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Idealized modeling of anticyclonic plumes from wildfires and volcanic eruptions in the stratosphere

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Anticyclonically-trapped plumes were first discovered following the 2020 Australian fires. Since then, they have been reported after several extreme wildfires and volcanic eruptions, including the 2017 Canadian wildfires, the 2019 Raikoke and the 2022 Hunga Tonga-Hunga Ha'apai eruptions. They appear as coherent plumes of aerosols and combustion/volcanic compounds confined within mesoscale anticyclones (100s to 1000 km diameter), which for several months resist dispersion and dilution by the large-scale flow. Due to their unusual composition, large radiative forcing is prevailing inside the plumes, generating significant diabatic responses in terms of vertical motions and potential vorticity.

In this presentation, we propose a conceptual model of the anticyclonic plumes. We will explore ramifications through idealized numerical simulations and theoretical investigations. Particular focus will be put on the condition of their formation and the dynamics of their maintenance and diabatic motions in the stratosphere.