



1
00:00:01,480 --> 00:00:12,320



2
00:00:12,720 --> 00:00:15,920
>>Our planet is a living example
of a delicate balance

3
00:00:16,480 --> 00:00:19,160
a complex system that is
constantly changing,

4
00:00:19,160 --> 00:00:22,520
constantly evolving,
constantly adapting.

5
00:00:28,160 --> 00:00:30,720
How do these changes
affect life on Earth?

6
00:00:31,240 --> 00:00:34,160
How does everyday life
affect our planet?

7
00:00:55,040 --> 00:00:59,080
We have a great capability to
absorb, interpret and comprehend

8
00:00:59,080 --> 00:01:02,360
And an urge to understand
the world we live in.

9
00:01:03,920 --> 00:01:06,840
This is what defines us
as human beings...

10
00:01:06,840 --> 00:01:08,840
What makes us who we are.

11
00:01:15,000 --> 00:01:17,080

With our technological
advancements

12

00:01:17,080 --> 00:01:20,640

we are now capable of exploring
new worlds, new frontiers.

13

00:01:21,880 --> 00:01:24,720

We're searching for answers that
may lay in front of us...

14

00:01:24,720 --> 00:01:26,880

Better yet... above us!

15

00:01:30,520 --> 00:01:33,400

The field phase of the
experiment is about to begin.

16

00:01:33,400 --> 00:01:37,600

All the planning, sleepless
nights, meetings and hard work

17

00:01:37,600 --> 00:01:40,360

the team has invested in
the mission are at stake.

18

00:01:42,840 --> 00:01:44,800

My name is Jasna Pittman,

19

00:01:44,800 --> 00:01:47,320

and I'm one of the many
scientists working on

20

00:01:47,320 --> 00:01:50,600

the Airborne Tropical
Tropopause Experiment (ATTREX)

21

00:01:55,200 --> 00:01:56,720

>>It is very natural for humans

22

00:01:56,720 --> 00:01:59,920

to want to understand how
the world around us works.

23

00:01:59,920 --> 00:02:02,320

>>Why the atmosphere
does what it does?

24

00:02:02,320 --> 00:02:04,400

It's like solving a puzzle!

25

00:02:04,400 --> 00:02:07,720

>>You just want to understand
how it works.

26

00:02:09,840 --> 00:02:12,800

>>We're trying to understand
how we're affecting,

27

00:02:12,800 --> 00:02:15,000

how humans are affecting
the atmosphere.

28

00:02:15,000 --> 00:02:17,440

>>Understanding how the
stratosphere changes

29

00:02:17,440 --> 00:02:21,160

very much reflects how
our climate is changing.

30

00:02:27,320 --> 00:02:30,160

>>I think that the work that is
done in atmospheric science

31

00:02:30,160 --> 00:02:33,640

is very important!

But it's also a lot of fun!

32

00:02:33,640 --> 00:02:37,000
>>It's like the best job possible!

33

00:02:45,200 --> 00:02:49,360



34

00:02:56,800 --> 00:02:59,760

>>NASA has been doing airborne science investigations

35

00:02:59,760 --> 00:03:01,480

for quite some time.

36

00:03:01,480 --> 00:03:04,520

Some of the earliest investigations we were doing

37

00:03:04,520 --> 00:03:08,960

was related to the early days of the Antarctic ozone hole.

38

00:03:08,960 --> 00:03:15,920

>>In 2009 we started a new program called the Earth Venture Program.

39

00:03:15,920 --> 00:03:18,800

It's got three parts; and the first of those parts

40

00:03:18,800 --> 00:03:21,960

is what we call sub-orbital science.

41

00:03:21,960 --> 00:03:29,560

this is science done not including a new satellite.

42

00:03:42,960 --> 00:03:45,120

>>With some of these newer missions

43

00:03:45,120 --> 00:03:47,960

we have let the community
come up with their own ideas,

44

00:03:47,960 --> 00:03:50,080

their own way of
implementing the mission,

45

00:03:50,080 --> 00:03:52,120

what their own science
requirements are

46

00:03:52,120 --> 00:03:54,280

and they bring their
measurements to the table.

47

00:03:54,280 --> 00:03:58,680

>>And ATTREX had
very good science,

48

00:03:58,680 --> 00:04:03,640

was very relevant to the kind
of questions we wanted answered,

49

00:04:03,640 --> 00:04:07,600

and its budget was
reasonable and appropriate.

50

00:04:23,160 --> 00:04:27,640

>>So ATTREX is an airborne
campaign to try to understand

51

00:04:27,640 --> 00:04:32,160

how stratospheric water vapor
affects climate.

52

00:04:32,160 --> 00:04:36,200

>>It causes perhaps, maybe,
15 to 20 percent

53

00:04:36,200 --> 00:04:40,760

of the warming that we've had
in the past 15 or 20 years.

54

00:04:45,440 --> 00:04:49,200

>>It turns out that small changes
in humidity in the stratosphere

55

00:04:49,200 --> 00:04:53,200

are very important for climate
and for surface temperature.

56

00:04:53,200 --> 00:04:56,080

They are actually comparable
to the importance

57

00:04:56,080 --> 00:04:58,920

of greenhouse gases that
everybody knows about.

