

# Reply to Reviewer 1 Comments

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

*\*Reviewers comments are in red, authors response and sections removed are in blue, and the revised manuscript sections are in black.*

**Reviewer comment:** “While high-resolution and high-spatial-accuracy fire perimeter datasets are crucial for studying fire regimes, this manuscript does not demonstrate good writing quality. There are several structural and methodological issues that need to be addressed to improve clarity, rigor, and scientific contribution.”

**General response.** We thank Reviewer 1 for the constructive feedback. The manuscript has been revised to align with ESSD expectations by clarifying the manuscript structure, tightening the Introduction, expanding the preprocessing and geospatial-method description, and converting the former spectral-channel figure into a table.

## Major Comment 1: Manuscript Structure

**Reviewer comment:** “Manuscript Structure: The current organization of the manuscript is not well structured, which makes it difficult to follow. I recommend adopting a more conventional scientific structure to improve clarity and readability, such as: Introduction – Data and Methods – Results – Discussion – Conclusion.”

**Response:** We thank the reviewer for this great suggestion. We adopted the suggested structure. The revised manuscript now separates the framing of the problem (Introduction), the workflow and implementation details (Data and Methods), the dataset characteristics and case examples (Results), and the interpretation of strengths and limitations (Discussion). In addition, the former standalone Motivation subsection was removed from Methods and its rationale was relocated to the Introduction.

## Major Comment 2: Introduction

**Reviewer comment:** “The Introduction is overly broad and somewhat verbose. It includes substantial discussion of topics (e.g., manual methods and various fire products) that are not directly relevant to this study.”

**Response:** We thank the reviewer for this important suggestion. The Introduction was streamlined by reducing broad historical context and by removing long descriptive passages on manual methods and early satellite-fire surveillance that were not essential to motivating CONFEX. Historical satellite-development context was reduced and moved to Supplementary Material S1.

## The revised “Introduction” now reads:

“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 often unsuitable 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 ignition location, final perimeter extent, geometric centroid, and 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 wildfire datasets and relevant foundational AF-based burned-area approaches and compares them with the CONUS Fire Extent (CONFEX) database.

Table 1: Comparison of existing wildfire 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.
FIREED	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 generate dynamic fire characterization	Rich, high-resolution fire characterization	Restricted geographic scope.
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 ( <b>Suomi National Polar-orbiting Partnership</b> ) 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 wildfire 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/FIREED), 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, final perimeter extent, 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.”

**Reviewer comment:** “Existing fire products are listed without clearly explaining their relevance or connection to the present work.”

**Response:** We thank the reviewer for this suggestion. Section 1 was revised so that the product review directly positions CONFEX relative to existing datasets in terms of spatial coverage, temporal coverage, spatial resolution, event definition, and known limitations. A comparative table was also added so the relationship between CONFEX and existing products is explicit rather than implicit.

**Exact revised manuscript text:**

“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 wildfire datasets and relevant foundational AF-based burned-area approaches and compares them with the CONUS Fire Extent (CONFEX) database.”

**Reviewer comment:** “The manuscript does not clearly identify a specific knowledge gap or methodological gap.”

**Response:** We thank the reviewer for this suggestion. An explicit gap statement was added to the Introduction to define the missing product class that CONFEX addresses: a spatially consistent, twice-daily, event-level VIIRS-based perimeter dataset for CONUS and Alaska at 375 m resolution.

**Exact relevant text in introduction:**

“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, final perimeter extent, and duration estimates for 2012–2024.”

**Reviewer comment:** “The advantages of fire perimeter datasets relative to burned area or active fire products are not sufficiently articulated.”

**Response:** We thank the reviewer for this important suggestion. The Introduction now explicitly explains why event-level perimeters are useful. The revised text contrasts instantaneous active-fire pixels, cumulative burned-area grids, and event-level perimeters, emphasizing ignition timing, duration, and coherent fire-object representation.

**Exact relevant text in “Introduction”:**

“While BA products are valuable for mapping the final fire footprints, they are often unsuitable 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 ignition location, final perimeter extent, geometric centroid, and temporal duration offers a level of operational detail that neither individual hotspots nor cumulative burned area grids can provide.”

