

Future Climate Change in Hawai'i

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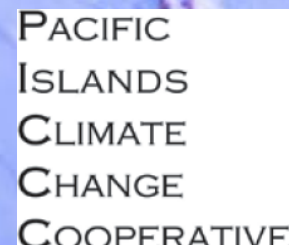
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Future Climate Change in Hawai'i: From Global Warming to Regional Change

**Physical
Principles**

**Data
Availability**

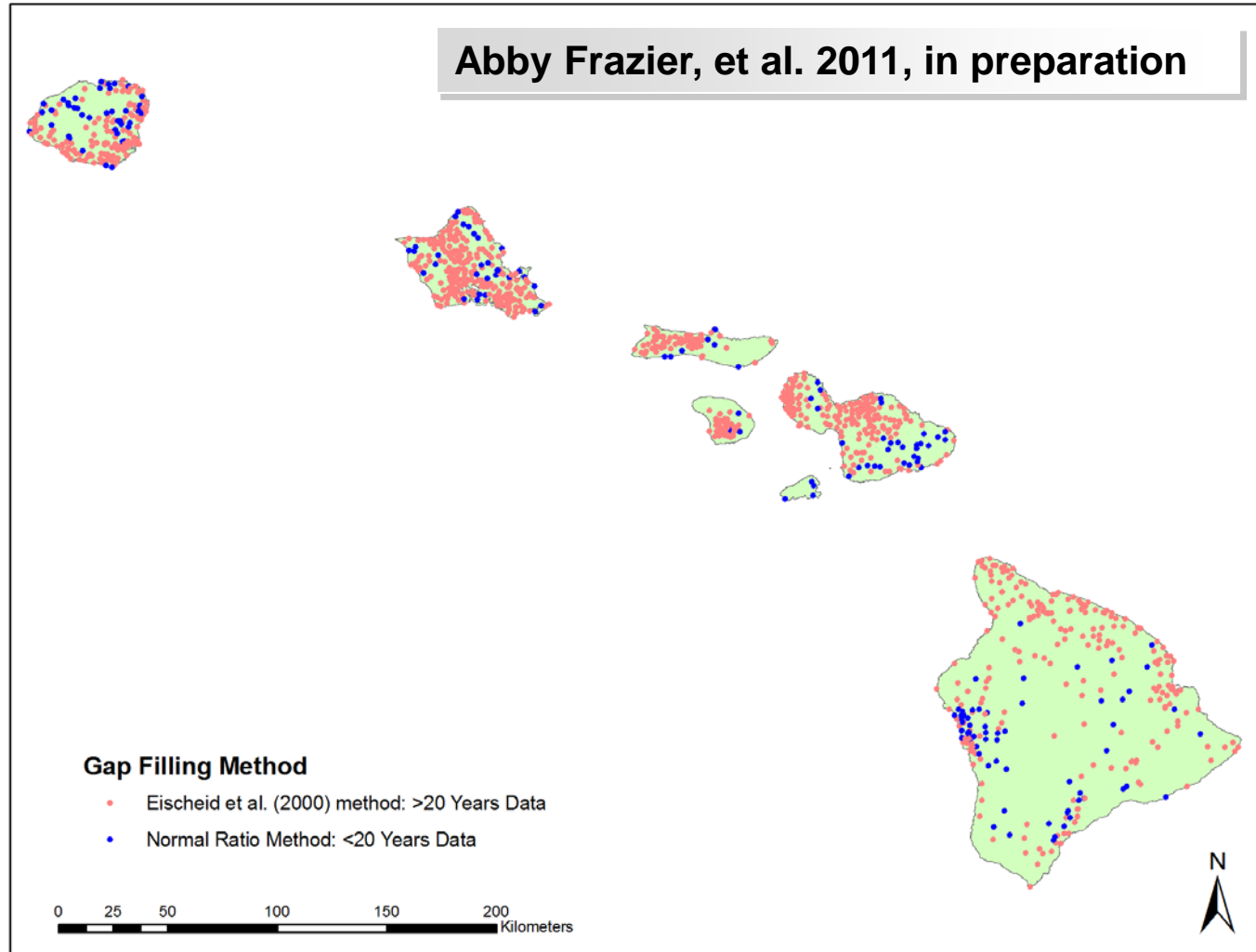
**Product
Development**

**Available
Resources**

**Data
Availability**

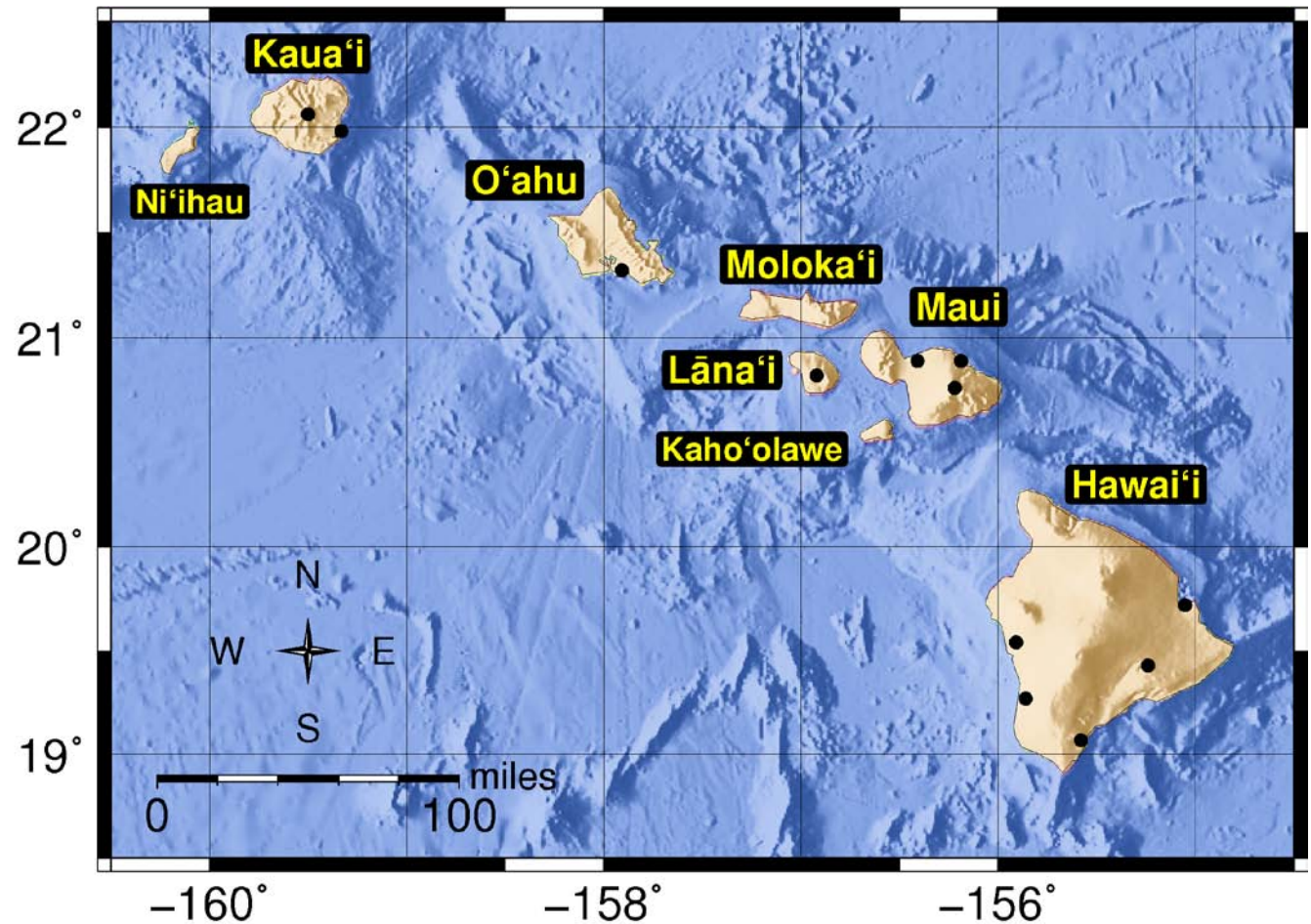
**Hawaii has a dense rain-gauge station network
with more than 1000 gap-filled stations
(monthly rainfall data 1920-2008)**

