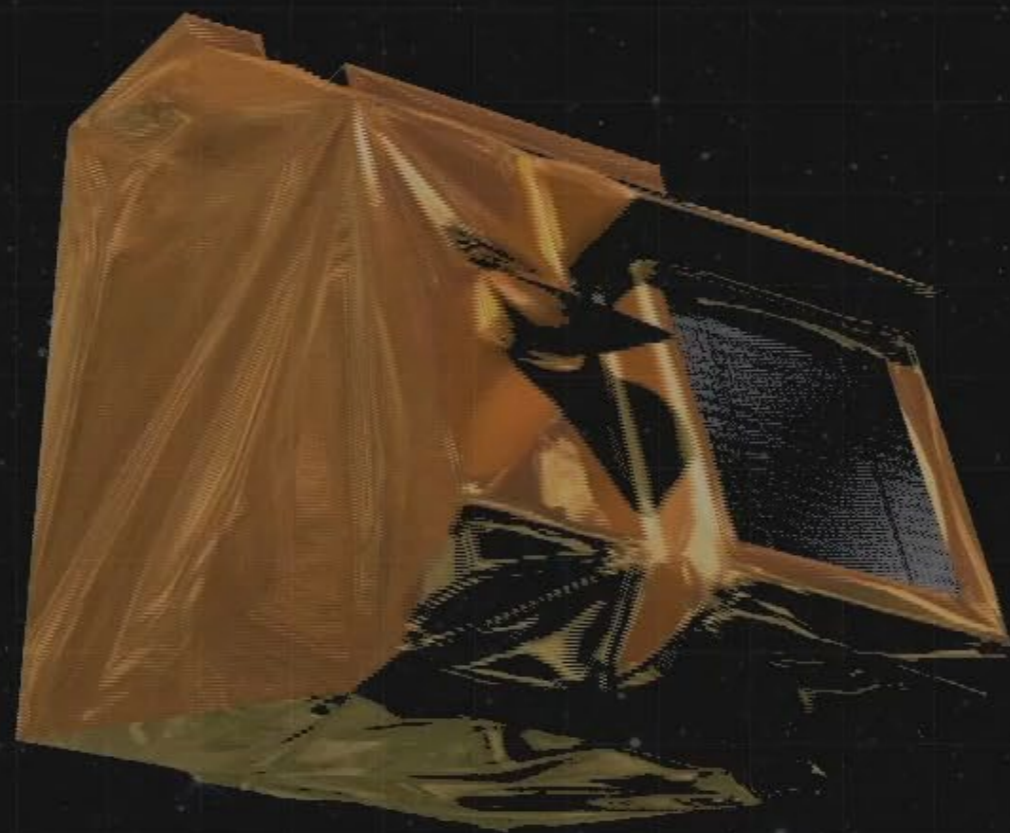




# IASI observations in 2021-2022 : some highlights

*Cathy Clerboux + LATMOS and ULB IASI Teams*

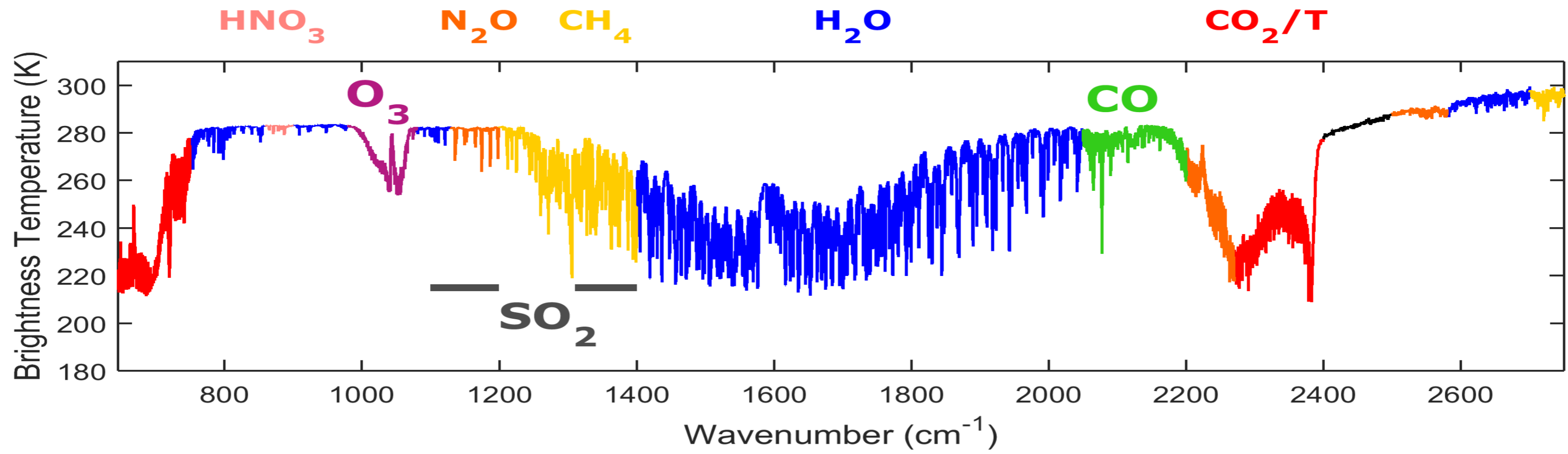
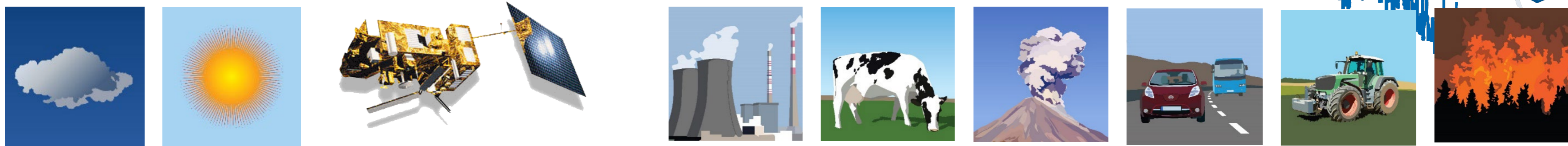


