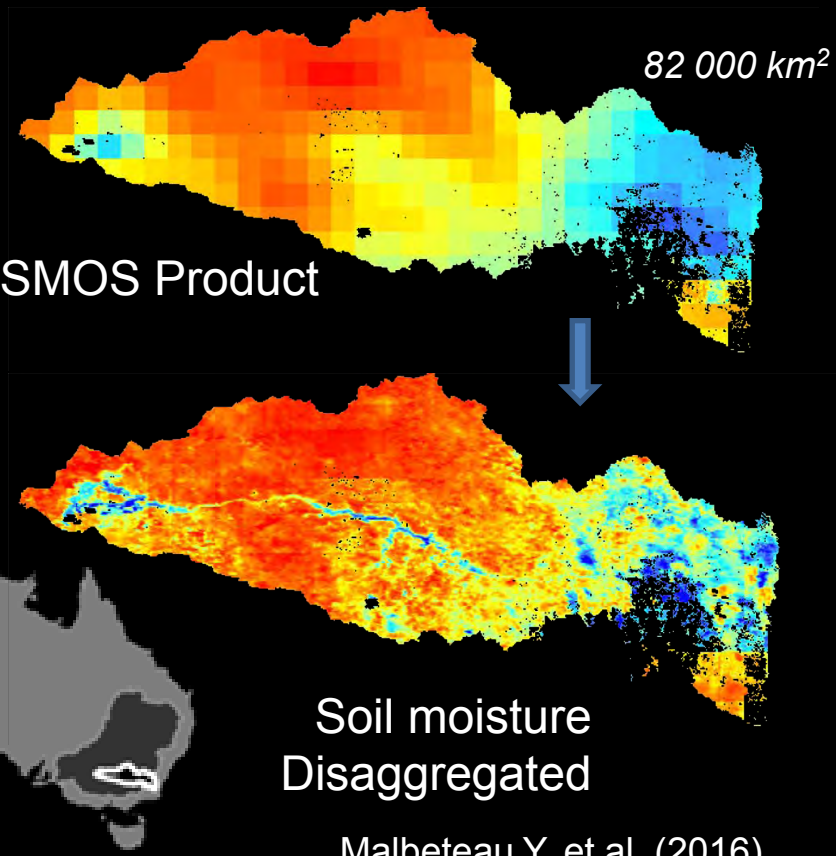
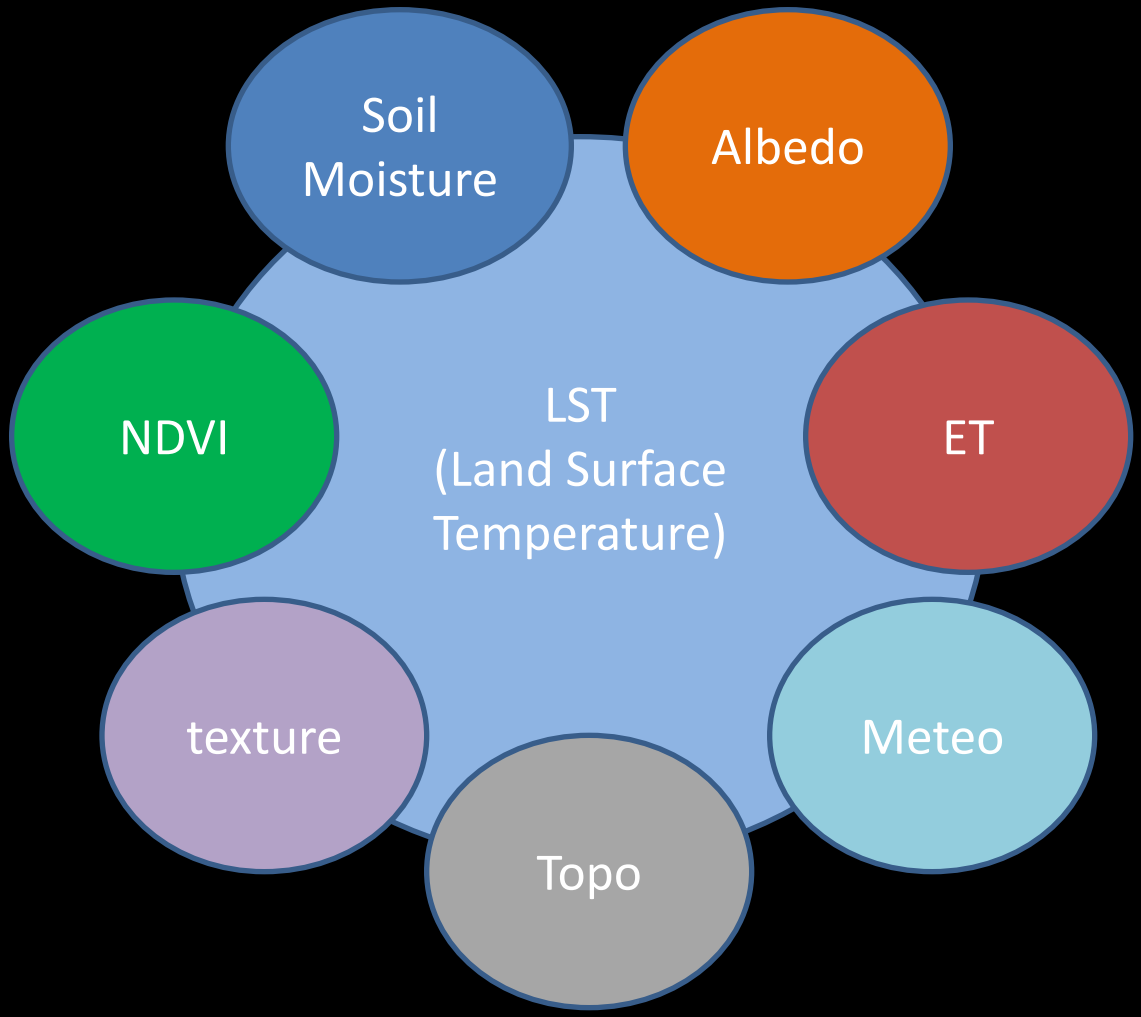


Malbeteau Y. et al. (2016)

Regional and parcel scale

What's land surface temperature ?



