



Review of Earth System Environment Variables

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Purpose of this Exercise

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- **To comprehensively define how we describe the Earth System with its different domains, subdomains, and attributes.**
 - **Examined from both a user perspective and monitoring and observing the Earth and Solar environments.**

 - **Practical implications include:**
 - Gather information for projects such as Digital Twins
 - Allow Extension of ASPEN for Architecture design and verification (v2.0)
 - Proposal to potentially extend NOAA COURL database (of obs needs)
 - Signal to NOAA the need to have additional capabilities
 - Could serve as input to Innovation and other maturation/extension programs
 - Etc

Description of Earth System Environment

Environmental Domain	Environmental Subdomain
Atmosphere	Neutral Atmosphere
	TOA Earth Radiation
	Atmospheric Composition
	Precipitation
	Clouds
Land/Hydrology	Surface Geophysical Properties
	Surface Radiative Properties
	Vegetation
	Fire

Environmental Domain	Environmental Subdomain
Cryosphere	Sea Ice
	Snow
	Lake and River Ice
	Glaciers, Ice Caps, Ice Sheets
	Icebergs
	Permafrost
Ocean	Open Ocean
	Coastal
	Inland Waters
	Bathymetry/ Seafloor Topography
	Ocean Composition and Optical Properties

Environmental Domain	Environmental Subdomain
Space Weather	Solar
	Heliosphere
	Magnetosphere
	Ionosphere
	Upper Atmosphere





DOMAIN: ATMOSPHERE

Subdomains:

Neutral Atmosphere

TOA Earth Radiation

Atmospheric Composition

Precipitation

Clouds



Domain: Atmosphere

Subdomain: Neutral Atmosphere (1/3)

Geophysical Variable Full Name	Units	Definition
Boundary Layer Depth	km	The depth of water vapor in the boundary layer.
Moisture Imagery	NA	Satellite imagery including digital maps of observed moisture.
Specific Humidity, Free Troposphere	g/kg	The ratio between the mass of water vapor and the mass of moist air for the free troposphere.
Specific Humidity: Planetary Boundary Layer	g/kg	The ratio between the mass of water vapor and the mass of moist air for the planetary boundary layer.
Total Precipitable Water	mm	The amount of water that can be obtained from the surface to the top of the atmosphere if all of the water and water vapor were condensed to a liquid phase.

Domain: Atmosphere

Subdomain: Neutral Atmosphere (2/3)

Geophysical Variable Full Name	Units	Definition
Air Temperature: Mid-Upper Stratosphere	K	Air temperature as described in the mid-upper stratosphere.
Air Temperature: Upper Troposphere-Lower Stratosphere	K	Air temperature as described in the upper troposphere to lower stratosphere.
Air Temperature: Free Troposphere	K	Air temperature as described in the free troposphere.
Air Temperature: Planetary Boundary Layer	K	Air temperature as described in the planetary boundary layer.
Air Temperature: Near Surface	K	Air temperature as described in near surface.

Domain: Atmosphere

Subdomain: Neutral Atmosphere (3/3)

Geophysical Variable Full Name	Units	Definition
Wind Speed Profile: Eastward Direction, Mid-Upper Stratosphere	m/s	Measure of wind speed in the eastward direction (u-component) in the mid to upper stratosphere.
Wind Speed Profile: Eastward Direction, Upper Troposphere-Lower Stratosphere	m/s	Measure of wind speed in the eastward direction (u-component) in the upper troposphere to lower stratosphere.
Wind Speed Profile: Eastward Direction, Free Troposphere	m/s	Measure of wind speed in the eastward direction (u-component) in the free troposphere.
Wind Speed Profile: Eastward Direction, Planetary Boundary Layer	m/s	Measure of wind speed in the eastward direction (u-component) in the planetary boundary layer.
Wind Speed Profile: Northward Direction, Mid-Upper Stratosphere	m/s	Measure of wind speed in the northward direction (v-component) in the mid to upper stratosphere.
Wind Speed Profile: Northward Direction, Upper Troposphere-Lower Stratosphere	m/s	Measure of wind speed in the northward direction (v-component) in the upper troposphere to lower stratosphere.
Wind Speed Profile: Northward Direction, Free Troposphere	m/s	Measure of wind speed in the northward direction (v-component) in the free troposphere.
Wind Speed Profile: Northward Direction, Planetary Boundary Layer	m/s	Measure of wind speed in the northward direction (v-component) in the planetary boundary layer.

Domain: Atmosphere

Subdomain: TOA Earth Radiation (1/1)

Geophysical Variable Full Name	Units	Definition
Incoming Shortwave Radiation: TOA	W/m ²	Incoming shortwave ultraviolet, visible, and infrared energy from the Sun, measured at the top of the atmosphere.
Outgoing Shortwave Radiation: TOA	W/m ²	Outgoing shortwave ultraviolet, visible, and infrared energy from the Earth, measured at the top of the atmosphere.
Outgoing Longwave Radiation: TOA	W/m ²	Outgoing longwave ultraviolet, visible, and infrared energy from the Earth, measured at the top of the atmosphere.
Albedo, TOA	unitless	Ratio of the intensity of reflected radiation to that of the incident radiation at the top of the atmosphere.

Domain: Atmosphere

Subdomain: Atmospheric Composition (1/9)

Geophysical Variable Full Name	Units	Definition
Aerosol Concentration (Vertical Profile)	micrograms/m ³	Mass concentration of particulate matter as a function of altitude.
Aerosol Concentration (Surface PM2.5)	micrograms/m ³	Mass concentration of particulate matter of particles smaller than 2.5 μm in median diameter.
Aerosol Concentration (Surface PM10)	micrograms/m ³	Mass concentration of particulate matter of particles smaller than 10 μm in median diameter.
Aerosol composition/type	unitless	The chemical composition of solid or aqueous particle matter suspended in the atmosphere, i.e., mineral dust, sea salt, sulfate, black and brown carbon, and various secondary organic species. Also known as aerosol speciation.
Aerosol Optical Depth/Thickness (Visible)	unitless	The effective depth of the aerosol column as measured by the extinction of light in the visible spectrum.
Aerosol Optical Depth/Thickness (UV)	unitless	The effective depth of the aerosol column as measured by the extinction of light in the UV spectrum.
Aerosol Refractive Index	unitless	The degree of refraction, i.e., the bending angle or redirection of electromagnetic radiation due to the interaction with molecules or particles.
Aerosol Layer Height	km	Height of vertically localized aerosol layer above sea level.

