

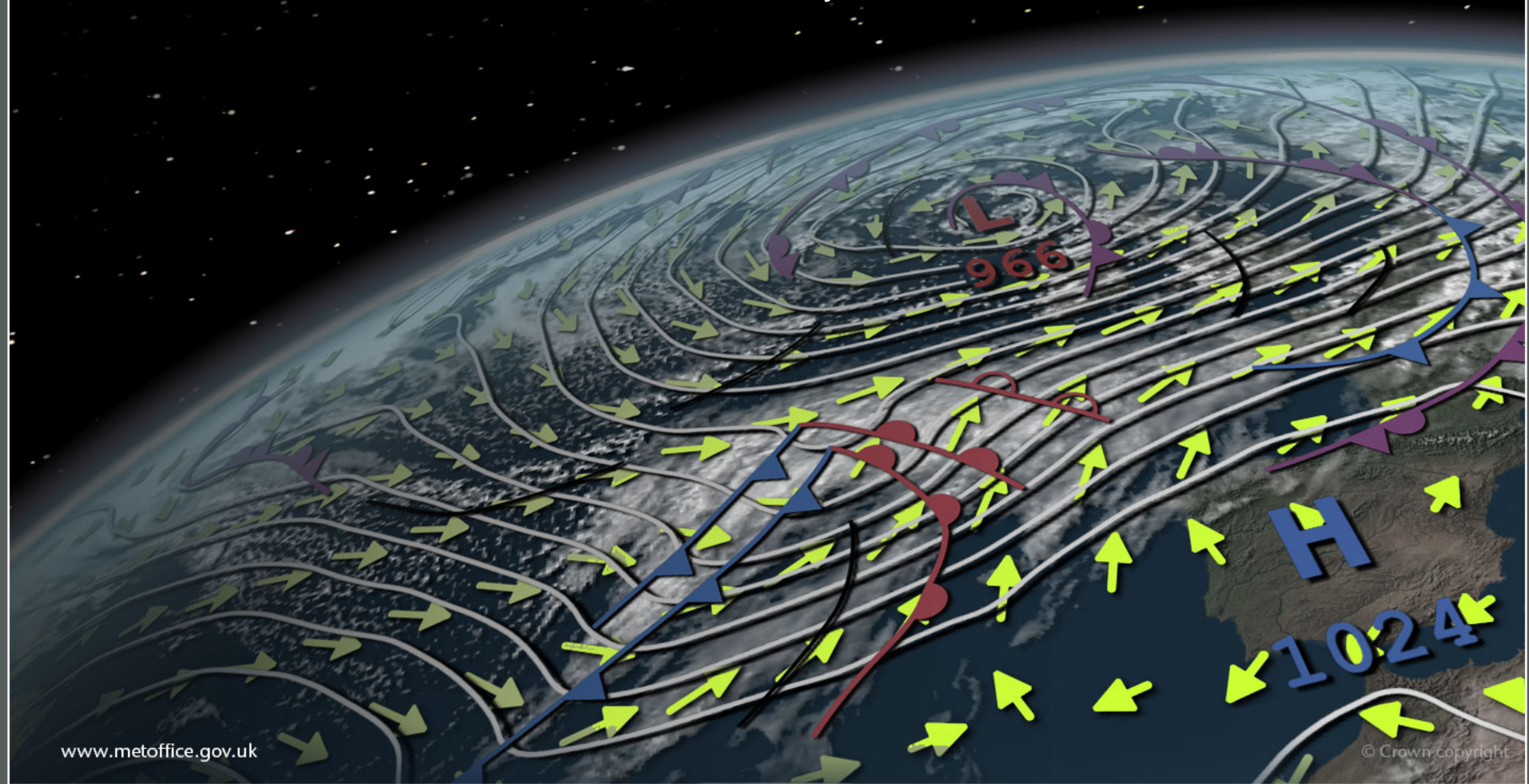


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Met Office contribution to WP3

Nick Rayner on behalf of Chris Atkinson, John Kennedy,
Holly Titchner, Roger Saunders, Rob Allan and Robert
Dunn

ERA-CLIM2 General Assembly, 9th December 2015, EUMETSAT



Met Office WP3 activities

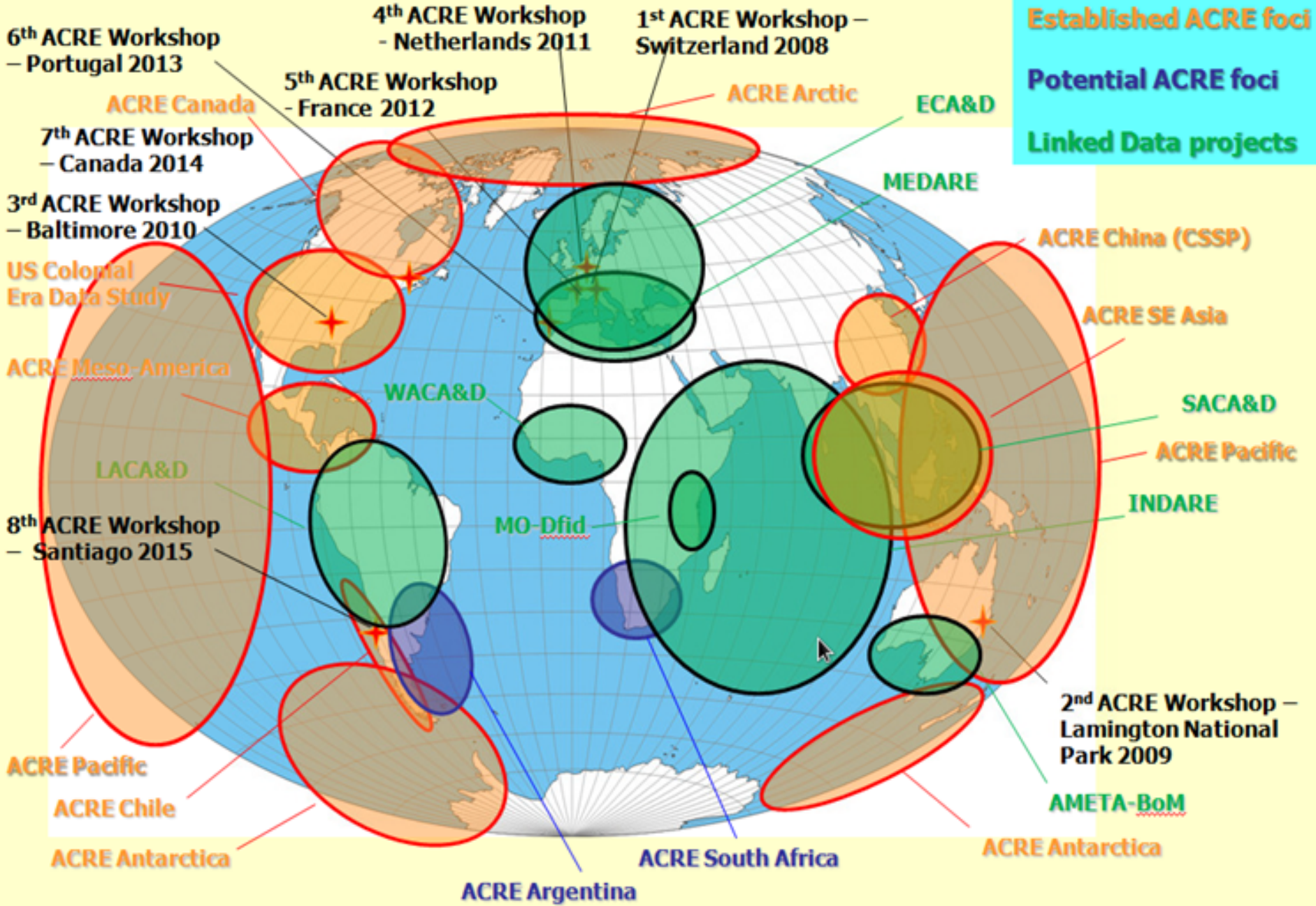
- ACRE coordination
 - data rescue
- Development of HadISD
 - sub-daily station data
- Development of HadIOD
 - surface and sub-surface ocean data
- Development of HadISST2
 - SST and sea ice boundary forcing
- Use of satellite data
 - advice and provision of RTTOV coefficients



