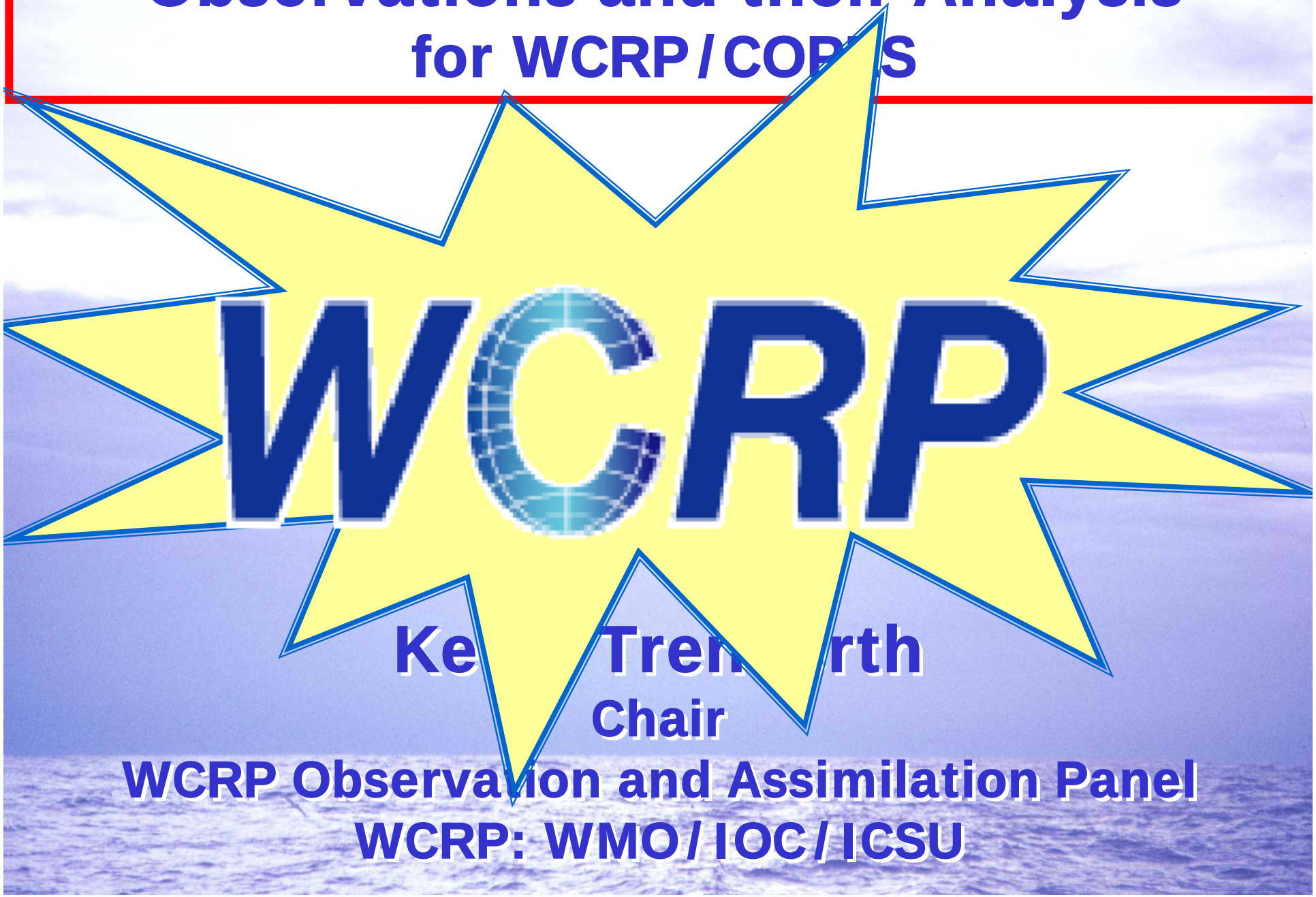
Observations and their Analysis
for WCRP/COP[illegible]S



Ke[illegible] Tren[illegible]rth
Chair
WCRP Observation and Assimilation Panel
WCRP: WMO/IOC/ICSU

Opportunity Lost?

"To advance our understanding of the causes and effects of global change, we need new observations of the Earth. These measurements must be global and synoptic, they must be long-term, and different processes must be measured simultaneously

* **Long-term continuity is crucial**. A 20-year time series of the crucial variables would provide a significant improvement in our understanding

* Now we are on the verge of establishing a global system of remote sensing instruments and Earth-based calibration and validation programs. Together, these space- and Earth-based measurements can provide the necessary data.

Earth System Science Committee, 1985

World Climate Research Programme

WCRP

Climate Observations

Recognizing the affiliation and role of AOPC, OOPC and GCOS as key parts of WCRP, the WOAP is established as a complementary Panel (to the Modeling Panel) to foster and promote synthesis of observations.

WCRP Observation and Assimilation Panel

First meeting 1-3 June 2005, New York
Second meeting will be 28-30 August 2006, Italy
WOAP is WCRP point of contact for GEOSS

TOR for WOAP: paraphrased

- Identify climate **observational requirements**
- Help **optimize** observations
- Act as a **focal point** for WCRP interactions with other groups
- Promote and coordinate **analysis, reprocessing, reanalysis and assimilation**
- Promote and coordinate **information and data management** activities, including web sites.

Observations include those from space platforms.

WOAP-1

Reanalyses

- Establish a clearing house for reanalyses
- Develop strategy of staggering analyses, coordination
- Advocacy
- Progress in building the basic dataset
- Document rationale for reanalyses: atmosphere, ocean, land, ice, stratosphere, coupled. (Report written)
- Merits, benefits, exploitation of new data

- Explore proposal for a reanalysis workshop to be held at ECMWF end of June 2006.
- Reanalyses Conference: A proposal to hold the next major reanalysis conference in Japan in fall 2007 was passed on and approved.
  Topics will include: Atmosphere, ocean, coupled

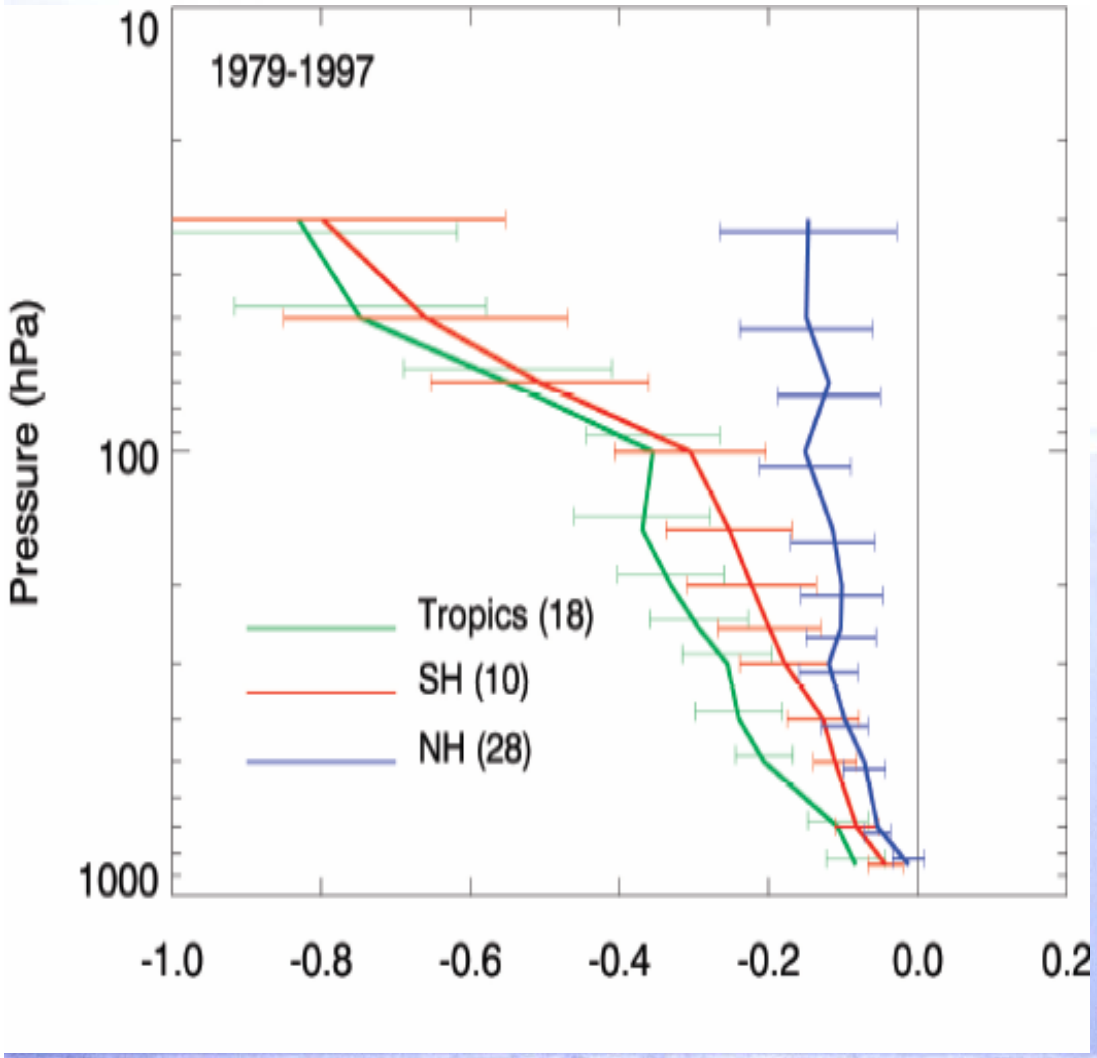
Reanalysis:

