



Royal Netherlands
Meteorological Institute
Ministry of Infrastructure and the
Environment

Assessment of EUSTACE surface air temperatures and accompanying uncertainties

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EUSTACE has received funding from the European Union's Horizon 2020 Programme for Research and Innovation, under Grant Agreement no 640171



Strategy

- Validation

- Validation against in situ air temperatures from land stations, ships, moored buoys and ice buoys.
 - Reference data are independent of data used as input to products
 - Reference data are publically available
 - Matchup code and EUSTACE-in situ matchups will be made publically available

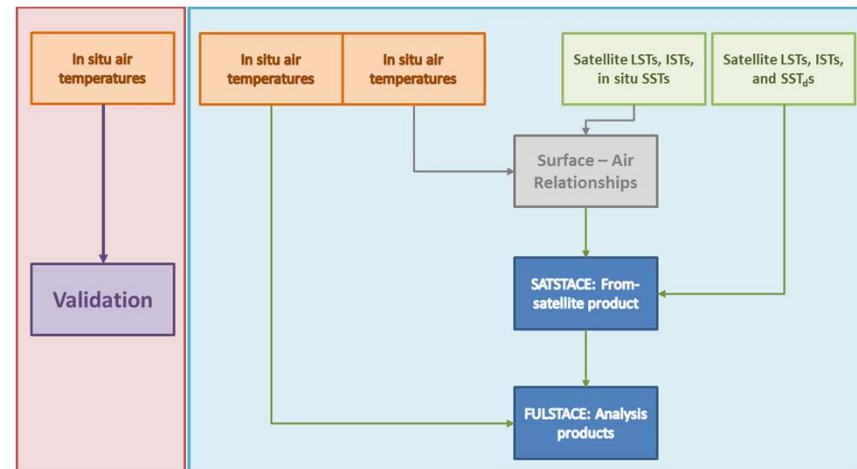
- Intercomparison

- Intercomparison on a common grid of EUSTACE SATSTACE and FULSTACE with other in situ analyses and reanalyses
 - Results reported in publically available document(s)



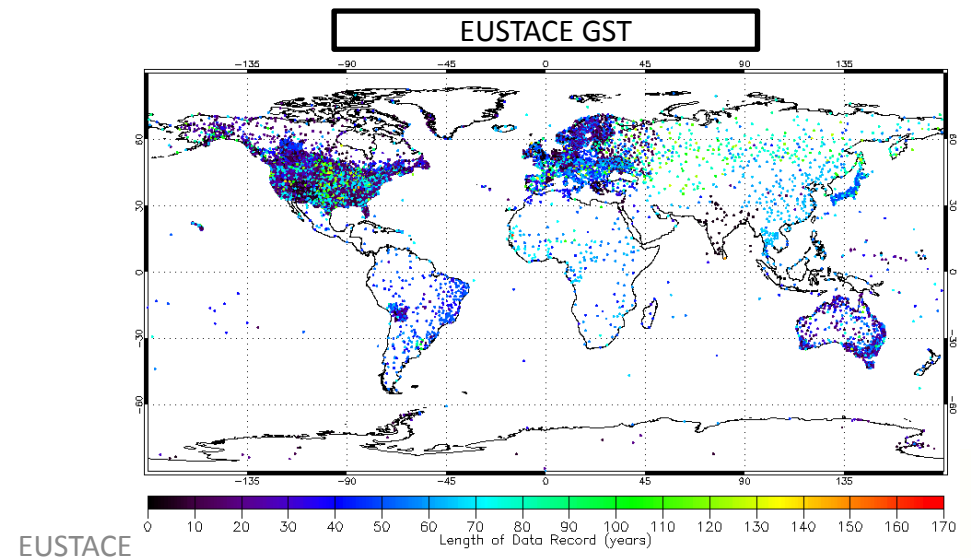
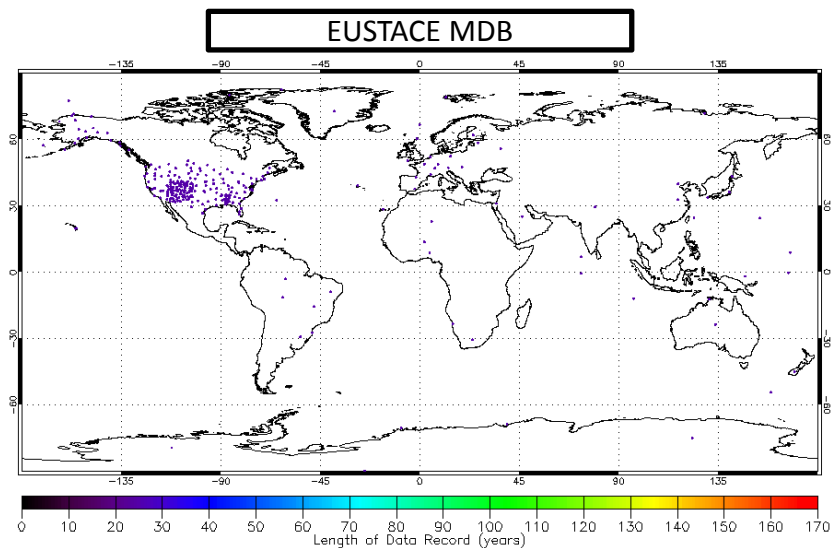
EUSTACE Products to assess

