Pascal

A Mars Climate Network Mission

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and the Pascal Team

Ames Research Center

ITT Industries
Engineered for life

LOCKHEED MARTIN

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

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 CO_2 cycles

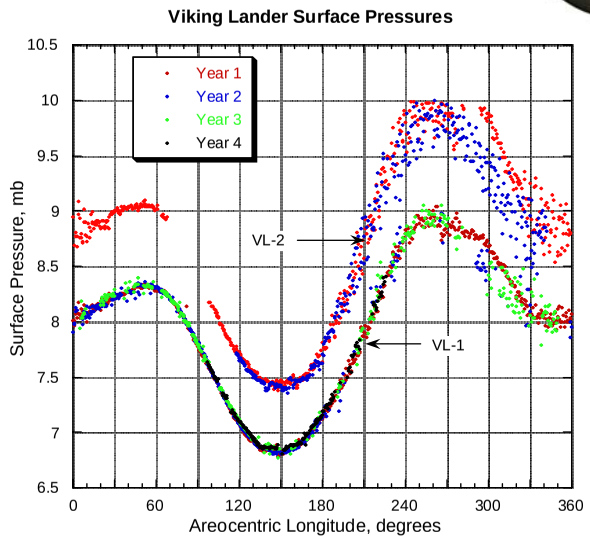
(3) Provide a basis for comparative planetary meteorology

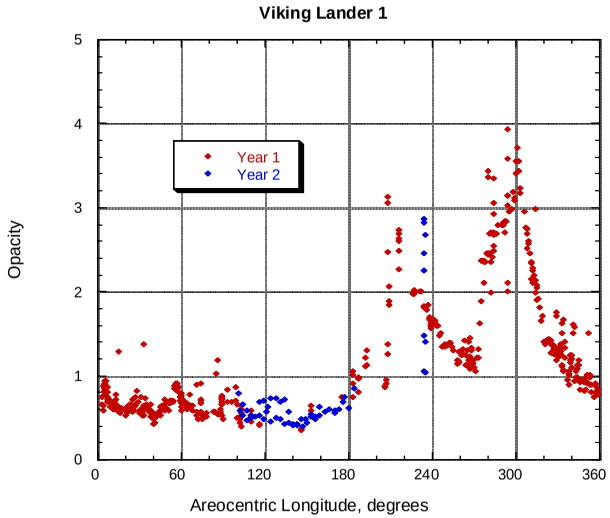
(4) Provide a weather monitoring infrastructure for future missions and synergy for all observations

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

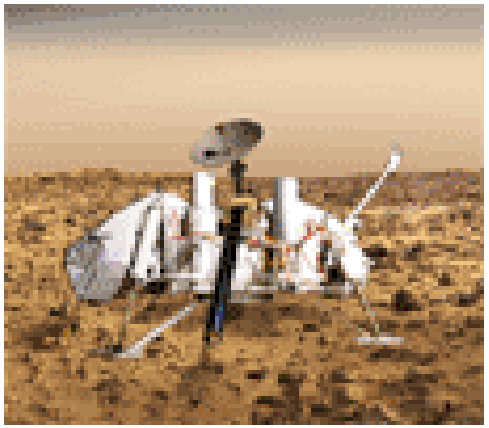
Pressure and Opacity Are the Most Important Measurements

- Pressure gives column mass
  - *Pressure gradients related to winds*
- Opacity gives the forcing
  - *Measures extinction of solar radiation*
- The combination also gives
  - CO_2 cycle
  - Dust cycle





Mission Design Philosophy



Capable landers:

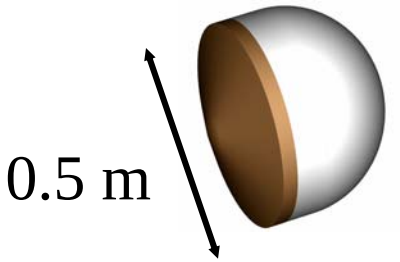
- Address multiple disciplines
- Become heavy and expensive
- Cannot deliver enough landers

