ISCCP Historical Perspective

Lake Balaton(1980) to GEWEX(today)

R.A. Schiffer & W.B. Rossow

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“In the beginning, there was light …..”

• WMO-GARP Report 16, *The Physical Basis of Climate*, 1975

• Paltridge, G., and T.H. VonderHaar, 1979: *Plan for Implementation of a Real-Time Satellite Observed Cloud Climatology Project*. Report o the JOC for the Climate Dynamics Sub-Programme of GARP, ICSU/WMO, Geneva

Brief ISCCP History

The specifications for a global cloud climatology were established originally in Oxford, England in 1978 by the World Meteorological Organization/International Council of Scientific Unions (WMO/ICSU) Joint Organizing Committee (JOC) for the Global Atmospheric Research Programme (GARP) (Study Conference on Parameterization of Extended Cloudiness and Radiation for Climate Models).

The International Satellite Cloud Climatology Project (ISCCP) was initially designed to provide for the production of a five year global cloud climatology by taking advantage of the global coverage provided by the international array of operational geostationary and polar orbiting meteorological satellites.

Refinements in the specifications were made at subsequent meetings held in Balatonalmadi, Hungary in June 1980 (Meeting on Real-Time Satellite Derived Cloud Climatology) and Hamburg in August-September 1981 (Workshop in Support of the ISCCP on Development of Algorithms). Details about the project are contained in the Preliminary Implementation Plan (WCP, 1982c) and also in Schiffer and Rossow (1983).

In 1988, the Joint Scientific Committee (JSC) of the World Climate Research Programme (WCRP) extended the ISCCP for an additional seven years. In 1995, it was given another five year extension. Further extensions carried ISCCP to the present. ISCCP continues as a key global data project of the Global Energy and Water Experiment (GEWEX) since 1990.

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Photo taken at Lake Balaton in June 1980. Can you identify these characters?

Recognizing Some Early ISCCP Contributors

Tom Vonder Haar*
Bill Rossow
Bob Schiffer*
Hans-Jurgen Bolle*
Pierre Morel
Roy Jenne*
Ehrhard Raschke
Bob Kandel
Yves Desormeaux
Johannes Schmetz
Gyorgy Major*
George Ohring*
Al Arking
Garrett Campbell
Tom Kaneshige
Genevieve Seze
Jim Coakley
Larry Stowe
Garth Paltridge

Pat Minnis
Michel Desbois
Chris Brest
Leonid Garder
Kathy Kidwell
Eberhard Ruprecht*
Edward Harrison
Eric Smith
Edward Kinsella
Fred Mosher
Don Wylie
Garry Hunt*
Andre Berroir*
E. Jattila*
John Morgan*
Guy Rochard*
Julius London
Martin Platt

* Balatonalmadi workshop attendees June 1980

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Basic Concept (ref. WCP-6, 1981)

- To make use of current geostationary and polar-orbiting satellite data for the acquisition, processing, and archiving of narrow band visible and infrared radiance statistics relevant to cloud determination.

- To develop, in parallel, algorithms for the conversion of radiance statistics into cloud properties.

- To assemble an adequate and coherent global radiance and cloud data set spanning 5 years.

ISCCP Scientific Objectives (1982)

1) to produce a global, reduced resolution, calibrated and normalized, infrared- and visible-radiance data set, along with basic information on the radiative properties of the atmosphere, from which cloud properties can be derived;

2) to coordinate basic research on techniques for inferring the physical properties of clouds from satellite radiance data, and to derive and validate a global cloud climatology:

3) to promote research using ISCCP data to improve parameterizations of clouds in climate models, and to improve understanding of the Earth's radiation budget (top-of-the-atmosphere and surface) and hydrological cycle.

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Major Challenges and Issues

(anticipated at Lake Balaton and still true today)

- Space Agency Stable Commitments (*now GCOS/GEOSS*)
- Global Coverage
- International Data Processing Network
- Satellite Calibration (*now CGMS/GSICS*)
- Cloud Retrieval Algorithms (*now mostly polar problem*)
- Data Products
- Verification/Validation

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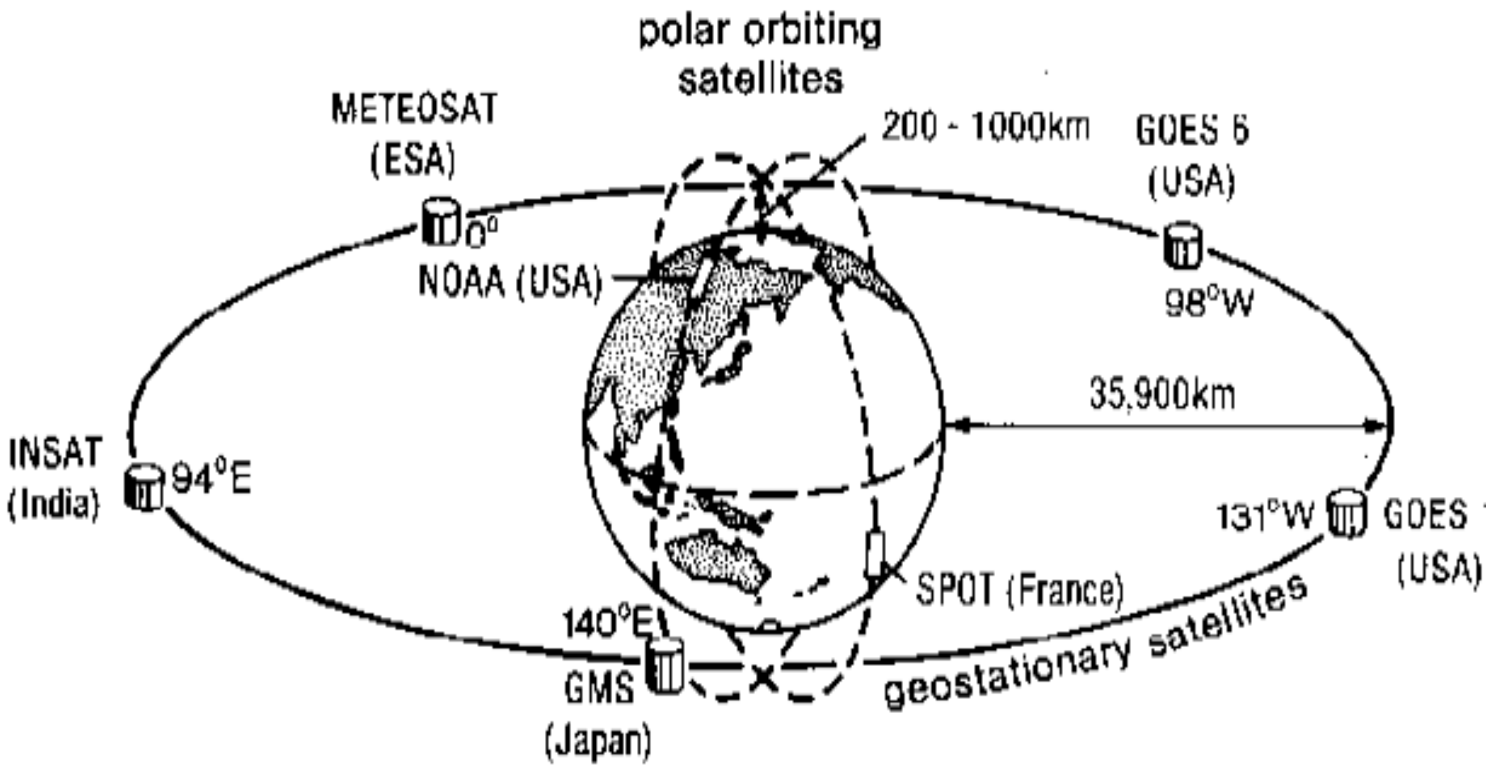

Earliest Concept of the ISCCP Global Observing System

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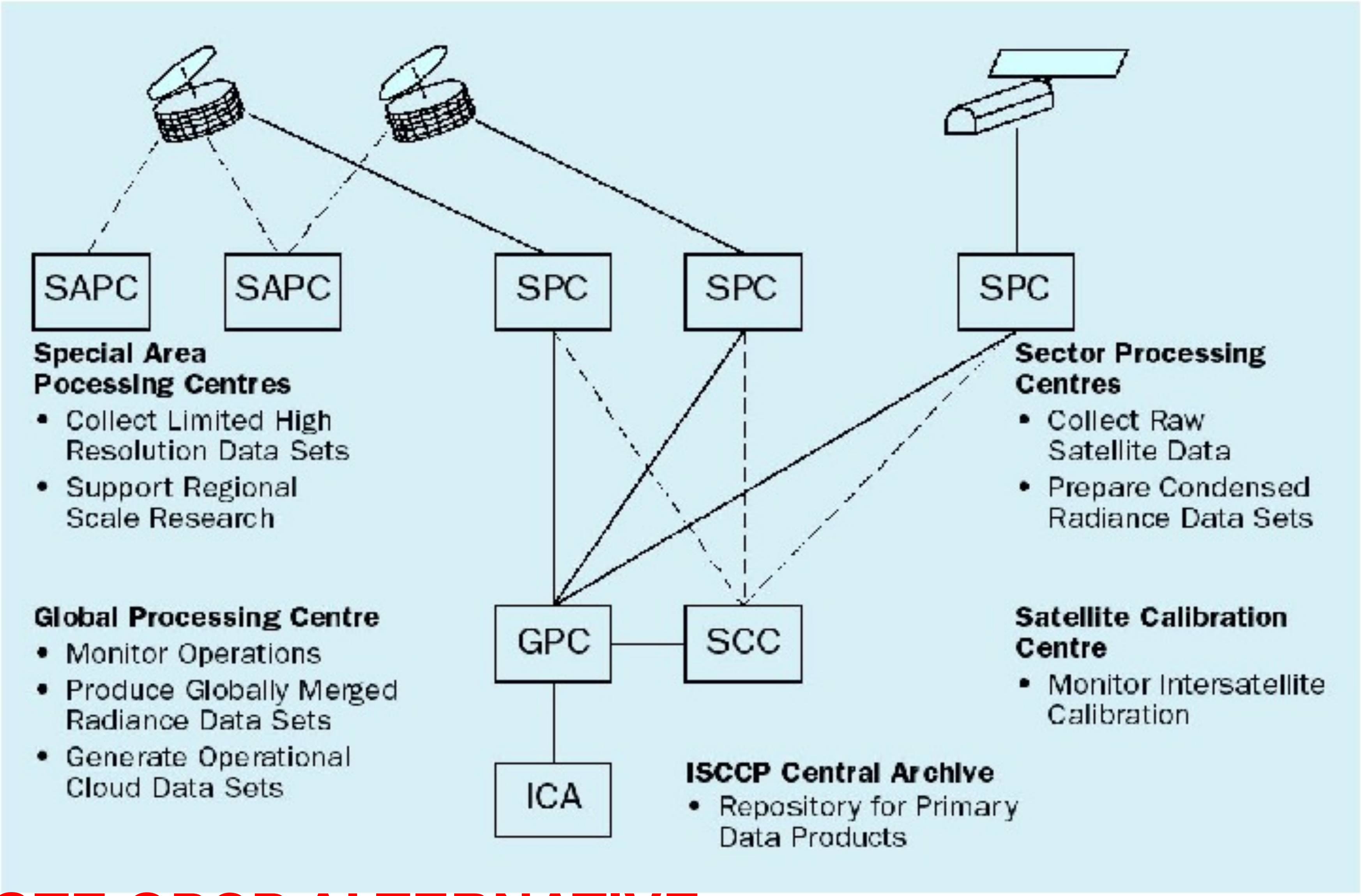
ISCCP Global Data Processing System



NOTE GPCP ALTERNATIVE

Sector Processing centers

SPC-Americas (GOES-East)

Univ. Wisc. ☞ AES ☞ Met. Services of Canada

SPC-East Pacific (GOES-West)

Colo.State.Univ - CIRA

SPC-West Pacific (GMS)

Japan Meteor. Agency- MSC

SPC-Europe/Africa (METEOSAT)

ESA ☞ EUMETSAT

SPC-Global (NOAA)

NOAA NESDIS Satellite Services ☞

NOAA National Climate Data Center

SPC-Indian

Indian Meteor. Dept. ☞ Eumetsat

SPC-East Asia

China

SPC-Atlantic

Brazil

Global Processing Center

NASA Goddard Institute for Space Studies

Satellite Calibration Center

Centre de Meteorologie Spatiale METEO FRANCE

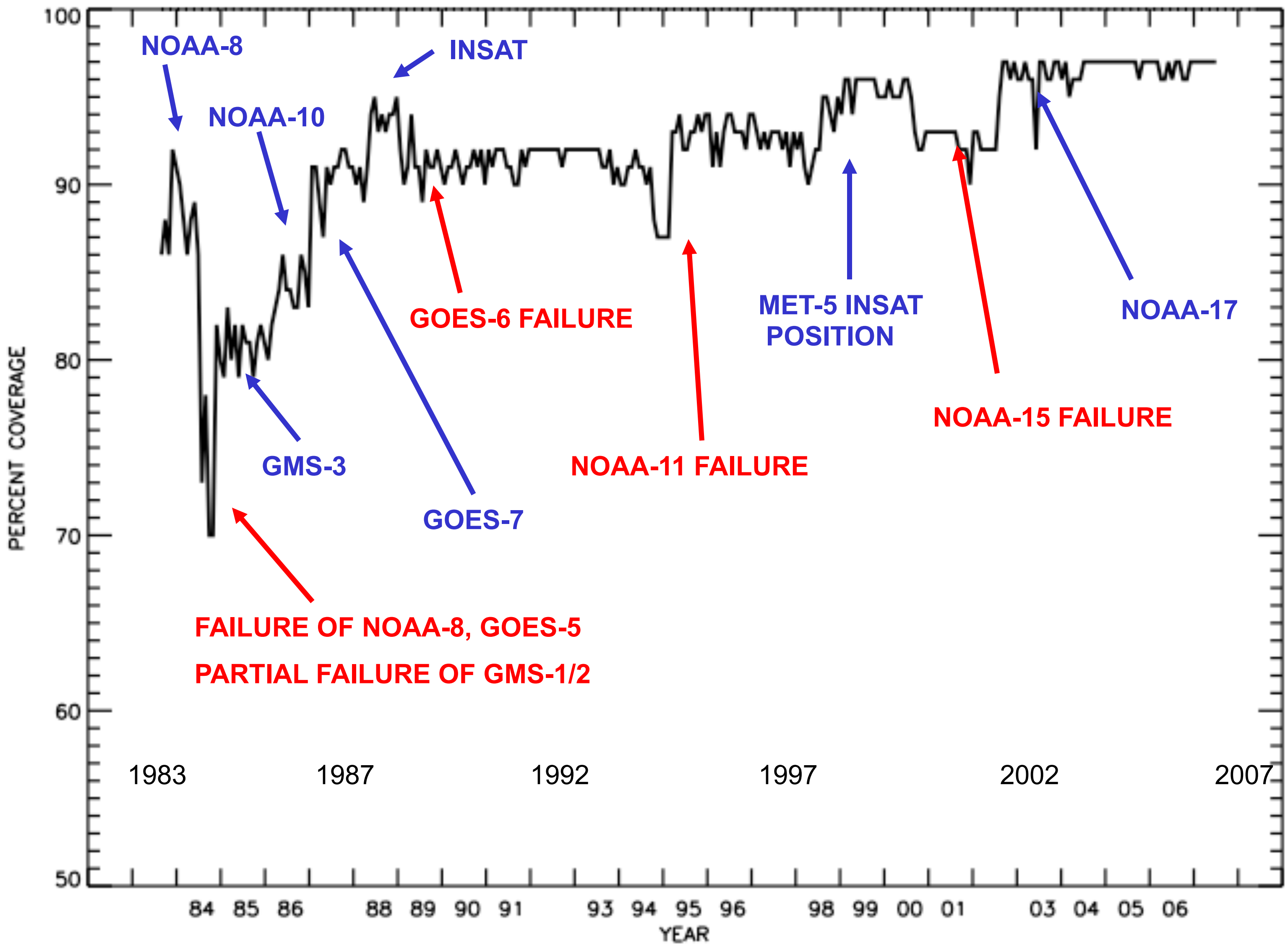
Data Archives

NOAA NESDIS Satellite Services ☞

NOAA National Climate Data Center (primary)

NASA Langley Research Center (Alternate)

ISCCP



ADJUSTING TO AN EVER-CHANGING OBSERVING SYSTEM

ISCCP Satellite Calibration Procedure (Rossow et al. 1992)

Applies to infrared 11um and visible 0.6um radiances

(1) normalization of each geostationary satellite radiometer to the standard "afternoon" polar orbiter every third month (more frequently as needed) by comparing coincident and co-located radiance measurements,

(2) elimination of shorter-term calibration variations for the geostationary radiometers by interpolation of the 3-monthly normalizations and examination of the complete time record of individual images at three hour intervals over each month,

§ (3) monitoring of the reference polar orbiter radiometer calibration to determine corrections that remove sudden changes and slow instrument drift,

§ (4) normalization of subsequent "afternoon" polar orbiter radiometer calibrations, when they replace the original reference standard, and of "morning" polar orbiter radiometers to the "afternoon" reference, and

§ (5) determination of an absolute radiometric calibration for the reference satellite radiometer by comparison to aircraft, surface and other vicarious estimates.

