Reply to Reviewer 2 Comments

Manuscript: CONFEX: A Database for CONUS Fire EXtent (essd-2026-116)

*Reviewer comments are in red, author responses are in blue, and revised manuscript sections are in black.

Reviewer comment: "The manuscript "CONFEX: A Database for CONUS Fire EXtent" presents an ambitious and valuable effort to build a wildfire perimeter dataset for CONUS and Alaska using VIIRS 375 m active fire detections. Providing a spatially comprehensive and temporally dynamic dataset is critical for fire management and ecological modeling. However, after a review of both the manuscript and the released geospatial data, I found that the current version suffers from important methodological limitations, severe geospatial inaccuracies, and a lack of robust uncertainty quantification. While the conceptual pipeline is promising, its execution introduces artifacts and biases that compromise the dataset's scientific reliability. Furthermore, the manuscript frequently substitutes rigorous quantitative validation with speculative language. In its current state, the dataset and the accompanying manuscript do not meet the rigorous "high-quality data" standards expected for publication in ESSD. I therefore recommend a major revision, and I detail my concerns below."

General Response: We would like to thank Reviewer 2 for the detailed and constructive evaluation. The manuscript and released workflow have been substantially revised. The revised version now (i) specifies the software environment; (ii) applies corrected CONUS and Alaska spatial-domain filtering; (iii) uses EPSG:5070 for CONUS and EPSG:3338 for Alaska; (iv) replaces the earlier single California tuning with regional threshold tuning; (v) excludes 1- and 2-detection clusters from the cleaned release; (vi) adds geometry and attribute quality control, volcanic screening, overlap flags, and boundary screening; and (vii) expands validation using MTBS and FRAP with object-, area-, fragmentation-, merging-, and near/far unmatched diagnostics. We also revised the Introduction and Data and Methods sections to reduce speculative language and to better distinguish CONFEX from burned-area products.

General Comment 1: Software environment

Reviewer comment: "While the manuscript clearly outlines the conceptual steps of the data processing pipeline, it does not currently specify the programming languages, software, or core libraries used to implement the clustering and perimeter generation. Please add a brief statement outlining the primary software environment and tools utilized to generate the CONFEX database."

Response: We thank the reviewer for their advice and we have added a dedicated Software Environment subsection to the Data and Methods. This subsection identifies the Python version and the core geospatial, numerical, raster, and clustering libraries used to generate the final database.

Exact revised manuscript subsection titled "Software Environment" in the "Data and Methods" section:

"All processing was implemented in Python 3.10.14 using GeoPandas 1.0.1, Shapely 2.0.2/GEOS 3.12.0, GDAL 3.7.2, Fiona 1.9.5, rasterio 1.3.8, pyproj 3.6.1, pandas 1.5.3, NumPy 1.26.4, and scikit-learn 1.7.2 for vector I/O, spatial joins, coordinate reprojection, topology validation, raster operations, alpha-shape construction, and DBSCAN clustering."

General Comment 2: Spatial-domain filtering

Reviewer comment: **"A serious spatial-domain issue must be addressed. Although the manuscript repeatedly describes CONFEX as a dataset for CONUS and Alaska, the released product appears to contain fire-event polygons outside that stated domain. For example, I identified a polygon with year = 2023 and cluster_final = 85586 (centroid: 44.9835°N, 66.9877°W) that lies entirely in Canada, and another with year = 2013 and cluster_final = 41847 (centroid: 27.1205°N, 99.4487°W) that lies entirely in Mexico. In addition, the dataset appears to contain nearly 1,000 Hawaii polygons. These records suggest that the spatial filtering, study-area clipping, or release-version control is not fully consistent with the manuscript's stated domain and must be corrected or clarified."**

Response: We thank the reviewer for identifying this important release-quality issue. We corrected the final release workflow by applying boundary screening after volcanic and overlap quality-control steps. The final release retains only fire objects whose ignition points fall within the CONUS or Alaska study-area boundaries. This removes exterior records while avoiding the inappropriate removal of events that legitimately ignited inside the study domain but whose perimeter may touch a boundary.

Exact revised manuscript text in the "Post-processing and Quality Control" subsection of "Data and Methods":

"Finally, boundary screening retained only fires whose ignition points fell within CONUS (EPSG:5070) or Alaska (EPSG:3338) study-area boundaries, producing the final CONFEX dataset."

General Comment 3: Parameter tuning from one region/year

Reviewer comment: **"A major methodological concern is the apparent reliance on parameter tuning from a single region and year. The key DBSCAN thresholds used in CONFEX (2000 m in space and 48 h in time) were tuned using only the 2020 California FRAP dataset, yet these same settings were applied across all of CONUS and Alaska. Given the drastic differences in fire regimes, fuels, climate, and fire behavior across the full study domain, it is unclear why a California-based calibration should generalize well. The authors must justify this transferability explicitly or provide sensitivity tests showing that the selected parameters remain appropriate outside California."**

Response: We thank the reviewer for this important insight. We agree that the earlier California-only tuning was not adequate for the full CONUS and Alaska product. The revised workflow replaces that approach with region-specific tuning across seven regions: Alaska, CONUS West, Southwest, Southeast, Western Midwest, Eastern Midwest, and Northeast. Final thresholds were selected using multi-objective criteria, including object agreement, area agreement, fragmentation, merging, and candidate-count behavior.

