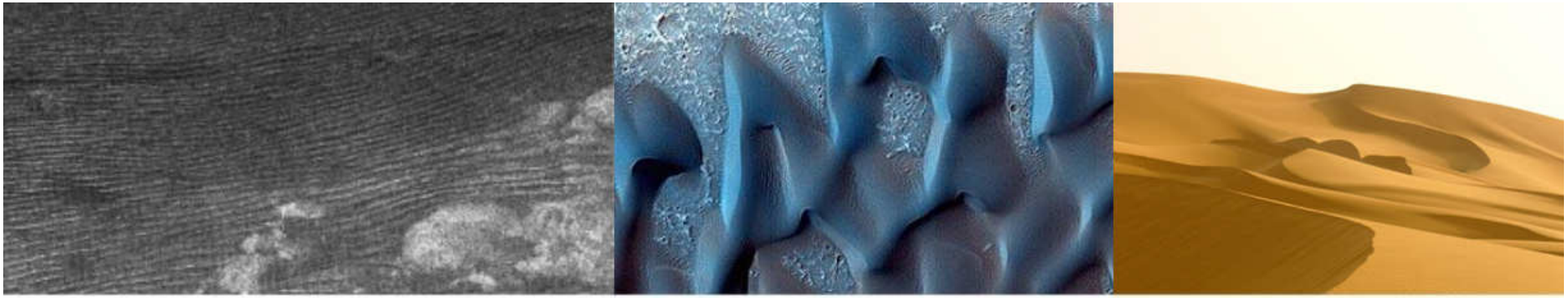
Planetary Dunes Workshop: A Record of Climate Change

Alamogordo, New Mexico
April 28 – May 2, 2008



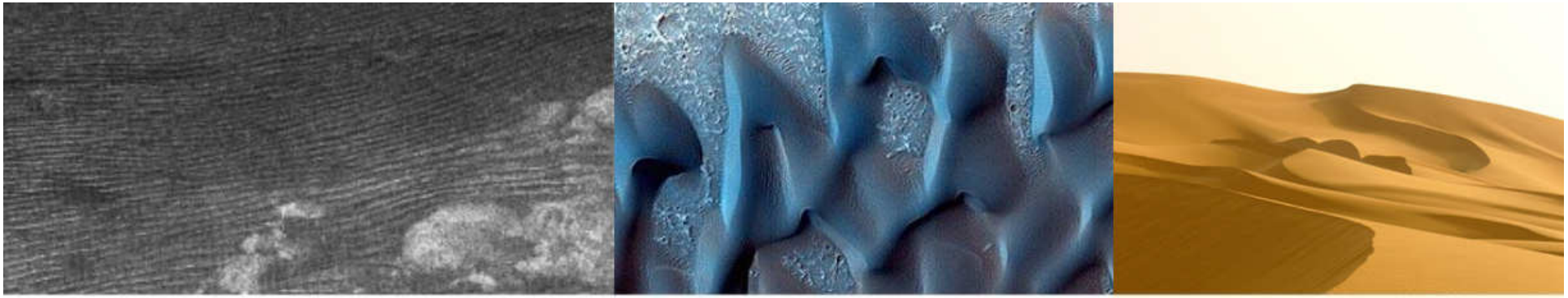
Planetary Dunes Workshop: A Record of Climate Change

Sponsors:

Lunar and Planetary Institute (Elizabeth Wagganer)
NASA's Mars Exploration Program

Organizing Committee:

Tim Titus, *USGS*
Rose Hayward, *USGS*
Mary Bourke, *Planetary Science Institute*
Nick Lancaster, *Desert Research Institute*
Lori Fenton, *Carl Sagan Center*



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Dunes common to several planetary bodies

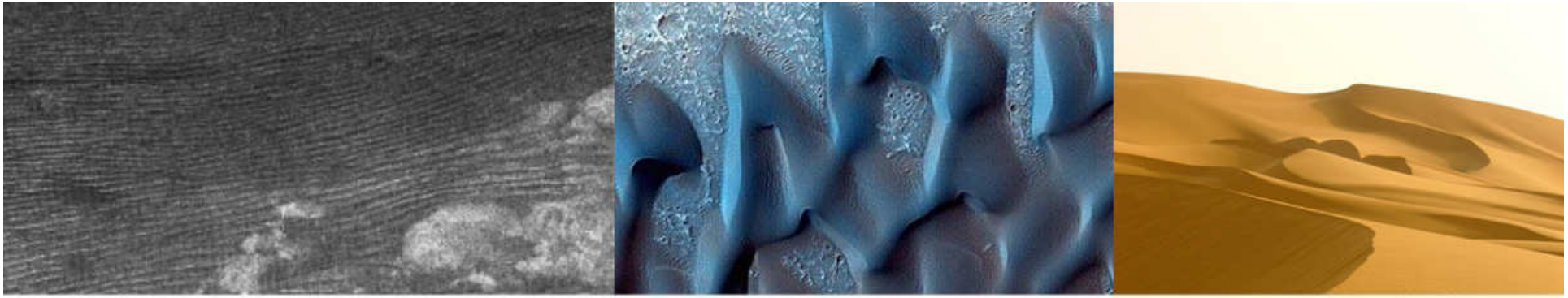
- Morphology and behavior reflect sedimentary and climatic history of regions where they are located

