

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

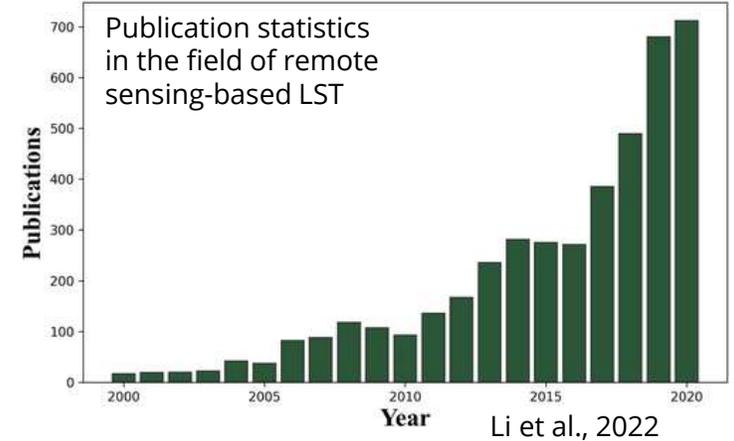
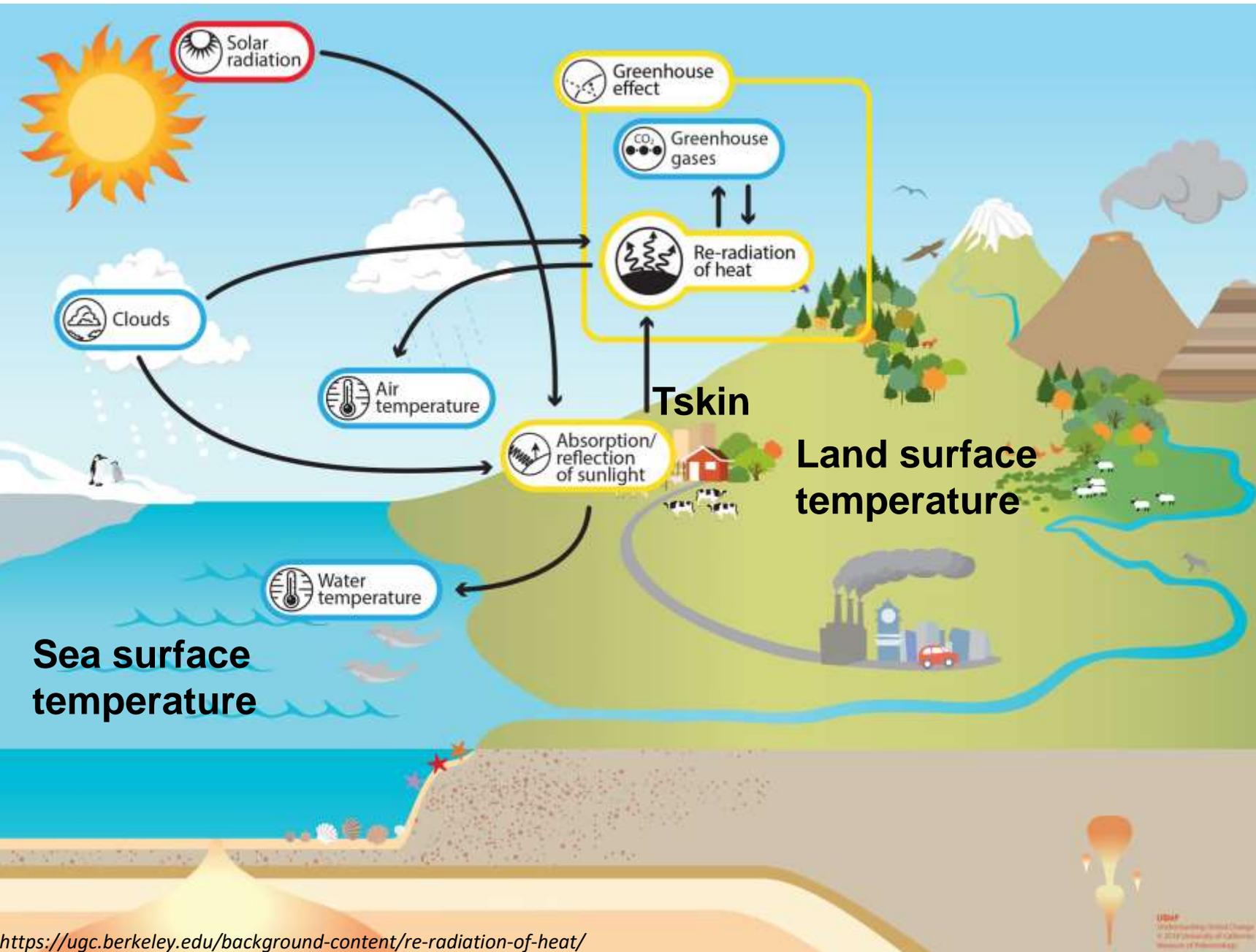
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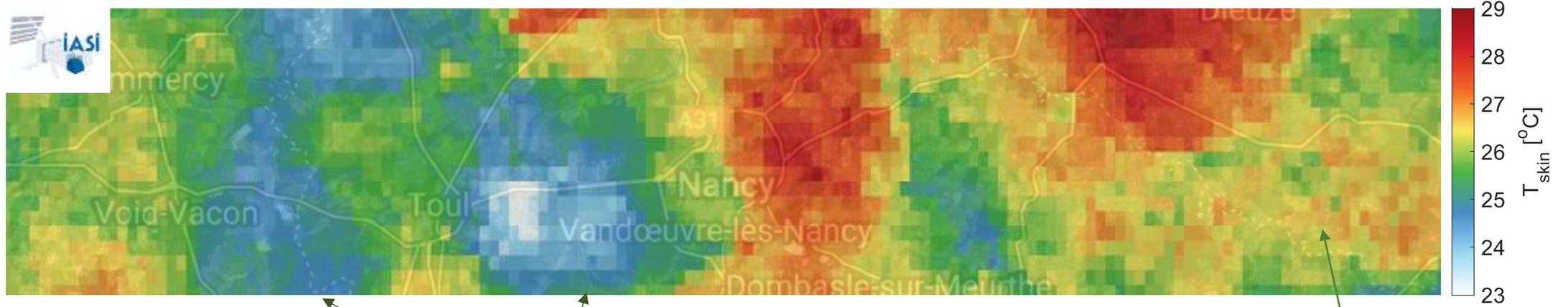
Why study Tskin from TIR instruments such as IASI?



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?



