TRANSIENT VOLCANO DEFORMATION EVENT DETECTION OVER VARIABLE SPATIAL SCALES IN ALASKA

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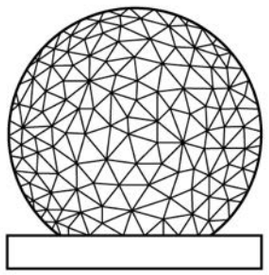
2016 NEROC Symposium

November 4th



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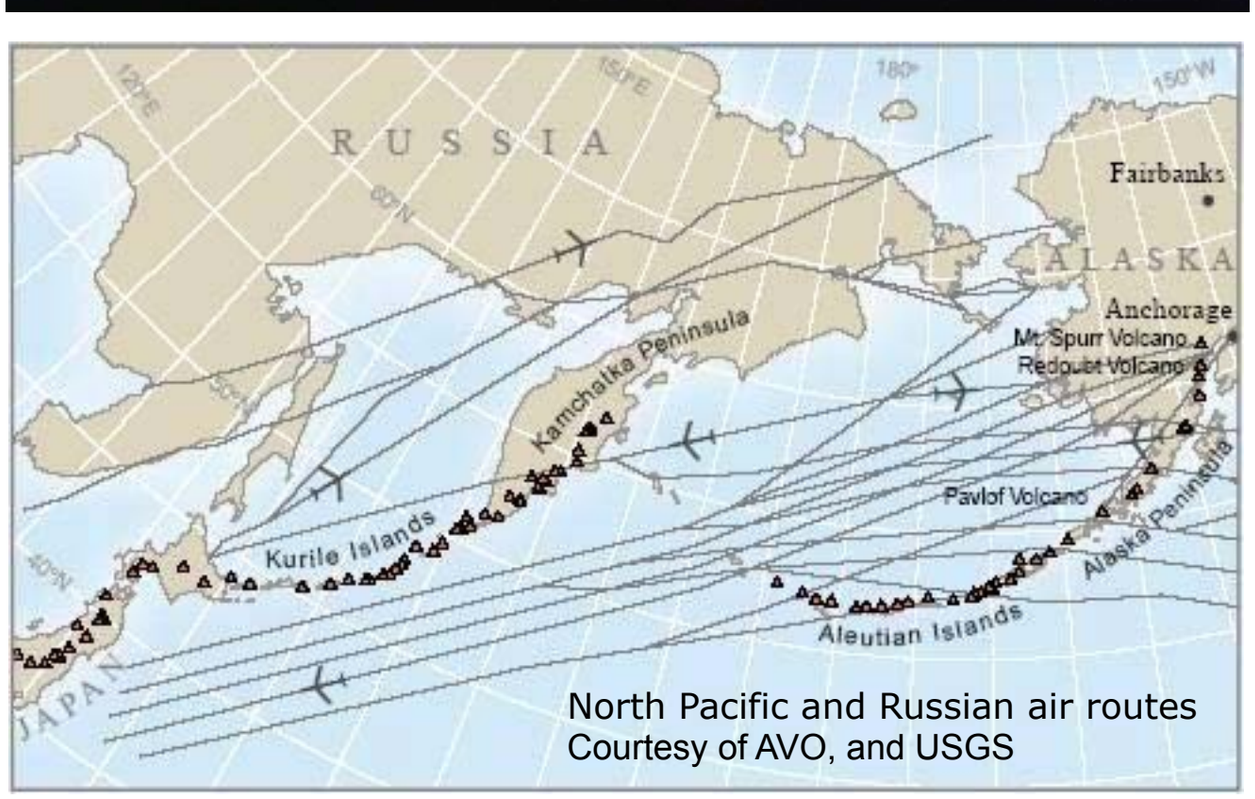
Outline

1. Why study Volcanoes?
2. How to study Volcanoes?
3. Which Volcanoes to study?
4. What did we find?

Why Study Volcanoes?

- Understanding of important geological and geophysical processes
- Instrumentation shared with other fields in geology and geodesy
- Monitoring and mitigation of volcanic hazards
  - Ash clouds and fallout
  - Induced Tsunami
  - Lava flow
  - Volcanic gasses
  - etc …

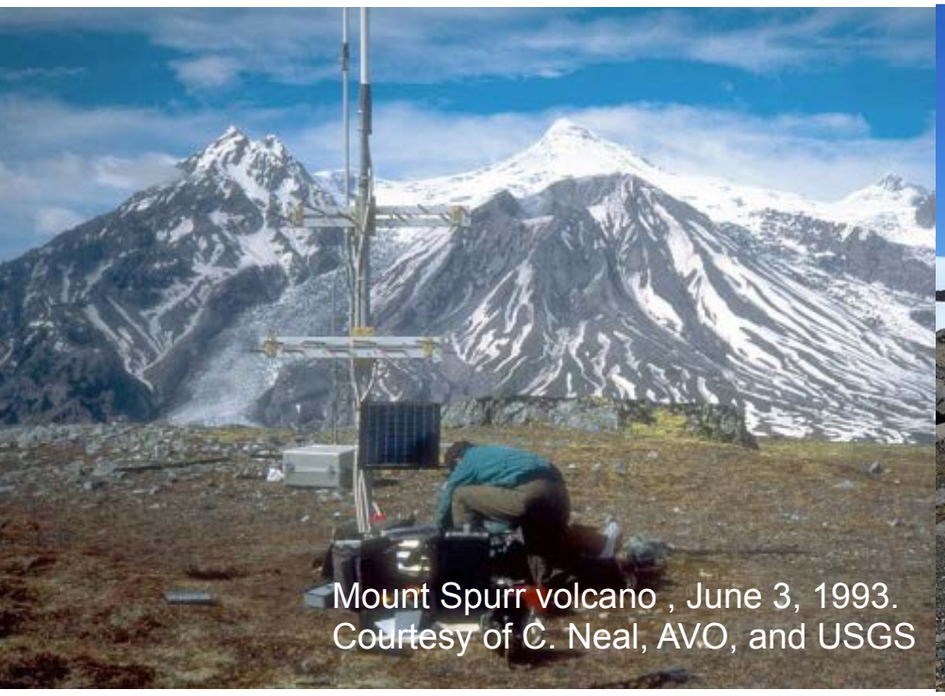
Redoubt Volcano, April 21, 1990.
Courtesy of Robert Clucas, AVO, and USGS



North Pacific and Russian air routes
Courtesy of AVO, and USGS

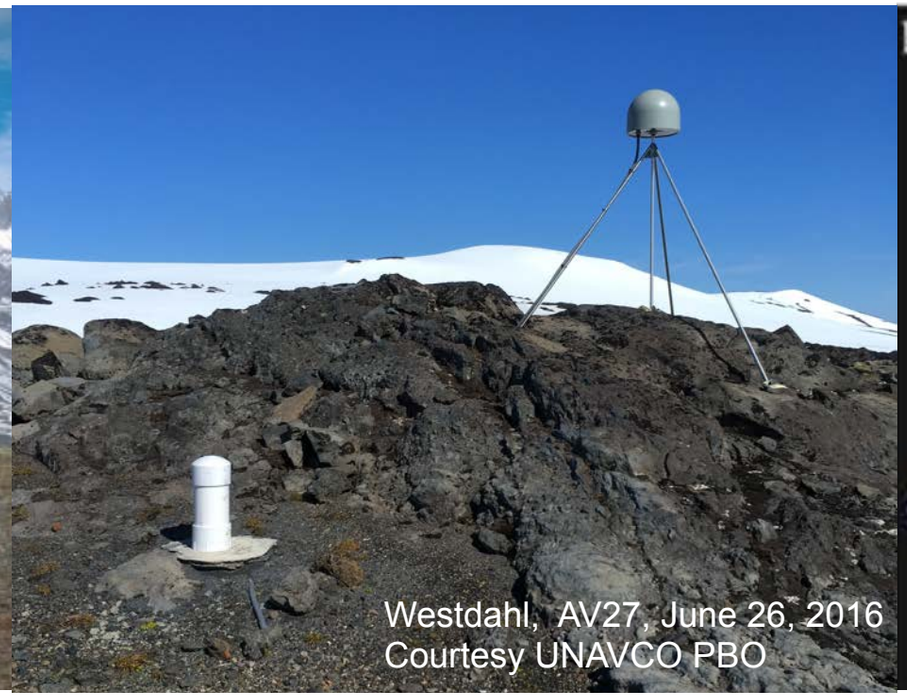
How to Study Volcanoes?

Seismometers



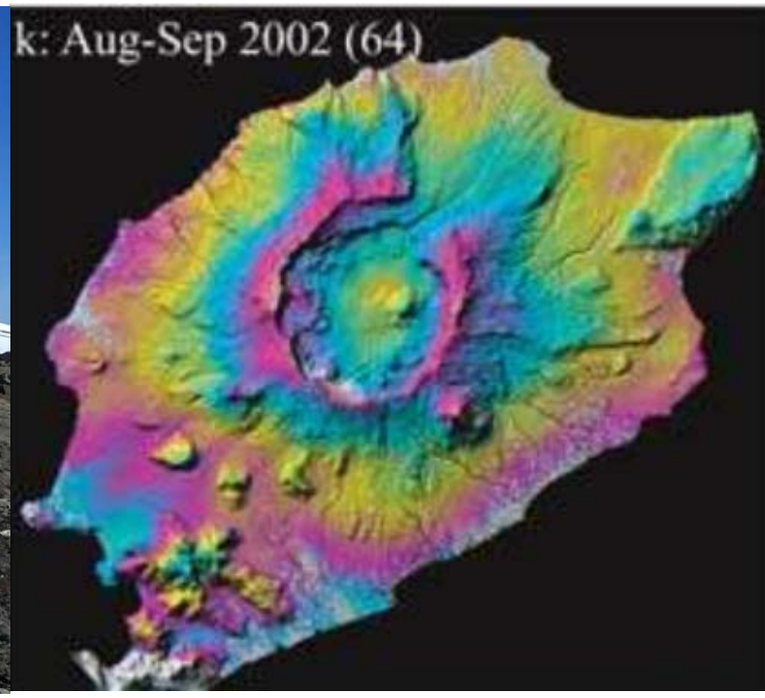
Mount Spurr volcano , June 3, 1993.
Courtesy of C. Neal, AVO, and USGS

