



Tropical Cyclone – Interactive Data Exchange and Analysis System (TC-IDEAS)

**Combining Airborne Field Data
Global Satellite Observations
and Model Simulations
of Tropical Cyclones**

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JPL

MSFC

7 April 2009





Outline of Presentation

❖ Introductions

1. Real Time Mission Monitor (RTMM)
2. Integrated Tropical Cyclone Information System (iTCIS)
3. TC - IDEAS





TC-IDEAS Joint Team Members

Marshall Space Flight Center

- Michael Goodman / NASA
- Helen Conover / University of Alabama Huntsville
- Joe Turk / JPL (formerly NRL)

Jet Propulsion Lab

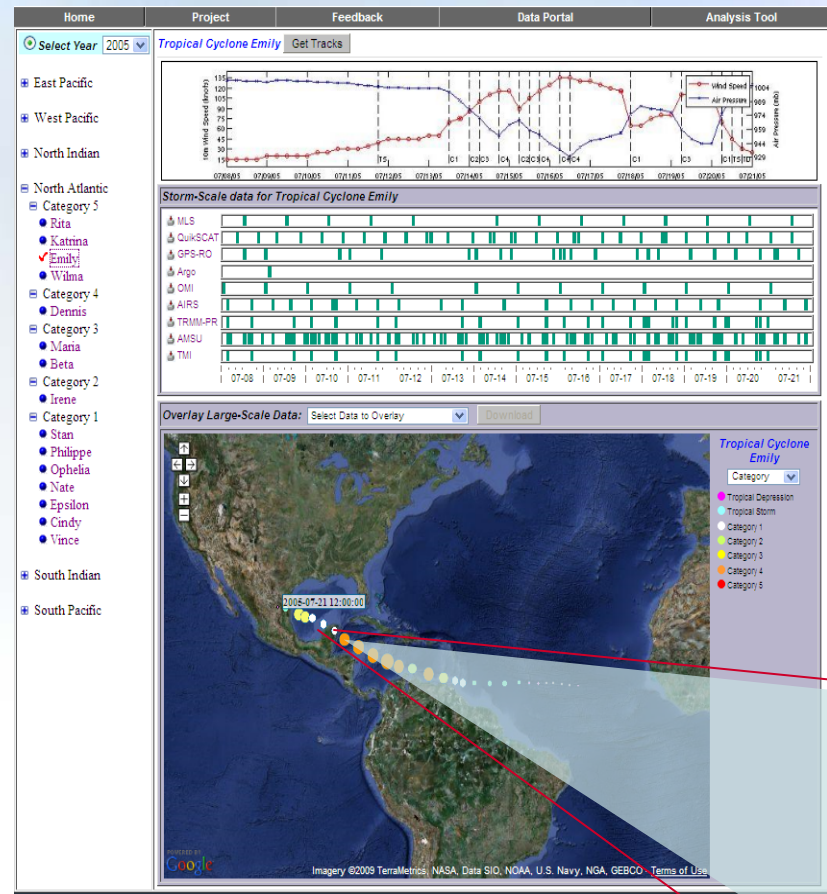
- Svetla Hristova-Veleva / JPL
- Bjorn Lambrigtsen / JPL
- Ziad Haddad / JPL
- Yi Chao / JPL
- Simone Tanelli / JPL
- Hui Su / JPL
- Rob Rogers / NOAA HRD
- Sharanaya Majumdar / Univ. Miami RSMAS





Tropical Cyclone – Integrated Data Exchange and Analysis System (TC-IDEAS)

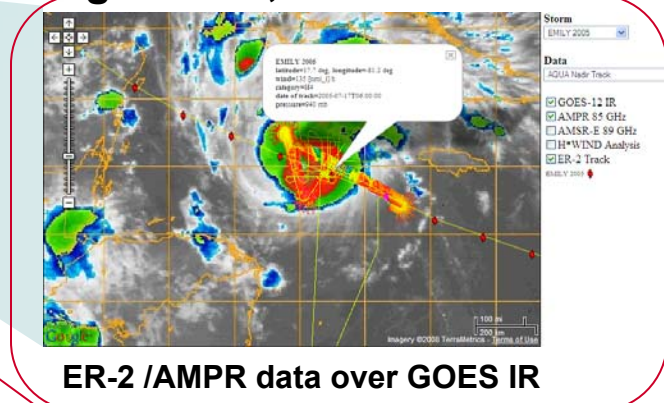
Joint NASA Jet Propulsion Lab and Marshall Space Flight Center Project



Select by basin, name, or category with corresponding data availability timelines

Objective: To provide fusion of multi-parameter hurricane observations (satellite, airborne and *in-situ*) and model simulations with the purpose of:

- supporting both research and field campaigns (incorporating RTMM)
- understanding the physical processes
- improving hurricane forecast by facilitating model validation and data assimilation
- enabling the development of new algorithms, sensors and missions.



ER-2 /AMPR data over GOES IR

RTMM

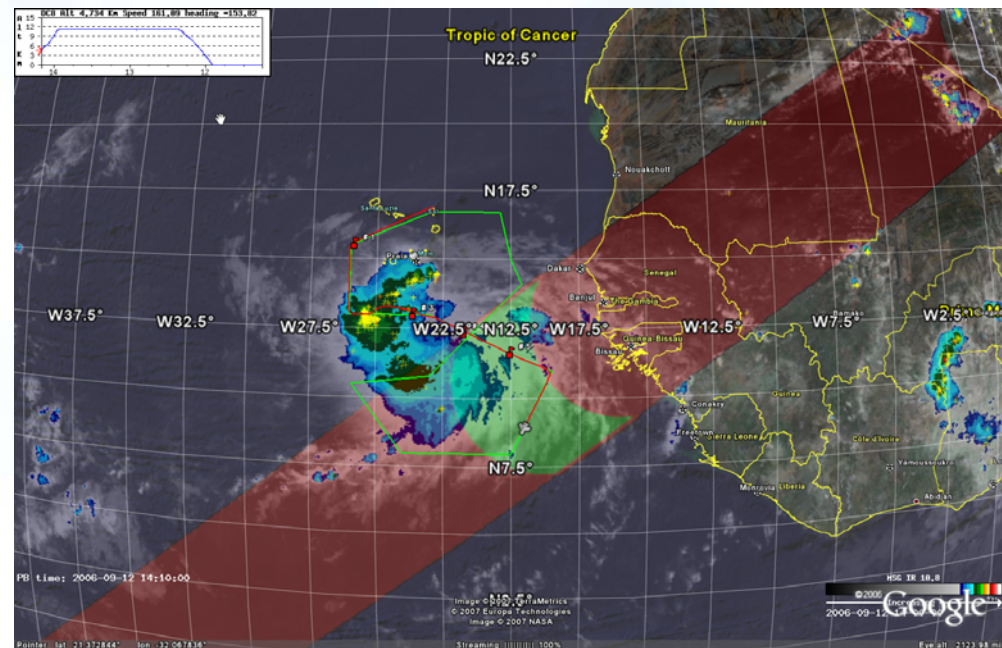




Part 1: The RTMM - a Component of TC-IDEAS

The Real Time Mission Monitor (RTMM) is an interactive visualization application that provides situational awareness and field asset management to enable adaptive and strategic decision making during airborne field experiments.

- Integrates satellite, airborne, and surface data sets
- Tracks airborne vehicle state information
- Displays model and forecast parameter fields



To paraphrase the BASF television commercial:
“We don’t make the science, we make the science easier”





Planning, Support and Analyses

RTMM facilitates:

- **Pre-flight planning**
 - Interactive waypoint tool
 - Satellite overpass predicts
 - Forecast parameters
- **In-flight monitoring and adaptive flight strategies**
 - Operations center focal point
 - Current weather conditions
 - Plane-to-plane data transfer
 - Enables real time collaborations
- **Post-flight analyses, research, and assessments**
 - Encapsulate and replay missions



- **RTMM used by:**
 - Scientists
 - Program Managers
 - Educators and Students
 - Media and Public Affairs