**Reviewer comment:** “Limitations of existing approaches (e.g., converting active fire detections to burned area or fire perimeters) are not clearly discussed.”

**Response:** We thank the reviewer for this suggestion. The Discussion section has been expanded to more clearly articulate the advances of CONFEX relative to existing work and to describe the main implications and applications of the dataset. Specifically, the revised text now explains that CONFEX provides a publicly available event-level fire perimeter dataset for CONUS and Alaska derived from VIIRS S-NPP 375 m active fire detections, thereby filling an important gap between instantaneous hotspot products and cumulative burned-area inventories. The revised discussion also clarifies that CONFEX is intended as a complementary event-based dataset rather than a replacement for burned-area products, and it now outlines potential applications including fire-regime analysis, historical event inventories, ignition-focused studies, and future fire-spread and coupled fire–atmosphere modeling workflows.

**Exact revised manuscript text in the “Discussion”:**

“Relative to existing work, the main advance of CONFEX is that it provides a publicly available event-level fire perimeter dataset for CONUS and Alaska derived from VIIRS S-NPP 375 m active fire detections. Existing products are either based on burned-area methods at coarser spatial resolution, geographically restricted, threshold-limited to larger fires, or do not provide event-level perimeter geometry. In contrast, CONFEX translates scattered active fire detections into coherent fire objects with associated ignition timing, duration, centroid, and final perimeter extent, thereby filling an important gap between instantaneous hotspot products and cumulative burned-area inventories.

These characteristics make CONFEX relevant for several applications. At regional scales, it can support fire-regime analysis, historical event inventories, and comparison of spatial and temporal fire characteristics across CONUS and Alaska. At the event scale, the inclusion of ignition-related timing and location information makes the dataset potentially useful for ignition-focused studies and for initialization or evaluation of fire-spread and coupled fire–atmosphere modeling workflows. At the

same time, the product should be interpreted in light of its current limitations: it is based on active-fire detections, it does not yet provide daily fire progression, and event partitioning remains more uncertain in some regions than in others. Thus, CONFEX is best viewed as a complementary event-based dataset that extends the utility of VIIRS observations for wildfire applications rather than as a replacement for burned-area products such as MTBS.”

**Reviewer comment:** “Overall, the Introduction would benefit from a more focused literature review and clearer positioning of the study within existing research. For example, relevant work such as Giglio et al. (2006) should be discussed to contextualize the contribution.”

**Response:** The literature review was refocused and Giglio et al. (2006) was added to place CONFEX in the context of active-fire-based burned-area inference and to distinguish event-level perimeter generation from coarse statistical hotspot-to-burned-area approaches.

**Exact relevant text in “Introduction”:**

“While BA products are valuable for mapping the final fire footprints, they are often unsuitable 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 ignition location, final perimeter extent, geometric centroid, and temporal duration offers a level of operational detail that neither individual hotspots nor cumulative burned area grids can provide.”

### **Major Comment 3: Satellite Wildfire Measurement**

**Reviewer comment:** “This section is also overly long and could be streamlined. Since the method is primarily based on VIIRS 375 m data:

- Discussion of other products (e.g., MODIS) should either be minimized or moved to supplementary materials.”

**Response:** We thank the reviewer for this suggestion. The former satellite wildfire measurement material was condensed and absorbed into a single Data and Methods section. The revised section now keeps only the VIIRS S-NPP specifications, channels, and data-source details that are necessary for understanding CONFEX generation.

**Text removed or condensed from the original manuscript:** The original manuscript contained a standalone “Satellite Wildfire Measurements” section with extended historical discussion of AVHRR, GOES, MODIS, VIIRS, and successive algorithm generations. That whole subsection has been moved to the supplementary document and concise details about the used product “VNP14IMGML (Suomi-NPP VIIRS 375 m ASCII fire location data)” have been incorporated into the Data Sources and Preprocessing subsection.

