NETHOPE GLOBAL SUMMIT 2023

DISASTER CONNECTIVITY MAP - understanding connectivity during and after disasters

www.nethopeglobalsummit.org
https://dcm.itu.int

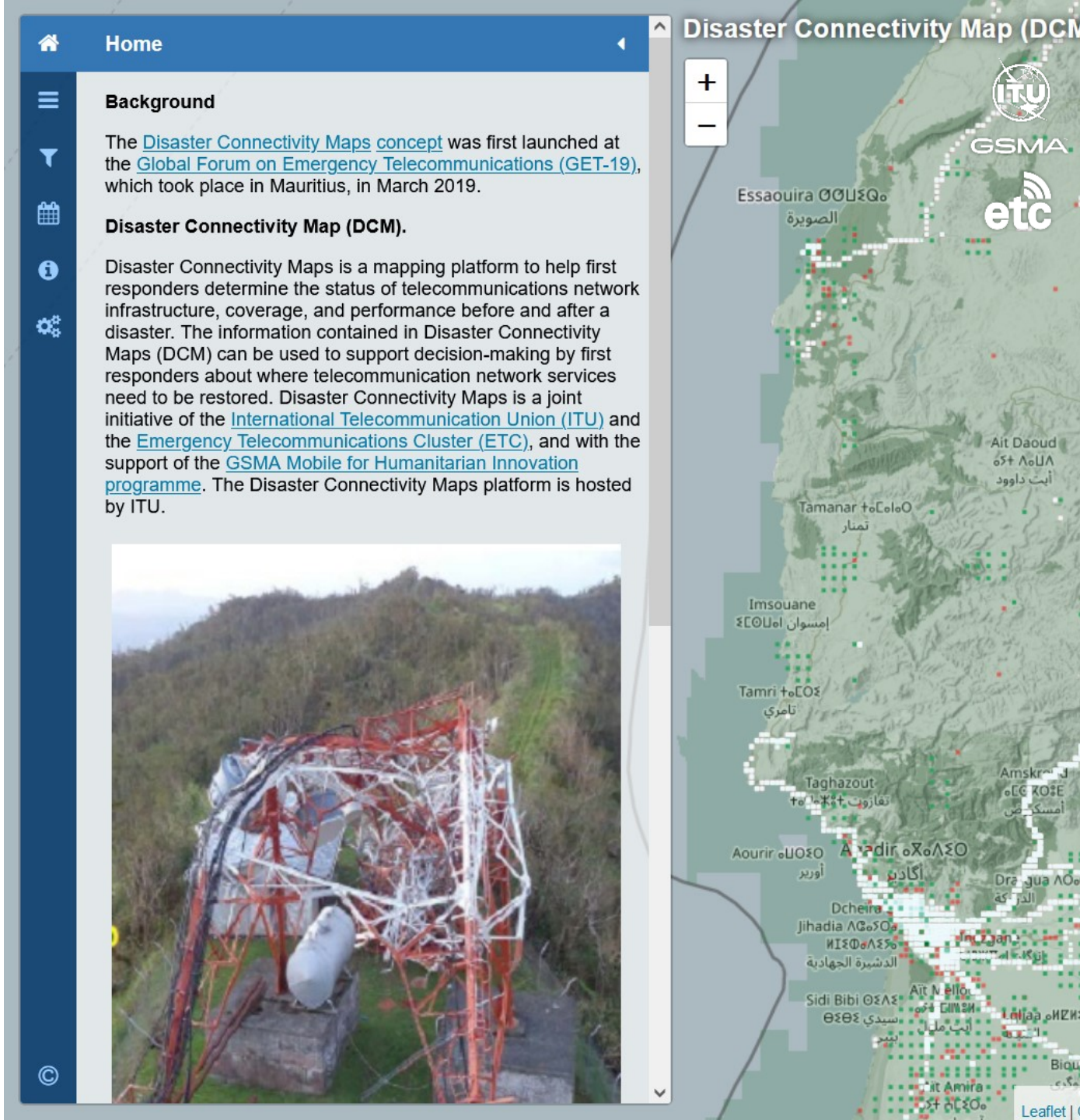
The problem

Fact: Knowing the extent of interruption to the communication system in a disaster helps to plan the humanitarian response.

The problem: When disaster strikes, telecom networks are impacted. Emergency responders and affected people do not have a clear picture of where **mobile networks are available** at a critical time.

The goal: Create a solution that shows the location of **communication gaps** in areas affected by disaster.

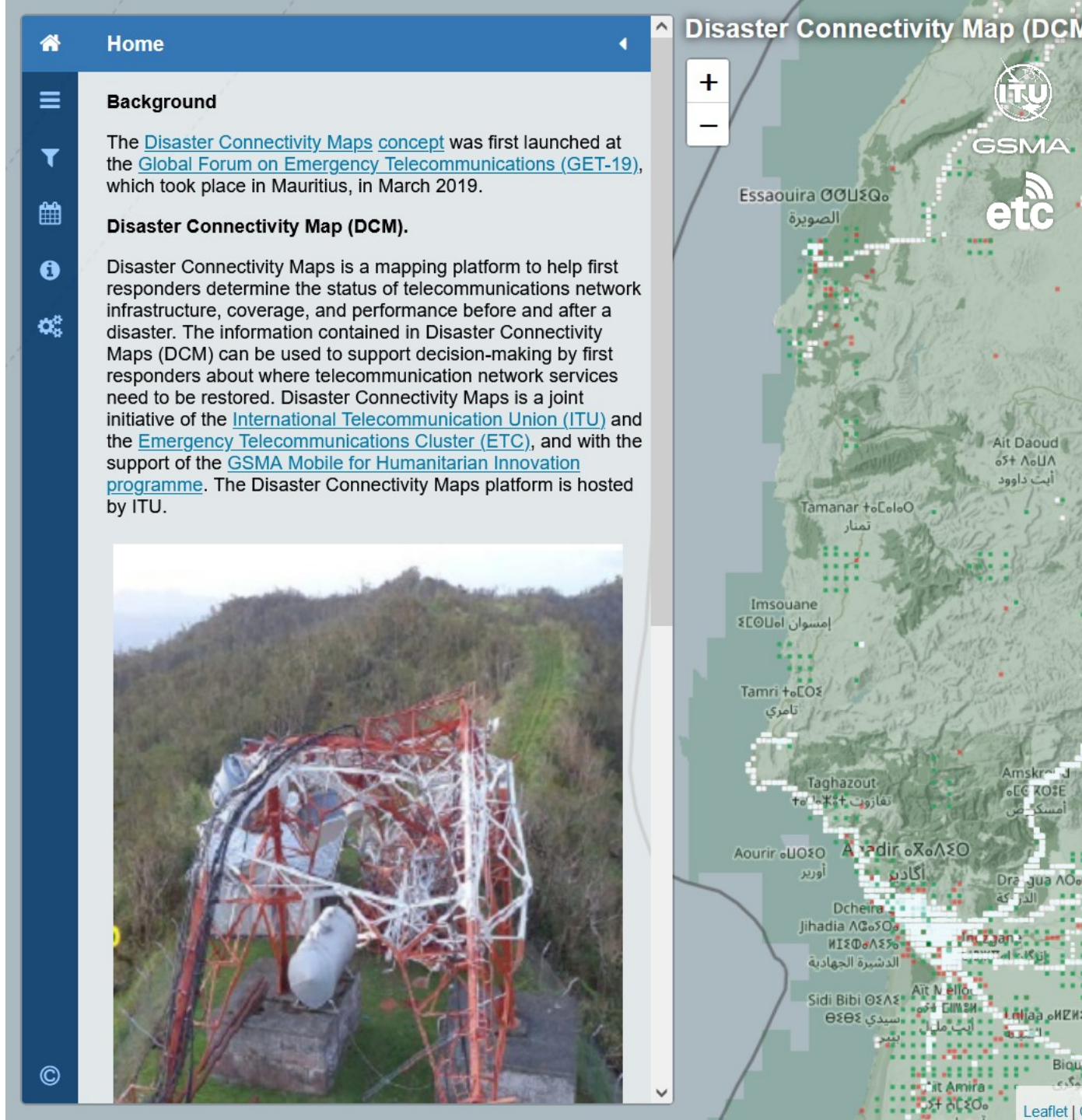
The challenge: **How to show on a map something that is not there**; how to detect complete or partial decreases in the level and quality of connectivity in disaster situations compared to normal service.



Our solution

Our solution: A dynamic **mapping service** that shows where telecom network outages are happening in disaster affected areas.

- Collect real-time **connectivity measurements** from probes, sensors, and geolocated IP addresses in mobile and fixed devices.
- Process and display this data as near **real-time** and **historic baseline** connectivity performance maps.
- **Compare** the real-time data against the historic baseline connectivity data to expose possible network outages.

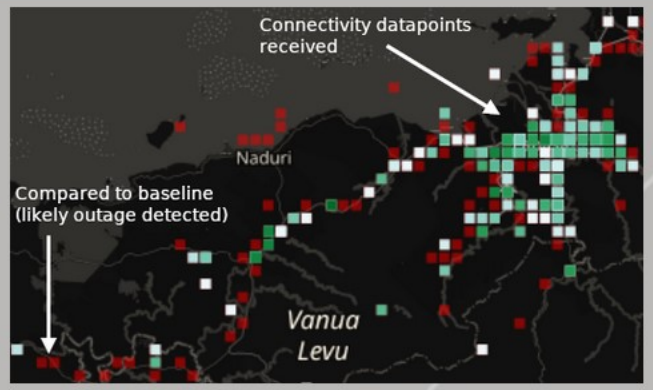


Disaster Connectivity Map (DCM)

Real-time connectivity datapoints received after disaster event GREEN

Possible outage compared to historic baseline connectivity datapoints RED

Connectivity Indicators

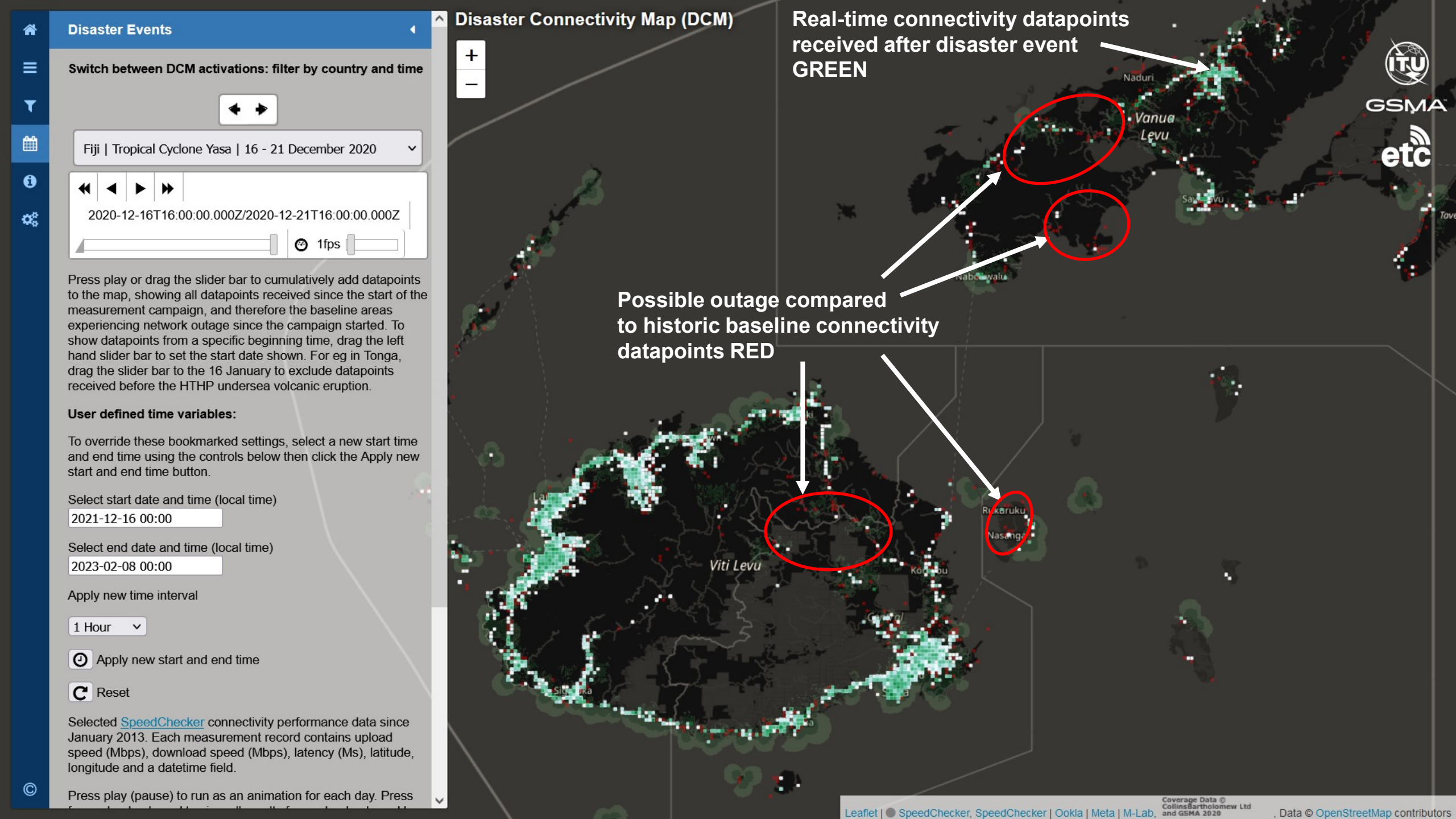


Select which connectivity measurement indicator to display.