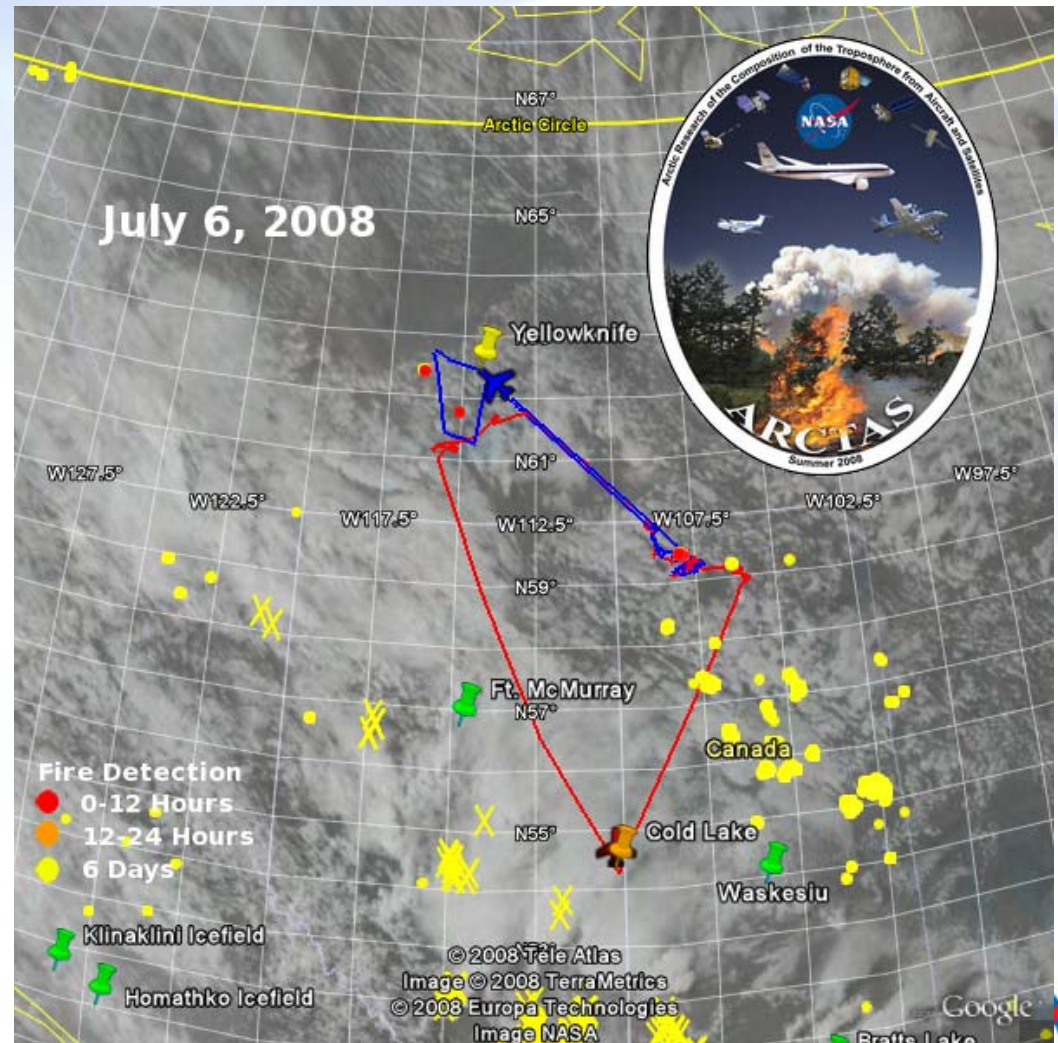




Recent Use of RTMM in ARCTAS

Arctic Research of the Composition of the Troposphere from Aircraft and Satellite

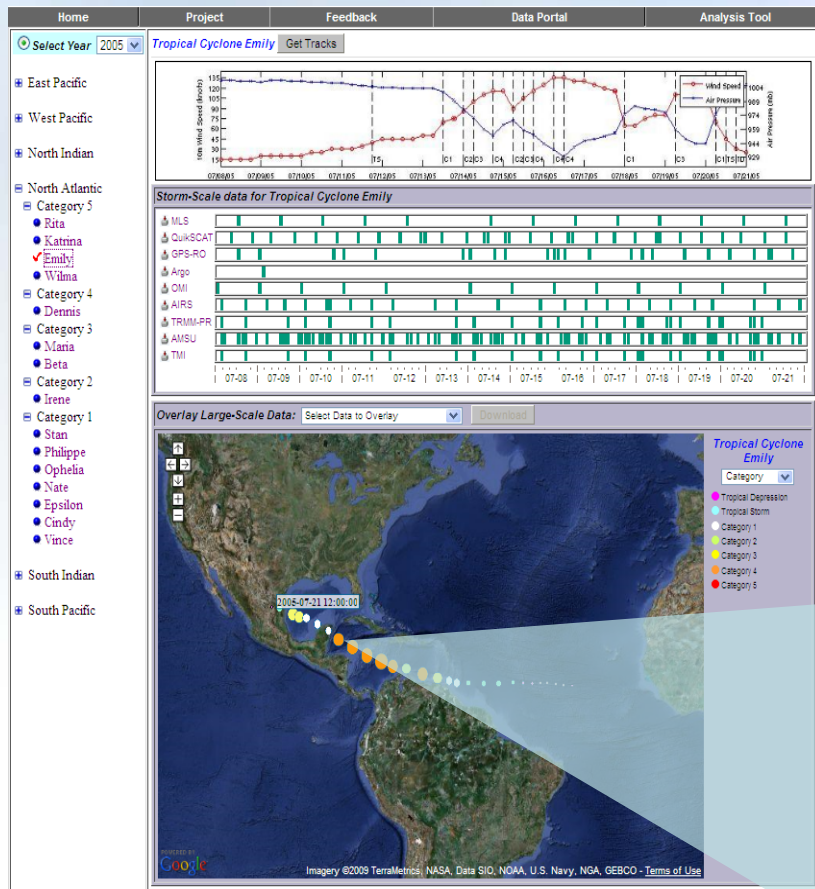
- ARCTAS Summer focused on boreal forest fires
- Searching for the elusive pyrocumulonimbus
- Tracked multiple aircraft and performed plane-plane transfer of HSRL Lidar data
- Waypoint Planning Tool used to plan the P-3 missions



Part 2: iTCIS - a Component of TC-IDEAS

Joint NASA Jet Propulsion Lab and Marshall Space Flight Center Project

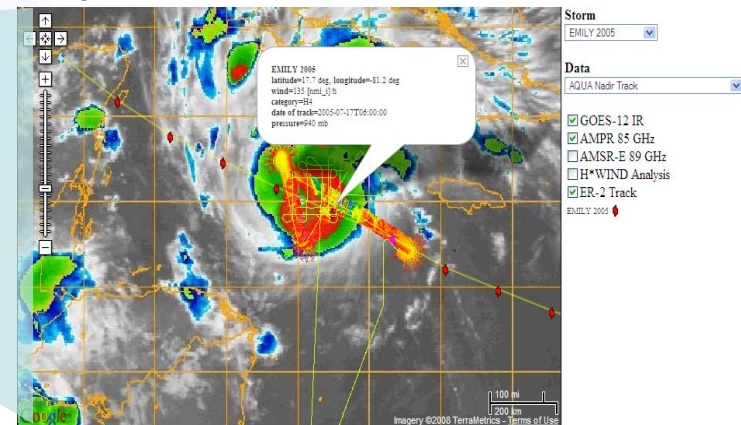
The JPL iTCIS



Select by basin, name, or category with corresponding data availability timelines

Objective: To provide fusion of multi-parameter hurricane observations (satellite, airborne and *in-situ*) and model simulations with the purpose of:

- supporting both research and field campaigns
- understanding the physical processes
- improving hurricane forecast by facilitating model validation and data assimilation
- enabling the development of new algorithms, sensors and missions.



ER-2 /AMPR data overlaid on GOES IR





Motivation for Developing iTCIS and TC-IDEAS

- In spite of recent improvements in hurricane track forecast accuracy, there are still many unanswered questions about the physical processes that determine hurricane genesis, track and intensity.
- Furthermore, there is a pressing need to validate and improve hurricane forecast models!!
- None of this can be accomplished without bringing together models and observations into a common analysis system which does not yet exist
- The JPL-MSFC team is very well positioned to accomplish that because of our:
 - extensive experience with satellite and airborne observations and intimate knowledge about retrieved products
 - ability to bring observations and models together by developing instrument simulators that use the model output and generate satellite “observables” needed:
 - for model-data comparisons
 - for data assimilation
 - for algorithm, instrument and mission design



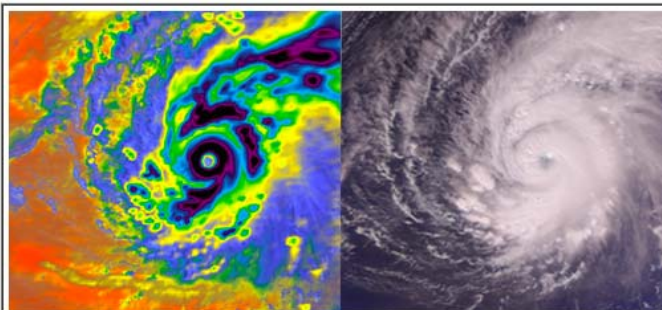


JPL Tropical Cyclone Information System

Home | Project | Feedback | Data Portal | Analysis Tool

Welcome to the JPL Tropical Cyclone Information System

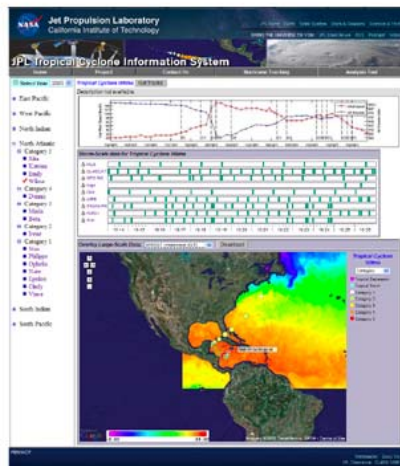
The JPL Tropical Cyclone Information System (TCIS) brings together satellite and in situ data sets from various sources to help you find information for a particular tropical cyclone over the world ocean. Currently, we have populated the entire 2005 and we will add data from other years in the future. We hope that you will find our analysis tools useful for your studies to improve hurricane models and plan future satellite missions with a particular focus on tropical cyclones.



Supertyphoon Pongsona struck the U.S. Island of Guam on Sunday, December 8, 2002. The composite image (left) of the supertyphoon was made by overlaying data from the infrared, microwave, and visible/near-infrared sensors that make up the AIRS sounding system. This storm can also be seen with the standard AIRS Vis/NIR (right).

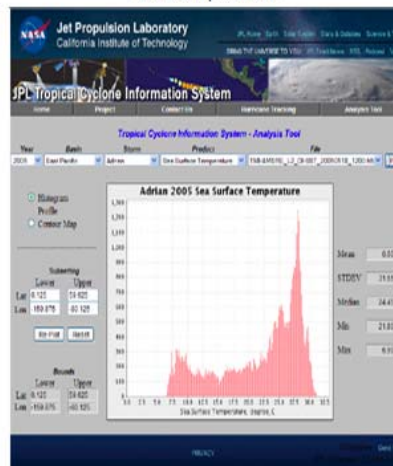
Tropical Cyclone Data Portal

Here you can search for specific storms in 2005 and directly access data and plots associated with that storm.

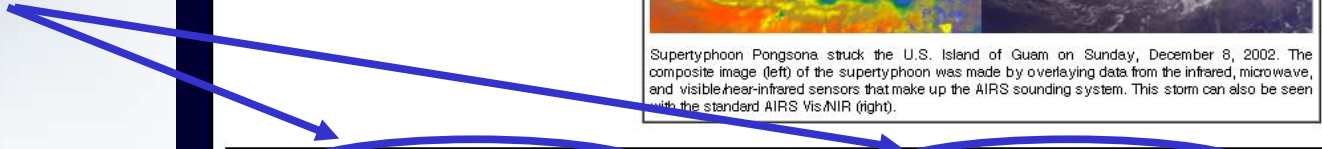


Data Analysis Tool

This tool will let you analyze data associated with a storm. You can plot histograms, maps, and profiles for many different data sets and products.



