

Monitoring Natural Hazards in Alaska using the TA Infrasound Network



DAVID FEE

*ALASKA VOLCANO OBSERVATORY, WILSON ALASKA TECHNICAL CENTER,
GEOPHYSICAL INSTITUTE, UNIVERSITY OF ALASKA FAIRBANKS*

MATT HANEY

ALASKA VOLCANO OBSERVATORY, U.S. GEOLOGICAL SURVEY

ROBIN MATOZA

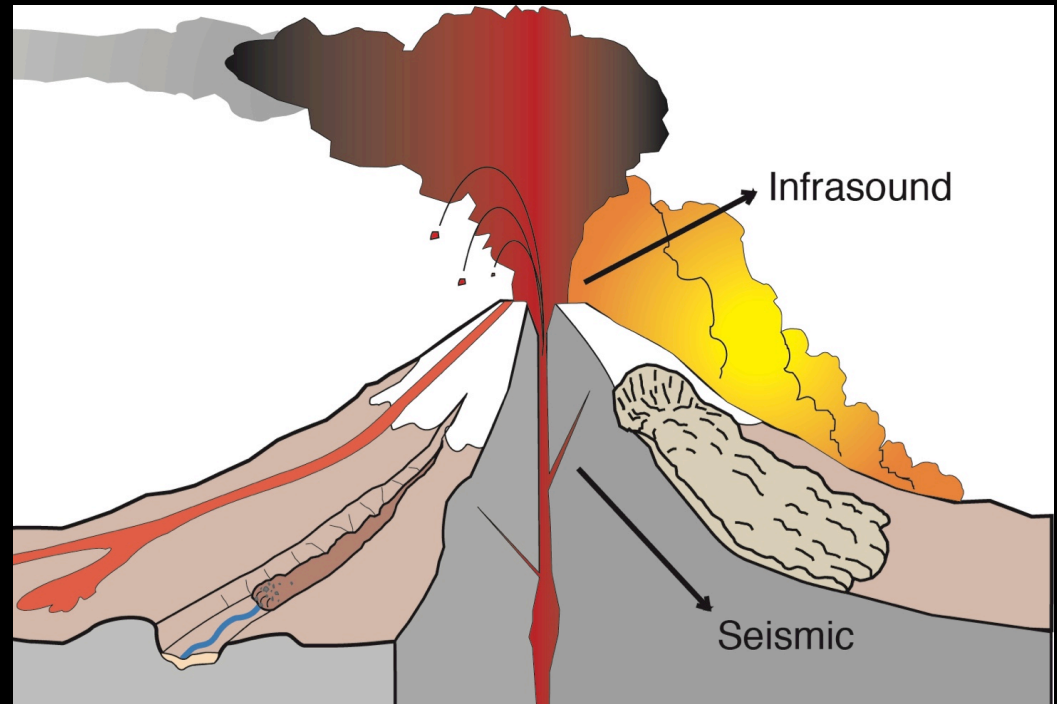
DEPARTMENT OF EARTH SCIENCE AND EARTH RESEARCH INSTITUTE, UNIVERSITY OF CALIFORNIA

MOTIVATION

- Numerous natural hazards present in Alaska
- TA infrasound network provides unique, unprecedented opportunity to study and monitor natural hazards



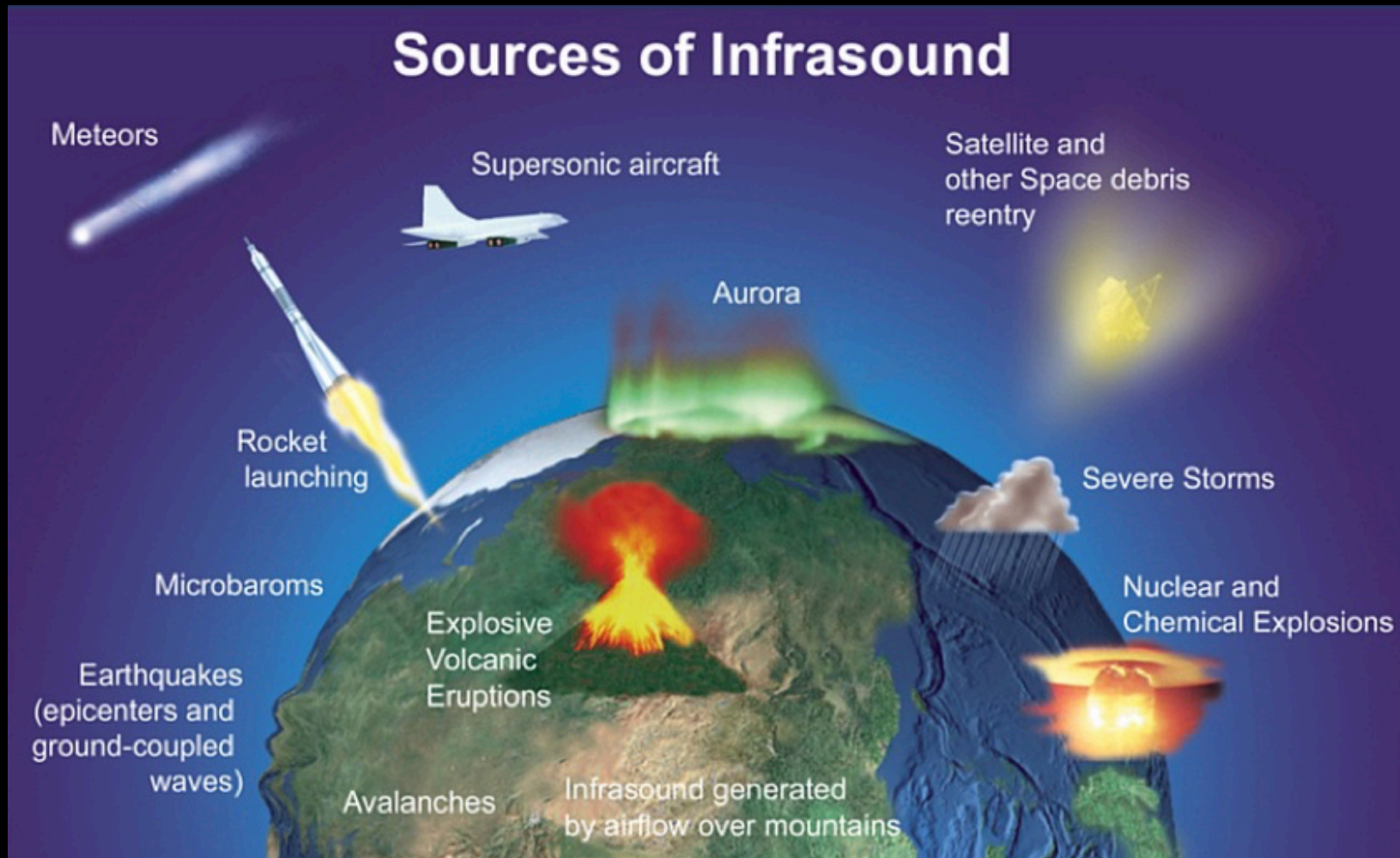
Okmok Volcano, 2008 (AVO)



