Surface observation usage in ERA-20C and CERA-20C

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Outline

- SHIP wind trend
- Atmospheric Tide bias
- Surface pressure trend

9Dec2015 ERA-CLIM2 GA @ EUMETSAT

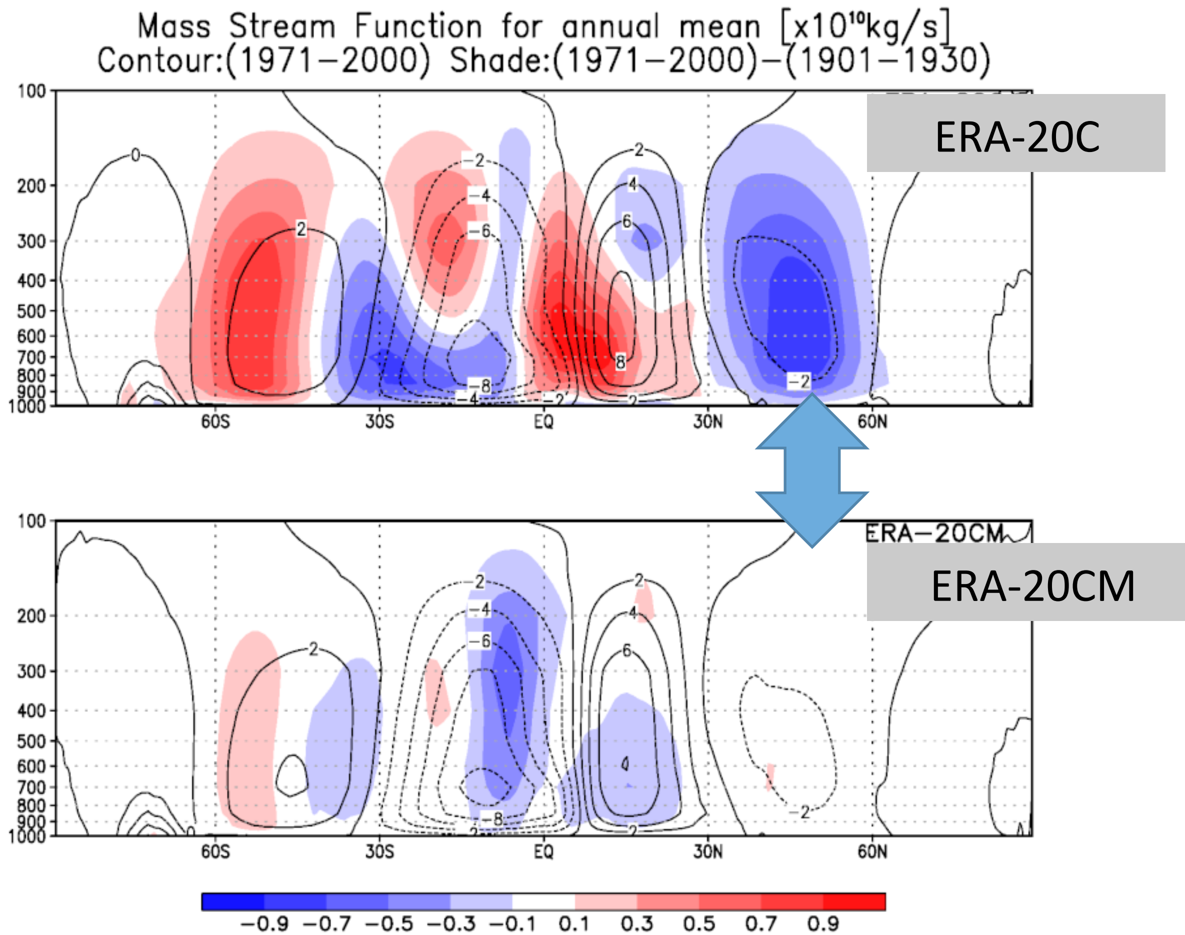
Surface observation

- marine pressure and wind from ICOADS2.5
- marine and land pressure from ISPD3.2.6

- Bias correction to P (U,V not corrected)

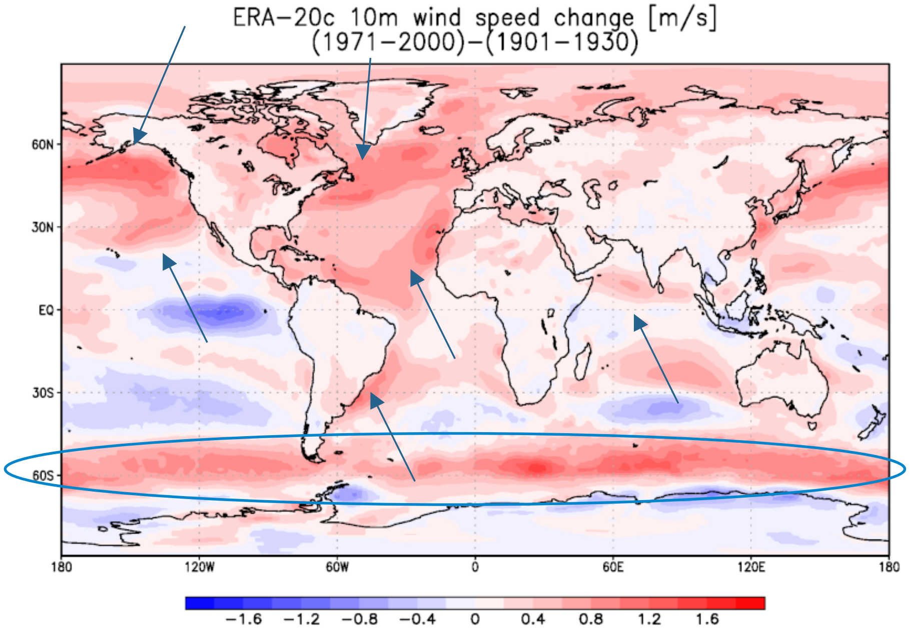
- Some observation issues found in ERA20C remain unresolved (Poli et al. 2015)

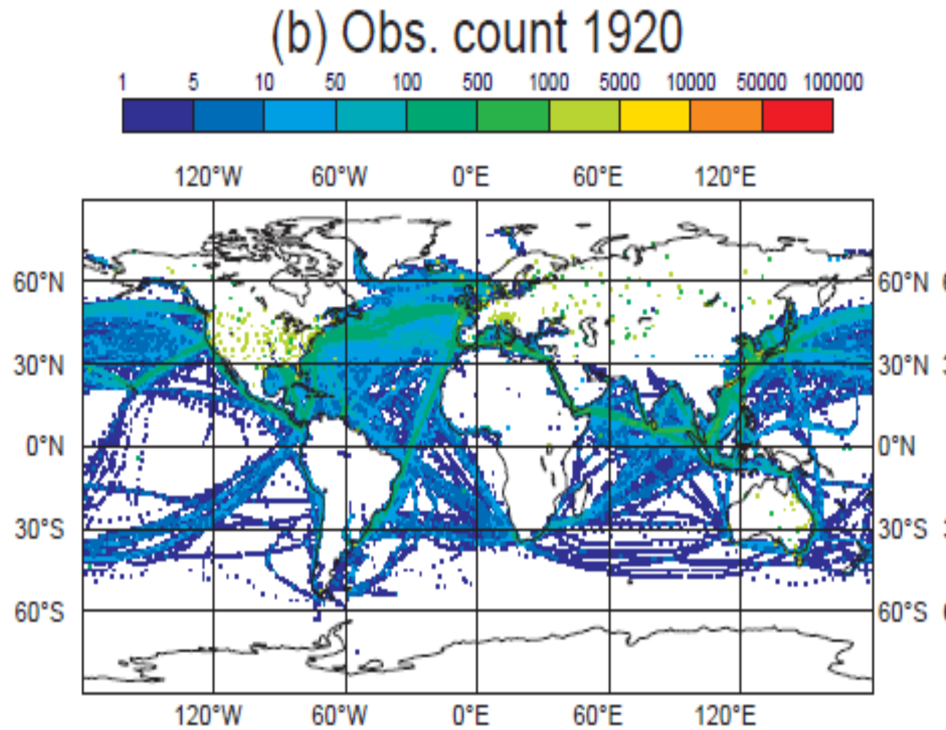
Changes in the meridional circulation



- Strengthening of eddy-driven cell in the NH
- ERA-20C : strengthening of Ferrel cell in the NH and poleward shift of the SH cell
- ERA-20CM : forced by observed SST and GHG like 20C but without observation

