Weather Satellites and Alaska Weather

Fall Semester 2018, Session II

“There’s No Such Thing as Bad Weather, Just Bad Clothing”
--Allegedly, A Norwegian
Let Us Start With A Bang!

• Some of the best eye candy satellite imagery on the Internet: Colorado State University’s “GOES-16 Loop of the Day”

• To demonstrate what this web site has to offer, let’s check out some recent loops showing Hurricane Michael and its impact on Florida

• http://rammb.cira.colostate.edu/ramstdis/online/loop_of_the_day/
Ask of Me Anything But Time

• Why are we here: to endure a four-week cascade of suffering and woe
• Why are we here: to investigating our wonderful state and its weather as seen by satellites
• **October 18**: Satellite Orbits and Satellite Instruments
• **October 25**: The Electromagnetic Spectrum and Multispectral Imagery
• **November 1**: Weather Maps and Numerical Weather Prediction
• **November 8**: The Peoples’ Choice Awards
“Son, all I've ever asked of my marines is that they obey my orders as they would the word of God.”
The Actual Ground Rules

• Please think critically, be curious, and ask questions: participation will be 50% of your grade. Bribery will be the other 90%.
• Jargon Alert: Please ask if an acronym or term is unfamiliar
• In case of questions too challenging to answer on the spot, your (tor)mentor will dodge them and then try to bring an answer to the following week’s session
• Fun is mandatory, suffering can be endured for optional extra credit
Your Instructor and (tor)Mentor’s Credentials

• Born and raised in North Dakota, moved to Fairbanks for the nicer winters
• Not a mad scientist, simply a disagreeable scientist
• Master’s in Atmospheric Science from Colorado State University
• Meteorologist with National Weather Service 1993-2011.
• Presently “Science Liaison” with UAF’s Geographic Information Network of Alaska (GINA)
• eric@gina.alaska.edu
The Challenge
The Alaska Challenge

• Alaska is a synoptic-scale Region within a mesoscale-oriented NWS
• Areas of responsibility are (comparatively) huge
• The land portion of these areas of responsibility are topographically complex, yielding myriad microclimates
• Many observational networks (including 88Ds) are very sparse...
  – Big problem because the first step in forecasting is analyzing and understanding the weather now at time = 0
• The specter of climate change being concentrated in the high latitudes means that old “rules of thumb” may suffer from diminishing relevance
National Doppler Radar Sites

Select radar location and click.

Requires Java/Javascript

Java is necessary for radar looping and is best optimized using Java version 1.4.2 or higher. Go to www.java.com/en for more information regarding Java.

Additional Info:
- Radar FAQ
- Brokering Images
- Doppler University

National Weather Service
Since 1870

Oct 18, 2018
The High Latitude Proving Ground

• Thanks to its high latitude, Alaska enjoys frequent coverage from polar orbiting satellites.

• The University of Alaska Fairbanks receives data from a number of polar orbiting satellites:
  – The data are then processed into AWIPS-ready imagery, as well as into non-AWIPS image formats.
  – The resulting imagery is delivered to the NWS via Local Data Management (LDM).

• This approach minimizes latency.
Johannes Kepler: The Lawgiver

1. Orbit of a planet is an ellipse, with the sun at one foci
2. A planet “sweeps out” equal areas in equal time
3. The square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit.

Good grief, luckily for our purposes tonight we can pretty much forget about law #3
Kepler’s Second Law
Kepler’s Second Law

- Planet sweeps out equal areas in equal time
- The closer to the sun, the faster the planet moves.
- The further from the sun, the slower the planet moves.
- Kepler’s Laws also apply to weather satellites orbiting the earth
Kinds of Satellite Orbits

• GEO: GEostationary Orbit
• LEO: Low Earth Orbit
• HEO: Highly Elliptical Orbit
• EIEIO: Old MacDonald Orbit
GEO and LEO
The GOES Advantage

• Can see the “full disk”
• Constant frame of reference means...movies!
The GOES Disadvantage

• Poor view of higher latitudes: Alaska
  – Degraded spatial resolution
  – Parallax
  – Some instruments or products simply not available poleward of a certain latitude

• The solution: Polar Orbiters
POES Pros and Cons

• Pros: Pass directly overhead, no matter where you are
  – Fine-scale spatial resolution
  – No parallax
  – High latitudes (Alaska) get lots of coverage

• Show that nifty cartoon

• Cons: no constant frame of reference (no movies), hard edge at side of images
Suomi NPP/JPSS, Metop, DMSP/DOD
Three-Orbit System

©The COMET Program
HEO: Highly Elliptical Orbit

- Doesn’t exist yet, at least as a civilian weather satellite
- Canadians leading effort for PCW mission: “Polar Communications and Weather”
- Idea is to blend GEO and LEO advantages into a single orbit
- If PCW happens, it will be great for Alaska, stay tuned...
Thank You!
Shortwave Sun, Longwave Earth

Graphic from: http://remote-sensing.net/concepts.html
VIIRS Day Night Band
2am December 25, 2015
Day-Night Band: Politics Illustrated
Minimal Light Pollution in Alaska: Plenty of Aurora

Legacy “Adaptive” DNB enhancement

New “Dynamic” DNB enhancement
Not Every Rectangle is a Square

• **Mutli-spectral Product**: any product made from more than one single-channel image
  — Thus the classic 11µm-3.9µm channel difference “fog product” is multi-spectral

• **RGB**: a multi-spectral product that contains single-channel or multi-spectral products in each of the red, green, and blue components of a color image
  — Thus all RGBs are multi-spectral, but not all multi-spectral products are RGBs
The Multi-spectral Advantage

• The Whole is Greater Than The Sum of the Parts
  – Some meteorological and terrain features only become obvious in multi-spectral products

• A more time-efficient way to evaluate all the new channels available from JPSS and GOES-R
  – Can combat data sprawl with data density: multispectral products are “more dense”
Pavlof Volcano settles down after March eruption

Associated Press | April 6, 2016

A remote Alaska volcano has settled down more than a week after it sent an ash cloud 37,000 feet into the sky.

Officials at the Alaska Volcano Observatory in Anchorage said Wednesday that eruptive activity at Pavlof Volcano has ended, and they downgraded its alert level to advisory status.

The volcano 625 miles southwest of Anchorage on the Alaska Peninsula erupted with little warning on March 27. It sent an ash cloud about 7 miles into the air, which drifted across Interior Alaska and into Canada.

Alaska Airlines canceled nearly 70 flights because of the ash, which can damage plane engines.

Authorities say Pavlof is one of Alaska’s most active volcanoes, and it could again start erupting with little warning.
USCG Rescues Mariner in Sailboat Trapped in Ice North of Barrow

WFO Anchorage sea ice forecasters provided “phenomenal weather products” that proved key to USCG decision makers, said Rear Adm. Dan Abel, commander, 17th Coast Guard District.