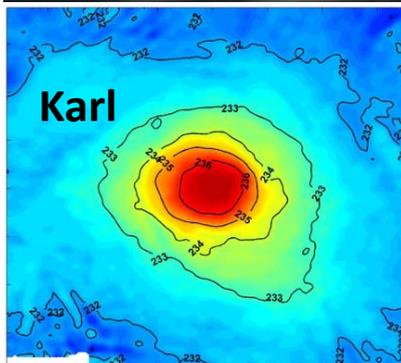
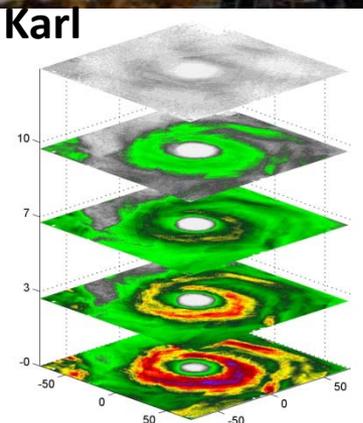


Performance of HAMS during GRIP

Shannon Brown, Bjorn Lambrigtsen, Richard Denning, Boon Lim, Jordan Tanabe, Alan Tanner

Jet Propulsion Laboratory, California Institute of Technology
Shannon.T.Brown@jpl.nasa.gov

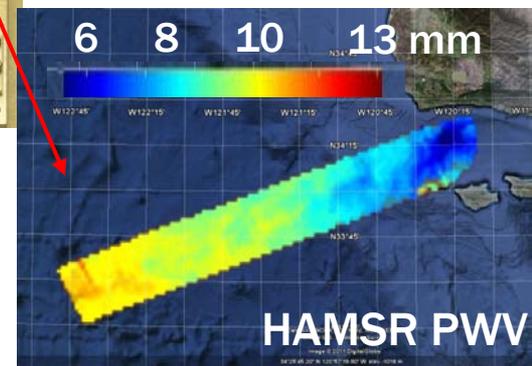
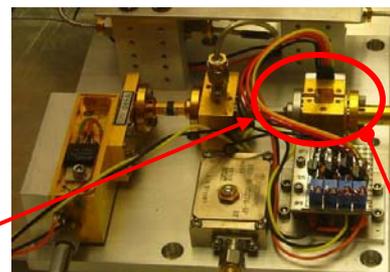
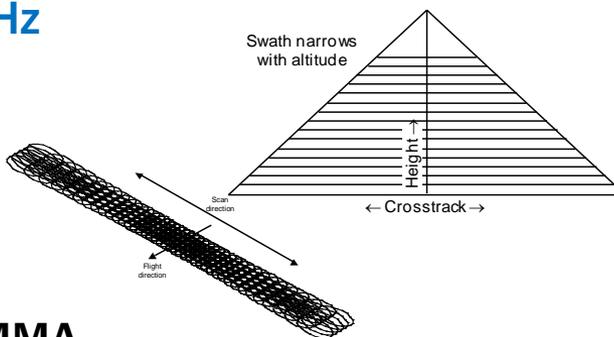




JPL High Altitude MMIC Sounding Radiometer (HAMSR)



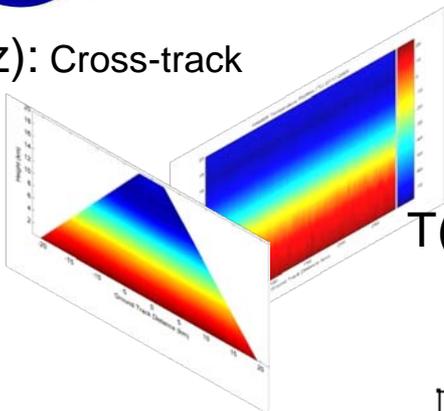
- JPL High Altitude MMIC Sounding Radiometer (HAMSR)
 - Microwave radiometer for 3-D all-weather temperature and water vapor sounding, similar to AMSU on NOAA platform
 - 25 sounding channels in three bands:
50-60 GHz, 118 GHz, 183 GHz
- Cross track scanning
 - $\pm 60^\circ$ off nadir
 - 65 km swath
 - 1.9 km resolution
- Flew in CAMEX-4, TCSP and NAMMA
- Upgraded for Global Hawk operations under NASA AITT
 - New state of the art receiver technology (developed under ESTO/ACT)
 - Upgraded data system for real time communication
 - Compact instrument packaging





