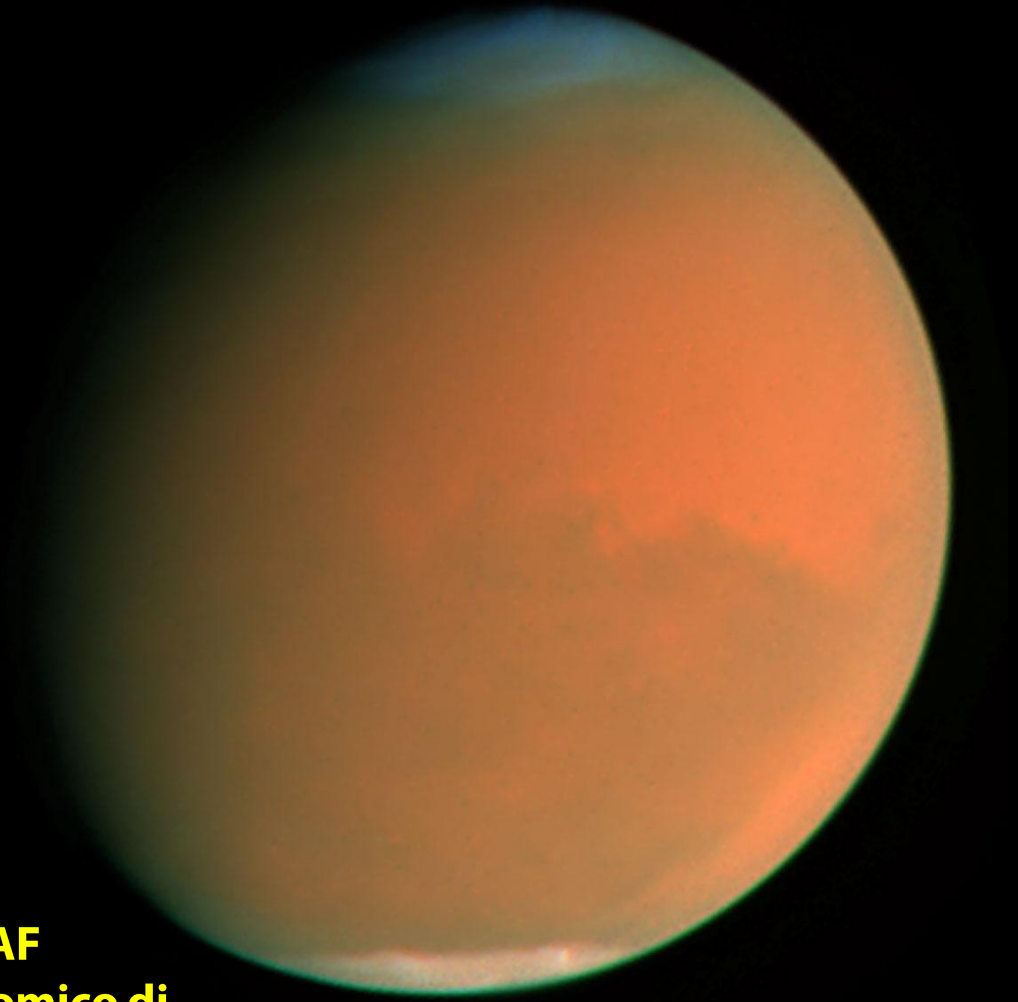
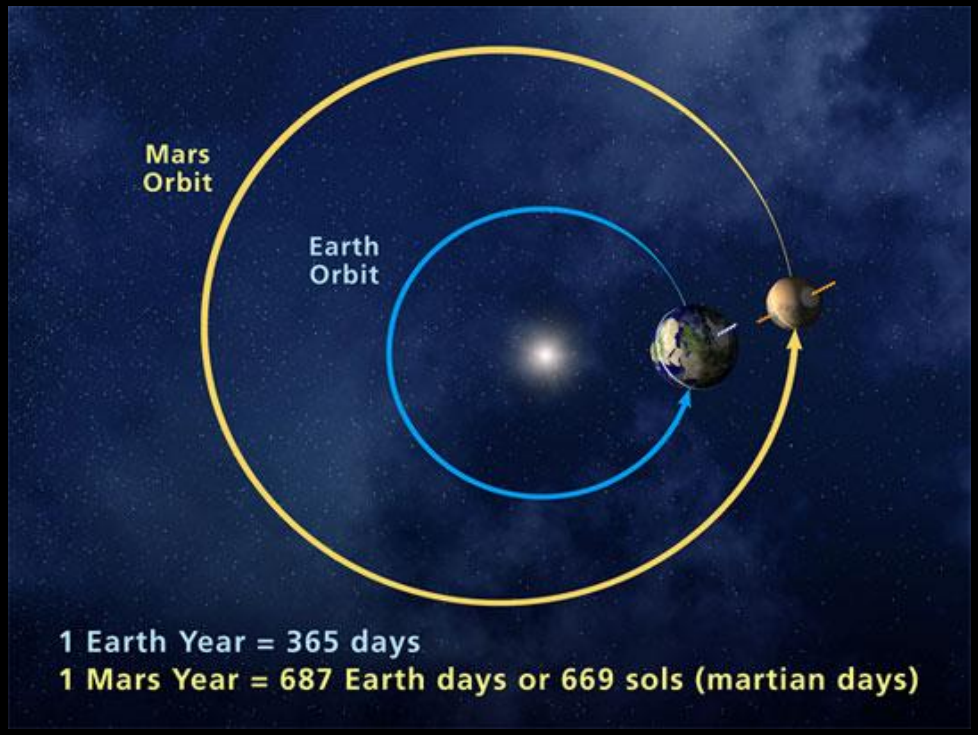
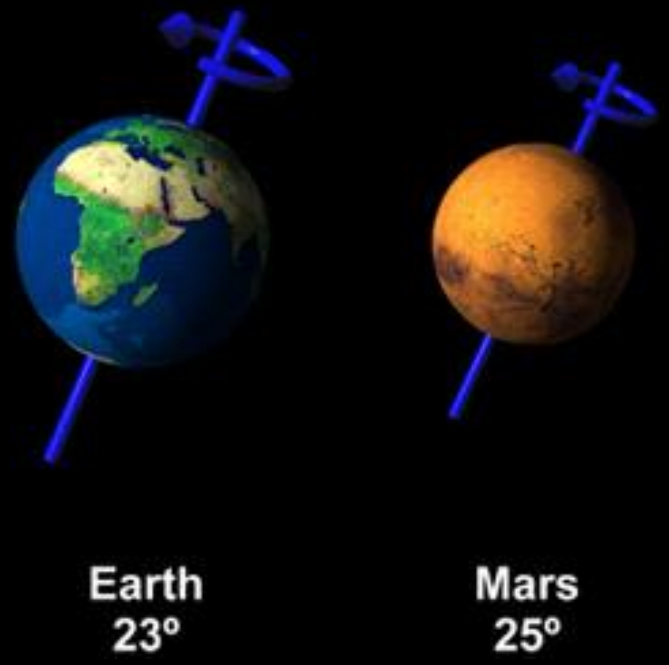
Processi eolici Marziani



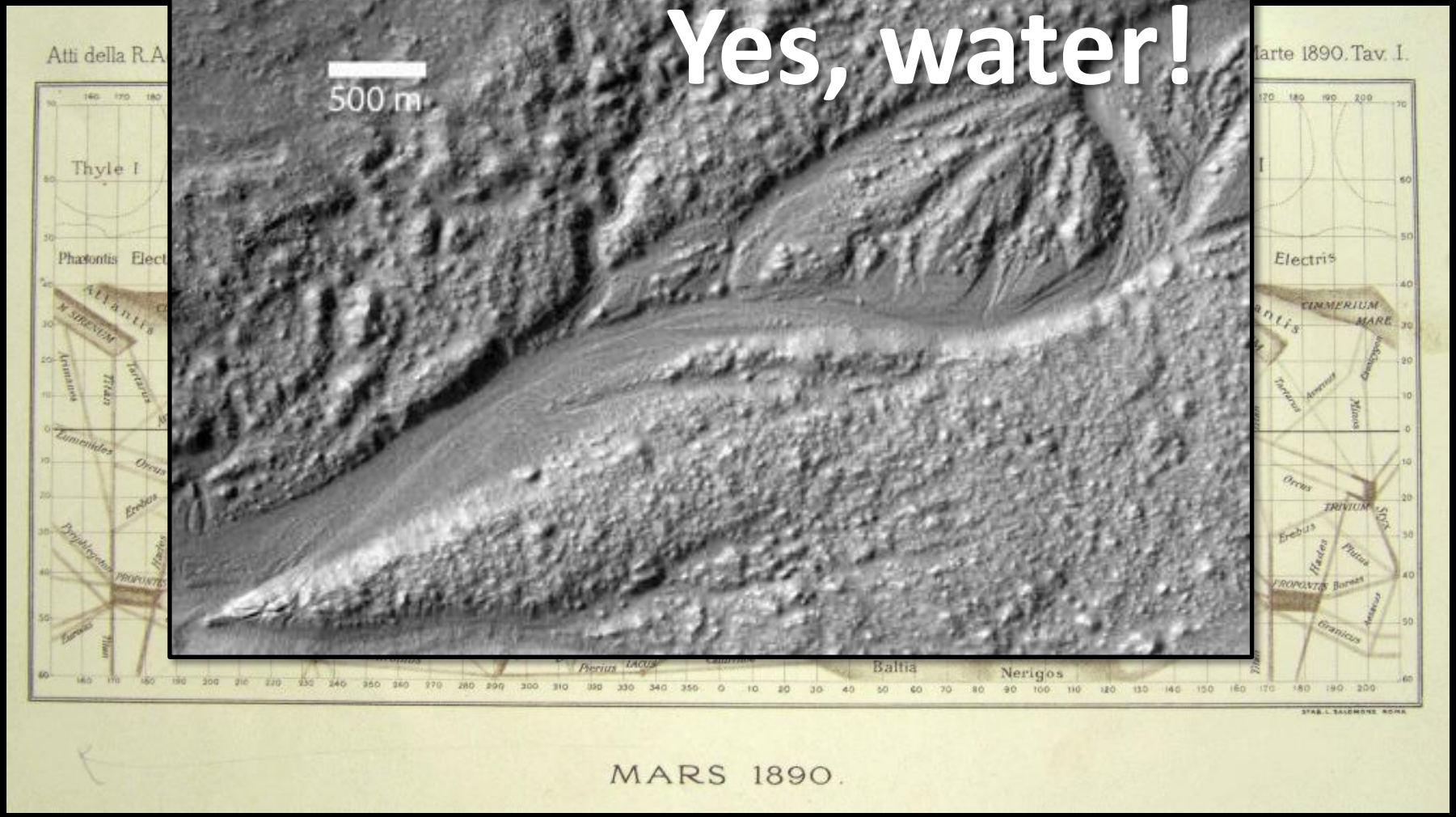
Simone Silvestro, INAF
Osservatorio Astronomico di Capodimonte



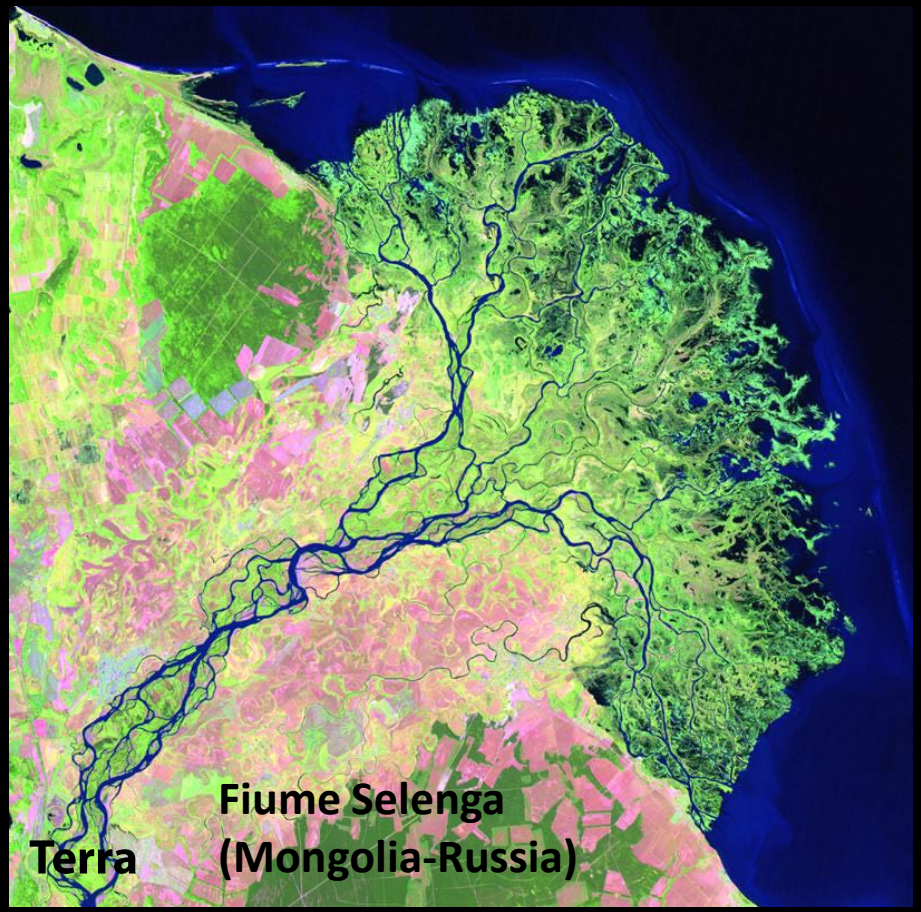
Giorno terrestre = 23 ore 56 minuti
Giorno marziano (sol) = 24 ore 39 minuti