GPS

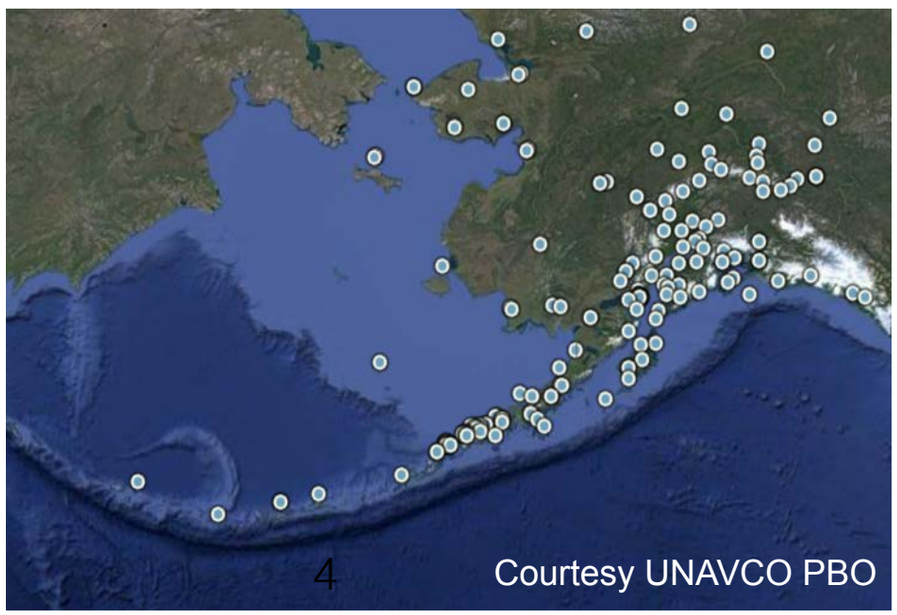


Westdahl, AV27, June 26, 2016
Courtesy UNAVCO PBO

InSAR



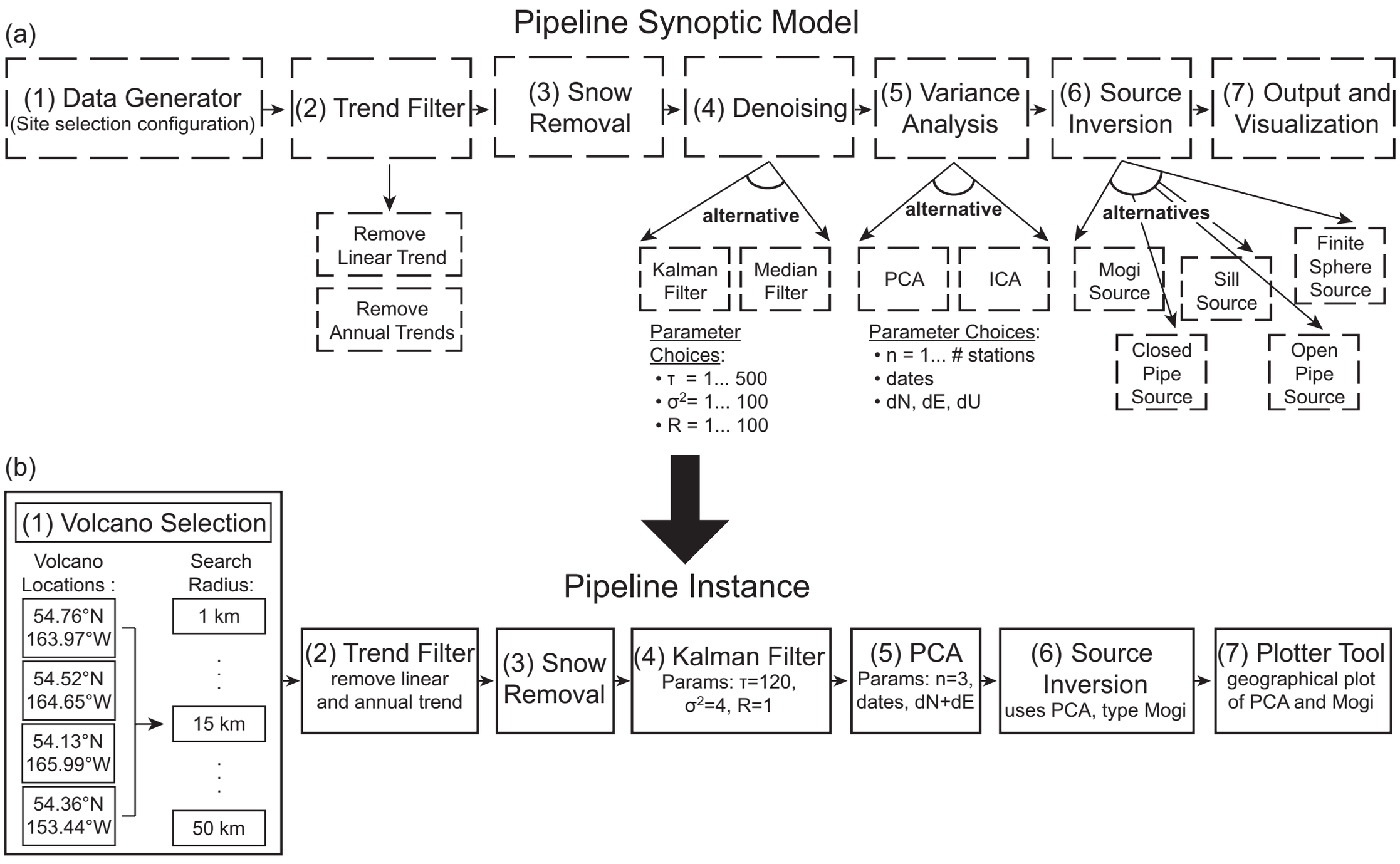
Courtesy of AVO



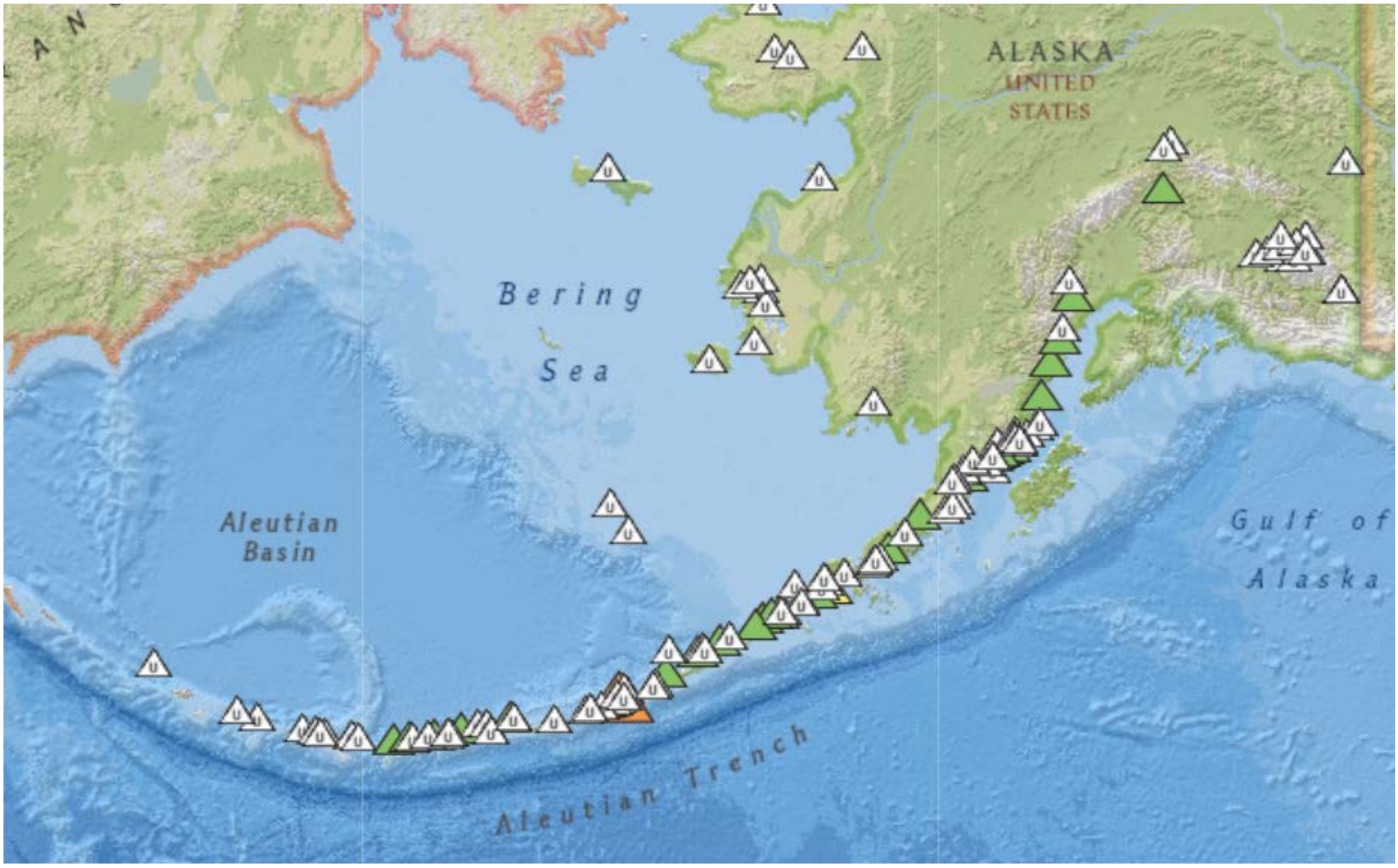
Courtesy UNAVCO PBO

https://en.wikipedia.org/wiki/Envisat

Geo-Informatics

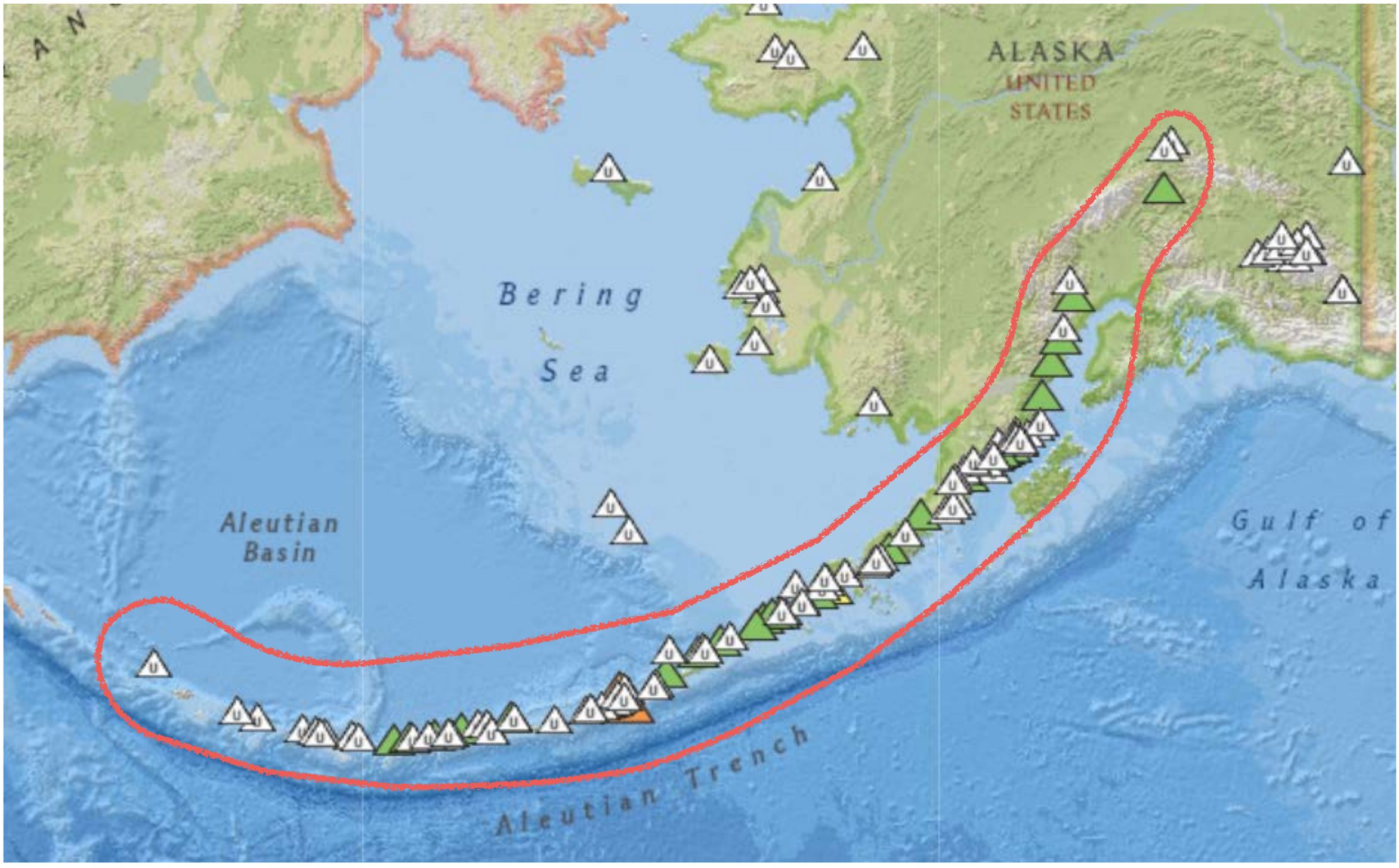


Which Volcanoes?



Map of Volcanoes from the Alaska Volcano Observatory (AVO) Website

Aleutian Islands, Alaska



Map of Volcanoes from the Alaska Volcano Observatory (AVO) Website

AKUTAN VOLCANO

AVO operates a network of 11 seismometers on Akutan Island, which are used to monitor Akutan Volcano 24 hours a day. Pictured above is station AKGG (gray hut in right foreground), with the 1980 lava flow in the middle distance.

Image courtesy of Helena Buurman, AVO/UAF-GI.

SHISHALDIN VOLCANO

Minor steam plume at Shishaldin, July 1, 2016.

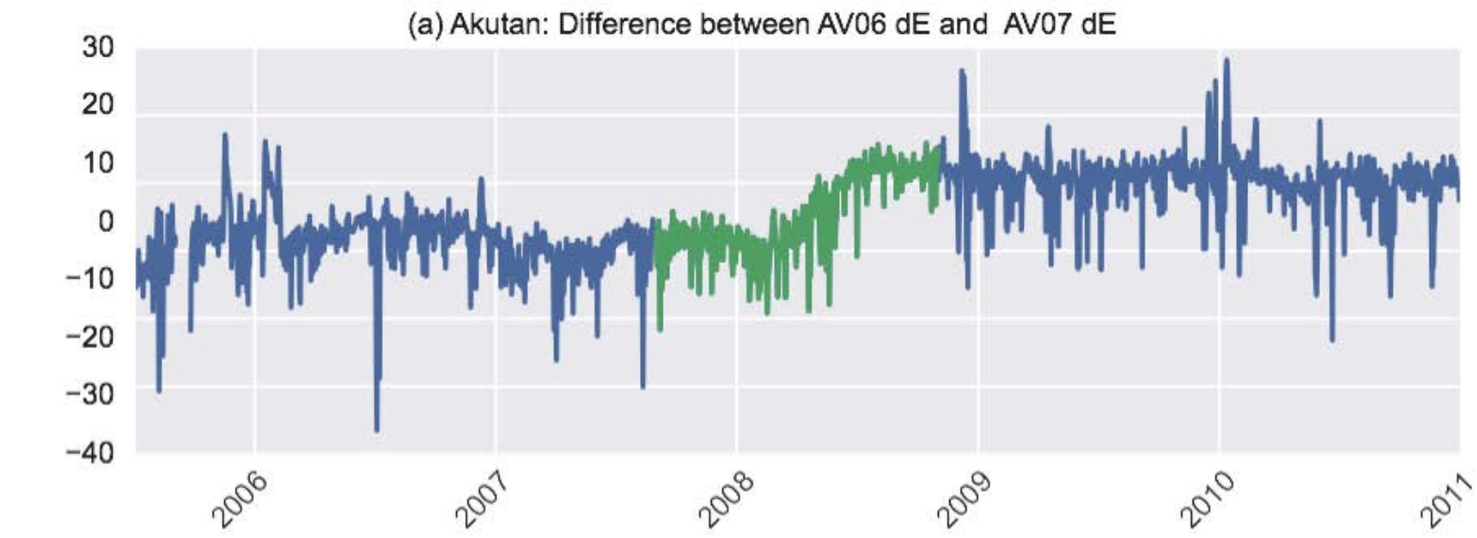
Image courtesy of Tarek Wetzel AVO.

