

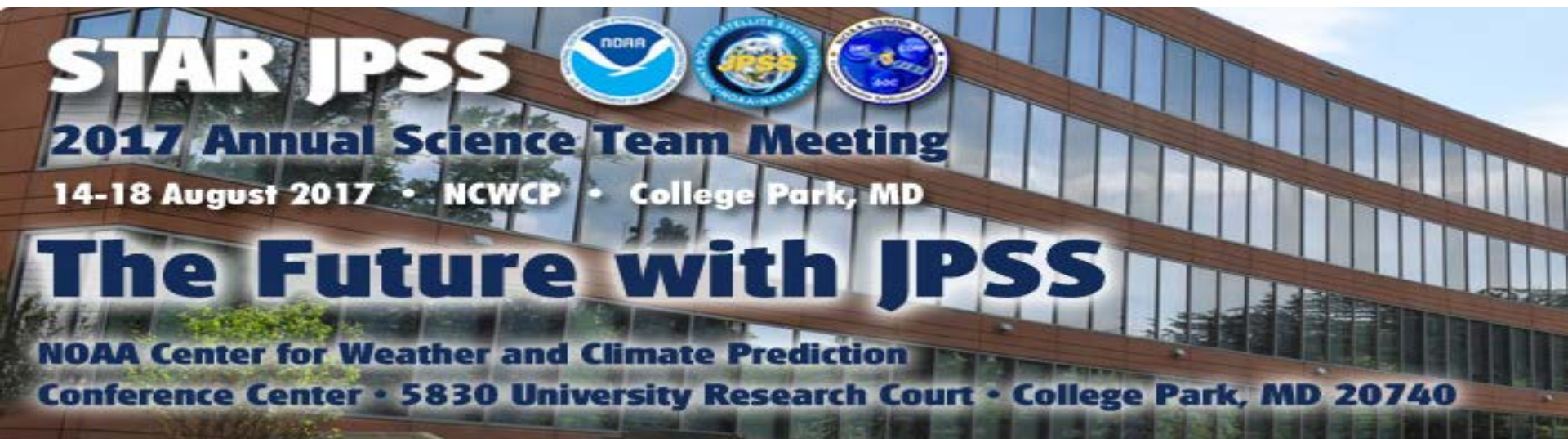


# NOAA's Joint Polar Satellite System's Proving Ground and Risk Reduction Initiatives

## NUCAPS Initiative

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16 Aug 2017



# JPSS PGRR Background Definitions



- **Proving Ground**

- Demonstration and utilization of data products by the end-user operational unit, such as a NWS Weather Forecast Office or Modeling Center.
- Promote outreach and coordination of new products with the end users, incorporating their feedback for product improvements

- **Risk Reduction**

- Development of new research and applications to maximize the benefits of JPSS satellite data
  - Example - use of Day Night Band for improved fog and low visibility products at night, benefiting transportation industry.
- Encourages fusion of data/information from multiple satellite, models and in-situ data
- Primary work is done at the algorithm and application developer's institution.
- Address potential risk in algorithms and data products by testing alternative algorithms.

# JPSS PGRR Background



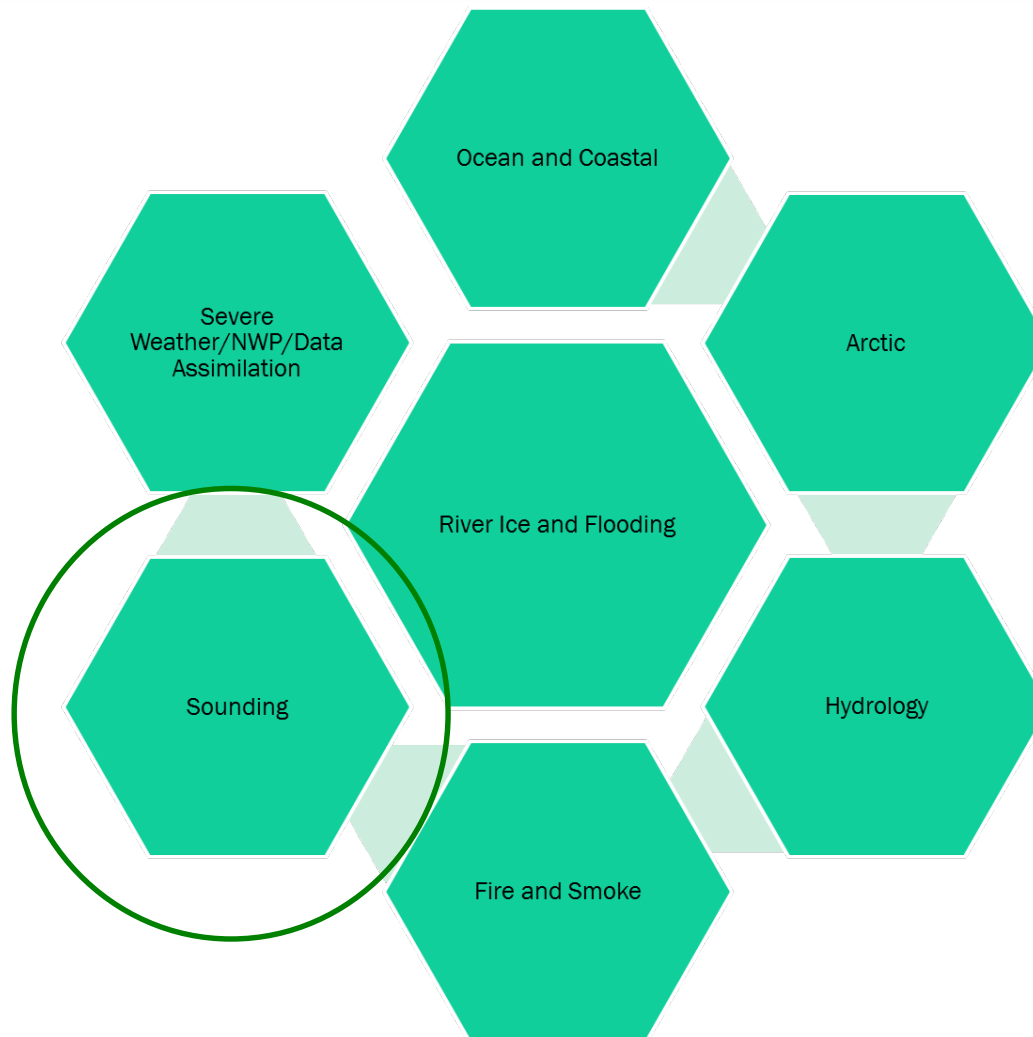
- The PGRR Program was established in early 2012, following the launch of the Suomi National Polar Partnership (SNPP) satellite on 28 Oct 2011
- Call-for-Proposals (CFPs)
  - The initial CFP in Jan 2012 resulted in 100 teams providing Letters-of-Intent (LOIs) with nearly 40 projects selected for funding
  - A second PGRR Program CFP went out in Dec 2014. PGRR Initiatives were used as a focus for the responses to this CFP. Over 130 LOIs were received
  - A third CFP will be prepared during the Fall of 2017
- These proposals went through a rigorous user-led selection – between 40-50 projects selected for funding each time
- Project managers work with the users to determine how best to use new JPSS data, and to quickly transition these capabilities to operations.

