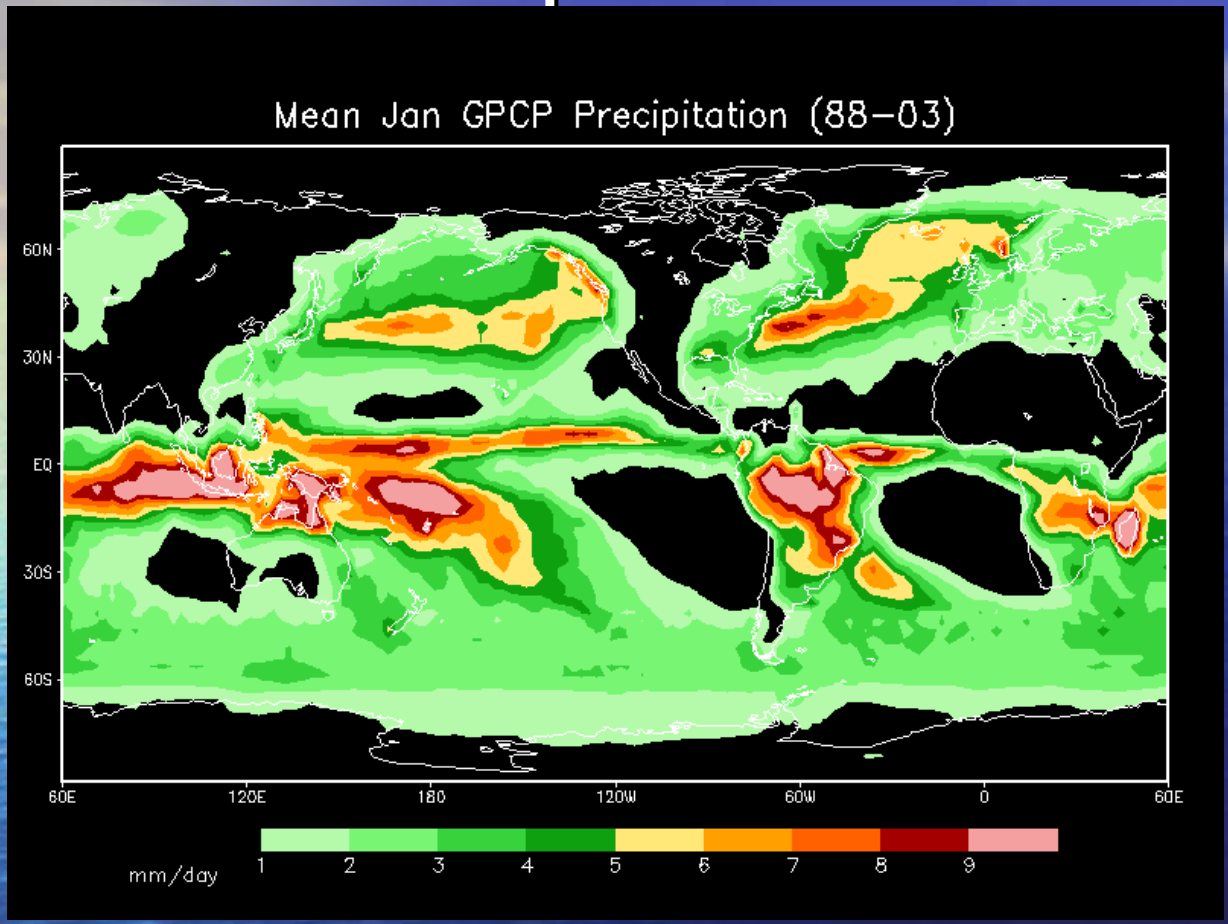
Global/Continental-Scale Precipitation

- Precipitation is a critical element of the global water and energy cycles, and thus has been a focus of CEOP and GEWEX (as well as other WCRP programs) from their inception
- Precipitation is among the parameters that are central to the IGOS-P IGWCO Theme as well as complementary activities such as the Global Water System Project
- Precipitation is also relatively unusual in that, unlike many components of the water cycle, it can be estimated relatively directly from a variety of observations nearly globally
- IGWCO has identified the preparation of an Integrated Precipitation Product as an early priority – the balance of this presentation is intended to explore current status and necessary/desirable actions

How far have we come?

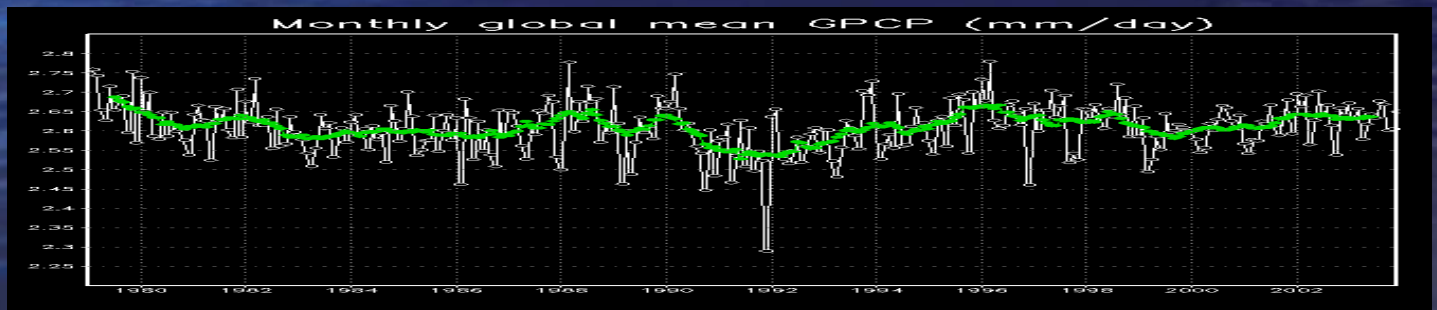
- 25 Years Ago:
  - Oceanic climatologies; gauge-based analyses over land
  - Qualitative indices of tropical convection
- Now:
  - Time series of global gridded monthly, pentad precipitation (GPCP, CMAP)
  - Powerful new observations (TRMM, GPM, SSM/I, AMSR, AMSU-B, high resolution geostationary vis/IR)
  - New algorithms for high resolution products (CMORPH, PERSIANN, TRMM-RT, numerous others)
  - Improved gauge-based analyses over land; oceanic reconstruction

Global Precipitation Climatology Project



Month and pentad beginning 1979; 2.5° global coverage.