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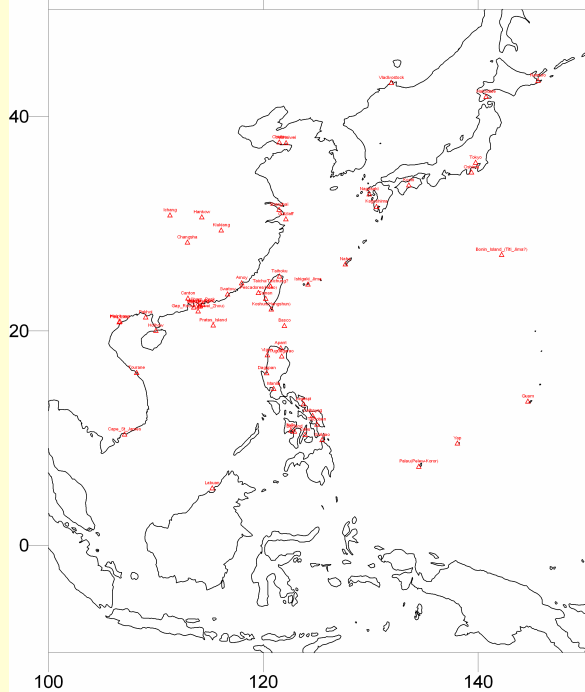
ACRE – Rob Allan

Atmospheric Circulation Reconstructions of Earth
Coordinating historical surface data rescue



ACRE Regional Foci & associated data rescue projects

CMA/BCC has digitised & provided historical data from 6 Chinese stations for the pre-1950 period in 2014 & will add in 20 more stations in 2015/6

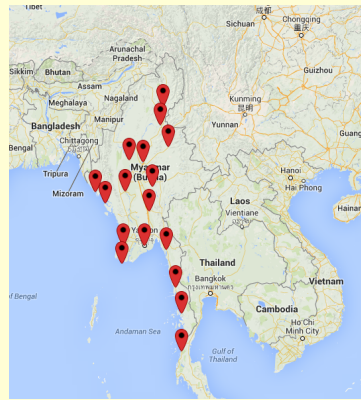


**China coast meteorological register (CCMR)
+ Monthly meteorological bulletin**
(sources: Hong Kong Observatory & Shanghai Observatory)

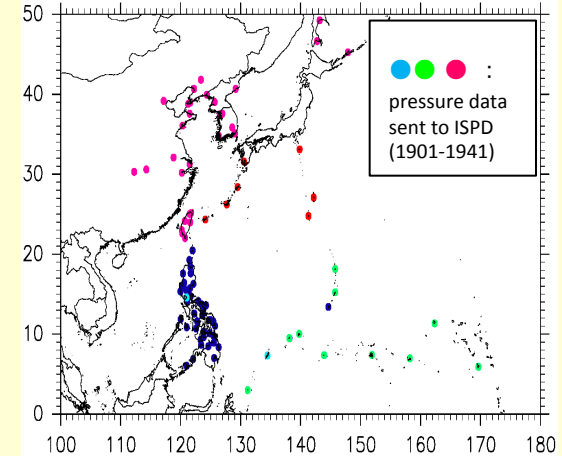
1873 -1893 (Hard Copy Met Office Archives),
1894 -1932 (NOAA Central Library Scanned images)
1906-1941 (Hard Copy Met Office Archives)

1873-1894 (daily weather observations)
Recovery & scanning by Robert Bickers students
Digitisation by Juerg Luterbacher's students plus independent via ACRE from Japanese colleagues (via Hisayuki Kubota)

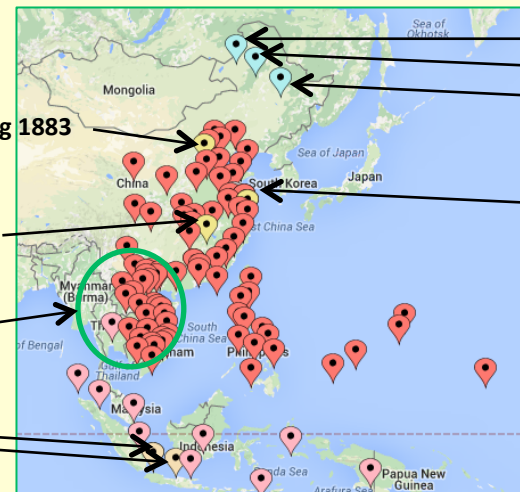
1894-1941 (daily surface pressure observations)
Digitised for ACRE by Alister Ferguson & Dan Bickle, supervised by Gail Kelly under original MO-CMA MoU



Burmese (Myanmar) daily weather observations 1920-1943 from Indian Daily weather Reports (IDWRs) (source: Hard Copy Met Office Archives) (digitised by Gail Kelly)



Station pressure data contributed to International Surface Pressure Databank (ISPD) v3 & v4 : 1901-1941
(Digitised data contributed by Japanese ACRE colleagues via Hisayuki Kubota)



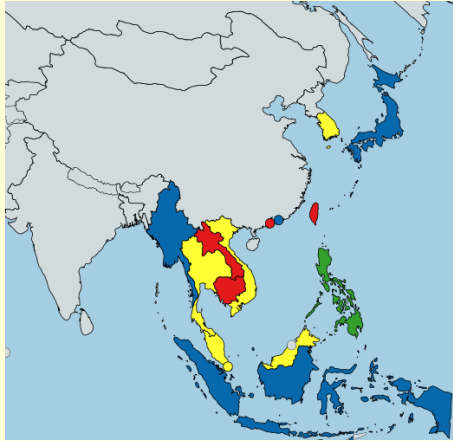
Tchang-kin-tchouang 1883 (Gail Kelly)
Hankou 1882 (Gail Kelly)
Daily pressure data for various stations in French Indo China 1898-1904 (Gail Kelly)
Batavia 1860
Semarang 1882-1891 (Gail Kelly)

Hailar 1899
Zalantun 1899
Harbin 1898 (Gail Kelly)
Zi-ka-wei 1876, 1880-1881 (Gail Kelly)





Various daily to sub-daily weather observations recovered & digitised for ACRE China

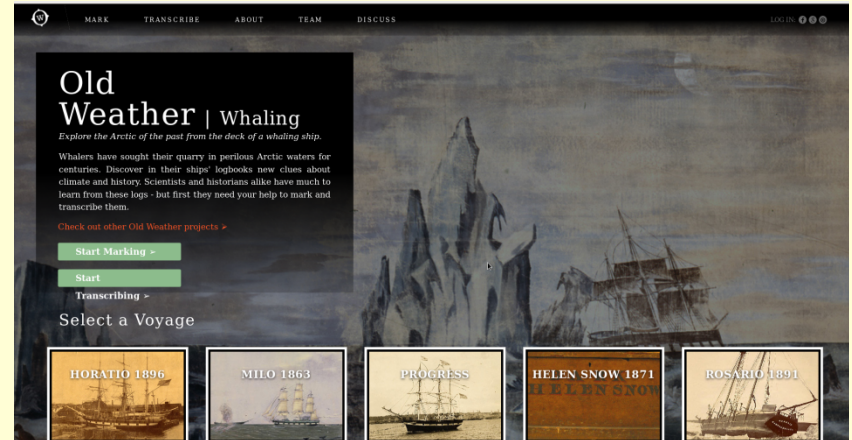
RED (China) = 1936-1937 (Jun Matsumoto's students under ACRE SE Asia)
RED (SE Asia & NW Pacific) = 1936-1940 (Jun Matsumoto's students under ACRE SE Asia)
LIGHT PINK (Indonesia & SE Asia) = 1936-1937 (Gail Kelly)

ACRE CHINA PROGRESS: REGIONAL LIAISONS, COLLABORATIONS & OLDWEATHER



Regional Data Liaisons & Collaborations

-  NMHS visited under ACRE SE Asia (Fiona Williamson)
-  NMHS visited under ACRE China (Fiona Williamson)
-  Proposed visit in 2016 (Fiona Williamson)
-  Collaborations via SACA&D, ACRE, INDARE



