Very-High-Resolution Radiosonde Data at NCEI

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Department of Commerce

NOAA
National Oceanic & Atmospheric Administration

NOAA Line Offices

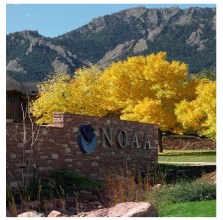
- National Environmental Satellite Data and Information Service
- National Marine Fisheries
- National Ocean Service
- Ocean and Atmospheric Research
- National Weather Service
- Office of Marine and Aviation Operations & NOAA Corps

National Environmental Satellite Data and Information Service (NESDIS) Line Offices

- National Centers for Environmental Information
- Office of Satellite and Product Operations
- Center for Satellite Operations and Research
- Office of Space Commerce
- Joint Polar Satellite System Program Office
- GOES-R Series Program Office
- Office of Projects, Planning and Analysis
- Office of Satellite Ground Services

National Centers for Environmental Information (NCEI)


Asheville, NC
Headquarters

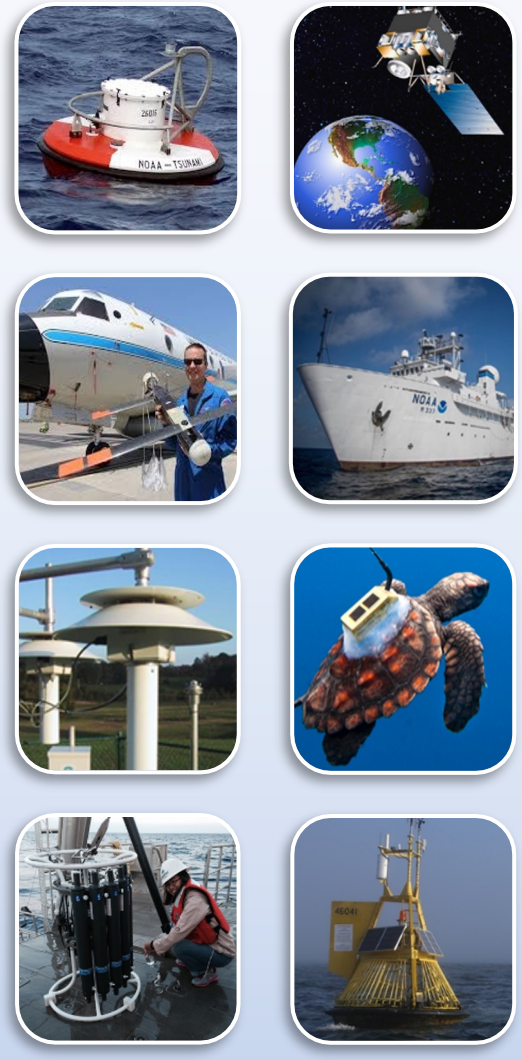

Boulder, CO


Silver Spring, MD


Stennis, MS

NOAA Data: High Impact, Global Reach

NOAA Observing Systems



Scientific Data Stewardship

Research-quality products for decision making

Climate & Weather

- Climate Assessments
- Climate Normals
- Billion $ Disasters
- Drought Monitoring