- Products
 - from-satellite air temperatures (SATSTACE)
 - filled products (FULSTACE)
 - over land, ocean and ice
 - Variables (SatSTACE:
 - Land: Tmin, Tmax
 - Ocean: Tmean
 - Ice: Tmin, Tmax, Tmean
 - Grid
 - 0.25 degree
 - Daily statistics for *local* midnight to midnight
- Approach
 - Validation data independent of products
 - Selected by platform
 - Stations
 - where data available calculate daily statistics at station on EUSTACE time grid
 - Otherwise compare daily statistics on potentially different time grids
 - Ships/buoy
 - compare EUSTACE daily statistics with observations



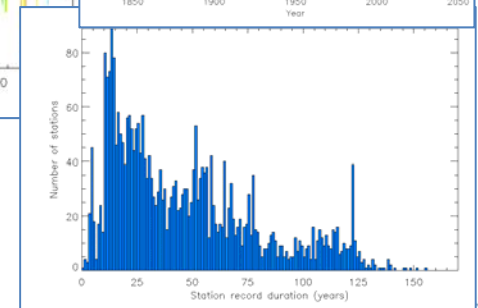
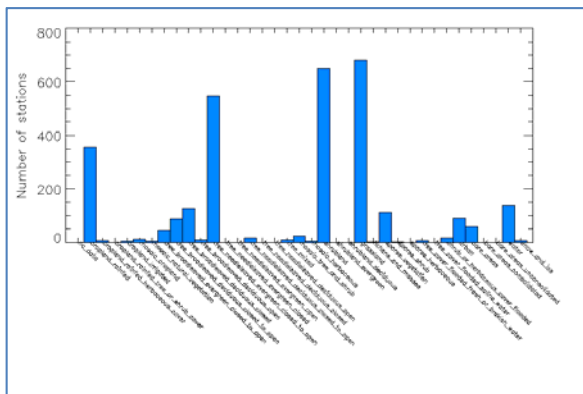
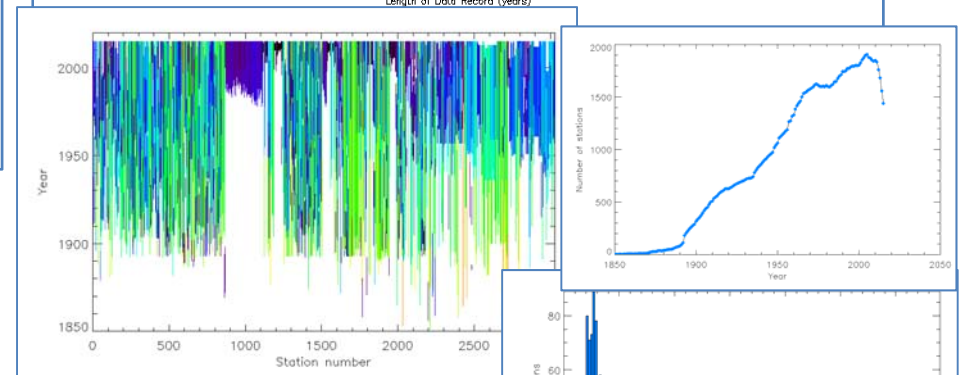
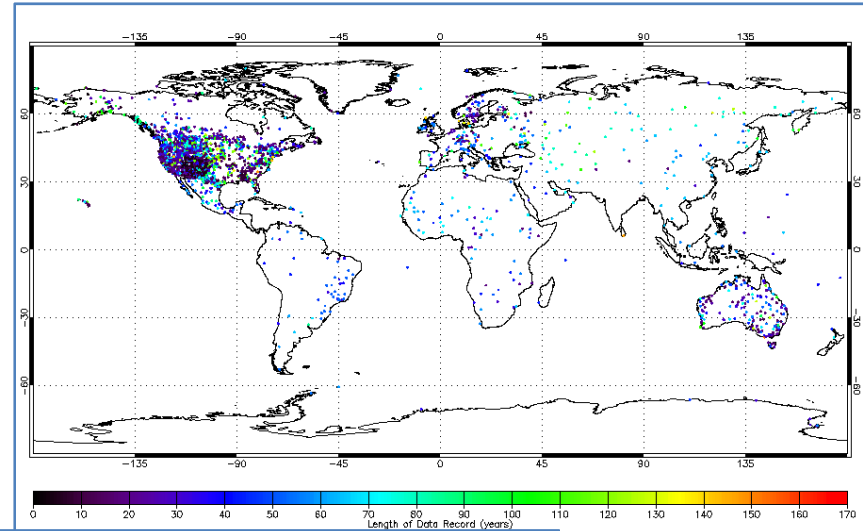
Reference data for validation: land

- EUSTACE matchup database (MDB)
 - ARM, BSRN, USCRN
 - Well maintained, traceable to SI
 - Use all observations to estimate daily Tmin, Tmax, Tmean on EUSTACE time grid
- EUSTACE global station dataset (GST)
 - Wider spatial and temporal coverage than EUSTACE MDB
 - Data are daily Tmin, Tmax (day definition and input to daily statistic calculation vary)
 - Data from approx. 10 % of stations reserved for validation



