

Assembling the International Surface Pressure Databank

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1. Introduction

The International Surface Pressure Databank (ISPD) represents the world's largest collection of sub-daily surface and sea level pressure observations from land and marine platforms. The ISPD has been developed as a cooperative effort between the international Atmospheric Circulation Reconstructions over the Earth (ACRE) initiative and working groups of Global Climate Observing System (GCOS) and the World Climate Research Program.

The ISPD merges more than 40 national and international collections containing pressure observations and currently spans from 1755-2008. The ISPD consists of three components: station observations⁶, marine observations⁵, and tropical cyclone best track pressure reports². The majority of the observations are derived from:

1. Integrated Surface Database (ISD)³

2. International Comprehensive Ocean-Atmosphere Data Set (ICOADS)⁵

3. International Best Track Archive for Climate Stewardship (IBTrACS)²

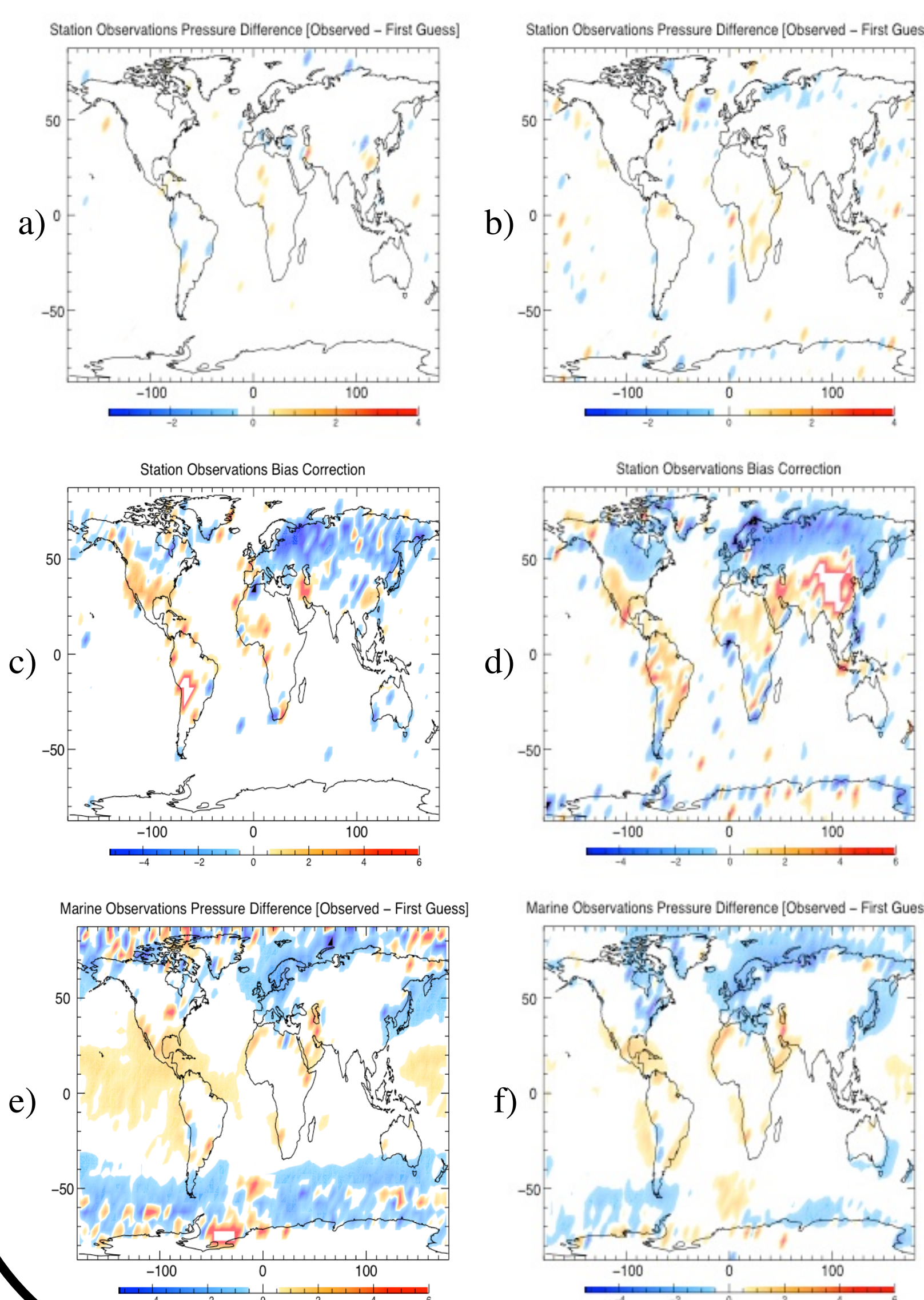
The ISPD has been constructed to facilitate the study of both the variations and gradients in surface air pressure which characterize the thermal and dynamic structures of the atmosphere that impact daily life and also to help in studying the variability of the sea level of the world's oceans.