Grid: Download Speed (Mbps)

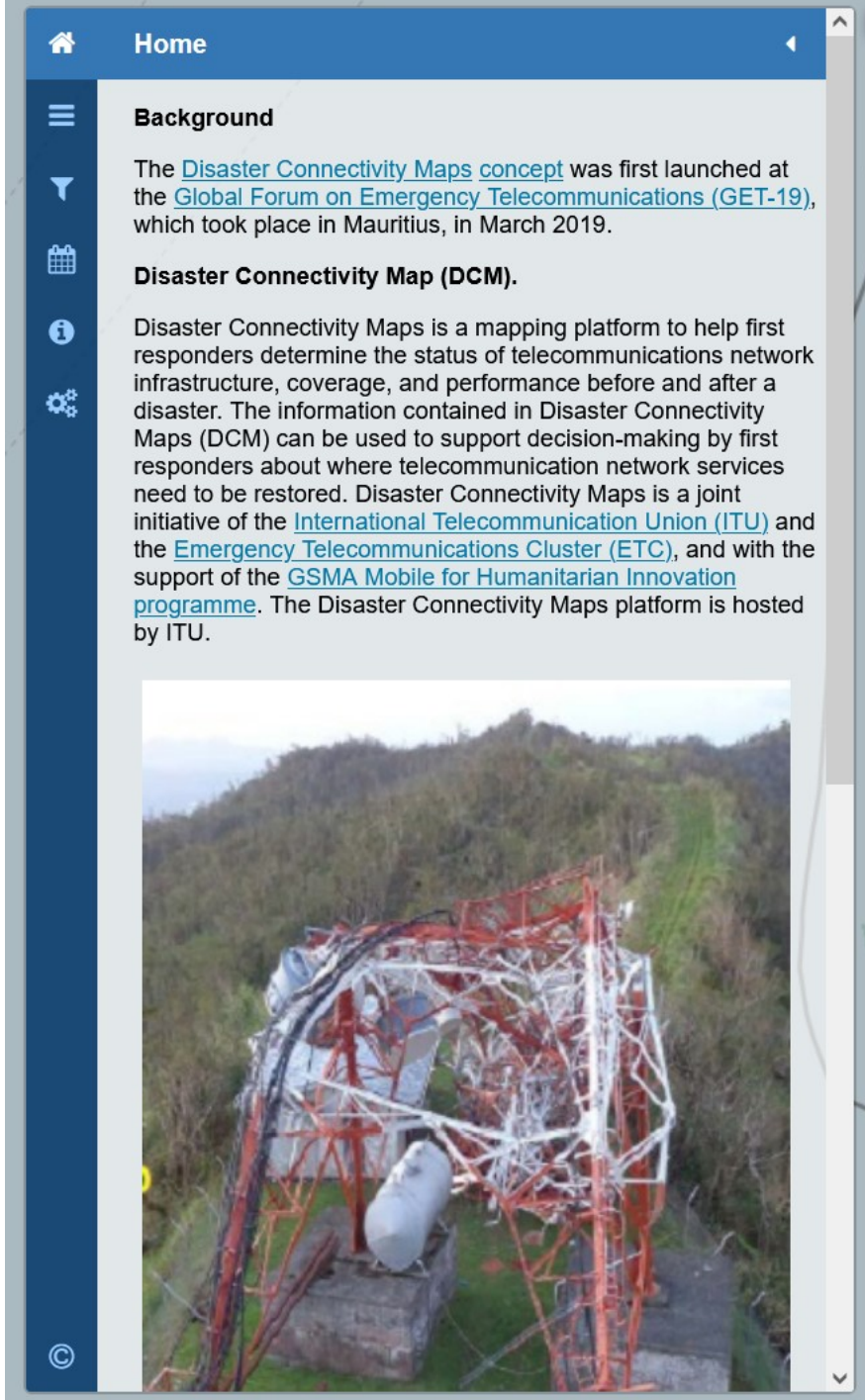
- <= 10 Mbps
- 10 Mbps - 20 Mbps
- 20 Mbps - 30 Mbps
- 30 Mbps - 40 Mbps
- 40 Mbps - 50 Mbps
- 50 Mbps - 75 Mbps
- 75 Mbps - 100 Mbps
- 100 Mbps - 125 Mbps
- 125 Mbps - 150 Mbps
- => 150 Mbps

Speedchecker baseline


Disaster Events
Switch between DCM activations: filter by country and time
Fiji | Tropical Cyclone Yasa | 16 - 21 December 2020
2020-12-16T16:00:00.000Z/2020-12-21T16:00:00.000Z
1fps
Press play or drag the slider bar to cumulatively add datapoints to the map, showing all datapoints received since the start of the measurement campaign, and therefore the baseline areas experiencing network outage since the campaign started. To show datapoints from a specific beginning time, drag the left hand slider bar to set the start date shown. For eg in Tonga, drag the slider bar to the 16 January to exclude datapoints received before the HTHP undersea volcanic eruption.
User defined time variables:
To override these bookmarked settings, select a new start time and end time using the controls below then click the Apply new start and end time button.
Select start date and time (local time)
2021-12-16 00:00
Select end date and time (local time)
2023-02-08 00:00
Apply new time interval
1 Hour
Apply new start and end time
Reset
Selected SpeedChecker connectivity performance data since January 2013. Each measurement record contains upload speed (Mbps), download speed (Mbps), latency (Ms), latitude, longitude and a datetime field.
Press play (pause) to run as an animation for each day. Press
Disaster Connectivity Map (DCM)
Real-time connectivity datapoints received after disaster event GREEN
Possible outage compared to historic baseline connectivity datapoints RED
Naduri
Vanua Levu
Viti Levu
Nasanga
GSMA
etc
Leaflet | SpeedChecker, SpeedChecker | Ookla | Meta | M-Lab, Coverage Data © CollinsBartholomew Ltd and GSMA 2020 , Data © OpenStreetMap contributors

DCM...

- Online platform
- Hosted and developed by the ITU
- Combines multiple data sources
- Presents near real-time information on a map
- Password protected (for sensitive information)
- Activated manually upon request (in response to a disaster)
- For emergency responders and disaster managers who decide where and when resources need to be directed in the aftermath of disaster.



Data sources

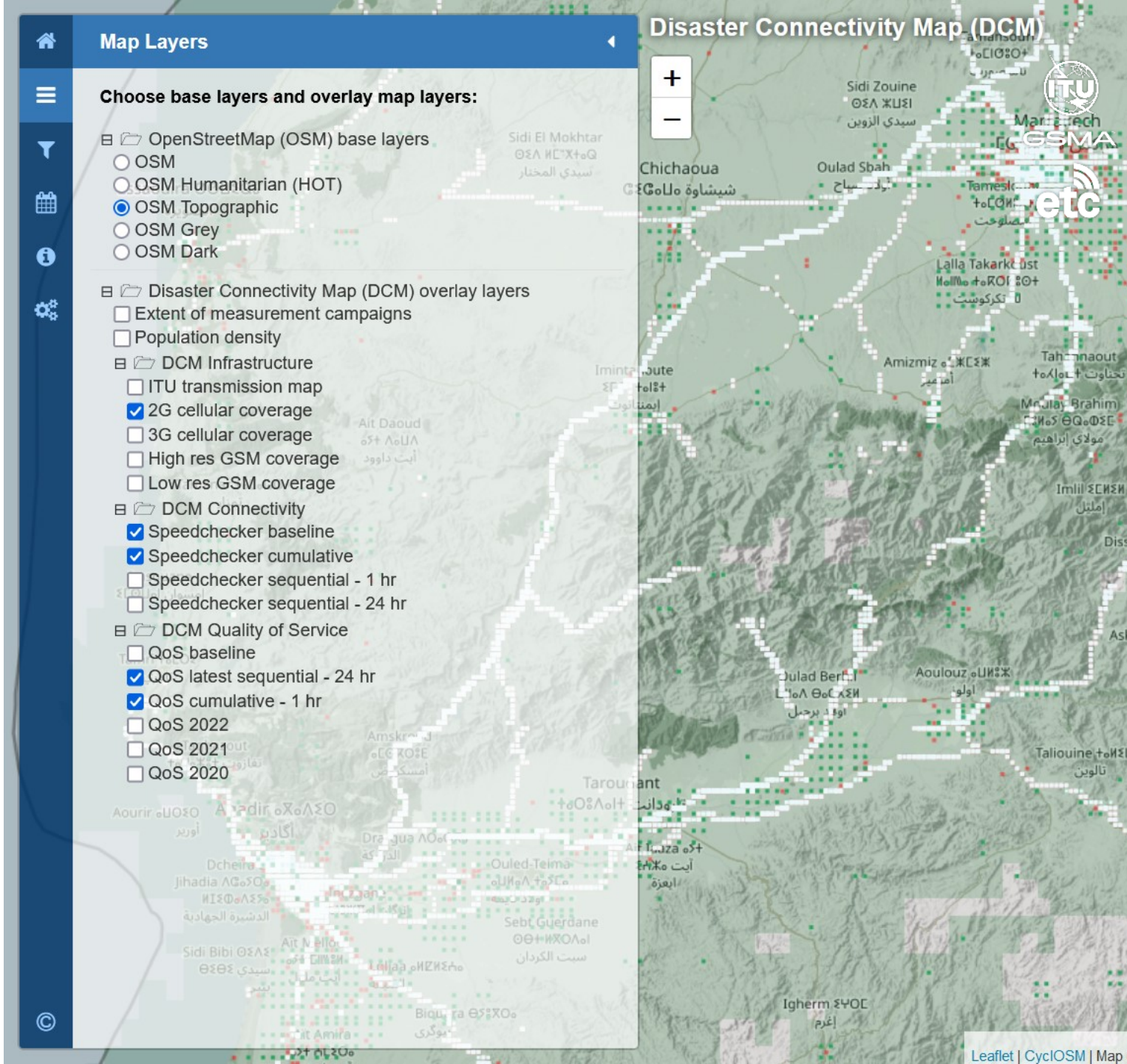
From the Map Layers tab

Infrastructure

- ITU transmission map
- TeleGeography submarine cable map
- OpenCelliD
- GSMA | Collins Bartholomew
- GSMA | Masae Analytics | CloudRF

Connectivity

- Speedchecker
- Ookla for Good
- Measurement Lab (M-Lab)
- Meta for Good
- Cloudflare | Google Transparency Report | Ripe Atlas



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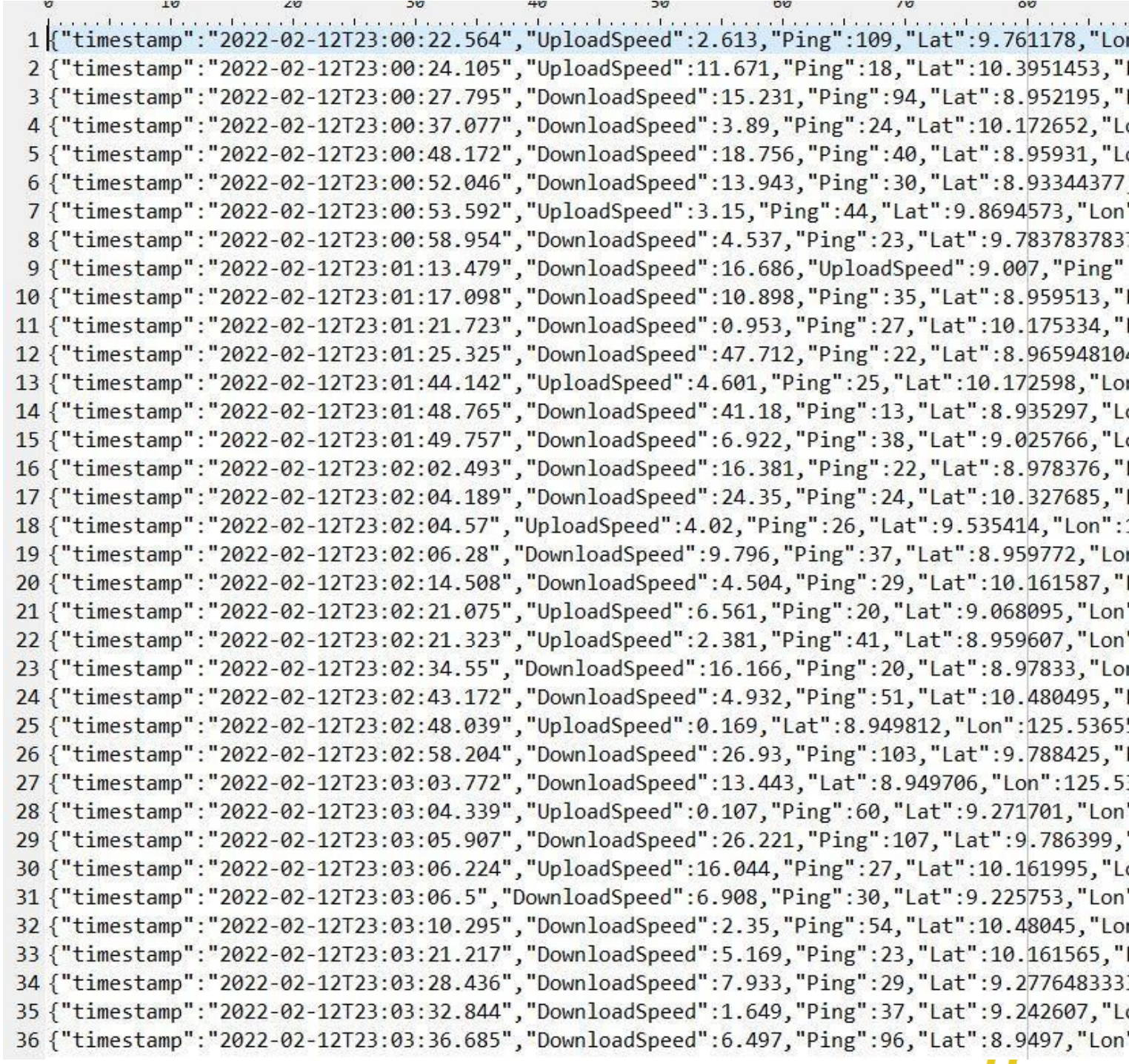
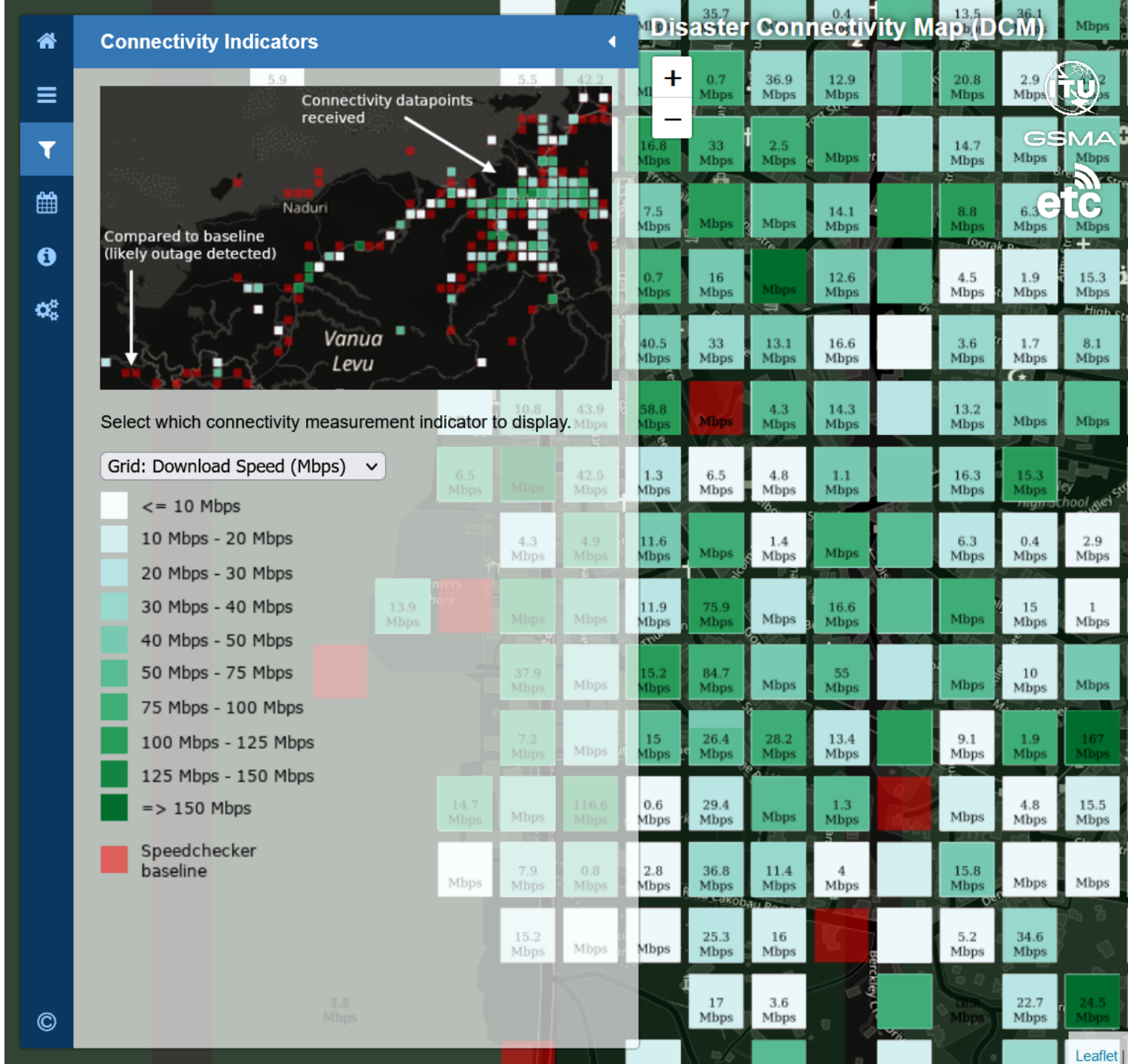


