

# Data availability

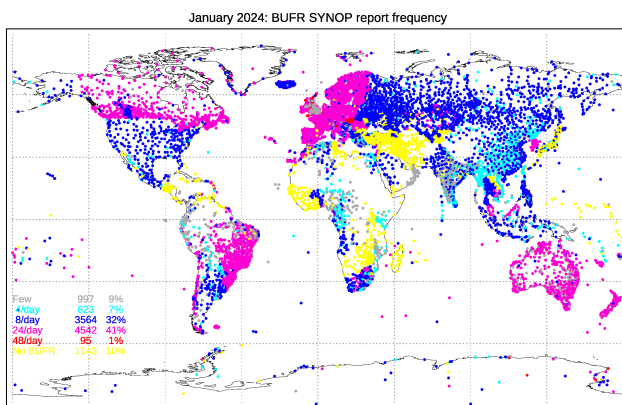
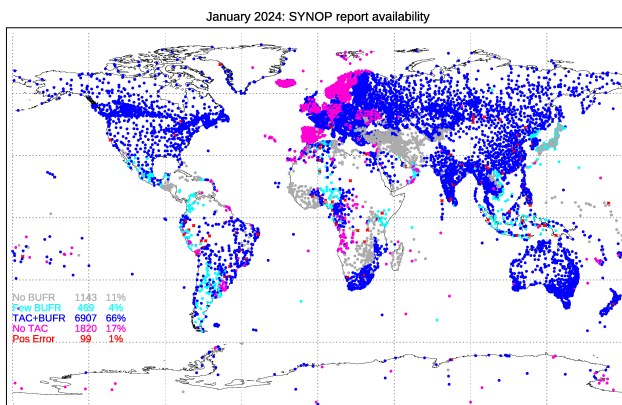
Below are plots of SYNOP/BUOY/radiosonde BUFR coverage for January 2024 - reports as decoded at ECMWF, some reports not in standard BUFR are not decoded. Daily coverage of BUFR reports (updated automatically) is available from the [Monitoring Maps](#). See also timeseries and maps from the NWP system: [Monitoring of Conventional observations](#) and WQMS: <https://wdqms.wmo.int>.

*Please can data producers ensure that there is a reasonable overlap of TAC and BUFR data on the GTS (at least two months, EUMETNET and GCOS recommend six months), any attempt to rush the change will result in more errors, extra work for NWP centres and possibly worse forecasts. Most countries give notice via METNOs or the [WMO Operational Newsletter](#). Note also that reformatted TEMP reports still as separate parts are **not** regulation BUFR and cause problems for NWP centres (some more than others).*

## Surface (SYNOP) coverage

About 90% of stations now report in BUFR (NB. the SYNOP maps below do not include stations reporting with WIGOS station identifiers - unless these map to a traditional 5 digit identifier). BUFR coverage for Europe is essentially complete apart from three NMSs (Bulgaria, Moldova and North Macedonia). For some countries stations/reports designated as "additional data" only are received in TAC but not in BUFR. Light blue markers indicate that fewer BUFR reports are received than SYNOP reports - in most cases the BUFR is six-hourly but the SYNOPs are three-hourly. (Unlike TEMP data, below, alphanumeric SYNOP reports reformatted into BUFR are generally acceptable.) The main event in late 2019 was the cessation of alphanumeric SYNOP reports from China on 3 December 2019 (not reflected in the plot as ECMWF receives Chinese SYNOPs reformatted to TAC in Washington! We intend to stop processing these reformatted reports - also from other areas - but some care is needed). As can be seen from the top map various stations are only available in BUFR. ECMWF is gradually assimilating a larger proportion of BUFR surface reports. There has been only minor progress in the migration over the last year. The lower map shows the frequency of reporting in BUFR - WIGOS now recommends global exchange of hourly reports (Australia and Canada improved provision of hourly reports during 2023. In late January ECMWF started retrieving hourly reports from the USA via a WIS2 server - not shown below).