The ISPD is stored in the HDF5 format, which is a very flexible data model that can represent complex data objects and a wide variety of metadata. One such data object is the Assimilation Feedback information which comes from the 20th Century Reanalysis Project¹. These so-called "feedback" records include the difference between the final analysis and each observation, the estimated uncertainty in the observation, and other quality information.

The 20CR used an Ensemble Kalman Filter data assimilation method.⁴ The background 'first guess' fields for the 20CR were supplied by the National Centers for Environmental Prediction's (NCEP) Global Forecast System (GFS) model with the ISPD v2 surface pressure, using observed monthly sea-surface temperature and sea-ice distributions as boundary conditions. The 20CR system was run over the period 1860 to 1870 to begin to examine earlier observations than used for the 20CR. Using the feedback information one can get a sense of the quantity and quality of data available in the ISPD.

3. Assimilated Observation Feedback Statistics

1860-1949 1950-2008

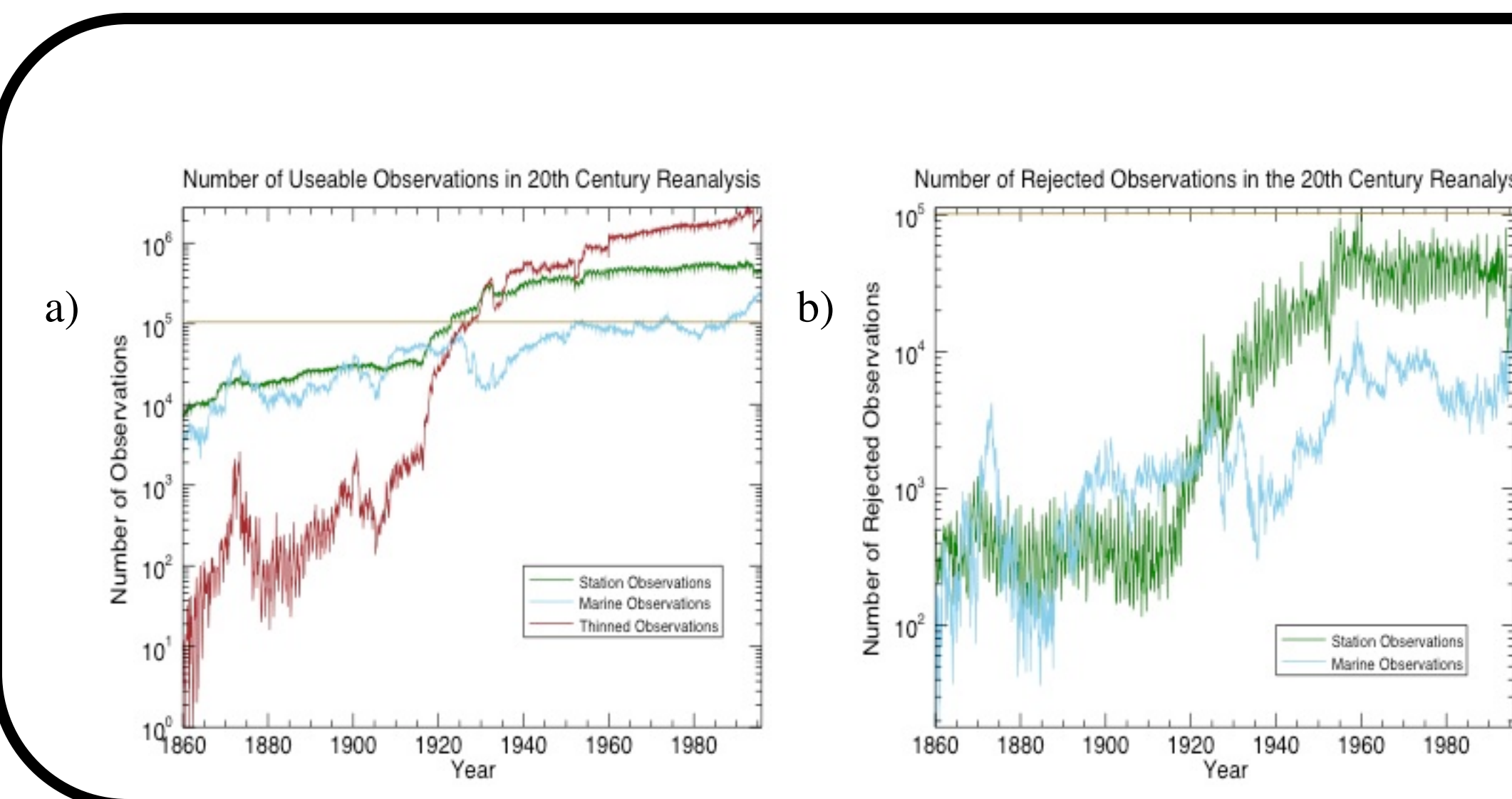


In this study we have averaged selected feedback information from the 20CR in monthly 5 degree bins.

The spatial coherence of the marine [observed - first guess] (panels e, f) and the bias correction applied to the stations (panels c, d) suggests a large-scale systematic bias in 20CR

Studying the reanalysis feedback information helps to improve the underlying observational database.

For example, the north-south negative station bias "streak" in blue, off the coast of Africa (b) was found to be stations with incorrect longitude information. The negative bias correction in Brazil (c) was found to be entirely from a single station for a one month period in 1947. Investigating the observations from central China (d), the pressures reported from all 9 available stations were all low, thus the bias correction very large (> 20hPa).



2. Observation Counts

From 1860 to 1917, the number of marine and station observations is comparable, but after 1917 most of the observations are from stations. The number of "useable" observations after the 1920's is significantly larger than the number of rejected observations. The thinned observations are those that were determined to be useable observations, but their addition to the analysis would not have had a significant impact.¹

4. Detailed Study of ISPD Feedback

Studies of the differences between 20CR fields and the ISPD observations show that the marine data appear to be biased both positively and negatively. Regions where the marine bias correction and the station bias appear correlated suggests more about the 20CR model than the quality of the observations.

