NOAA’s Plans for the Continuity of Earth Radiation Budget and Climate Data Records

John J. Bates

NOAA’s National Climatic Data Center (NCDC)

16 September 2010
Outline

• Summary and status of NOAA’s CDR Program
• Transition of mature cloud and radiation CDRs to sustained operations
• Plans for transition of Earth radiation budget to sustained operations at NOAA
### Global Essential Climate Variables (ECVs) with Heritage Records

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<td>Fire disturbance (active fire area, radiated power)</td>
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- **Green**: Generally considered adequate for developing CDRs
- **Yellow**: Usefulness is unknown, application-dependent, or access-dependent
- **Red**: Generally considered inadequate for developing CDRs
- **Black**: No viable observations available
**Fundamental Climate Data Record** (FCDR): Time series of calibrated signals for a family of sensors together with the ancillary data used to calibrate them.

**Thematic Climate Data Record** (TCDR): Geophysical variables derived from FCDRs, often generated by blending satellite observations, in-situ data, and model output.
CDR Project Functional Framework

Management Board

USGCRP Observations Management Structure

Product Development Teams (CDRs, CIRs and Support)
Experts in Instrument Characterization, Algorithms, Validation, Data Management, Applications, and Observing System Performance Monitoring

Leveraging Resources / Collaboration

GEOSS, CEOS

Int'l Data Programs

Other Agencies

Engaging User Community

Modeling
Monitoring
Prediction
Research

ObservingSystemPerformanceMonitoring

Production of Near Real-time CDRs

Processing of CDRs for Long-term Records

Climate Information Records

CDR Stewardship

Improved CDR and CIRs

Design for Future Systems

Improved CDR and CIRs

Design for Future Systems
# CDR Activities Address 3 Epochs

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<td>Systems</td>
<td>POES/GOES/DMSP</td>
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- **Uncover latent climate trend information in four decades of heritage operational data**
- **Extend CDRs using future systems**
- **Ensure climate quality data from NPP and build Climate Raw Data Records (CRDRs) to facilitate reprocessing**
Climate Sensor Coverage CDR Program Grants (future operational CDRs)

AVHRR (VIIRS)
- Cloud Properties (Kato)
- Snow/Ice (Key)
- VNIR Cal./Clouds Minnis)
- Thermal Calibration (Mittaz)
- Land/Carbon (Vermote)

AMSU (ATMS)
- Hydro Cycle (Ferraro)
- Upper Air Temp (Ho)
- Water Vapor (Luo)
- Temp. Profile (Zou)

HIRS (CrIS)
[Calibration development at STAR]
- Water Vapor (Luo)
- Cloud Properties (Menzel)

SBUV (OMPS)
- Ozone (Flynn)

Other Satellites
- GOES: Imager (ABI)
  - VNIR Cal./Clouds (Minnis)
- SORCE, Glory (TSIS)
  - Solar Irrad. (Pilewskie)
- DMSP: SSM/I, SSMIS (MIS)
  - Calibration (Kummerow)
    - Snow/Ice (Key)
    - Water Vapor (Luo)

WWW.NCDC.NOAA.GOV/SDS
Arrows identify key climate instruments
Preparing for CERES - ISCCP Reprocessing Data Flow

B1 | Multi-National Geostationary Satellite Data

B4 | Perform Mapping Operation

BX | Run Cloud Detection Algorithm

DX | Perform Radiative Retrievals

DS | Calculate Gridded Statistics

D1 | Merge the Various Satellites

D2 | Calculate Monthly Averages

NCDC has processed to this level

10 km pixel data every 3 hours

1 deg res every 3 hours

1 deg monthly

to SW and LW Flux calculations
Historically

- 2 U.S. military DMSP
- 2 U.S. civilian POES

Today

- 2 U.S. military DMSP
- 1 U.S. civilian POES
- 1 European MetOp

Future

- 1 U.S. civilian JPSS
- 1 U.S. military DMSP follow-on
- 1 European MetOp

DMSP: Defense Meteorological Satellite Program
MetOp: Meteorological Operational Satellite
POES: Polar-orbiting Operational Environmental Satellite
JPSS: Joint Polar Satellite System (NOAA / NASA)
CERES/ERBS Planning Schedule

For Official Use Only
NOAA Pre-Decisional Information

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<td>2009</td>
<td>Aqua</td>
<td>(CERES-4) extended operations thru 2011; Requires extension to Oct 2012 for NPP overlap</td>
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<td>2010</td>
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**Key Events:**
- Sensor Delivery
- JPSS 1 Launch Ready
- Planned for launch
- Authority to Proceed
- Sensor acquisition
- 5 year sensor design & build
- 18 mo Integration & Testing (I&T)

**Legend:**
- NASA launch & sensor mission life
- Planning/SEB activities
- Sensor acquisition
- Satellite integration & test
- NOAA launch & sensor mission life
- Projected launch & sensor mission life
- Satellite is operational beyond design life
- Key events
Long-Term Planning for Continuity of ERB

• NOAA has initiated long-term planning by initiating community requirements meetings
  – Continuity of Earth Radiation Budget (CERB) Workshop 13-14 July
    • Identify the purposes and current uses of Earth radiation budget observations.
    • Document the current status of research and applications of Earth radiation budget.
    • Identify observing system requirements for the continuity of the Earth radiation budget climate data records (CDRs).

• Workshop report being finalized – thanks to all for input
  – User Requirements
  – Instrument Requirements
  – Data Processing Requirements
Conclusions

• NOAA has successfully recovered most climate sensors and added CDR processing capabilities

• NOAA’s CDR Program has resources and is actively engaging the U.S. and international climate communities in sustaining climate observations, data production and services

• The current focus of NOAA’s CDR Program is the water and energy budget including clouds and Earth radiation
Role of Transient Eddies in the Tropical Water and Energy Cycle
Transient Wave Activity in the Subtropical Eastern Pacific

- Dynamically possible only in Northern Winter and Spring
- Large interannual variability associated with ENSO basic state (time-mean) flow
- Related to 'westerly duct' size determined by stationary Rossby wave number
- 2/3rds of extremes in UTWV time series occur in these months
Stationary Rossby Wave Number

- $K_s = (\beta^*/\bar{U})$, where $\beta^* = \beta - 2 \bar{U}/y^2$
- $K_s$ is the total wavenumber at which a barotropic Rossby is stationary with respect to the background flow
- Rossby wave numbers below 10 indicate regions of strong eddy activity, above 15 indicate regions of weak eddy activity
- Plot Rossby wave numbers for months of normal, moist extremes, and dry extremes of UTWV
Stationary Rossby Wave Number-Diagrams for Mar-Apr-May

- For UTWV normal, wave duct is open
- For moist UTWV extremes, wave duct is further open
- For dry UTWV extremes, wave duct is closed
Future Work

- To what extent is the tropical hydrological cycle determined by weather-climate connections?
- How do tropical subseasonal transients interact with seasonal, interannual and decadal variability?
- How does ‘feedback factor’ approach account for the important role of eddies vs mean quantities?