Topographic Correction of GPR Lines, Curonian Spit Sand Dunes

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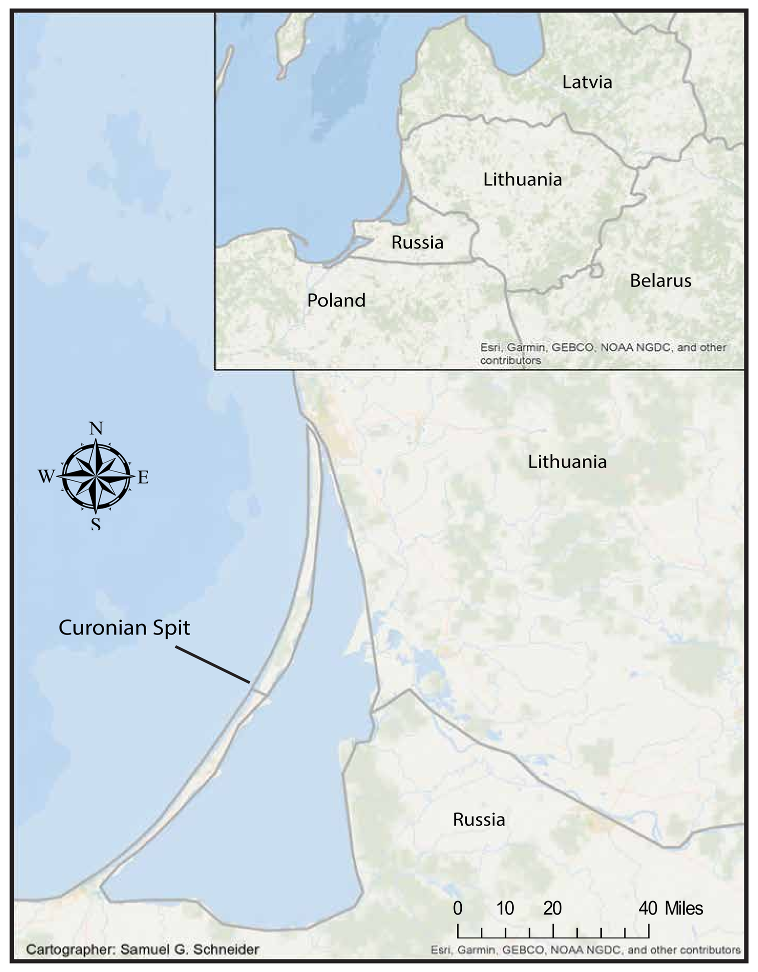
Abstract

The Curonian Spit is located off the western coast of Lithuania in eastern Europe. The Curonian Spit is a 98 km long spit that separates the Baltic Sea from the Curonian Lagoon. The Curonian Spit is covered in very large sand dunes that are always changing due to environmental factors. Ground Penetrating Radar (GPR) lines were collected across 7 sand dunes on the Curonian Spit. These lines were collected with a Topcon RL-H4C laser leveler. Topographic measurements were collected along the GPR lines within EKKO-Project 5 software. The original GPR data shows no elevation along the line, but the topographically corrected GPR data shows the topography of the sand dunes as they were when the data was collected. These topographically collected GPR lines can aid in the correct interpretation of the GPR data and show another perspective of viewing these aeolian landscapes.

Introduction

The Curonian Spit is a sand dune that separates the Curonian Lagoon from the Baltic Sea, which is in both Lithuania and Russia. The Curonian Spit is approximately 98 km long that is constantly being changed and formed by wind, sea currents and other environmental processes. A team of researchers during the summer of 2018 spent their time in Lithuania collecting GPR data to measure the Foredunes located on the Curonian Spit. Foredunes are sand dunes that have been formed in parallel to a close, large body of water, or to a lake on a vegetated land surface. GPR was used to collect data on these foredunes. GPR refers to Ground Penetrating Radar which sends electromagnetic pulses through the subsurface in a nondestructive way. The electromagentic pulses transferred through the subsurface are sent at various frequencies. Higher frequencies allow for a better resolution of stratigraphy. Lower frequencies account for a better penetration of deeper depth. This research allows for the foredunes of the Curonian Spit to be viewed in a unique perspective of its aeolian features. It allows for a visual aid in what the topography was like at the time of data collection in Lithuania.



