Upper Air Observations from a NOAA Perspective

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

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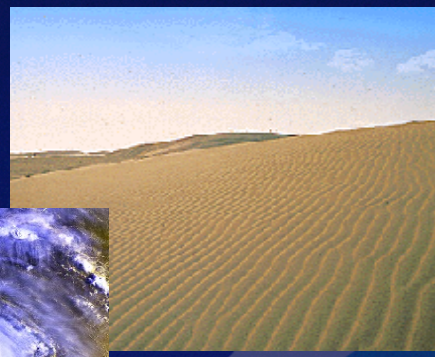
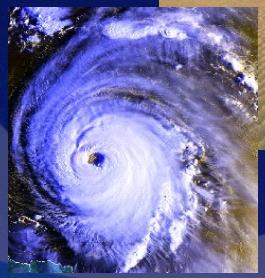
Thomas R. Karl
Director, National Climatic Data Center
Program Lead, NOAA Climate Observations and Analysis

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

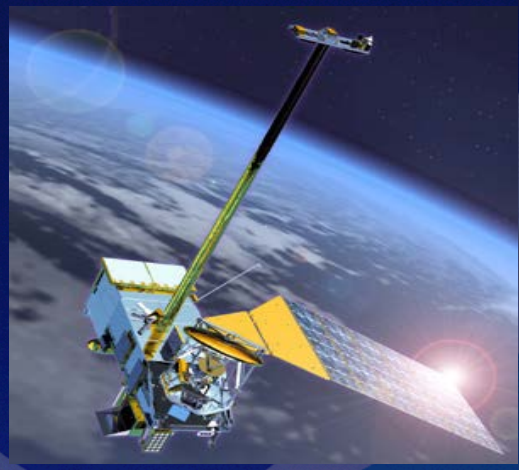
- ✓**NOAA Cross-Cutting Priorities**
  - Integrating Global Environmental Observations and Data Management
- ✓**NOAA Integrated Observing System (IOS)**
  - Integrated Upper Air Observing System (IUOS)
  - Integrated Surface Observing system (ISOS)
  - Integrated Ocean Observing system (IOOS)
  - Integrated Joint Satellite Observing Systems

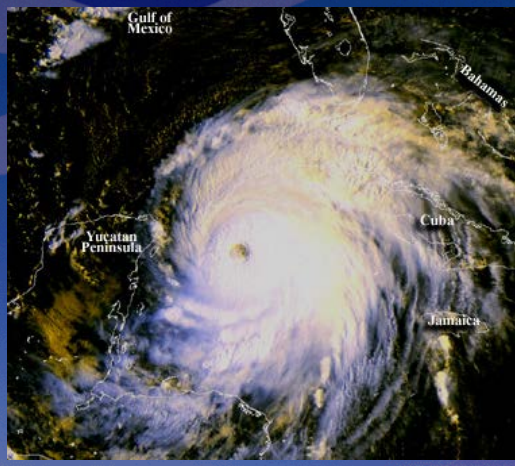
National Networks of Observing Systems
Federal, State, Local, Govt., University/Research, and Private Sector

