Lessons in Diversity: How 40 different data sources were combined to create Version 2 of the Integrated Global Radiosonde Archive

Paper 3.6

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Integrated Global Radiosonde Archive (IGRA)

- Observations: radiosonde and pilot balloon
- Coverage: global land, 1905-present
- Example applications: reanalysis input, climate assessments, satellite verification, air pollution modeling
- Created by merging data from 40 sources containing 11,500 station records

The Classic Duplicate Elimination Problem

Which source station records should be combined to form one IGRA station?

➢Input:
- Multiple, sometimes overlapping, time series for the same location

➢Desired output:
- One time series per location, containing as much data as possible
- No data duplication between distinct locations

➢Challenges:
- Imprecise and changing station locations
- Various names and station identifiers for the same location
- Differences in data precision

The IGRA Solution

Decision-making algorithm:

- Input: all ~11,500 source stations

- Steps:
  1. Identify matching pairs of source stations on the basis of data and metadata.
  2. Arrange paired stations into groups.
  3. Resolve conflicts.

- Output: final groups of source stations that constitute IGRA stations

Step 1: Find Pairs

- Compare data, station identifiers, station names, and station locations

Example 1: **Match**

Source: NCDC6301 WBAN= 24233 WMO= 72793 NAME= Seattle Tacoma AP	100% data match, IDs match 0.0 km apart	Source: NCAR-MIT WBAN= WMO= 72793 NAME= Seattle-Tacoma Intnl

Example 2: **Match**

Source: NCDC6301 WBAN= 24233 WMO= 72793 NAME= Seattle Tacoma AP	No overlap, IDs and names match 3.1 km apart	Source: CDMP-USM WBAN= 24233 WMO= NAME= Seattle-Tacoma Airport

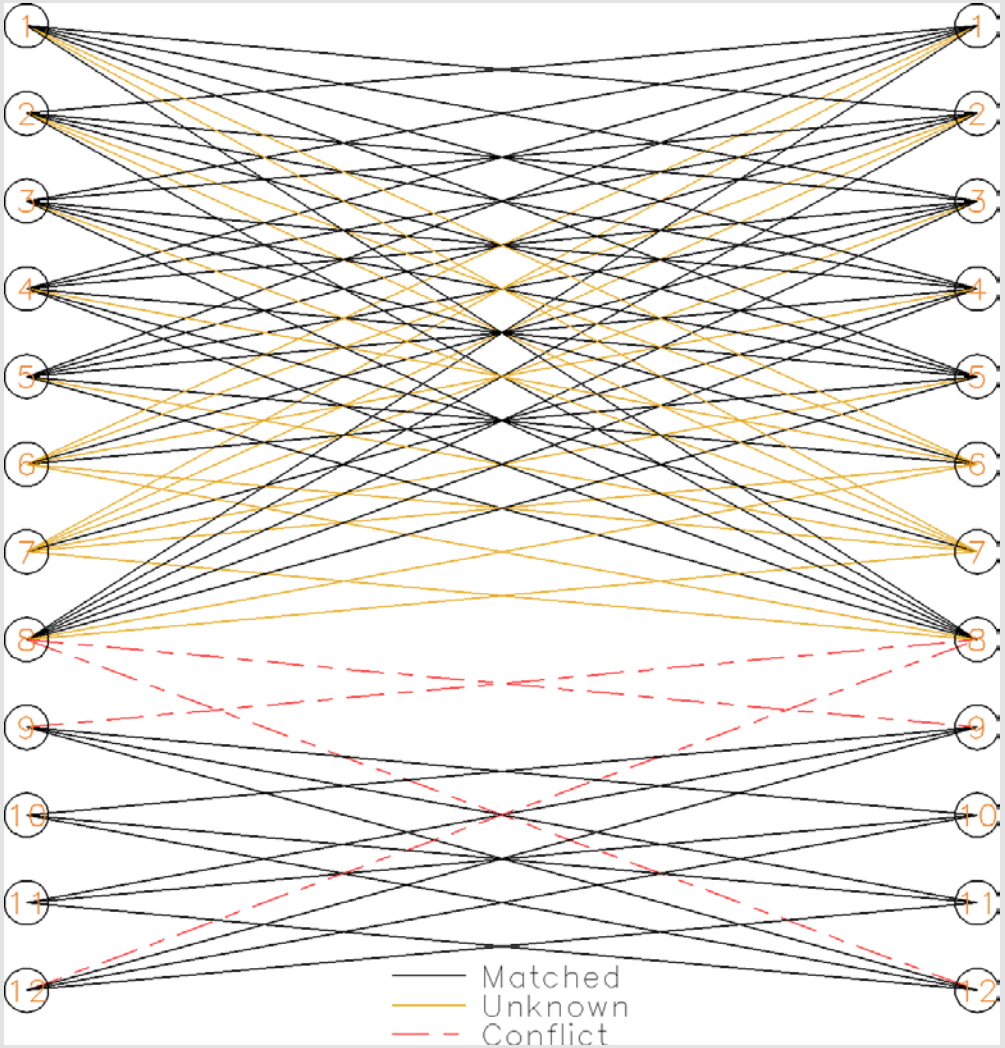
Example 3: **Conflict**

Source: NCAR-MIT WBAN= WMO= 72793 NAME= Seattle-Tacoma Intnl	100% data match 70.1 km apart	Source: NCDC6310 WBAN= WMO= 72792 NAME= OLYMPIA/MUNI (WASH)

