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New opportunities in planetary geomorphology: an assessment of the capabilities of the Colour and Stereo Surface Imaging System (CaSSIS) on The Exomars Trace Gas Orbiter through Image Simulation.

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The Colour and Stereo Surface Imaging System (CaSSIS) is a full-colour visible to near-infrared (VNIR) bi-directional pushframe stereo camera onboard the ExoMars 2016 Trace Gas Orbiter (TGO). For more details on ExoMars TGO and its payload, please see [4], and for the CaSSIS instrument see [1]. For details on the first Mars Capture Orbit (MCO)-acquired CaSSIS stereo images and preliminary 3D reconstructions from them [5]. CaSSIS will provide full-colour, stereo and repeat imaging spanning different times of day and covering all seasons. Such images will be used to address the following objectives: 1) characterizing possible [surface/subsurface] sources for methane and other trace gases; 2) investigating dynamic surface processes that may contribute to atmospheric gases; and 3) certifying and characterizing candidate landing site safety and hazards (e.g., rocks, slopes, etc.).

Here we present a summary, and some highlights, based on the creation and analysis of simulated CaSSIS image cubes [see 2, 3]. We generated simulated images that are spatially (4.6 m/px) and spectrally (4-bands) consistent with CaSSIS from existing Mars Reconnaissance Orbiter (MRO) datasets. Simulated CaSSIS colours were generated from hyperspectral VNIR (S-detector) data from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) after the methods of [6], which were then combined with spatially oversampled and resampled 32-bit calibrated I/F images from the Context Camera (CTX) and High Resolution Imaging Science Experiment (HiRISE) [2, 3]. For more of the details on the simulation process and the various products produced please see [2, 3].

Our simulations show that such colour coverage will be particularly valuable towards facilitating and enhancing seasonal process and change detection studies. For example, a simulation image of Gasa crater demonstrates exactly how additional colour context would facilitate gully change detections that can be subtle and difficult to detect in single-band images, or when missed by the HiRISE colour swath. Another result based on our colour analysis includes, excellent separation of ferrous- and ferric-bearing surface materials provided by band ratio colour composite images utilizing the two NIR bands of CaSSIS (3RED, 4NIR). These images will be particularly useful for associating CaSSIS colour units with spectral units defined by orbiting spectrometers (e.g., CRISM), and thereby extend spectral mapping to CaSSIS spatial scales. This will particularly be beneficial for landing sites where it is difficult to achieve continuous colour coverage with HiRISE. Our analysis shows that dune movement can be detected at the scale of CaSSIS, given a long enough baseline. Other results include resolving: 1) larger individual or sets of Recurring Slope Lineae (RSL), 2) small impacts (including ice excavators), and 3) surface changes associated with landers/rovers (NOTE: lander/rovers and their tracks are not resolvable).

References: [1] Thomas N. et al. (2016), submitted to SSR. [2] Tornabene L. et al. (2017), submitted to SSR. [3] Tornabene L. et al. (2016) LPSC 47, Abstract #2695. [4] Vago J. et al. (2015) SSR, 49 518-528. [5] Cremonese G. et al. (2017) LPSC 48. [6] Seelos F. et al. (2011) AGU Fall, vol. 23, Abstract #1714. [7] Delamere A. et al. (2010), Icarus, 205, 38-52.

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