Abby Frazier, et al. 2011, in preparation



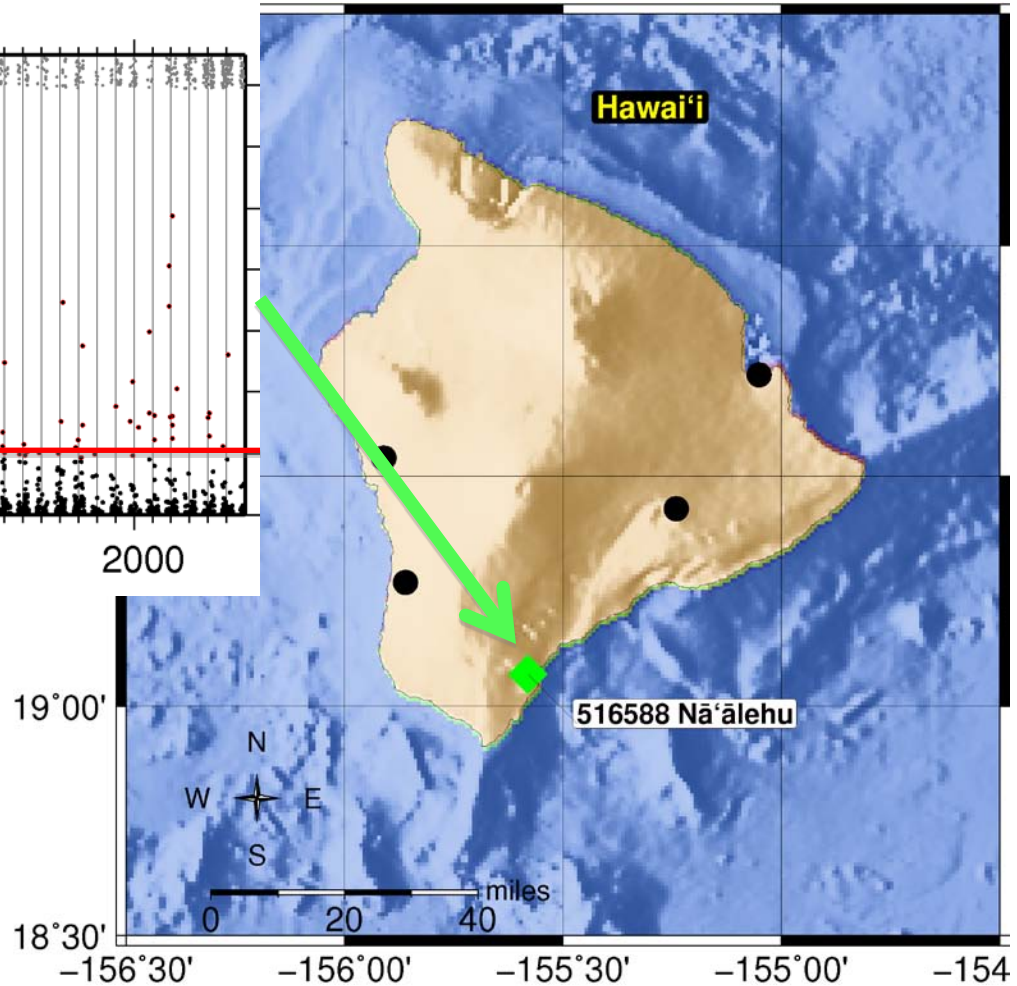
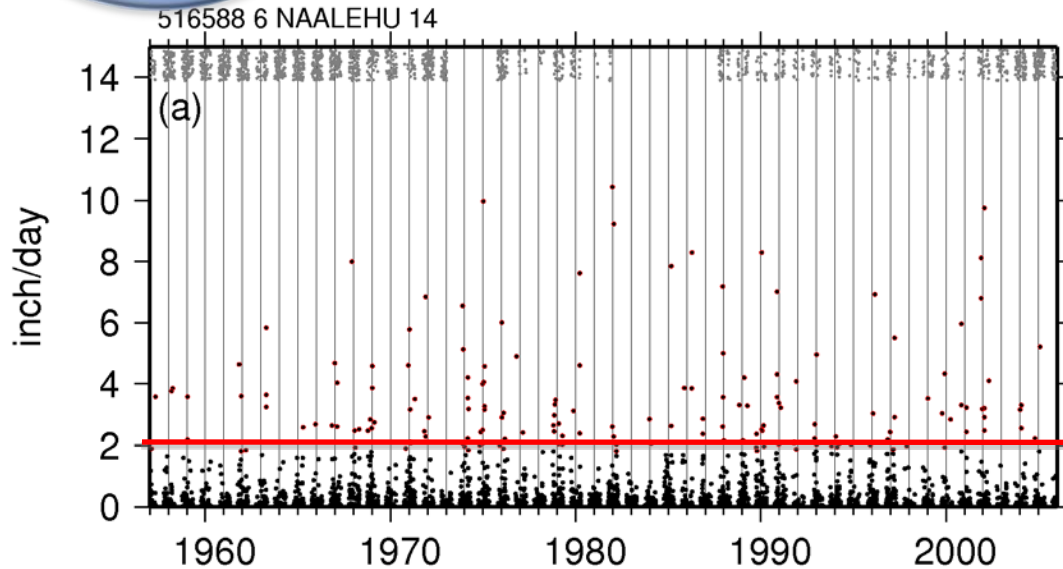
**Data
Availability**

Only a small number of stations provide long records with few missing observations for the analysis of daily rainfall extremes.



