University of Natural Resources and Life Sciences

Department of Civil Engineering and Natural Hazards

Institute of Mountain Risk Engineering

Peter Jordan Str. 82 Tel.: +43-1-47654-4350

A-1190 WIEN Fax: +43-1-47654-4390

IAN REPORT 148

SedAlp WP 5 Part 2

Operation, calibration and data analysis of the bedload monitoring station at Suggadinbach

die.wildbach
und lawinenverbauung

lebensministerium.at

Vienna, November 2014

Report 148 Sedalp WP5 Part 2:

Operation, calibration and data analysis of the bedload monitoring station at Suggadinbach

Projektleitung: Univ. Prof. Dipl.-Ing. Dr. Hübl Johannes

Mitarbeiter: Dipl.-Ing. Dr. Chiari Michael

Maximilian Berktold

Universität für Bodenkultur

Department Bautechnik und Naturgefahren

Institut für Alpine Naturgefahren

Peter Jordan Str. 82 Tel.: +43-1-47654-4350

A – 1190 Wien Fax: +43-1-47654-4390

Report Nr. 148 WP5 Part 2

Vienna, November 2014

Bedload transport monitoring station at Suggadinbach

A new bedload transport monitoring station has been designed by the Institute of Mountain Risk engineering at the Suggadinbach in Vorarlberg. In cooperation with the Austrian Service for Torrent and Avalanche Control the station has been installed in June 2013 in a check dam. All details are given in “Report 148 SedAlp WP5 Part 1: Conception, installation and first operation of a bedload monitoring station at Suggadinbach”.

Calibration

In the on-going project the sensor signal is related with a deposition volume below the station. Therefore stereoscopic images are made and analysed after bedload transporting events. The limitation of this method is that only bigger events can be quantified. A stereoscopic derived elevation model generated in February 2014 is shown in Figure 1.

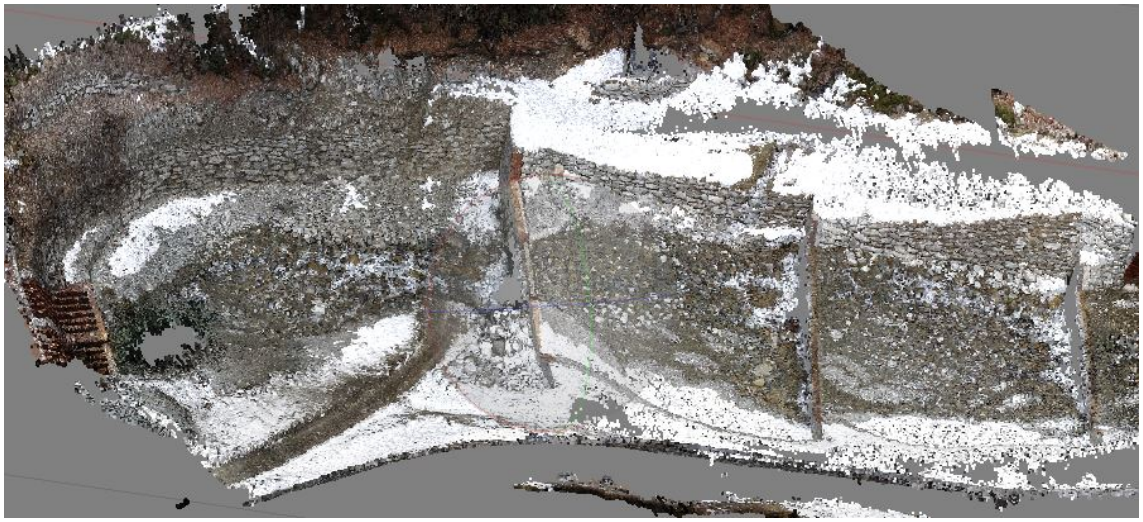

Figure 1: Stereoscopic derived elevation model from February 2014.

Therefore first field tests at medium water discharge (Figure 2) and controlled field tests at low water conditions (Figure 3) have been made in the framework of the ongoing SedAlp project. At the first test series sediment was added by a bucket at medium water conditions. During low water conditions without natural bedload transport sediment has been fed by a crane with a concrete container. A flume has been installed in order to obtain controlled flow and transport over the measuring system. The water was concentrated by sand bags in order to have higher transport capacity to be able to transport grain sizes up to 64 mm. The discharge was measured in the flume.

Four different grain classes as well as a mixture of all classes were tested. A total amount of 4 tons were fed during the experiments.

Both tests have their limitations. At higher discharges there is already natural bedload transport and one can-not be sure that the added sediment really hits the measuring system due to the high current in the stream. Tests as the second one at low water conditions cannot be repeated at higher discharges, because the mountain stream has to be wade able.

Figure 2: First test of the installed system.

Figure 3: Controlled field test at low water conditions (February 2014).

Data evaluation September 2013

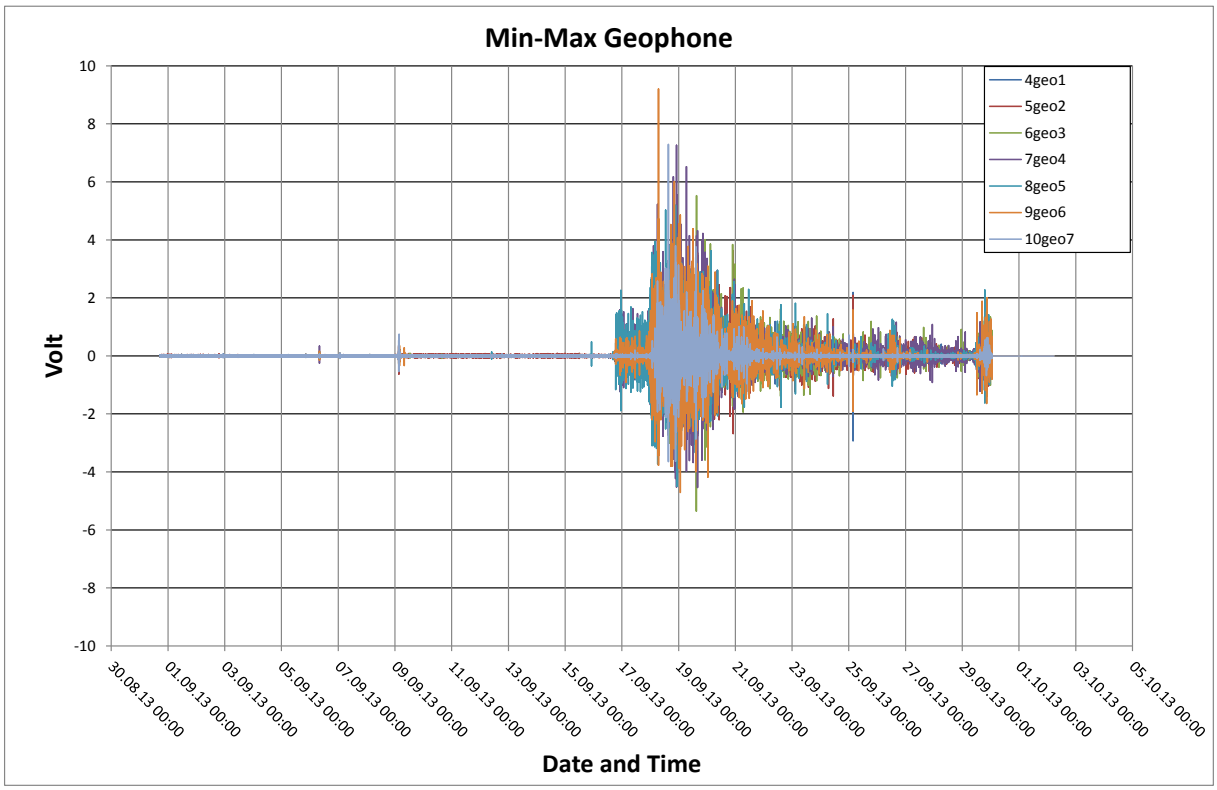

Figure 4: Minimum and maximum values per minute for the geophones 1-7 for the month September 2013.

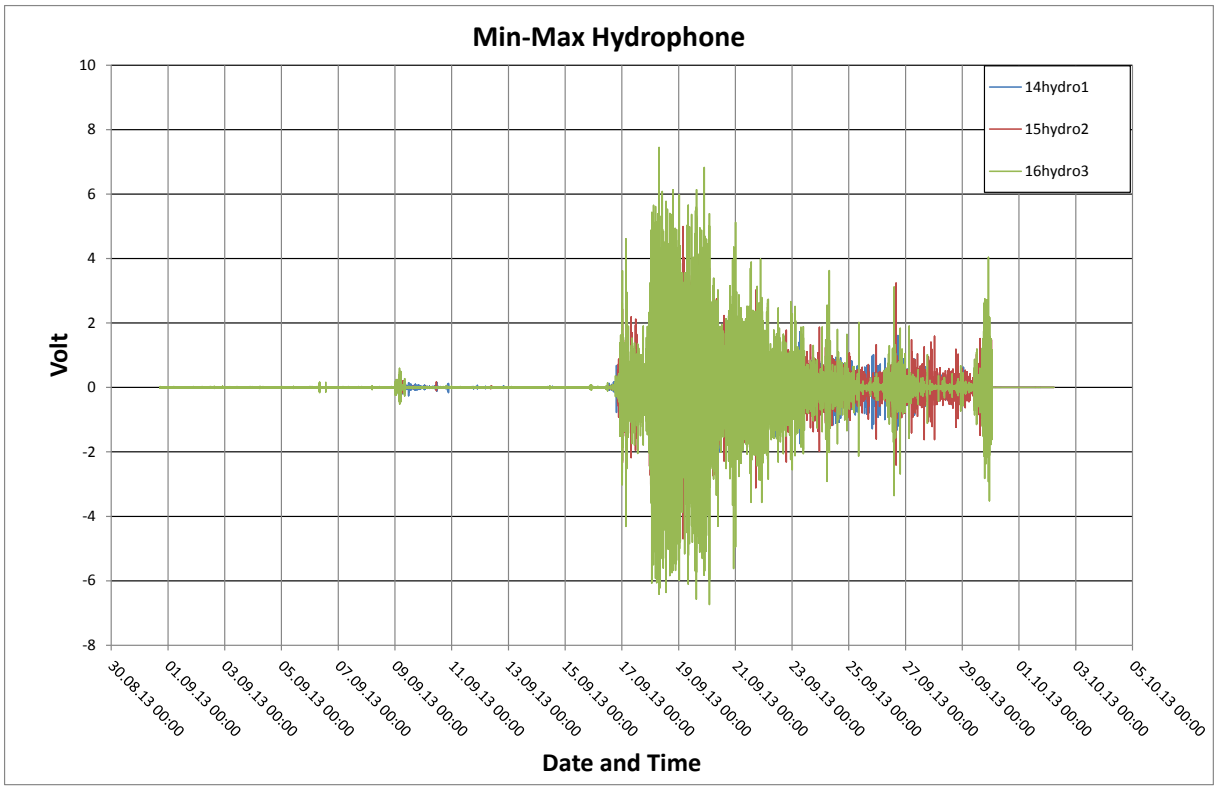

Figure 5: Minimum and maximum values per minute for the hydrophones 1-3 for the month September 2013.

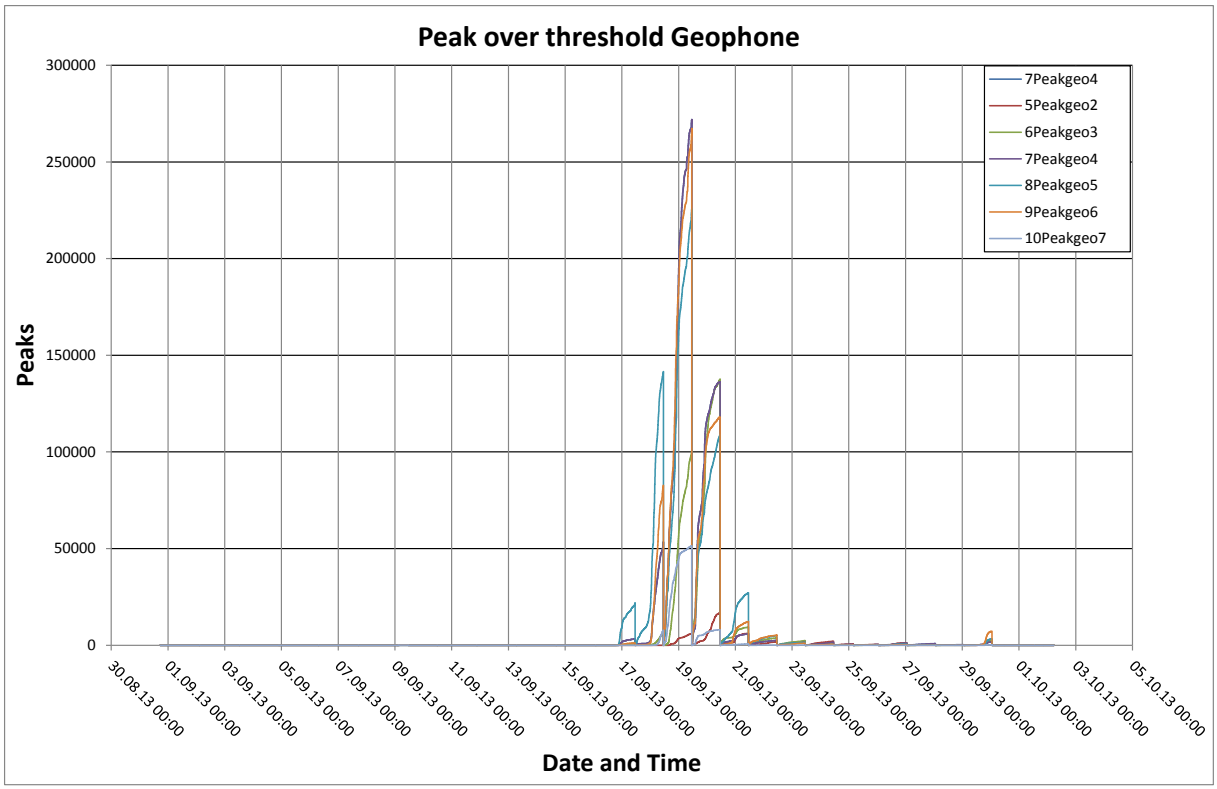

Figure 6: Peak over threshold for the geophones 1-7 per day for the month September 2013.

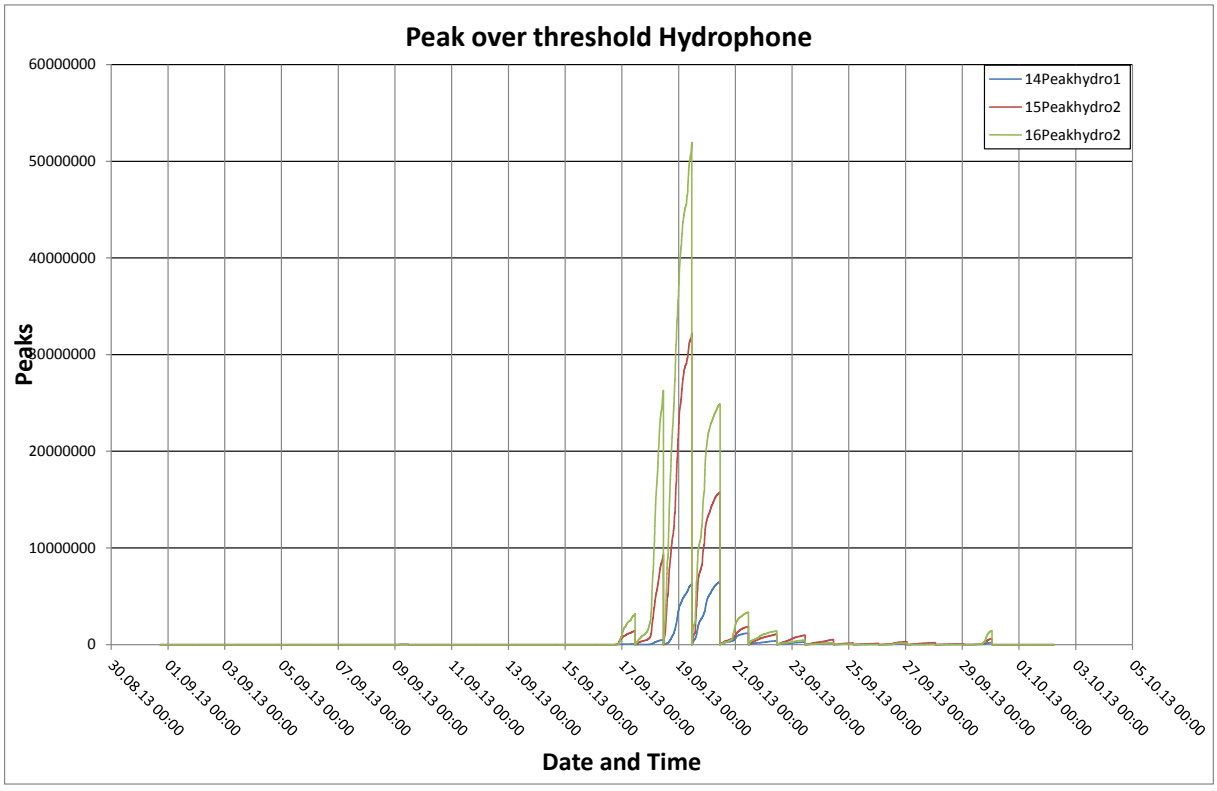

Figure 7: Peak over threshold for the hydrophones 1-3 per day for the month September 2013.

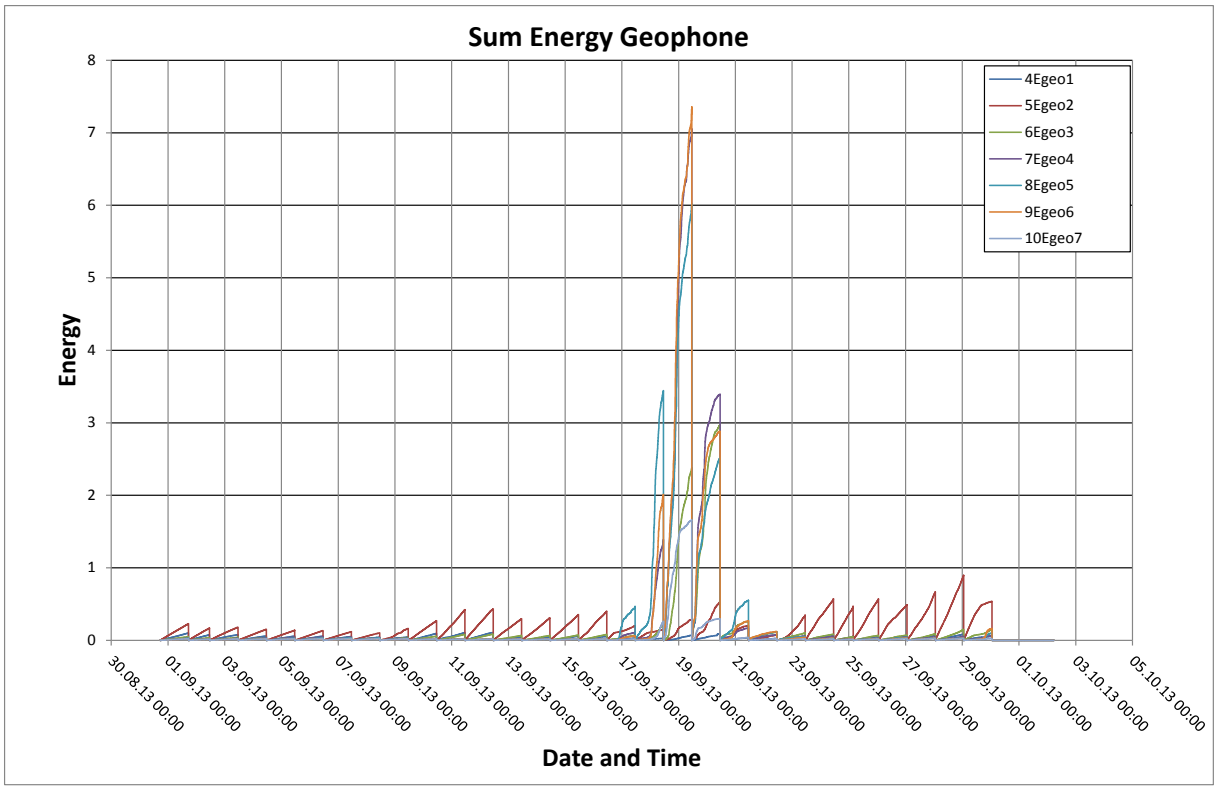

Figure 8: Energy sum for the geophones 1-7 per day for the month September 2013.

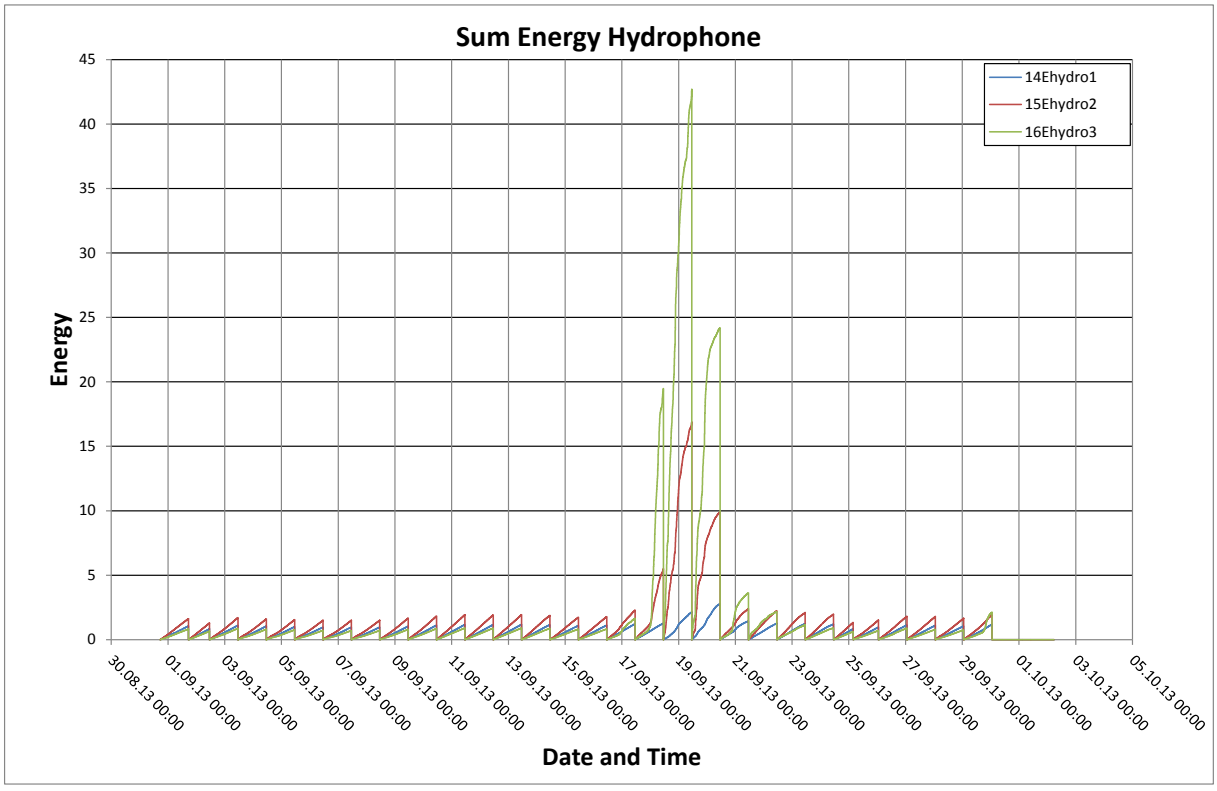

Figure 9: Energy sum for the hydrophones 1-3 per day for the month September 2013.

Data evaluation October 2013

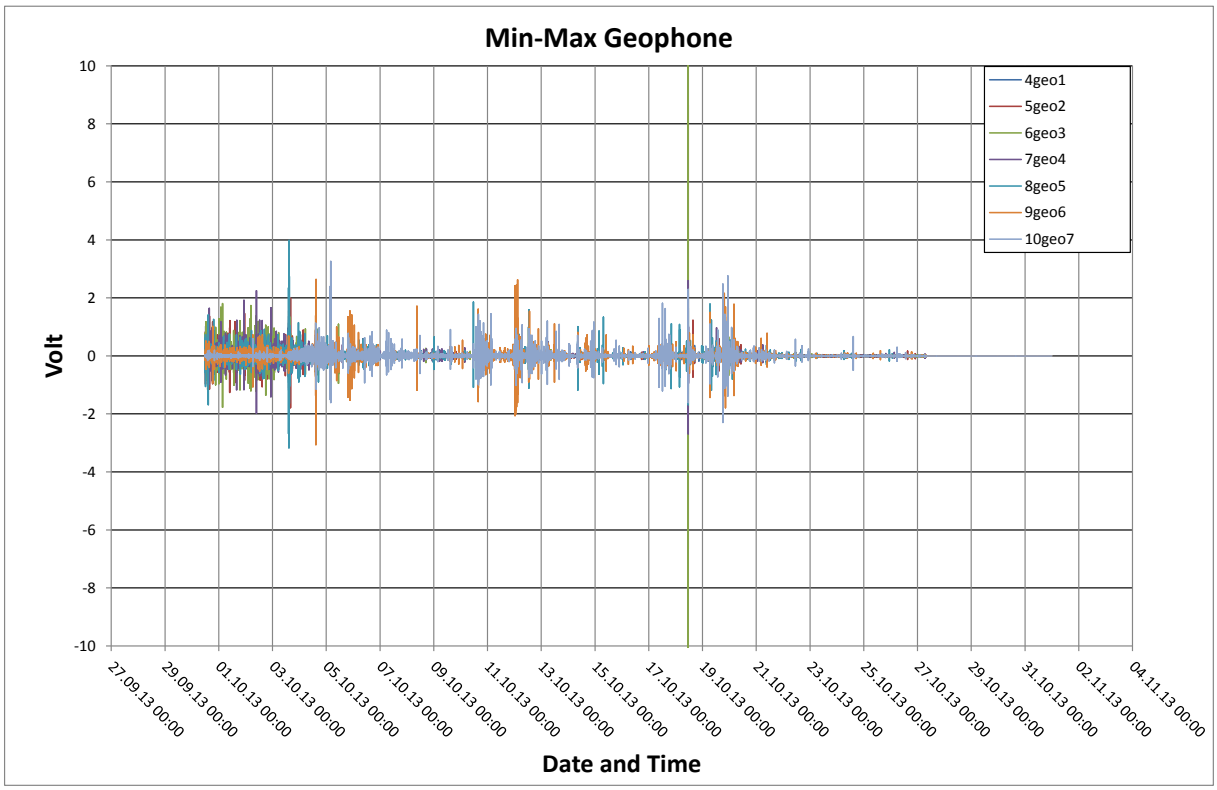

Figure 10: Minimum and maximum values per minute for the geophones 1-7 for the month October 2013.

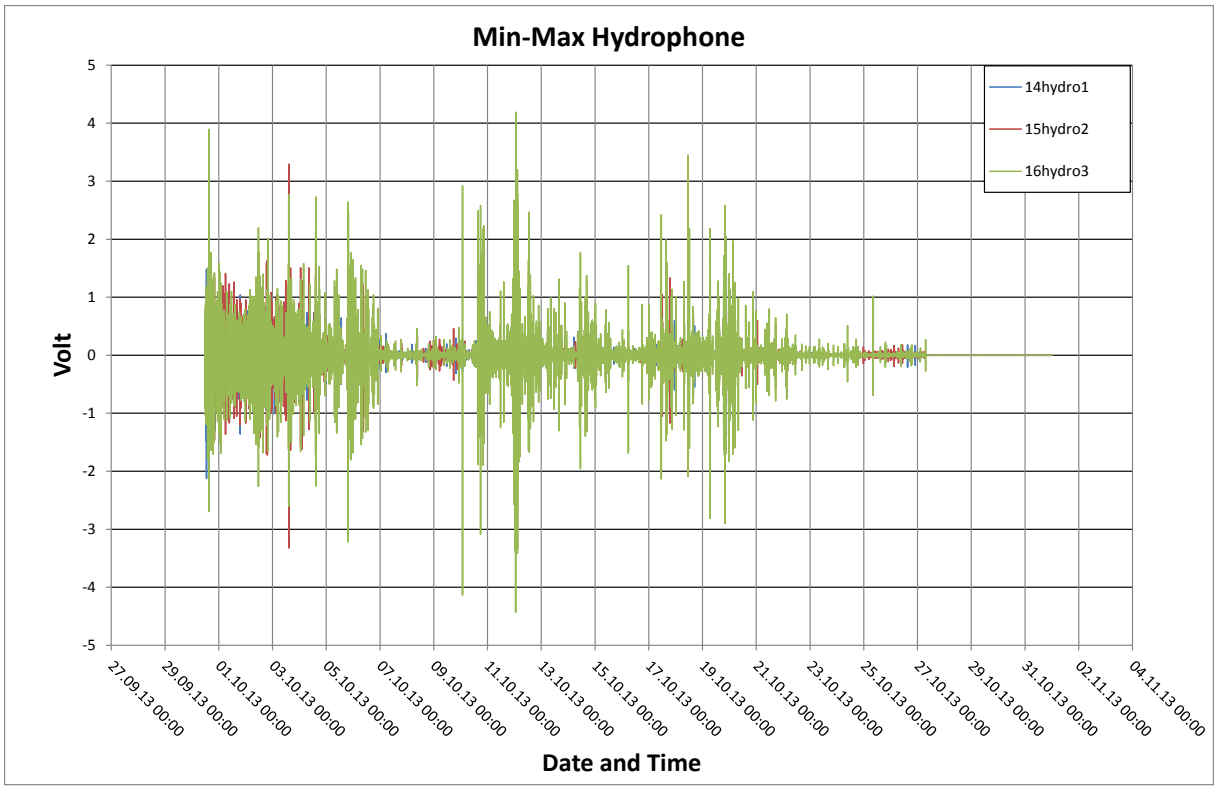

Figure 11: Minimum and maximum values per minute for the hydrophones 1-3 for the month October 2013.