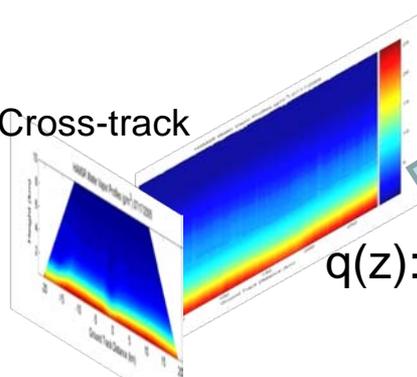
HAMSAR Measurements

T(z): Cross-track



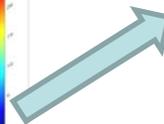
T(z): Along-track

q(z): Cross-track



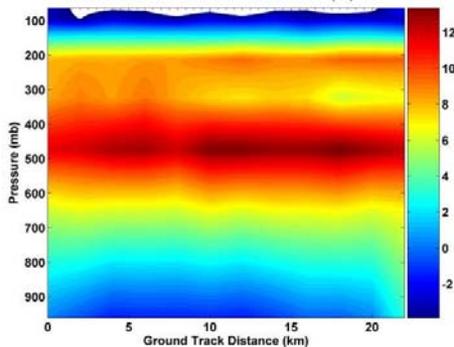
q(z): Along-track

Flight path

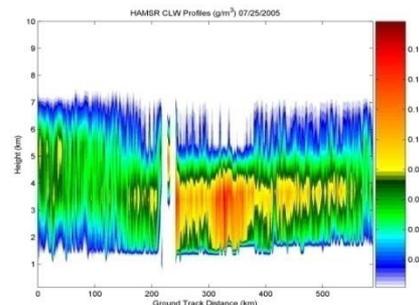


HAMSAR derived warm-core in Hurricane Erin

HAMSAR Observation of Hurricane Erin Warm Core (°C) 09/10/2001

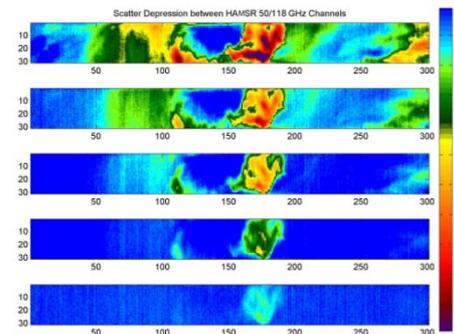
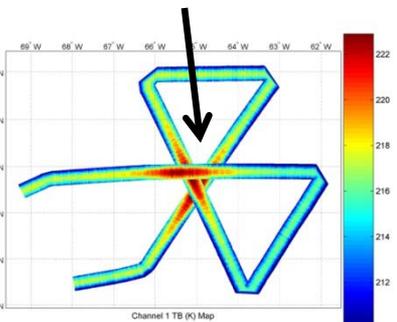


GRIP needs	HAMSAR contributions
Cloud cover and height	Vertical CLW(z) profiles
Temperature soundings	Vertical T(z) profiles (clear, cloudy, moderate rain)
Humidity soundings	Vertical q(z) profiles (clear, cloudy, moderate rain)
Rainfall intensity and structure	3-D precipitation structure and intensity
Ice scattering, convective structure	Scattering and reflectivity as a function of altitude