**Data
Availability**

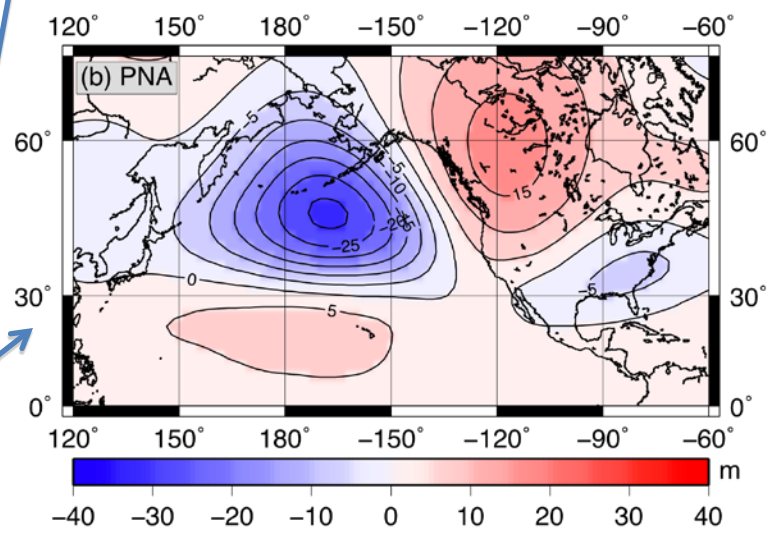
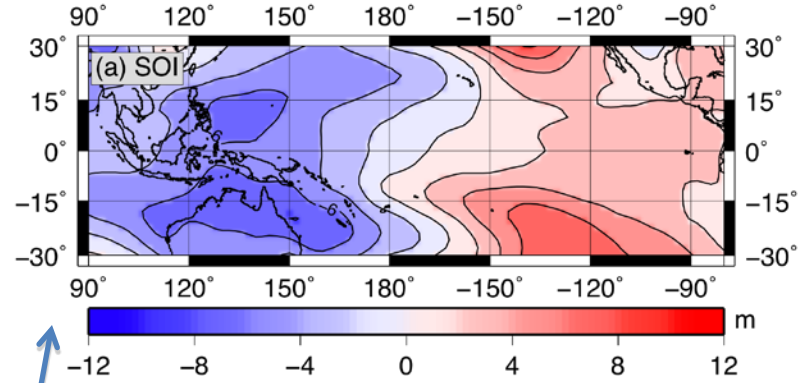
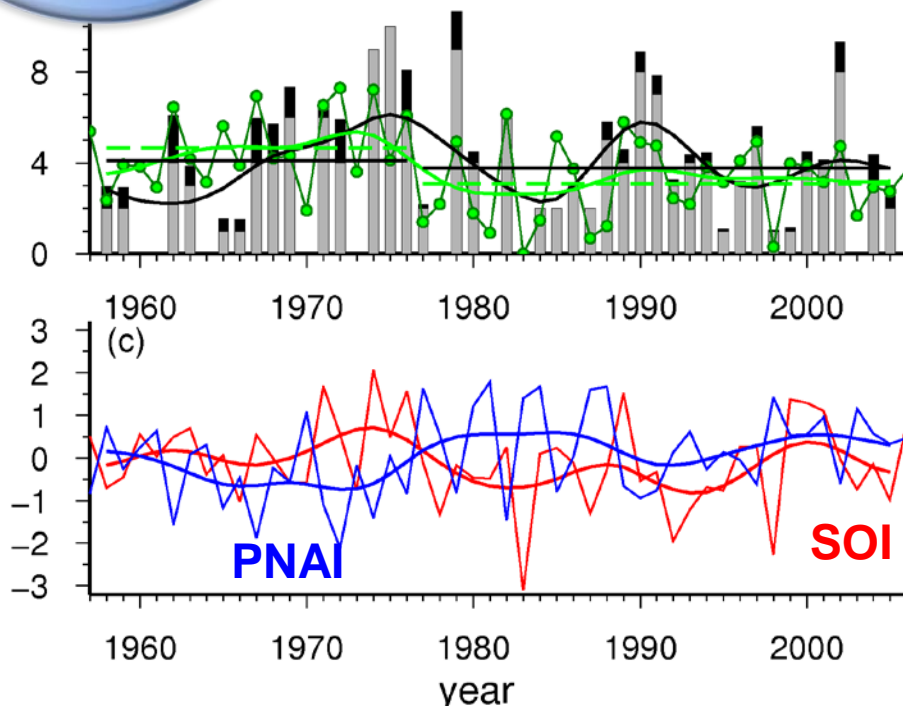
Only a small number of stations provide long records with few missing observations for the analysis of daily rainfall extremes.



Data source NOAA NCDC

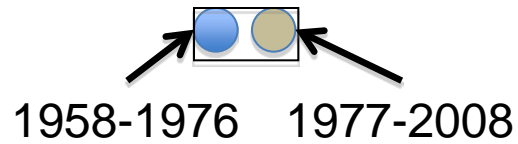
Large-scale
climate
&
heavy rain
frequency

Number of heavy rain events during wet
seasons (Nov-Apr) and its dependence
on large-scale circulation modes.



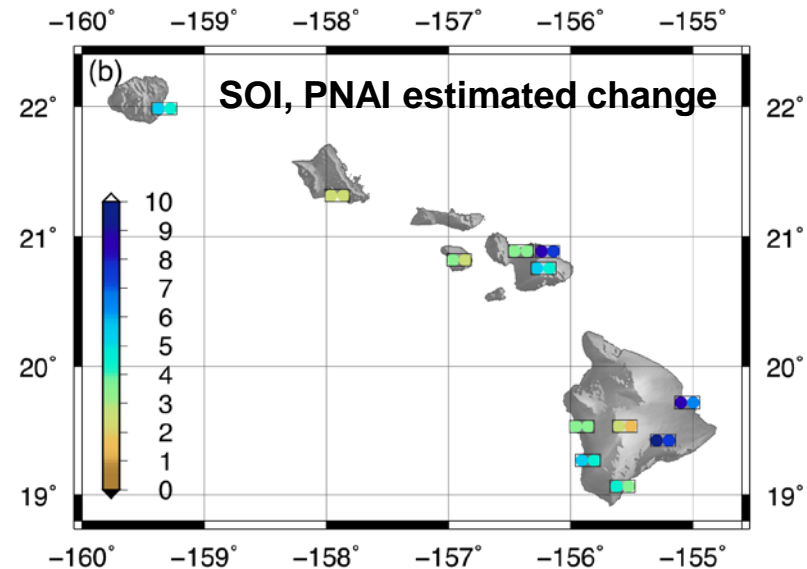
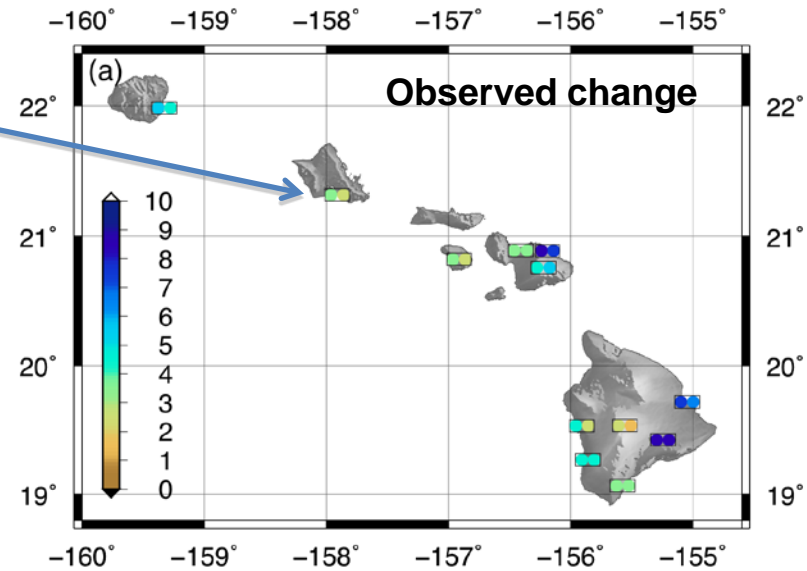
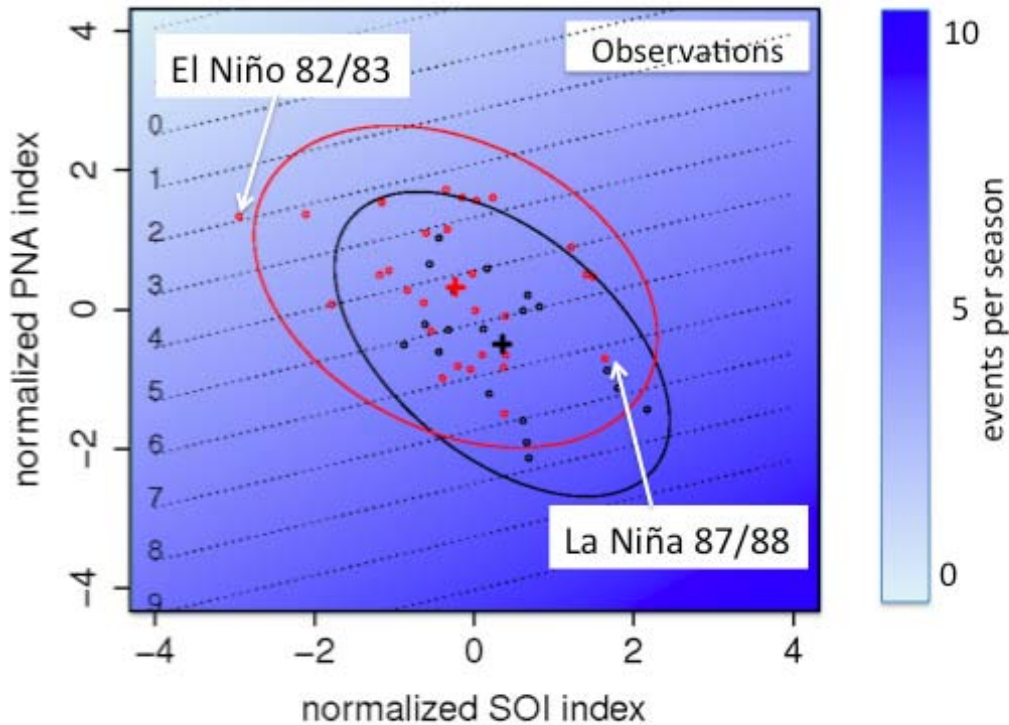
NCEP reanalysis 1000 and 500 hPa geopot.
height anomalies associated with SOI and PNA
index, respectively

