Evidence of shift in stubble burning timing over northwest India from geostationary satellite observations

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Northwest India, particularly the states of Punjab and Haryana, has experienced recurring stubble burning during the post-monsoon months of October and November, significantly affecting regional air quality. In the present study, we use high-temporal-resolution observations from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) onboard the Meteosat Second Generation (MSG) satellite to investigate recent changes in the timing of stubble burning. Our analysis shows a gradual shift in peak fire activity from ~13:30 IST in 2020 to ~17:00 IST in 2024, to avoid detection by polar-orbiting satellites. These findings demonstrate the importance of geostationary satellites for monitoring diurnal fire dynamics and highlight the implications of altered burning practices for emission inventories, air quality assessments, and mitigation strategies in the region.

Keywords: Active fire, geostationary satellite, SEVIRI, stubble burning, VIIRS

which, despite their coarser spatial resolution, can capture fire activity more effectively due to their strong temporal coverage.

In the present study, we used data from the Meteosat Second Generation (MSG) satellites[13], equipped with the Spinning Enhanced Visible and Infrared Imager (SEVIRI), operating in the Indian Ocean Data Coverage (IODC) mode[14]. Meteosat-8/9 (IODC mode) provides active fire monitoring products in the Common Alert Protocol (CAP) format, covering latitudes from 67.5°N to 67.5°S and longitudes from 22°W to 113°E. These products are archived and made available through the European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) Data Centre. Since June 2022, Meteosat-9 (positioned at 45.5°E) has served as the primary satellite for IODC service, replacing Meteosat-8 (positioned at 41.5°E).

We analysed MSG–SEVIRI fire detections over Punjab and Haryana (acquired every 15 min) for the period 15 October to 30 November during 2020–2024. Figure 1 *a* shows the distribution of fire events detected between 09:30 and 20:30 IST during the study period, while Figure 1 *b* maps the spatial locations of these events for each year. In 2020, fires typically ignited around noon, peaked near 13:30 IST, and subsided by 15:30 IST. For context, the equatorial crossing times of polar-orbiting fire detection sensors, including Moderate Resolution Imaging Spectroradiometer (MODIS) onboard Terra and Aqua, and the Visible Infrared Imaging Radiometer Suite (VIIRS) onboard Suomi National Polar-orbiting Partnership (NPP), are clos-