The chief outstanding issue:

The underlying data base is not constant, and changes disrupt the climate record.

- There is no baseline **reference** network to anchor the data
- **Radiosondes** improve and change type over time
- **Satellites** only after 1979, last order 5 years, drift in orbit, change instruments, calibration
- **Bias corrections** are applied but remain imperfect
- **Continuity** is a key issue, especially for climate change
- Further **technological development**, change and improvement is expected.
- Major challenge is to deal with **changing observations**

Radiosondes



Spurious cooling trends in sondes from reduced daytime heating:

Trend in ΔT *(00Z-12Z)* during 1979-1997 at LKS stations.

Tropics (30N-30S),

SH (90S-30S),

NH (30N-90N).

Error bars are 1 sigma sampling uncertainty. Figures in parentheses are number of stations used.

Sherwood et al (2005)

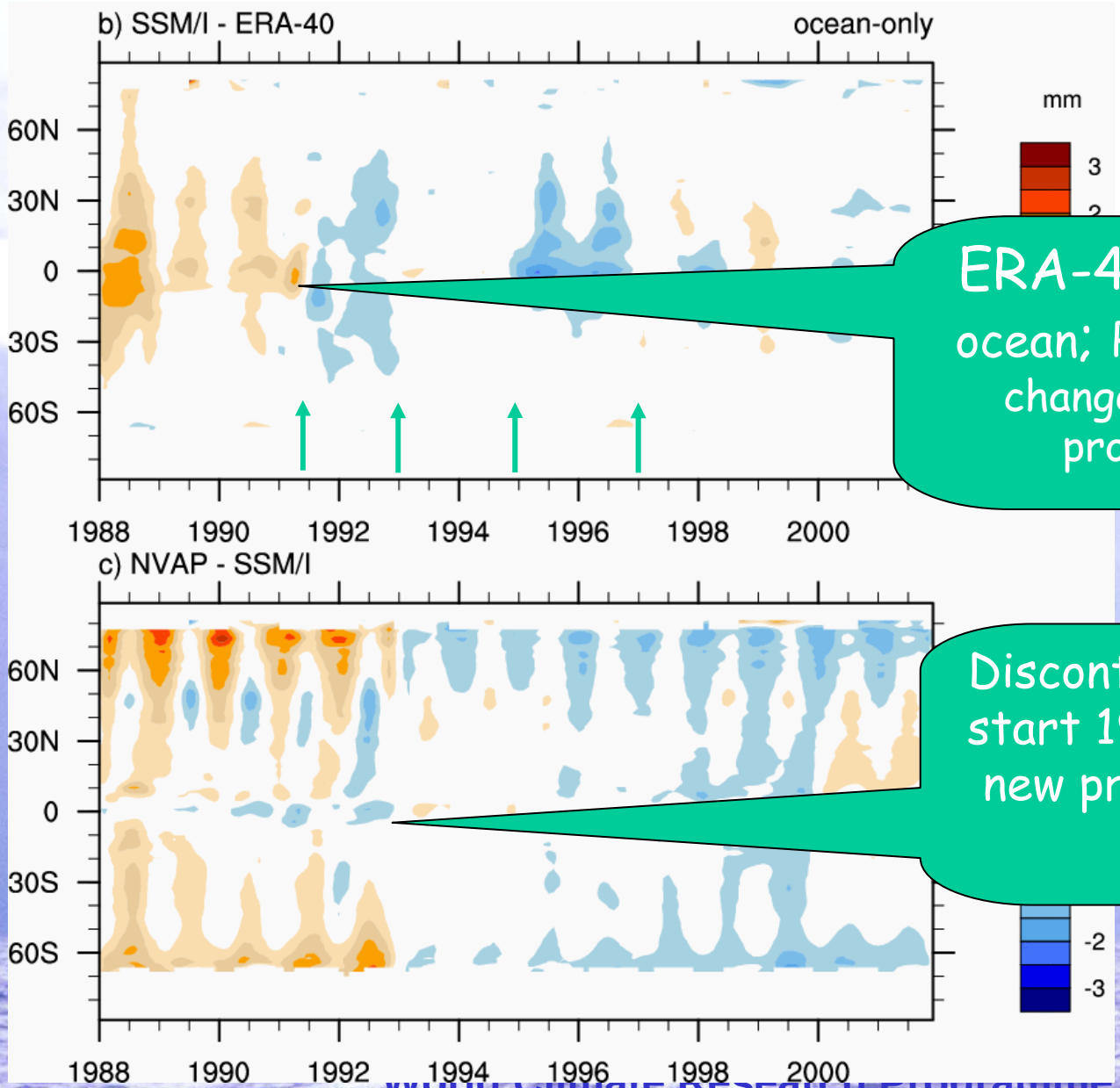
Radiosondes

The main issues with radiosondes are that:

1) They are not sufficiently accurate.
2) They keep changing. At a given station they change type and/or manufacturer. But even the same brand continually changes and evolves.
3) Records of metadata and how the changes have occurred over time are inadequate.
4) Calibration is grossly inadequate.

5) The result has been a fragmented and unreliable record that is of limited value for climate trends.

