Upper Air Observations from a NOAA Perspective

NOAA/GCOS WORKSHOP
To Define Climate Requirements for Upper-Air Observations

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Climate Requirements Will Be Integrated Into a Broader Framework

✓ NOAA Mission Goals

 Climate
  ▪ Observations and Analysis
  ▪ Climate Forcings
  ▪ Climate Predictions & Projections
  ▪ Ecosystems
  ▪ Regional Integrated Science Applications (RISA)

 Weather and Water (W&W)
  ▪ Local Forecasts and Warnings
  ▪ Air Quality
  ▪ Environmental Modeling
Climate Requirements Will Be Integrated Into a Broader Framework

✓ NOAA Mission Goals (cont’d)

➢ Commerce and Transportation (C&T)
  ▪ Aviation Weather
  ▪ Surface (land & marine) Weather

➢ Organizational Excellence, Infrastructure, & Support Goal
  ▪ Satellite Services Sub-goal
  ▪ Homeland Security Sub-goal
Related Issues to Consider in Developing Requirements

✓ NOAA Cross-Cutting Priorities
  - Integrating Global Environmental Observations and Data Management

✓ NOAA Integrated Observing System (IOS)
  - Integrated Upper Air Observing System (IUOS)
  - Integrated Surface Observing system (ISOS)
  - Integrated Ocean Observing system (IOOS)
  - Integrated Joint Satellite Observing Systems

National Networks of Observing Systems
Federal, State, Local, Govt., University/Research, and Private Sector
Linkages to NOAA’s Strategic Plan

✔ Corporate Decision Support:

- IUOS will support the Air Quality particulate matter forecast
- NOAA Profiler Network (NPN) transition plan, a component of IUOS
- In addition to G-IV and P-3 instrumentation upgrades, unmanned aerial vehicle (UAV) sensors will supplement IUOS adaptive observing system
- IUOS capabilities support the C&T Emergency Response program
- CT water vapor sensor installation will be a key component of IUOS
Requirements Will Be Vetted Through NOAA PPBES

FY07
NOAA Annual Guidance Memo

✓ Already disposed --- major items
  ➢ Taking the Pulse of the Planet – Integrated Global Observations
  ➢ Advance NOAA’s Modeling Capability
  ➢ Increase Climate Information, Services, and Products
  ➢ Support the U.S. Transportation Systems

✓ Enablers
  ➢ Maintain and Provide Necessary Platforms

FY08
NOAA AGM Spring 2005
Interagency & International Linkages

✓ U.S. Global Climate Observing System (GCOS)
  - Implementation Plan for the Global system for Climate in Support of UNFCCC, October 2004
  - The Second Report on the Adequacy of the Global Observing Systems for Climate in support of the UNFCCC, April 2003

✓ Global Earth Observations System (GEOS)
  - 10 Year Blueprint: Global Earth Observing System of Systems (GEOSS)
  - IWGEO Strategic Plan for the U.S. Integrated Earth Observation System

✓ Climate Change Science Program (CCSP) Strategic Plan

Other Related Documents

✓ Strategic Direction for NOAA’s Integrated Global Environmental Observation and Data Management

✓ NOAA Observing Systems Investment Strategies for FY 07 Preliminary, October 2004 (Restricted until Feb. 2006)
Upper Air Framework Within GEOSS

Observations
- GOES Sounder
- GOES Winds
- NPOESS, AMSU, MHS, IASI
- METOP, HIRS, AMSU, ATMS, APS
- Experimental
- Profiling radar
- GPS occultation
- NEXRAD radial winds
- Aircraft
- POES ATOVS
- AMSU-A, AMSU-B, HIRS

Space
- ATMOSPHERE
- Surface
- Atmosphere
- Space

Benefits
- Agriculture
- Ecosystems
- Energy
- Disasters
- Climate
- Water
- Weather

Data Management+
- Collection: Internet, private networks, satellite, physical transfer
- Ingest/management: Catalog and inventory
- Quality control: Basic, advanced, statistical, discontinuities, etc.
- Assimilation: Comparison with model output
- Observing and communication systems performance monitoring
- Preservation/Archive: Reformat, storage, backup
- Data Transport: On-line, internet, data products

Overarching the above are interoperable systems, effective user feedback and standards.
Upper Air Observing Requirements

✓ Requirements must be validated
  ➢ Why is it important to measure R.H. to within 1% at -40°C?
  ➢ Why measure temperature trends to within 0.1°C/century?

