



Telecommunication Development Bureau (BDT)
International Telecommunications Union (ITU)

Disaster Connectivity Map

User Guide

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1. Introduction

This document describes how to use Disaster Connectivity Map (DCM). The Disaster Connectivity Map is a joint initiative of the International Telecommunications Union (ITU) and the Emergency Telecommunications Cluster (ETC), with the support of the GSM Association (GSMA). The Disaster Connectivity Map platform is hosted by the ITU.

The Disaster Connectivity Map platform displays geographic maps that show network infrastructure, network coverage, and connectivity performance before and after a disaster strikes. The maps are intended to be used by first responders that are deployed to re-establish communication networks after a disaster such as a cyclone, earthquake or flood. The maps are designed to be used as a decision-making tool in conjunction with other information to help first responders identify areas where communication services need to be restored.

The Disaster Connectivity Map (DCM) is a web map service (WMS) intended for use by partners in their own GIS services. The web map service can be used in desktop GIS applications and in JavaScript web maps.

2. Information displayed in the Disaster Connectivity Map

The DCM has two grouped WMS layers, **DCM infrastructure** and **DCM connectivity**, each containing a number of individual map layers and datasets:

- a. **DCM infrastructure:** network infrastructure and coverage, that includes physical features such as terrestrial fibre-optic links, microwave network links, mobile network coverage, submarine cables, and mobile cellular sites.
- b. **DCM connectivity:** connectivity performance, that includes connectivity measurements such as ping, latency, and throughput (download/upload).

3. Authentication

Most map layers in DCM are publicly available for all users, however, some layers are subject to data licence agreements or certain terms of use. When a user connects to the DCM's WMS server using their desktop GIS software, the user will be prompted to enter a username and password. Currently, nearly all of the content displayed in the DCM web map is publicly available. After successfully logging into the DCM platform, some content is available for all users, but other layers only become visible to particular user groups.

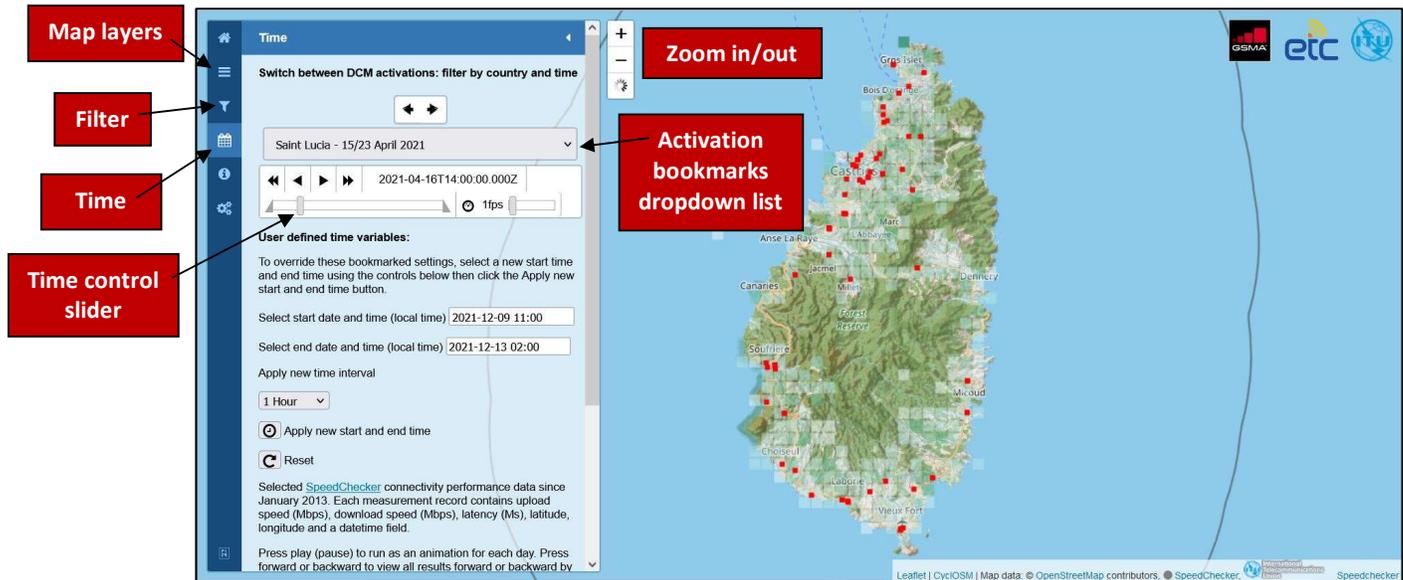
Three user groups (with separate usernames and passwords) have been pre-configured in the DCM platform if the need to password protect confidential data layers arises in the future. The user groups are: DCM_USER, DCM_CLOSED, and DCM_RESTRICTED. In addition, new user groups can be set up by DCM platform administrators as required on an ad hoc basis for particular countries or disaster events.

Authentication credentials to access the Disaster Connectivity Map platform are managed by the ITU. Platform access is limited so users will be informed if they are granted access after their access request is reviewed. To request access to Disaster Connectivity Maps, send an email to EETmail@itu.int

4. DCM web map application

The DCM web map is published at the following link:

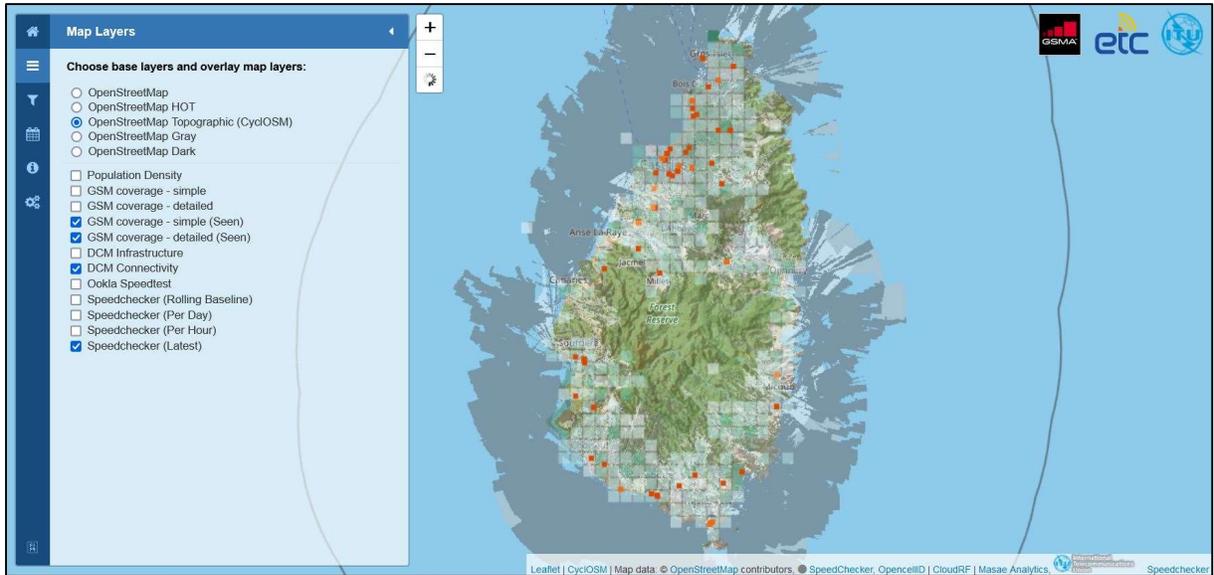
<https://dcm.itu.int>



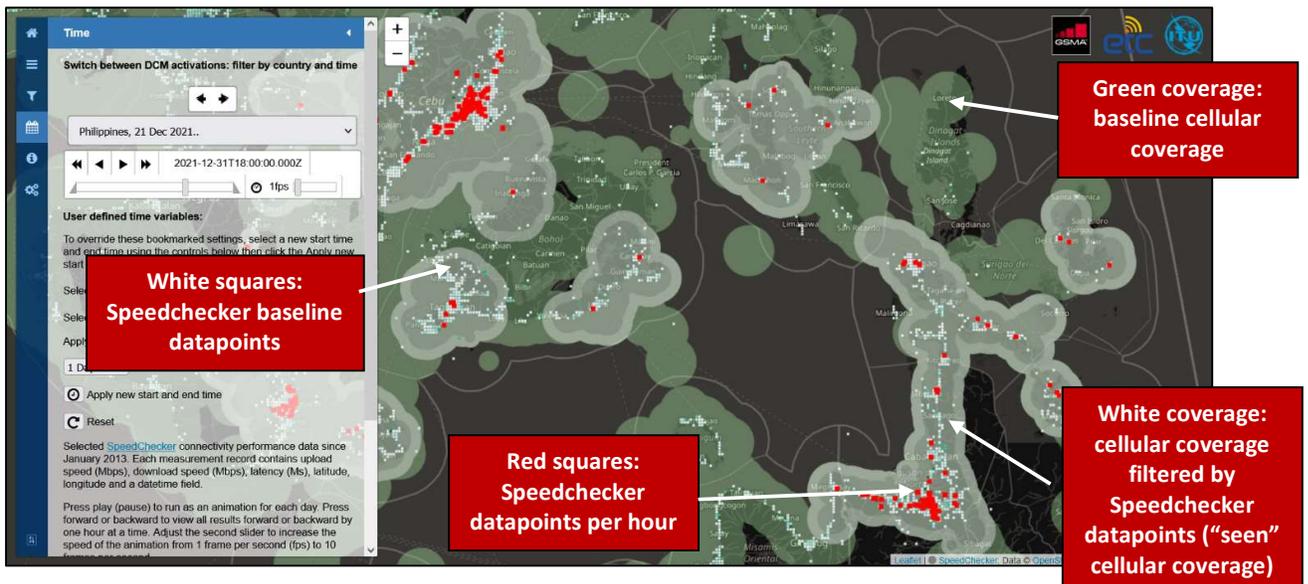
4.1 Map layers:

Select the 'map layers' button to toggle between different basemap and overlay layers. The basemap options include OpenStreetMap (OSM), Humanitarian OpenStreetMap (HOTOSM), and the topographic OSM basemap used by CycLOSM. There are also grey and dark versions of the OSM basemap to provide high contrast against other map layers. The overlay layers include DCM connectivity, DCM infrastructure, mobile network coverage, and population density.

High resolution cellular coverage: The mobile network coverage displayed in the DCM map is produced using mobile network operator (MNO) data if it is available, and using OpenCellID data as a backup. The coverage map is produced at two scales, a low resolution coverage for scales when zoomed out beyond 1: 300,000, and a high resolution coverage using radio frequency (RF) propagation model for scales when zoomed in closer than 1:300,000.

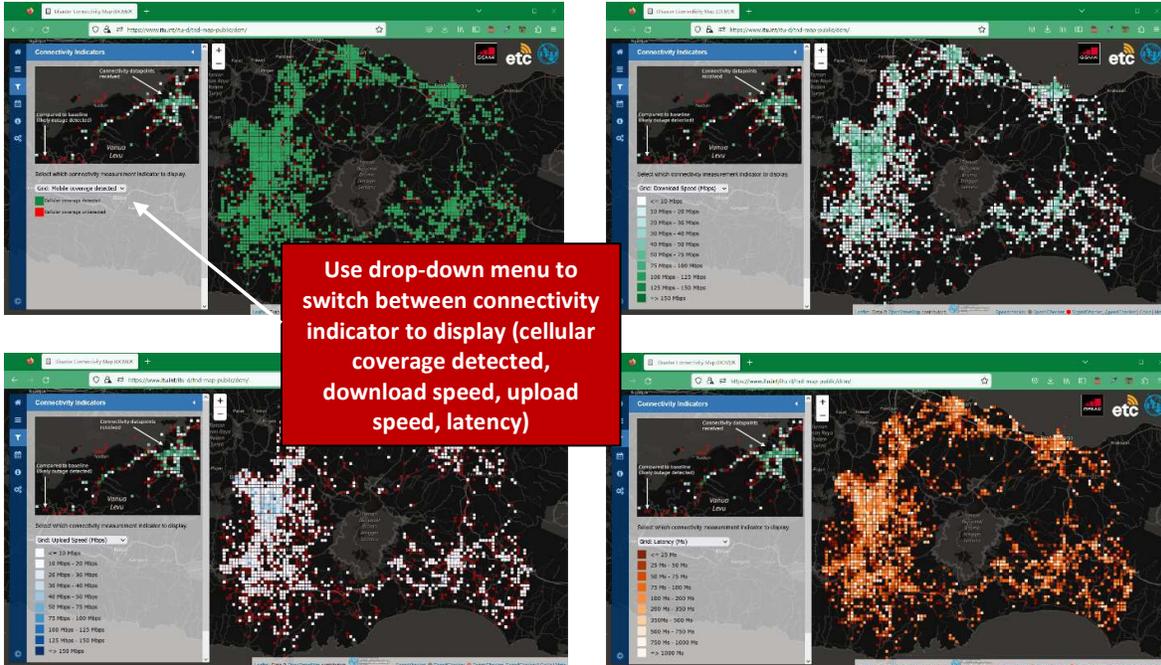


‘Seen’ cellular coverage: The high and low resolution cellular coverage map layers are filtered on-the-fly to only show those cells which contained a connectivity datapoint in the selected period. This shows which cells have been ‘seen’ or ‘not seen’ in the current selected period. In the example map below, nearly all baseline cell coverage (green coverage) contained a baseline Speedchecker datapoint (white square), but the coverage ‘seen’ in the latest hour (white coverage) are those cells which contain (for low resolution) or intersect (for high resolution) a Speedchecker datapoint received in that hour.



