

Supplement of

An integrated wildfire event database for improved fire science research for the continental United States, 1992-2021

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S1. Overview

Sections S2 and S3 of this Supplement present examples of the approaches used during the development of the iWED. Section S2 discusses visual interpretation of MTBS perimeter shape to determine the likely fire type, while Section S3 presents examples of the analyses carried out during the development of the iWED. Section S4 contains 34 figures that are discussed in Sections 2 and 3, while Section 5 contains several tables.

S2. Visual Interpretation of MTBS Fire Perimeter Images

By their very nature, prescribed fires are managed events following a plan to burn a predetermined area by using landscape features to constrain the spread of fire activity. The most common of these constraining features are roads, but natural features exist that restrict the spread of burning (including shorelines of lakes, reservoirs, oceans, and large rivers, and areas with wet soils, such as streambeds, riverbeds, and wetlands). Thus, when carrying out visual interpretation of the shape of a fire perimeter, a contextual understanding of the landscape features that can serve as fire breaks is important.

Perimeters of prescribed burns observed on the MTBS images most often have straight, linear edges based on using roads as ignition points as well as constraints for fire spread; thus prescribed fires can have straight edges and rectangular shapes, especially in prairie areas with well established road grids (Figure S1a). In many areas, roads are not established on a square or rectangular grid, resulting in perimeters with multiple straight edges at different angles (Figure S1b). The spread of the fire in Figure 1c was constrained by a combination of roads, a small lake, and the wetlands that bordered the lake. The spread of the fire in Figure 1d was constrained by a combination of a road, the Gulf of Mexico, a stream connecting the Gulf of Mexico to a small lake, and the small lake. Figure 1e presents the perimeter of a prescribed fire in northern Nebraska whose spread was constrained by prairie lakes and small ponds. Finally, Figure 1f presents the perimeter of a prescribed fire in a coastal salt marsh in Texas whose spread was most likely constrained by saturated wetland soils.

To develop an understanding of shape characteristics common to wildfires, 312 MTBS fire perimeter images selected from all study regions, ranging in size from 580 to 596,549 acres, were visually interpreted. In all fuel types, strong winds can result in a rapid spread of a wildfire and large growth in the fire perimeter and size over very short time periods. A rule of thumb is that the rate of spread is 10% of the wind speed at 10 m for forests and shrublands (Cruz and Alexander 2017) and 20% of the windspeed for grasslands and shrublands (Cruz et al. 2022). Under the influence of strong winds, a fire spreads away from its ignition point in the opposite direction of the wind, with perpendicular spread as well. In situations with rapid downwind spread (common to grasslands and shrublands), fire perimeters often have a conically-shaped perimeter, from narrow to broad (Figures S2a to S2c). The majority of wildfires had perimeters with lengths longer than widths. The average length to width ratio for all fires was 3.2 (standard deviation of 2.6), with 79% of the fires having a length to width ratio greater than 2. Over one in five wildfires had length to width ratios greater than 5, with elongated perimeters (Figures S2d

to S2f). The presence of multiple large and small arms (Figures 1b, 3 [center fire], S2f to S2h) or broader lobes (Figures S2i, S2j) are also a common characteristic of wildfire perimeters when there is a wind shift during the period of fire growth (see, e.g., Cruz et al. 2022). The perimeters of wildfires are most frequently non-linear, with their edges being serrated or crenulated (multiple examples in Figure S2). Even perimeters that have low length to width ratios have features that are characteristic of wildfires (e.g., non-linear, serrated or crenulated edges or the presence of lobes or arms; Figures S2k).

S3. Examples of Approaches and Procedures Used During the Development of the iWED

During the development of the integrated Wildfire Event Dataset (iWED), approaches and procedures were developed that led to changes in the number and sizes of wildfire events that were imported from fire management datasets and reports and from the MTBS fire perimeter dataset. This section provides discussions of lines of evidence that were followed in making changes to the number and sizes wildfire events in the iWED, including figures.

S3.1 MTBS Events Named as Complexes Containing Multiple Perimeters

The MTBS dataset included one event for the Antelope Complex, which was found to have six perimeters (Figure S3a). The names of the six fires in this group were listed in the annual report of the Western Great Basin Coordination Center and were all contained in the FS20 dataset. Viewing the NFIS/GeoMAC perimeters allowed matching the six MTBS perimeters with individual fire management events (Figure S3b).

The FS20 dataset matched the fire management Black Pulaski Complex event (117,292 acres) with the MTBS Black Pulaski Complex (124,599 acres) which included six perimeters. While earlier versions of the MTBS dataset included this event, the current version does not. Instead, the current version contains the Lost Creek (Black Pulaski Complex), Soda Creek (Black Pulaski Complex), Chalk Butte (Black Pulaski Complex), Lodgepole (Black Pulaski Complex), Black Pulaski (Black Pulaski Complex), and Hill Coulee (Black Pulaski Complex) with a total area burned of 125,073 acres. A Soda Creek fire (23,000 acres) was also contained in the FS20 dataset. The dataset from the Northern Rockies Coordination Center (NRCC) contained the Black Pulaski Complex, and listed seven fires that comprised this complex and their sizes. The NRCC dataset the six MTBS Black Pulaski fires and the Square Butte fire. Using OpenStreetMap, a Square Butte was found that was adjacent to the MTBS Black Pulaski Complex fires (Figure S4), indicating this fire had not merged with any of the fires in this complex. Because the total size of the two FS20 fires for this complex were much larger than the MTBS and NRCC sizes, it was concluded that the FS20 sizes were incorrect. The NRCC sizes were substituted for the fires in this complex, reducing the total area burned in this complex.

Information on the individual wildfires (names, locations, and in some cases, fire size) contained in a complex was often found in a government report or dataset or in media report found through a search of the world wide web. An example is the Sioux County Complex, which

the MTBS and FS20 datasets both contained as a single event. Viewing the MTBS event revealed this complex contained three perimeters (Figure S5), whose sizes were calculated based on estimating the fraction of total MTBS size using visual interpretation. A report obtained from a search of the world wide web (Scott J. and Erdkamp, B. Nebraska Forest Service Annual Report 2006 downloaded from <https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1007&context=nebforestpub>, last accessed on 30 March 2024) named the three events in the complex and provided information on their locations and relative sizes (Figure S5). Based on this information, the fire management size from the Sioux County Complex was allocated to the three fires in proportion to their MTBS size.

The SCU Lightning Complex was the name given to a group of wildfires that spread across five California counties east of the San Francisco Bay in the summer of 2020. In the FS20 dataset, the SCU Lightning Complex (Canyon) fire (396,694 acres) was matched with the MTBS the SCU Lightning Complex (405,787 ha) fire. Viewing the MTBS event using the WFEIS revealed this fire had one large and five small perimeters, where two of the small perimeters were well to the north of the others (Figure S6a). Visual interpretation was used to estimate the fraction of the total MTBS size in each perimeter, which in turn, was used to estimate the size of each perimeter. One of the perimeters was smaller than 247 acres. The remaining five perimeters were added to the iWED. Using OpenStreetMap, it was determined that the position of the FS20 SCU Lightning Complex (Canyon) fire was within the large MTBS perimeter and these were matched in the iWED. It was also determined that the position of the FS20 4-1 Marsh fire was within the larger of the northern-most MTBS perimeters while the position of the FS20 Deer fire was in the smaller of the northern-most MTBS perimeters (Figure S6b) and these events were matched in the iWED. The FS20 sizes for the 4-1 Marsh and Deer fires (1,000 and 2,400 acres, respectively) were significantly different than the MTBS sizes (2,975 and 902 acres, respectively). It was concluded that the sizes for these fires had been incorrectly estimated. Their FS20 sizes were added and then reallocated in proportion to their MTBS sizes. The two remaining MTBS perimeters were added to the iWED as individual events.

One protocol used during the development of the iWED was to visually examine the perimeter for each MTBS event named as a complex. Thus, while the FS20 size (12,018 acres) and MTBS size (12,211 acres) for the Jawbone Complex event were very close, the MTBS fire was found to have two perimeters (Figure S7a), as did the CalFire event (Figure 7b). Because the size for the CalFire perimeter (12,009 acres) was nearly identical to the FS20 size, it was concluded that this complex consisted of two separate fires, resulting in the addition of a matched fire management/MTBS event to the iWED. Visual interpretation was used to estimate the fraction of total MTBS size in each perimeter, which in turn was used to calculate the fire management and MTBS size for each perimeter.

S3.2 Other MTBS Events Containing Multiple Perimeters

In investigating matched events where the MTBS size was greater than the fire management size, a number of MTBS events were identified that had multiple perimeters. Information found for these additional fires varied between events, as illustrated in the following four examples.

The size of the MTBS Calamity Complex (Grapple) fire (2,331 acres) was over twice the size of the FS20 Grapple fire (1,056 acres). It was determined that the MTBS fire contained two perimeters (Figure S8a) which closely matched the two NIFS/GeoMAC perimeters for the Calamity Complex (Figure S8b). The annual report of the Northwest Interagency Coordination Center provided the two names of fires in this complex – Grapple and Poison Creek – where the Poison Creek fire was also contained in the FS20 dataset. Using OpenStreetMap, it was determined that the position for the Grapple fire was within the upper perimeter and the position of the Poison Creek fire was in the lower perimeter (Figure S8a).

The FS20 size (22,964 acres) for the Black Water was slightly larger than the MTBS size (19,388 acres) for this event. Using the WFEIS, it was determined the MTBS fire had three perimeters (Figure S9). Visual interpretation was used to estimate the fraction of total MTBS size in each perimeter, which in turn was used to calculate each perimeter's size. For this event, there was no additional information on fires adjacent to this fire, and it was assumed that the FS20 size was for all three MTBS perimeters. In reallocating the FS20 size in proportion to the MTBS perimeter sizes, it was determined that the MTBS and FS20 sizes for the smallest perimeter were less than 247 acres; therefore, this matched event was not added to the iWED.

The Birch fire was analyzed because its MTBS size (7,321 acres) was much larger than its FS20 size (1,001 acres). Viewing the MTBS event using the WFEIS revealed this fire had two perimeters (Figure S10a). Using OpenStreetMap revealed the position for the FS20 fire was within the smaller perimeter, and these events were matched in the iWED. The sizes of the two MTBS perimeters were calculated by using visual interpretation to estimate the fraction of total MTBS size in each perimeter, which in turn was used to calculate each perimeter's size. The deep red color within the perimeters in false-color Landsat image for this event (Figure 10b) confirmed the MTBS algorithm correctly mapped burned area for this fire. Since there were no fire management events whose position matched the large perimeter, it was entered into the iWED as an individual event.

S3.3 Identification of Merged and Joined Wildfire Events

There were a number of wildfires that were reported to have merged in a fire management report or media report but were contained as multiple, single events in fire management and/or MTBS datasets. An example is the Old Grouch Top and Hurst Creek fires that were reported to have merged in the AICC Incident Management Situation Report (IMSR). These fires occurred in southwest Alaska in the summer of 2019 where both were contained in the FS20 and MTBS datasets. There were significant differences in MTBS and FS20 sizes for

each event: the Hurst Creek fire (FS20 size: 85,361 acres; MTBS size: 139,405 acres) and the Old Grouch Top fire (FS20 size: 308,923 acres; MTBS size: 173,971 acres). A comparison showed that the MTBS perimeters for the Old Grouch Top and Hurst Creek fires (Figure S11a) shared a common border along the southeast corner of the Old Grouch Top fire and northwest corner of the Hurst Creek fire (Figure S11b), where the NIFS/GeoMAC perimeter enclosed and closely matched the two MTBS perimeters (Figure S11c). The size of the NIFS/GeoMAC perimeter for the Old Grouch Top fire (309,112 acres) was very close to the FS20 size. The NIFS/GeoMAC perimeter for the Hurst Creek fire was much smaller than the MTBS perimeter for this fire (Figure S11d), with a size that was close to the FS20 size (85,768 acres). These events not only represented two fires that had merged, but fire management events whose sizes were incorrectly reported. This example also shows that wildfire perimeter datasets often contain duplicate information.

Through visual interpretation, there were a number of instances where MTBS perimeters were determined to have shared borders and further evidence was found to conclude the fires had merged. The Lionshead wildfire (fire management size: 204,469 acres; MTBS size: 197,732 acres) and Beachie Creek wildfire (fire management size: 193,573 acres; MTBS size 194,619 acres) were two large events in west central Oregon that were both ignited on 17 August 2020. Although their ignition points were more than 30 km apart, viewing the MTBS events using the WFEIS showed these fires shared a common border. (Figure S12a). The MODIS burned area pixels for 11 September showed there was extensive fire activity on both sides of the border between the fires on this date (Figure S12b). The MODIS burned area pixels for 12 September (Figure S12c) and 14 September (Figure S12d) show that fire activity spanned the border between the fires on these dates, providing strong evidence that these two fires had merged. In the iWED, these two fires were reported as a merged event.

An approach utilized by the MTBS program in mapping perimeters is to use physical barriers, such as roadways, railways and rivers, to delineate the boundary of a fire event. However, since fires can physically jump these barriers through aerial dispersal of hot embers, this approach often leads to incorrect mapping of a fire's perimeter. An example is a group of fires that occurred in east-central Idaho during the same time period which included the FS20 Canyon II, Flossie, Three Bears, and Moore Creek fires. The FS20 data set matched the fire management Flossie (74,998 acres), Moore Creek (2,839 acres) and Three Bears (15,040) fires with the MTBS Flossie Complex event (90,611 acres), and the fire management Canyon II fire (15,230 acres) with the MTBS Canyon II fire (26,490 acres). The NICC IMSRs contained discussions on the Flossie Complex and Three Bears event, with the size of the latter being a few thousand acres more than the combined size of the Canyon II and Three Bears fires. It was also reported that the Three Bears fire was burning on both sides of the Snake River. In addition, on a day when the Flossie Complex was still growing in size, it was reported that this fire was close to joining the Three Bears fire. The MTBS perimeter for the Canyon II fire was on the north side of the Snake River (Figure S13a) and the MTBS perimeter for the Flossie fire was on the south side of the Snake River (Figure S13b), where there was a very narrow, continuous gap between the perimeters along the river. The fact that the start position for the Three Bears is on the south side of the Snake River (Figure S13c) combined with the NICC IMSR reports supports a conclusion that the

Three Bears fire had jumped the Snake River and merged with the Canyon II fire. The position for the Moore Creek fires was within the MTBS Flossie Complex perimeter. It was concluded that these four wildfires had merged and that the MTBS project had incorrectly mapped the single fire perimeter for this event by using the Snake River as the border between two separate fires. The three FS20 fires and two MTBS events were merged into a single fire in the iWED.

In some instances, it was found that the difference between the MTBS and fire management sizes was due to a combination of merged fires and multiple MTBS perimeters. This was the case for the Nu Snake fire (MTBS size of 2,074 acres; fire management size of 1,230 acres). It was determined that the MTBS fire contained two perimeters, where the position of the fire management Nu Snake fire was within the large perimeter (Figure S14). It was also determined that the positions for the Hay North was adjacent to the Nu Snake fire and the position for the Buckeye fire was within the smaller MTBS perimeter (Figure S14). It was concluded that the Hay North and Nu Snake had merged.

The Gibraltar Ridge fire was investigated because its FS20 size (12,938 acres) was much larger than its MTBS size (6,299 acres). The NIFS/GeoMAC Gibraltar Ridged event had two perimeters separated by less than 100 m, one on the east side of Grave Creek and the other on the west side (Figure S15a). There was very close agreement between the MTBS Gibraltar Ridge perimeter and the western NIFS/GeoMAC perimeter (Figure S15a). An Unnamed MTBS perimeter given a Prescribed Fire with a start date of 31 October type was found that closely matched the eastern NIFS/GeoMAC perimeter (Figure S15b). The total area of the two MTBS perimeters was 13,054 acres, close to the FS20 size. A review of the NICC ISMRs revealed that the Gibraltar Ridge fire was actively growing between 8 August to 14 September. It was shown that MODIS burned area pixels dated 5 August to 13 September almost completely filled the NIFS/GeoMAC and MTBS perimeters (Figure S15c). It was concluded that two MTBS perimeters were part of the Gibraltar Ridge fire and this was a single fire that had jumped Grave Creek.

The spread and growth of a wildfire often stops when it reaches an area that had previously burned during that year in an earlier wildfire. In many instances, these joined events were mapped as a single perimeter by the MTBS program. Many joined fires were discovered during research to determine the source for the difference between MTBS and fire management sizes reported for an event. An example is the Meadow fire whose MTBS size (30,199 acres) was much larger than its fire management size (21,686 acres). In the FS20 dataset, the Pass fire (5,954 acres) was matched with the MTBS Meadow fire along with the Granite fire. By using OneStreetMap, it was determined that the positions of both these fires were within the MTBS Meadow perimeter (Figure S16). Because the end date for the Meadow fire (31 July) was prior to the start date for the Pass fire (6 August), it was concluded these fires had joined, not merged. The MTBS sizes for these fires were calculated in proportion to their FS20 sizes, which resulted in reducing the MTBS size for the Meadow fire below 10,000 ha (24,700 acres).

The North Brownstone 3 fire was investigated because of the difference in MTBS size (7,316 acres) and fire management size (5,981 acres). Viewing this event using the WFEIS revealed the MTBS event had a single perimeter (Figure S17a) and the NIFS/GeoMAC dataset

contained three perimeters that were all within the MTBS perimeter (Figure S17b): the North Brownstone 3, North Brownstone 2, and the North Brownstown fire. The latter two also had fire management events. Since the end dates for the North Brownstown and North Brownstown 2 fires (8 and 9 August, respectively) were prior to the start date for the North Brownstown 3 fire (16 August), it was concluded that: (1) the Brownstown and Brownstown 2 fires had merged; (2) the merged fires had only joined the Brownstone 3 fire.

The SR116-Devonia fire was investigated because of the difference in MTBS size (3,077 acres) and FS20 size (781 acres). Viewing the SR116-Devonia event using the WFEIS revealed the MTBS fire had one large and one medium perimeter (Figure S18a). It also revealed the NIFS/GeoMAC data set had the SR116-Devonia perimeter that closely matched the medium MTBS SR116-Devonia perimeter and the Gilmore Trail and Bald Knob perimeters were both within the large MTBS SR116-Devonia perimeter (Figure S18b). These latter two fires were also in the FS20 dataset. Since the end date for the Gilmore Trail (10 November) was more than a week prior to the start date for the Bald Knob fire (20 November), it was concluded these fires had joined, not merged.

For some events, it was determined that the difference between the MTBS and fire management sizes was due to a combination of multiple perimeters and merged and joined fires. The fire management Bald Butte, Bear Canyon, Egley, Egley South, and Silver events were all matched with the MTBS Egley Complex in the FS20 dataset. Viewing the MTBS Egley Complex event using the WFEIS showed that this event contained one large and one medium perimeter (Figure S19a). Using OpenStreetMap, it was determined the position for the Silver fire was within the medium MTBS perimeter, and these events were matched in the iWED. It was determined that the positions for the other four fires were all within the large MTBS perimeter (Figure S19). All fires within the large perimeter had start dates of 5 or 6 July. Viewing the MODIS burned area pixels (Figure S19b) revealed that majority of the burning within the large MTBS perimeter occurred between 7 and 25 July, with the progression being in a north to south direction from the position of the Bear Canyon fire and in a north to south direction as well as a south to north direction from the position for the Egley fire. It was concluded that the Bald Butte, Egley, and Bear Canyon fires had merged. Because of its small size, position, and progression of the merged fire, it was concluded that the South Egley fire had joined with the merged fires.