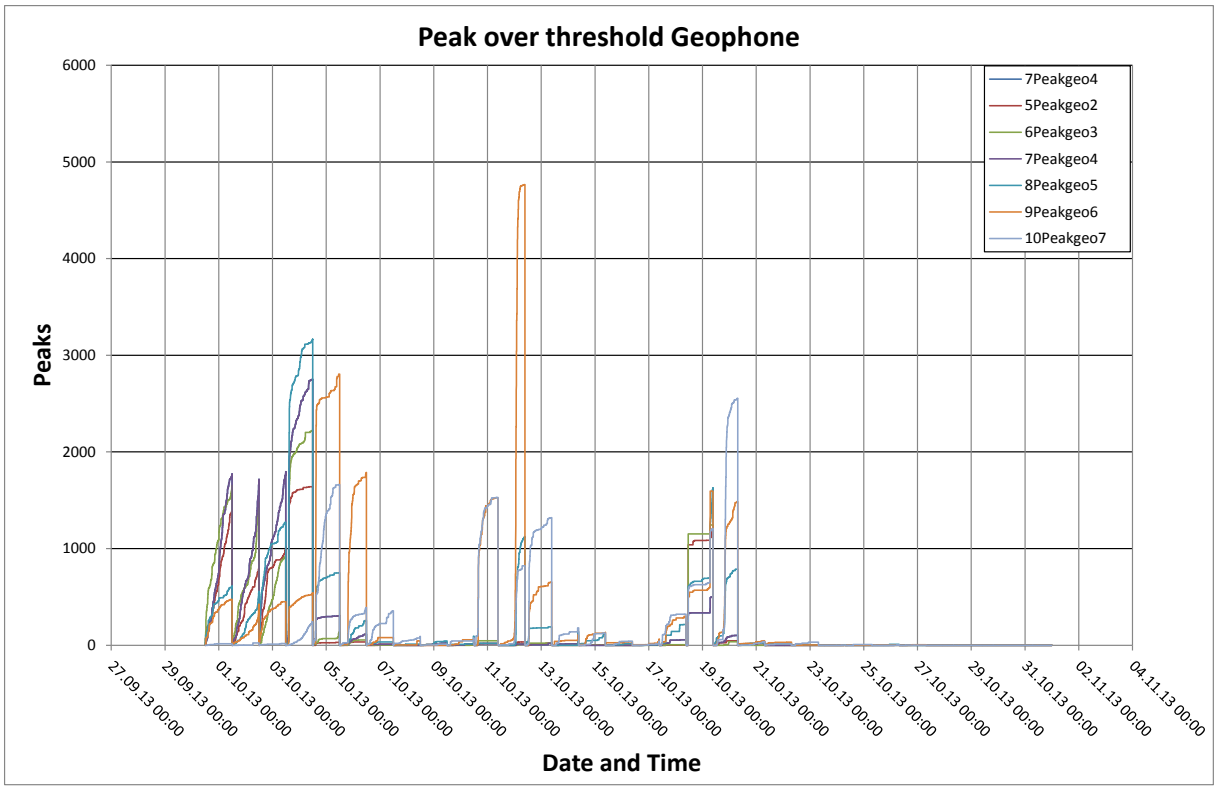

Figure 12: Peak over threshold for the geophones 1-7 per day for the month October 2013.

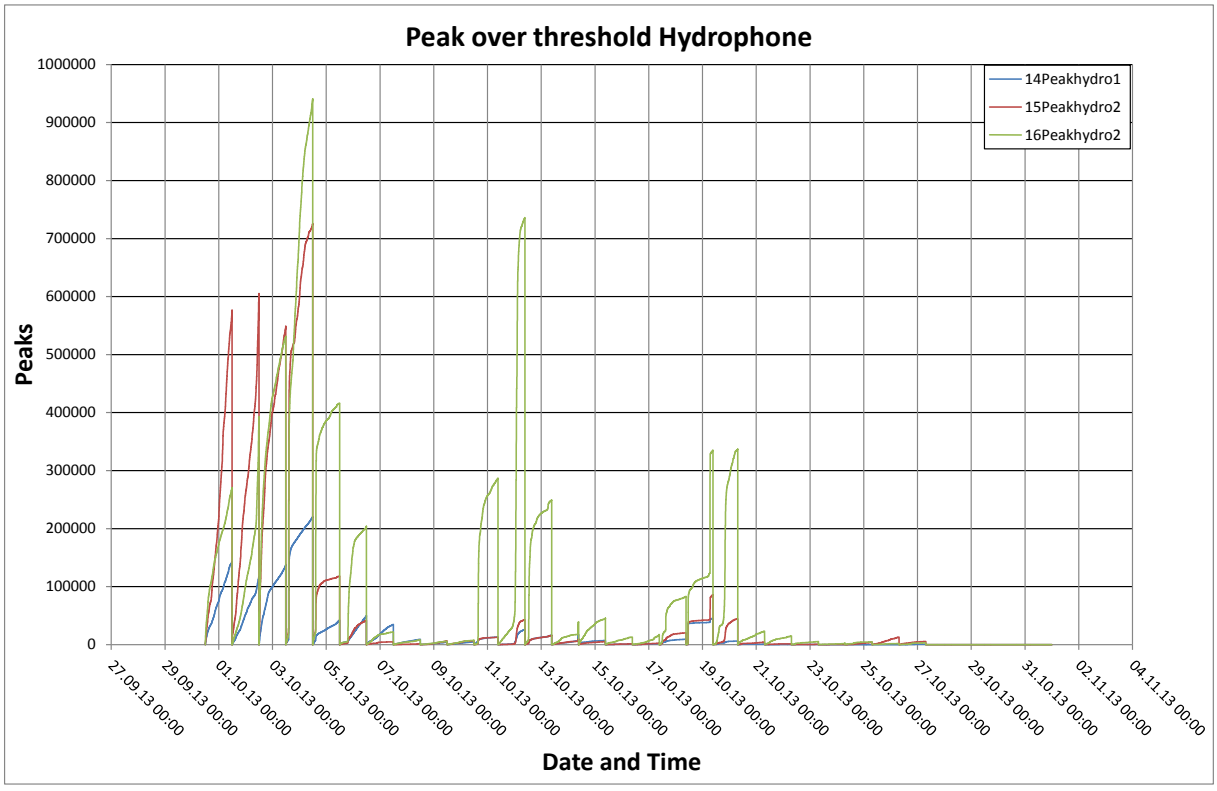

Figure 13: Peak over threshold for the hydrophones 1-3 per day for the month October 2013.

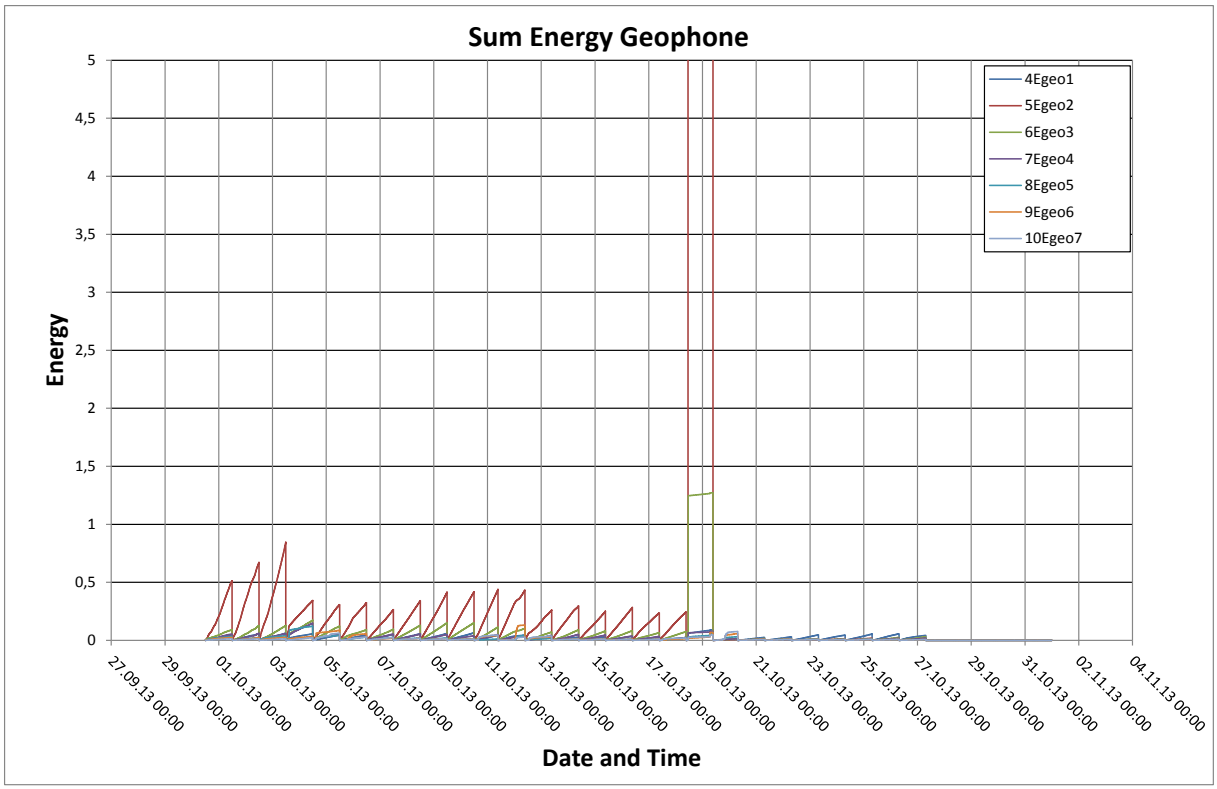

Figure 14: Energy sum for the geophones 1-7 per day for the month October 2013.

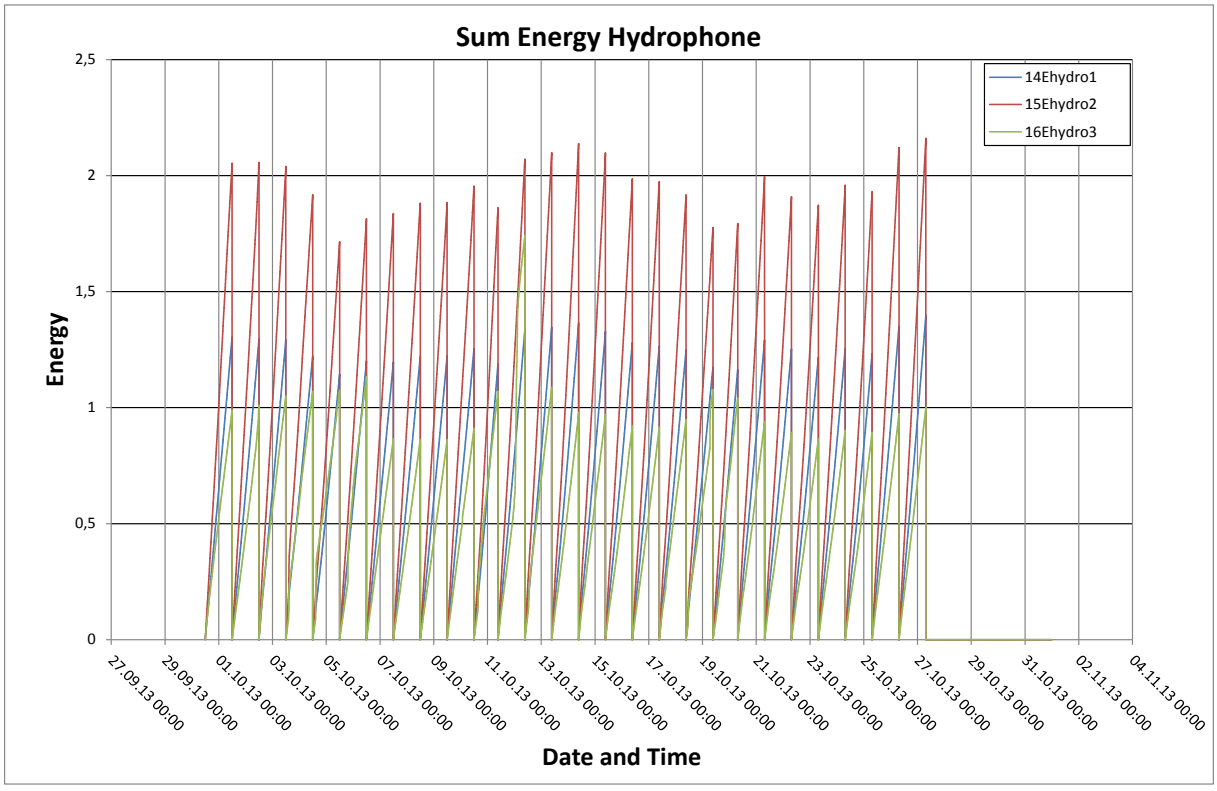

Figure 15: Energy sum for the hydrophones 1-3 per day for the month October 2013.

Data evaluation November 2013

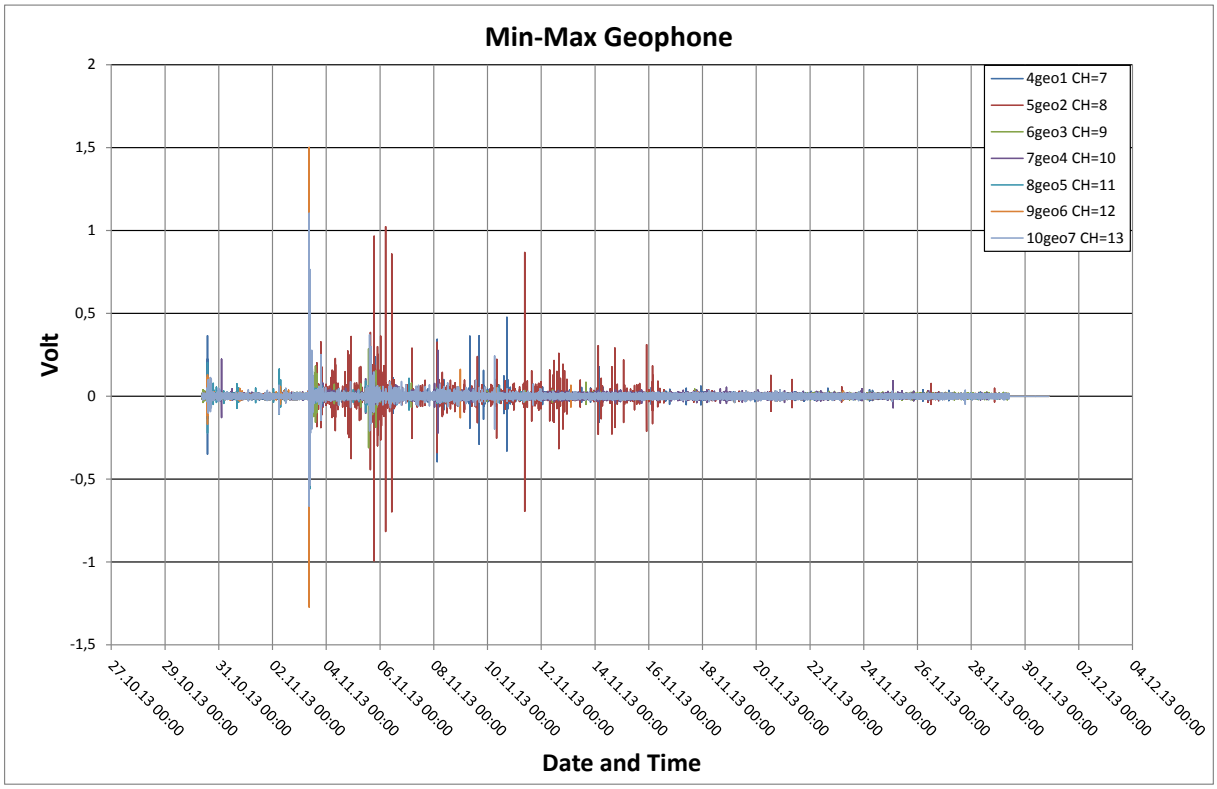

Figure 16: Minimum and maximum values per minute for the geophones 1-7 for the month November 2013.

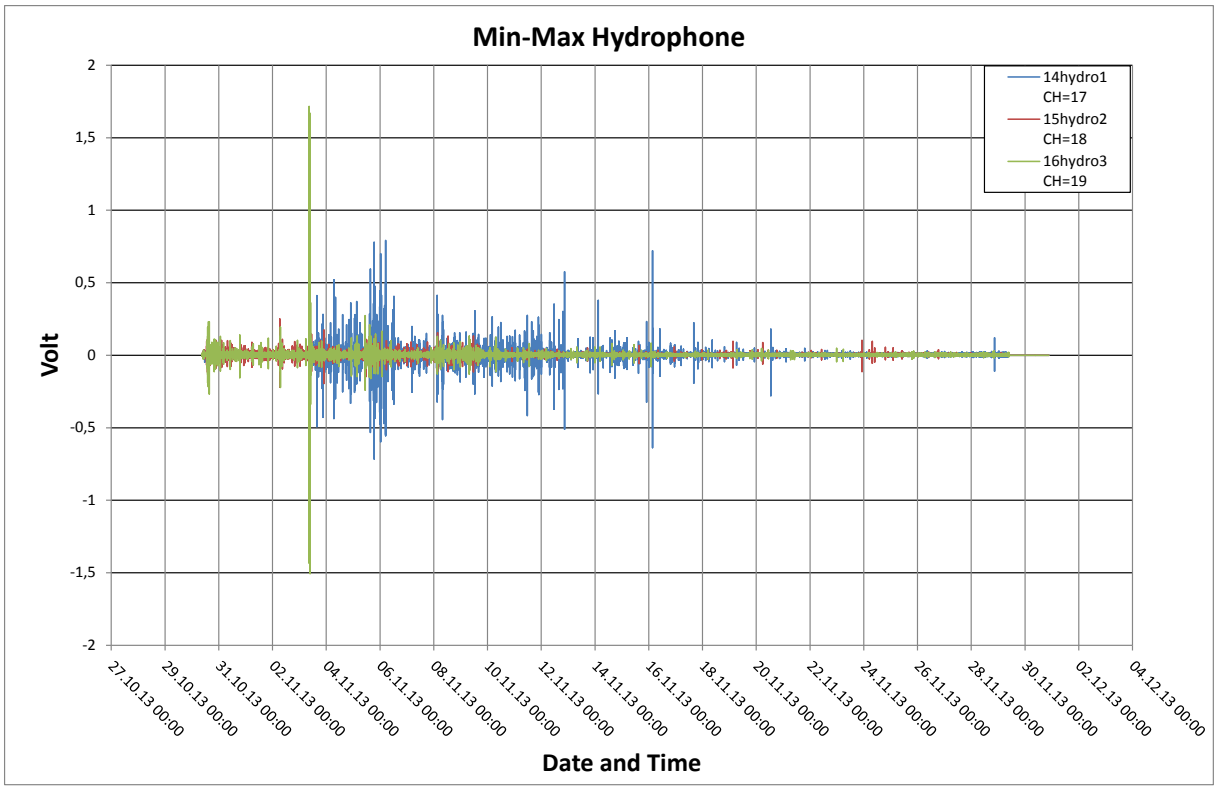

Figure 17: Minimum and maximum values per minute for the hydrophones 1-3 for the month November 2013.

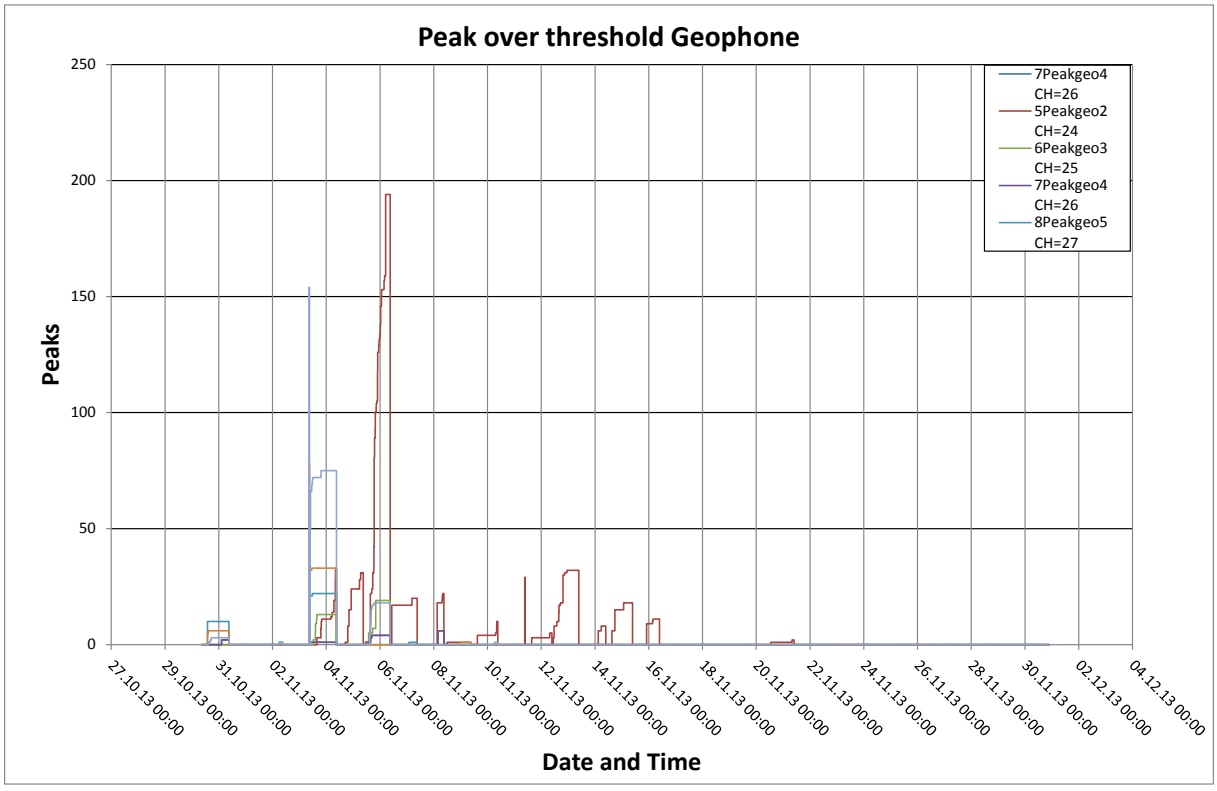

Figure 18: Peak over threshold for the geophones 1-7 per day for the month November 2013.

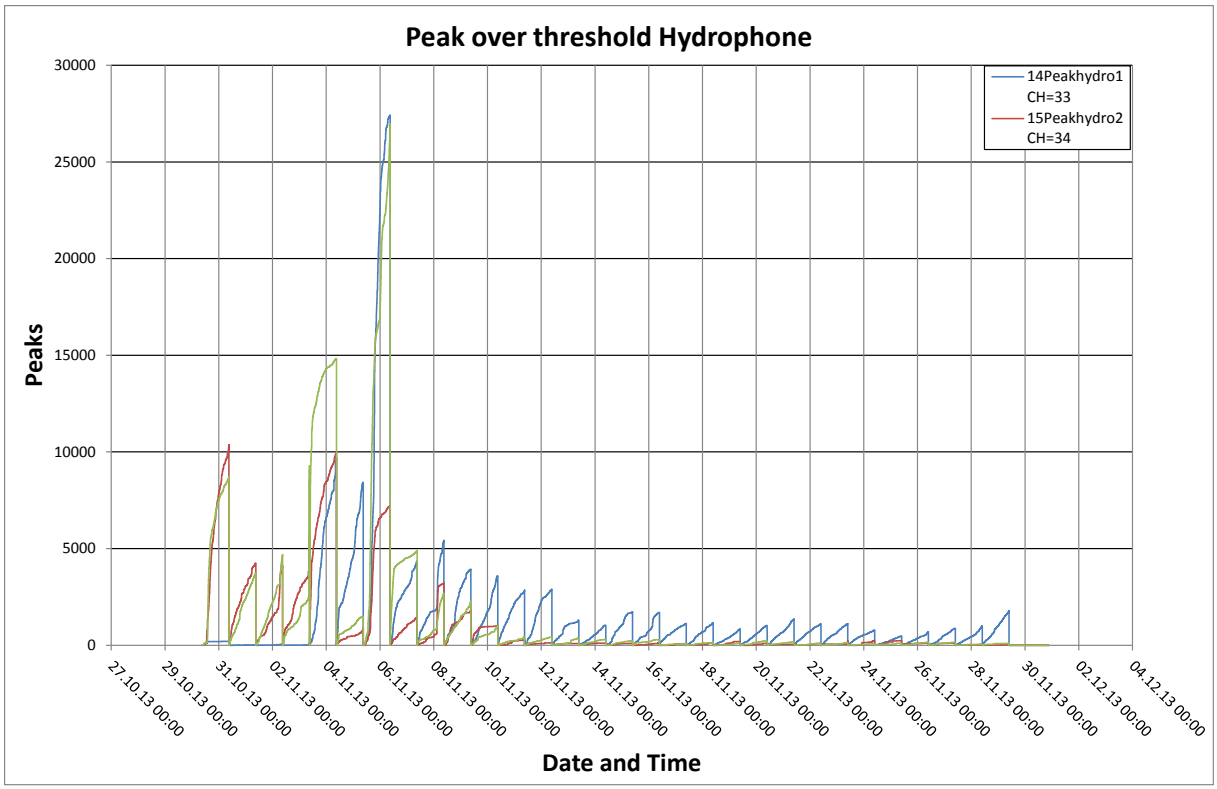

Figure 19: Peak over threshold for the hydrophones 1-3 per day for the month November 2013.

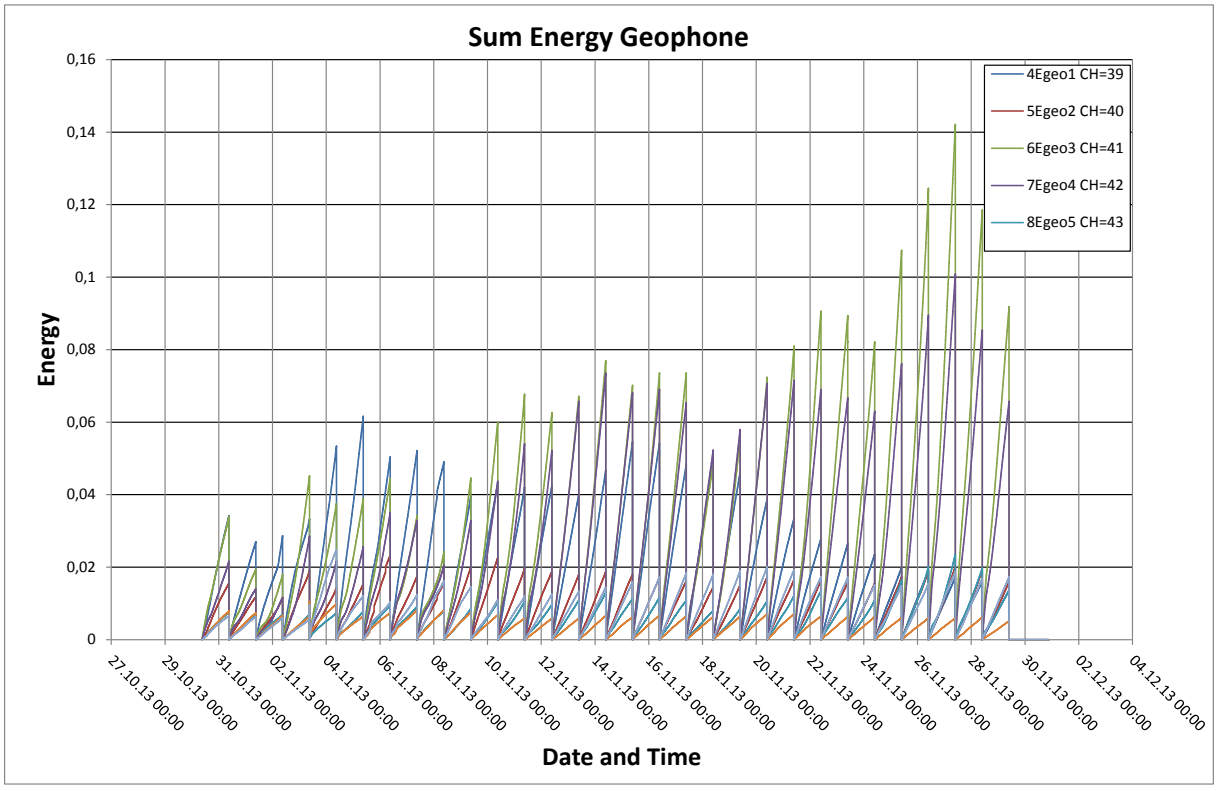

Figure 20: Energy sum for the geophones 1-7 per day for the month November 2013.

