| **MISSION PLAN** | | | |
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| **FLIGHT ID** | 20240925I1 | **STORM** | AL09/HELENE |
| **MISSION ID** | 1009A | **TAIL NUMBER** | NOAA-43 |
| **TASKING** | NHC/EMC TDR | **PLANNED PATTERN** | Butterfly |
| **MISSION SUMMARY** | | | |
| **TAKEOFF [UTC]** | 0906 | **LANDING [UTC]** | 1611 |
| **TAKEOFF LOCATION** | KLAL | **LANDING LOCATION** | KLAL |
| **FLIGHT TIME** | 07.08 | **BLOCK TIME** | 10:00 |
| **TOTAL REAL-TIME RADAR ANALYSES**  **(Transmitted)** | 4 (4) | **TOTAL DROPSONDES Deployed (Tx to GTS)** | 17 (16) |
| **OCEAN EXPENDABLES deployed (good)** | 8 AXBTs (4), 1 wavedrifter | **sUAS (Type)** | 2 S0s (11 HdOBS), 8 Streamsondes |
| **APHEX EXPERIMENTS / MODULES** | RICO SUAVE, Tail Doppler Radar Dual-PRF in Hurricanes, CHAOS, Distribution of Hazardous Winds | | |
| **HRD CREW MANIFEST** | | | |
| **LPS ONBOARD** | J. Zhang/Sellwood | **LPS GROUND** | Aberson/Montgomery |
| **TDR ONBOARD** | J. Zhang/Sellwood | **TDR GROUND** | Reasor |
| **ASPEN ONBOARD** | n/a | **ASPEN GROUND** | Kaplan |
| **sUAS SCIENTISTS** | Jack Elston (Blackswift), Josh Wadler (ERAU) | | |
| **GUESTS (Affiliation)** | Tom Fritz (media), Jennifer Brooks Bingham and Caitlin Durkovich (National Security Council) | | |
| **AOC CREW MANIFEST** | | | |
| **PILOTS** | Rannenberg/Palmer/Ellis | | |
| **NAVIGATOR** | Meier/Saunders | | |
| **FLIGHT ENGINEERS** | Ripp/Dittoe | | |
| **FLIGHT DIRECTOR** | Zawislak | | |
| **DATA TECHNICIAN** | Richards | | |
| **AVAPS** | Vargas/Hunnsiger | | |

| **PRE-FLIGHT** | |
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| **Flight Plan** | *Pattern: Fly butterfly pattern with 105 NM legs*   * *Pattern should be adjusted as needed to avoid land*   *Altitude:*   * *10 kft preferred - 8 kft if AF deconfliction is required (pressure altitude)*   *Research Modules:*   * *APHEX Mature Stage: RICO SUAVE - see notes below* * *APHEX Early Stage: Tail Doppler Radar Dual-PRF in Hurricanes - see notes below* * *APHEX Ocean Observing: CHAOS - see notes below* * *APHEX Mature Stage: Distribution of Hazardous Winds - see notes below* * *Distribution of Hazardous Winds Module*   + *If possible, during the ferry to the storm fly a straight and level leg starting 150 NM NE of the IP to the IP*   + *Fly at the same flight level at the planned in-pattern flight level* |
| **Expendable Distribution** | * Load 30 dropsondes   + Release at endpoints, midpoints, centers >> charged to NWS   + Possible extra sondes at the discretion of the onboard LPS >> charged to HRD or GOMO   + All dropsondes transmitted to the GTS * 8 AXBTs (UM) - see notes below   + All AXBTs transmitted to the AOC ground server if possible * sUAS: see notes below   + Load 3 BlackSwift s0s (2 planned launches)   + Load 20 Streamsondes |