OldWeather

Capability expansion of the oldWeather.org citizen science platform.
New version of oldWeather for whaling logbooks is now operational
(<https://whaling.oldweather.org>) (Zooniverse, U. Oxford)



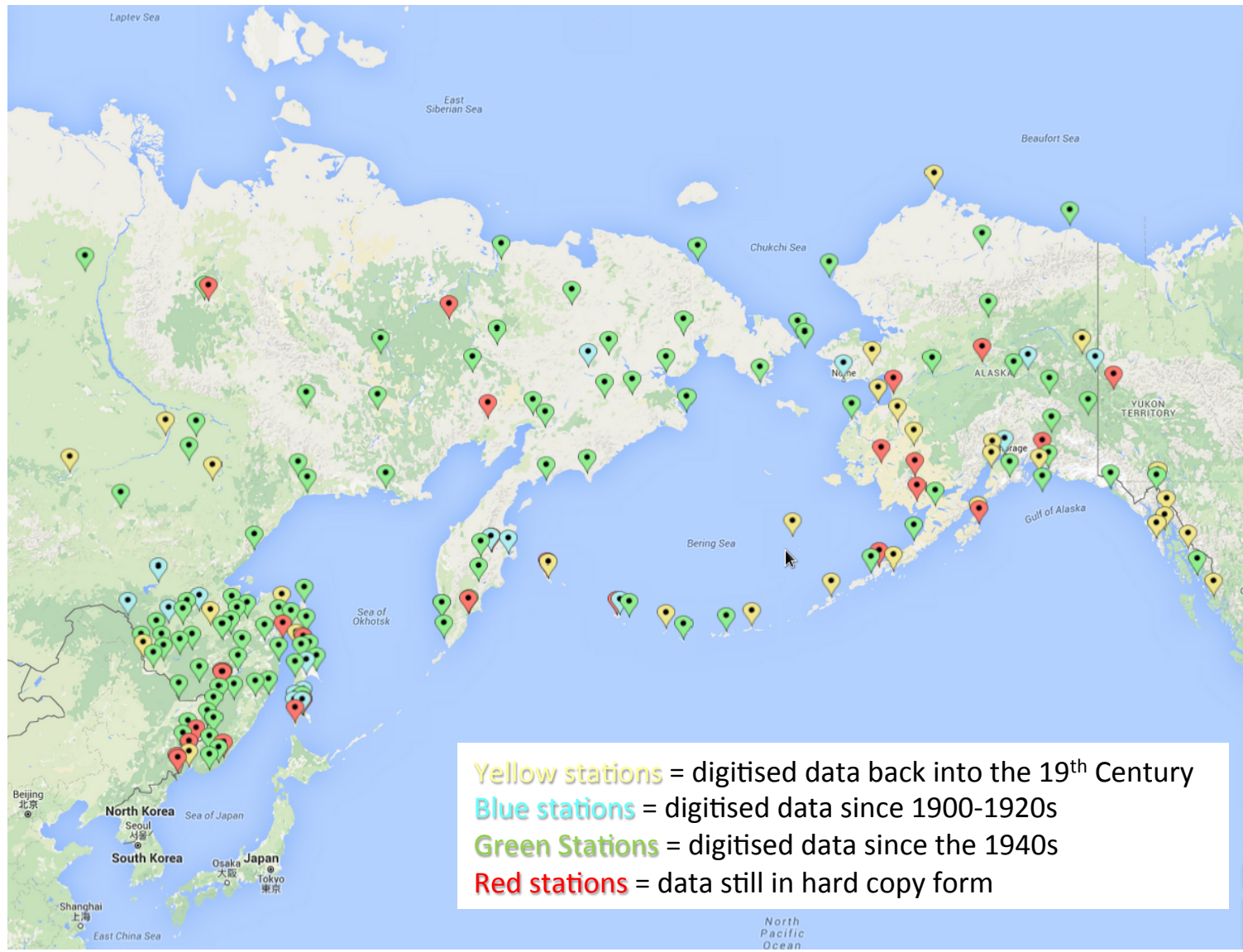
Recovery of Historical Weather Observations in the IDWRs for the Indian sub-continental region and 'Extra' India: the Indo-South East Asian Data Recovery Project

Proposal submitted to the Global Framework for Climate Services (GFCS) via the WMO/ACRE/GFCS Indian Ocean Data Rescue (INDARE) initiative


Engage the NMHS of Pakistan, Afghanistan, India, Nepal, Bhutan, Bangladesh, Myanmar, Sri Lanka, Seychelles, and the Maldives in the digitization and quality control of terrestrial and marine surface daily weather observations in the Indian Daily Weather Reports (IDWR).

- **Digitize the scans of the IDWR volumes from 1878-1947 (prior to Indian Independence) in collaboration with (Juerg Luterbacher's students, University of Giessen, Germany over the next 3 years under ACRE China with funding from CSSP China.**
- **Make available the remaining 1948-1992 IDWR scans to NMHS in the Indo-South East Asian region from a central repository for them to aid the digitization and quality control of the data tabulated in them.**

Far eastern Russian-Alaskan region stations with historical instrumental synoptic pressure



Sources: The International Surface Pressure Databank (ISPD)/ACRE; Japan Climate Data Program (JCDP); Climate Database Modernization Program (CDMP) 19th Century Forts & Voluntary Observers Database Build Project



HadISD developments – Robert Dunn

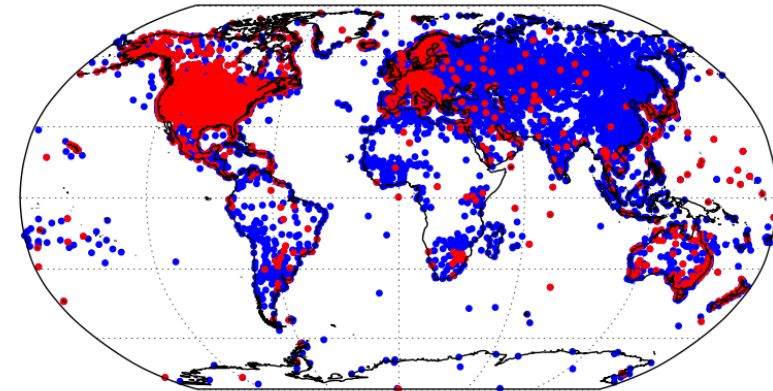
Quality control of sub-daily station data



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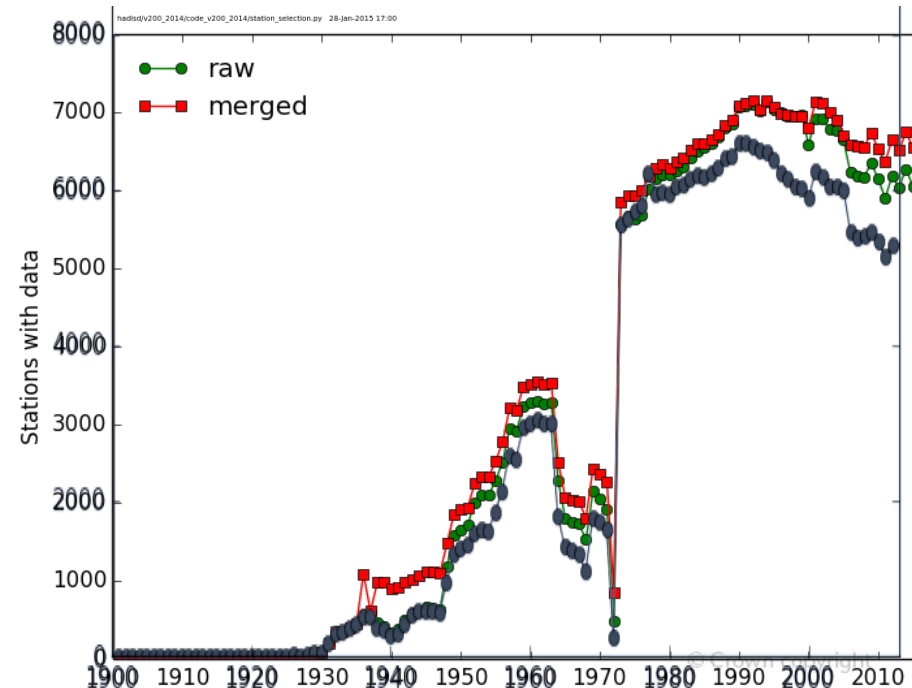
HadISD.2.0.0: sub-daily data from 1931-present

