



1
00:00:02,000 --> 00:00:06,160



2
00:00:07,360 --> 00:00:09,360

>>All right...
Good morning everybody.

3
00:00:09,680 --> 00:00:12,520

Roll call... Got the pilot,
got the co-pilot...

4
00:00:12,840 --> 00:00:16,120

GHOC operator...
Mission Director...

5
00:00:16,520 --> 00:00:20,560

All right! Flight mission crew,
FCIFs are complete

6
00:00:20,560 --> 00:00:23,440

and flight currencies
are all checked.

7
00:00:23,440 --> 00:00:25,560

Crew schedule
has been published...

8
00:00:25,560 --> 00:00:28,080

We are NASA872.

9
00:00:28,800 --> 00:00:31,080

Engine start expecting 0600,

10
00:00:31,080 --> 00:00:34,480

estimated landing 07
tomorrow morning,

11
00:00:35,320 --> 00:00:39,240

so the mission duration

is approximately 24.

12

00:00:39,520 --> 00:00:41,080

All right...

Thanks everybody!

13

00:00:44,400 --> 00:00:52,600

14

00:00:56,720 --> 00:00:59,000

>>Hawks are strong,
powerful birds

15

00:00:59,000 --> 00:01:01,680

capable of flying thousands
of miles each year.

16

00:01:02,200 --> 00:01:05,240

Some species undertake long
migrational journeys,

17

00:01:05,240 --> 00:01:08,000

a testimony to their
strength and stamina.

18

00:01:15,160 --> 00:01:18,280

Our bird will fly over
10,000 nautical miles

19

00:01:18,280 --> 00:01:21,480

and will reach an altitude
of 65,000 feet.

20

00:01:41,320 --> 00:01:43,000

>>The preparation for
an ATTREX flight

21

00:01:43,000 --> 00:01:45,200

starts a couple of days
before the flight

22

00:01:45,200 --> 00:01:48,440
when we get together and look
at the meteorological forecasts

23

00:01:48,440 --> 00:01:51,400
and decide where
to send the aircraft.

24

00:01:54,720 --> 00:01:57,760
>>Those targets are determined
by the circulation

25

00:01:57,760 --> 00:02:00,440
of the atmosphere which
varies from day to day.

26

00:02:00,760 --> 00:02:04,160
>>So we design a flight based
on meteorological data

27

00:02:04,160 --> 00:02:07,440
to go down and sample near
the tropical tropopause,

28

00:02:07,440 --> 00:02:09,080
so what altitude to sample.

29

00:02:09,080 --> 00:02:11,520
Also what latitude and
longitude to sample.

30

00:02:11,720 --> 00:02:14,920
>>We're looking at all the areas
where the scientists want to fly

31

00:02:14,920 --> 00:02:16,520
and we coordinate those areas

32

00:02:16,520 --> 00:02:18,760
with the Federal
Aviation Administration.

33

00:02:21,840 --> 00:02:24,600
>>We work with the scientists
beginning at that time

34

00:02:24,600 --> 00:02:28,920
to come up with options and a
plan to get them what they need.

35

00:02:28,920 --> 00:02:32,280
We try to maximize the time
that we spend in the air.

36

00:02:32,600 --> 00:02:35,440
>>For this experiment we
were focused on regions

37

00:02:35,440 --> 00:02:37,280
where temperatures are cold,

38

00:02:37,280 --> 00:02:40,280
because we're interested
in high altitude clouds.

39

00:02:40,680 --> 00:02:44,480
These clouds are about 10 miles
or 16 km above the surface.

40

00:02:44,840 --> 00:02:46,440
>>When all the instruments
are ready for flight

41

00:02:46,440 --> 00:02:47,440
and everything has
been checked out,

42

00:02:47,440 --> 00:02:48,840

the aircraft has
been checked out,

43

00:02:48,840 --> 00:02:52,120

we button up all the hatches
and we're ready for flight.

