Alaska C&V Camera Imagery Analytics

Friends and Partners in Aviation Weather (FPAW)
July 12th 2017

Mike Matthews
Jenny Colavito (FAA)

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

This material is based upon work supported by the Federal Aviation Administration under Air Force Contract No. FA8721-05-C-0002 and/or FA8702-15-D-0001. Any opinions, findings, conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the Federal Aviation Administration.

Video Analytics for Weather

- **DOT/FAA are increasing investment in cameras**
  - **Thousands of cameras installed nationwide**
  - **Primarily visual analysis**
  - **Difficult to monitor changing conditions**

- **Valuable weather condition information is not exploited**
  - **Ceiling and Visibility**
  - **Precipitation (type / intensity)**
  - **Pavement condition (dry / wet / snow)**
  - **Fog**

Lincoln Weather Video Analytics Timeline

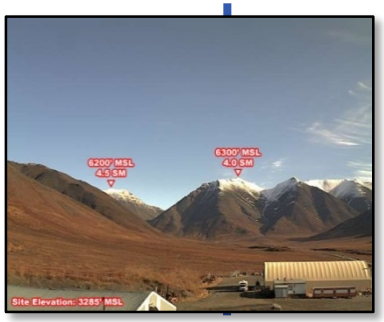
Imagery Location

Lexington, MA

Lexington, MA

Utah

North Adams, MA



Alaska

Funding Base

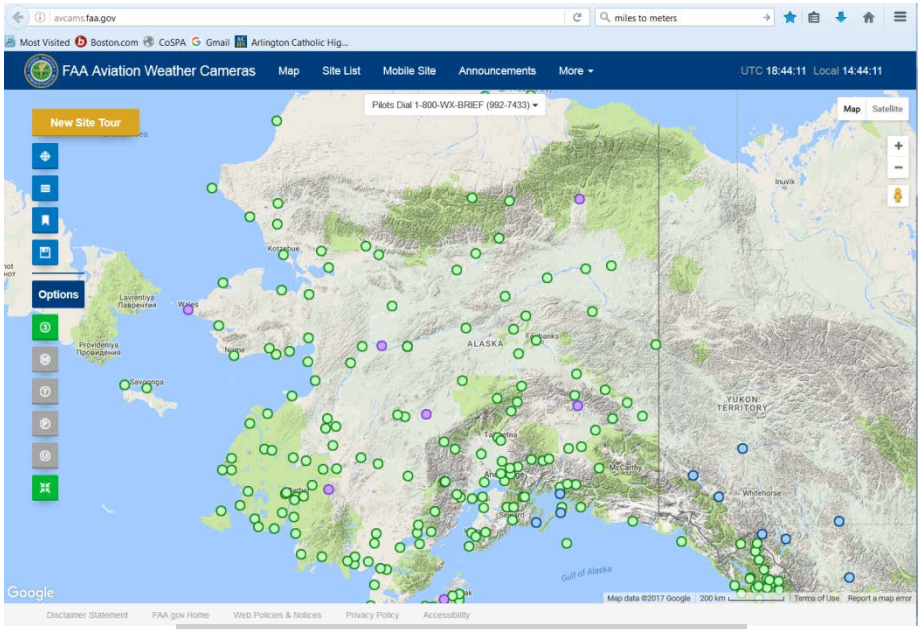
Army

National Highway

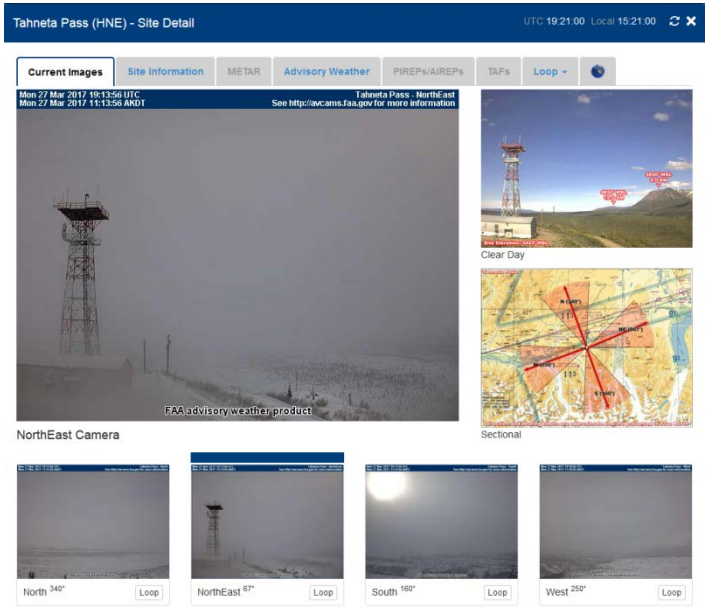
FAA

1995 2000 2005 2010 2015 2020

FAA C&V Camera Analytics*



FAA – Alaska 260 Camera Sites

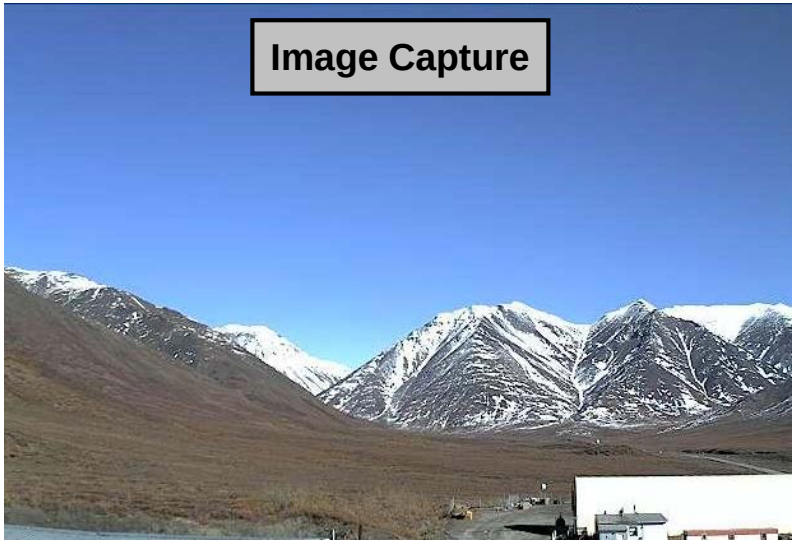


*Website is operated by an independent FAA office

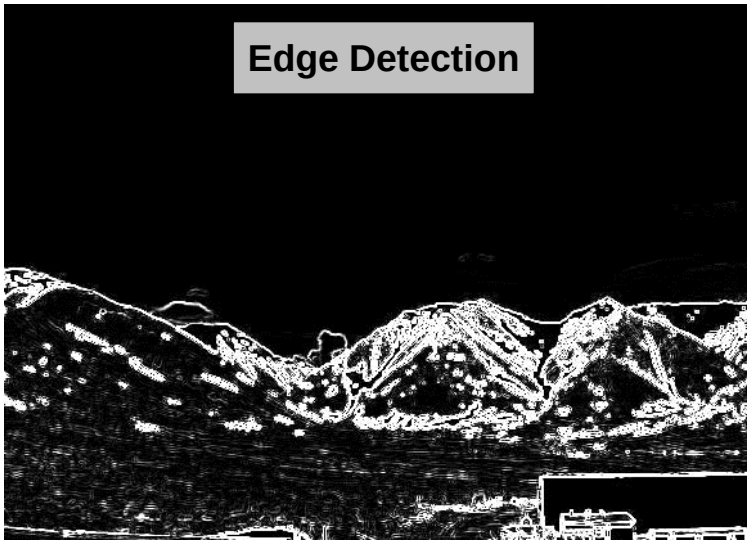
- **Utilize camera imagery for real-time extraction of C&V variables**
  - **Stand-up Lincoln visibility algorithm in 2016**
  - **Tune algorithm for Alaska**
  - **Analyze performance with ASOS measurements**
  - **Research improved concepts and/or ceiling estimates**