The occurrence of wildfires that burned and joined during the same year sometimes resulted in the incorrect mapping of their perimeters by the MTBS program. These occurrences were also discovered during research to determine the difference between fire management and MTBS size. An example is the Kinyon Road fire which was analyzed because of the difference between MTBS size (171,409 acres) and fire management size (210,874 acres). Figure S20a presents the MTBS perimeter (in blue) and NFIS/GeoMAC perimeters (in orange) for the Kinyon Road fire, where the NFIS/GeoMAC perimeter contains a large lobe to the west of the MTBS perimeter and a small additional pocket of burning on the southeast corner of the MTBS perimeter. Figure S20b presents the MTBS perimeters in the vicinity of the Kinyon Road fire, with the East Rock fire matching the western lobe of the NIFS/GeoMAC Kinyon Road perimeter, and the Balanced Road fire matching the pocket in the southeast corner of the MTBS Kinyon Road perimeter, where both of these fires shared common borders with the MTBS

Kinyon Road perimeter. While there was close agreement between the fire management and MTBS size for the Balance Road fire (6,425 vs. 6,436 acres, respectively), there was a large difference for the East Rock fire (2,688 vs. 39,744 acres, respectively). According to fire management records, these three fires took place between 3 and 4 June (Balanced Road), 7 and 15 July (Kinyon Road) and 5 and 9 August (East Rock). Figure S20c presents the MTBS East Rock perimeter (in blue) overlaid with the MODIS burned area pixels (in orange) from 9 July, nearly a month prior to the ignition date for this fire. The fire management position for East Rock fire was on the western edge of the MTBS perimeter in an area without MODIS burned area pixels. It was concluded that the majority of the area within the MTBS East Rock perimeter was burning from the Kinyon Road fire. This is an example where the MTBS program did not correctly map the burned area for two adjacent fire events that had joined, but not merged. To account for this, the MTBS sizes for the Kinyon Road and East Rock fires were added, and the adjusted MTBS sizes calculated in proportion to the fire management sizes.

S3.4 Identification of Wildfires that Spanned the U.S./Canada and U.S. Mexican Borders

The approach used by the MTBS program in mapping wildfires that spanned the US borders with Canada and Mexico was to include area burned in both countries. For most of these events, the fire management size included only the area burned in both countries, whereas for a small number, the fire management size included area burned in both countries. For MTBS events that spanned the US/Canada or US/Mexico border, the MTBS size was corrected based on the fraction of total area burned in the US based on visual interpretation of the MTBS perimeter overlaid onto a map that delineated the border.

The Truck Stop and Cloverdale 2 fires occurred in southwest New Mexico, where their MTBS sizes were significantly larger than their FS20 sizes. Viewing the MTBS events using the WFEIS revealed Truck Stop fire contained two perimeters, with one of the perimeters located in Mexico and the second spanning the New Mexico/Mexico border and the Cloverdale 2 fire had a single perimeter spanning the border, where it abutted the southern-most Truck Stop perimeter (Figure S21a). The WFEIS also contained NIFS/GeoMAC perimeters that closely matched the U.S. portions of these events (Figure 21b). The MTBS sizes for these two events were adjusted (e.g., recalculated) based on estimating the fraction of total MTBS size that was in the U.S. These adjustment resulted in the size of the MTBS Cloverdale 2 to fall below the size threshold for a mega fire (24,700 ha).

The Tatoosh fire is an event that spanned the U.S./Canada border, where the fire management size (48,862 acres) was close to the MTBS size (51,671 acres). Figures S22a and S22b illustrate that there was: (a) extremely close agreement between the edges of the MTBS and WFIS/GeoMAC perimeters for this event; and (b) that both perimeters spanned the U.S./Canada border. The Canadian wildfire database provided a perimeter for the Canadian portion of the Tatoosh fire (Figure S2bc) with a size of 13,434 acres, which allowed for the calculation of the fire management size in the U.S.

S3.5 Correction and Reallocation of Fire Sizes

In addition to corrections to MTBS and fire management sizes associated with fire events that spanned international borders, there were other circumstances that led to adjustments to wildfire size. The Higby, Columbus, Willie, Range, and Twin Springs fires all occurred in southern Nevada just north of Las Vegas during the spring/summer of 2006, where each of these fires was contained in the FS20 datasets. The MTBS dataset contained the Higby, Range and Twin Springs events. The earliest fire in this group was the Twin Springs fire (start date of 4 July; end date of 13 July), where its MTBS perimeter contained three perimeters (Figure S23). It was determined that the position of the FS20 Twin Springs fire was within one of the large MTBS perimeters (b1 in Figure S23) while the position for the Willie fire was within the other large MTBS perimeter (b2 in Figure S23). The large perimeter for the Range fire encompassed the Twin Springs fire (b1 in Figure S23) and overlapped the Wire fire (b2 in Figure S23). Because the Range fire (start date 23 July; end date 7 August) occurred after the Twin Springs fire, it was very unlikely that this fire reburned the areas within the two earlier fires. Because of this, the fire management and MTBSs for the larger portion of the Range fire was reduced by the sizes of the Twin Springs fire and the overlap area of the Wire fire. It was determined that the positions of the FS20 Higby and Columbus fires were within the perimeter of the MTBS Columbus perimeter. Because these fires occurred at the same time, it was concluded these fires had merged. These fires occurred well after the Wire fire, whose MTBS perimeter overlapped the Columbus MTBS perimeter, which also encompassed the small MTBS Twin Springs perimeter. The sizes for the Higby/Columbus fire were reduced to account for the areas of overlap.

The Proctor fire is another example of an MTBS perimeter that was incorrectly mapped because it overlapped other MTBS perimeters. This event was analyzed because of the difference in MTBS size (7,680 acres) and the FS20 size (9,045 acres). It was found that the position for the FS20 Proctor fire was within the MTBS Proctor fire, and that the position for the FS20 Fish fire (955 acres) was adjacent to the MTBS perimeter (Figure S24a). Because the start date for Proctor fire was two weeks after the end date for the Fish fire, it was concluded these fires had joined, not merged. Two Unnamed MTBS Prescribed fires that had burned in March were found in the region of the MTBS Proctor fire (Figure 24b). One of these Unnamed fires was within the Proctor fire, while the other one overlapped the Proctor fire. Because it was unlikely that the Proctor fire reburned the areas within these other two fires, the sizes for the Proctor fire were reduced.

Significant differences between the MTBS and fire management sizes were often due to incorrect reporting of fire management size. For the S. Obenchain fire, the MTBS size (32,875 acres) was much greater than the FS20 size (14,787 acres). A comparison showed the NIFS/GeoMAC perimeter (32,617 acres) (Figure 25a) was an exact match to the MTBS perimeter (Figure S25a). The Northwest Area Coordination Center (NWCC) annual report provided a size of 32,671 acres for the S. Obenchain fire. It was concluded that the FS20 size was incorrect and the NWCC size was substituted in the iWED.

In contrast, the MTBS size (30,967 acres) was smaller than the FS20 size (47,958 acres) for the Eiler fire. CalFire reported the Eiler fire had a size of 32,416 acres (<https://www.fire.ca.gov/incidents/2014/7/31/eiler-fire> last accessed on 22 September 2024), the same size as was reported in the NICC IMSR. A comparison showed there was close agreement between the MTBS and CalFire (31,950 acres) perimeters (Figures S26a,b). It was concluded that the FS20 size was incorrect and the CalFire size was substituted for the FS20 size in the iWED.

The Sand Tank Complex occurred in southwest Arizona in the summer of the 2005. The FS20 dataset contained the Sand Tank Complex (17,131 acres) while the MTBS dataset included the Sand Tank Complex (Sand Tank) (11,601 acres) and Sand Tank Complex (Home) (1,470 acres) fires. The NICC IMSR reported the Sand Tank Complex had three fires (Home, Northern and Sand Tank) with a total area burned of 17,131 acres. Finally, the Sand Tank (17,131 acres) and Home (1,616 acres) were contained in the dataset published by the Southwest Coordination Center fires were contained in the MTBS data set. It was determined that the position for the SWCC Home fire was within the MTBS Sand Tank (Home) perimeter. This fire was added to the iWED and matched with the MTBS perimeter. Viewing the MTBS Sand Tank fires revealed a third, Unnamed MTBS perimeter (9,537 acres) was near the other two fires (Figure 27). It was concluded that the Unnamed MTBS perimeter was most likely the North fire. The FS20 size for the Sand Tank fire was reallocated to the Sand Tank and North fires in proportion to the sizes of the MTBS perimeters.

S3.6 Evaluation of the Accuracy of MTBS versus Fire Management Sizes

Investigations of matched fire management and MTBS events where the differences in size was >15% of the fire management size often led to a conclusion that the MTBS size was more accurate than the fire management size. This conclusion was supported by one or more lines of evidence. An example of a matched event that contained all the lines of evidence was the the Miller Creek fire that occurred in northcentral Texas in April of 2011, where the MTBS size (10,888 acres) was much larger than the FS20 size (3,000) (Figure S28). First, recently burned area false-color Landsat image generated by the MTBS program have a distinct dark red color, as shown in the perimeters presented in Figures S1 and S2 as well as in Figure S28b for the Miller Creek fire. Second, for many matched events, the MTBS perimeter was shown to closely match a fire management perimeter (Figure S28c). Third, for some events it was found that the MTBS perimeter closely matched the burned area pixels from the Landsat burned area pixels (Figure 28d). And fourth, for some events it was found that the MTBS perimeter closely matched the burned area pixels from the MODIS burned area pixels (Figure 28e).

The East Amarillo Complex was the name given to a group of wildfires that occurred in March of 2006 in the Panhandle region of Texas. This complex was reported to have contained the I-40 and Borger fires in the NICC IMSRs with a final size of 907,245 acres. The MTBS East Amarillo Complex (593,364 acres) fire had two perimeters whose sizes were approximately equal (Figure 29a). The fire management Hwy 152 (479,549 acres) and I-40 (427,696 acres)

were matched with the MTBS East Amarillo event in the FS20 dataset. Based on their positions, the Hwy 152 fire was matched with the northern-most MTBS perimeter and the I-40 fire matched with the southern-most perimeter. The MTBS burned area pixels completely filled both MTBS perimeters (Figure 29b), showing that the MTBS size was more accurate than the fire management size for these events.

Figure S30a presents the MTBS perimeter for the NM 467 fire, whose FS20 (15,000 acres) was much smaller than the MTBS size (2,243 acres). The elongated perimeter shape for this fire is typical of wind-driven wildfires (see also, Figures S1a, S1b, S1d). Evidence supporting the MTBS size for this event included a combination of Landsat and MODIS burned area pixels (Figure S30b).

While it was demonstrated that the Birch fire had two MTBS perimeters where the small perimeter was matched with the FS20 event by its position (Figure 10a), the MTBS size for this fire (2,374 acres) was still significantly larger than its FS20 size (1,001 acres). Viewing the false-color Landsat image containing the two perimeters for the Birch fire (Figure 10b) clearly shows the areas within the perimeters have a deeper red color than the areas outside of the perimeter that is consistent with burned vegetation. Note that this fire occurred in a landscape dominated by sagebrush and grasslands and that the Landsat scenes used to generate this image were both collected in September, well after the summer growing season when grasses have begun to senesce. The dead grass at this time resulted in the pink color of the unburned vegetation. The conclusion from this assessment was the MTBS perimeter size was more accurate than the FS20 size.

S3.7 Incorrect Mapping of Burned Perimeters

There were a number wildfire events where the fire management size was determined to be more accurate than the MTBS size based on several lines of evidence, including comparison of MTBS perimeters to NIFS/GeoMAC perimeters and Landsat/MODIS burned area pixels and visual interpretation of false-color Landsat imagery containing the MTBS perimeter as well as fine resolution aerially photography of the area impacted by the fire. Five wildfire events are presented as illustrations: the Sheep Herder Hill, WF Texas Point Northeast, Buffalo Ranch, Wallow, and Proctor fires.

The fire management size (15,556 acres) was much larger than the MTBS size (10,759 acres) for the Sheep Herder Hill Complex fire. A comparison showed that while the MTBS and NIFS/GeoMAC perimeters were in close agreement for the north and south edges of the Sheep Herder Hill Complex fire, the NIFS/GeoMAC perimeter showed more extensive burning to the east of the MTBS perimeter and in a small area on the southwest corner (Figure S31a). There was a high concentration of Landsat burned area pixels throughout the NIFS/GeoMAC perimeter, except for the area in the southwest corner not mapped in the MTBS perimeter (Figure 31b). Comparison of the false-color Landsat image with the MTBS perimeter (Figure 31c) with the fine-resolution, color aerial photograph of the burned area (Figure 31d) showed that the northern edge of this fire can be discriminated on the aerial photograph because the unburned,

conifer forests on the northern side of the border and burned forests on the southern side of this border (trees that were burned during the 2012 fire that are lying on the ground can clearly be seen in an enlargement of the aerial photograph). Visual interpretation of the aerial photograph (Figure 31d) showed there was continuous, west to east change in vegetation cover within the MTBS perimeter from forest to shrubland to grassland, with grassland being the dominant vegetation in the additional area to the east of the MTBS perimeter that was within the NIFS/GeoMAC perimeter.

The WF Texas Point Northeast fire (fire management size: 6,161 acres; MTBS size: 4,635 acres) occurred in a saltwater wetland located along the coast of Texas in October 2016 (Figure S32a). The Landsat and MODIS burned area pixels show more extensive burning on the east end of this fire than mapped by the MTBS perimeter (Figures S32b) (Note the additional burned area pixels to the north of the WF Texas Point Northeast fire occurred in September). The false-color Landsat image with the MTBS perimeter for this fire showed the additional area mapped by the Landsat and MODIS hotspots had a dark blue mixed with black coloring (Figure S32c). There is a strong possibility that the additional burned areas mapped by Landsat and MODIS were flooded at the time the post-fire Landsat scene used to create the MTBS products, resulting in the incomplete mapping of burned area in the MODIS perimeter.

The Buffalo Ranch fire (fire management size: 4,923 acres; MTBS size: 2,892 acres) occurred in May 2016 in northwest Minnesota. A comparison of the MTBS and NIFS/GeoMAC perimeters (Figure S33a) revealed that the NIFS/GeoMAC perimeter on most sides of this fire. Visual interpretation of the false-color Landsat image for this fire (Figure S33b) showed that most of the additional burned areas within the NIFS/GeoMAC perimeter were black in color. In this situation, it is very likely that the black areas in this scene were due to cloud shadows, which resulted in the incomplete mapping of burned area for this event.

Extremely large wildfires (>50,000 ha) often include large patches within the outer perimeter that did not burn (hereafter referred to as unburned islands). Rarely are these unburned islands mapped by the MTBS algorithm, but the MTBS burn severity algorithm classifies these areas as unburned to low severity, which are included in the MTBS perimeter size. As fire mapping methods have improved, maps of larger fire events often include the outer perimeter of a fire as well as the larger unburned islands on the interior of an event. While the area of these unburned islands may be low on a relative scale, they can be large on an absolute scale and explain the difference between the fire management size and MTBS size. There were a number of wildfires where the mapping of unburned islands in fire management perimeters explained the difference in the sizes of fire management and MTBS fires.

An example is the Wallow fire which occurred in east-central Arizona in the early summer of 2011. This fire had a fire management size of 538,049 acres compared to an MTBS size of 563,664 acres. A comparison shows close agreement for the outer edge of this fire between the MTBS (Figure S34a) and NIFS/GeoMAC (Figure S34b) perimeters, where the fire management perimeter contains two large, unburned islands. A close inspection of the false-color Landsat image containing the MTBS perimeter (Figure S34c) shows that the areas within

the unburned islands mapped in the NIFS/GeoMAC perimeter are green, a color that is characteristic of unburned vegetation.

Finally, because the false-color Landsat scene for the Proctor fire (Figure 24c) shows there are areas outside of the Proctor and Unnamed B perimeters that have a dark pink color characteristic of burned vegetation, it is likely that the MTBS algorithm did not correctly map burned area for this fire. In addition, it is also possible that the burned area for the Proctor fire included the area burned for the Unnamed B fires.

4. Treatment of MTBS Events from the Flint Hills Ecoregion

The Flint Hills ecoregion (covering portions of eastern Kansas and northeast Oklahoma, where >90% is in Kansas), is an area where prescribed burning of tall grass prairies and pasture lands is common during the springtime, and is used to reduce weeds, hinder invasion of woody plants, and improve pasture conditions (Kansas Department of Health and the Environment (KDHE), 2027). Because this prescribed burning produces considerable smoke that impacts downwind communities, KDHE has developed the capability to estimate burned area during prescribed burning, the amount of resultant smoke, and the atmospheric transport of this smoke (Sabian et al. 2024). Methods to map area burned during in the counties containing the Flint Hills in Kansas using MODIS satellite remote sensing data have been developed (Scholtz et al. 2020), and are used by KDHE to produce daily, monthly, and annual estimates of burned area. These data showed that between 2000 and 2021, some 747,000 ha burned annually in the Flint Hills compared to an annual estimate of 193,000 ha from the MTBS events data contained in the iWED. A small amount of wildfire activity ($\sim 10,000$ ha yr⁻¹) was reported by fire management agencies.

There are several lines of evidence supporting using reclassified MTBS mega and mega-plus fires from the Flint Hills ecoregion in wildfire studies, including: (a) limited resources for fire suppression and reporting at the state level; (b) unreported wildfires on privately owned lands by landowners and local volunteer fire departments; and (c) the frequency and burned area in extreme fire days.

Unlike most states, Kansas has little state-owned land, no national forests, small national wildfire refuges. As a result, the state has devoted few resources for fire management activities, and what resources are available are spread across three agencies (State of Kansas 2018). In 2018, the state had only four trucks for fire suppression and four full-time fire fighters. Most wildfire activity in Kansas occur on private property where suppression is carried out by landowners and local volunteer fire departments. However, it has been noted that coordination of fire suppression across different jurisdictions is hindered by the lack of a state-wide system for reporting of wildfires (State of Kansas 2023, which also leads to under-reporting).

The Flint Hills ecoregion is located in the northeast corner of the Southern Great Plains, a region where Lindley et al. (2014, 2017, 2019) determined that the passage of weather fronts (low-level thermal ridges) produced the warmer temperatures, high winds, and low relative humidity that drive extreme wildfire activity over short periods (days). An analysis of all wildfire activity (including fire management and all MTBS events) in the Flint Hills ecoregion showed that between 1992 to 2021, 73.6% of the burned area occurred on just 18 days when >100,000 ha burned. All these extreme fire days occurred during the spring and are likely caused by the passage of the weather fronts identified by Lindley et al. (2017). While the mega fires in the Flint Hills ecoregion, may have been ignited as prescribed fires, it was

felt the growth of these fires was caused by extreme fire-weather conditions. Given the large number of fires that occurred on extreme-fire days (an average of 117) and the limited resources for managing prescribed burning, it is likely that mega and mega-plus fires were the result of prescribed fires that escaped control and containment. This escapement meets the criteria used to reclassify prescribed fires as wildfires in other regions.

5. Supplemental Figures

Figure S1. Examples of MTBS imaged illustrating the characteristics of prescribed fires. The false-color Landsat images presented in this figure were all generated by the Monitoring Trends in Burn Severity programmed and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6.

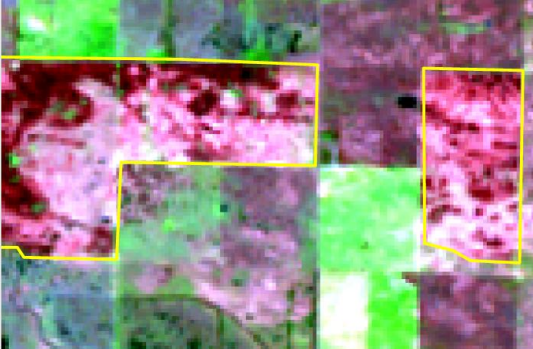
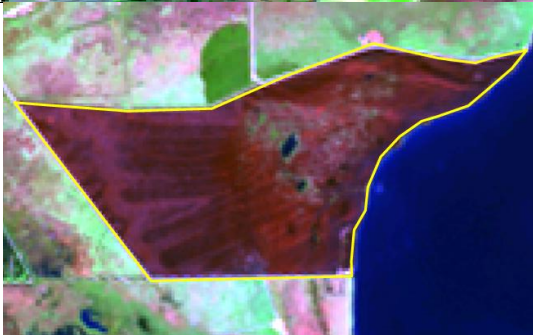
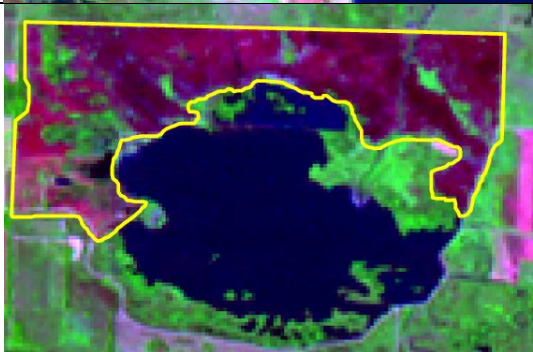
	a.
	b. The right-hand border of this perimeter is the Gulf of Mexico.
	c.

