Using the Aerosonde UAV During the the 2005 Atlantic Hurricane Season

Principal Investigator: Joseph J. Cione

NOAA's Hurricane Research Division

Co-collaborators: Jason Dunion (CIMAS/HRD); Eric Uhlhorn (CIMAS/HRD); Greg Holland(NCAR/MMM); Brenda Mulac (Aerosonde Corporation); Chris Sisco (NWS/NHC)

IHC 2005

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Project Goal:

Successfully fly an Aerosonde UAV into a Tropical Cyclone during the 2005 N. Atlantic hurricane season

(low level boundary layer flight(s))

Funding:

Joint NOAA/OAR, NASA, Aerosonde Corporation effort…

Resources Available:

75h Aerosonde flight for the upcoming 2005 season…

(Originally slotted for 2004…carried over to 2005)

Other Key Participants:

NHC, CARCAH

Standard Dimensions and Ranges of Operation for the Aerosonde

The following are the specifications for the Aerosonde platform:

WINGSPAN:	2.9m
ENGINE:	24cc fuel injected
FLIGHT SPEED RANGE:	15m s - 60m s
MAX RANGE:	2500 km (less for high speed, low altitude missions)
MAX DURATION:	25 hr (less for high speed, low altitude missions)
MAX PAYLOAD:	2kg (w/full fuel compliment)
AVAIL AUX POWER:	20-30 Watt sustained
ALTITUDE RANGE:	100m-5000 m (Š50m possible in certain cases)
COMMUNICATION:	radio com (line of site) and satom (Iridium)
MINIMUM DATA RATE	9.6 kbps
MAX WINDS (so far):	100kts+. (squall line convection)
LAUNCH /RECOVERY:	car/roof-rack system (55mph launch speed needed)
OPERATION LOCATION:	can monitor/modify flight track anywhere (see range map) (need: PC with Aerosonde's software and internet access)

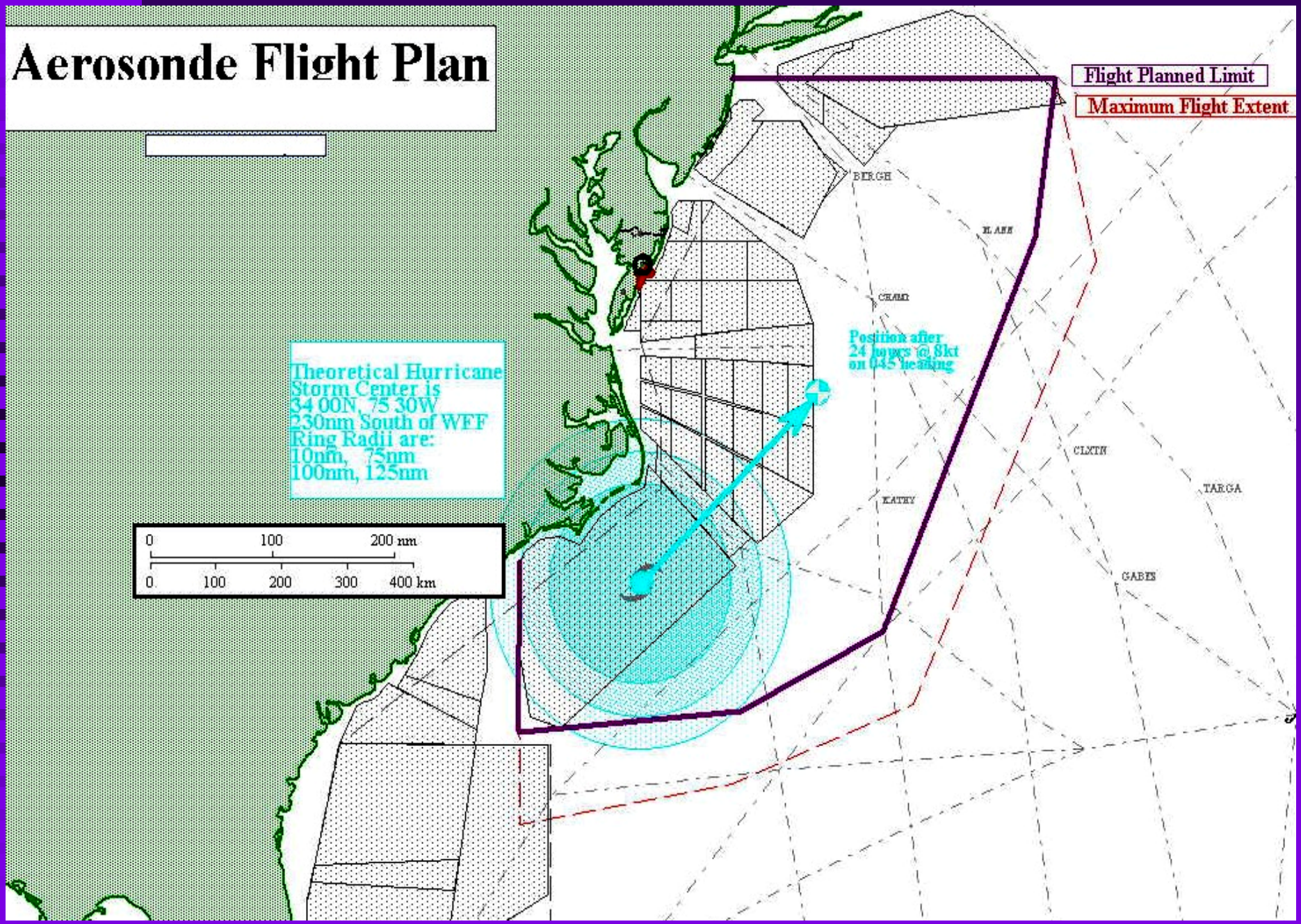
<u>Specific Aerosonde Instrumentation Requested for use in this study:</u>