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*

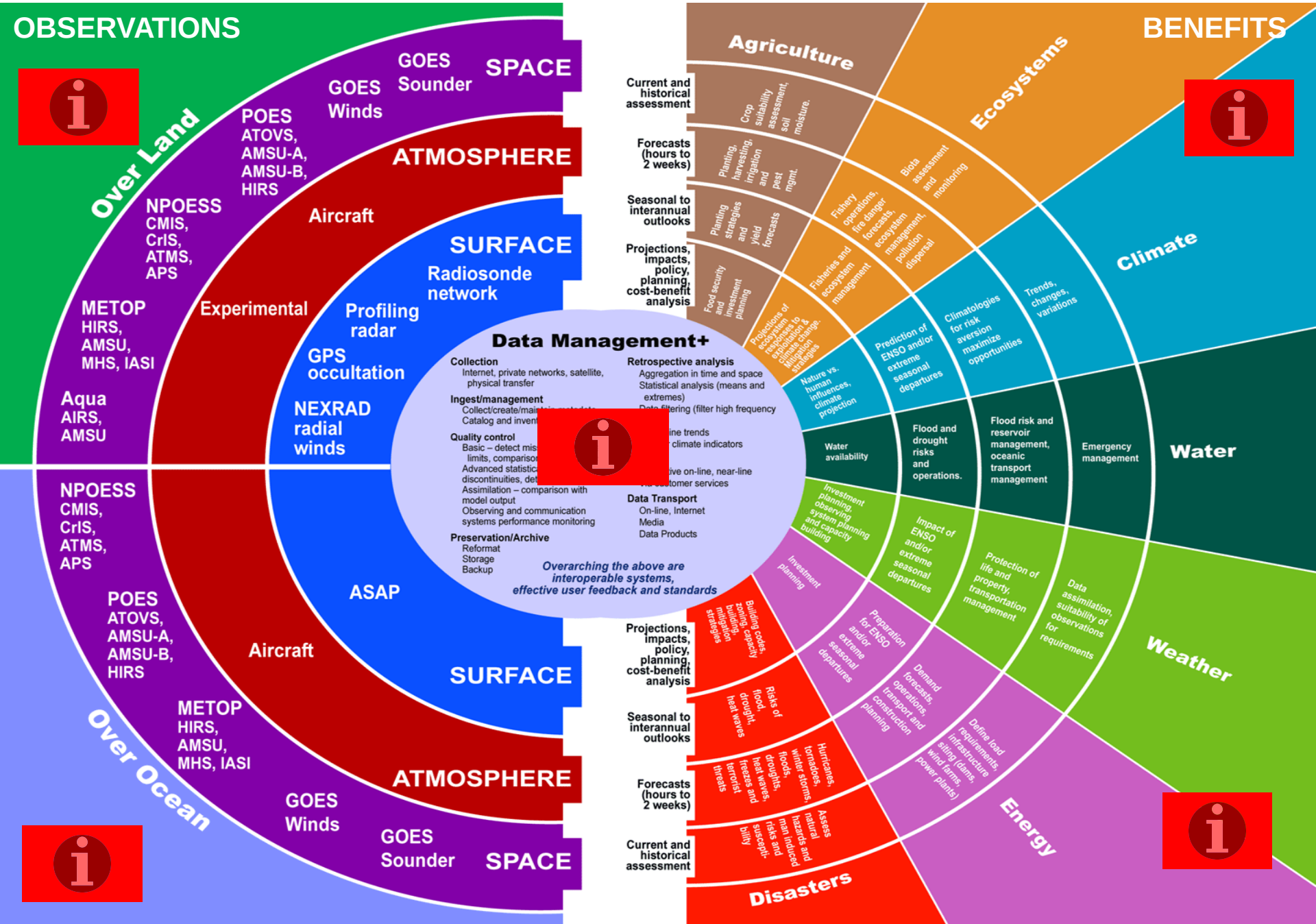
Interagency & International Linkages

- ✓ **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 Blue Print: 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



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**

Upper Air Observing Requirements

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

Upper Air Observing Requirements

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 depends on time and space sale 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

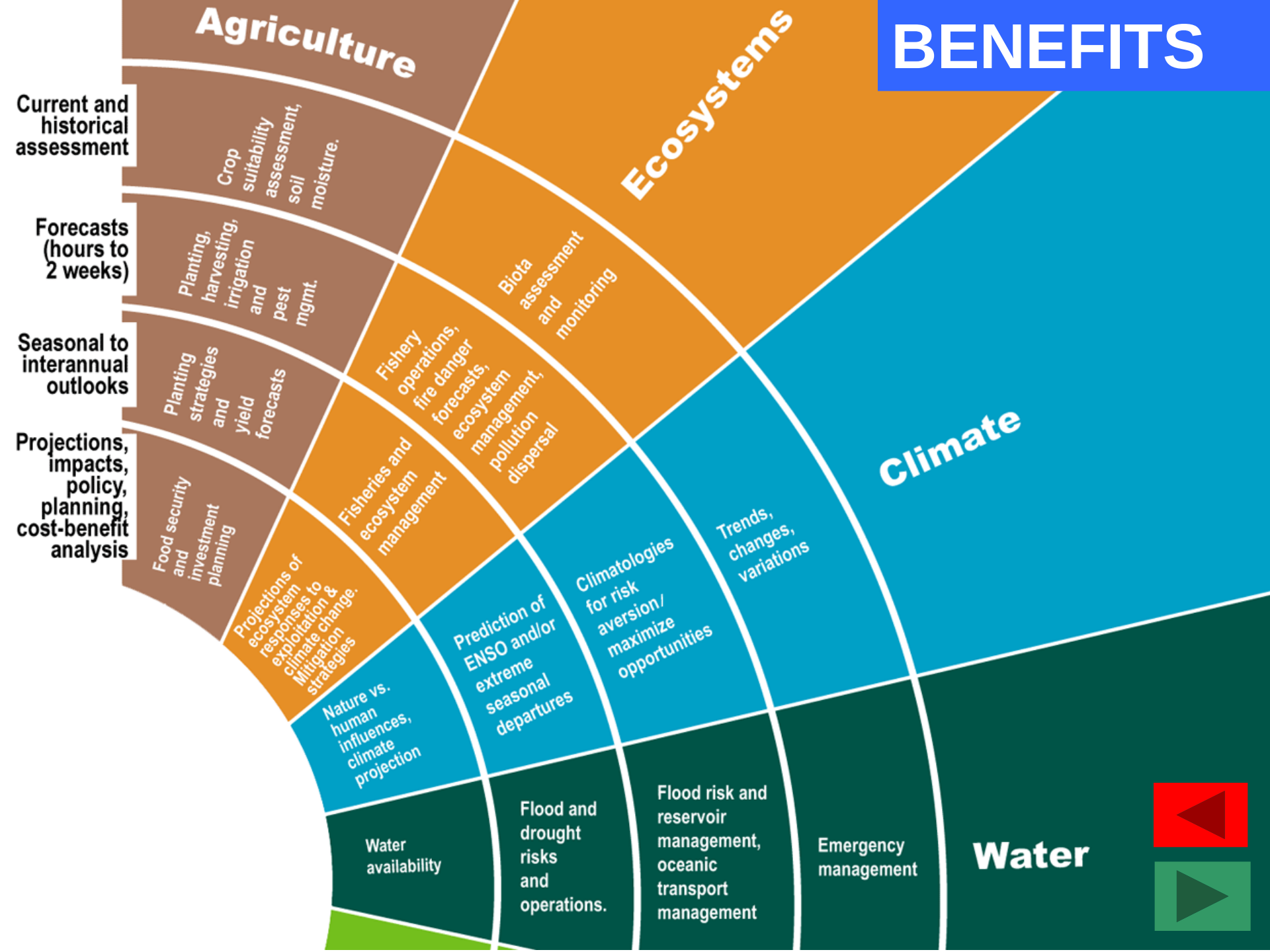
Preservation/Archive
- Reformat
- Storage
- Backup

