The influence of El Niño – Southern Oscillation on West Java

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This article is an extended summary of the paragraph on West Java of van Oldenborgh [1998] (in dutch)

The main influence of El Niño–Southern Oscillation (ENSO) on Indonesia is during the dry season [e.g., Berlage, 1957, Ropelewski and Halpert, 1987, Kiladis and Diaz, 1989]. In fact, in historical data the effects on Indonesia are, together with the West Pacific, the strongest in the world. The strength of ENSO can conveniently be parametrized by the NINO3 index: sea surface temperature anomalies in the region 5°S–5°N, 90°–150°W. This index has been reconstructed from 1856 to the present from ship measurements [Kaplan et al., 1998]. The largest linear correlation coefficient with NINO3 of all 10941 stations in the Global Historical Climate Network (GHCN) dataset with more than 40 years of data [Vose et al., 1992] is found in Indonesia. Banda Island (5°S, 130°E) has $r = -0.82^{+6}_{-4}$ for dry season (Aug–Nov) rainfall. The regional differences are large, though.

For West Java the year is divided in four seasons: the dry season from June to September, the onset of the rains in October and November, the rain season December to March, and the transition to dry season April and May. The influence on precipitation of El Niño can be seen in the maps of Fig. 1, which show the correlation between the strength of El Niño and local rainfall for all stations in the GHCN database in West Java with at least 40 years of data. One sees that the dry season (June–September) tends to be drier during El Niño and wetter during La Niña, especially in the mountains. The onset of the rains in October–November is generally delayed by El Niño, this effect is strongest in the Preanger. Curiously the Preanger has historically also received somewhat more rain during El Niño years in the rain season (December–March). There is no effect on the transition to the dry season (April–May).

Specializing to Jakarta, the Observatory measurements date back to 1864, so all relationships can be investigated using 130 years of data. The correlation with NINO3 as a function of the season is shown in Fig. 2, which shows the same features as discussed before: generally drier weather during the dry season with El Niño, a delayed onset, and no statistically significant influence during the rest of the year.

The scatterplots of rainfall against NINO3 in the different seasons (Fig 3) show that the dry-season (June–August) relationship has historically only held for large El Niño events (NINO3 > 1). The 1997 data are not yet in the GHCN database, but that year certainly fitted the pattern. There is no relationship when NINO3 < 1: weak El Niño events and La Niña events have not been associated with deviations in rainfall in the dry season in Jakarta. The amount of rain during the onset period (October–November) is to a good approximation linearly or expontially propor-

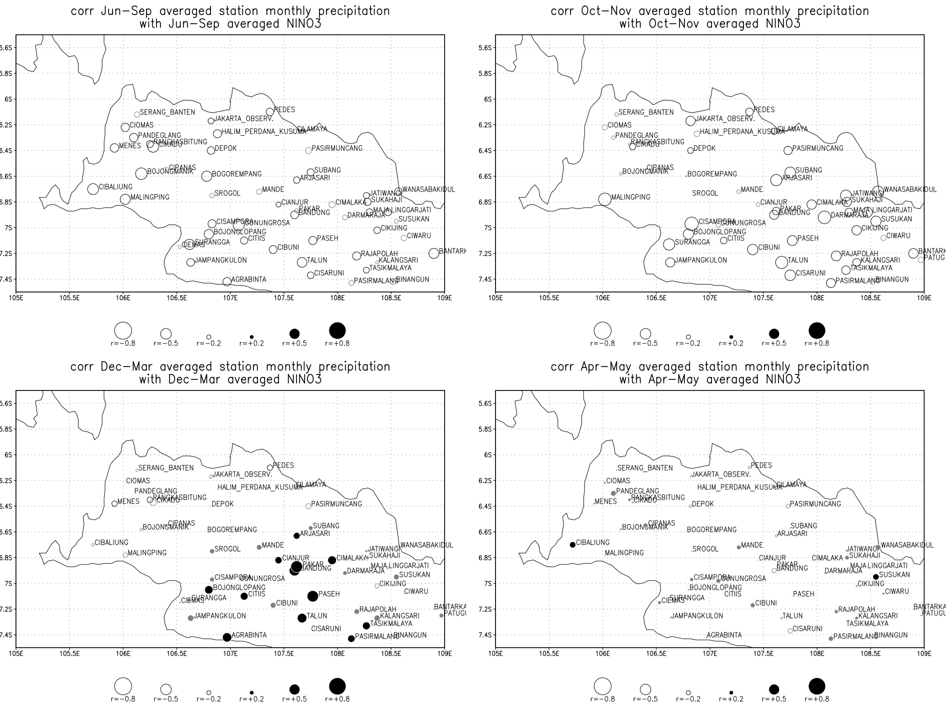

Figure 1: The influence of ENSO on rainall in West Java in the four seasons: dry, onset, wet and transition to dry.

