ATMOSPHERIC SCIENCE EXPERIMENT FOR MARS – ATMIS FOR THE NETLANDER 2005 MISSION.

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Introduction. ATMIS (Atmospheric and Meteorological Instrumentation System) is a versatile suite of atmospheric instrumentation to be accommodated onboard the Netlander Mission slated for launch in 2005. Four Netlanders are planned to form a geophysical measurement network on the surface of Mars. The atmospheric sciences are among the scientific disciplines benefiting most of the network concept. The goal of the ATMIS instrument is to provide new data on the atmospheric vertical structure, regional and global circulation phenomena, the Martian Planetary Boundary Layer (PBL) and atmosphere-surface interactions, dust storm triggering mechanisms, as well as the climatological cycles of H_2O, dust and CO_2. To reach the goal of characterization of a number of phenomena exhibiting both spatial and temporal variations, simultaneous observations of multiple variables at spatially displaced sites –forming a network – are required. The *in situ* observations made by the ATMIS sensors will be supported by extensive modeling efforts.

Vertical Structure of the Atmosphere. The atmospheric vertical structure is a function of local time, latitude, season, and dust loading. The NetLander will measure profiles of density (ρ), pressure (p), wind (V), and temperature (T). Currently only three vertical *in situ* profiles of density, pressure, wind, and temperature have been obtained, two daytime profiles from the Viking Landers and one night-time profile from the Pathfinder ([1], [2], [3]). The lander missions in implementation phase up to 2003 will perform only acceleration measurements during their entries, but no direct temperature or pressure measurements, hence underlining the significance of the ATMIS/NetLander experiment.

Atmospheric Flows. The key components of the Martian global circulation identified to date are ([5]): a Hadley cell between the summer hemisphere tropics to the winter hemisphere subtropics, baroclinic eddies in the winter hemisphere, stationary eddies induced by topographical and other surface variations, condensation/sublimation flow between the CO_2 polar caps, thermal tides, and normal mode oscillations (Figure 1). The main ATMIS-measured variable is p, supplemented by T, V, relative humidity (RH) and optical thickness (τ) observations at the surface as well as by global/synoptic scale orbital measurements. In the landing site selection the small number of landers forces a choice between either a more regional/sub-global focus or a wide site dispersion and hence poor observational correlations between the landers. As a result the four-lander network's global circulation investigations are limited to some – but not all – of the circulation components above. Longitudinal site coverage can account for the effect of large topography features and to resolve atmospheric waves extending over many longitudes. A robust characterisation of the full global circulation requires a more comprehensive surface network, using, *e.g.* [6].

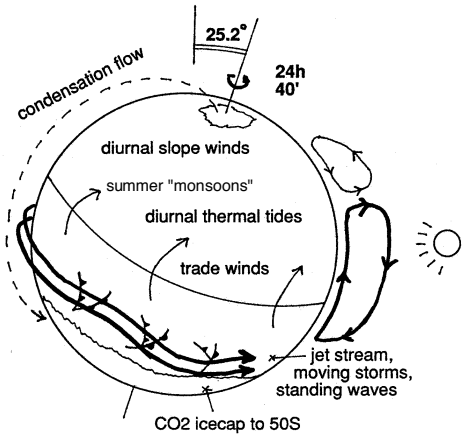

Fig. 1. Schematic representation of the main Martian wind systems during northern hemisphere midsummer [4].

Boundary Layer Observations. Based on the *in situ* surface observations, estimates have been made of PBL parameters such as stability, fluxes and the growth of the mixed layer up to the first inversion, ([7]). Resolution of PBL height and similar questions as well as the improvement of the descriptive models require observations at different latitudes, and sites with differing roughness and albedo.

Instrument. The ATMIS comprises sensors for the descent phase vertical profile of atmospheric pressure, temperature and density, as well as for surface pressure, temperature, wind, optical thickness and humidity. ATMIS benefits from the heritage of instruments already built for missions as Mars-96, Huygens, Pathfinder, as well as the Mars Polar Lander. The characteristics of the atmospheric conditions and phenomena anticipated to occur at tentative NetLander landing regions, as well as the design and the predicted performance of the ATMIS are discussed.

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