Tropical Pacific Proving Ground (TPPG)

GOES-R Application Development and Implementation

Steven Businger

OCONUS Meeting
Anchorage, Alaska June 2013

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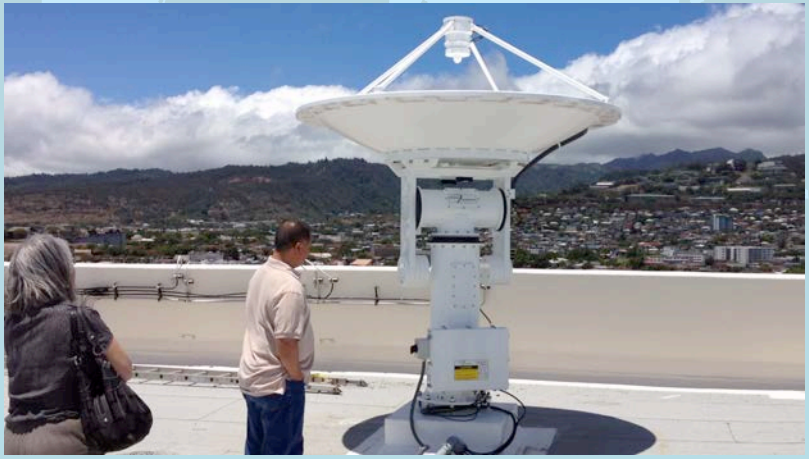
GOES-R Application Development and Implementation

Steven Businger (UH Manoa)

Roy Huff – Satellite Liaison (UH Manoa)



Project Authorization and Responsibilities

Project Authorization

- Steven Businger, University of Hawaii at Manoa (UHM), Principal Investigator – oversees the project
- Steve Goodman – GOES-R Chief Scientist and PG Program Manager
- Bill Ward – PAC ESSD Chief

Project Management

- Roy Huff – GOES-R Tropical Pacific Proving Ground Satellite Liaison
- Bob Ballard -- SOO, NWS WFO Honolulu – coordinates forecaster training
- Ray Tanabe -- acting MIC, NWS WFO Honolulu – Oversees WFO/ CPHC participation and product workload for the office
- Bill Ward -- Pacific Region ESSD Chief
- John Porter -- UHM, Principal Investigator – focus on satellite aerosol products
- Ed Fukada – JTWC
- Kathryn Mozer – Project Oversight and facilitation, NWS/OST and GOES-R Program Office

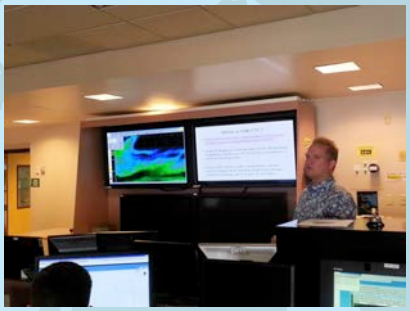
Product Evaluation

- Roy Huff – Lead
- NWS HFO – Bob Ballard, lead

Purpose and Scope of TPPG

Improve forecaster skills and tools

- Help educate developers in tropical cyclone-, heavy rainfall-, and aviation related operations and constraints.
- Help educate forecasters in latest tropical cyclone, heavy rainfall, and aviation research
- Support the production of tropical cyclone-, heavy rainfall-, and aviation- weather products, using Interactive Calibration of Four Dimensions (IC4D), Advanced Weather Interactive Processing System (AWIPS), AWIPS-II, and Automated Tropical Cyclone Forecasting (ATCF) System, as appropriate.



Roy Huff providing training at HFO

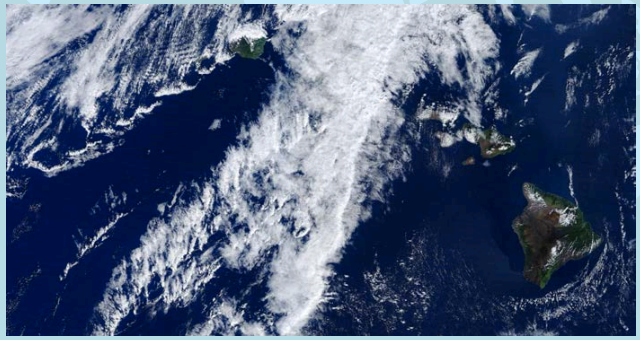
Goals of TPPG Project

This year's focus was on demonstrating GOES-R baseline, Risk Reduction (R3), Future Capabilities, and GOES Improved Measurement and Product Assurance Plan (GIMPAP) which are identified in Table 1. This strategy has the best chance of maximizing the Operations-to-Research feedback that is one of the PG and R3 goals.

