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Relationships between Stratospheric Quasi-Biennial Oscillation (QBO) and Precipitation Activities in Asia

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Abstract

The influence of stratospheric quasi-biennial oscillation (QBO) on global precipitation features was studied over a 25-year period. The years from 1980 to 2004 are classified into easterly and westerly phases of QBO. Composite analyses in Asia reveal noteworthy pluvial anomalies near the Philippines, and inactive front activity and typical drought events due to adiabatic descent over Japan during the easterly phase of QBO. Cool summers and extreme rainfall events in Japan tend to prevail in the westerly phase. In particular, ten Typhoons struck Japan in 2004 accompanied by the westerly phase of QBO.

Key words : stratospheric quasi-biennial oscillation (QBO), precipitation, Asian monsoon region, meridional circulation

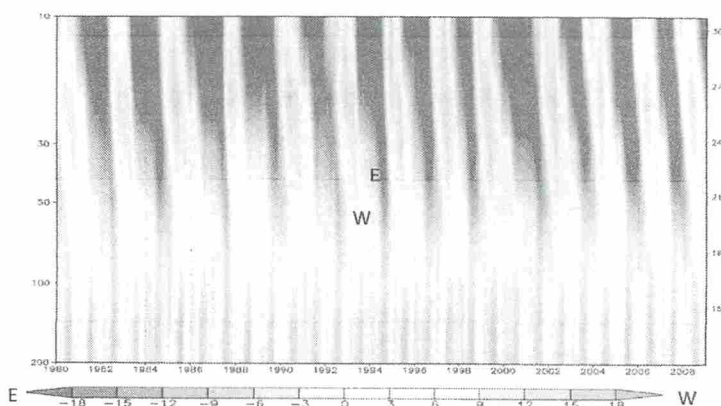


Fig. 1 Time-height cross-section of the monthly zonal-mean zonal wind (positive value is westerly) near the equator (5° N-5° S). Left and right axes indicate air pressure (hPa) and altitude (km), respectively. The unit of zonal wind is m s^{-1} .

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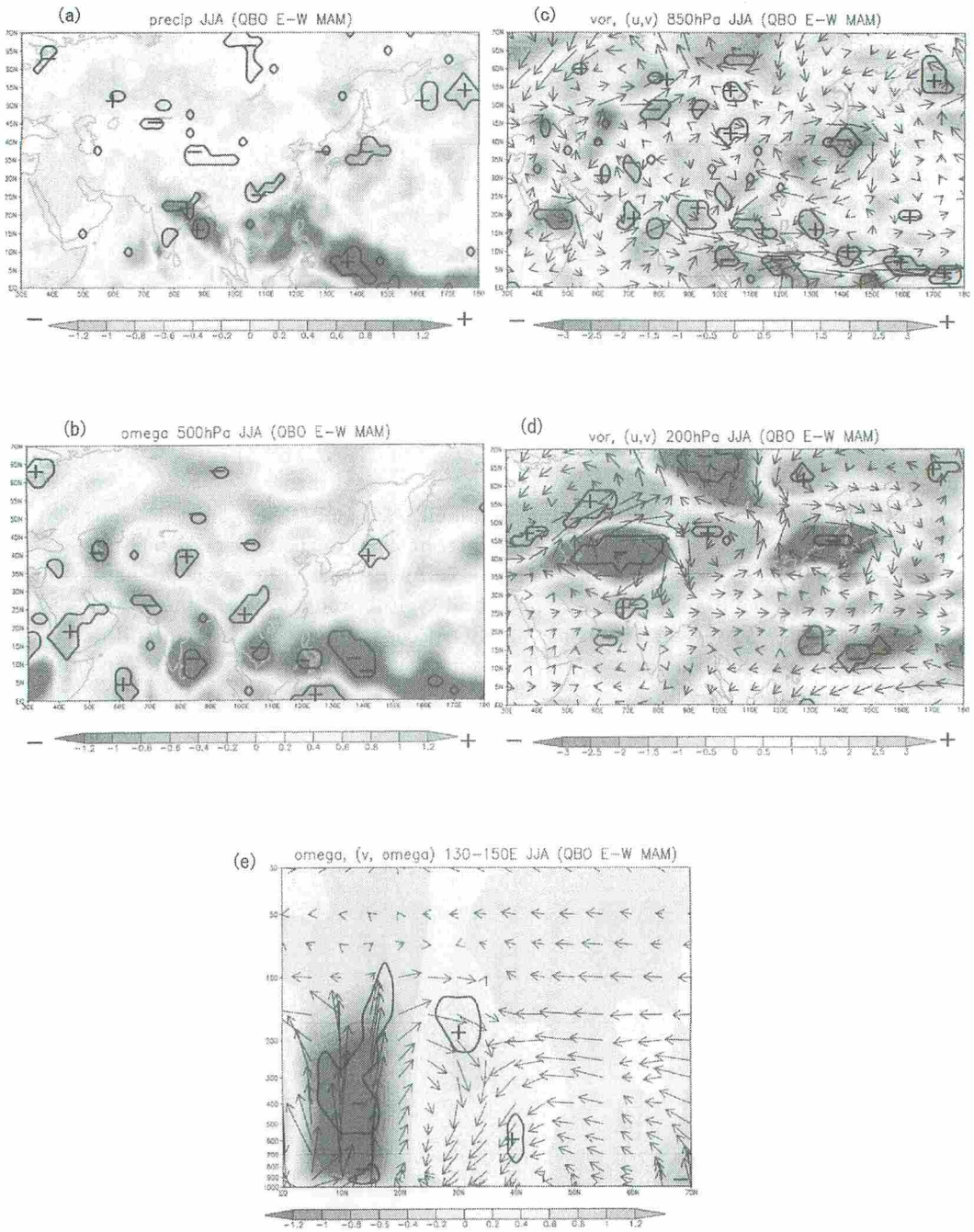


