“Operational deployments of drifting buoys into targeted Tropical Cyclones”

by

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SUMMARY

Result: Joint operations by ONR and NOAA

Drifter Deployment are by C-130 aircraft36 hours ahead of Tropical Storm Winds

Training Exercises of Deployments into Hurricanes:

September 2003 *(Fabian 11 of 16 survived)*
September 2004 *(Frances 38 of 39 survived)*

Operational Deployments in Atlantic and Pacific Tropical Cyclones

September 2005 *(Rita, 20 of 20 survived, all 8 T-chains worked)*
August 2007 (*Dean, 12 of 12 survived, all 8 T-chains worked)*
September *2008 (Gustav, 12 of 12 survived, all T-chains worked)*
Se;tember 2008 (Ike, 8 of 9 survived, 5 of 6
September 2008 *(Hagupit, 12 of 12 survived, all 6 T-chains worked)*
September 2008 *(Changmi, 11 of 12 survived, all 6 T-chains worked)*

SUMMARY

Result: Joint operations by ONR and NOAA

Drifter Data

Atmospheric Pressure

- Computation of cyclostophic wind speed agrees with NOAA U* Winds.

Wind Direction

- Radial wind component is computed from azimuthal cyclostrophic winds

Wind Speed

- WOTAN wind speed verified by QSCAT to 20-25 m/sec

Sea Surface Temperature and Cold Wake

- Wakes for: Fabain Frances,Rita, Dean; cold wake ahead of eye

Sub-surface Temperature

- New data set from Rita, Dean, Gustav, Ike, Hagupit, Changmi - T change dto 150m depth

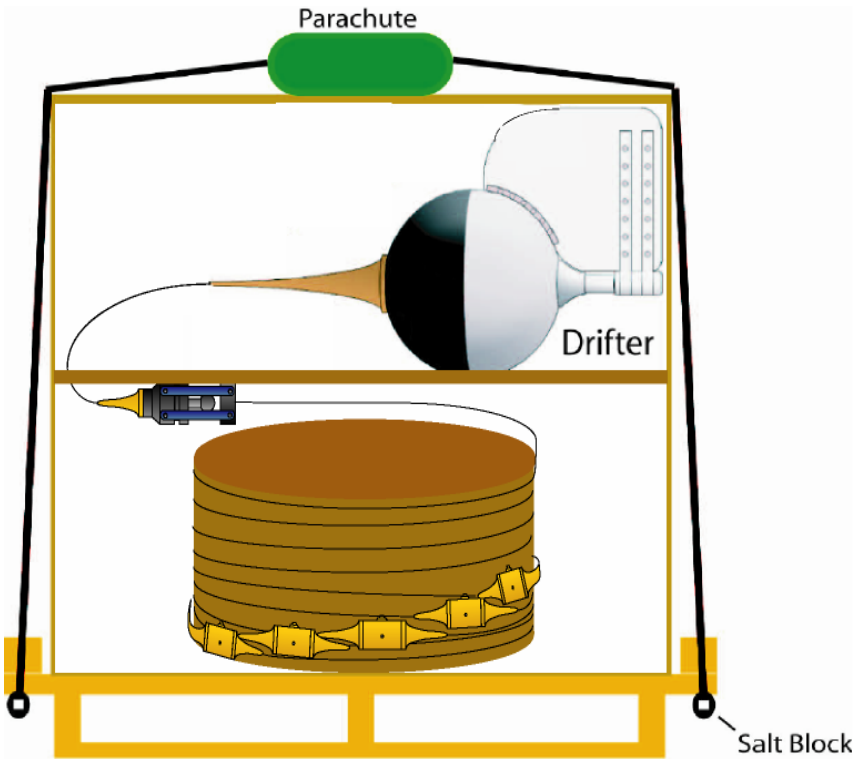
Ocean Response Models

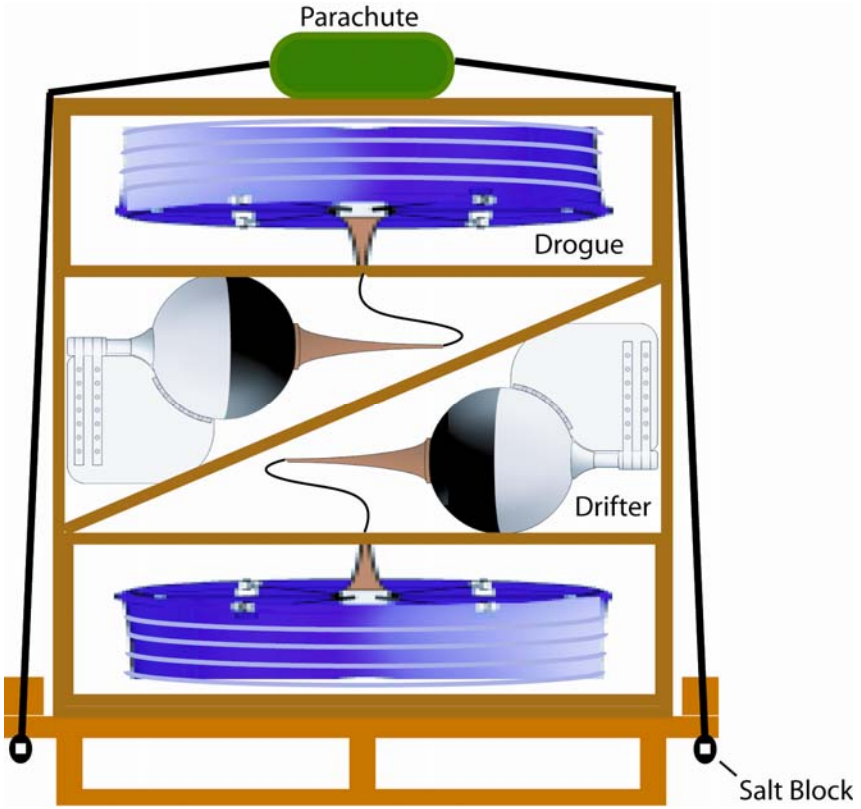
Different drag coefficients used in Frances simulation

