Detection, Analysis, and Mapping of Surface Material from Europa

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Europa Clipper, NASA’s next flagship mission launching in 2024, will closely study Jupiter’s icy ocean moon in order to determine if it has conditions favorable for life. Among the nine scientific instruments will be the Surface Dust Analyzer (SUDA), a state-of-the-art instrument for in situ chemical analysis of dust grains. During a series of close flybys of Europa (~25 to 100 km at closest approach), SUDA will collect and measure the chemical composition of thousands of ice and dust particles ranging from ~200 nm to 100 microns in radius, which will be direct samples from Europa’s surface. This is possible due to the flux of interplanetary micrometeoroids impacting the surface producing a cloud of ejecta particles, which SUDA detects and analyzes. Knowing the spacecraft trajectory, instrument pointing, and particle velocity through the instrument aperture, SUDA’s in situ chemical measurements will be linked to their site of origin on Europa’s surface near the spacecraft ground-track, thereby offering geological context for chemical composition. This method implements established models of impact ejecta dynamics and derives distributions for each measurement’s site of origin on the surface using Monte Carlo simulations. These studies are especially useful for evaluating the science return for particular tour designs since we can simulate SUDA’s effectiveness at mapping the composition of geologically interesting areas. With well targeted flybys by Europa Clipper, SUDA will help constrain the chemical composition of surface material originating from various geological features, particularly those characterized by non-icy materials. This will enhance our understanding of the exchange processes between the icy surface and subsurface ocean as well as assess the habitability of Europa.