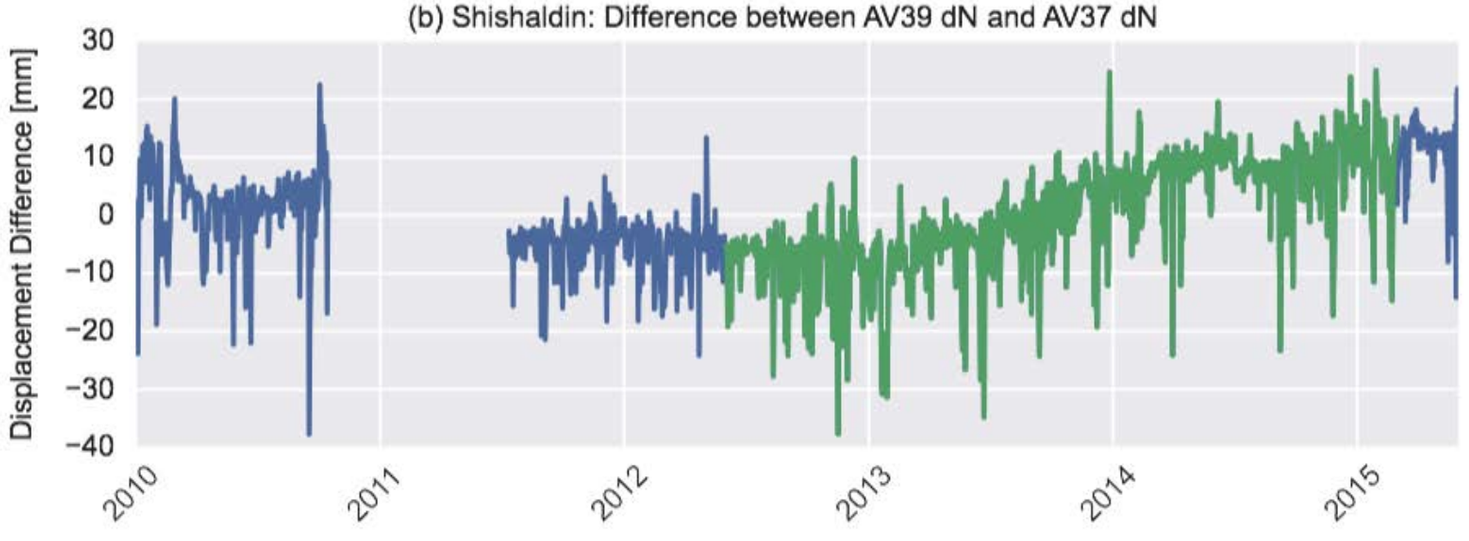
WESTDAHL PEAK

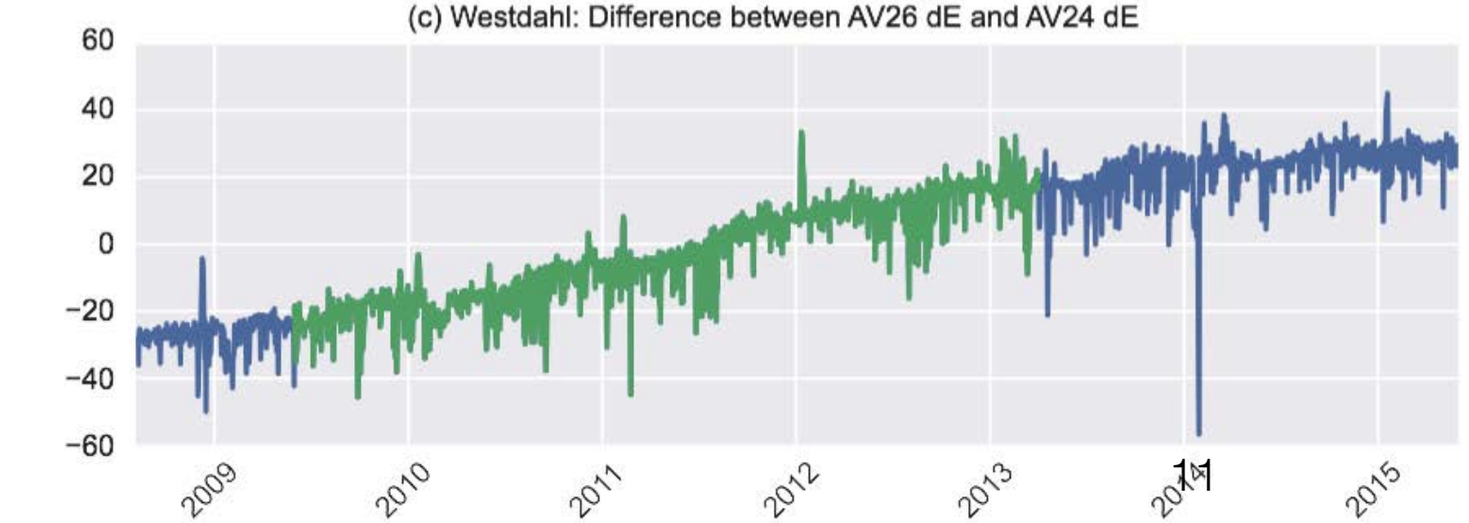
Westdahl eruption 1991. Westdahl plume. View to the North.

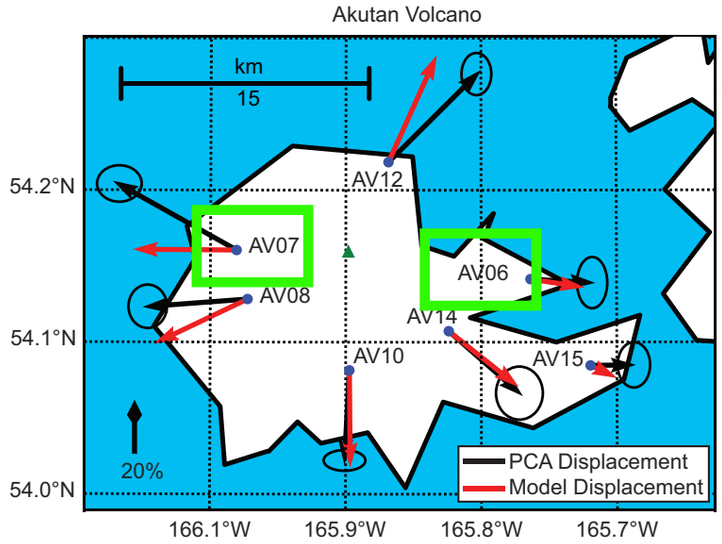
Image courtesy of C. Neal, AVO.

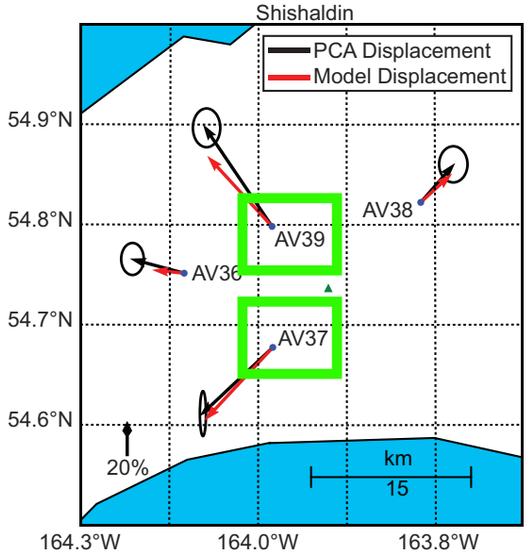
GPS - Volcanic Activity

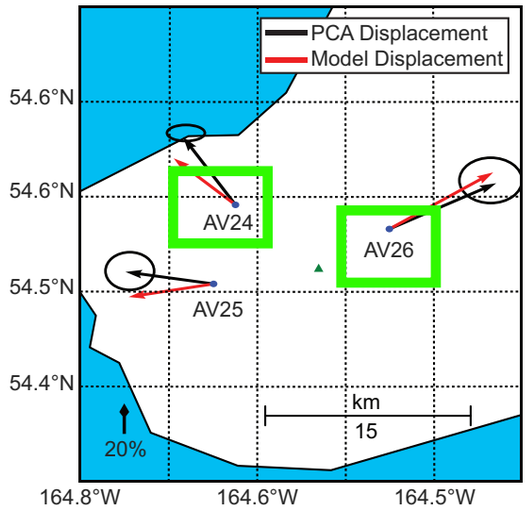












Analysis Pipeline Framework

(2) Data Generator
(Volcano Selection)

(2) Trend Filter
remove linear
and annual trend

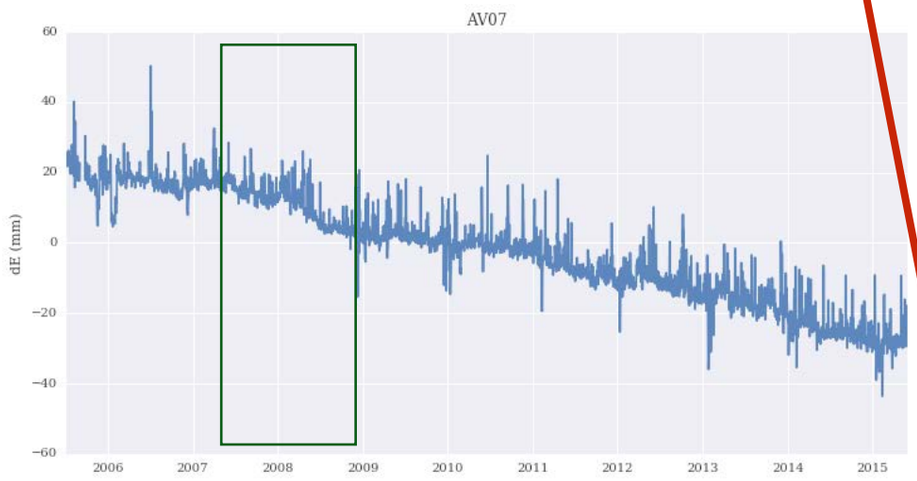
(3) Snow
Removal

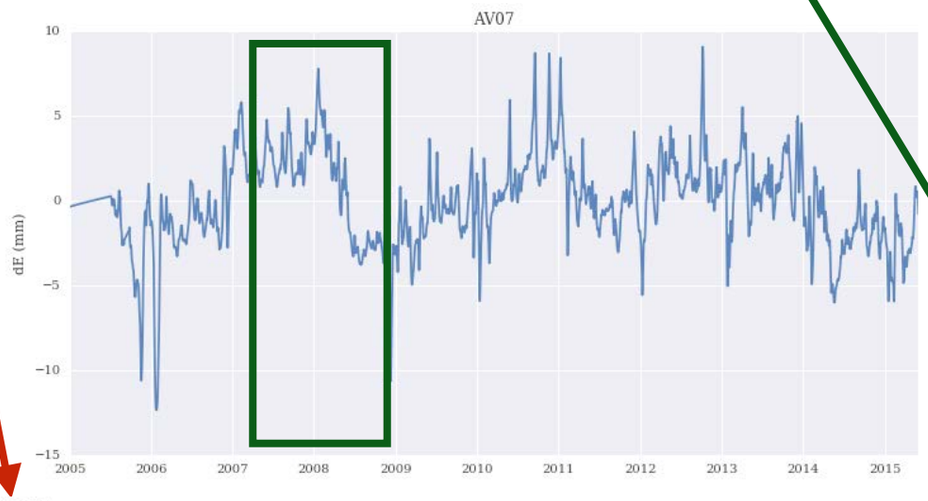
(4) Kalman Filter
Params: τ=120,
σ^2=4, R=1

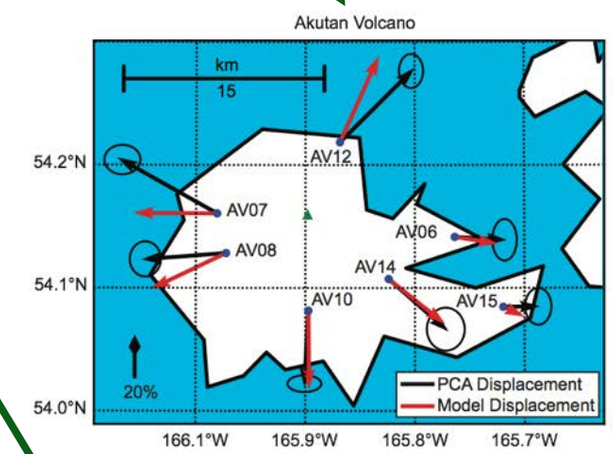
(5) PCA
Params: n=3,
dates, dN+dE

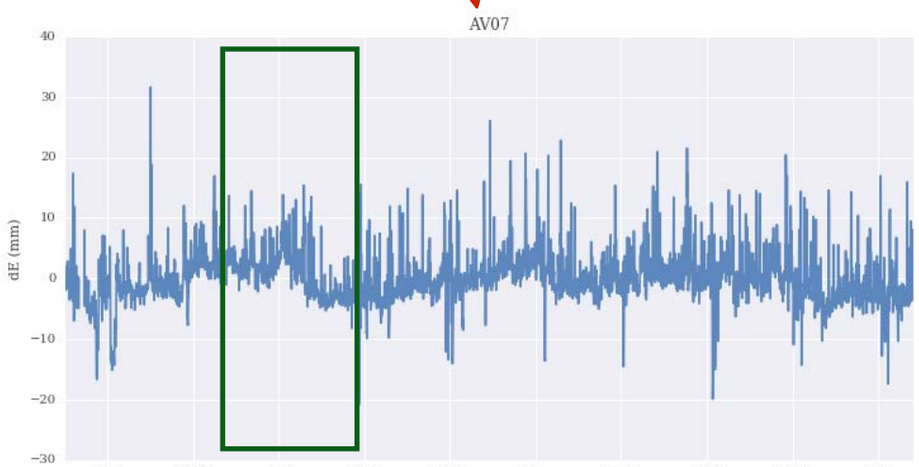
(6) Source
Inversion
uses PCA, type Mogi