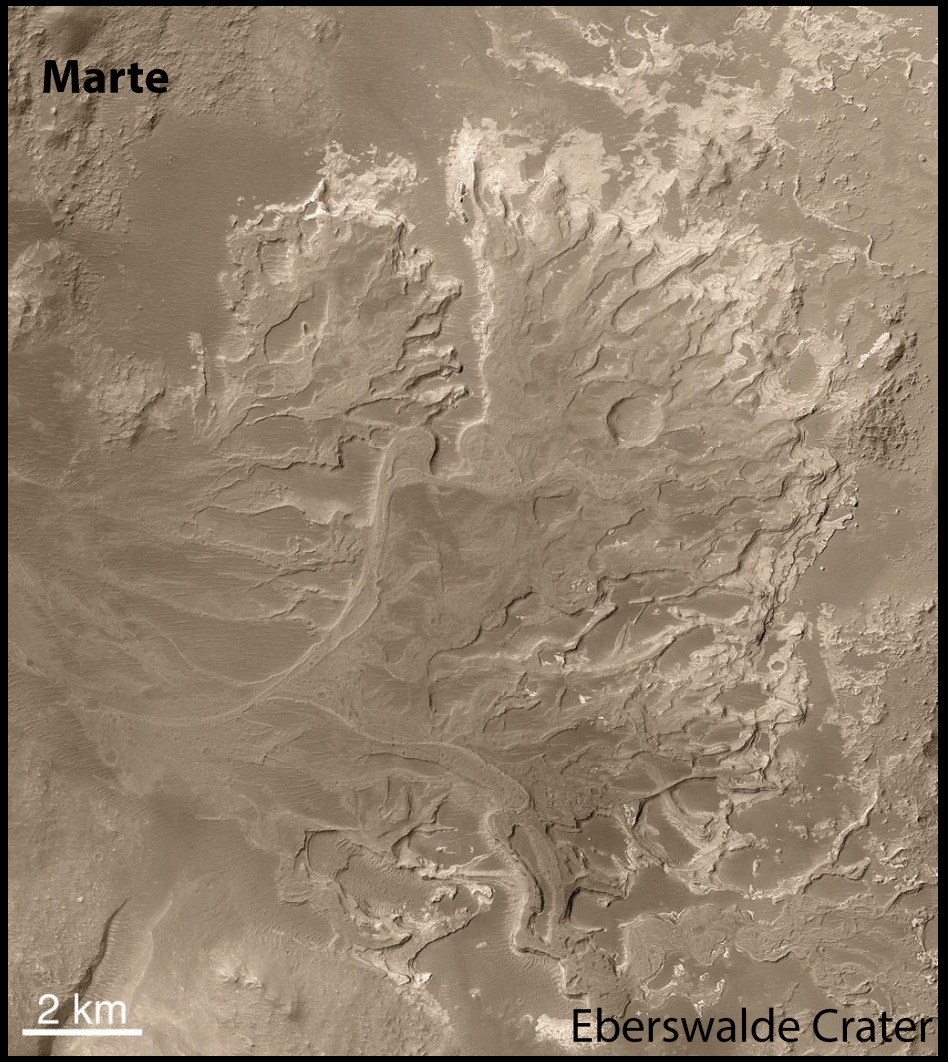


Schiaparelli, canali marziani



Acqua: canali, meandri e delta fluviali

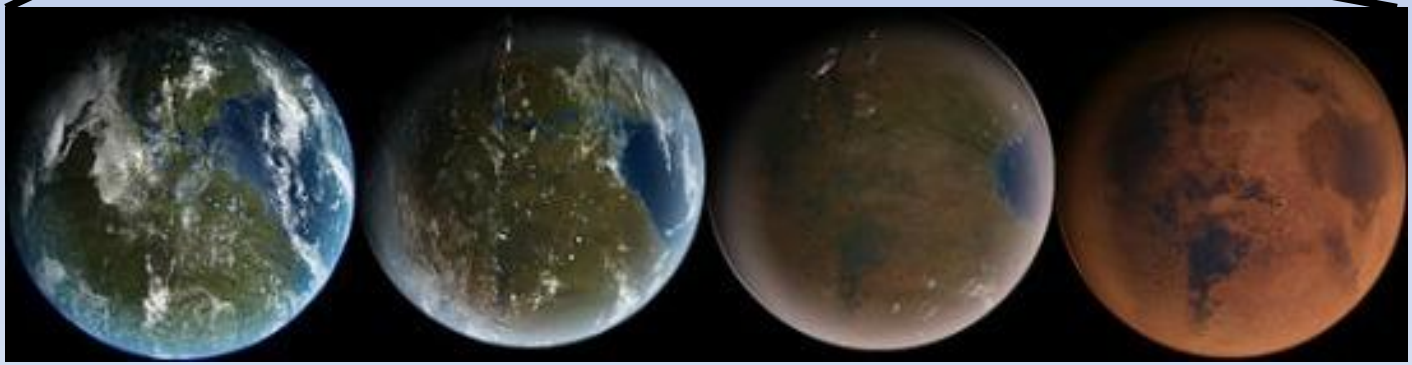




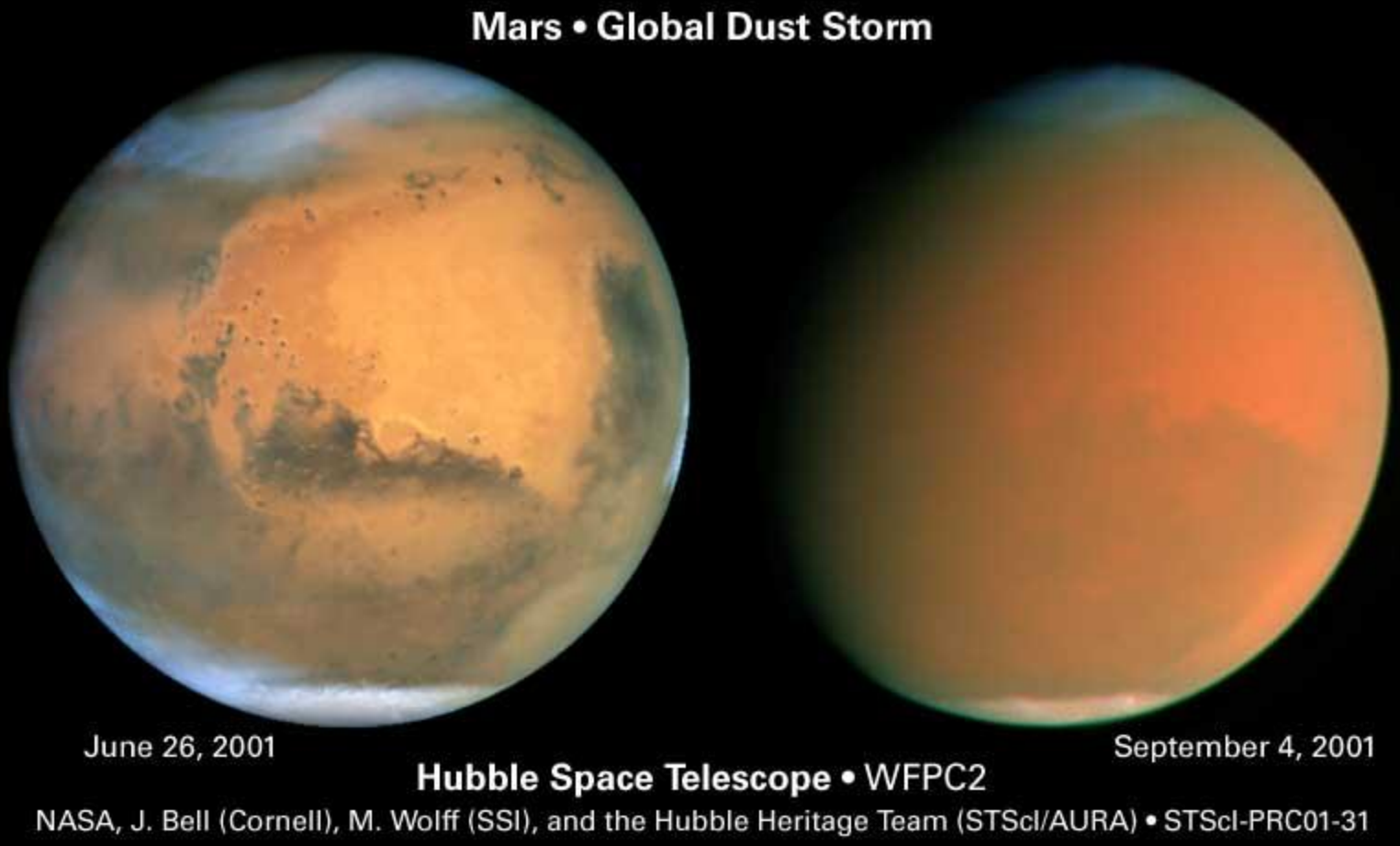
Millions of Years

4500 4000 3000 2000 1000 0

Noachian Hesperian Amazonian



Marte è un pianeta dominato dai processi eolici…



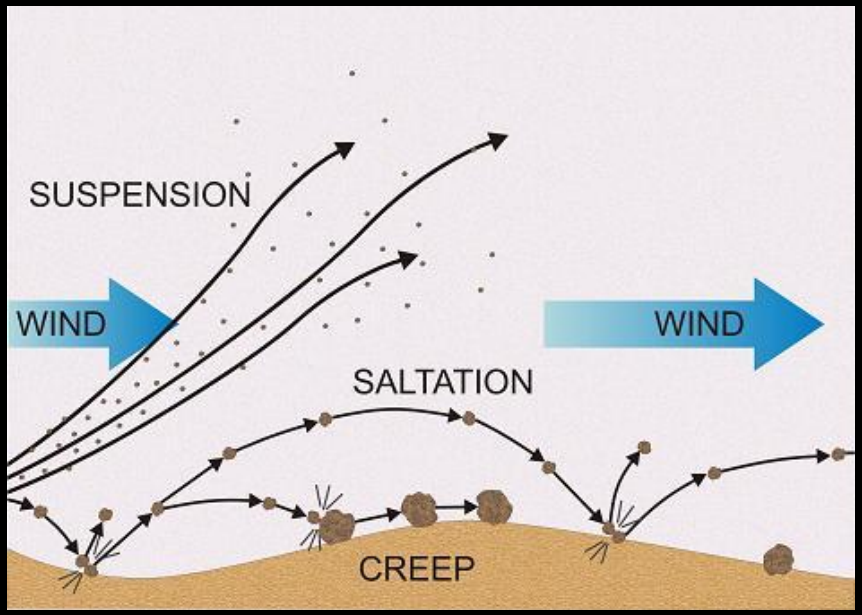
L' atmosfera marziana

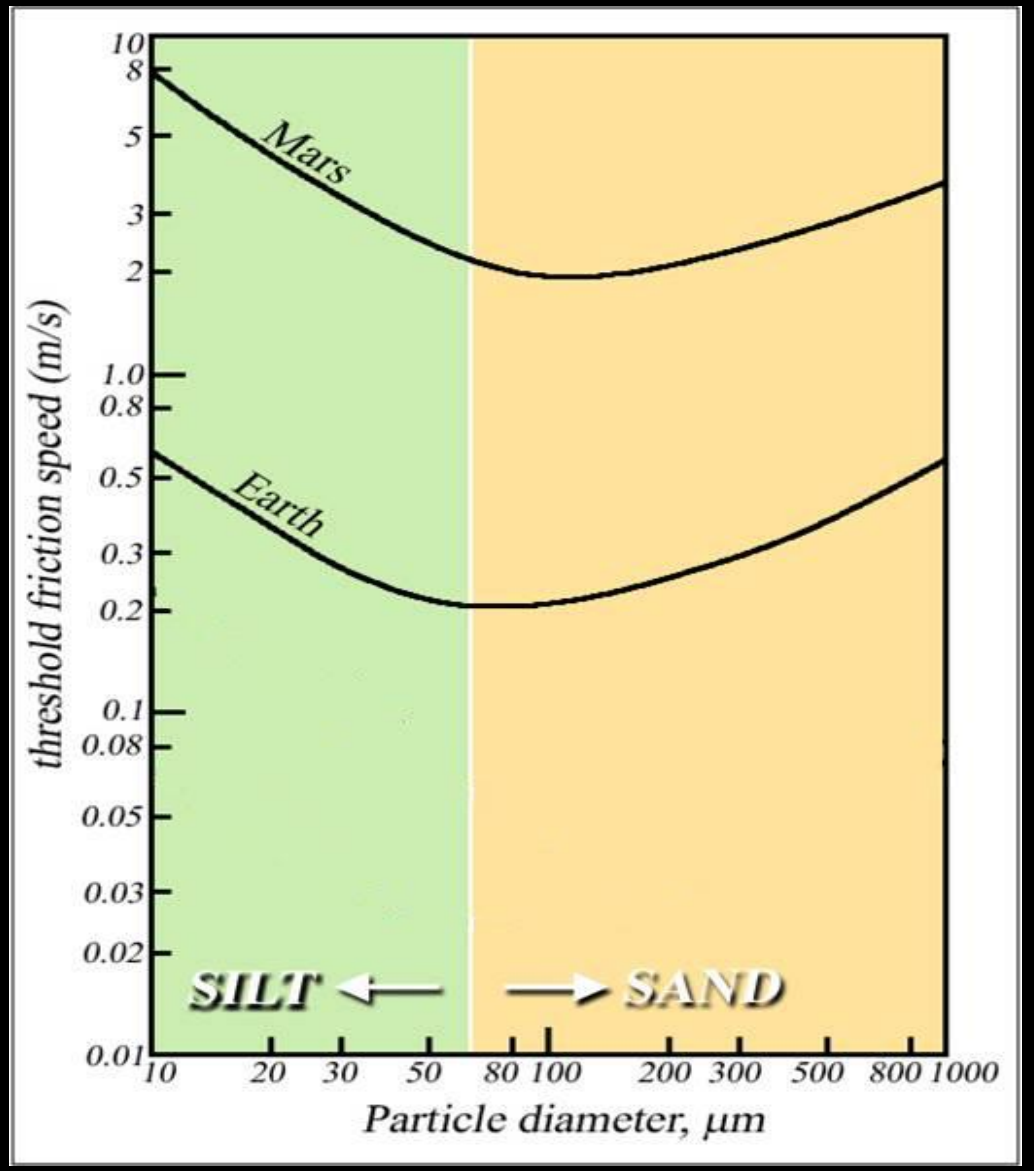
Gravity (m/s^2) = 3.71 (Earth = 9.81)

