Inter-comparison of Historical Sea Surface Temperature Datasets

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< Background >

Sea surface temperature (SST) is

- the observational element that can be prepared for a long period, and can cover the global ocean, and
- wildly used as a fundamental element for investigation of climate change, and a boundary condition of numerical models.

Significant differences exist among SST datasets.

<= the differential source data, gridding processes, and others (Trenberth et al. 1992; Folland et al. 1993; Hurrell and T. 1999)

However, intercomparison between SST datasets have been done rarely through the whole period.

[Purpose] is intercomparison of the SST datasets in terms of statistical viewpoint and representation of climate phenomena from the 1870s.

< Datasets >

Acronym	Period	Grid	Gridding method	Reference
HadISST	1870	1°	Reconstruction by RSOI	Rayner et al. (2003)
COBE	1850	1°	OI	Ishii et al. (2005)
ERSST	1854	2°	Reconstruction by EOF projection	Smith & Reynolds (2004)
LDEO	1856	5°	Reconstruction by RSOS	Kaplan et al. (1998)
COADS	1800	2°	Grid average	Worley et al. (2005)
HadSST	1850	5°	Grid average	Rayner et al. (2005)
TOHOKU	1817	5°	Grid average with smoothing	Yasunaka & Hanawa (2002)

< Datasets >

Acronym	Gridding method
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COBE	OI
ERSST	Reconstruction by EOF projection
LDEO	Reconstruction by RSOS
COADS	Grid average
HadSST	Grid average
TOHOKU	Grid average with smoothing

Except for 100% sea-ice covered grids

No missing grids

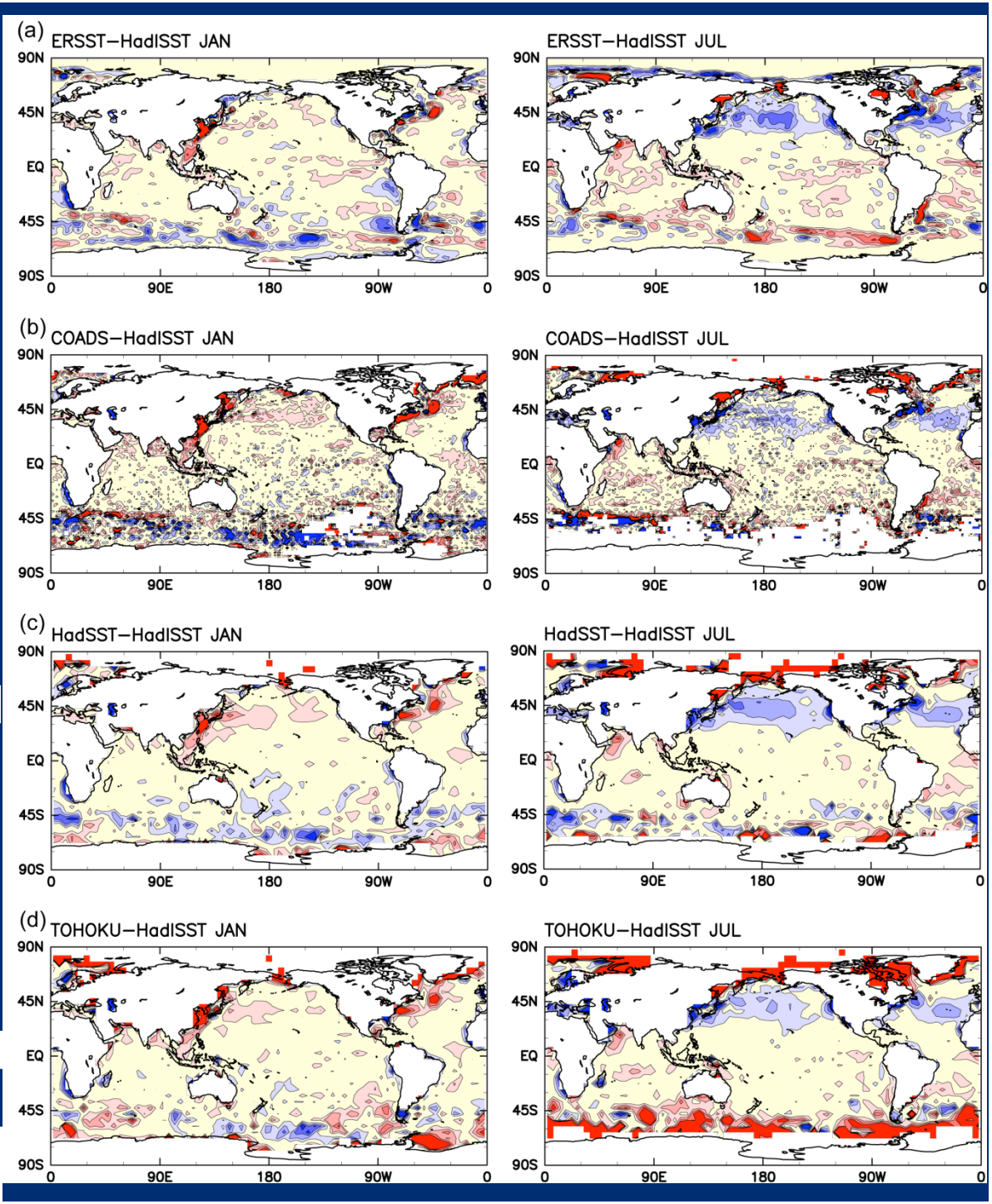
Except for the high latitudes

Many missing grids in the early period and in the high latitudes

- Climatology: 30 yr (1971-2000)

