
THE GEOCENTER OF THE EARTH IS CHANGING
(AND WHY THAT MATTERS)

1
00:00:00,000 --> 00:00:00,867
[Upbeat Music]

2
00:00:00,867 --> 00:00:02,268
Narrator: Where are you right now?

3
00:00:02,268 --> 00:00:04,571
Or better yet, how do you know where you are?

4
00:00:05,305 --> 00:00:08,808
Most likely you are using an app that is using a GPS

5
00:00:08,842 --> 00:00:11,444
to pinpoint where exactly you are on Earth.

6
00:00:12,245 --> 00:00:15,181
But what you might not know
is that behind your favorite navigation

7
00:00:15,181 --> 00:00:16,349
app is an invisible

8
00:00:16,349 --> 00:00:20,687
infrastructure of systems working together
to provide you an accurate location,

9
00:00:21,287 --> 00:00:24,491
and that the foundation of these systems
is a TRF

10
00:00:24,491 --> 00:00:26,793
or terrestrial reference frame.

11
00:00:27,861 --> 00:00:31,998
Dr. Stephen Merkowitz: So reference frame is fundamental

12
00:00:32,032 --> 00:00:37,771
to any kind of mapping, location,

positioning, navigation application.

13
00:00:37,804 --> 00:00:42,976
Narrator: That's Dr. Stephen Merkowitz,
NASA's Space Geodesy Project Manager

14
00:00:43,076 --> 00:00:45,345
Simply put, geodesy is the science

15
00:00:45,345 --> 00:00:47,914
of measuring and understanding the shape of the Earth,

16
00:00:48,348 --> 00:00:52,619
its orientation in space and gravity,
and how they change over time.

17
00:00:53,019 --> 00:00:57,891
Dr. Stephen Merkowitz: Earth is constantly changing shape,
and the land masses are constantly moving.

18
00:00:57,924 --> 00:01:02,095
It's at small levels, so it's not something
you would feel, you know, yourself.

19
00:01:02,228 --> 00:01:04,197
So we're constantly measuring

20
00:01:04,197 --> 00:01:07,801
what's happening with the Earth as a whole
and the Earth's surface.

21
00:01:08,034 --> 00:01:11,671
Narrator: To do this, NASA and international partners
monitor measurement

22
00:01:11,671 --> 00:01:15,475
stations dotted across the globe
that help us determine where,

23

00:01:15,742 --> 00:01:18,812
how much and in which direction
our planet is changing.

24
00:01:19,646 --> 00:01:22,582
Dr. Stephen Merkowitz: Since the Earth's surface
is always moving, any measurement

25
00:01:22,682 --> 00:01:24,851
isn't just in a fixed coordinate system.

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00:01:24,851 --> 00:01:26,319
It needs to take into account

27
00:01:26,319 --> 00:01:27,620
the fact that it's related

28
00:01:27,620 --> 00:01:31,491
to the landmass and where that landmass
is at any given time.

29
00:01:31,524 --> 00:01:34,427
Narrator: And just like a coordinate system
plotted on a piece of paper,

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00:01:34,627 --> 00:01:38,565
the TRF has an origin or in this case,
the center mass of the

31
00:01:38,565 --> 00:01:40,200
Earth - called the geocenter.

32
00:01:41,801 --> 00:01:44,104
Because of this, many Earth observing satellites

33
00:01:44,104 --> 00:01:48,675
orbit around the center mass of the Earth,
not the Earth's geographic center.

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00:01:49,042 --> 00:01:52,245
So it's critical for scientists to pinpoint where that is

35
00:01:52,245 --> 00:01:54,647
to make sure our Earth observations are accurate.

36
00:01:54,681 --> 00:01:57,250
Dr. Stephen Merkowitz: One complication is that the center
mass of the Earth

37
00:01:57,851 --> 00:02:00,186
is constantly changing over time

38
00:02:00,353 --> 00:02:02,555
with respect to the Earth's surface.

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00:02:02,555 --> 00:02:06,759
Narrator: Earthquakes, volcanoes, or even
atmospheric pressure changes all impact

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00:02:06,759 --> 00:02:09,395
where exactly the center
mass of the Earth is.

41
00:02:10,363 --> 00:02:14,400
But by using a network of ground stations
equipped with telescopes and lasers

42
00:02:14,400 --> 00:02:18,705
that fire pulses at specific satellites,
scientists can calculate

43
00:02:18,738 --> 00:02:23,710
where the geocenter of the Earth
is at any given time to a few millimeters.

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00:02:23,943 --> 00:02:28,781
Dr. Stephen Merkowitz: This is a very important product
that we generate for orbiting satellites,

45
00:02:28,781 --> 00:02:30,717
particularly for missions

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00:02:30,717 --> 00:02:34,320
that are either doing mapping
the gravitational field of the Earth or

47
00:02:35,054 --> 00:02:38,825
mapping the height of the Earth's surface,
whether it be land, vegetation,

48
00:02:38,825 --> 00:02:40,293
or sea level.

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00:02:40,293 --> 00:02:42,362
We make that available to the public,

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00:02:42,362 --> 00:02:45,498
we use the data there
to generate a higher level

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00:02:45,665 --> 00:02:49,569
of products, geodetic products,
that can be used by NASA missions

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00:02:50,170 --> 00:02:53,439
for many scientific applications.

53
00:02:53,673 --> 00:02:57,277
Since this is a global measurement, NASA can't do it alone.

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00:02:57,610 --> 00:03:00,079
We rely on the global community to

55
00:03:00,680 --> 00:03:04,551
provide all the data that's needed to provide global coverage.

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00:03:06,686 --> 00:03:07,520

Narrator: Having an agreed

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00:03:07,520 --> 00:03:11,257
upon international system is
what makes measuring our planet possible,