

Observations and their Analysis for WCRP/COPES



WCRP

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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.

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

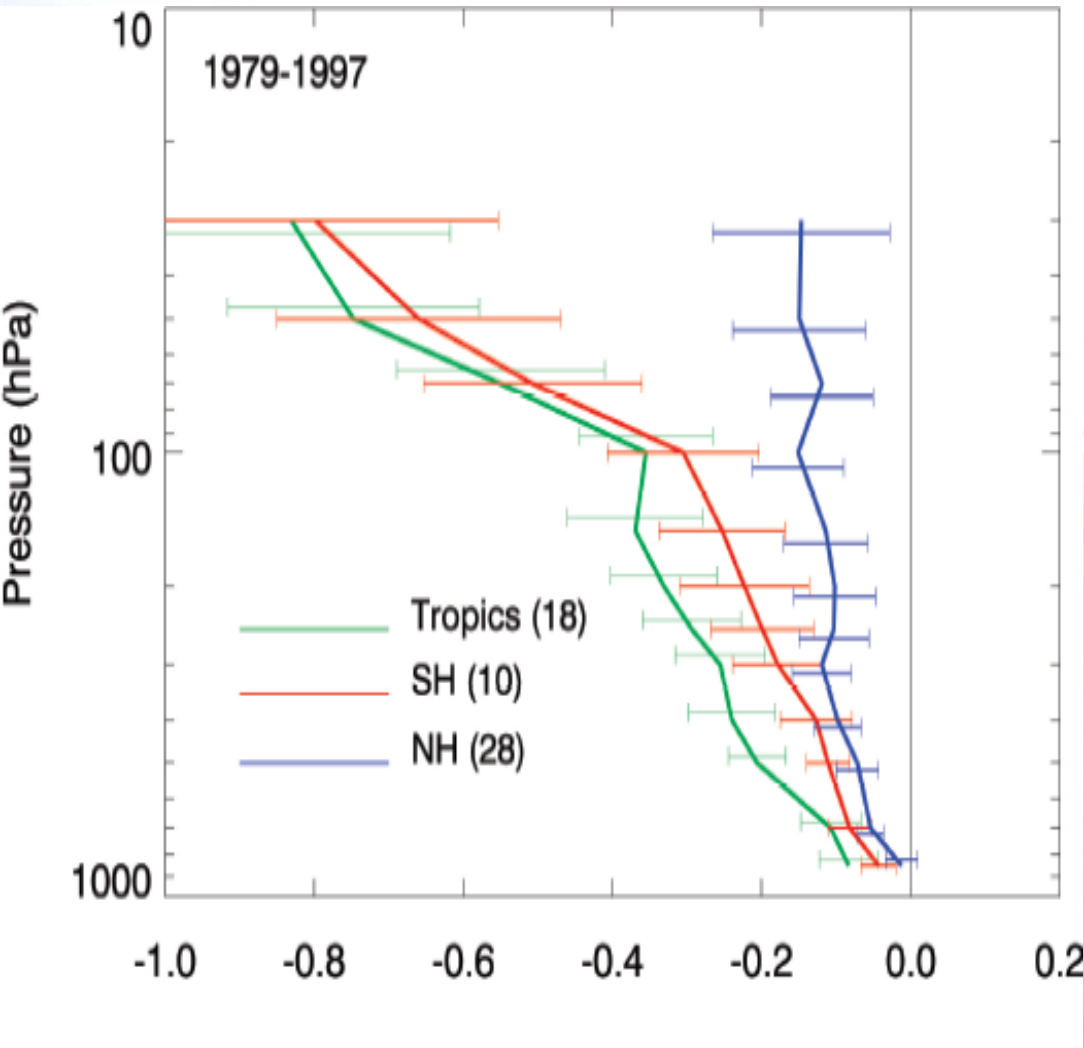
Reanalysis:

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.

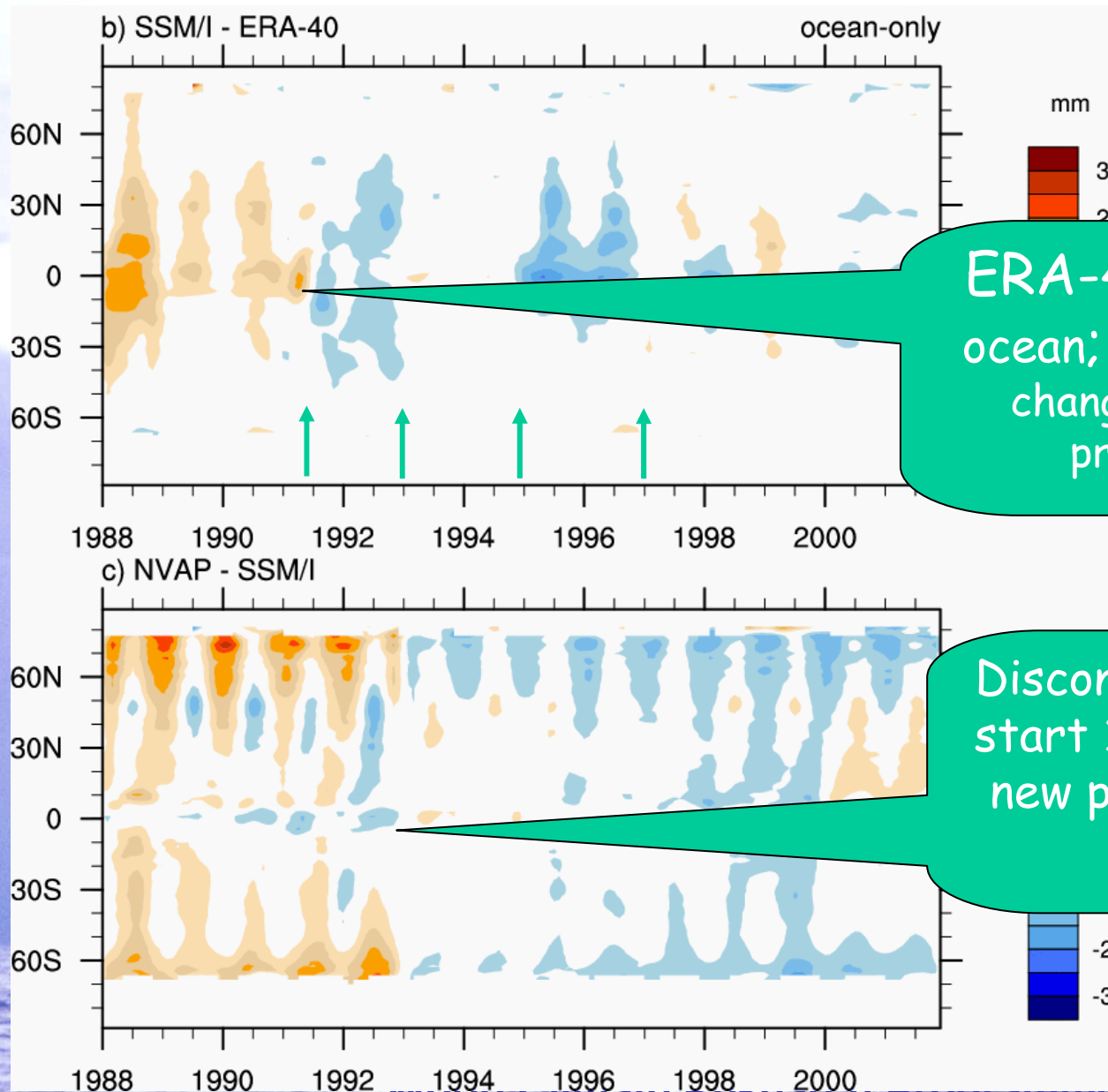
Sherwood et al (2005)

