Infrared imaging for air flow analyses in the Barringer Meteor Crater, Arizona, as part of METCRAX II

The second Meteor Crater Experiment (METCRAX II) took place in October 2013 at the Barringer Meteorite Crater in Arizona, USA to investigate nighttime downslope-windstorm-type flows that were discovered in the crater in 2006 during METCRAX I. Five thermal infrared (IR) cameras supplemented the extensive meteorological instrumentation in and around the crater. The cameras looked down into the crater and its surroundings from various locations on the crater’s rim, sensing thermal IR radiation and the effective radiation temperatures of the crater’s surfaces.

Adapted from MODIS; LUNAR AND PLANETARY INSTITUTE

The Barringer Meteorite Crater is a near circular basin, surrounded by a uniform plain sloping upwards to the SW with a 2% slope. It has a diameter of 1.2 km, is 170 m deep and its rim extends 30-50 m above the surrounding plain.

High temporal and spatial resolution temperature gradients can be determined within the crater along lines of IR pixels. Here we present an example of a profile line constructed from a sequence of 450 temperature sensitive IR pixels for IOP4 on 20 Oct 2013.

IR Cam 1: Cold-air pool (CAP) stacking 5:23-6:55 MST
IR Cam 1: Warm air intrusion 23:48-24:24 MST
IR Cam 3: Turbulent mixing 1:49-17 UTC
IR Cam 3: Cold-air pool (CAP) stacking 5:23-6:55 MST
IR Cam 3: Warm air intrusion (WAI) 23:48-24:24 MST
IR Cam 3: Turbulent mixing 1:49-17 UTC

The IR method has proven to be a useful supplement to the interpretation of dual-Doppler lidar images of airflow coming into the crater. The dual-Doppler 2D wind field is retrieved for a vertical plane oriented along the incoming airflow direction. The IR images provide a means of determining whether warm or cold air reaches the surface in connection with flow features such as waves and hydraulic jumps.

IR picture 22:18 MST
IR picture 22:46 MST

The influence of solar radiation on the surface can be measured using daytime IR data. Absolute temperatures provide information on the heat balance of individual IR pixels and delineate the edge of the shadow cast by the crater rim. Analyses can be performed for the whole crater floor; results can be used to validate solar shading models and to investigate the initiation and changing structure of the upslope flow on the heated slopes following sunrise.

1Ruhr-Universität Bochum, 2University of Basel, 3University of Utah, 4InfraTec GmbH, 5Technische Universität Dresden, 6University of Padova

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