
Pascal

A Mars Climate Network Mission

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and the Pascal Team



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Pascal A Mars Climate Network Mission



Pascal Team

Principal Investigator: Bob Haberle, ARC

Deputy PI: Aaron Zent, ARC

- US Co-I's:

- Conway Leovy, UW
- David Catling, UW
- Tim Schofield, JPL
- Dave Atkinson, UI
- Jim Murphy, NMSU
- Chris Webster, JPL
- Peter Smith, UA
- Anthony Colaprete, ARC
- Ron Greeley, ASU
- Jeff Barnes, OSU
- Jill Bauman, ARC

- International Co-I's:

- Jean-Pierre Pommereau, SA
- Pascal Rannou, SA
- Francois Forget, LMD
- Frederic Hourdin, LMD
- Oliver Talagrand, LMD
- Ari Matti Hari, FMI
- Industry Partners:
 - Ball Aerospace (Prime)
 - LMATC (Surface Station)
 - Aerotherm (Entry System)
- Mission Management:
 - JPL



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Science Objectives

- (1) **Joint characterization of the near-surface general circulation and its interaction with the surface.**
 - **Measure the surface signature of the general circulation**
 - **Monitor aeolian processes & water exchange**
- (2) **Determine how the general circulation controls the dust, water, and CO₂ cycles**
- (3) **Provide a basis for comparative planetary meteorology**
- (4) **Provide a weather monitoring infrastructure for future missions and synergy for all observations**

==> Characterize the Present Global Climate System <==



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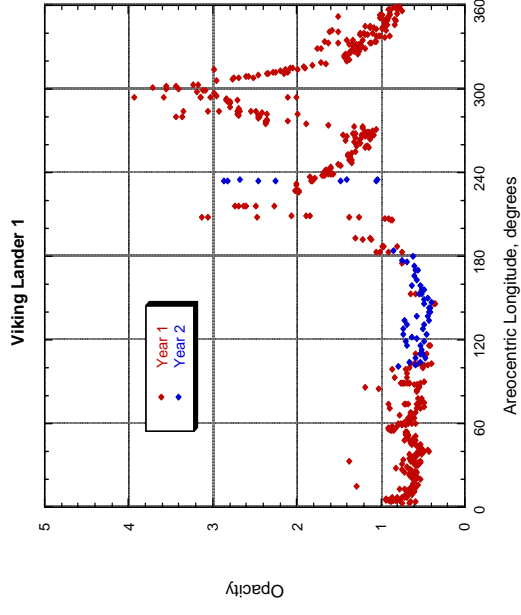
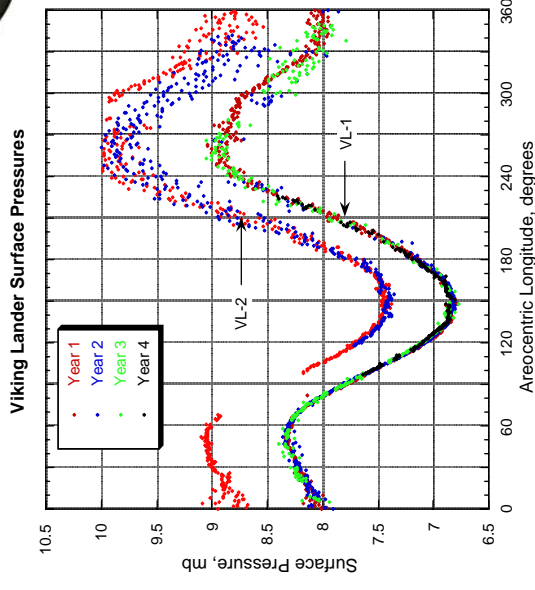


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Pressure and Opacity Are the Most Important Measurements

- Pressure gives column mass
 - *Pressure gradients related to winds*
- Opacity gives the forcing
 - *Measures extinction of solar radiation*
- The combination also gives
 - CO₂ cycle
 - Dust cycle



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Mission Design Philosophy

Capable landers:

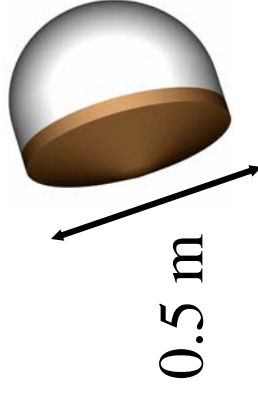
- Address multiple disciplines
- Become heavy and expensive
- Cannot deliver enough landers

Tradeoff:

- Instead of many measurements at a few sites
- Make a few measurements at many sites

Focus payload on key measurements:

- Pressure and Opacity
- Then enhance the science as resources permit



~ 20 kg

Entry Mass



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How Many Stations are Needed?