44

00:02:53,280 --> 00:02:57,200

[Radio chatter]

45

00:02:59,720 --> 00:03:01,640

>>Once everything is ready
in the control room

46

00:03:01,920 --> 00:03:04,200

we give the "OK"
for engine start.

47

00:03:05,160 --> 00:03:10,240

[Radio chatter]

48

00:03:50,760 --> 00:03:55,720

■

49

00:04:01,080 --> 00:04:03,080

>>We fly with a mouse and keyboard

50

00:04:03,080 --> 00:04:05,840

and it's more like
flying an airline

51

00:04:05,840 --> 00:04:08,400

that's always on autopilot.

52

00:04:08,640 --> 00:04:11,040

>>With the Global Hawk
we have the same controls

53

00:04:11,040 --> 00:04:13,080

only we're just on the ground

54

00:04:13,080 --> 00:04:16,800
and the aircraft could be
several thousand miles away.

55

00:04:17,080 --> 00:04:19,720
>>Rather than pointing the nose
in any given direction

56

00:04:19,720 --> 00:04:23,880
or setting a throttle for
a particular power setting

57

00:04:23,880 --> 00:04:26,000
we just tell the aircraft
go to this heading,

58

00:04:26,000 --> 00:04:29,200
go to this altitude,
go to this airspeed...

59

00:04:29,520 --> 00:04:32,240
the system itself decides on
the best way to get there.

60

00:04:32,400 --> 00:04:36,120
>>And one of our challenges is to
understand the contingency state

61

00:04:36,120 --> 00:04:37,600
that the aircraft is in

62

00:04:37,600 --> 00:04:40,320
and make sure we understand
what the aircraft is doing

63

00:04:40,320 --> 00:04:42,760
and that's what we truly
want the aircraft to do.

64

00:04:43,160 --> 00:04:45,000

>>Most of the time
the aircraft is flying

65

00:04:45,000 --> 00:04:46,880

in what we call a
"cruise climb mode".

66

00:04:46,880 --> 00:04:49,920

It's actually full throttle,
in a climb,

67

00:04:49,920 --> 00:04:52,160

it gets up to a maximum altitude

68

00:04:52,160 --> 00:04:54,880

and then it has to wait
to burn fuel off and,

69

00:04:54,880 --> 00:04:58,120

as the aircraft gets lighter,
it goes a little bit higher...

70

00:04:58,120 --> 00:04:59,120

and a little bit higher...

71

00:04:59,120 --> 00:05:02,640

up to a maximum ceiling
of about 65,000 feet.

72

00:05:03,440 --> 00:05:06,120

[Radio chatter]

73

00:05:12,880 --> 00:05:15,280

>>One of the things we do
during these flights is

74

00:05:15,280 --> 00:05:19,600

we have a meteorological team
of forecasters down the hall,

75

00:05:20,200 --> 00:05:22,400

who are watching
the satellite products

76

00:05:22,400 --> 00:05:26,440

and telling us where
thunderstorms are for example...

77

00:05:26,640 --> 00:05:29,440

>>There might be colder
temperatures south of Hawaii

78

00:05:29,440 --> 00:05:32,720

versus just off the coast
of South America...

79

00:05:32,720 --> 00:05:33,960

or Central America...

80

00:05:34,160 --> 00:05:35,720

So we have to know
where to direct the plane.

81

00:05:35,720 --> 00:05:39,800

So we look very carefully at the
meteorological situation first.

82

00:05:40,280 --> 00:05:43,120

Then when they're in the air
and you're flying along,

83

00:05:43,120 --> 00:05:45,160

often times these
forecasts are wrong.

84

00:05:45,680 --> 00:05:48,560

>>When the atmospheric conditions

change during the flight

85

00:05:48,560 --> 00:05:49,880
when we're out over the ocean,

86

00:05:50,240 --> 00:05:52,120
a lot of times there's a request

87

00:05:52,120 --> 00:05:53,840
for us to change
our flight track.

