Direct Readout at the Meteorological Service of Canada

CSPP Users Meeting 2015
Darmstadt, Germany
April 14-16, 2015

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**Meteorological Service of Canada**
Environment Canada

Outline

- Meteorological Service of Canada (MSC) Overview
- Direct Readout at MSC
- Data Processing Activities
- GOES-R
- Summary

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MSC Space Activities

- Weather Forecasts and Warnings
  - 1.5M forecasts, 10k weather warnings
  - Public, aviation, marine,defense, and ice

- Numerical Weather Prediction (NWP)
  - near-real time global data
  - 15-20 satellites, 11M+ obs/day assimilated
  - 80% of obs are space-based

- Sea Ice Monitoring and Forecasts
  - 2000+ ice charts, 400-500 warnings/yr
  - RADARSAT and other SAR satellites, meteorological missions
  - in partnership with Canadian Coast Guard

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MSC Space Activities

- **SAR Winds**
  - surface wind speed retrieval over water
  - 2013 - operational for marine forecasts and warnings
  - RADARSAT and other SAR

- **Pollution Detection and Deterrence**
  - ISTOP - Integrated Satellite Tracking of Ocean Pollution
  - aircraft, RADARSAT and other SAR

- **Environmental Emergency**
  - Volcanic Ash Advisory Centre – Dorval
  - plume analysis and reverse modeling (CBRN)
  - oil spill detection and response
 - met, optical, RADARSAT and other SAR

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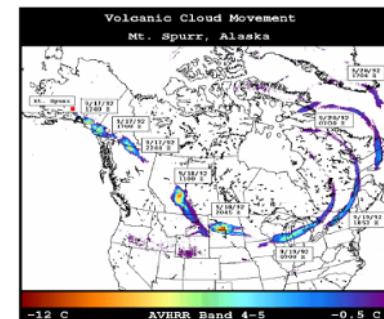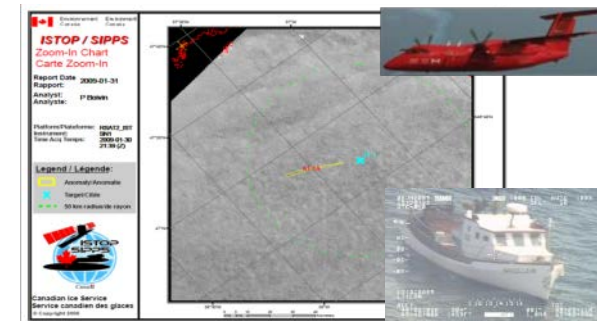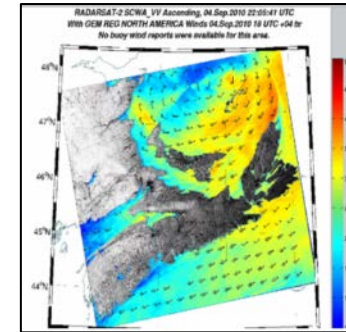
EC Satellite Reception Network

- Geostationary: GOES-E,GOES-W
- Polar Orbiting: POES, METOP, EOS, JPSS (NPP)

GOES Network

- Receives data broadcast from NOAA's Geostationary Operational Environmental Satellites (GOES)
  - Downlink data rate 2.11 Mbps
  - Downlink frequency 1685.7 MHz
- 6 GOES-E, 4 GOES-W stations
  - CMC provides national products
  - Regional provides products
- Ground Station Infrastructure
  - 5.0 m fixed-direction antennas
  - Receiver, bit-synch, frame-sync and processing workstation provided by Global Image / Info-Electronics Systems

- Coming Up: Transition to GOES-R
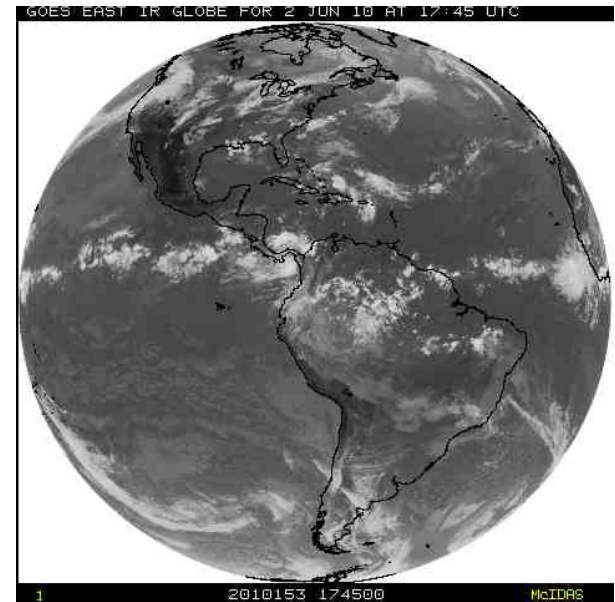
HRPT Network

- Stations located in:
  - Gander, Nfld (installed 2007)
  - Edmonton & Stony Plain, Alberta (installed 2009)
  - Resolute Bay, Nunavut (installed 2010)
- Satellites Tracked
  - L-Band: NOAA-15, 18, 19, METOP-A, B
  - X-Band (Gander, Edmonton): Terra, Aqua, S-NPP
- Ground Station Infrastructure
  - SeaSpace Corp Systems
    - 2.4 m X/L antennas,
    - Quorum receivers
    - Terascan software for acquisition & processing
    - REPS (T-REX) processing server
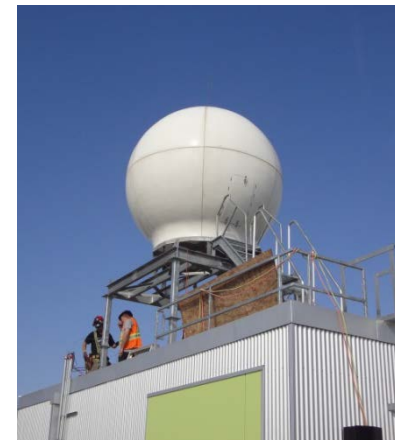
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EC National HRPT Coverage
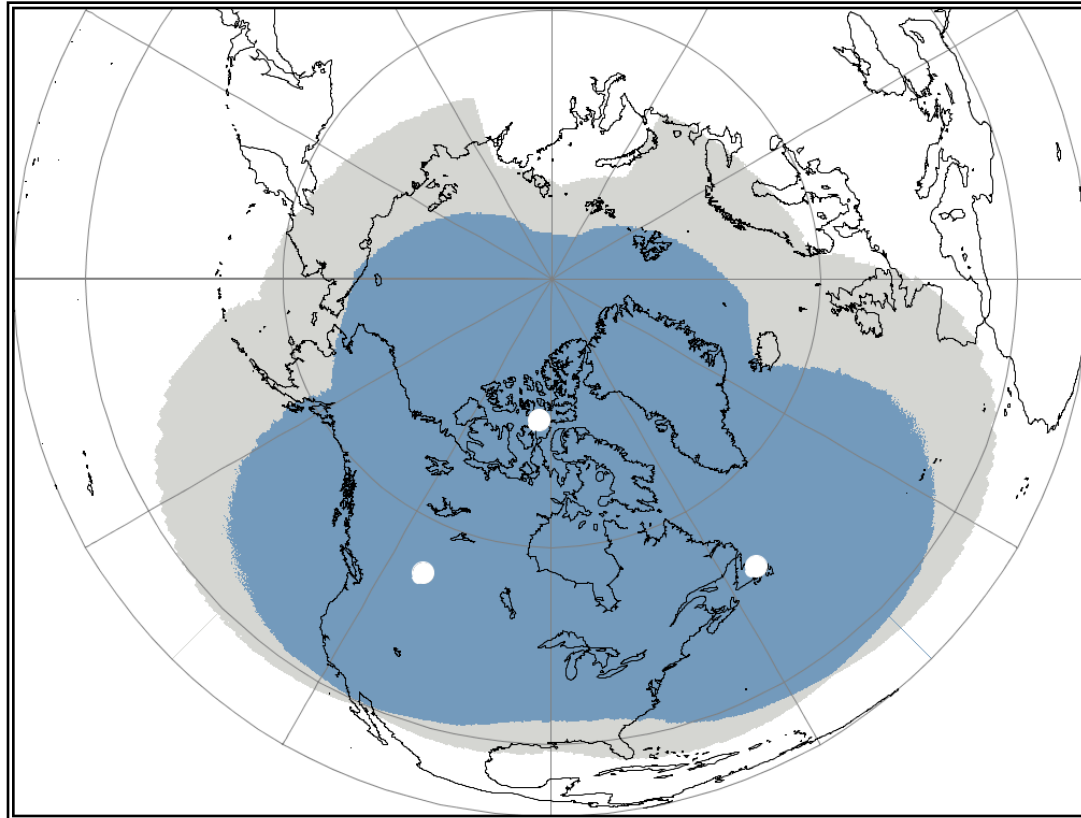
Blue: 50-100% of observations are collected
Grey: 0-50% of observations are collected

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HRPT - Gander

- Located at Gander Int'l Airport (Newfoundland)
- Installed January 2007
- Receiving L-Band: N15, N18, N19, Metop-A, B
- Receiving X-Band: Aqua, Terra, S-NPP

HRPT – Edmonton

- Located on Eastgate building in Edmonton, Alberta
  - Co-located with Storm Prediction Centre
- Installed August 2009
- Receiving L-Band: N15, N18, N19, Metop-B
- Receiving X-Band: Aqua, Terra, S-NPP