< Climatology >

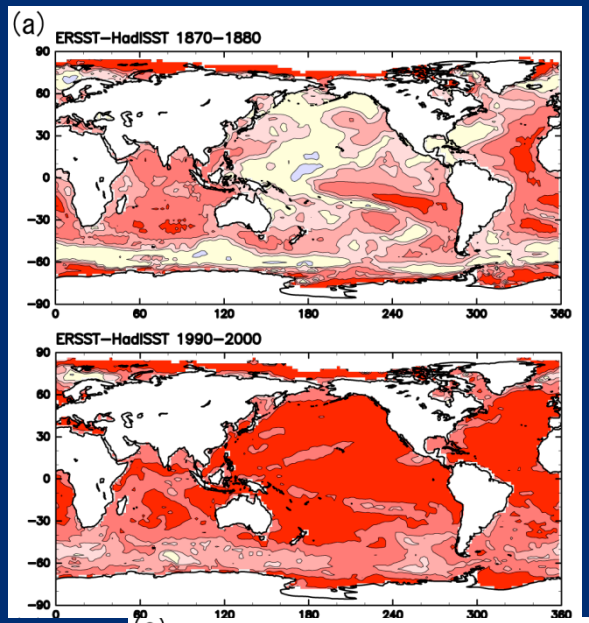
- Differences are
  < 0.5ºC over the most of the oceans,
  > 1ºC
  in the WBC regions and at high-latitudes.
- Seasonal cycle of HadISST
  is large in the NH mid latitudes.
- COADS, HadSST and TOHOKU show a lot of patches in extratropics of the SH

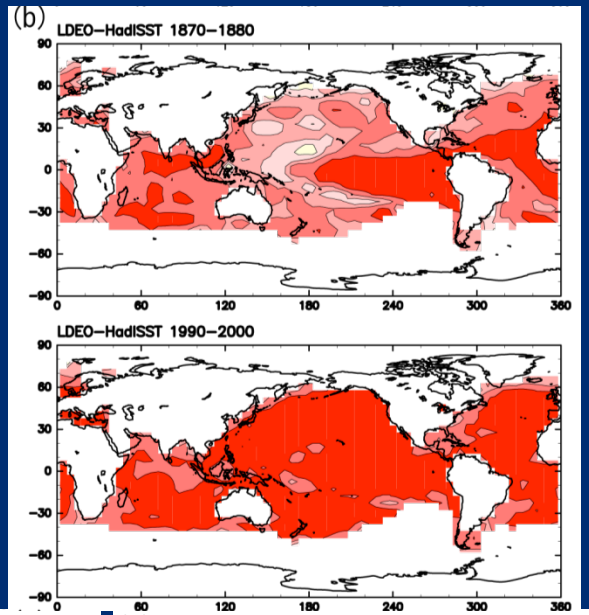


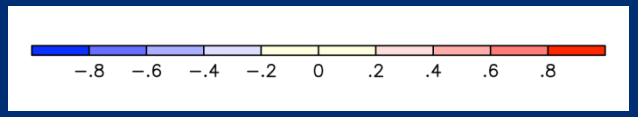
< Correlation >

High cor. are retained
- in main ship route from the early periods, and
- in low to mid latitudes in the recent years.

Tracing back to the earlier periods, correlations become lower.