General Circulation

- **Need broad latitudinal coverage**
 - sample each meteorological regime
 - 1 in tropics
 - 1 in mid-latitudes of each hemisphere
 - 1 in polar regions of each hemisphere
- **Need to resolve longitudinal structure**
 - wave 2 is dominant feature
 - need *at least* 4 stations ~ 90° apart
- **Don't need many polar stations**

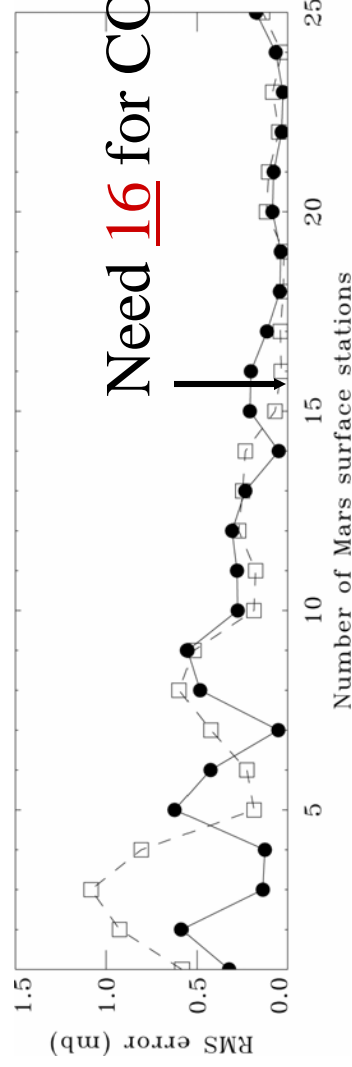
No. Stations

5

$$5 \times 4 = 20$$

$$20 - 4 = \underline{16}$$

CO₂ Cycle



Need 16 for CO₂ cycle



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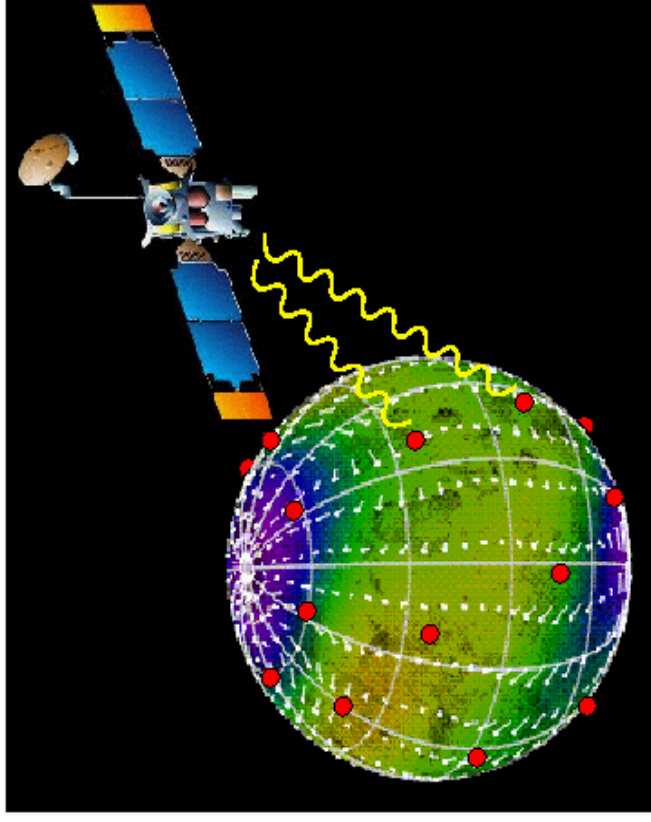
The Pascal Mission

Global network of 18 weather stations

Stations operate for 3 Mars years

Landed measurements:

- pressure (hourly)
- opacity (hourly)
- temperature (every 15 minutes)
- wind speed (every 15 minutes)
- water vapor (twice per sol)
- B&W panoramic images (1/Mars Mo)