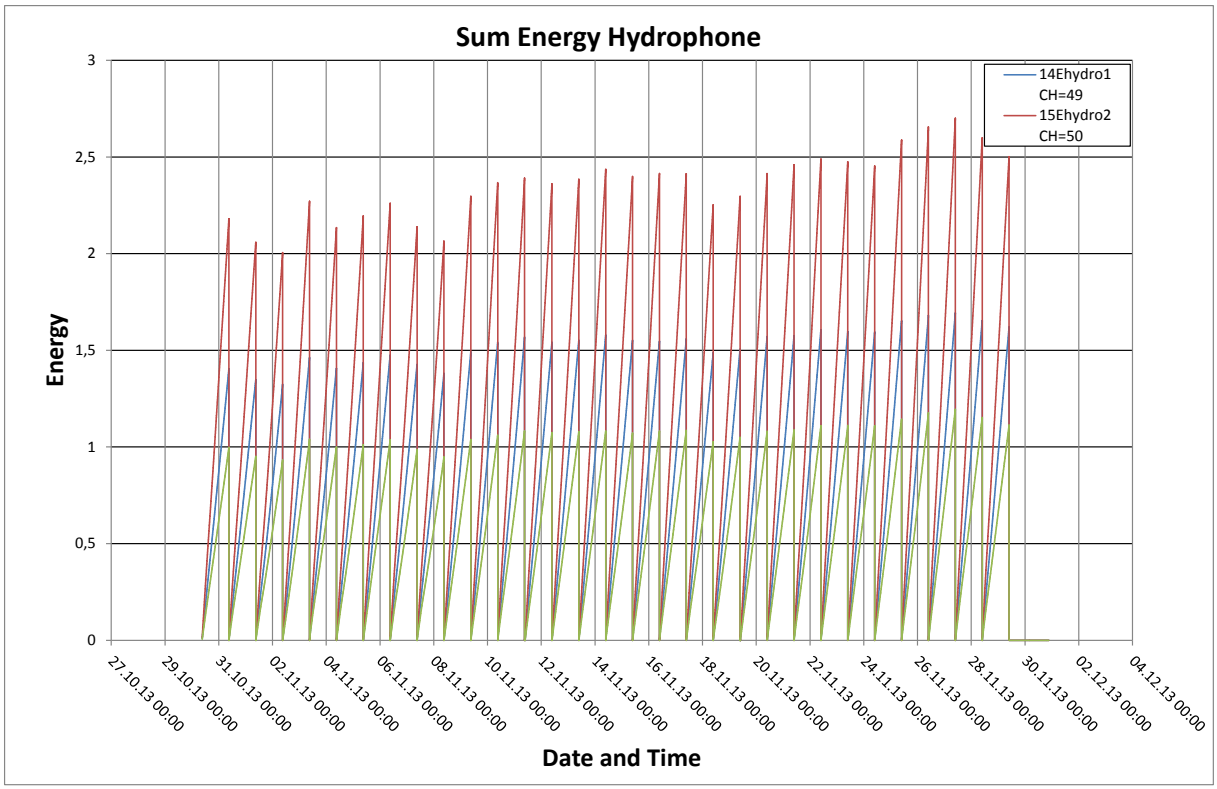

Figure 21: Energy sum for the hydrophones 1-3 per day for the month November 2013.

Data evaluation December 2013

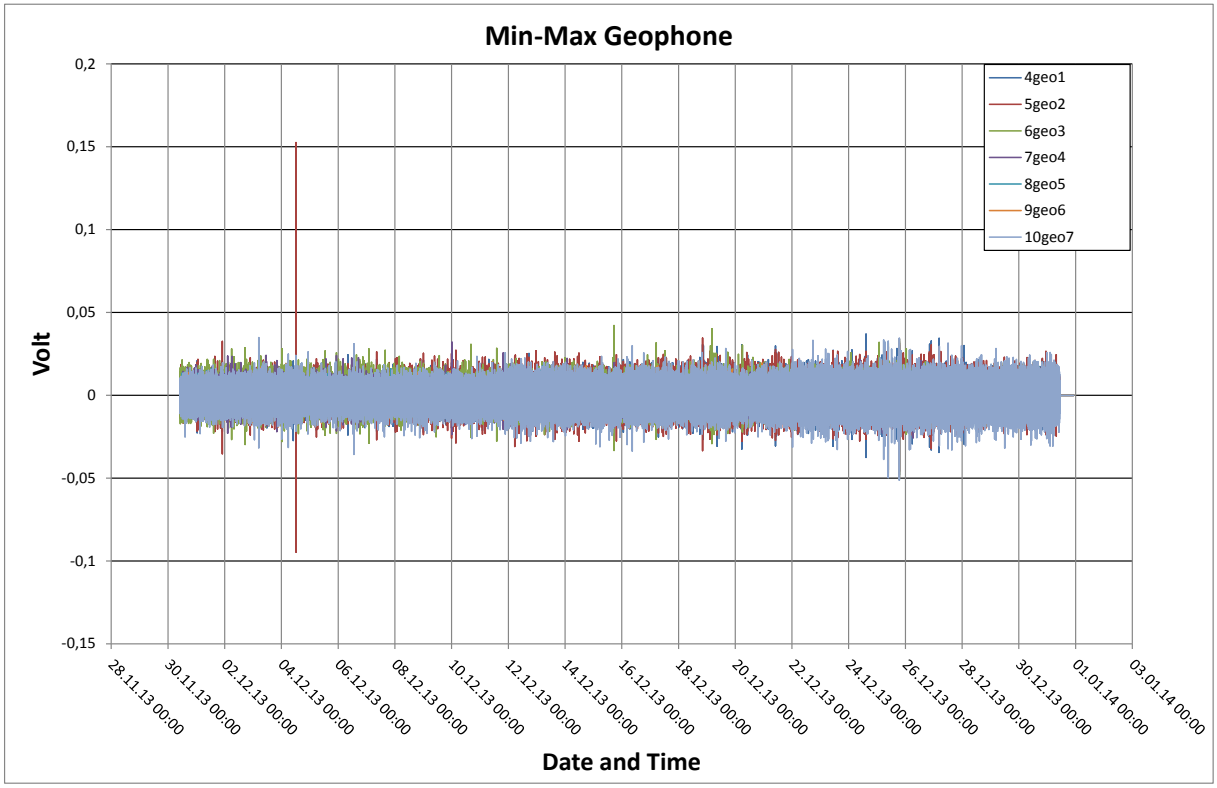

Figure 22: Minimum and maximum values per minute for the geophones 1-7 for the month December 2013.

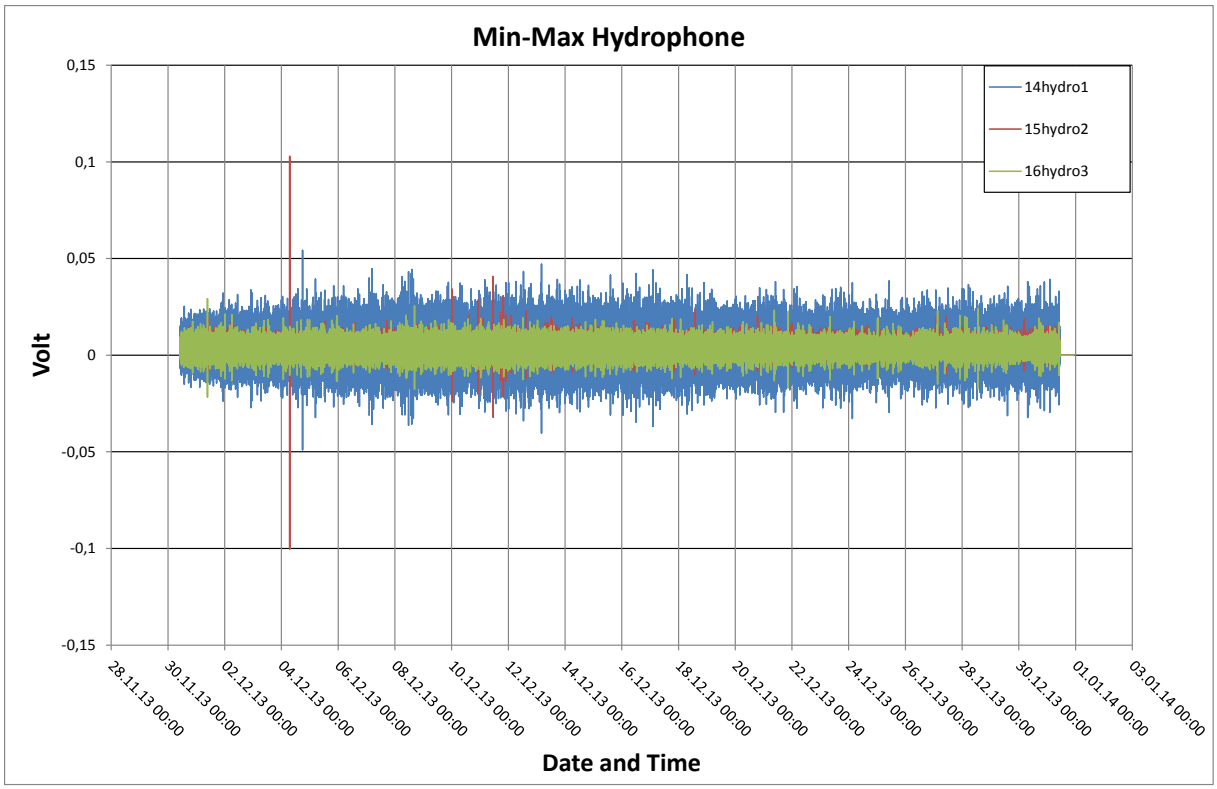

Figure 23: Minimum and maximum values per minute for the hydrophones 1-3 for the month December 2013.

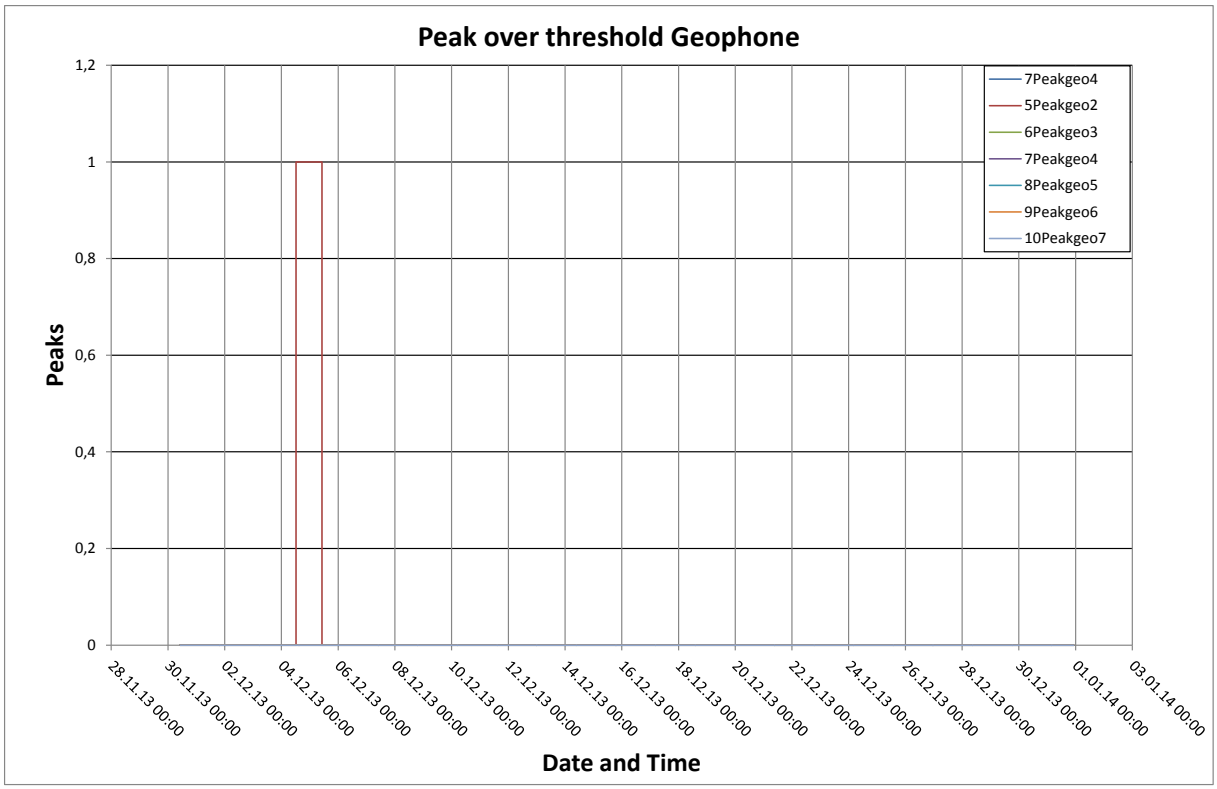

Figure 24: Peak over threshold for the geophones 1-7 per day for the month December 2013.

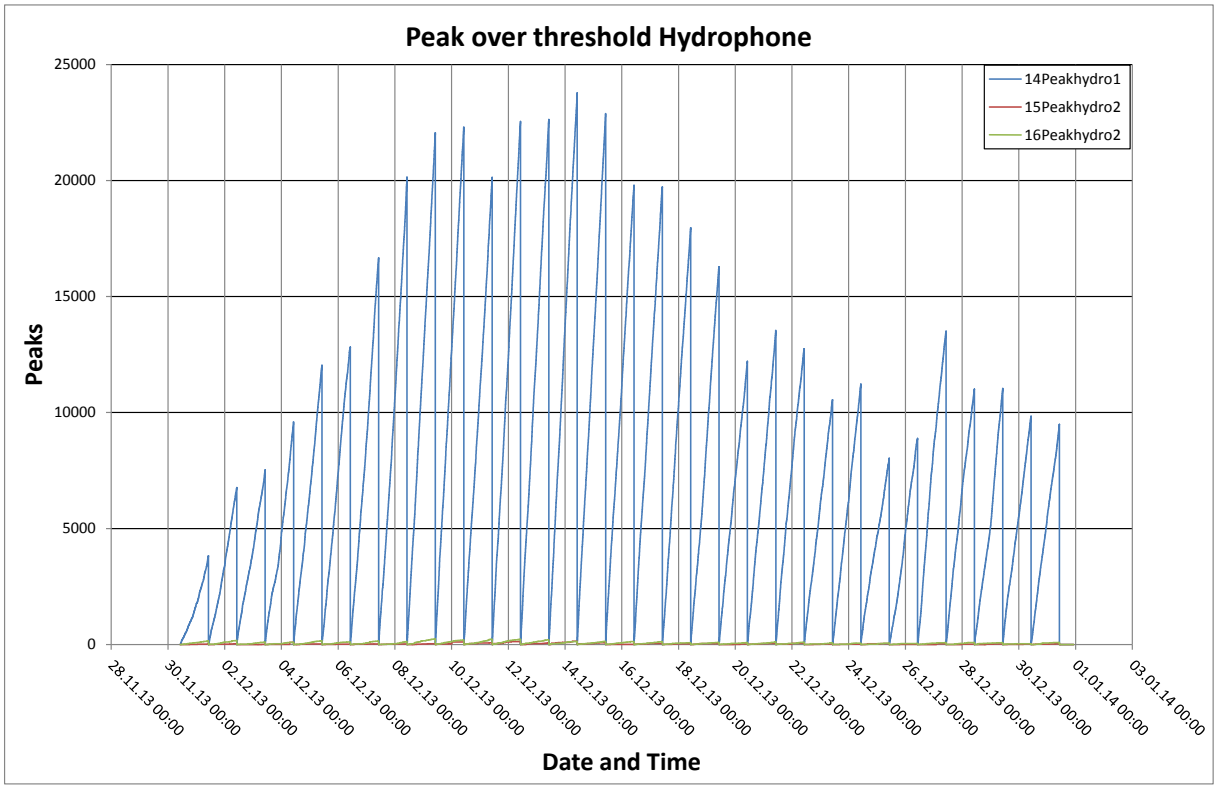

Figure 25: Peak over threshold for the hydrophones 1-3 per day for the month December 2013.

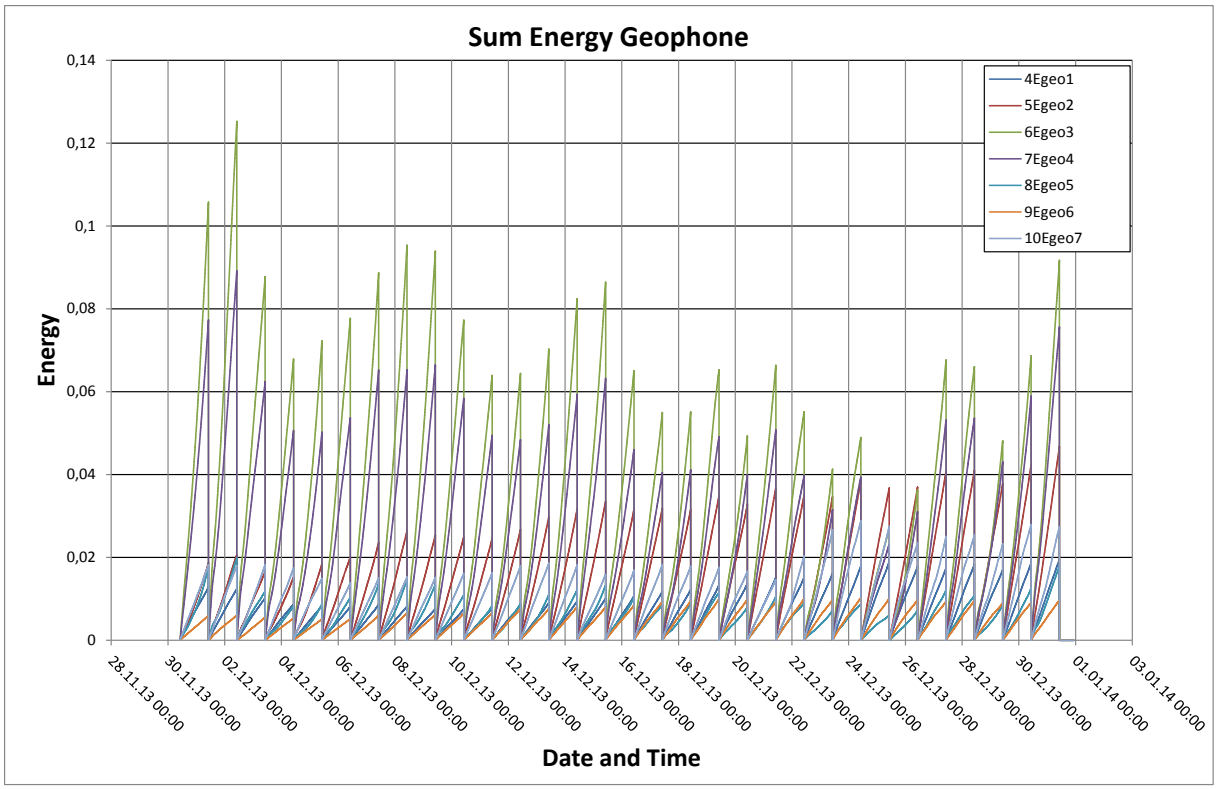

Figure 26: Energy sum for the geophones 1-7 per day for the month December 2013.

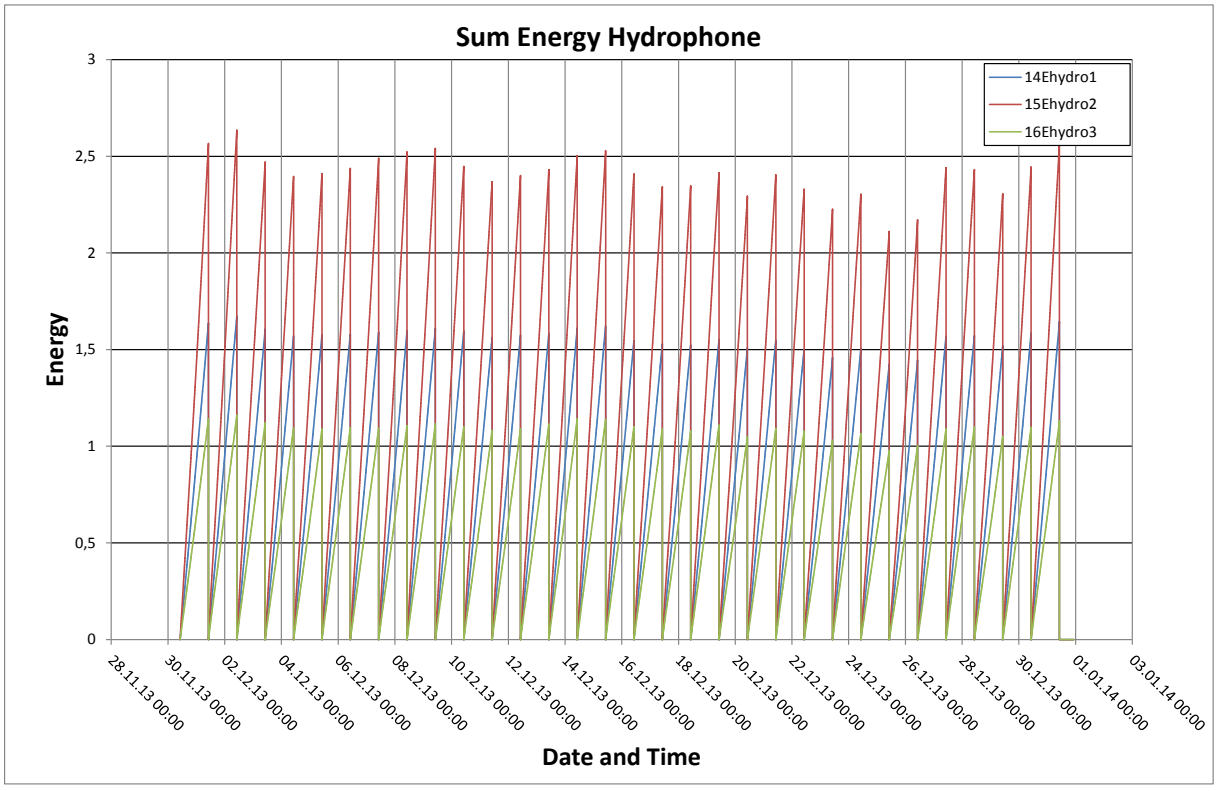

Figure 27: Energy sum for the hydrophones 1-3 per day for the month December 2013.

Data evaluation January 2014

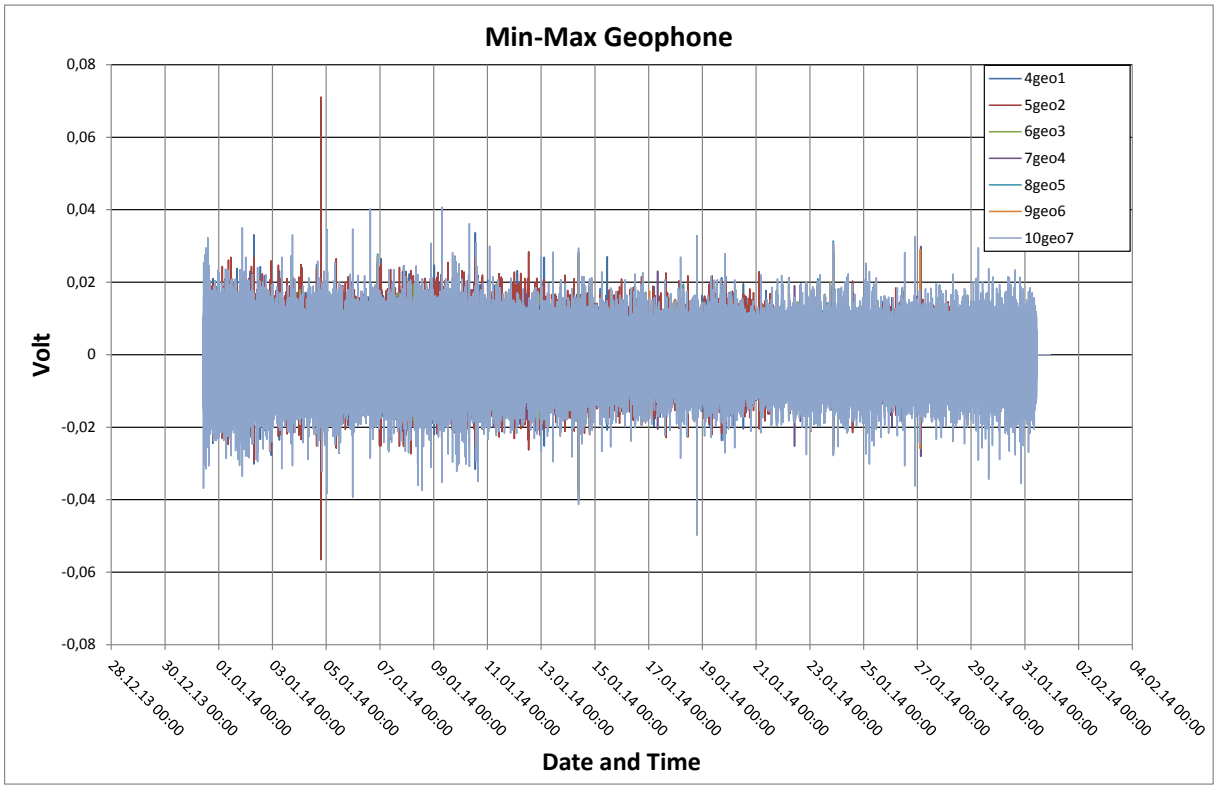

Figure 28: Minimum and maximum values per minute for the geophones 1-7 for the month January 2014.

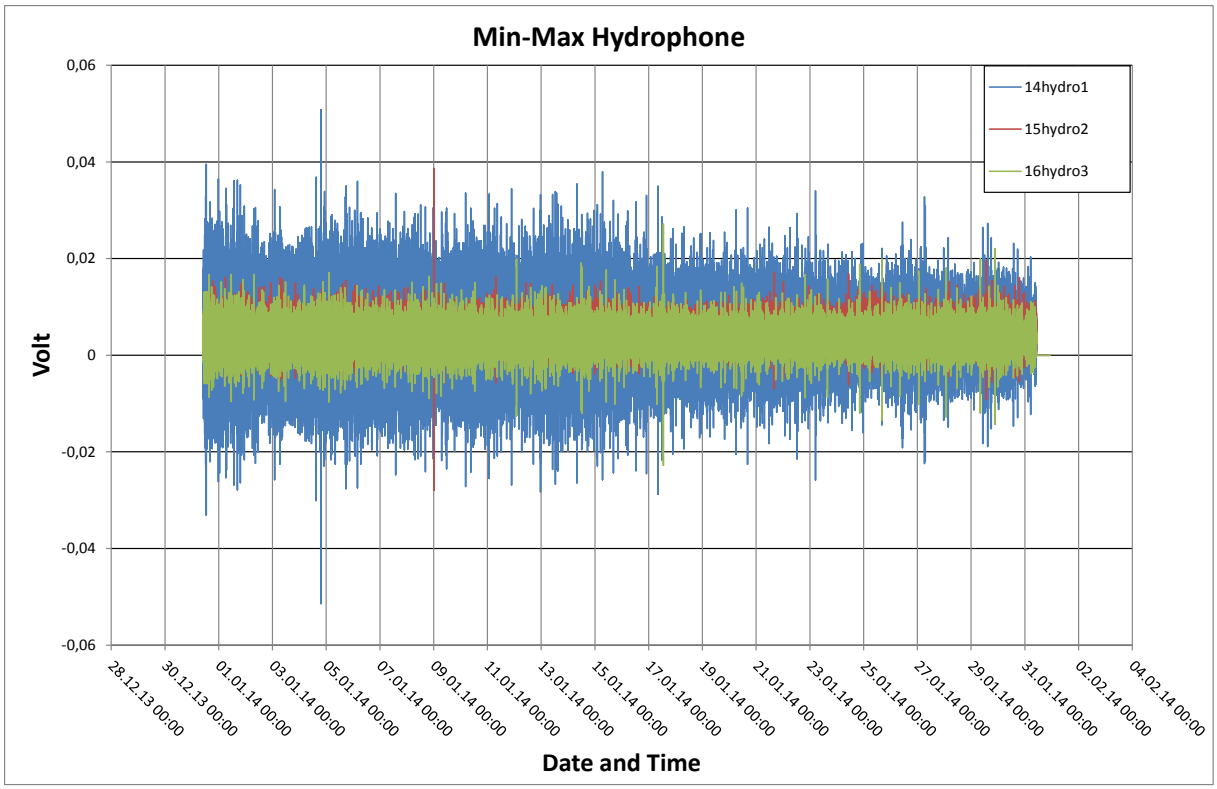

Figure 29: Minimum and maximum values per minute for the hydrophones 1-3 for the month January 2014.