# PGRR Proving Ground Initiatives Responding to User Feedback



- The River Ice and Flooding Initiative was the first attempt at this new partnership and it was established in response to Galena AK flooding in May 2013.
- The Initiative included River Ice and River Flooding Project teams, direct broadcast SMEs, and National Weather Service River Forecast Center forecasters.
- The success of River Ice and Flooding Initiative led to creation of other initiatives that guided the 2014 PGRR CFP.
- Initiatives have proven to be critical forums where JPSS personnel, product developers, and users interact. The effort is to evaluate current and future JPSS Capabilities in operational environments to determine which of these capabilities should be transitioned to operations.

# PGRR Proving Ground Initiatives Partial List



# PGRR Initiatives

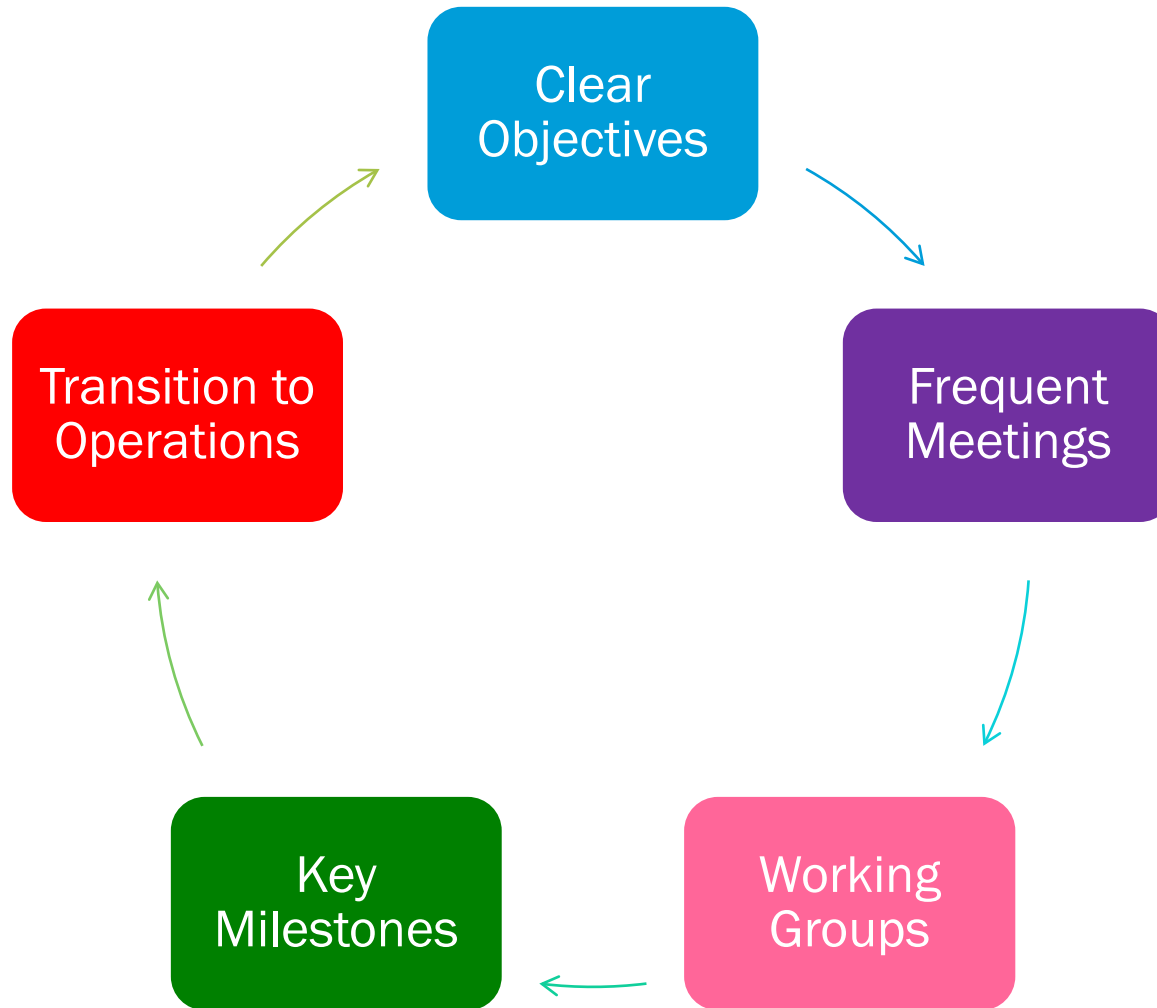


Initiative	Start Date
River Ice and Flooding	November 2013
Fire and Smoke	May 2014
Sounding Applications NOAA Unique CrIS/ATMS Processing System (NUCAPS)	July 2014
OCONUS and NCEP Service Centers AWIPS Initiative	June 2015
Hydrology	July 2015
Ocean and Coastal	March 2016
Severe Weather/NWP/Data Assimilation	March 2016
Arctic Initiative	June 2016

