

UNITED STATES AIR FORCE



ANDERSEN AIR FORCE BASE
GUAM USA

1
00:00:01,360 --> 00:00:05,360



2
00:00:06,200 --> 00:00:08,040

>>Tropical regions are
among the hottest

3
00:00:08,040 --> 00:00:10,000
and most humid places on Earth.

4
00:00:13,600 --> 00:00:16,000

But also the
coldest and driest

5
00:00:17,920 --> 00:00:19,400

Yeah... you heard right!

6
00:00:22,440 --> 00:00:24,600

While temperatures on
the surface can range

7
00:00:24,600 --> 00:00:28,120

from 80 to 90 degrees
Fahrenheit all year round,

8
00:00:28,480 --> 00:00:31,360

they can dramatically drop
as you go up in altitude.

9
00:00:36,040 --> 00:00:38,920

In fact, as you get closer
to the stratosphere,

10
00:00:38,920 --> 00:00:43,360

they can be as low as
-110 degrees Fahrenheit.

11
00:00:46,880 --> 00:00:48,800

This extremely cold

region between

12

00:00:48,800 --> 00:00:50,840

the troposphere and
the stratosphere

13

00:00:50,840 --> 00:00:53,680

is called the Tropical
Tropopause Layer (TTL).

14

00:01:00,080 --> 00:01:05,080

>>In the tropics, it's very warm
and moist down at the surface.

15

00:01:05,080 --> 00:01:07,960

When you get up to
the Tropopause Layer,

16

00:01:07,960 --> 00:01:10,120

it's very cold and dry.

17

00:01:10,400 --> 00:01:12,760

>>So it turns out that
the Tropopause

18

00:01:12,760 --> 00:01:15,880

is actually coldest
in the Western Pacific.

19

00:01:16,160 --> 00:01:18,880

>>Right above Guam is
an ideal place because

20

00:01:18,880 --> 00:01:23,600

it is the coldest and the
driest part of the tropics.

21

00:01:46,880 --> 00:01:48,760

>>Everything is ready for
the second phase

22

00:01:48,760 --> 00:01:50,440
of the field experiment.

23

00:01:51,120 --> 00:01:54,200
We are 13 degrees North of the
equator in the Pacific.

24

00:01:54,480 --> 00:01:58,320
Our new home away from home,
for the next several weeks.

25

00:01:59,360 --> 00:02:01,160
We are in Guam.

26

00:02:28,560 --> 00:02:32,720
>>So the tropics are the part of
the planet that gets the warmest

27

00:02:32,720 --> 00:02:34,160
from the heating from the sun

28

00:02:34,160 --> 00:02:36,640
because it gets the most
sunlight on average.

29

00:02:36,880 --> 00:02:42,120
>>Because the surface is so warm
and there is so much water,

30

00:02:42,120 --> 00:02:45,080
you evaporate water,
liquid water,

31

00:02:45,080 --> 00:02:49,040
it becomes a vapor so you have
this very hot, moist, air

32

00:02:49,040 --> 00:02:50,360

down here at the surface.

33

00:02:50,360 --> 00:02:52,360

So this is air that's got
a lot of energy.

34

00:02:52,600 --> 00:02:56,560

Just like a boiling pot of water
it can rise very high.

35

00:02:56,880 --> 00:02:58,560

>>And it tends to pull other gases

36

00:02:58,560 --> 00:03:00,080

that come from the
surface up with it.

37

00:03:00,080 --> 00:03:02,400

So this is the part of the world

38

00:03:02,400 --> 00:03:06,640

where most of the circulation
getting up from the surface,

39

00:03:06,640 --> 00:03:09,160

up into the upper part
of the troposphere

40

00:03:09,160 --> 00:03:11,720

and into stratosphere,
this is where it occurs.

41

00:03:21,560 --> 00:03:24,240

>>So here in the tropics
we see these thunderstorms,

42

00:03:24,240 --> 00:03:27,920

boiling up to very,
very high altitudes.

43

00:03:28,200 --> 00:03:30,840

And so we have a very
high elevated tropopause

44

00:03:30,840 --> 00:03:32,480

here in the tropics.

45

00:03:32,840 --> 00:03:35,800

>>As you get convective processes
going, the air rises.