58

00:05:00,920 --> 00:05:06,440

>>So we know that carbon dioxide
was less 30 years ago.

59

00:05:06,440 --> 00:05:09,880

Methane was less
30 years ago.

60

00:05:09,880 --> 00:05:12,640

Nitrous oxide was less
30 years ago.

61

00:05:12,640 --> 00:05:15,480

So we know these gases
are increasing with time.

62

00:05:15,480 --> 00:05:18,000

>>Gases that affect the
chemistry of the stratosphere

63

00:05:18,000 --> 00:05:20,400

which is where the
ozone layer exists

64

00:05:20,400 --> 00:05:23,040

and protects us from
ultraviolet radiation.

65

00:05:23,040 --> 00:05:26,120

>>So understanding the rate
at which this stuff

66

00:05:26,120 --> 00:05:28,880

gets into the stratosphere
and how it changes

67

00:05:28,880 --> 00:05:31,440

is extremely important to
looking at the climate

68

00:05:31,440 --> 00:05:33,880

of the stratosphere and how
the stratosphere climate affects

69

00:05:33,880 --> 00:05:35,520

the lower atmosphere.

70

00:05:35,800 --> 00:05:37,080

>>So we really need to understand

71

00:05:37,080 --> 00:05:40,840

what controls the humidity
of the stratosphere

72

00:05:40,840 --> 00:05:43,720

and actually be able to
predict that in the future

73

00:05:43,720 --> 00:05:46,760
in order to improve the accuracy

74

00:05:46,760 --> 00:05:50,080
of our predictions of
future climate change.

75

00:05:57,000 --> 00:06:00,360
And it turns out that the most
important place to go sample

76

00:06:00,360 --> 00:06:03,760
to understand that, is the
tropical upper troposphere.

77

00:06:03,760 --> 00:06:07,680
The top of the troposphere
in the tropics is called

78

00:06:07,680 --> 00:06:11,000
the "tropopause" which is
actually at a very high-altitude

79

00:06:11,000 --> 00:06:14,680
which is why we need a high
altitude aircraft to study it.

80

00:06:18,800 --> 00:06:20,560
>>So the tropical tropopause

81

00:06:20,560 --> 00:06:25,000
is at about 55,000 feet
in the tropics.

82

00:06:25,000 --> 00:06:27,720
So if you go down to the equator
you have to go up quite high

83

00:06:27,720 --> 00:06:29,320
above 50,000 feet.

84
00:06:29,320 --> 00:06:33,280
And the tropical tropopause is really important
to the global atmosphere

85
00:06:33,280 --> 00:06:36,960
because most of the gases
that get into the stratosphere,

86
00:06:36,960 --> 00:06:39,760
all the air that is circulating
upward into the stratosphere,

87
00:06:39,760 --> 00:06:42,720
goes through this tropical
tropopause region.

88
00:06:43,120 --> 00:06:45,600
>>So that is basically a
gateway to the stratosphere.

89
00:06:45,600 --> 00:06:49,360
General circulation transports
air upward in the tropics,

90
00:06:49,360 --> 00:06:51,240
goes into the stratosphere,

91
00:06:51,240 --> 00:06:53,520
and then spread throughout
the stratosphere

92
00:06:53,520 --> 00:06:57,080
and comes down at the higher
latitudes in the polar regions.

93
00:06:57,080 --> 00:06:59,200
>>And this is what ATTREX
is focused on,

94

00:06:59,200 --> 00:07:02,960

to look at that motion of air
into the stratosphere

95

00:07:02,960 --> 00:07:05,440

and how the water is removed

96

00:07:05,440 --> 00:07:08,000

from that air as
it rises upward.

97

00:07:08,000 --> 00:07:11,040

>>We know a lot about it,
but there are some puzzles

98

00:07:11,040 --> 00:07:14,120

about the details of
how the clouds form,

99

00:07:14,120 --> 00:07:16,280

and under what
conditions they form.

100

00:07:16,280 --> 00:07:18,400

So that's probably the
most important thing

101

00:07:18,400 --> 00:07:21,120

that we hope to
gain from ATTREX.

102

00:07:24,360 --> 00:07:28,400

>>ATTREX will address a number
of really important issues.

103

00:07:28,400 --> 00:07:31,480

It'll give us a better
understanding of the exchange

104

00:07:31,480 --> 00:07:33,960
between the troposphere
and stratosphere

105
00:07:33,960 --> 00:07:37,080
and how that impacts
atmospheric composition.

106
00:07:37,080 --> 00:07:40,880
How that affects the chemistry
in the upper atmosphere.

107
00:07:40,880 --> 00:07:42,400
And, in the longer term,

108
00:07:42,400 --> 00:07:44,320
how that will affect
the climate.

109
00:07:44,320 --> 00:07:48,720
>>And that will help us to
understand as we go forward

110
00:07:48,720 --> 00:07:52,040
trying to figure out what
to do about climate change

111
00:07:52,040 --> 00:07:55,160
to better predict it
and make better decisions.

112
00:08:10,800 --> 00:08:13,520
>>How does the interaction between
the upper troposphere

113
00:08:13,520 --> 00:08:16,360
and the lower stratosphere
affects us down below?

114
00:08:16,920 --> 00:08:18,680

How are we going to find out?

115

00:08:19,560 --> 00:08:21,040

We have the questions.