2 main components
In the current
JPL ITCIS





Tropical Cyclone Data Portal – Current Status

JPL Tropical Cyclone Information System

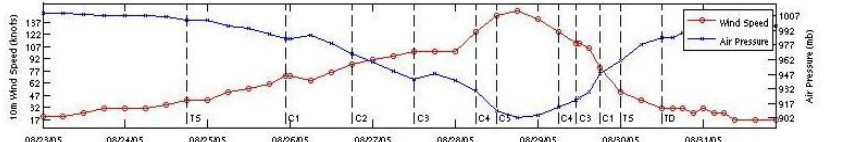
Home Project Feedback Data Portal Analysis Tool

Select Year 2005

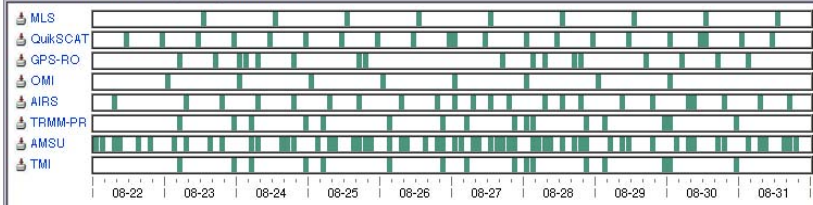
Tropical Cyclone Katrina Get Tracks

- East Pacific
- West Pacific
- North Indian
- North Atlantic
 - Category 5
 - Rita
 - Katrina
 - Emily
 - Wilma
 - Category 4
 - Dennis
 - Category 3
 - Maria
 - Beta
 - Category 2
 - Irene
 - Category 1
 - Stan
 - Philippe
 - Ophelia
 - Nate
 - Epsilon
 - Cindy
 - Vince

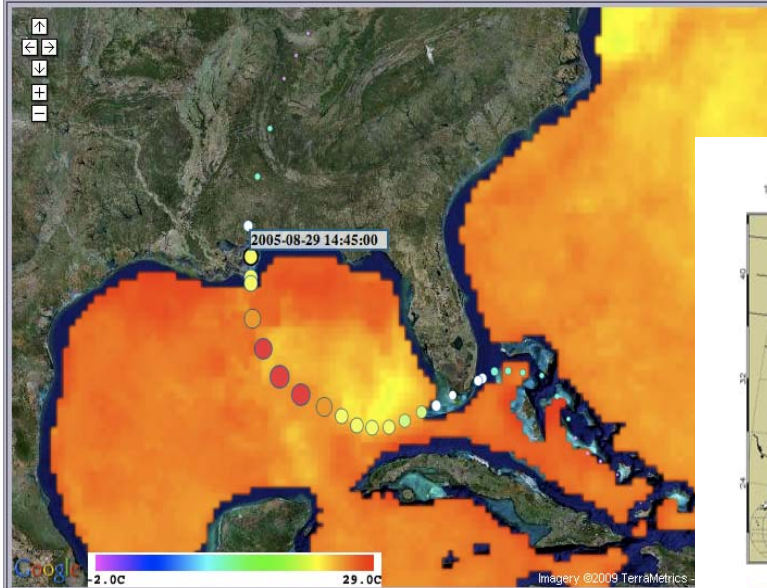
- South Indian
- South Pacific



Storm-Scale data for Tropical Cyclone Katrina

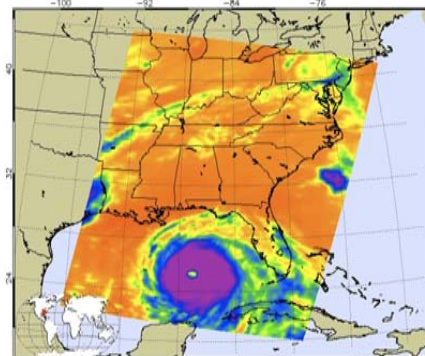


Overlay Large-Scale Data: MWSST (microwave SST) Download

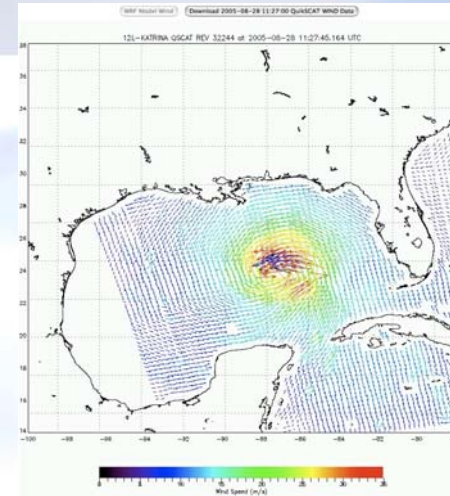


Tropical Cyclone Katrina Category Tropical Depression Tropical Storm Category 1

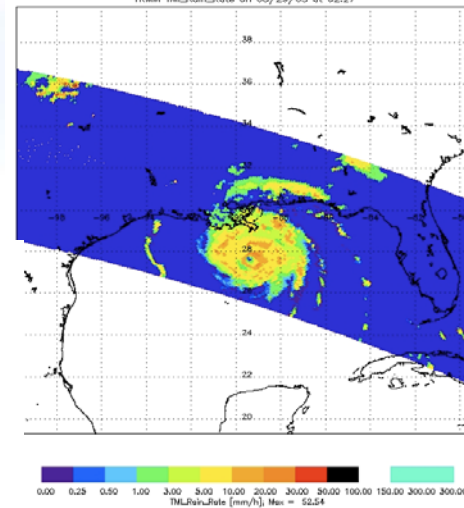
Download 2005-08-28 07:29:00 AIRS BRIGHTNESS Data
AIRS Level-1B Quick Browse Image
12.049 μm Brightness Temperature Aug 28, 2005 07:29:26 UTC Granule 075



Granule 11 - AIRS_2005_08_28_07_29_00_11_BAIRS_Level-1B_007103121828.tif



Download 2005-08-29 02:27:00 TMI RR Data





Analysis Tools – Current Status

Single Parameter Statistics

NASA Jet Propulsion Laboratory
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Tropical Cyclone Information System - Analysis Tool

Year: 2005 | Basin: North Atlantic | Storm: Katrina | Product: Wind Speed | File: QUIKSCAT_L2_WIND_20050828_1127.h5 | Plot

Select Plot Type

Histogram
 Profile
 Map

Spatial Subsetting

Lower Upper
Lat 16.200 33.480
Lon -96.210 -75.790

Re-Plot Reset

Data Boundaries

Lower Upper
Lat 16.200 33.480
Lon -96.210 -75.790

Katrina 2005 Wind Speed

Data Statistics

Mean: 0.830
STDEV: 42.420
Median: 9.790
Min: 11.238
Max: 6.046

PRIVACY | Webmaster: Quoc Vu | JPL Clearance: CL#08-3490

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Tropical Cyclone Information System - Analysis Tool

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High Resolution Modeling – to be included soon

WRF Model Simulations - RITA, September, 2005

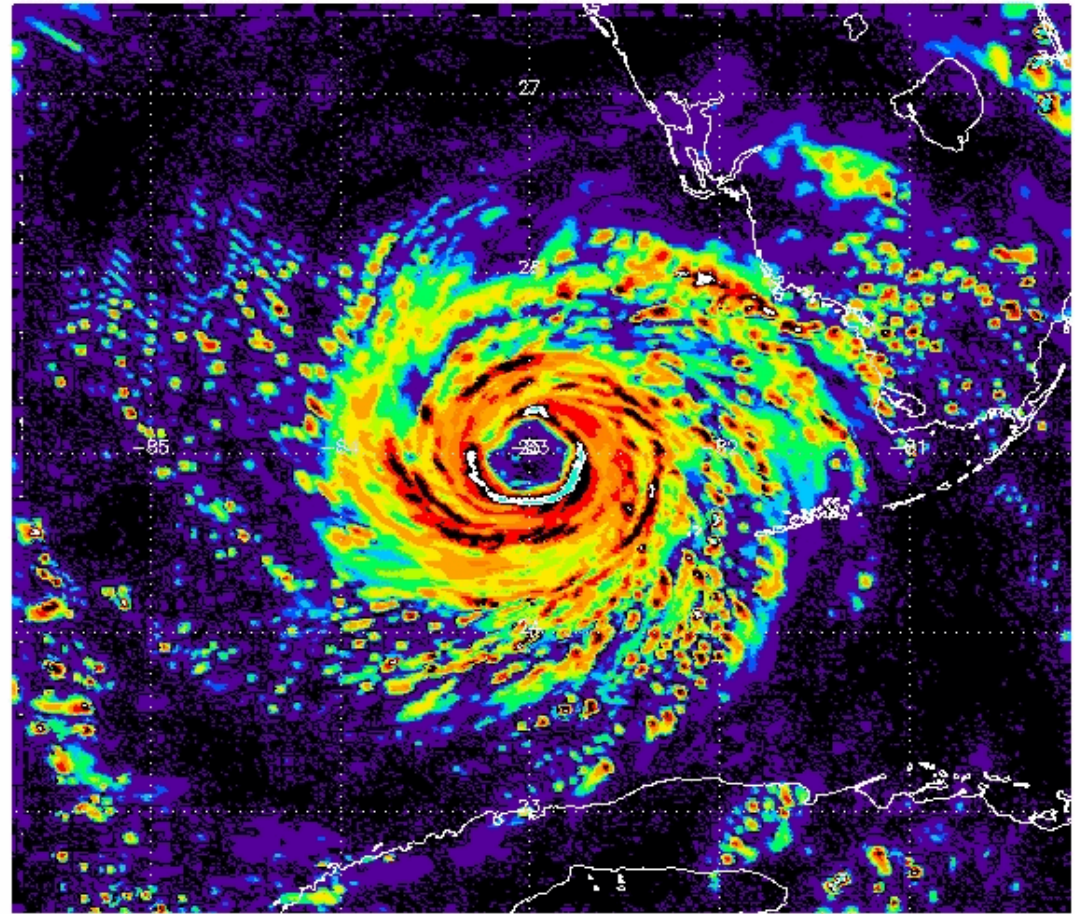
High-resolution model simulations provide a very detailed information on the structure and evolution of hurricanes. Observations with such high-resolution in both space and time do not yet exist!

