1
00:00:00,380 --> 00:00:02,620
[Music/Rainstorm]

2
00:00:02,620 --> 00:00:09,100
>>High Ice Water Contents are conditions found
in large convective storms.

3
00:00:09,100 --> 00:00:12,400
[Thunder]

4
00:00:12,400 --> 00:00:18,320
>>It could even be hurricanes, tropical storms, as we're flying in here in this location.

5
00:00:18,320 --> 00:00:25,240
HIWC conditions have high concentrations of ice crystals. The process by which these large

6
00:00:25,240 --> 00:00:33,219
volumes of ice crystals are formed is that you develop
an updraft in a warm, moist region. This air

7
00:00:33,219 --> 00:00:39,140
rises, and as it rises to higher altitudes,
it expands, because the density and pressure

8
00:00:39,140 --> 00:00:46,230
become smaller. This causes the temperatures
to become below freezing. So then the vapor

9
00:00:46,230 --> 00:00:53,850
condenses out, it forms into ice crystals.
The top parts of these large convective complex

10
00:00:53,850 --> 00:00:59,359
can expand over hundreds of square miles.
And so they're something that's not easily

11
00:00:59,359 --> 00:01:06,060
avoided and aircraft daily fly through these
type of scenarios. What we don't know is what

12
00:01:06,060 --> 00:01:11,370
is the concentration of ice crystals that
may occur in these clouds. They're not easily

13
00:01:11,370 --> 00:01:18,510
detected by radar because of their small size.
This leads to aircraft sometime flying into

14
00:01:18,510 --> 00:01:24,080
these ice crystals because they don't sense
that there is a threat from using their radar.

15
00:01:24,080 --> 00:01:30,350
These high density, or volume, of ice crystals
then can result in the engines losing power.

16
00:01:30,350 --> 00:01:37,060
And also they can result in certain sensors
on the airplane not functioning properly.

17
00:01:37,060 --> 00:01:43,840
One of the things that we want to do is to
utilize radars, existing radars that are onboard

18
00:01:43,840 --> 00:01:49,780
the aircraft, and develop algorithms which
will be able to detect these high levels of

19
00:01:49,780 --> 00:01:55,820
ice crystals that might be dangerous and allow
us to navigate through thunderstorm anvils

20
00:01:55,820 --> 00:02:01,060
or cloud masses that are produced from the
large convective systems.

21
00:02:01,060 --> 00:02:03,060
[Radio Chatter]

22
00:02:03,060 --> 00:02:08,180
[Airplane taking off]

23
00:02:08,180 --> 00:02:11,660
[Wind]

24
00:02:11,680 --> 00:02:18,580
[Music]

25
00:02:18,580 --> 00:02:20,740
>>PRCO radio, NASA 817...

26
00:02:20,740 --> 00:02:23,200
>>NASA 817, go ahead...

27
00:02:23,200 --> 00:02:27,900
>>Yes ma'am, just to keep you appraised of what
we're planning to do, we're gonna be working

28
00:02:27,900 --> 00:02:37,220
what's left of Hurricane Danny between 18
North 57 West and 15 North 57 West probably

29
00:02:37,220 --> 00:02:40,800
within about 20, 30 miles laterally back and
forth for about 2 hours.

30
00:02:40,800 --> 00:02:42,100
>>Ok, thank you.

31
00:02:42,100 --> 00:02:46,420
[Music]

32
00:02:46,420 --> 00:02:48,420
>>Mission, you getting readings?

33
00:02:48,420 --> 00:02:49,500
>>They're asking for HIWC readings.

34
00:02:49,500 --> 00:02:56,519
>>I see the IKP is registering a higher value,
we are in High Ice Water Content now

35
00:02:56,519 --> 00:02:58,540
>>Pilots are commenting it's pretty heavy.

36
00:02:58,540 --> 00:03:00,040
>>Lyle, what did we get for a peak there?