- Updated station selection:
 - 1931-present
 - 8129 unique station IDs
 - Selection to be run annually
- Updated merging process
 - Probability based
 - Country-specific checks
- Updated QC code
 - Python
 - Extra wind tests
 - Humidity and heat stress variables
 - Will be released on github
- Paper submitted, September 2015
 - Climate of the Past
 - Awaiting editor decision (20-Nov-2015)



8129 stations

••• HadISD stations ••• mergers





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HadIOD developments – Chris Atkinson

Integrating surface and sub-surface ocean temperature and salinity data

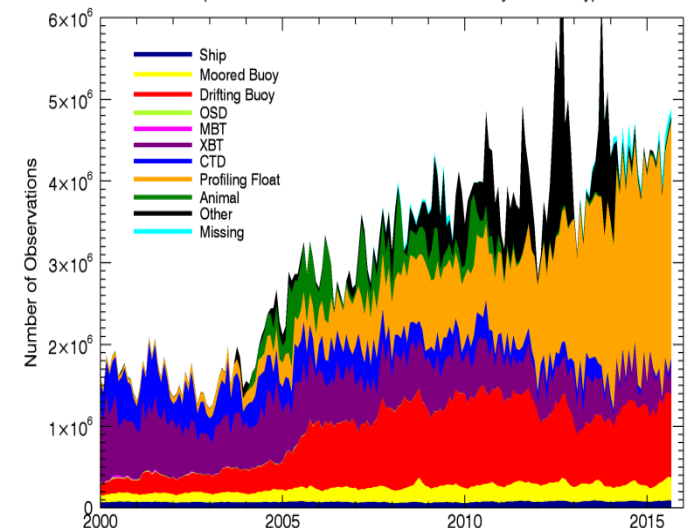
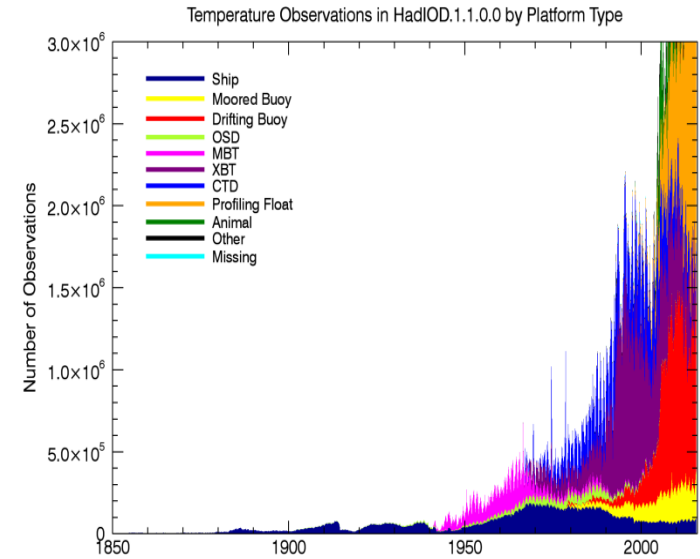
Updates to Marine Database

HadIOD* version 1.1.0.0 created

Improvements compared to v1.0.0.0:

- Use of latest (at the time) EN.4.1.0 profiles
- Surface coverage back to 1850
- Multiple sets of XBT corrections
- Tool to output to NetCDF feedback file format
- Monthly updates (with ~1.5 month delay)

HadIOD is the **Hadley Centre **I**ntegrated **O**cean **D**atabase – a database of surface and profile marine T & S observations created for ERA-CLIM for uses including coupled reanalysis; it includes ob QC flags, bias adjustments and uncertainty estimates*





Updates to Marine Database (ongoing work)

HadIOD version 1.2.0.0 (Spring 2016)

This marks the end of the latest block of development within ERA-CLIM2 and is likely the first release we will make publicly available. Improvements c.f. v1.1.0.0:

- Clean run of SST QC and ship callsign unmasking (**done**)
 - Improvement to drifting buoy and ship 'tracking SST QC' flags (**in progress**)
 - Addition of an ensemble of ship SST corrections from HadSST3
 - Inclusion of latest EN4 (due early 2016)
 - Addition of GOSUD data and NOCS hi-res surface-GTMBA data
 - Tool to output to 'non-specialist' NetCDF format
- Later in the project we will also fold in any findings from analysing feedback data

Any feedback is welcome: chris.atkinson@metoffice.gov.uk



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HadISST2 developments – John Kennedy and Holly Titchner

Sea surface temperature and sea ice

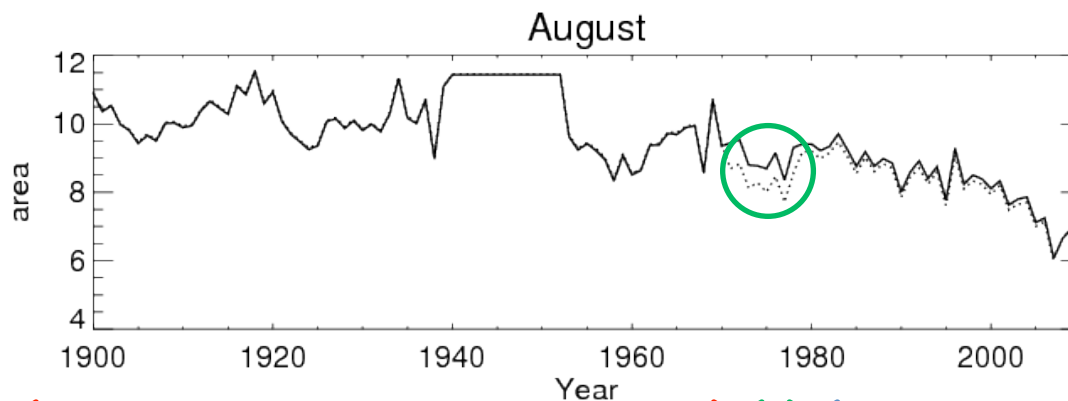
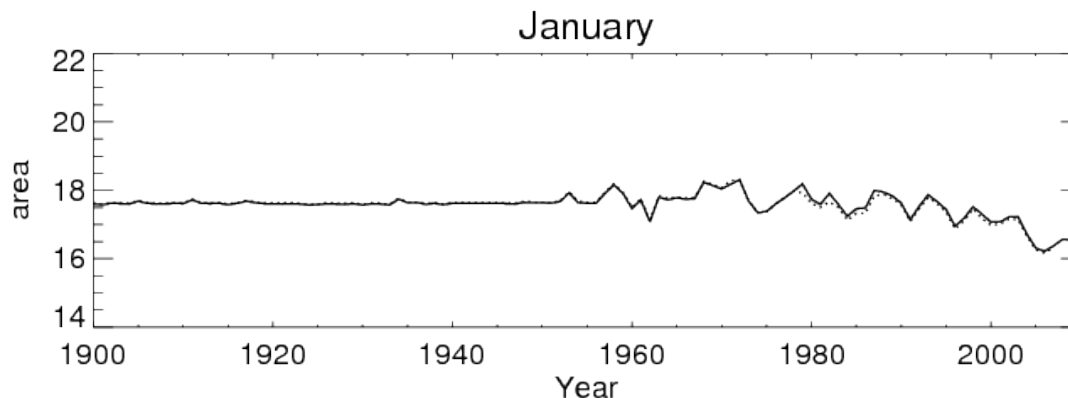