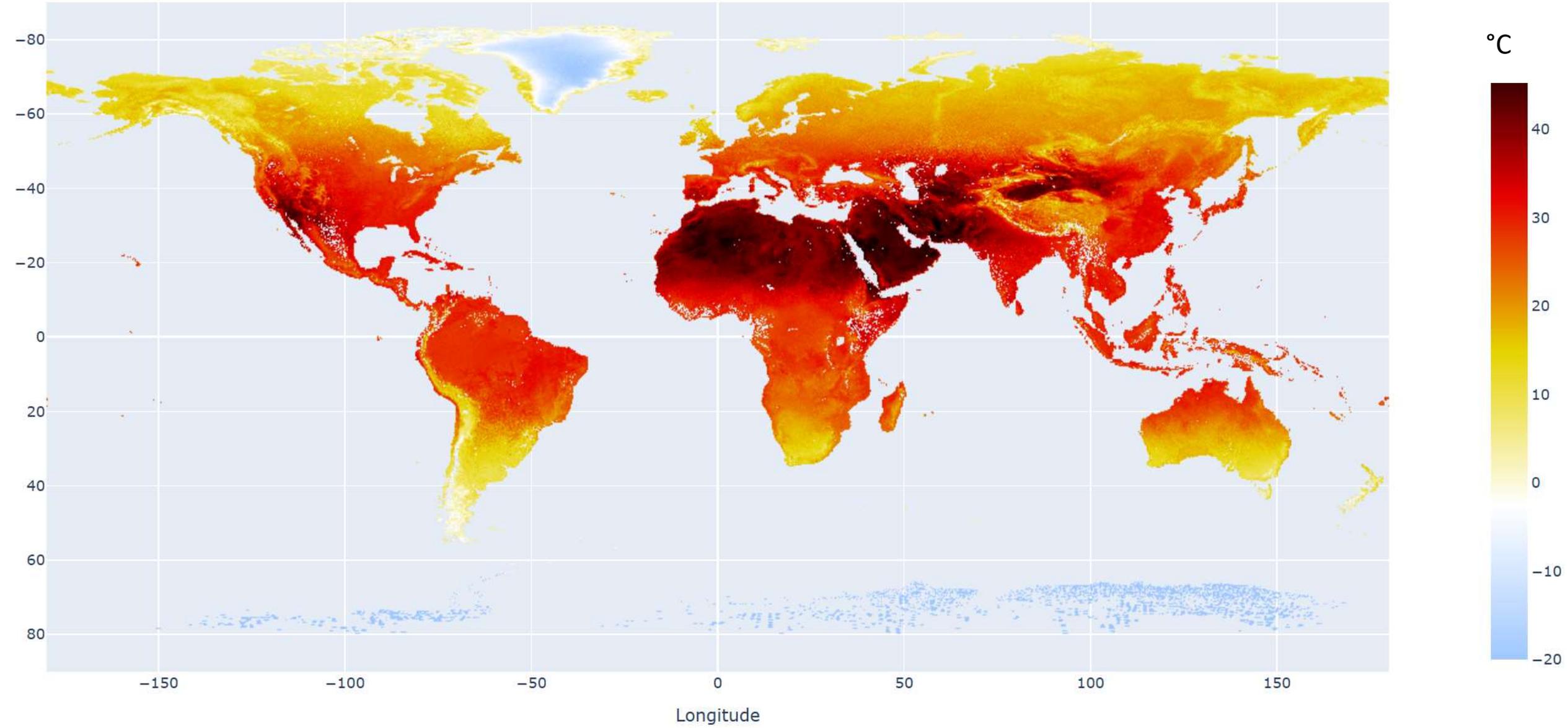
Forest/vegetation

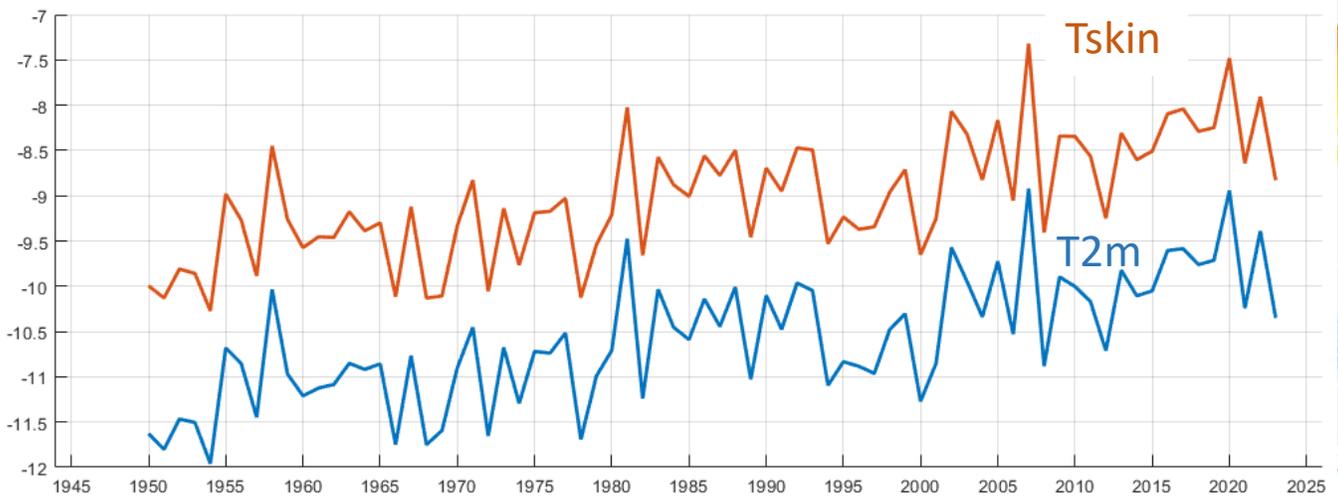
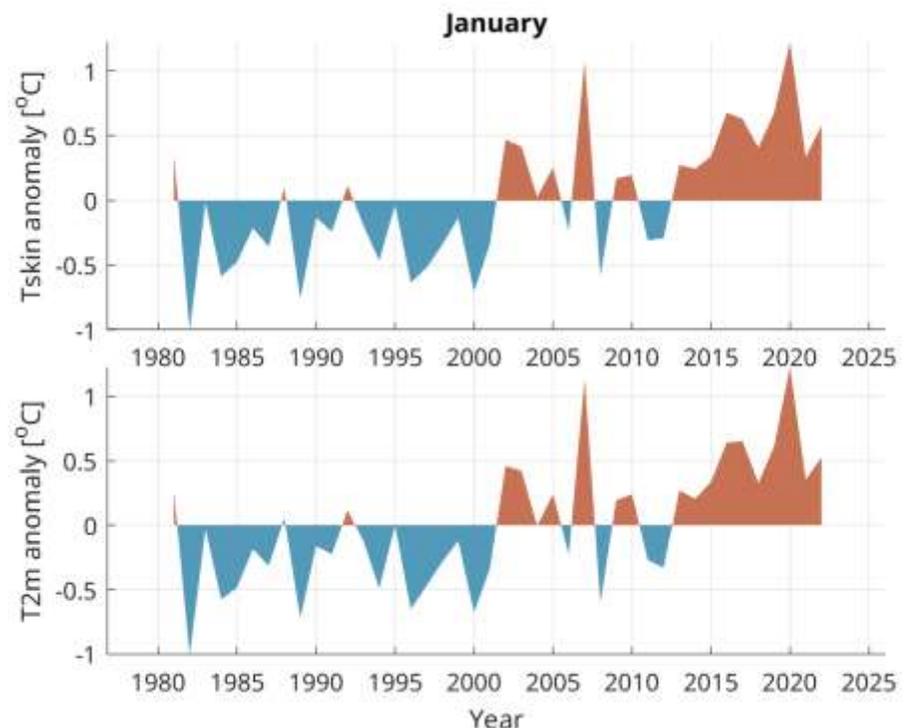
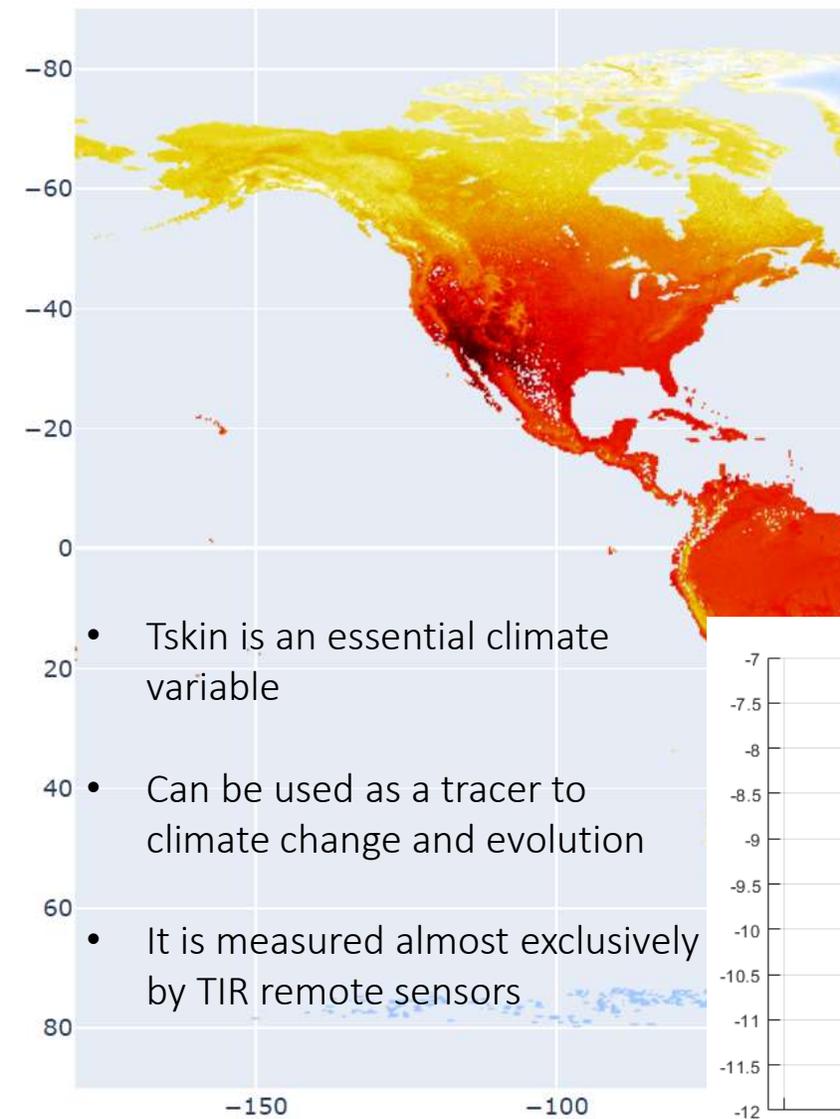
*Urban
concrete/roads, etc*

Agriculture

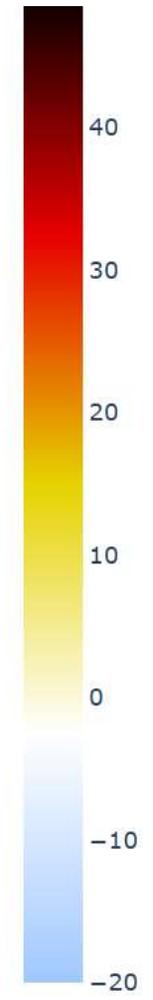


Tskin/LST or near surface temperature?

