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Seasonal effects on the nucleus of comet 67P revealed by Rosetta/VIRTIS

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We describe thermal effects on the nucleus of comet 67P. Due to the overall low thermal inertia of the nucleus surface, the surface temperature is essentially dominated by the instantaneous value of the solar incidence angle and the heliocentric distance. However, for each location, the smallest achievable value of insolation angle depends on the season and topography. Given the substantial obliquity of comet 67P, seasons are such that the northern hemisphere is mainly illuminated at aphelion while the southern hemisphere receives most insolation soon after perihelion. In addition, the heliocentric distance strongly affects the surface temperature, all other parameters being equal. This is a larger effect in comets than in asteroids, due to the wide range of heliocentric distance values spanned by comets.

When Rosetta started its global mapping observation campaign, in early August 2014, hyperspectral images acquired by the VIRTIS imaging spectrometer onboard the Rosetta Orbiter covered only the northern regions of the cometary surface, and the equatorial belt became gradually unveiled, while the southern region has been revealed from 2015 onwards. In parallel, the comet's heliocentric distance has been decreasing from ~ 3.6 AU down to 1.24 AU, the distance at which the perihelion passage occurred on 13 August 2015. By relating surface temperatures as measured by VIRTIS to three variables: solar incidence angle, true local solar time and heliocentric distance, we aim to separate the relative contributions due to season and to the heliocentric distance.

To do this, we use both VIRTIS-M data (namely data from the mapping spectrometer covering the $1\text{--}5\ \mu\text{m}$ range, available up to April 2015, i.e. before the failure of the IR cryocooler) and VIRTIS-H data (namely data from the high-resolution point spectrometer covering the $2\text{--}5\ \mu\text{m}$ range), and we focus in particular on three regions: one in the northern hemisphere, one in the equatorial region and one in the southern hemisphere. These three regions are chosen so as to be relatively smooth at the spatial resolution that is achieved from a distance of about 100 km (25 m/px for VIRTIS-M, $50\times 150\text{ m/px}$ for VIRTIS-H), in order to limit the effects of large-scale surface roughness.

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