4.2 Connectivity Indicator:

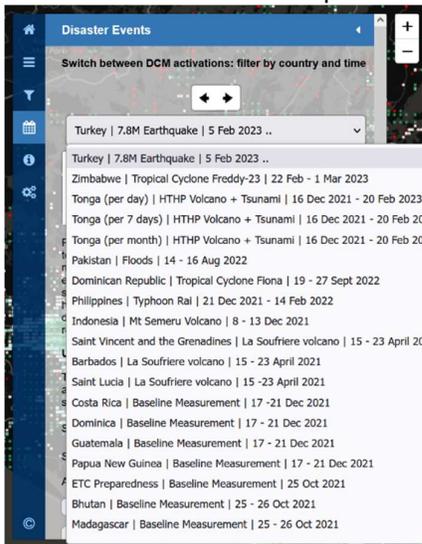
Select the ‘Connectivity Indicator’ button to choose which connectivity measurement indicator in the DCM connectivity map layer to display (ping, latency, upload speed, download speed). This filter allows the user to switch between indicators without adding separate map layers for each indicator.



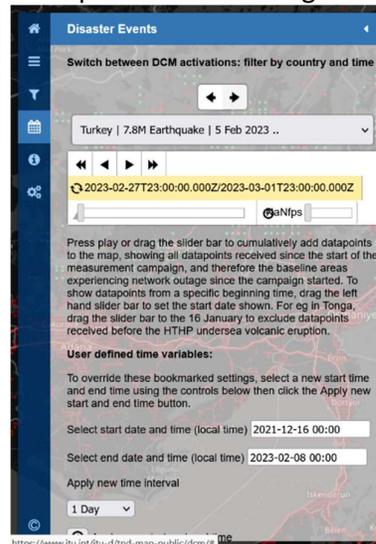
4.3 Time:

Select the 'Disaster Events' button from the sidebar menu to adjust the time settings. 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. The drop-down box will re-centre the coordinates and zoom level of the map to the chosen country/activation, and reset the time parameter for the duration of the selected activation. The arrows above the activation drop-down list allow the user to tab forward and backwards through the list of activations. 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). The user can then use the play forward, play reverse, tab forward or tab backward buttons to display the results.

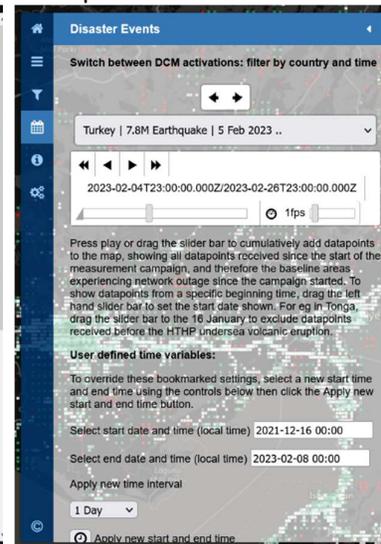
Select bookmark from dropdown



Time parameters loading



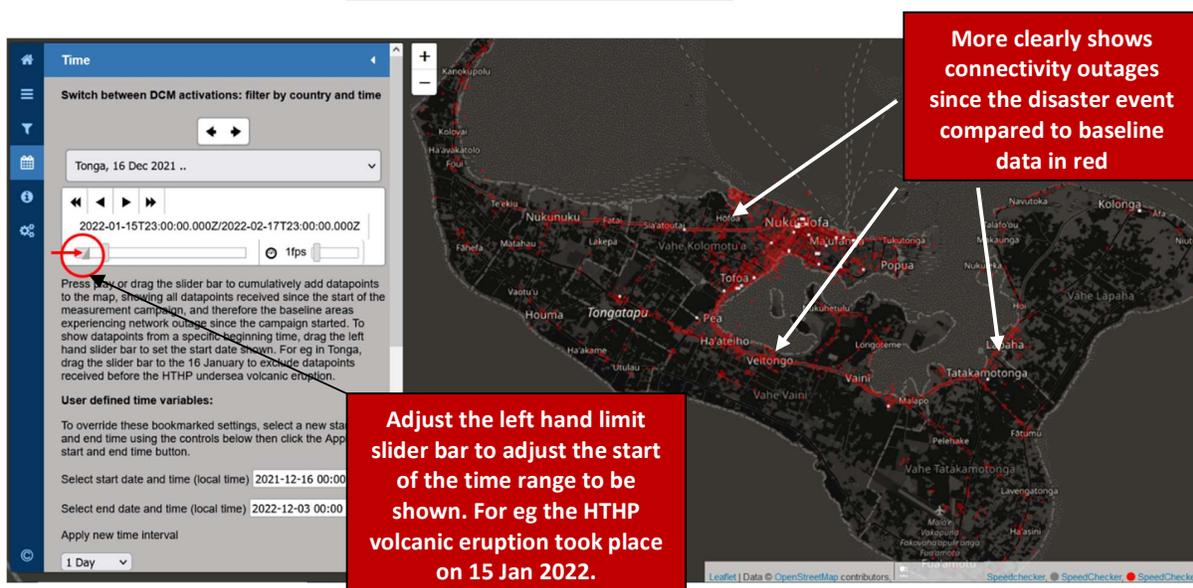
Time parameters loaded



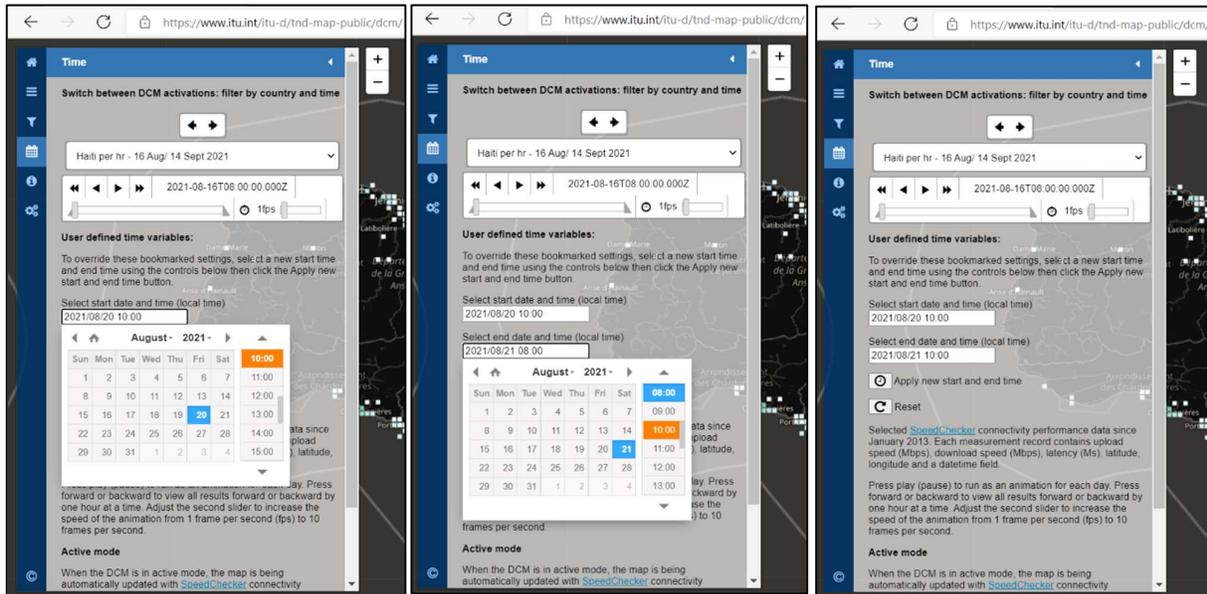
During an activation when a SpeedChecker campaign is running, the map is automatically updated every hour. Each SpeedChecker datapoint that is received is timestamped. The default interval time setting for the DCM Connectivity and SpeedChecker WMS layers is set at 1 hour, but this can also be changed by clicking the time interval drop-down list to select a different time interval.