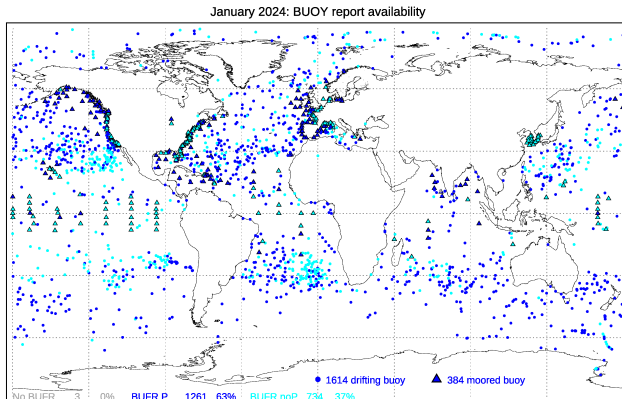
(Grey: TAC reports but no BUFR, Purple: BUFR reports but no TAC, Red \*: position error. Light/dark blue indicates that there are less/more than 60% of the reports available in BUFR.)



## BUOY coverage

On 6 June 2016 ECMWF started passively monitoring BUFR BUOY data in its operational system, assimilation of pressure data started in July 2016, many alphanumeric (FM18) reports ceased on 2 November 2016. For drifting buoys the BUFR feed is complete now helped by the fact that fewer data producers are involved (there are still 12 Indian moored buoys reporting only in FM18 as at mid-2021). In mid-2016 there were 51 pressure-reporting buoys reporting in BUFR but not in FM18, some of these were moored buoys including 7 PIRATA or RAMA buoys which also report subsurface temperature and salinity. Template 315008 is used for moored buoys and 315009 for drifting buoys. More details of the marine data can be found in the [Marine and ocean observations](#) pages (one issue is the move from 5-digit to 7-digit identifiers, this means that some newer buoys cannot really be coded using FM18). In December 2018 NOAA moored buoys started reporting in the correct 315008 template (they are mainly close to the US coast, but a few are further offshore). Moored buoys from Canada and the UK still report in SHIP format and are not shown in the plot below. *Note that about half the buoys, shown in light blue, do not report pressure* (especially those in the tropical Pacific and the Mediterranean, they are deployed to measure SST and currents). In the second quarter of 2019 we started receiving moored buoy data for the North American Great Lakes, but there is a complication in that they report both Pmsl and Pstn (marine TAC reports only contained Pmsl), but don't give the height of Pstn.

(Grey: TAC reports but no BUFR, Dark blue - BUFR reports including pressure, Light blue - BUFR reports without pressure. Circles/triangles - drifting /moored buoys.)



## Ship data

In 2017/18 a number of European ships started using new EUCAWS hardware and software. They report (with identifier EUC\*) in BUFR only. French TAC ship reports ceased in mid-January 2020. Some NMSs (most recently DWD - Germany) have stopped sending alphanumeric reports.

## Argo data

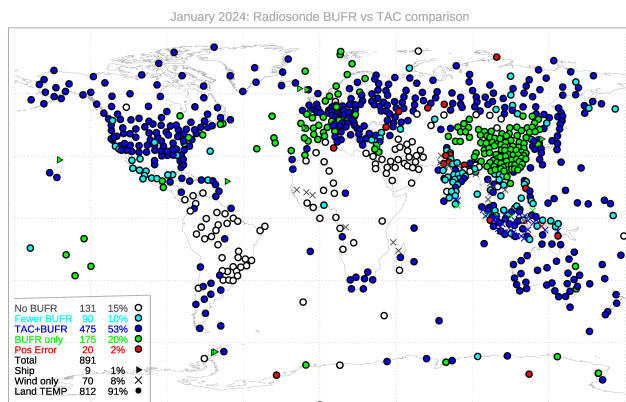
Most Argo reports are available in BUFR, with higher vertical resolution. **Argo buoys stopped reporting in the alphanumeric TESAC code on 1 July 2018.**

