Mars sand dune ripple migration
from HiRISE and COSI-Corr

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Nili Patera dune field & HiRISE
Ripple height \approx 40\text{cm}
Data & Processes

2007  2008  2009  2010  2011

T1  T2  S1  S2

3 years

2007  2008  2009  2010  2011

3 months

T1 \rightarrow T2


ISIS

COSI-Corr

Registered T1 & T2 + Displacement fields

UA - Socet Set

DEM (1m)
Registration & Correlation
The whole dune field is subject to ripple migration.

Can we infer sand flux and dunes migration rates?
Sand flux and dune migration rate

\[ Q_{total} = Q_{reptation} + Q_{saltation} \]

\[ Q_{total} = (1 + \lambda) \cdot Q_{reptation} \quad (Q_{saltation} = \lambda \cdot Q_{reptation}; \text{Andreotti, 2004}) \]

\[ Q_{reptation} = \frac{1}{2} \cdot H_{ripple} \cdot V_{ripple} \]

\[ Q_{total} = H_{dune} \cdot V_{dune} \]

\[ V_{dune} = \frac{(1 + \lambda) \cdot H_{ripple}}{2} \cdot \frac{V_{ripple}}{H_{dune}} \]

that requires: \[ D_{ripple} = k \cdot H_{dune} \]
Linear relationship between ripple migration and elevation on dune

\[ D_{\text{ripple}} = k \cdot H_{\text{dune}} \]

\[ V_{\text{dune}} = \frac{(1 + \lambda) \cdot H_{\text{ripple}}}{2} \cdot \frac{V_{\text{ripple}}}{H_{\text{dune}}} \]
The mean dune migration rate derived from ripple measurements is around 10 cm/year.
Dune migration rate measured from lee front advance

4 years

2007 2008 2009 2010 2011 2012
The mean dune migration rate derived from lee front measurements is around 60cm/year.
Nili Patera sand flux is similar to the flux of Victoria valley dune field (Antarctica)
Conclusion

- Nili Patera dune field is active, at equilibrium with current weather
- Its sand flux has been quantified and is similar to Victoria valley sand flux
- COSI-Corr methodology allows ripple migration monitoring. Can be applied to earth dune field