Mission Summary

Hurricane Helene
SALEX Research Mission Summary
060918N Aircraft: N49

Scientific Crew:

Lead Project Scientist s	Michael Black, Peter Black
Dropsonde Scientists	Michael Black, Peter Black

Aircraft Crew:

Aircraft Commader	Michele Finn
Pilots	Will Odell, John Longenecker
Flight Director	Barry Damiano
Engineers	Mark Rogers, John Hill, Bobby Peek

Mission Brief:

The G-IV will fly a Saharan Air Layer Experiment (SALEX) around Hurricane Helene with a takeoff from Barbados at 1500 UTC and a recovery there 7 hours later. This mission would be coordinated with NOAA42, which would fly an inner core pattern during the same time period. Before the flight, Hurricane Helene was analyzed by NHC as a Category 3 storm with maximum surface winds of 105 kts and a minimum central pressure estimated at 958 mb. The hurricane, located in the mid-Atlantic near 22.5°N, 50°W, was moving to the NW at about 6 kts but a more westward motion was expected to occur later in the day. There was a lot of uncertainty in the track forecast. Helene was imbedded between two large areas of moderately-dry air, according to satellite imagery (Fig. 1). The G-IV would sample this dry air by releasing dropsondes around the periphery of Helene, particularly in the environmental air west of the storm (Fig.2).

Mission Synopsis:

Takeoff from Barbados was at 1450 UTC and we headed NE to our first drop point at 15°N, 58.2°W (Fig. 3). In route we uploaded precipitable water imagery and other satellite pictures to determine if we needed to alter the flight plan. After looking at the imagery, we decided to try and make some minor modifications to the flight track. We conveyed these changes via X-Chat to Jason Dunion, the SALEX PI who was on NOAA42. He agreed to the changes and we requested them to Michele Finn, the G-IV Aircraft Commander. After discussing the changes with several FAA controllers, Michele received approval. The track changes included extending our NE point further east to 26.1°N, 46.5°W, heading straight south to 22°N along 46.5°W, then head straight west along 18°N (Fig. 3). We were hoping to sample some of the dry air immediately adjacent to Helene's convection on the East and South side of the storm.

The G-IV was flying through and above virtually cloud-free air during our northward run along 57°-59°W on Helene's west side (Fig.4). Here, we encountered very dry air that extended from flight altitude (~150-175mb) down to at least 850 mb (Fig. 5). In this area, the relative humidity (RH) ranged from 7-18% at 200 mb and from 27-82% at 850 mb. A photograph from the side window of the G-IV looking east toward Helene (Fig. 6) indicates the extent, both vertically and horizontally, of this dry air.

The G-IV turned to the east at 1655 UTC near 27°N, 59°W or about 900 km NW of Helene's eye (Fig 3). Here, we encountered a rather sharp gradient in moisture with the relative humidity observations becoming more moist as we approached and entered the periphery of the north side of the CDO near drop 12. The gradient was most pronounced at 500 mb where the RH varied between 15-87%. As we approached closer to Helene, the CDO was clearly visible from the right cockpit window (looking to the SE) and indicated a sharp transition between the dry environment and the precipitation of Helene's core (Fig. 7).

After traversing through cirrus clouds that ranged from thin to very thick, we reached drop 15 at 1827 UTC located about 300 km NE of Helene's center (Fig. 3). We then headed south along 46.5° W right along the eastern periphery of cirrus outflow from Helene's eyewall and rainbands. Here we were flying between two cirrus canopies, one that was beneath the flight-level of about 150 mb and another was that was located quite a bit higher than the G-IV's altitude. The RH at 200 mb (just below the G-IV) was dry, ranging from 10-20% while at 500 mb it was more moist with RH ranging from 68-88%. Below 500 mb, all of the sondes on Helen's east side recorded high amount of moistures with RH averaging about 80% in the lowest layers (Fig. 5).

We broke out of the cirrus between drops 20 and 21 (Fig. 3) and entered another region of very dry air (Fig. 5). Once again, we were just on the edge of the CDO and in an area where convection was very limited. Where convection did exist, it was relatively shallow. A photograph (Fig. 8) shows some of the shallow convection and the lower portion of the CDO on Helene's east side (looking toward the west). A rare isolated CB, with tops that were just below the G-IV's flight level was found in the area SE of Helene's center (Fig. 9). It is interesting that the horizontal spreading of the cirrus outflow from this CB in at least two opposite directions indicate that the shear was relatively low here locally.

Our final leg was on the south side of Helene, along 18°N which we traversed from 1923-2031 UTC (drops 21-26, Fig. 3). Here, the air was very dry from 200 mb to 700 mb with RH varying from 3-28% at 200 mb and from 7-34% at 700 mb. Visually, we flew in clear air the whole time and there was almost no convection nearby. An exception was another isolated thunderstorm, this time with cloud tops that exceeded the G-IV altitude (Fig. 10).

We landed without incident back at Barbados near 2145 UTC.

Problems:
We used vintage sondes that were manufactured between 2000 and 2003 (most where from 2001) and they mainly performed well. Five of the 26 drops had wind gaps, primarily at the lower levels. We did not observe any noticeable dry bias from these dropsondes.

