Comparison of Chinese SAT series since 1900 and development of CMA-LSAT

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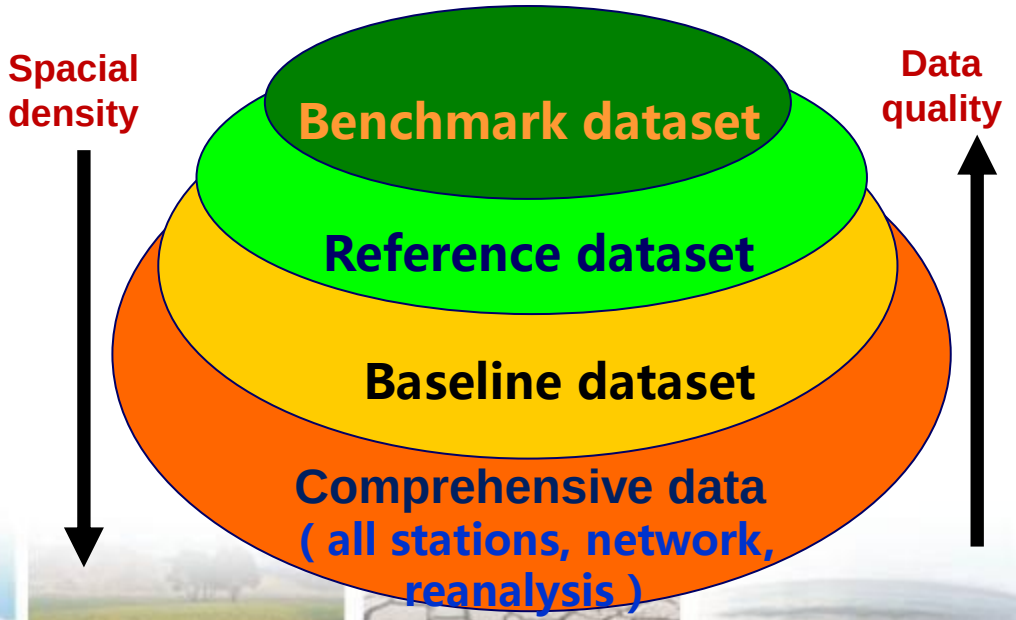
Background

- Baseline climate dataset
- Most important ECV.
  - Homogenized
  - Uncertainties assessed
  - **Multiple products**
  - ……..



Existing datasets

Dataset	Characteristic	Deficiency
GHCN	Real “Homogenized” dataset (automatic), FDM/CAM	Few stations in Asia, station number decreased greatly since 1990s;
GISTEMP	Based on GHCN. RSM	Same to above
CRUTEMP	More long-term series; selected Homogenized series; CAM	Few stations in Asia; fewer stations totally
BEST	more stations; rigorous Interpolation method, B-Kridging.	Few stations in Asia; stations added in some regions like US
JMA	Based on GHCN before 2001,	No literature found in Journals, no homogenization and QC information
ISTI	Largest station number	No derived homogenized dataset until now.

Background

Global or regional climate data is critical for climate change monitoring and studies.

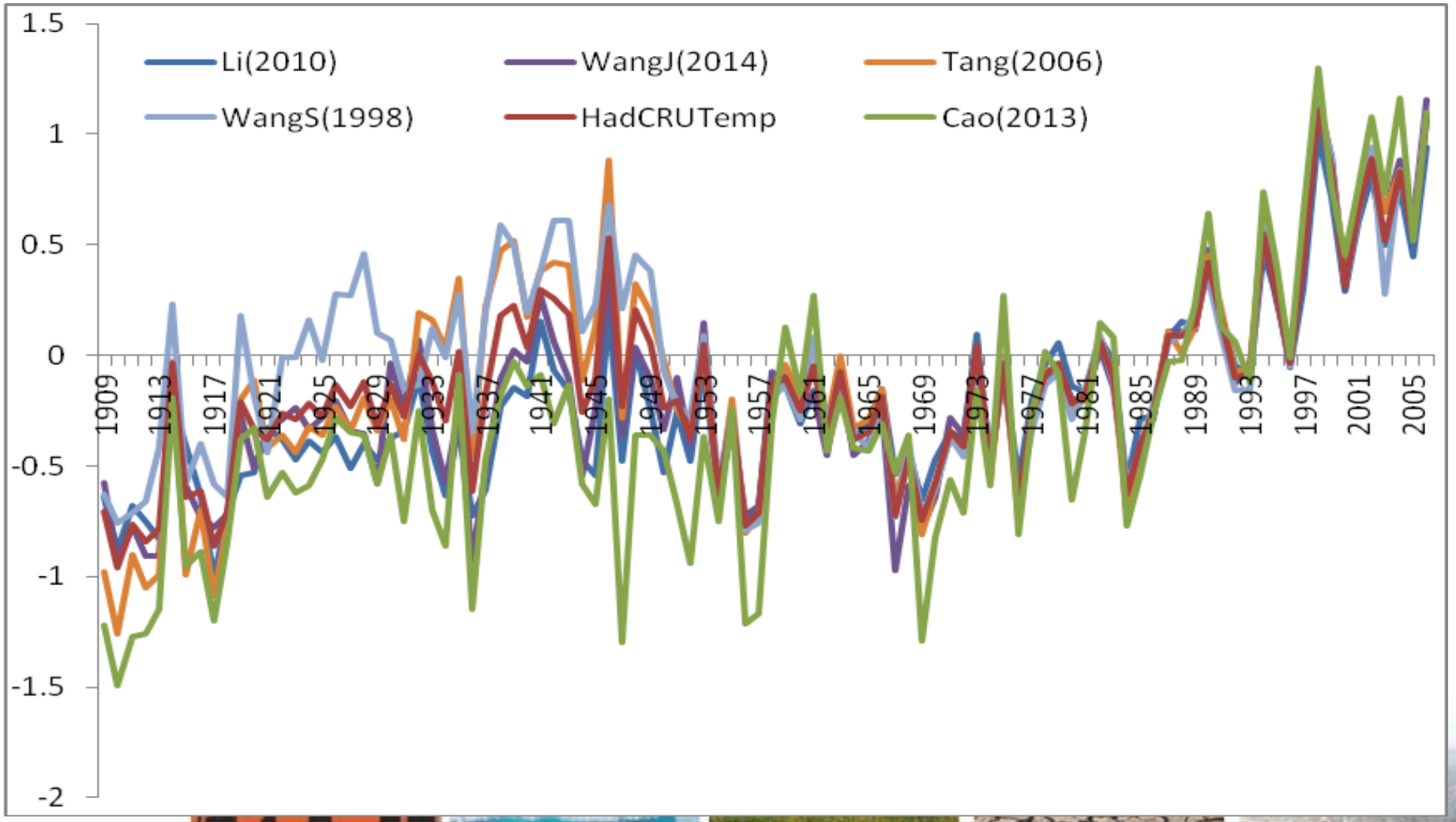
- Chinese SAT data for about 40% stations has been contaminated by inhomogeneity. (Li et al, 2003; 2004; Li and Dong, 2009; ….)
- More and more homogenized datasets have been developed in past decade.(Li et al, 2004; Li et al, 2009; Li and Yan, 2009; Xu et al, 2013(2nd generation, daily),…….
- But there is still no a widely accepted Chinese SAT observation series even until recently.

outline

- **A brief introduction for comparison of Chinese SAT series since 1900.**
- **Development of CMA-LSAT, another contribution to the baseline climate dataset development and global SAT change monitoring.**

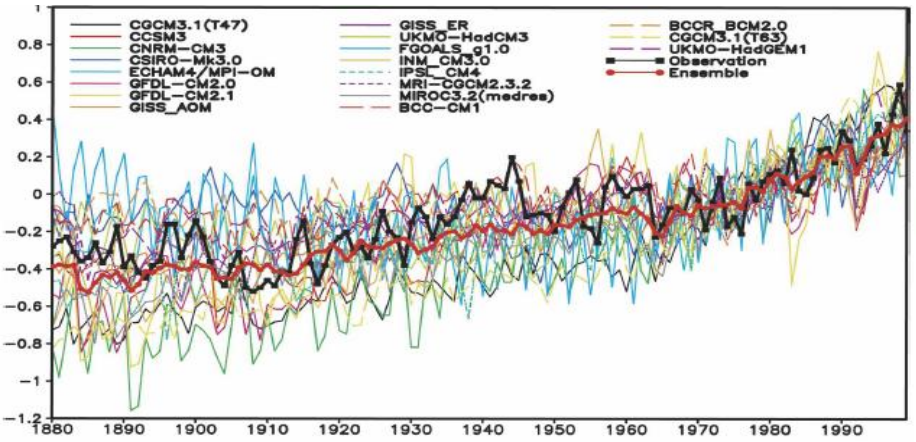
Problem 1) 100-yr Chinese SAT series- huge differences (from 1980s-2014)!

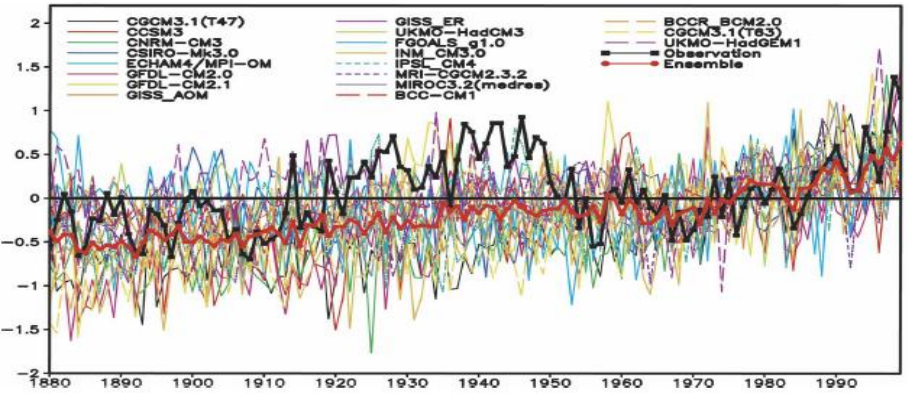
-observed data from similar stations, and gridded by same method (CAM)!