37
00:03:00,040 --> 00:03:02,240
>>Just at around 2 grams.

38
00:03:02,240 --> 00:03:06,820
[Music]

39
00:03:06,829 --> 00:03:12,349
>>What we are doing here with our in-situ measurements is trying to relate the Ice Water Content

40
00:03:12,349 --> 00:03:18,980
levels to what the radar signatures are being
recorded by Steve's systems.

41
00:03:18,980 --> 00:03:23,779
>>Here we are, collecting weather radar data
and in situ probes, and correlating the two

42
00:03:23,779 --> 00:03:28,709
along our flight path. The radar that we're
using today is a commercial weather radar.

43
00:03:28,709 --> 00:03:33,389
In front of me you can see four different
displays- various different tilts of the radar

44
00:03:33,389 --> 00:03:38,299
antenna. One that's significantly above our
flight level, one at our flight level, one

45
00:03:38,299 --> 00:03:42,639
below our flight level, and then one significantly
below our flight level. With that volume of

46
00:03:42,639 --> 00:03:47,389
space that we're covering, we're hoping to
be able to detect signatures, things that

47
00:03:47,389 --> 00:03:50,969
are like a thumbprint or a fingerprint of
this atmospheric condition.

48
00:03:50,969 --> 00:03:57,430
>>We have four instruments. We have an isokinetic
evaporator probe. What it does is the ice

49
00:03:57,430 --> 00:04:02,079
crystals are going inside the isokinetic probe,
where all of that ice crystal is evaporated.

50
00:04:02,079 --> 00:04:08,180
We're measuring the water vapor evaporating
through those particles to get the total condensate

51
00:04:08,180 --> 00:04:13,209
water vapor. We have three other probes on
the wingtips, they measure the ice particle

52
00:04:13,209 --> 00:04:18,070
sizes. This screen over here is one of the
particle probes that we have onboard the airplane.

53
00:04:18,070 --> 00:04:23,050
We're getting a representation of the particles
that we're flying through. What we see right

54
00:04:23,050 --> 00:04:30,020
here in this particular display is the satellite
IR depiction, with the flight track. What

55
00:04:30,020 --> 00:04:34,930
we're trying to do is find regions of High
Ice Water Content, which is typically found

56
00:04:34,930 --> 00:04:40,780
in the cold cloud top area, which is depicted
by the white and purple areas. We are working

57
00:04:40,780 --> 00:04:45,680
with the information from the ground, from the
satellite information, to pick out waypoints.

58
00:04:45,680 --> 00:04:49,680
We pass that information to the mission manager,
who provides it to the navigator, who provides

59
00:04:49,690 --> 00:04:51,690
it to the pilots.

60
00:04:51,690 --> 00:05:01,480
>>PRCO, NASA 817 we have one other point I'd
like to work, it's 1-5-0-0 North, 5-5-0-0

61
00:05:01,490 --> 00:05:02,090
West.

62
00:05:02,090 --> 00:05:05,870
>>We're monitoring and making sure that we are
getting into the kinds of conditions that

63
00:05:05,870 --> 00:05:07,069
we are wanting to get into.

64
00:05:07,069 --> 00:05:12,990
You can see we're currently flying in
the weather and looking for the icing. And

65
00:05:12,990 --> 00:05:16,590

you can't see anything out the front, so we're primarily relying on our instruments to know

66
00:05:16,590 --> 00:05:21,490
where we're going and make sure we're going where we need to go and collecting the data

67
00:05:21,490 --> 00:05:22,390
that we need.

68
00:05:22,390 --> 00:05:23,560
[Ice hitting window]

69
00:05:23,560 --> 00:05:27,289
>>Ice water went to near zero, and is now trending back up.

70
00:05:27,289 --> 00:05:31,610
>>So Steve, in that last run, when we reached about two, radar, was it still green?