- Observed SST change can constrain drag coefficient at high winds

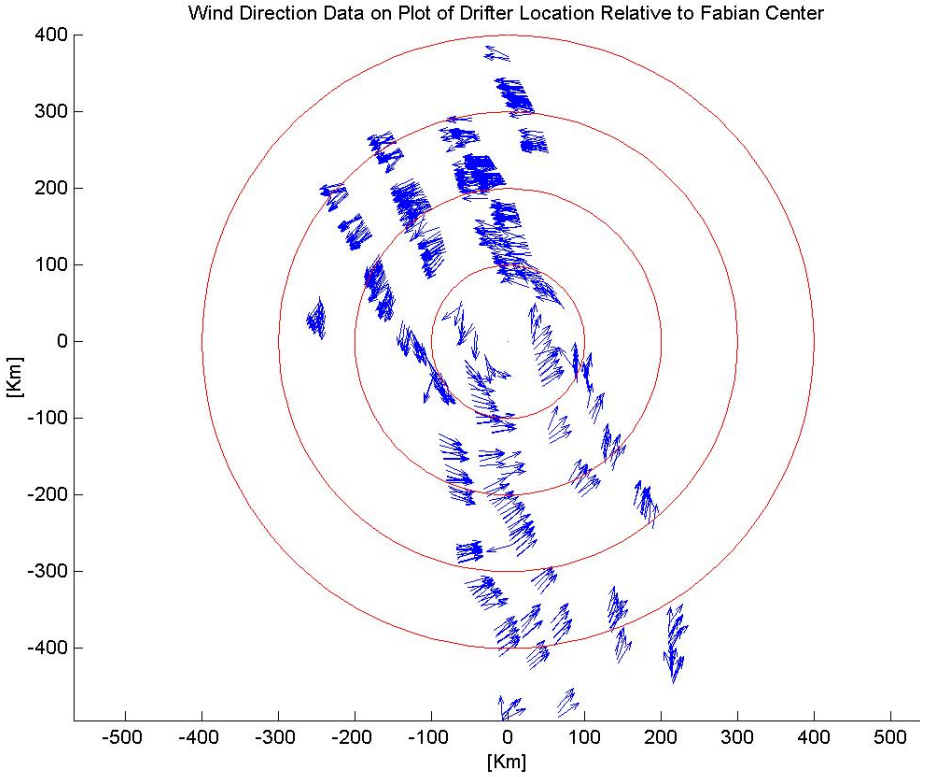
Operational Future: Multiple arrays of SVP-W-TC and SVP-W

Deployment Packaging

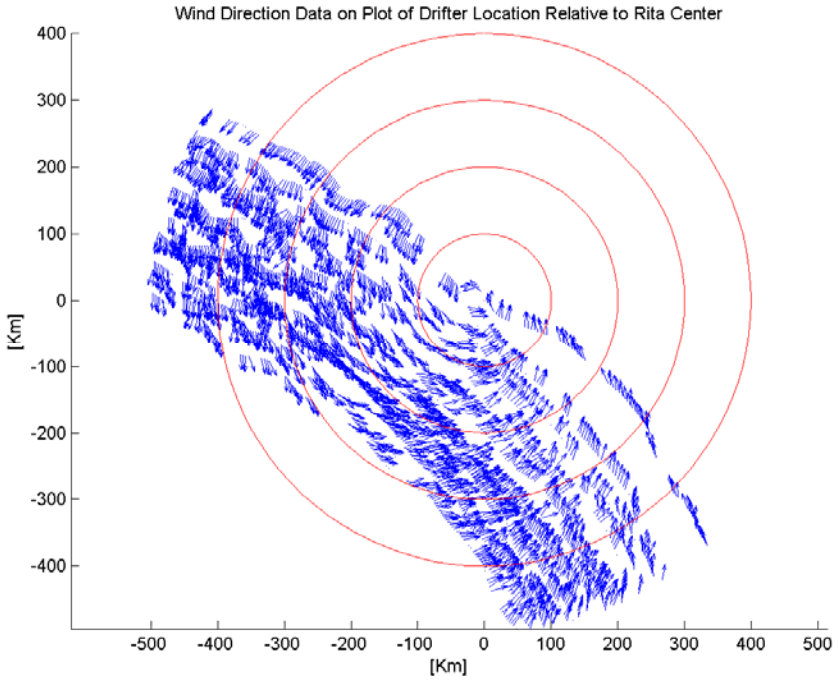




Data Location on Global Telecommunication System (GTS)

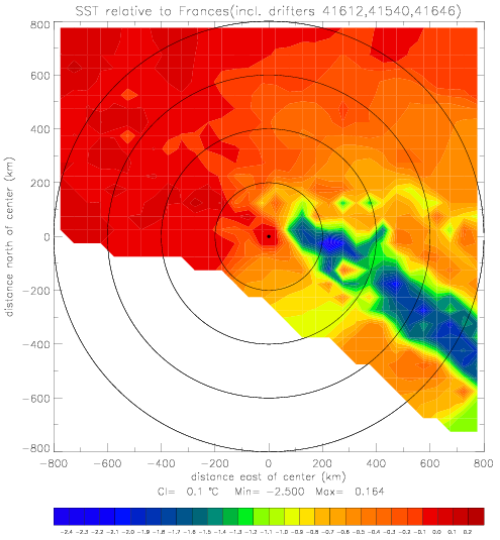


Fabian

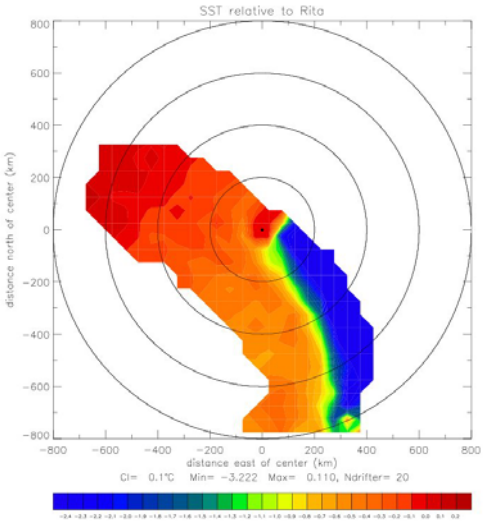


Frances

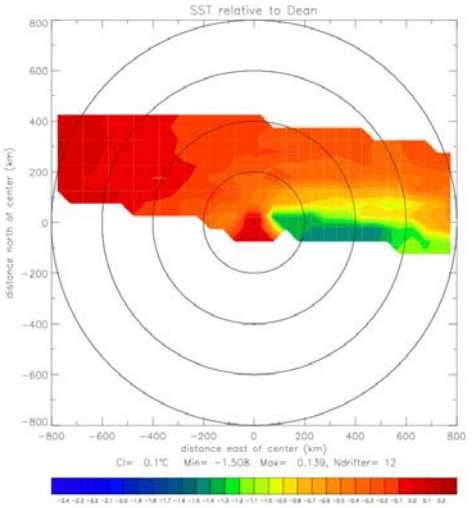
Change of SST relative to Cyclone center