CLW(z):
Along-track

Precipitation
Structure/Imagery

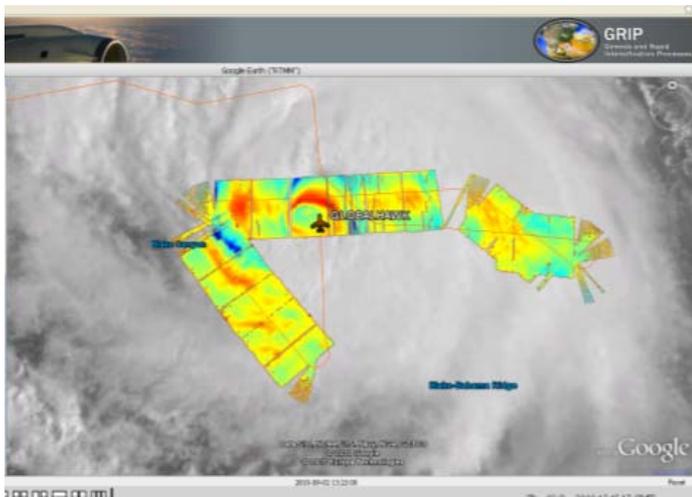




Instrument Status During GRIP



- Instrument performed exceptionally well, with only one channel not available for about 9 hours on 9/23
 - Only minor engineering tweaks needed after the first flight
 - After second flight, HAMS R remained on the plane for the rest of the campaign
- Swath TB imagery displayed in real time through RTMM from the first flight
 - Useful for storm center positioning and flight track planning



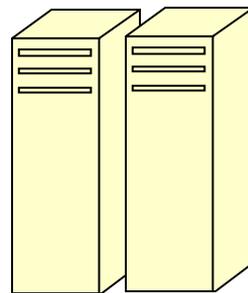
Flight Date	Duration [hrs]	HAMS R status
8/28	15	100%
9/1	25	100%
9/12	24	100%
9/16	25	100%
9/23	26	166 GHz channel not available for first~9 hrs



HAMSr GRIP Ground Data System



Commanding
Data downlink

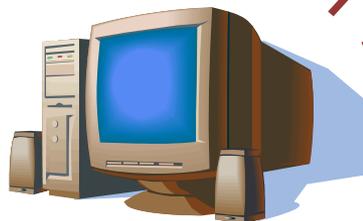
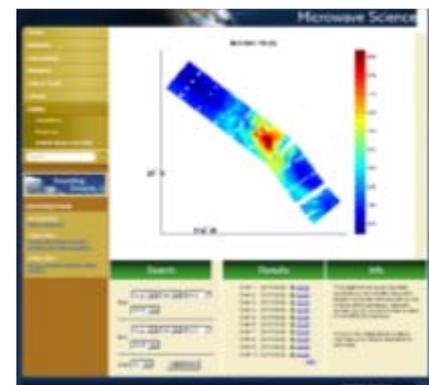