Indicators

Connectivity measurement indicators:

From the Connectivity Indicator tab, choose the indicator to show using the drop-down box:

- Cellular network coverage
- Download speed
- Upload speed
- Latency



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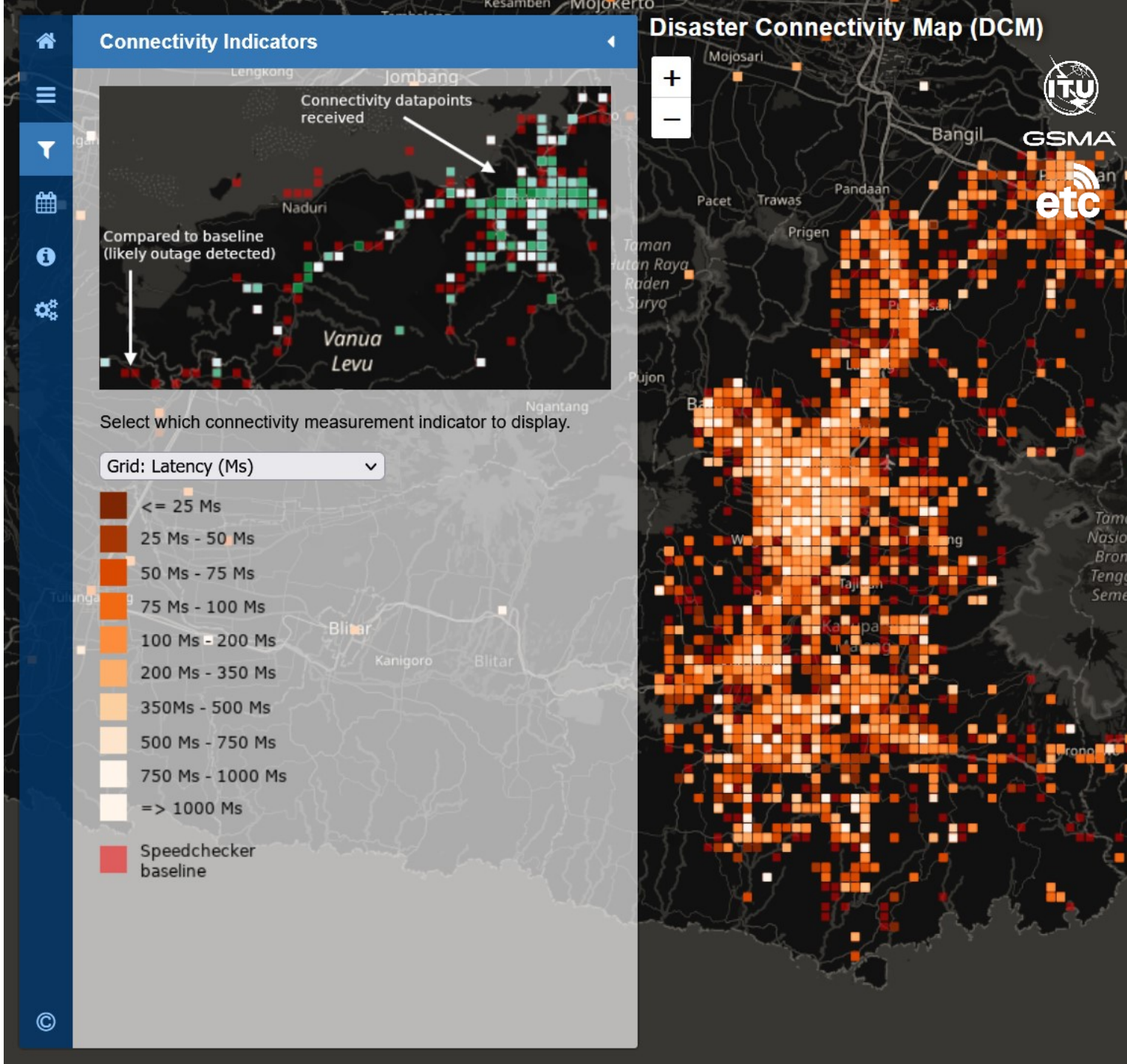


Activations

Activations

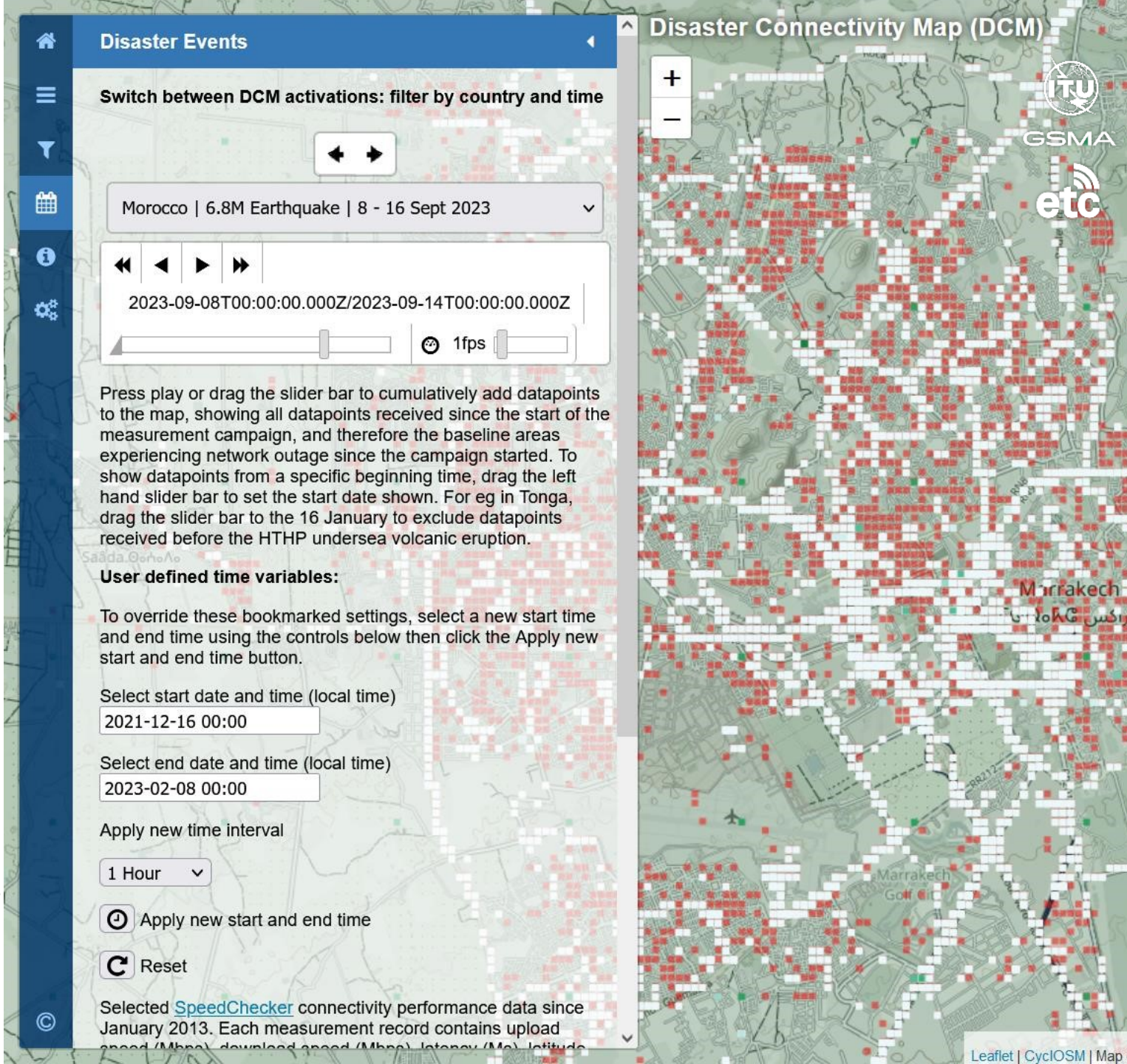
- Fiji 16 – 21 Dec 2020
- St Vincent & The Grenadines
- Barbados 15 – 23 Apr 2021
- St Lucia 15 – 23 Apr 2021
- Haiti 16 Aug – 14 Sept 2021
- Indonesia 8 – 13 Dec 2021
- Philippines Dec 2021 – Feb 2022
- Tonga 16 Dec 2021 – Feb 2023
- Pakistan 14 – 16 Aug 2022
- Dominican Rep. 19-27 Sept 2022
- Zimbabwe 22 Feb – 1 Mar 2023
- Vanuatu 1 – 12 Mar 2023
- Turkey 5 Feb – 12 Mar 2023
- Bangladesh 12 – 19 May 2023
- Korea (Rep.) 9 – 12 Aug 2023
- Morocco 8 – 16 Sept 2023

Baseline campaigns

- Antigua & Barbuda June 2021
- Grenada 16 – 21 June 2021
- Kiribati 16 – 21 June 2021
- Micronesia 16 – 21 June 2021
- Marshall Islands June 2021
- Nauru 16 – 21 June 2021
- St Kitts & Nevis 16 – 21 June 2021
- Tonga 16 – 21 June 2021
- Dominican Rep 1 – 2 July 2021
- Jamaica 1 – 2 July 2021
- Haiti 1 – 2 July 2021
- Dominican Rep 1 – 2 July 2021
- Jamaica 1 – 2 July 2021
- Bahamas 5 – 6 July 2021
- Samoa 5 – 6 July 2021
- Solomon Islands 5 – 6 July 2021
- Trinidad & Tobago 5 – 6 July 2021
- Guadeloupe 5 – 6 July 2021
- Bhutan 25 – 26 Oct 2021
- Madagascar 25 – 26 Oct 2021
- Mongolia 25 – 26 Oct 2021
- Mozambique 25 – 26 Oct 2021
- Brunei 2 – 14 Dec 2021

