**Response to Comments**

The authors would like to thank Reviewer 1 for the careful evaluation of our data description manuscript and for providing valuable comments and suggestions. We appreciate the recognition of the importance of the Nam Co Lake site and the value of publishing this eddy covariance dataset. The reviewer has raised several helpful suggestions to improve the manuscript. The following responses address the comments and the issues raised by Reviewer 1 point-by-point. We have responded (in black) to each comment (in blue).

1. The references should be more precise:

The eddy-covariance method has been well established for at least 20 years, apart from minor issues that are not addressed in this publication. Therefore, publications that have used this method in the last 10 years should not be cited; textbooks or similar publications would be more suitable (Aubinet et al., 2012; Mauder et al., 2021).

Mauder & Foken (2006) is not a publication on flagging systems. Here, one could cite Foken et al. (2004). For the 0-1-2 system used, the ICOS publication would be more appropriate (Sabbatini et al., 2018).

With Footprint, you should mention the most recent summary (Leclerc and Foken, 2014).

We thank the reviewer for this valuable suggestion regarding the use of more appropriate and authoritative references for established eddy covariance methodology. We agree that textbooks and synthesis publications provide a more suitable foundation for methodological descriptions in data papers. Accordingly, we have revised the manuscript to replace or complement recent application-based references with the recommended methodological references.

Influence of Nam Co Lake

Although the Fig. 3 is not readable for colour-blind people (Crameri et al., 2020), please correct, black and white if necessary, the influence in the NW sector is considerable. How to correct this is explained by Biermann et al. (2014).

We thank the reviewer for pointing that out. To improve accessibility for color-blind readers, we have updated Figure 3 using the Okabe–Ito color-blind–safe palette.

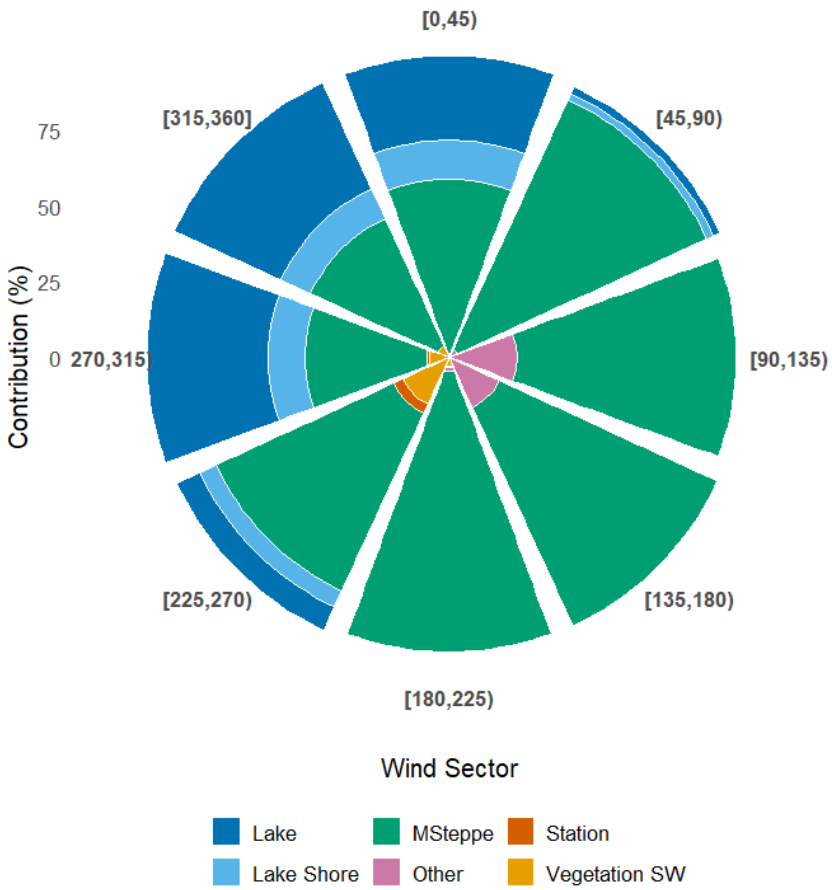


***Figure 3: Wind-sector weighted footprint contributions of land cover classes to the eddy covariance fluxes at the 19 m tower. Each sector represents an 8-point compass division of wind directions. The radial length shows the percentage contribution of each land cover class to the flux footprint, and stacked colours indicate the relative percentage contribution of different LULC classes within each wind sector. Data were filtered for qc_flag = 0.***

The authors acknowledge the considerable influence of the lake and the lake shore in the NW sector on the flux measurements. However, the primary focus of the dataset is to capture fluxes representative of the heterogeneous landscape, including steppe, lake, and shoreline surfaces. Footprint analysis shows that lake contributions account for 14.4 ± 16.6% of total fluxes. Therefore, the measured fluxes reflect the integrated landscape-scale exchange rather than a single surface type. This is consistent with the study objective.

The published dataset includes the footprint contributions of individual classes, including the lake. This allows data users to separate the lake contribution, perform gap-filling, or analyze fluxes from the main steppe sector specifically. We note, however, that restricting the analysis in this way reduces the number of high-quality observed fluxes, which may increase the uncertainty in gap-filled values.