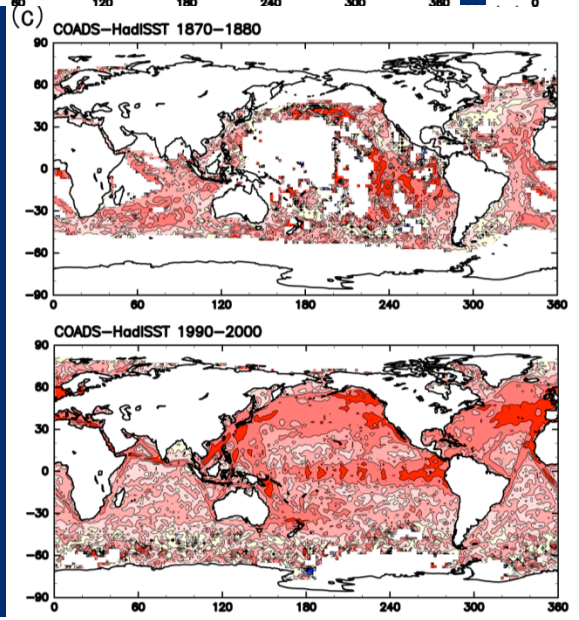


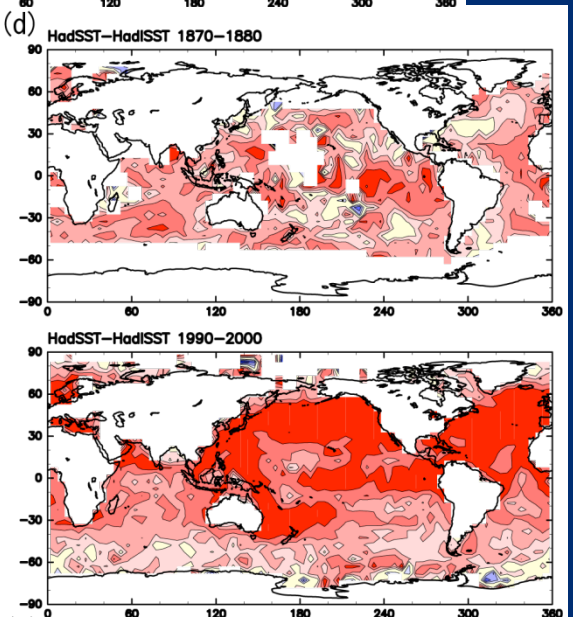


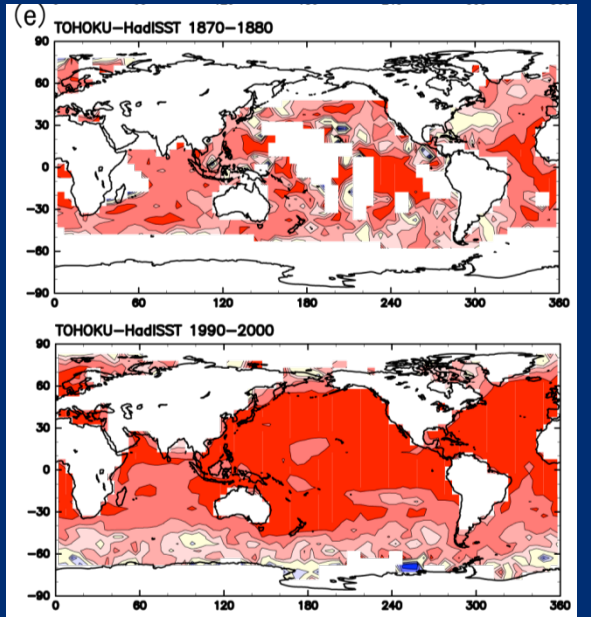


1870-1880

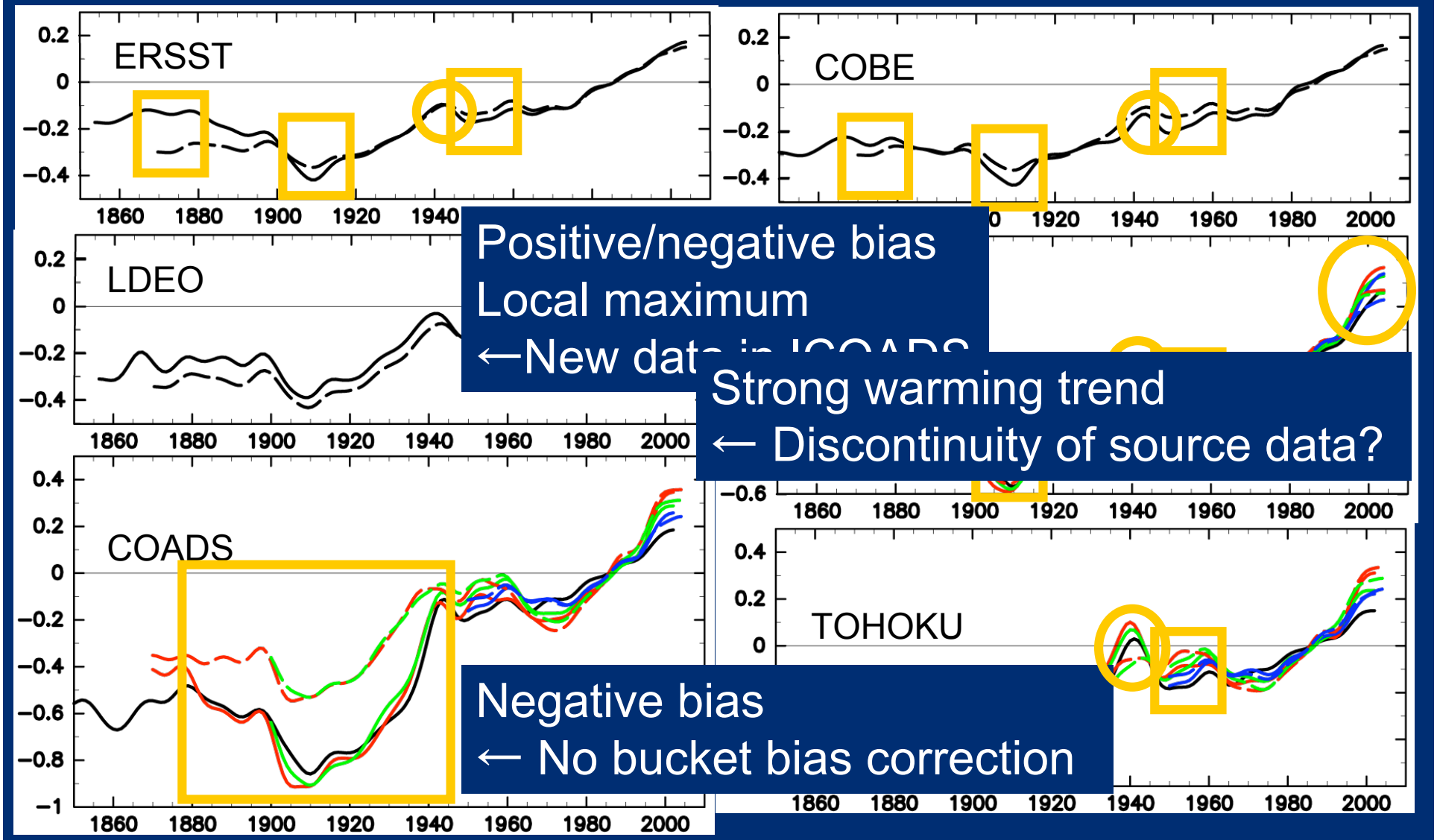
1990-2000





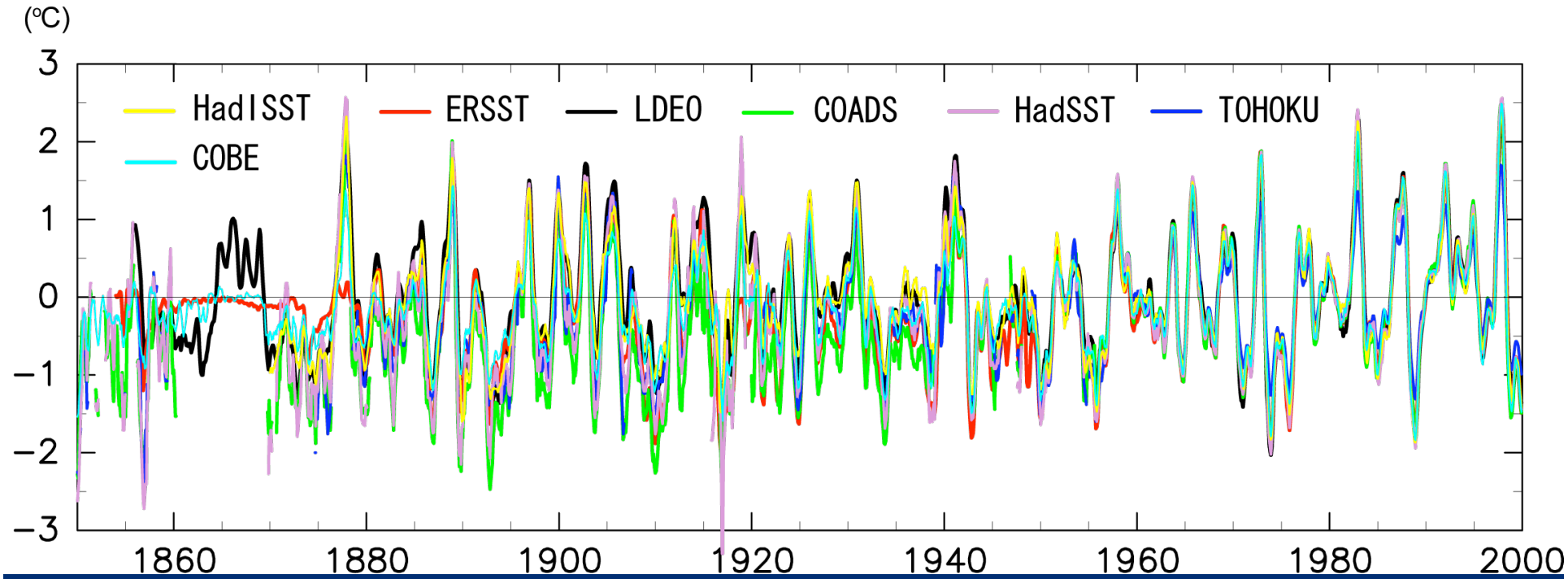


< Global mean >


ERSST
COBE
LDEO
COADS
TOHOKU
Positive/negative bias
Local maximum
←New data in ICOADS
Strong warming trend
← Discontinuity of source data?
Negative bias
← No bucket bias correction
1870-
1900-
1950-
All data
HadISST

< El Nino/Southern Oscillation >

Figure 4. Niño 3.4 index (averaged over 5ºN-5ºS, 120ºW -170ºW)



