

UPDATE 5 St. Eustatius - January 2021

This update reports on the activities of KNMI in 2020 with respect to the volcanic/seismic monitoring network at St. Eustatius. The COVID-19 pandemic provides certain challenges considering our work, mainly related to travel restrictions and delayed delivery of new equipment. Regular observations of the data continued regardless throughout the year. The current monitoring network, and its extension planned for January 2021, is displayed in Fig. 1.

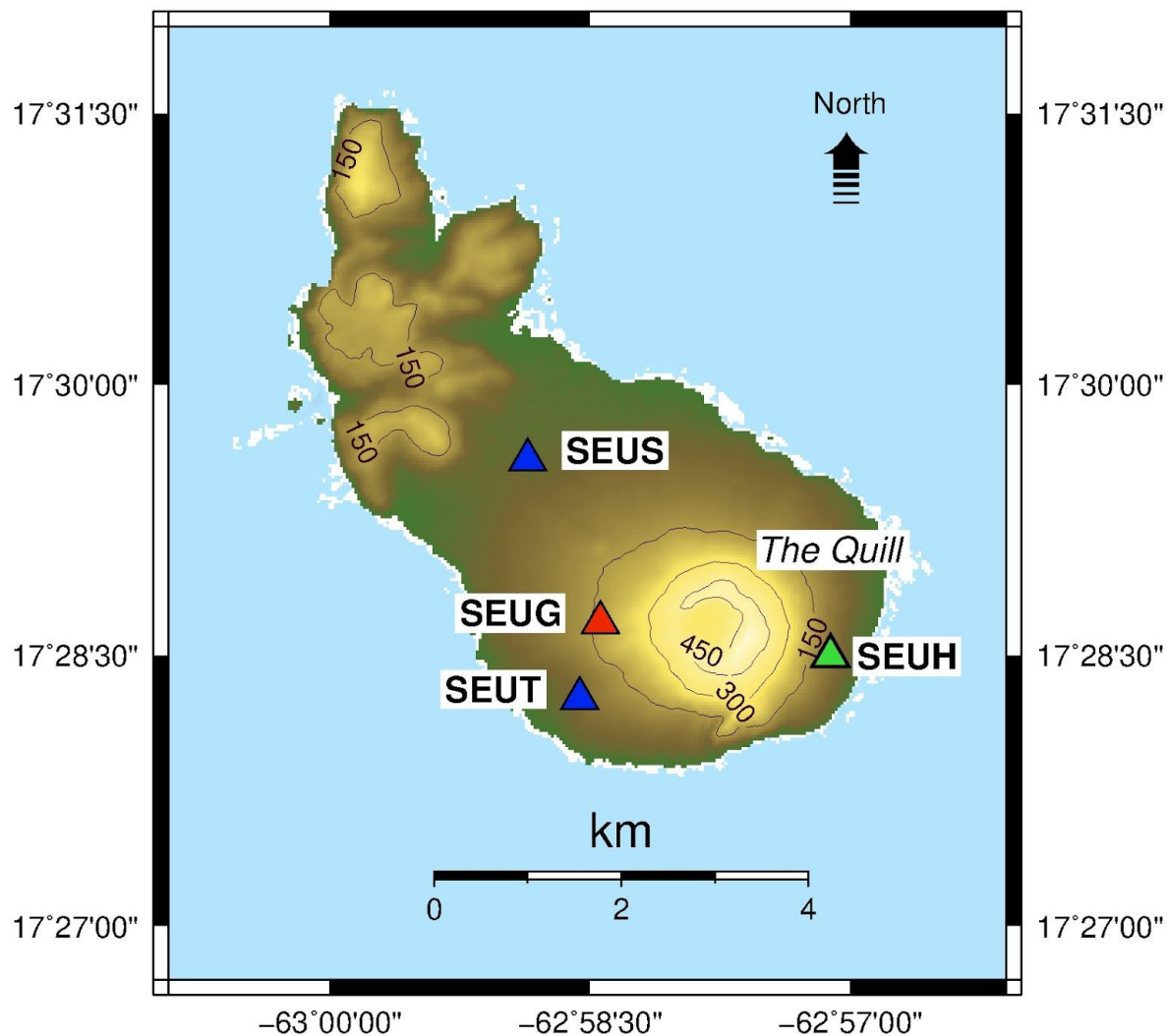


Fig. 1: Map showing the locations of current measurement sites on St. Eustatius with blue (GNSS/seismic stations) and red (seismic stations) triangles. In green the location of the proposed station at the botanical gardens (planned installation January 2021).