HRPT - Stony Plain

- Located in Stony Plain (40km from Edmonton, Alberta)
- Installed August 2009
- Receiving L-Band: N15, N18, N19, Metop-B
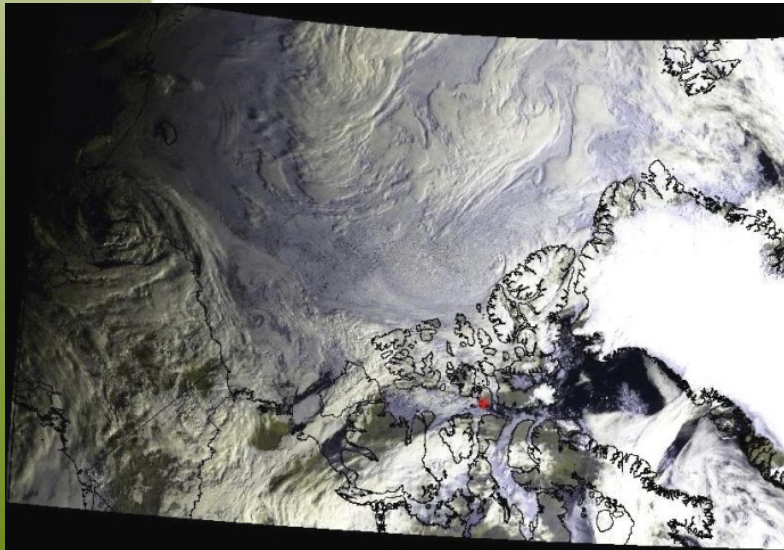- Planned X-Band Upgrade: 2016-17
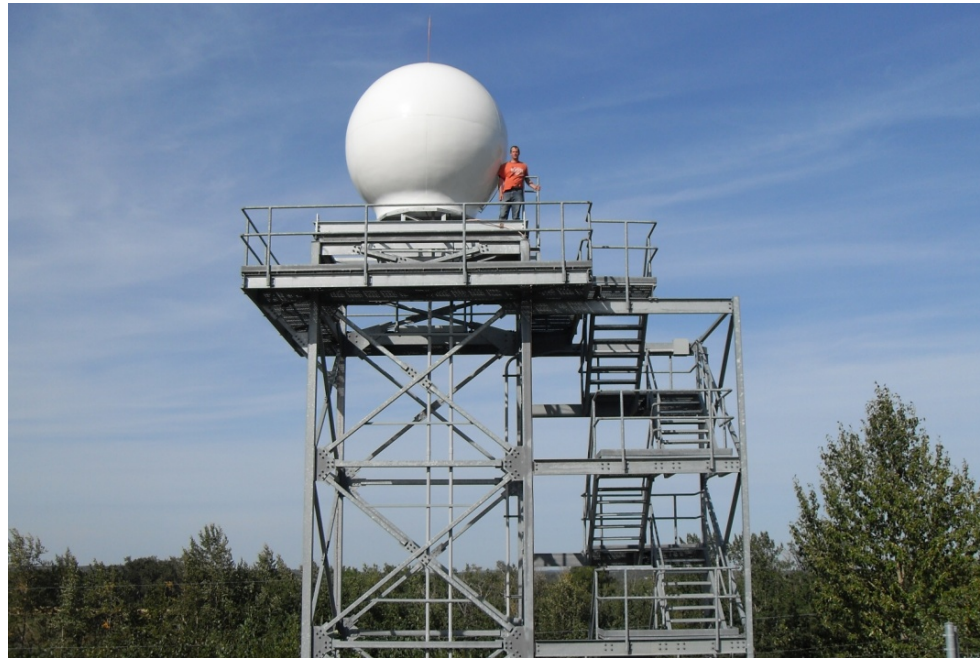
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HRPT - Resolute Bay

- Located in Resolute Bay, Nunavut (75N)
- Installed July 2010
- Receiving L-Band: N15, N18, N19
- Satellite (1.5Mbps) backhaul to Edmonton in real-time
- Planned addition of Metop-B in 2015
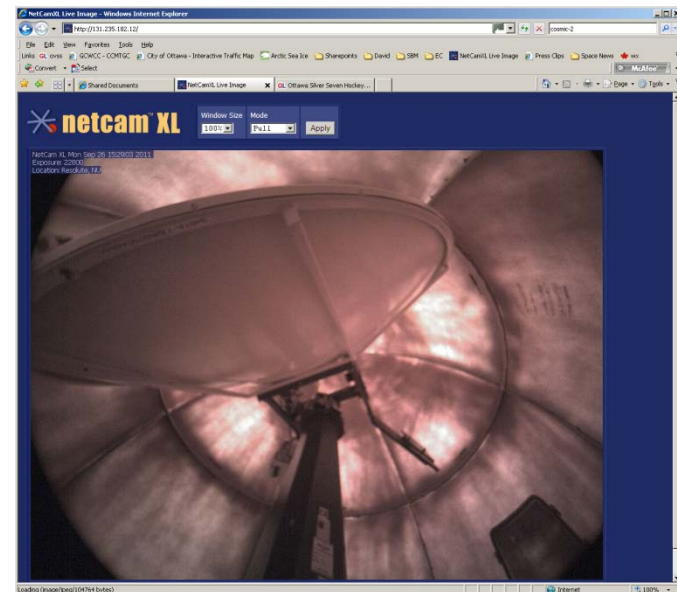
Resolute Bay HRPT satellite receiving station
First NOAA-AVHRR image acquired July 18 @ 1345 UTC

Data Processing Activities

- Current operational process uses Terascan to generate NOAA AVHRR, Metop-B AVHRR, and MODIS imagery for Ninjo (forecaster production & visualization tool)

- How best to optimize processing all of data acquired?

- Development activities include:
    – Combining Passes
    – Integrated Processing
   – Generating Examples
    – Sounder Processing

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Combining Passes

- CMC receives duplicate information from a single pass from multiple receiving sites

- Uses some basic logic to make satellite products from just *one* of the passes

- Better solution is to combine the data from the receiving sites into a single data file

- Process all imagery from the combined data file
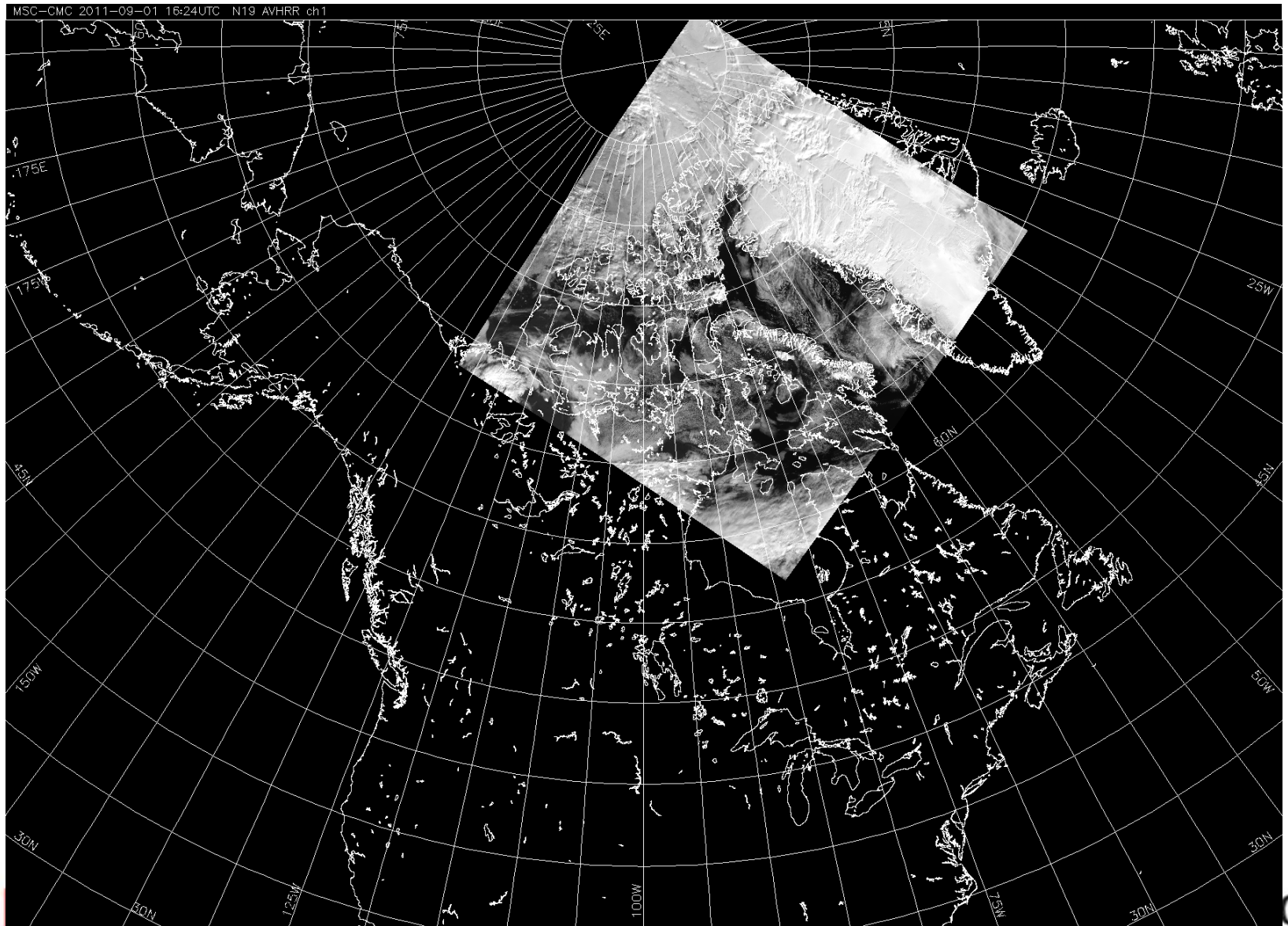
- Archive the combined file

