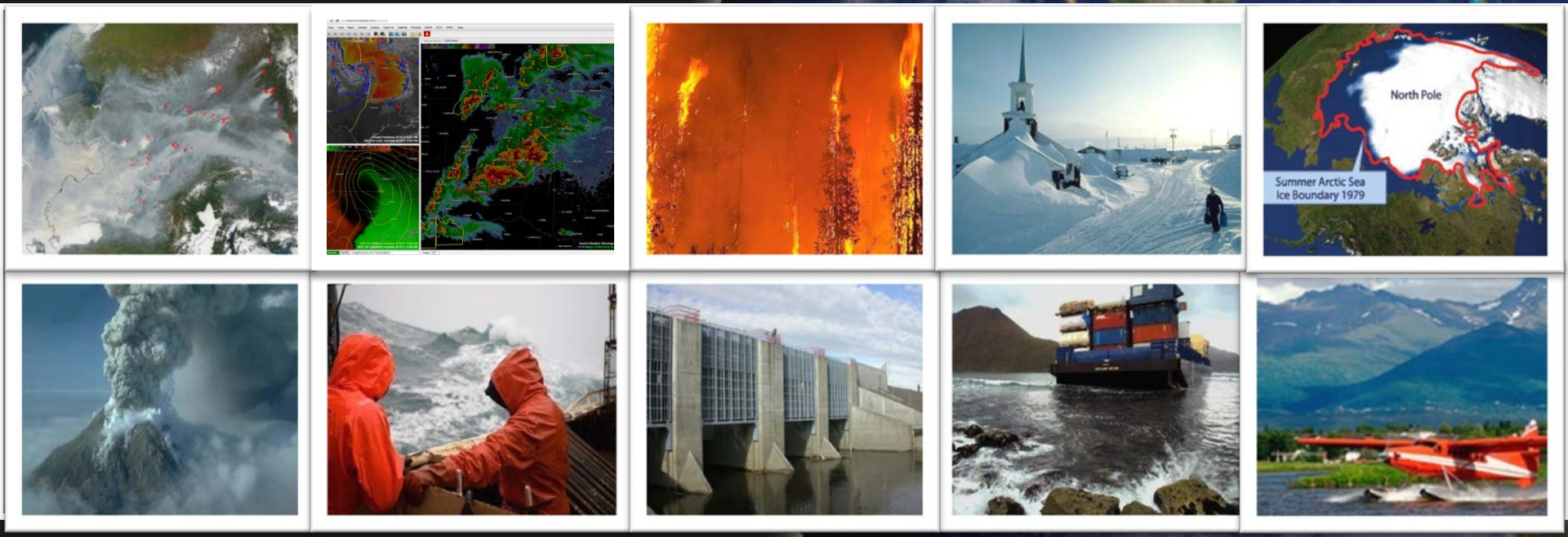
NOAA's National Weather Service Alaska Region



Alaska Aviation Weather Unit

Anchorage Volcanic Ash Advisory Center

Volcanic Ash in Alaska

Volcanic Ash Impacts in Anchorage International

- #1 in Cargo in all of U.S.
- Top 5 Cargo hub in the world
- 58 Commercial Air carriers
- North Pacific great circle

routes are in vicinity of over 100

Aleutian Island volcanos

- One VA SIGMET (6 hours) over

ANC, $5 Million in cargo operations

losses alone. (2009 Numbers)

Pavlof Eruption, 2 June 2014. Courtesy of Kristi Wallace, AVO

Forecasting VA in Alaska

Brightness Temperature Difference

- Lost GOES 11-12um/4-5 band capability with GOES-15 without channel 5 (12um).
  - Major impact to observing, tracking, forecasting VA in North Pacific especially in the winter and nighttime.
- Used now on polar orbiting satellites, MT-SAT, and will be used on GOES-R when it is operational along with new VA Products

