Construction and Testing of the Globally Complete HadISST1 data set

Nick Rayner

Hadley Centre for Climate Prediction and Research, Met Office, UK

nick.rayner@metoffice.com

Met Office

In collaboration with:

- Met Office
  - David Parker
  - Briony Horton
  - Chris Folland
  - Lisa Alexander
  - Dave Rowell
  - Jim Arnott
  - Povl Frich
- Internationally:
  - Alexey Kaplan (LDEO)
  - Dick Reynolds, Diane Stokes, Bob Grumbine (NOAA)
  - John Walsh, Bill Chapman (Univ. Illinois)
  - Jim Maslanik, Mark Serreze (Univ. Colorado)
  - Mike Fiorino, Pedro Viterbo (ERA40 team)

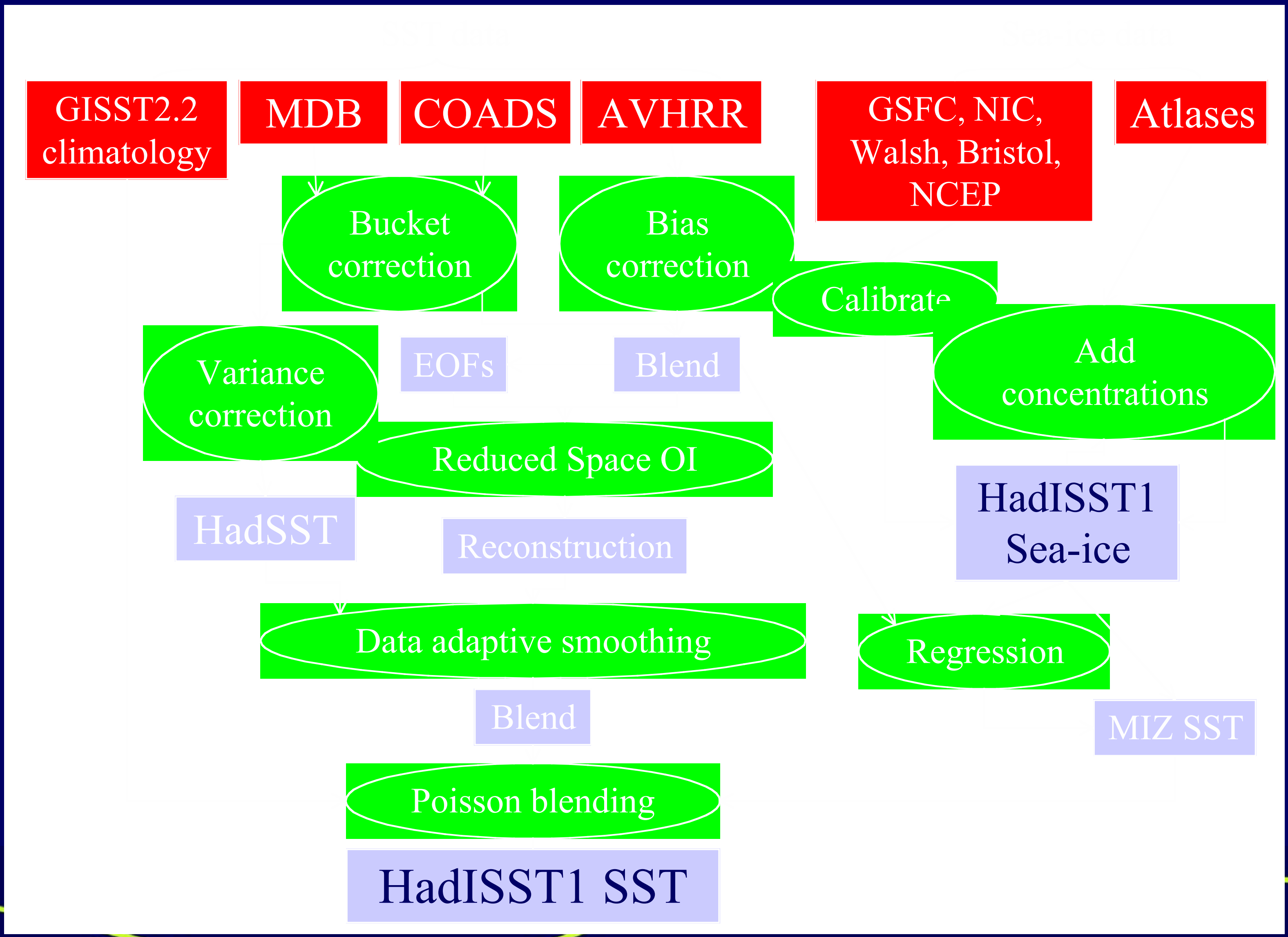
Overview

- Summary of the construction of HadISST1:
  - RSOI and dealing with changing mean
  - Blending reconstruction with “variance corrected” observations
  - Homogenisation of sea ice fields
  - SST from sea ice concentration
- Plans for the future

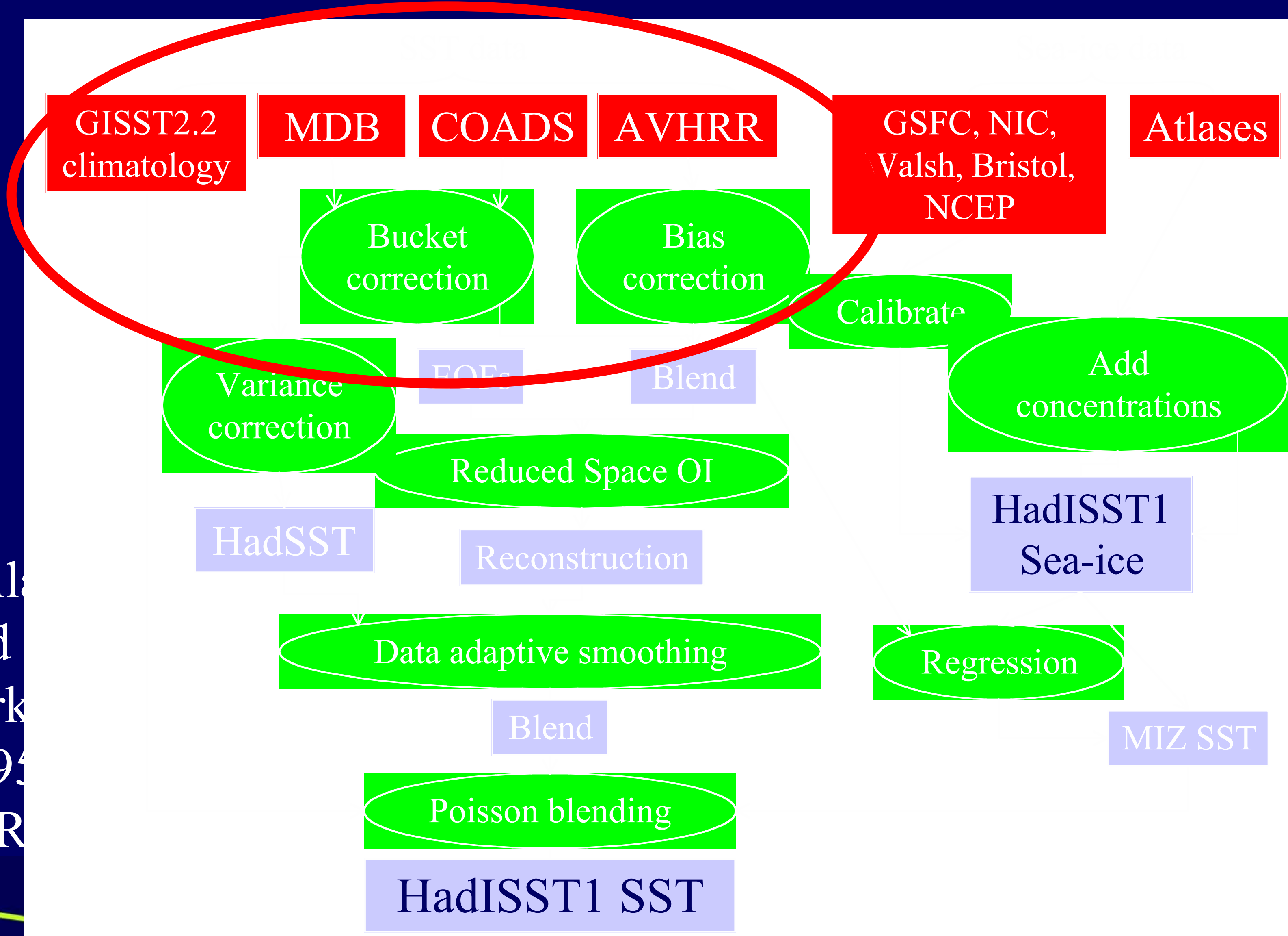
HadISST1 summary

- Globally complete fields of SST and sea ice concentration on 1° area resolution
- HadISST1 is monthly, 1870-1999
- Will be updated and produced automatically in near real time towards the end of this year
- Details to be found in journal paper to be submitted soon

Construction of HadISST1

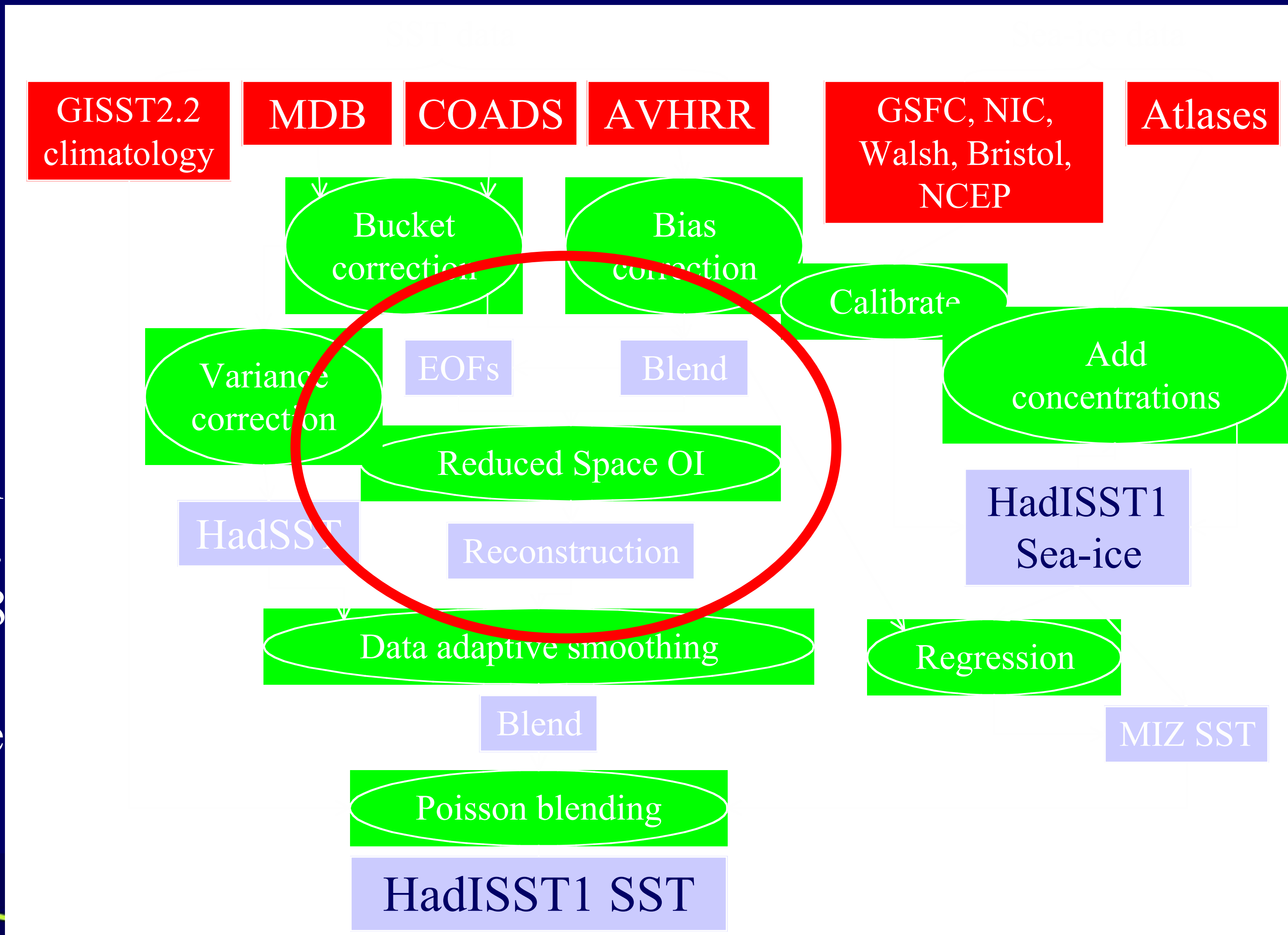


Construction of HadISST1



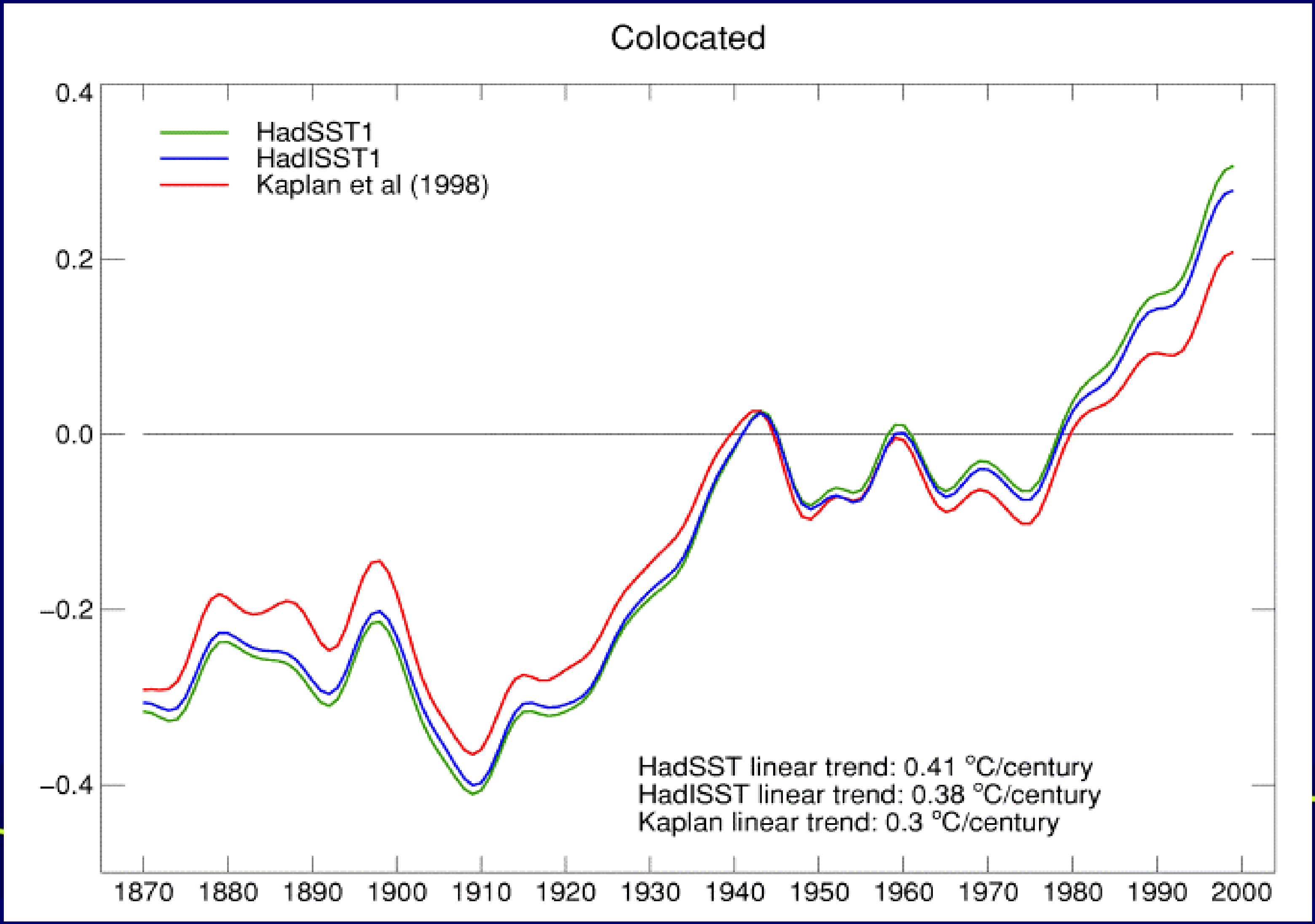
Foll
and
Park
199
QJR

Construction of HadISST1



Kapl
et al.
1998
JGR
(Oce

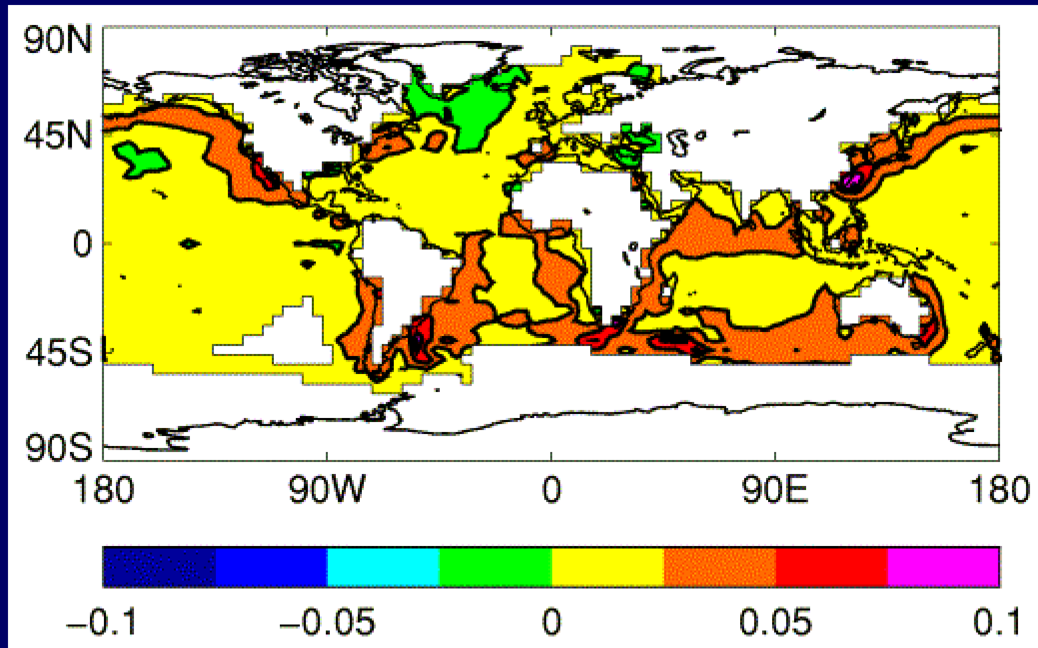
Annual global average colocated SST, 1870-1999