Yet much is not known about dunes

- Their age, origins, sediment sources, composition, and dynamics under present/past climate conditions

Intent of our meeting

- To gather our growing community and share ideas
- To identify priorities for future planetary dune research



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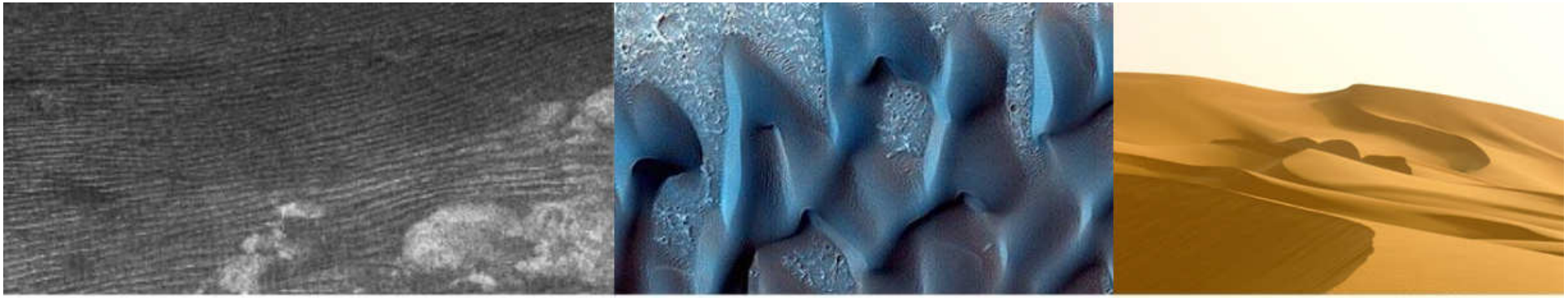
- 3 ½ day workshop, with field trip on 2nd day
- 47 attendees from 4 continents
- 39 abstracts (2 page LPI format)
- 5 oral sessions – 30 min talks (45 min invited)
  - Titan, Earth, Mars I, Mars II, Modeling
- 2 poster sessions:
  - Earth/Titan/Instruments, Mars



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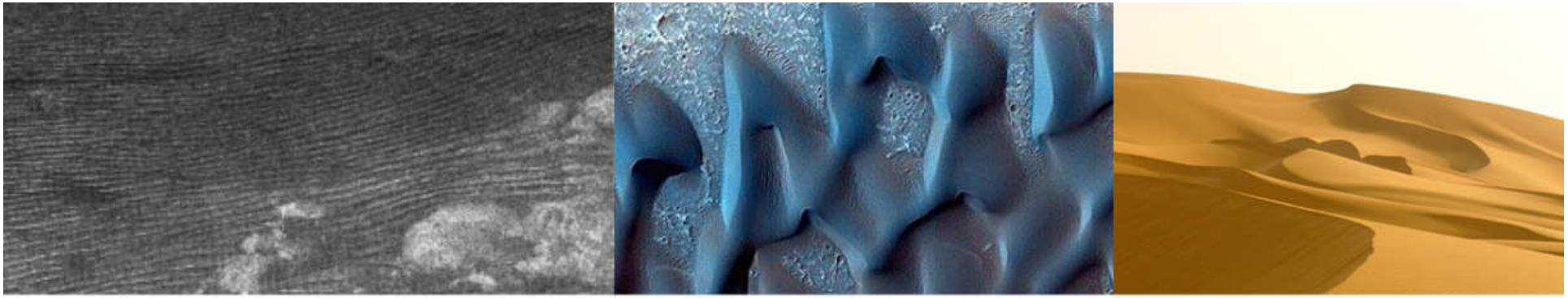
	Venus	Earth	Mars	Titan
g (m/s_2)	8.88	9.81	3.73	1.36
p (mb)	90000	1013	7	1600
Comp. (%)	CO_2 96 % N_2 3.5%	N_2 77% O_2 21%	CO_2 95% N_2 2.7%	N_2 90% CH_4 10%
T_{surf} (ºC)	480	22	–23	–200

(from Zimbelman, PD Wkshp. Abst. #7005)



