

# RECCO Observation Decoding

Reconnaissance reports are simple one- or two-line blocks of data in a numeric code. They are normally sent every 30 minutes enroute to and from the hurricane, and also at the turnpoints in the pattern. On low-level investigative missions, these will often be the only reports sent in the vicinity of the storm. Finally, these types of observations are taken on routine training missions and winter storm missions. This raw coded report is sent from the aircraft to National Hurricane Center. This message contains meteorological information, including pressure, temperature, wind, clouds and turbulence.

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## 1. The Basics of RECCO Code

RECCO observations are a series of 5-digit numbers. What you want to be able to do is recognize when and where the observation was taken, and some key meteorological data. (Die-hard meteorology buffs who want a full decoding of the RECCO code, continue to the next section.)

*Example:*

**URNT11 KNHC 161227  
AF967 0212A LILI OB 08 KNHC  
97779 12314 40169 82508 04000 22020 25218 /0007 42115;**

The first two lines are the heading of the message.

The first group is almost always "97779".

*Time.* The first four numbers in the second group is the time of the observation, in Greenwich Mean Time (subtract 4 hours to get Eastern Daylight Time, 5 hours to get Central Daylight Time, or subtract 6 hours to get Central Standard Time). In the example, "1231" is 1231 GMT, or 7:31 a.m. CDT.

*Location.* Find the latitude in the last three digits of the third group, and the longitude in the first three digits of the second group. The latitude and longitude are reported in degrees and tenths. If the longitude is 100.0 degrees or above, the first "1" is dropped in the code, for example, 104.3W is coded "043"; you need to look elsewhere in the code if you aren't sure if that was 4.3W or 104.3W. In the above example, the aircraft was at 16.9N 82.5W.

*Altitude.* The first three digits of the fifth group tells you approximately how high the aircraft is flying. It is coded in "decameters", which means you need to multiply this number by 10 to convert to meters, then multiply by 3.281 if you want to convert to feet. In the above example, the altitude is coded "040" = 40 dm = 400 m = 1312 ft. This tells you the aircraft is on a low-level mission.

*Winds.* The sixth group is the wind measured at the altitude of the airplane. The first two digits are the wind direction, to the nearest ten degrees. Wind direction is reported similar to compass headings, where 360 or 0 degrees is north. In the code, 09=east, 18=south, and 27=west. The next three digits is the wind speed in knots. Multiply by 1.152 to convert to miles per hour. In the above example, "22020" is a wind of 220 degrees (blowing out of the southwest) at 020 knots (23 mph).

*Pressure.* The eighth group, always begins with a "/". The second digit tells you at what level the aircraft is flying. A "0", as above, shows the aircraft is flying below 1500 feet and is estimating sea-level pressure. The next three digits is the pressure or height data. Only if the second digit is a "0" will this be sea-level pressure (in millibars). In the above example, the sea-level pressure is 1007 millibars. This is a complicated group, and for aircraft flying above 1500 feet, see the full decode below.

## 2. Here is the breakdown of the mandatory section of the code:

Each message consists of groups of five numbers. The position of group, and sometimes the first number in the group, helps to decode the report.

*Symbolic Form of the mandatory data:*

**9XXX9 GGggl YQLaLaLa LoLoLoBf hhhdd dffff TTTdTdw /jHHH**

**9XXX9**...The 9's on either end of this group are simply indicator numbers. The XXX is normally 777, which means the aircraft has radar capability, or 222, which means the radar is not working.

**GGggl**...GG is the hour of the report; gg is the minute of the report, in "Zulu" or Greenwich Mean Time, on a 24-hour clock. Zulu is 5 hours later than Central Daylight Savings Time, so a time of 2208Z translates to 1708 CDT or 5:08 p.m. CDT.