## Radiosonde coverage

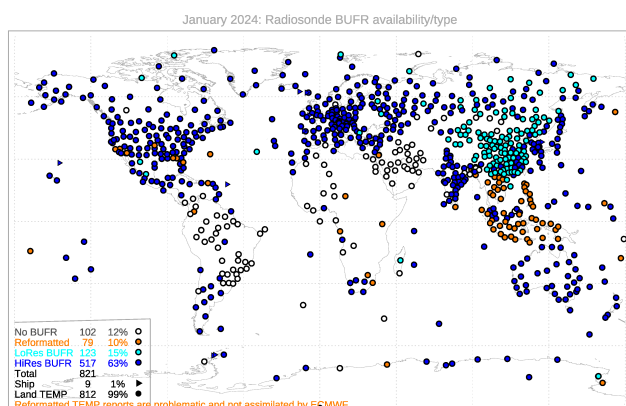
About 88% of stations report some BUFR, about 78% report native BUFR with roughly 10% reporting reformatted TEMP (see below). (In 2023 a problem was noted with BUFR reports from about 12 Indian stations and 8 Malaysian stations: the winds are in the wrong units! In BUFR winds should always be in m/s.) The proportion of native high-resolution reports is growing in fits and starts, recently in the USA (2017), Japan (July 2018), Chile+Argentina (2018), Brazil (2019 - incomplete) and some Russian stations (late 2018/2019) - this pushed the % with native reports over 50% in the second quarter of 2019. In October 2019 most Chinese stations started providing low-resolution native BUFR reports and most Chinese TAC radiosonde reports stopped in mid-January 2020. In 2021 the resolution at Chinese stations improved to about 200 levels at a few stations, then all Chinese stations at the start of June. A few Indian stations started providing high-resolution reports in 2020, but this has been erratic. In 2022 there have been a few more high-resolution reports from the USA and Caribbean and in Q2 2023 most Canadian stations started reporting high-resolution data, but Mexico regressed to TAC because of a Cyber attack. A small proportion of BUFR reports are incomplete (eg data above 100 hPa missing). Reports from the ASAP ships are now only available in BUFR format (most ASAPs changed identifier in late 2017). As of late 2019 stations in Finland, Norway, Sweden and France no longer provide alphanumeric reports, plus scattered stations elsewhere. About 10 European countries are now sending radiosonde descent data in BUFR (not shown). There was a dearth of radiosonde reports from West Africa in late-April/May 2019 but this recovered somewhat by June 2019.

In 2018 there were some high-resolution dropsonde reports on the GTS and there were more in 2019 and ECMWF started assimilating them on 4 September 2019 (NB dropsonde reports are intermittent). ECMWF is monitoring descent data from various radiosonde stations, mainly in Europe and started assimilating German descent profiles in July 2020 and RS41 descent data from ships in 2021.

(Grey: TAC reports but no BUFR, Purple: BUFR reports but no TAC, Red \*: position error. Blue: both BUFR and TAC, light blue indicates fewer ascents in BUFR. Triangle - ship report, X - wind-only report.)



The plot below distinguishes native BUFR (stations reporting valid radiosonde drift positions): high/low resolution (dark/light blue, using 300 level threshold) from reformatted TEMP (orange). There are now high resolution reports from all continents.



Almost all reformatted TEMP reports are sent as separate parts (A/B/C/D), this is contrary to the BUFR coding rules (there should be a single report containing data for the whole ascent) and reformatted TEMP reports are regarded as unusable by ECMWF and most other NWP centres. BUFR reports generated directly from the radiosonde raw data are much better.

See note on [Radiosonde BUFR templates](#)

BUFR radiosonde data are archived at NCEI

- 1) Global data from ECMWF:  
<https://www.ncei.noaa.gov/data/ecmwf-global-upper-air-bufr/>
- 2) Global data from NWS gateway:  
<https://www.ncei.noaa.gov/data/nws-global-upper-air-bufr/>
- 3) US data from NWS (since 2005, received directly from US observation sites near realtime)  
<https://www.ncei.noaa.gov/data/us-radiosonde-bufr/>

The files are in tar-gzip formats, and each file contains one-month of data received from the corresponding sources.

Users will need a BUFR decoder

[https://confluence.ecmwf.int/display/ECC/bufr\\_read\\_tempf](https://confluence.ecmwf.int/display/ECC/bufr_read_tempf) (EcCodes from ECMWF - example for radiosondes) or

<https://github.com/NOAA-EMC/NCEPLIBS-bufr/tree/master> (NCEP)