Morphology, optical properties & climate impact of soot nanoparticles

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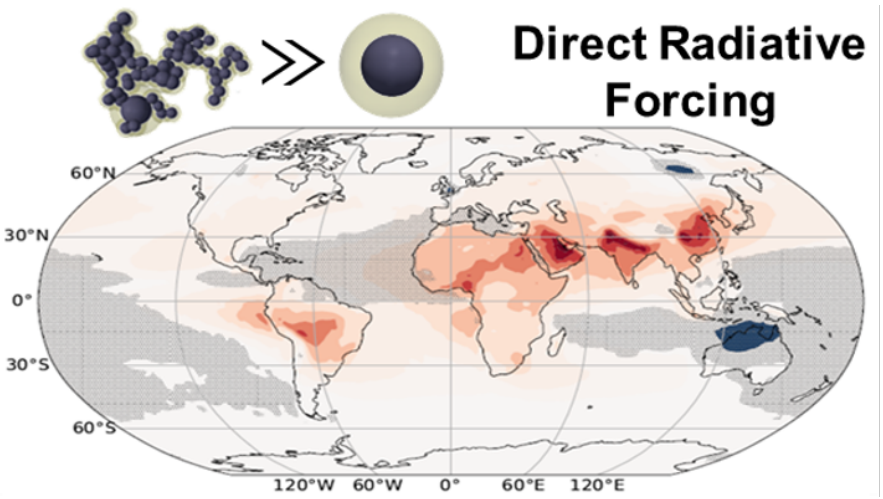

Soot is a major air pollutant produced by incomplete combustion of hydrocarbon fuels. The contribution of soot to global warming is currently estimated with large uncertainty (partly) due to the fractal-like agglomerate structure of its constituent nanoparticles. Here, the dynamics of soot nanoparticles are investigated to advance our current understanding of particle formation during combustion. Discrete element modeling (DEM) enables the detailed description of the particle morphology ([1]) and optical properties ([2]) in population balance models and computational fluid dynamics ([3]). Power laws relating the optical properties of soot to its filamentary structure are derived by DEM ([4]) to facilitate the accurate monitoring of soot emissions by aerosol ([5]), laser ([6]) diagnostics and fire detectors ([7]). Most importantly, these relations enable the estimation of the soot direct radiative forcing accounting for its realistic agglomerate structure ([8]).

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[2] **G. A. Kelesidis and S. E. Pratsinis** Soot light absorption and refractive index during agglomeration and surface growth. Proceedings of the Combustion Institute, 37(1):1177–1184, 2019.
[3] **M. R. Kholghy and G. A. Kelesidis** Surface growth, coagulation and oxidation of soot by a monodisperse population balance model. Combustion and Flame, 227:456–463, 2021.
[4] **G. A. Kelesidis, E. Goudeli, and S. E. Pratsinis**. Morphology and mobility diameter of carbonaceous aerosols during agglomeration and surface growth. Carbon, 121:527– 535, 2017.
[5] **G. A. Kelesidis and S. E. Pratsinis** Determination of the volume fraction of soot accounting for its composition and morphology. Proceedings of the Combustion Institute, 38(1):1189–1196, 2021.
[6] **G. A. Kelesidis and S. E. Pratsinis** Santoro flame: The volume fraction of soot accounting for its morphology & composition. Combustion and Flame, 240:112025, 2022.
[7] **G. A. Kelesidis, M. R. Kholghy, J. Zuercher, J. Robertz, M. Allemann, A. Duric, and S. E. Pratsinis**. Light scattering from nanoparticle agglomerates. Powder Technology, 365:52–59, 2020.
[8] **G. A. Kelesidis, D. Neubauer, L.-S. Fan, U. Lohmann, and S. E. Pratsinis**. Enhanced light absorption and radiative forcing by black carbon agglomerates. Environmental Science & Technology, 56(12):8610–8618, 06 2022.