Demonstrated Product	Category
Lightning Detection	Baseline
Volcanic Ash Detection and Height	Baseline
Rainfall Rate/QPE	Baseline
Total Precipitable Water	Baseline
Statistical Tropical Cyclone Intensity Models	Risk Reduction
Orographic Rain Index	Risk Reduction
SO2 Detection	Future Capabilities
Convective Initiation and Cloud Top Cooling Rate	Future Capabilities/GIMPAP

TPPG Consumers

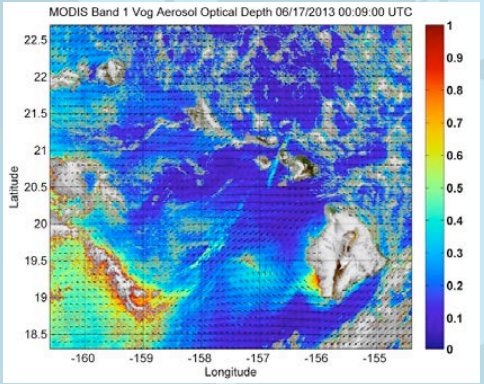
- University of Hawaii, Meteorology Department – Dr. Steven Businger, Roy Huff, Dr. Tiziana Cherubini, Dr. Jennifer Small, and Dr. John Porter
- NWS Pacific Region Headquarters – Bill Ward and Eric Lau
- NWS Weather Forecast Office (WFO), Honolulu, HI – Bob Ballard and Derek Wroe
- Central Pacific Hurricane Center – Bob Ballard
- Aviation Meteorological Watch Office (MWO) – Bob Ballard
- Joint Typhoon Warning Center (JTWC) – Ed Fukada



TPPG Activities 2012

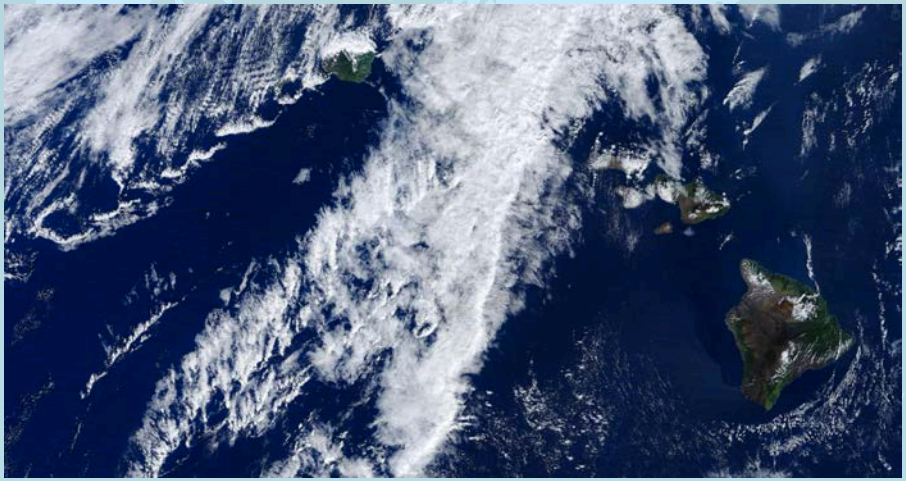
- January 2012 – Satellite training at UW Madison
- March 2012 – GOES-R product installation at PRH including CI/CTC, MIMIC TPW, AVHRR, & CRAAS.
- August 2012 – Final installation of X/L Band antenna and network setup. ADAM purchase, installation, and operation.
- Oct. 2012 – HFO LDM purchase and installation
- Nov. – MIMIC TPW/ CTC training and feedback during map discussions
- January 2013 – AMS TPPG presentation.
- Feb. – MIMIC TPW/ CTC training and feedback during map discussions
- May 2013 Pseudo Reflectivity Algorithm completed
- August 2013 – Satellite training planned in Honolulu.

The system is operational!

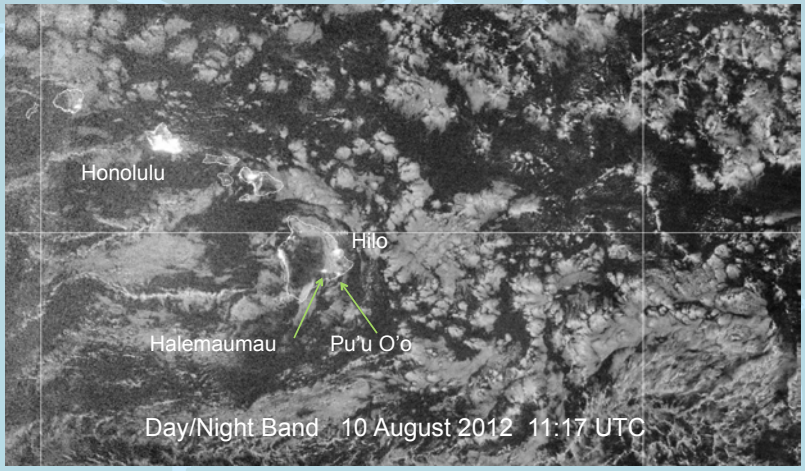


Aqua MODIS in Google Earth

2319 UTC, 8 August 2012

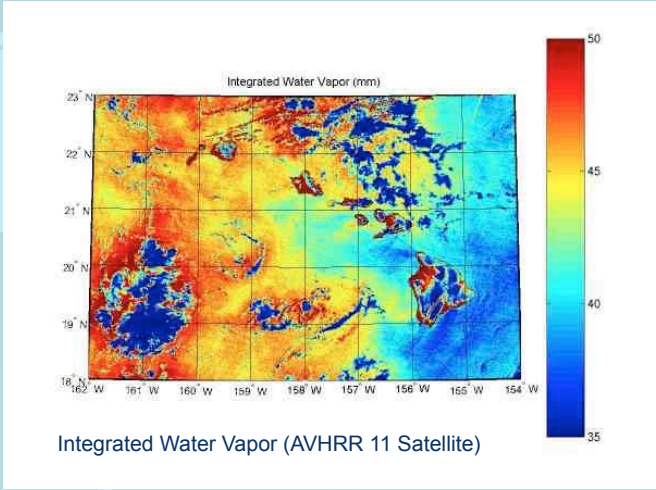


Hawaii VIIRS data in AWIPS



Forecasters at the HFO can distinguish for the first time at night between stable closed cell convection and unstable open-cell convection upstream.

