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Uncertainty in Radiosonde Temperatures Trend in China Relating to homogenization Using Reanalysis as Reference

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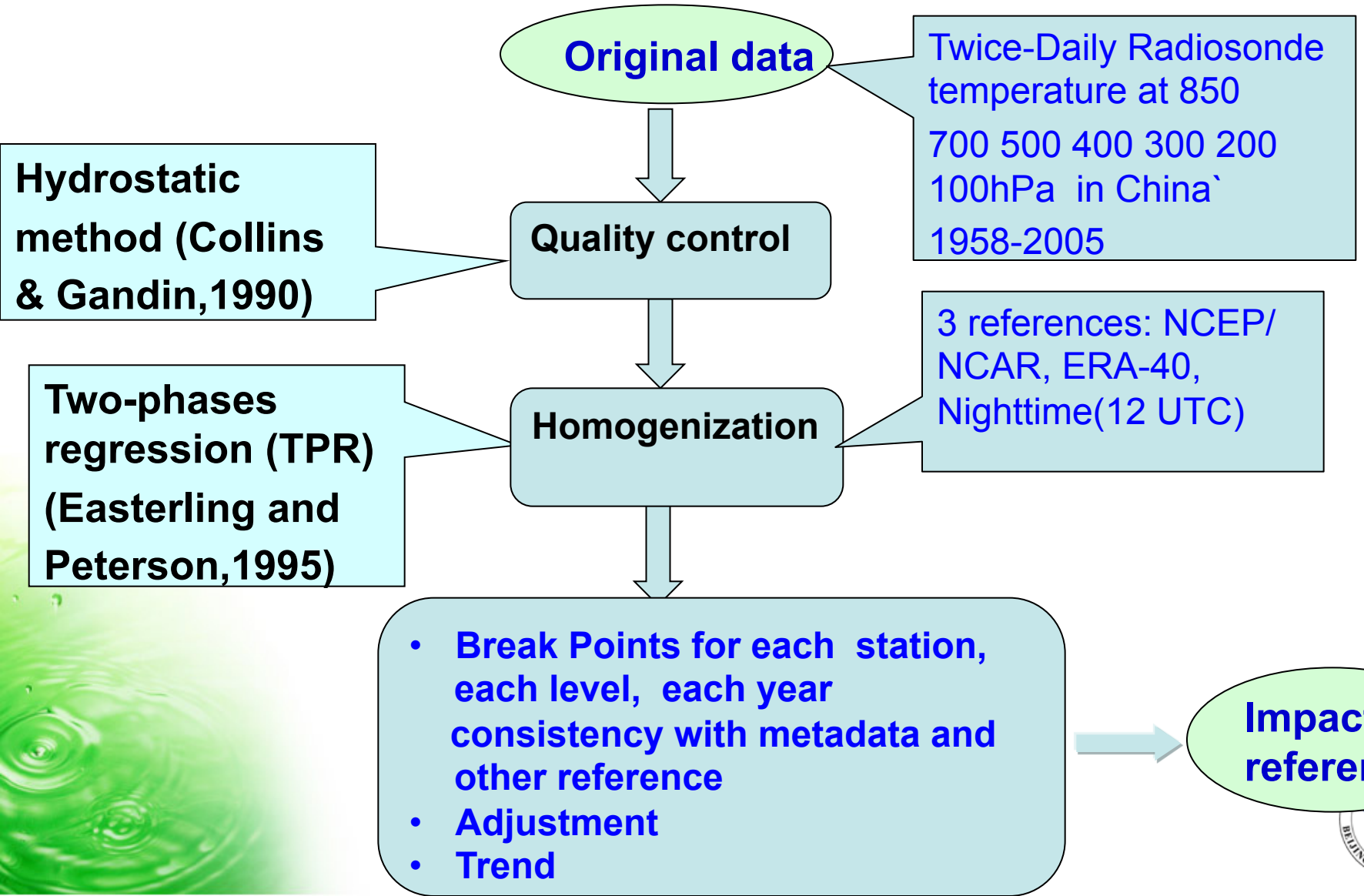
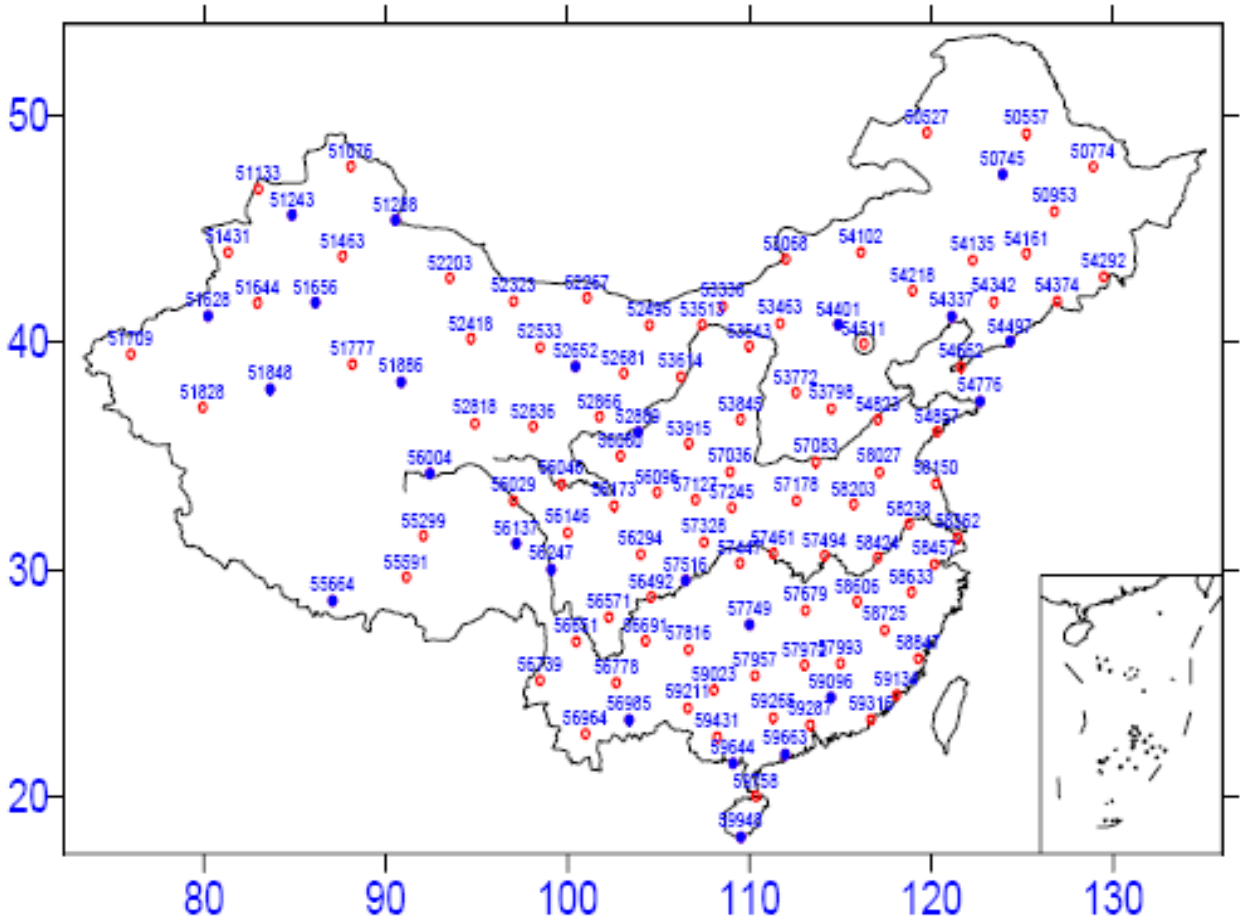
Outline