Seismic data

All seismometers (called “SEUG”, “SEUS” and “SEUT”) are functioning well and produce data of good quality for the purpose of detecting earthquakes.

For example, on Dec 27, 2020, at 23:56:18 UTC (19:56:18 local time), a magnitude 4 earthquake took place at a depth of 6 km, about 16 km south-west of St. Eustatius. Our automatic monitoring system detected this event using the recordings from all 3 seismometers at St. Eustatius, 3 seismometers on Saba and 1 on St. Maarten. The figures 2 and 3 show screenshots of the automatically determined earthquake parameters, as well as the recordings of the ground movement.

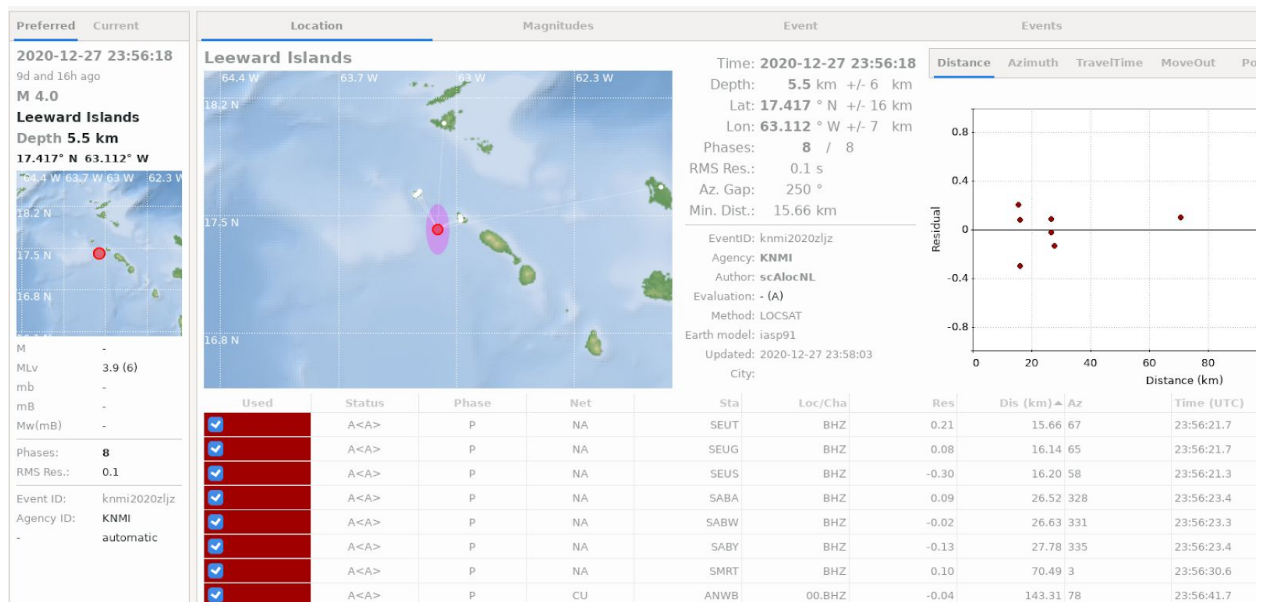


Fig. 2: Screenshot of the location of the earthquake at 27-12-2020 as derived by our automatic system from the seismometers at St. Eustatius, Saba and St. Maarten.