Oceans & Coasts

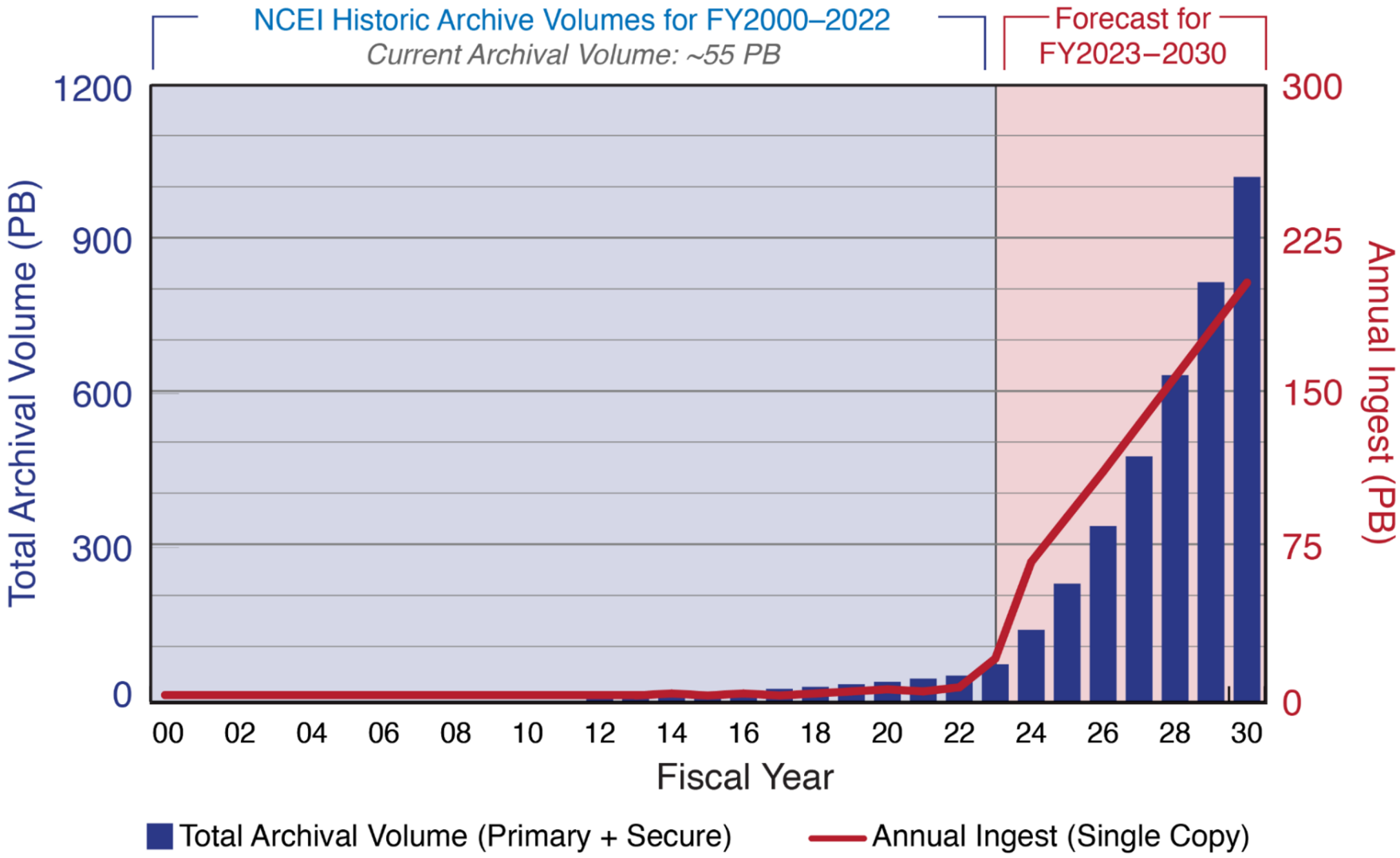
- Tsunami Warning
- Coastal Digital Elevation Models
- Extended Continental Shelf
- World Ocean Database

Geophysics

- Space Weather
- World Magnetic Model

NCEI Archival Volume History and Forecast

Increasing Data Volumes from Station, Model, Radar, UxS, Acoustics, 'Omics, and Satellite Sources



Radiosonde Data Archived at NCEI

- NWS observations in ASCII and BUFR
- GTS data from the NWS Telecommunications Gateway (NWSTG) in traditional alphanumeric code (TAC) and BUFR
- GTS data from ECMWF in BUFR
- Several dozen historical, static datasets acquired over time

Radiosonde Data Services at NCEI

- Access to raw data
- Feedback to NWS and WMO on observation quality and completeness
- Integrated Global Radiosonde Archive (IGRA)
- IGRA-based data products to improve the utility of the data
- Responses to customer requests for data and information

Transition to BUFR

History:

- WMO approved BUFR in 1998 and planned to fully replace TAC in 2014.
- Format specifications continue to be refined.
- Stations transmitting over the GTS have been migrating gradually from TAC to BUFR beginning with some ships in late 2014.
- A few countries now transmit data only in BUFR.
- Many others transmit both formats, some without taking advantage of the benefits of BUFR.

