
NASA
426NA
ptt

1
00:00:00,000 --> 00:00:15,012
[Piano playing]

2
00:00:15,012 --> 00:00:18,015
[Female speaker] The weather in this area is very dynamic.

3
00:00:19,016 --> 00:00:23,019
[Male speaker] The way that pollution impacts extreme weather\hconditions is extremely complicated

4
00:00:23,052 --> 00:00:26,355
and we don't\hreally fully understand it, which is why we're\hout here in the first place.

5
00:00:26,421 --> 00:00:29,850
We're trying to\hinvestigate this in one of the most complex\h\h

6
00:00:29,850 --> 00:00:35,160
meteorological regimes in the world. That is\h
around the South China Sea and Western Pacific\h\h

7
00:00:35,160 --> 00:00:43,050
[Air crew communication over headset]

8
00:00:43,050 --> 00:00:47,970
[Aircraft engine sounds]

9
00:00:47,970 --> 00:00:55,344
The largest uncertainty that we have right now\hin climate forcing is the relationship of aerosol\hparticles on clo

10
00:00:55,344 --> 00:00:58,410
...and in Southeast\h
Asia, two of the biggest sources of pollution are\h\h

11
00:00:58,410 --> 00:01:03,330
pollution from various sorts of cities like\h
Metro Manila, 20 million people live\hthere.

12
00:01:03,330 --> 00:01:07,680
The other really important source\h

of pollution in this area is from biomass\hburning.

13
00:01:07,687 --> 00:01:11,160
[Female speaker] And what's really interesting\h
in this region is that we have both.\h\h

14
00:01:11,160 --> 00:01:15,840
We both have this anthropogenic pollution\h
as well as this biomass burning pollution.\h\h

15
00:01:15,840 --> 00:01:23,934
So this is really sort of ground central for\hweather observations and weather and climate\hmodeling for earth s

16
00:01:24,201 --> 00:01:28,800
[Air crew communications over headset]

17
00:01:28,800 --> 00:01:33,115
[Aircraft engine takeoff sounds and air crew communications]

18
00:01:35,109 --> 00:01:48,019
[instrumental music with sound of wind]

19
00:01:48,353 --> 00:01:53,200
[Female speaker] So in this region there's a monsoon season that\hhappens every year. We have this evapora

20
00:01:53,200 --> 00:02:00,996
process of water vapor from the ocean and as\hthat water vapor cools and condenses as it\hgets lifted up you

21
00:02:01,697 --> 00:02:08,002
After they turn\hinto clouds, processes happen inside the cloud to\h\hcollide the different cloud droplets togethe

22
00:02:08,402 --> 00:02:10,390
and\heventually make droplets that are big enough to\h\h

23
00:02:10,390 --> 00:02:15,700
rain out of the clouds, and that rain goes back\h
into the ocean and completes the water cycle.

24

00:02:15,700 --> 00:02:18,410
[instrumental music]

25
00:02:18,790 --> 00:02:24,790
[Male speaker] One of the long-standing hypotheses that have\h
been in the scientific community that pollution\h\h

26
00:02:24,790 --> 00:02:32,110
emissions, whether it's from cities, shipping, or\h
biomass burning, or deforestation, can affect the\h\h

27
00:02:32,110 --> 00:02:38,026
climate and in particular there's concern in\h
the scientific community that these emissions\hcan affect clouds.

28
00:02:38,226 --> 00:02:41,028
So in order for the cloud\h
to actually be formed for water to be able to\h\h

29
00:02:41,230 --> 00:02:47,440
condense it needs something to condense onto. So\h
we call those cloud nuclei and those cloud nuclei\h\h

30
00:02:47,440 --> 00:02:55,039
basically can be sea salt. It can be particles\hfrom trees or from dust. Or it can be particles coming\hfrom huma

31
00:02:55,239 --> 00:02:59,950
[Female speaker] So the other particles\h
that water can condense around are aerosols and\h\h

32
00:02:59,950 --> 00:03:04,840
these can be in the form of anthropogenic, human-made aerosols, or biomass burning,\h\h

33
00:03:04,840 --> 00:03:13,621
which can also be induced by human activity, from farmers burning their fields, but also\hnatural sources such

34
00:03:13,687 --> 00:03:17,470
If you bring more\h
particles to the environment you get more cloud\hdroplets.

