

Glossary

Aerosols

Aerosols are airborne solids or liquids in fine particle form. Their many types include particles of natural origin blown up from land/sea surfaces, anthropogenic particles and secondary aerosols formed from anthropogenic and biogenic precursors. In addition to absorbing and scattering sunlight, they also provide condensation nuclei for clouds. Particulate matter 2.5 (PM_{2.5}) is the name given to aerosol particles measuring 2.5 micrometers or less in diameter (about 30 times thinner than a human hair), and is considered to have possible adverse effects on human health when inhaled.

Anthropogenic

Resulting from or produced by human activities.

Arctic Oscillation

The Arctic Oscillation (AO) is a major atmospheric circulation variation exhibiting an annular pattern of sea-level pressure anomalies in a seesaw fashion with one sign over the Arctic region and the opposite sign over the mid-latitudes. Its negative phase, which is characterized by positive and negative sea-level pressure anomalies over the Arctic region and the mid-latitudes, respectively, helps cold Arctic air move into the mid-latitudes. The positive phase, whose sea-level pressure anomaly pattern is reversed, keeps Arctic air over the Arctic region.

Erythemal UV radiation

Erythema is sunburn – a reddening of the skin resulting from continuous exposure to ultraviolet (UV) rays present in solar radiation. It is known that excessive erythema and long-term exposure to the sun can cause human health problems such as a high incidence of skin cancer and cataracts. Erythemal UV radiation is widely used as a scale of UV radiation for evaluation of its effects on the human body, and is calculated in consideration of various influences depending on wavelength.

Extreme climate event

In general, an extreme climate event is recognized as an unusually severe or rare climate event creating disaster conditions or exerting significant socio-economic influence. The definition includes severe weather conditions covering periods ranging from only a few hours (such as heavy rain or strong wind) to several months (such as drought or cold summer conditions). JMA defines extreme climate events as those occurring once every 30 years or longer.

IPCC (Intergovernmental Panel on Climate Change)

The Intergovernmental Panel on Climate Change (IPCC) is an international organization established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988. It reviews and assesses scientific, technical and socio-economic information on climate change, the potential impacts of such change and related vulnerability, and options for adaptation and mitigation, in collaboration with scientists and experts on an international basis. The Panel's reports highlight common understanding of such information to support political matters such as treaty negotiations on global warming.

Kosa (Aeolian dust)

Kosa (Aeolian dust) is a meteorological phenomenon in which fine dust is blown up to an altitude of several thousand meters by cyclonic or other wind systems from deserts or cropland in semi-arid areas of the Asian continent, and is transported over long distances by westerly winds, resulting in haze or dustfall in downstream areas. It is often observed between March and June in Japan and makes the sky yellow and hazy. Heavy Kosa can affect transportation by obstructing visibility.

Monsoon

The term *monsoon* primarily refers to seasonally reversing winds, and by extension includes related seasonal rainfall change with wet and dry phases. Monsoon climate regions where seasonal winds prevail are found in numerous places around the world, with a major one located over a broad area from the Asian continent to northern Australia.

Normals

Normals represent climatic conditions at meteorological stations, and are used as a base to evaluate meteorological variables (e.g., temperature, precipitation and sunshine duration) and produce generalizations (e.g., cool summer, warm winter and dry/wet months) for particular periods. JMA uses averages for the most recent three decades (currently 1981 – 2010) as normals, which are updated every decade in line with WMO Technical Regulations.

Terms relating to El Niño/La Niña events

El Niño/La Niña events: In an El Niño event, sea surface temperatures (SSTs) are higher than normal across a wide region from near the date line to the area off the coast of South America in the equatorial Pacific for about a year. In a La Niña event, SSTs are lower than normal in the same area. Both occur every few years, and are associated with frequent extreme climate conditions worldwide.

JMA recognizes the occurrence of an El Niño event when the five-month running mean of SST deviations from the climatological mean (based on a sliding 30-year period averaged over the NINO.3 El Niño Monitoring Region (5°N – 5°S, 150°W – 90°W; Figure A)) remains above +0.5°C for a period of six months or more. Similarly, a La Niña event is recognized when the corresponding figure is below –0.5°C for the same area/period.

