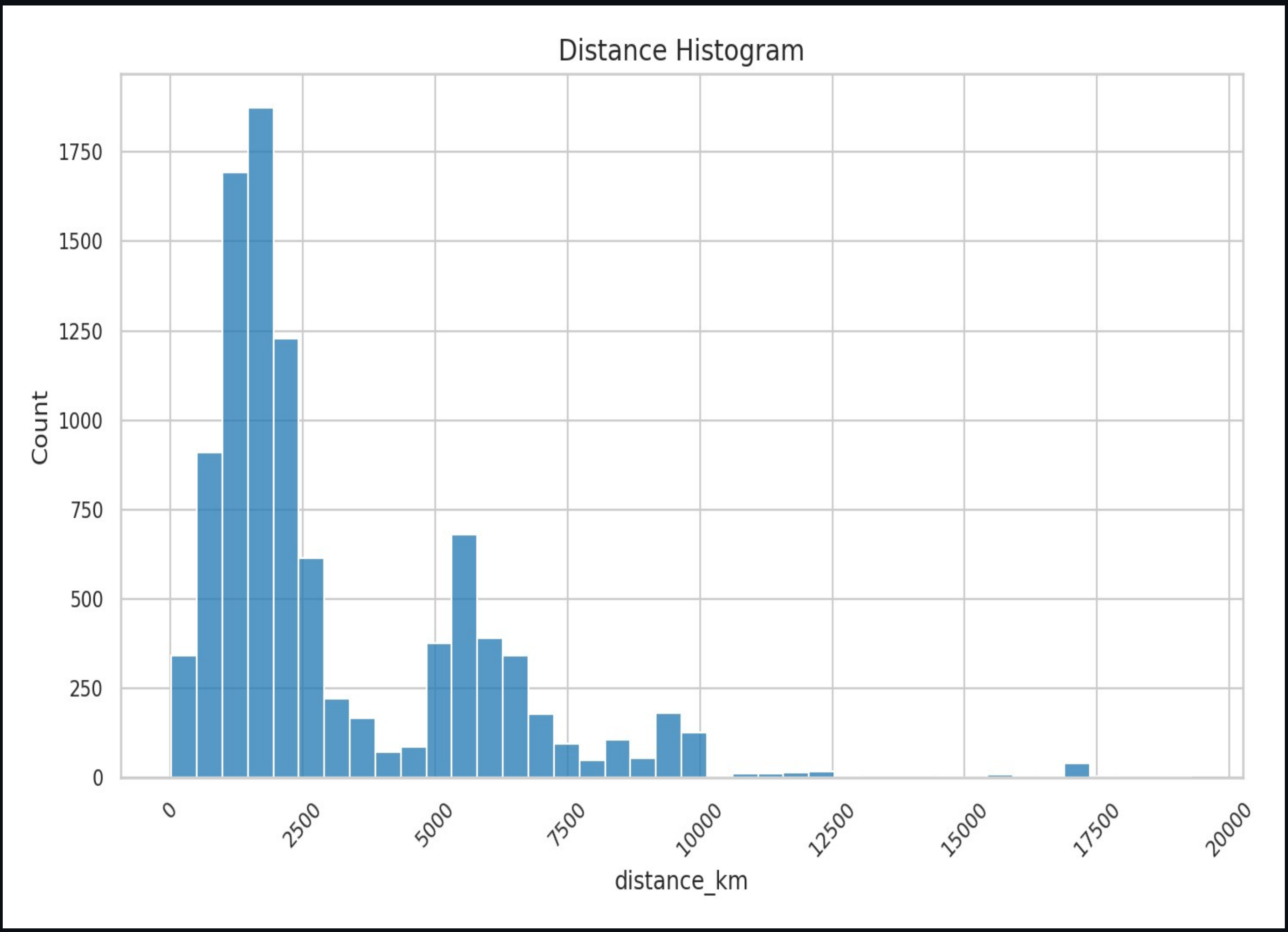
M7SQI QSO Analysis Report

All analysis presented herein is based on amateur radio activity from two QTHs: IO92iq (midlands-based) and IO70pq (North Cornwall). Unless otherwise stated, data from both locations is combined to reflect overall station performance, although the majority is taken from the latter.