Pilot countries, baseline campaigns

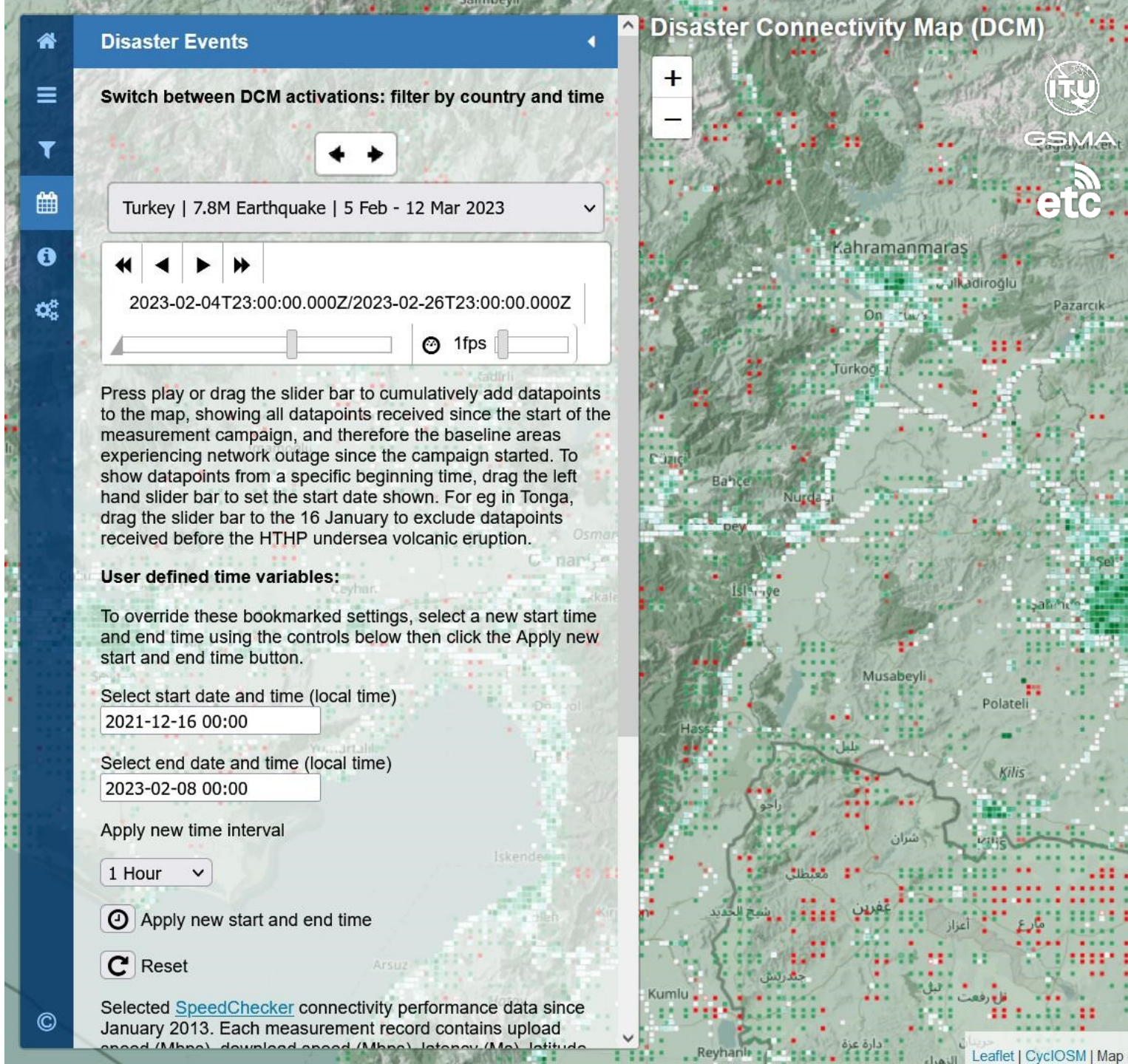
- Fiji 8 May 2020
- Dominica 8 May 2020
- Philippines 8 May 2020



Activations

Select the ‘Disaster Events’ button from the sidebar menu to see the map view for these activations:

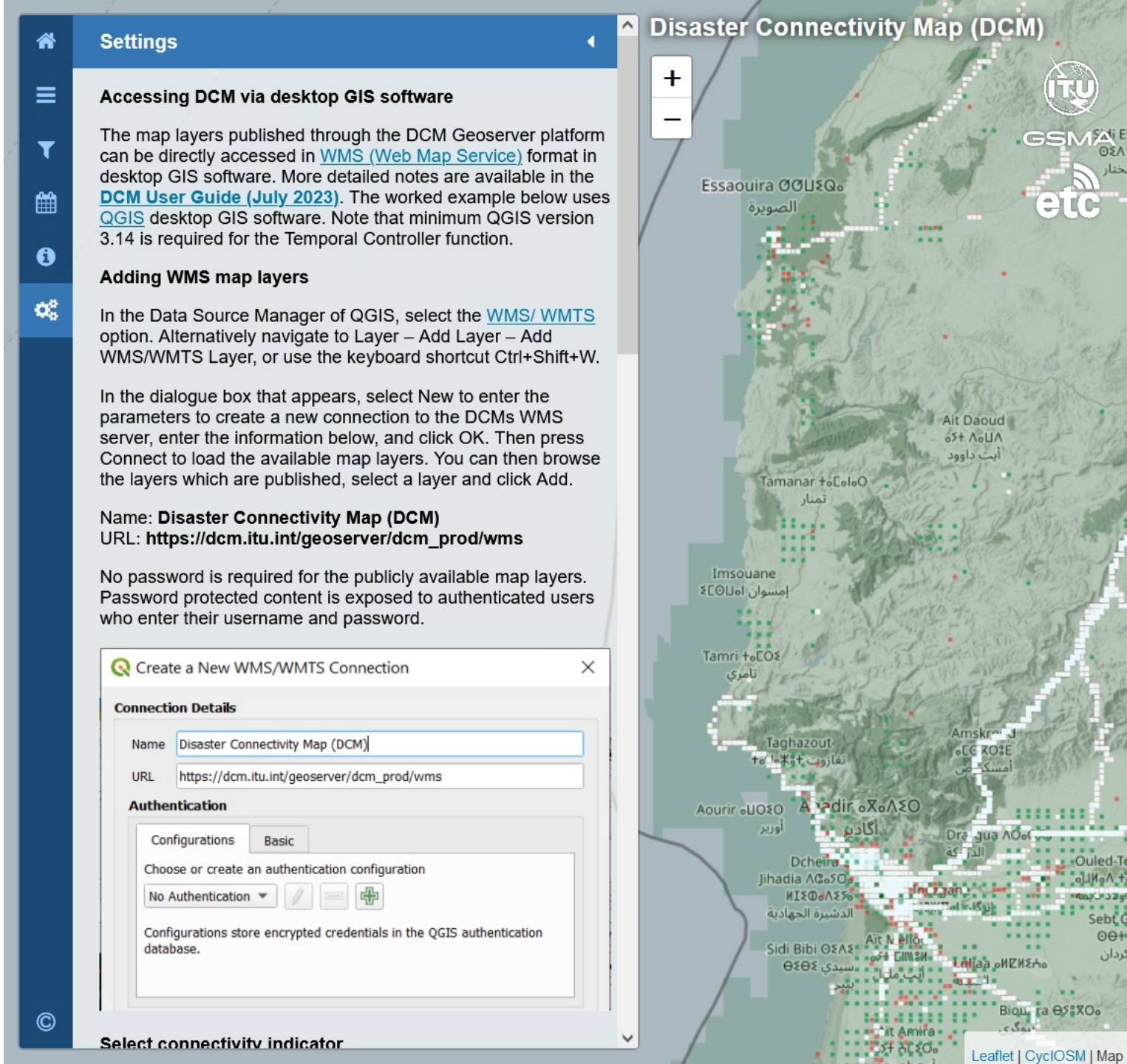
- **Drop-down list.** This menu presents a drop-down list of bookmarks so that a user can quickly switch between maps of different activations of the DCM service.
- **Select activation.** Selecting a bookmark from this drop-down list will re-centre the coordinates and zoom level of the map to the chosen country/activation, and reset the time parameters for the duration of the selected activation.
- **Time parameters loading.** It will take some seconds to load the new time parameters: the start date time, end date time, and the interval (per hour, per day).
- **Time parameters loaded.** The user can then use the play forward, play reverse, tab forward or tab backward buttons to display the results.



WMS access

Select the ‘Settings’ button from the sidebar menu for accessing the DCM in your own GIS software:

- In addition to the web map, users can directly access the map layers published through the DCM Geoserver platform in **WMS (Web Map Service)** format in desktop GIS software.
- In the settings button from the sidebar are basic instructions to access the DCM map layers in WMS format, and more detail notes are available in the DCM User Guide.



Results

Complete outages

Tonga | Hunga Tonga-Hunga Ha'apai undersea volcanic eruption | 16 January 2022

International and domestic submarine cables serving Tonga cut after undersea volcano and tsunami. Restored by satellite, microwave and HF radio connectivity.

Note that the time is displayed as a *range* between a start date of 15 December 2021 and 16 March 2022. Setting the time as a range therefore cumulatively displays all datapoints received between the start date and end date.

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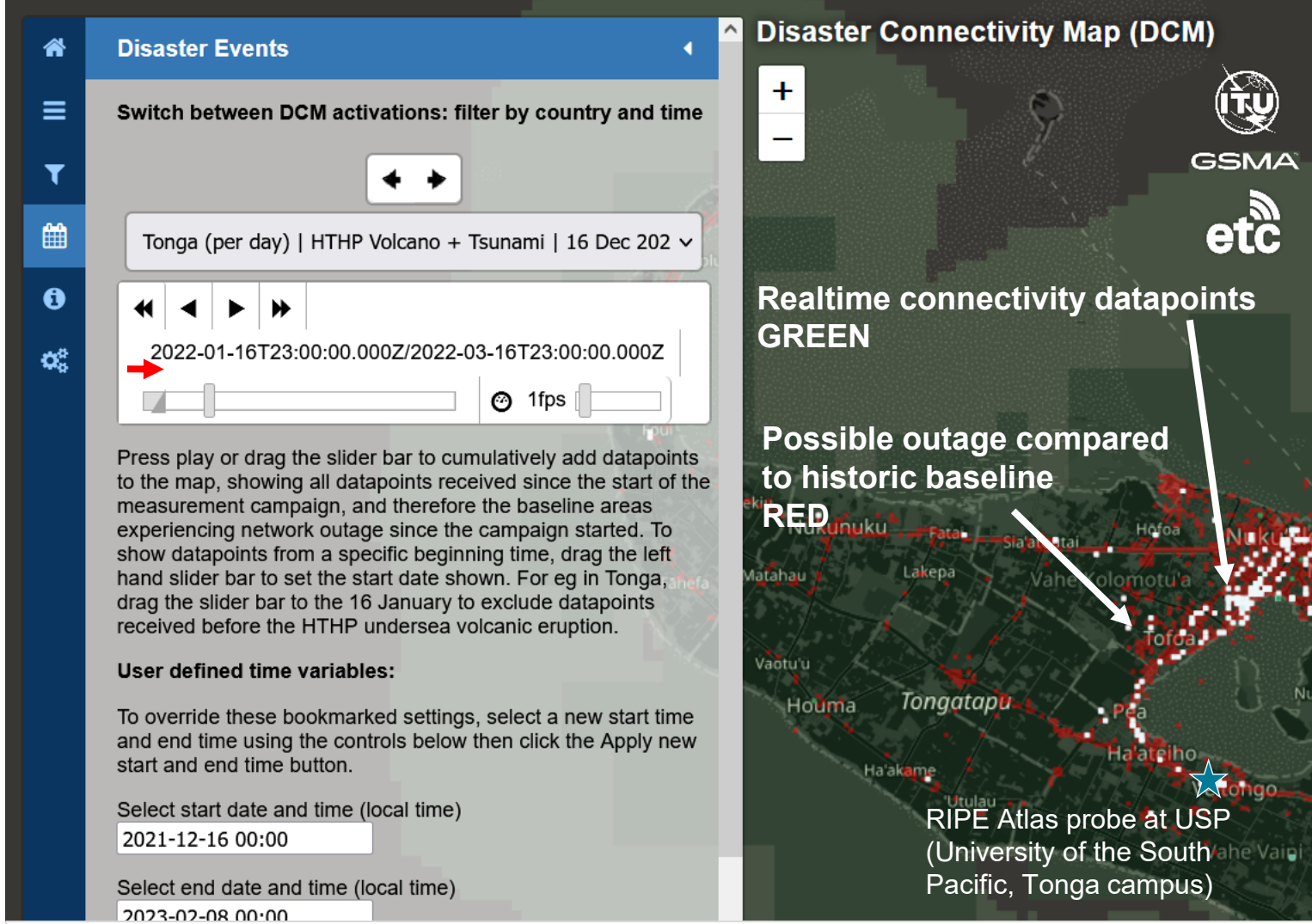
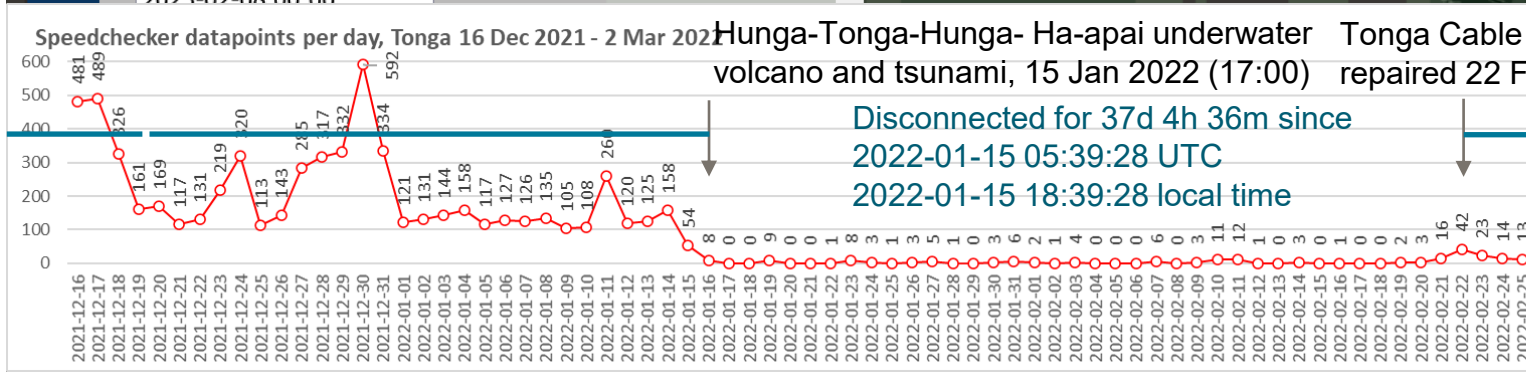