ASOS = Automated Surface Observing System

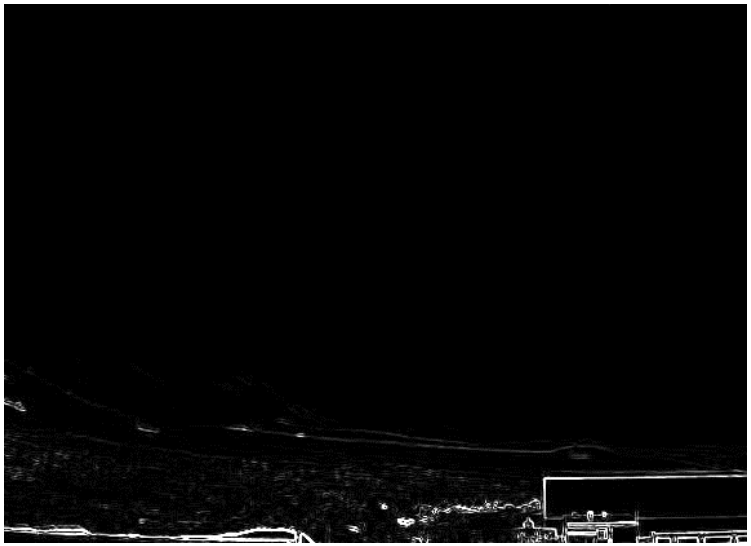
Extracting Visibility From Images



10+ miles



¼ mile



Algorithm Flow

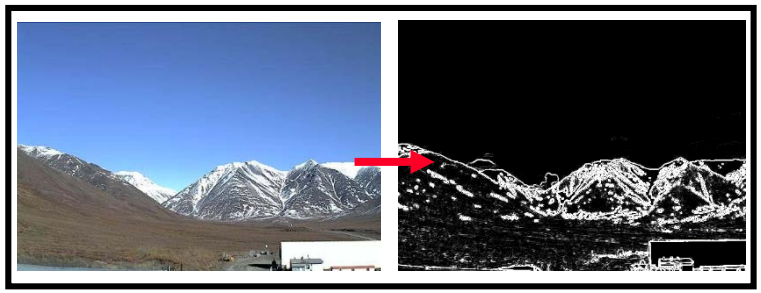


Image Capture

Edge Detection

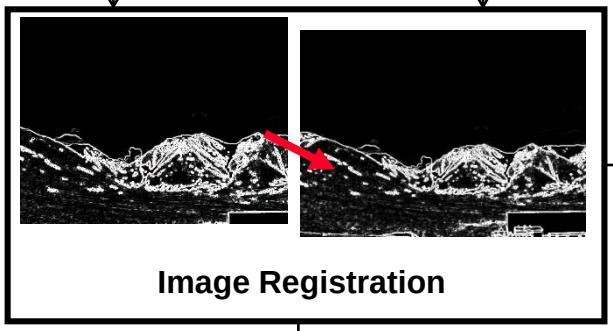
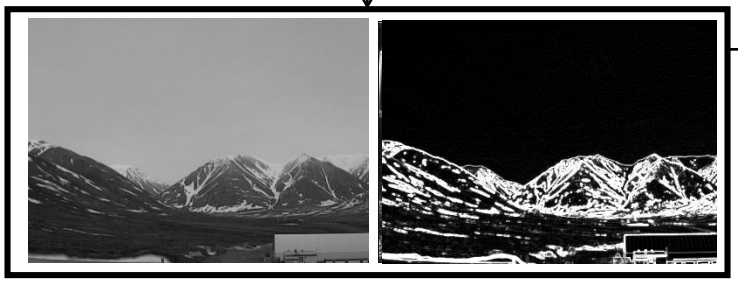