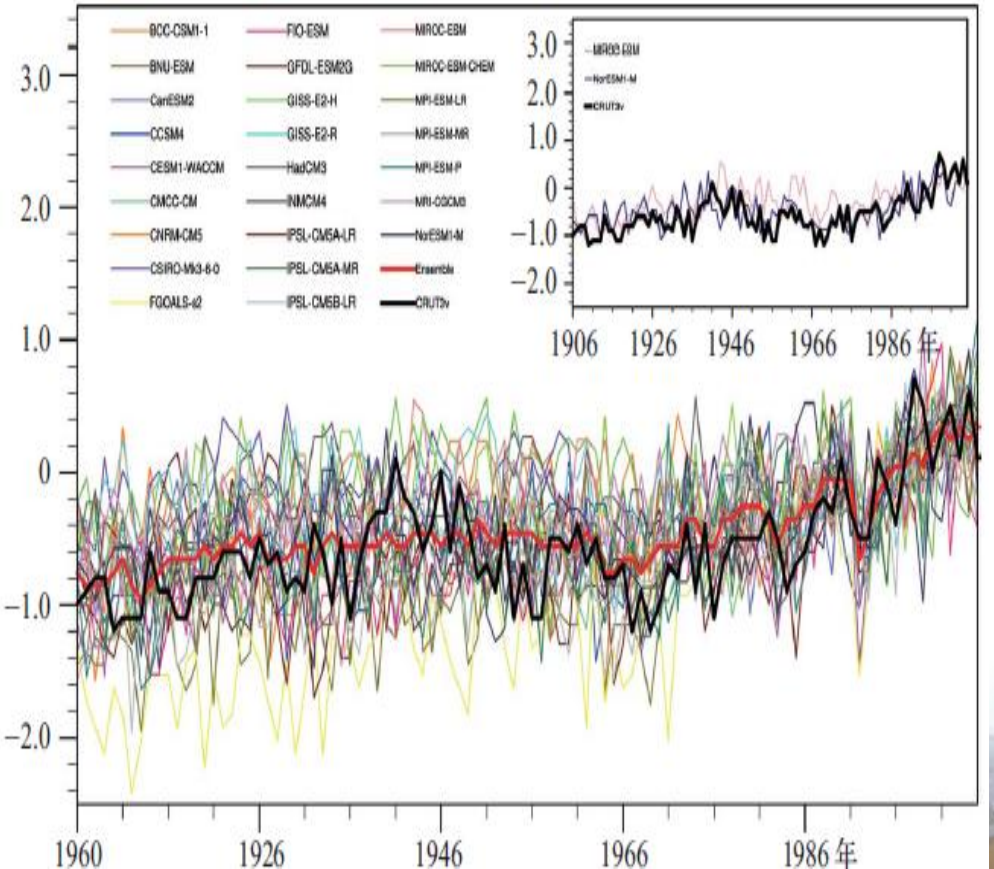


Problem 2) Climate models cannot simulate well the Chinese SAT change?

Zhou and Yu(2006) pointed out that CMIP3 cannot simulate well both global and Chinese series because they do not include the temporal variance natural forces; but CMIP5 still can not simulate Chinese SAT well.(Guo et al., 2013)







A new developed Chinese SAT series and the long-term warming trends (Li et al., 2010; 2017)

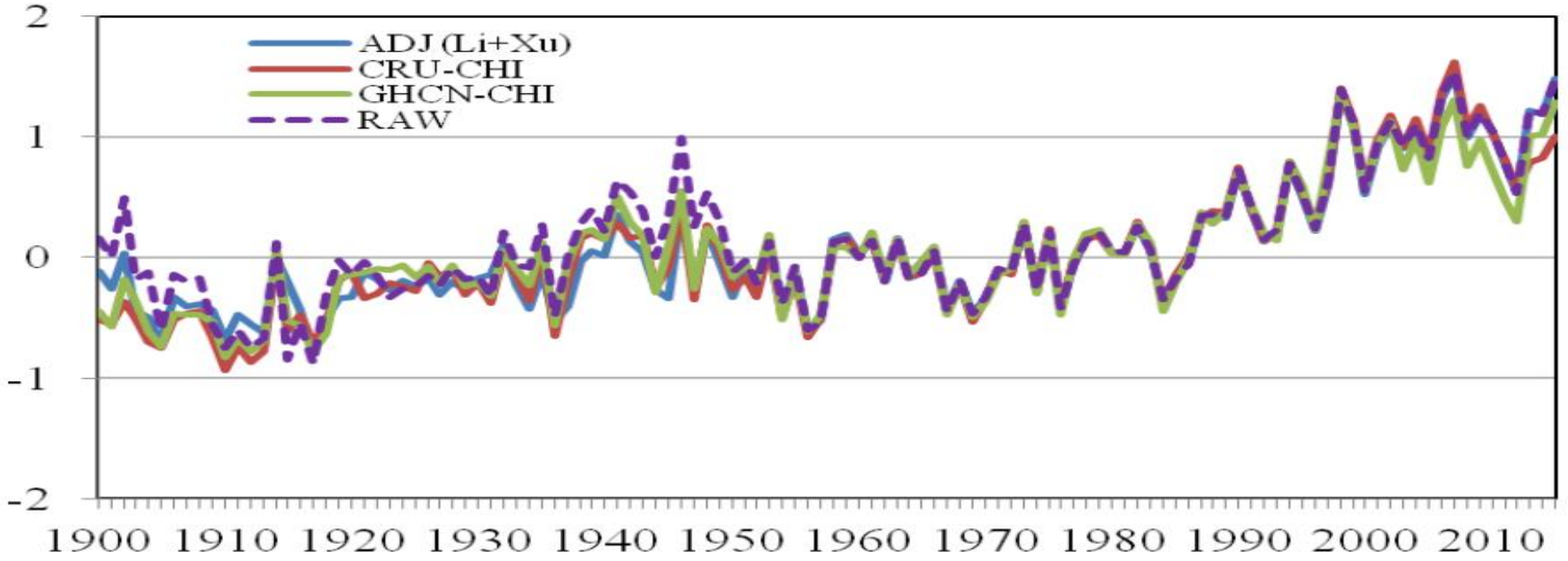
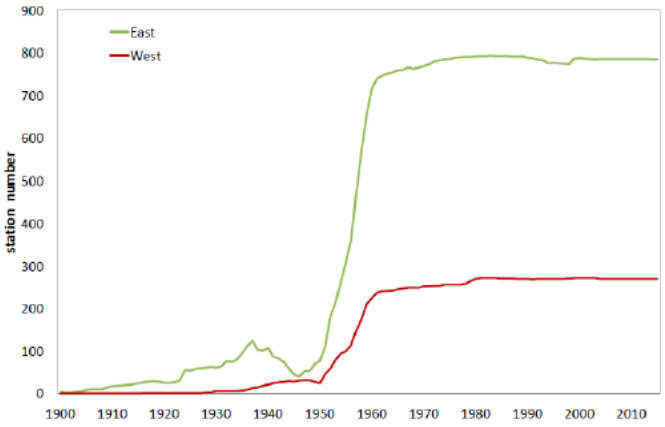


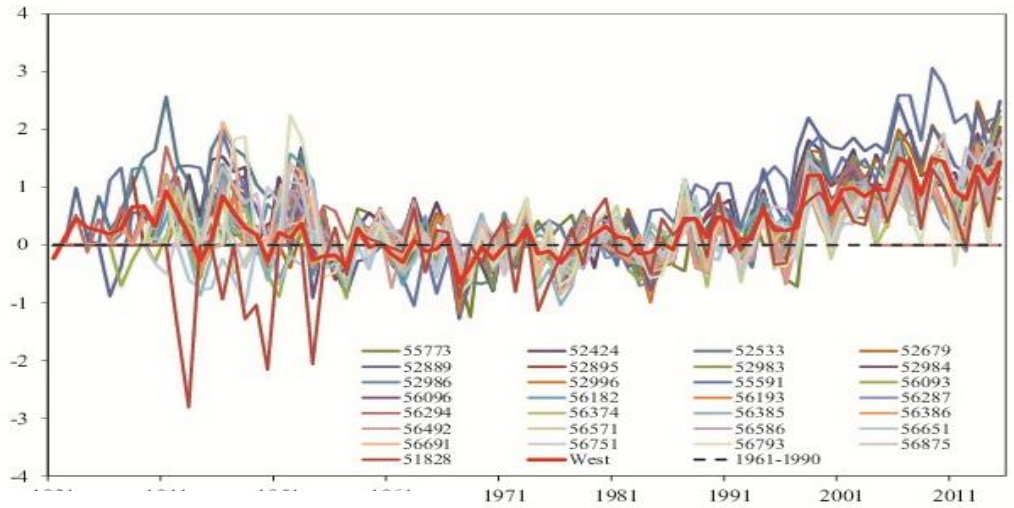
TABLE 2 Comparisons of the raw and homogenized SAT trends during different periods (unit: °C /10a)

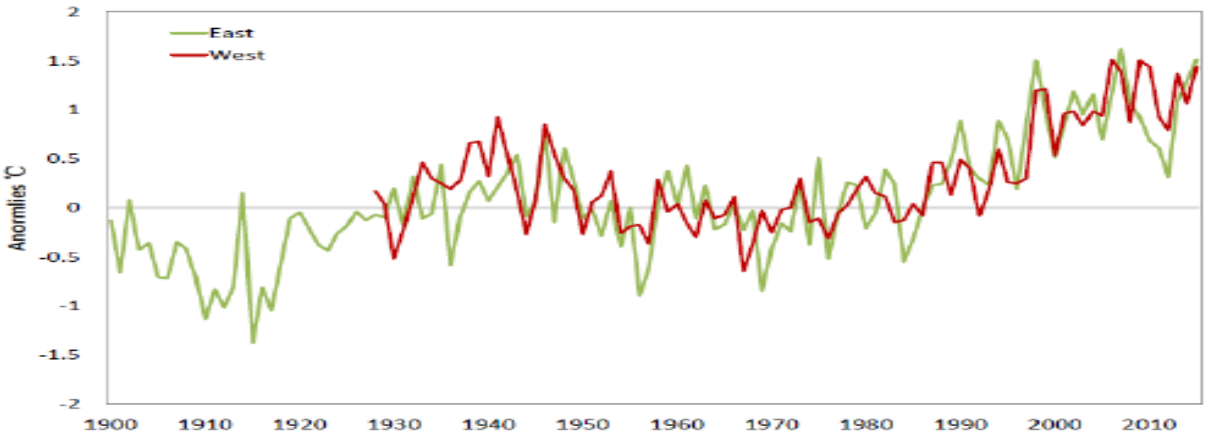
	1900-2015	1951-2015	1979-2015	1998-2015
RAW	0.107±0.010	0.247±0.021	0.381±0.045	0.059±0.13
ADJ	0.121±0.009	0.244±0.021	0.379±0.044	0.079±0.13
CRUTEM4	0.130±0.009	0.243±0.021	0.348±0.051	-0.171±0.14
GHCN	0.114±0.009	0.215±0.021	0.297±0.049	-0.093±0.14