A look at a foredune located on the Curonian Spit in Lithuania

Methods

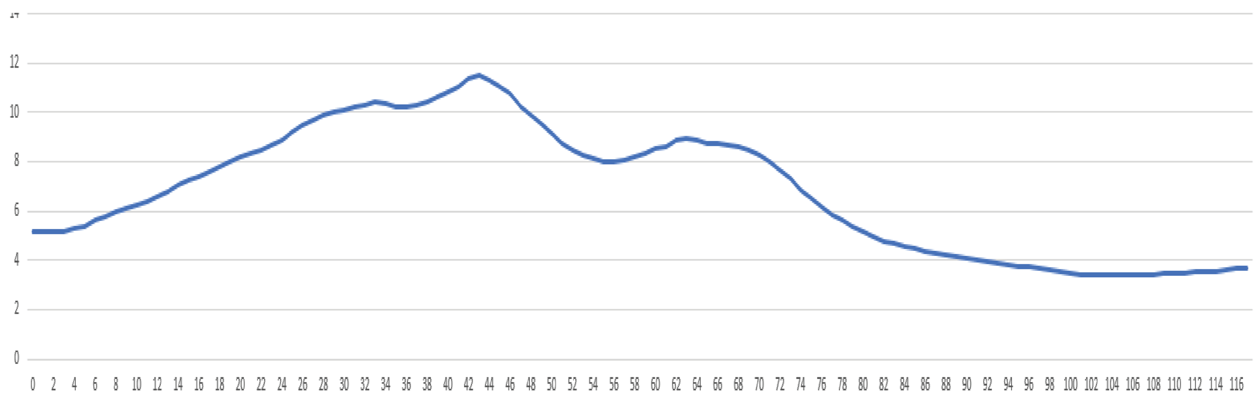
The GPR data for the foredunes was collected using a Sensors and Software pulseEKKO 1000 system equipped with 500MHz antennae. Using a TopCon RL-H3CL laser leveler at 1-meter intervals, the topographic data was collected. To allow a view of a cross sectional display, the surveys were measured perpendicular to the foredune ridges. After these various methods of data collection, the collected data was processed using a combination of Excel and EKKO_Project 5 software. In order to account for topography, data had to be transferred from a field notebook into Microsoft Excel sheets where it was organized into a table and a 2-D graph. To get the 2-D graph, a series of Microsoft Excel equations were created to get a realtive elevation to 0. To get the file into EKKO_Project 5, it must first be put into Notepad where it can be changed into a .top file. Once the foredune file is in a .top file, it can be transferred into EKKO_Project 5. Once it is put into EKKO_Project 5, each dune has to be corrected individually. Once corrected, EKKO_Project 5 will produce an image of each individual foredune with its elevation and topography at the time the data was collected in Lithuania.

A fellow research member, Chloe Kofman, and Harry Jol are seen collecting topography data on one of the foredunes located on the Curonian Spit in Lithuania. Harry is using the laser leveler while Chloe takes notes.

Results

Two foredunes, dune 6 and dune 7, were analyzed and processed from the Curonian Spit in Lithuania. The first row of images depicts the transfer of the raw field notebook data to Microsoft Excel, with various calculations a 2-D graph will be created as shown below. The 2nd row shows what the data looks like in EKKO_Project before it is corrected. The last row shows the final image of the dune after it is corrected in EKKO_Project. The last row of photos is very similar to the first row of Microsoft Excel graphs. The biggest difference you may notice are the differently angled lines underneath the dune. These lines are called stratigraphy, and they can be interpreted in various ways to determine how the foredunes deposits are layered. Seaward dipping lines can be interpreted as dune foreslope accretion. Whereas landward dipping lines can be interpreted as roll over deposits. Subparallel semi-continuous reflections can be seen as dune aggradation. Seaward dipping sigmoidal reflections are interpreted as spit progradation. These interpretations can aid in various perspectives of viewing these unique and forever changing foredunes.