1. Data source and method
2. Impact of references on homogenization
   - 2.1 Break points
     - Distribution
     - Consistency with metadata
     - with other references
   - 2.2 Adjustment
   - 2.3 Trend
3. Summary

Motivation: Impact of references on homogenization?



1. Data source and method



- Original data

multiple levels temperature data from Chinese radiosonde framework 1958-2005

- Nighttime, NCEP/NCAR, EAR-40
- Two Phase Regression

red ○ stations with data missing rate less than 30%,

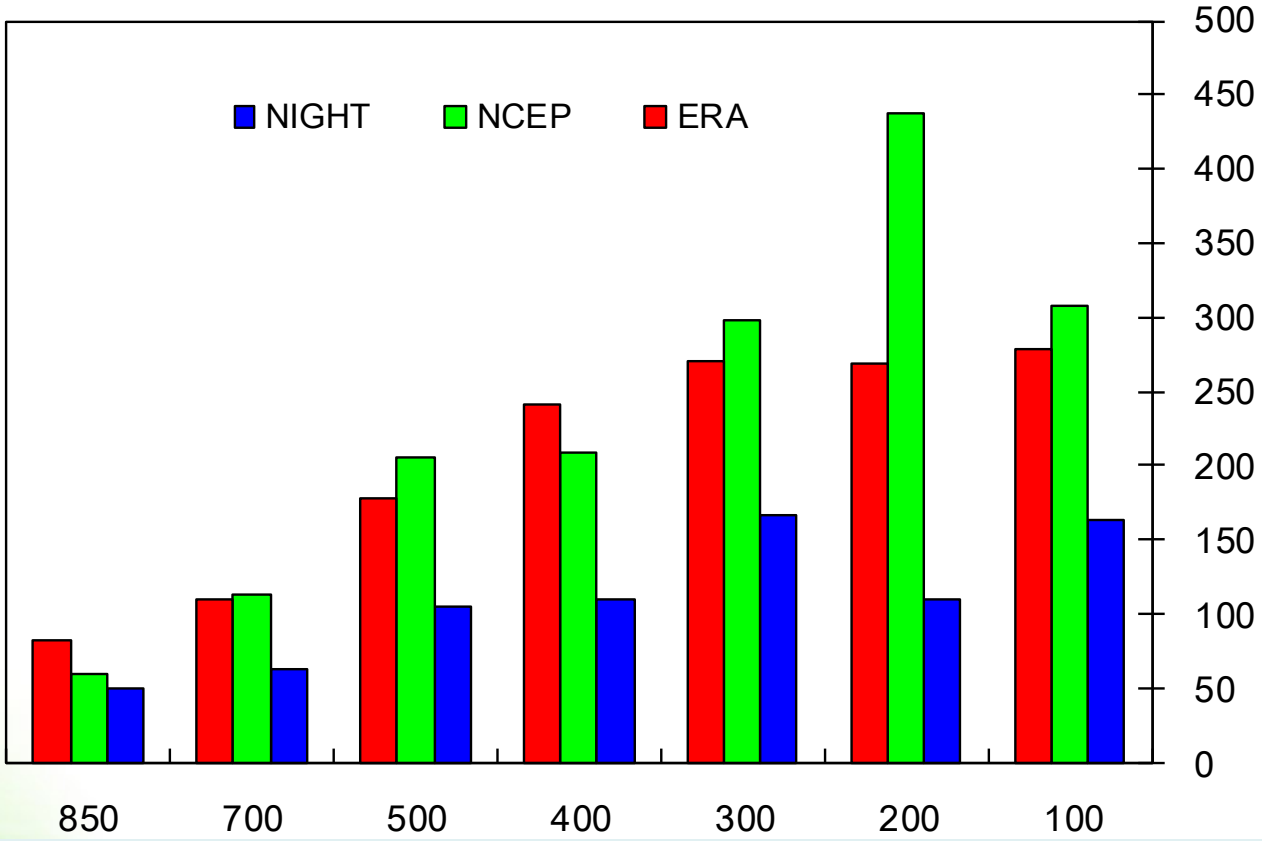
blue ● stations with missing > 30%.