46

00:03:35,800 --> 00:03:37,760

As you know, if you take
air and you expand it,

47

00:03:37,760 --> 00:03:39,240

it cools really fast.

48

00:03:39,440 --> 00:03:41,520

>>And it turns out that in fact,

49

00:03:41,520 --> 00:03:44,520

the warmest places in the world
they are in the tropics.

50

00:03:44,800 --> 00:03:49,320

But about 55,000 feet above us,
about 16 Kilometers,

51

00:03:49,320 --> 00:03:52,280

is one of the coldest
places on Earth.

52

00:03:52,920 --> 00:03:55,720

>>So what that does is,
as it cools really fast,

53

00:03:55,720 --> 00:03:58,680

all that water vapor in the air

going up gets squeezed out.

54

00:03:58,680 --> 00:04:00,440

It's like wringing a towel,

55

00:04:00,440 --> 00:04:02,280

and all of the water

starts to squeeze out,

56

00:04:02,280 --> 00:04:03,840

so you get cloud

processes formed

57

00:04:03,840 --> 00:04:05,000

that squeezes out the water.

58

00:04:05,160 --> 00:04:08,040

The air that comes out of

the top, tends to be dry.

59

00:04:08,400 --> 00:04:10,280

>>But you still get some

water making it up

60

00:04:10,280 --> 00:04:11,840

to the tropical tropopause.

61

00:04:11,840 --> 00:04:13,560

And there the

atmospheric motions

62

00:04:13,560 --> 00:04:15,840

transport air

into the stratosphere.

63

00:04:16,240 --> 00:04:18,000

So air is transported

into the stratosphere

64

00:04:18,000 --> 00:04:20,520

with a small amount of
water that's left behind.

65

00:04:20,800 --> 00:04:24,800

>>And this is the area that tends
to be the controlling mechanism

66

00:04:24,800 --> 00:04:27,360

for how much water gets
into the upper troposphere

67

00:04:27,360 --> 00:04:28,800

and then onto
the stratosphere.

68

00:04:29,280 --> 00:04:32,440

>>So if you want to understand the
composition of the stratosphere

69

00:04:32,440 --> 00:04:34,120

how much water there is...

70

00:04:34,120 --> 00:04:37,240

how much ozone
destroying substances

71

00:04:37,240 --> 00:04:39,080

or trace gases there are,

72

00:04:39,080 --> 00:04:41,160

you need to go to
the tropics and study

73

00:04:41,160 --> 00:04:44,360

the region around the
troposphere in the tropics.

74

00:04:44,680 --> 00:04:46,680

>>So this is the spot to be.

75

00:04:59,840 --> 00:05:02,720

So this is the area where the ocean gets the warmest

76

00:05:02,720 --> 00:05:04,760

The convection is the strongest

77

00:05:04,760 --> 00:05:07,640

And then, the air that comes at the top, gets the coldest

78

00:05:08,120 --> 00:05:10,360

>>We've known that for many decades...

79

00:05:10,360 --> 00:05:13,440

For at least 20 years we've known we really need to go

80

00:05:13,440 --> 00:05:14,920

to the Western Pacific

81

00:05:14,920 --> 00:05:19,000

to study the extreme dehydration where the Tropopause is coldest

82

00:05:19,000 --> 00:05:21,840

and where the most extreme dehydration

83

00:05:21,840 --> 00:05:24,600

to low water vapor concentrations occurs.

84

00:05:24,600 --> 00:05:30,920

>>Now, Guam is the coldest and driest part of the tropics.

85

00:05:31,400 --> 00:05:33,560

>>It's actually a warm region at the surface

86

00:05:33,560 --> 00:05:35,680

And a cold region at the tropopause.

87

00:05:36,200 --> 00:05:38,320

And Guam is right in the center of action.

88

00:05:38,320 --> 00:05:41,520

Plus it has the airfields and facilities we need

89

00:05:41,520 --> 00:05:43,920

to operate our high-altitude aircraft.

90

00:06:00,640 --> 00:06:04,200

>>It takes a lot of work to plan a remote deployment of this size

91

00:06:04,560 --> 00:06:08,200

>>Preparing for a mission where we are deployed,

92

00:06:08,200 --> 00:06:10,520

where we have to take the entire team and the aircraft

93

00:06:10,520 --> 00:06:12,840

and all of our equipment, it's really quite an effort.

