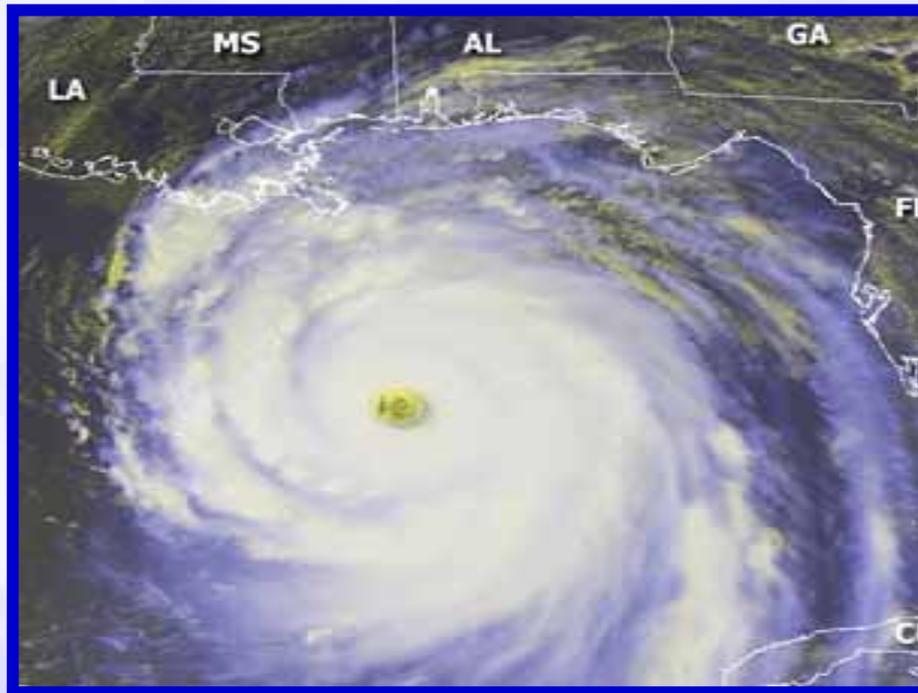


60th INTERDEPARTMENTAL HURRICANE CONFERENCE

Tropical Cyclone Reconnaissance and Observations Systems Wrap-up



Mr. Mark Welshinger
OFCM

Why Wrap-up?

- **Action item from 59th IHC:**
 - **Develop interagency strategy for future airborne / space-based tropical cyclone recon / observation**
 - **Addresses full range of observing technologies (e.g., manned, unmanned, space-based, SFMR upgrades, next generation dropwindsondes, etc.)**
- **Expected outcome from the 60th IHC:**
 - **A list of current and promising tropical cyclone observation capabilities**
 - **Serve as initial framework for development of future tropical cyclone airborne / space-based tropical cyclone observation needs and requirements**

Strategy

- **Used information from:**
 - ***Session 2: Observing the Tropical Cyclone and its Environment from Genesis to Post Storm: Current Capabilities to Future Requirements***
 - **Poster session**
 - **Other sessions**
 - ***Session 3: Tropical Cyclone Modeling and Prediction***
 - ***Session 4: JHT—Transitioning Research to Operations***

Aircraft

- **New airborne technology trifecta**
 - **Stepped Frequency Microwave Radiometer (SFMR)**
 - **C-band, nadir viewing radiometer**
 - **Airborne tail doppler radar**
 - **GPS dropsonde**
 - **Instrument trifecta is essential for real-time interpretation of rapidly changing events, especially near landfall**
- **Airborne ocean profilers (AXBT, AXCTD): ocean heat content**
- **Operational Scanning Radar Altimeter (SRA)**
 - **Airborne measurement of directional wave spectra**
 - **NASA system flown last mission; potential replacement funded by NOAA Phase I Small Business Innovative Research (SBIR) contract**
- **Imaging Wind and Rain Airborne Profiler (IWRAP)**
 - **Dual band (C and Ku), dual-polarized pencil-beam airborne radar**
 - **Obtain ocean surface wind field and vertical profiles of the atmospheric boundary layer (ABL) winds**

Aircraft

- **Future**
 - **NOAA SRA**
 - **SFMRs on AF WC-130s**
 - **Nov 06: Testing complete**
 - **'07 season: ~ 4 SFMR systems**
 - **'08 season: all WC-130s**
 - **Advanced Wind and Rain Airborne Profiler (AWRAP)**
 - **High resolution measurements of ABL winds, precipitation, and ocean surface winds**
 - **Much improved sensitivity; advanced algorithms applied to IWRAP raw data**
 - **Improved ABL obs (w/i 50 m of sfc) compared to IWRAP**