Water vapor problems



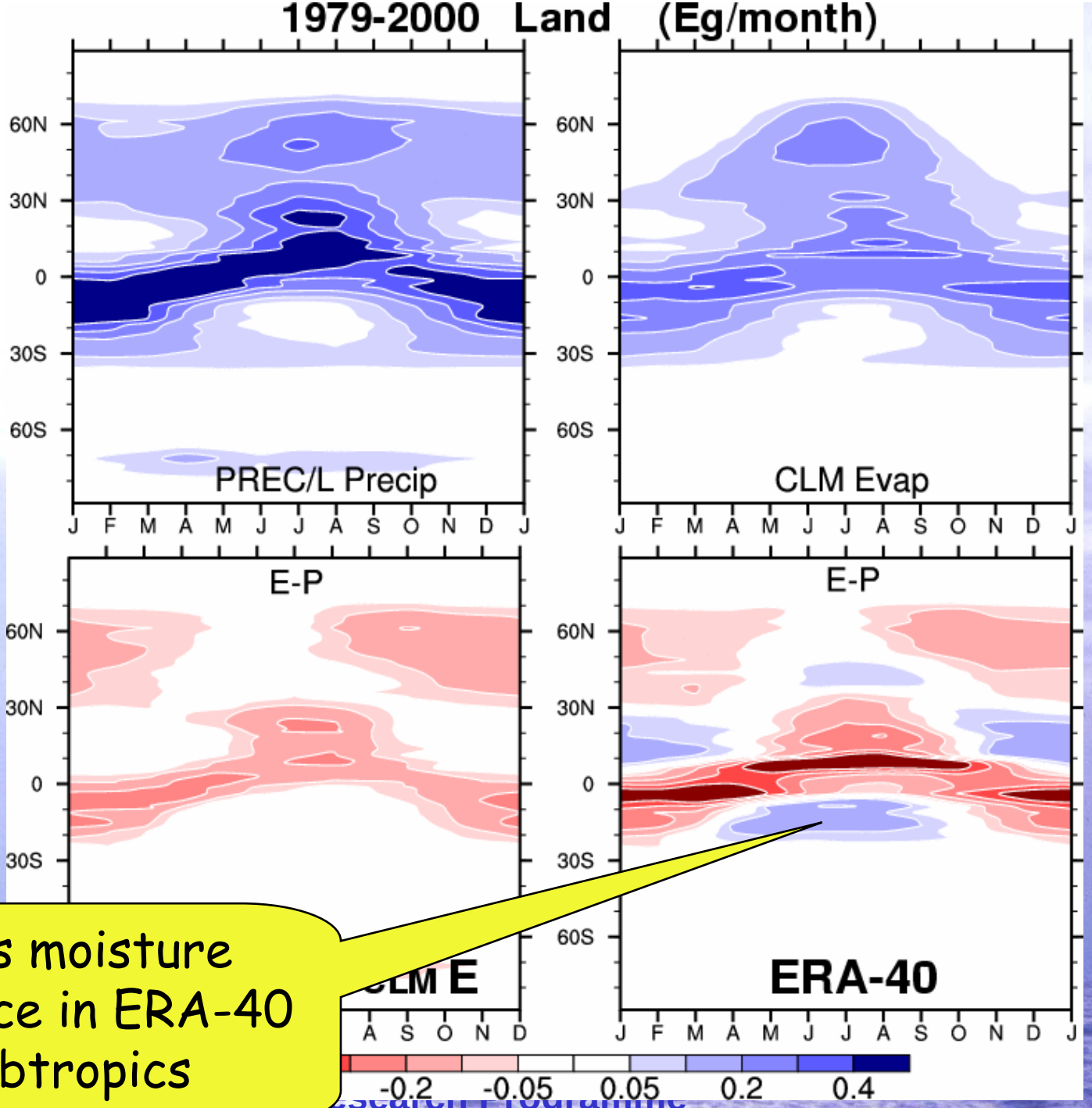
ERA-40 problems over ocean; Pinatubo (Jun 1991), changes in satellites and procedures (1997)

Discontinuities in NVAP at start 1993 and 2000 when new processing system in place

P observed
E from CLM3
⇒ E-P

vs

E-P from ERA-40 atmospheric moisture budget



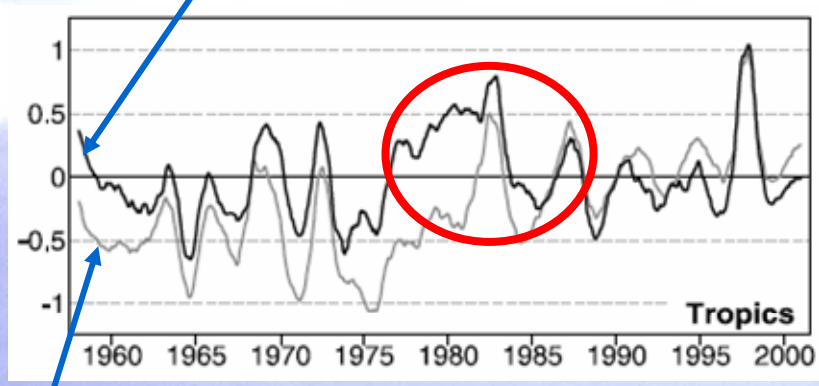
Excess moisture divergence in ERA-40 in subtropics

ERA-40

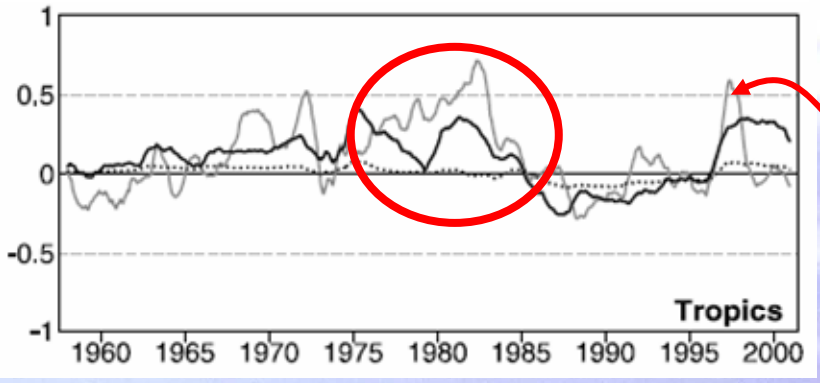
Simmons et al 2005

Bias correction problems:

Analysis



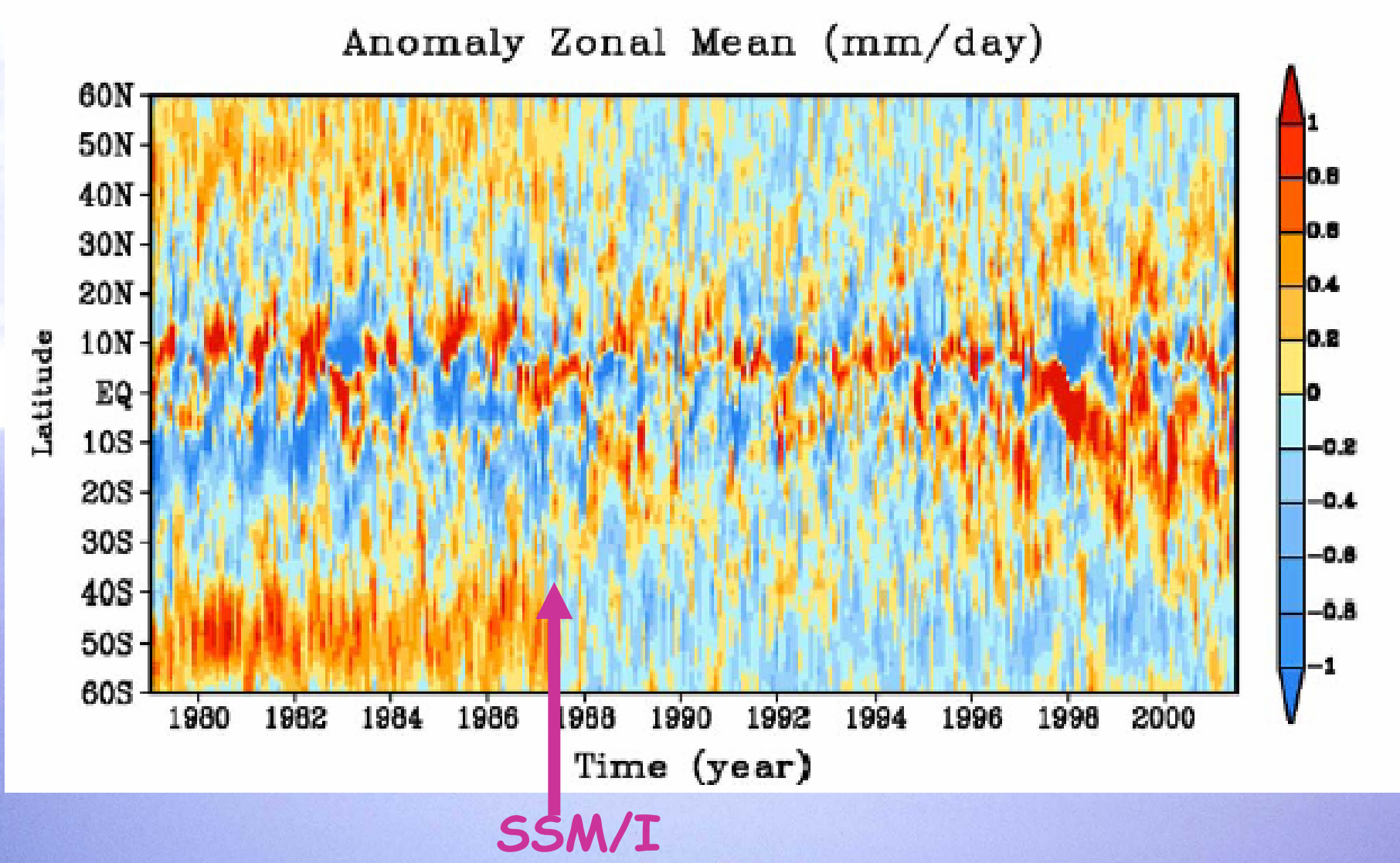
Model with specified SSTs



ERA-40 - NCEP

12-month running means of 500-hPa T anomalies; analyses (black) and model simulation (grey).

Differences background forecasts and sonde observations (black solid), analyses with obs (black dotted) and NCEP/NCAR analyses (grey).



The time variation of monthly zonal mean precipitation in JRA-25 reanalysis as the deviation from the mean annual cycle. Bosilovich et al. (2006)

Conclusion:

Internationally-coordinated reanalysis activities need to be enhanced and sustained by the involved Parties to meet the requirements for monitoring climate trends, to establish ocean reanalysis for the recent satellite era, and to include variables related to atmospheric composition and other aspects of climate forcing.

From: Executive Summary of
"The Second Report on the Adequacy of The Global Observing Systems for Climate in Support of the UNFCCC".

WOAP-1

Reprocessing: assess variables for need and readiness, and commitments. Include in GEOSS.

5 Principles for Re-Processing Climate Data Records

For climate, the value of an observational record increases with time, provided that the record is continuous and homogeneous.

As datasets are used, characteristics of the data and problems are exposed, and often solutions to problems or algorithm improvements are proposed. This is especially the case for satellite measurements.

Accordingly, **re-processing** of the record should be an integral part of the process of creating a **climate data record**.

Principles for Re-Processing Climate Data Records

1. Re-processing of climate data records should be motivated by a **scientific goal**, a specific use of the data that requires a demonstrated improvement over the currently available version or becomes possible because of improvements that can be achieved by re-processing.

2. Before re-processing commences, problems in the data record should have been identified and investigated to determine the causes of the problems and fixes or improvements should have been developed.

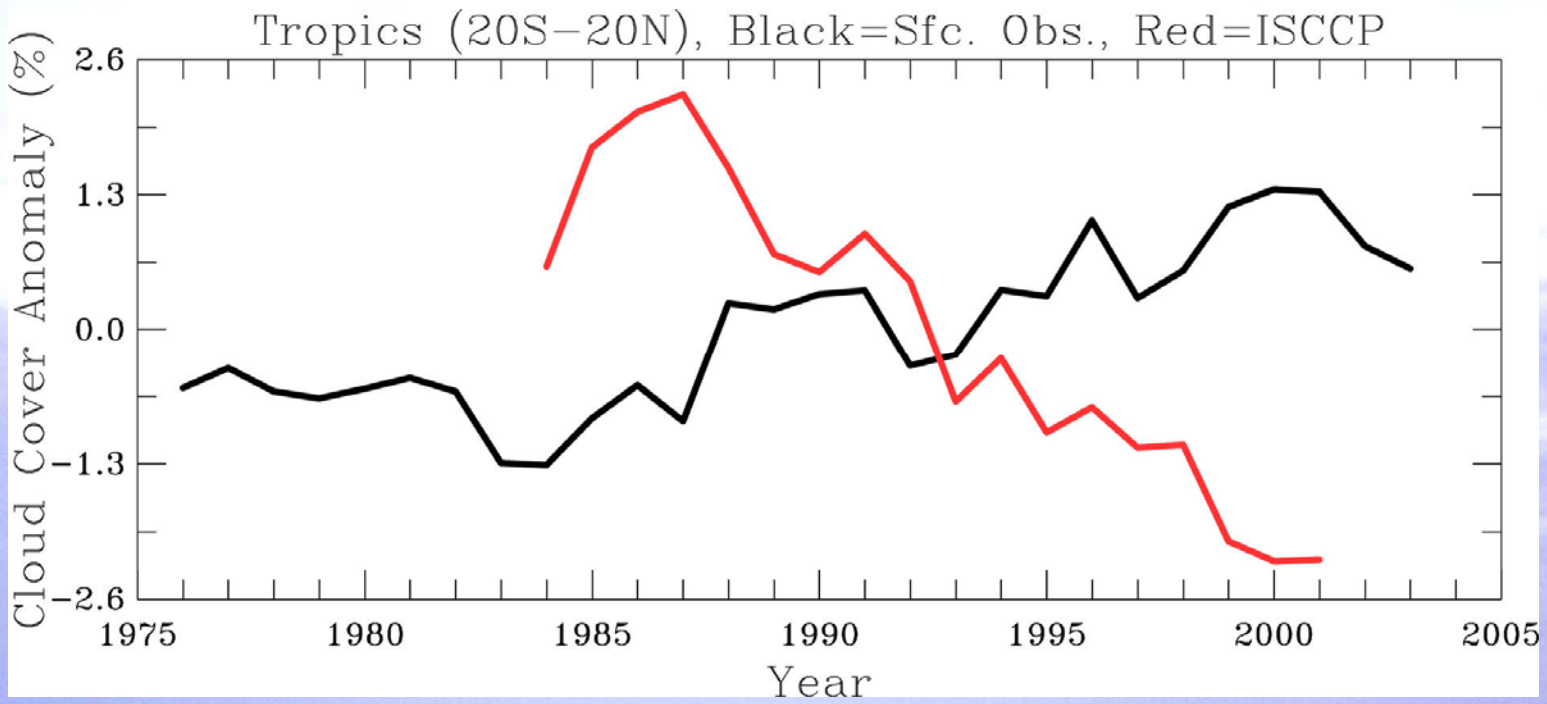
3. Before a data record is re-processed, the whole chain of processing from instrument calibration through retrieval to sampling should be reviewed and improvements sought.

Principles for Re-Processing Climate Data Records

4. The Climate Data Record Meta-data should be updated to include newly discovered aspects and characteristics of the record resulting from preparatory investigations (or any other new results) or during the re-processing and to facilitate the next re-processing.

5. An overall goal of Climate Data Record re-processing should be to increase the physical consistency among the available data products describing climate variations, as well as the continuity over time; hence, any re-processing project should also consider joint requirements with other Climate Data Records that may require coordinated re-processing of them as well.