Major changes of radiosonde observation in China during last 50 years

	Change content	Timing
Instrumentation model	RZ 049 to GZZ-2	Around 1966 (1963-1969)
	GZZ-2 to GTS1-LBand Radar	2002-2007
Correction method	Radiation correction at levels upper than 300 hPa	1966
	Acceleration of gravity	1999
	Radiation correction for all levels	2001

Because instruments or correction methods are modified simultaneously, neighbor reference series are not suitable in China

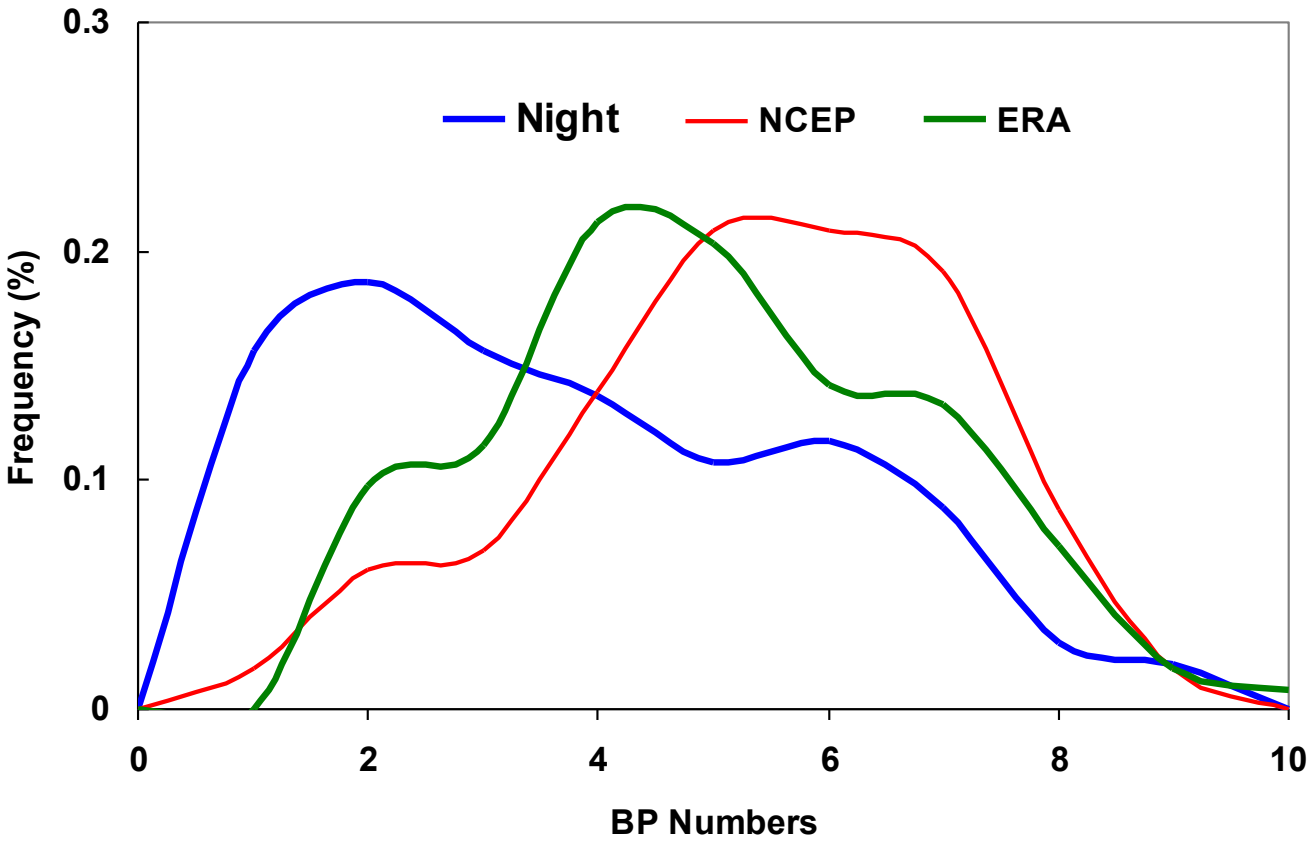
Break Points numbers detected at each level by three references



The numbers of BPs detected by the nighttime reference were much smaller than the reanalysis

BP Numbers increase with altitude with minimum at 850hPa

Frequency distributions of BP numbers for each station

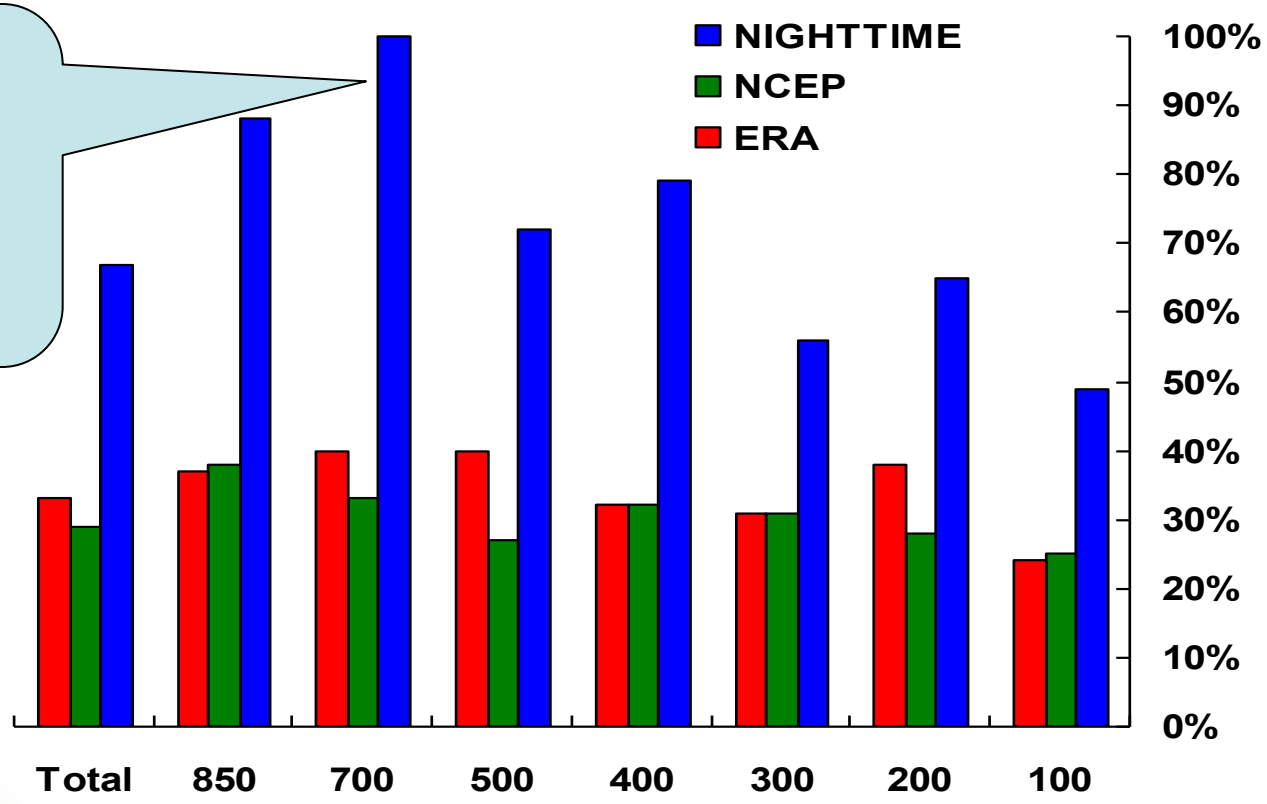


Nighttime reference:
nonsymmetrical distributio
two reanalysis references
exhibit similar distribution