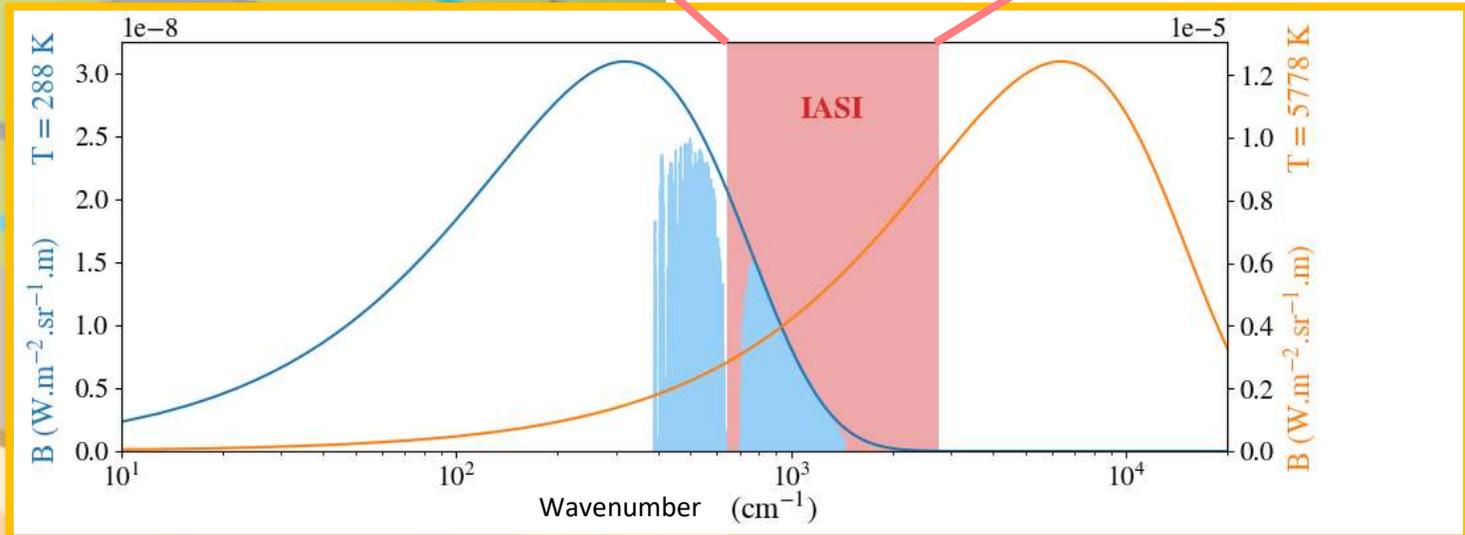
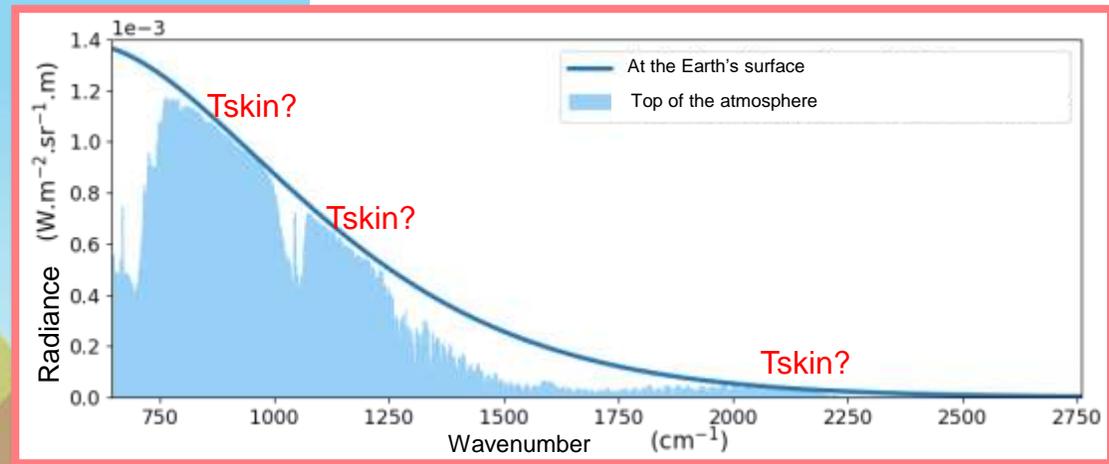
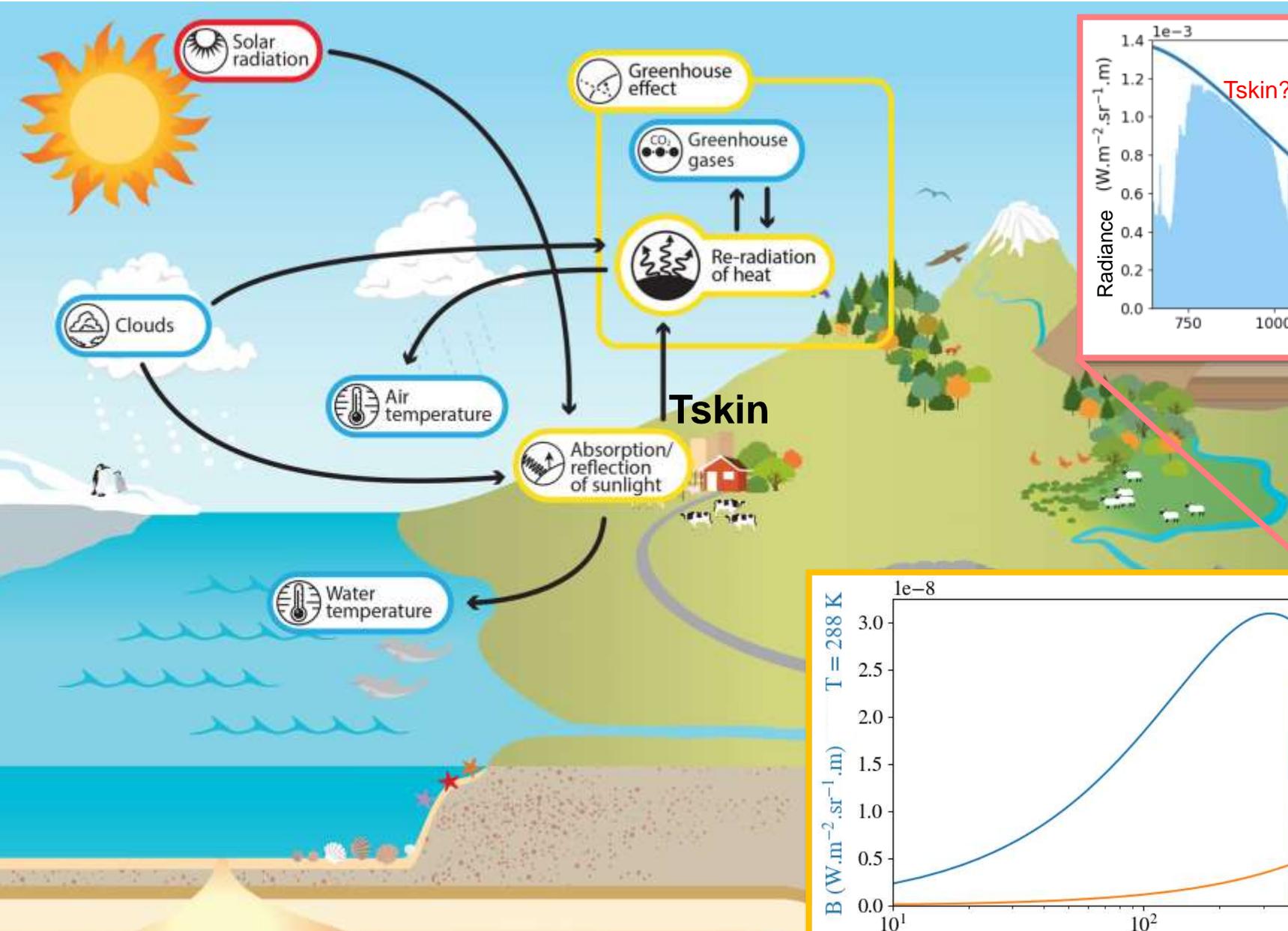




- Tskin is an essential climate variable
- Can be used as a tracer to climate change and evolution
- It is measured almost exclusively by TIR remote sensors



How is skin temperature measured by remote TIR sensors?



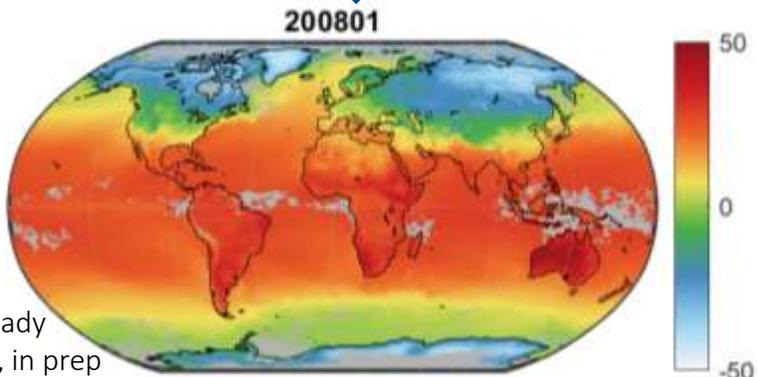
Credits: Marie bouillon

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)

