

## Appendix 1

List of the SIOS Core Data (SCD) and its references to Essential Climate Variables (Global Climate Observing System GCOS) and to Global Change Master Directory (GCMD) Keywords.

<b>SIOS Core Data</b>	<b>GCOS hierarchical structure</b> <i>Domain / Subdomain / Observed Variables</i>	<b>GCMD hierarchical structure</b> <i>Term / Variable_Level_1 / Variable_Level_2</i>	<b>GCOS Definition</b>	<b>GCMD Definition</b>
<b>SCD 1.1. WIND SPEED</b>	ATMOSPHERE / SURFACE / SURFACE WIND SPEED	ATMOSPHERIC WINDS / SURFACE WINDS / WIND SPEED	Speed of air at a known height above the surface which is to be specified in the metadata (m/s).	Ratio of the distance covered by the air to the time taken to cover it. The instantaneous speed corresponds to the case of an infinitely small-time interval. The mean speed corresponds to the case of a finite time interval. It is one component of wind velocity, the other being wind direction).
<b>SCD 1.2. WIND DIRECTION</b>	ATMOSPHERE / SURFACE / SURFACE WIND DIRECTION	ATMOSPHERIC WINDS / SURFACE WINDS / WIND DIRECTION	Direction from which wind is blowing at a known height above the surface which is to be specified in the metadata (degree true)	The direction from which the wind is blowing.
<b>SCD 1.3. AIR TEMPERATURE</b>	ATMOSPHERE / SURFACE / TEMPERATURE (NEAR SURFACE)	ATMOSPHERIC TEMPERATURE / SURFACE TEMPERATURE / AIR TEMPERATURE	Air temperature at a known height above surface, with the height specified in the metadata (K)	The temperature indicated by a thermometer exposed to the air in a place sheltered from direct solar radiation.
<b>SCD 1.4. NET RADIATION</b>	ATMOSPHERE / SURFACE / ENERGY AND TEMPERATURE	ATMOSPHERIC RADIATION / NET RADIATION /		Net radiation refers to the difference between the downward and upward (total and terrestrial) radiation. The net flux of all radiations. Can also refer to the net solar radiation which is the difference between the solar radiations directed downwards and upwards.
<b>SCD 1.5. SHORTWAVE RADIATION</b>	ATMOSPHERE / SURFACE / SURFACE ERB SHORTWAVE	ATMOSPHERIC RADIATION / SHORTWAVE RADIATION /	Flux density of the solar radiation at the Earth's surface (W/m <sup>2</sup> )	Shortwave radiation is radiation at wavelengths shorter than 4 microns. Sometimes called the solar radiation. Usually radiation in the visible and near-infrared wavelengths.
<b>SCD 1.6. LONGWAVE RADIATION</b>	ATMOSPHERE / SURFACE / SURFACE ERB LONGWAVE	ATMOSPHERIC RADIATION / LONGWAVE RADIATION /	Flux density of radiation emitted by the gases, aerosols and clouds of the atmosphere to the Earth's surface (W/m <sup>2</sup> )	Longwave radiation is radiation with wavelengths longer than 4 microns. Also referred to as infrared radiation or terrestrial radiation.
<b>SCD 1.7. 24 HOUR PRECIPITATION AMOUNT</b>	ATMOSPHERE / SURFACE / ESTIMATES OF LIQUID AND SOLID PRECIPITATION	PRECIPITATION / PRECIPITATION AMOUNT / 24 HOUR PRECIPITATION AMOUNT	Integration of solid and liquid precipitation rate reaching the ground over several time intervals. The reference requirement refers to integration over 24h.	The amount of precipitation collected and measured at a weather observing site during a 24 hour period.
<b>SCD 1.8. HUMIDITY</b>	ATMOSPHERE / SURFACE / WATER VAPOUR (RELATIVE HUMIDITY - SURFACE)	ATMOSPHERIC WATER VAPOR / WATER VAPOR INDICATORS / HUMIDITY	Relative humidity at a known height above surface, with the height specified in the metadata. It is the ratio of the	Generally, some measure of the water vapor content of air.

