

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.

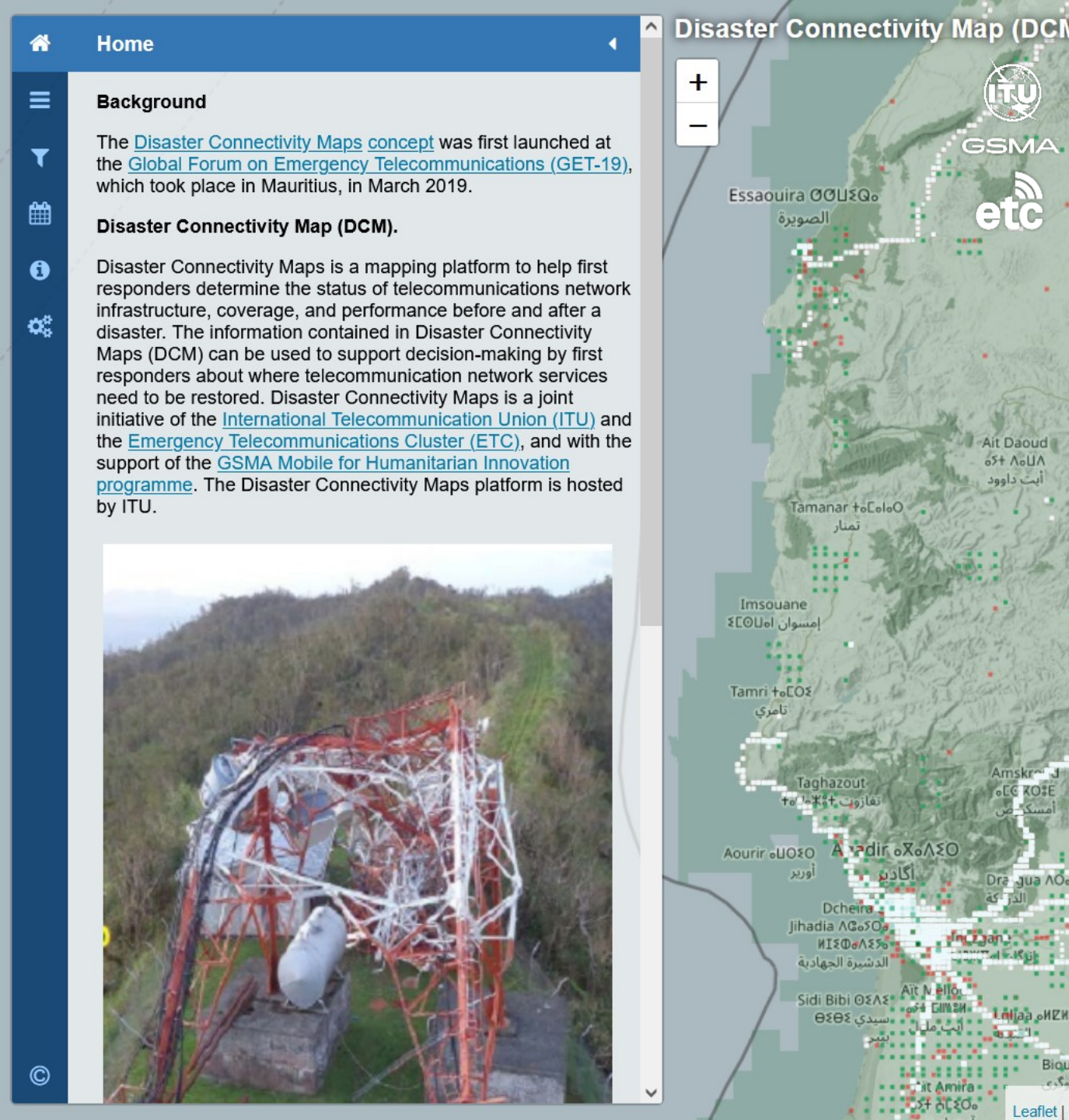


A screenshot of the Disaster Connectivity Map (DCM) web application. The interface has a dark blue sidebar on the left with navigation icons for Home, Background, and a map view. The main content area is titled 'Background' and contains text explaining the DCM concept, its launch at the GET-19 forum in March 2019, and its purpose as a mapping platform for first responders. Below the text is a photograph of a damaged telecommunications tower. On the right side of the interface is a map of Morocco, titled 'Disaster Connectivity Map (DCM)'. The map shows various locations with green and red dots indicating network status. Logos for ITU, GSMA, and etc are visible in the top right corner of the map area. The map also includes a zoom control (+/-) and a Leaflet logo at the bottom right.

Our solution

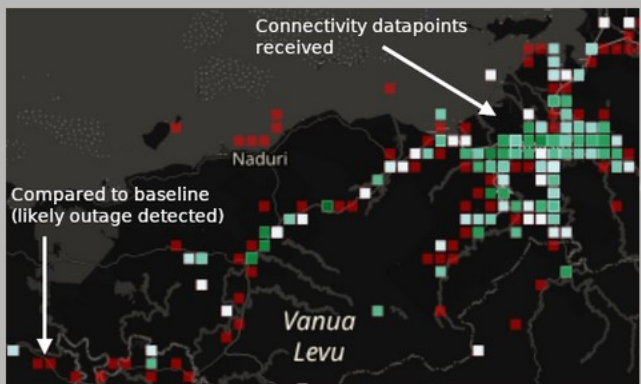
Our solution: A dynamic **mapping service** that shows where telecom network outages are happening in disaster affected areas.

- 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.





Connectivity Indicators

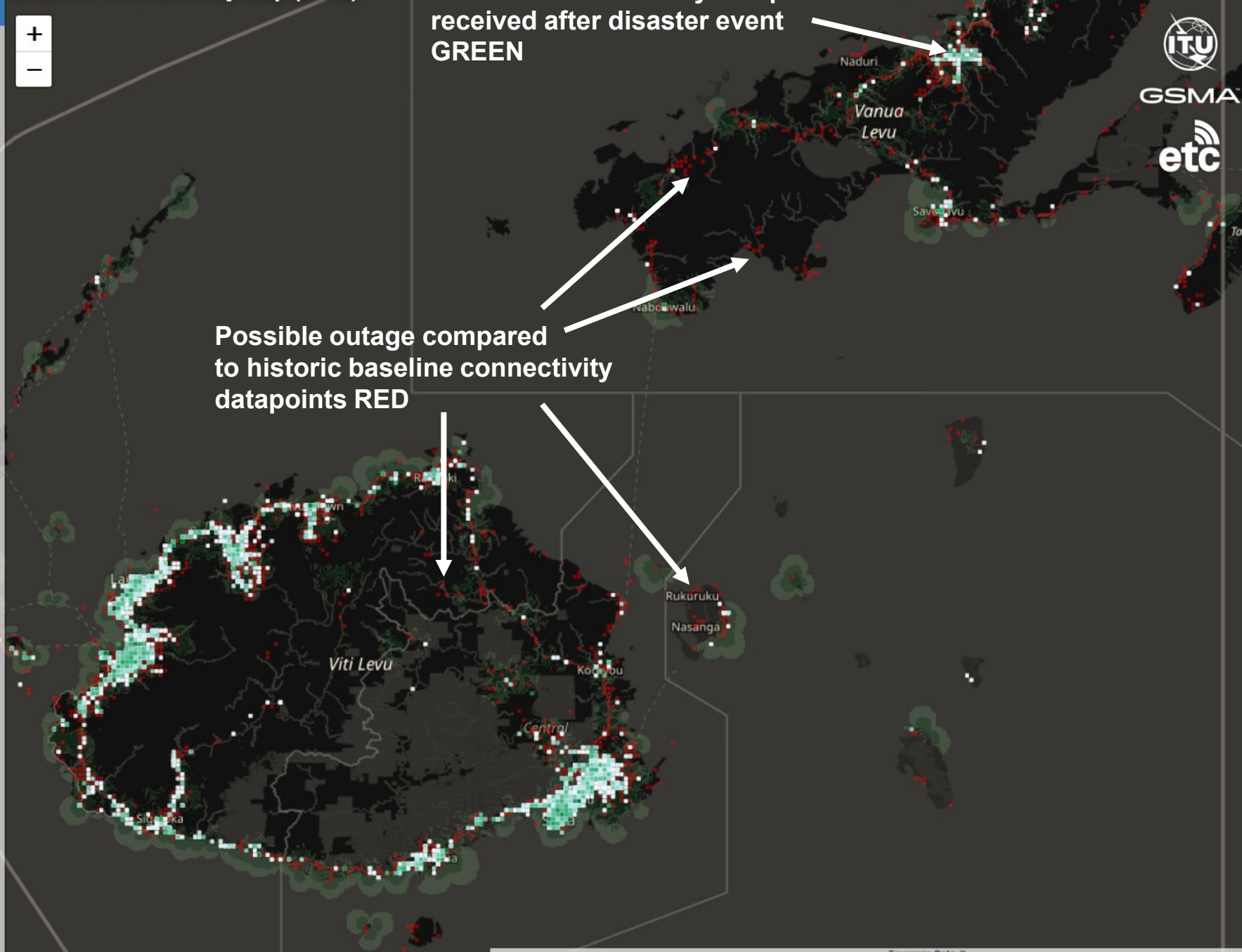


Select which connectivity measurement indicator to display.