www.avo.alaska.edu

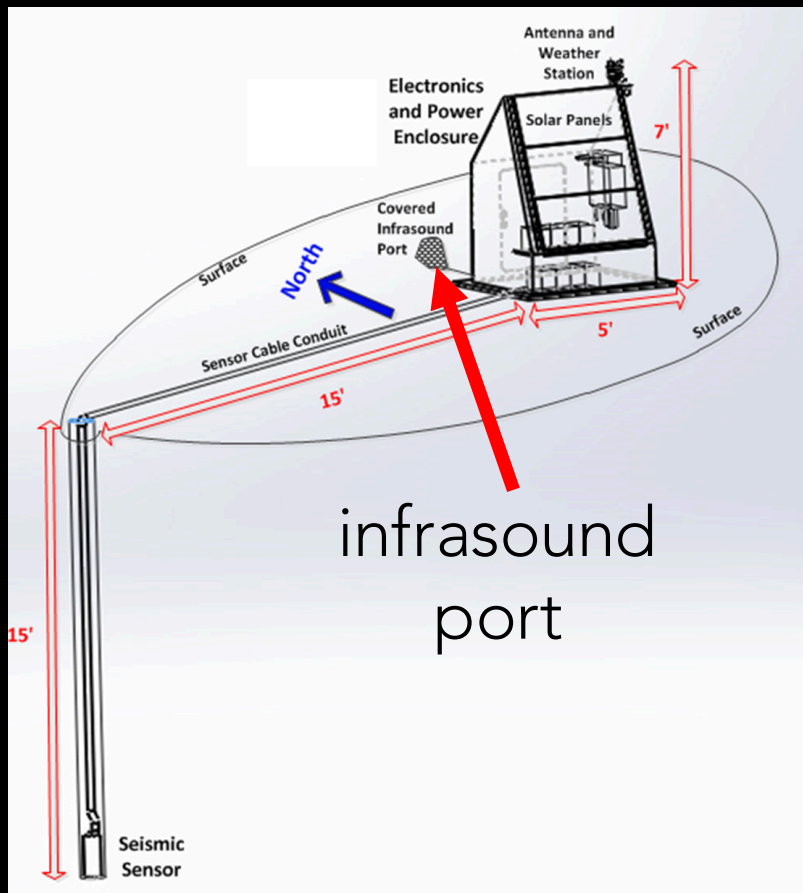
INFRASOUND: WHAT IS IT?

- Sound waves (pressure waves) at frequencies lower than humans can hear
- Similar to P-wave in seismology, except through the atmosphere
- Propagates long distances with little attenuation



