Integrating and Visualizing Tropical Cyclone Data Using the Real Time Mission Monitor
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Abstract
The Real Time Mission Monitor (RTMM) is a visualization and information system that fuses multiple Earth science data sources, to enable real time decision-making for airborne and ground validation experiments. Developed at the NASA Marshall Space Flight Center, RTMM is a situational awareness, decision-support system that integrates satellite imagery, radar, surface and airborne instrument data sets, model output parameters, lightning location observations, aircraft navigation data, soundings, and other applicable Earth science data sets. The integration and delivery of this information is made possible using data acquisition systems, network communication links, network server resources, and visualizations through the Google Earth virtual globe application.

RTMM is extremely valuable for optimizing individual Earth science airborne experiments. Flight planners, scientists, and managers appreciate the contributions that RTMM makes to their flight projects. A broad spectrum of interdisciplinary scientists used RTMM during field campaigns including the hurricane-focused 2006 NASA African Monsoon Multidisciplinary Analyses (NAMMA), 2007 NOAA/NASA Aerosonde Hurricane Noel flight, 2007 Tropical Composition, Cloud, and Climate Coupling (TC4), plus a soil moisture (SMAP-VEX) and two arctic research experiments (ARCAS) in 2008. Improving and evolving RTMM is a continuous process. RTMM recently integrated the Waypoint Planning Tool, a Java-based application that enables aircraft mission scientists to easily develop a pre-mission flight plan through an interactive point-and-click interface. Individual flight legs are automatically calculated “on the fly”. The resultant flight plan is then immediately posted to the Google Earth-based RTMM for interested scientists to view the planned flight track and subsequently compare it to the actual real time flight progress.

We are planning additional capabilities to RTMM including collaborations with the Jet Propulsion Laboratory in the joint development of a Tropical Cyclone Integrated Data Exchange and Analysis System (TC IDEAS) which will serve as a web portal for access to tropical cyclone data, visualizations and model output.

Tropical Cyclone – Integrated Data Exchange and Analysis System
Joint NASA Jet Propulsion Lab and Marshall Space Flight Center Project
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.

RTMM is available to:
- Scientists
- Program Managers
- Educators and Students
- Media and Public Affairs

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. RTMM makes to their flight projects. A broad spectrum of interdisciplinary scientists used RTMM during field campaigns including the hurricane-focused 2006 NASA African Monsoon Multidisciplinary Analyses (NAMMA), 2007 NOAA/NASA Aerosonde Hurricane Noel flight, 2007 Tropical Composition, Cloud, and Climate Coupling (TC4), plus a soil moisture (SMAP-VEX) and two arctic research experiments (ARCAS) in 2008. Improving and evolving RTMM is a continuous process. RTMM recently integrated the Waypoint Planning Tool, a Java-based application that enables aircraft mission scientists to easily develop a pre-mission flight plan through an interactive point-and-click interface. Individual flight legs are automatically calculated “on the fly”. The resultant flight plan is then immediately posted to the Google Earth-based RTMM for interested scientists to view the planned flight track and subsequently compare it to the actual real time flight progress.

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In Cooperation With:
- Larry Freudinger – NASA Dryden Global Test Range
- NASA/ARSS-ESPD (ESPF)
- Evandro Hristova-Velez – Jet Propulsion Laboratory
- The many aircraft and instrument scientists from CAMEX, TCSP, NAMMA, TC4, Aerosonde Demonstration, ARCAS & SMAP-VEX field campaigns

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- Ramesh Kakar – Weather Focus Program Manager
- Hal Mearing – Radiation Science Program Manager
- Jim Crawford – Tropospheric Chemistry Program Manager
- Andrew Roberts – Airborne Science Program Manager
- George Kumar – Earth Science Technology Office Manager

More Information:
To view animations and replays of individual flights, please go to the RTMM web site at:
http://rtmm.nasg.nasa.gov

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“Making Science Easier”

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Planning, Support, and Analysis

RTMM is useful in all three phases of field experiment. RTMM facilitates:
1. Pre-flight planning
   - Interactive waypoint tool
   - Satellite overpass predictions
2. In-flight monitoring and adaptive flight strategies
   - Operations center focal point
   - Current weather conditions
   - Plane-to-plane data transfer
3. Post-flight analyses, research, and assessments
   - Encapsulate and replay missions

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

Waypoint Planning Tool
- Standalone interactive point-and-click enables quick creation of flight plans
- Generates and reads KML files for insertion into RTMM
- Multiple aircraft, satellites, and instrument field of view
- Individual flight legs fully described and visualized

New web browser plug-in application provides greater flexibility and expands the capability to open multiple RTMM windows
a) Lidar curtain plot
b) Real time animated hurricane imagery
c) Satellite tracking – real time and predictive
d) Lightning alert – real time and historical

Waypoint Planning Tool Interface

Waypoint Planning Tool interface

Incorporation of hurricane field data sets with satellite data

ERAS/AMF passive microwave over flight of H. Emily during the 2005 TCSP field experiment

Incorporate historical archived tropical cyclone database into RTMM

NAMMA flight tracks & 2006 Hurricane Tracks

New Tools and Directions

- Advanced Microwave Precipitation Radiometer AMPR
- Aerosonde
- Advanced Remote Sensing Networks (ARDS) and Dartz
- Atmospheric Emitted Radiance Interferometer AERI
- Cloud and Aerosol Particle Characterization CAPAC
- Cloud Microphysics CAFP-IP
- Cloud Radar System CRS
- Cloud Water Content CWC
- Doppler and Radiosonde networks
- EDI-2 Doppler Radar EDOP
- High Aflificial WR5000
- Lightning Instrument Package LIP
- Limpet Aerostat Research Group Experiment LARGEE
- Lidar Atmospheric Sensing Experiment LAISE
- Lightning Instrument Package LIP
- Meteorological Measurement System MMS
- Microwave Temperature Profiler MTP
- Mobile Integrated Profiling System MIPS
- NOAA Airborne Slicer RS
- Multiparameter Atmospheric Mapping Sensor MAMS
- NOAA Lightning Altimeter
- Particle LIDAR (HSRL)
- P-3 Aircraft Radars
- P3-WRF Radar
- Sentinel Microwave Radiometer SMMR
- 25° C. Aircraft Precipitation Radar APR-2
- Scanning Lidar Lader
- Sensitive Rain Gage, Radiosonde, and Tower Flux sites
- SMART-COMM Mobile Lake
- TOGA Radar

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