Biermann et al. (2014) proposed a sector-wise footprint analysis and tile-based approach to derive surface-type-specific fluxes, relying on wind sectors with clear footprint dominance of individual surface types. In contrast, at our site, the NW sector footprint remains inherently mixed, with simultaneous contributions from lake, shoreline, and steppe surfaces. Consequently, a separation into surface-type-specific fluxes using a sector-based correction framework is not feasible without introducing additional assumptions. Since the aim of our study is to provide landscape-integrated fluxes rather than surface-specific fluxes, we retain the full footprint signal and provide the fractional surface contributions within the dataset for transparency.

## 2. Energy balance closure

The area around Nam Co lake is so heterogeneous in terms of its underlying characteristics that the problem cannot be ignored, see Mauder et al. (2020). This is all the more important because the fluxes are very small but highly relevant (Gerken et al., 2014; Gerken et al., 2015).

We thank the reviewer for highlighting the point on heterogeneity of the study area and the requirement of stating the energy balance closure. The 19 m EC measurement unit at Nam Co integrates fluxes over a broader area that includes alpine steppe with subtle vegetation density variations, more productive and wetter patches near the lakeshore, and occasional inclusion of the adjacent lake surface. We agree that such heterogeneity may contribute to incomplete energy balance closure through mesoscale circulations and advective processes.

For the published dataset period, an analysis of the energy balance closure at the study site showed 75 % closure (Figure below). This is consistent with previously and recently published results from the Nam Co region: Biermann et al., 2014: 70 %, Li et al., 2015: 78 %, and Wang et al., 2026: 82.8 %. The small variations between these values could be likely due to the different measurement footprints in the complex heterogeneous terrain at Nam Co. These values fall within the energy balance closure range (60 % to 90 %) reported for EC systems in complex and heterogeneous terrain (Foken, 2008; Foken et al., 2011; Twine et al., 2000; Yao et al., 2011).

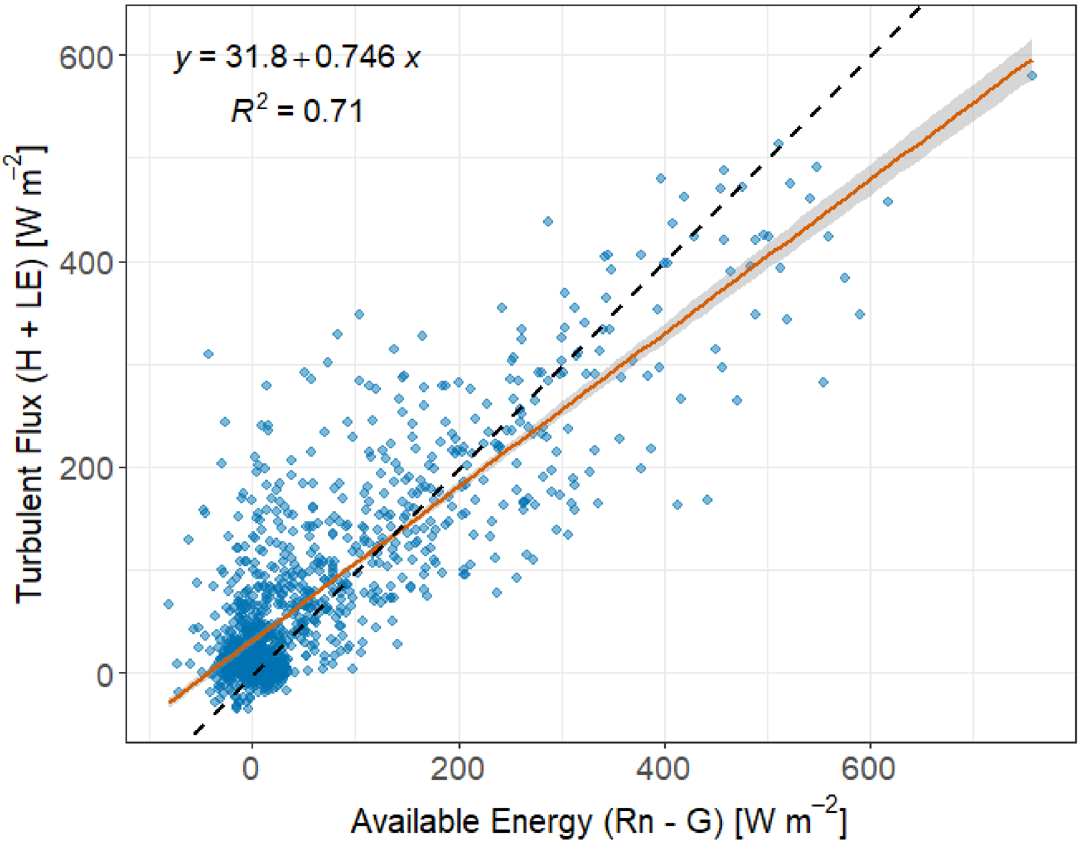


***Figure: Scatterplot of 30-min values of available energy (Rn − G) versus turbulent flux (H + LE) for the growing season during the study period. The solid reddish-orange line represents the linear regression fit (95% confidence interval shaded), while the black dashed line denotes the 1:1 energy balance condition. A total of 1148 paired observations are shown.***