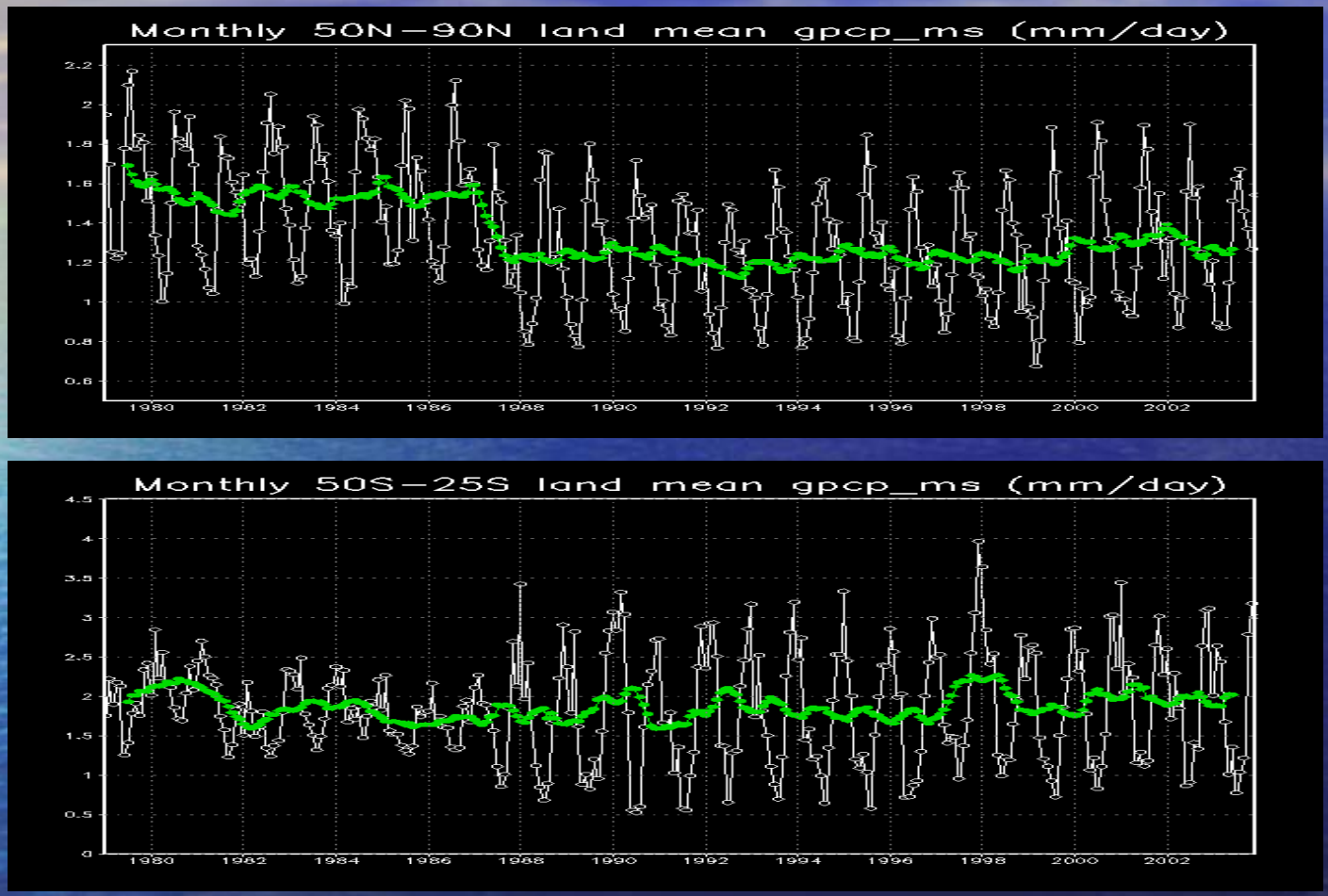
Mean annual cycle (above) and global mean precipitation (below)



Major Issues

- Data set inadequacies (inhomogeneities, artifacts, inability to specify trends, budgets,...)
- Observing system gaps/changes (passive microwave, radar, geostationary data)
- High latitude precipitation
- Orographic precipitation

