ACTIVE MEGARIPPLES AND TRANSVERSE AEOLIAN RIDGES ON MARS: AN UPDATE. M. Chojnacki[1], D. A. Vaz[2], S. Silvestro[3,4], & D. C. A. Silva[2]. [1]Planetary Science Institute, Lakewood, CO (mchojnacki@psi.edu); [2]Centre for Earth and Space Research of the University of Coimbra, Coimbra, Portugal; [3]INAF Osservatorio di Capodimonte, Napoli, Italy; [4]SETI Institute, Mountain View, CA.

Introduction and motivation: Megaripples provide a unique aeolian indicator that can vary significantly in terms of morphology and present-day activity. Intermediate in scale when compared to larger sand dunes and smaller dark-toned Martian ripples, megaripples can exists with or without other bedform classes. Whereas certain megaripples (MRs) and Transverse Aeolian Ridges (TARs) found on Mars are now known to be active in the present climate (*1–3*) (**Fig. 1**), many other occurrences show clear evidence of long-term inactivity including lithification (*4–8*).

This abstract aims to provide an update on a project dedicated to understanding how Martian aeolian bedform systems evolve over decadal time periods – particularly, the dynamics of megaripples and TARs, collectively termed here as "intermediate-scale" bedforms. Specifically, we will: 1) describe a survey that expands the current inventory of known active MRs/TARs, 2) quantify MR or TAR dynamics, and 3) provide preliminary characteristics of active vs. inactive intermediate-scale scale bedforms.

Summary of bedform classes: Bedform classification from orbital images is limited by the lack of in situ sedimentology from surface missions. However, broad-scale morphological classification can be afforded from images and topography from the High Resolution Imaging Science Experiment (HiRISE) camera (0.25–0.5 m/pix) (*9*). We largely adopt the terminology and classification proposed by *Day and Zimbelman* (see (*10*) for further details). The smallest bedform class observed from orbit (1-5 m spacing and ~40 cm tall) are *dark-toned ripples* (DTRs) often found atop dunes or within isolated patches (*8*, *11*). TARs and MRs were classified separately based on their different size, albedo, and stratigraphic relationship (**Fig. 1**). The larger (10-100 m spacing and 1-14 m tall) are light-toned and transverse bedforms designated *Transverse Aeolian Ridges* (*5*, *8*, *11*, *12*). They were typically observed stratigraphically below dark dunes and ripples where present. In contrast, *megaripples* were noted for smaller (5-25 m spacing, ~1-2 m tall), variable-albedo bedforms which were stratigraphically above or in continuity with neighboring bedforms. The brighter crests of MRs compared with DTRs is inferred to be due to a coarser grain size component (*3*, *11*, *13*).

Data sets and methods: Bedforms were assessed using detailed morphology from HiRISE and classified as DTRs, MRs, TARs, and dunes given the criteria previously described. Bedform activity was analyzed using long-baseline (3-7 Mars years) HiRISE orthoimages of sites with prior digital terrain models (1 m/post). A qualitative aeolian activity assessment was given with three categories: 1=static, 2= minor migration/changes, and 3=significant migration/changes.

This activity was quantified by GIS mapping three or more consecutive MR crests (per area) in both images. Wavelength and migration rate (m/Earth-year) were calculated. Bedform half heights, and ultimately MR flux estimates, were derived using the wavelength-height relationship that has been previously developed (*2*, *3*, *8*, *14*). Additional whole dune field fluxes (DTRs, MRs, and dunes) were quantified for select sites using COSI-Corr software, but not discussed in detail here. See (*2*, *3*) for further details.

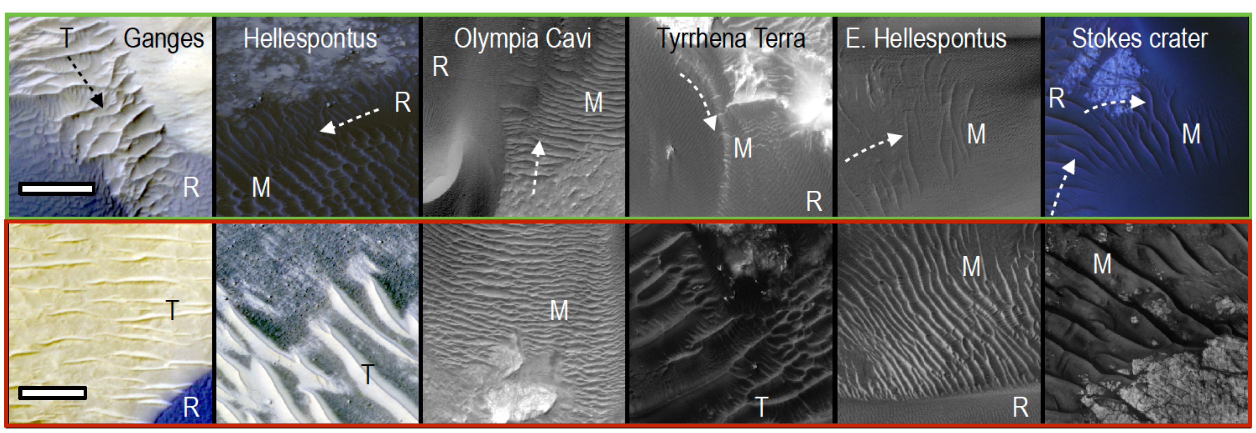

Fig. 1. Examples of active (top green row) and static (bottom red row) megaripples or Transverse Aeolian Ridges, where each column shows the same site. Scale bars (left column) are 100 m and all images are at the same scale. T=TARs, M=Megaripples, and R=Ripples. HiRISE images from left to right per column: PSP_008536_1725, ESP_014348_1345, ESP_036176_2640, PSP_005683_1640, ESP_016339_1380, and ESP_069623_2360.

