

Chevrier, Vincent; Chittenden, J. D.; Bryson, K.; Roe, L. A.; Sears, D. W.; Pilgrim, R. (2007) Experimental Study of the Effect of Wind on the Stability of Water Ice on Mars. American Astronomical Society, DPS meeting #39, #17.06

Abstract

We have studied the effect of wind velocity on the sublimation rate of pure water ice under simulated martian conditions. Measurements were made for wind velocities ranging from 0.5 m/s to 12 m/s, the range observed by the meteorological instruments on the surface of Mars, and at -15°C of surface temperature a value typical of the daily high temperature for most of the year at the Pathfinder lander site. At this temperature and low humidity (1%), sublimation rates ranged from 0.7 mm/h to 1 mm/h at 12 m/s. In high humidity (30%) atmosphere, the effect of wind velocity appears negligible, and the sublimation rate remains constant around 0.3 mm/h. Sublimation rates at zero wind speed are 4-10 times higher than predicted by theory, which is due to a strong thermal effect of the boundary layer above the ice, which is measured 10°C warmer than the ice surface. The cold surface of the ice results mainly from evaporative cooling. The sublimation rates we observe are about an order of magnitude less than predicted by forced convection. Our data provide a new semi-empirical expression for the sublimation rate that combines free and forced convection. Using this expression, we derive the sublimation rates of ice as a function of wind velocity and temperature. The results indicate that temperature remains the major factor in the sublimation rate of ice on Mars and that wind speed has a very minor effect. This program was funded by the W.M. Keck Foundation.