GHOC

netCDF L1B files

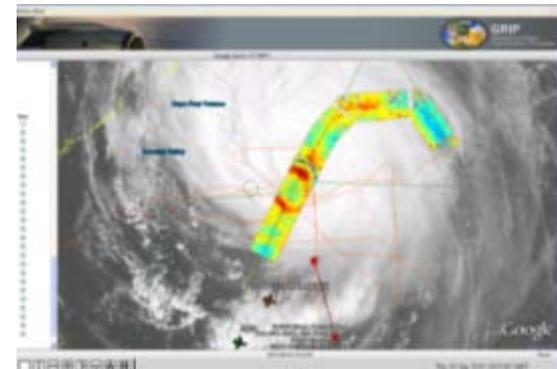
JPL Hurricane Portal

HAMSr website
quick look images



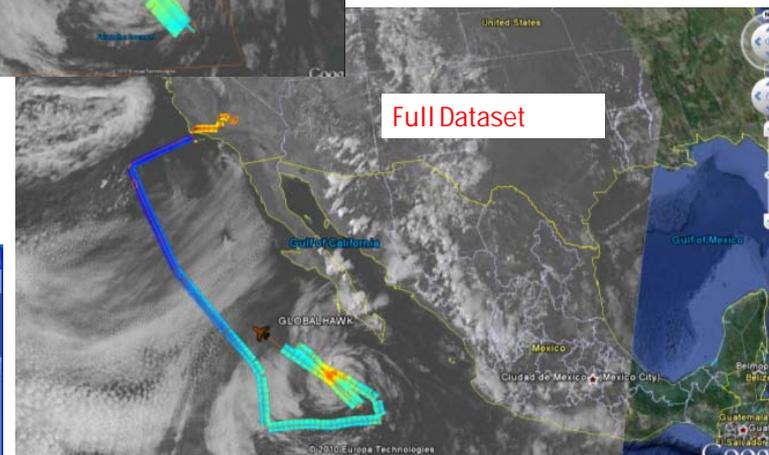
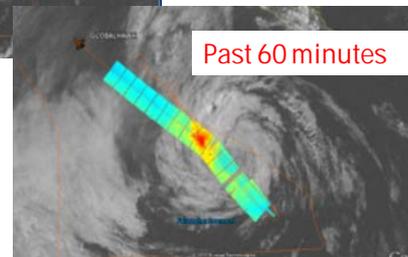
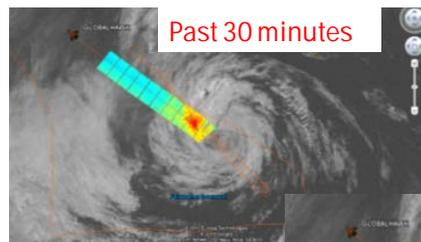
**HAMSr ground
data processor**

RTMM





HAMSR RTMM Display for GRIP



Select HAMSR channel – TB imagery
- Full data set, past 30 minutes or past 60 minutes

Real-Time Mission Monitor 2nd Generation v0.01 Genesis and Rapid Intensification Processes

RTMM
Real-time Mission Monitor

GRIP
Genesis and Rapid Intensification Processes

Ch.	Full	30 Min.	60 Min.	None
01	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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05	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
06	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
07	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
08	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
09	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
11	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
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Clear All

GLOBALHAWK

Subsweep Beamwidth

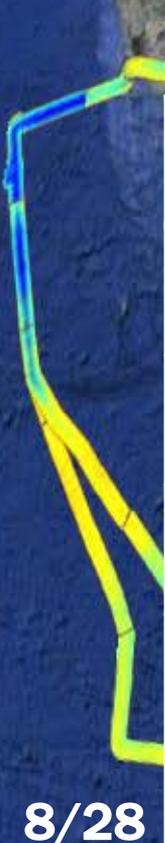
21°40'11.09" N - 113°09'39.22" W elev: 11831 ft

Sat: 28 Aug 2010 23:26:54 GMT

HAMSR software upgraded after GRIP to provide real-time imagery over Iridium

Successfully tested during 2011 WISPAR campaign

L1B files: <ftp://grip.nsstc.nasa.gov/grip/HAMSR/>
GE quick looks: <http://grip.jpl.nasa.gov/>



Flight Date	File Size	L1B Files
8/28	315 MB	HAMSR_L1B_20100828T052446_20100828T203646_v01.nc
9/1	517 MB	HAMSR_L1B_20100901T201020_20100902T204311_v01.nc
9/12	509 MB	HAMSR_L1B_20100912T040924_20100913T042651_v01.nc
9/16	521 MB	HAMSR_L1B_20100916T061217_20100917T070940_v01.nc
9/23	550 MB	HAMSR_L1B_20100923T071040_20100924T094512_v01.nc

8/28

9/23

All HAMSR Level 1B data processed and delivered

- Level 1B product contains quality controlled, calibrated, geo-located brightness temperatures for the Earth scene
 - L1B files in netCDF format, ~500MB/24 hours
 - Over 120 hours total for 5 flights



