# Skin temperature from IASI: agriculture and urban heat islands monitoring

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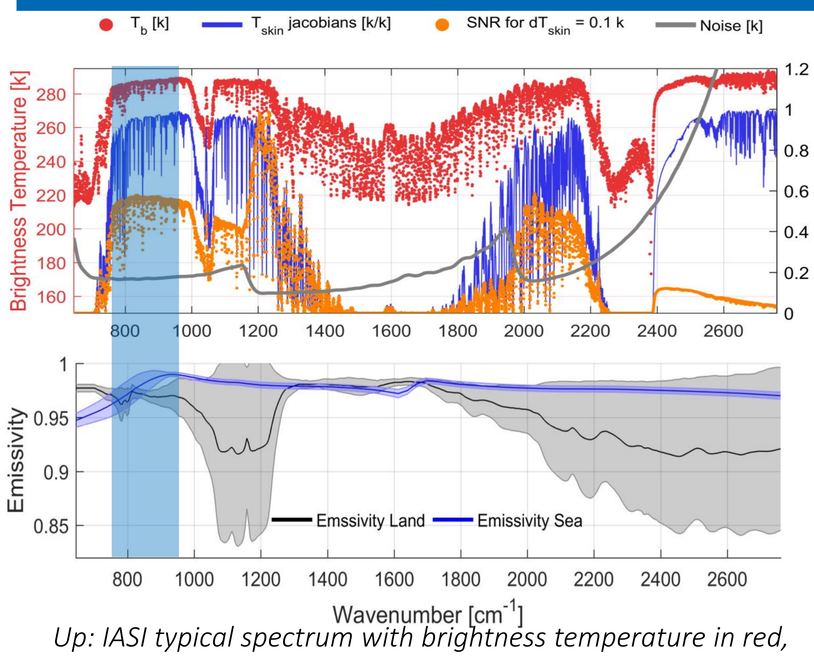
## Introduction

Skin temperature, (Tskin), also known as Land Surface Temperature is derived from infrared sensors and provides a continuous view of Earth's surface and allows for the monitoring of surface temperature changes relevant for climate trends. Tskin from the Infrared Atmospheric Sounding Interferometer (IASI) has not been properly exploited to date to assess its long-term spatio-temporal variability. In this study, we present a fast retrieval method of Tskin based on an artificial neural network from a set of IASI channels selected using entropy reduction technique.

We show the extent to which Tskin can be used to monitor land use in the past decade. We focus in particular on heatwaves and on agricultural and urban expansion with a focus on the Arabian Peninsula where extreme heat is recorded.

## Methods




*Up: IASI typical spectrum with brightness temperature in red, Tskin jacobians in blue, SNR in orange, and noise in grey. Bottom: surface emissivity over land and sea*

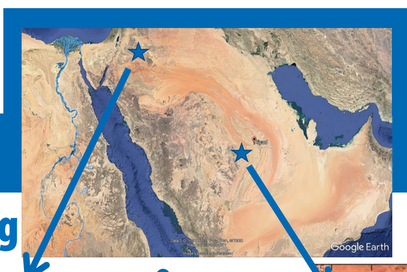
### CHANNEL SELECTION

Channels are selected in the shaded region after an analysis of the spectrum. This spectral region [780-980] $cm^{-1}$ is optimal in terms of SNR, radiometric noise, and emissivity effect and have the best information on skin temperature.

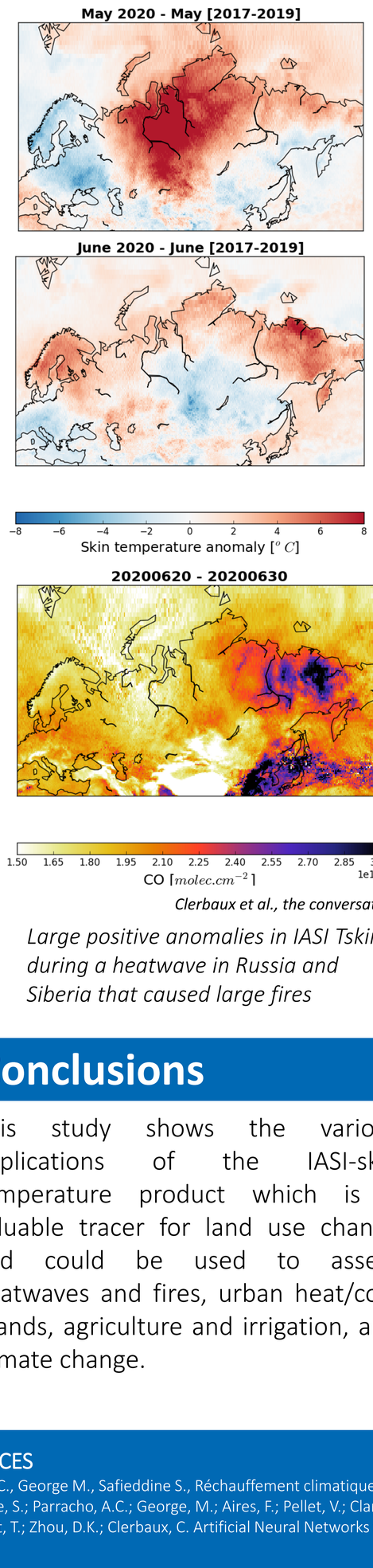
### NEURAL NETWORKS FOR $T_{SKIN}$ RETRIEVAL