| **Preflight Weather Briefing** | *341*  *WTNT44 KNHC 250854*  *TCDAT4*  *Tropical Storm Helene Discussion Number 8*  *NWS National Hurricane Center Miami FL AL092024*  *400 AM CDT Wed Sep 25 2024*  *Helen has strengthened some since the last advisory. Reports from*  *an Air Force Reserve Hurricane Hunter aircraft indicate that*  *the central pressure has fallen to 985 mb, and that the maximum*  *850 mb flight-level were 58 kt in the northeastern quadrant. A*  *dropsonde in the northwest quadrant reported a splash wind of 59*  *kt, but the boundary-layer average suggested sustained winds closer*  *to 45 kt. Based on these data and increasing satellite intensity*  *estimates, the initial intensity is increased to 55 kt. Despite*  *the increased intensity, the aircraft data, along with radar data*  *from Mexico and Cuba, show that Helen has not yet formed a*  *well-defined inner core.*  *The initial motion is 325/8 kt. Helen should turn northward during*  *the next 12 h or so on the western side of a mid-level ridge, and*  *then it should accelerate northward to north-northeastward as it*  *become embedded in the deep-layer flow between the ridge and a*  *mid-latitude trough/developing cut-off low over the Mississippi*  *valley. This motion should bring the center near the northeastern*  *coast of the Yucatan Peninsula this morning, then across the*  *eastern Gulf of Mexico tonight and Thursday to a landfall along the*  *northeast coast of the Gulf of Mexico late Thursday or Thursday*  *night. After landfall, Helene should curve cyclonically around the*  *cut-off low until it dissipates. The new forecast track is little*  *changed from the previous track.*  *Over the next couple of days, Helene will be moving through an*  *environment of low vertical wind shear, ample environmental*  *moisture, and over waters of high oceanic heat content. All*  *guidance forecasts steady to rapid intensification, including the*  *RI indices associated with the SHIPS model. The latest forecast*  *calls for a 105 kt intensity by 36 h, and this could be*  *conservative as some of the guidance is stronger. After landfall,*  *Helen is forecast to weaken and become post-tropical as it gets*  *tangled up in the baroclinic system over the southeastern United*  *States.*  *Helene's wind field is predicted to grow to a very large size in the*  *NHC forecast. Therefore storm surge, wind, and rainfall impacts*  *will likely extend well away from the center and outside the*  *forecast cone, particularly on the east side. In addition, the fast*  *forward speed while Helene crosses the coast will likely result in*  *farther inland penetration of strong winds over parts of the*  *southeastern United States after landfall.*  *KEY MESSAGES:*  *1. Helene is forecast to intensify and be near hurricane strength*  *when it passes near the northeastern coast of the Yucatan*  *Peninsula during the next several hours, where a Hurricane Warning*  *is in effect.*  *2. Helene is expected to rapidly intensify and grow in size over the*  *eastern Gulf of Mexico. There is a danger of life-threatening storm*  *surge along the entire west coast of the Florida Peninsula and*  *Florida Big Bend. The highest inundation levels are expected along*  *the coast of the Florida Big Bend. Residents in those areas should*  *follow advice given by local officials and evacuate if told to do*  *so.*  *3. Damaging hurricane-force winds are expected along portions of*  *coast of the Florida Big Bend, where a Hurricane Warning is now in*  *effect. Preparations to protect life and property should be*  *completed by early Thursday since tropical storm conditions are*  *expected to begin within this area on Thursday.