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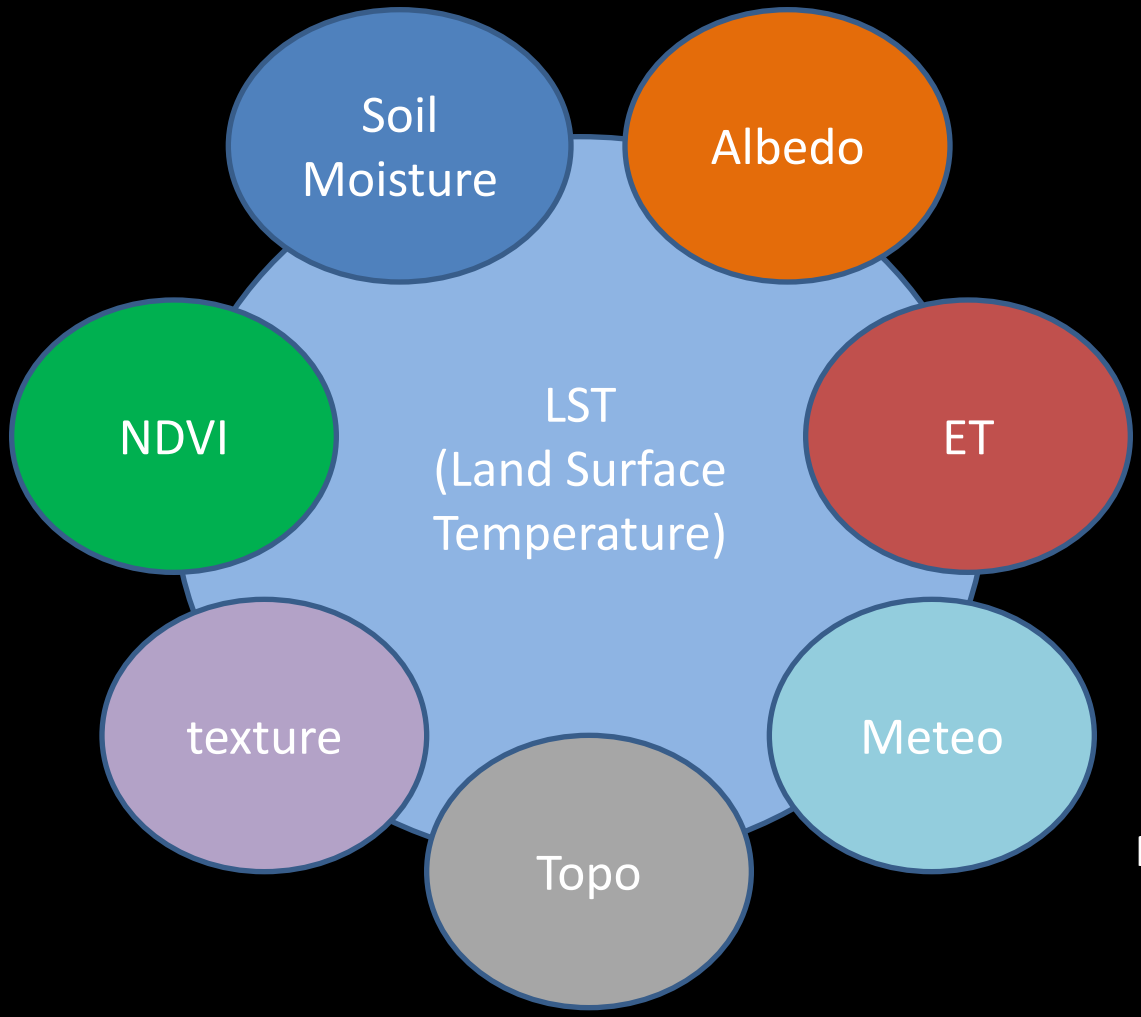
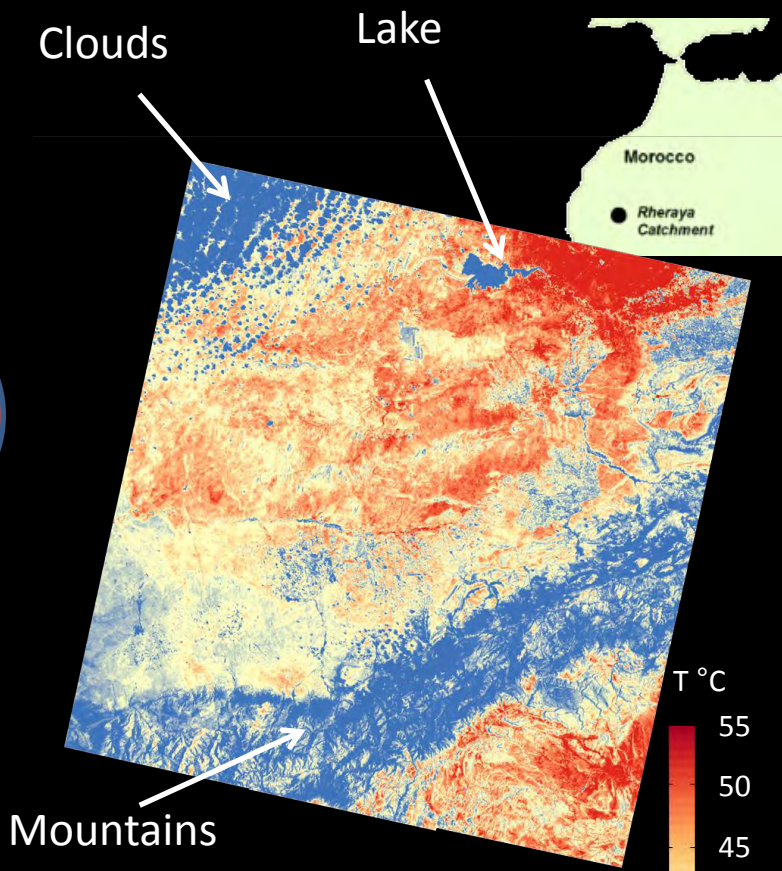
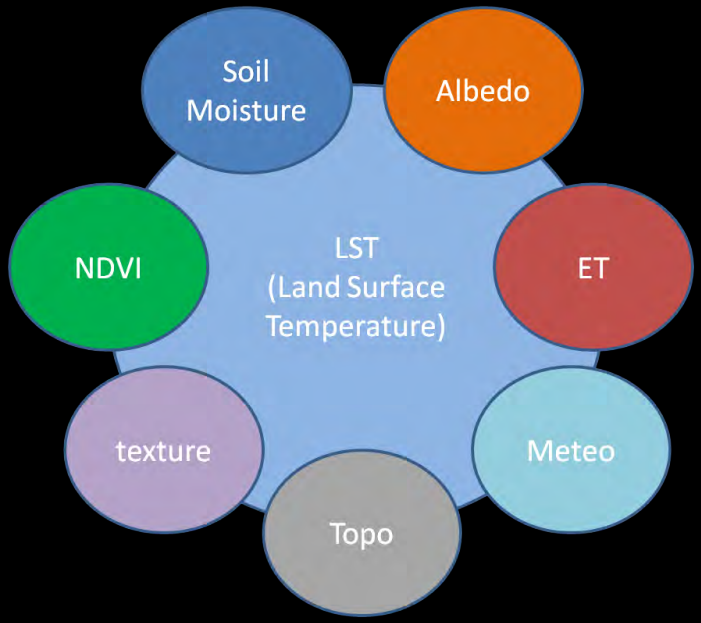