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NOAA-19 AVHRR received at Resolute for September 1, 2011
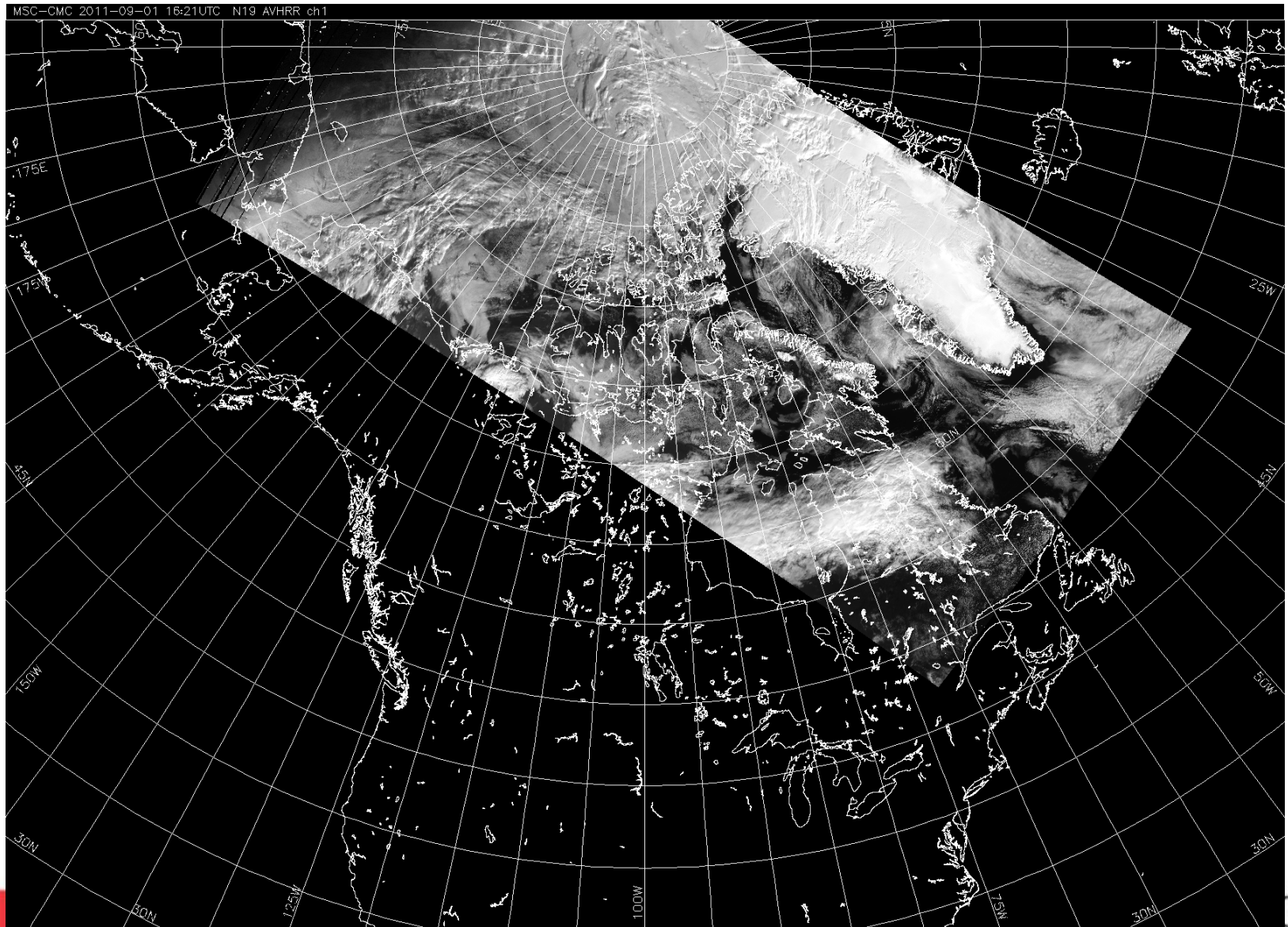
NOAA-19 AVHRR received at Gander for September 1, 2011
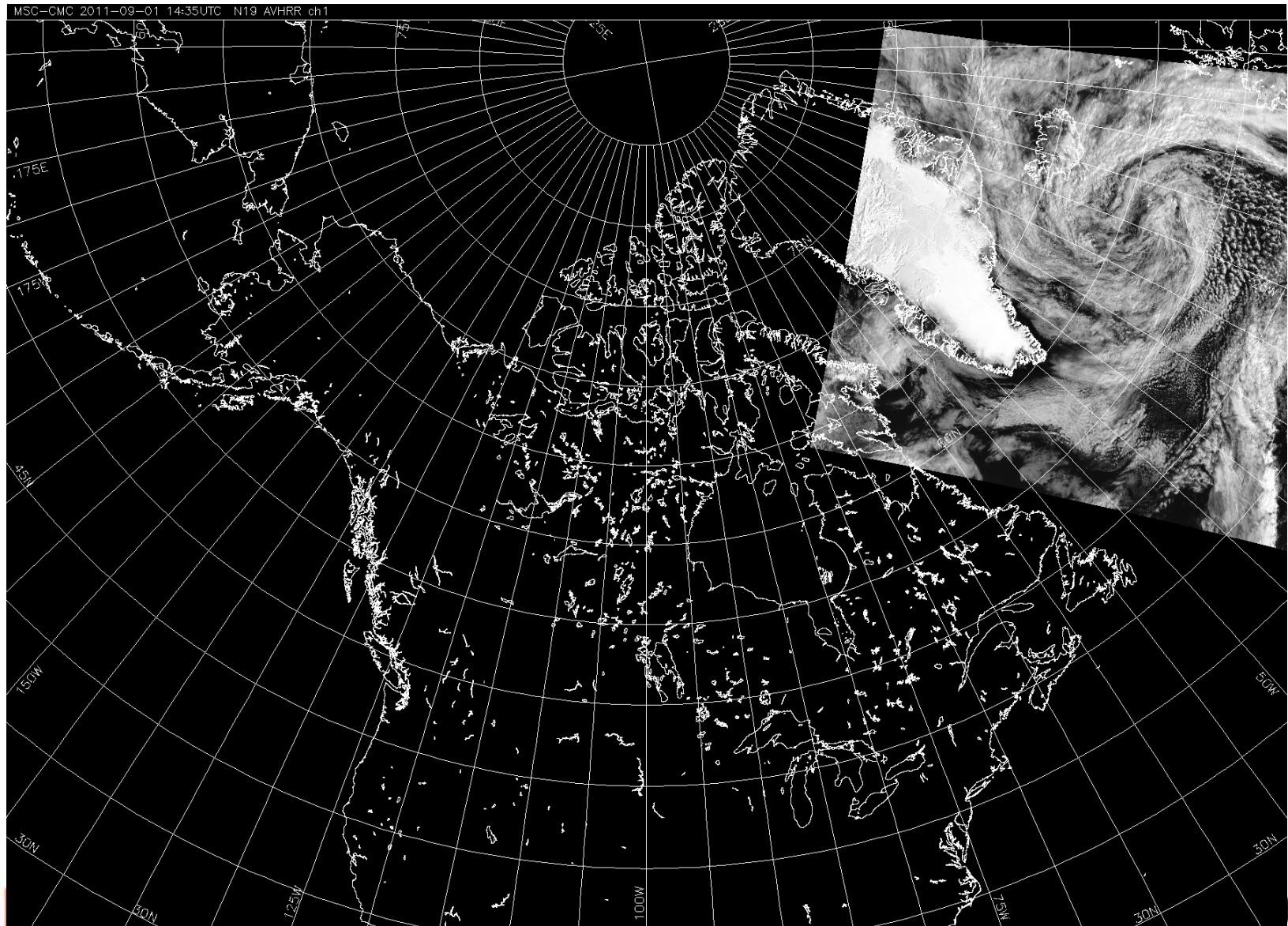
NOAA-19 AVHRR received at Edmonton for September 1, 2011