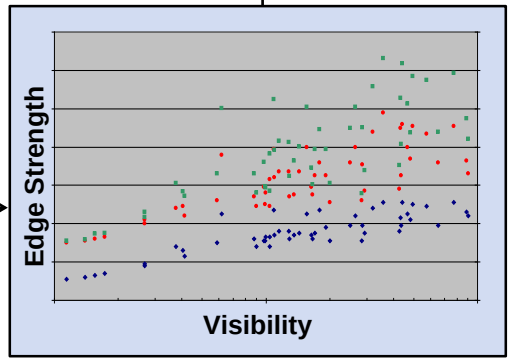
Image Registration



Clear day composite image & edges

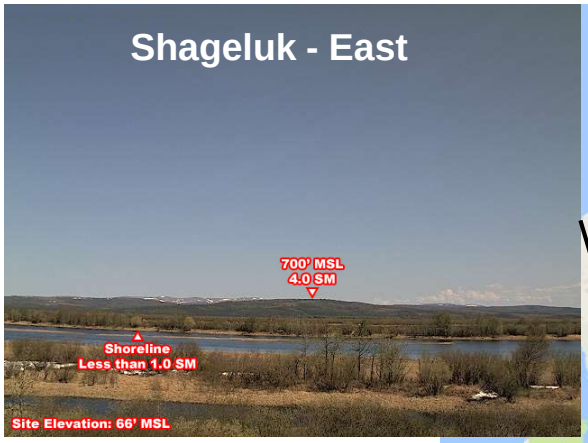
Normalized Edge Extraction

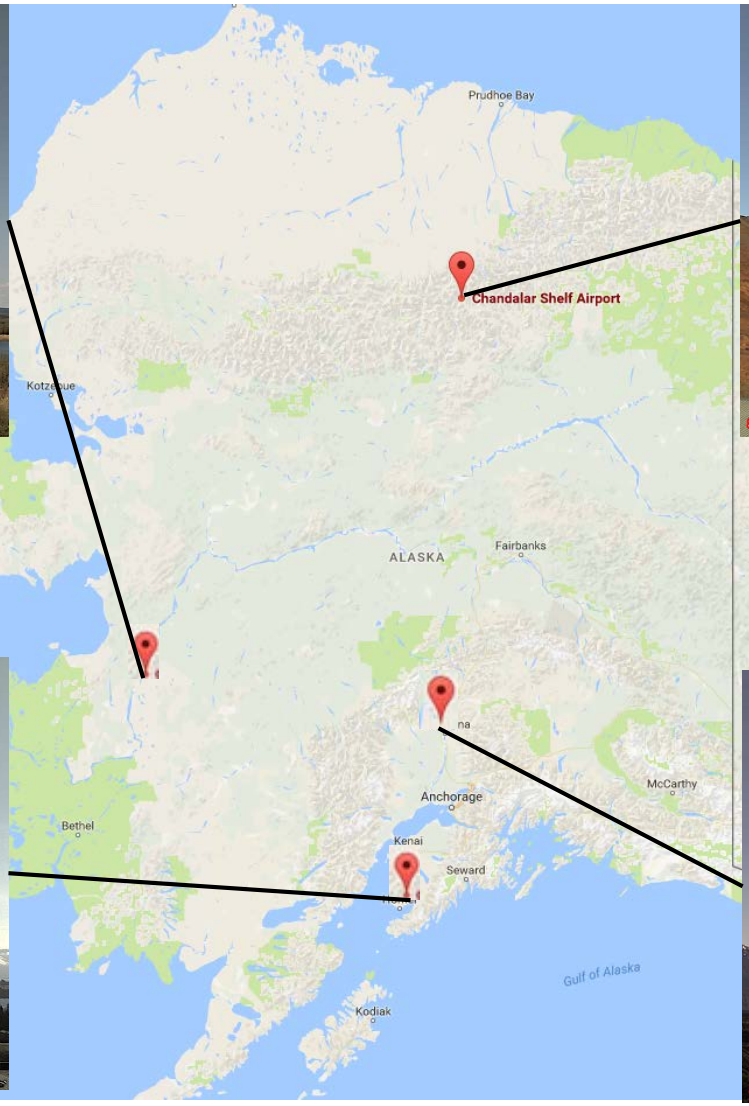
Visibility: 10+ miles

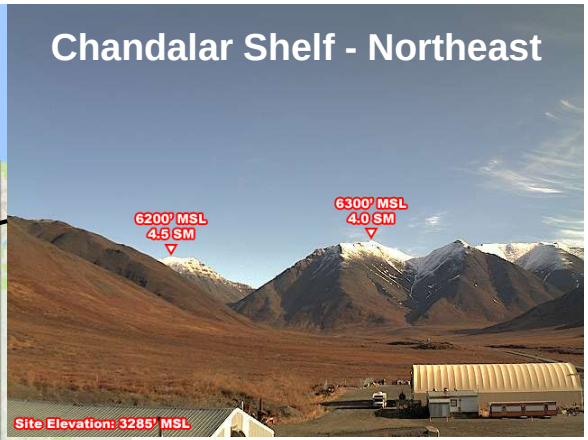


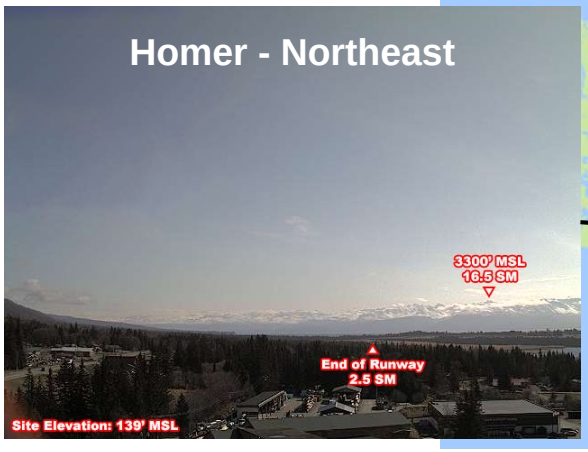
Visibility Estimator