**I** is an indicator regarding aircraft height and dewpoint sensing capability.

- 0..No dewpoint capability / aircraft below 10000 meters
- 1..No dewpoint capability / acft at or abv 10000 meters
- 2..No dewpoint cap / acft blo 10000 m / fl temp blo -50C

- 3..No dewpoint cap / acft aoa 10000 m / fl temp blo -50C
- 4..Dewpoint capability / aircraft below 10000 meters
- 5..Dewpoint capability / acft at or above 10000 meters
- 6..Dewpoint cap / acft below 10000 m / fl temp blo -50C
- 7..Dewpoint cap / acft aoa 10000 m / fl temp blo -50C

**YQLaLaLa**

*Y* is the day of the week..Sunday=1...Saturday=7

*Q* is the quadrant of the globe the aircraft is located:

- 0..0-90N / 0-90W
- 1..0-90N / 90W-180
- 2..0-90N / 180-90E
- 3..0-90N / 90E-0
- 4..Not used
- 5..0-90S / 0-90W
- 6..0-90S / 90W-180
- 7..0-90S / 180-90E
- 8..0-90S / 90E-0

*LaLaLa* is the latitude in tenths of degrees. 268 would be 26.8 degrees. To find out if it is 26.8 North or 26.8 South, you need to look back at *Q*, the second digit in this data group (normally 0 or 1).

**LoLoLoBf**

*LoLoLo* is the longitude of the aircraft in tenths of degrees.

880 would be 88.0 degrees, 110 would be 11.0 or 111.0

depending on the quadrant of the globe indicator in the last group.

West or East is also determined by *Q* in the previous data group.

*B* ..Turbulence group as follows..

- 0..No turbulence
- 1..Moderate turbulence..in clear air..infrequent
- 2..Moderate turbulence..in clear air..frequent
- 3..Moderate turbulence..in cloud..infrequent
- 4..Moderate turbulence..in cloud..frequent
- 5..Severe turbulence..in clear air..infrequent
- 6..Severe turbulence..in clear air..frequent
- 7..Severe turbulence..in cloud..infrequent
- 8..Severe turbulence..in cloud..frequent

*f* ..Conditions along route of flight as follows..

- 0..In the clear
- 8..In and out of clouds
- 9..In clouds all the time
- /..Impossible to determine due to darkness or other cause.

**hhhdtda**

*hhh* gives the pressure altitude of the aircraft to the nearest decameter. For example 305 is 305 decameters = 305 meters = 10,007 feet

*dtda* ..gives information about how the winds were calculated, as follows:

*dt* specifies if the wind is "0" Spot wind; "1" Average wind; or "/" meaning no wind report. Almost always a "spot wind"

*da* specifies how the winds were obtained. "0"-Winds obtained using doppler radar or inertial systems (almost always); "1"-Winds obtained using other navigation equipment / techniques "/"-Unable to determine wind or wind not compatible.

**ddfff**

Wind direction and speed at the flight level of the aircraft.

*dd* = true wind direction to the nearest 10 degrees, where 00=winds from the north 09=090 degrees=east, 18=180 degrees=south, 27=270 degrees=west

*fff* =wind speed in knots. To convert to miles per hour, multiply by 1.15

**TTTdTw**

*TT* is the temperature in Celsius. If the temperature is negative, 50 is added to the absolute value of the temperature, and any hundreds digits are omitted. For example, a temperature of -12 would be coded as 62 (12+50 = 62) To determine if a temperature of "10" is really +10 or -110, see the indicator number in the time group above. Missing temperatures are coded as //.

*TdTd* is the dewpoint at flight level. Dewpoints are encoded the same as temperature. When the dewpoint is colder than -49.4C, it is reported as // and a plain language remark is added with the actual dewpoint, i.e. DEW POINT M53C. // is also reported if the dewpoint is too dry to measure accurately, or missing.

*w* is the present weather group with the following meanings. The largest number is used if more than one type of weather is present.

- 0..Clear
- 1..Scattered clouds
- 2..Broken clouds
- 3..Overcast / Undercast
- 4..Fog, thick dust or haze
- 5..Drizzle
- 6..Rain (continuous or intermittent from stratoform clouds)
- 7..Snow, or rain and snow mixed
- 8..Rain (continuous or intermittent from cumuloform clouds)
- 9..Thunderstorm
- /..Unknown for any cause, including darkness

/jHHH...

/ is an indicator for this group

*j* is the code for the level being reported by HHH in this group. The code is as follows...