✓ Requirements most effective when linked to specific benefits
Current Status:

- **GCOS Global Upper Air Network**
- **Unable to confidently determine multi-decadal changes, e.g.**
  - Moisture --- especially upper troposphere not well measured
  - Temperature --- Too many uncertain adjustments required (CCSP draft: *Temperature Trends in the Lower Atmosphere* - Assessment Report 1.1)
Upper Air Observing Requirements

Minimizing Time Dependent Biases dependent upon:

✓ Maintenance and Calibration
✓ Data Management System
  - NOAA Administrative Order --- All new observing systems must include a Data Management System
  - Metadata
  - Observing System Performance Monitoring
  - Near-real time Climate Monitoring
  - Analysis System

✓ Cost Effectiveness
  - Optimizing investment strategy
  - Requirements (broadly considered beyond climate) and benefits (quantified, e.g., economic)
  - Overall Cost
Important Issues for Consideration:

- Reporting frequency (number per day or month)
- GCOS GUAN sites being upgraded to operational status
- Tiered System including a Reference Network?
- Multiple Uses, e.g.,
  - How will climate integrate with weather observing system?
  - How will sonde data compliment satellite retrievals?
Upper Air Observing Requirements

Variables to measure

- Use of Reanalysis can help address requirements for:
  - Accuracy
  - Precision
  - Vertical resolution
  - Spatial Resolution
  - Temporal Sampling
  - Introduction of New Instruments (Overlap issues)

- Ultimate decisions here depend on time and space scale of interest
Upper Air Observing Requirements

New Technology

✓ How to integrate Satellite Spatial Coverage and Increasing Vertical Resolution?

✓ Must look to NPOESS in the time frame we are discussing

✓ GPS (temp and humidity)

Communications

✓ Satellite vs. land lines
  ➢ Confidence intervals depend on time, space, scale of interest
THE END
Data Management+

Collection
- Internet, private networks, satellite, physical transfer

Ingest/management
- Collect/create/maintain metadata
- Catalog and inventory

Quality control
- Basic – detect missing data, value limits, comparison with neighbors
- Advanced statistical – detect discontinuities, determine biases
- Assimilation – comparison with model output
- Observing and communication systems performance monitoring

Retrospective analysis
- Aggregation in time and space
- Statistical analysis (means and extremes)
- Data filtering (filter high frequency noise)
- Determine trends
- Monitor climate indicators

Access
- Interactive on-line, near-line
- Via customer services

Data Transport
- On-line, Internet
- Media
- Data Products

Preservation/Archive
- Reformat
- Storage
- Backup

Overarching the above are interoperable systems, effective user feedback and standards
OBSERVATIONS
Six different adjustment schemes used to identify time-dependent biases

Adapted from: Free et al (2002)
## Chuuk/Truk (91334) Metadata Example

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<th>DD</th>
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<td>99</td>
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<td>NO CUTOFFS</td>
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<td>01</td>
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<td>MicroART (v.generic)</td>
<td>MicroART (v.2.97)</td>
</tr>
</tbody>
</table>

- **99 = UNKNOWN DATE**

- ✓ Metadata records recently updated for approx. 65 GUAN stations as part of NCDC GCOS Lead Centre responsibilities
Cost Effectiveness

Example portfolio

Based on meeting requirements or objectives

Non Monetized “Benefit”

Cost and “Benefit” of example portfolio

Checked options are included in example portfolio

The NOSC or other stakeholders can perform “what-ifs” – e.g. freezing options in or out of the portfolio and recalculating results.
2001 GUAN Station Sounding Completeness
(at least one mandatory level reported)
00 & 12 UTC

Percent of Possible Soundings
- 0.00
- 0.01 to 49.99
- 50.00 to 89.99
- 90.00 to 100.00
2004 GUAN Station Sounding Completeness
(at least one mandatory level reported)
00 & 12 UTC

Percent of Possible Soundings
- 0.00
- 0.01 to 49.99
- 50.00 to 89.99
- 90.00 to 100.00
GCOS Upper Air Network
Station Graphs

91334 - TRUK/CAROLINE IS. , PS.

Date Range: 195706 to 200412
   Hour: 00
   Level: 50
(9999 = Surface; 0 = Tropopause)

Temperature – Pre QC