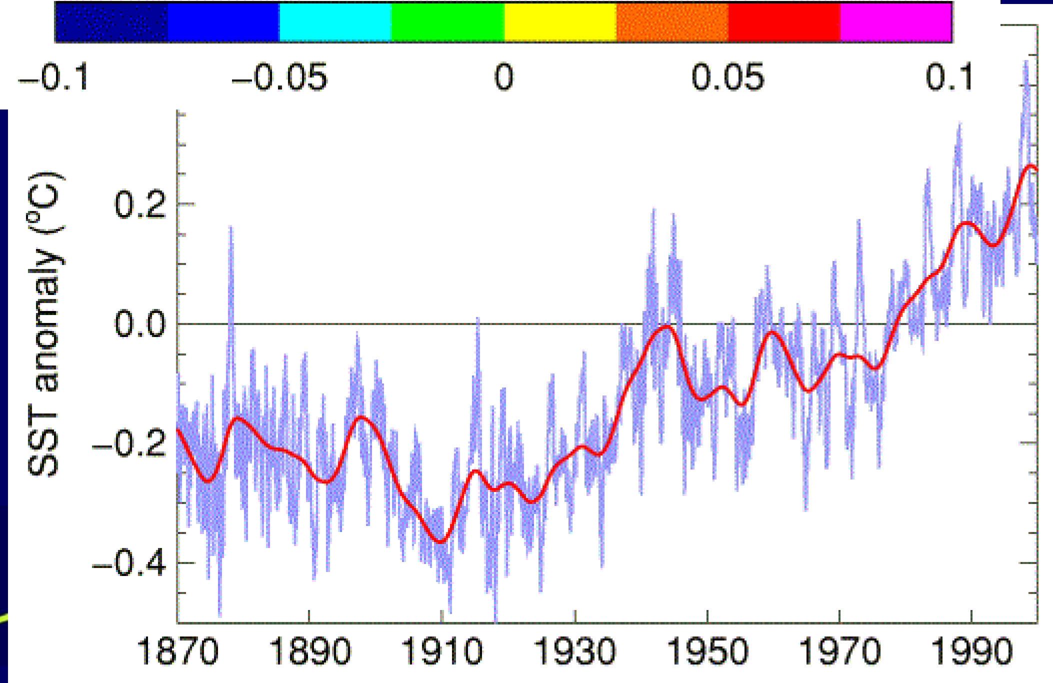


Met Office

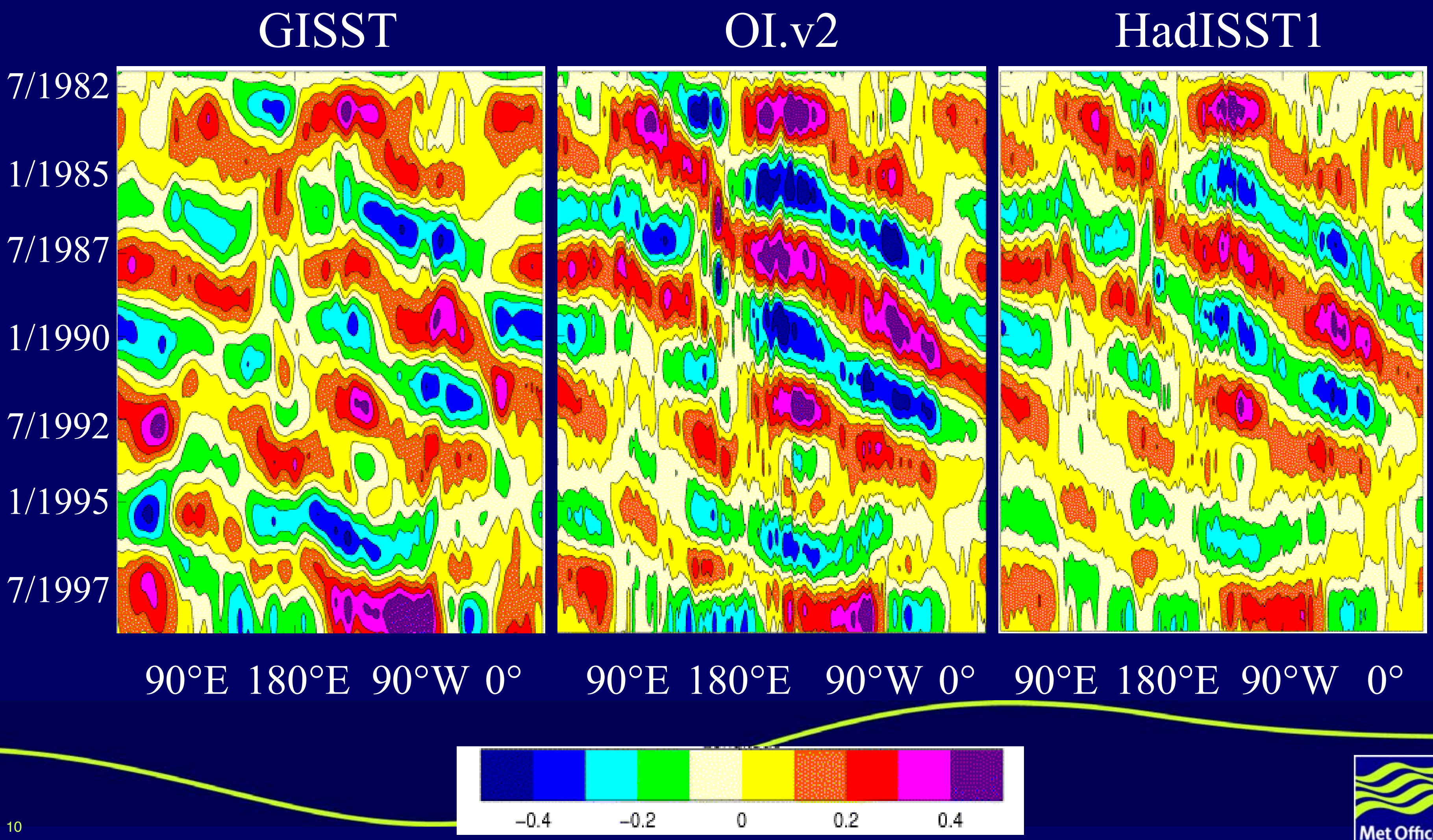
Reconstruction of spatially varying "trend"

- First EOF of low-pass filtered 4° area seasonal *in situ* / satellite SST anomalies for 1901-97 gives pattern of "trend".
- RSOI reconstruction thereof subtracted from monthly fields. EOFs of these detrended data for 1958-97 used in RSOI of detrended data for 1870 onwards.

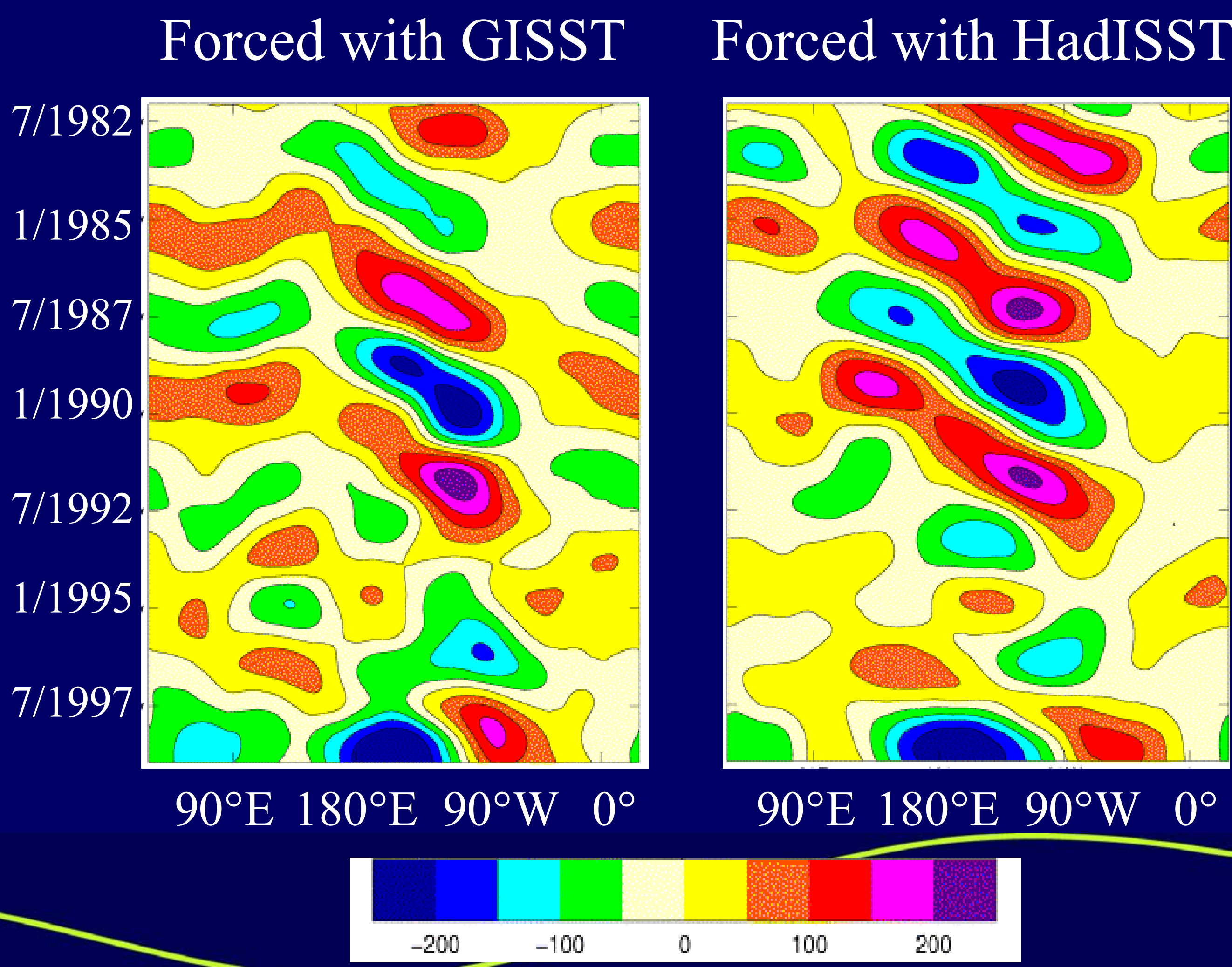




Antarctic Circumpolar Wave in SST anomaly (°C), 56°S, 1982-98



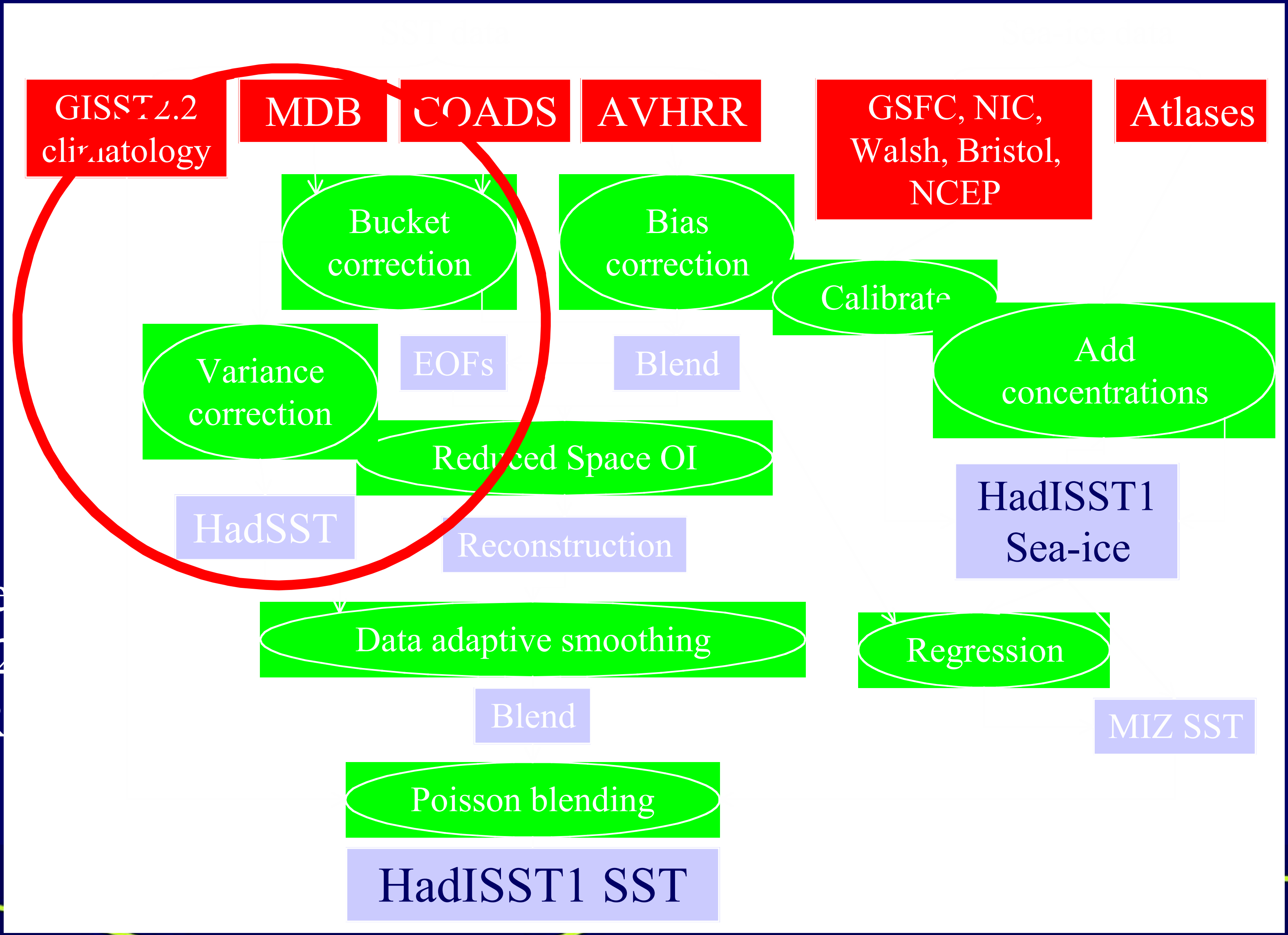
Antarctic Circumpolar Wave in HadAM3 MSLP (hPa), 1982-98



