



1
00:00:01,720 --> 00:00:07,960



2
00:00:11,360 --> 00:00:13,720

>>Hawks' sense of hearing is excellent

3
00:00:13,720 --> 00:00:17,280

and their eyesight the best in the entire animal world.

4
00:00:17,960 --> 00:00:21,040

Not only can they see greater distances than humans,

5
00:00:21,040 --> 00:00:24,880

but their visual acuity is eight times that of ours

6
00:00:29,120 --> 00:00:32,160

Yet we need to look even further, higher...

7
00:00:32,160 --> 00:00:34,120

deeper into the sky.

8
00:00:35,720 --> 00:00:37,960

>>We live in the lowest layer of the atmosphere

9
00:00:37,960 --> 00:00:39,560

which is the troposphere,

10
00:00:39,560 --> 00:00:42,400

the stratosphere is the next layer above us.

11
00:00:42,400 --> 00:00:45,360

So it's basically

above altitudes

12

00:00:45,360 --> 00:00:49,400
of somewhere between
30,000 and 50,000 feet.

13

00:00:49,400 --> 00:00:52,920
>>There are processes that take
place in the stratosphere

14

00:00:52,920 --> 00:00:55,160
that have very direct
impact on us.

15

00:00:55,160 --> 00:00:57,560
>>So it's extremely important
to understand

16

00:00:57,560 --> 00:01:01,120
the detailed process of
water turning into clouds...

17

00:01:01,120 --> 00:01:03,720
those particles and
clouds settling out...

18

00:01:03,720 --> 00:01:06,600
How does that detailed
process occur?

19

00:01:06,600 --> 00:01:08,960
And then, how will it
change in the future?

20

00:01:09,200 --> 00:01:11,120
>>What's been our big problem is

21

00:01:11,120 --> 00:01:13,760
getting the airplanes
to the right place

22

00:01:13,760 --> 00:01:16,000

where they can make
the measurements

23

00:01:16,000 --> 00:01:19,720

for long enough periods of time
to do the observations.

24

00:01:35,560 --> 00:01:40,480



25

00:01:41,360 --> 00:01:44,040

>>So it turns out the Global Hawk
is the perfect tool

26

00:01:44,040 --> 00:01:46,480

for sampling this part
of the atmosphere.

27

00:01:46,480 --> 00:01:48,600

It's a high-altitude
aircraft that flies

28

00:01:48,600 --> 00:01:51,720

considerably higher than
normal commercial aircrafts

29

00:01:51,720 --> 00:01:54,680

but it's also got this
extremely long range.

30

00:01:55,080 --> 00:01:58,480

>>So our bird here can
climb to a cruise altitude

31

00:01:58,480 --> 00:02:03,200

of 65,000 feet and fly
for up to 30 hours.

32

00:02:03,640 --> 00:02:05,280

>>For example...

33

00:02:05,280 --> 00:02:09,120

we could fly from here
to Australia in one flight.

34

00:02:16,200 --> 00:02:17,800

>>So the basic geometry
of the airplane...

35

00:02:17,800 --> 00:02:20,320

it has a wingspan of 116 feet

36

00:02:20,320 --> 00:02:23,400

which is equivalent to the
wingspan of a Boeing 737

37

00:02:23,400 --> 00:02:24,880

transport aircraft...

38

00:02:24,880 --> 00:02:26,920

a length of about 65 feet,

39

00:02:26,920 --> 00:02:31,240

weighs about 27 thousand
pounds fully fueled at take off.

40

00:02:36,440 --> 00:02:38,480

>>In comparison,
in the past,

41

00:02:38,480 --> 00:02:41,640

people have use manned
high-altitude aircrafts

42

00:02:41,640 --> 00:02:44,800

like the ER-2 or the WB-57.

43

00:02:44,800 --> 00:02:47,520

However those have
very short range.

44

00:02:48,040 --> 00:02:49,360

>>Now that we have
the Global Hawks,

45

00:02:49,360 --> 00:02:51,920

they have a much longer
flight duration,

46

00:02:51,920 --> 00:02:54,080

they can get to these key areas

47

00:02:54,080 --> 00:02:56,600

to appropriately attack
the science questions

48

00:02:56,600 --> 00:02:58,920

that we've been thinking
about for a very long time.

