LOW LATITUDE DAWN OBSERVATIONS OF MARS USING THE COLOUR AND STEREO SURFACE IMAGING SYSTEM (CaSSIS). A.Valantinas[1], N. Thomas[1], A. Pommerol[1], P. Becerra[1], G. Cremonese[2] and the CaSSIS Team[1]. [1]Physikalisches Institut, University of Bern, Sidlerstrasse 5, 3012 Bern, Switzerland, (adomas.valantinas@space.unibe.ch), [2]Osservatorio Astronomico di Padova, INAF, Padova, Italy.

Introduction: Surface processes driven by carbon dioxide sublimation and condensation are well documented in the high latitude and polar regions of Mars [1-3] and are closely tied to the seasonal exchange of CO_2 between the Martian surface and atmosphere [4]. Similarly, it is suggested that a diurnal CO_2 cycle is possibly responsible for formation of enigmatic slope streaks in the low thermal inertia regions [5]. This season-independent model suggests that CO_2 frost growth is active in dusty equatorial and mid latitudes, where night temperatures are low enough for CO_2 to condense. It is estimated that, at sunrise, carbon dioxide on the surface will sublimate in seconds to several tens of minutes. This diurnal sublimation and condensation cycle would prevent soil induration and increase regolith porosity, which drives avalanching, fluidization and dust gardening effects. However, no observational evidence of a diurnal CO_2 frost cycle exists, due to the physical and technical limitations of the imaging instruments currently in orbit around Mars. First, a non-Sun-synchronous orbit is required to observe a location at different times throughout the Martian day. Further, optical instruments rely on light reflected from the surface to achieve a high enough signal-to-noise ratio, so dawn observations are difficult.

In this study, we present new early morning observations at the equatorial and low latitude regions of Mars, taken by The Colour and Stereo Surface Imaging System (CaSSIS) [6] onboard the ExoMars Trace Gas Orbiter (TGO). TGO is in a non-Sun-synchronous orbit, therefore, CaSSIS can monitor surface changes at varying local solar times (LST), returning to approximately the same location every 30 days. CaSSIS also has an excellent absolute calibration and is sensitive enough to maintain good SNR for high incidence angle observations.

Results: As of CaSSIS' 2019-11-30 data release, 71 images with incidence angles ranging from 80° to 90° were acquired in regions predicted by Piqueux et al (2016) to include CO_2 frost at sunrise (see **Fig. 1**). 19 of those 71 observations have incidence angles between 85° and 90°. On some images we applied a 2x2 binning algorithm, which increases the SNR by a factor of 2. All of these images are single observations without repeated coverage yet. An example of a high incidence angle (88.2°) target is shown in **Fig. 2**. This color image was taken with 3 CaSSIS filers (BLU, PAN and NIR), and corresponds to an early Martian morning, around 10 minutes after sunrise. Visual inspection does not reveal CO_2 frost, however, in-depth photometric analysis is currently ongoing.

Future Work: Repeated observations of the locations shown in **Fig. 1** are planned. By comparing them with ones taken later during the day, spectral analysis of the color band ratios will allow us to identify the possible presence of CO_2. Also, more observations are expected at high incidence angles just before dawn >90° (night). At incidences angles of and above 90° the local surface is diffusely illuminated by aerosols, which makes spectral identification rather difficult.

CO_2 frost is predicted to survive from seconds to several tens of minutes in the areas outlined in **Fig. 1** [5], hence, several observations with varying parameters are needed. Another alternative idea is to target higher elevation targets where CO_2 is predicted to be thicker and long lasting. Furthermore, the CaSSIS database includes only a few equatorial observations. These areas are also known for slope streak activity [7].

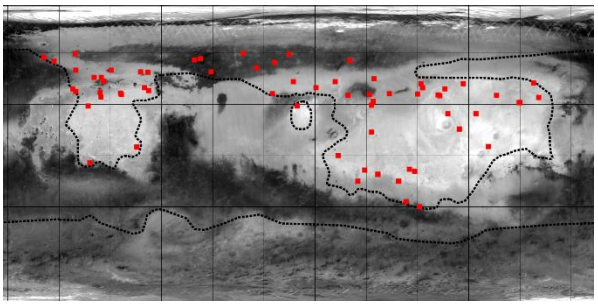

Figure 1. Modeled diurnal CO_2 frost mask (dashed black lines, adapted from [5]) and all CaSSIS dawn observations (90°–80° incidence) at latitude band ±60° as of 2019-11-30 (red dots). TES albedo base map.

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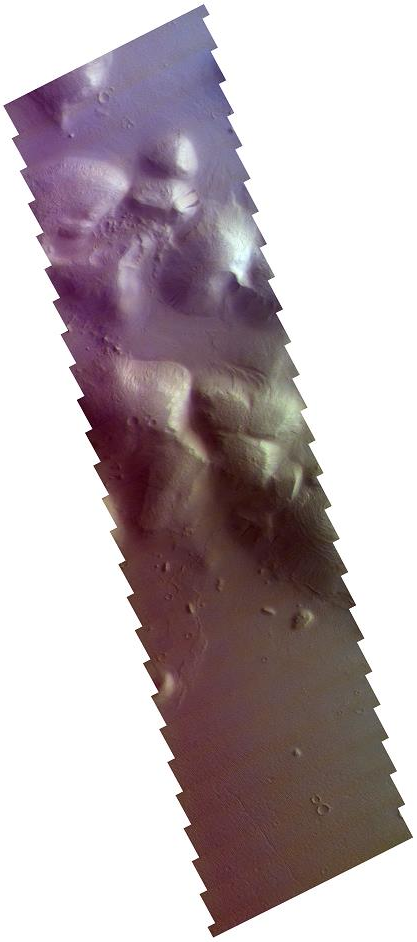

Figure 2. CaSSIS color image at 88.2° incidence. Approximately 10 minutes after sunrise. Coordinates (lat, lon): 29.3, 183.1. The image was binned 2x2. No visual presence of CO_2 frost is apparent. Repeated observations at this location later in the afternoon are needed to identify any possible homogenous frost in the scenery. (ID: MY35_008591_151_0).