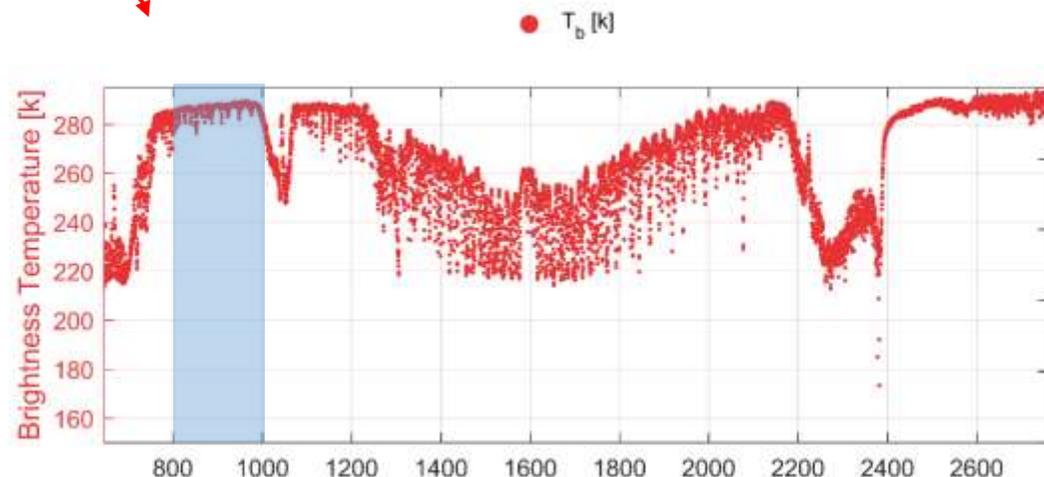
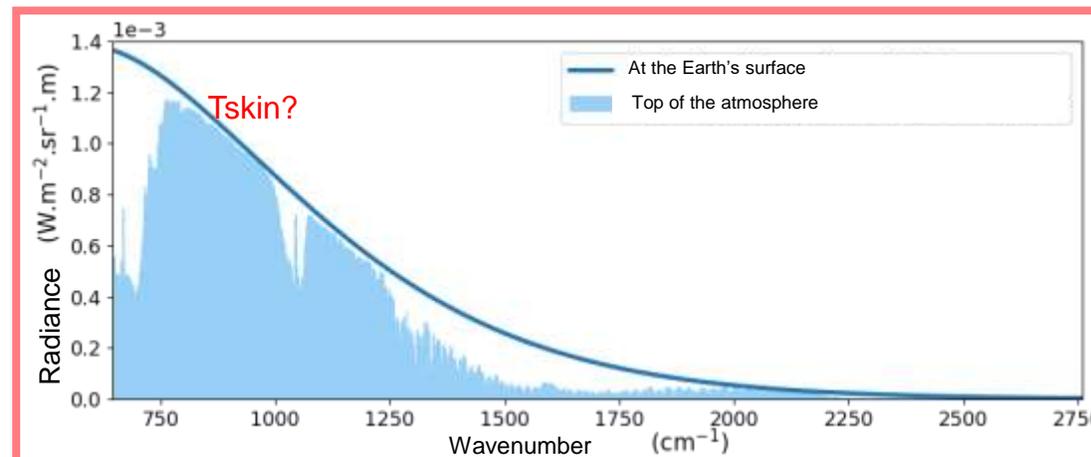
Output/
desired predictions

Tskin EUMETSAT
(Optimal estimation)



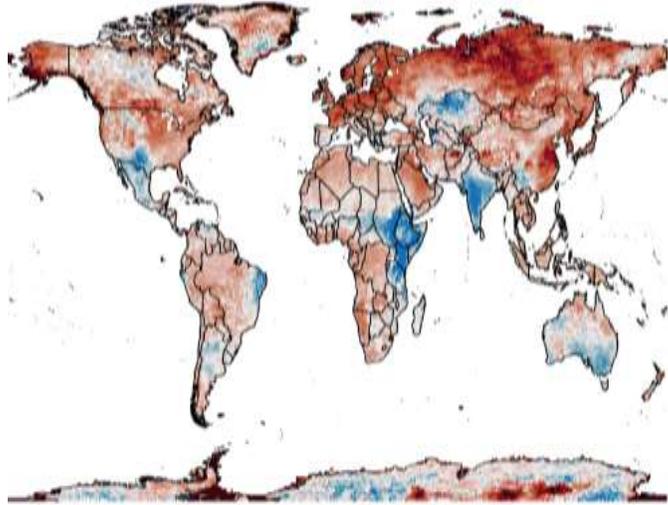
Version 2 ready
Safieddine et al., in prep

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

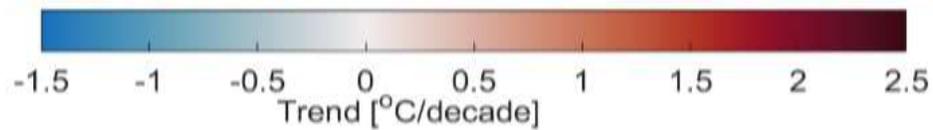
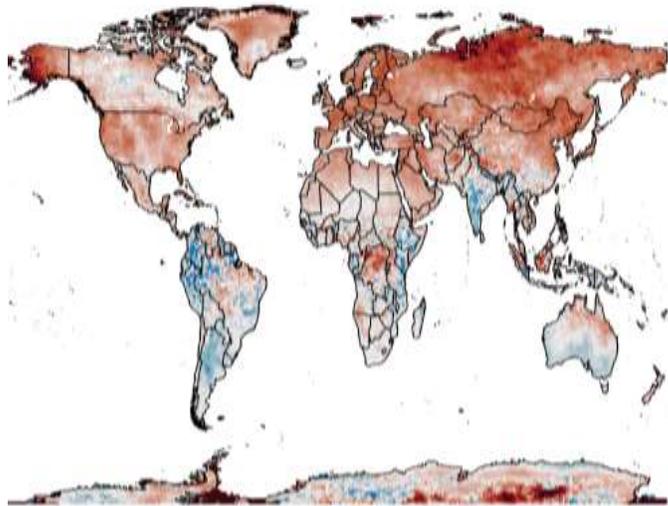