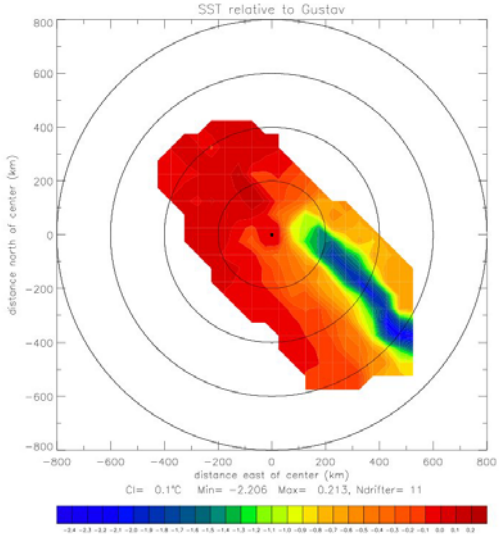
Frances 2004



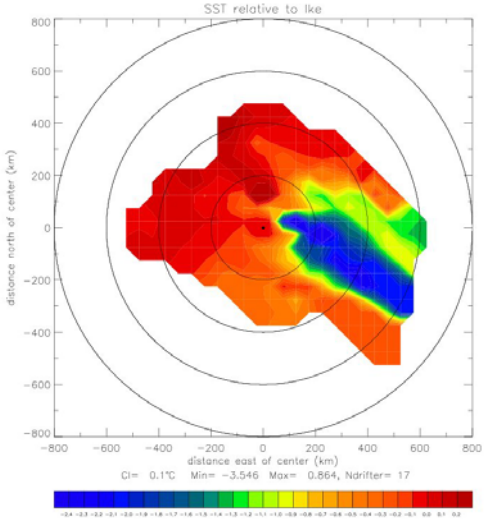
Rita 2005



Dean 2007



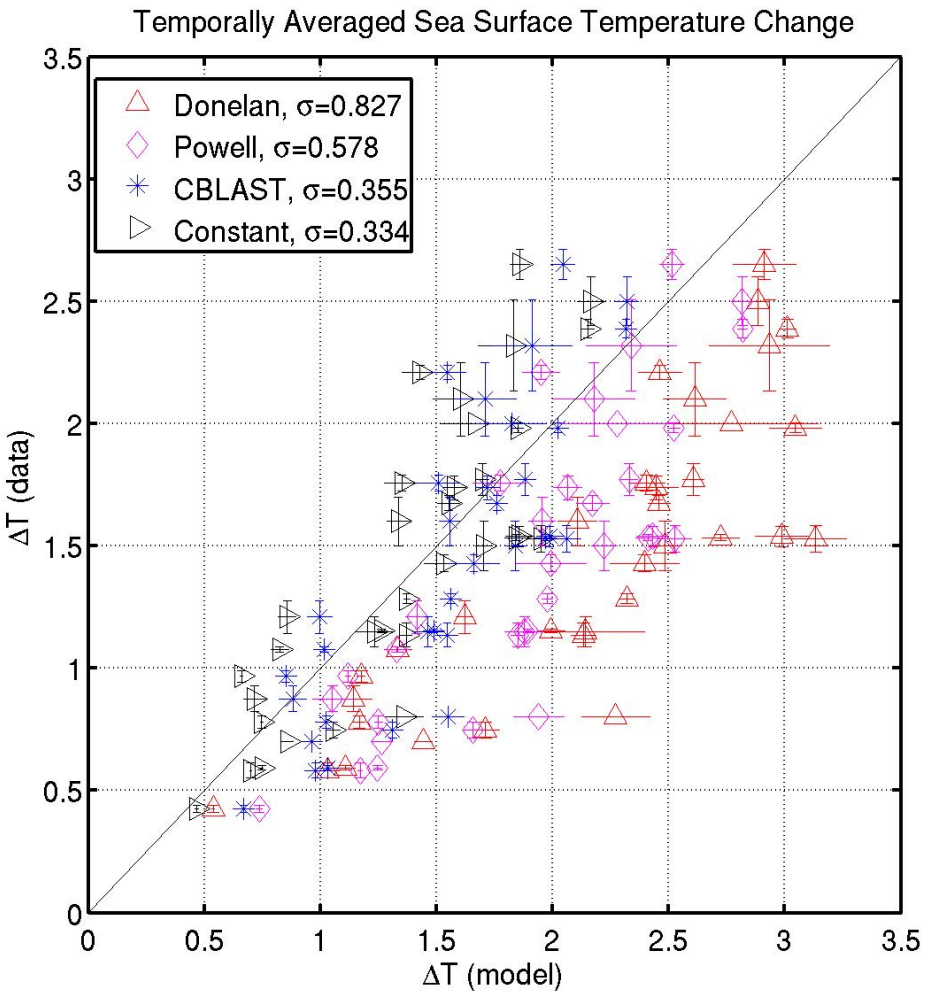
Gustav 2008



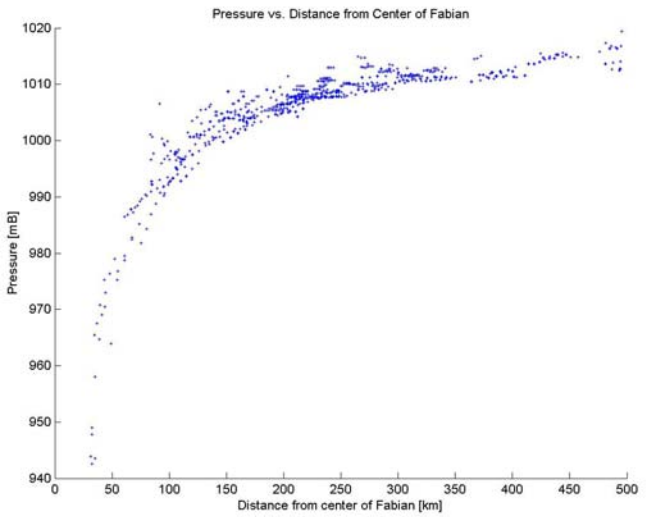
Ike 2008

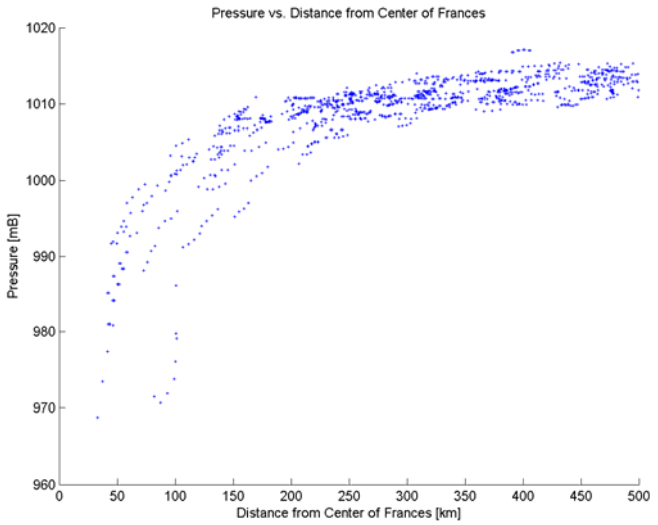
MIT/OGCM Model simulated vs observed change of SST averaged 24 hours before and after passage of *Frances* for different C_D formulations. Best model agreement of hurricane is with low stress drag coefficient.

