Hawaii Volcano Plume and Water Vapor From Satellite and Ground Measurements

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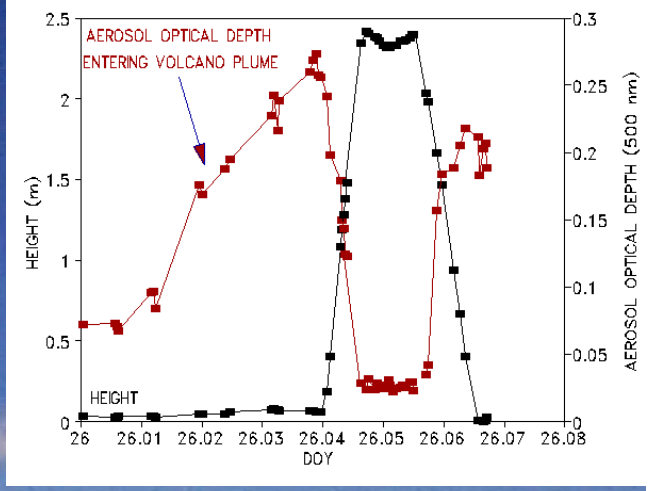
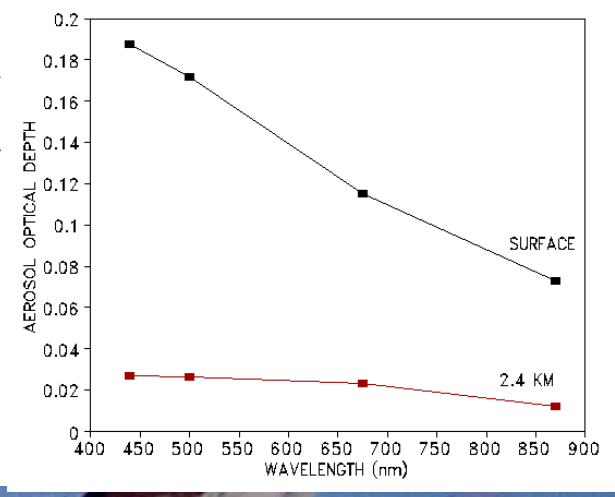
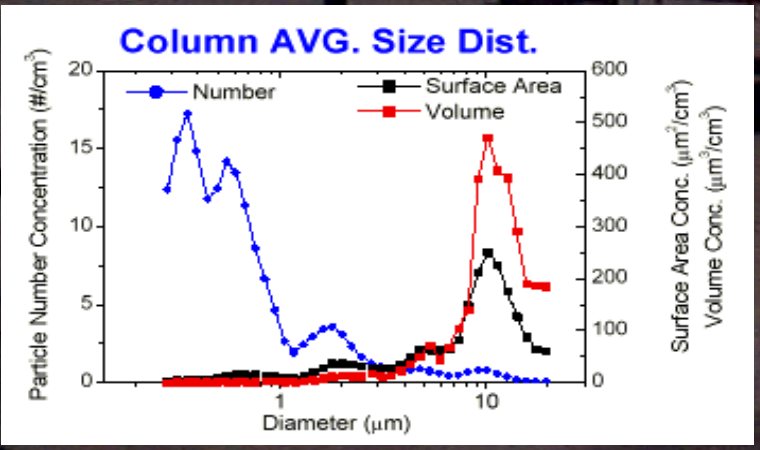
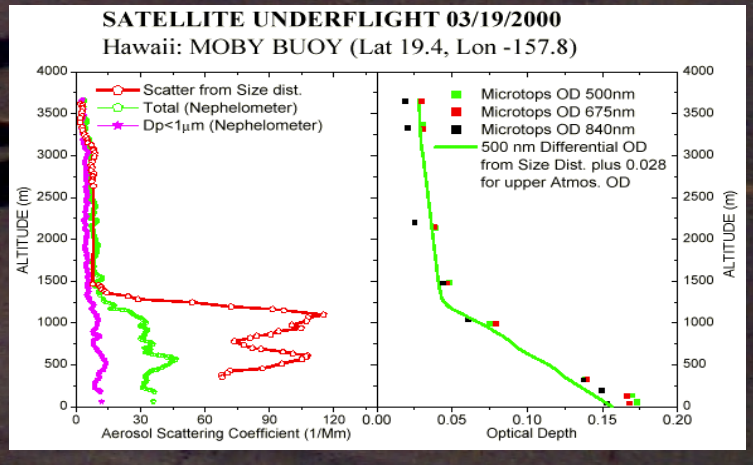
Aerosol Measurements and Optics
Satellite VOG Measurements
Lidar Measurements
Satellite Water Vapor Measurements

Satellite Aerosol Validation Efforts In Hawaii







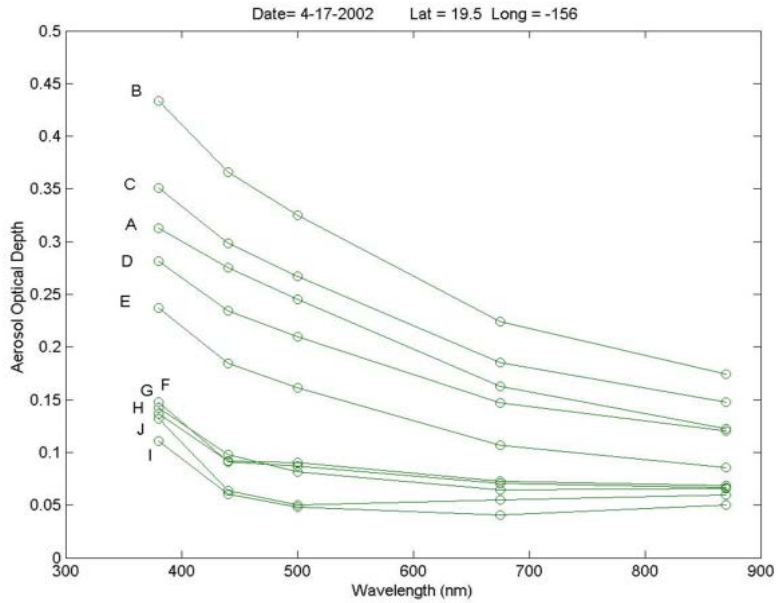


Porter, J. N., A.D. Clarke, and B. R. Lienert, Aircraft/Surface Derived Aerosol Optical Properties Near Hawaii For Satellite Validation, Proceedings of the SPIE Remote Sensing of the Atmosphere, Environment and Space, Sendai, Japan, ISBN 0-7803-6362-0, 167-174, 2000.

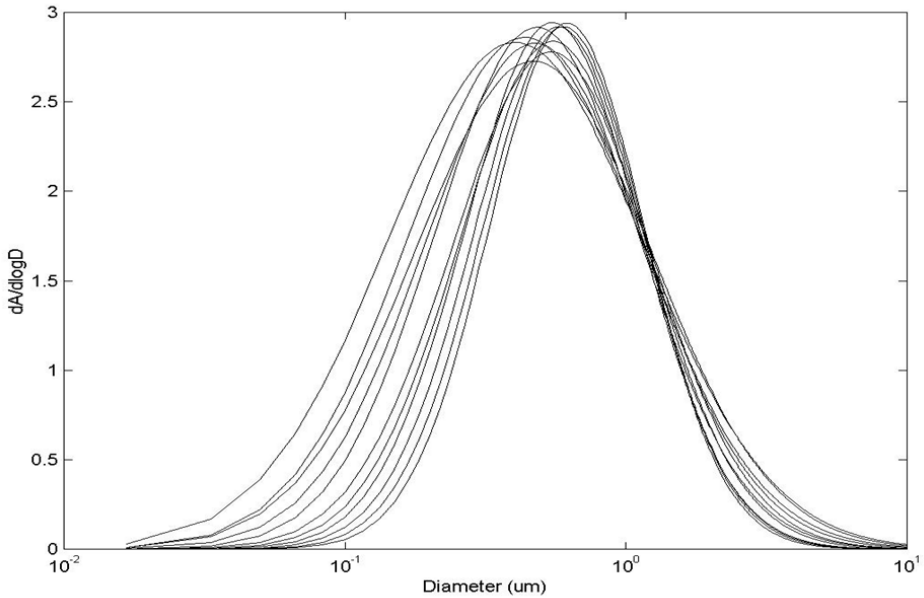
Porter, J.N. A. Clarke, J. Reid, G. Shaw, E. Reid, D. Kress, B. Lienert, Handheld Sun Photometer Measurements From Light Aircraft, J. Atmos. Ocean. Tech., 24, 1588-1597, 2007.

Volcano Aerosol Size Distribution Inverted From Spectral Sun Photometer Measurements

Aerosol Optical Depths



Volcano Aerosol Area Size Distributions



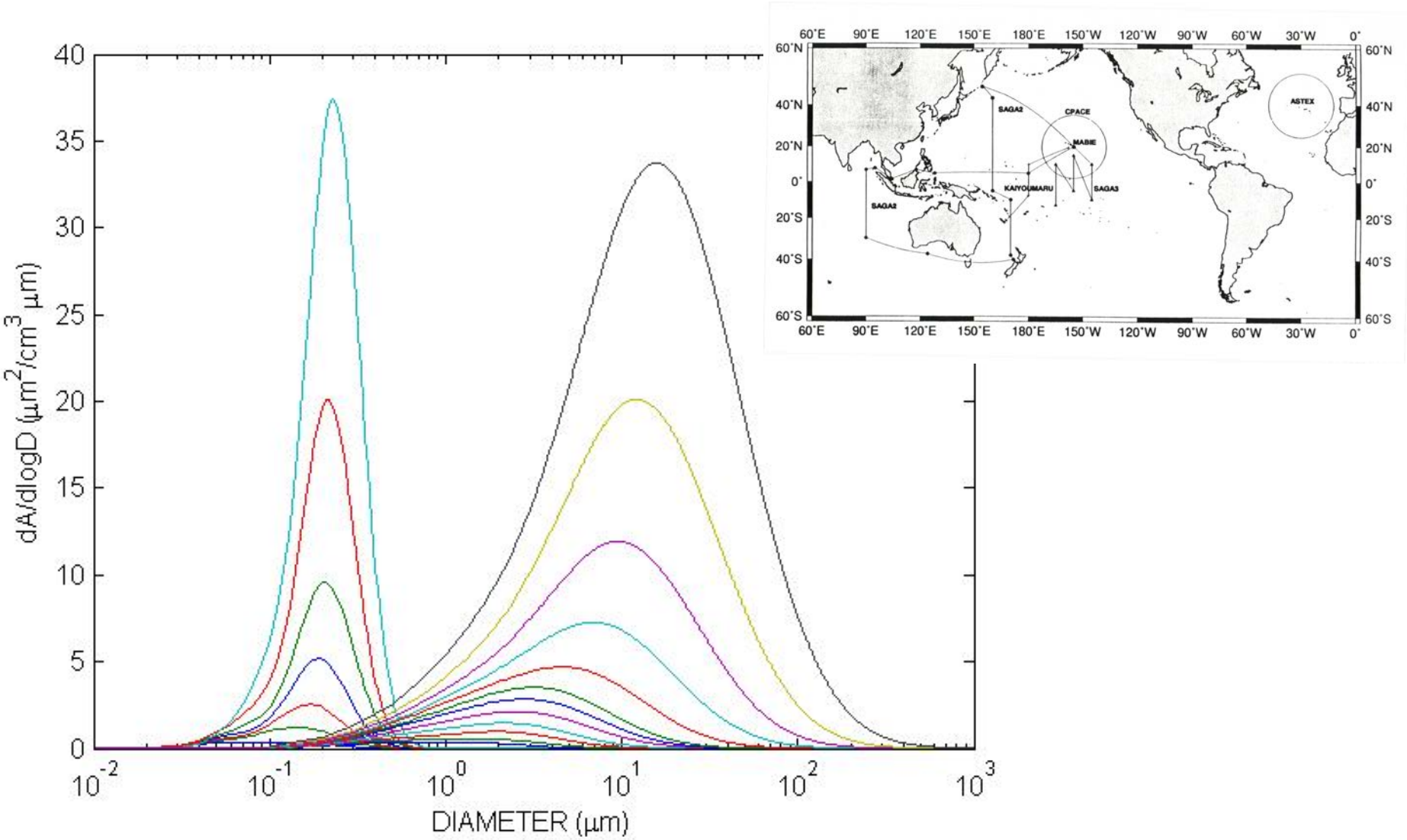
Aerosol size distribution models based on inversion of wavelength dependent sun photometer measurements in the volcano plume. Volcano plume aerosols are accumulation mode aerosols below 1 um diameter.

Porter, J, M. Miller, C., Pietras, and C. Motell, Ship-Based Sun Photometer Measurements Using Microtops Sun Photometers, Journal of Atmospheric and Oceanic Technology, 18, 765-774, 2001. (Basis of approach used in the NASA Marine Aerosol Network, MAN)

Lienert, B.R., J.N. Porter, and S.K. Sharma, Repetitive Genetic Inversion of Optical Extinction Data, Applied Optics, 40, 21, 3476-3482, 2001

Frouin, R., B. Holben, M. Miller, C. Pietras, E. Ainsworth, J. Porter and K. Voss, Sun and Sky Radiance Measurements and Data Analysis Protocols, chapter 14 in Ocean Optics Protocols for Satellite Ocean Color Sensor Validation, Revision 3, Volume 2, NASA/TM-2002-210004/Rev3-Vol2, pg 211-230, 2002.