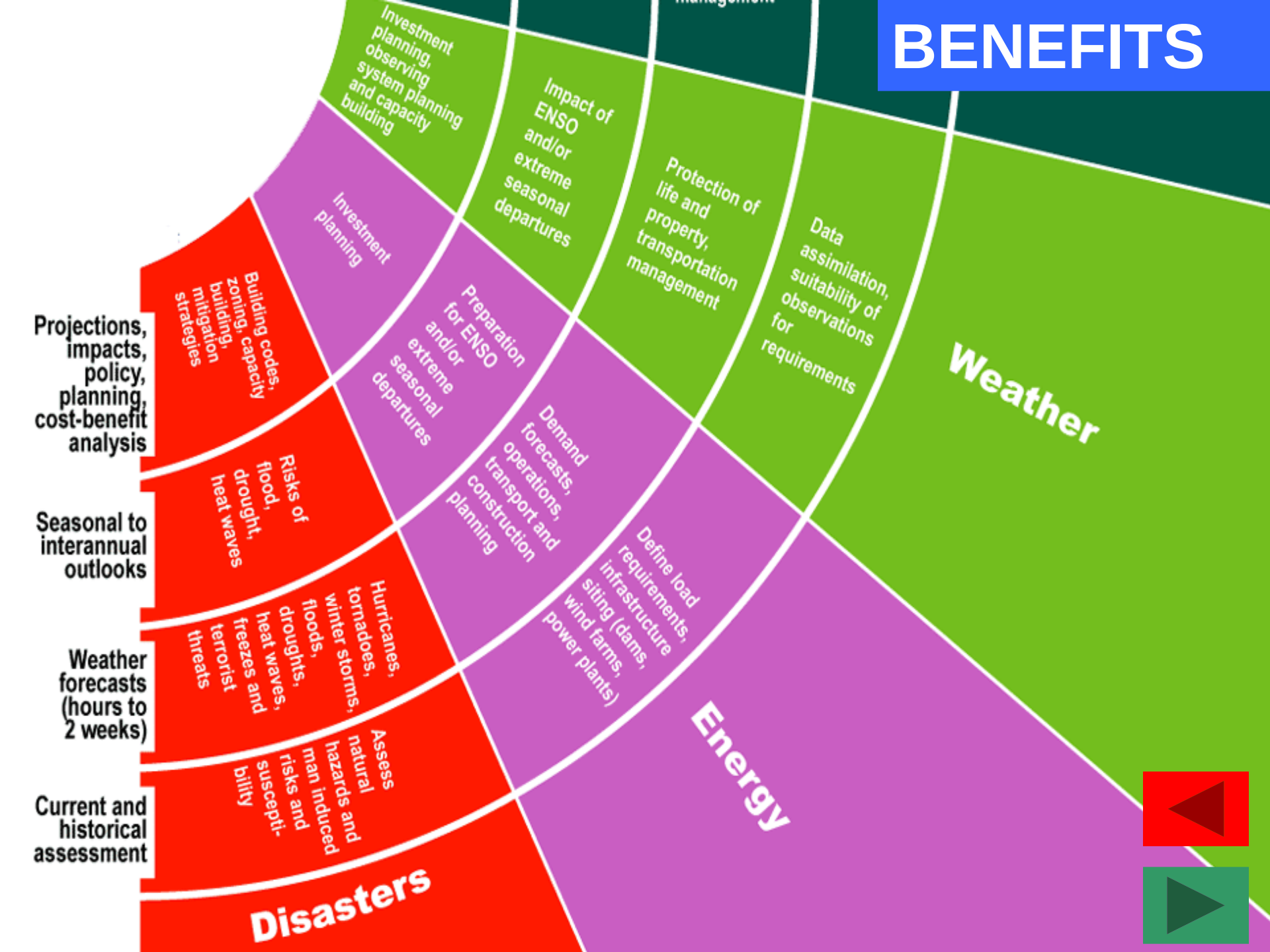
Retrospective analysis
- Aggregation in time and space
- Statistical analysis (means and extremes)
- Data filtering (filter high frequency noise)
- Determine trends
- Monitor climate indicators

