Molecular composition and biological effects of aerosols from ship diesel engines and wood combustion

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Ship engine and bio mass combustion emissions are important regarding PM-related health effects (e.g. lung, cardiovascular). The Virtual Helmholtz Institute HICE addresses chemical & physical properties and health effects of anthropogenic combustion emissions. We exposed human lung cells to fresh, diluted exhaust fumes from a ship engine running on heavy fuel oil (HFO) or cleaner diesel fuel (DF) as well as to wood combustion emissions. A field deployable air-liquid interface cell-exposure system in a mobile S2-biological laboratory was used. The biological effects were toxicologically and molecular-biologically characterized (transcriptional, proteomic and metabolomic profiling). Advanced chemical and physical analysis of the exhaust aerosols was performed and correlated with the biological results. Lung cell responses include inflammation and apoptosis. Surprisingly, DF ship emissions, which contain much less toxicants, induce a significantly stronger acute regulation of essential cellular pathways (e.g., mitochondrial function, intracellular transport in A549) and a higher cytotoxicity (RAW macrophages) than HFO-emissions. Wood combustion emissions from different compliances induce again lower acute biological impact in the exposed cells than DF and HFO ship emissions. By combining aerosol chemical and biological information, relevant compounds and factors for the observed biological effects are identified In addition to acute effects also long-term effects, induced e.g. by carcinogenic compounds are considered.