*  *4. Tropical Storm Helene will bring heavy rain to portions of the*  *western Caribbean with potentially significant flooding across*  *western Cuba and the northeastern Yucatan Peninsula. Considerable*  *and potentially life-threatening flash and urban flooding is*  *expected across portions of Florida, the Southeast, the Southern*  *Appalachians, and the Tennessee Valley beginning today through*  *Friday. This includes the risk of landslides across the southern*  *Appalachians. Widespread minor to moderate river flooding is likely,*  *and isolated major river flooding is possible.*  *FORECAST POSITIONS AND MAX WINDS*  *INIT 25/0900Z 20.7N 86.2W 55 KT 65 MPH*  *12H 25/1800Z 21.9N 86.5W 70 KT 80 MPH*  *24H 26/0600Z 24.1N 86.2W 90 KT 105 MPH*  *36H 26/1800Z 27.4N 85.0W 105 KT 120 MPH*  *48H 27/0600Z 32.0N 84.2W 65 KT 75 MPH...INLAND*  *60H 27/1800Z 35.9N 85.4W 30 KT 35 MPH...POST-TROP/INLAND*  *72H 28/0600Z 37.0N 87.8W 20 KT 25 MPH...POST-TROP/INLAND*  *96H 29/0600Z 36.5N 88.0W 20 KT 25 MPH...POST-TROP/INLAND*  *120H 30/0600Z...DISSIPATED*  *[Copy in GIF of recent (~6 hr) satellite loops (https://www.star.nesdis.noaa.gov/GOES/index.php)]*    *IR sat loop depicts several burst areas of convection to the NNW, E, and SW of the center.* |
| **Instrument Notes** | *All instruments functioning normally* |

| **IN-FLIGHT** | |
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| **Time [UTC]** | **Event** |
| 0906 | Take-off from KLAL |
| 0908 | Advanced Dvorak Technique Wind Radii Estimates extending from the center of the storm |
| 0944 | Decided to skip the *Hazardous Winds Module* due to time limitation for finishing TDR pattern |
| 1011 | Starting descent to science flight level 8000 ft to deconflict with AF |
| 1018 | Running s0 launch checklist while circling |
| 1022 | Onboard LPS is making the decision to drop S0 earlier so that it will be further away from land once it reaches the eyewall |
| 1029 | S0 launched |
| 1031 | S0 airborne |
| 1931 | S0 comms established, descending to 5 kft |
| 1037 | Drop 1, IP dropsonde and streamsonde released |
| 1039 | Cuban radar depicts what seems to be an elliptical, banding eye |
| 1042 | SO lost comms suddenly think it went into the water  About 10 min of data, 6 min straight and level, ~30 mile range |
| 1056 | Drop 2, Midpoint AXBT combo, BT no data |
| 1059 | Drop 3 Center Steamsonde combo no AXBT too close to land, sonde had bad T, RH. Can’t tell if wind and pressure are okay, so not sending  Slight track diversion to stay offshore  URNT12 KWBC  VORTEX DATA MESSAGE AL092024  A. 25/10:59:19Z  B. 21.05 deg N 086.19 deg W  C. NA  D. EXTRAP 981 mb  E. NA  F. NA  G. NA  H. NA  I. NA  J. 128 deg 64 kt  K. 027 deg 84 nm 10:39:22Z  L. NA  M. NA  N. 273 deg 61 kt  O. 179 deg 17 nm 11:03:26Z  P. 17 C / 2455 m  Q. 19 C / 2458 m  R. 15 C / NA  S. 12345 / NA  T. 0.01 / NA  U. NOAA3 1009A HELENE OB 99  SLP EXTRAP FROM 8000FT  MAX FL WIND 64 KT 027 / 84 NM 10:39:22Z |
| 1114 | Drop 4 MP SW Streamsonde Combo |
| 1126 | Drop 5 EP SW Streamsonde Combo |
| 1131 | Beginning checklist for second SO |
| 1138 | URNT12 KNHC 251158  VORTEX DATA MESSAGE AL092024  A. 25/11:38:20Z  B. 21.11 deg N 086.22 deg W  C. 700 mb 2954 m  D. 981 mb  E. 065 deg 25 kt  F. NA  G. NA  H. 53 kt  I. 307 deg 30 nm 11:30:00Z  J. 036 deg 51 kt  K. 305 deg 25 nm 11:31:30Z  L. 54 kt  M. 133 deg 28 nm 11:46:30Z  N. 230 deg 64 kt  O. 133 deg 26 nm 11:46:00Z  P. 11 C / 3044 m  Q. 14 C / 3044 m  R. 5 C / NA  S. 12345 / 7  T. 0.02 / 2 nm  U. AF309 1109A HELENE OB 05  MAX FL WIND 64 KT 133 / 26 NM 11:46:00Z |