TA INFRASOUND

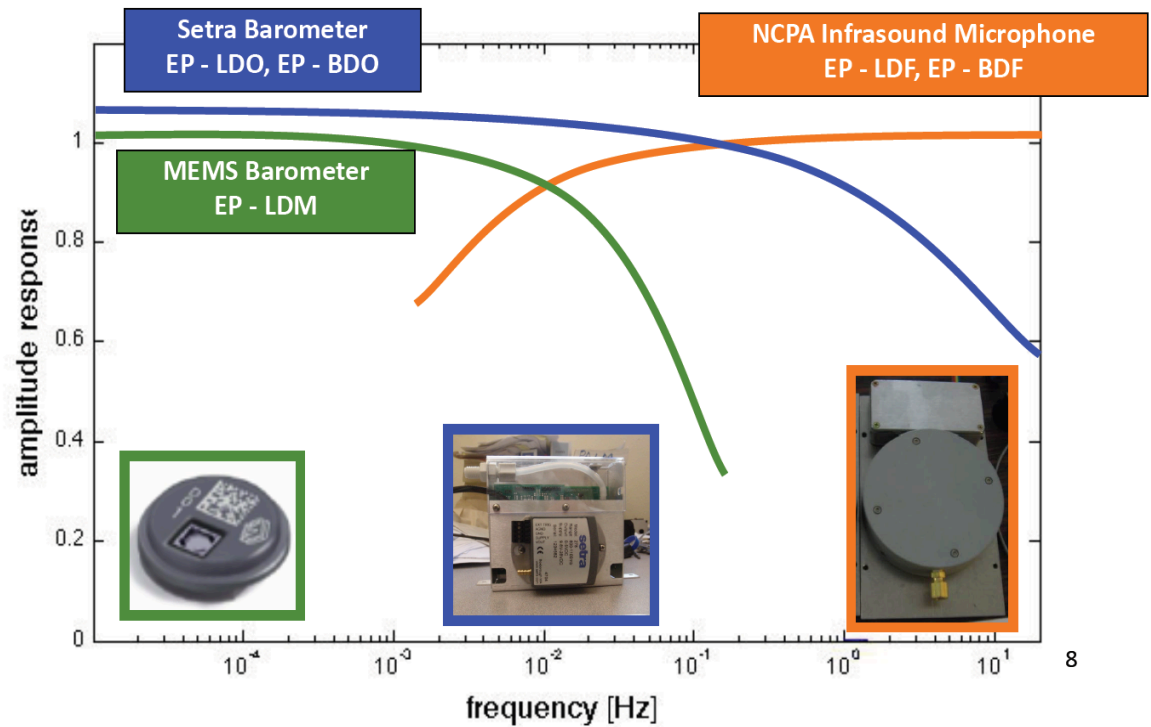
AK TA Design



www.iris.edu

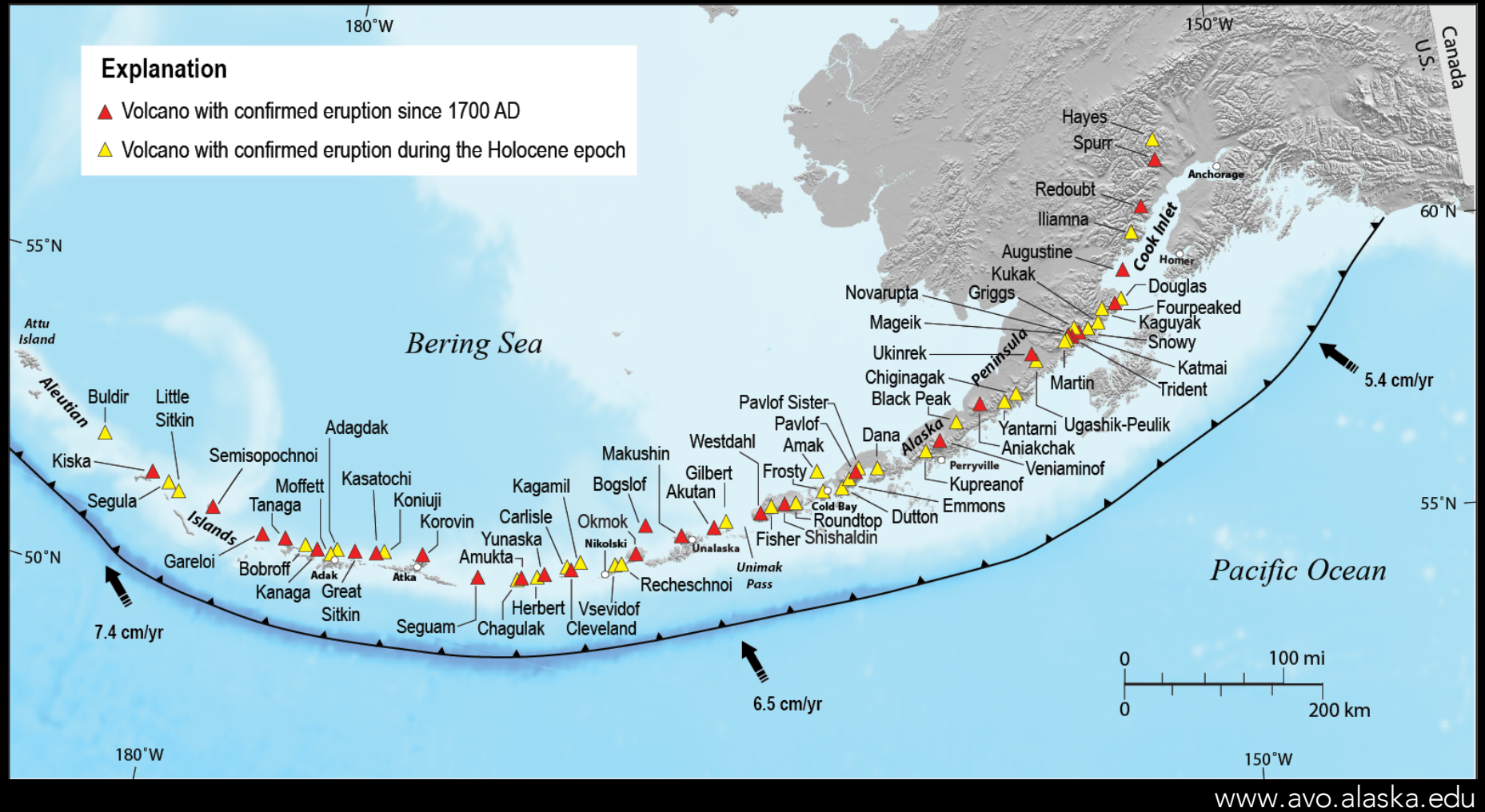
Infrasound and Pressure Sensors

Overlapping pass-bands provides continuous coverage from DC to 20 Hz