Figure S1 (concluded).

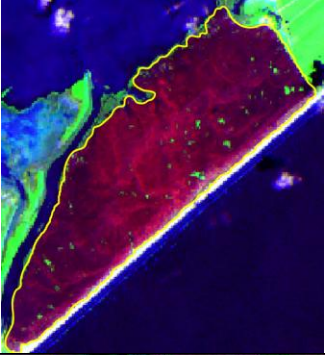
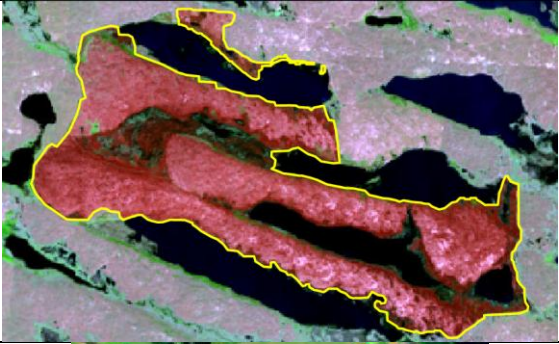
	d. The southern edge of this perimeter is the Gulf of Mexico.
	e.
	f.

Figure S2. Examples of MTBS images illustrating key characteristics of wildland fire perimeters. The false-color Landsat images presented in this figure were all generated by the Monitoring Trends in Burn Severity program and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6.

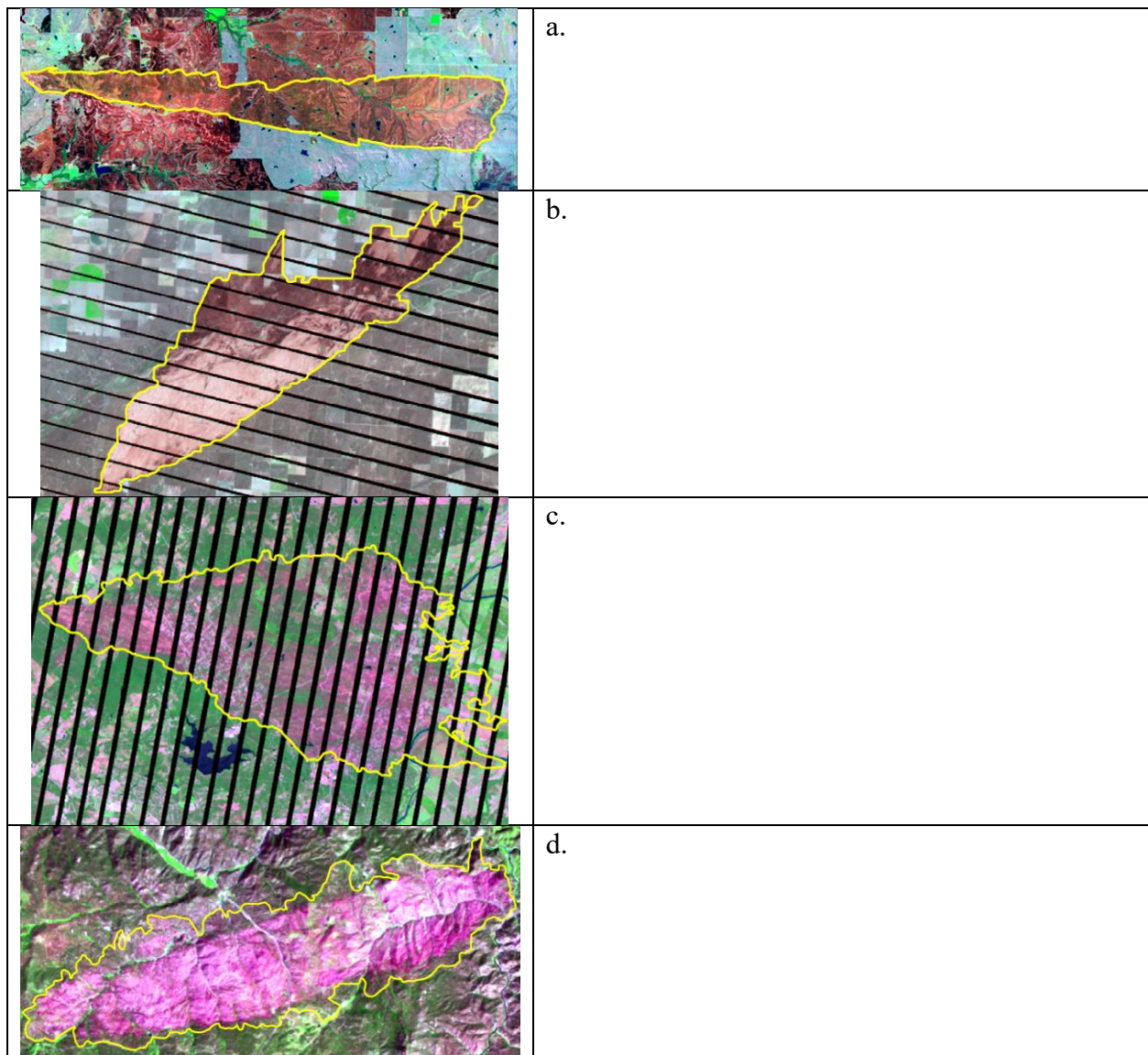


Figure S2 (continued).

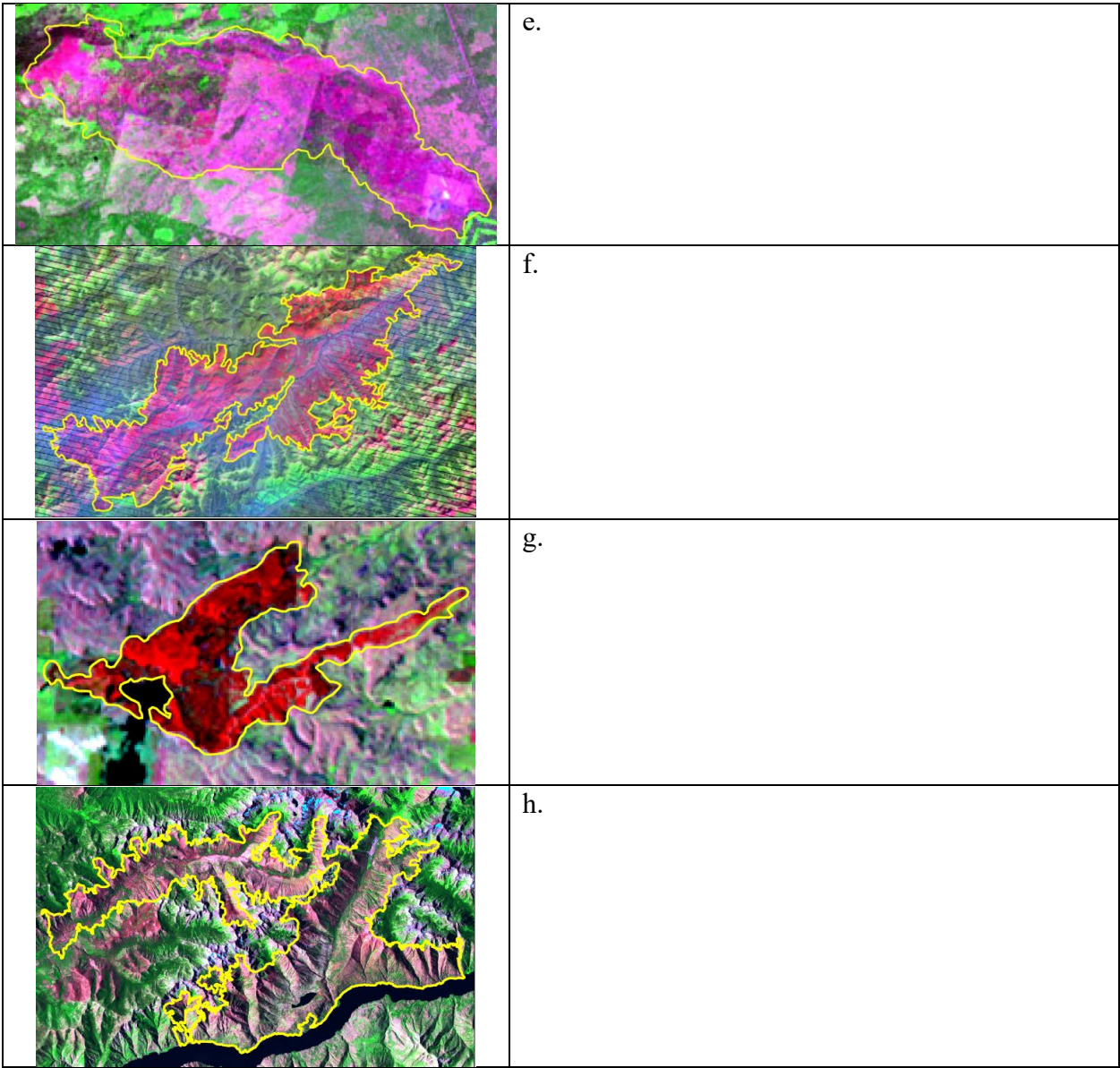


Figure S2 (concluded).

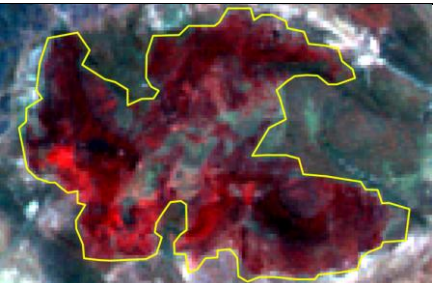
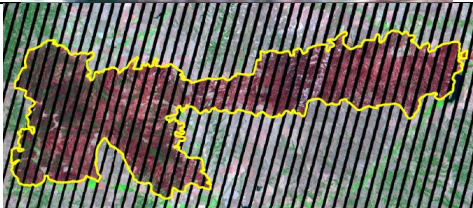
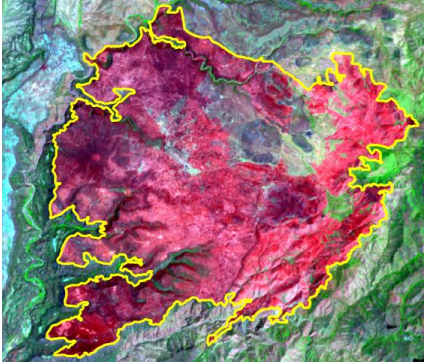
	i.
	j.
	k.
	l.

Figure S3. Individual fires comprising te Antelope Complex that occurred in northcentral Nevada in July 2006. (a) MTBS perimeters for the Elk Antelope Complex event; and (b) NIFS/GeoMAC perimeters from this region. The NIFS/GeoMAC image also contained small perimeters from other fires in this region. The six fires from the Antelope Complex are labeled as: (a) Dunphy; (b) Elephant Head (2 lobes connected by an isthmus; (c) Paris; (d) Carico; (e) Raven; and (f) Cain Mountain. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters in this figure are discussed in Section 2.2. of the paper.

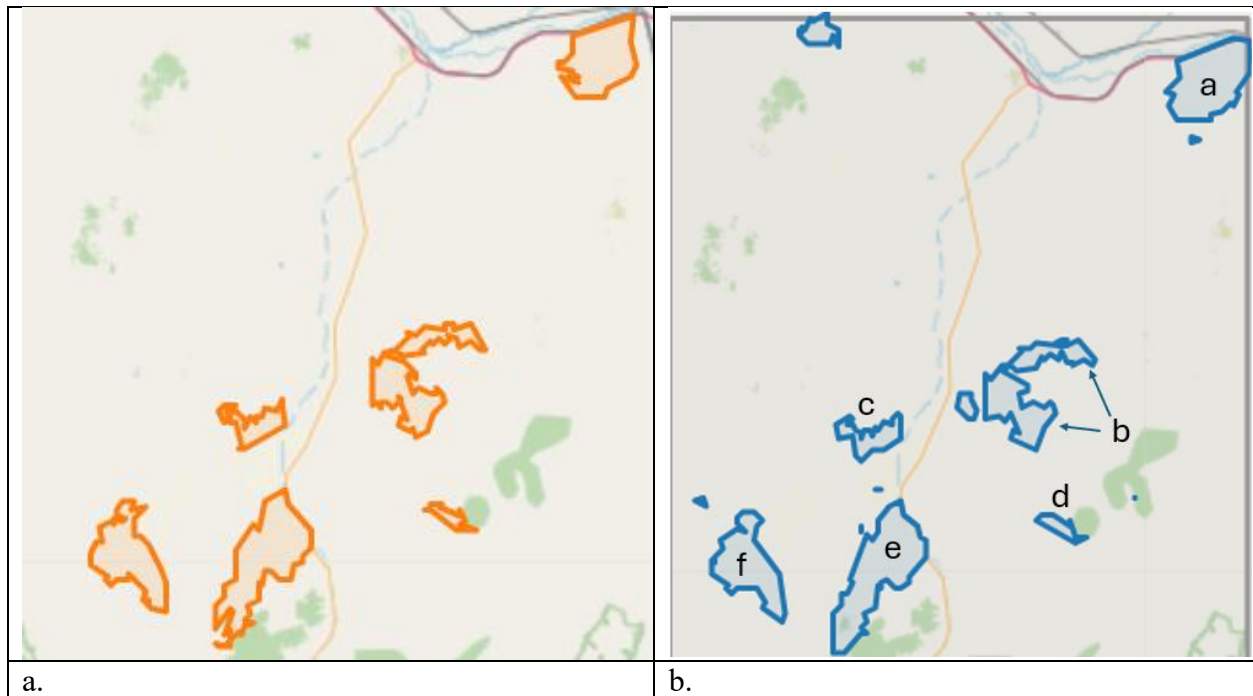


Figure S4. The Black Pulaski Complex occurred in northeast Montana along the Missouri River and included five larger fires with MTBS perimeters and one smaller fire without an MTBS perimeter. The perimeters of five fires include: (a) Soda fire; (b) Lost Creek fire; (c) Chalk Butte fire; (d) Hill Coulee fire; and (e) Lodge Pole fire. The two other perimeters in this figure are (f) a small fire within the Flat Tire Complex; and (g) Dove Tail fire. Using One Street Map revealed that a Square Butte (x) was to the south and east of the Black Pulaski fires. Since nearby geographic features are most frequently used to name wildfires, it was concluded that Square Butte was used as the name of the fire listed in the NRCC dataset. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

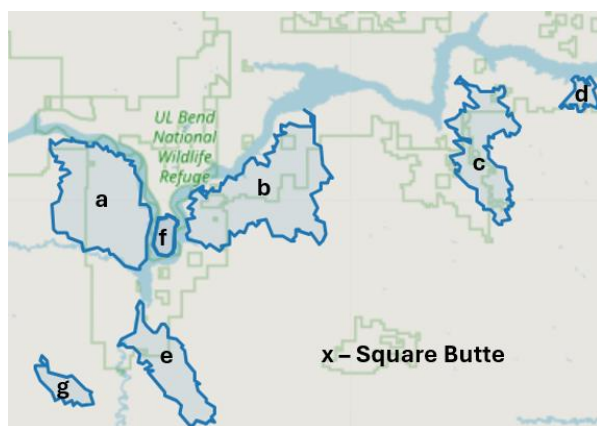


Figure S5. The Sioux County Complex of wildfires occurred in northwest Nebraska in July of 2007. The fires in this complex are labeled in the figure as: (a) Thayer fire; (b) Oldaker fire; and (c) Rudloff fire. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

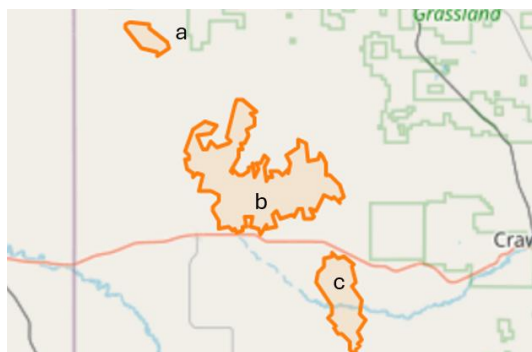


Figure S6. The SCU Lightning Complex of events occurred east of San Francisco Bay, California in August of 2020. (a) MTBS SCU Lightning Complex event; and (b) northern-most MTBS perimeters of this complex with the positions of the 4-1 Marsh (x) and Deer (y) fires. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeter presented in this figures is discussed in Section 2.2. of the paper.

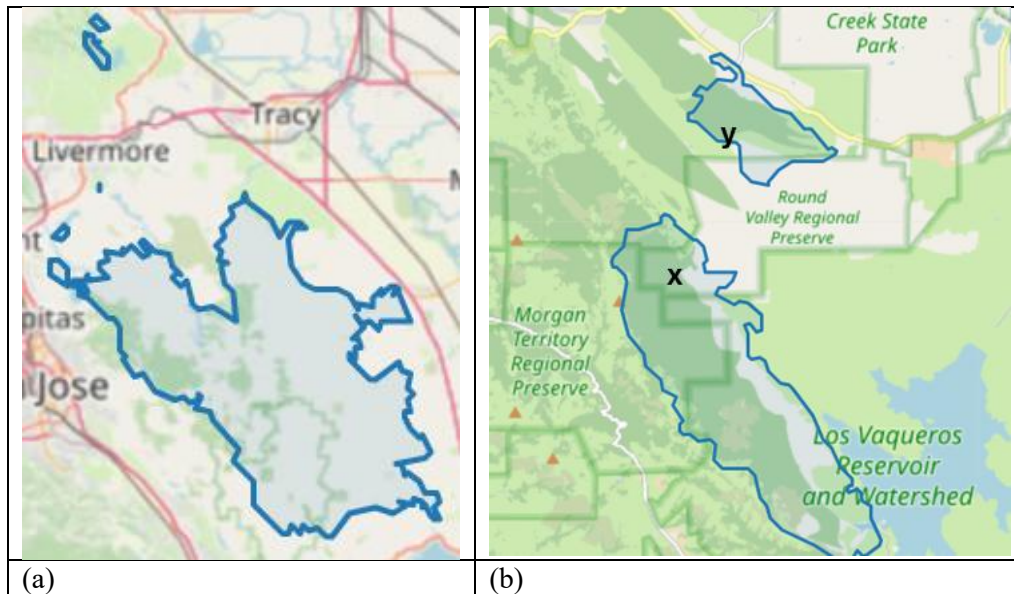


Figure S7. The Jawbone fire occurred in south-central California in August of 2012. (a) MTBS perimeters for the Jawbone fire; and (b) CalFire perimeters for the Jawbone Complex. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