Given that this manuscript presents a data publication, we provide the original, quality-controlled fluxes without enforcing artificial energy balance correction, allowing users to apply their preferred correction approach if required. We will add a paragraph in the revised manuscript on the energy balance closure calculation under an additional sub-section 2.6. The content is as follows:

***2.7.Energy balance closure***

*Energy balance closure (EBC) was calculated using the turbulent fluxes (H + LE) and the available (Rn – G) energy using the 30-min measurements. Observations from the growing season were used for the calculation. Net radiation (Rn) was calculated from the incoming and outgoing shortwave and long-wave radiation. The incoming long-wave radiation (LWD) was unavailable due to sensor failure for the entire published dataset period. In order to provide an estimate of the energy balance closure during this period, we estimated LWD following the* *approach of Brutsaert (1975), using air temperature, relative humidity, and cloud cover fraction (estimated using the incoming shortwave radiation). The method was tested and calibrated using the period during which LWD at the site was available (2006 - 2017). The ground heat flux (G) measurements were shifted forward by 30 min, taking the soil measurement lag into consideration (Li et al., 2015).*

*For the published dataset period, the EBC at the study site showed 75 % closure. This is consistent with previously and recently published results from the Nam Co region: Biermann et al., 2014: 70 %, Li et al., 2015: 78 %, and Wang et al., 2026: 82.8 %. The small variations between these values could be likely due to the different measurement footprints in the complex heterogeneous terrain at Nam Co. These values fall within the energy balance closure range (60 % to 90 %) reported for EC systems in complex and heterogeneous terrain (Foken, 2008; Foken et al., 2011; Twine et al., 2000; Yao et al., 2011).*

## References

Biermann, T., Babel, W., Ma, W., Chen, X., Thiem, E., Ma, Y., and Foken, T.: Turbulent flux observations and modelling over a shallow lake and a wet grassland in the Nam Co basin, Tibetan Plateau, Theor Appl Climatol, 116, 301–316, https://doi.org/10.1007/s00704-013-0953-6, 2014.

Brutsaert, W.: On a derivable formula for long-wave radiation from clear skies, Water Resources Research, 11, 742–744, https://doi.org/10.1029/WR011i005p00742, 1975.

Foken, T.: the energy balance closure problem: an overview, Ecological Applications, 18, 1351–1367, https://doi.org/10.1890/06-0922.1, 2008.

Foken, T., Aubinet, M., Finnigan, J. J., Leclerc, M. Y., Mauder, M., and Paw U, K. T.: Results Of A Panel Discussion About The Energy Balance Closure Correction For Trace Gases, Bulletin of the American Meteorological Society, 92, ES13–ES18, https://doi.org/10.1175/2011BAMS3130.1, 2011.

Li, M., Babel, W., Chen, X., Zhang, L., Sun, F., Wang, B., Ma, Y., Hu, Z., and Foken, T.: A 3-year dataset of sensible and latent heat fluxes from the Tibetan Plateau, derived using eddy covariance measurements, Theor Appl Climatol, 122, 457–469, https://doi.org/10.1007/s00704-014-1302-0, 2015.

Twine, T. E., Kustas, W. P., Norman, J. M., Cook, D. R., Houser, P. R., Meyers, T. P., Prueger, J. H., Starks, P. J., and Wesely, M. L.: Correcting eddy-covariance flux underestimates over a grassland, Agricultural and Forest Meteorology, 103, 279–300, https://doi.org/10.1016/S0168-1923(00)00123-4, 2000.

Wang, B., Ma, Y., Hu, Z., Li, X., Ma, W., Chen, X., Han, C., Xie, Z., Wang, Y., Li, M., Ma, B., Shi, X., Li, W., and Cai, Z.: Quantifying the spatial-seasonal patterns of land–atmosphere water, heat and $CO_2$ flux exchange over the Tibetan Plateau from an observational perspective, Earth Syst. Sci. Data, 18, 1147–1164, https://doi.org/10.5194/essd-18-1147-2026, 2026.

Yao, J., Zhao, L., Gu, L., Qiao, Y., and Jiao, K.: The surface energy budget in the permafrost region of the Tibetan Plateau, Atmospheric Research, 102, 394–407, https://doi.org/10.1016/j.atmosres.2011.09.001, 2011.

**Response to Comments RC2**

The authors would like to thank Reviewer 2 for the careful evaluation of our data description manuscript and for providing valuable comments and suggestions. The reviewer has raised several helpful suggestions to improve the manuscript. The following responses address the comments and the issues raised by Reviewer 2 point-by-point. We have responded (in black) to each comment (in blue).

The authors should enrich the discussion part on the footprint analyses, and representativity and landscape scale.