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)

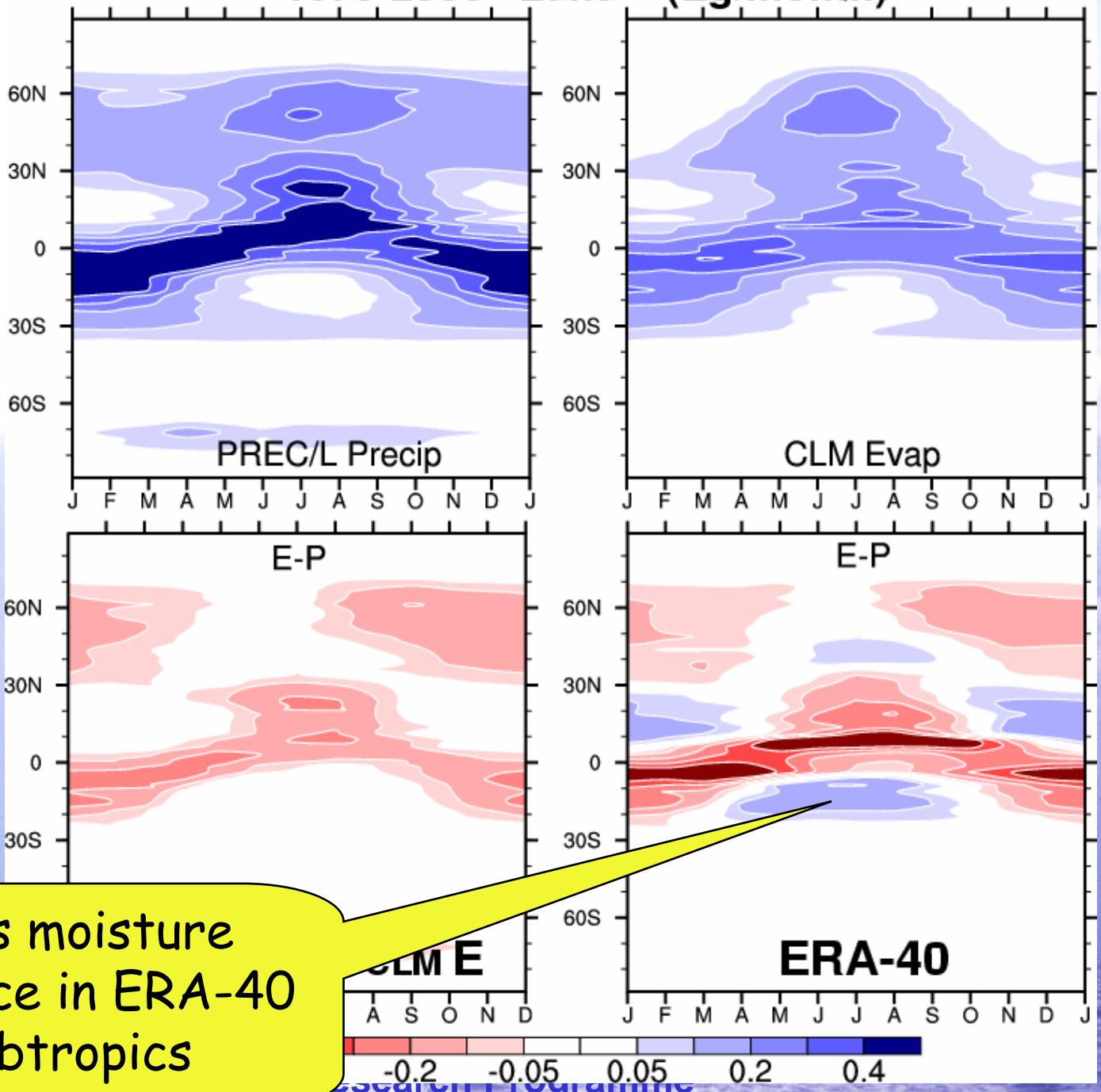
Discontinuities in NVAP at start 1993 and 2000 when new processing system in place

1979-2000 Land (Eg/month)