49

00:02:59,680 --> 00:03:02,960

■

50

00:03:26,880 --> 00:03:28,720

>>Basically for this program,

51

00:03:28,720 --> 00:03:30,880

we searched out the
best instrumentation,

52

00:03:30,880 --> 00:03:34,000

the best expertise in
making these measurements

53

00:03:34,000 --> 00:03:36,960

and invited them to be

part of the program

54

00:03:36,960 --> 00:03:40,280

for the proposal for
the ATTREX mission.

55

00:03:48,480 --> 00:03:53,640

>>Once the mission scientist
selects the instrument teams,

56

00:03:53,640 --> 00:03:55,800

that's really when
our work gets started.

57

00:03:55,800 --> 00:03:58,080

We will then visit them
and begin coordinating

58

00:03:58,080 --> 00:04:01,280

all the mechanical
and electrical interfaces

59

00:04:01,280 --> 00:04:04,160

we need to do to get them
mounted on the airplane.

60

00:04:07,200 --> 00:04:11,000

>>You have to determine everything
from the size of the instrument,

61

00:04:11,000 --> 00:04:15,240

so you know how much space it's
going to occupy in the aircraft

62

00:04:15,440 --> 00:04:16,840

to how much the instrument weights

63

00:04:16,840 --> 00:04:19,680

so you can be sure that what
you've designed mechanically,

64

00:04:19,680 --> 00:04:21,640
for installing the instrument
on the aircraft,

65

00:04:21,640 --> 00:04:23,440
is of sufficient strength

66

00:04:23,440 --> 00:04:26,040
to be able to hold the
instrument in the aircraft...

67

00:04:26,320 --> 00:04:28,760
>>In some case you'll see probes
sticking out of the airplane

68

00:04:28,760 --> 00:04:32,520
so all that has to go through
aerodynamic analysis etc...

69

00:04:32,960 --> 00:04:35,960
Structural mounts inside have
to be properly stress analyzed

70

00:04:35,960 --> 00:04:37,360
so we make sure
all that happens.

71

00:04:37,360 --> 00:04:40,560
So we coordinate with all the
proper technical fields

72

00:04:40,560 --> 00:04:43,160
to get ready for the
instrument to arrive here.

73

00:04:43,480 --> 00:04:45,480
>>From the time we first
start communicating with

74

00:04:45,480 --> 00:04:46,920
the instruments' teams

75

00:04:46,920 --> 00:04:49,040
until we're ready to actually
start performing science

76

00:04:49,040 --> 00:04:50,760
with all the instruments
on the aircraft,

77

00:04:50,760 --> 00:04:53,360
it takes about a year and
a half of really hard work,

78

00:04:53,360 --> 00:04:55,080
close coordination

79

00:04:55,080 --> 00:04:58,160
and a lot of good communication
between everybody.

80

00:05:11,920 --> 00:05:14,440
>>We're using state-of-the-art
instruments,

81

00:05:14,440 --> 00:05:16,200
cutting edge instruments,

82

00:05:16,200 --> 00:05:20,560
to measure things like water
vapor, clouds, temperature

83

00:05:20,560 --> 00:05:23,080
and a whole bunch
of trace gases.

84

00:05:23,520 --> 00:05:26,200
>>We have a very

sophisticated instrument,

85

00:05:26,200 --> 00:05:28,400
called the
Clouds Physics Lidar.

86

00:05:28,400 --> 00:05:32,000
it's a laser that shoots out
the bottom of the plane

87

00:05:32,000 --> 00:05:33,840
and, as the laser goes down,

88

00:05:33,840 --> 00:05:35,280
some of the light
gets scattered back...

89

00:05:35,280 --> 00:05:37,600
and there's a telescope
that collects that light!

90

00:05:37,600 --> 00:05:39,680
And, because you know
how long it takes the light

91

00:05:39,680 --> 00:05:41,520
to go down and come back up,

92

00:05:41,520 --> 00:05:44,000
you can tell what kind
of cloud structure

93

00:05:44,000 --> 00:05:45,520
there is below the plane.

94

00:05:45,520 --> 00:05:47,400
So if we see very thin clouds,

95

00:05:47,400 --> 00:05:49,960

this laser can detect
those very thin clouds.

96

00:05:50,360 --> 00:05:52,880

We have a meteorological
system on board the plane

97

00:05:52,880 --> 00:05:56,400

that measures winds,
temperatures and pressure.

98

00:05:56,400 --> 00:05:59,720

And it's the best meteorological
instrument in the world

99

00:05:59,720 --> 00:06:01,080

for measuring these.