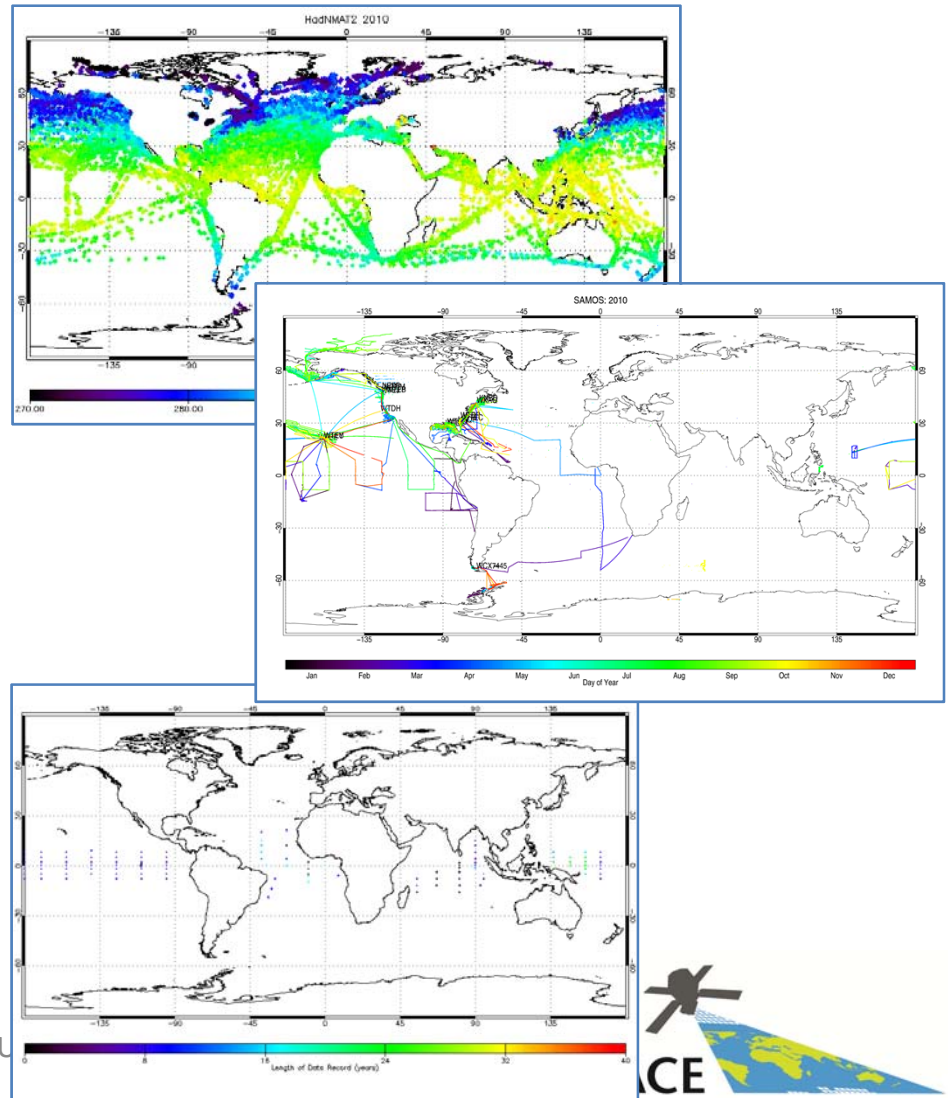
Land station selection: EUSTACE Global station dataset

- Data independent from products being validated
 - Select data by station
- Prioritize ARM, BSRN, USCRN, GCN
- Criteria
 - Landcover class at station matches dominant landcover class in EUSTACE gridbox (Landcover CCI 300m)
 - Station elevation within 1 sigma of EUSTACE gridbox mean elevation (GT030 DEM)
 - Station data record at least 10 years