MSC-CMC 2011-09-01 16:24UTC N19 AVHRR ch1

Pytroll/Trollcast

- Prototype system for NOAA/AVHRR demonstrated

- Not yet possible for other satellites using method adopted for prototype

- Other options are available but not yet explored

Resolute

Edmonton

Combined

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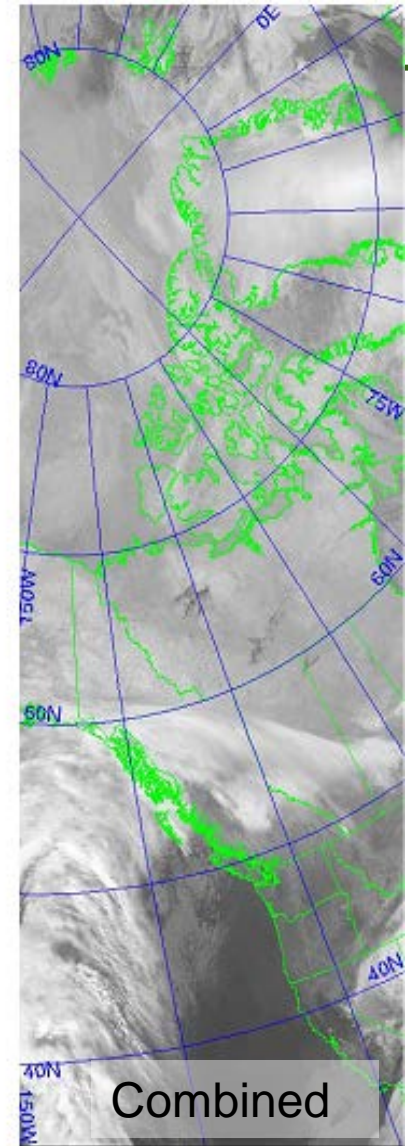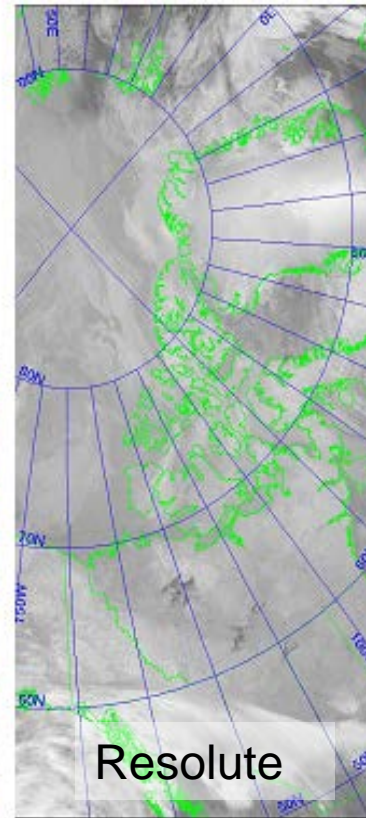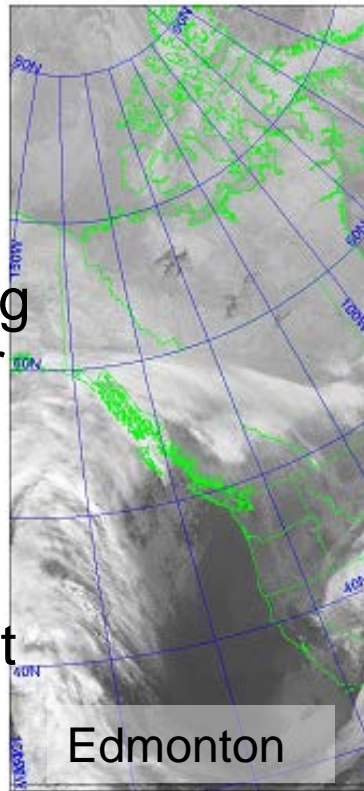
Prototype Processing System

Goal – Investigate new tools and software (free)

Goal – Improve current suite of output imagery and products

Developed prototype system for all data types using following tools:

- NPP: RT-STPS -> CSPP/SDR_2.0 -> Pytroll
- MODIS: RT-STPS -> MODISL1DB -> Pytroll
- METOP: METOPIZER -> AAPP -> Pytroll
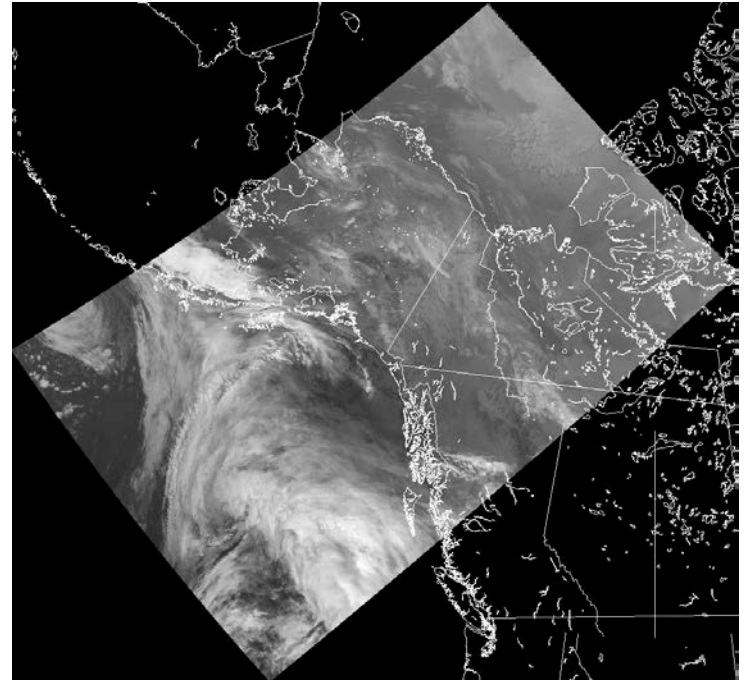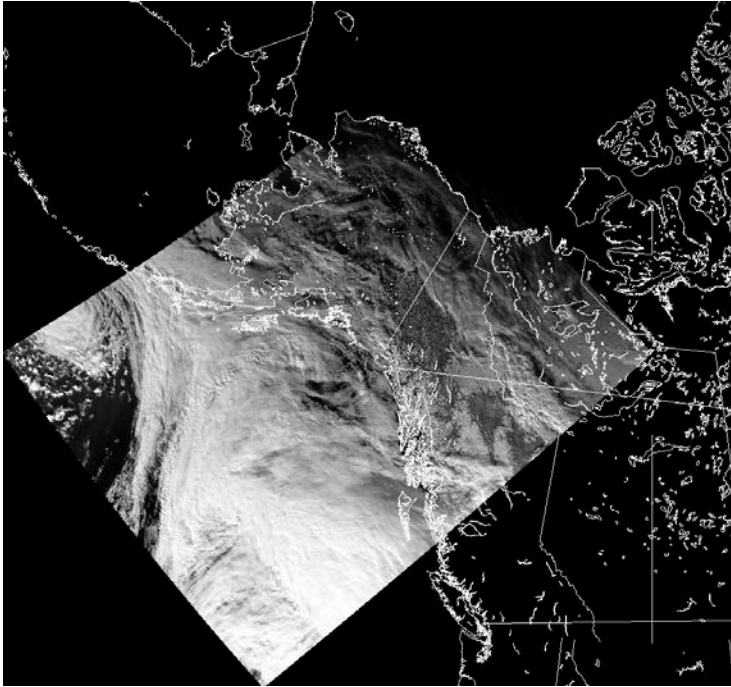- AVHRR: RAW -> AAPP -> Pytroll

Also looked at Polar2Grid

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Metop Example

Raw -> Metopizer -> AAPP -> Pytroll -> Geotiff Imagery
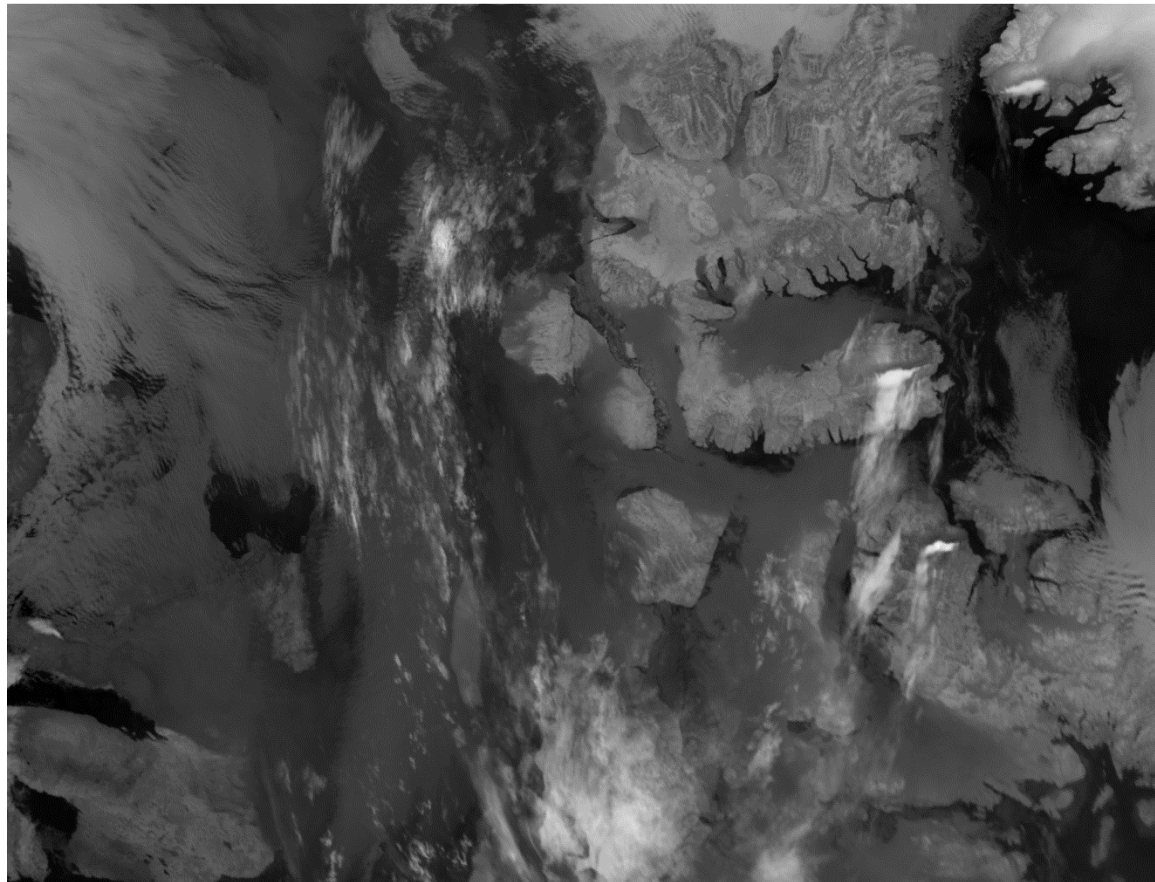
Pytroll – Terra Modis example

- Ninjo Compatible Geotiff (ninjotiff.py) – yes
- Automatic Minimum Bounding Box – yes
- Thumbnail jpgs with coast (pycoast) - yes