3-Channel Differencing

- Used now on polar orbiting satellites <u>when there is a pass</u>

Bottom Line

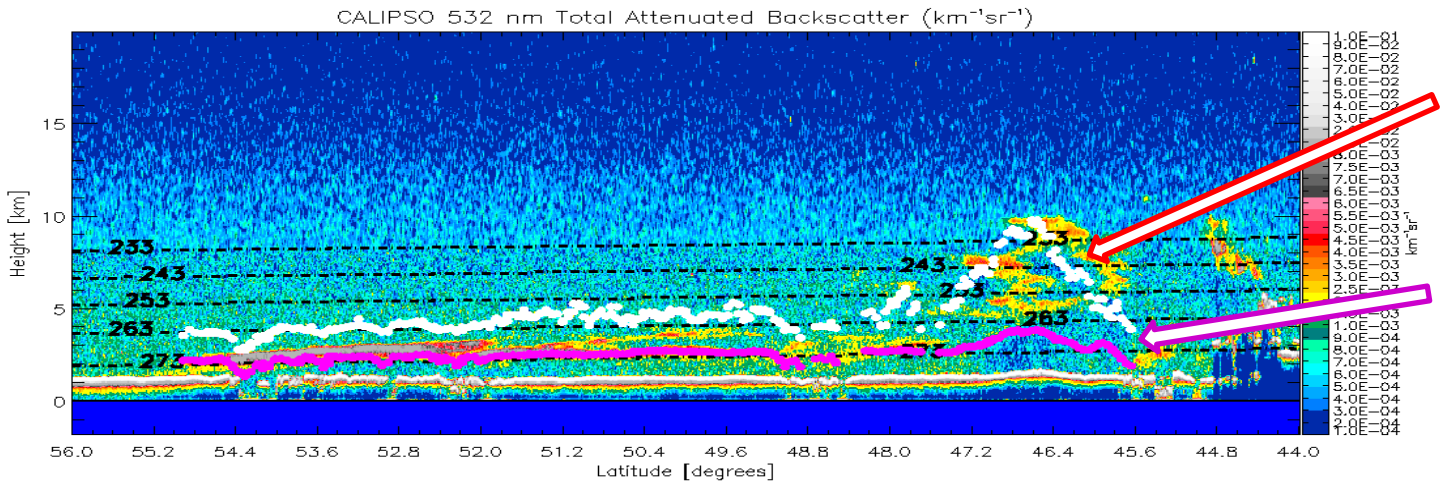
- Detection of VA is difficult, especially with minor eruptions

Forecasting VA in Alaska

Determining VA Cloud Height

- Two methods that are not very accurate (but it's all we have)
  - Use of IR band temps along with a nearby sounding profile
  - Geostationary tracking of speed/movement, correlated to either model data wind speed or nearby sounding profile.