Large-scale
climate
&
heavy rain
frequency



black: years 1958-1976
red: years 1977-2005

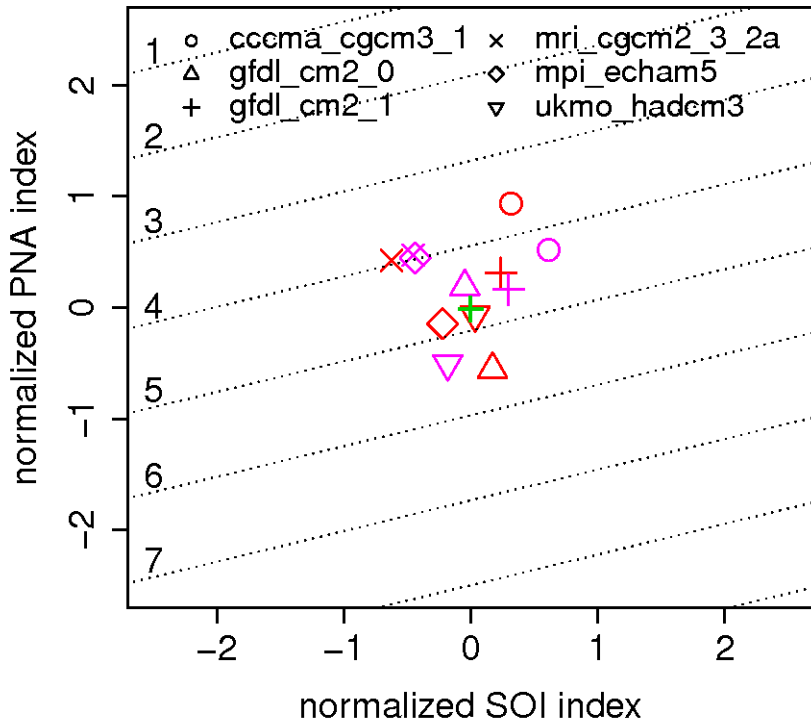
Mean changes for the 12 stations



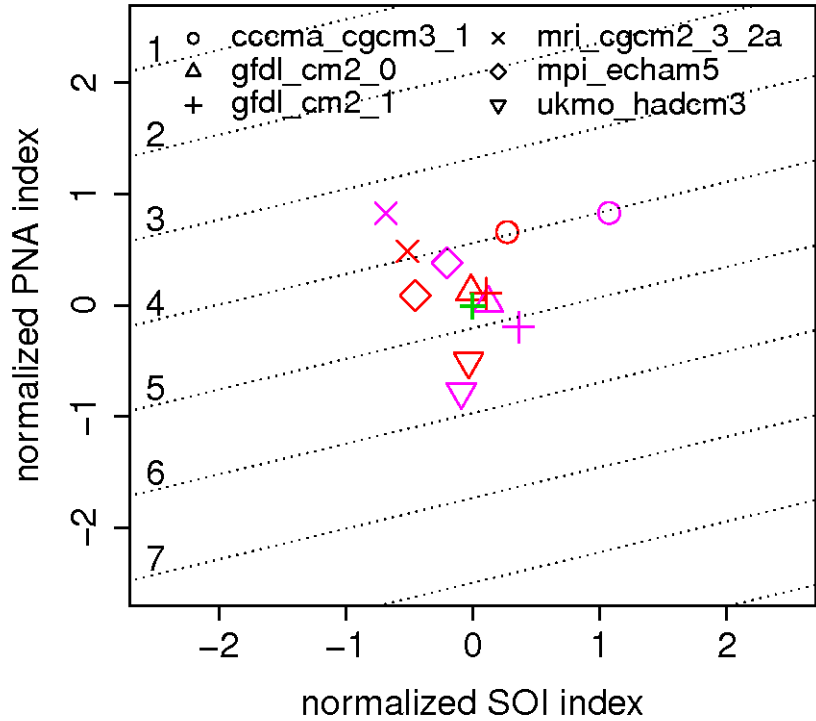
Future
projection
heavy rain
frequency

Green: present day
Red: 2046-2065
Purple: 2081-2100

Six-model ensemble scenario A1B



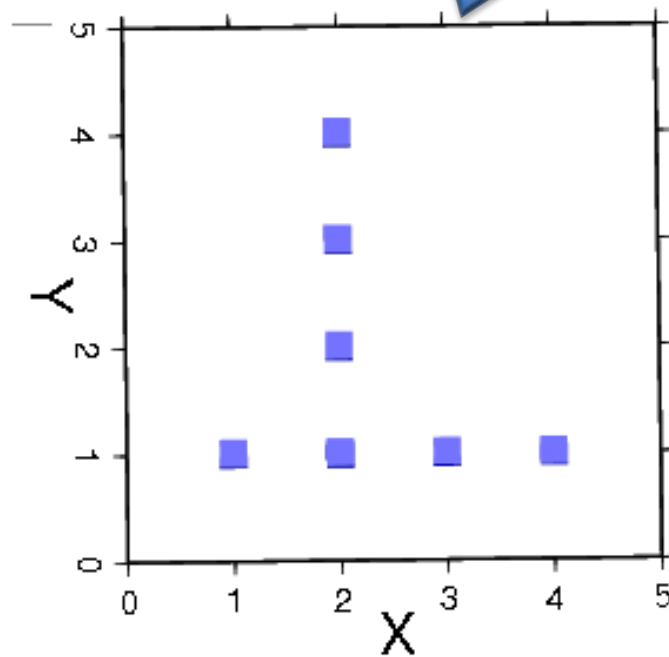
