The 20th Century Reanalysis Project

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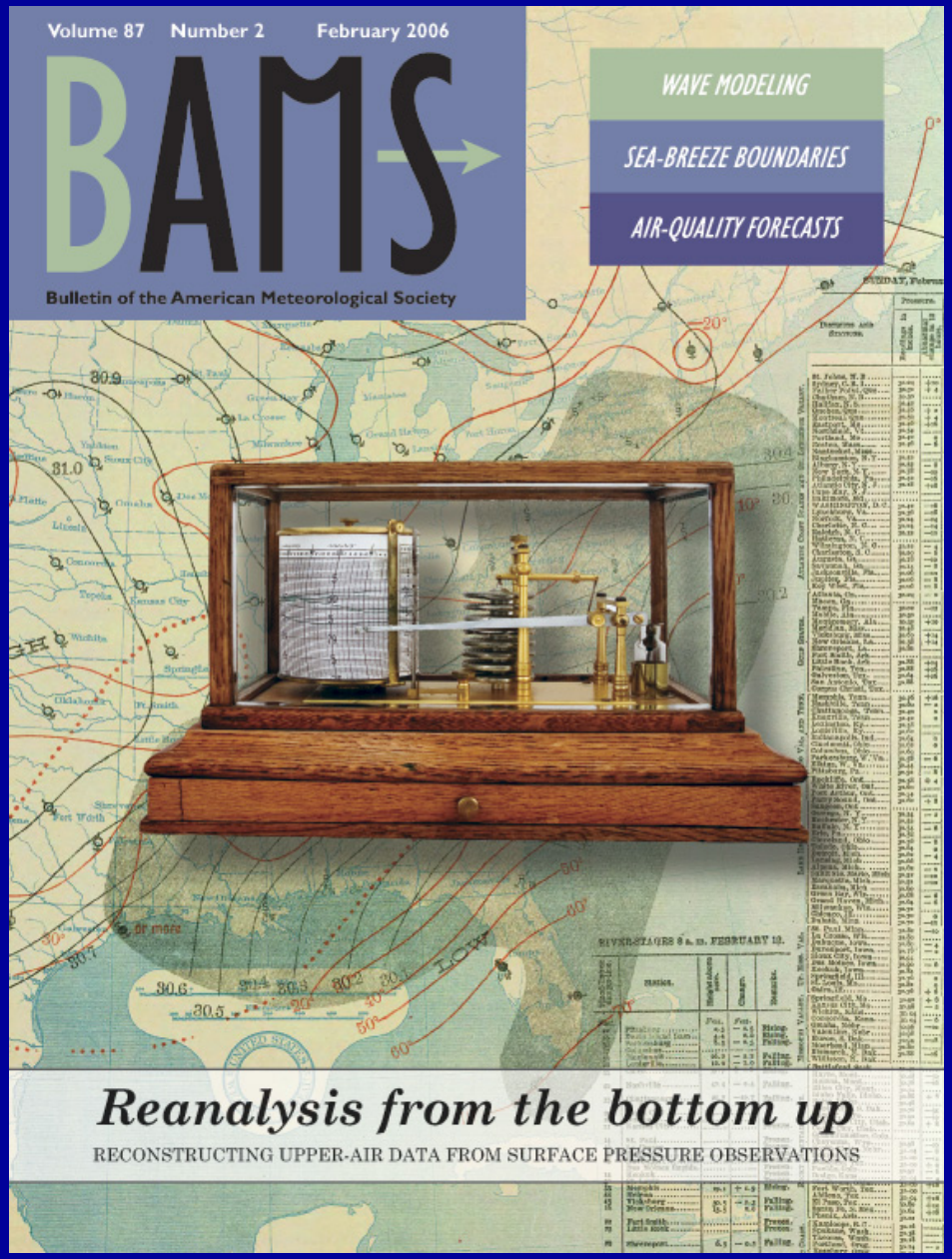


Special thanks to Nobuki Matsui, Russ Vose, Rob Allan

The 20th Century Reanalysis Project

Summary: An international collaborative project led by NOAA and CIRES to produce high-quality tropospheric reanalyses for the last 100 years ***using only surface observations***.

The reanalyses will provide:

-First-ever estimates of near-surface and tropospheric 6-hourly fields extending back to the beginning of the 20th century;

-Estimates of biases and uncertainties in the basic reanalyses;

-Estimates of biases and uncertainties in derived quantities (storm tracks, etc.)

Initial product will have higher quality in the Northern Hemisphere than in the Southern Hemisphere.

US Department of Energy INCITE computing award and NOAA Climate Program Office support to produce *1892-2007* by early 2009.

Initially produce 1918-1949.

Using 56 member Ensemble Kalman Filter

T62 (about 2 degree), 28 level NCEP CFS03 model

International Surface Pressure Databank

Subdaily observations assembled under GCOS AOPC/OOPC Working Group on Surface Pressure