	NIGHT	NCEP	ERA
peak	2	4	5
Majority range	1-4	4-7	2-7
proportion	75%	75%	90%

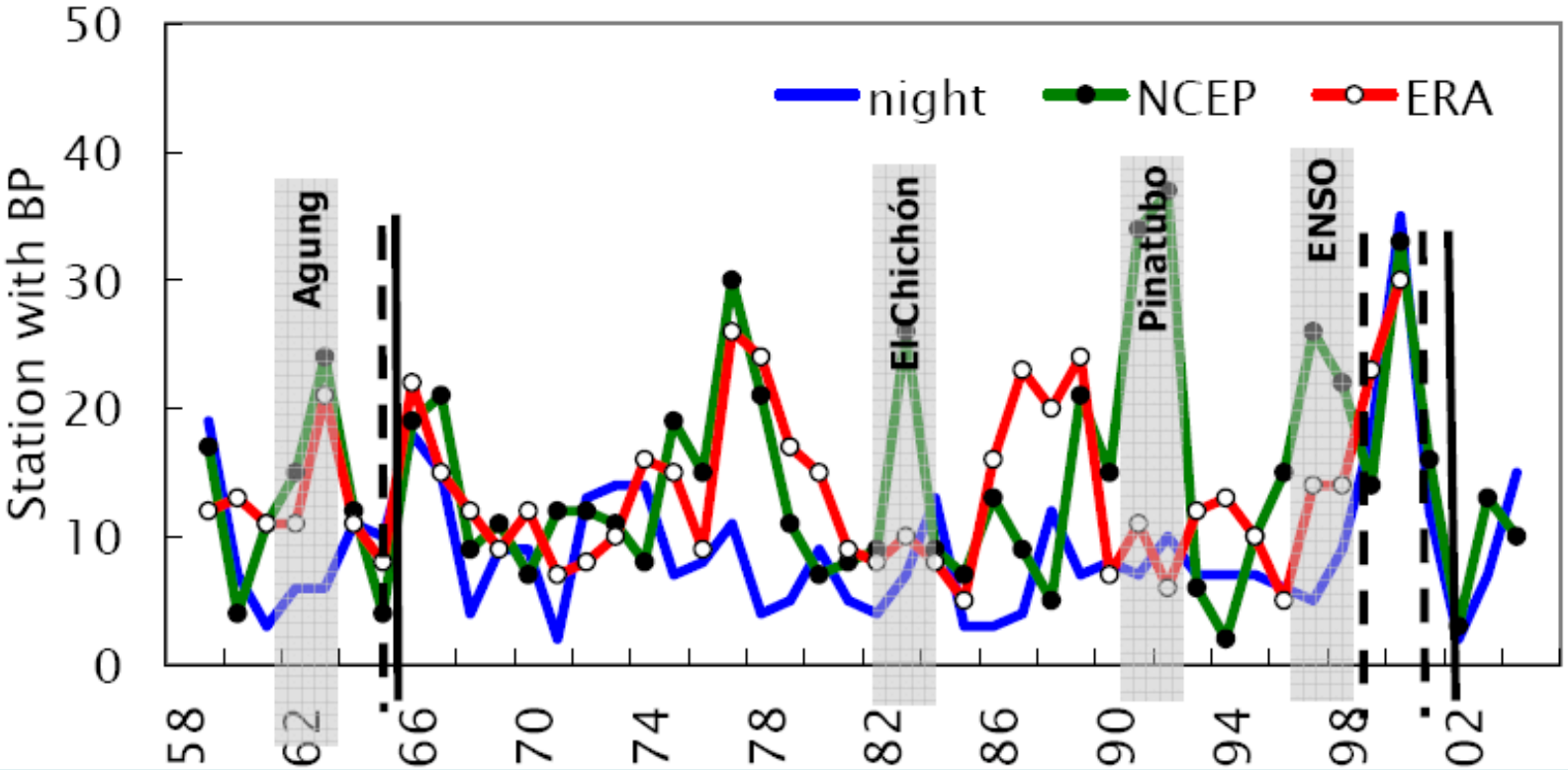
Percentage (%) of BP numbers consistent with the metadata at each level