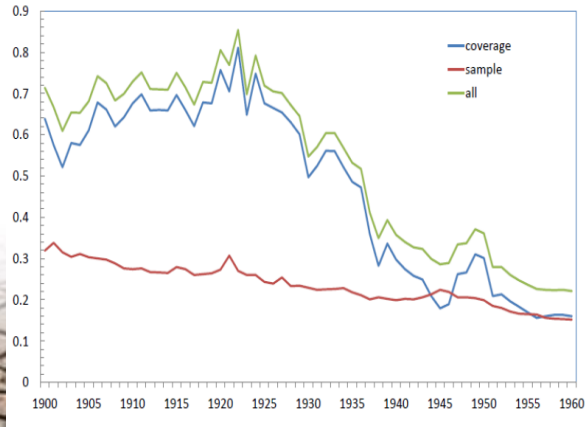
Reconstruction of eastern and western China SAT series

East (1900-), West(1928-), have good agreement on decadal changes; Lager uncertainties before 1950,due to data coverage.



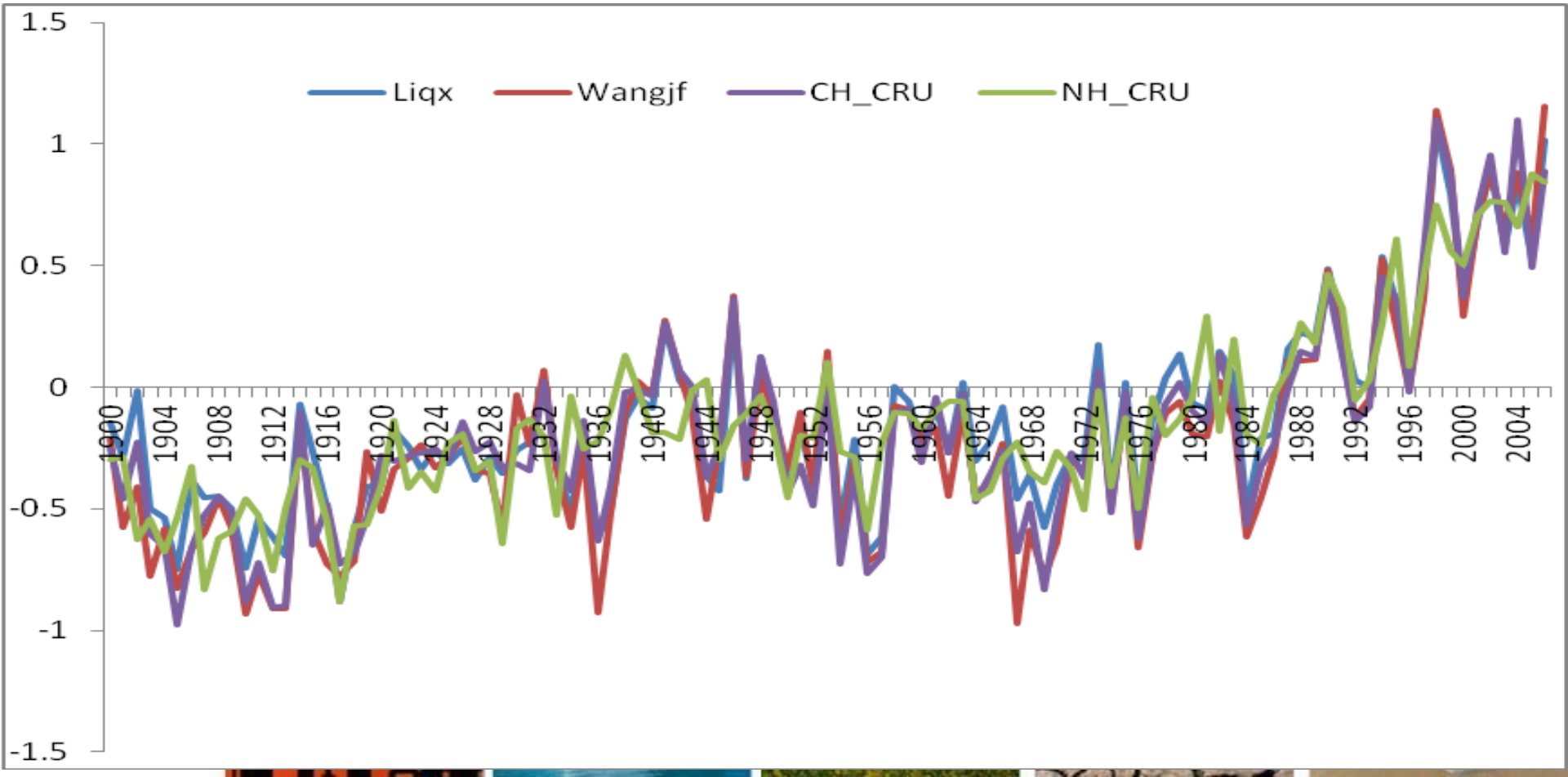






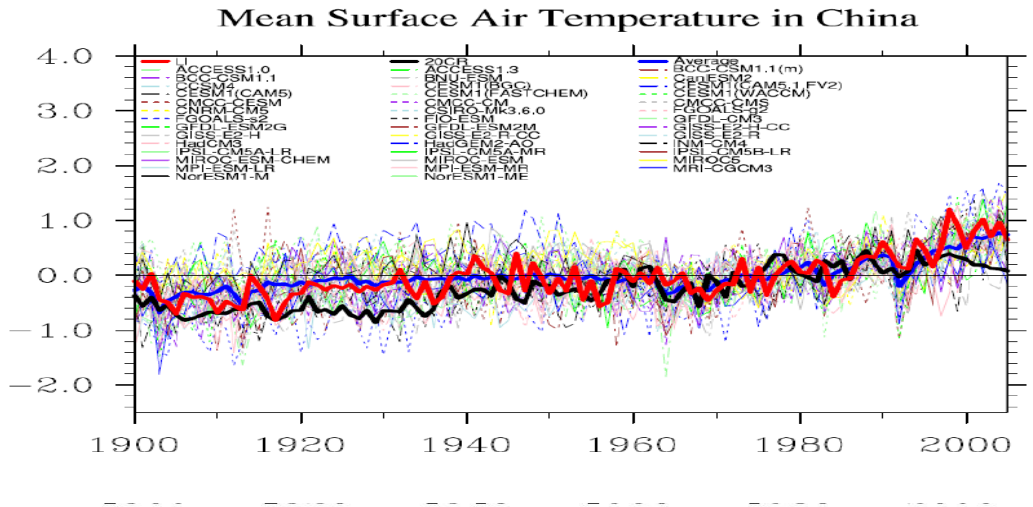
Truth 1) Data homogenization and biased sample rectification decreased the huge differences.

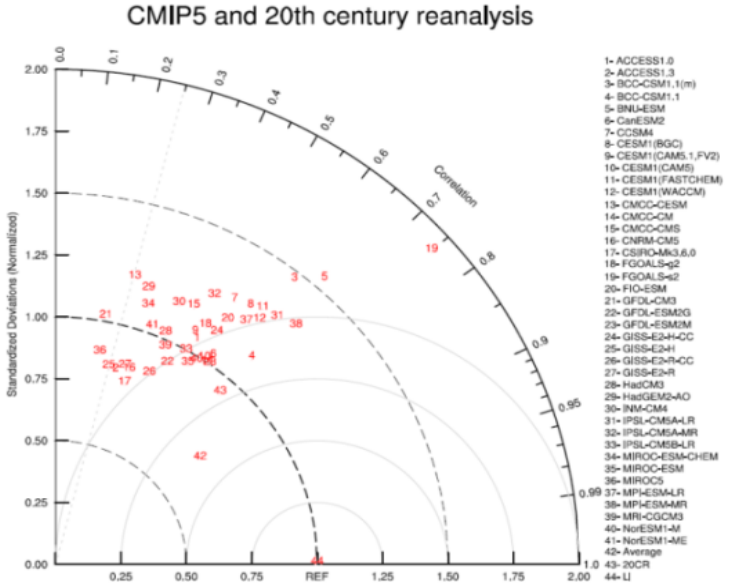
Agrees much more when using homogenized data and sample rectification by surrounding stations (Li et al, 2010) or statistical method (Wang et al, 2014)