Step 2: Identify Groups

- Classify connections between stations as:
  - ✓MATCH,
  - ✓SO-SO MATCH,
  - ✓CONFLICT,
  - ✓UNKNOWN, or
  - ✓SEPARATE.
- Form a group from each set of stations that are connected with matches or conflicts.

	Source	Station name
1.	usaf-ds3	SEATTLE-TACOMA INTL
2.	ncdc6309	SEATTLE/TACOMA INTL
3.	ncdc6310	SEATTLE-TACOMA INTNL
4.	ncdc6301	SEATTLE TACOMA AP
5.	chuan101	SEATTLE 3556
6.	chuan101	SEATTLE 3557
7.	cdmp-usm	SEATTLE-TACOMA AIRPORT
8.	ncar-mit	SEATTLE-TACOMA INTNL
9.	ncdc6301	OLYMPIA MUN I AP
10.	ncdc6326	OLYMPIA/MUNI (WASH)
11.	ncar-mit	OLYMPIA/MUNI (WASH)
12.	ncdc6310	OLYMPIA/MUNI (WASH)



Step 3: Resolve Conflicts

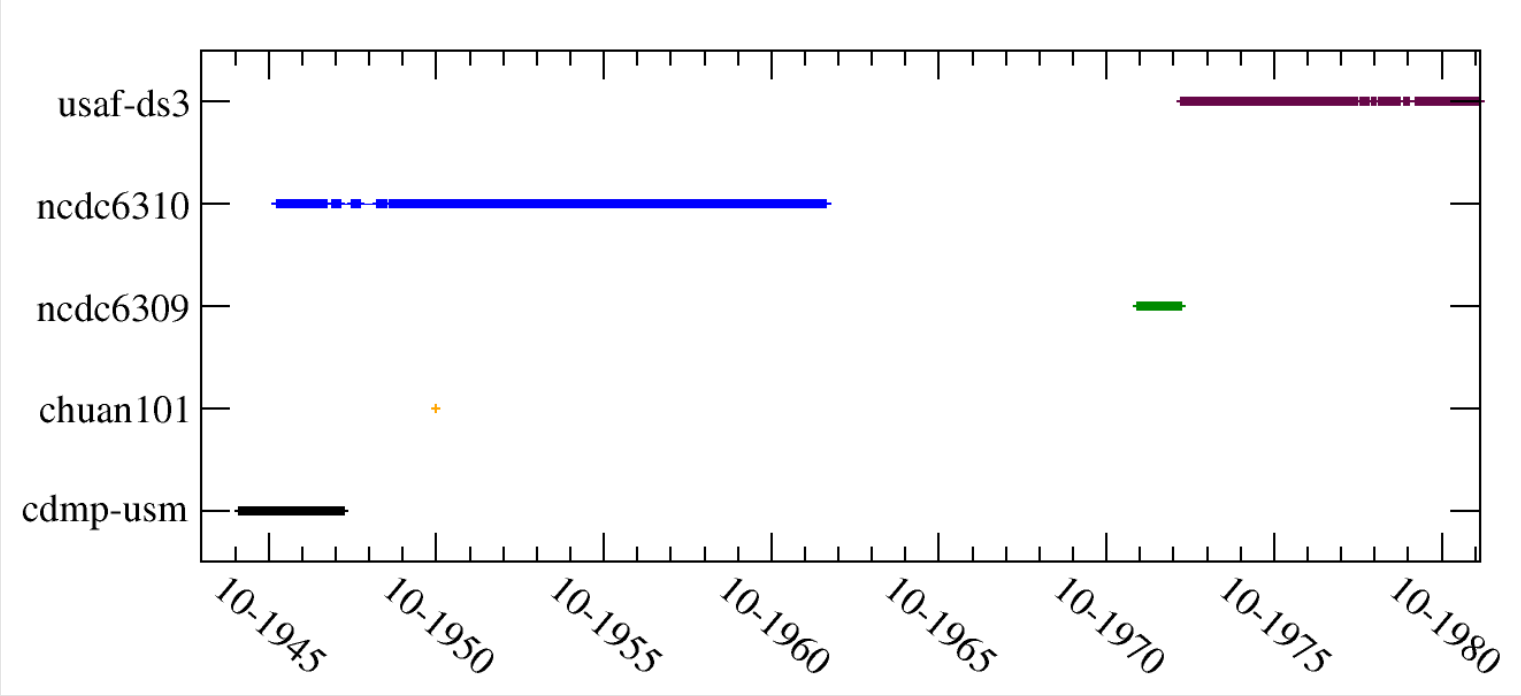
	1	2	3	4	5	6	7	8	9	10	11	12
1		2	2	2	2	0	0	2	-1	-1	-1	-1
2	2		2	2	2	0	0	2	-1	-1	-1	-1
3	2	2		2	2	1	0	2	-1	-1	-1	-1
4	2	2	2		2	0	2	2	-1	-1	-1	-1
5	2	2	2	2		1	0	2	-1	-1	-1	-1
6	0	0	1	0	1		0	0	-1	-1	-1	-1
7	0	0	0	2	0	0		0	-1	-1	-1	-1
8	2	2	2	2	2	0	0		-2	-1	-1	-2
9	-1	-1	-1	-1	-1	-1	-1	-2		2	2	2
10	-1	-1	-1	-1	-1	-1	-1	-1	2		2	2
11	-1	-1	-1	-1	-1	-1	-1	-1	2	2		2
12	-1	-1	-1	-1	-1	-1	-1	-2	2	2	2	