- 0..Sea level pressure in millibars (1000's omitted)
- 1..200 mb level in geopotential decameters (1000s omitted)
- 2..850 mb level in geopotential meters (1000's omitted)
- 3..700 mb level in geopotential meters (1000's omitted)
- 4..500 mb level in geopotential decameters
- 5..400 mb level in geopotential decameters
- 6..300 mb level in geopotential decameters
- 7..250 mb level in geopotential decameters (1000s omitted)
- 8..D-value in geopotential decameters (if negative, 500 is added to HHH)
- 9..925 mb level in geopotential meters

**HHH** ..Geopotential height or sea level pressure of the level specified in the *j* indicator just above.

Of the *optional data*, about the only extra group you are likely to see are surface winds, if the aircraft is flying at or below 10,000 feet. We'll show you how to decode surface winds here, then the rest of the RECCO code will be explained at the very end of this page.

#### 4dfff

*4* is the indicator that surface wind data follows

*dd* is the wind direction to the nearest ten degrees. 50 is added if the wind is over 100 kts, so a wind of 220 degrees at 10 knots will be coded as 42210, while a wind of 220 degrees at 110 knots will be coded as 47210.

*ff* is the wind speed in knots. Wind speeds above 130 kts are not coded, because the sea becomes covered by a solid sheet of spray and it is impossible to determine if the winds are 140 knots or 160 knots, etc: it all looks the same.

### 3. We'll decode one RECCO observation for you, then let you try the next:

**URNT11 KNHC 071215  
AF980 0910A JOSEPHINE OB 05 KNHC  
97779 12154 20256 86010 04900 19044 25218 /0997 41840**

Heading (first two lines). This RECCO observation is from Air Force Reserve aircraft 980. It is being flown on the 9th mission of the tenth tropical depression in the Atlantic/Gulf of Mexico/Caribbean basin, which is named "Josephine". (see the Vortex message for decoding hurricane mission headings; most training missions simply have "WX" following the aircraft tail number). This is the fifth observation of the mission, and was sent to the National Hurricane Center in Miami, Florida.

97779: The aircraft has radar capability.

12154: The time of the observation was 1215Z. (1215 GMT = 08:15 a.m. Eastern Daylight Savings Time). The dewpoint hygrometer is working, and the aircraft is below 10,000 meters.

20256: The day of the week is Monday. The report is from quadrant 0, which means the coordinates are between 0-90N and 0-90W. The latitude is 25.6N.

86010. The longitude is 86.0W. There is some light turbulence, but the aircraft is clear of clouds.

04900: The pressure altitude of the aircraft is 049 decameters = 490 meters (490 meters x 3.281 feet/meter = 1608 feet). The flight-level winds were spot winds using highly-accurate inertial navigation systems.

19044: The flight-level winds are from a direction of 190 degrees true, or out of the south-southwest. The windspeed is 44 knots, or 55 mph.

25218: The temperature was 25 Celsius (77 Fahrenheit), and the dewpoint was 21 Celsius (70 Fahrenheit). The present weather was "8", which means there were some towering Cumulus clouds producing rain showers within 30 miles of the observation point.

/0997. "/" is the indicator for the pressure group. The "0" shows the aircraft was low enough (below 1500 feet) to accurately extrapolate a sea-level pressure. The surface pressure was 997 millibars (997 heco-Pascals, or 29.44 inches-Hg).

41220. The "4" is an indicator for surface winds. "12" is the wind direction, in tens of degrees, or 120 degrees. This means the surface winds appeared to be blowing out of the southeast. The wind speed was 20 knots, or 23 mph.

### 4. Now your turn to decode. Look at the following observation and answer these questions:

**AF861 1015A MARILYN OB09 KNHC  
97779 12094 10219 66318 30700 18049 09099 /3109 41745**

1. What time was the observation collected?
2. What are the coordinates of the observation?
3. How high was the plane flying?
4. Any turbulence reported?
5. What was the temperature?
6. What were the winds?
7. What was the most significant (present) weather?
8. What was the pressure (height of standard surface?)
9. Any additional data?

**KEEP SCROLLING TO FIND THE ANSWERS:**

97779 12094 10219 66318 30700 18049 09099 /3109 41745

1. *What time was the observation collected?* 1209Z, or 7:09 a.m. CDT
2. *What are the coordinates of the observation?* 21.9N 66.3W
3. *How high was the plane flying?* 307 dm = 3070 meters = 10,072 ft
4. *Any turbulence reported?* No
5. *What was the temperature?* 9 Celsius = 48 Fahrenheit
6. *What were the winds?* 180 degrees (south) at 49 knots (56 mph)
7. *What was the most significant (present) weather?* Thunderstorms
8. *What was the pressure (height of standard surface?)* 700 millibar height was 3109 meters
9. *Any additional data?* Yes. The surface winds were 170 degrees at 45 knots.