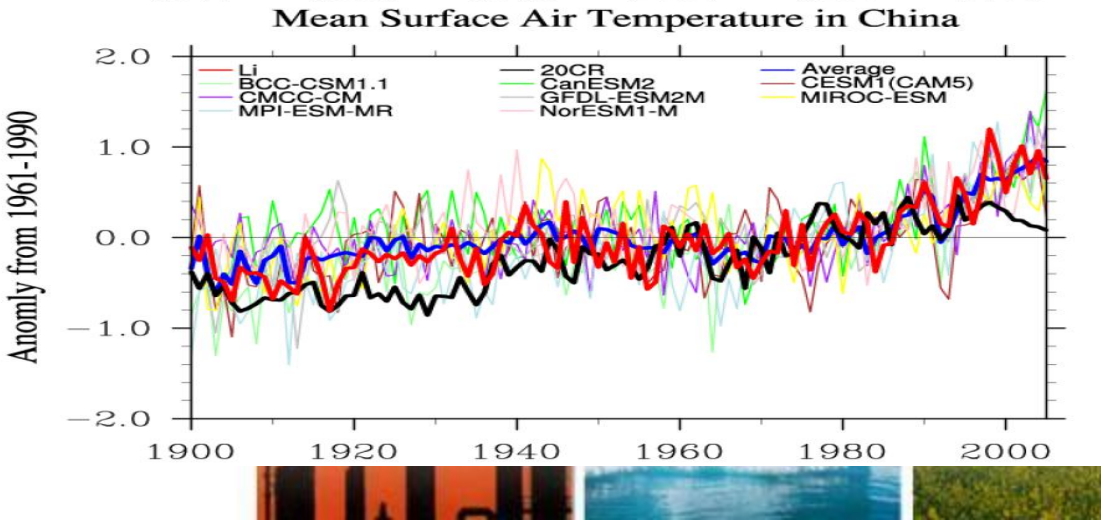


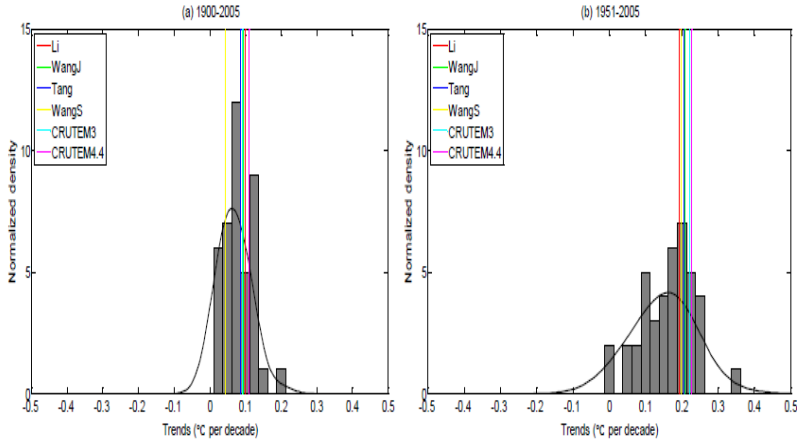
Truth 2) Models simulate the Chinese SAT change fair well

in both decadal changes (below) and long-term trend (right)









outline

- A brief introduction for comparison of Chinese SAT series since 1900.
- Development of CMA-LSAT, another contribution to the baseline climate dataset development and global SAT change monitoring.

Why develop a new dataset?

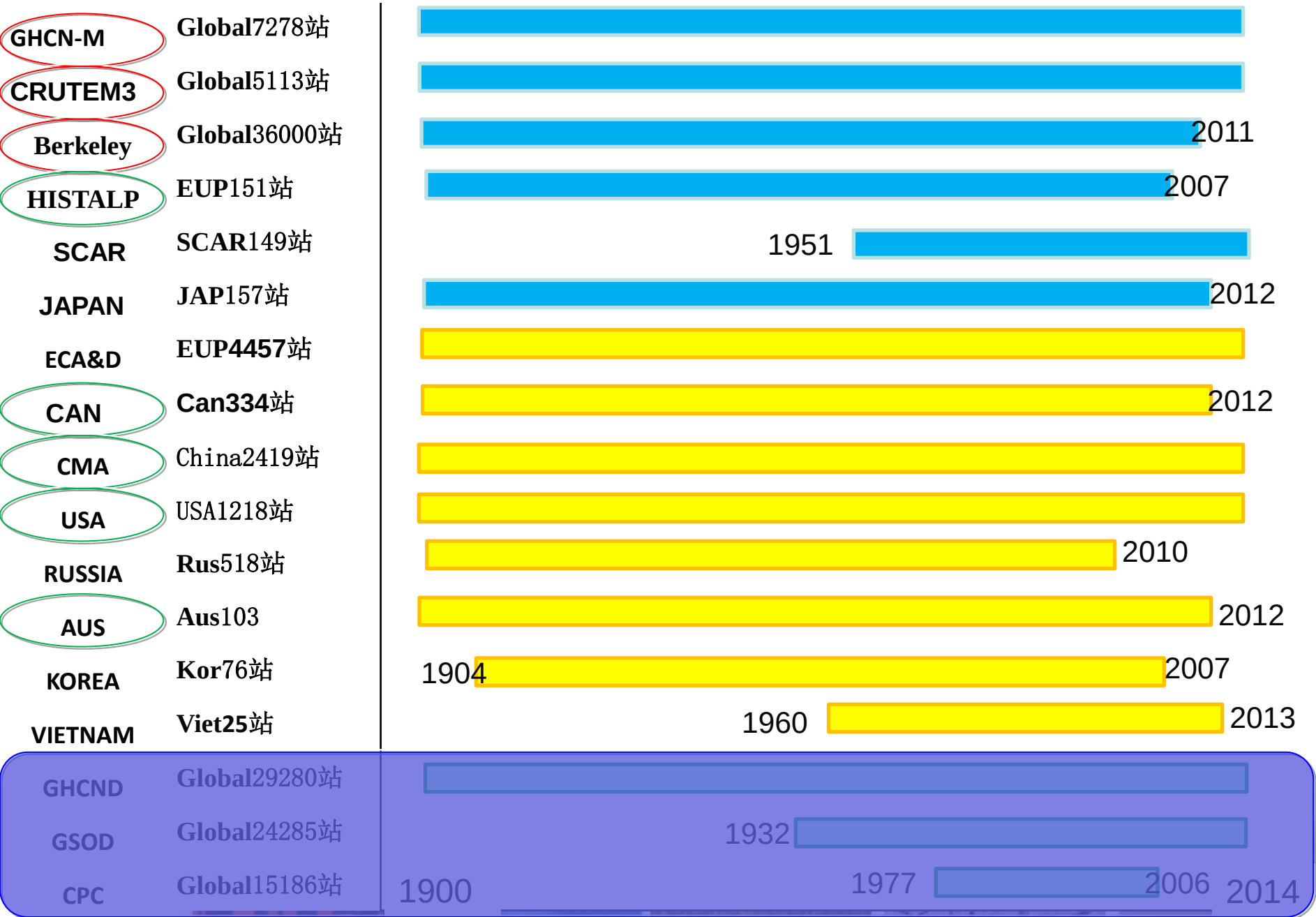
As the most important ECV, SAT needs further studies: in climate change detection and as the references to validate remote sensing, reanalysis, and other climate data products, etc.

IPCC WG1 continuously report the global SAT series in each ARs; agree more and more with each other in global scales, but still don't well enough in continental and national scales.

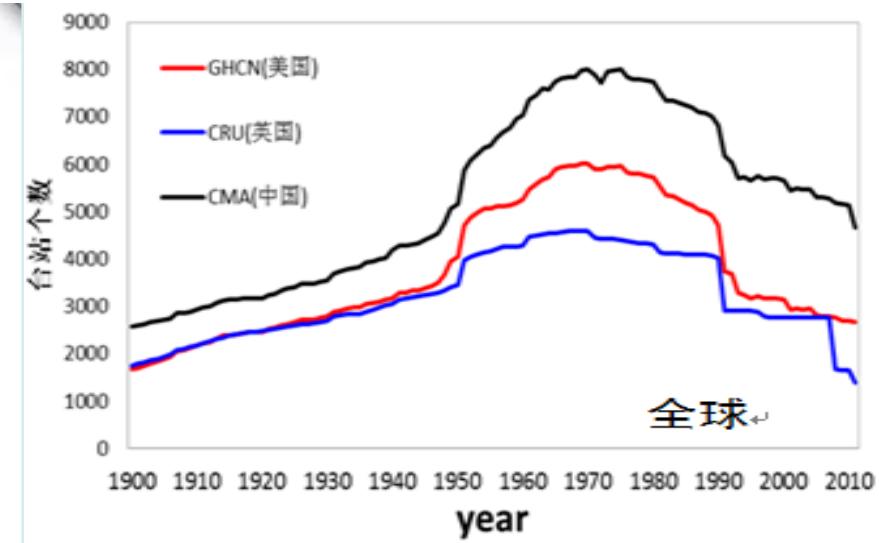
Much effort has been made in this aspect (e.g. Jones, 2016 in Adv Atmos Sci; and Victor are developing the national series for the global and countries).

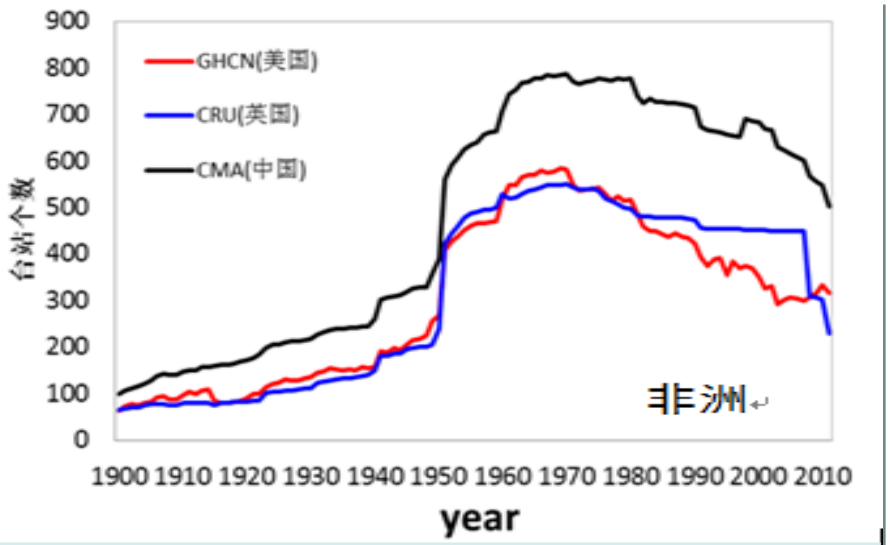
In this study, we: 1) aim to develop a new dataset that can better represent the changes at both global and regional scales. 2)The major advance in this dataset, relative to other global LSAT datasets, is the improved coverage in Asia.