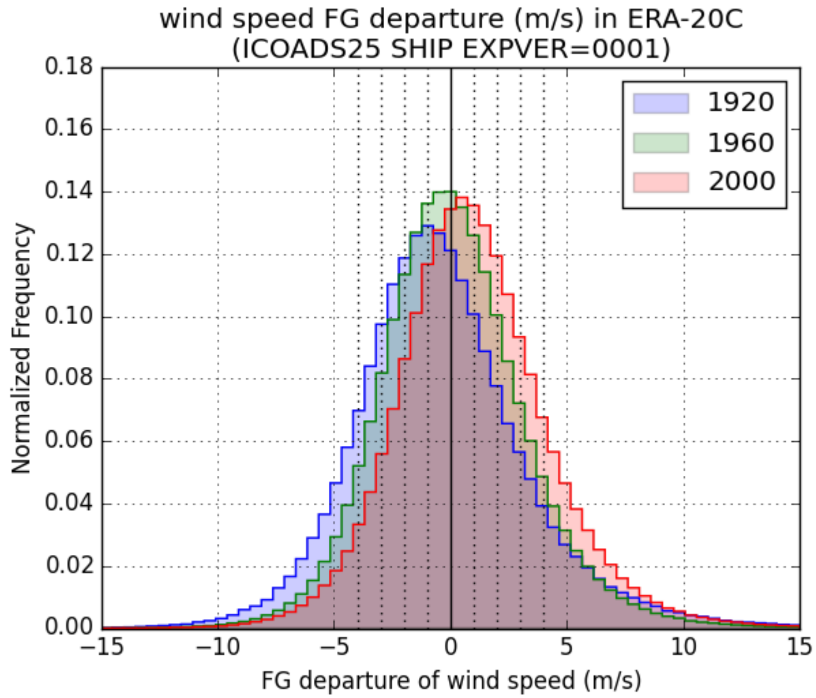
Wind speed trend in ERA-20C





- ➢ wind speed increasing along major ship lanes … (+1m/s or +10% local increase)
- ➢ a cause for the NH Ferrel cell trend ?
- ➢ (more) increasing trend of global evaporation (than 20CM)
- • Strengthening of SH polar vortex - indirect effects through large scale changes elsewhere (Poli et al. 2015) ?
  - ➢ Impacts on ACC in CERA-20C ? (Eric)

Wind speed feedback statistics in ERA-20C

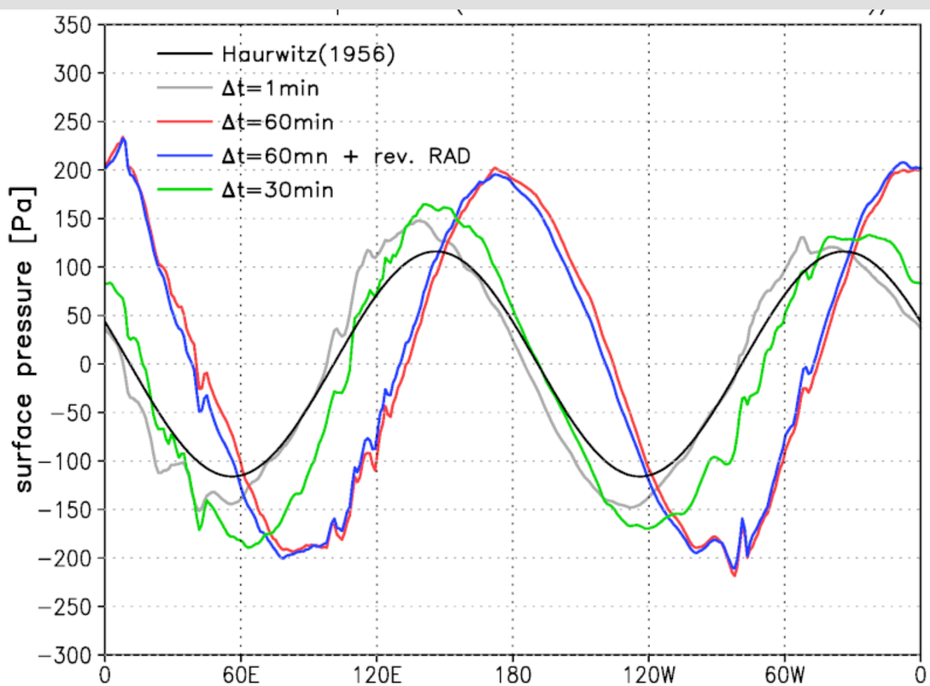


Observation-
Background

- ➢ Strengthening trend of observed wind
- ➢ Gradual transition from visual wind obs. to anemometers after WWII, increasing anemometer installation height (Ramage 1987, Cardon et al. 1990, Thomas et al. 2008)
- ➢ Analysed winds are biased low (Smith et al. 1990; Ingreby 2010; Thomas et al. 2008)
- ➢ CERA observation feedback as a valuable source to explore a better usage of historical observations
    - ➢ Uncertainty information from ensemble

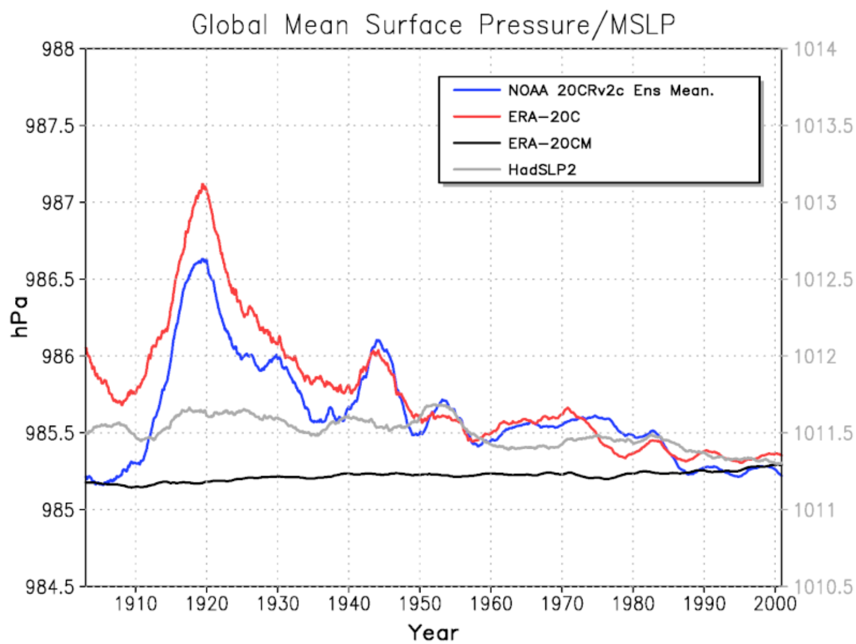
Surface pressure semidiurnal tide

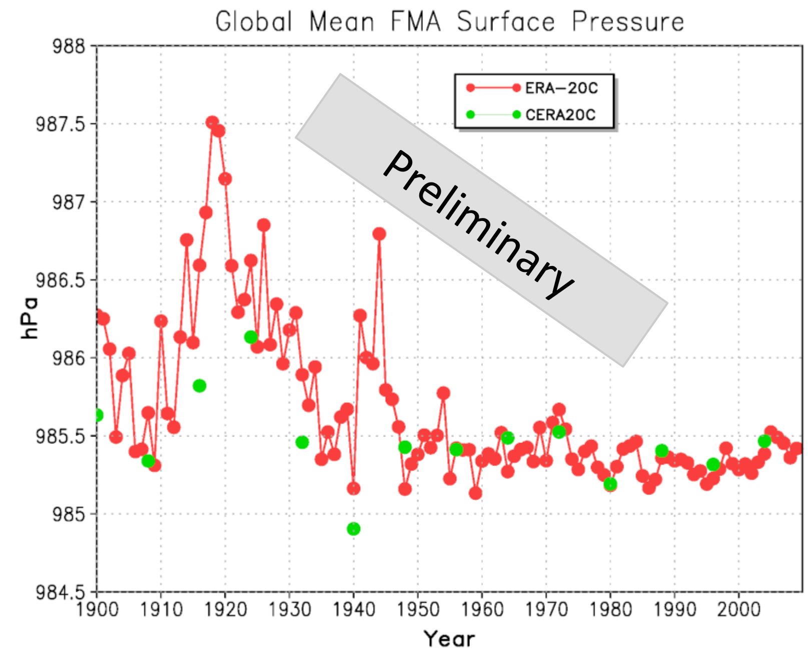
Surface Pressure composite anomaly at equator



- Phase delay and overestimation in the tidal signal, severe if DT=60 min (SHIP P obs. error = 2 ~ 1.2 hPa)
- DT=30min in CERA-20C seems to be a good compromise between better BG and production speed
- Improved temporal sampling scheme of solar zenith angle in the latest model cycle 41r2 (used in CERA; *Tech memo 758*) slightly improves the bias