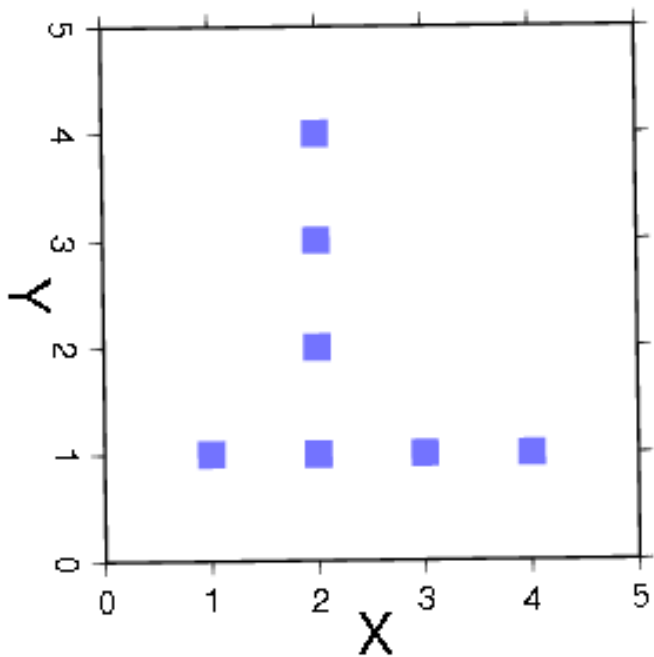
Six-model ensemble scenario A2





and our chances to
detect changes

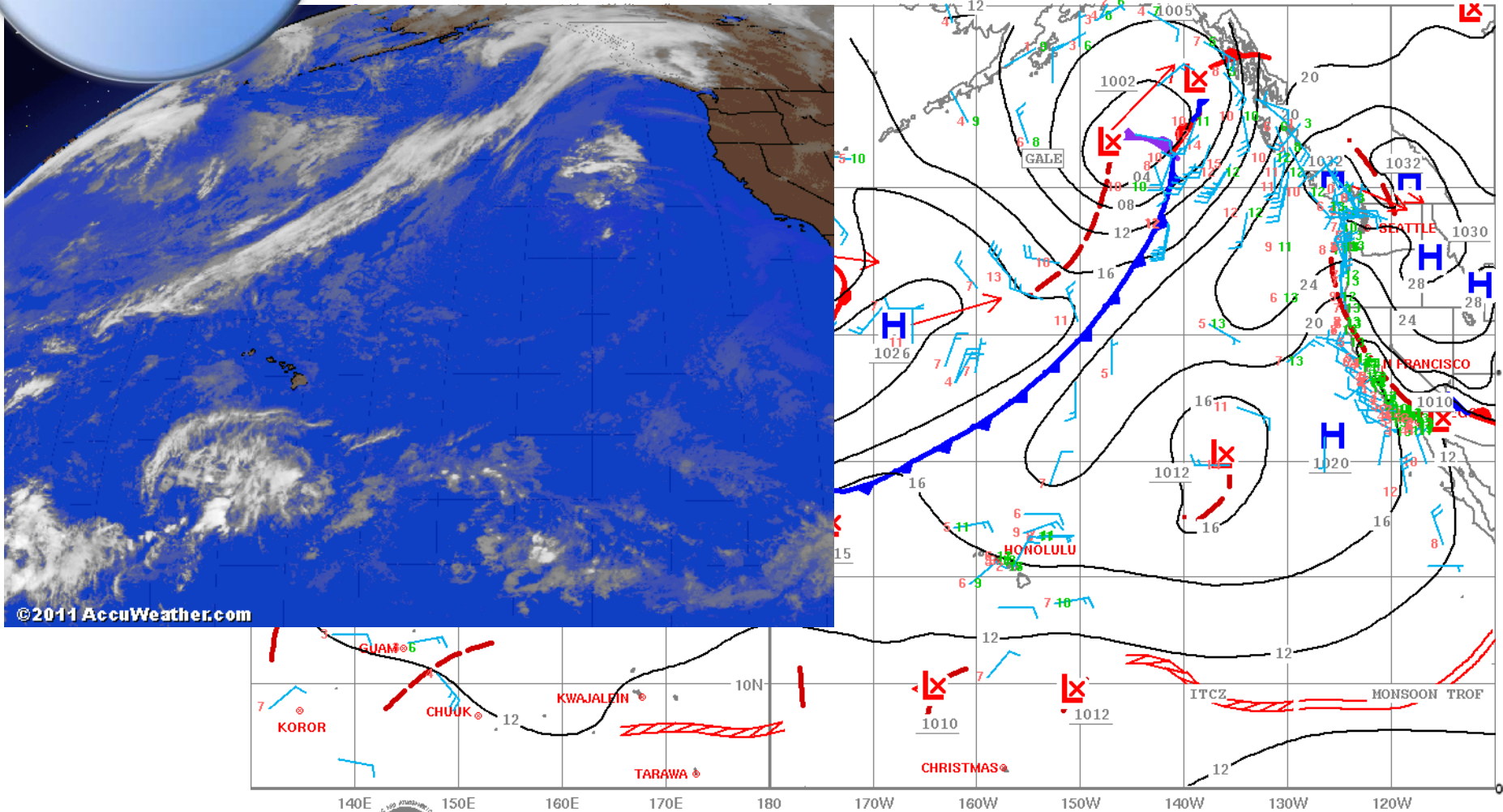
How dimension
reduction changes
our perception of
objects



From
weather to
climate
statistics

Rain-producing synoptic weather types during winter months

(e.g. Chu, Nash and Porter, J. Climate, Vol. 6, 1457-1462, 1993.)



