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Earth's skin temperature: the underrated variable tracer of the global climate

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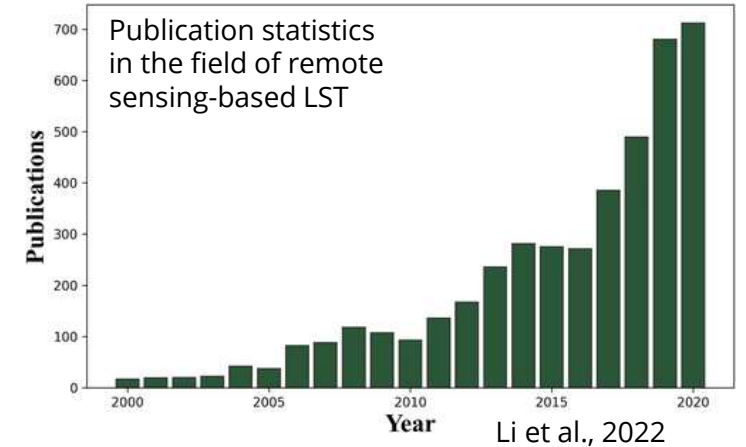
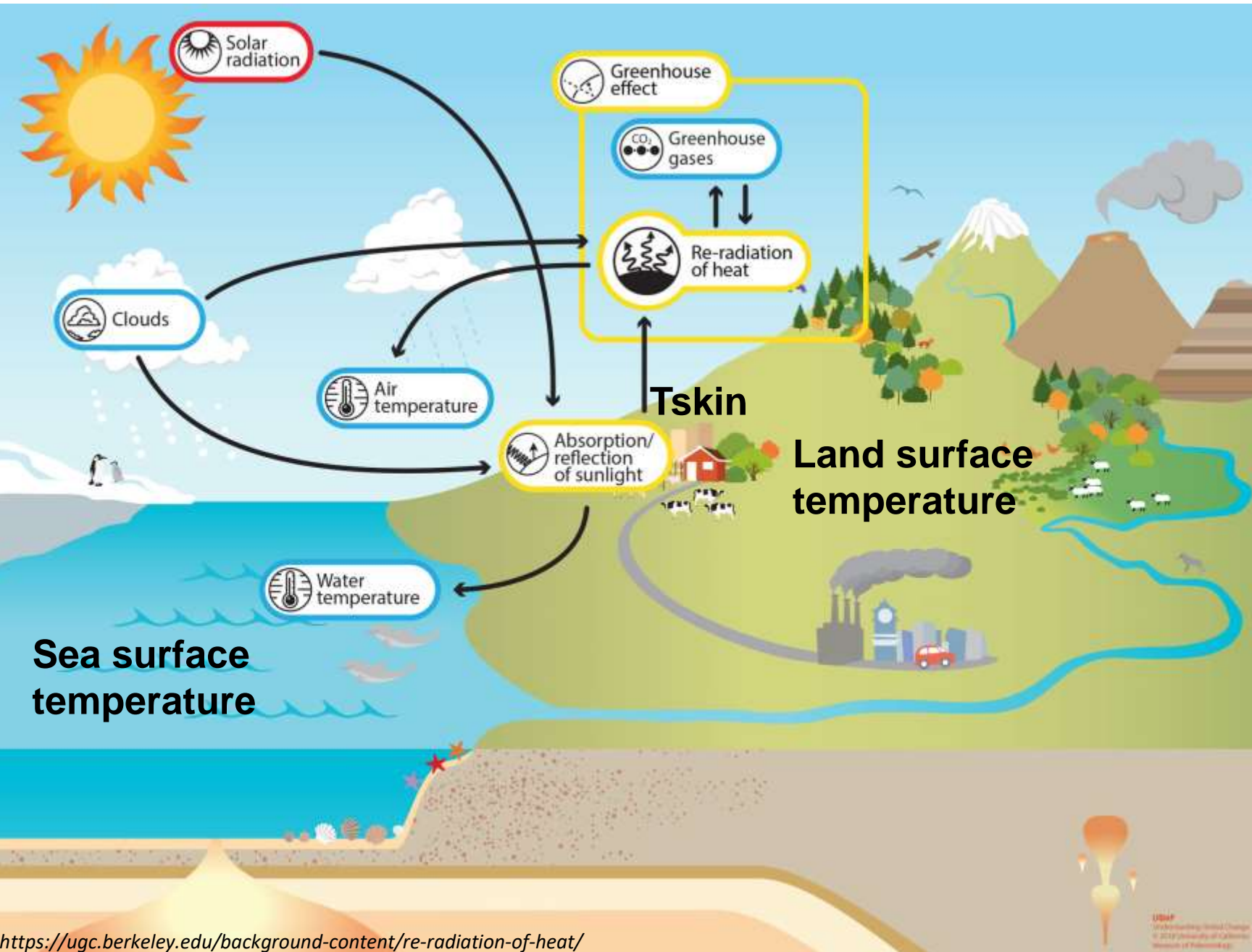
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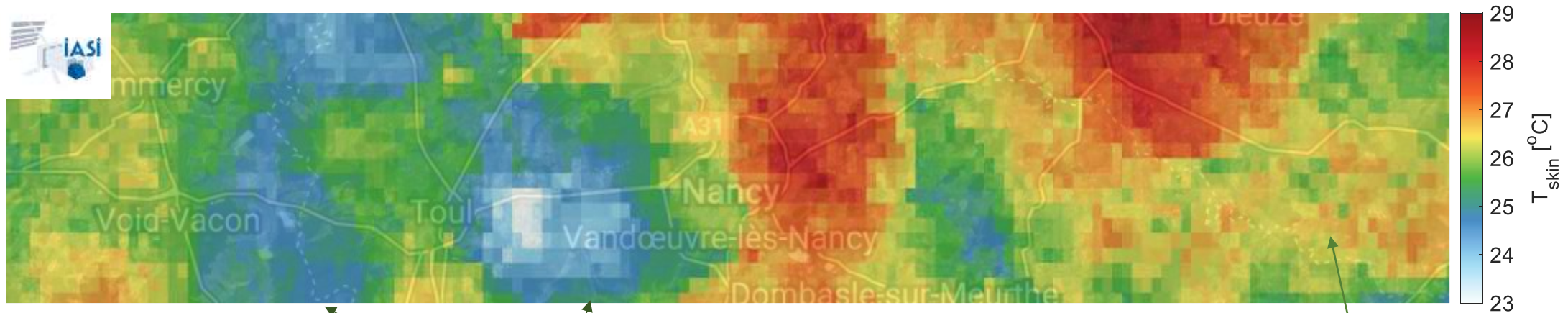
Why study Tskin from TIR instruments such as IASI?



Tskin studies are challenging(?) because:

- Very scarce ground based observations
- Rely on TIR remote sensors
- Data record relatively short (as compared to near surface temperatures)

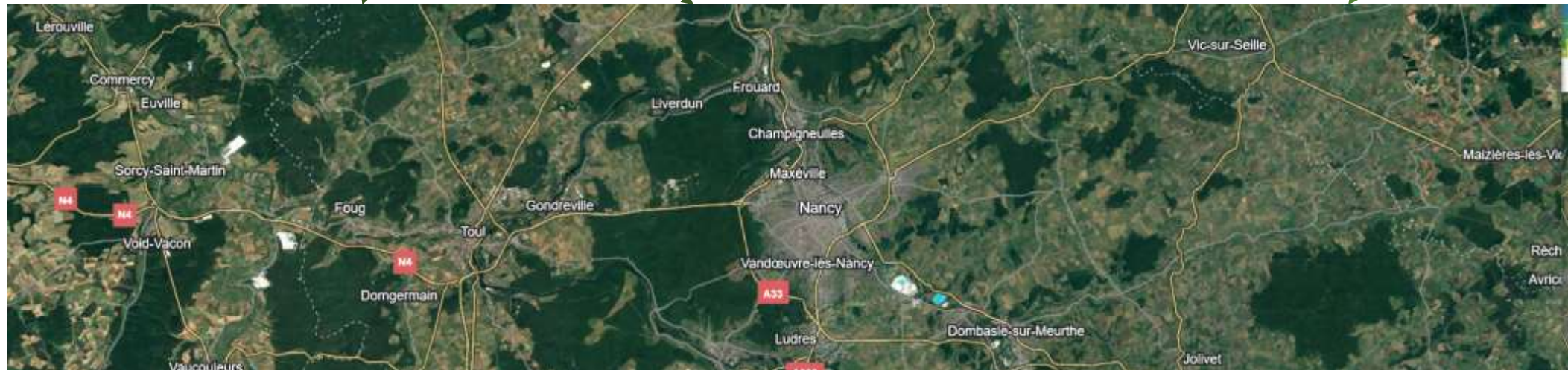
Why study Tskin?