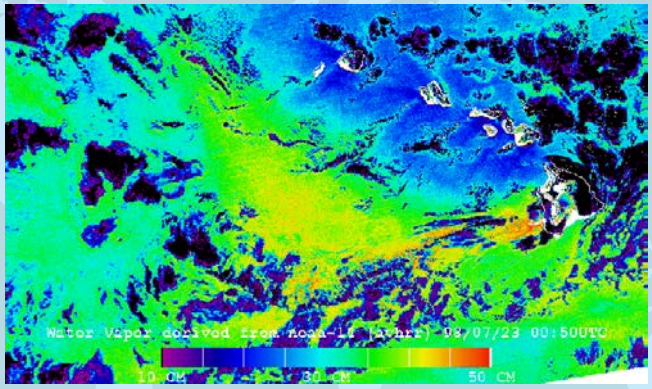
Improve Precipitable Water Estimation



Integrated Water Vapor (AVHRR 11 Satellite)

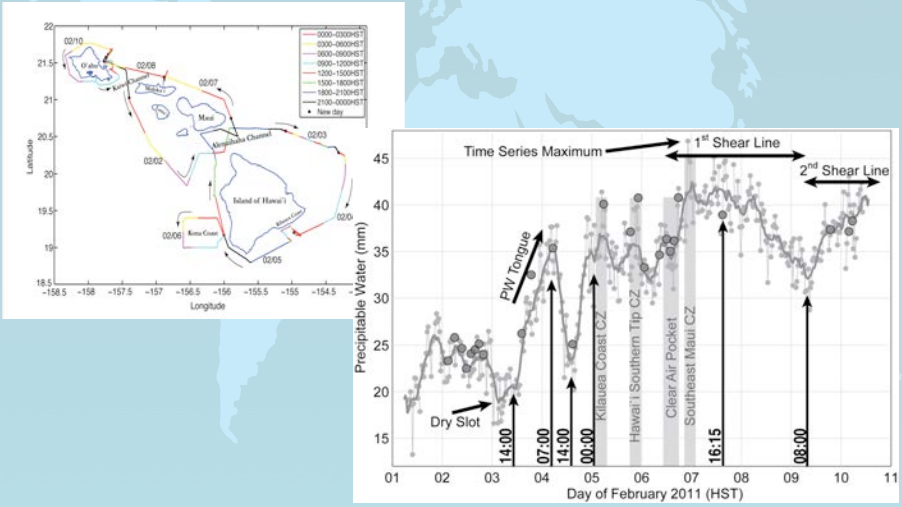
Knowledge of the meso-scale distribution in integrated water vapor adds skill to precipitation forecasts.

Improve Precipitable Water Estimation

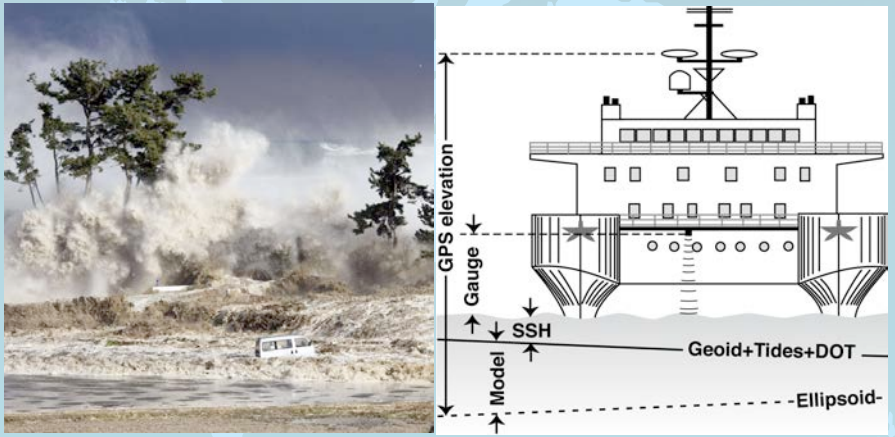


Investigate PW estimation using a multi-channel method with WRF model first guess and GPS calibration.