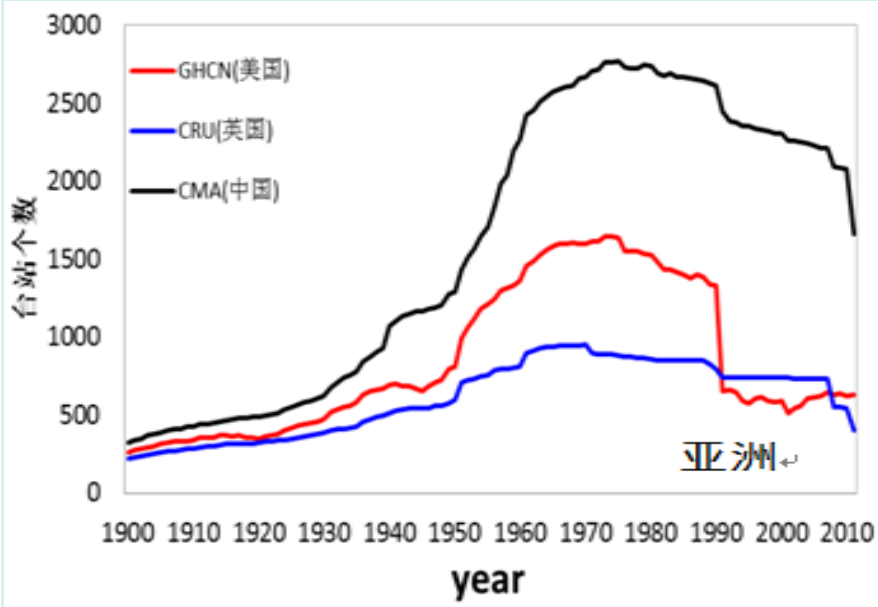
surface air temperature data sources

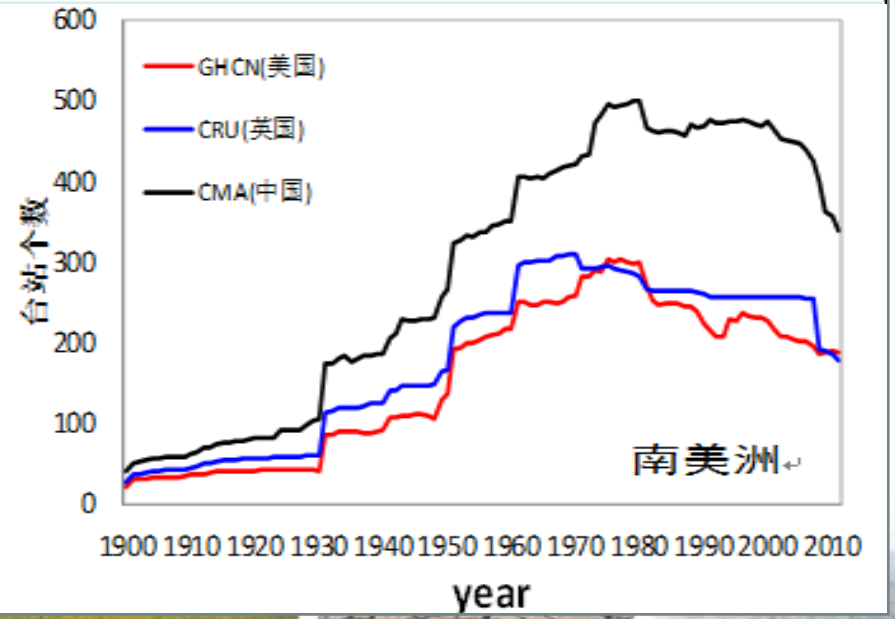


Station numbers comparison with other datasets

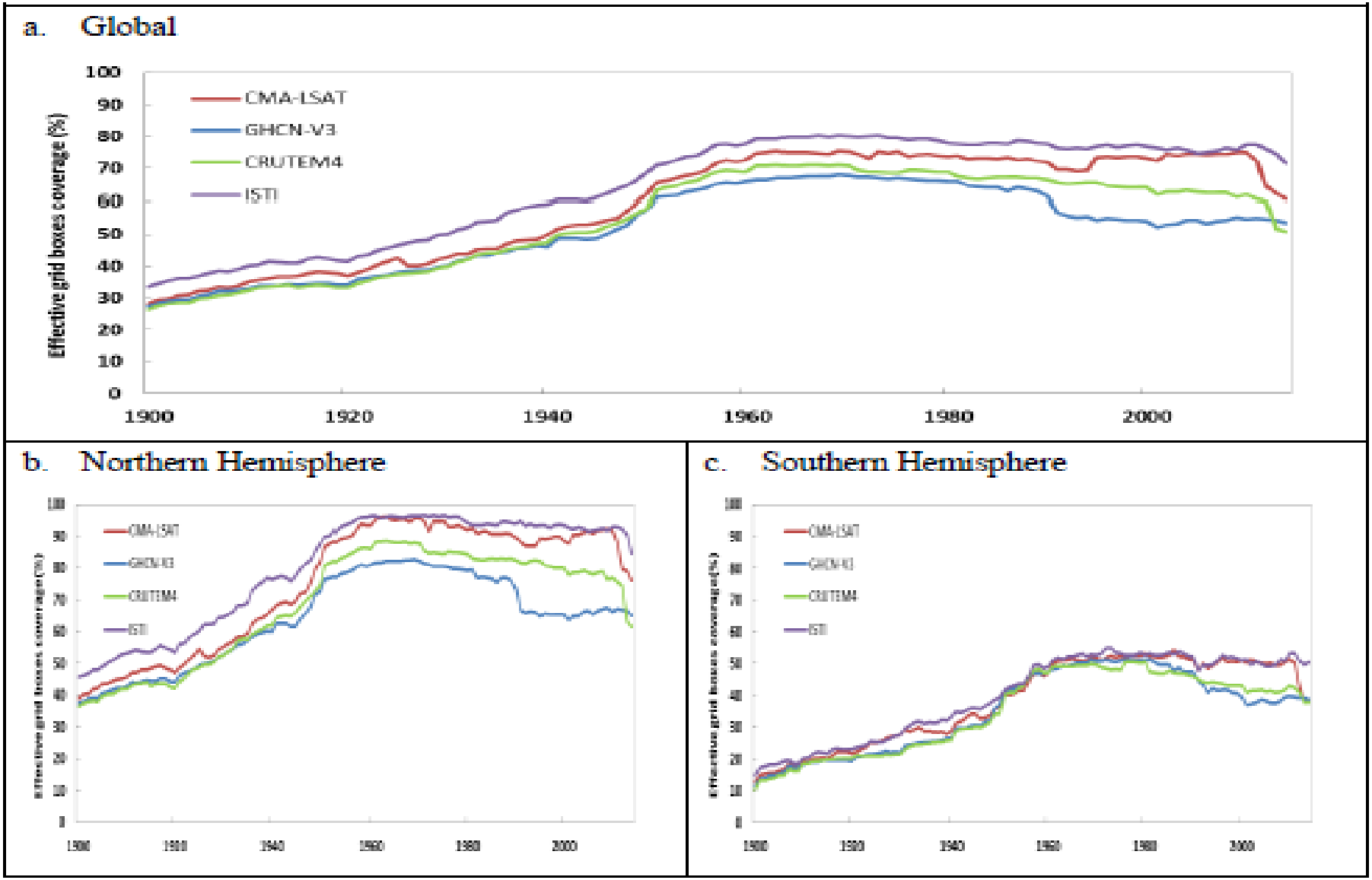








Grid numbers (coverage) comparison



Quality control

Step 1: Repetition Test

Step 2:Climate Anomaly Test

Step 3: Space consistency Check

Step 4: Internal Consistency Check

Step 1

```
USW00025704   19810701      1.3 1 0 0
USW00025704   19810702      1.3 1 0 0
USW00025704   19810703      1.3 1 0 0
USW00025704   19810704      1.3 1 0 0
USW00025704   19810705      1.3 1 0 0
USW00025704   19810706
USW0
USW0
USW0
USW0
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USW0
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USW00025704   19810720
USW00025704   19810721
USW00025704   19810722
USW00025704   19810723
USW00025704   19810724
USW00025704   19810725
USW00025704   19810726
USW00025704   19810727
USW00025704   19810728
USW00025704   19810729
USW00025704   19810730
USW00025704   19810731      1.3 1 0 0
```

Step 2

主要检验历

Step 3

$|Z$

$|Z$

Step 4

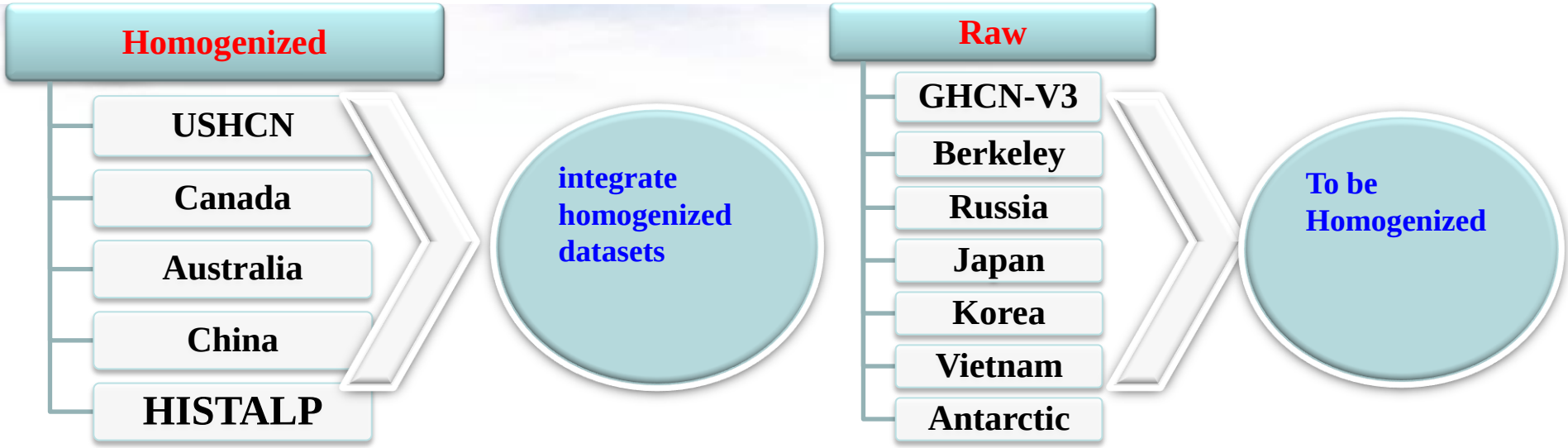
Stdnum	Time	Tmax	Tmin	Tavg
60714654000	20040400	16.3	10.7	10.7
61710962000	19961200	0.9	-4.5	-4.5
62316061000	19540300	9.1	3.0	9.8
62316061000	19540400	12.4	5.1	12.5
62316061000	19540600	21.9	13.3	22.0
62316061000	19540700	22.9	14.3	23.3
62316061000	19550200	5.5	-0.4	5.6
62316061000	19550300	7.4	1.1	8.2
62316061000	19550500	18.6	9.9	18.8
62316061000	19550600	20.8	13.0	21.6
62316061000	19550700	24.5	16.4	24.7
62316061000	19560400	10.7	4.0	11.7
62316061000	19560600	20.4	11.8	20.8
62316061000	19560700	23.8	15.7	23.9
62316061000	19570100	6.3	0.2	0.0
62316061000	19570400	12.8	5.8	13.0