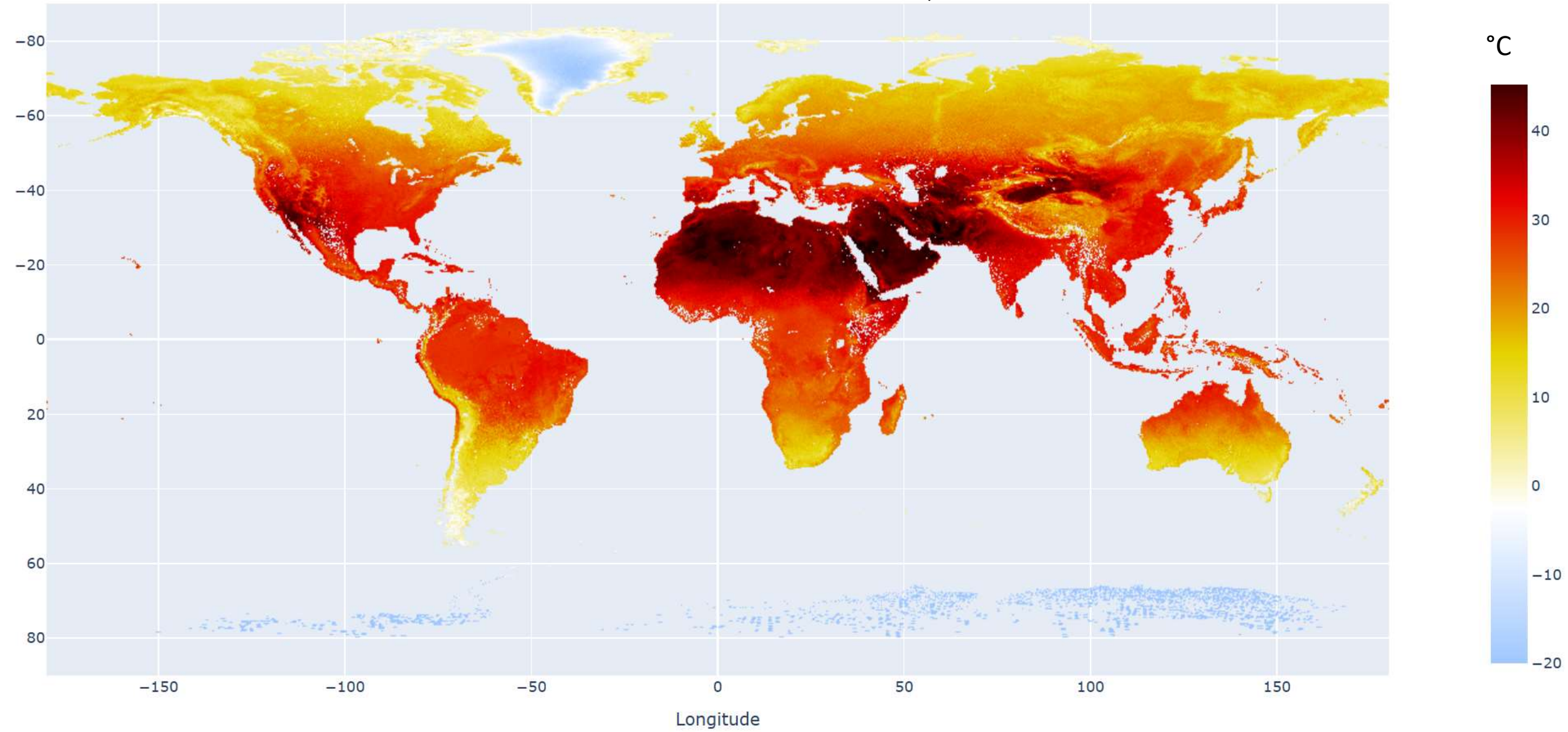
Forest/ vegetation

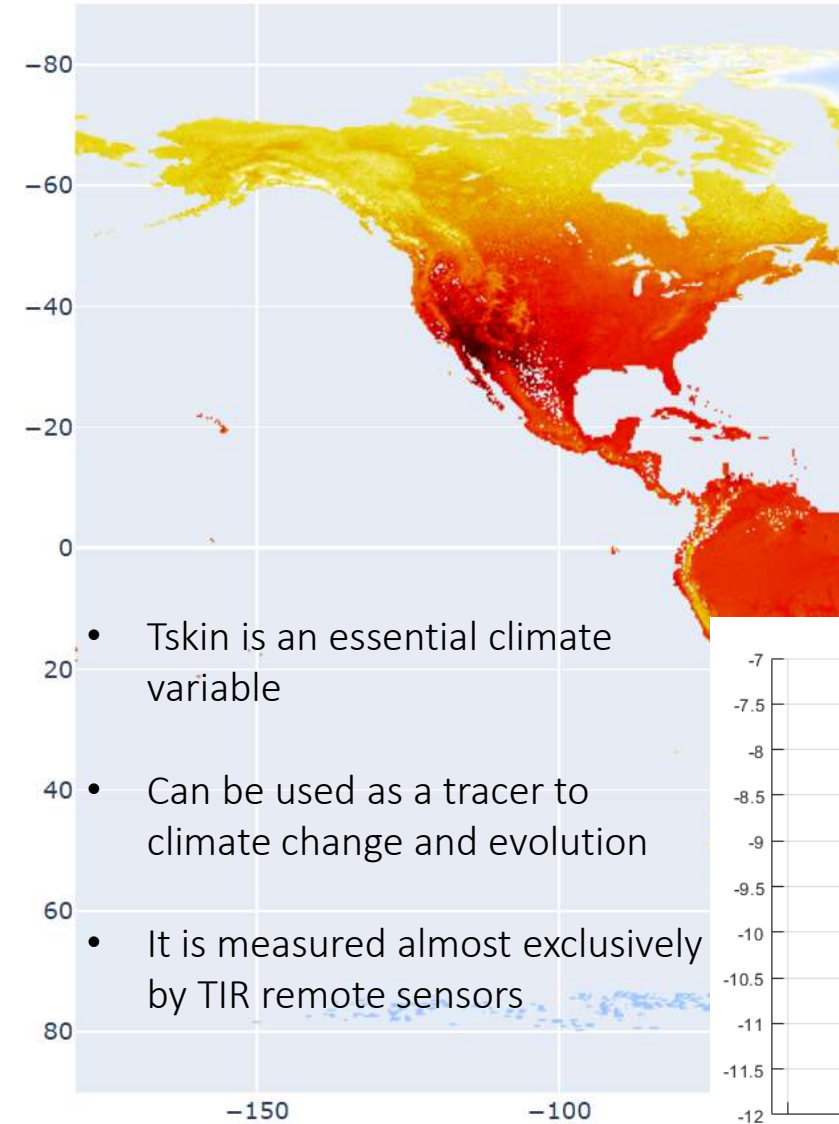
**Urban
concrete/roads, etc**

Agriculture

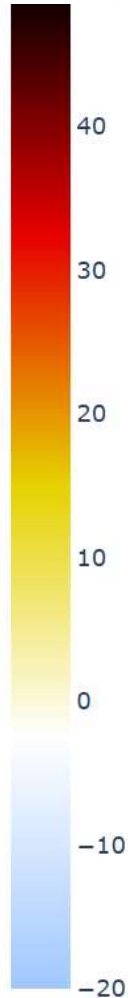
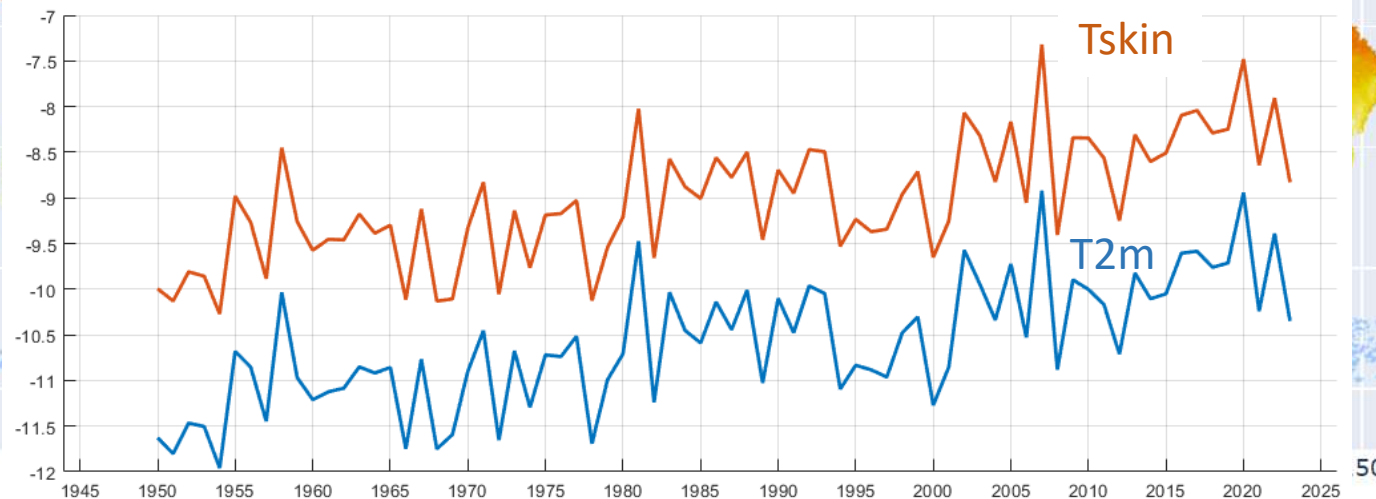
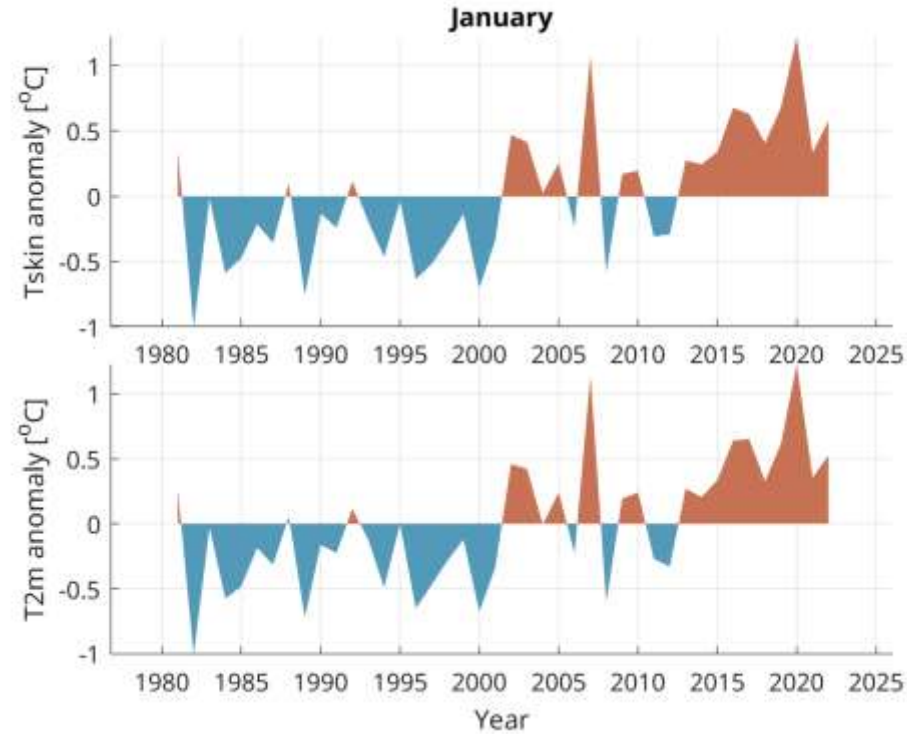