			amount of atmospheric moisture present relative to the amount that would be present if the air were saturated with respect to water or ice to be specified in the metadata (%)	
<b>SCD 1.9. UPPER AIR TEMPERATURE</b>	ATMOSPHERE / UPPER ATMOSPHERE / TEMPERATURE OF DEEP ATMOSPHERIC LAYERS	ATMOSPHERIC TEMPERATURE / UPPER AIR TEMPERATURE /	3D field of the atmospheric temperature of deep atmospheric layers (K)	Temperature is defined, in general, as the degree of hotness or coldness measured on some definite temperature scale by means of any of various types of thermometers. In meteorology, a profile is defined as a graph of the value of a scalar quantity versus a horizontal, vertical, or time scale. It usually refers to a vertical representation.
<b>SCD 1.10. UPPER LEVEL WINDS</b>	ATMOSPHERE / UPPER ATMOSPHERE / UPPER-AIR WIND RETRIEVALS	ATMOSPHERIC WINDS / UPPER LEVEL WINDS /	3D field of the horizontal vector component (2D) of the 3D wind vector (m/s)	Generally, the wind speeds and directions at various levels in the atmosphere above the domain of surface weather observations, as determined by any of the methods of winds-aloft observation.
<b>SCD 1.11. CLOUD TYPES</b>	WMO / WMO / CLOUD TYPE_WMO	CLOUDS / CLOUD TYPES /	At present, the only method for observing most cloud types is visual. Pictorial guides and coding information are available from many sources, such as WMO (1975, 1987), as well as from publications of National Meteorological Services.	(Also known as cloud genus) The main characteristic form of a cloud used in its identification
<b>SCD 1.12. CLOUD BASE HEIGHT</b>	WMO / WMO / CLOUD- BASE HEIGHT_WMO	CLOUDS / CLOUD PROPERTIES / CLOUD HEIGHT	The height of the cloud base lends itself to instrumental measurement, which is now widely used at places where cloud height is operationally important. However, the estimation of cloud-base height by human observer is still widespread.	In weather observations, the height of the cloud base above local terrain. In satellite remote sensing, cloud height is often referred to as the height of the cloud top above local terrain or above mean sea level. Also, can be defined as the vertical distance from the cloud base to the cloud top; more commonly referred to as the "thickness" or "depth" of the cloud.
<b>SCD 1.13. WATER VAPOR FLUX</b>	ATMOSPHERE / UPPER ATMOSPHERE / HYDROSPHERE	ATMOSPHERIC WATER VAPOR / WATER VAPOR PROCESSES / WATER VAPOR FLUX		Flow of Water Vapor across an area per unit time, for "water vapor flux" units of kg/m <sup>2</sup> /s
<b>SCD 1.14. CARBON DIOXIDE</b>	ATMOSPHERE / ATMOSPHERIC COMPOSITION / CARBON CYCLE AND OTHER GHGS	ATMOSPHERIC CHEMISTRY / CARBON AND HYDROCARBON COMPOUNDS / CARBON DIOXIDE	GCOS is reviewing and will update the requirements until 2022.	Human-generated carbon dioxide is caused mainly by the burning of fossil fuels and deforestation. The chemical formula for carbon dioxide is CO <sub>2</sub> . Long-term measurements of CO <sub>2</sub> in the atmosphere are conducted at Manua Loa, Hawaii and several international monitoring stations around the world.
<b>SCD 1.15. NITROGEN DIOXIDE</b>	ATMOSPHERE / ATMOSPHERIC COMPOSITION / CARBON CYCLE AND OTHER GHGS	ATMOSPHERIC CHEMISTRY / NITROGEN COMPOUNDS / NITROGEN DIOXIDE	GCOS is reviewing and will update the requirements until 2022.	A reddish-brown, highly poisonous gas, with the chemical formula NO <sub>2</sub> .
<b>SCD 1.16. OZONE</b>	ATMOSPHERE / ATMOSPHERIC	ATMOSPHERIC CHEMISTRY / OXYGEN COMPOUNDS / OZONE	GCOS is reviewing and will update the requirements until 2022.	Ozone (O <sub>3</sub> ) is a molecule that consists of three oxygen atoms bonded together. The ozone layer in the stratosphere absorbs UV radiation and creates a warm layer of air high in the stratosphere.

