



Climate monitoring of the free atmosphere:
Past mistakes and future plans

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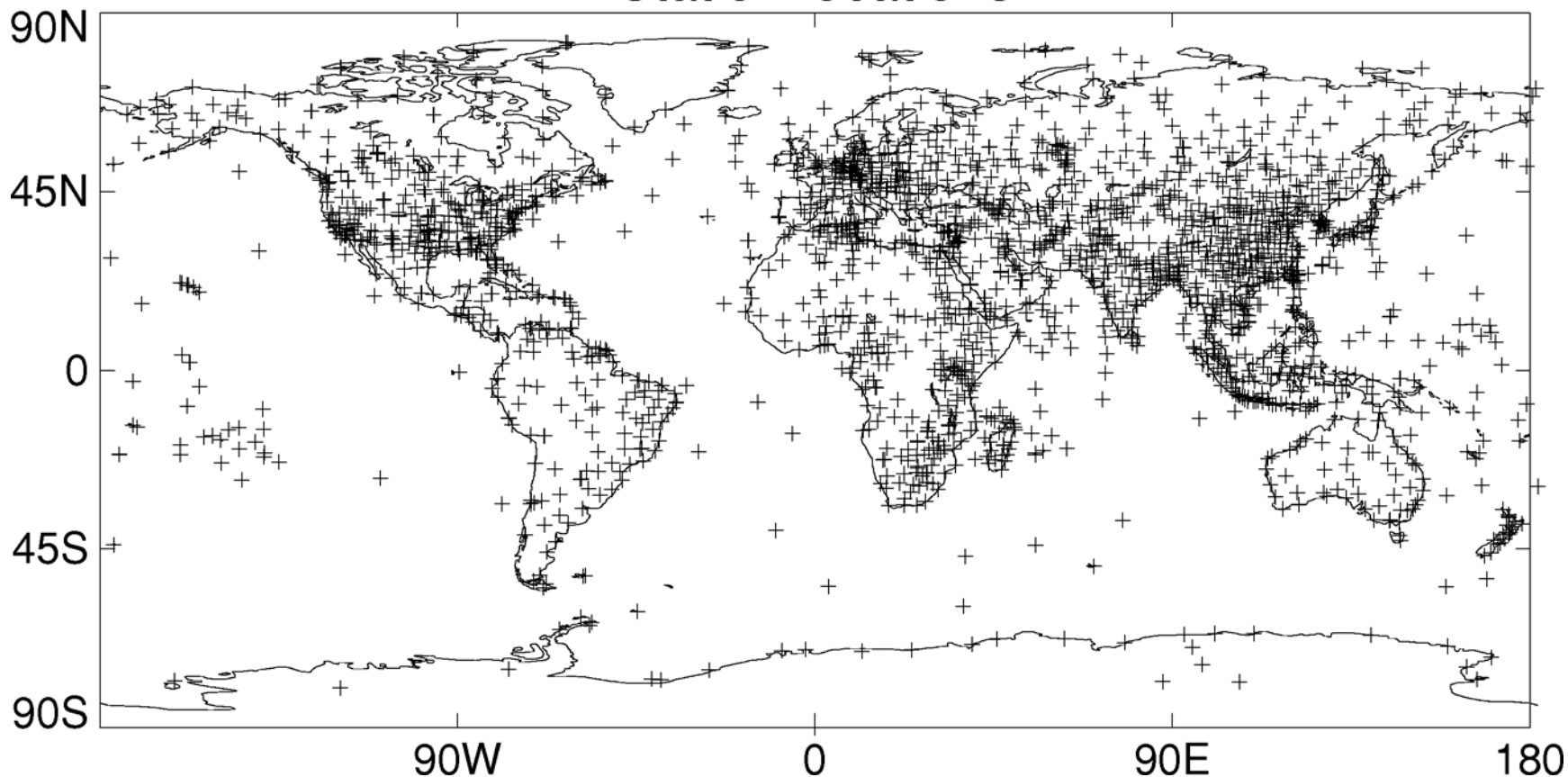
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1. Historical monitoring of upper-air climate



- Driven almost entirely by NWP requirements.
 - Changes in coverage, instrumentation and observing practice add a lot of non-climatic noise.
 - Data are in many cases poorly archived (if at all) and suffer from a paucity of metadata.
 - There is no historical absolute ground-truth
- Bottom line: To build a climate dataset we must make a lot of informed guesses!