Domain: Atmosphere

Subdomain: Atmospheric Composition (2/9)

Geophysical Variable Full Name	Units	Definition
Aerosol Scattering Index (UV)	unitless	Wavelength dependent changes in Rayleigh scattering due to the presence of aerosols in the UV spectral range. Represented as a ratio.
Aerosol Scattering Index (Visible)	unitless	Wavelength dependent changes in Rayleigh scattering due to the presence of aerosols in the visible spectral range. Represented as a ratio.
Aerosol Particle Size	micrometers	Mean effective radius of particle size distribution.
Aerosol Single Scattering Albedo	unitless	The spectrally dependent ratio of the aerosol scattering to the aerosol extinction
Aerosol Particle Shape Factor	unitless	Defines the shape of particles whether they are spherical or non-spherical
Speciated Aerosol Mass	micrograms/m ³	Mass concentration of speciated particulate matter as a function of altitude
Speciated PM2.5	micrograms/m ³	Mass concentration of speciated particulate matter of median diameters of 2.5 microns or less.
Total PM2.5	micrograms/m ³	Mass concentration of all particulate matter of median diameters of 2.5 microns or less.



Domain: Atmosphere

Subdomain: Atmospheric Composition (3/9)

Geophysical Variable Full Name	Units	Definition
Speciated PM10	micrograms/m ³	Mass concentration of speciated particulate matter of median diameters of 10 microns or less.
Total PM10	micrograms/m ³	Mass concentration of all particulate matter of median diameters of 10 microns or less.
Smoke/Dust Detection	unitless	Presence of smoke or dust.
Smoke/Dust Layer Height	km	Height of vertically localized smoke or dust aerosol layer above sea level.
Volcanic Ash Detection	unitless	Presence of volcanic ash.
Volcanic Ash Height	km	Height of vertically localized volcanic ash layer above sea level.
Volcanic Ash Concentration	tonnes/m ²	Mass column density of volcanic ash.

Domain: Atmosphere

Subdomain: Atmospheric Composition (4/9)

Geophysical Variable Full Name	Units	Definition
Carbon Dioxide/CO ₂	ppmv	Volume mixing ratio of carbon dioxide in the atmosphere. (*)
Methane/CH ₄	ppbv	Volume mixing ratio of methane in the atmosphere. (*)
Ozone Column	DU	Column integral of the ozone concentration through the entire atmosphere. 1 DU = 1 Dobson unit = 0.01 mm thickness of a column of gas compressed to surface standard temperature (0 deg C) and pressure (1000 mbar).
Ozone profile	ppmv	Volume mixing ratio of ozone in the atmosphere. (*)
Carbon Monoxide/CO	ppbv	Volume mixing ratio of carbon monoxide in the atmosphere. (*)
Sulfur Dioxide/SO ₂	ppbv	Volume mixing ratio sulfur dioxide in the atmosphere. (*)
Nitrogen Dioxide/NO ₂	ppbv	Volume mixing ratio of nitrogen dioxide in the atmosphere. (*)
Formaldehyde/CH ₂ O	ppbv	Volume mixing ratio of formaldehyde in the atmosphere. (*)
Glyoxal/C ₂ H ₂ O ₂	ppbv	Volume mixing ratio of glyoxal in the atmosphere. (*)

(*) Some variables are capable of providing profile information. Details will be determined with their attributes (vertical resolution, vertical extent, etc)

Domain: Atmosphere

Subdomain: Atmospheric Composition (5/9)

Geophysical Variable Full Name	Units	Definition
Isoprene/C5H8	ppbv	Volume mixing ratio of isoprene in the atmosphere. (*)
Nitric Acid/HNO3	ppbv	Volume mixing ratio of nitric acid in the atmosphere. (*)
Dinitrogen Pentoxide/N2O5	pptv	Volume mixing ratio of dinitrogen pentoxide in the atmosphere. (*)
Hydrogen Peroxide/H2O2	ppbv	Volume mixing ratio of hydrogen peroxide in the atmosphere. (*)
Hydrogen Chloride/HCl	ppbv	Volume mixing ratio of hydrogen chloride in the atmosphere. (*)
Chlorine Nitrate/ClONO2	ppbv	Volume mixing ratio of chlorine nitrate in the atmosphere. (*)
Chlorine Dioxide/ClO2	pptv	Volume mixing ratio of chlorine dioxide in the atmosphere. (*)
Chlorine Monoxide/ClO	pptv	Volume mixing ratio of chlorine monoxide in the atmosphere (*)
Nitrous Oxide/N2O	ppbv	Volume mixing ratio of nitrous oxide in the atmosphere. (*)

(*) Some variables are capable of providing profile information. Details will be determined with their attributes (vertical resolution, vertical extent, etc)

Domain: Atmosphere

Subdomain: Atmospheric Composition (6/9)

Geophysical Variable Full Name	Units	Definition
Trichlorofluoromethane/CFCI3	pptv	Volume mixing ratio of trichlorofluoromethane in the atmosphere. (*)
Dichlorodifluoromethane/CF2Cl2	ppbv	Volume mixing ratio of dichlorodifluoromethane in the atmosphere. (*)
Bromomethane/CH3Br	pptv	Volume mixing ratio of bromomethane in the atmosphere. (*)
Bromotrifluoromethane/CF3Br	pptv	Volume mixing ratio of bromotrifluoromethane in the atmosphere. (*)
Bromochlorodifluoromethane /CF2ClBr	pptv	Volume mixing ratio of bromochlorodifluoromethane in the atmosphere. (*)
Hydrogen Fluoride/HF	pptv	Volume mixing ratio of hydrogen fluoride in the atmosphere. (*)
Peroxyntiric Acid/HNO4	ppbv	Volume mixing ratio of peroxyntiric acid in the atmosphere. (*)
Hypochlorous Acid/HOCl	ppbv	Volume mixing ratio of hypochlorous acid in the atmosphere. (*)
Nitrate/NO3	ppbv	Volume mixing ratio of nitrate in the atmosphere. (*)

(*) Some variables are capable of providing profile information. Details will be determined with their attributes (vertical resolution, vertical extent, etc)

Domain: Atmosphere

Subdomain: Atmospheric Composition (7/9)

Geophysical Variable Full Name	Units	Definition
Nitrogen Oxide/NO	ppbv	Volume mixing ratio of nitrogen oxide in the atmosphere. (*)
Methyl Hydroperoxide/CH ₃ OOH	ppbv	Volume mixing ratio of methyl hydroperoxide in the atmosphere. (*)
Hydrogen Bromide/HBr	pptv	Volume mixing ratio of hydrogen bromide in the atmosphere. (*)
Bromine Monoxide/BrO	pptv	Volume mixing ratio of bromine oxide in the atmosphere. (*)
Bromine Nitrate/BrONO ₂	pptv	Volume mixing ratio of bromine nitrate in the atmosphere. (*)
Hypobromous Acid/HOBr	pptv	Volume mixing ratio of hypobromous acid in the atmosphere. (*)
Bromine Chloride/BrCl	pptv	Volume mixing ratio of bromine chloride in the atmosphere. (*)
Chlorine/Cl ₂	pptv	Volume mixing ratio of chlorine in the atmosphere. (*)
Peroxyacetyl Nitrate/C ₂ H ₃ O ₃ NO ₂	pptv	Volume mixing ratio of peroxyacetyl nitrate in the atmosphere. (*)
Peroxymethacryloyl Nitrate/C ₄ H ₅ O ₃ NO ₂	pptv	Volume mixing ratio of peroxymethacryloyl nitrate in the atmosphere. (*)

