Atmospheric Constraints on Landing Site Selection

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No meteorological package

→ Limited atmospheric science

→ No landing site preference

Atmospheric Constraints due to Engineering

Entry Descent and Landing (EDL)

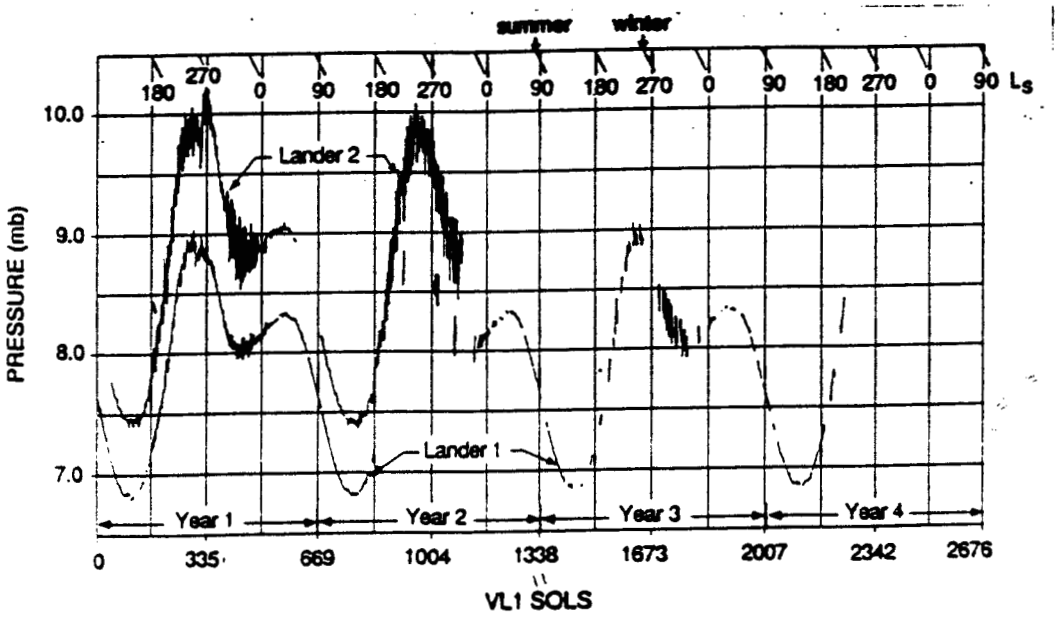
- Density and altitude
- Near surface winds

Surface Operations

- Environmental conditions (wind and temperature)
- Atmospheric Dust

Landing Times and Locations

	MER-A	MER-B	Pathfinder
Landing Day	1/4/04	2/8/04	7/4/96
min LTST at landing	13:49	12:35	03:00
max LTST at landing	14:18	12:44	
L_s (deg)	328	347	143
Latitude (deg)	-13.1	-5.6	19.3



Zurek *et al.*, *Mars*, 1992

EDL Wind Considerations

Both steady wind and wind shear are important

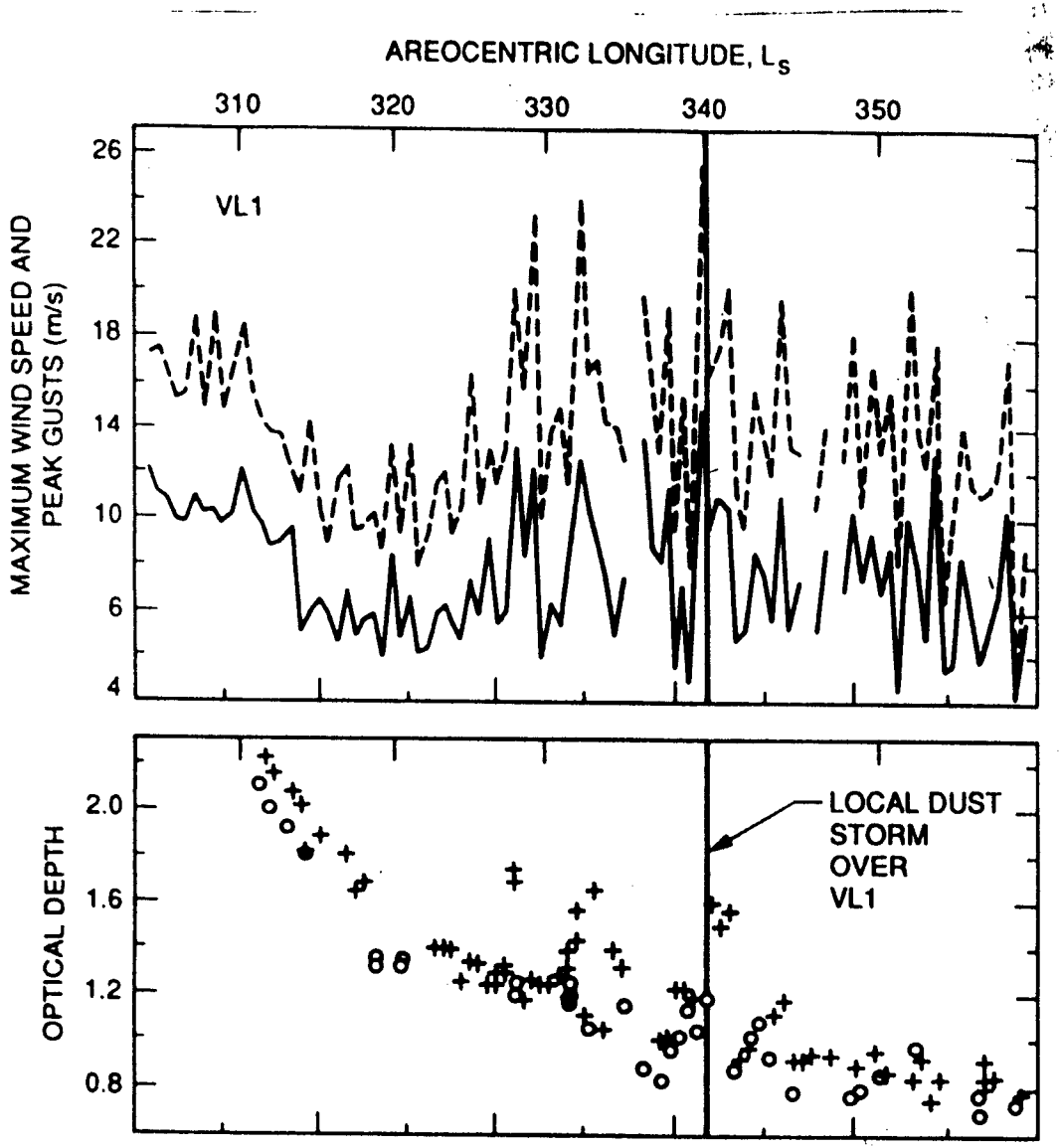
- Near surface (≤ 5 km) only
- Steady wind $\rightarrow$ horizontal velocity at landing
- Shear $\rightarrow$ canted firing of retro rockets