Artificial neural networks (ANN) method is used to approximate the complex radiative transfer function that maps the radiances to skin temperature. The training dataset is constructed out of clear-sky (cloud cover <10%) Level 1C (L1C) IASI radiances over 100 channels selected using Entropy Reduction. We train our ANN with these IASI radiances as input, and we use the $T_{skin}$ from the ERA5 reanalysis as output/target (Safieddine et al., 2020).

## Applications



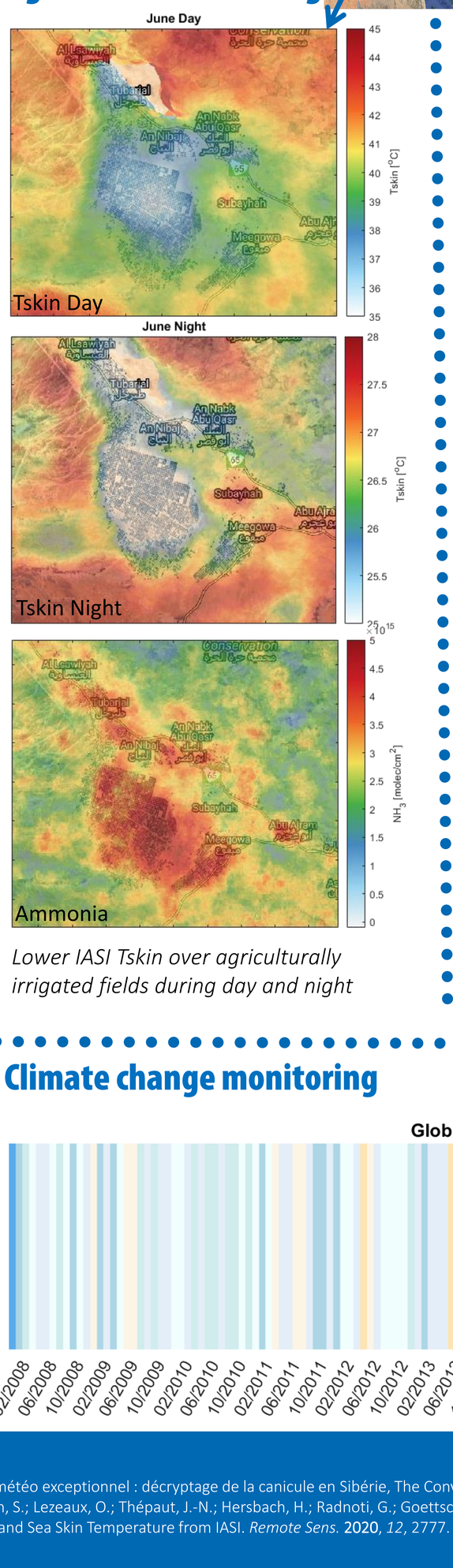

### Heatwaves and Fires




*Clerbaux et al., the conversation, 2020*

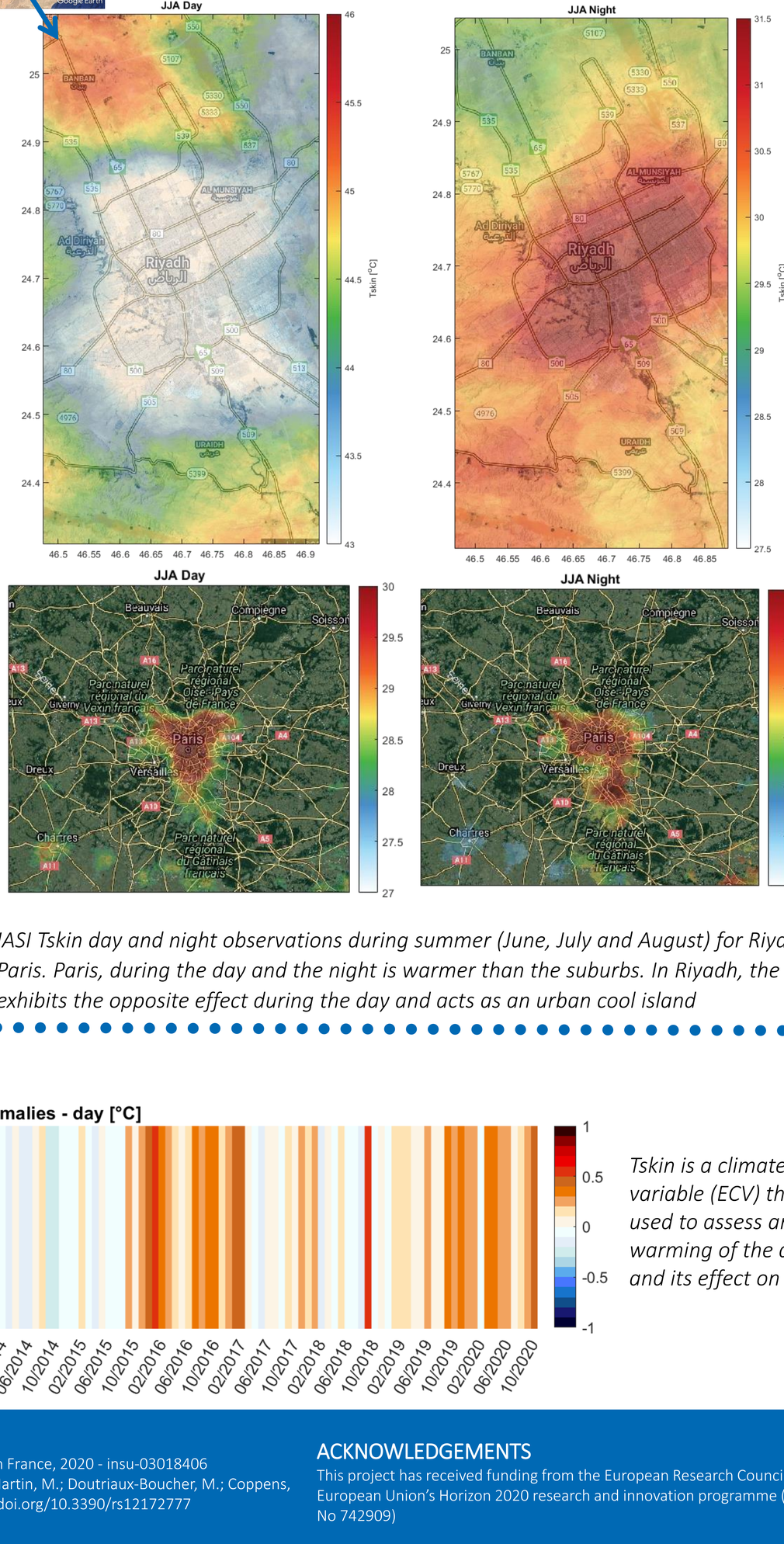
*Large positive anomalies in IASI Tskin during a heatwave in Russia and Siberia that caused large fires*

### Agriculture Monitoring




*Lower IASI Tskin over agriculturally irrigated fields during day and night*

### Urban Heat/Cool Islands




*IASI Tskin day and night observations during summer (June, July and August) for Riyadh and Paris. Paris, during the day and the night is warmer than the suburbs. In Riyadh, the city exhibits the opposite effect during the day and acts as an urban cool island*

## Conclusions

This study shows the various applications of the IASI-skin temperature product which is a valuable tracer for land use change and could be used to assess heatwaves and fires, urban heat/cool islands, agriculture and irrigation, and climate change.

### Climate change monitoring




*Tskin is a climate essential variable (ECV) that can be used to assess and detect the warming of the atmosphere and its effect on land and sea*

REFERENCES

- Clerbaux C., George M., Safieddine S., Réchauffement climatique et phénomène météo exceptionnel : décryptage de la canicule en Sibérie, The Conversation France, 2020 - insu-03018406
- Safieddine, S.; Parracho, A.C.; George, M.; Aires, F.; Pellet, V.; Clarisse, L.; Whitburn, S.; Lezeaux, O.; Thépaut, J.-N.; Hersbach, H.; Radnoti, G.; Goettsche, F.; Martin, M.; Doutriaux-Boucher, M.; Coppens, D.; August, T.; Zhou, D.K.; Clerbaux, C. Artificial Neural Networks to Retrieve Land and Sea Skin Temperature from IASI. *Remote Sens.* **2020**, *12*, 2777. https://doi.org/10.3390/rs12172777

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