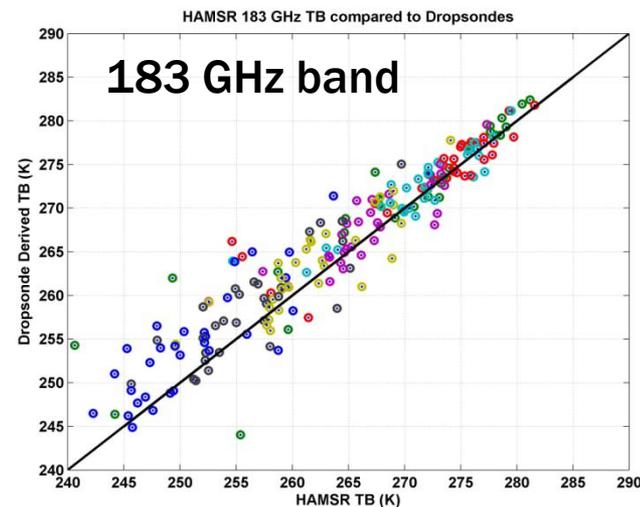
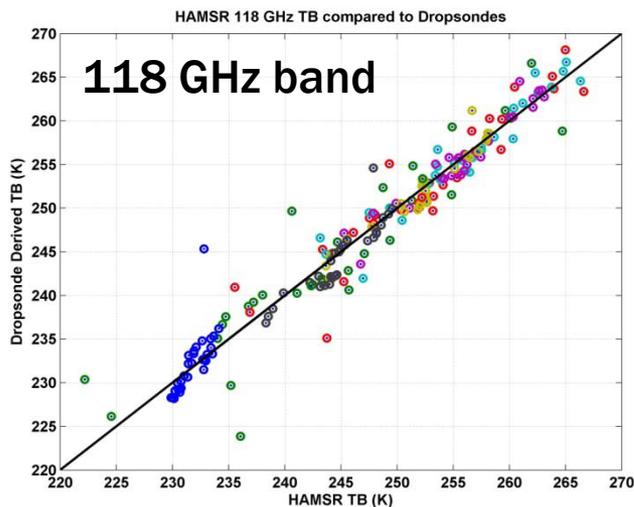
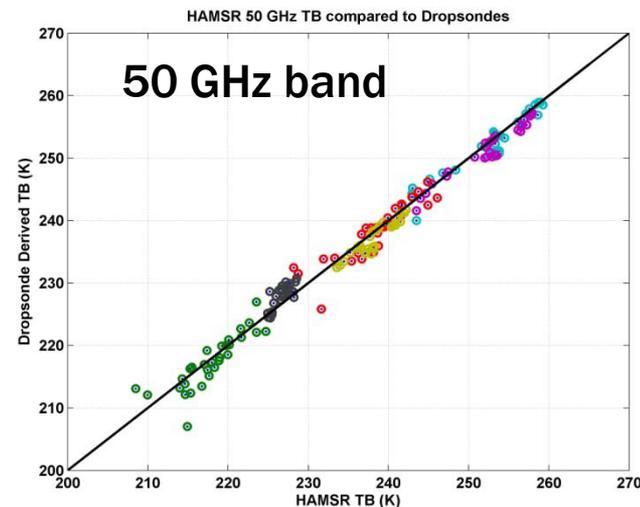
©2010 Google