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

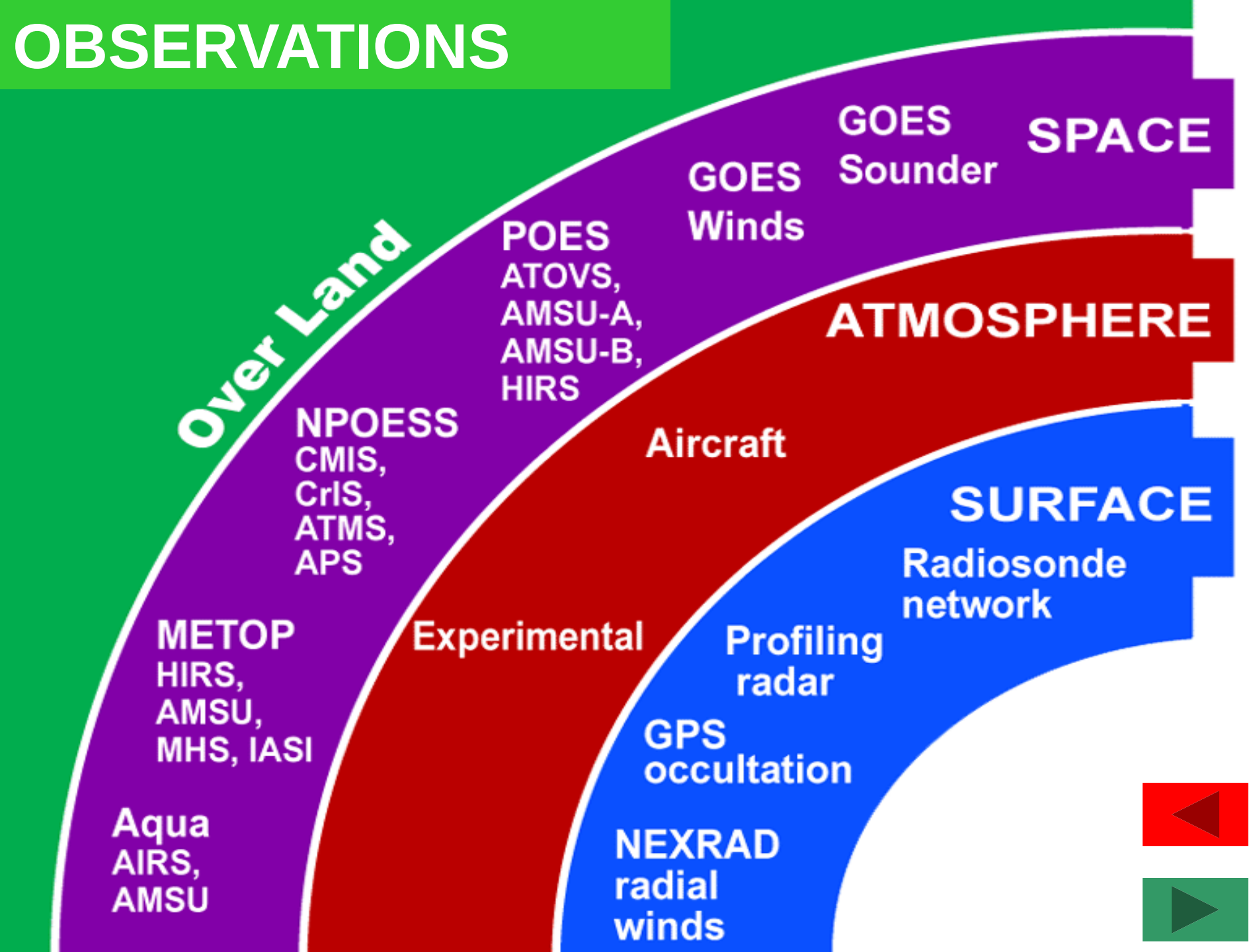
Data Transport
- On-line, Internet
- Media
- Data Products