Exact revised manuscript text in the "Threshold Tuning" subsection of "Data and Methods":

“We tuned our algorithm thresholds, for clustering distance, time and alpha value for alpha shapes, using the interagency fire product MTBS, which provides perimeter shapefiles data with different criteria for the West (>1000 acres) and the East (>500 acres). The parameter-tuning validation test was performed separately across seven regions, which is a rough attempt to capture the dominant fire regimes of the region, since the underlying classification (e.g., pyromes (128 in CONUS, 7 in Alaska; 136 total U.S. pyromes) or EPA Level-III ecoregions (84 in CONUS, 104 total U.S. ecoregions)) comprises 128 and 84 respectively more finely resolved units and such extensive work would make it extremely difficult to create perimeters, because many fire perimeters cross ecoregion boundaries (Figure 2; Short et al., 2014; Daassi et al., 2026; U.S. EPA, 2015; Short et al., 2020). The division was based on MTBS East–West demarcation and the four broad regions following the U.S. Census Bureau’s four region classification (Northeast, Midwest, South, and West (CONUS West and Alaska)), which is implemented in the Census cartographic boundary files for nationwide thematic mapping (U.S. Census Bureau, 2024). MTBS West contains Alaska, CONUS West, Western Midwest, and Southwest, and the rest of the three regions are in MTBS East. Alaska was taken separately from CONUS West because of its extended cloud cover. The tuning year for each region was decided based on the years with the maximum number of hotspots in each region, except for Northeast, which had only one MTBS perimeter for the highest VIIRS hotspot year (2022), so the year with maximum number of MTBS perimeters (2023) was taken.”

General Comment 4: Alaska projection

Reviewer comment: **“The manuscript states that EPSG:5070 (NAD83 / Conus Albers) was used as the unified processing CRS for both CONUS and Alaska to maintain "consistency". This justification is technically unsound. EPSG:5070 is an equal-area projection optimized for the contiguous United States; its accuracy degrades significantly when extended to high-latitude regions like Alaska. The authors should justify why this projection is acceptable for Alaska or provide sensitivity tests showing that the resulting distortions do not materially affect the perimeter area calculations.”**

Response: We thank the reviewer for the important suggestions. The revised workflow no longer processes Alaska in EPSG:5070. All Alaska-specific fire objects and validation operations are now processed in EPSG:3338, while CONUS-specific operations use EPSG:5070.

Exact revised manuscript text in the “Geospatial Framework and Projections” subsection of “Data and Methods”:

“Geometric operations were performed in projected coordinate systems to enable consistent planar distance and area calculations. EPSG:5070 (NAD83 / Conus Albers) was used for CONUS-only analysis, while EPSG:3338 (NAD83 / Alaska Albers Equal Area Conic) was used for Alaska-specific fire objects. This separation was adopted because EPSG:5070 is defined for the contiguous United States, whereas Alaska lies outside its intended area of use; projection-scale calculations using the EPSG:5070 parameters indicate a meridional linear scale factor of approximately 0.73 near 70° N, corresponding to about 27 % linear compression in that direction (EPSG, 2026; Snyder, 1987).”

General Comment 5: Low-detection events and min_samples = 1

Reviewer comment: **“The treatment of low-detection events is unconvincing. In the README, the authors recommend the "CONFEX_ALL_YEARS_min3pts.zip" subset because it provides "more reliable perimeters", implying that events with fewer than three detections have greater geometric uncertainty. Yet, the manuscript does not quantify this**

uncertainty. This issue is compounded by Figure 3, which shows that DBSCAN was run with "min_samples = 1". Since "min_samples" includes the point itself, setting it to 1 is an extremely permissive choice that allows isolated detections to become standalone clusters rather than noise. The authors should justify this choice carefully and provide a direct uncertainty analysis for single- and two-point events, rather than merely acknowledging their lower reliability in the README."

Response: We thank the reviewer for this important insight. We agree that low-detection events have higher geometric uncertainty. The final cleaned release now excludes clusters with 1 or 2 detections and treats them as noise. DBSCAN remains the initial candidate-clustering method, but the released product only retains clusters with at least three detections, and additional geometry/attribute QC removes selected suspicious low-hotspot geometries.

Exact revised manuscript text in the "Spatiotemporal Clustering Algorithm" subsection of "Data and Methods":

"Each cluster is taken as a candidate fire event. Clusters with 1 or 2 points were excluded from the final released product and treated as noise."

General Comment 6: Non-exclusive overlapping fire objects

Reviewer comment: "The dataset appears to contain at least some non-exclusive fire-event objects. For example, in "VIIRS_final_perims_ALL_YEARS.gpkg", cluster_final IDs 52266 (2022/06/19–2022/07/01) and 52424 (2022/06/20–2022/06/26) overlap both temporally and spatially, with approximately 27 km² of shared area. This overlap contradicts the premise of each cluster representing a distinct fire event and suggests that additional topological quality control is needed."

Response: We thank the reviewer for highlighting this case. We agree that spatiotemporal overlap between fire objects should be explicitly identified. Such overlaps can occur when multiple nearby ignitions evolve concurrently or when clustering separates closely interacting fire fronts into distinct objects. We chose not to automatically merge these cases, as merging introduces subjective decisions regarding event boundaries and can reduce reproducibility, particularly for complex multi-ignition fire events.

Instead, the revised dataset explicitly quantifies these cases by adding spatiotemporal overlap attributes. Fire perimeters with intersecting geometries and overlapping active periods are now assigned unique overlap identifiers, along with has_overlap, and overlap_ids attributes. This allows users to identify and optionally merge overlapping objects depending on their application, while preserving the original detection-based event structure.

Exact revised manuscript text in the "Post-processing and Quality Control" subsection of "Data and Methods":

"Spatiotemporal overlap flags (Overlap-#, has_overlap, overlap_ids) were added using GeoPandas spatial indexing for intersecting geometries with temporally overlapping periods."

