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In/out flux of atmospheric microplastics to/from the Persian Gulf and Oman Sea

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Relatively little is known about microplastics (MPs) in the atmosphere of the coastal zone, including their interaction with the sea surface. In this study, MPs have been determined and characterised in the lower atmosphere, advecting air, depositing dusts, coastal sediments and seawater of the Persian Gulf and Oman Sea using a variety of sampling techniques. MPs were detected in all samples and were dominated by fibres that were, in most cases, small (< 100 mm) and dark. MP numbers captured in advecting air showed no trends in the vertical or differences between locations or deployments over land and sea, but a clear increase was observed during strong winds. MPs in atmospheric suspension and in deposited dusts, sediments and seawater were also heterogeneously distributed. Environmental or transport pathway fractionation was evident according to morphology and particle size (% fibres and % small fibres) and to polymer density. Regarding the latter, relatively low-density polymers (e.g., polyethylene, polypropylene) were more abundant in the atmosphere, advecting air and seawater, whereas higher density polymers (e.g., cellulosics, polyethylene terephthalate) were more abundant in settling dusts and sediments. Flux calculations revealed advection was greater than deposition by at least three orders of magnitude over land but only by a factor of about 400 over sea. Neglecting any differences in resuspension, this suggests a greater net loss of airborne MPs over the ocean. Net settling velocities for the MP population in the lower atmosphere, derived from depositional fluxes and concentrations in air, ranged from about 1.3 to 13.1 m h^{-1}, with residence times ranging from 45 min to 8.3 h. Our observations suggest that long-range transport of the type of MPs detected is constrained by a succession of deposition-resuspension cycles that must be factored into future modelling.

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