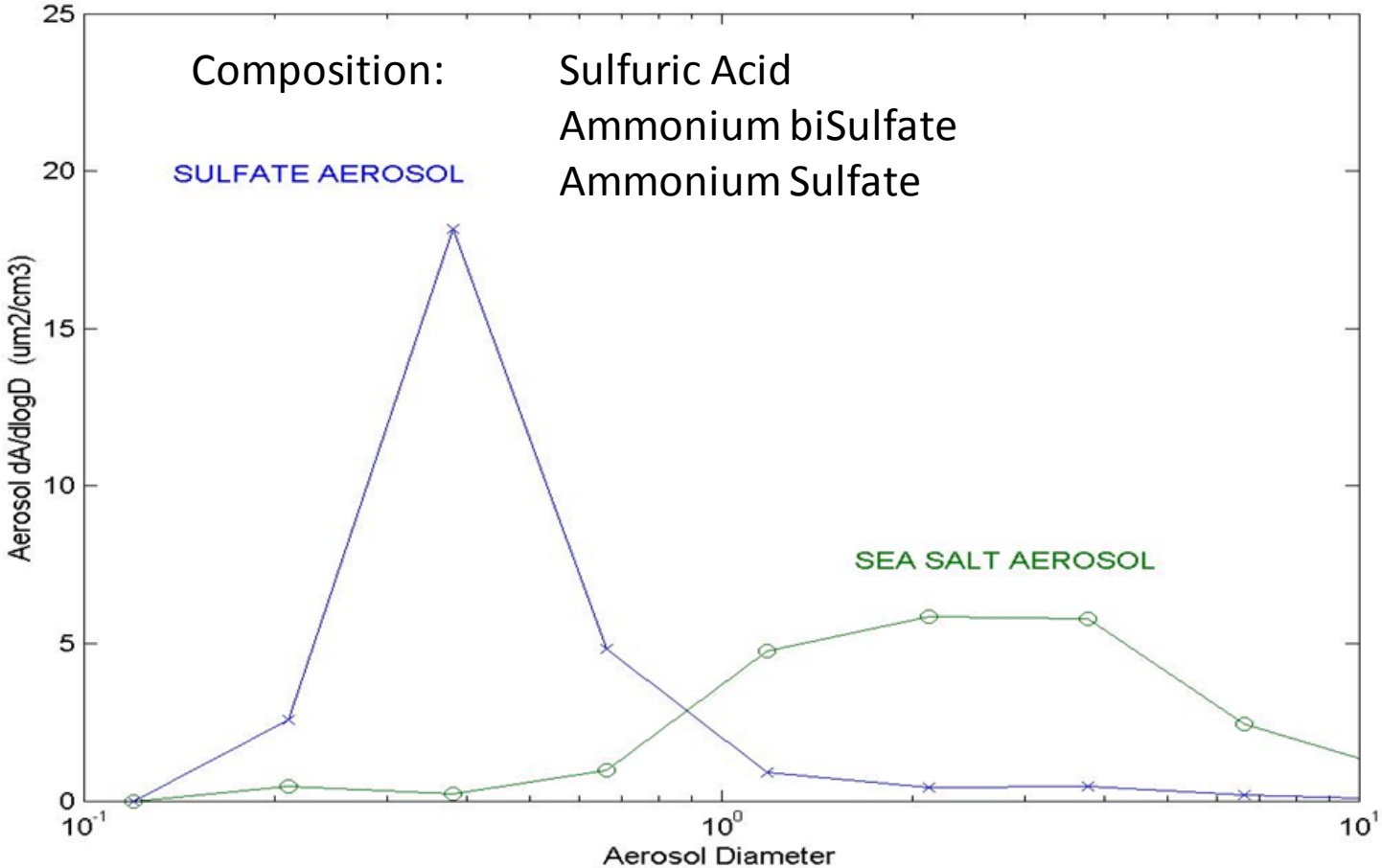
Aerosol Size Models To Constrain Satellite Retrievals



Aerosol size distribution models based on *in-situ* aerosol measurements.

Porter, J., and Clarke, A., Aerosol Size Distribution Models Based on In-Situ Measurements. J. Geophy. Res., 102, 6035-6045, 1997.

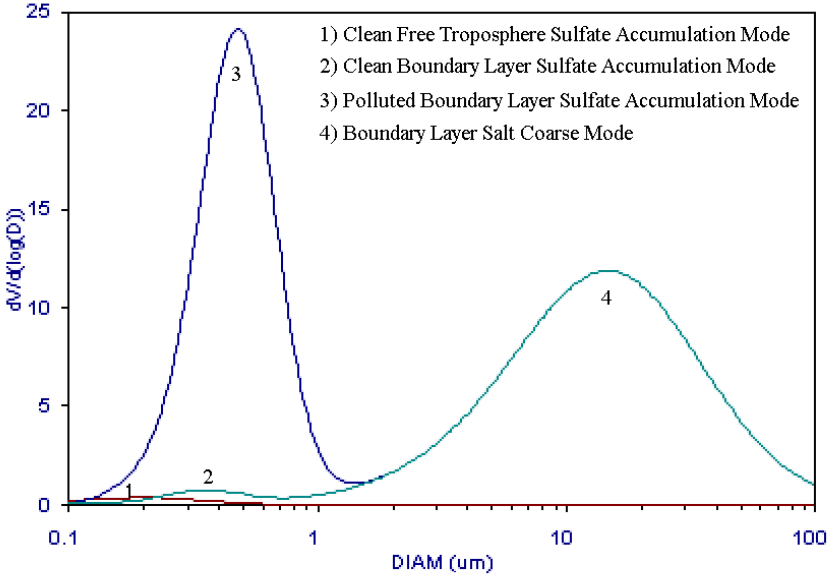
Volcano Plume Aerosol Chemistry

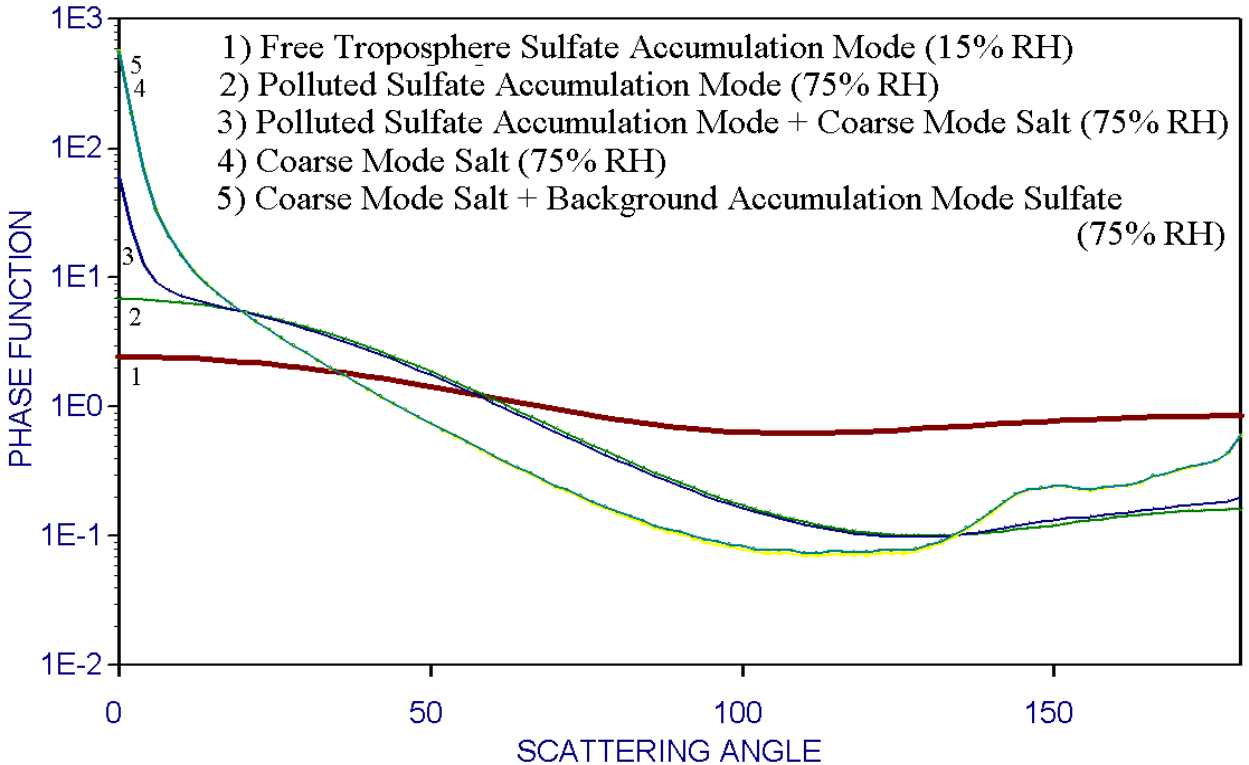


Aerosol size area distribution measured in Kona, Hawaii (Captain Cook, DOH sampling site) with a Moudi Impactor and IC analysis. The aerosol neutralization was between ammonium bi-sulfate and ammonium sulfate. This larger neutralization was likely due to the nearby fields which have ammonia based fertilizer (Porter, Chuang, Huebert, Howell, unpublished).

Common Aerosol Size Dist. and Their Phase Functions

(at 500 nm)