Global Mean Surface Pressure (Air mass) Trend

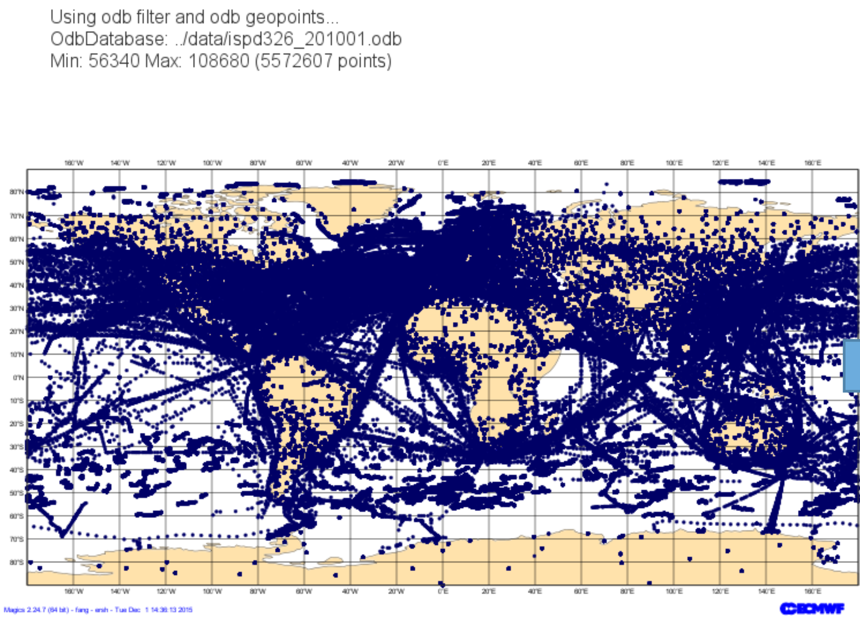


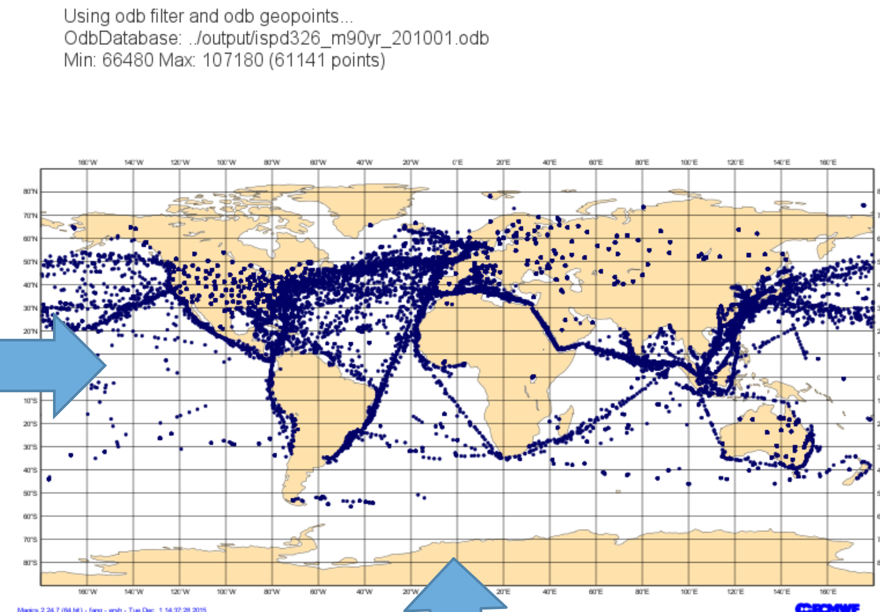


- Spurious long-term trend
- global mean surface pressure very stable in ERA-20CM
- NOAA 20CRv2c … different SST and sea ice, pressure only DA
- HadSLP2, a statistical analysis, does not show such a large trend/spiky peaks
- Feedback from CERA-20C to be compared with ERA-20C

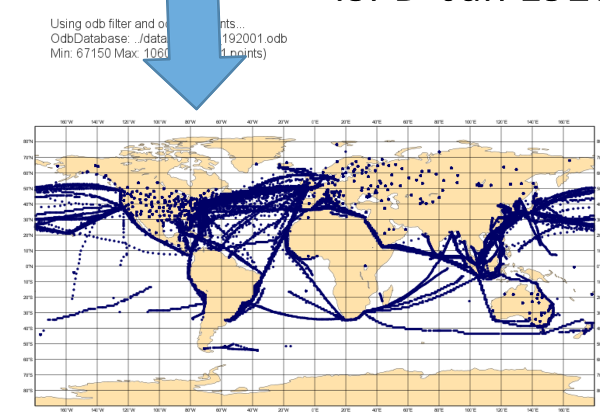
ISPD Jan 2010

Simulated Observing system 1920 generated from actual 2010 observations
("1920-ish 2010")



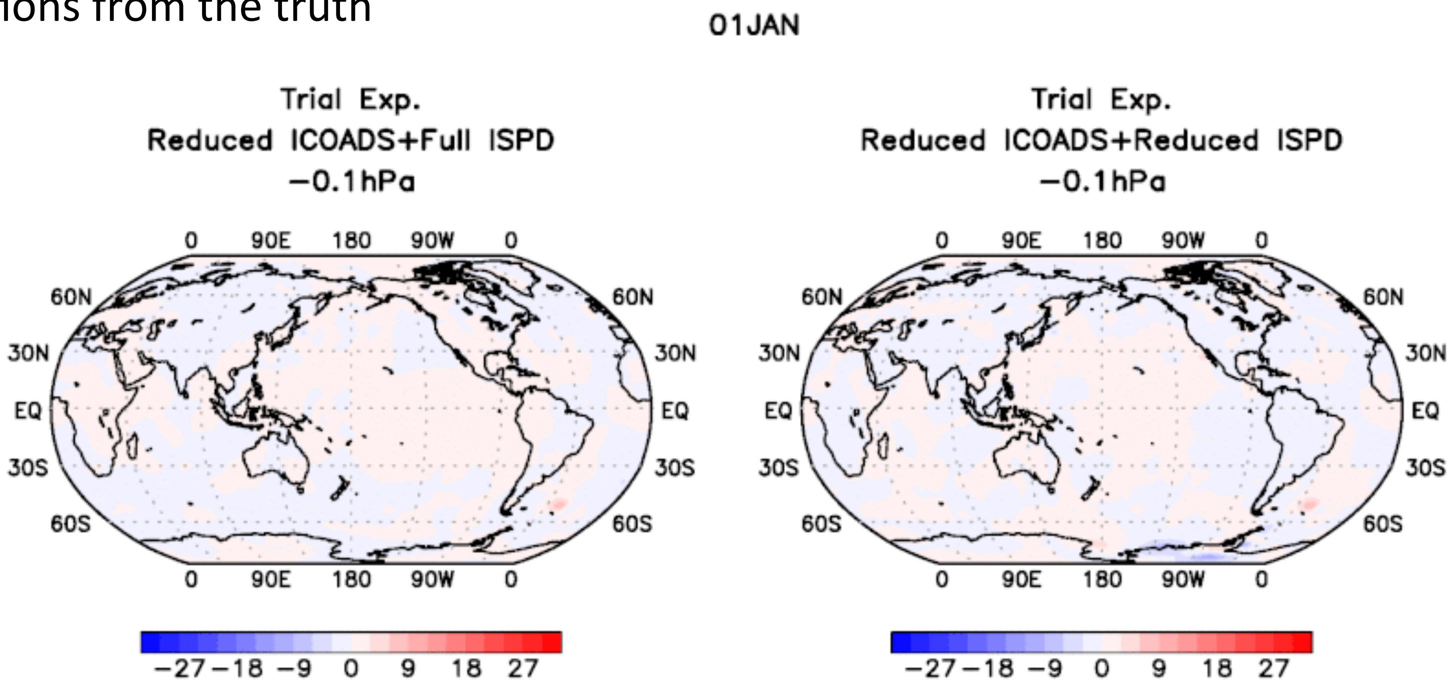


ISPD Jan 1920



- Thinning 2010 to simulate 1920
- Truth : 4Dvar with Full ICOADS+ISPD in 2010
- Interaction between sampling error + Var BC + model bias + sea ice
- Both poles not constrained by obs.