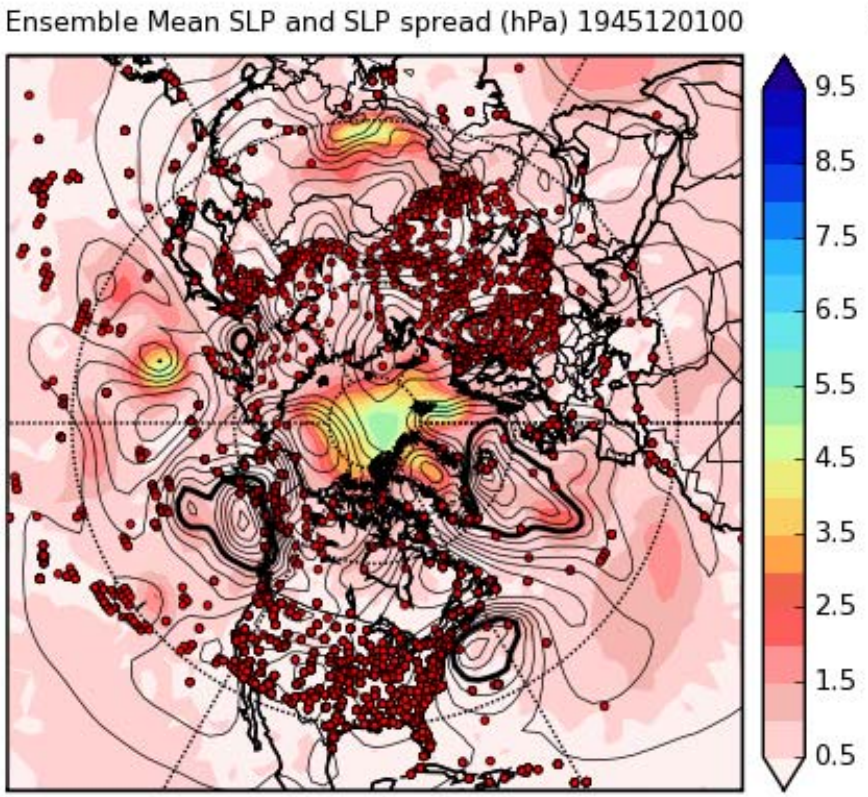
NCDC and ESRL: merging station data

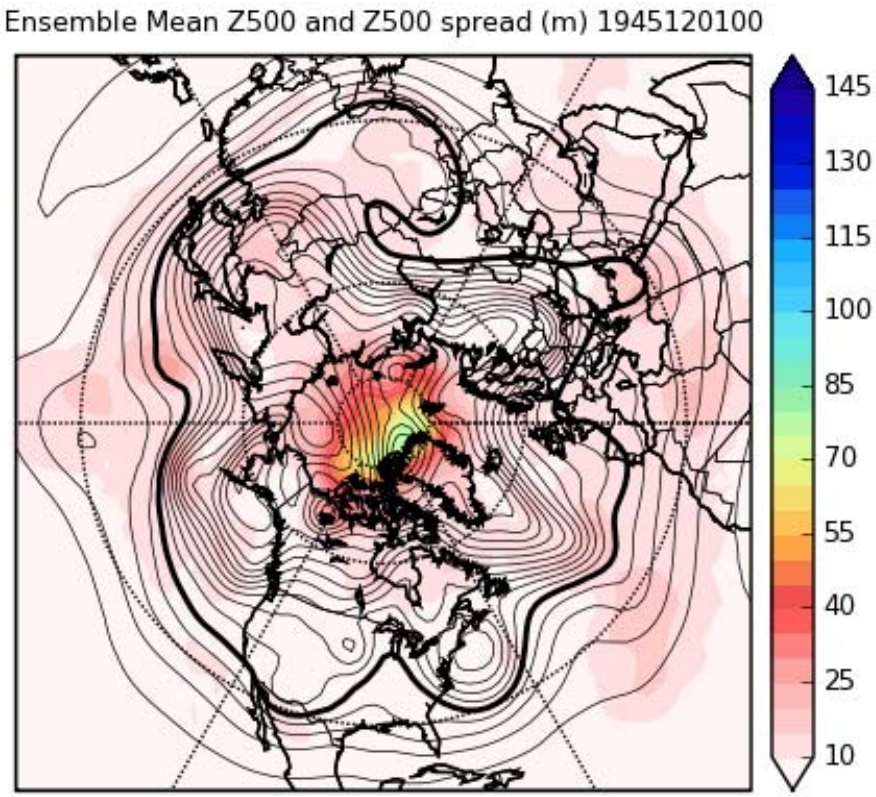
ESRL and NCAR (ICOADS): merging marine data

Thank you to partners contributing observations:

- All Union Research Institute of Hydrometeorological Information WDC
- Atmospheric Reconstructions over the Earth
- Australian Bureau of Meteorology
- British Antarctic Survey
- Danish Meteorological Institute
- Deutscher Wetterdienst
- EMULATE
- Environment Canada
- ETH-Zurich
- GCOS AOPC/OOPC Working Group on Surface Pressure
- Hong Kong Observatory
- ICOADS
- Instituto Geofisico da Universidade do Porto
- Jersey Met Dept.
- KNMI
- MeteoFrance
- Meteorological and Hydrological Service, Croatia
- National Center for Atmospheric Research
- NOAA Climate Database Modernization Program
- NOAA Earth System Research Laboratory
- NOAA National Climatic Data Center
- NOAA National Centers for Environmental Prediction
- NOAA Northeast Regional Climate Center at Cornell U.
- Norwegian Meteorological Institute
- Proudman Oceanographic Laboratory
- SIGN - Signatures of environmental change in the observations of the Geophysical Institutes
- South African Weather Service
- UK Met Office Hadley Centre
- U. of Colorado-CIRES/Climate Diagnostics Center
- U. of East Anglia-Climatic Research Unit
- U. of Lisbon-Instituto Geofisico do Infante D. Luiz
- U. of Lisbon- Instituto de Meteorologia
- U. of Milan-IFGA
- U. Rovira i Virgili-CCRG