more consistent with the metadata events at lower levels



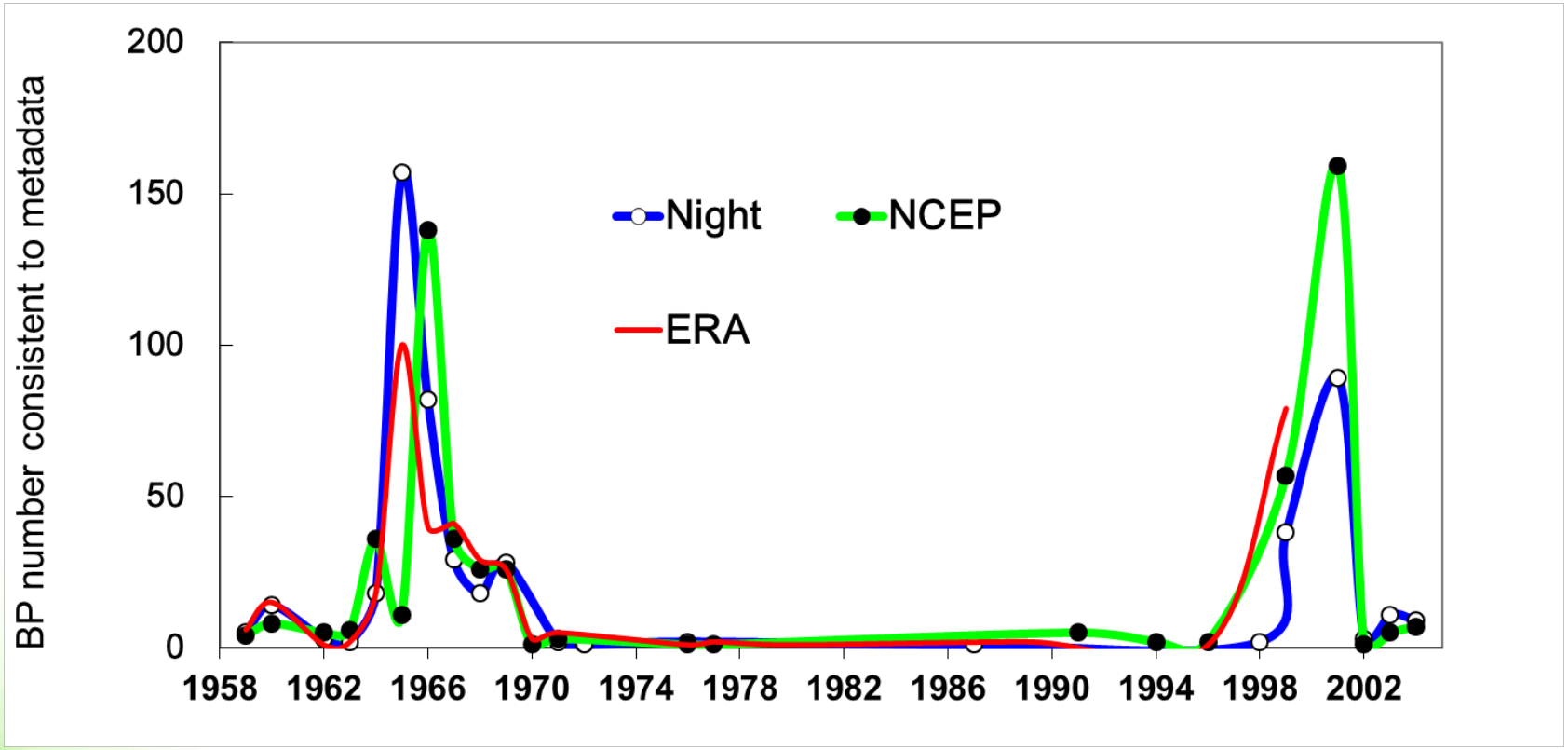
Nighttime reference(67%): more consistent with metadata events than reanalysis.

Number of stations with BP for each year metadata events of instrument model (solid line) and correction method (dashed line) changes



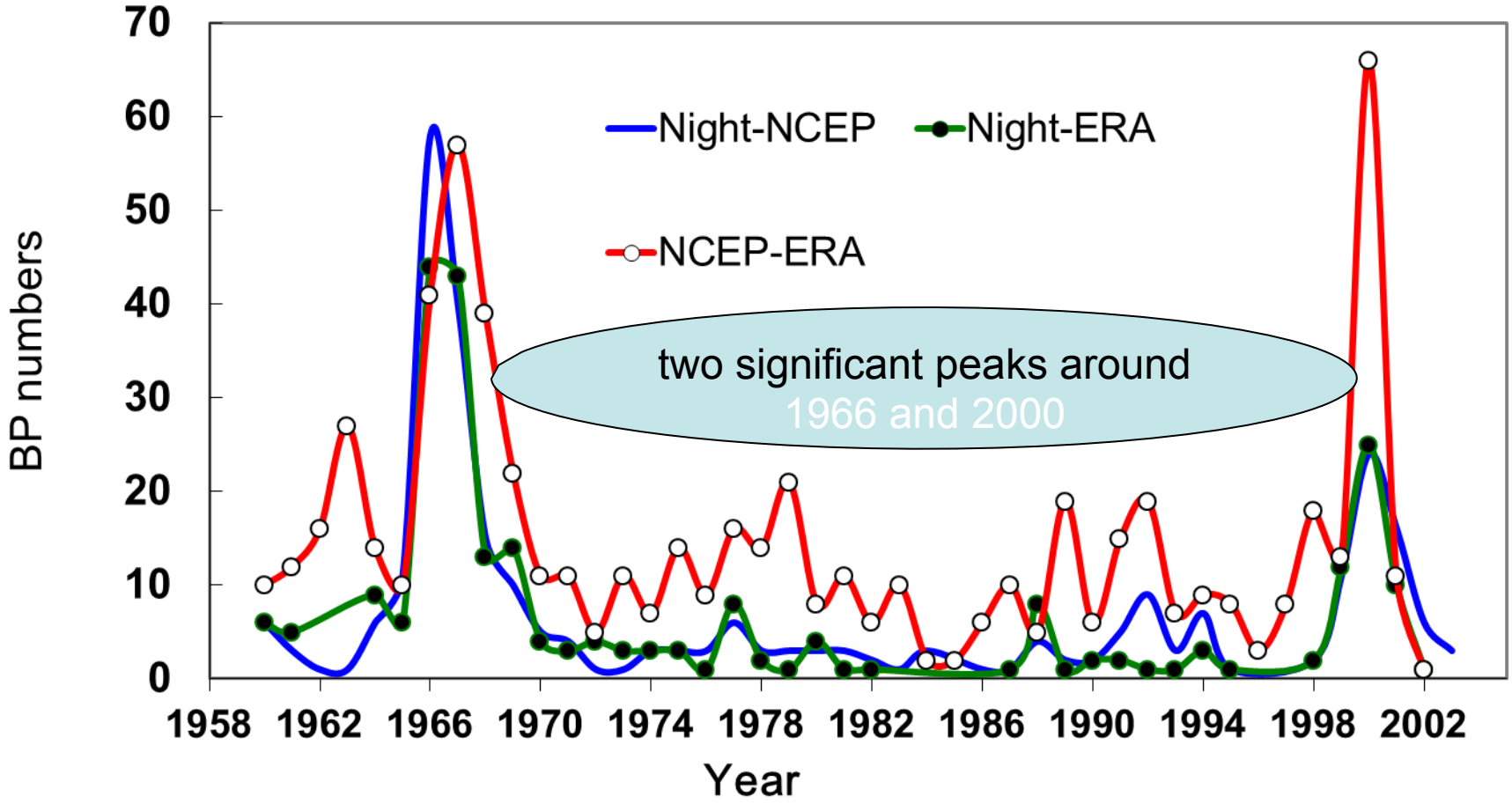
- Correction method or instrument change in 1966 and two correction changes in 1999 and 2001 with a peak in BP around 1966 and 2000
- Instrument model change during 1963-1969 and 2002-2007 did not lead to corresponding increase in the number of stations with BPs.
- Correction method improvement is more likely to cause a BP than instrument change.
- Climatic events that caused temperature shifts may be confused with BPs.