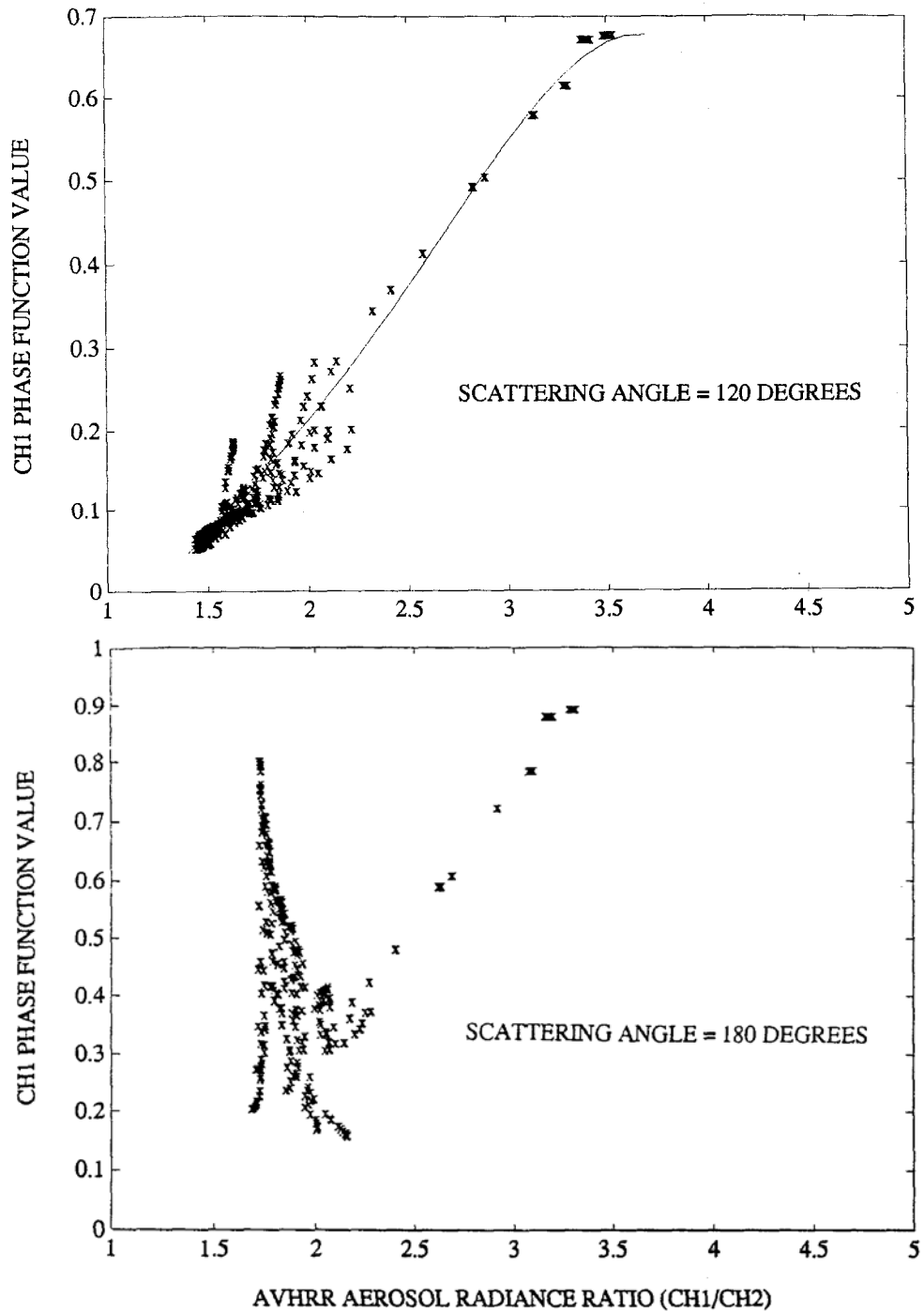




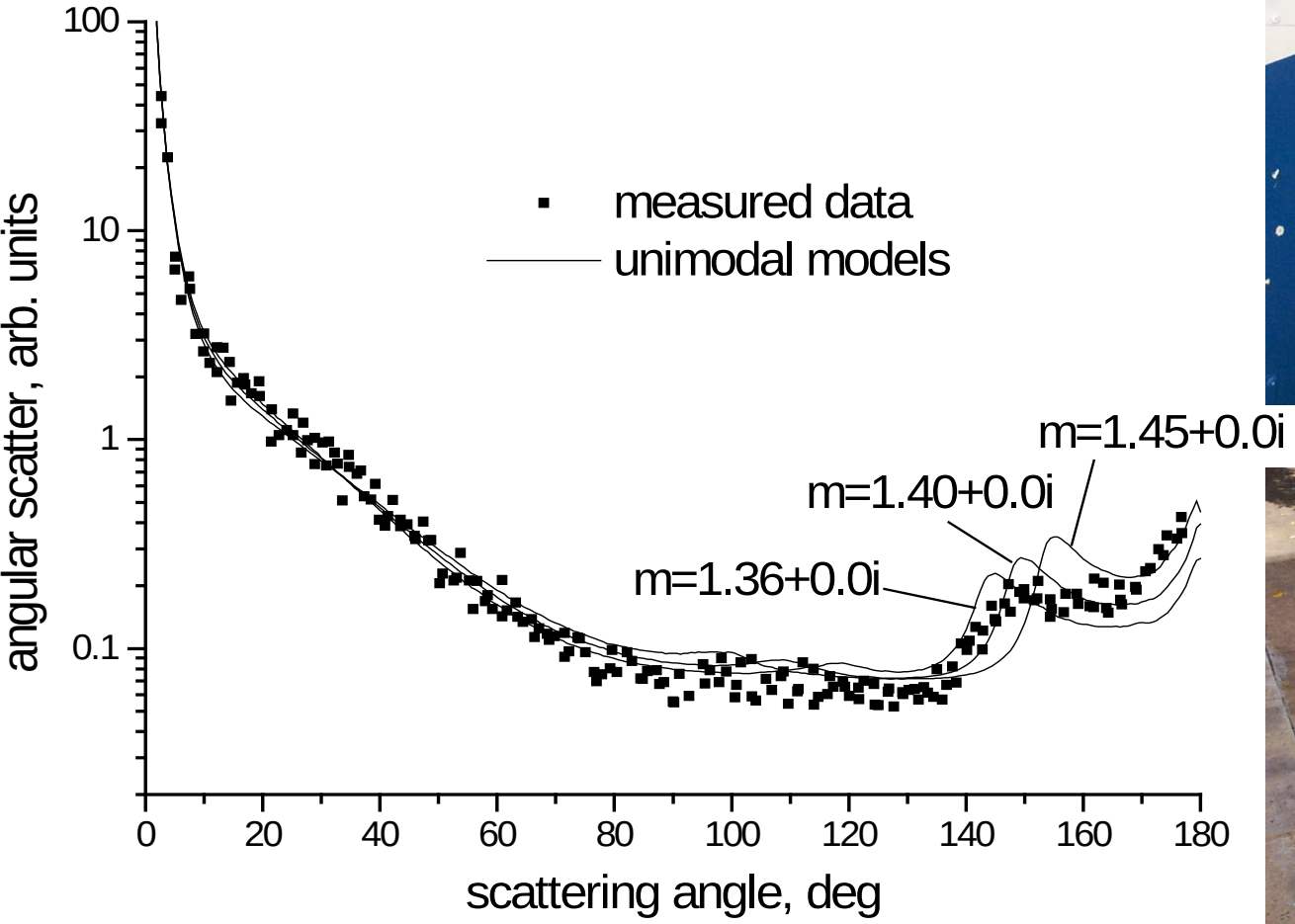
Deriving the Aerosol Phase Function From Multi-Wavelength Aerosol Scattered Light

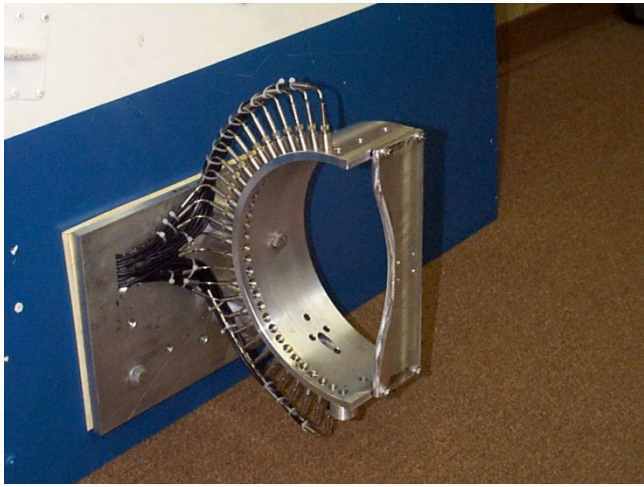
Calculate Aerosol Radiance For Many Size, Humidity, And Composition Combinations

Results Depend On Scattering Angle



Example Aerosol Phase Function Measurements



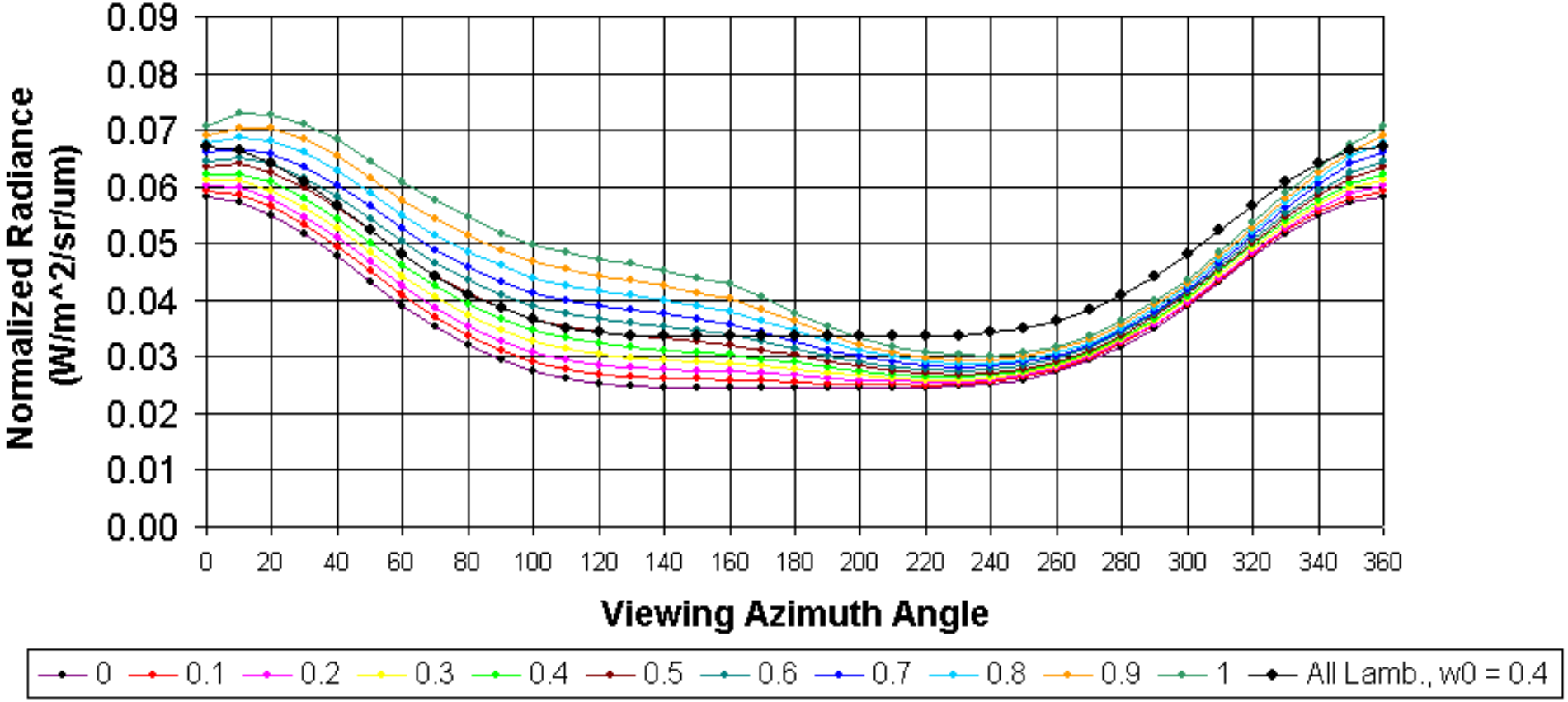


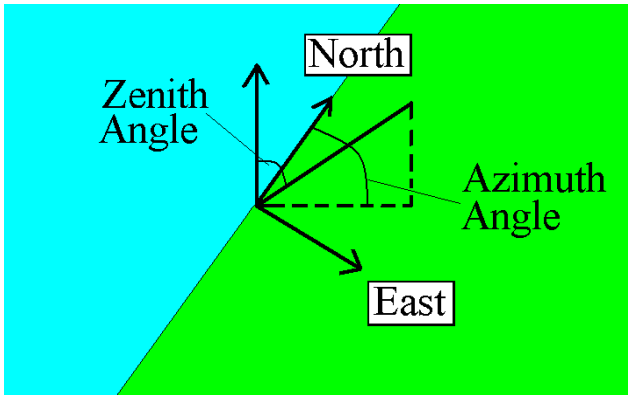
Porter, J.N., T.F. Cooney, C. Motell, Coastal Aerosol Phase Function Measurements With A Custom Polar Nephelometer, Ocean Optics XIV Conference, Kona, Hawaii, pp. 5, 1998.

Lienert, B. R., J. N. Porter and S. K. Sharma, Aerosol Size Distributions from Genetic Inversion of Polar Nephelometer Data (accepted in J. Atmospheric and Oceanic Tech., March 2003)

Monte Carlo Calculations of Sky Radiance at Surface

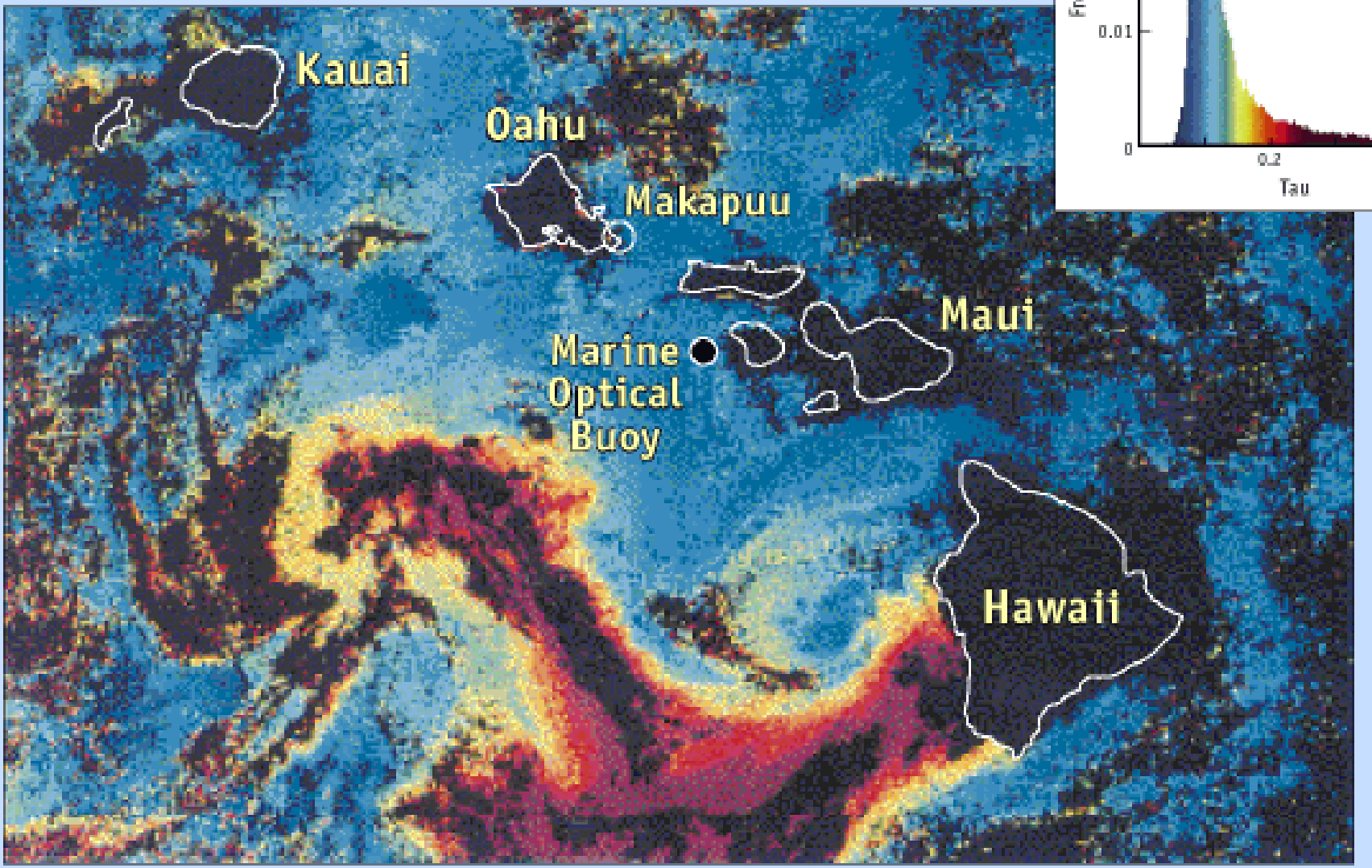
Standard Tropical Atmosphere, Sulfate Aerosol, AOD 0.5,
SZA = 60, SAA = 0, VZA = 60 degrees, Total-scatter, Plane-parallel atmosphere