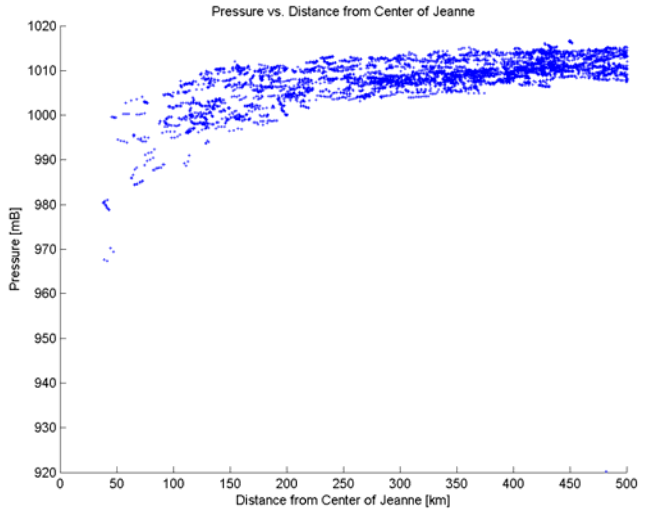
(Courtesy of S. Zedler)

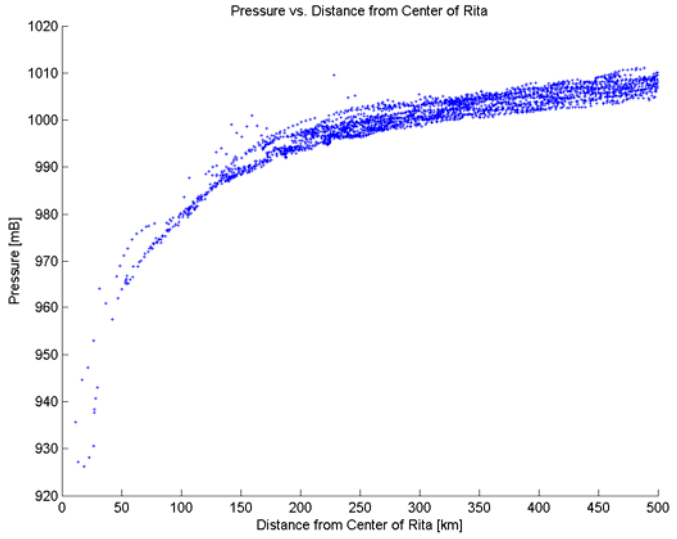


Sea Level Pressure





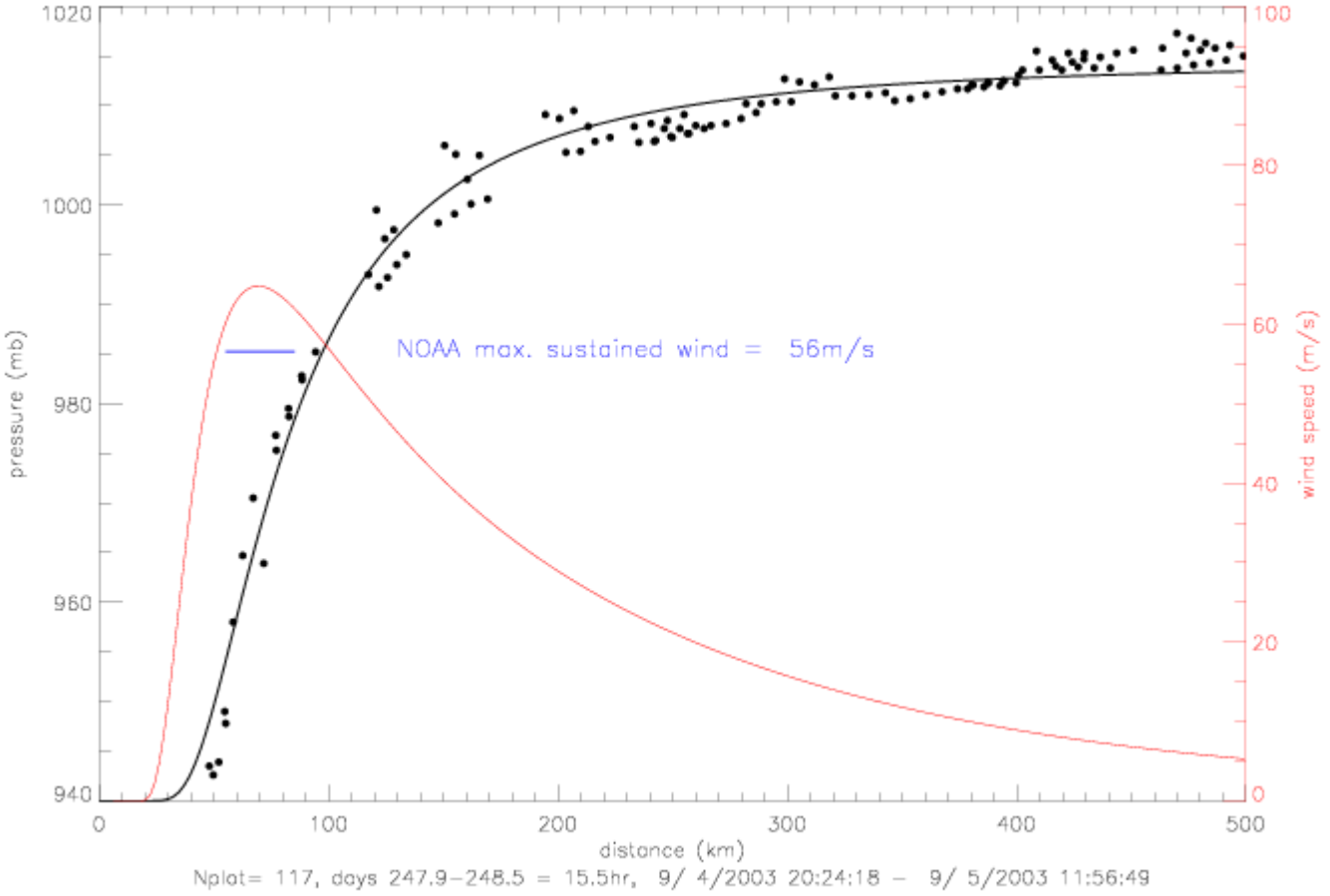




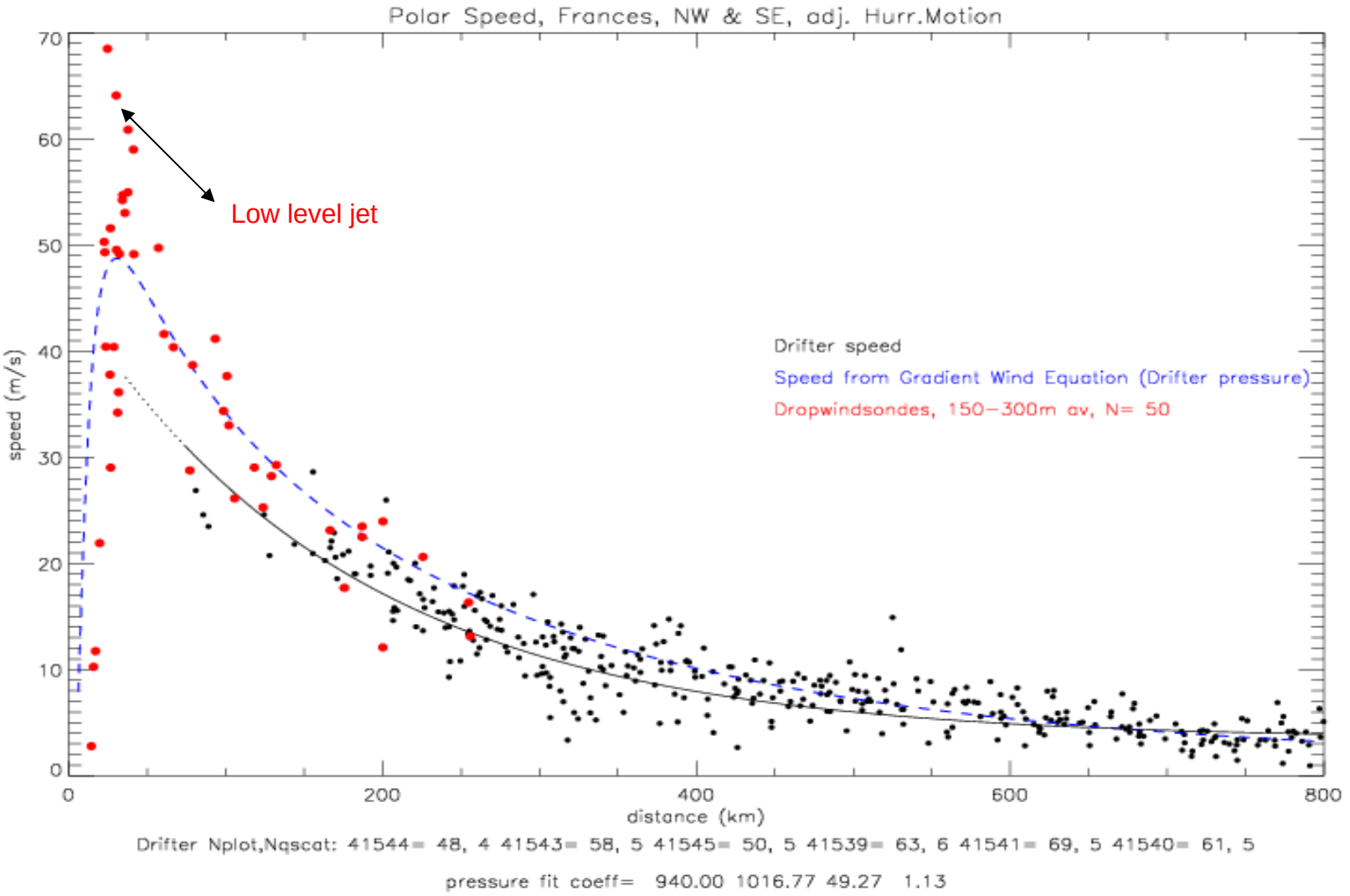