# PGRR Proving Ground Initiatives Partners



# PGRR Proving Ground Initiatives Best Practices





# NUCAPS Initiative Initial Objectives



- Organize a forum to allow stakeholder supporting NUCAPS development to interact with key users of the capabilities.
- Evaluate how NUCAPS soundings will look in AWIPS II and work to get field the correct visualization showing the soundings' Quality Control (G, Y, R).
- Discuss actions to prepare for a ops demo for Cold Air Aloft in AK during Winter 2014-2015
- Discuss actions needed to evaluate NUCAPS in HWT Spring Experiment 2015.
- Establish NUCAPS Training for WFO that currently have NUCAPS and have the training available for those WFOs upgrading to AWIPS II. Training would be a module in the Commerce Learning Center.
- Work to justify and then implement NUCAPS pre/post-processor for Metop-A/B AMSU/MHS/IASI. This allows NUCAPS products to be available at both 9:30 and 13:30 overpasses.
- As the Initiative Team met over the months and years, actions were taken to implement these objectives, and new objectives were identified and worked.

# Initiative Participants



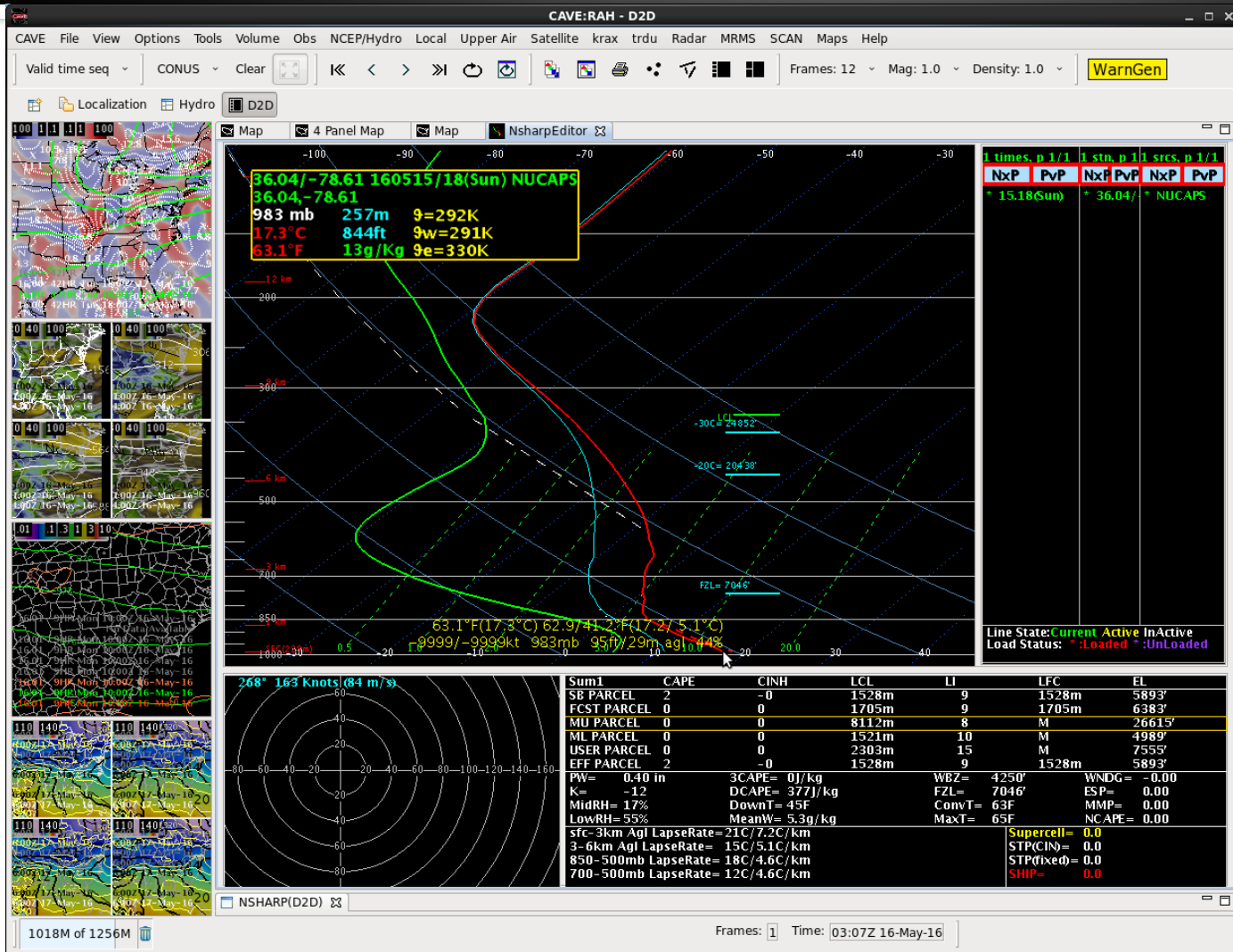
Name	Organization	Name	Organization
Chris Barnet	STC	AK Sharma	STAR
Emily Berndt	SPoRT	Bill Sjoberg	JPSS
Jack Dostalek	CIRA	Nadia Smith	CIMSS
Antonia Gambacorta	STAR	Eric Stevens	GINA
Chad Graville	NWS	Jorel Torres	JPSS Training Liaison
Brian Motta	NWS	Elisabeth Weisz	CCMIS
Nick Nalli	STAR	Ashley Wheeler	STC
Kim Rink	NWS	Brad Zavodsky	SPoRT



# Initiative Activities

- NUCAPS Soundings only available in AWIPS II Weather Forecast Offices – had to provide instructions on how to install
- NUCAPS Training was not widely available
- NUCAPS Quality Flags
- Cold Air Aloft in AK – when air is colder than -65F jet fuel begins to jell.
- Evaluated NUCAPS in three consecutive Spring Experiments at the Hazardous Weather Testbed in Norman OK (is NUCAPS available, does it look right.....)
- Operational testing of NUCAPS in convective environments in CONUS and Alaska in various environments
- Worked to create an IASI NUCAPS Products to take advantage of MetOp early morning orbits.
- Provided NUCAPS soundings for aircraft operations in several CalWater Experiments.
- Evaluated use of NUCAPS during Pineapple Express Atmospheric Event.
- Participated in El Nino Rapid Response Field Campaign.
- Used NUCAPS to study extratropical transition of tropical cyclones and hurricanes.
- NUCAPS provide stability info for IMETs on the fire line in convective environments
- AND MORE.....