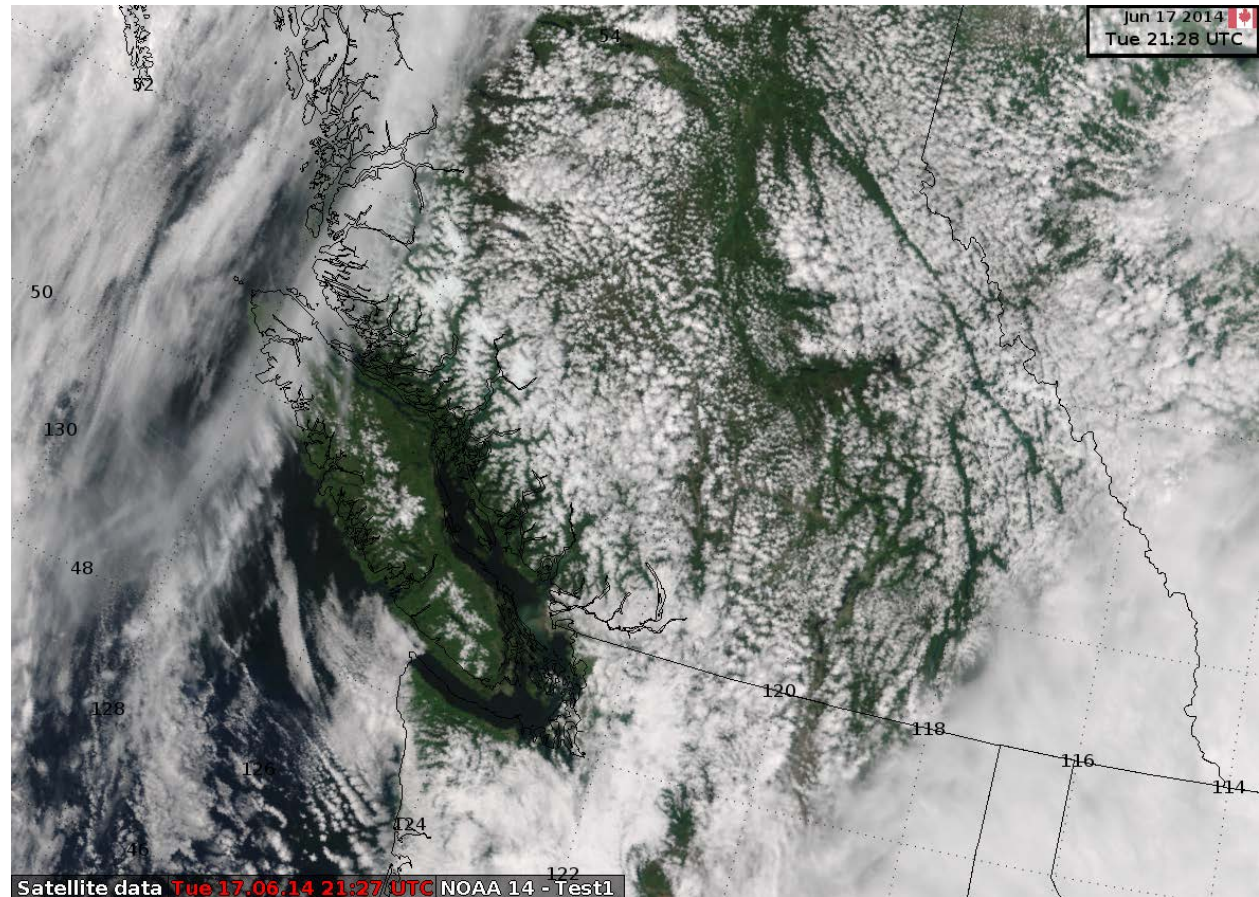- Advantage – leverage existing python modules already developed

CSPP Single Channel

- Can produce "rotated" imagery with proper geographic tags

- SeaSpace and GI both produce incorrect tags

- MSC Ingester does not use conventional tags

- Based on knowledge gained investigating CSPP, it is now possible to correct SeaSpace and GI tags.
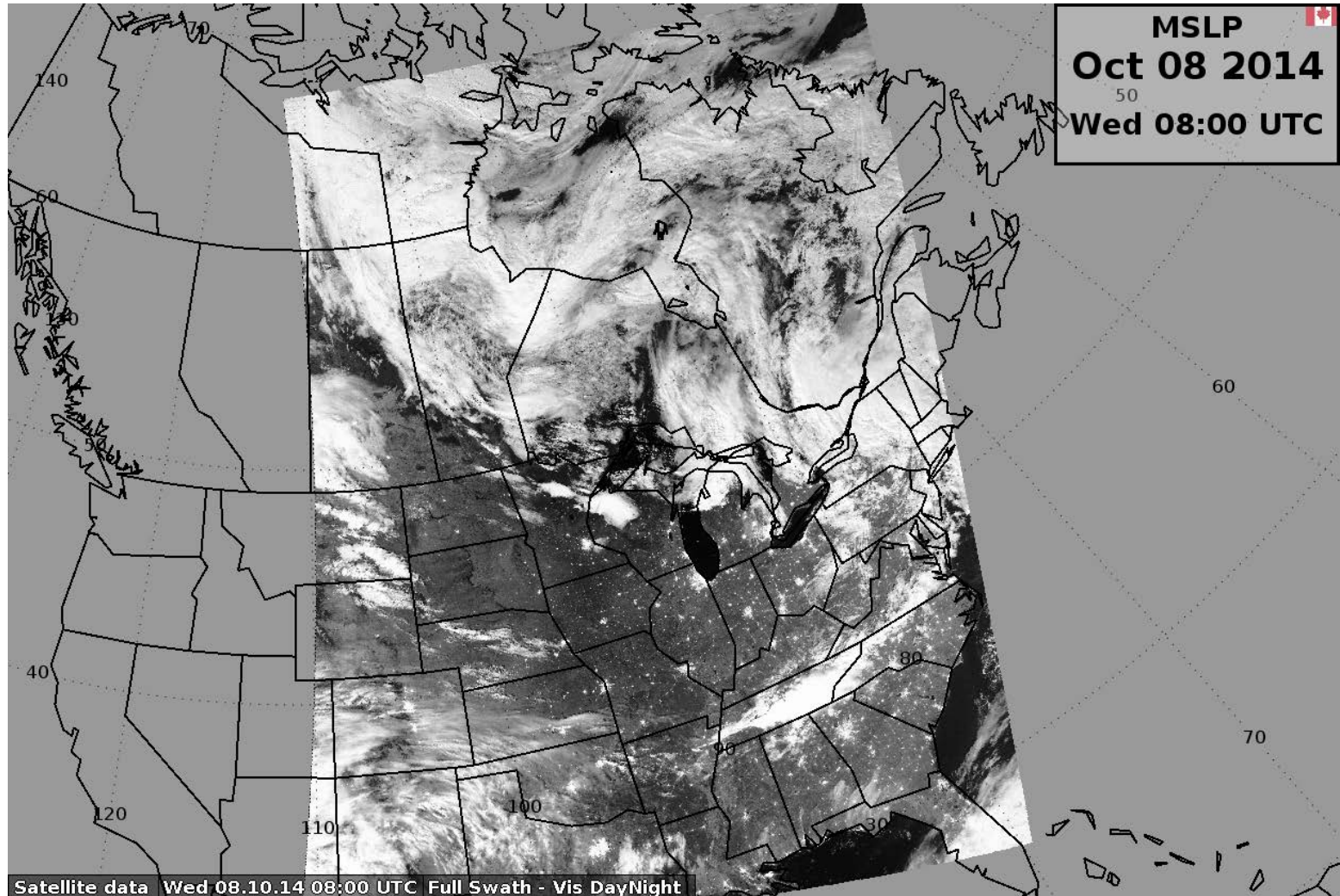

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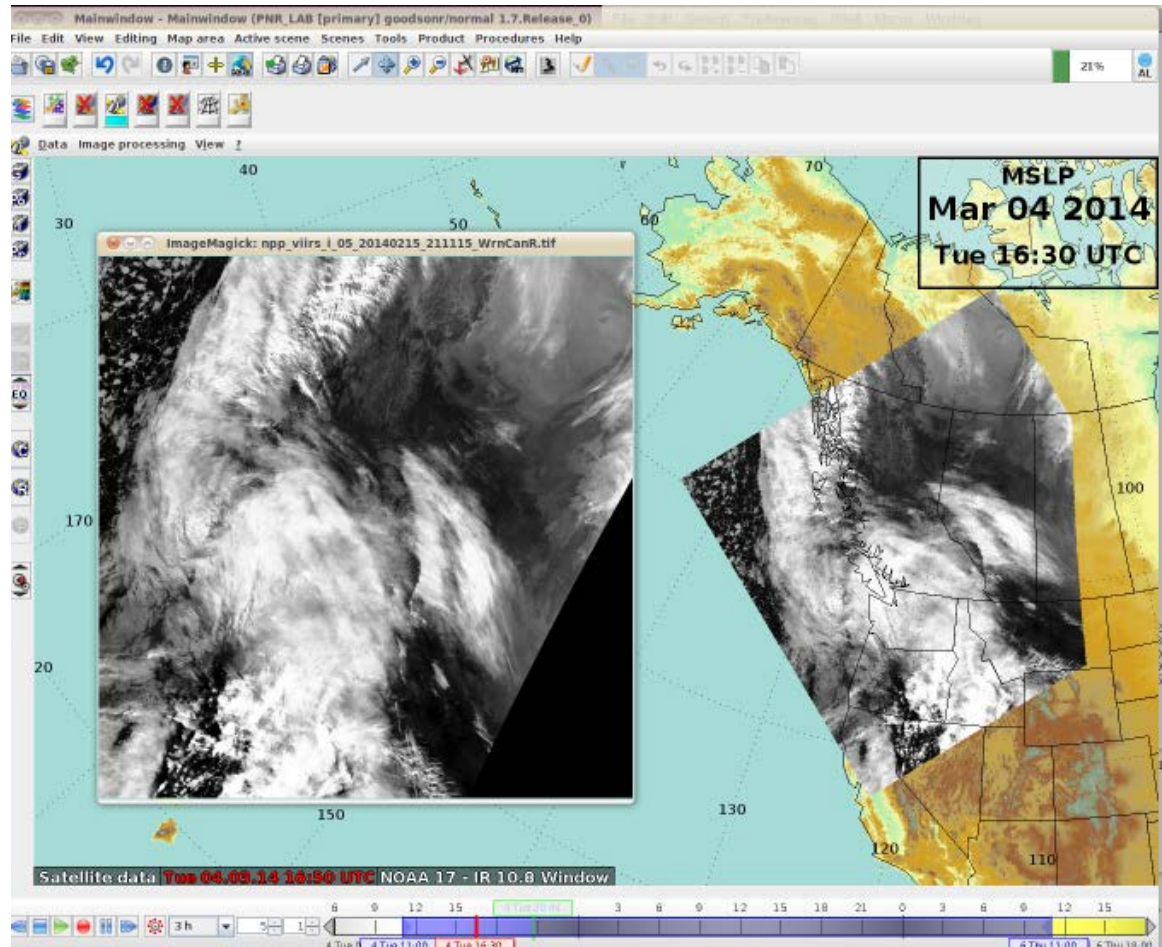
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CSPP TrueColor RGB