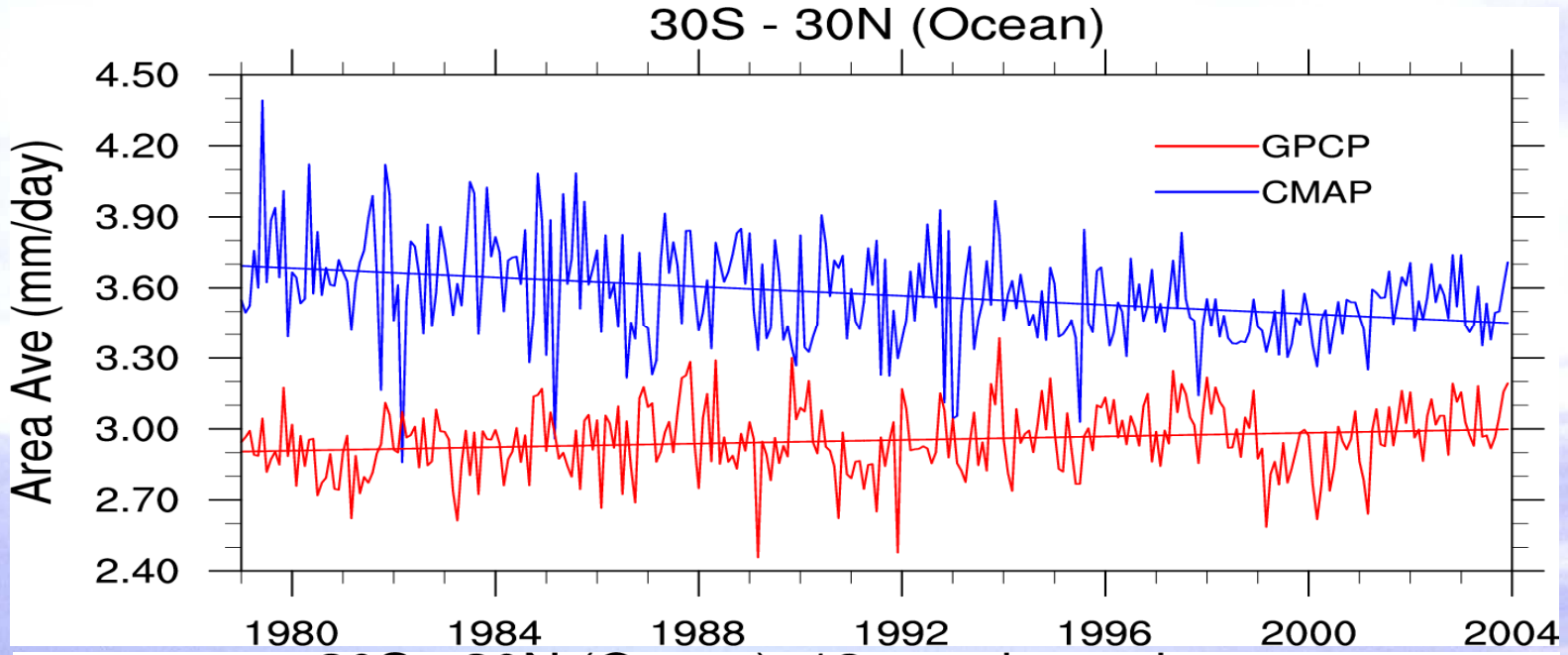
Cloud problems

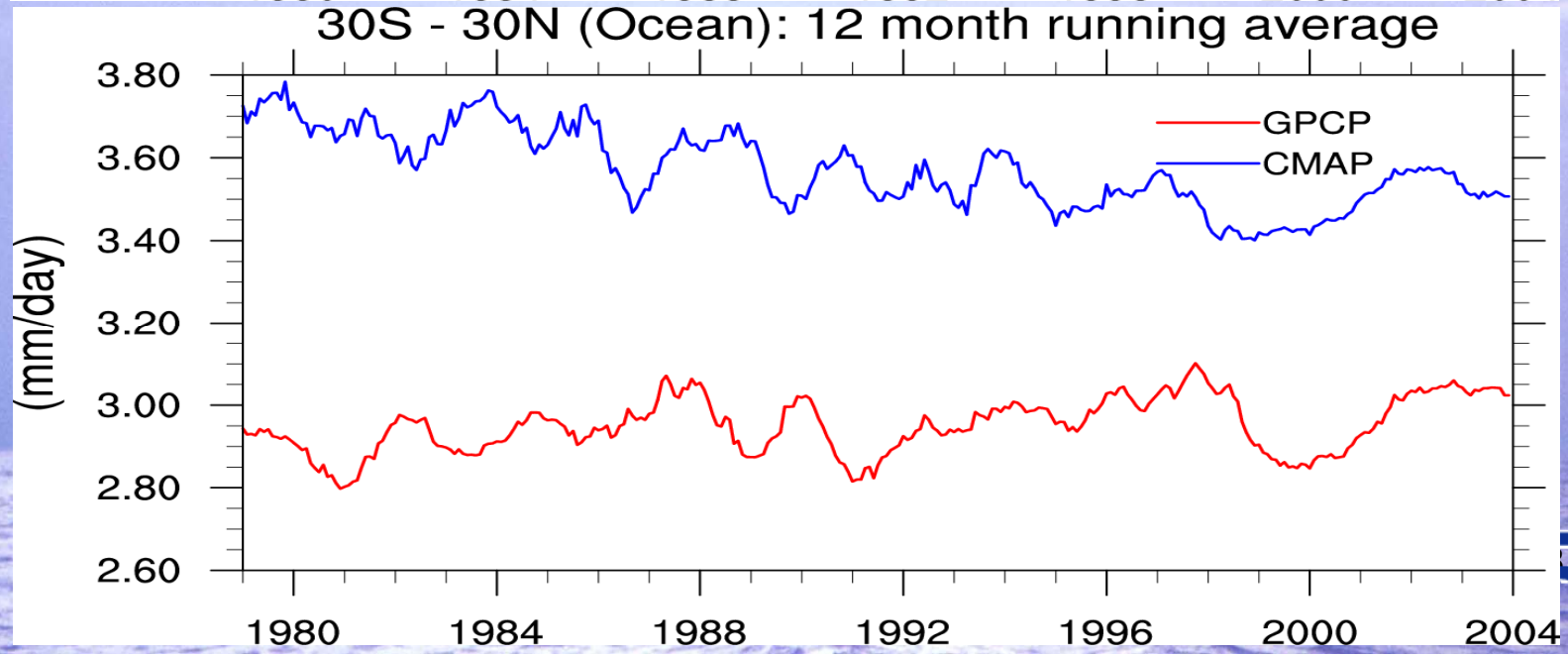


Cloud means from surface obs and ISCCP
Dai et al 2006 BAMS

Surface trends agree better with HIRS

Precipitation

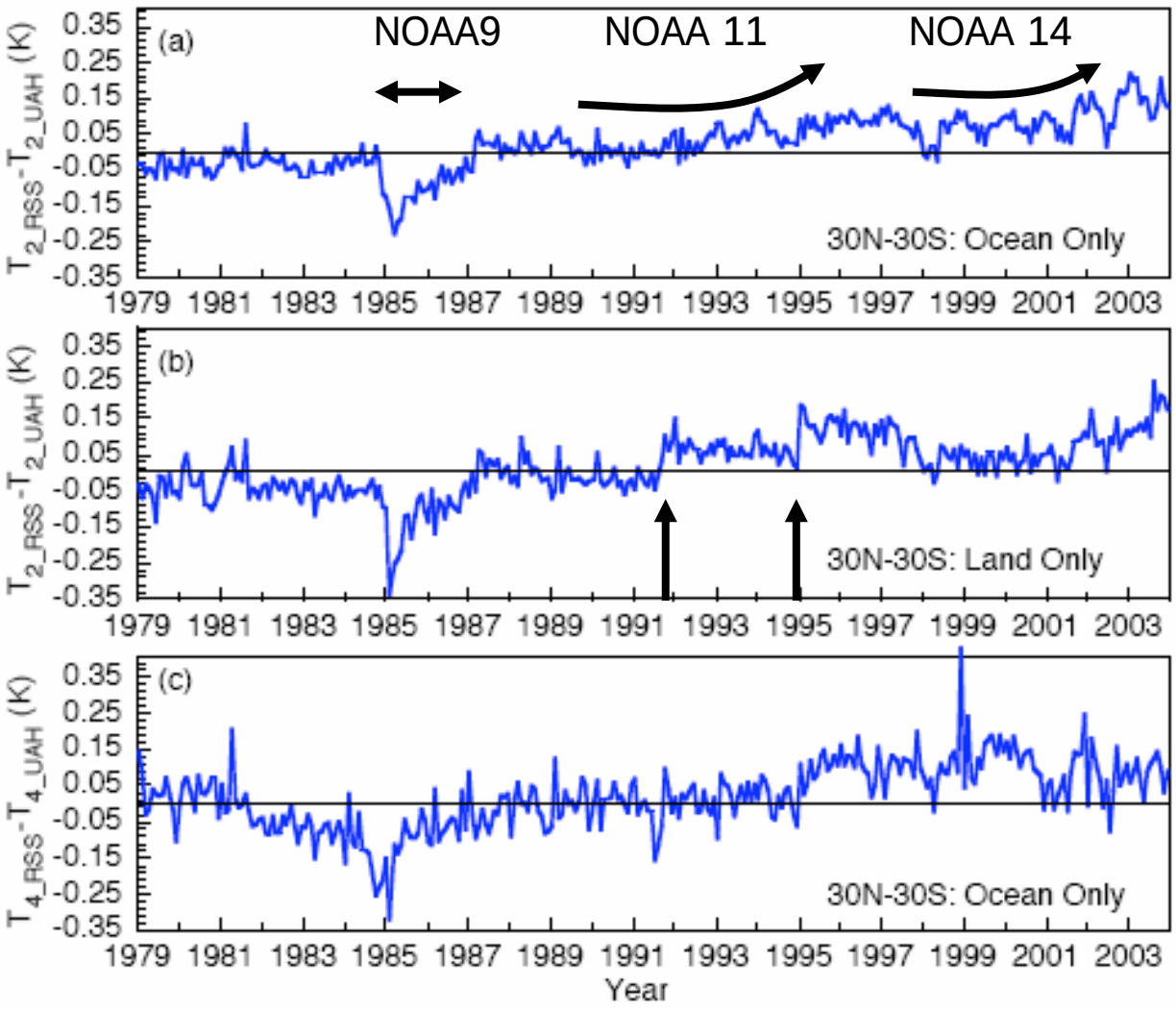




MSU
Channel 2

differences

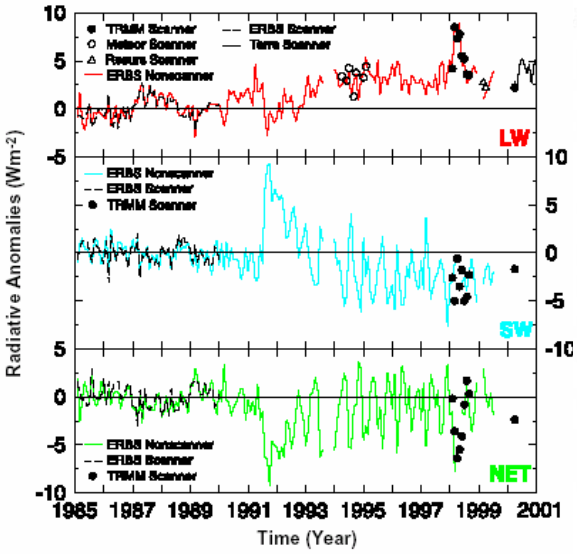