ULB

 EUMETSAT

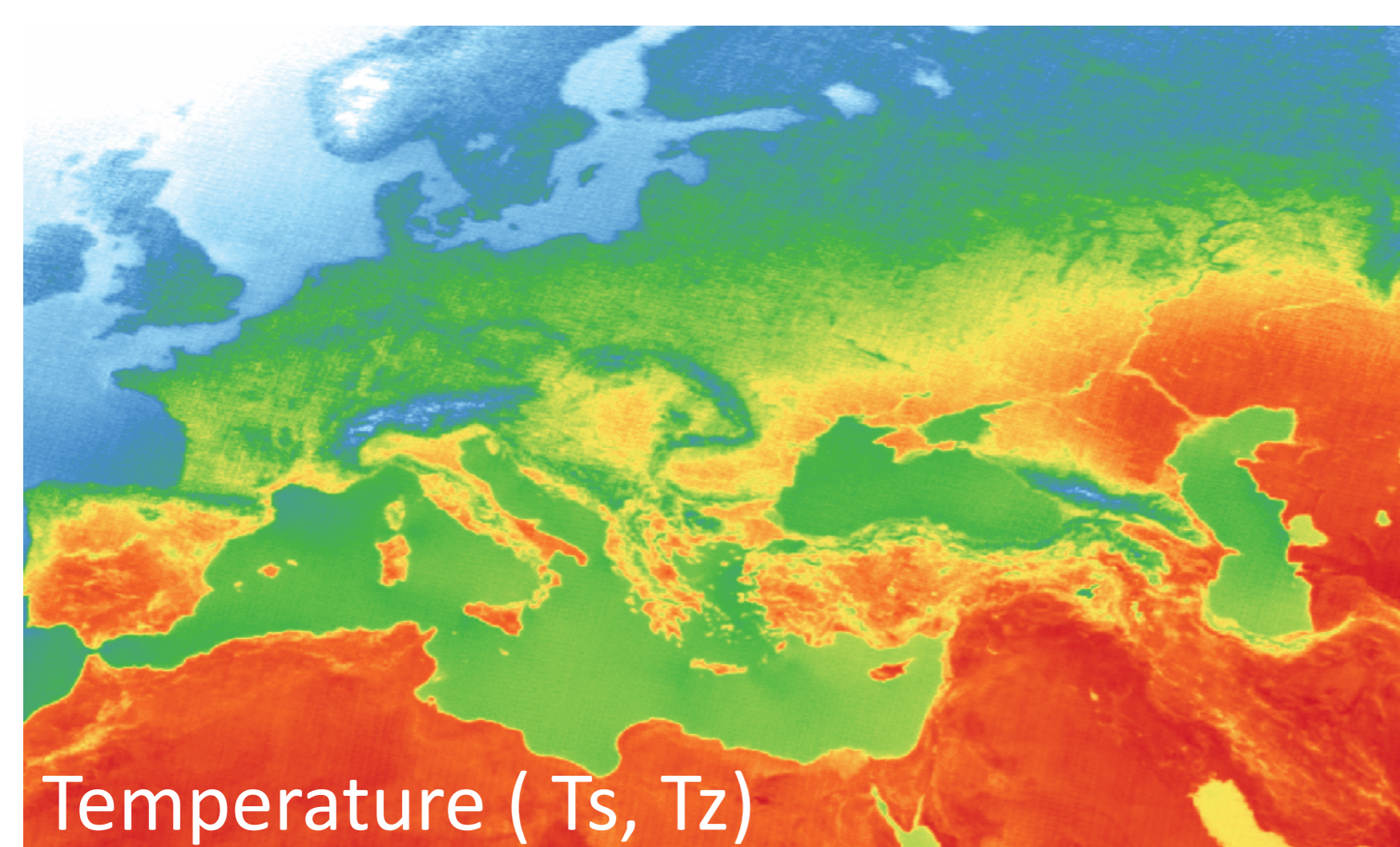
LATMOS 

 cnes



Now 33 species measured or *detected* by IASI

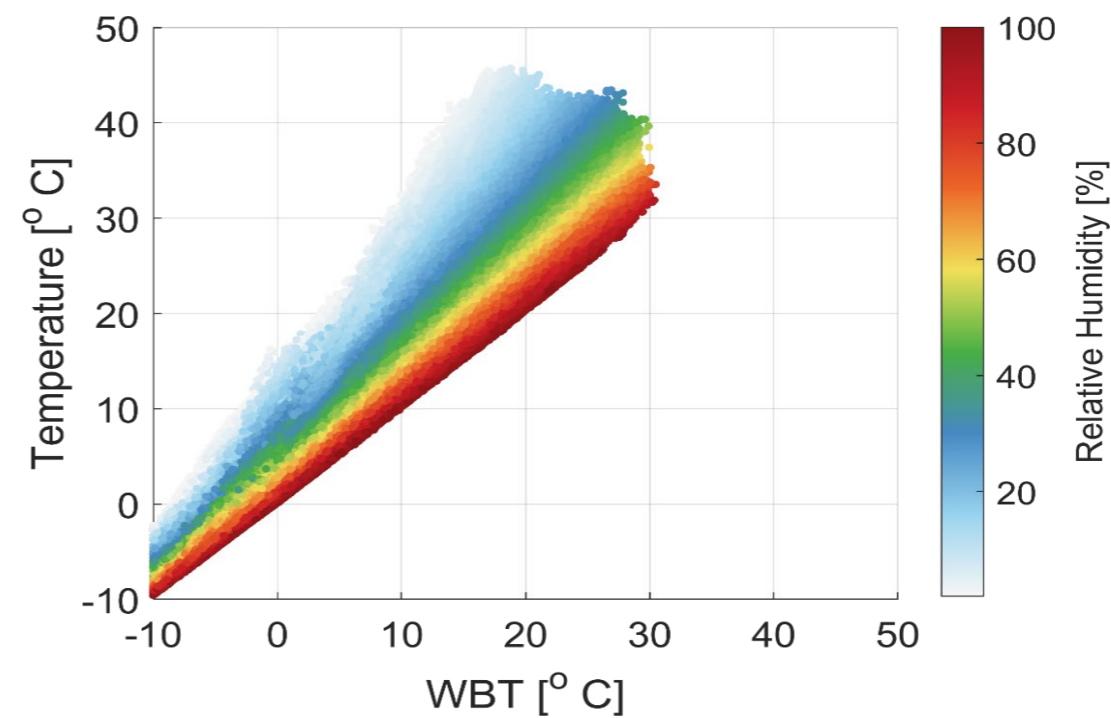
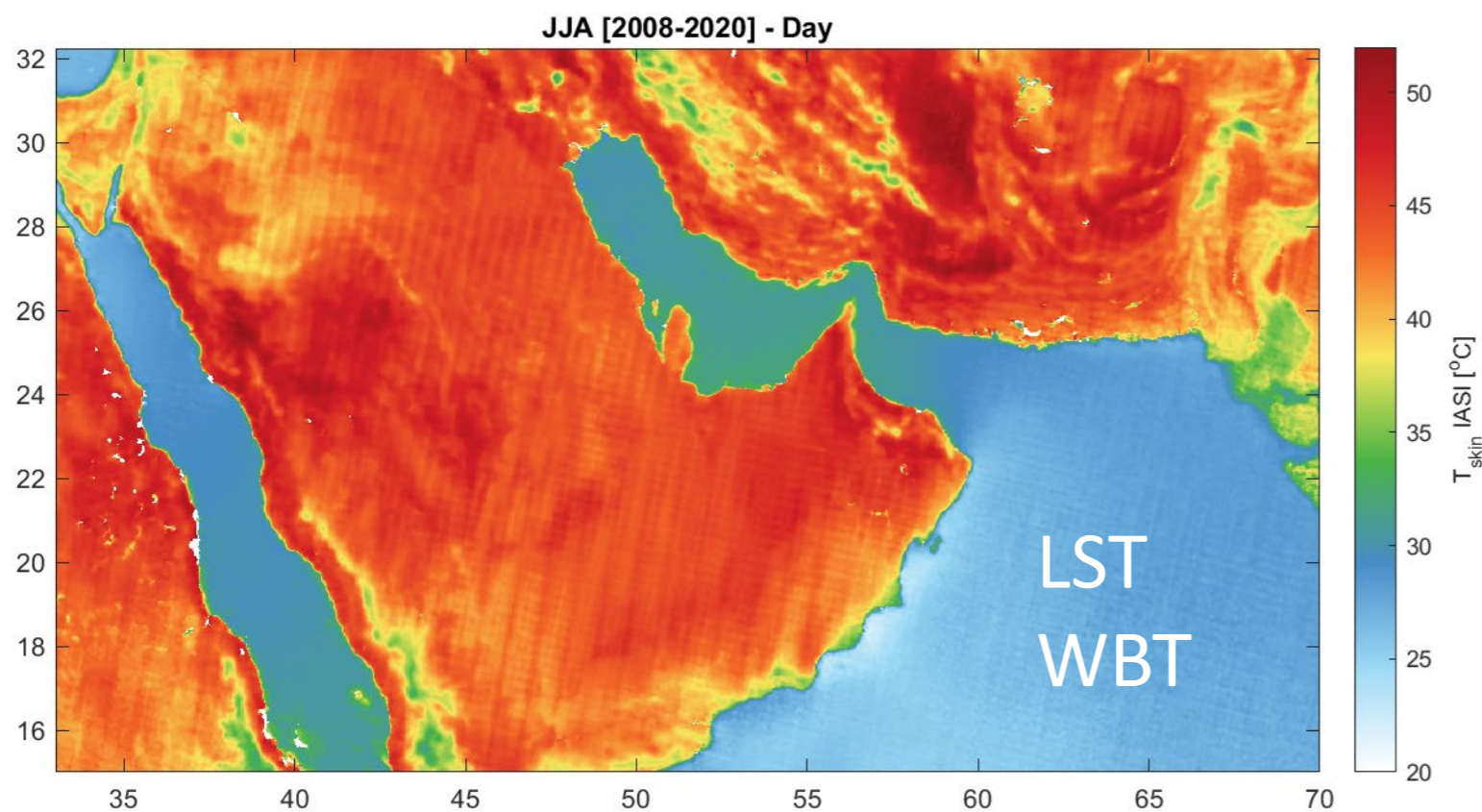
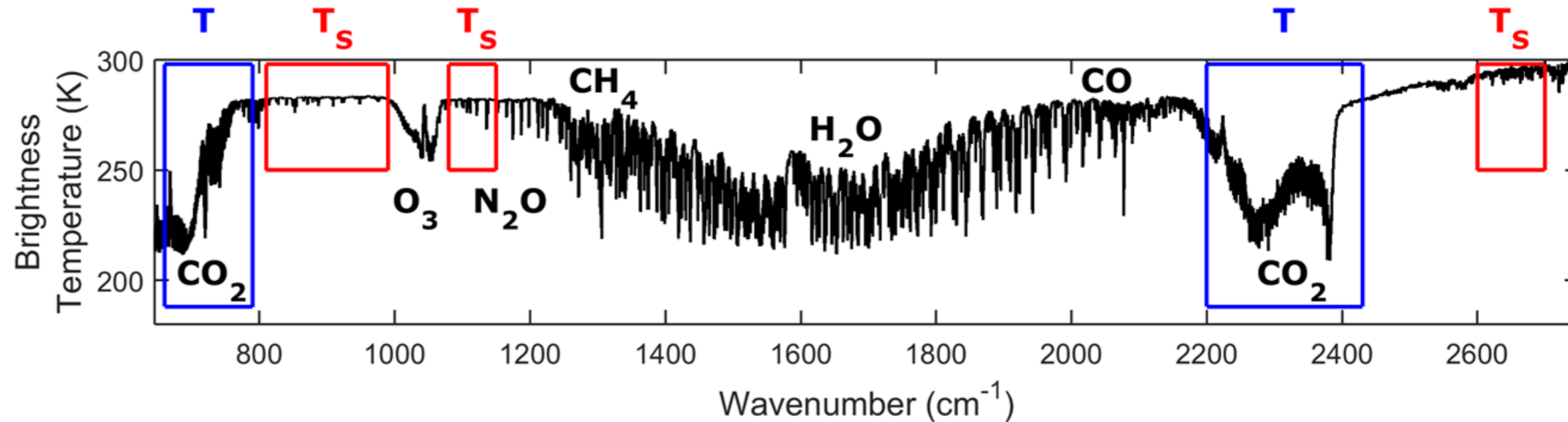
Greenhouse gases and ozone-related substances (13)	H <sub>2</sub> O, CO <sub>2</sub> , CH <sub>4</sub> , N <sub>2</sub> O, O <sub>3</sub> , HNO <sub>3</sub> , CFC-11, CFC-12, HCFC-22, CF <sub>4</sub> , SF <sub>6</sub> , CCl <sub>4</sub> , HFC-134a
Air quality and VOCs (12)	CO, CH <sub>3</sub> OH, HCOOH, CH <sub>3</sub> COOH, CH <sub>3</sub> COCH <sub>3</sub> , C <sub>2</sub> H <sub>2</sub> , C <sub>2</sub> H <sub>4</sub> , NH <sub>3</sub> , HCN, PAN, SO <sub>2</sub> , OCS
Concentrated plumes (6)	HCl, H <sub>2</sub> S, C <sub>3</sub> H <sub>6</sub> , C <sub>4</sub> H <sub>4</sub> O, HONO, HCHO



