Amendment to Reply to Reviewer 4 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.

General Comment: Qadiri and Cerrai present a new fire event dataset for the continental US (CONUS) and Alaska using clusters of active fire detections from the Suomi-NPP VIIRS instrument. The CONFEX dataset provides an estimated size and duration of individual fire events on an annual basis, with corrections to the estimated area of active fire clusters to remove areas without burnable fuels. CONFEX provides a set of attributes derived from the clustered fire detections for each fire perimeter, including start date and location, end date, duration, and size. Data from the Monitoring Trends in Burn Severity (MTBS) dataset were used to provide initial validation of large fire events in the overlapping time period (2012-2023).

General Response: We thank Reviewer 4 for the detailed evaluation and for recognizing the potential value of the CONFEX dataset. The manuscript has been substantially revised to address concerns related to validation depth, regional interpretation, comparison with existing fire datasets, and methodological clarity. In particular, we expanded the validation framework beyond the original MTBS comparison to include MTBS, FRAP, GeoMAC, and WFIGS where available; added area-based, object-level, merge/split, unmatched-object, overlap, and clean one-to-one diagnostics; clarified the distinction between active-fire-derived event perimeters and burned-area products; and expanded the discussion of uncertainty, regional limitations, and appropriate dataset interpretation.

MAJOR COMMENT

Reviewer comment: "The paper provides summary statistics for initial comparisons with MTBS data, but the limited information on matched and unmatched fires does not provide sufficient context for the potential strengths or limitations of the CONFEX data compared to MTBS. For example, the processing approach for CONFEX is retrospective, and the time lags for data production are not specified, such that it is unclear what the potential advantage of CONFEX would be for fires that also appear in the MTBS record. Further, the dataset provides a small subset of characteristics for each event, with few derived estimates of fire behavior compared to existing databases like FIRED, FEDS, or the Global Fire Atlas. What do clusters represent in

this analysis, and do they provide further insights into periods of growth or other patterns? What potential uses are there for the specific attributes associated with each CONFEX cluster?"

Response: We thank the reviewer for this important comment. We revised the manuscript to provide more context for matched and unmatched CONFEX comparisons with MTBS and other reference datasets. The revised threshold-tuning and validation framework now includes object-level agreement, area-level agreement, split/fragmentation diagnostics, merge diagnostics, candidate counts, unmatched-object diagnostics, overlap diagnostics, and clean one-to-one correspondence, rather than relying only on summary F1 values. We also clarified that MTBS is used as a structural reference rather than a complete truth set, so unmatched CONFEX detections are interpreted cautiously.

We also clarified what clusters represent in CONFEX. A cluster is the group of VIIRS hotspot detections identified by DBSCAN, a fire event is the retained geospatial object represented by that cluster after filtering and attribution, and the fire perimeter is the polygon generated from those detections. CONFEX is therefore best interpreted as a retrospective event-level perimeter and attribute database, not a near-real-time fire-progression or spread-dynamics product. The current product does not estimate daily fire progression, spread vectors, spread rate, or fire-line movement. Its main advantages are broad CONUS and Alaska coverage, VIIRS-derived event perimeters, ignition-proxy timing and location, centroid, duration, mapped area, and diagnostic context that can support regional fire-event characterization, historical inventory development for VIIRS-detected fires, ignition-focused studies, and comparison with other fire inventories.

Revised manuscript text: "Parameter performance was evaluated using a multi-objective set of diagnostics capturing area agreement, object-level correspondence, split, merging, and unmatched candidate behavior. Area precision, area recall, and area F1 were computed from unioned CONFEX and reference geometries within the target year. Area precision and merge diagnostics were used to avoid selecting overly permissive thresholds that increased apparent area recall by producing inflated or unrealistically merged perimeters."

"Object-level precision, object-level recall, and object-level F1 were computed using greedy one-to-one matching between CONFEX and reference objects under any positive spatial overlap, with overlapping candidate pairs ordered by intersection over union (IoU). IoU was used only to rank overlapping candidate pairs during greedy matching. Split, merge, candidate-count, unmatched-object, and clean one-to-one diagnostics were then used to avoid selecting thresholds that produced excessive split, unsupported candidate fire-event objects, or unrealistically merged perimeters."

Additional revised manuscript text: "Each cluster is taken as a candidate fire event object. In this study, a cluster refers to the group of VIIRS hotspot detections identified by DBSCAN, a fire event refers to the retained geospatial object represented by that cluster after filtering and attribution, and the fire perimeter refers to the polygon geometry generated from the cluster detections."