Analysis Surface pressure deviations from the truth

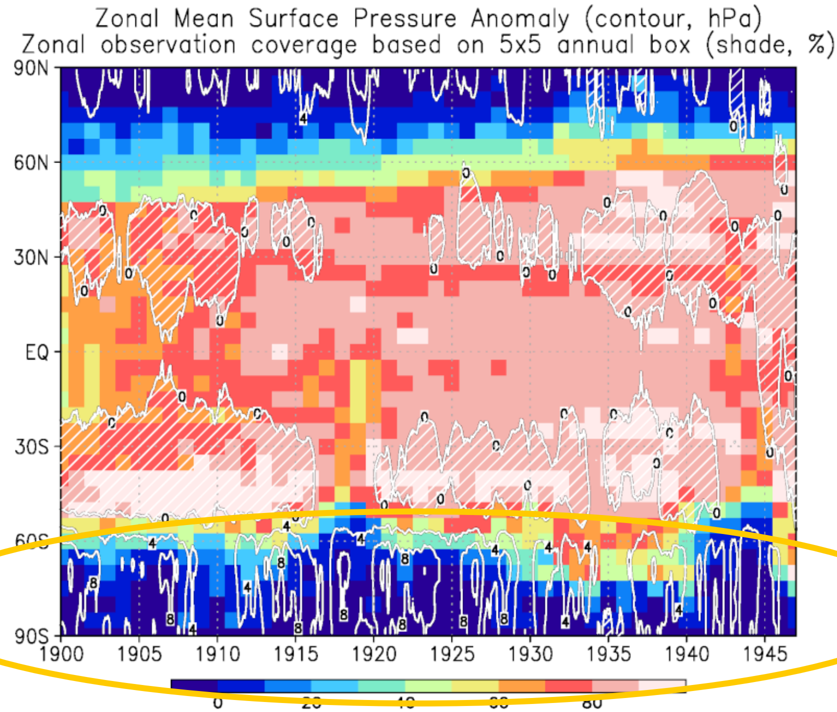


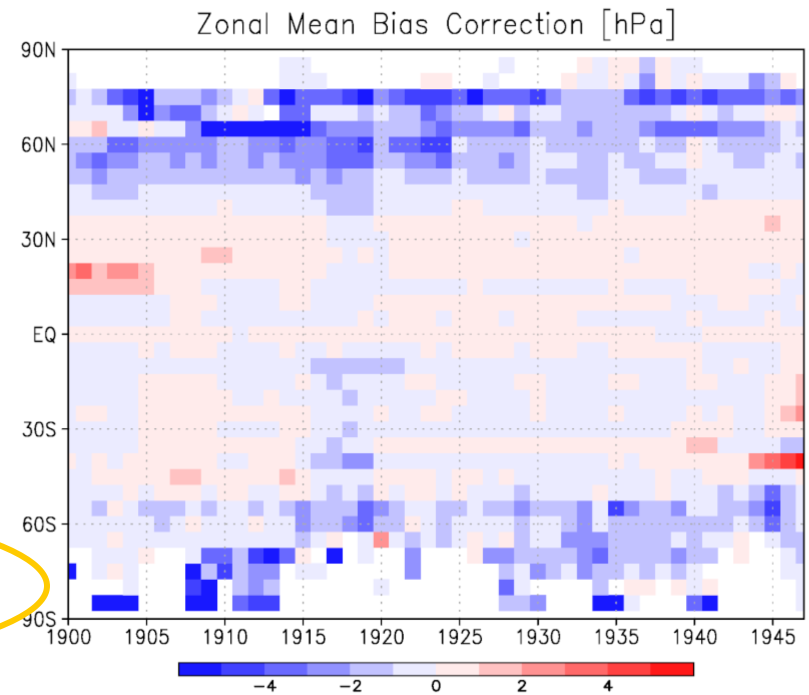
*Truth : Full ICOADS + Full ISPD

- With the 1920-ish observation network we can reproduce the global mean +/- 1 hPa mass budget imbalance
  - Global mean analysis increment is not zero (not shown)
  - why is net positive increment preferred in the real 1920 observations??
  - bad obs-bad forecast cycle? How does our VarBC cope with this situation?

Summary and future plan

- Wind speed trend in observation - requires impact assessment/solution
- Atmospheric tide bias slightly improved in CERA-20C
- Surface pressure trend - investigation in progress
- Further diagnostics for CERA-20C





