1
00:00:03,200 --> 00:00:06,160
■

2
00:00:07,120 --> 00:00:08,960
>> Throughout many field campaigns

3
00:00:08,960 --> 00:00:11,560
we've come a long way
in expanding our knowledge

4
00:00:11,560 --> 00:00:13,680
and understanding
of our atmosphere.

5
00:00:14,200 --> 00:00:17,040
But this hasn't been
a one person effort.

6
00:00:17,520 --> 00:00:19,680
Collaboration and
close coordination

7
00:00:19,680 --> 00:00:23,680
within the ATTREX team have
made this endeavor possible.

8
00:00:31,480 --> 00:00:33,680
>>For any field experiments you do,

9
00:00:33,680 --> 00:00:35,760
you have the questions that
you are trying to answer

10
00:00:35,760 --> 00:00:38,120
and then you figure out
which data do you need

11
00:00:38,120 --> 00:00:39,720
to best answer the questions.

12
00:00:40,040 --> 00:00:41,720
Once you've done that,
then you figure out

13
00:00:41,720 --> 00:00:44,760
who has the capability of
making those measurements.

14
00:00:45,080 --> 00:00:48,120
>>So basically, what we've done
is gather the leading experts,

15
00:00:48,120 --> 00:00:52,200
in theory... in modeling
of the atmosphere...

16
00:00:52,200 --> 00:00:54,440
and in making these very
challenging measurements.

17
00:00:54,640 --> 00:00:57,480
>>And that is the only way that
you can really do science.

18
00:00:57,720 --> 00:00:59,400
You have to go
to the right place

19
00:00:59,400 --> 00:01:02,600
and measure at the right time
with the right people.

20
00:01:03,000 --> 00:01:06,240
>>And part of the reason I really
like these airborne science campaigns

21
00:01:06,240 --> 00:01:08,200
is that they are sort of
these grand endeavors,

22
00:01:08,200 --> 00:01:09,840
where everyone comes
out to the field,

23
00:01:09,840 --> 00:01:12,560
we're all working very hard
with a common goal

24
00:01:12,760 --> 00:01:15,080
and very thankful
to have the opportunity

25
00:01:15,080 --> 00:01:17,040
to get these measurements.

26
00:01:22,560 --> 00:01:25,120
>>The other thing about
these NASA campaigns

27
00:01:25,120 --> 00:01:28,080
is the data will then be
shared with everybody.

28
00:01:28,520 --> 00:01:31,240
So it'll be used by people
from all different countries.

29
00:01:31,440 --> 00:01:33,040
>>The more people
that use the data,

30
00:01:33,040 --> 00:01:35,480
the more of an impact
our data have.

31
00:01:35,800 --> 00:01:37,840
>>Because we are all basically
working together,

32
00:01:37,840 --> 00:01:41,000
trying to understand how
the atmosphere works.

33
00:01:47,160 --> 00:01:48,680
>>The data we have gathered

34
00:01:48,680 --> 00:01:52,480
will be used to benefit humanity
for many years to come.

35
00:02:01,520 --> 00:02:04,560
■

36
00:02:11,520 --> 00:02:13,280
>>When you make an observation,

37
00:02:13,280 --> 00:02:16,320
that's only the beginning
of the story.

38
00:02:19,280 --> 00:02:22,760
It's like walking
into a crime scene

39
00:02:22,760 --> 00:02:25,560
and taking a picture and
collecting some evidence.

40
00:02:25,880 --> 00:02:27,880
Footwork begins after that.

41
00:02:27,880 --> 00:02:31,960
The real work of putting
everything together to produce

42
00:02:31,960 --> 00:02:35,480
a full picture of what's
happening in our atmosphere.

43
00:02:35,840 --> 00:02:38,160
>>And ATTREX is basically
part of that puzzle.

44
00:02:38,160 --> 00:02:41,160
We are addressing
a key uncertainty

45
00:02:41,160 --> 00:02:45,000
in how the models predict
future climate change.

46
00:02:45,240 --> 00:02:50,360
>>We have to actually figure out
how all of these things work.

47
00:03:01,640 --> 00:03:04,320
>>So the real underlying
objective of ATTREX

48
00:03:04,320 --> 00:03:06,960
is to understand climate change.

49
00:03:07,240 --> 00:03:09,680
It's well known that climate
change will have

50
00:03:09,680 --> 00:03:14,360
dramatic effects on people and
ecosystems across the planet.

51
00:03:14,560 --> 00:03:16,400
>>The atmosphere
is always changing

52
00:03:16,400 --> 00:03:18,560
Levels of gases
are changing...

53
00:03:18,560 --> 00:03:20,440
Temperatures are changing...

54
00:03:20,880 --> 00:03:24,880
And you have to make
very precise measurements

55
00:03:24,880 --> 00:03:27,720
in order to try to
see those changes.