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

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

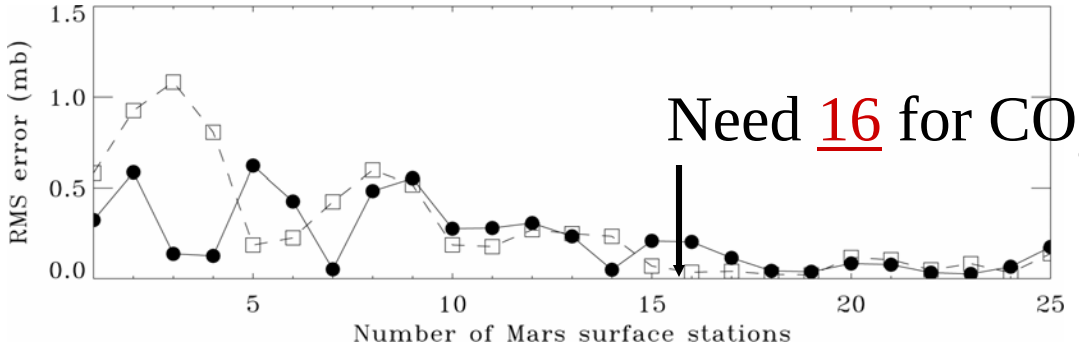
No. Stations

5

5x4 = 20

20-4 = **16**

CO_2 Cycle



Need 16 for CO_2 cycle

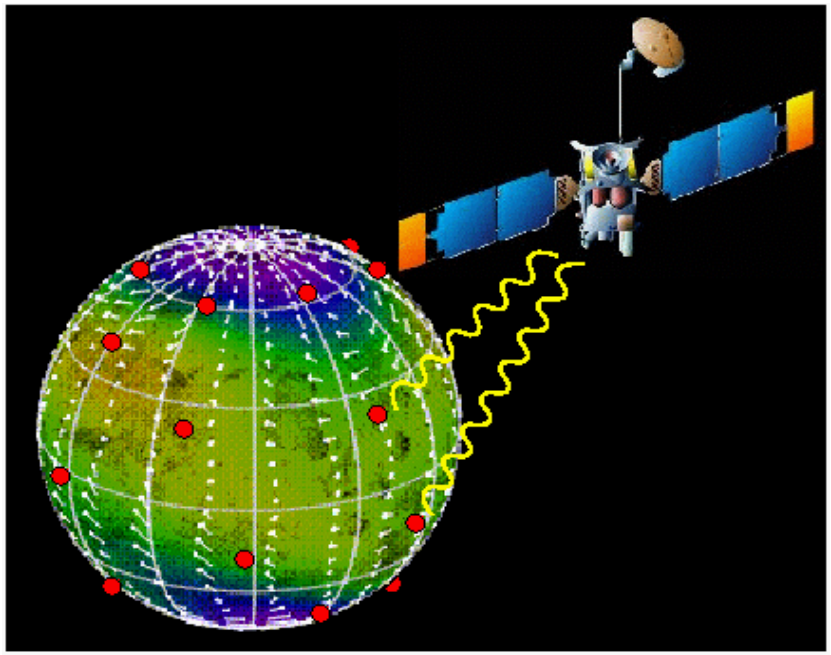
The Pascal Mission