Updated 29/07/2026

Distance Histogram

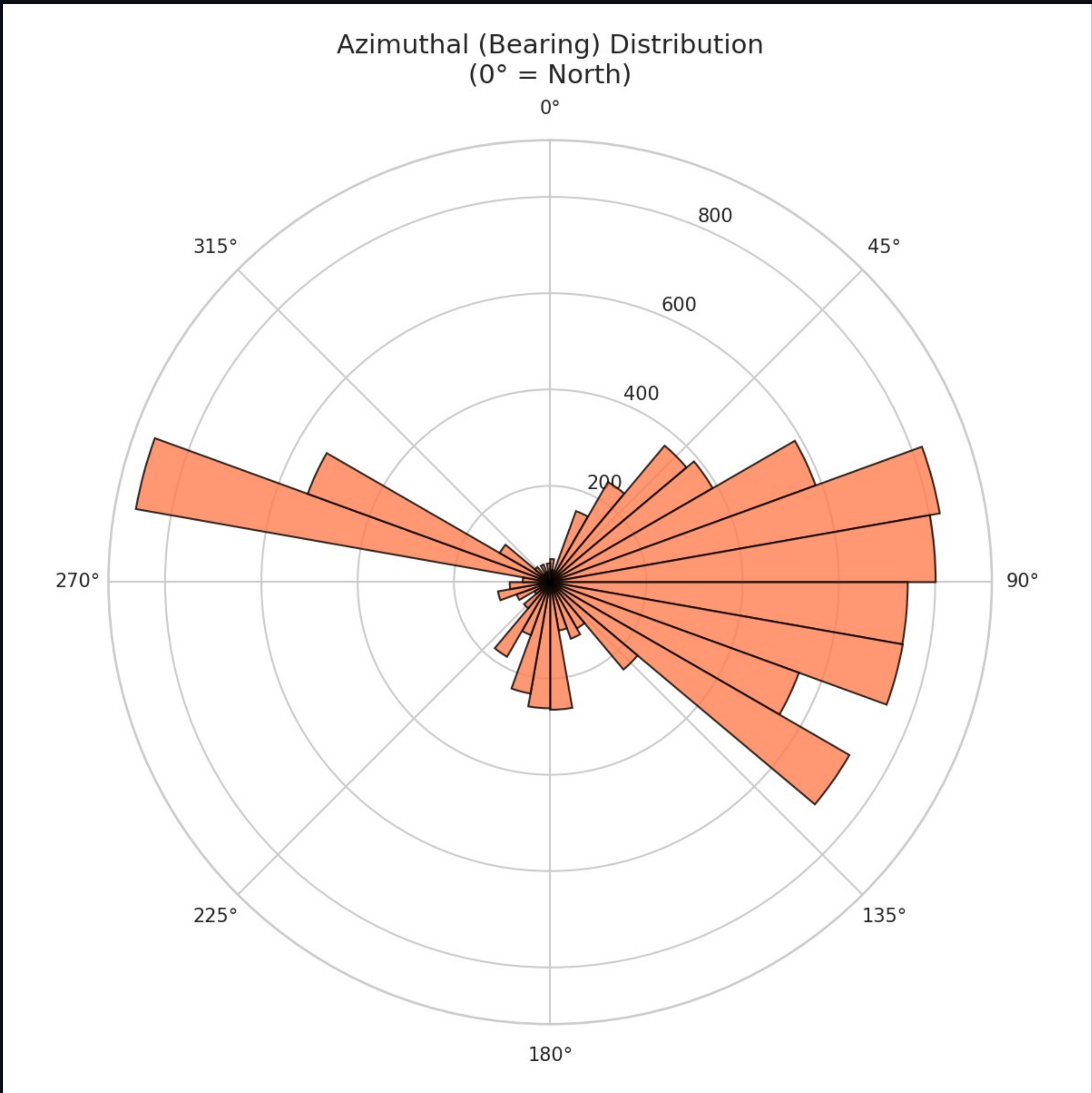
This histogram reveals the distribution of contact distances achieved from the QTH in IO92iq and IO70pq. The shape of the distribution reflects both propagation conditions and antenna characteristics. A central peak around 500 - 1,000 km suggests typical single-hop propagation (Sporadic-E or F-layer), while secondary peaks at greater distances may indicate multi-hop DX, grey-line enhancement, or transequatorial paths. The tapering tails highlight occasional long-haul or anomalous contacts, especially on higher bands like 10 m during active solar periods.



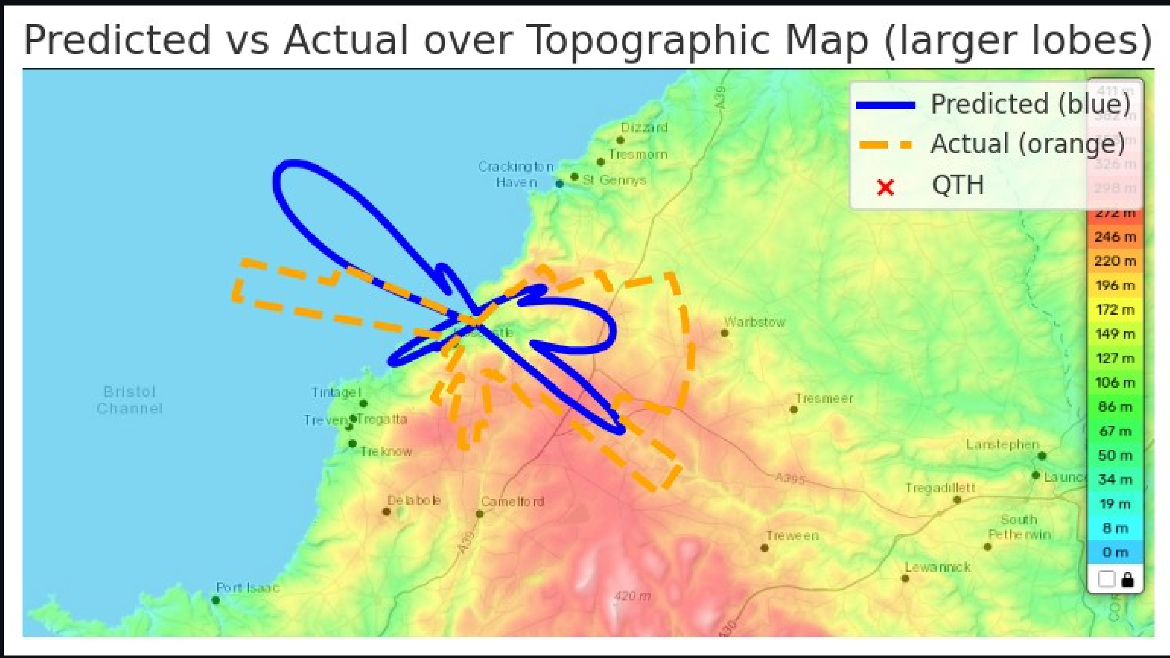
Distribution of QSO distances.

