Final Author Response

Manuscript: OpenMesh: Wireless Signal Dataset for Opportunistic Urban Weather Sensing in New York City

ESSD manuscript ID: `essd-2025-238`

Cover letter to the Editor

We thank the Handling Editor and Reviewers for their thorough evaluation. Guided by their feedback, we revised the manuscript to (i) focus the text on the dataset itself—content, structure, provenance, usability, and standards; (ii) improve data packaging and documentation and clarify the role of co-packaged reference datasets. We also released a new Zenodo version and updated the Data Availability section accordingly.

Summary of major revisions

- **Data package & DOI.** We released a new Zenodo version of the OpenMesh dataset and updated the manuscript accordingly (see Data and Code Availability sections).
- **Standards & formatting.** NetCDF remains compliant with OpenSense CML specifications (v1.1). We clarified variable typing, removed unused fields where constant, and documented metadata fields in the README. We also separated analysis code/workflows to a public repository and documented end-to-end reproducibility (including WUnderground/NOAA acquisition).
- **Standards, formatting & reference data.** NetCDF remains compliant with OpenSense CML v1.1; we clarified variable types, removed unused TSL fields where constant, and documented metadata in the README. We also split analysis workflows into a public repository and documented end-to-end reproducibility (including WU/NOAA acquisition). In addition, we incorporated ASOS minute-scale (NCEI) and daily (GHCN) records and clarified their role alongside PWS, with station lists, variables, and sampling detailed in Table 1 and Sect. 2.2.
- **Dataset description strengthened (vs. analysis).** We added a clear rationale and criteria for *OpenMesh subnetwork selection* and documented preprocessing (time alignment, interpolation rules, NaN handling, and a uniform 1-min grid for links). We retained the multi-band and snowfall use-cases but condensed methods to keep the focus on the dataset.
- **Figures.** To focus on dataset description over analysis/methods, we added reviewer-requested figures and removed others centered on extended analyses. Key additions include map, network topology for datasets descriptions and baseline-stability diagnostics and cumulative-precipitation comparisons (PWS vs. ASOS) align with suggested reviews. *A concise summary of all figure changes (additions, removals, and renumbering) is provided separately in the "Figures" note.*
- **Terminology & claims.** We softened statements about non-rain sensing and removed promotional wording, using clear, descriptive language for the dataset and the NYC Mesh network while trimming non-essential jargon.

Response to Editorial Comments

(E1) Compliance with standards. We confirm alignment with OpenSense CML v1.1. We detail variable types, units, and global attributes in the README; constant/unused fields (e.g., TSL where constant) are removed from the distributed NetCDF.

(E2) Packaging of related data sources. We provide:

- A small, redistributable PWS sample (for structure and quick-start), plus
- A reproducible acquisition pipeline (available at `https://github.com/drorjac/OpenMesh`) to fetch ASOS and PWS data from their official sources.

This preserves clarity about data lineage and ensures future users can rebuild the comparison dataset directly from the original providers.

Figures. Following reviews, the revised manuscript re-organized the figure set to emphasize dataset description and quality assessment while removing the more detailed analysis. Compared to the original manuscript, the revised includes the following changes:

- **Removed from Original:**
  - Fig. 7 – Path-averaged attenuation distributions for wet vs. dry periods.
  - Fig. 12 – ITU-R rainfall estimation vs. PWS comparison.
- **Added in Review:**
  - Fig. 1 – Standalone overview map of OpenMesh links, PWS, and ASOS stations.
  - Fig. 3 – NYC Mesh network architecture schematic.
  - Fig. 4b – Rooftop installation photographs.
  - Fig. 7b – Distribution of total RSL range (log scale).
  - Fig. 8 – Dynamic-baseline stability (STD, robust range, example trace).
  - Fig. 9 – Cumulative precipitation (PWS vs. ASOS networks).
  - Fig. 14 – The ASOS observations were added to establish a high-resolution reference for the snowfall periods derived from the wireless link data.
- **Renumbered / Retained:**
  - Fig. 1 (S2) → Fig. 2 (S1); Fig. 2 → Fig. 5; Fig. 3a → Fig. 4a; Fig. 3b → Fig. 6.
  - Fig. 4 → Fig. 10; Fig. 5 → Fig. 7a; Fig. 6b → Fig. 11b.
  - Fig. 8 → Fig. 12; Fig. 9 → Fig. 11a; Fig. 10 → Fig. 14; Fig. 11 → Fig. 13.
  - Fig. 6a (precipitation exceedance) replaced by cumulative precipitation (S1 Fig. 9).

Overall, the revision aligns the manuscript with ESSD's focus on dataset presentation and reproducibility by adding figures related to network architecture and baseline quality and removing plots of advanced rainfall applications.

