# Fuzzy Hierarchical Cross-Clustering of Romanian Mineral Waters

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Cluster analysis is a large field, both within fuzzy sets and beyond it. The application of Fuzzy sets in a classification function causes the class membership to become a relative one and consequently an object or sample can belong to several classes at the same time but with different degrees. In this investigation, Fuzzy hierarchical cross-clustering algorithm has been applied for simultaneous clustering of different Romanian mineral water samples and their chemical characteristics (ions concentration), and the results obtained have been allowing an objective interpretation of their similarity and differences, respectively. This very informative fuzzy approach allows the qualitative and quantitative identification of the characteristics responsible for the observed similarities and dissimilarities between mineral water samples. In addition, the fuzzy hierarchical characteristics clustering and fuzzy horizontal characteristics clustering procedures revealed a high similarity between some ions concentration and other features.

# Surfactants from the gas phase may promote aerosol cloud droplet nucleation

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The uptake of water-soluble volatile organic compounds (WSVOCs) by wet atmospheric aerosols can lead to the formation of secondary organic aerosol material (SOA). We have performed a series of laboratory studies in order to quantify of the impact of WSVOC uptake and aqueous-phase SOA formation on aerosol cloud condensation nuclei (CCN) activity. Deliquesced, acidified submicron ammonium sulfate aerosols at >60% RH were exposed to ppb levels of gas-phase methylglyoxal, acetaldehyde in a continuous-flow aerosol reaction chamber (residence time = 3-5 h). Aerosol size and CCN activity was monitored at the reactor outlet via scanning mobility particle sizer (SMPS) and continuous-flow streamwise thermal gradient chamber CCN counter (CFSTGC), respectively.

Methylglyoxal and acetaldehyde are known to form SOA and suppress surface tension in bulk aqueous aerosol mimics, but both of these species have relatively low Henry's Law constants. We found evidence that adsorption of these species from the gas phase to the gas-aerosol interface significantly impacts aerosol CCN activity, by directly altering the aerosol surface tension. Up to 15% reduction in critical dry diameter for activation was observed without any detectable particle growth due to bulk uptake of organics (Sareen *et al*., Proc. Natl. Acad. Sci. USA, 2013).

Finally, we have developed a general analytical approach for predicting aerosol surface tension based on gas-phase surfactant loadings, taking into account the effects of both bulk uptake and surface adsorption. These predictions allow calculation of the particle hygroscopicity and predictions of cloud droplet formation. We will present results for atmospheric scenarios and highlight needs for additional experimental work.

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