BP numbers consistent to metadata events for each year

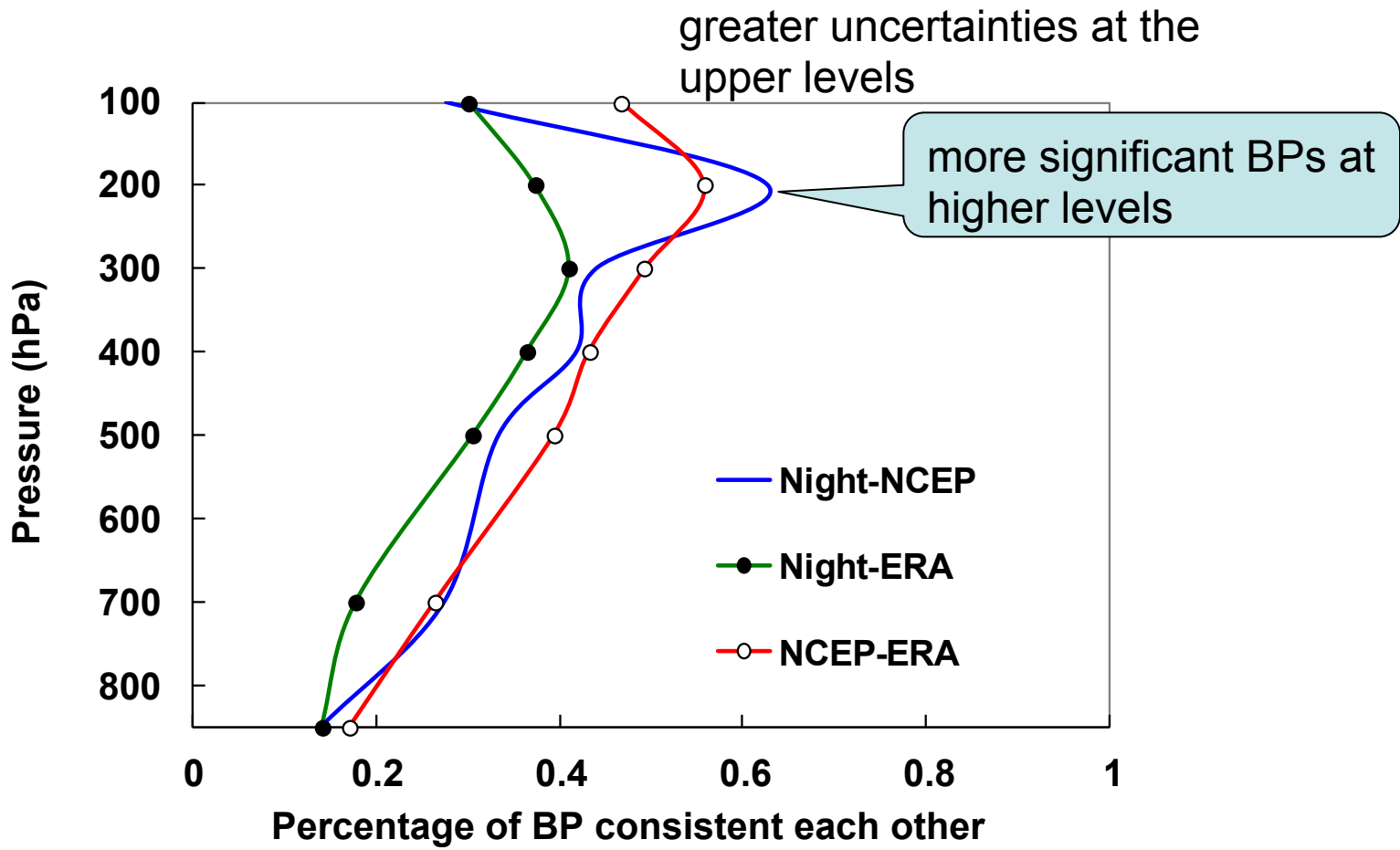


The peak values are consistent in both 1966 and 2000, when the correction method was changed in the Chinese radiosonde network.

