

DERIVING AIR TEMPERATURES FROM SATELLITE DATA AND INFILLING METHODS

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Material provided by project partners

EUSTACE User Consultations, EGU 19th April 2016

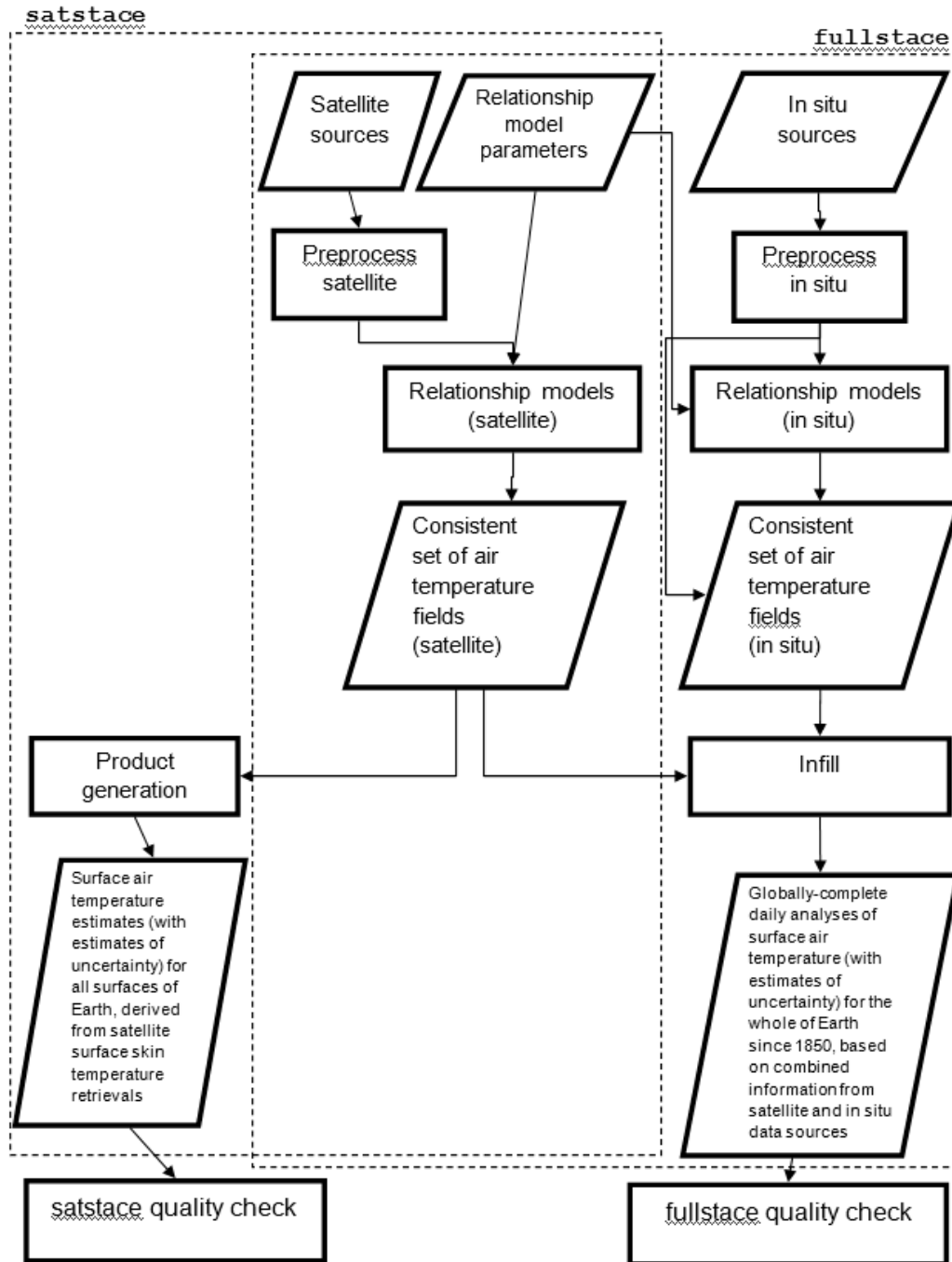
THE EUSTACE PRODUCTS

2 near-surface air temperature products

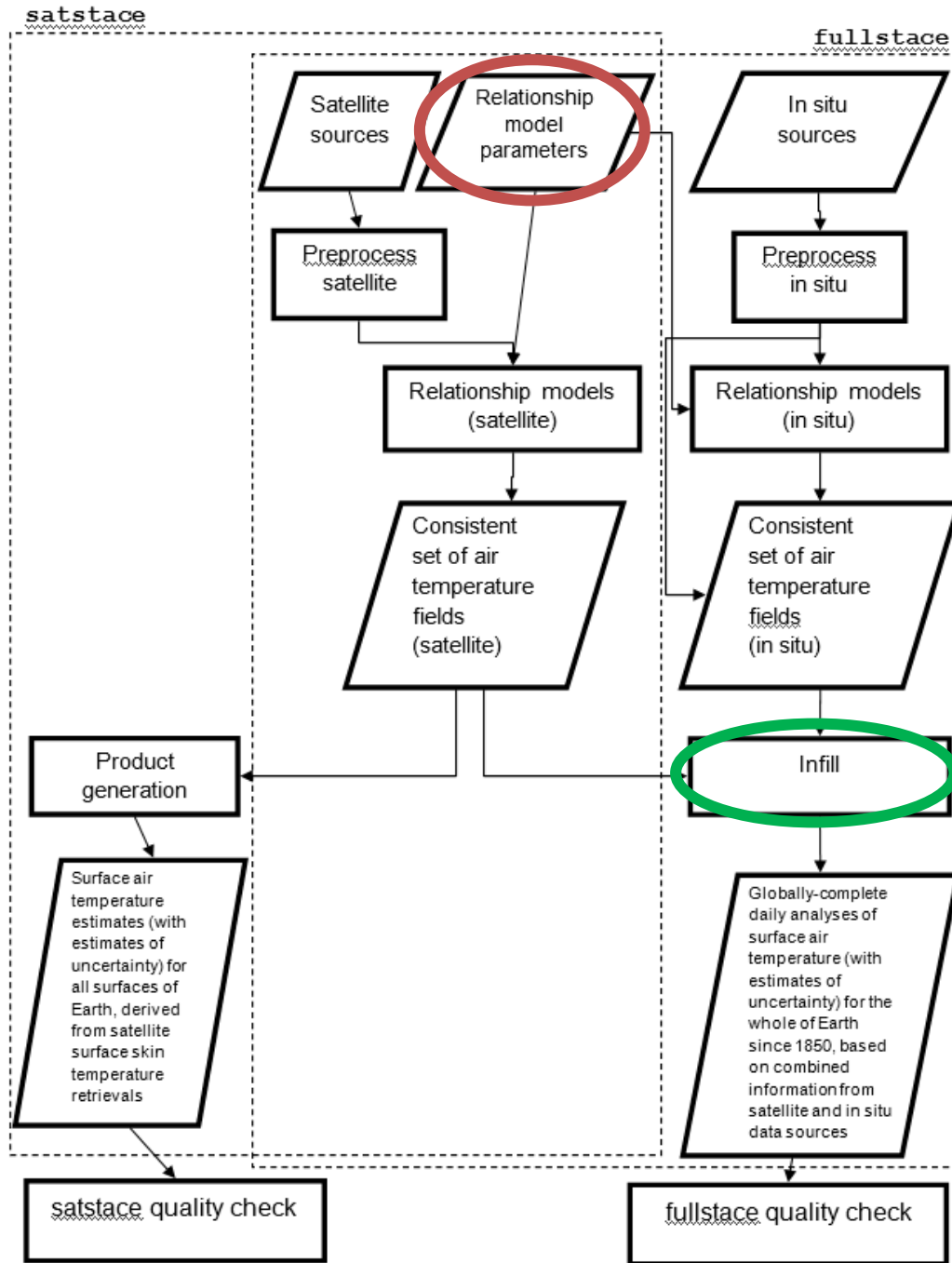
- Both contains estimates of uncertainties
- For all surfaces of Earth

Product	Description