94

00:06:13,040 --> 00:06:15,000

>>Making sure we had a hangar available to us...

95

00:06:15,000 --> 00:06:17,480

making sure we had
office space available...

96

00:06:17,880 --> 00:06:20,360

making sure that we had an
area where we could setup

97

00:06:20,360 --> 00:06:23,960

our aircraft control trailer and
our instrument control trailer

98

00:06:24,160 --> 00:06:26,520

>>It's also difficult
because you are away

99

00:06:26,520 --> 00:06:28,400

from where you
built your instrument,

100

00:06:28,400 --> 00:06:30,560

where you operate your aircraft.

101

00:06:30,560 --> 00:06:34,080

So, if you have a problem, you
have to ship everything here.

102

00:06:34,320 --> 00:06:36,920

>>Because when you are this
far from home, so to speak...

103

00:06:36,920 --> 00:06:38,520

you gotta have everything here.

104

00:06:38,520 --> 00:06:39,800

Not just the airplane
and the people,

105

00:06:39,800 --> 00:06:42,200

but all your equipment

including spares.

106

00:06:42,520 --> 00:06:45,360

>>Actually, all of the work that's going into this ATTREX project

107

00:06:45,360 --> 00:06:48,120

it's been one of the most difficult things I've ever done.

108

00:07:06,160 --> 00:07:10,480

>>When we operate out of Edwards we do it from a fixed structure

109

00:07:10,480 --> 00:07:13,080

called the "Global Hawk Operations Center"

110

00:07:13,360 --> 00:07:15,920

That's the main command and control center

111

00:07:15,920 --> 00:07:17,720

for the NASA Global Hawks.

112

00:07:18,040 --> 00:07:20,880

>>Well, what is different from operating here in Guam,

113

00:07:20,880 --> 00:07:22,440

versus operating back at Edwards

114

00:07:22,440 --> 00:07:24,880

is we have these mobile ground stations so...

115

00:07:24,880 --> 00:07:28,280

that's where we fly the airplane and operate our payloads from.

116

00:07:28,480 --> 00:07:30,880

>>So the front room of the flight operations room is replicated

117

00:07:30,880 --> 00:07:33,720

with a 40ft trailer with all the communications equipment,

118

00:07:33,720 --> 00:07:35,800

all the computers, all the servers, everything.

119

00:07:35,800 --> 00:07:39,120

And then another trailer replicates the 14 workstations

120

00:07:39,120 --> 00:07:41,480

that the payload operations room has.

121

00:07:41,480 --> 00:07:42,920

And that's in another trailer.

122

00:07:43,120 --> 00:07:46,320

>>And we are basically providing the same functionality

123

00:07:46,320 --> 00:07:49,200

from Andersen Air Force Base, in a forward location,

124

00:07:49,200 --> 00:07:52,200

that we would have back at Edwards Air Force Base.

125

00:07:52,480 --> 00:07:55,280

>>We can deploy anywhere in the world with these trailers

126

00:07:55,280 --> 00:07:58,360

as long as we have
the appropriate setup.

127

00:08:07,920 --> 00:08:09,360

>>For the ATTREX campaign,

128

00:08:09,360 --> 00:08:12,280

the NASA Global Hawk is basing
out of Andersen Air Force Base.

129

00:08:12,680 --> 00:08:15,320

And from Andersen Air Force Base
we'll be flying north

130

00:08:15,320 --> 00:08:17,240

all the way up
to the Aleutians.

131

00:08:17,600 --> 00:08:18,960

East towards the Philippines.

132

00:08:18,960 --> 00:08:21,680

South down by Australia
and New Zealand.

133

00:08:21,680 --> 00:08:26,160

And out to the East, all
the way to about Tahiti,

134

00:08:26,160 --> 00:08:28,440

the other side
of Hawaii basically.

135

00:08:28,960 --> 00:08:31,800

It's roughly about a
4,000 mile radius of range

136

00:08:31,800 --> 00:08:35,280

that the Global Hawk has

from here, at Andersen AFB.

137

00:08:44,200 --> 00:08:46,120

>>We really have daily meetings.

138

00:08:46,120 --> 00:08:49,880

The forecasters, the modeling group and our pilots

139

00:08:49,880 --> 00:08:51,960

meet almost everyday.