Additional revised manuscript text: "The database is retrospective and does not currently provide daily fire progression, spread vectors, spread rate, or fire-line movement."

Additional revised manuscript text: "By providing consistent VIIRS-derived event perimeters, ignition-proxy locations, timing attributes, duration, centroid locations, mapped area, and diagnostic context across the full 2012-2024 study period, CONFEX can support regional fire-regime analysis, historical inventory development for VIIRS-detected fire events, ignition-focused studies using first-detection proxies, stratified analyses by land-cover setting and ecoregion, and evaluation of differences between VIIRS-derived fire-event records and existing perimeter datasets."

Reviewer Comment: In addition, the descriptive material in the Results and Supplement lacks depth and context. What drives the differences between CONFEX and MTBS data by region, by state, or by year? How would one interpret the increase in fire events in VIIRS for specific seasons or land cover types relative to material in MTBS? What might be the advantages of CONFEX in these circumstances? These concepts are not clearly explored or explained.

Response: We thank the reviewer for this important comment. We agree that additional context was needed to interpret differences between CONFEX and MTBS across regions, states, years, seasons, and land-cover contexts. In the revised manuscript, we expanded the Methods, Results, and Discussion to include regional tuning rationale, validation metrics, and interpretation of regional performance differences. We clarified that differences between CONFEX and MTBS arise from both dataset characteristics and regional fire-regime differences. MTBS is a Landsat-based burned-area product with large-fire reporting thresholds, while CONFEX is derived from VIIRS active-fire detections and can identify candidate smaller, shorter-duration, managed, or temporally separated fire-event objects that may not appear in MTBS.

We also added regional and state-level thresholded comparisons, annual fire-count and mapped-area summaries, seasonal summaries, Level III ecoregion summaries, and managed-fire candidate interpretation. These additions clarify that higher CONFEX counts relative to MTBS should not be interpreted as a direct one-to-one increase in confirmed fire events. Instead, they may reflect additional VIIRS-detected fire activity, prescribed or managed burning, reference-dataset incompleteness, or different event definitions.. A full causal attribution of all state, seasonal, and land-cover differences is beyond the scope of this data-description article, but the revised dataset structure, event-level attributes, and tabular release files are intended to support future stratified analyses. CONFEX is therefore presented as complementary to MTBS rather than a replacement, with advantages in providing VIIRS-derived event perimeters, ignition-proxy timing and location, duration, centroid, mapped area, and diagnostic attributes for fire-regime analysis, ignition-focused studies, and comparison with other fire inventories.

Revised manuscript text:

“Lower area scores in the Midwest, Appalachian-Mid-Atlantic, and southeastern CONUS regions should be interpreted in relation to fire regime and reference-dataset coverage. These regions contain many smaller fires, managed burns, and fire activity that may fall below MTBS reporting thresholds or outside operational perimeter reporting. Consequently, lower object precision or lower unrestricted area precision does not necessarily indicate that all additional CONFEX objects are errors. Rather, it reflects the difficulty of comparing a detection-derived object inventory with perimeter datasets that preferentially represent larger fires or operationally mapped events. Northeast results were interpreted primarily using WFIGS because MTBS contained too few VIIRS-era reference fires in that region for stable regional validation.”

Additional revised manuscript text:

“State-level thresholded comparisons showed that CONFEX did not exceed MTBS in every state. After applying MTBS-size thresholds at the state level, CONFEX had more above-threshold objects than MTBS in 35 states, whereas MTBS had more above-threshold fires in 8 states. Area differences were also regionally variable: CONFEX thresholded area was higher in 29 states, MTBS thresholded area was higher in 9 states, and 5 states were within 5 %. These results show that state-level differences are not a uniform resolution-driven increase in CONFEX relative to MTBS.”

Additional revised manuscript text:

“Monthly fire counts show a strong bimodal seasonal pattern, with peaks in March–April and October–November. The derived managed-fire candidate classification indicates that this count-based bimodality is partly associated with managed-fire candidate fire-event objects, but not exclusively so. In CONUS, 62.7 % of March–April fire objects and 52.1 % of October–November fire objects were classified as managed-fire candidates, compared with 31.5 % during June–August. Summer months therefore show a greater relative contribution from wildfire-season activity, while Alaska differs from the CONUS pattern and shows a summer-dominated fire season, with the highest number of fire objects in June and July.”