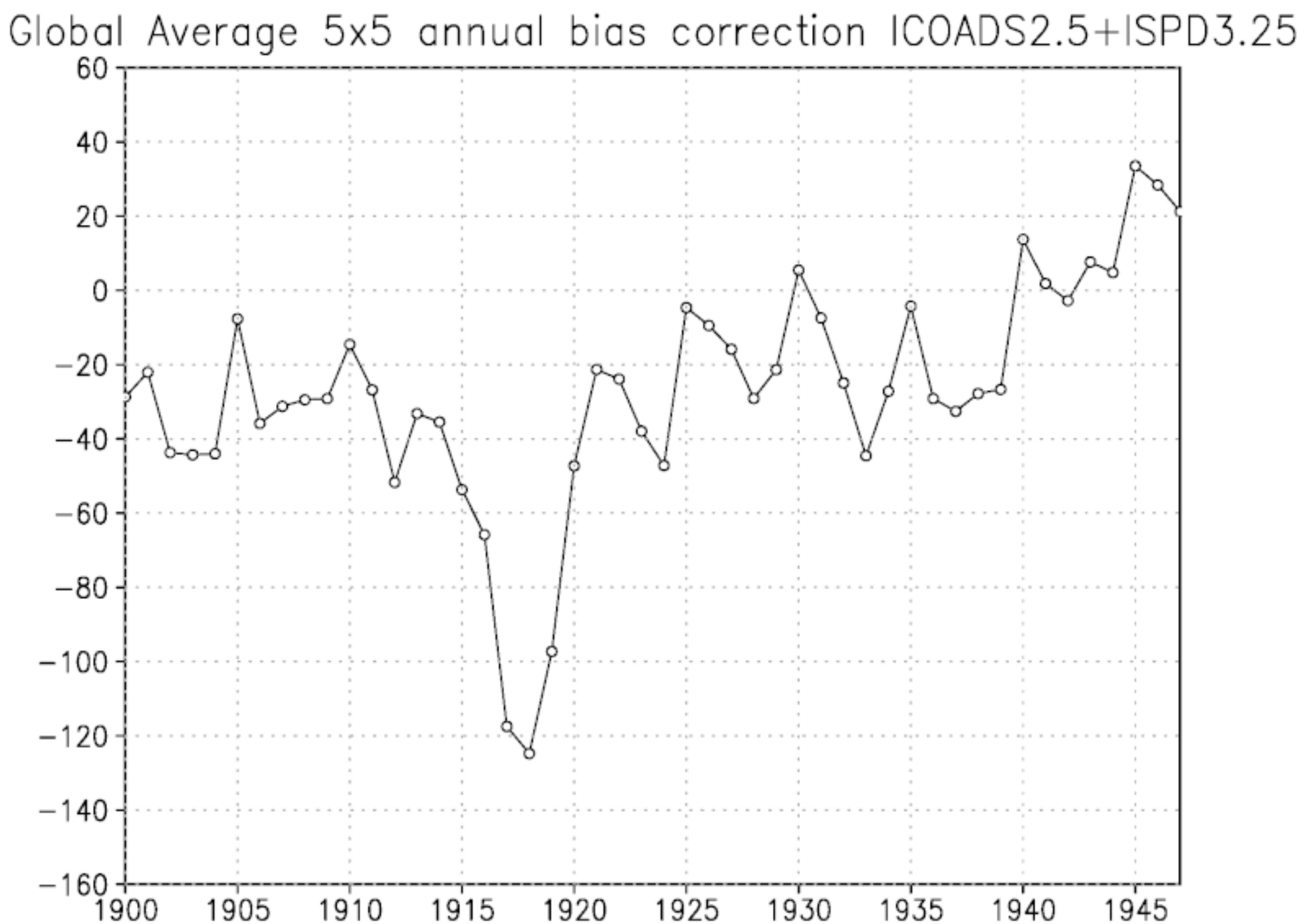
Top 3 deck IDs in 1919

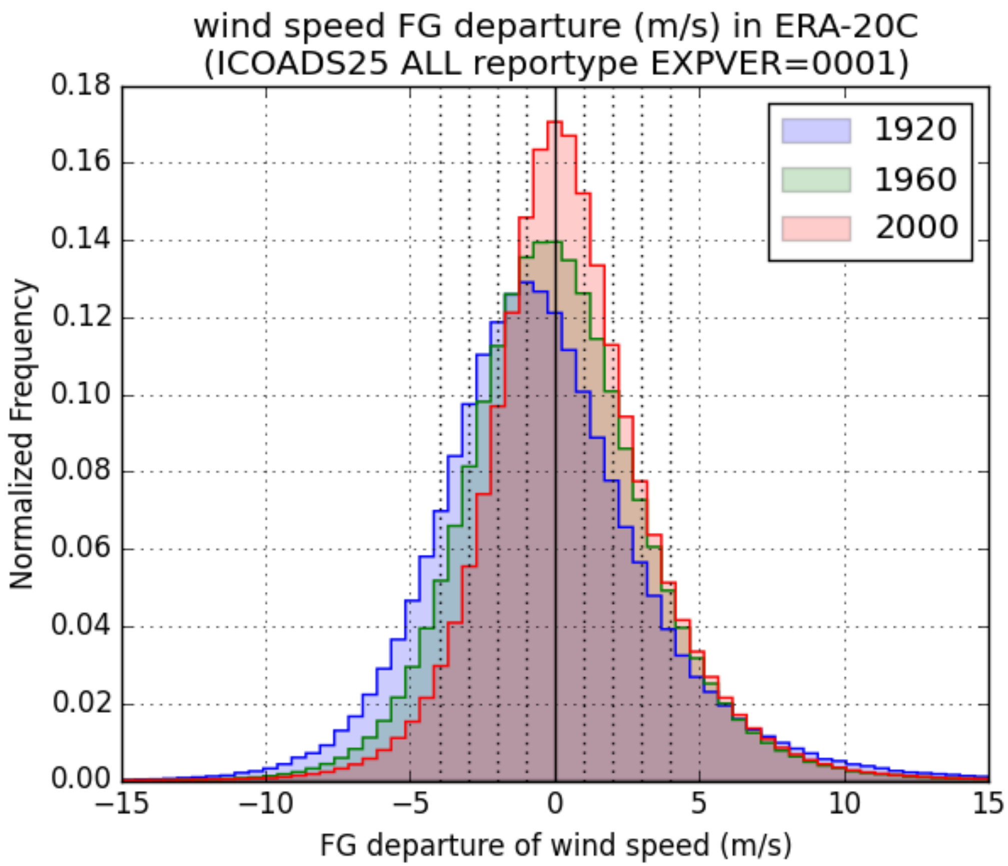
762 : Japanese Kobe Collection Data

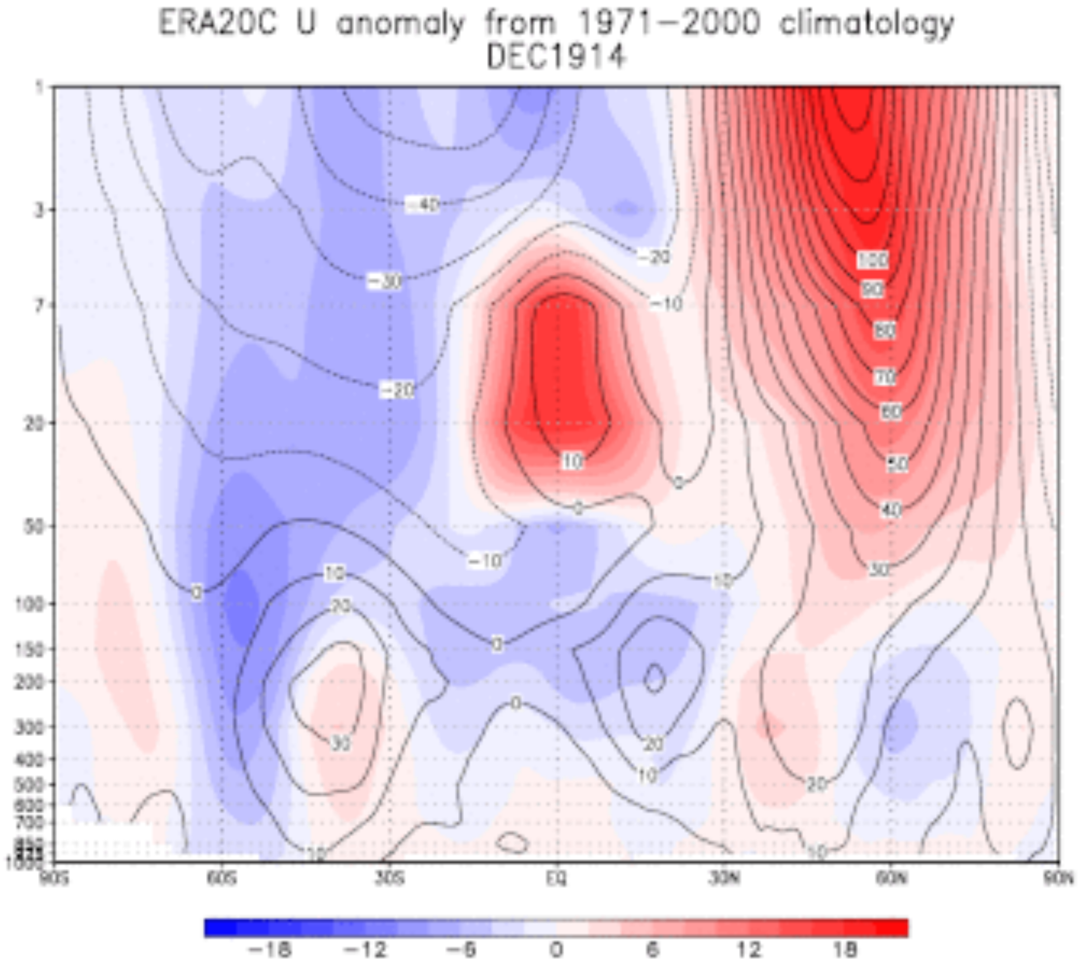
193: Netherlands Marine

706-707:US Merchant Marine Collection

ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS


Global Average 5x5 annual bias correction ICOADS2.5+ISPD3.25
60
40
20
0
−20
−40
−60
−80
−100
−120
−140
−160
1900
1905
1910
1915
1920
1925
1930
1935
1940
1945


wind speed FG departure (m/s) in ERA-20C
(ICOADS25 ALL reportype EXPVER=0001)
Normalized Frequency
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
−15
−10
−5
0
5
10
15
FG departure of wind speed (m/s)
1920
1960
2000


ERA20C U anomaly from 1971–2000 climatology
DEC1914
90S
60S
30S
EQ
30N
60N
90N
1
3
7
20
50
100
150
200
300
400
500
600
700
−18
−12
−6
0
6
12
18

SLP trend 90-60S (Poli et al. 2015 Fig.31)

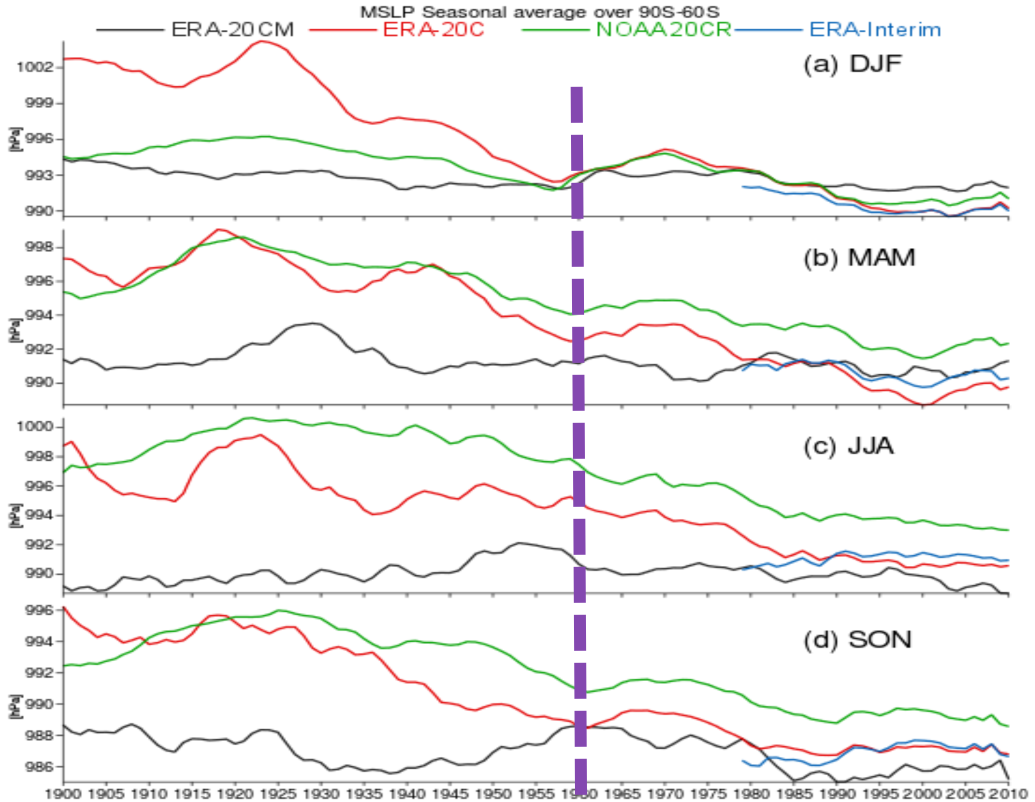


Figure 31: Timeseries of mean-sea-level pressure (MSLP) averaged over the latitudes 90S-60S in one model integration (ERA-20CM) and various reanalyses (ERA-20C, NOAA 20CR, ERA-Interim).