- Match fraction of coastal, urban, lake region of interest, other land stations to fraction of same for Earth surface using auxiliary datasets (PaCIOOS distance to coast, GLOBPLAKES distance to water, CCI Landcover)
- Aim for representation of all landcover classes



Reference data: ocean

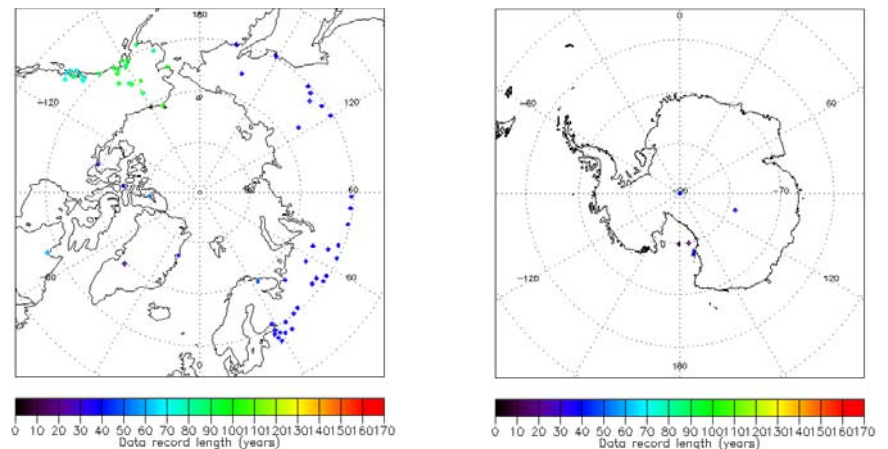
- HadNMat2
 - Hadley Centre Nighttime Marine Air Temperature 2
- SAMOS
 - Shipboard Automated Meteorological and Oceanographic System
 - research ship data
- GTMBA
 - Global Tropical Moored Buoy Array
 - Calculate daily Tmean on EUSTACE grid