Cyclostophic Gradient Wind Approximation

$$V^*V/r + f^*V = 1/\rho * dPa/dr$$

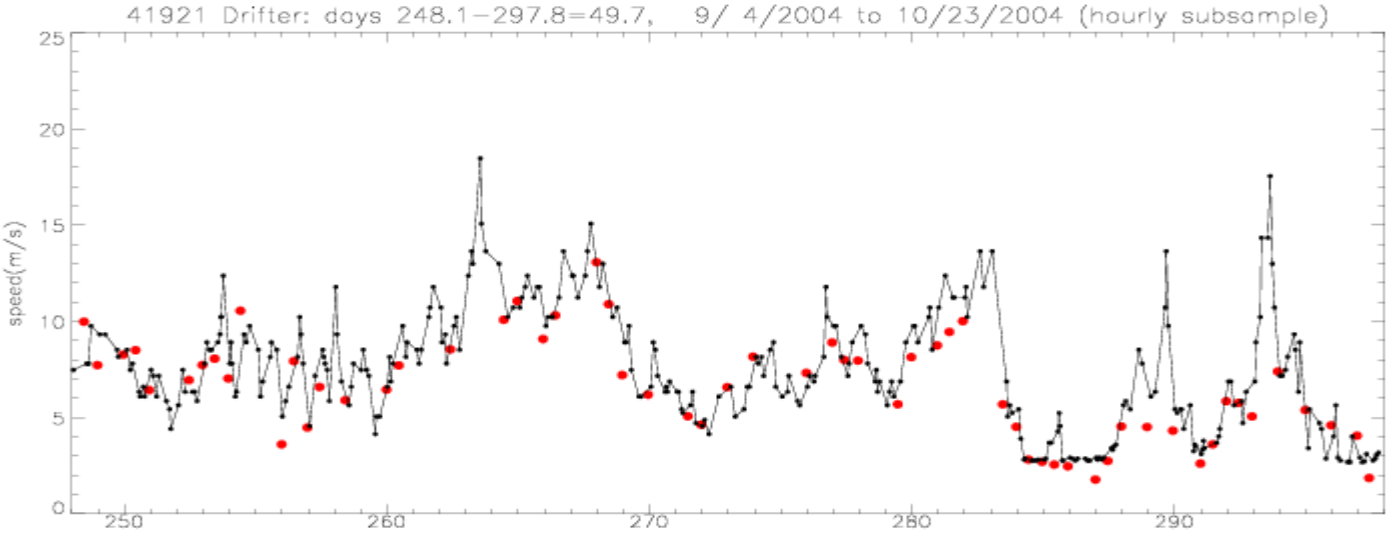
Drifter measured atmospheric pressure yields surface wind speed in Fabian