Cumulative time interval

Note that the time is displayed in the ISO 8601 standard format 2021-12-15T23:00:00.000Z/2022-04-20 T23:00:00.000Z, ie as a *range* between a start date of 15 December 2021 and 20 April 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, 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 Hunga Tonga-Hunga Ha'apai undersea volcanic eruption.

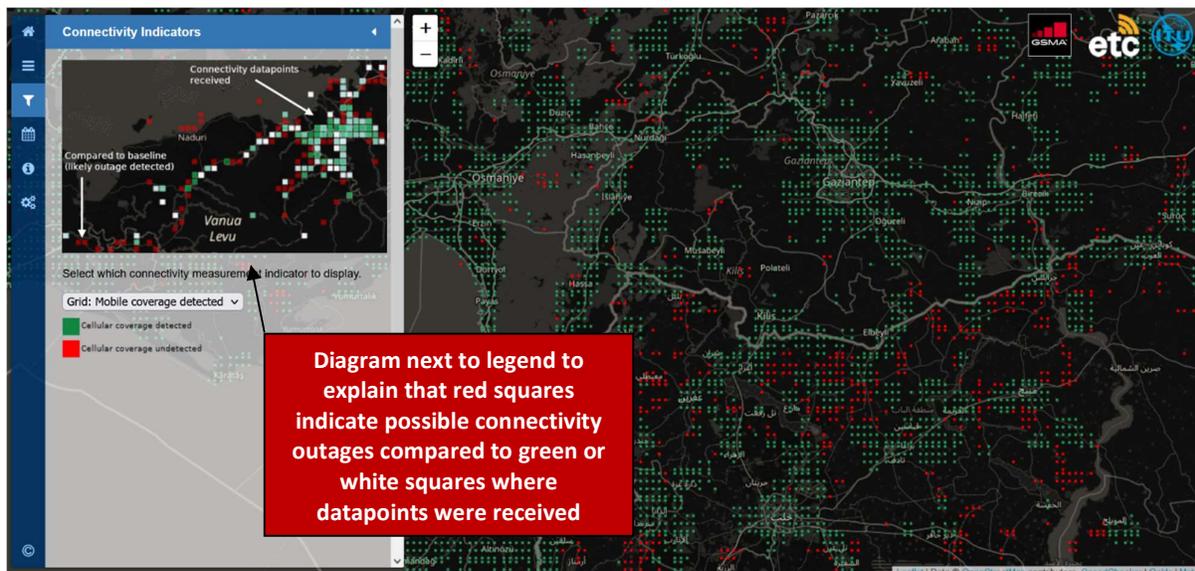


User defined time variables: the ‘select start date/time’ and ‘select end date/time’ options can be used to manually input and set arbitrary time parameters. For example, a new start date of 2021/08/20 10:00 and end date of 2021/08/21 10:00. The default interval is per hour, but that can be changed by manually selecting a different time interval. Press the clock button to apply the new start and end times.



4.4 Quality of Service (QoS) Layer:

The Quality of Service (QoS) map layer aggregates together all datapoints received from Ookla, Meta, and Speedchecker into one single global layer containing four connectivity indicators (mobile coverage detected, download speed, upload speed and latency). This is displayed in the example below as mobile cellular coverage which is either detected (green) or undetected (red) during a particular day.

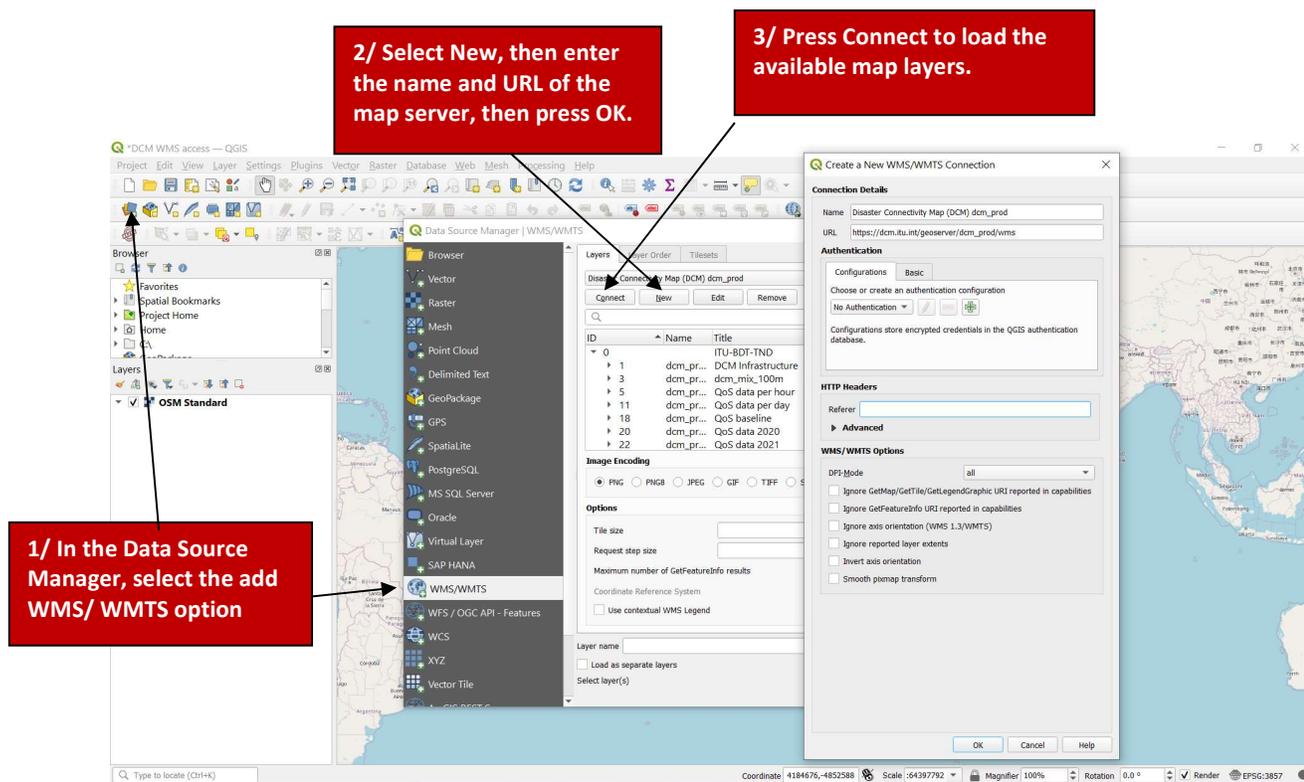


5. Accessing DCM via desktop GIS software

Users can also access the DCM WMS (Web Map Service) layers in their desktop GIS software. To create a new connection to a WMS server, enter the URL below and connect. This will provide access to the WMS layers which are published through the DCM Geoserver platform, which can be added to the users own desktop GIS project. The worked example below uses QGIS desktop GIS software (<https://www.qgis.org>). Note that minimum QGIS version 3.14 is required for the Temporal Controller function, in previous versions of QGIS the Time Manager plugin was required.