Version 1, using climatological emissivities by Zhou et al., 2010

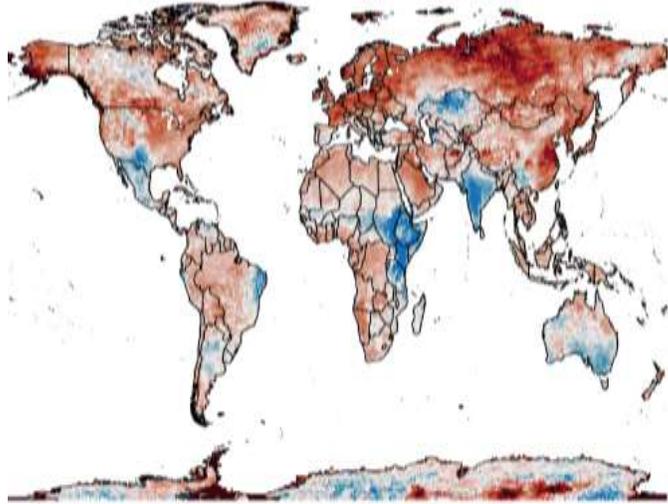
IASI @ 9:30 AM



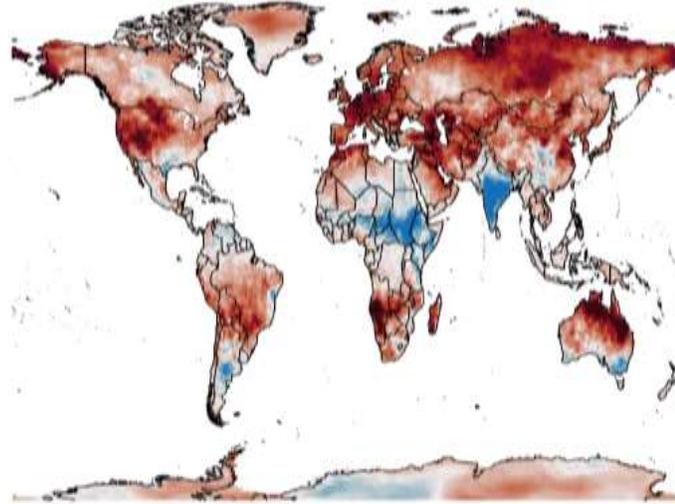
IASI @ 9:30 PM



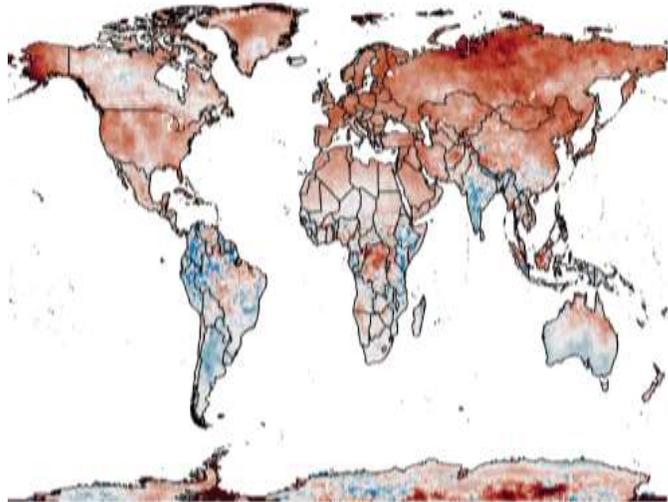
IASI @ 9:30 AM



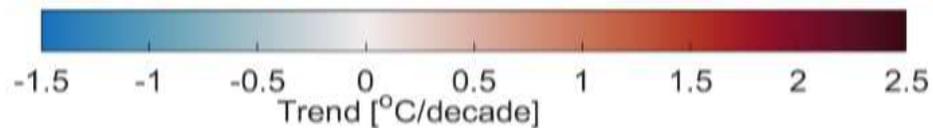
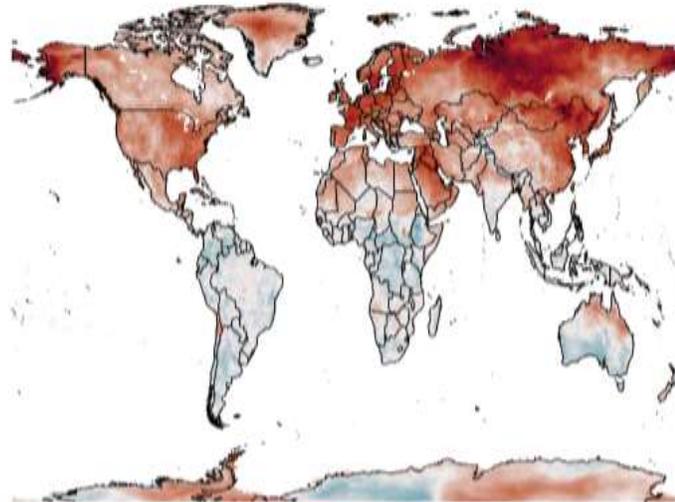
AIRS asc orbit @ 1:30 PM LT



IASI @ 9:30 PM



AIRS @ 1:30 AM LT

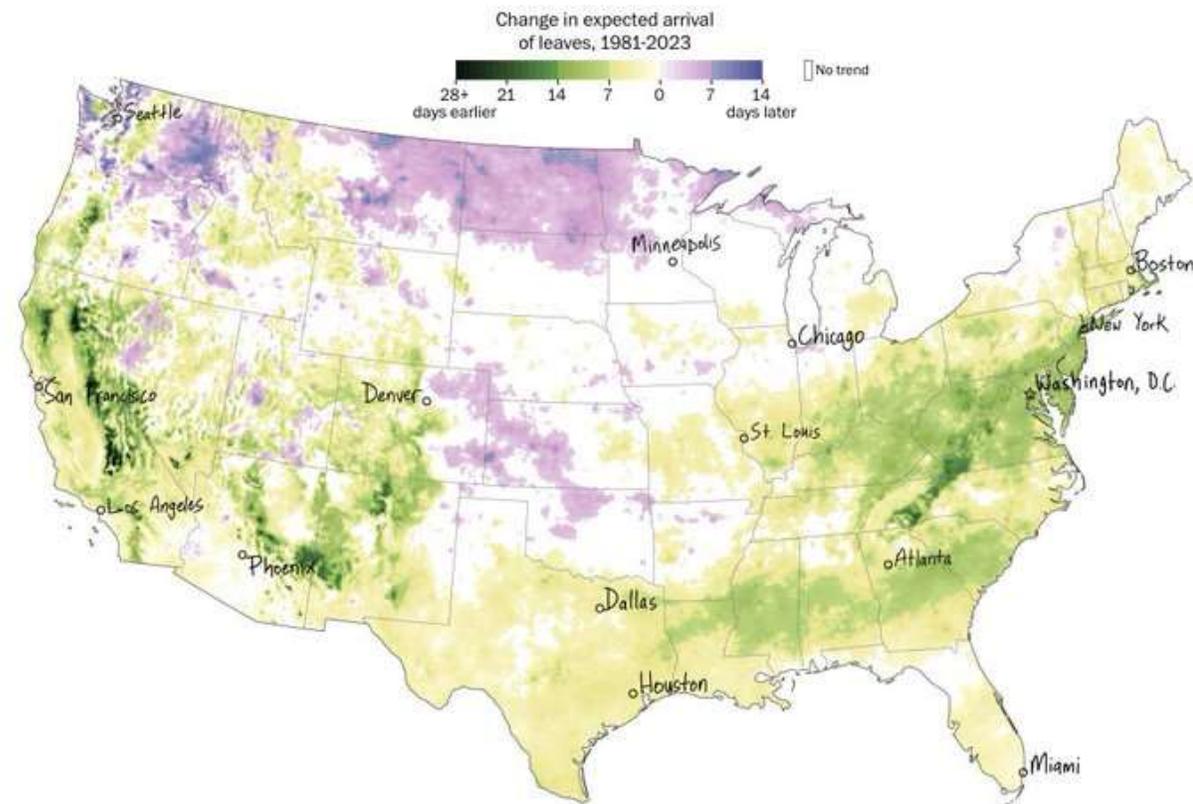


Tskin trends:

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

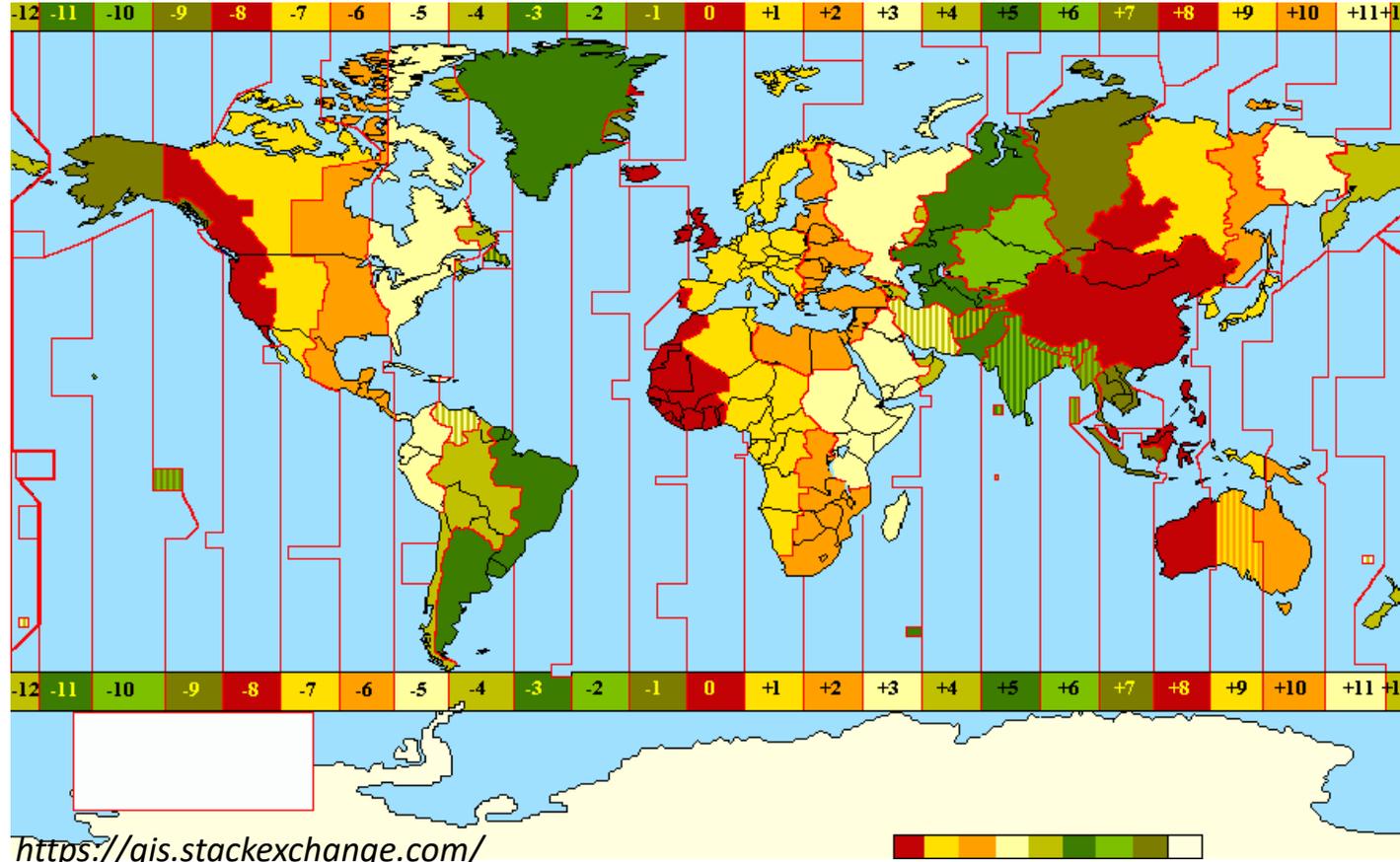
Are the temperature trends time/hour of the day dependent?

- 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).



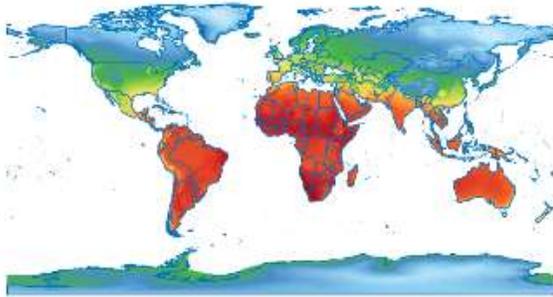
Are the temperature trends time dependent?

