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Modelling the H_2O outgassing from the southern hemisphere of comet 67P/Churyumov-Gerasimenko

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The Rosetta mission followed comet 67P/Churyumov-Gerasimenko (67P/CG) for 2 years and detected gas and dust outgassing from the nucleus. ROSINA on-board Rosetta provided information on gas abundances in the coma. This is used to investigate the distribution of gas emissions from the surface of the comet. Previous studies have looked at the activity distribution during summer at northern latitudes [1-8]. Based on these studies, we have focussed on the distribution of H_2O sources in the southern hemisphere at times before perihelion. We use 3D Direct Simulation Monte Carlo (DSMC) method to simulate the inner-gas coma of 67P/CG up to 10 km above the surface.

Our model has been tested for 10th July 2015. We use the same modelling approach described in [2], where an Effective Active Fraction (EAF) indicates the activity percentage with respect to the sublimation rate from a pure H_2O-ice surface. On 10th July 2015, the sub-solar latitude was about -30° and parts of the northern hemisphere were permanently unilluminated at this time. Comparing our model results with ROSINA/COPS and ROSINA/DFMS data, we can modify the EAF regionally in the southern regions to find the best fit possible.

Our results suggest that an insolation driven outgassing of an homogeneous surface distribution of H_2O-ice at southern latitudes is not a sufficient condition to explain ROSINA measurements. This conclusion is similar to that reached for the northern hemisphere by other authors. The results with insolation-driven activity follow the basic trend but they significantly overestimate the measured daily variations. This could be explained by an inhomogeneous distribution of ice sources on the nucleus. We have investigated this possibility and suggest an EAF that reconciles the model and the observational data.

References

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