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HadISST.2.2.0.0

HadISST.2.1.0.0

Northern Hemisphere sea ice



Walsh and Chapman compilation

National Ice Center sea ice charts

OSI SAF passive microwave

New bias adjustments in
NH for Summer months
(April-September)

Other bug fixes have
resulted in other (small)
changes

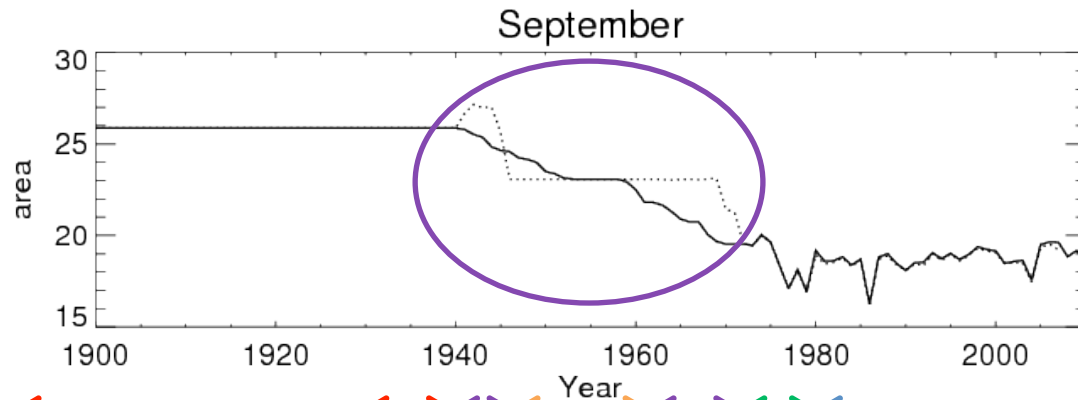
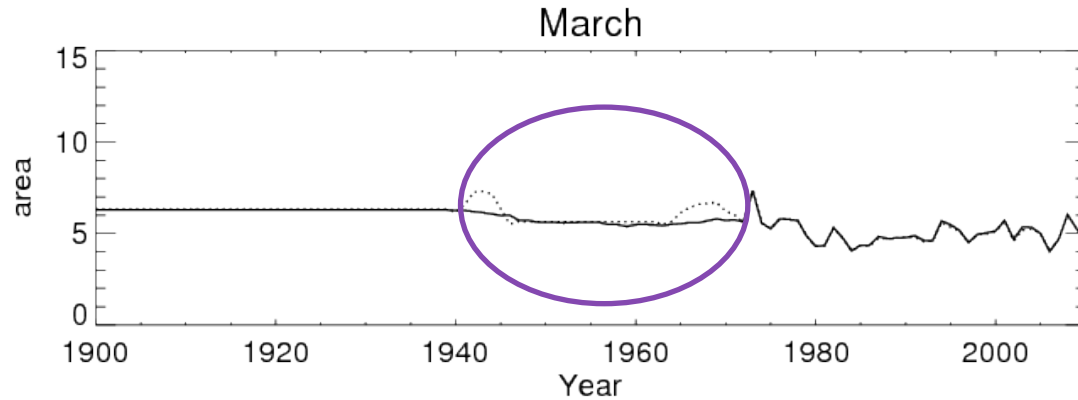


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HadISST.2.2.0.0

HadISST.2.1.0.0

Southern Hemisphere sea ice



German Atlas
climatology

Russian Atlas
climatology

National Ice Center
sea ice charts

OSI SAF passive microwave

New time series 1940-1972 smoother:
 - Russian atlas climatology period shortened/transitional periods extended
 - New method to calculate extents in transitional periods

Data gaps - transition between climatologies/observations

Other bug fixes have resulted in other (small) changes

Southern Ocean data rescue

Aim: Make inventories and undertake imaging, in various archives of historical observations of sea-ice and atmospheric variables from ships in the Antarctic-Southern Ocean region.

Sources:

- Christian Salvesen Archive, U of Edinburgh;
- National Oceanography Centre, Southampton;
- Sea Mammal Research Unit, U. of St Andrews;
- National Meteorological Archive (Met Office);
- Whaling Museum and the Vestfold Archive, Sandefjord, Norway;
- Maritime Museum, Mareihamn, Finland.

HadISST.2.2.0.0

SST data improvements

In situ

- new bias adjustment scheme base-lined using buoys
- Easier to reconcile with satellite records
- ship-by-ship bias adjustments (right) reduces effect of “ship tracks”

AVHRR

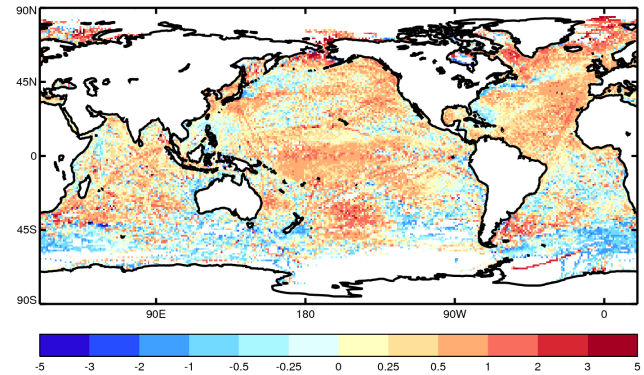
- using SST CCI AVHRR records
- better characterised uncertainty
- smaller biases

ATSR

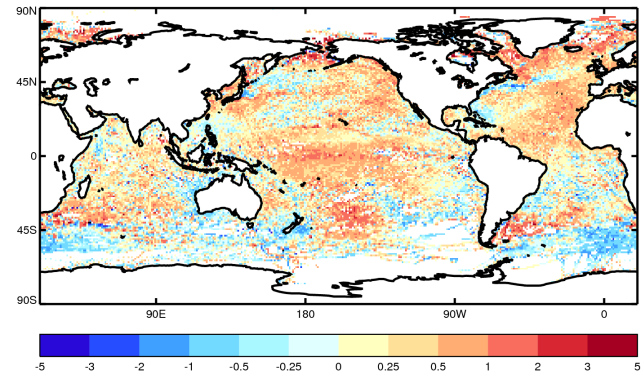
- still using ARC ATSR, still the best

Individual ship biases

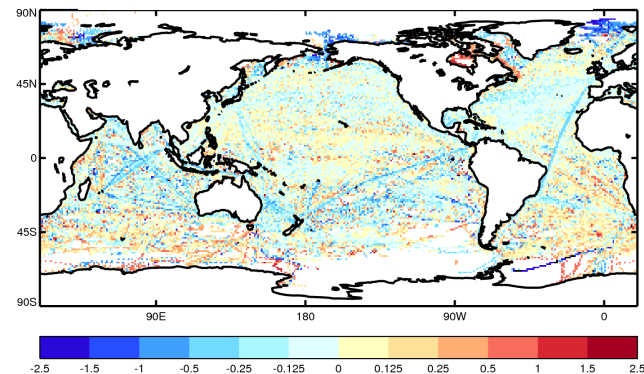
HadISST.2.1.0.0



HadISST.2.2.0.0



Difference for 2004





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Reconstruction

Large Scale reconstruction

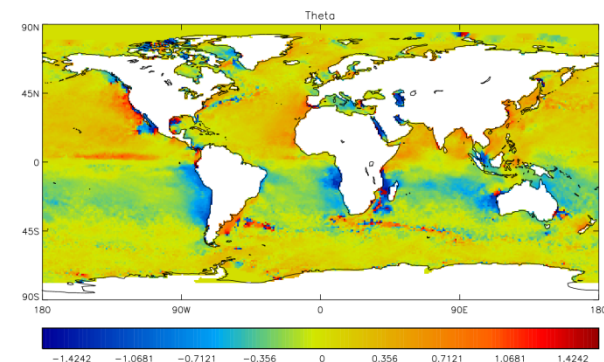
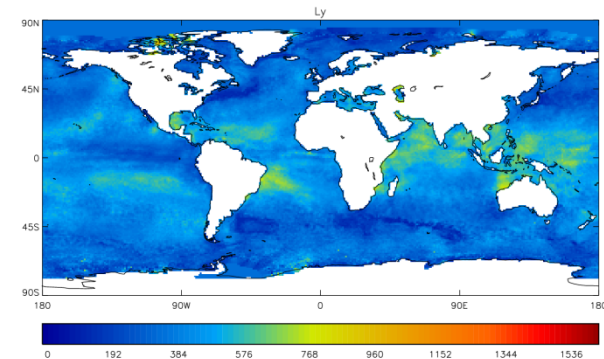
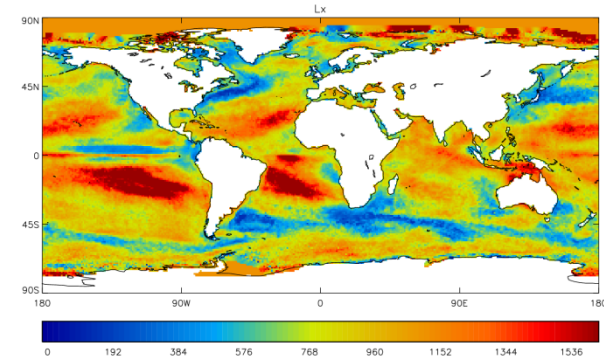
- Unchanged from earlier versions
- Based on Variational Bayesian Principal