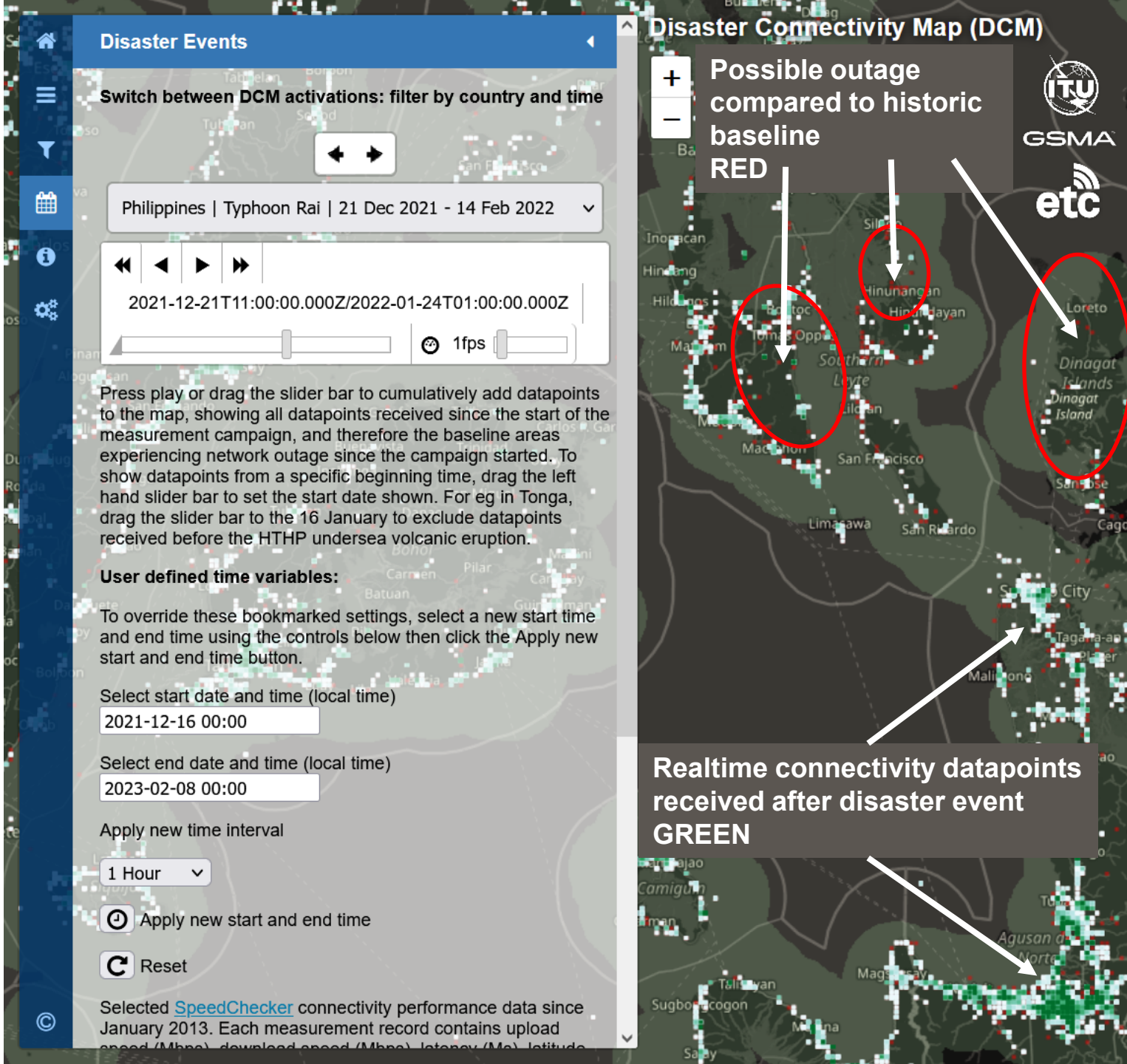


Results

Partial outages

Philippines | Typhoon Rai | 21 Dec 2021

Northern region of Mindanao (outskirts of Surigao City), Philippines January 2022. After Cat 5 Typhoon Rai (Odette) Dec 2021. Photo credit: John Lobaton/WFP



DISASTER CONNECTIVITY MAP

https://dcm.itu.int

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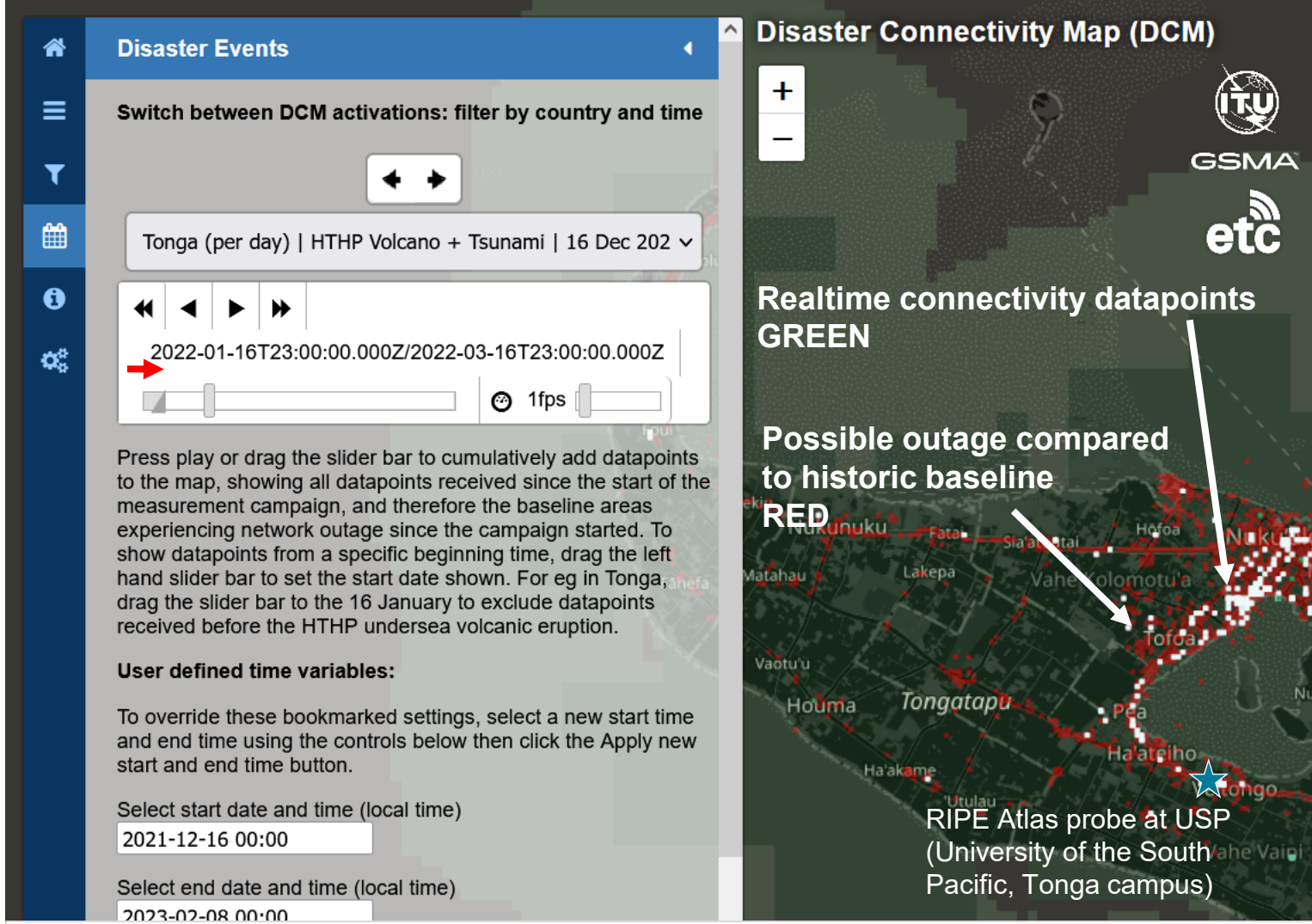

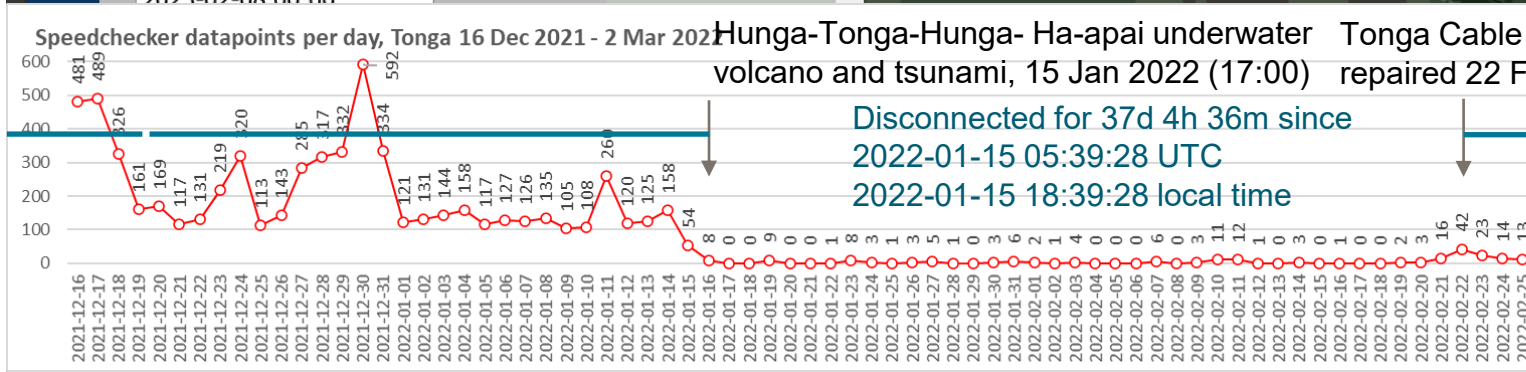

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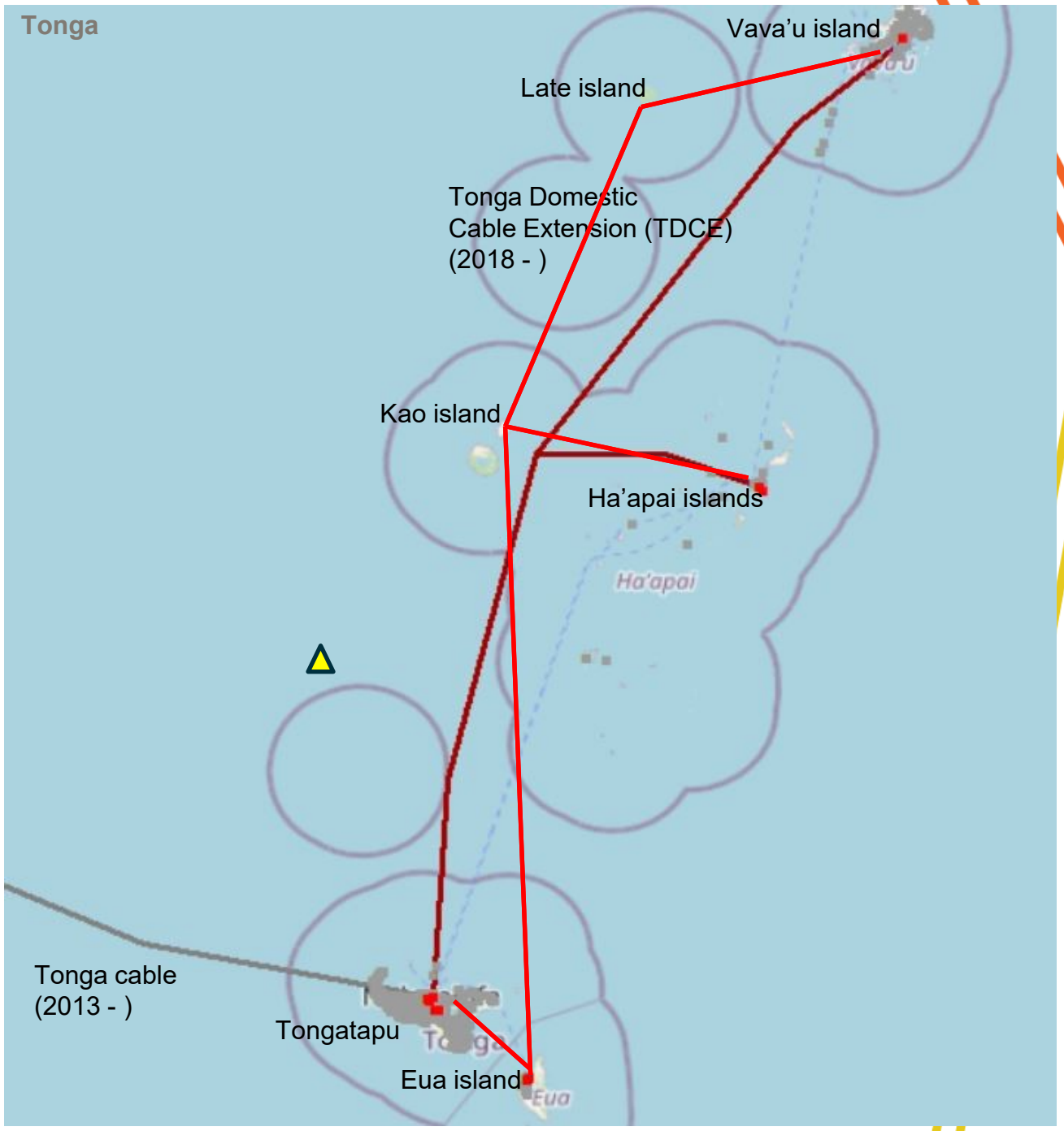
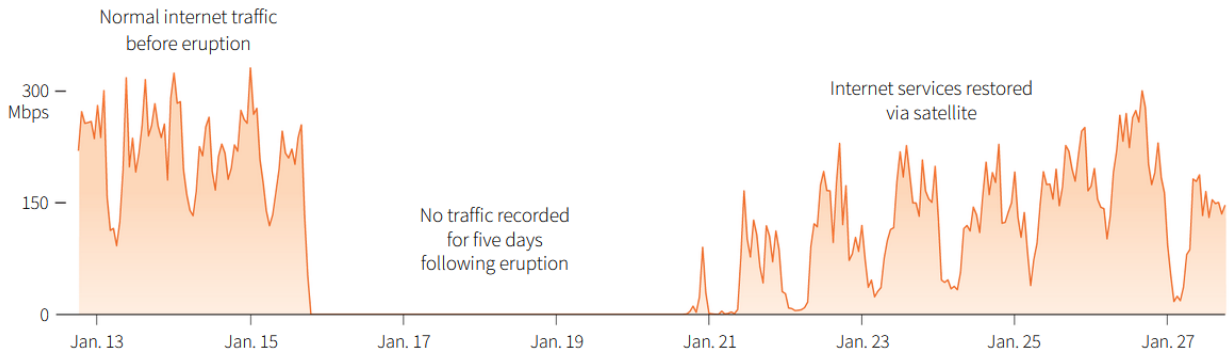