Benefits of BUFR Compared to TAC:

- Ten to 50 times higher vertical resolution: several thousand compared to about 100 data levels
- More metadata: e.g., elapsed time, coordinates at each level

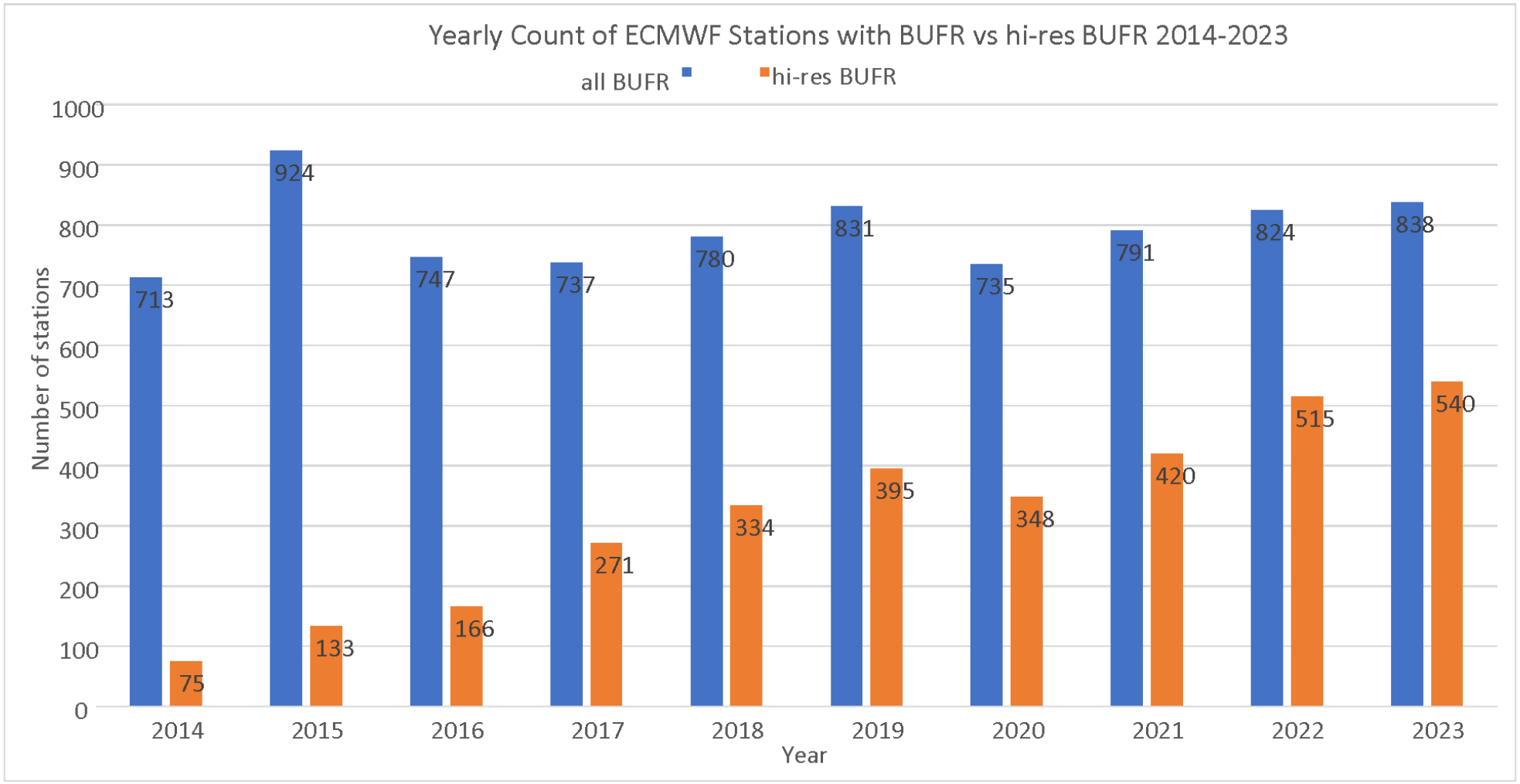
NCEI's Radiosonde Data in BUFR

Source	Ingest Frequency	Spatial Coverage	Temporal Coverage
ECMWF	Monthly	Global	2014-present
NWSTG	Hourly	Global	2017-present
NWS	Hourly	US	2005-present

Completeness of NWSTG and ECMWF BUFR Datasets Jan-Jul 2023

Number of Stations	ECMWF BUFR	NWSTG BUFR	Notes
Any data	838	542	
Unique to One Source	300	4	
No High-resolution profiles	298 (36%)	285 (53%)	High-resolution means >= 500 levels