56
00:03:28,000 --> 00:03:31,520
>>When satellites measure, they
do it by looking through

57
00:03:31,520 --> 00:03:34,080
the atmosphere over
a very long path length

58
00:03:34,080 --> 00:03:37,280
(multiple hundred of kilometers)
they're averaging the data over.

59
00:03:37,400 --> 00:03:40,160
So if you have lower water
and higher water,

60
00:03:40,160 --> 00:03:42,280
what you're going to measure
there is the average.

61
00:03:42,600 --> 00:03:45,080
When the airplane flies
through these air masses

62
00:03:45,080 --> 00:03:49,600
They are measuring over 10s and 20 meters at a time.

63
00:03:49,760 --> 00:03:52,120

So they are getting
an entire variability.

64
00:03:52,440 --> 00:03:55,840
>>So far, we've gathered these
fine structure measurements

65
00:03:55,840 --> 00:03:57,800
Of clouds and water vapor

66
00:03:57,800 --> 00:04:00,440
and the interaction between
water vapor and clouds.

67
00:04:00,720 --> 00:04:03,760
And that's being used to better
understand how the clouds form

68
00:04:03,760 --> 00:04:05,560
and how they affect
the amount of water

69
00:04:05,560 --> 00:04:07,800
that is getting in
the stratosphere.

70
00:04:08,280 --> 00:04:10,520
We've gotten a lot
of measurements

71
00:04:10,520 --> 00:04:13,320
of ozone destroying substances

72
00:04:13,320 --> 00:04:15,480
in the Tropical
Tropopause Layer,

73
00:04:15,640 --> 00:04:17,680
which will ultimately get
into the stratosphere,

74
00:04:17,680 --> 00:04:19,120
so we can better predict

75
00:04:19,120 --> 00:04:21,080
how much of these get
into the stratosphere

76
00:04:21,080 --> 00:04:24,000
and improve predictions
of ozone destruction

77
00:04:24,000 --> 00:04:25,880
and the ozone layer recovery.

78
00:04:26,200 --> 00:04:28,680
>>All of these processes are the
things that we are after

79
00:04:28,680 --> 00:04:30,440
with ATTREX.

80
00:04:31,680 --> 00:04:36,600
[Radio chatter]

81
00:04:40,280 --> 00:04:43,880
>>We've seen very
interesting relationships

82
00:04:43,880 --> 00:04:46,240
between temperature,
water and particles

83
00:04:46,240 --> 00:04:47,920
that we are seeing
in the atmosphere

84
00:04:48,040 --> 00:04:49,760
This is really

wonderful information

85
00:04:49,760 --> 00:04:53,760
and will be incredibly useful
for how we can improve

86
00:04:53,760 --> 00:04:55,600
our modeling
of the atmosphere

87
00:04:56,120 --> 00:04:58,360
>>But, any time you do
climate science...

88
00:04:58,360 --> 00:05:01,640
it can be contentious in
many parts of the world.

89
00:05:02,000 --> 00:05:07,400
So having data that is out there
free, open and defendable

90
00:05:07,800 --> 00:05:09,120
is important.

91
00:05:09,360 --> 00:05:11,200
If your data aren't
available for everybody

92
00:05:11,200 --> 00:05:12,840
it's always going
to be in question.

93
00:05:13,160 --> 00:05:15,040
>>The way we look at it from
the science community

94
00:05:15,040 --> 00:05:16,840
is that the data is all shared.

95
00:05:17,040 --> 00:05:19,360
So it'll be shared amongst
different institutions...

96
00:05:19,360 --> 00:05:20,920
different agencies...

97
00:05:20,920 --> 00:05:23,200
and even different countries
all around the world.

98
00:05:23,640 --> 00:05:25,880
Because we all have the common
goal of trying to understand

99
00:05:25,880 --> 00:05:27,680
how the atmosphere is working

100
00:05:27,800 --> 00:05:29,960
and how the atmosphere
is changing.

101
00:05:41,080 --> 00:05:43,560
>>The scientists' understanding
of the climate system

102
00:05:43,560 --> 00:05:46,080
and answering the key
questions that can help

103
00:05:46,080 --> 00:05:49,920
resolve the uncertainties that
decision makers have to make,

104
00:05:50,080 --> 00:05:51,080
is key.

105
00:05:51,280 --> 00:05:53,040
>>And so we'll still

need measurements

106
00:05:53,040 --> 00:05:54,960
and the measurements
will improve...

107
00:05:55,160 --> 00:05:56,720
and our understanding
will improve,

108
00:05:56,720 --> 00:05:58,320
but we'll need this
measurements to...

109
00:05:59,080 --> 00:06:02,160
further quantify how the
atmosphere is changing.

110
00:06:02,400 --> 00:06:04,440
>>The more we understand
the processes

111
00:06:04,640 --> 00:06:07,720
the better off society
will be because of it.