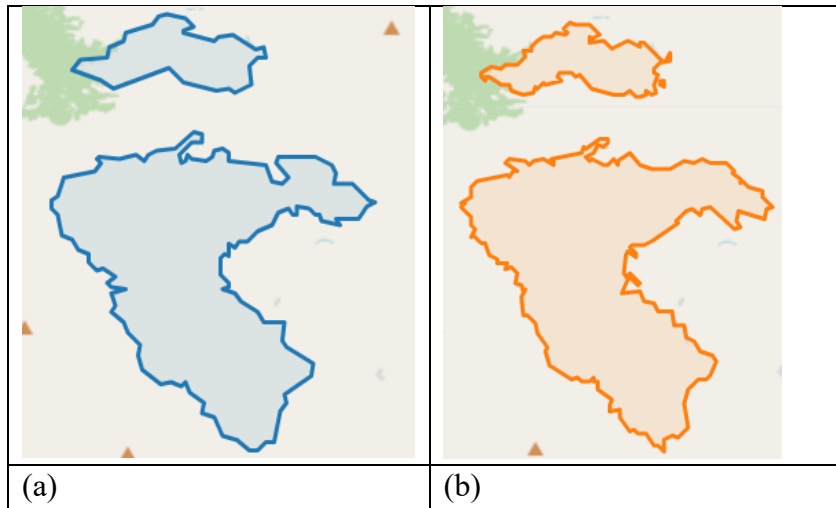


Figure S8. The Calamity Complex of fires occurred in west-central Oregon in July of 2007. (a) MTBS perimeters and (b) NIFS/GeoMAC perimeters for the three fires in the Calamity Complex (two large and one small). The fire management positions for the two large fires in the complex determined using OpenStreetMap are given as an “x” for the Grapple fire and a “y” for the Poison Creek fire. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

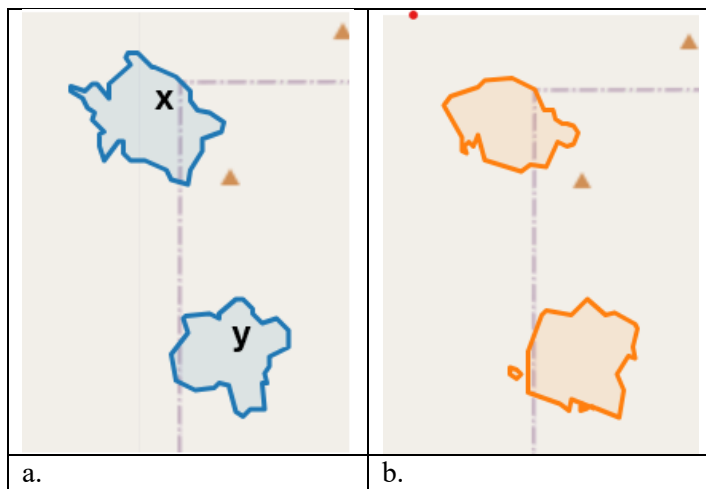


Figure S9. MTBS perimeters for the Black Water fire that occurred in southwest Alaska in July of 2005. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

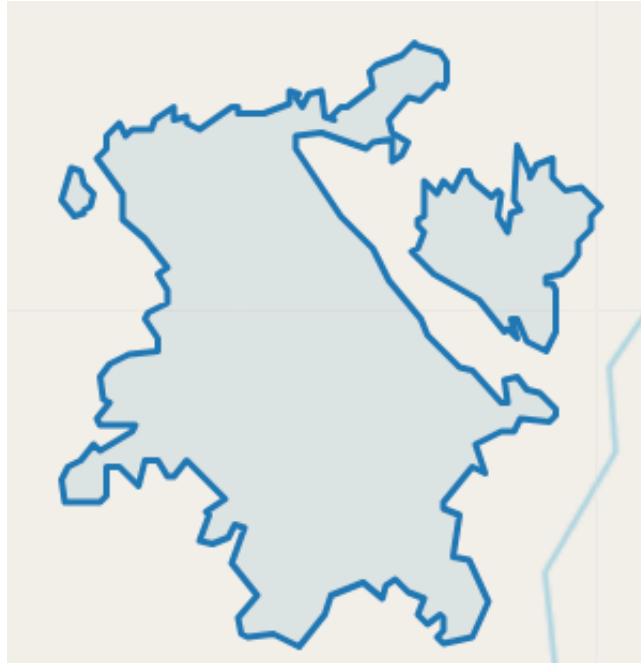


Figure S10. The Birch fire occurred in northeast Oregon in July of 2002. (a) MTBS perimeters for the Birch fire with the FS20 position marked in the eastern perimeter (x). (b) False-color Landsat image for this scene containing the MTBS perimeters for the Birch fire. The false-color Landsat image presented in this figure were generated by the Monitoring Trends in Burn Severity program and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6. The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figures is discussed in Section 2.2 of the paper.

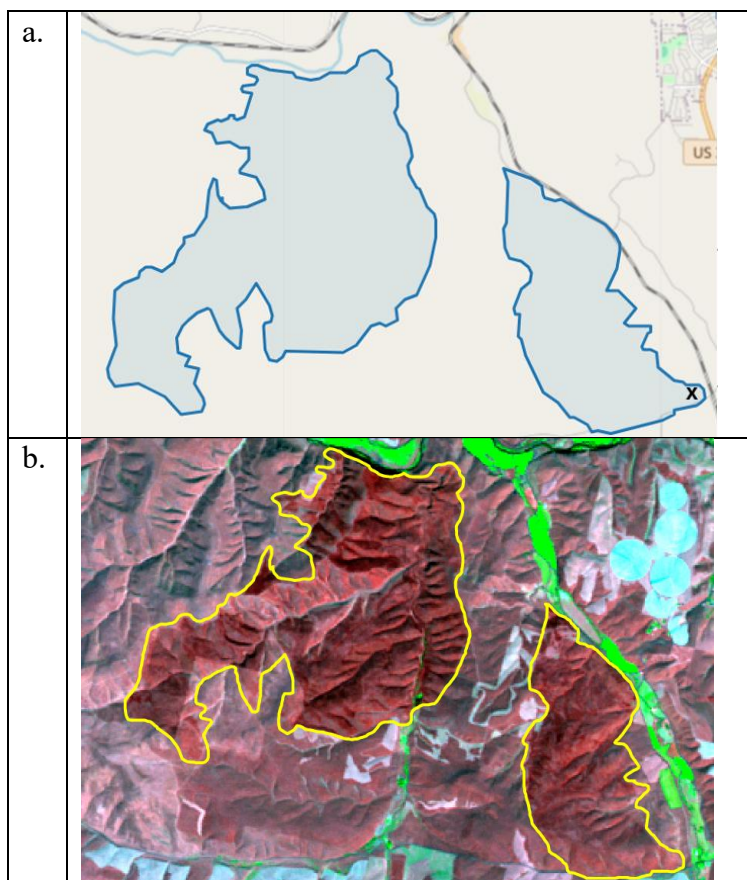


Figure S11. The Hurst Creek and Old Grouch Top fires occurred in southwest Alaska in June of 2019. (a) tMTBS perimeters for the Old Grouch Top (a) and Hurst Creek (b) fires; (b) enlargement of the MTBS perimeters for the Old Grouch Top and Hurst Creek fires in the region where the two fires shared a common boundary; (c) NIFS/GeoMAC perimeter for the Old Grouch Top fire; and (d) MTBS perimeters for the Old Grouch Top and Hurst Creek fires (in blue) and the NIFS/GeoMAC perimeter for the Hurst Creek fire (in orange). The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters pixels presented in this figure are discussed in Section 2.2. of the paper.

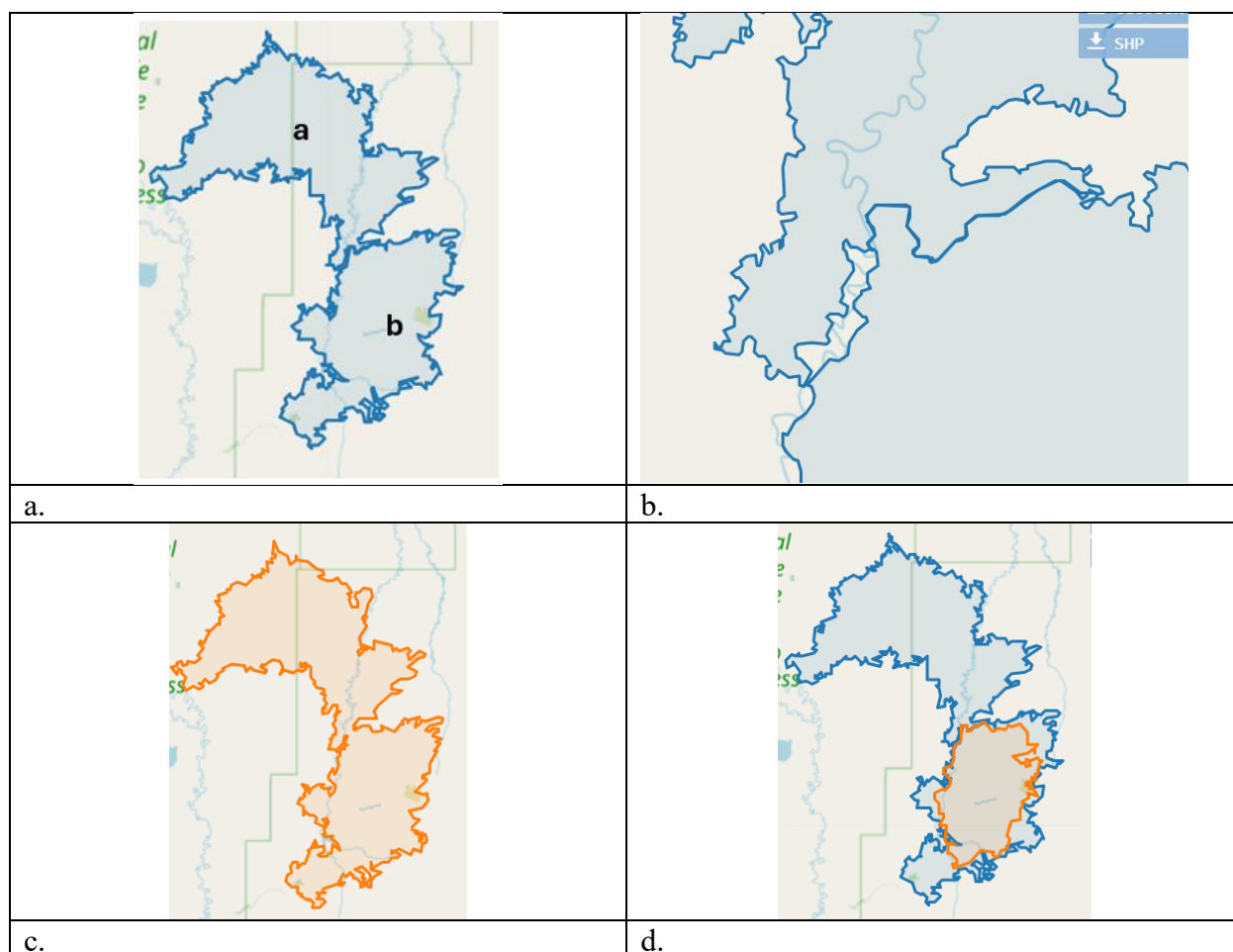


Figure S12. The Beachie Creek and Lionshead fires occurred in northwest Oregon in August of 2020. (a) MTBS perimeters for the two events; (b) MODIS burned area pixels from 11 September (in orange) overlaid onto the WFIGS perimeters for the two fires; (c) MODIS burned area pixels from 12 September (in orange) overlaid onto the WFIGS perimeters for the two fires; (d) MODIS burned area pixels from 14 September (in orange) overlaid onto the WFIGS perimeters for the two fires. The images of fire perimeters and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in this figure are discussed in Section 2.2. of the paper.

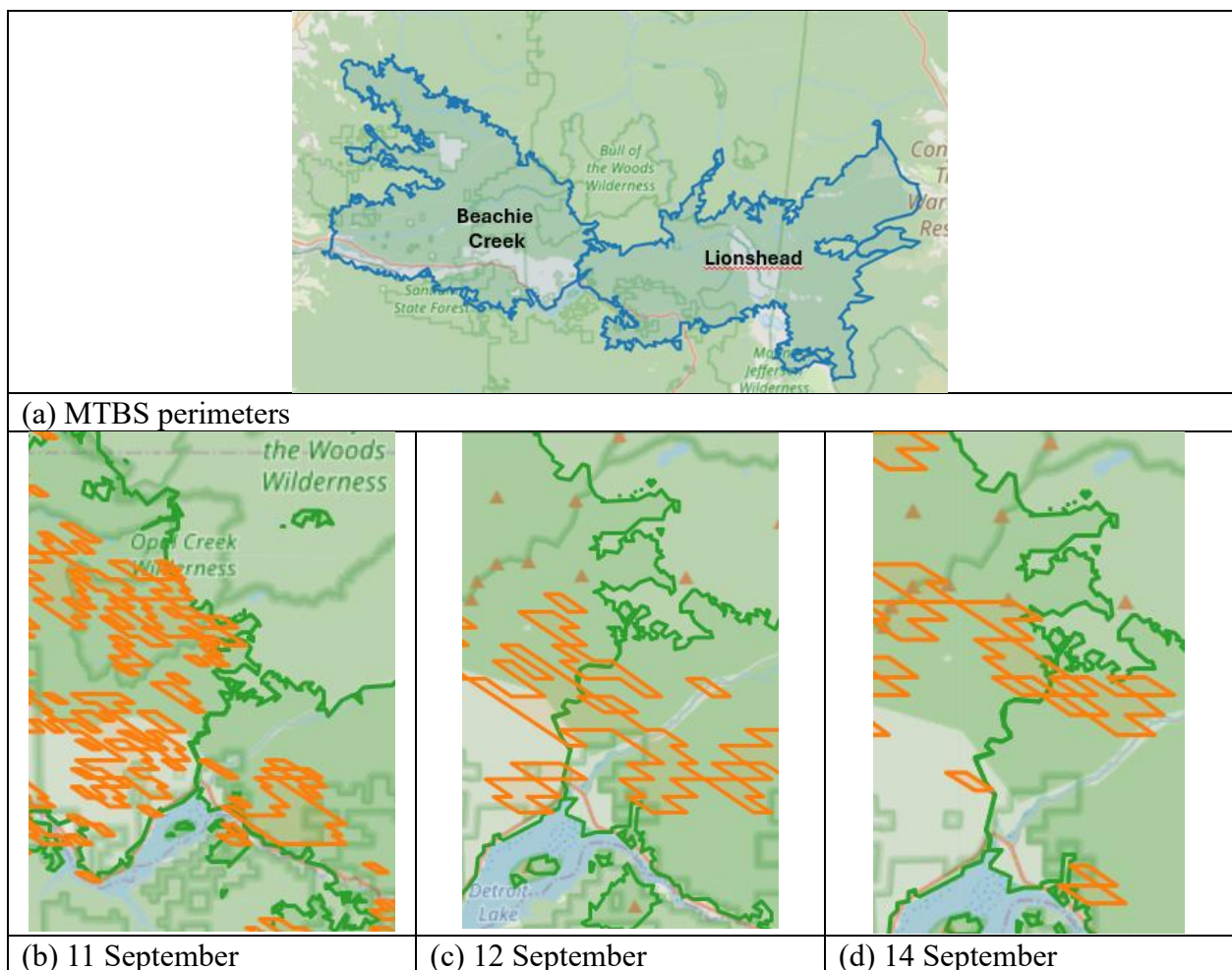


Figure S13. The Canyon II, Flossie, and Three Bear fires occurred along the border of Idaho and Montana in August of 2000. The screenshots in this figure obtained using the display capability of the WFEIS include: (a) the MTBS perimeter for the Canyon II fire; (b) the MTBS perimeter for the Flossie fire; and (c) the area where the two perimeters were adjacent to one another along the Snake River, with the start positions for the Canyon II fire (a) and Three Bears fire (b). The images of fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeter presented in this figure are discussed in Section 2.2. of the paper.

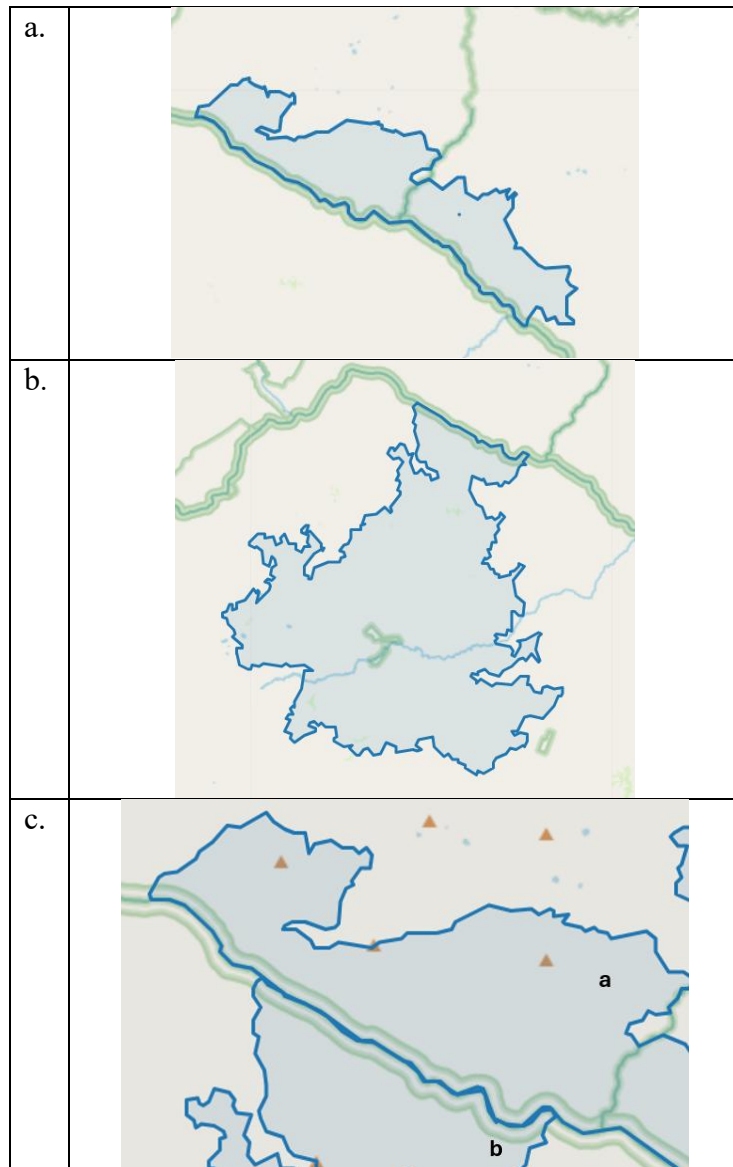


Figure S14. The Buckeye, Hay North, and Nu Snake fires took place in east-central Oklahoma in April of 2011. The MTBS Nu Snake fire contained two . It was determined that the Hay North and Nu Snake fires (positions a and b) had merged to create the large perimeter and that the position for the Buckeye fire (c) was within the small perimeter. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeter resented in these figure are discussed in Section 2.2. of the paper.

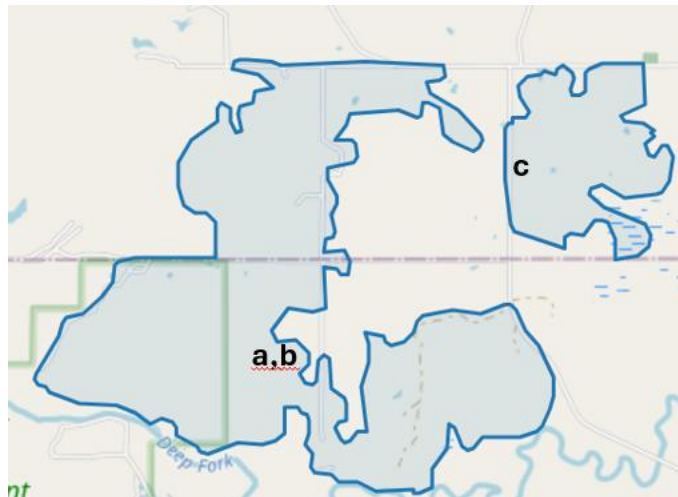


Figure S15. The Gibraltar Ridge fire occurred in northwest Montana in August of 2017. (a) MTBS Gibraltar Ridge event (in blue) and the NIFS/GeoMAC Gibraltar Ridge event in orange; (b) MTBS Gibraltar Ridge event and an adjacent Unnamed MTBS event; and (c) MTBS burned area pixels (in blue) from 5 August through 13 September overlain on the MTBS perimeters. The images of the fire perimeters and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in this figure are discussed in Section 2.2. of the paper.