satstace	Derived from satellite skin temperature Contains gaps, covers satellite period
fullstace	Combined information from satellite and in-situ data sources Complete daily analyses since 1850

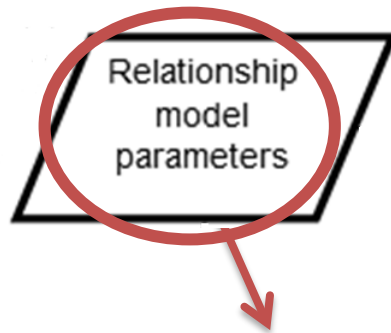
TOP-LEVEL SCHEMATIC



TOP-LEVEL SCHEMATIC

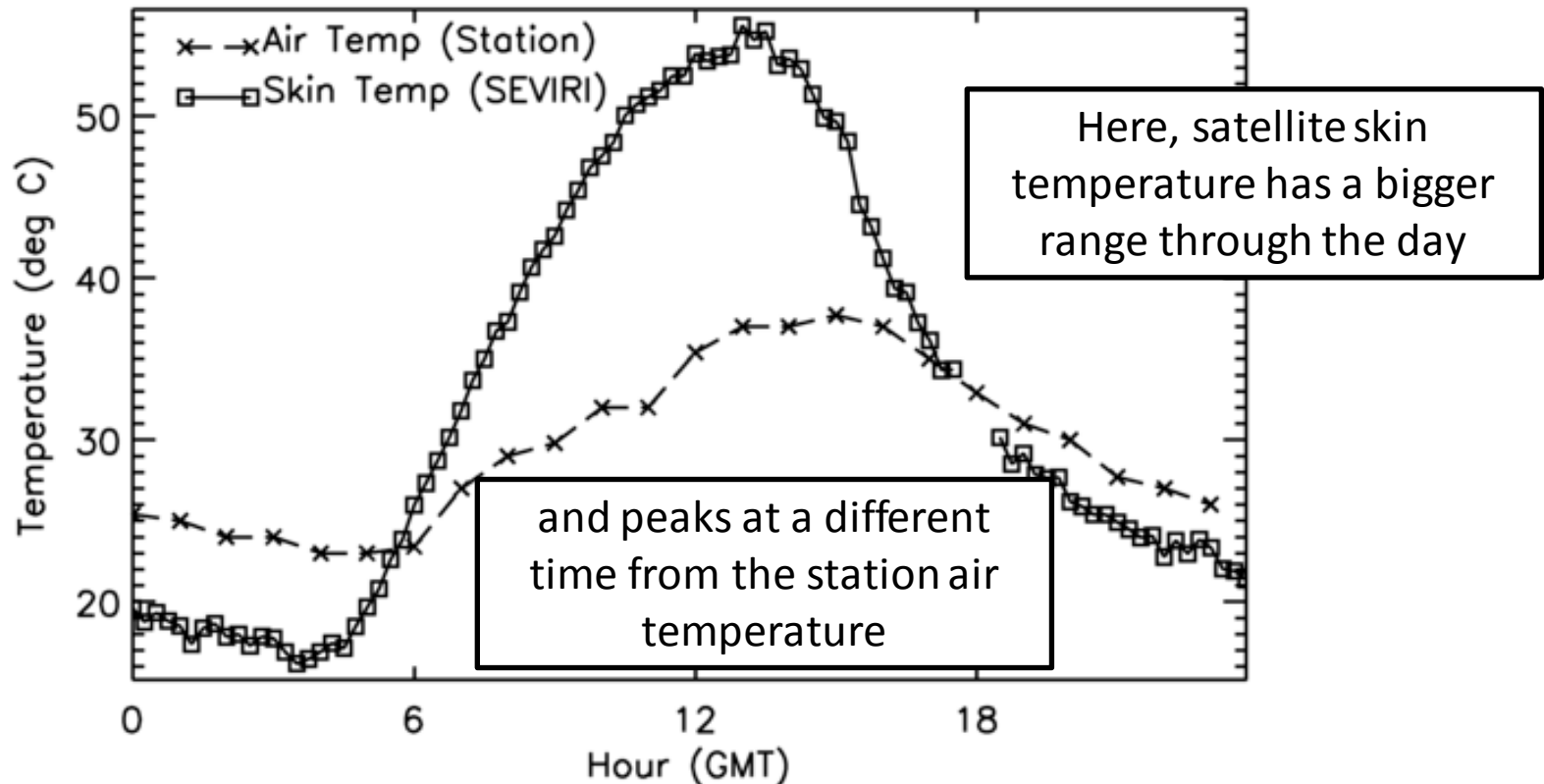


ESTIMATING AIR TEMPERATURE FROM SKIN TEMPERATURE



- Understand differences between skin and air temperatures and their variability
- Understand relationships with other parameters