# NUCAPS in AWIPS – Skew Ts

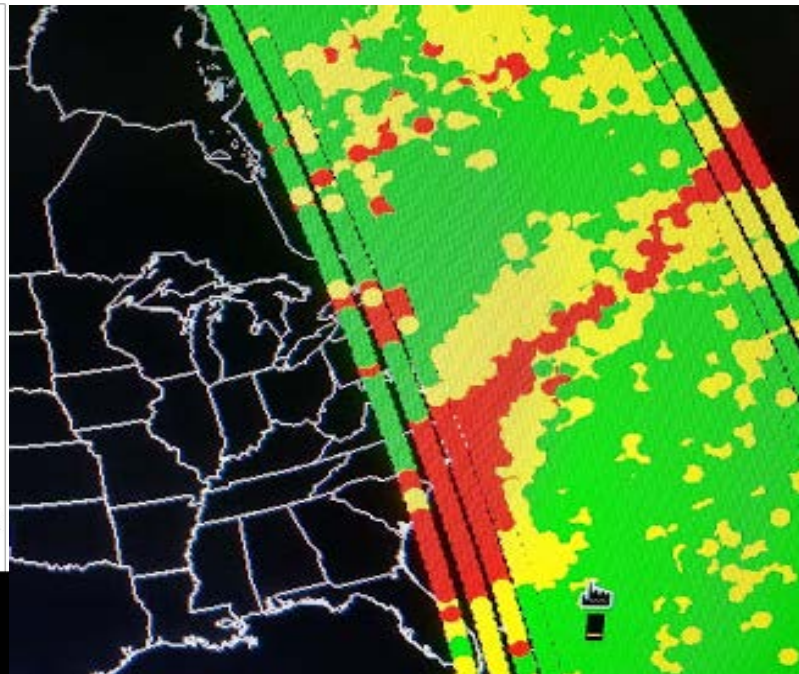
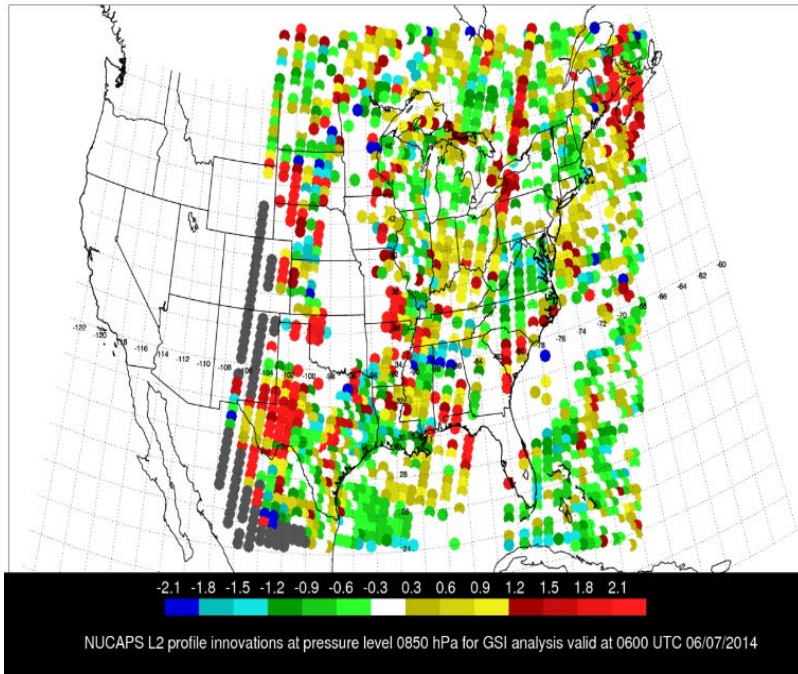


High vertical information content

Allows comparison to Radiosondes and Model soundings

But...  
 - Which dot to click on?  
 - NOT visible in Volume Browser

# Quality Flags (QFs)



**Red means the MW retrieval failed (by default that also means the IR failed)**

Yellow mean the MW retrieval passed but the IR retrieval failed (IR not used, microwave only)