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 Connectivity Map (DCM)



Real-time connectivity datapoints received after disaster event GREEN

Possible outage compared to historic baseline connectivity datapoints RED



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.



GSMA™



A screenshot of the Disaster Connectivity Map (DCM) web application. The interface has a dark blue sidebar on the left with navigation icons for Home, Background, and various map controls. The main content area is titled 'Home' and contains a 'Background' section with text explaining the DCM concept, its launch at the GET-19 forum in March 2019, and its purpose as a mapping platform for first responders. Below the text is a photograph of a damaged telecommunications tower. To the right of the text is a map of Morocco with various locations labeled in Arabic and French, including Essaouira, Ait Daoud, Tamar, Imsouane, Tamri, Taghazout, Aourir, Dcheira, Jihadia, Sidi Bibi, and Ait Amira. The map shows a network of green and red dots representing connectivity status. Logos for ITU, GSMA, and etc are visible in the top right corner of the map area. A 'Leaflet' logo is in the bottom right corner.

Data sources

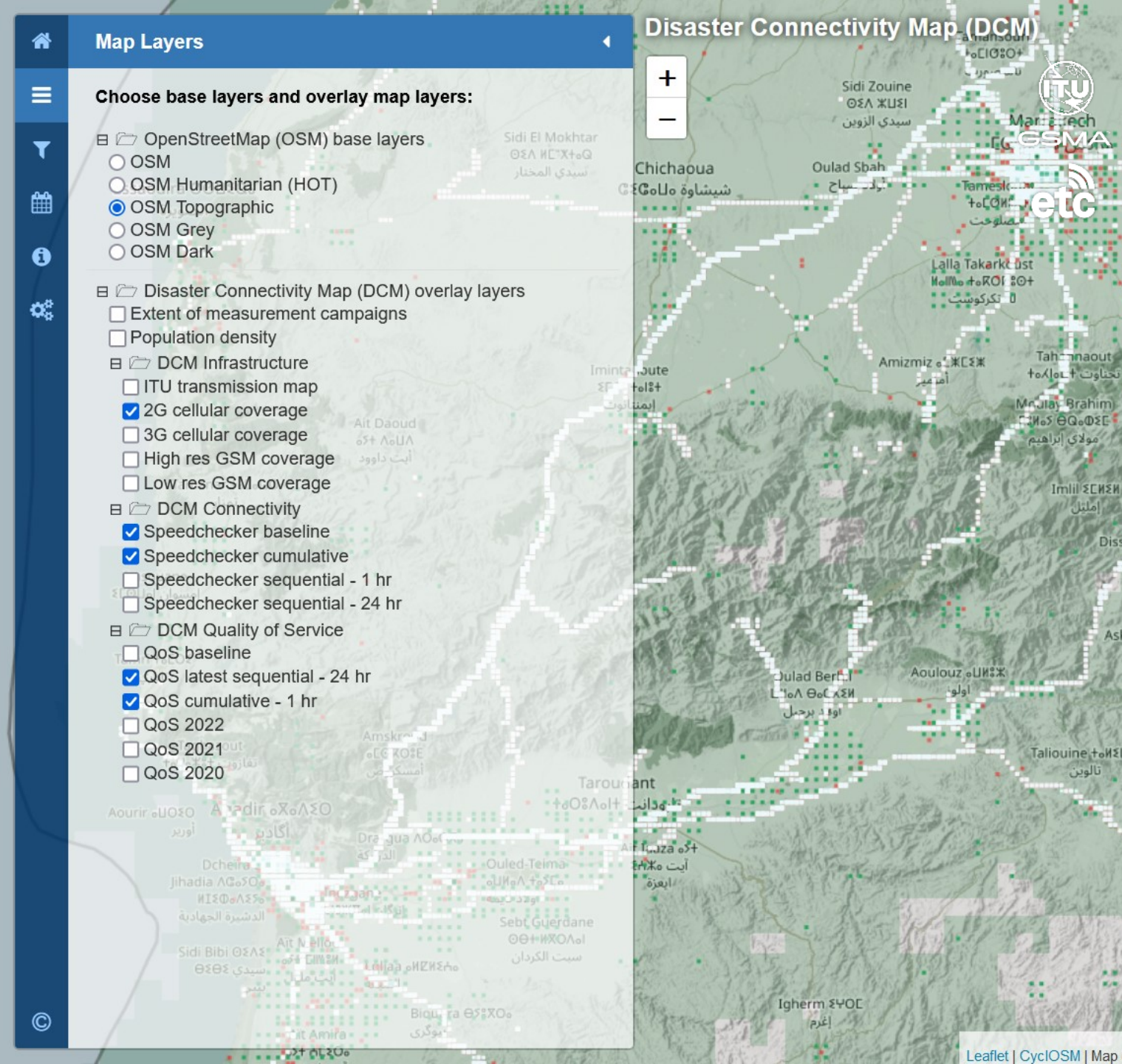
From the Map Layers tab

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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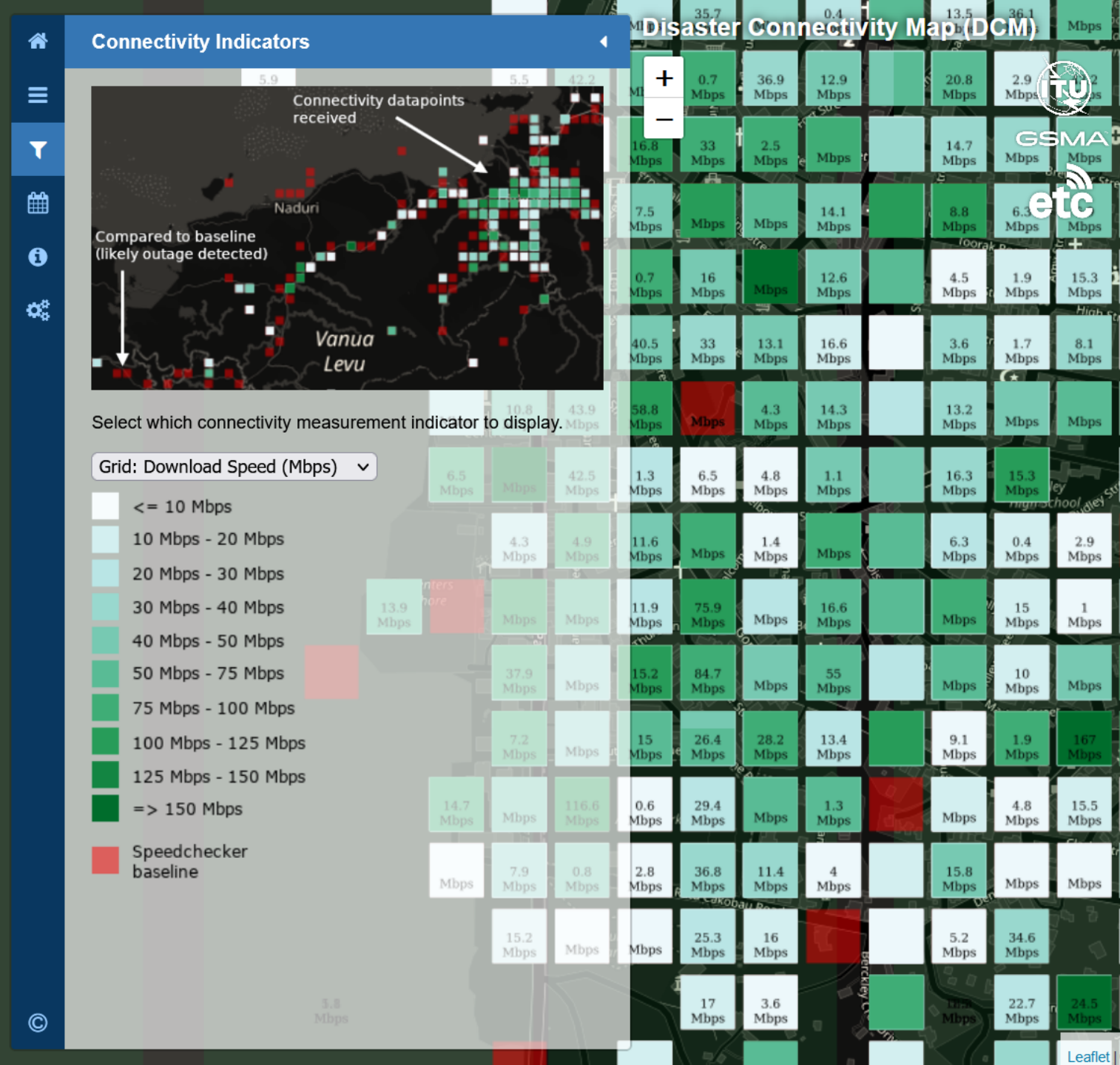
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Indicators