Additional revised manuscript text:

“Despite these limitations, CONFEX provides a broad-domain, moderately high-resolution fire-event perimeter and attribute database for CONUS and Alaska. By providing consistent VIIRS-derived event perimeters, ignition-proxy locations, timing attributes, duration, centroid locations, mapped area, and diagnostic context across the full 2012-2024 study period, CONFEX can support regional fire-regime analysis, historical inventory development for VIIRS-detected fire events, ignition-focused studies using first-detection proxies, stratified analyses by land-cover setting and ecoregion, and evaluation of differences between VIIRS-derived fire-event records and existing perimeter datasets.”

Reviewer comment: **2. “Methods: the full history of active fire detection by satellite is not needed.”**

Response: We thank the reviewer for this suggestion. We agree that the full history of satellite active-fire detection was not needed. In the revised manuscript, the standalone background discussion was removed or condensed, and the Methods now focus only on the VIIRS S-NPP 375 m active-fire product used to generate CONFEX. Concise product details were retained in the “Data Sources and Preprocessing” subsection, including the VNP14IMGML source, temporal coverage, relevant VIIRS channels, vegetation-fire filtering, and confidence-screening steps.

Revised manuscript text: “We used the standard VNP14IMGML (Suomi-NPP VIIRS 375 m ASCII fire location data) CSV data from the NASA FIRMS (NASA FIRMS, n.d.) for the period 2012–2024, which is the VIIRS-SNPP 375 m active fire product.”

“Additional historical background on satellite active-fire detection and the development of MODIS and VIIRS fire products is provided in Supplementary Note S1, and the VIIRS channels used in the 375 m active-fire detection algorithm are summarized in Supplementary Table S1.”

Reviewer comment: **3. Methods: the calibration of the clustering approach (2000 m, 48 h) uses FRAP data from 2020. Does this approach work universally across the three primary study regions (Alaska, Western US, Eastern US)? Existing databases use much longer time intervals to account for observational constraints and episodic changes in fire behavior (FIRED 11 days (from burned area), FEDS 5 days). What impact does this shorter clustering interval have on fragmentation of fire events in CONFEX?**

Response: We thank the reviewer for this important comment. We agree that applying the original California-derived 2000 m / 48 h threshold universally across CONUS and Alaska was not sufficient. In the revised workflow, the California-only calibration has been replaced with region-specific threshold tuning across seven broad regions: Alaska, CONUS West, Southwest and Southern Plains, Southeast, Eastern Midwest/Appalachian-Mid-Atlantic, Western Midwest/Northern Plains, and Northeast. MTBS was used for tuning where sufficient regional reference fires were available, while the Northeast was tuned using WFIGS because MTBS contained too few VIIRS-era reference fires for stable regional parameter selection. This directly addresses parameter transferability by allowing the clustering distance, temporal window, and alpha-shape value to vary by region.

The impact of shorter temporal windows on fragmentation is now explicitly considered in the tuning framework. Split counts were used to identify reference perimeters represented by multiple CONFEX objects, while merge counts were used to identify CONFEX objects overlapping multiple reference perimeters. Final thresholds were selected using object agreement, area agreement, fragmentation, merging, unmatched-object behavior, and candidate-count behavior rather than F1 score alone. For example, Alaska retained a much longer temporal window of 384 h to accommodate sparse detections and long-duration northern fire events, while several CONUS regions retained shorter windows where longer thresholds did not provide a defensible improvement. The revised manuscript therefore no longer assumes that the 48 h window works universally; instead, fragmentation is treated as a diagnostic in selecting regional thresholds and as a remaining limitation in more weakly constrained regions. Fragmentation was also considered in the final validation framework through object-based, area-based, split, merge, unmatched-object, and clean one-to-one diagnostics.

Revised manuscript text: “We tuned the clustering distance, temporal-window, and alpha-shape thresholds using MTBS reference perimeters, which apply different mapping thresholds in the western and eastern United States. The parameter-tuning validation was performed separately across seven broad regions to provide a practical regional framework for applying different clustering thresholds across CONUS and Alaska, while broadly reflecting known differences in fire regimes and MTBS East-West mapping thresholds."

Reviewer comment: 4. Methodology issues: Clustering vs. tracking. Very low "object" scores compared to area scores indicates an issue with the matching methodology, likely due to the overly strict 2 day threshold. This is discussed around L320: "Taken together, these results demonstrate that CONFEX adds value to FRAP by providing detection-inferred ignition location and characterization of fires with complex growth behavior at substantially higher temporal resolution than incident-based perimeter products"… is CONFEX supposed to be a final fire perimeter dataset, or a fire progression dataset? Inconsistent throughout.