More coherent structure and more like White and Peterson, 1996, Nature

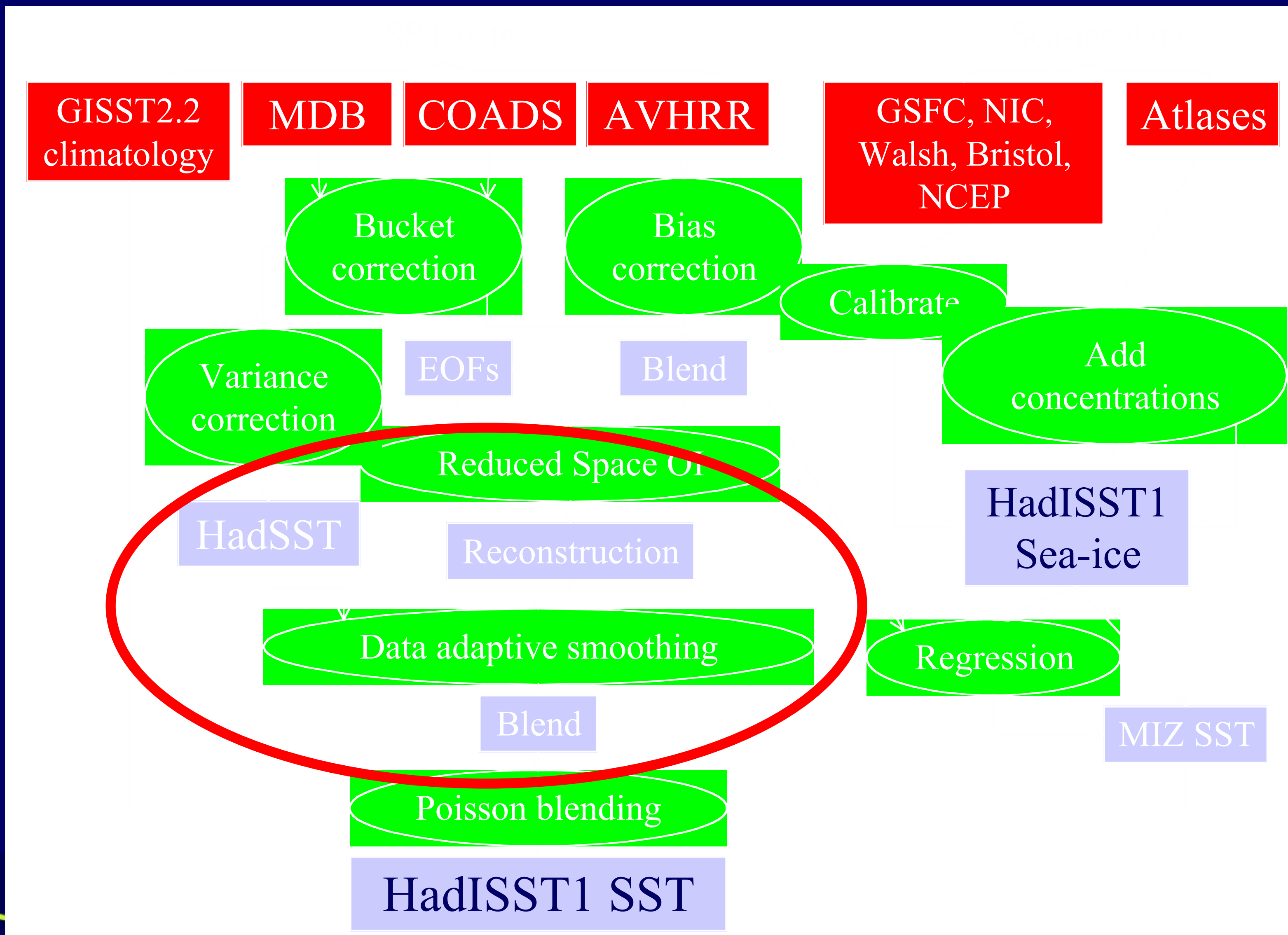
Met Office

Construction of HadISST1

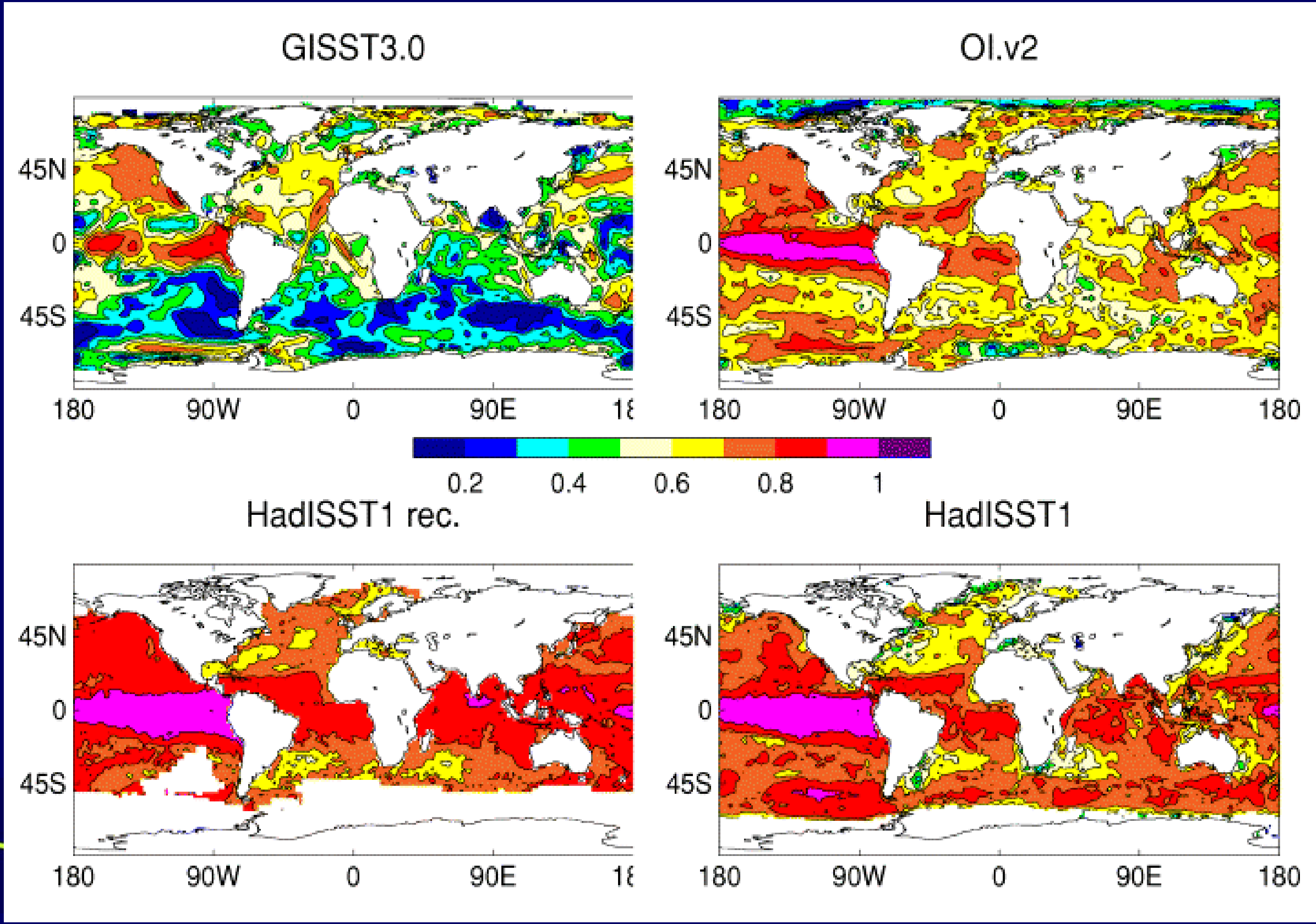


Jone
al., 2
JGR

Construction of HadISST1

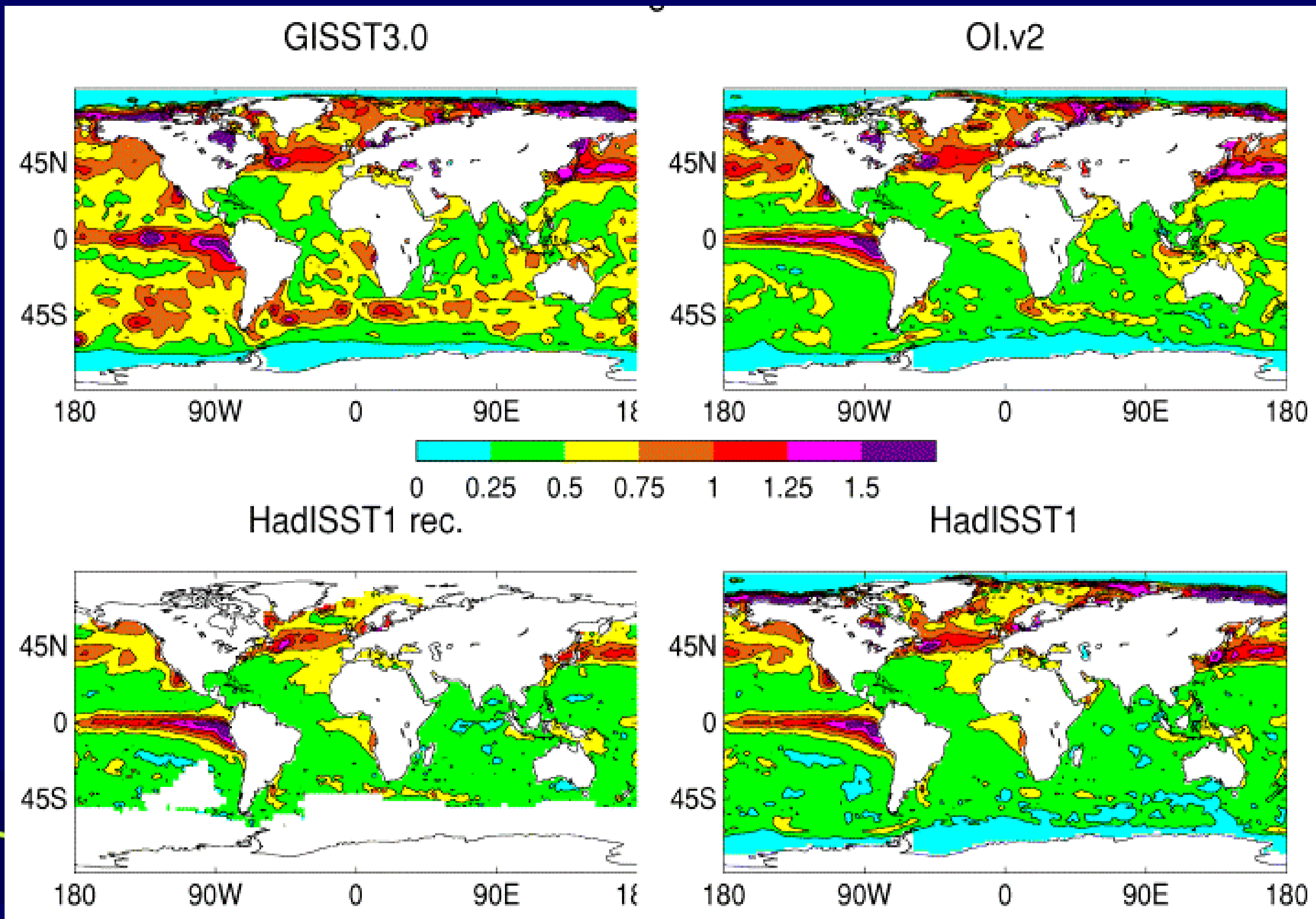


Lag 1 month autocorrelation detrended 2° area fields 1982-99

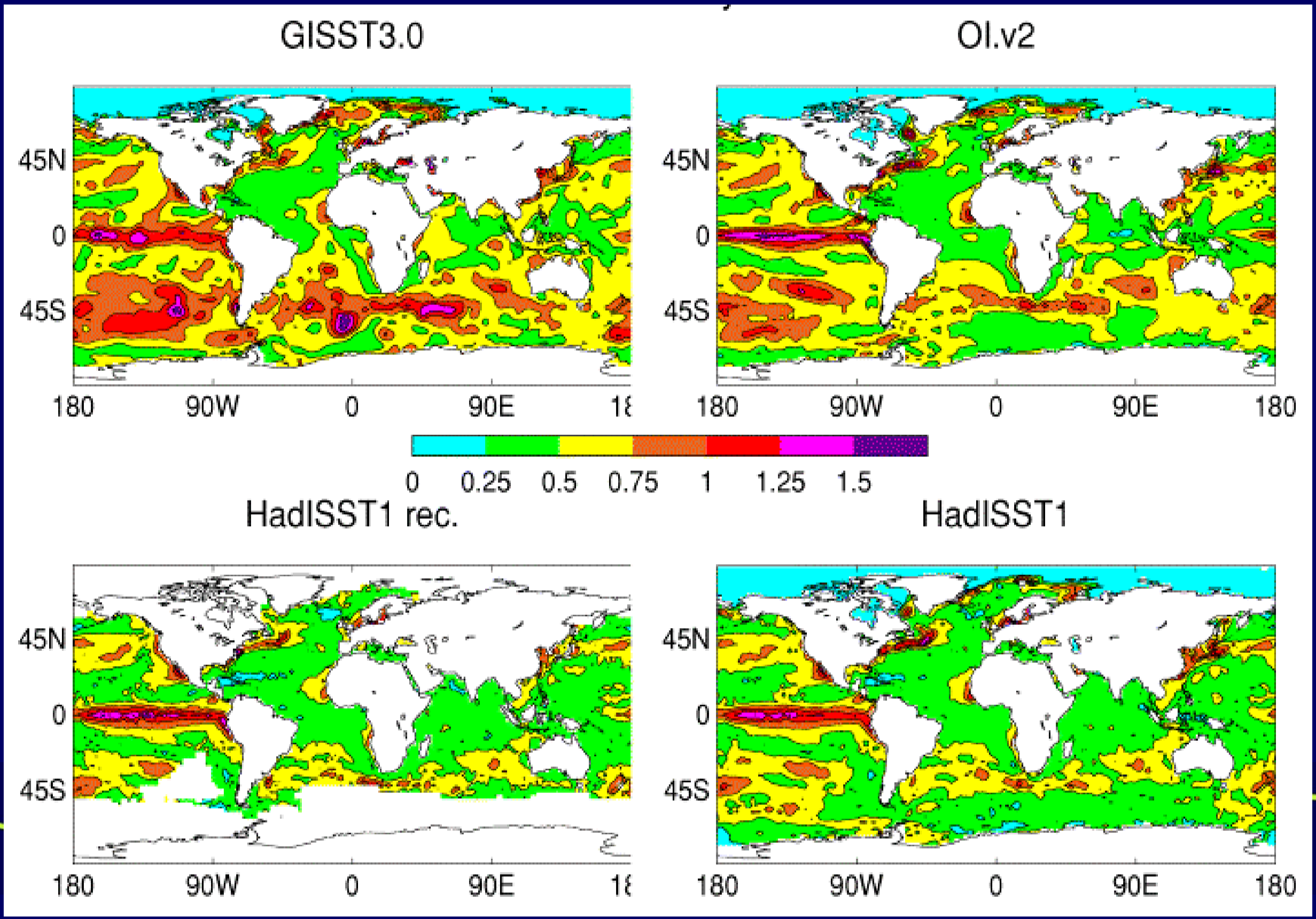


Met Office

Standard deviation (°C) of August SST anomalies 1982-99

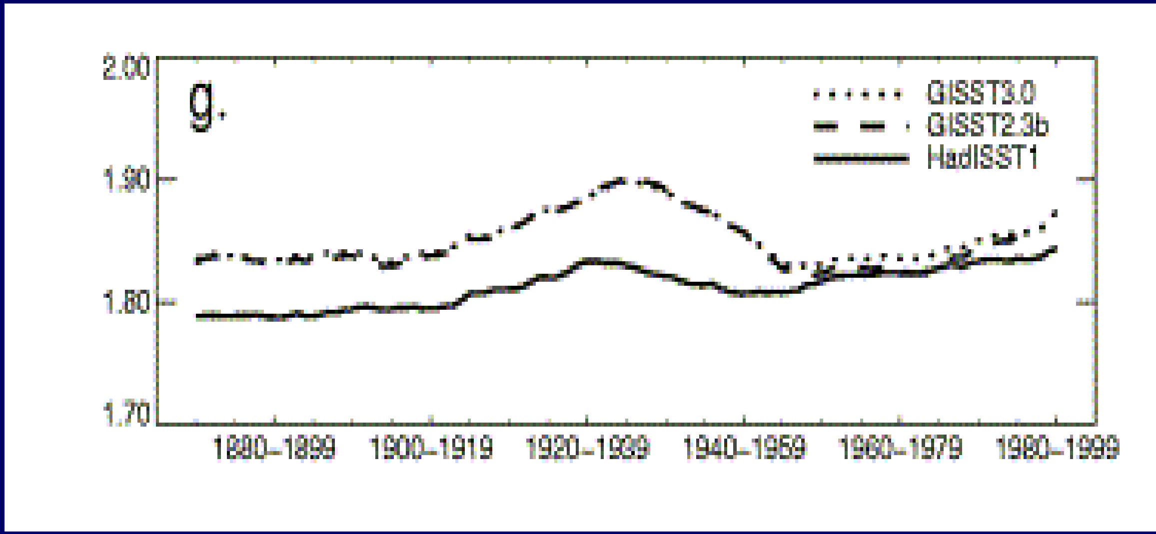


Standard deviation (°C) of February SST anomalies 1982-99

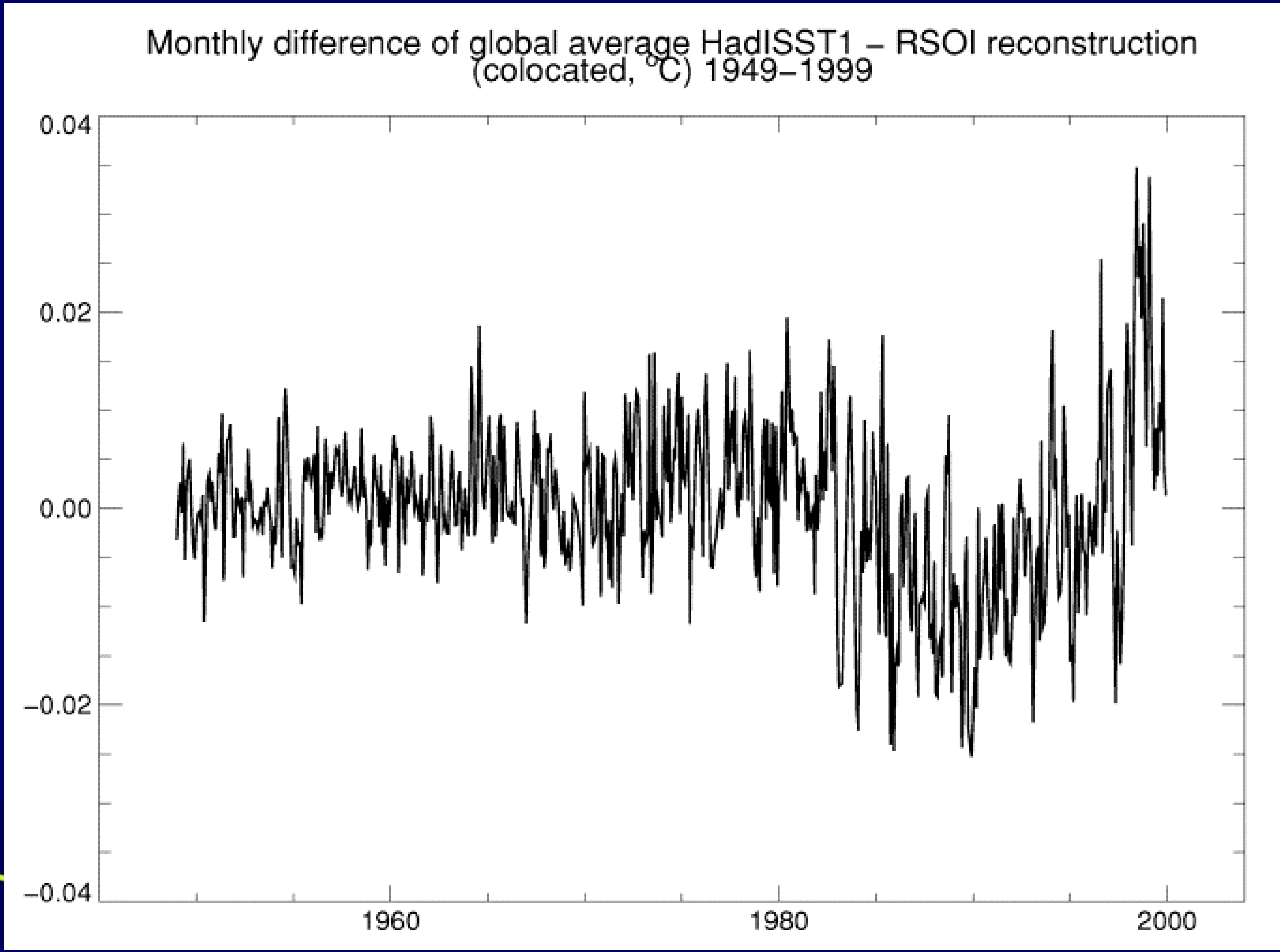


Met Office

Global root mean squared standard deviation in 20-year periods, 1870-1889, 1871-1890, etc.

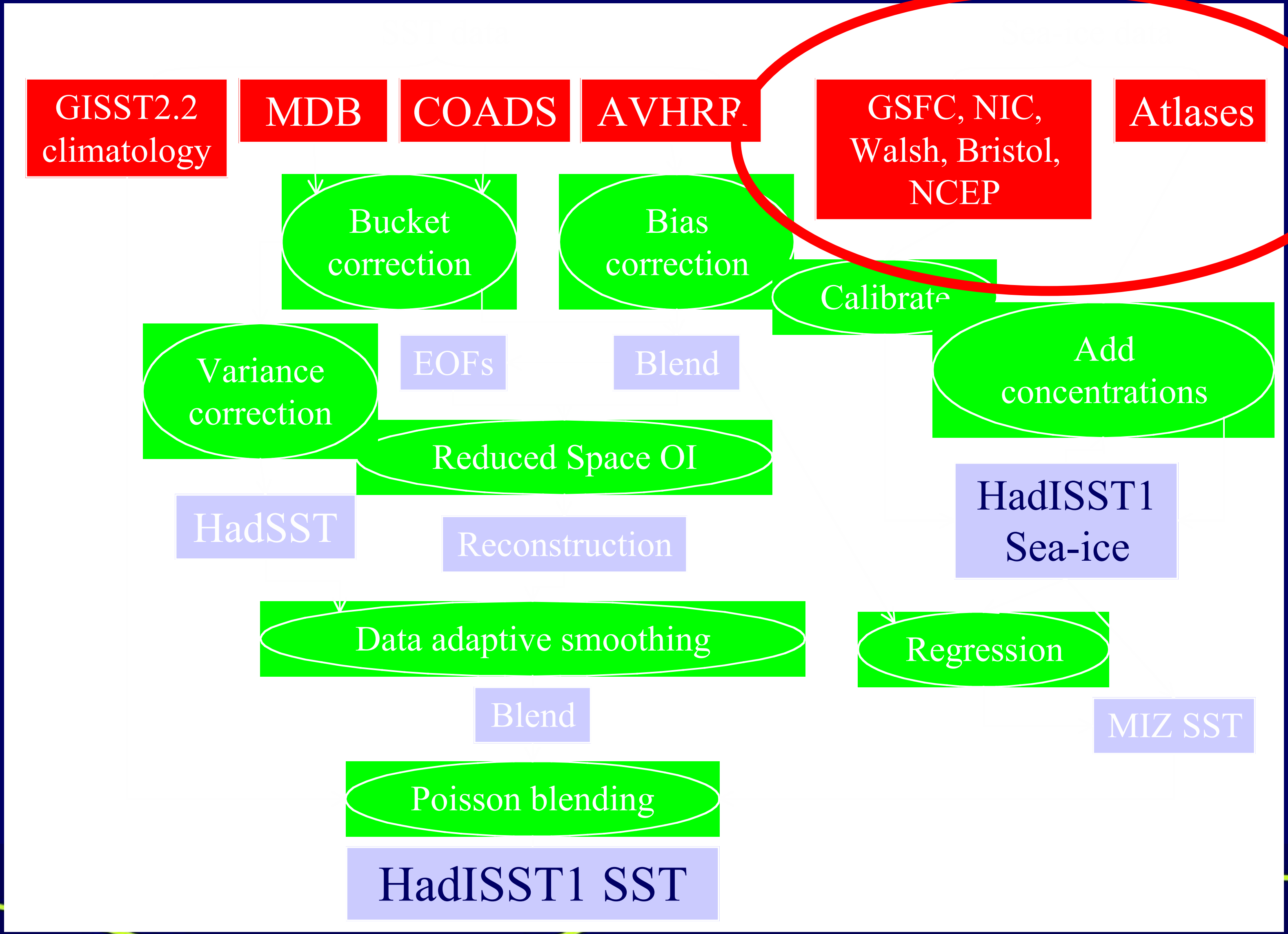


Effect on global mean of adding HadSST to reconstructions



Met Office

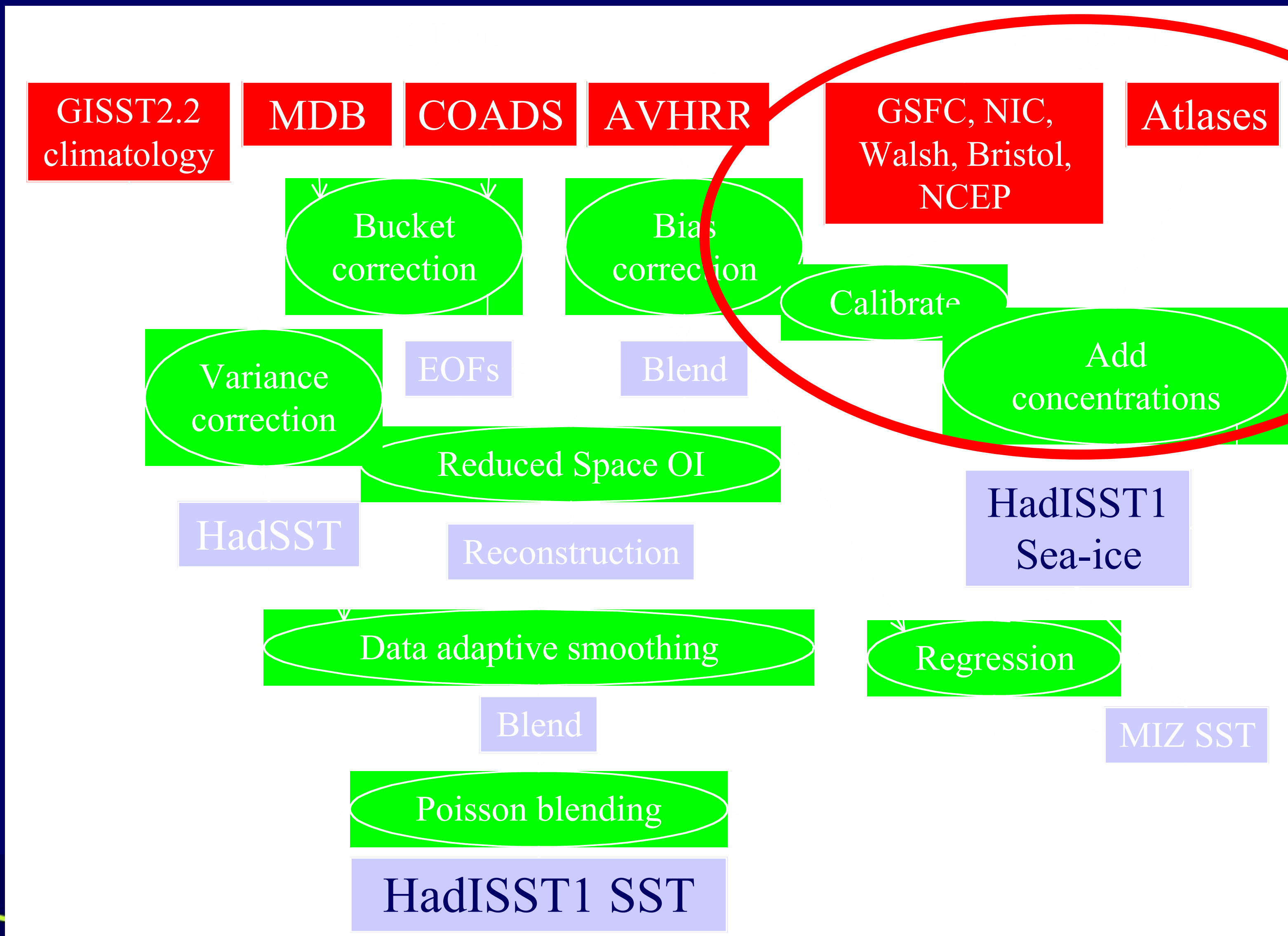
Construction of HadISST1



