



Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the
Environment

THE EUSTACE PROJECT: DELIVERING GLOBAL, DAILY INFORMATION ON SURFACE AIR TEMPERATURE

NICK RAYNER, SCIENCE COORDINATOR
JOINT EUSTACE AND GLOBTEMPERATURE USER MEETING,
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nick.rayner@metoffice.gov.uk



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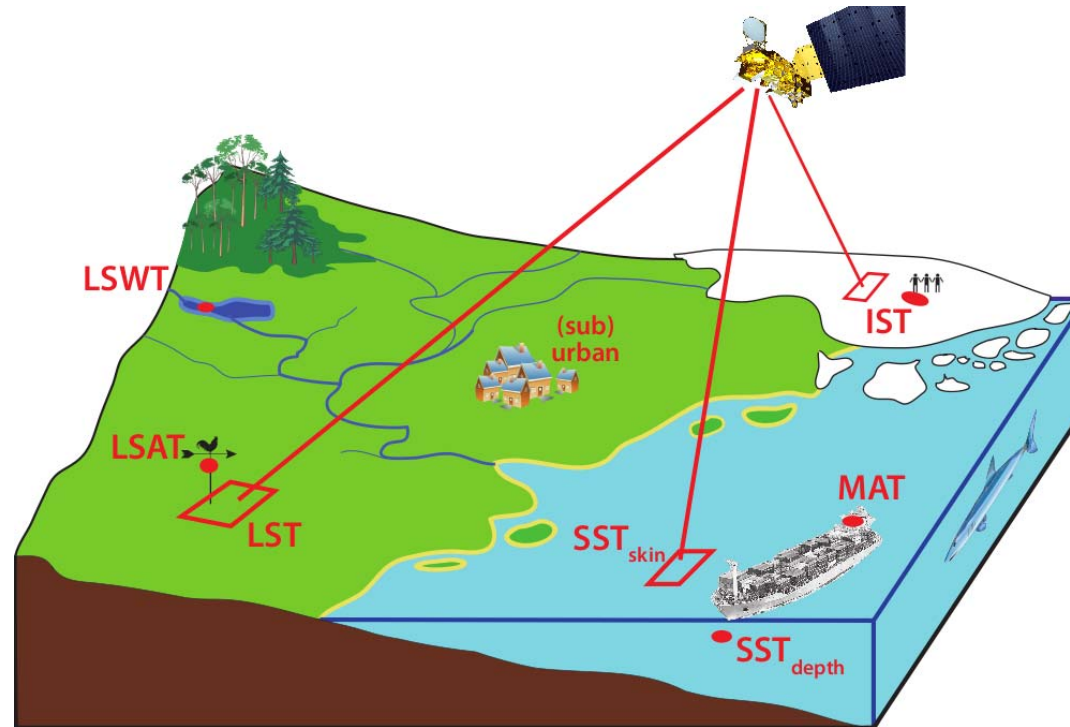
EUSTACE AIMS

EUSTACE will give publicly available daily estimates of surface air temperature since 1850 across the globe for the first time by combining surface and satellite data using novel statistical techniques. To do this, we need to:

- Identify non-climatic discontinuities in daily weather station data, *so users can trust the changes our records show*
- Produce consistent uncertainty estimates for satellite skin temperature retrievals over all surfaces (land, ocean, ice and lakes), *so we know how far to trust the estimates everywhere*
- Understand how surface temperature measured *in situ* and by satellite relates, *to estimate air from skin temperature*
- Estimate values in areas where we have no *in situ* or satellite data, *so users can have daily information here*



UNDERSTAND RELATIONSHIP BETWEEN AIR AND SKIN TEMPERATURE



From Merchant et al., 2013 community paper and roadmap:

<http://www.geosci-instrum-method-data-syst.net/2/305/2013/qi-2-305-2013.html>



ESTIMATING AIR TEMPERATURE FROM SKIN TEMPERATURE

Highest available resolution in-filled air temperature analysis from weather station measurements