| 1147 | Second S0 released  Total TOF (min): 105.0 min  S0 Serial Number: 32  Launch Altitude: 2481.0 m [MSL]  Launch Latitude: 19.372816 deg  Launch Longitude: -86.471252 deg  Termination Latitude: 21.446722  Termination Longitude: -85.825280 |
| 1148 | S0 Airborne |
|  | TDR center info from 240925I1\_1059\_xy.nc:  Alt (km) Lat (deg) Lon (deg W)  0.5 21.00 86.08  2.0 21.08 86.04  3.0 21.13 86.06  6.0 21.15 86.06  2-6-km Vortex Tilt: 8.3 km at 346 deg  77.6 kt wind at 0.5 km height |
| 1149 | S0 will drop to 5kft and start inflow module |
| 1149 | Drop 6 Super Combo SW (S0, AXBT, Streamsonde, Dropsonde) BT no data |
| 1155 | Drop 7 Combo SW, BT SST 29.23C |
| 1202 | S02 descending to 1000m |
| 1202 | Jun: Streamsonde software issue, will only drop dropsonde for next for next deployment |
| 1204 | S02 at 1000m |
| 120708 | URNT12 KWBC  VORTEX DATA MESSAGE AL092024  A. 25/12:07:08Z  B. 21.02 deg N 086.21 deg W  C. NA  D. 981 mb  E. 020 deg 04 kt  F. NA  G. NA  H. NA  I. NA  J. 263 deg 64 kt  K. 178 deg 20 nm 12:02:03Z  L. NA  M. NA  N. 088 deg 58 kt  O. 353 deg 52 nm 12:20:14Z  P. 18 C / 2449 m  Q. 16 C / 2457 m  R. 16 C / NA  S. 134 / NA  T. 0.01 / NA  U. NOAA3 1009A HELENE OB 99  MAX FL WIND 64 KT 178 / 20 NM 12:02:03Z  MAX FL TEMP 18 C 178 / 18 NM FROM FL CNTR  TDR center info from 240925I1\_1209\_xy.nc:  Alt (km) Lat (deg) Lon (deg W)  0.5 21.10 86.07  2.0 21.12 86.07  3.0 21.17 86.09  6.0 21.25 86.17  2-6-km Vortex Tilt: 17.2 km at 324 deg  Increase in tilt, but the mid-level center is elongated, so algorithm may not have found correct center. |
| 1209 | Drop 8, Center |
| 1221 | Jun: S0 at 500m for a couple of minutes |
| 1222 | TDR analysis from first pass depicts mostly stratiform with isolated areas of moderate to deep convection. |
| 1226 |  |
| 1223 | Drop 9 MP NW Streamsonde AXBT Combo, BT No Data |
| 1229 | S02 at 400m, Range 140 NM |
| 1233 | Jun: 150 NM range, S02 |
| 1235 | Wave Drifter Released, providing good data (4.63-m significant wave height) |
| 1235 | Drop 10, EP NW AXBT BT SST 28.28C |
| 1236 | S02 Range 160 NM, record longest range for S0 |
| 1243 | Ksell: Attempting to descend to 300m now, S02 |
| 1254 | Drop 11 IP NW, Streamsonde Combo |
| 1255 | Jun: 40 min battery left for S02 |
| 1310 | Jun: S02 Regained comms at 200m, saw 60kts |
| 1312 | URNT12 KNHC 251354  VORTEX DATA MESSAGE AL092024  A. 25/13:12:50Z  B. 21.33 deg N 086.16 deg W  C. 700 mb 2941 m  D. 982 mb  E. 360 deg 22 kt  F. OPEN NE-SE  G. E36/50/30  H. 47 kt  I. 036 deg 46 nm 13:00:00Z  J. 128 deg 51 kt  K. 042 deg 94 nm 12:46:30Z  L. 60 kt  M. 204 deg 29 nm 13:21:30Z  N. 284 deg 68 kt  O. 205 deg 39 nm 13:24:30Z  P. 10 C / 3049 m  Q. 16 C / 3049 m  R. 6 C / NA  S. 12345 / 7  T. 0.02 / 2 nm  U. AF309 1109A HELENE OB 11  MAX FL WIND 68 KT 205 / 39 NM 13:24:30Z |
| 1320 | Ksell: S0 descending to 100m |
| 1324 |  |