- Organize pairwise comparison results into one matrix per group.
- Eliminate certain source stations from groups with conflicts.
- Split groups into subgroups if needed.

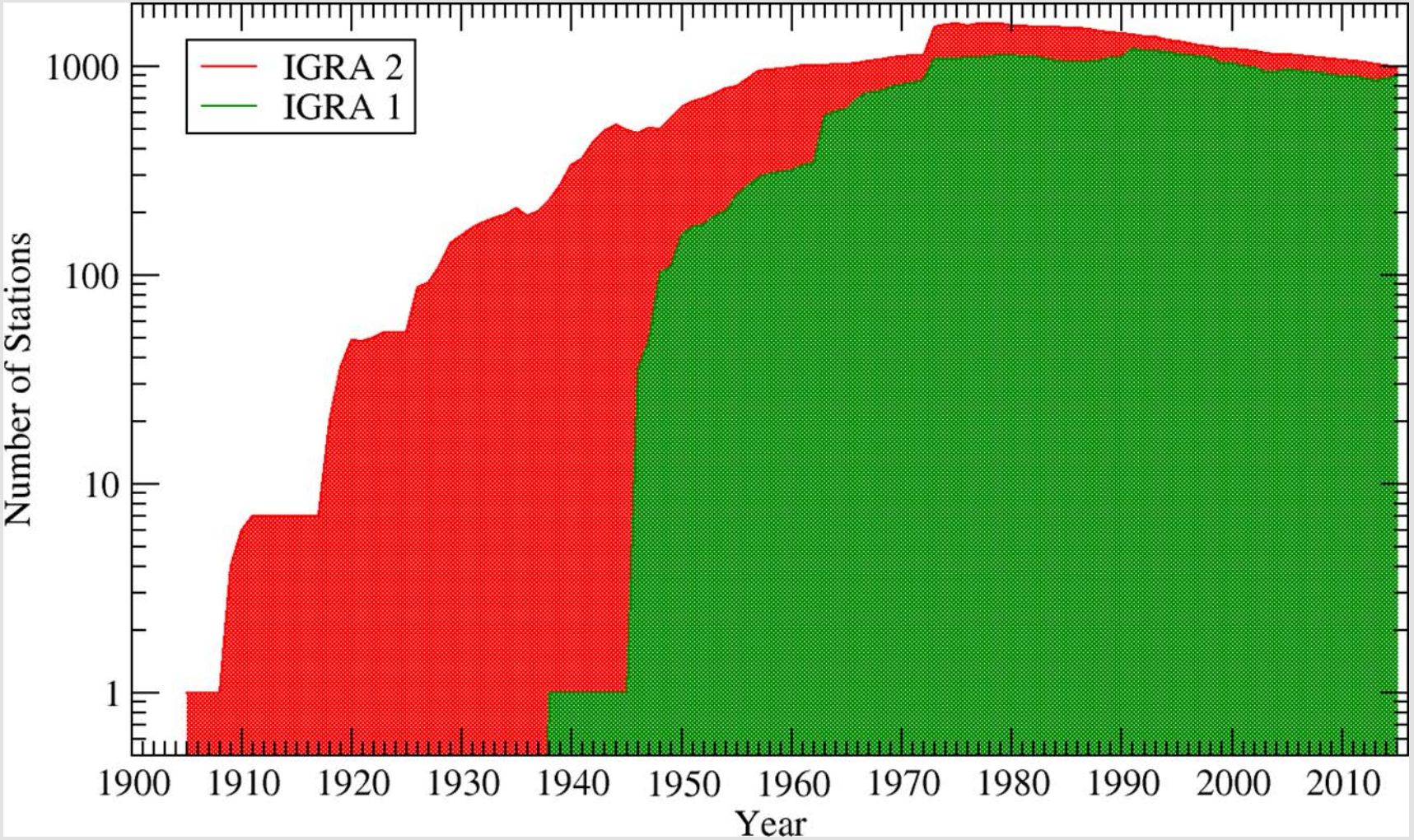
Outcome

- ✓ One multi-source time series per location
- ✓ More data per location than from a single source
- ✓ Clean separation of data for obviously distinct locations