Azimuthal (Bearing) Distribution

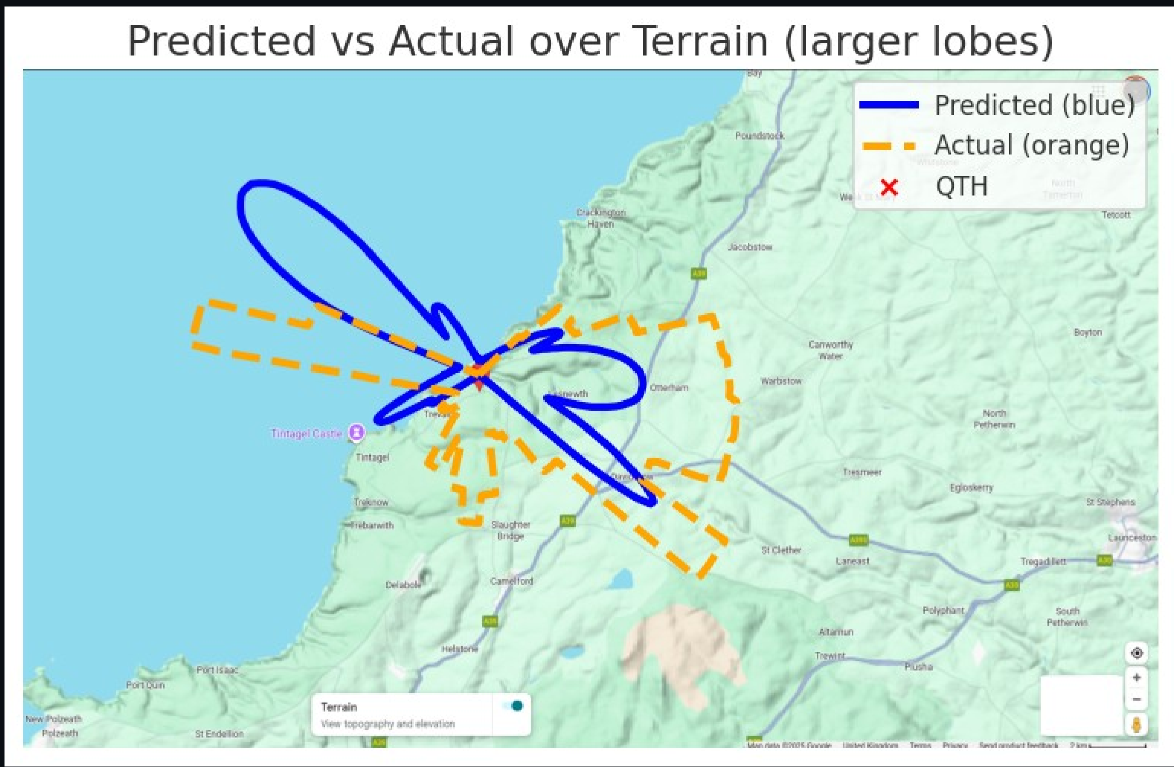
This polar histogram shows the azimuth (bearing) to worked stations, with 0° set to true North. It provides insight into directional antenna patterns, terrain obstructions, and common propagation corridors. A uniform circular spread implies omnidirectional coverage, while clustering suggests path bias - either due to beam headings or favoured skip directions. Peaks toward NE and SW typically represent European and North American QSOs, respectively.



Azimuthal distribution of QSOs (0°= true North).