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

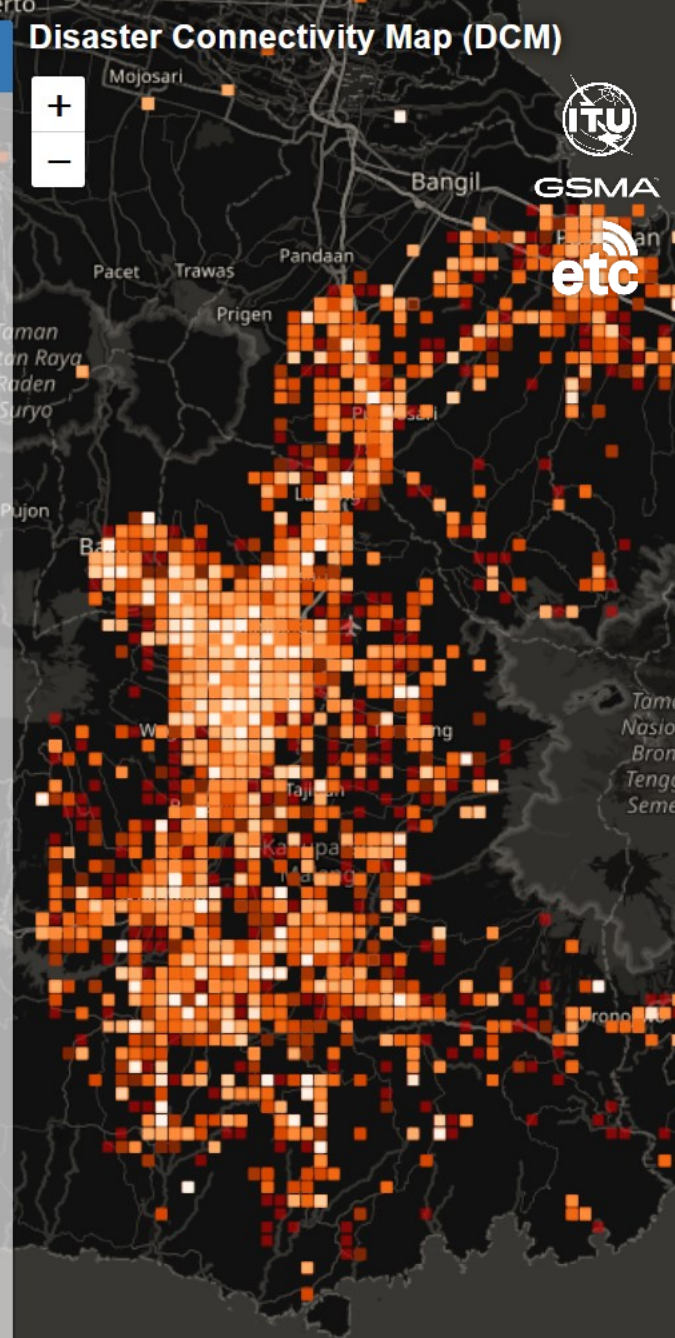
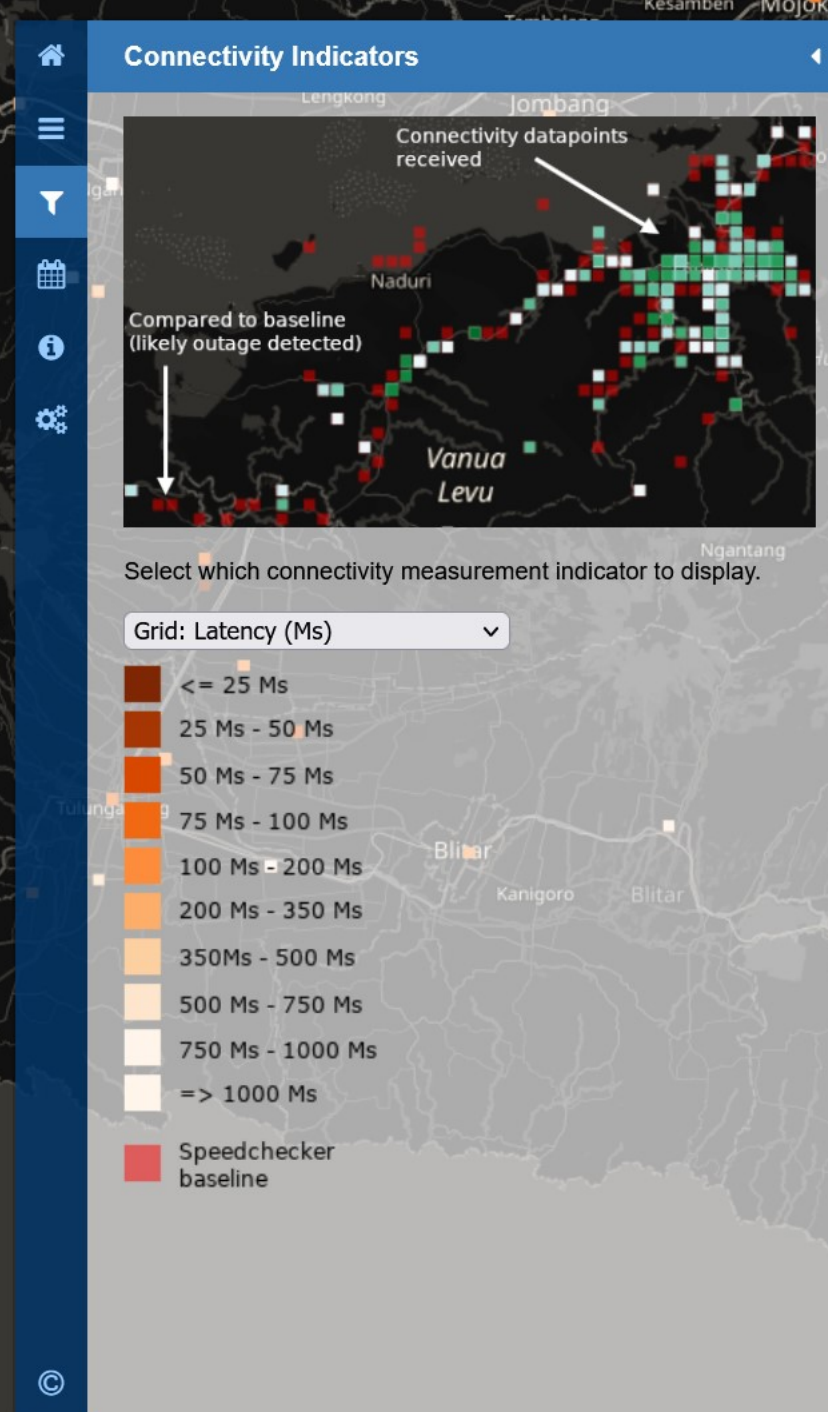