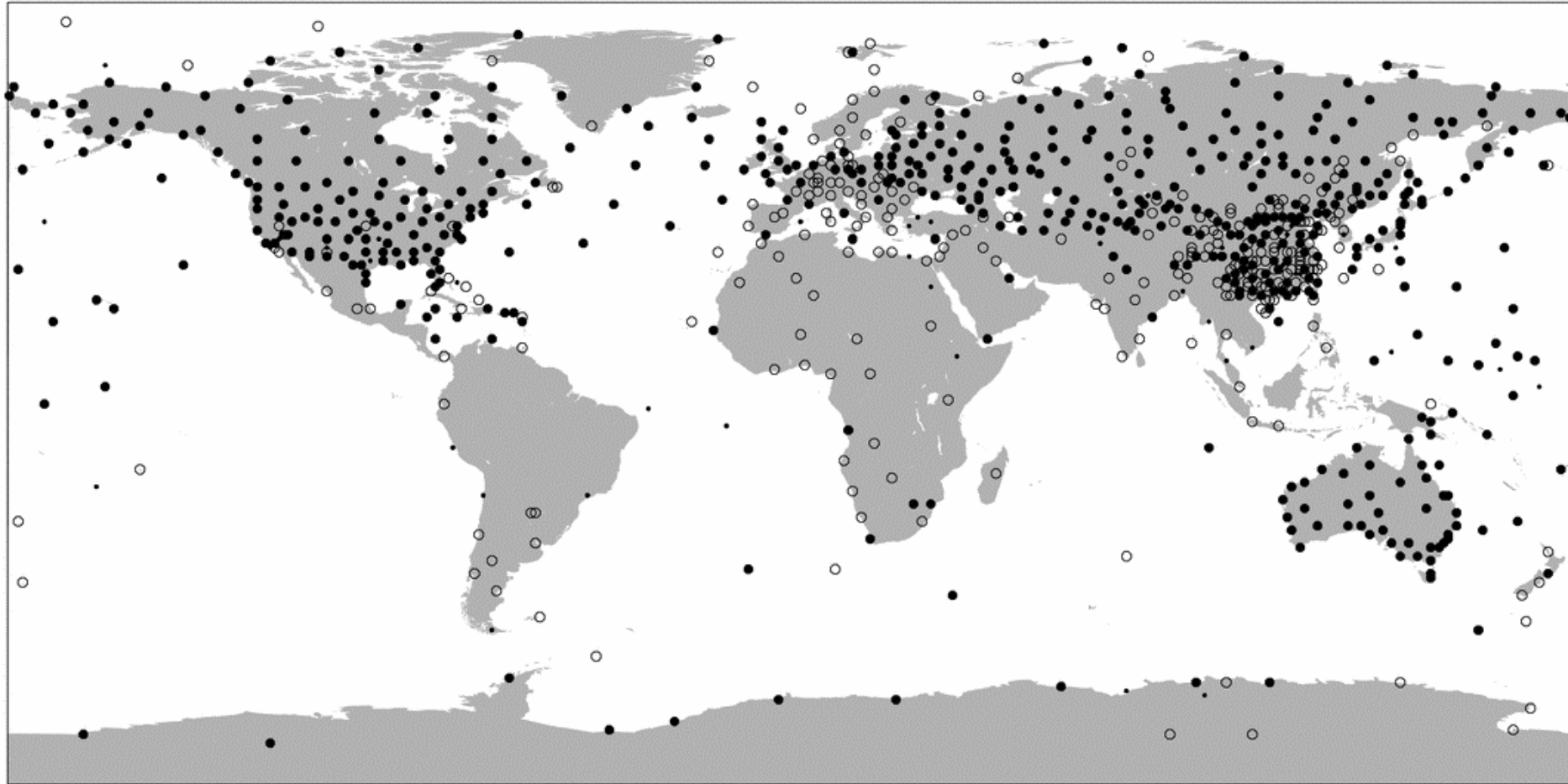
Station locations



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