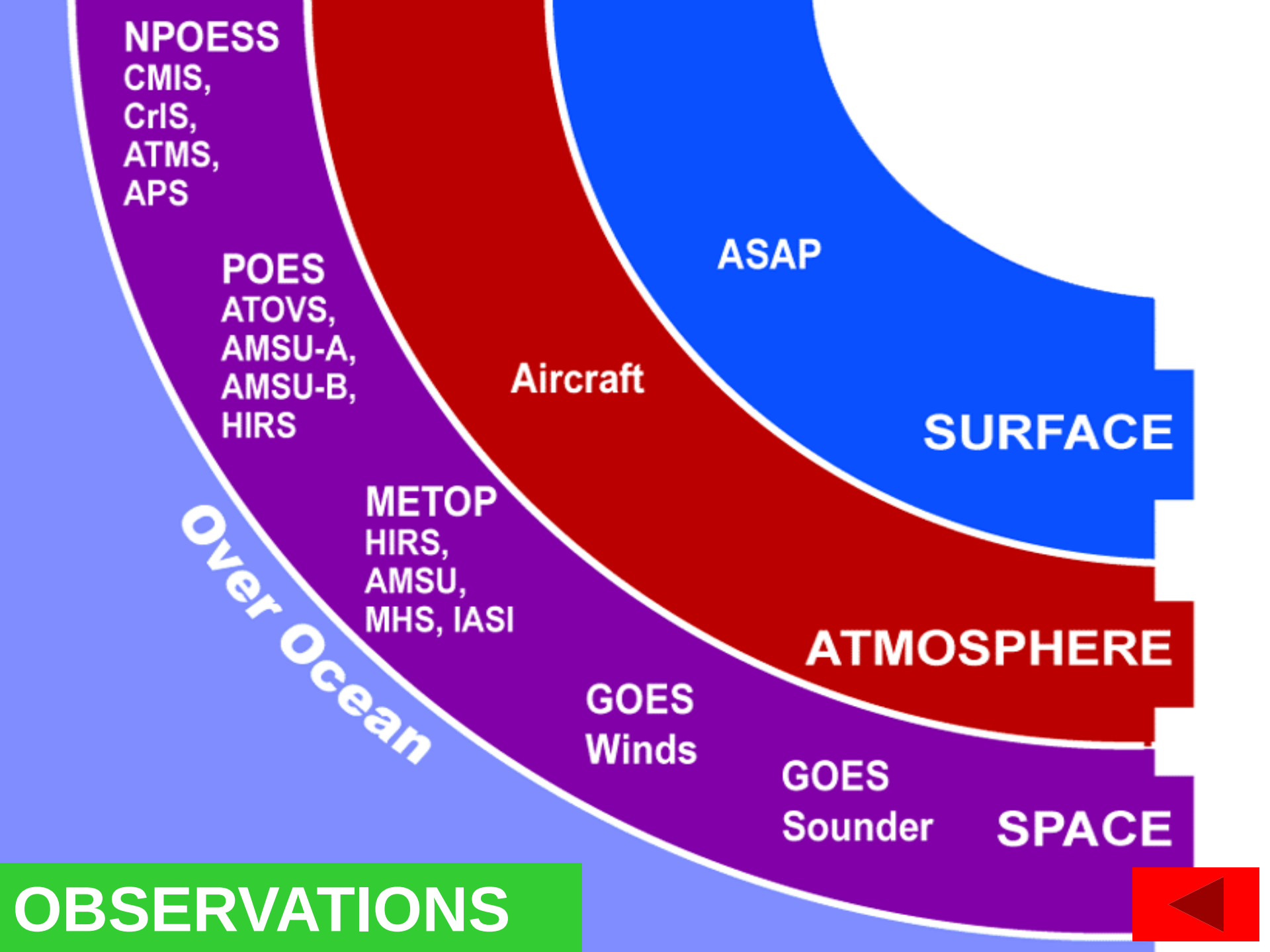
Overarching the above are interoperable systems, effective user feedback and standards


BENEFITS
Agriculture
Ecosystems
Climate
Water
Current and historical assessment
Forecasts (hours to 2 weeks)
Seasonal to interannual outlooks
Projections, impacts, policy, planning, cost-benefit analysis
Crop suitability assessment, soil moisture.
Planting, harvesting, irrigation and pest mgmt.
Planting strategies and yield forecasts
Food security and investment planning
Biota assessment and monitoring
Fishery operations, fire danger forecasts, ecosystem management, pollution dispersal
Fisheries and ecosystem management
Projections of ecosystem responses to exploitation & climate change. Mitigation strategies
Trends, changes, variations
Climatologies for risk aversion/ maximize opportunities
Prediction of ENSO and/or extreme seasonal departures
Nature vs. human influences, climate projection
Emergency management
Flood risk and reservoir management, oceanic transport management
Flood and drought risks and operations.
Water availability


BENEFITS
Weather
Energy
Disasters
Projections, impacts, policy, planning, cost-benefit analysis
Seasonal to interannual outlooks
Weather forecasts (hours to 2 weeks)
Current and historical assessment
Investment planning, observing system planning and capacity building
Impact of ENSO and/or extreme seasonal departures
Protection of life and property, transportation management
Data assimilation, suitability of observations for requirements
Investment planning
Preparation for ENSO and/or extreme seasonal departures
Demand forecasts, operations, transport and construction planning
Define load requirements, infrastructure siting (dams, wind farms, power plants)
Building codes, zoning, capacity building, mitigation strategies
Risks of flood, drought, heat waves
Hurricanes, tornadoes, winter storms, floods, droughts, heat waves, freezes and terrorist threats
Assess natural hazards and man induced risks and susceptibility