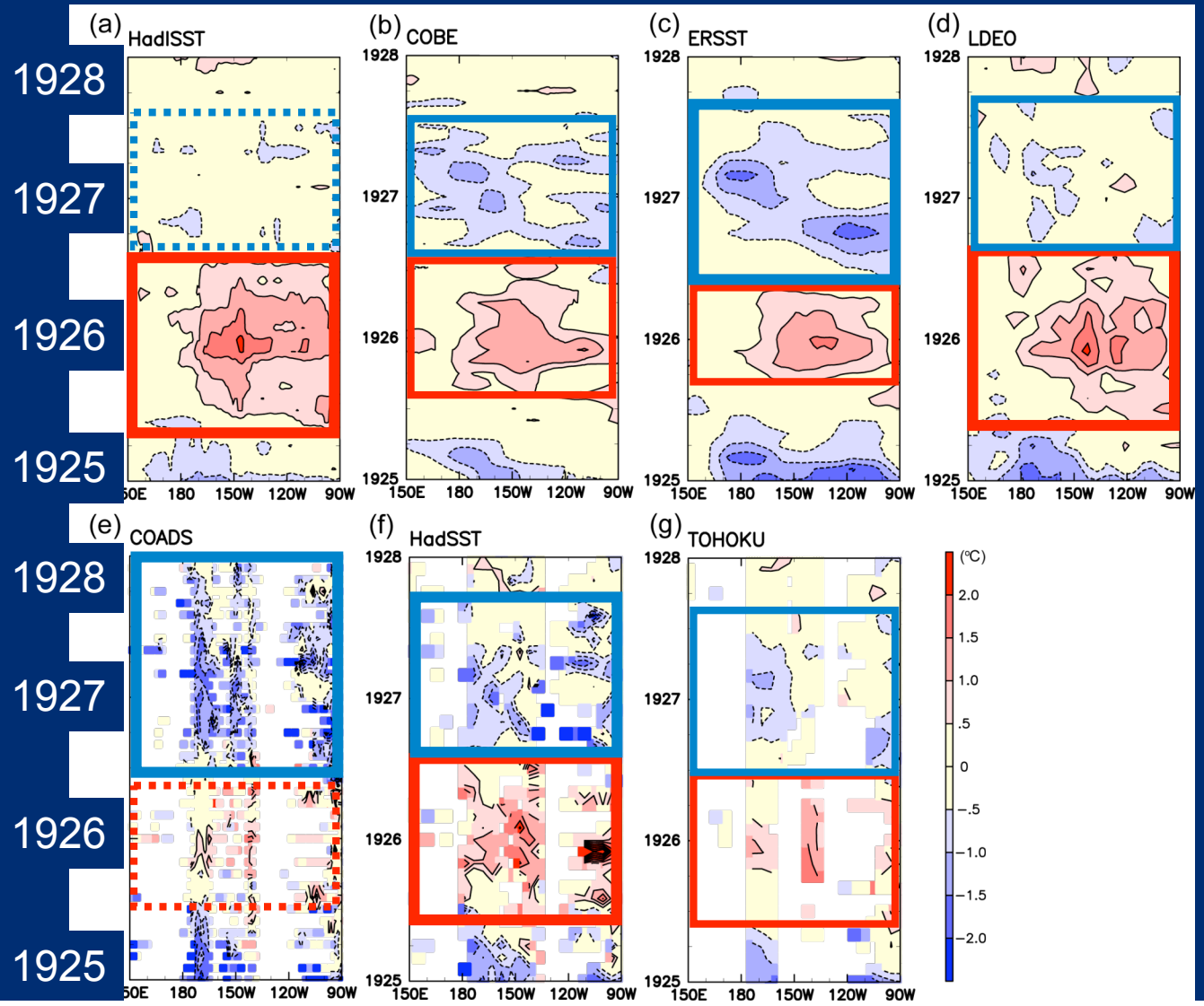
Different phase and amplitude
← Few observation

Correspond well
(R > 0.85)

Correspond very well
(R > 0.98)

< El Nino/Southern Oscillation >

X-T diagram in the tropical Pacific (5ºN-5ºS)