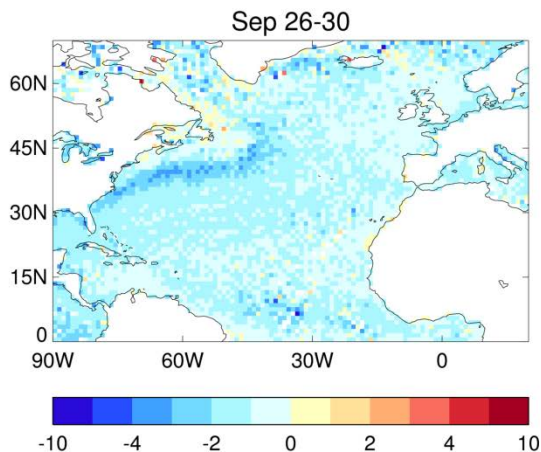
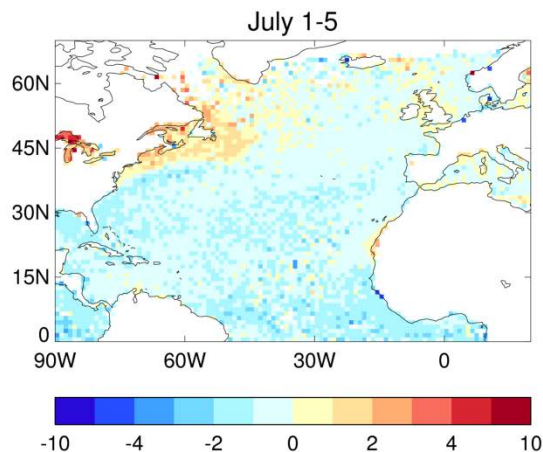
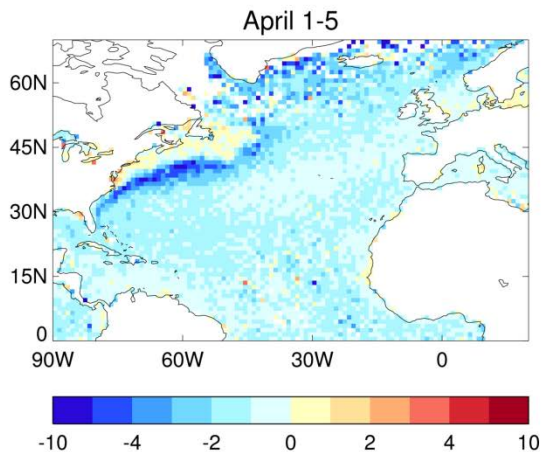
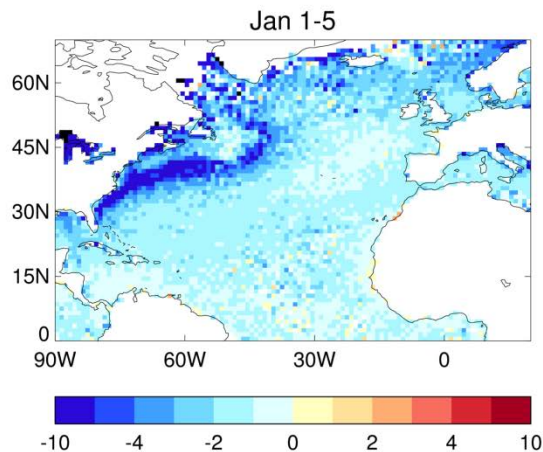
DIFFERENCES IN TEMPERATURE EVOLUTION THROUGH THE DAY



Extreme case of the diurnal cycle on 2 July 2011 of surface skin temperature (from the SEVIRI satellite) and surface air temperature (at a weather station) in Kairouan, Tunisia