General Comment 7: Eastern CONUS interpretation and Soberanes example

Reviewer comment: "L298-305: The paragraph discussing the poor performance in the Eastern CONUS suffers from severe analytical spin and a notable geographic error. By

reporting 9,084 false positives (FP) and 1,916 true positives (TP), the algorithm yields a precision of merely 17.4%, while 2,703 false negatives (FN) equate to a recall of 41.5%. It represents a fundamental algorithm limitation in the Eastern CONUS, not a "complementary" relationship, and claiming that more than 9,000 FPs simply identify "substantially more fire activity" without robust ground validation is scientifically unsound. Additionally, framing the splitting of a single MTBS fire into multiple fires as a "feature" ignores the artificial fragmentation likely caused by the rigid 48-hour temporal threshold. Compounding these analytical issues is a stark geographic mismatch: the authors use the Soberanes Fire—which occurred in California (Western CONUS)—to justify algorithm behavior in an Eastern CONUS error analysis. I recommend that the authors objectively state that the current clustering pipeline performs poorly in the East rather than spinning a 17% precision score as a strength, and completely remove the logically disconnected Soberanes fire example from this Eastern CONUS discussion."

Response: We thank the reviewer for this important insight. The revised manuscript removes the disconnected Soberanes example from the Eastern CONUS interpretation and avoids presenting high unmatched counts as a strength. The revised validation and tuning sections report regional performance objectively and interpret high unmatched rates as weaker tuning confidence rather than as automatic evidence of additional real fire activity.

Exact revised manuscript text in the subsection "Analysis workflow" in the "Threshold Tuning" subsection of "Data and Methods" section:

"Threshold selection was based on a multi-objective comparison of object-level agreement, area-level agreement, fragmentation, merging, and candidate-count behavior. Strict object precision, recall, and F1 measured whether individual CONFEX perimeters corresponded to individual MTBS perimeters under a one-to-one intersection-over-union (IoU) ≥ 0.10 matching rule. Area precision, area recall, and area F1 measured whether the regional union of CONFEX perimeters reproduced the total MTBS mapped area. Split counts identified MTBS fires represented by two or more CONFEX objects, while merge counts identified CONFEX objects overlapping two or more MTBS fires. The number of candidate CONFEX perimeters and the unmatched false-positive rate were used as additional diagnostics to avoid selecting thresholds that improved one metric by producing excessive fragmentation or many unmatched candidate fires. MTBS was used as a structural reference rather than a complete truth set for all fires; therefore, unmatched CONFEX detections were interpreted cautiously."

Specific comments

Specific Comment: FIRED description

Reviewer comment: **"L74: The manuscript incorrectly characterizes FIRED as a strictly "regionally focused effort" for CONUS, overlooking that it has already been expanded into a global fire perimeter dataset via the FIREDpy algorithm (Mahood et al., 2022, Scientific Data). Please update this statement and citation"**

Response: We revised the Introduction to state that FIRED began as a CONUS inventory and was later expanded into a global dataset, with the appropriate Mahood et al. citation.

Exact revised manuscript text in the "Introduction" section:

“Similarly, the FIRED (Fire Events Delineation) database (Balch et al., 2020) provides a comprehensive inventory for the CONUS and was later expanded into a global dataset (Mahood et al., 2022).”

Specific Comment: Background section too long

Reviewer comment: **“L100-152: The background section would be more effective if the discussion of the historical development of fire remote sensing were shortened and made more concise. At present, a substantial portion of the introduction reviews earlier satellite fire products and monitoring approaches, which is useful context but somewhat longer than necessary for a data description paper focused on presenting CONFEX. I suggest condensing this narrative and instead adding a summary table that compares the main existing datasets with CONFEX in terms of spatial coverage, temporal coverage, spatial resolution, event definition, and major strengths and limitations.”**

Response: We condensed the historical discussion and added a comparison table summarizing spatial coverage, temporal coverage, resolution, event definition, strengths, and limitations of existing products relative to CONFEX.

Exact revised “Introduction” section:

“Wildfire is a fundamental ecological process and a crucial component of the global carbon cycle (Santín et al., 2015). However, the implementation of fire suppression policies, curtailment of indigenous fire stewardship, mass deforestation of fire-resistant tall trees for fuel purposes, increased inhabitation of wildlands, and the influence of climate change, have contributed to the current intensifying fire regime (Greenler et al., 2024; Martinez et al., 2023; Copes-Gerbitz et al., 2024). Wildfire activity in the western fire regime of the continental United States has intensified significantly over the past two decades, and this increasing trend in frequency and severity is expected to continue (Westerling, 2016; Harvey, 2016; Westerling et al., 2006; Iglesias et al., 2022; Holden et al., 2018; Brown et al., 2004). Wildfire research and operational applications need accurate, detailed and spatially consistent datasets which can be utilized to study not only the spatial distribution of these fires, but also the temporal and spatial evolution of such fires, given the topographic expanse.

Wildfire-related data is traditionally acquired through manual or remote sensing methods. Manual data provides indispensable knowledge; however, this data is most accurate at urban or urban wildland interfaces, since these areas have been the priority for centuries. Remote sensing methods, utilizing satellite and low elevation airborne instruments, have emerged as a primary alternative. They typically use two distinct detection methods: active fire (AF) detections and burned area (BA) products. AF products identify instantaneous thermal anomalies at the time of satellite overpass by using the near infrared and mid-infrared spectral ranges (Schroeder et al., 2014). In contrast, BA products are based on detection of land-cover and moisture changes after a fire has already passed (Giglio et al., 2018). While BA products are valuable for mapping the final fire footprints, they are less suitable for rapid assessment because their algorithms require a sustained interval of post-fire observations to confirm surface changes (Chen et al., 2022). Seminal work by Giglio et al. (2006) established the foundational methodology for using AF pixel counts as a statistical proxy for burned area, at a coarse 1° resolution. Perimeter-based datasets generated from active fire detections are better for event-level analysis, as they synthesize these scattered detections into coherent fire objects that provide ignition and event duration information. Even in the absence of complex daily progression tracking, the provision of a validated ignition location, containment location, geometric centroid, and a precise temporal duration offers a level of operational detail that neither individual hotspots nor cumulative burned area grids can provide.