Winds Extremely difficult to observe

- Some data from VL parachute descent
- Relevance of surface data

Modeling efforts

- Scaling from terrestrial observations
- Boundary layer theory
- Mesoscale modeling
- Often topographically/regionally controlled



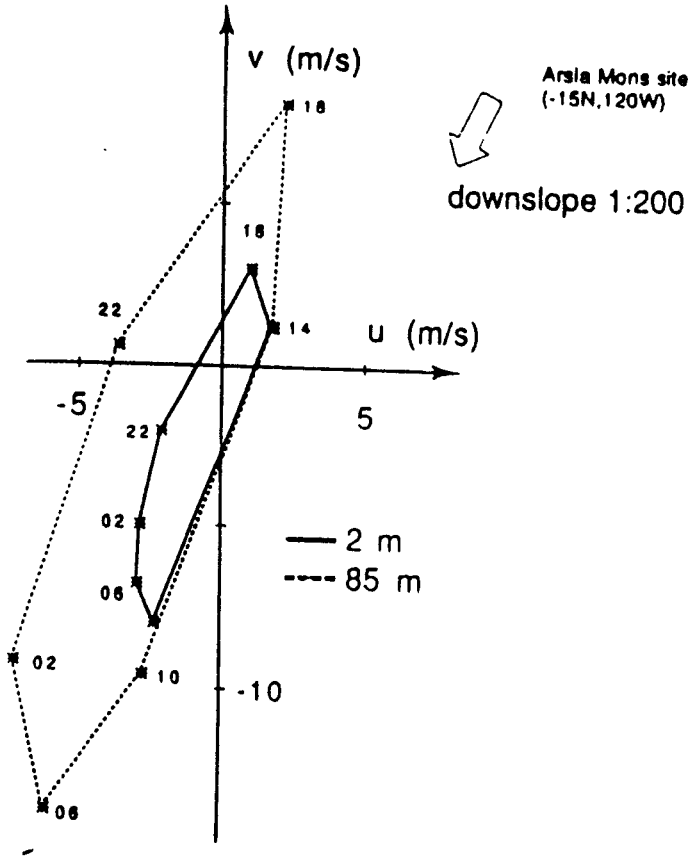


FIG. 11. As in Fig. 10 but for the Arsia Mons site (−15°N, 120°W; slope 0.26°).

Savijarvi and Siili, 1993.

Zurek *et al.*, *Mars*, 1992.

Wind and Temperature Conditions at Surface

- Controls amount of nighttime heating required
  - → amount of power available for science
  - → amount of power available for data return
- Rapid atmospheric equilibration with surface
  - About 5 minutes at 1.5 m
  - Implies affected by ~500 m upwind at night
  - Strongly affected by local conditions
    - regional slope and topography
    - diurnal surface temperature controlled by
      - thermal inertia
      - albedo
  - Winds can be channeled by surface features
    - canyons
    - craters
    - hills/mountains
    - other depressions
- Some data available:
  - Viking Lander data
  - Pathfinder data at different season
  - Mesoscale modeling for limited cases
  - Dunes may be indicative
  - But all for specific cases...

Dust

- Generally well mixed in lower atmosphere
  → lower landing sites are more dusty
  May be extra dust in outflow chasms and craters
    Dust Traps?
    Stronger local winds → more lifting
    Blowing off higher surrounding topography
  Affects power generation
    reduced light (effects are non-linear)
    panel deposition (reaches steady state?)

- Local dust storms (~48 hours and $\tau \sim 2$)
  Occur everywhere and at all seasons
  Possibly associated with weather fronts
  Limit science to conserve power
  More likely in enclosed or dusty locations?

- Global and regional storms
  Should be limited at selected season and latitudes
  But significant impact on science if occur.

Summary

Current estimate of restrictions:

- Below -1.3 km altitude
- Low winds at landing time (currently < 20 m/s)
- Benign Surface conditions:
  Albedo ($\sim< 0.28$)
  Thermal inertia (> 165 SI)
  Topographically controlled winds
- No known limits due to dust

Ongoing modeling efforts:

- Atmosphere (T, P, ρ) for selected landing sites
- Near surface winds based on several sources.
  Hopefully, mesoscale models for specific sites
- Surface conditions
  Updated from mesoscale models
  Boundary layer modeling at sites of interest
- Dust issues will be examined further