Fig. 2 Horizontal maps of (a) precipitation, (b) vertical p-velocity at 500 hPa, and vorticity at (c) 850 hPa and (d) 200 hPa in northern summer (June–July–August). Vectors on the vorticity maps indicate horizontal wind. (e) Latitude–height cross-section of vertical p-velocity (shade) and meridional circulation (vector) over East Asia (130–150° E) in northern summer (June–July–August). All values are evaluated as easterly phase years minus westerly phase years. The units are mm day⁻¹ for precipitation, 10^{-2} Pa s⁻¹ for vertical p-velocity, 10^{-6} s⁻¹ for vorticity, and m s⁻¹ for horizontal wind. Thick lines indicate the borders of the regions reaching a 95% significant level.

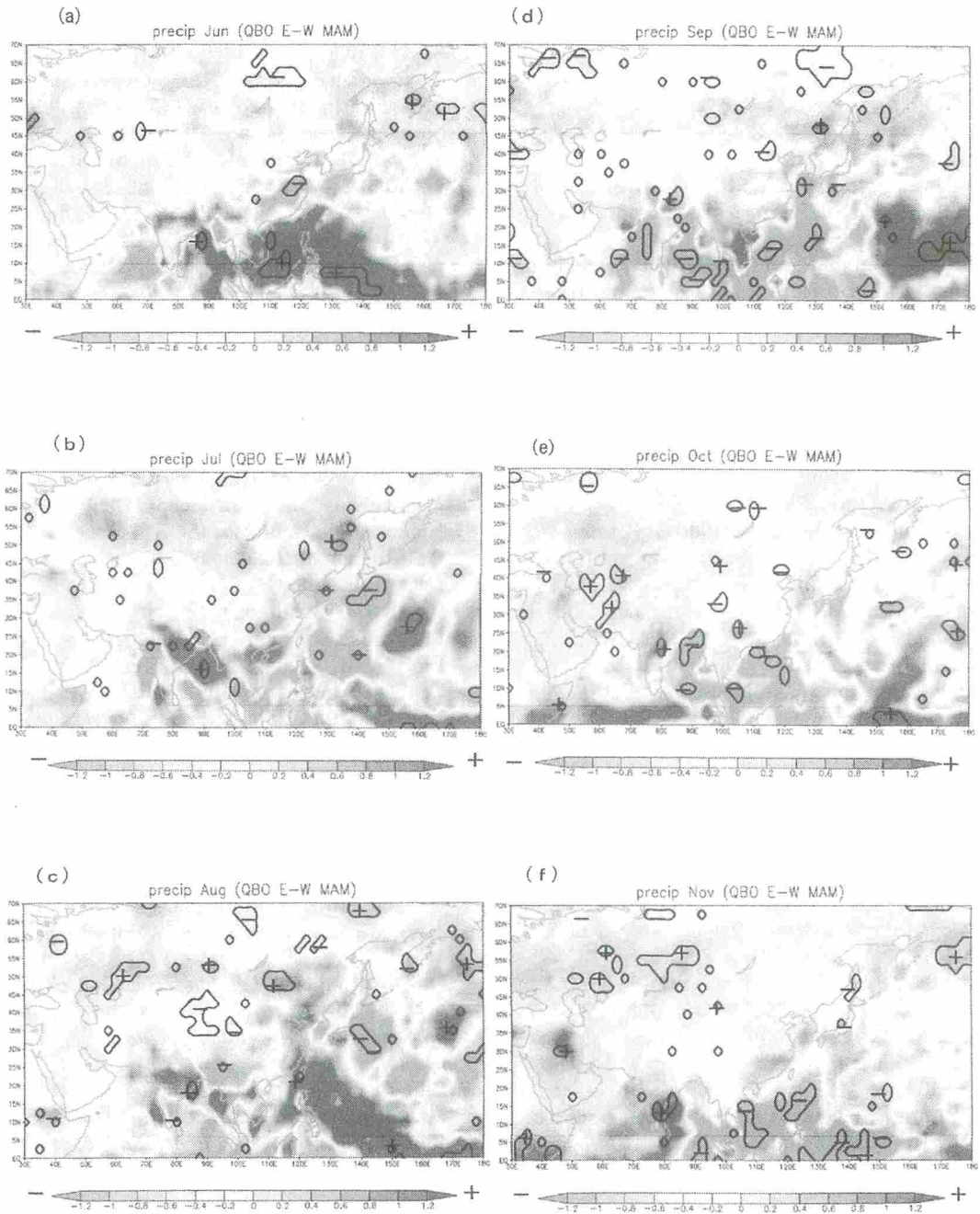


Fig. 3 Horizontal maps of precipitation in (a) June, (b) July, (c) August, (d) September, (e) October, and (f) November. All values are evaluated as easterly phase years minus westerly phase years. The unit is mm day^{-1} . Thick lines indicate the borders of regions reaching 95% significant level.

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