Channel 4

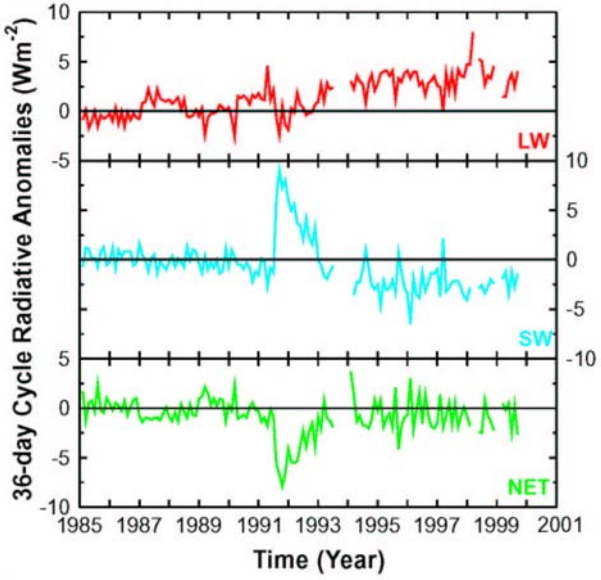


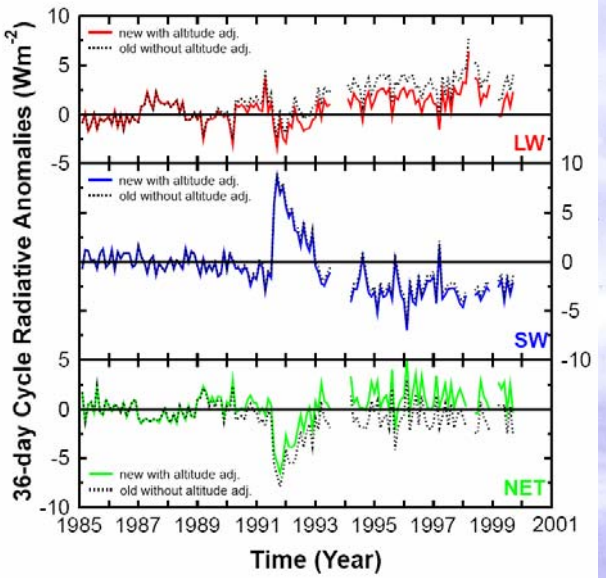
Fu and Johanson 2005 GRL show that jumps and drifts linked to satellite LECT exist in MSU records;

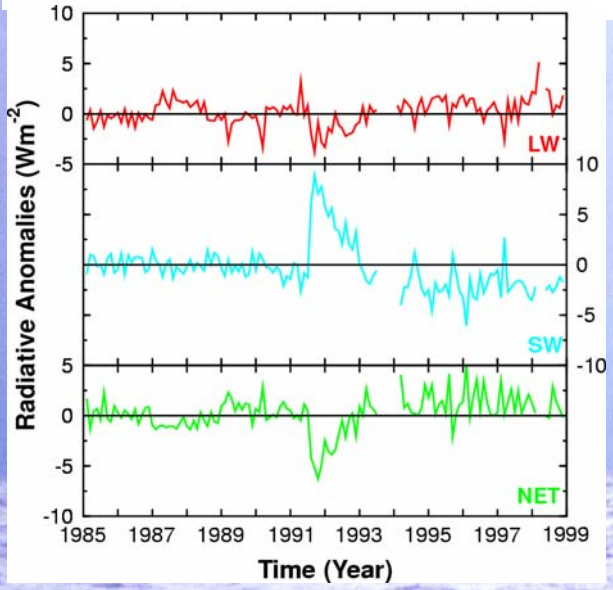
UAH 2LT was flawed. Confirmed: Mears and Wentz 2005