We thank the reviewer for this suggestion. In response, we have expanded the footprint discussion to more explicitly address representativeness and landscape-scale implications. This includes a more detailed characterization of secondary surface contributions and practical guidance for users on isolating target land cover fluxes; a comparison with the footprint characteristics of the earlier 3 m EC system at this site; an explicit link between the footprint scale and the spatial resolution of moderate-resolution satellite products (e.g., MODIS); a note on the limitations of footprint representativeness under less-sampled wind stability conditions; and a statement on the dataset's broader applicability for landscape-scale ecosystem and land surface modelling. The revised paragraph is shown below:

*"The footprint analysis ensures that the dataset is representative of the target ecosystem type, the 'alpine main steppe'." At the same time, contributions from adjacent surfaces, including lake water, shoreline vegetation, and mixed southwest vegetation, accounted for approximately 25–30% of the footprint. These secondary sources may influence certain flux components, particularly latent heat fluxes, due to differences in surface energy balance between steppe and aquatic environments. The NW sector remained inherently mixed (MSteppe, Lake, Lake Shore), with a considerable contribution from lake (14.4 ± 16.6%, mean ± SD over the study period). For half-hours when the footprint is dominated by mixed contributions (e.g., the NW sector), the flux signal cannot be decomposed into surface-type-specific components without introducing additional assumptions. However, the footprint contribution diagnostics included in the dataset allow users to identify and select time periods where the footprint is dominated by a single class such as MSteppe, enabling flux estimates that are effectively representative of that surface type alone. In contrast, lake and lake shore are almost never the dominant contributor to the footprint on their own, so flux estimates specific to these surfaces cannot be reliably isolated from this dataset. We note that this filtering approach is optional and intended*

*for users seeking surface-specific flux estimates. Since footprint-dominant periods are linked to wind direction, removing non MSteppe timestamps creates gaps that are not random but clustered by wind sector. Gap-filling such clustered, extended gaps is more uncertain than gap-filling the short, scattered gaps in the original dataset. Users should account for this added uncertainty when calculating cumulative or aggregated fluxes from a filtered subset.*

*The footprint distances (median ~350 m, 80% within ~780 m, 90% within ~1200 m) are consistent with landscape-scale representativeness and align with expectations for low-roughness open steppe environments. The spatial scale of the measurements integrates a greater degree of land cover heterogeneity compared to the 3 m EC system previously operated at this site (Nieberding et al., 2020), whose smaller, more homogeneous footprint primarily sampled the main steppe area alone. Unlike the typical EC system on grasslands, which represents a smaller footprint area, the larger footprint achieved by the current measurement setup allows for a more representative comparison and validation with satellite GPP products such as MODIS. The area encompassing 90% of the footprint climatology over the study period corresponds to a source area of approximately 280,000 m², closely matching the area of a single MODIS pixel (~250,000 m²), making the dataset a valuable resource for potential data users. Spatial representativeness may vary under wind directions or stability conditions. The inclusion of footprint diagnostics and the input variables needed to derive footprints in the dataset allows users to evaluate this variability directly for their specific applications. The larger footprint, together with the auxiliary meteorological variables provided in this dataset, further supports its use in land surface and ecosystem models requiring landscape-scale representation of vegetation, soil moisture, and temperature heterogeneity."*

**Abstract** Your results that you show in your manuscript are data rich in gap filling processing and Uncertainty analyses and your discussion is centered on these topics. In contrast you do not show comparison of your measurements versus e.g. MODIS products on Gross Primary Productivity (GPP) or Net Photosynthesis (PSN) at 500m to 1km resolution. Therefore, you cannot make the statements you currently show in your abstract: 'Owing to the higher measurement height (19 m) at this site, the measurement footprint closely aligns with the spatial resolution of Moderate Resolution Imaging Spectroradiometer (MODIS) products, facilitating more consistent landscape-scale comparisons. ' ….. 'supporting satellite product validation.'

We thank the reviewer for this thoughtful comment. The statement regarding MODIS pixel and EC footprint was not intended to present a comparison between our EC measurements and

MODIS products, but rather to highlight a characteristic of the higher measurement height at the site that makes such comparisons feasible in future studies. The 90 % of the footprint climatology for the entire study period represents a source area of approximately 280000 $m^2$, which closely matches the area of a single MODIS pixel (~250000 $m^2$). We consider this a relevant piece of information for potential data users. However, to avoid any impression that such a comparison was performed in this manuscript, we have revised the sentence to make the forward-looking, data-utility nature of this statement more explicit in the revised manuscript.

"*Owing to the higher measurement height (19 m) at this site, the footprint climatology (90% source area ≈ 280,000 m²) closely aligns with the spatial coverage of a Moderate Resolution Imaging Spectroradiometer (MODIS) 500 m pixel (~250,000 m²),* ***making this dataset particularly suitable for future landscape-scale comparisons and satellite product validation***".

***Secondary note:*** We also wish to note, for transparency, that a dedicated study comparing EC-derived fluxes at this site with MODIS GPP has just been published in Agricultural and Forest Meteorology (https://doi.org/10.1016/j.agrformet.2026.111320). This further supports the data utility described above.

Please enrich your abstract with more results and numbers , e.g. quality results of the gap filling, which gap filling method performed best, uncertainties, - consider to add details from your footprint analyses in your abstract. Name the auxiliary meteorological variables.