10-day cruise captured synoptic and mesoscale features

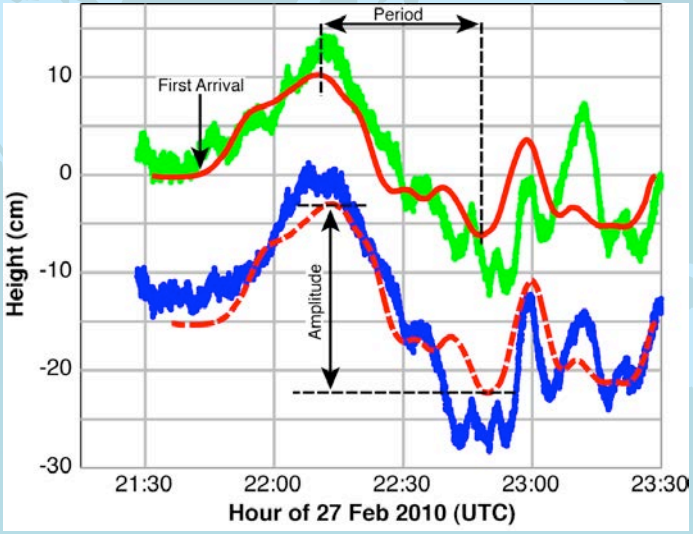


Tsunami Detection with Shipboard GPS

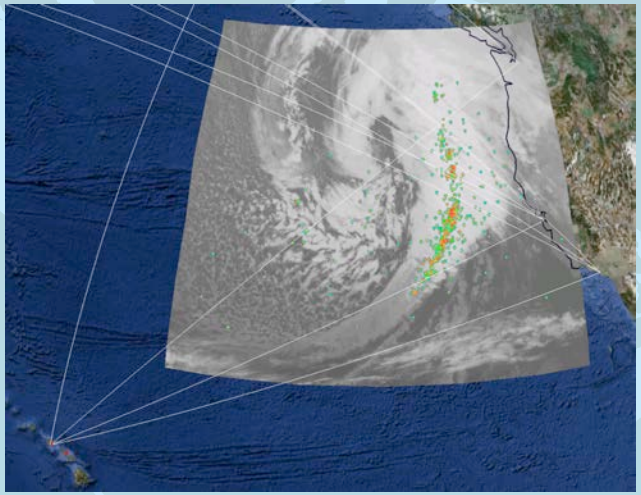


Have instrumented Matson vessels to collect GPS PW data and provide tsunami measurements in an effort with Dr. James Foster UH HIGP. Student Vanessa Almanza will investigate atmospheric rivers

The 27 Feb 2010 Chile Tsunami



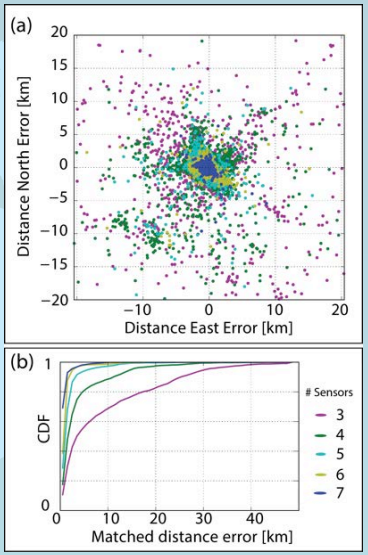
Pseudo Reflectivity Product



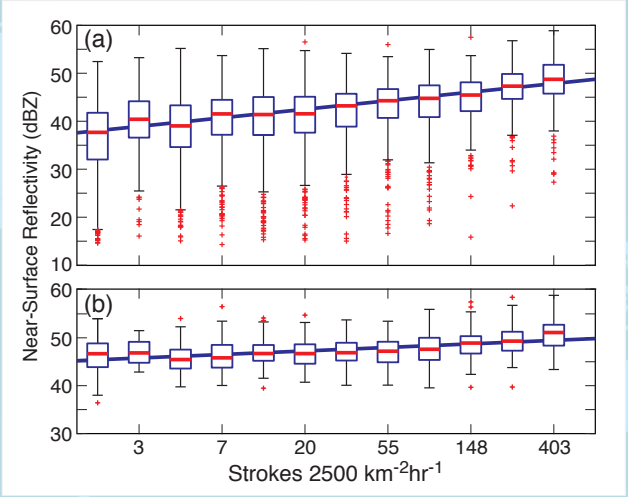
Lightning-derived reflectivity with airline flight tracks overlaid on IR satellite image.

Network Geometry and Location Accuracy

Vaisala is investing in additional lightning detectors in the Pacific that will improve both detection efficiency and location accuracy.



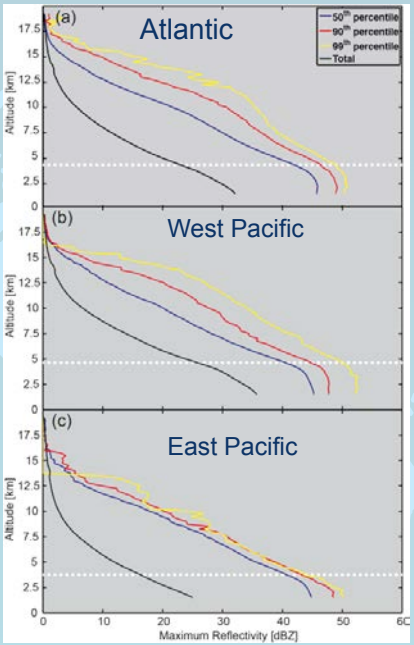
Surface Reflectivity vs Lightning Rate



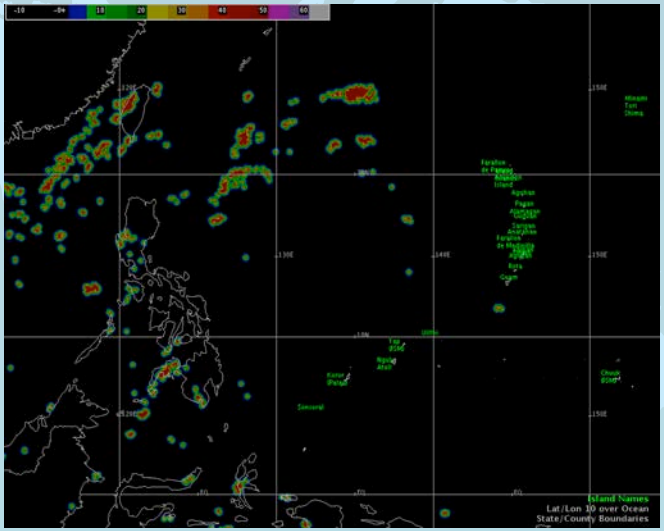
The stroke density observed by GLD360 versus near-surface

