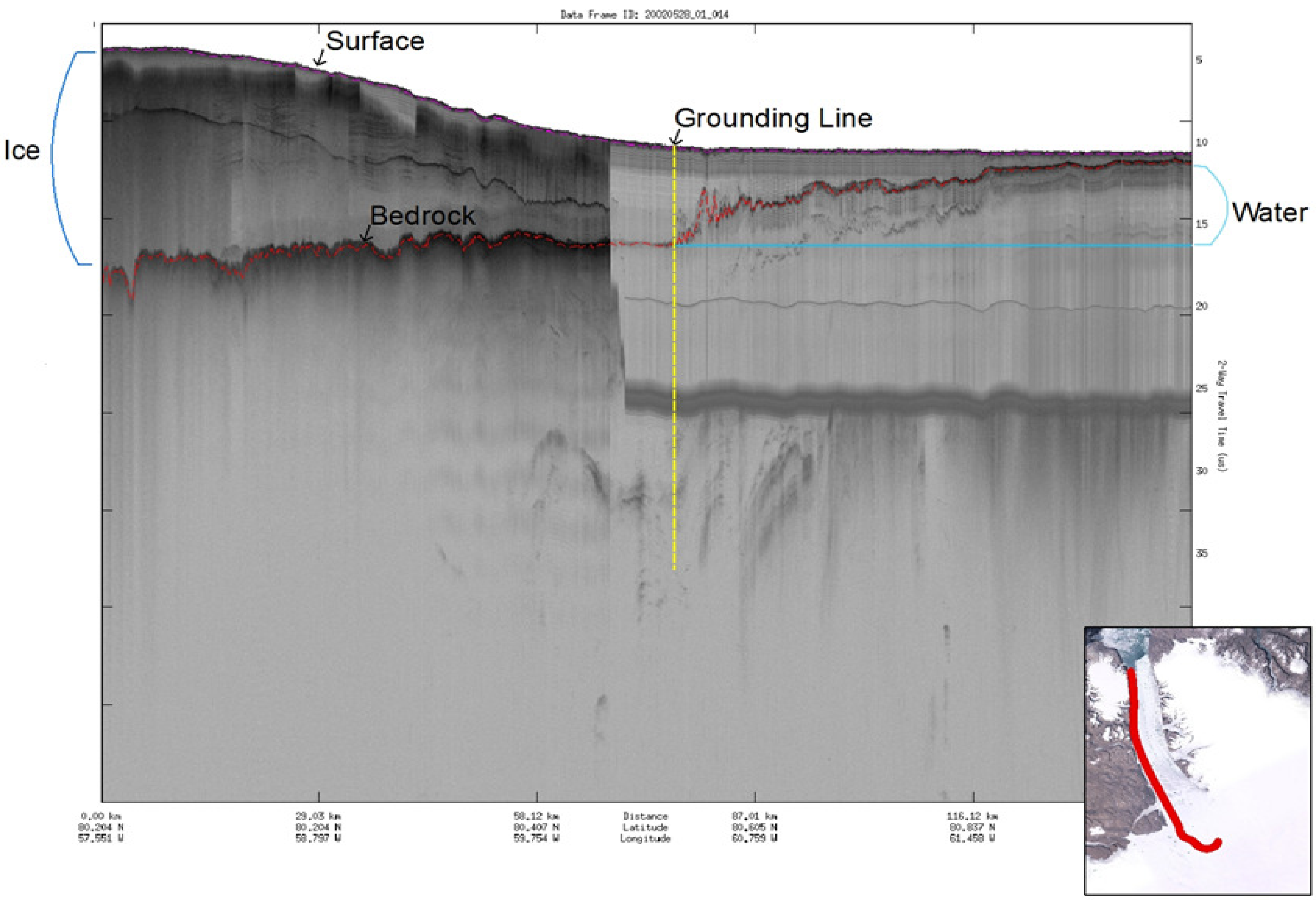
Interpreting an Echogram

Background information for use with Data Series lessons 'Grounding Line Location using Echograms' and 'Calculating Ice Thickness'.

The Echogram

The echogram is the product of thousands of radar signals put together to form a meaningful image of the physical structure of the ice located beneath the snow surface. Once the radar signal is sent down from the platform, that signal is reflected back from the bedrock and snow surface. When the signal is reflected by water there are some distortions in the echo return. When there is water under the ice, the radar is absorbed and the return signal is seen as blurry and scattered in the echogram. An important boundary, the grounding line, can be interpreted as a noticeable change in the image of the radar reflection when the image goes from bedrock to water or vice versa. The grounding line is the location where the glacier begins to float causing water displacement. Future ice sheet models will take into account how fast ice is moving over the grounding line and thereby how much impact it will have on sea level rise.



Additional information located at the bottom (x-axis) of the echogram includes latitude, longitude, and distance down range from where the data collection was initiated. Once the grounding line is located on the echogram, its approximate location can be determined by extending the line down to the coordinates. After locating the grounding line, students can use the coordinates and enter them into a variety of Geographic Information Systems (GIS) or other visualization programs such as Google Earth, to get a spatial sense of where the feature is located. Plotting locations over multiple years can provide a sense of how the grounding line has changed over time. The coordinates can also be used to identify the direction of the flight path (observe how the latitude/longitude values increase/decrease along the x-axis). For example, if the latitude is decreasing from 81.159 to 80.4676, then there is some southward motion in the direction the plane is flying.

Two-way travel time (in microseconds) is the amount of time for the electromagnetic (radar) wave to go from the transmitter on the airborne platform, reflect from a surface, and return to the receiver (y-axis). The signal typically reflects of the snow surface, or the bedrock surface located beneath the ice. The depth (in meters) is on the left side of the echograms from the CReSIS online data products but has been removed from the images in these lessons. The students can check their work by looking at the online data once they have calculated the ice thickness on their own.