Average pressure (mbar) = 6.1 (1013 on Earth)

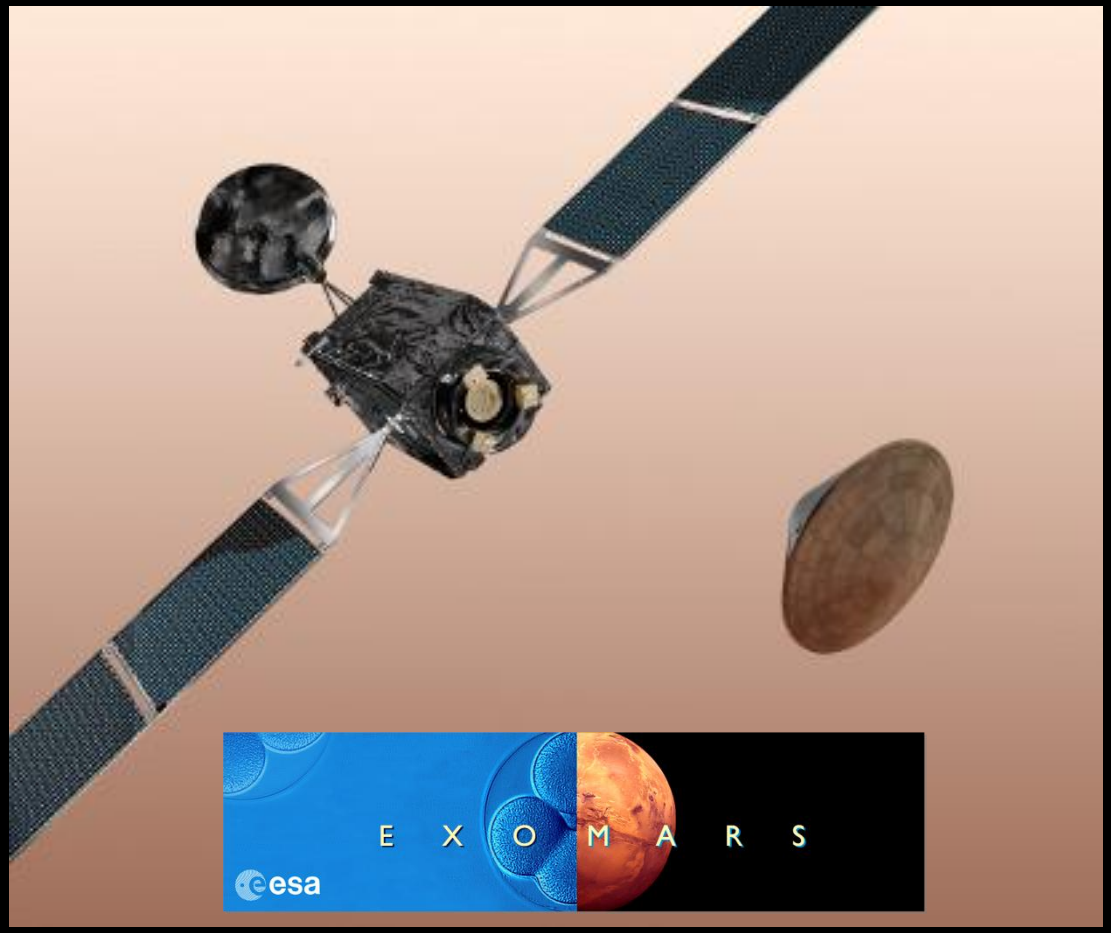
Average surface temperature (°K) = 210 (288 on Earth)

Composition = 95% CO_2, 2.7% N_2, 1.6% Ar
(Earth 78% N_2, 21% O_2, 0.93% Ar)


SUSPENSION
WIND
WIND
SALTATION
CREEP


threshold friction speed (m/s)
10
8
5
3
2
1.0
0.8
0.5
0.3
0.2
0.1
0.08
0.05
0.03
0.02
0.01
Mars
Earth
SILT
SAND
10
20
30
50
80
100
200
300
500
800
1000
Particle diameter, μm

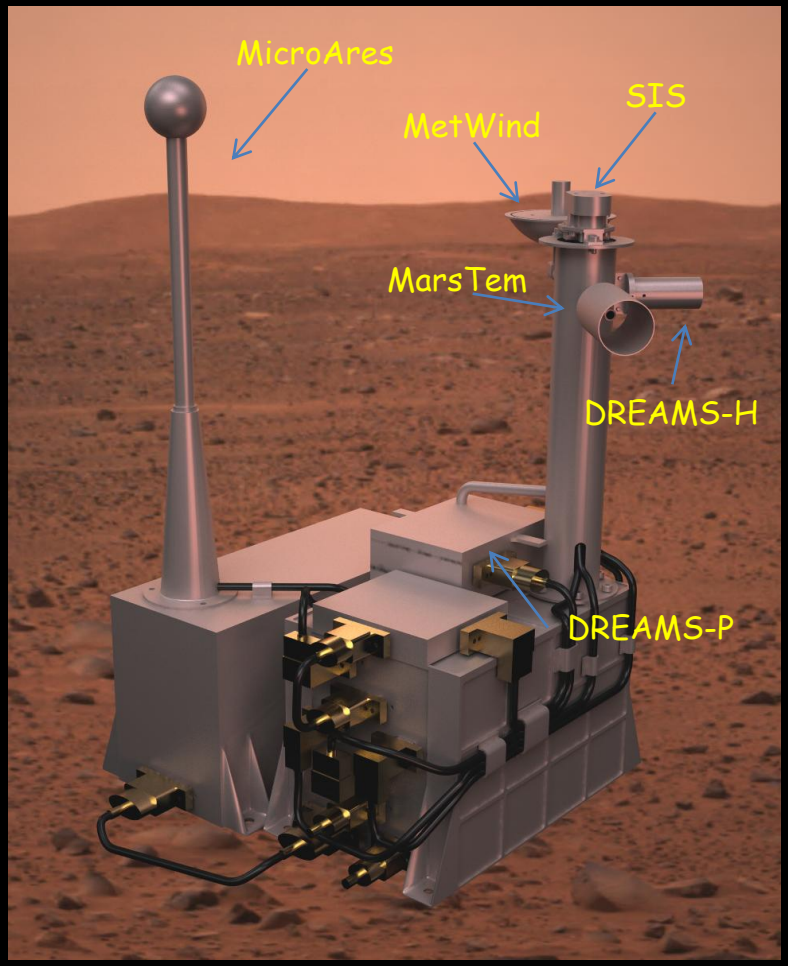
ESA ExoMars 2016



- *Studiare l'ambiente marziano durante il periodo statistico di tempeste di polvere.*

Strumentazione a bordo dell'EDM

DREAMS



DREAMS è una piccola stazione meteorologica con la capacità aggiuntiva di misurare il campo elettrico su Marte

Obiettivi di DREAMS:

- Caratterizzazione dell'atmosfera marziana in prossimità della superficie;
- Monitoraggio dei possibili pericoli per gli astronauti e la strumentazione: polvere, scariche elettriche, rumore elettromagnetico, radiazione UV.
- La prima misura in assoluto dei fenomeni elettrici dell'atmosfera marziana.
- Misure meteorologiche durante la stagione statistica delle tempeste di polvere.

Simulazione delle misure di DREAMS

Campagna di misure nel deserto marocchino

Campagna finalizzata allo studio dei parametri meteorologici durante le tempeste di polvere.

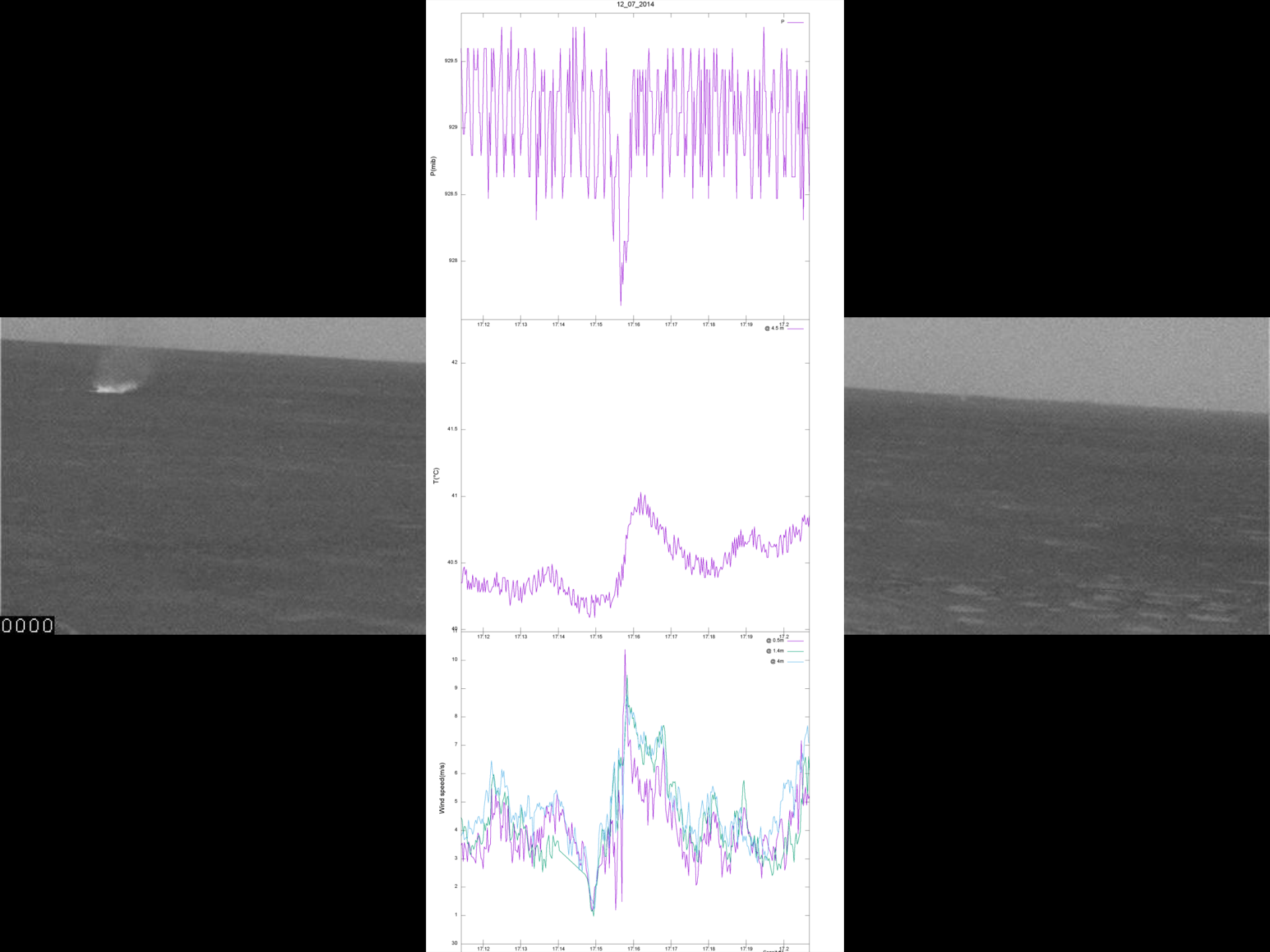
Simulazione delle misure di DREAMS

Campagna di misure nel deserto del Sahara

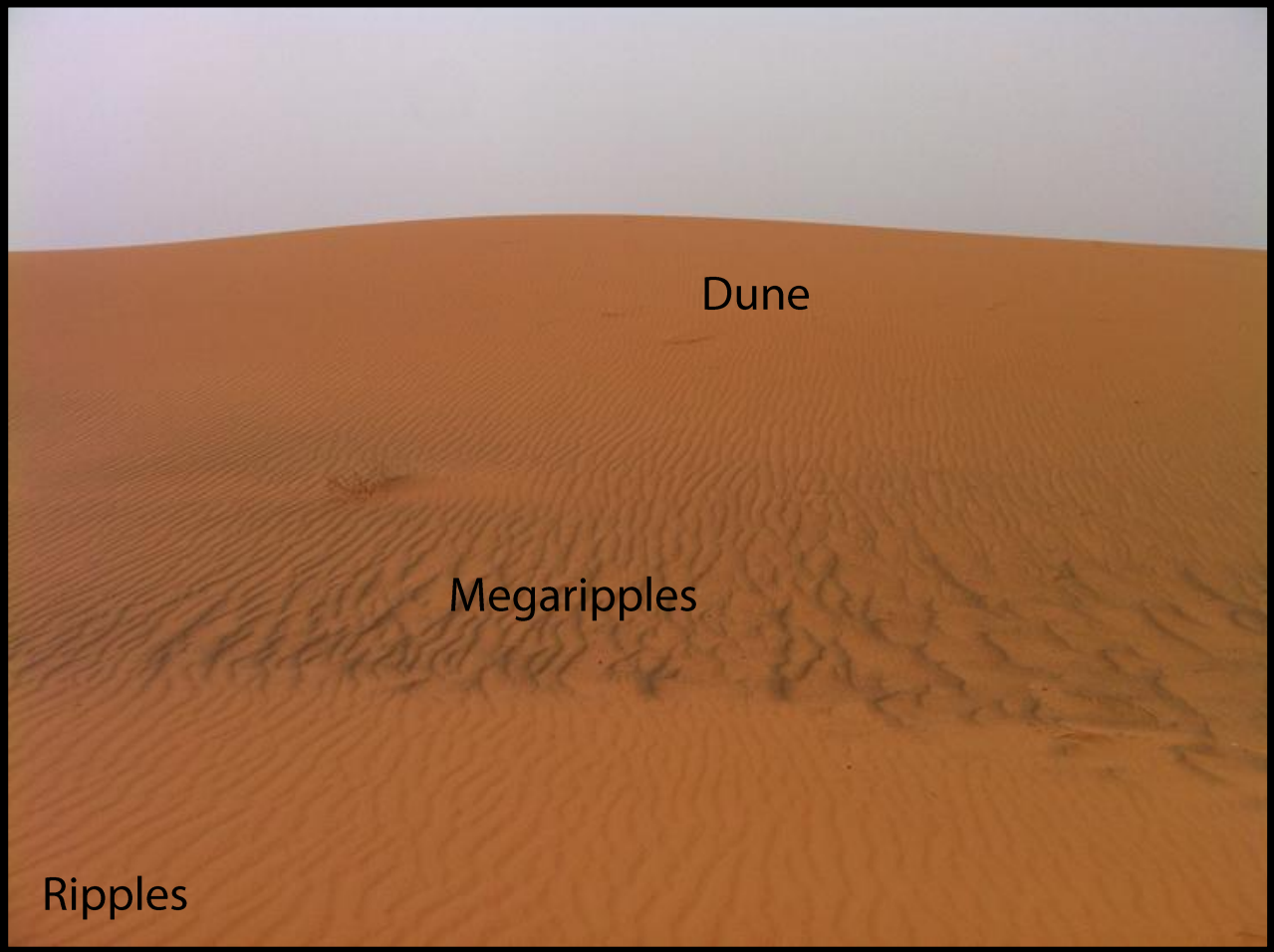
Campagna finalizzata allo studio dei parametri meteorologici durante le tempeste di polvere.