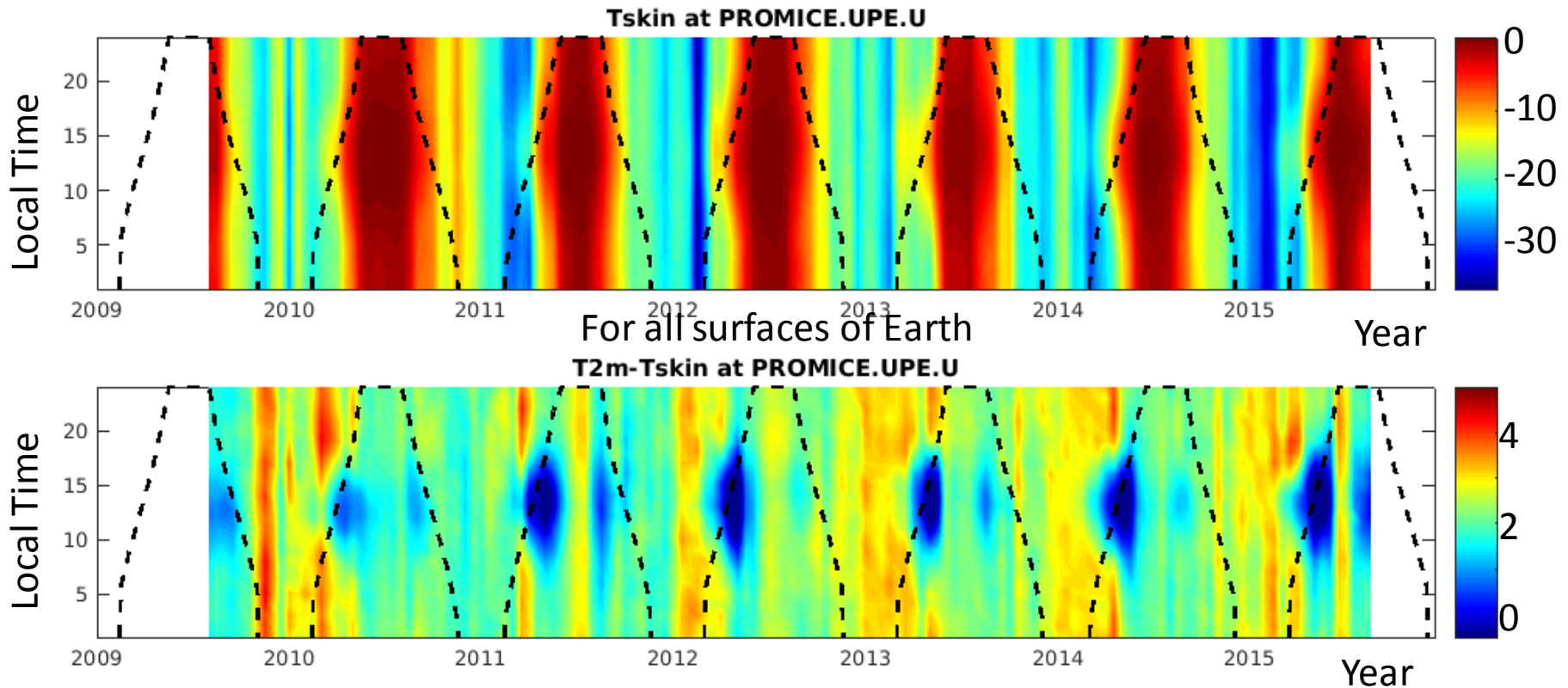
Courtesy Lizzie Good, Met Office

AVERAGE DIFFERENCE



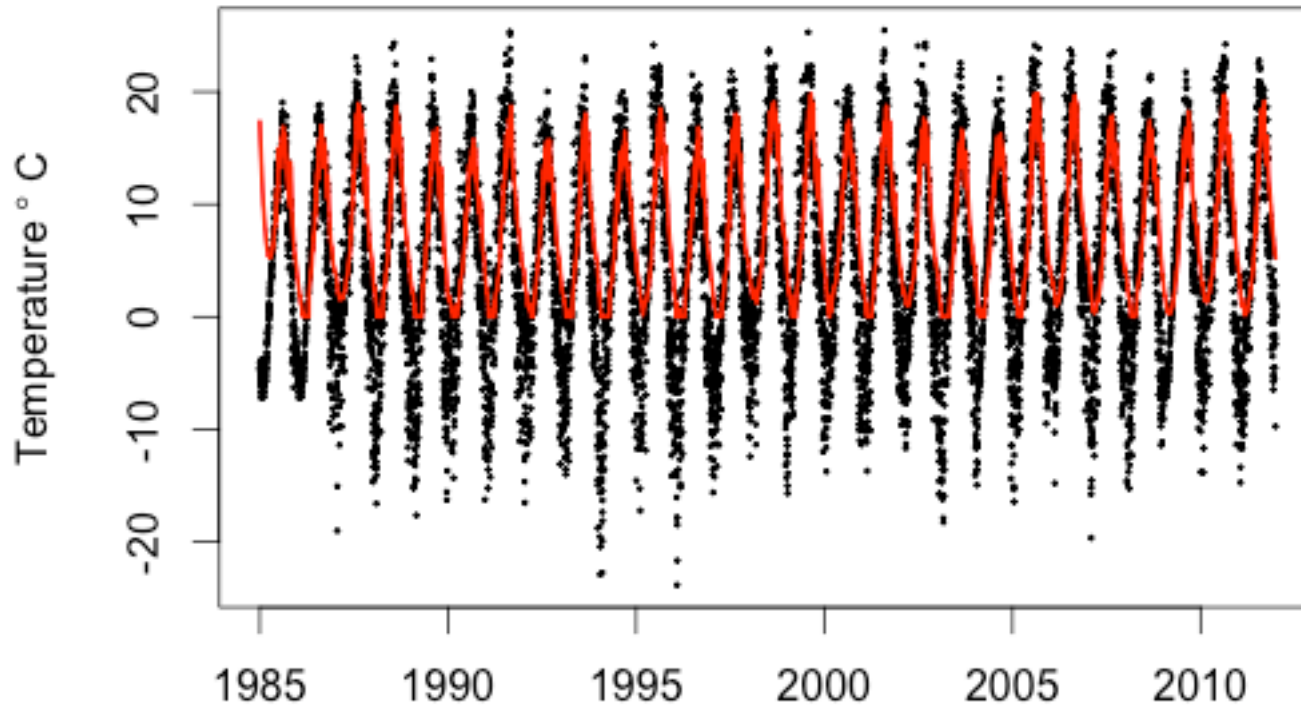
*Climatology of surface air - surface skin temperature differences
from the Atlantic Ocean*

TEMPERATURE EVOLUTION THROUGH THE DAY AND SEASON



6 years of weather station data from the Greenland Ice Sheet. Surface temperature (top) and difference between air and surface temperature (bottom).

LAKES: NO SKIN TEMPERATURE, BUT WATER TEMPERATURES...