35
00:03:17,470 --> 00:03:23,620
That changes the distribution of cloud\h
droplets, that changes precipitation processes.

36
00:03:23,620 --> 00:03:28,132
[instrumental music and wind sound]

37
00:03:28,420 --> 00:03:35,050
[Female speaker] So aerosol and cloud interactions have been\h
studied for a decent amount of time now\h\h

38
00:03:35,050 --> 00:03:39,100
and what's really important with the aerosol\hand cloud interactions is that the more\h\h

39
00:03:39,100 --> 00:03:43,344
aerosols that you have interacting with clouds\h
increases the number of cloud droplets.

40
00:03:44,011 --> 00:03:49,210
So if there's a lot of really small droplets compared\h
to a few bigger droplets we think it's actually\h\h

41
00:03:49,210 --> 00:03:54,620
harder for the clouds to make rain. [Female speaker] But it can\h
also change the reflectivity of the cloud\h\h

42
00:03:55,621 --> 00:04:00,640
or albedo, which then in turn looks at a bigger\h
picture of changing the heat balance within\h\h

43
00:04:00,640 --> 00:04:06,963
the local area near the Philippines\h
and the tropics, and then in the grand picture\hacross the globe.

44
00:04:07,030 --> 00:04:09,760
Yeah it's a really complicated balance when you add\h\h

45
00:04:09,760 --> 00:04:15,340
particles to a cloud to understand how that\h

actually affects the climate system as a whole.

46
00:04:16,003 --> 00:04:23,509
[instrumental music and thunder]

47
00:04:24,010 --> 00:04:28,200
[Male speaker] There have been many studies in the region that\h
have linked the presence of pollution and smoke\h\h

48
00:04:28,200 --> 00:04:33,017
particles to more severe weather. In particular\hlightning activity has been shown to

49
00:04:33,017 --> 00:04:36,486
increase in regions under the influence of pollutants.\h

50
00:04:36,520 --> 00:04:39,420
So understanding as we add more particles to\h\h

51
00:04:39,420 --> 00:04:43,740
the atmosphere how that changes the properties of\h
the clouds, how that changes the properties of the\h\h

52
00:04:43,740 --> 00:04:48,420
storm systems and how that changes the extreme\h
weather that results from those storm systems is\h\h

53
00:04:48,420 --> 00:04:52,050
really important as one of the things that we're\h
really trying to get at with this field campaign.

54
00:04:52,050 --> 00:04:58,003
[instrumental music and wind]

55
00:05:02,980 --> 00:05:09,610
[Male speaker] The waters around Southeast Asia can at times\h
exhibit some of the cleanest atmospheres on the\h\h

56
00:05:09,610 --> 00:05:16,300
planet. But at the same time, throughout Southeast\h

Asia, you have mega cities such as Metro Manila,\h\h

57
00:05:16,300 --> 00:05:23,690
Kuala Lumpur, Jakarta, and Singapore that all emit\h
aerosol particles into the region.

58
00:05:23,690 --> 00:05:29,795
[Female Speaker] Metro Manila is one of the biggest, largest, fastest-growing mega\hcity in the region.

59
00:05:29,795 --> 00:05:36,067
That means therefore that\hthere's a lot of development that emits pollution\h

60
00:05:36,067 --> 00:05:40,003
and one of those is transport.

61
00:05:40,170 --> 00:05:47,440
These aerosols are different from what we find naturally in\h
pristine areas and this difference has important\h\h

62
00:05:47,440 --> 00:05:52,813
implications on clouds and precipitation formation\h
in this area.

63
00:05:52,813 --> 00:05:57,817
[Second male speaker] The monsoonal flows of Southeast Asia bring all of these pollutants

64
00:05:57,817 --> 00:06:02,788
together\hup the South China Sea into the Philippines\hand to the Western Pacific.

65
00:06:02,821 --> 00:06:07,120
So therefore during this\h
season there are a lot of interactions that can\h\h

66
00:06:07,120 --> 00:06:10,361
happen with the pollution and the meteorological logical\h
conditions.

