| **MISSION PLAN** | | | |
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| **FLIGHT ID** | 20230909H1 | **STORM** | AL13/LEE |
| **MISSION ID** | 0913A | **TAIL NUMBER** | NOAA-42 |
| **TASKING** | EMC | **PLANNED PATTERN** | Butterfly |
| **MISSION SUMMARY** | | | |
| **TAKEOFF [UTC]** | 2024 | **LANDING [UTC]** | 0254 |
| **TAKEOFF LOCATION** | STX | **LANDING LOCATION** | STX |
| **FLIGHT TIME** | 6.5 | **BLOCK TIME** | 6.7 |
| **TOTAL REAL-TIME RADAR ANALYSES**  **(Transmitted)** | 5 (5) | **TOTAL DROPSONDES Deployed (Transmitted)** | 31 (29) |
| **OCEAN EXPENDABLES (Type)** | 4 (4) AXBTs | **sUAS (Type)** | N/A |
| **APHEX EXPERIMENTS / MODULES** | Ocean Winds Module | | |
| **HRD CREW MANIFEST** | | | |
| **LPS ONBOARD** | Hazelton | **LPS GROUND** | Rogers |
| **TDR ONBOARD** | Hazelton | **TDR GROUND** | Alvey |
| **ASPEN ONBOARD** | Sellwood | **ASPEN GROUND** |  |
| **NESDIS SCIENTISTS** | Zhang, Sapp, Jelenak, Bjorland | | |
| **GUESTS (Affiliation)** | Buohoo (Axios) | | |
| **AOC CREW MANIFEST** | | | |
| **PILOTS** | Doremus/Rannenberg/Palmer | | |
| **NAVIGATOR** | Hough/Schaefer | | |
| **FLIGHT ENGINEERS** | Stokes/Gee | | |
| **FLIGHT DIRECTOR** | Zawislak/Parrish | | |
| **DATA TECHNICIAN** | McAlister | | |
| **AVAPS** | Waggoner/Santoni | | |

| **PRE-FLIGHT** | |
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| **Flight Plan** | *Butterfly pattern, IP on SW side, 105 nm legs. Flight altitude 8 or 10 kft. After completion of the butterfly, attempt several modules, with the order of priority the Ocean Winds module, SFMR wind/wave validation, and FLAIMS (if Lee is intensifying or weakening)* |
| **Expendable Distribution** | *Sondes at endpoints, midpoints, RMWs, centers. 3 RMWs possible if winds seem useful. BTs at initial center, and center and endpoints on last leg.* |
| **Preflight Weather Briefing** | *Lee appears to be a steady-state Category 3 hurricane after battling with some shear and dry air intrusions over the last day. The forecast is for the shear to drop which may allow for some additional intensification in the next day or two.*    *Lee is showing recurring bursting occurring. Initiation of bursts consistent with notion of southwesterly shear impacting the storm. Numerous lightning flashes in the coldest cloud tops as convection develops and matures on the northwest (left of shear) side of storm.* |
| **Instrument Notes** | *Instruments working overall. We are operating with a slightly degraded MMR (no navigation capability)* |