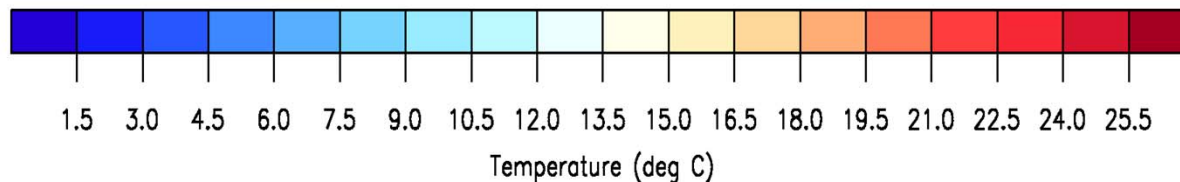
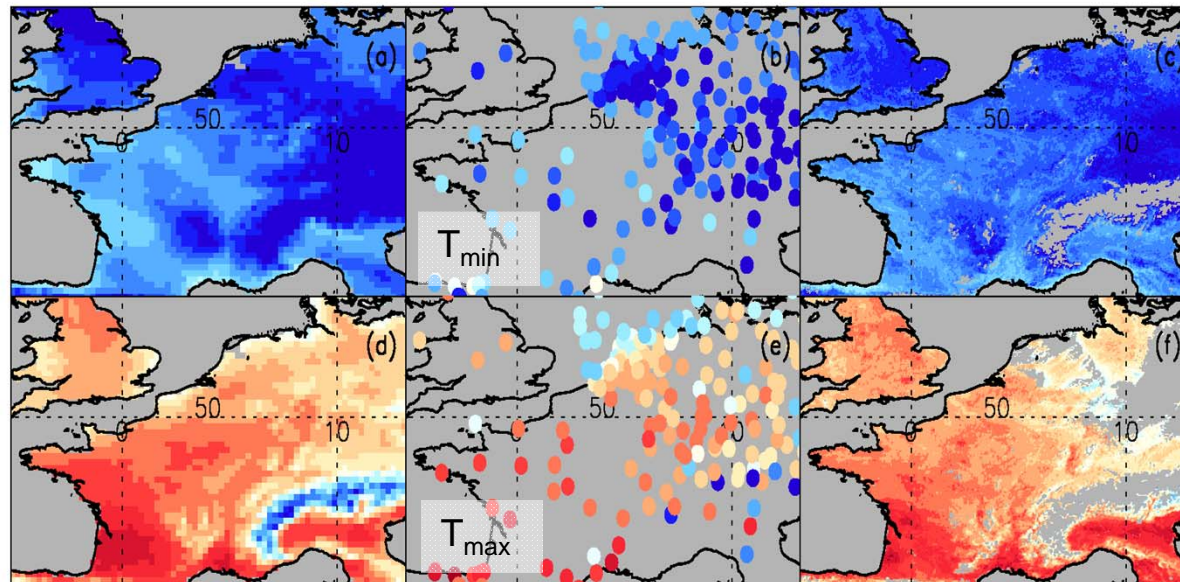
EOBS