- Contains sophisticated corrections to reflectance

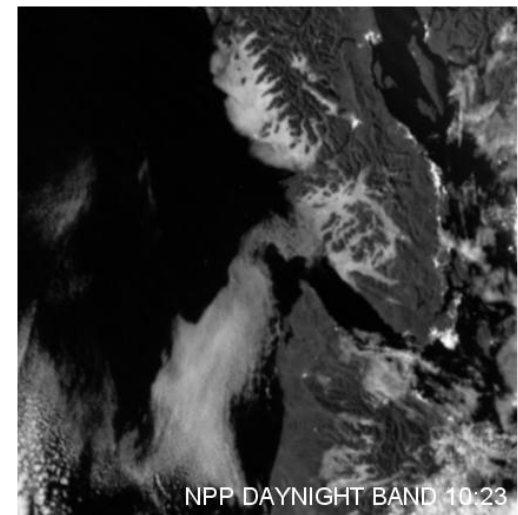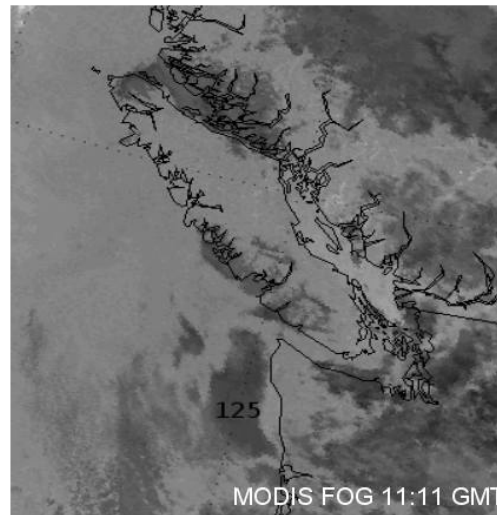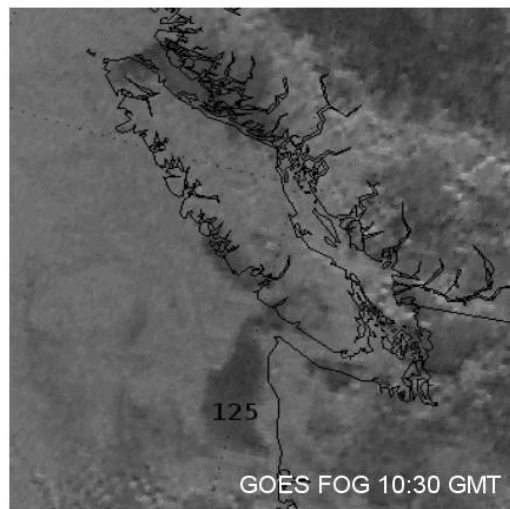- Much better output than simple channel combination in Ninjo

Jun 17 2014
Tue 21:28 UTC

Satellite data Tue 17.06.14 21:27 UTC NOAA 14 - Test1

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VIIRS Day Night Band in Ninjo

Stratus / Fog Case Study

GOES IR 10:30 GMT

SEPT 09 2014

MODIS IR 11:11 GMT

NPP DAYNIGHT BAND 10:23

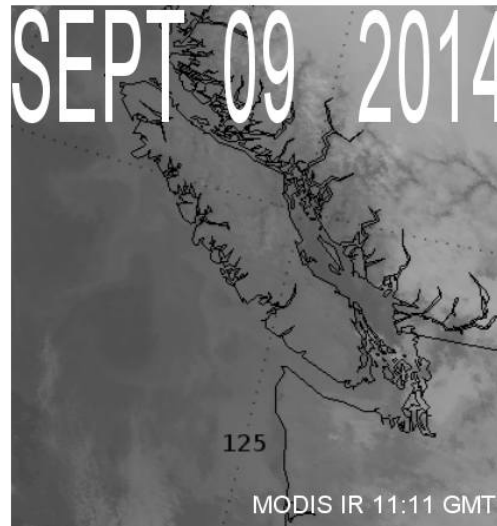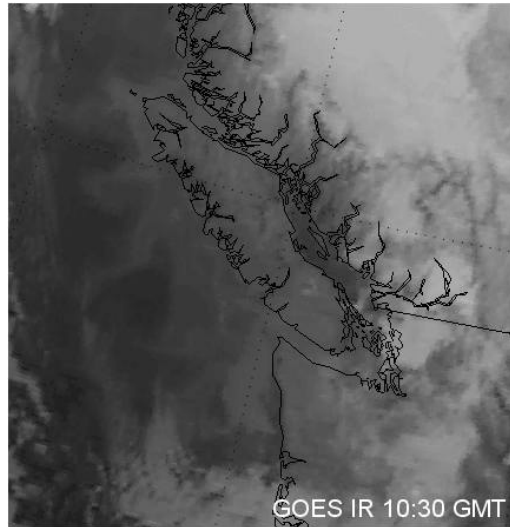GOES FOG 10:30 GMT

MODIS FOG 11:11 GMT

NPP DAYNIGHT BAND 10:23

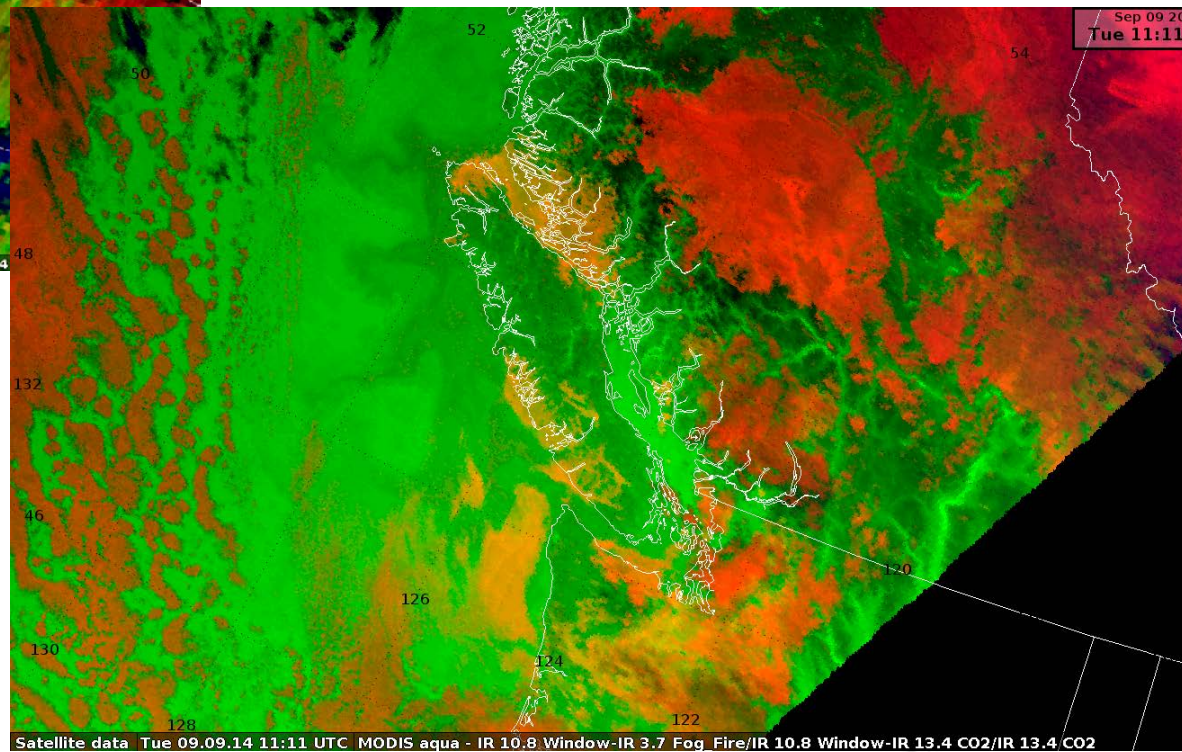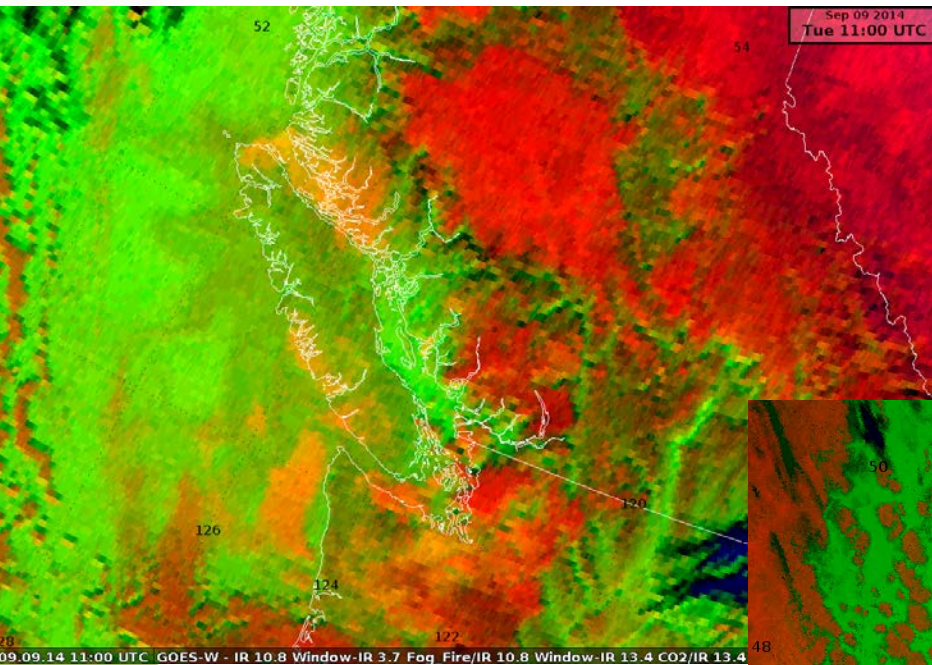Environment Canada   Environnement Canada