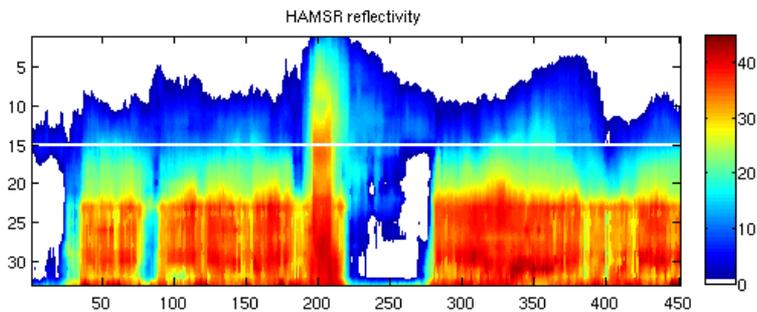
HAMSAR In-Flight Calibration Assessment



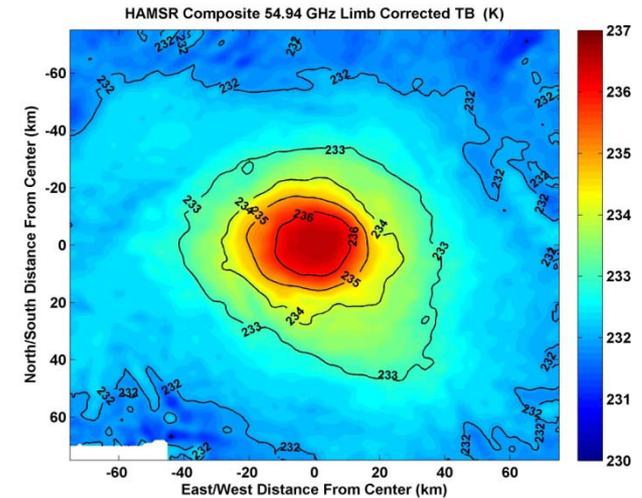
- HAMSAR participated with dropsondes in NOAA WISPAR 2011 campaign
- Preliminary dropsonde profiles used to generate model TBs at aircraft altitude
 - Compared to HAMSAR in each band for mostly cloud-free scenes (~30 profiles)
- Good agreement observed
 - More scatter at the higher frequencies mostly due to residual un-modeled clouds in scene
 - < 0.5K mean difference at 50/118 GHz
 - < 0.5K mean difference for upper 183 GHz channels
 - 1-2K difference for lower 183 GHz channels (model or calibration)



- Analysis of HAMSAR data on-going
 - Instrument calibration refinement
 - Retrieval algorithm validation and refinement, development of Level 2 product
 - Development of improved real-time visualization tools
 - Science data analysis



Day 2, 5pm: *“HAMSAR observations of the evolving inner-core structure of Karl during rapid intensification”, Lambrigtsen et al.*



8:50 -10 Poster Session: *“Evolution of the Thermodynamic Structure of the Eye of Hurricane Karl As Observed by HAMSAR During Rapid Intensification”, Brown et al.*



