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Martian equatorial CO2 clouds: a complementary OMEGA and HRSC data analysis

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One of the unique features of the Martian climate is the existence of CO2 ice clouds formed from the main atmospheric constituent. These clouds were thought to form only in the polar night, where the CO2 condenses on the winter pole. Recently, Mars Express has observed several occurrences of high-altitude CO2 clouds mainly in the equatorial areas. We use observations by OMEGA (Bibring et al., 2004) and HRSC (Jaumann et al., 2007) to analyse these high-altitude CO2 cloud occurrences. As shown by Montmessin et al. (2007), the spectral signature of CO2 clouds seen in OMEGA spectra exhibits one or two distinct peaks that appear inside a strong CO2 gas absorption band centered at 4.3 microns. We have mapped this spectral signature with a 3-sigma detection method. The mapping of the clouds in three Martian years of OMEGA data have provided a cloud dataset of about 60 occurrences. These observations provide information on the spatial and seasonal distribution of CO2 cloud formation at the equatorial region and information on variations of cloud particle size, related to the variations in the spectral signature of the clouds. The clouds exhibit variable morphology from clearly convective type, round structures (about 15% of all cases), to more filamented, cirrus type clouds. We have also analysed some properties of the clouds (altitude, particle size, opacity) using two shadow observations by OMEGA. We will present the results acquired so far using the datasets of the two instruments. OMEGA shows that the clouds exhibit interannual variations, but in general the clouds are concentrated on specific spatial and seasonal bins, mainly around the equator and around Ls=45 and Ls=135, before and after the northern summer solstice. Most high-altitude clouds are observed in a longitudinally limited area, between 150 W and 30 E. During the first year of observations the cloud shadow was also observed on two orbits. The analysis of the cloud observations have revealed that the clouds are thick with near-infrared opacities (at 1 micron) between 0.2–0.7, they are at around 80 km altitude in the atmosphere and the mean particle effective radius is mainly 1-2microns, although submicronic particles are also observed. HRSC images have also been analysed and the presence of these high-altitude clouds in them has been confirmed. The HRSC observes through a set of colour filters, which allows for the determination of the cloud altitude through photogrammetry analysis and westward wind speeds at cloud altitude through relative cloud movement between images taken through two filters at different times. HRSC observations provide also a higher spatial resolution, as well as a wider image, providing more context for mapping the cloud morphology. Preliminary analysis of the HRSC orbits have revealed CO2 cloud altitudes ranging from 59 km to 83 km, each with an altitude accuracy of +/- 1-2 km and cloud (wind) speeds of 15-107 m/s (+/-15m/s). One cloud, observed far from the equator, shows a varying altitude of 53-67 km in a latitude bin of 46-53 S. We will present the datasets and cloud characteristics acquired so far in the analysis.

Bibring, J.-P., Soufflot,A., Berthe,M., Langevin, Y., Gondet, B., Drossart, P., Bouye, M., Combes, M., Puget, P., Semery, A., Bellucci, G., Formisano, V., Moroz, V., Kottsov, V., the OMEGA Co-I team, Bonello, G., Erard, S., Forni, O., Gendrin, A., Manaud, N., Poulet, F., Poulleau, G., Encrenaz, T., Fouchet, T., Melchiorri, R., Altieri, F., Ignatiev, N., Titov, D., Zasova, L., Coradini, A., Capacionni, F., Cerroni, P., Fonti, S., Mangold, N., Pinet, P., Schmitt, B., Sotin, C., Hauber, E., Hoffmann, H., Jaumann, R., Keller, U., Arvidson, R., Mustard, J. and Forget, F.: OMEGA: Observatoire pour la minéralogie, l'eau, les glaces et l'activité. ESA SP-1240: Mars Express: the scientific payload, pp. 37-49, 2004.

R. Jaumann, G. Neukum, T. Behnke, T. C. Duxbury, J. Flohrer, S. V. Gasselt, B. Giese, K. Gwinner, E. Hauber, H. Hoffmann, A. Hoffmeister, U. Köhler, K.-D. Matz, T. B. McCord, V. Mertens, J. Oberst, R. Pischel, D. Reiss, E. Ress, T. Roatch, P. Saiger, F. Scholten, G. Schwarz, K. Stephan and M. Wählisch: The high resolution stereo camera (HRSC) experiment on Mars Express: Instrument aspects and experiment conduct from interplanetary cruise through the nominal mission. Planet. Space Sci., 55, pp. 928-952, 2007.

Montmessin, F., B. Gondet, J.-P. Bibring, Y. Langevin, P. Drossart, F. Forget and T. Fouchet: Hyper-spectral imaging of convective CO2 ice clouds in the equatorial mesosphere of Mars. J. Geophys. Res., 112, 2007.