Analysis Ensemble Mean and Spread
1 December 1918 - 1 December 1945





Sea Level Pressure

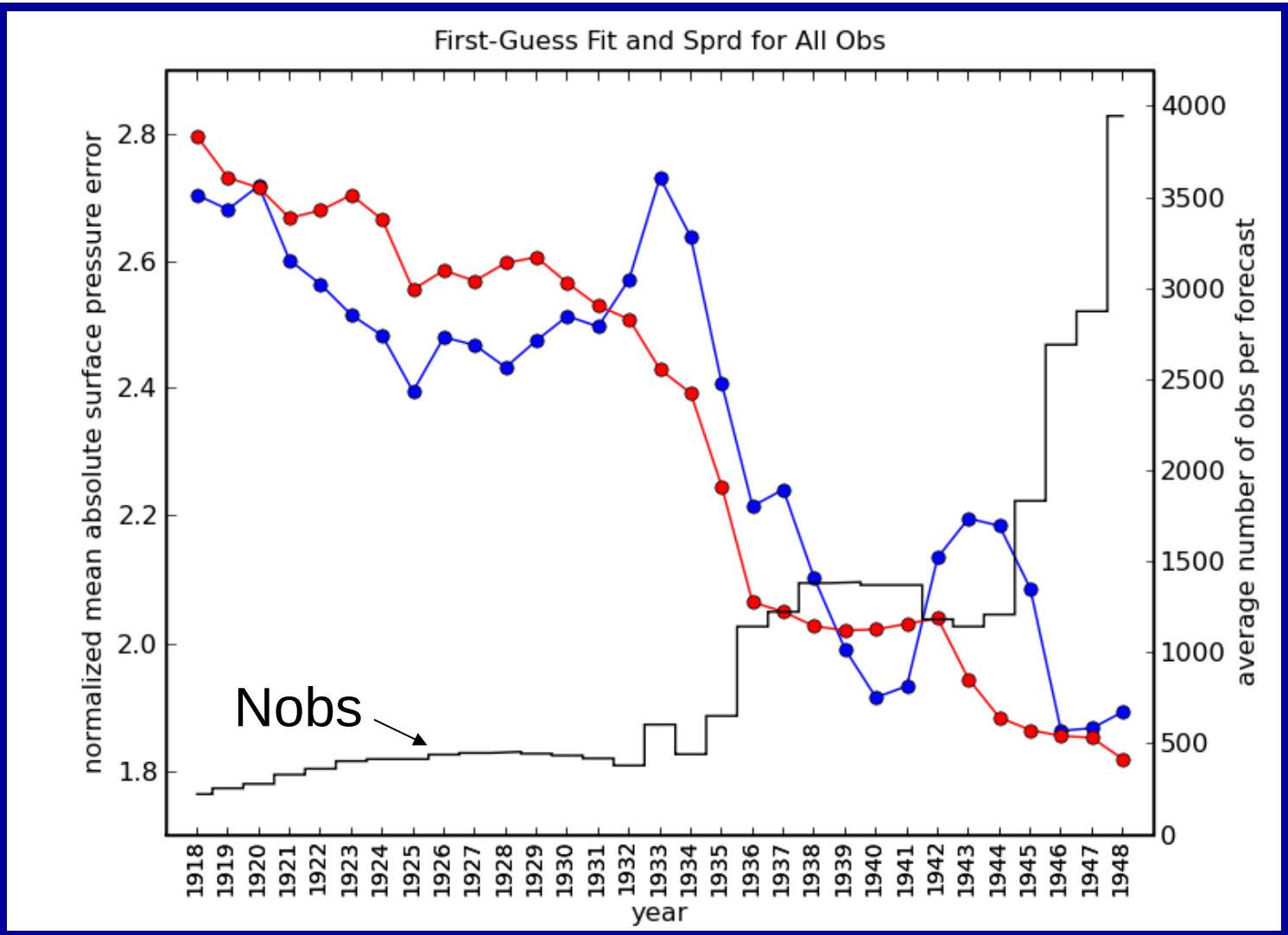
500 hPa Geopotential Height

Contours- ensemble mean
Shading- blue: more uncertain, white: more certain

Uncertainty estimate poleward of 20N

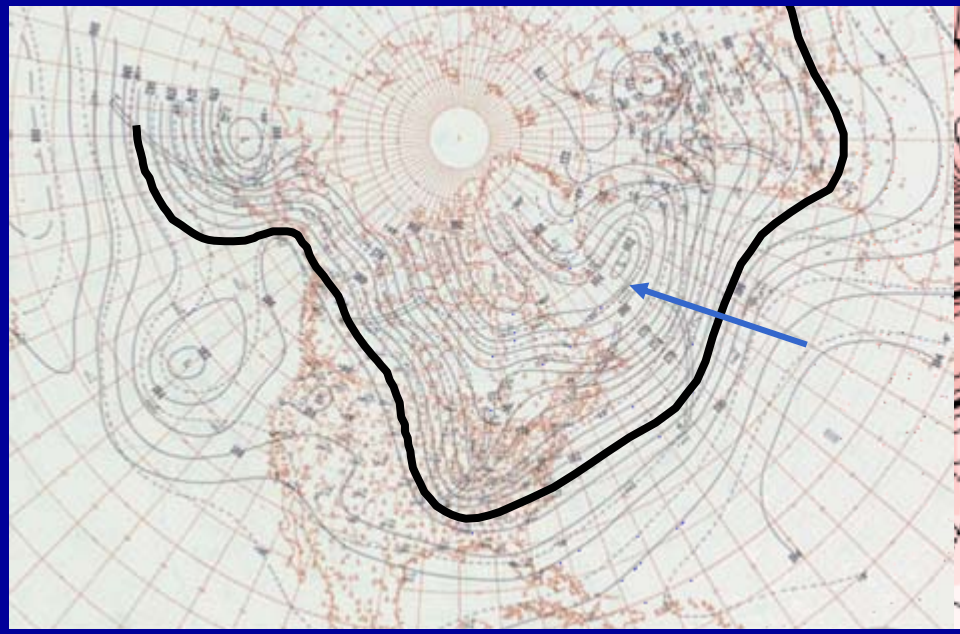
blue actual difference

red expected difference



500 hPa Geopotential Height Analysis
16 December 1944
“Battle of the Bulge”