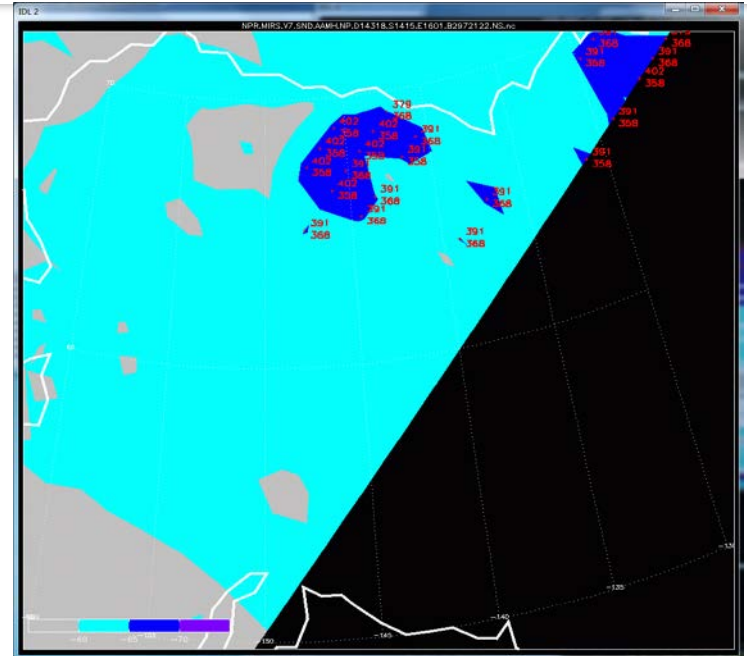
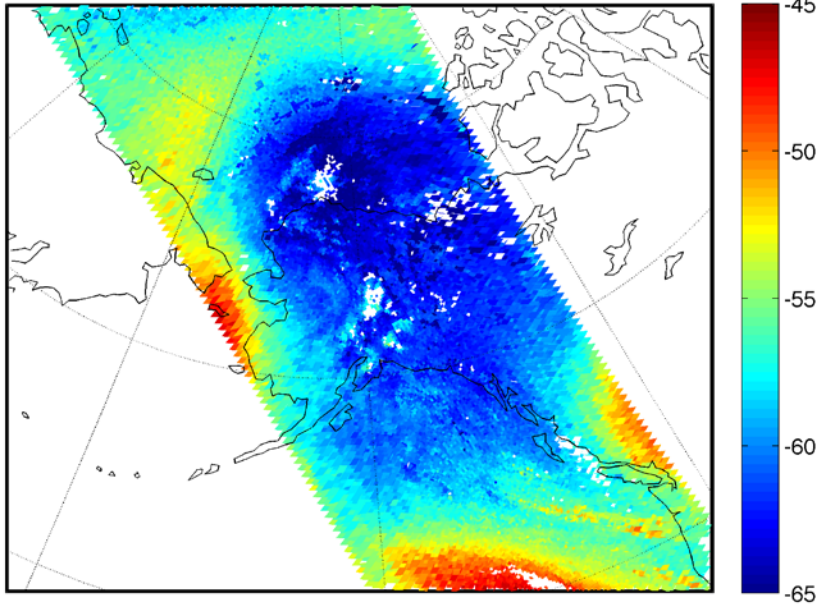
**Green means the IR retrieval passed (its actually an IR+MW retrieval, the point being the IR was used)**

- Original NUCAPS deployment did not have QFs
- Once QFs were ready they had to wait for a AWIPS II Build to be available to the forecasters
- Had to provide forecasters description of QFs

# Cold Air Aloft Visualization



CrIS 2014-11-12 215521-221121  
Temperature [°C] at 201.0 hPa



- Different visualizations were presented and discussed with the Anchorage Center Weather Service Unit (located in the FAA Air Route Traffic Control Center)
- Based on her feedback and the product that her group is responsible for delivering, single-swath, plan view images with identified flight levels (bottom and top) of the -65C air are optimal
- Forecasters can use the location of coldest air obtained from plan view data to further investigate NUCAPS soundings already in AWIPS II in more detail

# 2016 Spring Experiment at HWT Forecaster Feedback



“[Today, we use NUCAPS for] tracking trends in mid/upper level drying.” *Forecaster, End-of-Day Survey*

“I used them to see how the 0C and -20C levels were changing over the afternoon (they decreased in height a few thousand feet each). This was key for warning operations.” *Forecaster, End-of-Day Survey*

“[We used NUCAPS] to look at instability in a fairly data sparse region in the Pueblo CWA.”  
*Forecaster, End-of-Day Survey*

“IASI soundings were able to confirm the very low levels of CAPE values that RAP and GFS analysis are showing.” *Forecaster, “Mesoscale setup for Pueblo 5/11/16”, GOES-R HWT Blog*

“I used [NUCAPS] to look at how instability was evolving during the day. We had an 18Z OUN supplemental sounding, with a 20Z NUCAPS sounding showing how much instability had increased a couple of hours later.” *Forecaster, End-of-Day Survey*

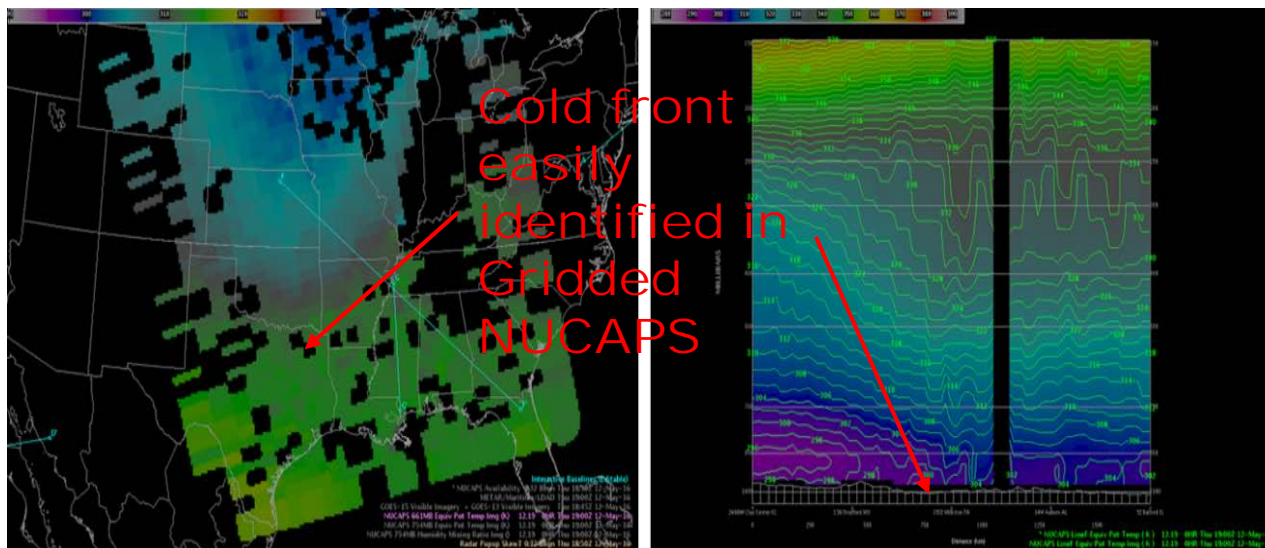
# Spring Experiment More Feedback



“We also used a cross-sectional view of Theta-E in the afternoon to determine the location of our cold front (Fig. 17).” *Forecaster, End-of-Day Survey*