Predicted vs. Actual Radiation Pattern over Topographic Map



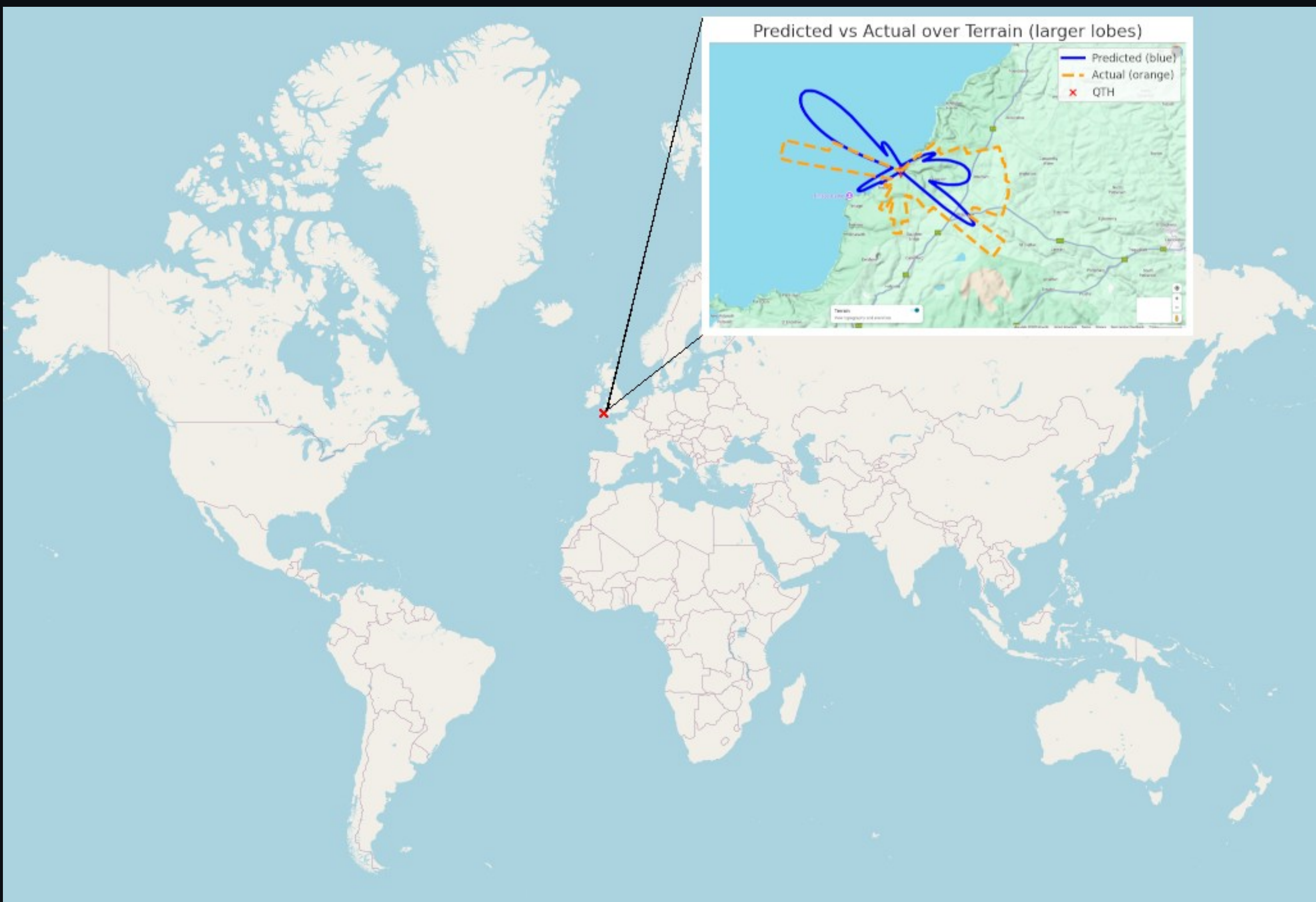
Predicted vs. Actual Radiation Pattern over Terrain Map

Why the predicted lobes don’t match the actual bearings (at this QTH)

TL;DR: the model assumes flat, uniform ground and a tidy radiator; reality gives cliffs, moor, seawater, metalwork, and an ionosphere that didn't read the NEC manual.

- Terrain tilts the pattern. Within ~5 - 10 km inland the land rises 200 - 300 m, while the coastal sector drops to sea level. Inland ridges diffract/absorb low-angle energy; the coastal sector favours lower take-off angles (TOA). Net effect: lobes rotate and stretch seaward, while inland lobes lift or shrink.
- Ground constants vary by azimuth. Over seawater (σ ≈ 5 S/m) the shallow-angle reflection is strong and in-phase, boosting gain; over granite/soil (σ ≈ 1 - 5 mS/m) it is weaker and lossier. Free-space or "average ground" patterns therefore overestimate inland and underestimate seaward directions.

- Low physical height, strong ground coupling. With the radiator ~2 - 3 m agl at a site ~90 m amsl, the system sits at ~0.1 - 0.3 λ on 15 - 10 m. Small changes in local slope, sag, or surroundings can shift vertical lobes/nulls by several degrees; the coastal slope plus seawater effectively lowers TOA seaward.
- Near-field coupling & common-mode. Gutters, mast, wiring, feedline, and counterpoise can re-radiate if choking is insufficient, so the effective radiator becomes "antenna + structure," reshaping azimuthal balance.
- Population/selection bias. "Actual" often aggregates counts of QSOs/spots. Dense European coverage (NE/E) and sparse Atlantic/Arctic coverage bias roses toward NE/E even when RF gain is comparable. Using WSPR median SNR by bearing may reduce this bias (in progress).
- Propagation anisotropy. Sporadic-E patches, F-layer tilts, greyline bending, and skewed paths (10 - 30° off great-circle) shift observed bearings. Example: from IO70pq the great-circle initial bearing to central Japan is ~028° true (NNE over Norway), but skew paths can nudge bearings further toward NE.