Reflectivity Profiles vs Lightning Rate

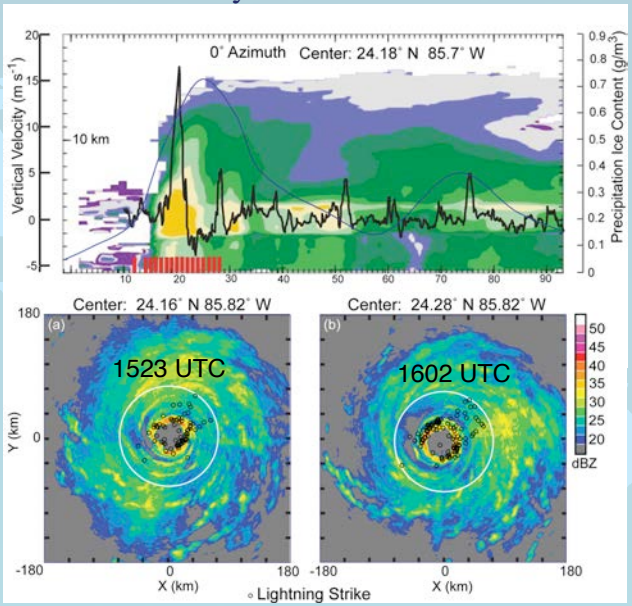
Comparison of TRMM precipitation radar reflectivity and GLD360 lightning rates.



Pseudo Reflectivity Product in AWIPS II

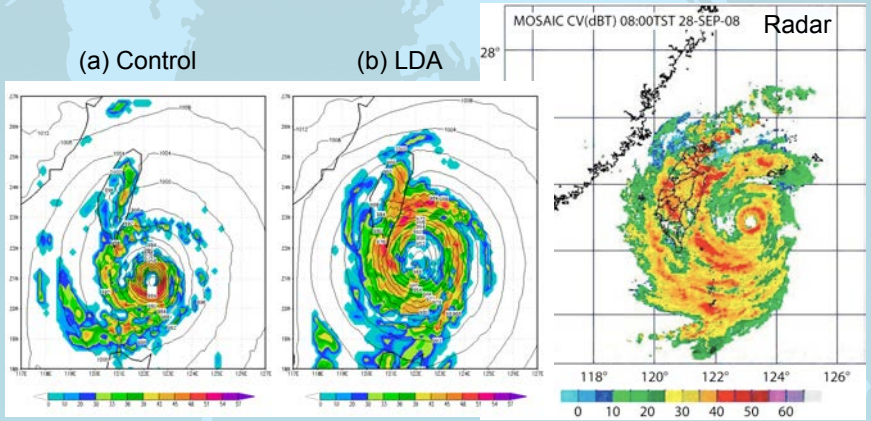


Rapid Intensification Eyewall Outbreak: Hurricane Rita



Aircraft radar on 21 Sept. overlaid with 20 min of lightning data

Typhoon Jangmi Pressure and dBZ - 36 h



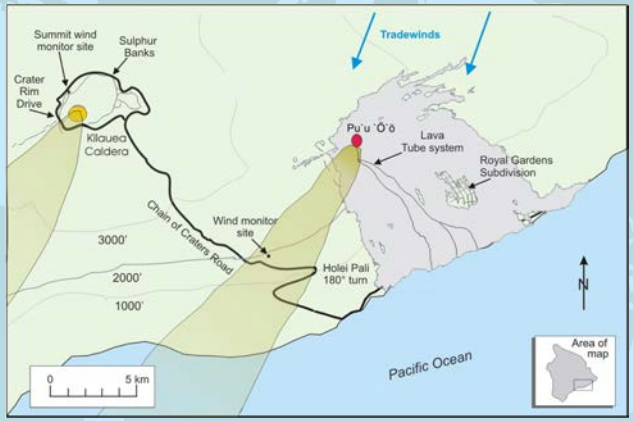
Sea-level pressure and simulated radar reflectivity at 0000 UTC 28 September. (a) Control run, (b) LDA run. The model was initialized with a bogus vortex. The central pressures of the control and LDA runs were 934 and 945 hPa. Observed value was 926 hPa.

TPPG Focus

Detection & Modeling of Volcanic Emissions

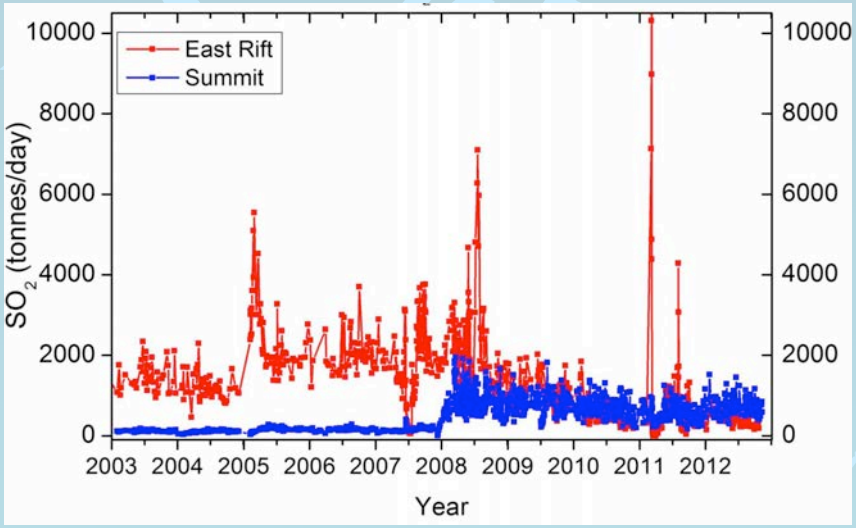
The active Kilauea Volcano creates an ongoing volcanic smog detection and forecasting challenge