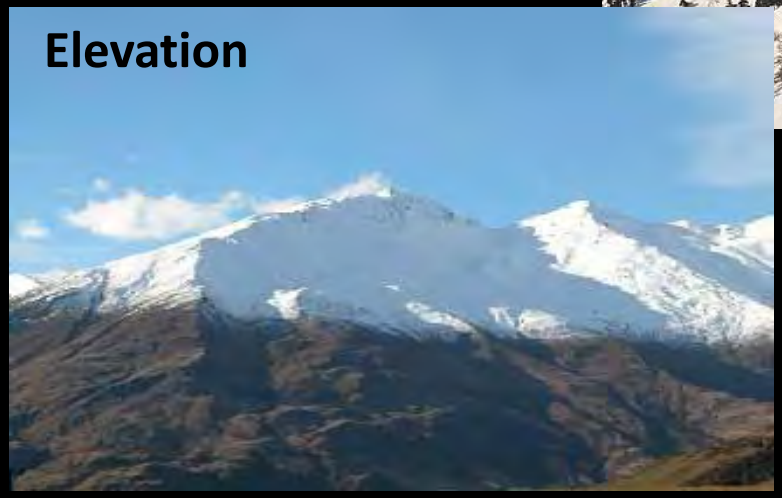


LST landsat at 100m resolution

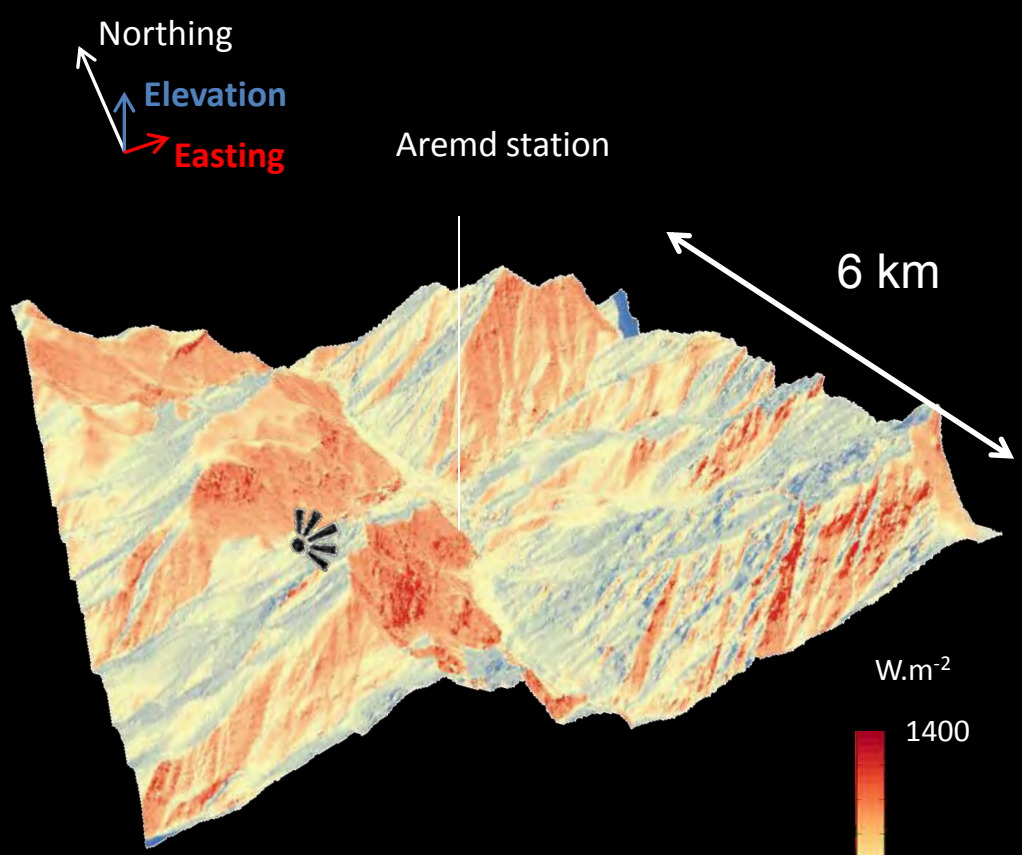
05 Septembre 2014

What's land surface temperature over mountains?