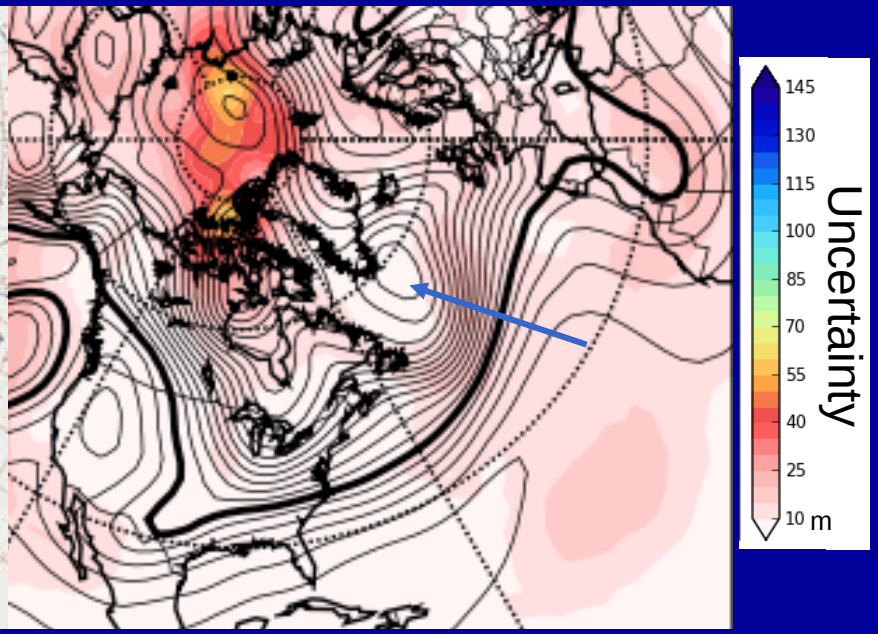
0400GMT US Weather Bureau



All available upper-air observations

18400 ft (5608 m) contour thickened

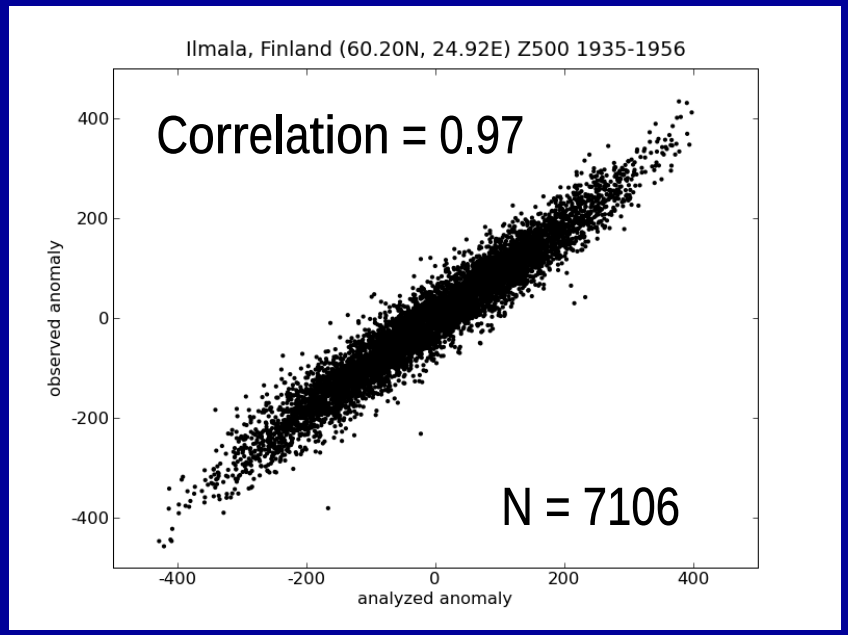
0600GMT Ensemble Filter

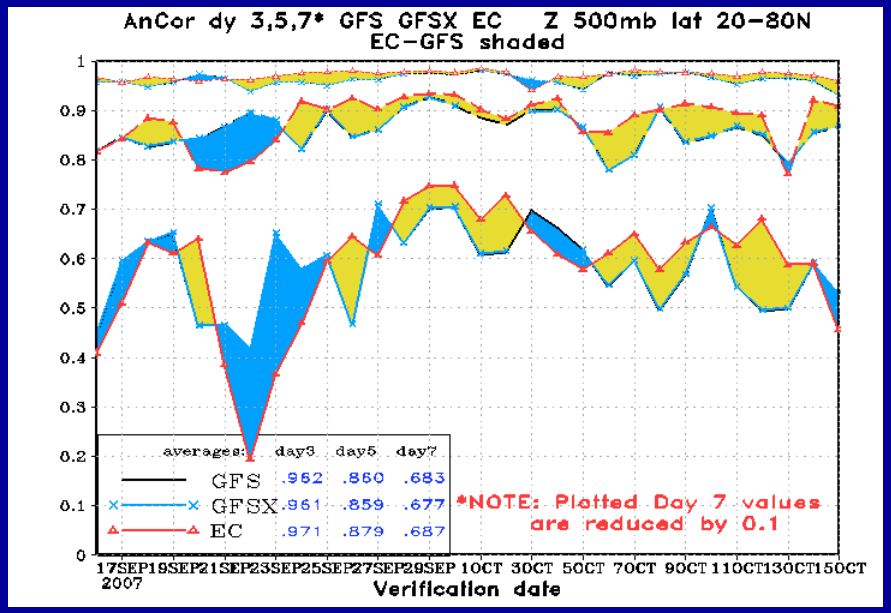


Only surface pressure observations

5600 m contour thickened

500 hPa Geopotential Height Verification using independent radiosonde observations (1935-1956)





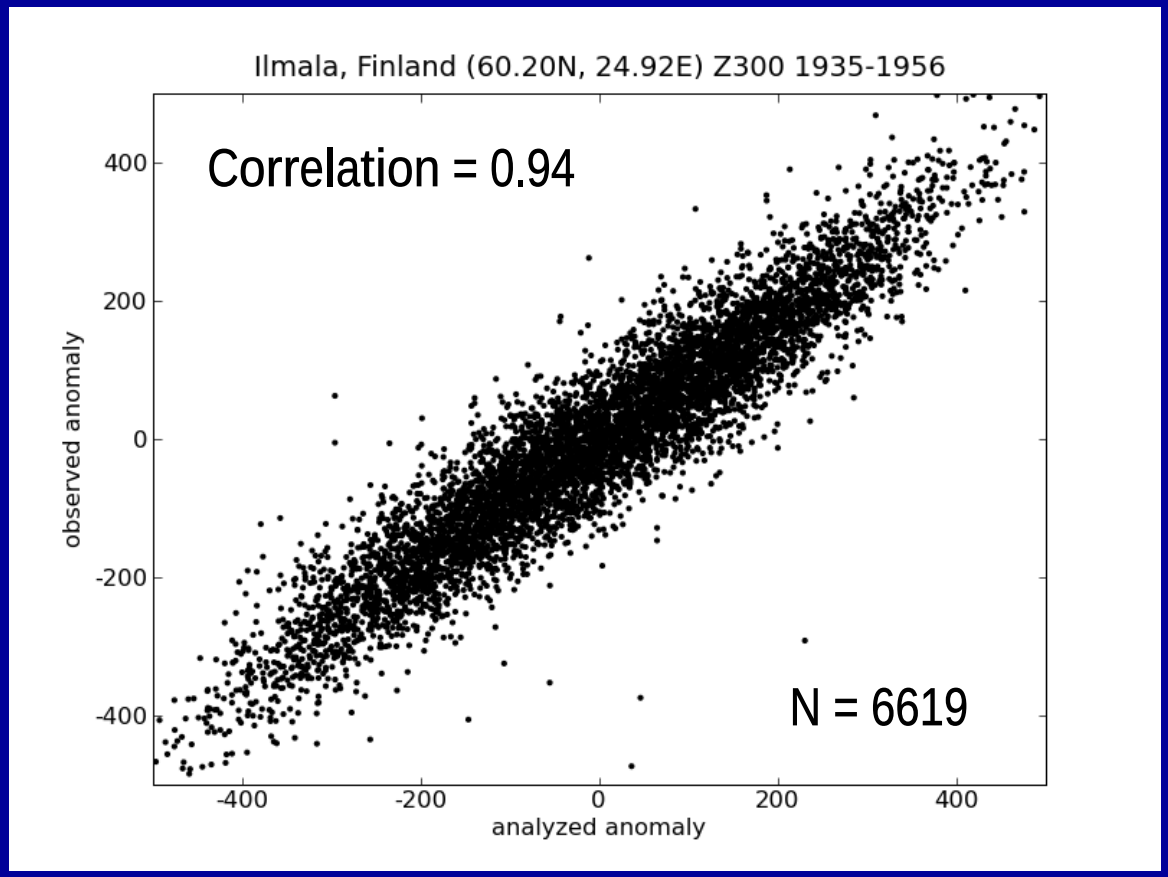
Median Absolute Error = 22.4 m
Expected Error = 21.5 m*
* Assumes observation error of 20 m

Sep-Oct 2007 Day 3 Pattern Correlation 0.96-0.97

Reanalysis correlation same as current Day-3 forecast skill

(courtesy S. Bronniman and A Grant, ETH)

300 hPa Geopotential Height Verification using independent radiosonde observations (1935-1956)



Median Abs Error = 39 m

Expected Error = 37 m*

* Assumes observation error of 35 m

(courtesy S. Bronniman and A Grant, ETH)