We could learn a lot about hurricane processes by studying model simulations.

However, this is true ONLY if we trust the model simulations ...

Detailed model - data comparisons are needed to validate and improve the models.

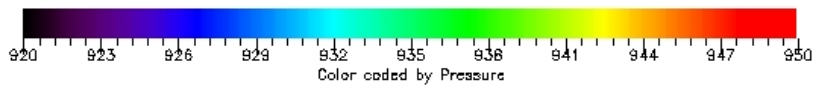
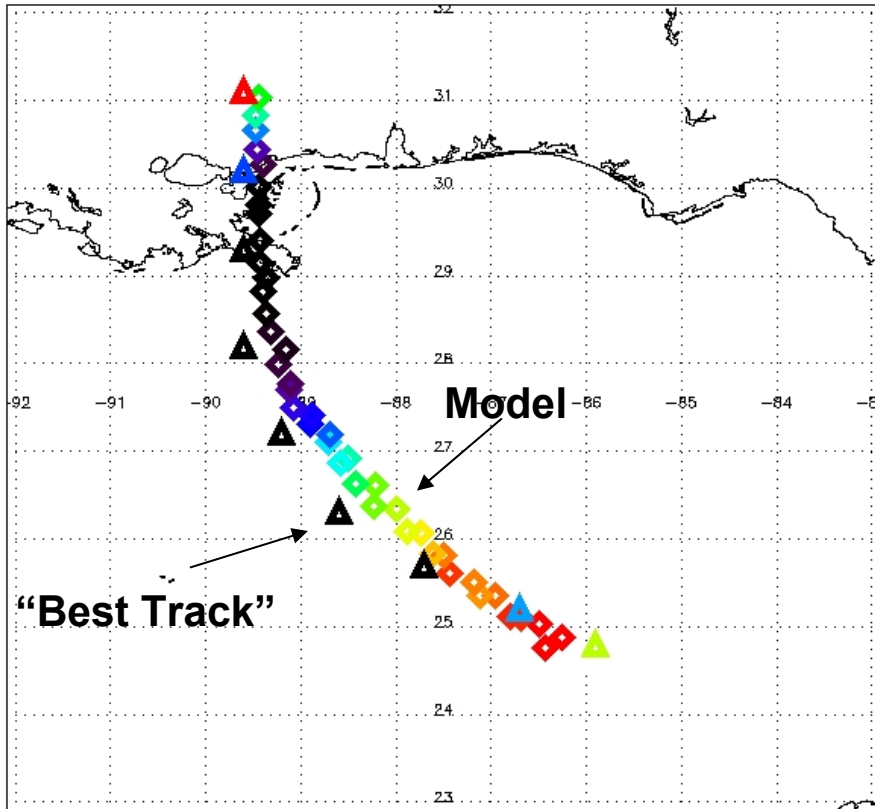
WRF-Rita; WindsSfc; Resolution:1.3km; Domain=402x402points; Date/Time: 2005264-050000



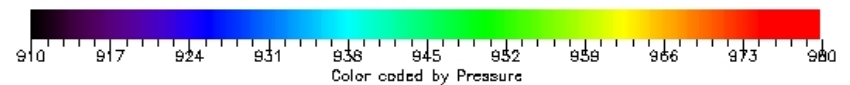
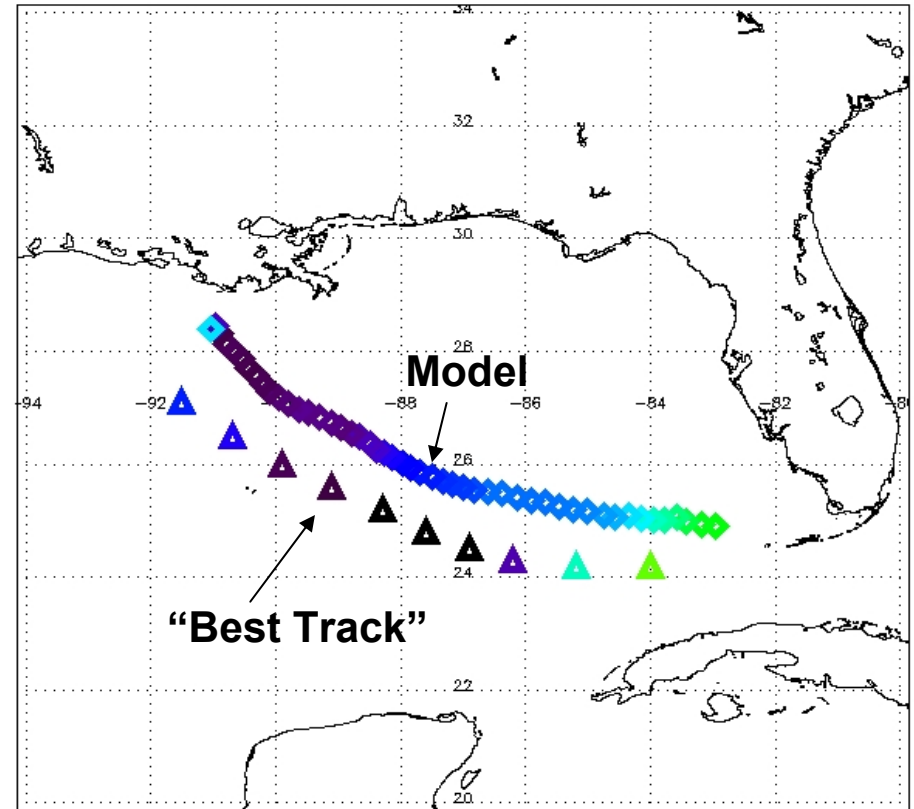
Evaluating hurricane simulations....

Tracks of simulated and observed storms

KATRINA - 2005



RITA - 2005





Instrument Simulators for Model Evaluation

WRF - Rain Rate

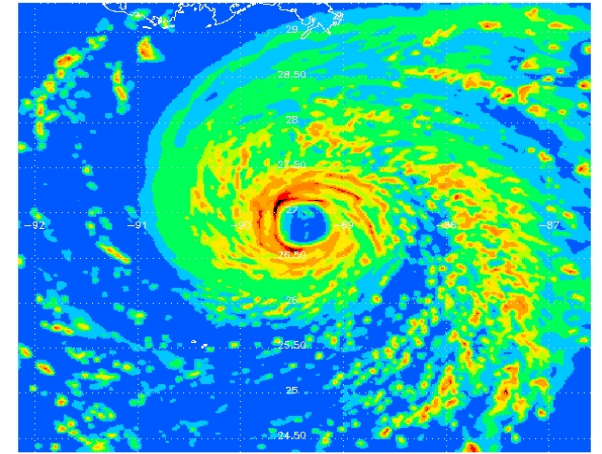
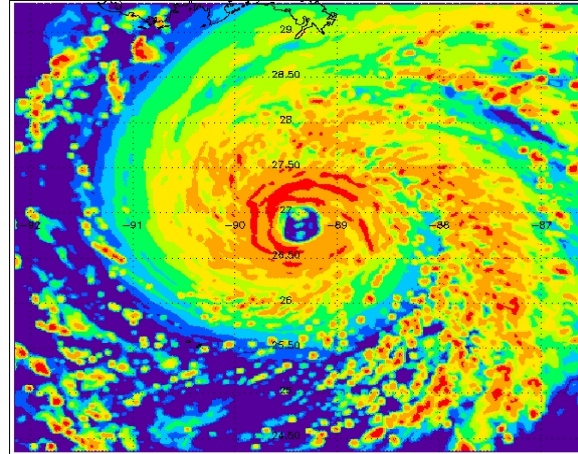
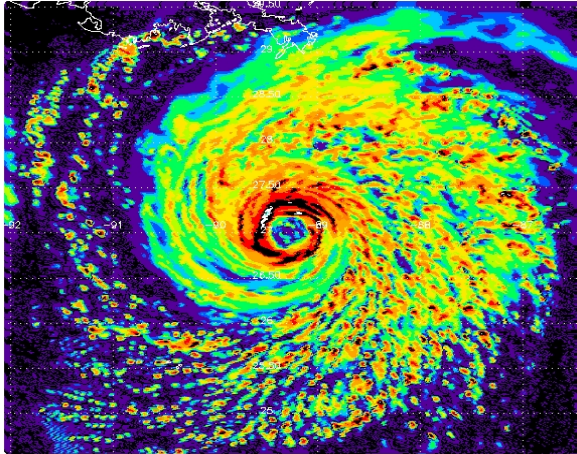
WRF - max reflectivity

WRF - Path Attenuation

WRF-RRta; Resolution=1.3km; Grid d0s: mp; cp1; pbl1; 112cpu; Date/Time: 2005265-143000

WRF-RRta; Resolution=4.0km; 402x402 points; KUBand(13.8GHz);Date/Time: 2005265-153000

WRF-RRta; Resolution=4.0km; 402x402 points; KUBand(13.8GHz);Date/Time: 2005265-153000



0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 100.00 150.00 300.00 300.00
RR [mm/h]; Max RR = 153.08 mm/h; Min RR = 0.00 mm/h