P observed
E from CLM3
⇒ E-P

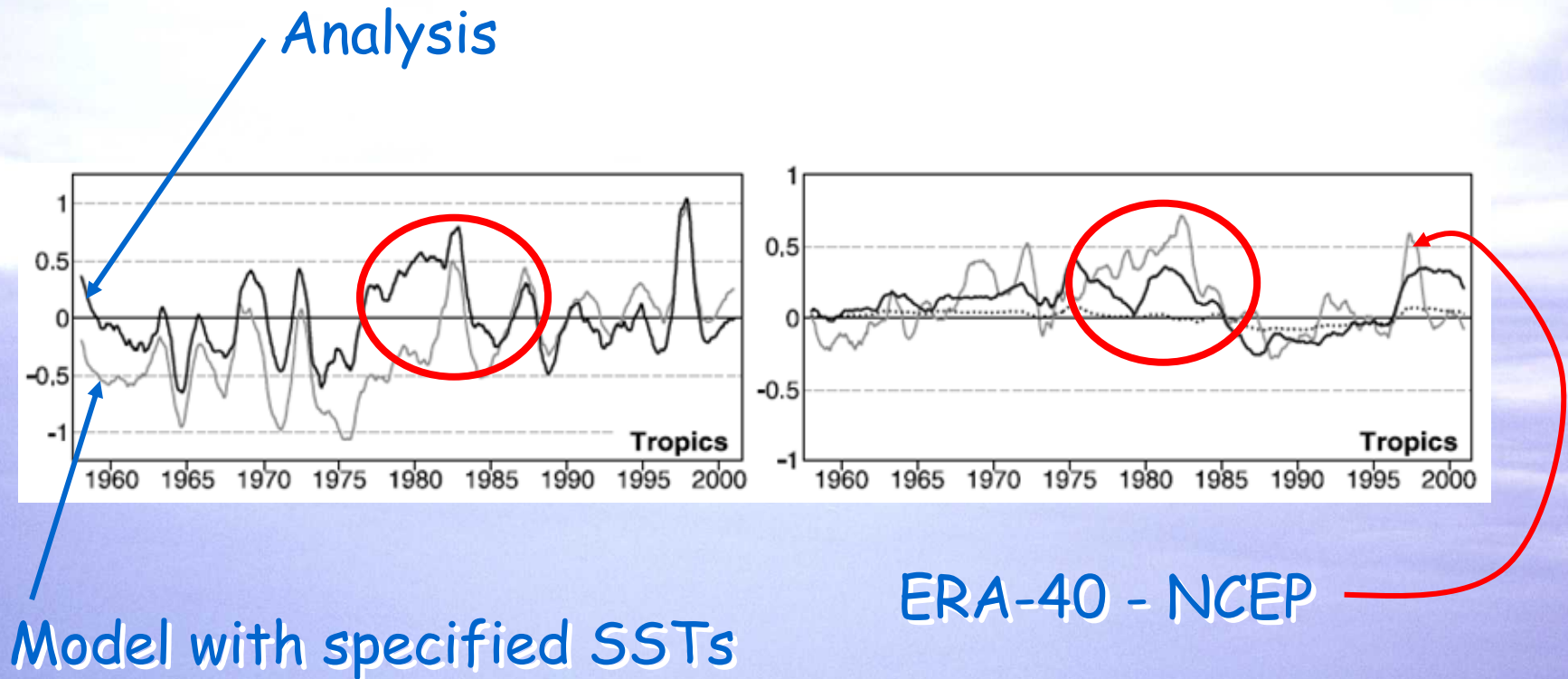
vs

E-P from
ERA-40
atmospheric
moisture
budget



Excess moisture divergence in ERA-40 in subtropics

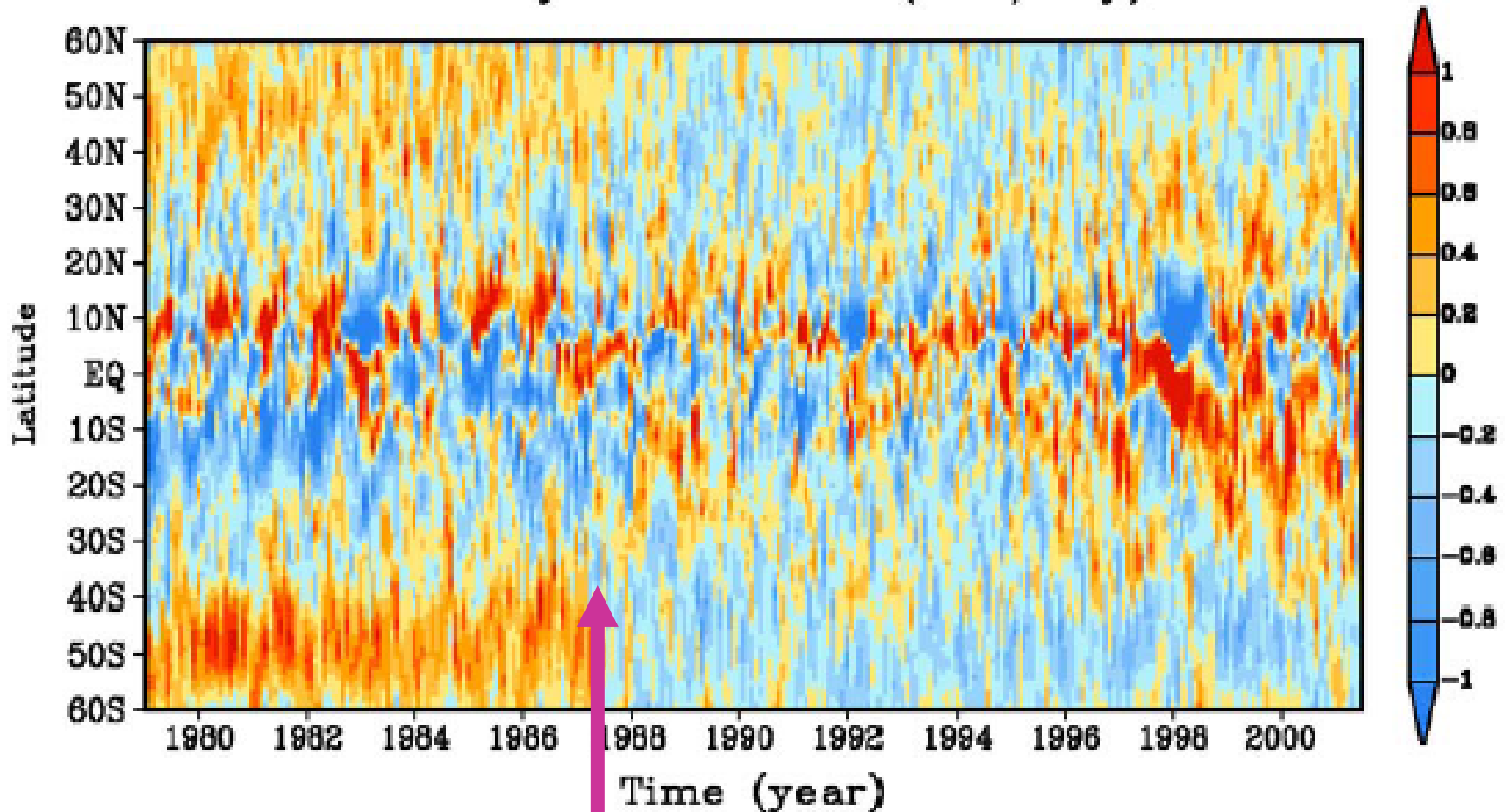
Bias correction problems:



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).