Tskin/LST or near surface temperature?

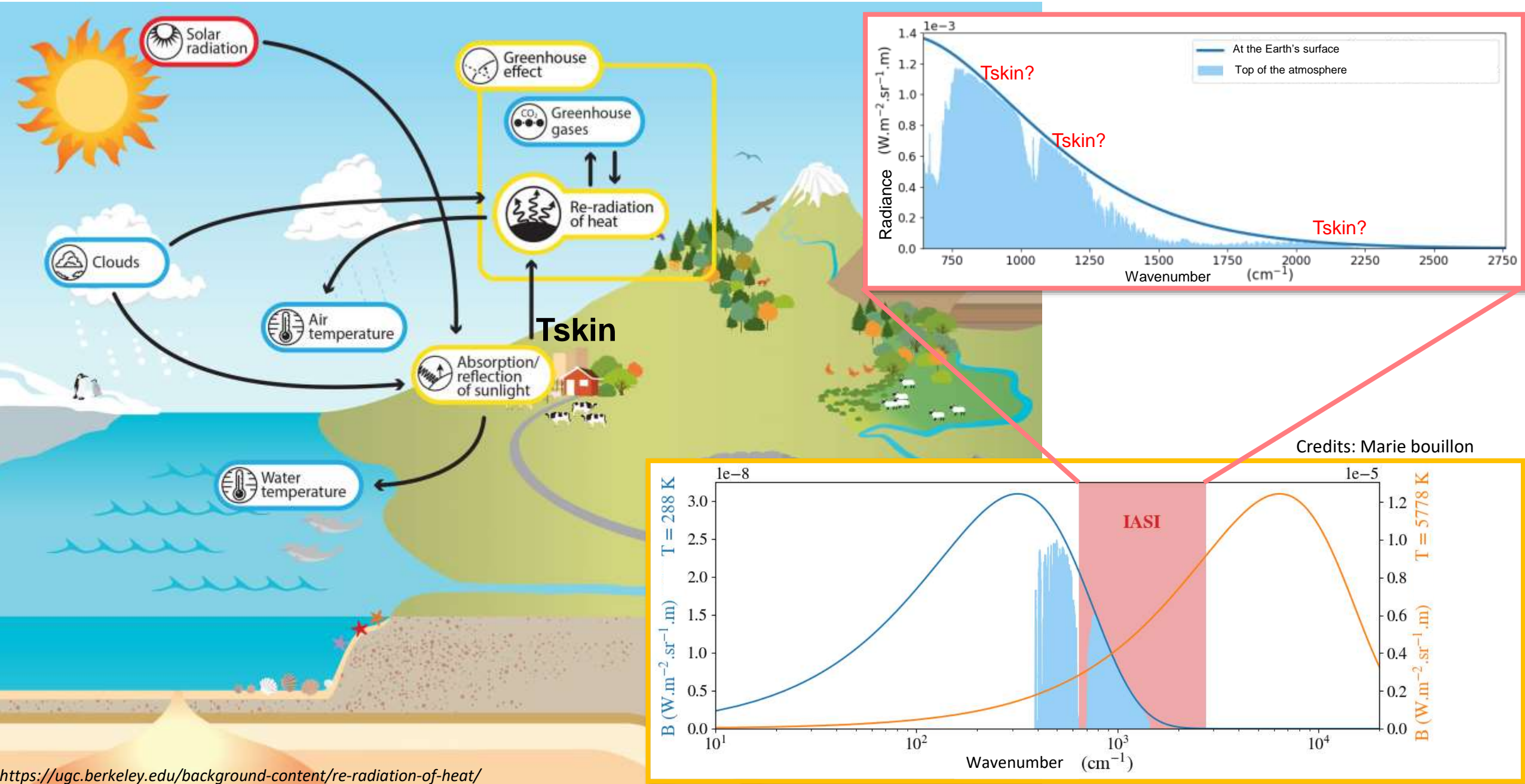




- Tskin is an essential climate variable
- Can be used as a tracer to climate change and evolution
- It is measured almost exclusively by TIR remote sensors



How is skin temperature measured by remote TIR sensors?



Input/features

87 Channels that are sensitive to Tskin from IASI

+

FOV/satellite angle

+

Lon/lat

+

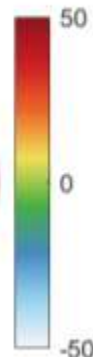
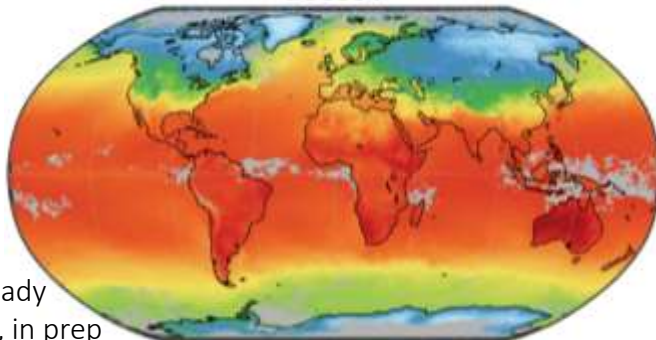
4 Channels of emissivity in the TIR from the CAMEL database
(monthly, over land)

Output/
desired predictions

Tskin EUMETSAT
(Optimal estimation)

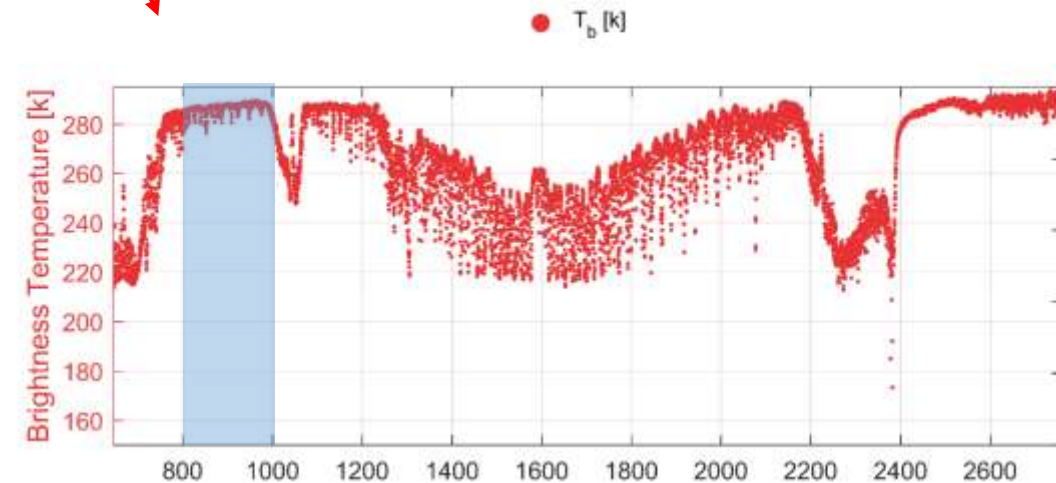
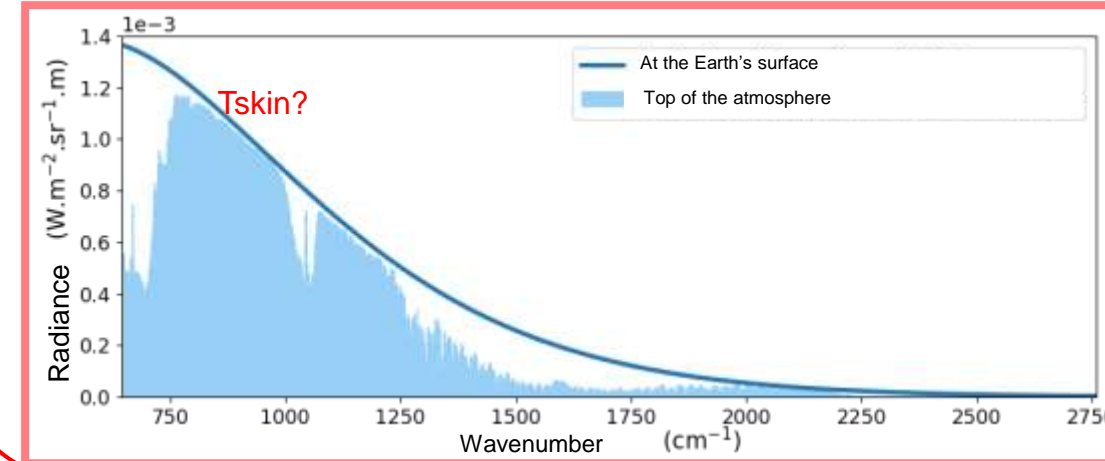