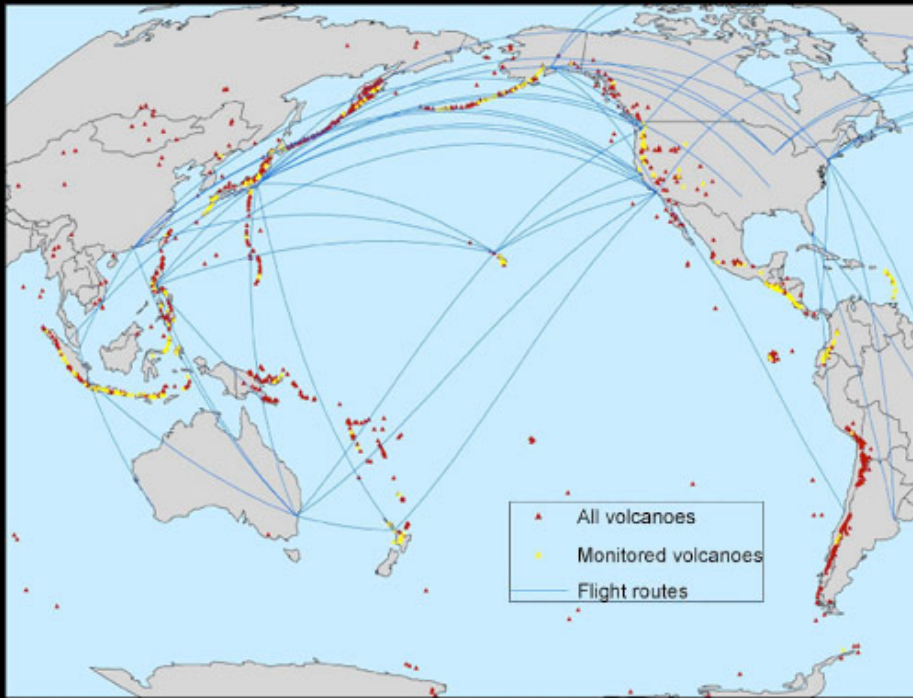
www.iris.edu

VOLCANIC HAZARDS IN ALASKA



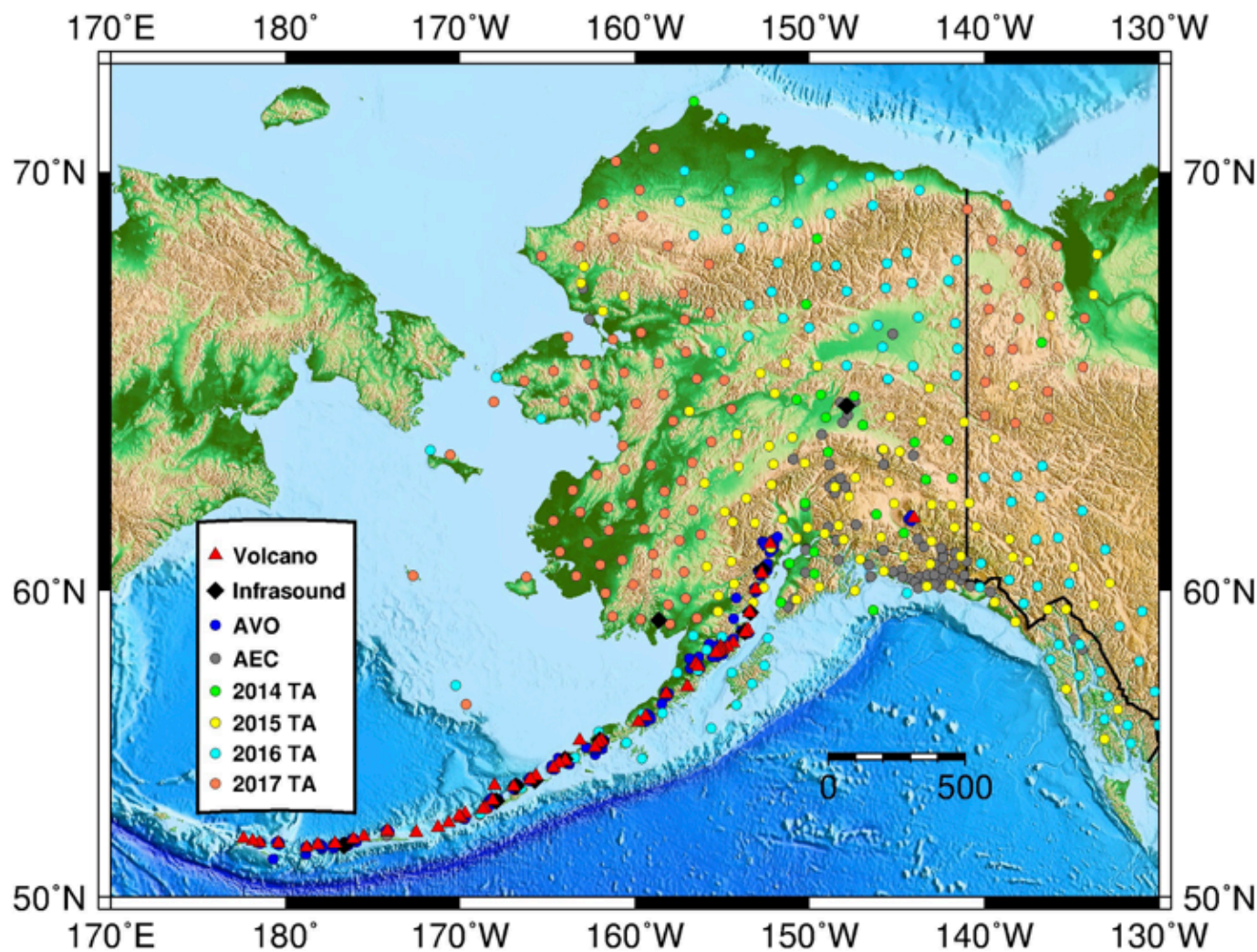
- 52 volcanoes with confirmed activity in the past 200 years
- >2 eruptions per year
- Most volcanoes remote and difficult to monitor