Over the past two decades, several fire event datasets have been developed to transition from pixel-level detections to object-based tracking. Global products like the Global Fire Atlas (Andela et al., 2019) and GlobFire (Artes et al., 2019) reconstruct fire events from the 500 m MODIS (Moderate Resolution Imaging Spectroradiometer) burned area product. Similarly, the FIRED (Fire Events Delineation) database (Balch et al., 2020) provides a comprehensive inventory for the CONUS and was later expanded into a global dataset (Mahood et al., 2022). Conversely, high-resolution datasets like FEDS (Fire Events Data Suite) (Chen et al., 2022) and Firelytics (McClure et al., 2023) leverage the 375 m Visible Infrared Imaging Radiometer Suite (VIIRS) active fire product but are geographically restricted to California. National products like MTBS (Monitoring Trends in Burn Severity) (Finco et al., 2012) offer 30 m resolution but are also limited by large fire area thresholds and omit the smaller events that comprise a significant portion of total fire counts. Table 1 summarizes these existing fire datasets and relevant foundational AF-based burned-area approaches and compares them with the CONUS Fire Extent (CONFEX) database.

Table 1. Comparison of existing fire datasets and relevant foundational approaches with CONFEX.

Dataset	Spatial coverage	Temporal coverage	Spatial resolution	Event definition / basis	Major strengths	Major limitations
Giglio et al. (2006)	Global	2000–2005	1° (~110 km)	Monthly gridded counts of active fire pixels	Foundational statistical methodology relating hotspots to burned area	Coarse resolution; monthly snapshots rather than event-level tracking.
Global Fire Atlas	Global	2003–2016	500 m	Fire events reconstructed from the MODIS burned area product by tracking daily burned pixel progression	Global consistency: useful for fire growth dynamics and spread direction	Coarser spatial resolution: dependent on MODIS burned area product.
FRY	Global	MODIS: 2000–2017; MERIS: 2005–2017	300–500 m	Burned pixels grouped into consistent fire patches based on morphological traits	Provides morphological fire traits; two spatial-resolution products	Older temporal coverage; based on burned area products.
GlobFire	Global	2001–2017	MODIS-based	Globally harmonized fire perimeters using threshold-based merging of MODIS detections	Globally harmonized fire perimeters	Coarser spatial basis; older temporal coverage.
FIRED	Global	2001–2021	500 m	Fire inventory derived from MODIS burned area data	Broad inventory; widely useful for regional analyses	Coarser spatial resolution.
FEDS	Primarily California	2012–2020	375 m	VIIRS-based fire event delineation with dynamic characterization	Higher spatial resolution; dynamic characterization	Restricted geographic scope; outdated temporal coverage.
Firelytics	Primarily California	2012–2022	375 m	VIIRS data and state agency records used to	Rich, high-resolution fire characterization	Restricted geographic scope.

				generate dynamic fire characterization		
Short (2022)	CONUS	1992–2020	Ground-based compilation	Fire entries obtained from local, state, and federal organizations	One of the most comprehensive ground-based datasets for CONUS; long record	Outdated temporal coverage; not a spatially consistent satellite-derived event product.
FRAP	California	Multi-year state record	Ground/ incident based	Ground-based reports and incident records	Comprehensive wildfire database for California; can complement spaceborne datasets for validation and analysis	Restricted geographic scope; not directly derived from satellites.
MTBS	CONUS, Alaska, and Hawaii	Multi-decadal	30 m	Landsat-based extent of fire and burn severity for large fires (>500 acres in the eastern CONUS and >1000 acres in the western CONUS and Alaska)	High spatial resolution; extent and burn-severity information	Omits smaller fires due to large-fire thresholds.
CONFEX	CONUS and Alaska	2012–2024	375 m	VIIRS S-NPP (Suomi National Polar-orbiting Partnership) active fire detections aggregated into fire events, perimeters, centroids, and ignition locations	Moderately high spatial resolution; broad spatial coverage; high temporal resolution; publicly accessible record	Dependent on active fire detections and event delineation assumptions.

The CONUS Fire Extent (CONFEX) database was developed to address the lack of a spatially consistent, moderately high-resolution fire event product for the entirety of CONUS and Alaska. To date, no publicly available dataset provides high-temporal-resolution (twice-daily), event-level fire perimeters at 375 m spatial resolution across CONUS and Alaska using the VIIRS S-NPP active fire product. Existing products are either too coarse (MODIS/FIRED), geographically limited (FRAP/FEDS), omit smaller fires (MTBS), or lack perimeter geometry (NASA FIRMS (National Aeronautics and Space Administration Fire Information for Resource Management System) hotspots). CONFEX fills this gap by providing a comprehensive, VIIRS-based event inventory with perimeters, centroids, ignition timing and location, containment timing and location, and duration estimates for 2012–2024. By utilizing the VIIRS S-NPP 375 m active fire product, CONFEX converts scattered hotspot detections into interpretable fire objects, thus offering a foundational resource for understanding fire regimes at a national scale with high temporal frequency.

Section 2 presents the data and methods. Section 3 presents the results and discussion. Section 4 summarizes the main conclusions.

Specific Comment: Chebyshev metric interpretation

Reviewer comment: "L202: An important methodological consideration concerns the geometric implication of using the Chebyshev metric in the normalized spatiotemporal feature space. As described in the manuscript, this choice enforces independent hard

thresholds in each dimension, which implies an axis-aligned square neighborhood in the spatial plane rather than a circular Euclidean neighborhood. Consequently, two hotspots can be linked even when their Euclidean separation exceeds 2000 m, provided that their separations along both coordinate axes remain within the 2000 m threshold, whereas two hotspots separated by slightly more than 2000 m along a single axis are forced into different clusters. This is a defensible design choice, but it has a clear physical interpretation that should be stated more explicitly. I therefore suggest that the authors either justify why a square spatial neighborhood is appropriate for this application, or provide a sensitivity comparison with an alternative formulation."

Response: We expanded the method description to explain that Chebyshev distance enforces independent hard thresholds in x, y, and time, preventing a large separation in one dimension from being offset by a small separation in another.