Observed NW peak ≈300–305° vs model ≈310–315° (−10–12°)

Field note (IO70pq):

the empirical NW peak sits around 300–305° while the model's NW lobe centres near 310–315°—an ≈10–12° anticlockwise skew (toward W). Likely contributors:

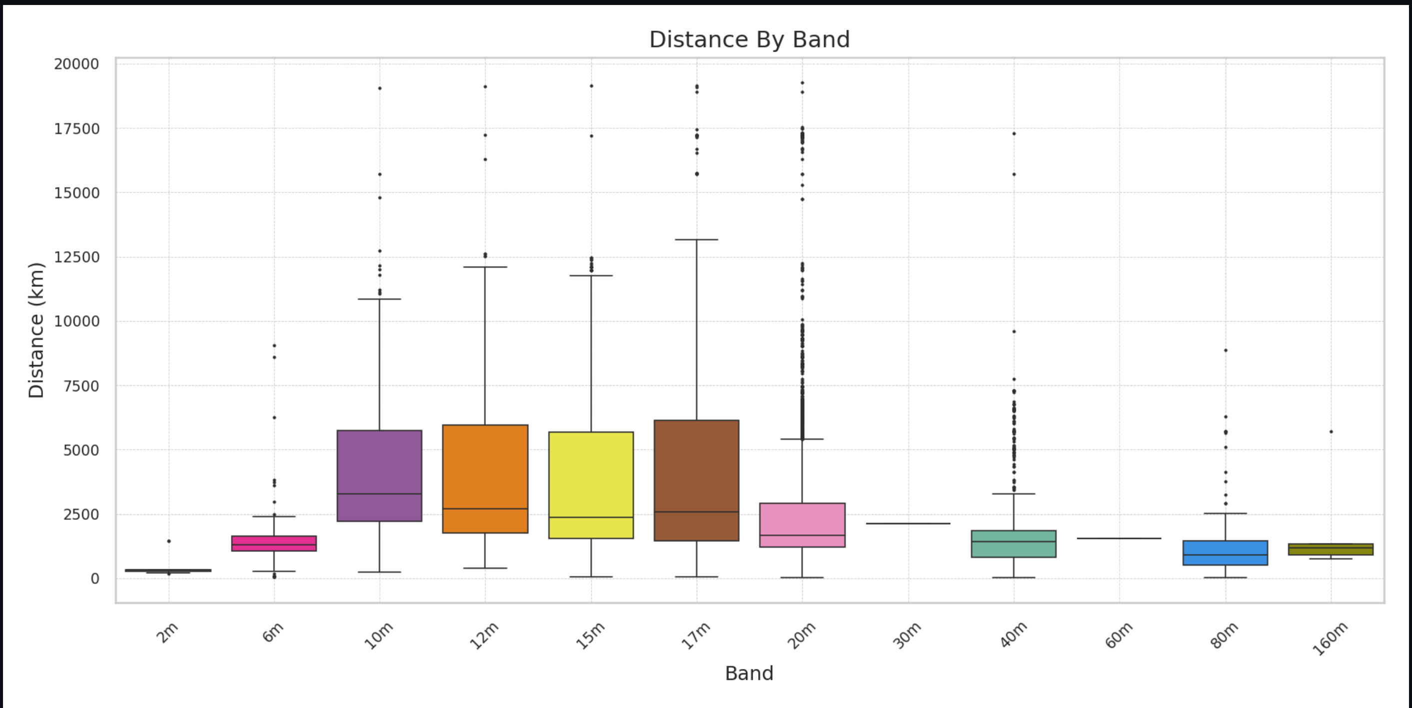
(i) **seaward conductivity** giving low-TOA gain westward,

(ii) gentle **downslope** to the Atlantic (Δh ≈ −5 m over 0.5–1 km → ~0.3–0.6° lower effective TOA), and

(iii) mild **near-field asymmetry**. Note that straight lines on Web Mercator are **rhumb lines**; comparisons to coverage should use **great-circle initial bearings**.
Real data.

Distance by Band

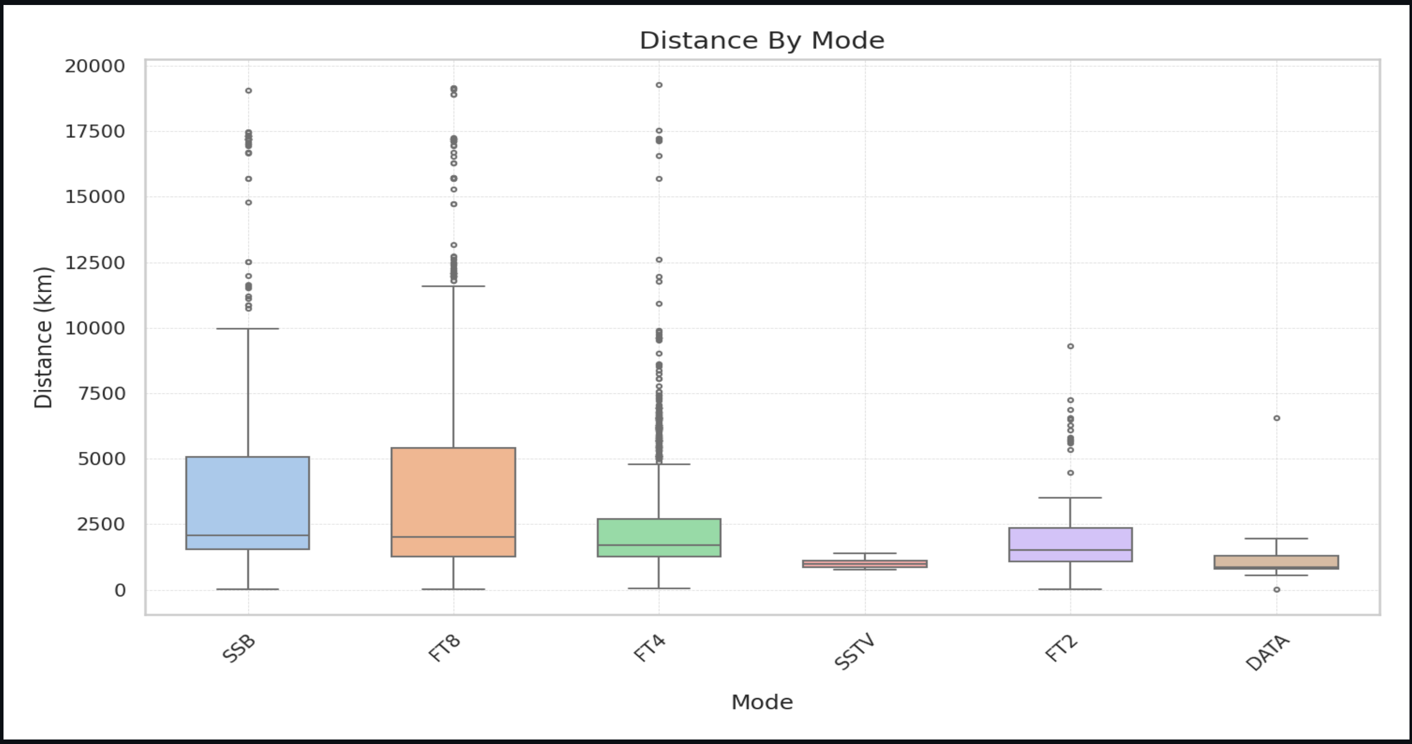
This box plot summarises the distance distributions per band. Lower bands (e.g., 40 m) tend toward shorter regional contacts, with limited skip distances and more groundwave influence. Bands like 20 m and 15 m offer broader reach, often supporting intercontinental paths. Notably, 10 m shows high variability - capable of both local and transcontinental contacts depending on solar activity. Outliers on all bands reveal rare openings or high-power DX chasers.