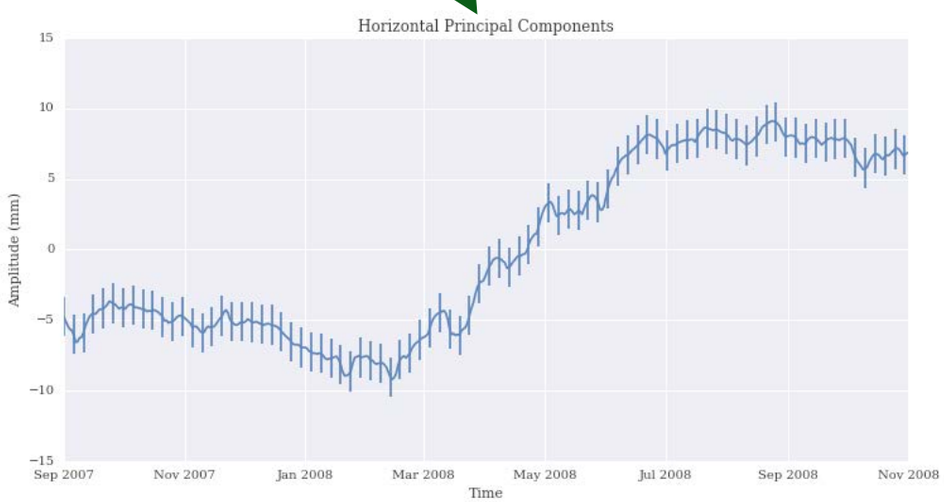
(7) Plotter Tool
geographical plot
of PCA and Mogi