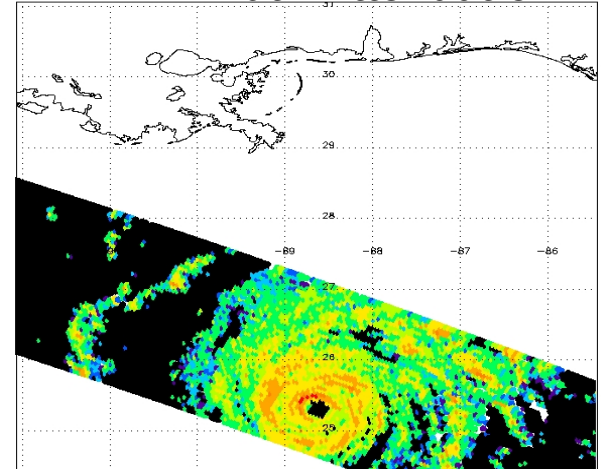
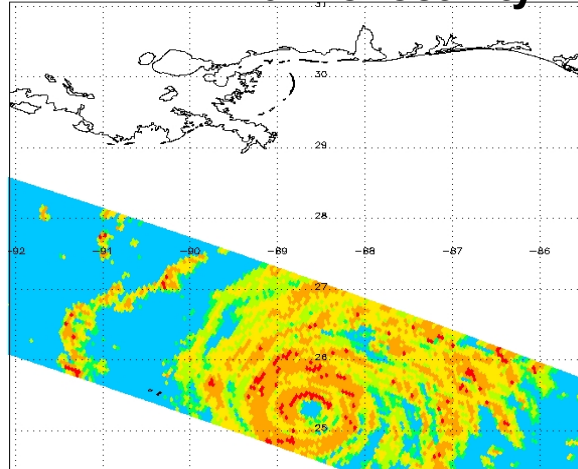
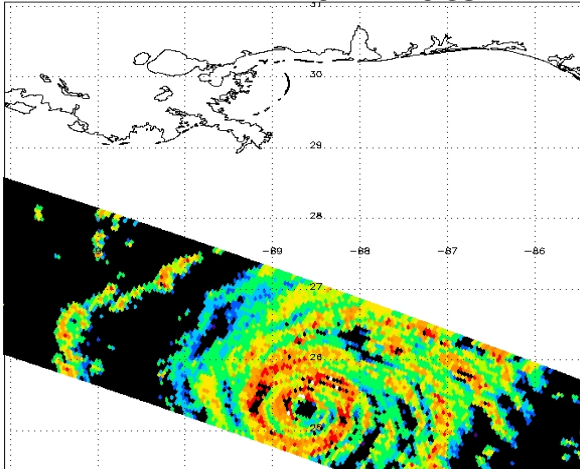
0.00 10.00 15.00 20.00 25.00 30.00 35.00 40.00 50.00 60.00 100.00 100.00
Max Attenuated Reflectivity [dB]; Max = 45.43;

0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 75.00 100.00 200.00 200.00
PathAttn [dB]; Max = 72.31; Incidence angle = 46.0 deg;

TRMM -Rain Rate

TRMM - max reflectivity

TRMM - Path Attenuation



0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 100.00 150.00 300.00 300.00
PR_Rain_Rate_abc [mm/h]; Max = 129.13

0.00 10.00 15.00 20.00 25.00 30.00 35.00 40.00 50.00 60.00 100.00 100.00
MaxZ [dB]; Max = 45.69

0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 75.00 100.00 200.00 200.00
Assumed Incidence Angle = 46.0 deg; PR_Attn_ZA21 [dB]; Max = 42.78



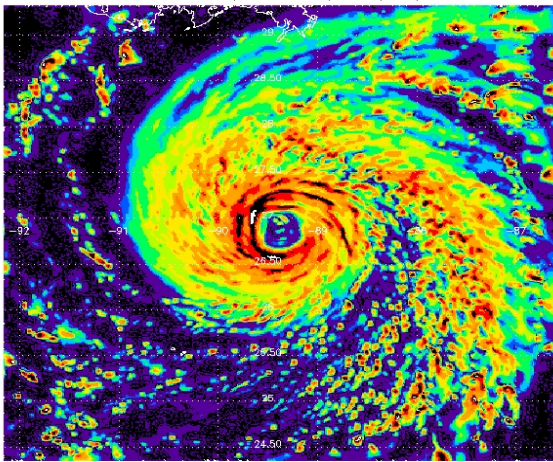
Hurricane Modelling and Instrument Simulators for Mission Design

WRF output fields can be used as input to instrument simulators (e.g. Volume Backscatter, Path Integrated Attenuation, Wind-Induced Sigma0)

Example: enable the design of the future scatterometers by simulating rain-associated contributions to the wind sigma0 for Rita – 15:30Z, Sep. 22, 2005

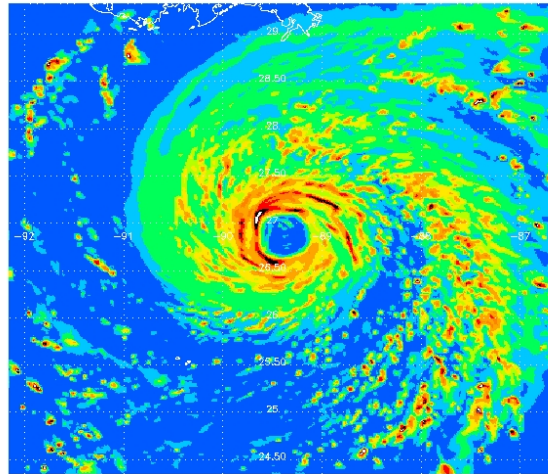
WRF Rain Rate

WRF-Rita; Resolution=1.3km; 402x402 points; KUbnd(13.8GHz);Date/Time: 2005265-153000



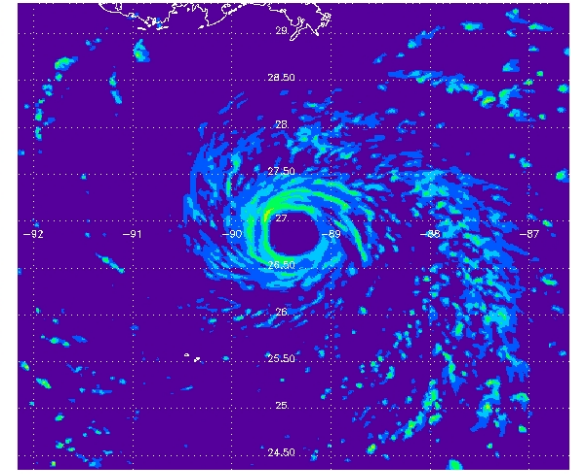
0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 100.00 150.00 300.00 300.00
SFC Rain Rate [mm/h]; Max = 138.03

Ku band - Attenuation



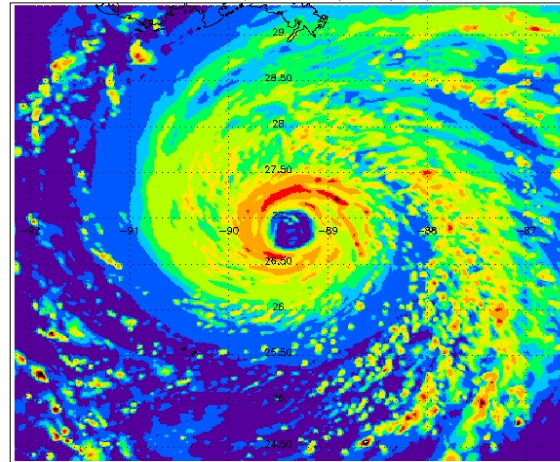
0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 75.00 100.00 200.00 200.00
PathAttn [dB]; Max = 113.38; Incidence angle = 46.0 deg;

C band - Attenuation



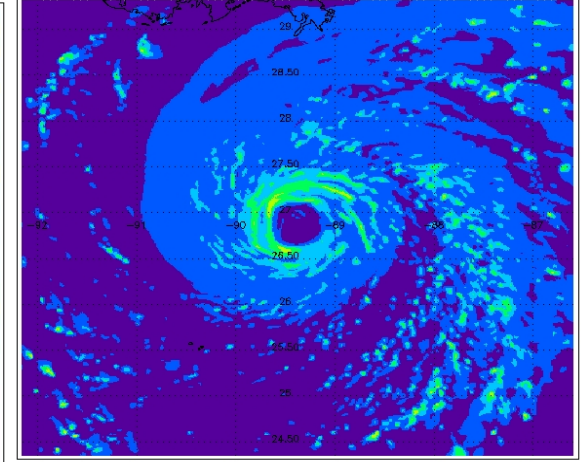
0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 75.00 100.00 200.00 200.00
PathAttn [dB]; Max = 5.19; Incidence angle = 46.0 deg;

Ku band - Rain Backscatter



-60.00 -45.00 -30.00 -25.00 -20.00 -15.00 -12.50 -10.00 -7.50 -5.00 0.00 0.00
VolSigma_0atn [dB]; Max = -4.43; Incidence angle = 46.0 deg;

C band - Rain Backscatter



-60.00 -45.00 -30.00 -25.00 -20.00 -15.00 -12.50 -10.00 -7.50 -5.00 0.00 0.00
VolSigma_0atn [dB]; Max = -15.94; Incidence angle = 46.0 deg;

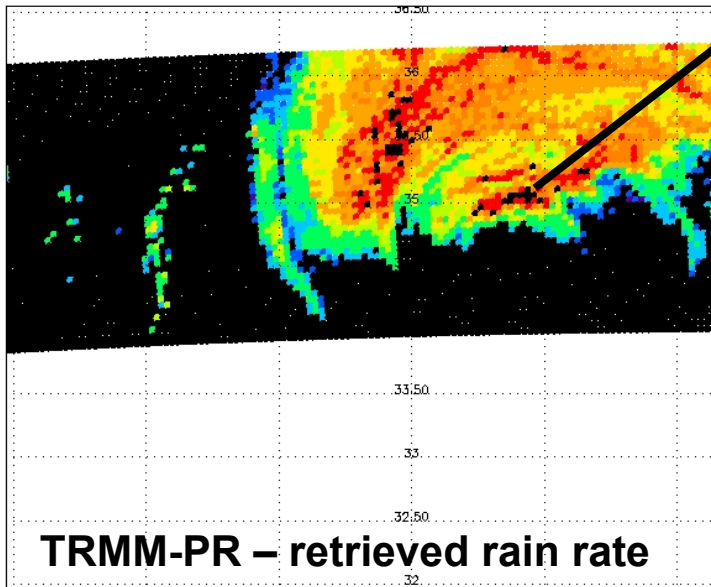
Evaluating Hurricane Simulations....

