CLIMATE CHANGE ASSESSMENT IN INDONESIA

(long term trend in climate average)

BMKG
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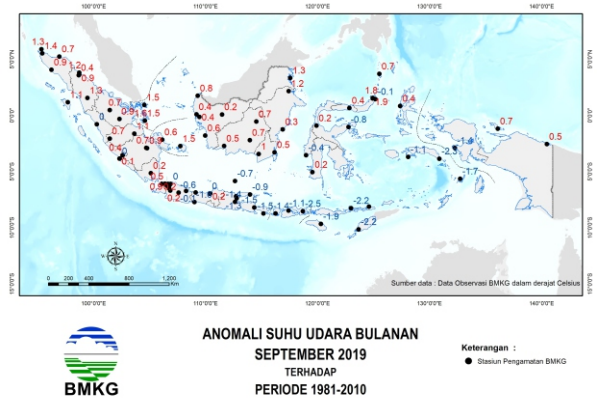
Climate variability explains about climate condition from short to long range periods over certain area. But beyond that period, there is possibility to look at a change that occurs on a long historical climate records which then can be projected for certain future periods.

As part of its responsibility, BMKG produces climate change analysis and information over Indonesia which are focused on: historical climate analysis, future climate projection and vulnerability assessment.

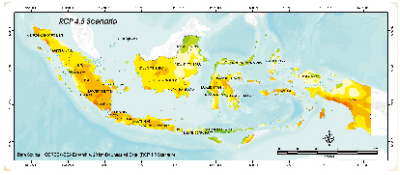


HISTORICAL CLIMATE ANALYSIS

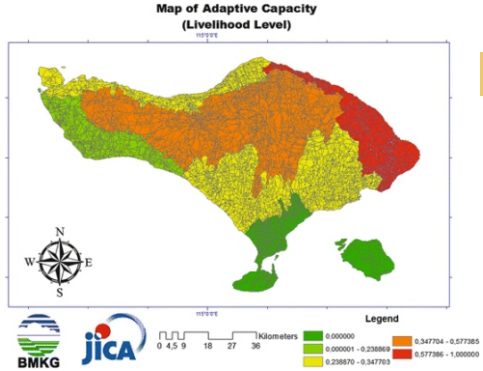
Focused on two main parameters, i.e. precipitation and temperatures. It is generated primarily by using BMKG surface observation data and blended global reanalysis products.

FUTURE CLIMATE PROJECTION

Processed and produced by using RCMs (Regional Climate Model) downscaled climate change projection of CMIP-IPCC model retrieved from regional cooperation network among Asian countries under the joint CORDEX-SEA framework. Several GCM (Global Circulation Model) in the CMIP - IPCC have been downscaled, i.e. CNRM-CM5 (CNRM France), CSIRO-Mk3.6.0 (CSIRO Australia), EC-EARTH (EC-EARTH consortium), IPSL-CM5A-LR (IPSL France), GFDL-ESM2M (GFDLUSA) and MPI-ESM-MR (MPIGermany)