- 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)

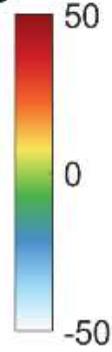
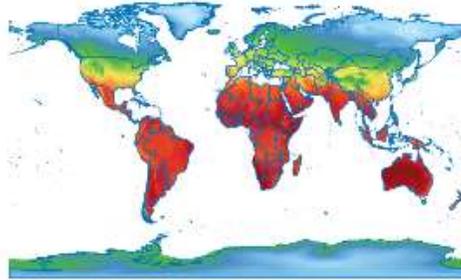


LST

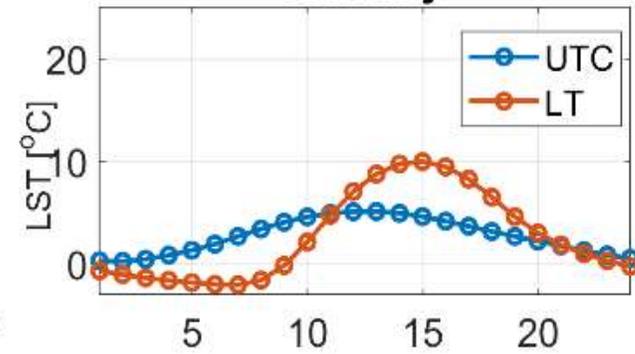
Hour of the day: 15 UTC



Hour of the day: 15 Local Time



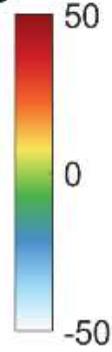
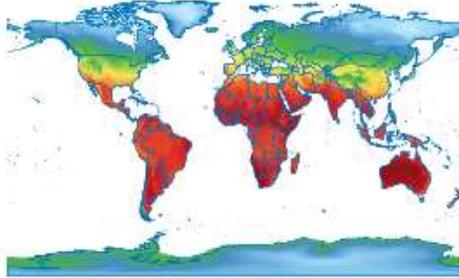
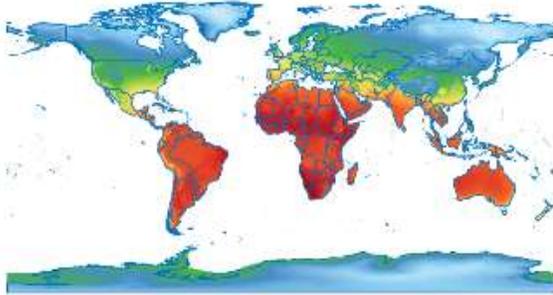
January



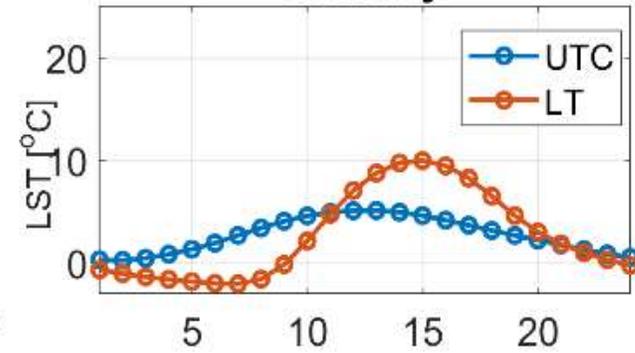
Hour of the day: 15 UTC

Hour of the day: 15 Local Time

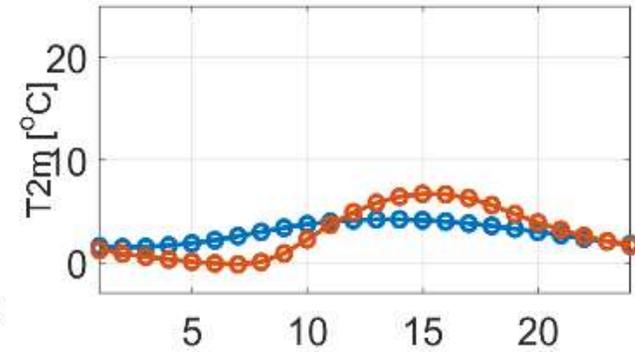
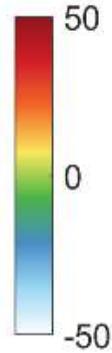
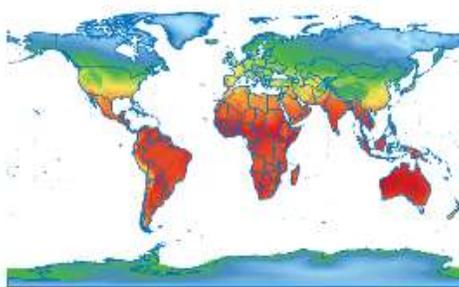
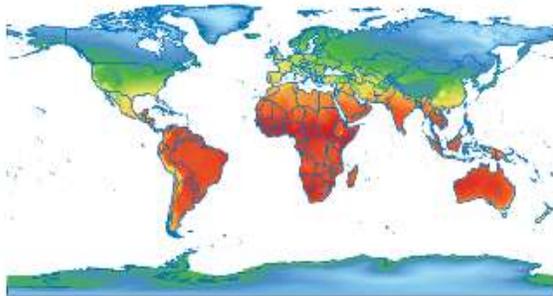
LST



January



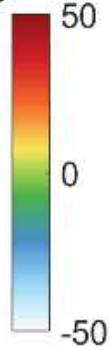
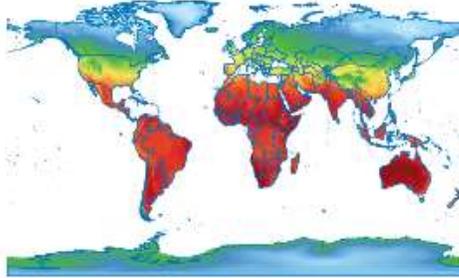
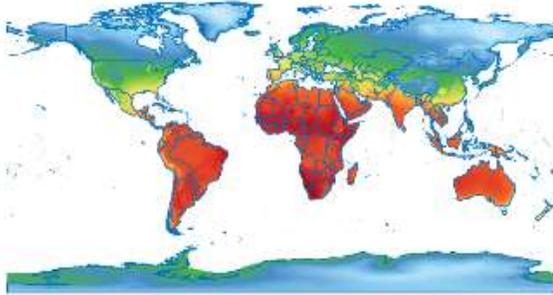
T2m



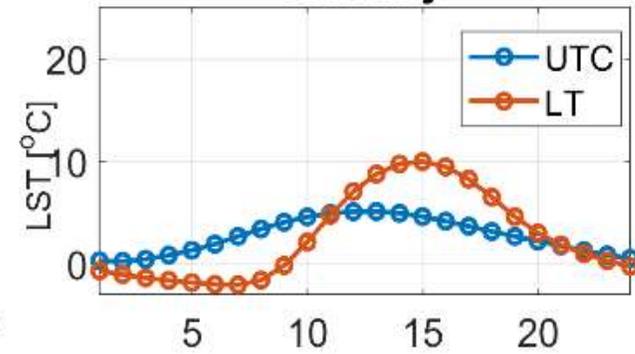
Hour of the day: 15 UTC

Hour of the day: 15 Local Time

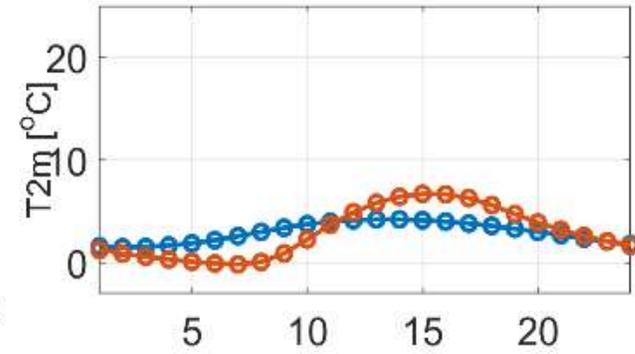
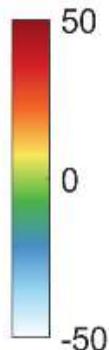
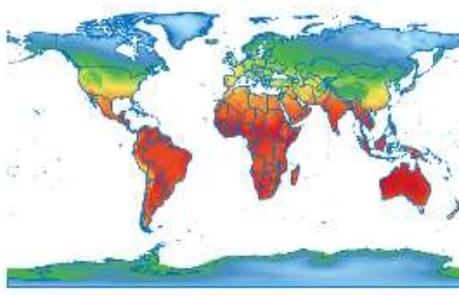
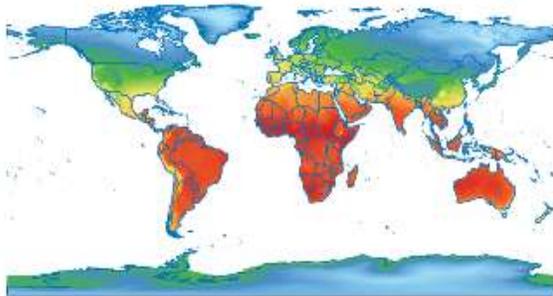
LST