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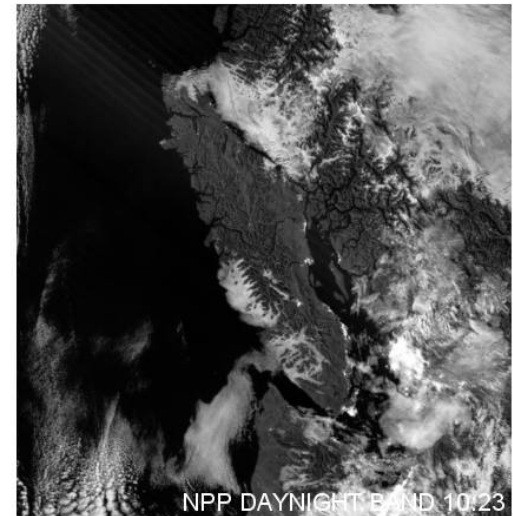
Stratus / Fog Case Study (con't)

Sounder Products
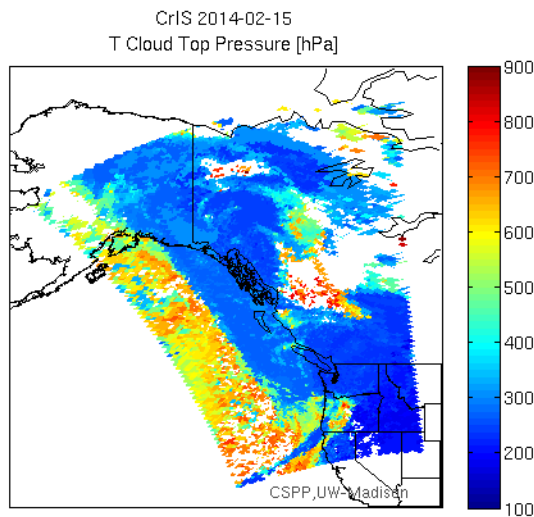
- Image or derived products available
  - Low resolution water vapour channels (imagery)
  - Precipitable Water
  - Cloud Top Pressure
  - Stability Indicies
  - Many, many more

- Have tested creating EDRs (HDF files) and viewing using CSPP tools

- Have tested creating graphical output as GeoTiff (using GDAL) and importing to NinJo

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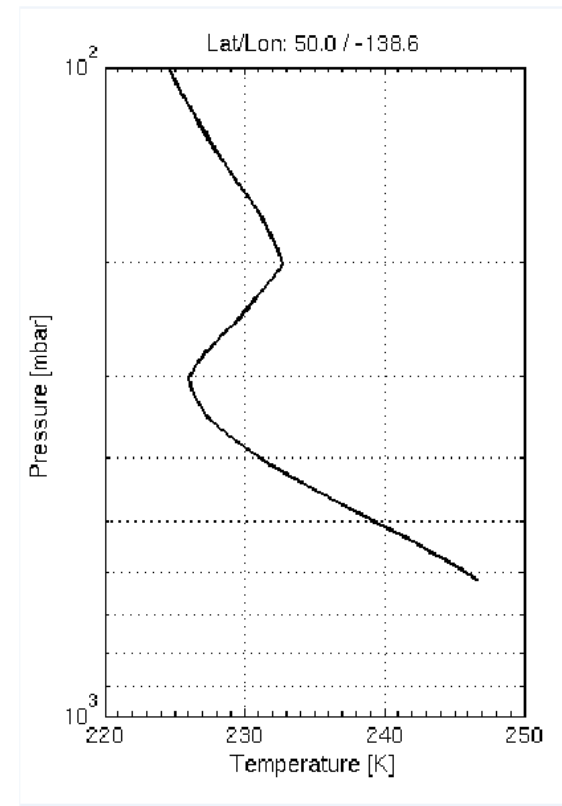# Sounder Products