200801



Version 2 ready
Safieddine et al., in prep

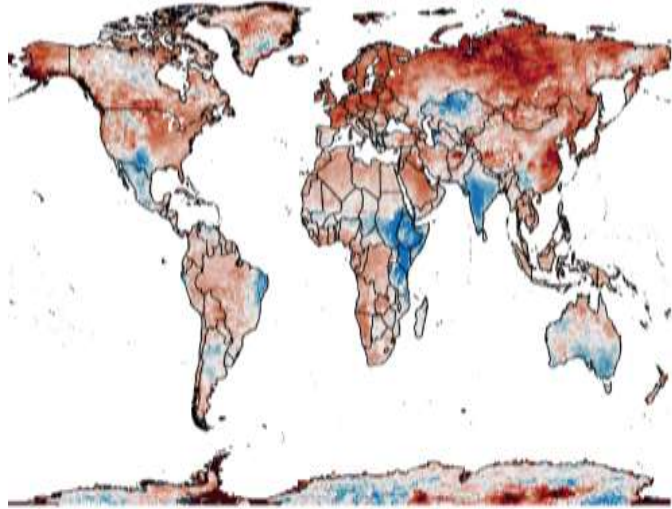
Poster # 44
(Valentine Jaquet)
on the different
applications of Tskin
on the global and
regional scale



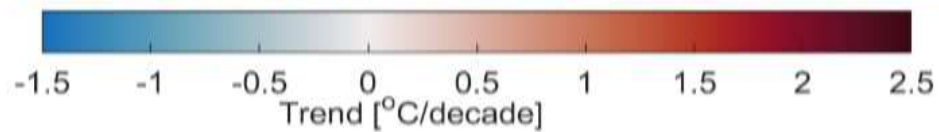
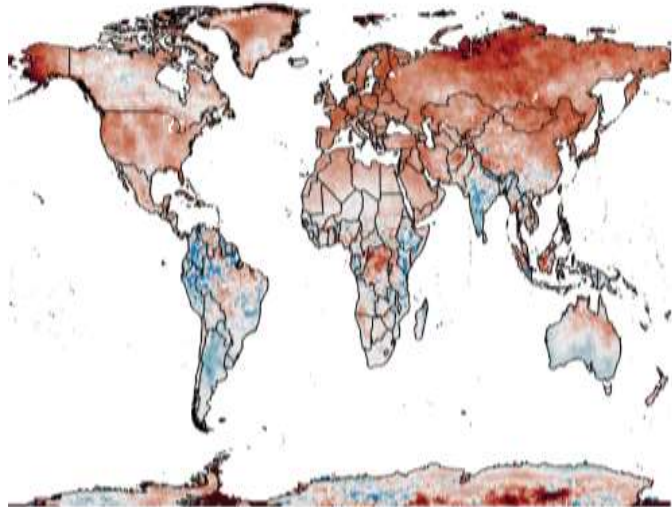
Version 1, using climatological
emissivities by Zhou et al., 2010

Safieddine et al., 2020
www.iasi-ft.eu

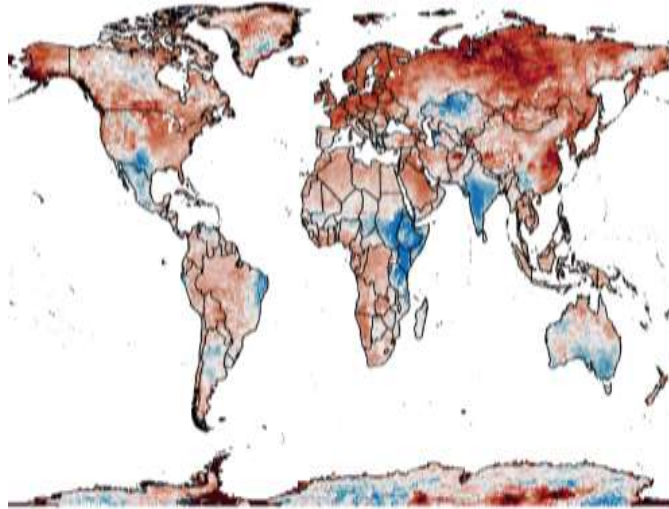
IASI @ 9:30 AM



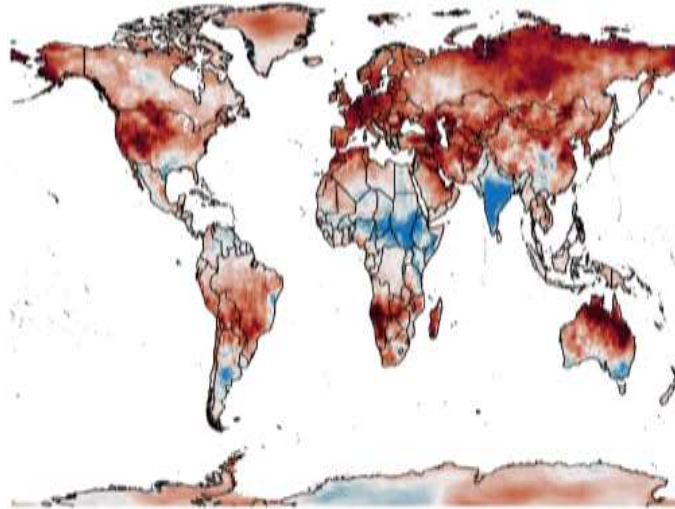
IASI @ 9:30 PM



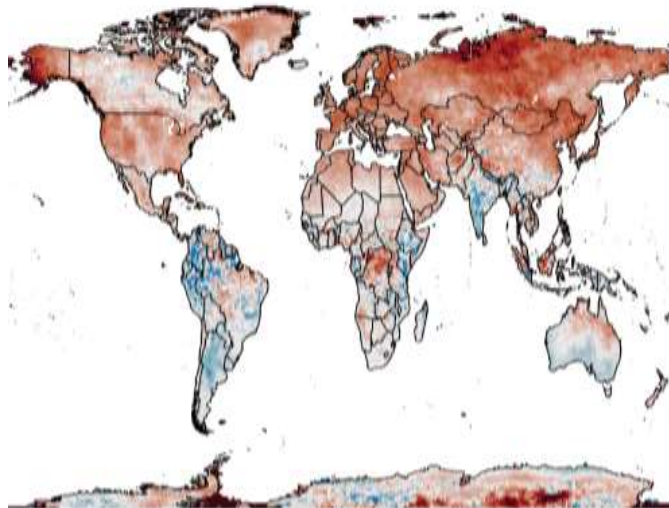
IASI @ 9:30 AM



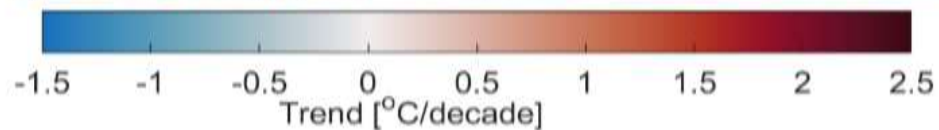
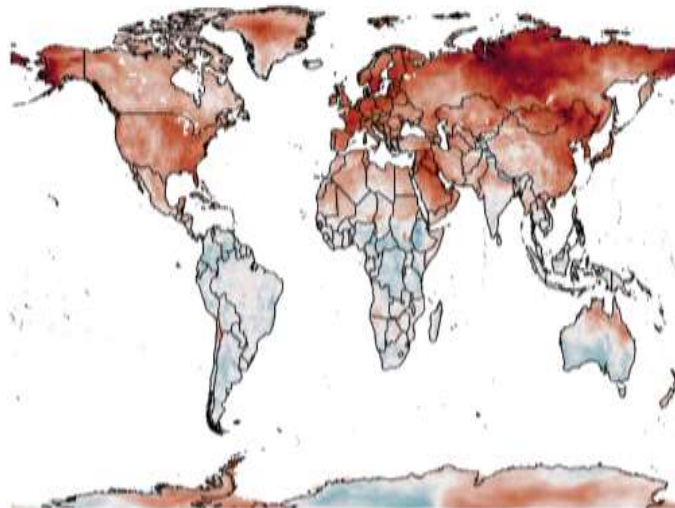
AIRS asc orbit @ 1:30 PM LT