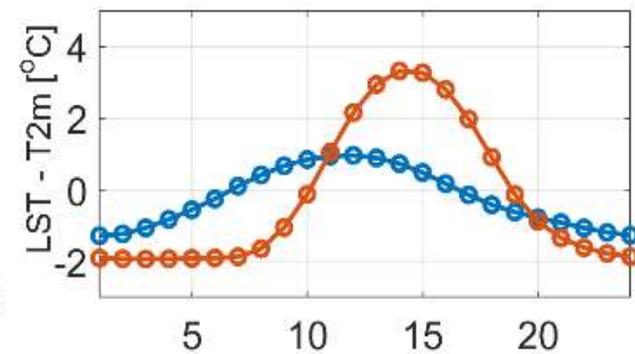
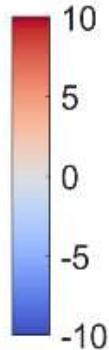
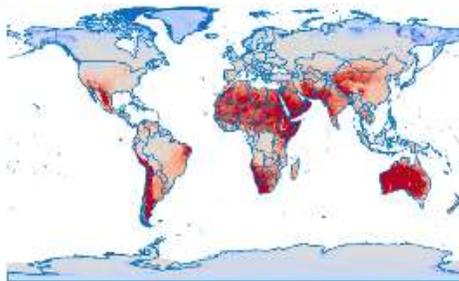
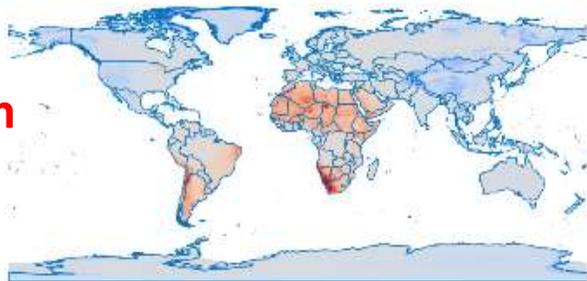
January



T2m



LST - T2m

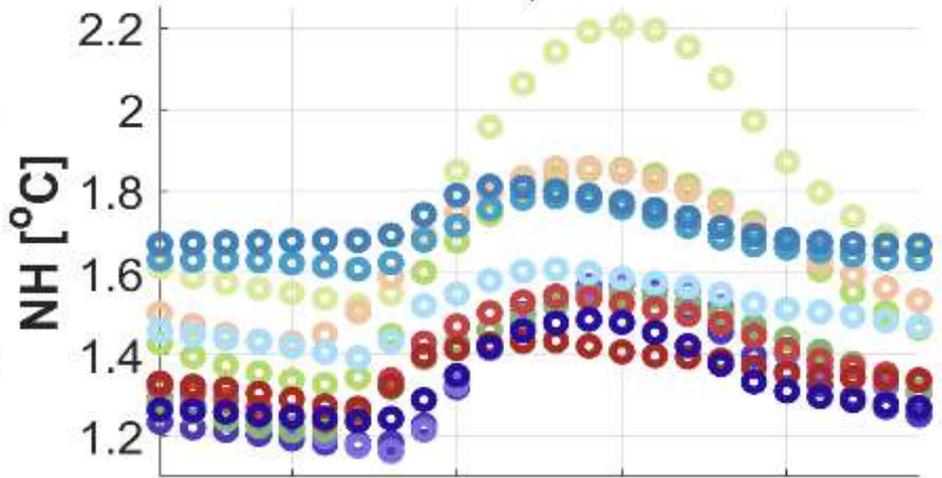


Hour of the day

LST trend, local time

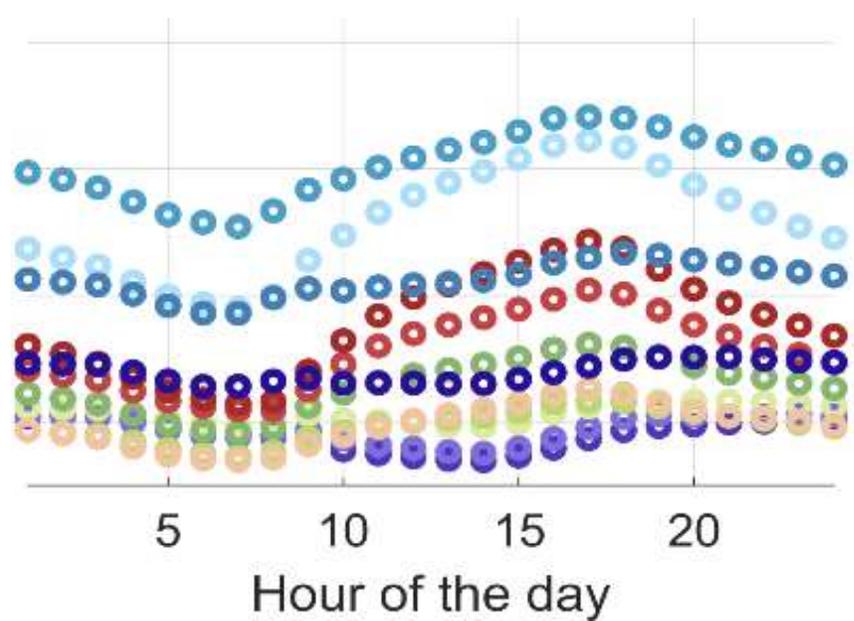
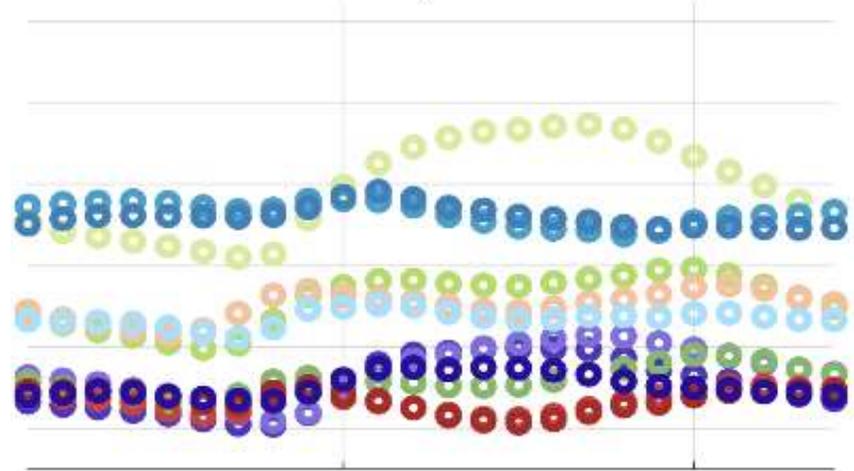
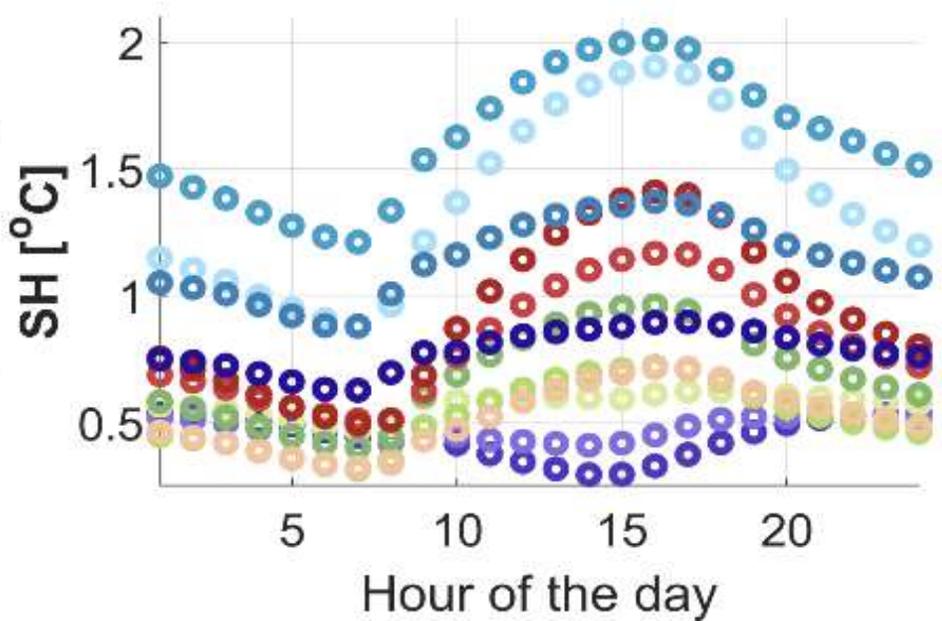
T2m trend, local time

[1981 2022]