Response: We thank the reviewer for this important clarification. We agree that the original manuscript was not sufficiently clear in distinguishing clustering-based event delineation from fire-progression tracking, and that the original fixed 2-day threshold could contribute to fragmentation. CONFEX is intended as a retrospective fire-event perimeter and attribute database, not a full fire-progression product. The revised manuscript now clarifies that clusters represent groups of VIIRS hotspot detections identified by DBSCAN, retained clusters become fire-event objects, and the fire perimeter is the polygon geometry generated from those detections.

We also revised the threshold approach. The earlier single 2000 m / 48 h setting is no longer applied universally. Instead, distance, time, and alpha-shape thresholds are tuned regionally across seven regions, with fragmentation and merging diagnostics included in both tuning and validation. This directly addresses the concern that a strict 2-day threshold may artificially split fires; for example, Alaska now uses a longer 384 h temporal window to accommodate sparse detections and long-duration northern fire events. The discussion has also been revised to avoid implying that CONFEX provides complete fire progression. It now presents CONFEX as an event-level perimeter product with ignition-proxy timing and location, end time, duration, centroid, mapped area, perimeter geometry, and diagnostic attributes.

Revised manuscript text: "Each cluster is taken as a candidate fire event object. In this study, a cluster refers to the group of VIIRS hotspot detections identified by DBSCAN, a fire event refers to the retained geospatial object represented by that cluster after filtering and attribution, and the fire perimeter refers to the polygon geometry generated from the cluster detections."

Additional revised manuscript text: "The database is retrospective and does not currently provide daily fire progression, spread vectors, spread rate, or fire-line movement."

Additional revised manuscript text: "Despite these limitations, CONFEX provides a broad-domain, moderately high-resolution fire-event perimeter and attribute database for CONUS and Alaska. By providing consistent VIIRS-derived event perimeters, ignition-proxy locations, timing attributes, duration, centroid locations, mapped area, and diagnostic context across the full 2012-2024 study period, CONFEX can support regional fire-regime analysis, historical inventory development for VIIRS-detected fire events, ignition-focused studies using first-detection proxies, stratified analyses by land-cover setting and ecoregion, and evaluation of differences between VIIRS-derived fire-event records and existing perimeter datasets."

Reviewer Comment: **7. Conceptually, or analytically, how does CONFEX compare to existing data (FEDS, FIRED)? Given that previous work (e.g., Chen et al. 2022) has published open source code for fire event tracking using VIIRS active fire detections, why not use an existing algorithm to develop a dataset covering this time period and spatial extent? It is not clear from the manuscript why the authors chose to develop a new algorithm rather than applying an existing one.**

Response: We thank the reviewer for this important suggestion. We agree that the original manuscript did not sufficiently justify why a new algorithm was developed or why a California-derived threshold should apply across CONUS and Alaska. In the original workflow, the clustering parameters were calibrated using California FRAP data, which was not adequate for national-scale application. In the revised workflow, we replaced the California-only calibration with region-specific threshold tuning across seven broad regions: Alaska, CONUS West, Southwest and Southern Plains, Southeast, Eastern Midwest/Appalachian-Mid-Atlantic, Western Midwest/Northern Plains, and Northeast.

We also revised the manuscript to compare CONFEX more clearly with existing fire-event products and to explain why CONFEX was developed as a separate framework. FIRED/FIREDpy is based on MODIS burned-area pixels and a spatiotemporal event-delineation framework, whereas FEDS uses VIIRS active-fire detections in a dynamic fire-progression tracking framework developed for tracking fire growth and spread through time. CONFEX is designed for a different purpose: a retrospective event-level perimeter and attribute database for CONUS and Alaska. Because our goal was to generate final detection-derived fire-event envelopes and consistent event attributes across the combined CONUS and Alaska domain, rather than half-daily fire-line progression or spread-rate estimates, we developed a clustering-and-perimeter framework with region-specific threshold tuning.

Exact revised manuscript addition: “The database is retrospective and does not currently provide daily fire progression, spread vectors, spread rate, or fire-line movement.”

Additional revised manuscript text: “Regional parameter tuning was performed to select the DBSCAN spatial threshold, temporal threshold, and perimeter-reconstruction alpha value used in the final CONFEX workflow. Because fire size, hotspot density, fire duration, and reference-data completeness vary substantially across Alaska and CONUS, tuning was conducted separately by region rather than applying a single national parameter set.”