Impact of model microphysics

The treatment of microphysical processes in hurricane models has impact on the structure and the intensity of the forecasted storms.

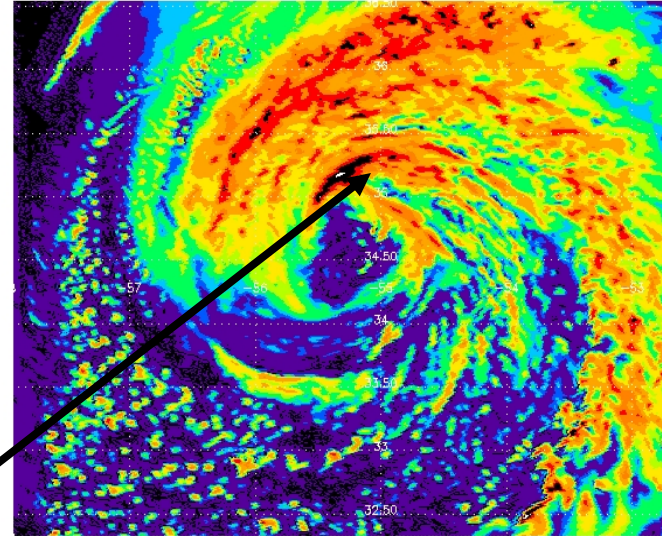
The question is whether satellite observations provide enough information to help select the microphysical parameterization that produces the most realistic storms.

Preliminary research shows that, indeed, satellite observations can help discriminate between simulations with different microphysics and select the most appropriate one.



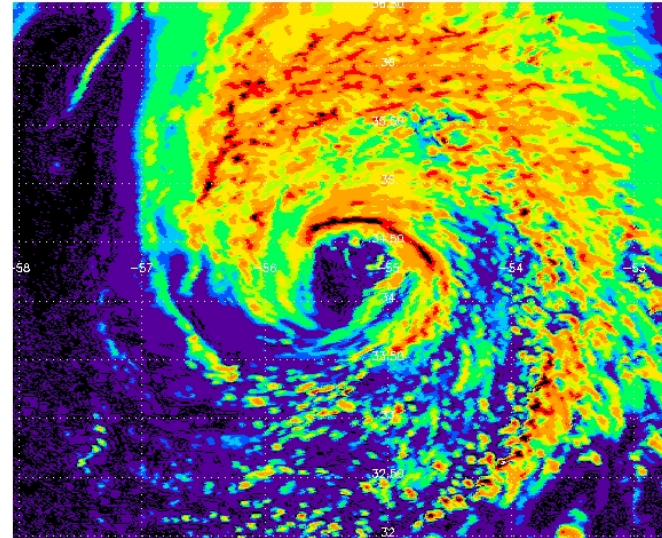
Better?

WRF-Rita; Resolution:1.3km; Grid_d02; mp6; cp1; pb11; 112cpu; Date/Time: 2006265-160000



Micro6

WRF-Rita; Resolution:1.3km; Grid_d02; mp3; cp1; pb11; 112cpu; Date/Time: 2006265-160000



Micro3

0.00 0.25 0.50 1.00 3.00 5.00 10.00 20.00 30.00 50.00 100.00 150.00 300.00 300.00

RR [mm/h]; Max RR = 116.92 mm/h; Min RR = 0.00 mm/h



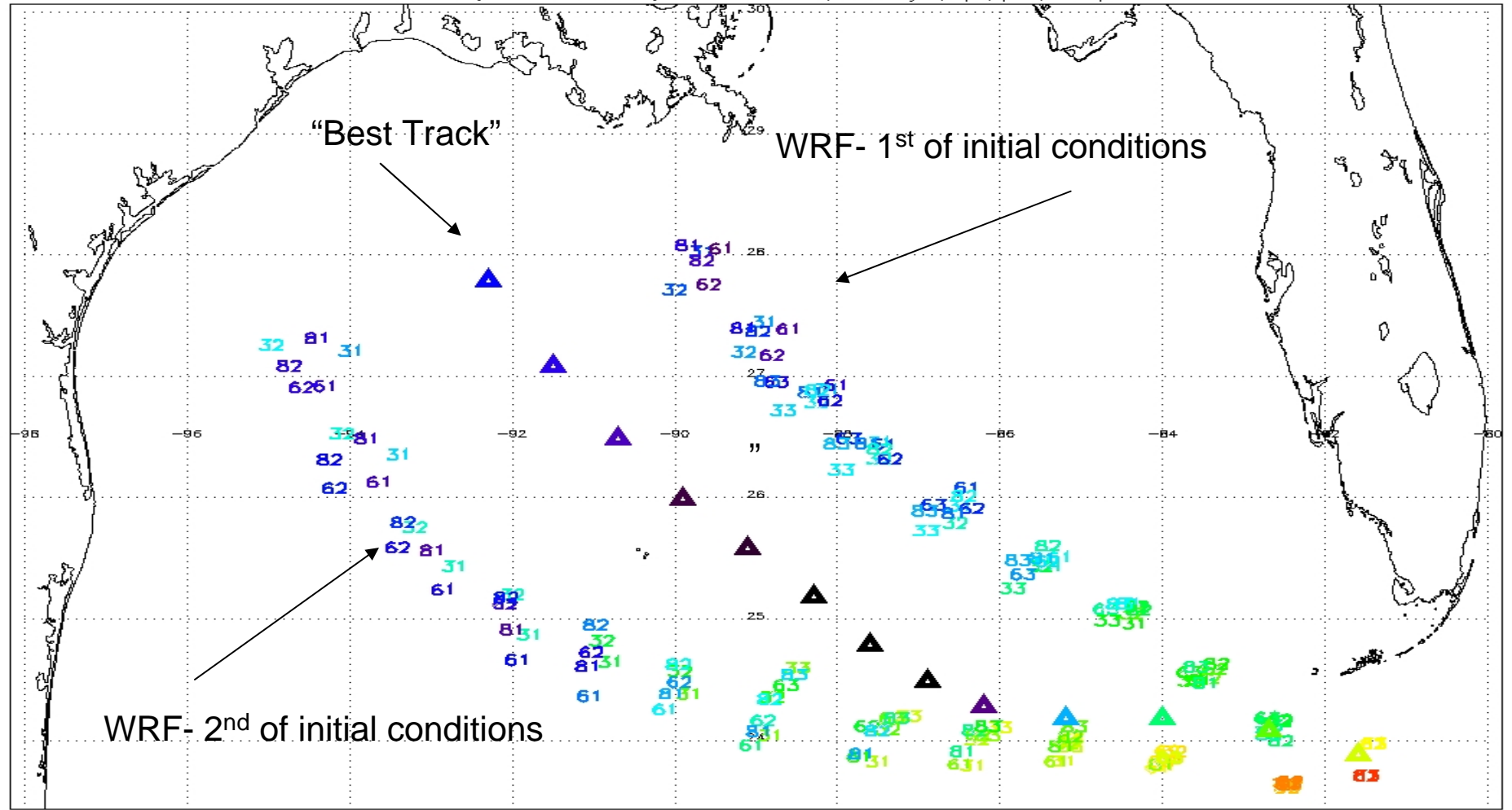


31 - microphysics 3; convective scheme 1
 32 - microphysics 3; convective scheme 2
 33 - microphysics 3; convective scheme 3

61 - micro. 6; conv. 1
 62 - micro. 6; conv. 2
 63 - micro. 6; conv. 3

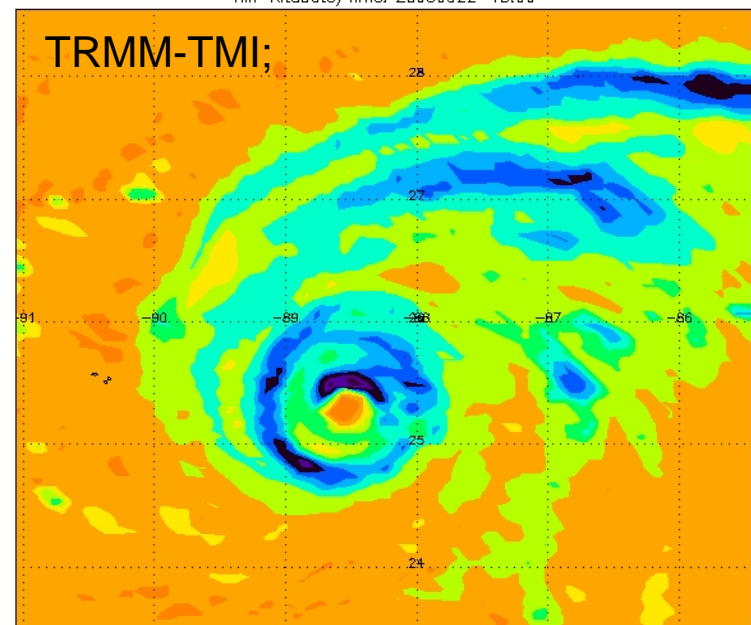
81 - micro. 8; conv. 1
 82 - micro. 8; conv. 2
 83 - micro. 8; conv. 3