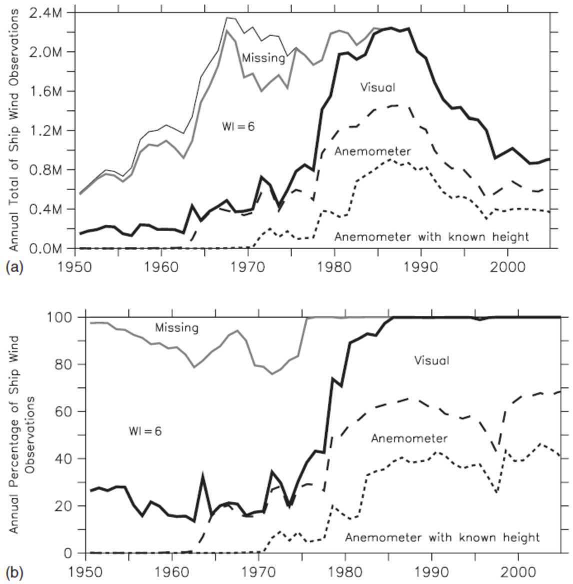


Figure 1. a) Time series of annual numbers of global VOS wind reports in ICOADS, 1950–2004, by observation method as indicated by the ICOADS wind indicator WI, plotted cumulatively, for: anemometer-measured only with known anemometer height (dotted); all anemometer-measured (dashed); visually estimated (not including WI = 6, thick solid); WI = 6 (grey); WI = missing (solid); b) as a) but as a percentage of the total number of ship reports with wind observations.

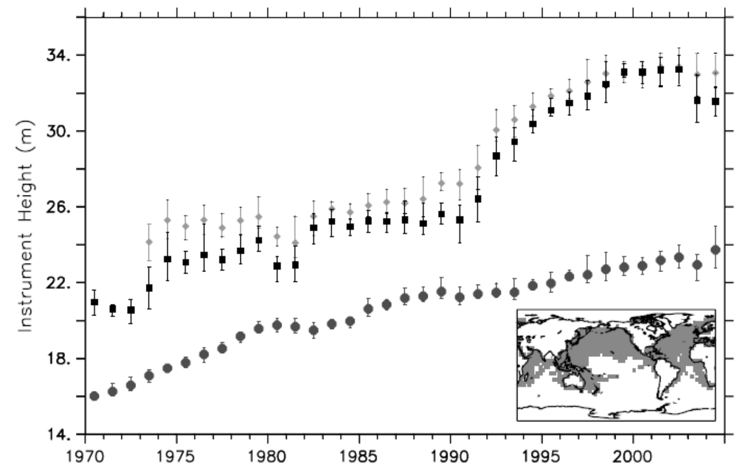
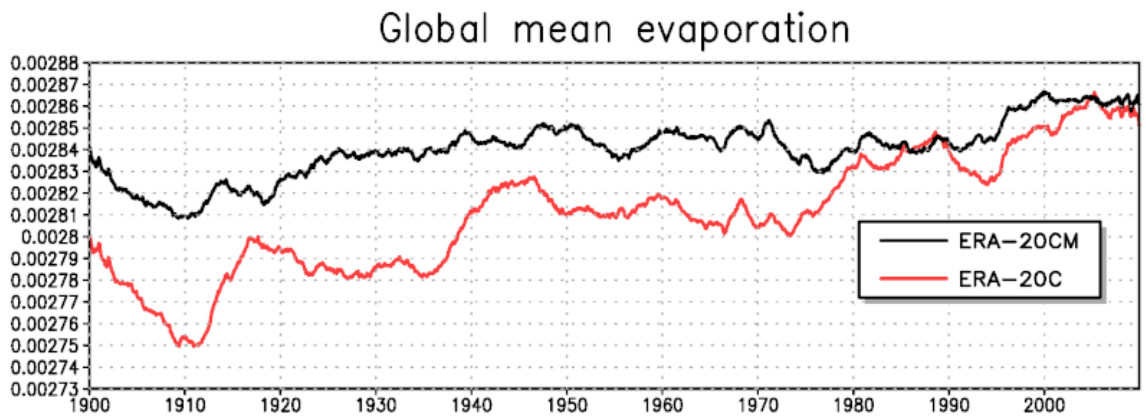
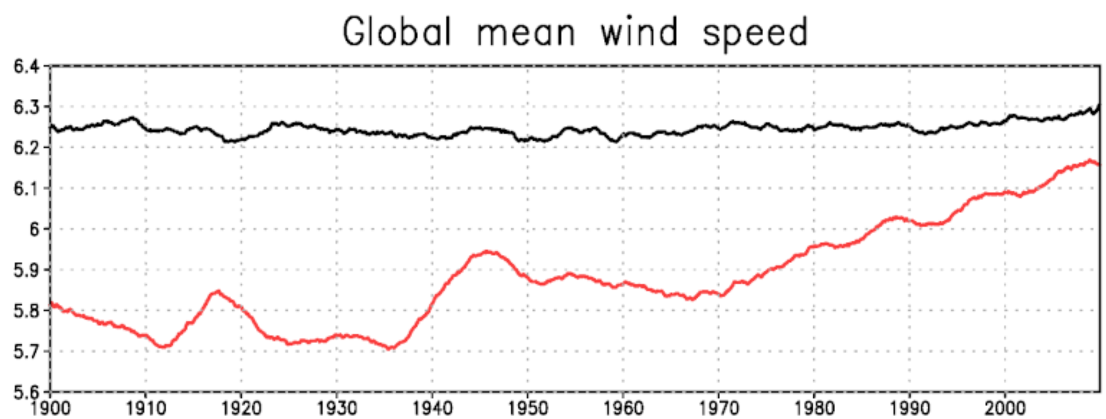


Figure 4. Time series of annual averages of monthly mean anemometer (black squares) and platform (dark grey circles) heights (in m), averaged over well-sampled 5° grid boxes 1970–2004 (area shown in map inset). Bars represent the range of monthly mean height in each year. Anemometer and platform heights are for all available data, whether reporting estimated or measured winds, and without the requirement that both fields be present for each report. Also plotted is the value of platform height + 10-m for those reports for which both anemometer and platform height were available (light grey diamonds).

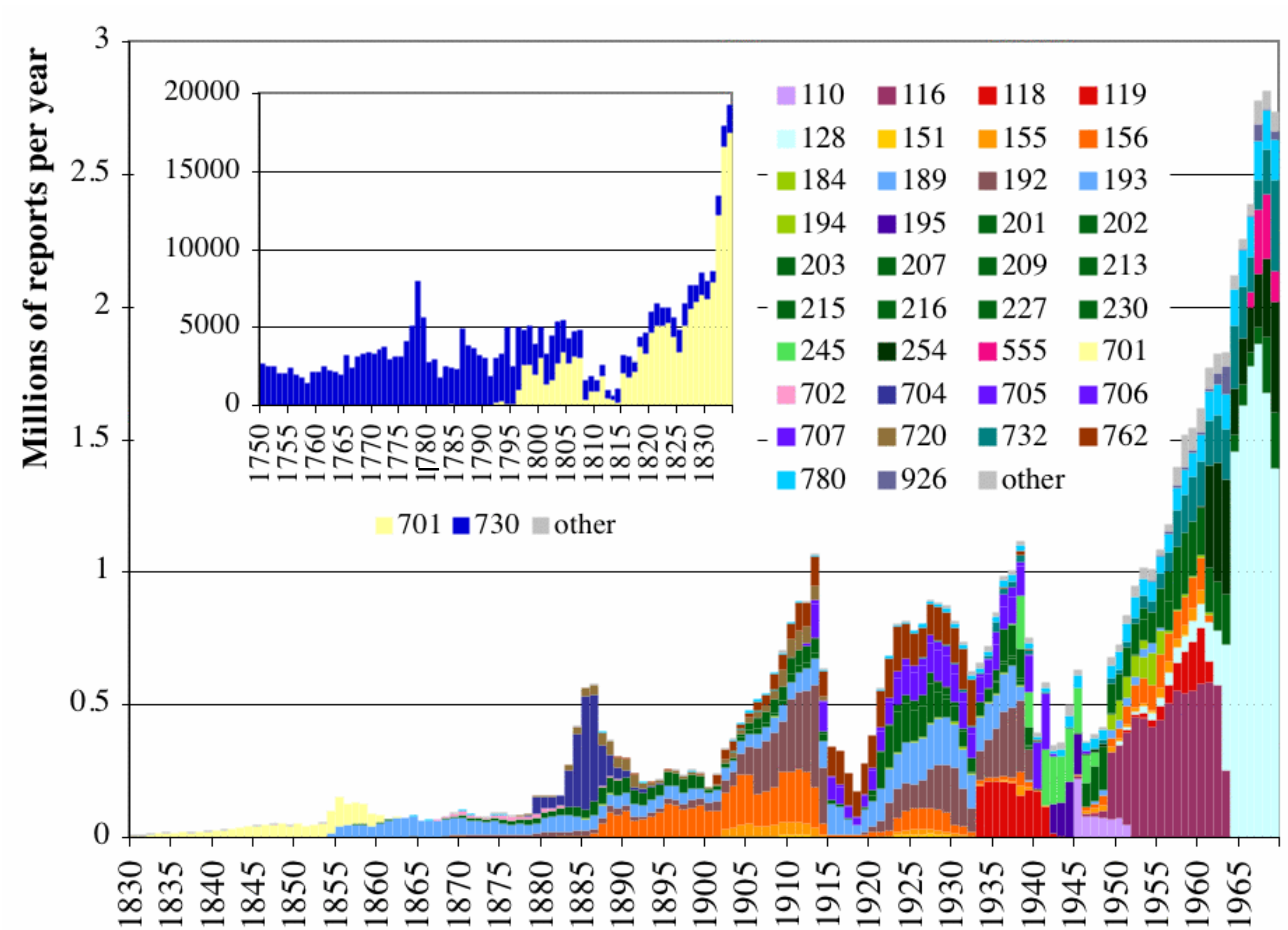
EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Thomas et al. (2008)