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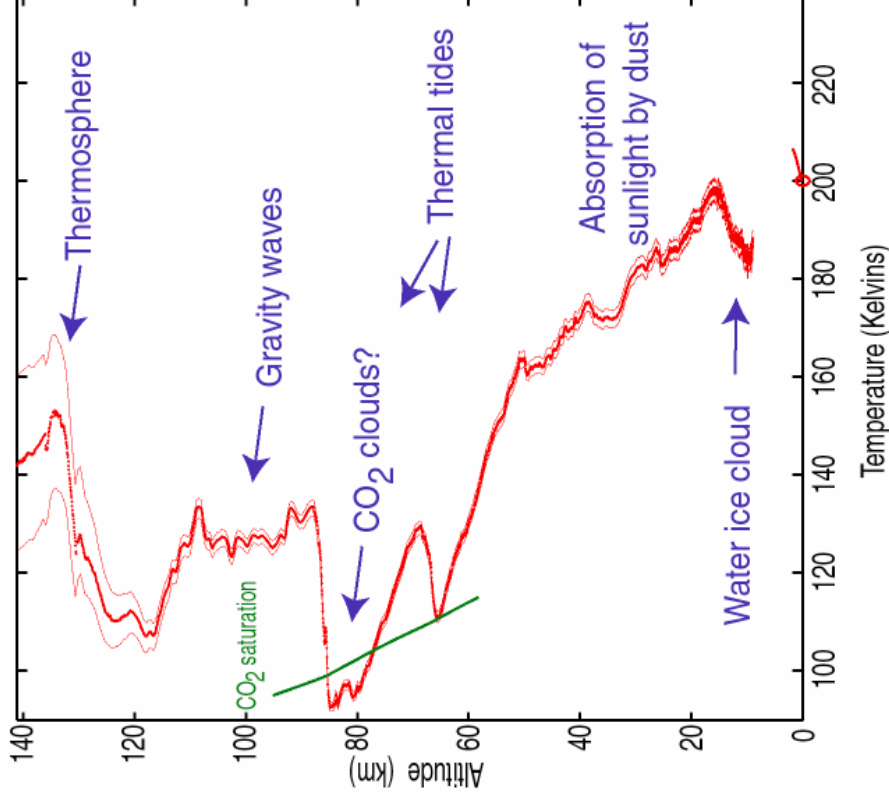


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Pascal EDL Measurements

Atmospheric Processes in Pathfinder ASI Profile



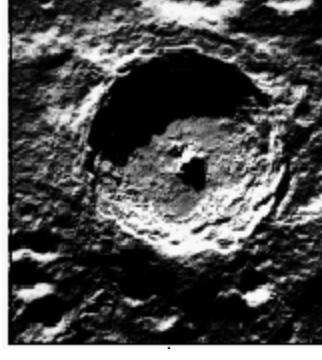
Entry Science

- 18 T-profiles
- 10-80 km
- Global
- Late AM/PM local times



Descent Imaging

- ~ 10 images
- Res: >30 cm/pix



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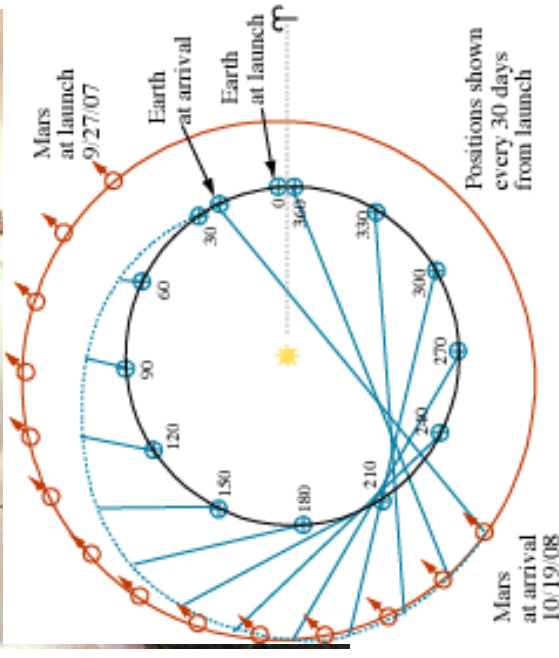


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Mission Concept

- **Launch:** 9/27/07 (20 day window)
 - Delta III-3940
 - Type II trajectory
- **Mars arrival:** 10/19/08 ($L_s=146^\circ$)
 - Release probes on approach
- **Probe entry, descent, and landing:**
 - Aeroshell, Parachute, Air bags
 - Entry data stored for later transmission
 - No communication during EDL
- **Autonomous surface ops: 3 Mars years**
- **Station power:**
 - Milli-watt Power Generator (MPG)
- **Communication:**
 - MEP Orbiters
 - Mars Express
 - Others?