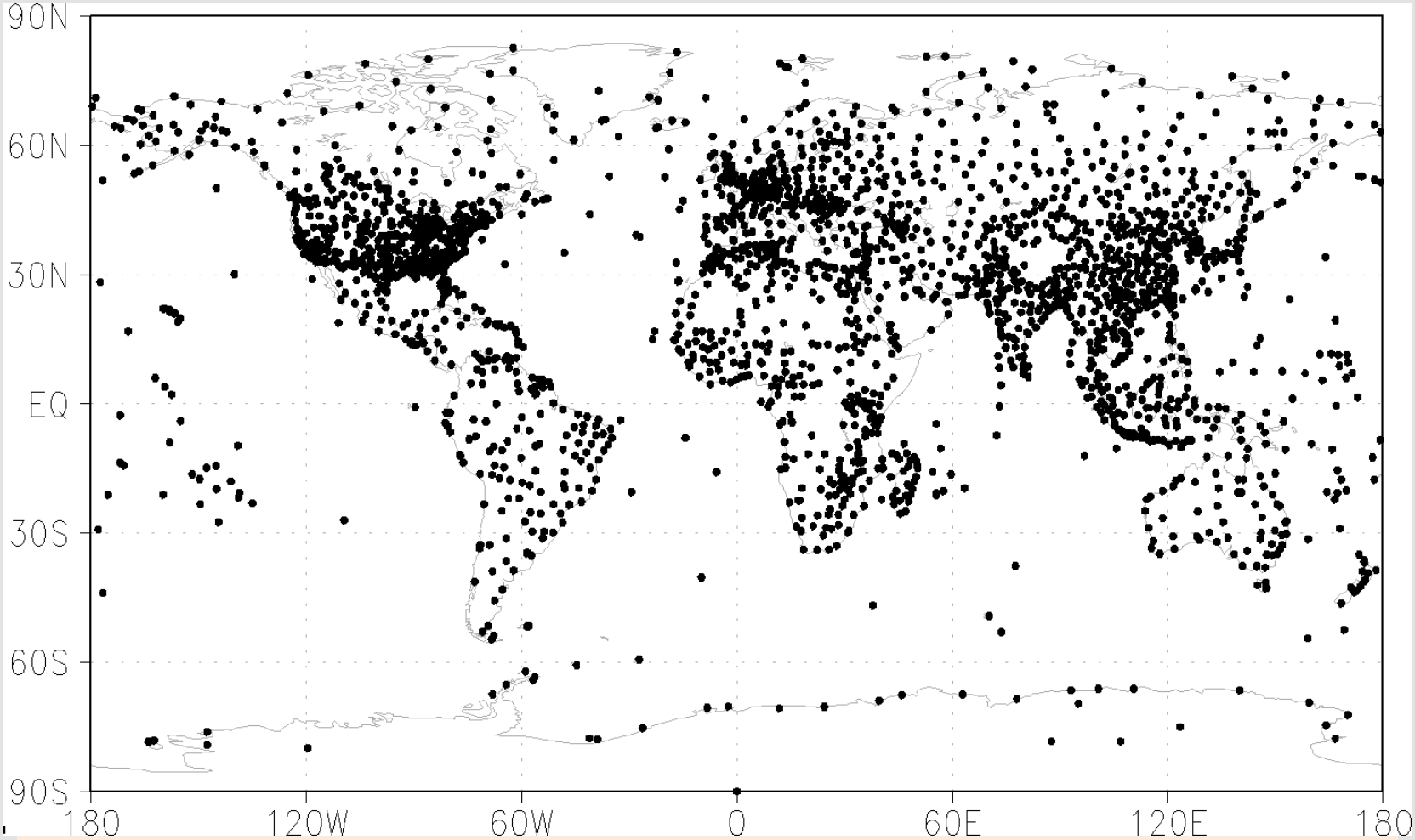
Time series indicating change data sources over time at Seattle Airport



Number of Stations by Year in IGRA 1 and IGRA 2



IGRA 2 Station Map



https://www.ncdc.noaa.gov/data-access/weather-balloon/integrated-global-radiosonde-archive/