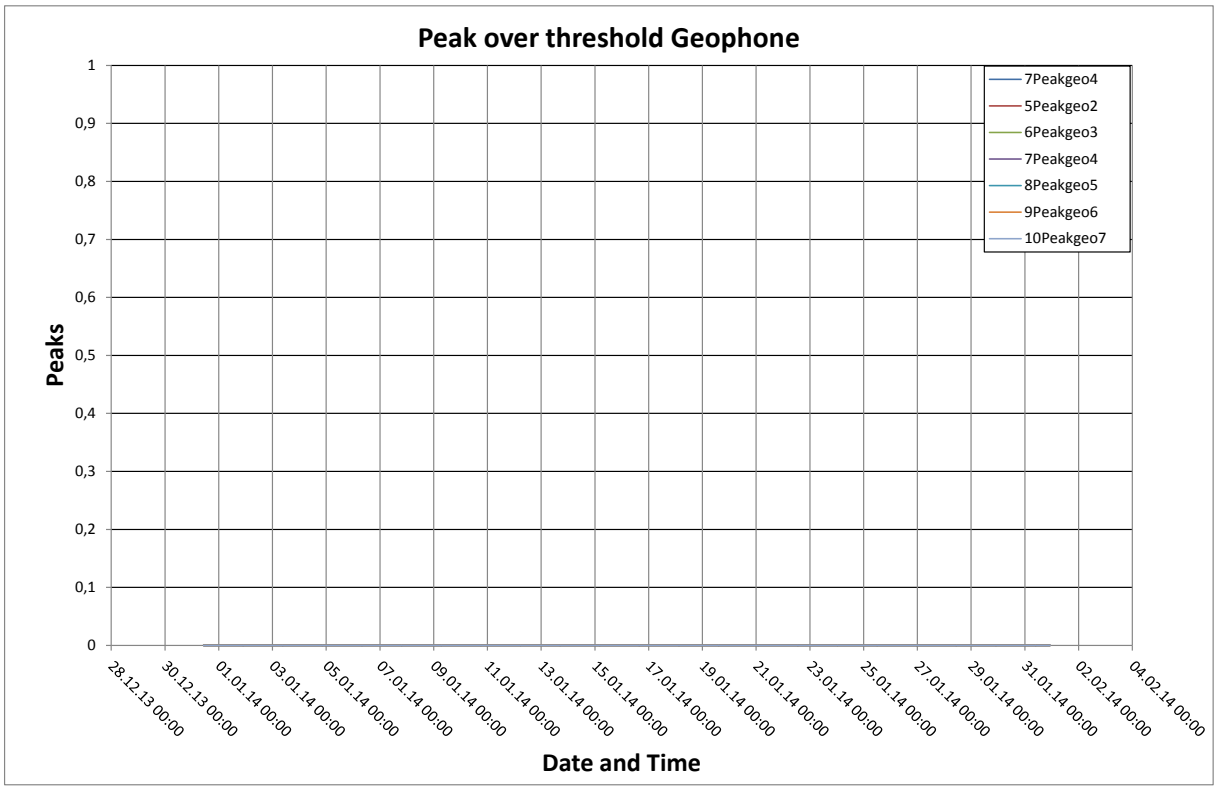

Figure 30: Peak over threshold for the geophones 1-7 per day for the month January 2014.

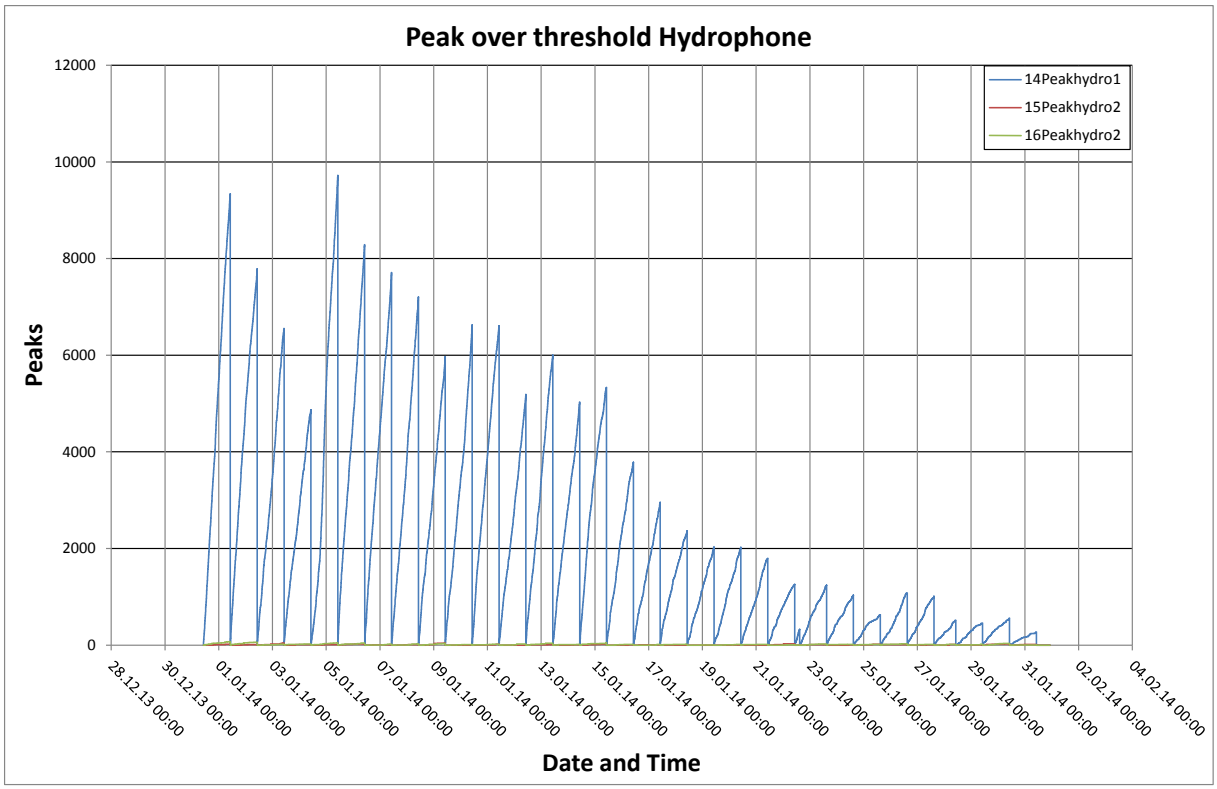

Figure 31: Peak over threshold for the hydrophones 1-3 per day for the month January 2014.

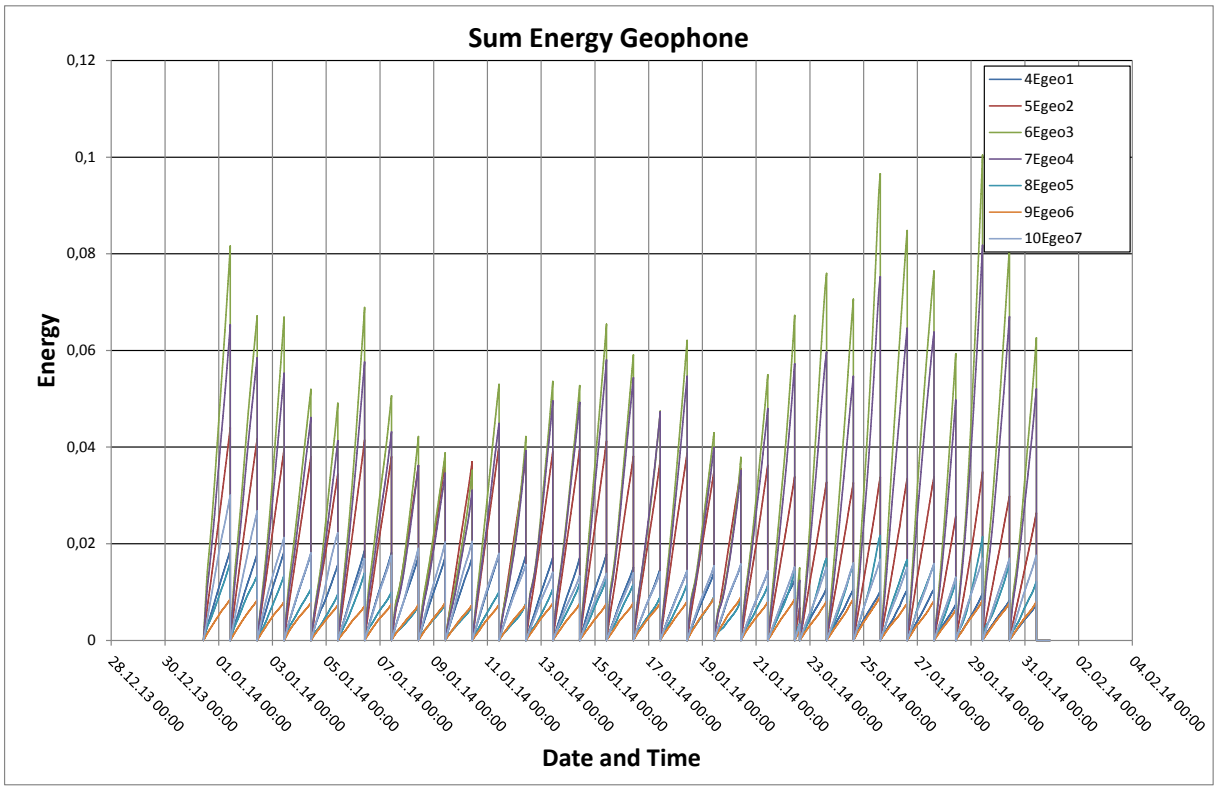

Figure 32: Energy sum for the geophones 1-7 per day for the month January 2014.

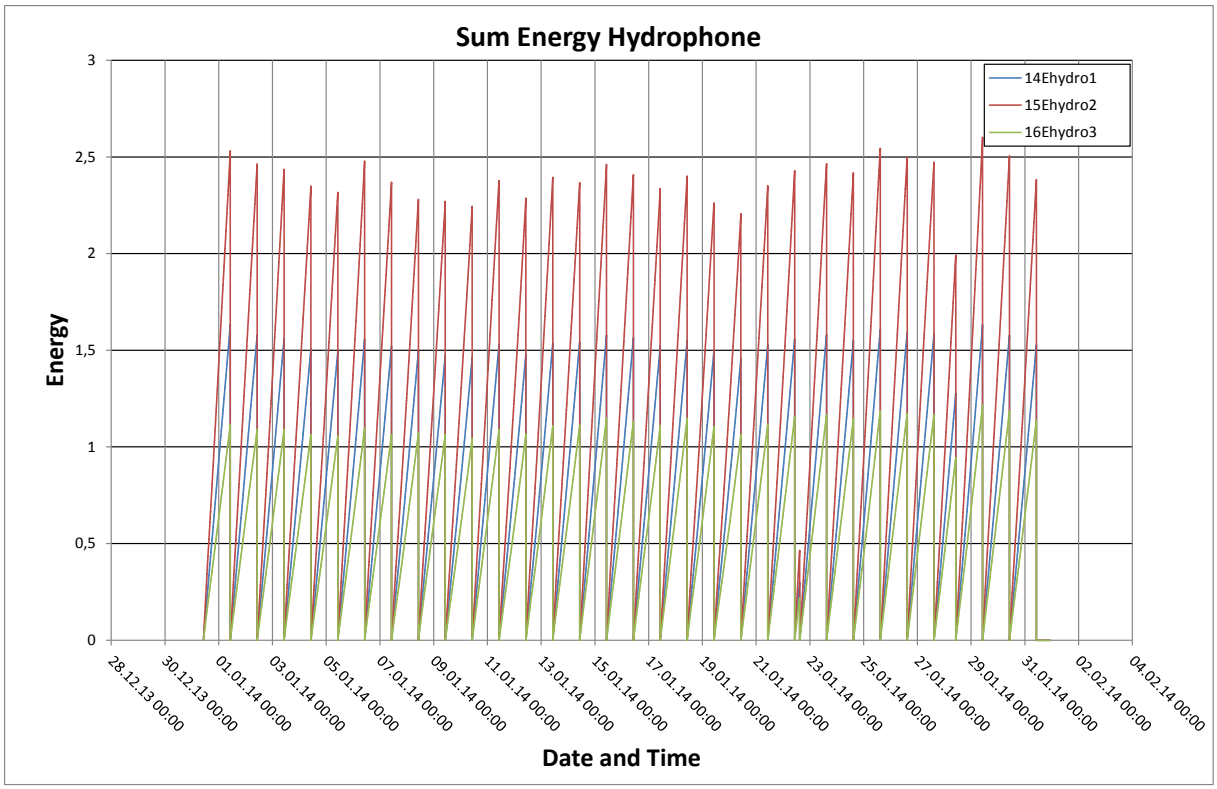

Figure 33: Energy sum for the hydrophones 1-3 per day for the month January 2014.

Data evaluation February 2014

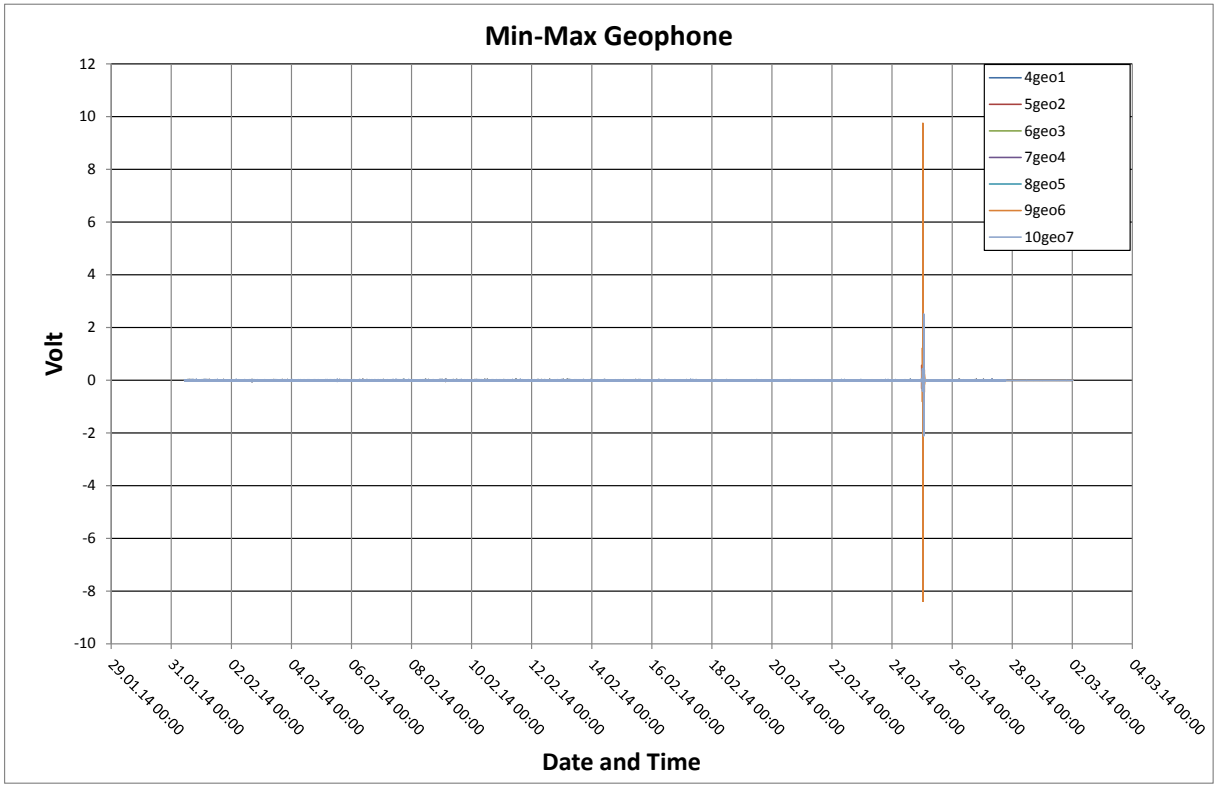

Figure 34: Minimum and maximum values per minute for the geophones 1-7 for the month February 2014.

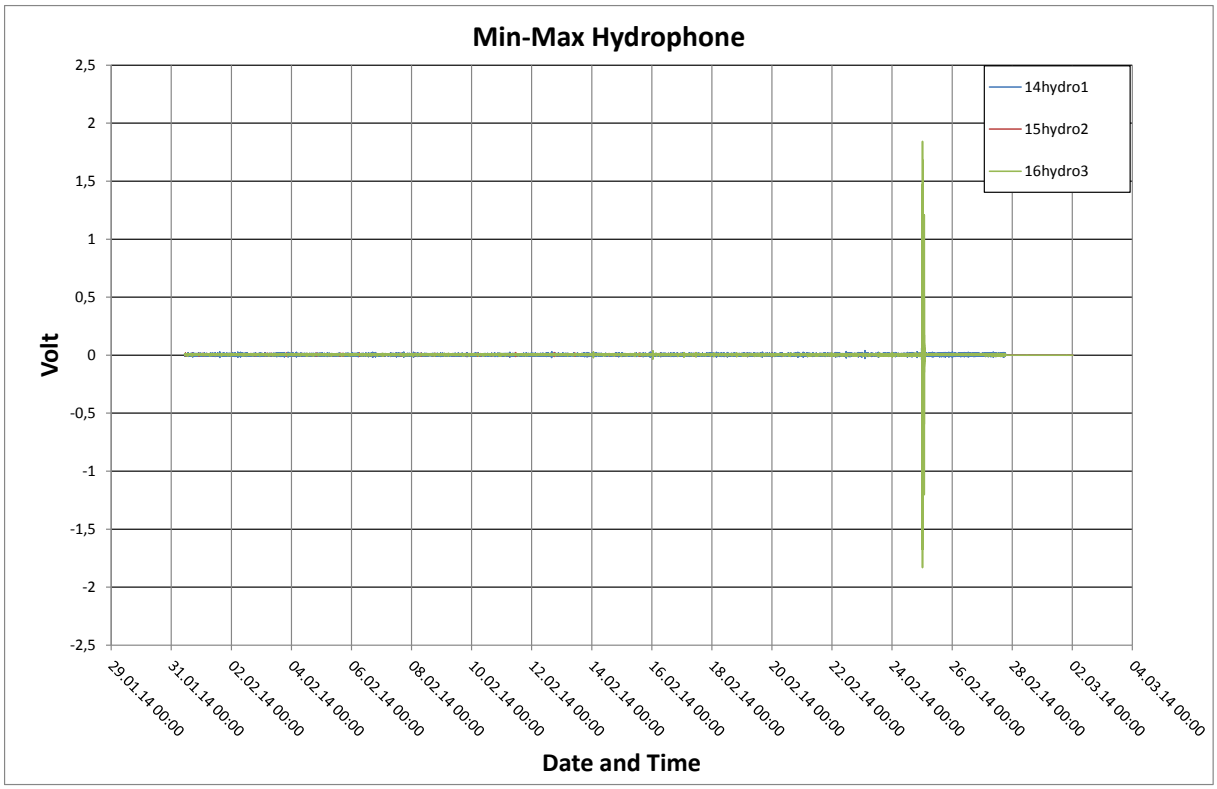

Figure 35: Minimum and maximum values per minute for the hydrophones 1-3 for the month February 2014.

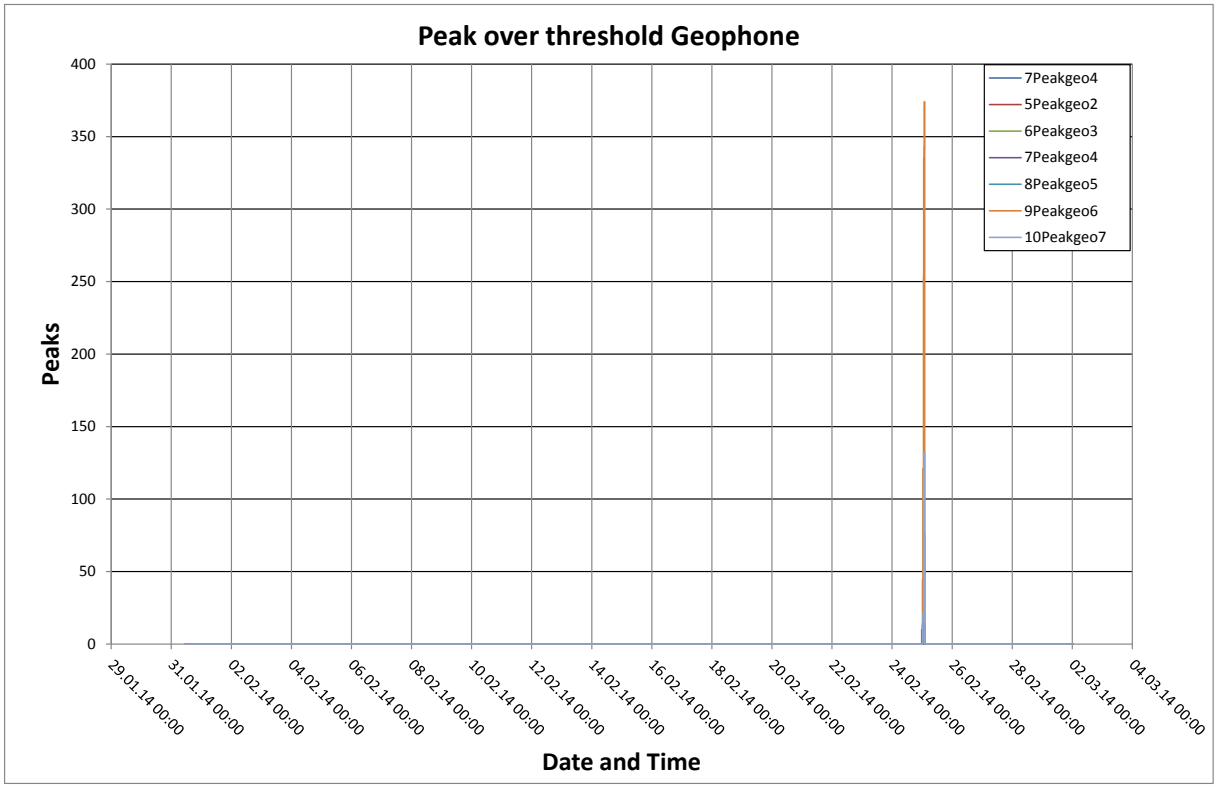

Figure 36: Peak over threshold for the geophones 1-7 per day for the month February 2014.

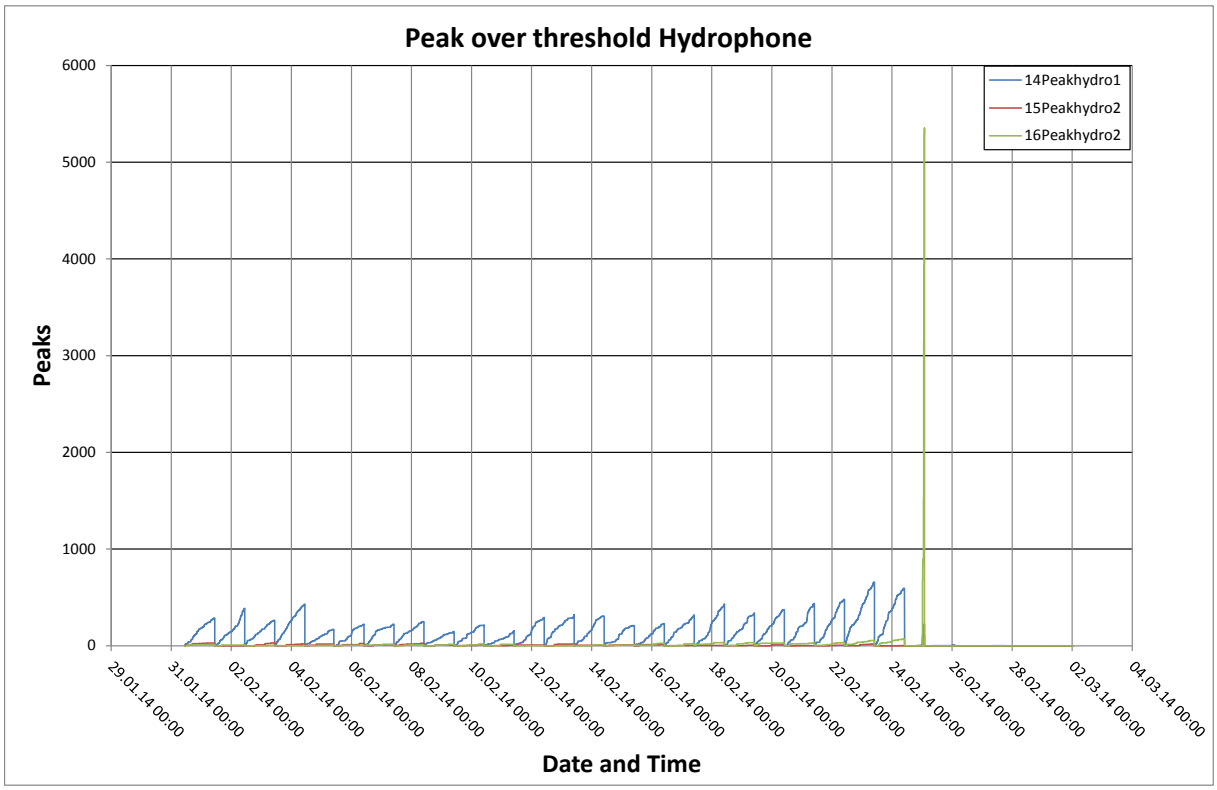

Figure 37: Peak over threshold for the hydrophones 1-3 per day for the month February 2014.

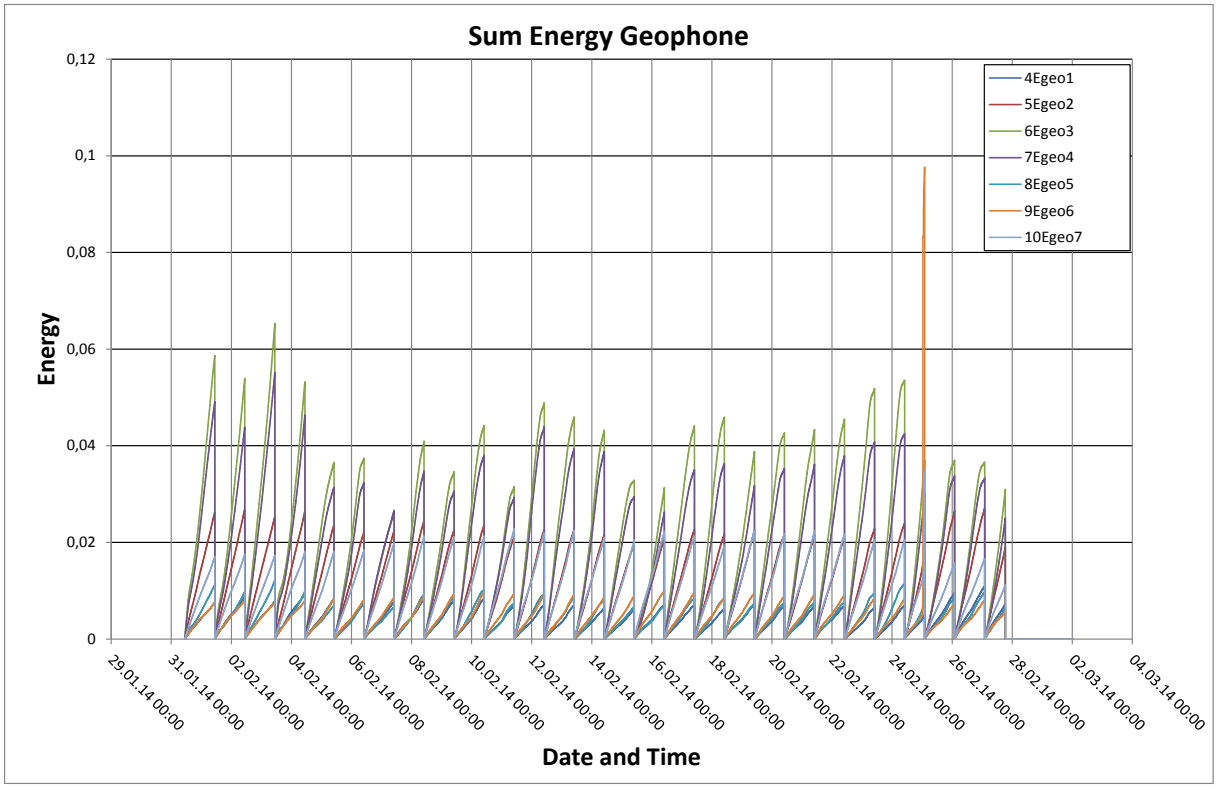

Figure 38: Energy sum for the geophones 1-7 per day for the month February 2014.