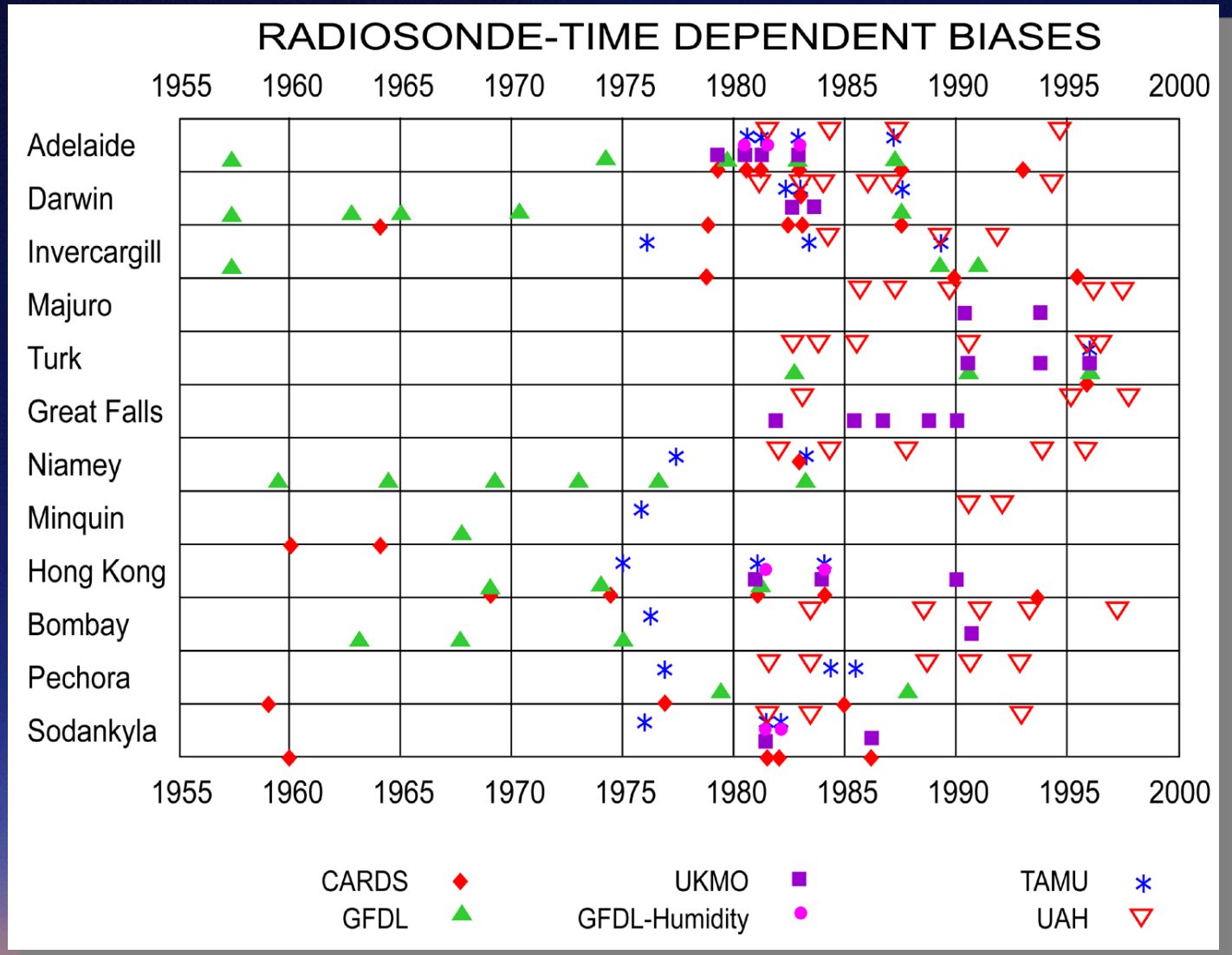
OBSERVATIONS




NPOESS
CMIS,
CrIS,
ATMS,
APS
POES
ATOVS,
AMSU-A,
AMSU-B,
HIRS
METOP
HIRS,
AMSU,
MHS, IASI
Over Ocean
Aircraft
ASAP
SURFACE
ATMOSPHERE
GOES
Winds
GOES
Sounder
SPACE
OBSERVATIONS

Observing and Data System Deficiencies

- ✓ Six different adjustment schemes used to identify time-dependent biases



Adapted from: Free et al (2002)

Chuuk/Truk (91334) Metadata Example

YYYY	MM	DD	EVENT	FROM	TO
1986	99	99	USING SONDE MODEL	VIZ (Generic)	
1988	10	01	CHANGE SONDE MODEL	VIZ (Generic)	toVIZ B
1990	07	99	CHANGE COMPUTER	MINI-ART 2 SYSTEM	?toMICRO-ART SYSTEM
1993	10	99	CHANGE RH ALGORITHM	DEW PT=30 FOR RH<20%	toNO CUTOFFS
1993	10	99	CHANGE DATA CUTOFF	MISC. ALGORITHM	toCORRECTED ALGORITHM
1993	10	99	CHANGE GRAVITY VAL.	9.8 M/S2	to9.80665 M/S2
1993	10	99	CHANGE RH ALGORITHM	RH MISSING FOR T<-40	toNO CUTOFFS
1995	12	01	CHANGE SONDE MODEL	VIZ B	toVAISALA RS80-56
1999	02	01	CHANGE COMPUTER	MicroART(v.generic)	toMicroART(v.2.97)