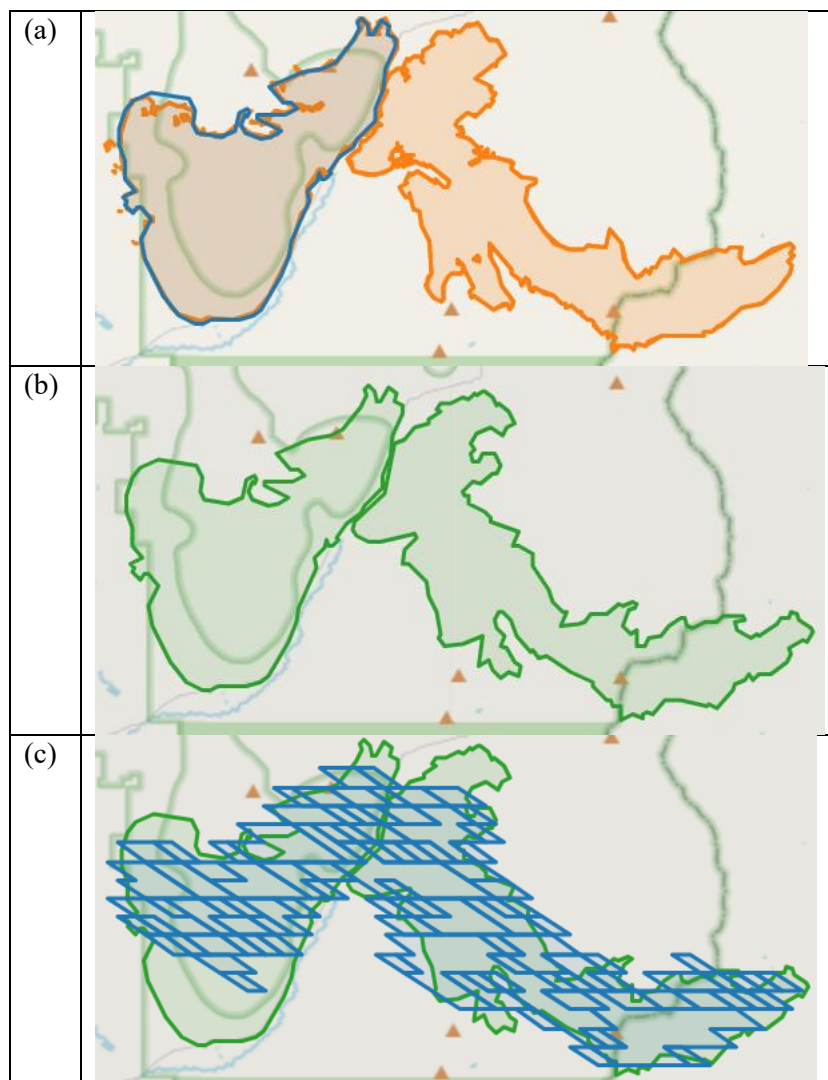


Figure S16. This figure contains the MTBS perimeter for the Meadow fire which occurred in southeast Nevada in July of 2008. This figure contains the position for fire management Meadow fire (x) and Pass fire (y). The image of the fire perimeter in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The source for the fire perimeter presented in this figure is discussed in Section 2.2. of the paper.

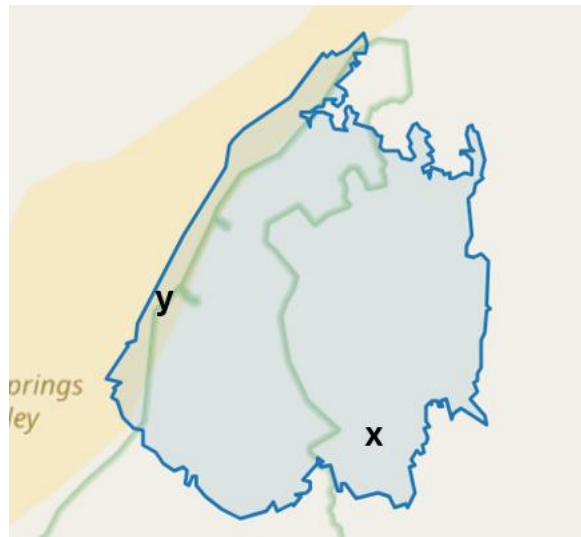


Figure S17. The Brownstone Complex of wildfires occurred in south-central Washington in August of 2020. (a) MTBS Brownstone 3 fire perimeter; and (b) NIFS/GeoMAC perimeters for the Brownstone 3 fire (x), Brownstone 2 fire (y), and Brownston (z) fire. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters in this figure are discussed in Section 2.2. of the paper.

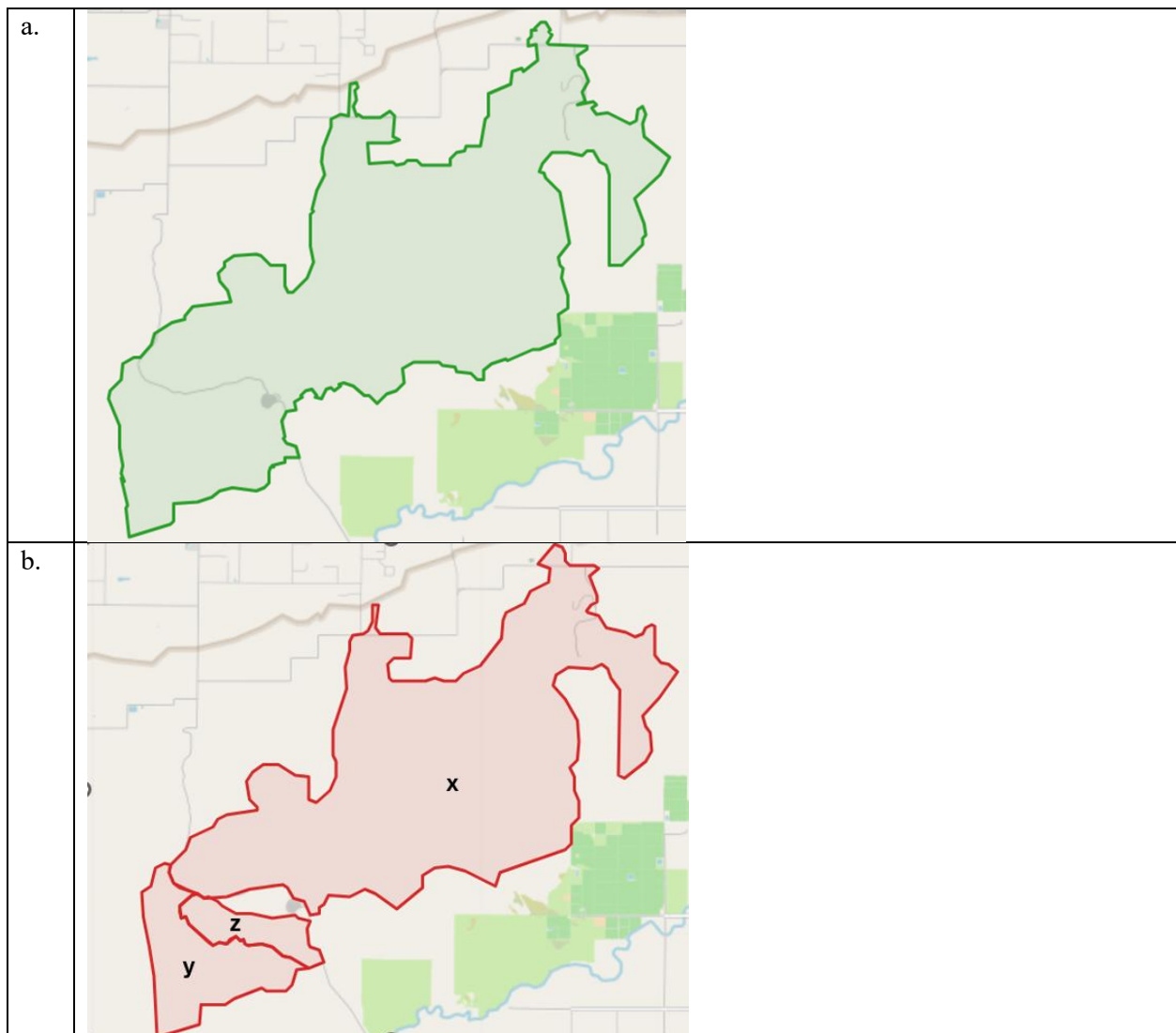


Figure S18. The SR116-Devonia, Gilmore Trail, and Bald Knob fires occurred in northeast Tennessee in November of 2016. a) MTBS SR116-Devonia fire; and (b) NIFS/GeoMAC perimeters for the SR116-Devonia fire (x), the Gilmore Trail (y) and Bald Knob (z) fires. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

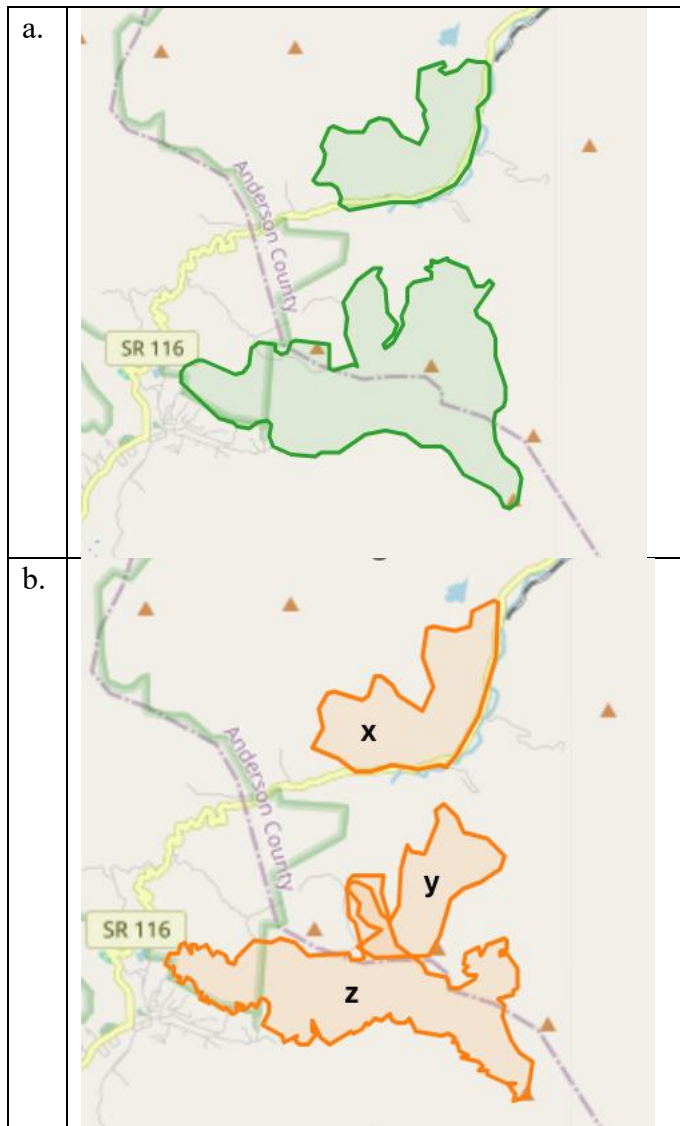


Figure S19. The Egley Complex of fires occurred in central Oregon in July 2007. (a) MTBS perimeters for this complex with the reported fire management positions for the five fires in this complex: (a) Egley; (b) Bear Canyon; (c) Bald Butte; (d) Egley South; and (e) Silver. (b) MODIS burned area pixels. The images of the fire perimeters and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in this figure are discussed in Section 2.2. of the paper.

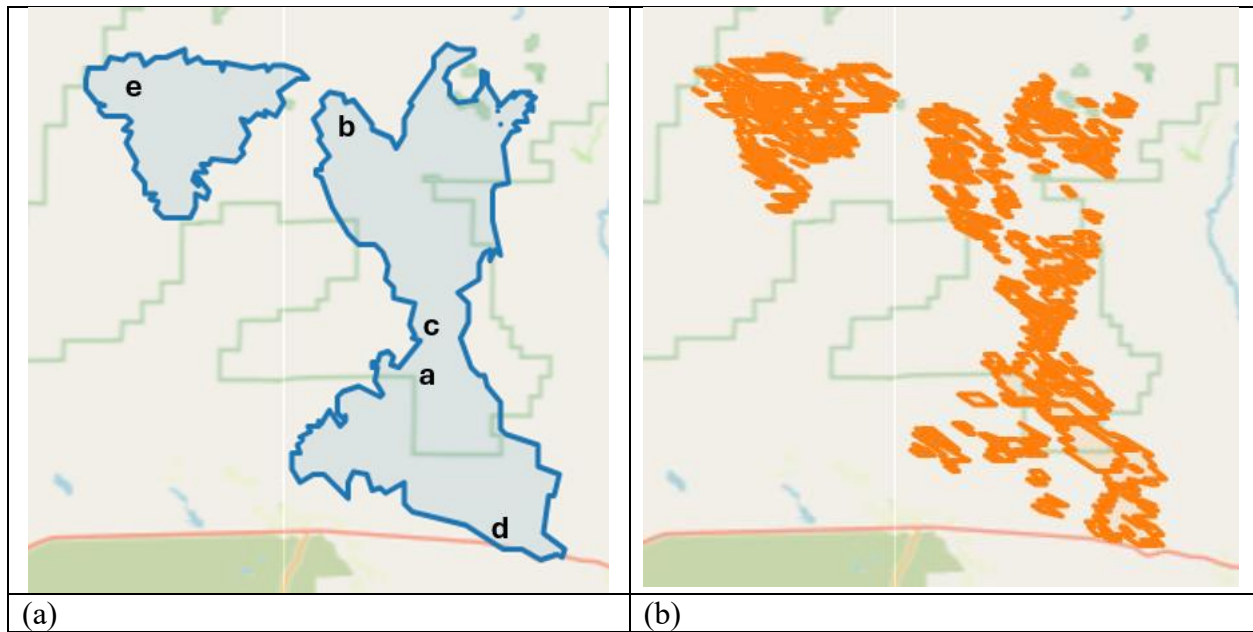


Figure S20. The Kinyon Road, East Rock, and Balanced Road fires occurred in southwest Idaho during the summer of 2012. (a) MTBS (in blue) and NIFS/GeoMAC (in orange) perimeters for the Kinyon Road and Balance Road fires; (b) MTBS perimeters for the East Rock, Kinyon Road, and Balanced Road fires; and (c) MTBS perimeter of the East Rock fire (in blue) overlaid with MODIS burned area pixels (in orange) dated 9 July. The images of the fire perimeters and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in this figure are discussed in Section 2.2. of the paper.

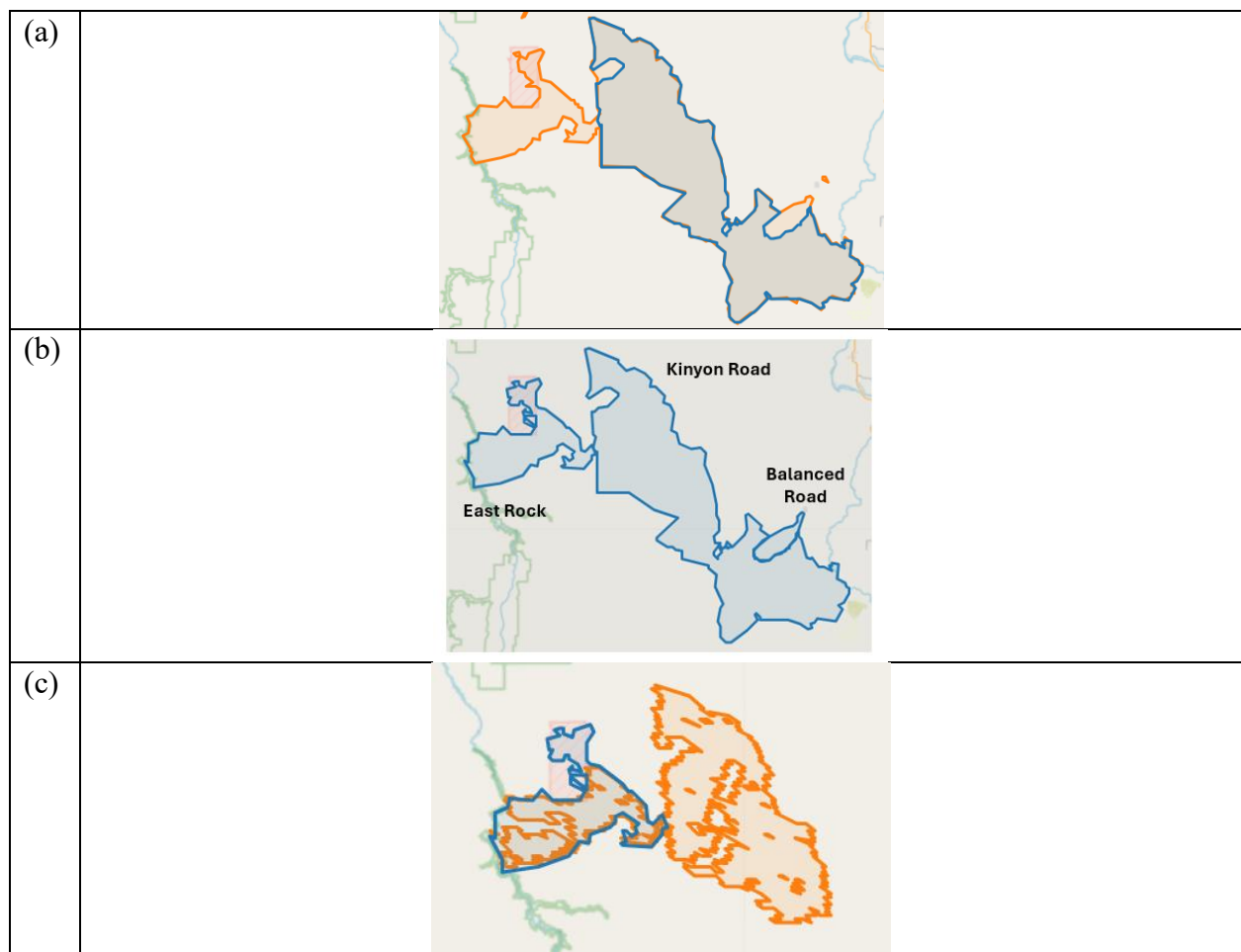


Figure S21. The Truck Stop and Cloverdale 2 fires occurred along the U.S./Mexico border in southwest New Mexico in the spring of 2011. (a) Two MTBS perimeters for the Truck Stop event (x) and single MTBS perimeter (y) for the Cloverdale 2 event, where the horizontal gray line is the US/Mexico border; and (b) The single NIFS/GeoMAC perimeters for the Truck Stop and Cloverdale 2 event. The small perimeter to the west of the Cloverdale 2 event is the Puerto Blanco fire. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