Global mean evaporation
0.00288
0.00287
0.00286
0.00285
0.00284
0.00283
0.00282
0.00281
0.0028
0.00279
0.00278
0.00277
0.00276
0.00275
0.00274
0.00273
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
ERA−20CM
ERA−20C


Global mean wind speed
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000

ICOADS 2.5



EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

www.icoads.noaa.gov/r2.5.html

Observation distribution

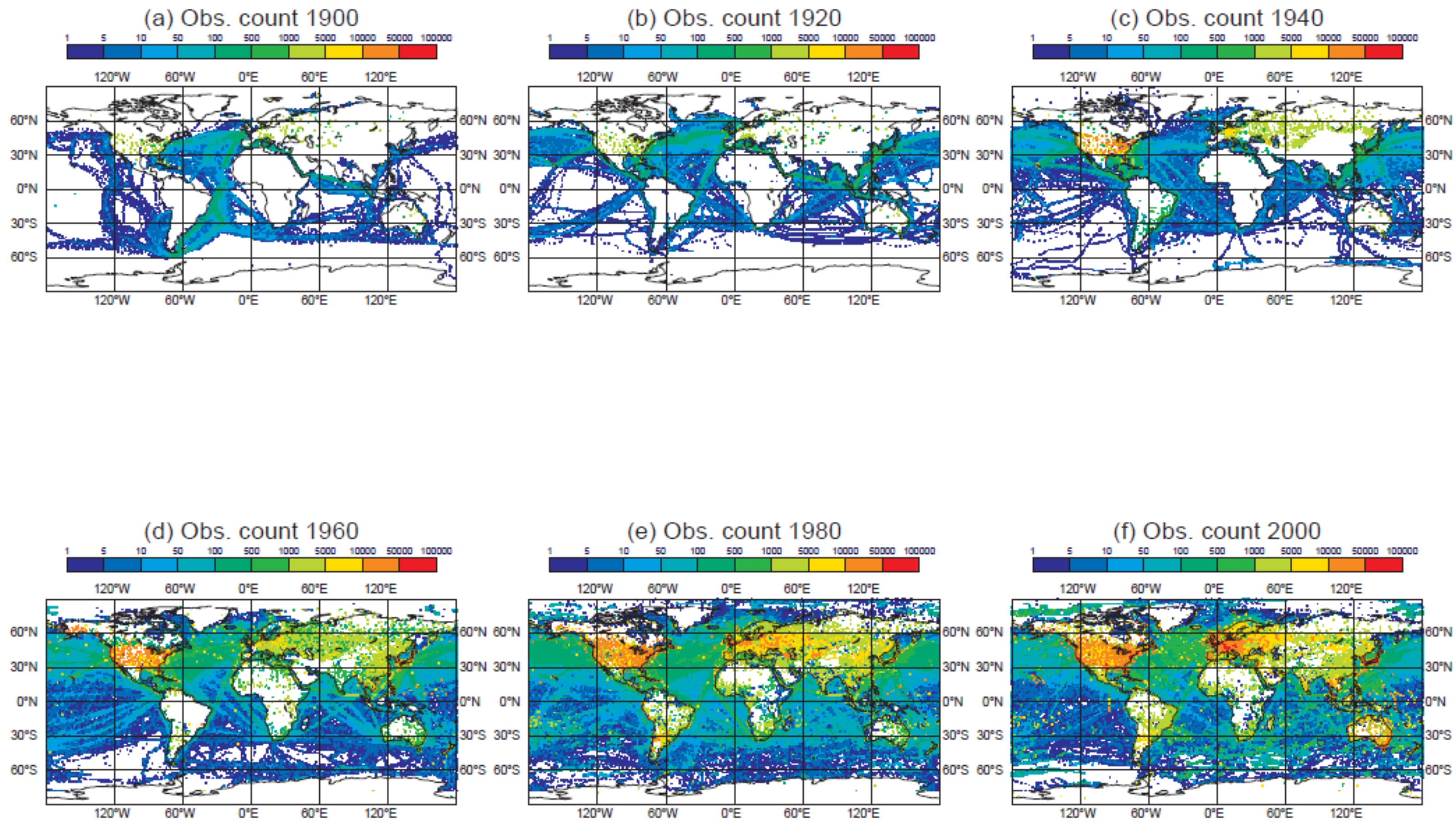
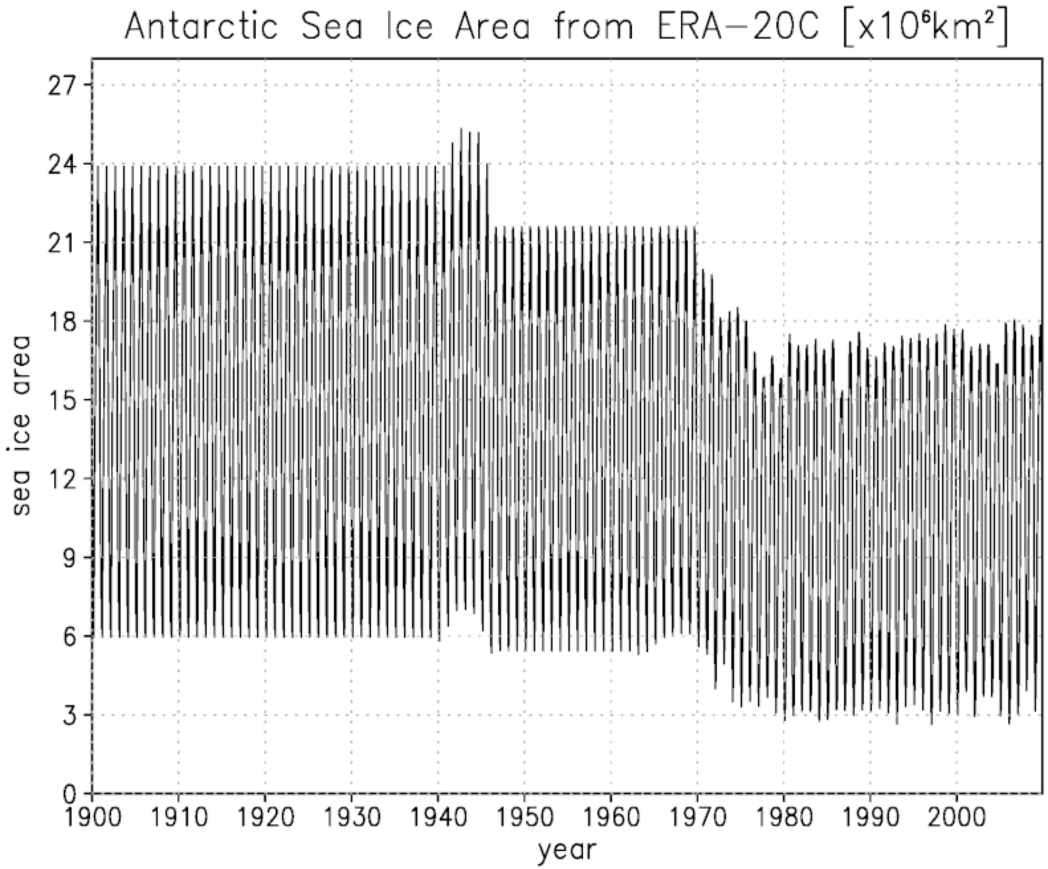


Figure 3: Maps of surface pressure observation count (combining ISPD 3.2.6 and ICOADS 2.5.1), for selected years, in 1° latitude × 1° longitude bins

Poli et al. 2013 Fig.3

- After 1960 pressure observations are increasingly available in 90-60S where we see good agreement between ERA-20C and 20CR