88

00:05:53,840 --> 00:05:55,720
Maybe the air that
they are interested in

89

00:05:55,720 --> 00:05:57,120
is in a different area.

90

00:05:57,120 --> 00:05:58,760
So, one of the things
that we will do

91

00:05:58,760 --> 00:06:00,880
is coordinate that
flight change.

92

00:06:01,200 --> 00:06:03,520
>>We will use the information
we're collecting

93

00:06:03,520 --> 00:06:06,200
as we fly along
to redirect the plane.

94

00:06:06,480 --> 00:06:08,760
>>If you notice, up in that
forward deck of the airplane,

95

00:06:08,760 --> 00:06:11,120
there's a big white
48 inch dish.

96
00:06:11,440 --> 00:06:14,560
That's a KU, a
commercial KU SatCom dish,

97
00:06:14,560 --> 00:06:17,520
and that is constantly
pointing at the satellite

98
00:06:17,520 --> 00:06:20,480
that we have subscribed to
for the missions.

99
00:06:20,760 --> 00:06:24,600
>>We actually get extensive
data transmission

100
00:06:24,600 --> 00:06:28,320
from what the instruments
are measuring in flight.

101
00:06:34,920 --> 00:06:37,000
>>We decide, based on
what we see,

102
00:06:37,000 --> 00:06:39,400
to send the aircraft
somewhere else

103
00:06:39,400 --> 00:06:42,240
or to have it go down
to different altitudes.

104
00:06:42,480 --> 00:06:44,880
>>The classic case, as I said,
as you look down

105

00:06:44,880 --> 00:06:49,160
you see a cloud on the LIDAR and
you say "we're gonna turn around

106
00:06:49,160 --> 00:06:51,480
descend into that cloud,
and sample it."

107
00:06:51,840 --> 00:06:55,520
>>So we'll profile down,
through these thin clouds,

108
00:06:55,520 --> 00:06:58,640
making measurements of
not only water vapor,

109
00:06:58,640 --> 00:07:00,240
but the temperature,
and the pressure

110
00:07:00,240 --> 00:07:03,440
and a range of other gases
including ozone,

111
00:07:03,440 --> 00:07:05,480
chlorofluorocarbons
and so forth.

112
00:07:05,800 --> 00:07:08,600
So that we can understand
the movement of air

113
00:07:08,600 --> 00:07:13,120
and the behavior of the air in
that layer as we dive down.

114
00:07:13,520 --> 00:07:15,480
>>One of the great
things about this is

115

00:07:15,480 --> 00:07:17,560

being that our ground
station is building-based,

116

00:07:17,560 --> 00:07:19,880

we have all the scientists
in the back room.

117

00:07:20,120 --> 00:07:21,960

We always fly with two pilots.

118

00:07:21,960 --> 00:07:24,280

This gives us the
opportunity for one pilot,

119

00:07:24,280 --> 00:07:27,920

the mission commander,
to get up, go to the back room

120

00:07:27,920 --> 00:07:30,280

leave the other guy
to monitor the airplane

121

00:07:30,280 --> 00:07:33,400

and we can talk with any one
of the particular scientists,

122

00:07:33,400 --> 00:07:37,080

whoever has the most important
data that they want to get

123

00:07:37,080 --> 00:07:38,720

at that particular time.

124

00:07:38,720 --> 00:07:40,960

We can work directly
with that scientist,

125

00:07:40,960 --> 00:07:43,360

sit right down at the

table with him or her,

126

00:07:43,360 --> 00:07:46,720
and decide what's the best way
to get them what they want

127

00:07:46,720 --> 00:07:48,920
and still meet everybody
else's needs.

128

00:07:49,120 --> 00:07:51,200
>>Obviously, the pilots
fly the plane

129

00:07:51,200 --> 00:07:53,680
they're the ones who are
talking to ground control,

130

00:07:53,680 --> 00:07:56,480
but the pilot has to
know where to go

131

00:07:56,480 --> 00:07:58,880
and that's where the
scientists' role comes in.