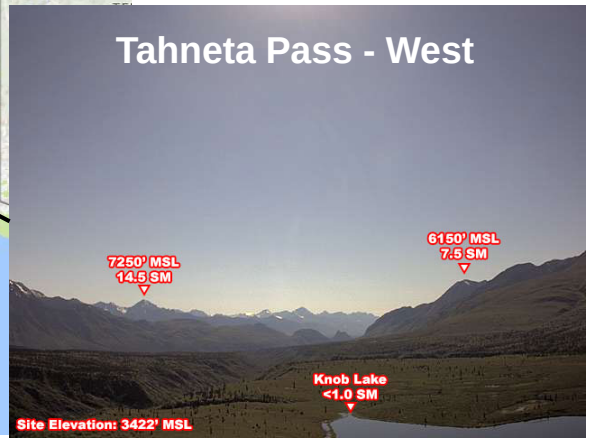
Initial Alaska Camera Analysis Sites



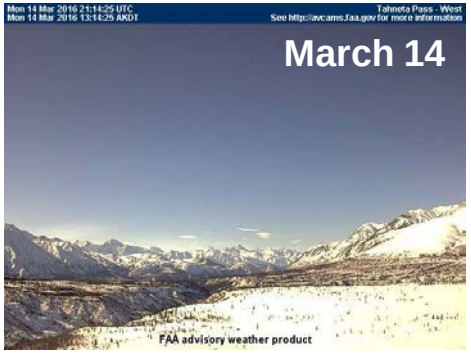


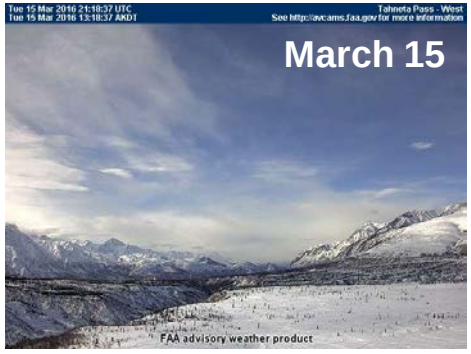


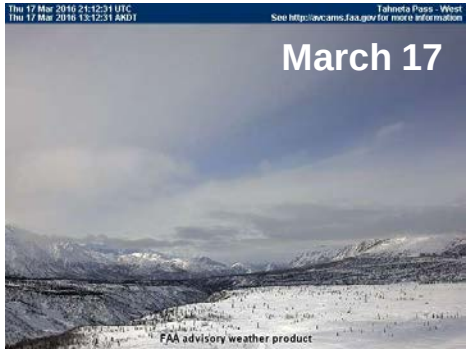


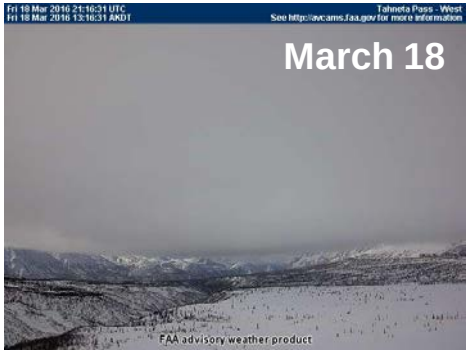


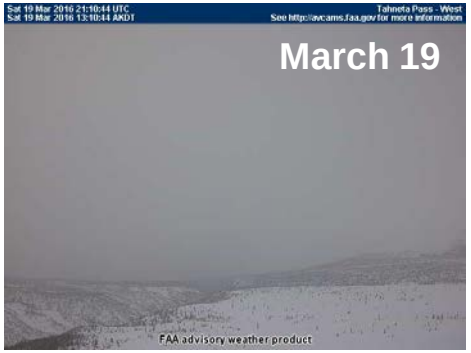
Example Visibility Estimates:
Tahneta Pass, March 14 to March 21, 2016