©2011 AccuWeather.com



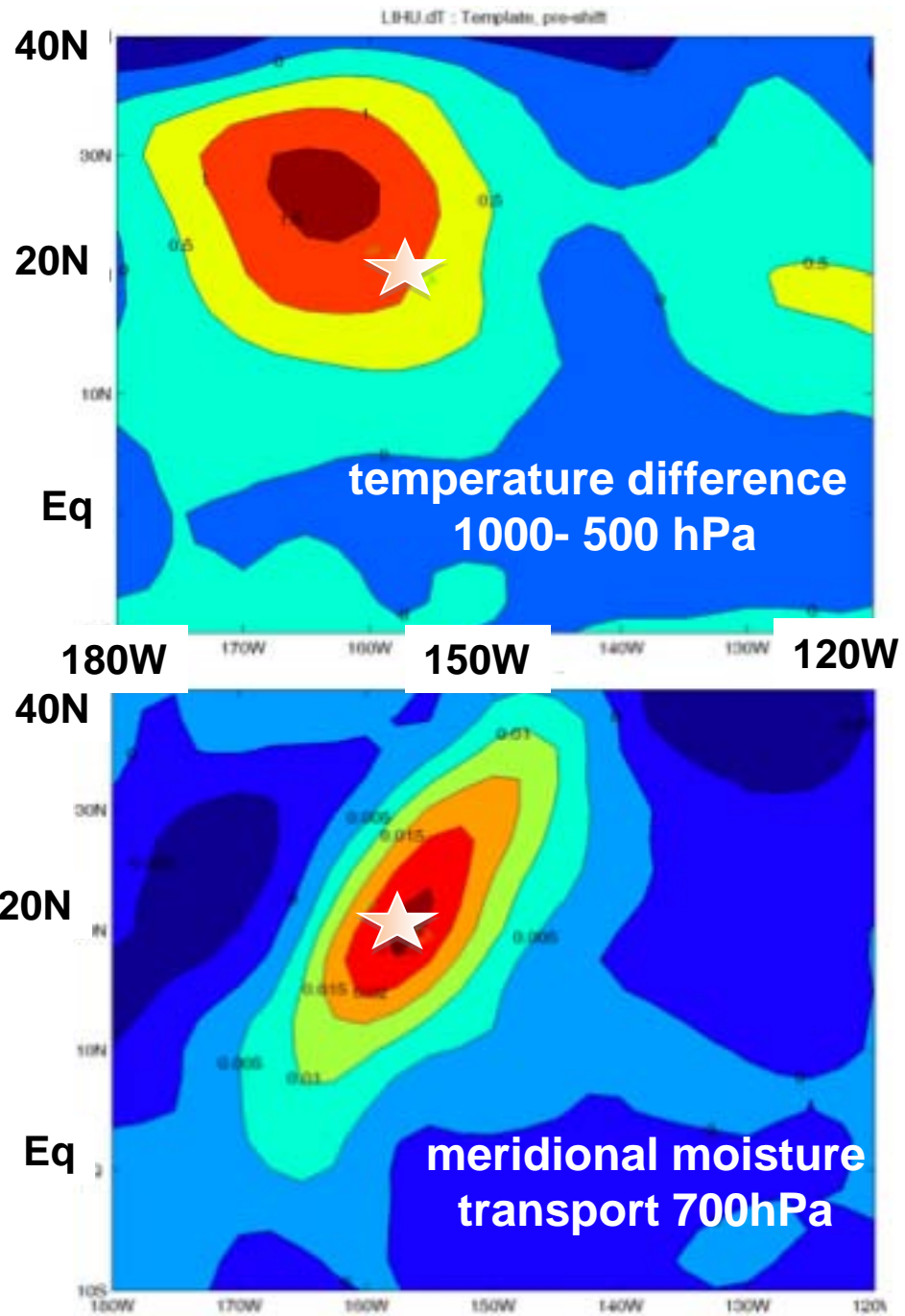
NORTH PACIFIC SURFACE ANALYSIS OCT 18 2011 00 UTC
U.S. Dept. of Commerce/NOAA/National Weather Service Honolulu, Hawaii

Composite Analysis

Composite analysis of the circulation anomalies using NCEP reanalysis data. Anomalies for days with precipitation greater than 90% percentile

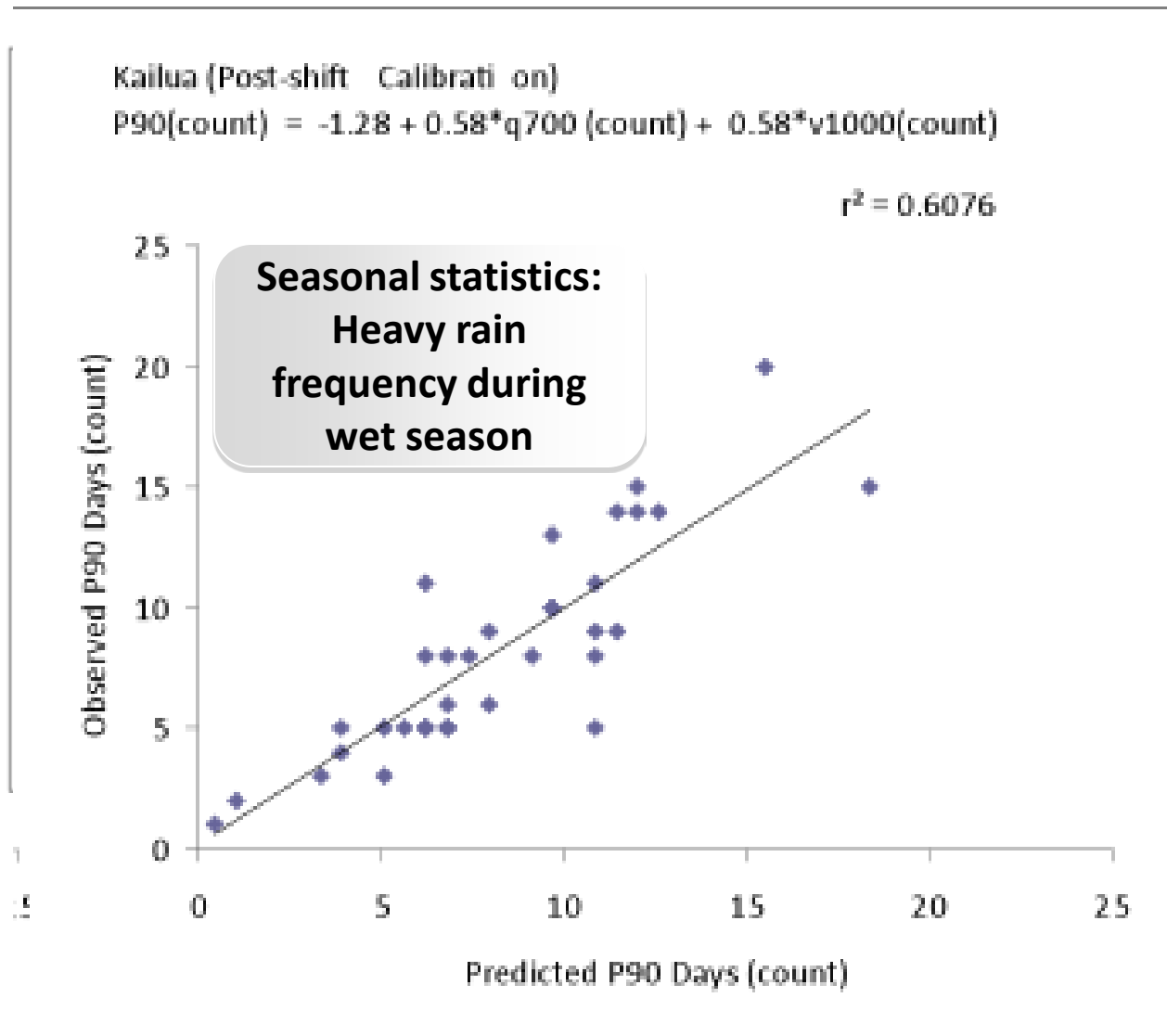
Rainfall at station Nā'alehu: Anomalous moisture advection from equatorial Pacific + upper level trough.