Only High-resolution profiles	225 (27%)	117 (22%)	High-resolution means >= 500 levels
Mostly High-resolution profiles	221 (26%)	78 (14%)	>=90% but < 100% of soundings are High-resolution
Unique to One Source and Mostly or All High-resolution	151	0	Mostly or All High-Resolution" means >=90% of profiles have >= 500 levels
Common to Both Sources and Mostly or All High-Resolution	295	193	Out of 538 total in common

Annual Number of Stations in ECMWF BUFR Data



Distribution of Land-Based TAC and BUFR Reports Jan-July 2023

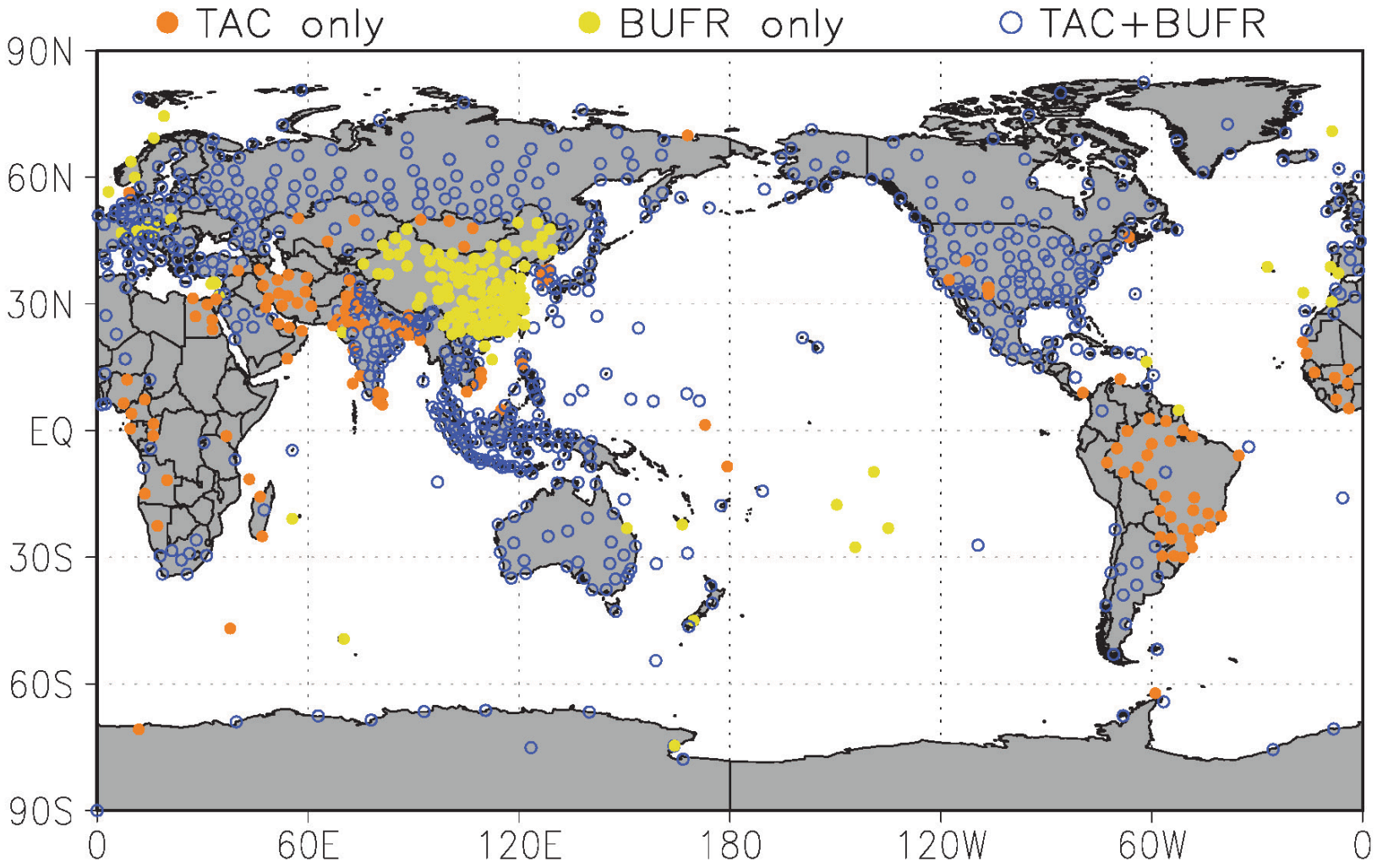
During Jan-July 2023:

937 fixed location radiosonde stations found in TAC and BUFR

148 TAC only stations (filled orange circle)

132 BUFR only stations (closed yellow circle)

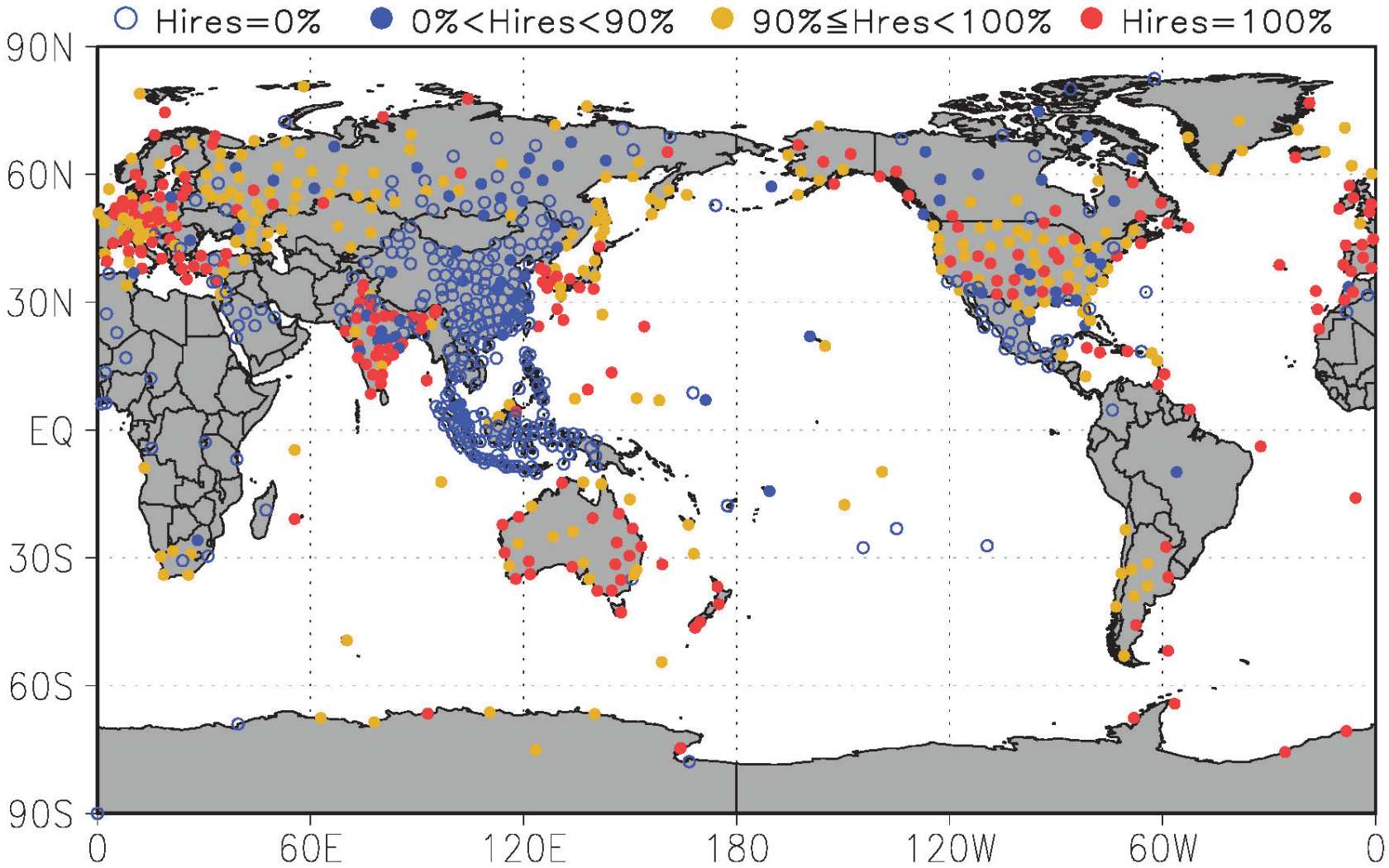
657 BUFR+TAC mixed stations (open blue circle)