Michael Black
10/04/06

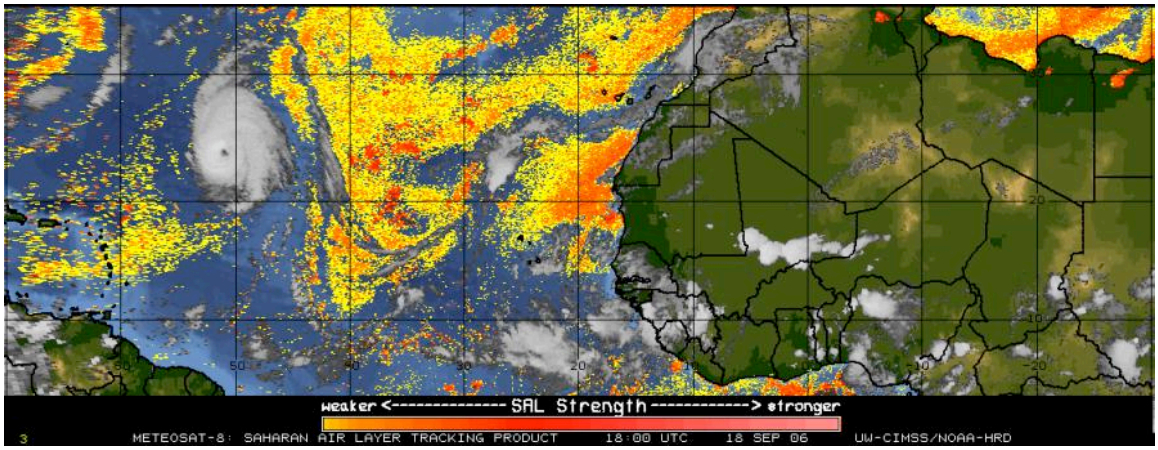


Fig. 1 Large scale, microwave-enhanced satellite image of Helene and the Eastern and Central Atlantic at 180 UTC 18 September.

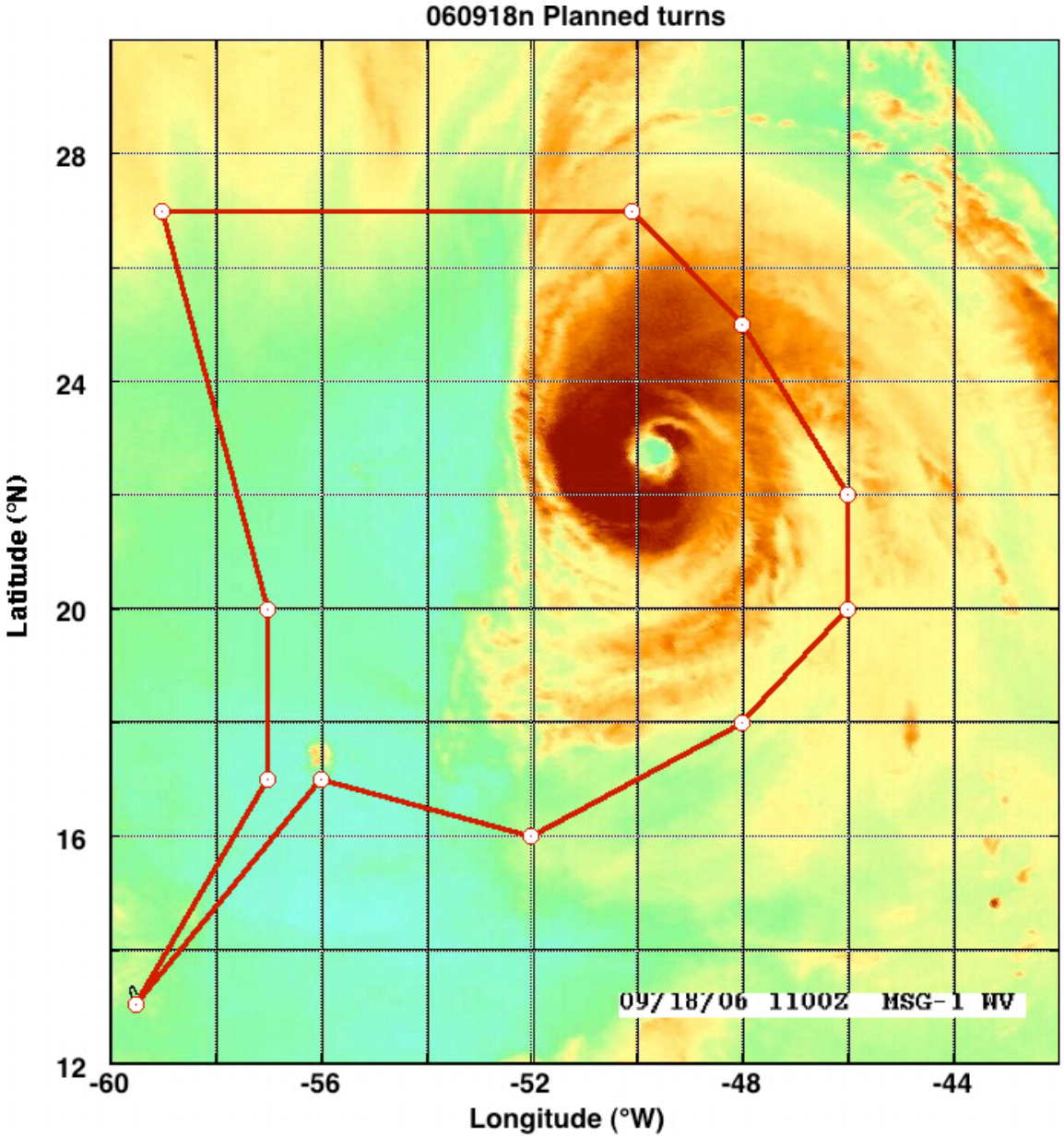


Fig. 2: Planned G-IV flight track and turn points overlaid on microwave water vapor imagery from early morning on 18 September.