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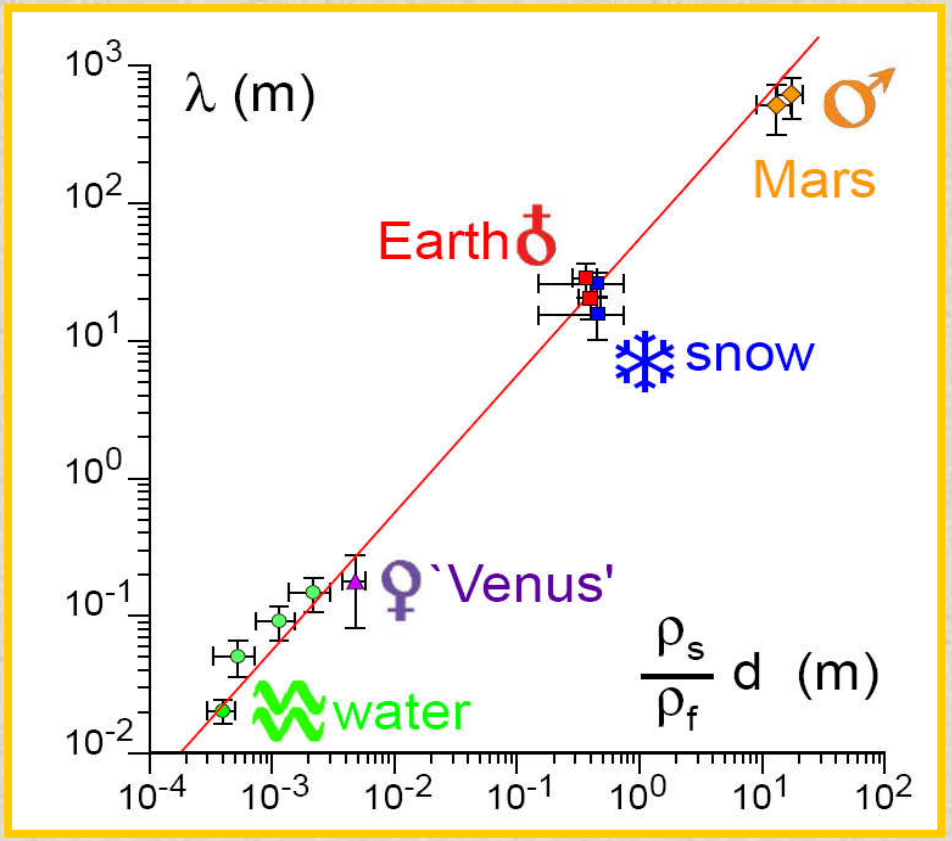


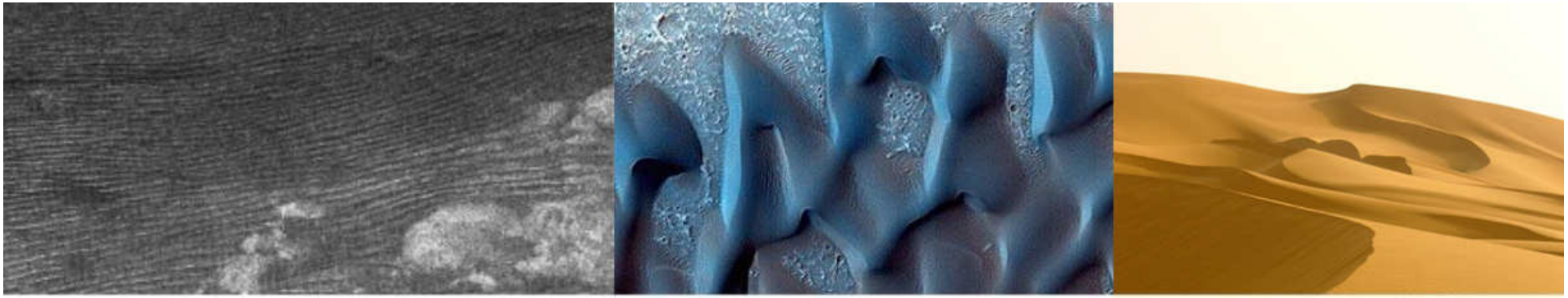
(From Claudin and Andreotti, PD Wkshp Abst. #7009)

Modeling

- Scaling law to understand bedform size

- Bedform initiation and growth

- Interactions of bedforms (e.g., collisions)