Figure B shows typical SST deviations from the normal during El Niño and La Niña events. The dark red and blue shading seen from the date line to the coast of South America indicates large deviations.

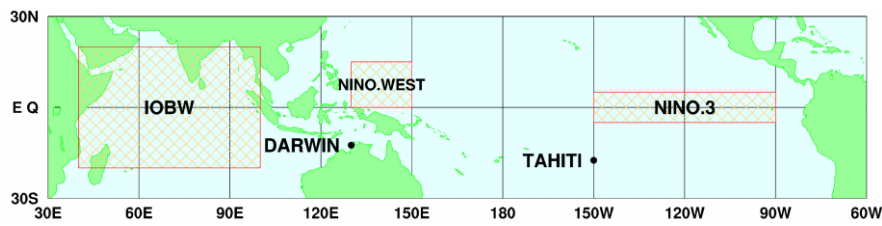


Figure A El Niño monitoring regions

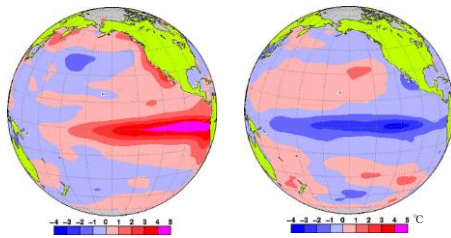


Figure B Left: monthly mean SST anomalies for El Niño (November 1997); right: for La Niña (December 1998)

Red and blue shading represents positive and negative SST deviations, respectively. Darker shading indicates larger deviations.

Southern Oscillation: El Niño and La Niña events are closely related to trade winds (easterlies blowing around the tropical Pacific), which tend to be weak during the former and strong during the latter. The strength of such winds is closely related to the sea level pressure difference between eastern and western parts of the Pacific. This pressure difference varies in a phenomenon known as Southern Oscillation. El Niño/La Niña events and Southern Oscillation are not independent of each other; they are different manifestations of the same phenomenon involving atmospheric and oceanic interaction, and are referred to as ENSO (El Niño – Southern Oscillation) for short.

Terms relating to the greenhouse effect

Greenhouse effect: Greenhouse gases (trace gases present in the earth’s atmosphere) absorb and re-radiate infrared rays. The earth’s infrared radiation consists of thermal emissions from its surface, which is warmed by solar radiation. Significant amounts of these emissions are absorbed into the atmosphere, reflected back and re-absorbed by the earth’s surface in a phenomenon known as the greenhouse effect. According to estimates, the average temperature of the earth’s surface would be $-19\text{ }^{\circ}\text{C}$ without this effect; with it, the actual value is calculated as $14\text{ }^{\circ}\text{C}$. Increased presence of greenhouse gases (whose major species include carbon dioxide, methane and nitrous oxide) in the atmosphere enhances the greenhouse effect, making the earth warmer. Water vapor has the largest overall greenhouse effect in the present atmosphere, but is generally not included among anthropogenic greenhouse gases in discussions of global warming issues.

Carbon dioxide: Of all greenhouse gases, carbon dioxide (CO_2) is the most significant contributor to global warming. Since the start of the industrial era in the mid-18th century, its atmospheric concentration has increased as a result of emissions from various human activities such as fossil fuel combustion, cement production and deforestation. Around half of all cumulative anthropogenic CO_2 emissions have remained in the atmosphere. The rest was removed from the atmosphere and stored in natural terrestrial ecosystems and oceans (IPCC, 2013).

Methane: Methane (CH_4) is the second most significant greenhouse gas after CO_2 , and is emitted into the atmosphere from various sources including wetlands, rice paddy fields, ruminant animals, natural gas production and biomass combustion (WMO, 2015). It is primarily removed from the atmosphere via photochemical reaction with reactive and unstable hydroxyl (OH) radicals.