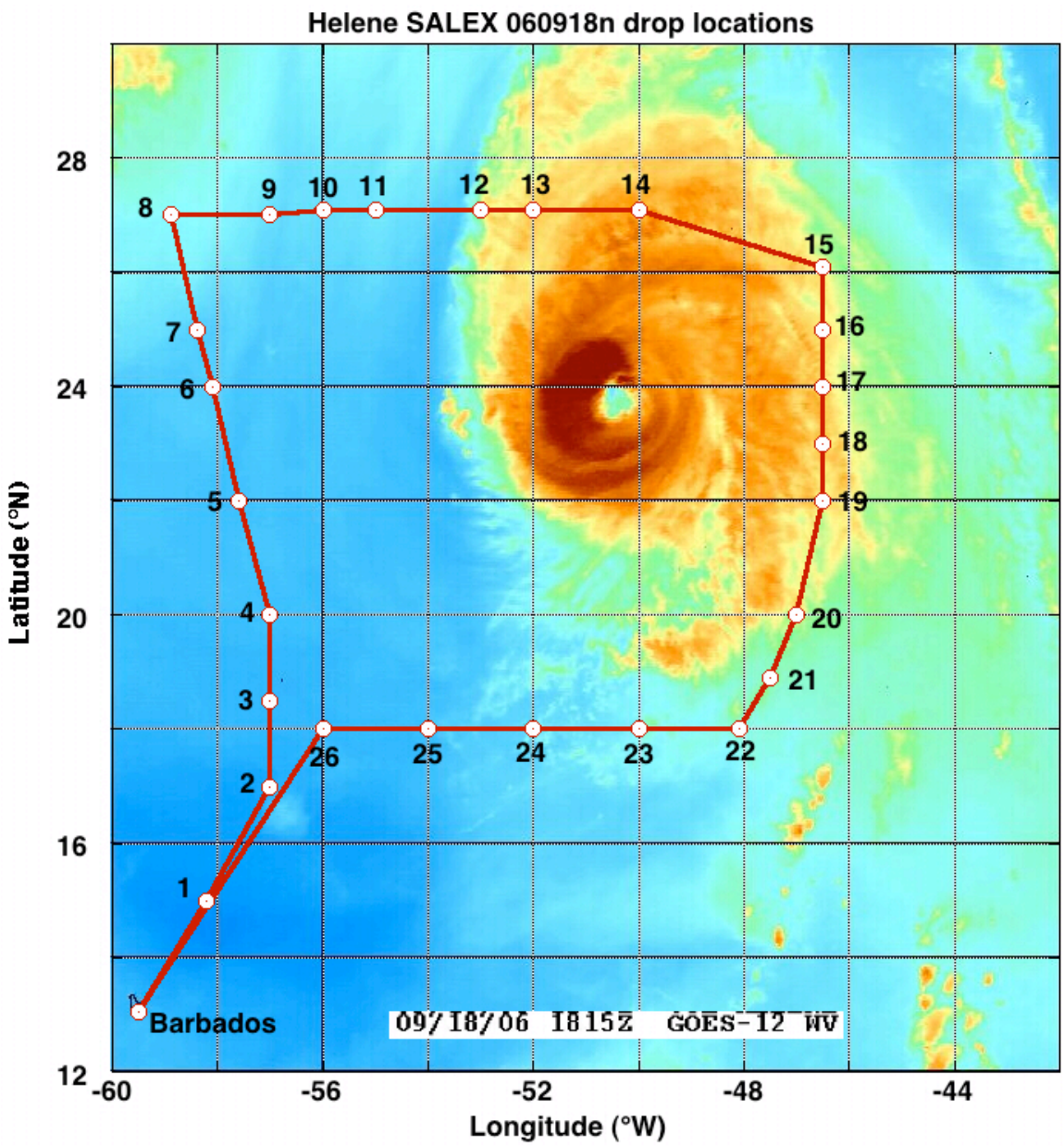


Fig. 3: Actual G-IV flight track and dropsonde locations overlaid on microwave water vapor satellite imagery from 1815 UTC 18 September .