IASI @ 9:30 PM



AIRS @ 1:30 AM LT

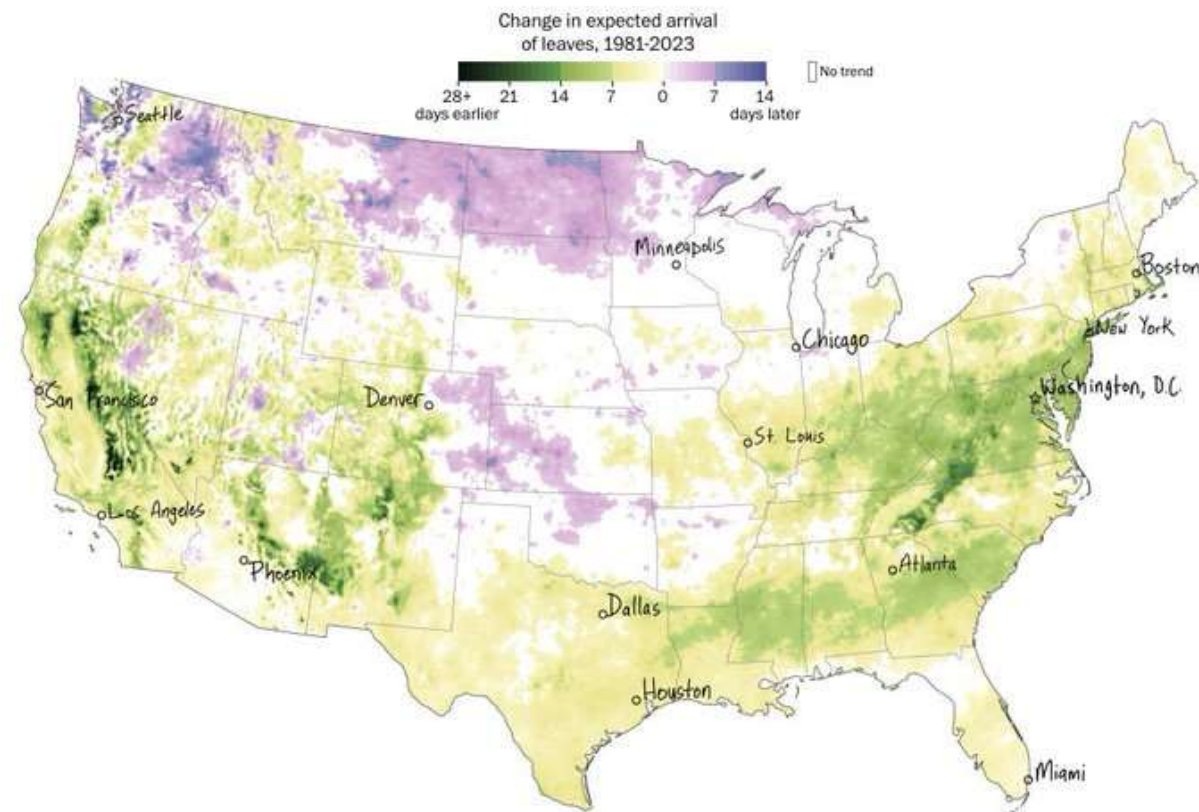


Tskin trends:

- Large spatial variability
- Higher in magnitude than T2m
- Depend on the hour of the day?

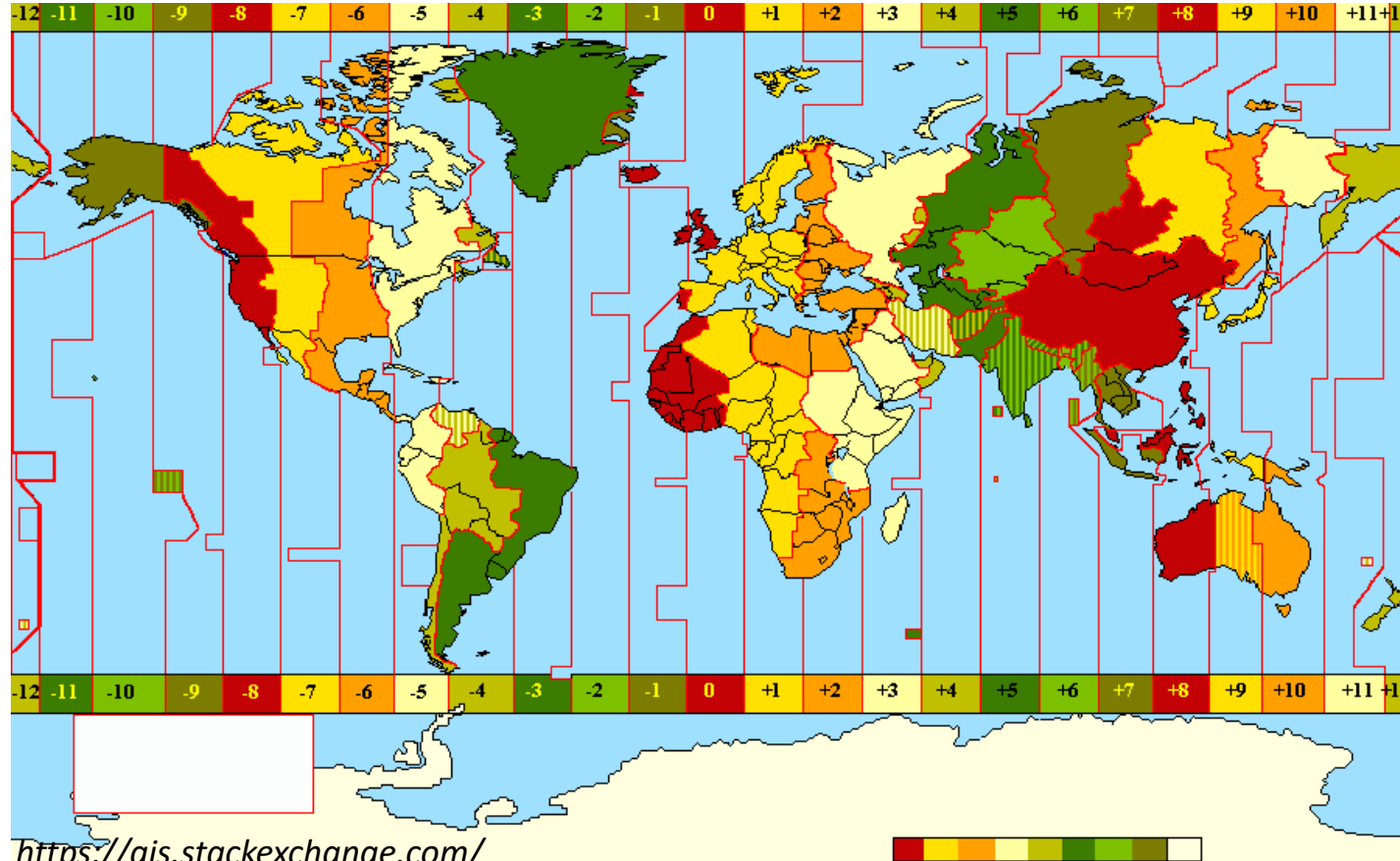
Are the temperature trends time/hour of the day dependent?

- Nighttime temperatures are rising faster than daytime temperatures in many regions, leading to a narrowing of the diurnal temperature range ($DTR = T_{max} - T_{min}$) (Karl et al., 1993; Zhou et al., 2010).
- Climate change is shifting the phenological cycles of plants with higher warming in spring particularly in the Northern Hemisphere (Buermann et al., 2018).



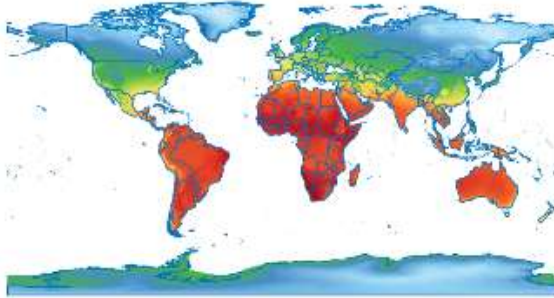
Are the temperature trends time dependent?