Exact revised manuscript text in the "Spatiotemporal Clustering Algorithm" subsection of "Data and Methods" section:

"Unlike the Euclidean metric, which allows for tradeoffs among dimensions, the Chebyshev metric requires detections to remain within the specified maximum separation in each normalized coordinate to be linked, defining an axis-aligned square (Chebyshev) neighborhood rather than a circular (Euclidean) neighborhood. In this formulation, detections are grouped only when they satisfy both the spatial threshold and the temporal threshold, rather than compensating for a larger separation in one dimension by a smaller separation in another. For fire event delineation, this is appropriate for our event-definition objective, as spatial continuity and temporal persistence are treated as separate constraints. Therefore, it reduces chaining errors in which unrelated ignitions could otherwise be merged through intermediate detections across longer time spans. This design is consistent with the broader spatiotemporal event-grouping logic used in contemporary fire datasets (Li et al., 2023; Chuvieco et al., 2019; Park et al., 2025), while providing stricter control over independent space–time linking."

Specific Comment: NLCD baseline year

Reviewer comment: **"L209-211: Applying a static 2016 NLCD layer uniformly to classify fires from 2012– 2024 could introduce classification inconsistencies due to land cover change. The authors should consider using time-matched land cover epochs or discuss the uncertainty introduced by a single baseline year."**

Response: We thank the reviewer for this important suggestion. The CONUS workflow now uses NLCD data across 2012-2024 rather than a single static CONUS layer. For Alaska, NLCD 2016 is still used because it is the only NLCD product available for Alaska during the study period, and this limitation is now stated.

Exact revised manuscript text in the "Spatiotemporal Clustering Algorithm" subsection of "Data and Methods" section:

"For CONUS, NLCD data (2012-2024) were sampled in the CONUS processing workflow, while for Alaska, NLCD 2016 was used throughout because it is the only NLCD product available for Alaska during the study period."

Specific Comment: Workflow figure branching logic

Reviewer comment: **“Figure 3 is oversimplified in several important respects. The diagram does not clearly show the branching logic for 1–2 point, 3-point, and ≥4-point clusters, even though these cases are handled differently in the algorithm.”**

Response: We thank the reviewer for this suggestion. The workflow figure was revised to make the perimeter-reconstruction branching logic explicit. In the revised workflow, 1–2 point clusters are excluded from the final released product, 3-point clusters are handled using collinearity-dependent logic, and clusters with ≥4 hotspots are reconstructed using alpha shapes with convex-hull fallback.

Exact revised figure in the “Spatiotemporal Clustering Algorithm” subsection:

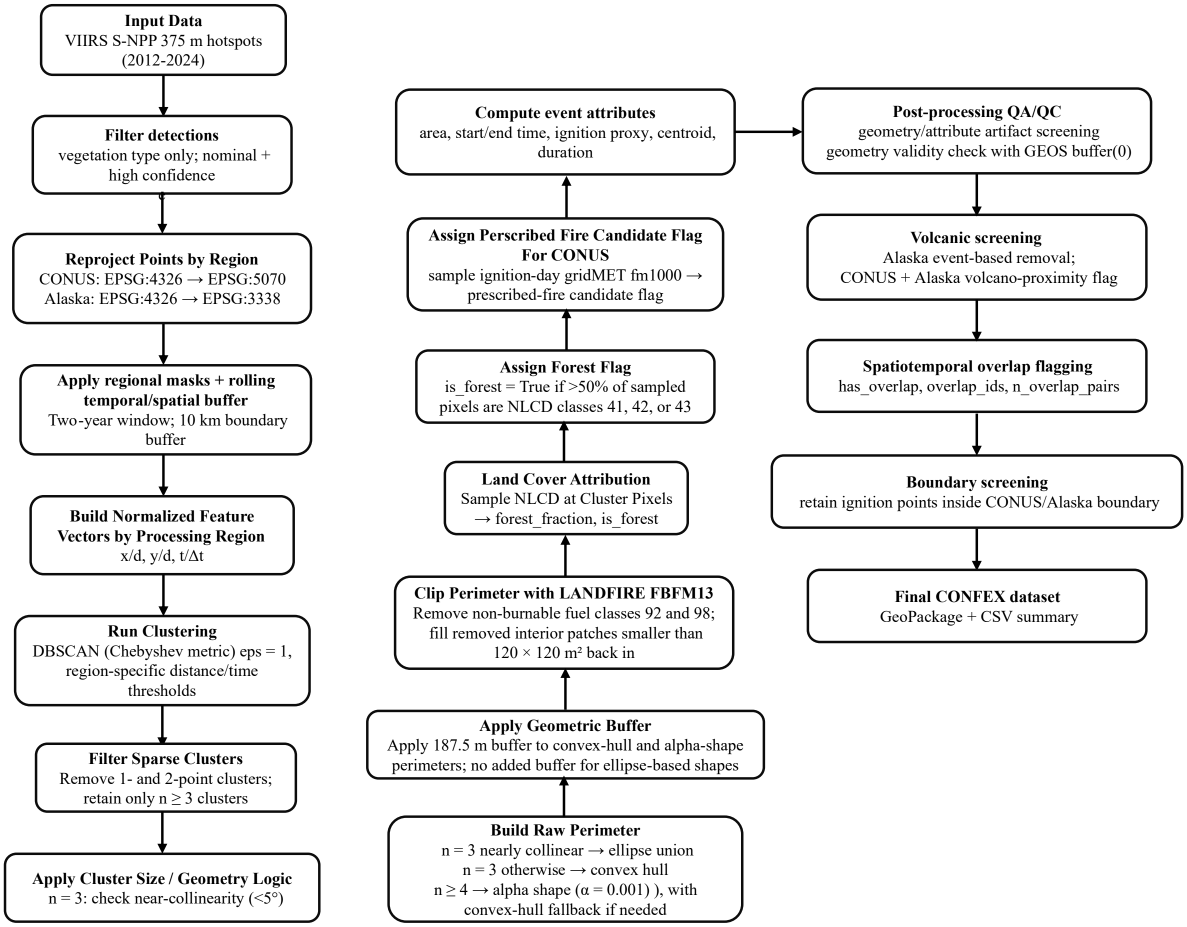

Figure 1. CONFEX processing workflow from VIIRS S-NPP 375 m active fire detections to final fire-event perimeters. The diagram highlights regional projection handling, normalized spatiotemporal DBSCAN clustering with the Chebyshev metric, cluster-size- dependent perimeter reconstruction, post-processing quality control, volcanic screening, overlap flagging, and final boundary screening.