Indicators

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Activations

Activations

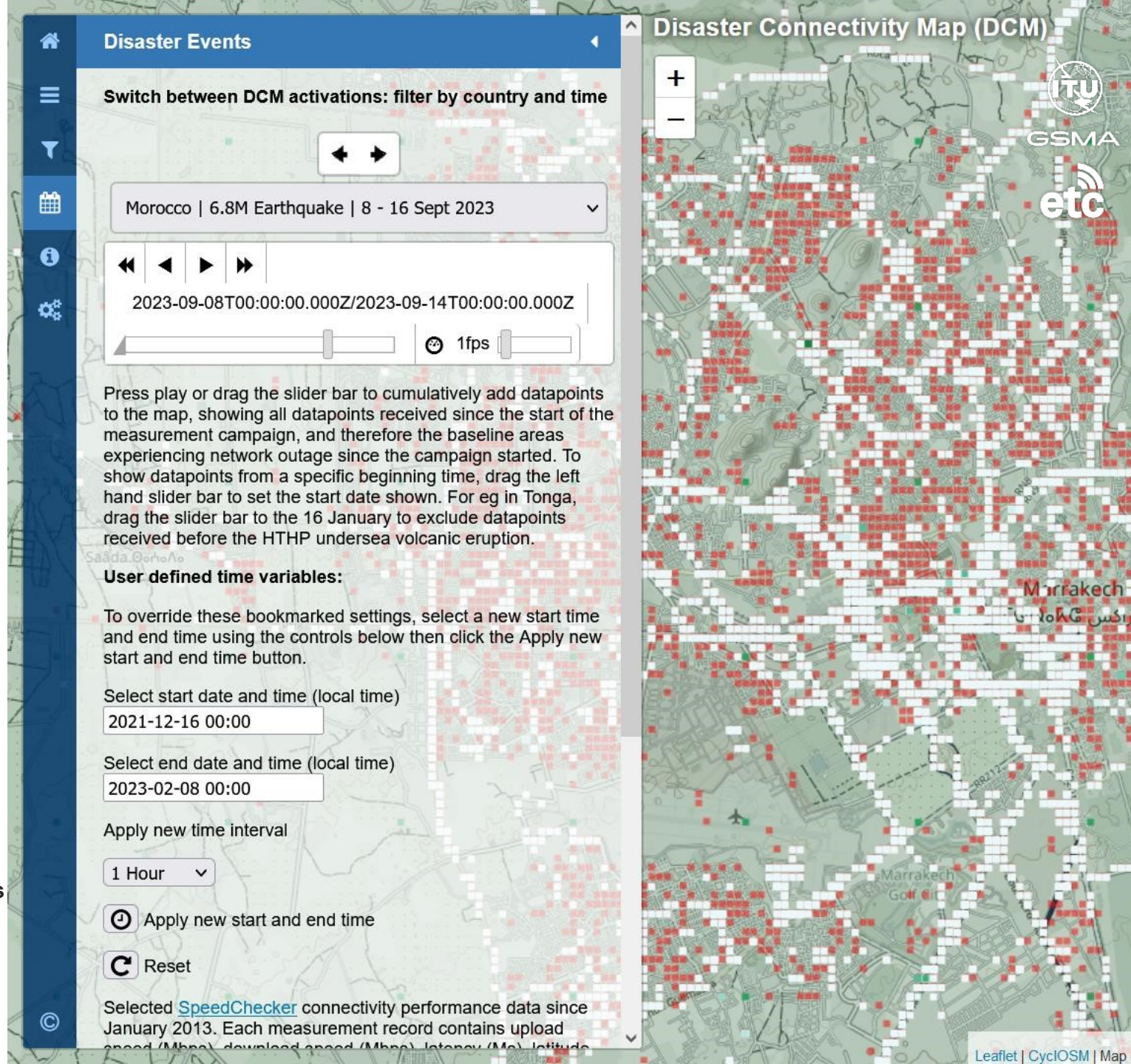
- Fiji 16 – 21 Dec 2020
- St Vincent & The Grenadines
- Barbados 15 – 23 Apr 2021
- St Lucia 15 – 23 Apr 2021
- Haiti 16 Aug – 14 Sept 2021
- Indonesia 8 – 13 Dec 2021
- Philippines Dec 2021 – Feb 2022
- Tonga 16 Dec 2021 – Feb 2023
- Pakistan 14 – 16 Aug 2022
- Dominican Rep. 19-27 Sept 2022
- Zimbabwe 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
- 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

Baseline campaigns

- Antigua & Barbuda June 2021
- Grenada 16 – 21 June 2021
- Kiribati 16 – 21 June 2021
- Micronesia 16 – 21 June 2021

Pilot countries, baseline campaigns

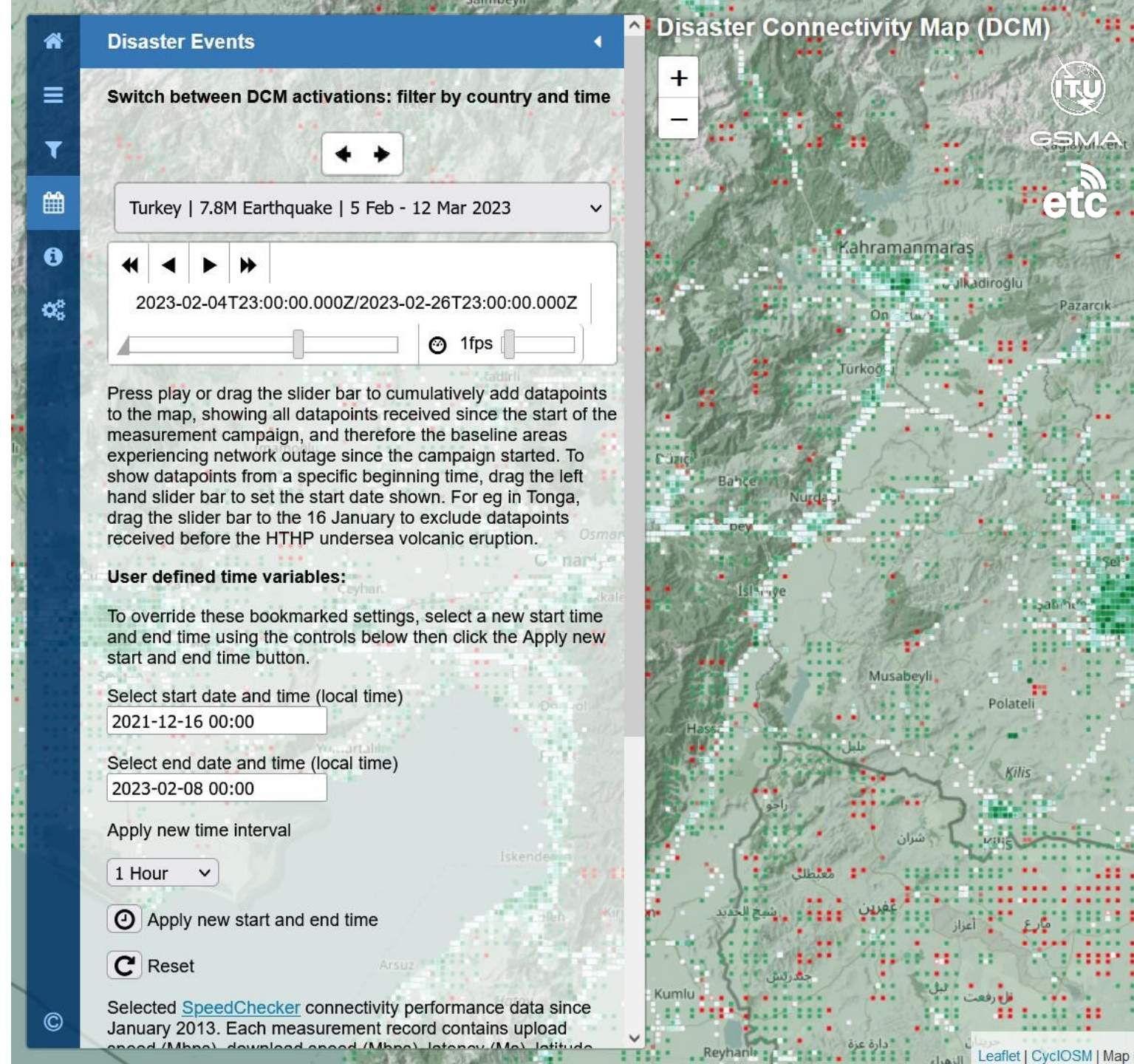
- Fiji 8 May 2020
- Dominica 8 May 2020
- Philippines 8 May 2020



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.

Settings

Home

Menu

Layers

Calendar

Info

Settings

Accessing DCM via desktop GIS software

The map layers published through the DCM Geoserver platform can be directly accessed in [WMS \(Web Map Service\)](#) format in desktop GIS software. More detailed notes are available in the [DCM User Guide \(July 2023\)](#). The worked example below uses [QGIS](#) desktop GIS software. Note that minimum QGIS version 3.14 is required for the Temporal Controller function.

Adding WMS map layers

In the Data Source Manager of QGIS, select the [WMS/ WMTS](#) option. Alternatively navigate to Layer – Add Layer – Add WMS/WMTS Layer, or use the keyboard shortcut Ctrl+Shift+W.

In the dialogue box that appears, select New to enter the parameters to create a new connection to the DCMs WMS server, enter the information below, and click OK. Then press Connect to load the available map layers. You can then browse the layers which are published, select a layer and click Add.

Name: **Disaster Connectivity Map (DCM)**
URL: https://dcm.itu.int/geoserver/dcm_prod/wms

No password is required for the publicly available map layers. Password protected content is exposed to authenticated users who enter their username and password.