140

00:08:51,960 --> 00:08:54,880

Whenever we are getting ready for a flight.

141

00:09:00,000 --> 00:09:02,280

We are working everyday on the aircraft

142

00:09:02,280 --> 00:09:03,600

work with the scientists.

143

00:09:03,600 --> 00:09:04,960

They've gotta pre-flight their instruments,

144

00:09:04,960 --> 00:09:06,240

after flight they've gotta post-flight their instruments...

145

00:09:06,240 --> 00:09:08,080

Some want to come off, some don't want to come off...

146

00:09:08,360 --> 00:09:11,280

So it's a constant ballet of activity around the airplane,

147

00:09:11,280 --> 00:09:13,120
in between flights,

148

00:09:13,320 --> 00:09:15,360
until the day when
we are ready to go.

149

00:09:15,360 --> 00:09:16,600
Everyone comes on.

150

00:09:16,600 --> 00:09:17,920
We'll have engine
start at 5 o'clock,

151

00:09:17,920 --> 00:09:19,760
which means they've got to
come in at 11 o'clock at night,

152

00:09:19,760 --> 00:09:22,240
work until 2 AM, do their
thing with the instruments...

153

00:09:22,240 --> 00:09:24,640
Then our crew comes in,
buttons up the jet...

154

00:09:24,880 --> 00:09:26,880
It's rolling out at 4 o'clock.

155

00:09:26,880 --> 00:09:29,280
Engine start at 5.
Take off at 6...

156

00:09:29,600 --> 00:09:34,480
It's an ensemble of people, all
doing really great work together

157

00:09:34,480 --> 00:09:36,440
to make this whole
thing happen.

158

00:09:37,320 --> 00:09:40,320

[Radio chatter]

159

00:09:48,400 --> 00:09:50,840

[Radio: And traffic can I get
a TAKE OFF Report?]

160

00:09:51,040 --> 00:09:53,640

[Radio: Yes sir, runway is clear.
You are go for TAKE OFF.]

161

00:09:53,880 --> 00:09:54,960

[Radio: Roger that.]

162

00:10:03,320 --> 00:10:06,840

[Radio: 3.... 2.... 1....
Launch!]

163

00:10:12,440 --> 00:10:15,760

[People cheering]

164

00:10:16,200 --> 00:10:18,080

>>So the Global Hawk
has great capability,

165

00:10:18,080 --> 00:10:19,800

with tremendous range
and endurance.

166

00:10:20,000 --> 00:10:22,480

>>So many lessons learned
from this campaign,

167

00:10:22,480 --> 00:10:25,160

that will make our
Global Hawk operation

168

00:10:25,160 --> 00:10:27,440

a much more globally
deployable package.

169

00:10:27,640 --> 00:10:29,560

>>And, as we've demonstrated,
we can do a lot of science

170

00:10:29,560 --> 00:10:32,000

from Dryden in California
or we can deploy,

171

00:10:32,000 --> 00:10:34,480

as we've illustrated here,
to reach out.

172

00:10:34,640 --> 00:10:35,600

And I think we've shown now

173

00:10:35,600 --> 00:10:37,280

that we can really go almost
anywhere in the world.

174

00:10:37,440 --> 00:10:39,560

>>Because this is our
first deployment away,

175

00:10:39,560 --> 00:10:41,560

really away from
the mainland...

176

00:10:41,560 --> 00:10:43,400

This might be our first,
but it won't be our last.

177

00:10:43,400 --> 00:10:46,240

And we will be well suited
to take our show on the road,

178

00:10:46,240 --> 00:10:48,400

anywhere in the world

from now on.

179

00:10:54,880 --> 00:10:58,120

[Engine noise of
airplane landing]

180

00:11:10,160 --> 00:11:15,120

[People clapping]

181

00:11:24,680 --> 00:11:27,920

>>We are collecting data over
the tropical Western Pacific.

182

00:11:28,280 --> 00:11:30,880

Data that will improve
our understanding

183

00:11:30,880 --> 00:11:33,520

of our atmosphere,
weather and climate.

184

00:11:41,760 --> 00:11:43,120

The ATTREX mission

185

00:11:43,120 --> 00:11:45,920

will help us better comprehend
the world we live in.