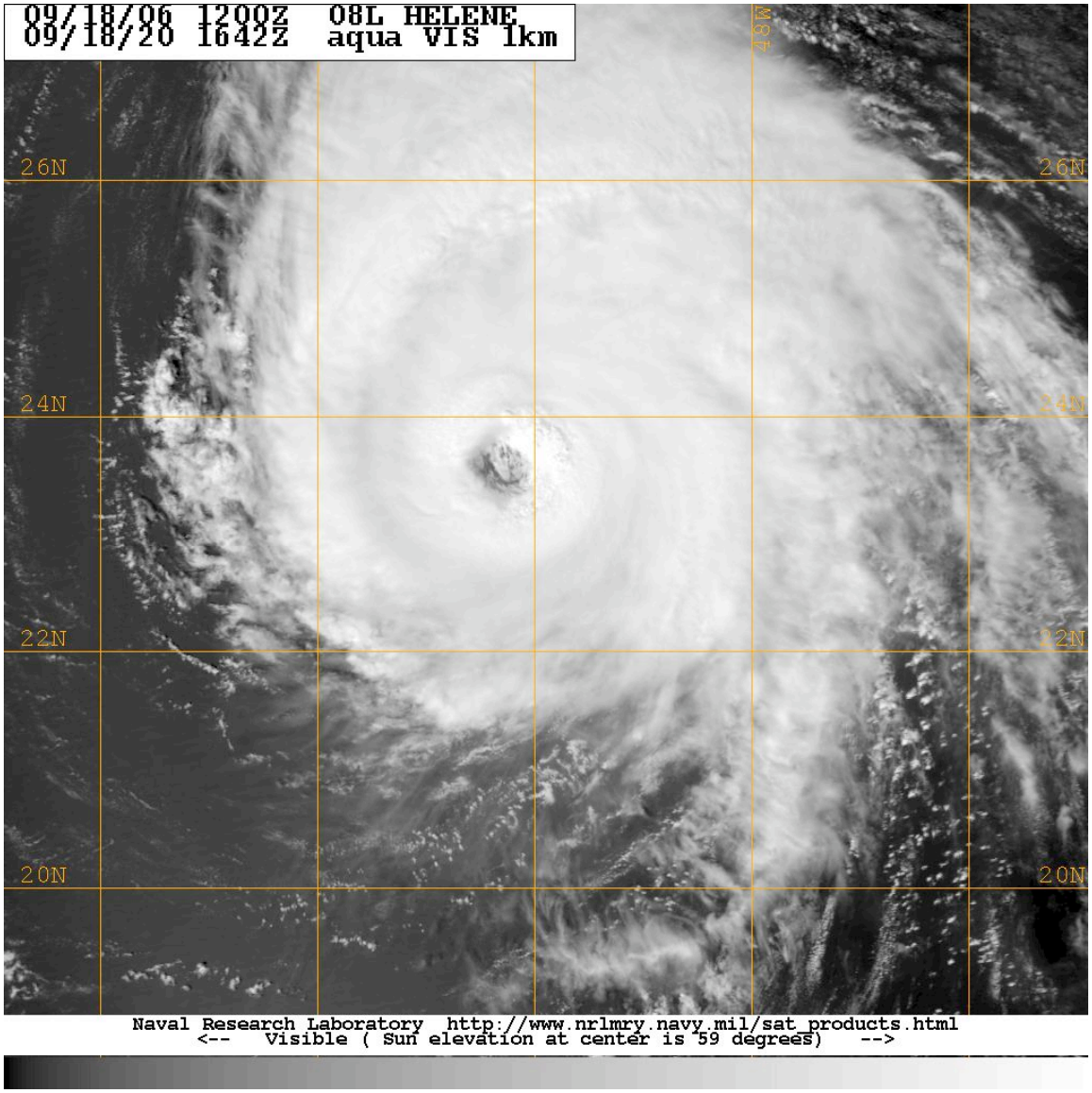
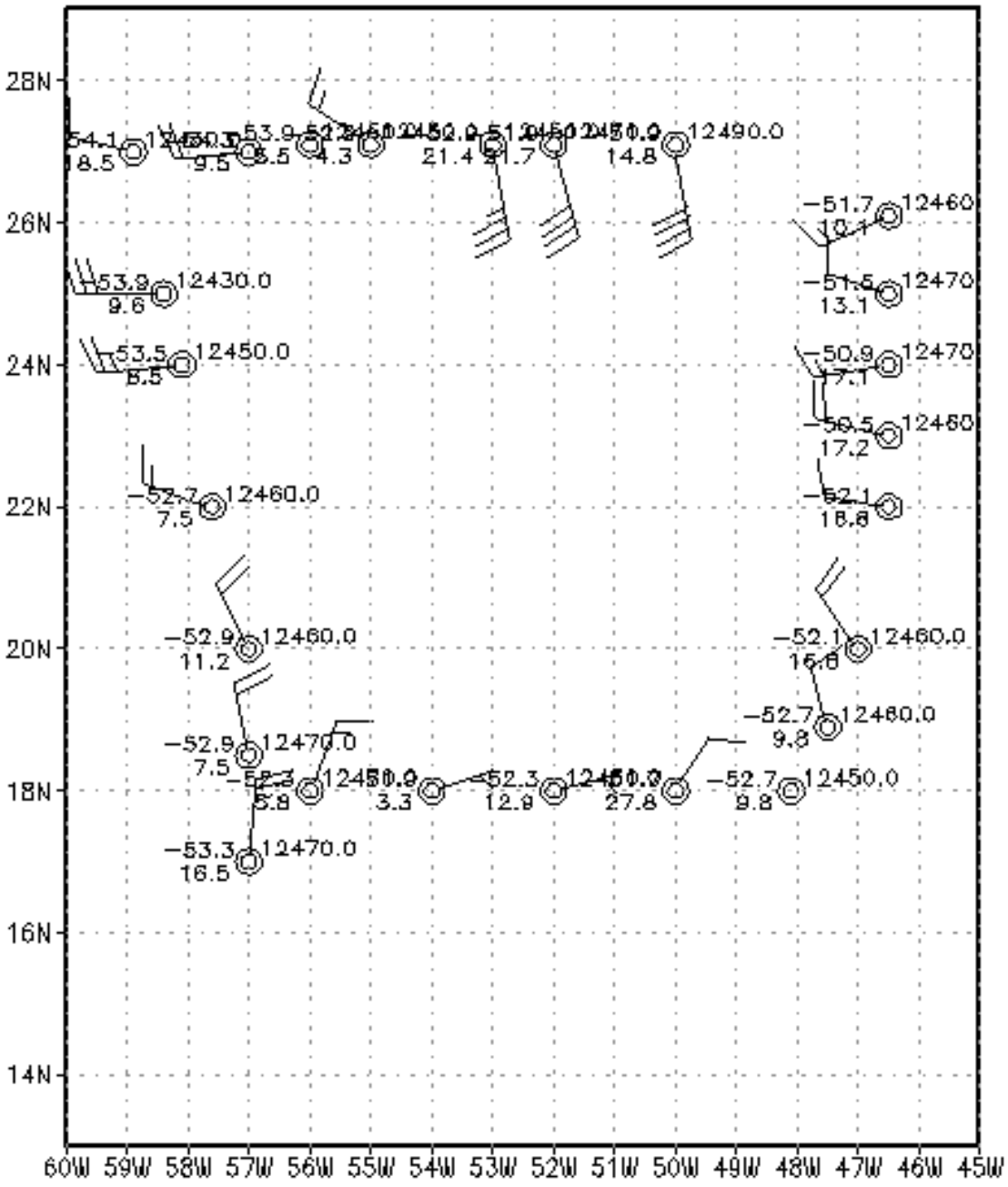