Dune 6



A 2-D graph of Dune 6 created in Microsoft Excel

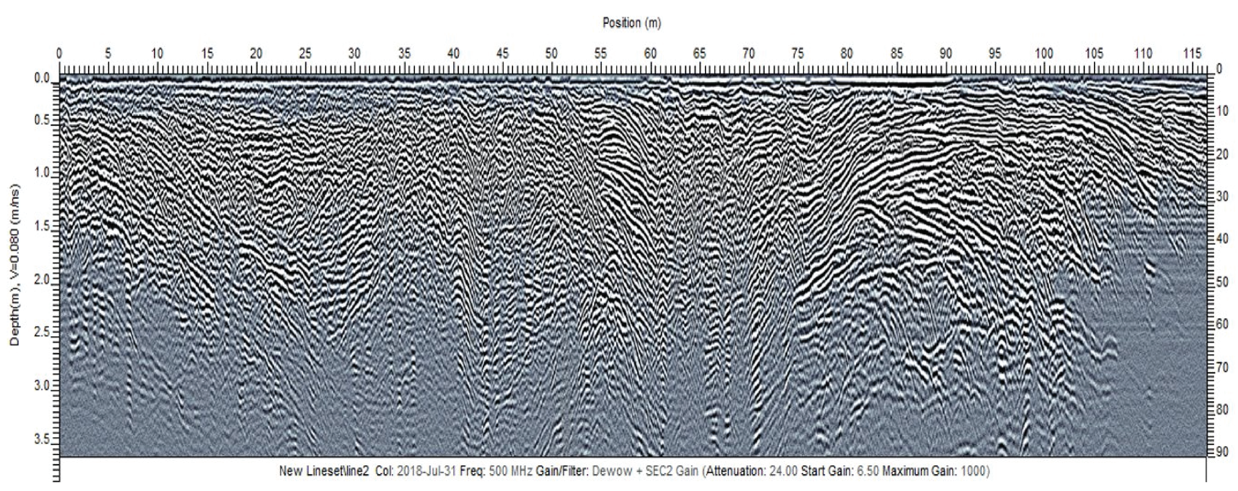


Image of Dune 6 before correction in EKKO_Project 5

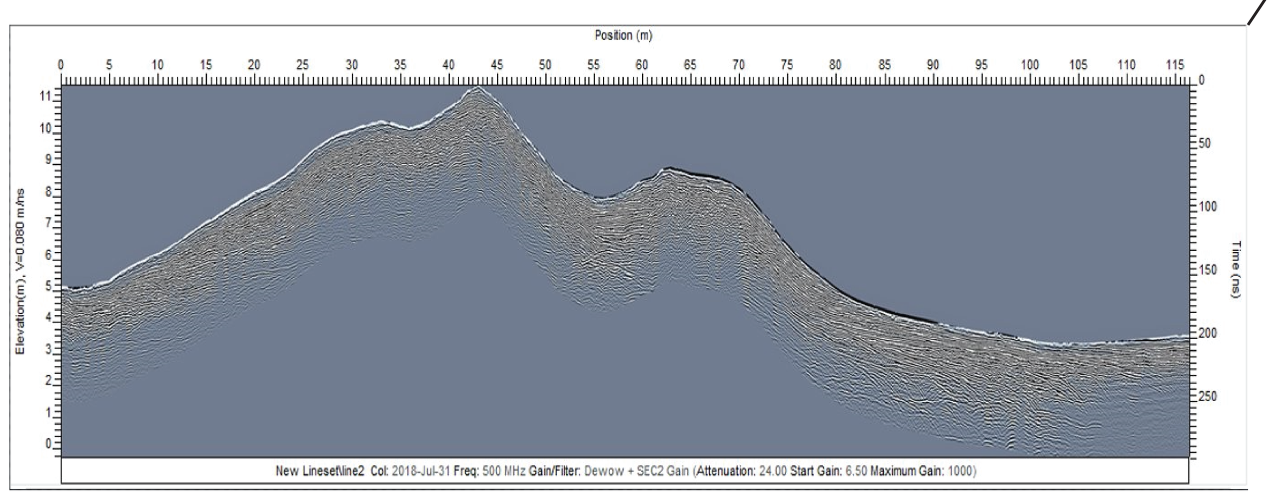
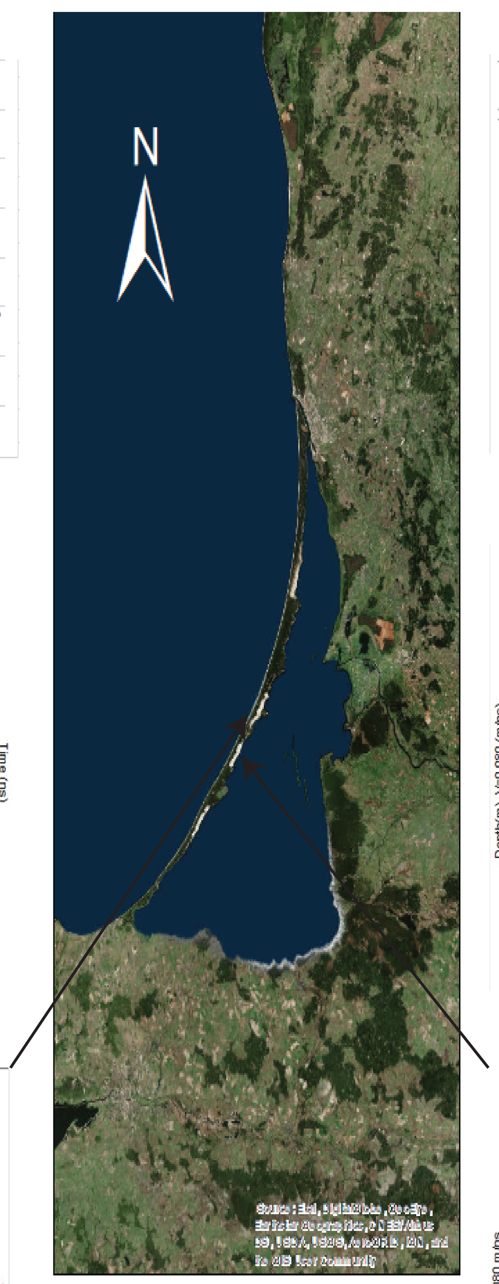
