Activity, seasons, mass transfer, and homogeneity.

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The extended observations of 67P by the Rosetta spacecraft over more than two years around the comet's perihelion passage revealed a bi-lobate nucleus with a greatly varying topography and surface morphology. The obliquity of more than 50° and the coincidence of the southern solstice with the perihelion lead to strong seasonal effects when the south polar region encounters the strongest insolation while the north pole area is in the dark. Overall the erosion due to activity is expected to be 4 times stronger on the southern than on the northern hemisphere. OSIRIS observations reveal that most of the dust mass is liberated in large decimeter size particles, many of which do not reach escape velocity and fall back onto dark or weakly insolated regions. This leads to a mass transfer from the south to the north. Major parts of the northern hemisphere reveal smooth surfaces and seem to be covered by the back fall.

Model calculations show that the observed activity (water production rate) of 67P can be compared to that of an equivalent sphere. This and dust and gas observations of the coma suggest that all the nucleus surface produces water on a rather uniform level in spite of the morphological heterogeneity. Analysis of the non-gravitational torque influencing the rotation period, however, requires variation of the regional activity levels. In addition, the activity also influences the orbital motion of 67P. Combining the constraints due to the water production rate, the rotational torque, and non-gravitational forces over the orbit of 67P should lead to a map of activity levels. The physical relevance of the result(s) strongly depends on our understanding of the physical processes of activity producing the fine dust and decimeter sized grains.