- **Locally-received Data Processed Using CSPP tools**
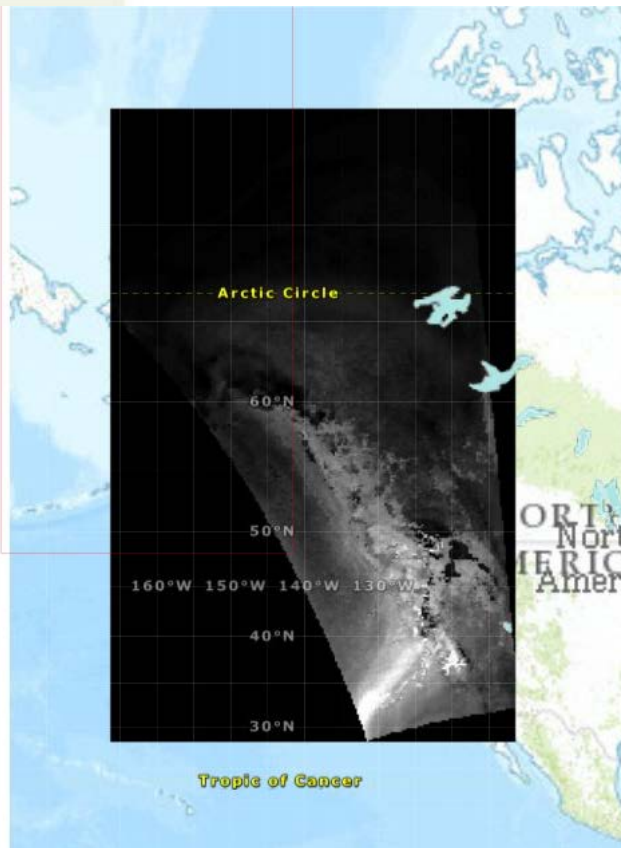
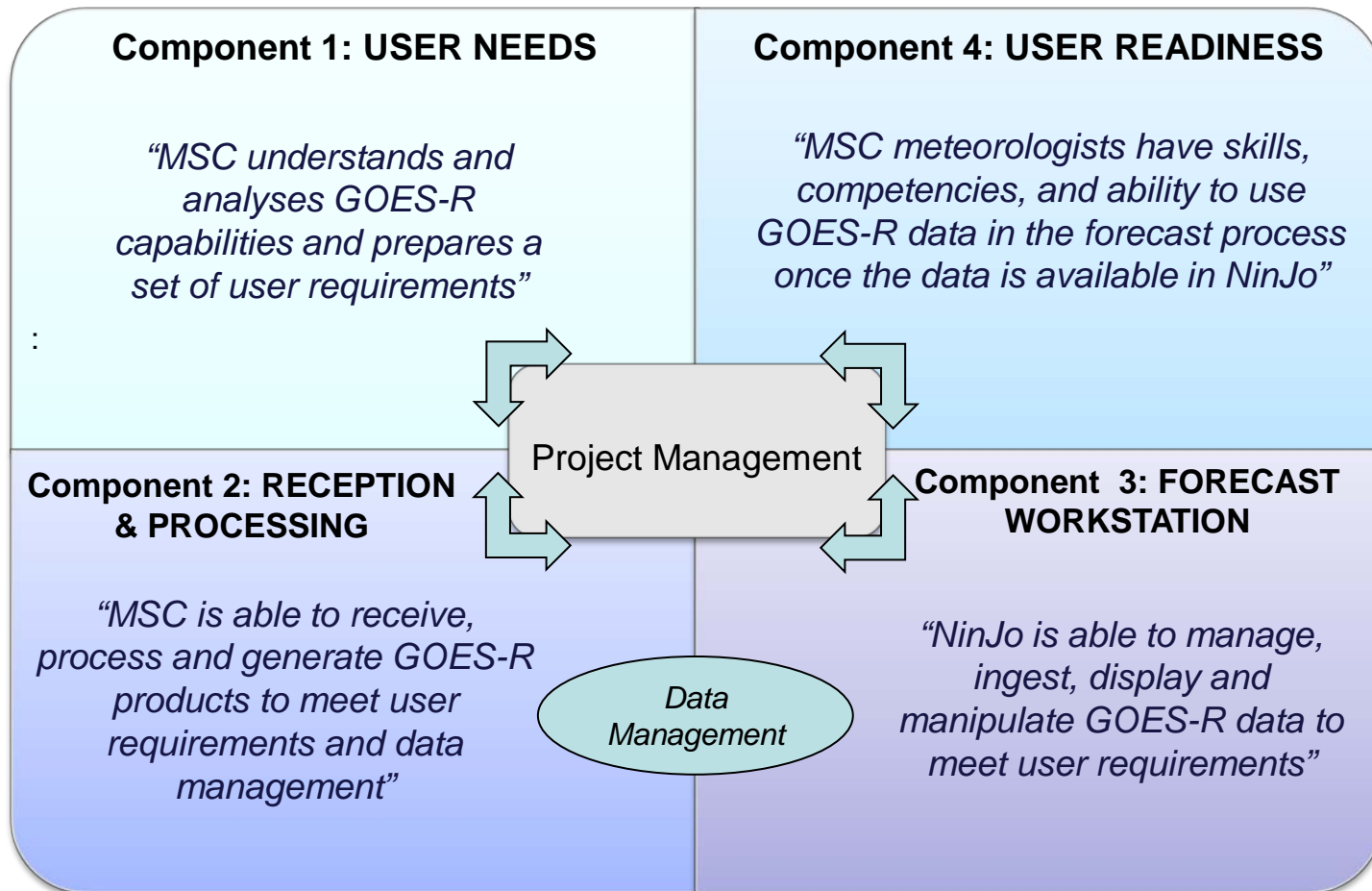TPW from ATMS exported as GeoTiff file using GDAL and viewed in ArcGIS Desktop Explorer
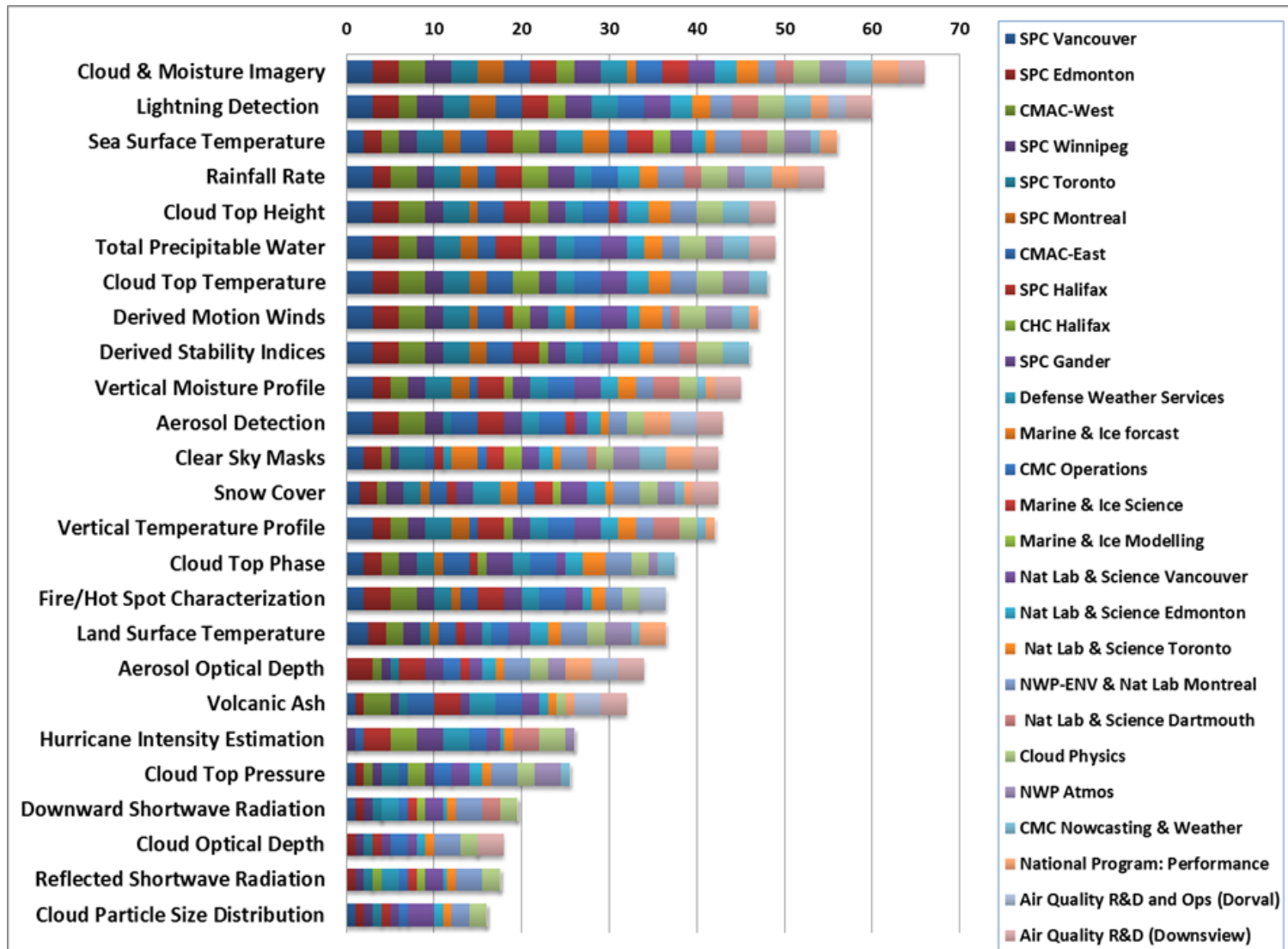

Cloud Top Pressure from CrIS

Temperature sounding from CrIS

Products created as "proof – of – concept"

Preparing for GOES-R

Component 1: USER NEEDS

"MSC understands and analyses GOES-R capabilities and prepares a set of user requirements"

:

Component 4: USER READINESS

"MSC meteorologists have skills, competencies, and ability to use GOES-R data in the forecast process once the data is available in NinJo"

Project Management

Component 2: RECEPTION & PROCESSING

"MSC is able to receive, process and generate GOES-R products to meet user requirements and data management"

Data Management

Component 3: FORECAST WORKSTATION

"NinJo is able to manage, ingest, display and manipulate GOES-R data to meet user requirements"
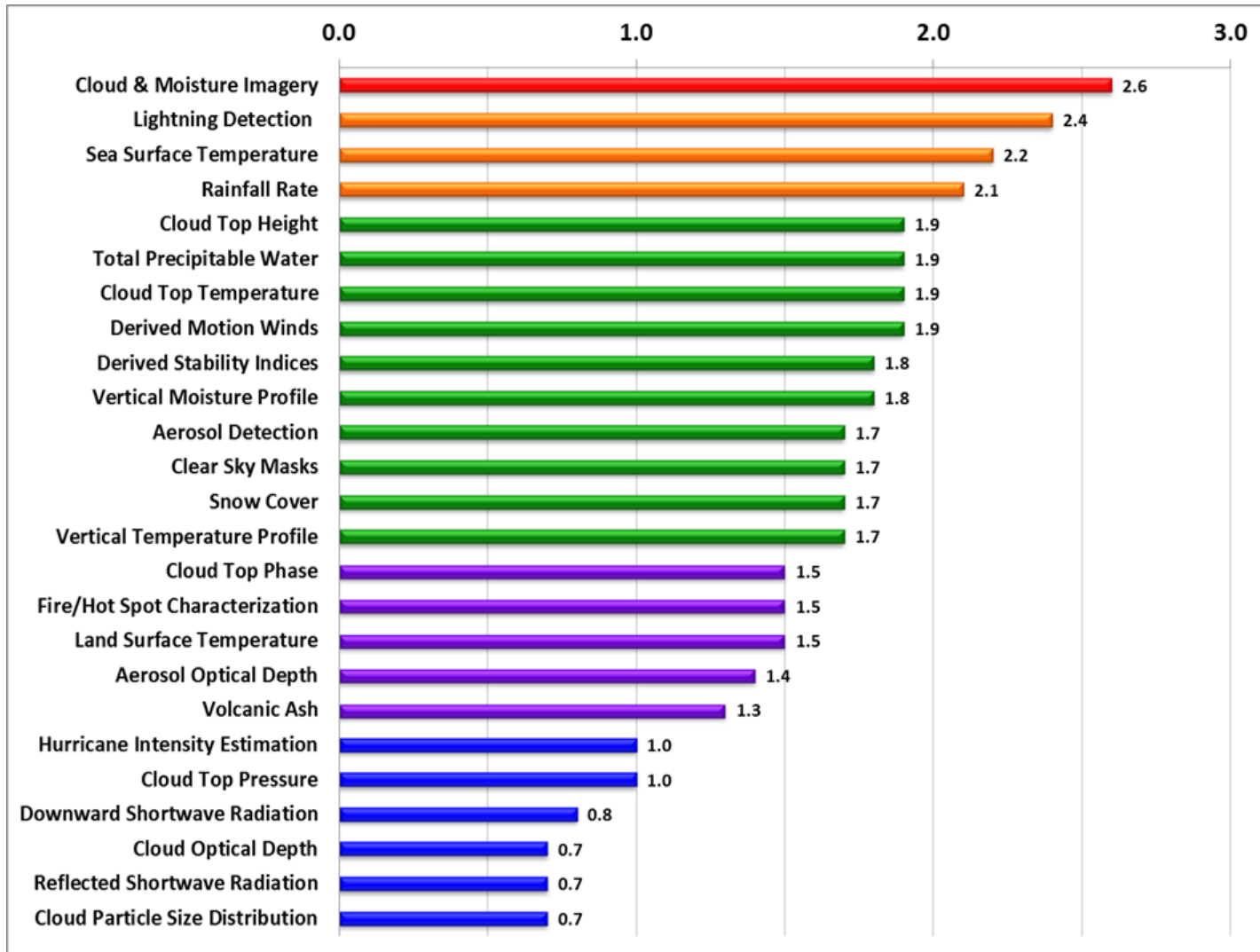
EC GOES-R User Requirements

EC GOES-R User Requirements

Summary

- Direct Readout infrastructure is stable, lots of data
- Working on data processing with goal of improved architecture to deliver better suite of products for Ninjo
  - Evaluating existing software, tools
  - Addressing challenges related to formats, standards (for both inputs and outputs)
  - Generating new evaluation products
- Preparing for GOES-R
  - Evaluating CSPP GOES-GRB software
- Thanks for support, quick responses, feedback!

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