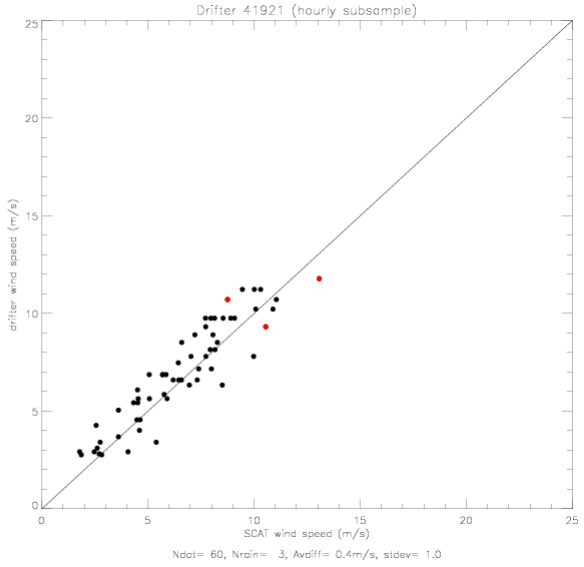


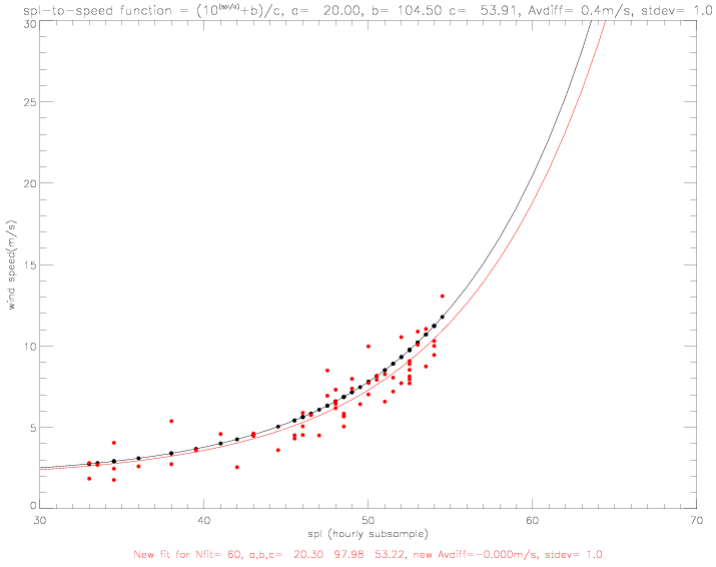
Comparison of azimuthal wind speed from drifter (black), pressure (blue) and dropsonde (red) observations in Hurricane Frances



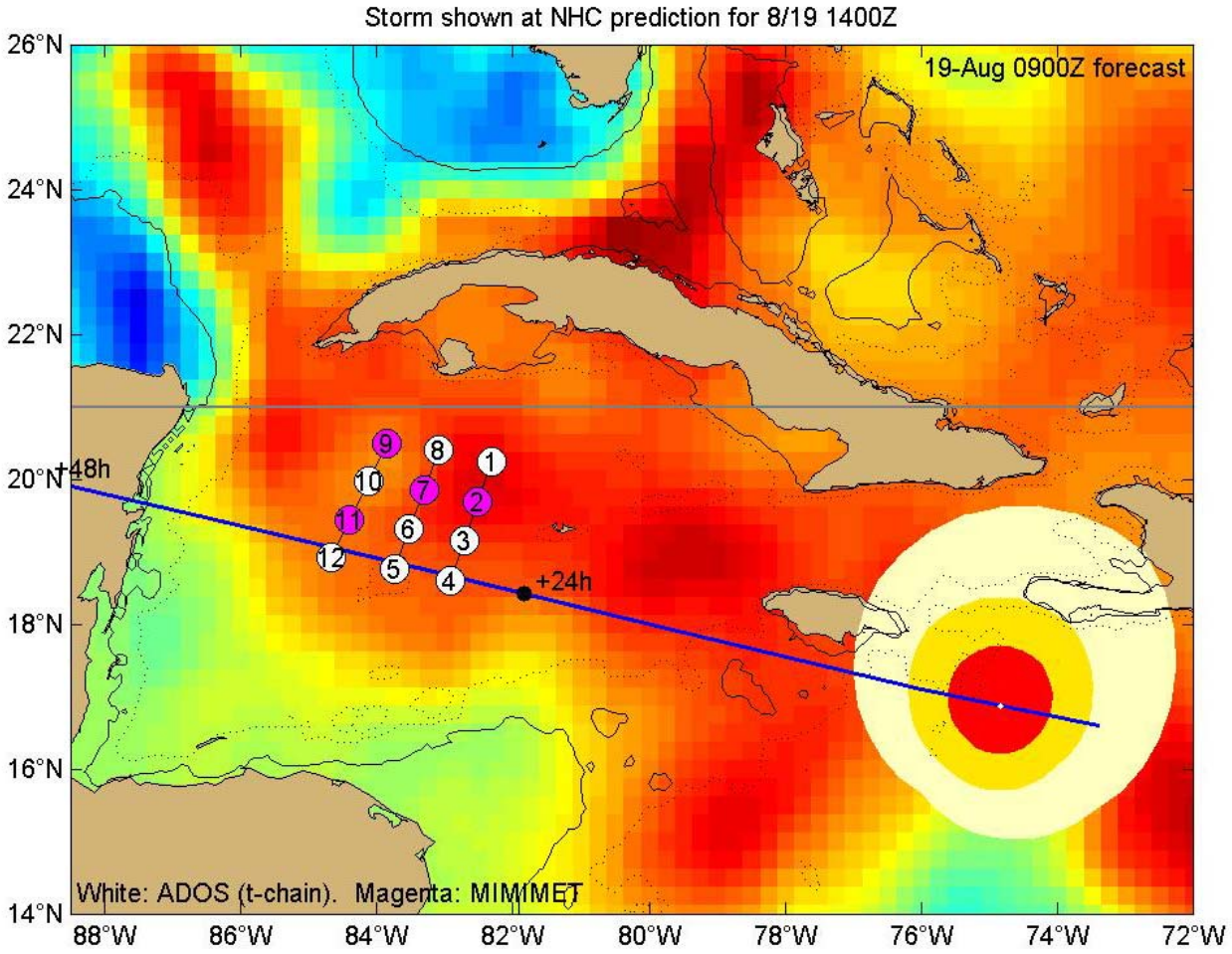
SVP-W wind speed in Trade wind conditions, hourly average



