



Upper air networks: GCOS requirements

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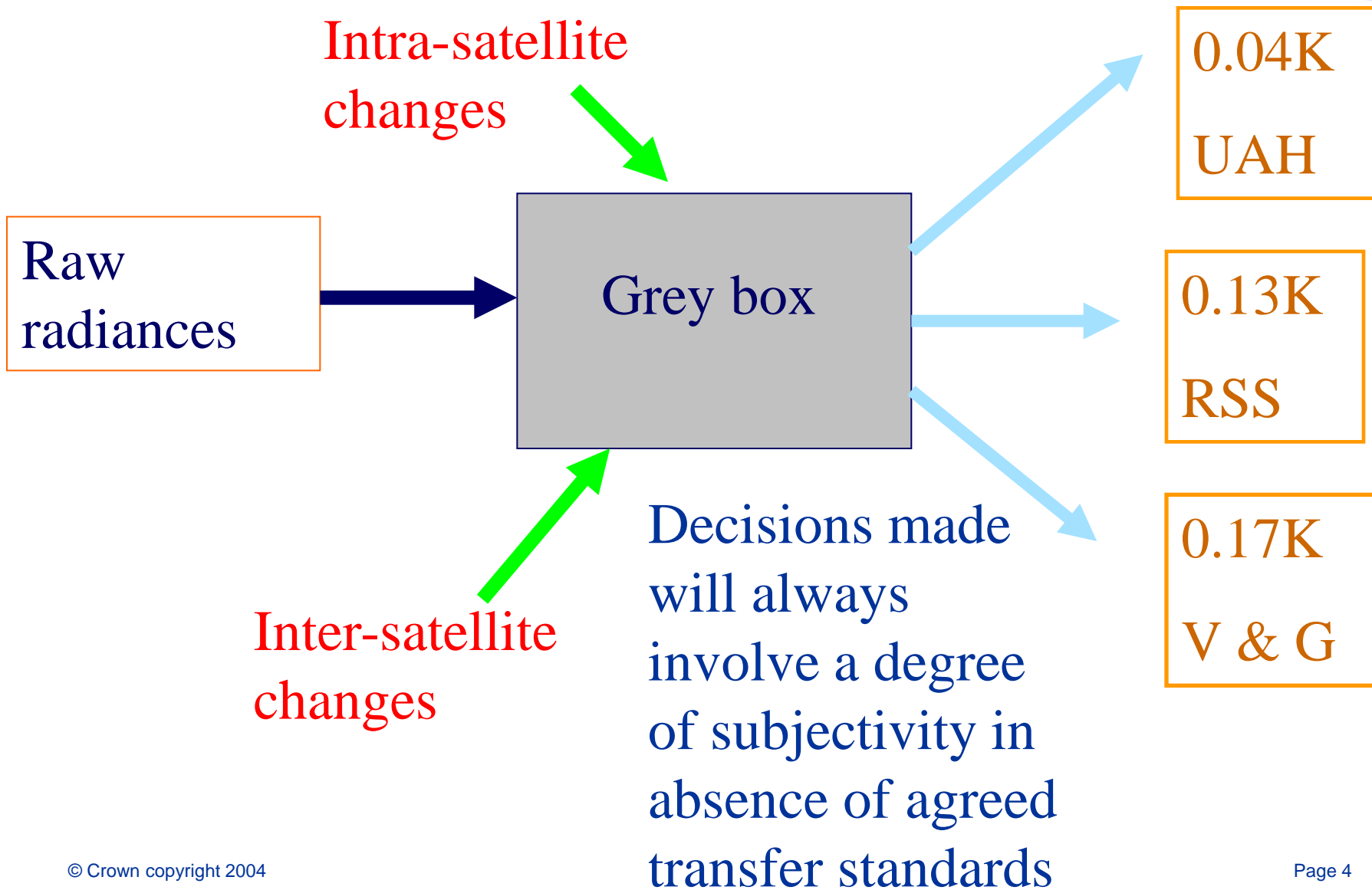
February 2005

- Set up to advise AOPC on temperature trends at the surface and aloft.
- Peter Thorne (Chair), John Christy, Imke Durre, Mitch Goldberg, Tom Karl, Neville Nicholls, Dian Seidel, Adrian Simmons, Kevin Trenberth, Panmao Zhai.
- First major task:
 - To help produce proposal for upper-air reference network by end of 2005.