Monitoring VOG

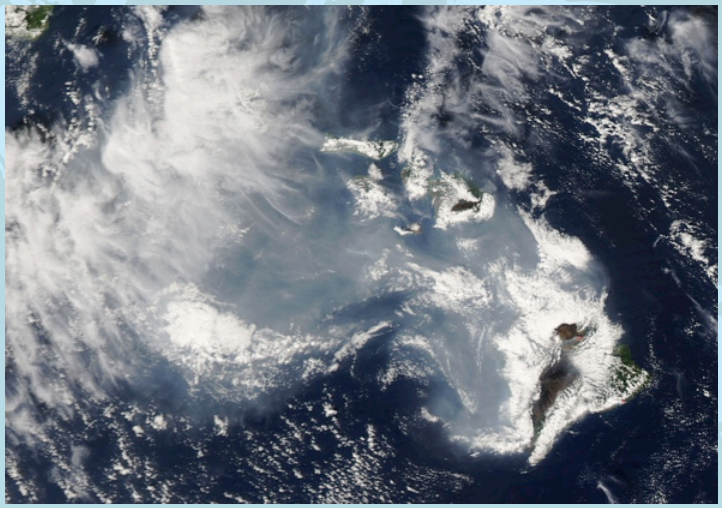


Vehicle-based SO_2 measurements are made downwind of the summit and east rift zone plumes on Crater Rim Drive and Chain of Craters Road during trade-wind conditions.

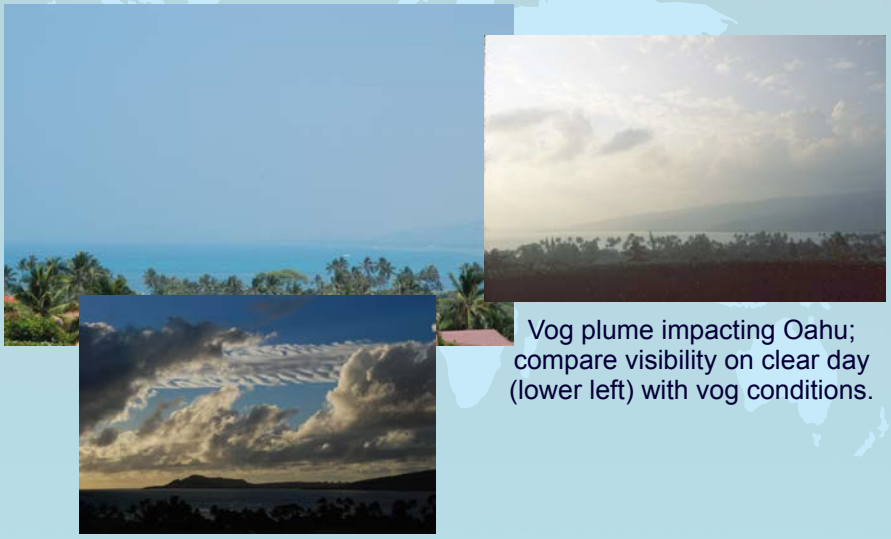
Kilauea SO_2 Emission Rates



Effects Felt far Downstream

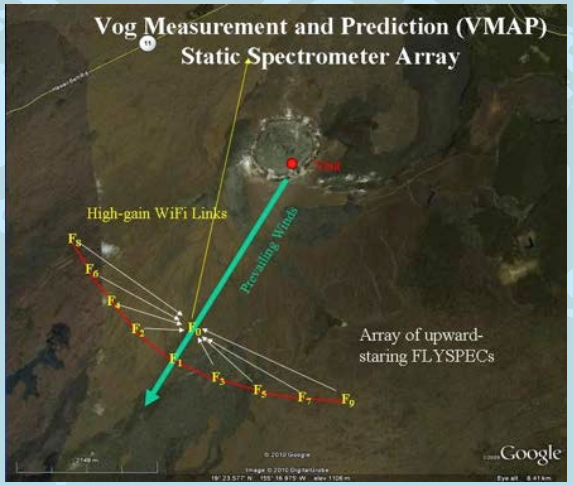


Effects Felt far Downstream



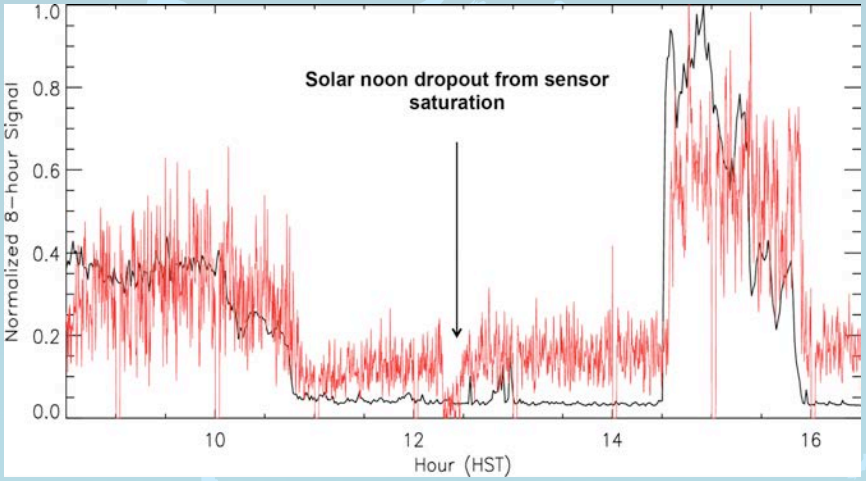
Vog plume impacting Oahu; compare visibility on clear day (lower left) with vog conditions.

