Objective Analyses of SST and Marine Meteorological Variables for the 20th Century using COADS and the Kobe Collection

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Purpose
- To obtain a "bird's-eye view" of historical marine data,
- To evaluate the Kobe Collection,
- To use for climate studies, and
- To use as inputs or boundary conditions of GCMs.
"The digitalization was completed in March 2003."

Data distribution in time
Yellow: COADS
Others: The Kobe Collection

"KC contains 5.8 million, and roughly speaking, double the number around WW-I and in the Pacific Ocean in I-COADS. (see Shouji et al.'s poster for details)"

Spatial data distribution for 1890-32
OA of SST and Marine-Met. Variables: COBE

- **Period:** 1900-2000
- **Elements:** SST, SLP, AT, NAT, TD, U, V, UU, CLOUD
- **Resolution:** Global 1 x 1 grid.
- **Climatology:** Original, plus JMA's global analysis for the polar regions and NCEP OI v2 for closed seas.
- **Daily Objective Analysis by OI**
  - Analysis error estimation
  - SLP-U simultaneous analysis with a geostrophic assumption
  - Sea-ice-to-SST conversion by a quadratic function of SIC.
- **Monthly Reconstruction with EOFs (1961-2000) by 2DVAR**
- **Database:** Analyzed values, analysis errors, and data distribution.
Quality Control (QC)

- **Before OA**
  - Ship Tracking Check
  - Monthly Black List

- **At OA**
  - Basic procedures by Ishii et al. (2003)
  - Day-night bias reduction
  - Bias and trend correction
    - SST: cold bias in bucket obs. (by Folland and Parker 1995)
    - Wind Speed: anemometer height correction (WMO Publication No.47, barometer height in KC, Kutsuwada 1998)
    - Air Temp.: extreme warmth around WW-II (Folland et al. 1984)
    - Cloudiness: clear-sky check (by Harn 1999)
    - Dew-Point Temp: spurious trend before 1960 removed by consistency with air temp.
Spurious Trend in Dew Point Temperature

Graph showing the comparison of TD corrected, TD, and NTA over the years from 1905 to 1970.

Scattering Map Ta vs Td 1955

Graph showing the relationship between Air Temperature Anomaly and Dew Point Temperature Anomaly.

Equation: $\delta Td = a \delta Ta + b$
Trend in Dew Point Temperature at Islands

Hachijo

Ishigaki

Diff. between TD & AT anomalies.
Trends of Global Means

Monthly, 13-month running averages, relative to 1961-90 averages, NOT reconstructed.

<table>
<thead>
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<tbody>
<tr>
<td>SST</td>
<td>0.51°C/100yr</td>
<td>0.29°C/50yr</td>
</tr>
<tr>
<td>NAT</td>
<td>0.47°C/100yr</td>
<td>0.21°C/50yr</td>
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<tr>
<td>TD</td>
<td>0.23°C/100yr</td>
<td>0.23°C/50yr</td>
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<tr>
<td>CLD</td>
<td>5.8%/100yr</td>
<td>3.3%/50yr</td>
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Trends in SLP and Wind

[Graph showing trends in SLP and wind over time, with maps indicating geographical distribution.]
Positive and Negative Aspects of KC

- **Positive**
  - No. of Data increased around WW-I and in the Pacific (Manabe 1999).
  - KC has some meta data, e.g., barometer height.
  - By use of KC in OA, variability becomes large over the North Pacific.

- **Negative**
  - KC includes severely biased data, especially, in the SST and SLP observations.

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**Black List:** More than 80% of N data are positive/negative biased; > 1σ when N>=100, > 2.5σ when N>=75, 3σ when N>=30). Moving > 30/60 deg. lat./lon. is required for SST. Data in -1, 0, and +1 months are used.
SOI: sign reversed. 5-mo running mean, relative to 1961-1990 means.
TAV (0-300m) anomalies -- EQ --

**CONTROL:**
- OGCM
- COBE air-sea fluxes

**STATIC:**
- WOA01 T & S profiles
- Daily T & S analysis by OI

**RESOLUTION:**
- 2.5 lon x 0.5-2 lat.
- 18 levels upper 1000m
Conclusion

Summary

- Historical analyses of marine meteorological elements have been carried out for the 20th century using COADS and the Kobe Collection.
- Tendencies toward global warming are confirmed in global mean marine temperatures and total cloudiness.
- Biases in dew point temperature are subtracted by comparing with air temperature. Small trends in SLP and scalar wind still remain. Further understanding of historical data (((separately for each data source!))) is necessary.
- ENSO indices of COBE agree well with those of other data sets and thermal changes in the equatorial Pacific are well reproduced by OGCM with COBE air-sea fluxes.

Projects

- The Japanese Reanalysis (JRA-25; 1979-2004) with COBE SST.
- Verification of COBE sea surface fluxes with high-resol OGCM.
- Ocean Data Assimilation for the 20th century.