

The ERAST Pathfinder Mission Over Kauai

Key Investigator: Steven Dunagan

NASA Ames Research Center, Earth Science Division,
Ecosystem Science and technology Branch

A science team comprised of researchers from the Earth Science Division at Ames Research Center and collaborators from around the country in a number of earth science disciplines participated in a remote sensing mission on the Hawaiian island of Kauai from September to November of 1997. The mission was exploratory in nature, with a variety of potential target areas in the general categories of plant canopy chemistry and coastal zone studies. The mission focused on evaluating the ability of two newly developed uncrewed aerodynamic vehicle (UAV) instruments in these study areas. Data were collected with the instruments installed on the ERAST Pathfinder UAV and on a supporting twin engine light aircraft.

Instruments included the airborne real-time imaging system (ARTIS) and visible and near-infrared digital array scanned interferometer (VNIR-DASI). ARTIS is comprised of a Kodak 460 color infrared camera sensor with a number of enhancements that permit autonomous operation and fast downlink of high resolution image data. The focal plane array (FPA) is 2000 by 3000 pixels with a red/infrared, blue, and green 3-color mosaic filter overlay. Accompanying interpolation software processed the raw 6 Mbyte image to an enhanced 18 Mbyte image with interpolated 3-band values

for each pixel. This instrument provided excellent spatial coverage and resolution within minutes to the research team on the ground. The pseudo-spectral mapping provided information on infrared reflection that was useful in the analysis of chlorophyll reflectance, particularly in regions of low spatial gradients.

The VNIR-DASI is an imaging interferometer with the capability of providing very high spectral resolution imagery. Fore-optics create a spatial distribution of 1-dimensional interferograms at the silicon charge coupled (CCD) FPA detector. Individual interferogram columns may be converted to spectra via the fourier transform process to define a single pixel in object space. A single FPA frame comprises a row of pixels. As the aircraft flies over the target area sequential frames are read out, scanning out an image hypercube. ARTIS and VNIR-DASI are complementary, offering the emphasis of high spatial or spectral resolution as needed for specific measurement objectives.

Sample data are presented on the image on the reverse. ARTIS images are presented for four of the approximately 500 sites collected for Kauai (approximately 1450 sites through the entire state). Study objectives associated with these sites include: forest dynamics along an altitude gradient in a native Koa and Ohia forest (Image 1), sugar cane crop stress and pest infestation (Image 2), papaya crop stress and evidence of pathogens (Image 3), and coastal water bio-chemical constituents and sedimentation (Image 4). While not apparent in these thumbnail images, full resolution ARTIS images presented excellent spatial detail. False color adjustment of the 3 color "bands" permits the emphasis of some broad spectral features. Vegetation mapping, for example, works very well using the red-infrared "band."

Sample data from VNIR-DASI are presented for a site in the Waimea Canyon. The 400 element spectral dimension of the image hypercube was integrated into G user defined bands (similar to the Landsat bands) to provide a quick-look image. Three of these bands, corresponding to the eye sensitivity ranges for red, green and blue, were used to construct Image 5.