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

5.1 Add WMS (web map service) layer to your project. In the Data Source Manager of QGIS, select the add WMS/ WMTS option. Alternatively navigate to Layer – Add Layer – Add WMS/WMTS Layer, or use the keyboard shortcut Ctrl+Shift+W.



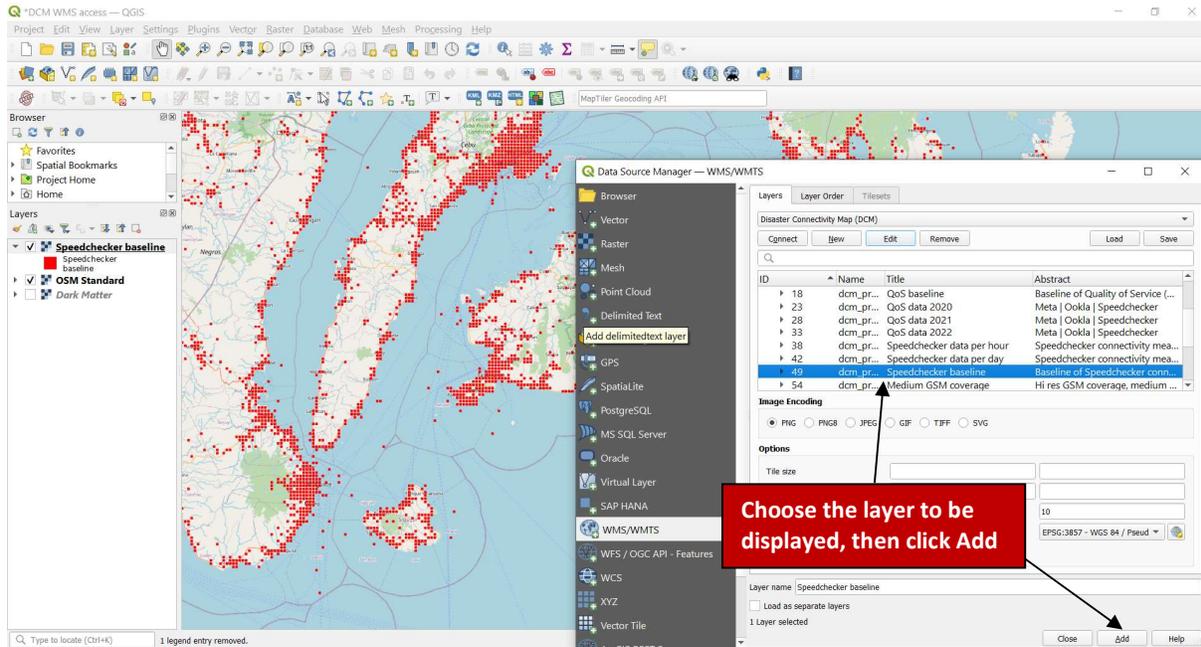
5.2 Connect to the DCM map server. In the dialogue box that appears, select **New** to enter the parameters to create a new connection to the DCMs WMS server, enter the information below, and click OK. Then press Connect to load the available map layers. You can then browse the layers which are published, select a layer and click Add. No password is required for the publicly available map layers. Password protected content is exposed to authenticated users who enter their username and password.

Name: Disaster Connectivity Map (DCM)

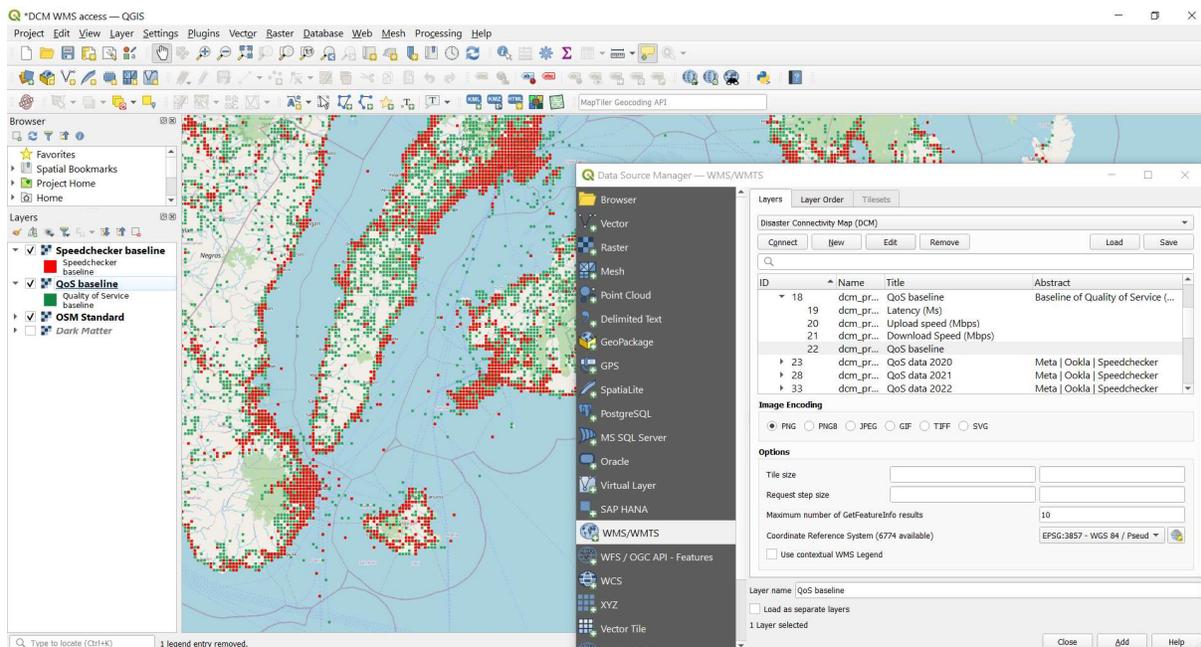
URL: https://dcm.itu.int/geoserver/dcm_prod/wms

5.3 Add WMS layers to your project. Choose the layer(s) to be displayed from the list given, then press Add. This will add the remote WMS map layer into the table of contents of your project.

Speedchecker baseline. This baseline layer shows all the Speedchecker datapoints that have been inputted into the DCM database, and is not time enabled. The default colour for this red, to be able to highlight areas of likely network outage when real time data is laid over the top.