Deserto marocchino scelto per la sua grande similitudine alla superficie di Marte.

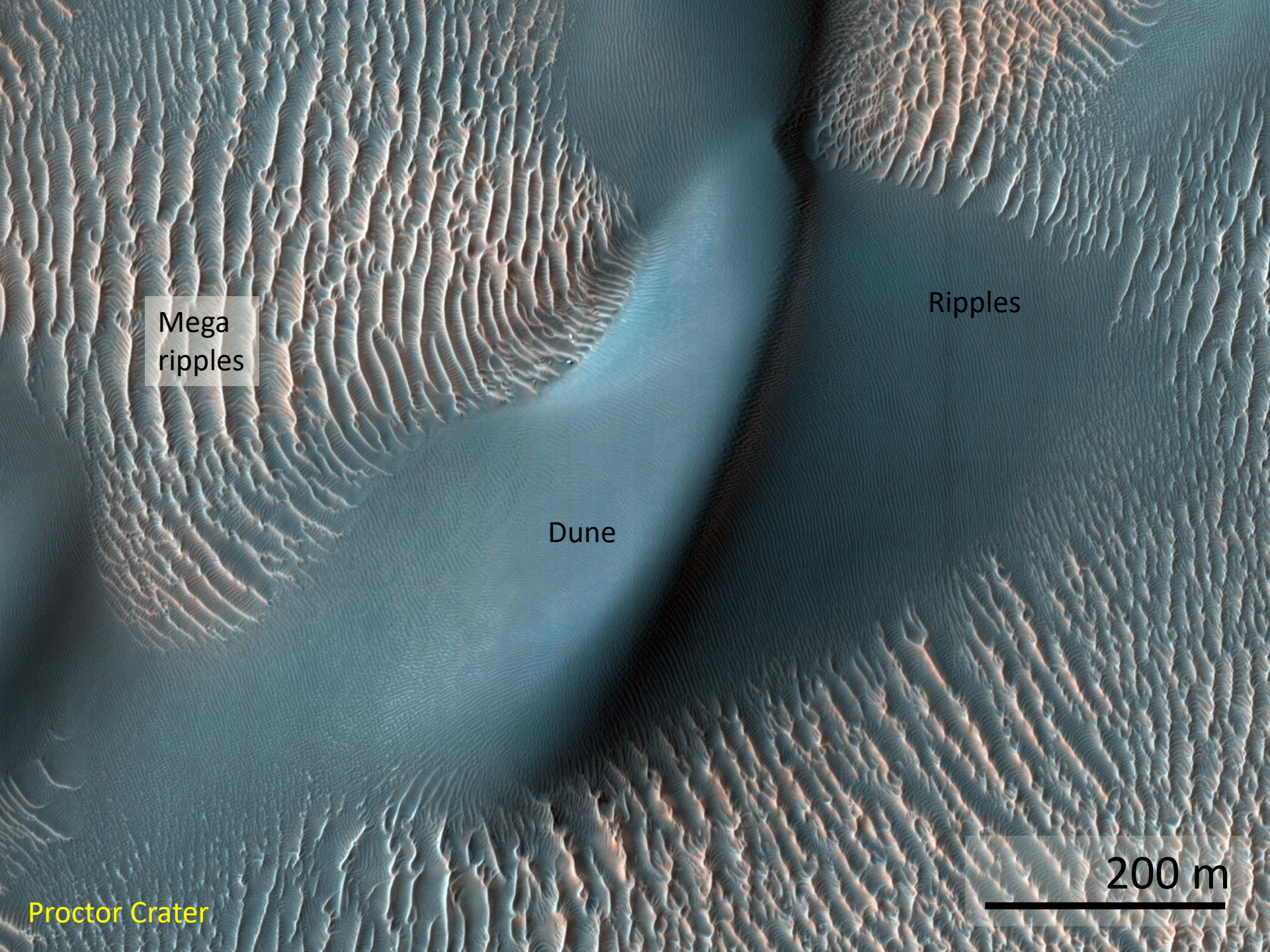
Tempeste di sabbia
nel deserto del Sahara


12_07_2014
P
P(mib)
929.5
929
928.5
928
17:12
17:13
17:14
17:15
17:16
17:17
17:18
17:19
17:2
@ 4.5 m
T(°C)
42
41.5
41
40.5
40
@ 0.5m
@ 1.4m
@ 4m
Wind speed(m/s)
10
9
8
7
6
5
4
3
2
1
30
0000

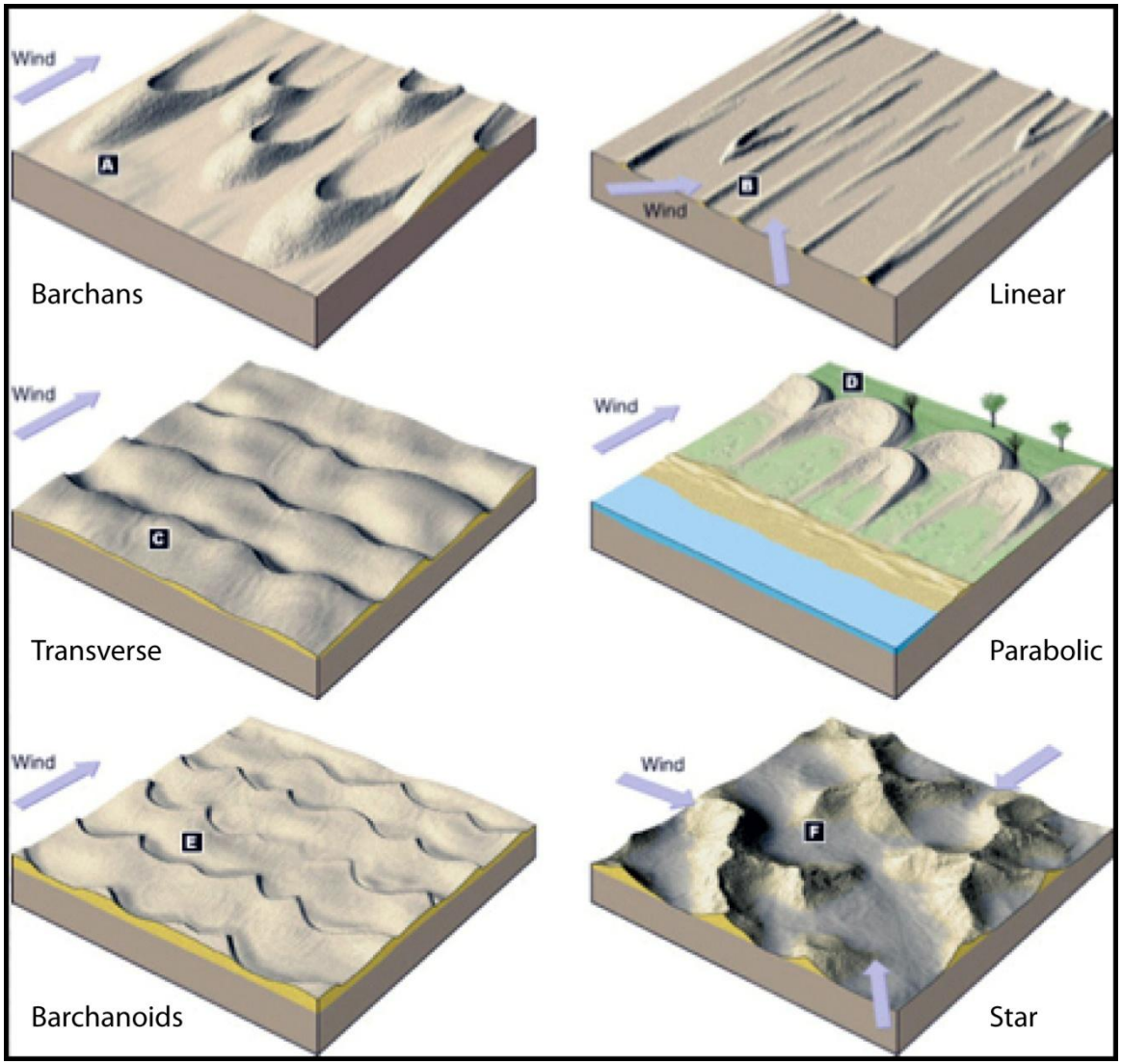
Morfologie eoliche



Erg Chebbi, Merzouga (Marocco)


Mega ripples
Ripples
Dune
200 m
Proctor Crater

Dune: indicatori del regime ventoso nel lungo periodo



- 1 slip face: barcane, trasversali, barcanoidi, paraboliche
- 2 o più slip face: lineari & stellate

NEWS | NOVEMBER 16, 2015

NASA's Curiosity Mars Rover Heads Toward Active Dunes

This Sept. 25, 2015, view from the Mast Camera on NASA's Curiosity Mars rover shows a dark sand dune in the middle distance. Credit: NASA/JPL-Caltech/MSSS
› Full image and caption

On its way to higher layers of the mountain where it is investigating how Mars' environment changed billions of years ago, NASA's Curiosity Mars rover will take advantage of a chance to study some modern Martian activity at mobile sand dunes.

In the next few days, the rover will get its first close-up look at these dark dunes, called the "Bagnold Dunes," which skirt the northwestern flank of Mount Sharp. No Mars rover has previously visited a sand dune, as opposed to smaller sand ripples or drifts. One dune Curiosity will investigate is as tall as a two-story building and as broad as a football field. The Bagnold Dunes are active: Images from orbit indicate some of them are migrating as much as about 3 feet (1 meter) per Earth year. No active dunes have been visited anywhere in the solar system

Popular

2015 and 1997 El Niños: Déjà vu, or Something New?

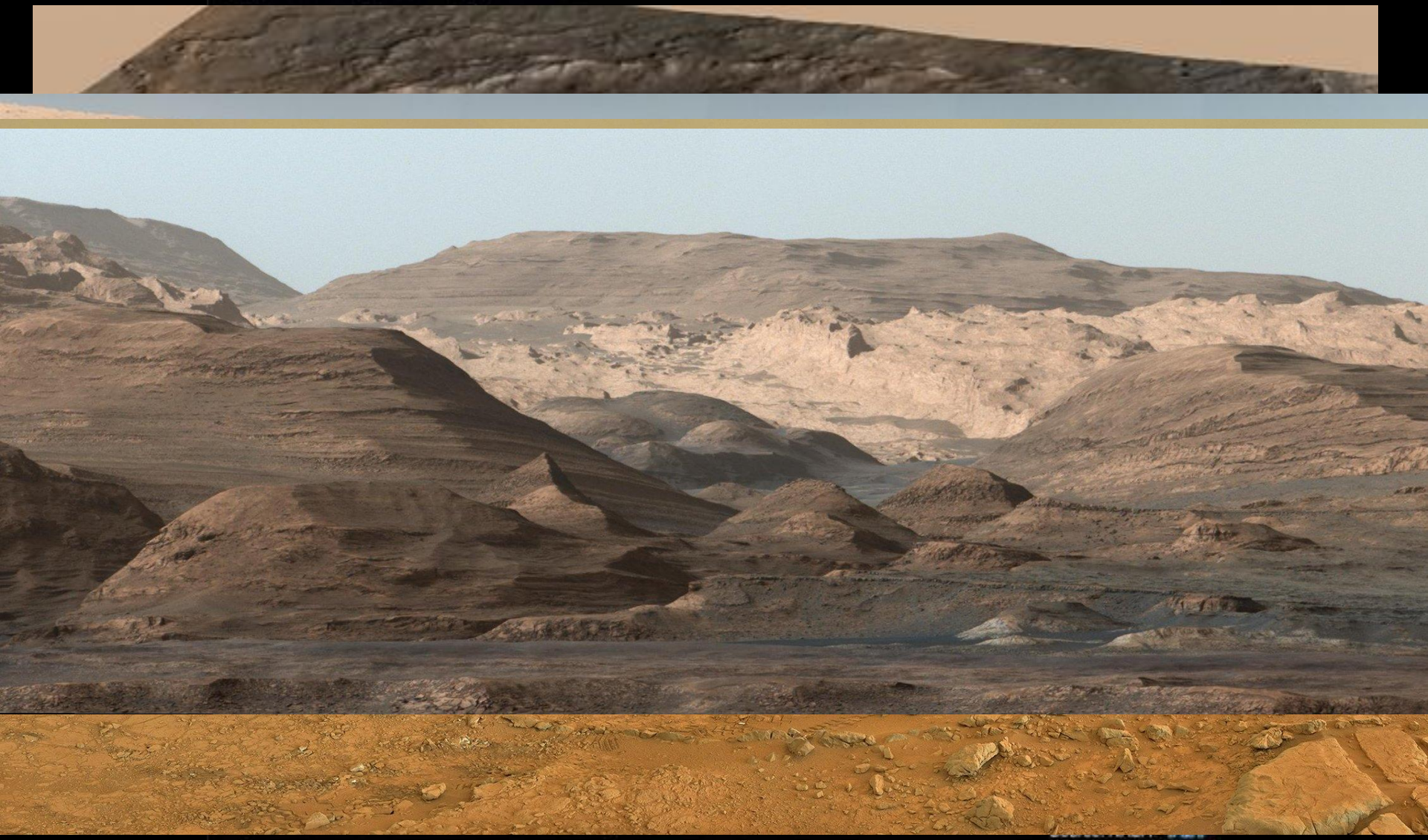
Satellite Sensors Would Deliver Global Fire Coverage