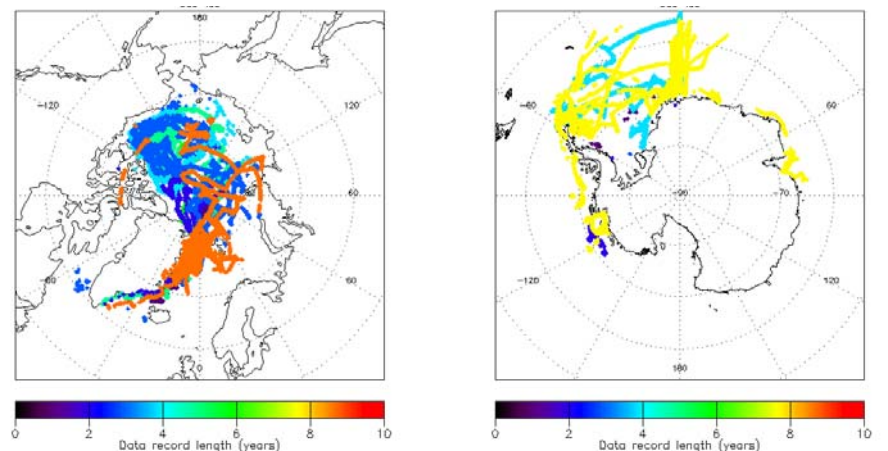
Reference data: ice

- DMI Quality controlled
- Land-ice stations, campaigns, sea-ice buoys
- Arctic sea-ice, Greenland ice-sheet, Antarctic sea-ice, sea-ice shelf and land ice-sheet