Response to Reviewer A

Main Comment A1: "Lack of reference and additional data in OpenMesh"
Response. We now (i) include a two-week PWS sample for structure and testing, and (ii) document a full acquisition workflow (ASOS minute-scale and daily; PWS) in the repository, with station lists, variables, and sampling tables referenced in the manuscript (Sect. 2.2 and Table 1). The manuscript text clarifies the role and limitations of each source (e.g., under-reporting and lag for PWS in frozen precipitation). Full complementary datasets, as suggested by the main editor and for ESSD compliance, are now available online. We ensure that all periods are provided in NetCDF format via our updated Zenodo DOI as samples. Specifically, the ASOS 5-minute dataset was applied to generate the cumulative plots (Figure 9) used for comparison with PWS data, and to delineate the snowfall periods (Figure 14) derived from the wireless link data. The highly recommended radar dataset is indeed available; however, its usage was not studied within the scope of this work, which focuses on comparing ASOS weather

stations and Weather Underground's dense PWS network. We find radar data integration interesting for future work and encourage its inclusion in future repository versions to extend the dataset with all available measurements for broader applications and more in-depth analysis.

Main Comment A2: "Issues regarding microwave-link dataset (subset choice, pairing)"

Response. We added a dedicated subsection describing the *subnetwork selection* criteria (data completeness/continuity, representativeness across bands, de-prioritization of very short/indoor 5 GHz hops). We also clarified bidirectional pairing and dual-band configurations both in the updated dataset raw and metadata files with description in the manuscript.

Main Comment A3: "Content/structure exceed ESSD scope"

Response. We significantly condensed Sections 3–4 (to one section). Methods are now concise and point to standard references and the public repository. We kept two short, representative use-cases that are directly motivated by the dataset: (i) a *dual-band* rain event (5.7 vs. 69 GHz) and (ii) two *snowfall* intervals illustrating frequency-dependent responses and PWS limitations in frozen precipitation.

Selected specific points (abbrev.)

- Intro claims about 5G/6G: rephrased to frequency-dependent trade-offs; removed unnecessary "NGN" and refined "mmWave" usage; clarified oxygen absorption near 60 GHz.
- "Satellite" wording: clarified to *satellite microwave links* in the opportunistic-sensing context.
- Non-rain applications: separated from rainfall (most mature); added cautionary language and references; removed implication of parity.
- Figures: added cumulative precipitation (PWS vs. ASOS), data-availability histograms, and baseline-stability diagnostics; improved map insets and captions; explicitly identify sublinks in case-study figures.
- Terminology: replaced "collapse" with "link outage due to attenuation"; clarified "x-haul" mentions and kept backhaul-focused phrasing consistent with dataset origin.
- Resampling: documented native sampling (PWS at 5–15 min) and uniform 1-min link grid, and handling of small gaps by interpolation; raw native timestamps are preserved in the acquisition workflow so users can choose their own resampling strategy.

Response to Reviewer B

Data file formatting. We retain float types for RSL per OpenSense; remove TSL where constant; document polarization both globally and per-sublink for convention. We standardized geospatial fields to single precision; time remains 64-bit epoch seconds for longevity. The `links_metadata.csv` no longer includes a potentially confusing "RSL" column; instead, median baselines and their dynamic stability are presented in-article and in diagnostics.

Figures and captions. Captions now identify exact sublinks; axes/labels and units are corrected; we added a scale/coordinates to the map, clarified rain-class thresholds in detection figures, and used consistent time bases across panels.

Referencing and code. We cite the NYC Mesh Wiki and GitHub as formal references. We also archived a dataset and code new *doi* release and documented the exact version in the manuscript.

List of concrete manuscript changes (by section)

- **Abstract & Data Availability.** Updated Zenodo DOI; added scope of ASOS/PWS references and range of weather captured.
- **Sect. 2 (Dataset Overview).** New *Subnetwork Data Selection* subsection; expanded *Data Specifications and Preprocessing* (time alignment; NaN handling; interpolation policy; minute-grid unification); clarified dual-band and bidirectional examples.
- **Sect. 2.2 (Meteorological Data).** Added ASOS minute-scale and GHCN daily details (variables, temporal resolution, purpose); clarified PWS limitations, QC strategy, and licensing considerations.
- **Sect. 3 (Data Analysis).** Added availability histograms; dynamic-baseline stability plots; cumulative precipitation figure; tightened exceedance plots and band-wise comparisons.
- **Use-cases.** Condensed to (i) dual-band rain event and (ii) snowfall days; captions, axes, and station/sublink IDs clarified.
- **Wording.** Replaced "link collapse" $\rightarrow$ "link outage due to attenuation"; removed superfluous jargon; frequency-dependent phenomena made explicit.
- **Code & Reproducibility.** Point to public repository with acquisition, pairing, and examples; document station lists and parameters used.

We believe these changes collectively address the Editor's and Reviewers' requests and improve clarity, usability, and reproducibility of the dataset and manuscript.