'Hedgehog' Robots Hop, Tumble in Microgravity

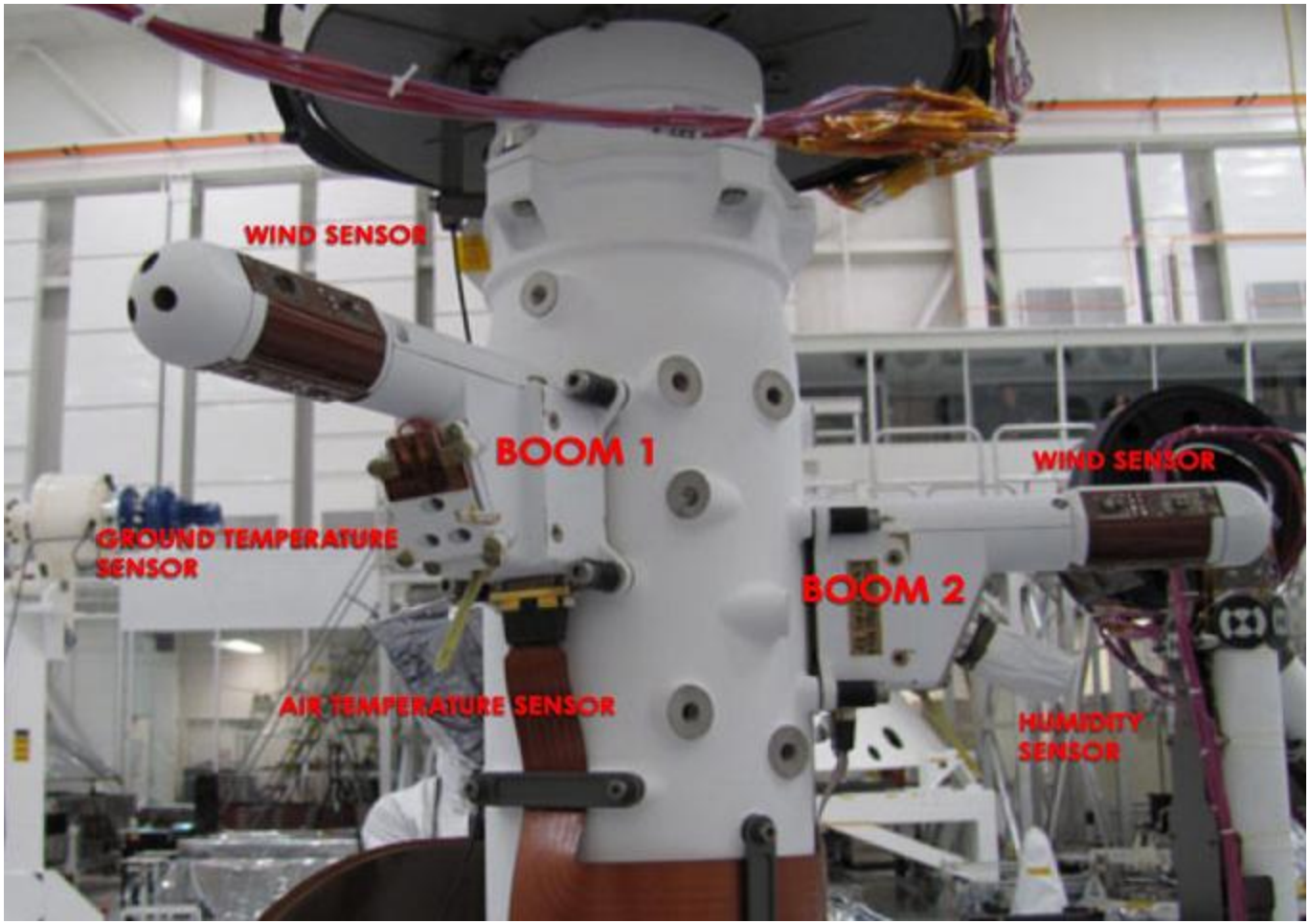
In Greenland, Another Major Glacier Comes Undone

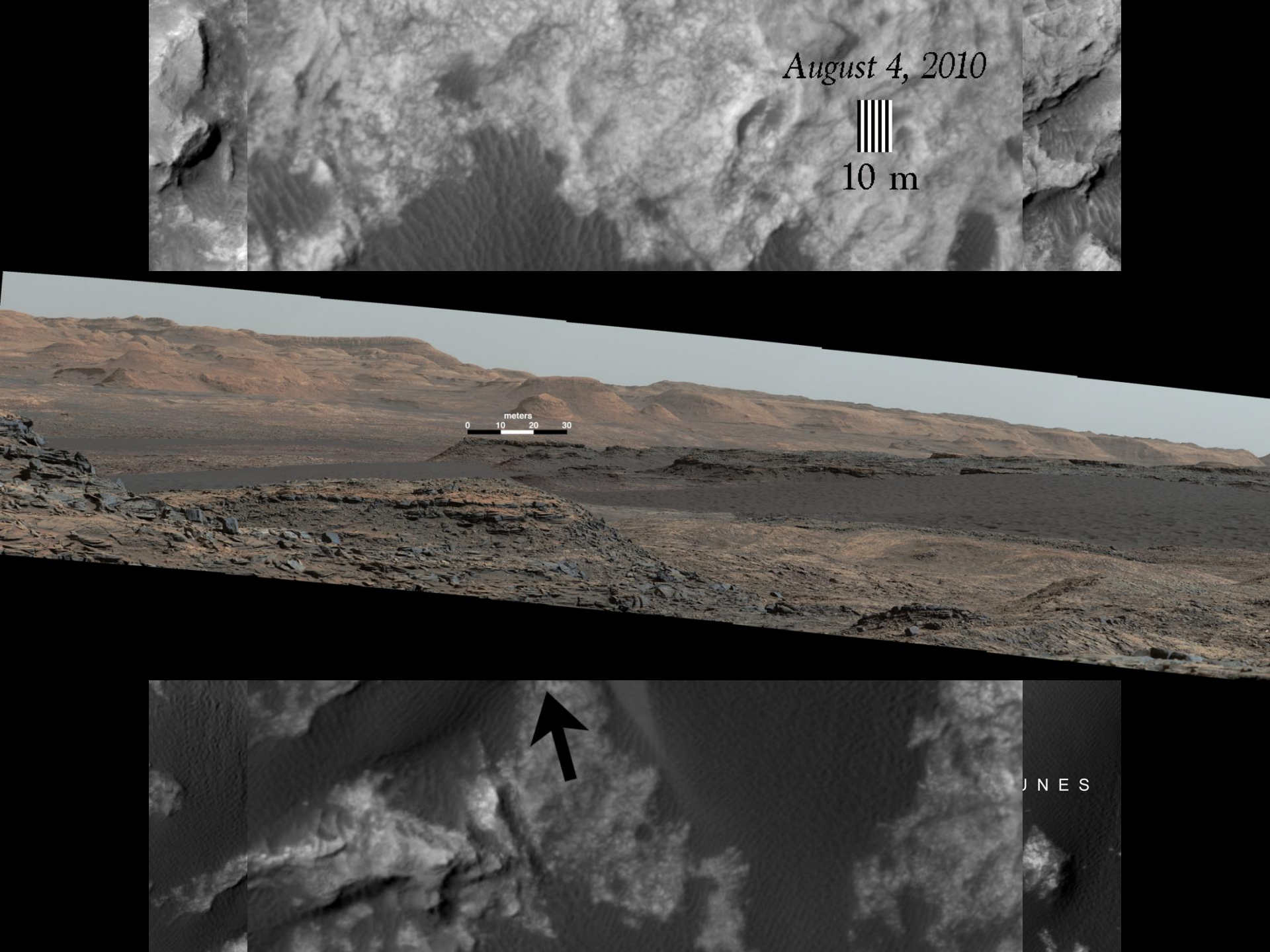
'Chemical Laptop' Could Search for Signs of Life Outside Earth

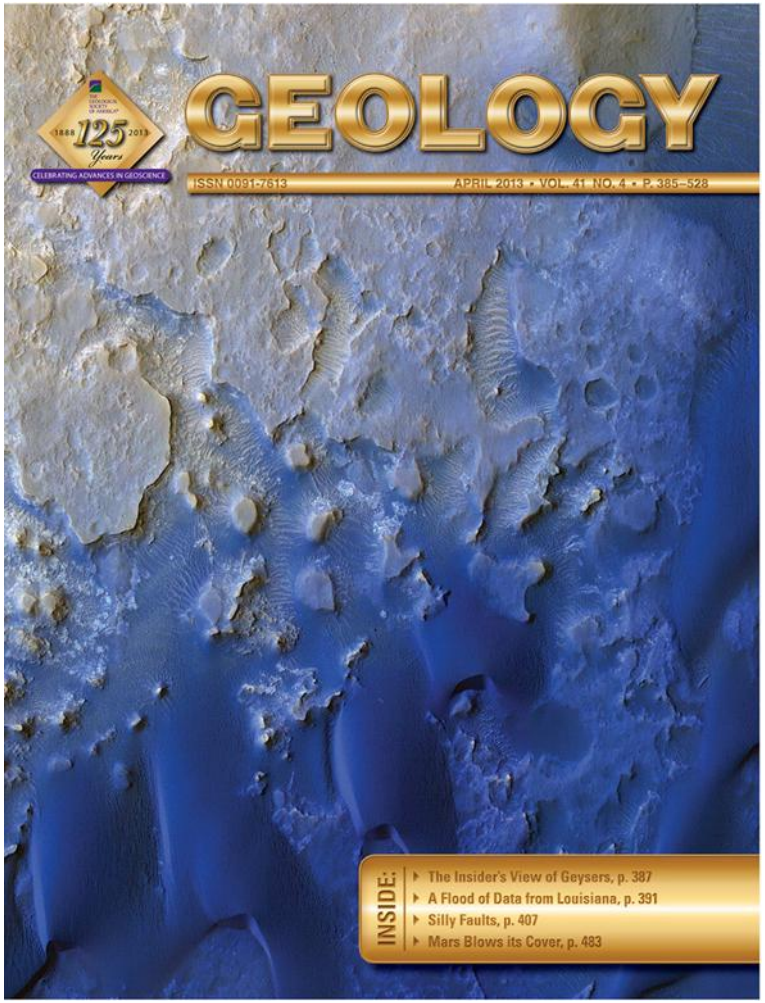
NASA Mars Rover Curiosity Sees 'Evening Star' Earth



Rover Environmental Monitoring Station (REMS)