Component Analysis

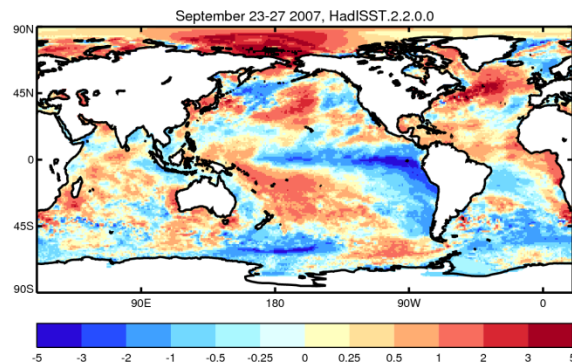
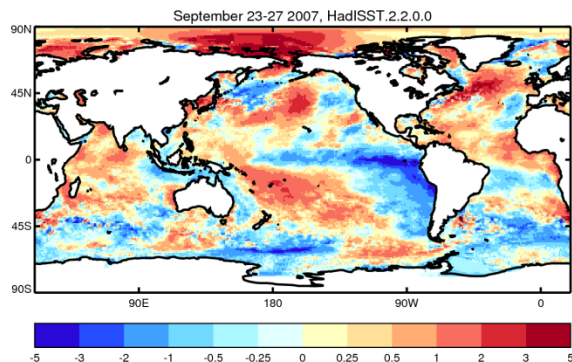
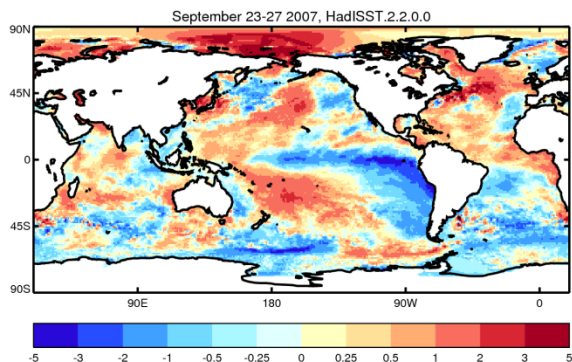
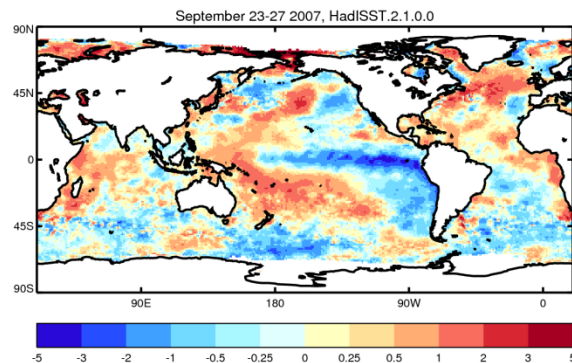
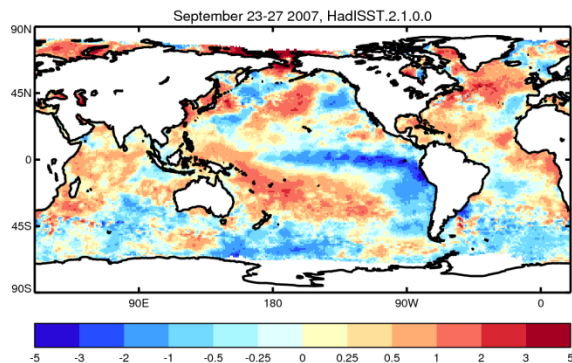
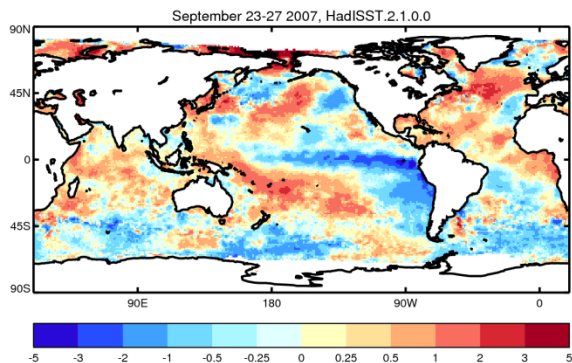
Small-scale reconstruction

- Uses local optimal interpolations with varying length scales and angle parameter (figure to right)
- Length scales are now **angular** distances
- We can now sample efficiently from posterior distribution
- Now globally complete

Variable length scales



Global Reconstruction

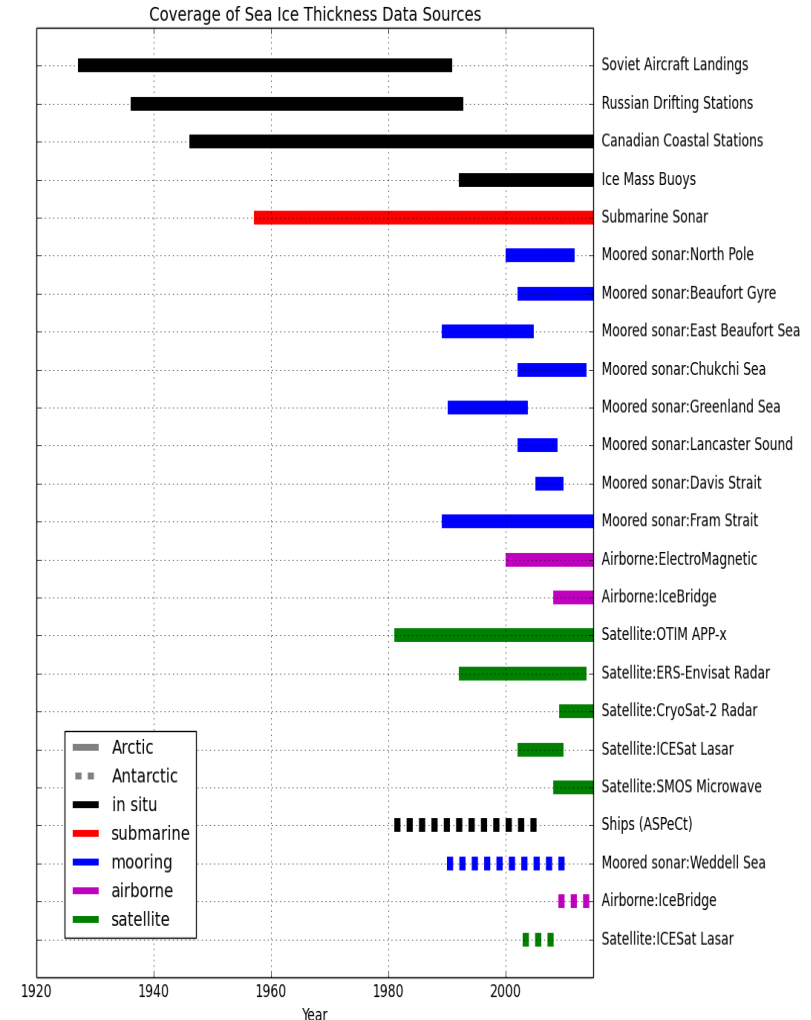


Consolidated Ice Thickness Data

D3.16: Consolidated Ice Thickness Data for Verification Purposes in a Common Format