'Kona-low' weather pattern



**Composite
Analysis +
Regression
model**

Example illustration: Conditional dependence of rainfall on the spatial correlation between composite and daily circulation anomalies.



**Future
projection
heavy rain
frequency**

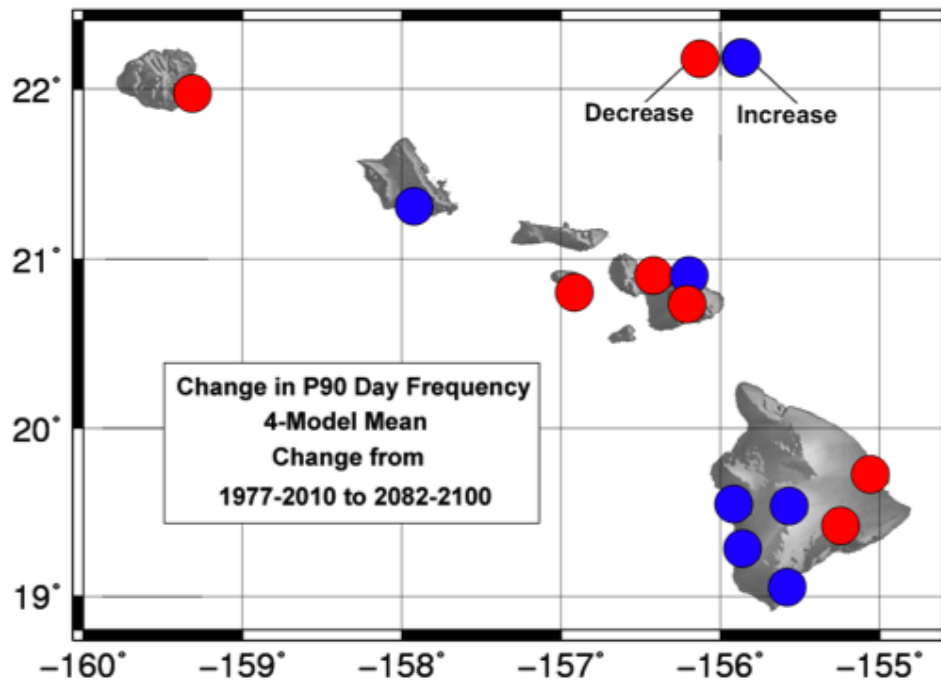
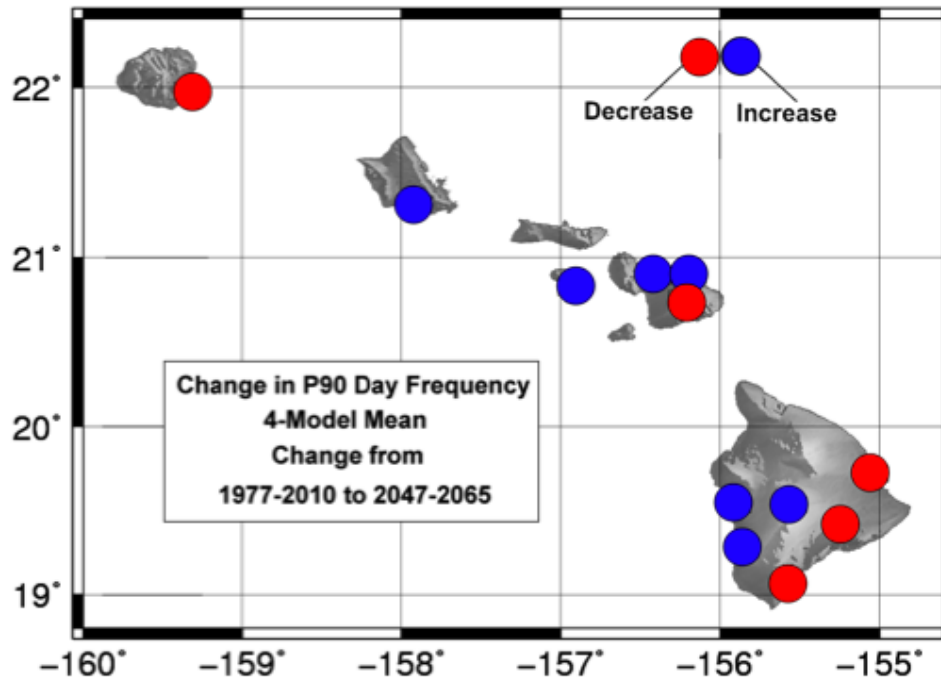
Summary:

◆ So far, no indicator for dramatic increase in the frequency of heavy rain events

◆ The limited number of stations available show equal number with positive and negative trends.

◆ Downscaling results vary considerably among the GCM models.

Elison Timm, O., M. Takahashi,
H. F. Diaz, T. W. Giambelluca,
in preparation.



Online access through interactive maps.

<http://apdrc.soest.hawaii.edu/projects/SD/>

Product
Development

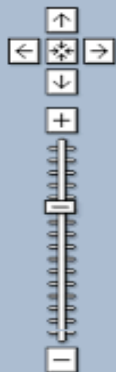
Data-Research Center | Statistical Downs...g of IPCC Climate Scenarios onto the Hawaiian Islands
/apdrc.soest.hawaii.edu/gg/rainSD.php



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Estimated rainfall changes for the late 21th century based on percentages of present averages

Kauai Oahu Molokai/Lanai Maui Hawaii Hawaiian Islands



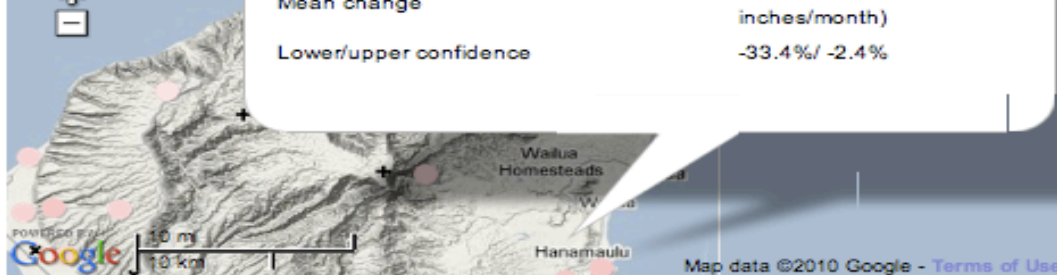
Map Satellite Terrain

Crosshairs

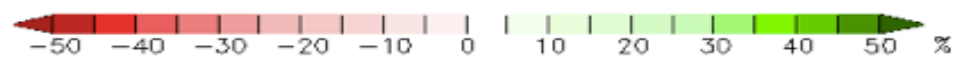
LIHUE 1020

ID	515575
Latitude	21° 58' 28" N
Longitude	159° 22' 05" W
Altitude	207
Wet season mean precipitation (1958-1988)	5.3 inches/month
Mean change	-17.9% (-1.0 inches/month)
Lower/upper confidence	-33.4%/ -2.4%