Publicly available weather station records

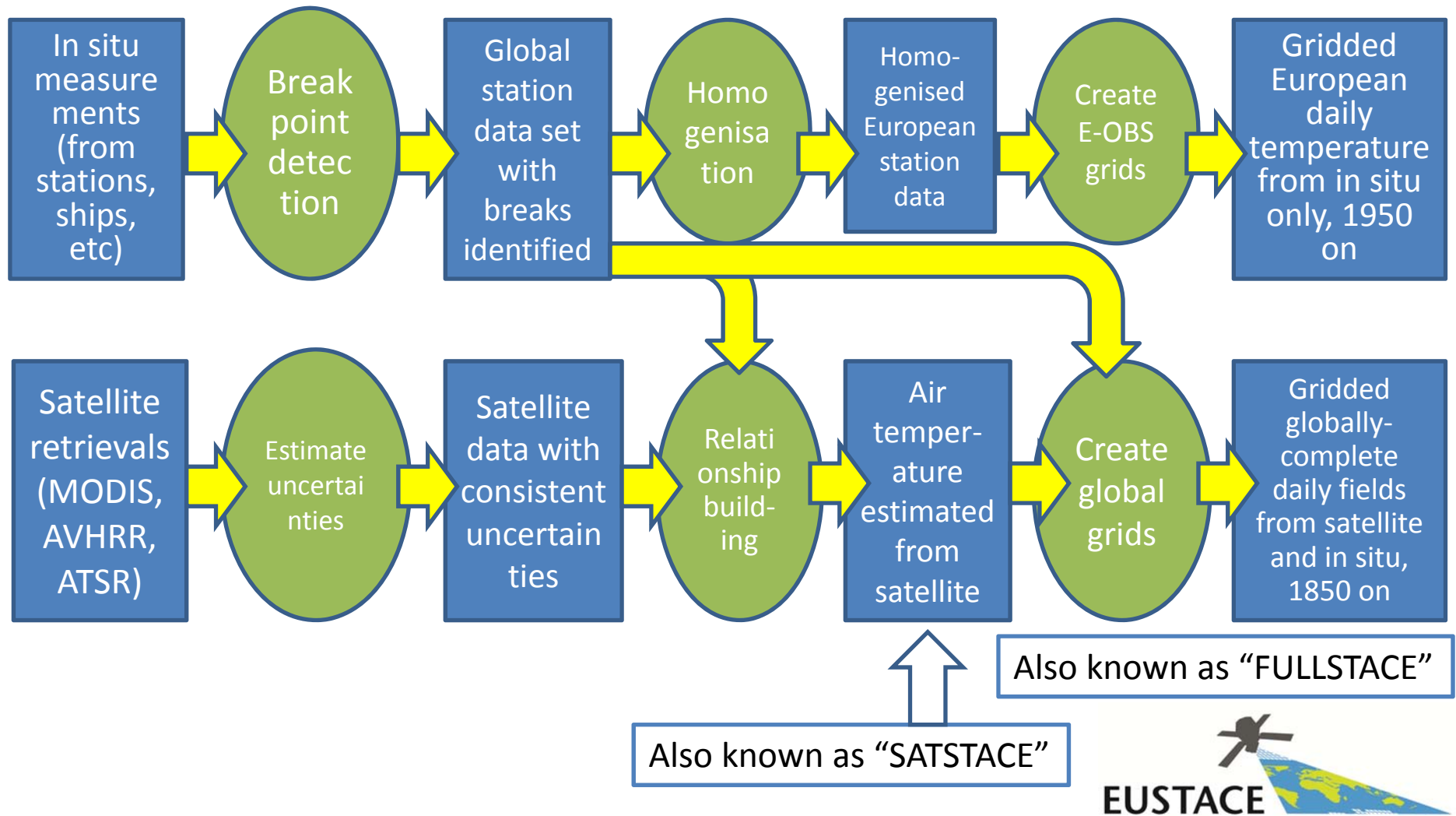
ECA&D

Satellite LSAT

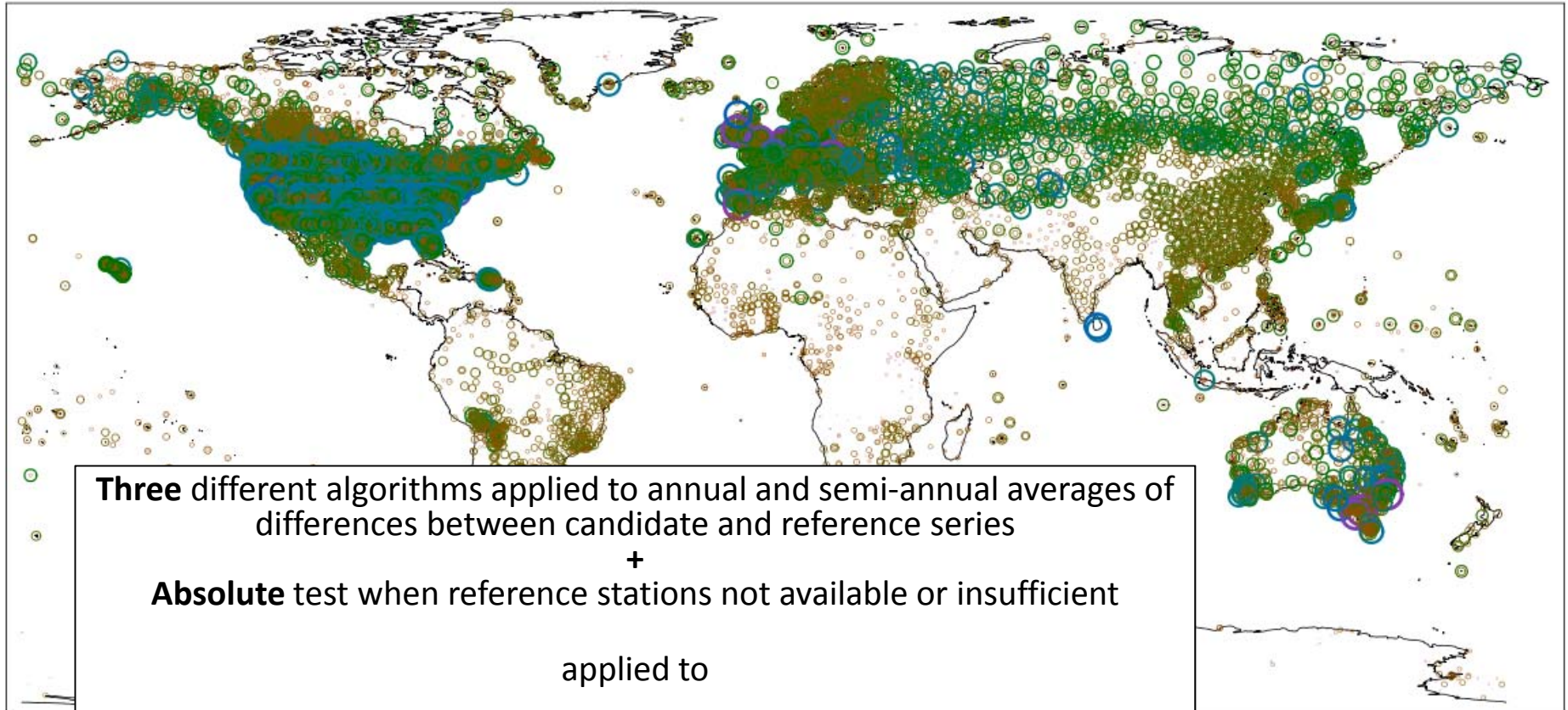
Higher resolution information on air temperature estimated using surface (skin) temperature from satellites