Distribution of Consistently High-Resolution Profiles Based on ECMWF BUFR Data in Jan-Jul 2023

ECMWF dataset during Jan-July 2023:

- 789 fixed stations sending BUFR data
- 294 with 0% Hi-res (blue open circle)
- 78 with Hi-res >0% and <90% (blue closed circle)
- 215 with Hi-res >=90% and < 100% (yellow closed circle)
- 202 with 100% Hi-res (red closed circle)



IGRA: Description

- Over 50 million radiosonde and pilot balloon observations
- Method: Drawn from 42 data sources, merged, quality-controlled
- Period of Record: 1905-present, updated daily
- Coverage: Global land, some ships; >2800 stations
- Vertical Resolution: Standard, significant, and some other levels
- Primary Applications: Validation, model/reanalysis input, process studies
- More Information on the IGRA website

https://www.ncei.noaa.gov/products/weather-balloon/integrated-global-radiosonde-archive

IGRA: Version History

- v1.0 (2004): First version as successor to NCDC's CARDS dataset.
- V2.0 (2018): 30% more data than v1; improved data integration and QC.
- v2.2 (2023): Introduced real-time BUFR data sources

IGRA: Use of BUFR Data

Current Approach:

- Recreated v2.2 of IGRA using a BUFR-augmented GTS record instead of the TAC-only GTS record.
- Use this augmentation approach in daily updates.