Create a New WMS/WMTS Connection

Connection Details

Name

Disaster Connectivity Map (DCM)

URL

https://dcm.itu.int/geoserver/dcm_prod/wms

Authentication

Configurations

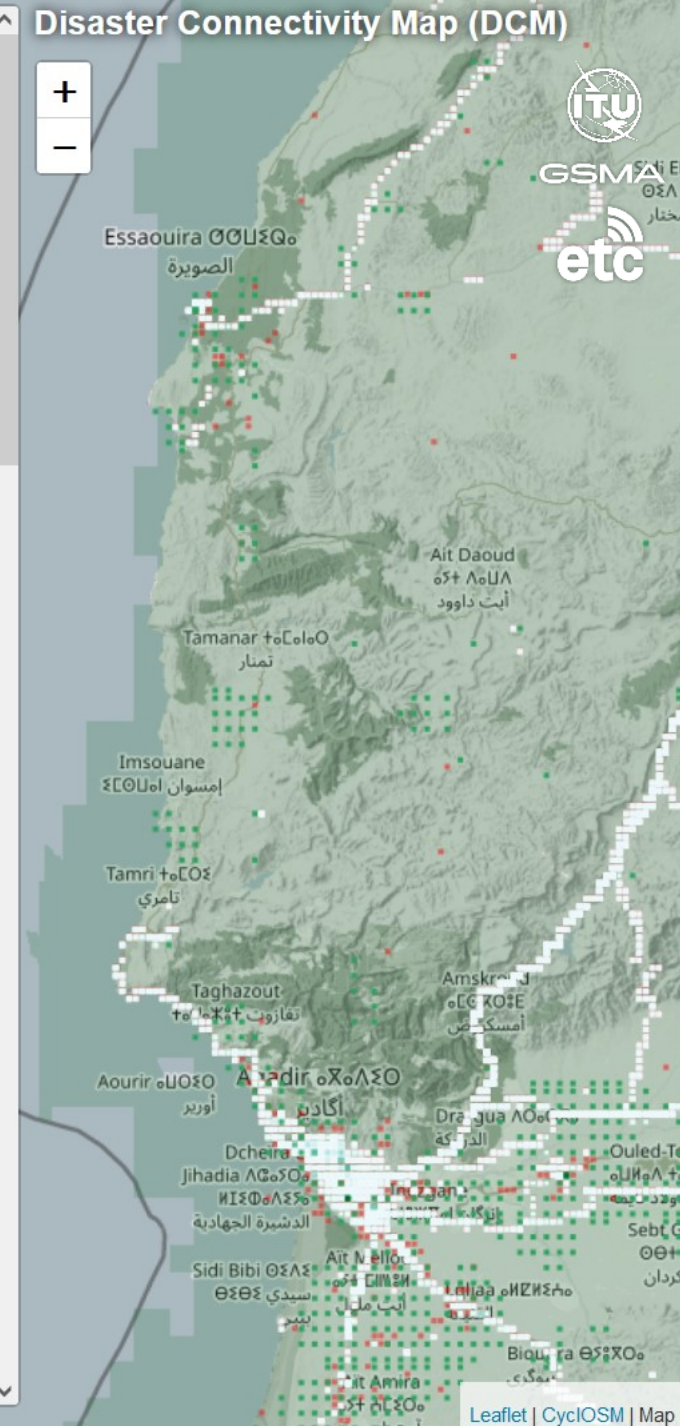
Basic

Choose or create an authentication configuration

No Authentication

Configurations store encrypted credentials in the QGIS authentication database.

Select connectivity indicator



Results

Complete outages

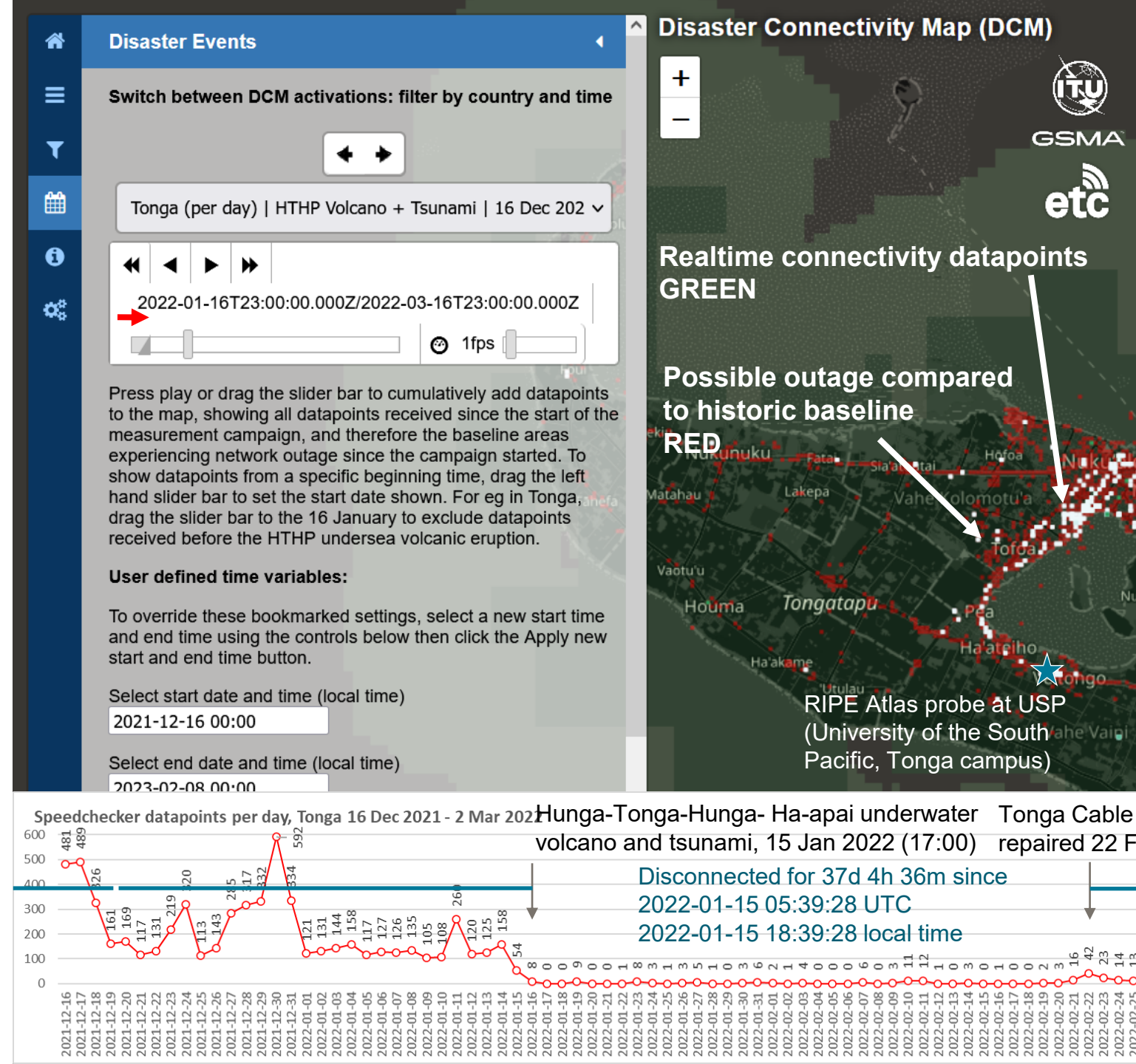
Tonga | Hunga Tonga-Hunga Ha'apai undersea volcanic eruption | 16 January 2022

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.

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, for eg 16 Jan 2022, drag the left hand slider bar to set the start date shown.