**The revised “Data Sources and Preprocessing” now reads:**

“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 375m active fire product. The VIIRS has 22 moderate 750 m resolution M (Moderate resolution)

bands, and 6 high 375 m resolution I (Imaging) bands. The temporal resolution is 12 h or less, and the threshold for fire detection at nighttime is as low as 5 m<sup>2</sup> (Schroeder et al., 2014). Each VIIRS instrument (S-NPP, NOAA-20 (National Oceanic and Atmospheric Administration-20), and NOAA-21) has a ~3,040 km swath and completes ~14 sun-synchronous orbits per day (orbital period ~100 min), resulting in ~2 overpasses per day at the equator and ~3–4 at mid-latitudes. For this study, only the S-NPP VIIRS data were used because they provide a continuous record since late 2011. The S-NPP VIIRS sensor data record has been extensively validated and is suitable for long-term analyses (Cao et al., 2013).

VNP14IMGML is based on fire detections from VIIRS 375m channels and fire radiative power (FRP) values from the 750m channel. We are only using the 375m hotspots in our product generation and the FRP analysis is out of the scope of our product. The product algorithm processes five I band, and one M band, given in Table 2. I4 (3.55 – 3.93 μm) is the main channel for fire detection and distinguishes between subpixel fires and non-fires, with a 367 K saturation temperature (Schroeder et al. 2014). Channel I5 (10.5 – 12.4 μm) is the thermal channel against which the I4 channel checks for non-fires. The rest of the three channels are used in the algorithm for water body discrimination, sun glint and clouds. For validation of VIIRS 375 imagery, Landsat- 8 data is used.

Table 2 Channels used in the 375 m active fire detection algorithm (adapted from Schroeder & Giglio, 2016).

VIIRS Channel	Spatial Resolution (m)	Spectral Resolution (μm)	Primary Purpose
I1	375	0.60 – 0.68	Cloud & water classification
I2	375	0.846 – 0.885	Cloud & water classification
I3	375	1.58 – 1.64	Water classification
I4	375	3.55 – 3.93	Fire detection
I5	375	10.5 – 12.4	Fire detection & cloud classification
M13*	750	3.973 – 4.128	FRP retrieval, fire detection over water and across the South Atlantic magnetic anomaly region

\* Aggregated (750×750 m nominal) & un-aggregated (250×750 m nominal) data are used

We filtered the data to keep only the vegetation type. We excluded low-confidence detections that are often glint, water, or false alarms, and we only kept nominal and high confidence pixels that the algorithm considers physically valid and robust detections (Schroeder & Giglio, 2016; Schroeder et al., 2014).”

**Reviewer comment:** “Instead of detailed descriptions, it would be sufficient to cite existing literature comparing MODIS and VIIRS fire products.”

**Response:** We thank the reviewer for this important suggestion. The detailed descriptions of historical satellite algorithms and products have been removed, and a table has been included in the Introduction comparing MODIS and VIIRS fire products along with other relevant products that are existing in literature. A small portion of the introduction also explains these products.

**Exact revised manuscript text in “Introduction”:**

“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 wildfire datasets and relevant foundational AF-based burned-area approaches and compares them with the CONUS Fire Extent (CONFEX) database.”

Table 2: Comparison of existing wildfire 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 generate dynamic fire characterization	Rich, high-resolution fire characterization	Restricted geographic scope.
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 ( <b>Suomi National Polar-orbiting Partnership</b> ) 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.

**Reviewer comment:** “I recommend merging this section with the subsequent one into a unified “Data and Methods” section.”

**Response:** We thank the reviewer for this suggestion. The standalone Motivation subsection was removed from Methods. Its conceptual motivation was incorporated into the Introduction, while Section 2 was reserved for data sources, preprocessing, projections, clustering, perimeter construction, parameter tuning and post-processing.

**Text removed or condensed from the original manuscript:** The original manuscript included “3.1 Motivation” immediately after the methodological section heading.

**Exact revised manuscript text in “Introduction”:**

“The CONUS Fire Extent (CONFEX) database was developed to address the lack of a spatially consistent, moderately high-resolution wildfire 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, final perimeter extent, 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.”