1. Defining the scientific requirement



- Setting up and maintaining observing networks is expensive and requires a clear rationale:
 - The apparent discrepancy between surface and tropospheric temperatures over the satellite era shows how important joined up network design is if we are to effectively monitor climate.
 - The requirement going forward is for the accurate characterisation of not just temperature, but also humidity, trace gases, winds, and other variables.
 - Important to confirm climate model “hindcasts” not just of temperature but also other variables.



2. GCOS cascade of networks



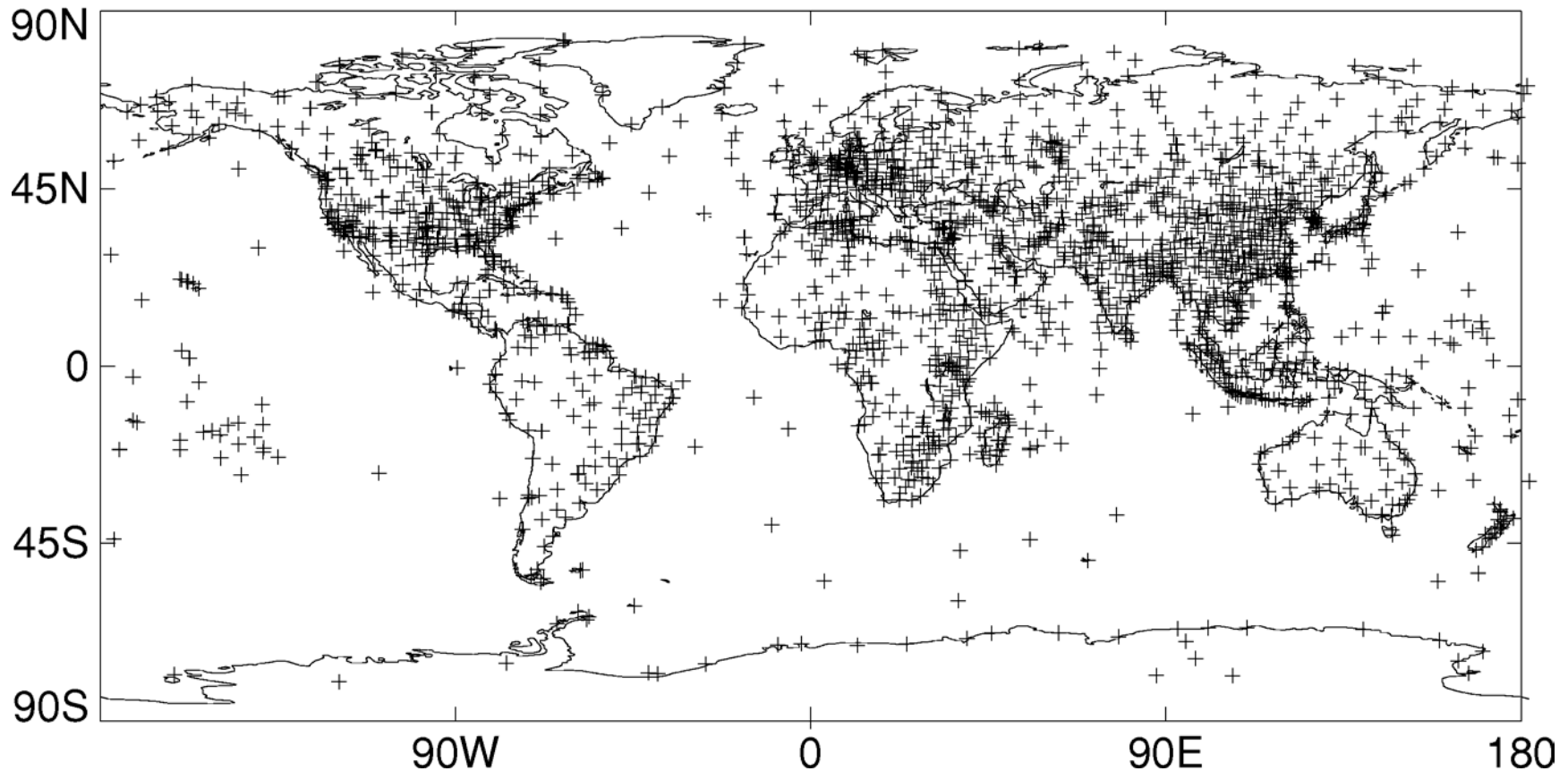
- Comprehensive global observing networks
 - All stations that report over the GTS or at a later date. Multiple data types including satellite data. Required to understand fine space and timescale structure changes and variability.
- Baseline global observing networks
 - Limited number of selected long-term stations to provide characterisation of global / large scale changes (and anchor Comprehensive networks).
- Reference networks
 - Provide highly detailed and accurate observations at a small number of stations. Two aims: (i) long-term accurate timeseries and (ii) calibration of more global networks (including satellites).