100

00:06:01,080 --> 00:06:04,040

Imagine how hard it is
to measure from a plane

101

00:06:04,040 --> 00:06:07,000

that is going a few
hundred miles per hour!

102

00:06:07,000 --> 00:06:10,240

It's a really hard measurement
to make and they do it.

103

00:06:16,200 --> 00:06:19,920

>>We have two water vapor
measurements on board the plane.

104

00:06:19,920 --> 00:06:23,480

Water vapor is important
to look at how air,

105

00:06:23,480 --> 00:06:26,720

that's going into the

stratosphere gets freeze dried

106

00:06:26,720 --> 00:06:29,920

so you need a really high
quality water vapor measurement

107

00:06:29,920 --> 00:06:32,240

and we have two
instruments to do that.

108

00:06:32,800 --> 00:06:37,020

We measure ozone
on board this plane.

109

00:06:37,020 --> 00:06:40,200

the ozone layer screens
ultraviolet radiation

110

00:06:40,200 --> 00:06:42,320

so we have to know what
the ozone looks like.

111

00:06:42,320 --> 00:06:44,520

There's actually very little
ozone in the lower atmosphere

112

00:06:44,520 --> 00:06:46,560

and there's a lot as you get
into the stratosphere.

113

00:06:46,560 --> 00:06:49,240

So we use ozone actually
to tell us the difference

114

00:06:49,240 --> 00:06:52,240

between stratospheric air
and tropospheric air.

115

00:06:52,720 --> 00:06:55,920

We have another instrument that

actually sucks gas samples.

116

00:06:55,920 --> 00:06:58,480

It has little cans...

So it'll suck in a little air

117

00:06:58,480 --> 00:07:01,200

and then you bring those cans

back, take them into a lab

118

00:07:01,200 --> 00:07:04,200

and you can literally measure

a hundred different gases

119

00:07:04,200 --> 00:07:06,400

from this little

gas sample cans.

120

00:07:06,720 --> 00:07:08,200

And that's really important

because you can look

121

00:07:08,200 --> 00:07:11,960

at all sorts of natural and

human produced gases

122

00:07:11,960 --> 00:07:16,560

to look at things like ozone

depletion and climate change.

123

00:07:16,960 --> 00:07:19,600

>>So all of these will tell us

how air is transported

124

00:07:19,600 --> 00:07:21,920

through the Tropical

Tropopause region

125

00:07:21,920 --> 00:07:24,400

and how it's dried

126

00:07:24,400 --> 00:07:27,240

to the very dry conditions
of the stratosphere.

127

00:07:37,800 --> 00:07:42,080

>>ATTREX is sort of a pathfinder

128

00:07:42,080 --> 00:07:45,840

in terms of investigating
some of these processes

129

00:07:45,840 --> 00:07:47,800

and, when I say pathfinder...

130

00:07:47,800 --> 00:07:52,440

it's utilizing a brand new tool
and that is the Global Hawk.

131

00:07:52,640 --> 00:07:54,160

>>This is a hybrid.

132

00:07:54,160 --> 00:07:58,920

It's like a satellite that you
control from a control room,

133

00:07:58,920 --> 00:08:01,720

but it has nobody in it!
Like a satellite!.

134

00:08:01,720 --> 00:08:04,400

So it's really a new and
revolutionary way

135

00:08:04,400 --> 00:08:06,200

of doing science.

136

00:08:06,560 --> 00:08:08,040

>>With the science that

we do at NASA,

137

00:08:08,040 --> 00:08:10,240

we need to combine
the satellite data

138

00:08:10,240 --> 00:08:12,720

with aircraft data,
with modeling data

139

00:08:12,720 --> 00:08:15,240

and even some measurements
from the ground all together

140

00:08:15,240 --> 00:08:17,560

to answer the science
questions the right way.

141

00:08:17,840 --> 00:08:21,040

>>In 50 years we'll look
back on this plane

142

00:08:21,040 --> 00:08:23,240

and it'll seem...
it'll be very common,

143

00:08:23,240 --> 00:08:24,800

it'll be used all over the world.

144

00:08:24,800 --> 00:08:27,240

I really believe that planes
like the Global Hawk

145

00:08:27,240 --> 00:08:31,400

are going to change atmospheric
science in a very profound way

146

00:08:31,400 --> 00:08:33,840

and for the betterment of
everybody who lives here

147

00:08:33,840 --> 00:08:35,840

on the Earth.