Safieddine et al., 2022

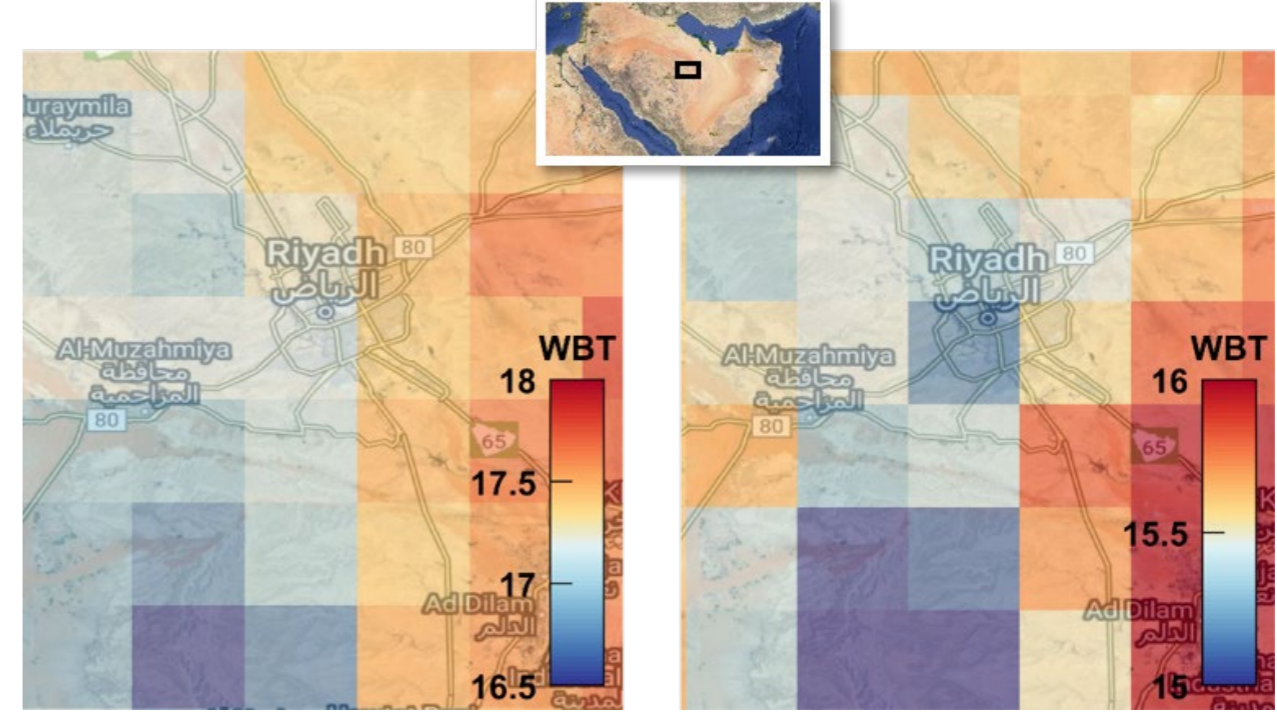
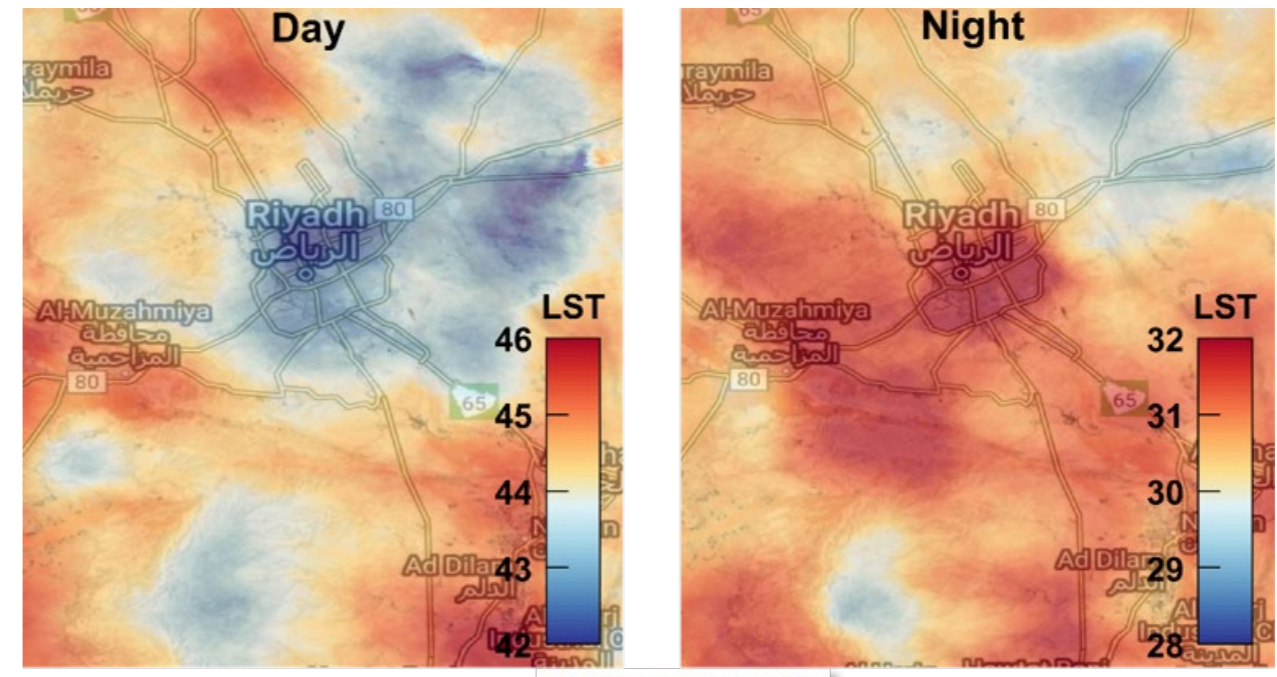
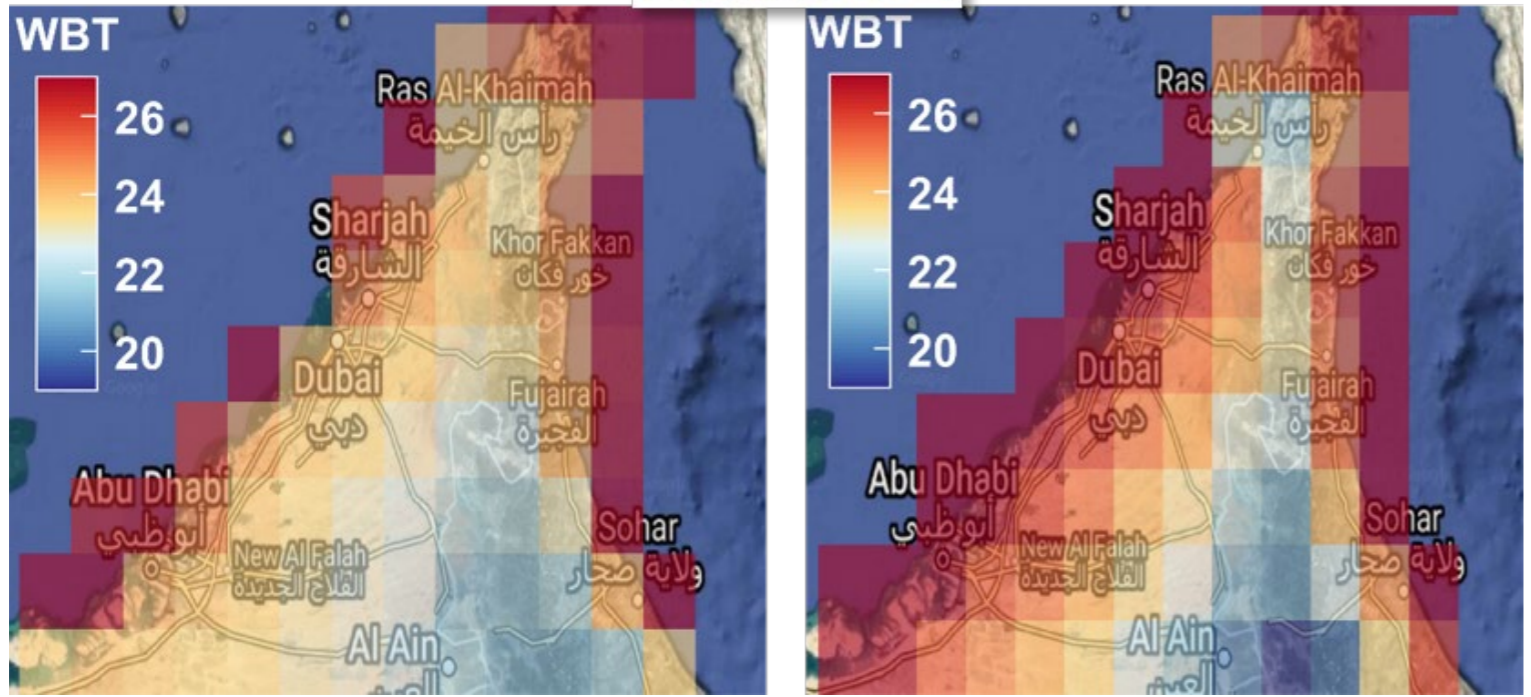
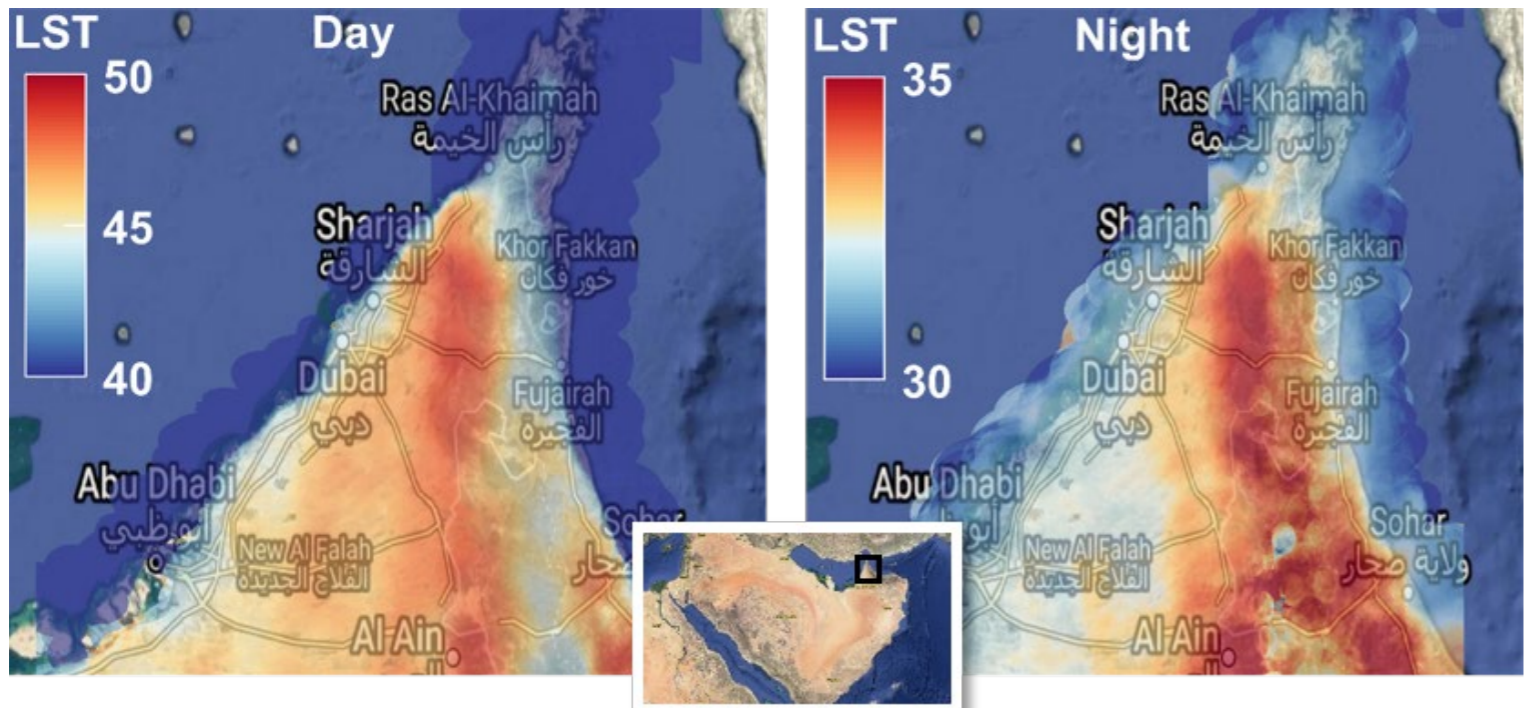
LETTER • OPEN ACCESS

Present and future land surface and wet bulb temperatures in the Arabian Peninsula

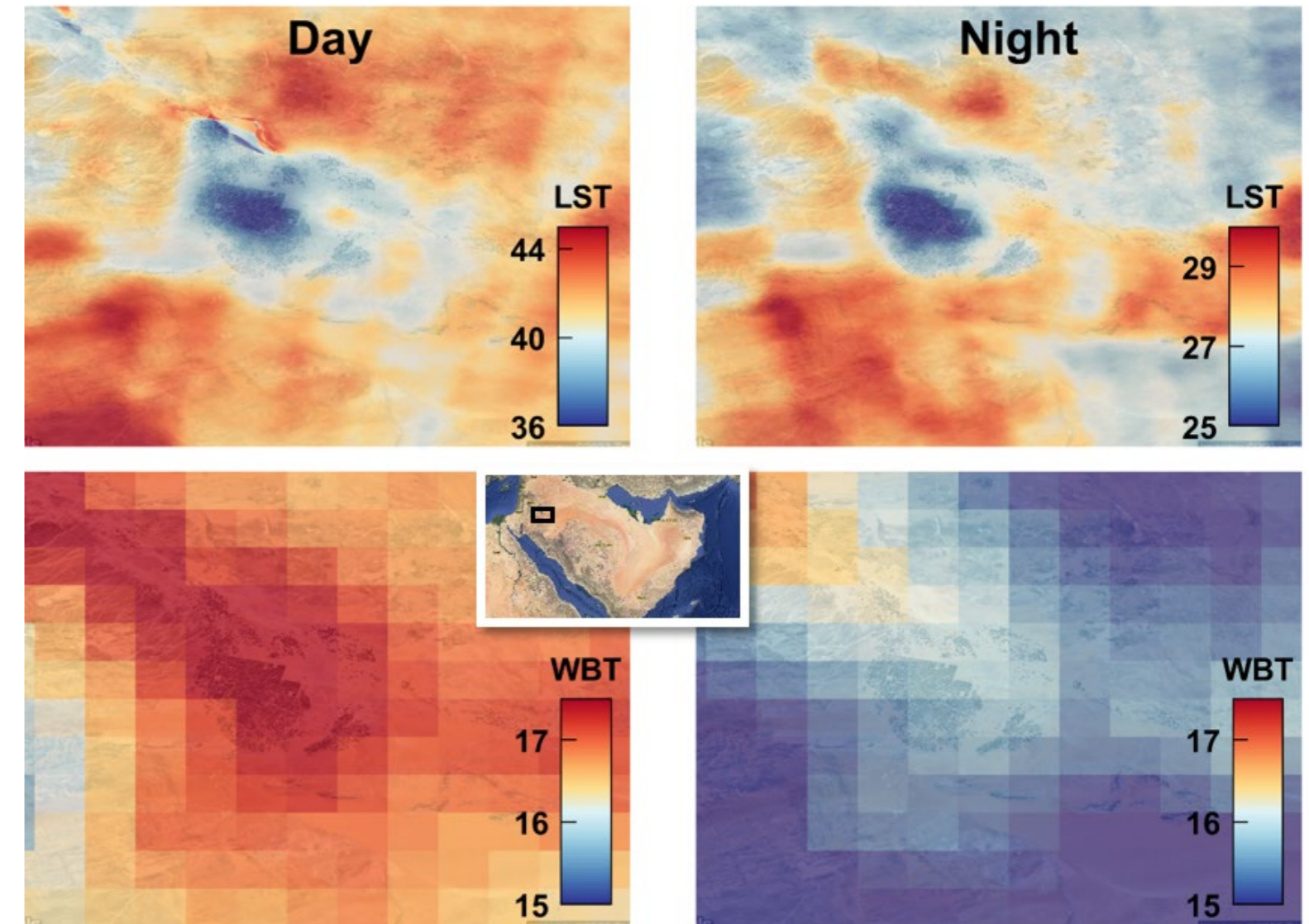
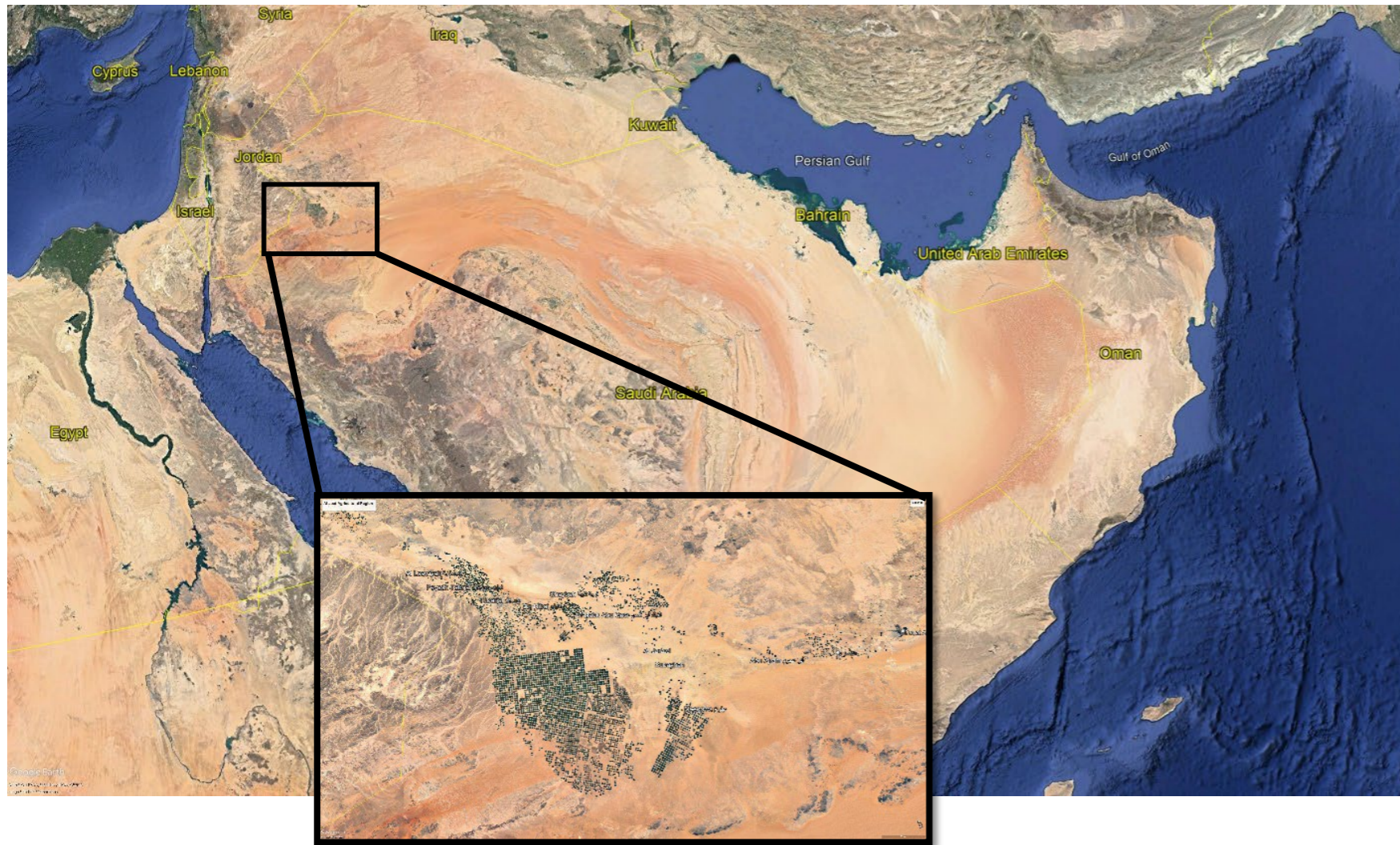


**WBT must remain below a threshold of 35 °C** : threshold limit of survivability for a fit human under well-ventilated outdoor conditions and is lower for most people.