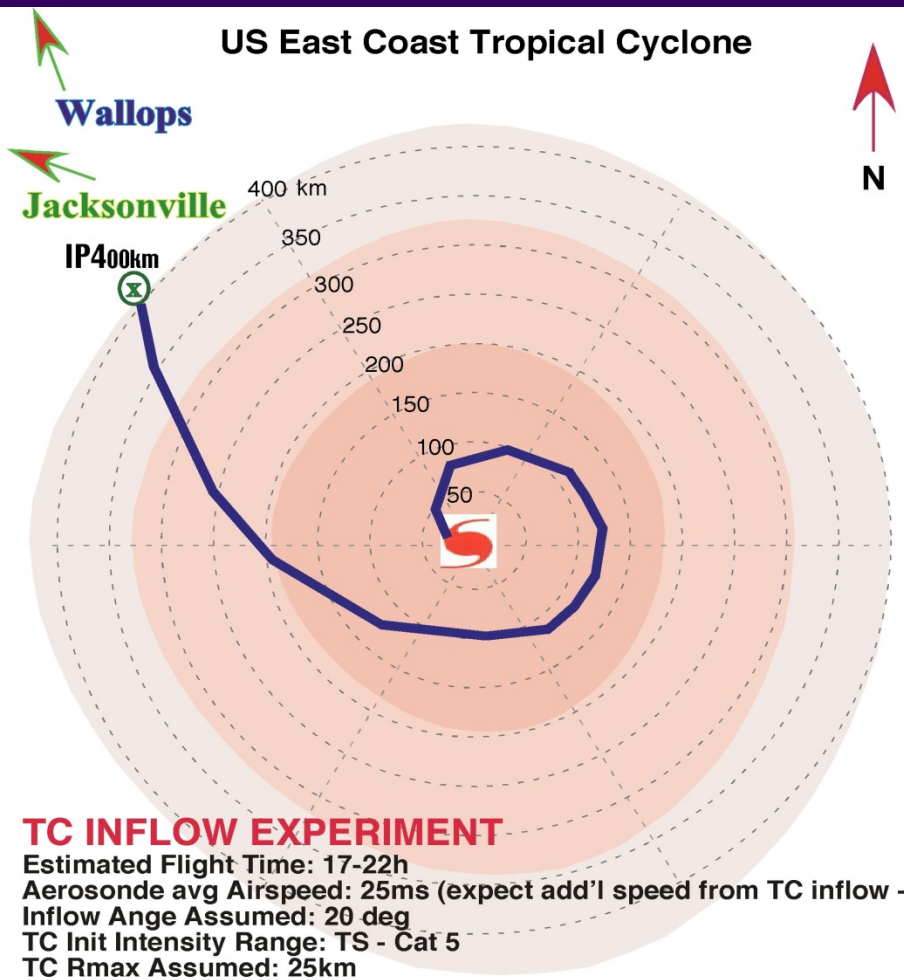
STANDARD MET PACKAGE:

Pressure, Temperature, Relative Humidity and Winds (Viasala w/1 backup; Errors:1hPa; 0.1 C; 2-5%RH; 1 m s^{-1})

OTHER REQUIRED SENSORS:

IR sensor (for surface T/SST); PMS (down to 10 microns);
Visible still imagery *POSSIBLE? ===> Mini PMS?*


Aerosonde Flight Plan
Flight Planned Limit
Maximum Flight Extent
BERGH
KATHY
CLXTN
TARGA
GABES
Theoretical Hurricane
Storm Center is
34 00N, 75 30W
230nm South of WFF
Ring Radii are:
10nm, 75nm
100nm, 125nm
0 100 200 nm
0 100 200 300 400 km



TC INFLOW EXPERIMENT

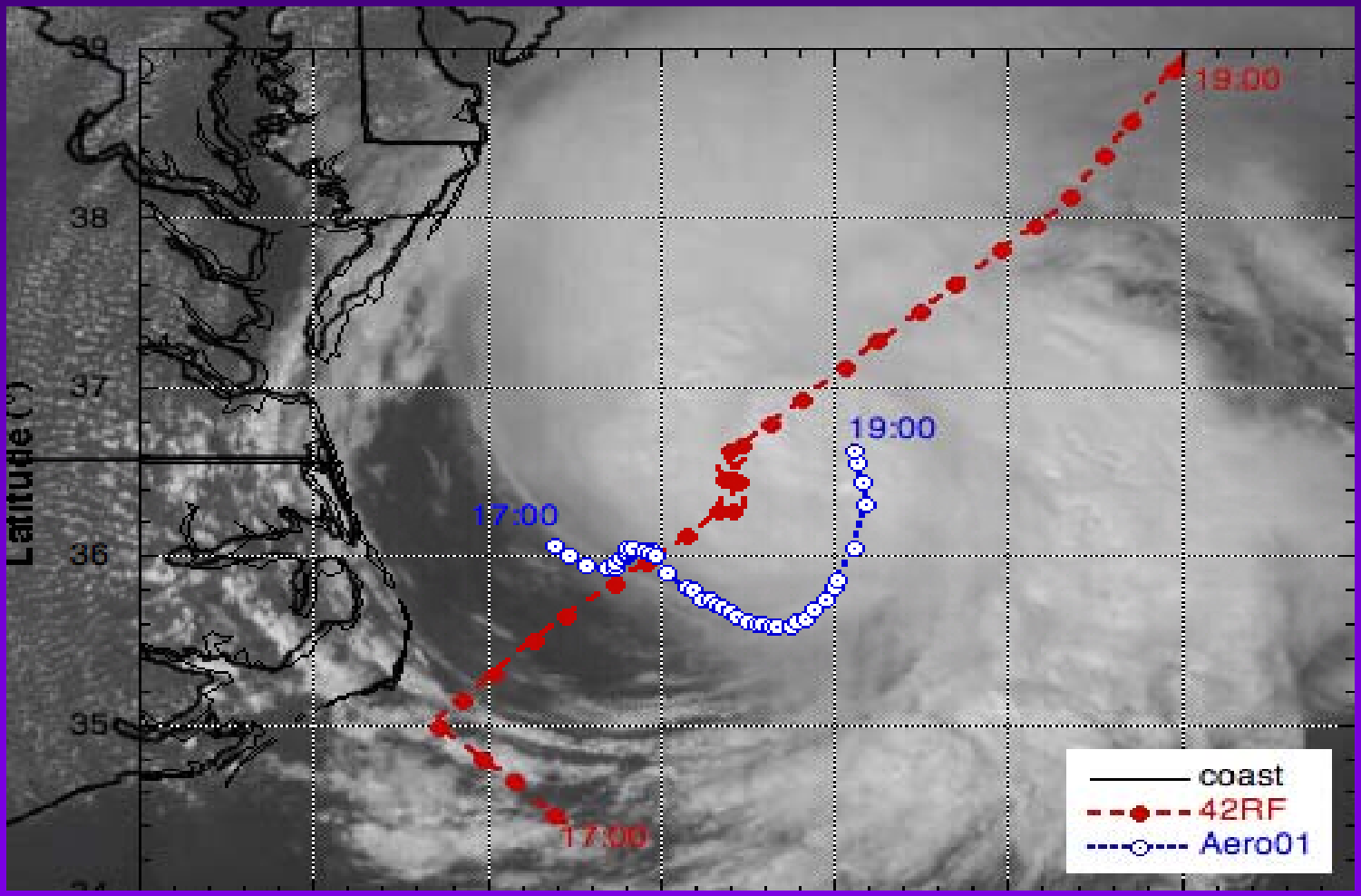
Estimated Flight Time: 17-22h
Aerosonde avg Airspeed: 25ms (expect add'l speed from TC inflow - Vr)
Inflow Ange Assumed: 20 deg
TC Init Intensity Range: TS - Cat 5
TC Rmax Assumed: 25km
Experiment Notes/Specifics -
Possible Origins: Wallops Flight Facility, Va // Jacksonville, Fla
Pre-IP: Aerosonde-Coastal Buoy/C-Man 50-100m comparisons (SST,Ta,Td,P,V)
IP: 400km from TC center (Initial IP flight level: 750m)
Descend to 50-100m (IR SST retrieval). Remain at 50-100m until 350km
At 350km, ascend to 700m, remain at 700m until 300km
Descend to 100m, remain at 100m until 250km
At 250km, ascend to 700m, remain at 700m until 200km
From 200-100km, continuous 700m-100m soundings (briefly below 100m if possible)
At 100km, ascend from 100m to 500m for eyewall penetration
In eye, descend to 50-100m (IR SST retreival) then corksrew eye sounding to 2km
Corkscrew descent in eye from 2km to 750m for final eyewall penetration
RETURN TO ORIGIN