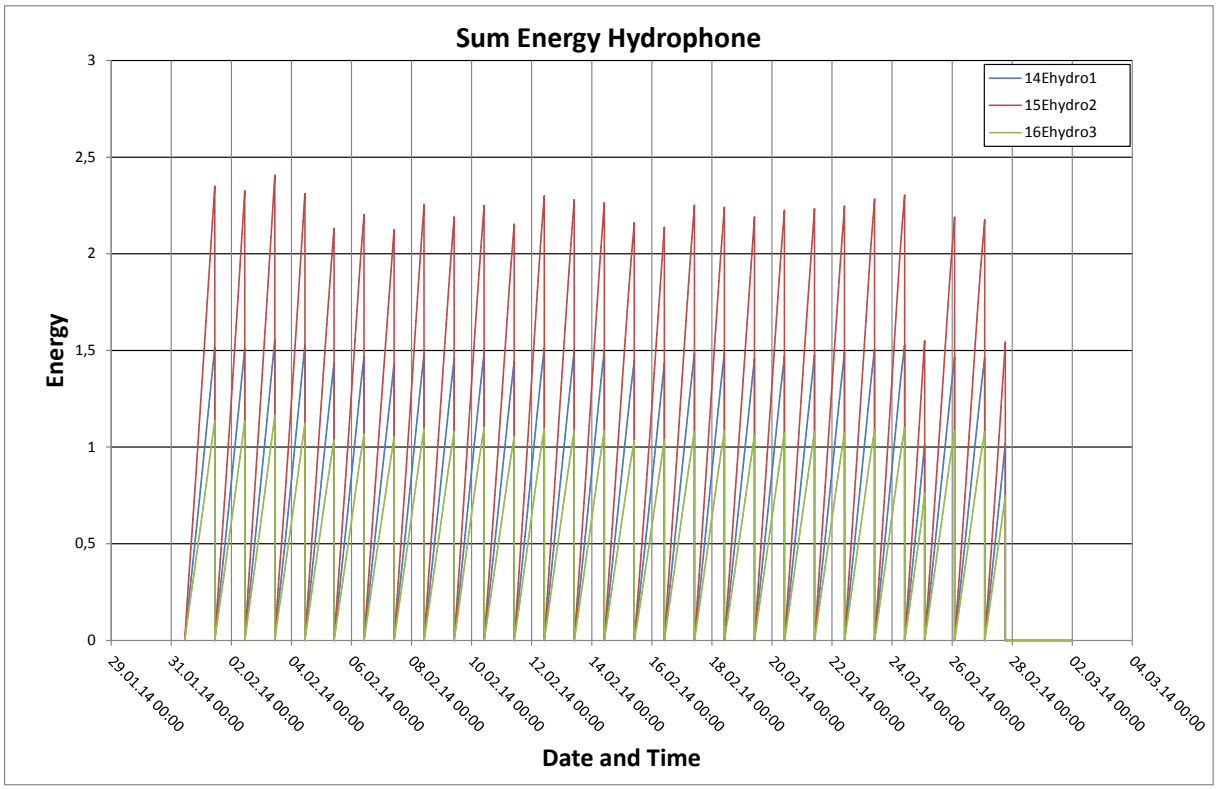

Figure 39: Energy sum for the hydrophones 1-3 per day for the month February 2014.

Data evaluation March 2014

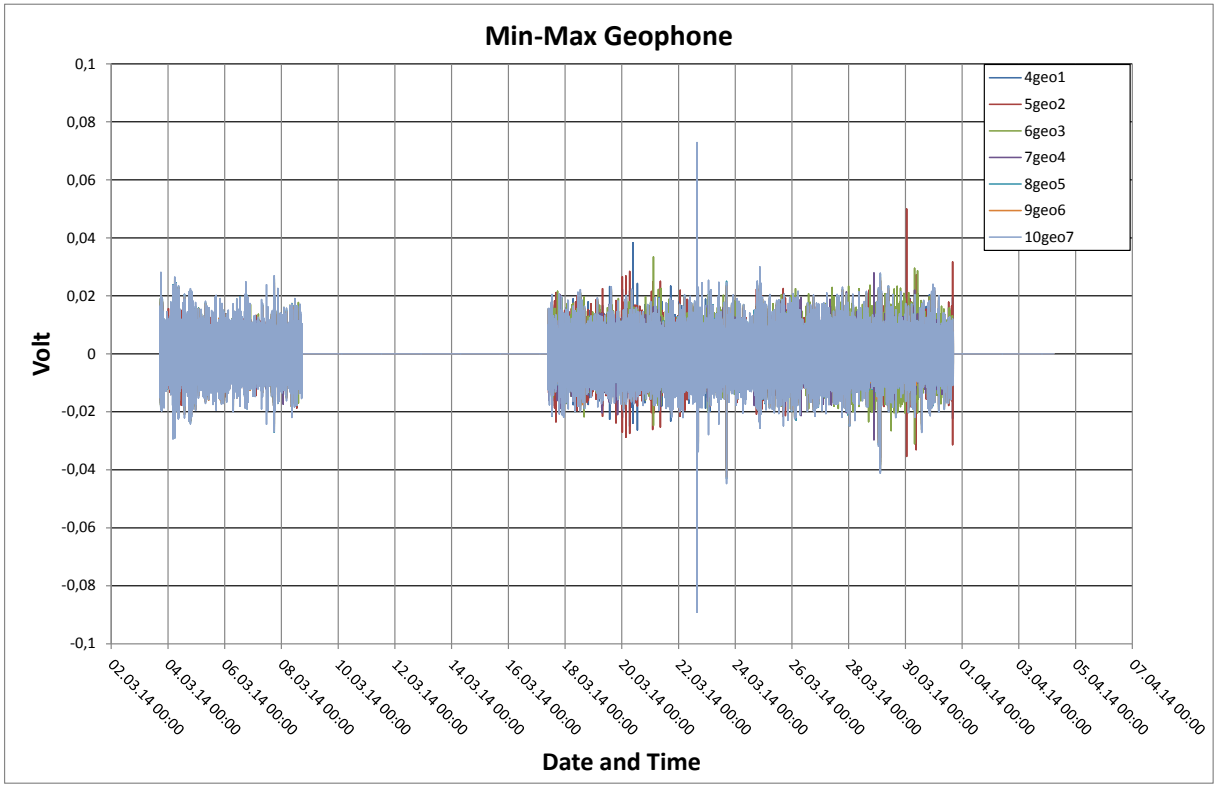

Figure 40: Minimum and maximum values per minute for the geophones 1-7 for the month March 2014.

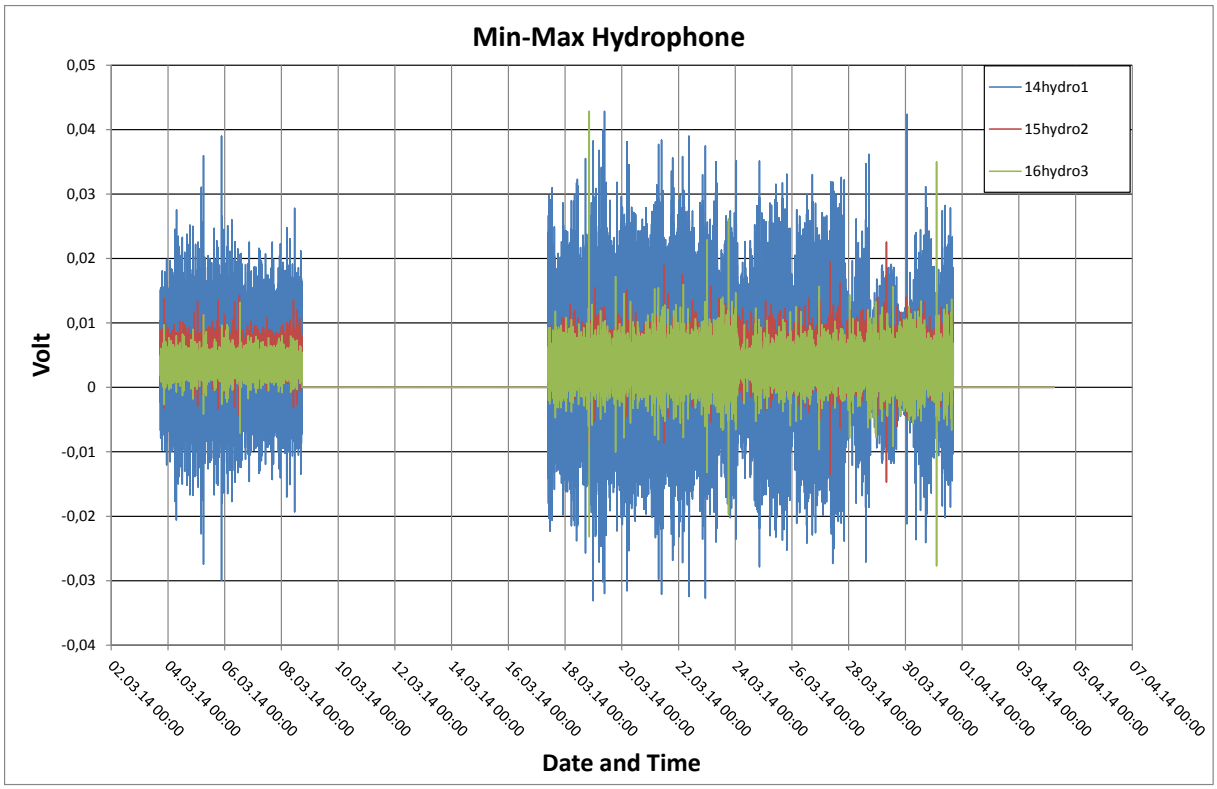

Figure 41: Minimum and maximum values per minute for the hydrophones 1-3 for the month March 2014.

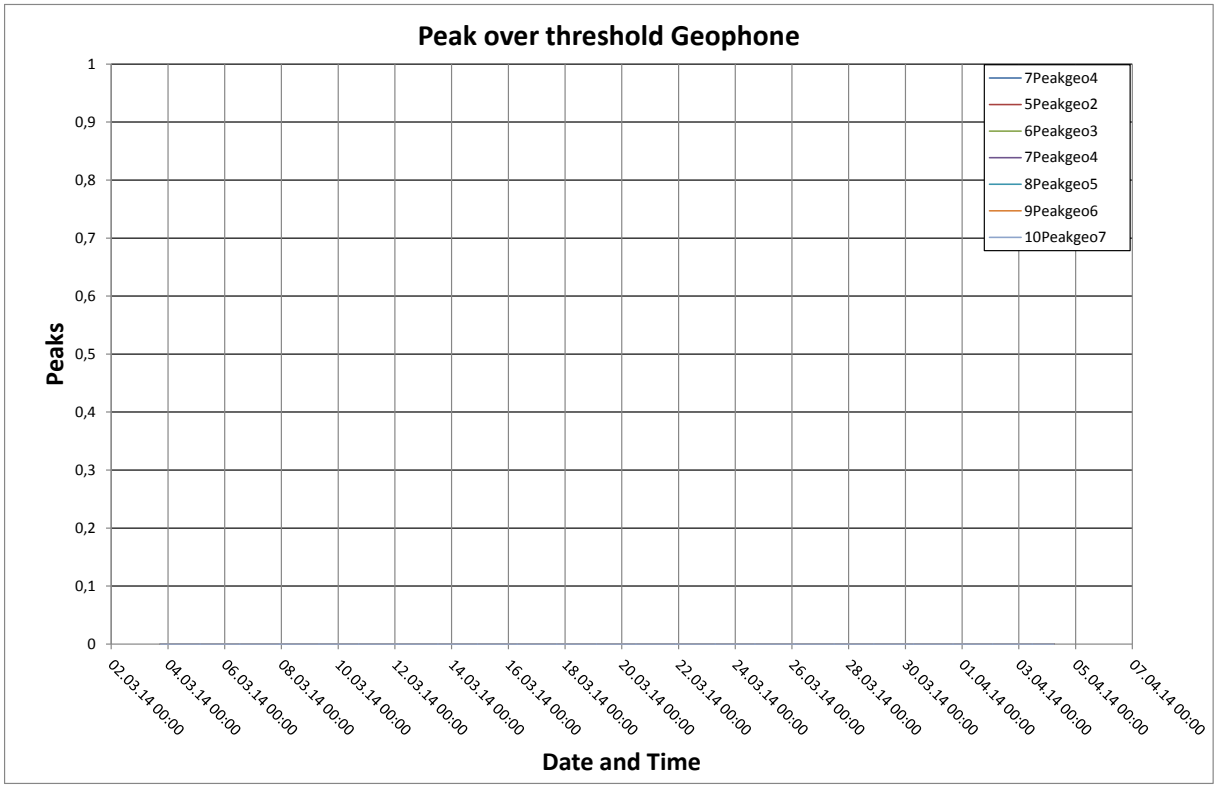

Figure 42: Peak over threshold for the geophones 1-7 per day for the month March 2014.

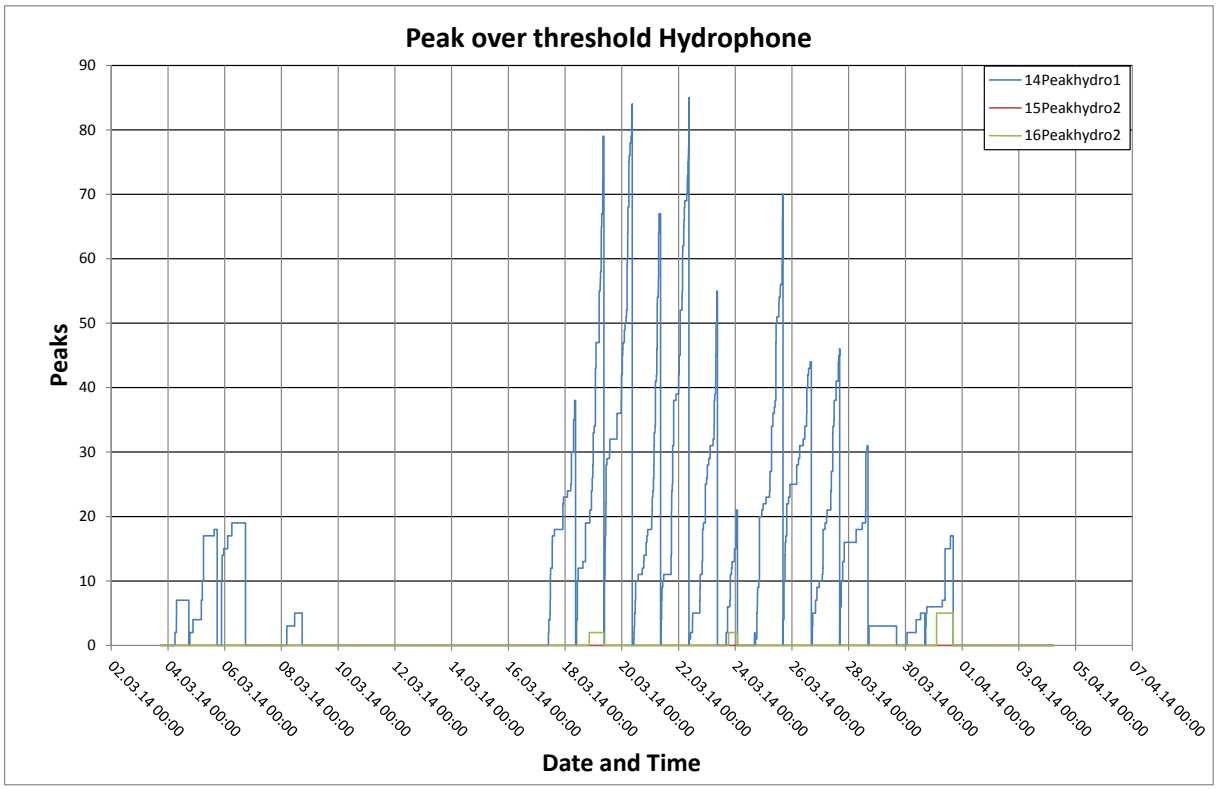

Figure 43: Peak over threshold for the hydrophones 1-3 per day for the month March 2014.

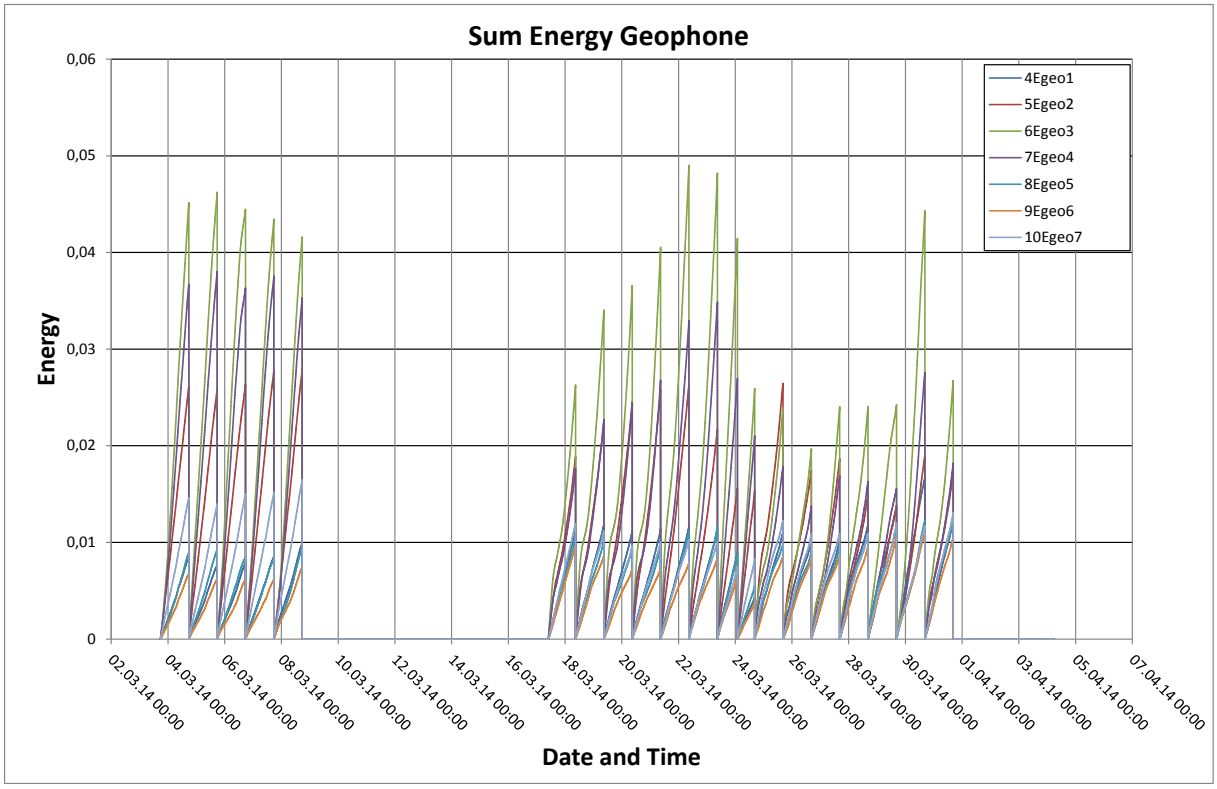

Figure 44: Energy sum for the geophones 1-7 per day for the month March 2014.

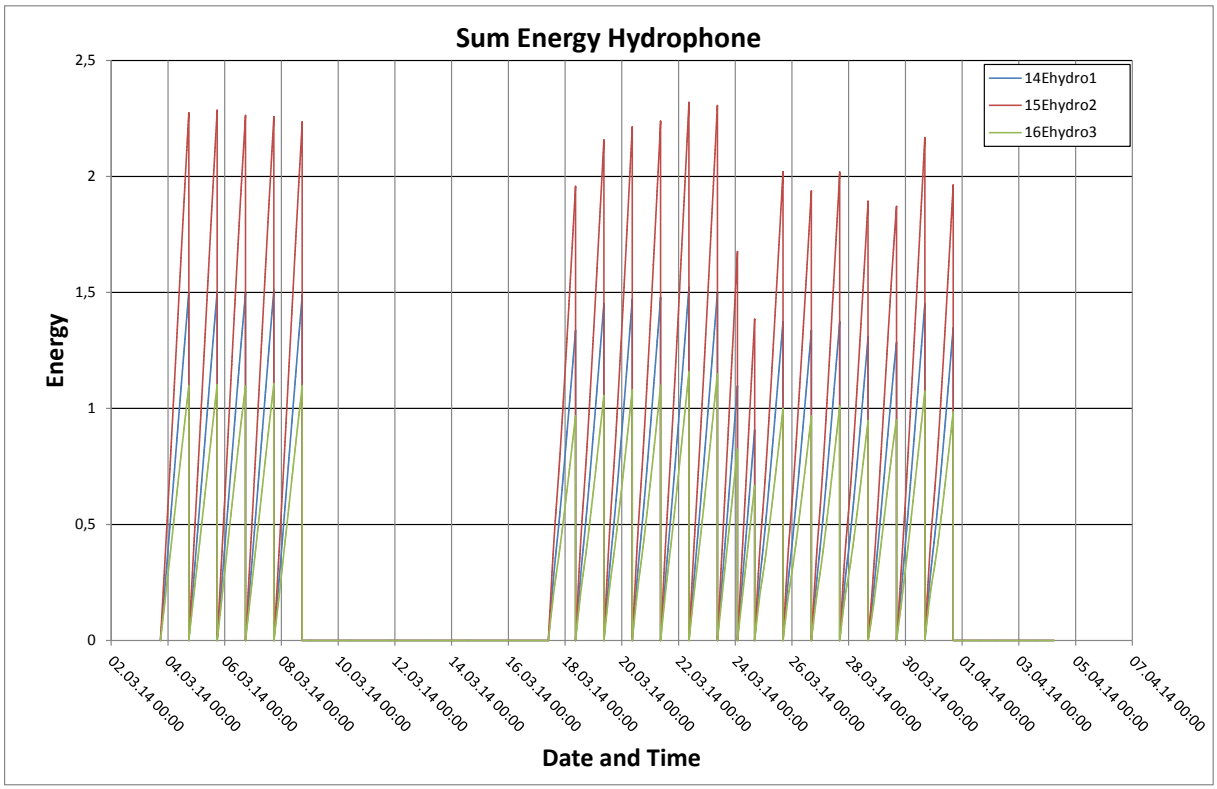

Figure 45: Energy sum for the hydrophones 1-3 per day for the month March 2014.

Data evaluation April 2014

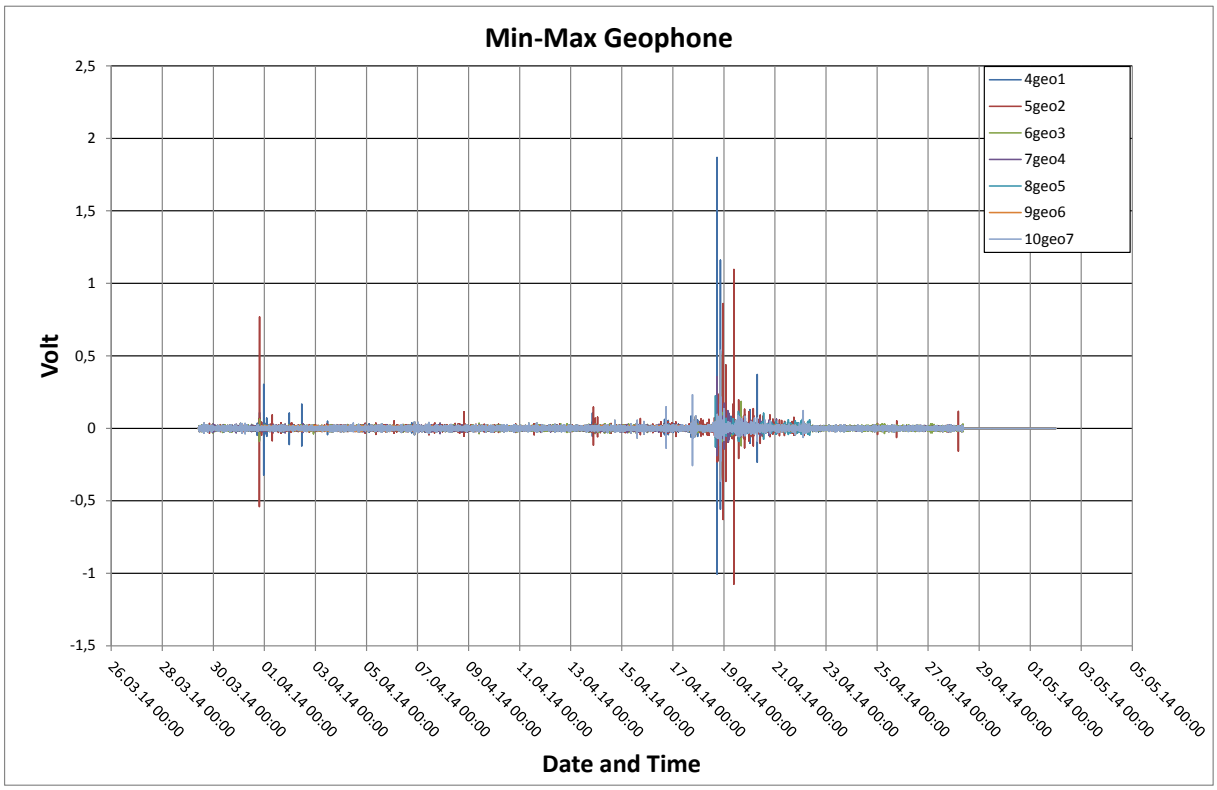

Figure 46: Minimum and maximum values per minute for the geophones 1-7 for the month April 2014.

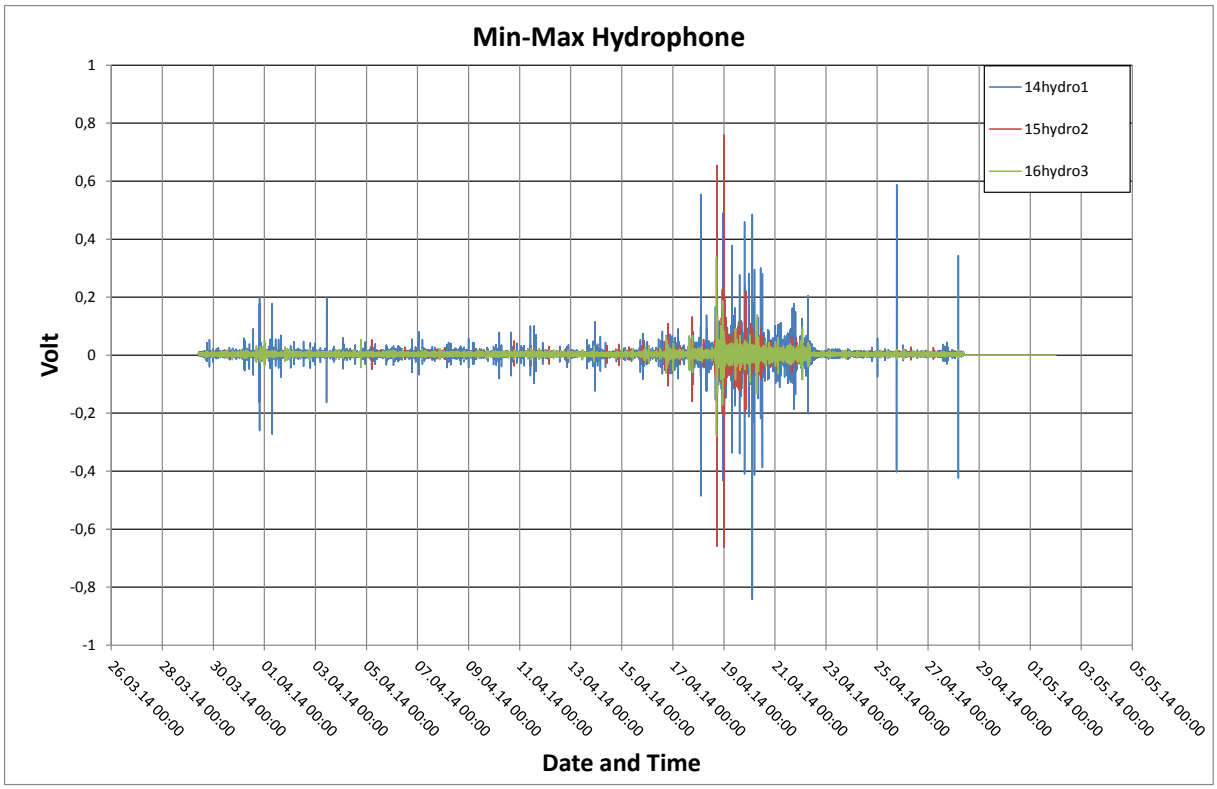

Figure 47: Minimum and maximum values per minute for the hydrophones 1-3 for the month April 2014.