### **5. OPTIONAL DATA:**

**1kNsNsNs ChhHH ..... 4ddff 6WsSsWdd 7IrItSbSe 7hhHH 8ddSrOe 8EwElci 9ViTwTwTw**

#### **1kNsNsNs**

*I* is the indicator for clouds.

*k* is the total number of different clouds observed. You need to know this so you can tell when all the cloud groups end, and the next optional data groups begin.

*Ns* is the amount of coverage of the most significant cloud, in eighths.

*Ns* is the eighths coverage of the second most significant cloud

*Ns* is the eighths coverage of the third most significant cloud

#### **ChhHH**

*C* is the cloud type corresponding to the first *Ns* reported above, coded as follows:

0..cirrus

1..cirrocumulus

2..cirrostratus

3..altocumulus

4..altostratus

5..nimbostratus

6..stratocumulus

7..stratus

8..cumulus

9..cumulonimbus

/.Cloud type unknown due to darkness or other phenomena.

*hh* is the base (height of the bottom edge) of the cloud,

If the number is below 50, the height is in hundreds of feet, i.e. 34 is 3400 feet

Numbers coded between 51 and 55 are not used.

Numbers coded between 56 and 79 are in thousands of feet after 50 is subtracted from the number, i.e. 62 is a base of 12,000 ft (62-50=12)

*HH* is the height of the top of the cloud using the same decode as the base.

**NOTE: AT THIS POINT THERE WILL BE A FIVE NUMBER CLOUD GROUP (CHsHsHtHt) FOR EACH CLOUD LAYER AS INDICATED IN THE 1kNsNsNs GROUP. IF THERE ARE MORE THAN THREE LAYERS OF CLOUDS, THE FIRST THREE ChhHH GROUPS WILL BE FOLLOWED BY ANOTHER 1kNsNsNs GROUP, WHERE "k" NOW SHOWS HOW MANY CLOUD LAYERS ARE LEFT.**

#### **4ddff**

Although sea-surface winds fall under the optional data section, we've decoded them above along with the mandatory data, since they are often reported in storm observations.

#### **6WsSsWddw**

*6* is the group indicator for significant and distant weather

*Ws* gives any significant weather changes as listed in the following table:

0..No change

1..Marked wind shift

2..Beginning or ending of marked turbulence

3..Marked temperature change (non-altitude)

4..Precipitation begins or ends

5..Change in cloud forms

6..Fog or ice fog begins or ends

7..Warm front

8..Cold front

9..Front, type not specified

*Ss* is the distance of occurrence of *Ws* above, where

0..No report

- 1..Previous position
- 2..Present position
- 3..30 nm
- 4..60 nm
- 5..90 nm
- 6..120 nm
- 7..150 nm
- 8..180 nm
- 9..More than 180 nm

*Wd* is the distant weather (more than 30 miles away), where

- 0..No report
- 1..Signs of a tropical cyclone
- 2..Ugly threatening sky
- 3..Duststorm or sandstorm
- 4..Fog or ice fog
- 5..Waterspout
- 6..Cirrostratus shield or bank
- 7..Altostratus / altocumulus shield or bank
- 8..Line of heavy cumulus
- 9..Cumulonimbus heads or thunderstorms

*dw* is the bearing of *Wd* above, where

- 0..No report
- 1..NE 2..E 3..SE 4..S 5..SW 6..W 7..NW 8..N 9..All directions

### 7IrItSbSe

*7* is the icing group indicator. Icing is reported in two groups, this and the next.

*Ir* is the rate of icing, where

- 7..Light 8..Moderate 9..Severe / Unknown or contrails

*It* is the type of icing, where

- 0..None
- 1..Rime ice in clouds
- 2..Clear ice in clouds
- 3..Mixed ice in clouds
- 4..Rime ice in precipitation
- 5..Clear ice in precipitation
- 6..Mixed ice in precipitation
- 7..Frost (icing in clear air)
- 8..Nonpersistent contrails (under 1/4 nm long)
- 9..Persistent contrails

*Sb* is the distance to beginning of ice, using the same table as *dw* above

*Se* is the distance to ending of ice, using the same table as *dw* above

### 7hhHH

*7* is the icing group indicator. This is the second group of the icing group pair.