- LST and T2m from ERA5 trends per hour and month
- These are in UTC and the satellite crossing time is in local time →
- Transform UTC to local time (using longitude-based time zones)

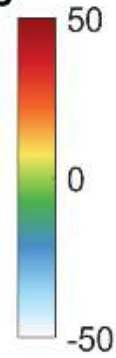
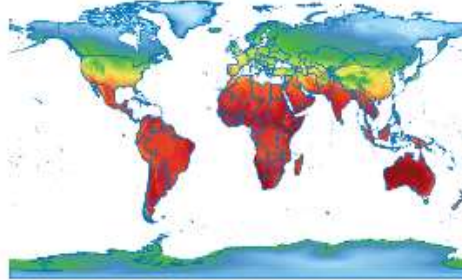


LST

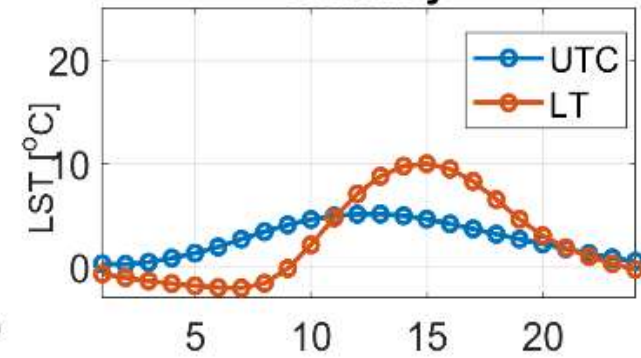
Hour of the day: 15 UTC



Hour of the day: 15 Local Time

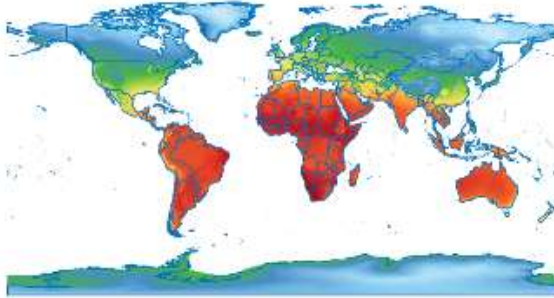


January

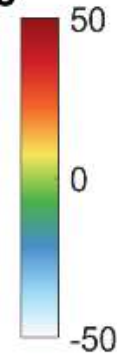
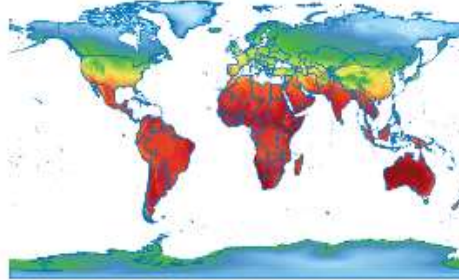


LST

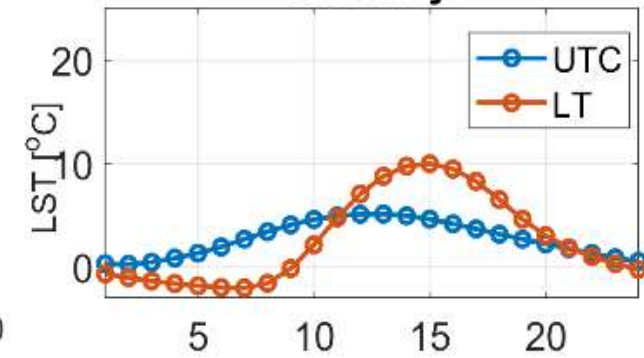
Hour of the day: 15 UTC



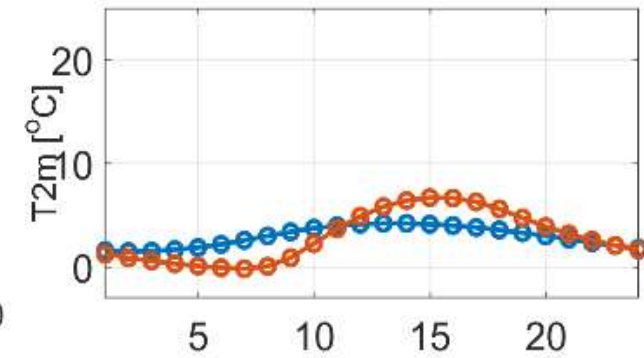
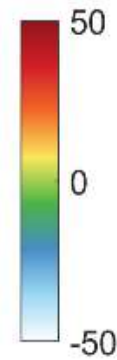
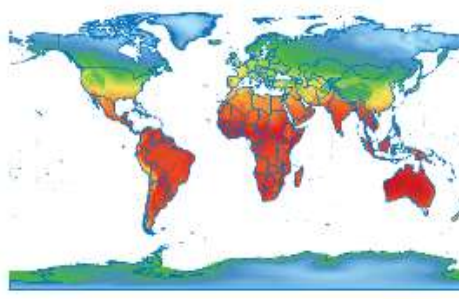
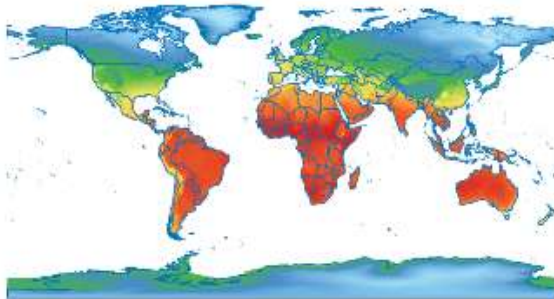
Hour of the day: 15 Local Time



January



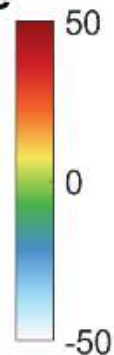
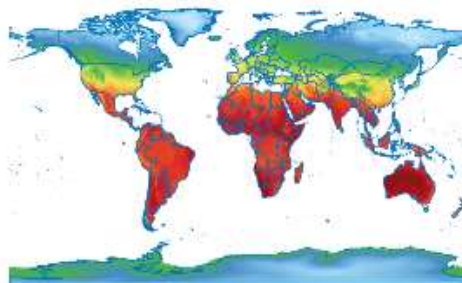
T2m



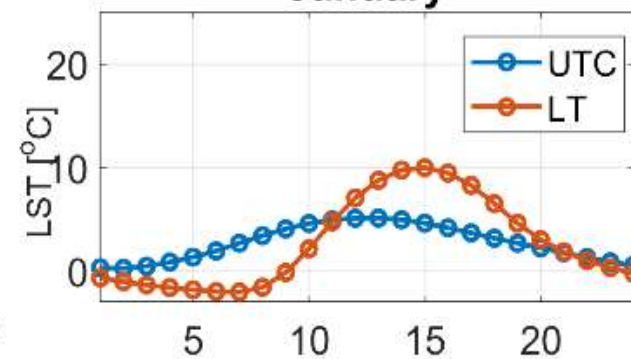
Hour of the day: 15 UTC

Hour of the day: 15 Local Time

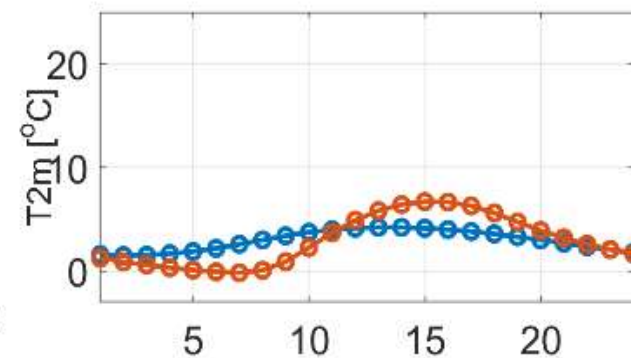
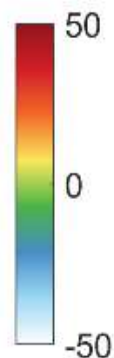
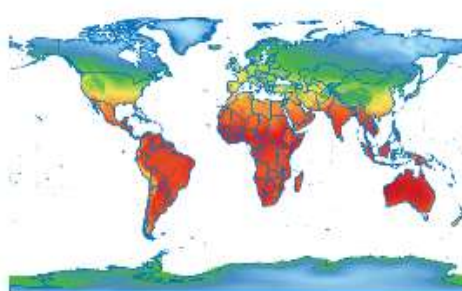
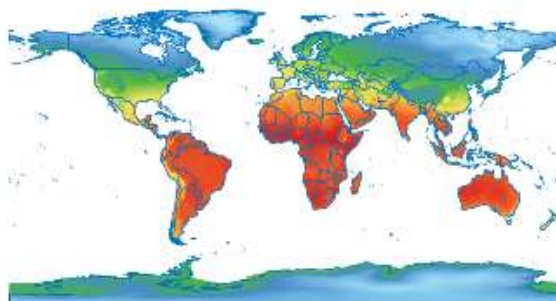
LST



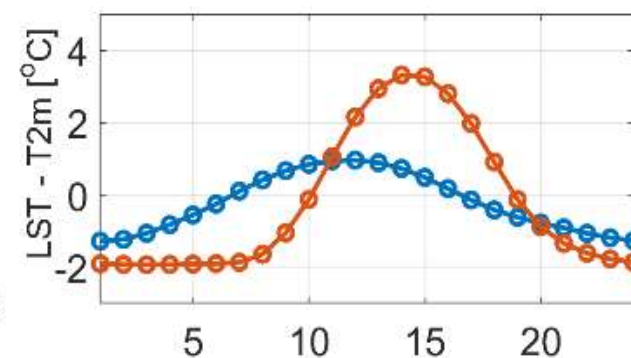
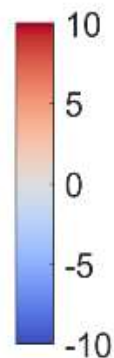
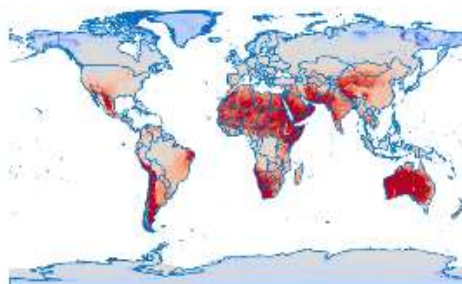
January



