Phoenix CubeSat

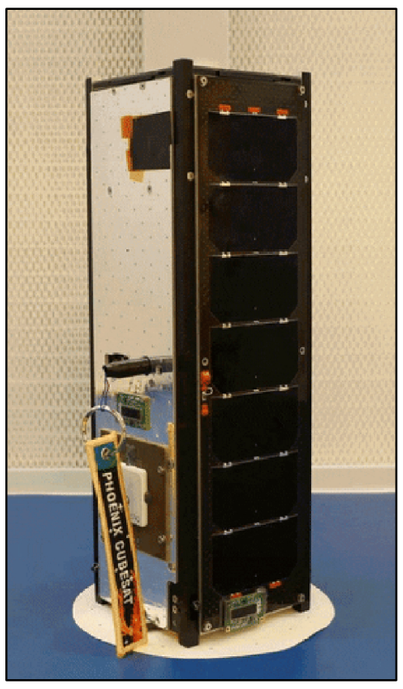
Spacecraft to study the impacts of Urban Heat Islands on the Environment

Project Overview

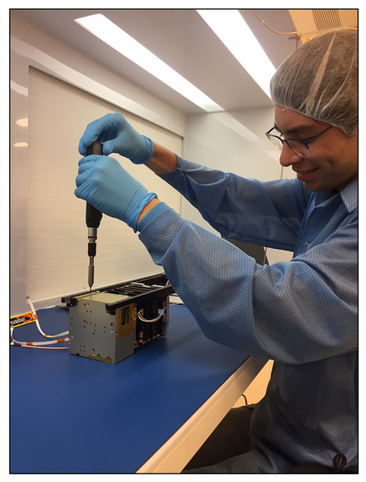
Phoenix is a 3U CubeSat designed to study the effects of Urban Heat Islands (UHIs) on major US cities through infrared remote sensing

The project is ASU's first fully student-led CubeSat project. The team was primarily comprised of undergraduate students with minimal graduate student involvement

Funded by NASA USIP and the NASA Space Grant Consortium in 2016, Phoenix has provided ~80 students in engineering and science backgrounds with significant experience in interdisciplinary teamwork, systems level design, testing and validation, industry--standard documentation, and project management. The project has since spearheaded the future involvement of undergraduate students in cubesat proposals at ASU



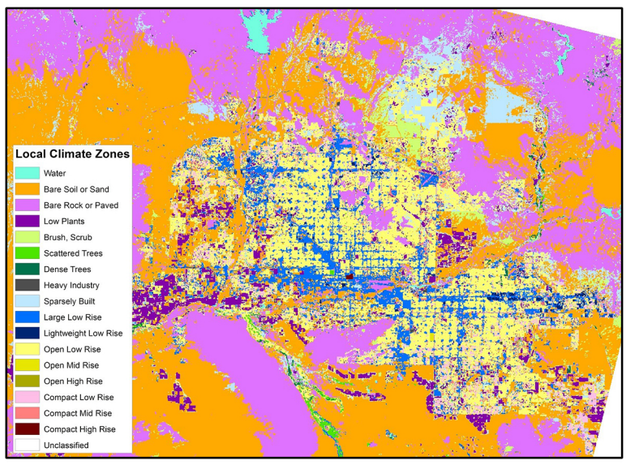
Fully Assembled CubeSat[3]

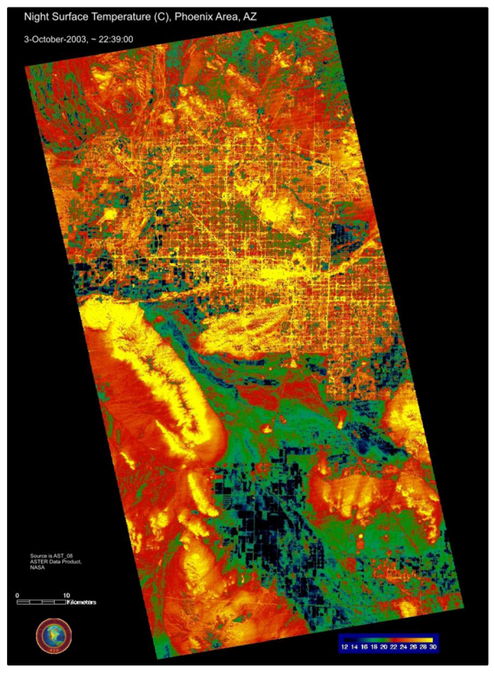


Images : Student Team Pictured in the lab [4] (top-left), Jaime Sanchez de la Vega assembling the flight model[5] (top-right), Sarah Rogers and Vivek Jacob Chacko perform system testing with lab ground station[6] (bottom-right)

Scientific Motivation

The Urban Heat Island Effect contributes to rising surface temperatures as materials, such as concrete and asphalt, retain heat throughout the day. During the evening, this energy is released back into the environment, which reheats the ground and air, creating warmer nighttime temperatures. The effects of UHIs are further increased by building density, local geography, and city size.