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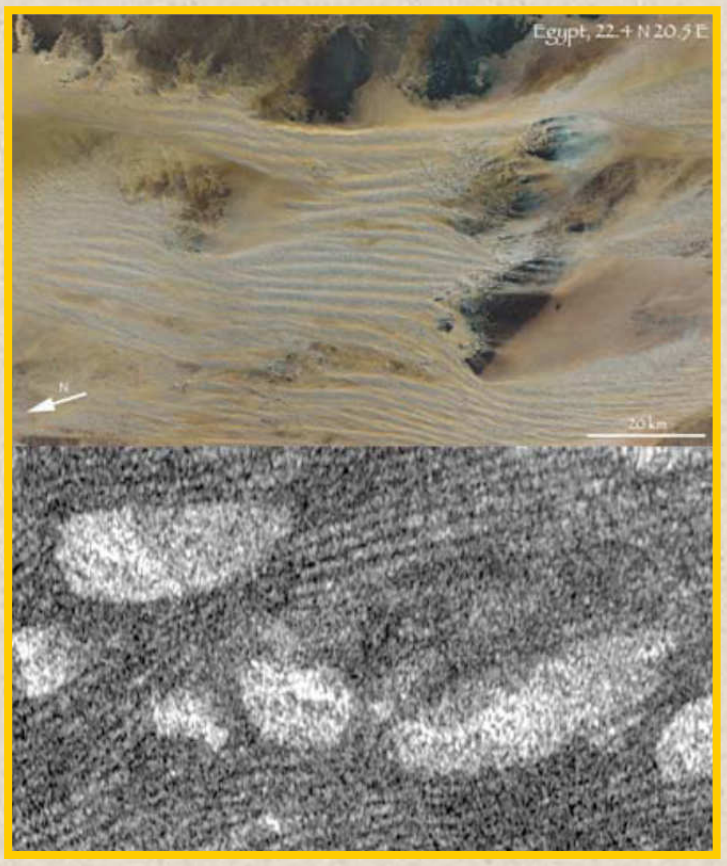
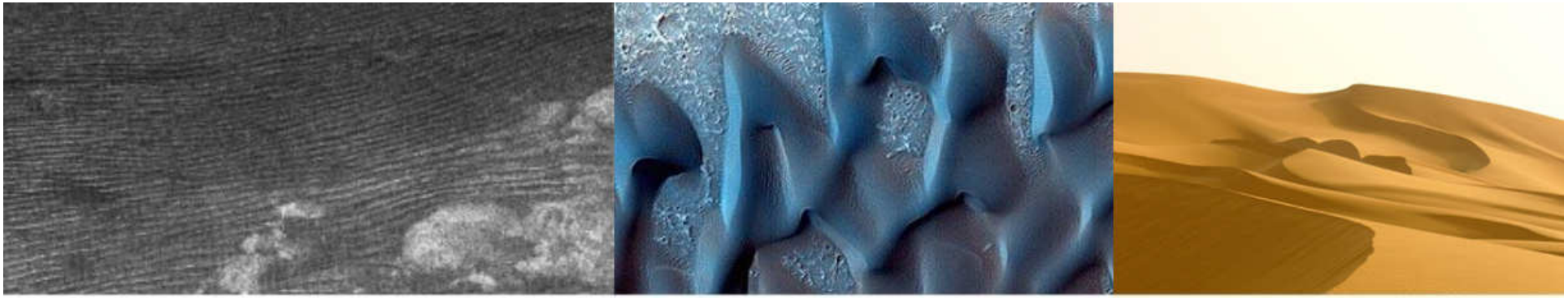


(From Radebaugh et al., PD Wkshp. Abst. #7037)

Titan: Hyrdrocarbon Sand

- Equatorial belt of dunes
  → implications for humidity/precip. patterns
- Formed by westerly winds
  → implications for atmospheric circulation



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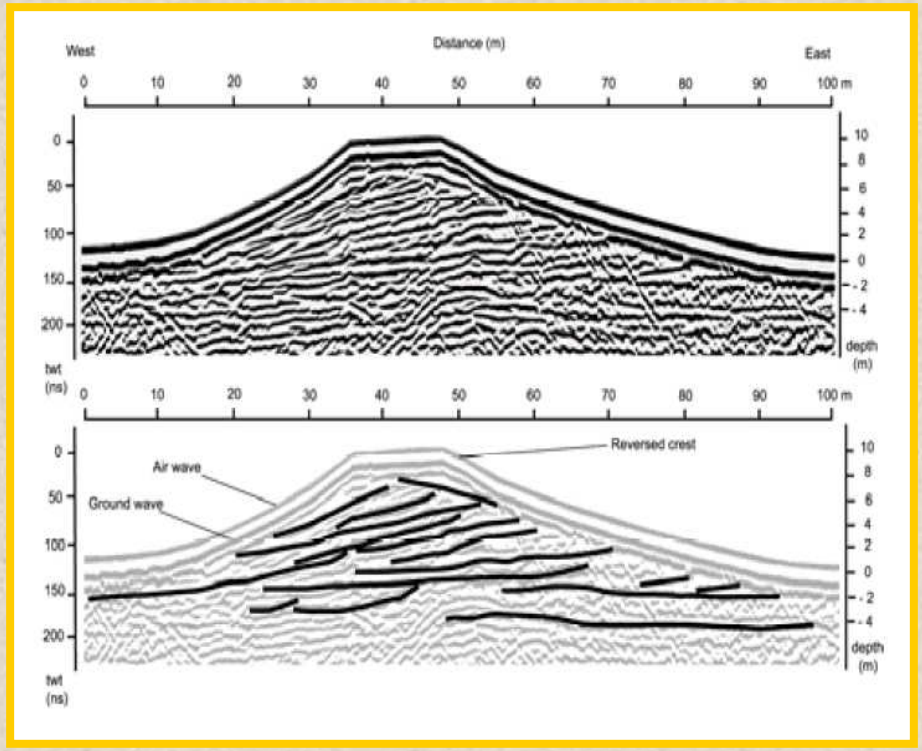
Earth: The Analog Planet

samples and field data help determine:

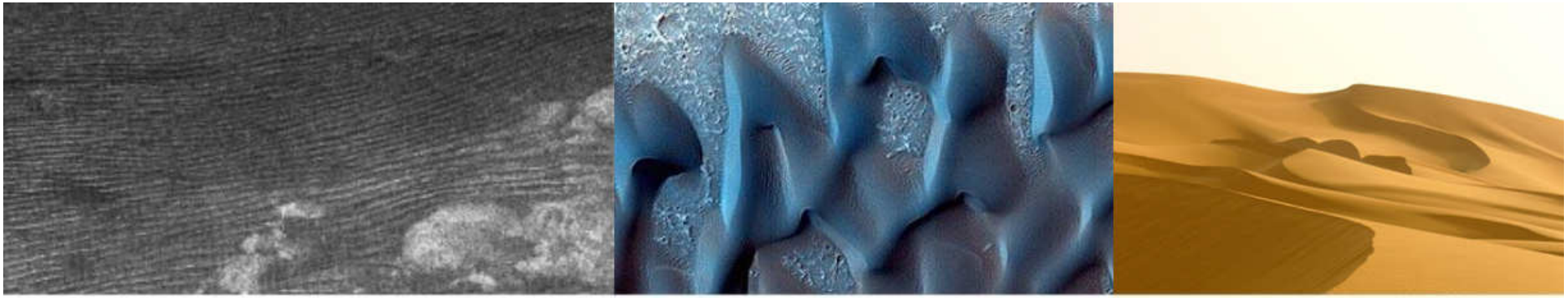
→ Geochemically identified sand sources

→Internal dune stratigraphy

→ Absolute age dating of sand grain deposition with OSL



(From Bristow et al., PD Wkshp., Abst. #7004)



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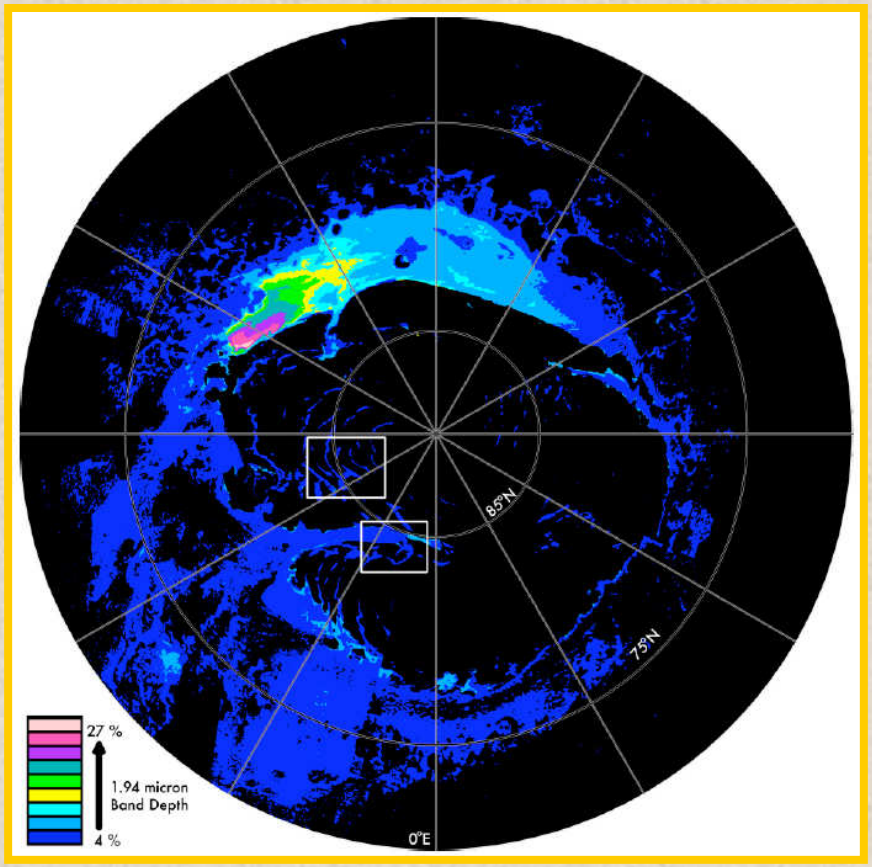
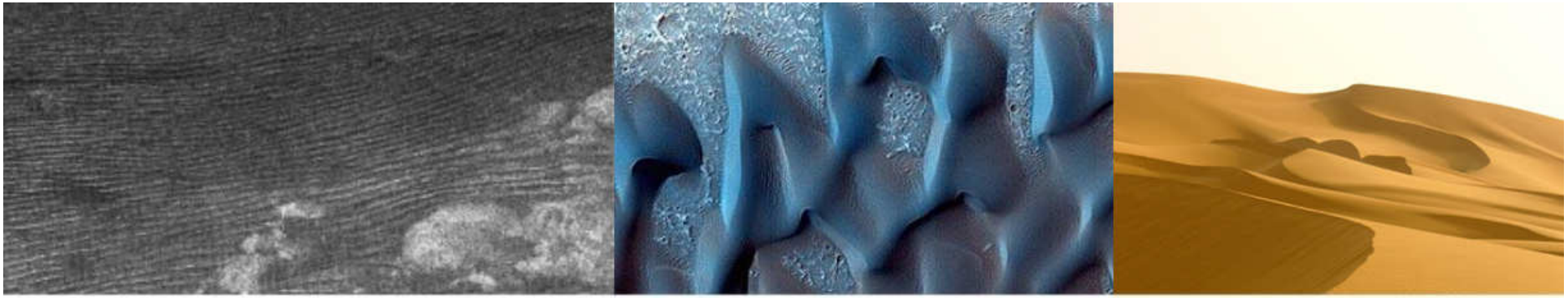