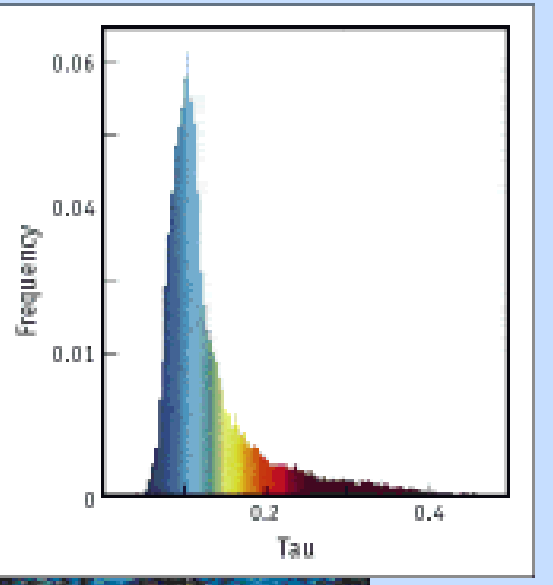




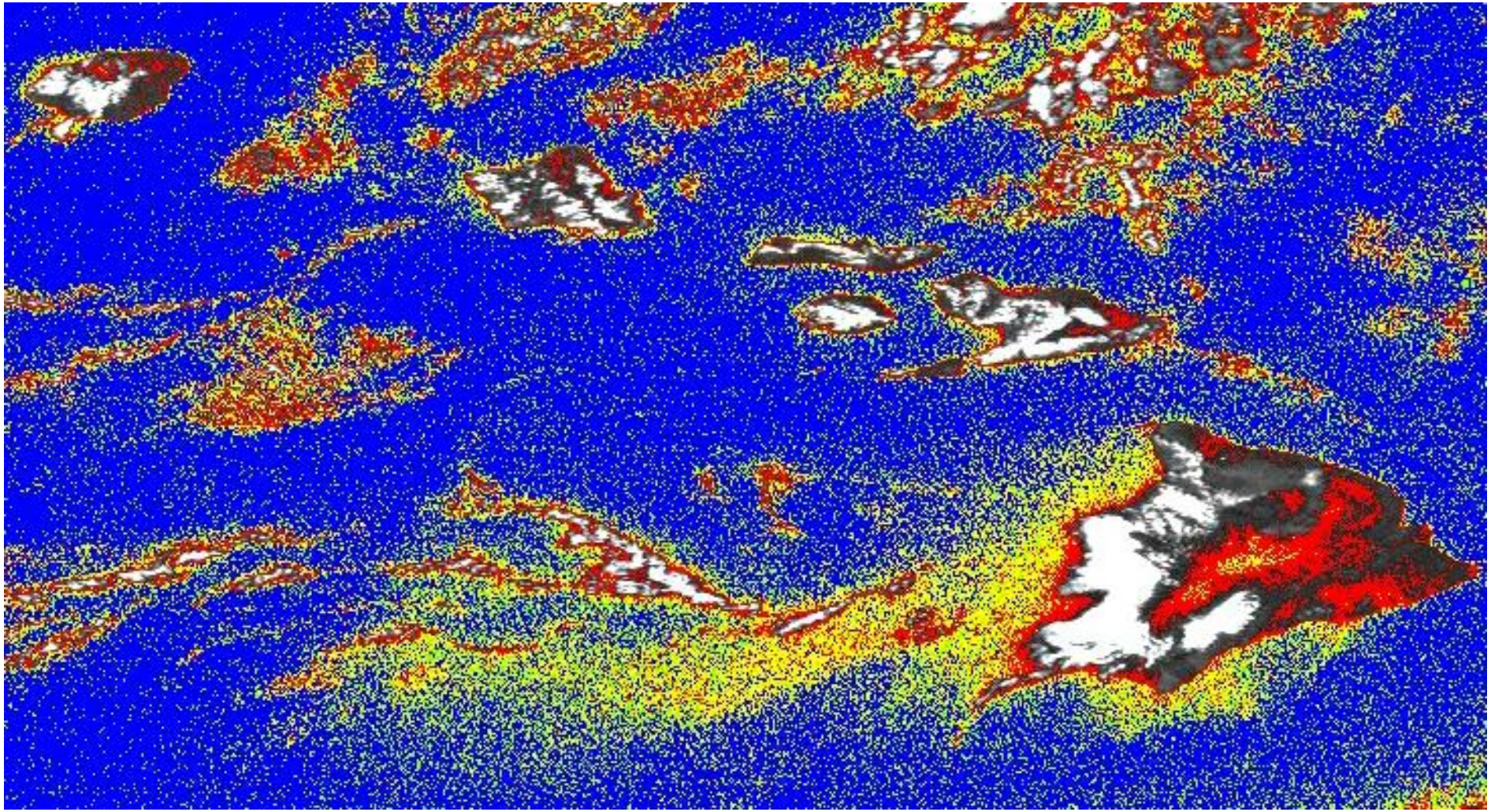
Bates, D.E., and J.N. Porter, AO3D: A Monte Carlo Code for Modeling of Environmental Light Propagation, JOSRT, 109, 1802-1914, 2008.

Aerosol Optical Depth From AVHRR Satellite (1993)

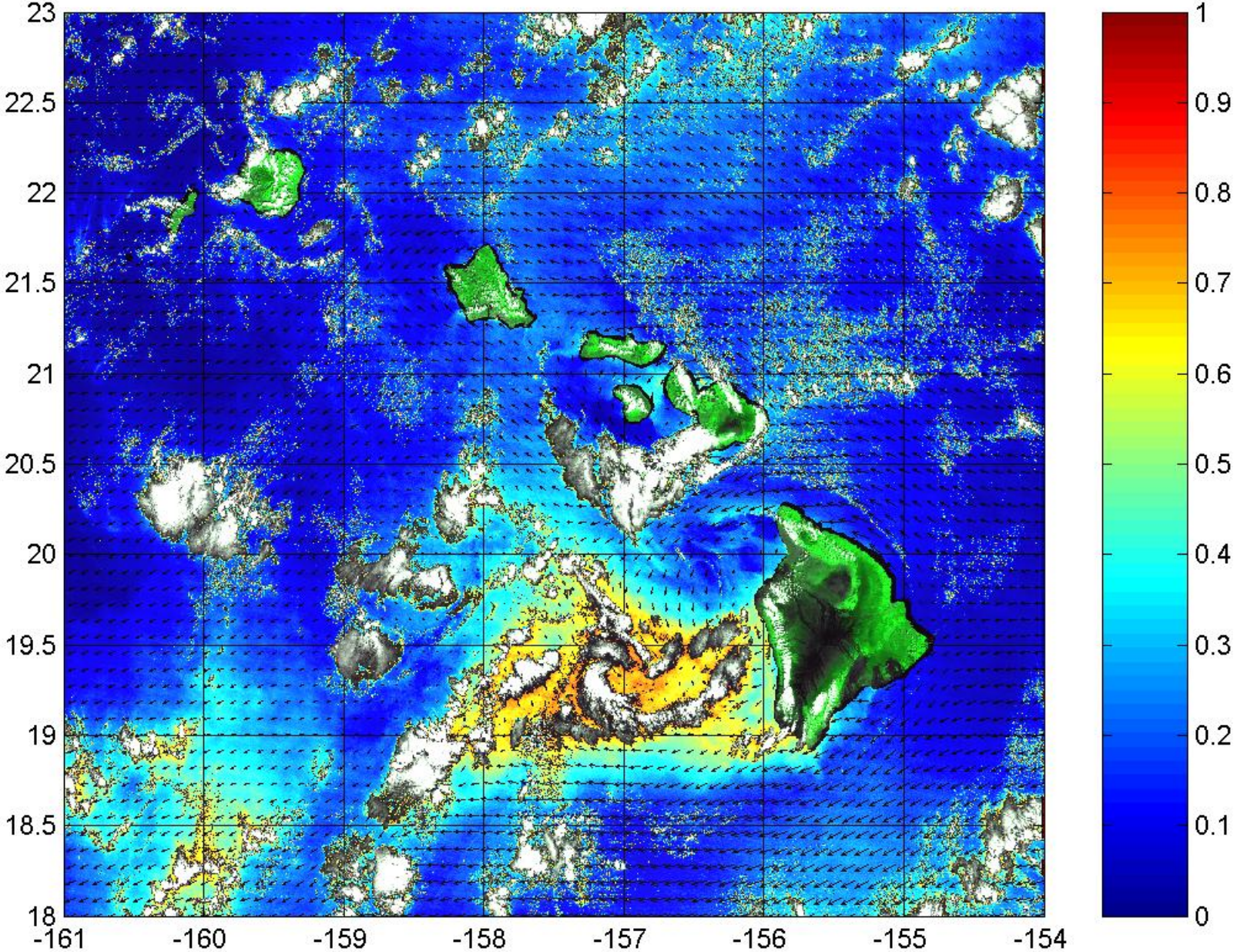


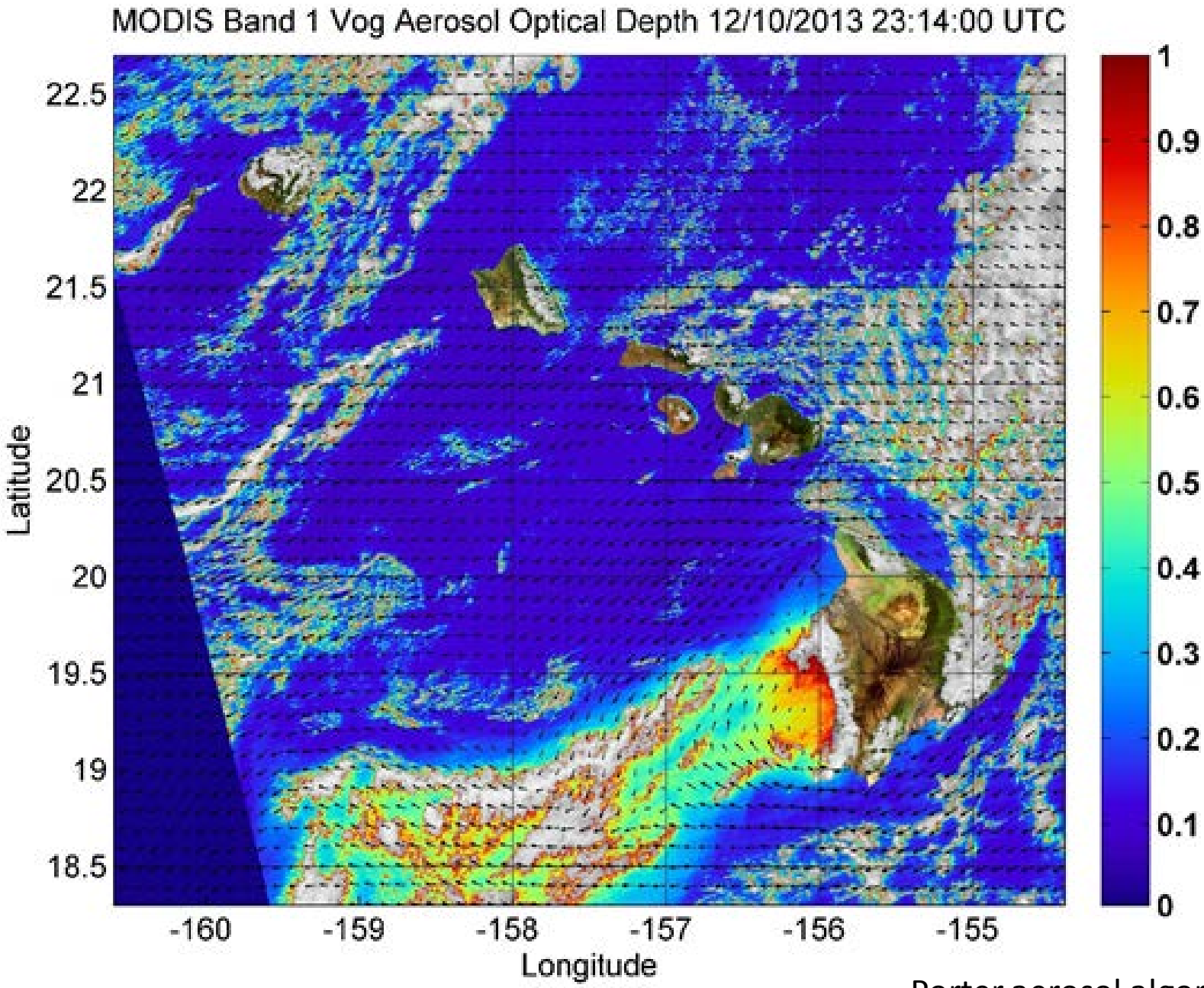


Aerosol Optical Depth From GOES Satellite (2001)

