Supplement of "CONFEX: A Database for CONUS Fire EXtent"

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S1. Additional comparison between CONFEX and MTBS

This section presents additional comparisons between the CONFEX database and MTBS in terms of the number of fire events above specific area thresholds and for different regions (eastern CONUS, western CONUS, and Alaska) (see main text Figure 9 (panel a)). These figures complement the main-text analyses by highlighting regional differences in detection and event counts and by illustrating how the two datasets respond to interannual variability in fire activity.

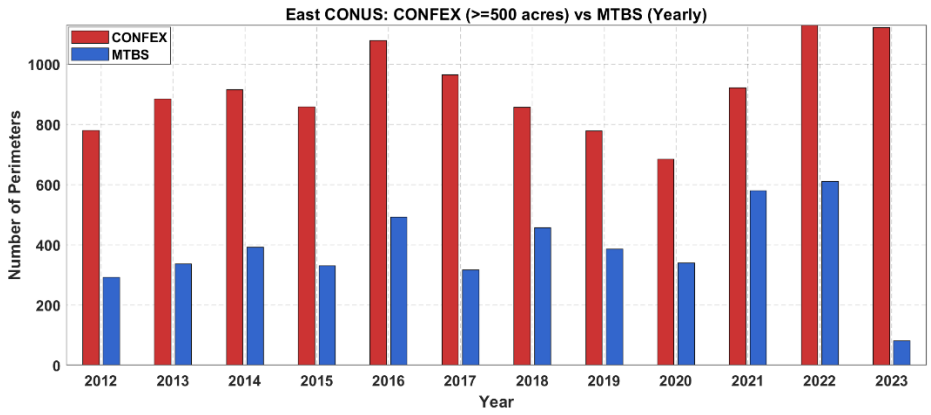

Figure S1: Annual number of fire events ≥ 500 acres detected by CONFEX and MTBS in the eastern CONUS, 2012–2023.

Figure S1 highlights differences in the number of moderate-to-large events detected by CONFEX and MTBS in the eastern CONUS. Differences may arise from the distinct detection methodologies, minimum mapping units, and event definition criteria used by the two datasets.

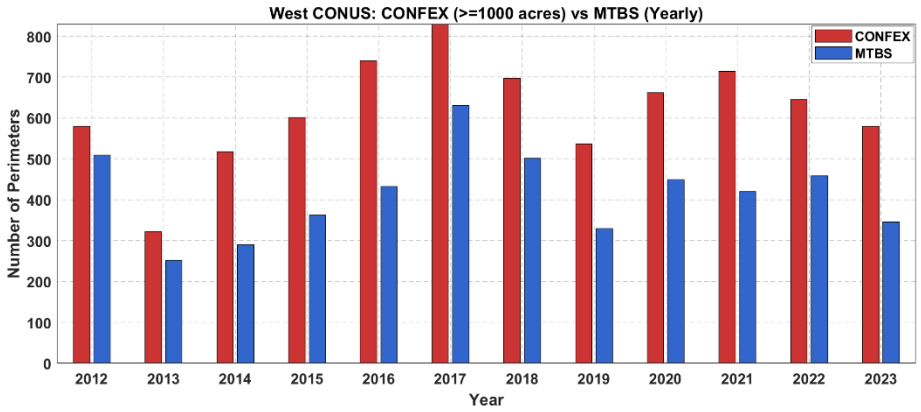

Figure S2: Annual number of fire events ≥ 1000 acres detected by CONFEX and MTBS in the western CONUS, 2012–2023.

In the western CONUS, where larger fires are more common, this figure shows the temporal evolution of large events (≥ 1000 acres) and the relative consistency or divergence between CONFEX and MTBS across years.