Ash clouds



GOES-R Product Height detection in white

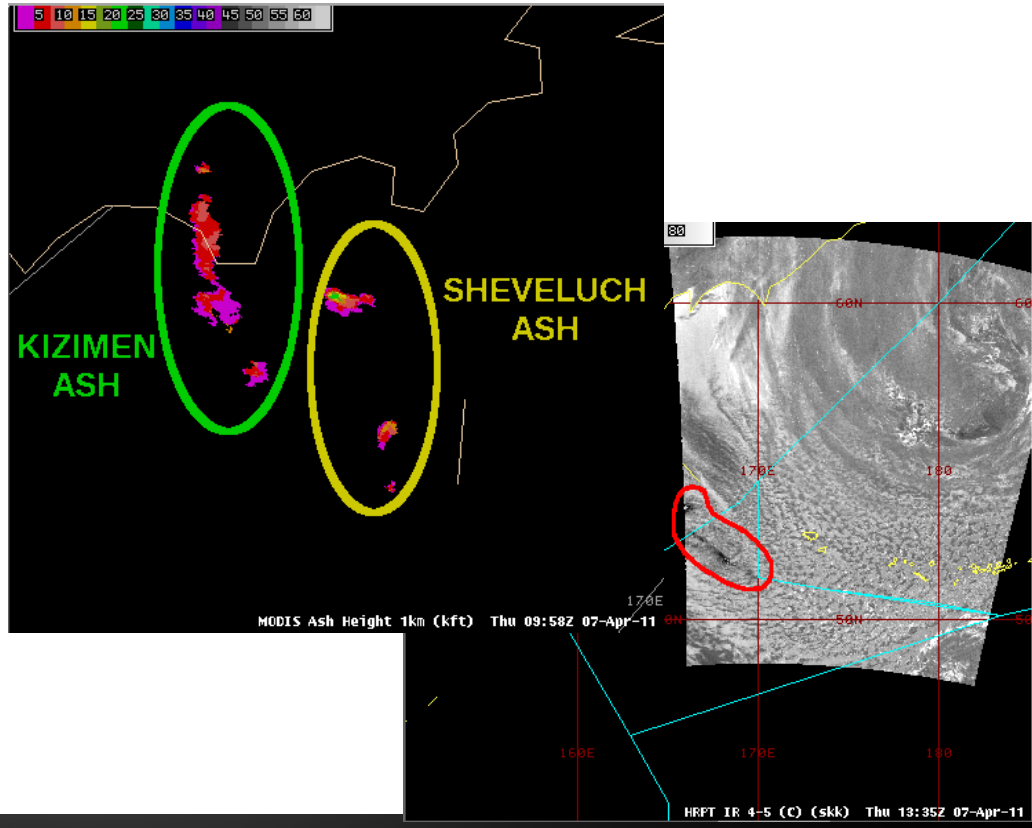
IR Temps alone in magenta

Diagram from GOES-R Proving Ground training provided to AAWU forecasters by Mike Pavolonis and Justin Sieglaff in the Spring 2011.

GOES-R Proving Ground VA Products in Alaska

Kizimen-Sheveluch Event
Kamchatka Peninsula/Western Aleutians
7 April 2011

- This was the first significant eruptive behavior that reached the Anchorage FIR where the products were used
- Two ash plumes from two different volcanoes were in close proximity in this unique event (Kizimen and Sheveluch)
- Ash cloud heights from the products tended to agree with the forecast heights from Tokyo VAAC and winds aloft from NWP



Interesting Forecast Case

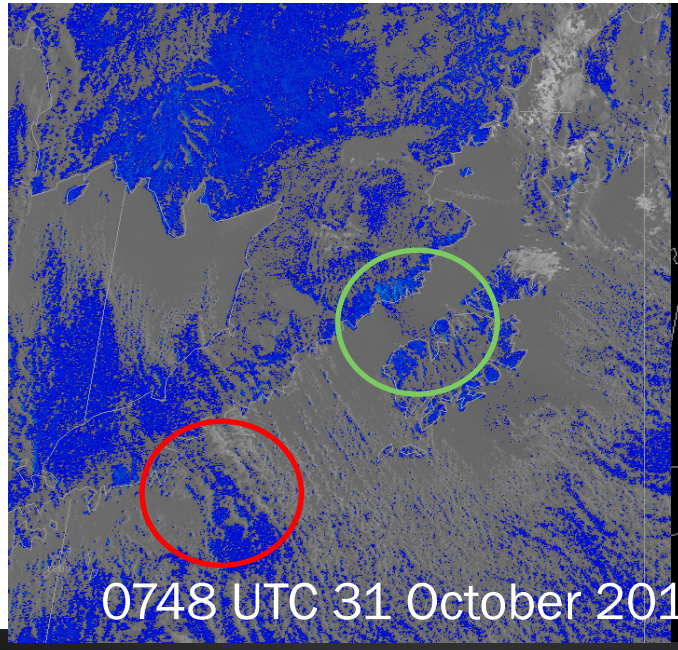
Katmai, Novarupta 1912 Eruption, VA re-suspension

- Frequent enough for forecasters to know the pattern in which these occur
- Couple times per year
- VA is usually diffuse and nearly impossible for geostationary to detect
- Extent and VA height are often difficult to determine

