State of U.S. CCSP, NASA EOS, CERES, NPOESS, NPP

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CERES-II 1st Science Team Meeting
NCAR
March 29-31, 2004
U.S Climate Change Science Program (CCSP)

• Draft 2 of the CCSP Strategic Plan out: major redraft
• NRC review indicated it was much improved, but no clear funding to implement is a major weakness.
• Observations Working Group (OWG) chartered under CCSP to oversee implementation of:
  – chapter 12 (observations)
  – chapter 13 (data management)
• OWG early activities:
  – co-chairs selected from NOAA and NASA.
  – terms of reference developed and in approval by agencies
  – select early action items to focus on for the first year
  – climate data record risks examined early: gaps (e.g. radiation budget), disappearing data (e.g. paleo corals, tree rings, glaciers).
  – assist with U.S. climate obs input to IWGEO 10-year plan/review.
NIST/NASA/NOAA/NPOESS
Satellite Calibration Workshop (11/02)

• Workshop report in press (NIST). Electronic copy available.
• Planned for use by NOAA climate observations as guidance
  – not clear if NPOESS will accept climate calibration/stability metrics as “critical” requirements analogous to weather requirements
• Climate Data Records (CDRs) will be produced separately from EDRs (weather near-real time data) to allow for calibration corrections, drift removal, algorithm constant over time.
• Will be considered by CCSP Observations Working Group as part of climate observation system requirements
NASA Earth Observing System Status

- Terra and Aqua missions working well
- TRMM continues and likely to at least 2006
- GLAS encountered lidar lifetime problems: only a few months so expect little Terra/Aqua coincident data
- CALIPSO lidar design is ok: lower power/temperature design and fully life tested in space conditions (vacuum).
- CALIPSO lidar and Cloudsat radar expected to launch 4/05 and fly in formation with Aqua mission: CERES, AIRS/AMSU, AMSR
- Aqua MHB instrument failed shortly after launch other Aqua fine
- All Terra instruments and spacecraft fine.
- Aura to be launched 2004.
- Next ESSPs selected: land soil moisture and ocean salinity
CERES Program Status

• Recompetition of EOS mission algorithms/science in FY03.
• CERES algorithm proposal received “A”’s on all science and technical areas, but questioned on budget levels: entire proposal had to fit in 40 pages, so budget detail sacrificed.
• Selected for CERES-II algorithm team to complete data products, but budget cuts of 10% in FY03 and further 20% in FY04, followed by additional 5%/yr thereafter. 20% staff reductions in FY03/04.
• Full cost accounting implementation: lots of chaos.
• Added CERES Co-Is from science investigations: 40 total including algorithm/qc/validation team.
NPOESS status

• Merged NOAA/DoD weather satellite system
• Also to be used for Climate Data Records
• Copies of CERES called ERBS (Earth Radiation Budget Sensor) to be flown in the 1:30pm sunsynchronous orbit
• ERBS launch in 2011
• Plan is to use CERES SSF and CRS data products in near real time for EDRs (weather quality data for TOA and surface fluxes)
• CERES team working with Raytheon to convert code.
• Later re-analyze into Climate Data Records (CDRs) but not clear if NASA or NOAA will fund CDRs. Will likely vary with climate variable.
• For ERBS processing and distribution of CDRs may happen on LaRC Atmospheric Sciences Data Center.
• NPOESS archive at NOAA currently planned to be run by NESDIS. May be a challenge with weather versus climate priorities/requirements
NPP Status

- Gap risk from CERES on Aqua/Terra nominal lifetime to 2008 versus NPOESS launch in 2011. Gap risk estimated from past instrument and spacecraft lifetimes at 50%.
- Gap issue is overlap and intercalibration: instrument stability greatly exceeds absolute accuracy (analogous to solar constant)
  - Absolute calibration: 1% SW, 0.5% LW, so non-overlapped data can permit changes of up to 2 Wm\(^{-2}\) SW flux, and 2.5 Wm\(^{-2}\) LW flux
  - CERES stability/decade estimated at ~ 0.5% SW and 0.2% LW
  - Radiative forcing (IPCC) ~ 0.6 Wm\(^{-2}\) per decade
  - 50% net cloud feedback is ~ 0.3 Wm\(^{-2}\) per decade change in CRF.
  - CERES stability controls uncertainty in decadal CRF change to
    \[ \text{SWCF} = 50 \times 0.005 = 0.25 \text{ Wm}^{-2}, \quad \text{LWCF} = 30 \times 0.002 = 0.06 \text{ Wm}^{-2}, \]
    \[ \text{NetCF} = 0.25 \text{ Wm}^{-2}. \]
  - Without overlap uncertainty bound is:
    \[ \text{SWCF} = 50 \times 0.02 = 1 \text{ Wm}^{-2}, \quad \text{LWCF} = 30 \times 0.01 = 0.3 \text{ Wm}^{-2} \text{ LWCF}, \]
    \[ \text{NetCF} = 1.3 \text{ Wm}^{-2}. \]
How does cloud feedback uncertainty map into climate measurement requirements?

**Answer:**

Varies with:

- Radiative Flux
- Cloud Property
- Changing SWCF/LWCF
- Global Mean Clouds Shown Here

Decadal Stability in Climate Measurements of 0.3 W/m² per decade

Cloud Feedback Modifies Global Temperature Change by This Factor (No cloud feedback is a value of 1)
NPP Status Continued

- CERES has one more instrument copy in storage
- NASA studied cost/implementation of adding CERES FM-5 to the NPP gap filling mission with launch late 2006, 6-year lifetime
- Summer, 2004 NASA added CERES FM-5 to NPP, concluded cost would be factor of 3 less than launching on its own smallsat, and factor of 10 less than original CERES development effort per year of global data.
- Fall, 2004 NASAs ESE budget took reductions in the new exploration program, and had cost over-runs on new missions
  - removed CERES copy from NPP mission
  - delayed Global Precipitation Mission 2 years
  - eliminated ocean scatterometer gap mission.
NPP Status Continued

- Requirement to avoid climate record gaps, especially for calibration in records such as radiation budget:
  - CCSP Chapter 12 (2003)
  - Several recent previous NRC reports
- GEWEX Radiation Panel recommending to eliminate 50% gap risk (2002, re-iterated in 2003)
- U.S. CLIVAR planning similar recommendation
- Will be considered by new CCSP OWG in next 2 months
- Likely 6 month or longer delay in NPP: NPOESS imager and sounder development behind original schedule.
- Train has left the station slowly and we are now running after it!
- Can we get a climate modeling community statement as users?