WRF-Rita; Resolution: 1.3km; Fields from =d03; MicroPhys3; cp1; pbl1; 112cpu



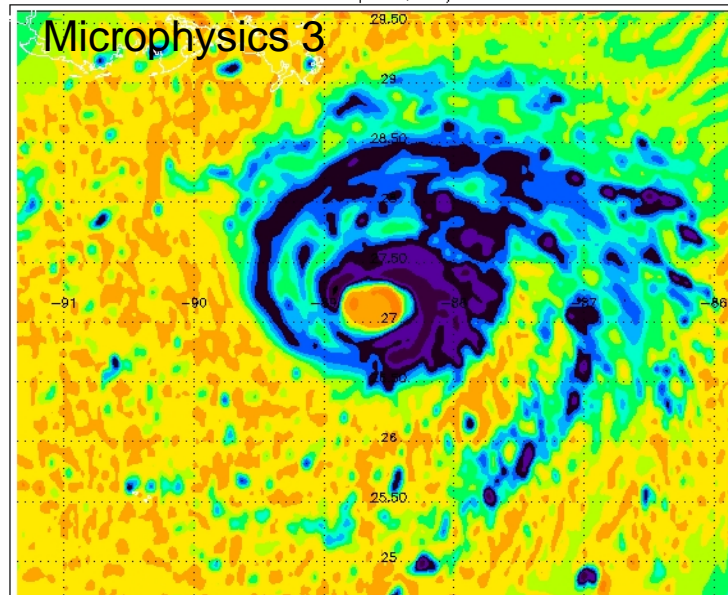
TMI-RitaDate/Time: 20050922-15:00

TRMM-TMI;



WRF-Rita Domain = 402x402 points;Date/Time: 20050922-15:00

Microphysics 3

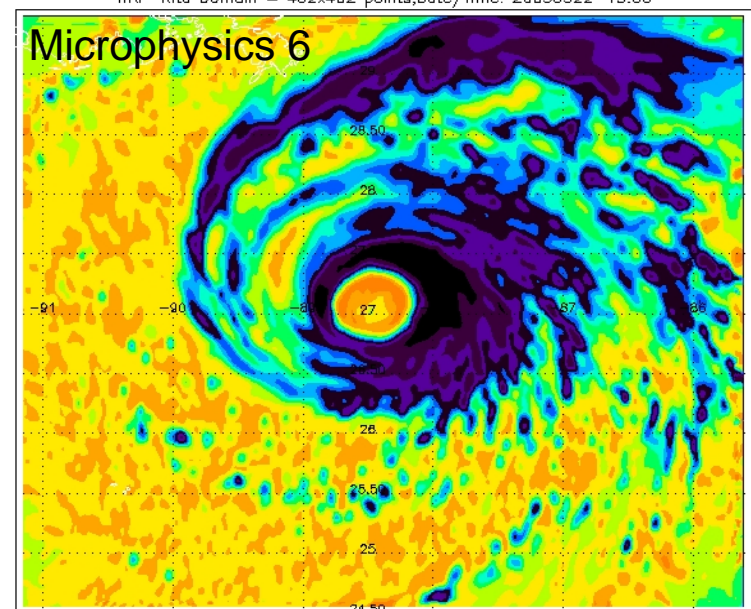


xv 3.10a-20070520: tmp_test_mp6cu1ir1_f00/TB_89_H_resTMI_402x402_2005

xv 3.10a-20070520: tmp_test_mp8cu1ir1_f00/TB_89_H_resTMI_402x402_2005

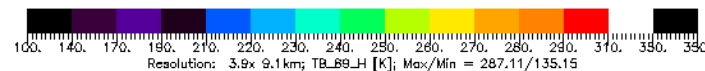
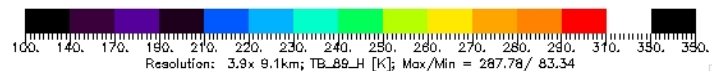
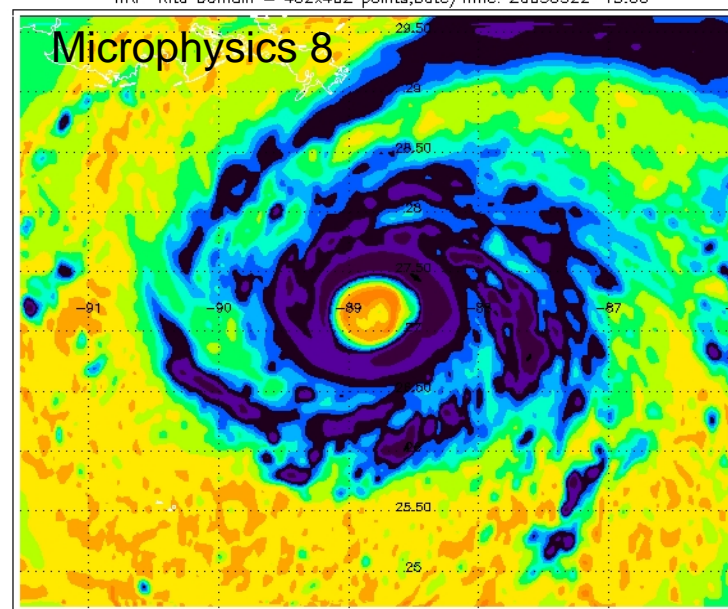
WRF-Rita Domain = 402x402 points;Date/Time: 20050922-15:00

Microphysics 6



WRF-Rita Domain = 402x402 points;Date/Time: 20050922-15:00

Microphysics 8



Example of
Using
Instrument simulators
and
Object Comparison
to investigate
the impact
of microphysics
on storm structure





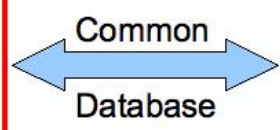
Part 3: TC-IDEAS Combining Databases, Tools and Applications

Field Campaign Database and RTMM

This interface displays a map of the tropical region with various data overlays. A sidebar on the left lists navigation options like 'Home', 'Real Time Mission Monitor', 'About RTMM', 'Introduction', 'Mission Data', 'Data Access', 'References', 'NASA Real Time Monitor', and 'Data Categories'. The main content area features a title 'The Real Time Mission Monitor' and a detailed text description of the mission's objectives and data collection methods.

Satellite, Airborne, In Situ and Model Database

This interface provides a comprehensive view of tropical cyclone data. It includes a top navigation bar with 'Home', 'About', 'Data', 'Tools', 'Help', and 'Contact'. The main area is divided into several sections: a 'Data Access' section with a table of data sources, a 'Tools' section with a list of analysis tools, and a 'Maps' section with a large satellite-style map showing storm tracks and intensity.



Marshall

JPL

Google Earth From Marshall

This screenshot shows Google Earth with a 3D visualization of a tropical storm system. A data window is open over the storm, displaying various parameters such as 'Storm: DRELY 2008', 'Date: 2008 Nov 20', and a list of data layers including 'GOES-12 IR', 'AMSU-2 85 GHz', 'TIASSE-8 89 GHz', 'FLIR WIND Analysis', and 'PIER-2 Trade'. A scale bar at the bottom indicates 100 km.

1/23/09

Query, Statistical Analysis and Overlays

This tool will let you analyze data associated with a storm. You can plot histograms, maps, and profiles for many different data sets and products.

This interface is designed for data analysis. It features a top navigation bar and a main section titled 'Tropical Cyclone Information System - Analysis Tool'. A prominent histogram shows 'Adrian 2005 Sea Surface Temperature' with a peak around 30°C. The interface includes various controls for data selection, time ranges, and analysis parameters.





The Components of TC-IDEAS

- **Observations**
 - Satellite, airborne, *in-situ*
 - Large scale and storm scale (centered on the storm)
 - Atmosphere and Ocean
 - Data and images - organized to determine coincident obs
- **Real Time Mission Monitoring (RTMM) and on-demand overlay of various observations**
- **High-resolution model simulations**
- **Instrument simulators**
 - (e.g. radar reflectivity, brightness temperatures etc. at the geometry of current and future missions)
- **Analysis tools**
 - Principal Component Analysis; CFADs (Contoured Frequency by Altitude Diagrams)
 - Multi-parameter, spatial and temporal covariances for use in data assimilation





Joint TC-IDEAS Tasks

- 1. Develop, populate and update a distributed inter-center TC-IDEAS database**
- 2. Add high resolution model simulations**
- 3. Increase functionality of the JPL analysis tools**
- 4. Provide standards based visualization services for field campaign data**
- 5. Develop a Google web browser plug-in application linked to TC-IDEAS database**
- 6. Harvest additional historical satellite TC imagery with / without annotations and grids**
- 7. Develop prototype near real time TC web site**
- 8. Develop a tropical cyclone tracking tool**





1. Develop, Populate and Update TC-IDEAS Database

- Add Airborne Field Campaign Data to JPL database; Available for analysis and download from there as well as from MSFC

FY	2009	2010	2011	2012
	TSCP	NAMMA & GRIP	CAMEX-4	NHC/HRD?

- Add New Data Types

- Add AMSR-E and global IR data (8km resolution, hourly data)
- Consider adding SSM/I, SSMI/S
- Anything else ?

- Add More years

FY	2009	2010	2011	2012
Current Year	Yes	Yes	Yes	Yes
Previous Years	Finish CY2005	CY2006	CY2001	2007 &2008

- Other suggestions ??
- Global or over the Atlantic and East Pacific only ?





2. Add High Resolution Model Simulations

- **Develop the framework for including high-resolution model simulations in TC-IDEAS. This task has three components**
 - including the model simulations in the database
 - incorporating them in the analysis system; will address issues related to sampling equalization (subsetting and resolution adjustments) needed for satellite-model comparison.
 - making them available for input into the instrument simulators during the last year of the project.
- Use only a limited number of model simulations to illustrate the capability.
 - Will include the **already produced at JPL WRF high-resolution simulations of: Katrina (2005); ensemble simulations of Rita (2005) and several simulations of Helene (2006).**
 - Will consider the including a limited number of simulations from HWRF
 - Inclusion of additional model simulations available from the community will be made at a later time, given additional funding opportunities.
- We will present the plan to the Science Team at the end of the first year and will ask for input on priorities and strategies.