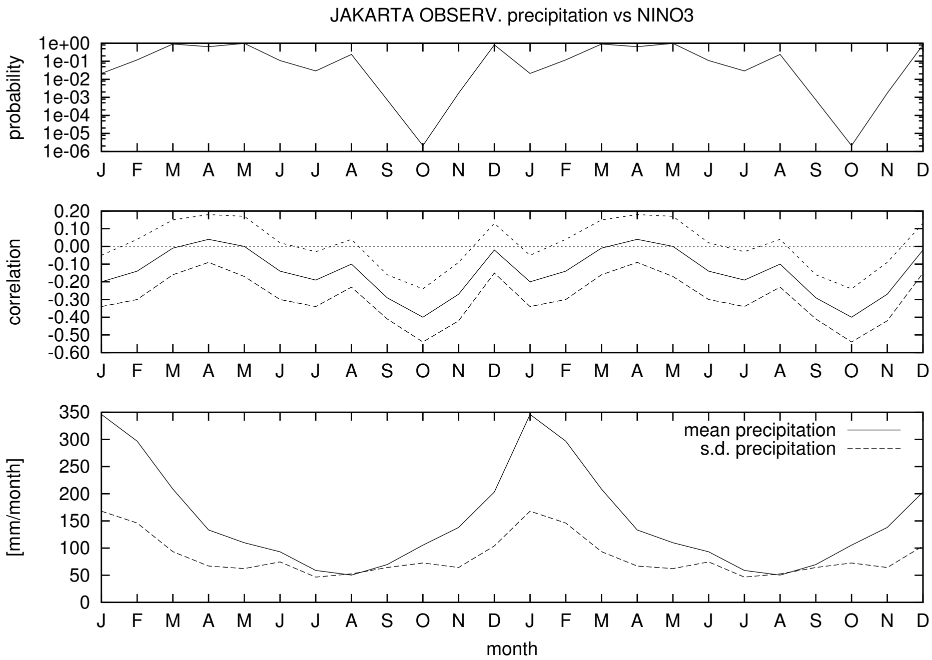

Figure 2: The influence of ENSO on rainall in Jakarta. Bottom: rainfall, middle: correlation coefficient with 2-standard deviation bounds; top: significance.

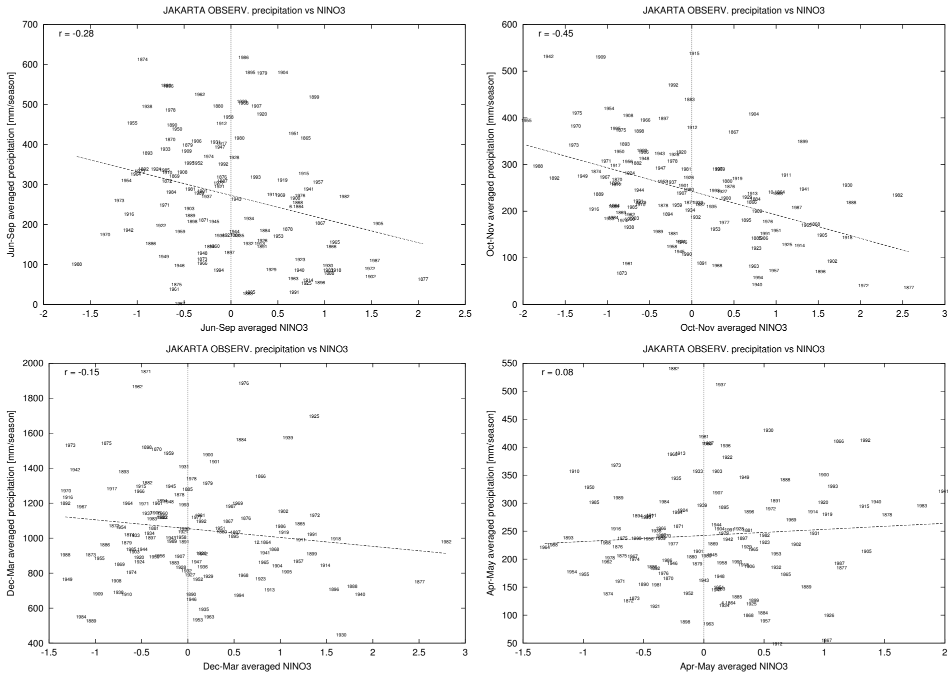

Figure 3: The influence of ENSO on rainall in Jakarta in the four seasons.

tional to NINO3 for both El Niño and La Niña. The other seasons show no trends.

All the figures were made with the publicly accessible KNMI Climate Explorer web application at http://climexp.knmi.nl, which has been designed to be able to investigate quickly the effects of ENSO on the weather world-wide.

References

H. P. Berlage. *Fluctuations of the general atmospheric circulation of more than one year, their nature and progniostic value*. Number 69 in Mededelingen en verhandelingen. KNMI, De Bilt, Netherlands, 1957.

A. Kaplan, M. A. Cane, Y. Kushnir, A. C. Clement, M. B. Blumenthal, and B. Rajagopalan. Analyses of global sea surface temperature 1856–1991. *J. Geophys. Res.*, 103:18567–18589, 1998. Data are available from ingrid.ldgo.columbia.edu.

G. N. Kiladis and H. F. Diaz. Global climatic anomalies associated with extremes in the southern oscillation. *J. Climate*, 2:1069–1090, 1989.

C. F. Ropelewski and M. S. Halpert. Global and regional scale precipitation patterns associated with the El Niño/Southern Oscillation. *Mon. Wea. Rev.*, 115:1606–1626, 1987.

G. J. van Oldenborgh. El niño en de grote droogte in indonesië. *Meteorologica*, maart, 1998.

R. S. Vose, R. L. Schmoyer, P. M. Steurer, T. C. Peterson, R. Heim, T. R. Karl, and J. K. Eischeid. The global historical climatology network: Long-term monthly temperature, precipitation, sea level pressure, and station pressure data. Technical Report NDP-041, Carbon Dioxide Information Analysis Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee, U.S.A., 1992.