

Table 1: Climate Forcing Mechanisms

“Sphere” of the Forcing Mechanism	Forcing Mechanism	Time Scale (Years)	Notes
Astronomical	Solar evolution Solar variation Galactic Dust Milankovitch Cycles -eccentricity -obliquity -precession	Billions 10 – 200 200-500 million 413k, 125k, 96k 41k 23k, 19k	All forcings are external radiative. Galactic dust has not been widely accepted as a forcing mechanism
Lithosphere	Plate tectonics -continental drift -mountain building -ocean circulation -atmospheric circulation -chemical weathering Isostatic Sea Level Changes Volcanism	 10 million to 500 million 10k to 100 million 1 year - millions	Can be considered external to the climate system. Chemical weathering removes carbon during formation of limestone and related rocks.
Hydrosphere	Sea Level Change From land ice changes Circulation -deep water -shallow water CO₂ content	10k – 100k 1000 100 – 1000 100 years	Deep water circulation is the thermohaline circulation and is often referred to as the Global Conveyor Belt.
Cryosphere	Ice sheets growth and decay Black carbon deposition	100 – 10k 1 - 100	Black carbon is also called soot and increases the absorption of solar radiation which increases melting.
Atmosphere	Greenhouse gases -long term levels -glacial vs. interglacial Circulation	1 million – 10 million 1000 – 10k months – 10	Long term refers to the evolution of Earth. Glacial vs. interglacial refers to natural greenhouse gas changes.
Biosphere	Forest Growth Swamps and Peat Bogs	100 – 1000	Swamps and bogs produce methane.
Human Forcings	Fossil Fuels Land Use	10 – 100 10 – 100	Deforestation reduces carbon uptake by photosynthetic plants.