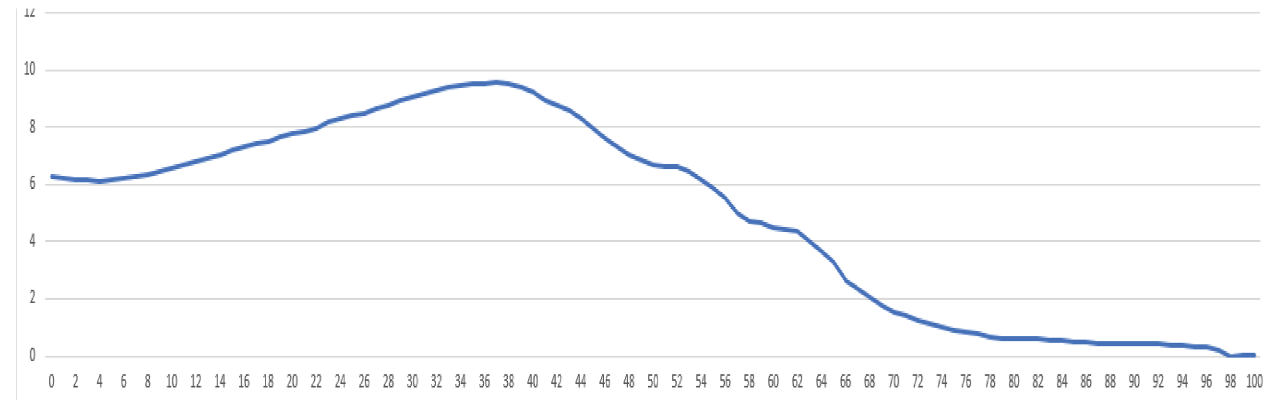


Image of Dune 6 after correction in EKKO_Project 5



This image depicts a zoomed in view of the Curonian Spit, along with the location of dune 6 and 7 that I worked with

