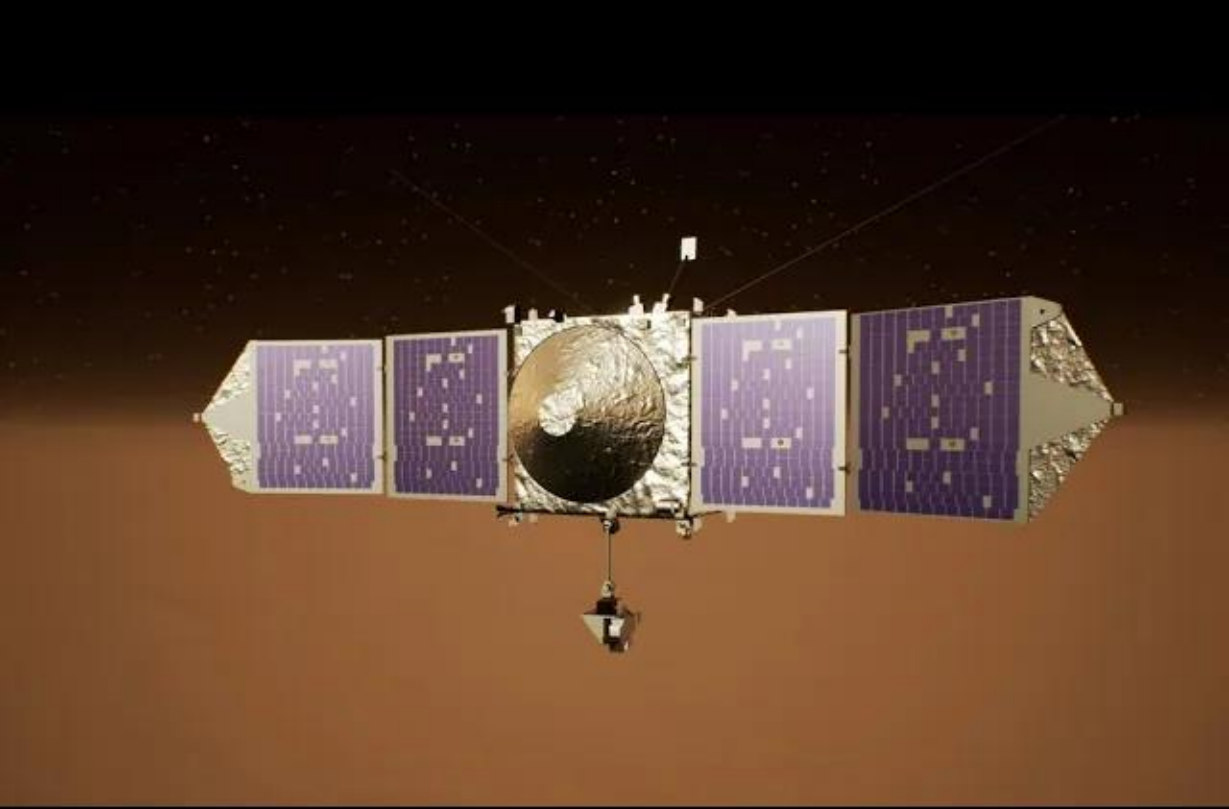

1
00:00:05,430 --> 00:00:03,750
early in its history mars had a far more

2
00:00:07,829 --> 00:00:05,440
hospitable climate than the one that we

3
00:00:09,669 --> 00:00:07,839
see today with a thick atmosphere and

4
00:00:12,150 --> 00:00:09,679
abundant flowing water

5
00:00:14,150 --> 00:00:12,160
so how did it evolve from warm and wet

6
00:00:17,029 --> 00:00:14,160
to cold and dry

7
00:00:19,029 --> 00:00:17,039
since 2015 nasa's maven mission has been

8
00:00:21,510 --> 00:00:19,039
investigating this question by studying

9
00:00:23,830 --> 00:00:21,520
the red planet's upper atmosphere

10
00:00:26,950 --> 00:00:23,840
now it has mapped high-altitude global

11
00:00:28,790 --> 00:00:26,960
wind patterns at mars for the first time

12
00:00:31,109 --> 00:00:28,800
during the closest part of its orbit

13
00:00:33,190 --> 00:00:31,119

maven skims through the upper atmosphere

14
00:00:35,030 --> 00:00:33,200
ingesting air molecules and determining

15
00:00:36,709 --> 00:00:35,040
their composition with an instrument

16
00:00:39,110 --> 00:00:36,719
called engemes

17
00:00:41,750 --> 00:00:39,120
maven can also rotate engamps back and

18
00:00:43,750 --> 00:00:41,760
forth to measure the air's velocity

19
00:00:45,590 --> 00:00:43,760
these measurements provide a snapshot of

20
00:00:47,350 --> 00:00:45,600
wind speed and direction along a track

21
00:00:49,510 --> 00:00:47,360
of maven's orbit

22
00:00:51,670 --> 00:00:49,520
because the orbit evolves over time or

23
00:00:53,510 --> 00:00:51,680
precesses the spacecraft's closest

24
00:00:55,910 --> 00:00:53,520
approach to mars drifts across the

25
00:00:57,670 --> 00:00:55,920
planet allowing it to take snapshots at

26
00:00:59,990 --> 00:00:57,680
different locations

27
00:01:02,549 --> 00:01:00,000
over the past four years maven's tracks

28
00:01:04,710 --> 00:01:02,559
have added up crisscrossing mars at many

29
00:01:06,950 --> 00:01:04,720
locations and at various seasons and

30
00:01:09,109 --> 00:01:06,960
times of day wrapping the planet in a

31
00:01:10,710 --> 00:01:09,119
web of observations

32
00:01:12,950 --> 00:01:10,720
the measurements reveal how the winds

33
00:01:14,550 --> 00:01:12,960
vary with location and evolve throughout

34
00:01:17,190 --> 00:01:14,560
the martian year

35
00:01:19,109 --> 00:01:17,200
now scientists have used maven data to

36
00:01:21,830 --> 00:01:19,119
build a global map of wind currents

37
00:01:23,510 --> 00:01:21,840