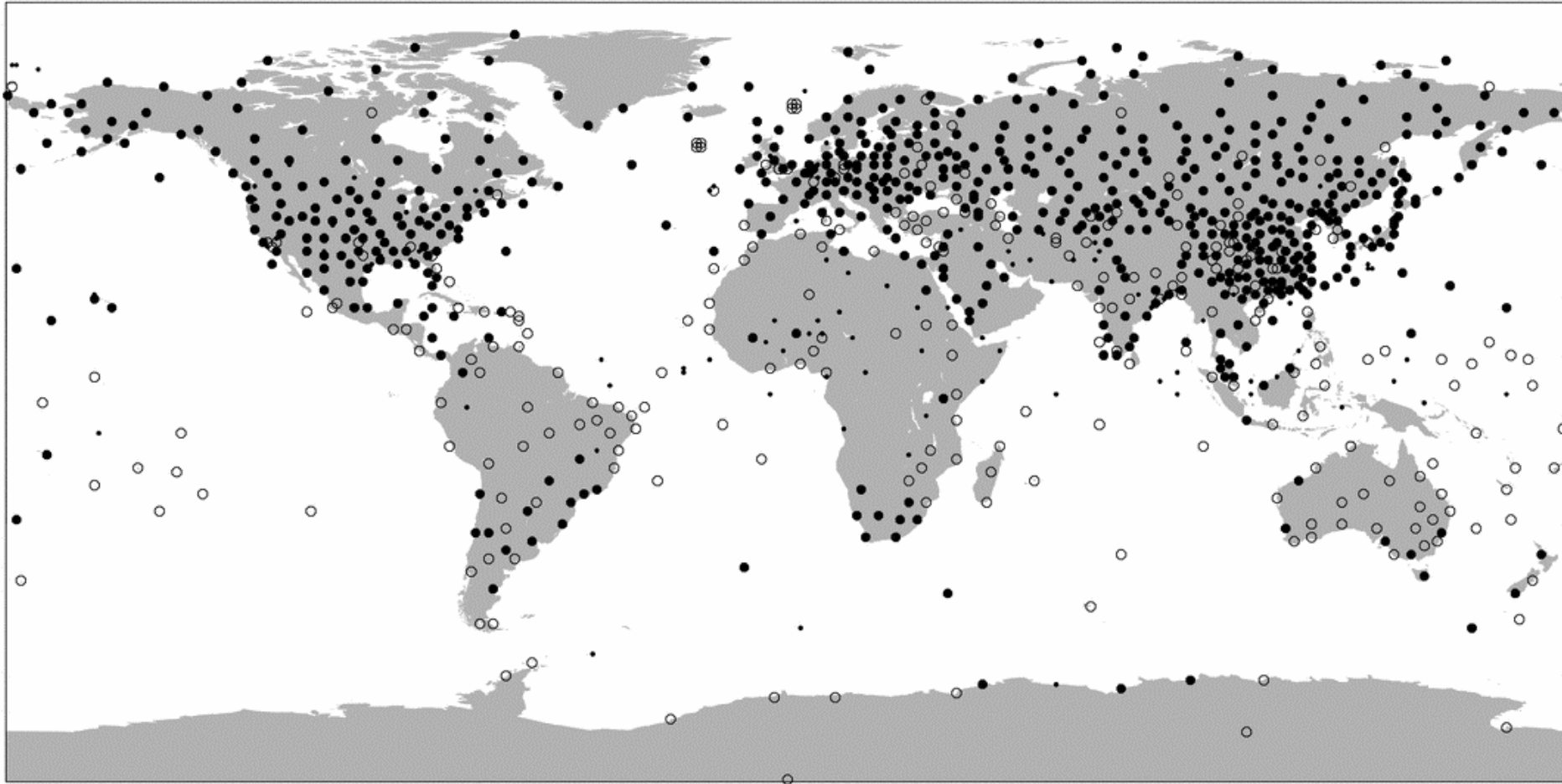
1°1° average in 3 categories: > 1 per week -> 0.5 per day: 0.5 per day -> 1.5 per day: > 1.5 per day