- 1- On the Persian Gulf: humid on the coasts, very dry and hot inland
- 2- The capital of SA, 500 km from the nearest coast



### 3- The largest agricultural region in SA: irrigation effect

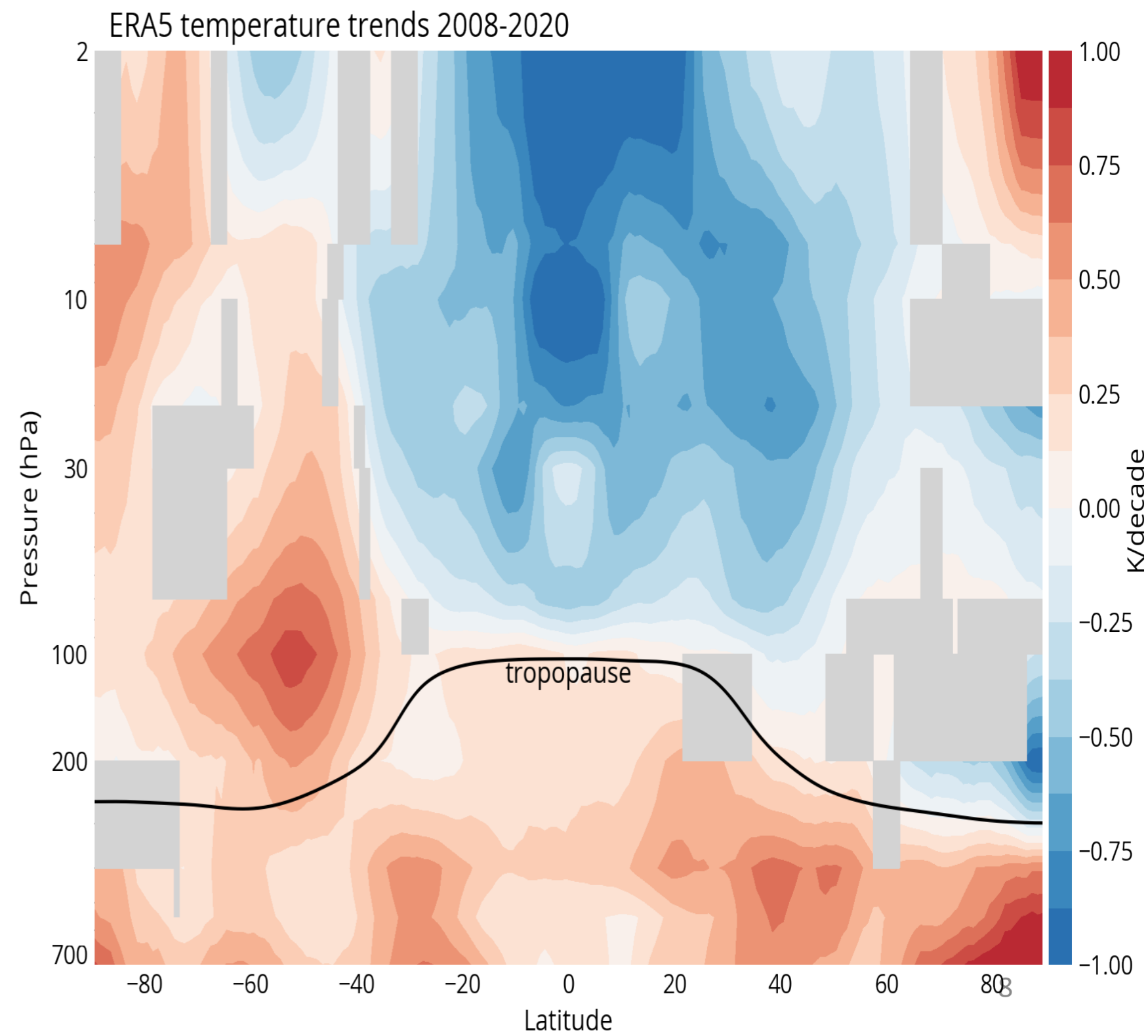
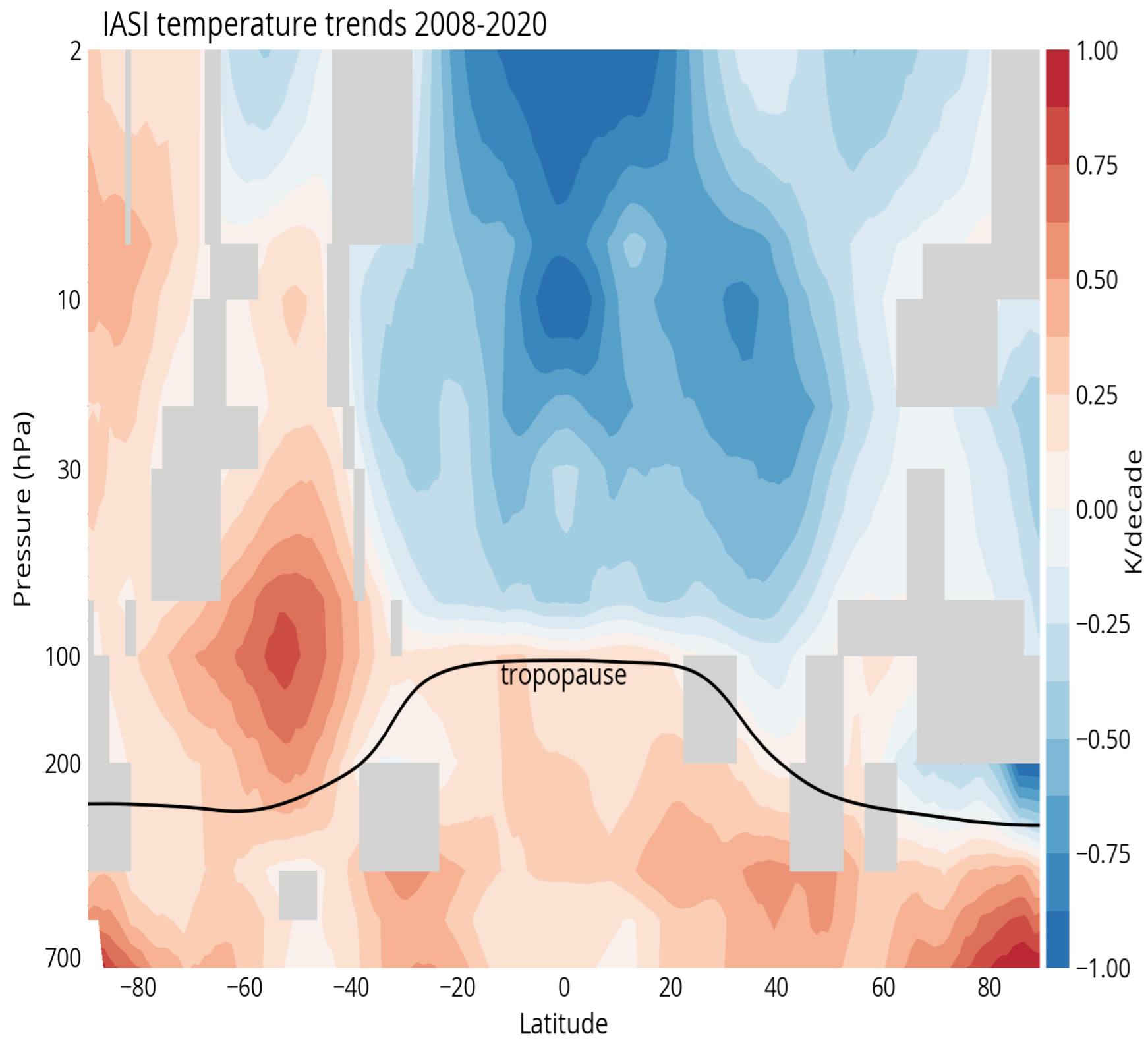


LST and WBT change with the time of the day. For WBT, the cities on the Persian Gulf have higher current and future WBT in early evenings of the summer (air saturated with humidity), when people tend to go out.

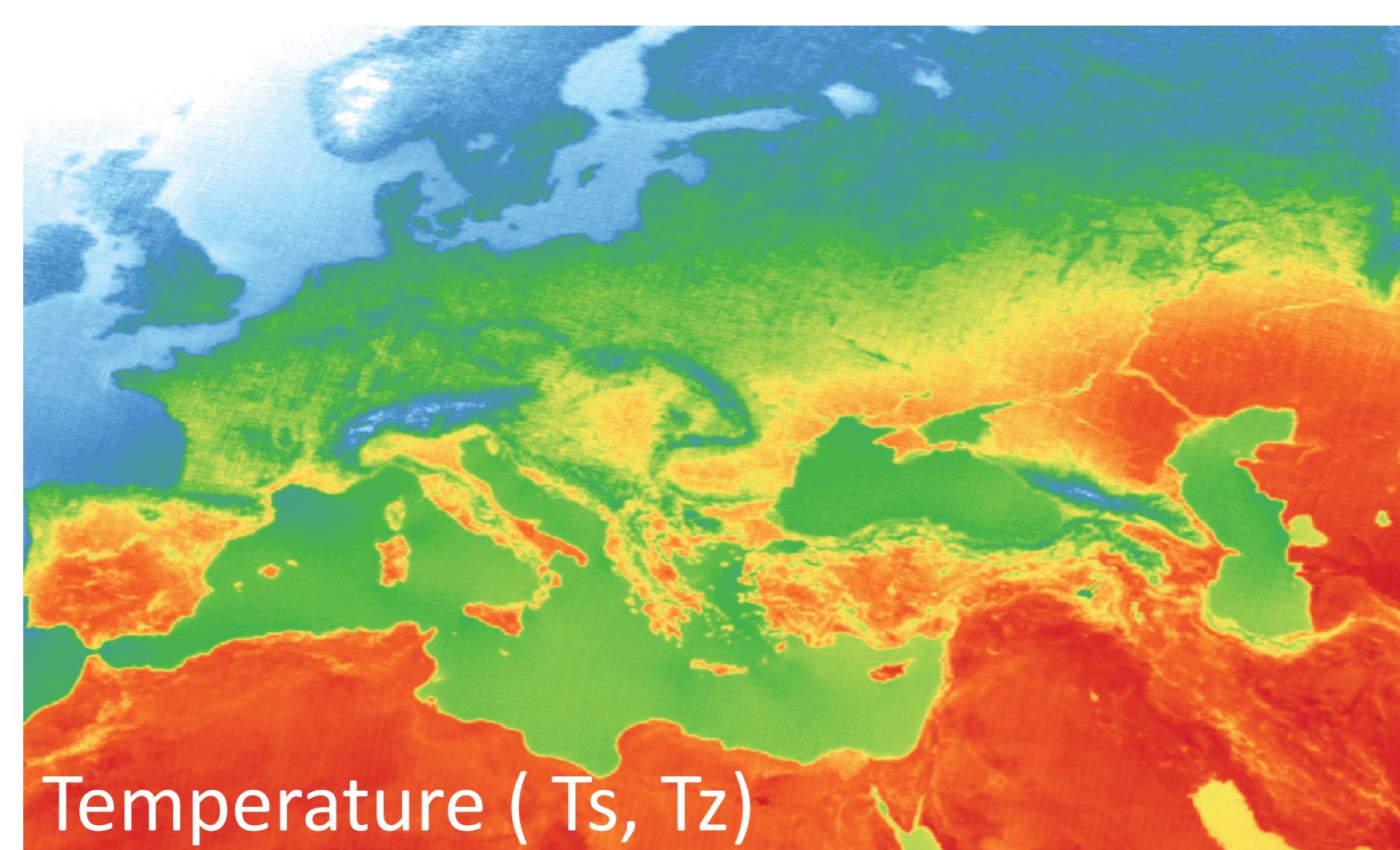
Vegetated spaces can reduce the surface and near surface temperatures through evapotranspiration and shade. However, vegetation in arid regions requires irrigation irrigation enhances the heat stress with an increase in WBT reaching +2 °C with respect to the surroundings