roughly 200 kilometers above mars the

38
00:01:25,590 --> 00:01:23,520

first time the winds have been mapped

39
00:01:27,670 --> 00:01:25,600
globally and at such high altitude

40
00:01:29,910 --> 00:01:27,680
anywhere beyond earth

41
00:01:32,390 --> 00:01:29,920
within the new map scientists discovered

42
00:01:34,230 --> 00:01:32,400
an unexpected feature imprints of rugged

43
00:01:36,550 --> 00:01:34,240
terrain far below

44
00:01:38,310 --> 00:01:36,560
as an example during two of its orbits

45
00:01:40,390 --> 00:01:38,320
maven saw winds above the tharsis

46
00:01:42,950 --> 00:01:40,400
plateau diverting away from elevated

47
00:01:44,230 --> 00:01:42,960
terrain driven by giant shield volcanoes

48
00:01:47,270 --> 00:01:44,240
reaching twice the height of mount

49
00:01:49,030 --> 00:01:47,280
everest here's how the process works

50
00:01:51,190 --> 00:01:49,040
down at the martian surface winds are

51
00:01:53,429 --> 00:01:51,200
forced around and over obstacles when

52
00:01:55,910 --> 00:01:53,439
they encounter mountainous terrain

53
00:01:58,149 --> 00:01:55,920
disturbances in surface level winds also

54
00:02:00,870 --> 00:01:58,159
disturb the air above propagating up

55
00:02:02,870 --> 00:02:00,880
through the atmosphere as gravity waves

56
00:02:04,870 --> 00:02:02,880
when they reach the upper atmosphere the

57
00:02:07,350 --> 00:02:04,880
gravity waves block the high altitude

58
00:02:09,270 --> 00:02:07,360
winds causing them to alter course and

59
00:02:11,029 --> 00:02:09,280
allowing maven to sense the presence of

60
00:02:13,910 --> 00:02:11,039
mountains and valleys on the surface

61
00:02:16,150 --> 00:02:13,920
while skimming the edge of space

62
00:02:18,390 --> 00:02:16,160
high above mars maven is studying the

63
00:02:19,830 --> 00:02:18,400

upper atmosphere and reaching out to

64
00:02:21,830 --> 00:02:19,840
feel the breeze

65
00:02:23,670 --> 00:02:21,840
it has now made the first measurement of

66
00:02:25,910 --> 00:02:23,680
high-altitude global circulation

67
00:02:28,390 --> 00:02:25,920
patterns and discovered a surprising

68
00:02:30,630 --> 00:02:28,400
connection to features on the surface

69
00:02:32,550 --> 00:02:30,640
these measurements also shed new light

70
00:02:35,670 --> 00:02:32,560
on ancient mars with its thick

71
00:02:37,430 --> 00:02:35,680
atmosphere and its warm wet climate

72
00:02:39,990 --> 00:02:37,440
by revealing how the climate of mars

73
00:02:42,309 --> 00:02:40,000
works today maven is helping scientists