Dune 7



A 2-D graph of Dune 7 created in Microsoft Excel

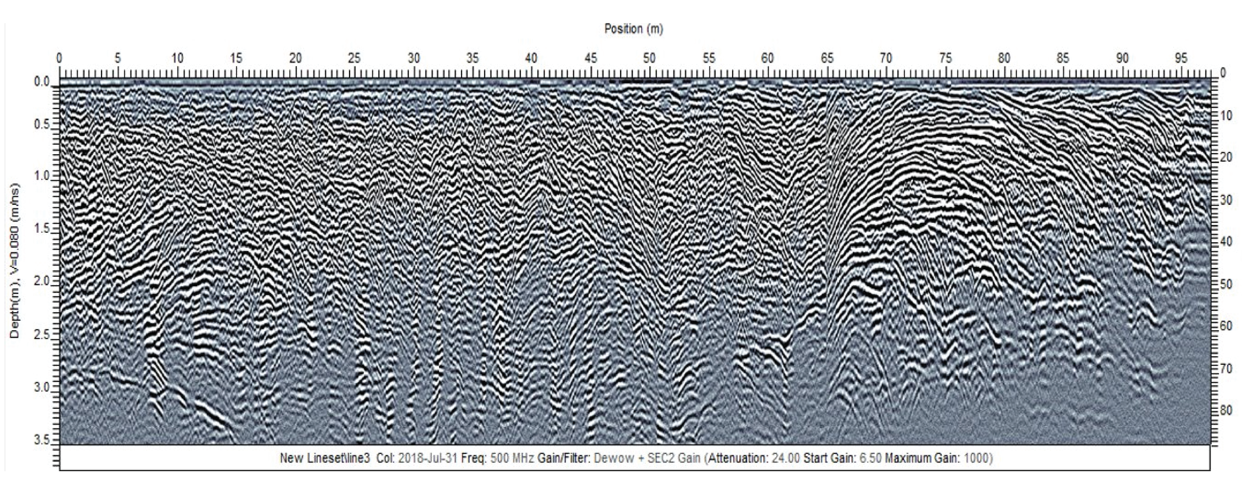


Image of Dune 7 before correction in EKKO_Project 5

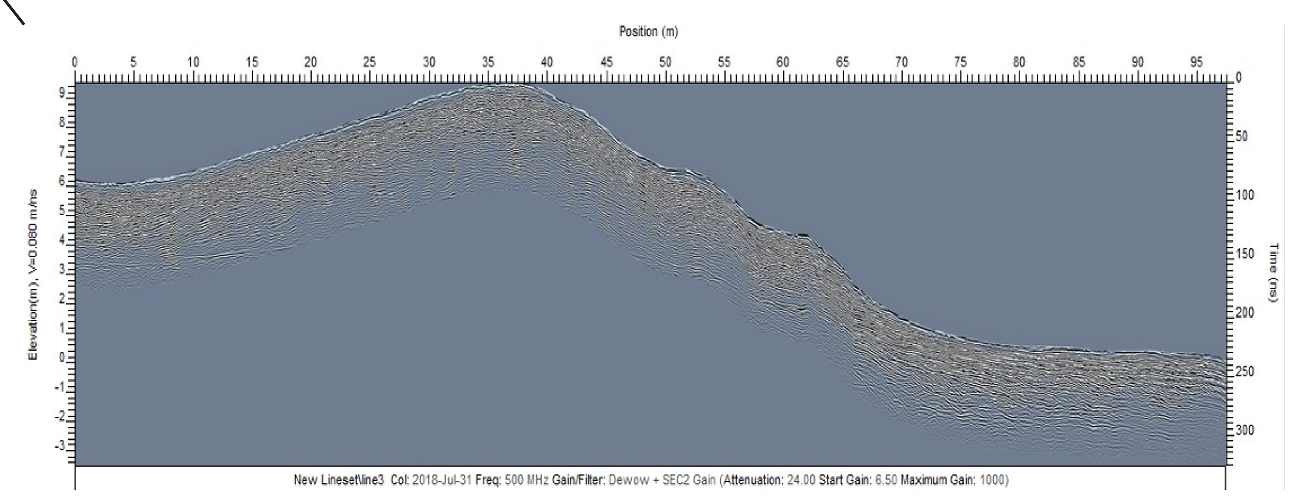


Image of Dune 7 after correction in EKKO_Project 5

Conclusions

This research aided into how GPR can collect data without disrupting the subsurface. For the purpose of this research, we were able to look at the topography of sand dunes located in Lithuania on the Curonian Spit. Once the data from the foredunes were processed through Microsoft Excel and EKKO_Project 5, one can see that no two foredunes looked the same. The various environmental process that shape the Curonian Spit effect each and every dune differently. With the help of EKKO_Project 5, one can interpret how the aeolian features were formed just by looking at the stratigraphy. The correction of foredunes in EKKO_Project 5 can help to interpret the foredunes sediment layers by the way that it is sloping. GPR is a great source of technology to view the subsurface and to collect data without disrupting anything. Future studies include being in Lithuania this summer to explore how GPR works and what other elements and pieces are needed to work with GPR complete correct data measurements of foredunes.

Acknowledgements

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References

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