Comparison of BP numbers consistent with other reference during 1958-2005

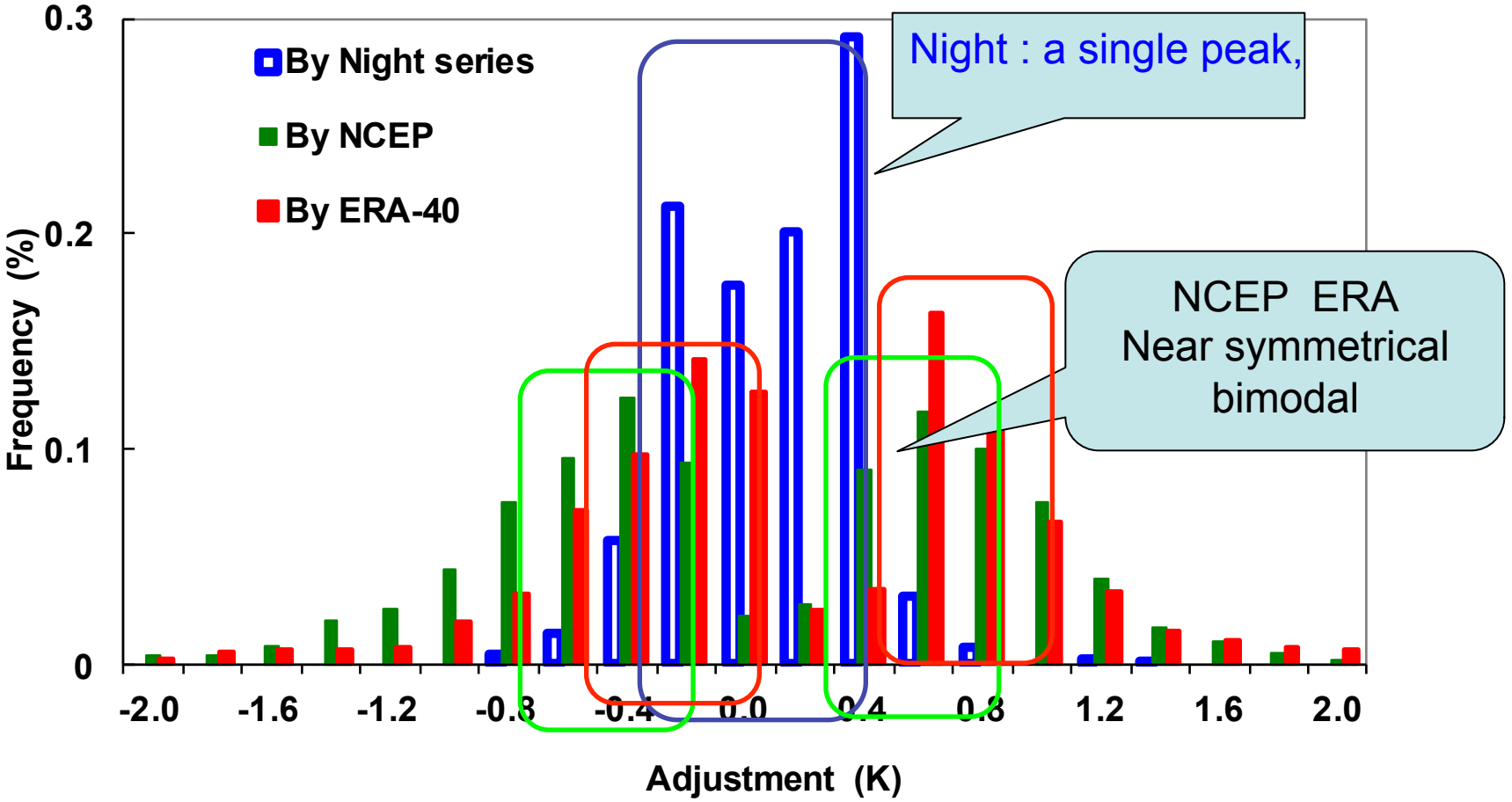


Consistency of BPs identified at each level with other reference



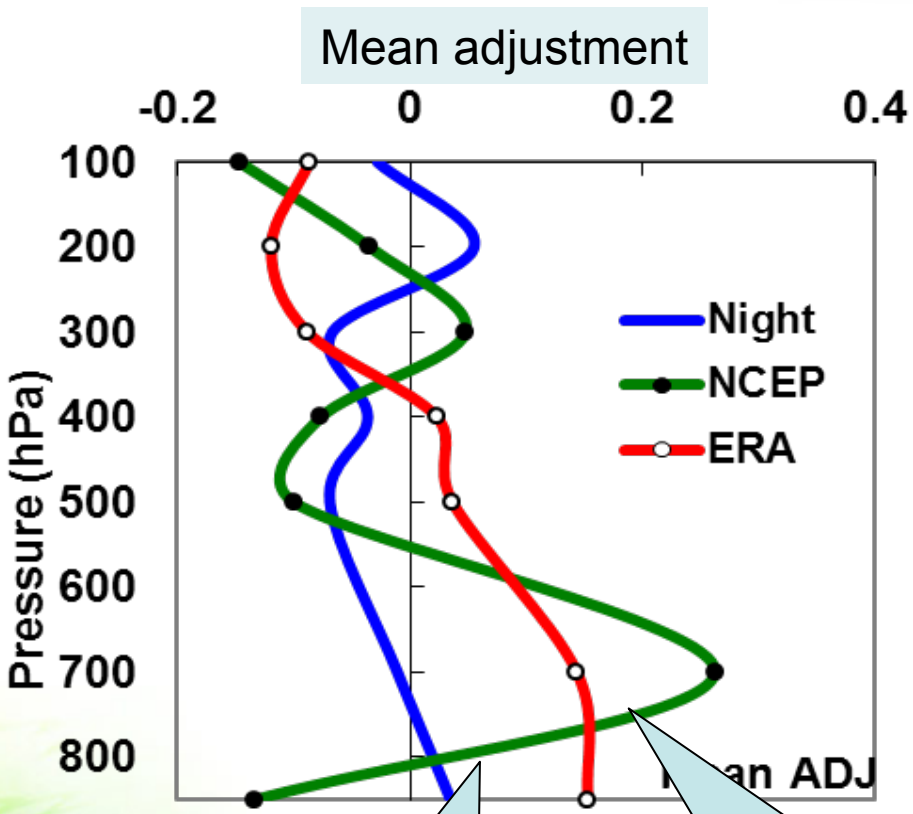
The proportion of BPs consistent with other reference increased with increasing height, with a minimum (14%-17%) at 850 hPa.

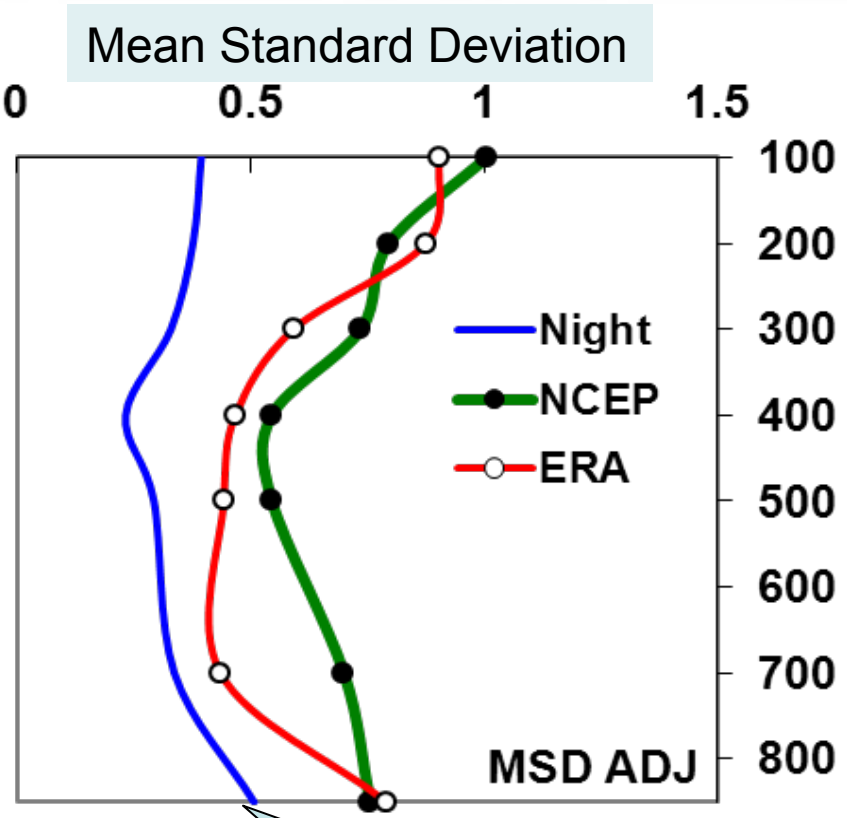
Distribution of adjustment with different references