EUSTACE SCHEMATIC



EUSTACE DAILY STATION DATASET



Three different algorithms applied to annual and semi-annual averages of differences between candidate and reference series

+

Absolute test when reference stations not available or insufficient

applied to

$$T_{\max}$$
$$T_{\min}$$

$$T_{\text{avg}} = (T_{\max} + T_{\min}) / 2$$

$$\text{DTR} = T_{\max} - T_{\min}$$

and monthly data

es (T_{\max})

thern Hemisphere

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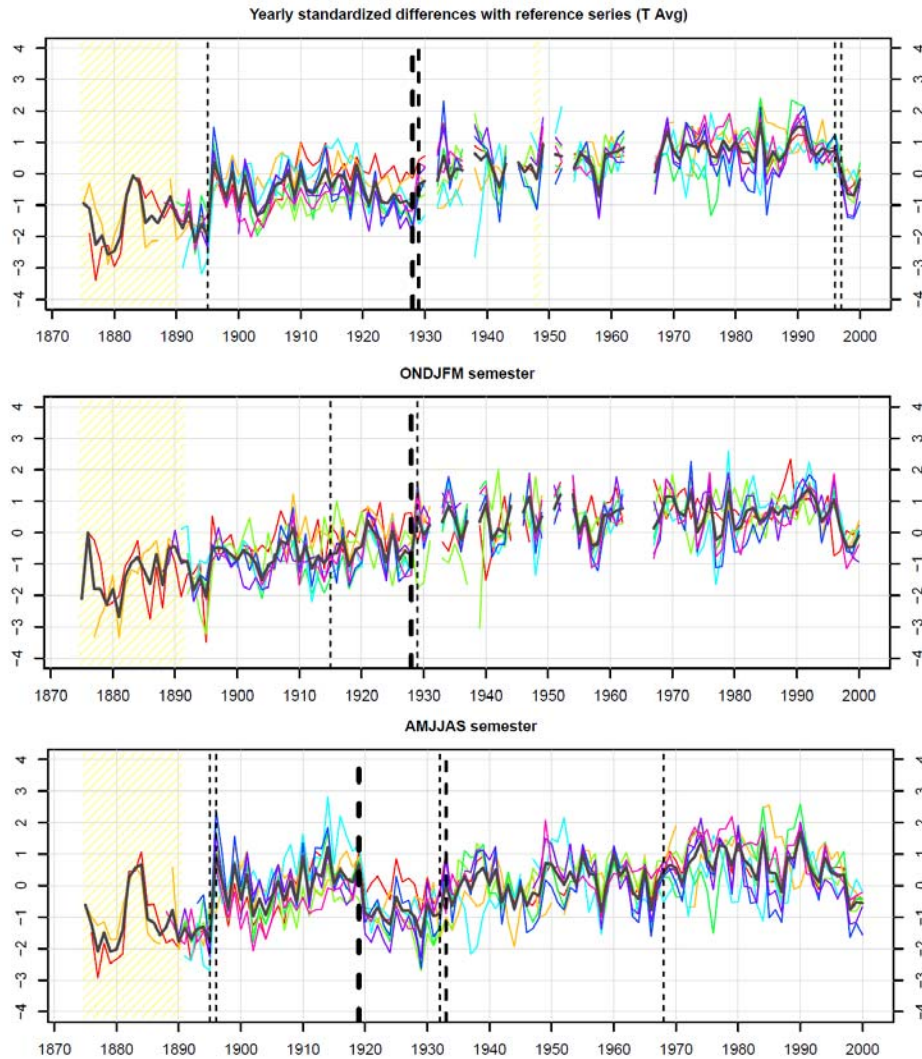
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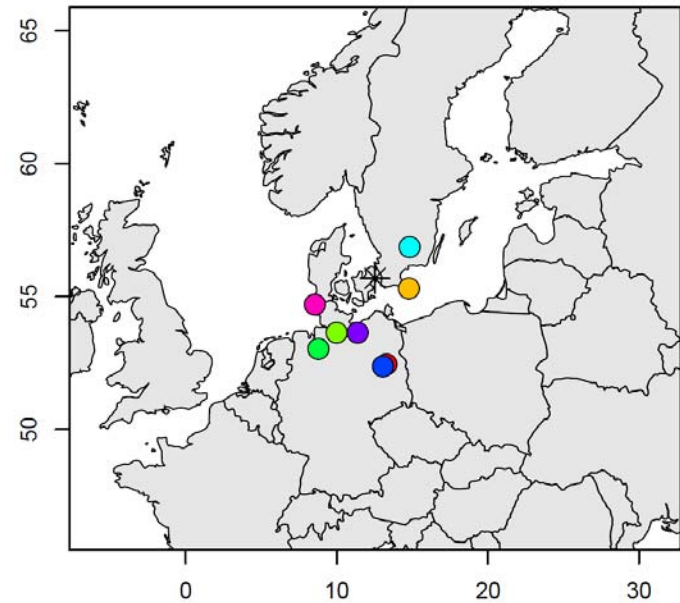