| **IN-FLIGHT** | |
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| **Time [UTC]** | **Event** |
| 2024 | Take-off from STX |
| 2054 | P-3 on ferry to IP, IR image shows obscured eye, CDO, some evidence of banding structures on east side wrapping around to south side, and extending out in the northwest quadrant |
| 2106 | Most recent microwave overpass with good coverage (0914 UTC, or about 12 h prior) showed bands coming out into northwest quadrant, and an outer band wrapping around the east and southeast sides. This appears generally consistent with the IR presentation shown above, even though this microwave image is 12 h old. |
| 2117 | Descending to IP |
| 2126 | At IP, sonde 1, SW endpt |
| 2130 | FL winds 30 m/s even ~80 nm SW of center |
| 2139 | Sonde 2, SW midpt |
| 2139 | Encountered a slight local FL wind maximum about 50 nm SW of center, not really co-located with much precipitation. MMR showing concentric eyewalls. |
| 2146 | Sonde 3, outer eyewall SW. Sonde failed, no backup |
| 2147 | Eye is open SW |
| 2149 | Onboard LPS reports pressure field seems broader than yesterday |
| 2150 | Both FL and SFMR winds show a local spike in winds on SW inbound leg |
| 2150 | Sonde 4, SW inner RMW. |
| 2152 | Sonde 5, center drop, combo (BT1). 29.09 C SST |
| 2154 | Sondes 6,7, rapid-fire drops NE RMW |
| 2155 | Sonde 8, NE RMW |
| 2201 | Concentric eyewalls, inner at 20 nm, outer at 80 nm |
| 2203 | Sonde 9, NE midpt |
| 2208 | Time series of FL and SFMR winds shows a highly asymmetric storm from SW to NE eyewall. Multiple maxima on SW side, some indications on NE side. |
| 2218 | Sonde 10, NE endpt |
| 2245 | Sonde 11, inbound N endpt |
| 2254 | Profile analysis shows outer wind maximum on the SW side, broad wind field with upper-level wind maximum sloping outward on the NE side |
| 2254 | Reflectivity analysis shows broad area of stratiform precipitation, moderate convection on the SW side, deep convection in the NE eyewall and more mixed convective/stratiform region outer NE |
| 2257 | Sonde 12, midpt N |
| 2300 | Storm seems to be pretty aligned between 2 and 6 km |
| 2309 | SFMR plots. Snapshots of possible rain spikes with SFMR wind dropouts in the N eyewall. |
| 2303 | Sonde 13, 1st RMW N |
| 2304 | Sonde 14, 2nd RMW N |
| 2305 | Sonde 15, 3rd RMW N |
| 2306 | Sonde 16, 4th RMW N |
| 2309 | Sonde 17, center |
| 2313 | Sonde 18, RMW S |
| 2318 | Extensive area of lightning in the NW eyewall |
| 2322 | Sonde 19 midpt S |
| 2333 | Sonde 20, endpt S |
| 2351 | Plan for mission after butterfly pattern is complete: We are probably gonna try to come back in from the NW to the center, then go out 45 degrees to a turn point, come back in, drop a sonde (or two) and overfly. Then come back in along that radial, and repeat. Working our way counter-clockwise (downwind) |
| 2352 | Comparisons of SFMR with new IWRAP rain rate and surface 10 m scatterometer wind retrieval (not corrected for rain attenuation yet so they should be lower than SFMR) products |
| 2354 | Sonde 21, endpt SE, combo (BT3), 29.41 C SST |
| 0005 | MMR and nose radar indicate the outer eyewall may be contracting |
| 0006 | Sonde 22, midpt SE |
| 0016 | Sonde 23, RMW SE |
| 0018 | Sonde 24, center drop |
| 0019 | Tilt from 1st to 2nd pass shows 6-km center now NW of 2-km center, possible precession upshear? |
| 0021 | Profile analysis shows very broad wind field on N side, secondary wind maximum at around 120 km N of center |
| 0020 | Sonde 25, 1st NW RMW |
| 0021 | Sonde 26, 2nd NW RMW |
| 0021 | Sonde 27, 3rd NW RMW |
| 0022 | Sonde 28, 4th NW RMW |
| 0023 | MMR picture of the eye at 0018 UTC |
| 0030 | Sonde 29, midpt NW |
| 0044 | Sonde 30, endpt NW, combo |
| 0053 | Sonde 31, end NW (Backup) |
| 0110 | Updated plan for module: inbound from NW, out 45, in 45, drop RMW, to center, overfly splash, inbound from that point, drop RMW, overfly (probably NW/W) and then RTB |
| 0118 | Centers on 3rd pass show vortex better-aligned from previous two passes, toward the N with tilt |
| 0120 | Composite shows strongest winds in eyewall in the NE. Some indication of an outer wind speed max at 3 km in the NW and N quadrants |
| 0121 | Profile on the NW side confirms this outer wind maximum. Multiple maxima in fact (DSL quad). |
| 0127 | MMR view of eyewall at 0119 UTC. Aircraft pointing toward NE, showing asymmetric eyewall open on the S and SE. |
| 0129 | Aircraft coming back inbound as part of Ocean Winds module. Encountering turbulent conditions in the NE eyewall. Lightning in vicinity as well. |
| 0130 | An issue arose with the MMR, mission is cutting off science and modules, and returning to base |
| 0250 | Land in STX |
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|  | << INSERT ADDITIONAL ROW AS NEEDED >> |

| **POST-FLIGHT** | |
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| **Mission Summary** | *Primary butterfly pattern was flown successfully. TC remains steady-state, with evidence of multiple wind maxima particularly on the NW side, but also SW and NE. System remains essentially aligned, with tilt magnitude on the order of 6-7 km, with tilts toward the N or NNW. Concentric eyewalls likely to develop, if not already present. Sea-surface temperatures are in the 29 C range. The primary factors that seem to be inhibiting intensification is the presence of this broader wind field (SEF potential) and midlevel SW shear impacting the system. SHIPS forecasts the shear dropping in 6-12 h, so potential for intensification is there.*  *After completion of the butterfly, returned inbound to begin some legs for Ocean Winds. Went outbound along a 45 azimuth, returned back inbound. However, MMR had a failure on the inbound leg as the aircraft encountered turbulence and the mission was forced to end science and return to base.*  *31 sondes dropped (29 sent), 21 charged to NWS, 10 charged to ONR, 4 AXBTs dropped.* |
| **Actual Standard Pattern Flown** | *Butterfly* |
| **APHEX Experiments / Modules Flown** | *TDR pattern, Ocean Winds module* |
| **Plain Language Summary** | * *P-3 flew mission into Hurricane Lee, collecting important radar and dropsonde data that was transmitted to the ground in real-time to improve numerical model forecasts* * *Lee remains at a steady-state intensity, though the wind field has expanded in size with evidence of outer wind maxima (outside of the usual eyewall wind maximum)* * *Data was collected that compares surface wind measurements with other instruments that can be used to improve those surface wind estimates* |
| **Instrument Notes** | *Instruments worked fine until the Ocean Winds module, where the MMR failed, prompting a RTB* |
| **Final Mission Track** |  |