Major Issues: Inhomogeneities in data and products, high latitudes

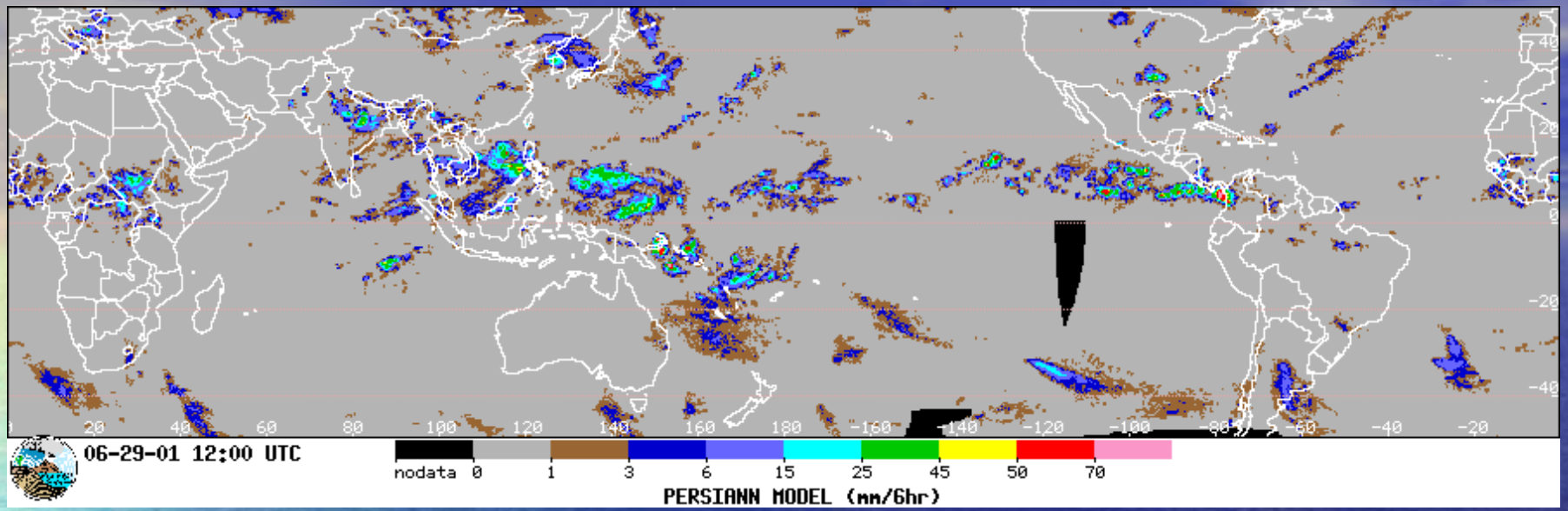


GPCP satellite-only precipitation for land areas 50° N-90° N (top) and 25° S-50° S (bottom)

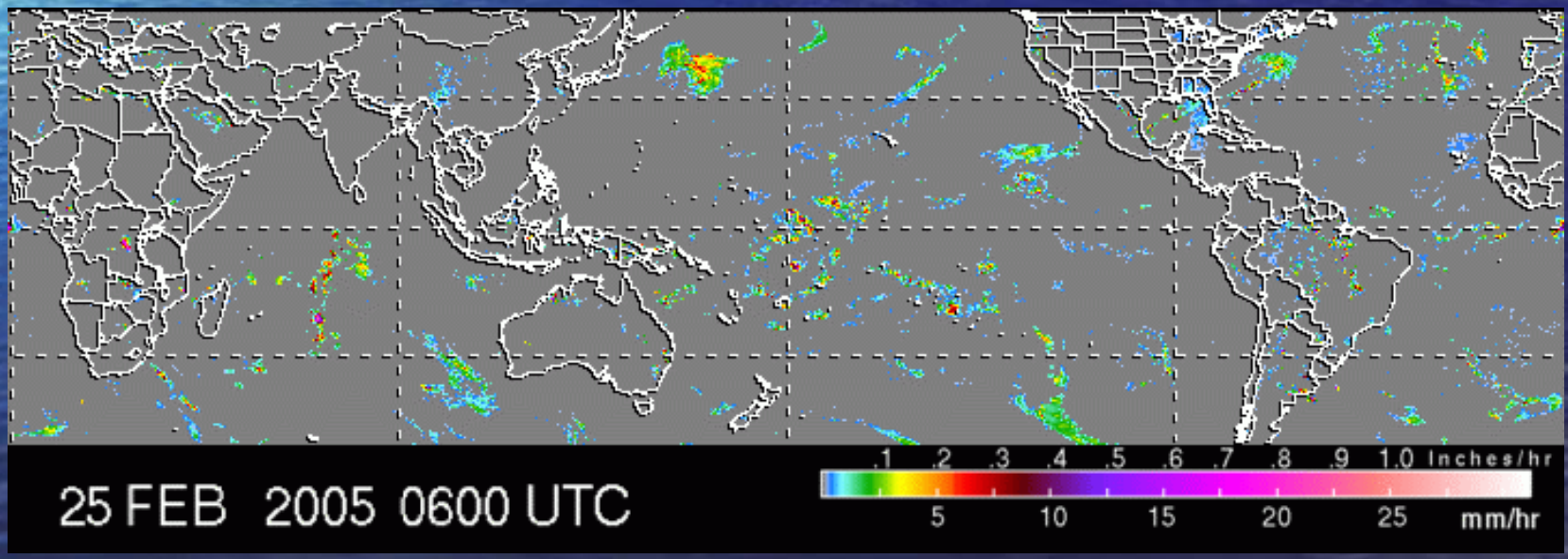
New High Time/Space Resolution Precipitation Products

- Even if these problems were corrected, the spatial and temporal resolution of GPCP and CMAP are not adequate for many of the requirements of IGWCO and the WCRP programs
- Recent new observations and research have made much higher resolution products possible, and extensive development and implementation has taken place
- The products generally rely on innovative methods that combine geostationary IR observations/estimates with estimates from passive microwave observations
- These products have time scales of about 3-hourly, spatial resolutions of 0.25°, coverage from 60° N-60° S, and records beginning within the last few years