(*) Some variables are capable of providing profile information. Details will be determined with their attributes (vertical resolution, vertical extent, etc)

Domain: Atmosphere

Subdomain: Atmospheric Composition (8/9)

Geophysical Variable Full Name	Units	Definition
Ammonia/NH ₃	ppbv	Volume mixing ratio of ammonia in the atmosphere. (*)
Dimethyl Sulfide/(CH ₃) ₂ S	ppbv	Volume mixing ratio of dimethyl sulfide in the atmosphere. (*)
Ethane/C ₂ H ₆	ppbv	Volume mixing ratio of ethane in the atmosphere. (*)
Ethanal/CH ₃ CHO	ppbv	Volume mixing ratio of ethanal in the atmosphere. (*)
Ethyl Hydroperoxide/CH ₃ CH ₂ OOH	ppbv	Volume mixing ratio of ethyl hydroperoxide in the atmosphere. (*)
Acetone/C ₃ H ₆ O	pptv	Volume mixing ratio of acetone in the atmosphere. (*)
Methylglyoxal/C ₃ H ₄ O ₂	ppbv	Volume mixing ratio of methylglyoxal in the atmosphere. (*)
Acetylene/C ₂ H ₂	ppbv	Volume mixing ratio of acetylene in the atmosphere. (*)
Ethylene/C ₂ H ₄	ppbv	Volume mixing ratio of ethylene in the atmosphere. (*)
Propane/C ₃ H ₈	ppbv	Volume mixing ratio of propane in the atmosphere. (*)

(*) Some variables are capable of providing profile information. Details will be determined with their attributes (vertical resolution, vertical extent, etc)

Domain: Atmosphere

Subdomain: Atmospheric Composition (9/9)

Geophysical Variable Full Name	Units	Definition
Methanol/CH ₃ OH	ppbv	Volume mixing ratio of methanol in the atmosphere. (*)
Methacrolein/C ₄ H ₆ O	ppbv	Volume mixing ratio of methacrolein in the atmosphere. (*)
SF ₆ - Sulphur Hexafluoride	ppmv	Volume mixing ratio of sulphur hexafluoride in the atmosphere. (*)
OH – Hydroxyl Radical	pptv	Volume mixing ratio of hydroxyl radical in the atmosphere. (*)
HO ₂ – Hydroperoxy Radical	pptv	Volume mixing ratio of hydroperoxy radical in the atmosphere. (*)

(*) Some variables are capable of providing profile information. Details will be determined with their attributes (vertical resolution, vertical extent, etc)

Domain: Atmosphere

Subdomain: Clouds (1/2)

Geophysical Variable Full Name	Units	Definition
Cloud Cover	%	Fraction of sky filled by clouds.
Cloud Imagery	NA	Satellite imagery including digital maps of observed clouds.
Cloud Liquid Water Path	g/m ²	The total amount of liquid water present between two points in the atmosphere.
Cloud Ice Water Path	g/m ²	The integral of the ice water content (IWC) through the depth of an ice.
Liquid Water Path	kg/m ²	A measure of the weight of the liquid water droplets in the atmosphere above a unit surface area on the earth
Cloud Drop Size (at Cloud Top)	micron	Size distribution of liquid water drops, assimilated to spheres of the same volume.
Hydrometeor Size for Low Cloud and Fog	%	The size of hydrometeors that indicate the presence of low clouds and fog.
Ice Cloud Particle Size	micron	The size of an ice particle that helps in the formation of ice crystals in clouds

Domain: Atmosphere

Subdomain: Clouds (2/2)

Geophysical Variable Full Name	Units	Definition
Cloud Top Temperature	K	Temperature of the top of the highest cloud.
Cloud Base Height	km	The height of the cloud base above local terrain, often referred to as the height of the cloud top above local terrain or above mean sea level.
Cloud Thickness	km	The vertical distance from the cloud base to the cloud top; more commonly referred to as the 'thickness' or 'depth' of the cloud.
Cloud Optical Depth	unitless	The vertical optical thickness between the top and bottom of a cloud.
Total Lightning	%	Total number of detected flashes in the corresponding time interval and the space unit.

Domain: Atmosphere

Subdomain: Precipitation (1/1)

Geophysical Variable Full Name	Units	Definition
Rain Rate	mm/hr	The amount of precipitation that is collected over a specific time period; usually measured in inches/hour or millimeters/hour.
Snowfall Rate	mm/hr	Rate of precipitation reaching the ground (snowfall).
Precipitation Type	unitless	The form of precipitation falling to the ground.
Precipitation Detection	unitless	The detection of any form of precipitation.
Rain Water Path	g/m ²	Measure of the weight of the liquid water droplets in the atmosphere above a unit surface area on the earth
Rain Particle Size	micron	Effective radius of rain particle distribution.
Snow Particle Size	micron	Effective radius of snow particle distribution.



DOMAIN: LAND/ HYDROLOGY

Subdomains:

Surface Geophysical Properties

Surface Radiative Properties

Fire

Vegetation



Domain: Land/Hydrology

Subdomain: Surface Geophysical Properties (1/1)

Geophysical Variable Full Name	Units	Definition
Surface water: Extent	%	Fraction of an area flooded by water. Historical extent.
Soil Moisture: Surface Wetness	m ³ /m ³	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.
Land Surface Temperature	K	Refers to how hot the “surface” of the Earth would feel to the touch in a particular location. From a satellite’s point of view, the “surface” is whatever it sees when it looks through the atmosphere to the ground. It could be snow and ice, the grass on a lawn, the roof of a building, or the leaves in the canopy of a forest. Thus, land surface temperature is not the same as the air temperature that is included in the daily weather report.
Land Surface Type	unitless	The surface values, which could include floods, dense vegetation, dry soil, moist soil, semi-desert, desert, snow, glacial ice, water, and others.
Surface Pressure	hPa	Air pressure at a known height above the surface.
Visibility	km	The greatest distance in a given direction at which it is just possible to see and identify a standard object with the unaided eye.