VOLCANIC HAZARDS IN ALASKA



- About 60% of Alaska's population (~430,000) is in south-central Alaska, within 300 km and downwind of 4 active volcanoes.
- Anchorage airport is a transportation hub for both passenger and cargo (2nd largest cargo airport in the US, 4th worldwide)
- ~50,000 people and 200-300 flights traverse AK airspace daily

TA INFRASOUND AND AK VOLCANO MONITORING



- TA mostly in mainland AK, but long-range detection and AK peninsula stations will be valuable for eruption monitoring
- NSF funded project to Fee (UAF), Matoza (UCSB), and Haney (USGS-AVO) to develop operational TA volcano monitoring systems

PAVLOF ERUPTION: MARCH 2016



Image courtesy Colt Snapp

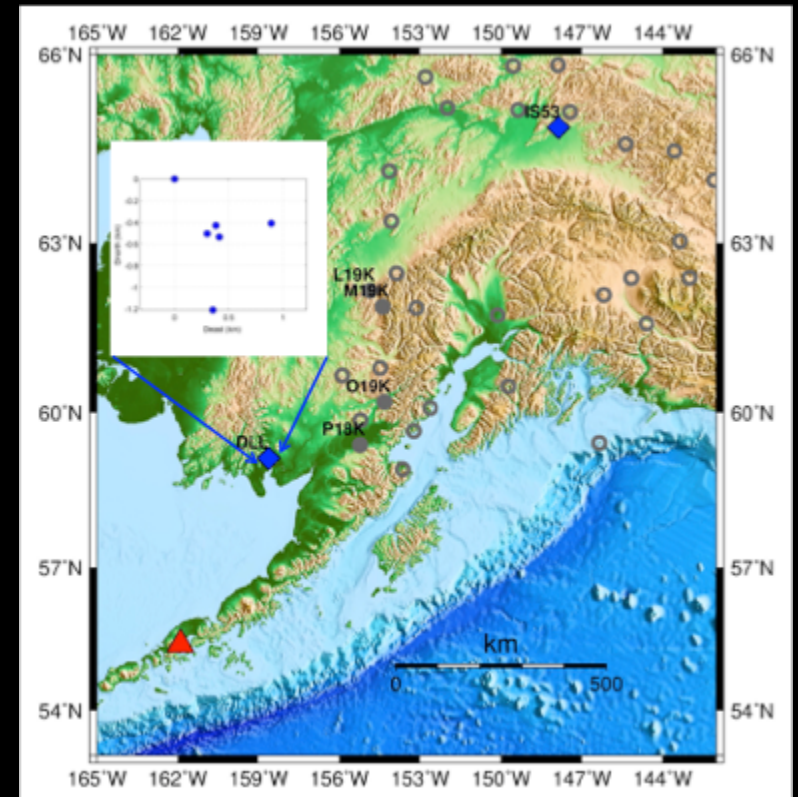
- Explosive eruption on March 28
- No precursory activity
- Extensive, sustained ash cloud cancelled ~100 flights
- Sen. Murkowski's flight grounded in Fairbanks

Seismic:

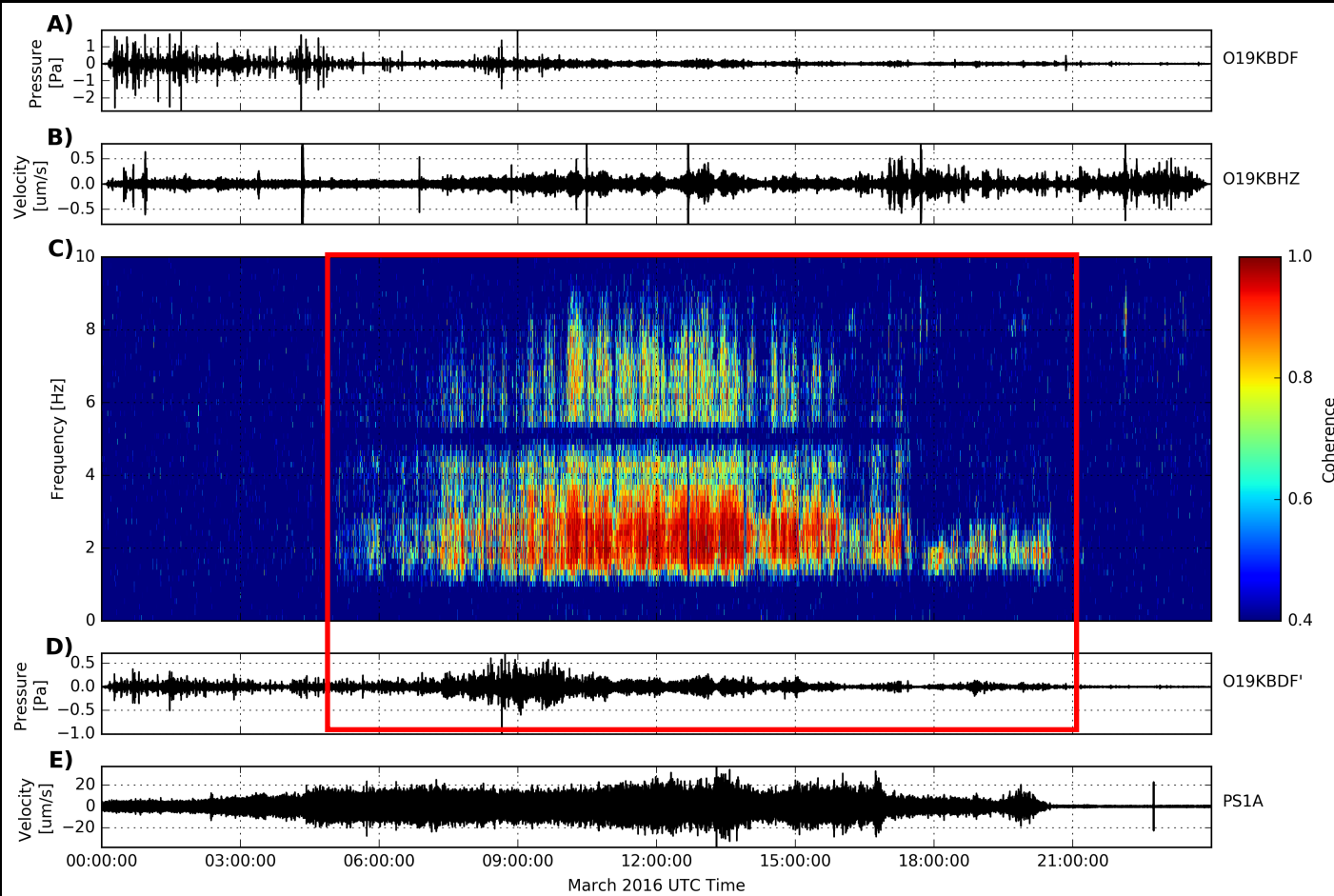
- Recorded on 4 stations locally

Infrasound:

- Recorded clearly at UAF Dillingham station
 - 458 km away
- 4 station detection on the EarthScope TA
 - O19K, 695 km



PAVLOF TA DETECTION

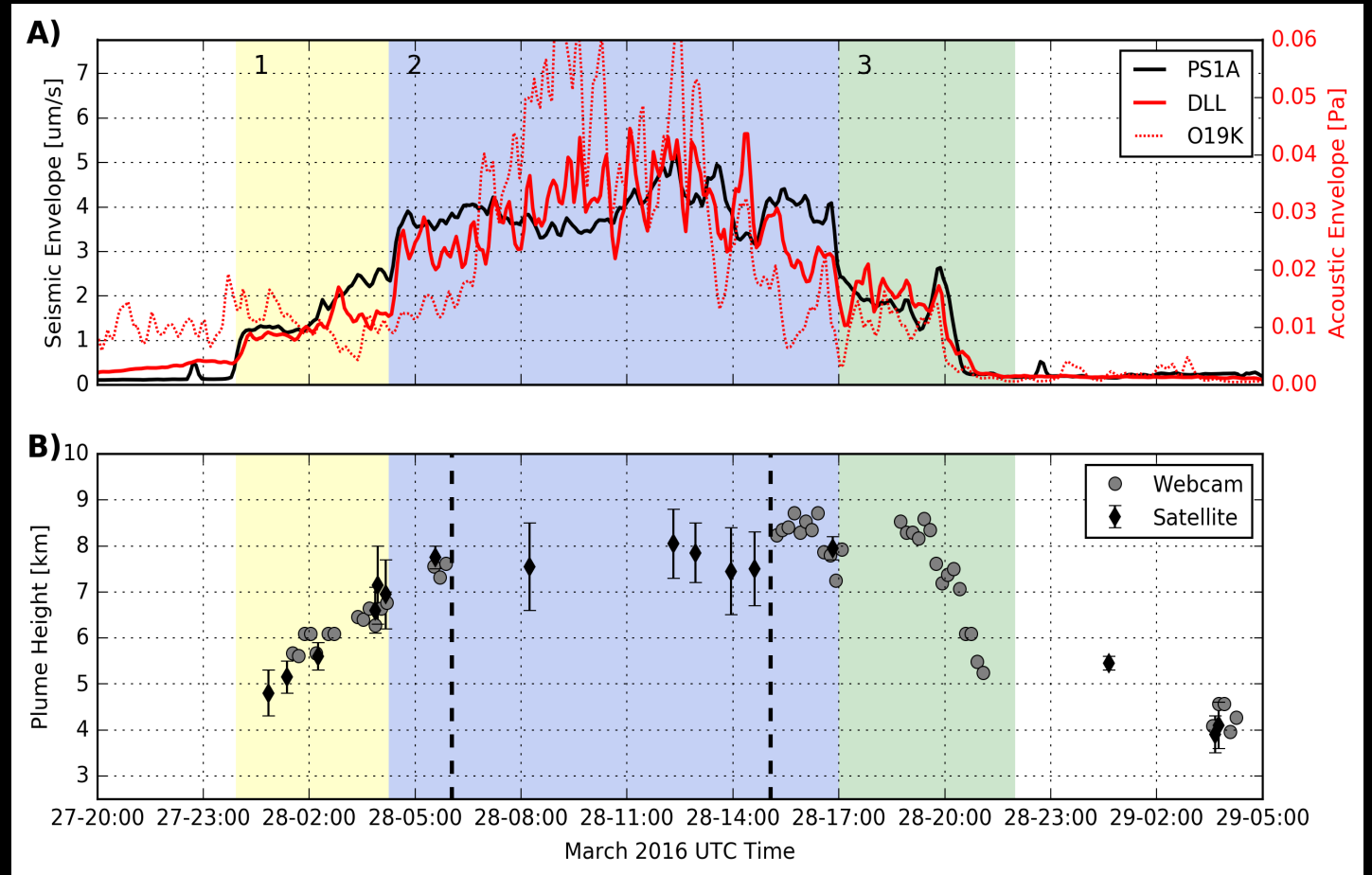


[Fee et al., in review]