Lake Superior monitoring station air (black) and water temperature (red) time series



Then

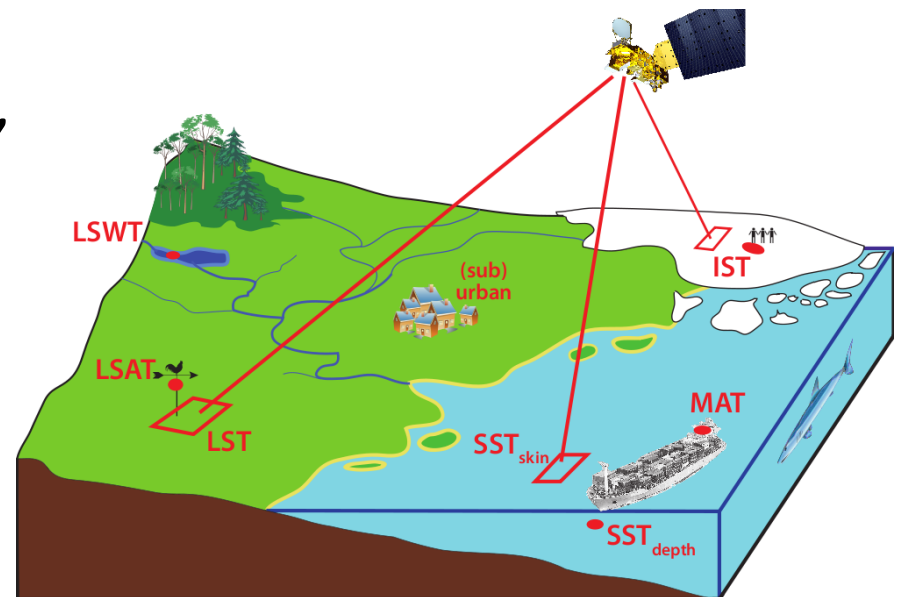


...and now

RELATIONSHIPS WITH OTHER PARAMETERS

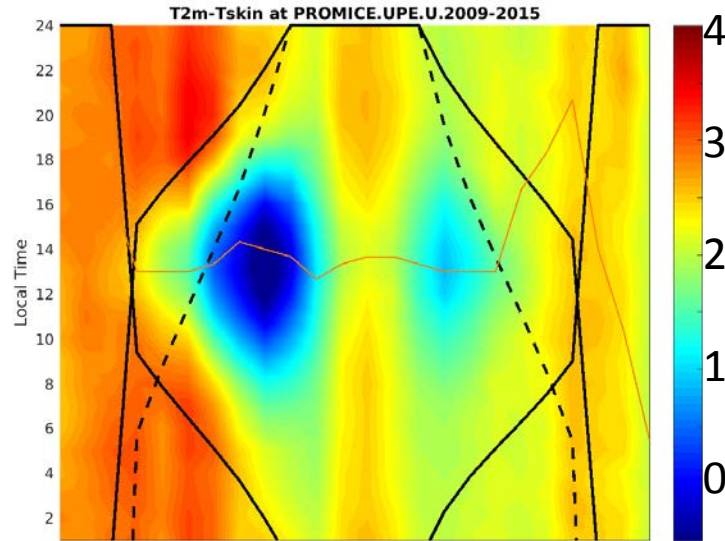
Investigated dependencies

- Surface type: Ocean, land, ice, lake
- Latitude / solar height
- Clouds
- Wind
- Vegetation (land)
- Snow cover
- Altitude
- Satellite measuring angle

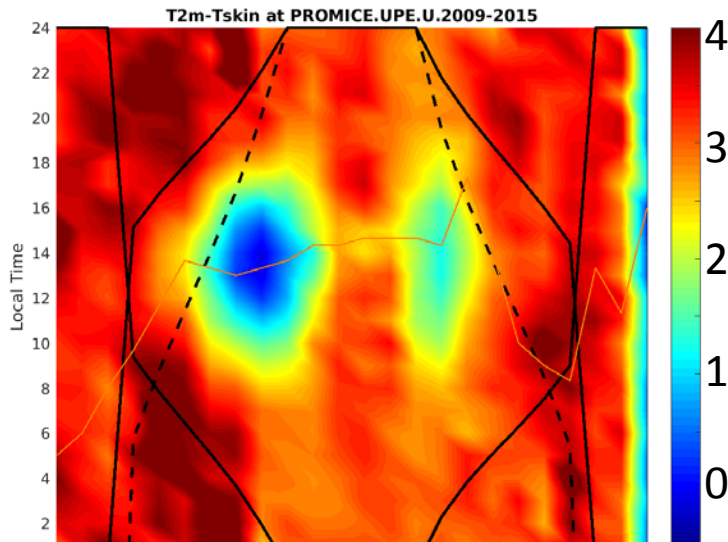


From Merchant et al., 2013

RELATIONSHIP WITH CLOUDS

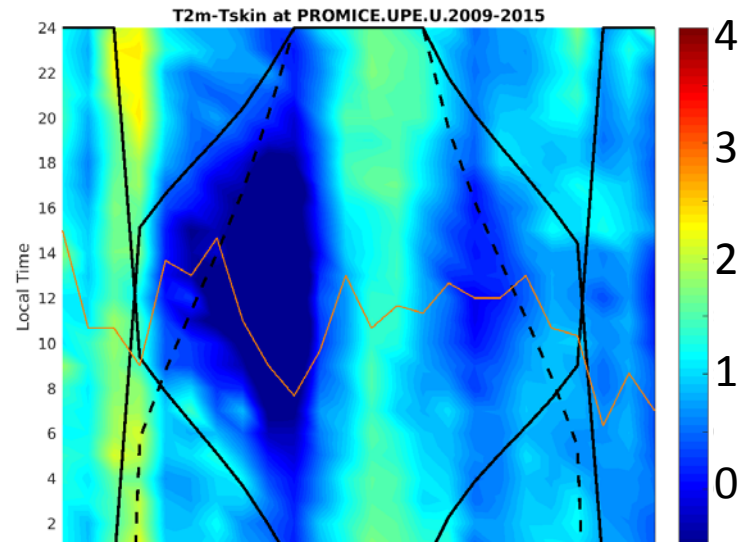


Difference between air and surface temperature for all sky conditions, cloud free conditions and cloudy conditions. Example from the Greenland Ice Sheet.



Clear-sky

All-sky



Overcast



RELATIONSHIPS WITH CLOUDS AND WIND

- Wind speed and cloud are important factors governing instantaneous differences between skin and air temperatures.
- Influence less clear on extremes.