其中，Z_i 为目标站标准化气温，Z_{ij} 为目标站300公里内邻近站（最多20个）的标准化气温，$\overline{Z_{ij}}$ 为邻近站标准化气温的平均，σ_{ij} 为邻近站标准化气温的标准差。





Integration and Homogenization

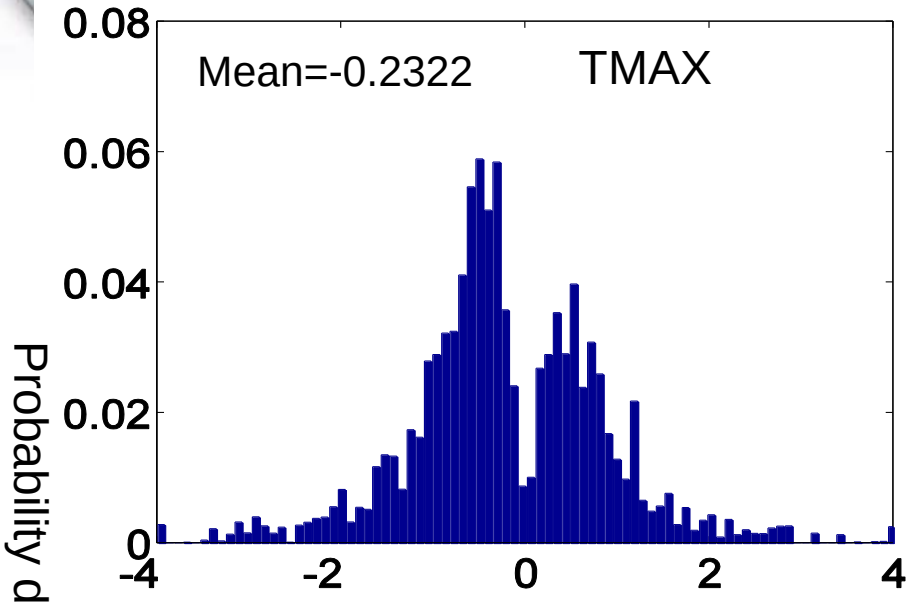


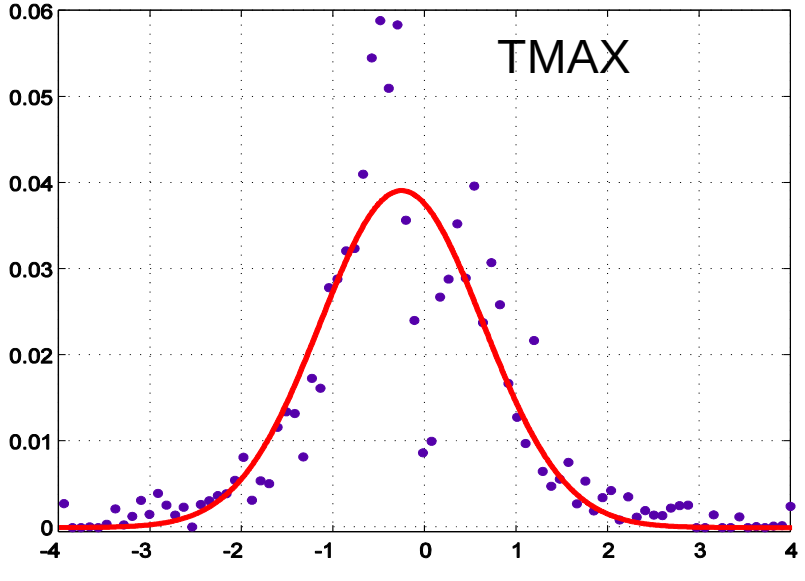
Homogenization Method:

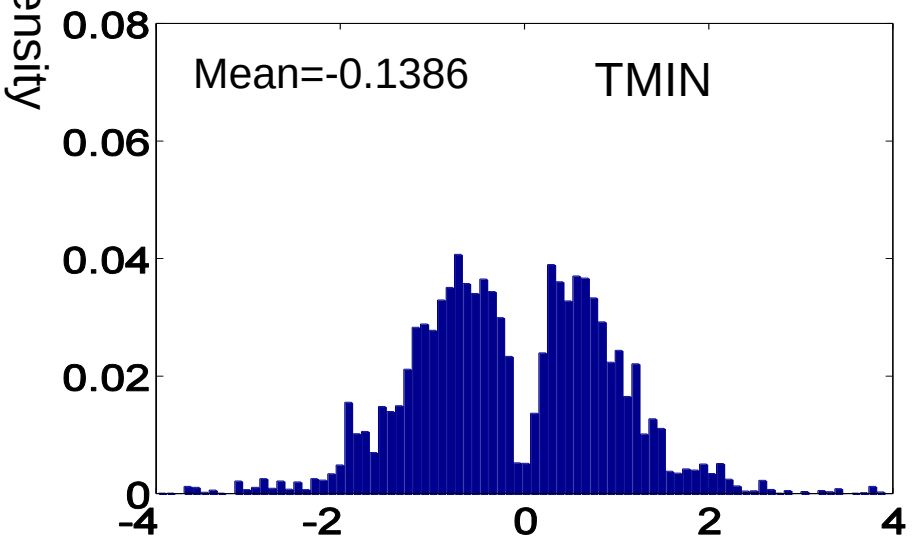
The RHtestsV4 software package

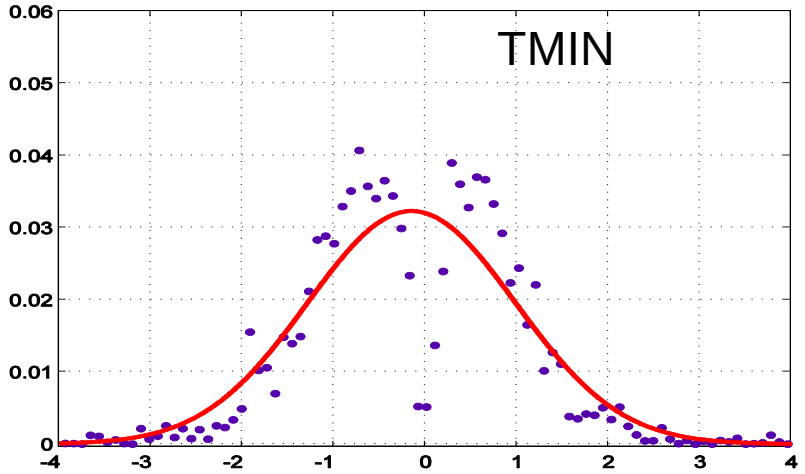
This package includes two algorithms: the PMTred algorithm is based on the penalized maximal t test (PMT) [Wang et al., 2007] and the PMFred algorithm is based on the penalized maximal F (PMF) test [Wang, 2008b].