- First volcanic eruption recorded on the TA
- Sustained infrasound for >14 hours

PAVLOF ERUPTION: PLUME HEIGHTS

- Seismic and acoustic data (top) correlate with ash cloud height (bottom)
- TA and seismo-acoustic data can be used to estimate eruption intensity and size



[Fee et al., in review]

Future eruptions will be recorded and potentially monitored with TA infrasound

LANDSLIDES

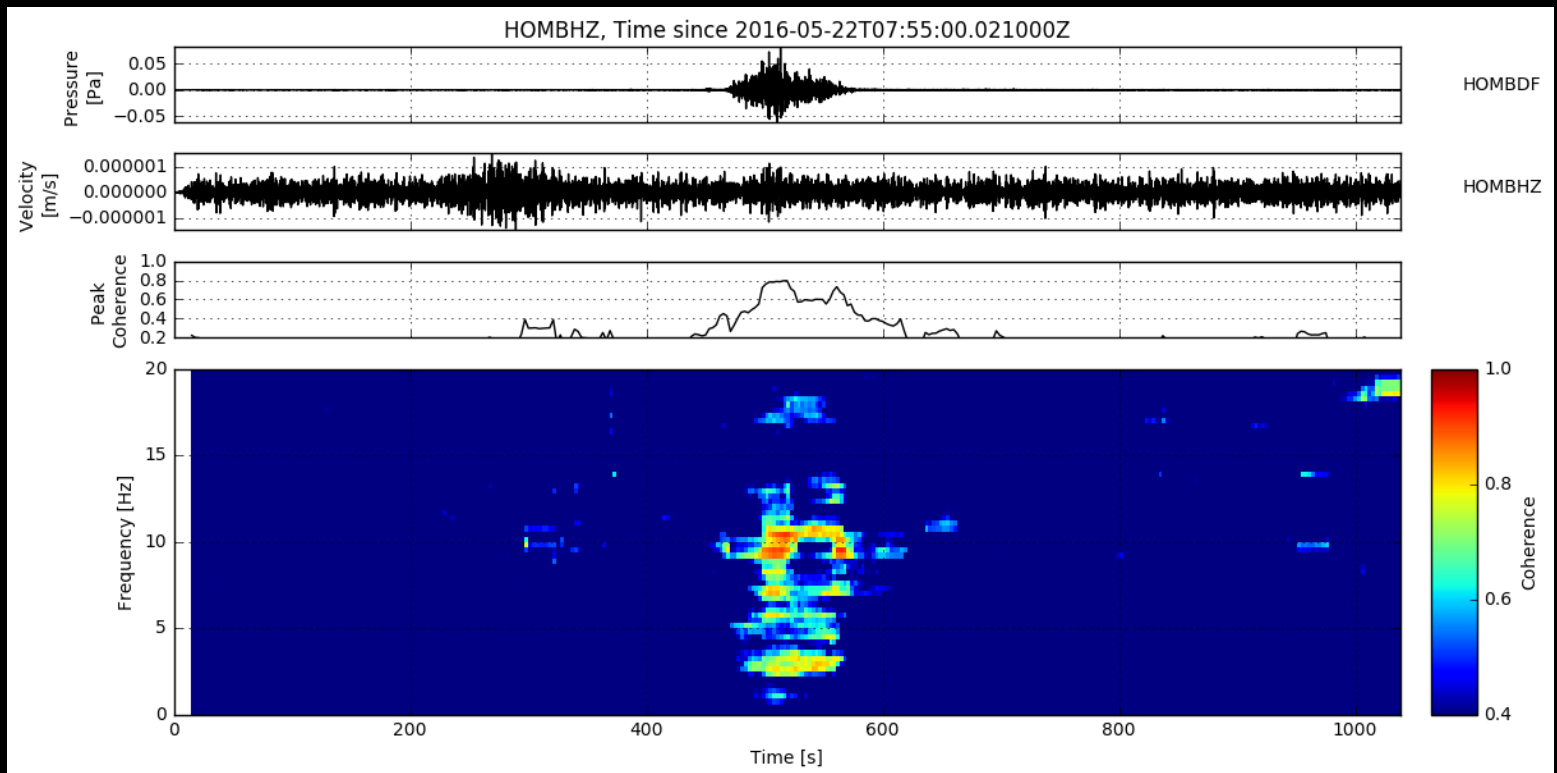
- Large landslides produce noticeable infrasound
- May 2016 Mt. Iliamna landslide produced significant seismic and acoustic signals recorded on the TA



acoustic

seismic

coherence
detection



After a period of heavy rains, a mountainside near Tyndall Glacier collapsed into a fiord of Icy Bay on October 17, 2015. The displaced water generated a wave that sheared alders more than 500 feet up on a hillside across from the slide.