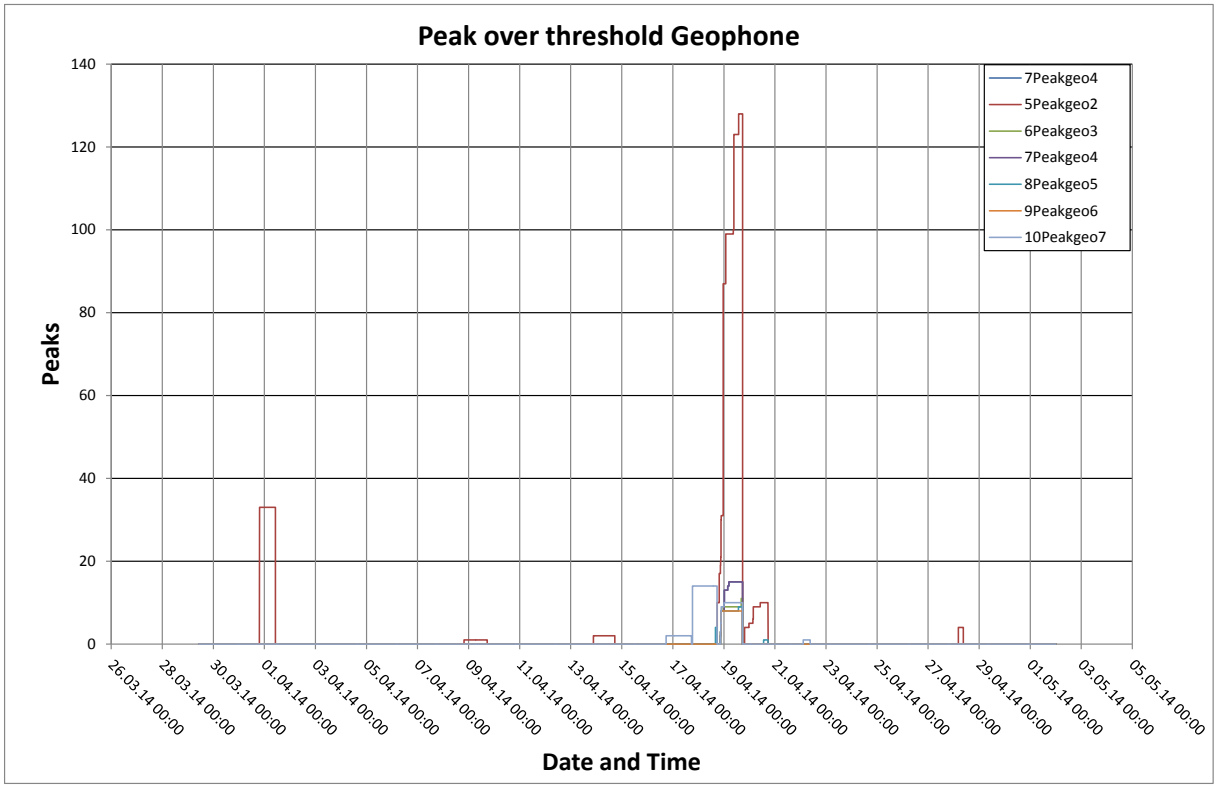

Figure 48: Peak over threshold for the geophones 1-7 per day for the month April 2014.

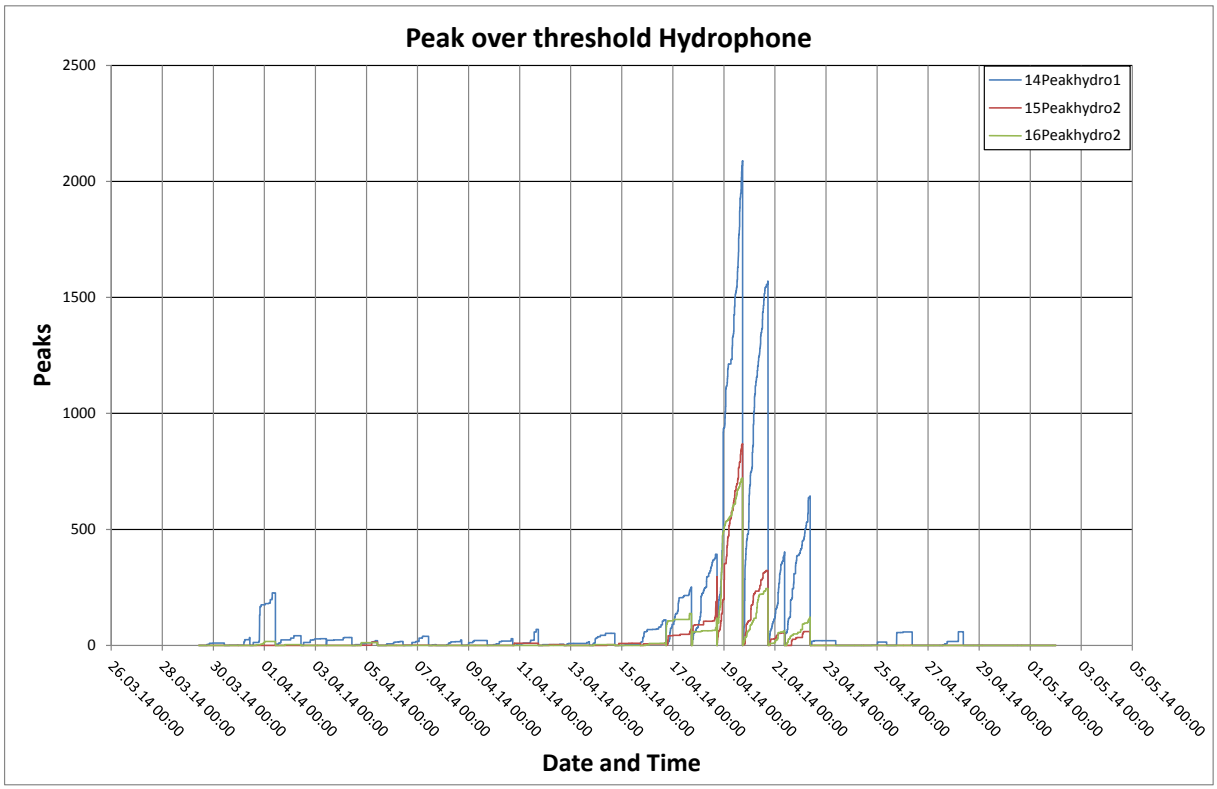

Figure 49: Peak over threshold for the hydrophones 1-3 per day for the month April 2014.

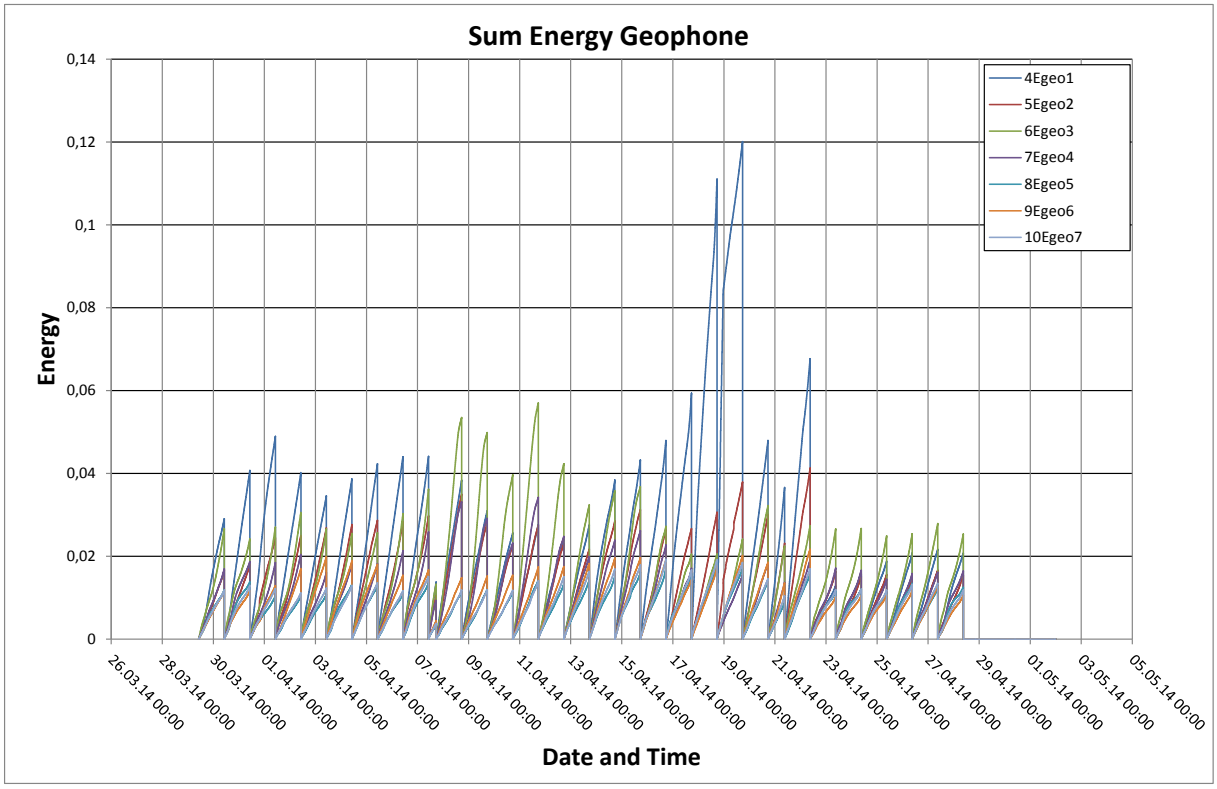

Figure 50: Energy sum for the geophones 1-7 per day for the month April 2014.

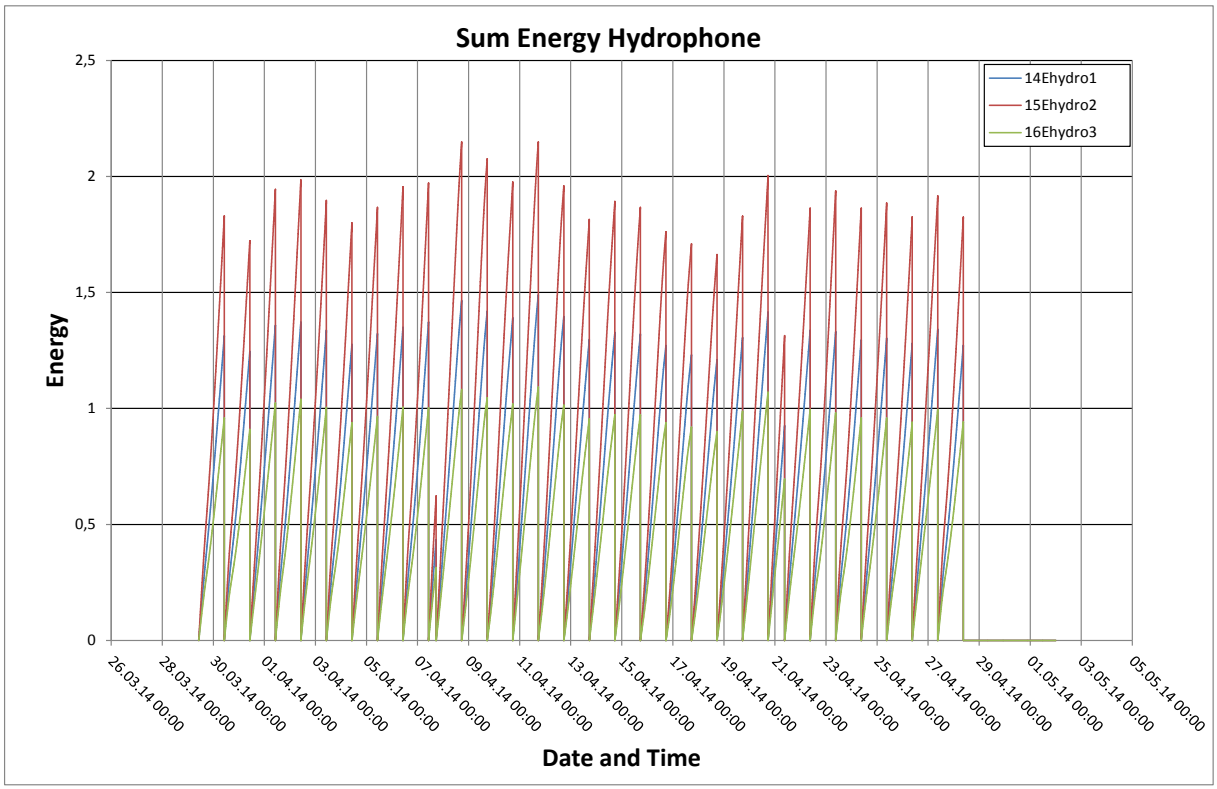

Figure 51: Energy sum for the hydrophones 1-3 per day for the month April 2014.

Data evaluation Mai 2014

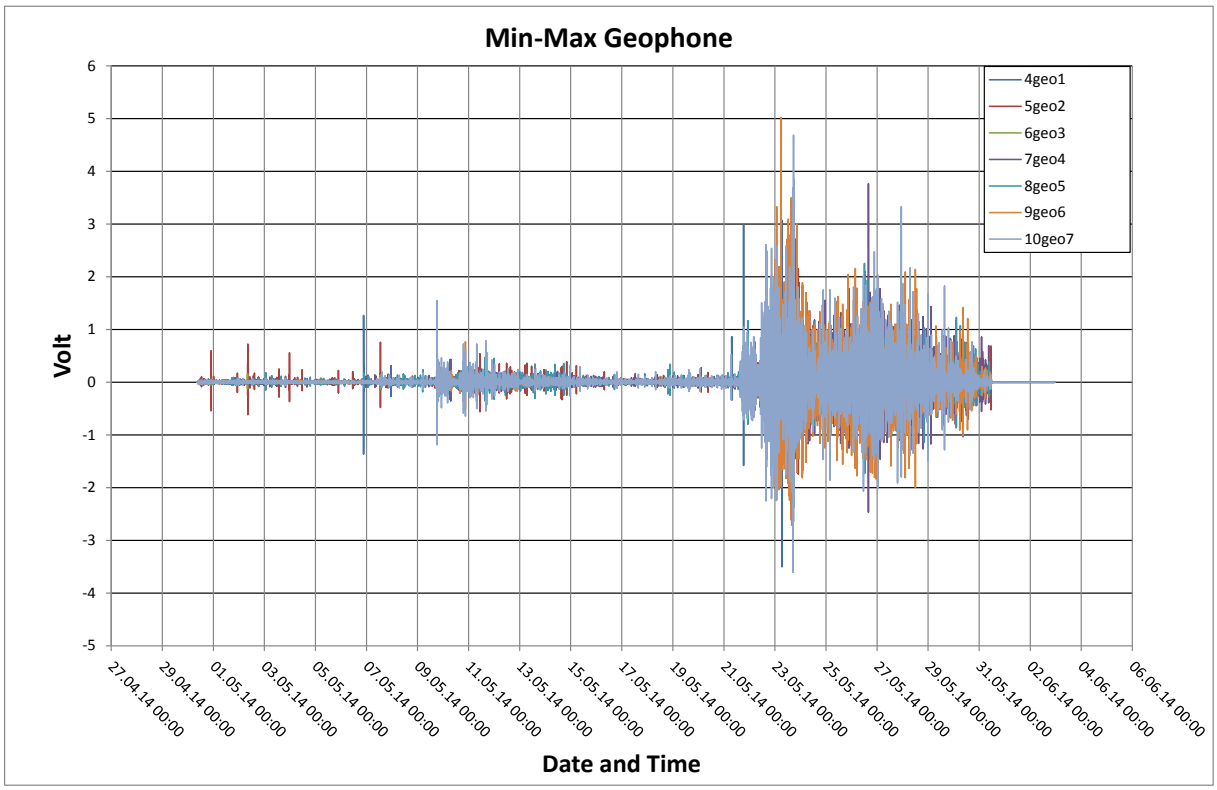

Figure 52: Minimum and maximum values per minute for the geophones 1-7 for the month Mai 2014.

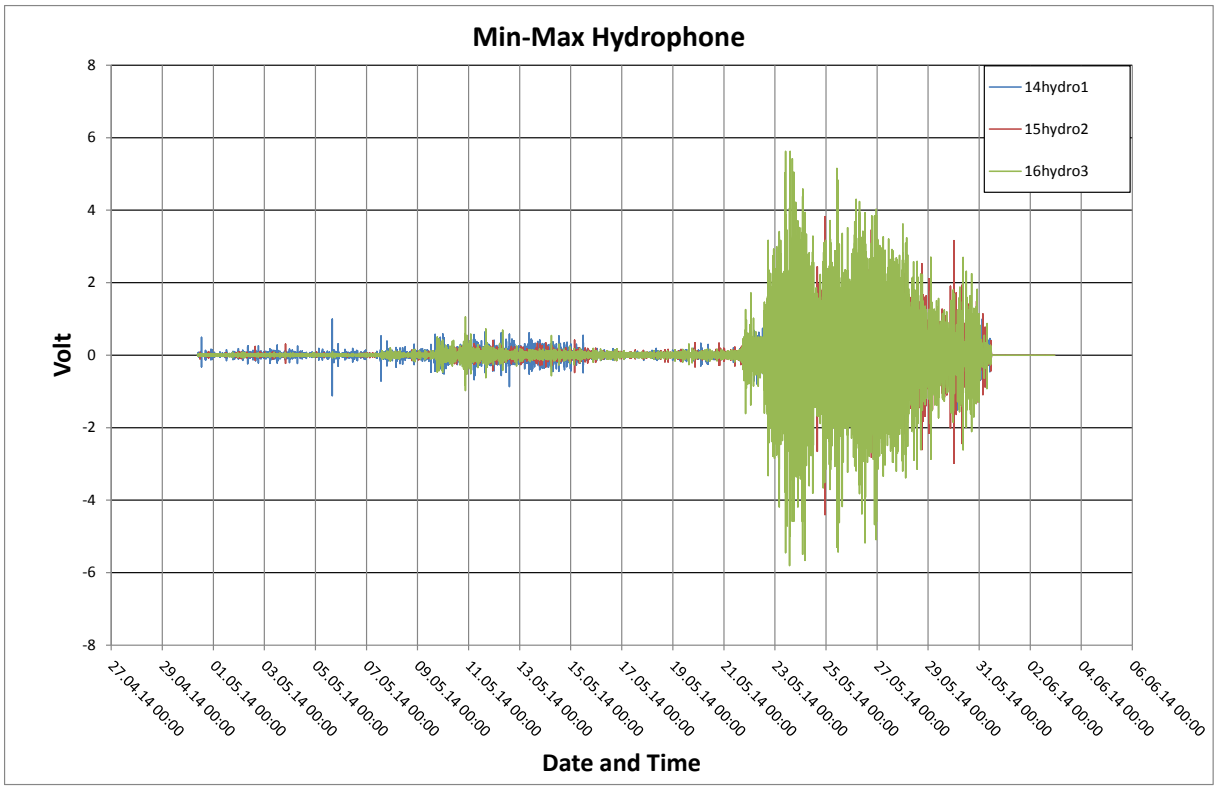

Figure 53: Minimum and maximum values per minute for the hydrophones 1-3 for the month Mai 2014.

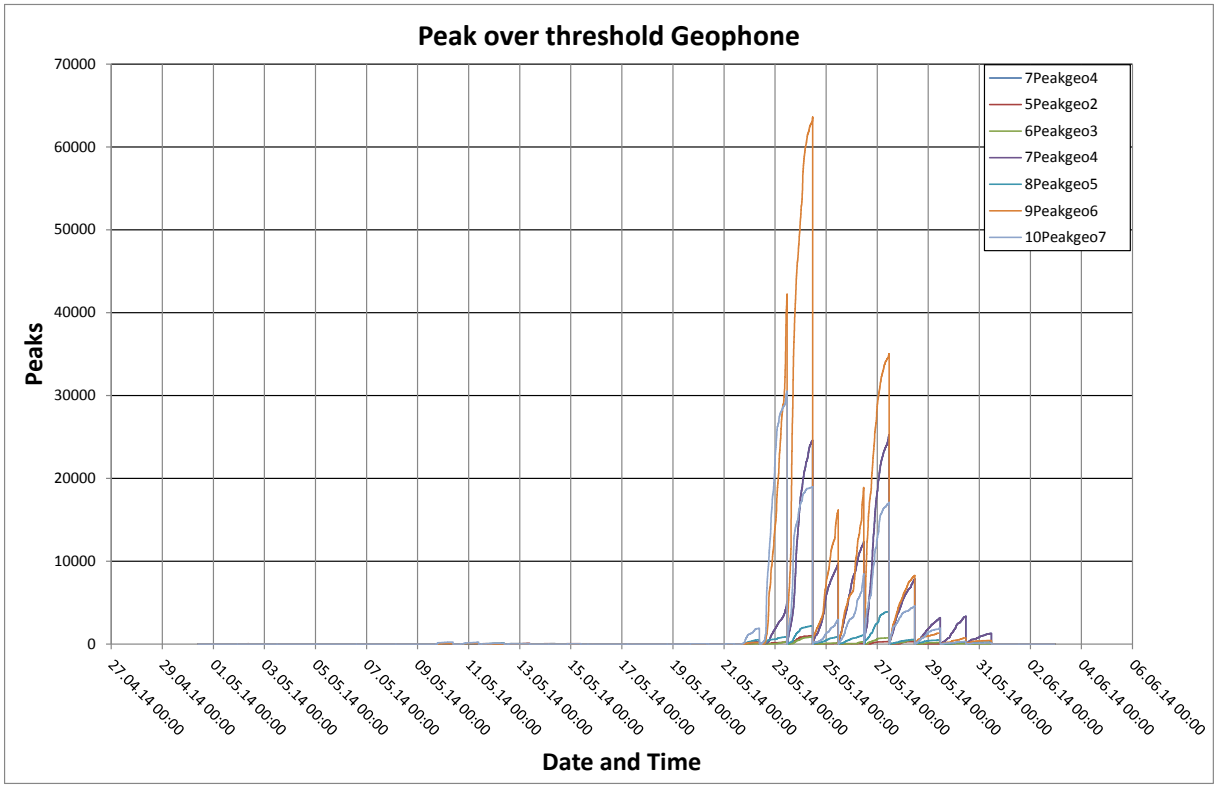

Figure 54: Peak over threshold for the geophones 1-7 per day for the month Mai 2014.

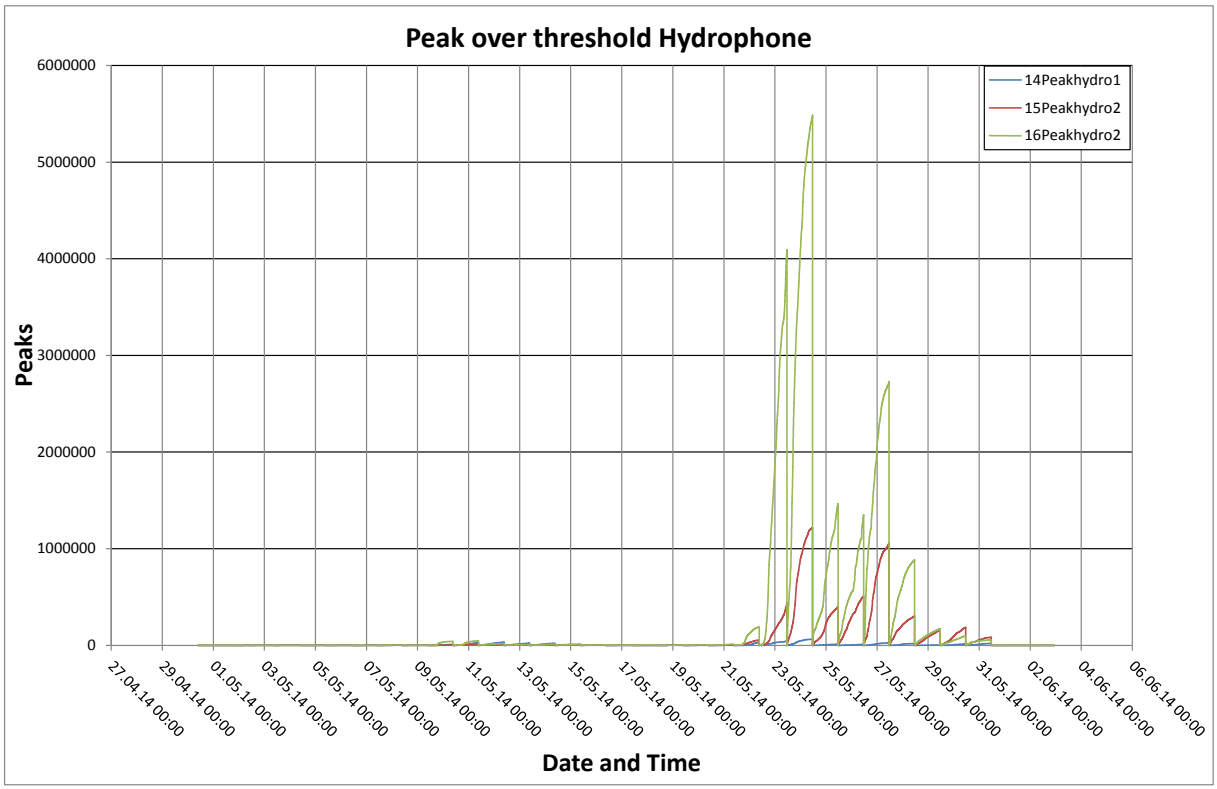

Figure 55: Peak over threshold for the hydrophones 1-3 per day for the month Mai 2014.

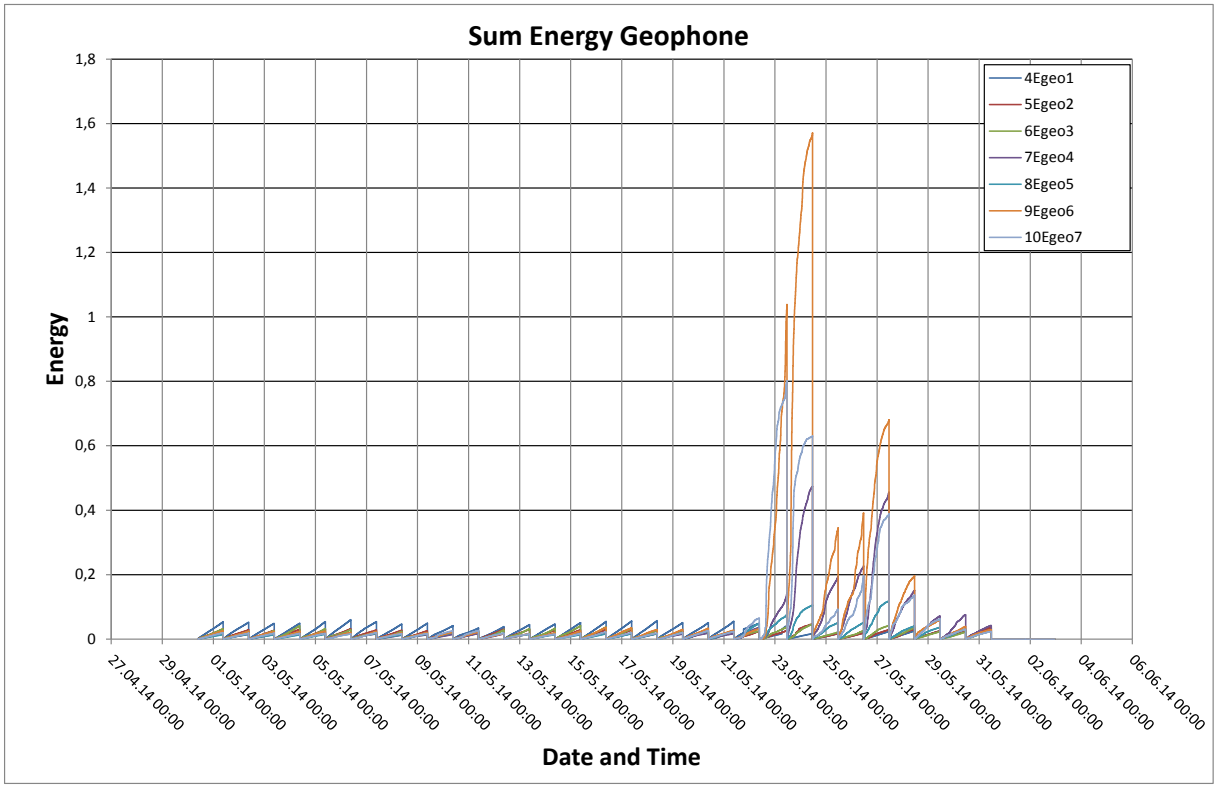

Figure 56: Energy sum for the geophones 1-7 per day for the month Mai 2014.

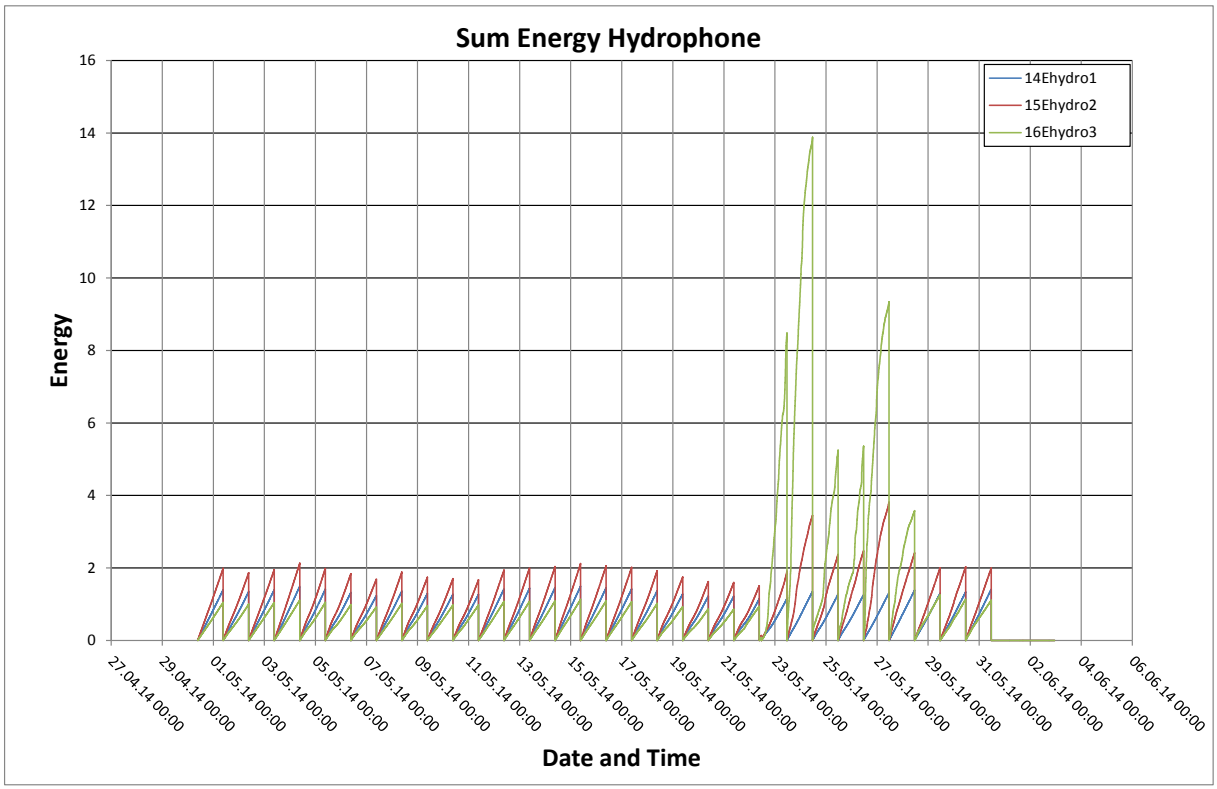

Figure 57: Energy sum for the hydrophones 1-3 per day for the month Mai 2014.