Anomaly Zonal Mean (mm/day)



SSM/I

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".

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

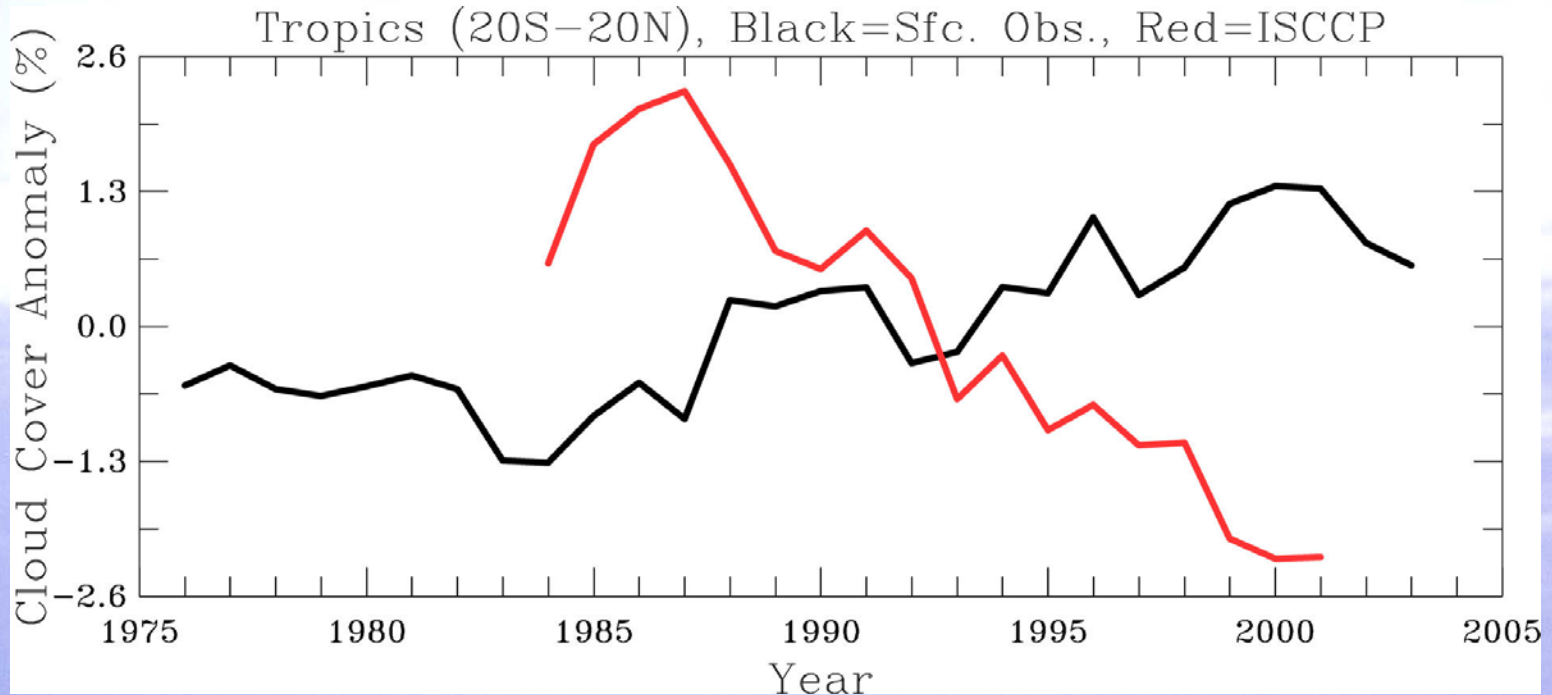
5 Principles for Re-Processing Climate Data Records

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.