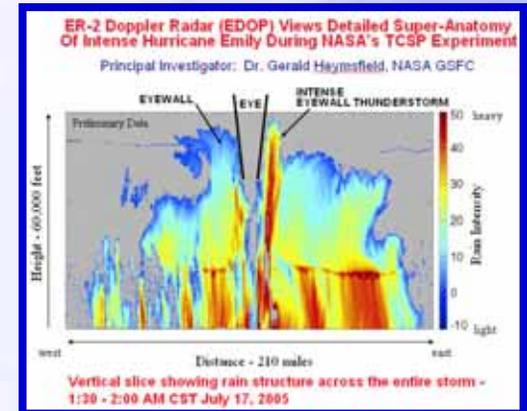
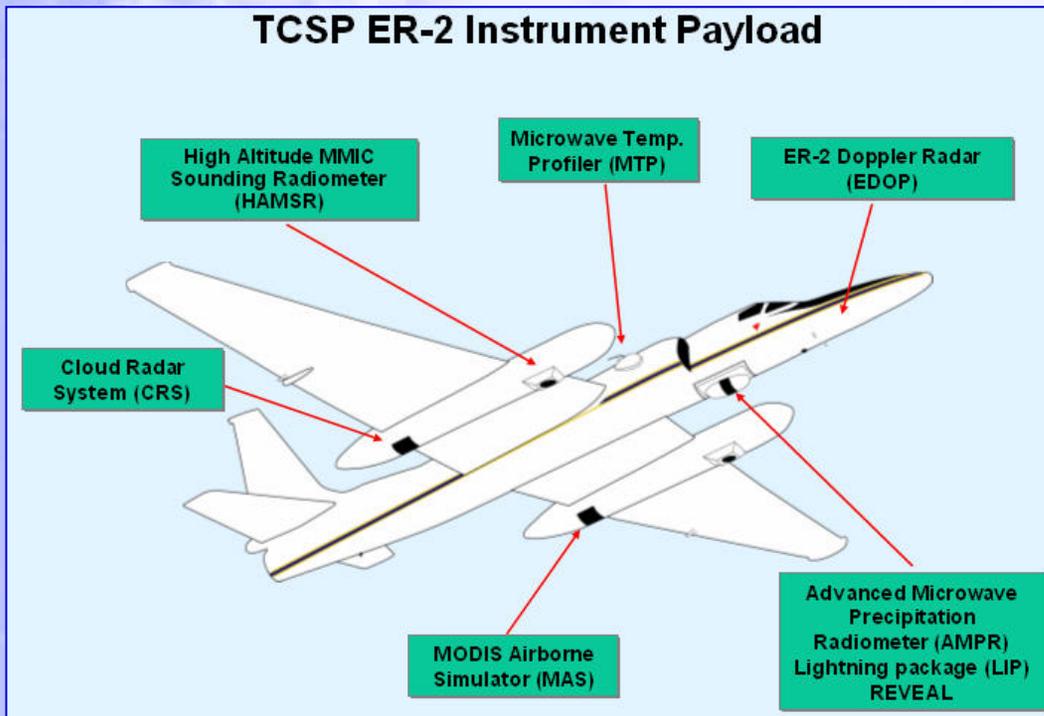
Aircraft

- **Future**
 - **Hurricane Imaging Radiometer (HIRad)**
 - **Follow-on to SFMRs**
 - **Compatible with airborne platforms, including unmanned aircraft systems (UAS), and payload for space-based platforms**
 - **Global Environmental Micro Sensors (GEMS) (??)**
 - **Lagrangian drifters**
 - **Operational Issues**
 - **Deployment scenarios (cost, practicality, etc.)**
 - **Aviation hazards**
 - **Robustness to harsh conditions in tropical cyclones (e.g. rain out)**

Aircraft - Hurricane Research

- NOAA P-3s, NCAR ELDORA, NRL P-3
 - Vital instrumentation: key to advancing hurricane science
- NASA ER-2