## Time evolution of temperature profiles retrieved from 13 years of infrared atmospheric sounding interferometer (IASI) data using an artificial neural network

Marie Bouillon<sup>1</sup>, Sarah Safieddine<sup>1</sup>, Simon Whitburn<sup>2</sup>, Lieven Clarisse<sup>2</sup>, Filipe Aires<sup>3</sup>, Victor Pellet<sup>3</sup>, Olivier Lezeaux<sup>4</sup>, Noëlle A. Scott<sup>5</sup>, Marie Doutriaux-Boucher<sup>6</sup>, and Cathy Clerbaux<sup>1,2</sup>

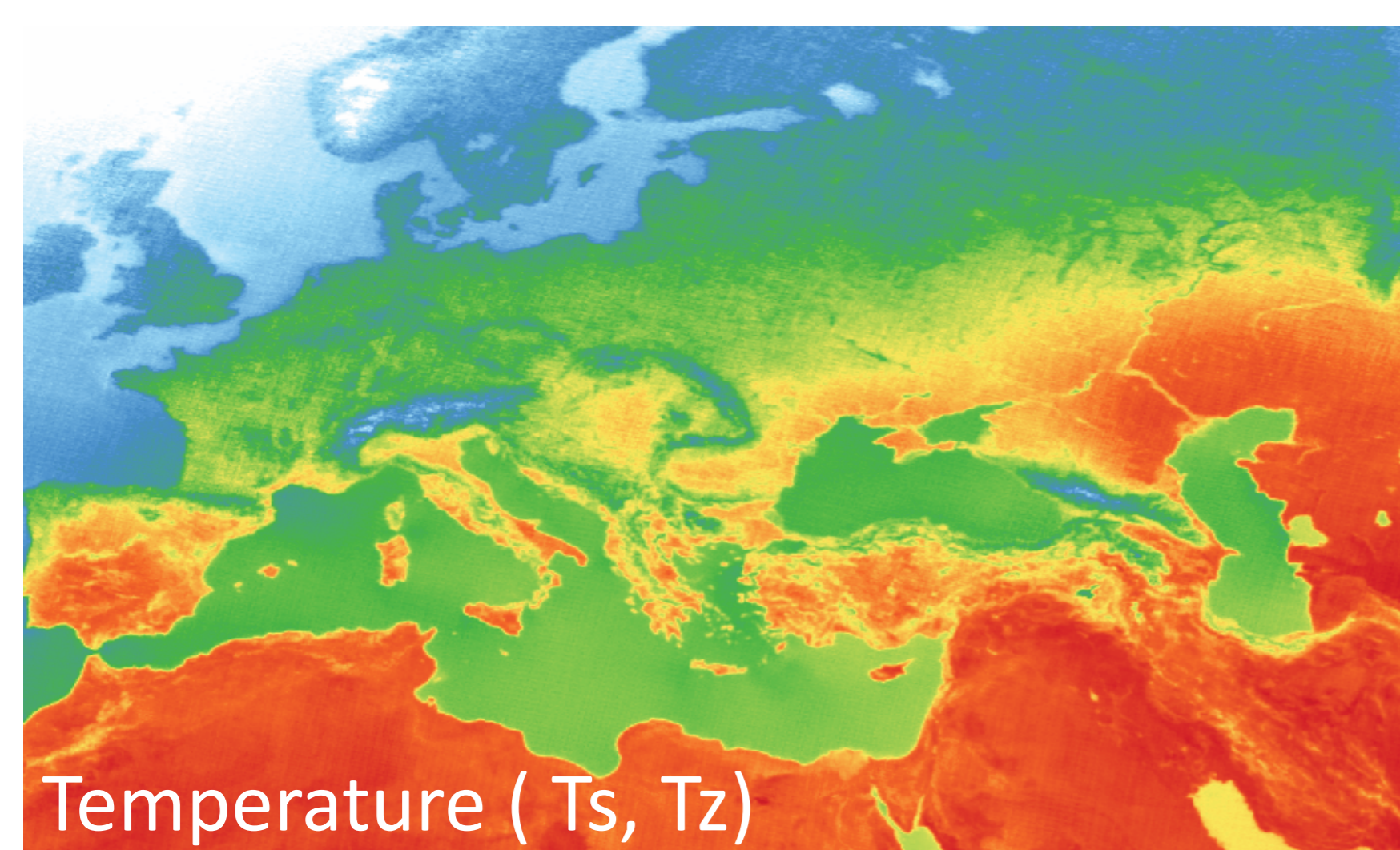


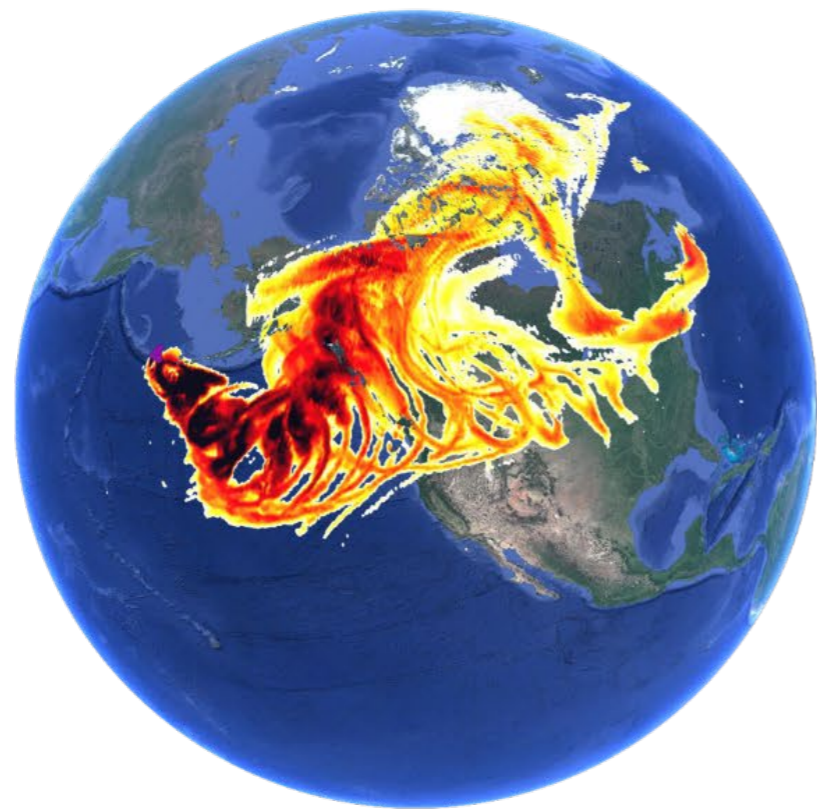
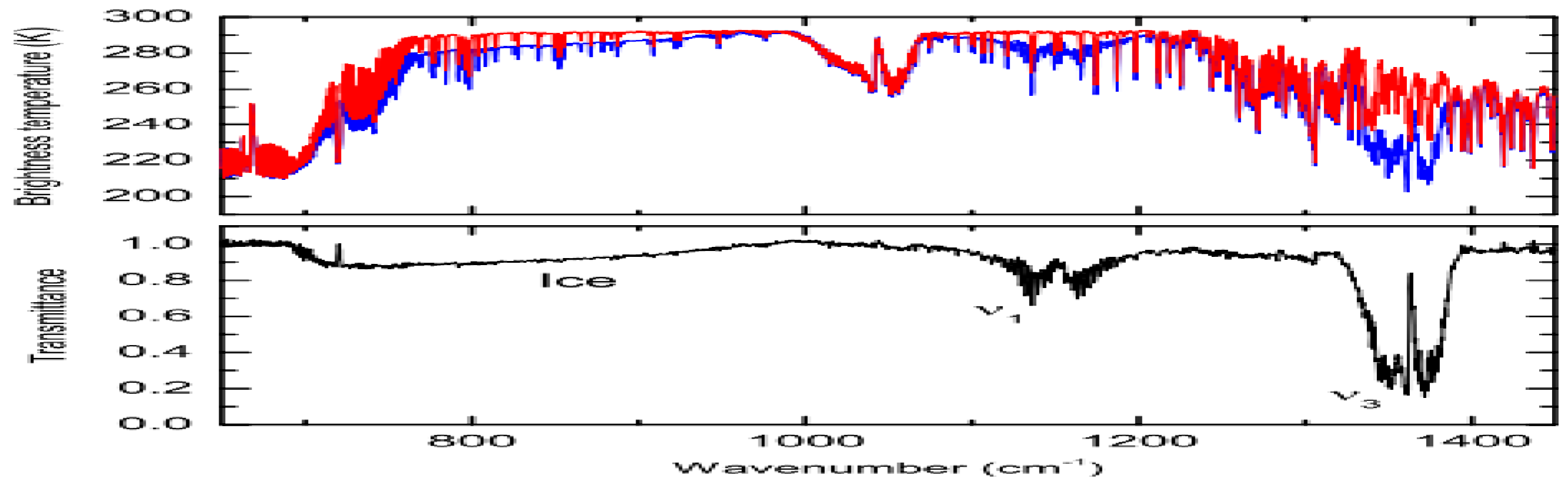