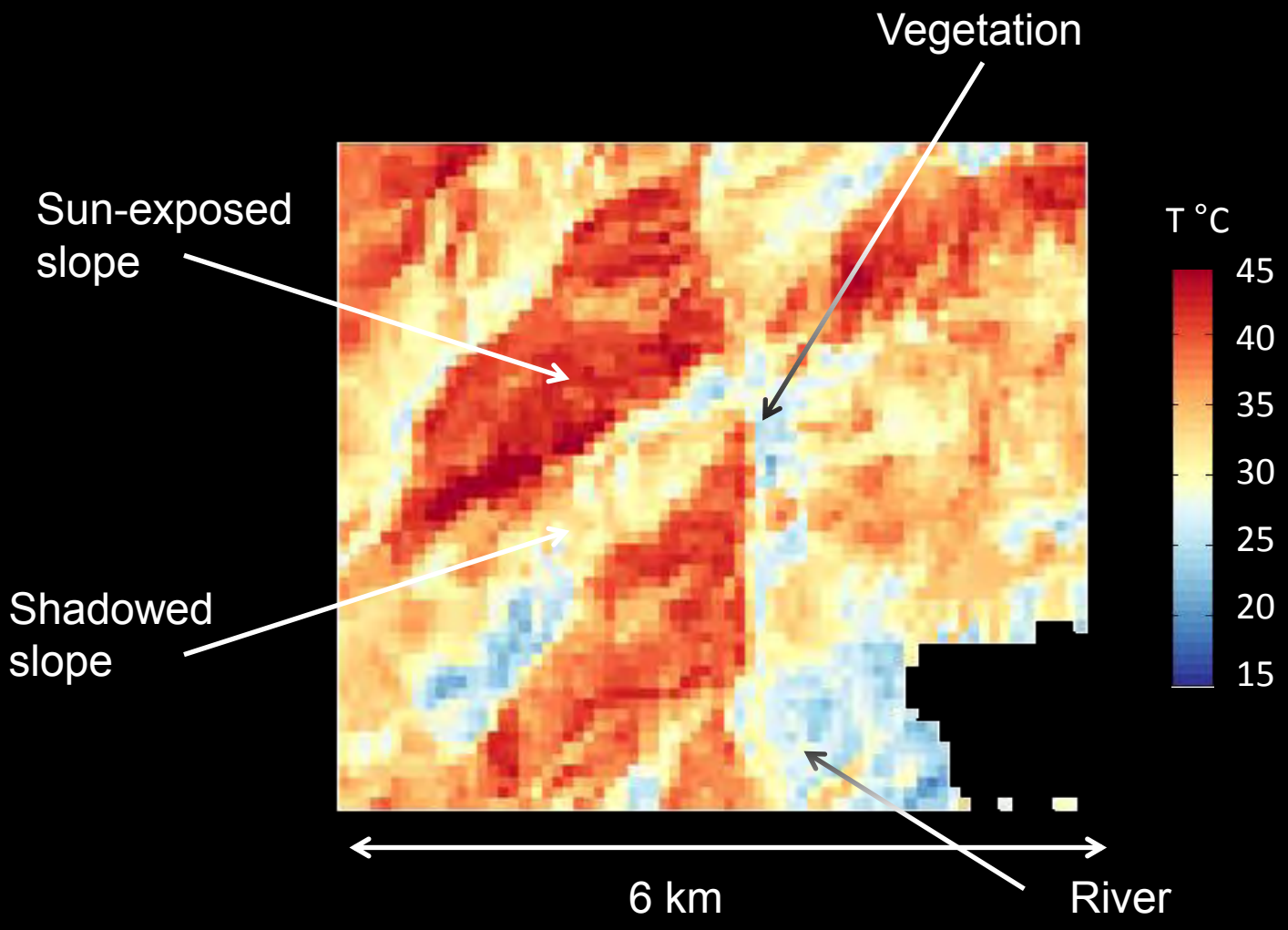


Land surface temperature over mountains



Net Radiation at 8m (from DART model)
at 11h21, the 05th of September

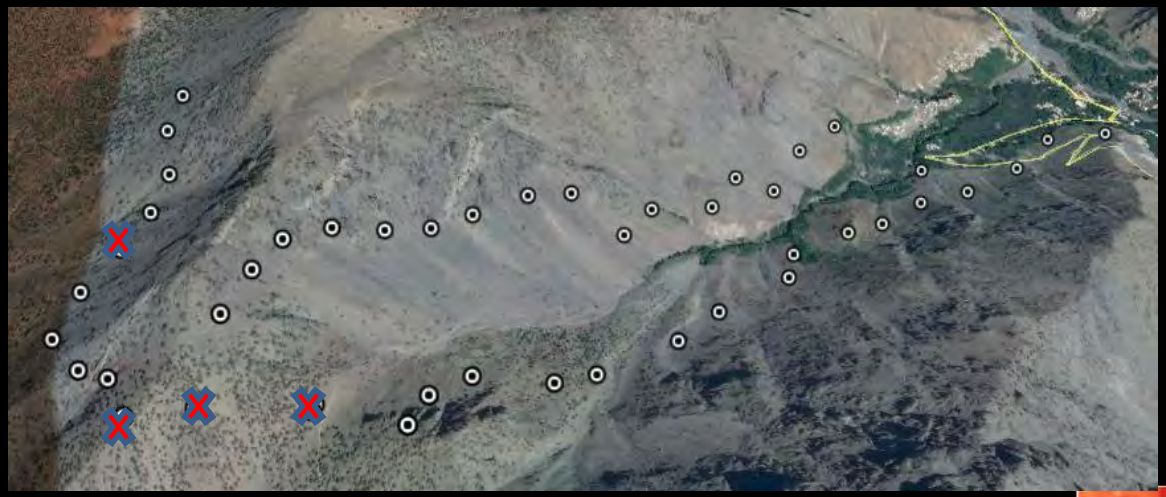
Land surface temperature over mountains



Land surface temperature observed by ASTER satellite

Scheme placement …

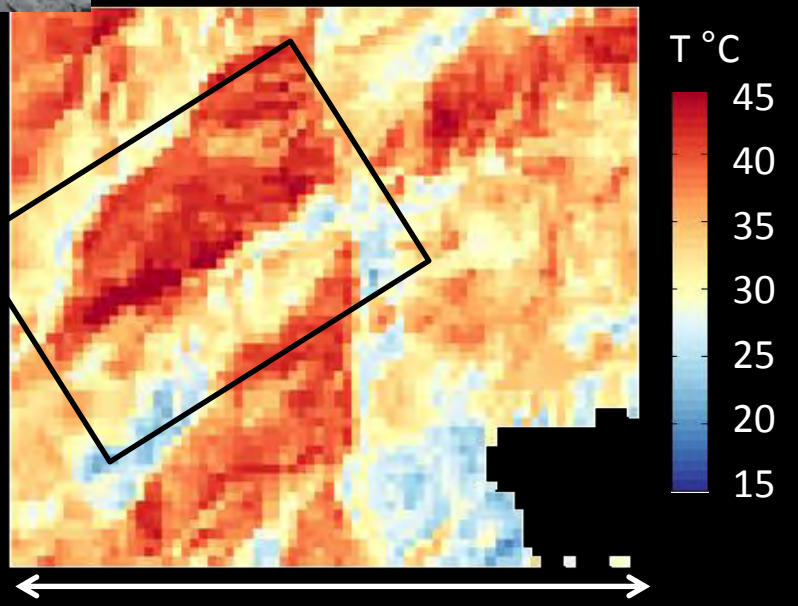
Temperature sensors/loggers



Different illumination and elevation

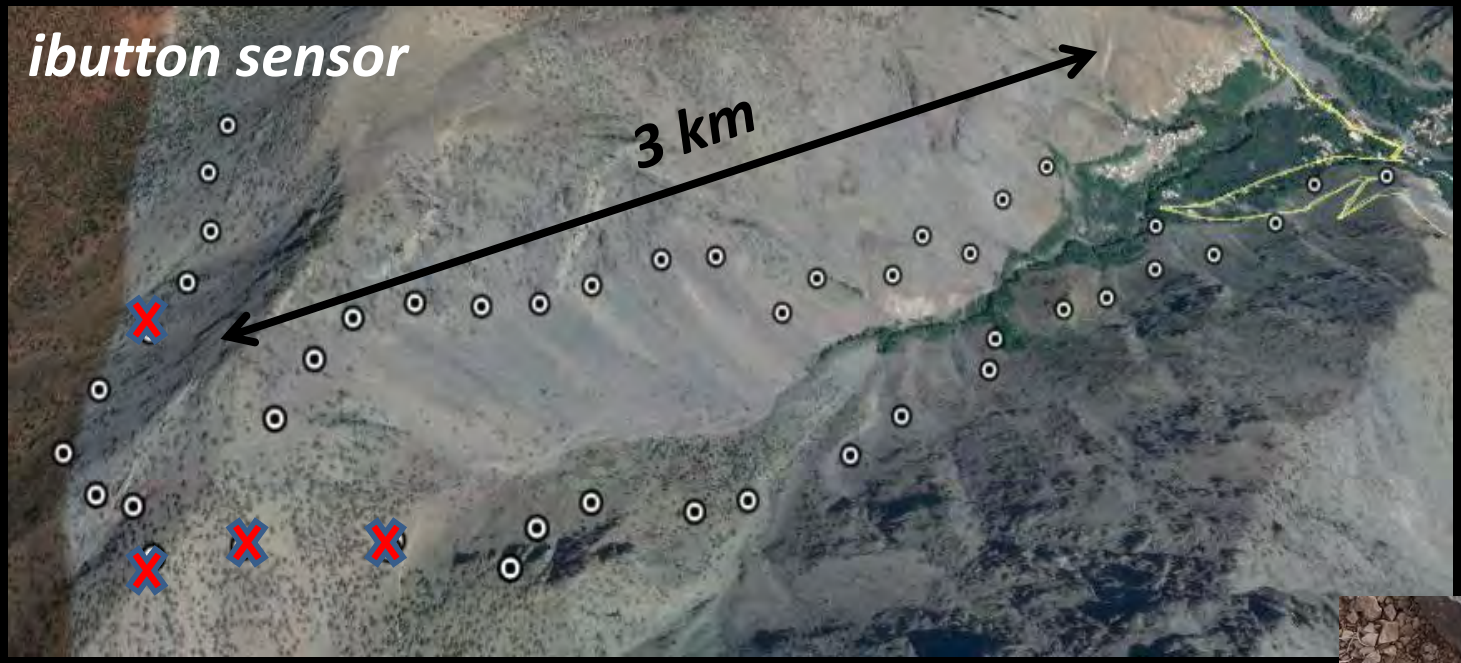
Spacing: ~100m
(ASTER/landsat resolution)

6 months



How can we validate surface temperature ?