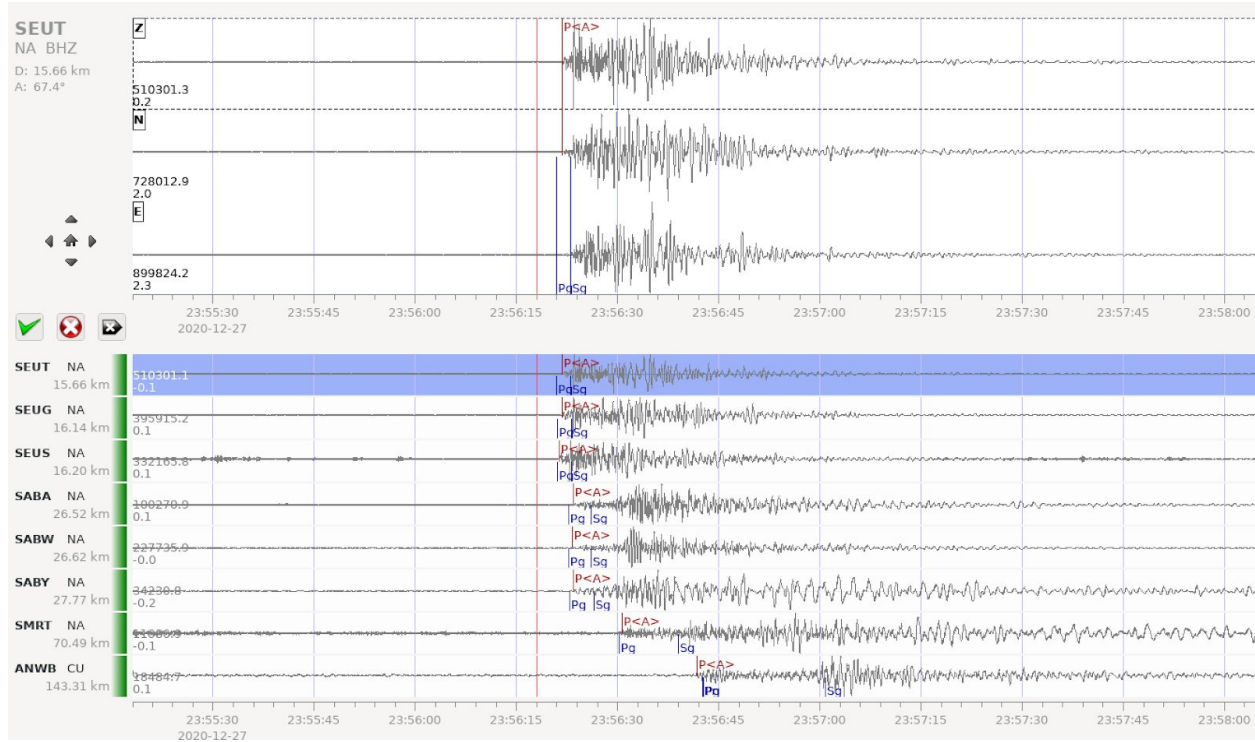


Fig. 3: Screenshot of the recorded seismic waveforms after the earthquake at 27-12-2020.

Don't forget that if you feel an earthquake it helps us if you fill out this form: <https://www.knmi.nl/nederland-nu/seismologie/aardbevingen/melden>

GNSS data

The two GNSS stations, at the EUTEL facility at dove road (called "SEUT") and at the airport (called "SEUS") worked well most of 2020. Unfortunately in October station SEUS was hit by lightning. Essential parts for the repair are on their way to St. Eustatius and repairs should take place in January 2021.

For each instrument we calculate the daily position very precisely. The result is plotted in a graph as a point, and by adding a new data point to the graph each day a time series is formed (Fig. 4). Station SEUT has been operational since January 2018 and hence has a longer time series than station SEUS, which became operational in February 2019.

Changes through time can be viewed in the time series for three components:

1) horizontal North-South, 2) horizontal East-West and 3) vertical Up-Down. Uncertainties for each point are, as expected, a few mm for the East and North component and up to a few cm for the Up component. The data show a horizontal movement towards the NE for both stations. This movement is due to well-known plate tectonics whereby the North and South American plates subduct underneath the Caribbean Plate. We can evaluate local deformation better by removing the plate tectonic signal from the data. Data corrected for the plate spreading signal are constant through time indicating no local deformation occurred. In most cases deformation of the flank of the volcano in the order of multiple centimeters to decimeters precedes a volcanic eruption. This will be best visible in the horizontal components of the data (North and East) as these have the highest accuracy.