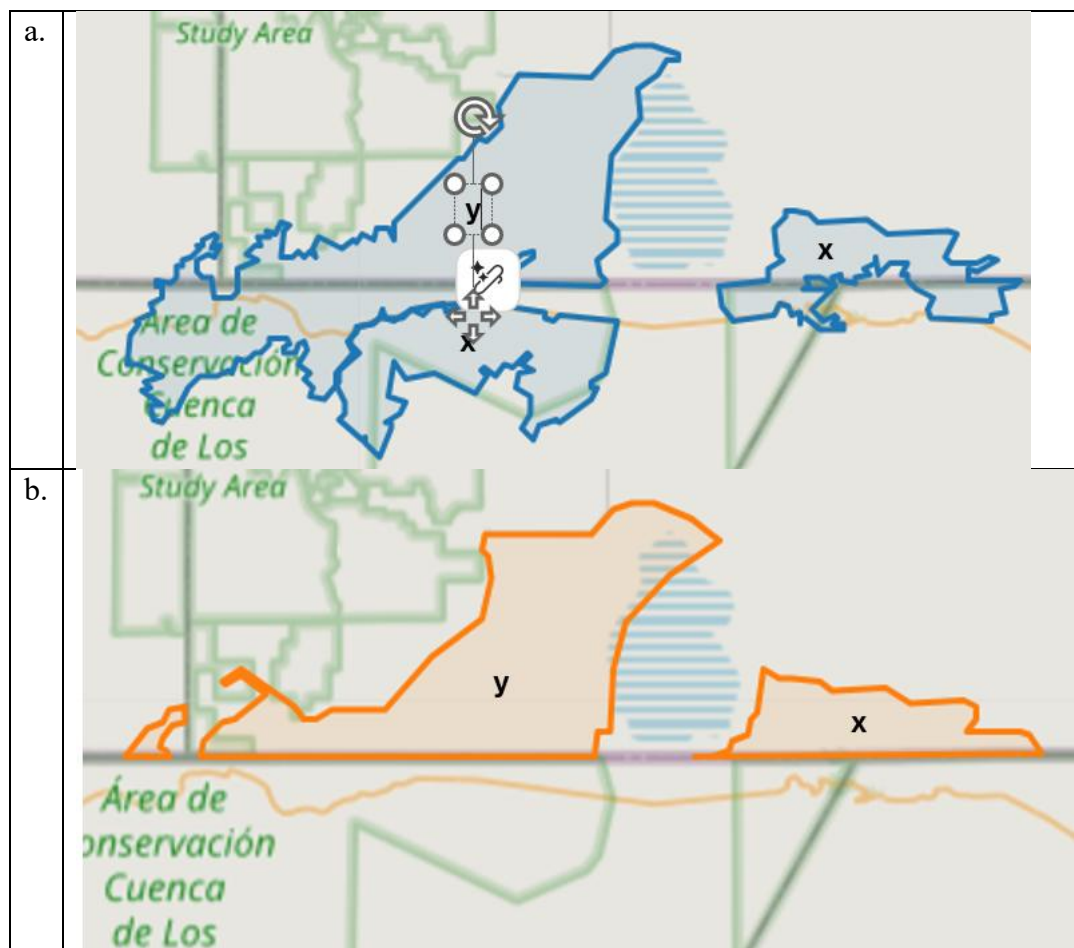


Figure S22. The Tatoosh Complex fires spanned the U.S./Canada border in north-central Washington and occurred in August 2006. a) MTBS perimeter; (b) NIFS/GeoMAC perimeter; and (c) Canadian CNFDB perimeter (in green) overlaid onto the NIFS/GeoMAC perimeter. The U.S./Canada Border is the thick gray line in the upper half of the images. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

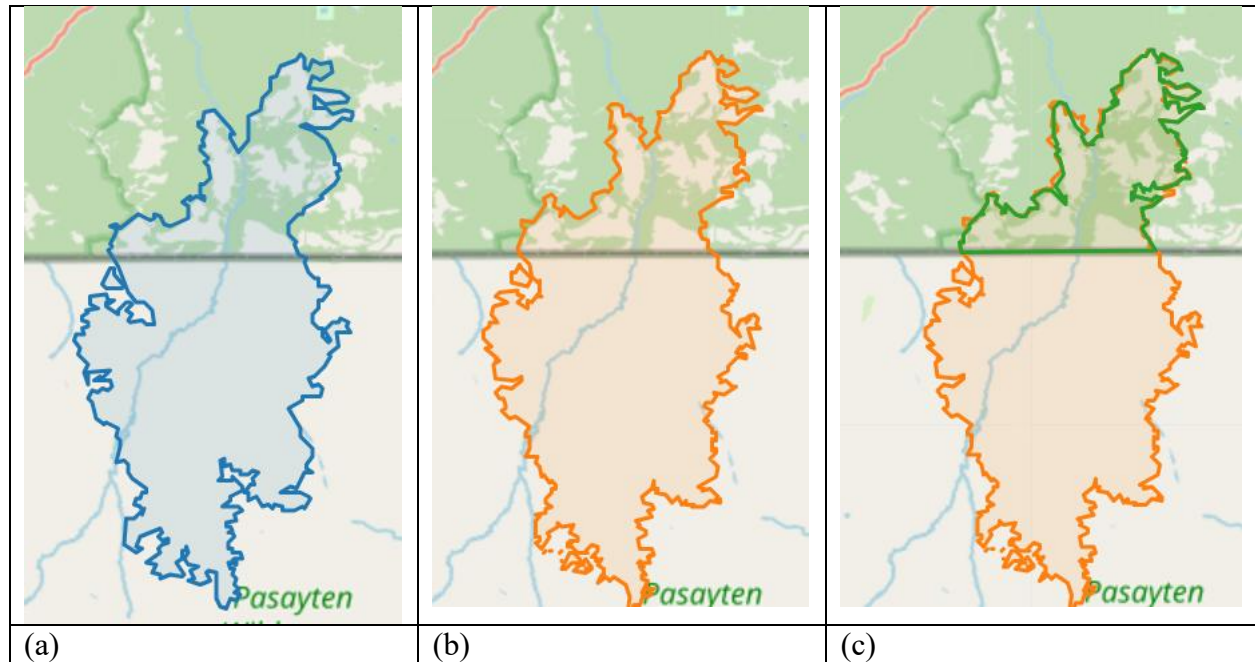


Figure S23. The Higby, Twin Springs, and Range fires occurred in southern Nevada during the summer of 2006 in close proximity to one another. The MTBS Higby fire (a) contained a single perimeter and the Range fire contained a large (b1) and small (b2) perimeter, where the large perimeter was adjacent to the Higby fire. The Twin Springs fire contained three perimeters, where one perimeter was within the Range perimeter (c1), one perimeter was between the Range and Higby fires, and one perimeter was within the Higby fires. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The source for the fire perimeters presented in this figures is discussed in Section 2.2. of the paper.

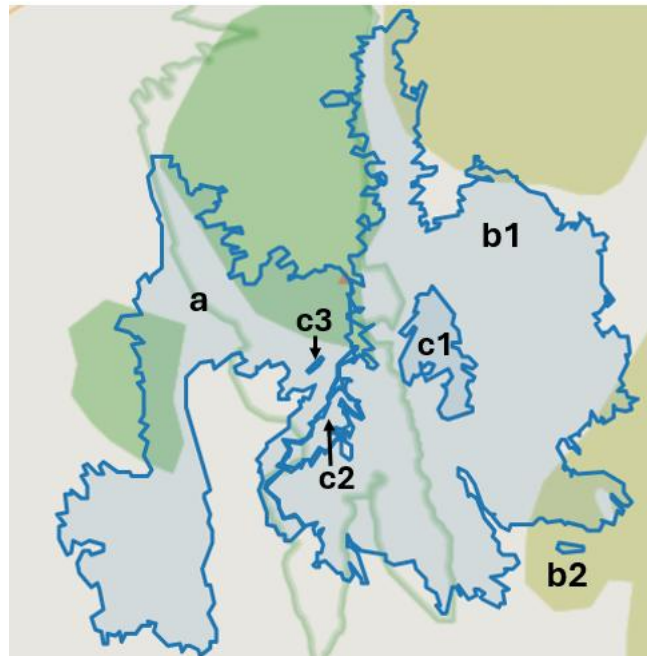


Figure 24. The Proctor fire occurred in east-central Oklahoma in November 2005 while the Fish Creek fire occurred in March 2005. There were two Unnamed MTBS fires in the vicinity of the MTBS Proctor fire. (a) MTBS Proctor with the location of the FS20 Proctor (x) and Fish Creek (y) fires; (b) the MTBS perimeters for the Proctor, Unnamed A, and Unnamed B fires, plus the overlap (O) between the Proctor and Unnamed B areas; and (c) a false-color Landsat image containing the Proctor fire perimeter. The false-color Landsat image presented in this figure was generated by the Monitoring Trends in Burn Severity program and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The source for the fire perimeters presented in this figure is discussed in Section 2.2. in the paper.

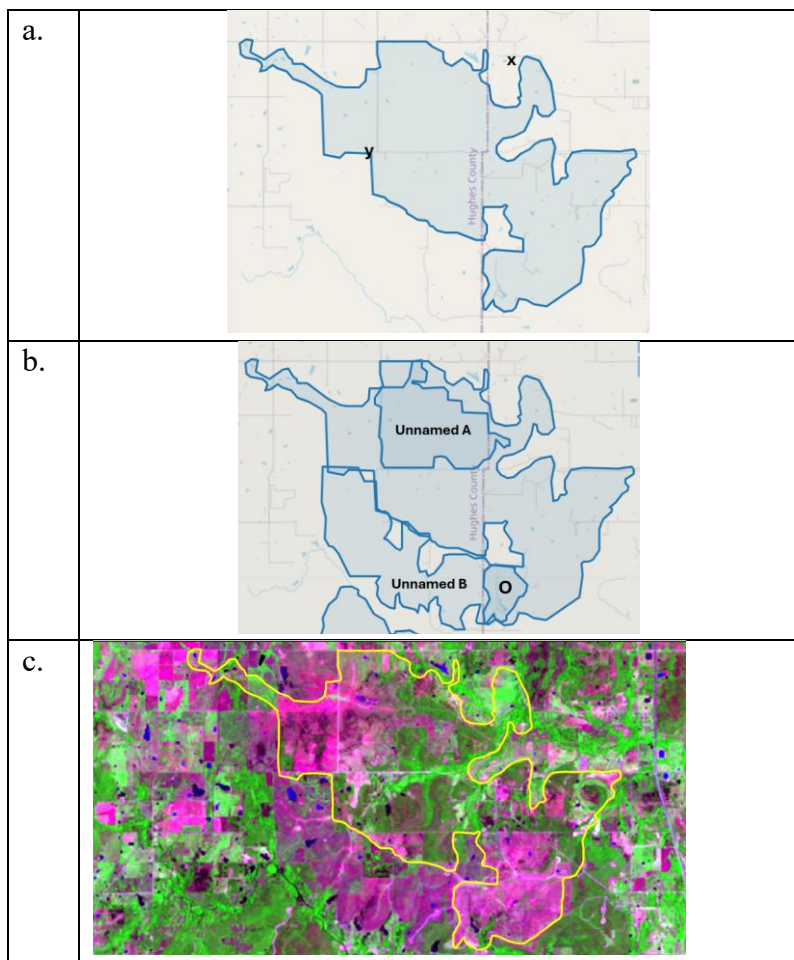


Figure S25. The S. Obenchain fire occurred in southcentral Oregon during September of 2020.(a) MTBS perimeter; and (b) the NIFS/GeoMAC perimeter. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

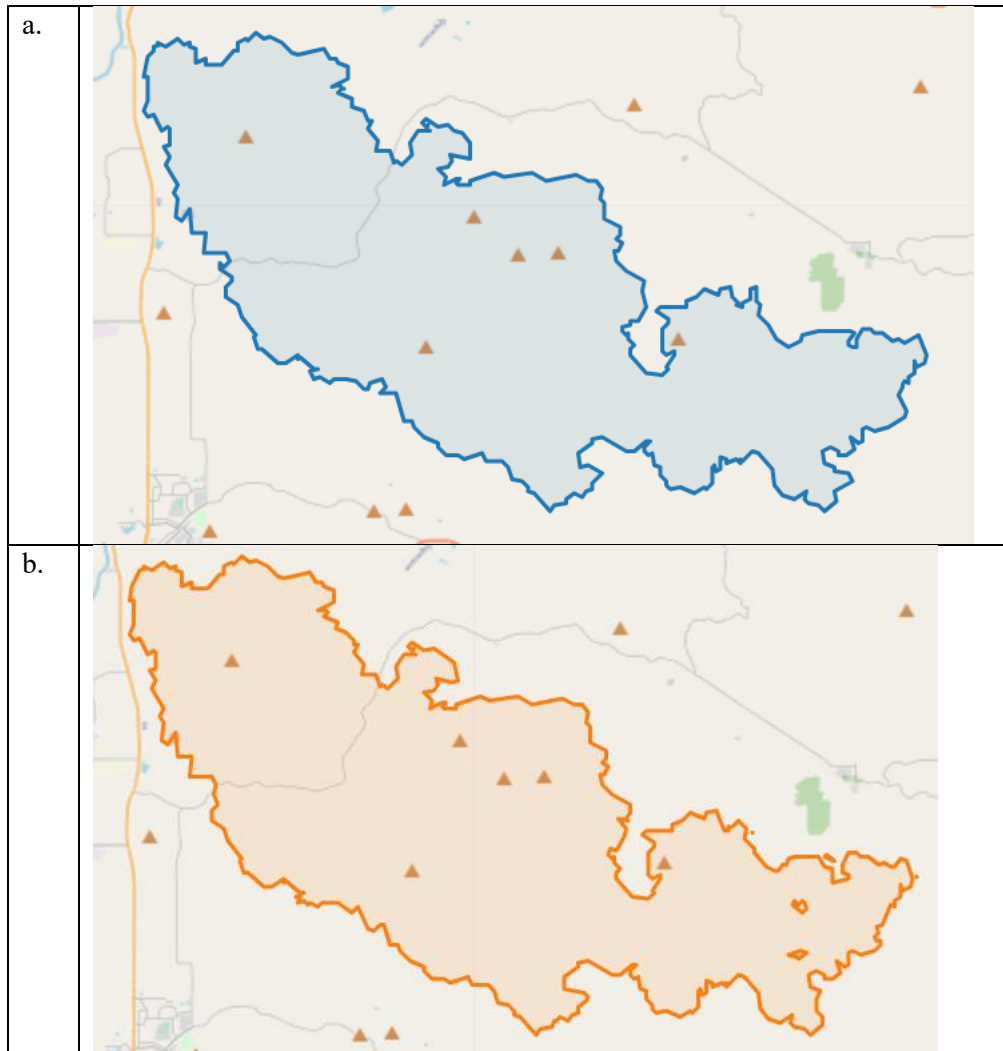


Figure S26. The Eiler fire occurred in north-central California during August of 2014: (a) the MTBS perimeter; and (b) the CalFire perimeter. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure are discussed in Section 2.2. of the paper.

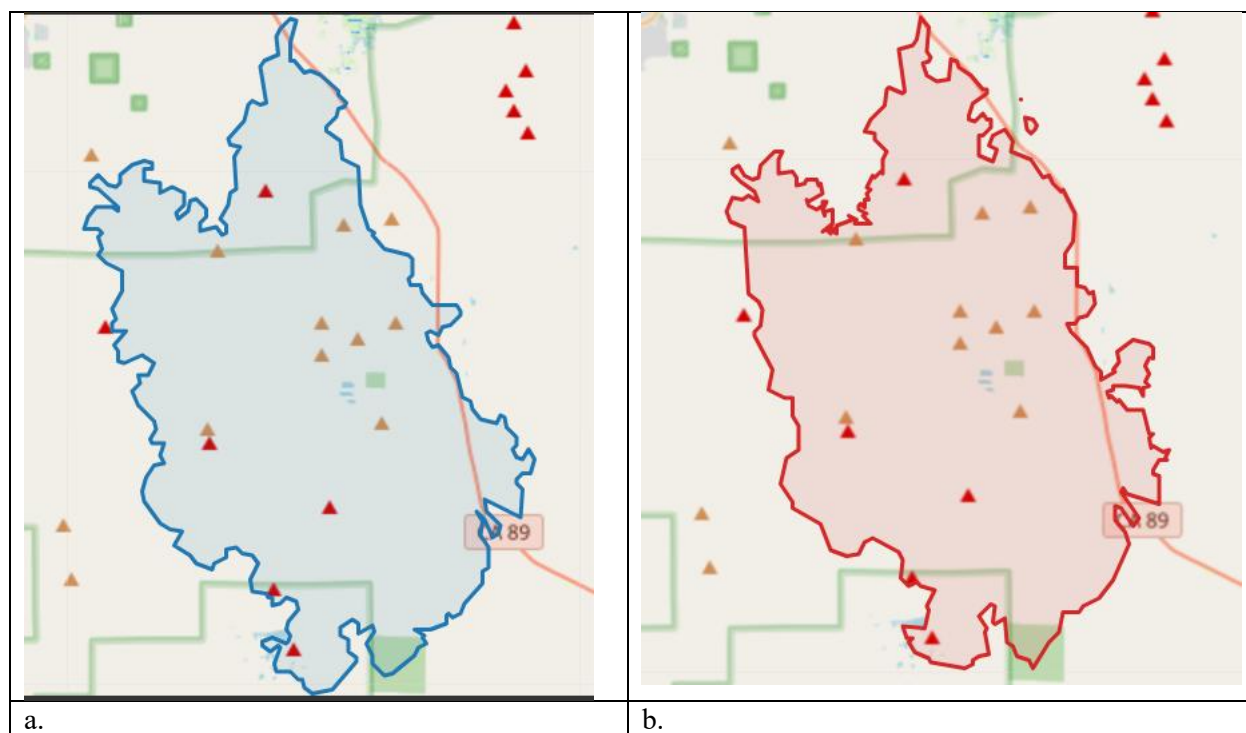


Figure 27. The Sand Tank Complex of fires occurred in southwest Arizona in June of 2005 and included (a) the MTBS Sand Tank Complex (Sand Tank) and (b) Sand Tank Complex (Home) fires. An Unnamed MTBS fire (c) was also found in the vicinity of the two Sand Tank fires. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The source for the fire perimeters presented in this figure is discussed in Section 2.2. of the paper.



Figure S28. The Miller Creek fire occurred in north-central Texas during April of 2011. This figure presents examples of approaches used to determine that MTBS fire size was more accurate than fire management size for the Miller Creek fire. (a) MTBS perimeter; (b) false-color Landsat image containing the MTBS perimeter; (c) NIFS/GeoMAC perimeter; (d) MTBS perimeter (in blue) and Landsat burned area pixels (in orange); and (e) MTBS perimeter (in blue) and MODIS burned area pixels (in green). The false-color Landsat image presented in this figure was generated by the Monitoring Trends in Burn Severity program and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6. The images of fire perimeters and Landsat and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in these figures are discussed in Section 2.2. in the paper.

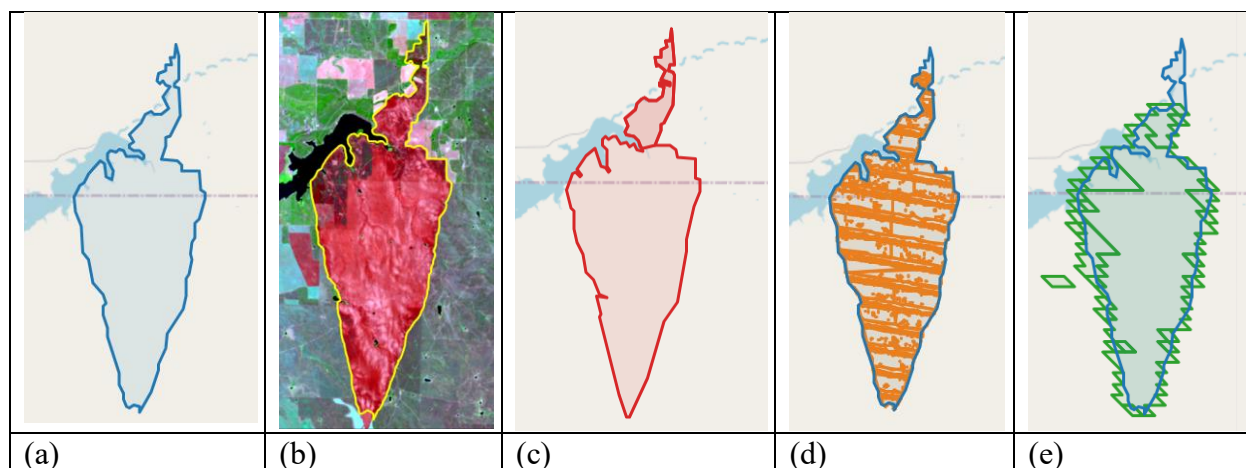


Figure S29. The East Amarillo Complex took place in north-central Texas in March of 2006. (a) MTBS perimeters; and (b) MODIS hotspot pixels. The top perimeter is the Hwy 52 fire and the bottom perimeter is the I-40 fire. The images of the fire perimeters and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in these figures are discussed in Section 2.2. of the paper.