Data evaluation June 2014

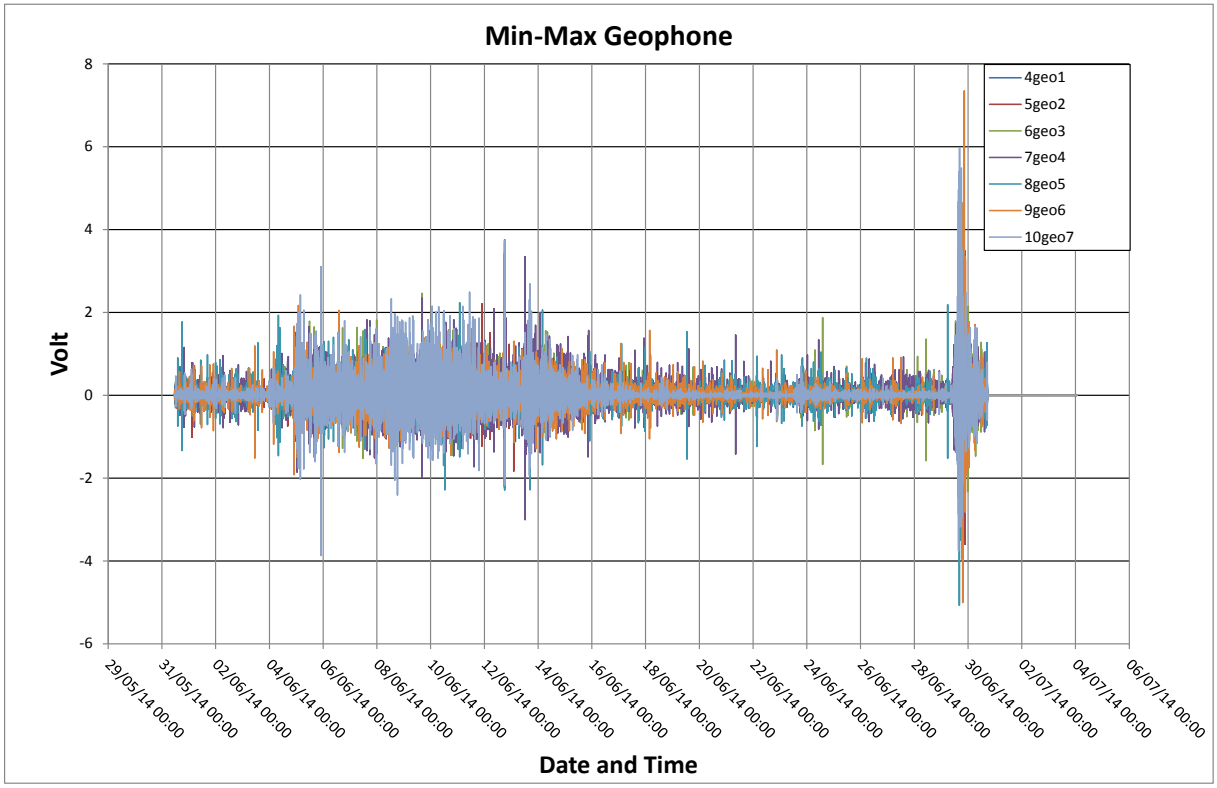

Figure 58: Minimum and maximum values per minute for the geophones 1-7 for the month June 2014.

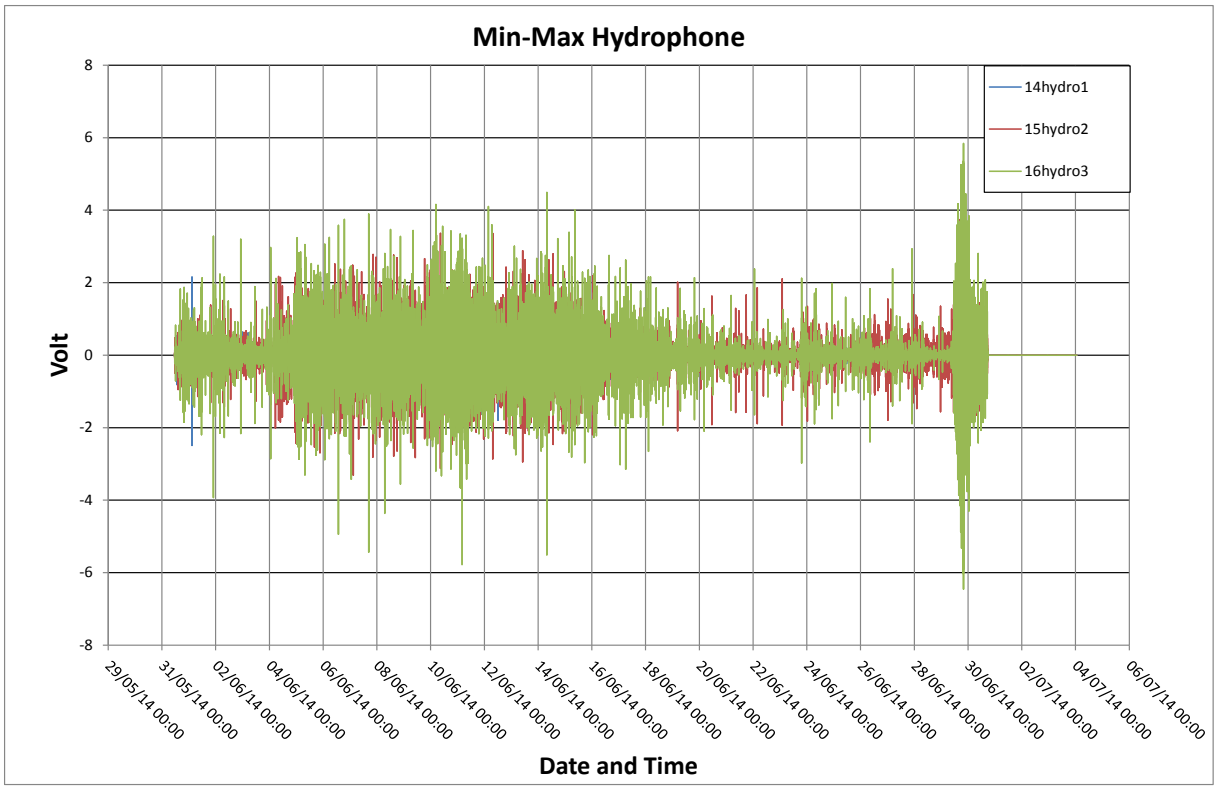

Figure 59: Minimum and maximum values per minute for the hydrophones 1-3 for the month June 2014.

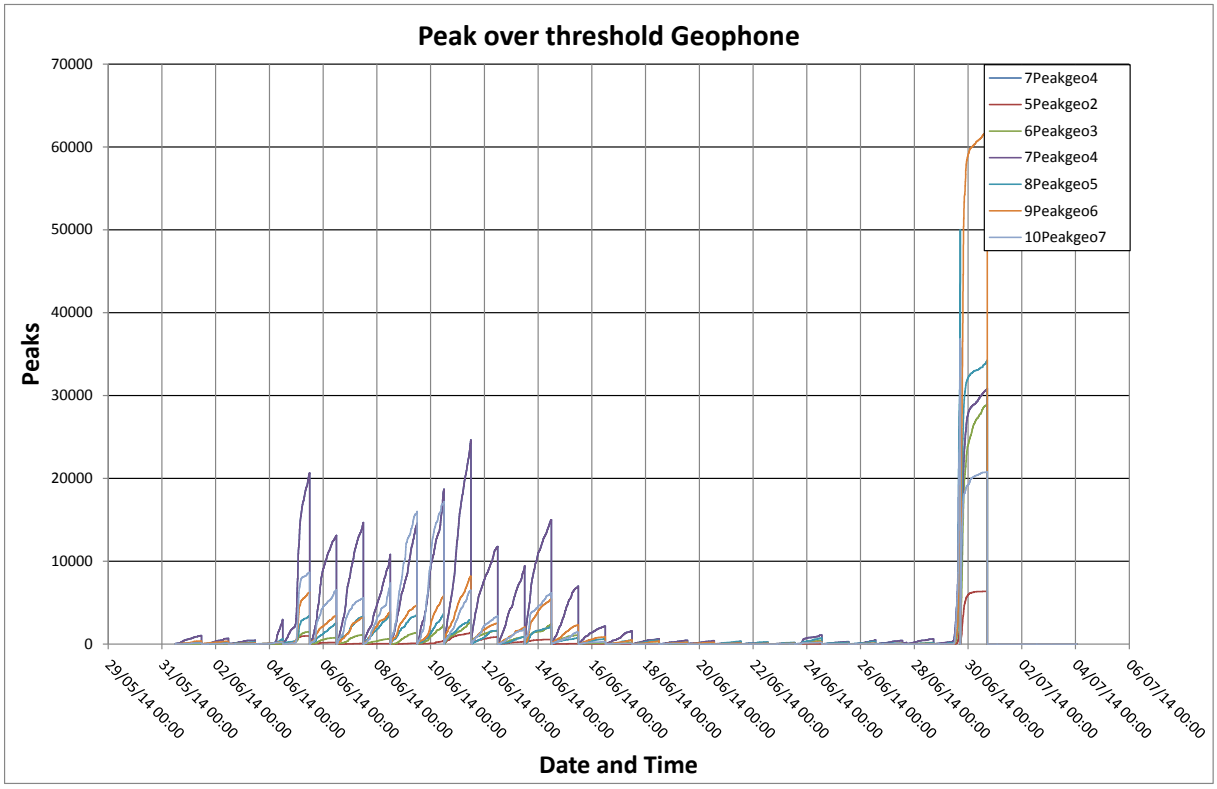

Figure 60: Peak over threshold for the geophones 1-7 per day for the month June 2014.

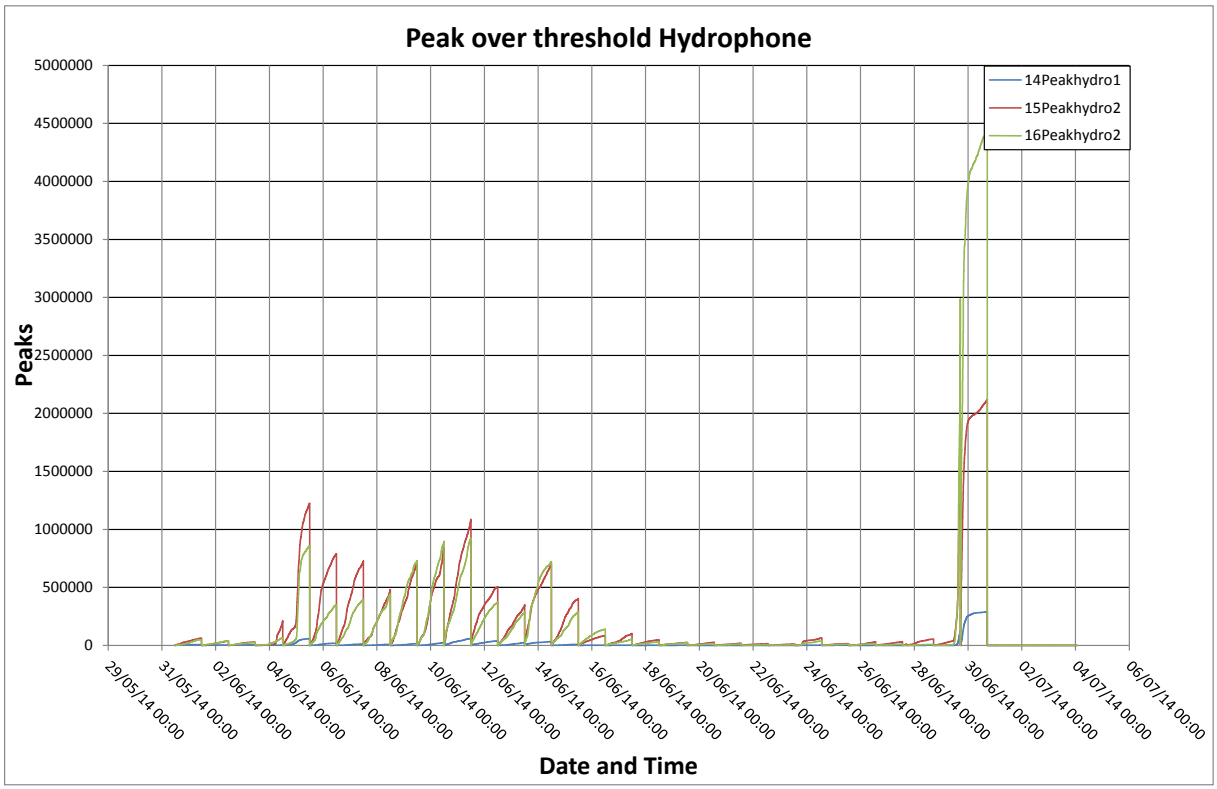

Figure 61: Peak over threshold for the hydrophones 1-3 per day for the month June 2014.

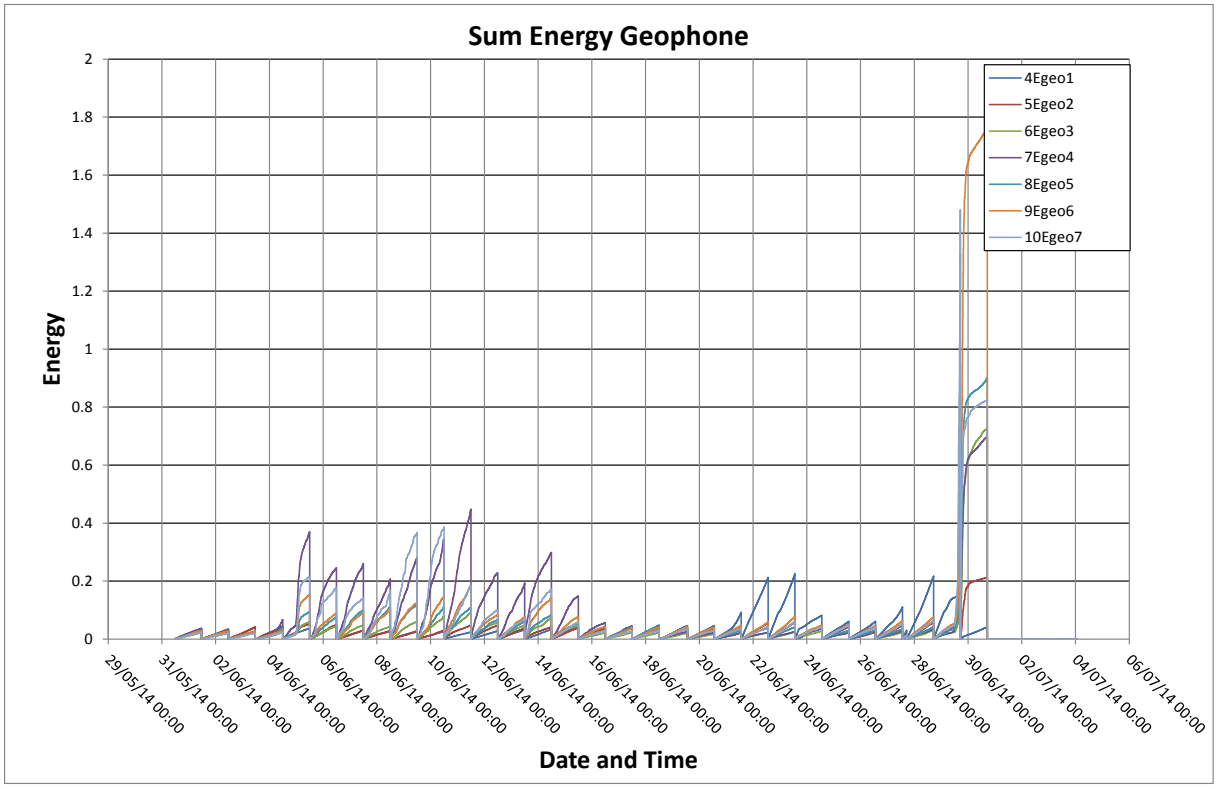

Figure 62: Energy sum for the geophones 1-7 per day for the month June 2014.

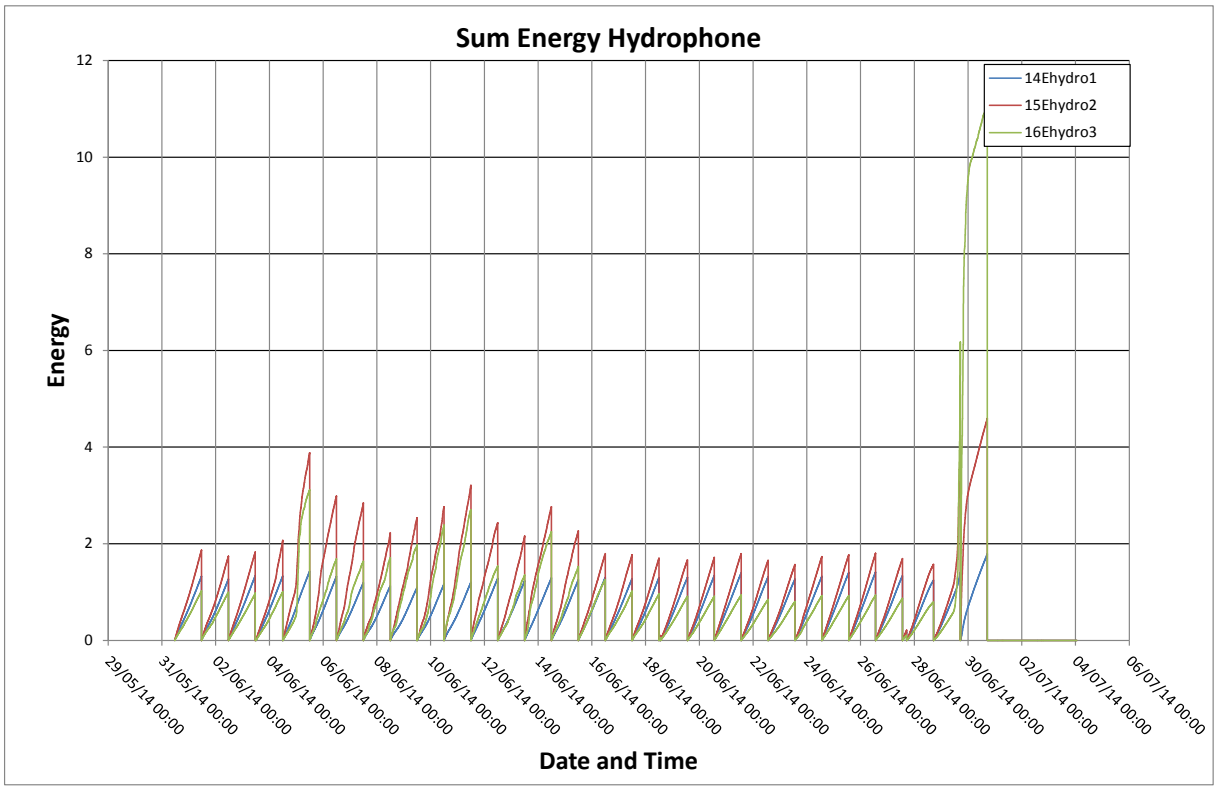

Figure 63: Energy sum for the hydrophones 1-3 per day for the month June 2014.

Data evaluation July 2014

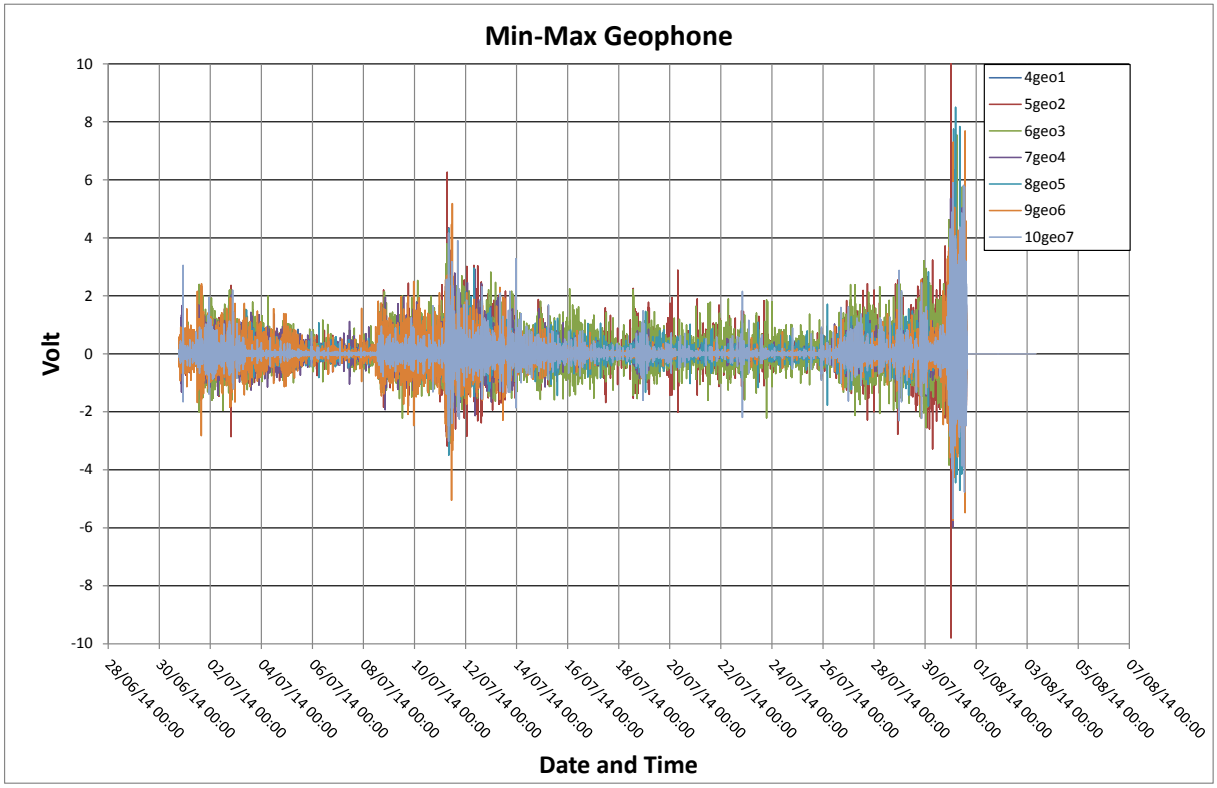

Figure 64: Minimum and maximum values per minute for the geophones 1-7 for the month July 2014.

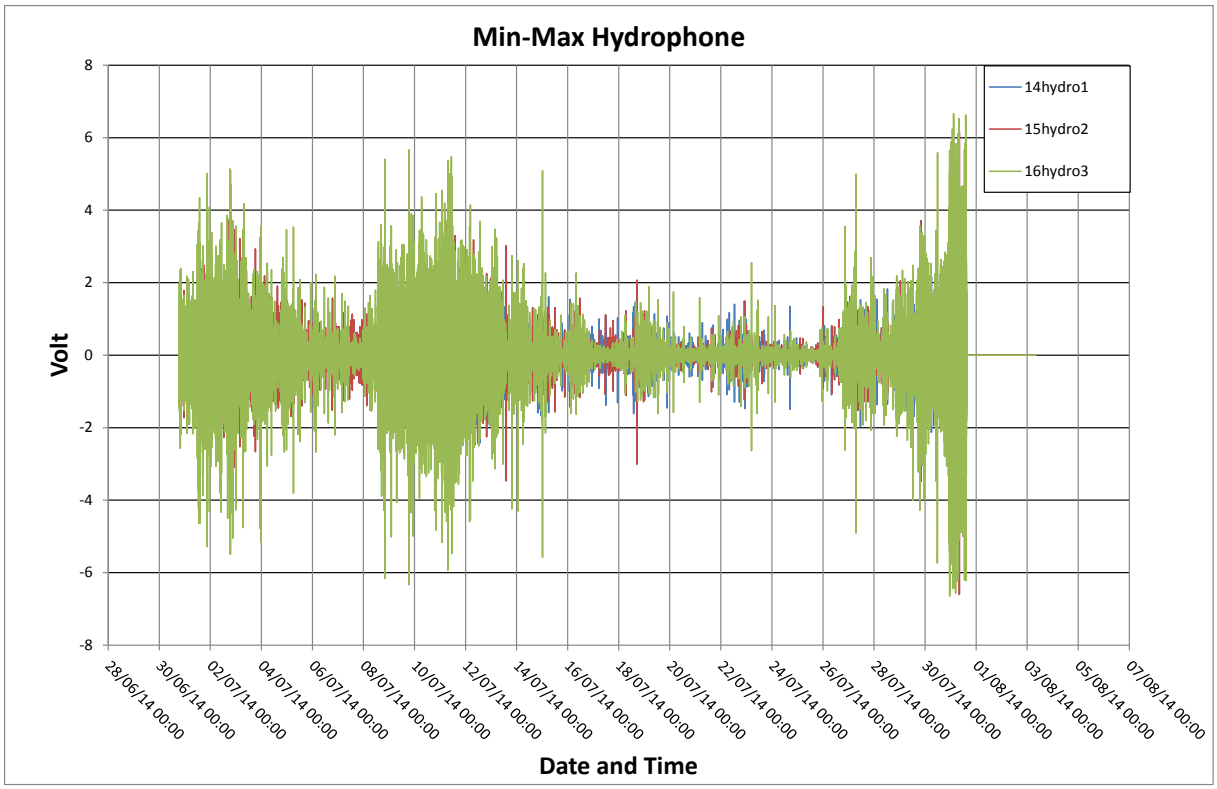

Figure 65: Minimum and maximum values per minute for the hydrophones 1-3 for the month July 2014.

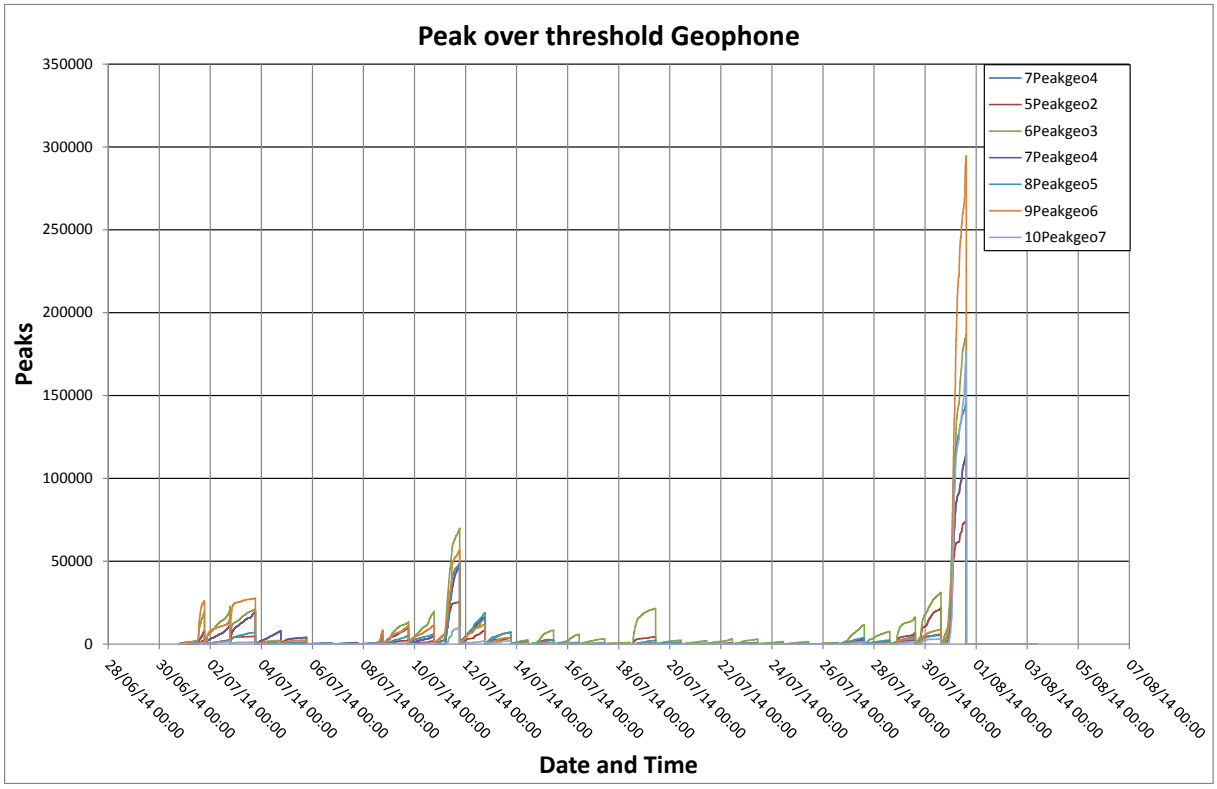

Figure 66: Peak over threshold for the geophones 1-7 per day for the month July 2014.