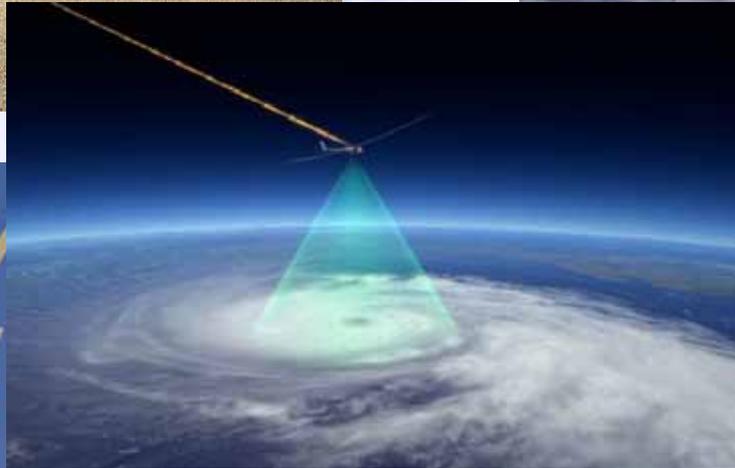
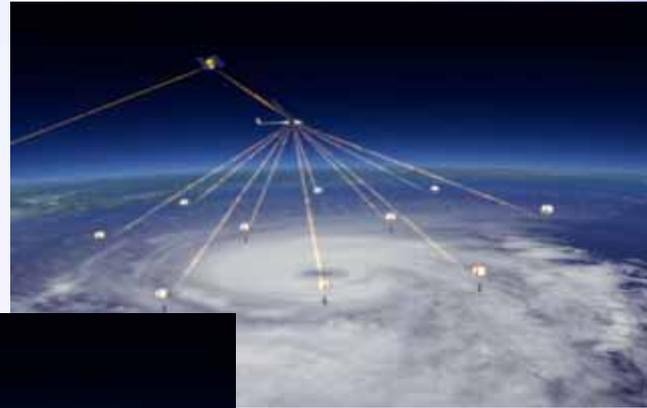
TCSP ER-2 Instrument Payload



- Hurricane Dennis, Tropical Storms Eugene & Gert, Hurricane Emily (night overflight!)

UAS - Hurricane Research

- Unmanned Aircraft Systems (UAS)
- Ms. Sara Summers (NOAA/ESRL)



UAS - Hurricane Research

Potential Use of High Altitude Long Endurance (HALE) UAS

- An aircraft like the Global Hawk could fly **above** the hurricane at 60 to 65 K, **staying with the storm** for extended periods
- It could use remote sensors (radar and Stepped Frequency Microwave) to continuously monitor hurricane **surface winds**
- It could drop sondes to continuously monitor **storm central pressure**, and oceanic sondes to determine sea temperatures
- It could carry repeaters so that it could **maintain cell phone communications** in the affected areas as the storm makes landfall

UAS - Hurricane Research

Potential Use of Low Level UAS

- **Low level hurricane environment too dangerous for manned planes**
- **Location of environment where the ocean's warm water energy is directly transferred to the atmosphere just above it**
- **Low-level in situ measurements will potentially enhance existing observational capabilities within the tropical cyclone environment**

UAS - Hurricane Workshop

Key participants:

NOAA: Ed Rappaport and Naomi Surgi

NASA: Ramesh Kakar and Robbie Hood

Air Force: Col Mark Weadon

Question: How can we collaborate on hurricane monitoring + research ?

- Our Agencies have different mission objectives, but our end goals are the same
- First step in our pathway forward: National mission / experiment involving UAS
- Develop a plan for Near Term

#1 NOAA Priority identified by modeling and forecasting community: very low altitude operations & research, i.e. <300M

- Conduct a low level UAS Hurricane demonstration in 2006 (Joe Cione)

UAS - Hurricane Workshop

Key Questions

- **Will UAS platforms / instruments provide data that will IMPROVE THE FORECAST ?**
- **Will the data improve the models and provide a better analysis for forecasters, particularly in the short-term ?**
- **What will the data provide above what we are already getting from satellites and manned planes ?**
- **Where are the current data gaps, and what combination of UAS(s) and sensors would serve to fill those gaps ?**
- **Could the UAS test platform(s) be used to develop and test new instruments ?**

Satellite

- **Continuing to exploit current satellite data**
 - **Positive impact of satellite data for SHIPS**
 - **Data assimilation into NWP**
 - **Identification of signals of secondary eyewall formation**
 - **Precursor of eyewall replacement cycles**
 - **WindSat**
 - **Advanced Dvorak Technique (ADT)**
 - **Satellite-based Tropical Cyclone Current Intensity Consensus (SATCON)**
- **Future**
 - **Prepare to exploit data from future satellites: COSMIC, GPM, NPOESS, GOES-R+**

Summary / Next Step

- **Have developed framework of future tropical cyclone airborne / space-based tropical cyclone observation needs and requirements**
- **As required, form Joint Action Group to review / refine**
 - **Develop interagency plan for future airborne / spaced-based tropical cyclone recon / observation**