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Properties of distributed gas sources in comet comae

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Comets produce a gas and a dust coma. We use a fairly simple model to illustrate how icy dust inevitably must contribute to the gas coma in the form of distributed sources. Such distributed sources may be important for some species and unimportant for others, depending on the desorption rates of the species concerned and the dust grain characteristics. We argue that (1) the distributed source mechanism is ubiquitous in comet comae, (2) the distributed source contribution for the major ice components depends on nucleus structure and the overall refractory-to-volatile ratio, (3) the contribution for highly volatile species is expected to be less than that for the major ice components, (4) distributed sources can be important for minor volatile species, and the more so if they are locked up in layered icy grain environments, and (5) distributed sources can be important also for highly non-volatile matter condensed on the grains. These conclusions are compatible with Rosetta's findings at comet 67P/Churyumov-Gerasimenko, in particular its observations of outgassing from decimetre-scale aggregates, various indications that the distributed source for water is not very strong, and its detection of a significant distributed source for the hydrogen halides (HF, HCl, HBr).