High Resolution Precipitation Products

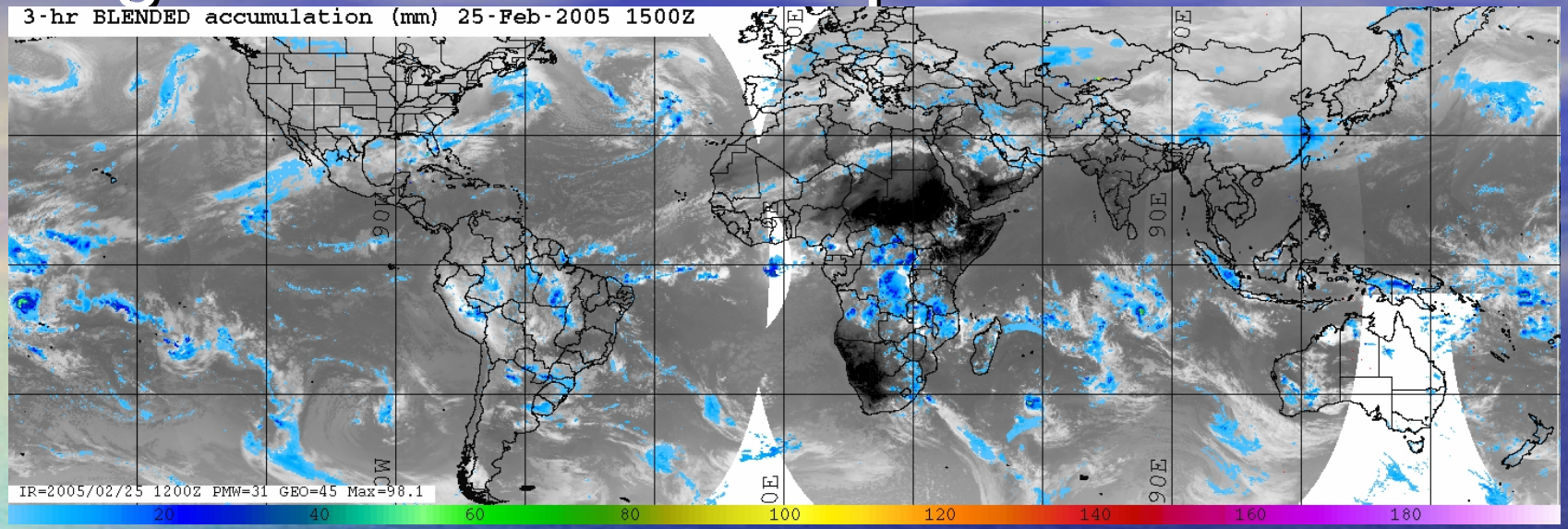


PERSIANN 6-hourly/0.25˚ real-time analyses

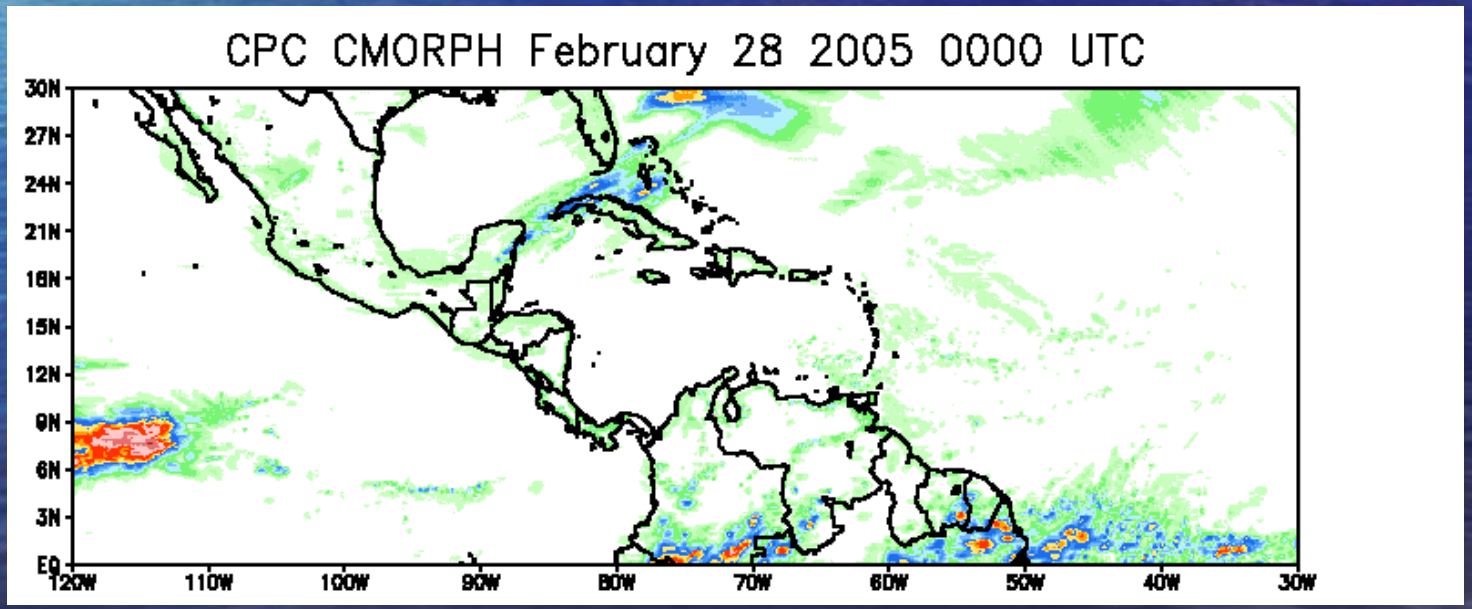


TRMM 3-hourly/0.25˚ real-time analyses

High Resolution Precipitation Products



