COMPLEX DARK DUNE FIELDS IN NOACHIS TERRA, MARS. RELATIONSHIP BETWEEN MORPHOLOGIES AND WIND REGIMES. S.Silvestro[1], L. K. Fenton[2], T. I. Michaels[3] and G. G. Ori[1,4], [1]International Research School of Planetary Sciences, Università d'Annunzio, Pescara, Italy (simone@irsps.unich.it), [2] Carl Sagan Center, NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035-1000, USA, [3]Southwest Research Institute, 1050 Walnut St Suite 300, Boulder, CO 80302, USA, [4] Ibn Battuta Centre, Universitè Cadi Ayyad, Marrakech, Morocco.

Introduction: The wind regime is the most important factor controlling the morphology of the aeolian deposits on the Martian surface. Despite the fact thatthe great part of the dark ergs on Mars consist of barchan and transverse dunes [1] the analysis of high resolution images from the MOC and HiRISE instruments have lead to the identification of more complex dune morphologies reflecting a convergence of winds from different directions [2,3,4,5,6]. In this work we investigate three dark dune fields in Noachis Terra (Figs. 1a, 1b, 1c) (48°S, 34°E) which share a similar dune pattern that is likely influenced by a complex wind regime. With the aid of two kinds of atmospheric models, at regional (GCM) and local scale (MRAMS), we try to correlate the observed morphologies with the present atmospheric conditions.

Methods: To constrain the wind regime responsible for the formation of the studied ergs we performed a detailed mapping of the dune morphology using CTX, MOC NA, and HiRISE images (processed using ISIS software). All data sets were integrated into a GIS project (sinusoidal projection). Modeled winds were obtained from simulations performed using the NASA Ames Research Center General Circulation Model (GCM) [7] and from the Mars Regional Atmospheric Modeling System (MRAMS; a mesoscale model) [8].

Ergs morphology, observations: The ergs consist of several types of dunes. Like in many terrestrial ergs barchans occur on the margin of the dune fields (Figs. 1d, 1e), while star dunes are chiefly present in the center (Fig. 1f). The three dune fields reach a remarkable elevation, more than 300 m as measured on MOLA data, and present a steeper eastern slope where the dune fields climb over the northeastern crater rims.

Modeled winds: Figures 2a and 2b represent the regional winds modeled by the GCM (data from the two nearest grid points to the studied dune fields at 45°S, 36°E and 50°S, 36°E). These plots show winds with an associated surface stress greater than 0.005 Pa as a function of local time and direction. Slip face orientations within the three ergs are also plotted (as red, blue and light blue dashed lines). Dominant westerly winds are predicted in the study area, with some weak flows from other directions during the southern spring and summer. In Fig. 2c we show a snapshot (Ls=290°, 19.49 UTM) from the MRAMS mesoscale model. The red polygons indicate the approximate position and extent of the studied ergs. Easterly flows are locally enhanced in correspondence with the northeastern crater rim in all three studied craters. The stress exerted on the surface is locally above the threshold for sand movement (0.0225 Pa; corresponding to 22.5 units in the plot) calculated by [9].

Discussion: The morphology of the dunes observed in the three studied ergs is consistent with a complex multi-directional wind regime with dominant westerly and easterly winds. The similar arrangement of dune pattern in the three dune fields suggest that they form in similar wind conditions. Strong westerly flows are predicted by the GCM and could explain the slip face orientations in the western portion of the ergs. The MRAMS model is able to predict easterly flows that are locally enhanced above the threshold for sand movement by the crater topography. MRAMS results indicate that the evening near-surface wind enhancement in each crater is due to momentum transport from aloft associated with a lee mountain wave (in this case the eastern portion of each crater's rim). These mountain waves form in response to the daily (at this season) east-to-west passage of a relatively strong cold front emanating from the western rim of Hellas (to the east of the study location). These flows are in agreement with the slip face orientations observed in the eastern portion of the dune fields. A consistent sediment supply [10] is also necessary to explain the relatively large area covered by the dune fields (450 km^2 – 210 km^2 – 230 km^2).

Conclusion: The studied dune fields exhibit a similar dune pattern suggesting that the three ergs form in similar wind conditions. The convergence of winds from different directions is suggested as a primary cause for the localized concentration of large amounts of sand within the craters. The combination of our morphological analysis with the data from both regional and local wind models further suggests that the observed ergs could be in equilibrium with present day atmospheric conditions. The mesoscale atmospheric model results highlight the relevance of the underlying topography (crater rims) in enhancing the wind velocity consistently above the threshold for sand movement. The application of such model simulations appears to be important for understanding the nature of small to medium scale aeolian bed forms.

References: [1] Greeley R. et al. (1992) *Mars* [2] Fenton L. and Bandfield L. (2003) *JGR, 108,* (E12). [3] Hayward, R. K. et al. (2007) *JGR 112*, (E11) [4] Silvestro S. et al. (2008) *LPS XXXIX*, Abstract #1893. [5] Silvestro S. et al., (2008) *pldu.work.*, Abstract *#7019*. [6] Gardin E. et al., (2008) *pldu.work.*, Abstract *#7022*. [7] Kahre et al. (2006) *JGR 111*(E6). [8] Rafkin et al. (2001) *Icarus, 111*, 228-256. [9] Haberle R. M. (2002) *Icarus, 161*, 66-89 . [10] Kocurek G. and Lancaster N. (1999) *Sedimentology 46*, 505-515.