Ice Stations

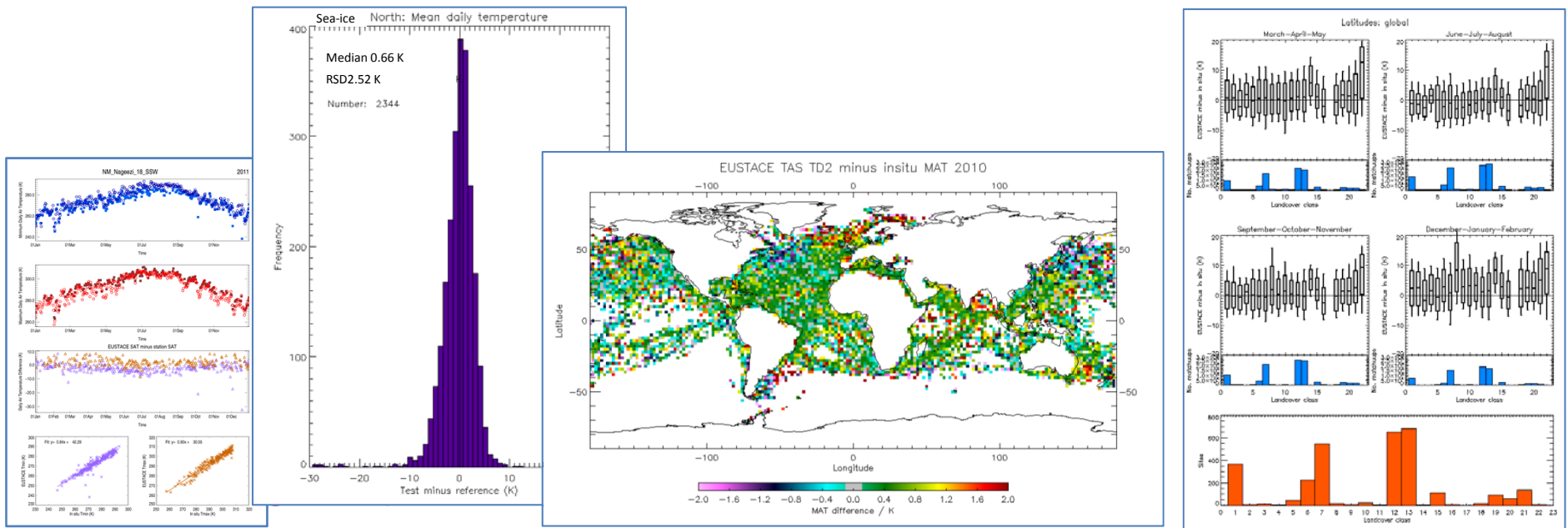


Sea-ice buoy data



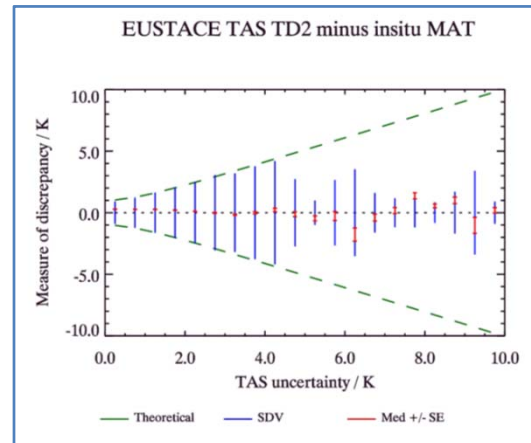
Diagnostics 1: Validation of air temperature estimates

- Matchup discrepancy = EUSTACE gridded – reference (in situ) point
 - Use robust statistics: median, median absolute deviation from median (MAD)
 - Individual station plots
 - Global and regional statistics
 - Seasonal breakdown
 - Spatial maps (median and spread)
 - Discrepancy versus e.g. latitude, land cover class, local time



Diagnostics 2: Validation of uncertainty estimates

- Model variance in discrepancy as
 - Variance due to in situ uncertainty + variance due to EUSTACE uncertainty + variance due to matchup process
 - Matchup contribution: e.g. point to grid comparison, difference in measurement height/time
 - $\sigma_{discr}^2 = \sigma_{in\ situ}^2 + \sigma_{EUSTACE}^2 + \sigma_{matchup}^2$