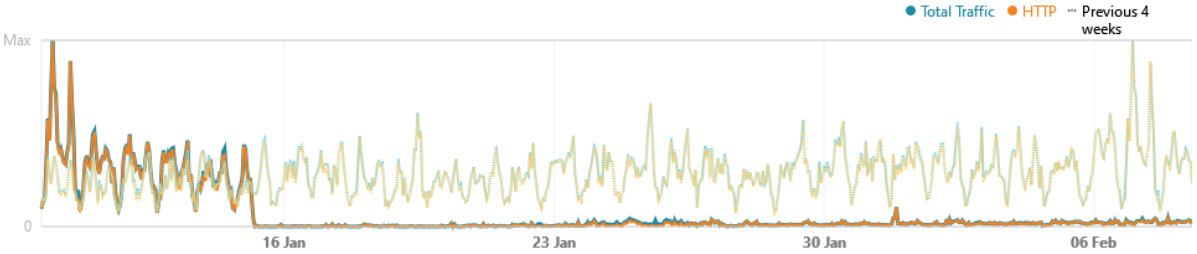
Internet traffic in Tonga



Note: Internet traffic measured in hourly average of megabits per second (Mbps). Data is a sample of network traffic to all telecom operators in Tonga as monitored by Kentik. Does not represent all internet traffic to Tonga.

https://graphics.reuters.com/TONGA-VOLCANO/znpnejbjovl/
https://www.kentik.com/blog/tonga-downed-by-massive-undersea-volcano-eruption/

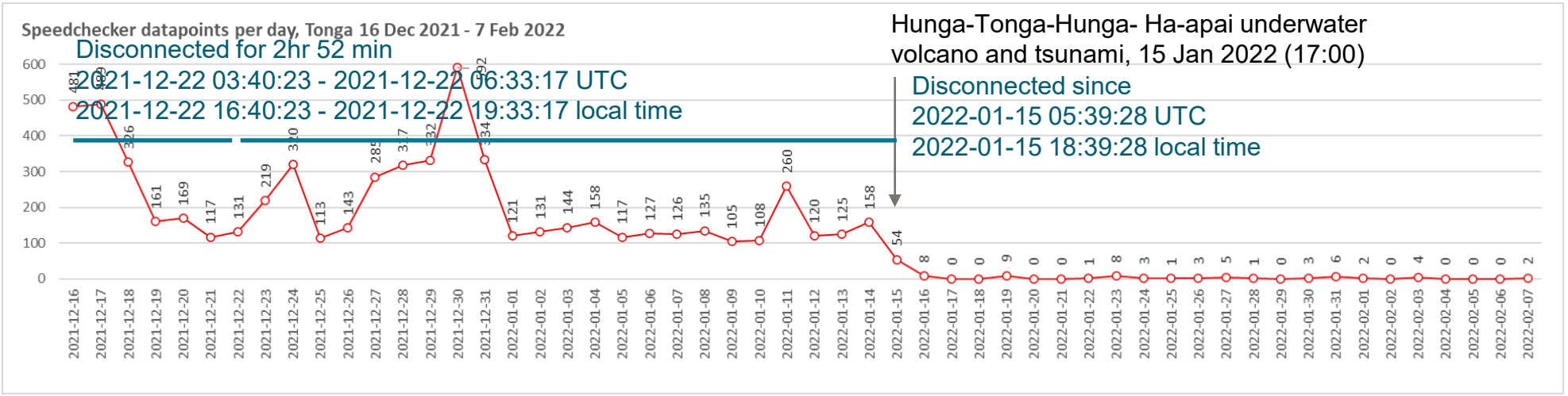
Change in Internet Traffic in Tonga (Last 30 days)

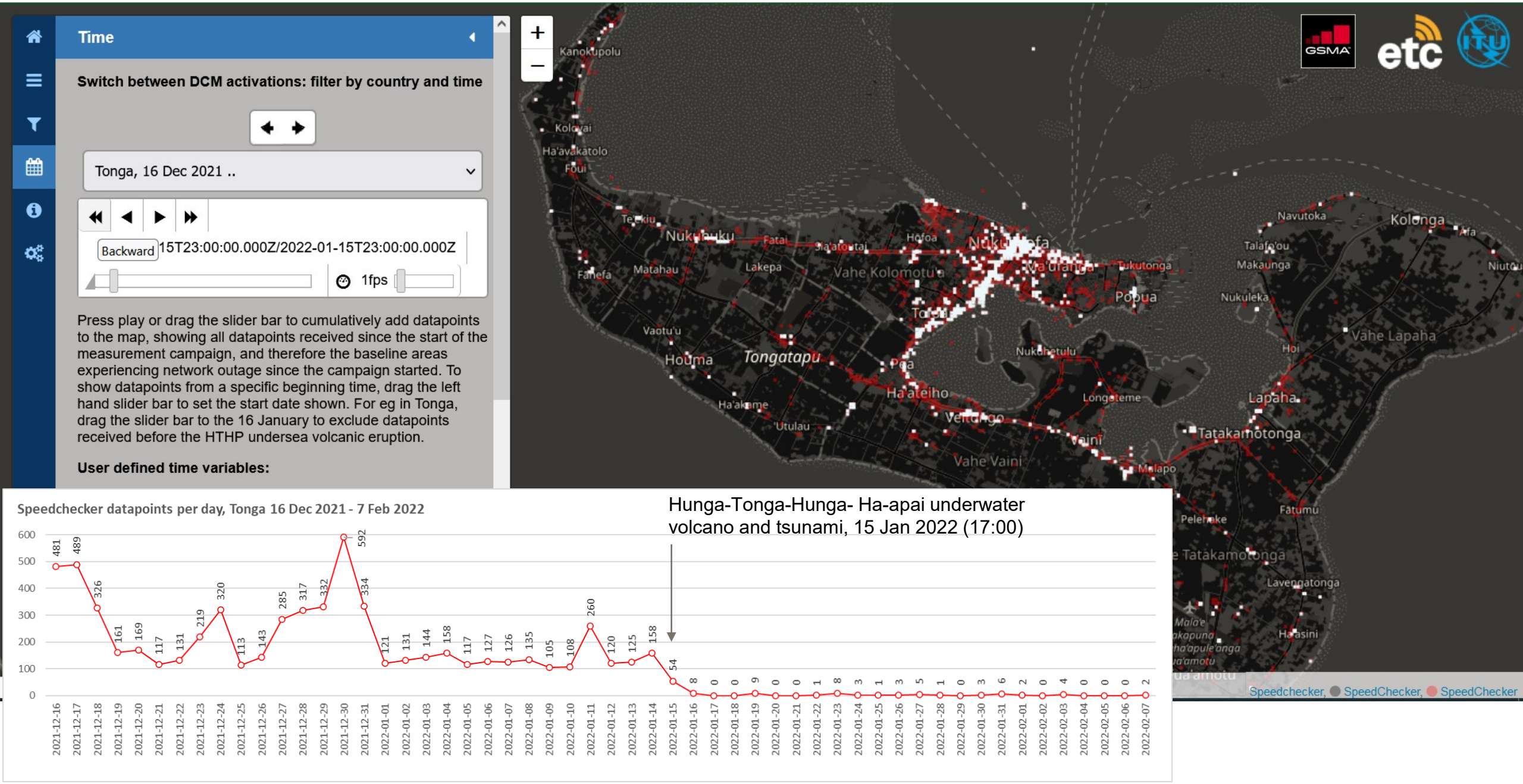


CLOUDFLARE

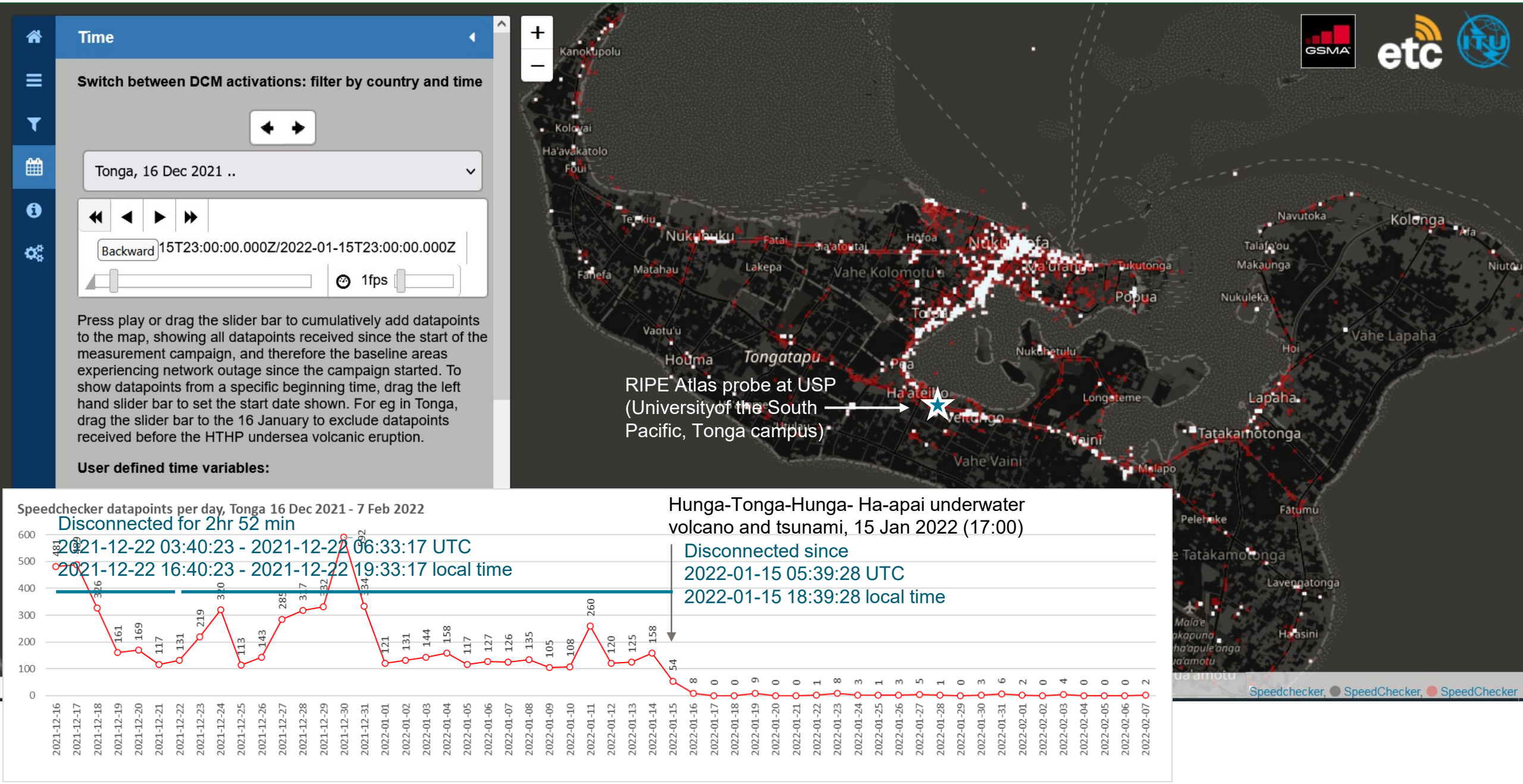
Data shown from Jan 9, 2022 5:00 PM (UTC) to Feb 8, 2022 1:00 PM (UTC)

https://radar.cloudflare.com/to?date_filter=last_30_days
https://blog.cloudflare.com/tonga-internet-outage/




Time
Switch between DCM activations: filter by country and time
Tonga, 16 Dec 2021 ..
Backward
15T23:00:00.000Z/2022-01-15T23:00:00.000Z
1fps
Press play or drag the slider bar to cumulatively add datapoints to the map, showing all datapoints received since the start of the measurement campaign, and therefore the baseline areas experiencing network outage since the campaign started. To show datapoints from a specific beginning time, drag the left hand slider bar to set the start date shown. For eg in Tonga, drag the slider bar to the 16 January to exclude datapoints received before the HTHP undersea volcanic eruption.
User defined time variables:
Kanokupolu
Kolovai
Ha'avakatolo
Fo'ui
Nukunuku
Fatai
Hofoa
Fanefa
Matahau
Lakepa
Vaotu'u
Houma
Tongatapu
Ha'ateiho
Ha'akame
'Utulau
Vahe Kolomotu'a
Tukutonga
Popua
Nukuleka
Navutoka
Kolonga
Talafo'ou
Makaunga
Vahe Lapaha
Hoi
Lapaha
Tatakamotonga
Vaini
Vahe Vaini
Longoteme
Fatumu
Lavengatonga
Ha'asini
Speedchecker, SpeedChecker, SpeedChecker