August 4, 2010
10 m
meters
0 10 20 30
UNES



Geology, published online on 7 February 2013 as doi:10.1130/G34162.1

Pervasive aeolian activity along rover Curiosity's traverse in Gale Crater, Mars

Simone Silvestro[1]*, D.A. Vaz[2,3], R.C. Ewing[4], A.P. Rossi[5], L.K. Fenton[1], T.I. Michaels[1], J. Flahaut[6], and P.E. Geissler[7]
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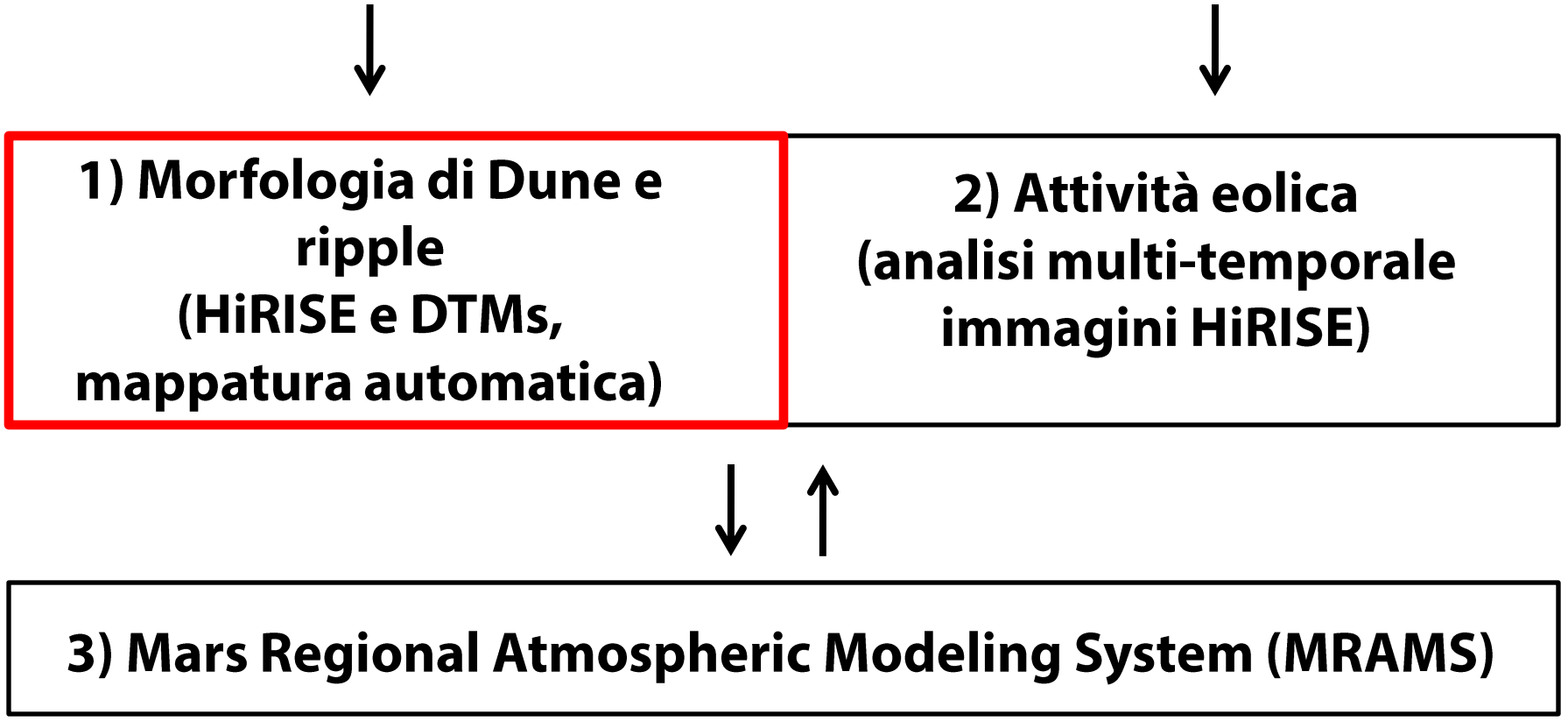
[2]Centre for Geophysics of the University of Coimbra, Observatório Astronómico da Universidade de Coimbra, Almas de Freire, 3040-004 Coimbra, Portugal
[3]CERENA, Instituto Superior Técnico, Avenida Rovisco Pais, 1049-001 Lisbon, Portugal
[4]University of Alabama, Department of Geological Sciences, Tuscaloosa, Alabama 35487, USA
[5]Jacobs University, Campus Ring 1, 28759 Bremen, Germany
[6]Institut d'Astrophysique Spatiale (IAS), CNRS / Université Paris XI, 91405 Orsay, France
[7]U.S. Geological Survey, 2255 North Gemini Drive, Flagstaff, Arizona 86001, USA

ABSTRACT

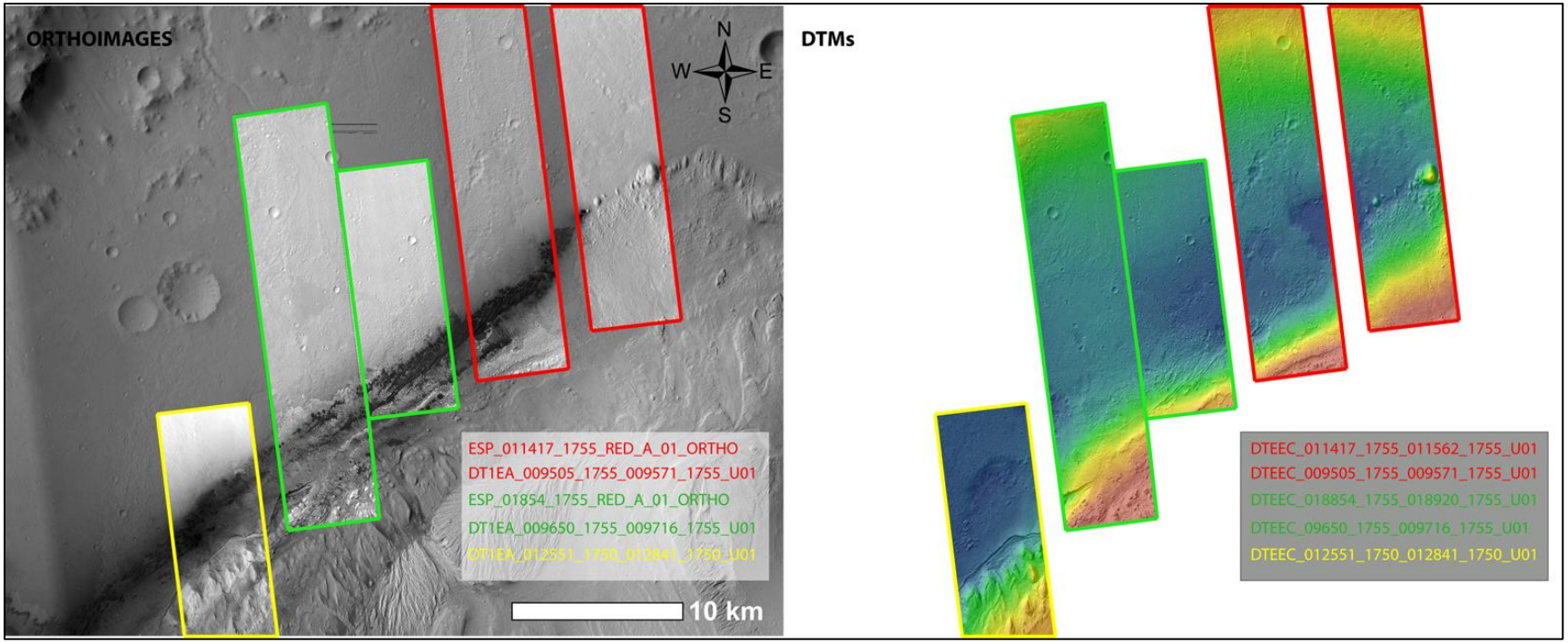
The NASA Mars Science Laboratory (MSL) rover, Curiosity, has safely landed near a 35-km-long dark dune field in Gale Crater on Mars. This dune field crosses the landing site from the northeast to the southwest and lies along Curiosity's traverse to Aeolis Mons. Here we present the first evidence of recent aeolian activity in the form of ripple and dune migration, and further estimate wind directions within the dune field through analysis of ripple and dune morphologies and the Mars Regional Atmospheric Modeling System (MRAMS). We measured a minimum ripple migration rate of 0.66 m per Earth year, and dune migration rate of 0.4 m per Earth year, in the southwest portion of the field. A strongly bidirectional ripple crestline orientation, nearly orthogonal dune slipfaces, and linear seif or oblique dunes indicate a bidirectional wind regime with winds mainly coming from the ENE and from the northwest; however, MRAMS results indicate primary winds from the ENE. Our constraints on the wind regime provide the unique opportunity to use ground measurements from MSL to test the accuracy of winds predicted from orbital data.

wavelength. This implies that the measured migration distance represents a minimum (Silvestro et al., 2010). The T3 image is affected by noise, which prevented further correlation of the same ripples with the first two images. Dune migration was measured in the T1-T3 pair over eight dunes by averaging the vectors that link the dune slipface toes in the two overlapping images (Fig. DR6).

The Mars Regional Atmospheric Modeling System (MRAMS) (Rafkin et al., 2001; Michaels and Rafkin, 2008; see the Data Repository) was used to estimate the contemporary surface stresses and wind directions in the landing site

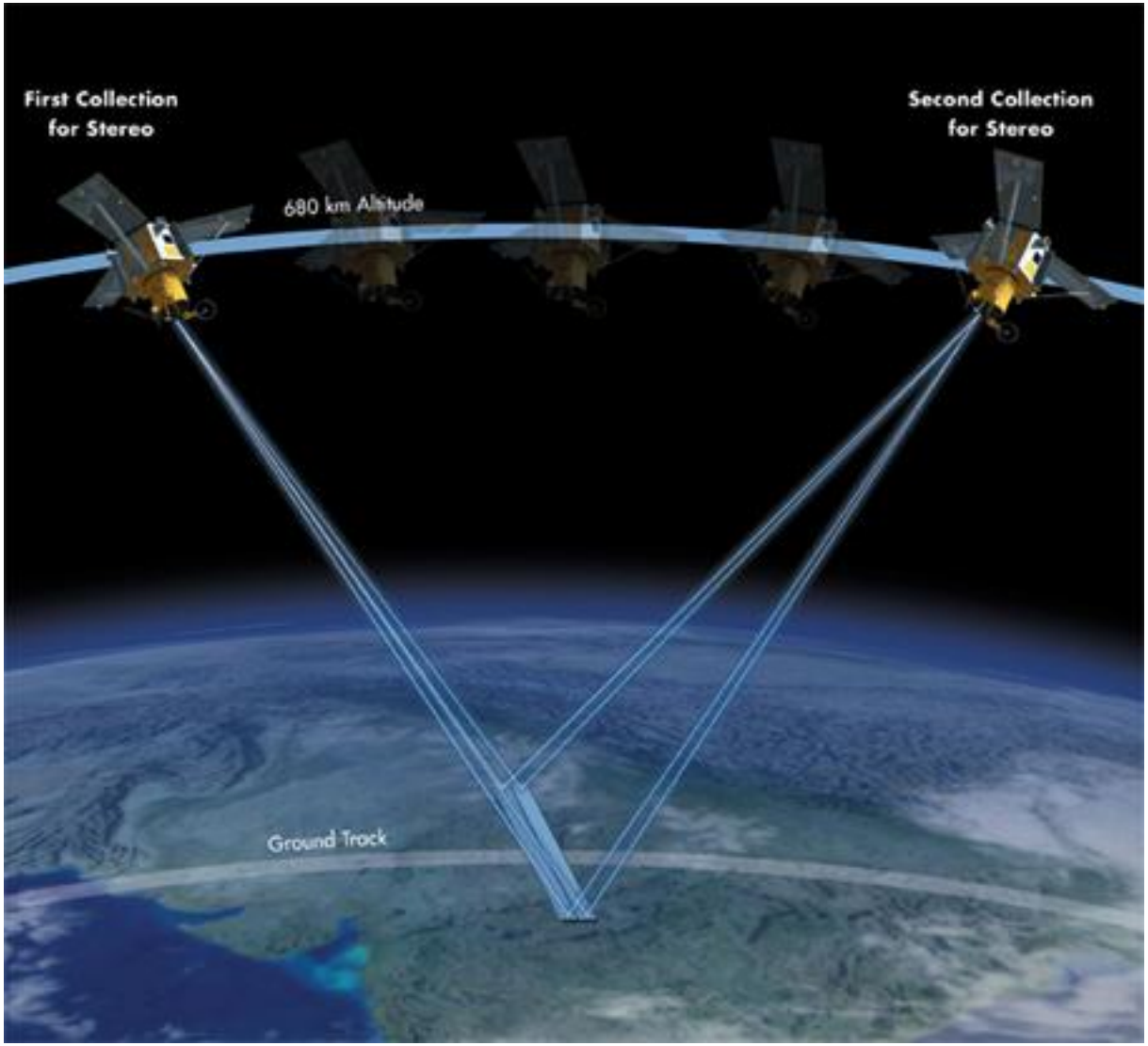

Regime di venti sito atterraggio Curiosity
1) Morfologia di Dune e ripple (HiRISE e DTMs, mappatura automatica)
2) Attività eolica (analisi multi-temporale immagini HiRISE)
3) Mars Regional Atmospheric Modeling System (MRAMS)

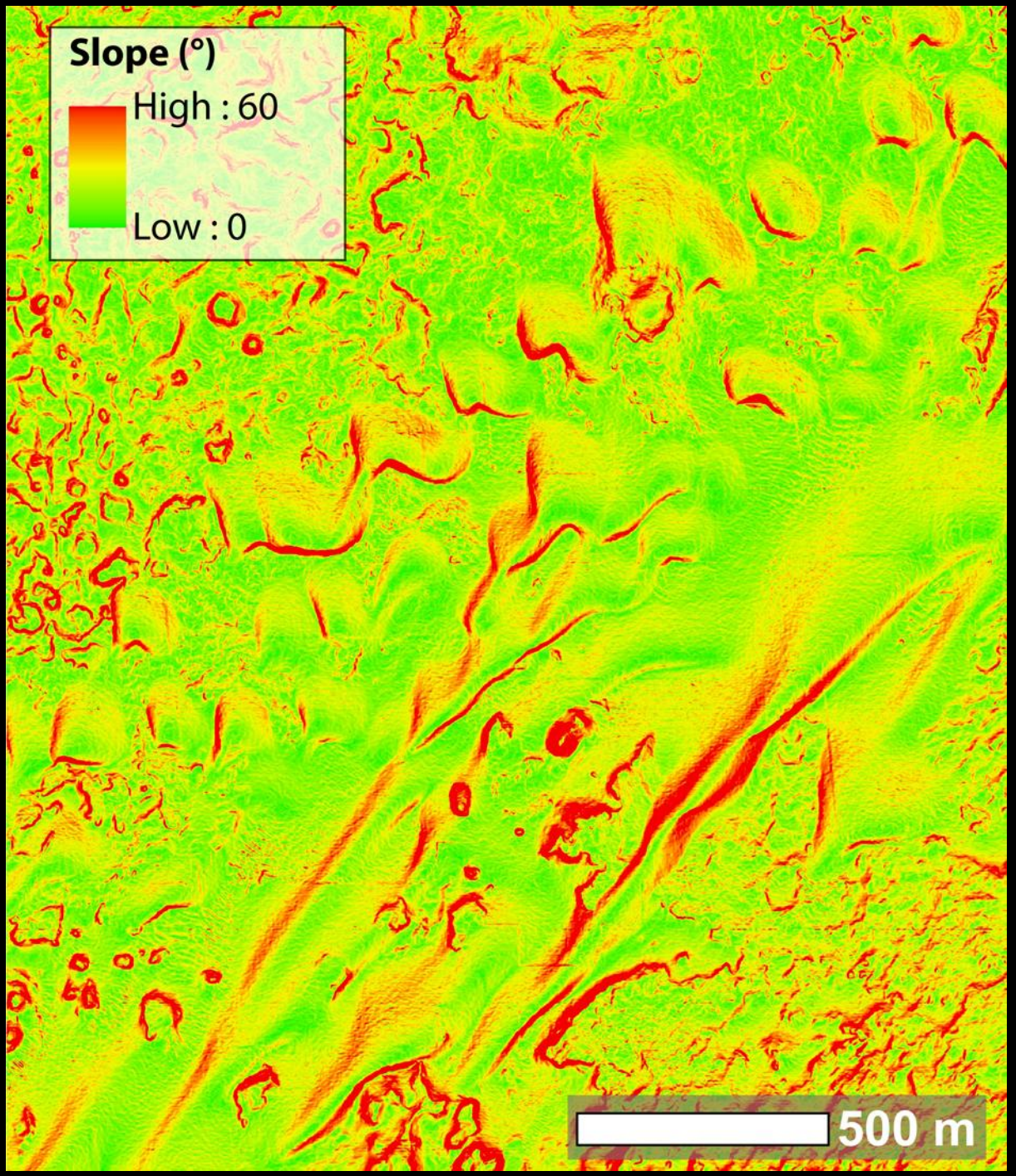
1) Morfologia delle dune, dati HiRISE – analisi delle slip face