| 1324 | Drop 12 Center Combo, BT no data  TDR center info from 240925I1\_1324\_xy.nc:  Alt (km) Lat (deg) Lon (deg W)  0.5 99.99 99.99  2.0 21.35 86.13  3.0 21.35 86.17  6.0 21.34 86.19  2-6-km Vortex Tilt: 6.3 km at 252 deg  URNT12 KWBC  VORTEX DATA MESSAGE AL092024  A. 25/13:23:08Z  B. 21.27 deg N 086.24 deg W  C. NA  D. EXTRAP 983 mb  E. NA  F. NA  G. NA  H. NA  I. NA  J. 011 deg 63 kt  K. 285 deg 33 nm 13:14:55Z  L. NA  M. NA  N. 210 deg 63 kt  O. 101 deg 37 nm 13:31:52Z  P. 14 C / 2453 m  Q. 19 C / 2450 m  R. 13 C / NA  S. 1234 / NA  T. 0.01 / NA  U. NOAA3 1009A HELENE OB 99  SLP EXTRAP FROM  MAX FL WIND 64 KT 178 / 20 NM 12:02:03Z  MAX FL TEMP 20 C 090 / 6 NM FROM FL CNTR |
| 1327 | S0 descent to 50m, there for 5 min |
| 1334 | S0 splashed, record time and range for mission |
| 1337 | s0 splashed after 105 min flight time. record time and range this mission, max range ~160 nm |
| 1338 | Drop 13 MP SE Combo AXBT, BT SST 29.89C |
|  | Will head back in on same radial for dual-PRF, then outbound NE to do Hazardous Winds Module |
| 1347 | Drop 14 EP SE Combo AXBT, BT SST 29.93C |
| 1349 | Turn inbound, switch to dual-PRF, no realtime radar analyses during this period |
| 1415 | URNT12 KWBC  VORTEX DATA MESSAGE AL092024  A. 25/14:15:52Z  B. 21.40 deg N 086.18 deg W  C. NA  D. EXTRAP 979 mb  E. NA  F. NA  G. NA  H. NA  I. NA  J. 219 deg 78 kt  K. 116 deg 30 nm 14:08:39Z  L. NA  M. NA  N. 137 deg 64 kt  O. 043 deg 97 nm 14:39:58Z  P. 17 C / 2453 m  Q. 19 C / 2439 m  R. 13 C / NA  S. 1234 / NA  T. 0.01 / NA  U. NOAA3 1009A HELENE OB 99  SLP EXTRAP FROM 8000FT  MAX FL WIND 78 KT 116 / 30 NM 14:08:39Z  MAX FL TEMP 20 C 101 / 8 NM FROM FL CNTR |
| 1424 | Drop 15 RMW NE (a second sonde had a launch detect on the aircraft, so data were transmitted). |
|  | Paul Reasor: As a whole, Helene is tilted to the W (downshear-left) with height ... pretty clear in the swath analyses on that last pass |
| 1436 | URNT12 KNHC 251532  VORTEX DATA MESSAGE AL092024  A. 25/14:36:40Z  B. 21.42 deg N 086.12 deg W  C. 700 mb 2938 m  D. EXTRAP 982 mb  E. NA  F. OPEN N-E  G. C35  H. 50 kt  I. 123 deg 24 nm 14:29:30Z  J. 220 deg 81 kt  K. 121 deg 19 nm 14:31:00Z  L. 56 kt  M. 312 deg 91 nm 15:04:30Z  N. 038 deg 57 kt  O. 308 deg 51 nm 14:52:30Z  P. 12 C / 3047 m  Q. 17 C / 3042 m  R. 4 C / NA  S. 1235 / 7  T. 0.02 / 2 nm  U. AF309 1109A HELENE OB 18  MAX FL WIND 81 KT 121 / 19 NM 14:31:00Z  SLP EXTRAP FROM 700 MB |
| 1442 | Drop 16 EP NE, bad sonde, start hazardous wind module |
| 1446 | Drop 17 EP NE, replacement, LAST |
| 1502 | totals 17 minis + 8 Streamsonde + 8 BTs + 1 wave drifter/float + 2 s0s  11 sUAS HDOBS sent |
|  |  |
| 1510 | Completion of Hazard Winds Module, TDR left on in Dual-PRF mode. |

| **POST-FLIGHT** | |
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| **Mission Summary** | *Deep radial inflow in azimuthal average.*  *Flight level winds increased enough to make Helene a hurricane*  *Record S0 deployment* |
| **Actual Standard Pattern Flown** | *Butterfly* |
| **APHEX Experiments / Modules Flown** | *RICO SUAVE,* Tail Doppler Radar Dual-PRF in Hurricanes, CHAOS, Distribution of Hazardous Winds |
| **Plain Language Summary** | *Helene has begun intensifying after forming a coherent and lightly tilted core. Low- and mid-level centers seem to be wobbling around each other. Record-deployment of Blackswift S0 shows utility of sUAS.* |
| **Instrument Notes** | *All instruments seemed to work except for Streamsondes* |
| **Final Mission Track** |  |