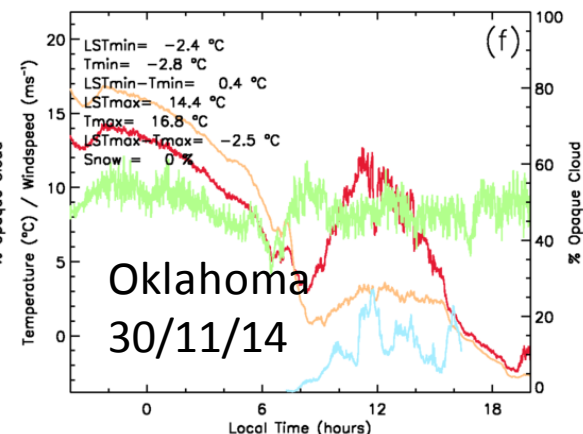
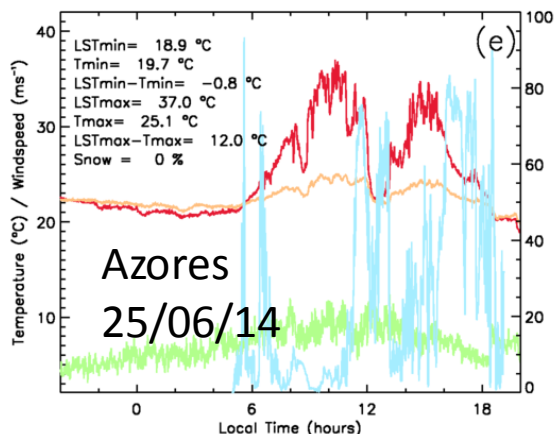
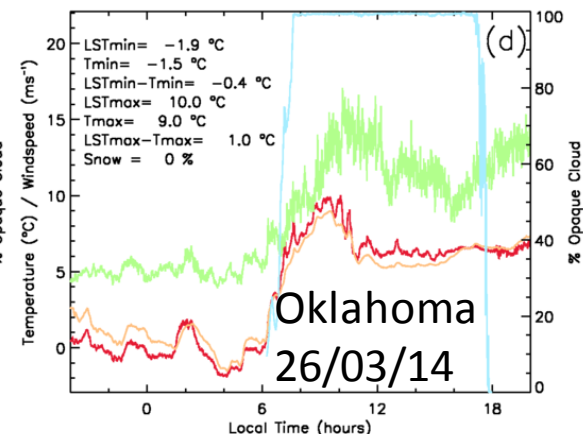
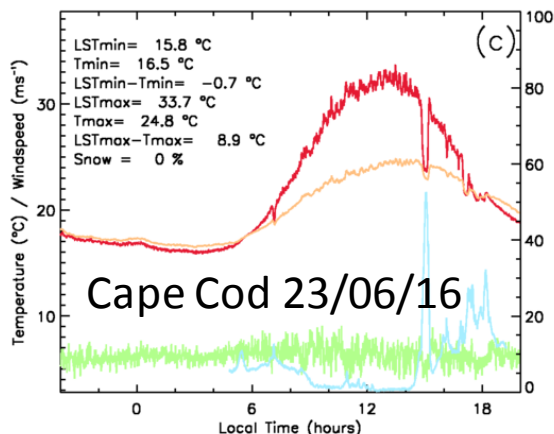
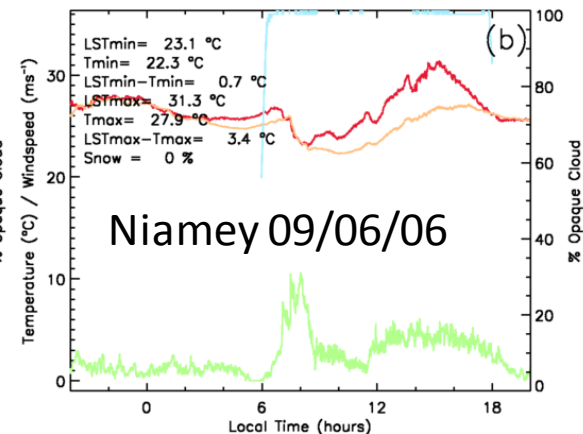
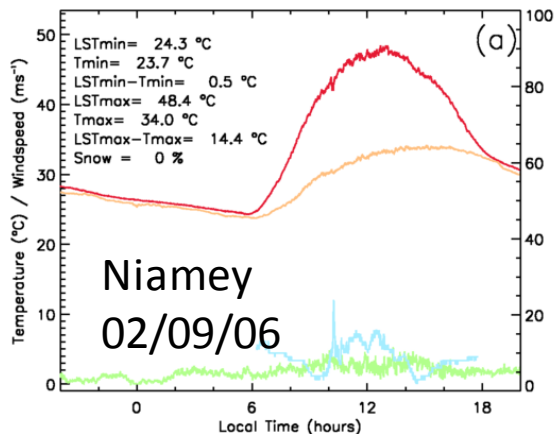
Examples of the diurnal cycle