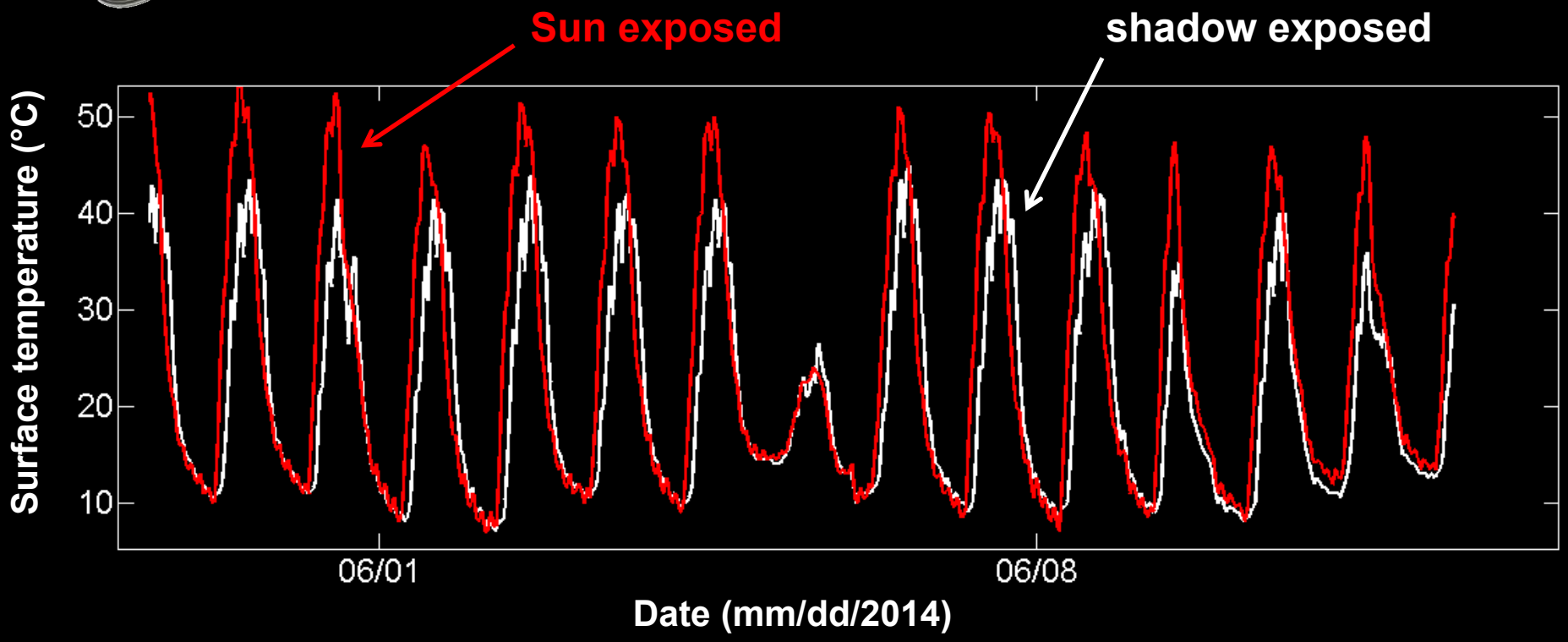
Temperature sensors/loggers



135 ibuttons
Set up over
45 points

Locations of the 45 ibutton plates, each of them containing 3 ibutton sensors.
Red cross indicate plates not used for the study.

Results: sample of in situ surface temperature



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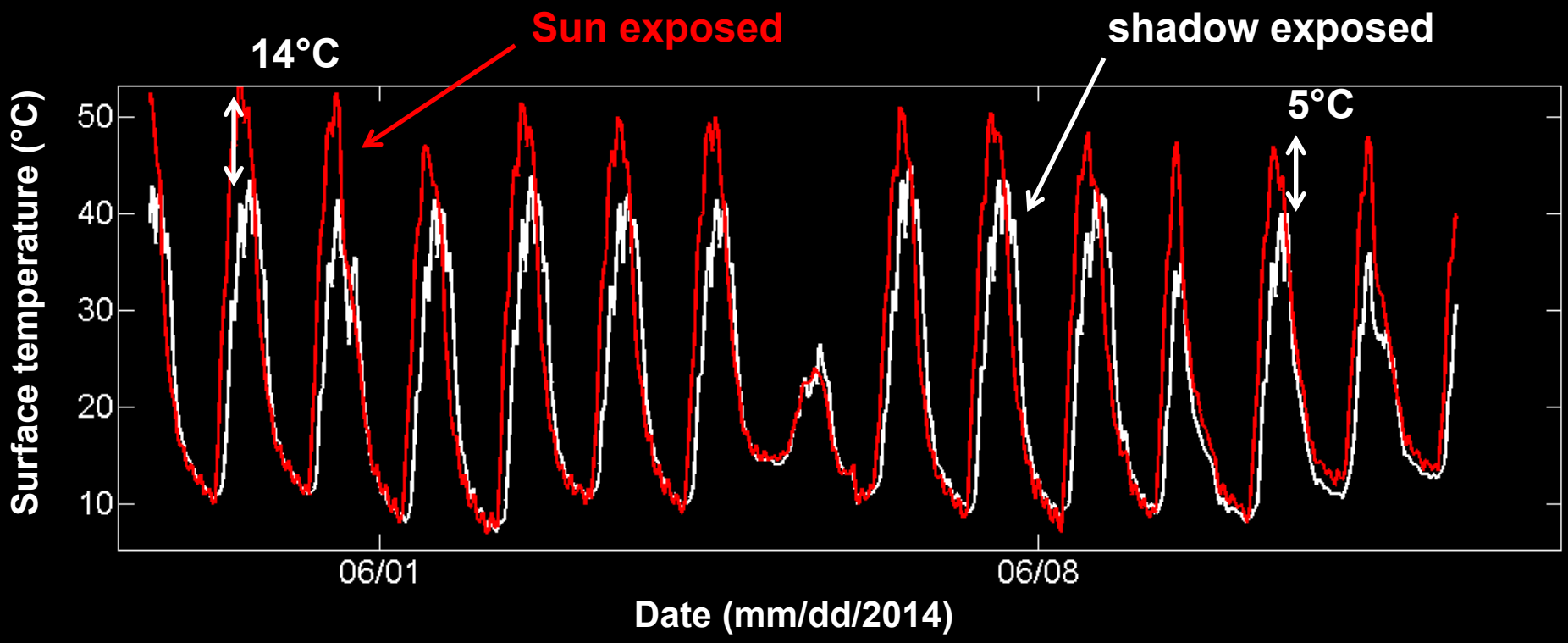

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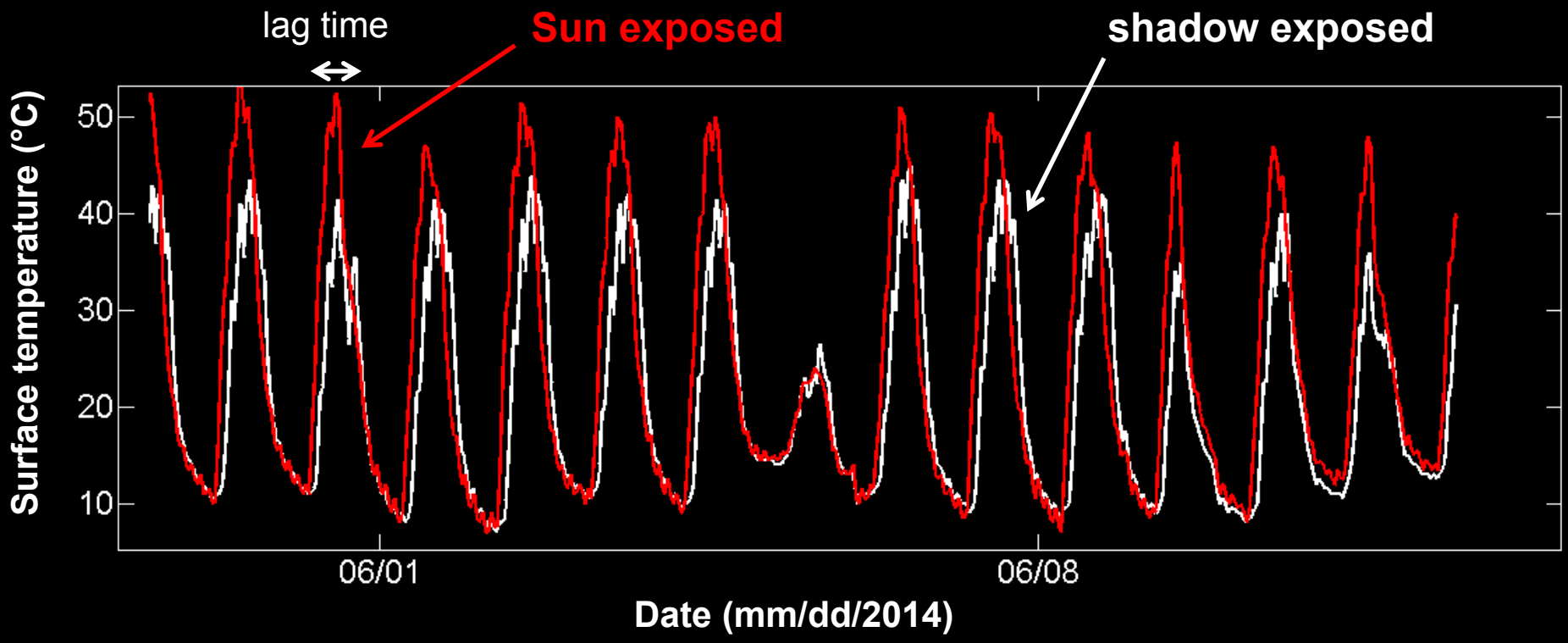