Speedchecker datapoints per day, Tonga 16 Dec 2021 - 7 Feb 2022
Hunga-Tonga-Hunga- Ha-apai underwater volcano and tsunami, 15 Jan 2022 (17:00)
600
500
400
300
200
100
0
481 489 326 161 169 117 131 219 320 113 143 285 317 332 592 334 121 131 144 158 117 127 126 135 105 108 260 120 125 158 54 8 0 0 9 0 0 1 8 3 1 3 5 1 0 3 6 2 0 4 0 0 0 2
2021-12-16 2021-12-17 2021-12-18 2021-12-19 2021-12-20 2021-12-21 2021-12-22 2021-12-23 2021-12-24 2021-12-25 2021-12-26 2021-12-27 2021-12-28 2021-12-29 2021-12-30 2021-12-31 2022-01-01 2022-01-02 2022-01-03 2022-01-04 2022-01-05 2022-01-06 2022-01-07 2022-01-08 2022-01-09 2022-01-10 2022-01-11 2022-01-12 2022-01-13 2022-01-14 2022-01-15 2022-01-16 2022-01-17 2022-01-18 2022-01-19 2022-01-20 2022-01-21 2022-01-22 2022-01-23 2022-01-24 2022-01-25 2022-01-26 2022-01-27 2022-01-28 2022-01-29 2022-01-30 2022-01-31 2022-02-01 2022-02-02 2022-02-03 2022-02-04 2022-02-05 2022-02-06 2022-02-07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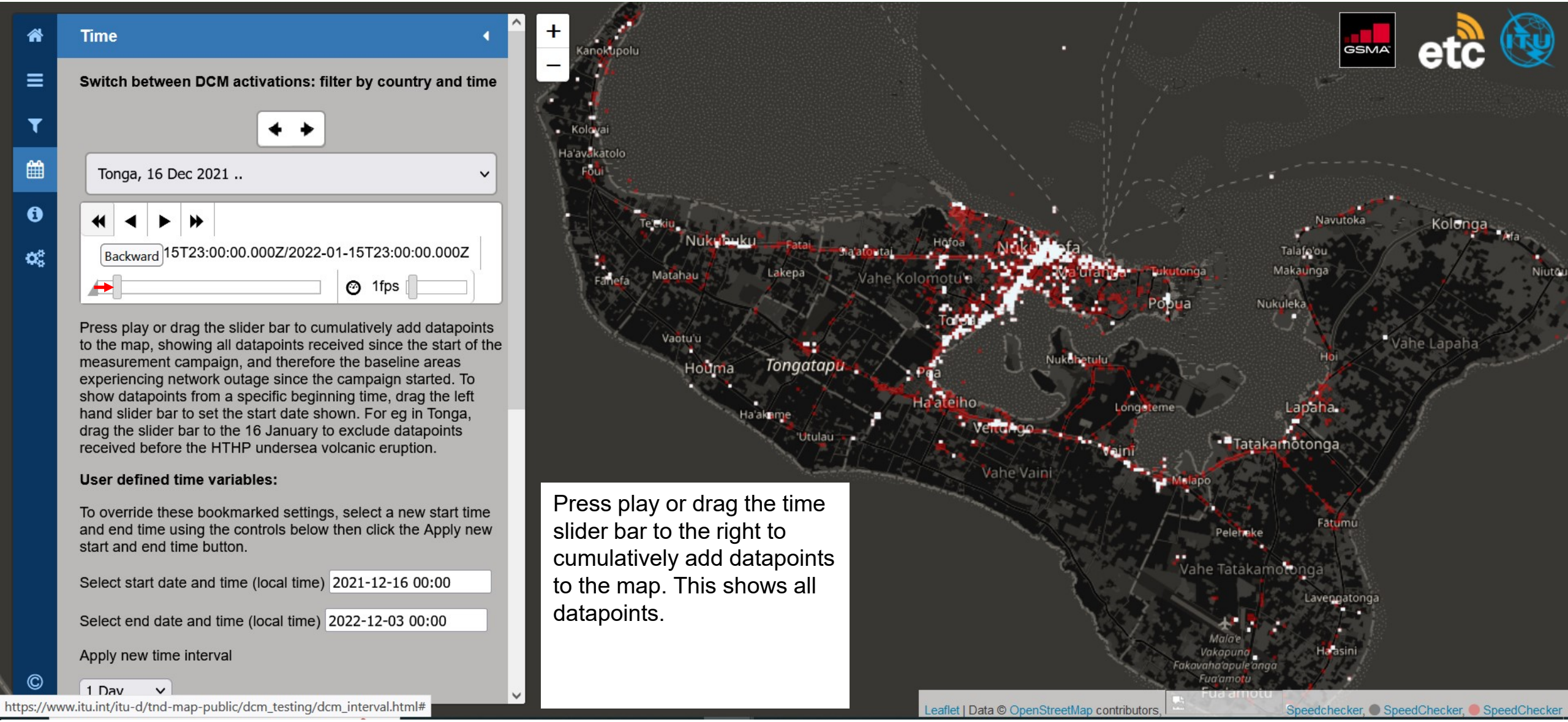
User defined time variables:
RIPE Atlas probe at USP (Universityof the South Pacific, Tonga campus)
Speedchecker datapoints per day, Tonga 16 Dec 2021 - 7 Feb 2022
Disconnected for 2hr 52 min
2021-12-22 03:40:23 - 2021-12-22 06:33:17 UTC
2021-12-22 16:40:23 - 2021-12-22 19:33:17 local time
Hunga-Tonga-Hunga- Ha-apai underwater volcano and tsunami, 15 Jan 2022 (17:00)
Disconnected since
2022-01-15 05:39:28 UTC
2022-01-15 18:39:28 local time
Speedchecker, SpeedChecker, SpeedChecker

Functionality improvements: Cumulatively add datapoints to the map



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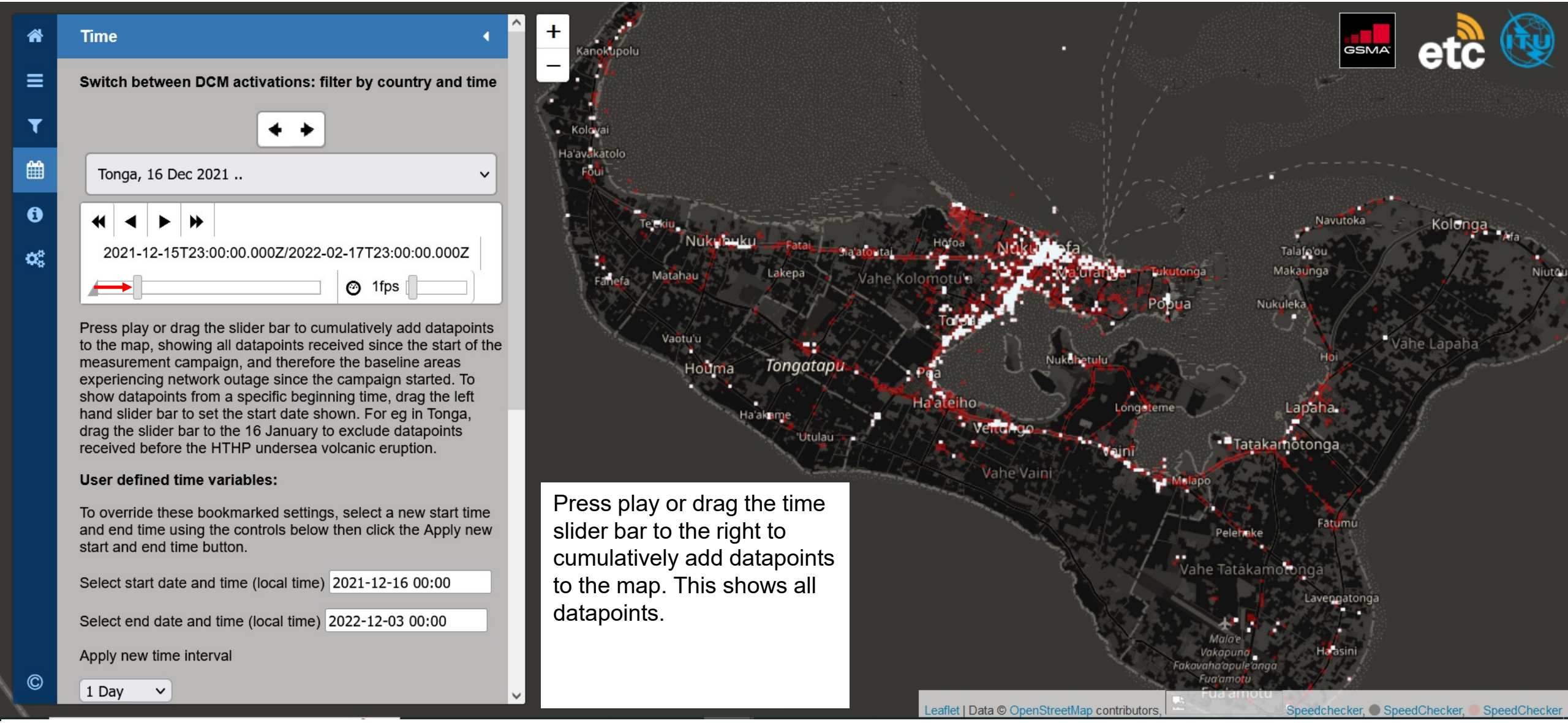

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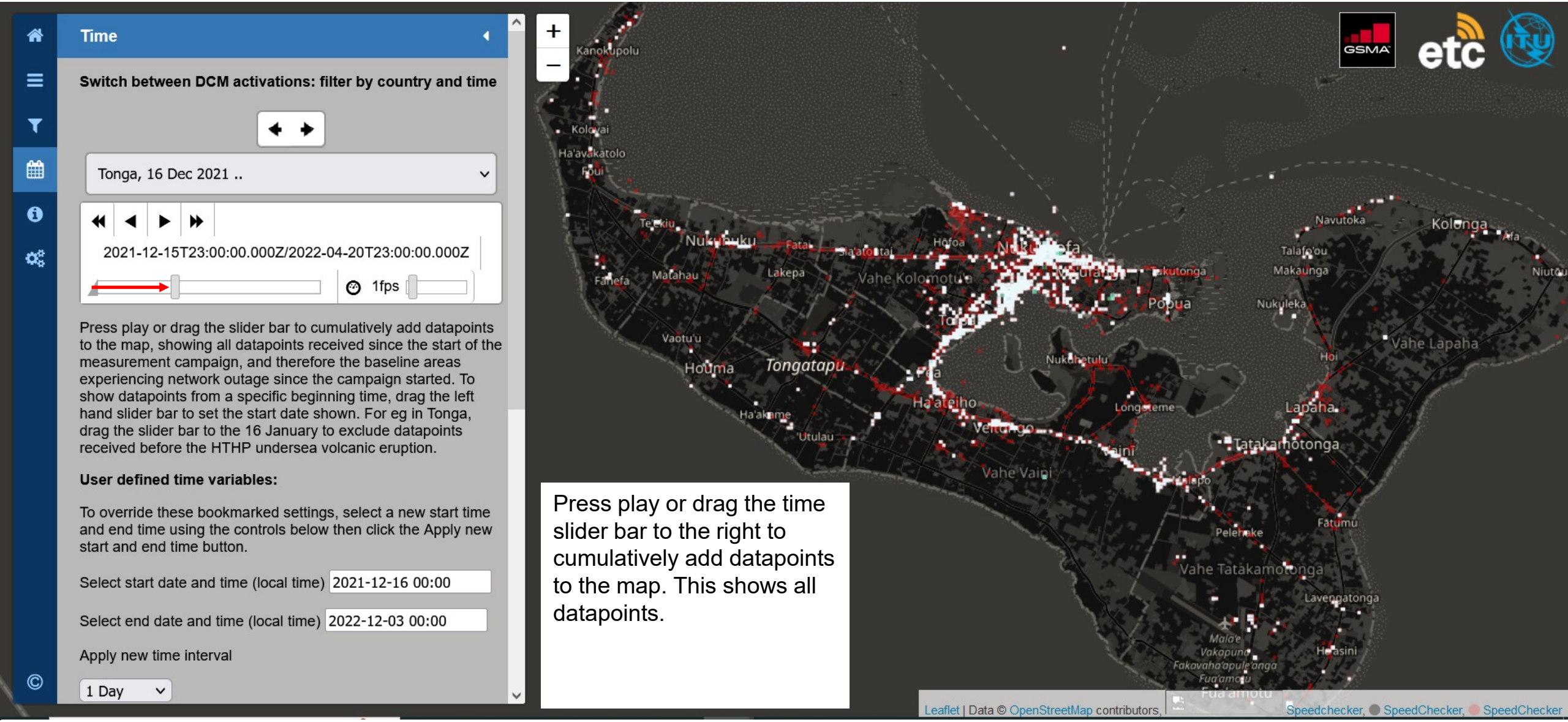