(from Horgan et al., PD Wkshp., Abst. #7035)

Mars: North Polar Dunes

- Wind pattern in dunes suggests a temporal shift in direction
- Hydrated minerals present in all dunes and troughs, not just Olympia Planitia
- Updated TI analysis suggests dunes are unconsolidated sand overlying rock or ice

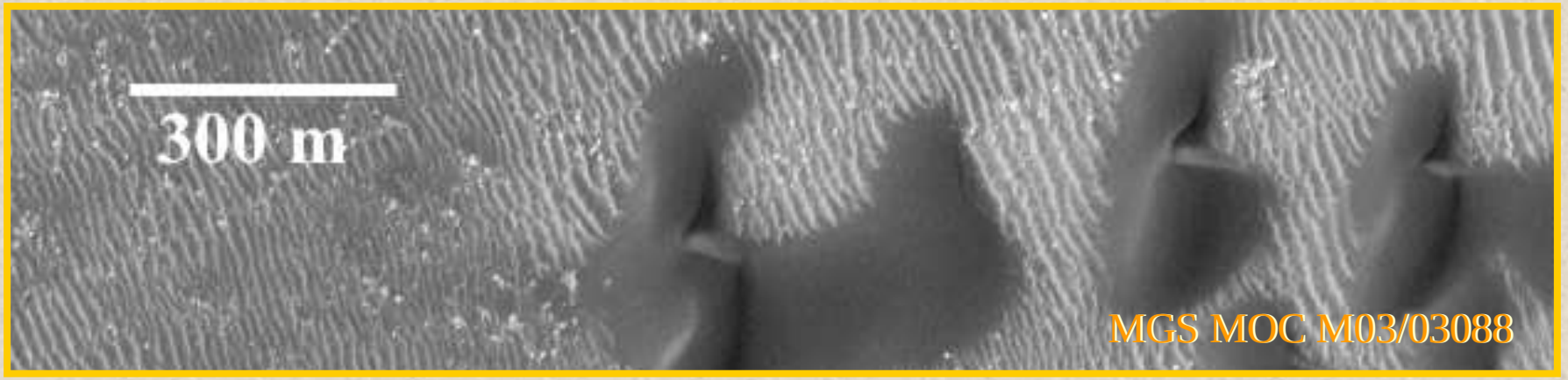


Mars: Continued

Beginning to decipher how variations in morphology and mineralogy relate to dune field history, wind regime, dune activity

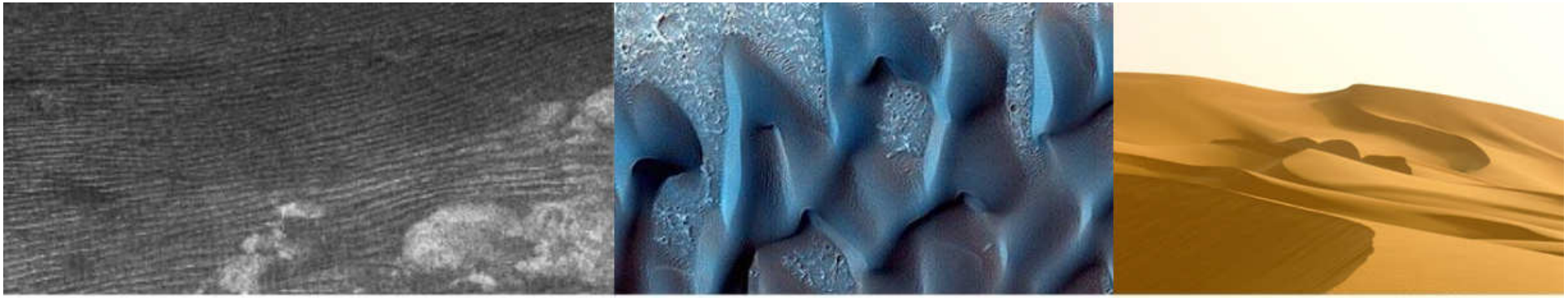
→ Using techniques with available Mars data and analog sites on Earth