71
00:05:31,610 --> 00:05:34,199
>>Yeah, no, I think it was even black.

72
00:05:34,199 --> 00:05:39,039
>>This is a pretty interesting section here. Just like Steve predicted.

73
00:05:40,220 --> 00:05:41,780
>>Tim, I think you've got a pitot disagree.

74
00:05:41,780 --> 00:05:43,569
>>We have a pitot issue right now.

75
00:05:43,569 --> 00:05:45,289
>>We lost both airspeeds.

76
00:05:45,289 --> 00:05:49,629
>>This HIWC mission is a little bit different

than most of our science missions. You know,

77
00:05:49,629 --> 00:05:56,659
our concern that we're flying our four engines
into engine icing conditions. We are also

78
00:05:56,659 --> 00:06:04,210
concerned about our pitot static and our total
air temperature probes, that they could ice

79
00:06:04,210 --> 00:06:08,689
up during the mission. With both pitots failed,
we can continue for about ten more minutes

80
00:06:08,689 --> 00:06:13,840
in the failed, anomalous situation. But we're
looking for a way to get out of the icing

81
00:06:13,840 --> 00:06:17,150
condition. Typically, it's just flying out
of the clouds and things will clear up, the

82
00:06:17,150 --> 00:06:20,510
other way is to actually descend.

83
00:06:21,220 --> 00:06:25,020
They're coming back. Looks like they're back.
Science, our pitots are back.

84
00:06:25,080 --> 00:06:27,199
>>Steve, will you be good for East-West runs?

85
00:06:27,199 --> 00:06:28,879
>>I should be.

86
00:06:28,880 --> 00:06:34,860
>>Maybe we can get a recommendation from the
ground on what those might be.

87

00:06:34,860 --> 00:06:40,880
[Music]

88
00:06:41,420 --> 00:06:45,759
>>It looks like we're starting to get the decline
in ice water. We're down about six tenths

89
00:06:45,759 --> 00:06:48,129
now, half a gram, six tenths.

90
00:06:48,129 --> 00:06:50,749
>>Ok. Nice profile though, eh? Gee.

91
00:06:50,749 --> 00:06:53,249
>>It's good data.

92
00:06:53,249 --> 00:06:57,029
[Music]

93
00:07:01,200 --> 00:07:03,440
[Airplane Landing]

94
00:07:03,440 --> 00:07:07,699
>>This has been different. We had our anomalies
with some of like, the air data computers,

95
00:07:07,699 --> 00:07:12,479
which loses the airspeed indication for the
pilots. We had those happen because of all

96
00:07:12,479 --> 00:07:15,919
the icing and stuff that was getting on the
pitot probes. Kind of got everybody on edge,

97
00:07:15,919 --> 00:07:19,979
and everybody's just kind of making sure that
we're staying within our correct airspeed

98
00:07:19,979 --> 00:07:23,620

and we're not, something else is not being
effected at the same time.

99
00:07:23,620 --> 00:07:27,419
>>We're flying in the soup, as pilots would
call it, because there's clouds all around.

100
00:07:27,419 --> 00:07:32,270
The aircraft itself is getting exposed to
a lot of moisture and cold air, when you start

101
00:07:32,270 --> 00:07:35,610
coming out of it to return to base, it thaws
out.

102
00:07:35,610 --> 00:07:37,610
[Music/Background Noise]

103
00:07:37,610 --> 00:07:40,250
>>We have to check the radome occasionally,

104
00:07:40,250 --> 00:07:44,789
especially after flying for awhile in there,
because those small particles can start eroding

105
00:07:44,789 --> 00:07:50,069
away the coating. And the moisture inside
the radome will make the radar ineffective.

106
00:07:51,380 --> 00:07:55,960
>>What we were able to accomplish during this
3 week campaign, we had ten flights, and we

107
00:07:55,960 --> 00:08:02,280
were able to gather the radar data and the
in situ measurements for high ice water content