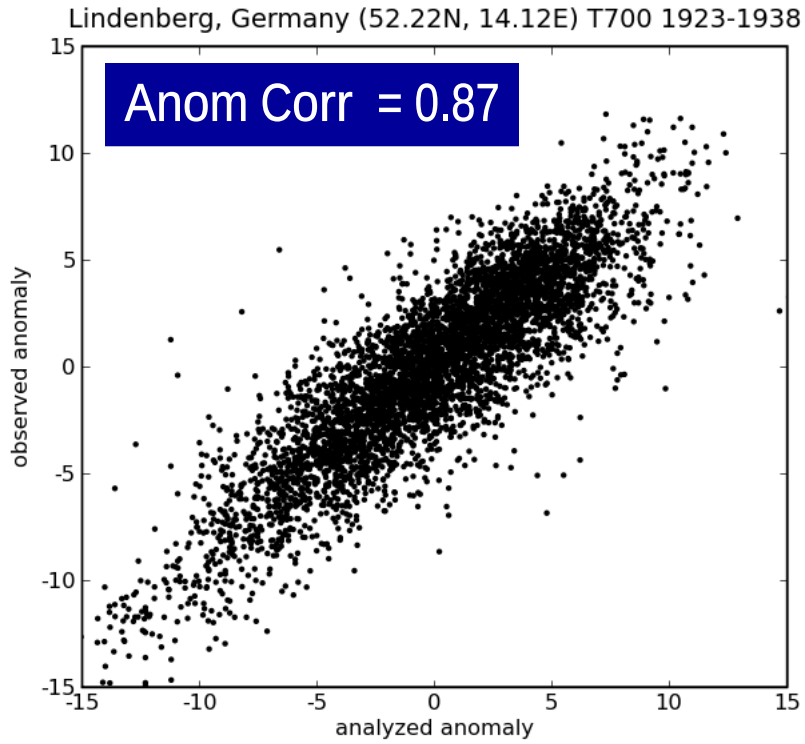
Summary

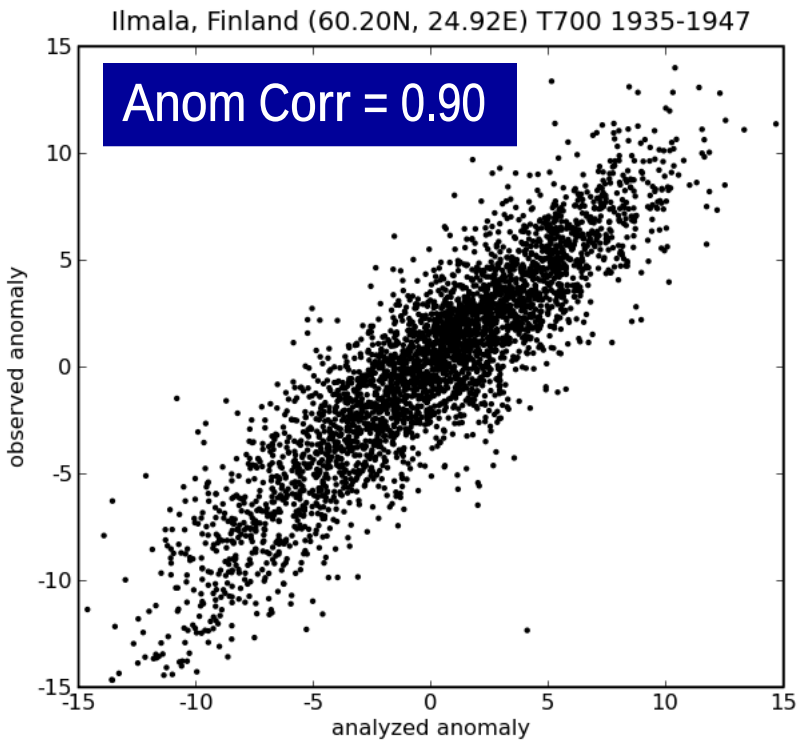
- **Accuracy:** Mid-tropospheric NH circulation fields about as accurate as a 3-day forecast today.
- **Timeline**: 1918-1949 done, full 1892-present done by Spring 2009.
- **Data Access**: Will be freely available from NCAR, NOAA/ESRL and NOAA/NCDC.

  1918-1949 in Spring 2008.

  1892-2007 in Spring 2009.
- 1850-2007, Partnering with GCOS Working Group on Surface Pressure, Atmospheric Circulation Reconstructions over the Earth (Rob Allan at the UK Hadley Centre), RECLAIM, NOAA/CDMP, many National and University surface pressure data recovery efforts.
- For status updates, email
  - jeffrey.s.whitaker@noaa.gov,
  - gilbert.p.compo@noaa.gov, or compo@colorado.edu

T700 Verification - Independent Obs (courtesy S. Bronniman and A. Grant, ETH)