Domain: Land/Hydrology

Subdomain: Surface Radiative Properties (1/1)

Geophysical Variable Full Name	Units	Definition
Land Surface Albedo	unitless	The fraction of solar radiation incident at the Earth's surface that is returned to space by reflection from the Earth's surface.
Land Surface Emissivity	unitless	The ratio of the radiation emitted for various frequencies by a surface to the radiation emitted by a perfect blackbody radiator at the same temperature.
Incoming Shortwave Radiation: Surface	W/m ²	Incoming shortwave ultraviolet, visible, and infrared energy from the Sun, measured at the surface.
Incoming Longwave Radiation: Surface	W/m ²	Incoming longwave ultraviolet, visible, and infrared energy from the Sun, measured at the surface.
Outgoing Longwave Radiation: Surface	W/m ²	Incoming longwave ultraviolet, visible, and infrared energy from the Sun, measured at the top of the atmosphere.
Effective Reflectivity	%	Measure of the of the fraction of radiation reflected by a given surface.

Domain: Land/Hydrology

Subdomain: Fire (1/1)

Geophysical Variable Full Name	Units	Definition
Fire Radiative Power	MW	Power radiated by the fire occurring within an area.
Fire Size	km ²	The size of a fire.
Fire Location	lat/lon	The location of a fire.
Fire Temperature	K	The temperature of a fire.
Fire Detection	unitless	The presence of a fire.
Burned Area Extent	km ²	The extent of burn scars and surfaces which have been sufficiently affected by fire, including changes in vegetation cover.

Domain: Land/Hydrology

Subdomain: Vegetation (1/1)

Geophysical Variable Full Name	Units	Definition
Normalized Difference Vegetation Index	unitless	Difference between maximum and minimum vegetation reflectance, normalized to the summation.
Green Vegetation Fraction	unitless	Fractional green vegetation cover within a specific grid cell
Leaf Area Index	%	The total one-sided area of photosynthetic tissue per unit ground surface area.



DOMAIN: CRYOSPHERE

Subdomains:

Sea Ice

Snow

Lake and River Ice

Glaciers, Ice Caps, Ice Sheets

Icebergs

Permafrost



Domain: Cryosphere

Subdomain: Sea Ice (1/5)

Geophysical Variable Full Name	Units	Definition
Sea Ice Age	yr	The age of the sea ice is usually a distinction between first-year and multiyear ice. Multiyear sea ice is usually thicker, has more ridges, and can be more of a hindrance to ship travel than first-year ice. Microwave remote sensing studies have shown that first-year sea ice has a higher emissivity at the 1.55 cm wavelength than multiyear ice, thus making it possible to distinguish between different ice ages from satellites. Ice age can also be qualitatively determined using visible, infrared and radar wavelengths from satellites.
Sea Ice Type	unitless	The surface values of sea ice including first-year ice and multi-year ice.
Sea Ice Concentration	%	The ratio of the area of the water surface covered by ice as a fraction of the whole area. Sea ice concentration has been monitored by polar orbiting satellites at all wavelengths.
Sea Ice Thickness	m	Thickness of the ice cover. It is related to sea-ice elevation and ice density.
Sea Ice Area	km ²	Sea ice extent is the integral sum of the areas of all ice-covered grid cells commonly defined as having at least 15% ice concentration.
Sea Ice Extent	km ²	The total area covered by some amount of ice. This can include open water between ice floes.

Domain: Cryosphere

Subdomain: Sea Ice (2/5)

Geophysical Variable Full Name	Units	Definition
Sea Ice Motion, Speed	m/s	The speed component of sea ice motion, which is primarily caused by wind and ocean currents.
Sea Ice Motion, Direction	deg	The direction component of sea ice motion, which is primarily caused by wind and ocean currents.
Sea Ice Freeboard	m	The difference between the height of the surface of sea ice and the water.
Sea Ice Draft	m	A measurement of the ice thickness below the waterline.
Sea Ice Elevation	m	The measurement of the surface height of the sea ice.
Sea Ice Bottom	m	The bottom of a sea ice cover.
Sea Ice Density	mg/m ³	The mass of a unit volume of sea ice.
Sea Ice Mass Balance	kg	The net balance between the mass gained by snow deposition, sea ice growth, and the loss of mass by melting and calving.
Marginal Sea Ice Zone	m ²	A part of the seasonal ice zone that varies in width (100 to 200 kilometers, 62 to 124 miles) that extends from the ice edge into the ice pack, where waves and swells affect the ice; often characterized by highly variable ice conditions; in general, it is wider in the Antarctic than the Arctic.
Sea Ice Edge	lat/lon	The demarcation at any given time between the open sea and sea ice of any kind, whether fast or drifting. It may be termed compacted or diffuse.

Domain: Cryosphere

Subdomain: Sea Ice (3/5)

Geophysical Variable Full Name	Units	Definition
Sea Ice Leads and Polynyas	%	Open water and fractures within the sea ice pack. Can also be measured in area, width, length, orientation.
Meltponds on Sea Ice	%	A pond of melted sea ice on top of sea ice.
Sea Ice Texture	unitless	The geometry and spatial arrangement of ice crystals in the sea ice.
Sea Ice Deformation	m	Ice that has been squeezed together, and in places, forced upwards and downwards.
Sea Ice Ridges	m	A line or wall of broken ice forced up by pressure.
Sea Ice Salinity Profile	PSU	Profile of salinity throughout the depth of the sea ice.
Sea Ice Surface Temperature	K	The skin temperature of the ice surface.
Sea Ice Temperature Profiles	K	The variation in ice temperature with depth.
Sea Ice Rafting	m	Pressure processes whereby one piece of ice overrides another. Most common in new and young ice.
Sea Ice Rubble Accumulation	m ²	Accumulation of ice fragments or small pieces of ice that covers a larger expanse of area without any particular order to it.
Sea Ice Pressure	hPa	Horizontal pressure of compact ice concentration conditions.

Domain: Cryosphere

Subdomain: Sea Ice (4/5)

Geophysical Variable Full Name	Units	Definition
Ice Breccia	unitless	Ice of different stages of development frozen together.
Brash Ice	unitless	An accumulation of floating ice made up of fragments not more than 2 meters across.
Ice Keel	m	A downward-projecting ridge on the underside of the ice canopy.
Sea Ice Location	lat/lon	The location of sea ice.
Landfast Sea Ice Distribution	km ²	Landfast ice remains stationary and attached to the coast for most of the year.
Sea Ice Biological Constituents	unitless	Microorganisms in sea ice that contribute to ecological functions in icy habitats.
Sea Ice Chemical Constituents	unitless	The chemical elements and compounds measured in sea ice.
Ice Objects	lat/lon	The location of ice objects.
Sea Ice Algal Coverage	km ²	Algal coverage on sea ice.
Icebergs	unitless	A large floating mass of ice detached from a glacier or ice sheet and carried out to sea.
Bergy Bits	m ²	A medium to large fragment of ice. Its height is generally greater than three feet but less than 16 feet above sea level.