→ Patterns on scale of regional dune field trends and individual dunes



Field trip to White Sands National Monument

led by Dave Bustos, Ryan Ewing, Gary Kocurek



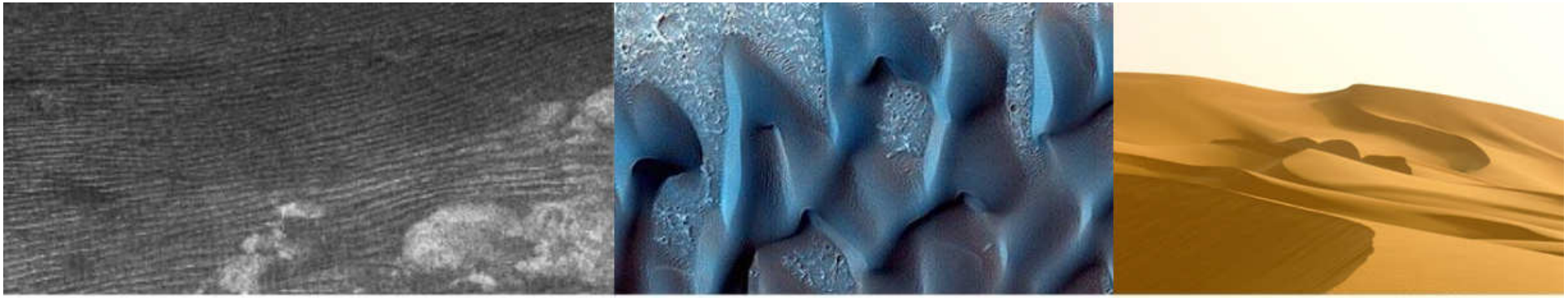
PLANETARY DUNES WORKSHOP: A RECORD OF CLIMATE CHANGE

10 priorities for planetary dune research:

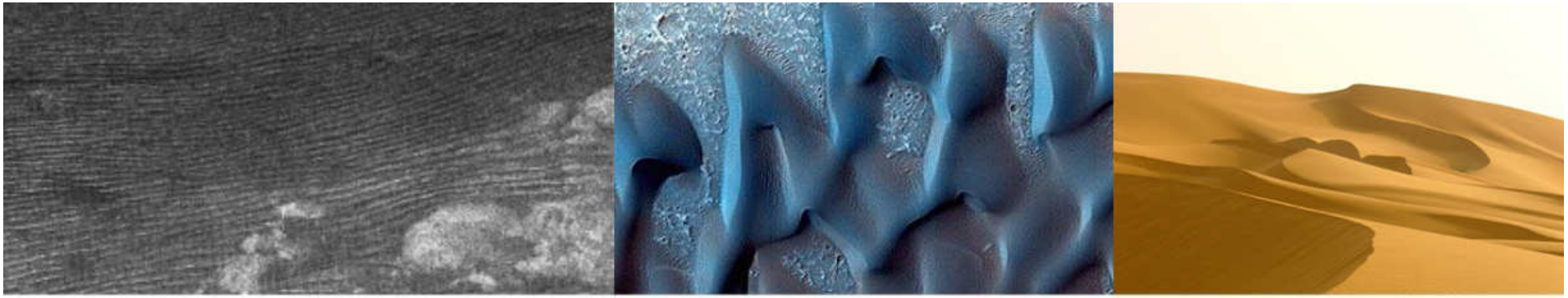
from Titus et al. (2008), *Eos Trans. AGU*, *89*(45)

1. Facilitate better communication between scientists studying dunes on ALL planetary surfaces through joint research, future workshops, and special sessions at meetings.