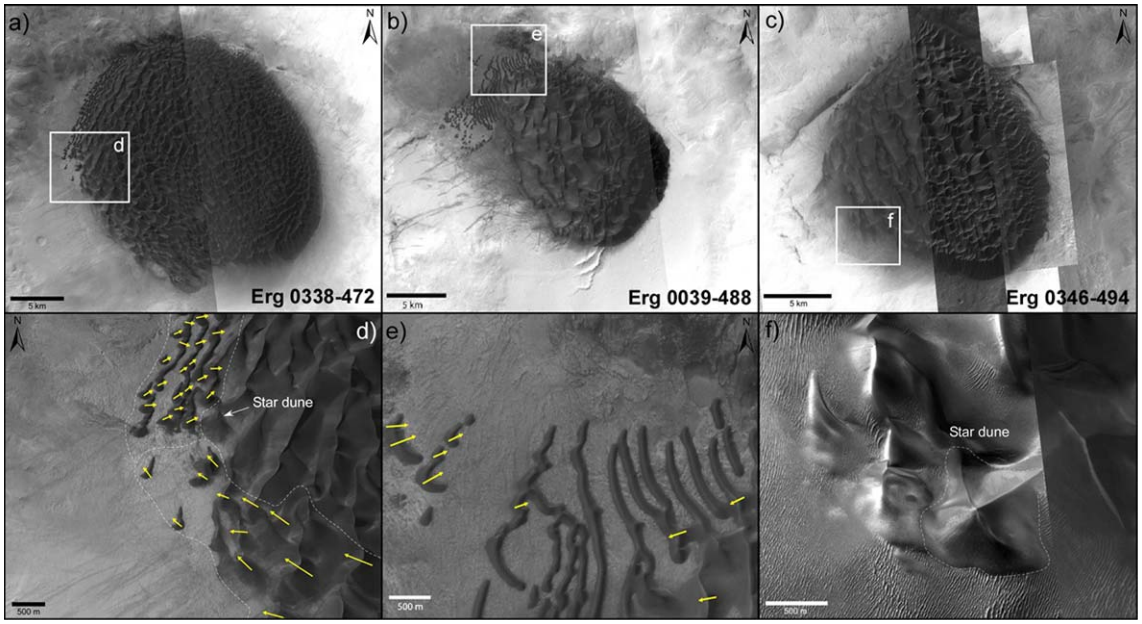

Fig. 1. Studied dune fields, where the white boxes represent the locations of panels d, e and f **a)** Erg 0338-472 **b)** Erg 0039-488 **c)** Erg 0346-494 **d)** Barchan dunes in the erg 0338-472, yellow arrows represent the deduced wind directions from the SW and from the SE. **e)** Barchan dunes formed by different winds from the SW and the NE in the erg 0039-488 **f)** Star dune on the SW edge of the erg 0346-494. CTX P13_006147_1312, P12_005580_1310, HiRISE PSP_006648_1300, PSP_007650_1300, MOC NA E0200526.

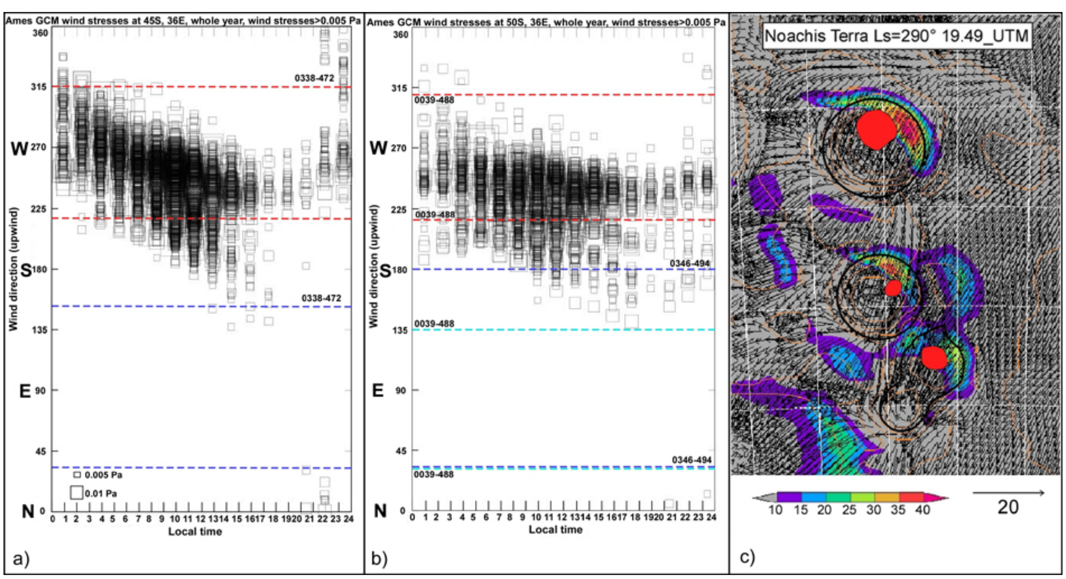

Fig. 2. Modeled winds **a)** GCM at 45°S, 36°E **b)** GCM at 50°S, 36°E. Direction and magnitude of the surface wind stress in degree clockwise from N (0° = wind from the N, 90° = winds from the east, etc). Dashed lines represent the slip face orientations in the three studied ergs **c)** Snapshot of the MRAMS model results at Ls=290°, 19.49 UTM. Strong winds from the NE blow above the threshold over the NE edge of the studied ergs (red polygons)