Radiation Top-of Atmosphere: Wielicki et al. 2002



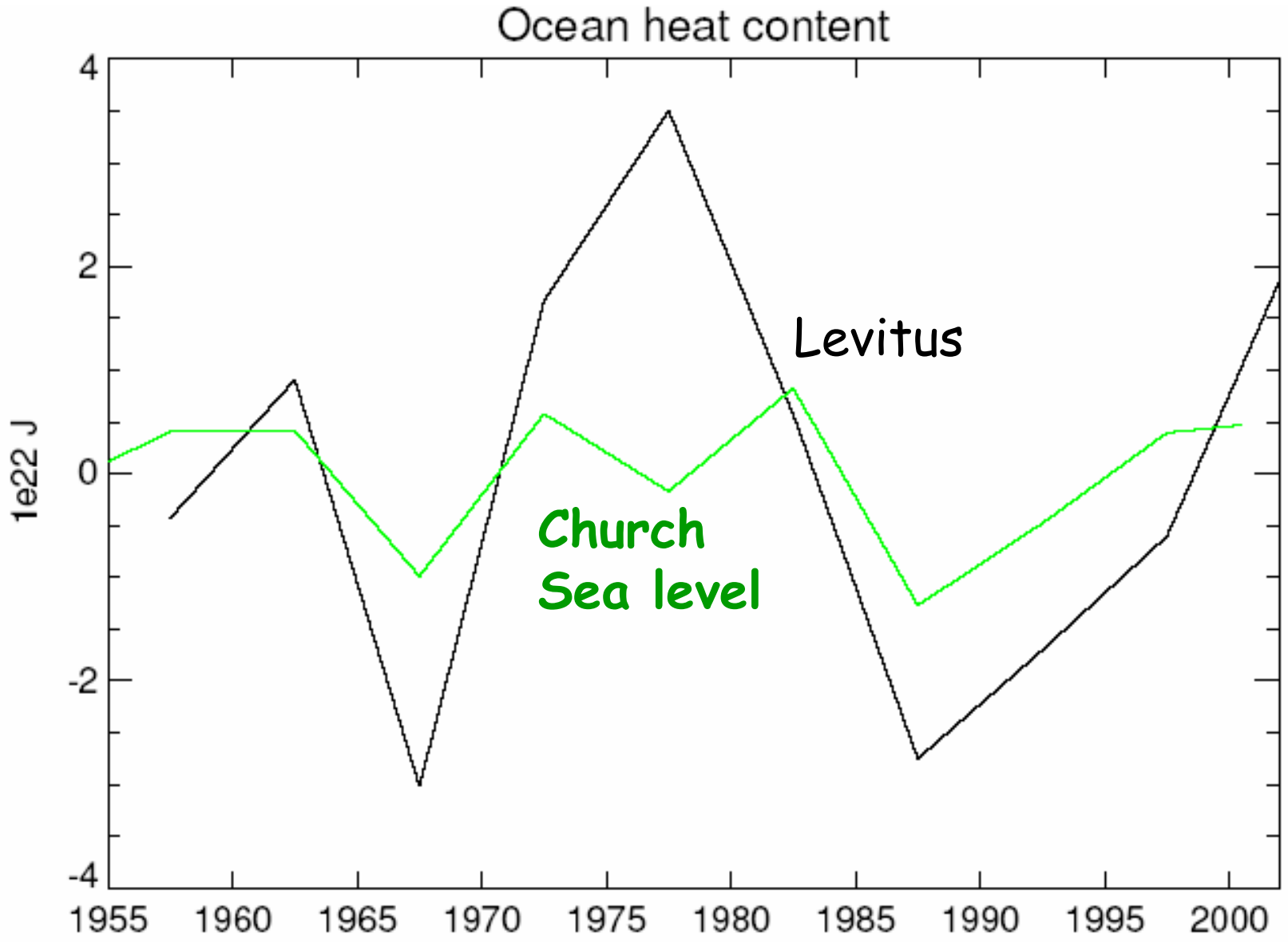




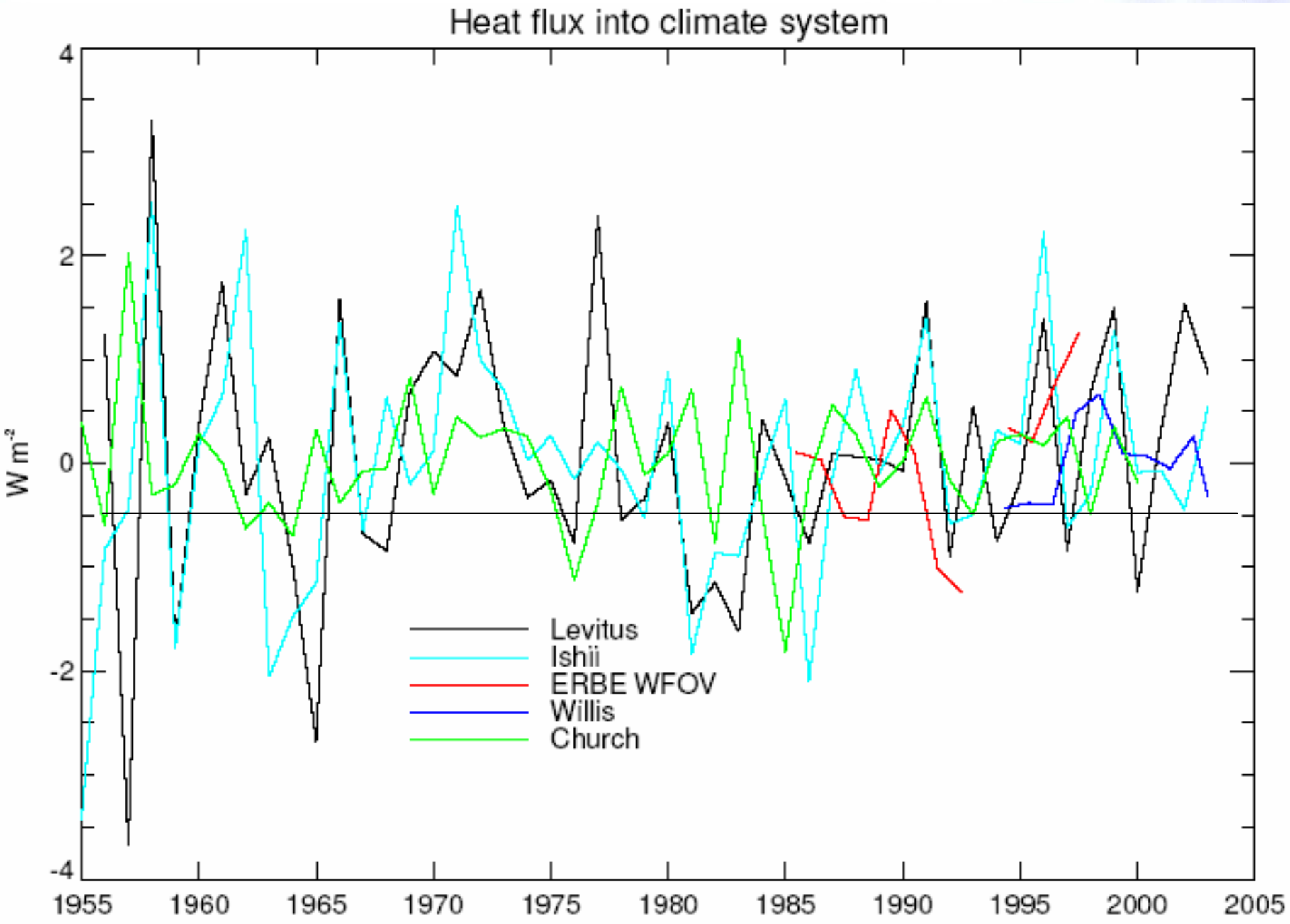


1. Published *Science*
2. Revised following comment
3. Edition 2 (orbit decay correction)
4. Edition 3 (SW filter dome)

Is decadal variability in ocean heat content real?



If so, and models do not simulate it, then?


Heat flux into climate system
W m-2
4
2
0
-2
-4
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Levitus
Ishii
ERBE WFOV
Willis
Church

J Gregory

WOAP-1

7/ Drafted and sent a **letter** on need to exploit satellite data we already have and continue observational **streams** on behalf of WCRP, to **CEOS members** and **GEO co-chairs.** Pointed out and endorsed GCOS IP, WCRP needs, GEOSS links. Main points:

1) ensure the continuity of established capabilities;
2) need for continuity and homogeneity of observations for climate purposes;
3) need for more attention to data synthesis, reprocessing, analysis and re-analysis of existing data sets; and
4) recognition of the need for a complementary in situ observation strategy.

Done 30 June

Response received 15 August (not satisfactory)

Other topics:

Task group reviewed CEOP: regarded as a **prototype GEOSS** example

Task group on data assimilation has written a short report on issues of **coordination among WCRP projects, resolution** of DA models and full utilization of satellite data.

The data management task group is reviewing existing WCRP web structure and sites, making recommendations for WCRP-wide over-arching structure and site contents, and will propose a data policy for WCRP.