Document available reviewing ice thickness data:

- Comprehensive review of available ice thickness data (as of Summer 2015) and their uncertainties in table format
- Recommendation of Unified Sea Ice Thickness Climate Data Record from Polar Science Centre (APL, Washington Uni.)
- Some outstanding issues for use in verification discussed (e.g. format, coverage, homogenisation, ice draft->ice thickness conversion)
- Some complementary data files produced





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Use of satellite data – Roger Saunders

Advice on use of historical satellite data and provision of
RTTOV coefficients

Satellite data for ERA-CLIM-2

- Continue to provide advice on use of satellite datasets for ERA-5
- Maintain current list of early satellite datasets and their availability and characteristics
 - SSM/T-2 (see Kobayashi Paper¹)
 - SSU, PMR (see next slide)
- Maintenance and development of RTTOV coefficients for old satellites
- Interpretation of O-B stats and other feedback information for reprocessed AMSU-B/MHS/SSM-T2 radiances

1. Kobayashi, S. and P. Poli and V. John CM-SAF Visiting Scientist Activity CM_VS14_01 Report: Characterisation of SSM/T-2 radiances using ERA-Interim and other reanalyses

Status of old satellites for ERA-CLIM

All listed have RTTOV coeffs computed

Satellite	Sensor	Period	Status of data
NIMBUS-3	IRIS	1969-1971	Data at ECMWF
NIMBUS-6	PMR	1975-1978	Data at Met Office under assessment
NIMBUS-6	HIRS-1	1975-1976	Available at NASA/GSFC
NIMBUS-7	SMMR	1978-1987	Data at CM-SAF
NOAA	SSU	1979-2005	Data at ECMWF
DMSP	SSM/T	1992-2005	Data in NOAA CLASS archive
DMSP	SSM/T2	1992-2005	Data at ECMWF
NIMBUS-6	SCAMS	1975-1976	Only L2 products available
Revised spectral responses			
NOAA/Metop	HIRS	1979-now	Data at ECMWF
NOAA/Metop	AMSU-A	1998-now	Data at ECMWF

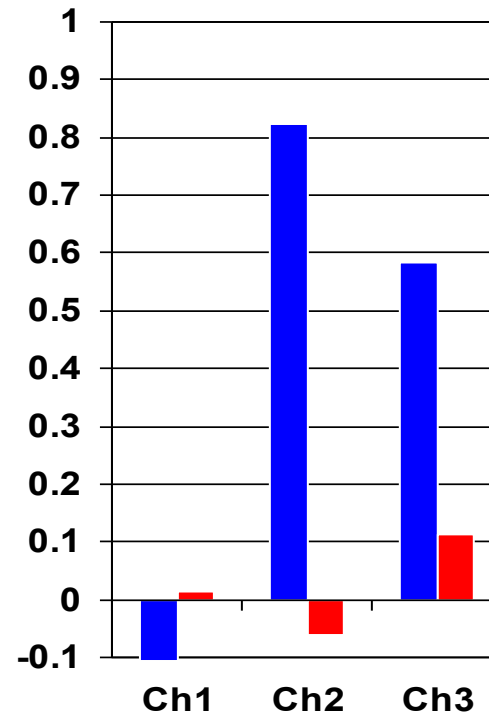


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SSU and PMR (Nimbus-6)

- New set of SSU coefficients based on latest spectroscopy
- Predictors developed to take into account change in cell pressure with time
- Characteristics of Nimbus-6 PMR gathered. Plan to produce PMR RTTOV coeffs similar to SSU
- Above should lead to better representation of stratosphere in ERA5 from mid 70s.

NOAA-14 minus NOAA-9 SSU



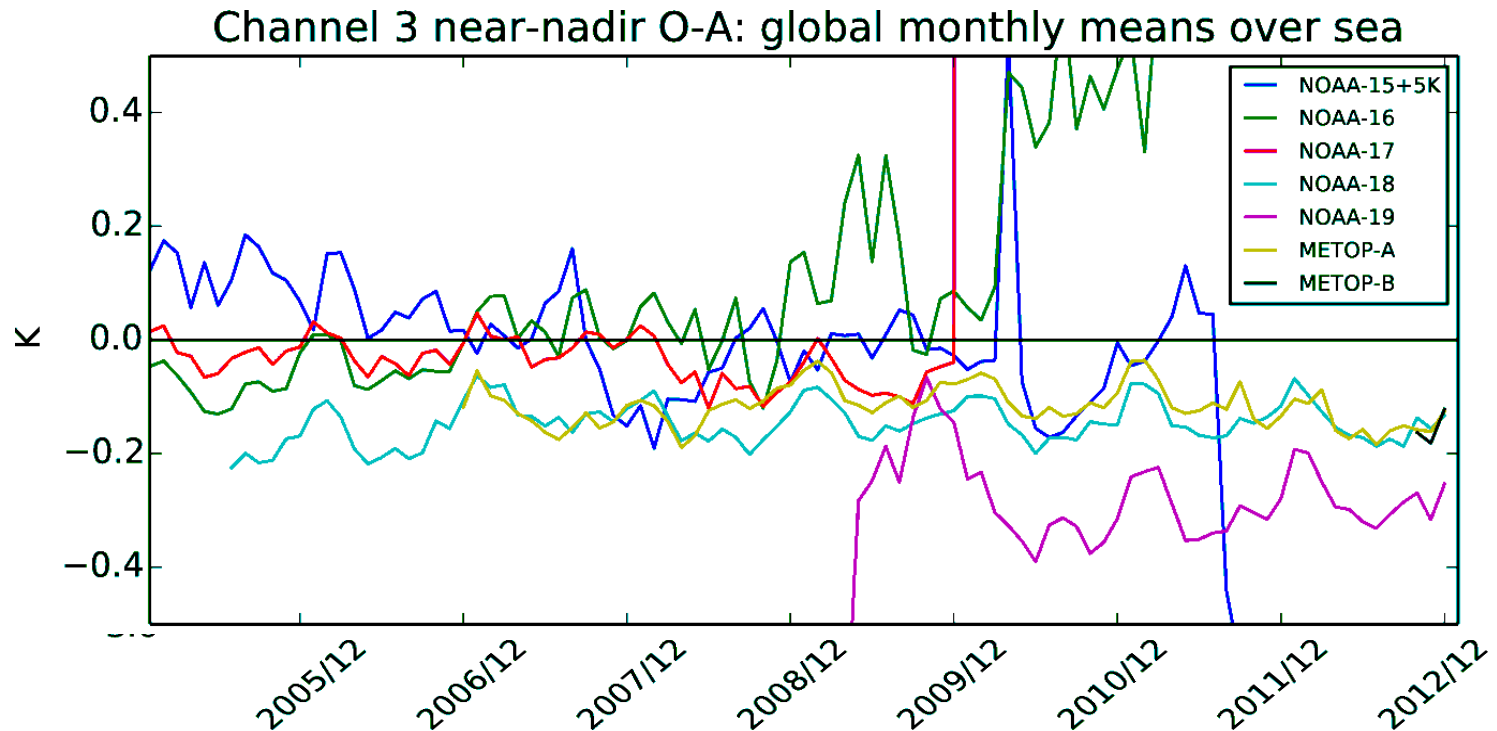
Using independent diverse set of 52 profiles for 30° scan angle

■ Orig
■ Corr

Orig = comparison N14 vs. N9 without new scheme
Corr = comparison N14 vs. N9 allowing for cell pressures changes

AMSU-B/MHS Radiances

The AMSU-B/MHS upper tropospheric humidity sounding channel was compared with ERA interim for all available satellites.