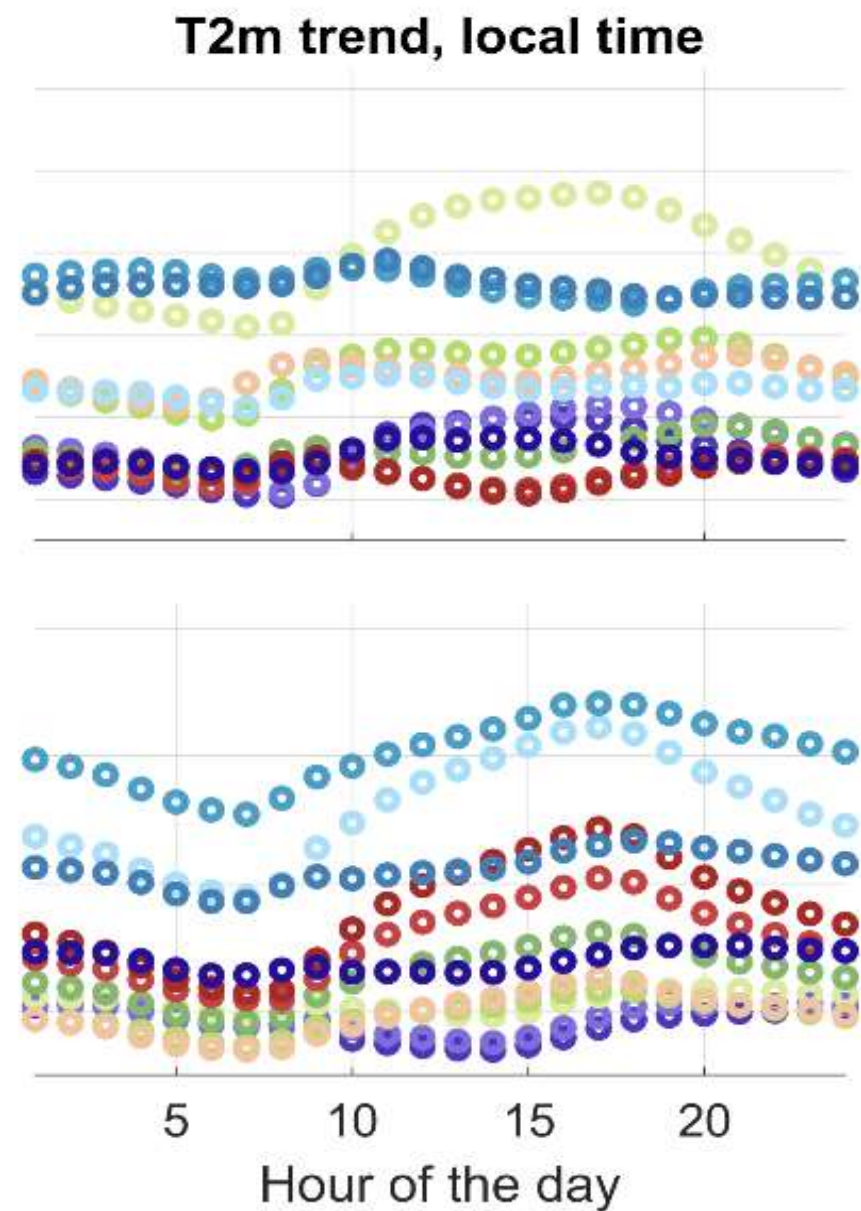
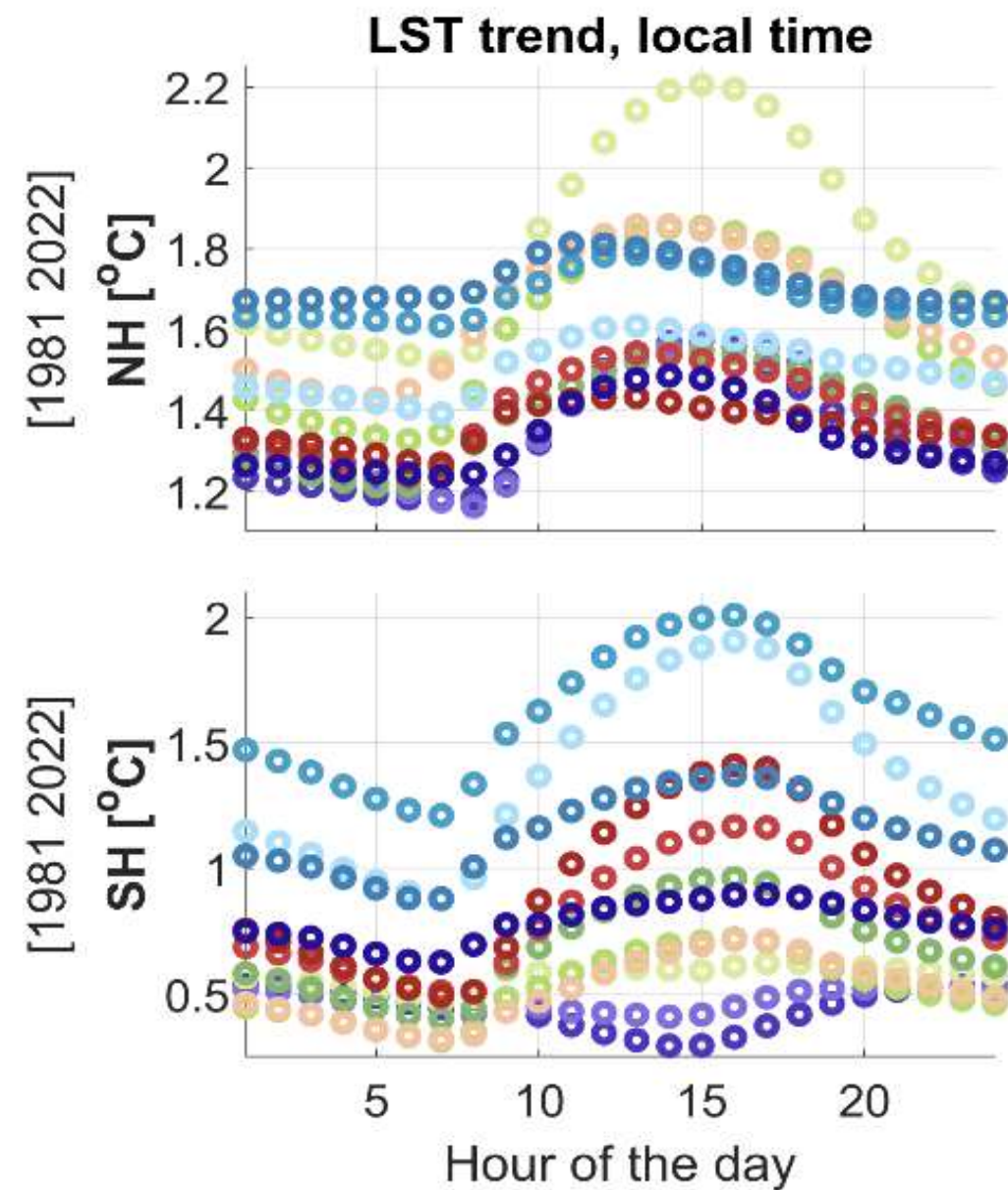
T2m