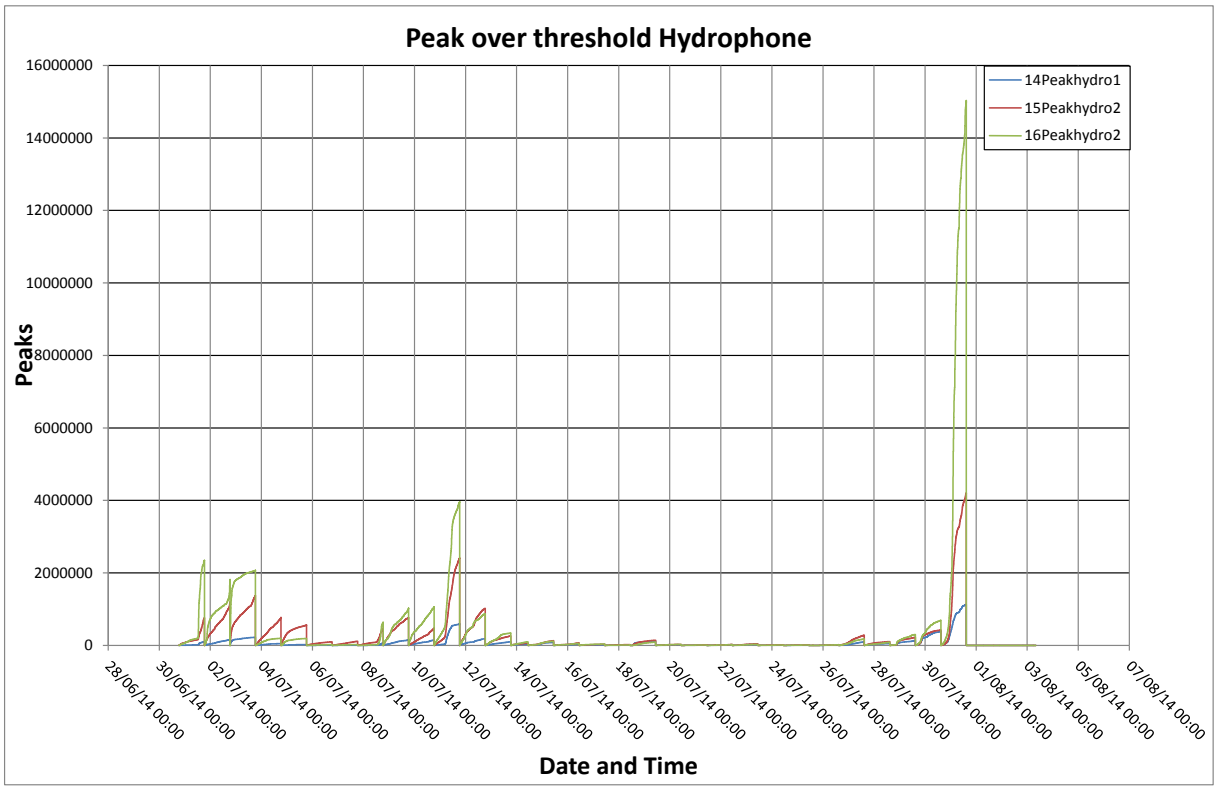

Figure 67: Peak over threshold for the hydrophones 1-3 per day for the month July 2014.

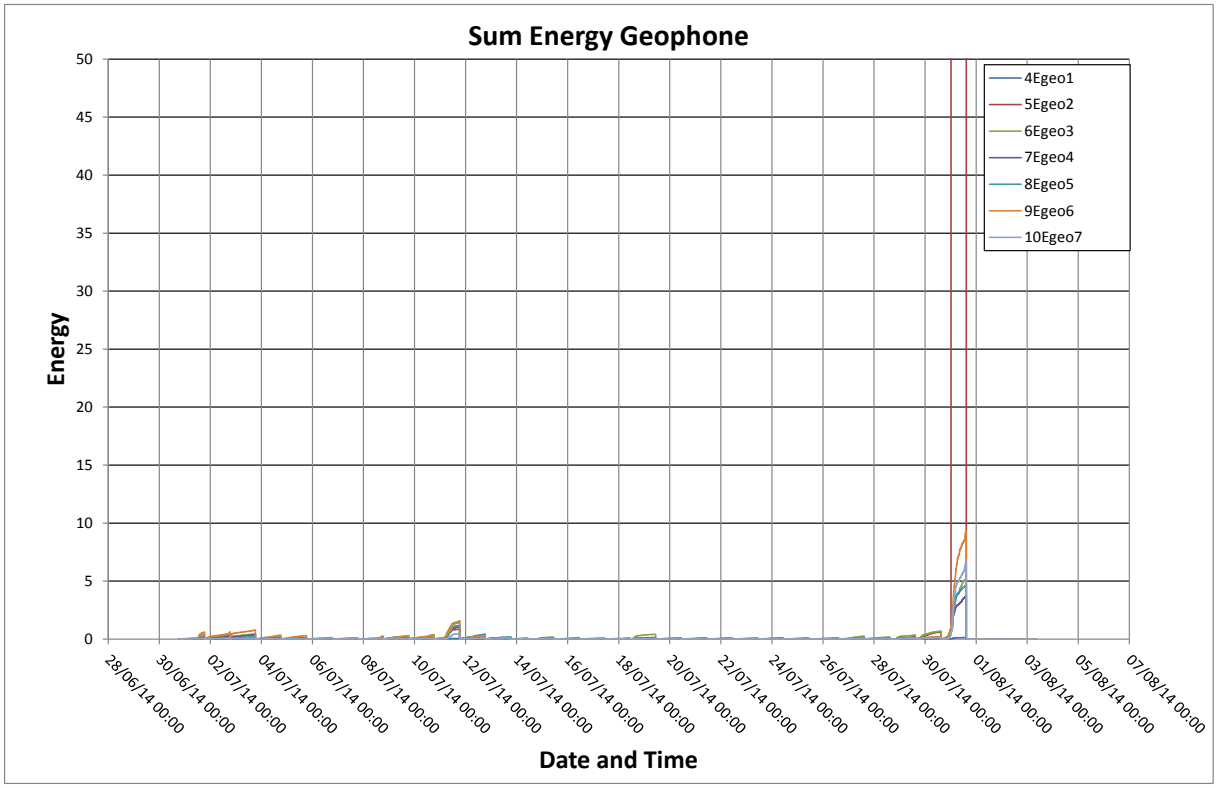

Figure 68: Energy sum for the geophones 1-7 per day for the month July 2014.

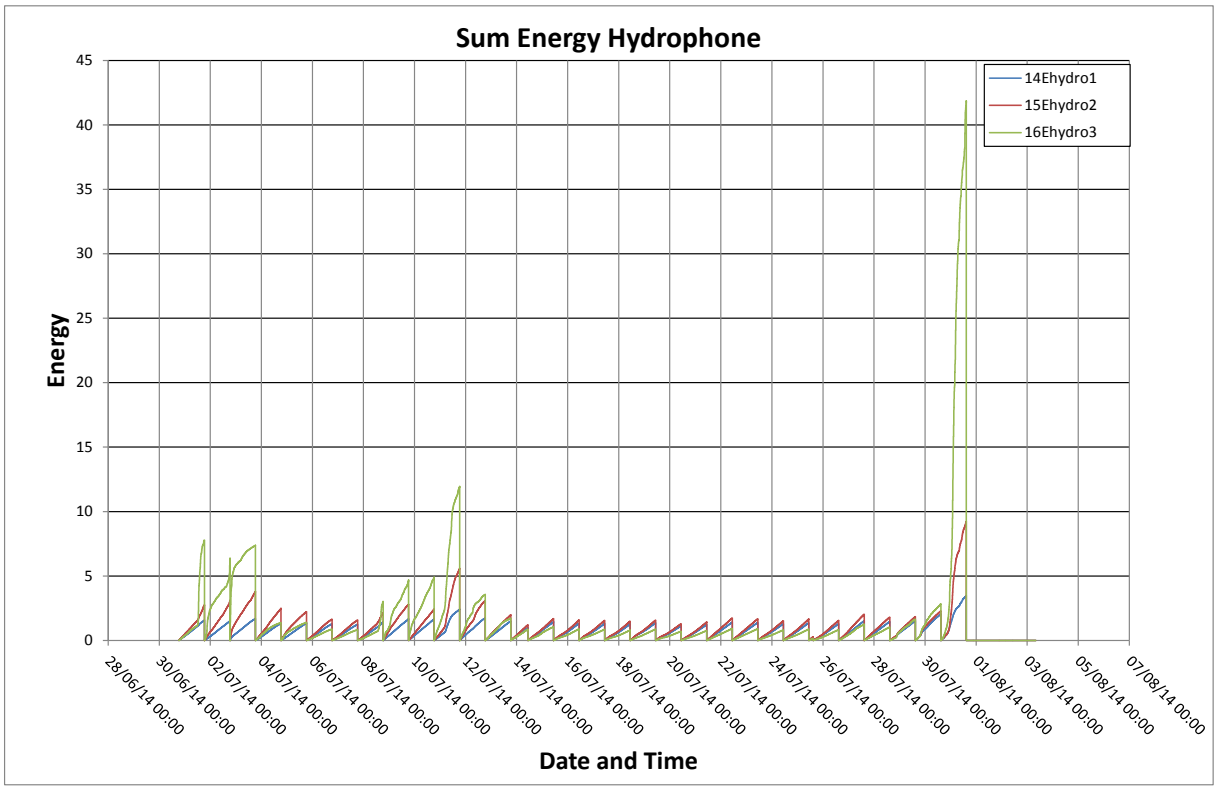

Figure 69: Energy sum for the hydrophones 1-3 per day for the month July 2014.

Data evaluation August 2014

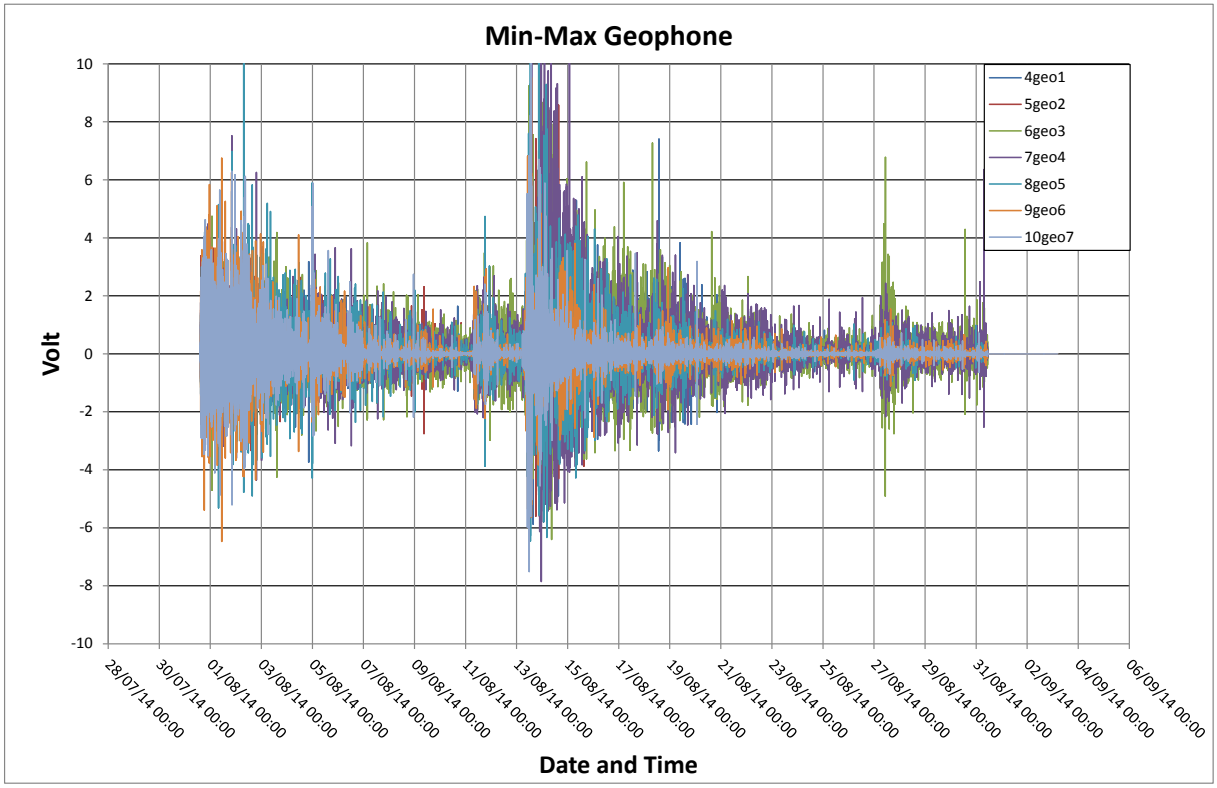

Figure 70: Minimum and maximum values per minute for the geophones 1-7 for the month August 2014.

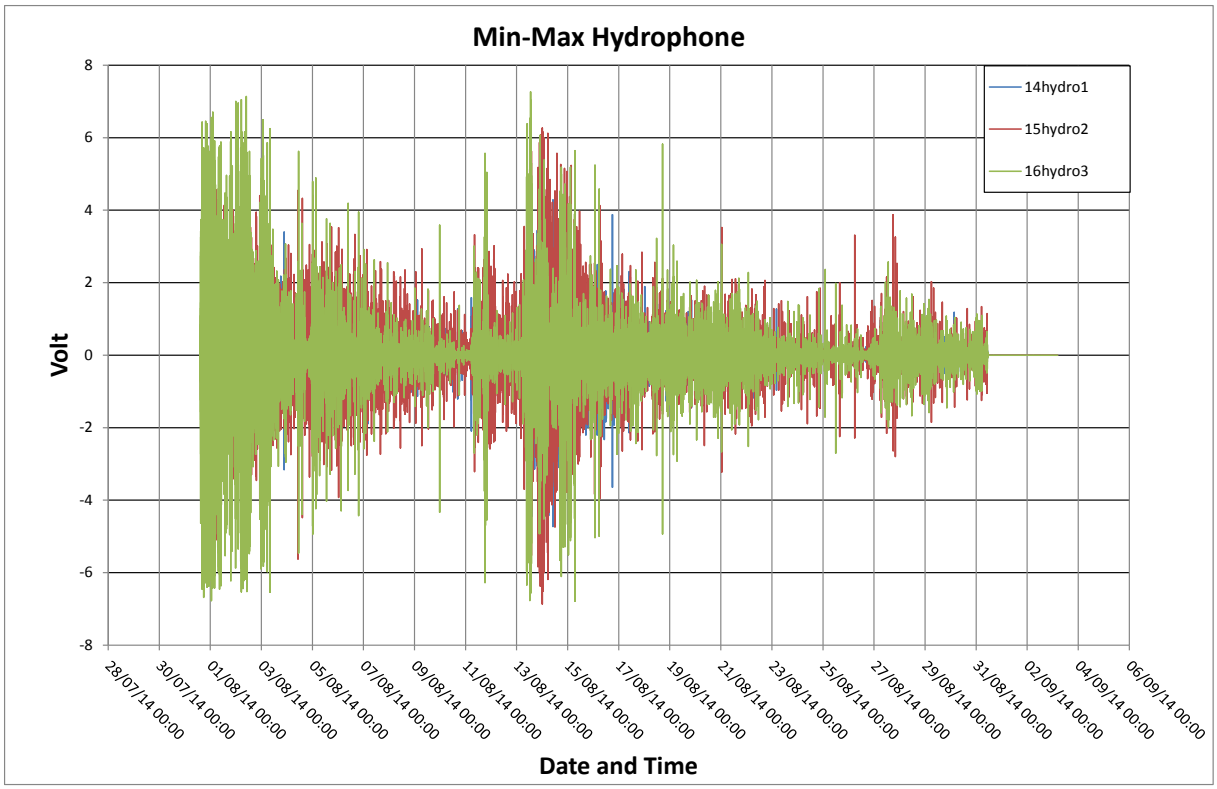

Figure 71: Minimum and maximum values per minute for the hydrophones 1-3 for the month August 2014.

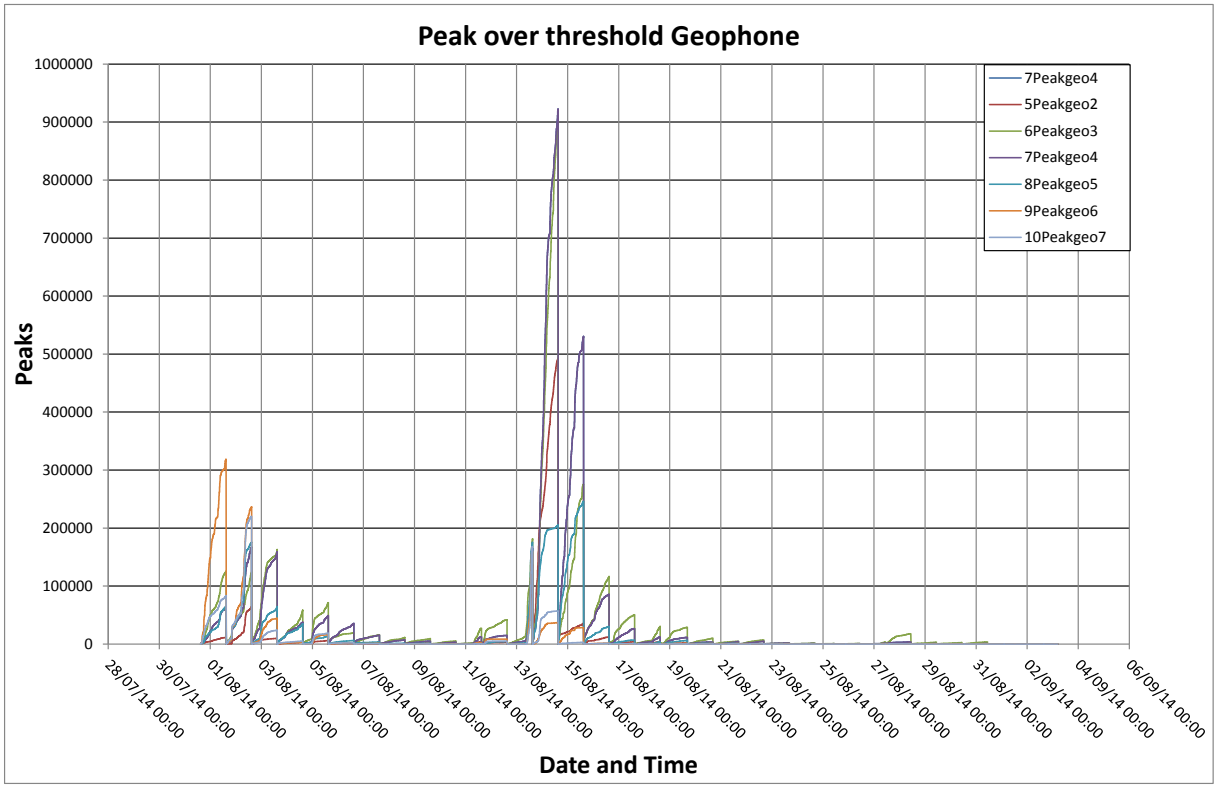

Figure 72: Peak over threshold for the geophones 1-7 per day for the month August 2014.

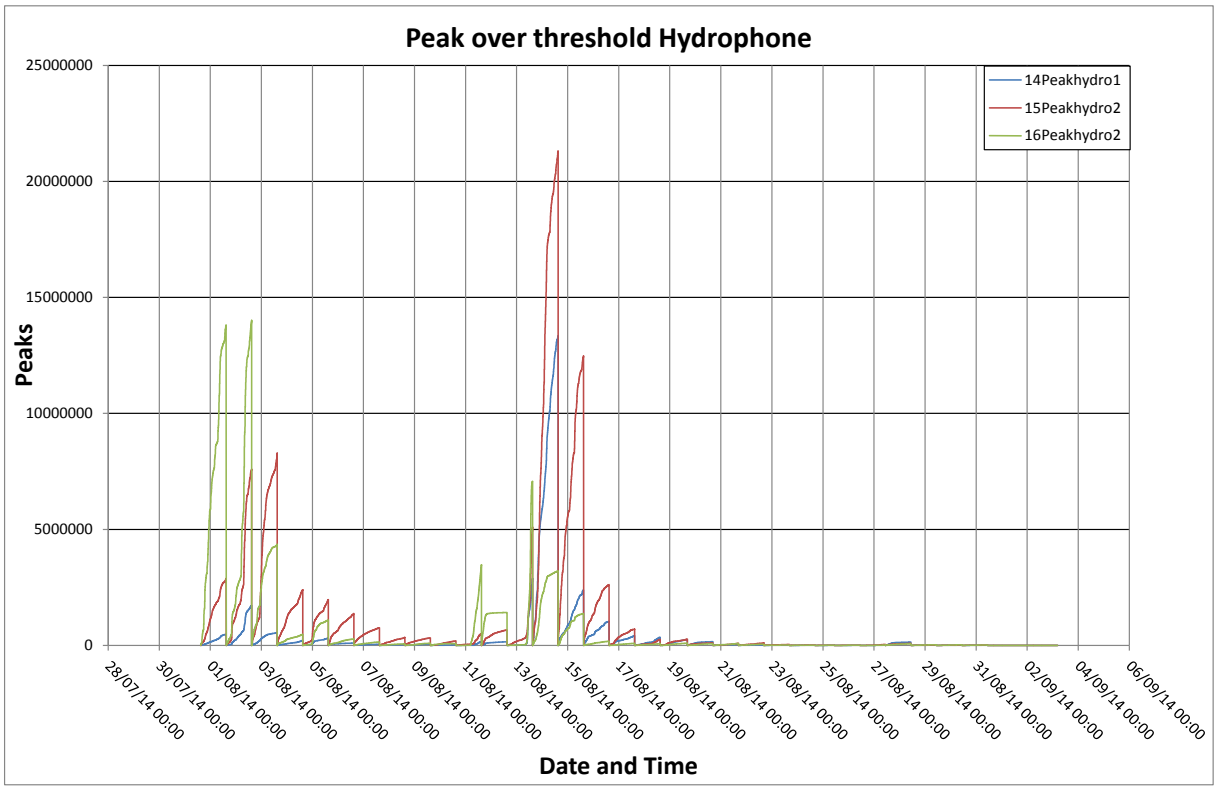

Figure 73: Peak over threshold for the hydrophones 1-3 per day for the month August 2014.

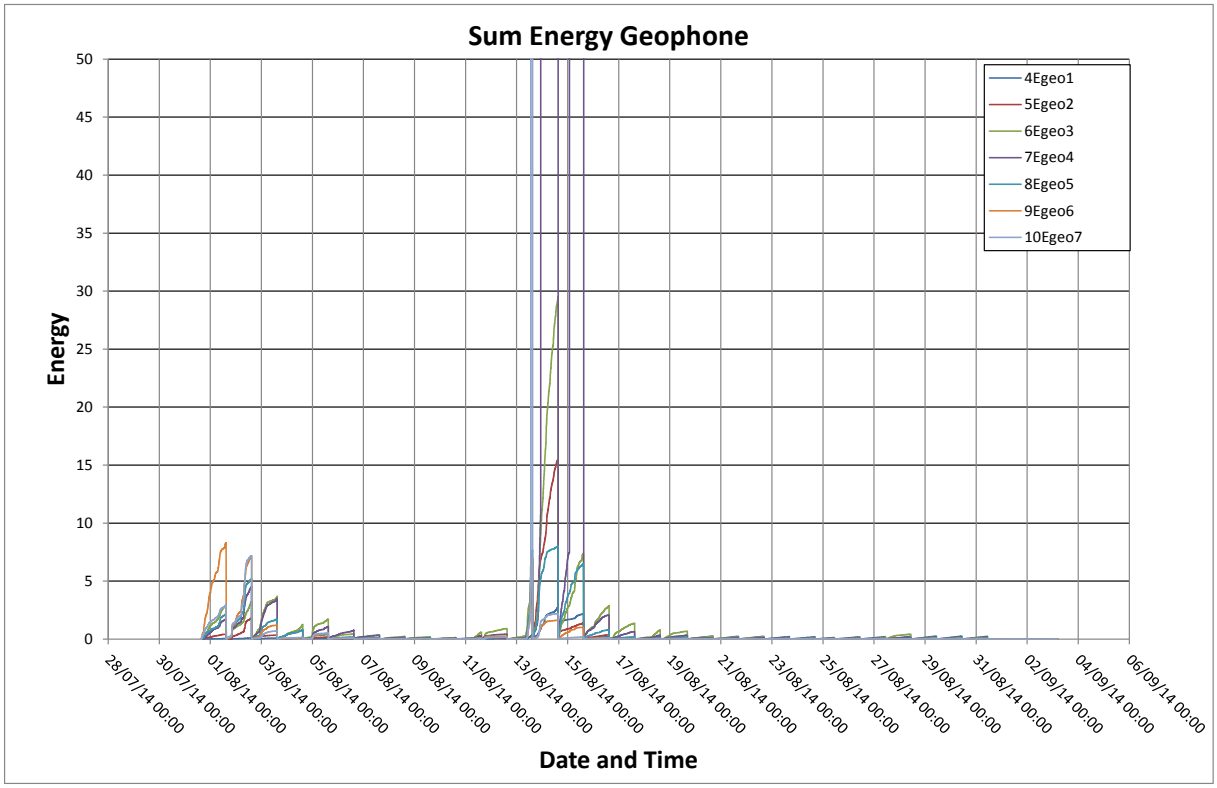

Figure 74: Energy sum for the geophones 1-7 per day for the month August 2014.

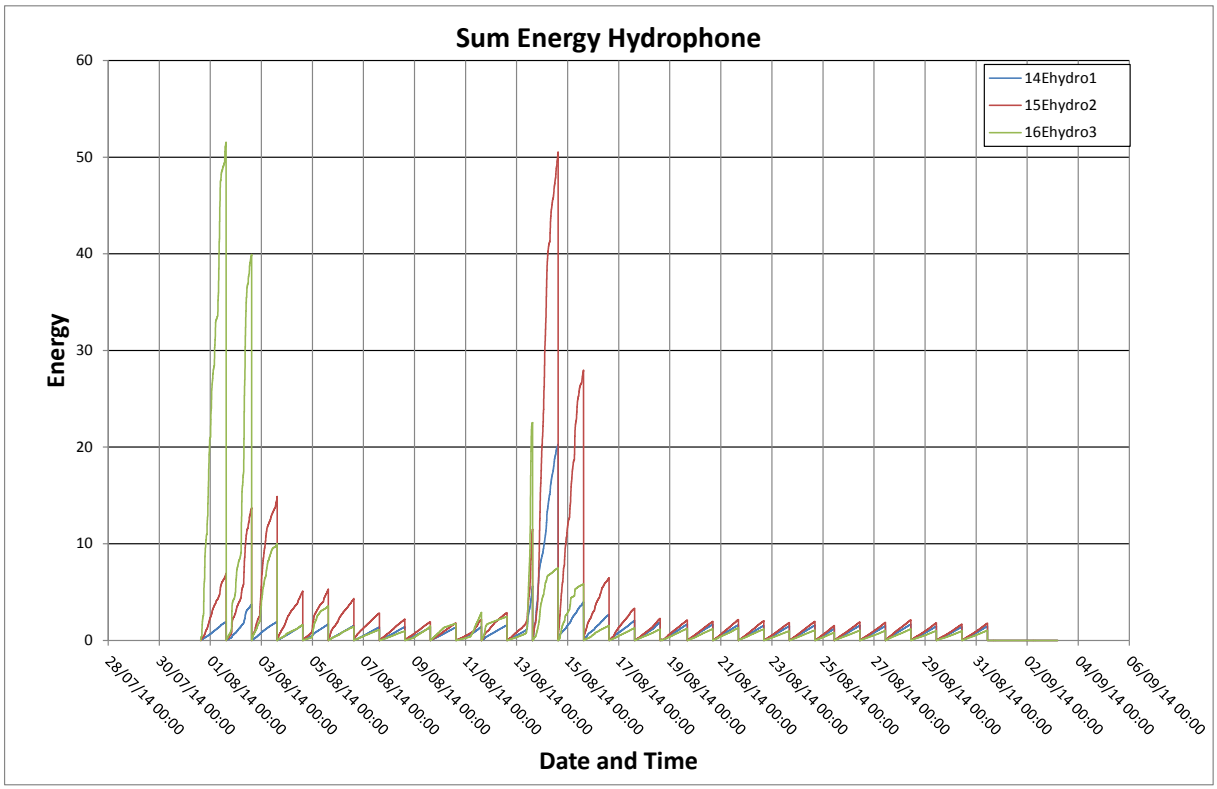

Figure 75: Energy sum for the hydrophones 1-3 per day for the month August 2014.