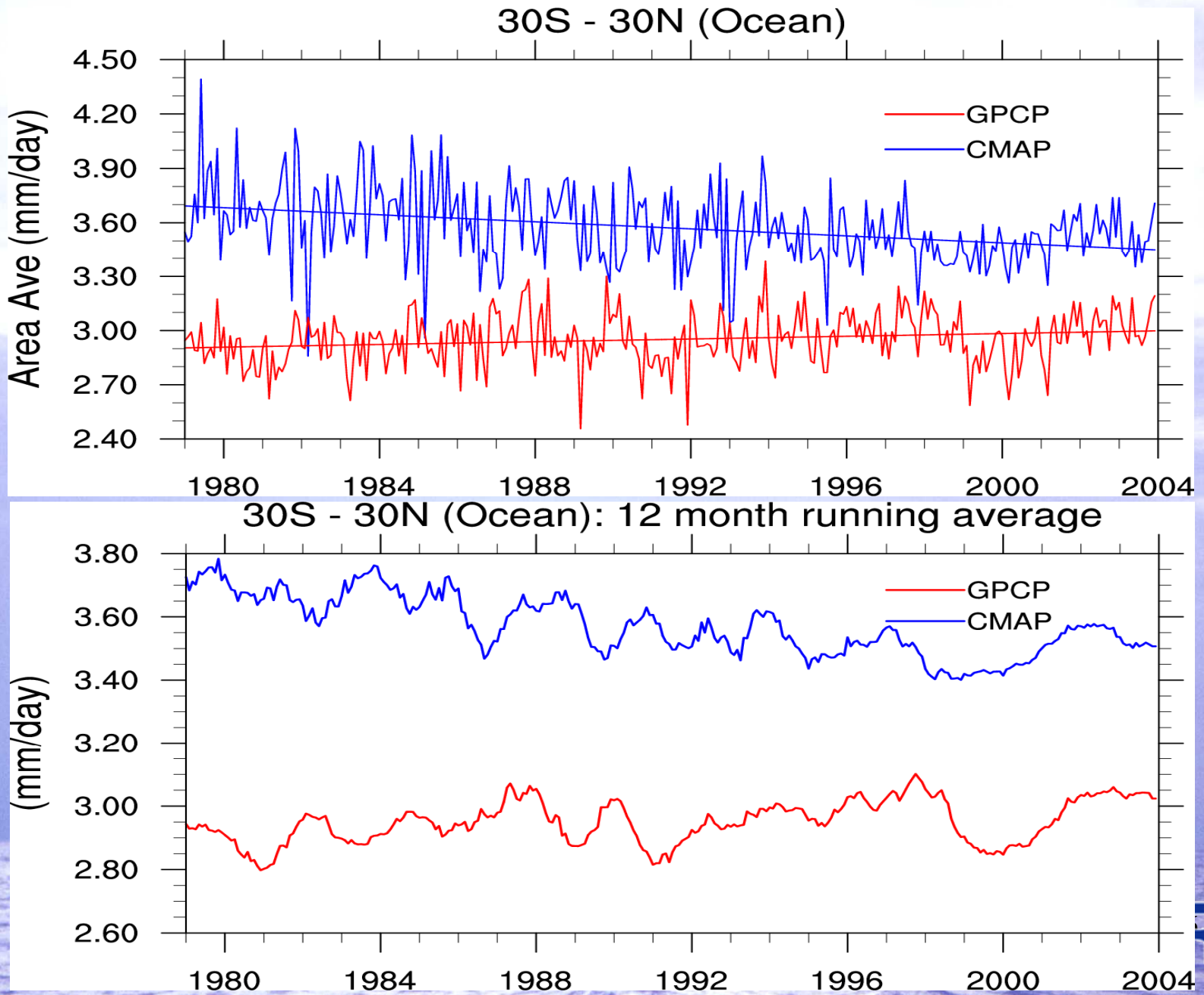
Cloud problems



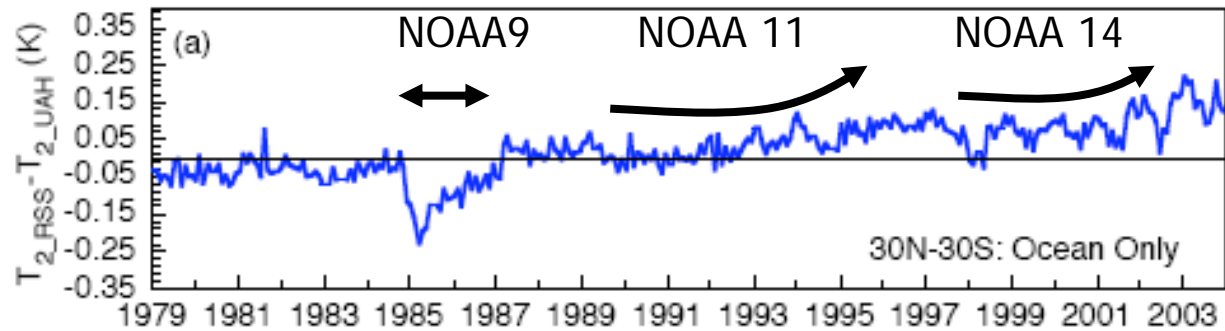
Cloud means from surface obs and ISCCP
Dai et al 2006 BAMS