Domain: Cryosphere

Subdomain: Sea Ice (5/5)

Geophysical Variable Full Name	Units	Definition
Growlers	m ²	Small chunks of ice less than 2 m across.
Sea Ice Frequency	yr	The number of years at a given location in which sea ice with at least 15% concentration has occurred.
Sea Ice Islands	m	Tabular icebergs.
Sea Ice Crack Length	km	Any fracture or rift in floating ice not sufficiently wide to be described as a lead.
Flooding at Snow-Ice Interface	true/false	The presence of flooding at the snow-ice interface.
Sea Ice Sail Height	m	The height of the ridge above sea level.
Sea Ice Floe Size	m	The size of the floe, a separate patch of floating ice or flat sheet of unbroken pack ice, greater than 20 meters.
Sea Ice Albedo	unitless	The ratio of reflected flux density to incident flux density at the sea ice surface.
Floating Ice	unitless	Any form of ice found floating in water.

Domain: Cryosphere

Subdomain: Snow (1/2)

Geophysical Variable Full Name	Units	Definition
Snow Water Equivalent	mm	The water content obtained from melting accumulated snow.
Snow Cover	%	Pertaining to the extent, depth, and longevity of snow pack.
Snow Extent	km ²	Pertaining to the extent of snow pack, typically, hemisphere or continental-scale.
Snow Depth	m	Pertaining to the thickness of snow pack throughout the year.
Snow Grain Size	mm	The size of a snow grain can impact the reflection by a snow pack.
Snow Conductivity	W/mK	Thermal conductivity of snow.
Snow Density	kg/m ³	The mass of a unit volume of snow.

Domain: Cryosphere

Subdomain: Snow (2/2)

Geophysical Variable Full Name	Units	Definition
Snow Stability	unitless	Property of the snowpack describing the propensity of a snow-covered slope to avalanche. This is human measured and described as very poor, poor, fair, and good.
Snow Stratigraphic Structure		The individual layers of snow, which can have vary vertically in terms of density, crystal shape, grain size, and hardness.
Snow Strength	Pa	The maximum stress snow can withstand without failing or fracturing. This is measured in situ.
Snow Surface Temperature	K	The surface temperature of snow.
Snow Surface Wetness	m^3/m^3	Snow wetness occurs when the cold content of part or all of the snowpack is less than the positive energy fluxes from radiative, sensible, or latent heat transfer.
Snow Albedo	unitless	The fraction of solar radiation incident upon snow that is returned to space by reflection from snow.

Domain: Cryosphere

Subdomain: Lake and River Ice (1/1)

Geophysical Variable Full Name	Units	Definition
Lake and River Ice Cover	%	Lake and River surface covered by ice (in terms of ice-covered area percentage).
Lake and River Ice Freeze up or Breakup	%	Breakup or freeze up of lake and river ice coverage.
Lake and River Ice Thickness	m	Thickness of the ice sheet in a lake or river.
Lake and River Snow on Ice	%	The areal extent of snow-covered lake or river ice, usually expressed as percent of total area in a given region.
Lake and River Ice Crystals	unitless	As the ocean water begins to freeze, small needle-like ice crystals form. They are typically 3 to 4 millimeters in diameter.
Lake and River Ice Type	unitless	The surface types of lake and river ice including first-year ice and multi-year ice.
Lake and River Ice Type Distribution	%	Shows the characterization of how the sea ice varies.
Lake and River Ice Temperature	K	Skin temperature of the lake and river ice.
Lake and River Ice Albedo	unitless	The proportion of the incident light or radiation that is reflected by only Lake and River Ice.
Lake Levels	m	Elevation of lake ice.

Domain: Cryosphere

Subdomain: Glaciers, Ice Caps, Ice Sheets (1/2)

Geophysical Variable Full Name	Units	Definition
Glaciers General	lat/lon	Location of a huge mass of ice slowly flowing over a landmass, formed from compacted snow in an area where snow accumulation has exceeded melting and sublimation.
Glacier Thickness	m	Thickness of a glacier.
Glacier Coverage	%	The area covered by glacial ice.
Glacier Ice Velocity	m/yr	The speed and direction of the horizontal movement of a glacier.
Glacier Lakes	lat/lon	A body of water with origins from glacier activity. They are formed when a glacier erodes the land and then melts, filling the depression created by the glacier.
Glacier Length	m	The length of a glacier.
Glacier Elevation/Topography	km	The elevation of a glacier.
Glacier Calving Front Locations	lat/lon	The calving front is the leading edge of a glacier where icebergs originate.
Glacier Grounding Lines	lat/lon	The transition boundary where land ice meets with ocean waters along the periphery of the glacier; a floating glacier terminus.

Domain: Cryosphere

Subdomain: Glaciers, Ice Caps, Ice Sheets (2/2)

Geophysical Variable Full Name	Units	Definition
Firn Temperature	K	Temperature of the partially compacted granular snow that is the intermediate stage between snow and glacial ice. Firn is found under the snow that accumulates at the head of a glacier. It is formed under the pressure of overlying snow by the processes of compaction, recrystallization, localized melting, and the crushing of individual snowflakes.
Snowline or Equilibrium Line	lat/lon	The boundary between a snow-covered and snow-free glacier surface.
Glacier Snow on Ice	%	The coverage of snow on glacial ice.

Domain: Cryosphere

Subdomain: Icebergs (1/2)

Geophysical Variable Full Name	Units	Definition
Iceberg Position	lat/lon	The location and position of of icebergs.
Iceberg Length	m	The length of an iceberg.
Iceberg Width	m	The width of an iceberg.
Iceberg Height	m	The height of an iceberg.
Iceberg Draft	m	The size of an iceberg underwater.
Iceberg Area	m ²	The area of an iceberg.
Iceberg Mass	ton	The mass of an iceberg.

Domain: Cryosphere

Subdomain: Icebergs (2/2)

Geophysical Variable Full Name	Units	Definition
Iceberg Volume	m ³	The volume of an iceberg.
Iceberg Shape	unitless	The shape of an iceberg can be tabular, sloping, domed, pinnacle, drydocked, weathered, or blocky.
Iceberg Drift Speed	km/h	The speed of the iceberg drift. Can also be measured in nm/day.
Iceberg Drift Direction	azimuth	The direction of drift movement of an iceberg.

Domain: Cryosphere

Subdomain: Permafrost (1/1)

Geophysical Variable Full Name	Units	Definition
Permafrost General	%	Permafrost is ground that continuously remains below 0 °C (32 °F) for two or more years.
Permafrost Surface Temperature	K	Surface temperature of permafrost.
Permafrost Soil Temperature	K	Soil temperature of permafrost.
Permafrost Active Layer Thickness	m	The distance between the permafrost table and the permafrost base at the depth of 0 °C isotherm.
Permafrost Soil Moisture	m ³ /m ³	Moisture content profile of permafrost.
Permafrost Borehole Temperature	K	Temperature profile of permafrost.
Permafrost Extent	km ²	The total geographic area containing some amount of permafrost.
Permafrost Snow Cover	km ²	Extent of snow coverage on permafrost.