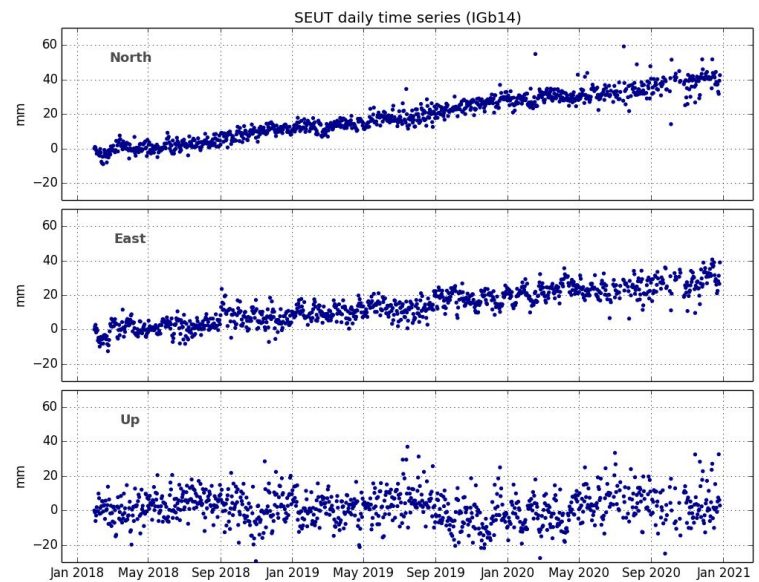
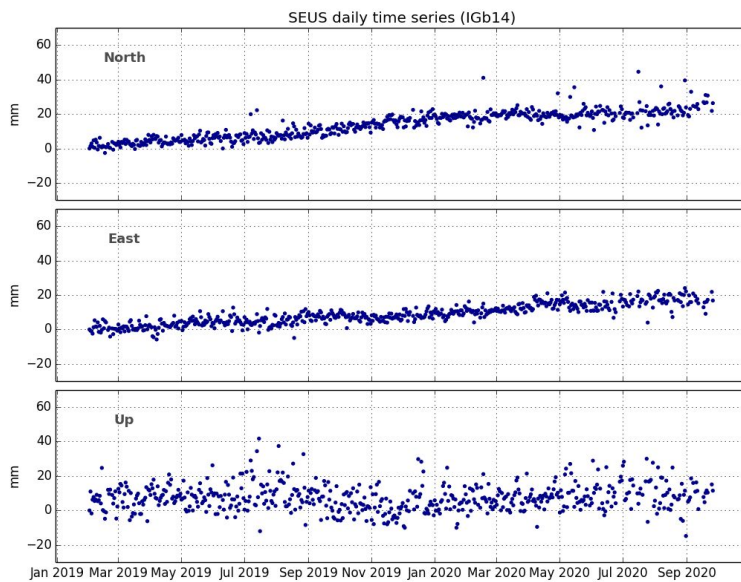
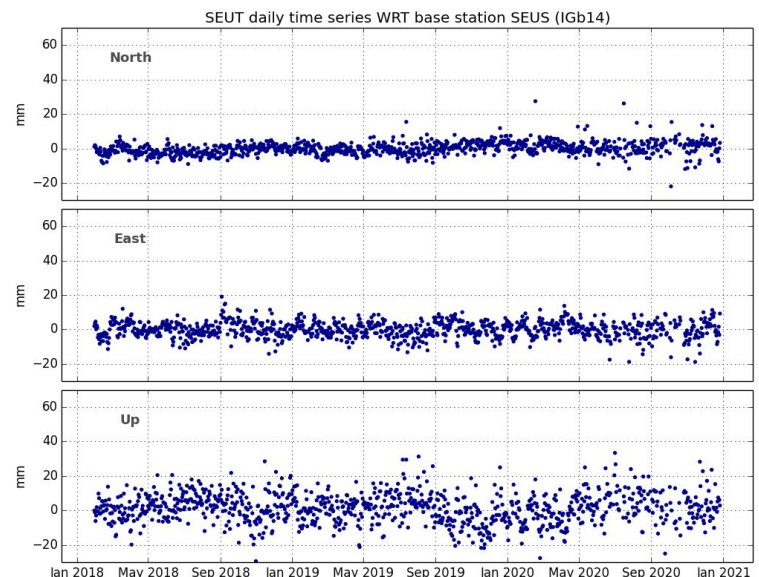


Fig. 4: GNSS data from stations SEUS (upper left) and SEUT (upper right). When the plate spreading signal is removed data show very little deviation from a horizontal line (bottom right).



Installation new site botanical gardens

A new GNSS/seismic installation is planned for January 2021 at the Botanical gardens. All materials for this installation have been shipped to St. Eustatius. This installation is innovative as it will be completely stand-alone. Satellite communication will be used to send the data to KNMI and solar panels/batteries will be used to power the site.

In October/November 2020 we tested the set-up at KNMI (Fig. 5). The GNSS/seismic station will consist of 1) a GNSS antenna mounted on a monument, 2) a concrete box housing the seismometer, 3) a VSAT dish needed to transmit the data, 4) two solar panels to power the equipment and 5) a cabinet housing all electronics.



Fig.5: GNSS antenna mounted on a concrete monument (left). Concrete box for the seismometer not displayed. Test set-up at KNMI (right) showing VSAT dish, solar panels with cabinet underneath (5).