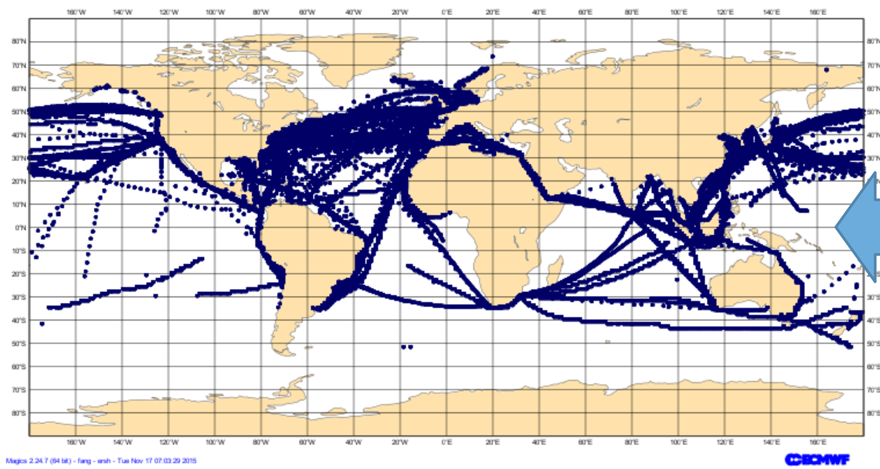
Monthly mean sea ice area in the Antarctic



- shrinking trend of sea ice area
- Large seasonal cycle in the first half of 20th century

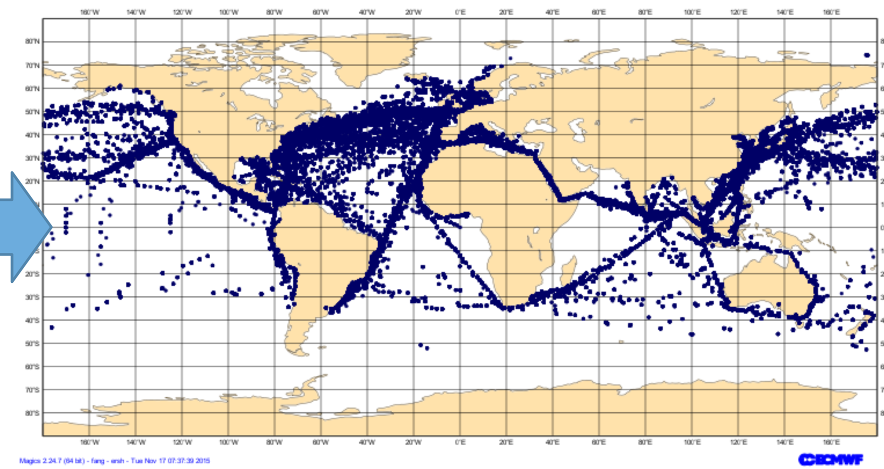
ICOADS Observation Network in Jan 1920

Using odb filter and odb geopoints...
OdbDatabase: ../data/icoads_192001.odb
Min: -32.4514 Max: 105790 (222336 points)



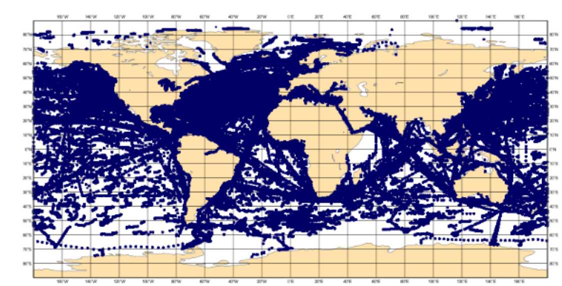
Simulated observation for 1920 from 2010 ("1920-ish 2010")

Using odb filter and odb geopoints...
OdbDatabase: ../output/simulated_icoads_201001.odb
Min: -3000 Max: 107100 (196229 points)



ICOADS 2010

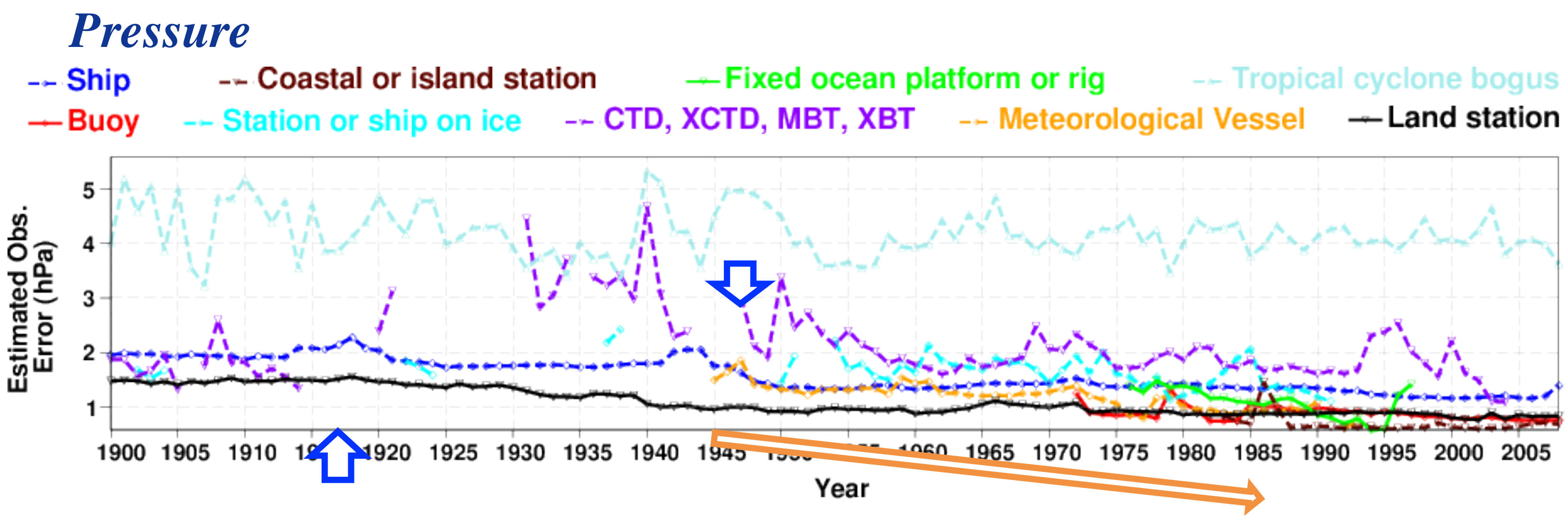
Using odb filter and odb geopoints...
OdbDatabase: ../data/icoads_201001.odb
Min: -5000 Max: 107100 (8913672 points)

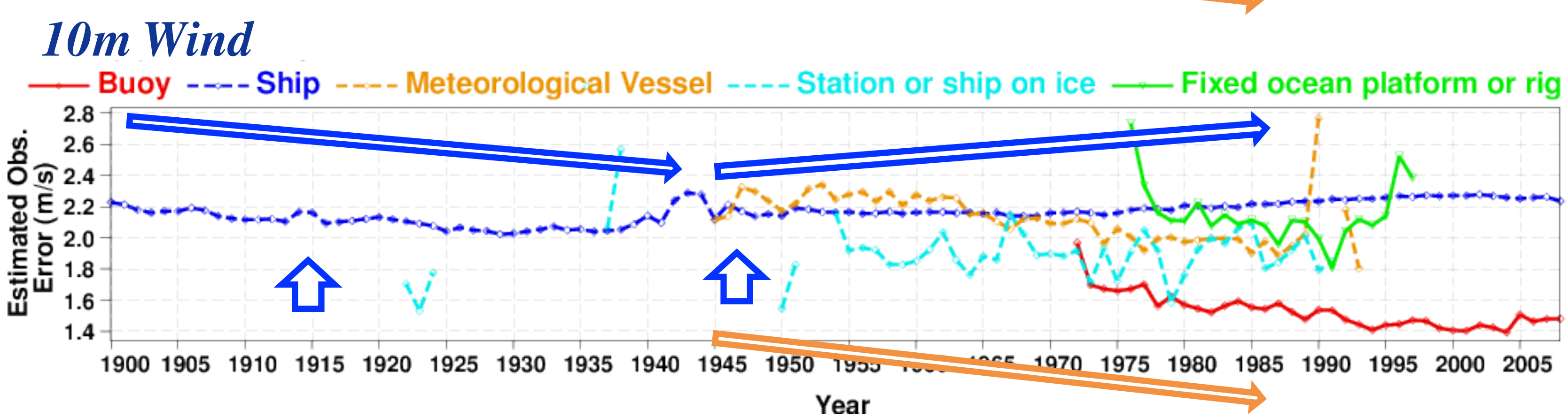


Feedback: estimates on observation error

(Desrosier et. al 2005)

from (model-obs) departure statistics





- ➢ Potentially useful in erroneous data/metadata detection