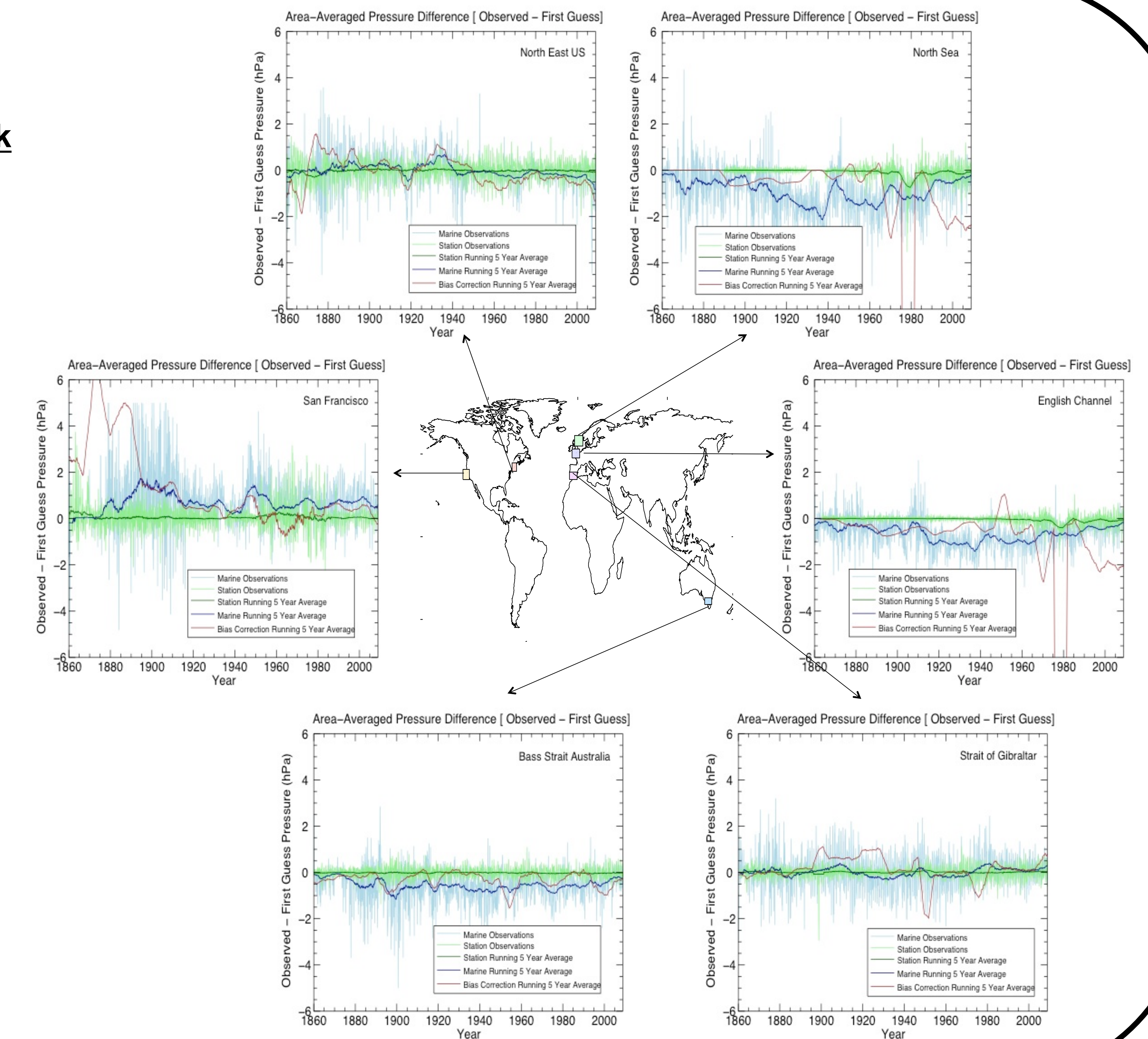
The San Francisco region seems to have a positive marine bias, with a linear correlation between the station bias correction and the marine bias of 0.12

The North East US region seems to be unbiased, and has the largest linear correlation between station bias correction and marine bias of 0.36

Both the North Sea and the English Channel regions are showing a negative marine bias, with something very interesting occurring 1974-1984.

The Strait of Gibraltar region seems to be unbiased, although it had two time periods of very sparse marine data 1918 & 1940.

In the Bass Strait region there is a negative marine bias, with linear correlation between the station bias correction and the marine bias 0.28



5. Conclusion The ISPD is expected to be useful for future reanalyses, such as the planned NOAA-CIRES Sparse Input Reanalysis for Climate Applications (SIRCA) 1850-2014 and ECMWF Reanalysis for climate (ERA-CLIM), and for climate and extreme event studies. More information on the ISPD can be found at <https://reanalyses.org/observations/international-surface-pressure-databank>.