Surface trends agree better with HIRS

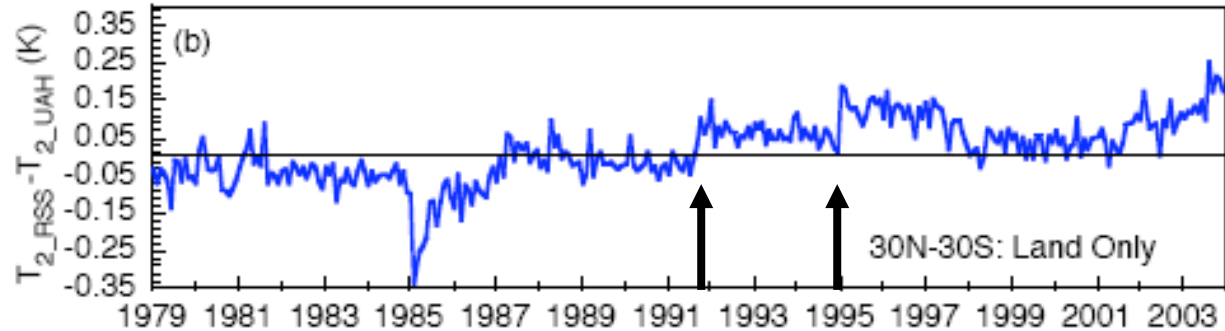
Precipitation



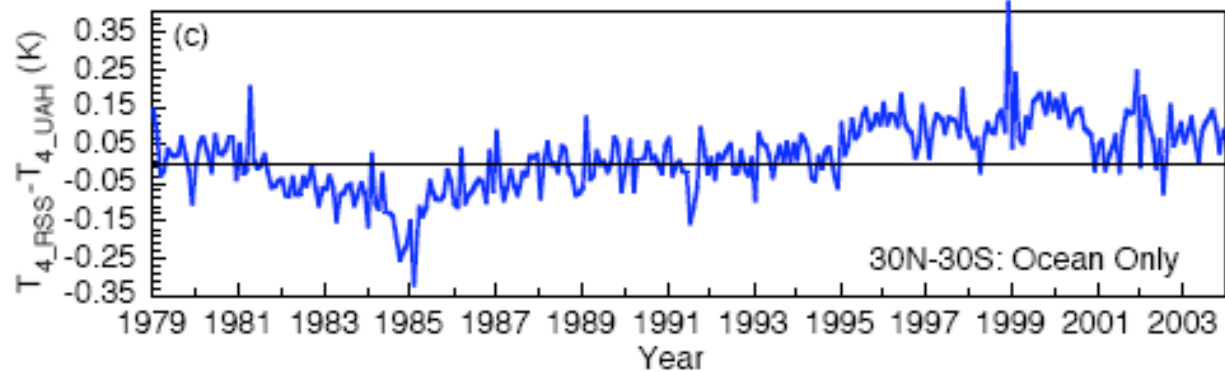
MSU
Channel 2



differences



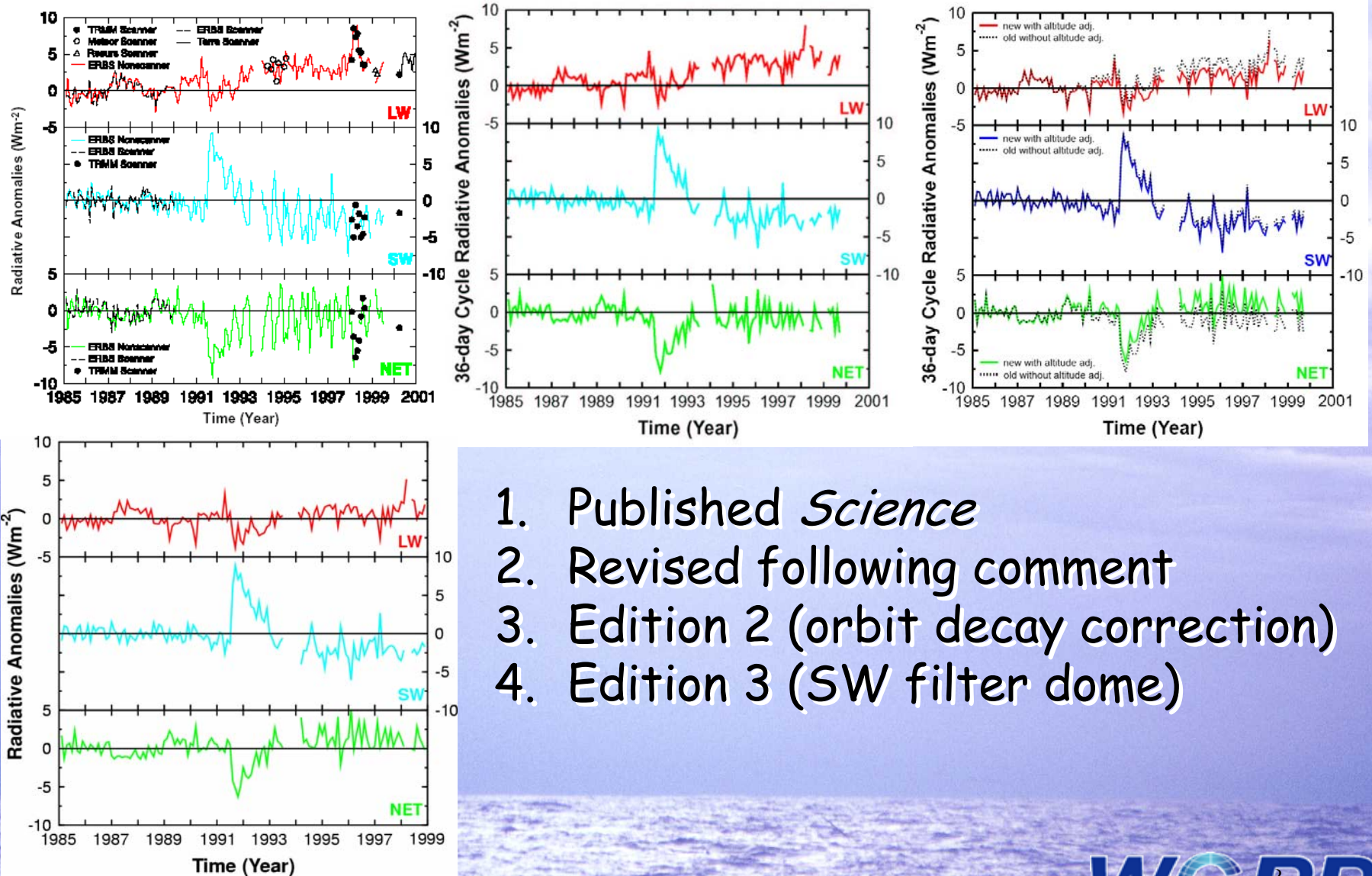
Channel 4



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

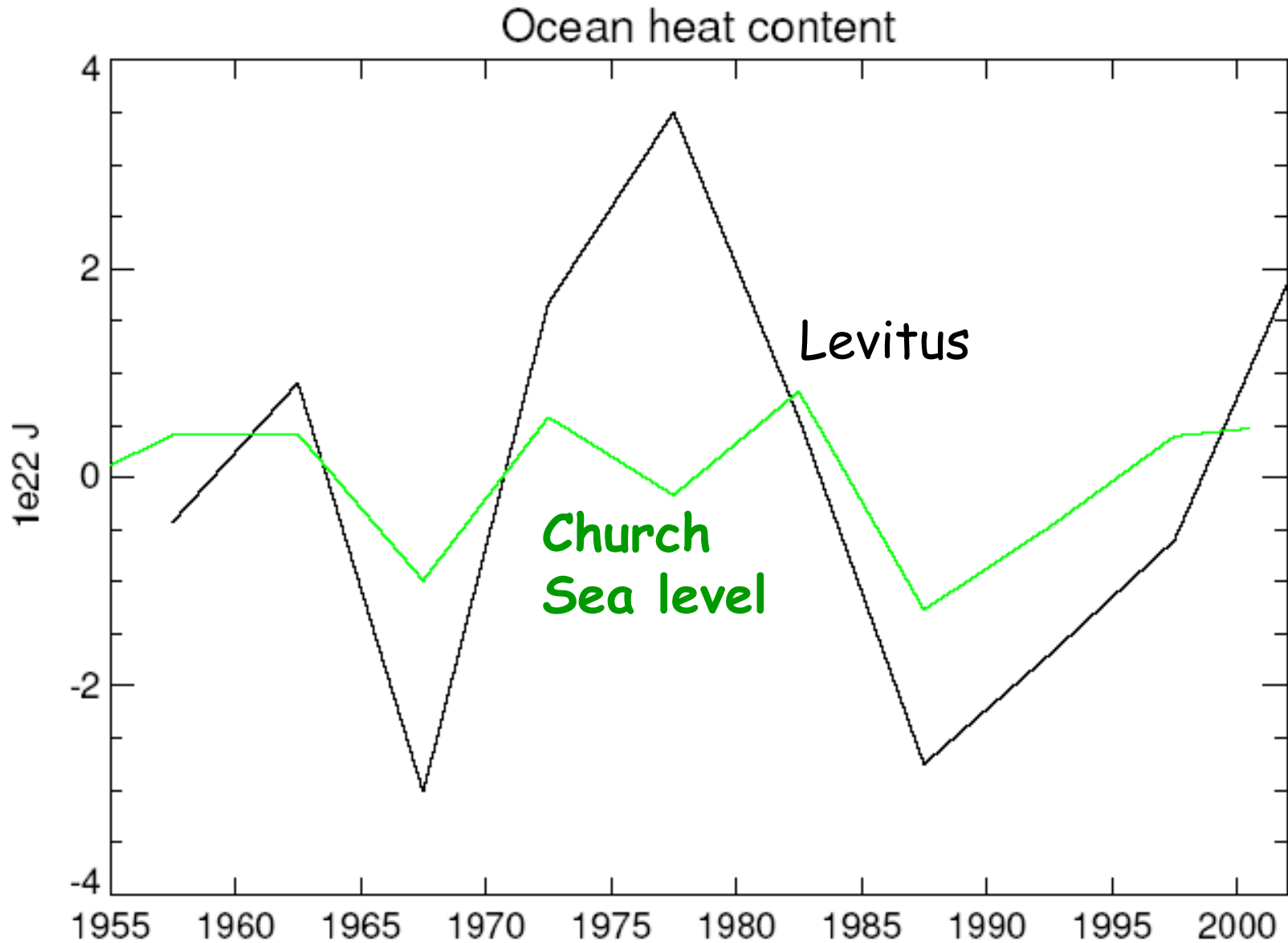
UAH 2LT was flawed. Confirmed: Mears and Wentz 2005