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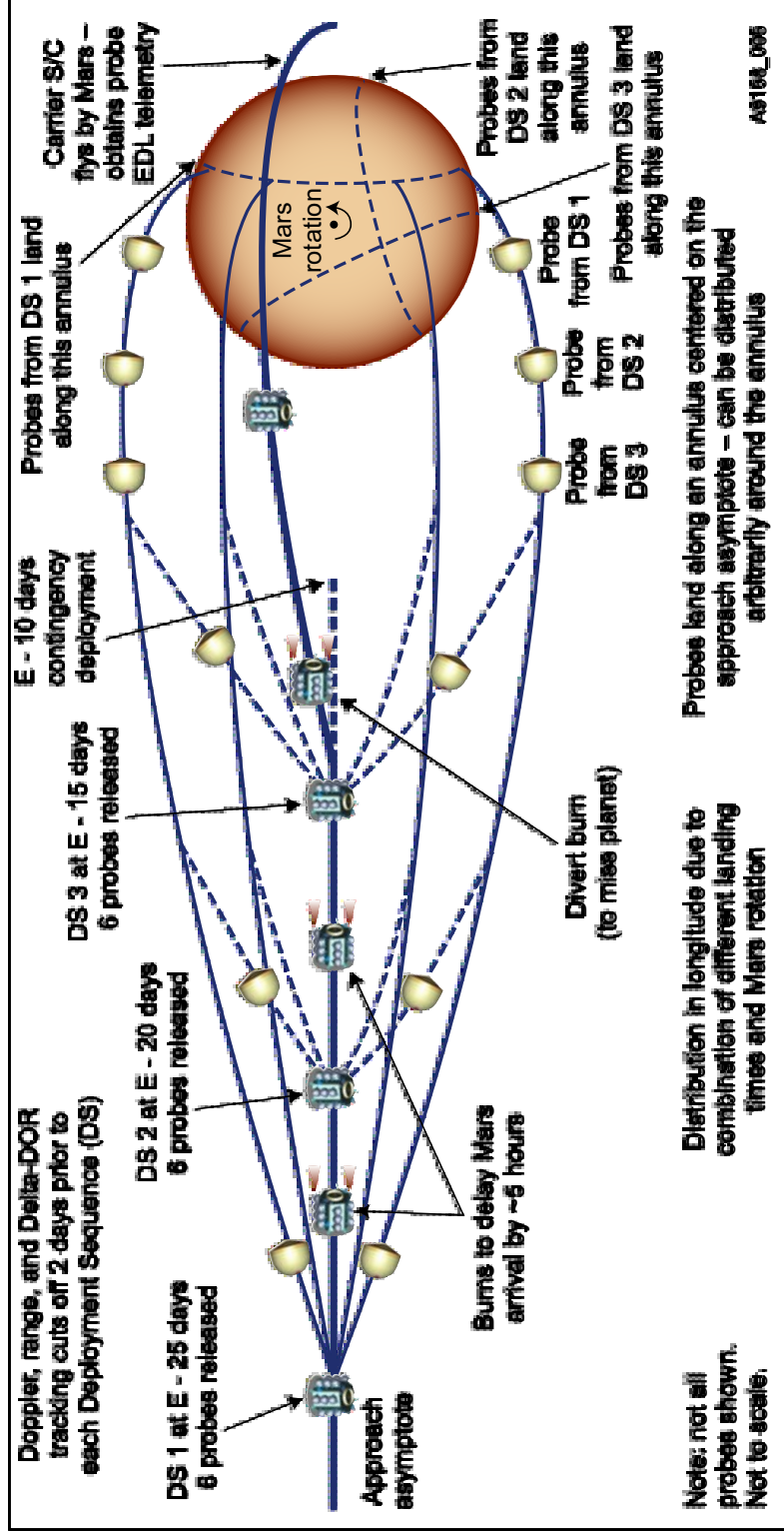
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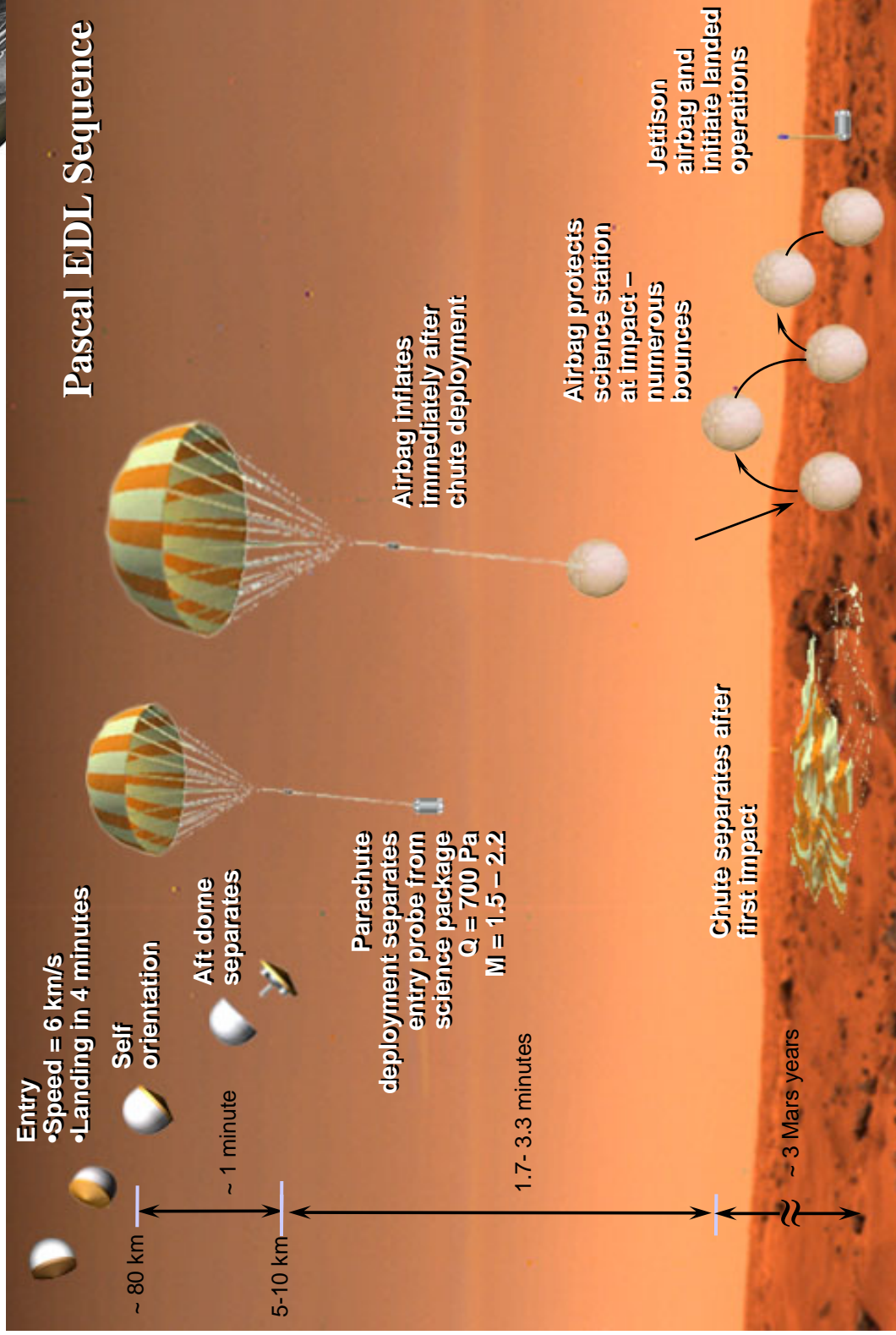
Pascal Probe Deployment Sequence



