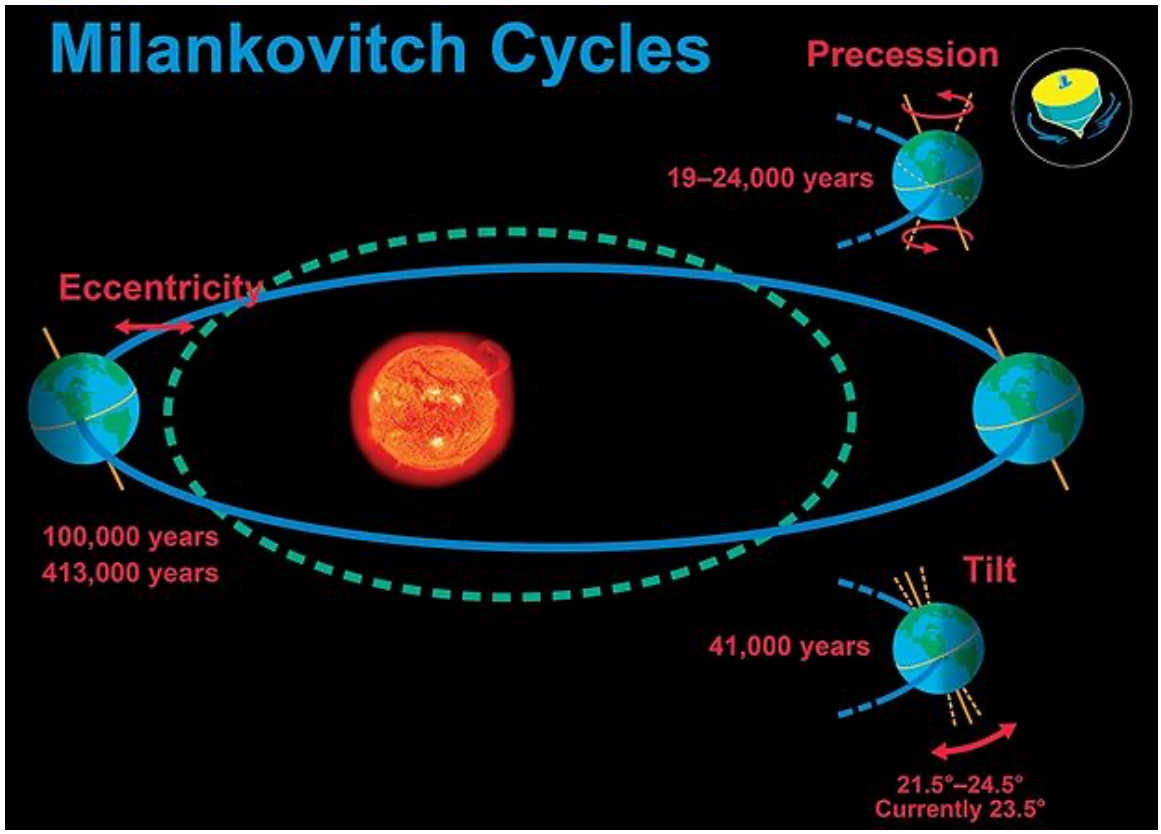

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Earth's climate has varied drastically throughout geologic time. It's hard to imagine that global climate can swing from being completely ice-free, as it was approximately 56 million years ago during the *Paleocene-Eocene Thermal Maximum*, to an Ice Age in a relatively short (geologically speaking) time frame. Imagine a time when tropical plants and animals lived closer to the poles contrasted with the Last Glacial Maximum (19,000-26,000 years ago) when roughly 30% of the Earth was covered in ice. This is pretty drastic change! Earth is currently somewhere in between these two extremes. Exp. 341 is interested in studying sediments deposited within the last 6 million years to gain a better understanding of long-term climate variation, so we'll discuss the causes of long-term climate change we're observing in our Pleistocene sediments.

One of the most groundbreaking theories regarding the cause of long-term climate cycles was the life work of Serbian geophysicist, Milutin Milanković. Around the time of the First World War, he refined previous observations that the amount of solar radiation reaching the Earth changes in a periodic way over time due to gravitational forces acting in our solar system. The Milankovitch Theory describes (through mathematical calculations) how the precession of the Earth, the angle of the Earth's tilt, and the eccentricity of the Earth's orbit change over time.

Precession, Tilt, and Eccentricity…What's up with that?

Precession refers to the fact that planet Earth wobbles on its axis like a spinning top. The amount of precession of Earth's axis varies over 26,000-year periods throughout geologic time. Also, Earth is tilted on its axis at an angle of approximately 23.5 degrees. We experience seasons because Earth is tilted on its axis; this affects how much direct sunlight either hemisphere is exposed to at any given time. The tilt of Earth's axis changes from 22 to 24.5 degrees on 41,000-year cycles. When the tilt of Earth's axis is greater, Earth experiences more extremes between summer and winter seasons. Finally, eccentricity is a measure of how the shape of the Earth's orbit varies from nearly circular to slightly elliptical over time, which changes the distance from the Earth to the Sun. The shape of Earth's orbit fluctuates on approximately 100,000-year cycles. Basically, when these three orbital variations are superimposed on one another it affects the amount of sunlight reaching Earth, which ultimately affects global climate.

Scientific investigations (like Expedition 341!!) involving rocks, sediments, fossils, ice cores, corals, tree rings and other information contained in the rock record indicate that interglacials occur on approximately 100,000-year intervals. Evidence obtained from nature mirror astronomical observations. Out here in the Gulf of Alaska, we can see evidence of glacials and interglacials as we core through Pleistocene sediments!

So, are Milankovitch Cycles the only factor controlling long-term climate variability? The short answer is no. Other factors, such as the composition of gases in our atmosphere, also affect Earth's climate by changing global temperature. Milankovitch Cycles help Earth scientists understand the climatic cycles observed on roughly 100,000-year time scales, like the change reflected in Gulf of Alaska sediments.

Courtesy Alison Mote