112
00:06:08,040 --> 00:06:09,760
And, some of those
key processes,

113
00:06:09,760 --> 00:06:11,400
the only way you are
going to answer them,

114
00:06:11,400 --> 00:06:14,640
are through airborne campaigns
like the one we're doing here.

115
00:06:18,040 --> 00:06:19,800
>>Our future very much depends

116
00:06:19,800 --> 00:06:22,560
on the understanding of
the world around us.

117
00:06:24,000 --> 00:06:27,440
On how this complex system
we call Earth changes.

118
00:06:32,760 --> 00:06:36,160
That's why our mission is not
only about doing research,

119
00:06:36,160 --> 00:06:39,480
but also about encouraging
younger generations.

120
00:06:39,840 --> 00:06:41,880
They are the future of science

121
00:06:41,880 --> 00:06:45,600
and the key to continue
understanding and improving

122
00:06:45,600 --> 00:06:49,720
the lives of all of us
who call this planet home.

123
00:06:55,600 --> 00:06:59,080
>>The students do not normally
have an opportunity to see this.

124
00:06:59,080 --> 00:07:00,720
>>To show them that
there's actually stuff

125
00:07:00,720 --> 00:07:03,920
beyond just looking at what's
in a book is very invaluable.

126
00:07:03,920 --> 00:07:06,280
>>It gives them
meaning and relevance

127
00:07:06,280 --> 00:07:08,400
to the the work that
they do in school.

128
00:07:08,640 --> 00:07:10,880
>>I can't stress it enough
just how important it is

129
00:07:10,880 --> 00:07:12,880
for the students to
make that connection,

130
00:07:12,880 --> 00:07:14,560
because that's where
they make their decision

131
00:07:14,560 --> 00:07:16,840
as to what they're gonna do
for the rest of their lives.

132
00:07:20,560 --> 00:07:22,120
>>It's fantastic to have

133
00:07:22,120 --> 00:07:26,000
real scientist, real pilots,
real engineers and technicians

134
00:07:26,000 --> 00:07:29,000
coming in and sharing their
experiences with the kids,

135
00:07:29,000 --> 00:07:31,360
because that brings
science to life.

136

00:07:31,600 --> 00:07:34,200
>>So we are bringing our science
into their classrooms

137
00:07:34,200 --> 00:07:36,400
as well as bringing
the students here

138
00:07:36,400 --> 00:07:38,280
to see our science in action.

139
00:07:38,560 --> 00:07:41,640
And we're hoping that this will
inspire some of the students

140
00:07:41,640 --> 00:07:44,680
to pursue careers in science,
technology, engineering or math

141
00:07:44,680 --> 00:07:46,880
And one day even work for NASA!

142
00:07:53,160 --> 00:07:56,640
>>I saw how excited
the kids were so...

143
00:07:56,640 --> 00:07:58,680
It's awesome!

144
00:08:06,720 --> 00:08:09,320
■

145
00:08:18,600 --> 00:08:22,000
[Radio chatter]

146
00:08:58,080 --> 00:09:02,000
>>So, on December 24, 1968...

147
00:09:02,400 --> 00:09:06,520

astronaut William Anders
took a picture of the Earth.

148
00:09:06,520 --> 00:09:08,880
He was in Apollo 8 and
he was orbiting the moon

149
00:09:08,880 --> 00:09:11,440
and took a picture of
the Earth that is called

150
00:09:11,440 --> 00:09:13,120
the “Earthrise picture”.

151
00:09:13,360 --> 00:09:15,400
[William Anders: Oh my God! Look at that picture over there!]

152
00:09:15,400 --> 00:09:18,400
[There's the Earth coming up.
Wow, is that pretty.]

153
00:09:18,920 --> 00:09:20,520
[Frank F. Borman: You got it!]

154
00:09:20,520 --> 00:09:22,360
[Oh... That's a beautiful shot!]

155
00:09:23,280 --> 00:09:24,360
>>And you look at that...

156
00:09:24,360 --> 00:09:28,120
and the vastness of space
with this grey moon...

157
00:09:28,120 --> 00:09:32,560
and you realize what a unique
thing the Earth really is!

158
00:09:37,720 --> 00:09:41,720

And the Earth doesn't come
with an owners manual.

159
00:09:42,080 --> 00:09:44,720
It's for us to try to figure out

160
00:09:44,720 --> 00:09:48,000
all of the complexity
that we see here.

161
00:09:55,080 --> 00:09:57,080
>>Our campaign is
coming to an end,

162
00:09:57,320 --> 00:09:59,600
but new ones will
continue exploring...

163
00:09:59,920 --> 00:10:01,760
making new discoveries.

164
00:10:04,280 --> 00:10:06,040
Our journey is not over.

165
00:10:06,280 --> 00:10:07,760
Keep watching....