Thermal Design Considerations for Integration of the DWTS Instrument in a Nano-Satellite

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The Doppler Wind and Temperature Sounder instrument (DWTS) developed by Global Atmospheric Technologies and Sciences (GATS) will measure the dynamics of the upper atmosphere. At the core of DWTS is a mid-wave infrared camera paired with a nitrous oxide gas cell, which acts as a scanning spectral filter. Wind velocities and kinetic temperatures in the stratosphere and lower thermosphere are extracted by measuring the induced Doppler shift and Doppler broadening of emissions as they pass through the DWTS field of view. The DWTS could potentially improve accuracy in predicting weather determination among other terrestrial benefits, and the technology can be adapted to study the dynamics of other planetary atmospheres. In partnership with GATS, NOAA, NASA Ames Research Center is preparing to evaluate the DWTS instrument on a nano-satellite. The first technology demonstration will involve a single DWTS instrument in an approximately 2U payload volume. With an estimated power consumption of 50 watts, the instrument will maintain the imaging focal plane array at 80 K with an integrated Stirling cryocooler. To enhance the DWTS sensitivity, it is also desired to cool the lens assembly to 150 K. A subsequent mission will involve validating the instrument's full altitude coverage capabilities, currently estimated from 20 to 200 km during both day and night. This new atmospheric observational capability will come from a single small satellite equipped with three DWTS imagers, each hosting a different gas cell chemistry. The intention of this flight series is not only to advance understanding of Earth atmospheric dynamics but to advance an instrument for the study of Martian atmosphere. This paper will provide an overview of the planned approach in meeting the thermal requirements of DWTS for the initial flight mission, within the constraints of a 'U-Class' spacecraft.