67
00:06:10,361 --> 00:06:12,362
And one of the primary reasons why the\h\h

68
00:06:12,370 --> 00:06:17,470
CAMP2Ex mission is centered here in the Philippines\h
is that we can see this transition from very\h\h

69
00:06:17,470 --> 00:06:21,790
polluted environments to the south to the much\h
cleaner environments of the western Pacific.\h\h

70
00:06:23,338 --> 00:06:27,174
[instrumental music]

71
00:06:30,610 --> 00:06:37,990
[Male speaker] So at least in the Philippines it is very important\h
because we are often affected by a lot of extreme\h\h

72
00:06:37,990 --> 00:06:45,520
weather events and by extreme weather that can\h
mean sometimes no rain or very intense rain and that\h\h

73
00:06:45,520 --> 00:06:51,040
affects our water resources for agriculture,\h
for our daily living, for taking a bath. So all of these\h\h

74
00:06:51,040 --> 00:06:57,031
basic activities are very reliant on having these\h
resources.

75
00:06:57,031 --> 00:07:00,010
One of the hypotheses that started the\h\h

76
00:07:00,010 --> 00:07:07,000
whole CAMP2Ex mission was that farmers in Mindanao\h
had noticed that the droughts have been longer\h\h

77
00:07:07,000 --> 00:07:12,190
but when rain does come it becomes more severe.\h
One of the science objectives of this mission\h\h

78

00:07:12,190 --> 00:07:16,680
is to investigate, are aerosol particles a part\h
of the cause of that?

79
00:07:16,680 --> 00:07:18,181
So the measurements therefore\h\h

80
00:07:18,190 --> 00:07:26,380
from this field campaign will input into how we\h
are running our models. For now models that are\h\h

81
00:07:26,380 --> 00:07:31,450
run for weather forecasting over Metro Manila\h
or for other places in the Philippines for that\h\h

82
00:07:31,450 --> 00:07:35,028
matter, do not take into account pollution.

83
00:07:35,028 --> 00:07:43,668
It's\hvery important to study the interactions between\hmeteorology and pollution because we rely\hon it so mu

84
00:07:43,668 --> 00:07:55,120
This campaign is the first step towards incorporating measurements and\hobservations into our model and try t

85
00:07:55,120 --> 00:08:02,800
these aerosol particles are significantly, or are\h
going to significantly, impact rainfall formation.

86
00:08:02,800 --> 00:08:17,228
[undeciphered talking with music]

87
00:08:19,029 --> 00:08:23,870
[Female speaker\} So what's really interesting about CAMP2Ex is\hthis region of the world is really hard to\h\h

88
00:08:23,870 --> 00:08:26,669
study just using remote sensing or satellites. \h

89
00:08:26,669 --> 00:08:29,671
[Male speaker] You\hhave thunderstorms forming over the mountains.

90
00:08:29,690 --> 00:08:34,850
You have tropical cyclones or other tropical\h
activity forming over the western Pacific.\h\h

91
00:08:34,850 --> 00:08:39,560
You have monsoonal flows and thunderstorms\h
over the South China Sea. All of that clouds\h\h

92
00:08:39,560 --> 00:08:44,016
our ability to see what's actually going on in\h
the lower to middle atmosphere.

93
00:08:44,016 --> 00:08:51,050
So in order to\hunderstand how these pollution changes are\h
changing the clouds we have to actually fly\h\h

94
00:08:51,050 --> 00:08:56,540
below the satellites and below the high cirrus\h
clouds and look down from the plane and take the\h\h

95
00:08:56,540 --> 00:09:00,028
plane into various clouds to understand how these\h
processes are changing.

96
00:09:00,028 --> 00:09:05,032
[Second male speaker] So we can have both points\hof view. We can actually see what the satellite\his seeing

97
00:09:05,032 --> 00:09:11,004
and then we can combine that with\hwhat the aircraft is seeing directly underneath\hthe satellite track.

98
00:09:11,004 --> 00:09:17,009
[Female Speaker] The importance of CAMP2Ex is for us to study those aerosols and clouds that\hthe satellites

99
00:09:17,009 --> 00:09:23,270
what we find here we're going to be able to validate against\h
the satellite retrievals that we are capturing.