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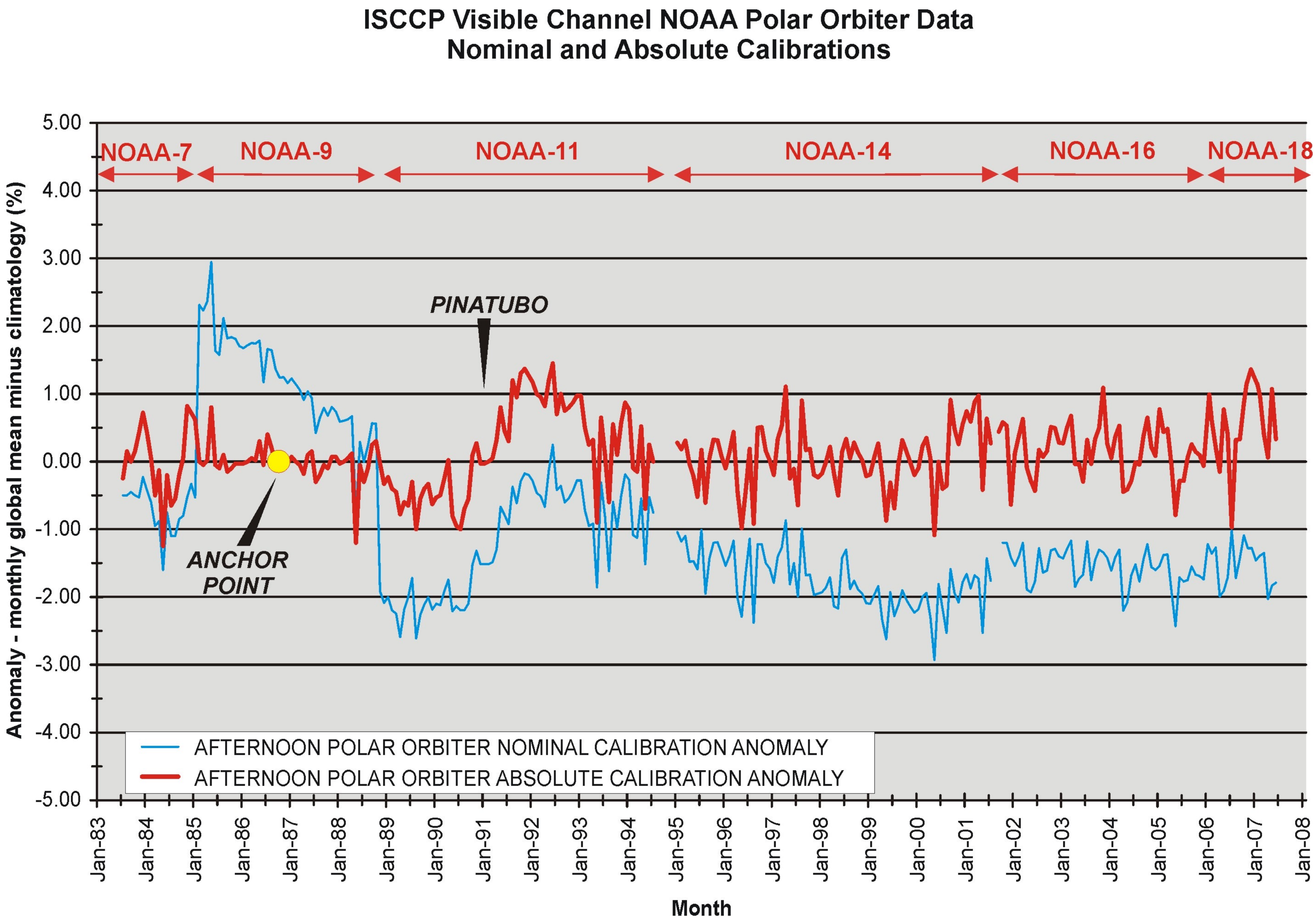
§ NOT PLANNED FOR



ISCCP Visible Channel NOAA Polar Orbiter Data
Nominal and Absolute Calibrations
NOAA-7
NOAA-9
NOAA-11
NOAA-14
NOAA-16
NOAA-18
PINATUBO
ANCHOR POINT
AFTERNOON POLAR ORBITER NOMINAL CALIBRATION ANOMALY
AFTERNOON POLAR ORBITER ABSOLUTE CALIBRATION ANOMALY
Anomaly - monthly global mean minus climatology (%)
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
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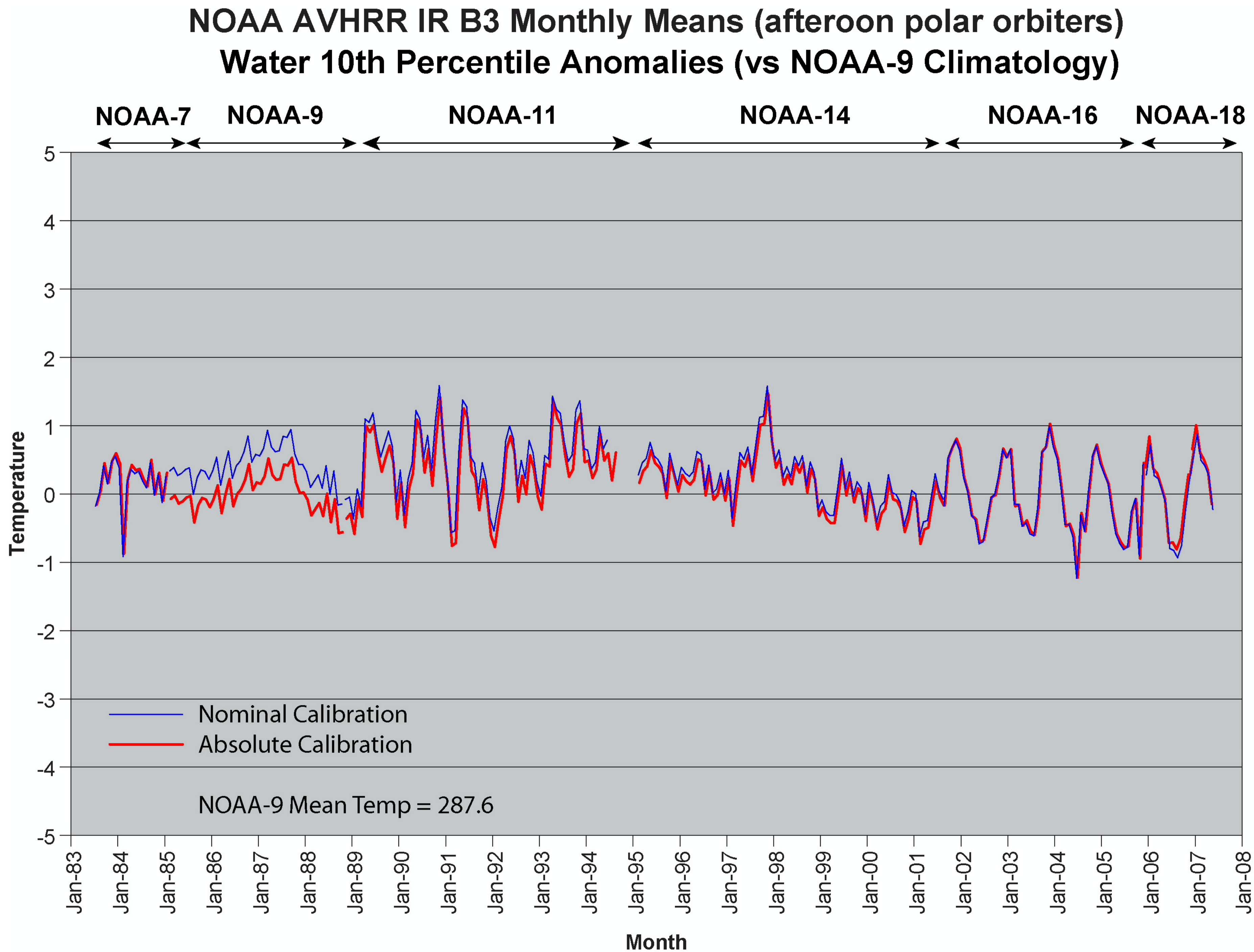
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Month



NOAA AVHRR IR B3 Monthly Means (afteroon polar orbiters)
Water 10th Percentile Anomalies (vs NOAA-9 Climatology)
NOAA-7
NOAA-9
NOAA-11
NOAA-14
NOAA-16
NOAA-18
Temperature
Month
Nominal Calibration
Absolute Calibration
NOAA-9 Mean Temp = 287.6
5
4
3
2
1
0
-1
-2
-3
-4
-5
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
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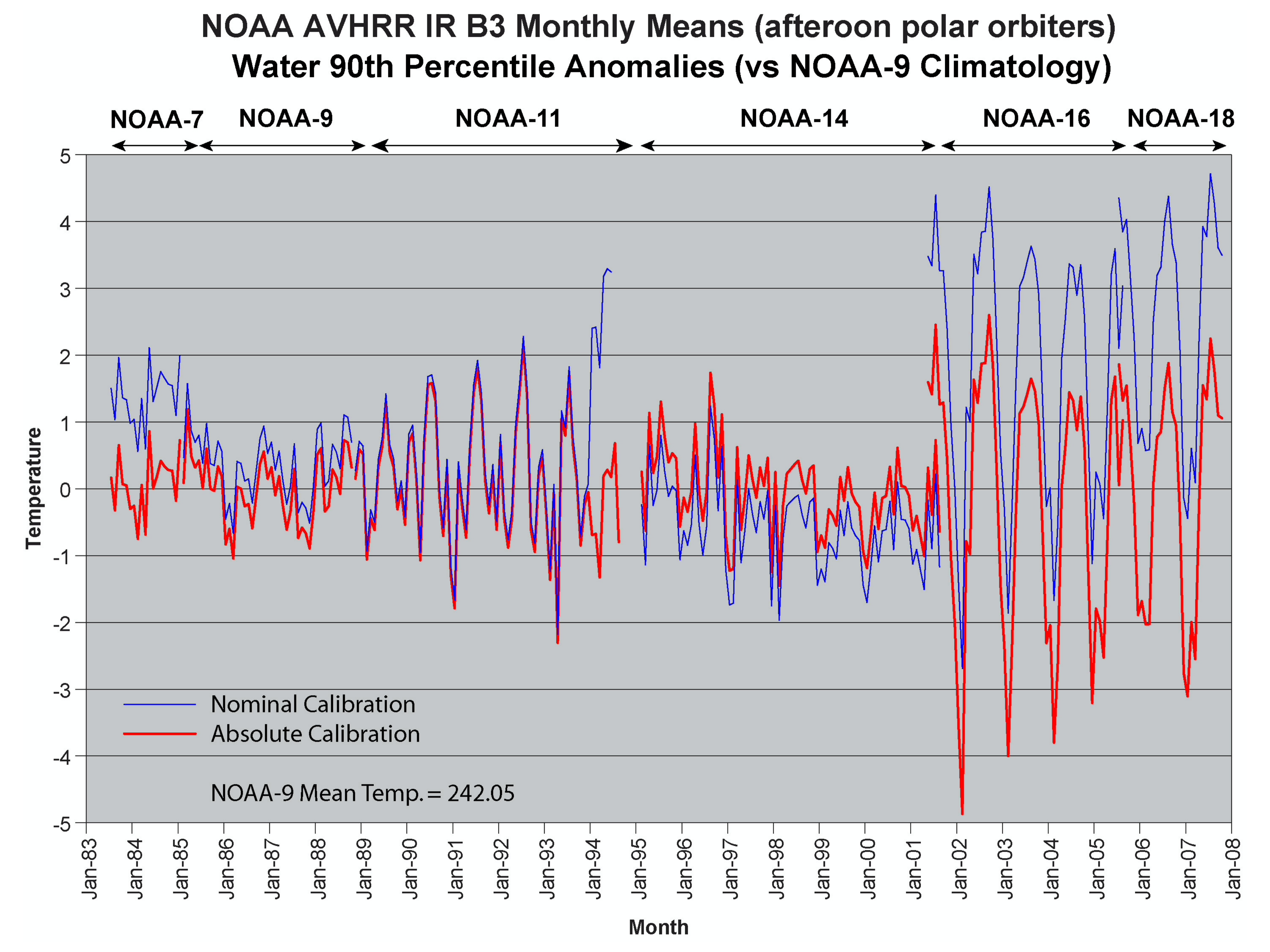
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08


NOAA AVHRR IR B3 Monthly Means (afteroon polar orbiters)
Water 90th Percentile Anomalies (vs NOAA-9 Climatology)
NOAA-7
NOAA-9
NOAA-11
NOAA-14
NOAA-16
NOAA-18
Temperature
5
4
3
2
1
0
-1
-2
-3
-4
-5
Nominal Calibration
Absolute Calibration
NOAA-9 Mean Temp. = 242.05
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Month

Original ISCCP Data Specifications

TABLE 1. Data specification for the International Satellite Cloud Climatology Project.

Parameters—Spatial and temporal averages and variances (or another statistical measure of the shape of the temporal distribution) are required for each of the following parameters.

	Precision (30-day averages)
Amounts	
Total cloud amount (fraction)*	±0.03
Cirrus cloud amount (fraction)*	±0.05
Middle cloud amount (fraction)	±0.05
Low cloud amount (fraction)*	±0.05
Deep convective cloud amount (fraction)	±0.05
Height	
Cirrus cloud-top height (km)*	±1.00
Middle level cloud-top height (km)	±1.00
Low-level cloud-top height (km)	±0.50
Deep convective cloud-top height (km)	±1.00
Cloud-Top Temperature (K) for each cloud category*	±1.00
Cloud Optical Depth	
Cloud Size Distribution	
Average Narrow Band Radiances (VIS and IR)*	

Spatial Averaging—The information is to be averaged over approximately 250-km by 250-km boxes

Time Sampling—Every 3 hours, i.e., 8 times a day, centered around the synoptic observation times

Time Averaging—The global cloud climatology will consist of 30-day averages for each of the 8 observing times per day

Length of Time Series—5 years

* Highest priority

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ISCCP Cloud Algorithm Intercomparison Pilot Study (1982-1983)

- Visible Threshold (VIS TH)
- Infared Threshold (IR TH)
- Bispectral Threshold (RT TH)
- Hybrid Bispectral Threshold (HB TH) 4
- Asymetric Gaussian Gaussian Histogram (AG HIS)
- Dynamic Cluster Histogram (DC HIS)
- Dynamic Bispectral Threshold (DB TH)
- IR radiance Spatial Coherence (IR SC)
- Maximal Clustering (MC HIS)

Ref. WCP-73, March 1984

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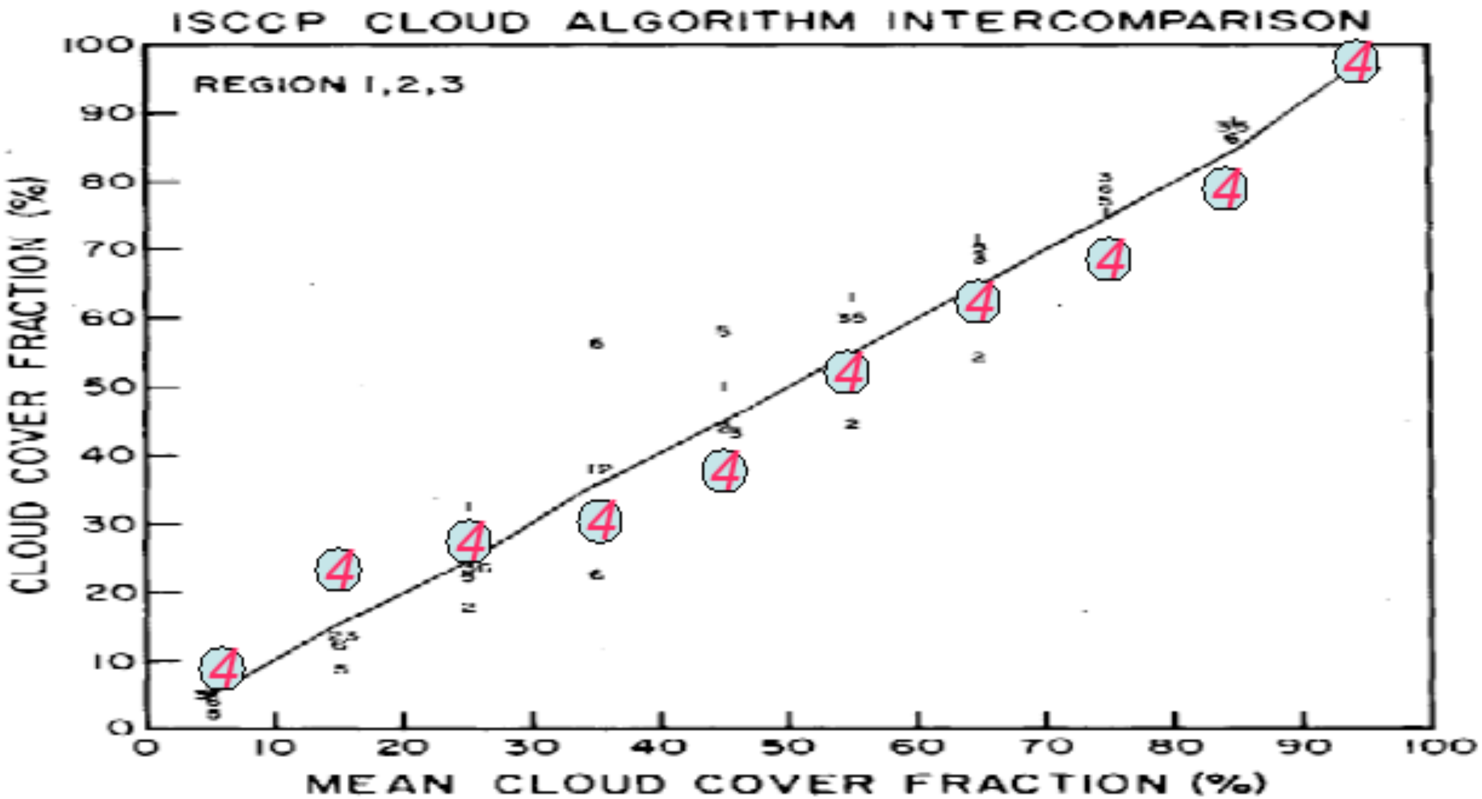

FIG. 2. Regression relation between cloud cover fraction obtained by each individual algorithm (ordinate) with the average of all methods (abscissa). The plotted values for each method represent the average value of cloud cover obtained by that method in all 2.5° boxes with the cloud cover, averaged over all methods, equal to the value indicated on the abscissa. The methods are (1) VIS TH, (2) IR TH, (3) RT TH, (4) HB TH, (5) AG HIS and (6) DC HIS. Results averaged over all three regions for all five days (see text).

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ALGORITHM IMPROVEMENTS in 1996

- Improved Cirrus Detection over Land by Reducing IR Thresholds
- Improved Low-Level Cloud Detection at High Latitudes by Reducing VIS Thresholds
- Improved Polar Cloud Detection by Adding 3.7 Micron Channel Thresholds

- Improved Treatment of Water Vapor Absorption
- Added Treatment of IR Scattering in Clouds
- Improved Retrieval of Optical Thicknesses over Snow/Ice Surfaces by Using 3.7 Micron Channel
- Introduced Explicit Treatment of Ice Phase Clouds

ISCCP PRODUCTS

- **Reduced Resolution Radiances**
  (B3 = 1.1 GB/month, 330 GB for 25 yr)
- **Reduced Resolution Radiances**
  (B1 = 10 GB/month, 3000 GB for 25 yr)
- **Radiance Calibration**
  (BT = 0.073 GB/month, 22 GB for 25 yr)
- **Ice/Snow and Atmospheric Temperature/Humidity**
  (IS & TV = 0.006 GB/month, 1.9 GB for 25 yr)
  - **Pixel-level Cloud Product**
    (DX = 5 GB/month, 1500 GB for 25 yr)
  - **Gridded Cloud Product**
    (D1 = 0.32 GB/month, 96 GB for 25 yr)
  - **Climate Summary Cloud Product**
    (D2 = 0.0075 GB/month, 2.3 GB for 25 yr)
    - **Cloud Particle Size**
      (RE = 0.4 GB/month, 96 GB for 20 yr)
    - **Radiative Flux Profiles**
      (FD = 0.54 GB/month, 162 GB for 25 yr)
    - **Cloud Dynamics Types**
      (CT, CS, CL, CyT, CyC = 0.3 GB/month, 90 GB for 25 yr)

ISCCP Data Available

Stage B3 and BT:	July 1983 - June 2007
Atmospheric Data:	July 1983 - June 2007
Sea Ice and Snow Data:	July 1983 - June 2007
Stage DX, D1 and D2:	July 1983 - June 2007

