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In situ observations of nightime warm katabatic winds on Gale by REMS.

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We report the first in-situ observations of warm nighttime winds at Gale
landing site. Gale is an impact crater basin with 5 km depth and an internal mound of the same height. This sharp topographic contrast induces huge environmental differences after sunset that leads to the appearance of downslope winds. Katabatic winds are produced as the descending mass of air is compressed adiabatically because of the pressure difference. This leads to the injection at the base of the crater of a jet of air with increased temperature.

The Rover Environmental Monitoring Station (REMS) on the Mars Science Laboratory (MSL) mission has sensors recording air and ground temperature, pressure, relative humidity, wind speed and ultraviolet radiation in different bands. REMS collects data from all sensors simultaneously daily during the course of the mission. REMS has detected the signatures of katabatic winds simultaneously in 4 of its sensors: pressure wiggles associated with the incoming mass of air (pressure sensor), sudden air temperature increments up to 10 K (air temperature sensor); an associated modulation in the ground temperature (ground temperature sensor); and variations of strength and orientation indicating a donwnslope wind (wind sensor).

The hot air winds observed by REMS show a pattern with a certain characteristic frequency along the nighttime hours. The magnitude and signature of the air temperature increase after sunset changes when the local column of dust increases suggesting a strong dependence on the local circulation of air and local column of dust.

Katabatic winds must be ubiquous on Mars given the huge topographic
differences of its poorly eroded landscape. These warm nighttime winds
prevent cooling of the ground surface and may lead to erroneous thermal
inertia estimates when the ground temperature is remotely measured from orbiters, that usually do not take them into account them in the retrieval process.

Furthermore the signature of katabatic winds changes along seasons showing a strong dependence with the local atmospheric dynamics and dust loading processes. Finally the rapid surface temperature changes induced by these jets and the systematic orientation associated with the slope may influence the erosional processes and depositional patterns in areas with sharp topographic relief.

REMS will monitor daily and hourly all the relevant parameters to study the evolution of katabatic winds providing a unique data-base to pin-point the characteristics of this local weather phenomenon.