Specific Comment: Alpha-shape parameter grid

Reviewer comment: **“L247: In the Parameter Tuning Section, the alpha-shape parameter of 1, 0.01, and 0.001 was checked, but there appears to be a geometric mismatch between these values and the 375 m nominal spatial resolution of the VIIRS detections. Based on the**

formulation where retained triangles must have a circumradius < 1/alpha, testing alpha = 1 and alpha = 0.01 translates to thresholds of 1 m and 100 m, respectively, which are geometrically highly restrictive given the 375 m pixel spacing and would likely reject almost all triangles. Consequently, the selection of alpha = 0.001 (a 1000 m threshold) might appear optimal primarily because the other two values fall well below the spatial limit of the sensor, rather than representing a comprehensive tuning of the algorithm's behavior."

Response: We thank the reviewer for this suggestion. The revised regional tuning uses a more appropriate alpha grid of 0.0001, 0.0005, and 0.001, which better matches the spatial scale of VIIRS detections.

Exact revised manuscript text in the subsection "Analysis workflow" in the "Threshold Tuning" subsection of "Data and Methods" section:

"The tested grid spanned distance thresholds from 750 to 4000 m (250 m interval), temporal thresholds from 48 to 504 h (24 h interval), and alpha values of 0.0001, 0.0005, and 0.001."

Specific Comment: Overlap verification and fragmentation

Reviewer comment: **"L273: The statement "it is also possible that these two groups overlap" is too tentative in this context. It would be preferable to verify this directly with a spatial analysis and report the result explicitly, rather than leaving the relationship between the two groups uncertain. Clarifying this point would make the validation discussion more precise and easier to follow."**

Response: We thank the reviewer for this suggestion. We replaced speculative language with explicit spatial diagnostics. The revised validation computes pairwise polygon intersections, fragmentation, merging, relaxed overlap, and near/far unmatched counts. The final dataset also includes spatiotemporal overlap flags.

Exact revised manuscript text:

"Validation used the same object-based, area-based, fragmentation, merging, and near/far unmatched diagnostics described in the threshold-tuning workflow."

Specific Comment: Role of FRAP

Reviewer comment: **"L280-282: The discussion of FRAP durations is helpful, but I think the role of FRAP in the validation framework should be clarified. If the authors conclude that FRAP durations are not representative of actual fire spread or acreage, it becomes somewhat unclear how this dataset can still serve as a benchmark for evaluating the temporal performance of CONFEX. I suggest that the authors explain more explicitly which aspects of FRAP remain suitable for comparison and which should be treated with caution."**

Response: We thank the reviewer for this suggestion. We clarified that FRAP is used as an additional California spatial comparison dataset, not as a universal benchmark for active-fire temporal behavior. FRAP remains useful for evaluating spatial agreement with mapped California fire perimeters, while incident durations and administrative event definitions are interpreted cautiously.

Exact revised manuscript text:

“Validation used temporal matching to align CONFEX and reference fire events by year/date, while the performance assessment focused primarily on spatial agreement. MTBS burn boundaries are derived from Landsat-based burned-area mapping and depend on the availability of suitable pre- and post-fire imagery (MTBS, 2024), whereas FRAP provides an incident-based historical fire perimeter dataset for California (CAL FIRE, 2025). Accordingly, temporal information was used to restrict candidate matches to corresponding events, and object matching and performance metrics were based on spatial overlap diagnostics.”

Specific Comment: 2024 validation data

Reviewer comment: **“L287, 310-311: Please explain why the 2024 data for both MTBS and FRAP were excluded from the validation analyses, given that both are currently available and the CONFEX dataset extends to 2024.”**

Response: The validation has been updated to include the full 2012-2024 CONFEX period where reference data are available, and the final validation script summarizes yearly, all-years, and non-tuning-year validation.

Exact revised manuscript text:

“Validation was summarized for each year from 2012-2024, for all years combined, and for non-tuning years after excluding each region’s tuning year.”

Specific Comment: Wildfire versus broader fire events

Reviewer comment: **“L337-338: The manuscript describes CONFEX as a wildfire database, but some of the detected large fire events in regions such as Florida may include prescribed burns. Because prescribed fires and wildfires can differ in their drivers and behavior, it would be helpful for the authors to clarify whether the current product represents wildfire only or a broader fire-event database.”**

Response: We thank the reviewer for highlighting this important distinction. CONFEX is a broader VIIRS-derived fire-event perimeter database that captures wildfires, prescribed fires, and other vegetation-fire events. The dataset prioritizes wildfires but includes other fire types detected by VIIRS. The revised manuscript clarifies this point and adds a prescribed-fire candidate attribute for CONUS based on 1000-hour dead fuel moisture following Chen et al. (2022) and also a volcanic event flag based on the NOAA/NCEI Global Volcano Locations Database.

Exact revised manuscript text:

Introduction:

“The CONUS Fire Extent (CONFEX) database was developed to address the lack of a spatially consistent, moderately high-resolution fire event product for the entirety of CONUS and Alaska.”