We have carefully considered the suggestion to enrich the abstract with gap-filling quality results, method performance, uncertainty estimates, footprint details, and auxiliary meteorological variables. In response to this suggestion, we revised the abstract to include the requested quantitative results and details. The revised abstract is below:

"*The Tibetan Plateau (TP) is warming rapidly, with future projections suggesting continued warming that may amplify climate–carbon feedbacks. However, sparse in-situ observations and pronounced spatial heterogeneity in vegetation, soil moisture, and climate have limited our understanding of these ecosystem responses. Here, we present a continuous record of carbon and energy fluxes measured at a landscape scale (~30 ha / 0.3 km²) in an alpine steppe ecosystem on the TP from July 2018 to June 2019. The dataset yields a cumulative net ecosystem exchange (NEE) of −12.6 ± 16.4 g C m⁻², indicating a near carbon-neutral budget. Flux measurements were quality-filtered, retaining 33 – 44 % of high-quality data across fluxes, and gap-filled to produce a complete seasonal record using two complementary* *approaches, marginal distribution sampling (MDS) and random forest (RF), with RF outperforming MDS for all the fluxes. Eddy covariance measurements represent integrated fluxes over their footprint area, which are often much smaller than most model grids or remote sensing pixels, particularly in grassland ecosystems. Owing to the higher measurement height (19 m) at this site, the footprint climatology (90% source area ≈ 280,000 m²) closely aligns with the spatial coverage of a Moderate Resolution Imaging Spectroradiometer (MODIS) 500 m pixel (~250,000 m²), making this dataset particularly suitable for future landscape-scale comparisons and satellite product validation, facilitating more consistent landscape-scale comparisons. The data include quality flags indicating observed or gap-filled values, uncertainty estimates, footprint diagnostics, and auxiliary meteorological variables (air and soil temperature, soil moisture, radiation, relative humidity, vapour pressure deficit). The data described in this manuscript provides a robust foundation for examining carbon–climate interactions in alpine environments, supporting ecosystem modeling and satellite product validation.*"

While incorporating these details, we have also aimed to keep the abstract concise. The detailed quality metrics, gap-filling performance, uncertainty analyses, and footprint diagnostics are thoroughly presented and discussed in the respective sections of the manuscript, where readers can evaluate them in full context. We hope this strikes an appropriate balance between conciseness and the level of detail requested by the reviewer.

**Introduction** You are starting strong with the statement on the world's largest alpine grassland … (Wang et al., 2021), continuing to cite Cai et al (2025) on the estimated vegetation carbon sequestration potential of about 1965.6 Tg across the Tibetan Plateau, however the largest contributions in Cai et al (2025) is from evergreen coniferous forest i) not representing large areas of the Tibetan Plateau and ii) not representing your land cover unit (alpine grasslands). In Cai et al. (2025) alpine grasslands on the Tibetan Plateau provide 229.25 Tg, please differentiate in your statement on carbon and also cite the estimated magnitude linked to the alpine grasslands of the Tibetan Plateau.

We thank the reviewer for this observation. We have revised the sentence accordingly as follows:

"*Despite being in one of the most extreme environmental conditions on Earth, these ecosystems play a vital role in the exchange of water, energy, and carbon (Liu et al., 2024), with an* *estimated vegetation carbon sequestration potential of about 229.25 Tg from its alpine grasslands in 2020 (Cai et al., 2025) .*"

**Figure 1** –this important figure would need some edits for harmonization and improvement:

- please align the upper and lower borders of images B and E, and C and D
- please enlarge the letters of latitude, longitude. Further enhancements E, D you could shift the longitude axis below the image D, (not E and do remove the longitude values below image E)
- The order of images looks not familiar, usually with A linked to the inlet map: the letters B, C would be used for the upper row of images, D, E for the lower row or B, D for the upper row and C, E for the lower row
- Figure caption issues: It is also more common to show the letter in the beginning of the sentences, please adapt
- Image A – you could enhance the visibility of the location symbol in the overview map with a larger symbol and brighter color. – latitude and longitude letters are too small – please enlarge and you could choose larger steps between
- Image B – color scale DEM is missing, SRTM reference is missing
- Image C '19 m EC covariance unit' is not a good wording please describe in more detail in the figure caption what the photo shows.
- Image D also this figure caption text 'the 95% footprint climatology overlaid on classified NDVI' is not so clear and can be improved, please name Sentinel-2 as NDVI source, better name your NDVI visualization 'color-coded' and not 'classified' - is climatology the correct wording in this context?
- Image E Sentinel 2 – MSS (20 May 2019) false colour composite (FCC) imagery'. Please correct: i) The imaging sensor on board Sentinel 2 is the Multispectral Instrument (MSI), there exists no MSS sensor, however it would be enough to name Sentinel 2 without adding the sensor, ii) FCC: Despite on Sentinel hub the band imagery combination with the NIR band on the red channel is called ' False Color Composite' the FFC term is specifically the term used for airborne or droneborne RGB composites using the NIR channel. Please follow the NASA recommendations to cite this type of RGB band combination as Color Infrared RGB composite (8-4-

3), please see also https://www.earthdata.nasa.gov/learn/tutorials/customize-hls-rgb-imagery-composites-worldview

We thank the reviewer for these valuable suggestions. The figure has been revised accordingly, addressing all the points raised, including panel alignment, enlargement of latitude/longitude labels, figure caption revision, enhancement of the location symbol in all panels, addition of the elevation value range (colour scale) in the SRTM DEM, a more detailed description of EC at 19 m, and revised sentinel and NDVI images with footprint climatology. The panels are reordered and numbered them as suggested.