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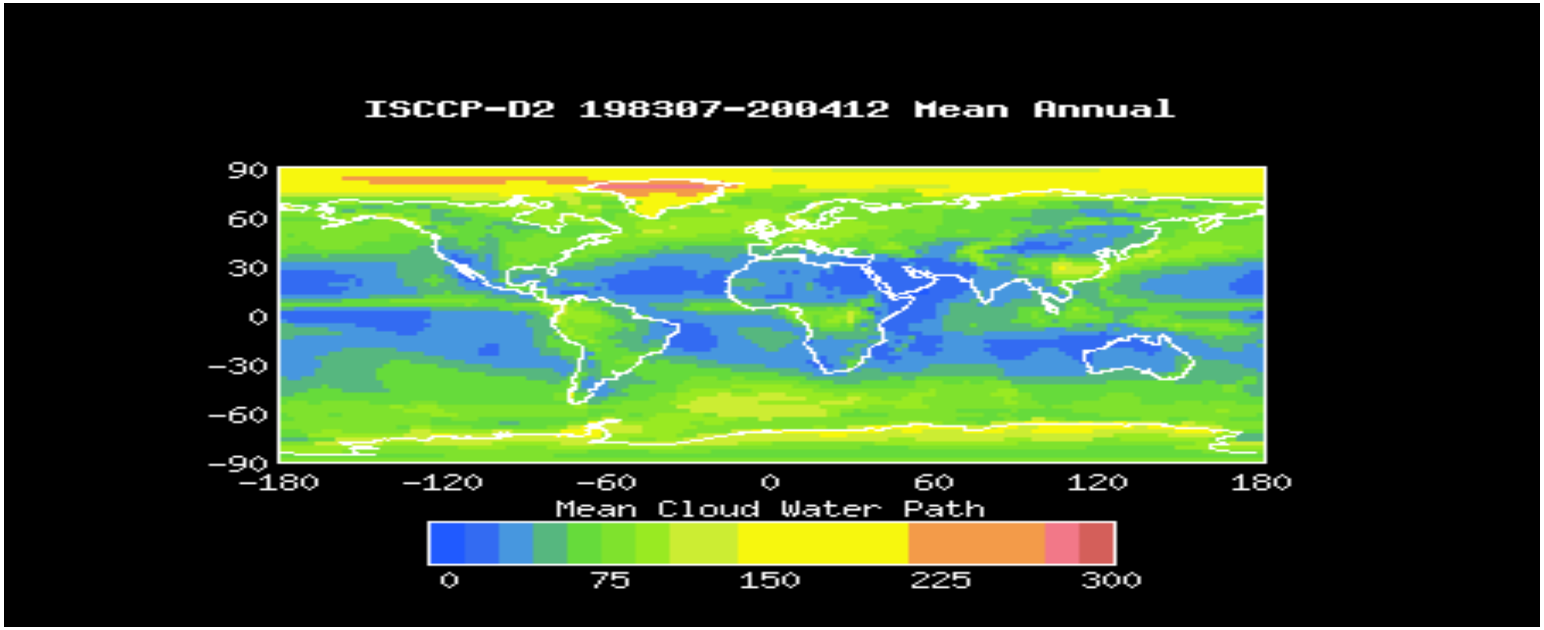
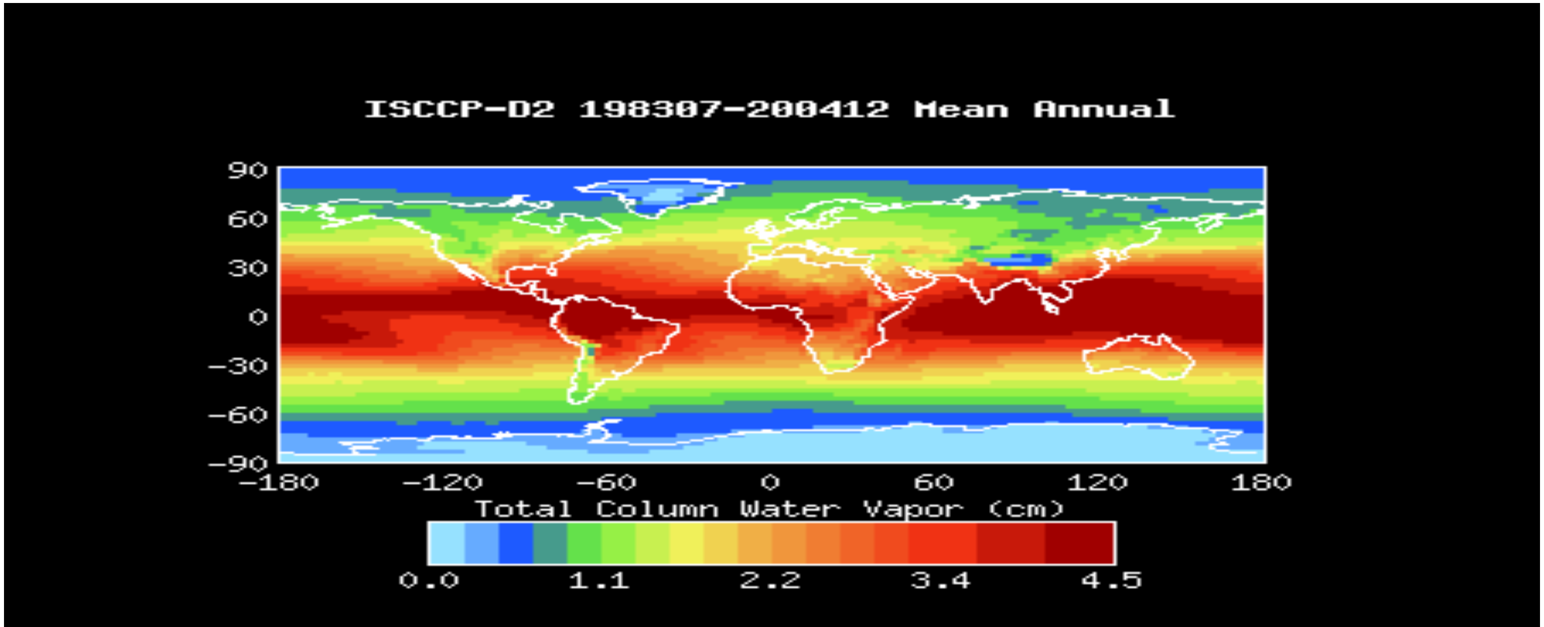
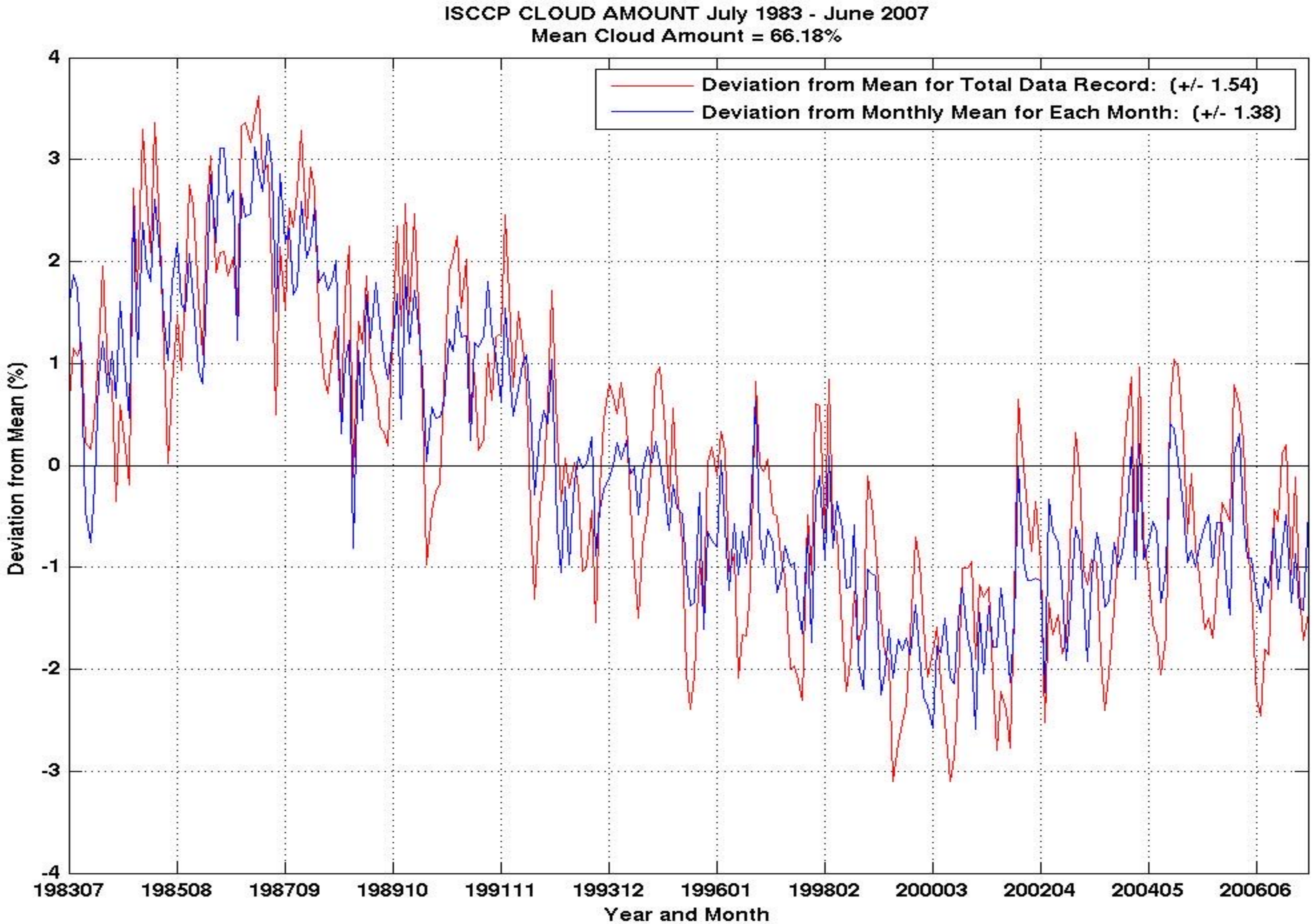
Global Distribution of Cloud Water and Water Vapor







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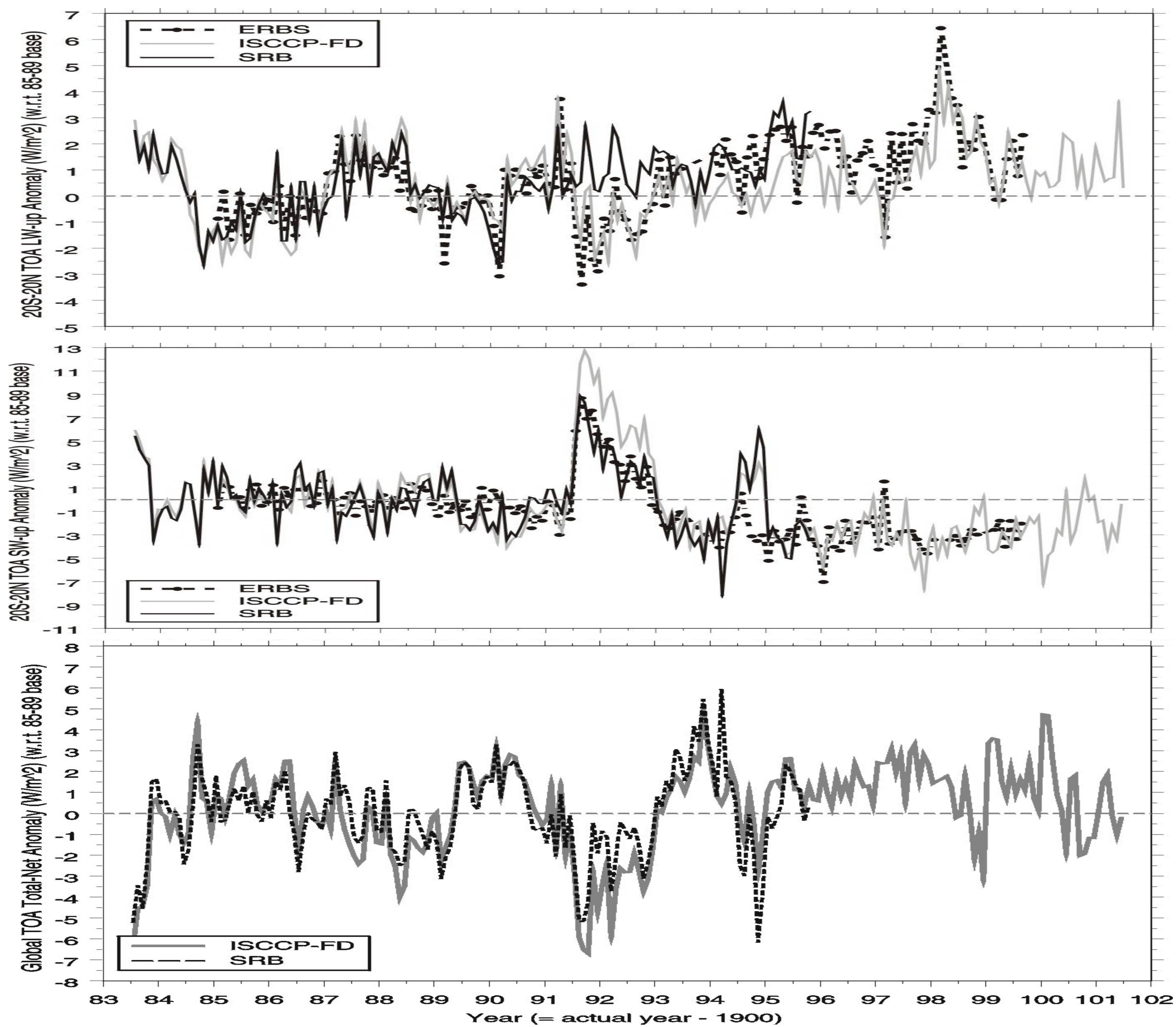
ERBE VS ISCCP-FD at TOA



Comparisons with ISCCP Products

ISCCP - HIRS Cloud Comparisons

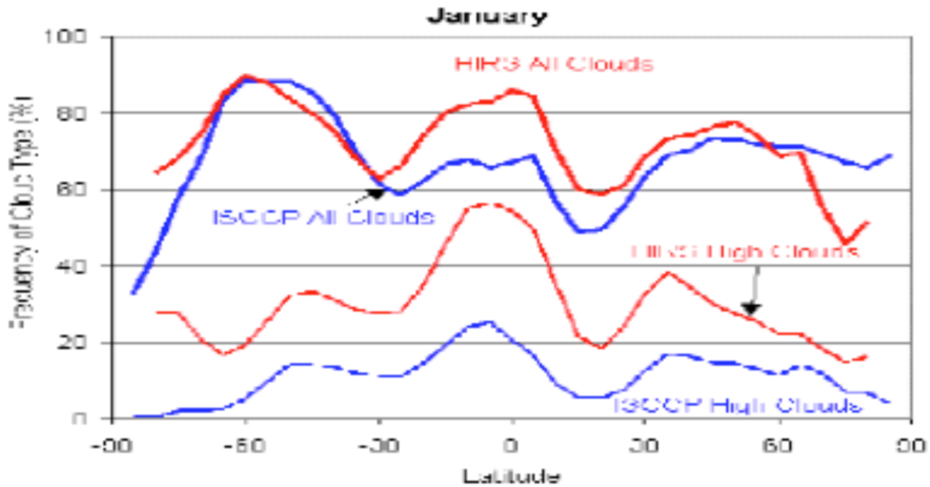


Figure 1: The frequency of detection of All Clouds (Total Cloud) and High Cloud (above 440 mb) for the UW HIRS and the ISCCP analyses. Results from four Januarys in 1990 93 were averaged

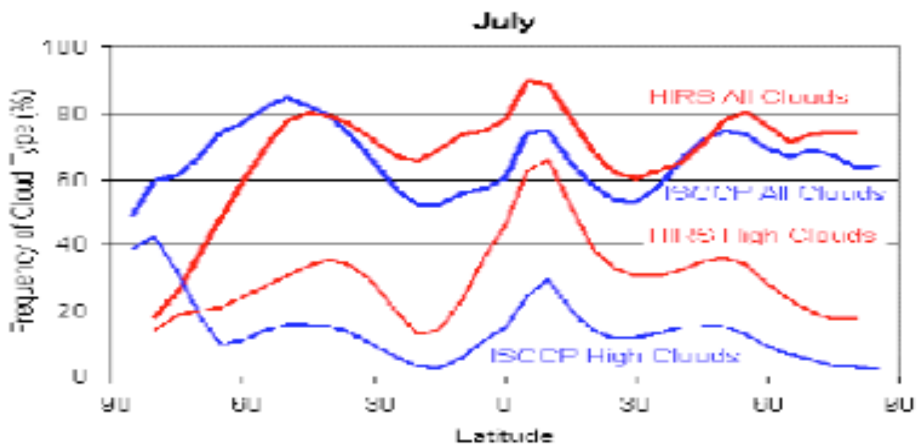
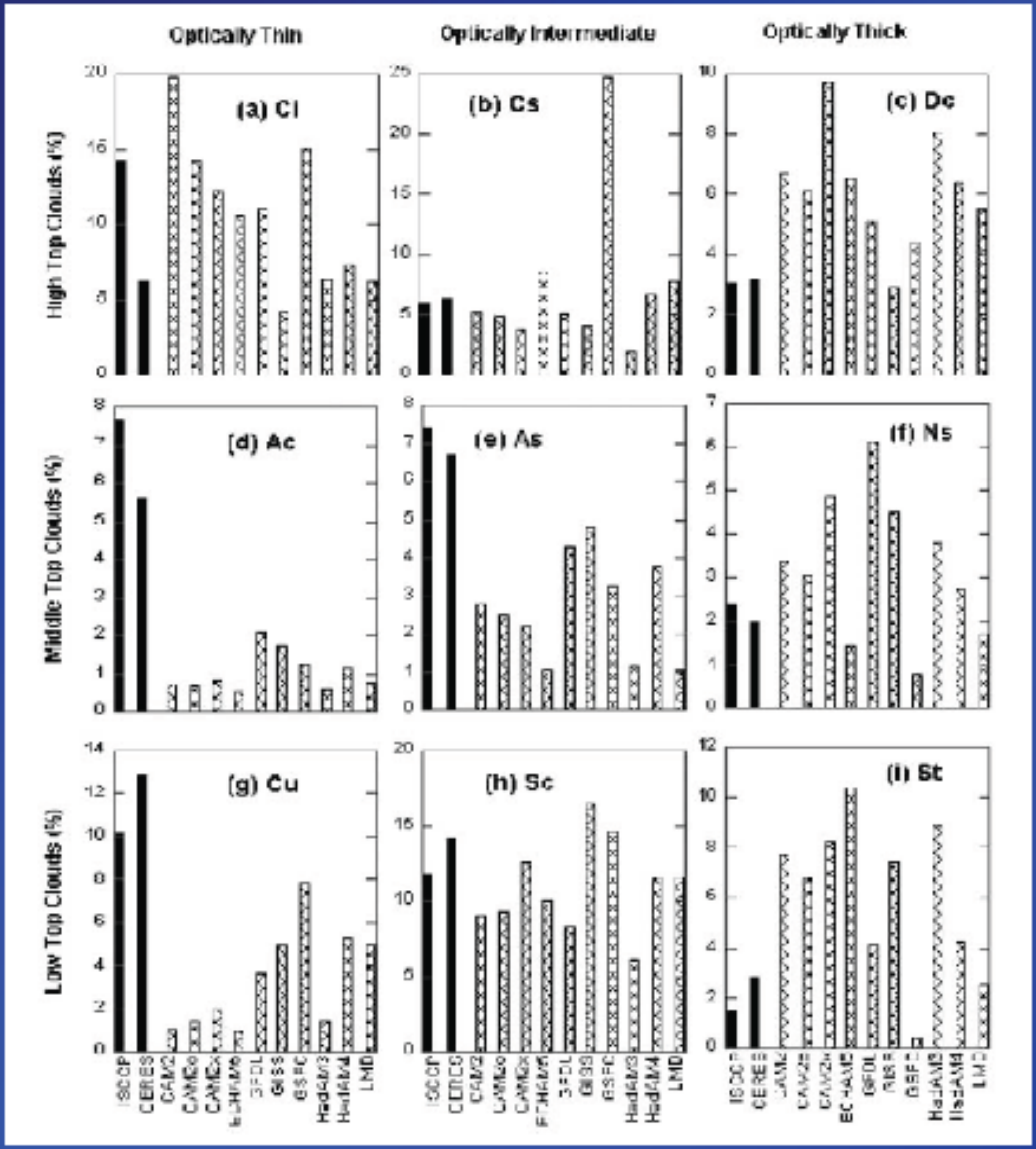


Figure 2: The frequencies of detection of All Clouds (total cloud cover) and High Clouds for fiv Julys from 1989-93

Ref. D.Wylie



DJF Cloud Types by Height / Optical Depth Class

Large climate model errors by cloud type

Climate Models vs CERES-MODIS and ISCCP Cloud Data (DJF, 60S - 60N)