AEROSONDE FLIGHT LIMITATIONS...

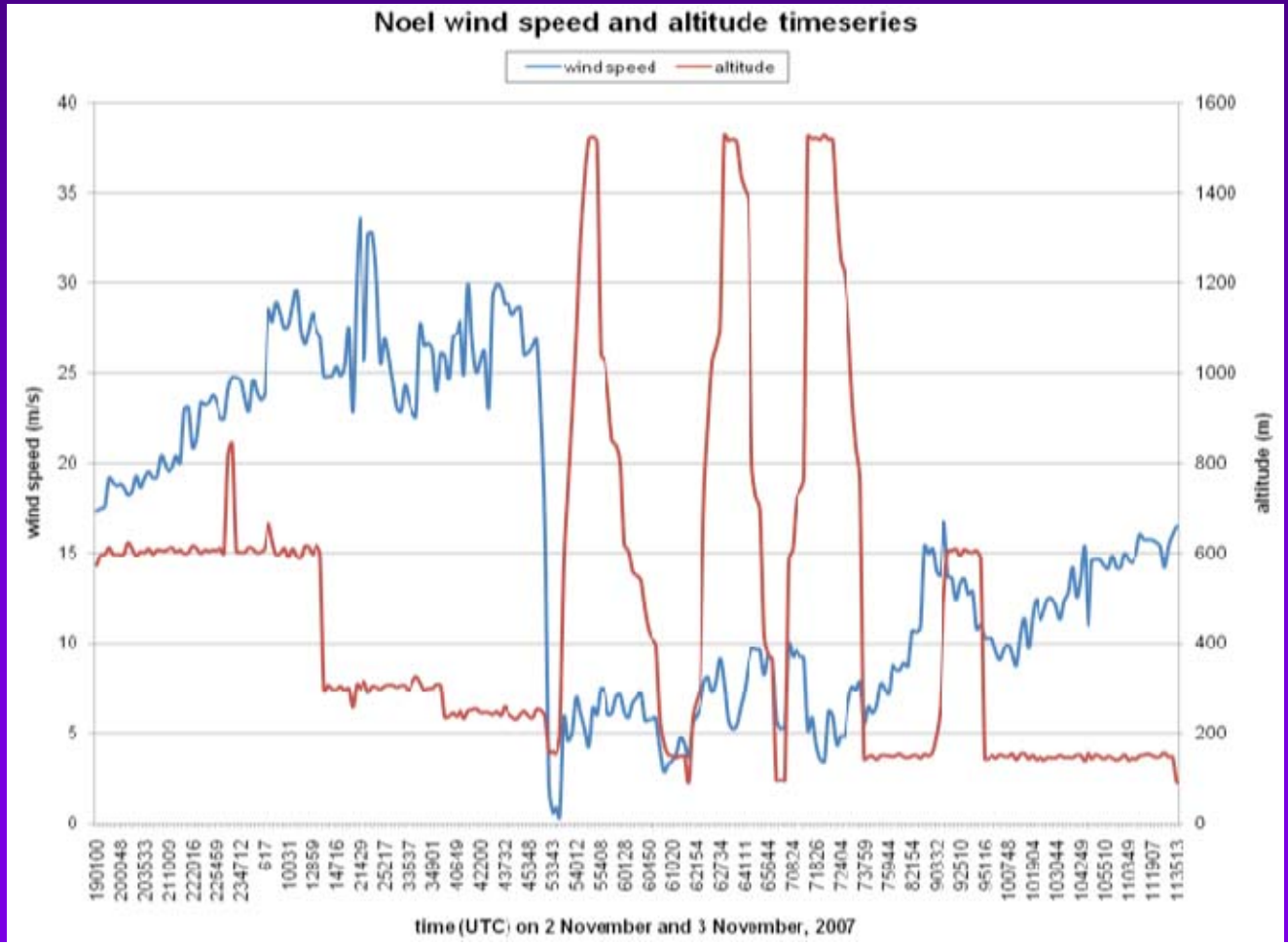
The following flight constraints were placed on the Aerosonde during CAMEX-4 in 2001. These limitations will also be used during the 2005 Atlantic Hurricane Season for any proposed Aerosonde mission.

1) ***Autonomous flight termination at 2500ft***
2) *Autonomous flight termination on lost SATCOM link (Iridium) SATCOM link timeout to be set at 45min*
3) *Flight termination ability from AMPI Aerosonde Mission Planning Interface*
4) *AMPI to be setup in CARCAH with Aerosonde operator present*
5) *On command from CARCAH the aerosonde must terminate the flight if there are separation conflicts*
6) *When the 53rd AF has been tasked for a low level invest or fix, there will be no Aerosonde flights* ***Specifically added for 2005 flight plans***