Radiation Top-of Atmosphere: Wielicki et al. 2002



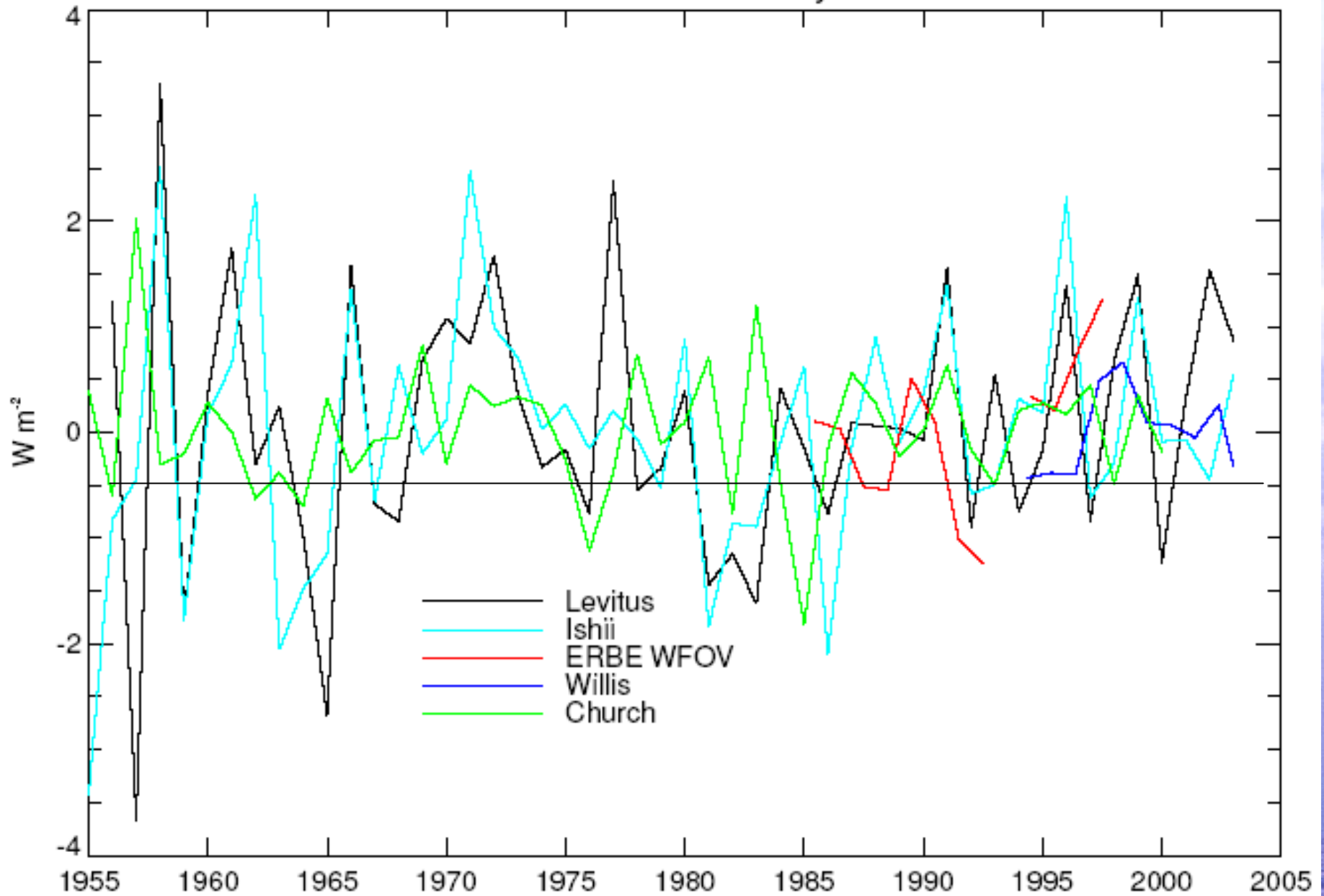
1. Published *Science*
2. Revised following comment
3. Edition 2 (orbit decay correction)
4. Edition 3 (SW filter dome)

Is decadal variability in ocean heat content real?



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

Heat flux into climate system



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.