Dataset Limitations:

“CONFEX was developed for wildfire applications but unavoidably includes prescribed burns, other vegetation fires, and potential volcanic thermal detections identified by VIIRS. These probabilistic prescribed-fire candidates and volcanic events are flagged rather than filtered to maintain detection completeness, making CONFEX a fire-event database rather than a strictly wildfire database.”

Specific Comment: Alaska ecoregion terminology

Reviewer comment: **“L359-360: The sentence stating that Alaskan fires are "spread across two different ecoregions of boreal and tundra forests" contains two errors. The term "tundra forests" is ecologically incorrect. By definition, the tundra biome is characterized by the absence of trees. Alaska comprises more than two Level I ecoregions. According to the standard Commission for Environmental Cooperation (CEC) framework, Alaska also includes Marine West Coast Forests, and Northwestern Forested Mountains. Please rephrase to use accurate ecological terminology.”**

Response: We thank the reviewer for identifying the ecological inaccuracy. We revised the Alaska discussion to eliminate "tundra forests" and accurately describe Alaska's fire-prone ecoregions using EPA Level III terminology (boreal forest, tundra, and other ecoregions).

Exact revised manuscript text:

"Understanding the fire regime of Alaska presents unique challenges, as the fire occurrences are sparse and spread across boreal forest, tundra, and other ecoregions (Kasischke & Turetsky, 2006; Mack et al., 2011; US EPA, 2015). The boreal fire regime is well documented through manual datasets, however, there isn't adequate manual data about the tundra and remote areas owing to sparse population and limited reporting coverage (Jenkins et al., 2014)."

Specific Comment: Strict 48-hour threshold in Alaska

Reviewer comment: **“L378-379: Applying a strict 48-hour "hard threshold" makes the algorithm highly vulnerable in regions known for prolonged cloudiness, such as Alaska. If a fire smolders under cloud cover for three days without a satellite pass, the rigid cutoff will artificially split one continuous fire into multiple separate events. I suggest exploring or discussing the feasibility of a dynamically adjusted temporal threshold to enhance robustness against missing data.”**

Response: We thank the reviewer for this important suggestion. The revised workflow no longer applies a uniform 48-hour temporal threshold to Alaska. Alaska now uses a regionally selected 360-hour temporal threshold based on tuning against MTBS.

Exact revised manuscript text from “Table 3. Final selected and working thresholds with regional interpretation”:

“Retained as the earliest defensible plateau point. At 2500 m, the 360 h run is the first setting where area F1 has already reached the Alaska performance plateau while split has fallen to a low stable value. Longer windows provide only small strict-object-F1 gains but require more aggressive temporal linkage and do not provide a commensurate geometric improvement.”

Specific Comment: Figures S1 and S2

Reviewer comment: “Figures S1 and S2: Please redraw with appropriate y-axis limits. The tallest CONFEX bars are visibly truncated in Figure S1, preventing full inspection of the data.”

Response: We thank the reviewer for this important observation. We redrew the supplementary figures with corrected y-axis limits so the tallest bars are not truncated.

Specific Comment: Events with fewer than three detections

Reviewer comment: **“Supplement L67-70: The authors mention in S2 that events with < 3 detections have "associated uncertainty". This is a severe understatement. A single VIIRS 375m pixel covers approximately 35 acres. If an event has only 1 or 2 detections, its true physical footprint cannot exceed 100 acres. If such events are somehow bypassing the 500-acre or 1000-acre filters, it proves that the current algorithm is generating massive, physically impossible areas.”**

Response: We agree with the reviewer. To address this concern, the final released product now excludes 1- and 2-point clusters and treats them as noise. In addition, we added a post-processing quality-control step to remove suspicious low-hotspot artifacts, including low-hotspot large-area perimeters and low-hotspot long-duration perimeters. The revised manuscript now states that these features were evaluated as suspicious perimeter-shape indicators and that low-hotspot large-area perimeters were among the features removed automatically from the cleaned release.

Exact revised manuscript text:

“Clusters with 1 or 2 points were excluded from the final released product and treated as noise.”

And in Section 2.5:

“Only the most clearly suspicious features were removed automatically from the cleaned release. These consisted of high elongation, near-zero area, elongated low-hotspot geometries, small highly elongated geometries, low-hotspot long-duration perimeters, and low-hotspot large-area perimeters.”

Specific Comment: Nevada/Utah reversal

Reviewer comment: **“Supplement L72-73: Throughout the manuscript and in Figure S5, the authors claim that CONFEX consistently detects more fire events than MTBS due to its high-resolution clustering. However, Figure S5 clearly shows a distinct reversal in Nevada (and to a lesser extent, Utah), where MTBS reports more >1000-acre fires than CONFEX. The authors should explicitly explain this discrepancy.”**

Response: We revised the statement, so it no longer claims that CONFEX consistently detects more events in every state. The results now treat state-level differences as regionally variable and interprets areas where MTBS exceeds CONFEX cautiously.

Specific Comment: Quantify fragments

Reviewer comment: **“Supplement L98: The authors use highly speculative language to explain the data discrepancies: "many of which may be near or just above and perhaps smaller, spatially fractured burns...". The authors have the shapefiles for both CONFEX and MTBS. They should perform a simple spatial intersection to quantitatively report exactly how many extra CONFEX polygons are fragments of a single MTBS fire, and how many are genuinely new ignitions.”**

Response: We added quantitative fragmentation and merging diagnostics. Fragmentation is defined as one reference perimeter overlapping two or more CONFEX objects, and merging is defined as one CONFEX object overlapping two or more reference perimeters.

Exact revised manuscript text:

“Split counts identified MTBS fires represented by two or more CONFEX objects, while merge counts identified CONFEX objects overlapping two or more MTBS fires.”