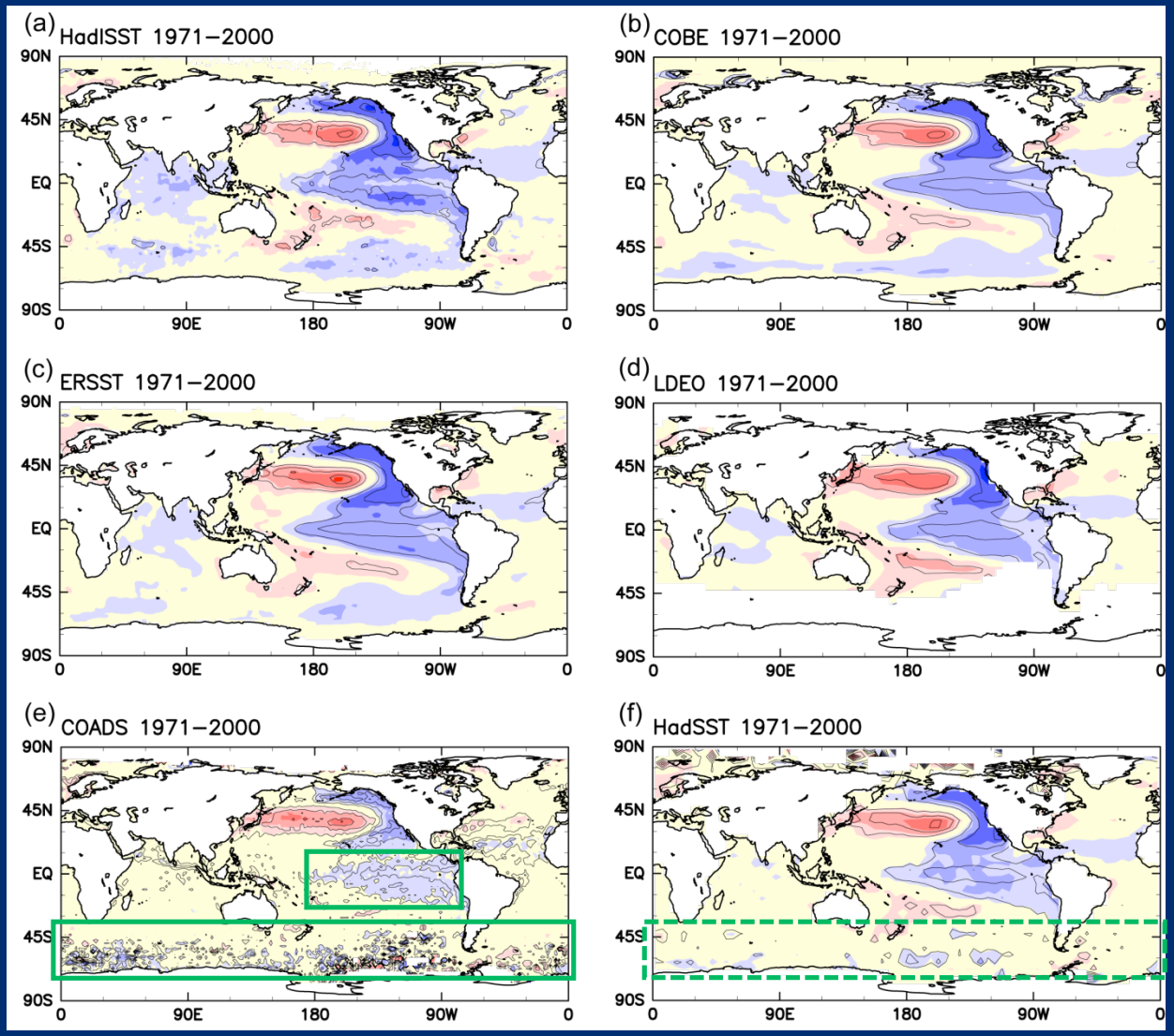
La Nina

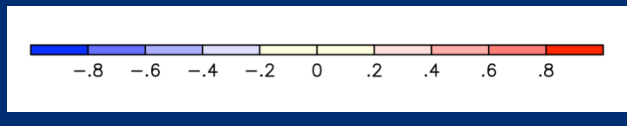
El Nino

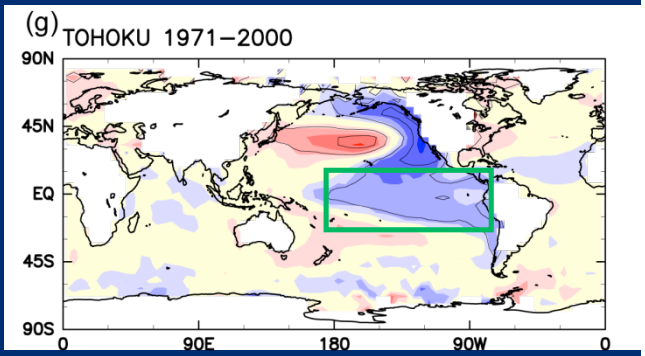
< Pacific Decadal Oscillation >

- North Pacific PC1 (1971-2000)