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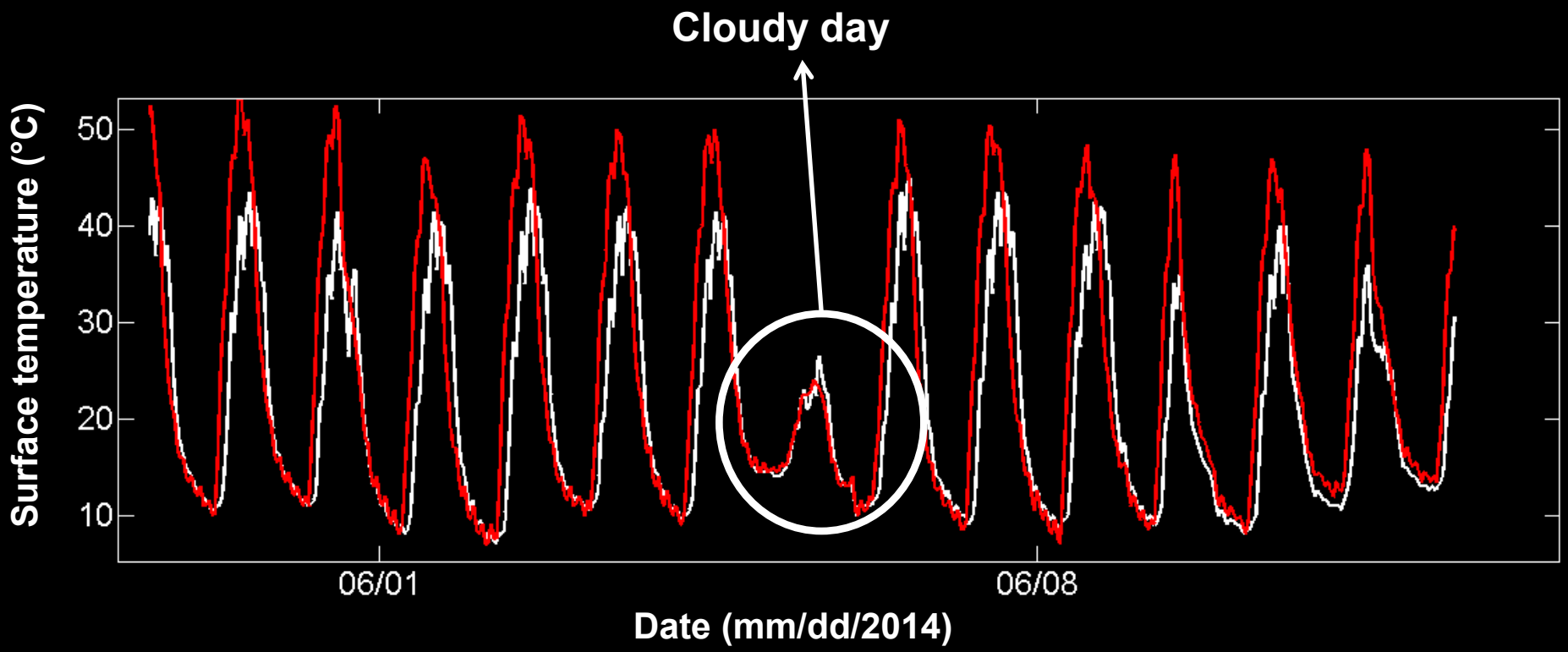
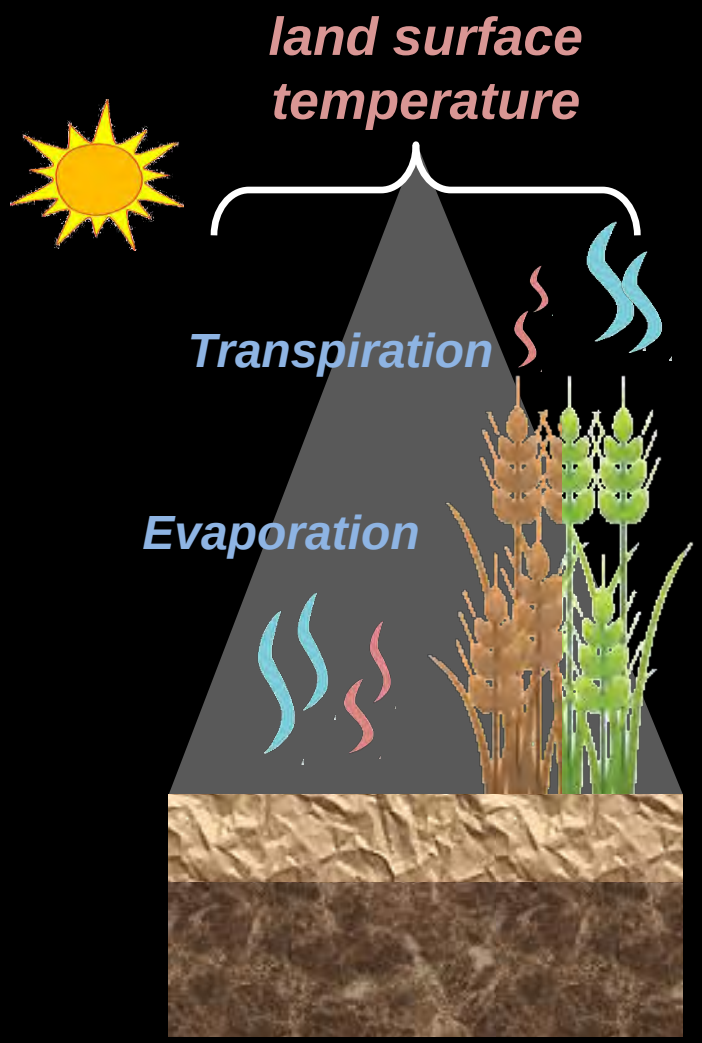