100
00:09:23,270 --> 00:09:33,021

[music and low talking]

101
00:09:33,021 --> 00:09:38,025
[music]

102
00:09:38,025 --> 00:09:46,400
[Male speaker] Weather forecasting provided is conducted in\h
different time periods. So we have long-range\h\h

103
00:09:46,400 --> 00:09:52,070
forecasts that we provide for three days,\h
approximately three days out, or 72 hours.\h\h

104
00:09:52,070 --> 00:10:00,380
Then we try to provide what we consider a short-term\h
forecast out to about 24 hours. And at the day\hof the flight

105
00:10:00,380 --> 00:10:11,018
we do an update, and the reason for\hall this is that the weather in and around the\hPhilippines is very, very dif

106
00:10:11,018 --> 00:10:16,022
[music]

107
00:10:16,022 --> 00:10:18,630
\h
[Female speaker] When we have a flight day typically we wake up\h\h

108
00:10:18,630 --> 00:10:24,300
around 1 a.m. and we make sure that the conditions\h
are looking good for us to complete our mission.\h\h

109
00:10:24,300 --> 00:10:30,033
If there's bad weather in the region we\h
might consider delaying takeoff or not flying at\hall.

110
00:10:30,033 --> 00:10:34,620
[Male speaker] If the weather is not appropriate for us to\h
take off in, if the weather it's not going to be\h\h

111

00:10:34,620 --> 00:10:38,550
appropriate for us to land in, or if the weather\h
where we want a sample isn't what we're looking\h\h

112
00:10:38,550 --> 00:10:43,010
for that day, we can choose to cancel the flight\hthat morning.

113
00:10:43,010 --> 00:10:53,460
It's important to get the right\hconditions for the aircraft to fly in so they\hcan optimize their sampling strategies.

114
00:10:53,460 --> 00:10:57,690
Generally we've been giving the go-ahead. But\hoccasionally we have had circumstances where\h\h

115
00:10:57,690 --> 00:11:01,020
it just was obvious that we weren't going to be\h
able to meet our flight objectives and we could\h\h

116
00:11:01,020 --> 00:11:06,390
send everybody back to bed. But by 2:30 in the\h
morning we have to give a go/no-go decision to\h\h

117
00:11:06,390 --> 00:11:11,100
the entire science team to hop into the bus and
come to the airfield and get the airplane going.

118
00:11:11,100 --> 00:11:18,839
[music and aircraft engine sounds]

119
00:11:18,850 --> 00:11:23,200
[Male speaker] The power comes on in the plane three hours\h
before we take off and certain instruments\h\h

120
00:11:23,200 --> 00:11:27,700
have to be in there three hours before\h
takeoff to get their instruments calibrated,\h\h

121
00:11:27,700 --> 00:11:31,960
get their instruments set up ready to\h
go. You know it takes them three\h\h

122
00:11:31,960 --> 00:11:36,940
whole hours just to make sure that the flying\h
laboratory has all of its instruments working.

123
00:11:36,940 --> 00:11:46,027
[music, low talking, and aircraft engine sounds]

124
00:11:46,027 --> 00:11:50,240
[Male speaker] So to pre-flight the aircraft we want to\h
get a good look at the entire aircraft from\h\h

125
00:11:50,240 --> 00:11:53,240
top to bottom to make sure it's ready to\h
go and ready to fly safely for everybody\h\h

126
00:11:53,240 --> 00:11:58,100
that's gonna be on board. So we'll look up in\h
all the flap wells, we'll look at the landing\h\h

127
00:11:58,100 --> 00:12:02,930
gear we'll check the brakes, we'll check the\h
lights, we check the props for any leakage or\h\h

128
00:12:02,930 --> 00:12:08,660
for any for chips, or any damage of any kind. We\h
look over the fuselage as a whole. We look for\h\h

129
00:12:08,660 --> 00:12:13,190
missing pieces, we look for anything cracked, or\h
anything that's going to be unsafe in general.\h\h

130
00:12:13,190 --> 00:12:19,910
At that time I'm in the operations room talking\h
with the pilots and the flight scientist going\h\h

131
00:12:19,910 --> 00:12:22,356
over what our mission is today what we're gonna\hsample.

132
00:12:22,356 --> 00:12:26,025

[Male speaker] And we have to tell the pilots this is\hthe weather you want to be flying into today.\h\h

133
00:12:26,025 --> 00:12:30,028
And this is what you need to be aware of when\hthey're actually flying the plane today. \h

134
00:12:30,028 --> 00:12:37,034
[Second male speaker] Doors close\hat about 5:15 in the morning and the plane is in\hthe air by 6:00 a.m.