Distance by band.

Distance by Mode

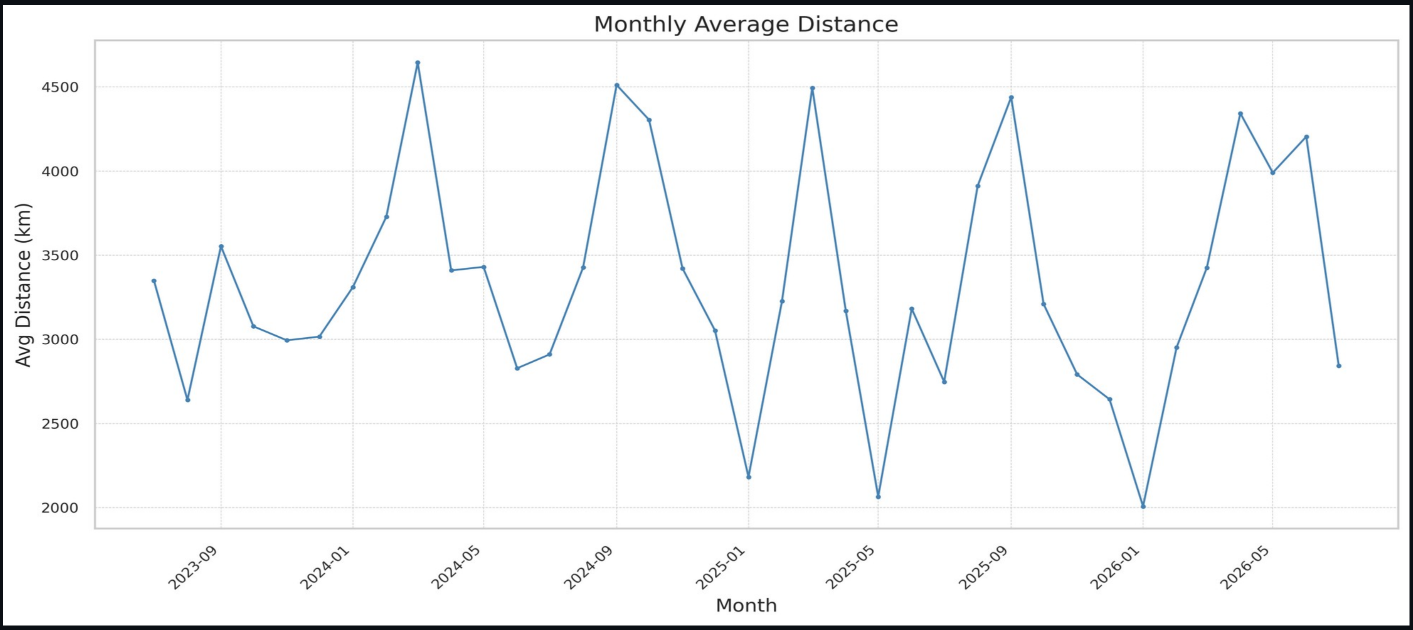
Digital modes, especially FT8, dominate the long-distance range thanks to their low signal-to-noise efficiency. CW remains a robust mode for DX, while SSB results vary more with conditions and QRM levels. This plot highlights operational strategy -whether the operator prioritises weak-signal work, contesting, or casual phone operation. The broad spread of FT8 shows both local and DX capability under a wide range of band conditions.



Distance by mode.

