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Remote and insitu sensing of surface and atmosphere using small aerial unmanned systems (UAS)

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Recent technological developments with unmanned aerial systems (UAS) have resulted in a reduction in cost, greater reliability and adoption into areas where they had previously not been considered. Uses in coastal and border patrol, forestry and agriculture have recently been evaluated in an effort to expand the observed area and reduce surveillance and reconnaissance costs for information gathering. The scientific community has both contributed and benefited greatly in this development. A larger suite of light-weight miniaturized sensors now exists for a range of applications which in turn has led to an increase in the gathering of information from these autonomous vehicles. Current capabilities and experiences with UAS science applications conducted by small airborne vehicles developed by Advanced Ceramics Research (ACR) include volcano monitoring trials during an episode of volcanic unrest at Mt St Helens volcano, Washington USA; aerosol-cloud-radiation interactions, Maldives, which required high altitude, long-range, high precision formation flying of three stacked UASs; and mammal tracking such as whale monitoring in the costal regions of the USA. New instrumentation recently developed to be deployed on ACR's UAS platforms include a high resolution hyperspectral imager, UV and IR remote sensing spectrometers, and laser fluorescence spectrometers for monitoring of heavy metals. Additional projects being planned include scientific projects employing magnetometers, FLIR thermal imaging, and gas/particle sampling, among others. The capabilities demonstrated to date by ACR's UAS platforms include high altitude ($>$5,000 m) and difficult environments. These UASs are capable of water landings, have completed missions in winds in excess of 50 knots ($>$25 m/s) and are engineered for cold conditions. Combined with miniaturized sensors, UASs show promise as an effective tool for a wide range of geoscience research, even in polar regions.