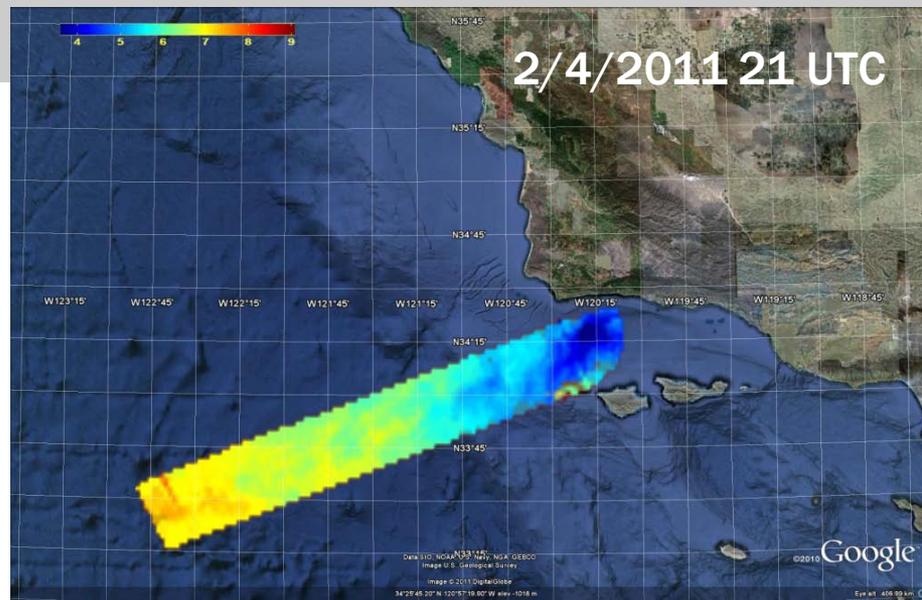
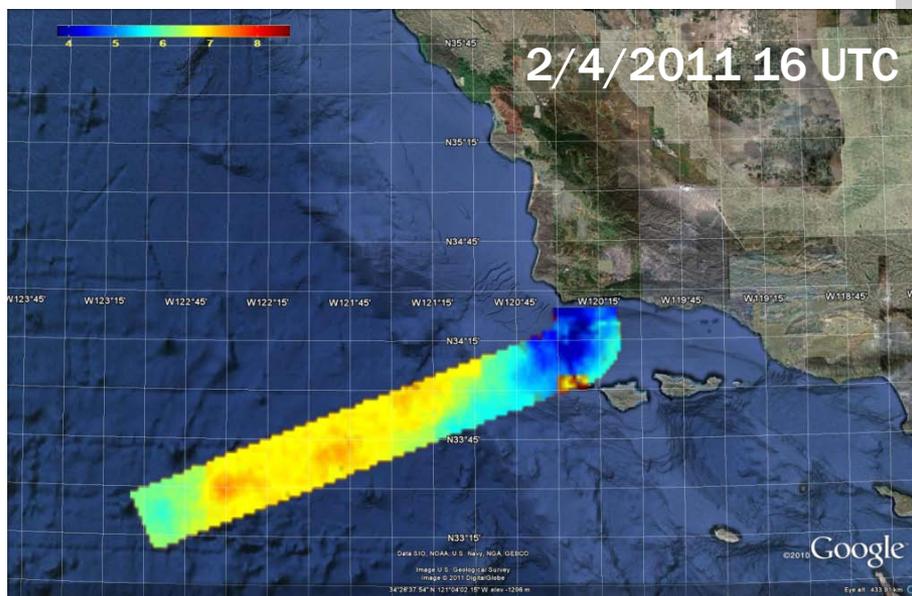
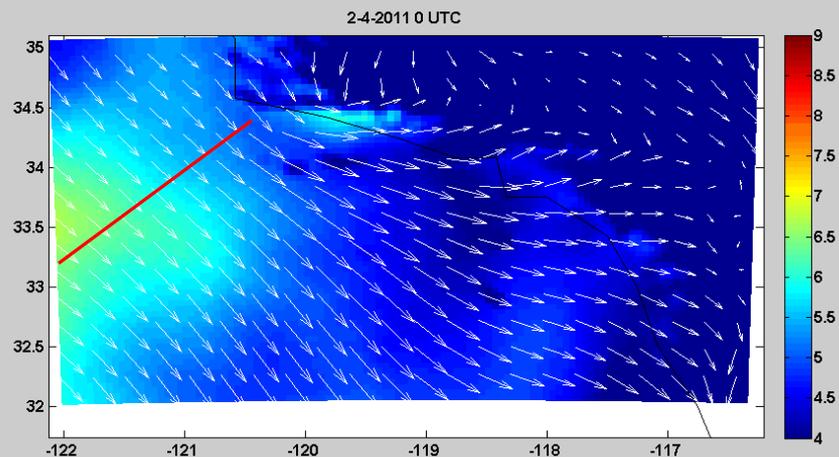
- backup



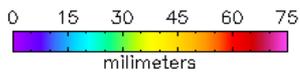
In Flight Illustration of 183 GHz Improvement



- HAMSAR retrieved integrated water vapor compared to WRF model off Southern California coast
- Retrieval of small scale variability possible with new system



AMSR-E, 2010-Sept-02, Descending Passes
Atmospheric Water Vapor, Zoom Factor = 5



ice land no data

Statistics :
Min: 19.50
Max: 63.90
Mean: 46.67
Rms: 9.92