NRL (Turk) 3-hourly/0.25˚ real-time analyses



CMORPH 30-minute/8 km real-time analyses

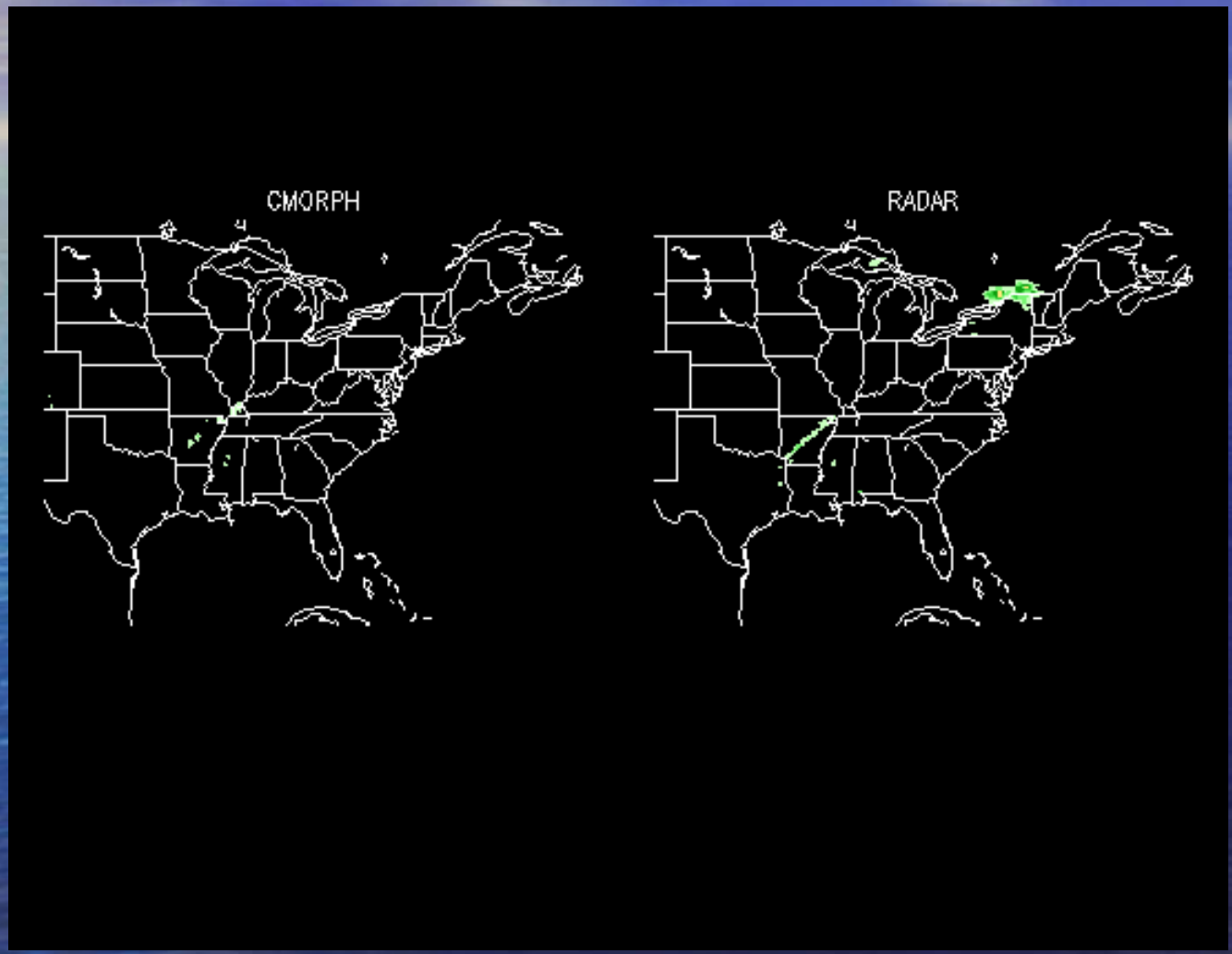
CMORPH -A High Time-Space Resolution Global Precipitation Analysis Using Passive Microwave and Infrared Data

