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Seasonal variability of Personal Care Products in Antarctic snow

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Personal care products (PCPs) have become ubiquitous in daily life, resulting in their continuous release into the environment on a global scale. PCPs are organic compounds commonly found in products such as cosmetics, detergents, and deodorants. The growing interest in these substances is primarily driven by their potential to track shifts in human behaviors and consumption patterns. Key characteristics of these compounds include large-scale industrial production, high daily usage volumes, persistence after application, and semi-volatility.

Among these products, fragrances are widely used in cosmetics, shampoos, soaps, and detergents, while UV-filters are key components of sunscreen lotions, outdoor polymers, and paints. Some of these compounds have been included on the EU's watchlist due to their potential harmful effects. Additionally, several countries in the Southern Hemisphere have already implemented regulations to limit the use of PCPs, driven by concerns over their negative impacts on coral reefs and marine ecosystems.

Fragrances, owing to their semi-volatile nature, can easily enter the atmosphere and be transported over long distances, even reaching remote regions such as Antarctica. In these areas, they can be deposited through both dry and wet deposition processes and undergo cycles of fractionation, evaporation, and re-deposition. Local sources of PCPs, such as scientific research stations and tourism activities, contribute to their presence in these environments. Notably, PCPs have already been detected in the sewage of the Mario Zucchelli Station (MZS) in Antarctica.

This study examined the spatial distribution and temporal variations PCPs in Antarctic surface snow collected during the 2021-2022 season, between November 2021 and February 2022, along the Ross Sea coast, with a particular focus on how seasonality may influence deposition processes. Comparison of the average PCPs concentrations revealed higher values in late summer, with a concentration pattern showing salicylates as the dominant compounds, followed by UV-filters, while musks contributed the least to the total concentration. Salicylates predominated at all sampling sites, including the snow pit dug on McCarthy Ridge. This result may be attributed to potential selectivity in atmospheric transport, likely influenced by the prevailing synoptic air-mass circulation during austral summer.

Additionally, the study was able to differentiate between local and long-range sources by analyzing the concentration trends observed in samples from remote regions and the sewage of the Mario Zucchelli Station. These findings provide a broader understanding of the dynamics involved in long-

range atmospheric transport, which require further investigation.