Average Distance by Month

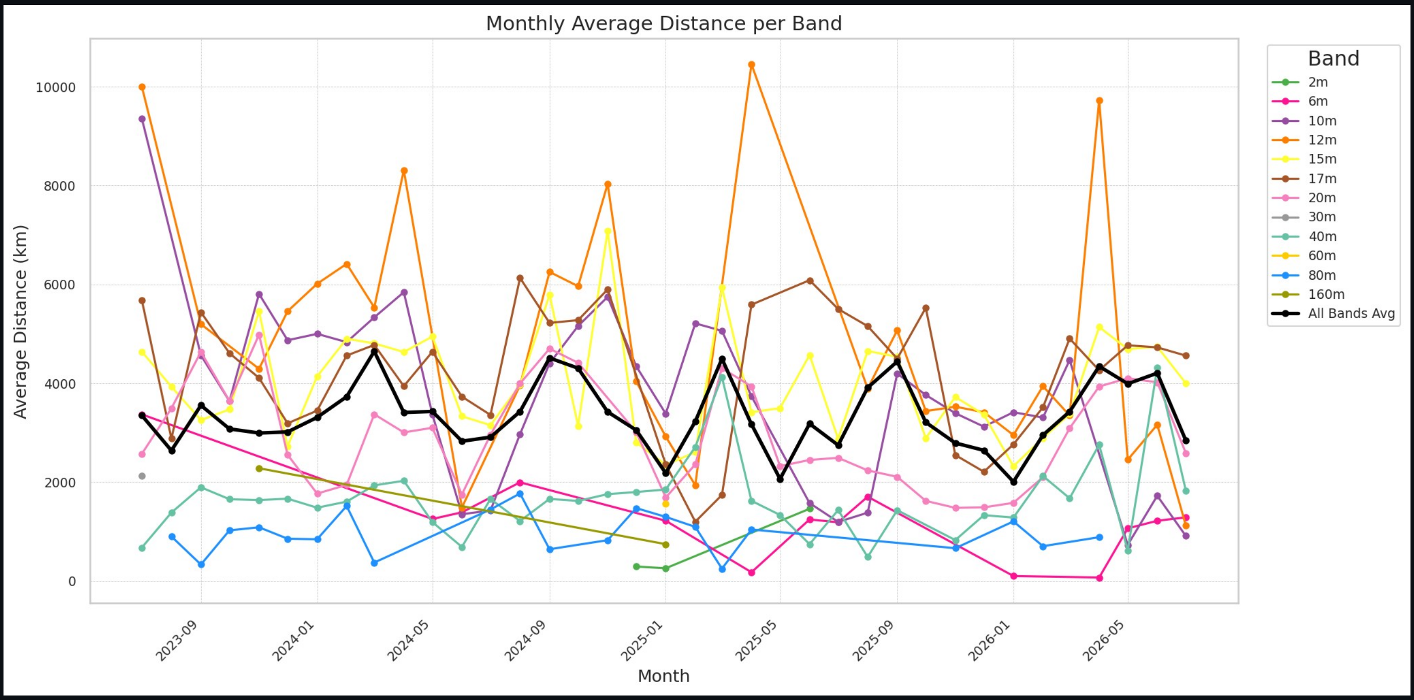
This time-series tracks average QSO distances by month. It reflects seasonal propagation effects (e.g., spring/autumn equinox enhancements), solar cycle shifts, or even changes in operator activity. Rising monthly distances often coincide with higher solar flux and increased MUF. Flat or declining trends may hint at equipment changes, poor band conditions, or QRT periods.



Average QSO distance by month.

Average Distance by Band and Month

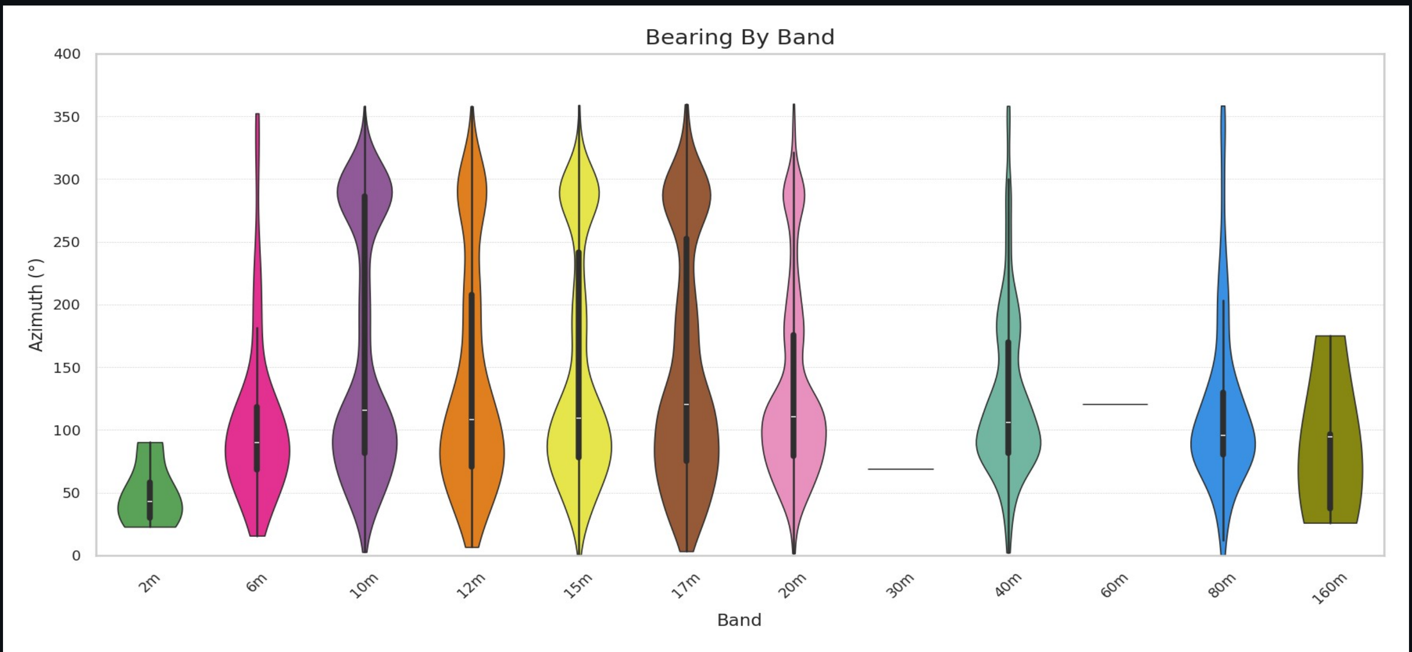
This plot illustrates how propagation evolves monthly across bands. Higher-frequency bands (10 m, 12 m) show distance spikes during high solar activity and Sporadic-E seasons; lower bands (40 m, 80 m) stay steadier with nocturnal F-layer behaviour. 17 m and 20 m straddle the middle - reliable DX, yet sensitive to diurnal/seasonal ionospheric shifts.