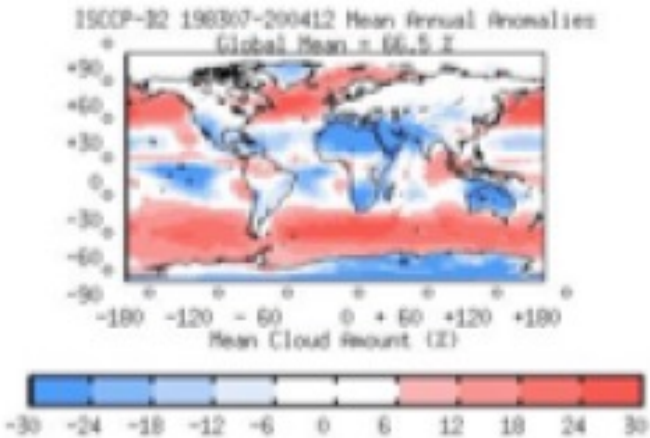
Zhang et al., 2005

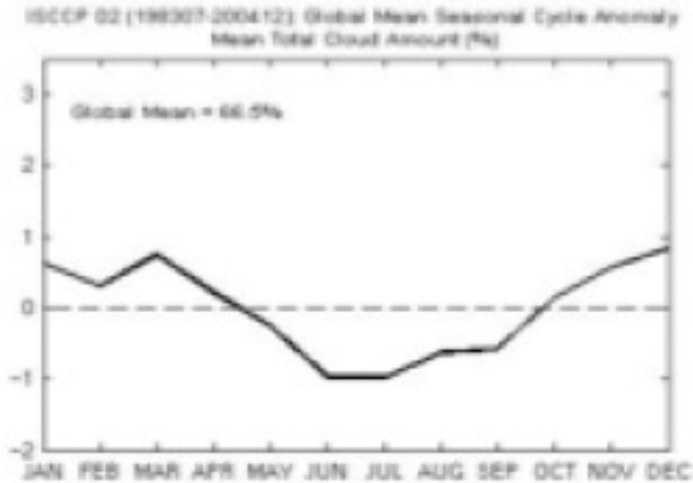
DATASETS AND RESULTS

MEAN ANNUAL TOTAL CLOUD AMOUNTS

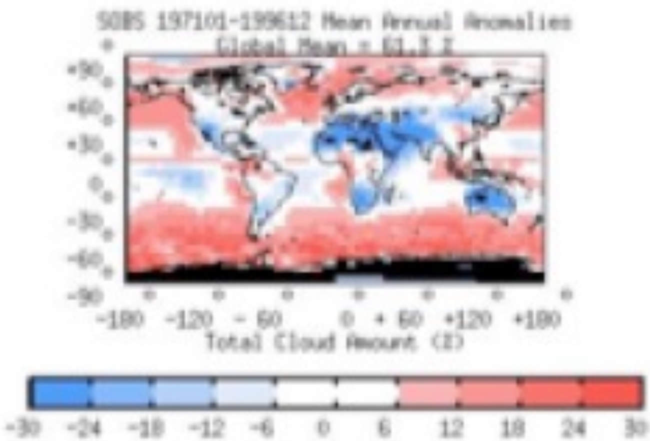
MEAN SEASONAL CYCLE ANOMALY

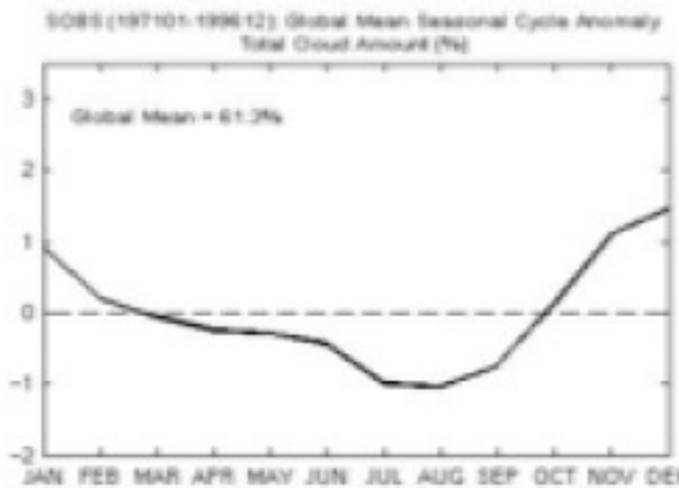
ISCCP D2



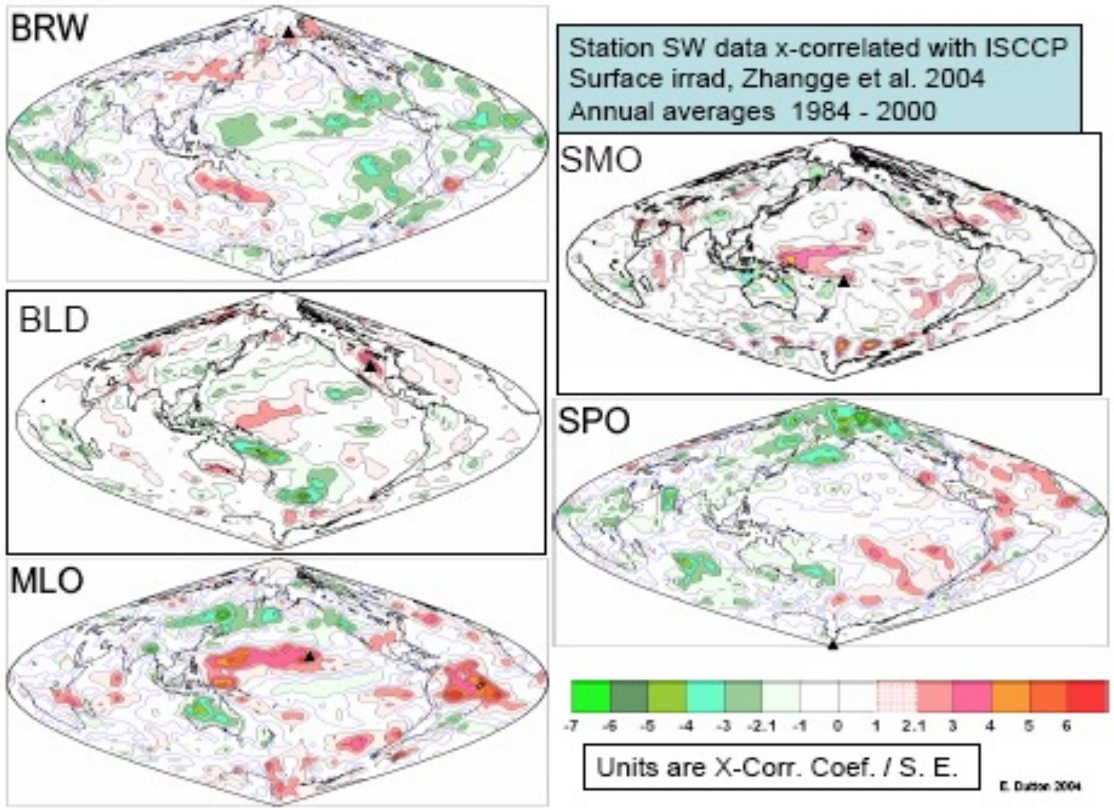


SOBS



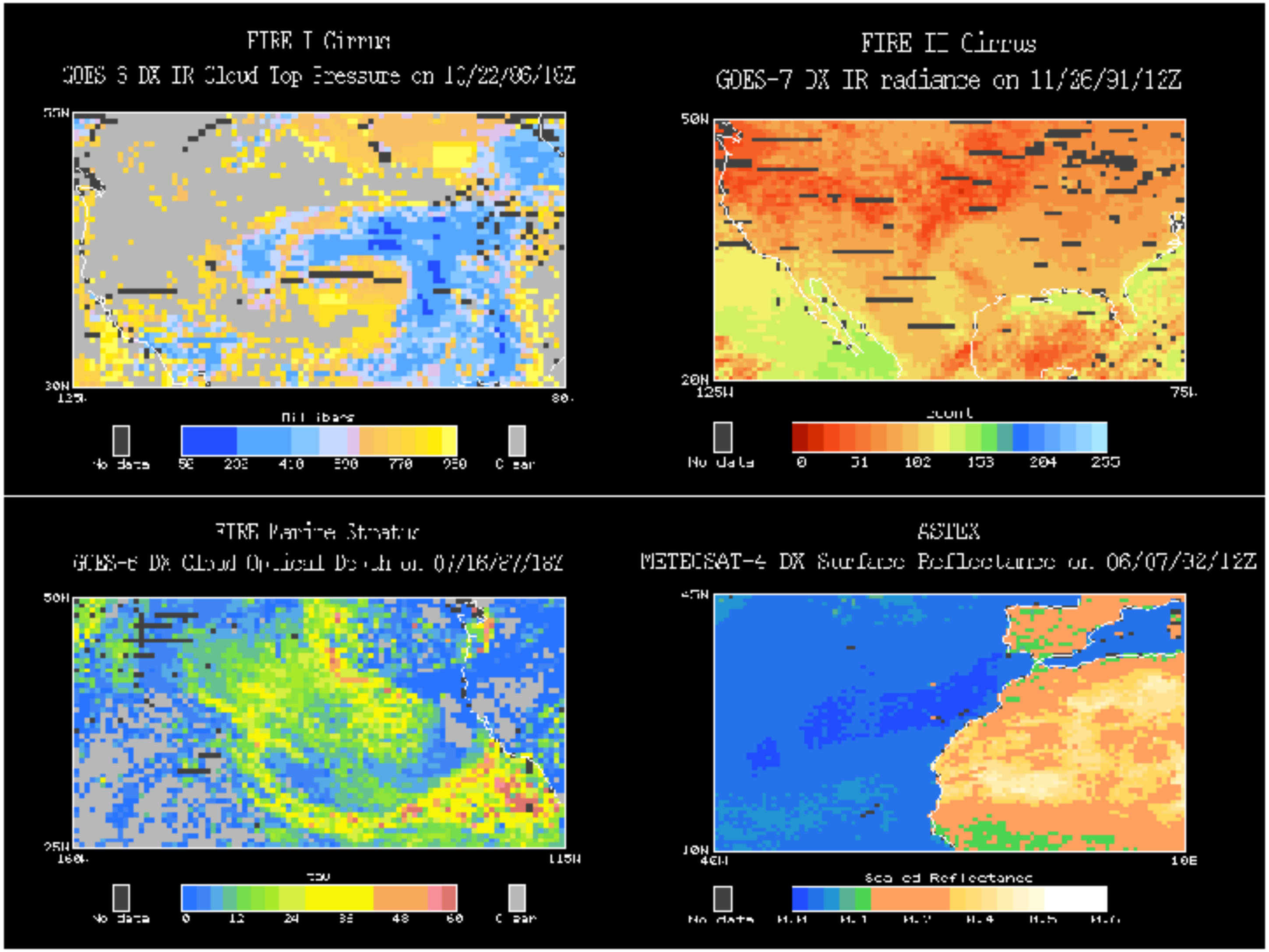


BSRN GEWEX Validation



Ref. E. Dutton

FIRE—ICE—EUCREX—ASTEX—FIRE-ACE—CRYSTAL TWP-ICE--???



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GEWEX ORGANIZATION

RADIATION

GEWEX Radiation Panel (GRP) -- W. Rossow, Chair

- **BSRN** **Baseline Surface Radiation Network** (E. Dutton)
- **CIRC** **Continuous Intercomparison of Radiation Codes** (L. Oreopoulus)
- **GACP** **Global Aerosol Climatology Project** (M. Mishchenko)
- **GPCP** **Global Precipitation Climatology Project** (R. Adler)
- **GVaP** **Global Water Vapor Project**
- **I3RC** **Intercomparison of 3-D Radiation Codes** (R. Cahalan)
- **ICRCCM** **InterComparison of Radiation Codes in Climate Models** (R. Ellingson)
- **ISCCP** **International Satellite Cloud Climatology Project** (W. Rossow)
- **LandFlux** **Land Surface Fluxes**
- **SRB** **Surface Radiation Budget Project** (P. Stackhouse)
- **SeaFlux** **Sea Surface Fluxes** (C. Clayson)
- **WGCAP** **Working Group for Cloud and Aerosol Profiling** (T. Ackerman)
- **WGDMA** **Working Group on Data Management and Analysis** (W. Rossow)
- **WGPRN** **Working Group for Precipitation Radar Networks** (V. Levizzani)

MODELLING AND PREDICTION

GEWEX Modelling and Prediction Panel (GMPP) - C. Jakob, Chair

- **GABLS** **GEWEX Atmospheric Boundary Layer Study** (B. Holtslag; G. Svensson)
- **GCSS** **GEWEX Cloud System Study** (P. Siebesma)
  - **Boundary Layer Clouds** (P. Siebesma)
  - **Cirrus Cloud Systems** (S. Dobbie)
  - **Extra Tropical Layer Clouds** (G. Tselioudis)
  - **Precipitating Convective Cloud Systems** (J. Petch)
  - **Polar Clouds** (J. Pinto)
  - **GPCI - GCSS Pacific Cross-section Intercomparison** (J. Teixeira)
- **GLASS** **GEWEX Global Land/Atmosphere System Study** (A. Pitman; B. van den Hurk)
  - **ALMA** **Assistance for Land-surface Modelling Activities** (T. Oki)
  - **GLACE-2** **Global Land/Atmospheric Coupling Experiment** (R. Koster)
  - **GSWP-2** **Global Soil Wetness Project** (P. Dirmeyer)
  - **LoCo** **Local land-atmospheric Coupling** (B. van den Hurk)
  - **PILPS** **Project for Intercomparison of Land Surface Parameterization Schemes** (A. Pitman)

HYDROCLIMATE

Coordinated Energy and Water-Cycle Observations Project (CEOP) - T. Koike, J. Roads, Co-chairs

Regional Hydroclimate Projects (RHPs)

- **AMMA** **African Monsoon Multidisciplinary Analysis Project** (A. Gaye)
- **BALTEX** **Baltic Sea Experiment** (H.J. Isemer)
- **CPPA** **Climate Prediction Program for the Americas** (J. Huang)
- **LBA** **Large-Scale Biosphere-Atmosphere Experiment in Amazonia** (J. Maia)
- **LPB** **La Plata Basin Project** (H. Berbery)
- **MAHASRI** **Monsoon Asian Hydro-Atmospheric Science Research and prediction Initiative** (J. Matsumoto)
- **MDB** **Murray-Darling Basin Water Budget Project** (A. Seed)
- **NEESPI** **Northern Eurasia Earth Science Partnership Initiative** (P. Groisman)

Regional Studies

- **High Altitude** (G. Tartari)
- **Monsoon** (J. Matsumoto)
- **Polar** (T. Ohata)
- **Semi-arid** (C. Fu)

Data Management

- **In Situ, River Basins** (S. Williams)
- **Model Output** (M. Lautenschlager)
- **Satellite** (T. Koike)
- **Data Integration and Dissemination** (K. McDonald)

Cross-Cutting Studies

- **Water and Energy Budget Studies** (J. Roads)
- **Extremes** (R. Stewart)
- **Stable Water Isotope Working Group** (D. Noone)
- **Aerosols** (W. Lau)

Modelling Studies

- **Global Models** (M. Bosilovich)
- **Regional Models**
  - **Inter-Continental Transferability Study** (B. Rockel)
  - **Regional Modelling for Variability and Extremes** (R. Arritt)
  - **GEWEX Modelling and Prediction Panel** (C. Jones)
- **Land Surface Models** (M. Rodell)
- **Hydrologic Applications Project** (E. Wood)

Affiliated Global Organizations

- **GPCC** **Global Precipitation Climatology Centre** (T. Fuchs)
- **GRDC** **Global Runoff Data Centre** (T. Maurer)
- **IAHS** **International Association of Hydrological Sciences** (A. Hall)

1 Step ►►► 5 Steps

ISCCP DATA Archives

Official ISCCP Archive NOAA/NESDIS/NCDC Satellite Services Group can be contacted at: ncdc.atorder@noaa.gov

ISCCP DX Data available at: ftp://eclipse.ncdc.noaa.bov/pub/isccp/dx

ISCCP data also available from the NASA Langley Research Center EOS DAAC at:
<http://eosweb.larc.nasa.gov/PRODOCS/isccp/table_isccp.html>

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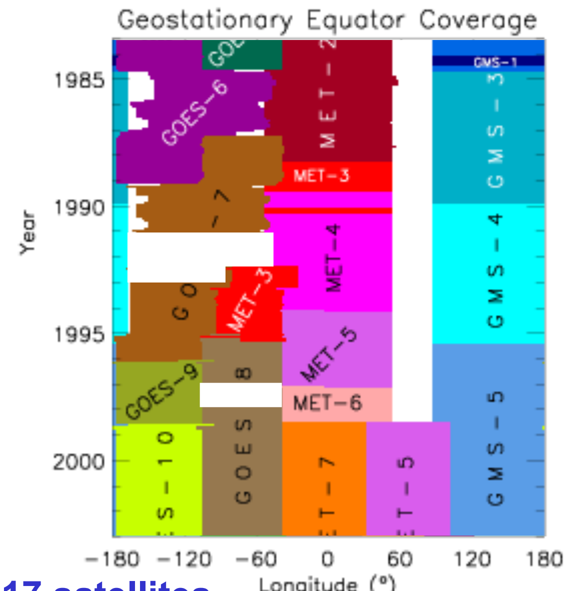
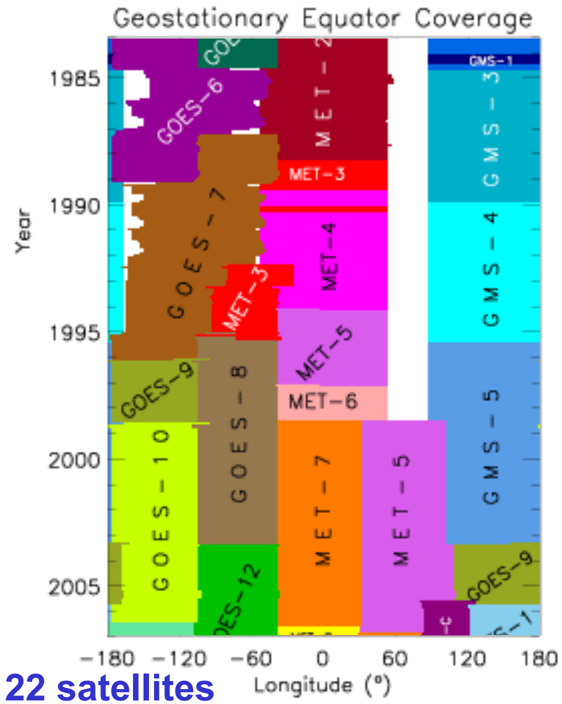
Data Rescue Efforts: Ought Seven

B1 Status - 2003



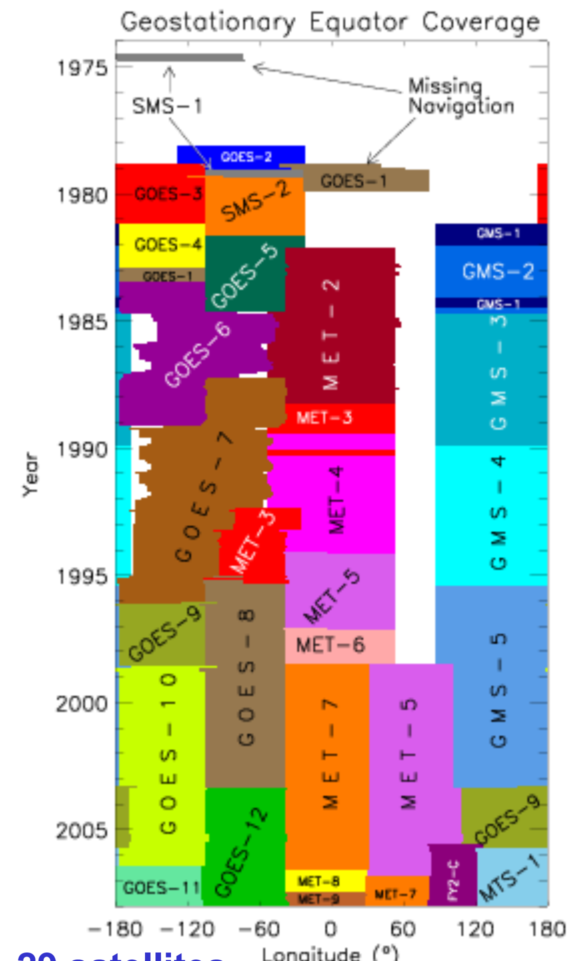
17 satellites

B1 Status - 2006



22 satellites

B1 Status - 2007



29 satellites

Concluding Remarks

• ISCCP is the longest running satellite driven international research effort that continues to provide the scientific community with essential information about the least understood component of the global climate system

• It has served as an effective partnership for bringing the climate observation, modeling and theoretical communities together in pursuit of common goals

• It has continued to keep pace with improvements in technology and understanding since its inception

• It is the most widely referenced source for cloud information which also, according to Pierre Morel, “helps to keep the climate modelers honest”

ISCCP

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ISCCP ACHIEVEMENTS

- **Common Format "Whole-Constellation" Radiance Dataset**
- **First Accurate and Common Radiance Calibrations**
- **First Analysis System with Full Radiative Retrieval and Multi-Stream Data Processing**
- **Quantified Sampling, Averaging and Resolution Effects**
- **First Global Survey of Cloud Layer Diurnal Variations**
- **First Survey of Cloud Optical Thicknesses**
- **First Global Survey of Surface Temperature Diurnal Variations**
- **First Global Survey of Liquid Cloud Droplet Sizes**
- **First Survey of Ice Cloud Water Paths**
- **First Globally-Complete Statistical Model of 3-D Cloud Distribution**
- **Quantified Effects of Clouds on Planetary and Surface Radiative Fluxes**
- **Nearly 1500 Papers Published Using ISCCP Data Products**