	COMPOSITION / CARBON CYCLE AND OTHER GHGS			Ozone that is present in the troposphere is mostly a result of anthropogenic pollution and therefore higher concentrations are found in urban areas. Ozone is involved with NOx in the photochemical production of many of the constituents of pollution environments (see nitrogen oxides and hydroxyl definitions).
<b>SCD 1.17. METHANE</b>	ATMOSPHERE / ATMOSPHERIC COMPOSITION / CARBON CYCLE AND OTHER GHGS	ATMOSPHERIC CHEMISTRY / CARBON AND HYDROCARBON COMPOUNDS / METHANE	GCOS is reviewing and will update the requirements until 2022.	Methane (CH <sub>4</sub> ) is a colorless, odorless, flammable, greenhouse gas. It is released naturally into the air from marshes, swamps, rice fields, ruminant animals (such as cattle), and sewage sludge. CH <sub>4</sub> is also released from methane-producing bacteria (methanogens) that live in anaerobic places.
<b>SCD 1.18. AEROSOL OPTICAL DEPTH/THICKNESS</b>	ATMOSPHERE / ATMOSPHERIC COMPOSITION / AEROSOL OPTICAL DEPTH, COLUMNAR	AEROSOLS / AEROSOL OPTICAL DEPTH/THICKNESS /	The AOD is the spectral dependent aerosol extinction coefficient integrated over the geometrical path length (dimensionless)	The degree to which Aerosols prevent light from passing through. Optical depth/thickness depends upon the physical constitution, the form, and the concentration of particles.
<b>SCD 1.19. AEROSOL PARTICLE PROPERTIES</b>	ATMOSPHERE / ATMOSPHERIC COMPOSITION /	AEROSOLS / AEROSOL PARTICLE PROPERTIES /		Properties of aerosol particles including: composition, size (distributin), diameter.
<b>SCD 1.20. AEROSOL CHEMICAL COMPOSITION</b>	ATMOSPHERE / ATMOSPHERIC COMPOSITION /	AEROSOLS / CHEMICAL COMPOSITION /		no definition
<b>SCD 1.21. CO<sub>2</sub>, FLUX</b>				
<b>SCD 1.22. CH<sub>4</sub>, FLUX</b>				
<b>SCD 1.23. AEROSOL IN SITU ABSORPTION</b>				
<b>SCD 1.24. AEROSOL IN SITU SCATTERING</b>				
<b>SCD 1.25. BLACK CARBON</b>				
<b>SCD 1.26. U/V WIND COMPONENTS</b>	ATMOSPHERE / UPPER ATMOSPHERE / PHYSICAL PROPERTIES	ATMOSPHERIC WINDS / UPPER LEVEL WINDS / U/V WIND COMPONENTS		Zonal (U) and Meridional (V) wind velocity.
<b>SCD 1.27. TURBULENCE</b>	ATMOSPHERE / UPPER ATMOSPHERE / PHYSICAL PROPERTIES	ATMOSPHERIC WINDS / WIND DYNAMICS / TURBULENCE		Random and continuously changing air motions that are superposed on the mean motion of the air.
<b>SCD 1.28. VERTICAL WIND VELOCITY/SPEED</b>	ATMOSPHERE / UPPER ATMOSPHERE / PHYSICAL PROPERTIES	ATMOSPHERIC WINDS / WIND DYNAMICS / VERTICAL WIND VELOCITY/SPEED		The component of wind motion rising perpendicular to the plane of the horizon.