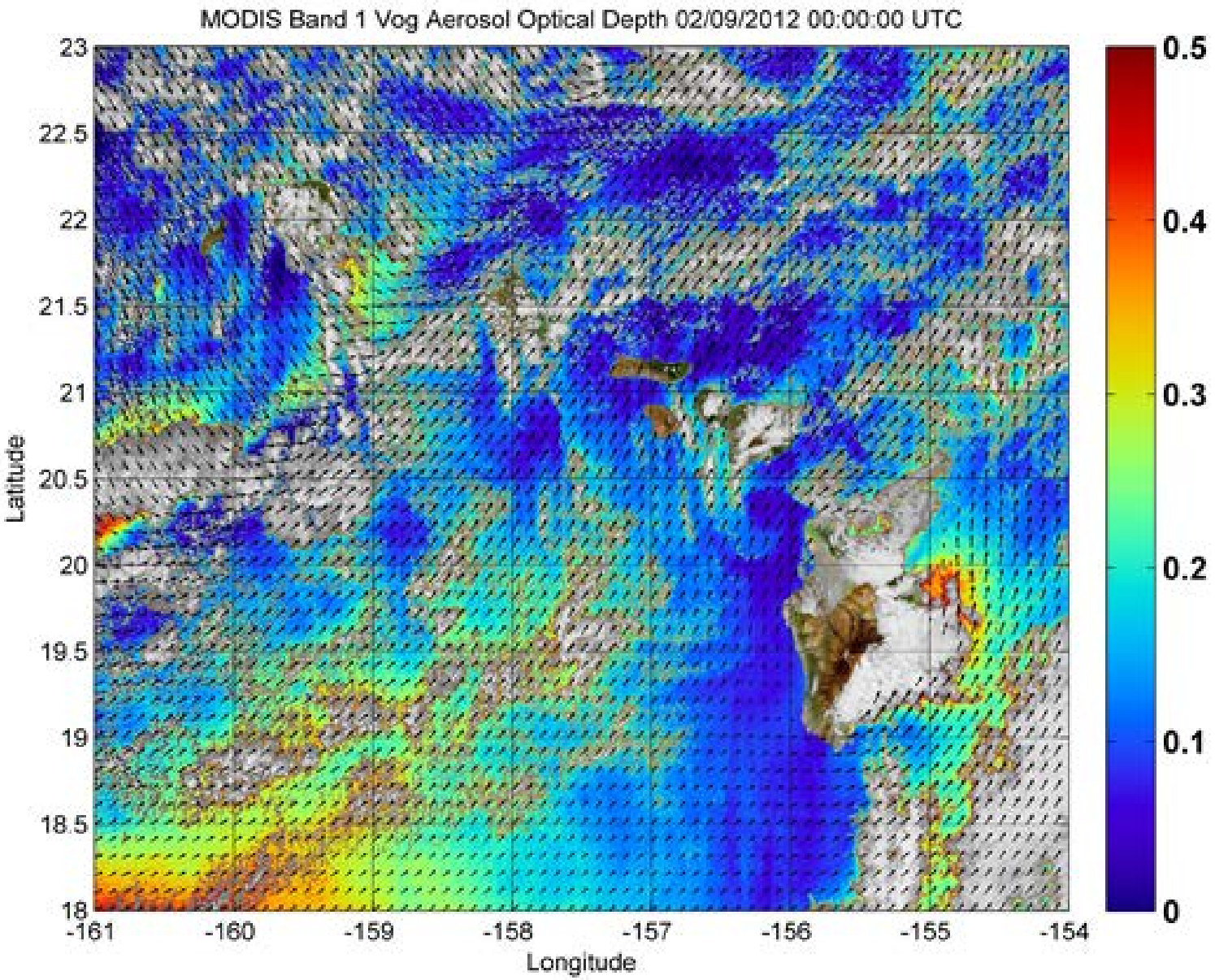


Aerosol Optical Depth From MODIS Satellite





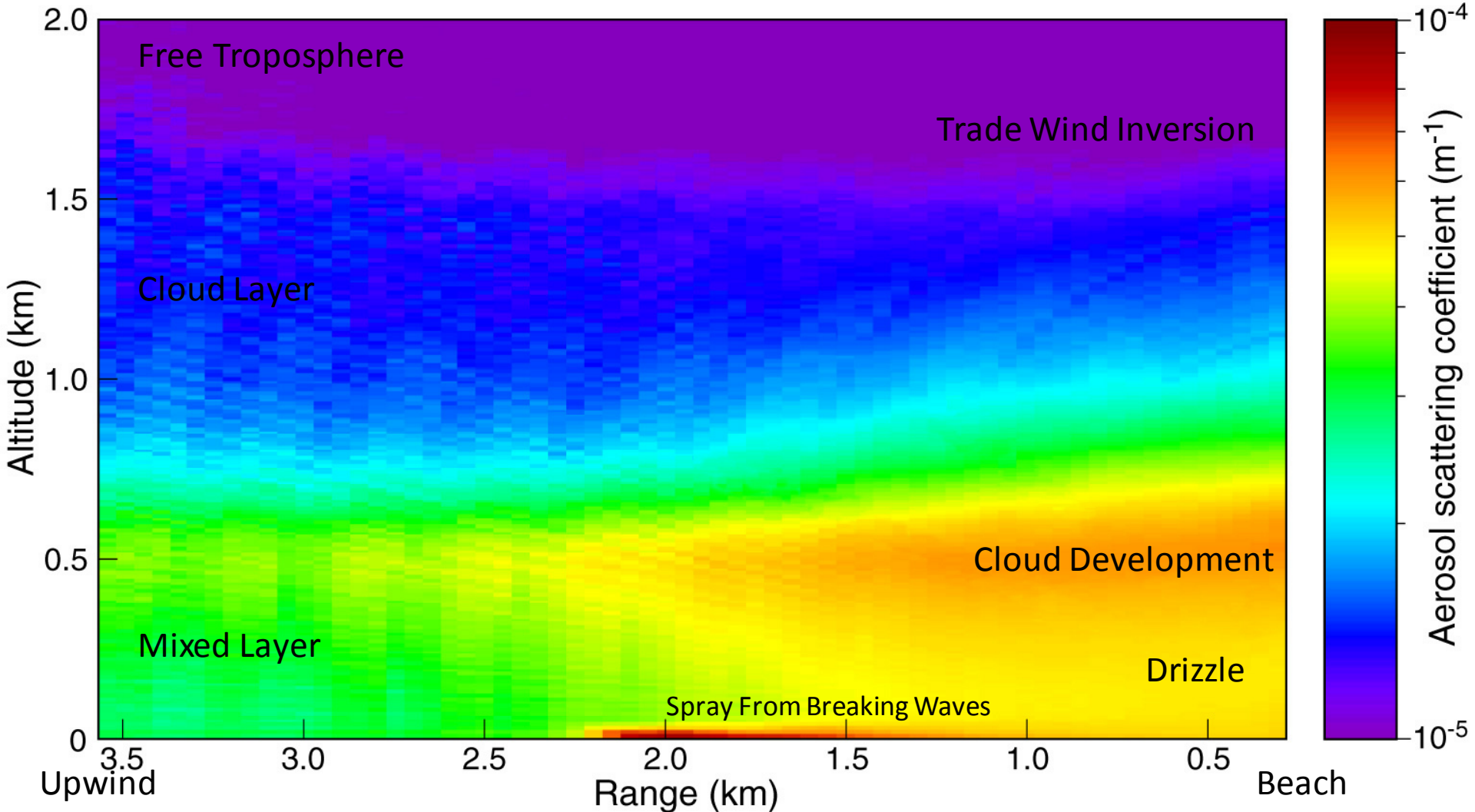
Porter aerosol algorithm



Porter aerosol algo

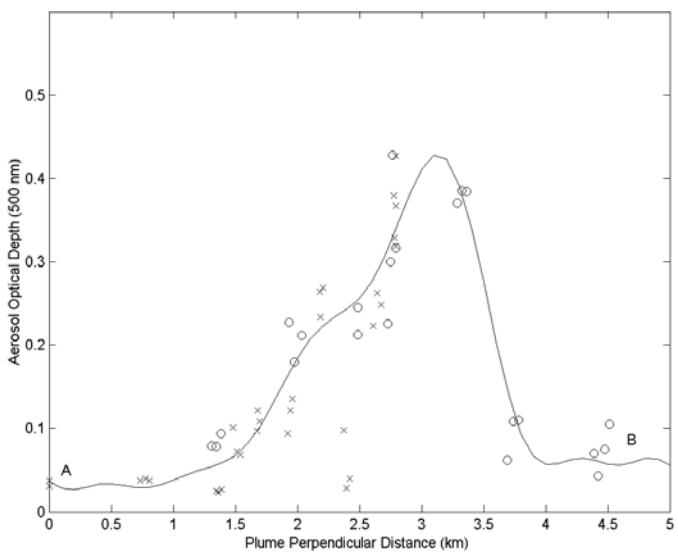
4 Day Average Of Scanning Lidar Measurements At Bellows Beach During the SEAS Experiment

Porter, J.N., S.K. Sharma, B. R. Lienert, E. Lau and K. Horton, Vertical and Horizontal Aerosol Scattering Fields Over Bellows Beach, Oahu During the SEAS Experiment, (in press, J. Atmospheric and Oceanic Tech., Dec. 2003).

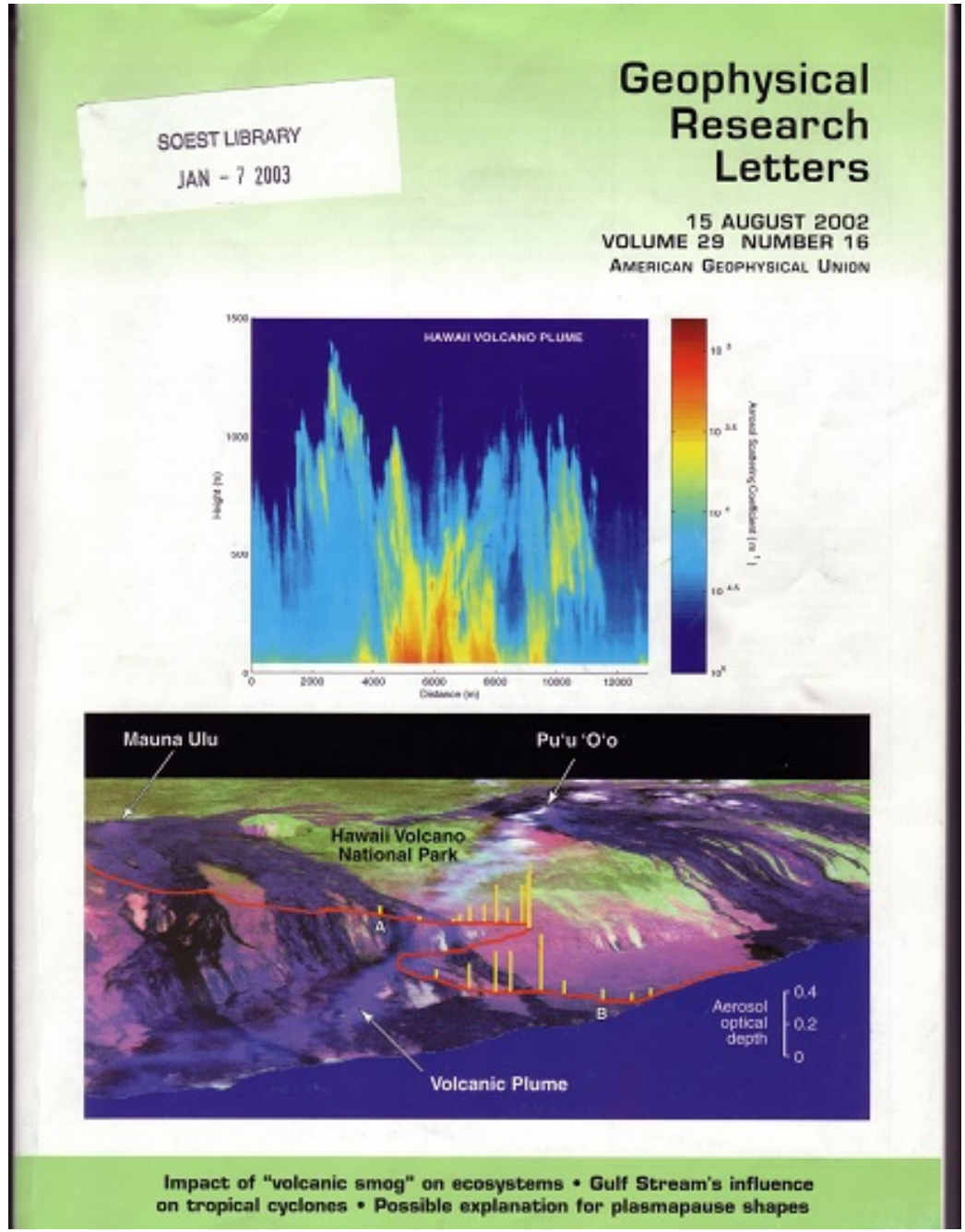


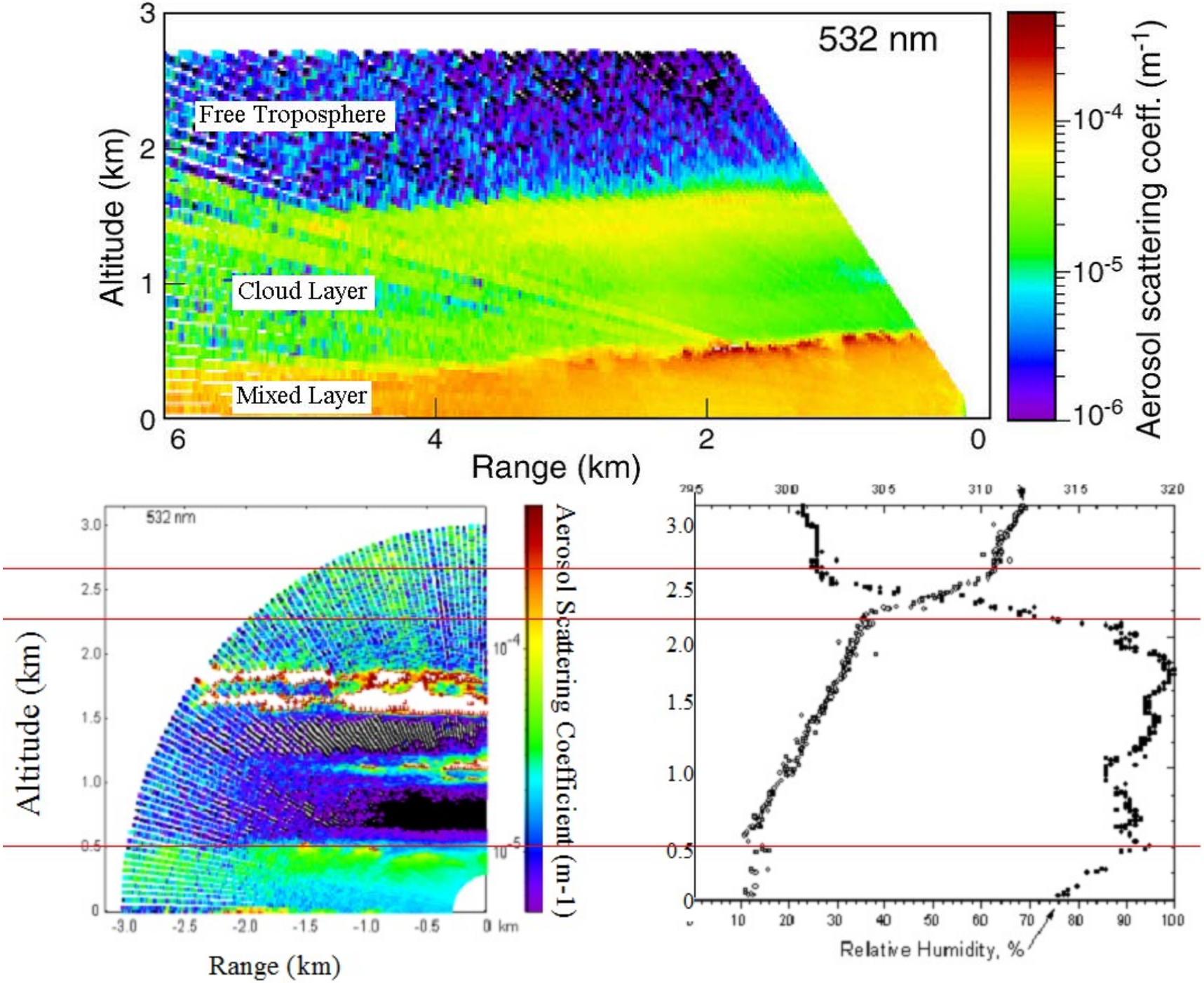
Hawaii Volcano Plume Flux Measurements.