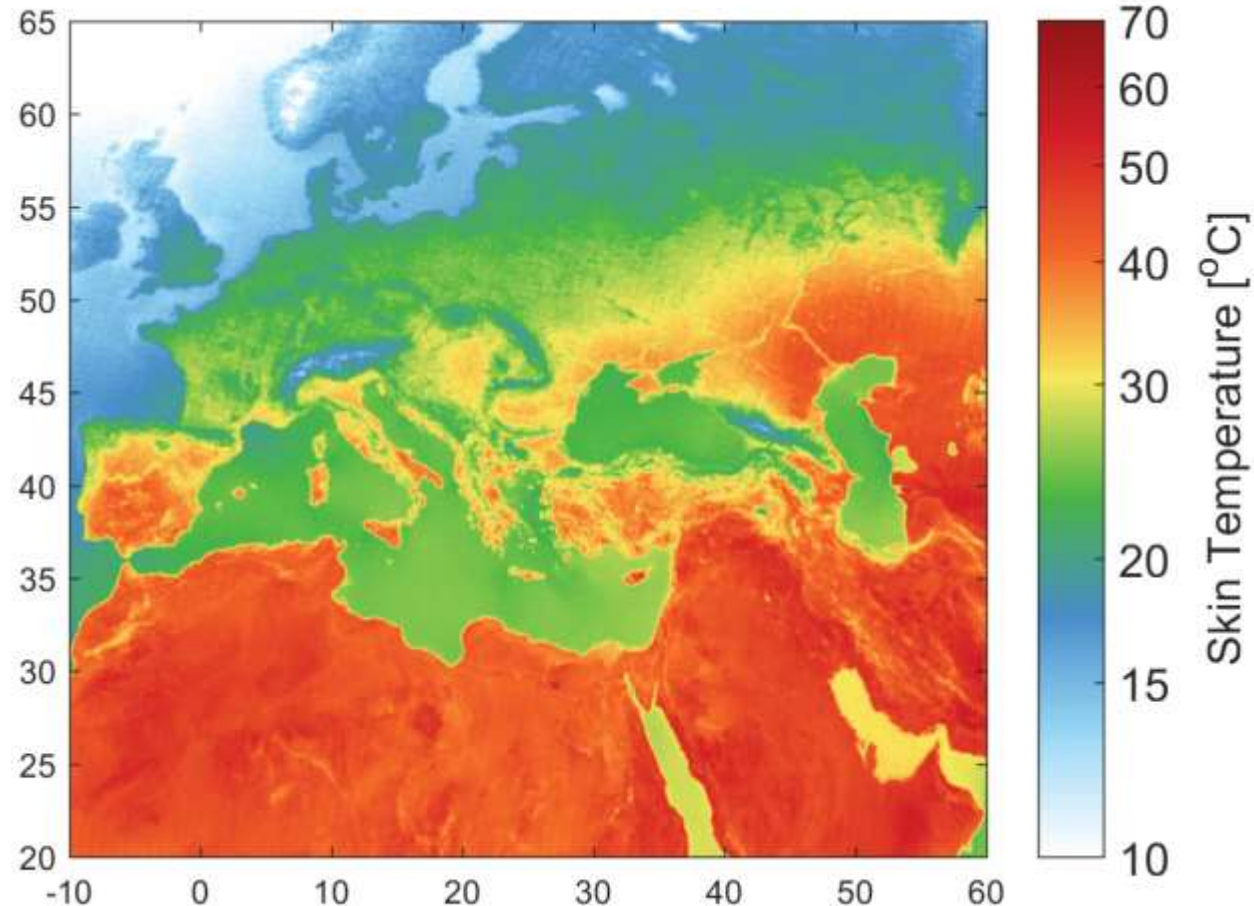
LST - T2m



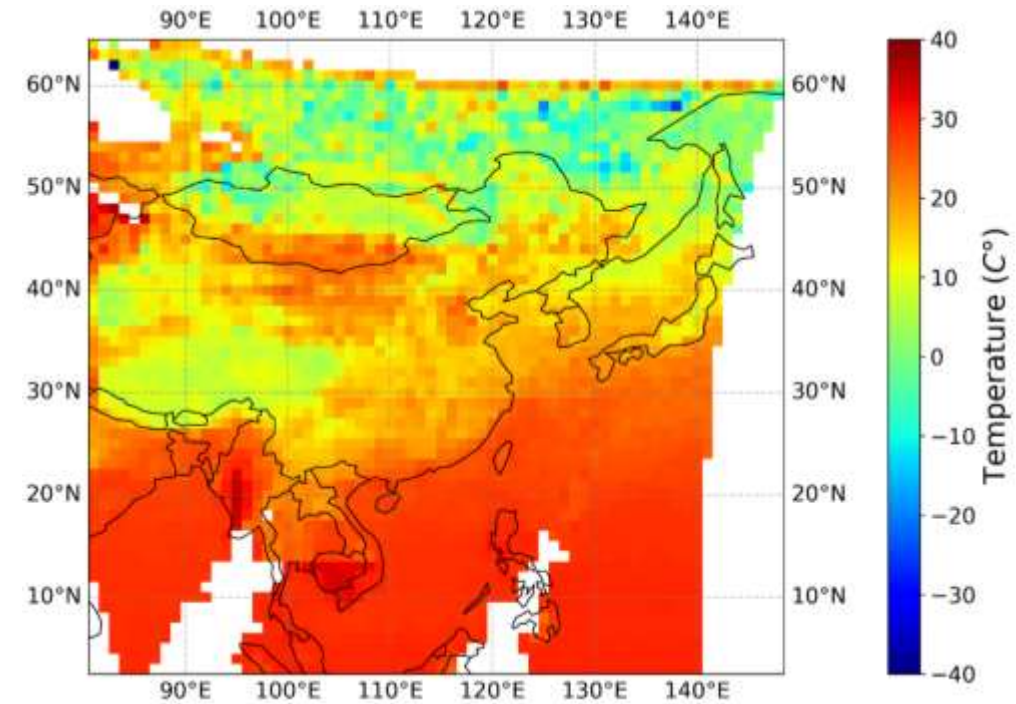
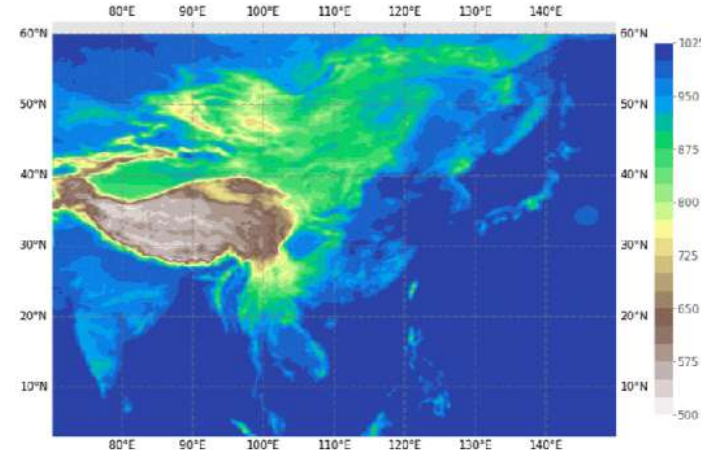
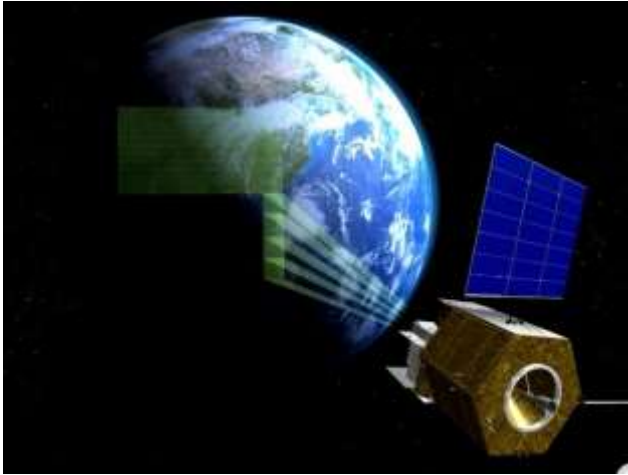
Hour of the day



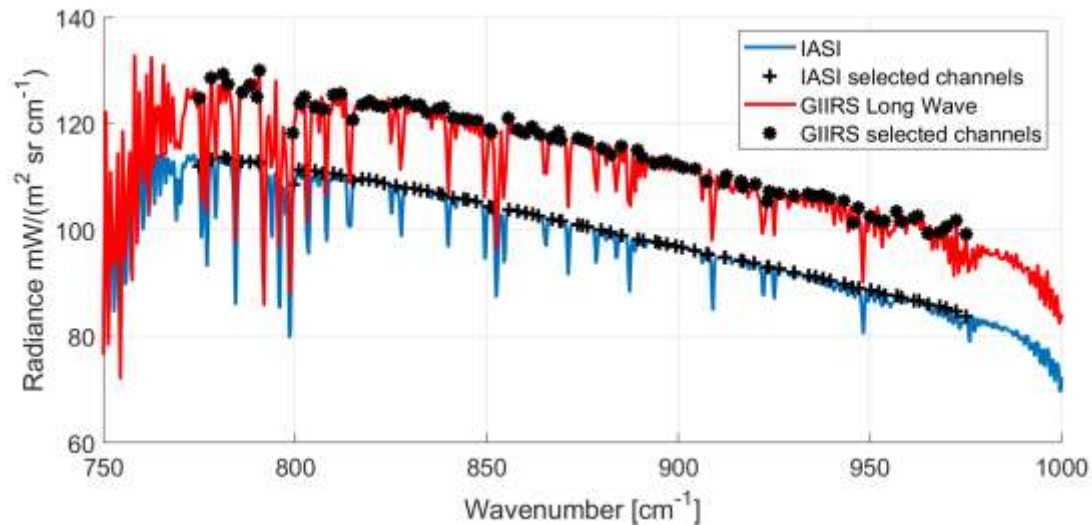
- Tskin is an essential, underrated climate variable
- TIR remote sensors' Tskin is therefore valuable because it is continuous and global
- Tskin can be easily retrieved from IASI using artificial neural networks (1 min/day/per instrument)
- Tskin trends are now possible but depend on the crossing time of the instrument which is in local time
- Our technique can be used as a framework for other instruments such as GIIRS and IRS



GIIRS, and soon IRS



Credits: Mohamad Zalat, LATMOS



Poster # 46
(Mohamad Zalat)
AI retrievals of Tskin
from GIIRS