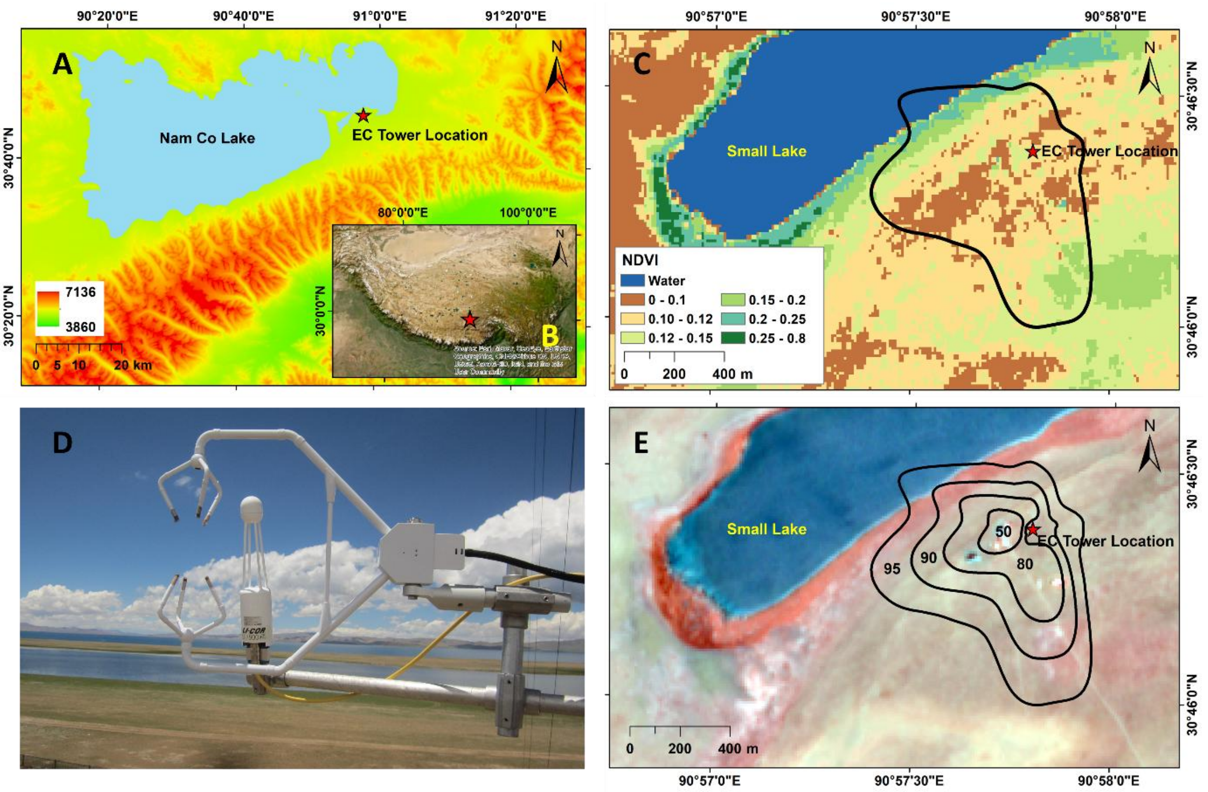


*Figure 1: (A) The study area at the NAMORS station – SRTM DEM, (B) Google Earth imagery showing the location of the Nam Co station on the TP (© Google Earth), (C) the 95% footprint climatology overlaid on the colour-coded NDVI map derived from Sentinel 2 Imagery acquired on 20 May 2019, (D)The eddy covariance (EC) measurement system at Nam Co (Photo credit: Felix Nieberding) consisting of a CSAT3 ultra sonic anemometer and an LI-7500RS open path infrared gas analyzer, (E) footprint contours representing the cumulative source area over the measurement period overlaid on Sentinel 2 imagery acquired on 20 May 2019 (Colour Infrared composite of the bands 8-4-3).*

**L84** you could already introduce the abbreviations for the radiation products in this paragraph, e.g. Rg

For a better overview, could you provide **a table** with the variables, variable codes, and instruments

We thank the reviewer for this suggestion. While a comprehensive list of variables, variable codes, and corresponding instruments is already provided in the dataset description documentation, we agree that including this information directly in the manuscript improves readability. We have therefore added Table 2 (Meteorological variables measured at site Nam Co), listing the variables, variable codes, and corresponding instruments, in the revised manuscript.