SO_2 Half Life In Hawaii Volcano Plume 6 Hours (+-4 Hours)

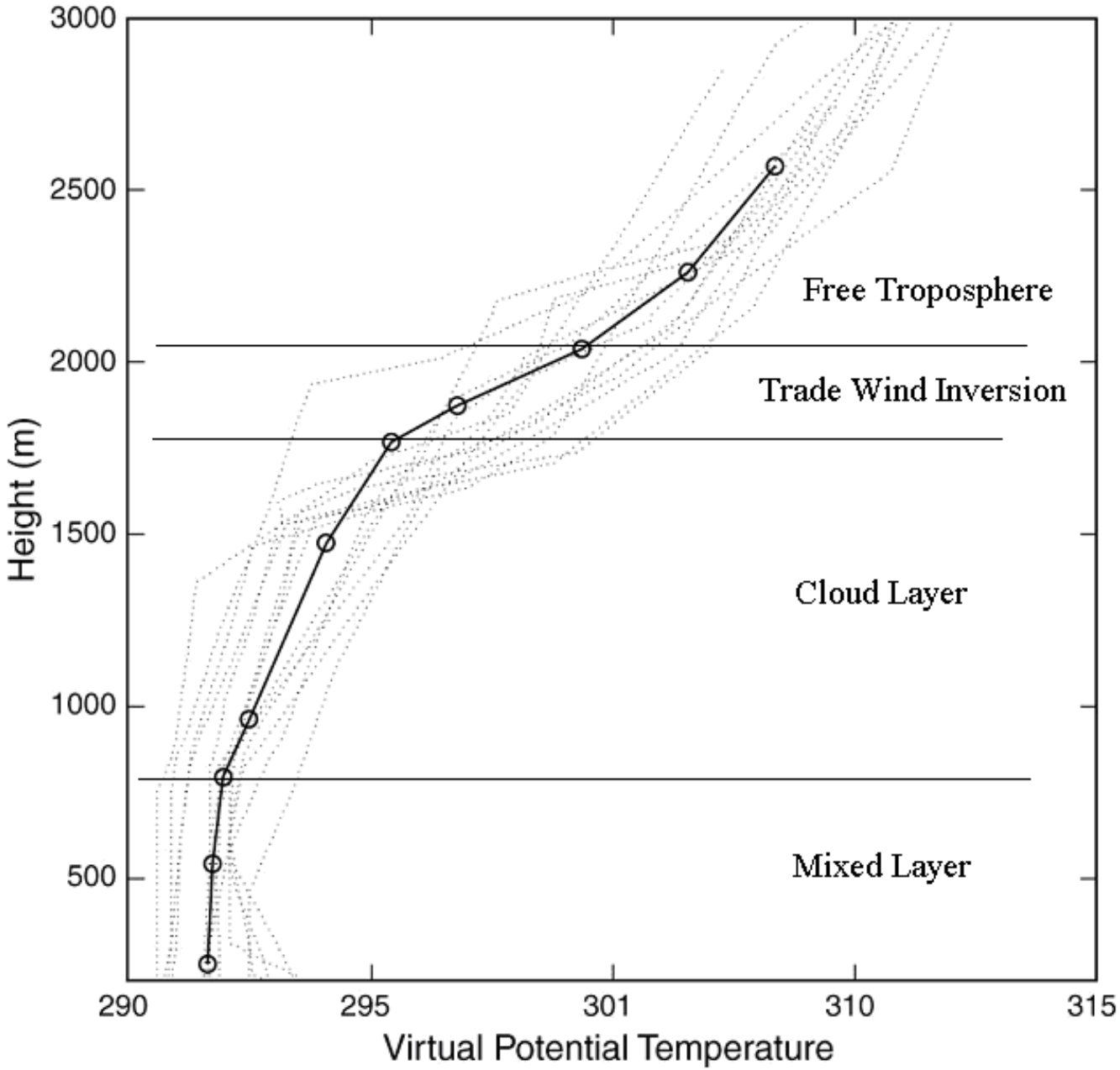


Porter, et al., 2002, Lidar and Sun Photometer Measurements of The Hawaii Pu'u O'o Volcano Plume: Estimates of SO_2 and Aerosol Flux Rates and SO_2 Lifetimes, Geo. Res. Let., 29, 2002GL014744, 2002

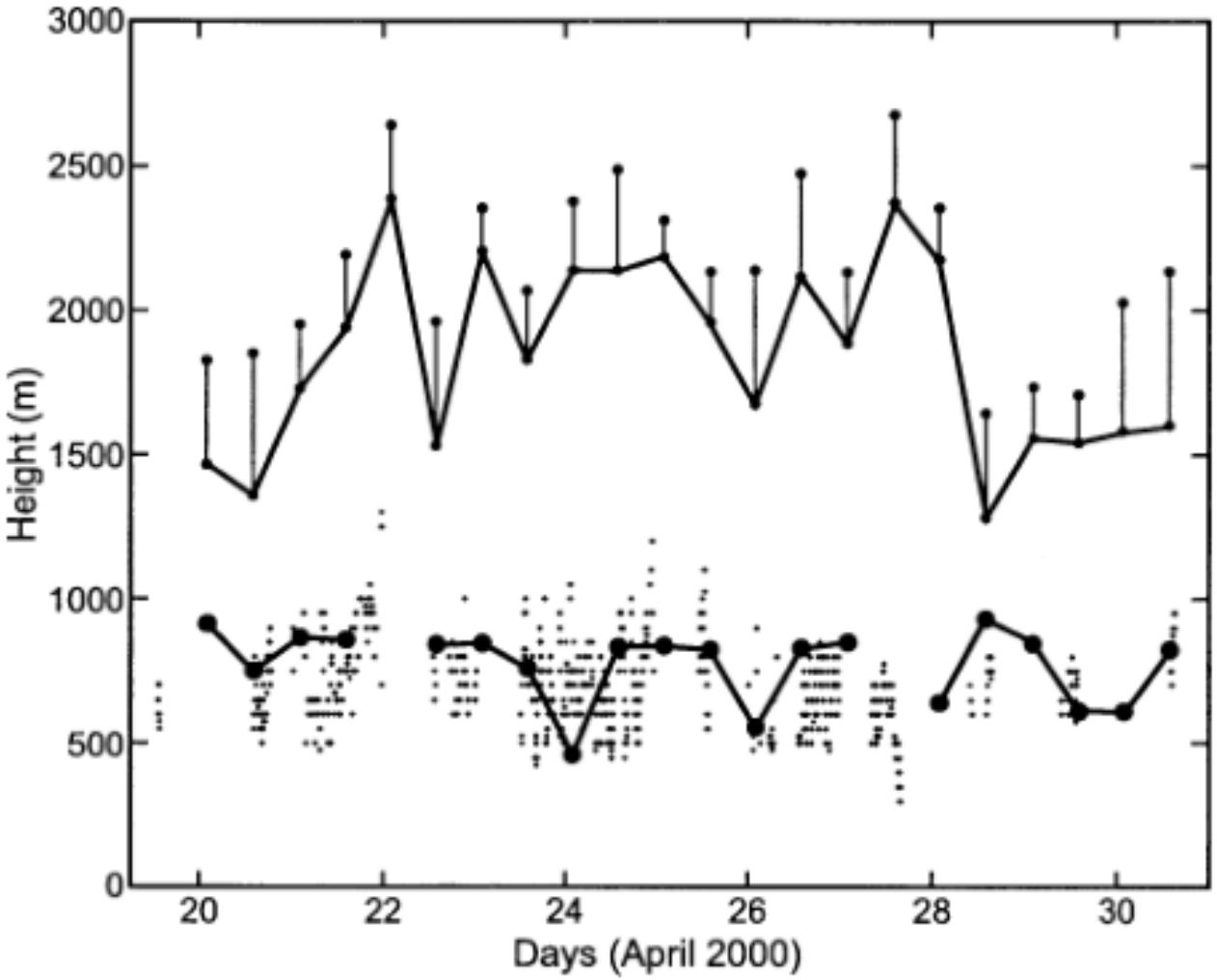



532 nm
Free Troposphere
Cloud Layer
Mixed Layer
Altitude (km)
Range (km)
Aerosol scattering coeff. (m-1)
532 nm
Altitude (km)
Range (km)
Aerosol Scattering Coefficient (m-1)
Relative Humidity, %

Trade Wind Profile (Feature Preserving Average)



Surprising Rapid Variability In Trade Wind Mixed Layer Depth

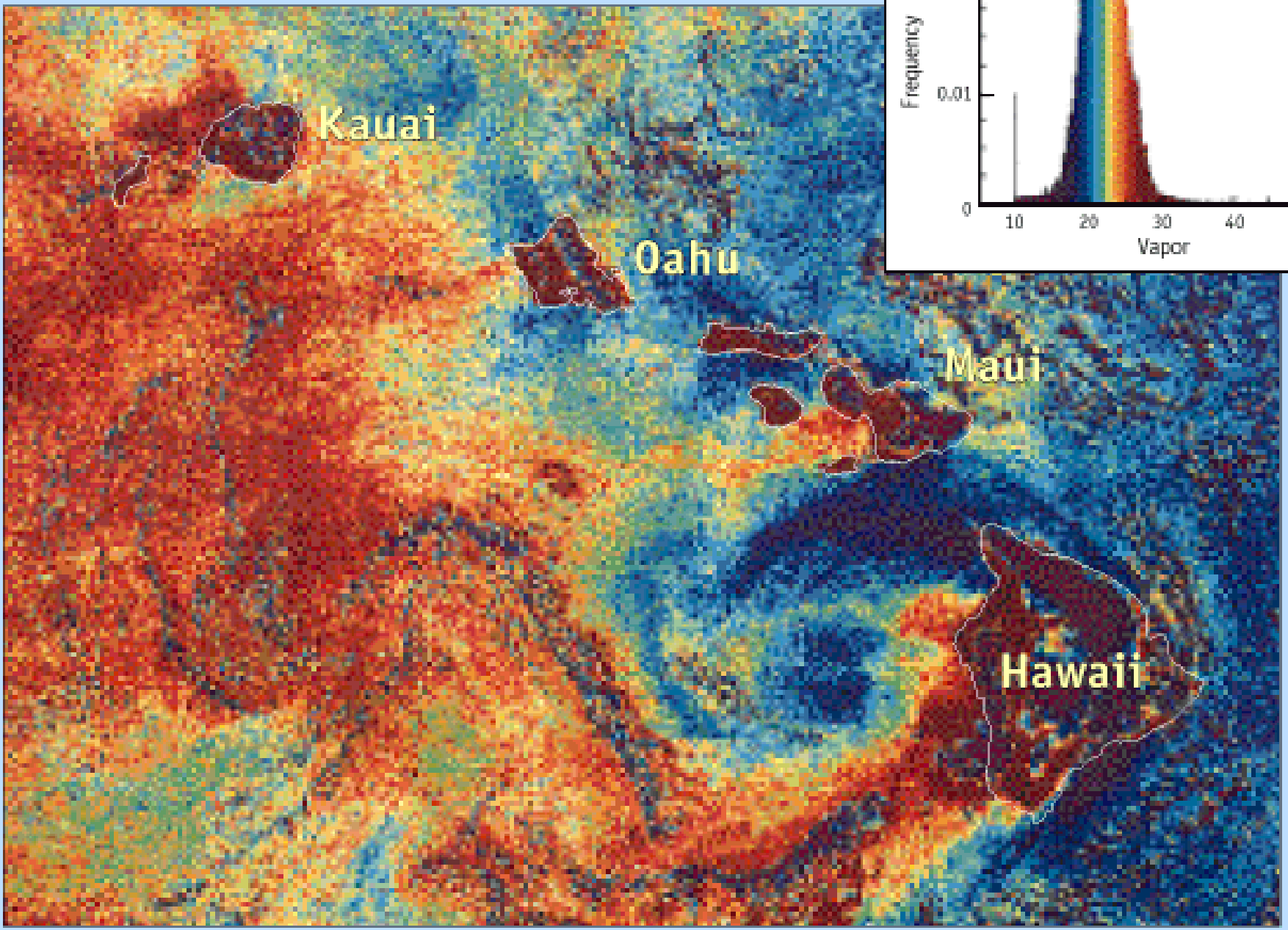


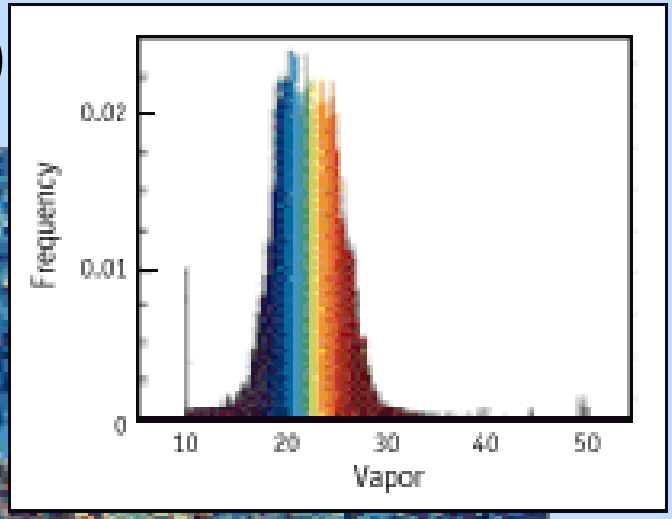
Trade Wind Inversion Base and Top From Lihue Radiosonde

Mixed Layer Depth Lihue Radiosonde And Lidar

Porter, J.N., S.K. Sharma, B. R. Lienert, E. Lau and K. Horton, Vertical and Horizontal Aerosol Scattering Fields Over Bellows Beach, Oahu During the SEAS Experiment, J. Atmos. Oceanic Technol., 20, 1375-1387, 2003.