*hh* is the base of the icing, the same format as that used to report cloud bases *hshs* noted previously

*HH* is the top of the icing, the same format as that used to report cloud bases *hshs* noted previously

### 8drdrSrOe

*8* is the radar group indicator. There are two groups to report radar.

*drdr* is the bearing (direction) of the echo center in tens of degrees, where 00 is north, 09 is east, 18 is south, and 27 is west.

*Sr* is the distance to echo center, where

- 0..0 nm
- 1..10 nm
- 2..20 nm
- 3..30 nm
- 4..40 nm
- 5..50 nm
- 6..60-80 nm
- 7..80-100 nm
- 8..100-150 nm
- 9..Greater than 150 nm

*/.*..Unknown

*Oe* is the orientation of echo, where

- 0..Circular 1..NNE-SSW 2..NE-SW 3..ENE-WSW 4..E-W 5..ESE-WNW 6..SE-NW 7..SSE-NNW 8..S-N */.*..Unknown

### 8EwElceie

*8* is the echo indicator group. This is the second group of the radar code.

*Ew* is the echo width or diameter using the same format as *Sr* above

*El* is the length of major axis using the same format as *Sr* above

*ce* is the character of the echo, where

- 1..Scattered area 2..Solid area 3..Scattered line 4..Solid line 5..Scattered all quadrants 6..Solid, all quads */.*..Unknown

*ie* is the intensity of the echo, where

- 2..Weak 5..Moderate 8..Strong */.*..Unknown

### 9ViTwTwTw

*9* is the group indicator

$V_i$  is the inflight visibility, where

1..0 to 1 nm 2..1 to 3 nm 3..over 3 nm

$T_w T_w T_w$  is the sea surface temperature in tenths of degrees (no longer measured)

6. Example:

**URNT10 KNHC 191956**

**AF977 TRACK 03 OB02**

**97779 19564 30410 71600 92800 28117 94/// /6924 14132 92080 62040 46262 11500 28080 60081 80366 81732**

AF977 TRACK 03 OB 02. This is observation two from aircraft 977 flying a winter storm mission on Track 03.

97779. A RECCO observation, with radar capability.

19564. Observation was collected at 1956Z (1356 Central Standard Time, or 1:56 p.m. CST). The dewpoint hygrometer works, and the aircraft is below 10,000 meters.

30410. Tuesday. In octant 0, so latitude is between 0 and 90N, and longitude is between 0 and 90W. Latitude is 41.0 North.

71600. Longitude is 71.6W. Spot winds measured by inertial navigation systems (very accurate).

92820. Pressure altitude of the aircraft is 928 decameters = 9280 meters = 30,448 feet (yes, we fly winter storms quite high, for a turboprop aircraft!). There is light to moderate turbulence in clear air.

28117. Flight level winds are from 280 degrees (west) at 117 knots (135 mph).

94//9. Temperature is -44 Celsius (94-50=44). Dewpoint is too dry to measure. There are thunderstorms within 30 nautical miles of the observation point.

/6924. The height of the 300 millibar surface is 924 decameters.

14132 92080 62040 46262. There are a total of four cloud layers. Of the first three, 1/8 of the area is covered by cumulonimbus (9) clouds, which extend from 2000 feet to 30,000 feet. 3/8 of the area is covered by stratocumulus clouds, which extend from 2000 feet to 4000 feet. 2/8 of the area is covered by alto- stratus, which lie at 12,000 feet.

11500 28080. The fourth and final layer of clouds consist of a layer of cirrostratus which covers 5/8ths of its portion of the sky, and it is at an altitude around 30,000 feet.

60081. Some distant weather was seen (no significant weather), a line of towering cumulus to the northeast.

80366 81732. Radar group. Radar echoes were seen towards the northeast (bearing 030 degrees). They were 60-80 nautical miles away, oriented southeast-northwest. The echoes were 10 miles wide and 80-100 miles long, and consisted of a long, scattered line of weak echoes.