DOMAIN: OCEAN

Subdomains:

Open Ocean

Coastal

Inland Waters

Bathymetry/Seafloor Topography

Ocean Composition and Optical Properties



Domain: Ocean

Subdomain: Open Ocean (1/3)

Geophysical Variable Full Name	Units	Definition
Salinity, Surface	PSU	Salinity of sea water in the surface layer.
Salinity, Profiles	PSU	Salinity of sea water in the profile.
Sea Surface Height	cm	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.
Open Ocean Sea Surface Temperature	K	Temperature of the sea water at surface, open ocean.
Ocean Temperature, profiles	K	Vertical profiles of ocean temperature (including upper and deep ocean).
Open Ocean Mixed Layer Depth	m	Thickness of the mixed layer; or the depth to the top of the thermocline.
Sea Level	m	An average level of the surface of Earth's oceans from which heights such as elevation may be measured.

Domain: Ocean

Subdomain: Open Ocean (2/3)

Geophysical Variable Full Name	Units	Definition
Open Ocean Wave Height	m	Vertical distance between a wave crest and the adjacent wave troughs.
Open Ocean Wave Period	m	The time for successive wave crests to pass a fixed point.
Open Ocean Wave Spectra	m	The energy distribution of a sampling of waves per their frequency.
Open Ocean Wave Direction	deg	The line along which a wave travels with respect to it's compass heading.
Open Ocean Swell Height	m	The estimated average height of the highest one-third of the swells. It is estimated from determining how the wave energy is distributed among various periods (frequencies), determining if a separate swell energy peak exists, and then, picking a frequency to separate swell and wind-waves. The swell height is calculated from the wave energies below the separation frequency.
Open Ocean Swell Period	m	This is the peak period in seconds of the swells. If more than one swell is present, this is the period of the swell containing the maximum energy.
Open Ocean Swell Direction	deg	The direction that the swells are coming from. Direction is given on a 16 point compass scale.
Open Ocean Currents: Direction, Surface	deg	The direction of ocean currents at the surface, open ocean.
Open Ocean Currents: Speed, Surface	m/s	The speed of ocean currents at the surface, open ocean.

Domain: Ocean

Subdomain: Open Ocean (3/3)

Geophysical Variable Full Name	Units	Definition
Global Sea Surface Wind Speed	m/s	Measure of atmospheric wind speed at the sea/atmosphere interface in clear sky and cloudy conditions.
Global Sea Surface Wind Direction	deg	Measure of atmospheric wind direction at the sea/atmosphere interface in clear sky and cloudy conditions.
Oil Spill Location	lat/lon	The location of an oil spill.
Ocean Turbidity	Nephelometric Turbidity Units (NTU)	A measure of the level of particles such as sediment, plankton, or organic by-products, in the ocean.
Ocean Object Detection	lat/lon	The location of objects such as ships and oil platforms.

Domain: Ocean

Subdomain: Coastal (1/1)

Geophysical Variable Full Name	Units	Definition
Coastal Ocean Currents: Direction, Surface	deg	The direction of ocean currents at the surface, coastal.
Coastal Ocean Currents: Speed, Surface	m/s	The speed of ocean currents at the surface, coastal.
Coastal Sea Surface Temperature	K	Temperature of the sea water at surface, coastal.
Coastal Sea Surface Wind Speed	m/s	Measure of atmospheric wind speed at the sea/atmosphere interface in clear sky and cloudy conditions at the coast.
Coastal Sea Surface Wind Direction	deg	Measure of atmospheric wind direction at the sea/atmosphere interface in clear sky and cloudy conditions at the coast.
Suspended Particulate Matter	g/m ³	Variable extracted from ocean color observation. Indicative of river outflow, re-suspension or pollution of other-than-biological origin.
Coastal Flooding	%	The extent of flooding along the coastlines.

Domain: Ocean

Subdomain: Inland Waters (1/1)

Geophysical Variable Full Name	Units	Definition
Inland Water Temperature	K	The temperature of the surface of inland waters.
Inland Flooding	%	The extent of flooding in inland waters.



List of Variables:

Domain: Ocean

Subdomain: Bathymetry/Seafloor Topography (1/1)

Geophysical Variable Full Name	Units	Definition
Bathymetry	m	The measurement and charting of the spatial variation of the ocean depths.



Domain: Ocean

Subdomain: Ocean Composition and Optical Properties (1/1)

Geophysical Variable Full Name	Units	Definition
Ocean color: Chlorophyll-a Concentration	mg/m ³	Indicator of living phytoplankton biomass, extracted from ocean color observation.
Water-leaving Radiance	mW/(cm ² nm sr)	Radiation from the sun, reflected off particles in the water, and exiting the ocean surface back into the atmosphere. The upwelling radiance at the ocean surface.
Ocean Optical Properties Absorption Coefficient	unitless	Absorption coefficient.
Ocean Optical Properties Phytoplankton Absorption Coefficient	unitless	Phytoplankton absorption coefficient.
Ocean Optical Properties Detrital Absorption Coefficient	unitless	Detrital absorption coefficient.
Ocean Optical Properties Backscattering Coefficient	unitless	Backscattering coefficient.
Ocean Optical Properties Backscattering Coefficient for Particles	unitless	Backscattering coefficient for particles.



DOMAIN: SPACE WEATHER

Subdomains:

Solar

Heliosphere

Magnetosphere

Ionosphere

Upper Atmosphere



Domain: Space Weather

Subdomain: Solar (1/3)

Geophysical Variable Full Name	Units	Definition
Solar UV Flux	W/m ²	Images of the Sun in the UV wavelengths.
Solar EUV Imagery (SEL)	erg·(cm ² arcsec s) ⁻¹	Imagery of the sun in the extreme UV bands on the Sun Earth Line.
Solar EUV Imagery (Off-SEL)	erg·(cm ² arcsec s) ⁻¹	Imagery of the sun in the extreme UV bands off the Sun Earth Line.
Solar EUV Irradiance (SEL)	W/m ²	The radiant flux of solar extreme UV bands received by a surface per unit area on the Sun Earth Line.
Solar UV Imagery	erg·(cm ² arcsec s) ⁻¹	Imagery of the sun in the UV bands.
Solar X-Ray Imagery	erg·(cm ² arcsec s) ⁻¹	Imagery of the sun in the X-Ray bands.
Solar IR Imagery	erg·(cm ² arcsec s) ⁻¹	Imagery of the sun in the IR bands.
Solar Radio Emissions: Total		Emissions of the Sun at radio wavelengths from centimeters to decameters, under quiet conditions.
Solar Radio Emissions: Spectral Flux	W/m ²	Emissions of the Sun at radio wavelengths from centimeters to decameters, under quiet conditions.