WCRP CORDEX

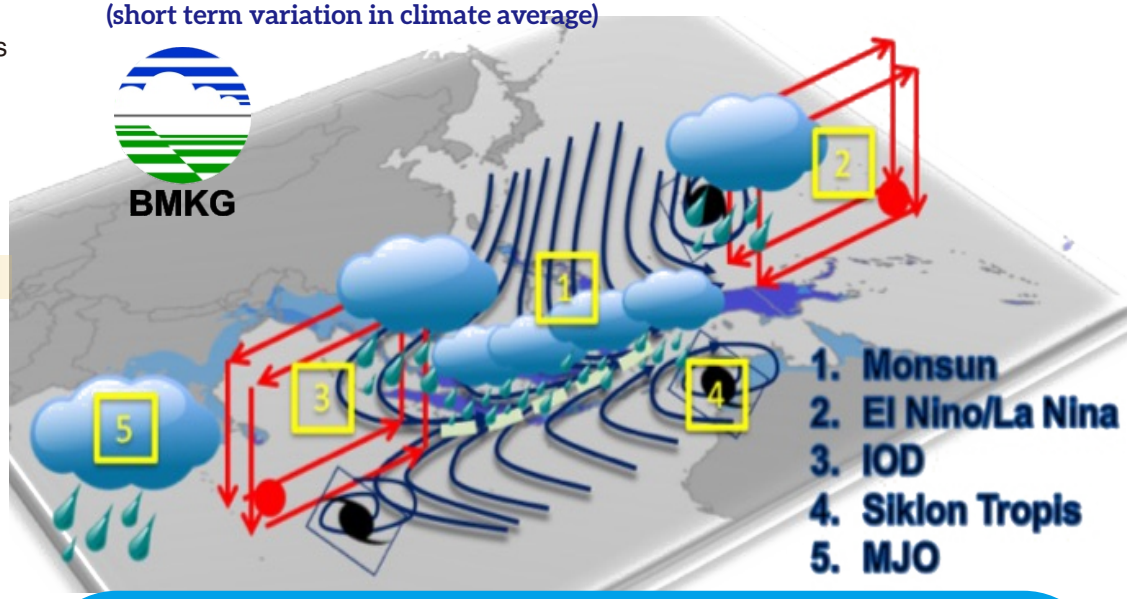


VULNERABILITY ASSESMENT

To support sectoral demand on climate change information related to its adaptation (climate risk and hazard) and mitigation, vulnerability assessment based on specific sectors are conducted. It has been implemented for various fields, such as agriculture, fisheries, health and infrastructure.

CLIMATE VARIABILITY OF INDONESIA

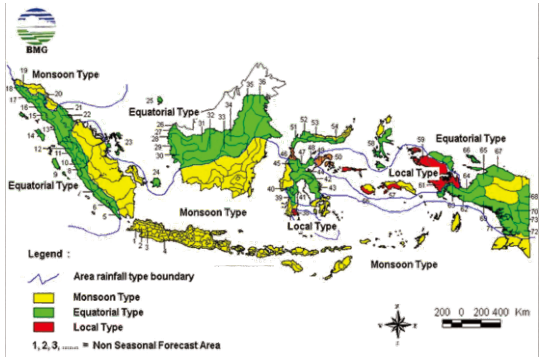
(short term variation in climate average)



"Understanding the past, predicting the future"

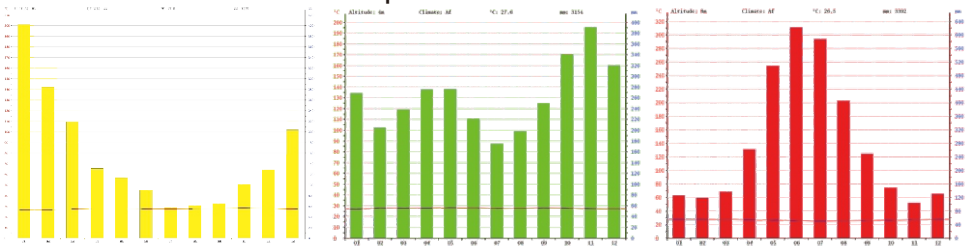
The past is the key for the future, but in a changing climate information should be kept as current

As passed by the equator, Indonesia has an almost entirely tropical climate. The climate is shaped by uniformly warm water that makes up 81% of Indonesia's area ensures that temperatures on land are about 28°C in average in the coastal area, 26°C in the inland area, and about 23°C for the higher mountain area. Indonesia has less temperatures variability from season to season. Indonesia's climate is also characterized by three rainfall patterns. They are monsoonal, equatorial, and local pattern.



Monsoonal pattern is mostly affected by the monsoon circulation that change direction every half year. It has one peak in rainy season and dry season, respectively. The equatorial pattern reflects the semi-monsoonal pattern with two peaks of rainy season and dry season. For the local pattern, it has an opposite pattern as monsoonal rainfall type.

Monsoonal Pattern | Equatorial Pattern | Local Pattern



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These three rainfall patterns and the temperature variability are also affected by global and regional phenomena in the seasonal, annual, and interannual to decadal time scales. These phenomenas include Asia-Australia Monsoon Circulation, ITCZ, ENSO, IOD and SST.

Annual climate variability in Indonesia is generally described by a seasonal cycle, in which influenced by monsoonal system known as Asia – Australia Monsoon Circulation system.

In rainy season, the monsoonal wind blows from Asia to Australia. It delivers more water vapor which then turn into rainfall in Indonesia region. The rainy season in Indonesia generally occurs from October to March. Meanwhile, in dry season, the monsoon wind with less water vapor blows from Australia to Asia. It passes through Indonesia region, resulting rainfall reduction which is then known as dry season in Indonesia. It generally occurs from April to November.

In seasonal variations, the rainfall variability is also driven by **ITCZ**. ITCZ (Intertropical Convergence Zone) is an area where two air masses from northern hemisphere and southern hemisphere converged in a low pressure area that extends from west to east near tropical band. Its position changes following the pseudo movement of the sun to the north and south of the equator. In general, Indonesia region that is passed by ITCZ has the potential for the growth of rain clouds.