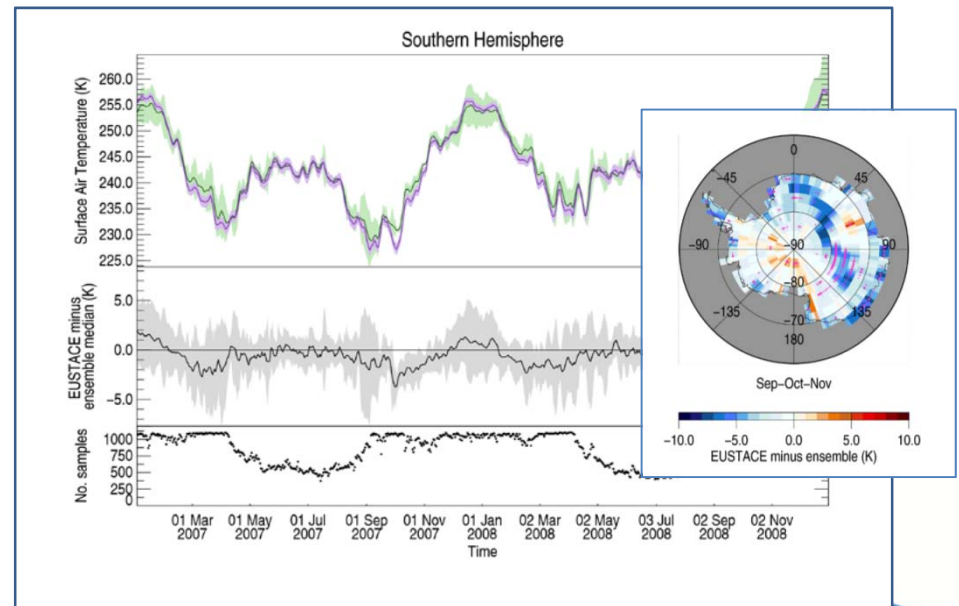
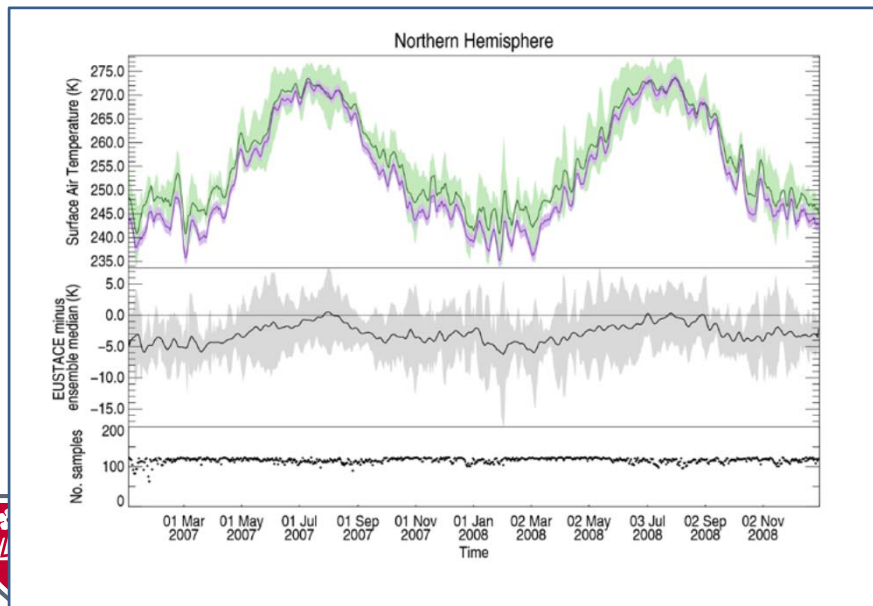
Intercomparison

- Datasets
 - Air temperature datasets: e.g. HadCrut4, GISTEMP, Berkley, CRUTeM4, GHCN-M anomalies, AIRS
 - In situ reanalyses: ERA Interim, MERRA2, JRA55, ERACLIM global, UERRA HR for Europe, 20CR, ERA5
- Method
 - Regrid to common grid
 - Nb. Compare daily Tmean on EUSTACE time grid
 - Consider Tmean = average of Tmin and Tmax
 - Compare EUSTACE to median of ensemble of analyses
 - Compare monthly/seasonal anomalies, climate indices, trends



Example: Intercomparison of EUSTACE test estimates of air temperature over land-ice with an ensemble of 4 reanalyses (ERA Interim, NCEP CFS, JRA55 and MERRA)

- Greenland
 - EUSTACE colder than ensemble for most of year and by ~ 3 K during winter
 - Validation against in situ showed EUSTACE median biases (RSD) of 0.74 (3.43) K for Greenland
- Antarctica:
 - EUSTACE estimates colder than reanalysis ensemble in Spring and Autumn, particularly East Antarctica.
 - Validation results from stations in region (Dome C, Nico, JASE7 and Panda South) found median discrepancies (EUSTACE minus in situ) between -0.3 K and 2.3 K with r.s.d.s between 2.2 K and 3.0 K
- Results agree with previous work that shows reanalyses are biased warm in Arctic cold season [Serreze et al, 2012] and ERA Interim has warm biases of up to 5 K compared to inland stations on the Antarctic continent [Jones and Lister, 2015]



Summary

- EUSTACE air temperature estimates and their accompanying uncertainty estimates will be validated against in situ surface air temperatures from publically available datasets.
 - Validation data will be independent of data used in the products
 - Validation matchup code and matchup data will be made publically available.
- Further assesement of EUSTACE products will be made by intercomparison with other air temperature analyses and reanalyses.





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QUESTIONS



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