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Automated tracking of dust-emitting cold pool outflow boundaries in the Central and Western Sahara using MSG-SEVIRI

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Dust models vary considerably in their estimates of net Saharan dust output from year to year. As a result, projections of Saharan emissions into the future are highly uncertain. Cold pool outflows are thought to be a dominant driver of dust emission during boreal summer. However, the surface winds associated with these phenomena are largely unrepresented in global models. To diagnose this source of error, knowledge of the spatial distribution and timing of CPOs near Saharan dust hotspots is needed. Few long-term observations of these powerful convective phenomena exist. To address this, we develop an algorithm for automated detection, tracking and speed estimation of summertime dust-emitting cold pool outflow boundaries using data from the Spinning Enhanced Visible and Infrared Imager (SEVIRI) aboard Meteosat Second Generation satellites.

The algorithm performs well under conditions with strong moisture and dust gradients, with 74% of manually identified events correctly detected by the automated system. 5,149 events are detected from 14 summers (June, July and August) of high-resolution satellite data, revealing hotspots of cold pool outflow generation near the Aïr Mountains and in northern Mali. These hotspots shift with the position of the intertropical discontinuity; a decline in cold pool frequency through July and August could explain some of the reduced dust source activation observed later in the summer season. Outflow boundary propagation speed decays through the lifetime of cold pools. While the frequency of cold pool outflows peaks between 1700-1800 UTC, a maximum in propagation speed is found several hours later. Availability of this climatology of cold pools could inform targeted observation campaigns to further study their characteristics, and serves as a useful benchmark for models.