“The plan view fields were more helpful than the actual soundings. I enjoyed looking at the mixing ratio field for this product and can see the utility of having plan view and cross sections available for NUCAPS fields such as LR, CAPE, RH, Dewpoints, etc.” *Forecaster, End-of-Day Survey*

“I would like to say that having the IASI soundings was very helpful and getting them 4 times per day would be great. This could also help with your buy in because getting data in between the synoptic times is always helpful.” *Forecaster, End-of-Week Survey*





# Spring Experiment

## Suggested Improvement Feedback

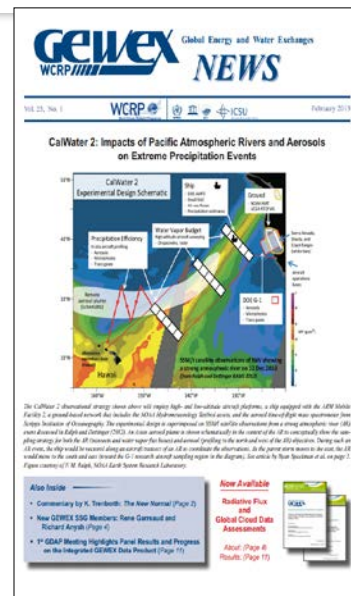
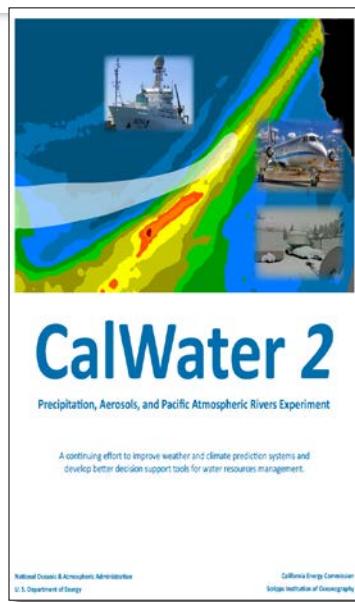


“With some improvement to the lower levels, this could be a very useful operational tool to check against model derived fields and the current state of the atmosphere. After careful thought, as a forecaster I would like to keep all data coming from NUCAPS observational, even if this means that the quality of the data is a bit suspect at times. By introducing model data to the process you could make it look better but you are introducing a second possible source of error into the product.” *Forecaster, End-of-Day Survey*

“The smoothed nature of the soundings limits the potential usefulness of the soundings. The inability to see capping inversions and saturated layers is a real drawback.” *Forecaster, End-of-Week Survey*

“Automated modification in the 850-500 hPa layer is important as this is the portion of the sounding where the CAP is most prevalent.” *Forecaster, End-of-Week Survey*

# The CalWater 2 Field Campaign



- CalWater 2 is a 5-year broad interagency vision to address key water cycle science gaps along the US West Coast

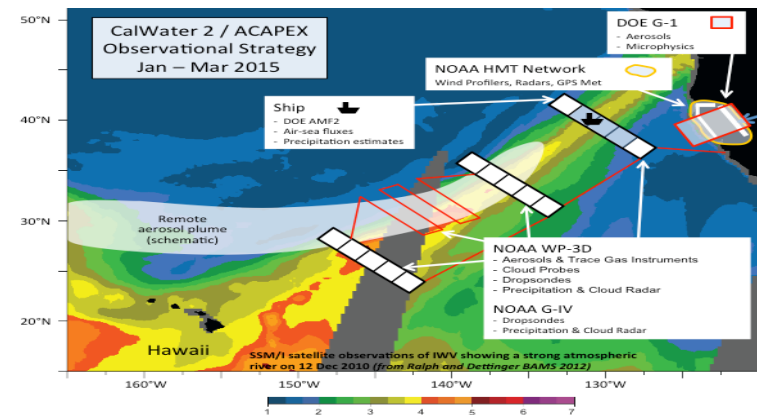
**Objective:** to examine the development and structure of ARs before landfall to improve forecasts of extreme precipitation events along the US West Coast

An opportunity for us to (1) evaluate NUCAPS moisture products in extreme environments; (2) to train and develop new user applications.

# CalWater 2/ACAPEX Field Campaign



- Interagency Campaign:
  - Scripps (Marty Ralph, Kim Prather)
  - NOAA (Allen White, Ryan Spackman)
  - DOE (PI: L. Ruby Leung) ACAPEX = ARM Cloud Aerosol Precipitation Experiment
- White paper at <http://esrl.noaa.gov/psd/calwater>



Platform	Range of Obs	Duration	Types of sensors
AR Observatories and Hydro-Met Testbed	ARO sites: CA(4), OR(2), WA(1)	Full campaign	Snow level radar (S-band), 449 MHz wind profilers, soil moisture, 10 meter surface tower
NOAA WP-3D	1-22 kft, 4000 km range	80h over 4 weeks	~150 droppsondes, W-band radar (clouds), IWRAP Radar, Tail Doppler Radar, Cloud Probes, SFMR
NOAA G-IV	1-45 kft	90h over 6 weeks	~300 droppsondes, Tail Doppler Radar, NOAA O3, SFMR
DOE G-1 with ~40 instruments	1-23 kft	120h over 8 weeks	Cloud properties (Liq/water content, size), aerosol properties (concentration, size, CCN), trace gases (H2O, O3, CO)
NOAA R.H. Brown	Can move $\leq 5$ deg/day to stay within AR	30 days	AMF2: Aerosol Observing System, Ka, X, W-Band Cloud Radars, DOE, Micropulse LIDAR, Wind Speed, Rain Guages RS-92 Sondes: ~260 (~half dedicated overpass time)