   → Planetary Dunes Workshop 2010, Alamosa, CO

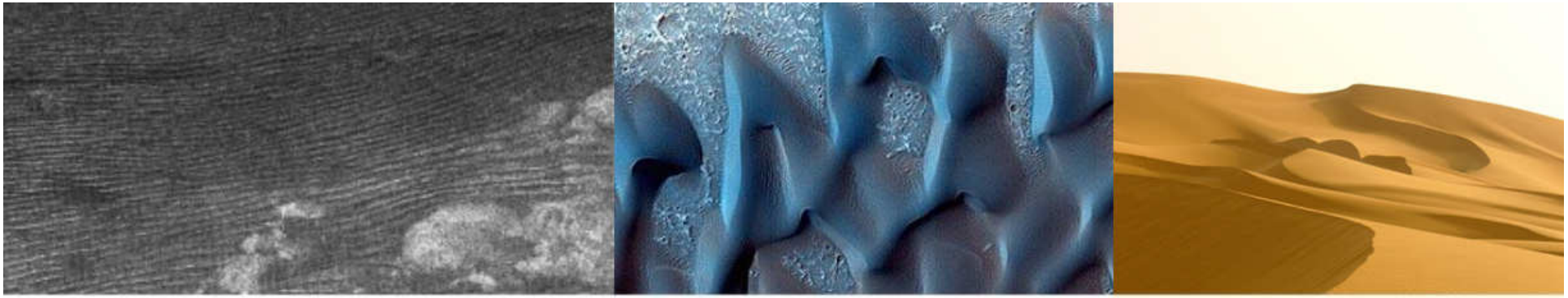


2. More studies of terrestrial analogs are needed to better understand fundamental processes:
   - Field analog studies of BOTH morphology and processes are suggested.
   - Because Mars is a cold desert, terrestrial field study sites should include both cold deserts.
   - The potential importance of Pleistocene para- and peri-glacial landscapes is important, given the temperature regime of Mars and the widespread occurrence of frozen ground phenomena.



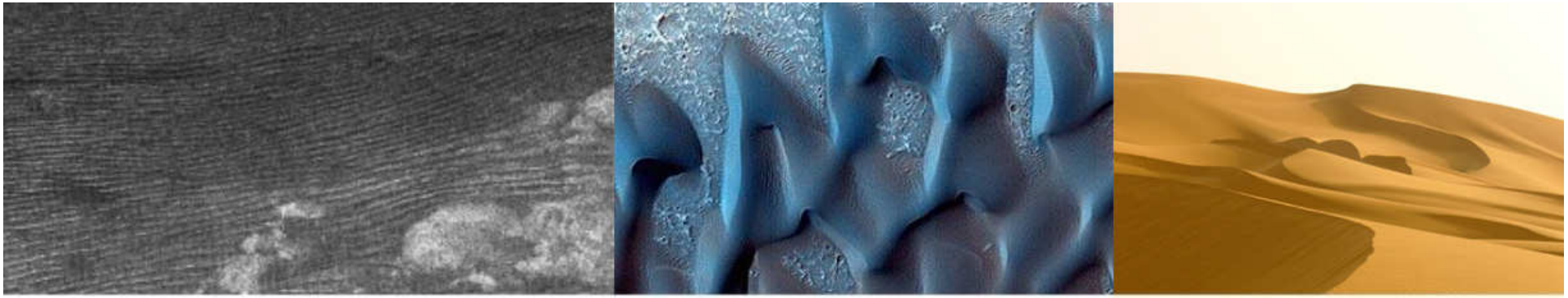
3. Study the fundamental differences in atmospheric properties (especially density) between planetary bodies having an important effect on boundary layer characteristics and therefore sand transport processes.

4. The relations between dune orientations and winds are known in general terms, but information on specific dune fields is often lacking.



5. Development, completion and/or expansion of planetary dune databases is required.
   → Mars dune database nearing completion

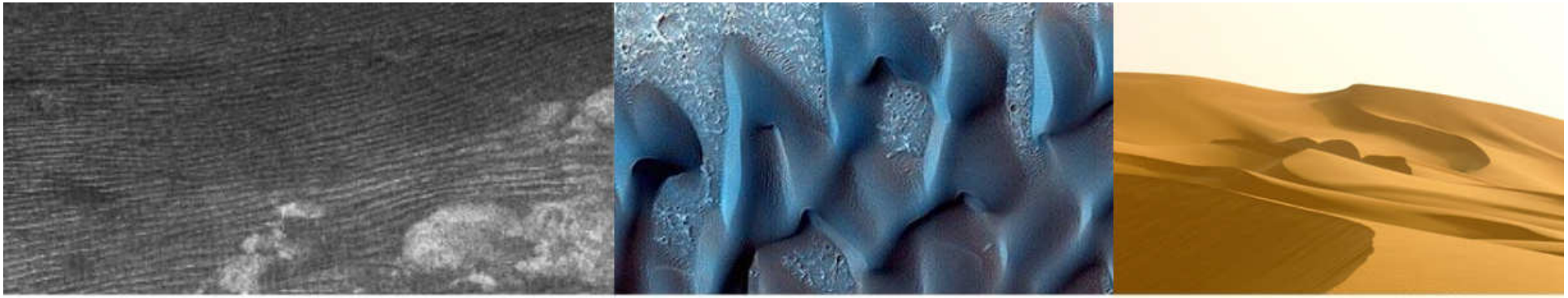
6. Additional research is needed to develop or refine dune classification schemes to consider both morphology and formation processes



7. More research on the formation process of linear dunes is needed, especially those formed in the lee of topographic obstacles.

8. More research is required to constrain physical properties of dune sands.

9. Additional numerical and laboratory studies are a priority for understanding observed dune patterns and the sedimentary history they record.



10. Quantification of atmospheric parameters important to aeolian processes is necessary for understanding fundamental aspects of sediment transport on planetary surfaces ***yet such data are rarely acquired by landers and rovers.***

Inclusion of such instruments on future planetary missions is needed to advance understanding of the dynamics of wind transport of sediment on planetary surfaces.