NEW ISCCP

Switch from B3 to B1 Radiances – 10 km Sampling

Improved Polar Cloud Detection

Revised Retrieval to Account for Ice Particle Shape, Aerosol and Surface Effects Better

?? -- Improved Accuracy Atmospheric Temperature and Humidity Profiles

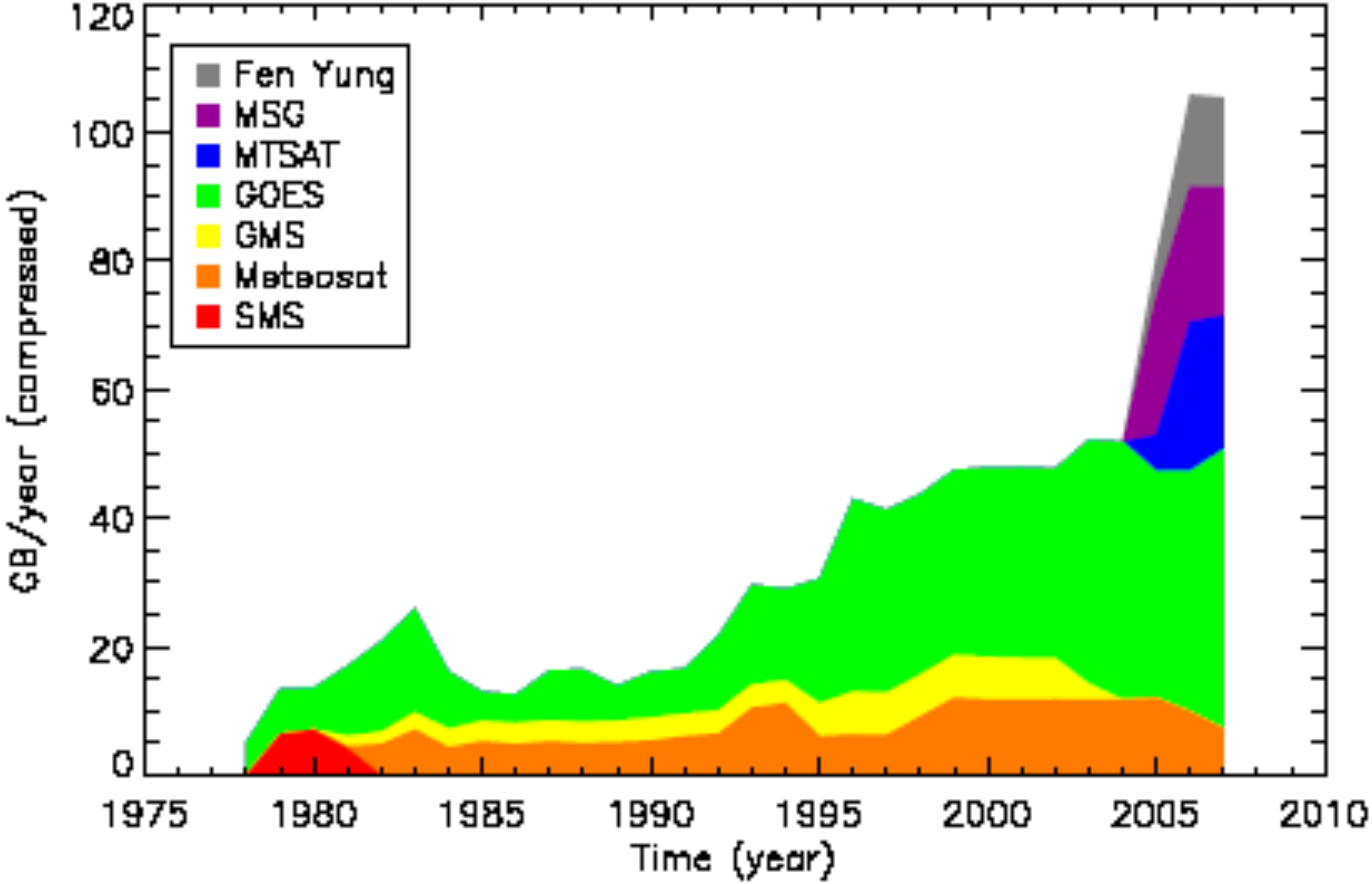


Figure 2 – Annual compressed data volume of the ISCCP B1 data sorted by satellite series.

K. KNAPP

ISCCP to Climate Data Record

Investigate and Reduce Artifacts
From Sampling, Angle-Variations, Ancillary Data

Re-Design System for Consistency

Modernize Code

Complete Automation

Complete Documentation

HAVE WE MET OUR GOALS?

- Provided Datasets for Research
- Developed Usefully Accurate Analysis Procedures
- Cloud Effects on Radiation Budget Quantified

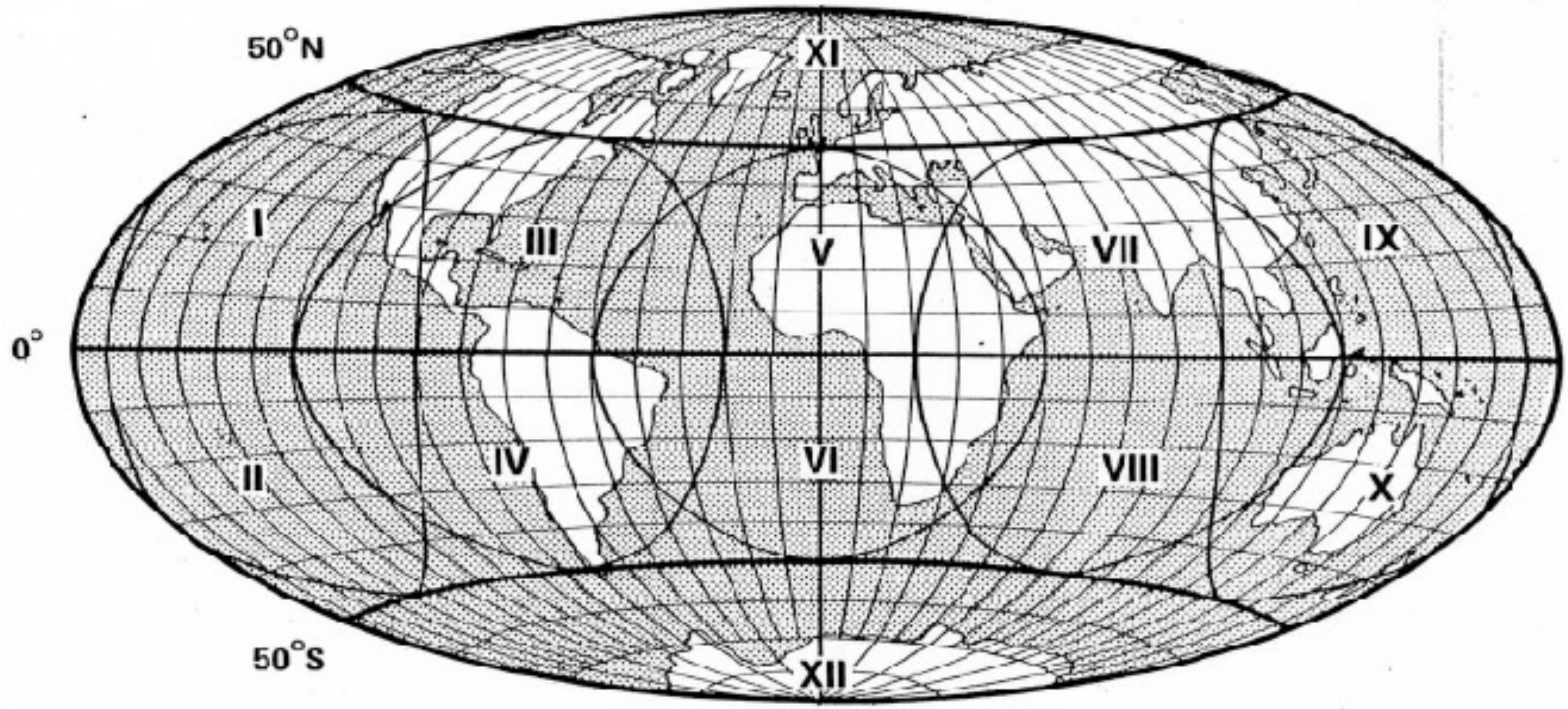
§ **Cloud Role in Hydrological Cycle Still to be Done**

? Analysis of Observations and Models Has not Had Much Discernable Impact yet

► **Cloud-Climate Feedbacks Still to be Understood**

BACKUP SLIDES

Initial Data processing Sectors for ISCCP



I GOES-W
II GOES-W
III GOES-E
IV GOES-E
V METEOSAT
VI METEOSAT
VII INSAT
VIII INSAT
IX GMS
X GMS
XI NOAA*; METEOR
XII NOAA*; METEOR

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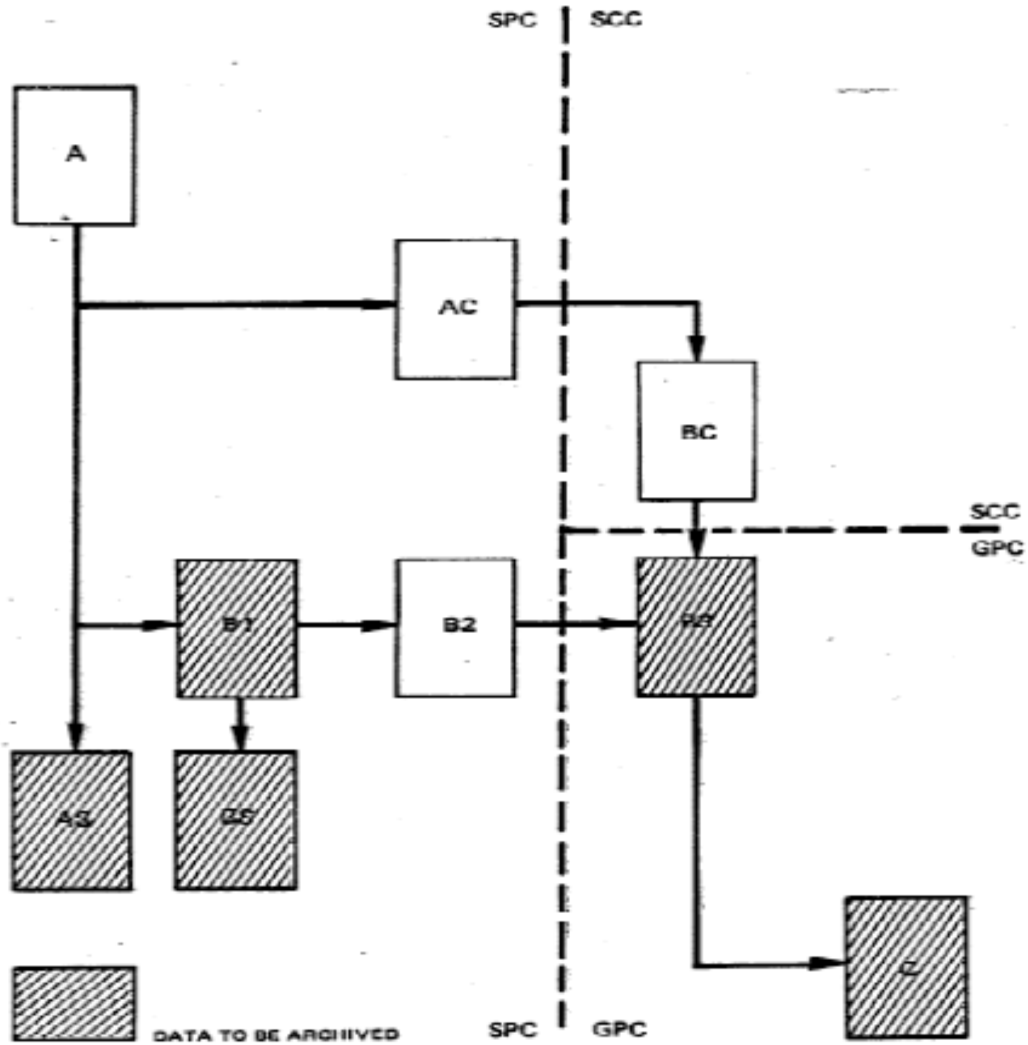
Initial ISCCP Data Stages



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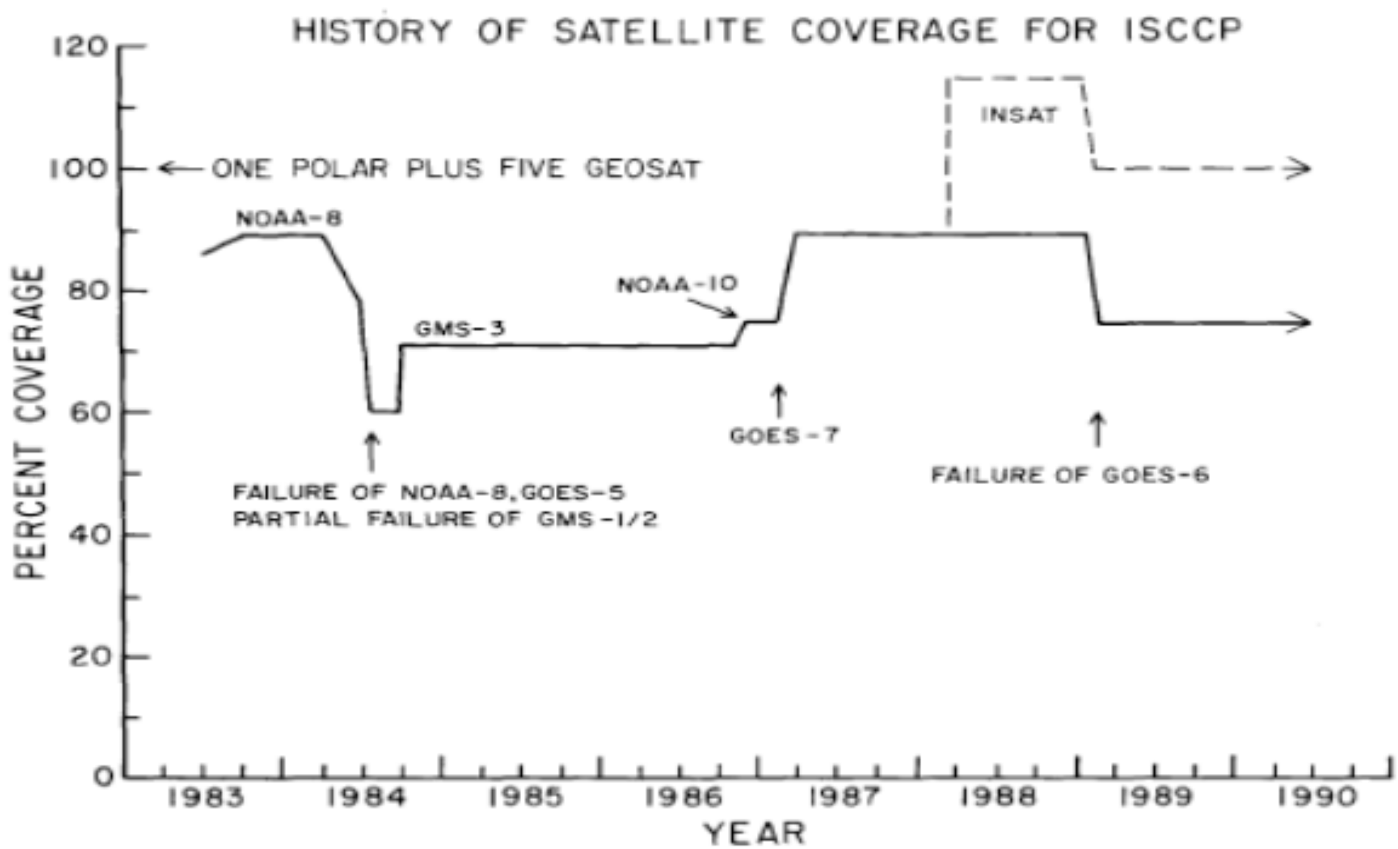
Adjusting to an Ever Changing Observing System



Ref. Rossow & Schiffer, BAMS, Vol. 72. No. 1, January 1991

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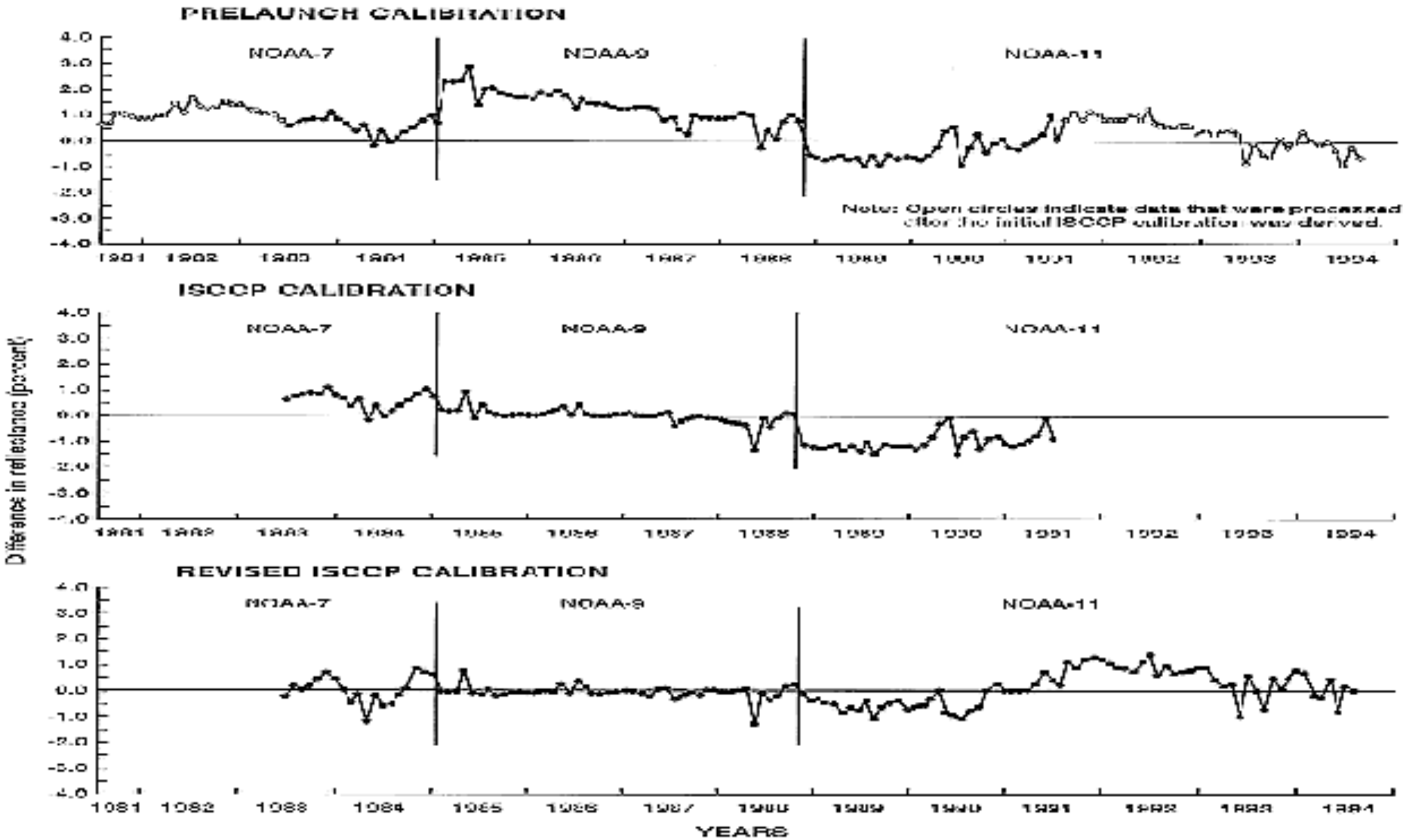
ISCCP NOAA Satellite Calibration