135
00:12:37,768 --> 00:12:41,004
[Air Traffic Control] Your takeoff checklist\h
is complete. You're cleared to line up\hand wait. Runway 2.

136
00:12:42,004 --> 00:12:45,207
[P-3 Air Crew] Up and wait. Copy. 10-77. Brakes coming off.

137
00:12:45,207 --> 00:12:51,178
[music and aircraft engine sounds]

138
00:12:55,015 --> 00:13:01,140
[Female speaker] So after the plane takes off I monitor\h
the status of the aircraft, the location, making\h\h

139
00:13:01,140 --> 00:13:07,590
sure everything is working between ground\h
control and operations on the flight.\h\h

140
00:13:07,590 --> 00:13:13,029
The plane stays in the air anywhere from eight to\h
nine hours returning at about three o'clock in\hthe afternoon.

141
00:13:13,029 --> 00:13:17,670
And nine hour flights are quite\h
long but because we're out there for so long we\h\h

142
00:13:17,670 --> 00:13:23,760
can get so many good samples on different clouds\h
and it allows us to really examine the evolution of\h\h

143
00:13:23,760 --> 00:13:27,007

clouds throughout a day even with nine hour\hflights.

144
00:13:27,007 --> 00:13:33,078
[Female speaker] We'll also send up satellite imagery to the flight scientists so they can know where\hthey war

145
00:13:33,078 --> 00:13:39,060
They might want to deviate off the course that we planned for them\hto sample different types of clouds or aero

146
00:13:39,060 --> 00:13:46,055
[music]

147
00:13:46,180 --> 00:13:54,028
[Male speaker] So we have two aircraft in the region. We have the\hP-3 and then we also have the SPEC incor

148
00:13:54,028 --> 00:13:59,860
[Second male speaker] So the Learjet is basically here to\h
support the NASA P-3 aircraft, while the NASA\h\h

149
00:13:59,860 --> 00:14:06,130
P-3 aircraft has a unique set of remote sensors\h
onboard. They fly above the clouds or below the\h\h

150
00:14:06,130 --> 00:14:10,930
clouds, while we fly in the clouds and get\h
the measurements in the clouds knowing how\h\h

151
00:14:10,930 --> 00:14:14,860
many droplets there are, how many ice crystals there are,\hhow much water is in\h\h

152
00:14:14,860 --> 00:14:20,740
the clouds. And this is then compared to the\h
remote sensors -- the radars, the lidars, microwave\h\h

153
00:14:20,740 --> 00:14:25,690
radiometers -- so that we can interpret the\h
data from in the cloud where we get the\h\h

154
00:14:25,690 --> 00:14:30,880
real data with the remote sensor data and\h

then understand really what is happening\h\h

155
00:14:30,880 --> 00:14:35,740
in the cloud and also being able to then\h
understand what the satellites are measuring.

156
00:14:35,740 --> 00:14:52,007
[music and aircraft engine sounds]

157
00:14:52,340 --> 00:14:57,350
[Female speaker] So after the plane lands our work isn't over. We\hhave a meeting with the pilots and the flight

158
00:14:57,350 --> 00:15:03,016
scientists to see how our mission went and how\h
we need to adapt or change what we did for the\hfuture flights.

159
00:15:03,016 --> 00:15:07,640
[Male speaker] For the instrument teams there\h
after a flight, they work on shutting down their\h\h

160
00:15:07,640 --> 00:15:12,230
instruments properly, making sure it's ready for\h
the next flight, and downloading their data.\h\h

161
00:15:12,230 --> 00:15:16,190
For some of these instruments it's quite a lot of\h
data that's produced on a single flight, it's hard\hdrives\h

162
00:15:16,190 --> 00:15:21,030
worth of data produced on a single flight,\h
and downloading that data can take quite a long\htime.

163
00:15:21,030 --> 00:15:26,600
[Second male speaker] While the plane is in the air we're already\h
planning the next flight the following day or the\h\h

164
00:15:26,600 --> 00:15:31,970
subsequent days. So when the\h
plane is in the air at 9:30 in the morning we\h\h

165
00:15:31,970 --> 00:15:36,830
have another weather brief and we start the\h
flight planning process for the next day.\h\h

166
00:15:36,830 --> 00:15:42,170
As soon as the pilots land we give them the plan for\h
the very next flight, and they file that and the\h\h

167
00:15:42,170 --> 00:15:45,917
whole process starts all over again at about 1:00\hin the morning.