Integrated Water Vapor (Split Window, AVHRR)





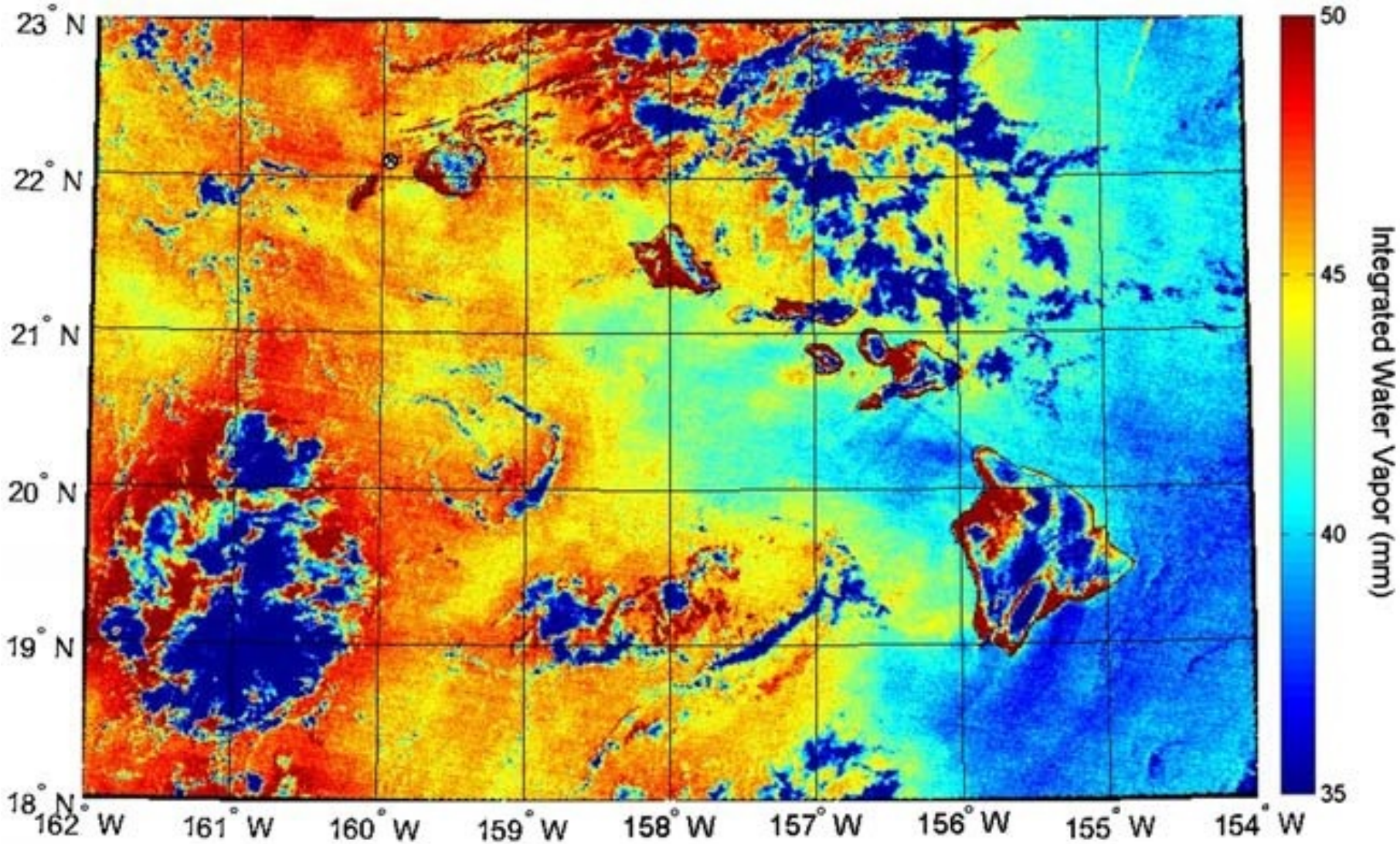
Helios prototype solar aircraft lost in mishap

NASA-DFRC NEWS RELEASE

Posted: June 26, 2003

The remotely operated Helios Prototype aircraft, a proof-of-concept solar-electric flying wing designed to operate at extremely high altitudes for long duration, was destroyed when it crashed today during a checkout flight from the U.S. Navy's Pacific Missile Range Facility (PMRF) on the Hawaiian island of Kauai.

Integrated Water Vapor (MODIS) On Day Of Helios Crash

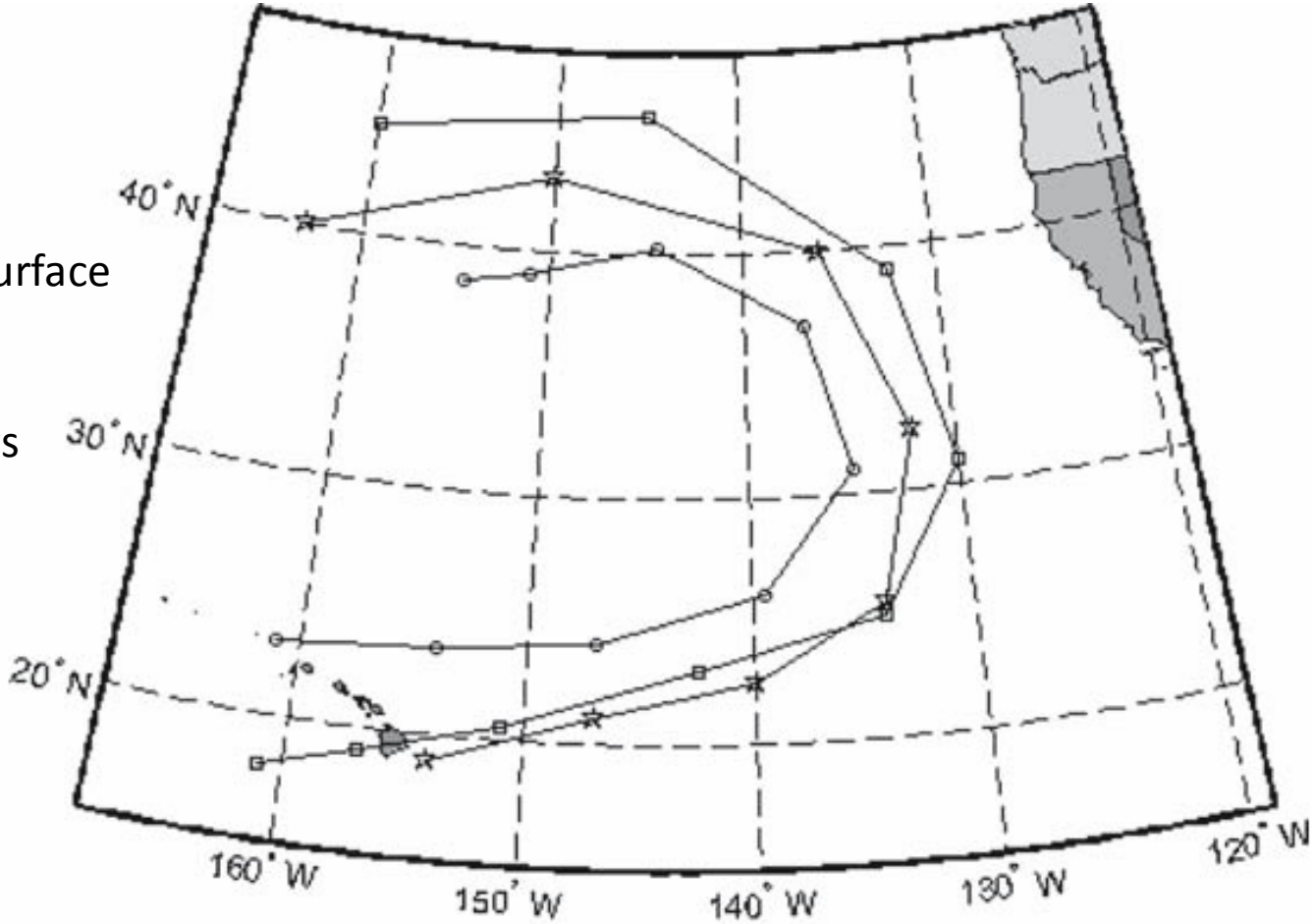


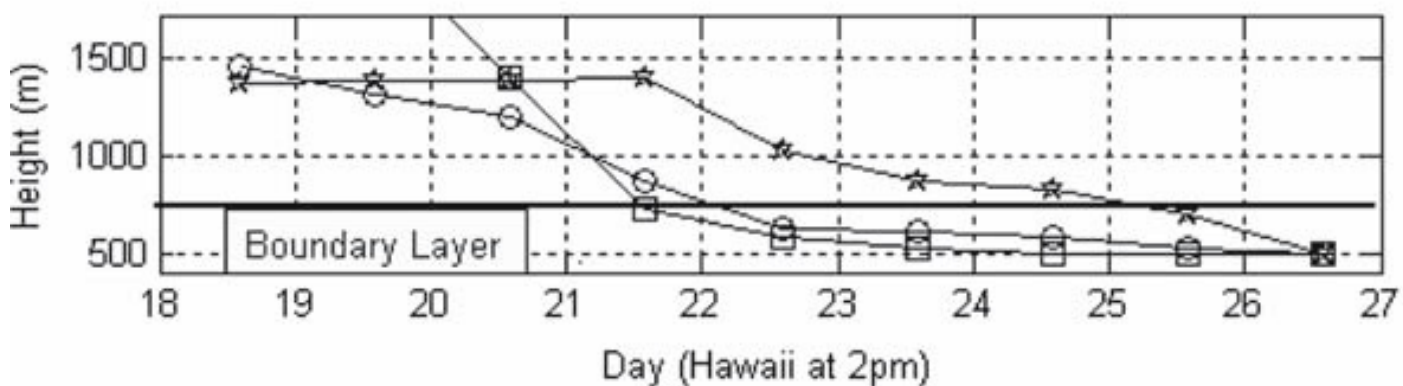
Porter, J.N, D. Stevens, K. Roe, S. Kono, D. Kress and Eric Lau, Wind Environment in the Lee of Kauai Island, Hawaii during trade wind conditions: weather setting for the Helios Mishap, Boundary Layer Meteorology, 123: 463-480, 2007.

Motell, C., J.N. Porter, J. Foster, M. Bevis, and S. Businger: Comparisons of Water Vapor Derived from GPS, Sounding and the Split Window Technique, Int. J. of Remote Sensing, 23, 11, 2335-2339, 2002.