Fig. 4: High-resolution MODIS visible satellite image of Helene at 1642 UTC 18 September when the G-IV was NW of Helene's center.

200 mb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14.8
−51.7 12460
10.1
−51.5 12470
13.1
−50.9 12470
17.1
−50.5 12460
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7.5
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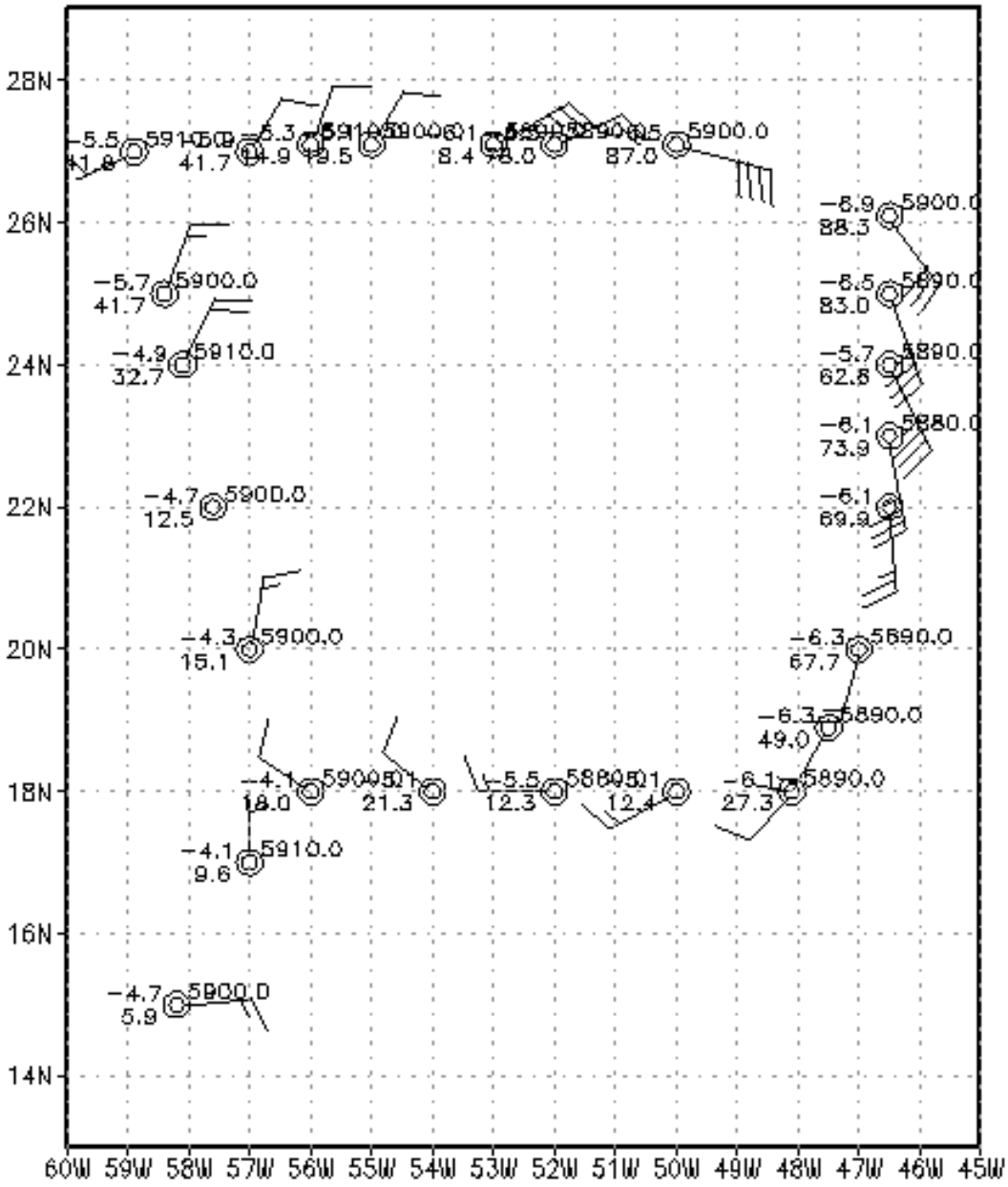
16.5