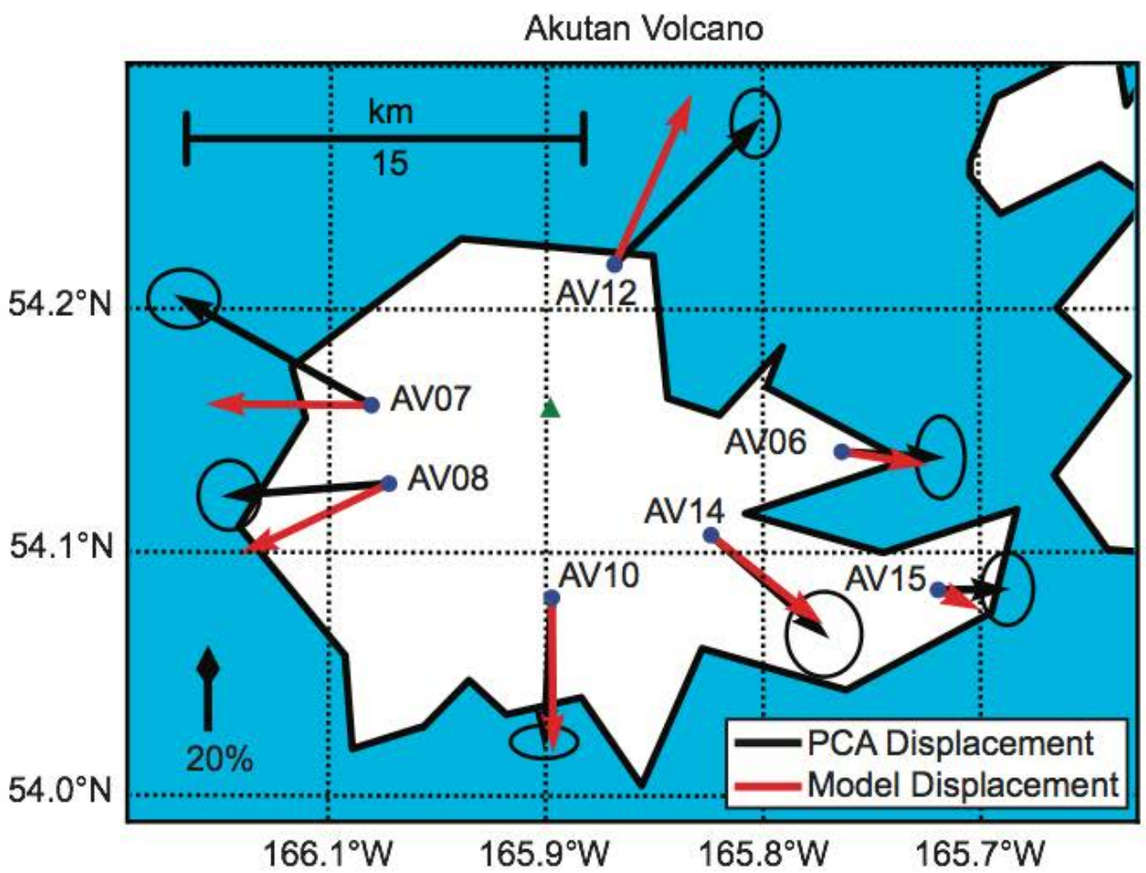


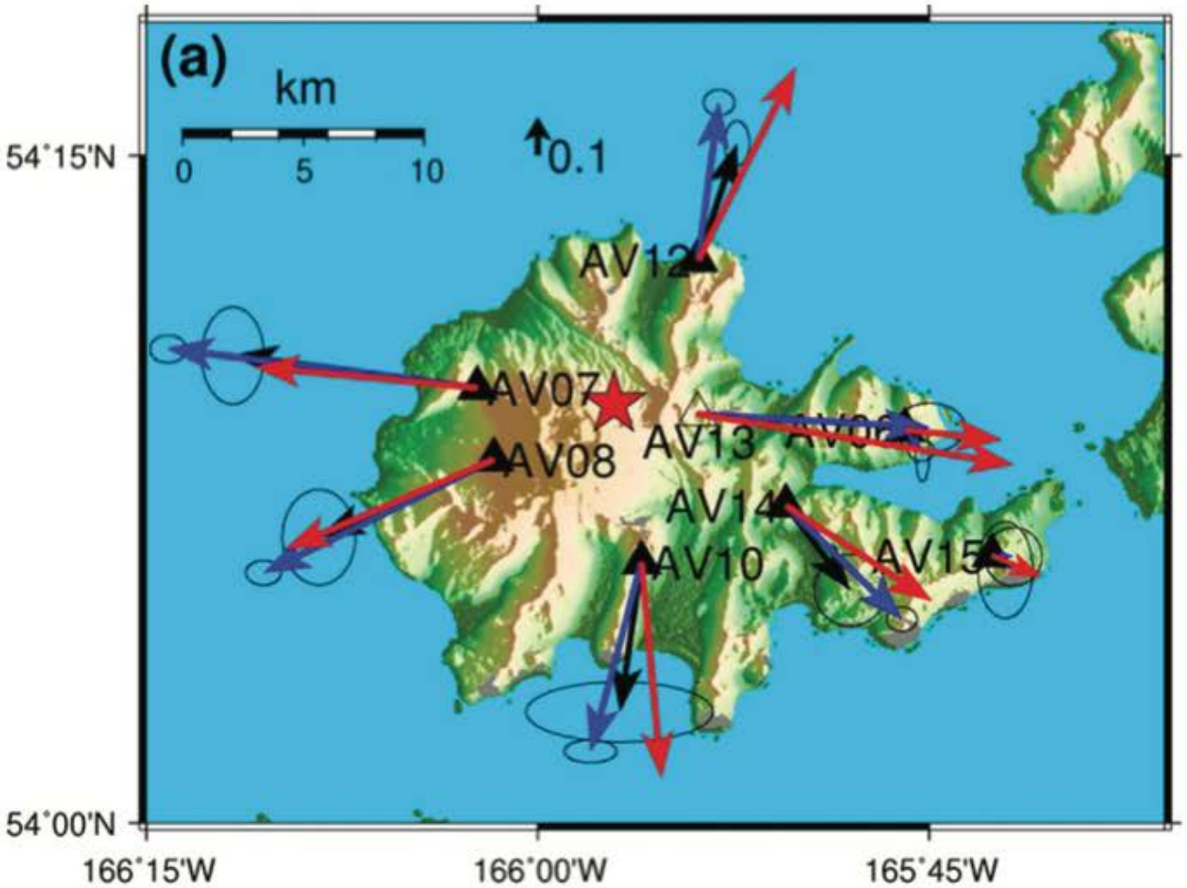


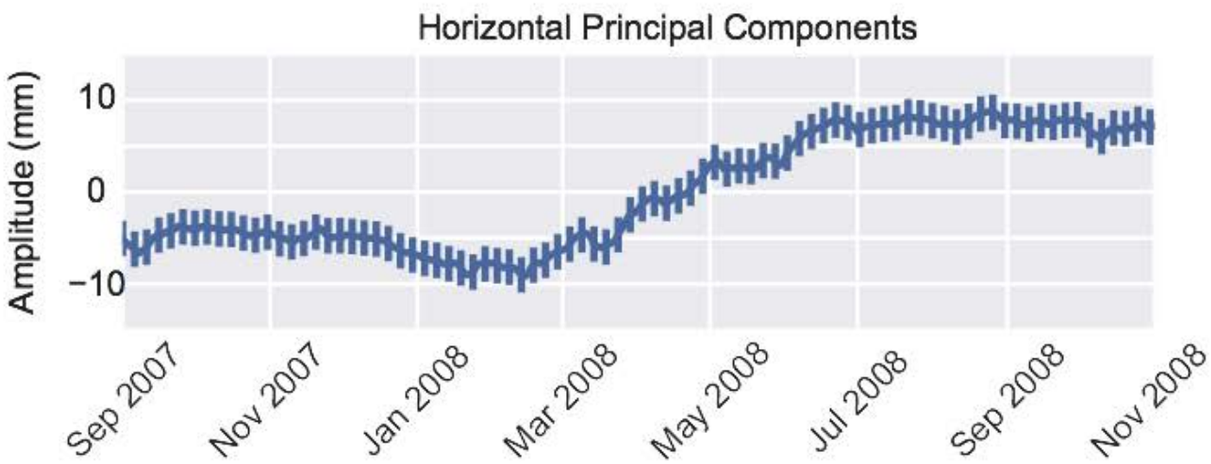


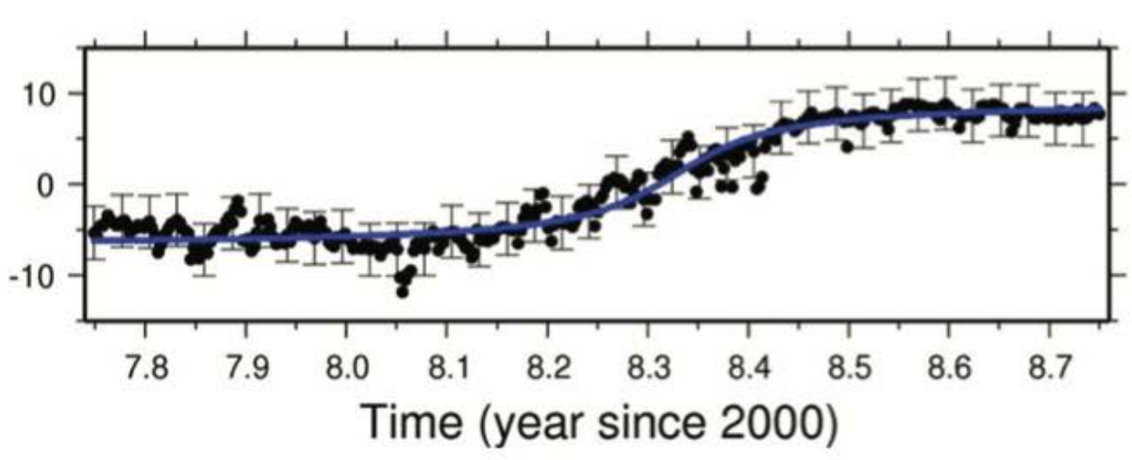


Akutan Volcano

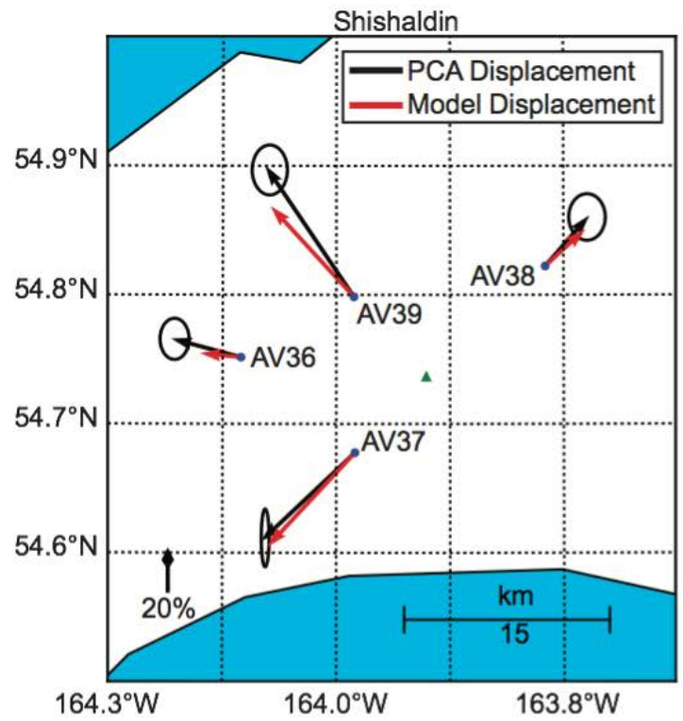


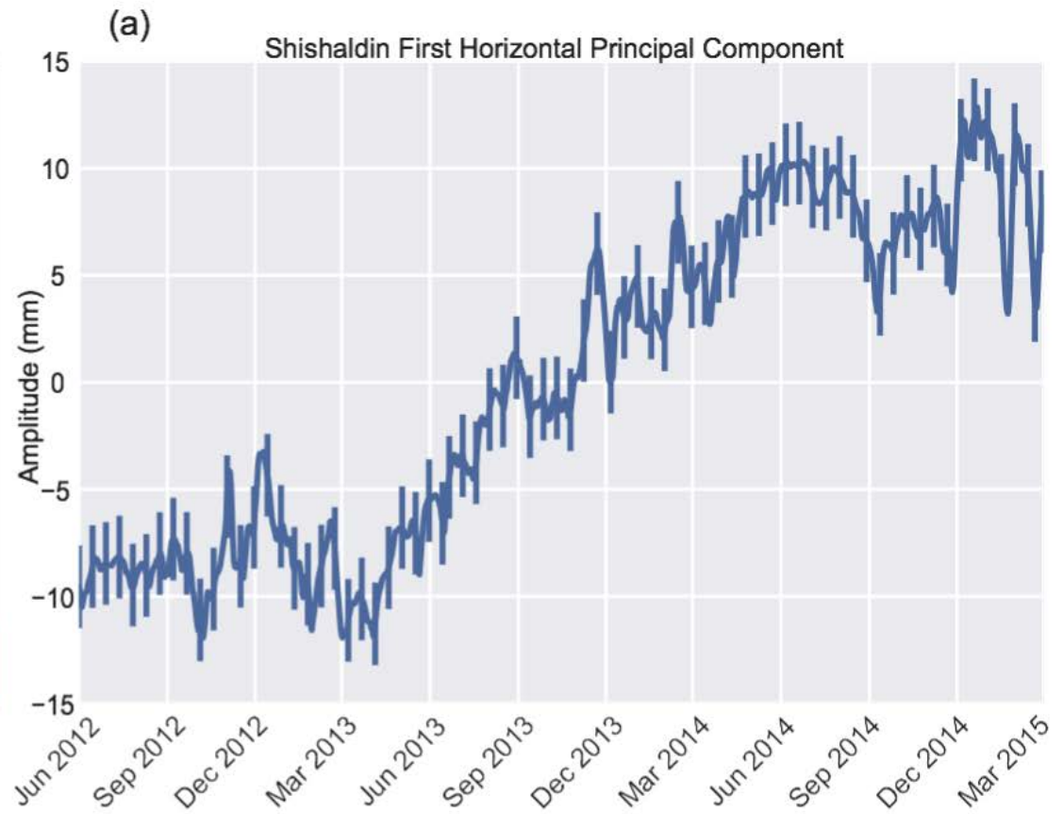


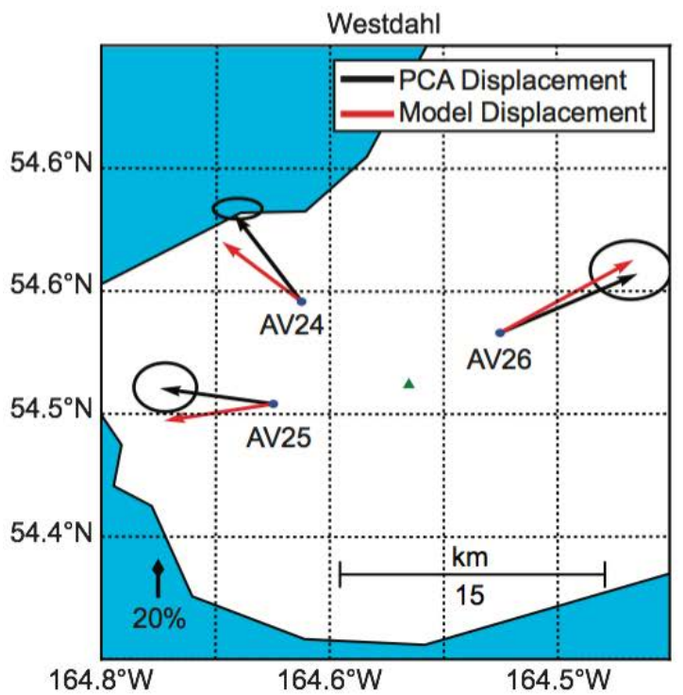


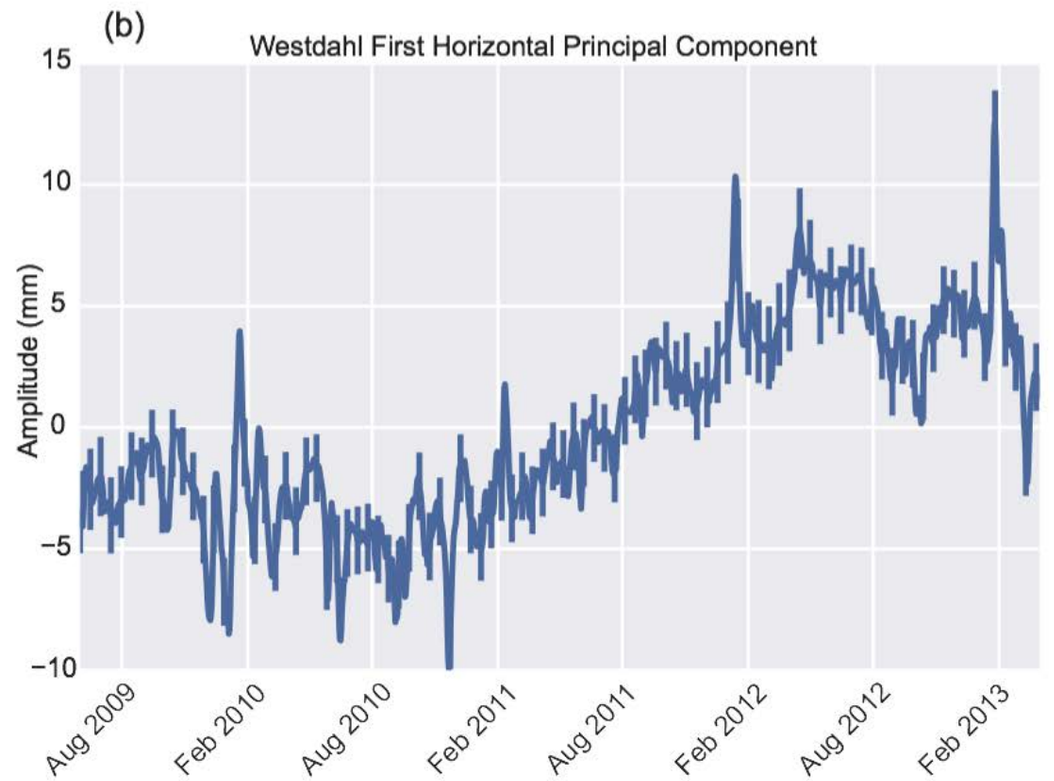


Results: Shishaldin + Westdahl Volcanoes

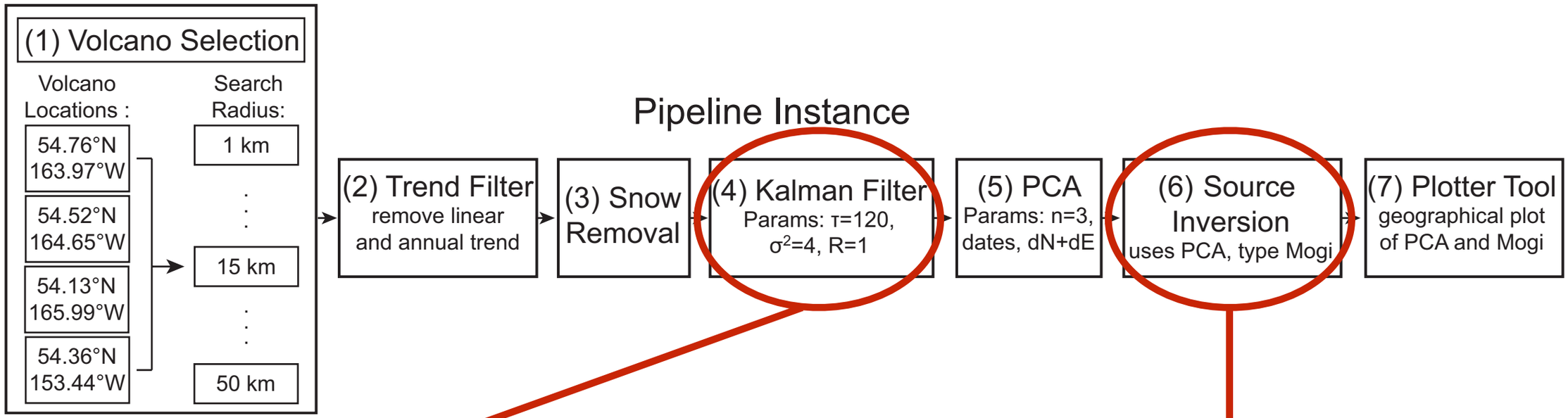