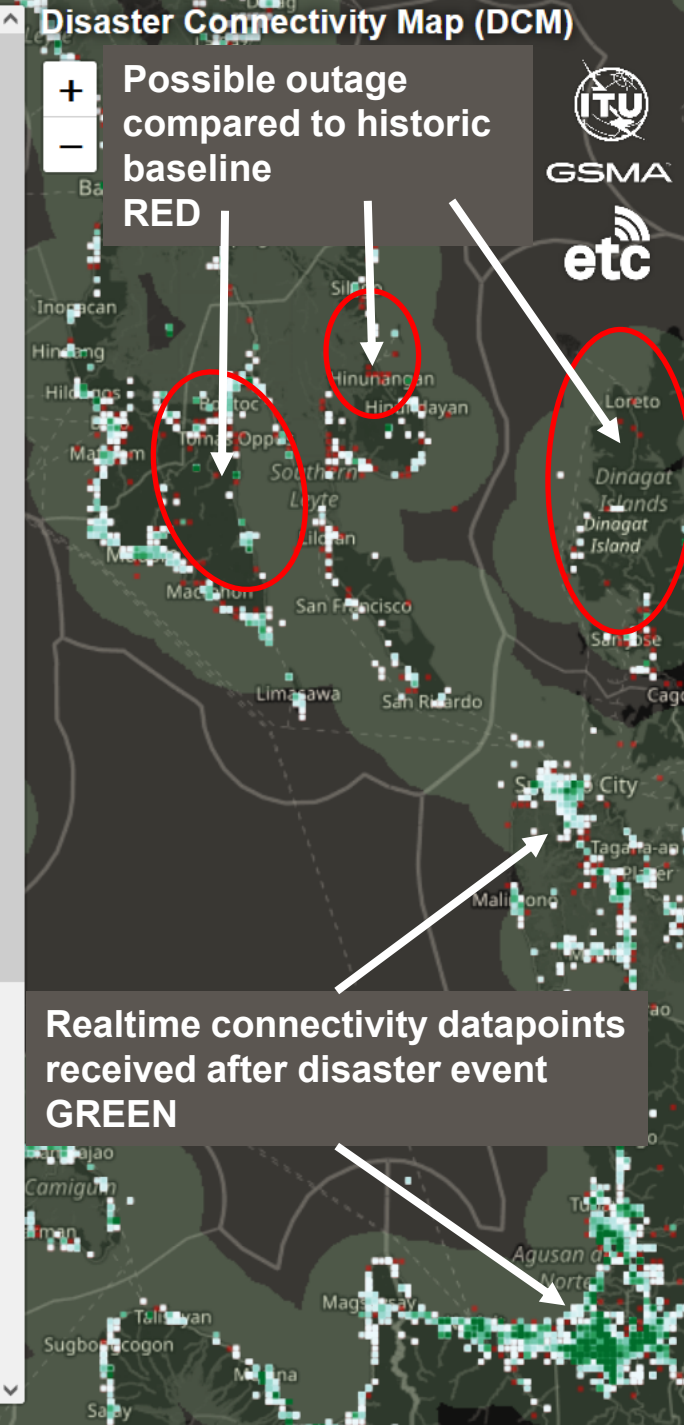
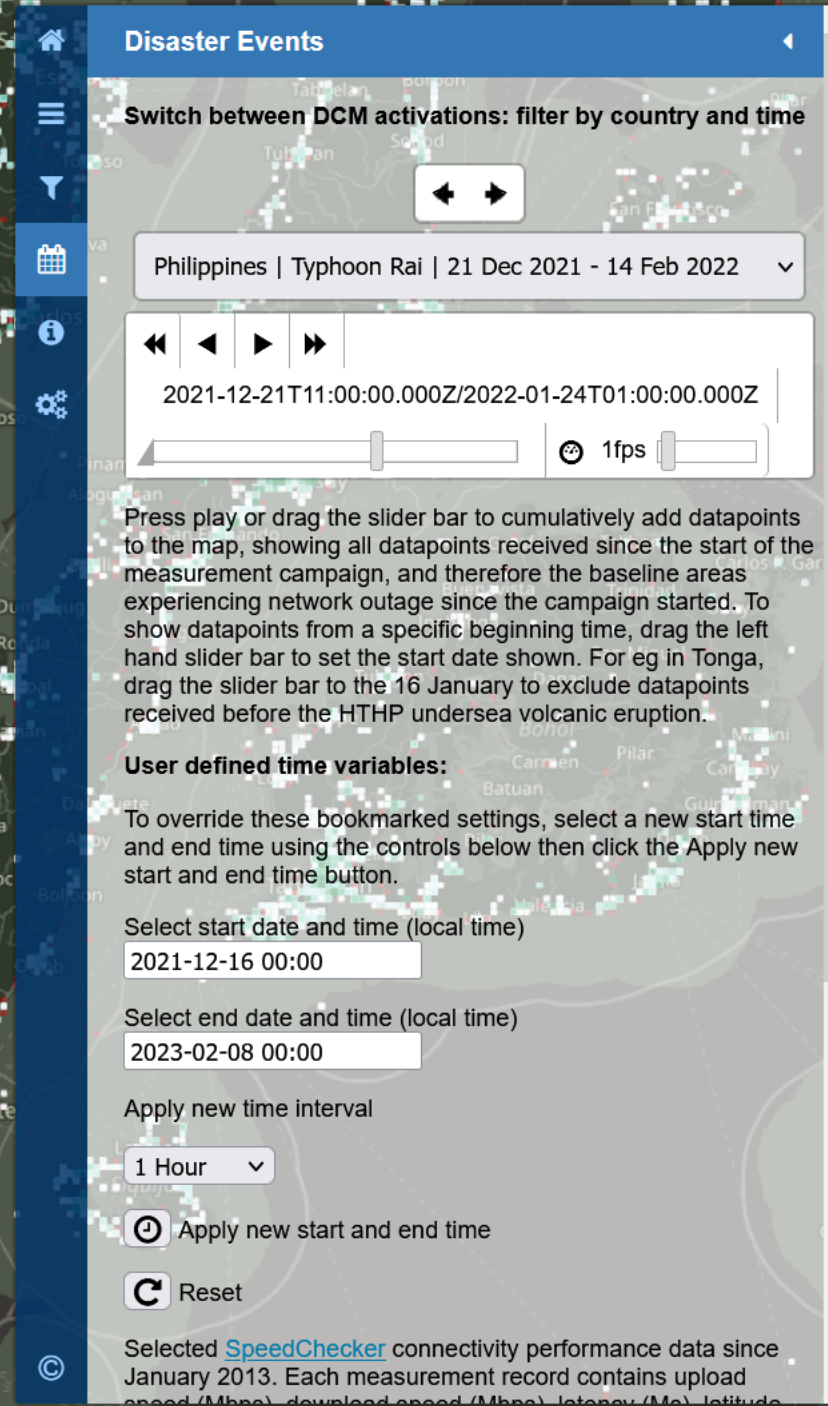
Results

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>



GSMA™



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Programme (WFP)
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Results

Complete outages

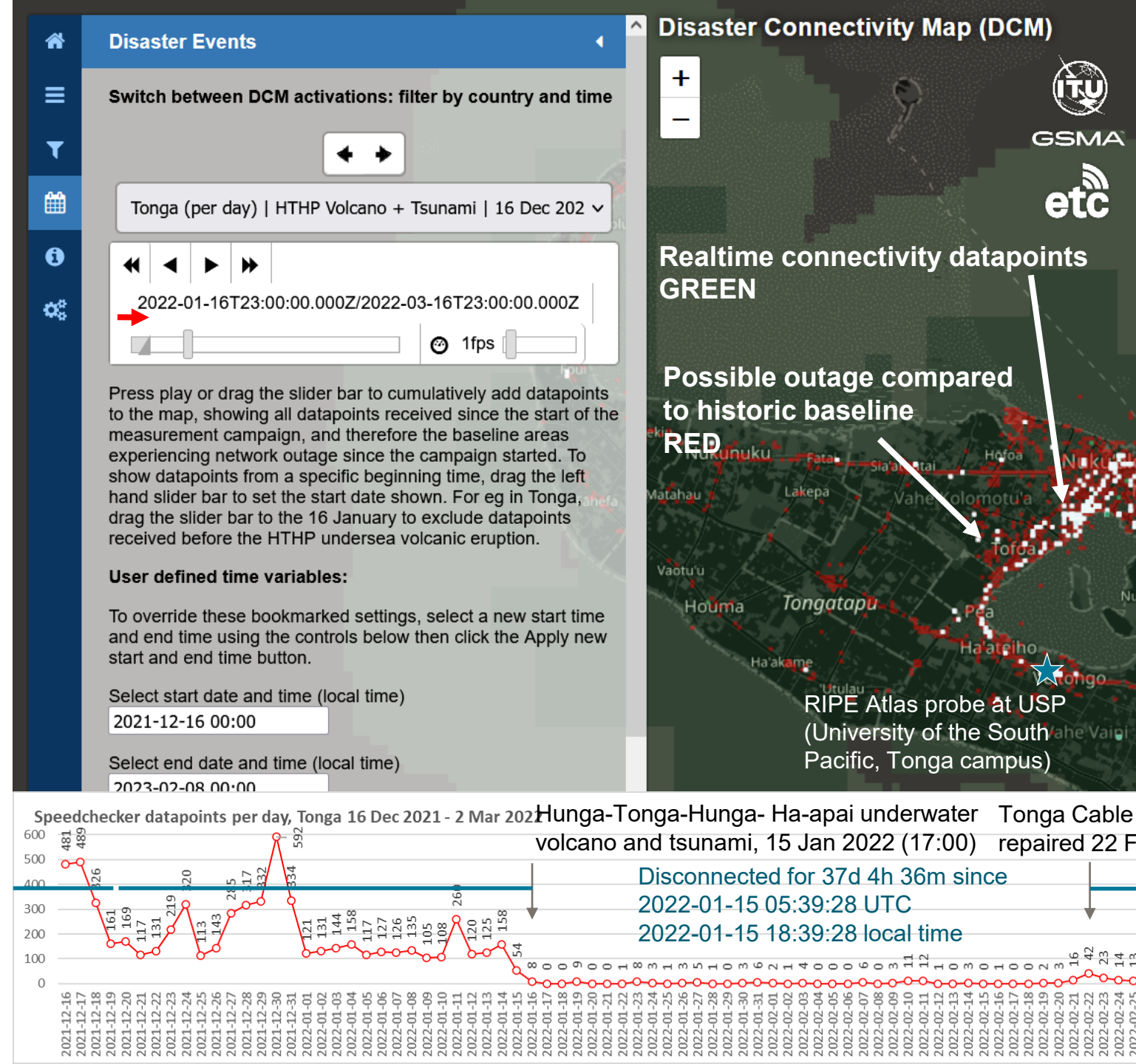
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Results