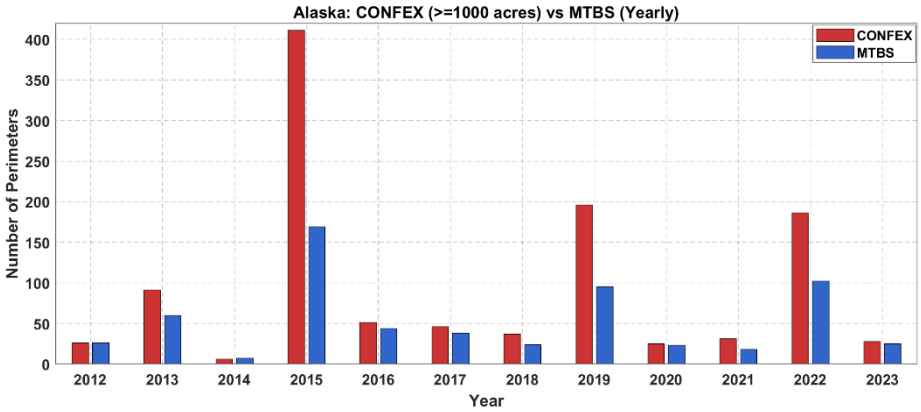

Figure S3: Annual number of fire events ≥ 1000 acres detected by CONFEX and MTBS in Alaska, 2012–2023.

Over the period 2012–2023, CONFEX has 1134 perimeters ≥ 1000 acres in Alaska, while the MTBS database shows 631 events meeting the same area threshold. The annual time series shows that the most significant differences occur in years with intense fire activity.

S1.1 Methods for CONFEX–MTBS comparisons

The comparisons shown in Figures S1–S3 are based on annual counts of fire events derived directly from the CONFEX and MTBS perimeter datasets.

For CONFEX purposes, a fire event corresponds to a single DBSCAN cluster, as explained in Section 3.3 (Algorithm Description). We calculated the burned area from the concave or convex hull of the VIIRS 375 m detections for each cluster. We assigned the event to a region (eastern CONUS, western CONUS, or Alaska) based on the event centroid. We then counted the number of events in each region that exceeded the MTBS threshold each year. For MTBS, we used the official MTBS perimeter polygons and treated each perimeter as an individual fire event. Annual counts were obtained by assigning each event to the year of ignition.

Area thresholds were:

- Eastern CONUS: events with burned area ≥ 500 acres
- Western CONUS: events with burned area ≥ 1000 acres
- Alaska: events with burned area ≥ 1000 acres

S1.2 Interpretation of regional time series (Figures S1–S3)

Annual data from the eastern CONUS (Figure S1) indicate that CONFEX consistently registers more events ≥ 500 acres than MTBS does over 2012–2023. In 2016 and 2022, CONFEX reported more than twice as many events as MTBS. In lower activity years, such as 2020, the CONFEX counts are still approximately twice MTBS. The model results imply that the higher spatial resolution (375 m VIIRS) and perimeter construction based on DBSCAN used in CONFEX improve the detection of many moderately sized fires that were not mapped or were differently aggregated in MTBS. Both datasets exhibit broadly similar interannual variability; for example, both datasets find greater fire activity in 2016 and in the period 2021-2023, albeit with different absolute values.

In the western CONUS (Figure S2), for events ≥ 1000 acres, CONFEX reports more events than MTBS again, but the relative difference is smaller than found in the East. Both datasets clearly depict years of high fire activity, such as 2016–2018 and 2020–2022. This shows that for larger fires in the western CONUS, CONFEX and MTBS capture the primary temporal signal, but CONFEX also shows additional event detection around 1000 acres.

The difference between CONFEX and MTBS is pronounced in Alaska (Figure S3). CONFEX identifies 1134 events over 1000 acres from 2012–2023, while MTBS indicates 631 events of that size. The most significant discrepancies occur during years of high fire activity, such as 2015 and 2022, when CONFEX reports more than twice as many events as MTBS. The findings suggest that, in a landscape with many overlapping burn areas, the higher spatiotemporal resolution of the VIIRS product and the cluster-based approach in CONFEX likely resolve more distinct events than MTBS, which may employ more conservative mapping and generalization criteria.