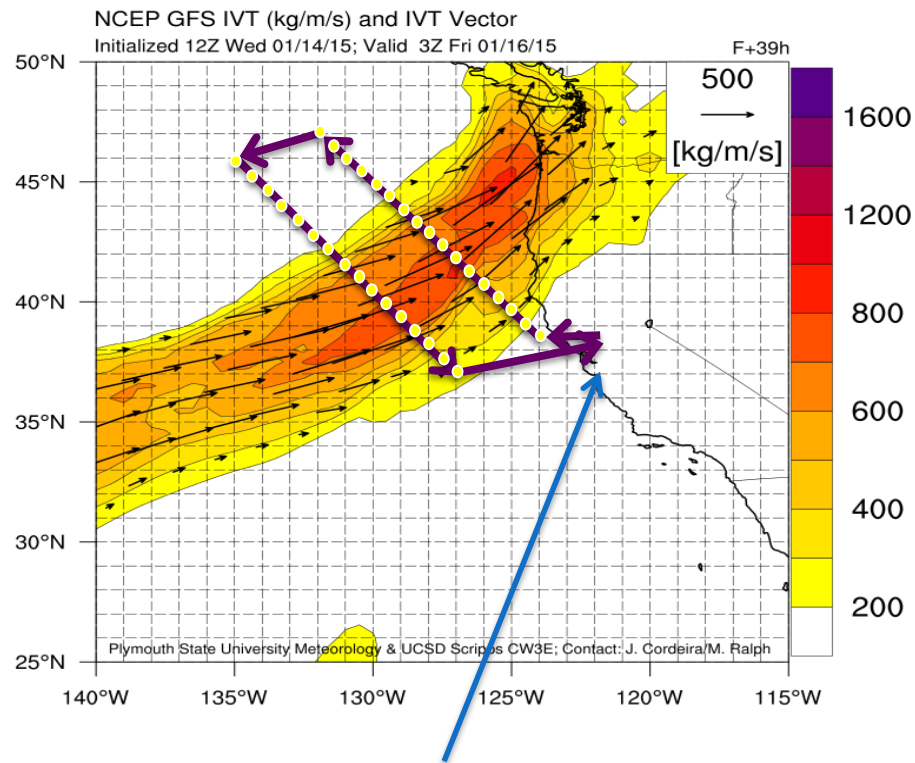
# Example of Jan. 15, 2015 flight planning: Integrated Vapor Transport (IVT) forecast



Vertical structure of water vapor in ARs is crucial to forecast integrated vapor transport correctly

The 2014 CalWater campaign suggested NUCAPS retrievals from CrIS and ATMS could improve land falling forecasts

In CalWater 2015 we demonstrated the capability to provide real time direct broadcast NUCAPS retrievals to a field campaign.

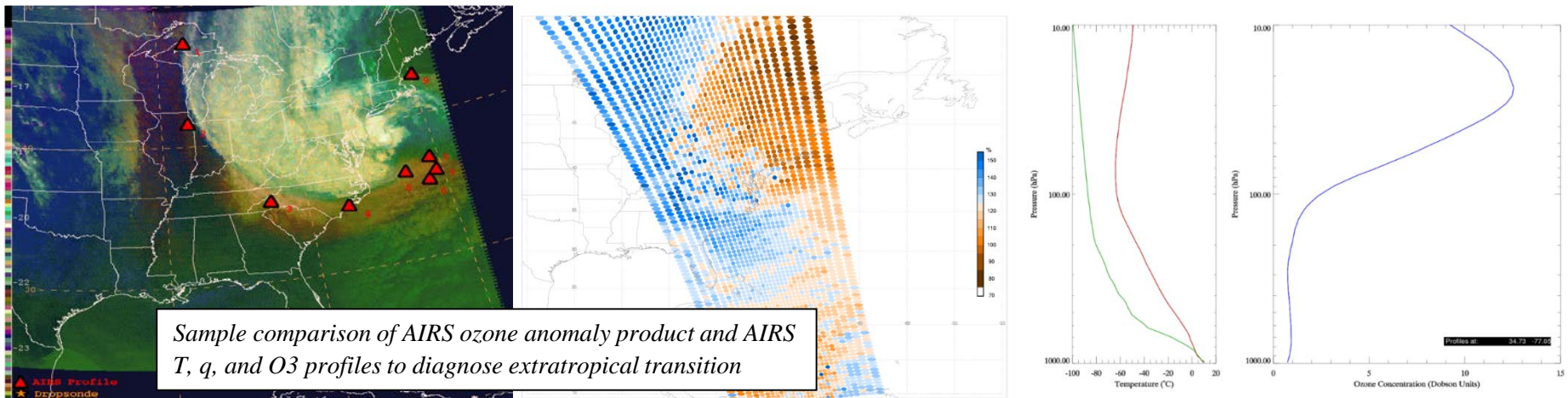


NOAA G-IV aircraft flight track  
Take off time: 2100UT on 2015-01-15;  
Landing time: ~0300UT on 2015-01-16  
(flight duration ~ 6 hours)

# Extratropical Transition Project



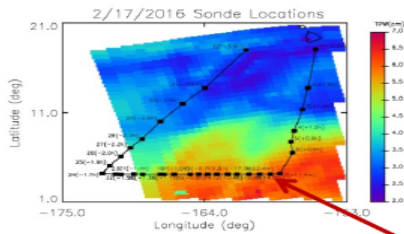
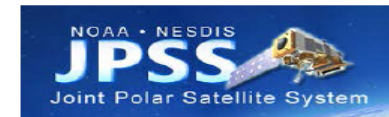
- Investigate utility of NUCAPS T, q, and O3 profiles to diagnose hurricane extra-tropical transition
- Since ET events often occur over data sparse regions, satellite retrievals would provide a wealth of data where ground based observations are lacking
- NUCAPS soundings are already in AWIPS-II and available to forecasters, this project would provide feedback to JPSS management, NUCAPS product developers, NOAA training developers, satellite liaisons, and forecasters on the benefit S-NPP/JPSS data can provide for forecasting unique events.