Assembly of sea ice fields

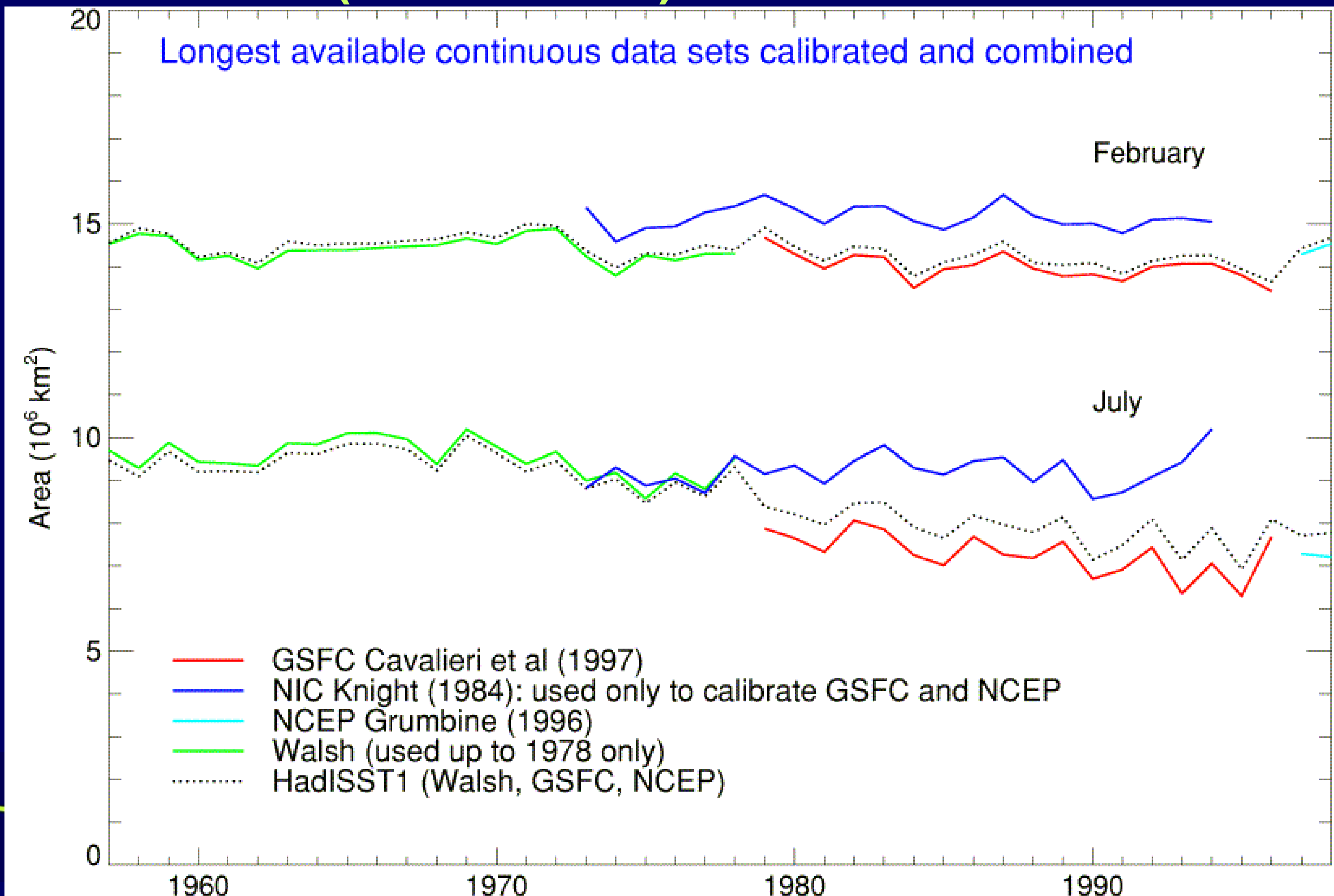
- Long data set requires sea ice fields to be taken from a variety of sources
- Sea ice data from different sources are very inhomogeneous
- Data set required to be homogeneous
- Sea ice data used both explicitly and to specify SST in grid boxes where both sea ice and open water occur
- Need to make time series as homogeneous as possible, but this is not necessarily the most **accurate** sea ice data set available

Construction of HadISST1



Met Office

Northern Hemisphere average sea ice area ($10^6 km^2$), 1957-98



Met Office

Sea-ice calibration process

Arctic

- Correct for effect of surface melt on passive microwave data sets (GSFC, NCEP) away from ice edge
- Add microwave variability to inner ice-pack of chart-derived data set (Walsh)
- Add climatologies to missing regions