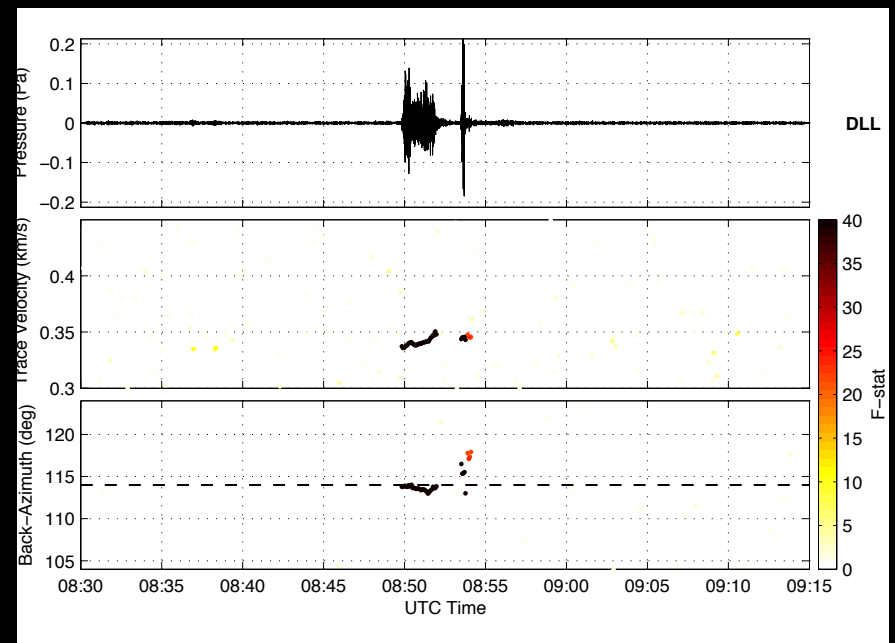


EXPLOSION MONITORING

- Explosions are prodigious sources of infrasound
- Rocket explosion at Kodiak launch facility detected well by UAF infrasound arrays
- TA will detect numerous man-made explosions (e.g. mining, satellite re-entry, meteors, etc.)



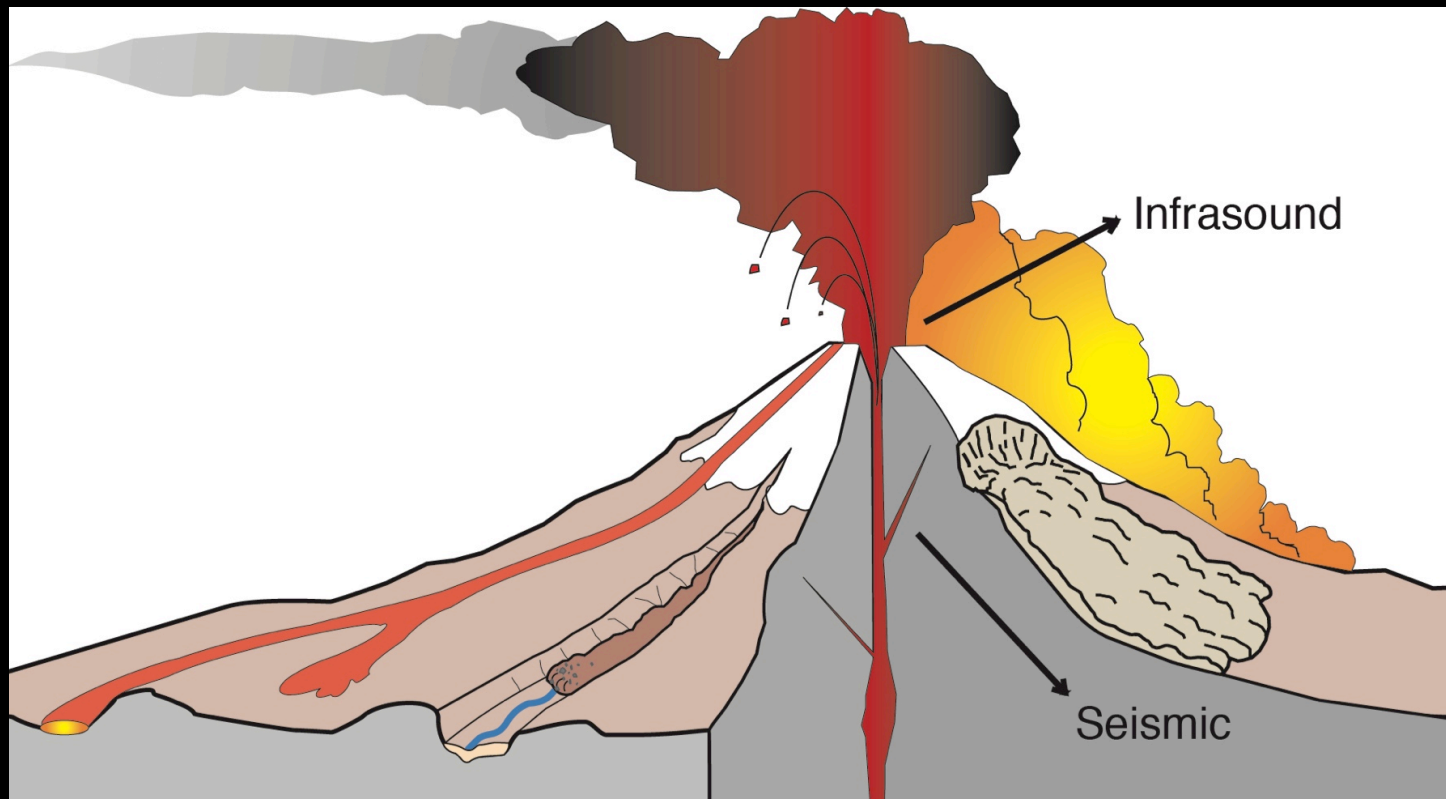
www.adn.com



CONCLUSIONS

- Opportunity to use existing networks and TA infrasound and seismic data to monitor and study natural hazards in Alaska.
- TA provides unique and complementary information to existing seismic and remote sensing capabilities.
- Current research is developing operational algorithms to detect natural hazards (e.g. volcanoes, landslides) as well as man-made events (e.g. explosions).

VOLCANO INFRASOUND



www.avo.alaska.edu

Volcano Infrasound

- Infrasound produced by flux of material into atmosphere
- Used to detect, locate, characterize, and quantify eruptive activity
- Infrasound signals indicative of eruption mechanisms
- Readily combined with other datasets