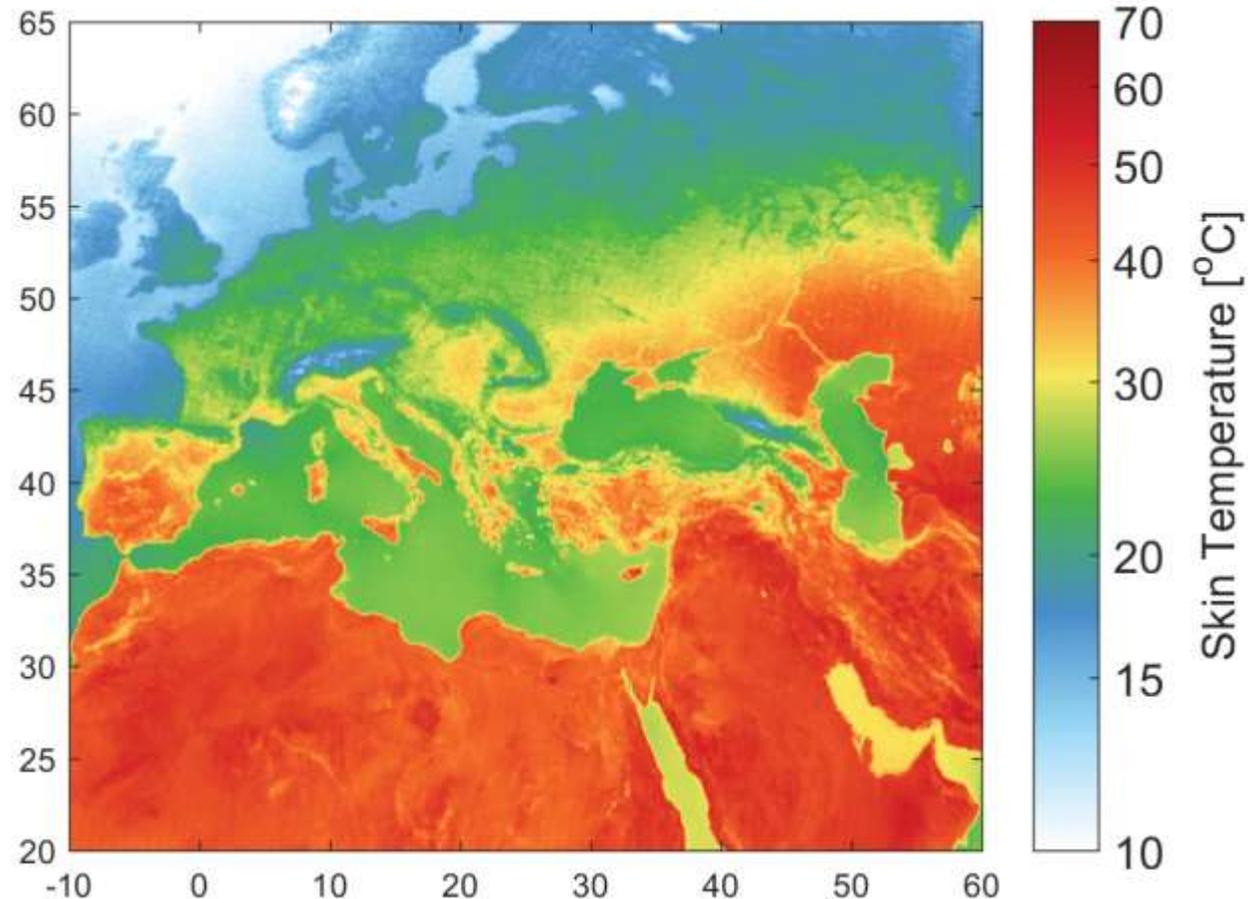
- Jan
- Feb
- Mar
- Apr
- May
- Jun
- Jul
- Aug
- Sep
- Oct
- Nov
- Dec

[1981 2022]

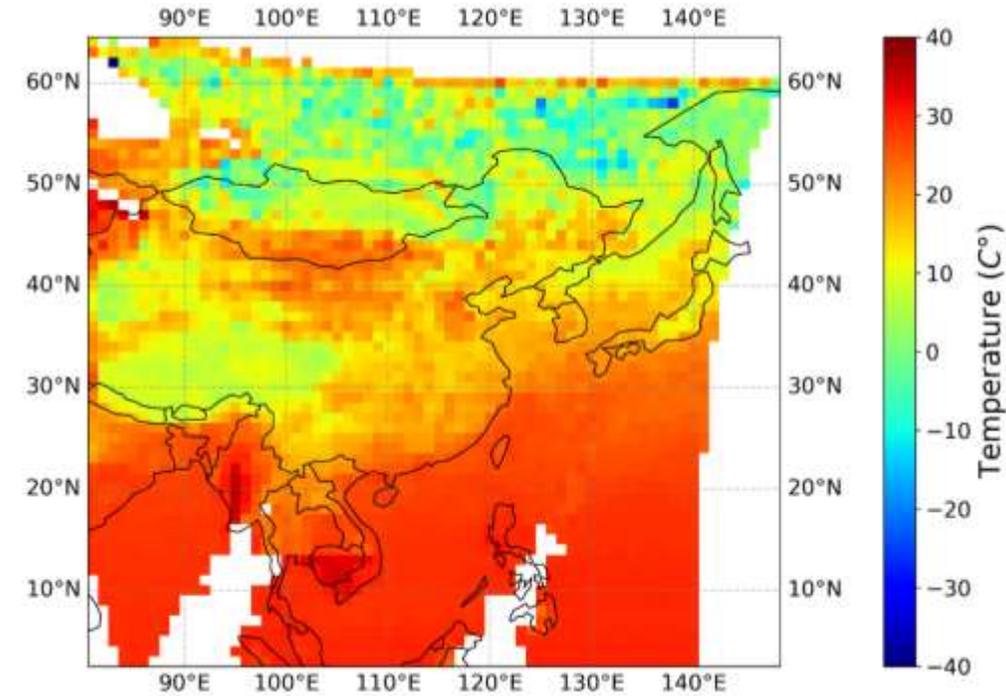
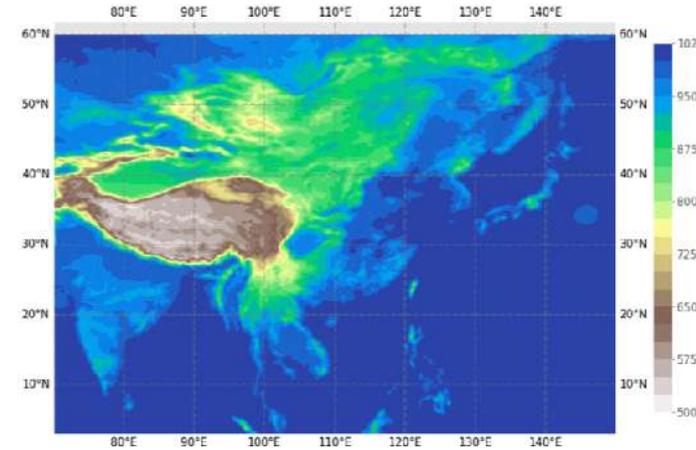
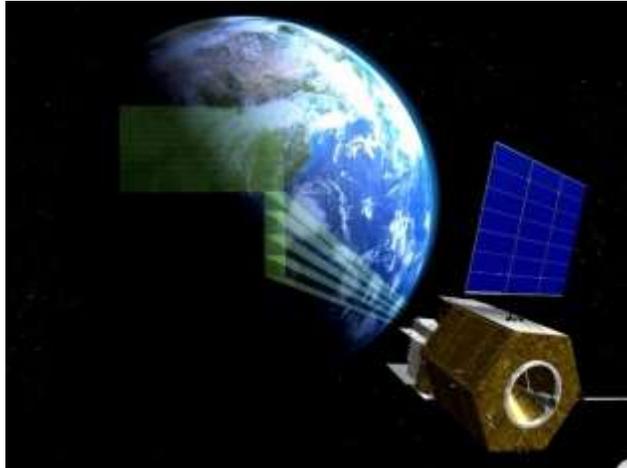


Hour of the day

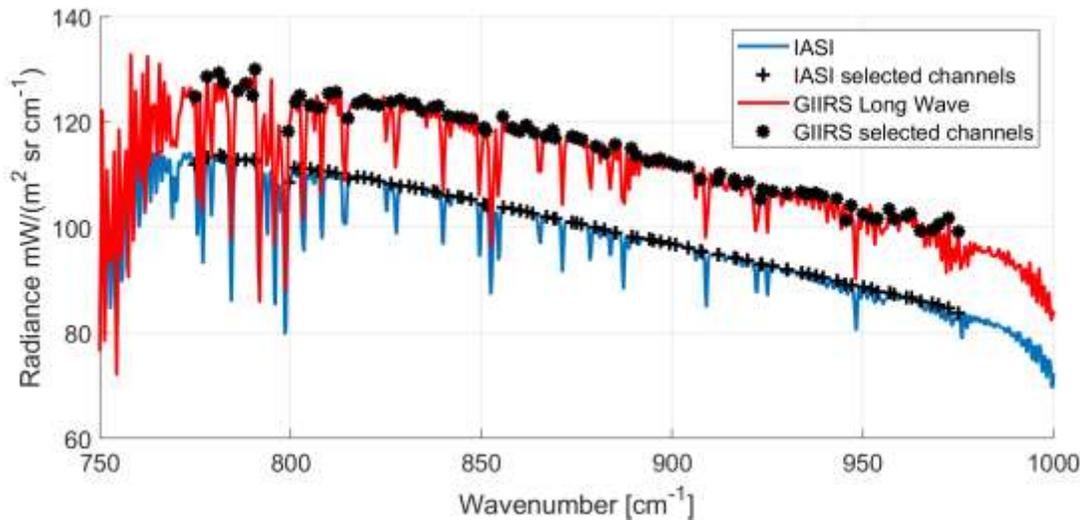
- Tskin is an essential, underrated climate variable
- TIR remote sensors' Tskin is therefore valuable because it is continuous and global
- Tskin can be easily retrieved from IASI using artificial neural networks (1 min/day/per instrument)
- Tskin trends are now possible but depend on the crossing time 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