Antarctic

Met Office

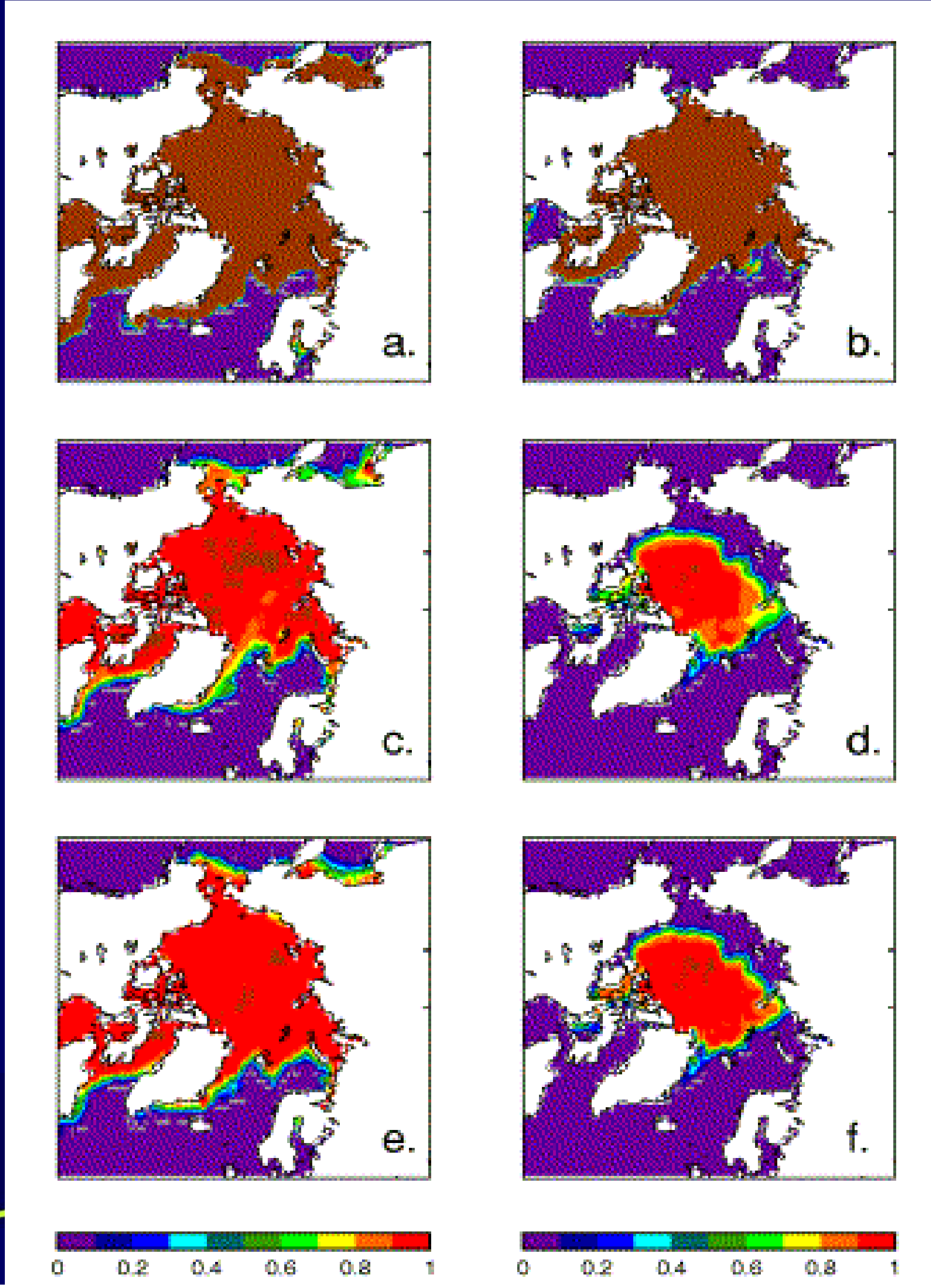
Arctic sea ice concentration

January August

Walsh
1930

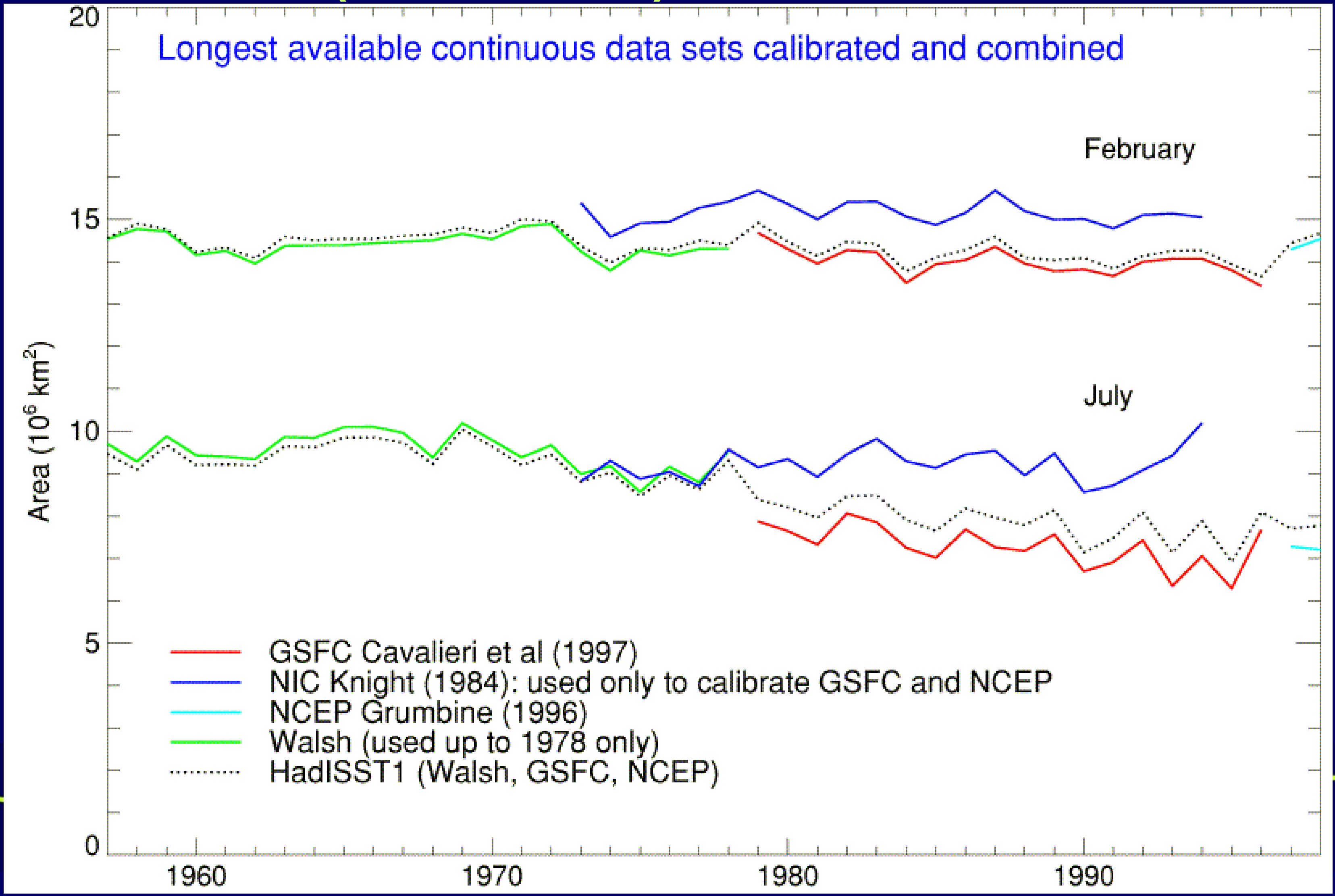
GSFC
1990

HadISST1
1930



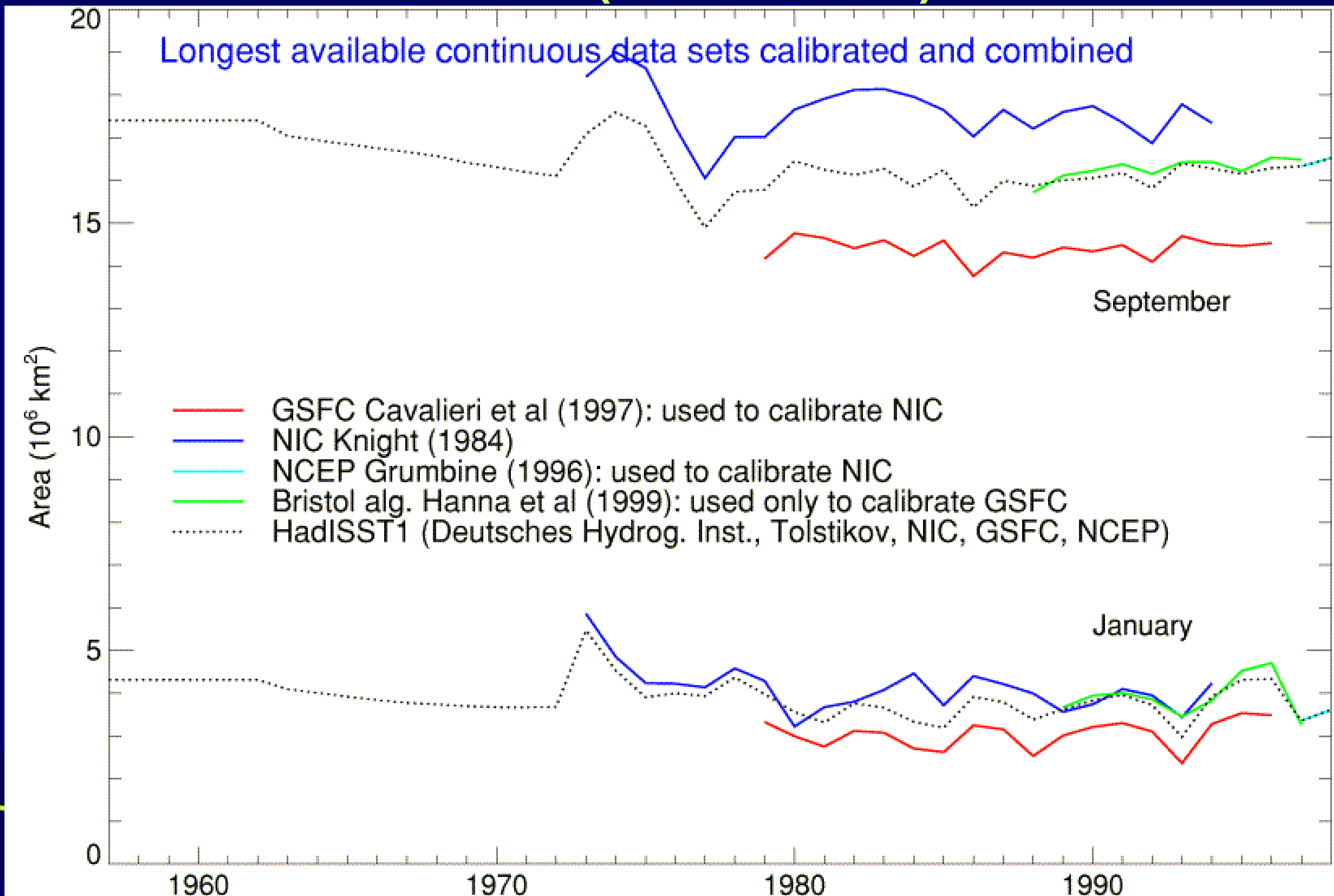
1990

Northern Hemisphere average sea ice area ($10^6 km^2$), 1957-98



Met Office

Southern Hemisphere average sea ice area ($10^6 km^2$), 1957-98



Met Office

Sea-ice calibration process

Arctic

- Correct for effect of surface melt on passive microwave data sets (GSFC, NCEP) away from ice edge
- Add microwave variability to inner ice-pack of chart-derived data set (Walsh)
- Add climatologies to missing regions

Antarctic

- Calibrate low conc. GSFC using Bristol algorithm data
- Calibrate high conc. NIC using GSFC and NCEP
- Fill atlas climatologies using modern climatological concs.
- Interpolate into data-void periods