#### **Major Comment 4: Methodology**

**Reviewer comment:** Section 3.1: The inclusion of “motivation” in this section is inappropriate; it should be moved to the Introduction.

**Response:** We thank the reviewer for this suggestion. The standalone Motivation subsection was removed from Methods. Its conceptual motivation was incorporated into the Introduction.

**Reviewer comment:** Section 3.2: This section is too brief to stand alone, and the description of preprocessing steps lacks sufficient detail.

**Response:** Section 3.2 was expanded to specify the source product, period of record, confidence filtering, and vegetation-only screening. The revised “Data Sources and Preprocessing” section is provided in response to comment 3 above.

**Reviewer comment:** Restricting the analysis to nominal and high-confidence pixels may lead to omission of important fire types (e.g., peatland fires).

**Response:** We agree with the reviewer that filtering for nominal and high-confidence pixels introduces a trade-off between data purity and detection completeness. While this filter is essential for removing false alarms caused by sun glint, water reflections, and urban heat sources (Schroeder & Giglio, 2016), it may indeed omit low-intensity or smoldering fire types, such as those found in peatlands, which often lack the strong thermal signature required for high-confidence classification (Usup et al., 2004). We have acknowledged this specific limitation in Section 4.2 (Dataset Limitations) and added the relevant citations to the manuscript.

**Exact revised manuscript text in “Dataset Limitations”:**

“The filtering of the database to nominal- and high-confidence detections is necessary to reduce false alarms associated with sun glint, water, and other non-fire artifacts, however it does introduce a

known omission bias for low-intensity or smouldering fire types (NASA FIRMS, n.d.; Schroeder et al., 2014). This is particularly relevant for peatland fires, which are often slow-moving and smouldering, and therefore more difficult to detect with satellite active fire algorithms (Usup et al., 2004; Rein and Huang, 2021). As a result, CONFEX may underrepresent these fire regimes, especially in high-latitude regions such as Alaska.”

**Reviewer comment:** The methods are presented largely as an operational workflow, with limited explanation of innovation, justification, or methodological advancement.

**Response:** We thank the reviewer for this important insight. We revised the Methods section to better emphasize methodological justification and innovation. Specifically, the revised text now explains that the Chebyshev metric enforces independent hard thresholds in space and time, thereby reducing chaining errors that may arise under Euclidean distance. It also clarifies that threshold selection was based on region-specific tuning years and multi-metric evaluation rather than single-metric optimization alone. In addition, the revised section explains the geometric decision logic used for perimeter reconstruction, the use of region-specific projected coordinate systems for CONUS and Alaska, and the inclusion of 1000-hour dead fuel moisture for identification of prescribed-fire candidates in the CONUS workflow.

**Reviewer comment:** The calculation of the centroid (an output of CONFEX) is not described. It is unclear whether this refers to a geometric centroid or another definition. The relevance of this variable is also not sufficiently justified.

**Response:** We thank the reviewer for this suggestion. We have clarified that CONFEX provides the geometric centroid (center of mass) of the final fire perimeter polygon. This is calculated using the standard Shapely.centroid attribute in our Python processing pipeline. The centroid serves as a critical single-point proxy for the fire event, which is essential for:

Spatial Indexing: Allowing rapid geolocation and query performance in large-scale geospatial databases.

Distance-based Analysis: Facilitating proximity calculations to critical infrastructure, weather stations, or population centers without the computational overhead of polygon-to-point operations.

National-scale Visualization: Enabling efficient cartographic display at scales where rendering hundreds of thousands of complex polygons is computationally prohibitive.

Database Integration: Serving as a unique spatial identifier for linking perimeter data with other point-based wildfire inventories.

We have added these justifications in the supplementary document.

**Reviewer comment:** More informative outputs—such as initial ignition points, fire spread dynamics, or temporal progression—could significantly enhance the dataset’s value.