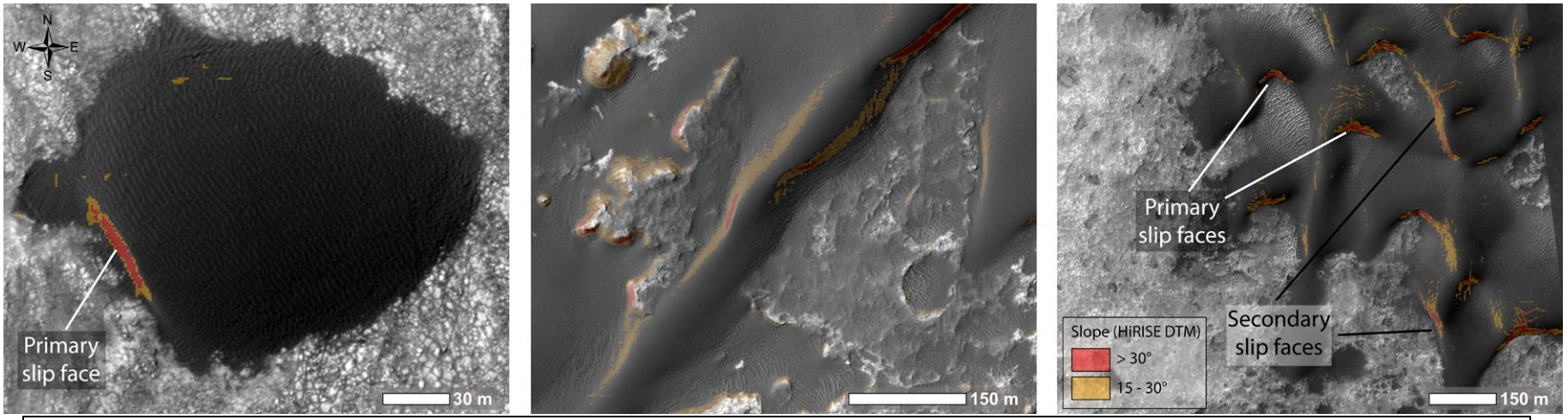
Cos'è un DTM (Digital Terrain Model)?

Rappresentazione 3D della superficie derivata da 2 immagini della stessa area acquisite da angoli diversi (stereo coppia)

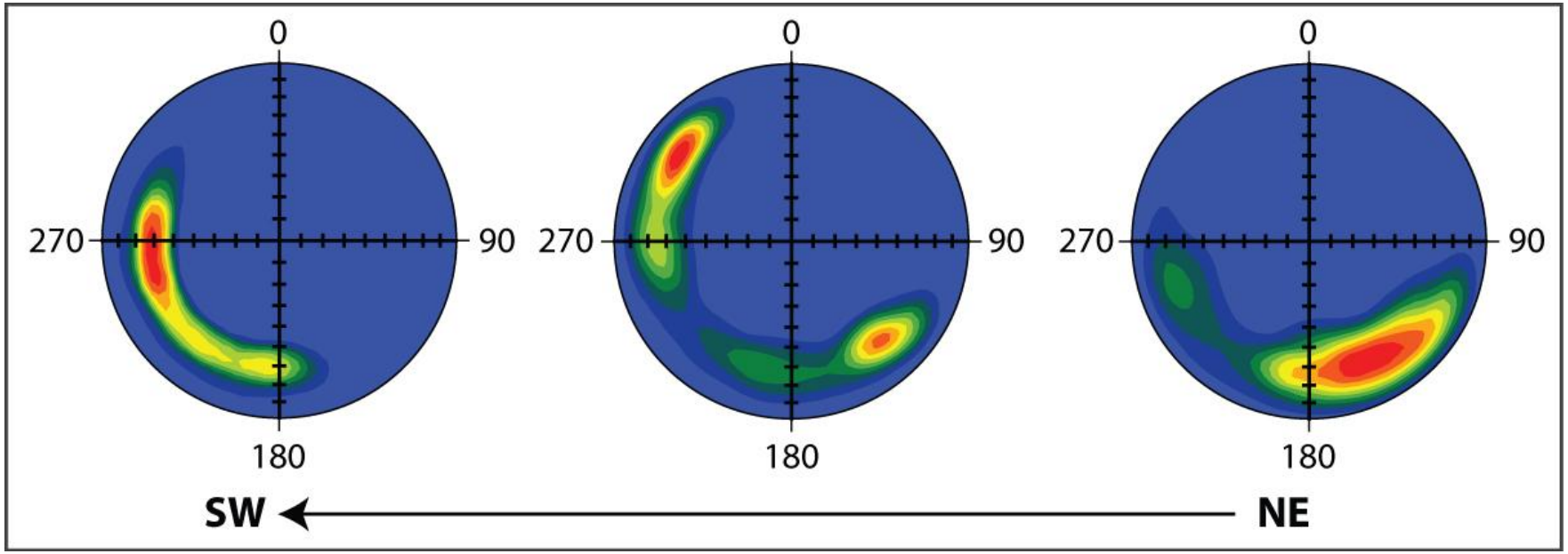



Slope (°)
High : 60
Low : 0
500 m

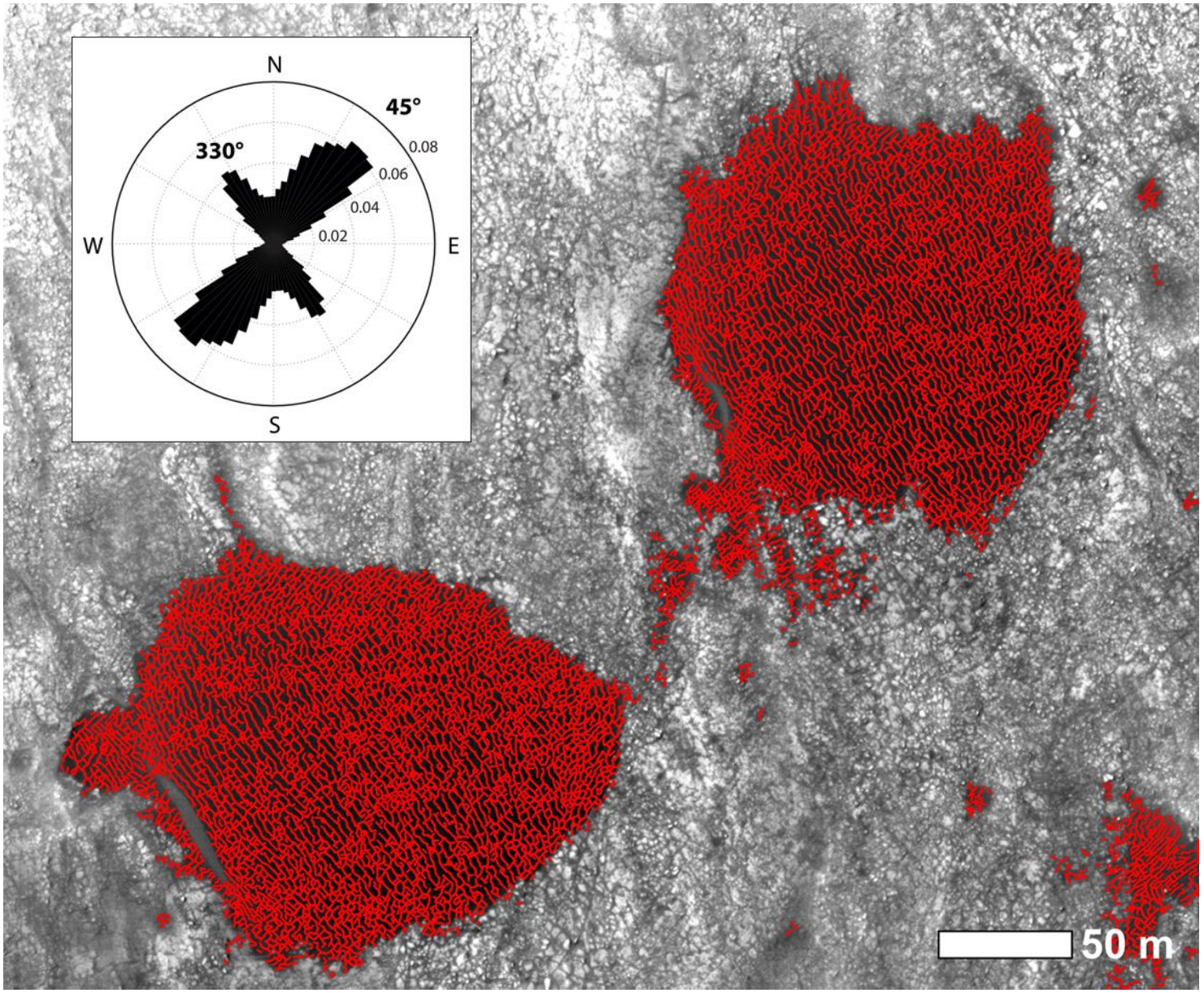
1) Morfologia delle dune, dati HiRISE – analisi delle slip face



2 dominant winds: from the ENE (along the whole dune field) and from the NW



1) Ripple pattern



Regime di venti sito atterraggio Curiosity

↓ ↓

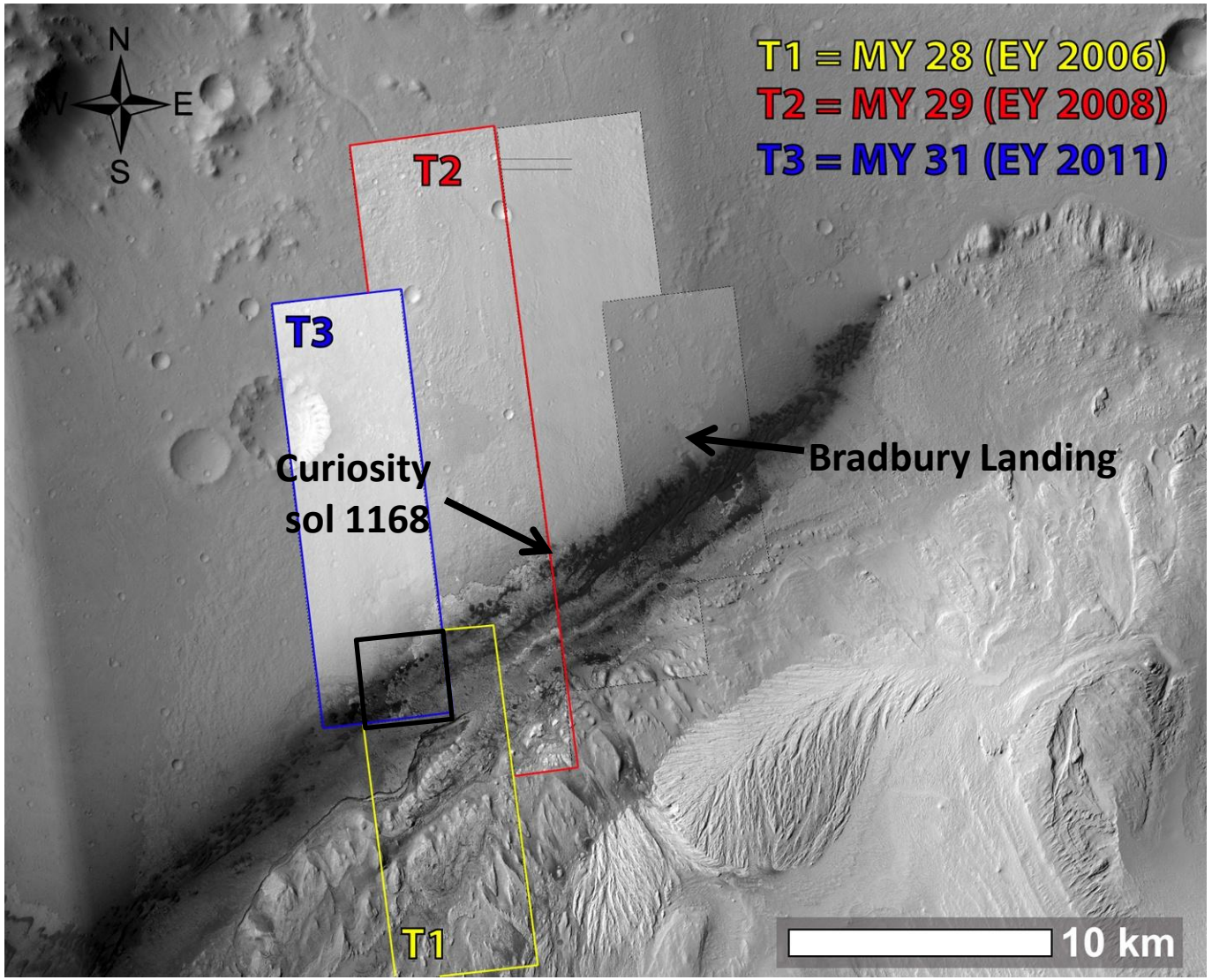
1) Morfologia di Dune e ripple (HiRISE e DTMs, mappatura automatica)