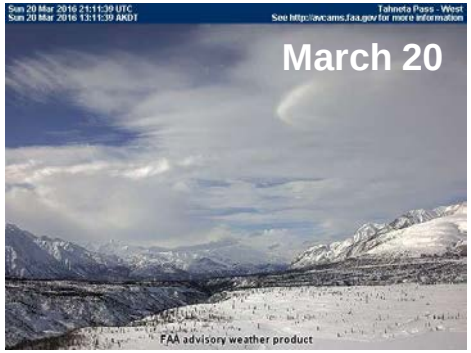


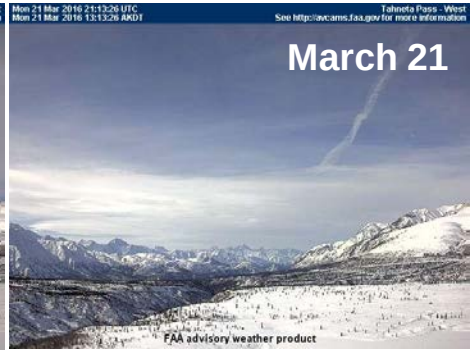




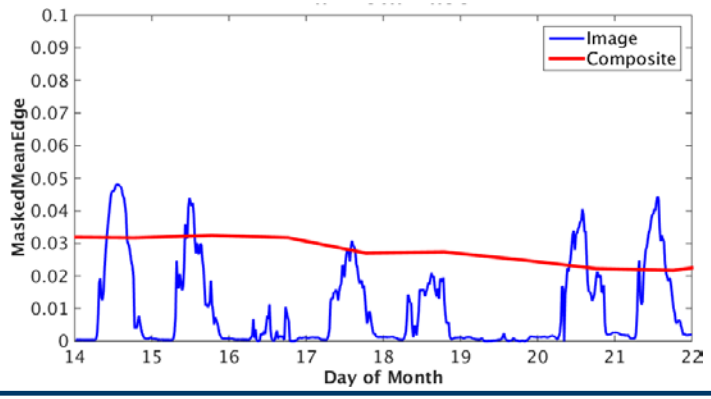


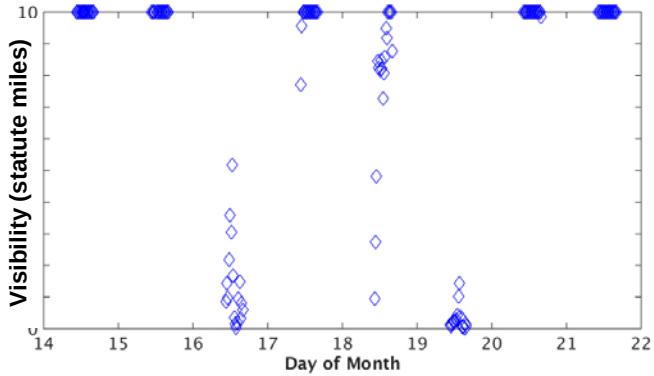






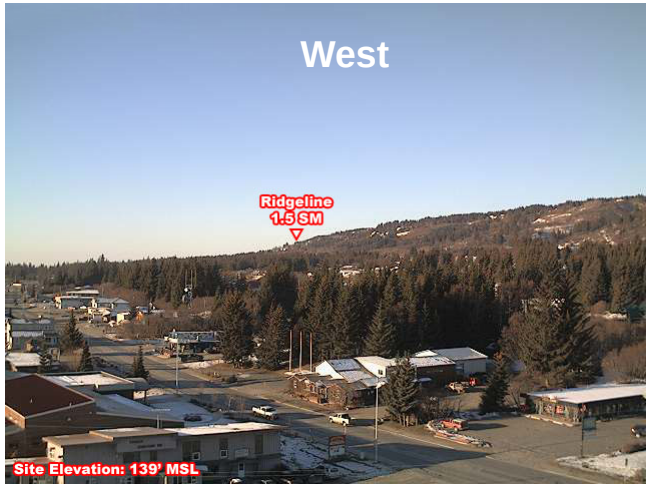
Edge strength

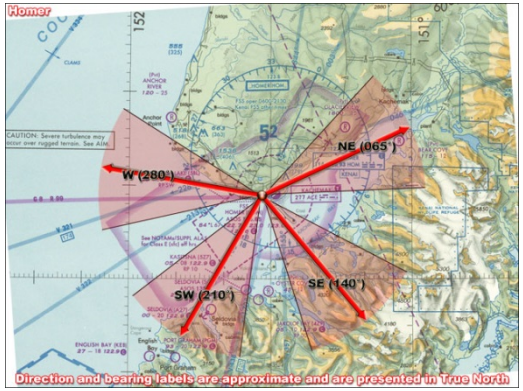


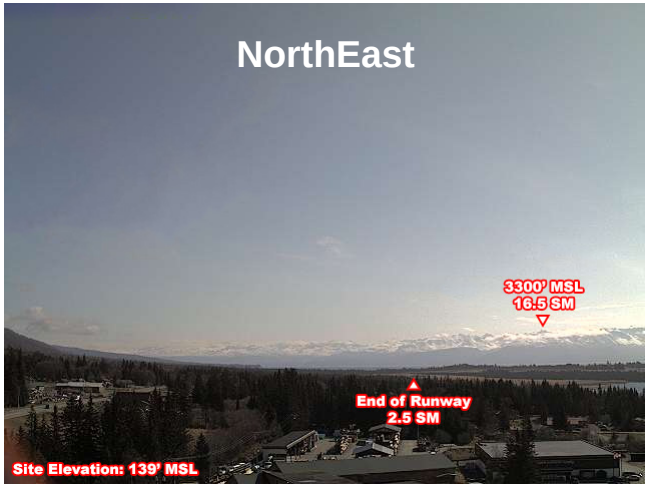


Visibility estimate

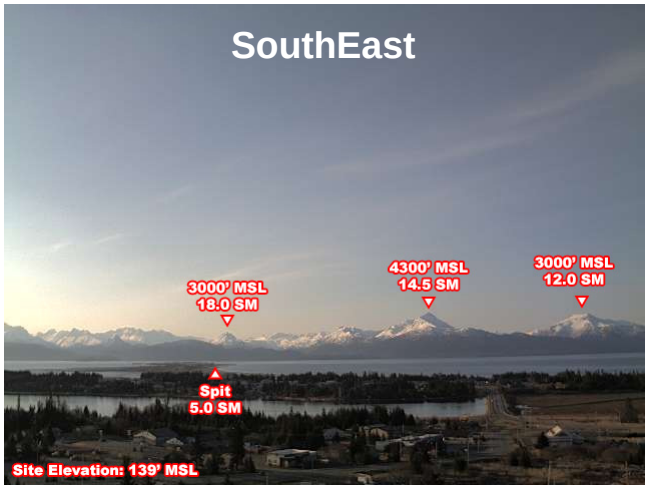
Example Co-Located Video / ASOS
Homer, Alaska







Five minute ASOS



ASOS = Automated Surface Observing System

Example Preliminary Comparison
Homer, AK Northeast