**Response:** We thank the reviewer for this suggestion. The dataset already includes ignition-related proxy information: event attributes include detection-inferred ignition timing and location, together with end time, burned area, and perimeter centroid coordinates. Ignition-related attributes should be interpreted as detection-inferred proxies derived from the first associated VIIRS observations (line 236; Fig. 4, Original manuscript). We agree that additional outputs such as fire spread dynamics and explicit temporal progression would further enhance the value of the product. These developments

are an important direction for future work and are currently being explored by the authors. However, they are beyond the scope of the present study, whose focus is on the construction and validation of an event-level perimeter database derived from VIIRS S-NPP detections.

**Reviewer comment:**

**Regarding evaluation:**

• **The manuscript uses burned area products for validation but does not clearly explain the relationship and differences between burned area and fire perimeter datasets.**

**Response:** We thank the reviewer for this important comment. The revised manuscript now more clearly distinguishes active fire detections, burned area products, and event-level fire perimeter datasets. In the Introduction, we explain that active fire products capture instantaneous thermal anomalies at the time of satellite overpass, whereas burned area products identify post-fire land-surface change and therefore represent cumulative end-state fire footprints rather than event-based fire evolution. We further clarify that perimeter datasets derived from active fire detections are intended for event-level analysis because they aggregate individual hotspots into coherent fire objects with ignition timing, event duration, and spatial extent. This distinction is also reflected in the revised validation framing, where MTBS and FRAP are used as reference datasets for spatial comparison, while acknowledging that burned area and perimeter products are not strictly equivalent representations of fire.

**Exact revised manuscript text in “Introduction”:**

“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 often unsuitable 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 ignition location, final perimeter extent, geometric centroid, and temporal duration offers a level of operational detail that neither individual hotspots nor cumulative burned area grids can provide.”

**Reviewer comment:**

• **It is unclear whether the fire perimeter product is intended as a substitute for burned area. If so, the novelty relative to studies such as Giglio et al. (2006) should be more explicitly emphasized.**

**Response:** We thank the reviewer for this comment. CONFEX is not intended as a substitute for a burned area product. Rather, it is designed as a complementary event-level fire perimeter dataset

derived from VIIRS active fire detections. Its primary purpose is to represent individual fire objects with associated ignition timing, event duration, and spatial extent, which makes it more suitable for applications such as ignition analysis, event-based fire tracking, and fire propagation studies. In contrast, burned area products represent cumulative post-fire surface change and are therefore conceptually different from event-based perimeter datasets. We have revised the Introduction to make this distinction more explicit and to clarify the relationship to Giglio et al. (2006), whose work established a foundational methodology for relating active fire detections to burned area at coarse spatial resolution. We now state more clearly that CONFEX extends the use of active fire detections in a different direction, namely toward event-level perimeter delineation rather than burned area estimation. We also clarify that MTBS is used in this study as a high-resolution spatial reference dataset for validation, not because burned area and fire perimeter products are identical, but because MTBS provides a consistent benchmark for comparison of final fire extent.

#### **Exact revised manuscript text in “Introduction”:**

“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 often unsuitable 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 ignition location, final perimeter extent, geometric centroid, and temporal duration offers a level of operational detail that neither individual hotspots nor cumulative burned area grids can provide.”

#### **Major Comment 5: Data Characteristics and Discussion**

**This section should be reorganized for clarity:**

- **Separate into two sections: Results and Discussion.**
- **Suggested structure:**
  - o **Section 4.1: Content currently in lines 324–357**
  - o **Section 4.2: “Alaska Fire Dynamics”**
  - o **Discussion: “Dataset Limitations” and broader interpretation**

**Response:** We thank the reviewer for this suggestion. The manuscript has been reorganized so that descriptive and interpretive material are now separated into distinct Results and Discussion sections. Content that was previously combined has been redistributed as follows: the revised Results section now includes 4.1 Validation, 4.2 Data Characteristics, 4.3 Case Studies, and 4.4 Alaska Fire Dynamics, while interpretive material has been moved to the revised Discussion section, which includes 5.1 Dataset Limitations and 5.2 Broader Interpretation. This restructuring improves clarity by separating objective presentation of dataset characteristics from their interpretation and limitations.