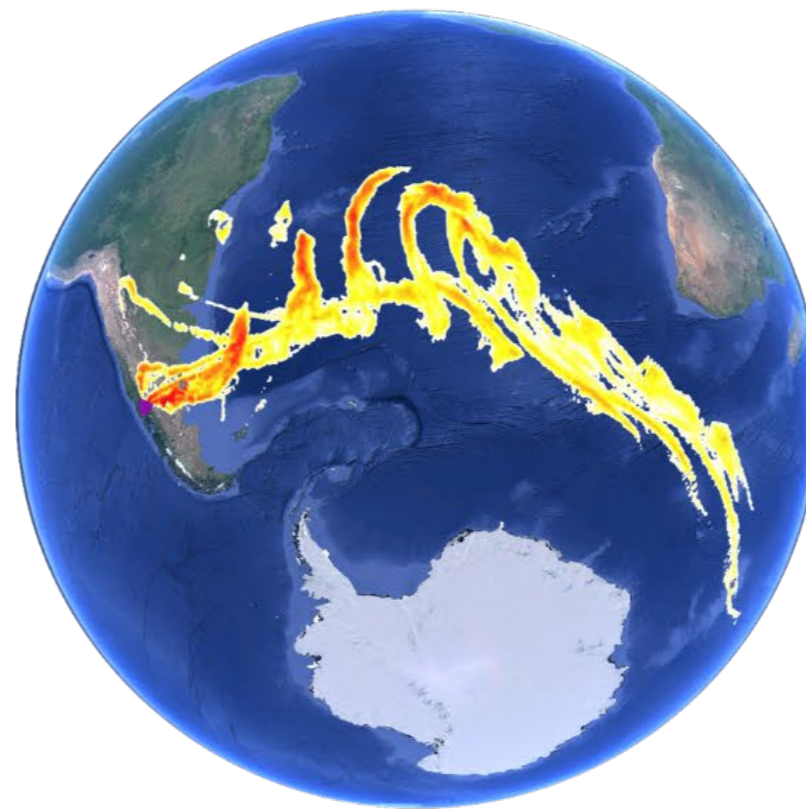


Google Earth  
Data SIO, NOAA, U.S. Navy

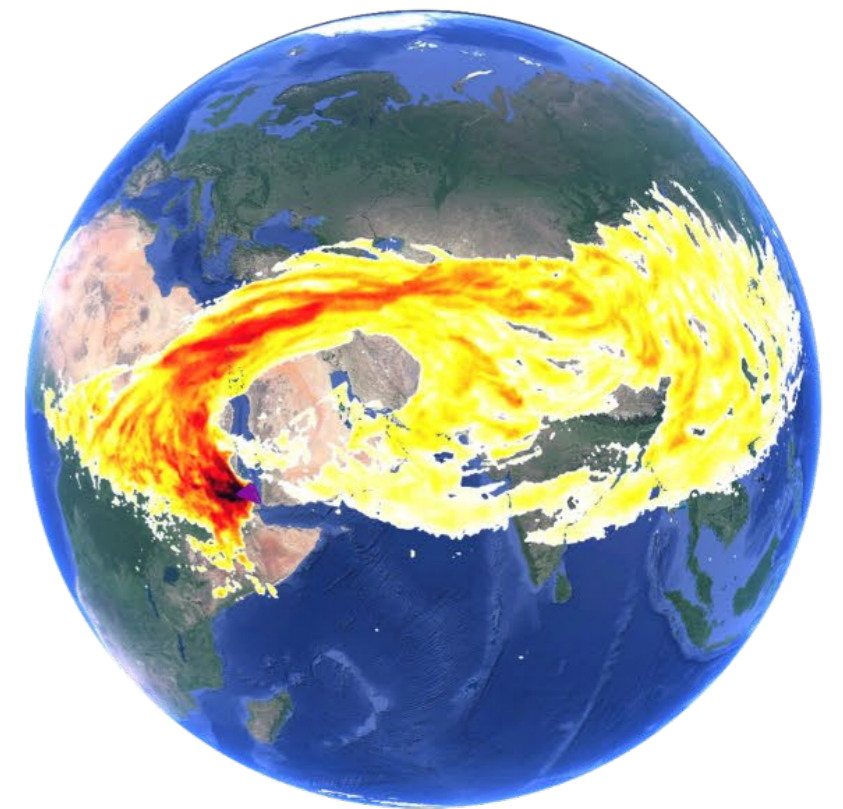




Kasatoshi  
Aug. 2008



Puhehue  
June 2011



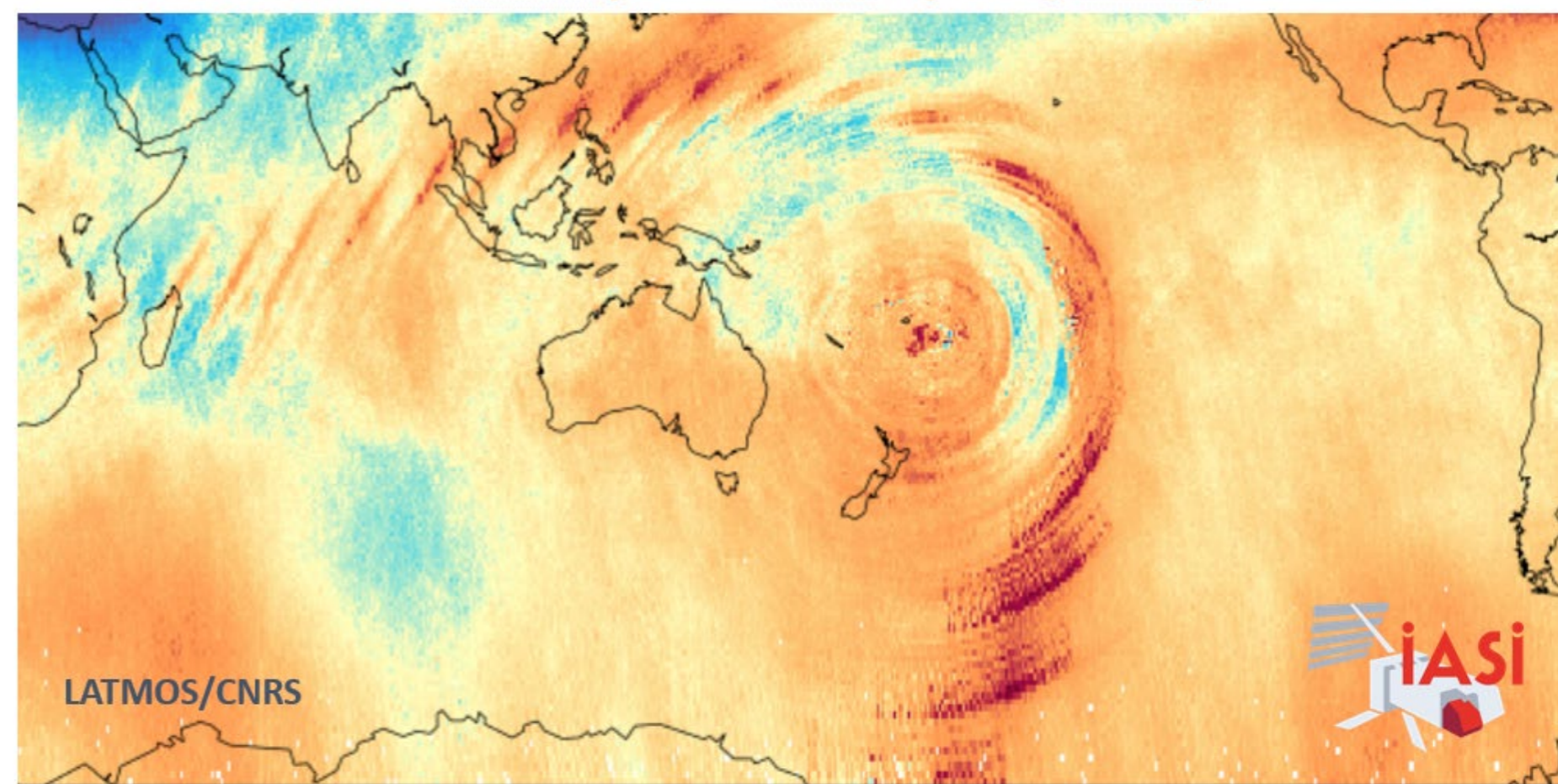
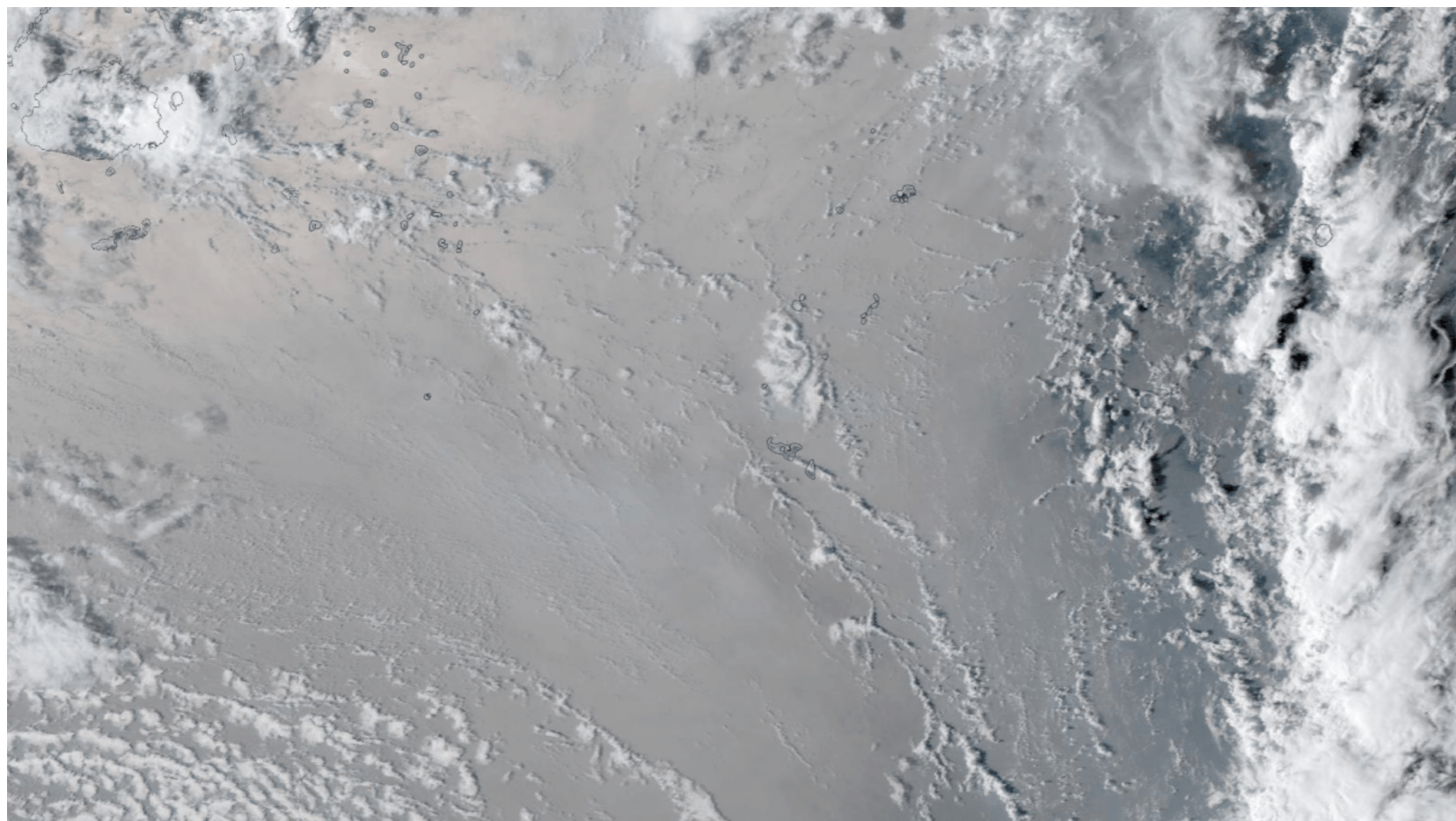
Nabro  
June 2011