Global survey results: Of the 73 aeolian system monitoring sites investigated: 27 had significant migration/changes (37%), 21 had minor but unambiguous migration/changes (29%), 21 have no changes (29%), while the remaining 4 had no MRs/TARs present (**Fig. 2**).

Mapping at 27 sites yields average wavelengths (per site) ranging 5–13 m (avg. 7.5±2 m)(**Fig. 3**) while derived heights were 0.5–1.26 m (avg. 0.9±0.2 m). Study site migration rates ranged between 0.06–0.27 m/yr (avg. 0.13±0.05 m/yr) with sand fluxes for these bedforms ranging between 0.02–0.14 $m^3m^{-1}yr^{-1}$ (avg. 0.05±0.03 $m^3m^{-1}yr^{-1}$). Four sites hosted bedforms with characteristics commonly attributed to TARs and were found to be migrating.

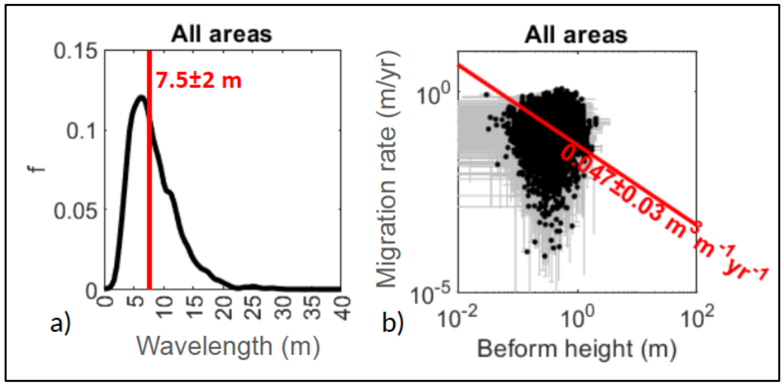

Fig. 3. Results from 27 locations with active megaripples and/or TARs. Average values for all sites are given in red. a) Bedform wavelength histogram. b) Plot of migration rates (y-axis) vs. wavelength derived heights (x-axis). These include work from (2, 3).

Preliminary trends:

- Active megaripples show spatial heterogeneity in their global distribution. Notable areas include the north polar erg, Syrtis Major, Hellespontus, Valles Marineris, and Meridiani/Arabia Terra (**Fig. 2**).
- Active megaripples are present at location of high sand fluxes dune fields, but also for some areas with lower flux dunes (e.g., Herschel crater).
- This activity is most evident on the upwind edges of dune fields, but also within inter-erg areas or near topographic constrictions (**Fig. 1**).
- Smaller DTRs and other mobile sand surfaces were always co-located. With a few exceptions, megaripple migration directions were broadly aligned with that of nearby DTRs and dunes (downwind).
- The few active TARs detected were among high sand transport areas, rather than those isolated.
- In many cases, unambiguous migration is evident in shorter-term annual pairs.
- Average megaripple fluxes tend to be two orders of magnitude lower than nearby dune fluxes (*2*, *3*).

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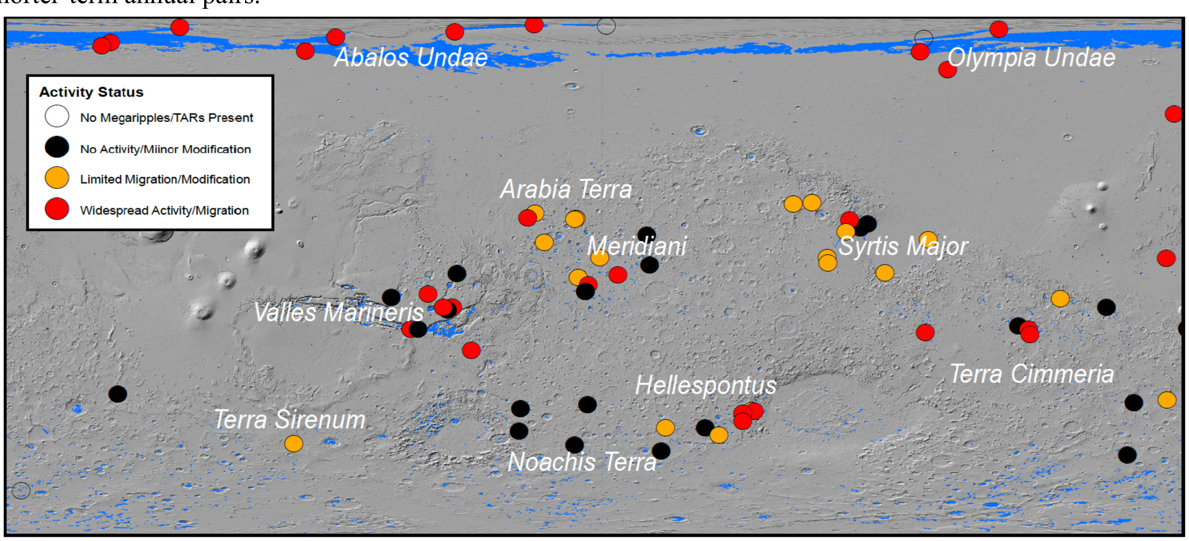

Fig. 2. Survey showing HiRISE monitoring locations of megaripples or TAR-candidates, and sites lacking either bedform class. Dune field distribution are shown in blue as mapped by Hayward et al. (2014).