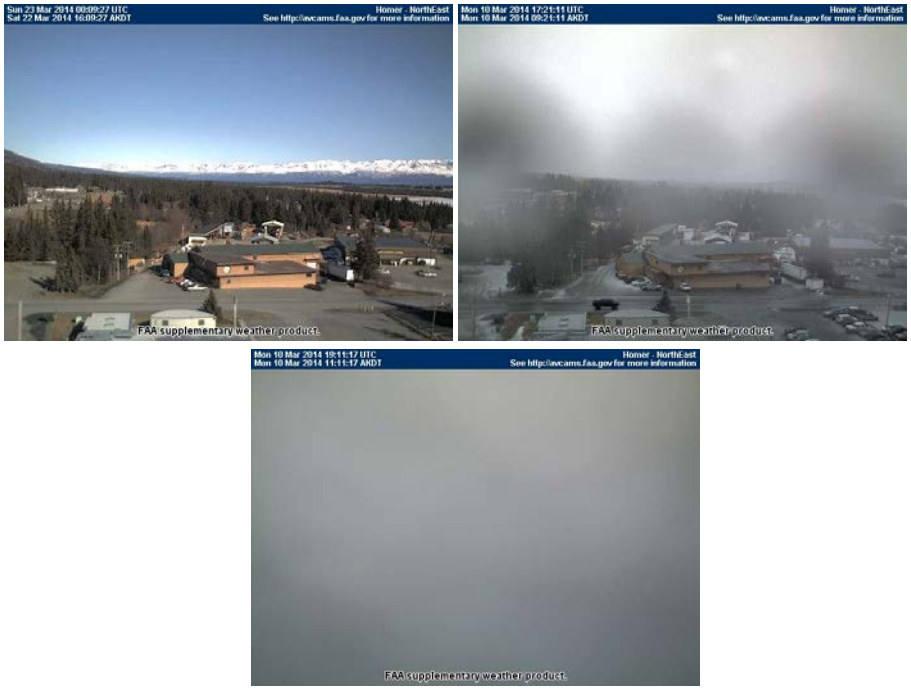
ASOS Visibility (miles)

Video Algorithm Visibility (miles)	<1	1-5	5-10	≥ 10
<1	12	16	2	9
1-5	17	36	57	236
5-10	4	55	207	1507
≥ 10	3	79	222	9629

Homer NE Camera, Jan 2014 – Dec 2015

Max Visibility = 12.0 SM

Each cell = number of observations



Overall match rate = 82%
<10 mile match rate = 36%

Currently pursuing modifications to improve performance

Status and Future Work

- **FY2017 Activities**
  - **Initial Lincoln algorithm applied to AK images**
  - **Results are promising**
  - **Continuing to adapt to Alaskan environmental challenges**
    - **Seasonal variations in composite**
    - **Sun angle limits**
    - **Camera positioning**
  - **Performing comparison with ASOS (39 sites with 5-min ASOS)**
  - **Implementing prototype live capability (limited sites)**

- **FY2018 Activities**
  - **Engaging with Alaska Camera Program Office**
  - **Extending algorithm for sites with multiple cameras**
  - **Exploring expanded set of metrics and methods**
    - **Sky brightness for visibility and/or sky cover**
    - **Machine learning techniques**