http://www.cpc.ncep.noaa.gov/products/janowiak/cmorph.html

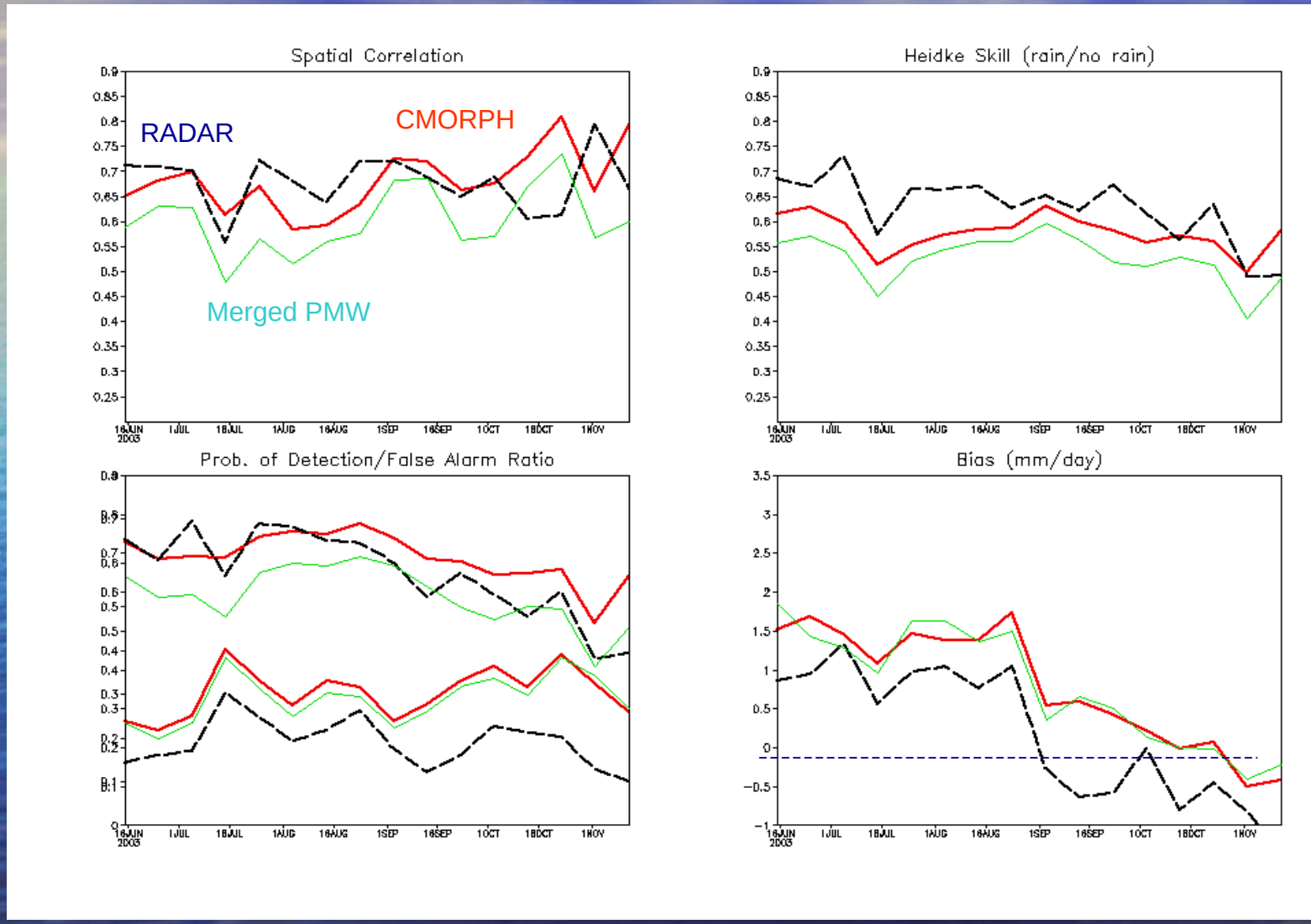
Joyce et al., 2004, J. Hydrometeorology

- Team: Bob Joyce, John Janowiak, Pingping Xie (Climate Prediction Center, NOAA)
- Concept:
  - Take maximum advantage of accuracy of microwave estimates and coverage of IR
  - Don't use IR to estimate precipitation – all methods developed so far have significant and difficult-to-quantify errors, particularly on fine scales
  - Use IR to estimate storm motion instead – errors are smaller and easier to understand

18Z 5 March – 17Z 6 March, 2004



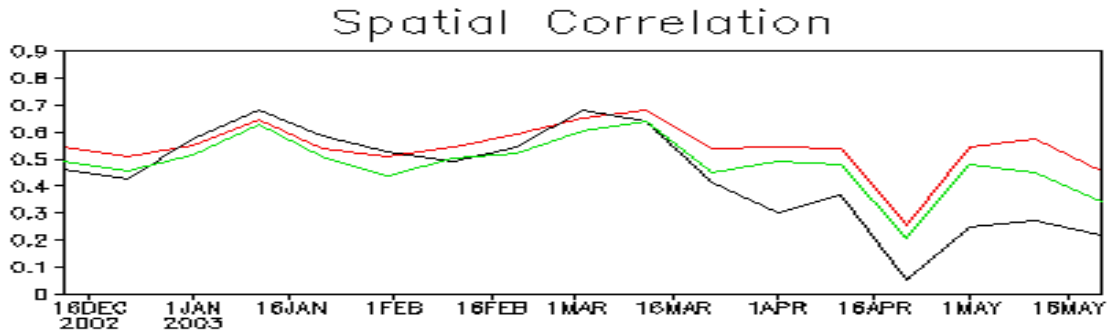
Comparison with U.S. Gauge Analyses: Results from http://www.cpc.ncep.noaa.gov/products/janowiak/us_web.shtml