Average distance by band vs month.

Bearing by Band

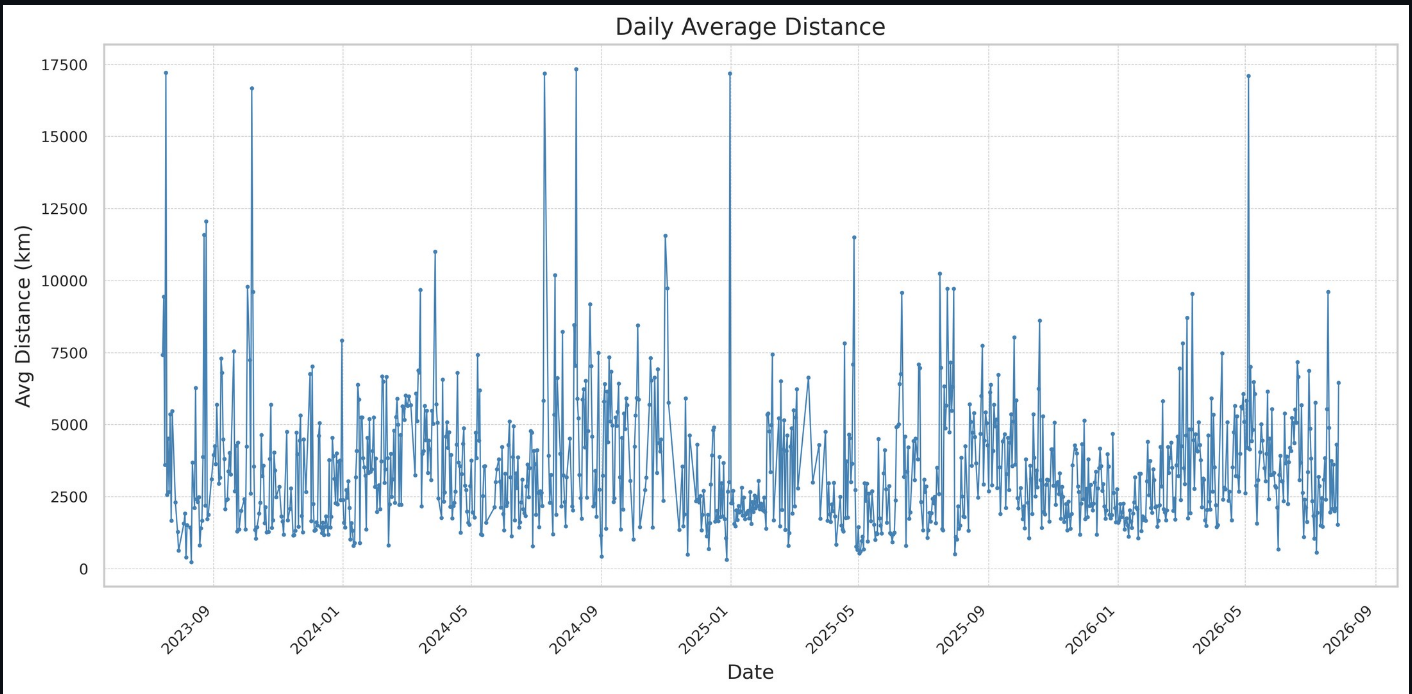
These violin plots show how contact directions vary by band. Narrow shapes suggest focused headings (beams/terrain), broader shapes imply even coverage. For instance, 20 m may favour NW - SE during grey-line; 40 m is often more regional. Quartile boxes indicate typical azimuth ranges.



Bearing distribution by band.

Daily Average Distance

Daily fluctuations highlight band openings, contests, or solar events. Spikes often mark exceptional propagation; lulls may be inactivity or poor conditions. Handy for diagnosing antenna performance and diurnal patterns.



Daily average QSO distance.