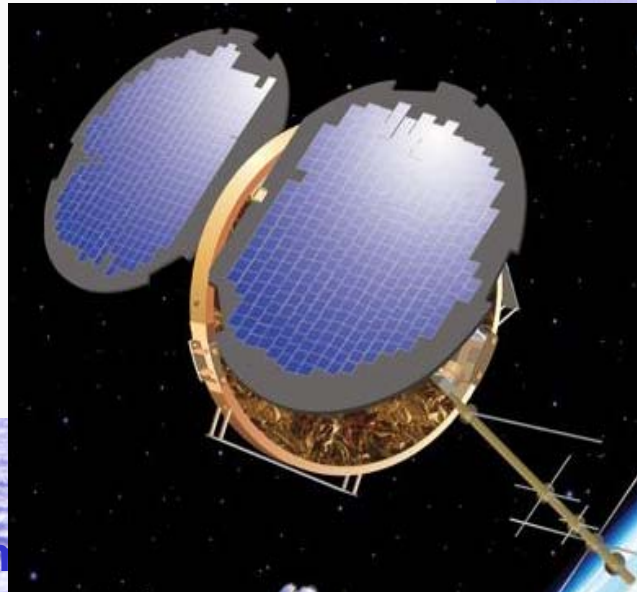
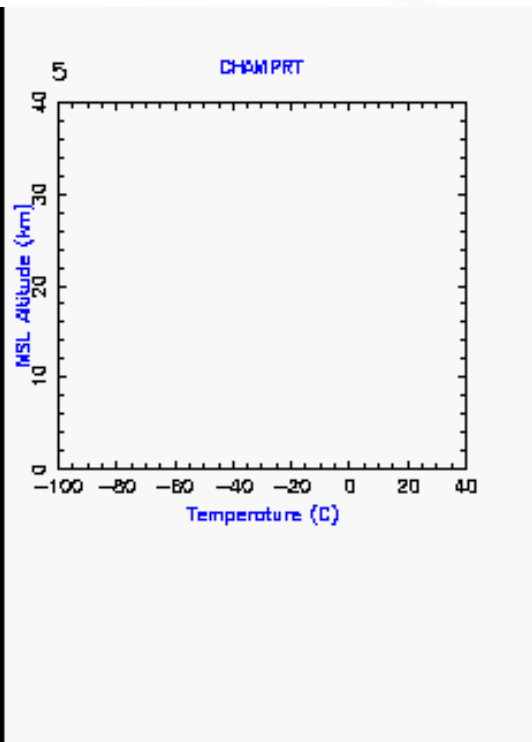
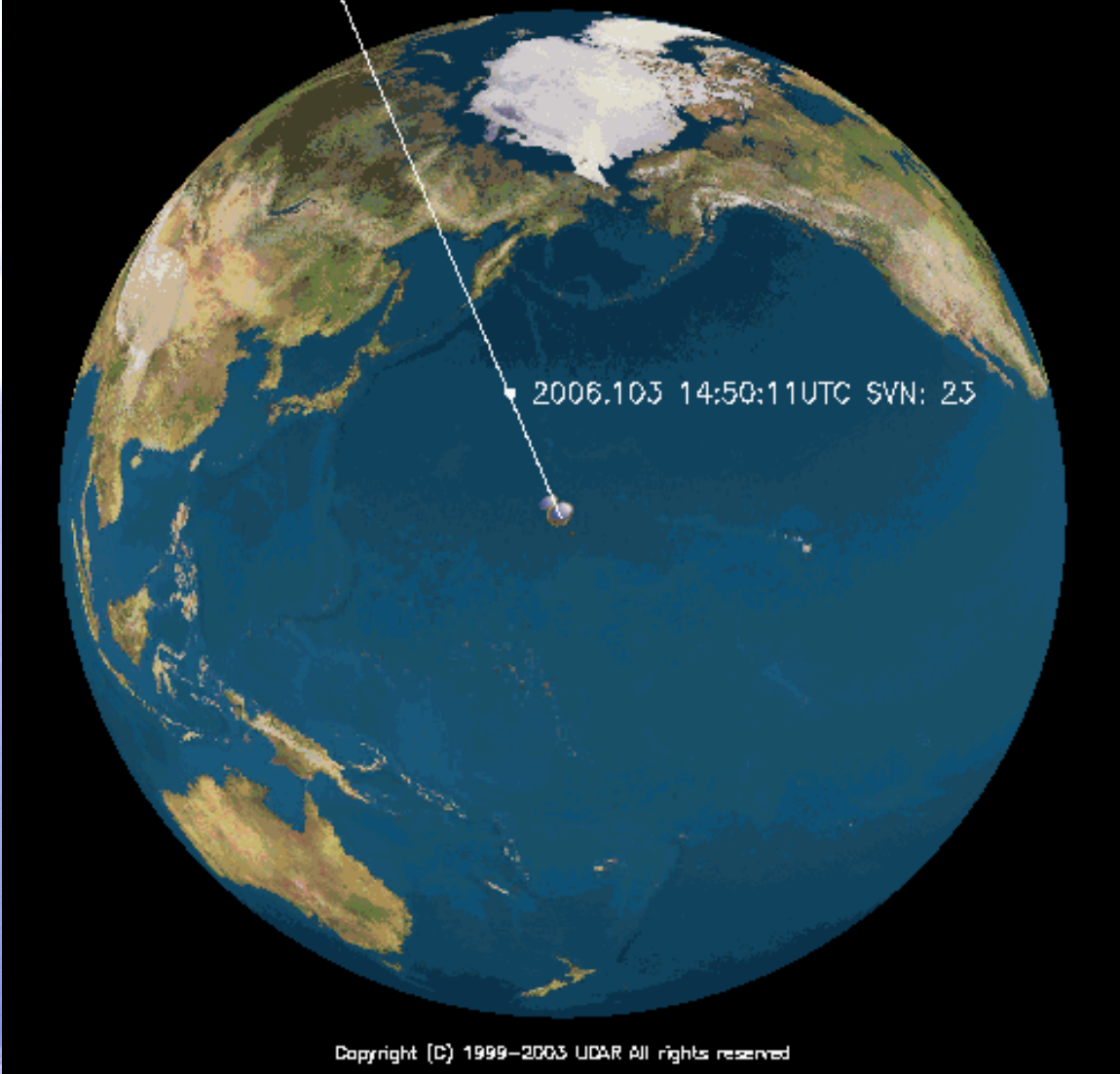
The **data management** task group is reviewing existing
WCRP web structure and sites, making
recommendations for WCRP-wide over-arching
structure and site contents, and will propose a data
policy for WCRP.

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

5 Last 5 occultations (champrt) at 2006.104.14.37.26



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