Ref. Brest, Rossow, Roiter, JAOT, Vol.14,Issue 5,Oct 1997

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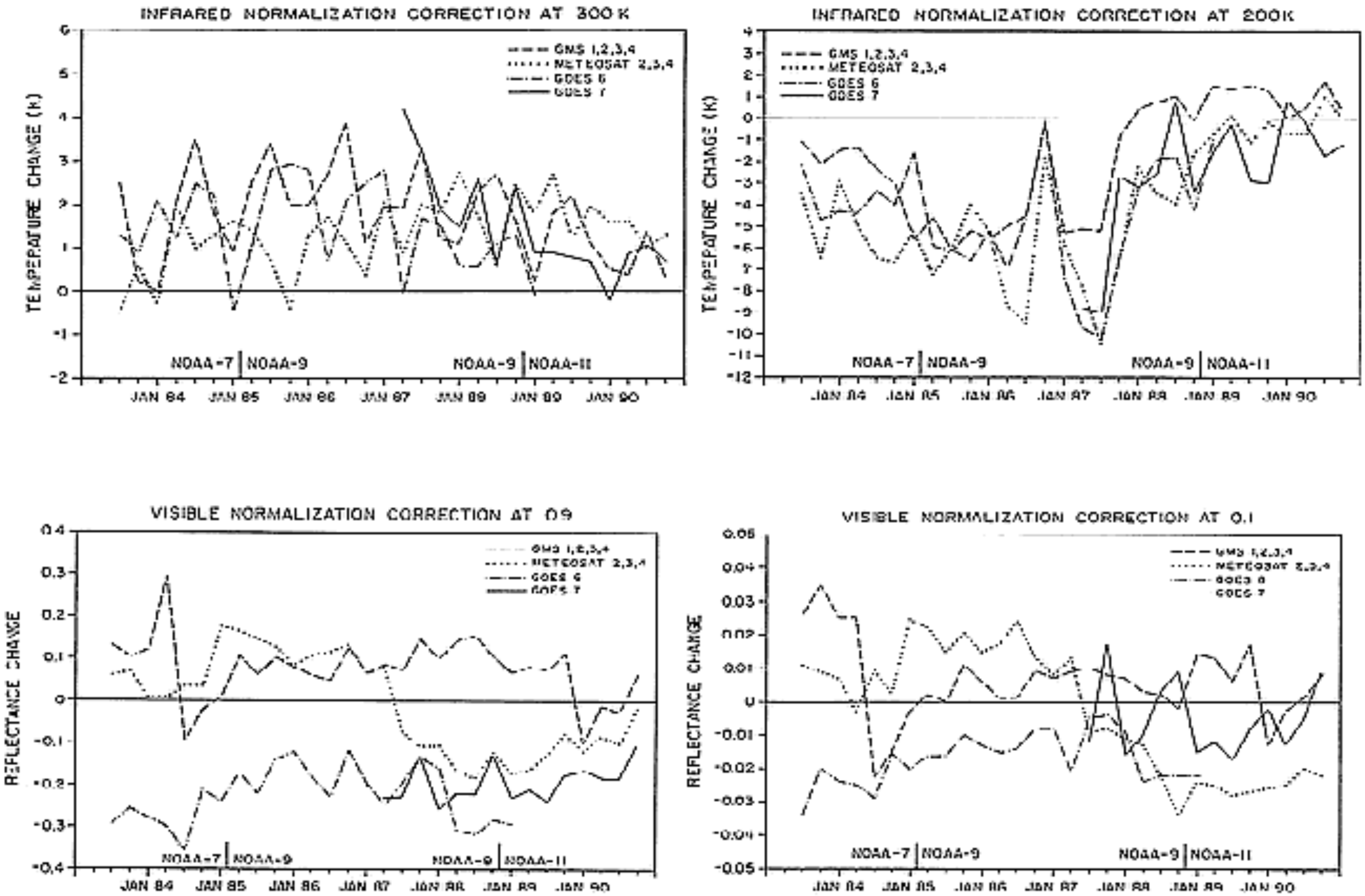
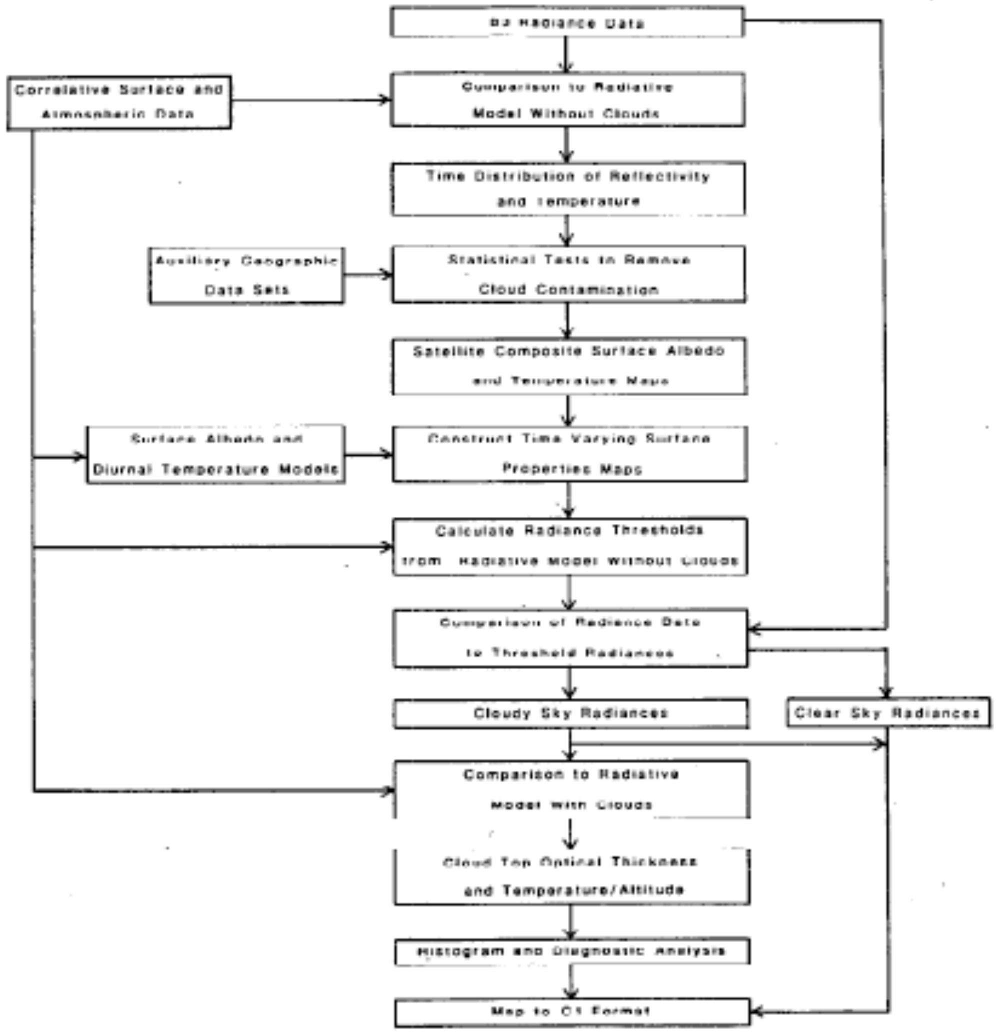
ISCCP History of Calibration Changes for Visible and Infrared Channels on Operational Geostationary Satellites



Ref. Brest, Rossow, Roiter, JAOT, Vol.14,Issue 5,Oct 1997

Initial ISCCP Operational Algorithm (1983)



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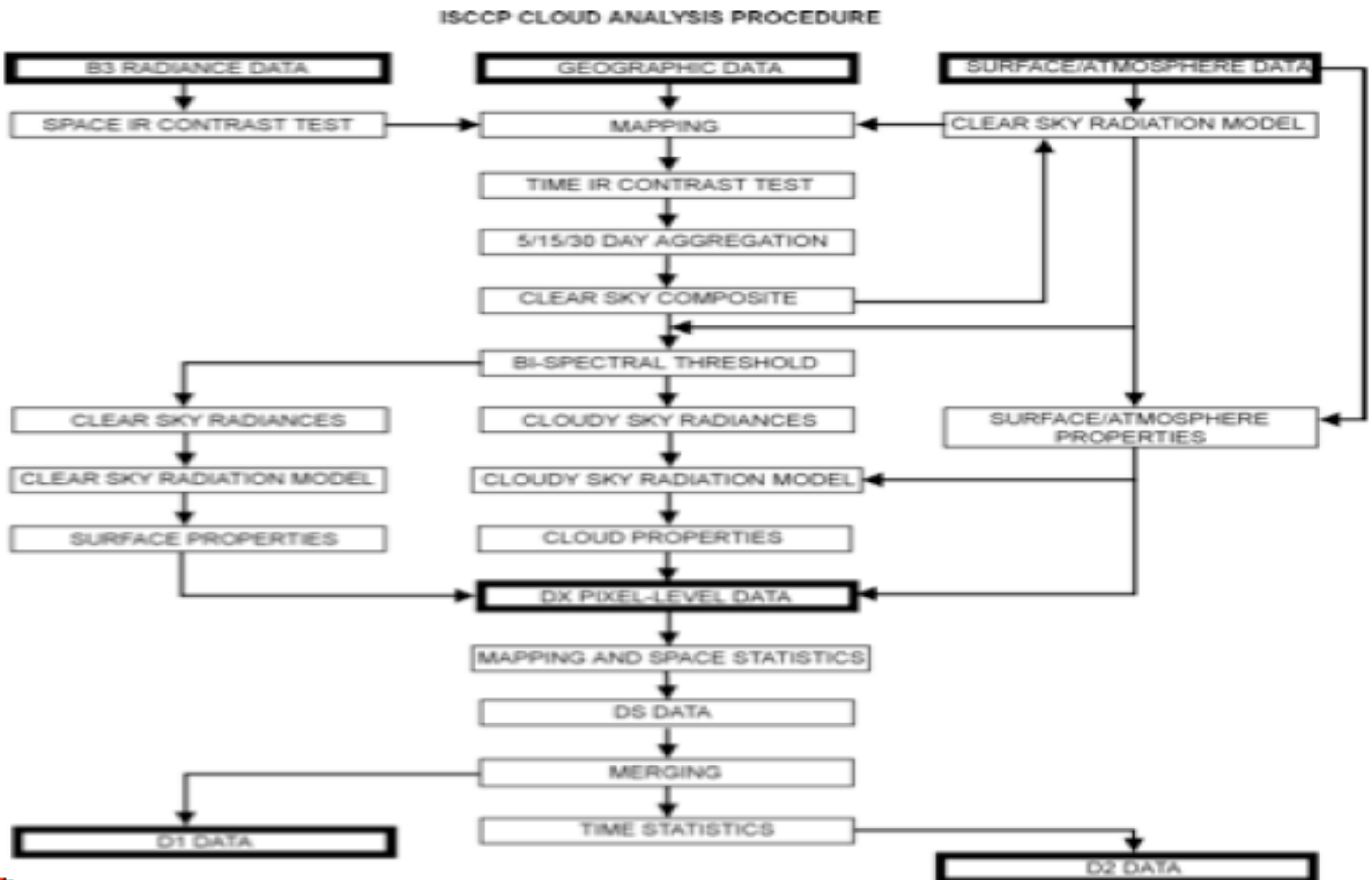
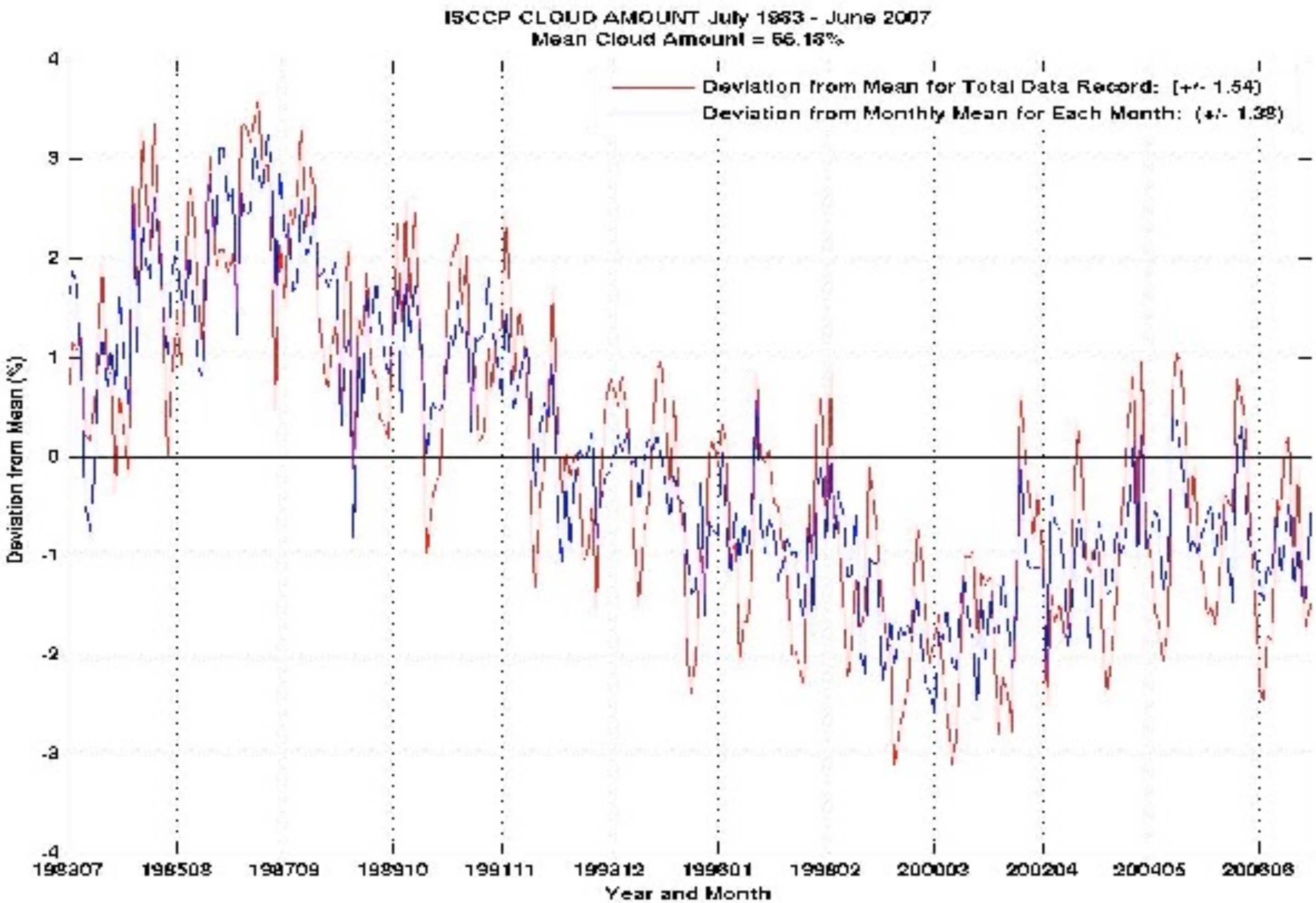
Description of Revised Algorithm



ISCCP Data Available

Stage B3 and BT:	July 1983 - June 2007
Atmospheric Data:	July 1983 - June 2007
Sea Ice and Snow Data:	July 1983 - June 2007
Stage DX, D1 and D2:	July 1983 - June 2007



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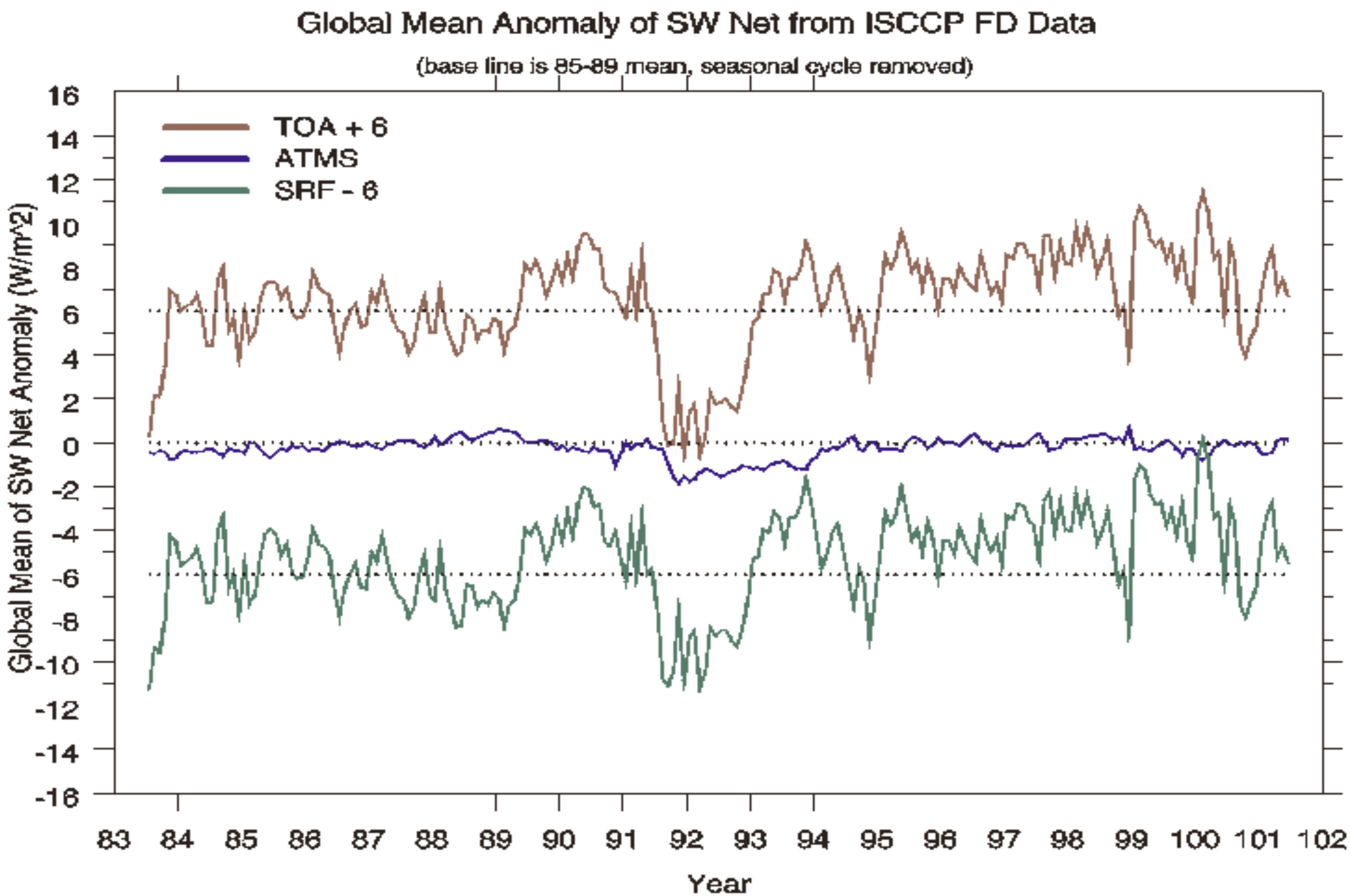
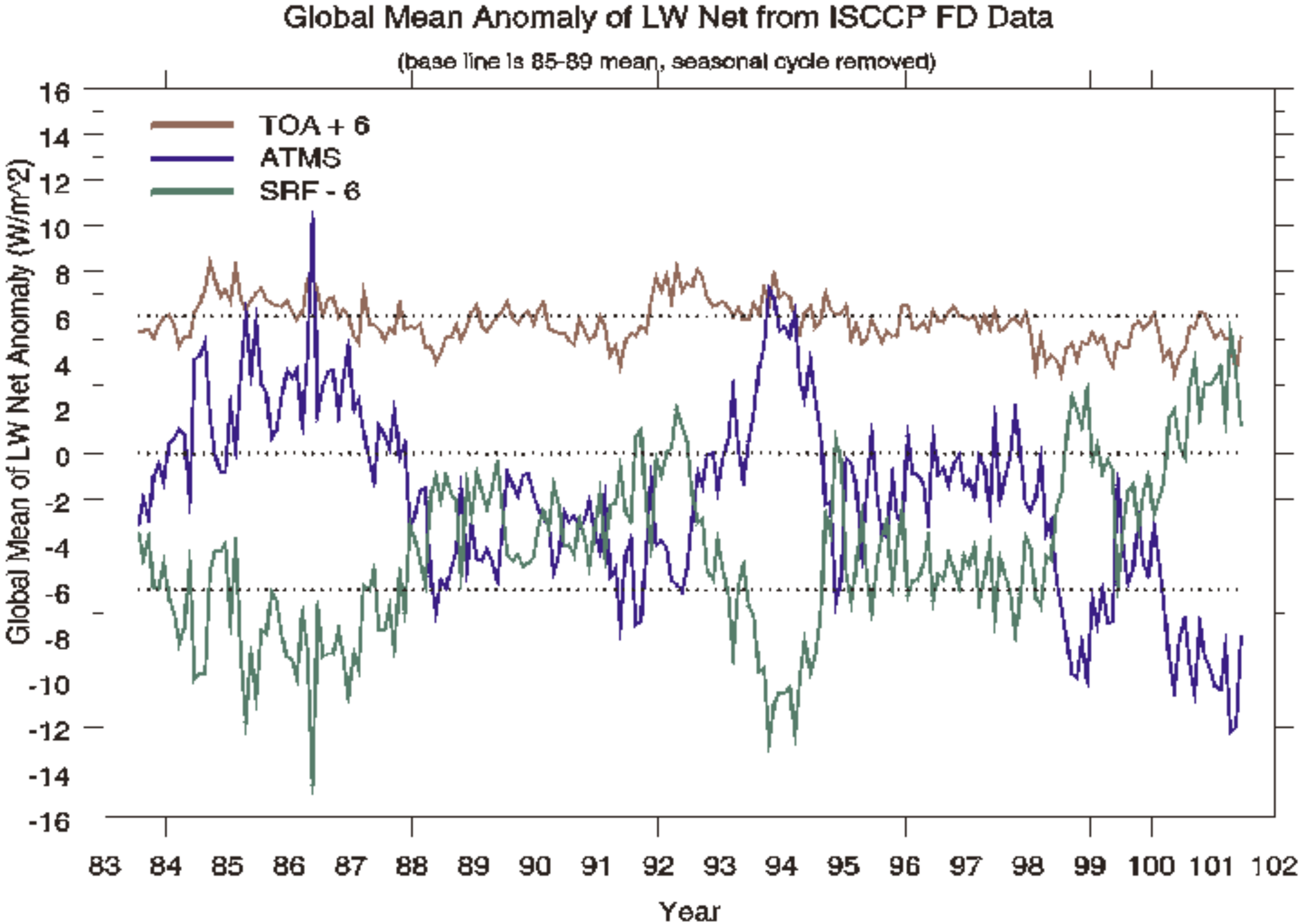