Complete outages

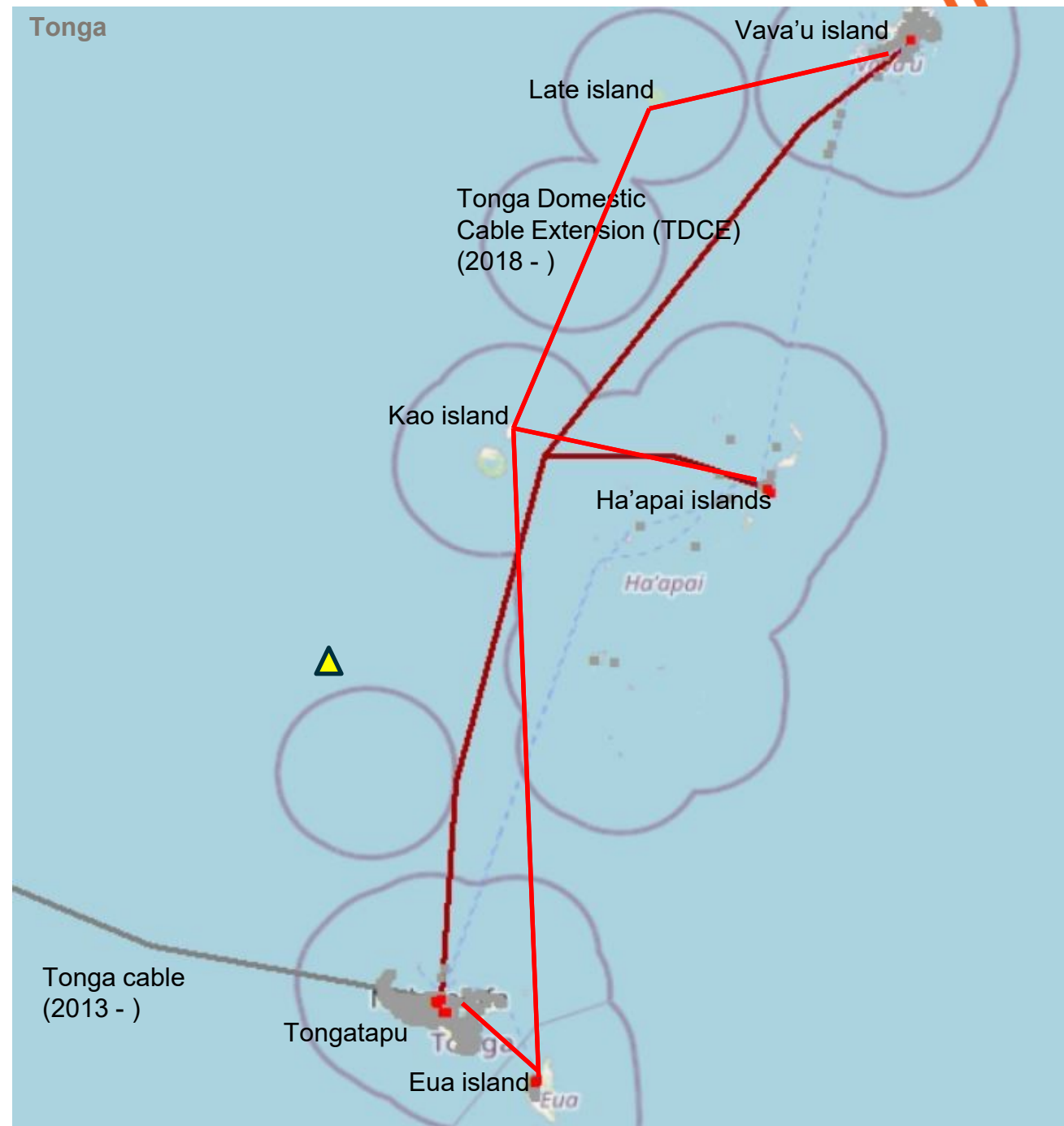
Tonga | Hunga Tonga-Hunga Ha'apai undersea volcanic eruption | 16 January 2022

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

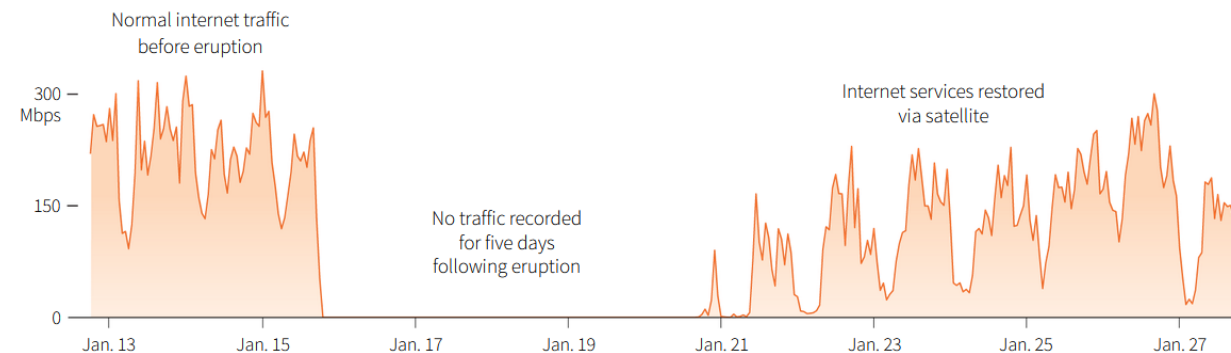
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To show datapoints from a specific beginning time, for eg 16 Jan 2022, drag the left hand slider bar to set the start date shown.



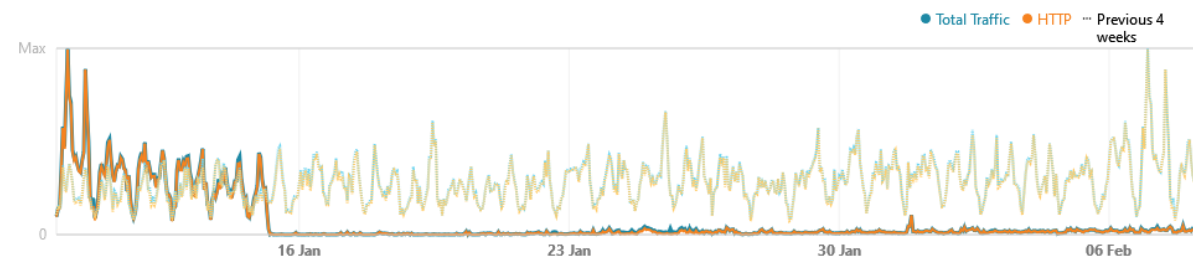
Internet traffic in Tonga



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.

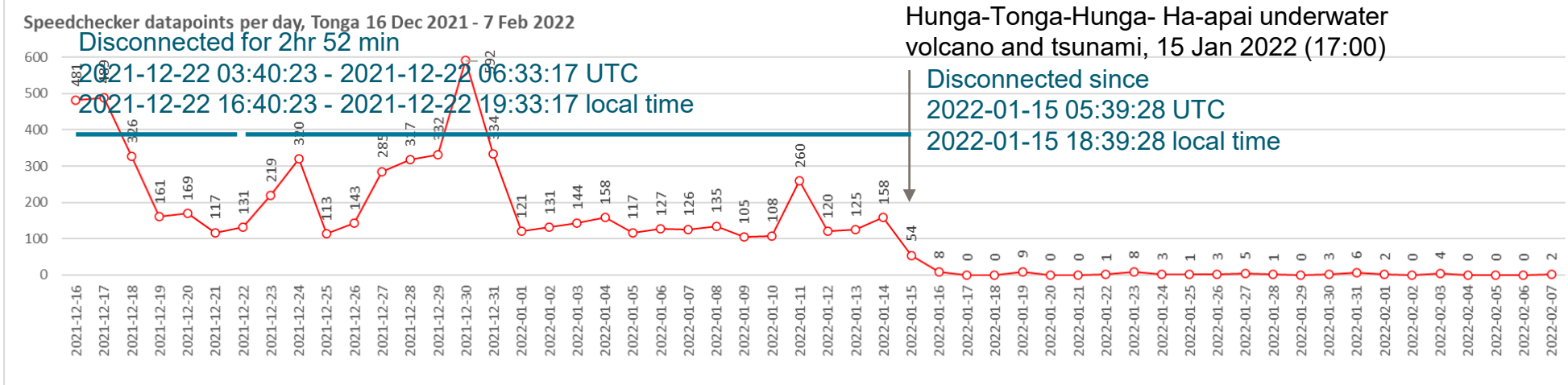
<https://graphics.reuters.com/TONGA-VOLCANO/znpnejbjov/>
<https://www.kentik.com/blog/tonga-downed-by-massive-undersea-volcano-eruption/>

Change in Internet Traffic in Tonga (Last 30 days)



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:

RIPE Atlas probe at USP (University of 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