3. Current GCOS upper-air networks status



- Comprehensive network
 - Many radiosondes are being dropped altogether or decreasing their launch frequency.
 - Increasing amount of ground-based and aircraft-based sounding instrumentation.
 - Plans to continue ATOVS type satellite soundings in an AM/PM overpass for at least a decade.
 - New GPS occultation retrievals
 - Multi-spectral measurements coming on-line will increase satellite data vertical resolution and hugely increase data volumes.

Station locations

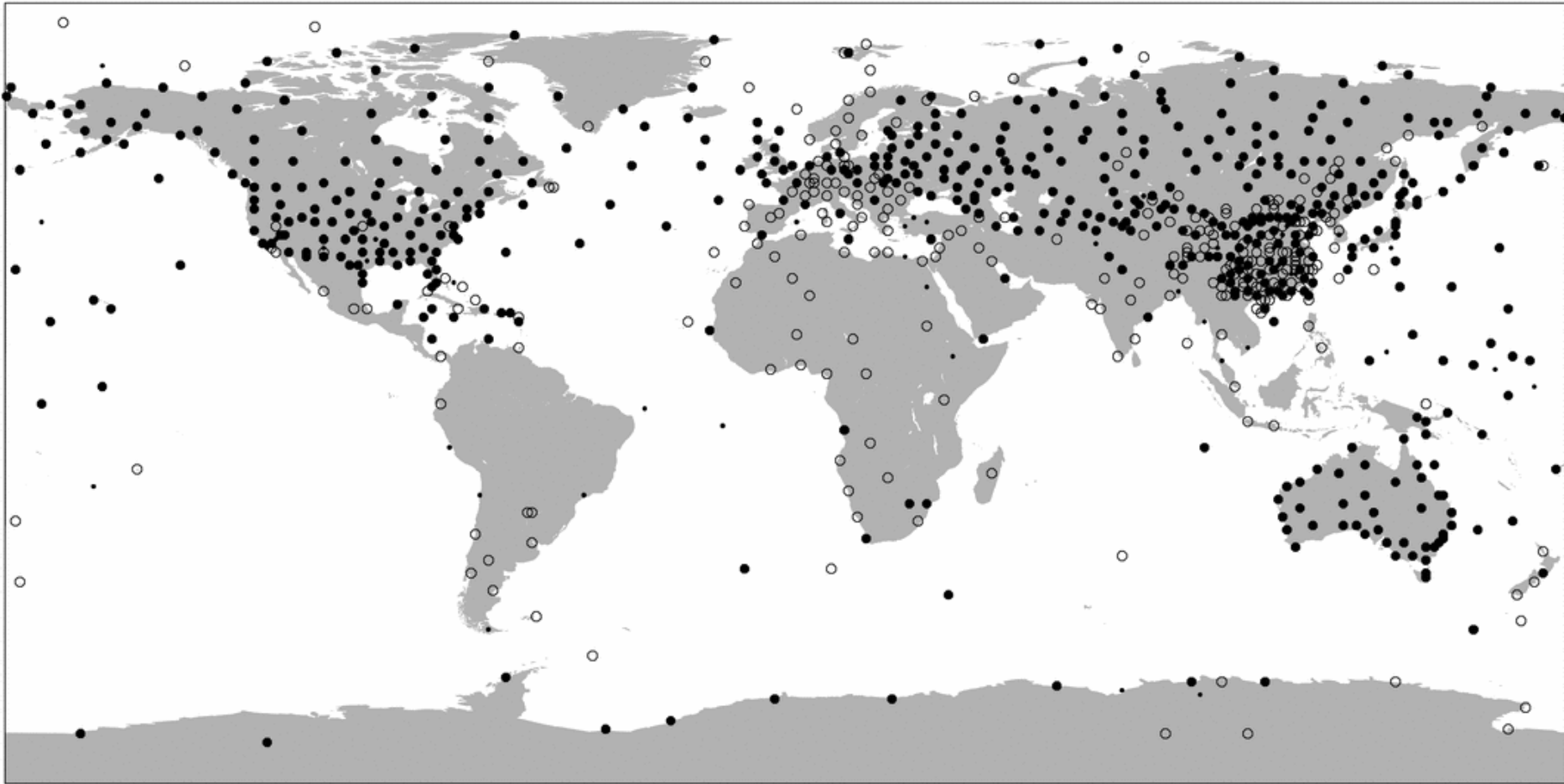


All radiosonde stations which have ever recorded and been at least partially digitally archived regardless of the length of the record.

Radiosonde coverage for 1958



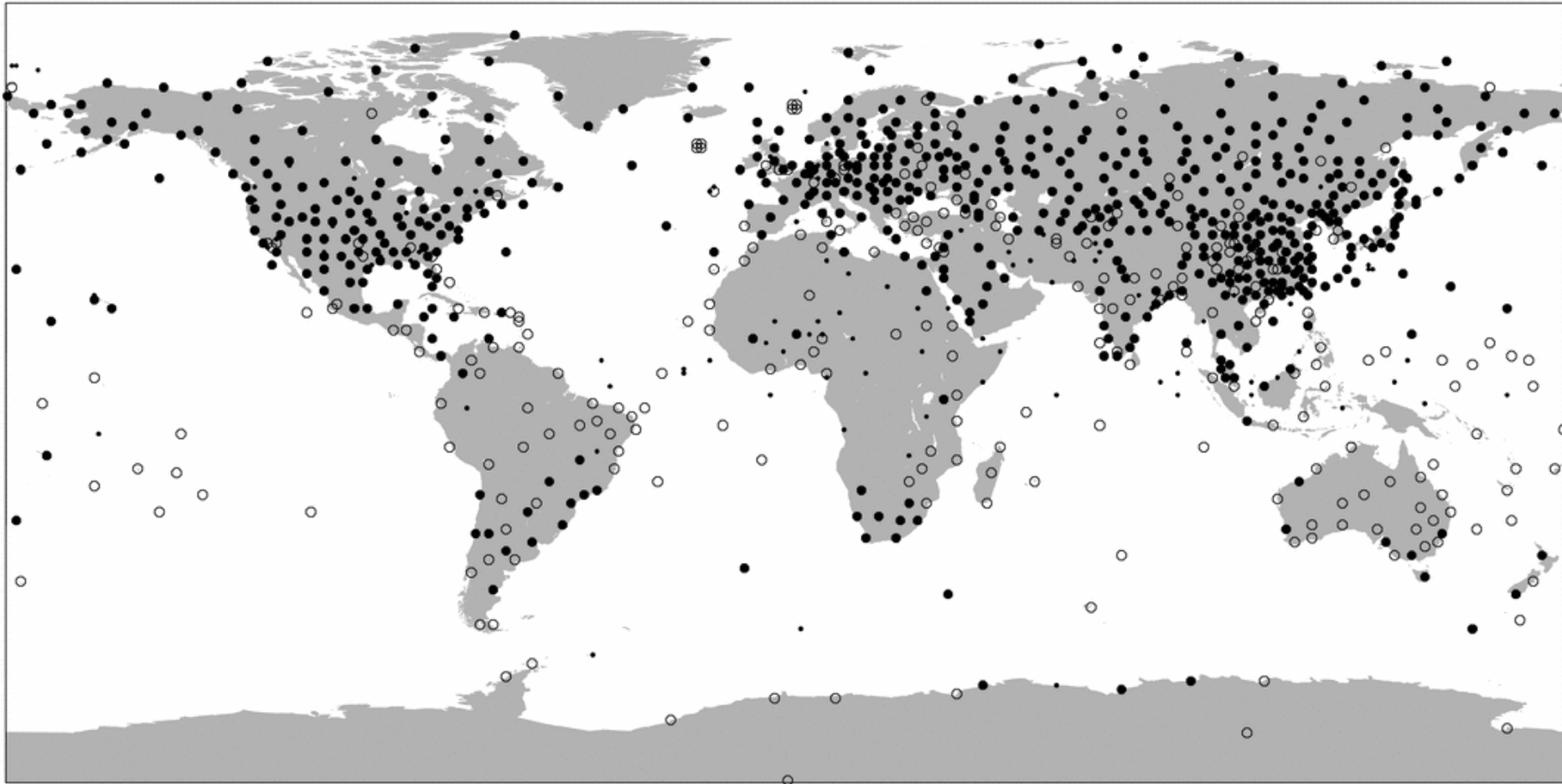
1°1° average in 3 categories: > 1 per week -> 0.5 per day: 0.5 per day -> 1.5 per day: > 1.5 per day



