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Air-temperature variations and ENSO effects in Indonesia, the Philippines and El Salvador. ENSO patterns and changes from 1866â€“1993

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Abstract

The major features in development of the â€œEl Nino-Southern Oscillationâ€ (ENSO) involve oscillation of the Pacific ocean-atmosphere in an essentially unpredictable (chaotic) fashion. The system moves between extremes of the so-called â€œwarm eventsâ€ lasting one or two years and involving movement of warm sea water from the western Pacific along the equator to impact on the west coast of the American continent and â€œcold-eventsâ€ associated with easterly trade-wind-induced flows of colder water from the eastern Pacific towards the west. Historical data indicate that ENSO years as experienced by the Island of Java are either much warmer than non-ENSO years or only slightly, if at all, warmer than normal (non-ENSO) years. Hot-dry years within the ENSO warm event cycle are almost always followed by cooler wet years

years within the ENSO warm event cycle are almost always followed by cooler wet years and *vice versa*. This pattern also extends to include the year immediately following the terminal year of an ENSO warm event set. The initial year of an ENSO warm event set may be either hot with a long dry season or relatively cool (nearer to the temperature of a non-ENSO year) and having a short dry season. In recent years, since 1950, of the 9 ENSO warm events, the initial year tends to have been hot and dry for 6 (1951, 1957, 1963, 1972, 1982, 1991) and neutral or cool and wet for 3 (1968, 1976, 1986).

An area of 88,000 ha burned in 1991 (Jakarta Post 30 November 1991) largely in Kalimantan in association with the 1991â€“1992 ENSO event, an extensive pall of smoke developed over Kalimantan, Singapore and Malaysia during Septemberâ€“October of 1991. Surface vegetation-based fires continued to burn in East Kalimantan as of 29 April 1992 and extended into the 1992 dry season, in response to the ENSO conditions carrying forward from 1991.

The increasing annual trend in air-temperature exhibited by the mean monthly values over the period 1866â€“1993, for the Jakarta and the Semarang data taken together is 1.64Â°C (0.0132Â°C per year from 25.771 to 27.409Â°C). The major industrial development in infrastructure for Jakarta has been significant only since 1980 or so and was not apparent before 1970 when the city had the aspect of an extended village with few large buildings (greater than 3â€“4 stories) and no extensive highways. The 1.65Â° difference between 1866 and 1991 can presumably by partitioned into: (1) urban heat-island effect, (2) effect of deforestation, (3) effect of secular micro-climate shift, (4) influence of general global warming with particular reference to the tropics.

When the blocks of non-ENSO years in themselves are considered, the deviations from the secular trend for warmest month mean temperatures in successive years are correlated with that of the next immediate year deviation so that either continual warming or cooling appears to take place from the termination of one ENSO to the initiation of the next. When the deviations around the secular trend shown by the warmest month average temperatures are summed for the inter-ENSO intervals (the separate non-ENSO years) the resultant â€œheat-loadingâ€ index is positively correlated with the following (initial) ENSO warmest month deviation from the overall ENSO warmest month secular trend. This provides an immediate predictive mechanism for the likely strength of an ENSO, in terms of the dry season impact to the Island of Java, should one occur in the next year to break a non-ENSO sequence. The length of the build-up and the build-up achieved seems not to be related. The relationship does not in itself however, predict the occurrence of the â€œnextâ€ ENSO.

The data show that a consistent structure underlies ENSO events for the last century and a quarter. However, as a process monitored by mean monthly air-temperature measurements at Jakarta-Semarang, the system is changing in character with time in association with an overall atmospheric temperature increase in a way that involves increased intra-annual temperature fluctuations. In general ENSO years are associated with higher temperatures than non-ENSO years, with a significant negative correlation between subsequent years which are thereafter systematically cooler. This may be because the ENSO event actively mixes excess heat energy into the ocean-sink to an extent that is in direct proportion to the outstanding positive temperature deviation. A weak ENSO, preceded by a relatively modest temperature build-up in the lead-up non-ENSO years, then results in limited mixing which leads to a relatively warm subsequent year while a strong event leads to extensive mixing and so generally results in a following very much cooler year. Atmospheric temperature build-up possibly associated with the greenhouse effect may be coupled to an increasingly wider temperature swing in west and central Java associated with the warm pool influence but anchored by the ocean-sink.

Keywords

El Nino; southeast Asia; drought; global change; warm events

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