Perennial ice is ice that lasts more than one year. Ice that doesn’t melt over the summer period. If the ice in an area melts one year, it’s more likely to melt again the next year – positive feedback mechanism. Diaries from ships, from particular whaling ships in the North Atlantic are quite important sources for information about the extent of sea ice at certain times of the year. Proxies- any sort of line of evidence that can stand in for a direct measurement.

Figure 3 – In a spring- hunting walrus

1.

**Figure 4.** The relationship between temperature (°C) and sea ice conditions off Iceland for selected years between AD 1846-1919.

Mean annual temperature – AD 1000 = 3.47°C, AD 1450= 3.19°C

2.

**The general assumption is that the initial settlement of Greenland was boosted by the local onset of cooler conditions. The increasing extent of pack ice negatively affected shipping and encouraged hunts for marine mammals such as walrus. The sea ice incidence sharply increased after 1150 AD and fluctuated around the value 2 months/yr. It reached its top value (2.7 months/yr) during the three continuous years-1610 AD, 1750 AD and 1890 AD. After these highest values, there was a significant drop in ice incidence during the year 1900 AD. However, the period prior to 1600 is much less certain, because the estimations are based upon documentary record. Maybe this is a case why figure 1 and figure 2 provide different values such as years 1050-1420 AD. The figure 1 suggests high values of sea incidence, whereas figure 2 records significant decrease.**

**Our scatterplot illustrates the medium negative relationship; therefore, we can assume that there is a linkage between sea ice incidence and mean annual temperature. However, there comes into play other factors that have an impact on the sea ice decline: natural variability, global warming, and the Arctic Oscillation, what is the dominant cause of atmospheric variability around the North Pole.**

**There is a reduced sea ice cover between ca. 1050-1420 A.D. succeeded by a sharp increase in sea ice incidence that continuously culminated during the late 19th century. Until the year 1150 AD the extent of sea ice in the North Atlantic Ocean fluctuated around the same values. The cumulative deviation of the chloride from mean shows the most significant shift within a short time of the final extinction of the Norse settlement (AD 1450). The Norse Green landers had disappeared in circumstances that are unresolved, but probably it was the combination of factors such as environmental degradation, maladaptation, and climatic deterioration. Economic marginalization due to opening of the Mediterranean trade routes and re-introduction of elephant ivory on the European market also contribute to the Greenlanders disappearance.**

**Contemporary, commercial ships can navigate through Arctic seas from roughly July to October. As sea ice constantly decreasing, this region might become a maritime highway between Asia and Europe. This represents a serious threat to the fragile Arctic ecosystem.**

Figure 2

Proxy evidence for sea ice -shows essentially what’s called the excess chloride recorded in the Greenland ice sheet. The higher that amount of chloride within the ice core, the greater the incidence of sea ice during that year.

Narrow line- the chloride excess in parts per billion, each measurement reflects an average over a five year period (taking that year plus the two years either side).

Also measuring the excess chloride as a deviation from the mean. Baseline of zero- the mean values. The graph above that values is indicating that you’ve got more or increasing sea ice over that period of time. Decreasing sea ice is below the line.

Thick black line- cumulative deviations from the mean. When the slope is going down, the values for chloride excess in the ice core are below average consistently yar after year. Curve starts to rise, it indicates that the chloride excess is above average. Can be used as a proxy for whether the extent of sea ice is actually increasing or decreasing over time.