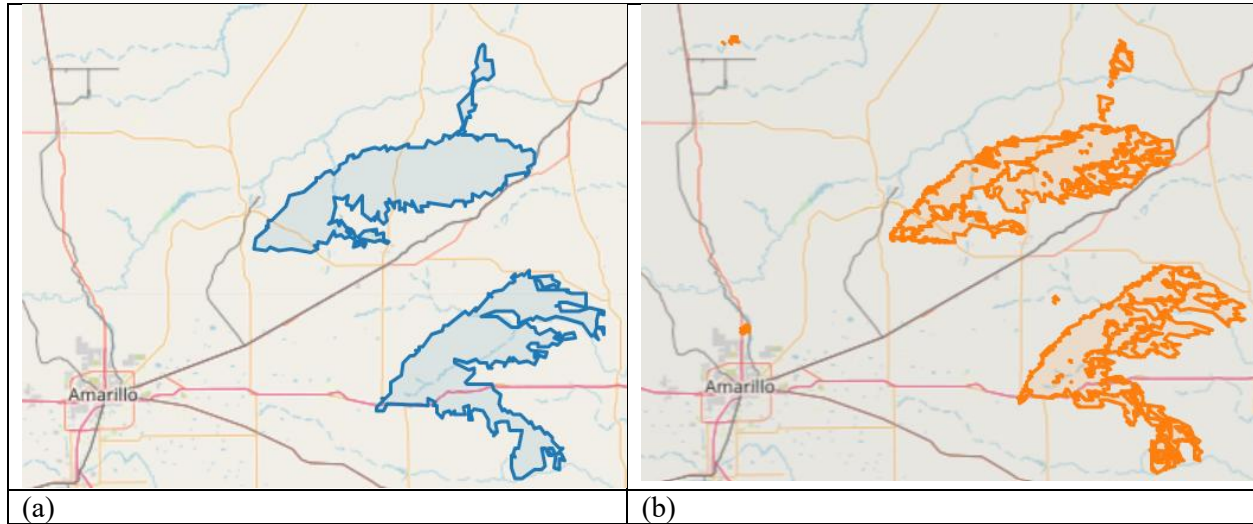


Figure S30. The NM 467 fire occurred in east-central New Mexico in October of 2017. This figure presents examples of approaches used to determine that MTBS fire size was more accurate than fire management size for the NM 467 fire using screenshots from the WFEIS display and a false-color Landsat image: (a) MTBS perimeter; and (b) MTBS perimeter (in blue) with the Landsat burned area pixels (in orange) and MODIS burned area pixels (in green). The images of the fire perimeters and Landsat and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in these figures are discussed in Section 2.2. of the paper.

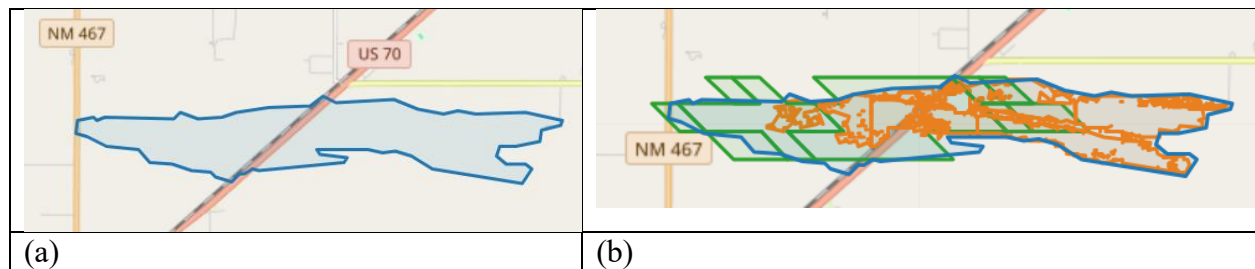


Figure S31. The Sheep Herder Hill fire occurred in Wyoming in September of 2012. (a) the MTBS perimeter is in blue and the NIFS/GeoMAC perimeter is in red; (b) WFEIS screenshots of the NIFS/GeoMAC perimeter (in red) overlaid by the Landsat burned area pixels; (c) a false-color Landsat image with the MTBS perimeter; and (d) a fine-resolution, color image obtained from Google Earth. The false-color Landsat image presented in this figure was generated by the Monitoring Trends in Burn Severity program and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6. The images of fire perimeters and Landsat burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in these figures are discussed in Section 2.2. in the paper.

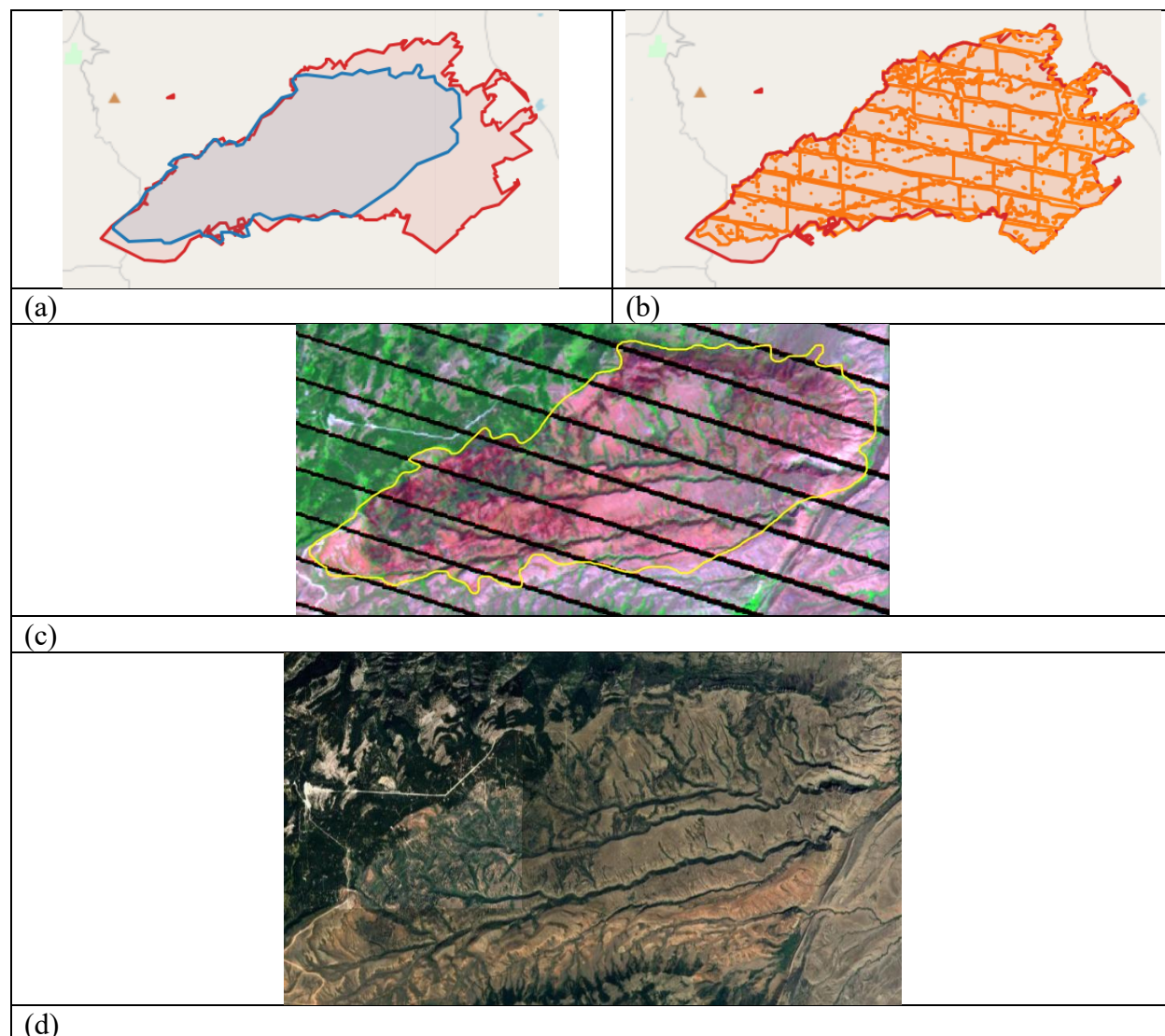


Figure S32. The WF Texas Point Northeast fire occurred in southeast Texas adjacent to the Gulf of Mexico in October of 2015. (a) MTBS perimeter for the WF Texas Point Northeast fire; (b) Landsat (in orange) and MODIS (in purple) hot spot pixels; and (c) a false-color Landsat image with an MTBS perimeter (in yellow). The false-color Landsat image presented in this figure was generated by the Monitoring Trends in Burn Severity program and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6. The images of fire perimeters and Landsat and MODIS burned area pixels in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in these figures are discussed in Section 2.2. in the paper.

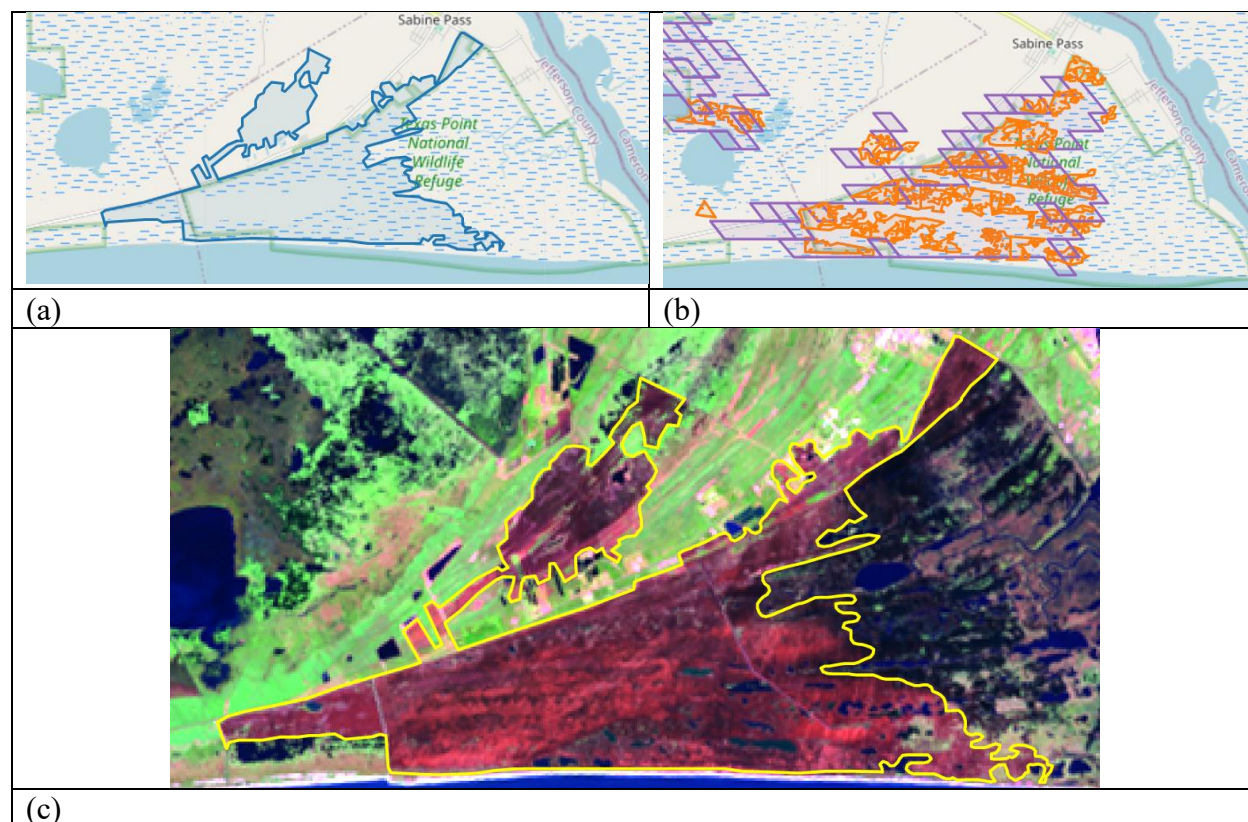


Figure S33. The Buffalo Ranch fire occurred in north-central Minnesota in May of 2013. (a) the MTBS perimeter in blue and NIFS/GeoMAC perimeter in red; and (b) false-color Landsat image with an MTBS perimeter (in yellow) for the Buffalo Ranch fire. The false-color Landsat image presented in this figure was generated by the Monitoring Trends in Burn Severity programmed and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters presented in this figure is discussed in Section 2.2. in the paper.

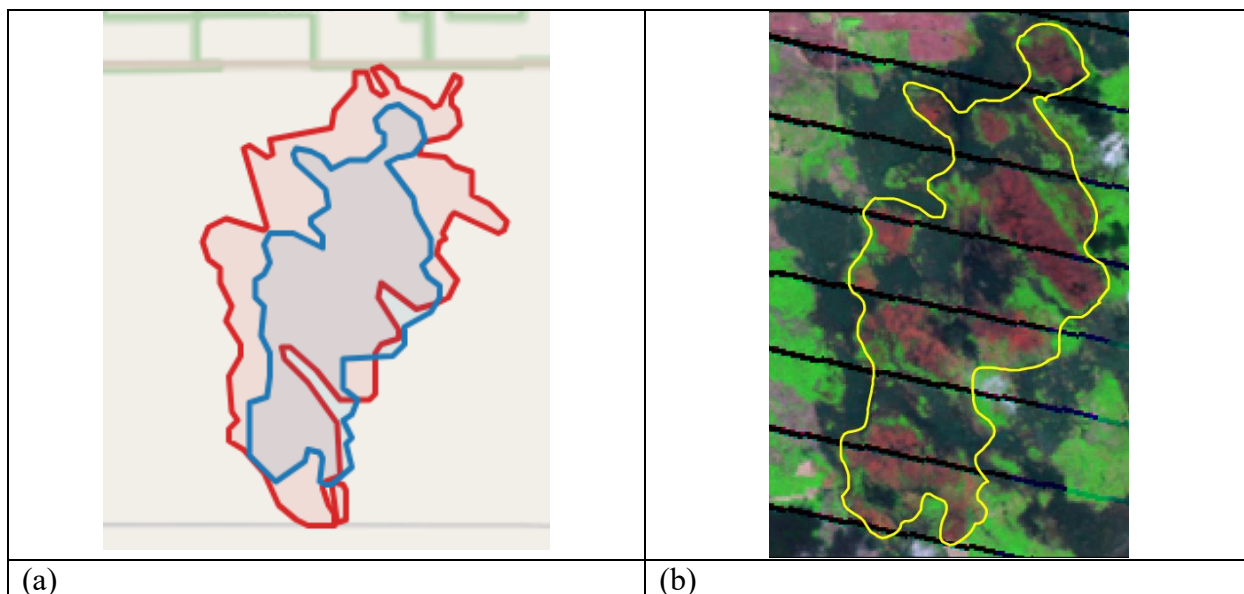
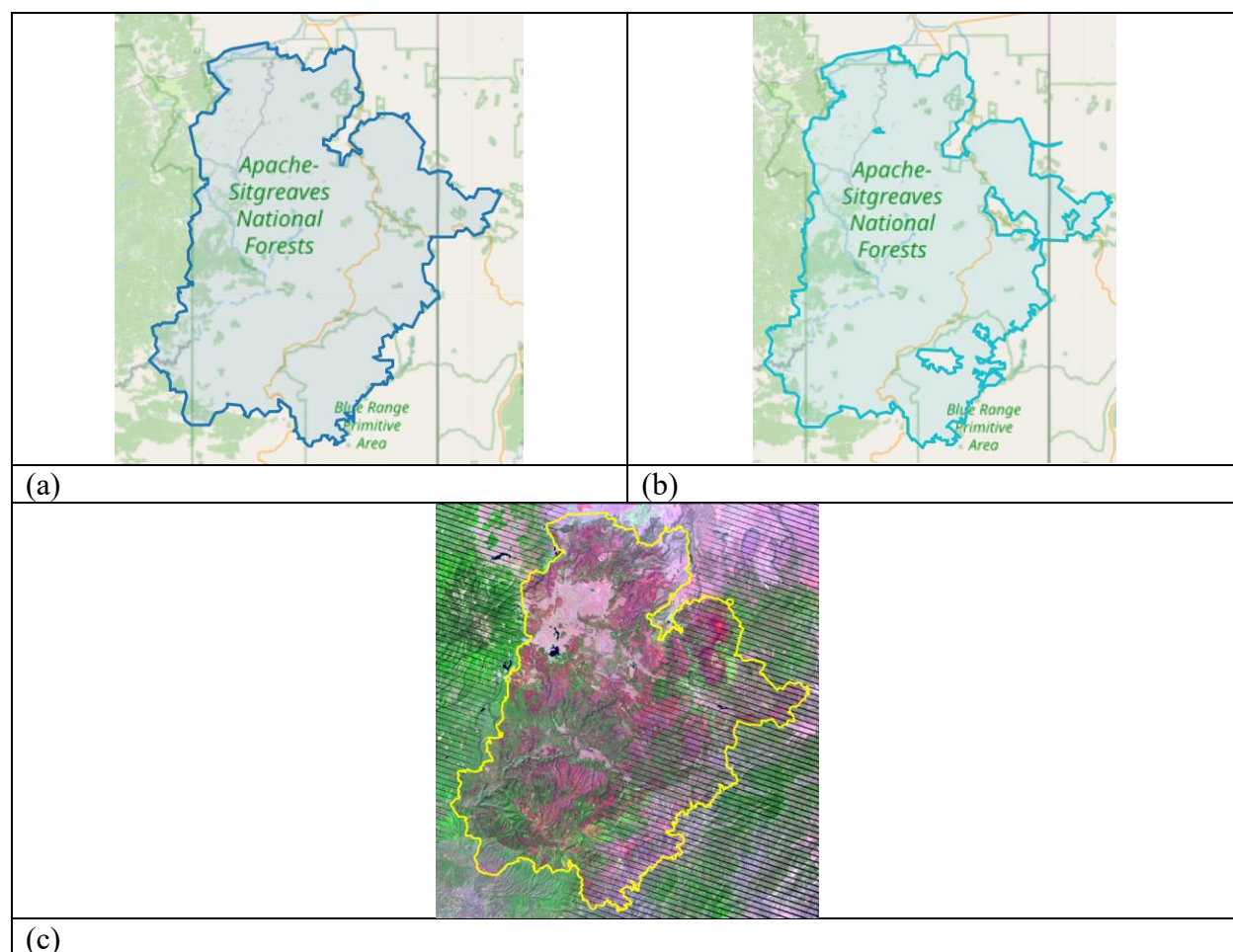


Figure S34. The Wallow fire occurred in east-central Arizona during May of 2011. (a) the MTBS perimeter; and (b) the NIFS/GeoMAC perimeter; and (c) a false-color Landsat image containing the MTBS perimeter. The false-color Landsat image presented in this figure was generated by the Monitoring Trends in Burn Severity program and were obtained from publicly available PDF documents downloaded from the MTBS Direct Download website prior to the January of 2026 (<https://www.mtbs.gov/direct-download>). As a result of changes made to this website in the spring of 2026, it is no longer possible to download PDFs for individual MTBS events. The MTBS Fire IDs and additional fire information for each false color Landsat image are presented in Table S2 in Section 6. The images of the fire perimeters in this figure are from screenshots from the display capability of the Wildland Fire Emissions Inventory System (<https://wfeis.mtri.org/calculator> last accessed on 1 June 2026). The sources for the fire perimeters and burned area pixels presented in these figures are discussed in Section 2.2. in the paper.



6. Supplemental Tables

Table S1. Articles that used fire event data from three data sources, including the U.S. Forest Service fire occurrence datasets (Short, 2014, 2017, 2021, 2022), the MTBS dataset, and wildfire events mined from the Incident Command System Incident Status Summary Form 209 (ICS) (St. Denis et al., 2023). These articles include those reporting on studies that used these datasets at regional to national scales using the number of fires, fire size, extreme wildfires, and burned area, but does not include studies using the MTBS dataset to analyze burn severity.

