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Mars Exploration – Science, Instruments and Technologies (3B)

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MARS BOUNDARY LAYER EXPLORER - A SYSTEM AND MISSION CONCEPT FOR A
BALLOON-BORNE ATMOSPHERIC PROBE**Abstract**

Observations of the atmospheric processes within the planetary boundary layer are crucial to generally understand the dynamics and energy balance in the lower atmosphere as well as to prepare for and to de-risk entry, descent and landing operations for future human class landing crafts. Related investigations over scales from local to global and diurnal to seasonal are cross-cutting between each other and have been identified by the Mars Exploration Program Analysis Group (MEPAG) as high priority investigations for the upcoming years. Balloon-borne instruments could bridge the gap in both temporal and spatial resolution in mesoscale distances between local, lander-based surface stations and global, orbiter-based observations. The basic idea to use a balloon system for such purposes is not new in essence and has been proposed already in various concepts of operation. Most concepts considered such balloon systems however as main or primary mission with the balloons being inflated airborne during the descend phase of the carrier entry vehicle. With a diameter of about 7m, the balloon proposed here is – with regard to earlier Martian balloon concepts – a comparatively small system. Its floating altitude is selected to stay within the convective layer in order to observe its daily build-up. The inflation and launch strategy for such a small probe outlined in this paper focuses on launching it from the Martian surface, e.g. off the payload deck of a lander. The probe is designed to consider mass and volume budget constraints typically imposed for payloads being accommodated on the payload deck of landing vehicles such as e.g. the NASA Phoenix/InSight class lander or an ESA Exomars type landing platform. This paper presents the feasibility assessment for this instrument and gives further details on the scientific and operational concept, its technical components – with a focus on the balloon hull, its inflation system and the gondola – and the associated budget estimates. In particular it addresses also the risks involved in automatically launching such balloon-system from the Martian surface.