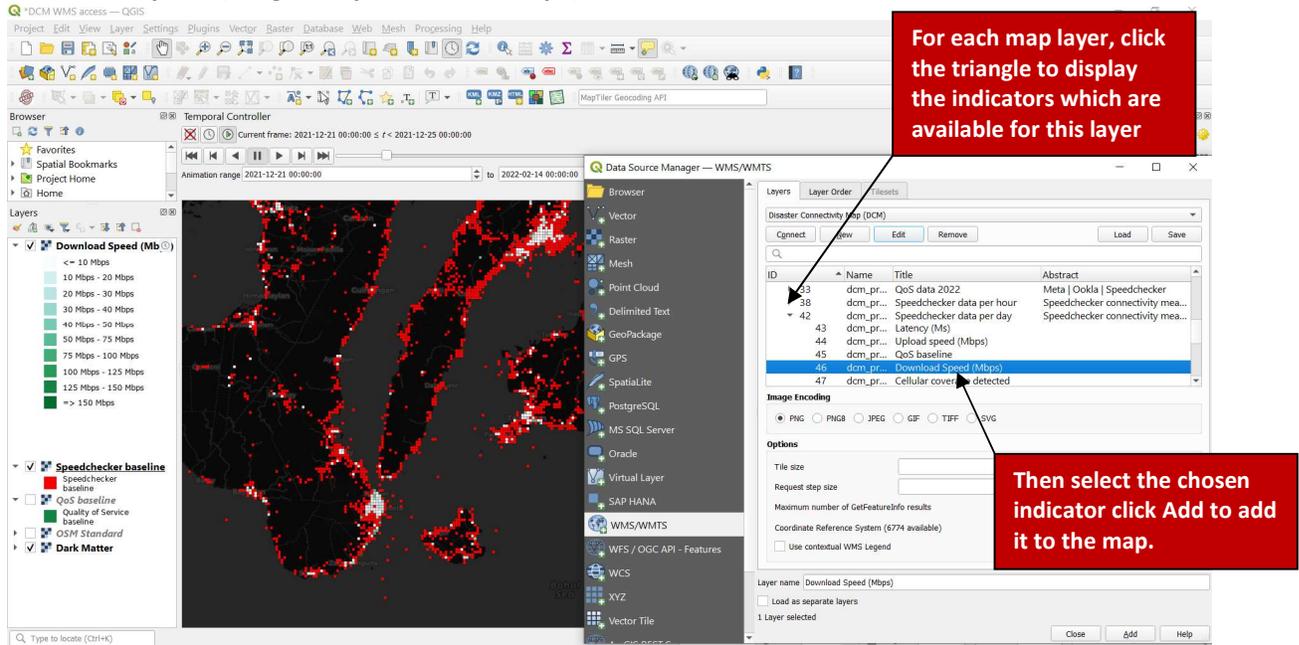


QoS baseline. This baseline layer shows all the Speedchecker, Ookla and Meta datapoints that have been inputted into the DCM database, and is not time enabled. The default colour for this green, to be able to show the fullest coverage where connectivity measurements that have been inputted into the database.

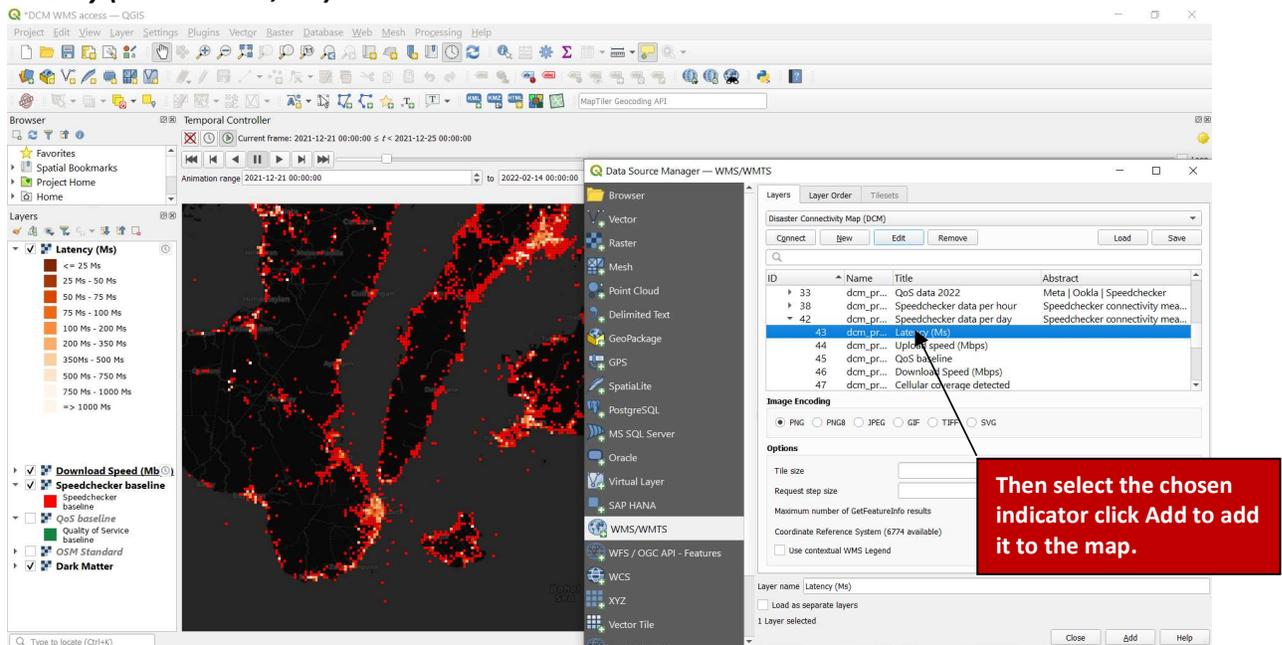


5.4 Select connectivity indicator. The DCM map layers contain four connectivity indicators: download speed (Mbps), upload speed (Mbps), latency (Ms), and mobile coverage detected (yes or no). In the web map, the indicator can be changed using the drop-down menu in the Connectivity Indicator tab, which changes the style to display a different indicator (see 4.2 above). In desktop GIS, the different indicators are shown instead as options below each map layer in the menu. From each map layer (for example “QoS baseline”), click the triangle to show the connectivity indicators which are available (for example “Latency (Ms)”), then select the chosen layer and click Add to add that to the map. Note that the colour scheme and legend has changed depending on the indicator selected, and only those datapoints with values for the selected indicator will be shown.