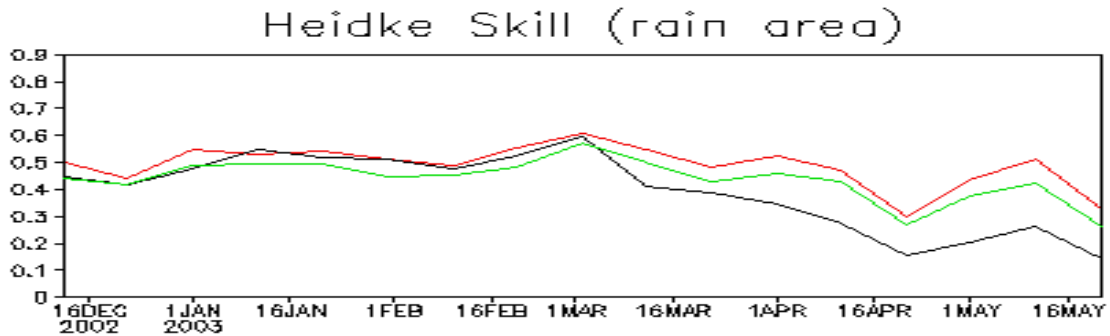


Summer and Fall 2003

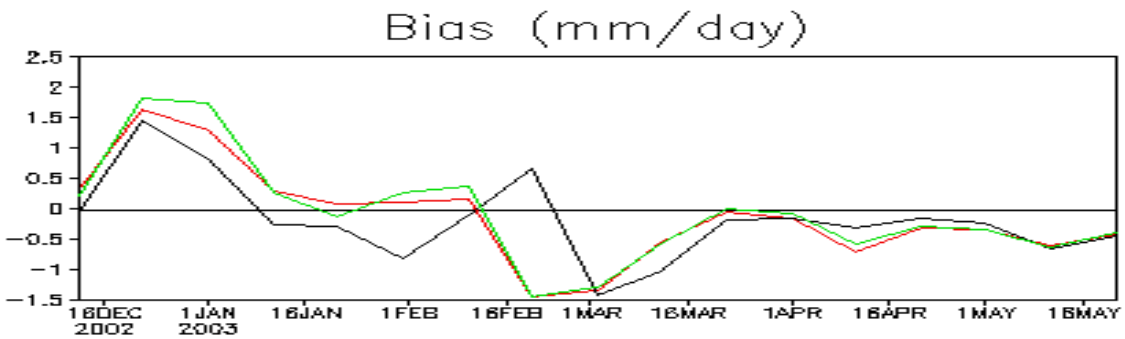
Comparison with rain gauge analysis over Australia
(Statistics on daily data computed over 10-day periods)

GPI (IR)
CMORPH
MW-merged





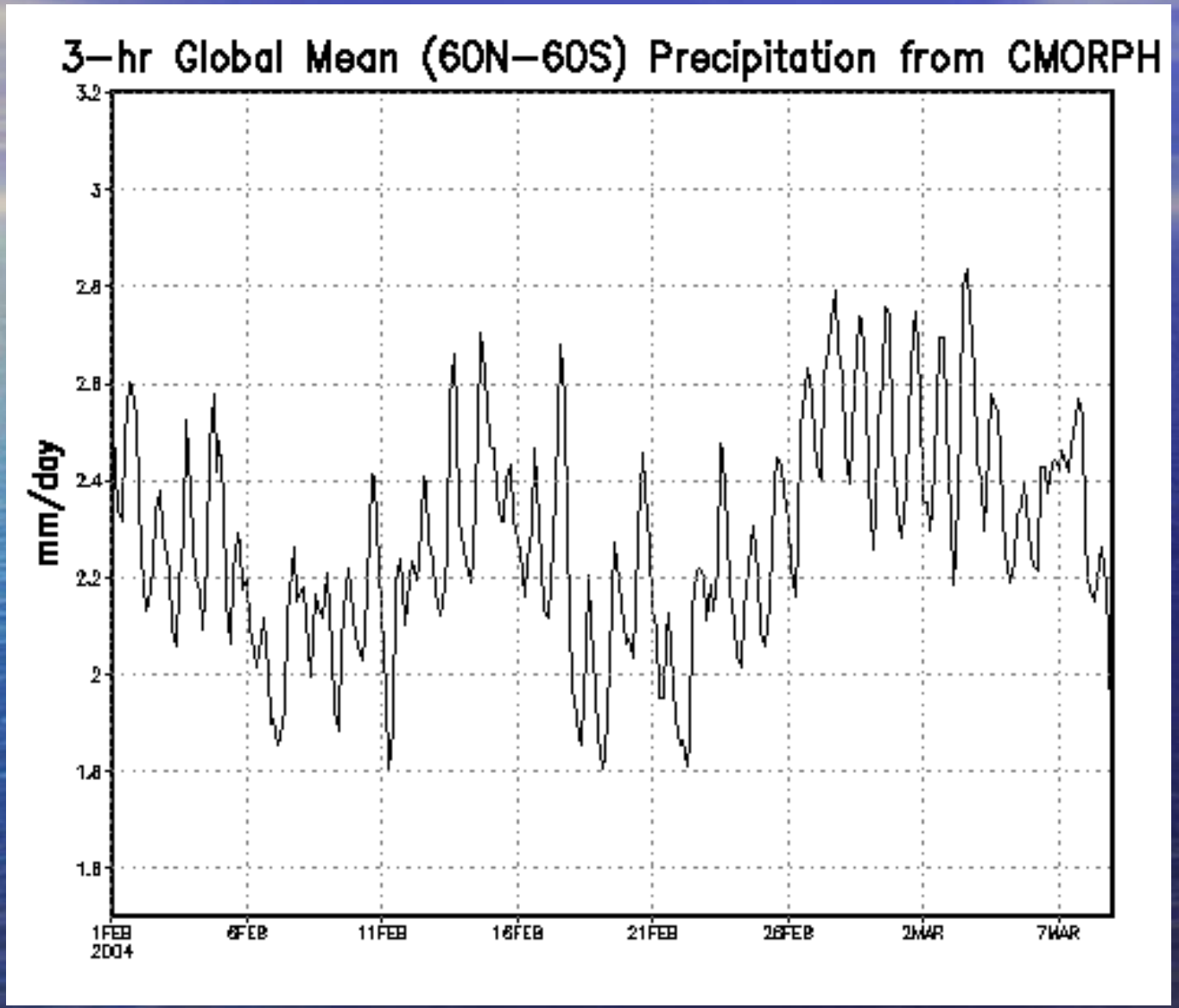
IR competitive (not better) during summer; clearly worse during cool season