Nitrous oxide: Nitrous oxide (N_2O) is a significant greenhouse gas because of its large radiative effect per unit mass (about 300 times greater than that of CO_2) and its long lifetime

(about 121 years) in the atmosphere. It is emitted into the atmosphere by elements of nature such as soil and the ocean, and as a result of human activities such as the use of nitrate fertilizers and various industrial processes. It is photodissociated in the stratosphere by ultraviolet radiation.

ppm, ppb, ppt: Concentrations of greenhouse gases are indicated with mole fractions as parts per million (ppm), parts per billion (ppb) and parts per trillion (ppt).

Terms relating to the ozone layer

Total ozone: Total ozone at any location on the globe is defined as the sum of all ozone in the atmosphere directly above that location, and is often reported in m atm-cm or Dobson units. The unit of m atm-cm (read as “milli-atmosphere centimeters”) indicates the columnar density of a trace gas (ozone) in the earth’s atmosphere. A value of 1 m atm-cm represents a layer of gas that would be 10 μm thick under standard temperature and pressure conditions. For example, 300 m atm-cm of ozone brought down to the earth’s surface at 0°C would occupy a layer 3 mm thick. Typical values of total ozone vary between 200 and 500 m atm-cm over the globe, and the global mean is about 300 m atm-cm.

Ozone-depleting substances: Ozone-depleting substances (ODSs) are those that deplete the ozone layer as listed in the Montreal Protocol, which bans their production. Major ODS species include chlorofluorocarbons (CFC-11, CFC-12 and CFC-113 among others), carbon tetrachloride, hydrochlorofluorocarbons (HCFCs), 1,1,1-trichloroethane, chloromethane, halons and bromomethane. These are also powerful greenhouse gases that trap heat in the atmosphere and contribute to global warming.

Ozone hole: The phenomenon referred to as the ozone hole is a reduction in the concentration of ozone high above the earth in the stratosphere. For simplicity, it is often regarded as the area in which the total ozone amount is equal to or less than 220 m atm-cm. The hole has steadily grown in size and annual length of presence (from August to December) over the last two decades of the last century.

Montreal Protocol: The Montreal Protocol on Substances that Deplete the Ozone Layer (a protocol to the Vienna Convention for the Protection of the Ozone Layer) is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances believed to be responsible for ozone depletion. The treaty was opened for signatures in 1987 and came into force in 1989. Since then, it has undergone several revisions. Japan ratified the protocol in 1988.

Terms relating to marine observation

Cooperative Study of the Kuroshio and Adjacent Regions (CSK): A cooperative international undertaking under the auspices of the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific and Cultural Organization (UNESCO), involving the main aim of clarifying the vertical and horizontal structure of the Kuroshio current and its spatial/temporal variability and the roles of heat, salt, chemical/biological elements and other influences. Contributors: 10 countries and territories including Japan, the USA and the USSR.

World Ocean Circulation Experiment (WOCE): An initiative conducted under the World Climate Research Programme (WCRP) to clarify the roles of the world’s oceans in the earth’s climate system. A major element is a ship-based program operated to monitor global fields of temperature, salinity, nutrition, oxygen and other variables.

Global Ocean Ship-based Hydrographic Investigation Program (GO-SHIP): Established in 2007, the program has resulted in a recommendation for the development of a sustained repeat hydrography initiative.

North Pacific Subtropical Mode Water (NPSTMW) area: A thermostat between the

seasonal and main thermoclines. The NPSTMW area is considered to form in the surface mixed layer just south of the Kuroshio Extension as a result of huge heat loss in winter. It is defined as an area of 16 – 18-degree water at depths of 100 to 400 m at around 20 to 30°N along the 137°E line.

North Pacific Tropical Water (NPTW) area: A water mass characterized by a surface ocean salinity maximum. The NPTW area forms at the sea surface in subtropical areas where evaporation exceeds precipitation. It is defined as water with a salinity level of 34.9 or more at depths about 150 m at around 10 to 30°N along the 137°E line.

North Pacific Intermediate Water (NPIW) area: The NPIW area forms in the mixed region between the Kuroshio Extension and the Oyashio front. It is defined as water with a salinity level of 34.0 or less at a depth of around 800 m at around 20 to 30°N along the 137°E line.