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

Radiosonde coverage for 1979

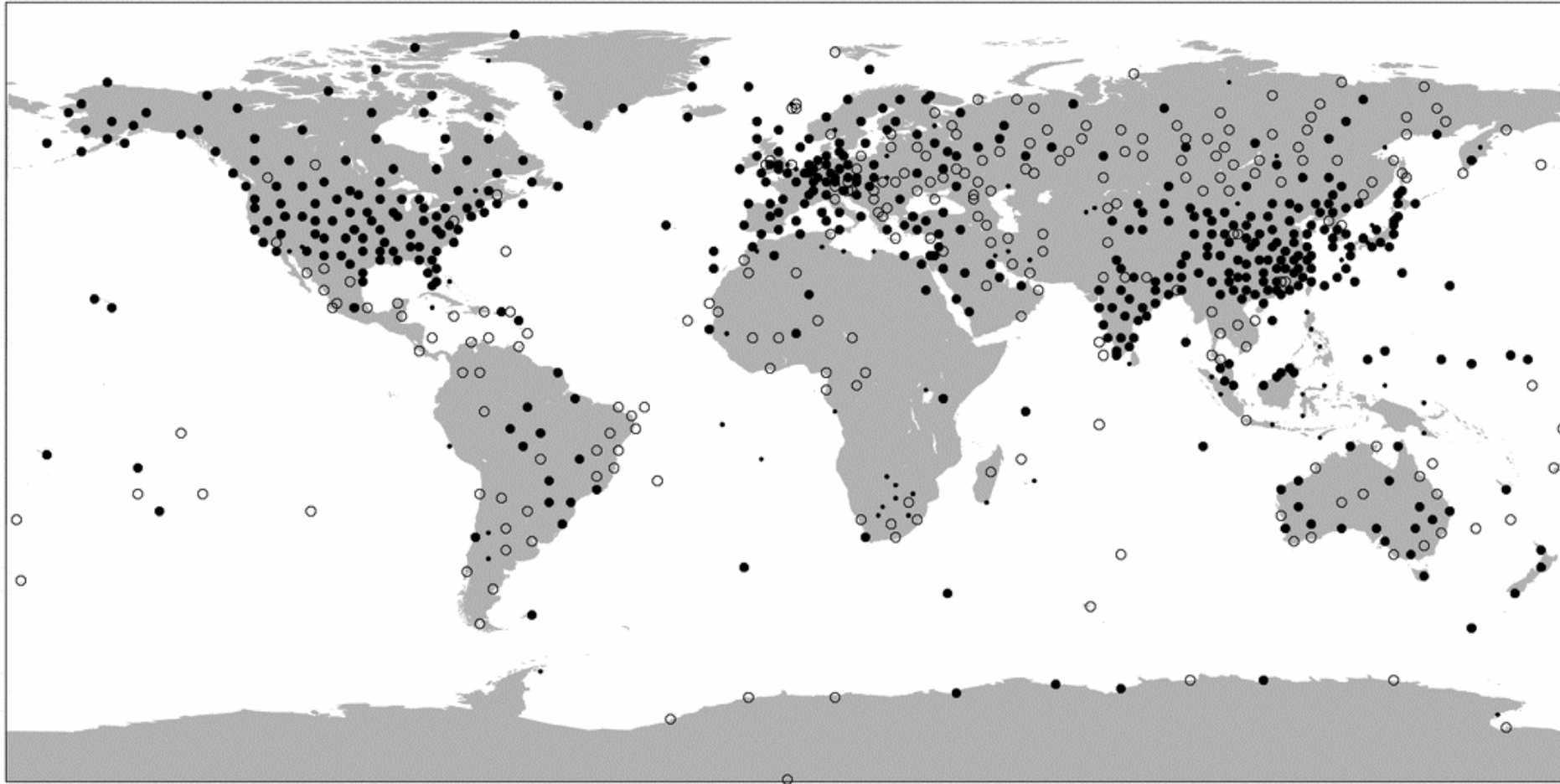
1°1° average in 3 categories: > 1 per week -> 0.5 per day: 0.5 per day -> 1.5 per day: > 1.5 per day