Average number of soundings per day: 1609
(source: ECMWF)

Radiosonde coverage for 1979

1°1° average in 3 categories: > 1 per week -> 0.5 per day: 0.5 per day -> 1.5 per day: > 1.5 per day

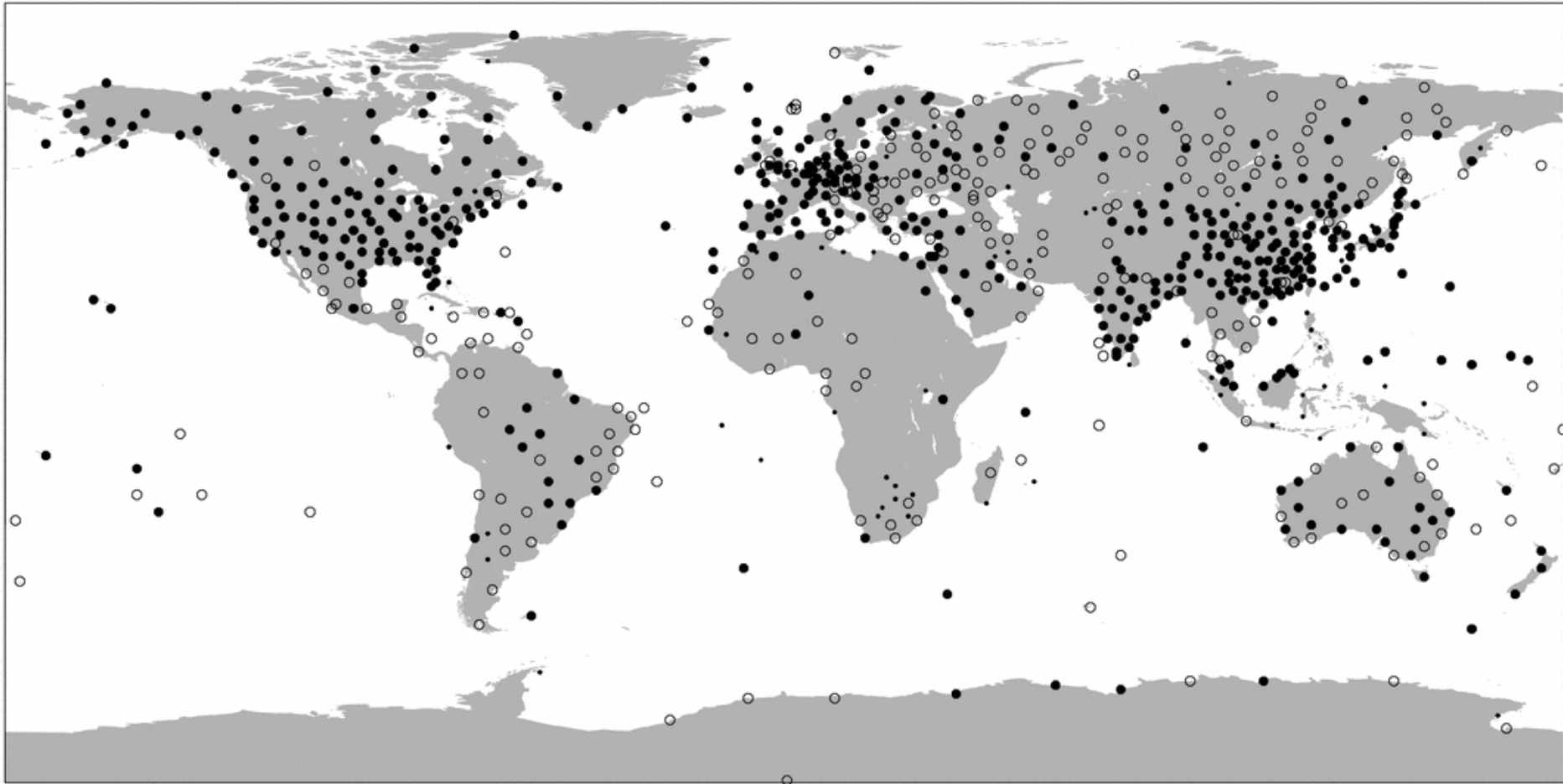


Average number of soundings per day: 1626
(Source: ECMWF)