Global network of 18 weather stations

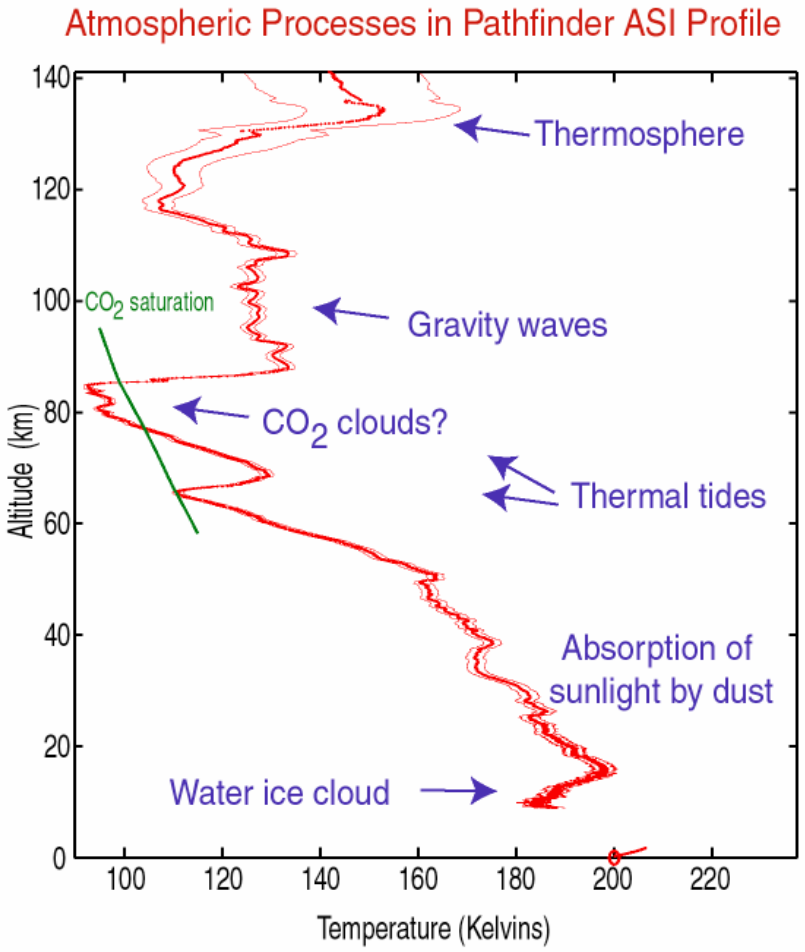
Stations operate for 3 Mars years

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)



Pascal EDL Measurements



Entry Science

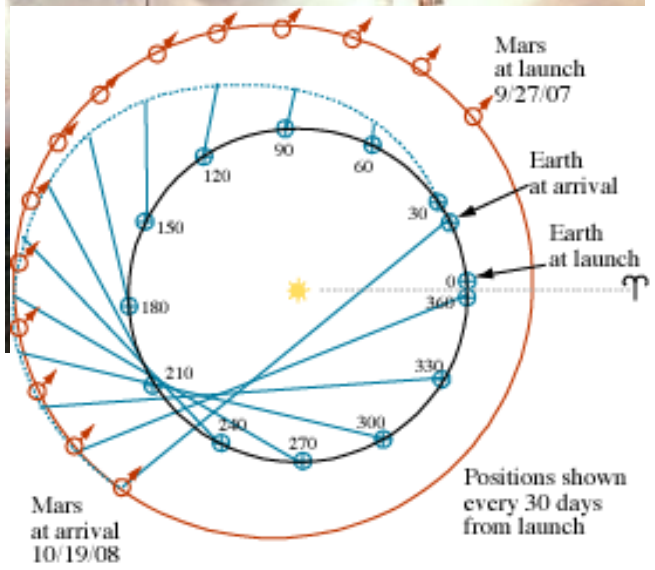
- 18 T-profiles
- 10-80 km
- Global
- Late AM/PM local times