Statistics of adjustment





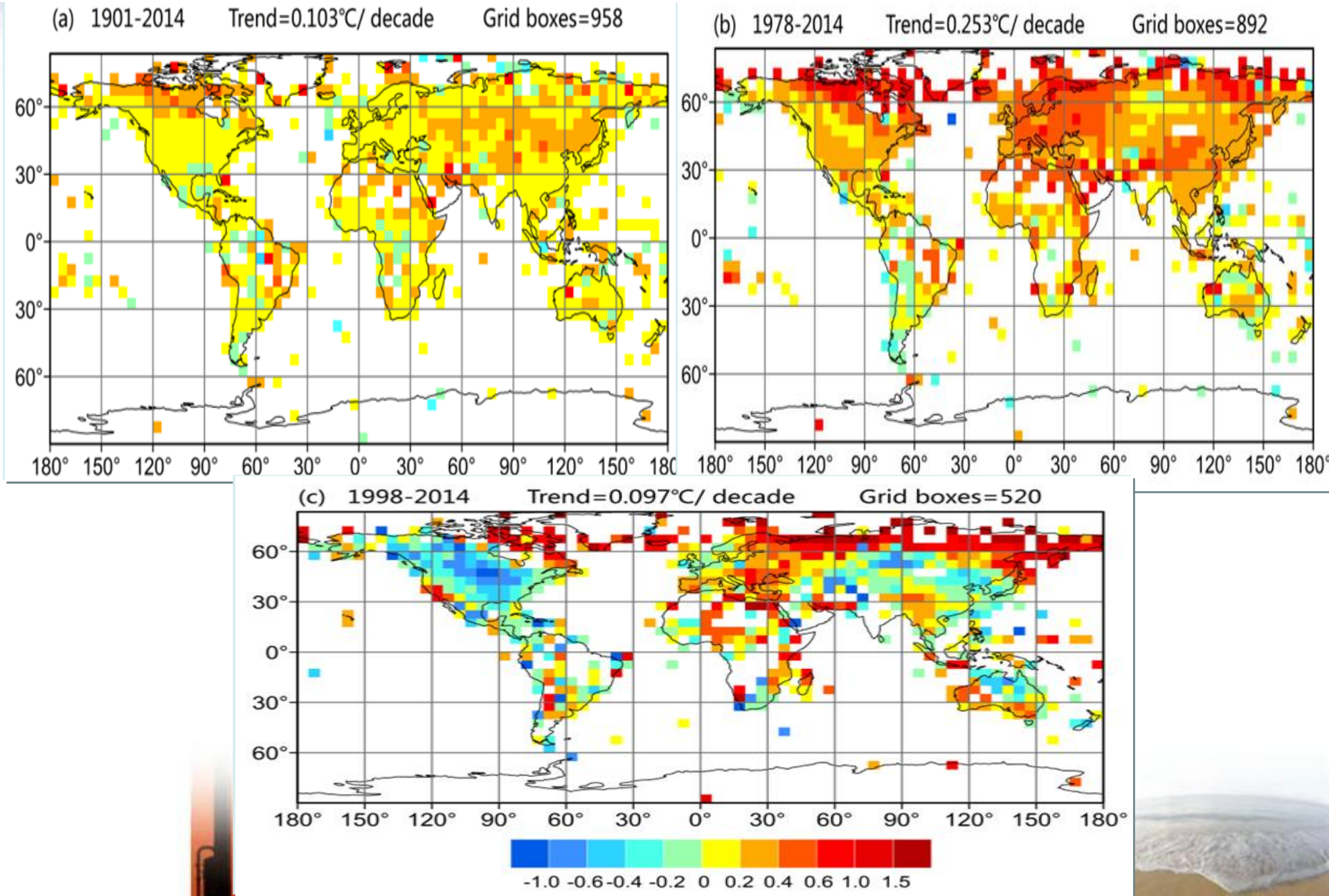




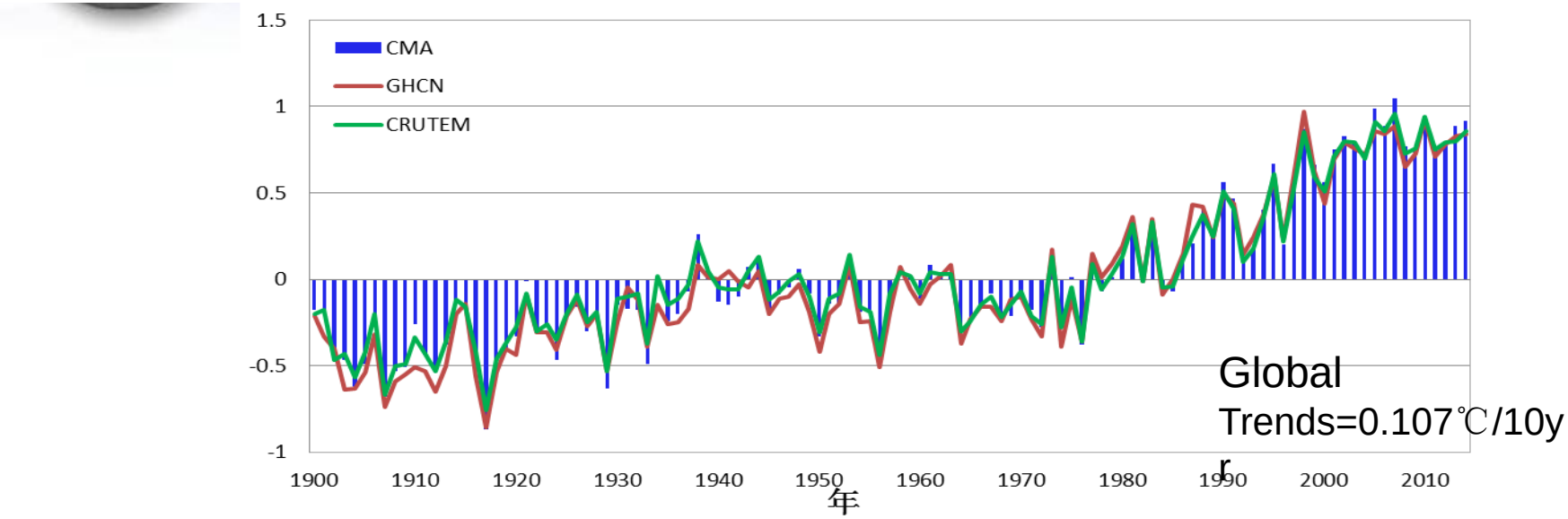
Adjustment(℃)

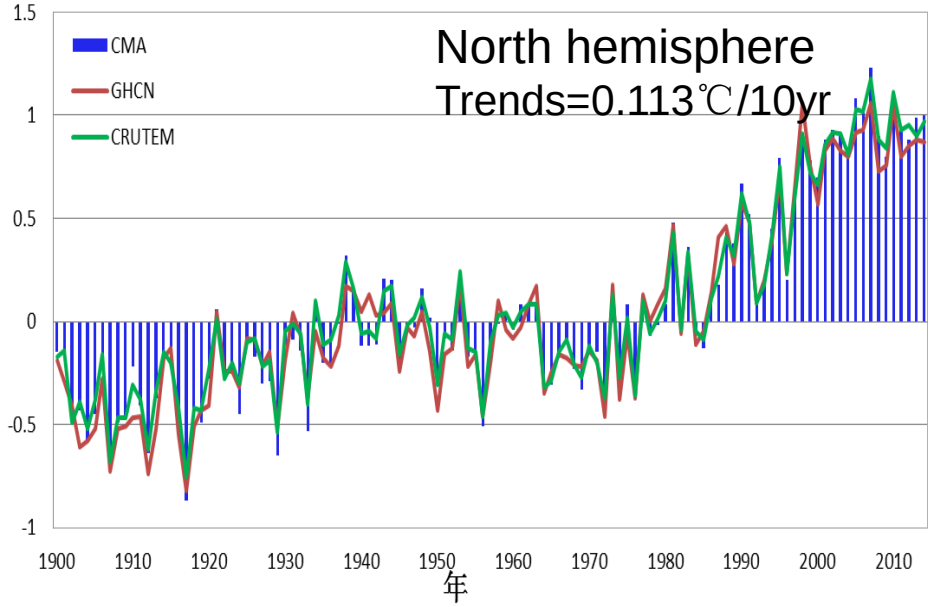
Adjustment(℃)

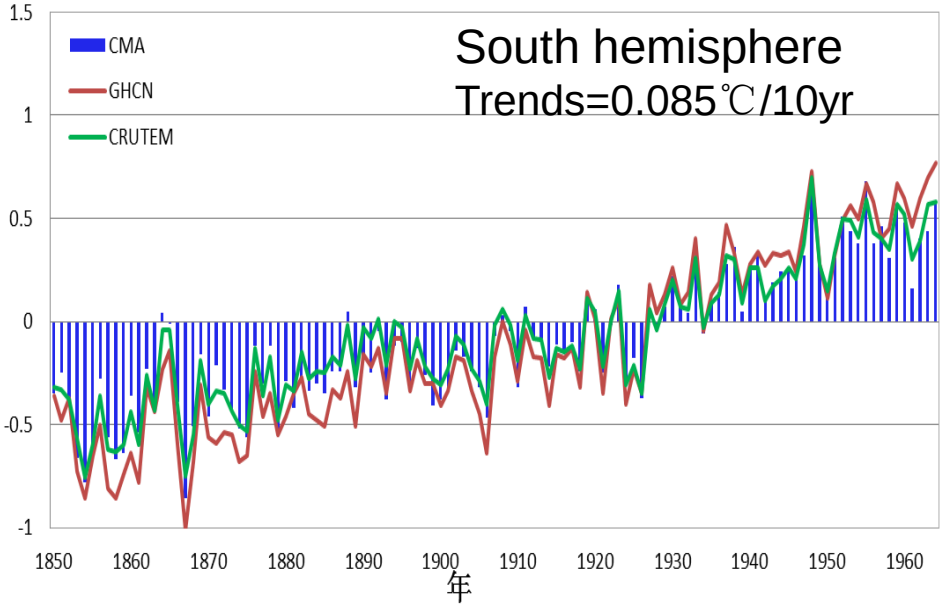
Trends in global LSAT over different periods



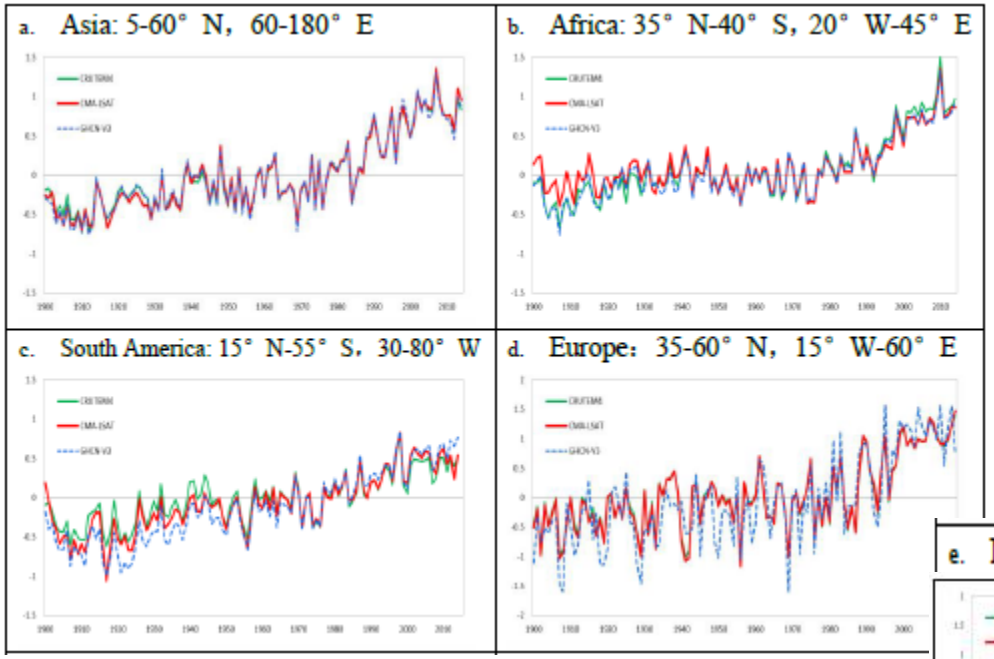
Global and Hemispheric temperature anomaly series