Surface skin temperature

Surface air temperature

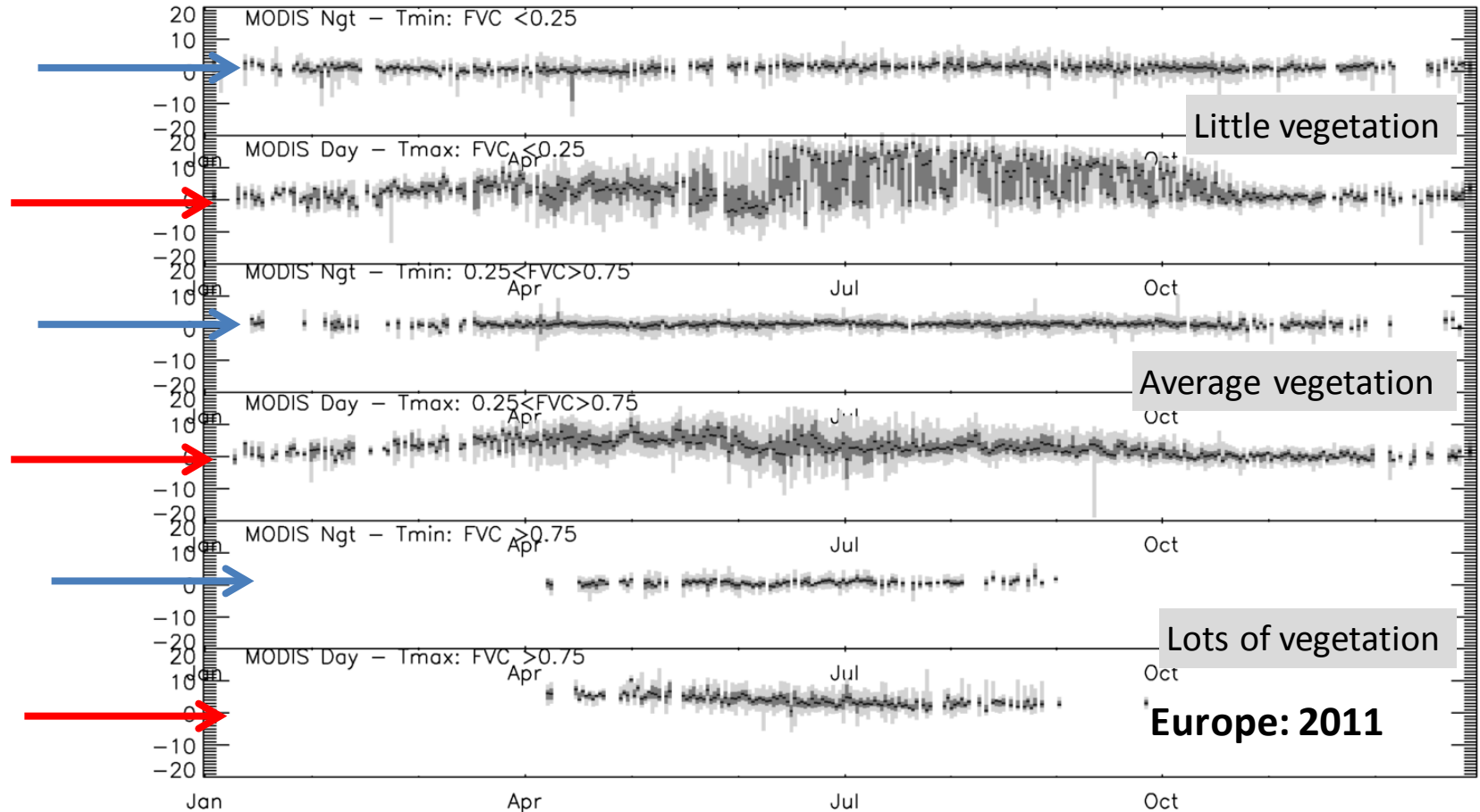
Wind speed

Cloud cover



— LST — T2m — Wind — Cloud

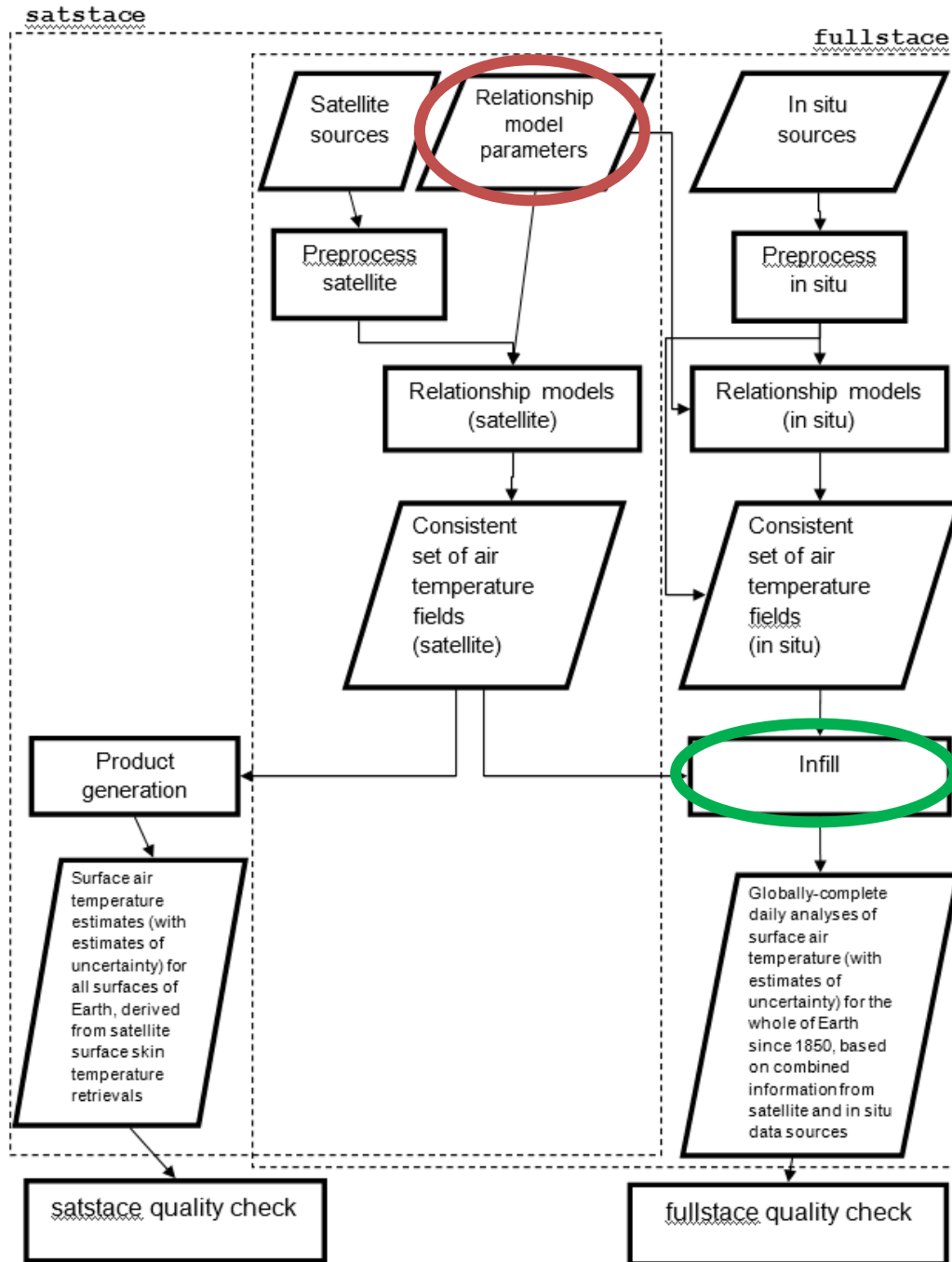
RELATIONSHIP WITH VEGETATION



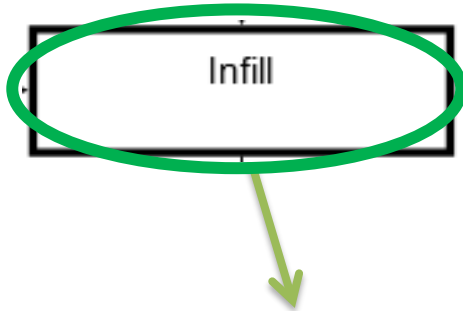
Minimum temperature difference: little impact by changing vegetation filter

Maximum temperature difference: more vegetation = less extreme differences

TOP-LEVEL SCHEMATIC



CREATING FIELDS WITHOUT GAPS



Motivation

- Combine several different data sources
- Get temperature information with uncertainty estimations for all corners of the Earth
- ... this process fills data gaps 😊

THE EUSTACE ANALYSIS METHODS

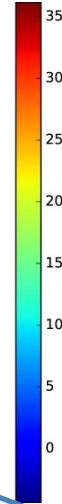
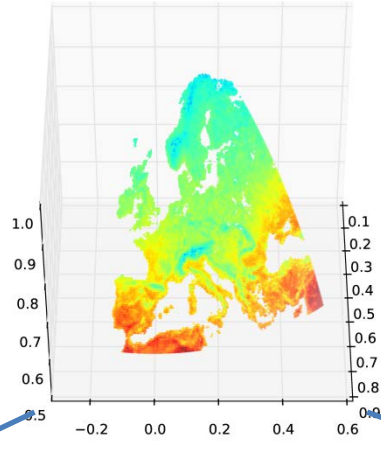
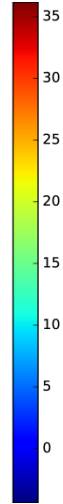
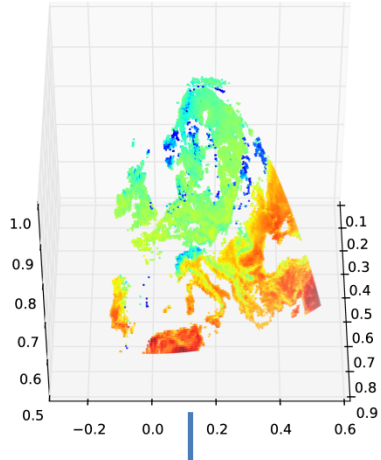
- Merges satellite and in-situ data sources including uncertainties