Volcanic activity in the region

Currently several volcanoes in the Caribbean show increased levels of activity (see Fig. 8). This is not uncommon, for example in 1902 both Mt. Pelée, Martinique and La Soufrière, St. Vincent erupted. The Caribbean volcanoes are all formed by the same process: subduction at the plate boundary, but they do not share the same magma chamber, nor are they connected by long magma conduits. A volcanic eruption on one island can therefore not trigger an eruption on another island. For more information on the activity of other Caribbean volcanoes see:

- <http://uwiseismic.com> and <http://nemo.gov.vc/nemo/index.php/home/welcome> for Grenada, Grenadines, St. Vincent, St. Lucia, Dominica, St. Kitts and Nevis
- <https://www.ipgp.fr/fr/ovsm/observatoire-volcanologique-sismologique-de-martinique-ovsm-ipgp> for Martinique

- <https://www.ipgp.fr/fr/ovsg/actualites-ovsg> for Guadeloupe
- <http://www.mvo.ms/> for Montserrat.

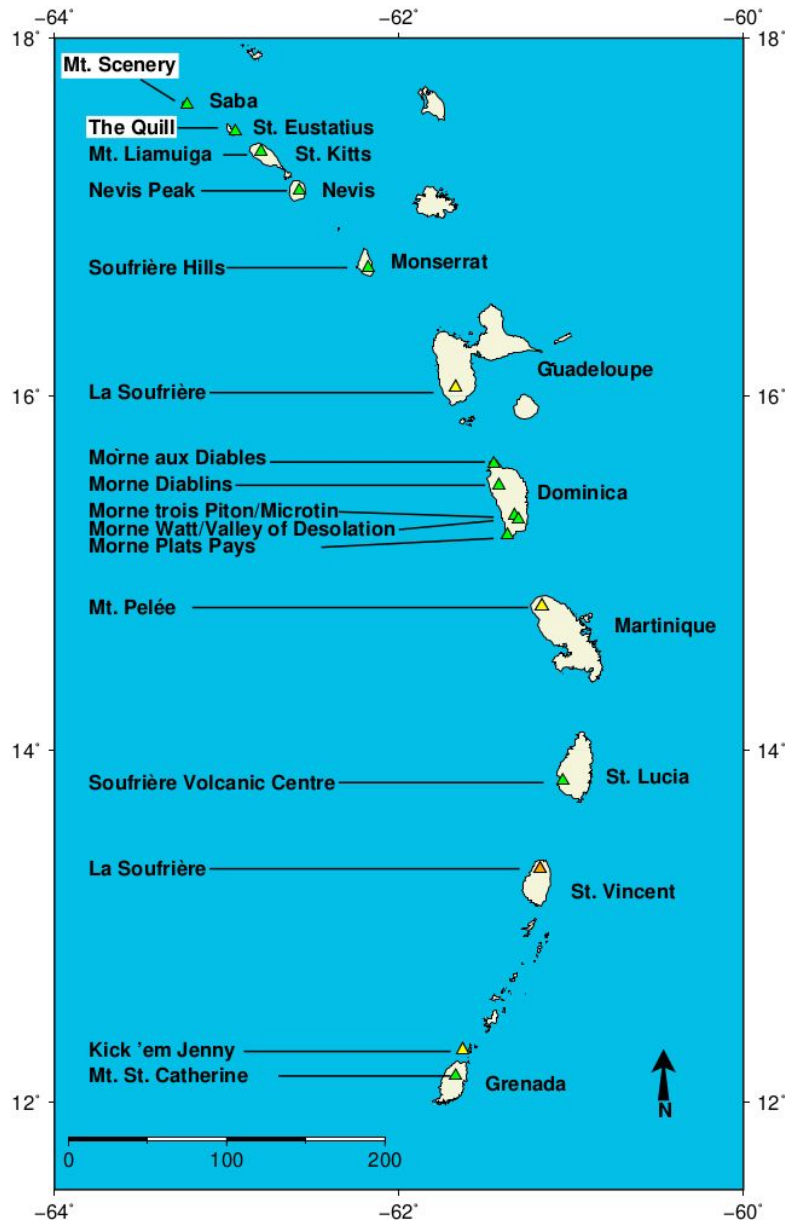


Fig. 8: The active arc of the Lesser Antilles showing the islands of Saba and St. Eustatius in the far north, as well as the other islands of the chain. The triangles depict the location of an active volcano, and their names are shown on the left. Mt. Scenery and The Quill are highlighted. The color of the triangle depicts the state of the volcano as of 5 Jan 2021 whereby green=normal, yellow=advisory and orange=watch.

A team from KNMI will visit the island in January 2021 for the installation. We hope to meet you once we are out of quarantine!