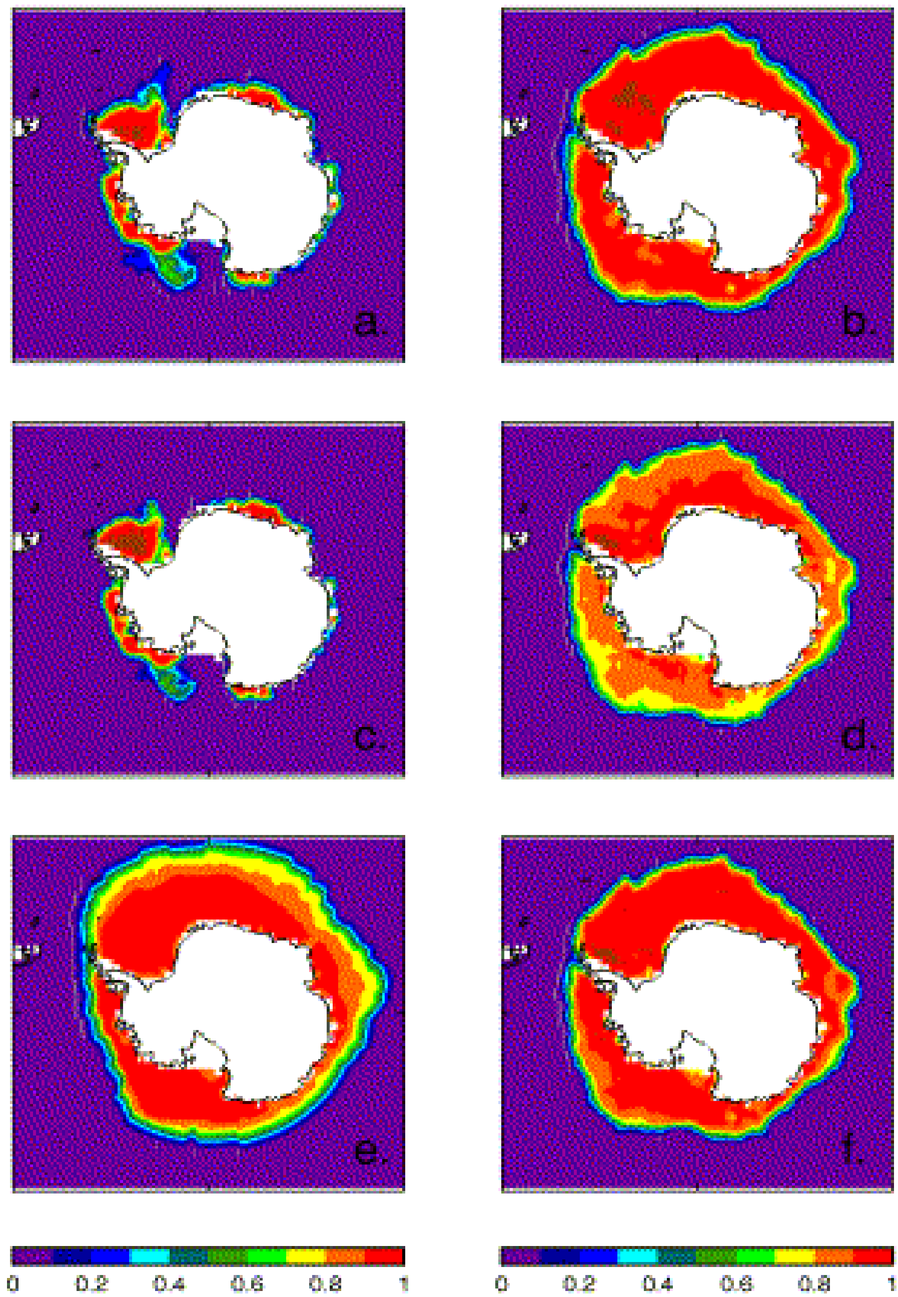
Antarctic sea ice concentration

January August

Bristol 1990

GSFC 1990

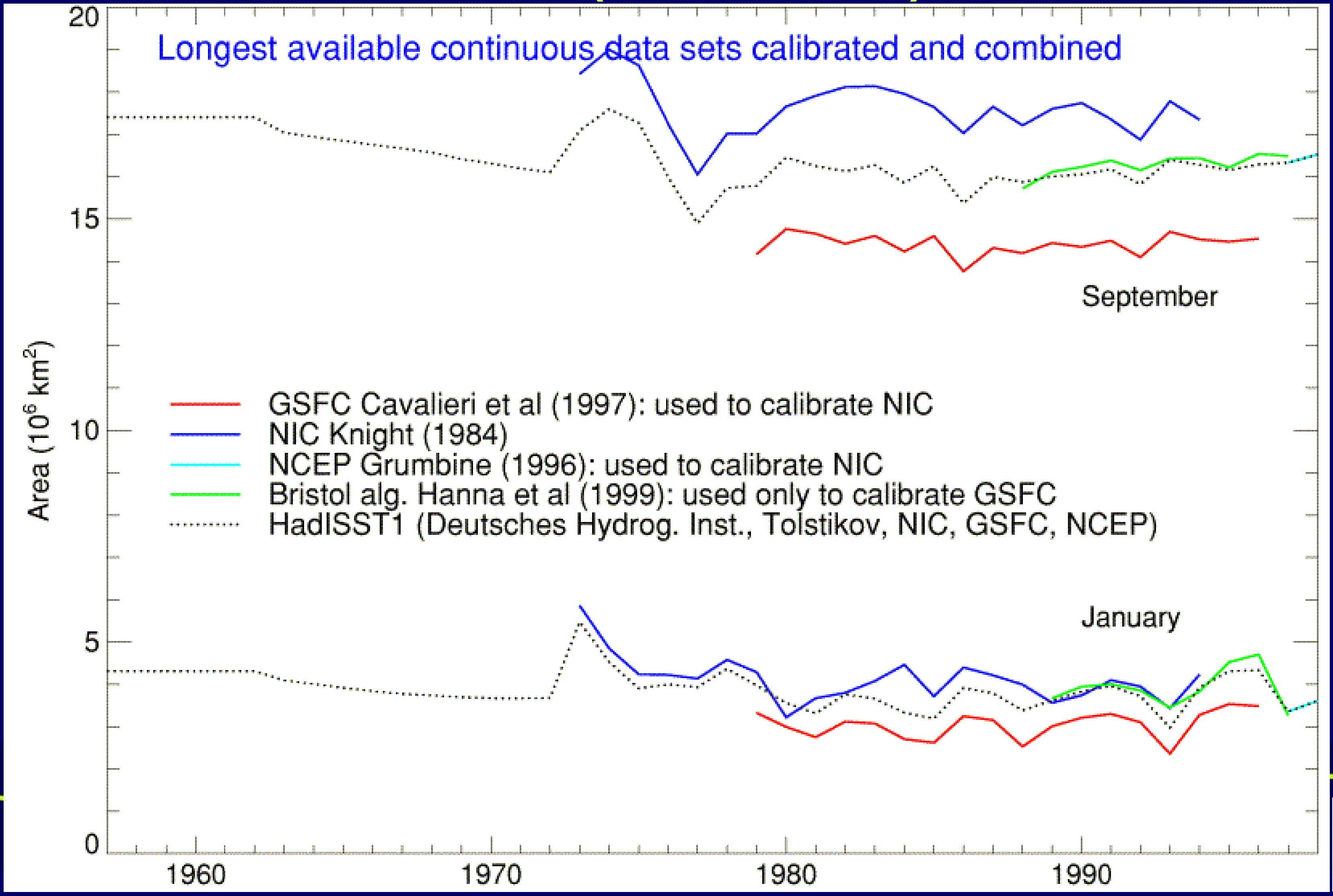
HadISST1 8/1930



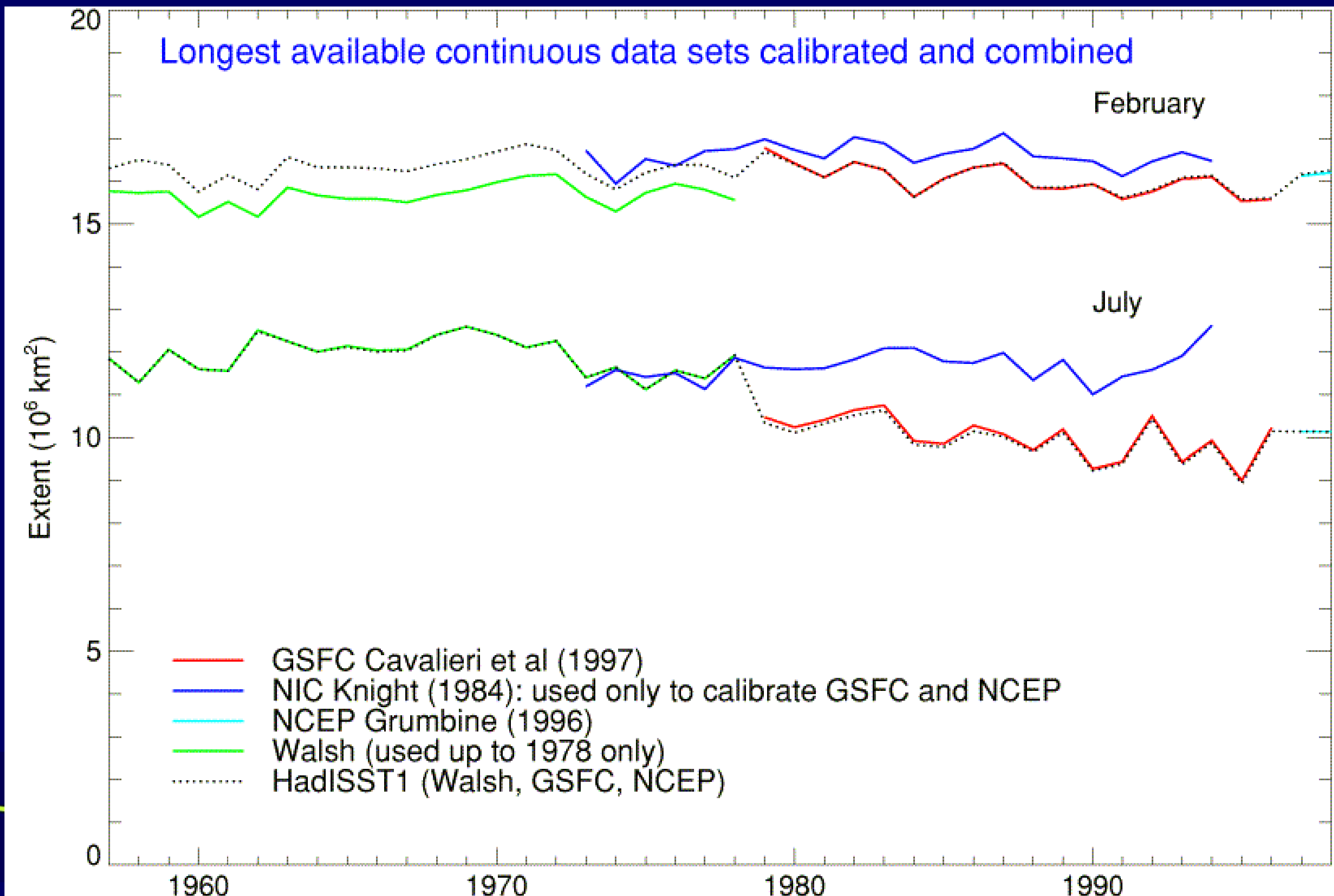
1990

Met Office

Southern Hemisphere average sea ice area ($10^6 km^2$), 1957-98

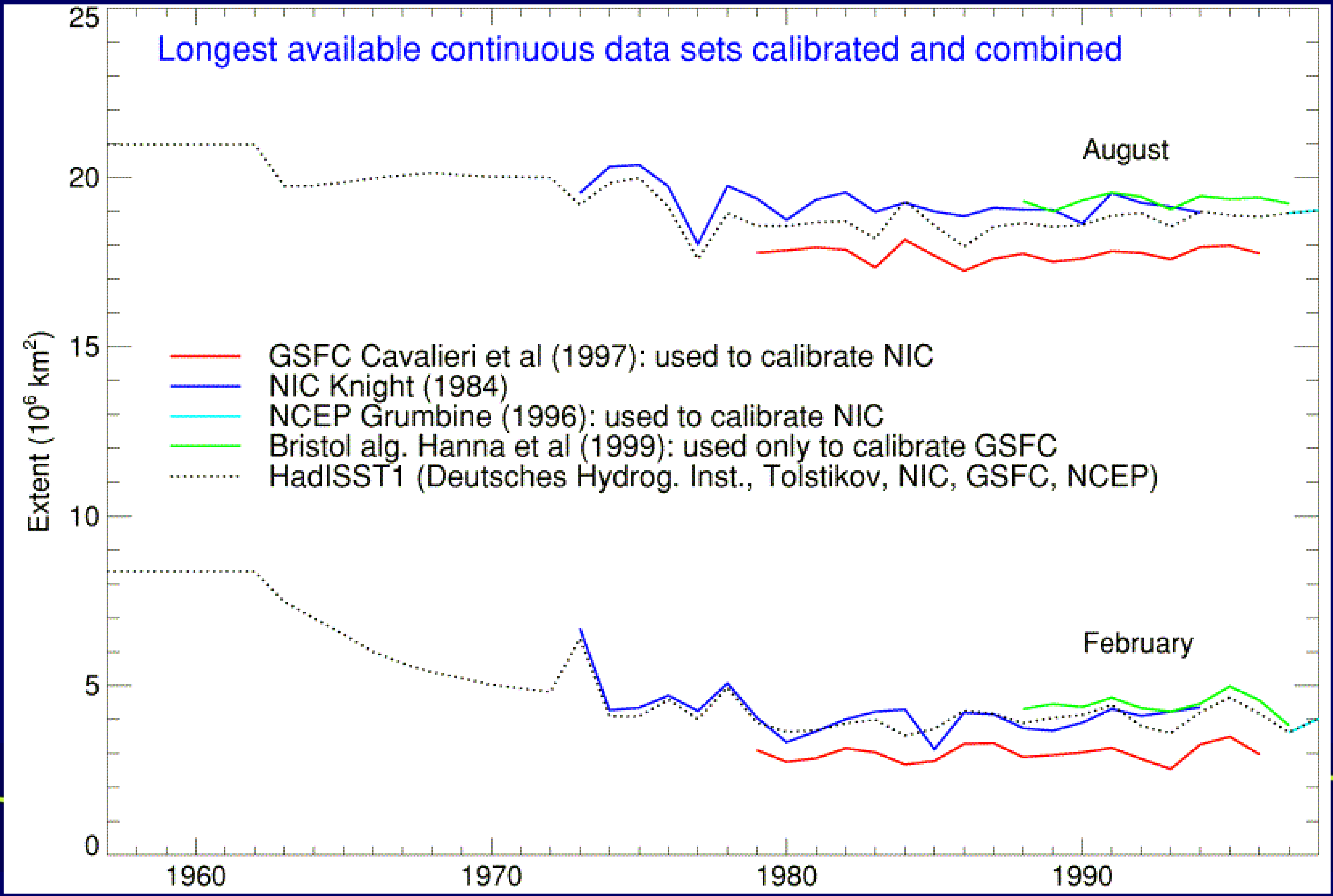


Northern Hemisphere average sea ice extent ($10^6 km^2$), 1957-98

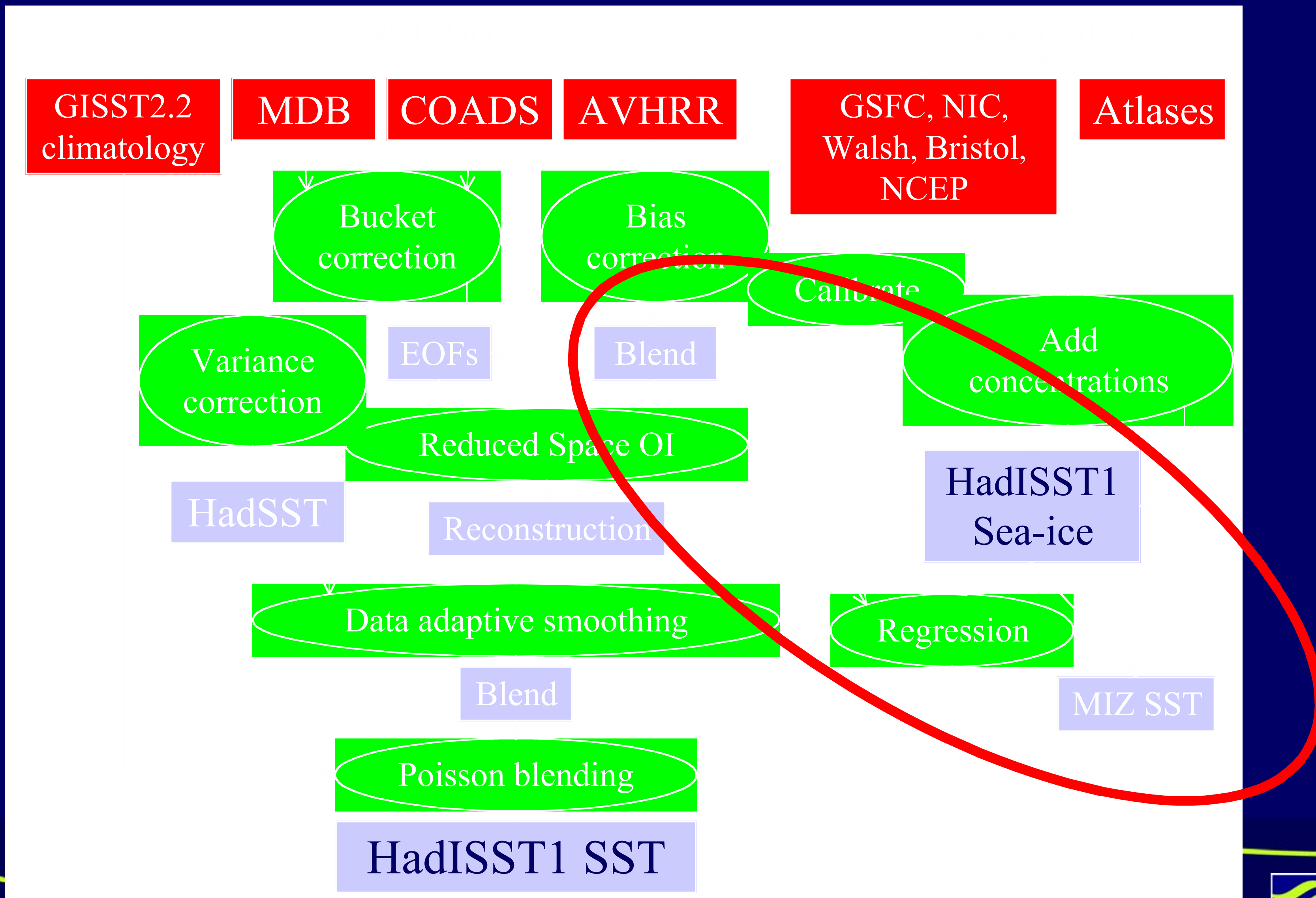


Met Office

Southern Hemisphere average sea ice extent ($10^6 km^2$), 1957-98



Construction of HadISST1



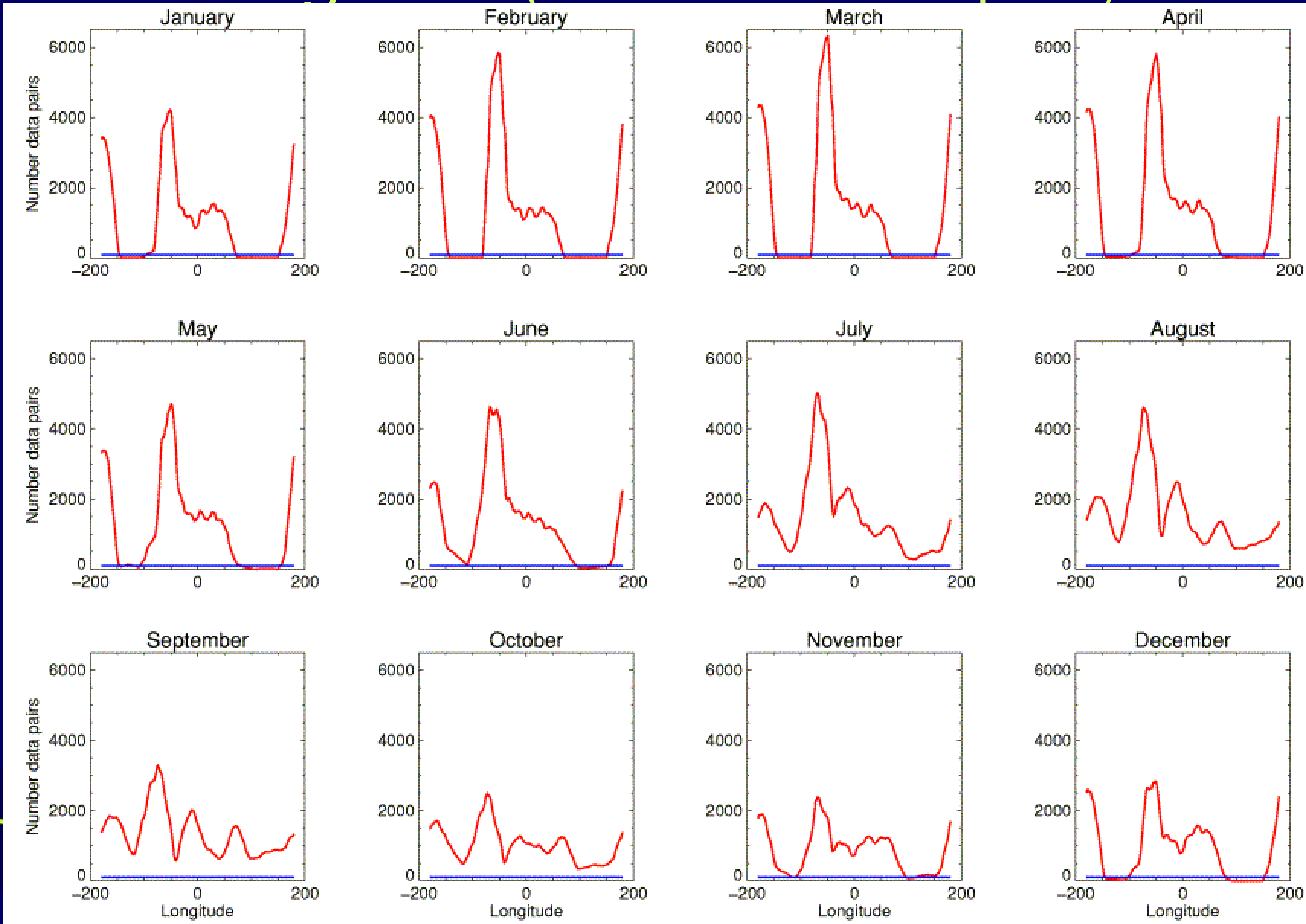
SST near sea ice

- SST in partially ice-covered grid boxes specified using sea ice concentration
- Monthly- and geographically-varying relationships between SST (*in situ* and bias-adjusted AVHRR) and sea ice concentration developed using coincident pairs of data
- Separate relationships for each calendar month were developed using 12 overlapping 3-month seasons