EXAMPLE BREAKPOINT DETECTION

KOEBENHAVN: LANDBOHOJSKOLEN



- High «likelihood»
- Low «likelihood»
- //// Low detection score

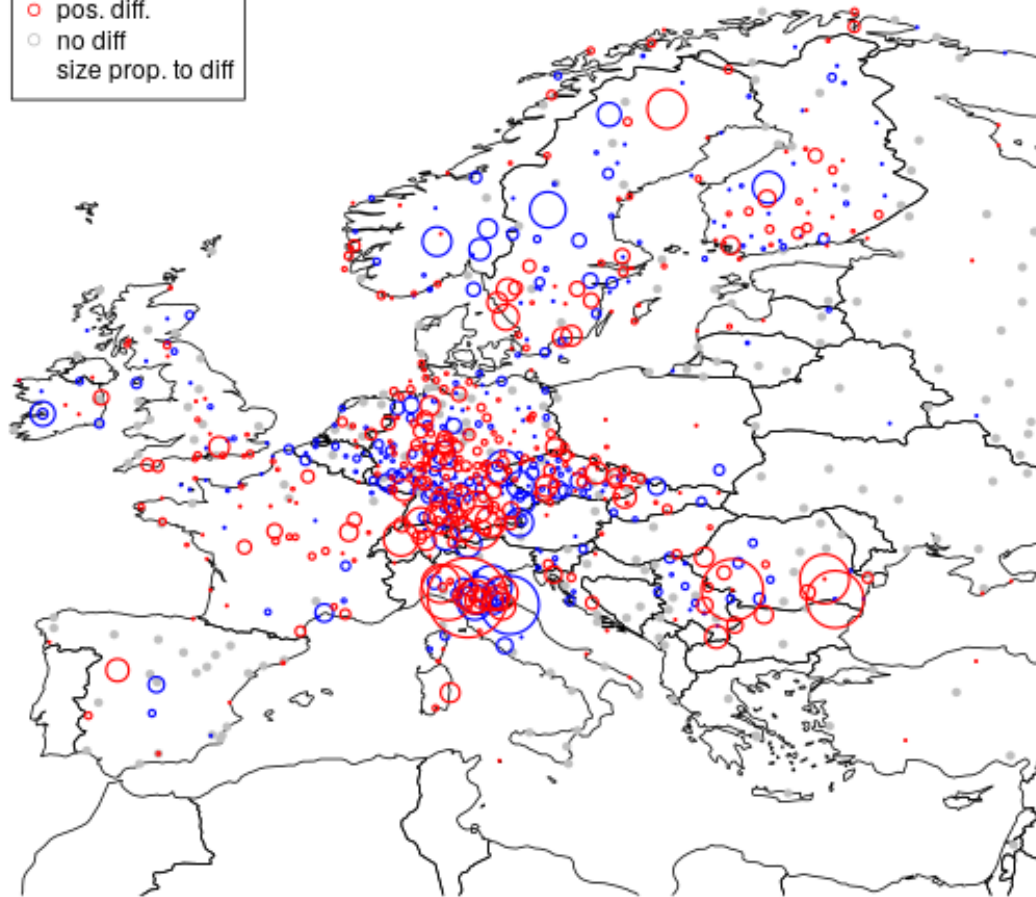


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DIFFERENCE IN TRENDS

TN Difference in trend of annual mean (2iter), 1951-2010

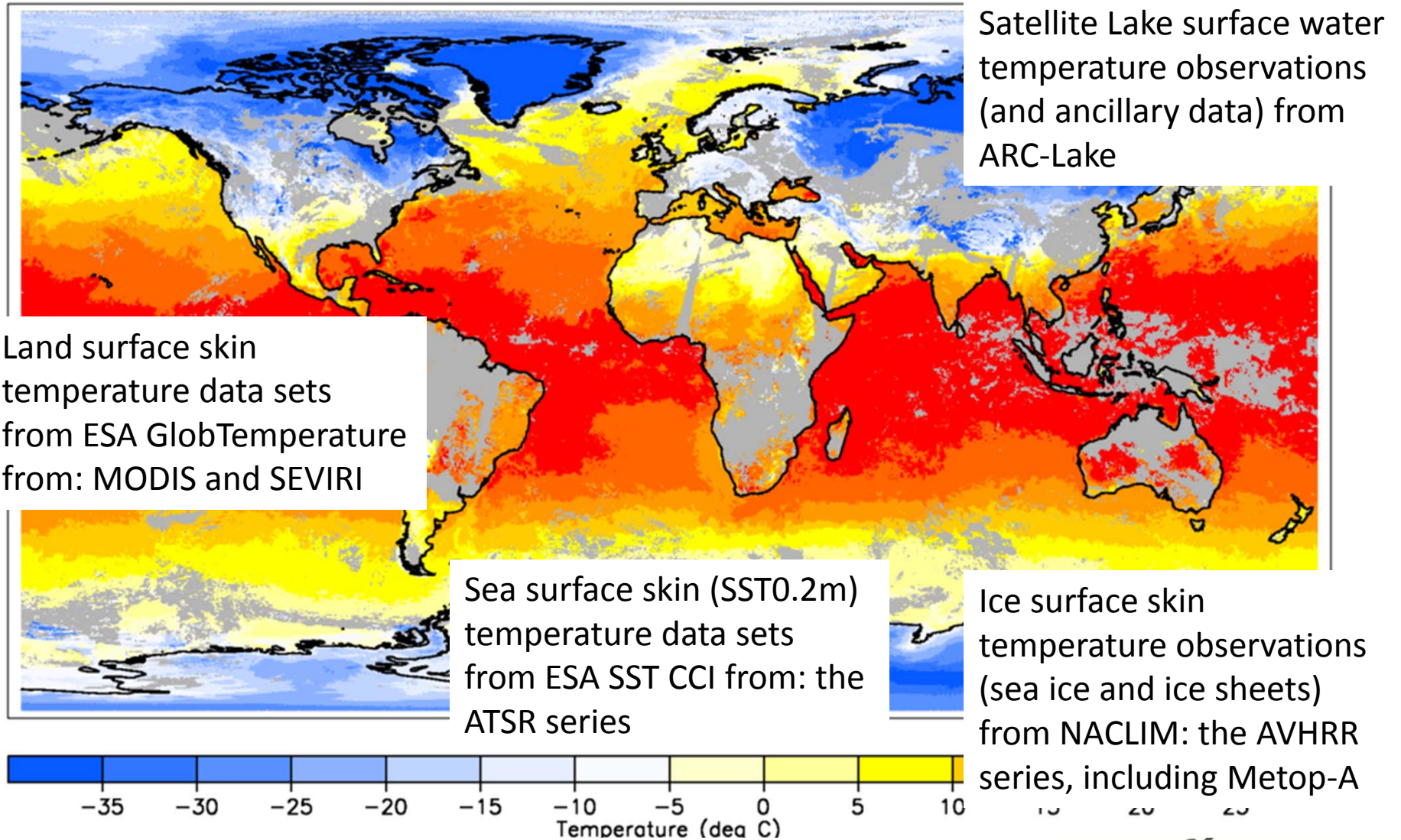
- neg. diff.
- pos. diff.
- no diff
- size prop. to diff



Difference signs in the corrections.

Corrections on trends can also be negative. Stations that showed negative trends now show positive trends in most cases