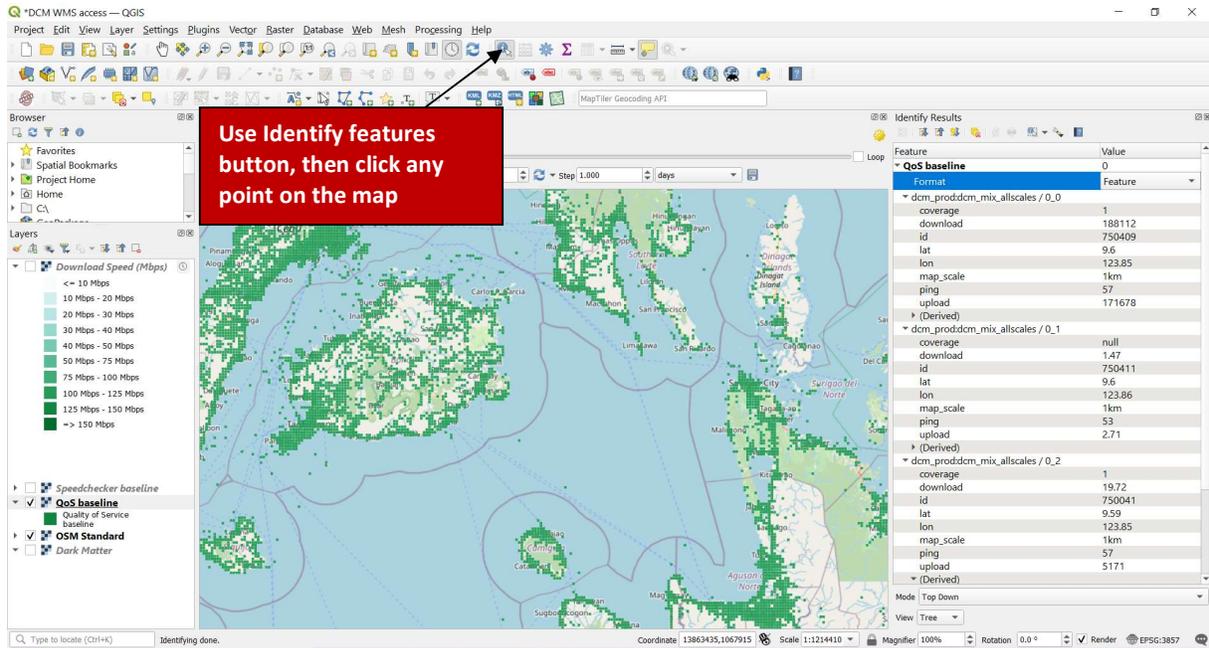
Download speed (Megabits per second, Mbps)



Latency (Milliseconds, Ms)



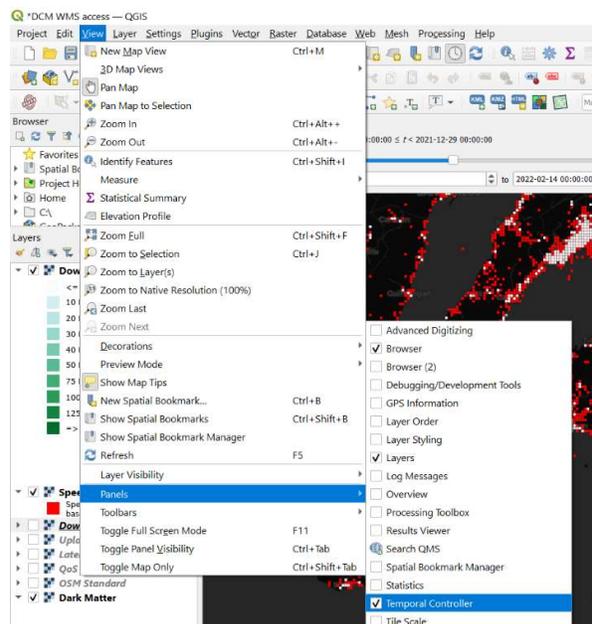
5.5 Identify features. To view the underlying data in any of the map layers, make sure that the layer is selected and highlighted in the table of contents in the left hand side, then using the **Identify features** button from the toolbar click any point on the map. This will then display the results in the panel which appears on the right hand side of the map.



5.6 Time control. Note that some map layers in the DCM are time enabled (called WMS-T, or WMS-Time), and other layers are not. When a layer is added to the map, a clock icon appears to the right of the layer in the table of contents indicating that it is a Temporal Layer.

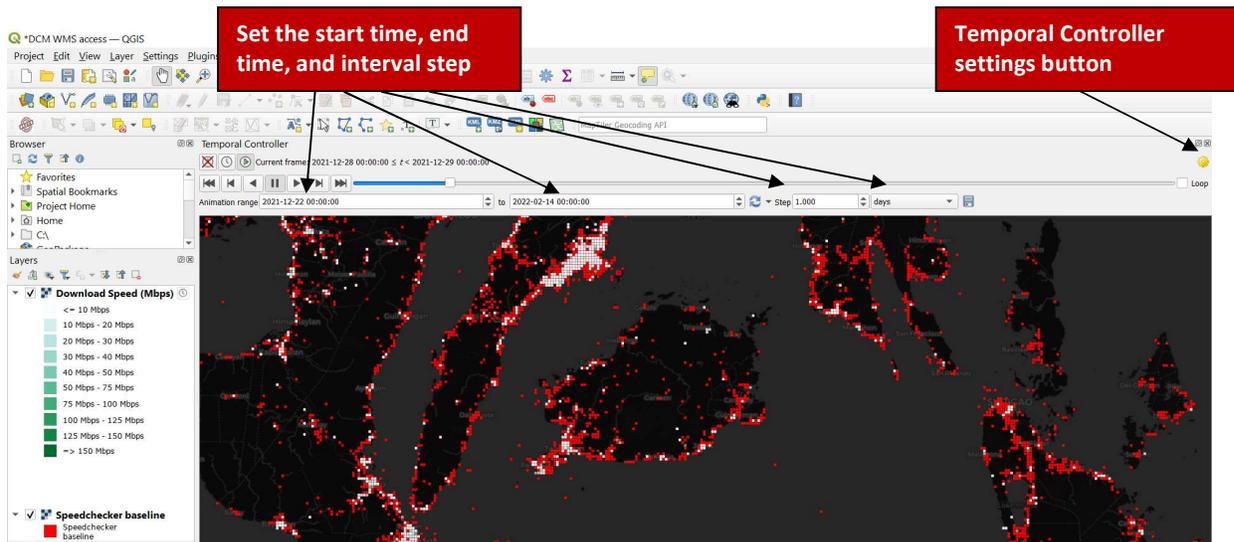
The DCM Infrastructure, QoS baseline and Speedchecker baseline map layers do not have a time dimension. All of the other map layers contain a time dimension, which must be set using the Temporal Controller otherwise there will be nothing to see since the time parameter has not been defined.

To display the Temporal Controller panel in QGIS, select **View – Panels – Temporal Controller**.