Modeling topographic effect over mountains

Energy balance



$$T_{EB} = fv\, Tv_{EB} + (1 - fv)\, Ts_{EB}$$

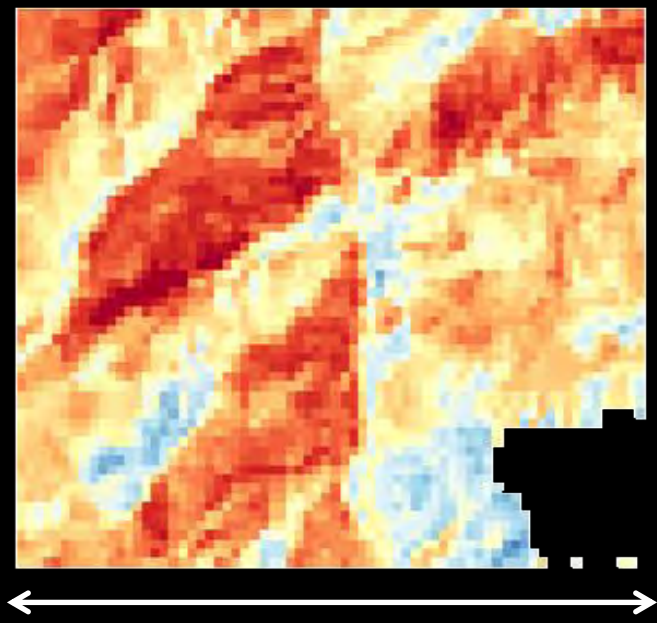
$$\begin{cases} Ts_{EB} = fss\, Ts,dry_{EB} + (1 - fss)\, Ts,wet_{EB} \\ Tv_{EB} = fsv\, Tv,dry_{EB} + (1 - fsv)\, Tv,wet_{EB} \end{cases}$$

Based on double source (vegetation/soil) energy balance model

Modeling topographic effect over mountains

90 m resolution

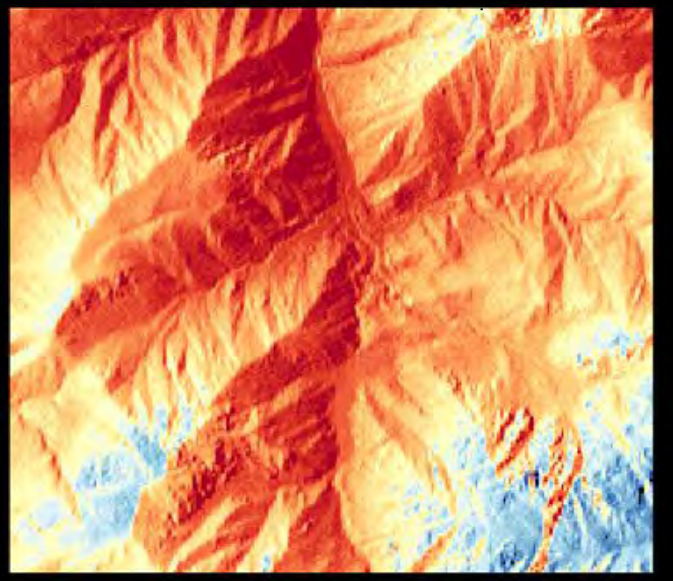
ASTER LST



6 km

8 m resolution

simulated LST



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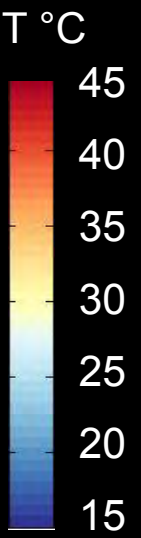
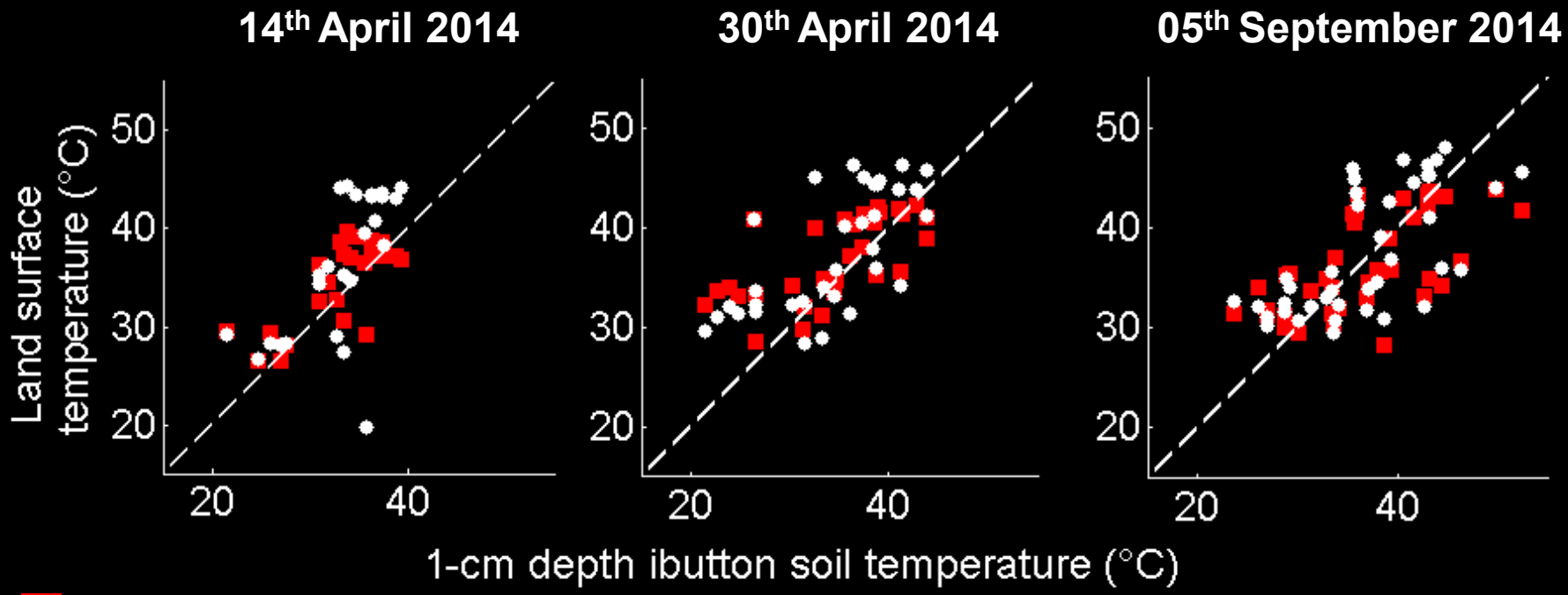


Representativeness

Useful for model and observed data validation

R (correlation)	14th April	30th April	05th September
Simulated LST	0.75	0.68	0.64
Observed LST	0.64	0.68	0.67