S2. State-level fire event statistics

This section presents state-level summaries of the number of fire events detected by CONFEX and MTBS for different size thresholds and regions. These maps highlight spatial patterns in fire activity and illustrate how event counts differ between the two products at the state scale.

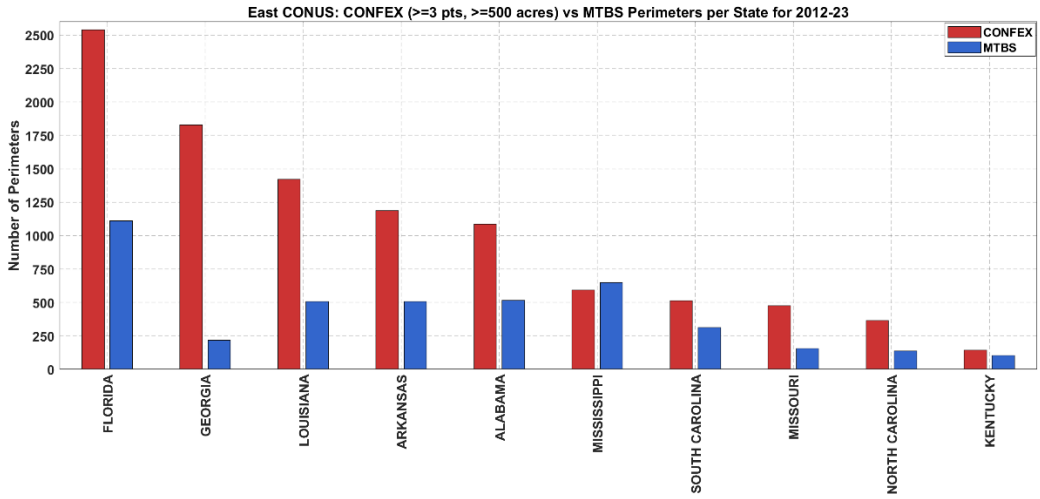

Figure S4: State-level number of fire events (CONFEX: ≥ 3 detections and ≥ 500 acres; MTBS: ≥ 500 acres) in the eastern CONUS, 2012–2023.

Figure S4 shows how the number of moderate-sized events (≥ 500 acres) varies among eastern CONUS states, and how the event counts from CONFEX compare with MTBS when a ≥ 3-detection criterion is applied to CONFEX events. The three-detection criterion was used because the areas allotted to less than 3-detection events by the CONFEX algorithm have associated uncertainty.

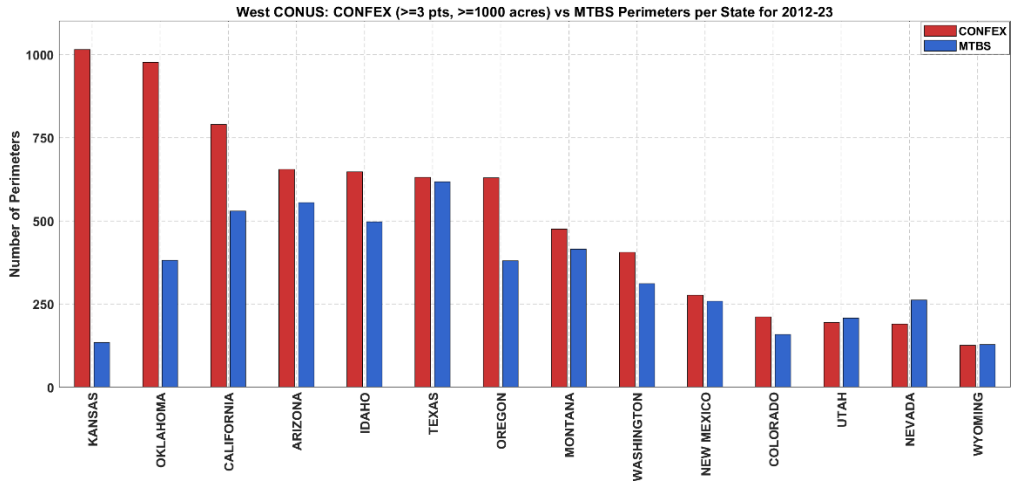

Figure S5: State-level number of fire events (CONFEX: ≥ 3 detections and ≥ 1000 acres; MTBS: ≥ 1000 acres) in the western CONUS, 2012–2023.