 - produce spatially and temporally complete temperature estimates
 - quantified uncertainties
- Two methods are being developed in parallel:
 - *Advanced Standard*: links to existing methods for observational climate data sets
 - *Ambitious*: more experimental
- Both approaches require novel techniques to work with daily data at EUSTACE resolutions

TEST APPLICATION

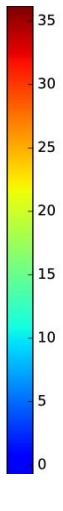
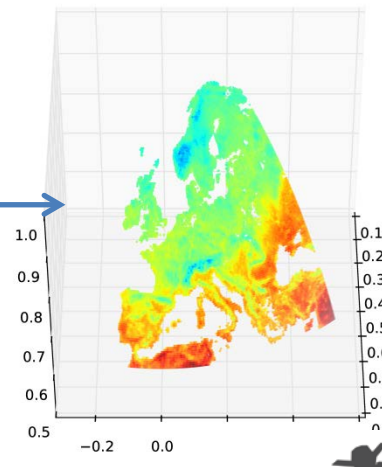
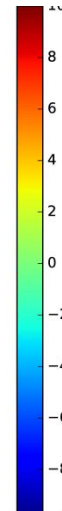
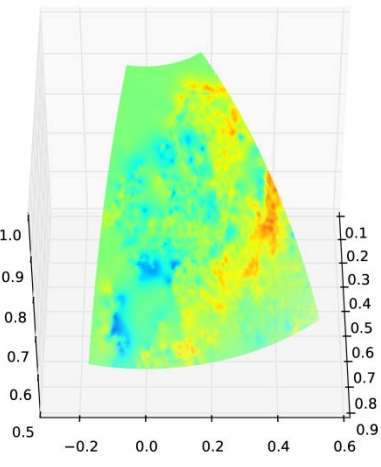
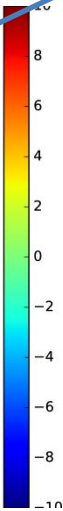
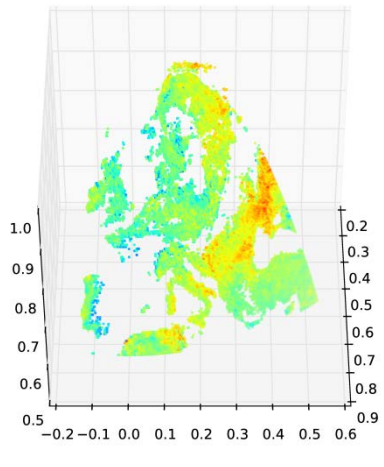
Derived from satellite observations

Climatology (31 day mean)

Maximum near-surface air temperature over Europe 16/07/2010



Local analysis + climatology



Observations - climatology

Local analysis (SPDE)



MANY THANKS FOR LISTENING

TIME FOR QUESTIONS



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