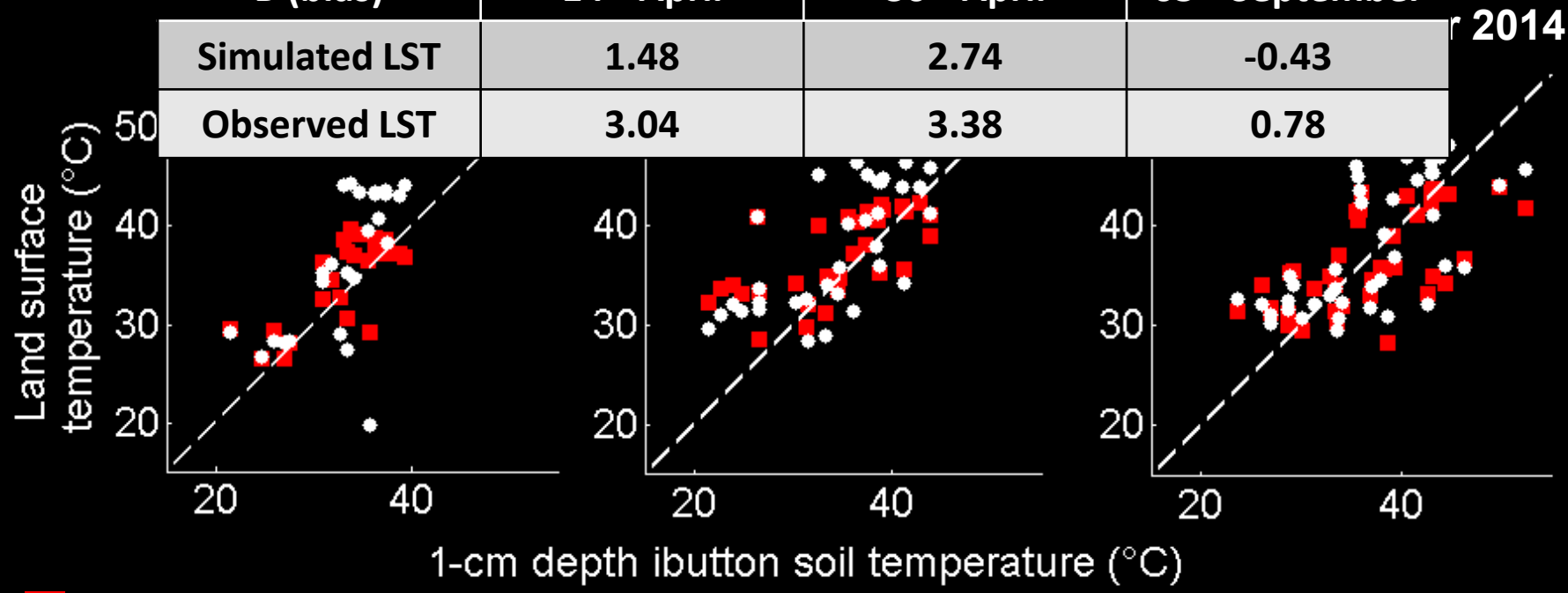


Scatterplots of ASTER and simulated LST at 90m resolution versus ibutton measurements

Useful for model and observed data validation

R (correlation)	14th April	30th April	05th September
Simulated LST	0.75	0.68	0.64
Observed LST	0.64	0.68	0.67

B (bias)	14th April	30th April	05th September
Simulated LST	1.48	2.74	-0.43
Observed LST	3.04	3.38	0.78



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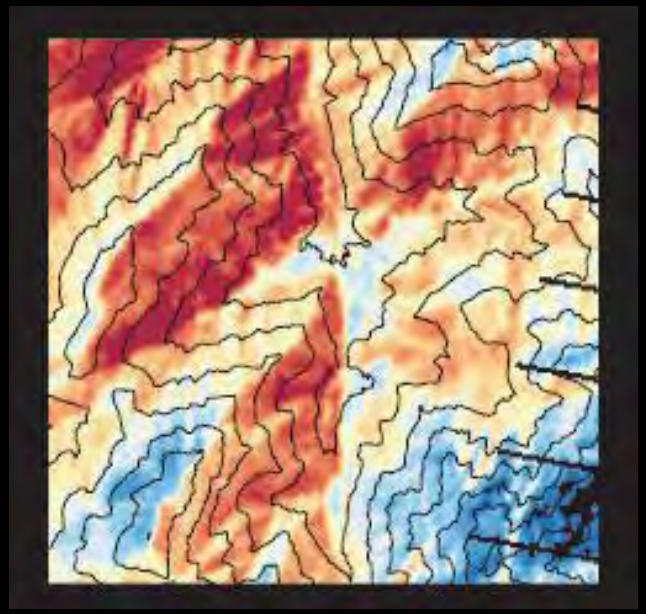
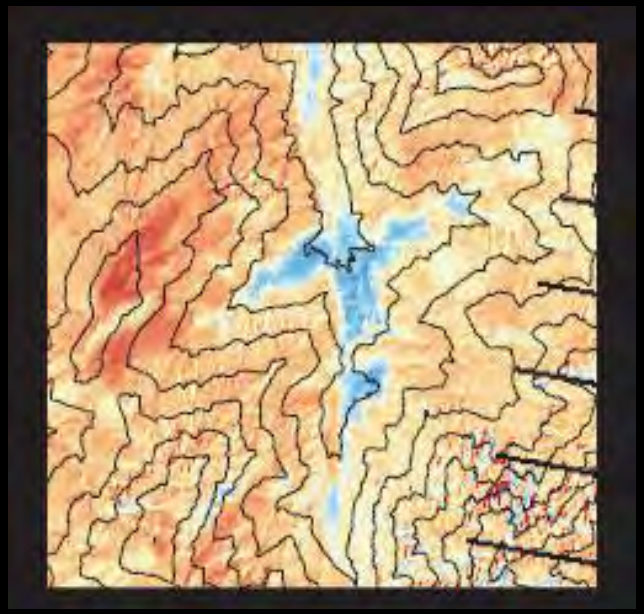
Additional slide….

for future application over mountains



Before correction



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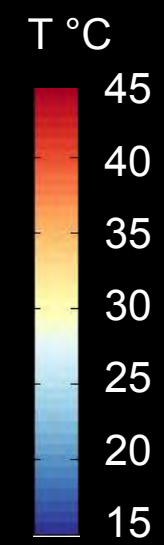

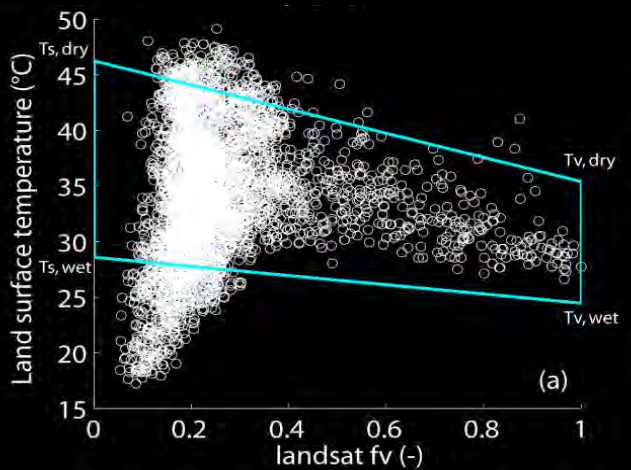

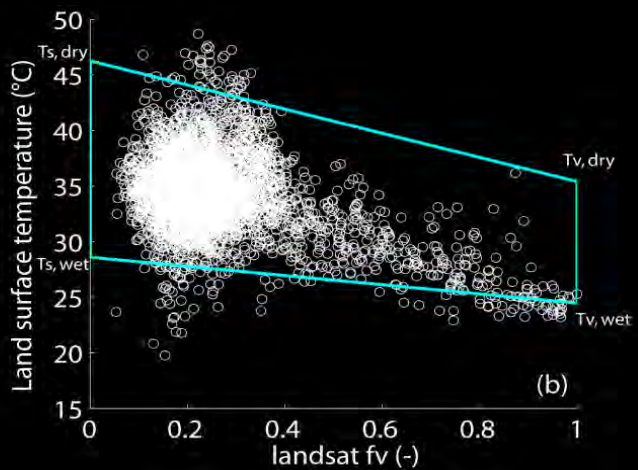

Conclusion

Challenges:

Representativeness of in situ measurement for remote sensing data validation

solution ? *very dense in situ measurement → aggregation*
few in situ measurement → disaggregation (downscaling)
in situ measurement representative at the scale resolution

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Terrain accessibility

But it is great …

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