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## Characterisation of episodic aerosol types over the Australian continent

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**Abstract.** Classification of Australian continental aerosol types resulting from episodes of enhanced source activity, such as smoke plumes and dust outbreaks, is carried out via cluster analysis of optical properties obtained from inversion of sky radiance distributions at Australian aerosol ground stations using data obtained over the last decade. The cluster analysis distinguishes four significant classes, which are identified on the basis of their optical properties and provenance as determined by satellite imagery and back-trajectory analysis. The four classes are identified respectively as aged smoke, fresh smoke, coarse dust and a super-absorptive aerosol. While the first three classes show similarities with comparable aerosol types identified elsewhere, the super-absorptive aerosol has no obvious foreign prototype. The class identified as coarse dust shows a prominent depression in single scattering albedo in the blue spectral region due to absorption by hematite, which is shown to be more abundant in central Australian dust relative to the "dust belt" of the Northern Hemisphere. The super-absorptive class is distinctive in view of its very low single scattering albedo ( $\sim 0.7$  at 500 nm) and variable enhanced absorption at 440 nm. The strong absorption by this aerosol requires a high black carbon content while the enhanced blue-band absorption may derive from organic compounds emitted during the burning of specific vegetation types. This aerosol exerts a positive radiative forcing at the top of atmosphere (TOA), with a large deposition of energy in the atmosphere per unit aerosol optical depth. This contrasts to the other three classes where the TOA forcing is negative. Optical properties of the four types will be used to improve the representation of Australian continental aerosol in climate models, and to enhance the accuracy of satellite-based aerosol retrievals over Australia.

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