Met Office

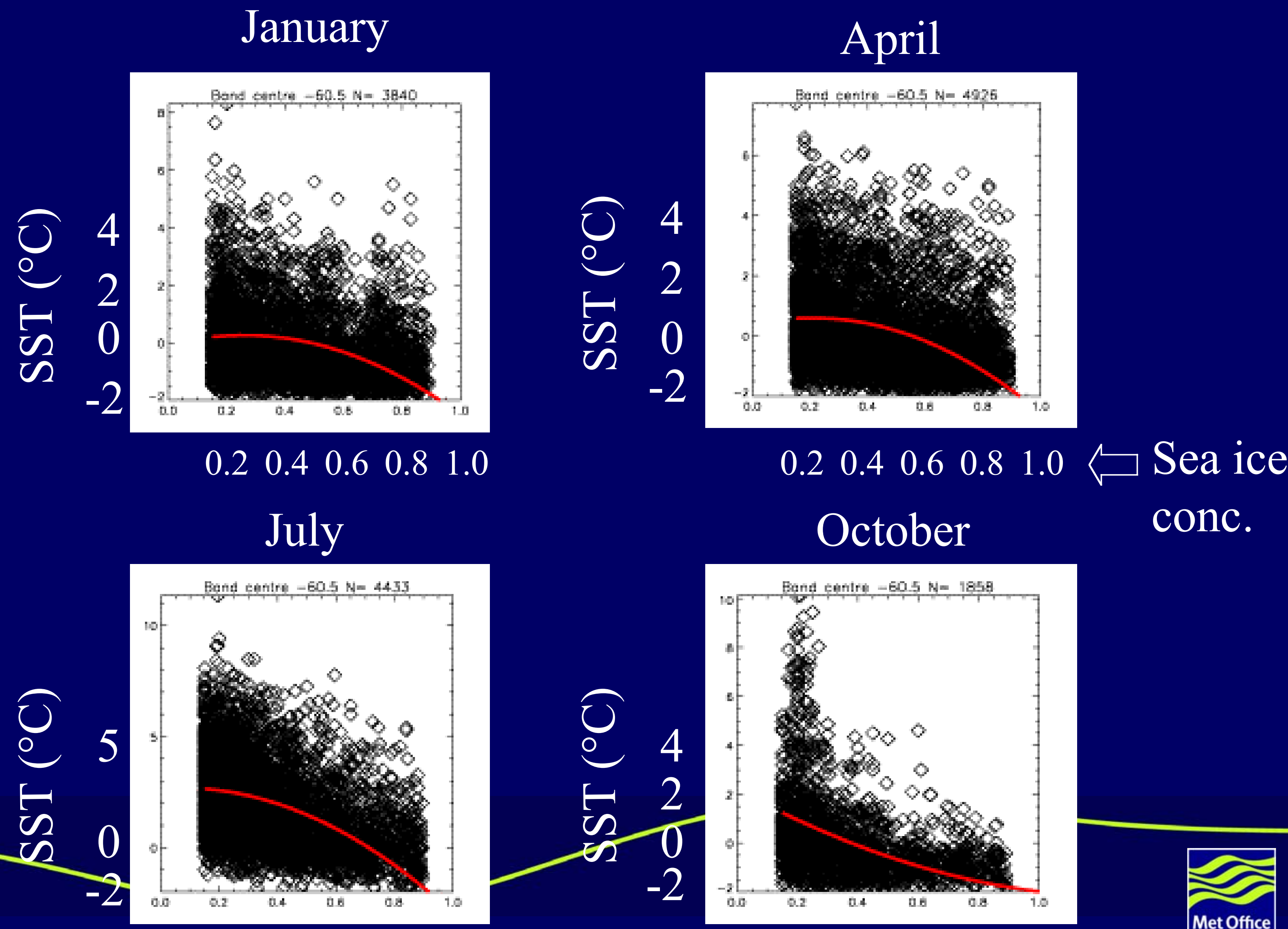
- Hemispheres split into 360 31°-longitude sectors. Peripheral regions separated
- SST = a $(ICE)^2$ + b (ICE) + c , constrained such that SST = -1.8°C (in Great Lakes, SST = 0°C) when ICE >= 0.9
- If < 100 data pairs, coefficients linearly interpolated from neighbouring sectors/months
- SST specified using relationship centred on target location/month

No. SST/sea ice pairs in Arctic vs longitude (blue line = < 100 pairs)



Office

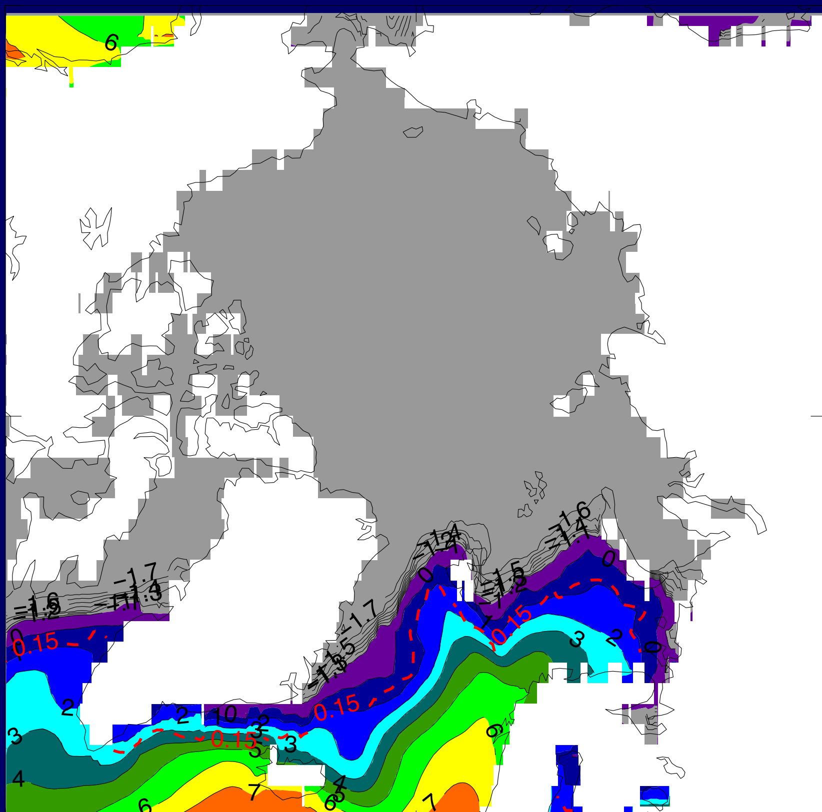
N. Hem. SST/sea ice fits for 60°W



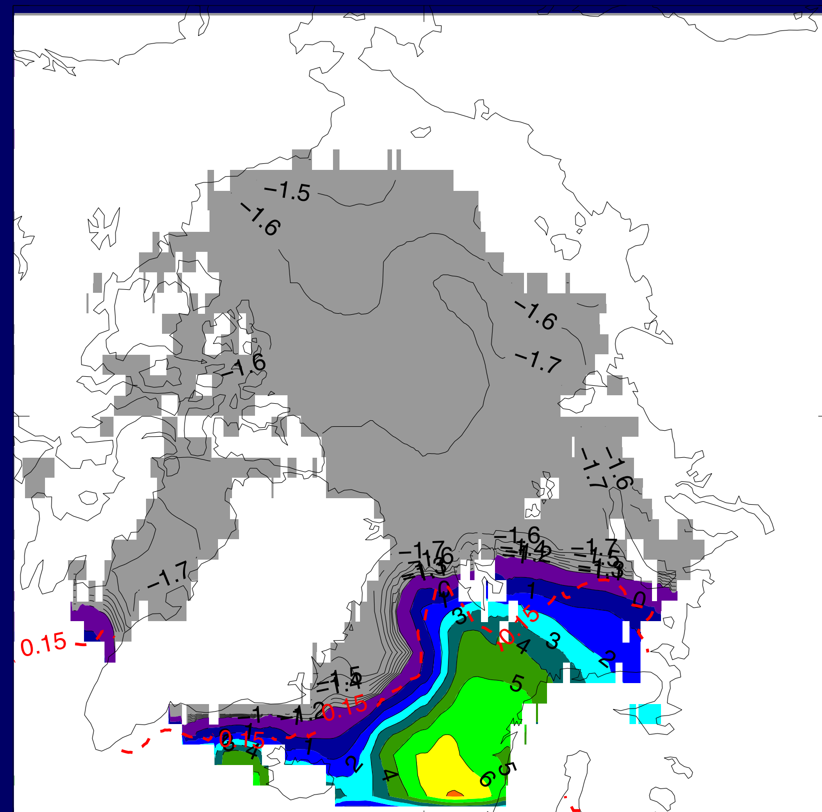
Met Office

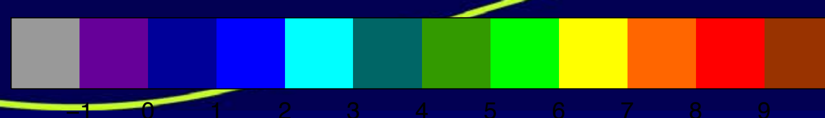
Arctic SST (°C) climatology, January

HadISST1

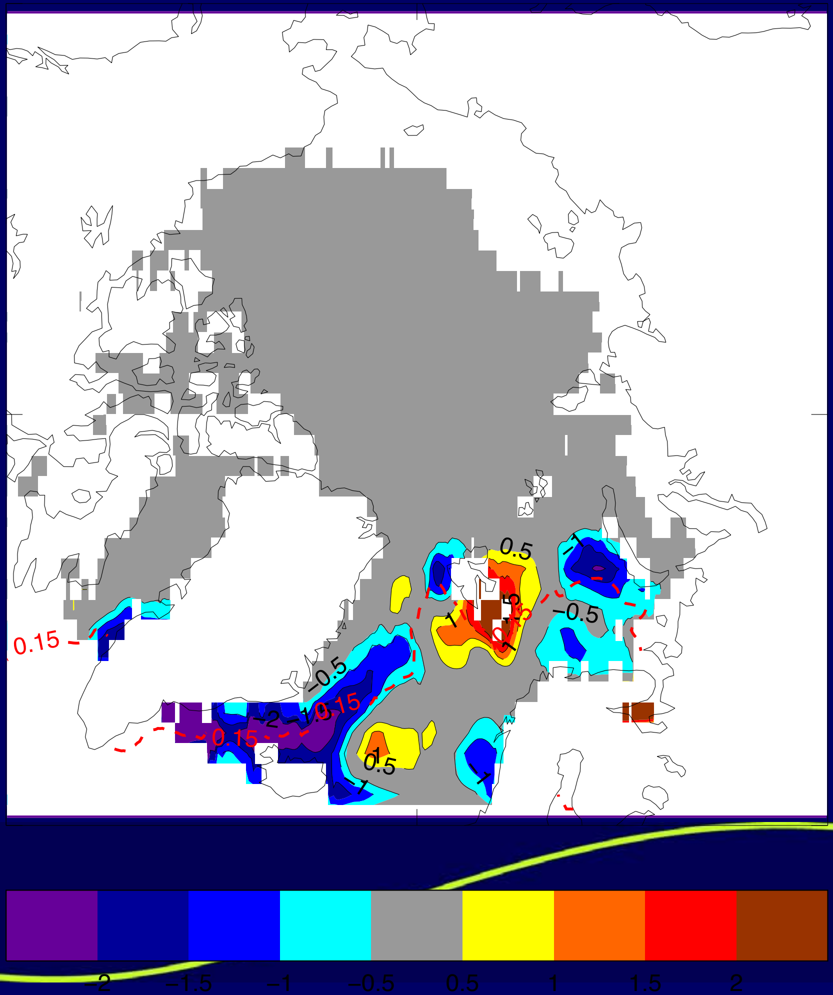


U.S. Navy GDEM climatology





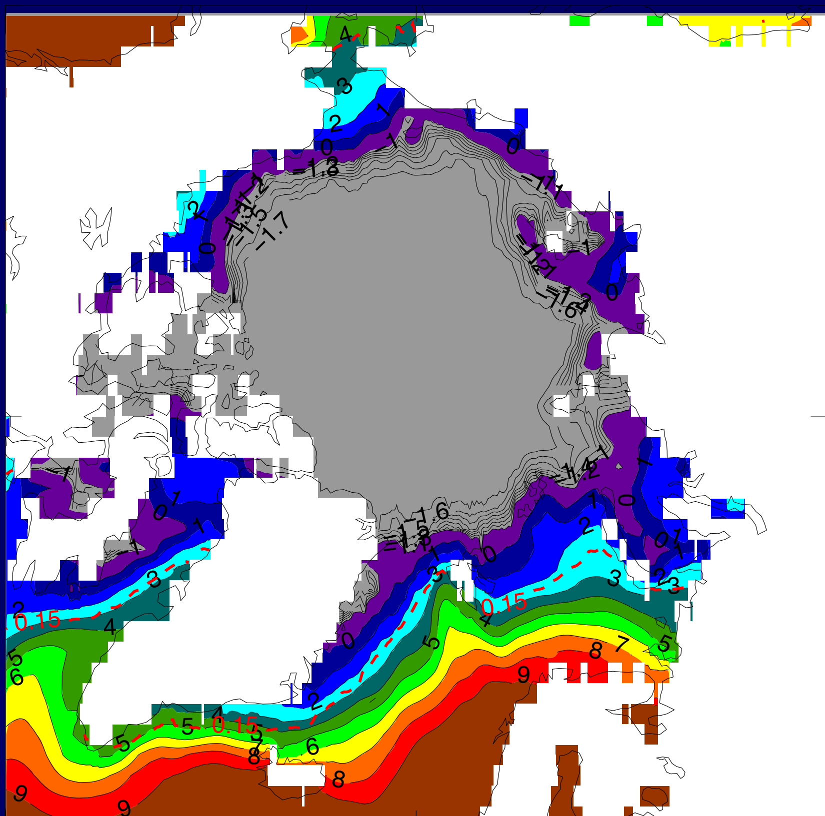
SST climatology difference, January, Navy GDEM - HadISST1