Figure S5 emphasizes spatial gradients in large-fire activity (≥ 1000 acres) across western CONUS states. Differences between CONFEX and MTBS events at the state level may reflect both the increased sensitivity of VIIRS-based detection and the distinct event aggregation approaches in the two datasets.

For Alaska, the state-level statistics are equivalent to the regional statistics in Figure S3: CONFEX identifies 1134 events ≥ 1000 acres, whereas MTBS reports 631 events meeting the same threshold.

S2.1 Methods for state-level counts and no double-counting

To conduct state-level comparisons, CONFEX and MTBS events were aggregated by state.

For CONFEX:

1. We selected all events that had a burned area above the relevant threshold (≥ 500 acres in the eastern CONUS; ≥ 1000 acres in the western CONUS and Alaska).

2. Each cluster must contain at least 3 detections from the 375 m VIIRS instrument.

3. For each event, we determined a state based on the centroid of the event perimeter polygon.

For MTBS:

1. We selected all perimeters, since the thresholds were set based on MTBS.

2. We assigned each event to a state based on the centroid of the perimeter polygon.

Events that cross state boundaries in the CONUS, therefore, contribute to exactly one state count, determined by the location of the event centroid. For Alaska, which is represented by a single state polygon, the state-level and regional counts coincide.

S2.2 Interpretation of state-level patterns (Figures S4–S5)

The state-level comparison in the eastern CONUS (Figure S4) shows systematic differences between CONFEX and MTBS in the number of events ≥ 500 acres. According to the CONFEX database, very high counts are reported in Florida, Georgia, Louisiana, Arkansas and Alabama over 2012–2023, while the MTBS counts for the same states are much lower. What this implies is that in the southeastern states prone to fire, CONFEX is capturing larger numbers of moderate-sized burns, many of which may be near or just above and perhaps smaller, spatially fractured burns that MTBS does not map separately. States with lower fire activity (e.g., the mid-Atlantic and northeastern states) tend to show smaller absolute differences. However, a bias toward higher CONFEX counts remains apparent, consistent with regional time series.

In the western CONUS (Figure S5), for events ≥ 1000 acres, CONFEX and MTBS again show similar spatial patterns but different magnitudes. CONFEX tends to identify more large fires, especially in the Great Plains and southern Great Plains (e.g., Kansas, Oklahoma, Texas), where frequent grassland and shrubland fires may propagate rapidly and produce multiple VIIRS detections, but may be mapped more conservatively in MTBS. In contrast, in mountainous and forested states (e.g., California, Idaho, Montana), the discrepancy is smaller, and both datasets highlight the same high-activity states.

For Alaska, where state-level and regional statistics coincide, the large difference between the CONFEX and MTBS event counts reinforces the conclusion from Figure S3 that the finer-resolution, cluster-based approach in CONFEX resolves more distinct burn events in a landscape dominated by extensive fires, complex perimeters, and overlapping burn scars.

Overall, the state-level comparisons show that:

1. CONFEX reproduces the broad geographic pattern of fire activity found in MTBS (e.g., high activity in the Southeast, the western fire belt, and Alaska), and

2. CONFEX consistently reports more events, especially in regions with frequent, moderate-sized fires and in landscapes where MTBS may aggregate or omit some events.

These differences should be considered when using CONFEX and MTBS jointly, for example, in model evaluation or long-term trend analyses, particularly at moderate area thresholds and in regions with many small to medium fires.