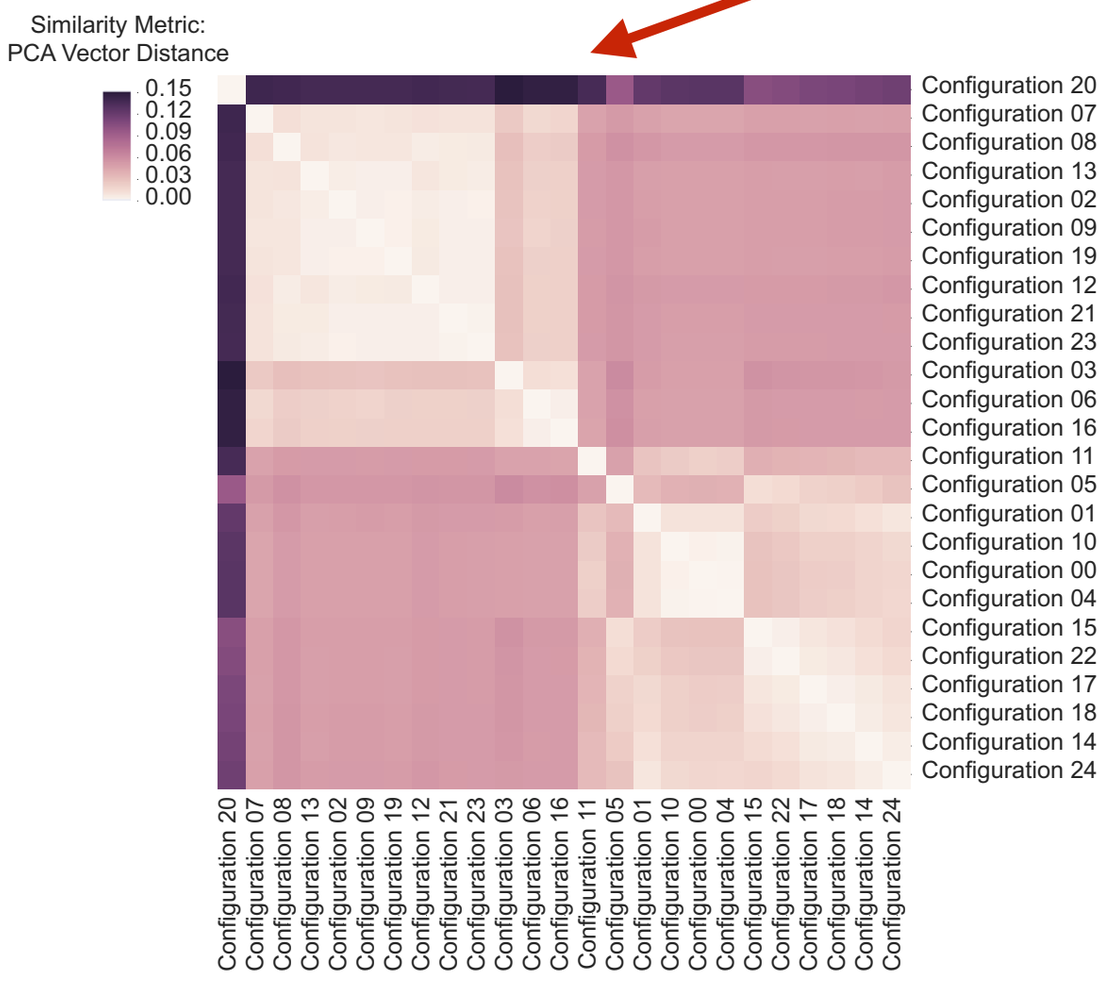


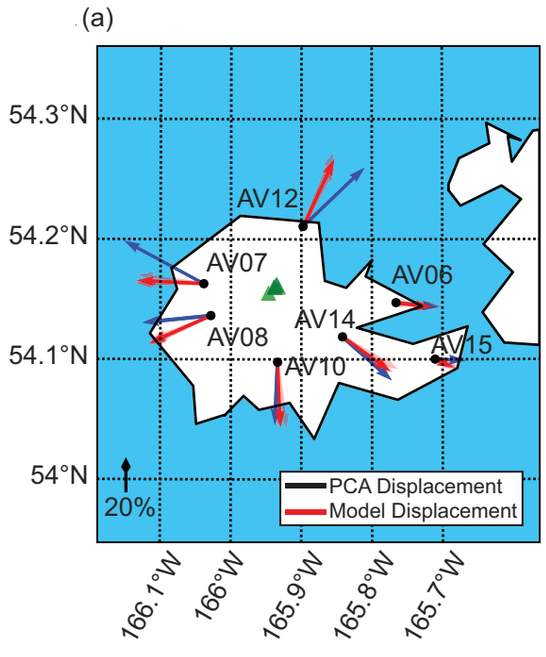


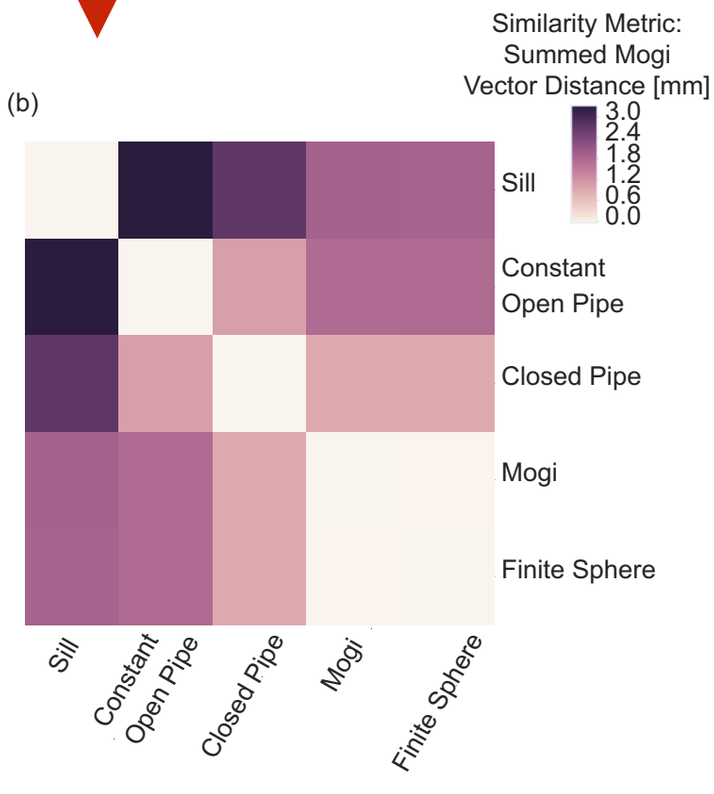


Results: Model and Parameter Fitting









Summary

1. Why study Volcanoes?
    A) Important for understanding geological and magmatic properties and processes
    B) Needed for damage warning and mitigation

2. How to study Volcanoes?
    A) Use shared/common instrumentation
    B) Computer-aided discovery framework and pipeline

3. Which Volcanoes to study?
    A) Volcanoes in the Aleutian Islands, Alaska
    B) Data recorded by and available through UNAVCO PBO
    C) Validation through AVO reports

4. What did we find?
    A) New framework works — validated the Akutan result with prior work
    B) Discovered two new inflation events at Westdahl and Shishaldin
    C) Presented a framework for testing different event model assumptions and source types

Thank You!