EUSTACE SATELLITE OBSERVATIONS

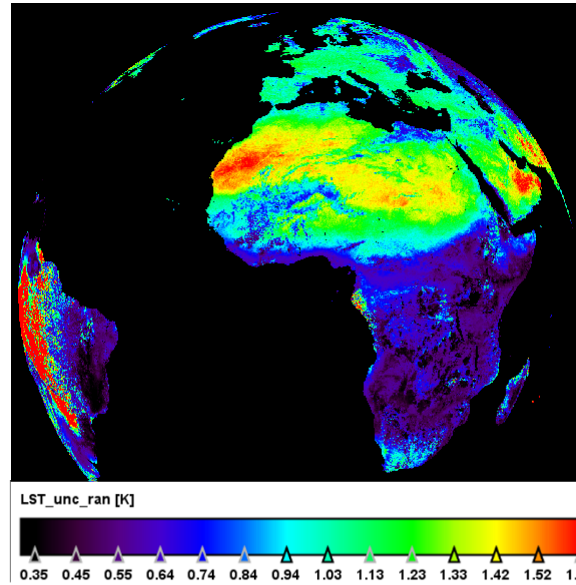


ESTIMATING CONSISTENT UNCERTAINTIES IN SATELLITE RETRIEVALS

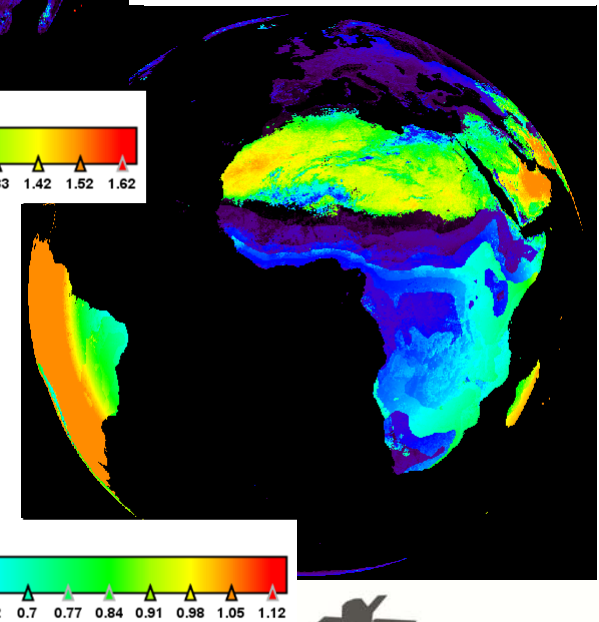
Random

- Uncertainties categorised by effects whose errors have distinct correlation properties:

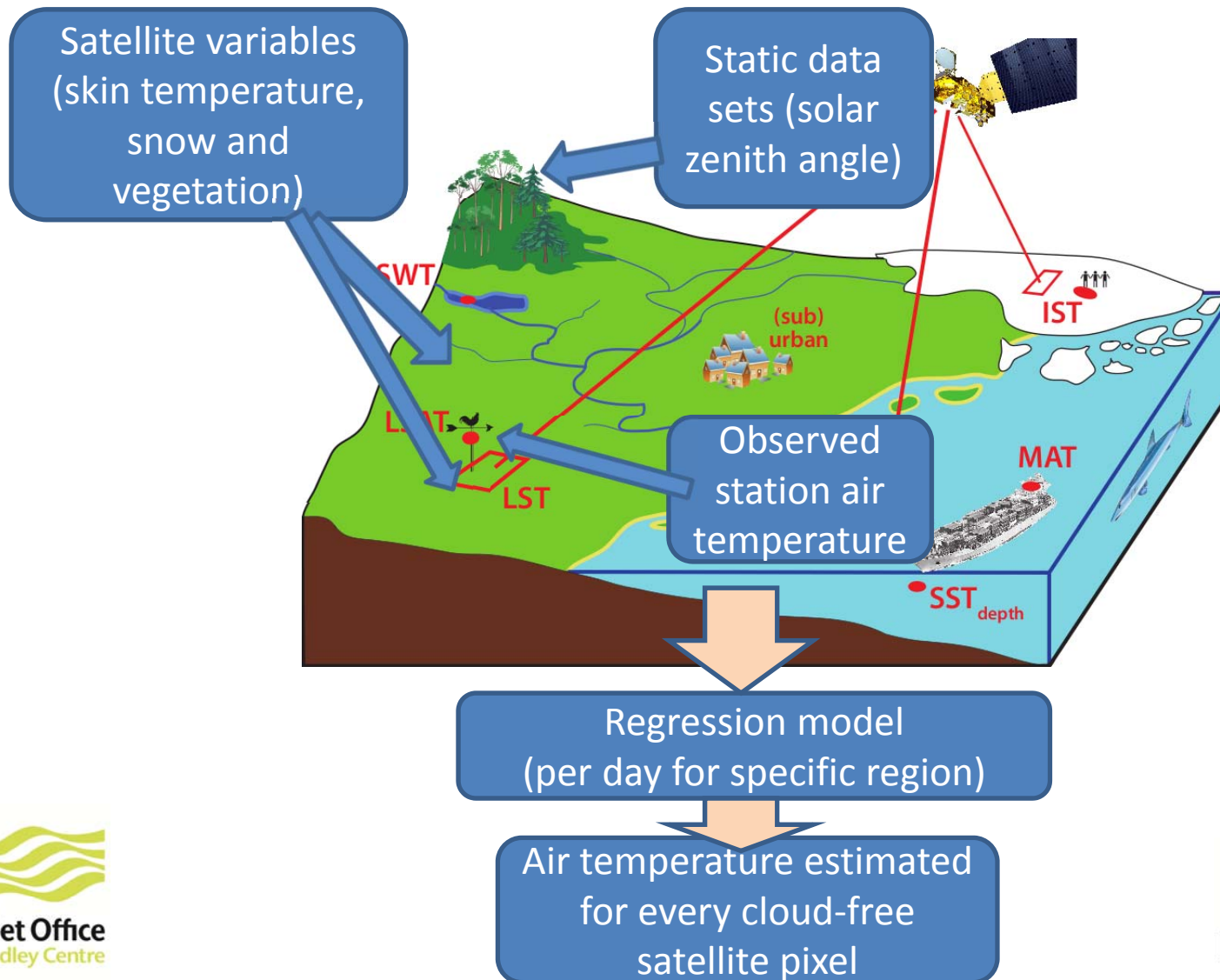
- random
- locally correlated
- (large-scale) correlated