Enhanced Observations of Emissions



Networked FLYSPEC array deployed around Halemaumau vent (red dot), consists of units F_0-F_9.

SO_2 vs Seismic Activity



Plot of 10 m Real-time Seismic Amplitude Monitoring (RSAM) seismic signal (black) for 15 August 2012, with 10 s array SO2 emission rate (red), both normalized to their maximum values.

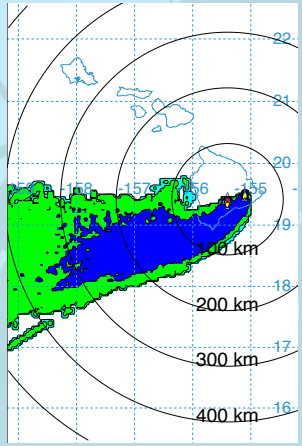
Vog Model: Based on HYSPLIT Model

Hybrid Single Particle Lagrangian Integrated Trajectory Model Version 4.9

Developed by Roland Draxler (et al.) at NOAA-ARL

Components:

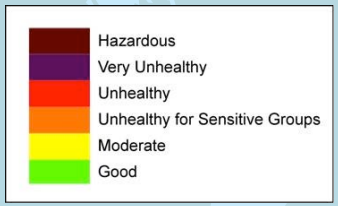
- Trajectory Simulation
  - Time integrated advection
- Dispersion
  - Vertical diffusivity profile and wind shear
  - Horizontal deformation of the wind field
- Pollutant Concentrations
  - Particles: Cell-averaged
  - Puffs: Calculated at a specific grid point
- Variable grid resolution
- Nested grid capability



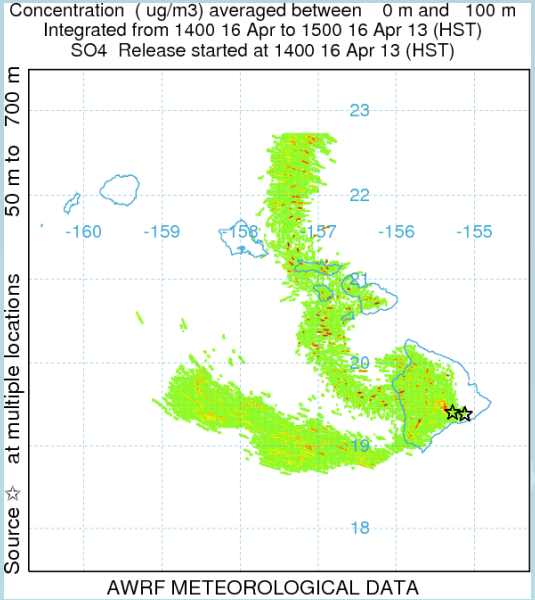
Input for HYSPLIT

Weekly Averaged SO_2 emissions from HVO for the summit and East Rift Zone.

Meteorological Fields from the Weather Research and Forecast (WRF) model.



Andre Pattantyus – PhD candidate will further the vog modeling effort.

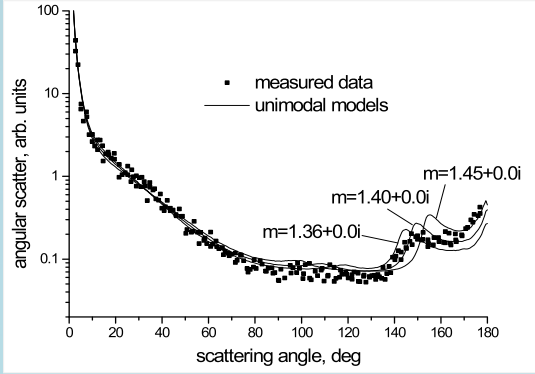


TPPG Opportunity – Vog

To improve the satellite remote sensing of SO_2 and sulfate aerosol.

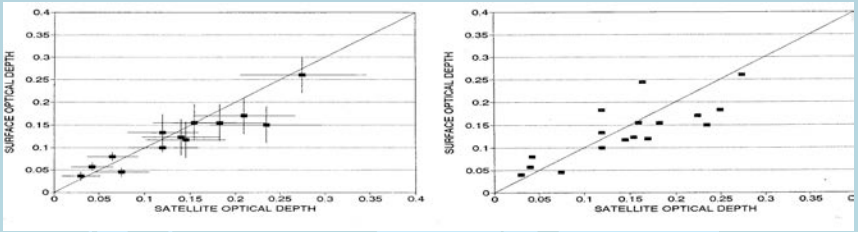
The size distribution and phase function of sulfate aerosols differs from that of sea salt and free tropospheric aerosols.