1 Surface-to-space atmospheric waves from Hunga

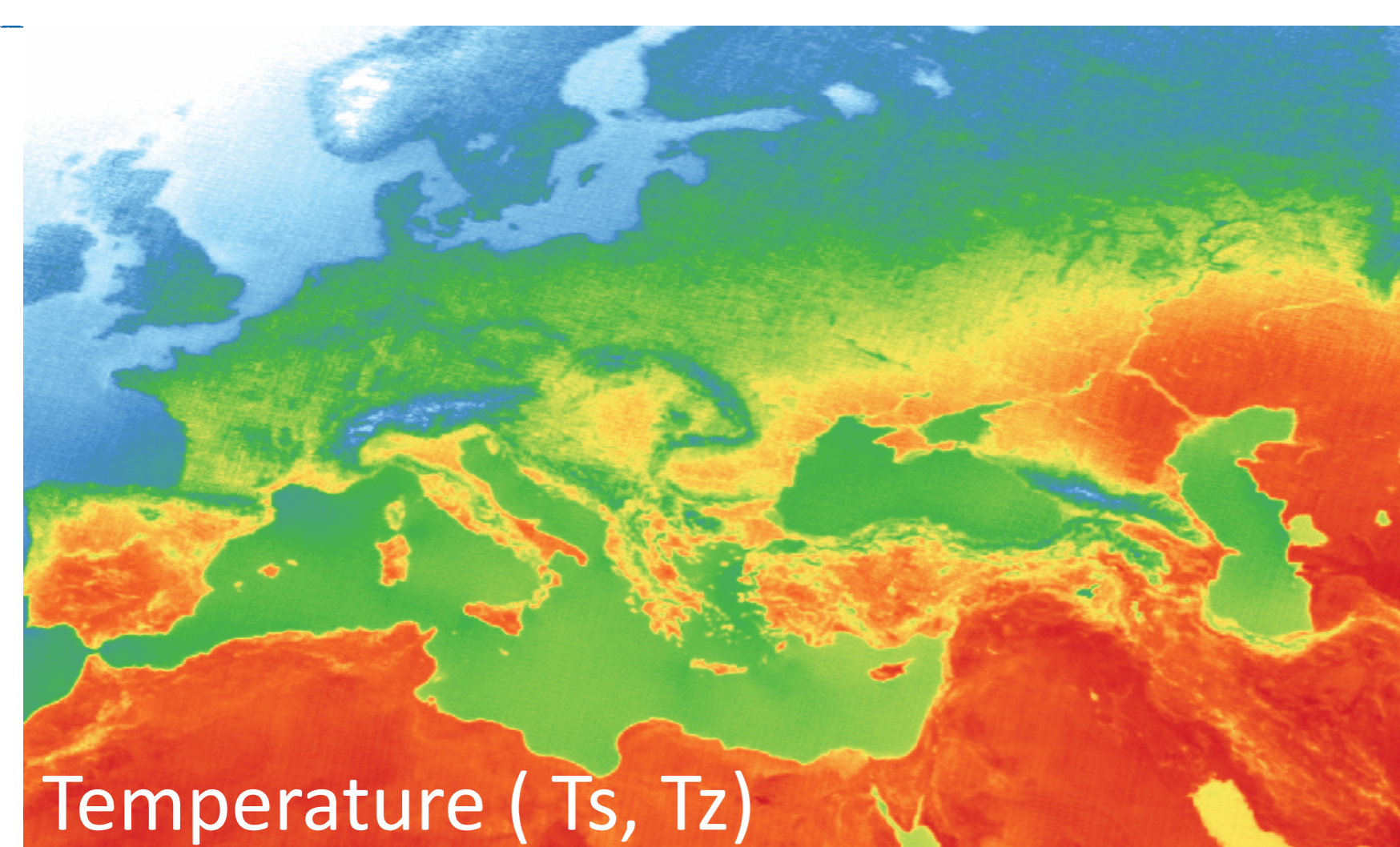
2 Tonga-Hunga Ha'apai eruption

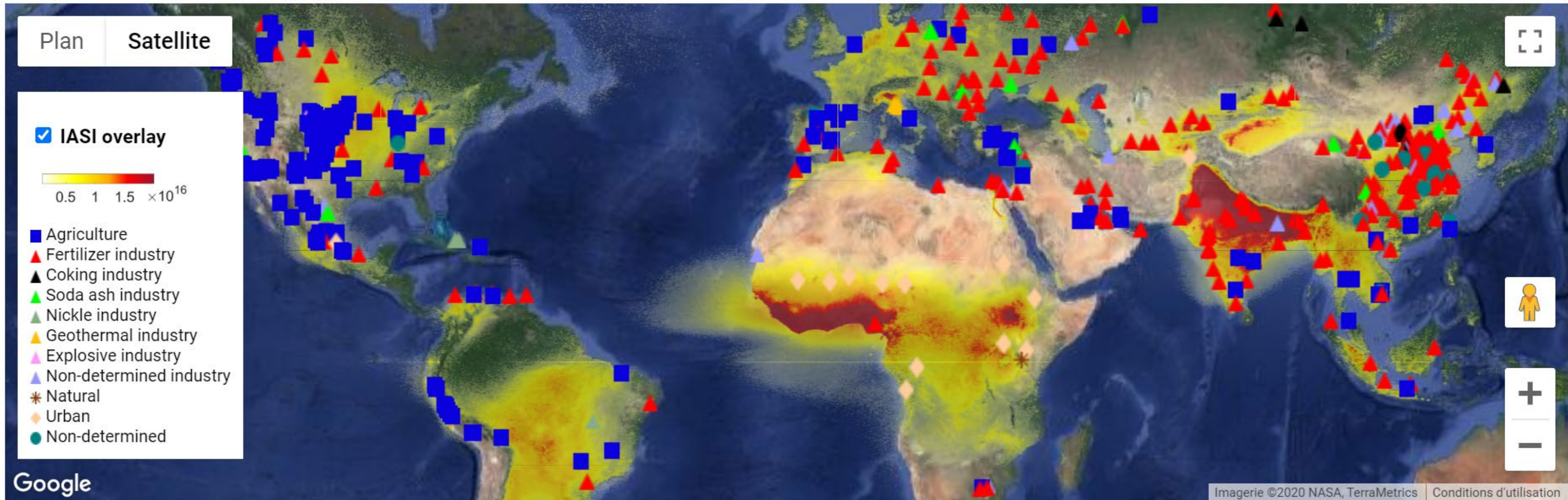
Nature, accepted

3 Corwin J Wright\*<sup>1</sup>, Neil P Hindley<sup>1</sup>, M Joan Alexander<sup>2</sup>, Mathew Barlow<sup>3</sup>, Lars Hoffmann<sup>4</sup>, Cathryn  
4 N Mitchell<sup>1</sup>, Fred Prata<sup>5,6</sup>, Marie Bouillon<sup>7</sup>, Justin Carstens<sup>8</sup>, Cathy Clerbaux<sup>7</sup>, Scott M Osprey<sup>9</sup>, Nick  
5 Powell<sup>10</sup>, Cora E Randall<sup>11,12</sup>, and Jia Yue<sup>13,14</sup>



Temperature differences in °C





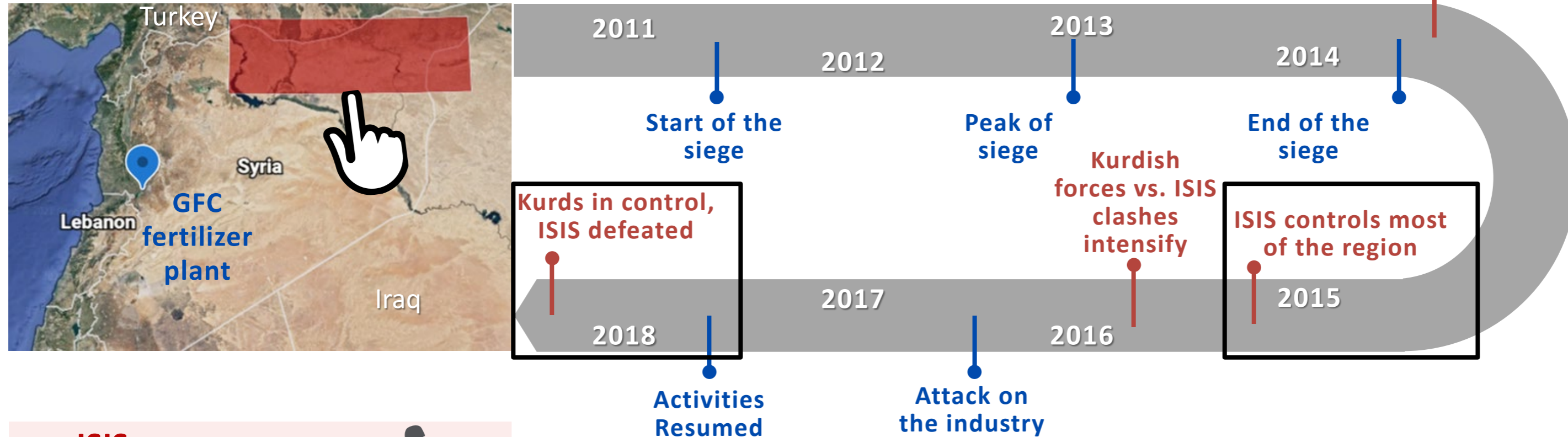
Global ammonia point sources as seen by IASI satellite instruments

<https://www2.ulb.ac.be/cpm/NH3-IASI.html>

Van Damme, M., Clarisse, L., Whitburn, S., Hadji-Lazaro, J., Hurtmans, D., Clerbaux, C., Coheur, P.-F. **Industrial and agricultural ammonia point sources exposed.** *Nature* **564**, 99-103, doi: [10.1038/s41586-018-0747-1](https://doi.org/10.1038/s41586-018-0747-1), 2018

# Geographical/socio-political context

**Agricultural area** in northeast Syria that witnessed changes in land use/land cover.




- ISIS
  - Kurdish forces
- 

**2013 and onward...**

Ammonia (NH<sub>3</sub>) is a tracer of agricultural activities

## A space view of agricultural and industrial changes during the Syrian civil war

Collections: Knowledge Domain: Atmospheric Science

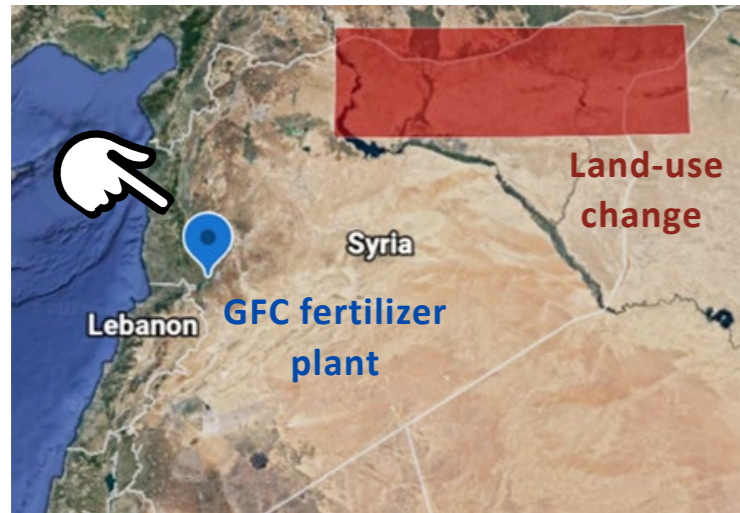
Rimal Abeed , Cathy Clerbaux, Lieven Clarisse, Martin Van Damme, Pierre-François Coheur, Sarah Safieddine

\* Email: [rimal.abeed@latmos.ipsl.fr](mailto:rimal.abeed@latmos.ipsl.fr)

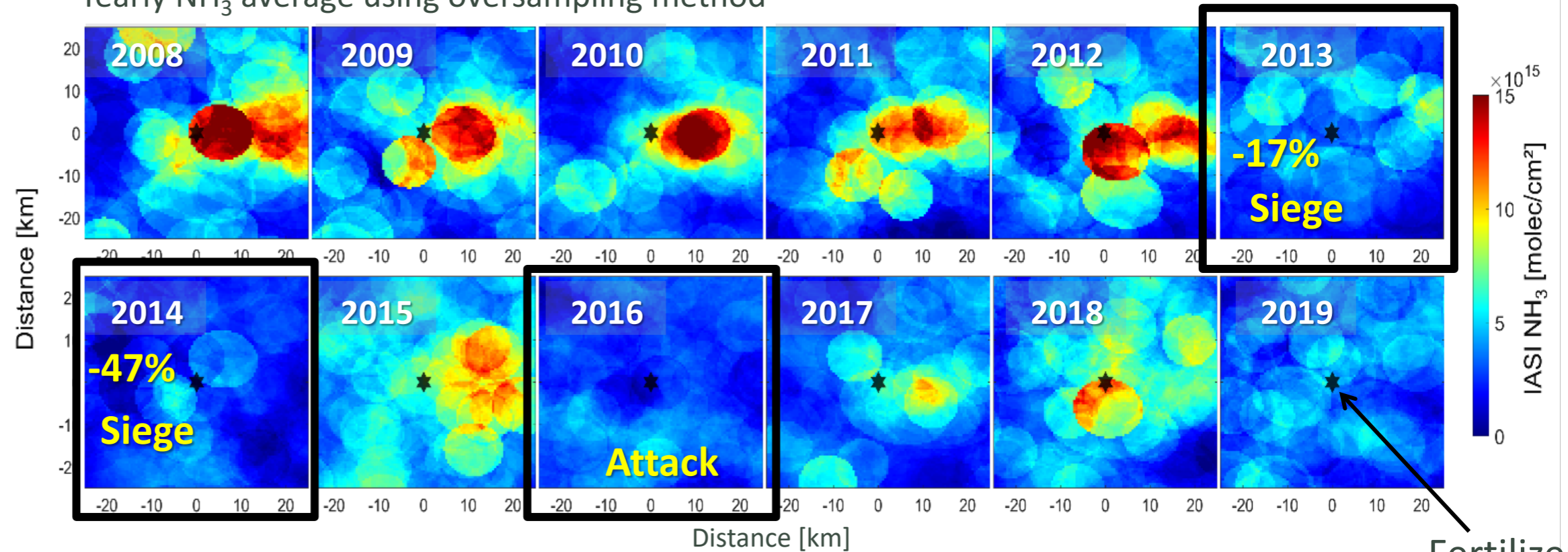
*Elementa: Science of the Anthropocene* (2021) 9 (1): 000041.