Images: Local Climate Zone map of Phoenix, AZ (left) [1], thermal image of Phoenix, AZ (right) [2]

Phoenix aims to classify how the makeup of our cities contributes to UHIs, and how this phenomenon can be mitigated by improvements to urban planning. To do this, thermal images captured by the spacecraft will be overlaid with maps of Local Climate Zones (LCZs), which classify land based on surface structure and surface cover. Therefore, by analyzing the relative temperature within a city, we can infer how urban planning can be best optimized to make our cities cooler and more sustainable and provide feedback to urban planners to combat climate change.

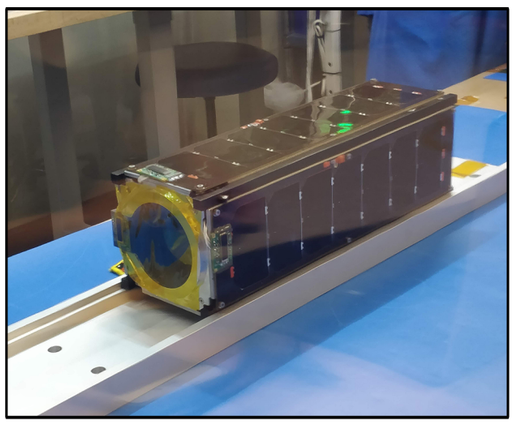
All scientific findings and satellite telemetry will be made publicly available on the project website:

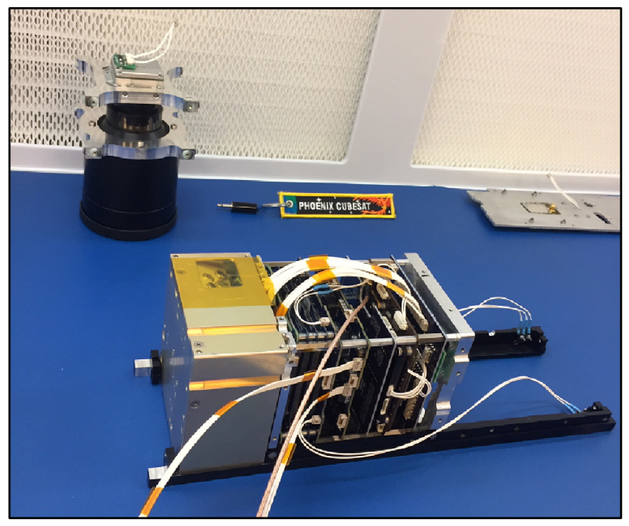
phxcubesat.asu.edu

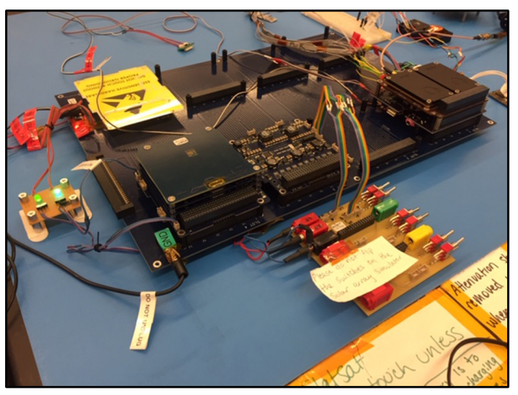
Scan the QR code to visit webpage

System Overview

- Orbit: 400 km altitude, 51.6° inclination, 2-year mission lifetime
- Comprised of COTS components, with interface boards designed by the student team to support harnessing and data/power routing
- 3U Structure designed and fabricated by the student team
- **Attitude control**
  - 3 reaction wheels, 3 magnetorque rods
- **Attitude determination:**
  - 2 Earth Limb Sensors, 6 external sun sensors, magnetometer
- **Power generation:**
  - 2 body solar panels, Clyde Space 40Whr battery, ClydeSpace 3U EPS
- **Communications**
  - TX/RX: UHF amateur bands (437.35 MHz)
  - ASU Ground station will be used for operations
- **Payload Specifications:**
  - FOV: 6.2° x 5° (43.5km x 35 km ground footprint)
  - Imaging band: 7.5 - 13.5 µm
  - Image resolution: 68 m/pixel (best)
    - Finer resolution than Aster (90 m/pixel) and Landsat (100 m/pixel)







Images : Flatsat[5] (bottom-left), Fully assembled cubesat before final integration[3] (top-left), Flight hardware during preparation for assembly[5] (bottom-right)

Picture Courtesy

[1] Ariane Middel Chuyuan Wang, Shai Kaplan, Jonas Lukasczyk Soe W Myint Anthony J Brazel,(in preparation) Local Climate Zones in Arid Cities An Assessment for Phoenix, AZ and Las Vegas, NV, USA, Remote Sensing of Environment
[2] Tan, Howard L. "Urban Change." NASA, NASA JPL, https://asterweb.jpl.nasa.gov/content/03_data/05_Application_Examples/urban/.
[3] Vivek Jacob Chacko [4] Craig Knoblauch [5] Sarah Rogers [6] Rob Burnham

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Arizona Space Grant Consortium