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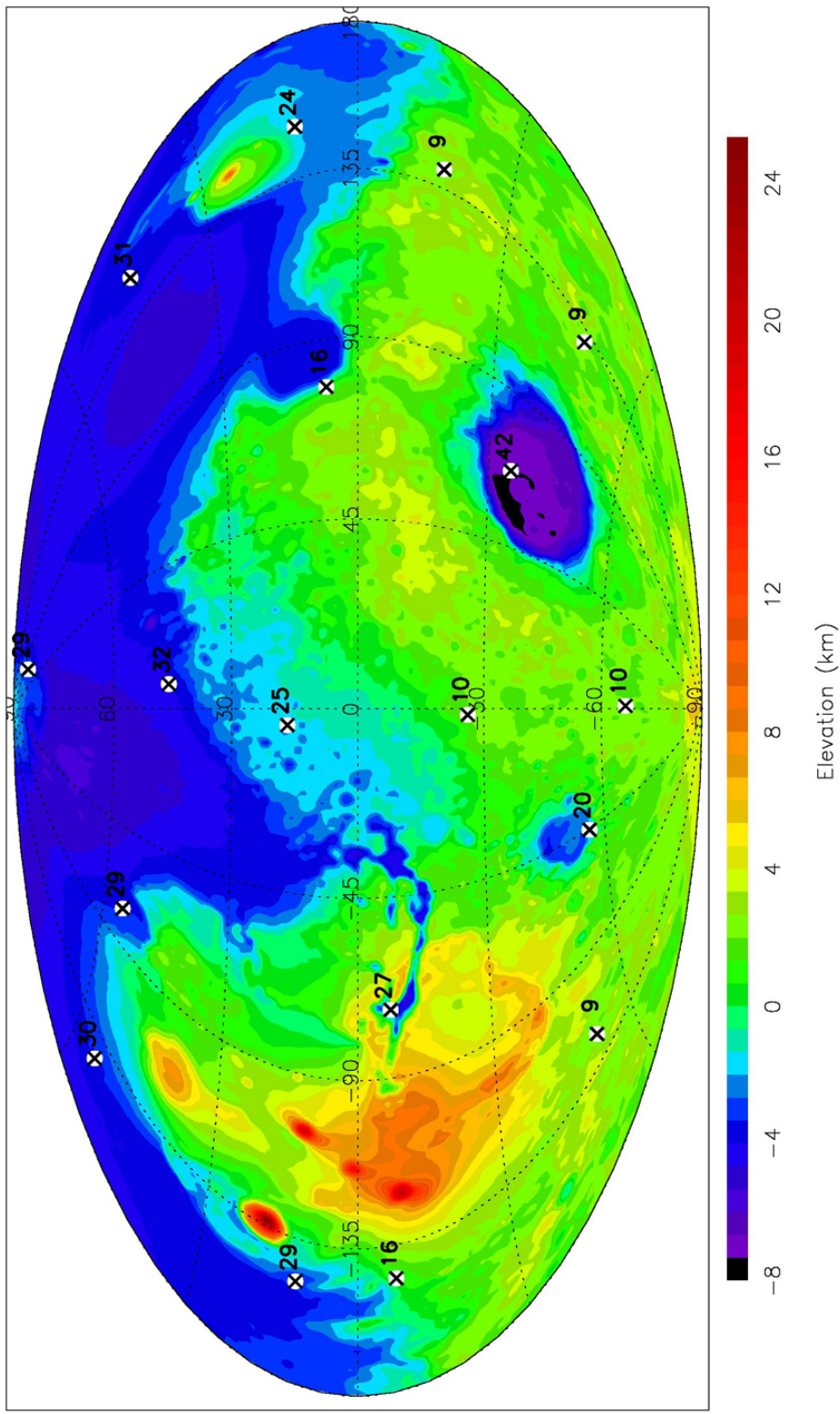
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Sample Network Configuration