Maps showing the location of stations in a selected year can be browsed at <http://www.esrl.noaa.gov/psd/data/ISPD/v2.0/>. Version 2 of the ISPD can be obtained courtesy of Data Support Section of the Computational and Information Systems Laboratory at the National Center for Atmospheric Research from <http://dss.ucar.edu/datasets/ds132.0>. Subsetting tools are available to retrieve the data in ASCII or HDF5. For the period 1871-2008, Version 2 includes metadata information from the quality control system of the 20CR. The "feedback" records include the difference between the final analysis and each observation, the estimated uncertainty in the observation, and other quality information.

6. Future Plans Version 4 of the International Surface Pressure Databank is currently being assembled. For station observations, please submit your observations to NOAA's National Climatic Data Center Xungang.Yin@noaa.gov using the ASCII exchange format v1.0 (https://reanalyses.org/sites/default/files/groups/ASCII_transfer_v1_0.pdf), by the 15th of October 2012 for version 5.

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International Surface Pressure Databank Contributing Organizations

- All-Russian Research Institute of Hydrometeorological Information World Data Center
- Atmospheric Circulation Reconstructions over the Earth (ACRE)
- Australian Bureau of Meteorology
- Australian Meteorological Association, Todd Project team
- MeteoFrance
- British Antarctic Survey
- Cook Islands Meteorological Service
- Danish Meteorological Institute
- Deutscher Wetterdienst (DWD; German Weather Service)
- European and North Atlantic Daily to Multidecadal Climate Variability (EMULATE)
- Environment Canada
- ETH Zurich, Switzerland
- European Reanalysis and Observations for Monitoring
- GCOS Atmospheric Observation and Ocean Observation Panels for Climate WG on Surface Pressure
- GCOS/WCRP Working Group on Observational Data Sets for Reanalysis
- Hong Kong Observatory
- Icelandic Meteorological Office (IMO)
- International Best Track Archive for Climate Stewardship (IBTrACS)
- International Comprehensive Ocean-Atmosphere Data Set (ICOADS)
- International Environmental Data Rescue Organization (IEDRO)
- Instituto Geofísico da Universidade do Porto, Portugal
- Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
- Japan Meteorological Agency
- Jersey Met Department
- Koninkrijk Nederlands Meteorologisch Instituut (KNMI; Royal Netherlands Meteorological Institute)
- MeteoFrance - Division of Climate
- Meteorological and Hydrological Service, Croatia
- Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
- Met Office Hadley Centre, UK
- National Center for Atmospheric Research (NCAR), USA
- National Institute for Water and Atmospheric Research (NIWA), New Zealand
- Niue Meteorological Service
- Nicolaus Copernicus University
- NOAA Climate Database Modernization Program (CDMP), USA
- NOAA Earth System Research Laboratory (ESRL), USA
- NOAA National Climatic Data Center (NCDC), USA
- NOAA National Centers for Environmental Prediction (NCEP), USA
- NOAA Northeast Regional Climate Center at Cornell Univ., USA
- NOAA Midwest Regional Climate Center at UIUC, USA
- NOAA Pacific Marine Environmental Laboratory, USA
- Norwegian Meteorological Institute
- Oldweather.org
- Ohio State Univ.—Byrd Polar Research Center, USA
- Proudman Oceanographic Laboratory, UK
- Signatures of environmental change in the observations of the Geophysical Institutes (SIGN)
- South African Weather Service
- Univ. of Bern, Switzerland
- Univ. of Colorado—Climate Diagnostics Center (CDC) of the Cooperative Institute for Research in Environmental Sciences (CIRES)
- Univ. of East Anglia—Climatic Research Unit, UK
- Univ. of Gießen—Department of Geography, Germany
- Univ. of Lisbon—Instituto Geofísico do Infante D. Luiz, Portugal
- Univ. of Milan—Instituto de Meteorologia, Portugal
- Univ. of Rovira i Virgili—Center for Climate Change (C3), Spain
- Univ. of South Carolina, USA
- Univ. of Washington, USA
- Univ. of Toronto—Department of Physics, Canada
- World Meteorological Organization-Mediterranean Climate Data Rescue (MEDARE)
- Zentralanstalt für Meteorologie und Geodynamik (ZAMG; Austrian Weather Service)