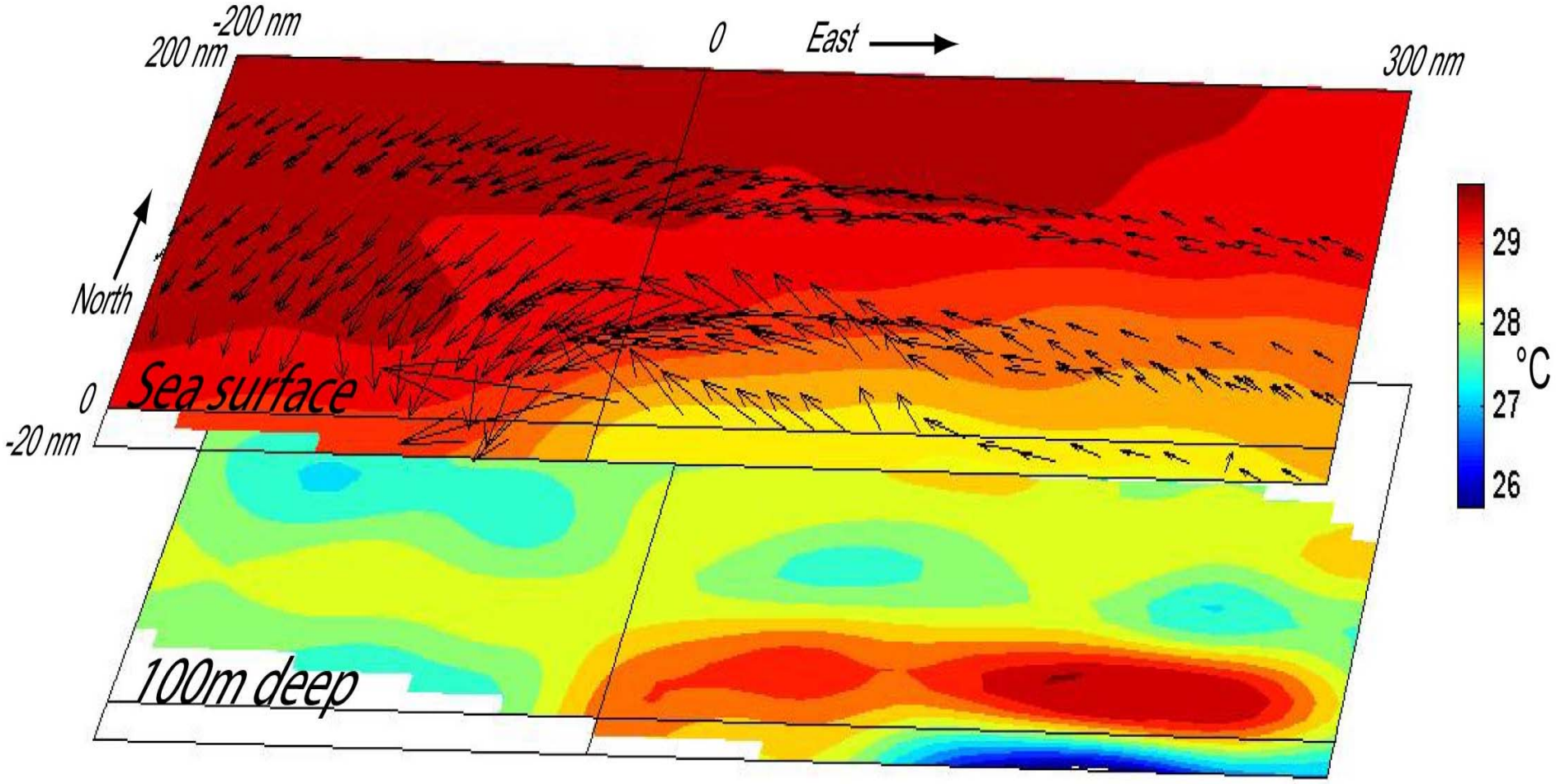




Drifters deployed 36 hours ahead of Hurricane *Dean*

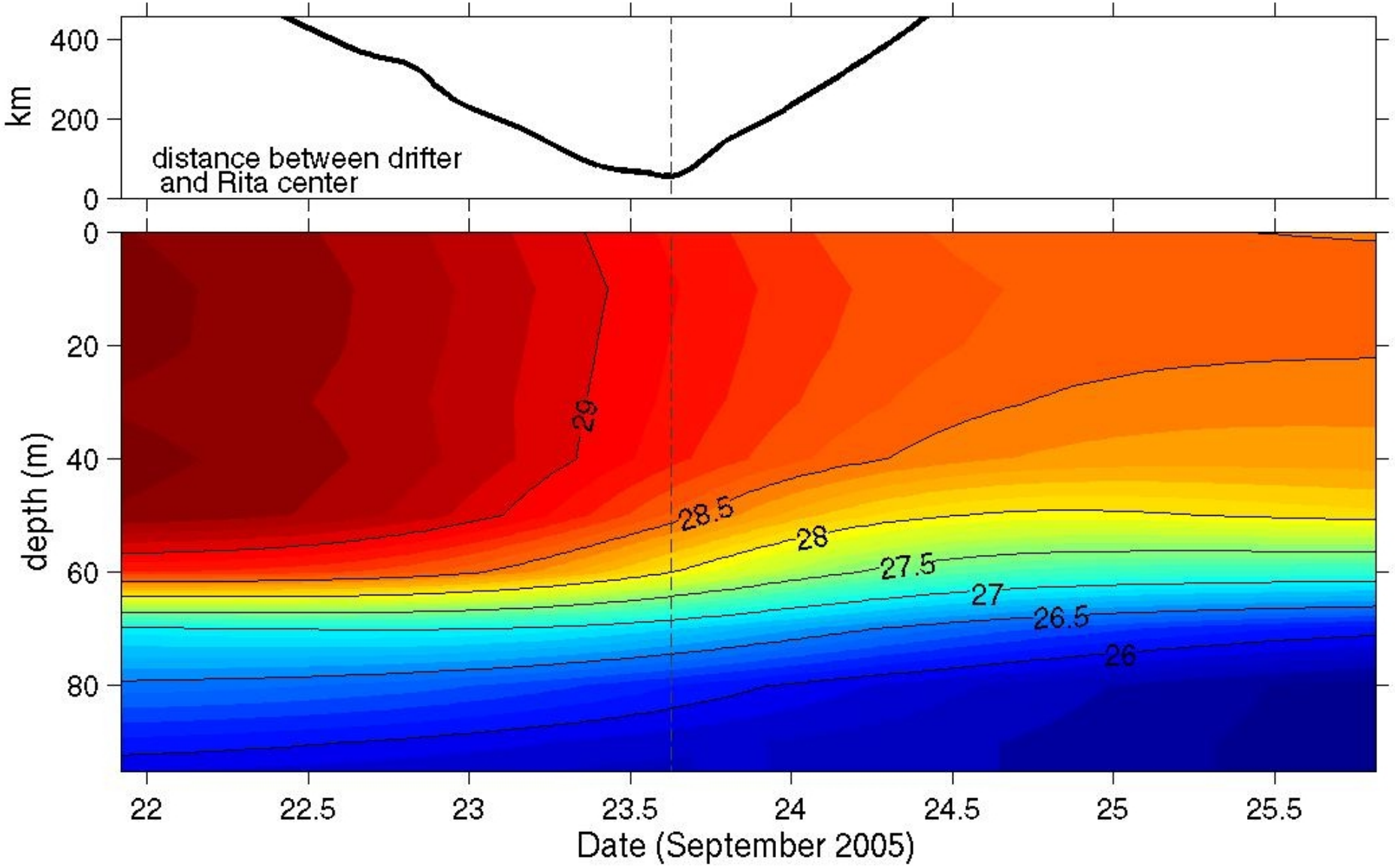


Top: Hurricane *Dean* Sea surface temperature (shading, °C) and winds (arrows) measured by the hurricane drifter array at top. Bottom: subsurface temperatures at a depth of 100m



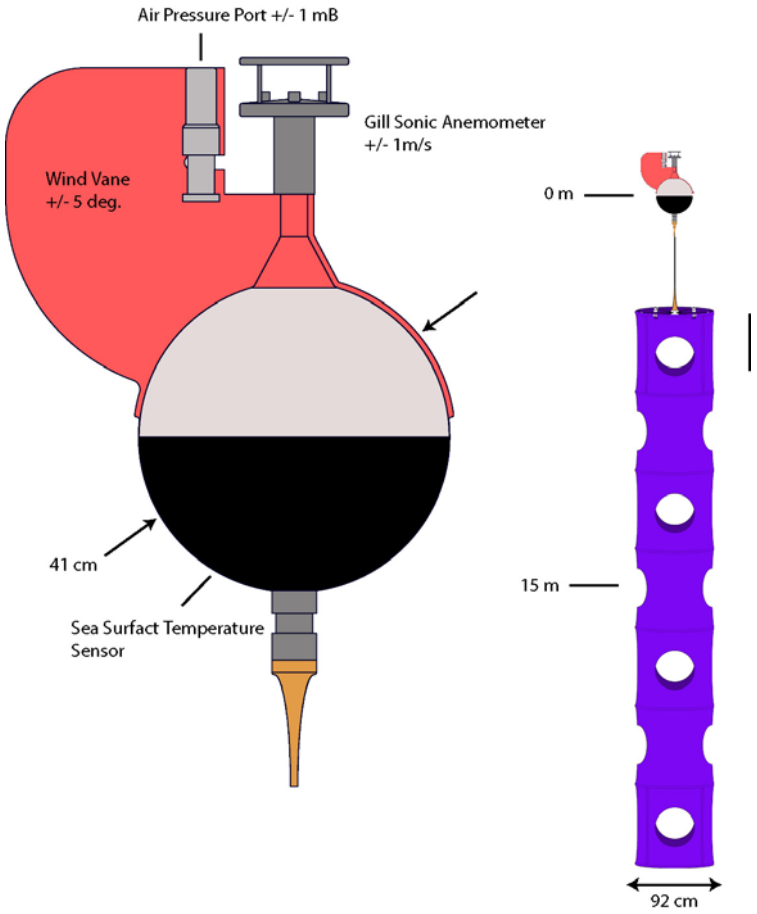
Sub-surface Data - *Rita*

Note that SST changes before storm center arrives

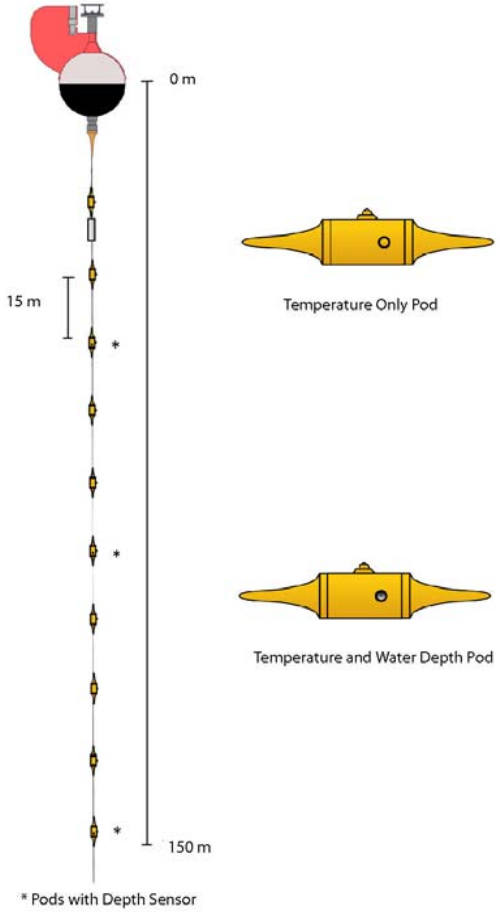


New Sonic Minimet and T-chain Drifters for Tropical Cyclone studies

Sonic Minimet Drifter



Sonic T-Chain Drifter



CONCLUSIONS

- “Operational” system for targeted C-130 air deployments of various SVP drifters is completed.
- “High quality” measurements of Pa, SST, wind direction and T(z=150m) through hurricanes can be made
- Wind speed sensors are being improved with sonic anemometers
- All data is available in operational mode on GTS and delayed mode for model verificatioin and research