



The Surface Distributions of the Production of the Major Volatile Species, H₂O, CO₂, CO and O₂, from the Nucleus of Comet 67P/Churyumov-Gerasimenko throughout the Rosetta Mission

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The Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) suite of instruments operated throughout the just over two years of the Rosetta mission operations in the vicinity of comet 67P/Churyumov-Gerasimenko. It measured gas densities and composition throughout the comet's atmosphere, or coma. Here we present two-years' worth of measurements of the four major volatile species in the coma of the comet, H₂O, CO₂, CO and O₂, by one of the ROSINA sub-systems called the Double Focusing Mass Spectrometer (DFMS). DFMS is a very high mass resolution and high sensitivity mass spectrometer able to resolve at a tiny fraction of an atomic mass unit. We have analyzed the DFMS measurements using an inversion scheme based on spherical harmonics that solves for the distribution of potential surface activity of each species as the comet rotates, changing solar illumination, over short time intervals and as the comet changes distance from the sun and orientation of its spin axis over long time intervals. We also use the surface boundary conditions derived from the inversion scheme to simulate the whole coma with our fully kinetic Direct Simulation Monte Carlo model and calculate the production rates of the four major species throughout the mission. We compare the derived production rates with remote sensing observations by the Visible and Infrared Thermal Imaging Spectrometer (VIRTIS) as well as with published observations from the Microwave Instrument for the Rosetta Orbiter (MIRO). Finally we use the variation of the surface production of the major species to calculate the total mass loss distribution over the surface throughout the mission.