**Table 2. Meteorological variables measured at site Nam Co**

| **Meteorological Variables** | **Variable Code** | **Instrument** |
|---|---|---|
| Air Temperature | Tair | Vaisala HMP 45D |
| Soil Temperature | Tsoil | Datamark PT100 |
| Soil Moisture | SMC | IMKO Trime EZ |
| Relative humidity | RH | Vaisala HMP 45D |
| Vapour pressure deficit | VPD | Derived |
| Wind direction | WD | Vaisala WAV151 |
| Wind Speed | WS | Vaisala WAA151 |
| Incoming shortwave radiation | Rg | Kipp&Zonen CNR1 |
| Incoming long-wave radiation | LWD | Kipp&Zonen CNR1 |
| Net Radiation | Rn | Kipp&Zonen CNR1 |
| Ground heat flux | G | Hukseflux |

Regarding the abbreviations for radiation components at L84, we prefer to introduce their abbreviations at their first explicit use later in the manuscript. This is because radiation encompasses multiple components, and not all of them are used in the manuscript, making it impractical to abbreviate at this general mention.

**L92** 3 m EC dataset could you either introduce an abbreviation or formulate it with more text: EC measured at 3 m height, similar for 'within the 19 m footprint'

We thank the reviewer for this suggestion. The abbreviations '3 m EC' and '19 m EC' have been introduced at their first mention in the text.

"*The first long-term (2005–2019) eddy covariance dataset of carbon and water fluxes from the same site, measured at* ***3 m height (3 m EC),*** *has been published by Nieberding et al. (2020, 2020a). In this study, to evaluate the fluxes at a larger spatial scale (landscape scale), a* *measurement unit with a CSAT3 ultrasonic anemometer and Li-7500RS open-path infrared gas analyser was installed on the PBL tower at 19 m above ground level (**19 m EC**) from July 2018 onwards (Pillai et al., 2026). The source area of the **19 m EC** measurement covers a substantially broader area than that of the previously published **3 m EC** dataset, encompassing alpine steppe with subtle vegetation density variations, more productive and wetter patches near the lakeshore, and occasional inclusion of the adjacent lake surface*."

**L130** u* , was this term introduced before?

We thank the reviewer for pointing this out. L130 mention u* for the first time in the manuscript. In the revised version, we have added the term 'friction velocity' before u*.

For a better overview, could you provide **a table** for the variables named in the paragraph 2.6 of the foot print modelling

A table summarizing the input parameters used in the Kormann and Meixner footprint modelling, including their symbols, units, and sources, has been added as Table S1 in the supplementary material.

**Table S1. Input parameters used in Kormann and Meixner footprint modelling.**

| **Parameters** | **Symbol** | **Unit** | **Source** |
|---|---|---|---|
| Measurement height | zm | m | EddyPro output file |
| Mean wind speed | WS | $ms^{-1}$ | |
| Monin-Obukhov length | L | m | |
| Standard deviation of cross-winds | sv | $ms^{-1}$ | |
| Friction velocity | ustar | $ms^{-1}$ | |
| Wind direction | WD | degrees | |
| Roughness length | z0 | m | Calculated from ustar, WS, WD, L, and zm |

**L220** '.. land use land cover (LULC) map (Figure S2). The LULC map was created by visual interpretation of cloud-free Sentinel-2 Level-1C (L1C)' - I understand that your map was created by digitization of the land cover units on the computer screen. Did you use the Color Infrared RGB composite (8-4-3) (e.g. Figure 1 E), and / or the True Color RGB composite (4-3-2) visualization of the 10 m band res. Sentinel-2 image bands? (Sentinel-2 also has 20 m res.

bands). Please add these few more technical details in this paragraph and the information that the map was created by digitization.

In addition, I advise not to use the more operationally used term LULC for your digitized map. You could e.g. use the term land cover map or land unit map.

The term 'LULC' has been replaced with 'land cover map' throughout the manuscript. Additional technical details, including the Sentinel-2 band specifications, spatial resolution, and the digitization process, have been added to the paragraph as suggested.

"*Half-hourly KM footprint probability matrices were generated and overlaid with the* ***land cover map (Figure S2). The land cover map*** *was created by visual interpretation of cloud-free Sentinel-2 Level-1C (L1C) MSI imagery acquired for the site.* ***The data were downloaded for cloud-free dates from Google Earth Engine. All bands were downloaded separately and stacked into multi-band images across multiple dates to facilitate visual comparison during digitisation. The base image used for digitisation was acquired on 20th May 2019. Each stacked image had a spatial resolution of 10 m. Digitization of land cover units was performed on a colour infrared RGB composite using bands 8 (Near Infrared; 833 nm), 4 (Red; 665 nm), and 3 (Green; 560 nm).*** *For each half-hourly period, the footprint probability of each pixel was multiplied by a binary mask of each LULC class (1 if the pixel belongs to that class, 0 otherwise), and the weighted values were summed over all pixels to calculate the fractional contribution of each class to the total footprint area*."