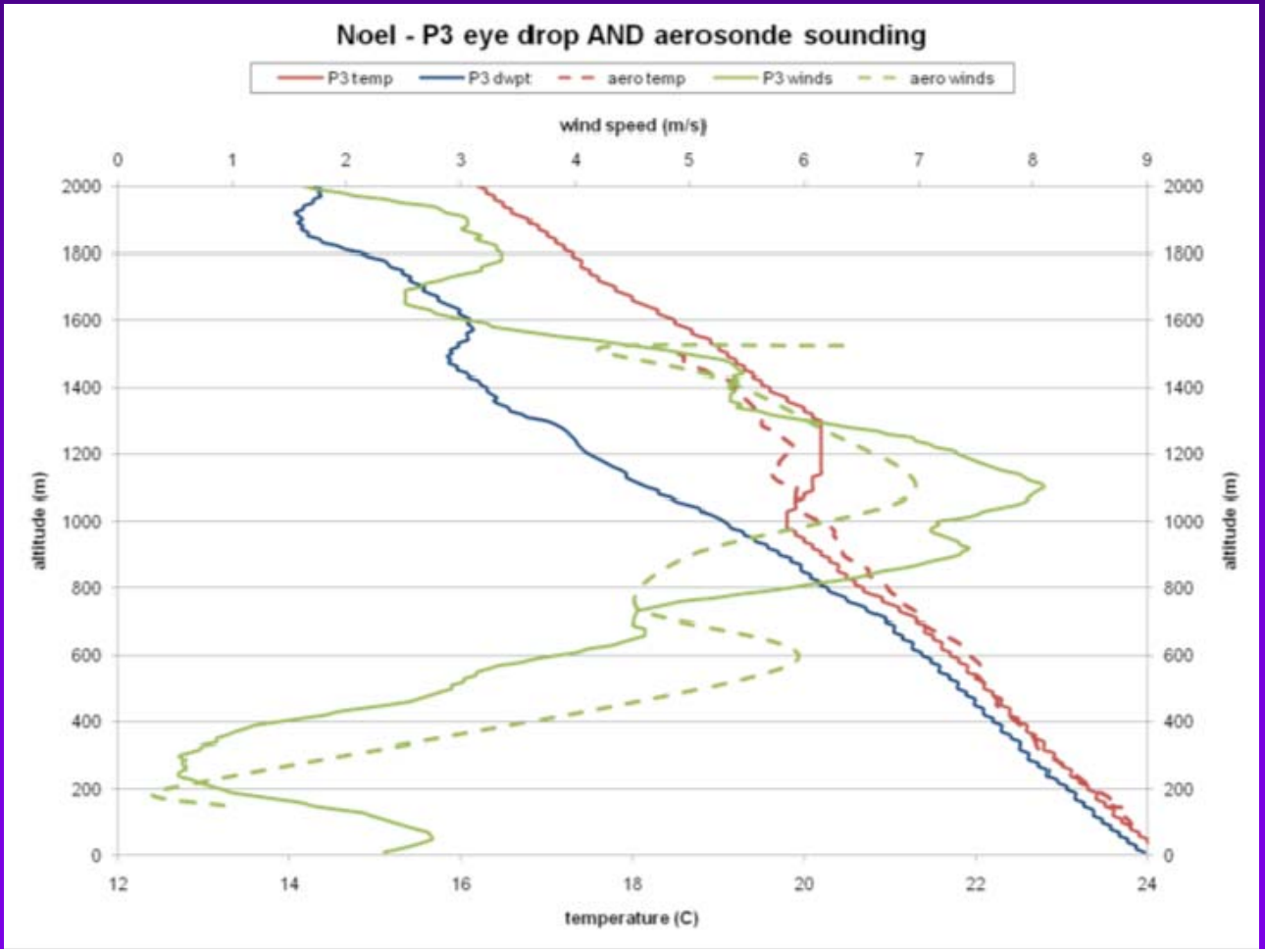
P-3 (red) & Aerosonde (blue) tracks in Tropical Storm Ophelia, Sept 16, 2005



Aerosonde altitude & wind speed, showing transition into low winds of eye, Nov. 2, 2007, Hurricane Noel



Comparison P-3 and Aerosonde wind speed & temp (dewpt=blue, failed on Aerosonde). Hurricane Noel 11/2/2007



Summary Results: Ophelia (2005) and Noel (2007)