SCD 1.29. All-sky (630.0 nm, 557.7nm, 427.8 nm., cloud observation)				
SCD 1.30. Nem(F2), hm(F2) - Peak values of electron density and altitude of Ne maximum, ionosphere F2 layer				
SCD 2.1. GLACIER MASS BALANCE	TERRESTRIAL / CRYOSPHERE / GLACIER MASS CHANGE	GLACIERS/ICE SHEETS / GLACIER MASS BALANCE/ICE SHEET MASS BALANCE /	Annual change in total mass of glacier (at the end of the ablation period)	
SCD 2.2. GLACIER ELEVATION	TERRESTRIAL / CRYOSPHERE / GLACIER ELEVATION CHANGE	GLACIERS/ICE SHEETS / GLACIER ELEVATION/ICE SHEET ELEVATION /	2d map of change in height of surface of glacier	
SCD 2.3. ICE VELOCITY	TERRESTRIAL / CRYOSPHERE / ICE VELOCITY	SNOW/ICE / ICE VELOCITY /	Surface-parallel vector of the surface ice flow	
SCD 2.4. PERMAFROST TEMPERATURE	TERRESTRIAL / CRYOSPHERE / THERMAL STATE OF PERMAFROST	FROZEN GROUND / PERMAFROST / PERMAFROST TEMPERATURE	Ground temperatures measured at specified depths along profiles	Pertaining to the temperature of permafrost, frozen subsoil. layer of soil or rock, at some depth beneath the surface, in which the temperature has been continuously below 0°C for at least several years; it exists where summer heating fails to reach the base of the layer of frozen ground.
SCD 2.5. ACTIVE LAYER	TERRESTRIAL / CRYOSPHERE / ACTIVE LAYER THICKNESS	FROZEN GROUND / ACTIVE LAYER /	Thickness of seasonally thawed ground measured in (cm)	Active layer, also called frost zone or mollisol, is part of the soil included with the suprapermafrost layer (i.e., existing above permafrost) that usually freezes in winter and thaws in summer. Its bottom surface is the frost table, beneath which may lie permafrost or talik. The depth of the active layer varies anywhere from a few inches to several feet.
SCD 2.6. PERMAFROST	TERRESTRIAL / CRYOSPHERE	FROZEN GROUND / PERMAFROST /		1. (Also called perennially frozen ground, pergelisol, permanently frozen ground.) A layer of soil or bedrock at a variable depth beneath the surface of the earth in which the temperature has been below freezing continuously from a few to several thousands of years. Permafrost exists where the summer heating fails to descend to the base of the layer of frozen ground. A continuous stratum of permafrost is found where the annual mean temperature is below about 5C (23F). 2. As limited in application by P. F. Svetsov, soil that is known to have been frozen for at least a century.

<b>SCD 2.7. GROUND ICE</b>	TERRESTRIAL / CRYOSPHERE / ICE CONTENT	FROZEN GROUND / GROUND ICE /		A general term referring to all types of ice contained in freezing and frozen ground. Ground ice occurs in pores, cavities, voids or other openings in soil or rock and includes massive ice. It may occur as lenses, wedges, veins, sheets, seams, irregular masses, or as individual crystals or coatings on mineral or organic particles. Perennial ground ice can only occur within permafrost bodies.
<b>SCD 2.8. SNOW DEPTH</b>	TERRESTRIAL / CRYOSPHERE / SNOW DEPTH	SNOW/ICE / SNOW DEPTH /	Snow depth is the perpendicular distance between snowpack surface and the underlying ground.	Pertaining to the thickness of snow pack throughout the year.
<b>SCD 2.9. SNOW WATER EQUIVALENT</b>	TERRESTRIAL / CRYOSPHERE / SNOW WATER EQUIVALENT	SNOW/ICE / SNOW WATER EQUIVALENT /	It is depth of water that result from the snowpack melting in a unit of area.	Pertaining to the measurement of the amount of water in a given snow pack.
<b>SCD 2.10. SNOW COVER</b>	TERRESTRIAL / CRYOSPHERE / SNOW AND ICE	SNOW/ICE / SNOW COVER /		Pertaining to the extent, depth, and longevity of snow pack.
<b>SCD 2.11. SNOW/ICE TEMPERATURE</b>	TERRESTRIAL / CRYOSPHERE / SNOW AND ICE	SNOW/ICE / SNOW/ICE TEMPERATURE /		Pertaining to the measured internal temperature of snow/ice pack(s).