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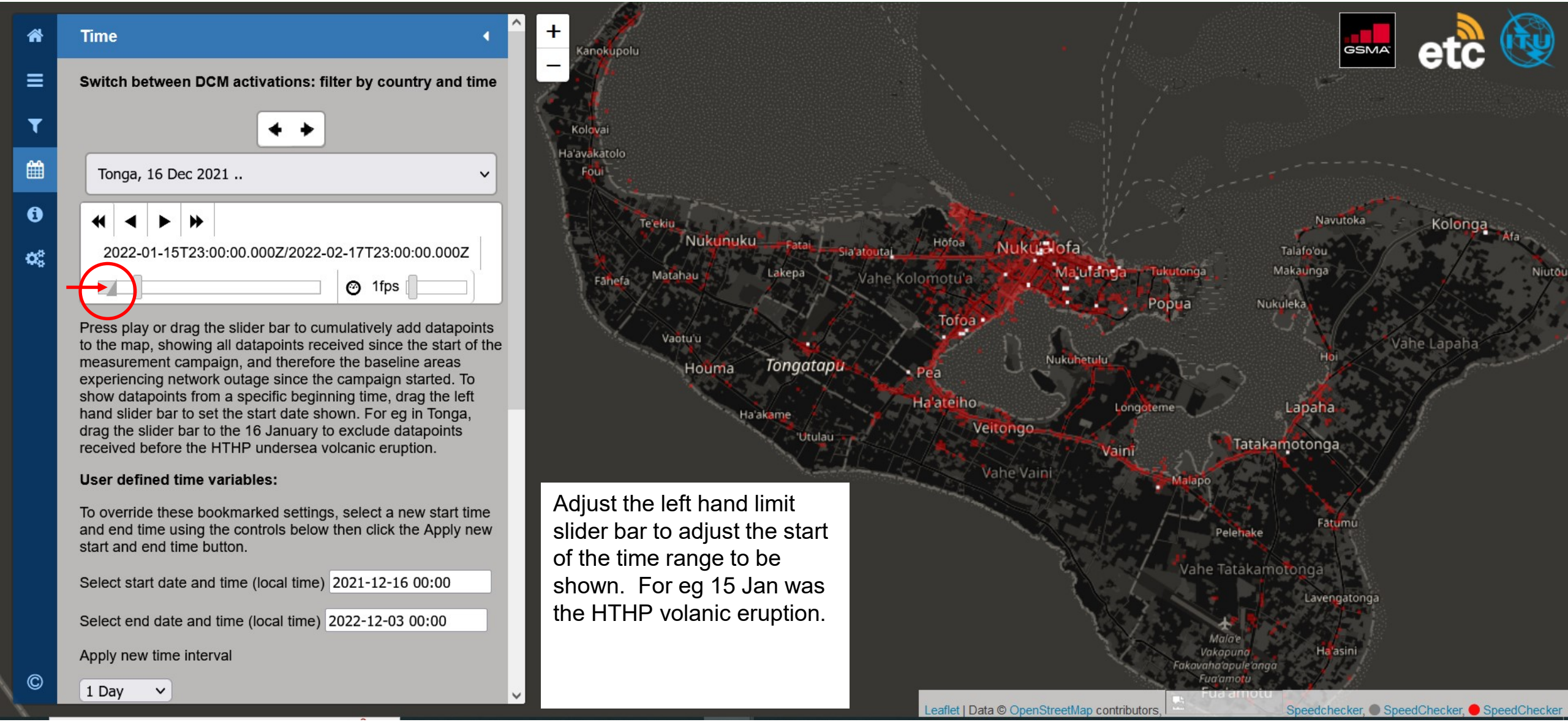
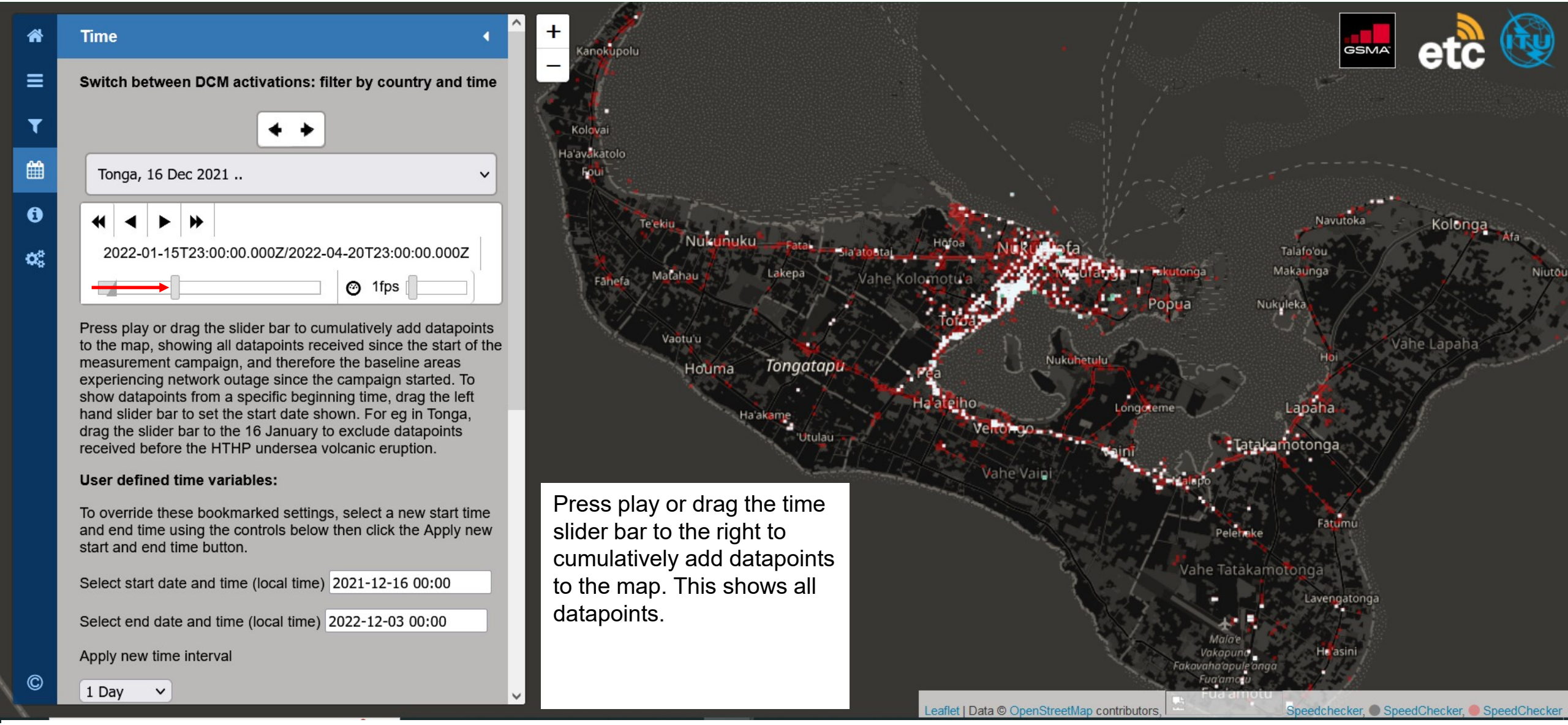
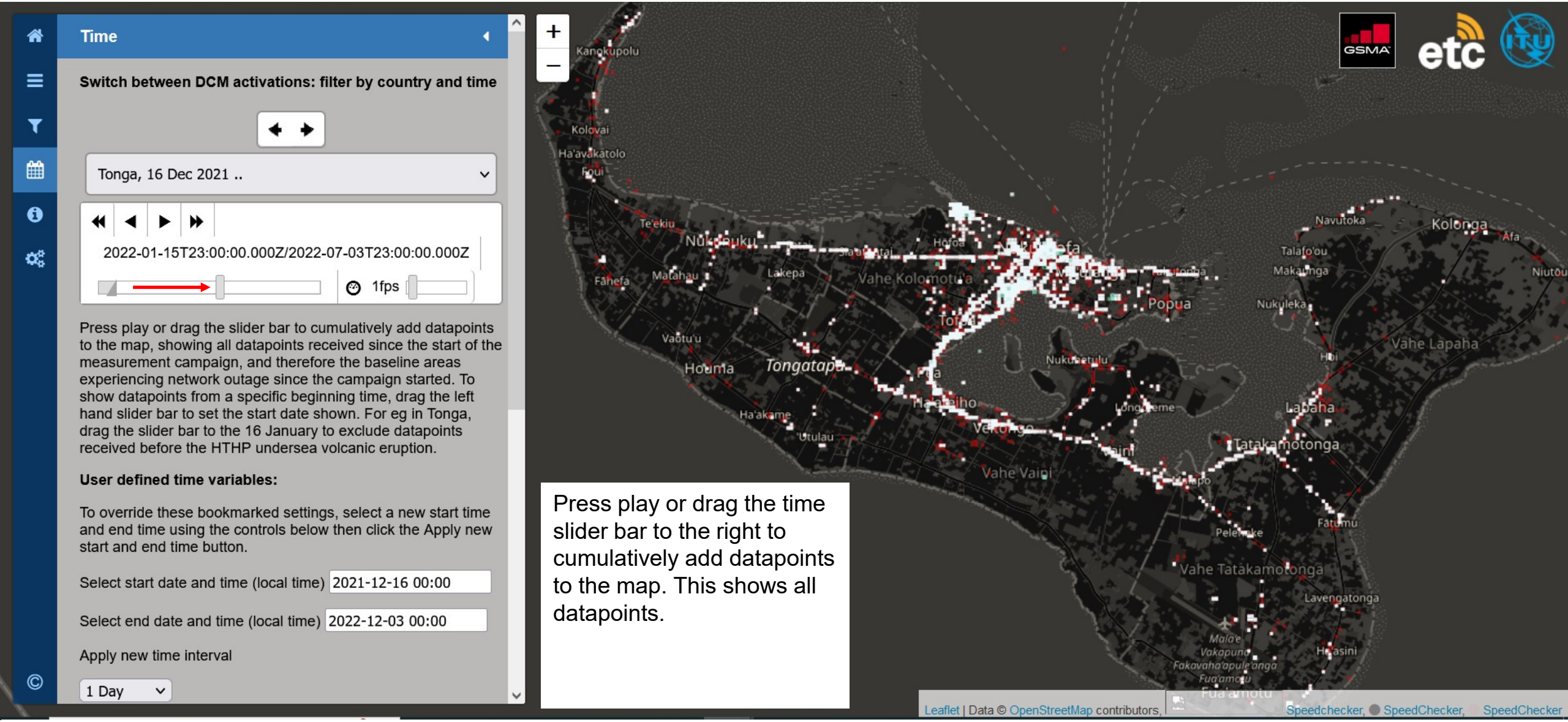


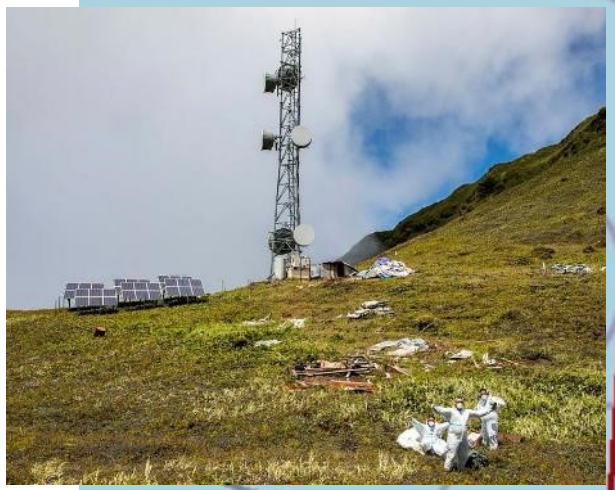
Adjust the left hand limit slider bar to adjust the start of the time range to be shown. For eg 15 Jan was the HTHP volanic eruption.

Functionality improvements: Cumulatively add datapoints to the map



Functionality improvements: Cumulatively add datapoints to the map





Case study: worlds longest microwave link (189-km).

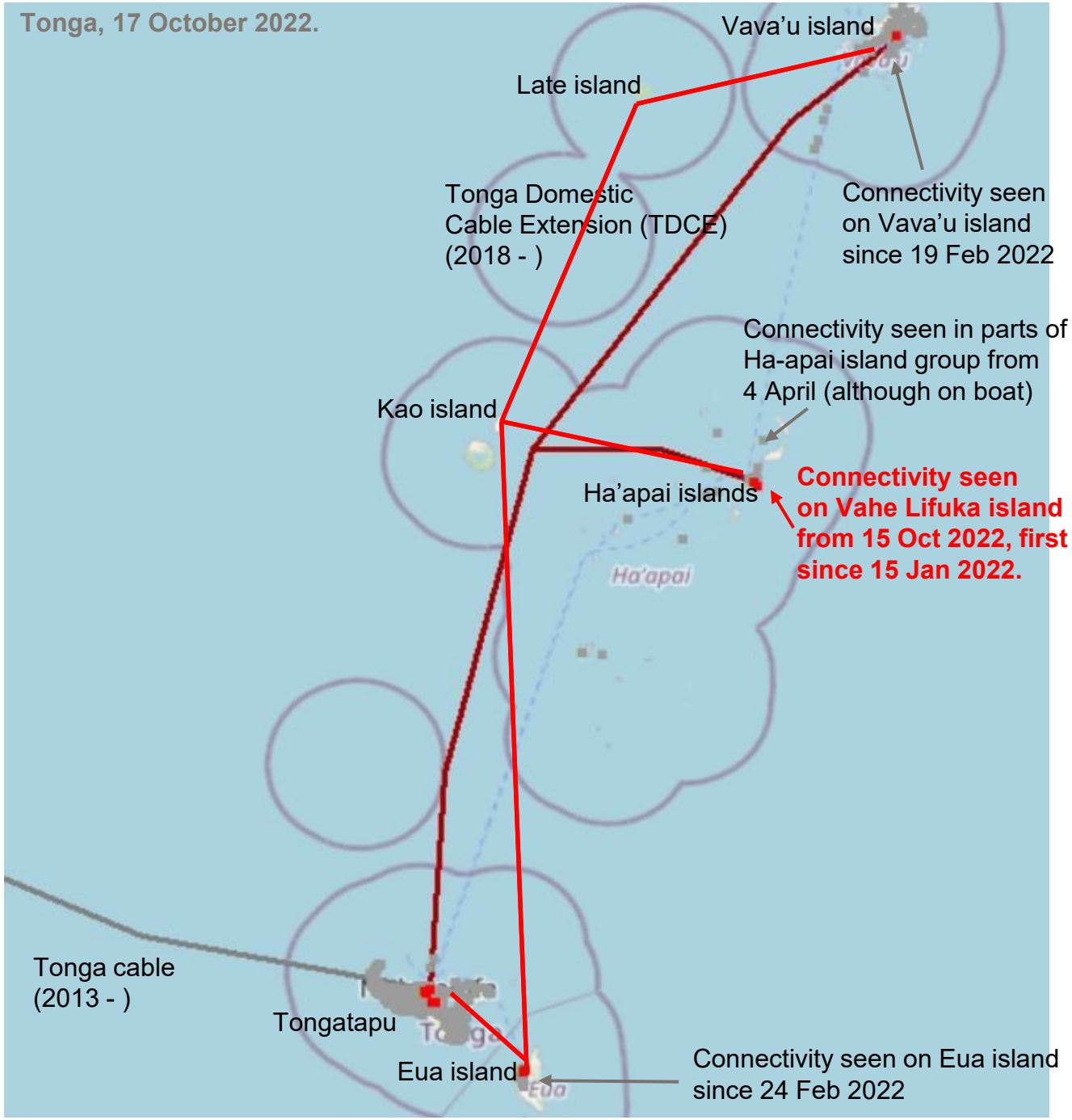
1. In 2016, Digicel and Aviat Networks deployed a microwave relay on Kao island to connect Tongatapu, Ha'apai and Vava'u island groups with a 189-km link. In 2018 the TDCE submarine cable entered service.

2. Line of site problems because the Ha'apai and Vava'u island groups are over the horizon from Tongatapu (28m high). Kao island is 1033-m high uninhabited extinct volcano, Eua island 312m high ridge, Late island 518m.

3. New link increased capacity to 200 Mbps (vs. 20 Mbps via satellite) and latency reduced to 5 milliseconds (vs. 500 milliseconds). Autonomous power supply on Kao island: solar, batteries, diesel generators.

4. After the HTHP eruption on 15 January 2022, the TDCE was badly damaged, and the microwave link also stopped working. Australian Defence Force (ADF) Chinook helicopter dropped off Digicel team for repairs.

5. In October 2022, Digicel announced USD 200,000 investment to upgrade microwave links on Kao


Tonga, 17 October 2022.
Vava'u island
Late island
Tonga Domestic
Cable Extension (TDCE)
(2018 -)
Connectivity seen
on Vava'u island
since 19 Feb 2022
Connectivity seen in parts of
Ha-apai island group from
4 April (although on boat)
Kao island
Ha'apai islands
Connectivity seen
on Vahe Lifuka island
from 15 Oct 2022, first
since 15 Jan 2022.
Ha'apai
Tonga cable
(2013 -)
Tongatapu
Eua island
Connectivity seen on Eua island
since 24 Feb 2022