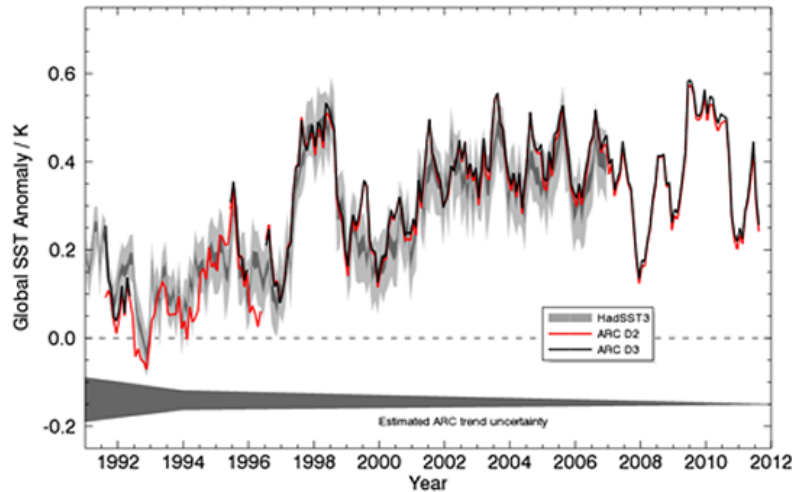
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Extra slides

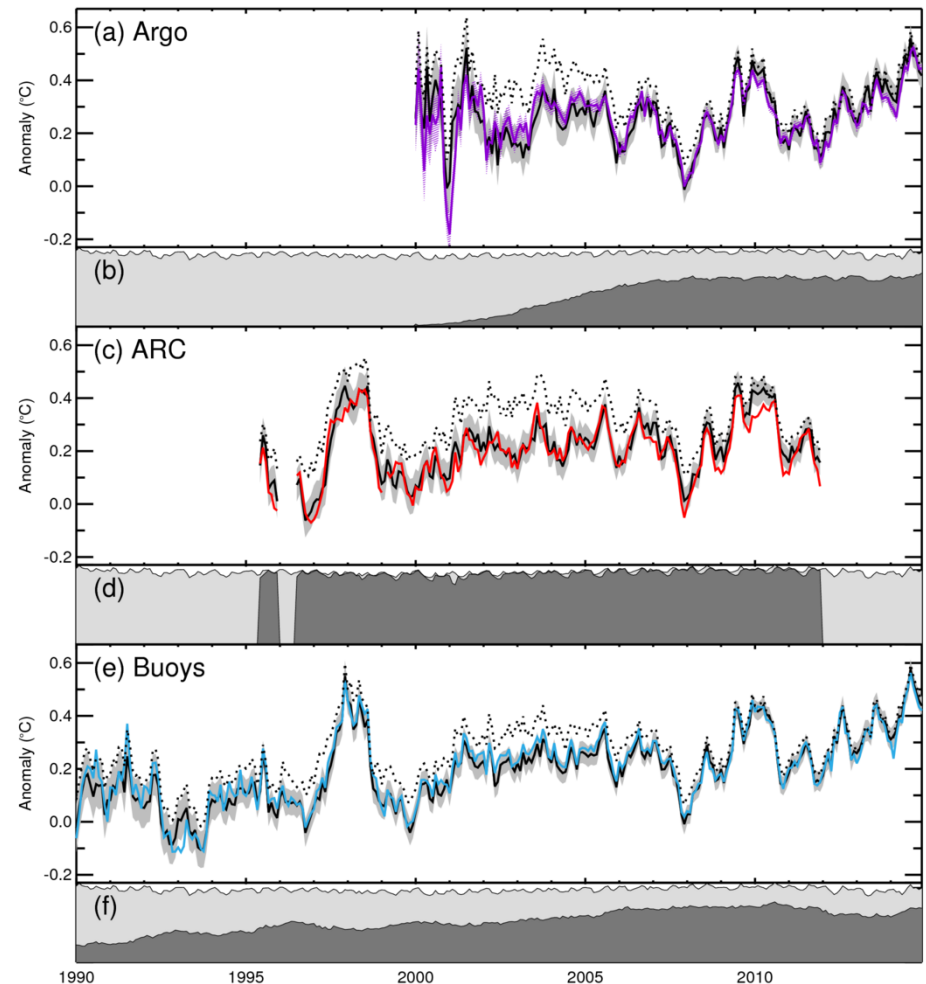
Improved in situ adjustments in drifting buoy era

Validates well against Argo, ARC

HadSST.3.1



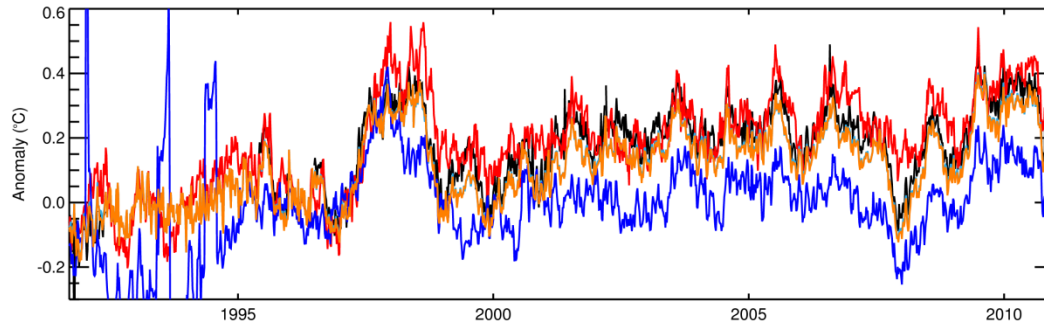
HadSST.3.2



- Improved bias adjustments
- Narrower ensemble spread in satellite era
- More efficiently create large ensembles of HadISST.2.2.0.0

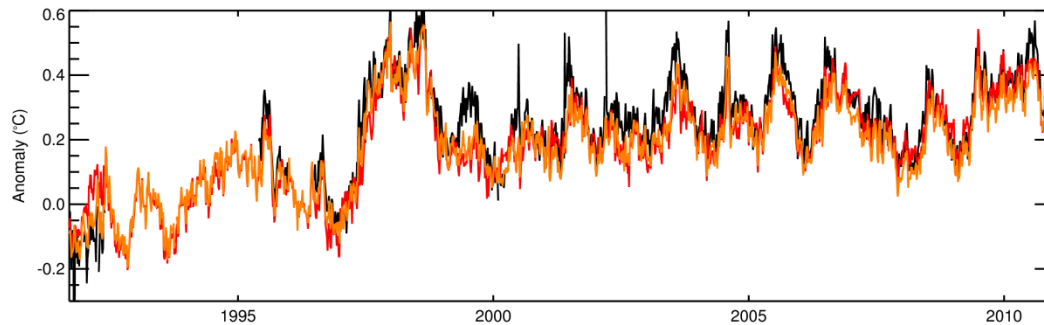
AVHRR data

Full coverage data sets



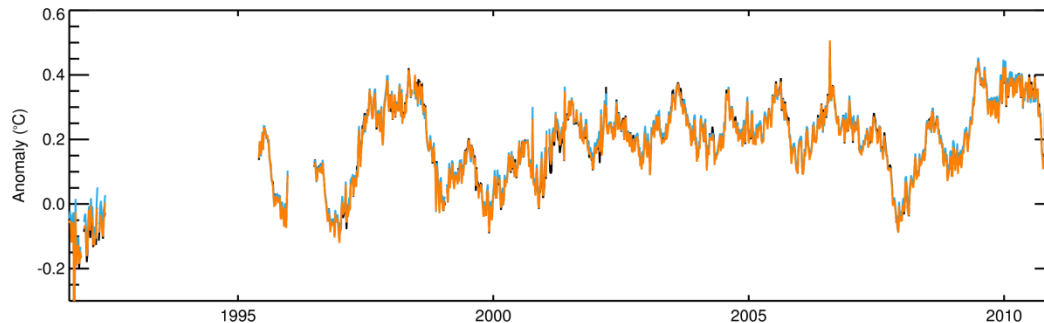
IN SITU
AVHRR RAW
AVHRR ADJUSTED

Colocated with in situ data



ARC
ATSR

Colocated with ATSR



ARC
IN SITU
AVHRR BLEND