## **Reviewer Comment:**

**Additionally, the Discussion section needs substantial expansion, including:**

- **Clear articulation of the study's advances relative to existing work**
- **Implications and potential applications of the dataset**

## **Response:**

We thank the reviewer for this important suggestion. The Discussion section has been expanded to more clearly articulate both the advances of CONFEX relative to existing datasets and the implications of the released product. Specifically, the revised manuscript now emphasizes that CONFEX differs from prior burned-area and active-fire products by providing a publicly available, event-level perimeter database for CONUS and Alaska derived from VIIRS S-NPP 375 m detections, with associated ignition timing, centroid, duration, and final extent attributes. The discussion now also places CONFEX in the context of existing products such as Global Fire Atlas, GlobFire, FIRED, FEDS, Firelytics, MTBS, and FRAP, clarifying that CONFEX is intended as a complementary event-based dataset rather than a substitute for burned-area inventories. In addition, we have expanded the text describing the implications and potential applications of the dataset, including its use for fire-regime analysis, ignition-focused studies, historical event inventories, and as an input for future fire-spread and coupled fire–atmosphere modeling workflows. We also explicitly note that daily progression and spread-dynamics products would be valuable future extensions but remain beyond the scope of the present study.

## **Exact revised manuscript text in “Discussion”:**

“Relative to existing work, the main advance of CONFEX is that it provides a publicly available event-level fire perimeter dataset for CONUS and Alaska derived from VIIRS S-NPP 375 m active fire detections. Existing products are either based on burned-area methods at coarser spatial resolution, geographically restricted, threshold-limited to larger fires, or do not provide event-level perimeter geometry. In contrast, CONFEX translates scattered active fire detections into coherent fire objects with associated ignition timing, duration, centroid, and final perimeter extent, thereby filling an important gap between instantaneous hotspot products and cumulative burned-area inventories.

These characteristics make CONFEX relevant for several applications. At regional scales, it can support fire-regime analysis, historical event inventories, and comparison of spatial and temporal fire characteristics across CONUS and Alaska. At the event scale, the inclusion of ignition-related timing and location information makes the dataset potentially useful for ignition-focused studies and for initialization or evaluation of fire-spread and coupled fire–atmosphere modeling workflows. At the same time, the product should be interpreted in light of its current limitations: it is based on active-fire detections, it does not yet provide daily fire progression, and event partitioning remains more uncertain in some regions than in others. Thus, CONFEX is best viewed as a complementary event-based dataset that extends the utility of VIIRS observations for wildfire applications rather than as a replacement for burned-area products such as MTBS.”

## **Major comment 6: Data Availability**

**The Data Availability section should be moved to follow the Conclusion**

**Response:** We thank the reviewer for this suggestion. The Data Availability section has been relocated to follow the Conclusion, consistent with the recommended manuscript structure.

#### Minor Comments:

**Reviewer comment:** “Figure 1: This appears to function as a table rather than a figure. I recommend converting it to Table 2.”

**Response:** We thank the reviewer for this suggestion. The former spectral-channel figure was converted into a table so that the sensor bands and their roles can be retrieved more clearly and cited more naturally in the methods section.

#### Exact revised manuscript text:

**Table 2: Channels used in the 375 m active fire detection algorithm (adapted from Schroeder & Giglio, 2016).**

VIIRS Channel	Spatial Resolution (m)	Spectral Resolution ( $\mu\text{m}$ )	Primary Purpose
I1	375	0.60 – 0.68	Cloud & water classification
I2	375	0.846 – 0.885	Cloud & water classification
I3	375	1.58 – 1.64	Water classification
I4	375	3.55 – 3.93	Fire detection
I5	375	10.5 – 12.4	Fire detection & cloud classification
M13*	750	3.973 – 4.128	FRP retrieval, fire detection over water and across the South Atlantic magnetic anomaly region

\* Aggregated (750×750 m nominal) & un-aggregated (250×750 m nominal) data are used