Reference	Geographic area	Time frame	Wildfire parameter	Study focus
	<i>MTBS dataset</i>			
Abatzoglou & Kolden 2013	Western US	1984-2010	Burned area	Trends in annual burned area in forests
Abatzoglou & Williams 2016	Western US	1984-2015	Burned area	Trends in annual burned area
Albano et al. 2017	Southwest US, California, Great Basin	1989-2012	Burned area	Atmospheric rivers and wildfires
Alexandre et al. 2015	Contiguous US	2000-2005	Burned area	Impacts on new housing
Alexandre et al. 2016	Contiguous US	2000-2010	Burned area	Impacts on building loss
Asadian et al. 2026	Continental US	1984-2024	Number of fires, fire size	Statistical modeling of large fires
Baker 2013	Western US	1984-2008	Burned area	Area burned trends in sagebrush ecoregions
Ball et al.	Western US	1984-2014	Burned area	Trends in annual burned area in fluvial networks
Barbero et al. 2014	Conterminous US	1984-2010	Frequency of very large fires	Relationship between weather/climate and very large (>5,000 ha) wildfires
Barbero et al. 2015a	Eastern US	1984-2010	Frequency of very large fires	Relationship between weather/climate and very large (>3,000 ha) wildfires
Barbero et al. 2015b	Intermountain NW	1984-2012	Frequency of very large fires	Influence of El Nino on very large fires (1,000 ha; 2,000 ha; and 3,000 ha)
Brown et al. 2021	Continental US	1984-2017	Burned area	Burned area and drought
Brucker et al. 2025	Western US	1984-2021	Burned area	Impacts on water quality
Buch et al. 2023	Western US	1984-2020	Number of fires, burned area	Modeling of wildfire
Buma et al. 2020	Western US	1984-2016	Burned area	Trends in reburn rates in western ecoregions
Carlson et al. 2025a	Contiguous US	2016-2022	Number of fires	Wildfire occurrence model validation
Carlson et al. 2025b	Contiguous US	2002-2022	Burned area, fire size	Building destruction

Table S1. (continued)

Reference	Geographic area	Time frame	Wildfire parameter	Study focus
Chen et al. 2023	Western US	1984-2018	Burned area, number of fires	Climate controls on wildfire
Cheng et al. 2026	Western US	1984-2020	Burned area	Vapor pressure deficit and burned area
Coates et al. 2016	Great Basin	1984-2013	Burned area	Invasive grass, fire, climate interactions on ecosystem structure
Crimmins et al. 2025	Southwest US	1984-2021	Burned area	Wildfire and climate
Dennison et al. 2014	Western US	1984-2011	Number of fires, burned area, fire size	Trends in the number of large fires
Donato et al. 2023	Northwest US	1985-2020	Burned area	Trends in burned area
Donovan et al. 2017	Great Plains	1984-2014	Number of fires, burned area	Trends in number of fires and annual burned area
Donovan et al. 2020a	Great Plains	1993-2014	Number of fires, burned area	Wildfire and land use
Donovan et al. 2020b	Great Plains	2000-2012	Fire size	Resilience to catastrophic fire
Donovan et al. 2023	Eastern US	1984-2020	Burned area, fire size	Trends in burned area and average fire size
Ebel 2024	Contiguous US	1984-2024	Fire size	Impacts on floods
Finney et al. 2025	Contiguous US	1984-202?	Fire size	Factors influence wildfire containment
French et al. 2014	Continental US	1984-2014	Fire Size	Estimation of pyrogenic emissions
Gonzalez et al.	Western US and Great Plains	1984-2019	Burned area	Exposure of oil wells to wildfire
Gould et al. 2023	Southeast US, Southern Great Plains	1984-202?	Burned area	Development of firescapes
Hallar et al. 2017	Intermountain West	1988-2013	Burned area, fire size	Controls on pyrogenic emissions
Hallema et al. 2018	Conterminous US	1984-2016	Burned area	Impacts on streamflow
Hart et al. 2015	Western US	1984-2013	Burned area	Trends in annual burned area
Hawbaker et al. 2023	Southern Rockies	1990 to 2019	Burned area	Trends in annual burned area
Hoell et al. 2026	Contiguous US	1984-2022	Burned area	ENSO and burned area
Holden et al. 2012	Western US	1984-2012	Burned area	Impacts on streamflow
Holden et al 2018	Western US	1984-2015	Burned area	Trends in annual burned area
Hoover and Smith 2025	Contiguous US	2001-2021	Burned area	Estimation of pyrogenic emissions
Iglesias et al 2022	Contiguous US	1984-2016	Burned area, number of fires, fire size	Trends in burned area, fire size, and fire frequency in three sub-continental regions

Table S1. (continued)

Reference	Geographic area	Time frame	Wildfire parameter	Study focus
Ivey et al. 2024	Eastern US	1992-2021	Burned area	Trends in wilfire frequency as a function of forest cover
Jones et al. 2024	Contiguous US	1999-2020	Burned area	Wildfire management
Joseph et al. 2019	Contiguous US	1984-2016	Fire size	Modeling extreme wildfires
Juang et al. 2022	Western US	1984-2019	Burned area, number of fires, fire size	Trends in annual burned area in forests
Kampf et al. 2022	West US	1984-2016	Burned area	Impacts on spring snowpack melt
Kearns et al. 2022	Contiguous US	1984-2019	Number of fires, burned area	Modeling of wildfire risk
Kramer et al. 2018	Contiguous US	2000-2013	Burned area	Impacts on buildings
Lannom et al. 2014	NW US forested areas	1984-2010	Frequency of very large fires (top 1 to 10% in size)	Identification of extreme fires by top 1, 5, and 10% of fires as well as other metrics
Lawler & Shaby 2024	Contiguous US	1990-2020	Number of fires, burned area, fire size	Model development and validation
Li et al. 2021	Western US	1984-2017	Burned area	Trends in burned area in rangelands
Liu & Wimberly 2015	Western US	1984-2010	Fire number, fire size	Climate and landscape controls on wildfire
Liu et al. 2024	Northwest US	2000-2019	Burned area	Climate controls on fall wildfire activity
McCoullough et al. 2019	Contiguous US	1984-2017	Burned area	Impacts on lakes
McGinnis et al. 2023	Contiguous US	1984-2016	Number of fires	Trends in burned area
Meigs et al. 2015	Northwest US	1984-2012	Burned area	Effects of insect outbreaks on burned area
Mietkiewicz & Kulakowski 2016	Western US	1984-2003	Burned area	Mountain pine beetle outbreaks and wildfires
Morton et al. 2013	Continental US	1984-2009	Burned area	Climate controls on burned area
Mueller et al. 2020	Southwest US	1984-2015	Burned area	Trends in annual burned area in low and high severity fires
Pennino et al. 2022	Contiguous US	1984-2018	Burned area	Impacts on drinking water hazards
Picotte et al. 2016	Conterminous US	1984-2010	Burned area	Trends in annual burned area in vegetation macrogroups
Platt et al. 2024	Western US	1986-2021	Number of fires, burned area, fire size	Changes in area of fire refugia

Table S1. (continued)

Reference	Geographic area	Time frame	Wildfire parameter	Study focus
Podschwit & Cullen 2020	Continental US	1984-2105	Number of fires	Occurrence of simultaneous wildfires within different fire management regions for large (>405 ha), very large (>4,050 ha) and extremely large (20,250 ha)
Pokharel et al. 2023	Contiguous US	2000-2015	Burned area, fire size	Model development and validation
Potter & McEvoy 2021	Western US	2014-2017	Number of extreme fires (10,000 to 30,000 ha)	Factors controlling extreme wildfires fires (10,000 to 30,000 ha)
Prudencio et al. 2018	Intermountain West	1984-2015	Burned area, number of fires	Changes in fire regime characteristics
Rad et al. 2023	Contiguous US	2000-2019	Burned area	Exposure of human infrastructure
Radeloff et al. 2023	Contiguous US	1990-2020	Burned area	Exposure of human infrastructure
Rauscher & Cao 2024	Continental US	1984-2022	Extreme fire (>5,000 a) area burned	Impacts on infant health
Remigio et al. 2025	Contiguous US	1997-2003	Burned area	Impacts on lung cancer mortality
Riley et al. 2013	Western US	1994-2018	Burned area, number of large fires	Relationships of fire occurrence to drought and fire weather indices
Salguero et al. 2020	Contiguous US	1984-2017	Burned area, number of fires, fire size	Trends in annual burned area in different US regions
Schollaert et al. 2024	Northwest US, California	2012-2020	Burned area	Estimation of pyrogenic emissions
Schuman et al. 2024	Contiguous US	1984-2018	Burned area	Impacts on social vulnerability
Smith et al. 2023a	Western US	1990-2020	Burned area	Trends in burned area in sagebrush ecosystems
Smith et al. 2023b	Great Basin	1988-2018	Number of fires, burned area, fire size	Modeling wildfire hazards
Stavros et al. 2014	Western US	1984-2010	Frequency of very large fires (>20,250 ha)	Modeling climatic factors controlling occurrence of very large wildfires (>20,250 ha) in western US management units
Stephens et al. 2026	Contiguous US	1984-2019	Number of fires, fire size	Trends in fire size
Wachter et al. 2025	Western US	1984-2020	Burned area	Impacts on watershed exposure
Weidig et al. 2024	Eastern US	1986-2021	Burned area	Changes in burned area in the wildland-urban interface
Wibbenmeyer & Robertson 2022	Western US	1984-2018	Burned area	Modeling of wildfire hazard

Table S1. (continued)

Reference	Geographic area	Time frame	Wildfire parameter	Study focus
Wing & Long 2015	Northwest US	1994-2008	Number of fires, burned area	Trends in annual burned area
Yocum et al. 2019	Southwest	1984-2016	Fire size	Controls on fire spread
Yu et al. 2023	Contiguous US	1984-2019	Fire frequency, burned area	Modeling wildfire danger
Zhai et al. 2023	California, Northwest US	1984-2018	Number of fires, burned area	Wildfire and land cover and topography
Zhang et al. 2020	Conterminous US	1984-2014	Burned area	Trend in annual burned area
Zhong et al. 2020	Western US	1984-2014	Number of very large (>20,250 ha) and extremely large (40,500 ha) fires	Climate factors controlling the occurrence of very large (20,250 ha) and extremely large (>40,500 ha) wildfires
Zou et al. 2021	Western US	1984-2019	Burned area	Impacts of changes in Arctic sea ice and wildfire
<i>FS20 dataset</i>				
Abatzoglou et al. 2016	Western US	1992-2013	Burned area	Effect of climate lightning-ignited lightning wildfires
Bendick & Hoylman 2020	Conterminous US	1992-2015	Fire size	Modeling of extreme wildfires
Brey et al. 2018	Southeast, Western US	1992-2015	Number of fires, burned area	Estimating pyrogenic emissions
Carlson et al. 2021	Northeast US	2005-2017	Number of fires, burned area	Modeling wildfire hazards
Hu et al. 2024	Continental US	1992-2018	Burned area	Modeling wildfire risk
Keeping et al. 2024	Contiguous US	2012-2018	Number of fires	Modeling wildfire occurrence
Masoudvaziri et al. 2022	California	2001-2015	Burned Area	Controls on wildfire size
Montazeri et al. 2026	Western US	1992-2020	Burned area	Trends in wildfire activity
Nagy et al. 2018	Contiguous US	1992-2015	Fire Size	Identified large wildfires based on largest 10% of fires in an ecoregion
Nauslar et al. 2019	Southwest US	1992-2015	Number of fires, burned area	Impact of monsoon season on wildfire
Palaiologou et al. 2019	Western US	1992-2015	Number of fires, fire size	Cross-boundary wildfire occurrence
Pourmohamad et al. 2026	Western US	1992-2020	Number of fires	Modeling wildfire ignitions
Strader 2018	Contiguous US	1992-2015	Burned area, fire size	Modeling ildfire exposure

Table S1. (concluded)

Reference	Geographic area	Time frame	Wildfire parameter	Study focus
<i>ICS dataset</i>				
Higuera et al. 2023	Western US	1999-2020	Burned area	Building losses from wildfires
Pietruszka et al. 2023	USFS lands	1999-2020	Burned area	Identification of consequential fires
<i>Separate use of FS20 and MTBS datasets</i>				
Balch et al. 2017	Contiguous US	1992-2012	Burned area, fire season	Effects of human ignitions on fire season
Cattau et al. 2022	Contiguous US	1992-2018	FS18 Fire number, burned area, fire size	Mapping of pyromes
			MTBS Burned area	Mapping of pyromes
Feng et al. 2025	Western US	1992-2020	Burned area	Model development and validation
<i>Integration of USFS and MTBS datasets</i>				
Mietkiewicz et al. 2020	Contiguous US	1992-2015	Burned area	Impacts of human ignited wildfires and homes
McGranahan & Walker 2024	Western Great Plains	1980-2020	Burned area	Trends in burned area and number of fires at an ecoregion scale
<i>Integration of ICS and MTBS datasets</i>				
McConnell et al. 2024	Contiguous US	1999-2020	Burned area	Impacts on buildings and human migration
Tang et al. 2025	Contiguous US	2000-2020	Burned area	Pyrogenic emissions from building fires
McConnell et al. 2026	Contiguous US	1999-2020	Burned area	Impacts on urban areas

Table S2. The states comprising the twelve study regions used during the development of the iWED.

Region	States
Alaska	Alaska
California	California
Great Basin	Nevada, Utah
Middle South	Delaware, Kentucky, Kentucky, Maryland, North Carolina, Tennessee, Virginia, West Virginia
North Central	Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Wisconsin
Northeast	Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont
Northern Plains	Nebraska, North Dakota, South Dakota
Northwest	Oregon, Washington
Rocky Mountain	Colorado, Idaho, Montana, Wyoming
Southern Plains	Kansas, Oklahoma, Texas
Southeast	Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, South Carolina
Southwest	Arizona, New Mexico

Table S3. Summary of the MTBS scenes used to illustrate methods and approaches used during the development of the iWED in Figures S1 to S30 in the Online Supplemental Materials.

Figure	MTBS Fire ID	MTBS Name	Start Date	Size (acres)
S1a	KS3812309847720050321	H RX F Darrynane South	21-Mar-2005	1,250
S1b	TX2957709454920171130	TXAHR FY18 RX Yellow Rail 17	30-Nov-2016	1,368
S1c	KS3810109849720090825	W-RX-F West LSM	25-Aug-2009	1,245
S1d	TX2825909657320190908	TXARR-FY19-RX-Matagorda G5	8-Sep-2019	2,924
S1e	NE4252310060220210423	Hackberry South RX	23-Apr-2021	6,463
S1f	TX2910909526220190305	TXTMR-FY19-RX-Alligator Marsh	5-Mar-2019	2,435
S2a	KS3735209656120160304	Ferguson Ranch	4-Mar-2016	13,625
S2b	KS3707910189920110508	Tunner	8-May-2011	17,774
S2c	TX3015109722520110904	Bastrom County Complex	4-Sep-2011	31,838
S2d	CO3937210525219960518	BuffaloCreek	18-May-1996	11,690
S2e	OR4438412172820020723	Cache Mountain	23-Jul-2002	3,945
S2f	AK6520614551720040607	Central Complex (Wolf Creek)	7-Jun-2004	228,337
S2g	ND4635010081119990326	Solen	26-Mar-1999	1,155
S2h	WA4822612066620150629	Wolverine	29-Jun-2015	66,329
S2i	NV4098811976920060626	Duck	26-Jun-2006	1,426
S2j	NE4282410260920120829	Wellnitz	29-Aug-2012	77,277
S2k	AZ3414811196320170707	Brooklyn	7-Jul-2017	39,780
S2l	WA4636511885519960629	Juniper	29-Jun-1996	8,145
S3a	NV4011611706720070716	Antelope Complex	16-Jul-2007	135,524
S4	MT4752310773120060717	Lost Creek (Black Pulaski Complex)	17-Jul-2006	38,550
S4	MT4751410798920060717	Soda Creek (Black Pulaski Complex)	17-Jul-2006	33,767
S4	MT4757610736020060717	Chalk Butte (Black Pulaski Complex)	17-Jul-2006	19,339
S4	MT4733110788320060717	Lodgepole (Black Pulaski Complex)	17-Jul-2006	15,248
S4	MT4767110671620060717	Black Pulaski (Black Pulaski Complex)	17-Jul-2006	15,504
S4	MT4763610719520060717	Hill Coulee (Black Pulaski Complex)	17-Jul-2006	2,665
S5	NE4275510381220060727	Sioux County Complex	27-Jul-2006	39,565
S6	CA3742412156820200816	SCU Lightning Complex	16-Aug-2020	405,787
S7a	CA3534111823820120810	Jawbone Complex	10-Aug-2012	12,211
S8a	OR4401611881420070706	Calamity Complex (Grapple)	6-Jul-2007	2,331
S9	AK6260115516920050720	Black Water	20-Jul-2005	19,388
S10	OR4561511888020020723	Birch	23-Jul-2002	7,321
S11a	AK6301715733920190622	Hurst Creek	22-Jun-2019	139,405
S11a	AK6330815738820190605	Old Grouch Top	5-Jun-2019	173,971
S12a	OR4482112218820200816	Beachie Creek	16-Aug-2020	194,619
S12a	OR4472312167920200817	Lionshead	17-Aug-2020	197,732
S13a,c	ID4551811500220000731	Canyon II	31-Jul-2000	26,490
S13b,c	ID4540111516420000731	Flossie Complex	31-Jul-2000	90,611
S14	OK3563109630220110406	Nu Snake	06-Apr-2011	2,074

Table S2 (concluded). Summary of the MTBS scenes used to illustrate methods and approaches used during the development of the iWED in Figures S1 to S30 in the Online Supplemental Materials (concluded).

Figure	MTBS Fire ID	MTBS Name	Start Date	Size (acres)
S15a,b	MT4885711485720170808	Gibraltar Ridge	8-Aug-2017	6,299
S15b	MT4883211469920171031	Unnamed	31-Oct-2017	6,755
S16	NV3720111460119930728	Meadow	28 July 1993	31,199
S17a	WA4648712061720200816	North Brownstone 3	16-Aug-2020	7,316
S18a	TN3612508440820161104	SR116-Devonia	4-Nov-2016	3,077
S19a	OR4382211938920070706	Egley Complex	6-Jul-2007	139,515
S20a,b	ID4245311502520120707	Kinyon Road	7-Jul-2012	171,409
S20b,c	ID4259311566320120806	East Rock	6-Aug-2012	39,774
S21a	NM3133610881020110330	Truck Stop	30-Mar-2011	19,656
S21a	NM3135610886320110507	Cloverdale2	7-May-2011	33,552
S22a	WA4897812059620060822	Tatoosh Complex	22-Aug-2006	48,862
S23	NV3742311510120060823	Higby	23-Aug-2006	12,869
S23	NV3746711499320060724	Range	24-Jul-2006	23,506
S23	NV3745511502620060705	Twin Springs	5-Jul-2006	1,660
S24a	OK3520009598720051117	Proctor	17-Nov-2005	9,044
S24b	OK3517909600720050318	Unnamed A	18-Mar-2005	3,017
S24b	OK3521409600020050318	Unnamed B	18-Mar-2005	1,829
S25a	OR4246712268320200908	S Obenchain	8-Sep-2020	32,875
S26a	CA4072012156220140731	Eiler	31-Jul-2014	30,967
S27	AZ3283211294820050629	Sand Tank Complex (Sand Tank)	29-Jun-2005	11,601
S27	AZ3270211261720050630	Sand Tank Complex (Home)	30-Jun-2005	1,470
S27	AZ3282411272720050628	Unnamed	28-Jun-2005	9,537
S28a,b,d,e	TX3341909935720110429	Miller Creek	29-Apr-2011	10,888
S29	TX3551510078020060312	East Amarillo Complex	12-Mar-2006	593,364
S30a,b	NM3423510326420071017	NM 467	17-Oct-2007	2,243
S31ac	WY4271110631220120909	Sheep Herder Hill Complex	9-Sep-2012	10,759
S32a,c	TX2970809391120151004	WF Texas Point Northeast	4-Oct-2015	4,635
S33a	MN4812109553220130513	Buffalo Ranch Fire	13-May-2013	2,892
S34a,c	AZ3360210944920110529	Wallow	29-May-2011	563,664

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