Knowing these parameters allows MODIS imagery can be processed to get aerosol optical depth.

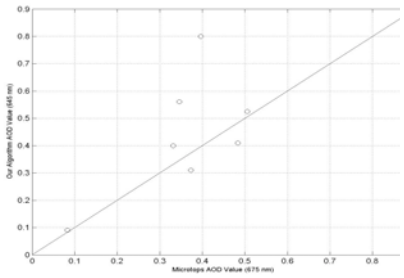


Dr. John Porter

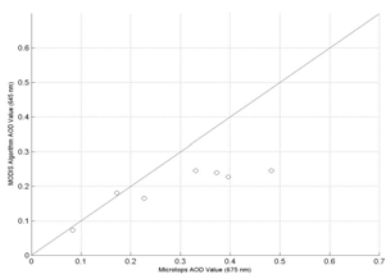
Comparison To Sun Photometer Measurements



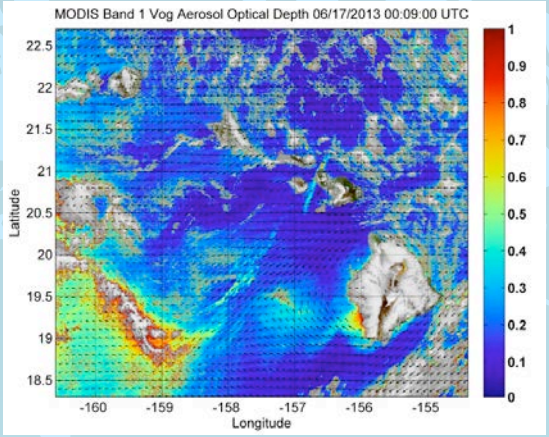
Single Chan. Algorithm (0.25 km)



NASA Algorithm (10 km)

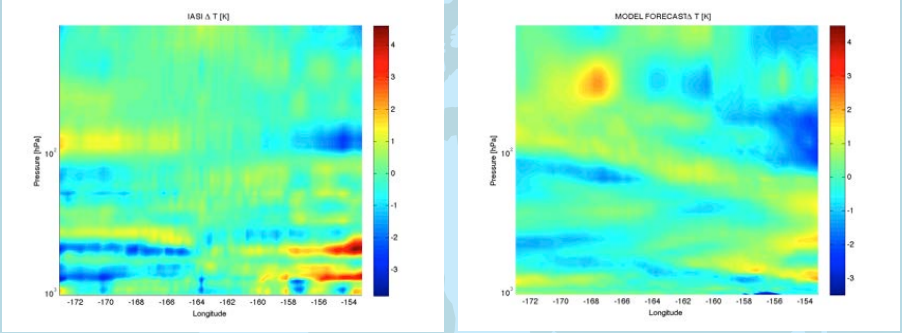


Vog Aerosol Optical Depth



This image is from a single channel. Plan to improve on this product by using two channels.

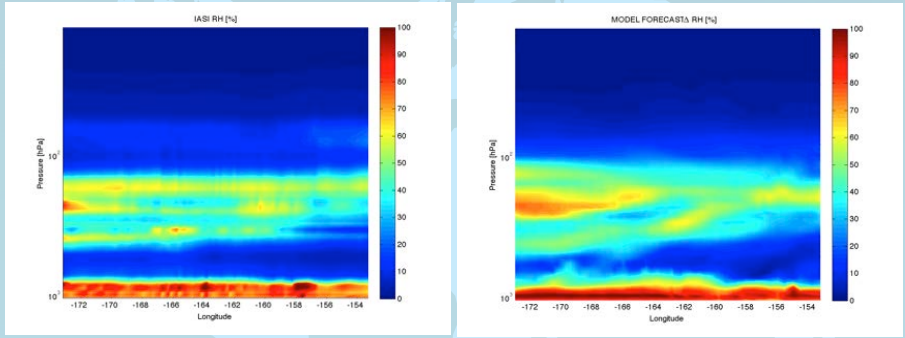
Assimilation of Hyperspectral Data



Vertical cross section of temperature deviation from the mean in [K] derived from IASI observations (left) and from 8h WRF forecast (right) as function of longitude.

Clear skies near Hawaii, a uniform ocean background, a DB downlink, and operational WRF runs at UH, make the central Pacific an idea location to test assimilation of data from hyperspectral sounders (AIRS-AQUA, CrIS- NPP, and IASI-METOP)

Assimilation of Hyperspectral Data



Vertical cross section of relative humidity derived from IASI observations (left) and from 8h WRF forecast (right) as function of longitude.

Funding received from EUMETSAT for a pilot study to assimilate level 2 hyperspectral data from AIRS-AQUA, CrIS- NPP, and IASI-METOP.

Summary and Conclusions

- Installation of DB downlink has brought a new suite of data and products into the PR and HFO.
- GOES-R PG products have been integrated into AWIPS and forecasters are using the products in their forecast process with positive response.
- Lightning - radar reflectivity relationship has been refined, resulting in a robust pseudo-reflectivity product for nowcasting and assimilation of lightning data in NWP.
- Vog is a significant hazard in Hawaii. Improved aerosol optical depth specific to sulfate aerosol would provide valuable data for nowcasting, model initial condition, and model verification.
- There is an opportunity to improve mesoscale precipitable water estimation. PW provides critical guidance for precipitation forecasts in the PR.
- Training, Path to Operations, Integration with data from other data sources, Strategic Vision, Understand the forecast process

Questions?