=> Regression pattern

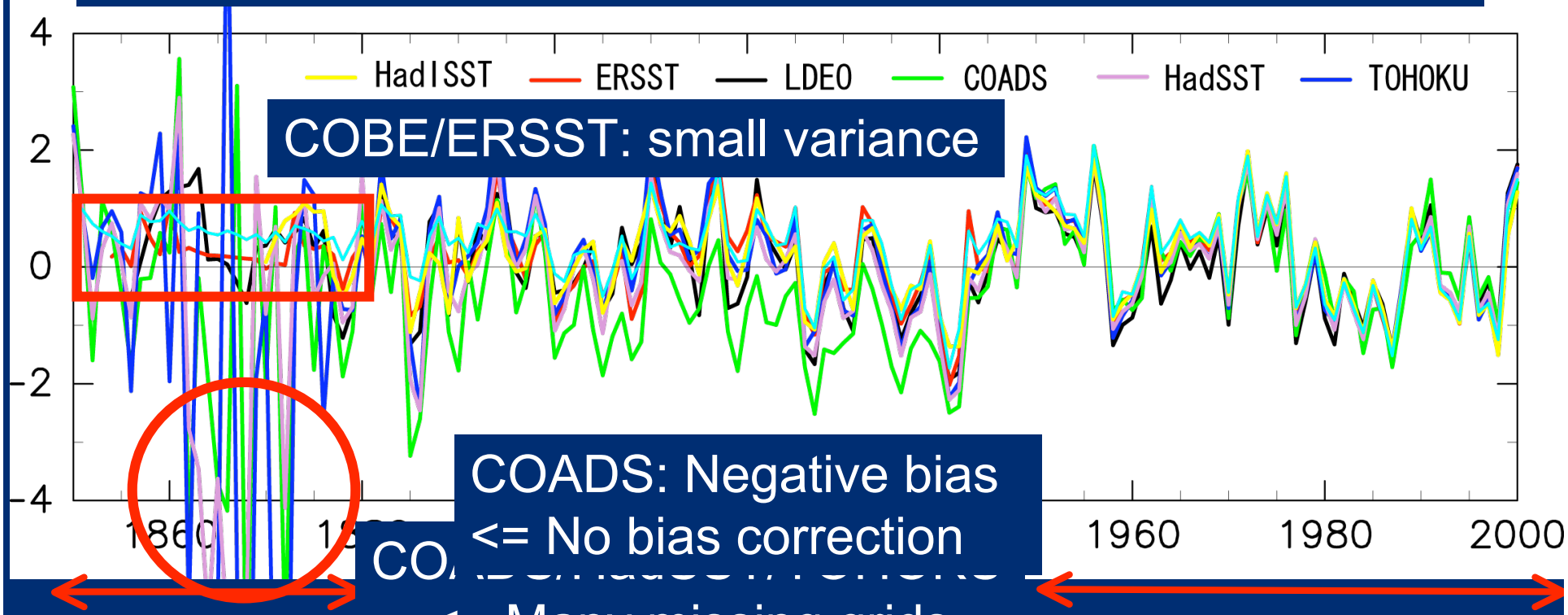






< Pacific Decadal Oscillation >

- PDO Index <= Projection onto the spatial pattern



COBE/ERSST: small variance

COADS: Negative bias
<= No bias correction

CO

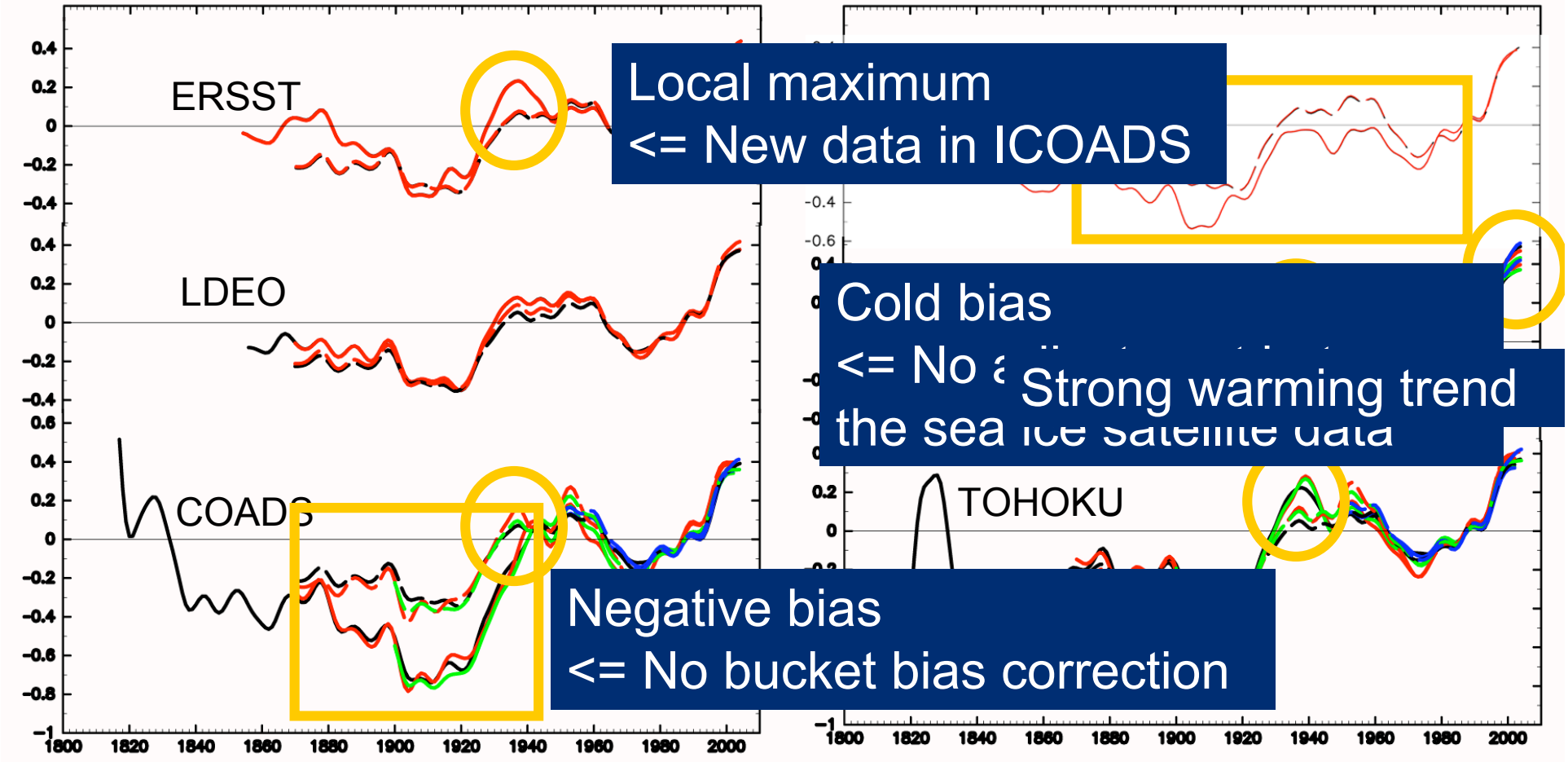
<= Many missing grids

Different phase and amplitude
<= Limited observation

Correspond well

< Atlantic Multidecadal Oscillation >

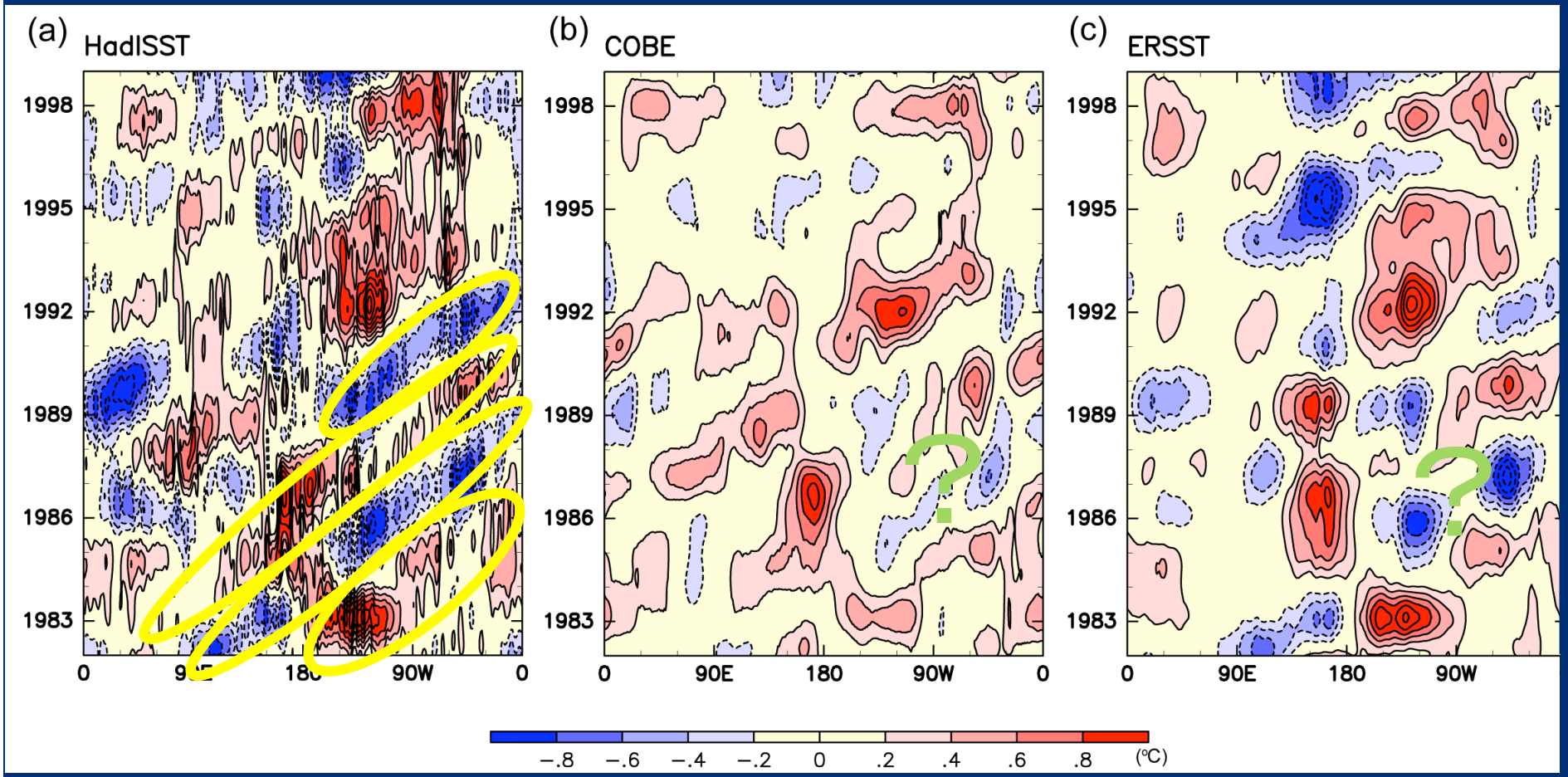
- AMO index: SST averaged in the North Atlantic



1870- 1900- 1950- All data HadISST

< Antarctic Circumpolar Wave >

- X-T diagram in the Southern Ocean (55-57°S)



LDEO: Out of the analysis area

COADS/HadSST/TOHOKU: Many missing grids

< Summary >

[Result]: differences between historical SST datasets were detected in the statistical view points and climate signals.

Climatology: Seasonal cycle of HadISST is large in the NH mid-lat.

Correlation: High cor. were retained in main ship route from the early periods, and in low to mid latitudes in the recent years. Tracing back to the earlier periods, correlations became lower.

Global mean: Systematical biases, by source data or bucket correction, existed in some periods.

ENSO: Indices highly correlated with each other after 1880, although durations and intensities of each event were different.

PDO: Indices and spatial pattern corresponded well after 1950s, on the other hand, they were scattered before 1880.

AMO: Systematical biases, by source data or bucket correction, existed in some periods.

ACW: Only HadISST showed clear propagation.

Concluding remarks

[Result]: differences between historical SST datasets were detected in the statistical view points and climate signals.

For climate study and/or model experiment:

- In order to avoid counterfeit signals which arise from gridding procedures, enough attention has to be paid to the characteristics of the dataset.
- In some cases, comparison of the results from various datasets is meaningful in order to confirm obtained results.

AVHRR - in situ SST
from Rayner et al. (2003)

ERSST - HadISST