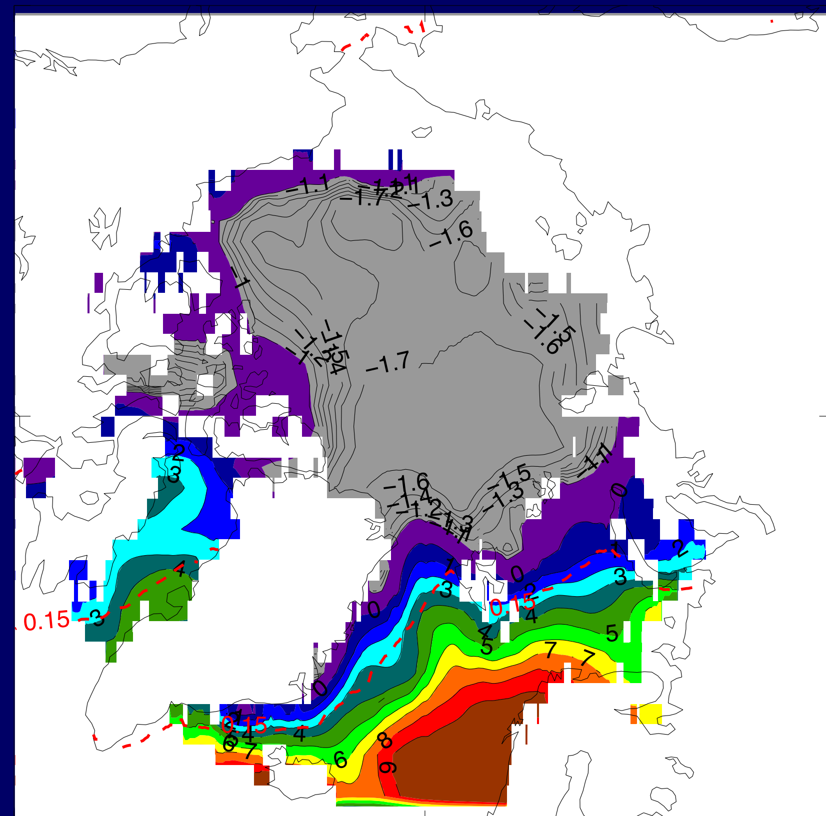
Met Office

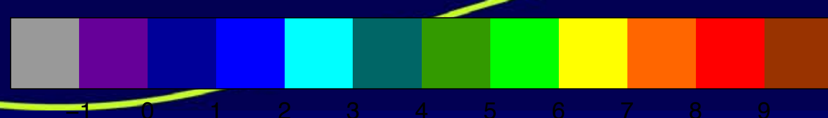
Arctic SST (°C) climatology, July

HadISST1

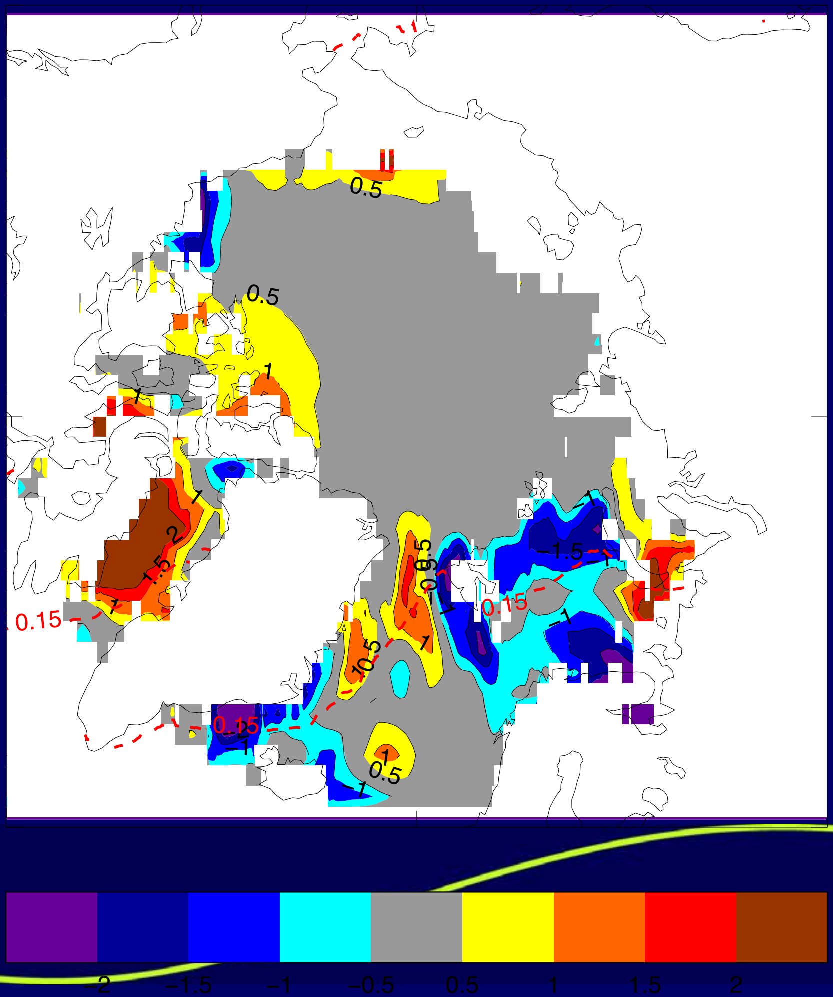


U.S. Navy GDEM climatology





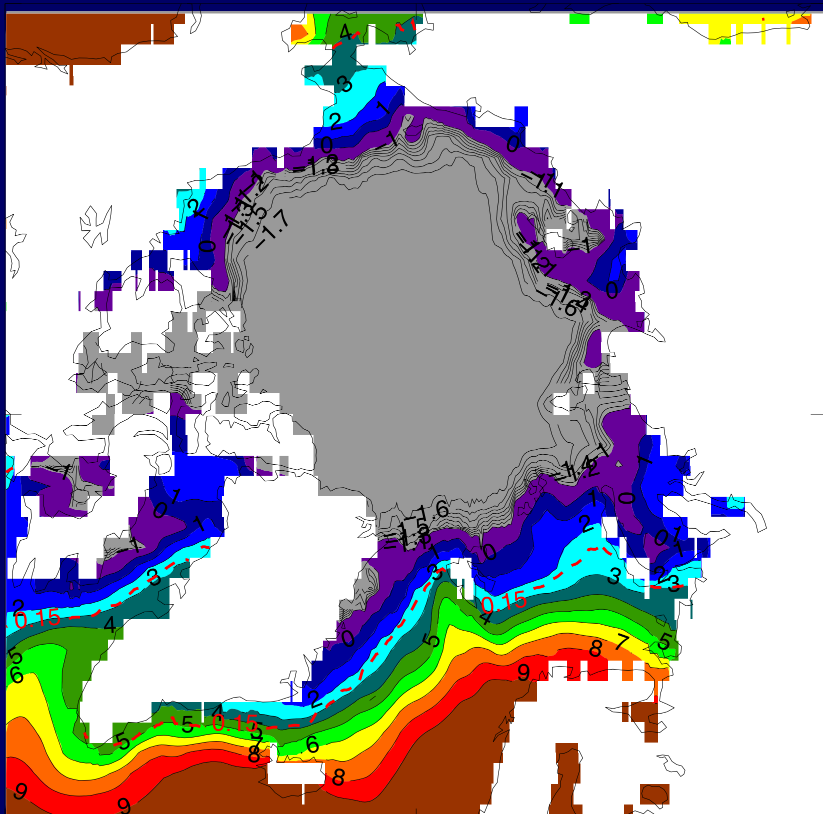
SST climatology difference, July, Navy GDEM - HadISST1



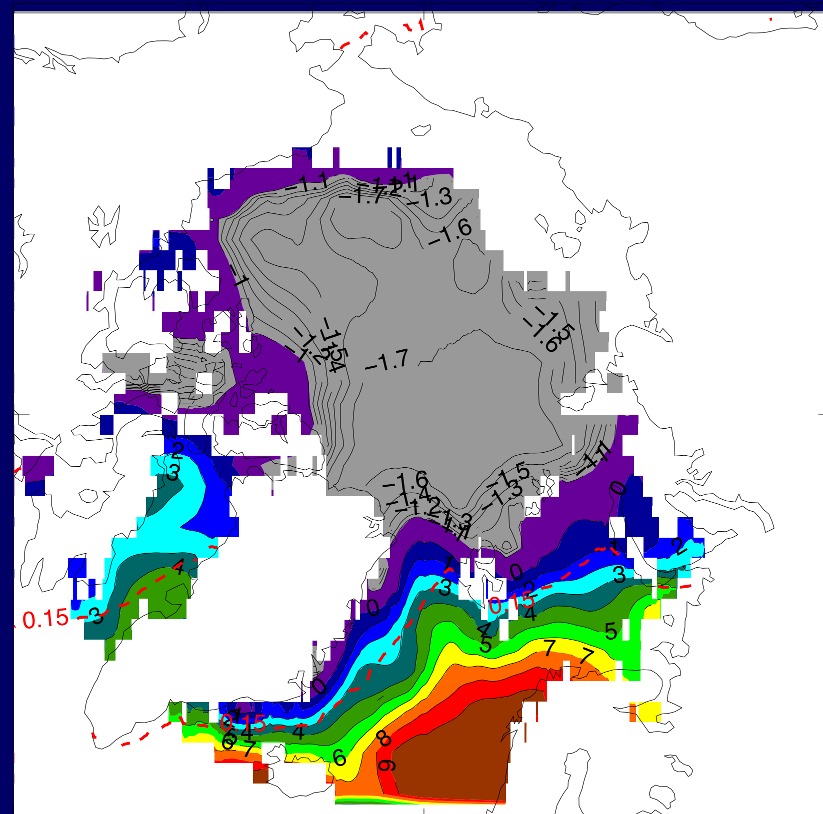
Met Office

Arctic SST (°C) climatology, July

HadISST1

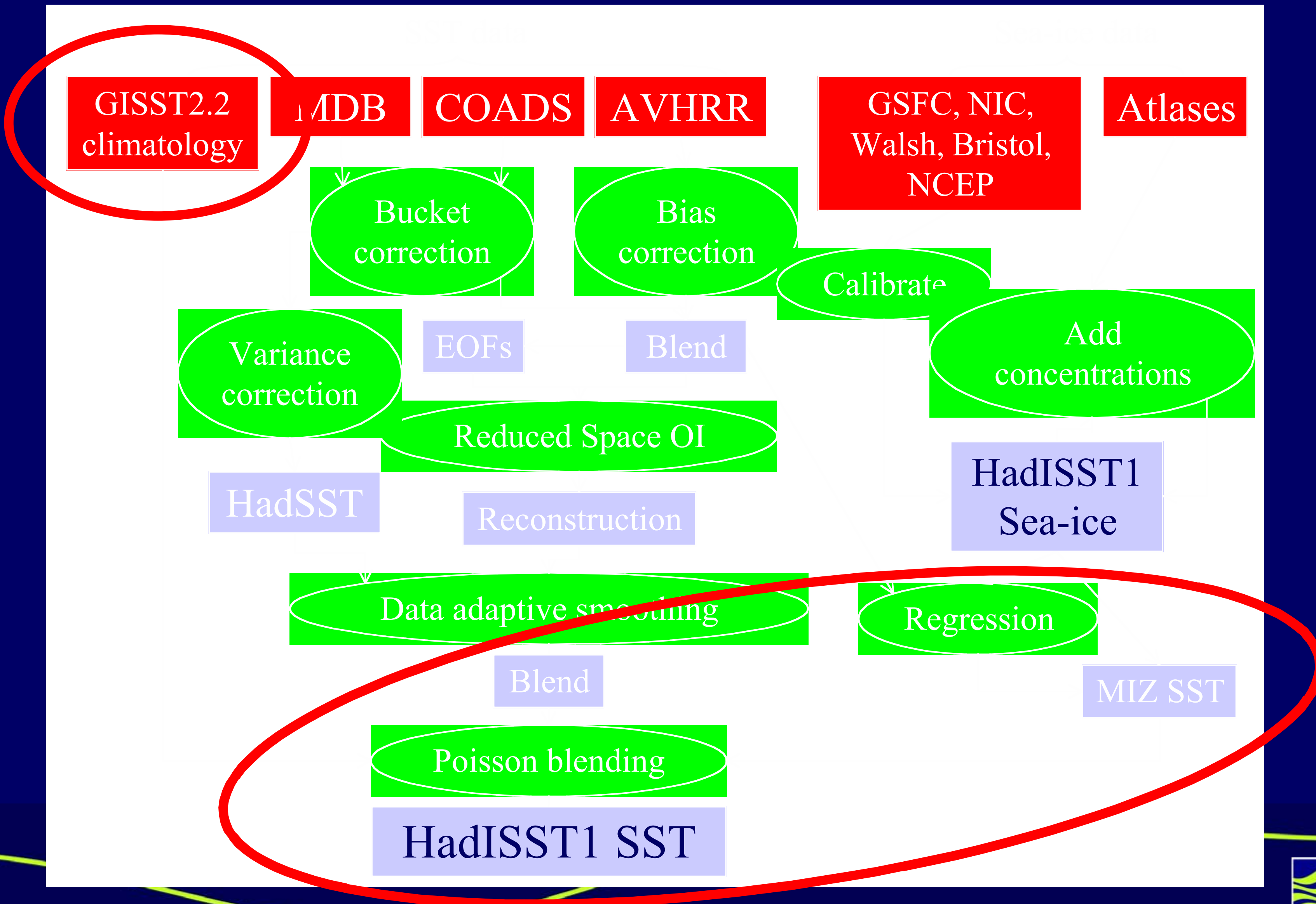


U.S. Navy GDEM climatology



Met Office

Construction of HadISST1



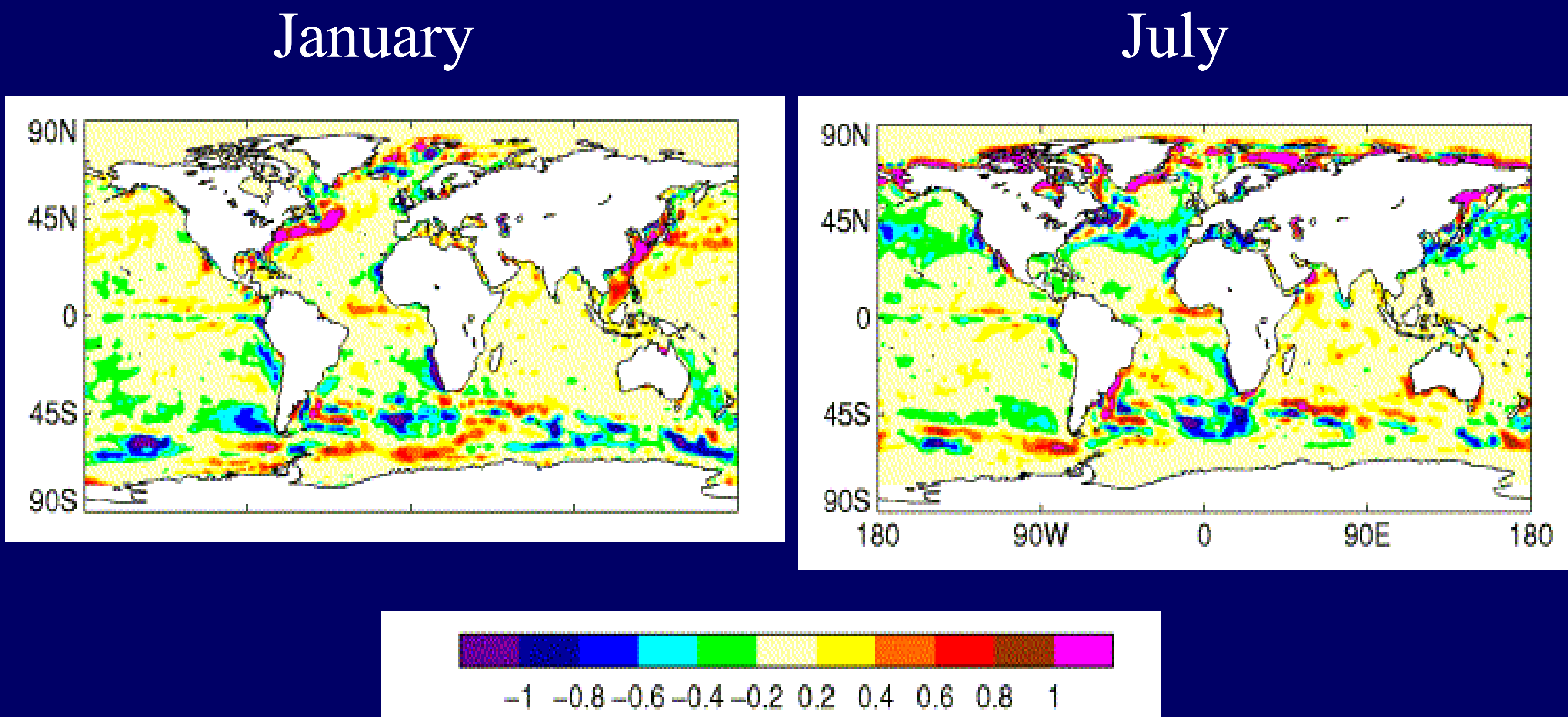
The future

- Rework using the new blend as input
- Multi-step OI procedure using RSOS to give basic broad-scale analysis
- Possible improvement in “trend” reconstruction
- Attempt to reconstruct Southern Ocean before 1982
- Use of AATSR and reprocessed ATSR will help to improve resolution and remove AVHRR-associated problems
- Improved sea ice and SST near sea ice
- Error estimate for each grid box

Summary

- HadISST1 was constructed with data from a variety of sources and using a number of reconstruction techniques
- Due to relative biases between the input data sets, corrections were applied before their use
- HadISST1 is an improvement on GISST, particularly in the period 1949 onwards
- Further improvements will be made over the next 18 months with the aid of new input data and techniques

Climatology differences (°C), adj OI.v2 - HadISST1, 1971-2000



Met Office