Kauai

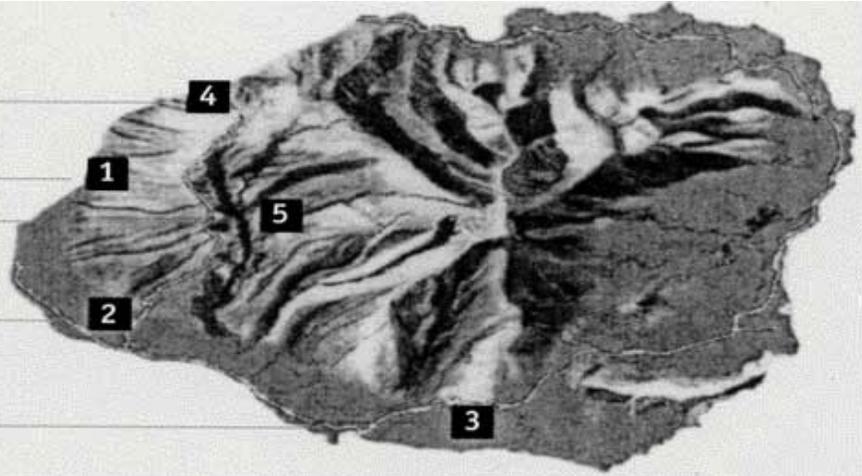
Na Pali Coast

Mesic Koa Ohia Forest

Waimea Canyon

Sugar cane fields

Coffee fields

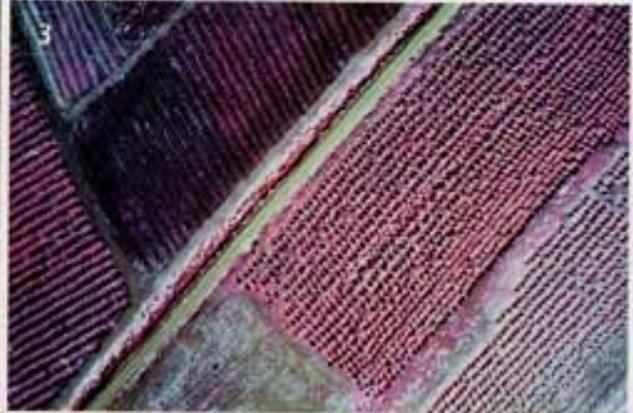


ERAST Pathfinder Mission

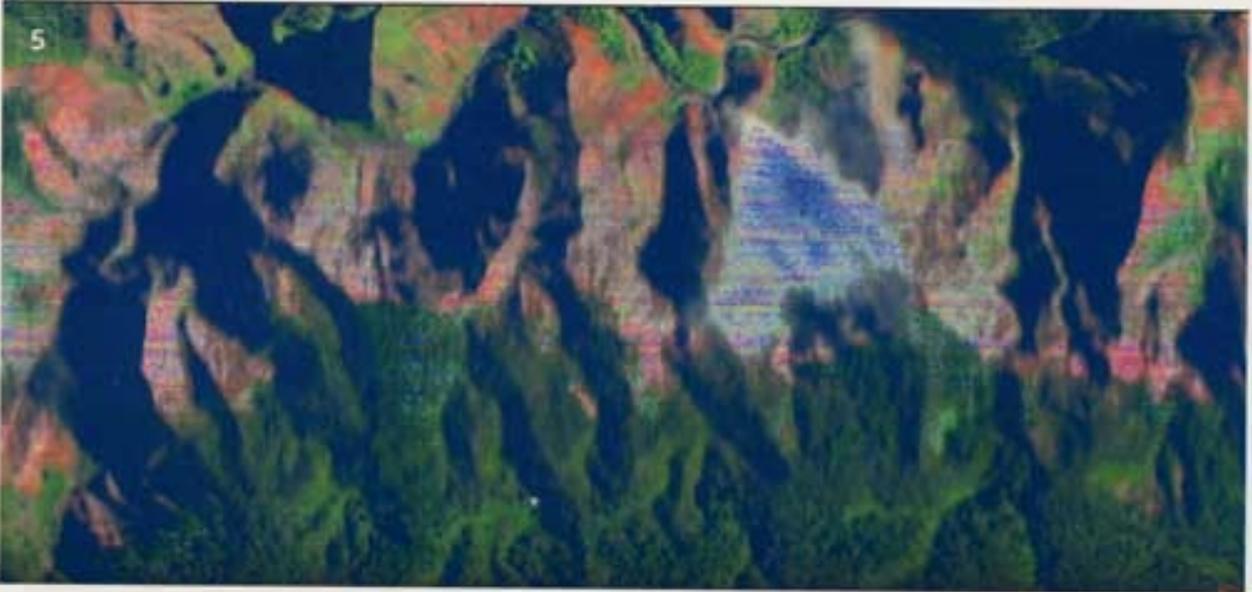
Over Kauai



ARTIS IMAGERY



DASI IMAGERY



- 1** Mesic Koa Ohia Forest
- 2** Sugar cane fields
- 3** Coffee fields
- 4** Na Pali Coast
- 5** Waimea Canyon