**Figure S2:** please enhance Figure descriptions, legend and figure caption of the land cover map Figure S2.

- On the map, please add the lake names 'Namco Lake' and Small Lake – then you can change the legend code for the color blue from lake to water
- Legend text needs to be enhanced please write out the words and find better descriptions for your placeholder names of the classes, not 'main steppe' but alpine steppe– can you assign a vegetation composition for the class you name now vegetation south west – you could use e.g. the class aggregations in Cai et al (2025) from field sampling – e.g. eventually drier less productive land cover class units represent alpine desert grassland patches?
- Figure caption: please formulate a sentence with more details, e.g. that the land units are digitized on Sentinel-2 imagery, add the date of the acquisition

Thank you for these suggestions. As suggested, the lake names (Nam Co Lake, Small Lake) were added to the map, and the figure caption has been revised as follows:

"*Figure S2: Land cover map of the Nam Co study area derived by digitization of cloud-free Sentinel-2 Level-1C MSI imagery (20 May 2019). Land cover units were visually interpreted and digitized using a false colour RGB composite (Bands 8-4-3) at 10 m spatial resolution*"

Regarding assigning a detailed vegetation composition to each class, we note that these land cover classes were derived from visual interpretation of the satellite imagery rather than field vegetation surveys, and we do not have site-specific field sampling data to confirm compositional assignment with confidence. This land cover map is provided as a supplementary visual aid to contextualize the footprint analyses rather than as a validated vegetation classification product, and we have therefore retained descriptive terminology consistent with what we can confirm from our data rather than assign specific compositional classes we cannot verify.

**3.3. L257** …'the main steppe (MSteppe)' and other class names seem to represent placeholder names only, not proper class names. Please also see the comments related to the place holder name of the classes in the land cover map (Figure S2) and table 2. The place holder name 'lake shore' seems to cover the only class with dense productive vegetation according to the high NDVI values in Figure 1. Can you find a better class name expressing this high productive vegetation. What type of vegetation is represented by the place holder name 'Vegetation SW'? You can use your land cover description in the last paragraph of the introduction to describe the landscape (2-3 sentences more) e.g. the class main steppe could be named 'alpine steppe' etc., please revise Figure S2 and Figure 3, Table 3 and the class names in the text accordingly.

We thank the reviewer for this valid point on clearer class names. We would like to clarify that the current land cover classes were derived from visual interpretation of the satellite imagery, without reference to field-based vegetation surveys or a priori ecological categories. As this is a data-descriptor paper rather than a vegetation classification study, the class labels are intended as positional/descriptive reference names, primarily to help readers distinguish spatial zones within the broader alpine steppe landscape discussed in the footprint analyses, rather than as validated vegetation types. We recognize that readers with specific field or ecological expertise may wish to interpret or relabel these classes further according to their own objectives, and we have aimed to keep the current names general enough to accommodate this.

Regarding the specific class names, we would like to clarify the purpose of these sub-classes, as we believe this will help address the reviewer's underlying concern. Our study area represents an alpine steppe ecosystem at Nam Co, central Tibetan Plateau, where a long-term eddy covariance (EC) flux dataset has previously been measured at a height of 3 m (2005–2019), typical for grassland-scale flux towers. Our dataset, measured at 19 m, integrates fluxes over a substantially larger footprint than the earlier 3 m system. The land cover sub-classes were therefore delineated primarily to help readers relate the spatial origin of flux contributions within this larger footprint to distinct sub-areas, rather than to represent formal, field-validated vegetation types. The land cover class "MSteppe" represents the open to sparsely vegetated area that largely corresponds to the source area of the earlier 3 m EC system, while "Vegetation SW" and "Lake Shore" represent spatially distinct areas within the same broader alpine steppe landscape that appear comparatively wetter and more productive, based on visual interpretation and NDVI patterns.

We agree that "Lake Shore" corresponds to the class with the highest NDVI values in Figure 1, consistent with denser vegetation near the water margin. Similarly, "Vegetation SW" reflects a spectrally distinct area that appears comparatively wetter and more productive than the surrounding steppe. In both cases, however, we do not have field verification to confirm a specific vegetation type, and we therefore prefer to retain these positional descriptors rather than assign ecological terms we cannot support with our data.

We recognize that the current names for these classes are general; however, based on the reasoning above, we believe positional descriptors are more appropriate than assigning unverified vegetation-type names in this context. Regarding "MSteppe" specifically, we note that our manuscript already refers to the broader ecosystem as "alpine steppe" throughout; retaining "MSteppe" as a distinct sub-class label helps readers differentiate this specific, relatively open/sparse zone from the ecosystem-level term used elsewhere in the manuscript. We therefore prefer to retain the current class names, and will expand the landscape description in the methodology section, where the footprint and land cover are discussed.

**Discussion:** consider to structure your discussion by subchapters centered on the different topics, e.g. foot print analyses could become a separate discussion subchapter.

We thank the reviewer for this suggestion. In the revised manuscript, the discussion will be restructured into two subchapters: 4.1 Data quality, gap-filling, and uncertainty, and 4.2 Footprint analyses and implications

Your **Codes** are added to the zipped supplement, this does not seem appropriate for a FAIR DATA ESSD publication, please consider to publish your code and add the information in the availability section

The processing code will be made publicly available alongside the dataset in the GFZ Data Services repository (https://doi.org/10.5880/GFZ.TKVR.2026.001). We have initiated the process of adding the code along with the data.

**General:**

- please do not use abbreviations in the titles and subtitles –
- please decide if you use a non-breaking space between values and units or if you use no space between, and apply consistently
- please correctly introduce all abbreviations when they first appear in the text, e.g. carbon dioxide for $CO_2$, Net Ecosystem Exchange for NEE, etc.

All these points have been carefully addressed in the revised manuscript.