



## Factors driving climate—the dynamic sun radiating to a dynamic earth

Excerpt from **Thriving with Nature & Humanity**

There appear to be hundreds, perhaps many hundreds of factors affecting climate. These operate across many scales including the following partial list (with those likely most significant in *italics*):

- Galactic. eg, 150 million year cycle of our solar system passing through high cosmic wind radiation bands in our galaxy.
- Solar system and sun. These are many, varied and appear highly significant for climate including *variations in sun's solar output; output of solar particles; sun's magnetic field polarity and strength*; Earth's orbit; solar system's centre-of-gravity; Earth's axis tilt and precession; sun's polarity; sun spot cycles; moon's orbit.
- Planetary. These appear to include Earth's axis tilt; geotectonic and *volcanic activity*; many forms of energy including kinetic and magnetic; Earth's polarity and movement of the poles; length of day; seasons of the year; volume of water in the global hydrological cycle; Earth's geothermal heat flow; Earth's interior heat source - vastly greater by many orders of magnitude than oceans as a heat sink.
- Earth's surface. eg, topography; Earth's surface temperatures; seasonal variations in temperature; fires; relative differentials between regions around the Earth's surface, especially polar to tropical; photochemical -dynamical changes; sea ice; sea level; Earth's internal constitution.
- Atmospheric. eg, variations in strength of Earth's magnetic field - deflecting of photons; *atmospheric water content; cloud cover*; precipitation - rain, snow; variability in wind currents; lower and upper atmospheric temperatures and their relationships; natural aerosols (far outweigh human-made aerosols); ozone; natural mineral aerosols; atmospheric pressure; storm activity; auroral lights.
- Oceanic. eg, *ocean temperature; salinity; currents; sea surface temperatures*; iron content; Earth's tides due to interaction of sun and moon.
- *Cyclic regional decadal circulation patterns such as North American Oscillation and the southern Pacific ocean's El Nino together with their variation over time.*
- Biological. eg, marine phytoplankton producing natural aerosols like sea salt and dimethyl sulphide; enzyme action of microbes;
- Nature's large scale changes to vegetation.
- Interactions. eg, of wind currents and ocean currents; conversion of energy forms (eg, from sun's e-m energy to cloud seeds); environmental processes involving the interaction of climate, biological and geological processes and, at times, extraterrestrial bombardment by meteorites; area of snow cover; heat content and transfers spatially and vertically around and within Earth; heat transfers between ocean and atmosphere and between land and atmosphere;
- water vapour transfers spatially and vertically; release of volatiles at deep ocean vents.
- Human. eg, relatively tiny human production of aerosols (eg, soot); aircraft contrails; land use. Due to Earth's relative enormity, the impact of human factors is restricted to local and occasionally regional.