<b>SCD 3.1. SOIL MOISTURE/WATER CONTENT</b>	TERRESTRIAL / HYDROLOGY / HYDROSPHERE	SOILS / SOIL MOISTURE/WATER CONTENT /	Surface soil moisture - average water content in topmost soil layer (0-5 cm)	Soil Water Content: The water lost from soil upon drying to constant mass at 105 degrees Celsius; expressed either as the mass of water per unit mass of dry soil or as the volume of water per unit bulk volume of soil. For GCMD purpose, this also includes all measurements related to soil water, such as capacity, potential, and pressure, etc...
<b>SCD 4.1. SEA SURFACE HEIGHT</b>	OCEAN / PHYSICAL / REGIONAL MEAN SEA LEVEL	SEA SURFACE TOPOGRAPHY / SEA SURFACE HEIGHT /	The height of the ocean surface relative to a reference geoid or an agreed regional datum	The height of the ocean surface above a datum, such as a vertical datum for sea level measurements, or a reference ellipsoid for satellite altimetric measurements
<b>SCD 4.2. SEA LEVEL RISE</b>	OCEAN / PHYSICAL / GLOBAL MEAN SEA LEVEL	COASTAL PROCESSES / SEA LEVEL RISE /	The height of the ocean surface relative to a reference geoid.	An increase in the average height of the sea surface over a vertical datum.
<b>SCD 4.3. OCEAN CURRENTS</b>	OCEAN / PHYSICAL / SURFACE GEOSTROPHIC CURRENT	OCEAN CIRCULATION / OCEAN CURRENTS /	Ocean Vector motion measured at or near the surface (at stated depth)	Horizontal flow of water in an established, defined pattern.
<b>SCD 4.4. SEA SURFACE TEMPERATURE</b>	OCEAN / PHYSICAL / SEA SURFACE TEMPERATURE	OCEAN TEMPERATURE / SEA SURFACE TEMPERATURE /	Radiative skin sea surface temperature, or Bulk sea surface temperature at Stated depth	A measure of the average kinetic energy of the vibration of water molecules, measured or estimated at the sea surface.
<b>SCD 4.5. SALINITY</b>	OCEAN / PHYSICAL / SEA SURFACE SALINITY	SALINITY/DENSITY / SALINITY /	Salinity of seawater, at or near the surface - Salinity is unitless, and is expressed with the suffix psu (practical salinity unit, PSS-78).	The total amount of dissolved material in water and its effect on water's mass-to-volume ratio. Scientific measurements related to either salinity or density are included under this Term.
<b>SCD 4.6. OCEAN HEAT BUDGET</b>	OCEAN / PHYSICAL / RADIATIVE HEAT FLUX	OCEAN HEAT BUDGET / /	The heat exchanged between the ocean and atmosphere resulting from the balance between radiation leaving the sea surface (reflected and emitted) and radiation passing through the sea surface	Study of the heat energy gains and losses of the oceans, on global or regional scales. Variables include the terms in the heat budget equation.

			into the ocean; often divided into an infrared or longwave and a visible or shortwave component.	
<b>SCD 4.7. SEA STATE</b>	OCEAN / PHYSICAL / WAVE HEIGHT	OCEAN WAVES / SEA STATE /	The distance between the trough of the wave and the adjacent crest of the wave. The significant wave height is the mean wave height (trough to crest) of the highest third of the waves in a wave spectrum	A measure of the roughness of the sea surface; a scale of surface wave conditions related to the speed of wind.
<b>SCD 4.8. WATER TEMPERATURE</b>	OCEAN / PHYSICAL / INTERIOR TEMPERATURE	OCEAN TEMPERATURE / WATER TEMPERATURE /	Seawater temperature measured with depth (degrees Celsius/Kelvin)	
<b>SCD 4.9. CHLOROPHYLL CONCENTRATIONS</b>	OCEAN / BIOGEOCHEMICAL / CHLOROPHYLL-A CONCENTRATION	OCEAN CHEMISTRY / CHLOROPHYLL / CHLOROPHYLL CONCENTRATIONS	Concentration of chlorophyll-a pigment in the surface water [ $\mu\text{g l}^{-1}$ ]	