Locally correlated

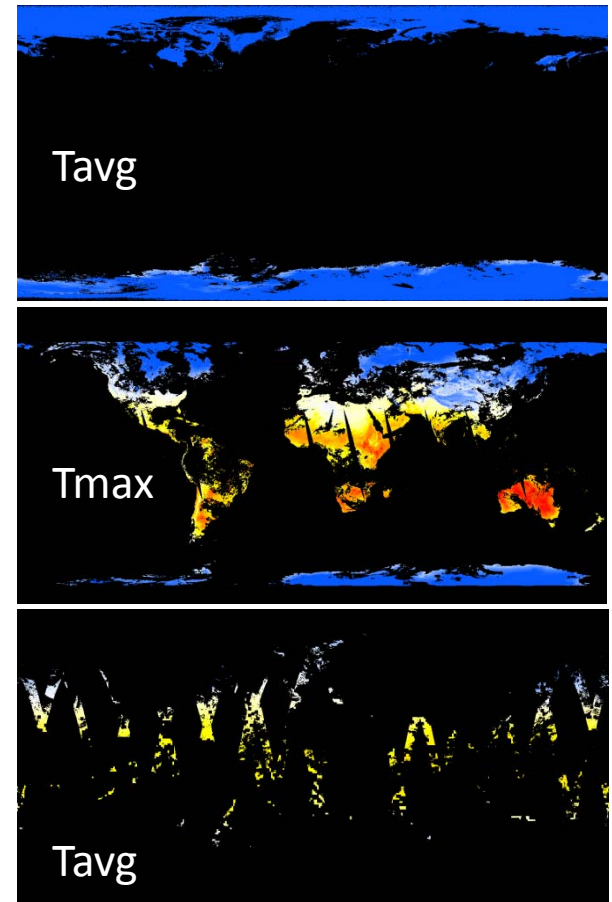


ESTIMATING AIR TEMPERATURE FROM SKIN TEMPERATURE



CONSISTENT AIR TEMPERATURE ESTIMATED FROM SATELLITE DATA

- A main surface air temperature file per day per surface type (land, ocean, ice)
- The main files contain total uncertainty budget per grid box and so uncertainty is consistently expressed for all surface types
- There is an ancillary file per day per surface type which contains more detailed uncertainty information. These depend on surface type as uncertainty models differ.



Also known as “SATSTACE”

TWO STRANDS OF DEVELOPMENT OF STATISTICAL INTERPOLATION

AMBITIOUS

- Novel statistical methods created specifically for EUSTACE
- State of the art
- Idea is to use CEMS computing facility to the full
- Challenging for implementation

ADVANCED STANDARD

- Extend current methods to proposed EUSTACE resolution and data volumes
- Low risk
- Designed to be extended to greater complexity
- Sharing techniques with the ambitious method for efficient processing.



EUSTACE PRODUCTS

Product	Description	Date
Station series and E-OBS update	Global data set of daily weather station air temperature measurements (Tmax and Tmin) with non-climatic breaks identified – Station time series and gridded for Europe	Completed 2017
Satellite skin temperature retrievals	Daily satellite skin temperature estimates for all surfaces of Earth with consistent uncertainty estimates – Gridded or along satellite's track	Release 2017
Skin/air temperature relationships	Understanding of the relationship between surface skin and surface air temperature over all surfaces of Earth and in different seasons – A report on EUSTACE website	Publish 2017
Air temperature estimates from satellites	Gridded daily estimates of surface air temperature from skin temperature retrievals	Complete 2017
Globally complete air temperature fields	Globally-complete daily fields of surface air temperature over all corners of Earth since 1850 – Gridded (0.25° lat/lon) perhaps an ensemble. (Tmax and Tmin over land, Tmean elsewhere.)	Release 2018
Derived products	For example, global means and climatologies	Release 2018

SUMMARY/FURTHER INFO

- EUSTACE is producing global, daily information on surface air temperature by combining measurements made in situ with satellite retrievals
- Non-climatic breaks in global station data have been identified and removed from European station data
- Consistent estimates of uncertainty have been estimated for skin temperature retrievals
- Relationships between skin and air temperature have been used to estimate air temperature from satellite retrievals
- Statistical interpolation methods are being developed
- For further information about EUSTACE, visit <https://www.eustaceproject.eu/>





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QUESTIONS



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