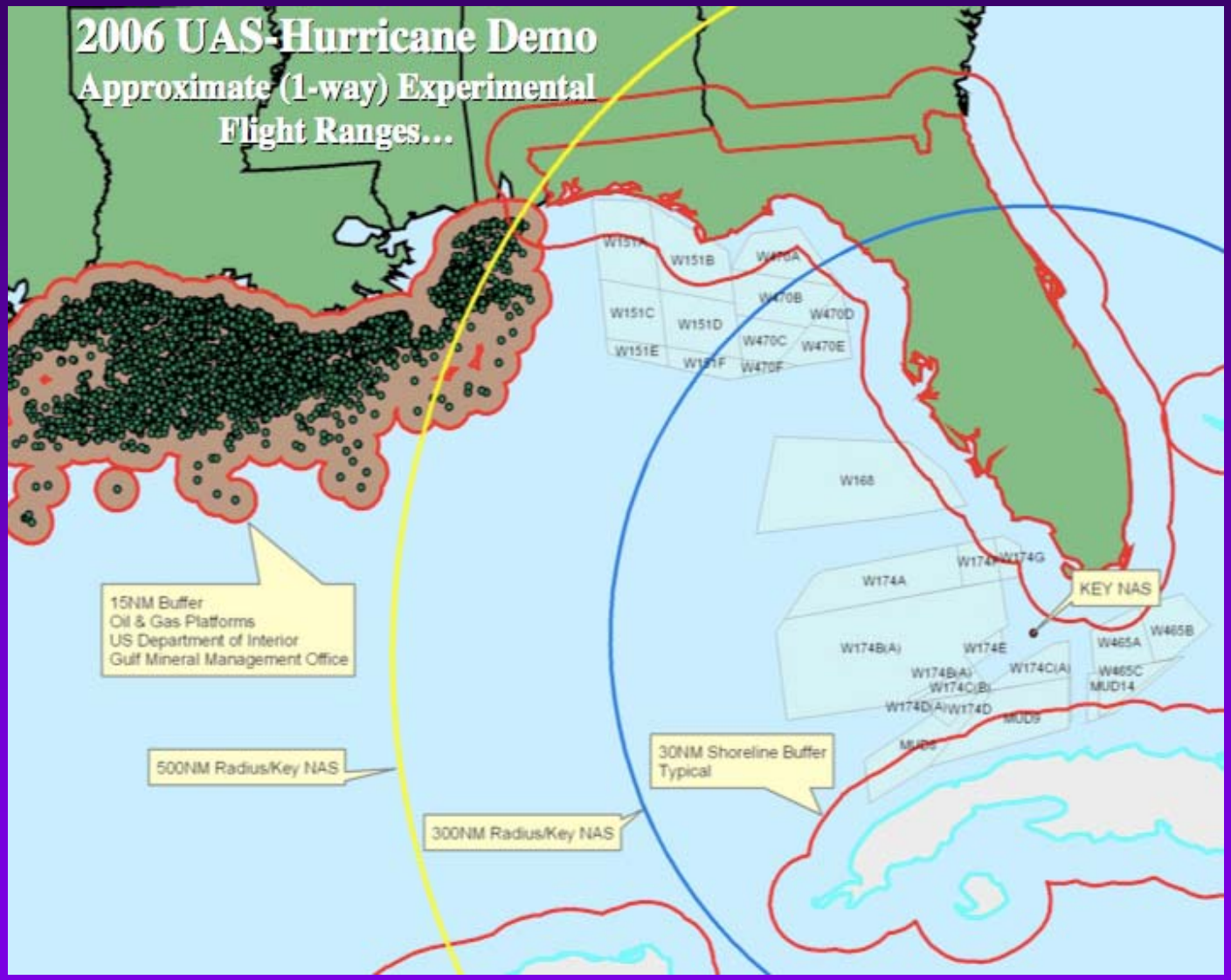
Opehlia: Flew 300-800m, 10 hrs, to 55 kt (115mph) winds,

IR SST sensor failed, heavy (1lb.), not using again

Noel: Flew 82-1500m, mostly 100-500m, 17hrs,

Rh (moisture) sensor saturated, believed due to salt spray, low flight altitude. Can use different sensor.

Intended 2006 Op area out of KW NAS



Lessons Learned:

- UAS data continuous, better than dropsondes
- FAA CoA process >12 months, still requires instrument flight rules
- Important to streamline in-flight comms coordination among stakeholders
- Close coordination w USN, AF needed to deconflict their airspace use (including covert)
- Land-based launches reduce endurance on scene
- Nov.06- 1st ever lo-altitude CoA for UAS; useful to extend CoA NY Oceanic airspace N. of 18oN
- Barbados contacts in place, good for future use