Date	Datapoints
2021-12-16	481
2021-12-17	326
2021-12-18	161
2021-12-19	169
2021-12-20	117
2021-12-21	131
2021-12-22	219
2021-12-23	330
2021-12-24	113
2021-12-25	143
2021-12-26	285
2021-12-27	317
2021-12-28	332
2021-12-29	334
2021-12-30	332
2021-12-31	121
2022-01-01	131
2022-01-02	144
2022-01-03	158
2022-01-04	117
2022-01-05	127
2022-01-06	126
2022-01-07	135
2022-01-08	105
2022-01-09	108
2022-01-10	260
2022-01-11	120
2022-01-12	125
2022-01-13	158
2022-01-14	54
2022-01-15	8
2022-01-16	0
2022-01-17	0
2022-01-18	0
2022-01-19	9
2022-01-20	0
2022-01-21	0
2022-01-22	1
2022-01-23	8
2022-01-24	3
2022-01-25	1
2022-01-26	3
2022-01-27	5
2022-01-28	1
2022-01-29	0
2022-01-30	3
2022-01-31	6
2022-02-01	2
2022-02-02	0
2022-02-03	4
2022-02-04	0
2022-02-05	0
2022-02-06	0
2022-02-07	2

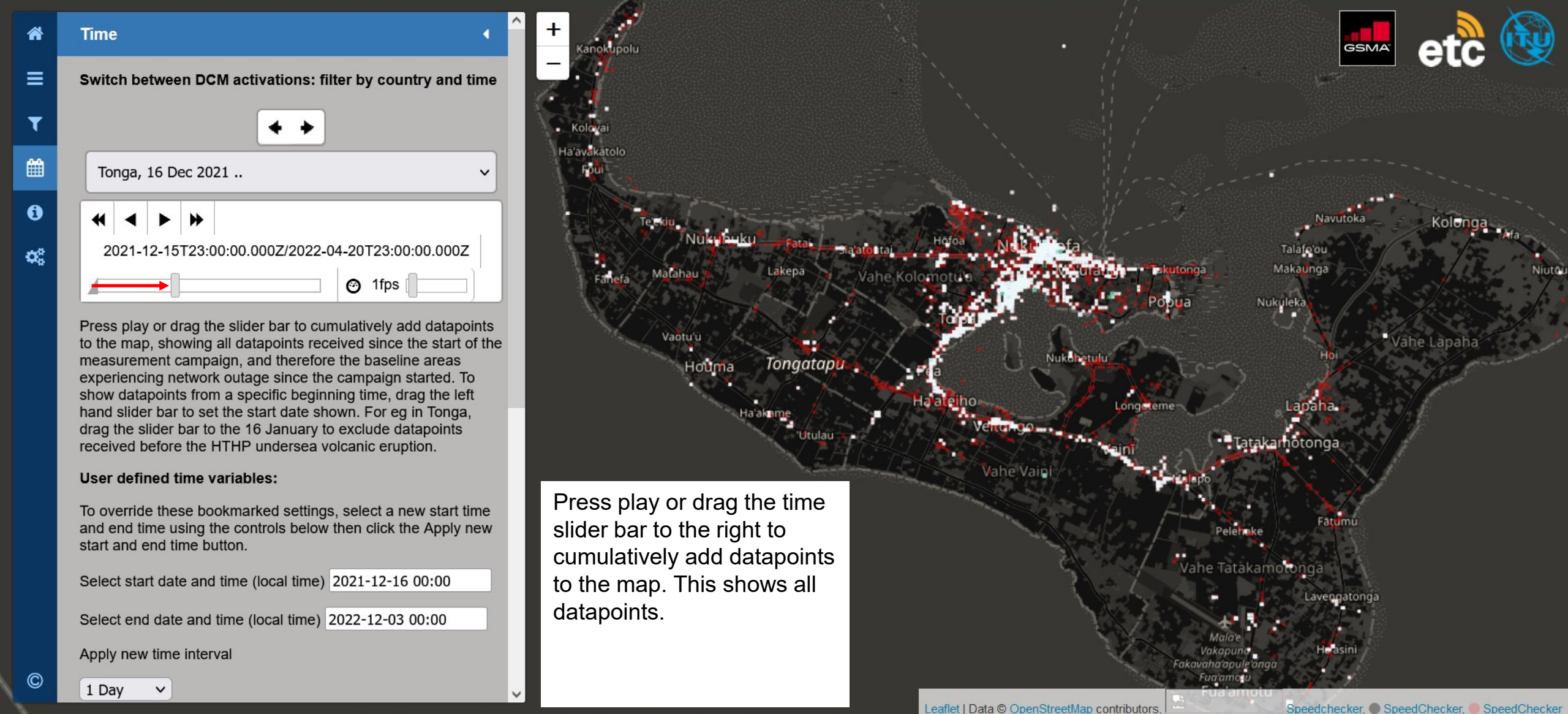
https://www.itu.int/itu-d/tnd-map-public/dcm_testing/dcm_interval.html#



Press play or drag the time slider bar to the right to cumulatively add datapoints to the map. This shows all datapoints.

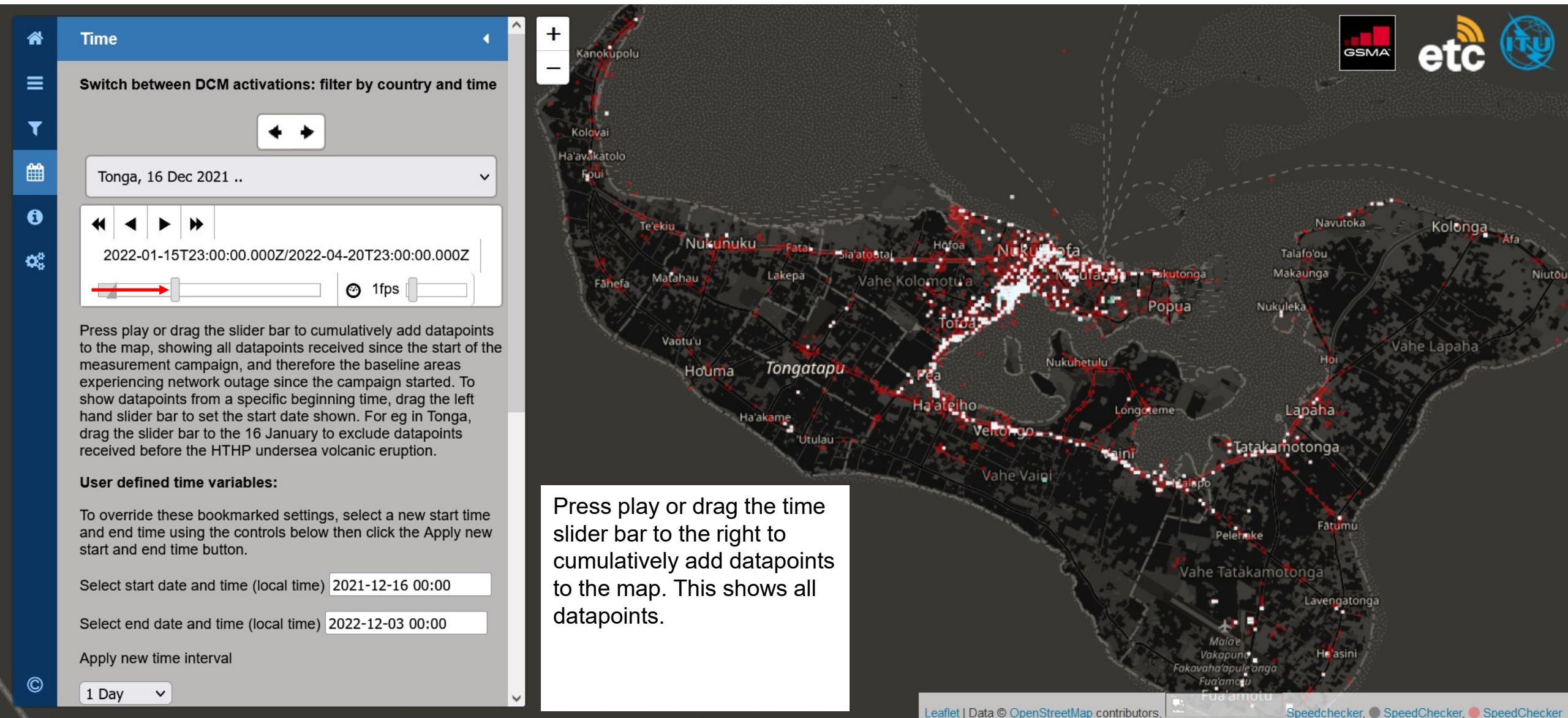
Press play or drag the time slider bar to the right to cumulatively add datapoints to the map. This shows all datapoints.

Functionality improvements: Cumulatively add datapoints to the map



[illegible]

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Leaflet | Data © OpenStreetMap contributors, Speedchecker, SpeedChecker, SpeedChecker



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.