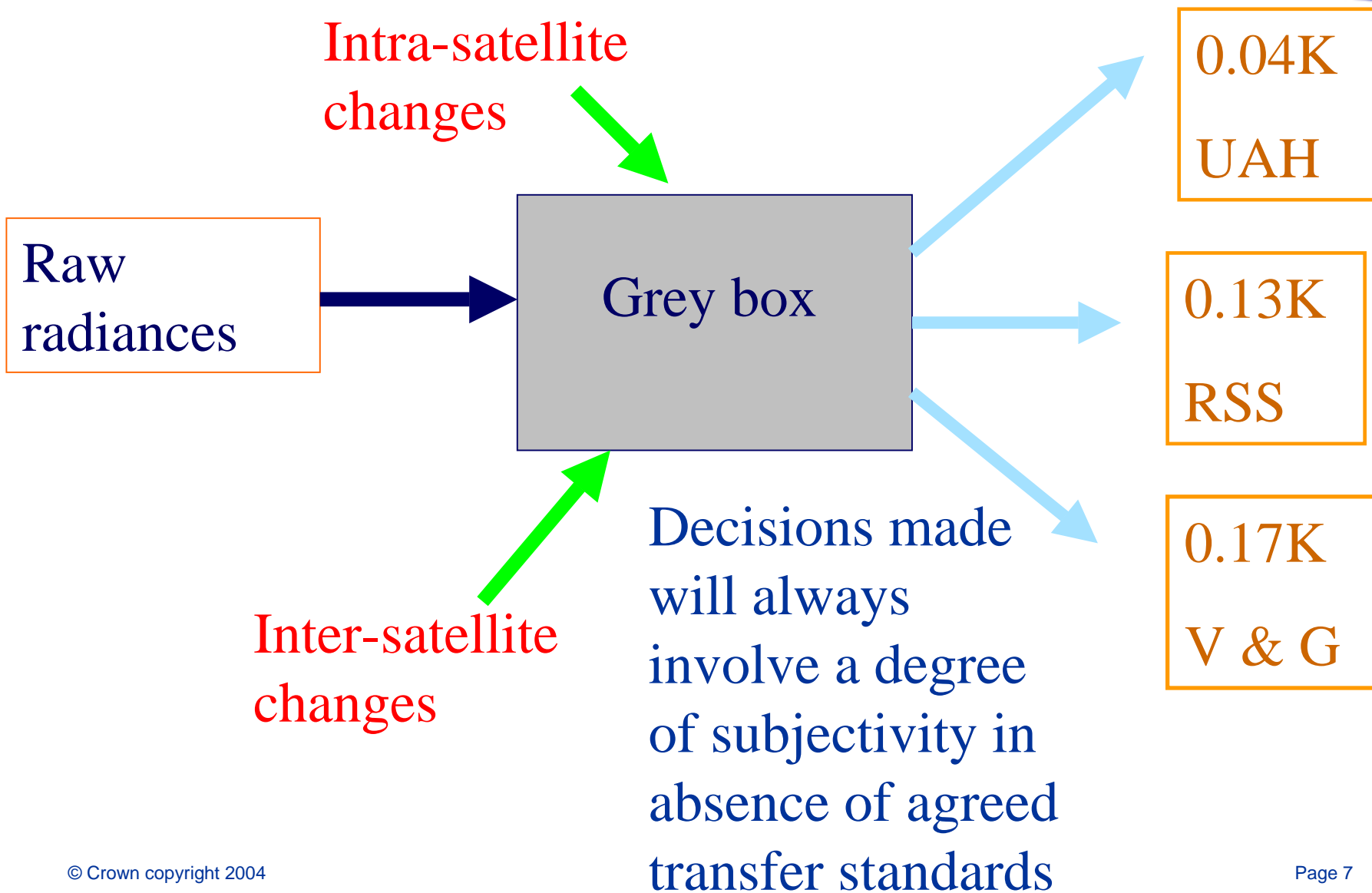
Average number of soundings per day: 1626
(Source: ECMWF)