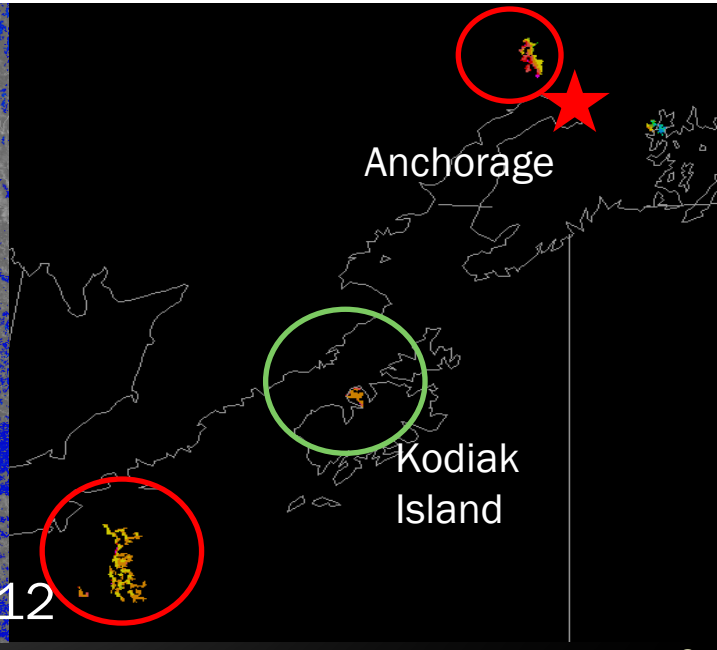
Green circles indicate detected VA areas

Red circles are believed to be false alarms

11-12 Split Window



MODIS/GOES-R VA Product



Successes

GOES-R Proving Ground VA Products Use in Operational Events

The MODIS based products have been used in multiple Kamchatka events as well as a couple Katmai VA re-suspension events

- Use varied from just detecting VA, to determining a more specific height
- These seemingly simple aids were a big help in determining impacts to aircraft operations through VA height and/or spatial extent
- VA height product has helped correct estimated VA heights in subsequent Volcanic Ash Advisories and VA SIGMETs
    - Past practices did not really involve changing VA heights given that this was a big unknown with a low accuracy
- Additionally, helped forecasters become comfortable with new products before GOES-R becomes operational
- Hopefully, the few cases we've shared have helped reduce false alarms

Challenges

GOES-R Proving Ground VA Products Use in Operational Events

The MODIS based products have been used, but are limited in availability

- Frustrating to forecasters when quality VA heights and spatial extent cannot be detected
  - Due to limited passes or pass does not cover VA event
  - In some cases, false alarms have limited the use (this has improved)
- VA height product has helped, but the other products that WILL be useful
  - VA Mass Loading and VA Effective Particle Radius
    - Difficult for operational application without more case studies and their applications to forecasting problems
    - May not realize their full application without geostationary imagery
      - MODIS data gives us a snapshot which is useful for detection, but less useful for tracking and forecasting
- Latitude extent of geostationary will still limit their use in future cases
  - Having this capability on other polar orbiting satellites would help

Operational User Thoughts on the Future Possibilities

GOES-R VA Products Use in Future Operational Events

Just the idea of an authoritative VA height detection and product is a big step forward for operations

- The impacts to aircraft operations and the associated costs should be reduced with this capability alone
- Automated alerts will aid forecasters in the production of warning products

In time, VA Effective Radius and Mass Loading will help forecasters determine atmospheric residency times

- No technique currently exists, other than experience (which is limited)
- Commercial aviation users need to do route planning beyond current forecast capabilities.

A bigger goal would be to aid dispersion models with input of estimated concentrations to be able to forecast VA that has been in the atmosphere for extended periods of time. This is one of the biggest challenges for VAAC forecasters.

Additional Questions or Comments?

Nathan Eckstein

Science and Operations Officer

Alaska Aviation Weather Unit

Anchorage Volcanic Ash Advisory Center

nathan.eckstein@noaa.gov

907-266-5112