Questions?

We acknowledge support from NASA AIST NNX15AG84G, NSF ACI 1442997, and an Amazon Web Services Research Grant, and data from EarthScope Plate Boundary Observatory services provided by UNAVCO and the Alaska Volcano Observatory.

MIT HAYSTACK OBSERVATORY

NEROC

Alaska Volcano Observatory

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Cleveland | Pavlof

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- Yellowstone

MEMBER AGENCIES

The Alaska Volcano Observatory (AVO) is a joint program of the United States Geological Survey (USGS), the Geophysical Institute of the University of Alaska Fairbanks (UAFGI), and the State of Alaska Division of Geological and Geophysical Surveys (ADGGS).

RESTLESS VOLCANOES

Cleveland

Color Code **ORANGE** / Alert Level WATCH

Full details ...

Pavlof

Color Code **YELLOW** / Alert Level ADVISORY

Full details ...

LAST ACTIVITY REPORT

Get these reports emailed to you: USGS VNS

ALASKA VOLCANO OBSERVATORY DAILY UPDATE
U.S. Geological Survey
Wednesday, October 26, 2016, 12:09 PM AKDT (Wednesday, October 26, 2016, 20:09 UTC)

PAVLOF VOLCANO (VNUM #312030)
55°25'2" N 161°53'37" W, Summit Elevation 8261 ft (2518 m)
Current Volcano Alert Level: ADVISORY
Current Aviation Color Code: YELLOW

Low-level unrest continues at Pavlof Volcano. No activity was detected in mostly cloudy satellite and web camera images over the past 24 hours. Nothing significant was detected in seismic or pressure sensor data over the past day.

CLEVELAND VOLCANO (VNUM #311240)

NEWS

News archives

RUSSIAN VOLCANO INFORMATION

Kamchatka:
Latest release and Webcams

More information on Kamchatka volcanoes and KVERT

Kuriles:
Latest release

More information on Kurile volcanoes and SVERT

Tokyo VAAC

Anchorage VAAC

OUTSIDE LINKS

Volcano
- USGS Volcano Hazards Program
- VolcanoWorld
- Global Volcanism Program
- Kamchatka Volcanoes
- USGS Ash-fall Preparedness
- Consortium of US Volcano Observatories
- Global Volcano Model Network

Weather
- National Weather Service

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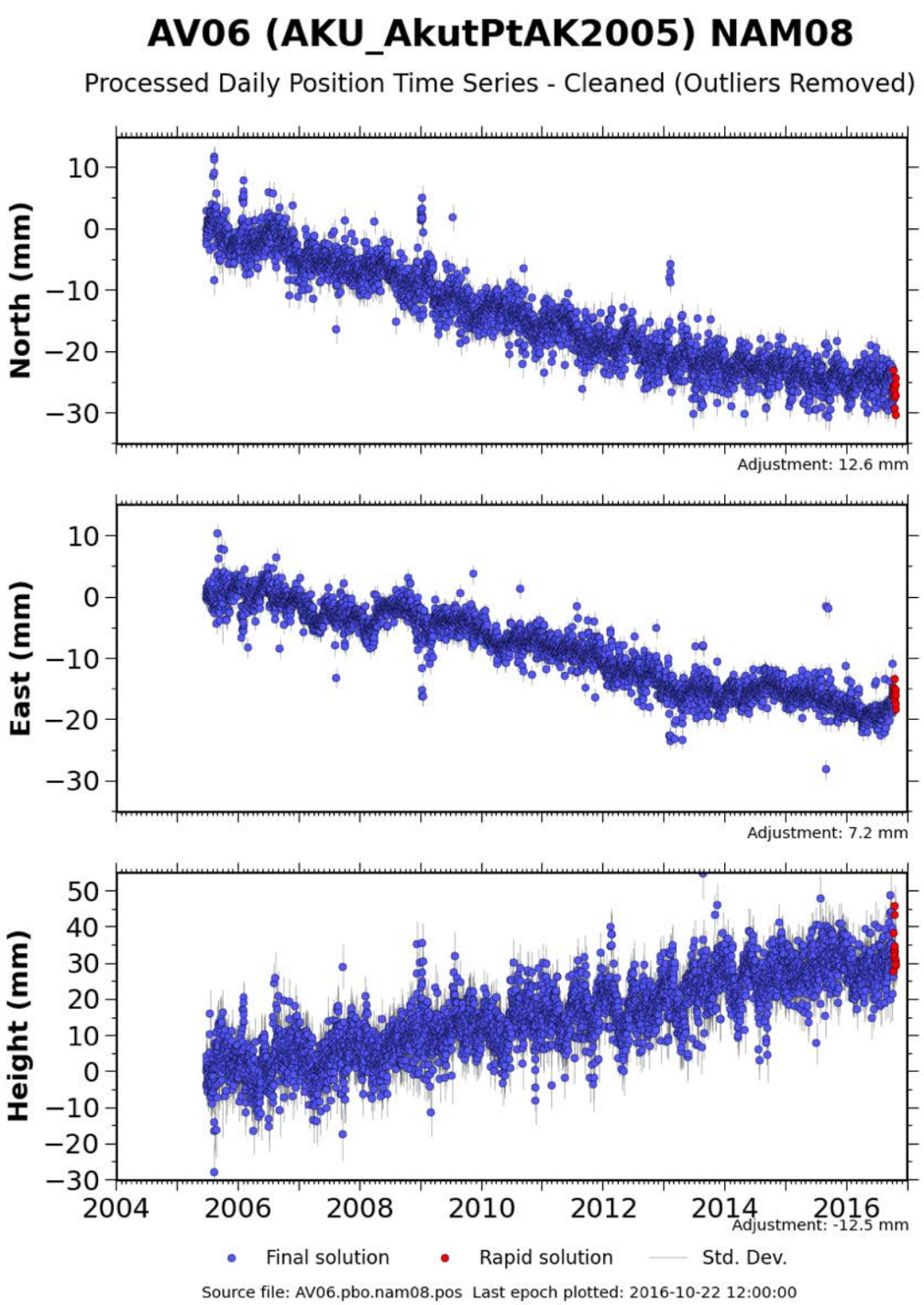
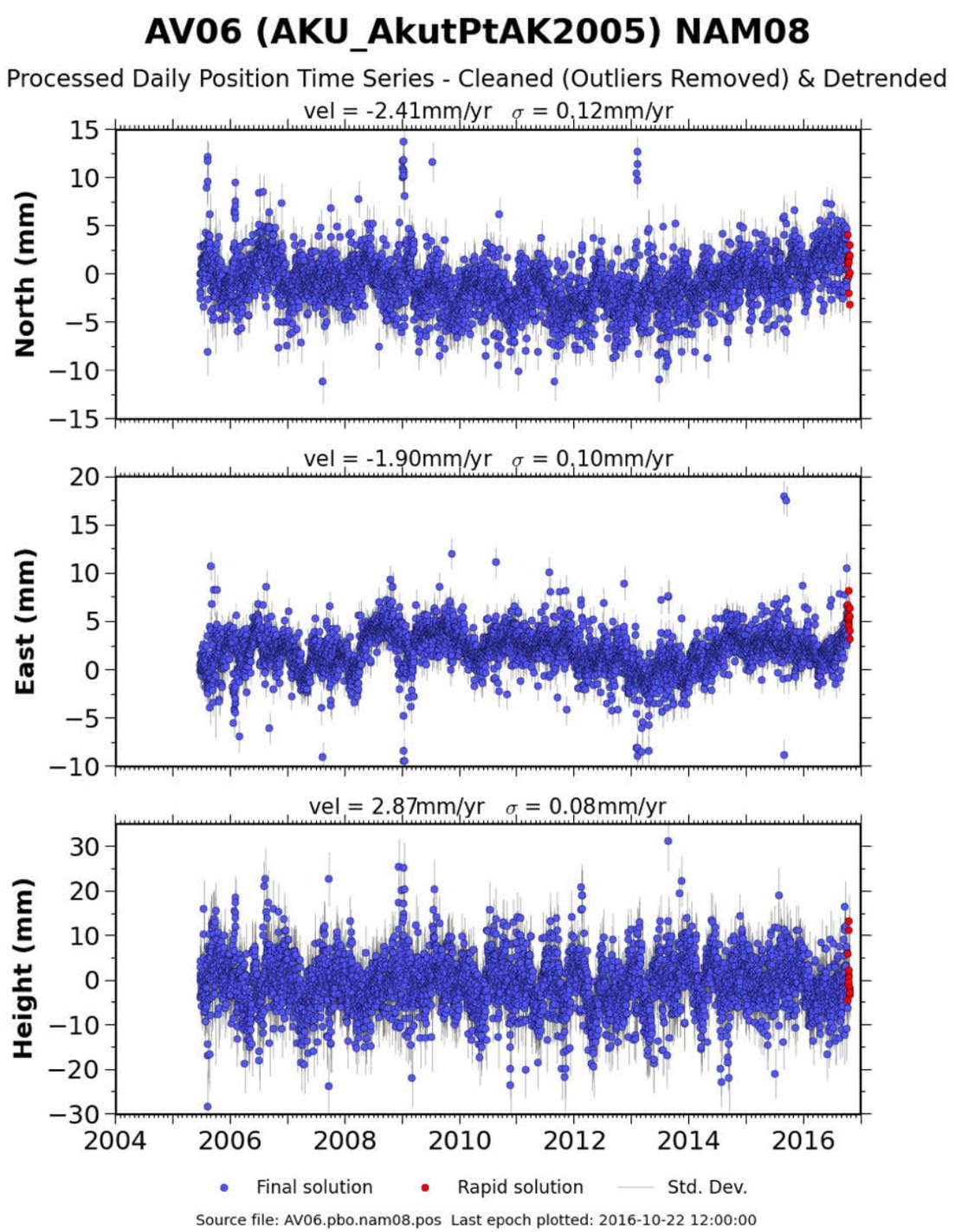
PBO Raw + Cleaned Preview Data





Removing Snow Artifacts