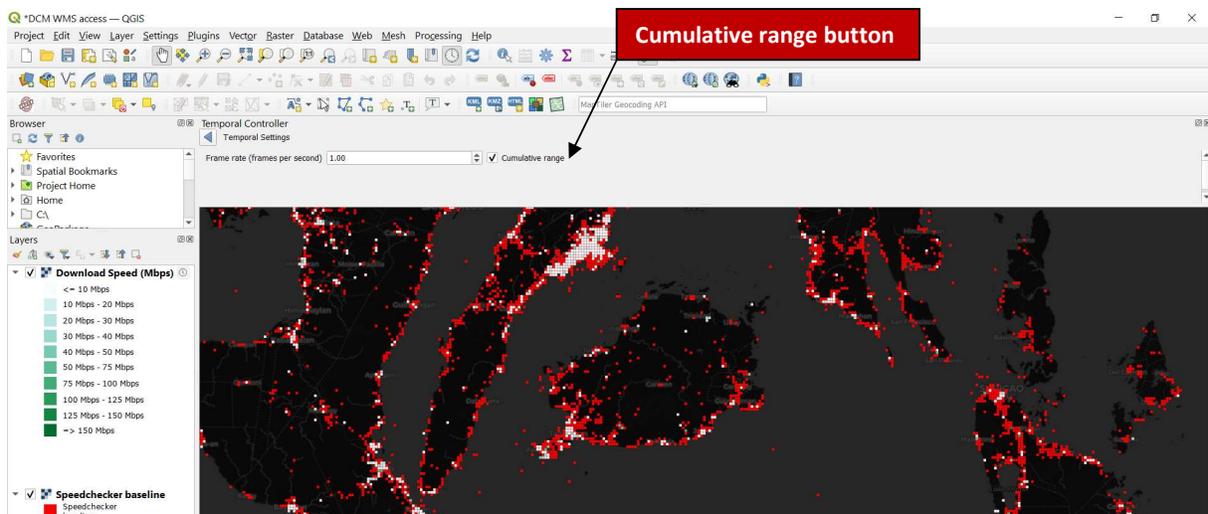


The Temporal Controller allows you to configure the start time, end time, the interval (hours, days, months etc) and the number of interval steps (1,2,3 etc). Using the bookmarks from the drop-down menu in the Disaster Event tab in the web map, you can find the start time and end time for each activation. The interval step should be set to 1 day, although in some activations this is also available for every hour, and for the historic Quality of Service layers this is set to quarterly (so 3 months), see 6.7 below. You can now use the play, next frame and fast forward buttons to view the data for individual days.

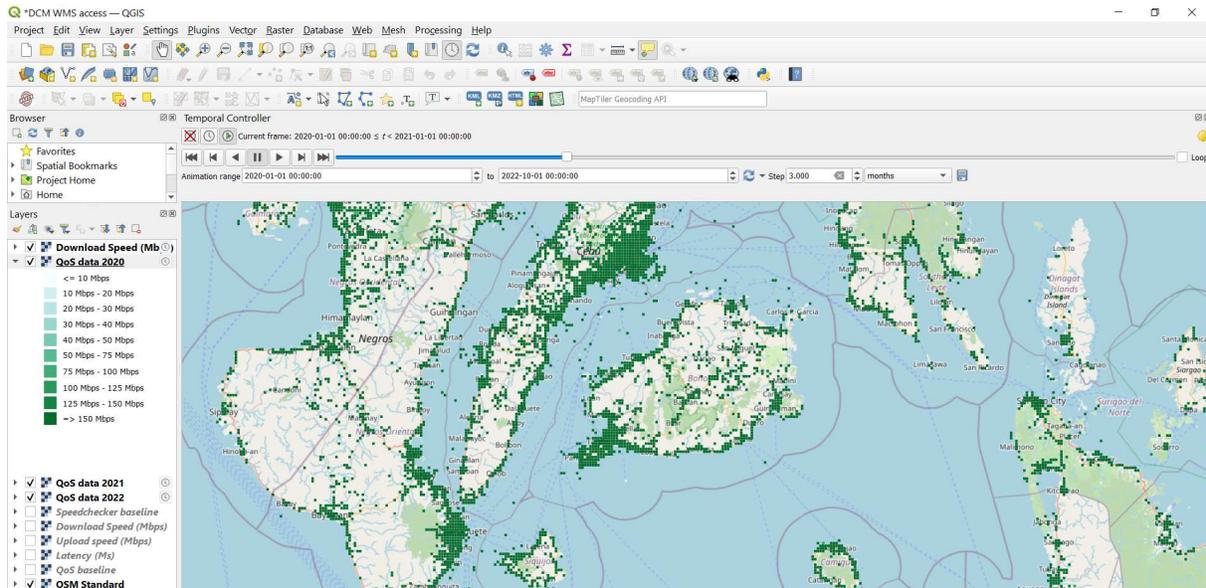
Time slice range mode. By default the data is presented in sequential time slots, clicking play button shows the data in the currently selected time slot, for day one, then day two, day three etc. This is important to see the results on a particular day, but is difficult to see persistent outages since a disaster event has occurred.



Cumulative time range mode. In the Temporal Controller's settings (yellow gear) button on the right hand side there is a **Cumulative range** button. With the Cumulative range button selected, all data is shown from the start date to the currently selected time slot. This feature is useful to identify areas highlighted in red which have seen persistent network outages since a disaster event has occurred.



5.7 Viewing historic data. The worldwide Quality of Service data is available from Q1 2020, with archived layers for each year containing all datapoints inputted to the DCM database from Meta, Ookla, and Speedchecker. To view this worldwide data, add the QoS 2020, QoS 2021 and QoS 2022 map layers to your project. The time parameters need to be set to show a start time of 2020-01-01 00:00:00, end time to 2023-10-01 00:00:00, interval to months, and step to 3. Allow the map to load these parameters, and you can then play a quarterly animation of the Quality of Service indicators.



To learn more about how to add a WMS layer to your desktop GIS application, visit these resources:

- ESRI ArcGIS: <https://desktop.arcgis.com/en/arcmap/latest/map/web-maps-and-services/adding-wms-services.htm>
- QGIS: https://docs.qgis.org/3.28/en/docs/user_manual/working_with_ogc/ogc_client_support.html#wms-wmts-client

6. Using DCM map layers in web map applications

The DCM WMS layers can be displayed in a user's own JavaScript web map application. Below is a snippet of code to include the DCM infrastructure layer in a Leaflet web map:

```
var dcm_inf = L.tileLayer.wms('https://dcm.itu.int/geoserver/dcm_prod/wms?', {
  layers: 'dcm_prod:dcm_infrastructure',
  format: 'image/png',
  transparent: true,
  attribution: '<a href="https://www.itu.int" target="_new"><a hr
});

var dcm_scr_baseline = L.tileLayer.wms('https://dcm.itu.int/geoserver/dcm_prod/wms?', {
  layers: 'dcm_prod:dcm_scr_allscapes',
  format: 'image/png',
  opacity: 0.5,
  transparent: true,
  attribution: '<a href="https://www.itu.int" target="_new"></a>
});
```

To learn how to add a DCM WMS map layers into other JavaScript web maps, visit these resources:

- ESRI Javascript API: <https://developers.arcgis.com/javascript/latest/sample-code/layers-wms/index.html>
- Leaflet: <https://leafletjs.com/examples/wms/wms.html>
- Mapbox: <https://docs.mapbox.com/mapbox-gl-js/example/wms/>
- OpenLayers: <https://openlayers.org/en/latest/examples/wms-tiled-wrap-180.html>