3. Increase Functionality of the JPL Analysis Tools

- **Increase the functionality of the analysis tools**
 - adding time-series analysis (lead/lag);
 - developing ability for temporal and spatial subsetting and composites;
 - convective/stratiform separation algorithm
 - development of Principal Component Analysis, CFADs and Skew-T analysis;
 - adding multivariate analysis including joint PDFs, scatter plots, conditioned subsetting, computation of covariances.
- A special effort will be dedicated to developing model-observations comparison strategies and visualization. An emphasis will be put on developing sampling equalization as a component of the model-observations comparison.
- Instrument simulators will be developed in a companion effort sponsored by AIST and lead by Dr. Simone Tanelli of JPL. The instrument simulators will be incorporated in the TC-IDEAS during the fourth year of the project.





4. Provide Standards-based Visualization Services

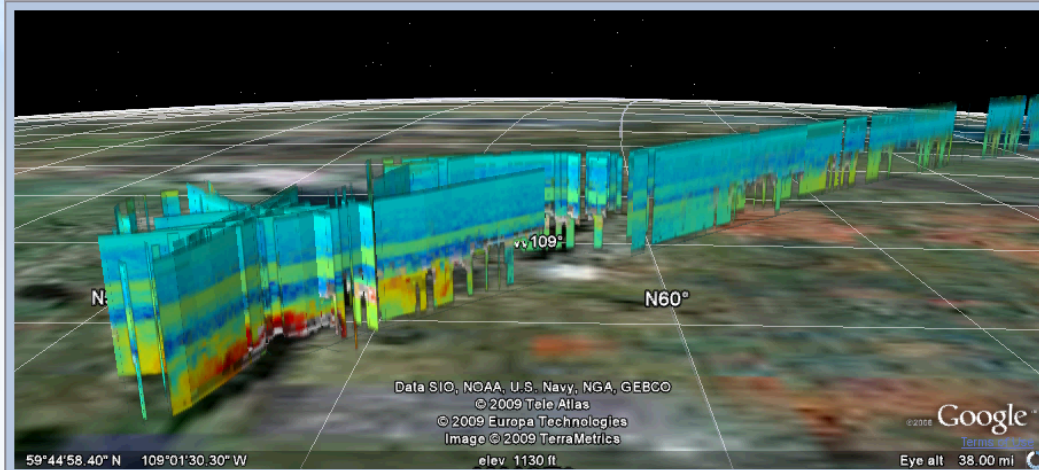
- **Implement and apply Open Geospatial Consortium standards and protocols**
 - **Web Map Services (WMS)**
 - **Sensor Observation Services (SOS)**
 - **Time-enabled Keyhole Model Language (KML)**
- **Users may import / integrate standards-based data into own visualization systems**





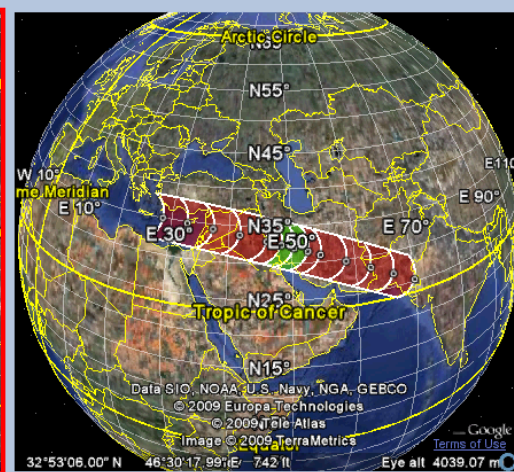
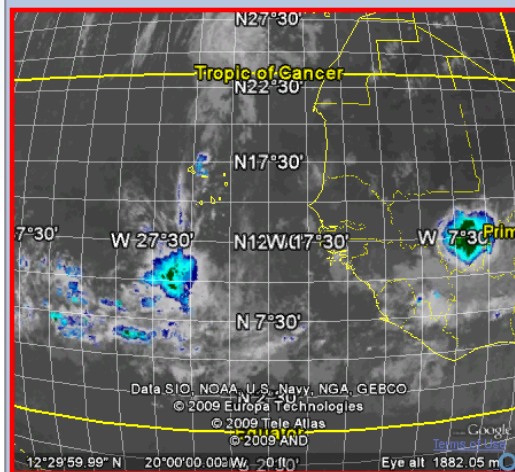
5. Develop Google Apps Linked to TC-IDEAS Database

Simultaneous multiple views



Curtain views

Animations, looping, storm tracks, and aircraft tracks



Real time and predictive satellite tracks

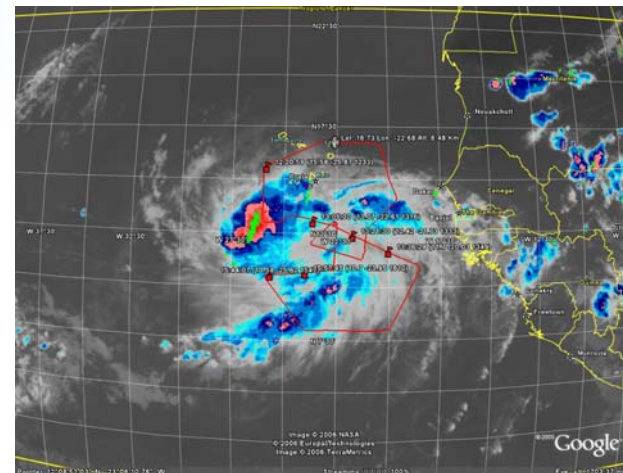
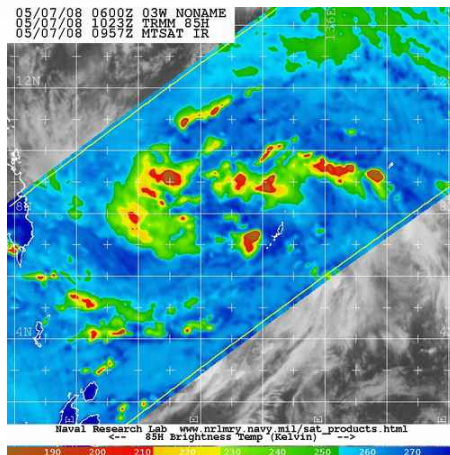
Window <input type="button" value="Hide"/> <input type="button" value="Show"/> <input type="button" value="Hide"/> <input type="button" value="Hide"/> <input type="button" value="Home"/> <input type="button" value="Clear"/> Aircraft <input type="text" value="None"/> <input type="checkbox"/> Tracking	Options Set Focus <input checked="" type="checkbox"/> External <input type="checkbox"/> Grid <input type="checkbox"/> Navigation <input type="checkbox"/> Boundary R/T Recent Year Month Day Hour Minute Duration <input type="checkbox"/> <input type="checkbox"/> 2006 09 10 00 00 108 Hour Satellite <input checked="" type="checkbox"/> Swath <input checked="" type="checkbox"/> Footprint <input checked="" type="checkbox"/> Tracking <input type="text" value="None"/> <input type="checkbox"/> TL <input type="checkbox"/> TR <input type="checkbox"/> BL <input type="checkbox"/> BR Aircraft Instrument <input type="text" value="None"/> <input checked="" type="checkbox"/> Rotate <input type="button" value="Setup"/> <input type="button" value="Save"/> <input type="button" value="Load"/>	Imagery 2006-09-10 00:00:00 << - + >> Domain Instrument Channel NAMMA MSCFC 12.0 um Start Low <input type="text" value=""/> High Lightning <input type="checkbox"/> NALMA <input type="checkbox"/> DCLMA <input type="checkbox"/> NLDN <input type="button" value="Stop"/> <input type="checkbox"/> VAILR <input type="checkbox"/> LDARII <input type="checkbox"/> WWLLN <input type="checkbox"/> CRLN <input type="checkbox"/> ATD <input type="checkbox"/> ZBUS <input type="checkbox"/> CLDN <input type="button" value="Close"/>
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6. Harvest Additional Historical Satellite TC imagery

- Harvest satellite database
- Two sets of imagery will be generated
 - With gridlines and/or boundaries
 - For standalone services
 - Support for virtual Earth applications
 - No overlay annotations, no grid lines nor boundaries





7. Develop Prototype Near Real Time TC Web Site

- **Separate component designed to reflect the needs of a field campaign operation.**
 - develop capability for creating a database of NRT satellite products and connect them to the analysis system.
 - develop imagery - the images will be displayed in both the NRT TC-IDEAS framework as well as in the RTMM.
 - The goal is to set up a system that could be operational during the 2010 GRIP field campaign.
- During the first year - develop the NRT TC capabilities and test the system on a couple of cases.
- The development will involve **testing the NRT latency** of a number of satellite data (**e.g., TRMM, CloudSat, AMSR-E, AIRS, AMSU, MLS, OMI, GOES, MODIS, QuikSCAT, JPL Global 1-km SST (G1SST), OHC, LIS and surface lightning, buoy, some forecast model ...**).
- We will present a status at the next HSRP science team meeting and seek feedback on instruments and products to be included





8. Develop a Hurricane Track Tool

- Create a map of all historical hurricane tracks for a given time period (possibly from 1980s through to the present date).
 - Requires evaluation and reconciliation of existing storm track databases at JPL, MSFC, NHC and IBTrACS (International Best Track Archive for Climate Stewardship) database.
 - Using Google Maps technology, display any or all the tracks of a given hurricane season in a particular basin or globally.
 - MSFC will leverage existing OGC WFS and SOS services to provide standards-based access to these storm tracks for interactive display (e.g., to RTMM).
- Allow users to run basic statistical analyses for each hurricane season (on a basin or global basis).
 - average wind speed, average pressure, min and max storm counts, and frequency of a particular storm category – all for a user-defined set of seasons.
 - query storm tracks by basin, year, month, landfall, genesis location, and lifespan.
- As with all our efforts, we will seek Science Team input for the priority and the scope of this task





More Information

To learn more about RTMM and to view movies and playbacks of individual flights, please go to the RTMM web site at:

<http://rtmm.nsstc.nasa.gov>

To learn more information about TCIS, search for specific storms, directly access data, and plot histograms, maps, and profiles for many different data sets and products, please go to:

<http://tropicalcyclone.jpl.nasa.gov/hurricane/>

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