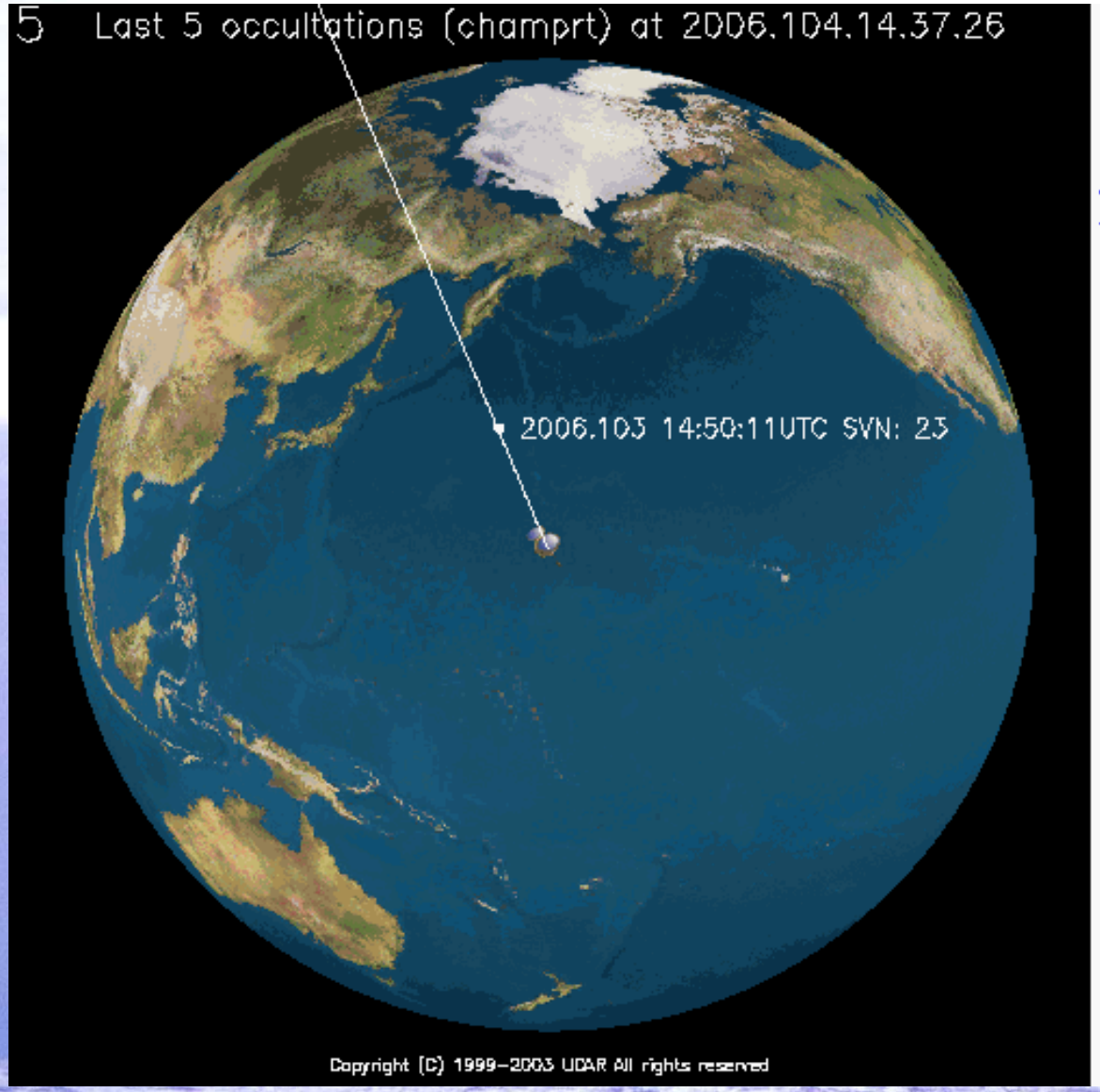
http://copes.ipsl.jussieu.fr/Organization/COPESStructure/WGOA.html

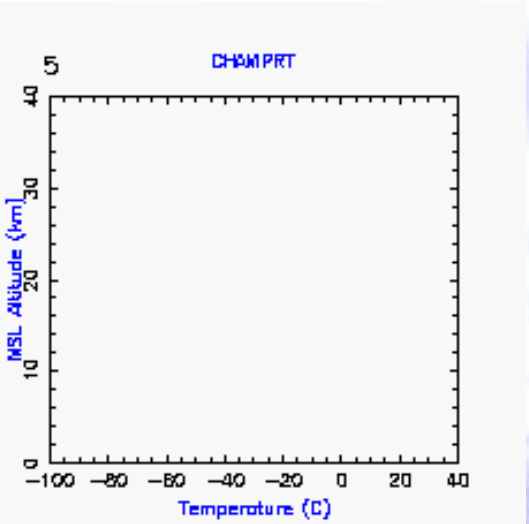
So the main message:

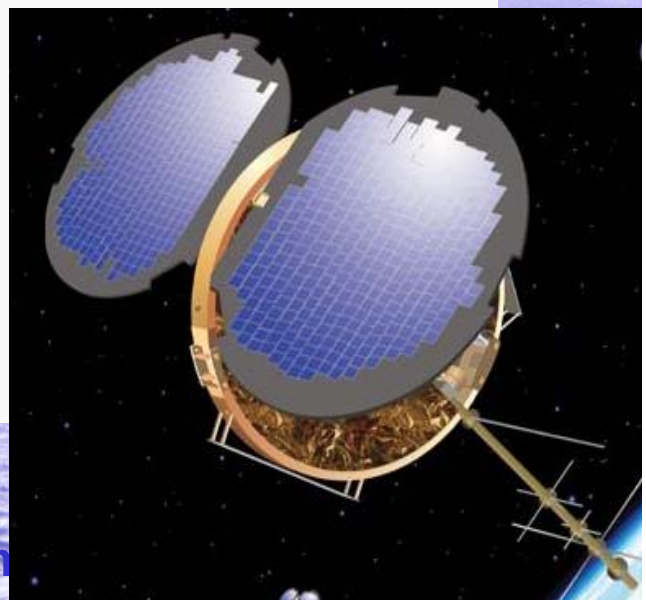
1. There is a need to better come to grips with the continually changing observing system.
2. There is no baseline network to anchor the analyses
   The radiosonde network is not it!
3. The challenge is to improve continuity and be able to relate a current set of observations to those taken 20 years ago.
4. There is a need for more attention to data synthesis, reprocessing, analysis and re-analysis of existing data sets; and
5. There must be a baseline set of measurements:
   - reference radiosonde network
   - GPS Radio Occultation.

Further Premises

1) GPS **radio occultation (RO)** will become operational. Currently a new 6 satellite array of small receivers has been launched: ***COSMIC***
2) Such RO will provide a benchmark that can be used to help calibrate other observations: especially microwave and IR soundings.
3) Above about 6 km RO estimates temperature, but below the signal is mixed with water vapor.
4) RO itself needs to be calibrated initially to ensure contamination from the ionosphere effects, and other issues, including water vapor effects, are dealt with.
5) **Water vapor** will remain an issue, although the developing surface network of GPS used to get column water vapor will help enormously.
6) **A surface GPS receiver must be co-located and planned for with the reference sounding site.**


5 Last 5 occultations (champrt) at 2006.104.14.37.26
2006.103 14:50:11UTC SVN: 23
Copyright (C) 1999-2003 UCAR All rights reserved


CHAMPRT
MSL Altitude (km)
Temperature (C)
0
10
20
30
40
-100
-80
-60
-40
-20
0
20
40



A vision for the future:

- ✓ Few regular radiosonde stations
- ✓ GPS RO for temperatures above 500 mb
- ✓ IR and microwave soundings (T and water vapor)
- ✓ Winds from AMDAR, profilers
- ✓ Ground based GPS column water vapor network continuous in time
- ✓ Sparse network (30-40) of "reference sondes" for satellite calibration and climate monitoring, and UT water vapor
- ✓ Co-locate new sondes with regular sonde sites to replace them at appropriate times
- ✓ Integrate with ozone sondes and/or GAW and BSRN

- ✓ Modelers and reanalysis scientists should support observations developments