- 99 = UNKNOWN DATE

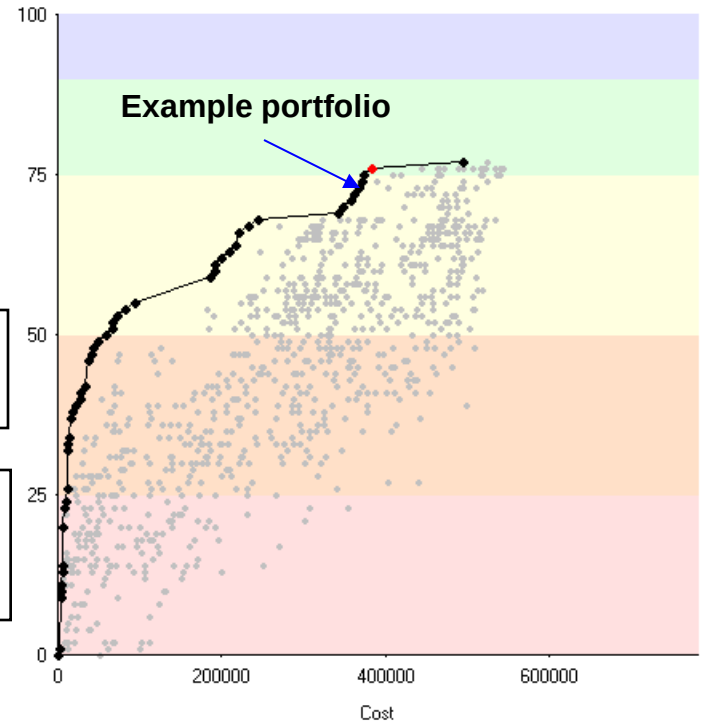
✓ **Metadata records recently updated for approx. 65 GUAN stations as part of NCDC GCOS Lead Centre responsibilities**

Cost Effectiveness

PALMA - NOSA Investment Analysis Demo

File Legal Write Mode Adjust Genetic

Tree Graph Impact Data



Non Monetized "Benefit"

Based on meeting requirements or objectives

Cost

Cost and "Benefit" of example portfolio

Un In Out System A
Un In Out System A Expanded
Un In Out System B
Un In Out System B Expanded
Un In Out System C
Un In Out System C Upgraded and Expanded
Un In Out System D
Un In Out System E
Un In Out External data
Un In Out System F
Un In Out System G
Un In Out System H
Un In Out System I
Un In Out System J
Un In Out System J Upgraded
Un In Out System K
Un In Out System K Expanded
Un In Out System L
Un In Out System L Expanded
Un In Out System M

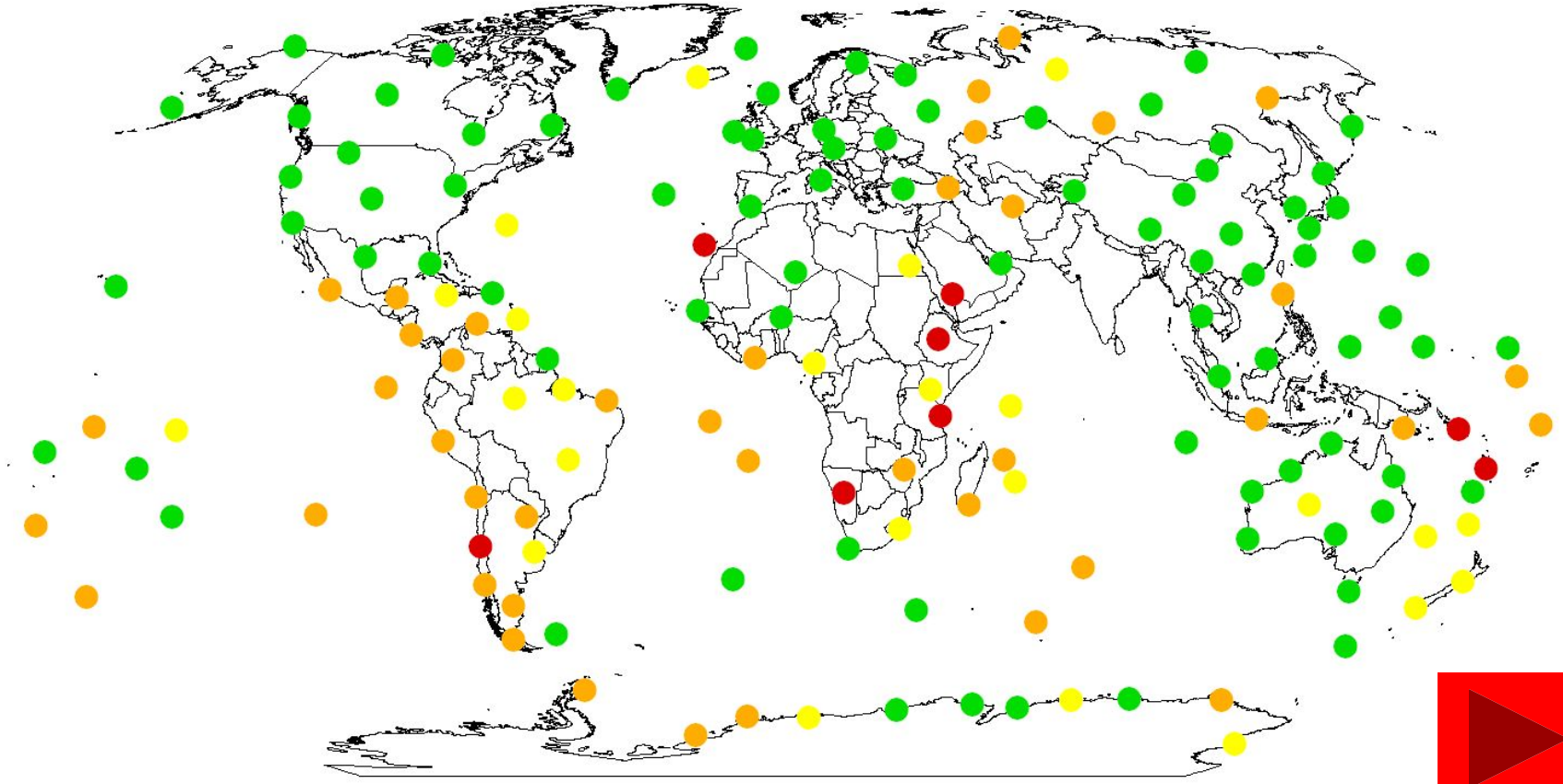
Checked options are included in example portfolio