Domain: Space Weather

Subdomain: Solar (2/3)

Geophysical Variable Full Name	Units	Definition
Solar Radio Burst Location		Emissions of the Sun at radio wavelengths from centimeters to decameters, under disturbed conditions.
Solar Radio Burst Type		Emissions of the Sun at radio wavelengths from centimeters to decameters, under disturbed conditions.
Solar Radio Burst Polarization		Emissions of the Sun at radio wavelengths from centimeters to decameters, under disturbed conditions.
Coronal White Light Imagery (SEL)	$\text{erg} \cdot (\text{cm}^2 \text{ arcsec s})^{-1}$	The Sun's corona as seen at visible wavelengths during total solar eclipses and with coronagraphs, on the Sun-Earth Line.
Coronal White Light Imagery (Off-SEL)	$\text{erg} \cdot (\text{cm}^2 \text{ arcsec s})^{-1}$	The Sun's corona as seen at visible wavelengths during total solar eclipses and with coronagraphs, off the Sun-Earth Line.
Solar X-ray Irradiance (SEL)	W/m^2	The amount of light energy from one thing hitting a square meter of another each second in the X-ray wavelengths, on the Sun-Earth line.
Solar X-ray Irradiance (Off-SEL)	W/m^2	The amount of light energy from one thing hitting a square meter of another each second in the X-ray wavelengths, off the Sun-Earth line
Solar Imagery: Off-angle	unitless	Off angle imagery of the sun.
Helio Seismology		Provides information of the magnetic activity at the far side of the Sun.

Domain: Space Weather

Subdomain: Solar (3/3)

Geophysical Variable Full Name	Units	Definition
Photospheric Magnetograph Imagery (SEL)	nm	Imagery of the magnetic fields in the photosphere, the Sun's visible surface, on the Sun-Earth Line.
Photospheric Magnetograph Imagery (Off-SEL)	nm	Imagery of the magnetic fields in the photosphere, the Sun's visible surface, off the Sun-Earth Line.
Neutron Flux	W/m ²	Flux of neutrons near the surface of Earth due to collisions in the atmosphere of cosmic rays impacting Earth atmosphere from the Sun and outer space.
F10.7 Solar Flux	W/m ²	Also known as solar radio emissions. Emissions of the sun in radio wavelengths from centimeters to decameters, under both quiet and disturbed conditions.
A Indices	unitless	Calculated for individual magnetometer stations as the average of eight, three-hourly station equivalent amplitude indices observed during a day, and provides a single, average value to indicate the activity level for that day.
K Indices	unitless	Related to the maximum fluctuations of horizontal components observed on a magnetometer relative to a quiet day, during a three-hour interval.

Domain: Space Weather

Subdomain: Heliosphere (1/3)

Geophysical Variable Full Name	Units	Definition
Heliospheric Magnetic Field (SEL)		The extension of the magnetic field of the sun and its corona that is carried out into space by the highly conductive solar wind on the Sun Earth Line.
Heliospheric Magnetic Field (Off-SEL)		The extension of the magnetic field of the sun and its corona that is carried out into space by the highly conductive solar wind off the Sun Earth Line.
Solar Wind Velocity (SEL)	km/s	Measurements of the thermal characteristics of the solar wind plasma to forecast the occurrence of geomagnetic storms on the Sun Earth Line.
Solar Wind Velocity (Off-SEL)	km/s	Measurements of the thermal characteristics of the solar wind plasma to forecast the occurrence of geomagnetic storms off the Sun Earth Line.
Heliospheric Imagery (SEL)	$\text{erg} \cdot (\text{cm}^2 \text{ arcsec s})^{-1}$	Image of the interplanetary space between the Sun and Earth on the Sun Earth Line
Heliospheric Imagery (Off-SEL)	$\text{erg} \cdot (\text{cm}^2 \text{ arcsec s})^{-1}$	Image of the interplanetary space between the Sun and Earth not on the Sun Earth Line
Relativistic Electrons		Observations of near-light-speed electrons generated in solar energetic particle events
Solar High Energy Protons		Observations of the flux of energetic protons.

Domain: Space Weather

Subdomain: Heliosphere (2/3)

Geophysical Variable Full Name	Units	Definition
Solar High Energy Cosmic Rays		High energy particles and photons emitted by stellar processes. The highest energies have been observed at 10^8 Tev and are believed to come from shocks emanating from galaxies. Solar cosmic rays are protons observed at 1 Gev, having been accelerated by shocks associated with solar flares.
Solar Wind Low Energy Proton Flux (SEL)		A measurement of proton flux in extreme low solar winds on Sun Earth Line
Solar Wind Low Energy Proton Flux (Off-SEL)		A measurement of proton flux in extreme low solar winds on Sun Earth Line
Solar Energetic Particles (SEL)	#/(cm ² -s-sr-MeV)	High-energy, charged particles originating in the solar atmosphere and solar wind on the Sun Earth Line.
Solar Energetic Particles (Off-SEL)	#/(cm ² -s-sr-MeV)	High-energy, charged particles originating in the solar atmosphere and solar wind off the Sun Earth Line.

Domain: Space Weather

Subdomain: Heliosphere (3/3)

Geophysical Variable Full Name	Units	Definition
Solar Wind Temperature (SEL)	K	Measurements of the thermal characteristics of the solar wind plasma to forecast the occurrence of geomagnetic storms on the Sun Earth Line.
Solar Wind Temperature (Off-SEL)	K	Measurements of the thermal characteristics of the solar wind plasma to forecast the occurrence of geomagnetic storms off the Sun Earth Line.
Solar Wind Density (SEL)	$\#/cm^3$	Measurements of the thermal characteristics of the solar wind plasma to forecast the occurrence of geomagnetic storms on the Sun Earth Line.
Solar Wind Density (Off-SEL)	$\#/cm^4$	Measurements of the thermal characteristics of the solar wind plasma to forecast the occurrence of geomagnetic storms off the Sun Earth Line.