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

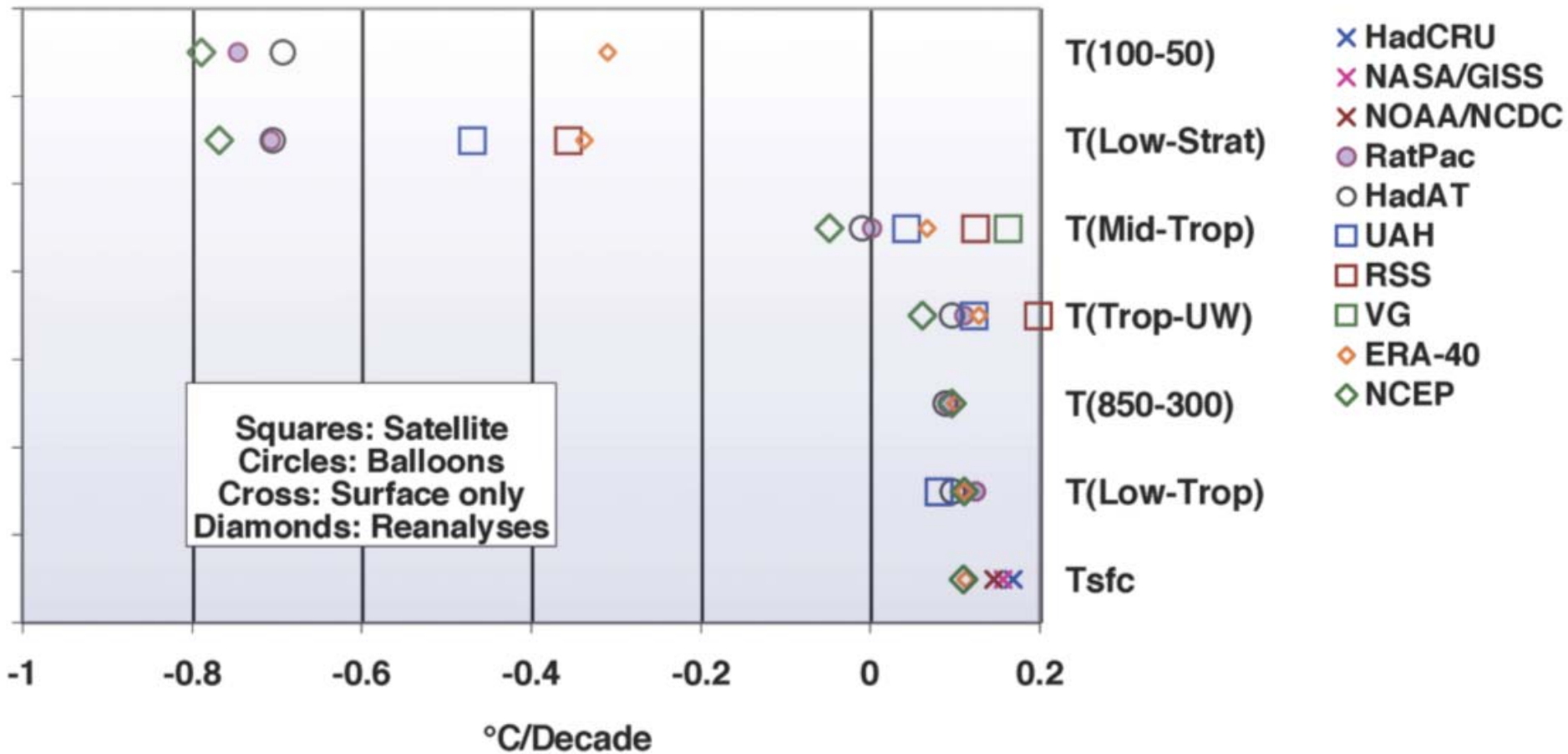


Average number of soundings per day: 1189
(Source: ECMWF)



And its not just the satellites ...!

Global 1979-2003



Density of coverage

Degree to which climate is primary customer

Benchmark Network

- Traceable to international standards (SI units)
- Absolute accuracy

Reference Network

- Sites of Multi-instrument redundancy
- Coverage sufficient to act as anchor points for more globally complete networks
- Maintained with providing continuity and explicit characterisation of effect of instrument changes (e.g. Satellite platform changes) in mind.

Baseline Network

- Sufficient coverage of upper-air stations to characterise hemispheric and global scale change and variability.
- Commitment to twice-daily radiosonde launches

Comprehensive Network

- As globally complete coverage from multiple instruments and platforms as possible.

- Proposed in the GCOS Implementation Plan (2004) which has been adopted by GEOSS.
- Expected to be operational by 2009
- Should be a subset of the Baseline 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. A reference series must ...



Be driven by climate requirements.

Provide the multi-instrument redundancy that will permit unambiguous removal of non-climatic influences. Research is needed to inform this.

Involve a dedicated end-to-end data stewardship management programme including metadata.

Be an open-ended commitment to multi-instrument, multi-parameter (T, q, cloud properties etc.) monitoring.

Cost the earth. Given the costs of trying to extract a climate signal and associated research its probably a cost saving!

Be global coverage. Its providing our anchor points or “islands of truth”

Be useful just to climate.

Flying satellites without a form of “ground truth” is never going to unambiguously satisfy the requirements of climate monitoring where we are searching for small multi-decadal signals in noisy data.

If we want to pay more than lip service to climate monitoring from satellites we need to support a reference network to make optimal use of the satellite data.

International TOVS Study Conference, 14th, ITSC-14, Beijing, China, 25-31 May 2005.
Madison, WI, University of Wisconsin-Madison, Space Science and Engineering Center,
Cooperative Institute for Meteorological Satellite Studies, 2005.