2) Attività eolica (analisi multi-temporale immagini HiRISE)

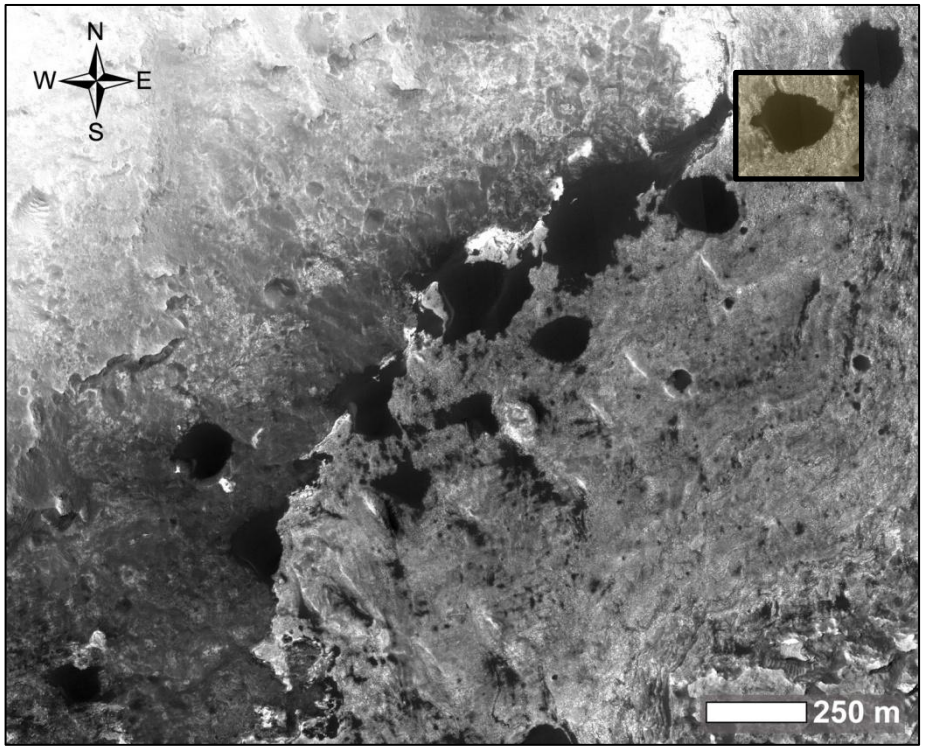
↓ ↑

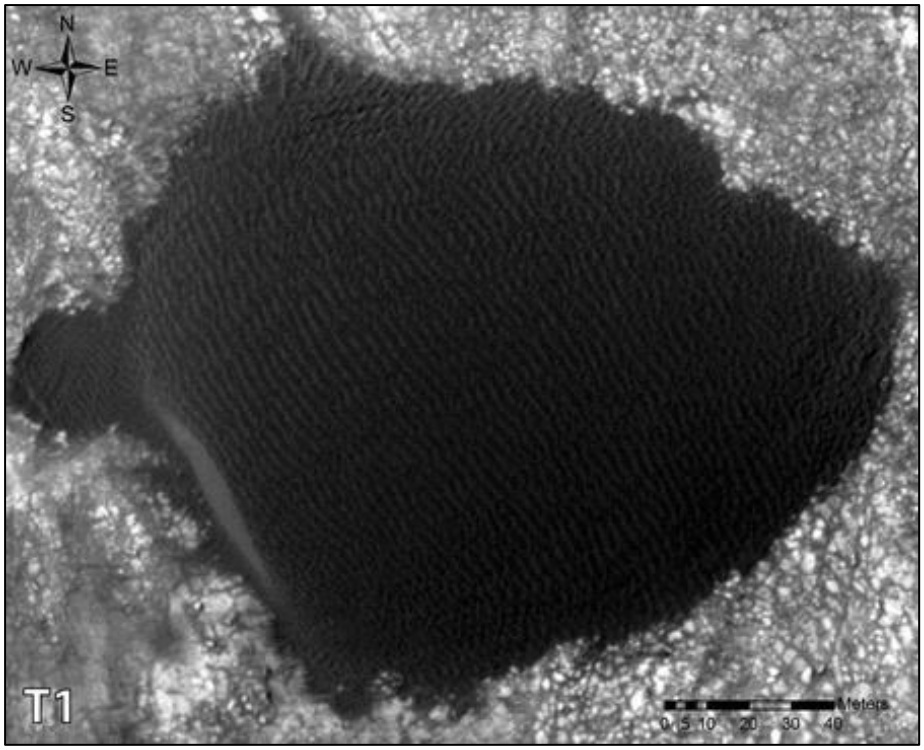
3) Mars Regional Atmospheric Modeling System (MRAMS)

Attività eolica: migrazione di ripple & dune



Attività eolica: migrazione dune





Regime di venti sito atterraggio Curiosity

↓ ↓

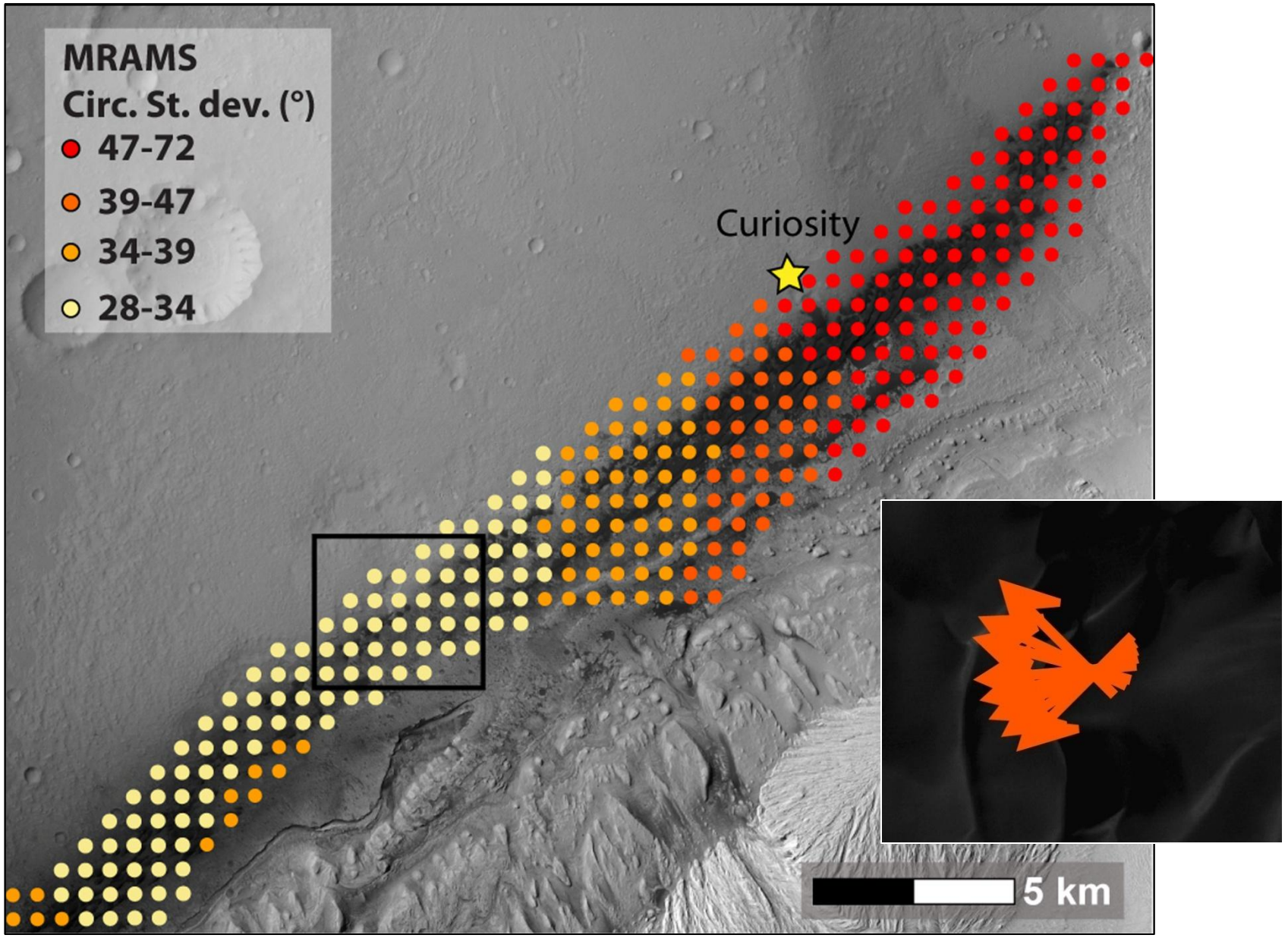
1) Morfologia di Dune e ripple (HiRISE e DTMs, mappatura automatica)

2) Attività eolica (analisi multi-temporale immagini HiRISE)

↓ ↑

3) Mars Regional Atmospheric Modeling System (MRAMS)

3) MRAMS results

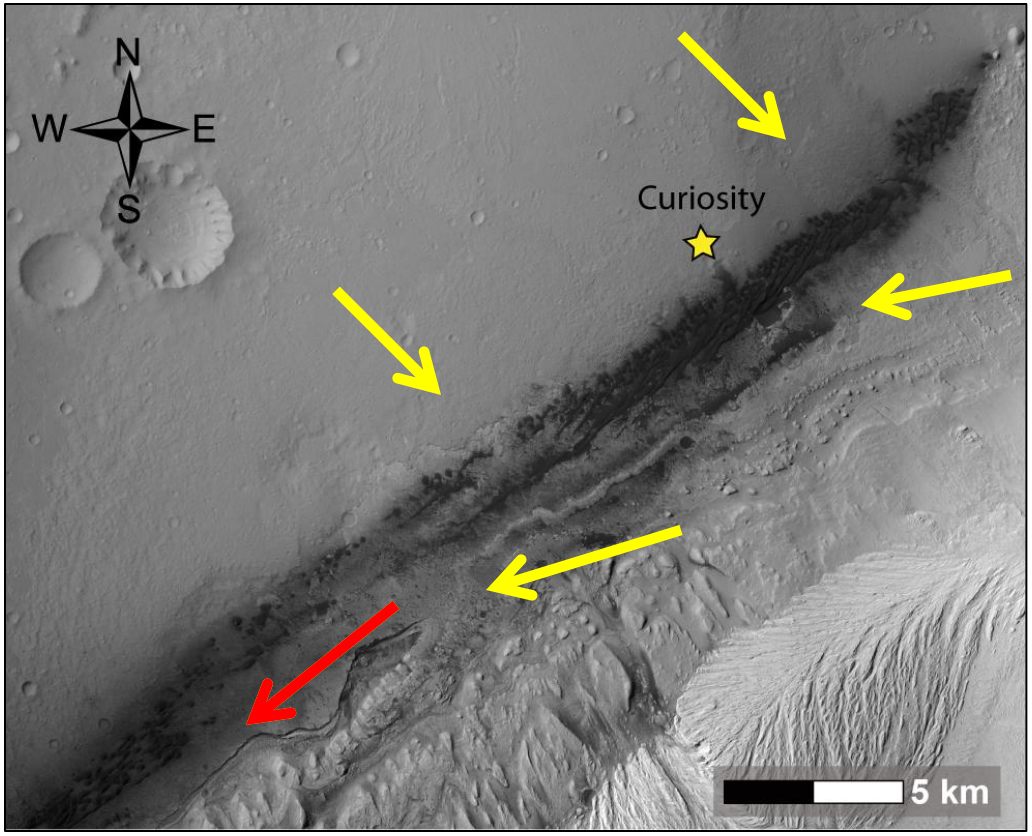


Conclusioni

Il campo di dune è attivo ed influenzato da almeno 2 venti

Venti da ENE dominanti nel periodo 2006-2011 e influenzati dalla topografia

Movendosi verso SW i venti sono più forti (35-3.5 m/s at 1.5 m) e anche più uni-direzionali (dune con una sola slip face che migrano verso SW)



Venti secondari da NW necessari per spiegare la presenza di dune lineari (2 slip face) e il trend bimodale dei ripple.

MSL Curiosity

Mass of 899 kg including 80 kg of scientific instruments.
The rover is 2.9 m long by 2.7 m wide by 2.2 m in height.
Curiosity is equipped with six 50 cm diameter wheels.
It can travel up to 90 metres per hour but average speed is about 30 metres per hour

Instruments

Mast Camera (MastCam), multiple spectra and true-color imaging with two cameras.
Chemistry and Camera complex (ChemCam), a laser-induced breakdown spectroscopy (LIBS) and a Remote Micro Imager (RMI) telescope.
Navigation cameras (navcams), two pairs of black and white navigation cameras with a 45° angle of view to capture stereoscopic 3-D imagery.
Rover Environmental Monitoring Station (REMS).
Hazard avoidance cameras (hazcams).
Mars Hand Lens Imager (MAHLI), acquires microscopic images of rock and soil.
Alpha Particle X-ray Spectrometer (APXS).
Chemistry and Mineralogy (CheMin).
Sample Analysis at Mars (SAM).
Dust Removal Tool (DRT).
Radiation assessment detector (RAD).
Dynamic Albedo of Neutrons (DAN).
Mars Descent Imager (MARDI).

Mars

Atmosphere: 10 km (6 km on Earth)

Mars also has the largest **dust storms** in the Solar System. They tend to occur when Mars is closest to the Sun, and have been shown to increase the global temperature.

Mars's **average distance** from the Sun is roughly 230 million kilometres.

Mars has a relatively **pronounced orbital eccentricity** of about 0.09 (2 highest)

Mt Sharp: 5,5 km