# Fertilizers industry



Yearly NH<sub>3</sub> average using oversampling method



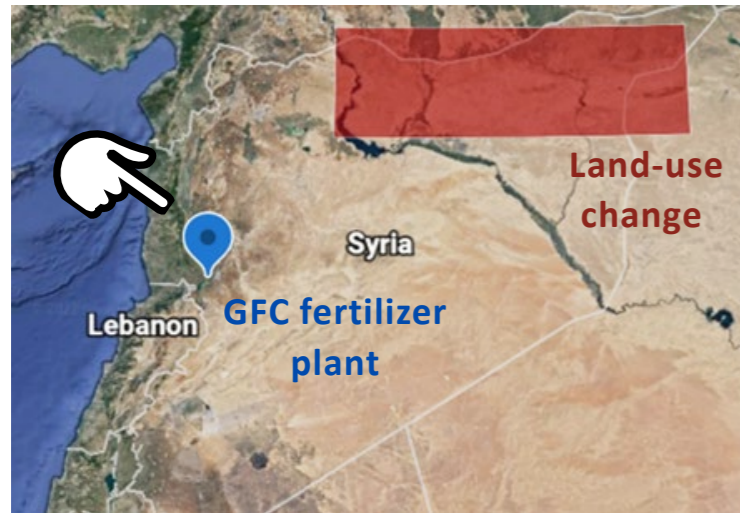
 **2013 – 2014:** Siege / clashes

 **2016:** Attack

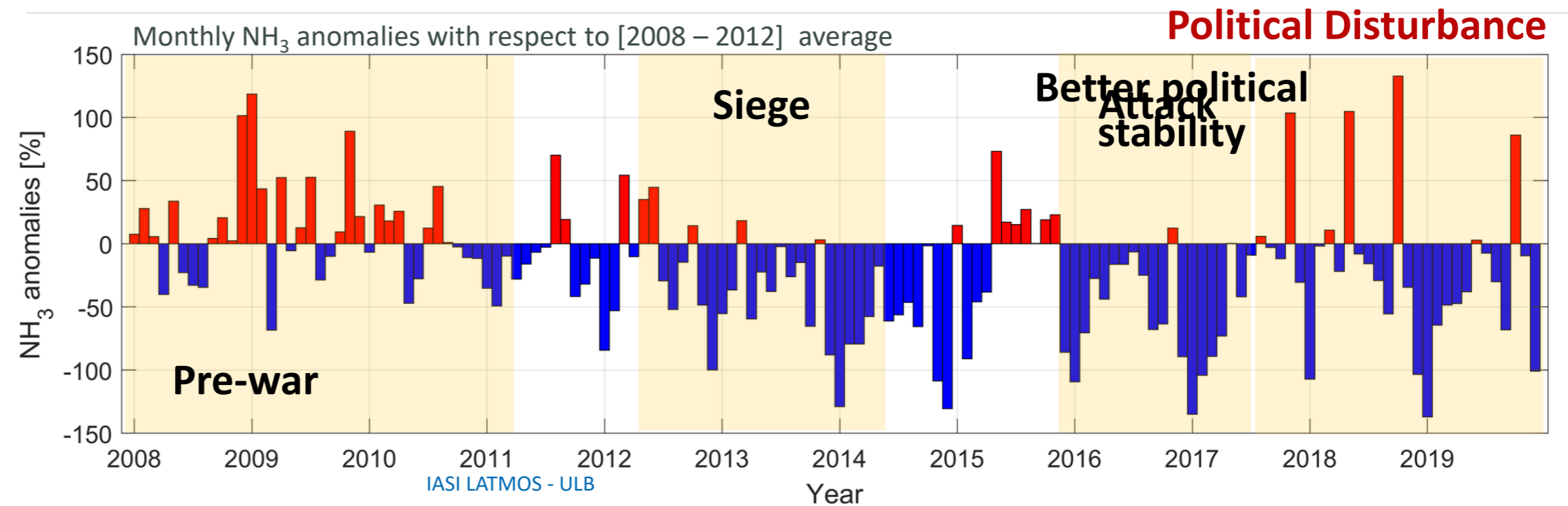
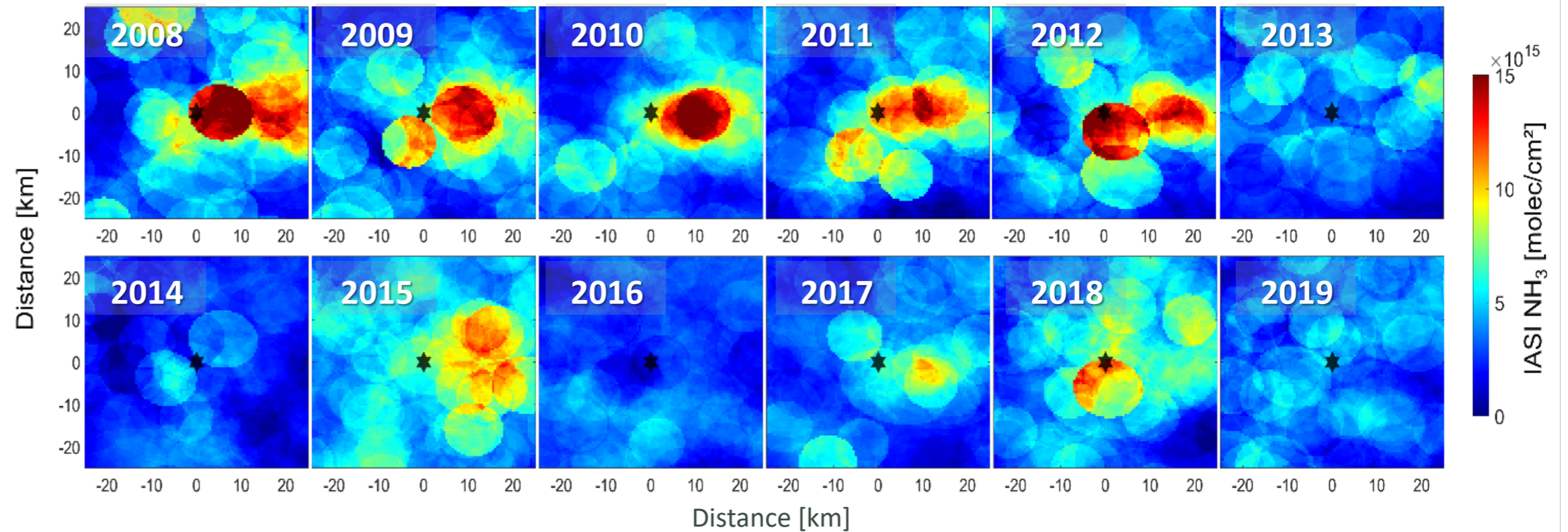
 **2019:** Shortage in workforce

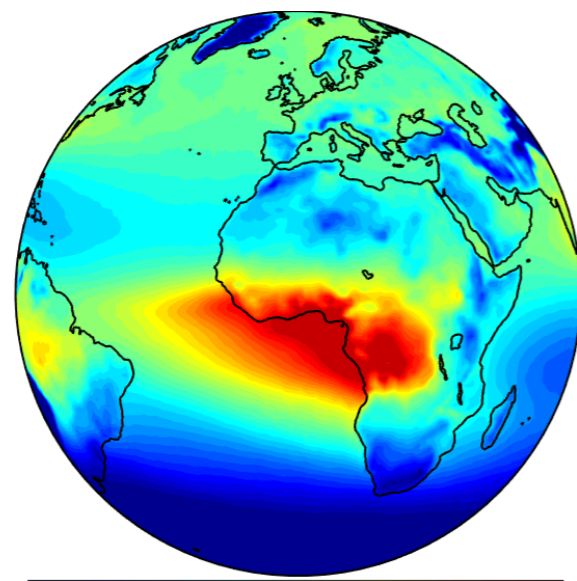
Fertilizers industry

# Fertilizers industry

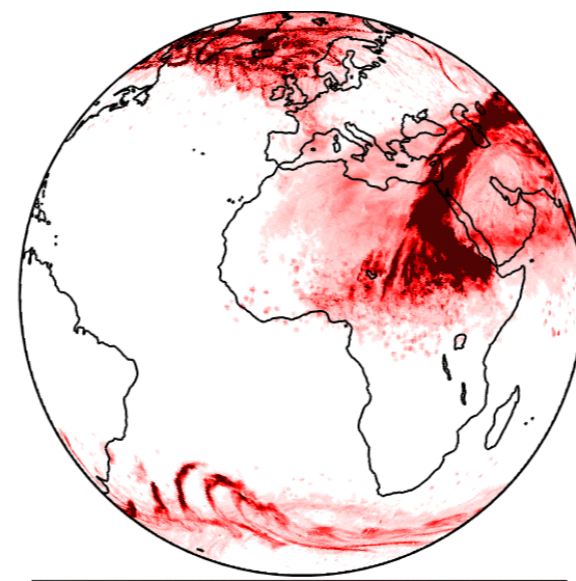


Yearly NH<sub>3</sub> average using oversampling method

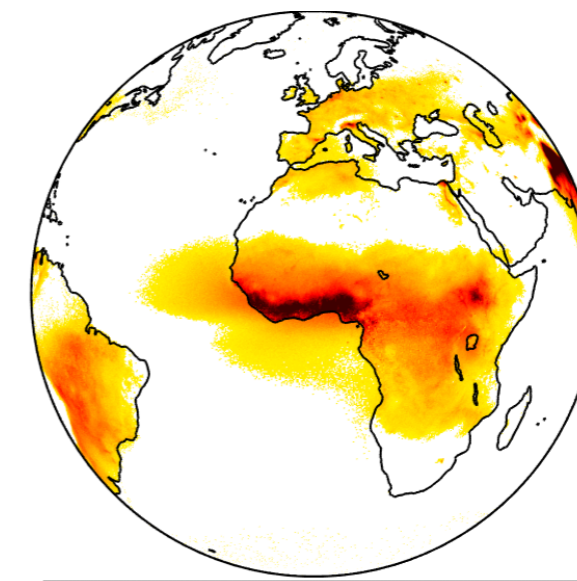




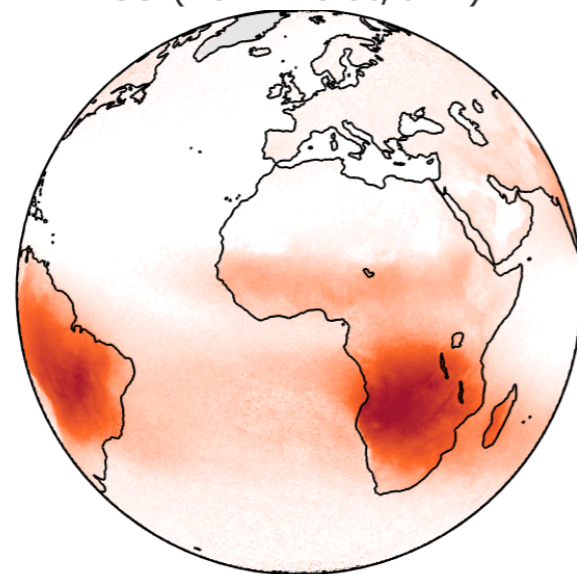
0.8 1 1.2 1.4 1.6 1.8 2 2.2 2.4 2.6 2.8 3  
CO ( $10^{18}$  molec/cm<sup>2</sup>)



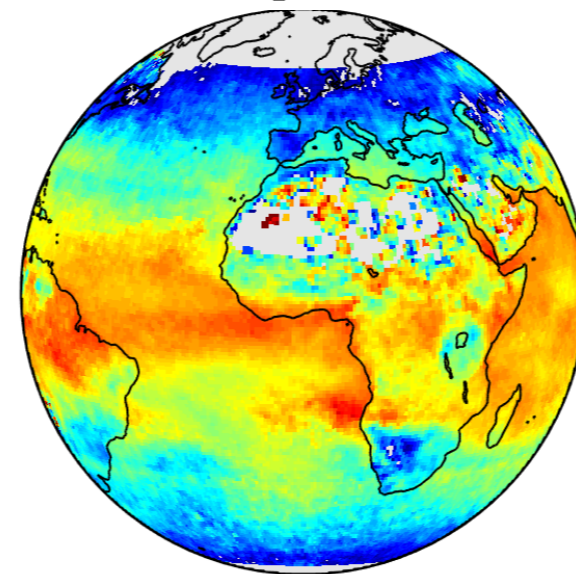
0 2 4 6 8 10  
SO<sub>2</sub> (DU)



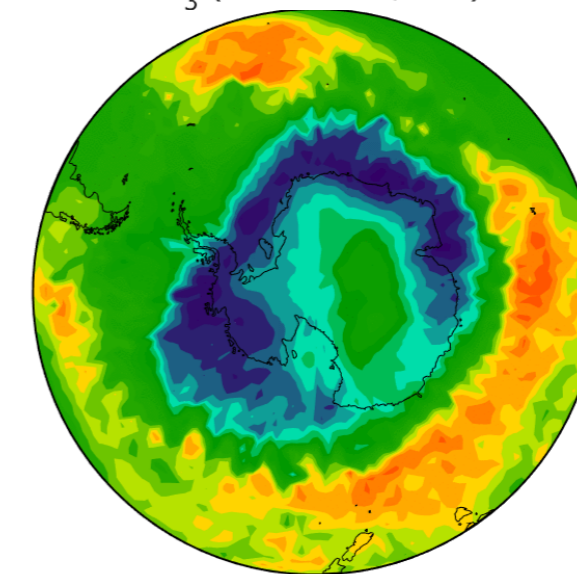
0 0.5 1 1.5 2 2.5  
NH<sub>3</sub> ( $10^{16}$  molec/cm<sup>2</sup>)



0 0.5 1 1.5 2  
HCOOH ( $10^{16}$  molec/cm<sup>2</sup>)



-400 -350 -300 -250 -200 -150 -100  
delta D (per mil)



100 150 200 250 300 350 400 450 500  
O<sub>3</sub> (DU)

<https://iasi.aeris-data.fr/>

<http://iasi.aeris-data.fr/CO/>

<http://iasi.aeris-data.fr/NH3/>

<http://iasi.aeris-data.fr/HCOOH/>

<http://iasi.aeris-data.fr/O3/>

<http://iasi.aeris-data.fr/SO2/>