Descent Imaging

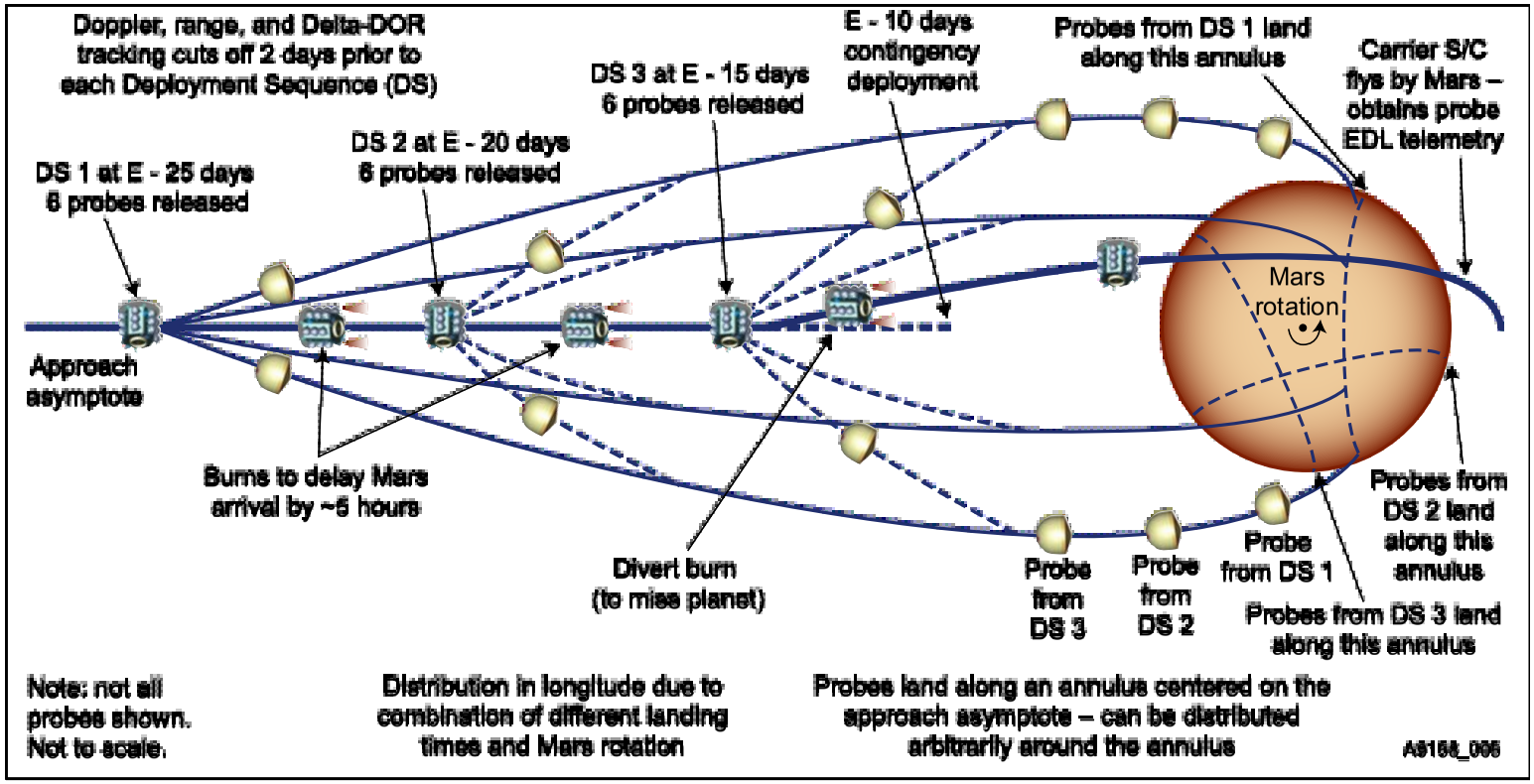
- ~ 10 images
- Res: >30 cm/pix

Mission Concept

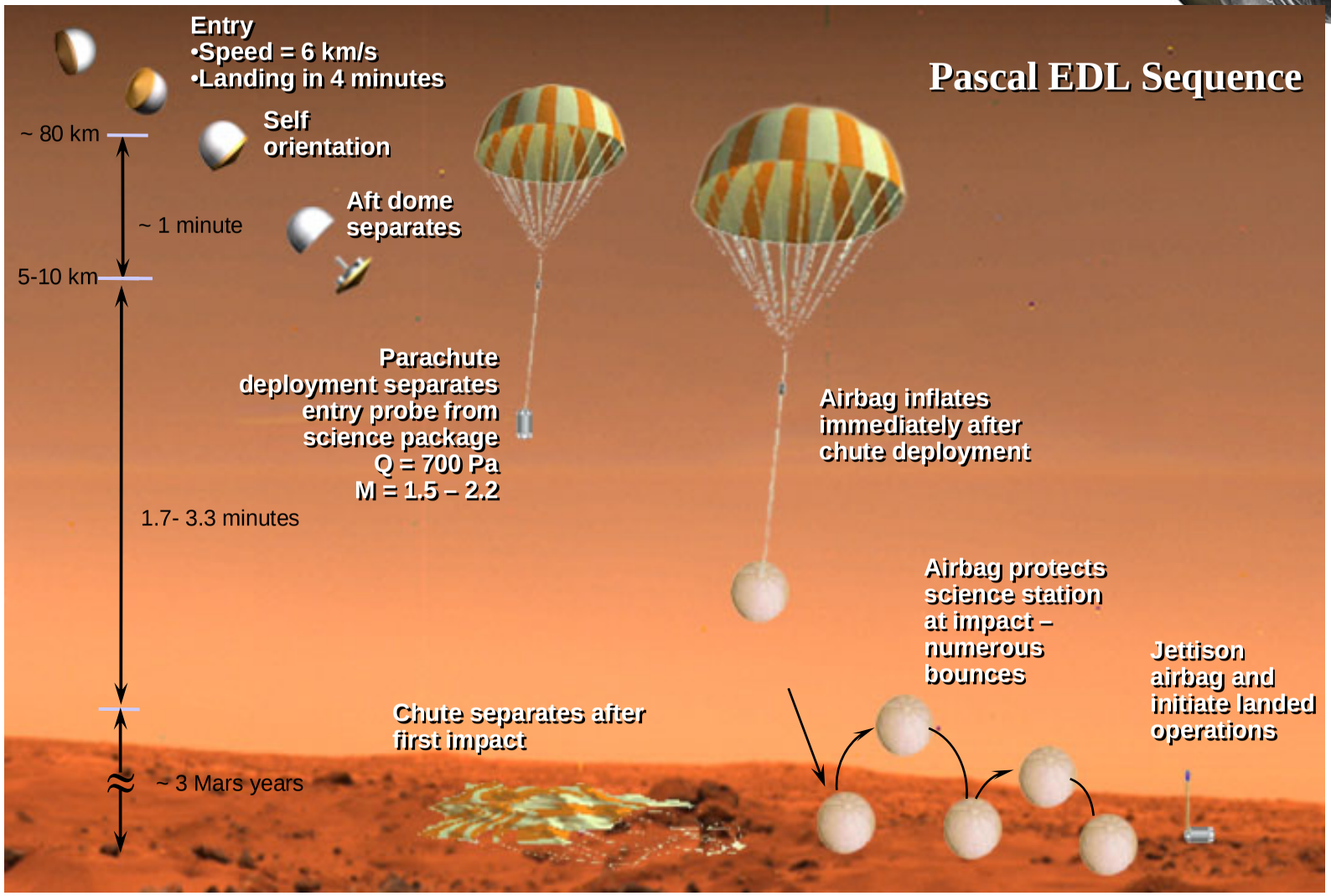
- **Launch:** 9/27/07 (20 day window)
  - Delta III-3940
  - Type II trajectory
- **Mars arrival:** 10/19/08 (L_s=146°)
  - Release probes on approach
- **Probe entry, descent, and landing:**
  - Aeroshell, Parachute, Air bags
  - Entry data stored for later transmission
  - No communication during EDL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