168
00:15:45,917 --> 00:15:55,024
Oh man, in total we're at\hthe airport for about 14 hours every single\hday, and awake for 16, it's a long\hday.

169
00:15:55,691 --> 00:15:58,026
Everyone is holding it together amazingly\hwell.

170
00:15:58,694 --> 00:16:02,163
[Female speaker] It gets exhausting fast but it's rewarding.

171
00:16:02,163 --> 00:16:19,010
[music]

172
00:16:19,010 --> 00:16:24,190
[Male speaker] I work for the ESPO office which is\h
the Earth Science Project Office (ESPO) and we\h\h

173
00:16:24,190 --> 00:16:29,440
focus on managing and organizing\h
field campaigns around the world.

174
00:16:29,440 --> 00:16:36,100
Because we start from the\h
ground up with all these projects, all these\h\h

175
00:16:36,100 --> 00:16:41,050
campaigns, we make connections with the\h
local authorities to provide the services\h\h

176
00:16:41,050 --> 00:16:46,960
for the campaign. So ESPO tends to be the\h
center of the organization of the campaign.

177
00:16:46,960 --> 00:16:56,950
So our job during the field campaign is to make\hsure that the infrastructure is there and then\h\h

178
00:16:56,950 --> 00:17:02,290
it's continually providing the support\h
for the field campaign for the scientists doing\h\h

179
00:17:02,290 --> 00:17:05,320
the observations. That means that we have to make sure that there's\h\h

180
00:17:05,320 --> 00:17:09,940
enough infrastructure to support deploying\h an aircraft in this far away place.

181
00:17:09,940 --> 00:17:20,025
[music]

182
00:17:20,025 --> 00:17:25,550
[Male speaker] Campaigns like this are very difficult because\hthey involve different cultures, different time\h\h

183
00:17:25,550 --> 00:17:30,740
zones. Day time here is night time back\h
home, so people are away from their families. It's\h\h

184
00:17:30,740 --> 00:17:37,940
stressful but everybody is handling it really, really\h
well and it's been a great, successful campaigns\hso far.

185
00:17:37,940 --> 00:17:50,015
[music]

186
00:17:51,016 --> 00:17:54,018
[Male speaker] Here no day has been the same. Every day has been\hdifferent.

187
00:17:54,018 --> 00:18:00,310

So the exciting aspect of fieldwork\his that you actually get to see how the data is\hcollected. You're not just sit

188
00:18:00,310 --> 00:18:05,140
computer back, at least for me, in Illinois and you\h
know...I don't know how this data was collected.\h

189
00:18:05,140 --> 00:18:10,690
Some days I'm sitting on a plane dropping dropsondes out of the back of the plane. Some days\h\h

190
00:18:10,690 --> 00:18:16,030
we're working on the dropsonde system. Every\h
day is just so different here than what it is at home.

191
00:18:17,003 --> 00:18:25,010
[music]

192
00:18:25,010 --> 00:18:30,320
[Male speaker] Field campaigns are important for students, not\h
just because they can see where data comes from\h\h

193
00:18:30,320 --> 00:18:34,017
but they're gonna create friendships that will\h
last them the rest of their lives.

194
00:18:34,017 --> 00:18:40,022
If any graduate student or scientist has the opportunity to\hdo fieldwork, I highly recommend it.\h

195
00:18:40,022 --> 00:18:45,140
Being in the field has been an incredible experience. As\h
a graduate student I have learned so much from\h\h

196
00:18:45,140 --> 00:18:49,029
so many different people it's been an incredible\hexperience.

197
00:18:49,029 --> 00:18:54,366
[Male speaker] We were actually very surprised because\ha lot of the scientists were giving us praise and\hwe

198
00:18:54,366 --> 00:19:01,250
telling us that we're doing\hgood work and hearing this from the people\hthat you admire, the people you read

199
00:19:01,250 --> 00:19:06,140
the "greats", so to speak, in this field and\h
then just to hear that from them it's really\h\h