Domain: Space Weather

Subdomain: Magnetosphere (1/2)

Geophysical Variable Full Name	Units	Definition
Medium Charged Particles: Total Flux	W/m ²	Measurement of ions for assessment of total spacecraft charge.
Trapped Particles: Protons		High-energy protons generated, for example, in solar flares and in coronal mass ejection (CME) shock fronts, or by particle decay processes, that can be trapped in the Earth's inner radiation belts.
Trapped Particles: Electrons		High-energy electrons generated, for example, in solar flares and in coronal mass ejection (CME) shock fronts, or by particle decay processes, that can be trapped in the Earth's inner radiation belts.
Trapped Particles: Waves		High-energy waves generated, for example, in solar flares and in coronal mass ejection (CME) shock fronts, or by particle decay processes, that can be trapped in the Earth's inner radiation belts.
Supra-thermal through Auroral Energy Particles: Energy		Auroral downward electron energy in the energy range of tens of eV to 10 keV.
Supra-thermal through Auroral Energy Particles: Flux	W/m ²	Auroral downward electron flux in the energy range of tens of eV to 10 keV.
Supra-thermal through Auroral Energy Particles: Diff Dir		Auroral downward electron differential direction in the energy range of tens of eV to 10 keV.

Domain: Space Weather

Subdomain: Magnetosphere (2/2)

Geophysical Variable Full Name	Units	Definition
Magnetic Field Strength	nT	The extent and evolution of geomagnetic activity in space.
Magnetic Field Direction	nT	Measurement of the extent and evolution of geomagnetic activity in space.

Domain: Space Weather

Subdomain: Ionosphere (1/2)

Geophysical Variable Full Name	Units	Definition
Auroral Imagery	W/m ²	Imagery of disturbances in the magnetosphere caused by the solar wind.
Ionospheric Scintillation: Phase		Measurement of rapid fluctuations in phase of radio waves propagating through the ionosphere.
Ionospheric Scintillation: Amplitude		Measurement of rapid fluctuations in amplitude of radio waves propagating through the ionosphere.
Ionospheric Characterization: Layer Height	km	Heights of the reflective layers of the ionosphere.
Ionospheric Characterization: Frequency		Plasma frequencies of the reflective layers of the ionosphere.
Total Electron Content		Measure of the number of electrons in a volume of air along a signal path.

Domain: Space Weather

Subdomain: Ionosphere (2/2)

Geophysical Variable Full Name	Units	Definition
Electric Field		Provides the electrodynamic characteristic of the ionosphere.
Electron Density Profile	$\#/cm^3$	The probability of an electron being present in a profile.
Ion Drift Velocity	m/s	The average velocity with which ions drift in the presence of an electric field.
Energetic Particle Differential Flux	W/m^2	The particle flux density per unit energy incident on a surface.



Domain: Space Weather

Subdomain: Upper Atmosphere (1/1)

Geophysical Variable Full Name	Units	Definition
Mesospheric Temperature	K	Profile temperature in the mesosphere
Upper Atmosphere Wind Speed	m/s	Wind speed in the upper atmosphere
Upper Atmosphere Wind Direction	deg	Wind direction in the upper atmosphere
Neutral Composition		The composition of neutral gases in the Earth's upper atmosphere
Neutral Temperature	K	The temperature in the neutral atmosphere (thermosphere and mesosphere).
Upper Thermospheric Density (LEO)	kg/m ³	The density of the upper thermosphere.
Thermospheric Composition		The composition of gases in the thermosphere.
Thermospheric O/N ₂ Ratio (GEO)	unitless	The ratio of oxygen and nitrogen in the thermosphere.



Attributes (1/3)



Spatial Domain	dimensionless	Spatial (usually geographic) domain or region observed (e.g., CONUS).
Spatial Density	(100 km) ⁻²	Number of observations within the observing swath per (100 km) square area.
Spatial Precision	km	Error standard deviation of the location information associated with the observation.
Spatial Resolution	km	Typical length of the GIFOV (ground-projected instantaneous field of view).
Spatial Refresh Rate	%	Percent of the Spatial Domain "painted over" per 12 h period.
Sampling Time	s	Average time between two observations.
Time of Day	dimensionless	Distinguishes between day only, night only, or day and night observations.
Vertical Extent Bottom	km	Bottom of vertical region observed.
Vertical Extent Top	km	Top of vertical region observed.
Vertical Resolution	km	Average vertical distance between observations with independent random errors.



Attributes (2/3)



Angular Resolution	radians/steradians	Average angular resolution.
Spectral Range Low	spectral units	Lowest value of observed spectrum.
Spectral Range High	spectral units	Highest value of observed spectrum.
Spectral Resolution	spectral units	Average spectral increment.
Classification Scheme	dimensionless	The classification scheme used to represent this variable.
Images	logical	This parameter is represented by imagery.
Precision: Clear, Ocean (Std Dev)	Error units	Error standard deviation under clear conditions over ocean.
Precision: Clear, Land/Ice/Snow (Std Dev)	Error units	Error standard deviation under clear conditions over land/ice/snow
Precision: Cloudy, Ocean (Std Dev)	Error units	Error standard deviation under cloudy conditions over ocean.
Precision: Cloudy, Land/Ice/Snow (Std Dev)	Error units	Error standard deviation under cloudy conditions over land/ice/snow



Attributes (3/3)



Validity Range Low (Noise Floor)	Variable units	Low value that can be observed.
Validity Range High (Saturation Level)	Variable units	High value that can be observed.
Prior Data	logical	Is prior data used/allowed for this variable.
Robustness	dimensionless	Number of sources making this observation.
Data Latency	s	Time from 'image taken' to ready to be used by applications.
Continuity	calendar years	Period in calendar years for which the observations are available or required.
Long Term Stability	Error units	Long term changes in precision (noise).



Backup Slides



Description of Earth System Environment - TPIO



Environmental Domain	Environmental Subdomain
Atmosphere	Aerosols
	Air Quality
	Atmos Chemistry
	Atmos Pressure
	Atmos Radiation
	Atmos Temperature
	Atmos Water Vapor
	Atmos Winds
	Clouds
	Precipitation
	Weather Events
Biosphere	Vegetation
Terrestrial/ Hydrosphere	Snow/Ice
	Surface Water

Environmental Domain	Environmental Subdomain	
Oceans	Bathymetry/ Seafloor Topography	
	Ocean Circulation	
	Ocean Optics	
	Ocean Temperature	
	Ocean Waves	
	Salinity/Density	
	Sea Ice	
	Sea Surface Topography	
	Human Dimensions	Environmental Impacts
		Land Use/Land Cover
Natural Hazards		
Land Surface	Soils	
	Surface Radiative Properties	
	Surface Thermal Properties	

Environmental Domain	Environmental Subdomain
Cryosphere	Frozen Ground
	Glaciers/Ice Sheets
	Land Ice/Ocean Classification
	Sea Ice
	Snow/Ice
Solid Earth	Geomagnetism
Sun-earth Interactions	Geomagnetism
Sun-earth Interactions	Ionosphere/Magnetosphere Dynamics
Sun-earth Interactions	Solar Activity
Sun-earth Interactions	Solar Energetic Particle Flux
Sun-earth Interactions	Solar Energetic Particle Properties