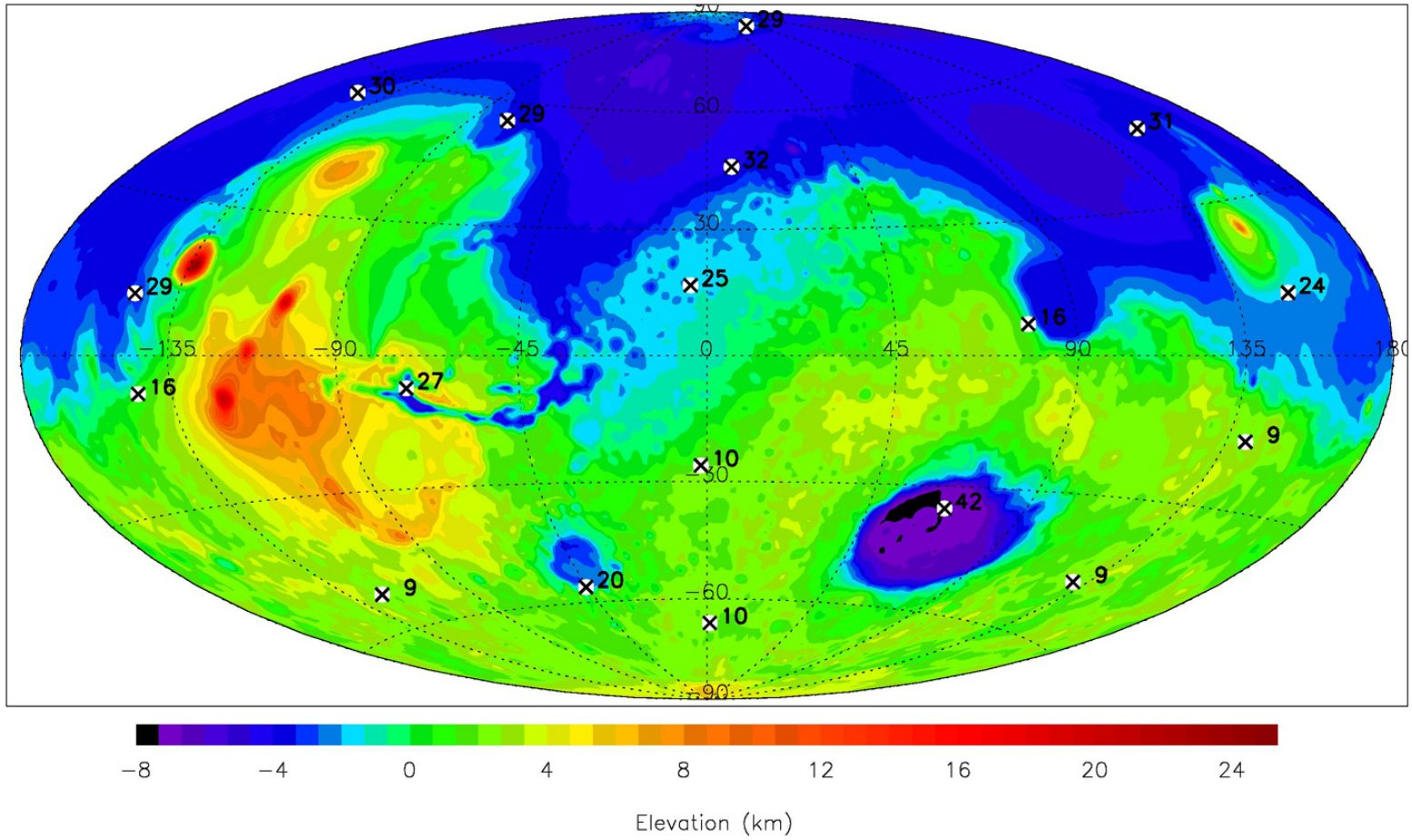
Pascal Probe Deployment Sequence



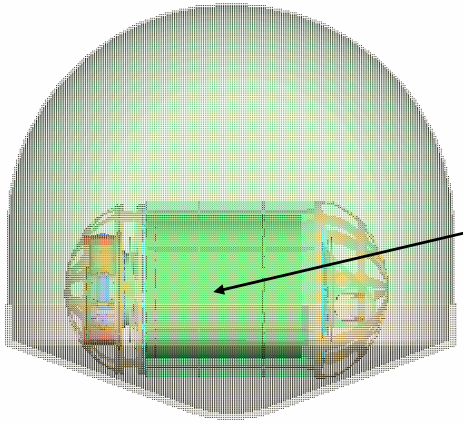
Pascal A Mars Climate Network Mission



Sample Network Configuration

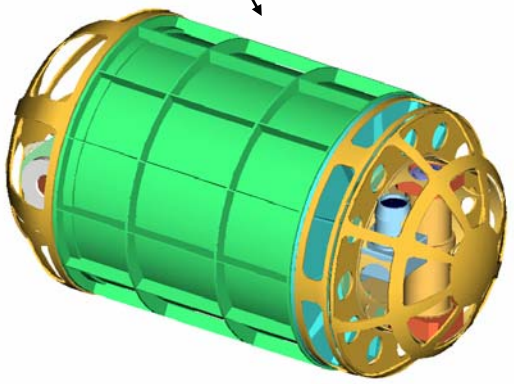


Probe Entry System



0.5 m

Science Station



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

The NASA Ames GCM & Probes

Excellent tool to plan EDL:

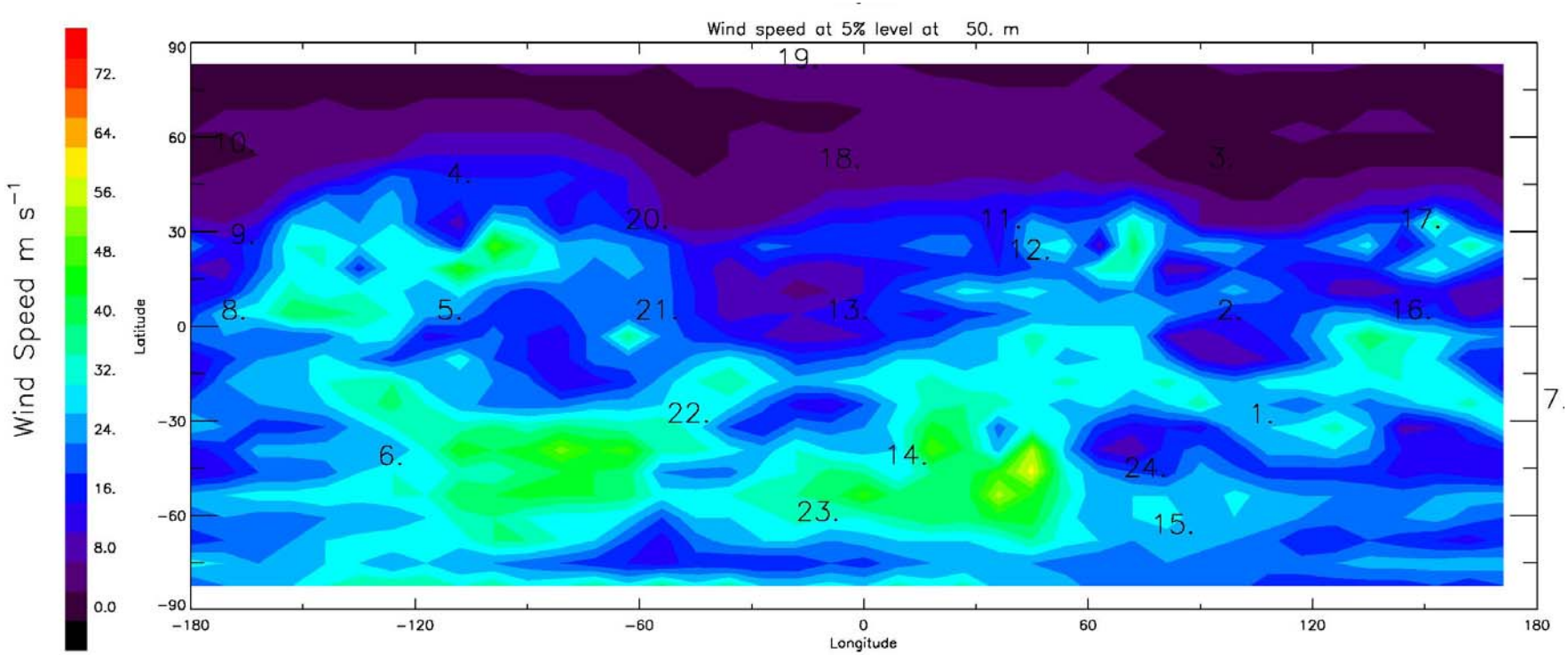
- Winds
- Atmospheric density

Provides BC's for Mesoscale Models:

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

Pascal would provide the BEST validation of the GCM

Predicted 3σ Winds at z = 50 m for Ls = 140



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