Global Mean Anomaly of SW Net from ISCCP FD Data
(base line is 85-89 mean, seasonal cycle removed)
TOA + 6
ATMS
SRF - 6
Global Mean of SW Net Anomaly (W/m^2)
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
Year



Global Mean Anomaly of LW Net from ISCCP FD Data
(base line is 85-89 mean, seasonal cycle removed)
TOA + 6
ATMS
SRF - 6
Global Mean of LW Net Anomaly (W/m^2)
16
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
83
84
85
86
87
88
89
90
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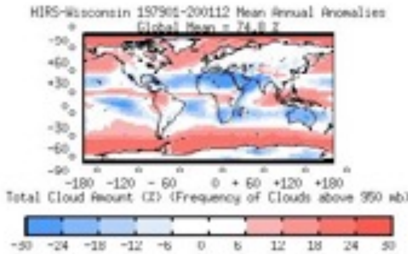
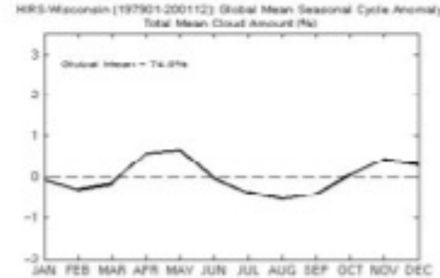
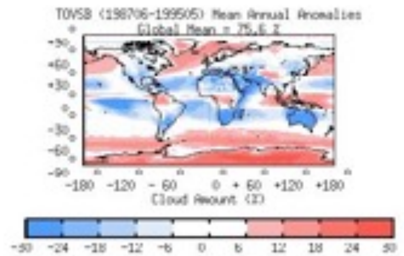
92
93
94
95
96
97
98
99
100
101
102
Year

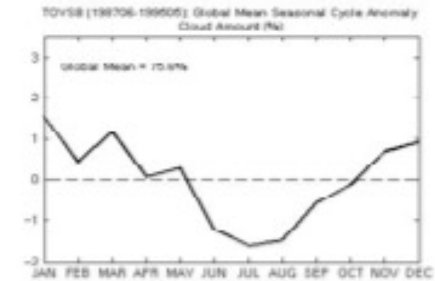
HIRS
Wisconsin



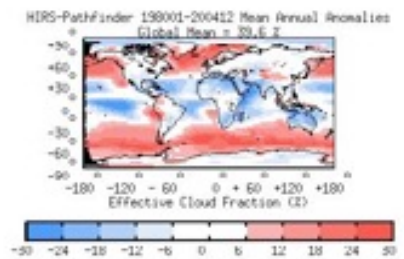


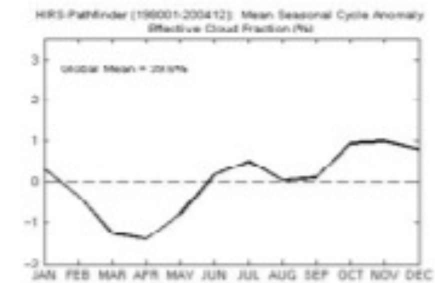
TOVS
Path-B



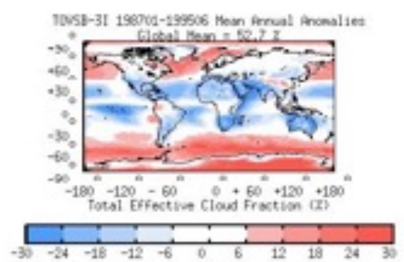


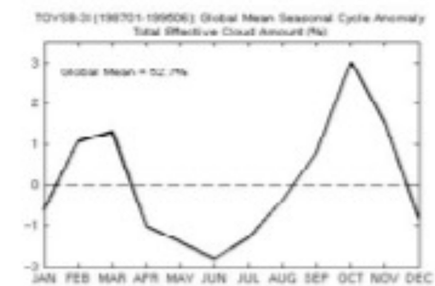
HIRS
Pathfinder
TOVS-A





TOVSB-3I





MEAN ANNUAL TOTAL CLOUD AMOUNTS

MEAN SEASONAL CYCLE ANOMALY

ISCCP Related Science

With encouragement from Verner Suomi, Francis Bretherton and Tom VonderHaar, FIRE (First ISCCP Regional Experiment), was organized in 1983 to investigate the relationships between cloud systems and climate and to verify and improve cloud monitoring techniques from satellite platforms.

Initial thrusts envisioned: a modeling program that encompassed GCMs, process models, large-eddy simulation (LES) models and radiative transfer models; a cirrus (FIRE I) and a marine boundary layer (FIRE II) cloud observing program.

Subsequently, Arctic (FIRE III) and upper-tropospheric components were added in 1995. A Florida area cirrus experiment (FIRE IV-CRYSTAL) was added in 2000.

FIRE Strategy

- Intensive coordinated field observations to observe cloud systems with high resolution and spatial sampling

- Extended time observations to support ISCCP and GCM validation

- Modeling to improve cloud radiation and dynamics models, cloud retrieval techniques, and GCM cloud parameterizations

First data were collected in October 1986 in central Wisconsin (cirrus IFO)

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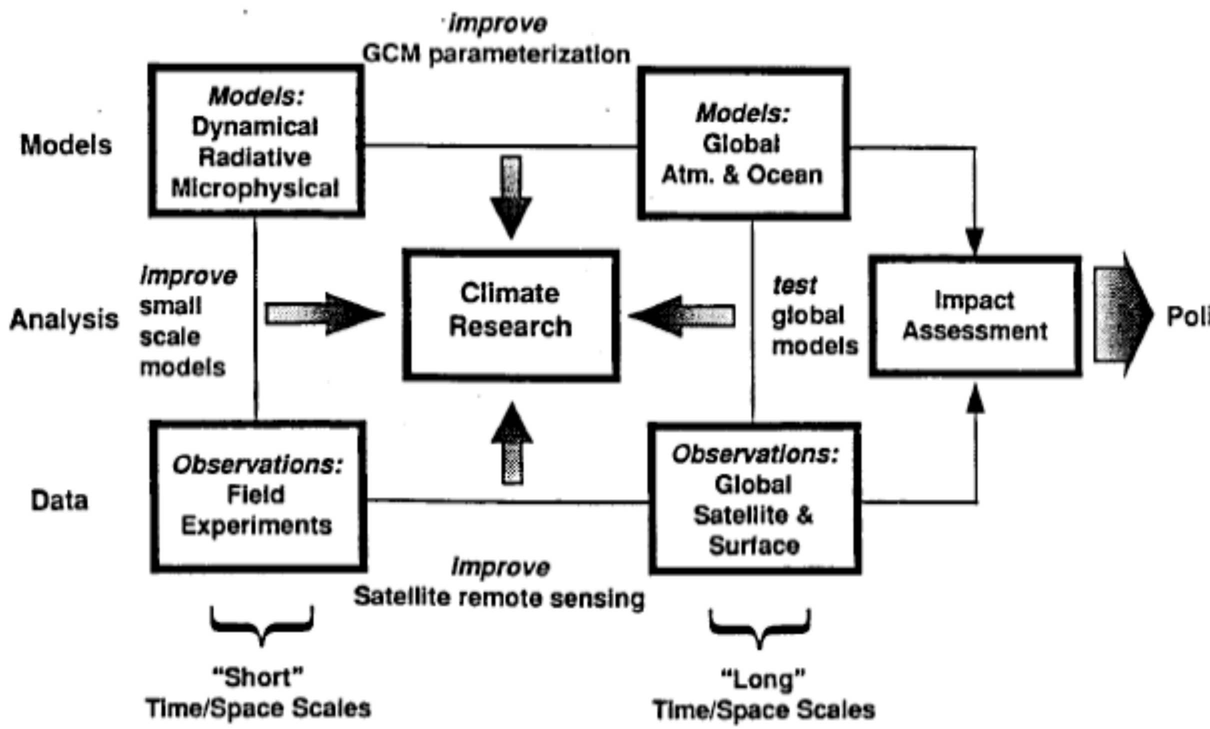
Observational Strategy for Determination of the Role of Clouds in Climate



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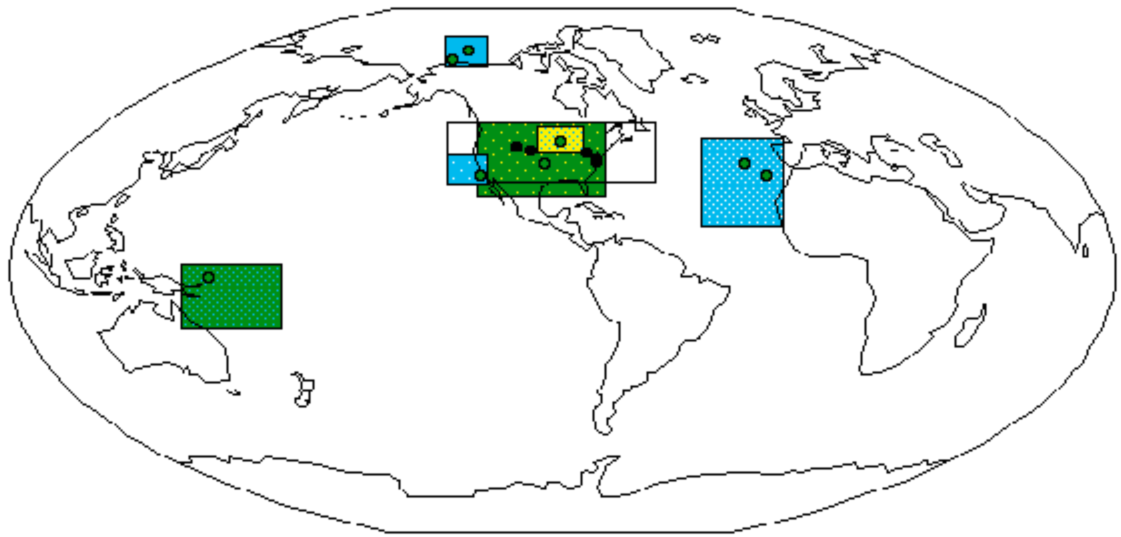
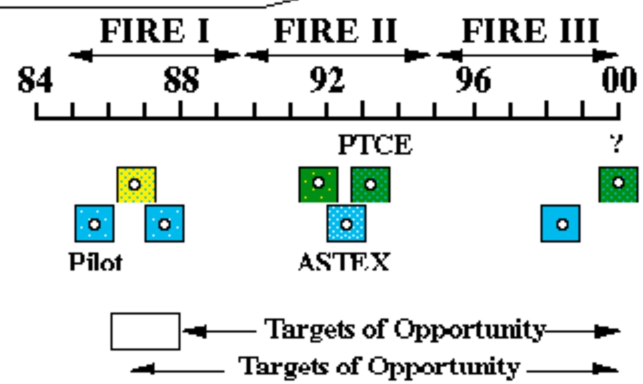
FIRE INTENSIVE FIELD AND EXTENTED TIME OBSERVATIONS





Intensive Field Observations
- **Cirrus**
- **Marine Stratocumulus**

Extended Time Observations
- **Satellite**
- **Special Sites (•)**

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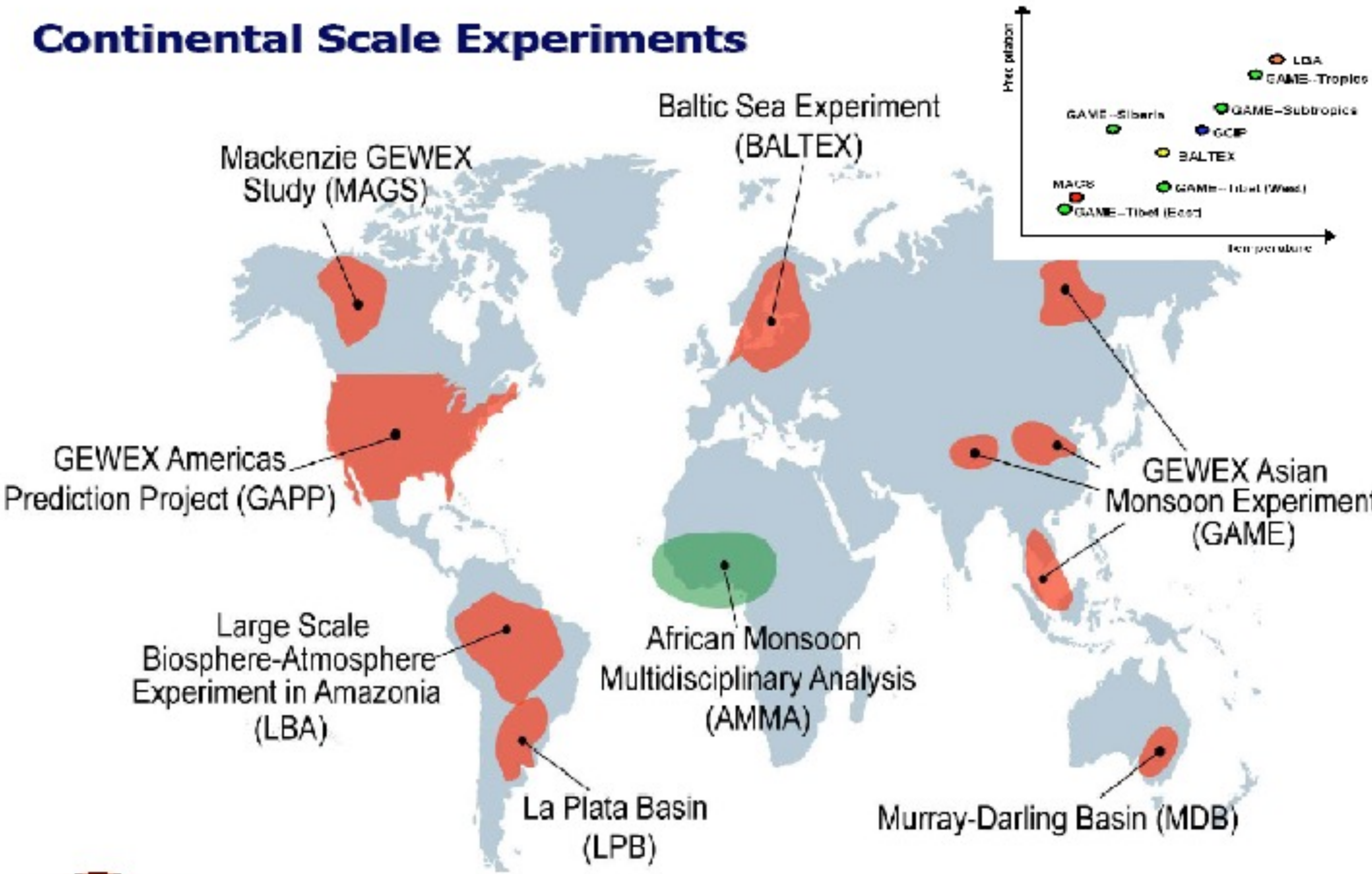
Some Examples of FIRE Results

Continental Scale Experiments



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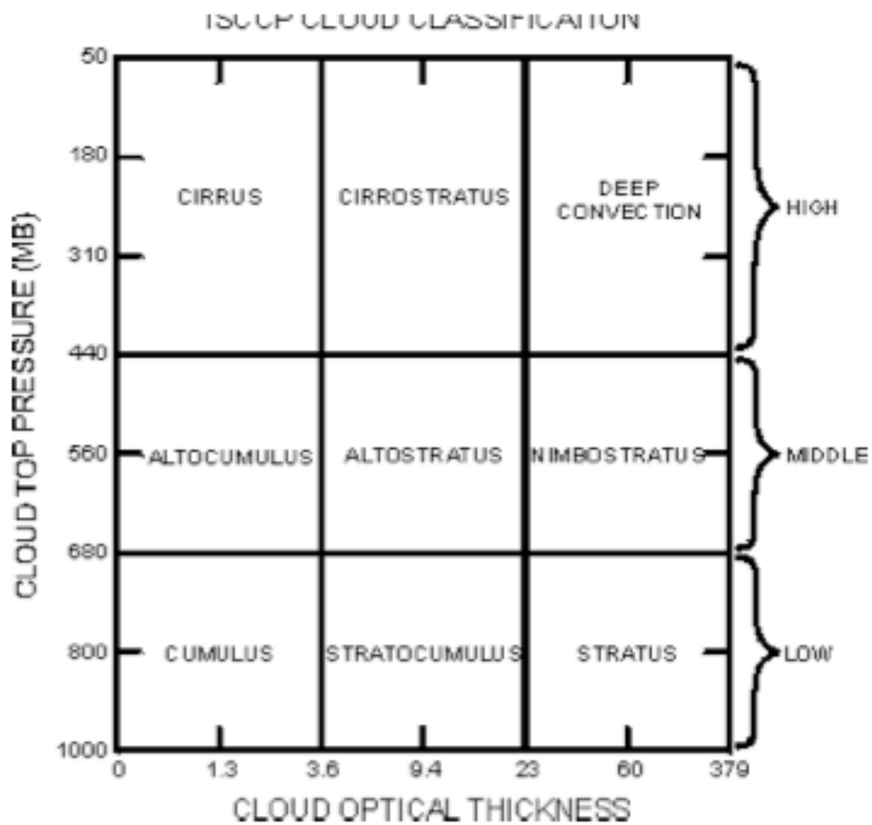
ISCCP Cloud Classification (D series)