132

00:07:59,120 --> 00:08:01,240
The scientists will
pick the targets

133

00:08:01,240 --> 00:08:03,960
and direct the plane towards
the appropriate targets.

134

00:08:03,960 --> 00:08:07,800
Both, before we fly,
and while we are flying.

135

00:08:08,560 --> 00:08:10,040
>>It's quite a process

because, sometimes,

136

00:08:10,040 --> 00:08:12,400

it can mean a major shift
in the flight track.

137

00:08:12,760 --> 00:08:16,120

We'll look at what they propose
and provide some feedback.

138

00:08:16,120 --> 00:08:18,600

And then we have to talk
to Air Traffic Control

139

00:08:18,600 --> 00:08:21,400

to make sure that what we're
proposing is okay with them.

140

00:08:21,920 --> 00:08:23,120

So we will change
the flight track,

141

00:08:23,120 --> 00:08:24,920

sometimes many times,
during the flight.

142

00:08:25,240 --> 00:08:26,720

>>And so that's how we
coordinate between

143

00:08:26,720 --> 00:08:28,760

the flight operations team and
the payload operations team.

144

00:08:28,760 --> 00:08:31,640

So it's a very close
collaboration during a flight

145

00:08:31,640 --> 00:08:33,040

between both groups.

146

00:08:33,400 --> 00:08:35,480

>>Very interesting for
me too, because,

147

00:08:35,480 --> 00:08:40,000

coming from a platform where
we would just have instruments

148

00:08:40,000 --> 00:08:42,560

loaded on the plane and
we just go fly a mission,

149

00:08:42,880 --> 00:08:45,520

we get real time interaction
with the scientists.

150

00:08:45,520 --> 00:08:47,080

And I've learned a whole lot

151

00:08:47,080 --> 00:08:49,120

just in the few years
I've been doing this

152

00:08:49,120 --> 00:08:51,680

on what's going on in the
back end of the airplane.

153

00:08:51,920 --> 00:08:54,600

Very exciting and
very interesting.

154

00:09:00,920 --> 00:09:06,680

[Radio chatter]

155

00:09:09,320 --> 00:09:12,040

>>Well... What next and
what's important to do?

156

00:09:12,320 --> 00:09:15,080

>>We hope that ATTREX will improve our understanding

157

00:09:15,080 --> 00:09:16,360

of this part of the atmosphere,

158

00:09:16,360 --> 00:09:17,880

but ultimately

ATTREX will raise

159

00:09:17,880 --> 00:09:19,440

some additional

questions as well.

160

00:09:19,720 --> 00:09:21,200

>>We have a lot of work to go

161

00:09:21,200 --> 00:09:24,760

and we hope that doing ATTREX

with multiple missions,

162

00:09:24,760 --> 00:09:27,680

different times of the year,

in different parts of,

163

00:09:27,680 --> 00:09:30,960

mostly over the Pacific

but into the Indian Ocean,

164

00:09:31,240 --> 00:09:35,720

to fully understand the range

of conditions that we'll see

165

00:09:35,720 --> 00:09:38,880

that models have to consider all

of those ranges of conditions

166

00:09:38,880 --> 00:09:42,960

in order to understand

the climate system properly.

167

00:09:43,200 --> 00:09:45,600

>>We need to develop
some more instruments

168

00:09:45,600 --> 00:09:50,200

and fly them on the Global Hawk
and other high-altitude aircraft

169

00:09:50,200 --> 00:09:52,760

to make measurements
there as well

170

00:10:01,520 --> 00:10:03,480

>>Emily Dickinson once wrote:

171

00:10:03,480 --> 00:10:05,760

“The brain is wider
than the sky”

172

00:10:08,440 --> 00:10:10,840

Many questions have been
addressed along the way

173

00:10:10,840 --> 00:10:12,800

and new ones have surfaced