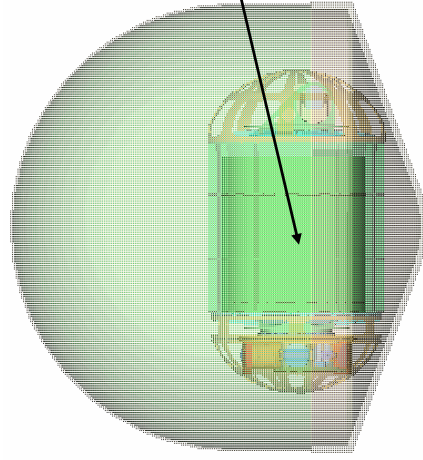
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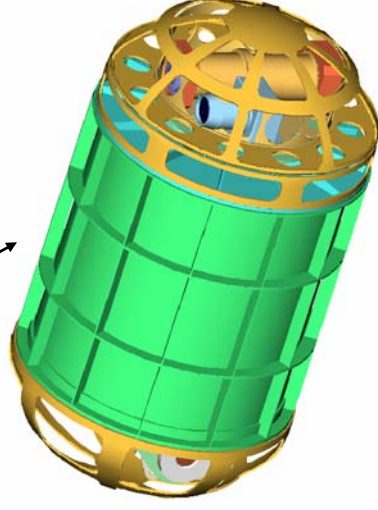
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Probe Entry System