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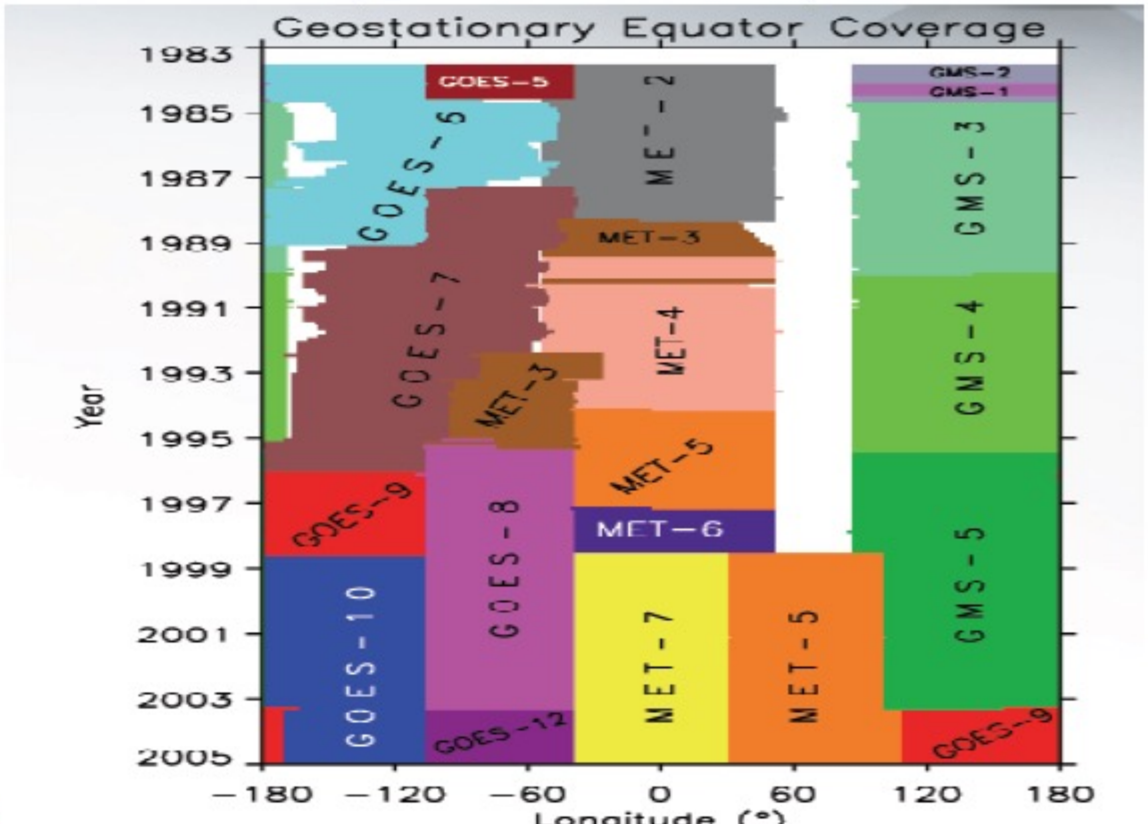
NOAA Comprehensive Large-Array Data Stewardship System (CLASS)
(ref: WWW.CLASS.NOAA.GOV)



Ref: John bates NCDC

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Evolution of ISCCP Products

Basic Required Products (1983):

- Cloud amount and distribution information
- Average total cloud properties
- Average surface properties
- Average radiances
- Average atmospheric properties
- Joint histograms of cloud properties and cloud types

Current additional and Value-added Products:

- Additional radiometer channels
- Improved satellite calibration
- TOA and surface fluxes
- Precipitable water
- Cloud particle sizes and cloud type dynamic

Currently Available ISCCP Data Products

- Reduced Resolution Radiance Data (B3) **1.1 GB/month = 330 GB for 25 yr**
- Calibration Table Data Set (BT)
- Ice/Snow Data Set (IS)
- TOVS Data Set (TV)
- ~~Pixel Level Cloud Product (CX)~~
- Pixel Level Cloud Product: Revised Algorithm (DX)
- ~~Pixel Level Cloud Product: Revised Algorithm (C1)~~
- Gridded Cloud Product (D1)
- ~~Climatological Summary product (C2)~~
- Climatological Summary Product; Revised Algorithm (D2)
- Radiative Flux Profiles (FD)
- Climatological Summary Product : Monthly Mean Radiative Flux Profiles(FD-MPF)
- Convective Systems/Convective Tracking
- Weather States from Cloud Property Distributions
- Cloud Particle Sizes
- Cyclone Systems/Tracking

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Algorithm Improvements (1983 to the present)

Radiance Calibrations

- Revised VIS and IR calibrations to eliminate spurious changes between different reference polar orbiters (Brest et al. 1996)
- Revised normalizations of geostationary satellite calibrations to eliminate occasional short-term deviations (Brest et al. 1996)

Cloud Detection

- Improved cirrus detection over land by lowering IR threshold from 6K to 4K
- Improved polar cloud detection over ice and snow surfaces by lowering VIS threshold from 0.12 to 0.06 and by using threshold test on 3.7 micron radiances
- Improved detection of low clouds at high latitudes by changing to VIS reflectance threshold test

Radiative Model

- Improved treatment of cold (top temperature < 260 K) clouds by using ice polycrystal scattering phase function to retrieve optical thickness and top temperature
- Improved retrieval of cloud optical thicknesses over ice and snow surfaces using 3.7 micron radiances
- Improved retrieval of cloud top temperatures by including effects of IR scattering
- Improved retrieval of surface and cloud top temperatures by adopting new treatment of water vapor continuum absorption in IR

Gridded Product Contents

- Better resolved variations of optically thicker clouds by adding 6th optical thickness category
- Added correct cloud water path parameter
- Reported actual average values of cloud top temperature, pressure, optical thickness and water path for each of nine cloud types defined by cloud top pressure and optical thickness in the 3-hourly dataset
- Reported separate cloud properties for liquid and ice forms of low and middle-level clouds
- Provided conversion of cloud top pressures to cloud top heights above mean sea level based on atmospheric temperature profile
- Added cloud amount frequency distribution to monthly dataset

Field Experiments Addressing Cloud Systems

Ref. GCSS, BAMS vol. 74, No.3, March 1993

ALPEX	Alpine Experiment
AMEX	Australian Monsoon Experiment
AMTEX	Air Mass Transformation Experiment
ARM	Atmospheric Radiation Measurement
ASTEX	Atlantic Stratocumulus Transformation Experiment
ATEX	Atlantic Trade Wind Experiment
BASE	Beaufort and Arctic Storm Experiment
BOMEX	Barbados Oceanographic Meteorological Experiment
BOREAS	Boreal Ecosystems Atmosphere Study
CASP	Canadian Atlantic Storms Project
CLEOPATRA	Cloud Experiment Oberpfaffenhofen and Transports
COPT	Convection Profonde Tropicale
EMEX	Equatorial Mesoscale Experiment
EUCREX	European Cirrus Experiment
FIRE	First ISCCP Regional Experiment
FRONTS	A series of frontal observing programs mainly involving U.K. and France
GATE	(Global Atmospheric Research Program) Atlantic Tropical Experiment
GCIP	GEWEX Continental International Project
ICE	International Cirrus Experiment
JASIN	Joint Air–Sea Interaction Experiment
KONTROL	Convection and Roll Vortices Experiment
KONTUR	Convection and Turbulence Experiment
MCTEX	Maritime Continent Thunderstorm Experiment
SMONEX	Summer Monsoon Experiment
STORM	Stormscale Operational and Research Meteorology
STREX	Storm Transfer and Response Experiment
TAMEX	Taiwan Area Mesoscale Experiment
TOGA COARE	TOGA Coupled Ocean–Atmosphere Response Experiment
WAMFLEX	Wave and Momentum Flux Experiment
WMONEX	Winter Monsoon Experiment

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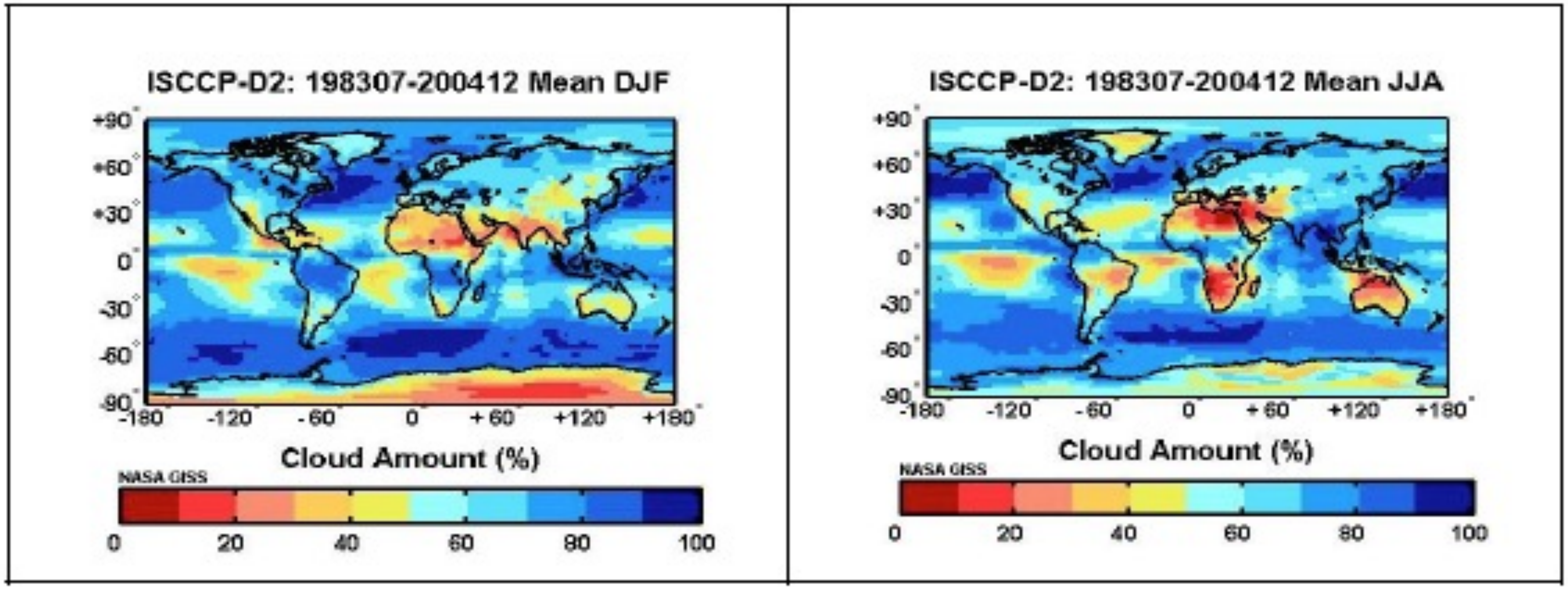
FIRE was organized by NASA to address fundamental processes involving clouds and radiation in the climate system.

Planning directed by steering committee led by S.Cox, D.McDougal, D.Randall, and R.Schiffer

Plan outlined a coordinated research effort to expand the basic knowledge of the interaction between clouds and climate, to improve the understanding of radiative and physical processes, and climatically important cloud systems, and to improve satellite-based cloud-radiative monitoring systems (e.g., ISCCP) and global climate model parameterizations.

ISCCP Long-Term Seasonal Average Cloud Amount
(1983-2004)



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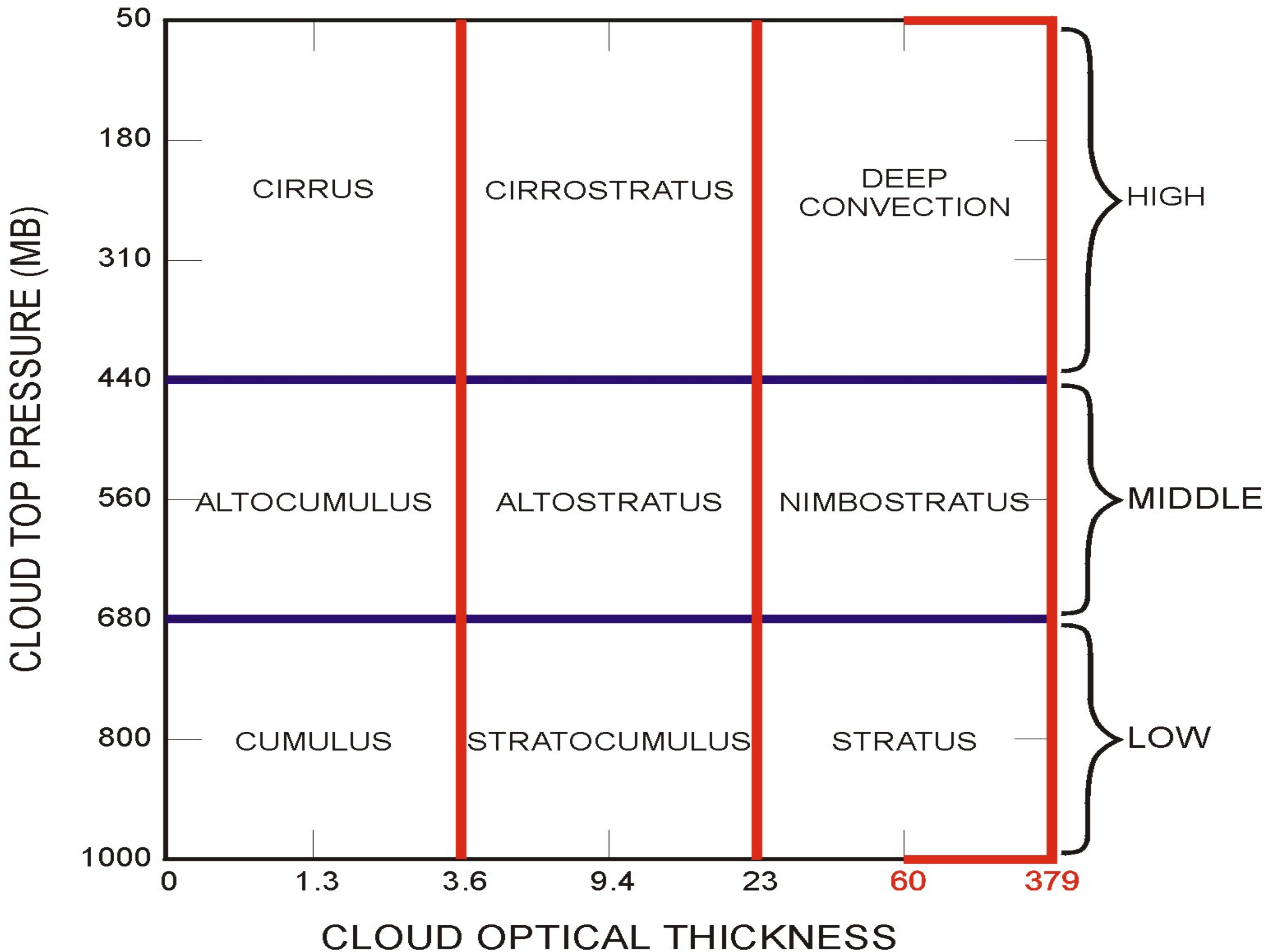
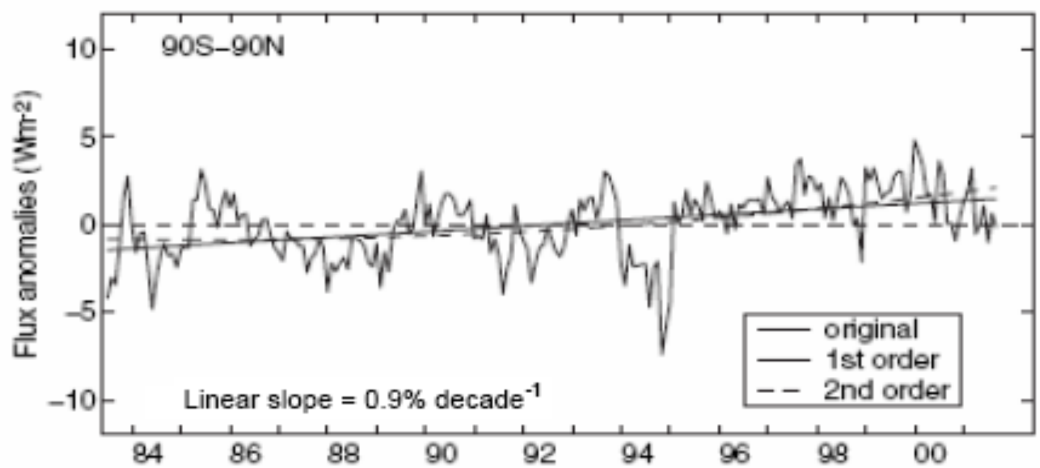
NEW
ISCCP CLOUD CLASSIFICATION

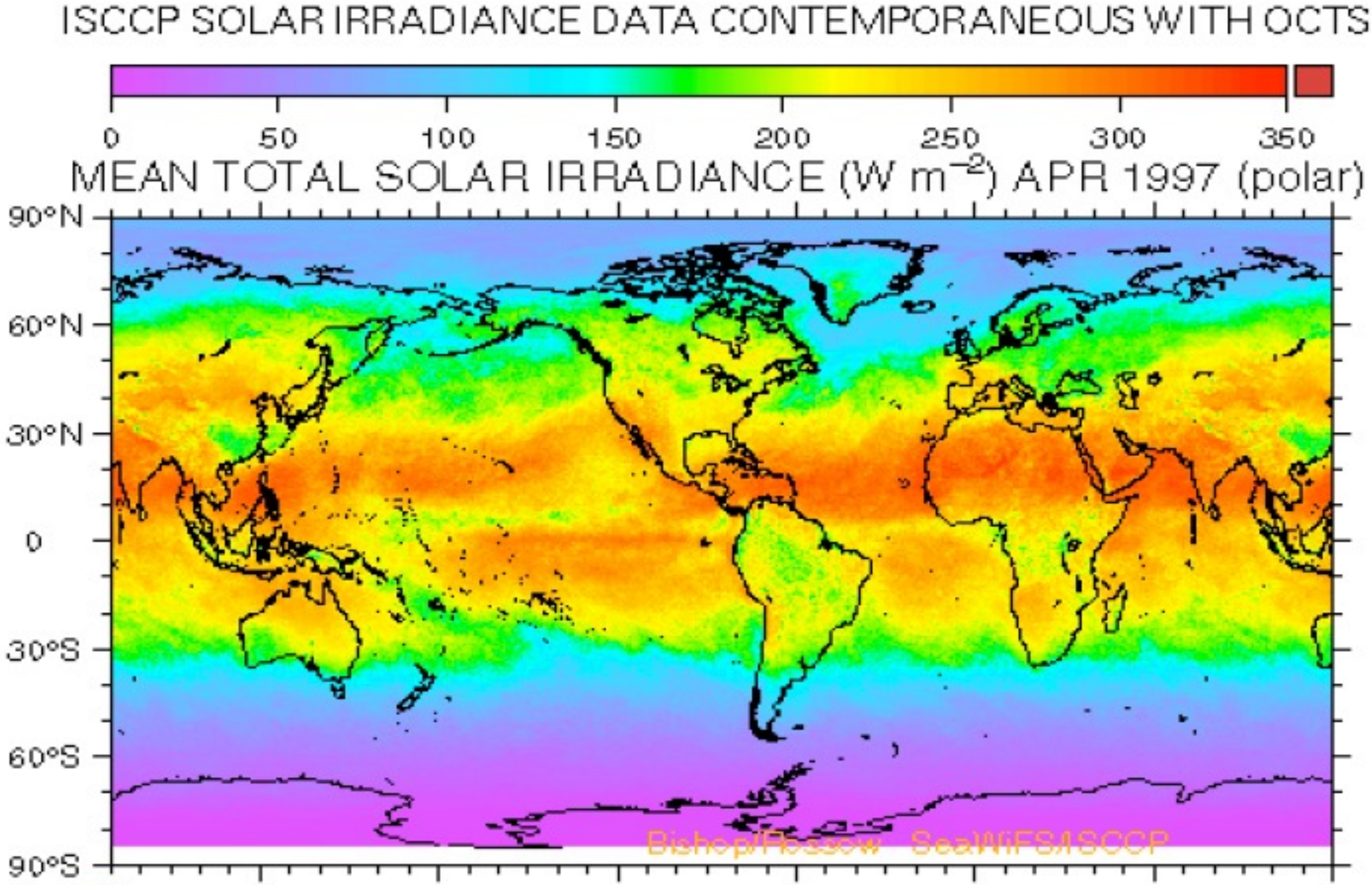


Surface Level Solar Irradiance

Satellite Derived Global-mean Solar Irradiance Anomalies



Pinker et al. Science, 2005
Derived using GEWEX / ISCCP



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