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Understanding the escape of water from Enceladus

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The discovery of geological activity at Saturn's moon Enceladus will rank among Cassini's greatest discoveries. Although the mechanism driving this activity is not currently understood, its effects include complex surface features, abnormally warm ice, and water geysers all concentrated in the south polar region. Another important consequence of geological activity is the creation and continuous resupply of an exosphere composed primarily of water. Aspects of this tenuous gas have been measured *in situ* and remotely by many Cassini instruments including CAPS, INMS, MAG, and UVIS. Together they portray a dynamic atmosphere streaming away from Enceladus to create a water torus encircling Saturn. The cloud provides a major source region for Saturn's magnetospheric plasma.

On 14 July 2005, Cassini passed within 175 km of Enceladus' surface enabling a direct measurement of the water density by the Ion Neutral Mass Spectrometer (INMS). These data are consistent with a two component atmosphere; the first with a weak, isotropic source on the surface, and the second with a strong, faster source located at the south pole. This latter source is possibly coincident with the "tiger stripe" series of fractures where warm ice was measured.

We use a three dimensional, Monte-Carlo neutral cloud model to understand the nature of the water source at Enceladus. Water molecules are ejected from the surface with a mean speed greater than Enceladus' escape velocity to form the Saturnian water torus. These high speeds, greater than 250 m/s, are consistent with images of the water ice plume. Charge exchange between the neutral water and the magnetospheric ions measured by the Cassini Plasma Spectrometer (CAPS) limit the extent of the neutral cloud.