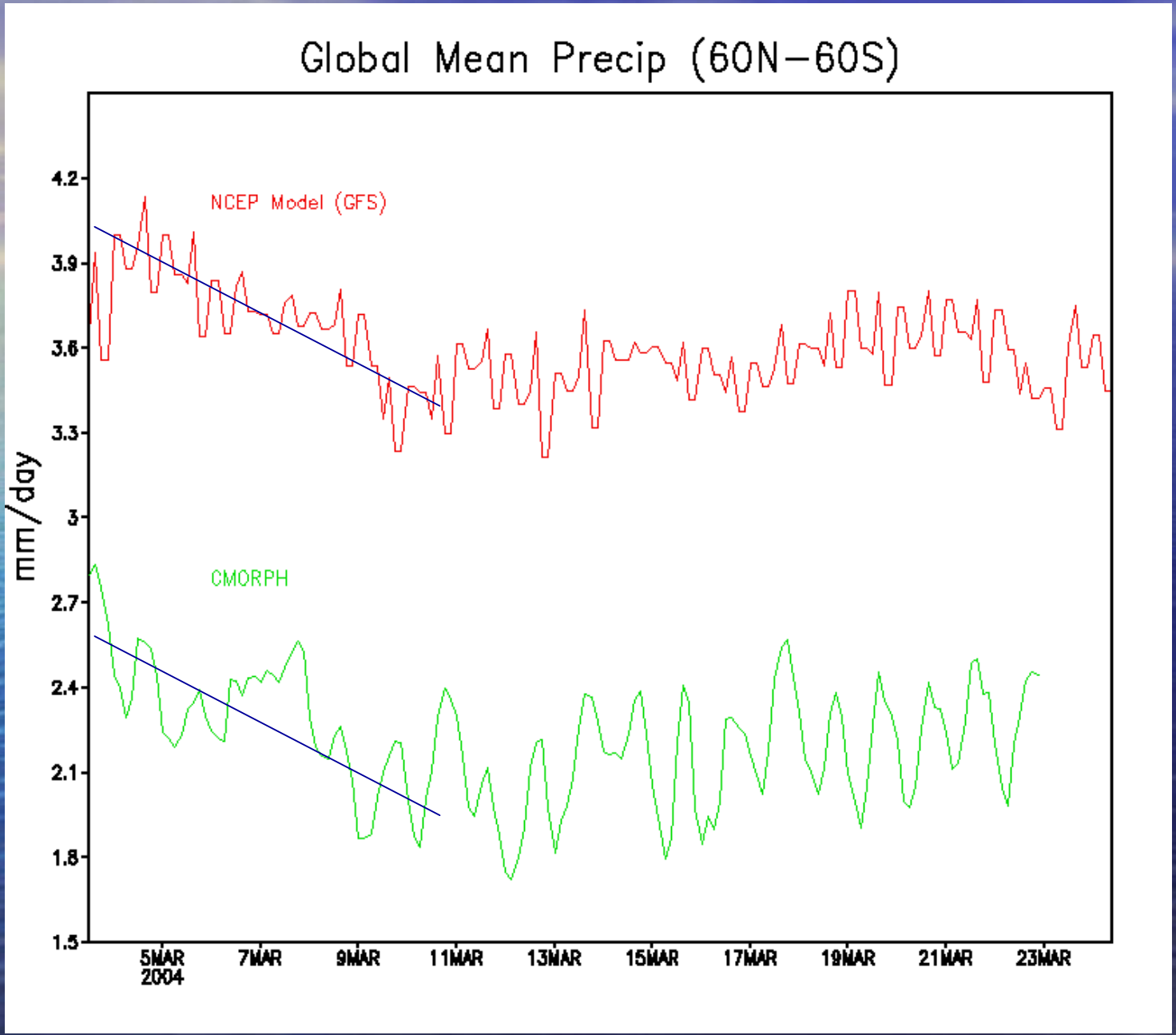


Here as well, CMORPH consistently better than microwave alone

See Beth Ebert's web page for more:
http://www.bom.gov.au/bmrc/wefor/staff/eee/SatRainVal/sat_val_aus.html

Global Diurnal Cycle




Global Mean Precip (60N–60S)
NCEP Model (GFS)
CMORPH
mm/day
4.2
3.9
3.6
3.3
3
2.7
2.4
2.1
1.8
1.5
5MAR
2004
7MAR
9MAR
11MAR
13MAR
15MAR
17MAR
19MAR
21MAR
23MAR

These results are encouraging (and are so no matter which of the high resolution products is used)

Necessary Next Steps

- Reanalyze the modern record of global precipitation
- Reconstruct global oceanic precipitation
- Evaluate the new high resolution precipitation products and recommend a path to a consensus high resolution analysis

- Reanalyze global precipitation for 1988 – present
  - Use period of robust, relatively consistent data: SSM/I++, geostationary
  - Extend back to 1979/1974 if possible by utilizing NOAA OLR dataset
  - Remove/reduce artifacts, use advanced products (GPROF for SSM/I, microwave/IR combinations), develop/use improved analysis procedures
- Reconstruct historical global oceanic precipitation
  - Use empirical orthogonal functions of modern era as basis functions together with island, gauge and ship observations
  - 1950 – present clearly feasible (already done); 1900 – present for Northern Hemisphere and parts of tropics may be possible

Program for the Evaluation of High Resolution Precipitation Products

- Recommended by IPWG (Working Group of CGMS)
- Process:
  - Recruit participants; identify/collect necessary data
  - Compare with dense gauge networks via Ebert, Janowiak, Kidd efforts
  - Use CEOP time series to extend spatial coverage
  - Apply coordinated diagnoses with other datasets, circulation data
- Outcomes:
  - Reach consensus on necessary development steps
  - Recommend algorithm(s) to be used for IGWCP IPP
  - Recommend actions by space agencies to provide data sets necessary to extend products back to early 1990s
- Timeline:
  - Initial discussions ongoing; side meeting during GEWEX Conference possible
  - Data collection and analysis efforts: Jan 2005 – June 2006
  - Concluding workshop: June or July 2006

Thanks for your attention!