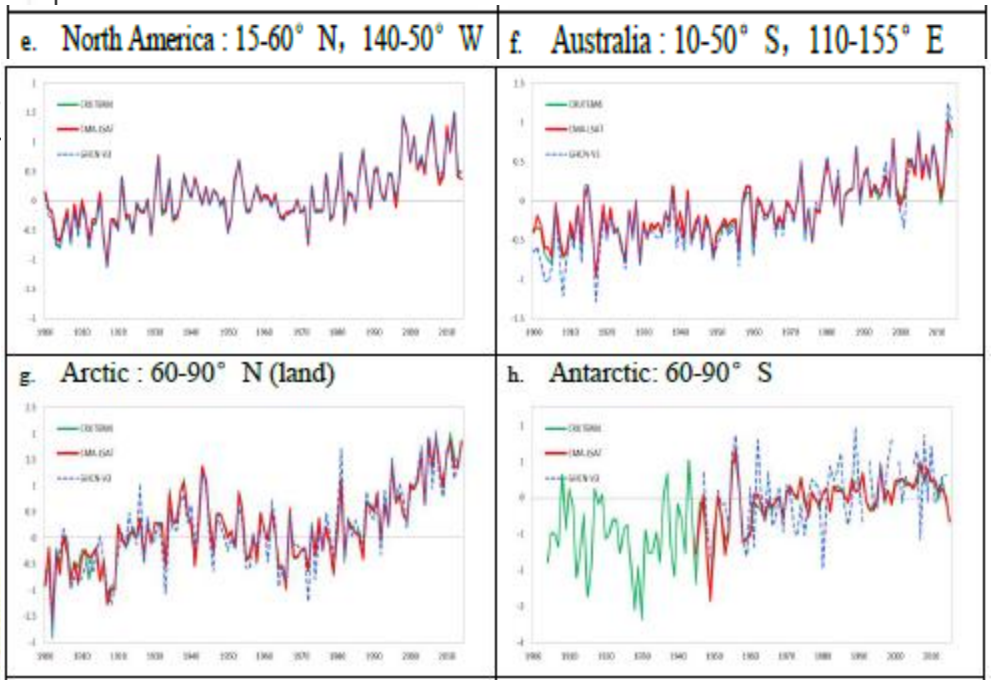




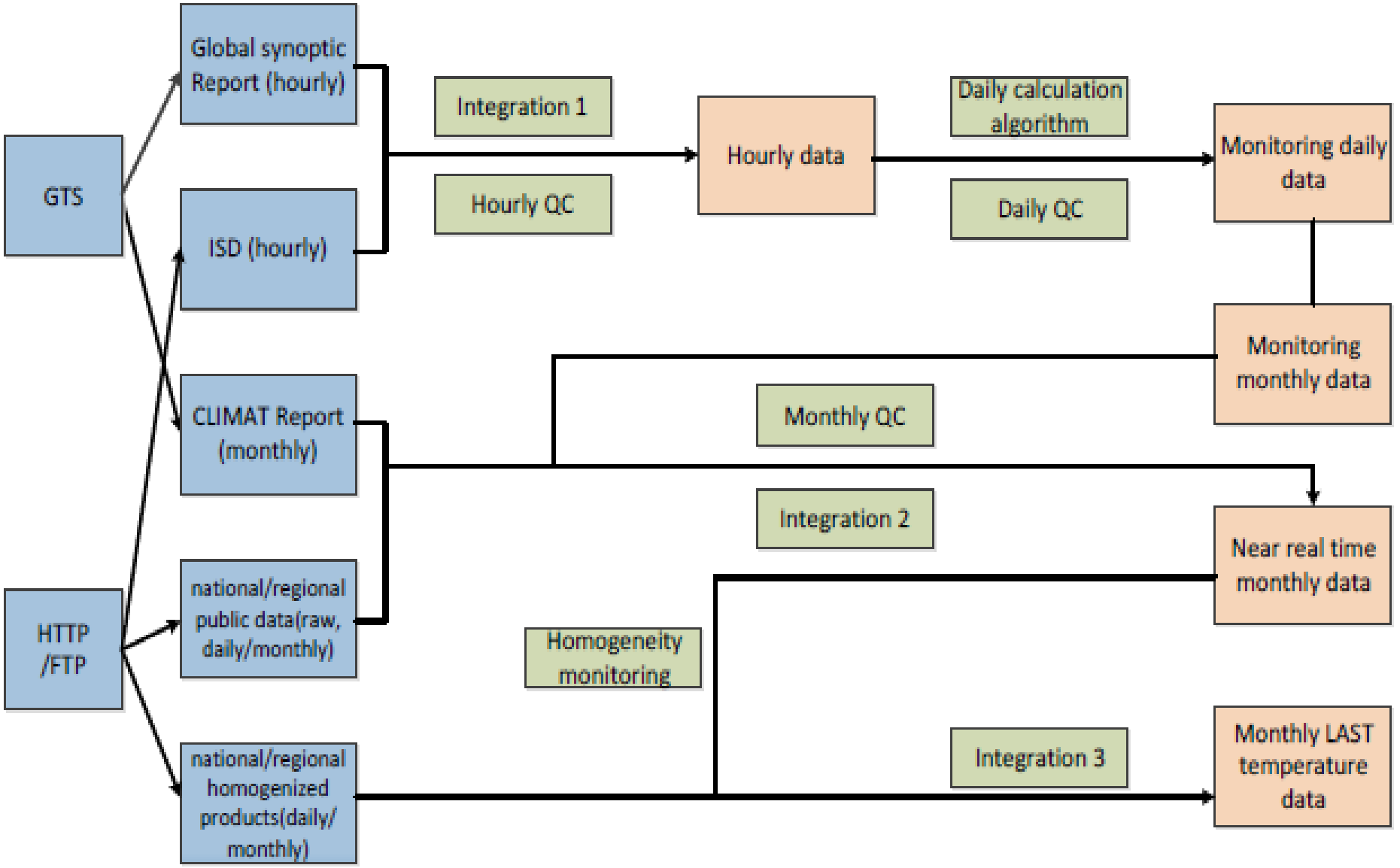


Continental and regional temperature anomaly series

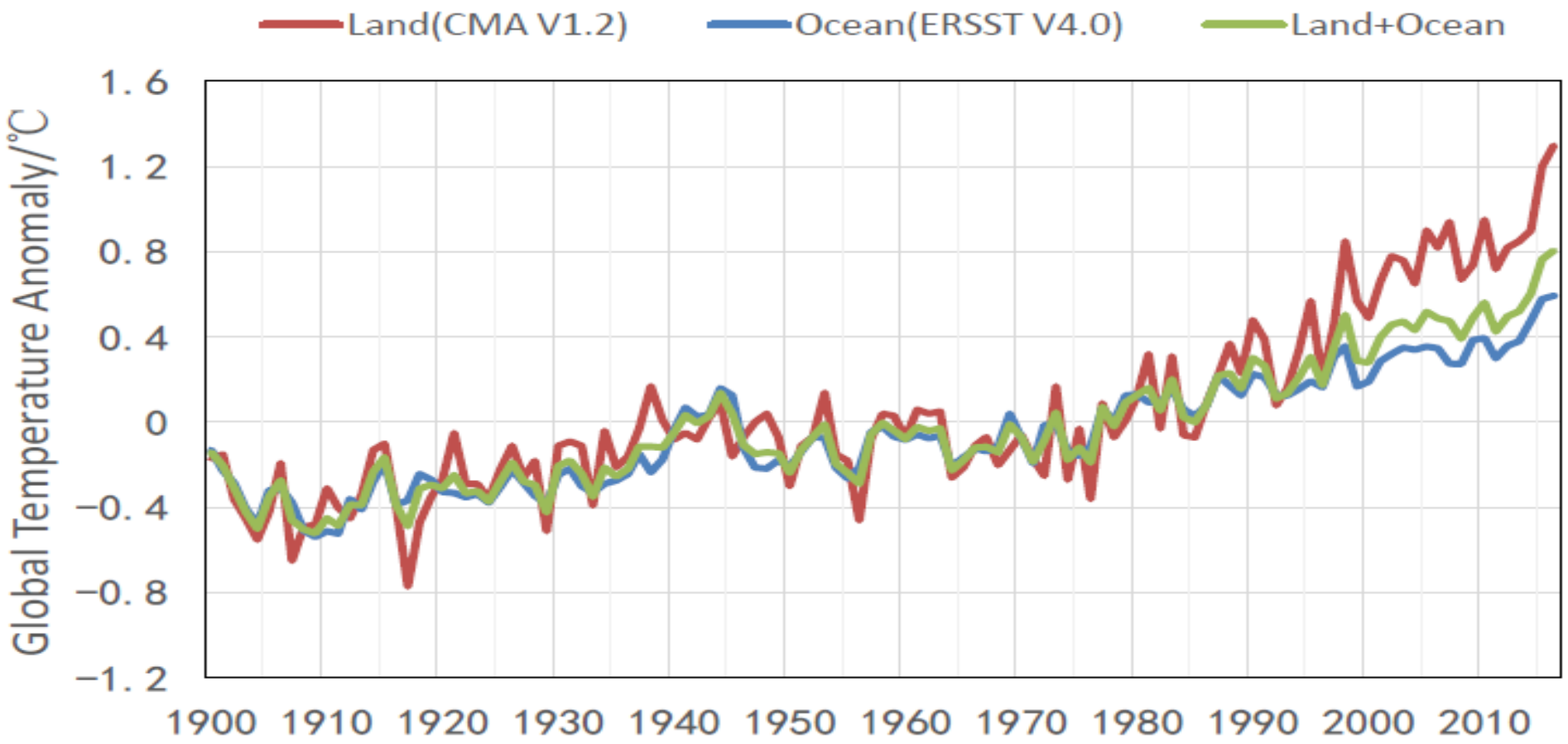




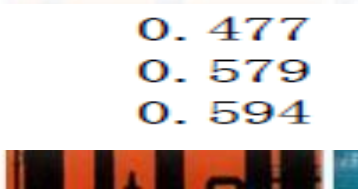
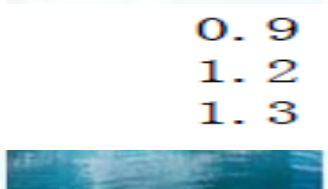
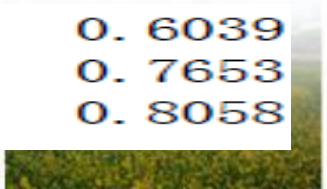
Near-real-time integration and updating procedures for CMA-LSAT



2016: the warmest year



Year	Ocean	land	Land+Ocean
2014	0.477	0.9	0.6039
2015	0.579	1.2	0.7653
2016	0.594	1.3	0.8058

THANK YOU!