The NOSC or other stakeholders can perform "what-ifs" –e.g. freezing options in or out of the portfolio and recalculating results.

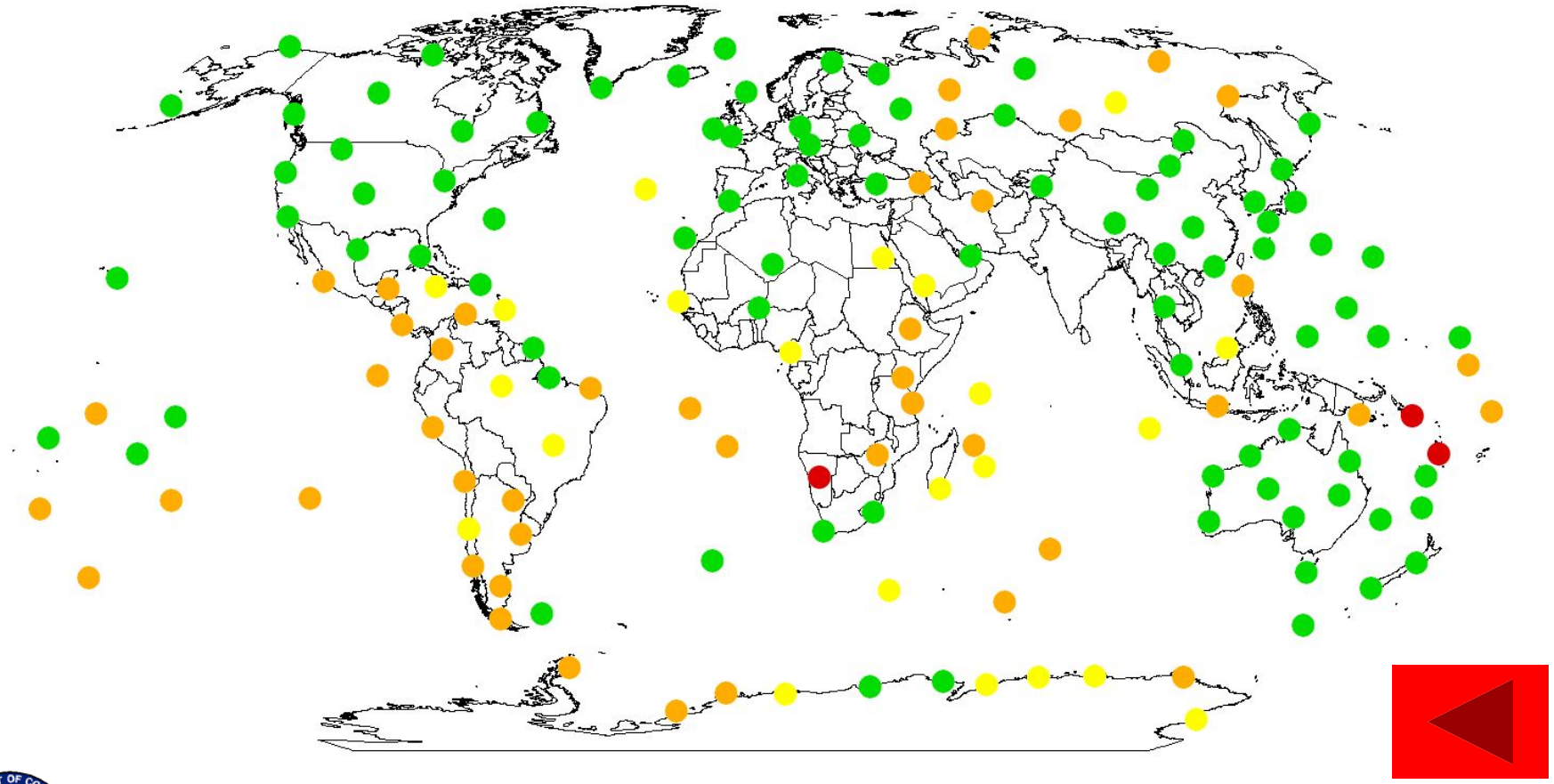
2001 GUAN Station Sounding Completeness
(at least one mandatory level reported)
00 & 12 UTC

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



GCOS Upper Air Network
Station Graphs

91334 - TRUK/CAROLINE IS. , PS.

Date Range: 195706 to 200412

Hour: 00

Level: 50

(9999 = Surface; 0 = Tropopause)