Reviewer comment: “**Supplement S1.2 and S2.2: The claim that CONFEX registers more events because its resolution "resolves more distinct events" is contradictory. Given the 48-hour temporal truncation issue identified in the main text (which fragmented 16 FRAP fires into 88 pieces), the inflated CONFEX counts are demonstrably driven by algorithmic over-fragmentation, not solely superior detection.”**

Response: We agree that higher CONFEX counts should not be attributed solely to superior detection. We revised the text to clarify that increased counts can arise from both the higher temporal/spatial sampling of VIIRS and the event-definition choices in CONFEX, including temporal truncation and fragmentation of long-duration fires. We now describe this as a limitation and avoid implying that all additional CONFEX objects represent independent new ignitions.

Exact revised manuscript text to add:

“Higher CONFEX event counts should therefore be interpreted cautiously. Some additional CONFEX objects may represent distinct detections or smaller fires not mapped by MTBS, whereas others may result from algorithmic fragmentation caused by temporal gaps, cloud obscuration, or the fixed temporal clustering window.”

Specific Comment: Data structure and shapefile fields

Reviewer comment: **“Data Structure: The released shapefile attributes are difficult to interpret because several field names have been truncated to meet the 10-character limit of the shapefile format. For example, columns such as "centroid_l", and "centroid_1" are no longer self-explanatory, which increases the risk of misinterpretation. I suggest either shortening all exported field names to clear, unambiguous names within the shapefile limit, or preferably using GeoPackage as the primary distributed vector format, since it preserves full field names and avoids this limitation.”**

Response: We completely agree with the reviewer. We revised the data-release format so that GeoPackage is the primary distributed vector format. GeoPackage preserves full attribute names and geospatial metadata, avoiding the 10-character field-name limitation of shapefiles.

Specific Comment: Geospatial artifacts from LANDFIRE raster mask

Reviewer comment: **“Geospatial Artifacts: Visual inspection of the vector perimeters (e.g., cluster_final=79727 in 2017) reveals severe geometric artifacts. The perimeters exhibit highly fragmented boundaries and deep, orthogonal "stair-step" trenches. These artifacts appear to be caused by using a high-resolution 30 m raster mask (LANDFIRE) to hard-clip perimeters derived from 375 m VIIRS detections, imprinting the arbitrary 30m raster grid onto the vector dataset. The authors should discuss whether additional geometric smoothing or topological cleaning is warranted.”**

Response: We agree with the reviewer. We revised the masking workflow to reduce raster-imprinted artifacts. In the updated workflow, only snow/ice and open water are removed from the LANDFIRE nonburnable mask, while urban/developed and bare-ground classes are no longer used for clipping because they produced staircase artifacts. We also added small-hole filling and geometry/attribute quality control to reduce remaining artifacts.

Exact revised manuscript text:

"To create the mask, we used classes 92 (NB2 Snow/Ice: perennial snow or ice) and 98 (NB8 Open Water: lakes, rivers, reservoirs, and other water surfaces). The classes 91 (NB1 Urban / Developed) and 99 (NB9 Bare Ground: land devoid of enough fuel to support wildland fire spread) were not included because they created staircase artifacts in the dataset."

Specific Comment: References and ESSD data citation guidelines

Reviewer comment: "References: The reference list appears to contain several entries that are not cited in the main text (e.g., Bright et al., 2019; Giglio and Kendall, 2001; Itten et al., 2008; Marks-Block and Tripp, 2021; Urbanski et al., 2018; van Marle et al., 2017; van Wees et al., 2022). All dataset and institutional citations must be reformatted to adhere to the strict ESSD data citation guidelines. Please add missing DOIs where available."

Response: We agree with the reviewer. The reference list was reviewed to remove uncited entries, add missing dataset citations where needed, and reformat dataset and institutional references closer to ESSD data-citation style, including dataset title, version where applicable, repository or institution, DOI when available, and access date.

Technical corrections

Reviewer comment: "L21: Replace "thirst" with a more formal academic term."

Response: We thank the reviewer for this great suggestion. It has been revised to "increased inhabitation of wildlands."

Reviewer comment: "L59: Replace "nearest infrared" with "near infrared.""

Response: We thank the reviewer for this great suggestion. It has been corrected during the revision process.

Reviewer comment: "L71: Remove the redundant closing parenthesis after "2005-2017))"."

Response: We thank the reviewer for this great suggestion. It has been corrected during Introduction restructuring.

Reviewer comment: "L152: "Figure 1" is a tabular representation and should be relabeled as "Table 1"."

Response: The former channel figure was converted to a table; in the revised manuscript it is Table 2 because Table 1 is the dataset-comparison table.

Reviewer comment: "L256: Replace the colloquial idiom "hit the sweet spot" with a formal expression."

Response: We thank the reviewer for this important suggestion. The phrase has been removed in the revised script, and informal words have been avoided during the revision process.

Reviewer comment: "L275, 286, 292: Figures and tables should be cited in the main text in the order of their first appearance. At present, the manuscript refers to Figure 9a in Section 3.5 before earlier figures such as Figure 6 are introduced, and some display items, including Figure 5 and Table 4, do not appear to have clear in-text callouts in the relevant discussion. The authors should therefore revise the numbering and citation order so that all figures and

tables are introduced sequentially and explicitly referenced at the appropriate places in the text"

Response: Figure and table numbering were revised to follow their first appearance.

Reviewer comment: "L325, 346: Use km² rather than Km2."

Response: We thank the reviewer for this suggestion. It has been corrected throughout.

Reviewer comment: "L337: Revise "Florida has highest number" to "Florida has the highest number""

Response: Revised to "Florida has the highest number."

Reviewer comment: "L364-365: Change "reliant" to "reliable.""

Response: Revised "less reliant" to "less reliable."

Reviewer comment: "L404: Replace "have-it-all.""

Response: We thank the reviewer for this great suggestion. The phrase has been removed in the revised script.

Reviewer comment: "Define abbreviations such as FRP, DBSCAN, HDBSCAN, MTBS, FRAP, and VIIRS at first mention."

Response: Abbreviations were checked and defined at first mention in the revised manuscript.