500 mb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41.7
5900.0
-6.9
88.3
-5.7
41.7
-6.5
83.0
-4.9
32.7
5910.0
-5.7
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-6.1
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12.5
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49.0
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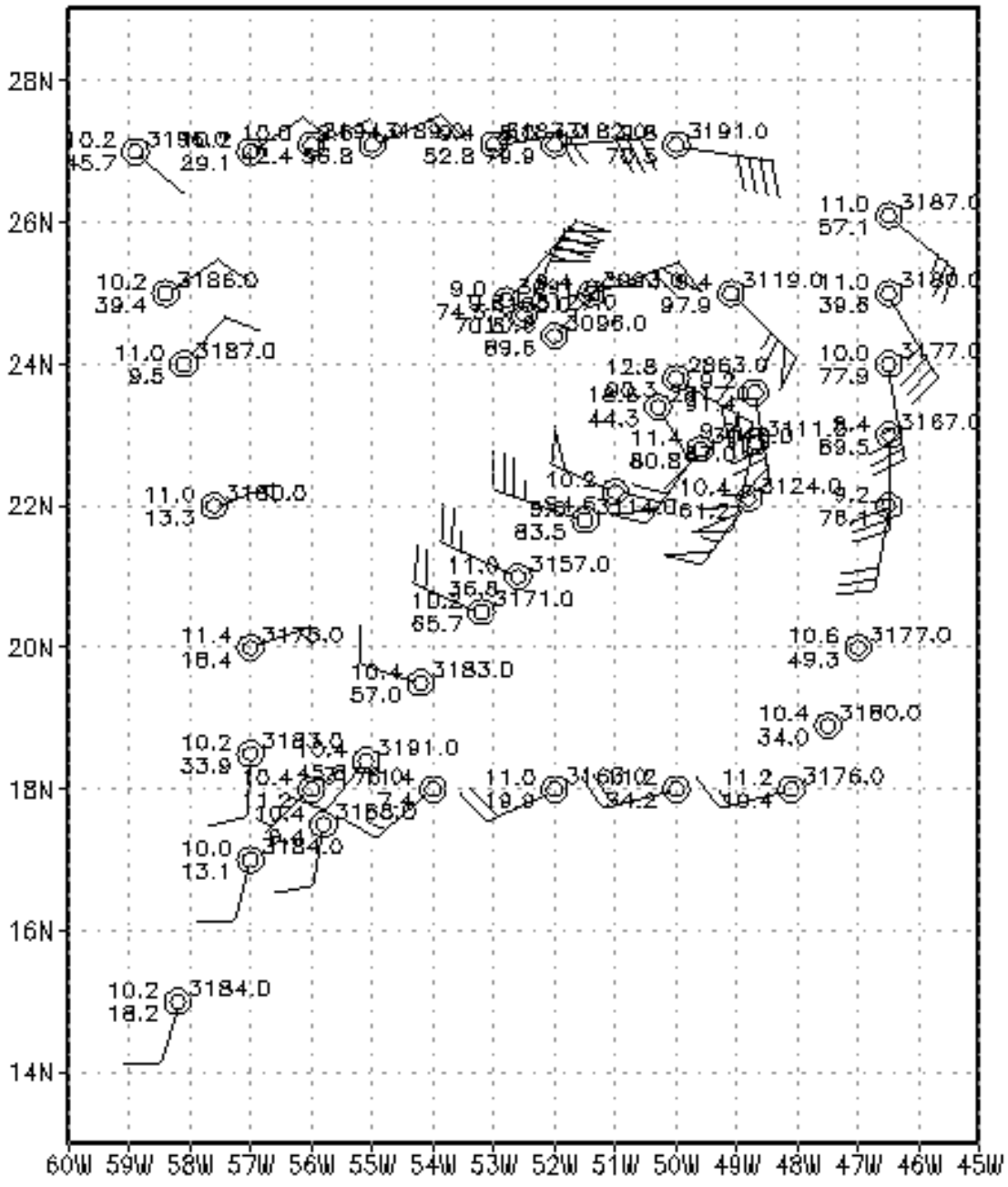
700 mb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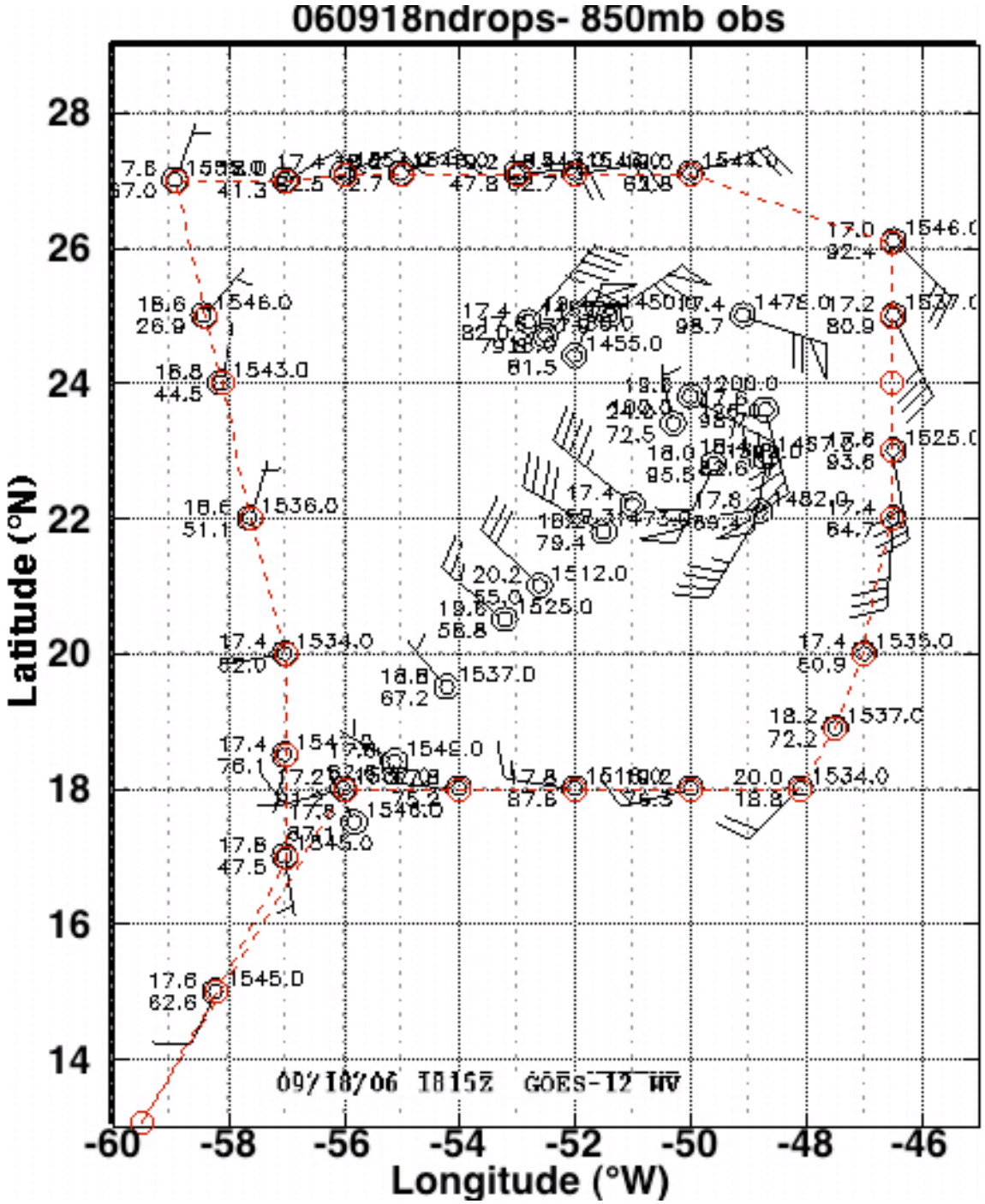
060918ndrops- 850mb obs
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Longitude (°W)
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09/18/06 1815Z GOES-12 WV