- Dry: CCCMA CGCM3 1
- Dry: GFDL CM2 0
- Dry: GFDL CM2 1
- Dry: MPI ECHAM5
- Dry: MRI CGCM2 3 2A
- Dry: UKMO HADCM3
- Dry: 6-Member ensemble mean
- Wet: CCCMA CGCM3 1
- Wet: GFDL CM2 0
- Wet: GFDL CM2 1
- Wet: MPI ECHAM5
- Wet: MRI CGCM2 3 2A
- Wet: UKMO HADCM3
- Wet: 6-Member ensemble mean



Legend:



Product
Development

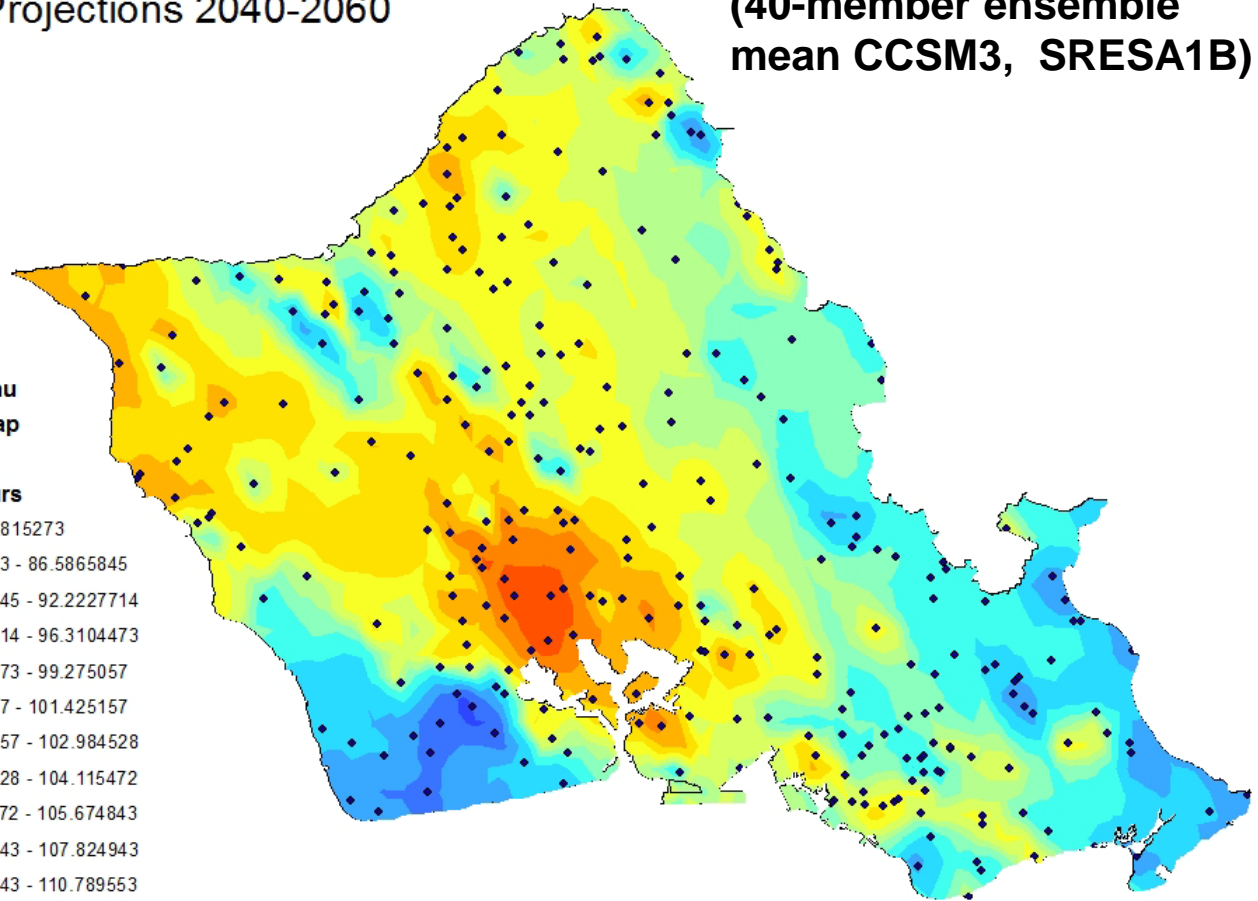
Spatial statistics for GIS Map productions: Example showing downscaled wet season precipitation changes for 2040-2060

Oahu Projections 2040-2060

(40-member ensemble
mean CCSM3, SRESA1B)

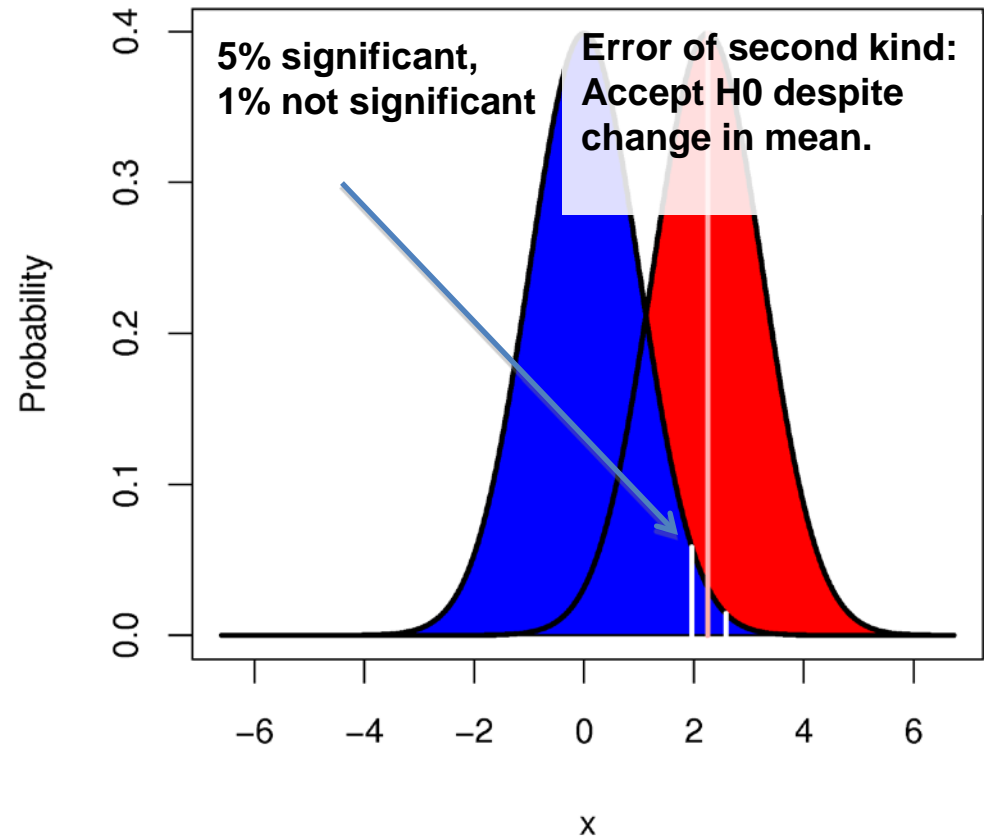
Kriging_Oahu
Prediction Map

Filled Contours



Product Development

Null Hypothesis: No change in mean



**Product
Development**

Null Hypothesis: All edible!

**Product development
must include confidence
/significance estimates!**

**Scientists must take the
risk into account!**



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Hypholoma fasciculare

Hypholoma capnoide