NIGHT	NCEP		ERA	
88%	30%	30%	37%	34%
-0.2~0.4 K	-0.6~-0.2K	0.4~0.8K	-0.4~0	0.6~1.0K

Comparison of the statistical character of adjustment





NCEP: contrast adjustment at 700 and 850hPa.

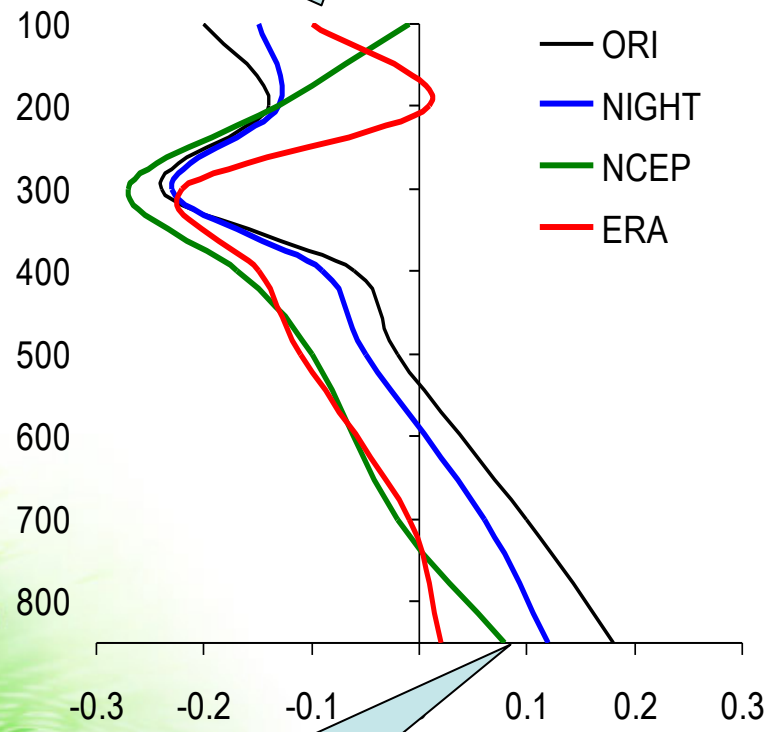
ERA-40: varied regularly with increasing height.

Nighttime: smaller than other two references

Impact on temperature trend over China

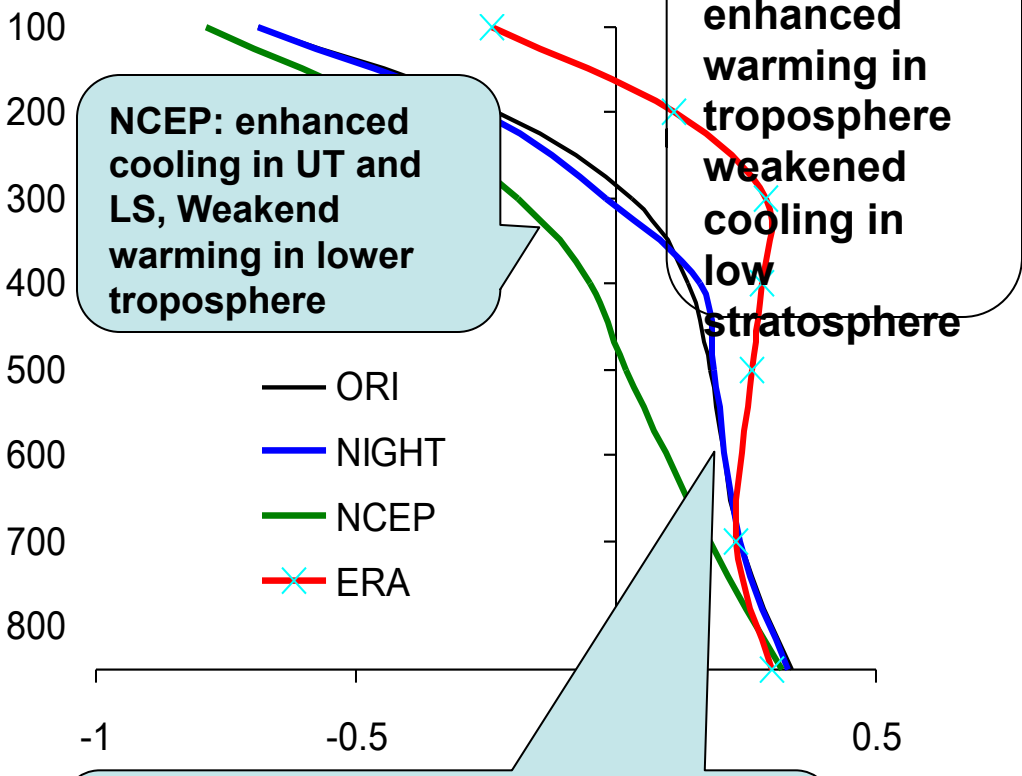
weakened cooling in the UT and LS

1958-2005



weaken warming in the lower troposphere

1979-2005



NCEP: enhanced cooling in UT and LS, Weakend warming in lower troposphere

ERA enhanced warming in troposphere weakened cooling in low stratosphere

Nighttime reference is rather smaller than the other two references.

Summary

- Although results showed limited consistency in the temporal and spatial distribution of identified BPs in context of metadata events, significant uncertainties still existed in BP identification, adjustment and impact on trend.
- Reanalysis reference series generally led to more BP identification in homogenization. The adjustment deduced from the reanalysis ranged widely and were larger than those from the nighttime series and impacted temperature trend.

Thanks for your attention!