Physical and chemical properties of deposited airborne particulates over the Arabian Red Sea coastal plain

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Supplement

Sampling Sites Meta-data

The NEO sampling site (DT3, DT4) is within a fenced area about 200 m in length and 50 m in width, situated along the southeastern border of the KAUST campus. The soil surface is covered by a layer of gravel and paved walkways, to contain local dust emissions. The Frisbee deposition samplers as well as several experimental photovoltaic (PV) and meteorological systems are installed at the NEO site. Besides the regional dust, the site is impacted by local emissions from vehicles traveling along the paved road to the south and in the paved parking lot to the north. Depending on the wind, the site was periodically exposed to dirt road and construction dust from building activities immediately outside the KAUST campus.

The CMOR sampling site (DT3) is on a concrete paved quay about 200 m in length and 50 m wide, providing docking facilities for small and medium size boats in the KAUST harbor. The deposition sampler was set up close to the furthest edge of the quay, approximately 5m from the water’s edge, about 1m above the water line, and approximately 65 m from the CMOR building entrance. The sampler is exposed to local emissions from cargo loading activities and other traffic, as well as sea spray during stormy conditions.

One Frisbee sampler (DT1) was installed on the pebble covered flat garage rooftop of a residential home (G3705), located approximately 1.5 km to the beach area in the west and about 1 km from the harbor to the south. The site is impacted by local paved road traffic, a nearby bus terminal, and activities at a local shopping center. The sampler was set about 5m above the street level, and to some extent above street level dust and local transport emissions.

<u>Dust Deposition on Solar Panels</u>

Dust deposits on solar panels are known to have a severe detrimental effect on the efficiency of photovoltaic systems (Goossens and Van Kerschaever, 1999; Hamou et al., 2014; Mejia et al., 2014; Rao et al., 2014; Sulaiman et al., 2014; Ilse et al., 2016). High humidity is experienced at KAUST throughout the year, more often during the late summer months of July to September. This is reflected by dew being formed on radiating cool surfaces such as solar panels, as well as coastal fog during the early morning hours. The gypsum component of dust being collected by the Frisbee samplers and on all exposed surfaces is being partly dissolved by the dew, and on drying being recrystallized. XRD measurements performed directly on dust collected on zero background silicon wafers exposed over a period of several months showed the dust surface to be hardened by the crystallization of blades of gypsum. These surface crusts of gypsum were shown to have a distinct preferred orientation, having their (010) crystal planes parallel to the surface of the silicon wafer, as will be the case on other flat surfaces. The cementation of dust on glass surfaces by gypsum encrustation increases the adhesion of dust on the solar panels, and a resultant attenuation of solar panel efficiency. Dust mineralogy and mineralogical interrelationships, together with climatic conditions are variables determining the nature of dust deposits on solar panels. These need to be understood with the planning and placement of solar arrays.