Science Station



0.5 m

- 70° half angle cone
- Hemispherical backshell
- 20 kg entry mass



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The NASA Ames GCM & Probes

Excellent tool to plan EDL:

- Winds
- Atmospheric density

Provides BC's for Mesoscale Models:

- Dan Taylor (MM5)
- Scot Rafkin (MRAMS)

Pascal would provide the BEST validation of the GCM



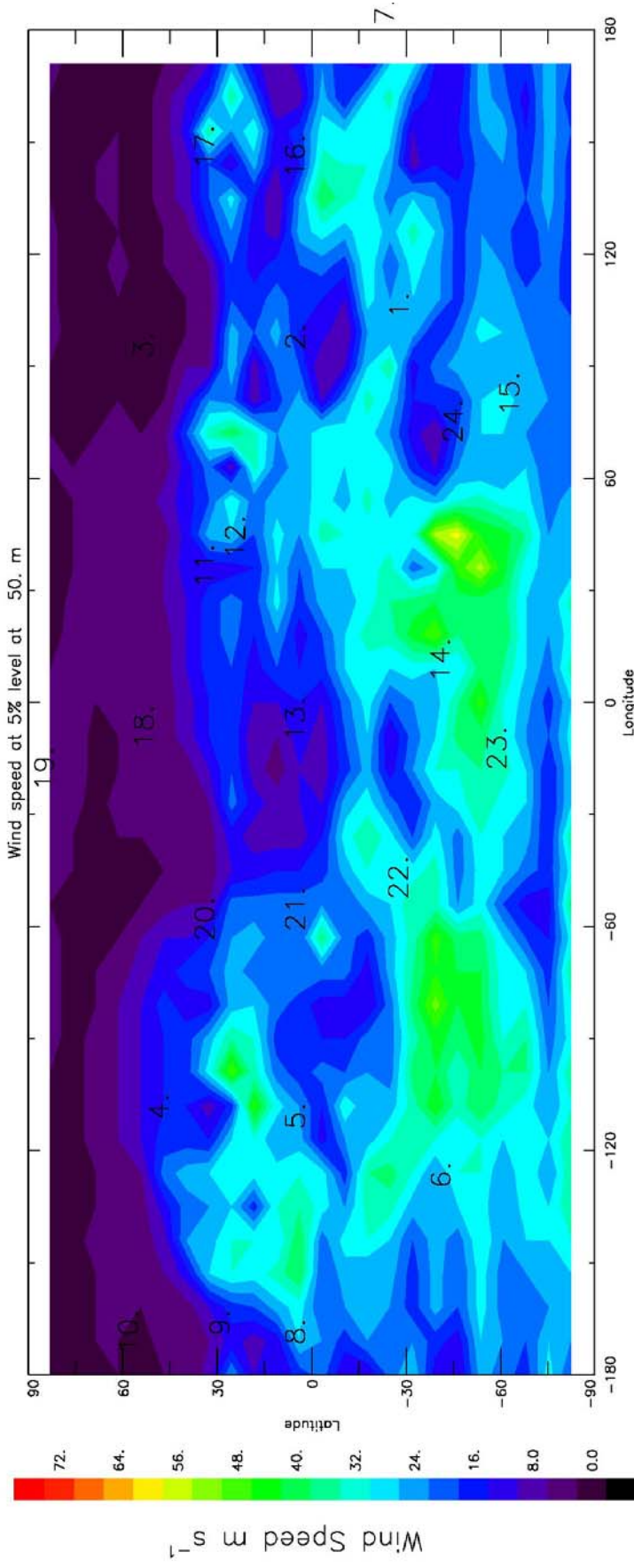
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Predicted 3σ Winds at $z = 50$ m for $L_s = 140$



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Pascal Future

- Next Scout opportunity scheduled for 2011
- Much development work is needed
 - Power Source
 - Science Station
 - EDL system
 - Instrument prototypes
- Funding the development effort will be difficult
 - No single source
- Pascal's future is very uncertain



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