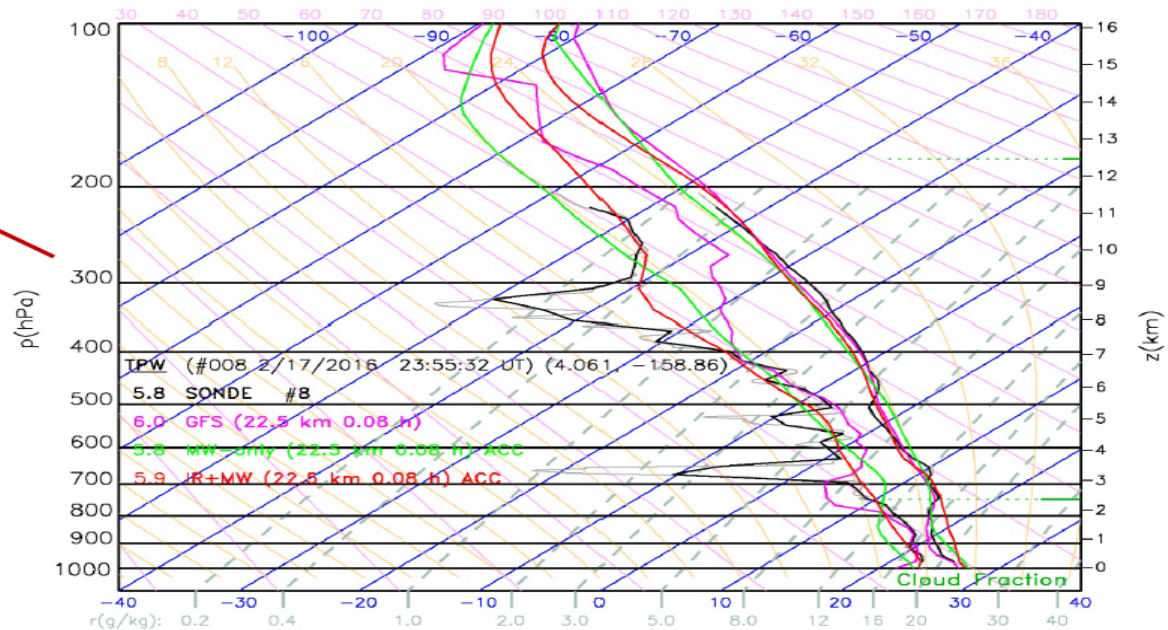
# El Nino Rapid Response Field Campaign - 2016



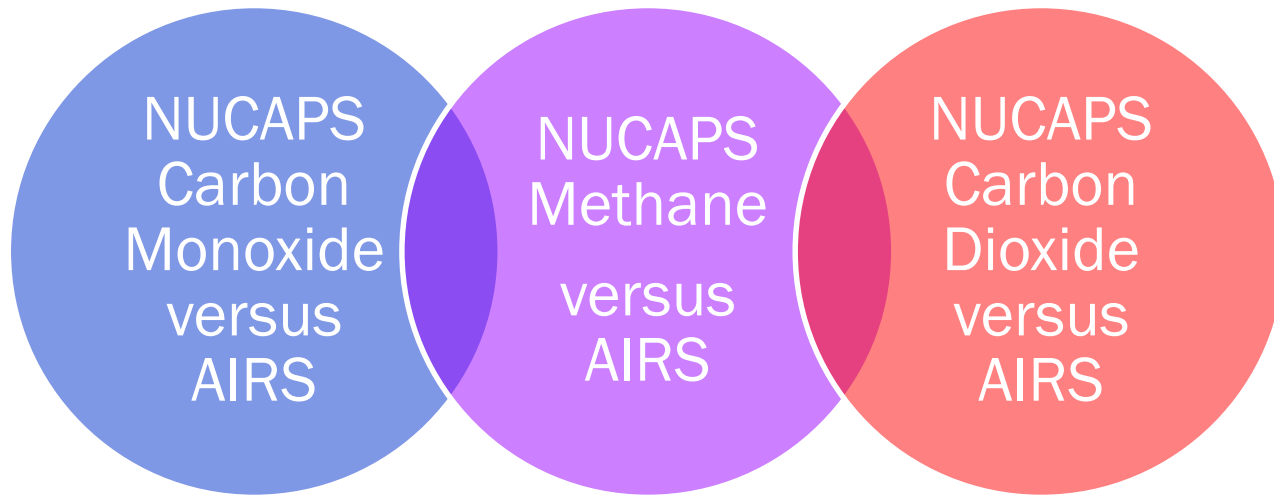
Feb. 17, Sonde #8: near overpass time



NUCAPS is capturing large scale vertical structures



# NUCAPS CrIS Full-Resolution Carbon Trace Gas Validation



## Other Variables

- CrIS Full Resolution Baseline
- CrIS Full Resolution IR +MW
- AIRS v6 Baseline

# Way Forward



- Format and tailor NUCAPS Training for NWS Foundational Course
- Evaluate Results from Spring Experiment 2017 to determine additional changes for SE 2018
- Prepare for NUCAPS evaluation in NWS Operational Proving Ground in 2018 – evaluate NUCAPS in winter environments.
- Work with AWIPS II Developers to include IASI NUCAPS and NUCAPS horizontal cross sections
- Respond to new ideas from the field





# Summary

- The Initiative Process is a journey not a destination.
- A fully engaged Initiative Team is key to success.... New ideas can spring from anywhere.
- Initial success builds momentum to long-term effectiveness
- If the right people aren't engaged....find them and invite them to participate!
- A little organization goes a long way. Meeting note, action items, and standardized agendas have been successful.
- Do initiatives ever end? Don't know yet...there always seems to be a lot more work to do!