Asian Monsoon

(October – March)

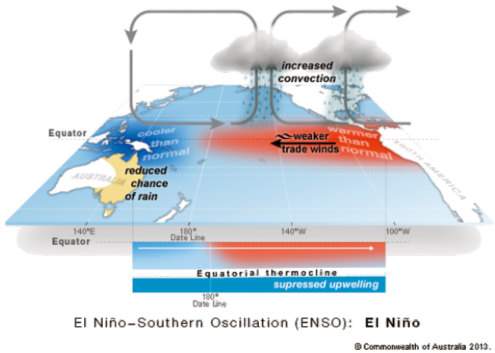
Australian Monsoon

(April – November)

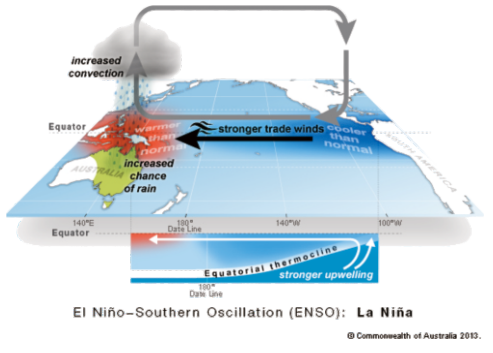
The non-seasonal variation that is reflected by its interannual variability, is influenced by ENSO and IOD.

ENSO (El-Nino Southern Oscillation) is a recurring climate pattern involving changes of sea temperatures in the central and eastern tropical Pacific Ocean. For about every two to seven years, the surface waters across a large swath of the tropical Pacific Ocean is warm or cool by anywhere from 10°C to 30°C, compared to normal. This oscillation (known as ENSO cycle) affects rainfall distribution in tropic regions and other parts of the world, including Indonesia.

El-Nino and La-Nina are the extreme phases of the ENSO cycle. While ENSO-Neutral is the third phase between both of them, where the Sea Surface Temperatures (SST) in tropical Pacific Ocean are generally close to average.



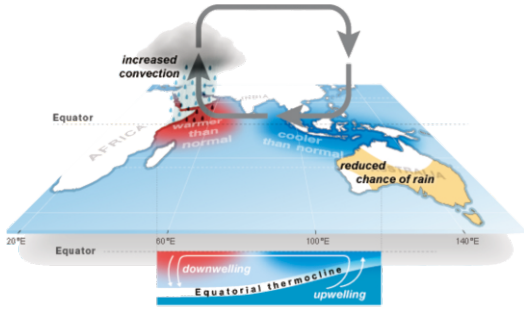
El Niño–Southern Oscillation (ENSO): **El Niño**



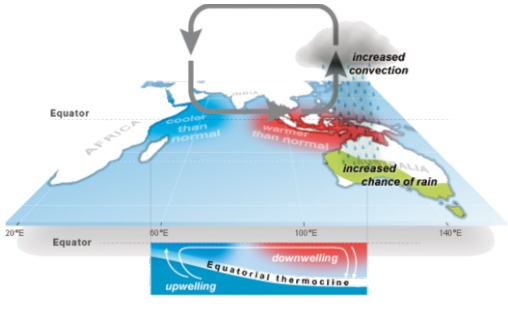
El Niño–Southern Oscillation (ENSO): **La Niña**

El Nino is defined as a warming of the ocean surface or above-average SST in certain threshold) in the central and eastern tropical Pacific Ocean. During El-Nino, rainfall in mostly Indonesia region tend to decrease but tend to increase over the central and eastern tropical Pacific Ocean. In general, the warmer the ocean temperature anomalies, the stronger the El-Nino (and vice versa).

La-Nina is known as a cooling of the ocean surface (or below-average SST in certain threshold) in the central and eastern tropical Pacific Ocean. This condition tends to increase the rainfall over Indonesia and reduce it in the central and eastern tropical Pacific Ocean. In general, the cooler the ocean temperature anomalies, the stronger the La-Nina (and vice -versa).



Indian Ocean Dipole (IOD): **Positive phase**



Indian Ocean Dipole (IOD): **Negative phase**

IOD (Indian Ocean Dipole) is a phenomenon of sea-atmospheric interaction in the Indian Ocean which is calculated based on differences of SST anomalies in the east coast of Africa and west of Sumatra waters. IOD is quantified in DMI (Dipole Mode Index). In general, positive DMI will affect the rainfall reducing, while negative DMI will affect the rainfall increasing in west Indonesia.

Beside those global-regional phenomena, rainfall in Indonesia is also affected by Sea Surface Temperature (SST) conditions in the Indonesian waters. **SST** in Indonesia can be used as an indicator of water vapor availability in the atmosphere. It is closely related to the process of cloud formation over Indonesian territory. If the SST is cold, then there will be less potential water vapor content in the atmosphere. On the contrary, the heat of SST will potentially cause the rise of water vapor content in the atmosphere.