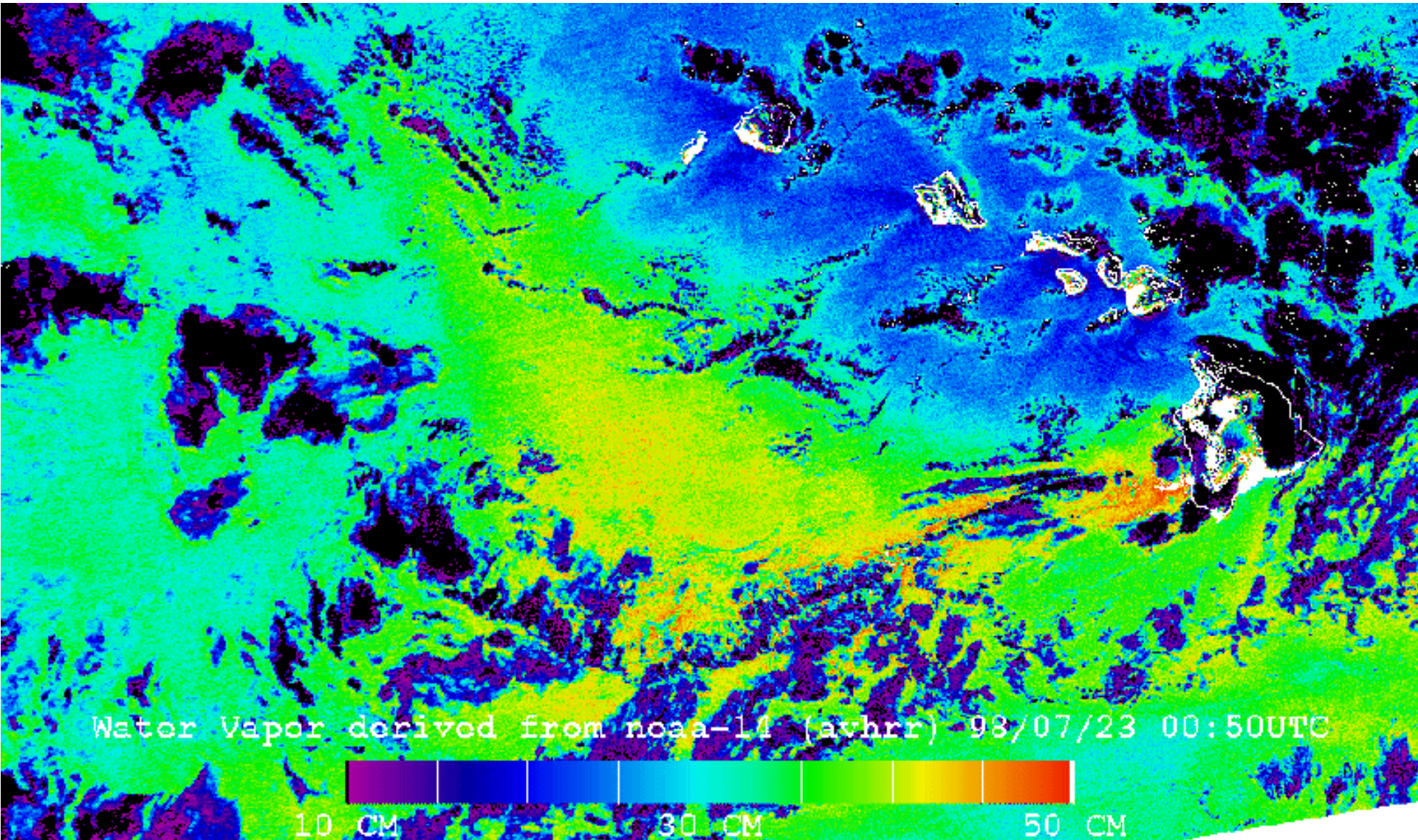
Dry Area Descended To Surface On Last Day Only.

Humid Area Spent ~4 days Near Surface.

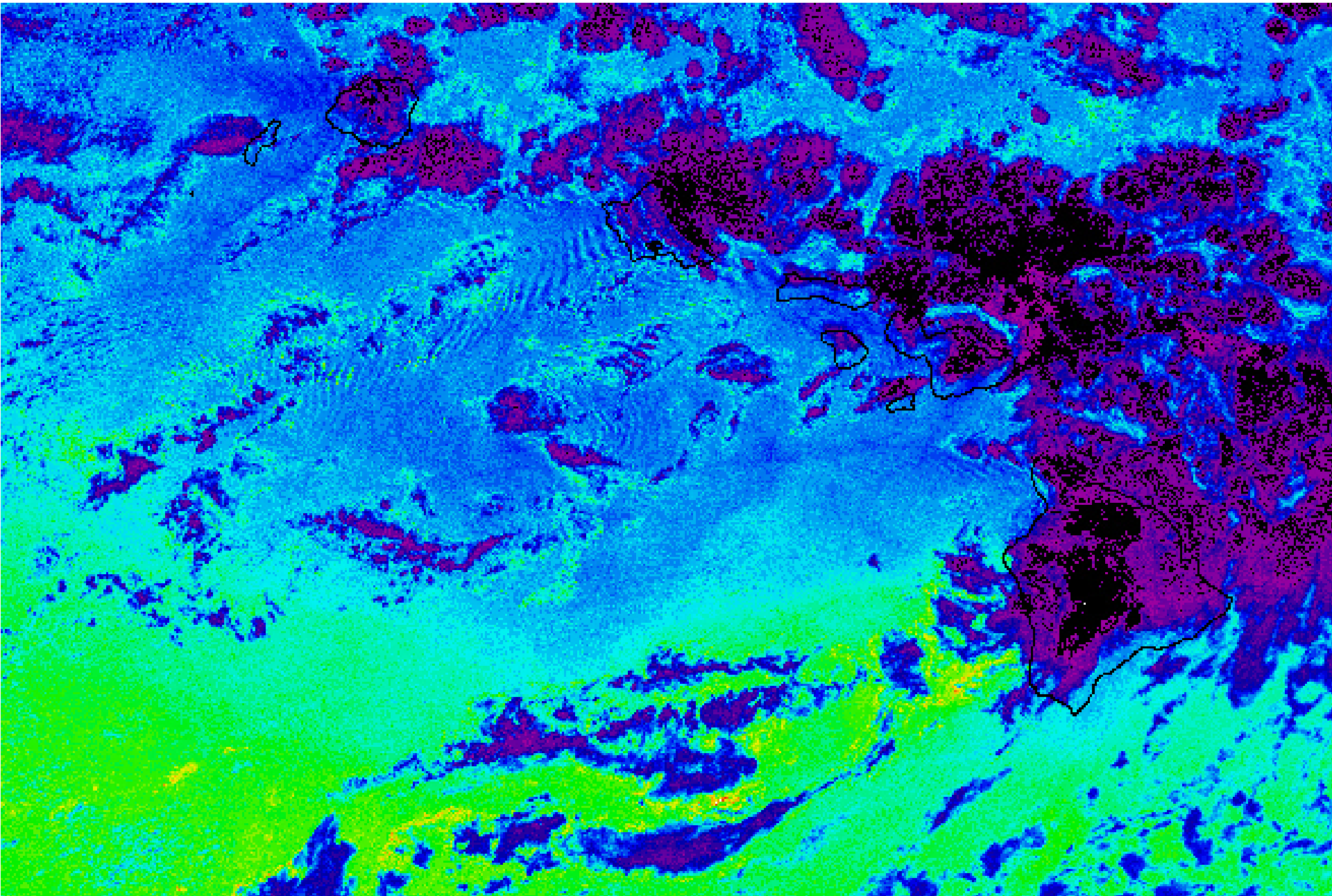




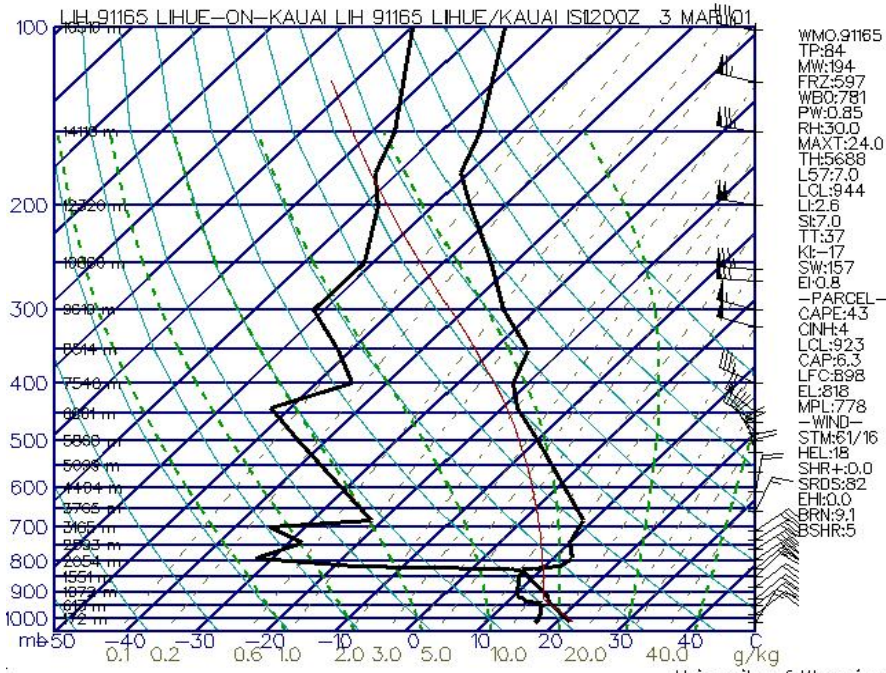
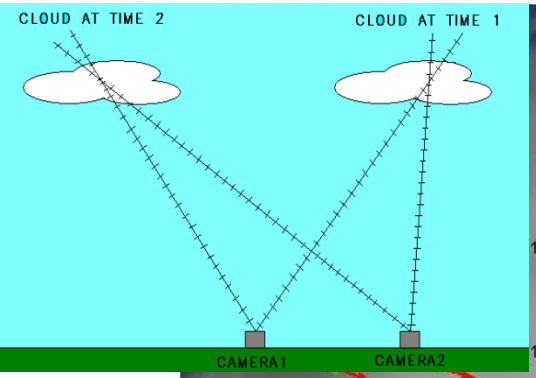
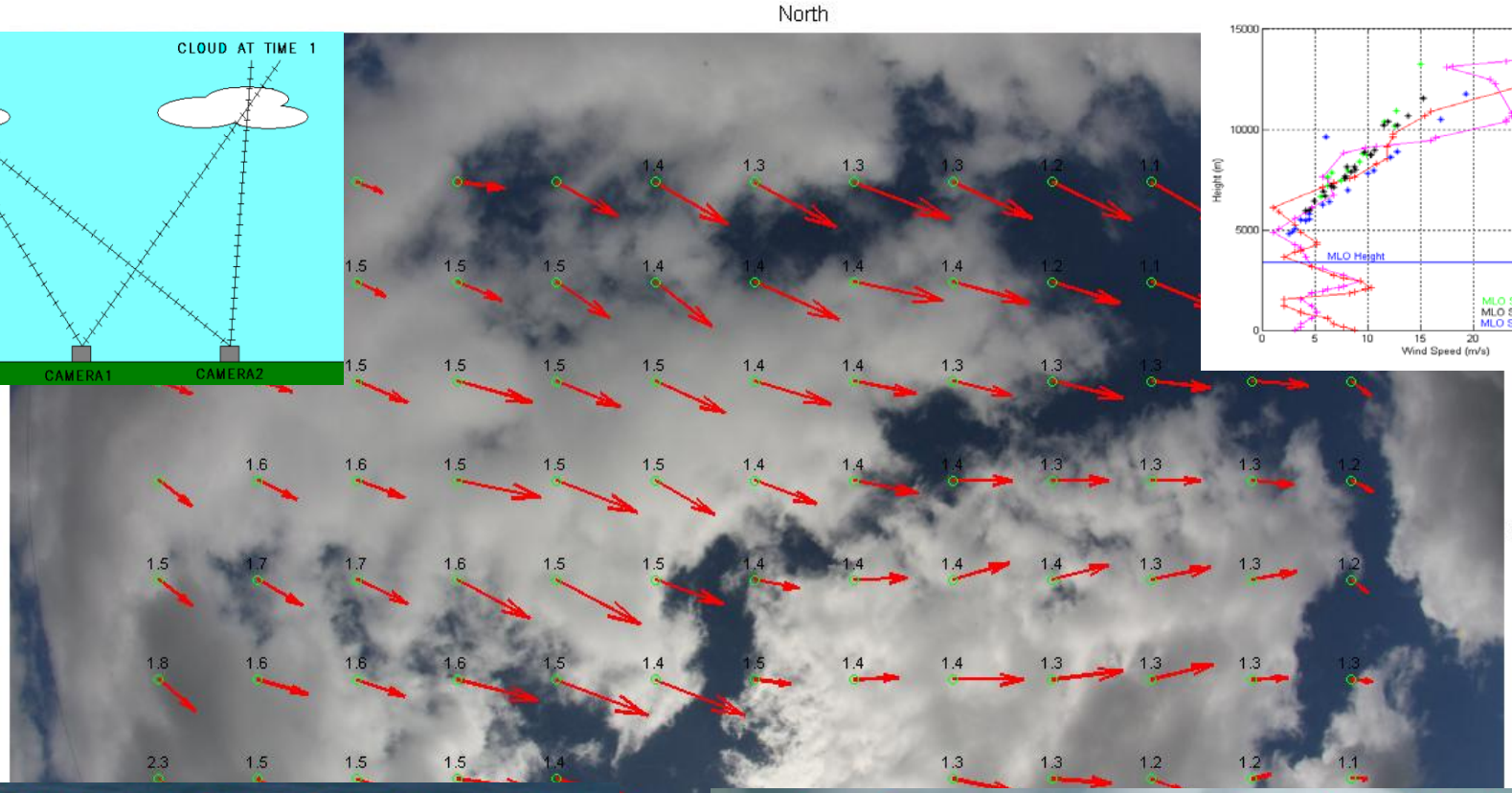
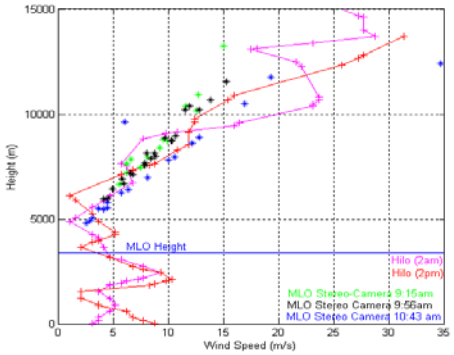
Integrated Water Vapor From NOAA 11 Split Window



Gravity Waves, Integrated Water Vapor (Split Window, AVHRR)



Gravity Waves Off Oahu
AVHRR 9



Stereo Camera Wind and Current Measurements