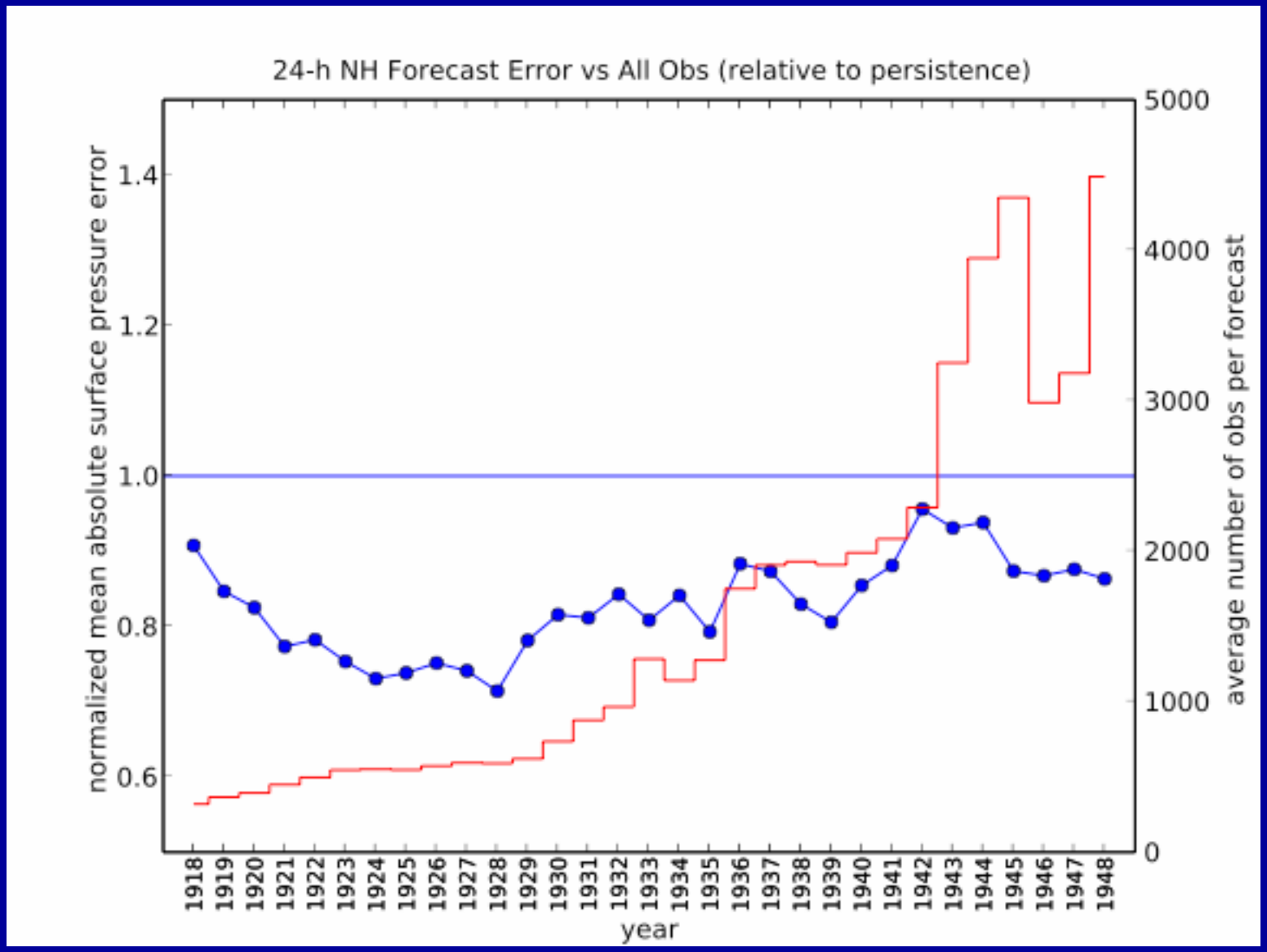


MAE = 1.59 K
Expected Error = 1.73 K*

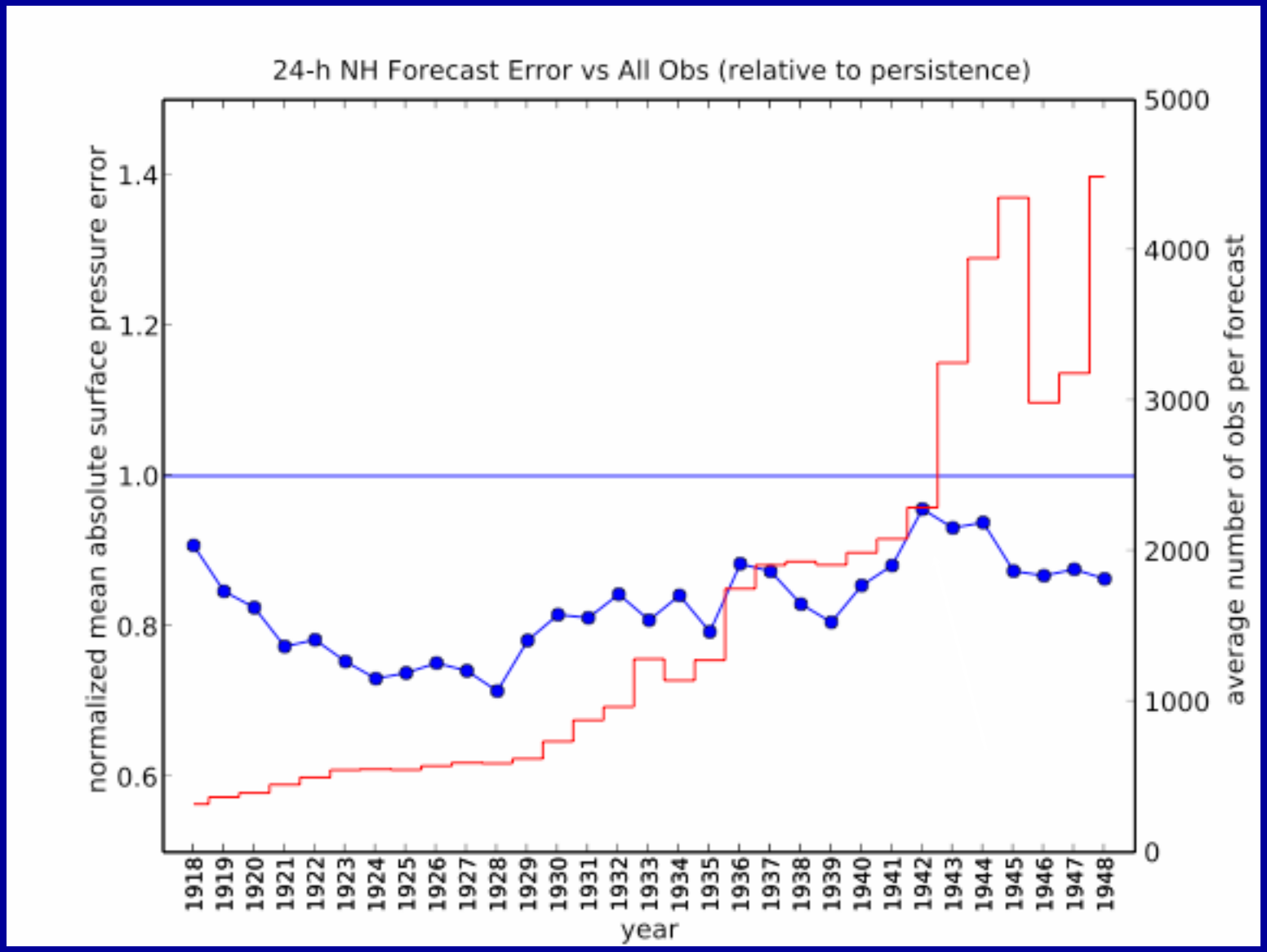
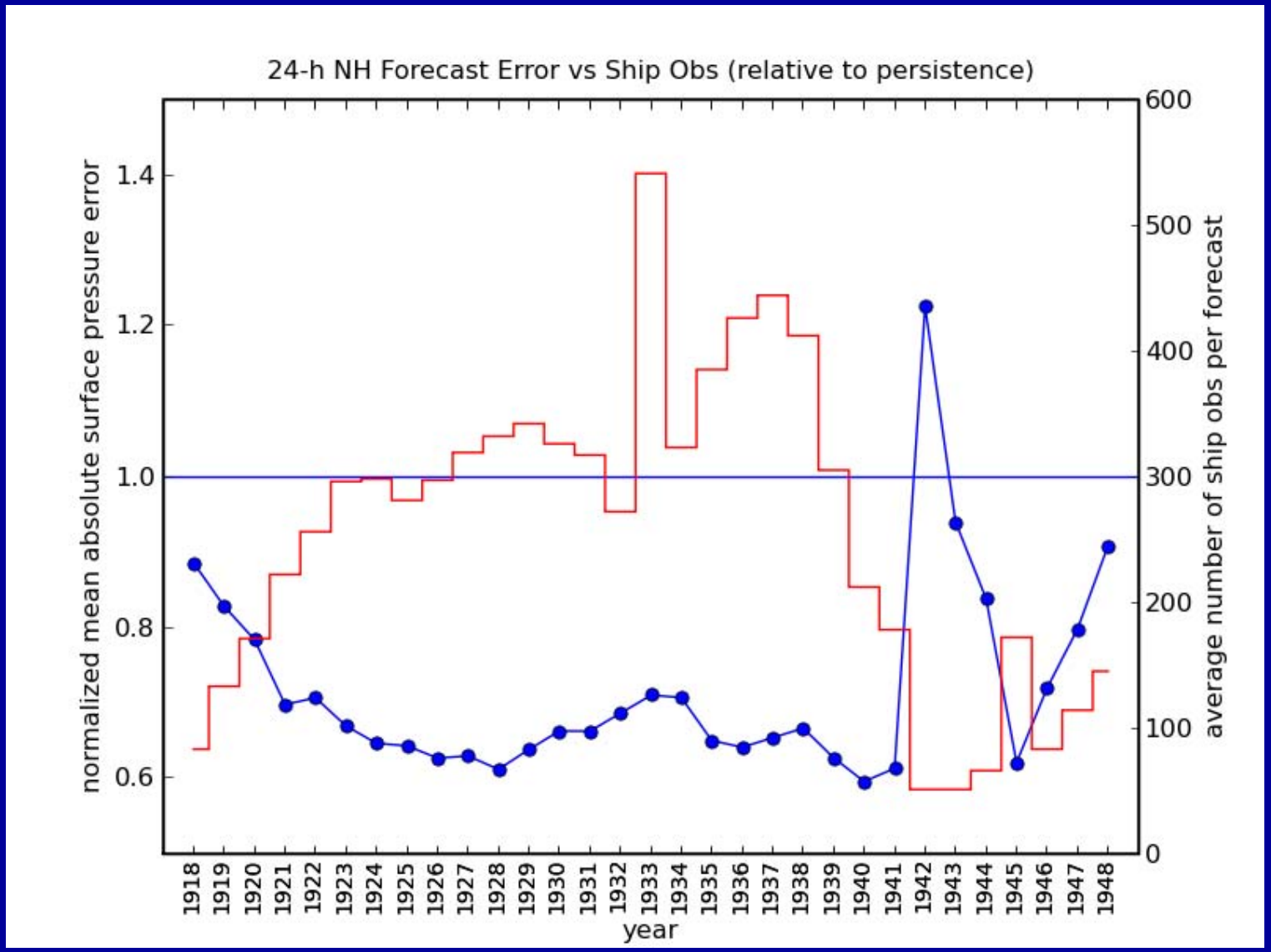
MAE = 1.58 K
Expected Error = 1.71 K*

* Assumes observation error of 1.5 K

1918-1948: 24-h forecast skill



1918-1948: 24-h forecast skill



1918-1948: 24-h forecast skill