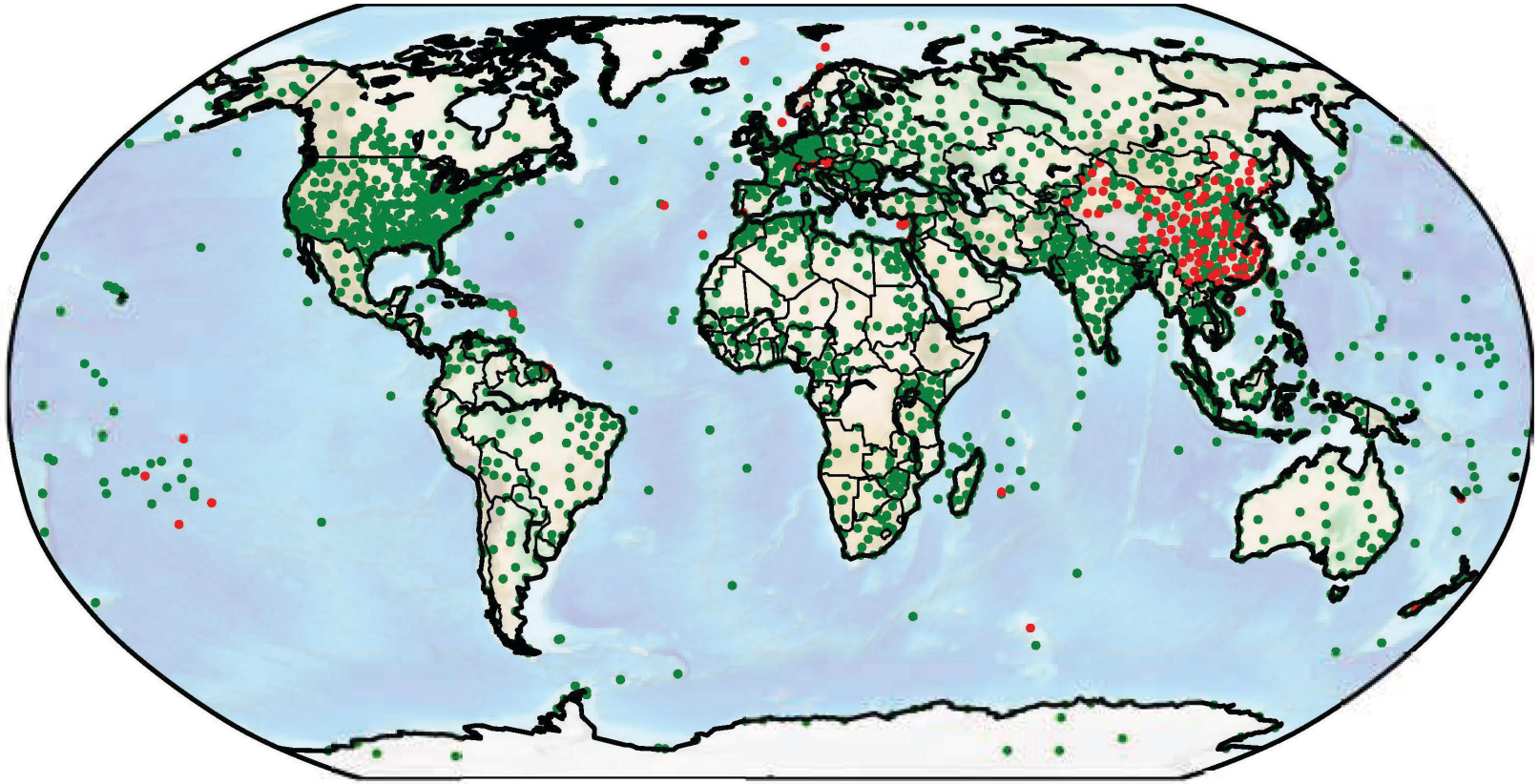
Method:

- Append TAC GTS records with soundings from the BUFR streams when BUFR sources have newer data.
- Use raw BUFR data from NWSTG (2017-present, received daily) and ECMWF (2014-present, received monthly).
- Use EcCodes from ECMWF as the decoder.
- Use NWS conventions to down-sample high-resolution profiles to the historically typical standard and significant pressure levels.

IGRA: Number of stations fully migrated to BUFR and recovered in v2.2

Total number of stations in v2.2: **2879**

Number of stations filled with BUFR in v2.2 (2023): **125 (red filled circle)**



BUFR-Related Plans

- Process Improvements: Migration to the cloud
- IGRA-HR: Create integrated dataset of high-resolution profiles.
- Full Integration into IGRA-LR: Rebuild IGRA with ECMWF, NWSTG, and non-GTS NWS BUFR sources.
- Access Improvements: Utilize cloud services.

Learn More

NCEI Website: **www.ncei.noaa.gov**

IGRA Website:
www.ncei.noaa.gov/products/weather-balloon/integrated-global-radiosonde-archive

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