Radiosonde coverage for 2001

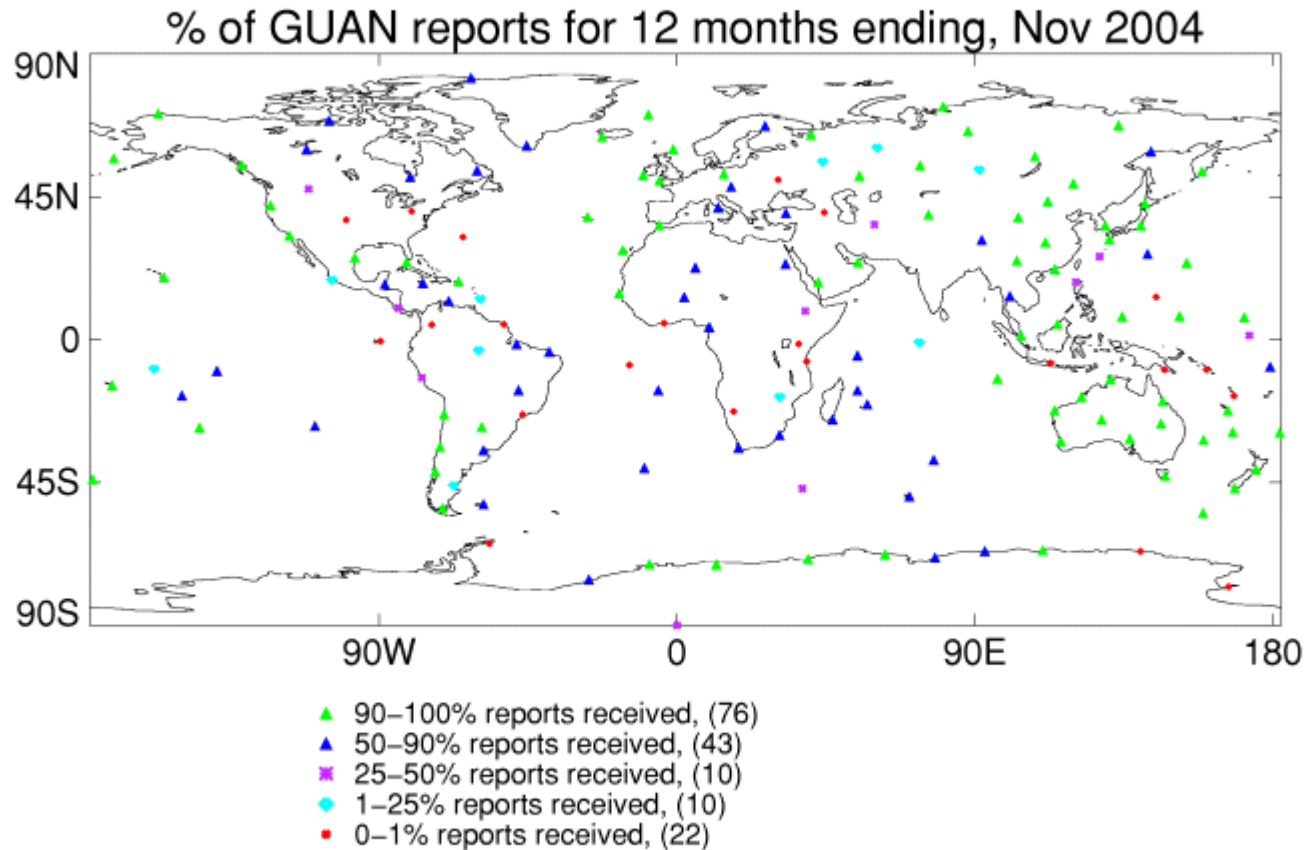


1°1° average in 3 categories: > 1 per week -> 0.5 per day: 0.5 per day -> 1.5 per day: > 1.5 per day



Average number of soundings per day: 1189
(Source: ECMWF)

- **Baseline network – GUAN**
 - 161 globally spread radiosonde stations
 - Mandated by GCOS (and agreed by NMS's) to continuously monitor upper-air variability by twice daily launches of radiosondes.
 - Monitoring at ECMWF (daily) and Hadley Centre (monthly).
 - Metadata available from NCDC.
 - Climate products available from Hadley Centre and NCDC.



Caveat: this considers only CLIMAT TEMP reports. Some stations make soundings but do not report CLIMAT TEMPs. Likely 10-20% under-estimate of performance.

- Work in hand / potential modifications to GUAN:
 - NCDC are actively trying to improve metadata for GUAN sites.
 - There are a few requests to add / change stations from certain NMS's that are under consideration.
 - Recent efforts have been made to improve the reporting performance for a number of stations, particularly remote island stations (but we're still not getting 100% performance!)

- Gan, Maldives - restarted the station September 2004
- Penrhyn, Cook islands - restarted in July 2004
- Laoag, Philippines - only 1 report in 2003, we have received 5 of the last 8 months
- Comodoro Rivadavia, Argentina - stopped in 2001, restarted November 2004
- Juan Santamaria, Costa Rica, restarted September 2004
- Dar es Salaam, Tanzania; Galapagos; Yerevan, Armenia all restarted but no CLIMAT TEMP reports to date

■ Reference network

- Proposed in the GCOS Implementation Plan (2004) and the primary driver behind GCOS involvement in this workshop series.
- Expected to be operational by 2009 (requires plan by end of 2005)
- Should be a subset of the GUAN network (some latitude to change GUAN network)
- Needs to be aligned with all users including satellite agencies.

- Action A16 (GIP, 2004):

“Specify and implement a Reference Network of high-altitude, high-quality radiosondes, including operational requirements and data management, archiving and analysis.”

Initialising and implementing this network on a five year timetable is a very high priority.

4. The GCOS requirement from this workshop series



- This workshop series should produce a final proposal for the upper-air reference network:
 - Scientific justification
 - Siting options and rationale.
 - Technical requirements
 - Instrumentation (not limited to radiosondes alone)
 - Launch protocols (for sondes)
 - Stewardship, metadata and archival requirements
 - Costings