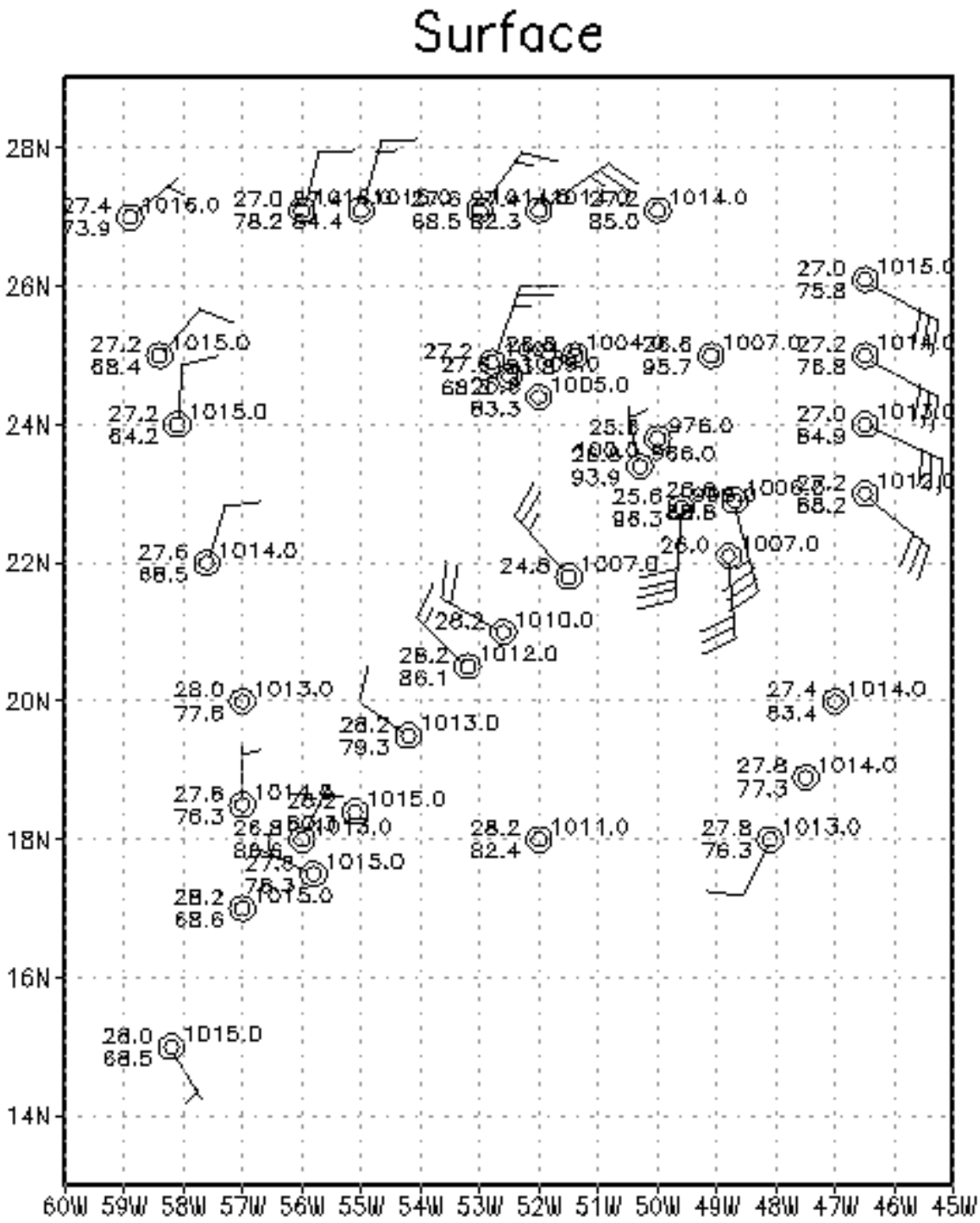

Fig. 5: Dropsonde observations from both the G-IV and NOAA42 P3 missions on 18 September. From top to bottom are the observations at 200 mb, 500 mb, 700 mb, 850 mb, and the surface. The 850 mb plot shows the G-IV flight track in red to distinguish the jet's dropsondes from those of the P3 in the inner core. Thanks to Sim Aberson for plotting these observations in near real time.

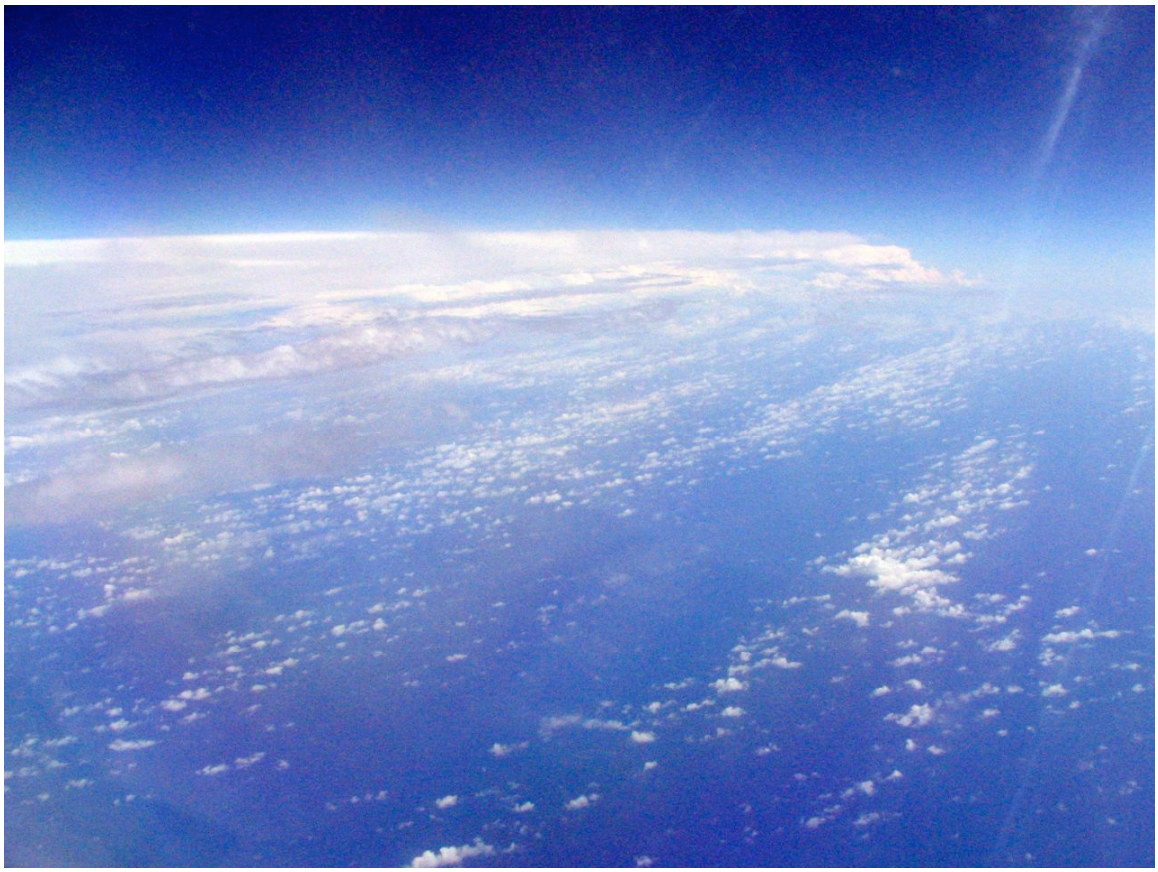

Fig. 6: Photograph taken from the G-IV while several hundred km to the west of Helene showing the horizontal and vertical extent of the dry air.

Fig. 7: Photograph from the cockpit of the G-IV while approaching the CDO from the NW side of Helene.

Fig. 8: Photograph from the G-IV looking west from the east side of Helene, just outside of the CDO.

Fig. 9: Photograph from the G-IV of an isolated CB with vertical development on the SE side of Helene, within the dry air.

Fig. 10: Photograph from the G-IV of an isolated CB on the south side of Helene with vertical development that exceeded the 150 mb flight-level.