Development of an Integrated Data Product for Hawaii Climate

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PRIDE Project
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Purpose of the project

- develop an integrated product for Hawaii climate research
- mainly ground radar and satellite data (polar orbiter) high resolution rainfall dataset, combined with mesoscale model and in situ data
- key element: integration of various climate data into one format and map
Climate variability
small islands but large spatial and temporal rainfall variability
Societal impact of climate variability

winters - rainy, local floods

summers - dry, prone to fires
Monthly rainfall

Honolulu Airport – monthly rainfall (mm)
ENSO variability

El-Nino = dry conditions in Hawaii
Effect of ENSO on Hawaiian regional rainfall

2004/2005 winter unusually wet and stormy

GPCP rainfall seasonal anomaly (Nov Dec Jan)

LIS flash count (sum 159-157W 20-22N)
Motivation

- *unusual* winter 2004/05 – more rainy and more lightning activity in weak El Nino winter
- need for high resolution weather and climate data
  - focus on rainfall
- advantage of remote sensing data (satellite), ground radar, and mesoscale model data
Relevance

- local communities - risk management, local flood
- coastal risk management (regional ocean modeling)
- fire danger potential assessment
- public health – air pollution control
- water resource management
- research into small scale climate variability in Hawaii (example winter 2004/05)
- effect of large scale circulation patterns variability on local weather and climate (rainfall)
- relation between small Cu, SST and topography
Benefits

Integrated dataset

- integration of various data in one format and one common map displayable by GrADS
- high temporal and spatial rain data (and others) – unique dataset for Hawaii – **RADAR** (~ 1km, 1 hourly rain rate data), model output data (9km and 1.5km)
- data served at APDRC – one center
Project Description

- acquire and process the following:

  - Radar data November, December 2004, January 2005 (from NCDC)
  - MODIS data – one month of data (June 2004)
  - LIS daily data 1998-2005 (MSFC)
  - weather service and cooperative stations 2000-2005 (NCDC)
  - mesoscale model output
Description – RADAR data

- Level III Radar data acquired from NCDC – 4 sites (Kauai, Molokai, Kamuela, South Shore) 6 minute frequency, 1km x 1 angular degree
- Selected variables (rain rate, reflectivity, liquid water content, echo top and radial velocity) converted to binary
- 6-minute data averaged to 1 hourly means
- Hourly mean data for each radar site merged and remapped to uniform grid 1550x1100 @ 1km (nearest neighborhood algorithm)
- Overlapping regions – distance weighted average
Description - Radar

- remapping of Radar data

Location and ranges  resulting radar rain rate map (Nov. 2004 mm/hr)
Accomplishments


- advantage of **Radar** – coverage and resolution
Accomplishments: mesoscale model

- nested domains – state 9km, island scale 1.5km, archived 3-hourly output fields
- vector wind T, Td, height, rainfall, full 3-D spatial coverage
- MSM archived since April 2002, MM5 since July 2003
Accomplishments

- MODIS - June 2004 data acquired, SST and cloud mask retrieved
- LIS – lightning data 1998-2005 - converted
- In situ data
  - weather service station data 2000-2005, year 2004 converted into GrADS displayable format
  - cooperative station data – 1hr. rainfall 2000-2005, y. 2004 converted into GrADS displayable format
Example of integration

radar rainfall and station data – overlap on one map
To be completed

- calculate radar derived climatology (hourly)
- MODIS – complete the rest of the data (total 3 mos.) process and establish cloudiness climatology for the Hawaiian Islands – cooperation with John Porter
- complete the LIS climatology based on daily values
- finish station data conversion
- integrate mesoscale model output data, surface wind: Yi-Leng Chen contribution
To be completed

- **data quality control** - needs to be yet addressed
- address the scientific questions
  - research into small scale climate variability in Hawaii (example rainfall in winter 2004/05)
  - effect of large scale circulation patterns variability on local weather and climate (rainfall)
  - relation between small Cu, SST and topography
Challenges

- data volume esp. Radar data - can be challenging but it is manageable
- some difficulties with format conversions – solved now
Future opportunities

- other seasons and years – continuation in time

- expand the scope of data collection to other sources: e.g. ocean chlorophyll, TRMM Precipitation Radar data, include possibly NWS data

- start building regional weather/climate/ocean data center as a primary data source to serve general and scientific community as a part of APDRC
  - local risk and natural resources management
  - Hawaii weather/climate related research