



*Geophysical Research Letters*

Supporting Information for

**On the genesis of the 2021 Atlantic Niño**

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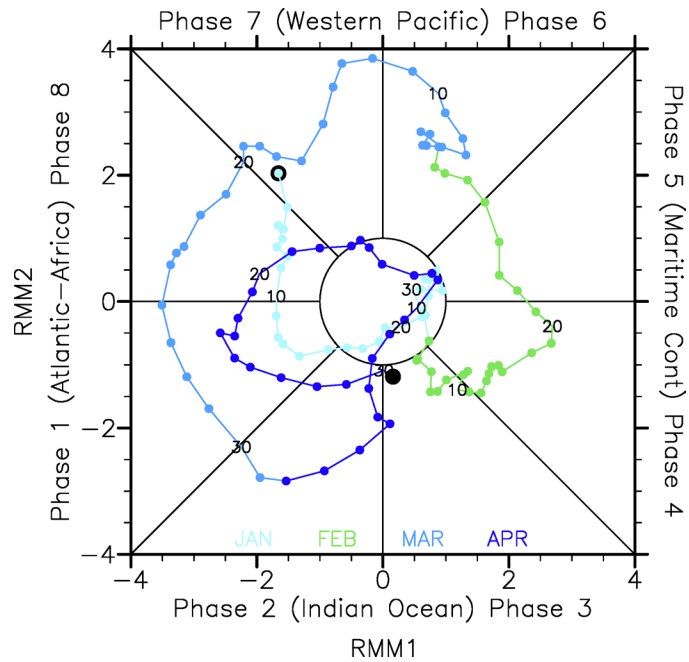
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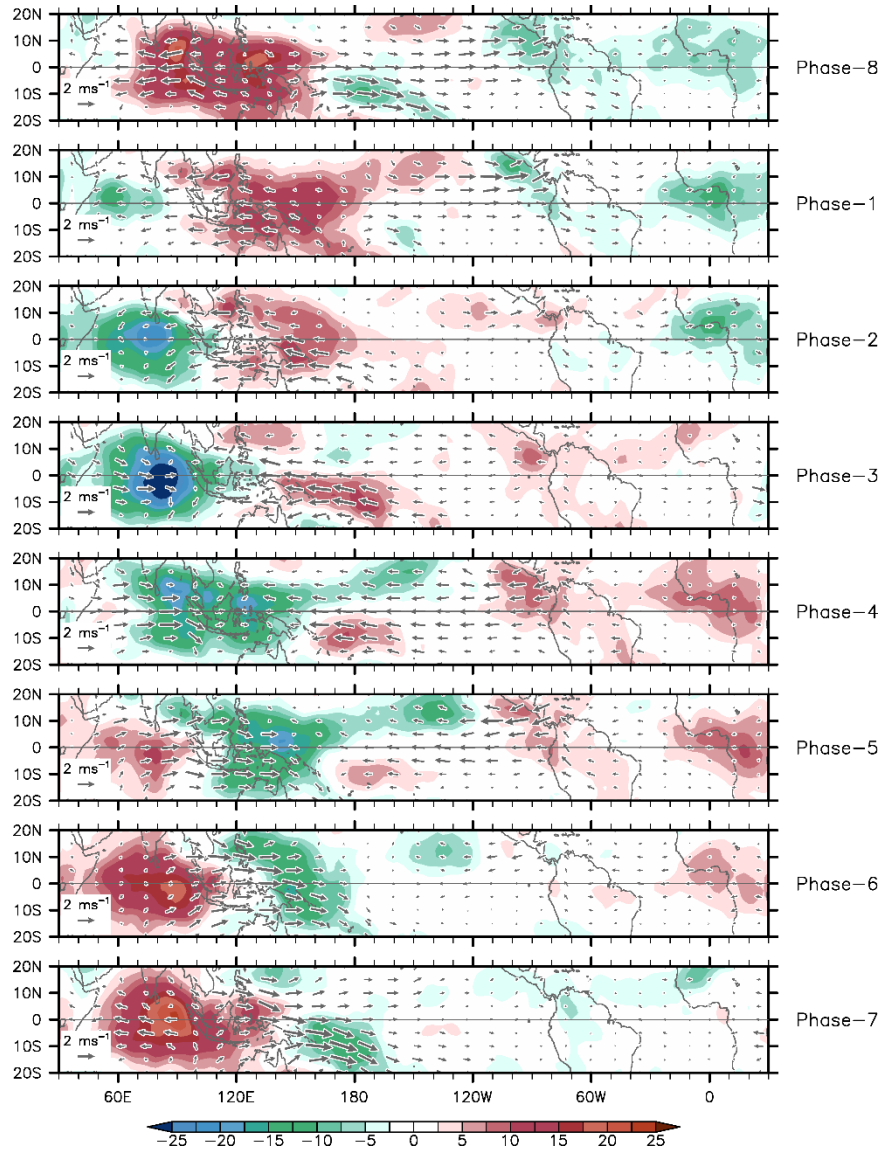
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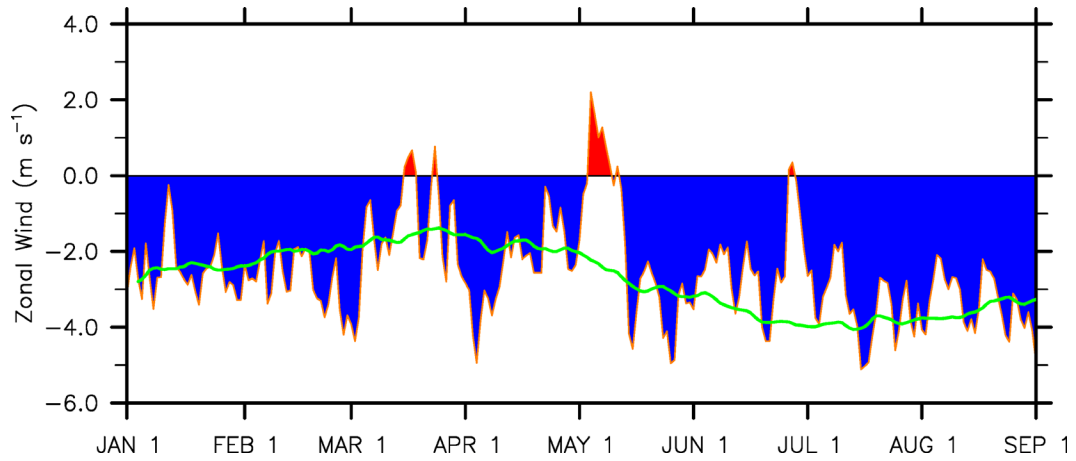
Figures S1 – S8 and Table S1.



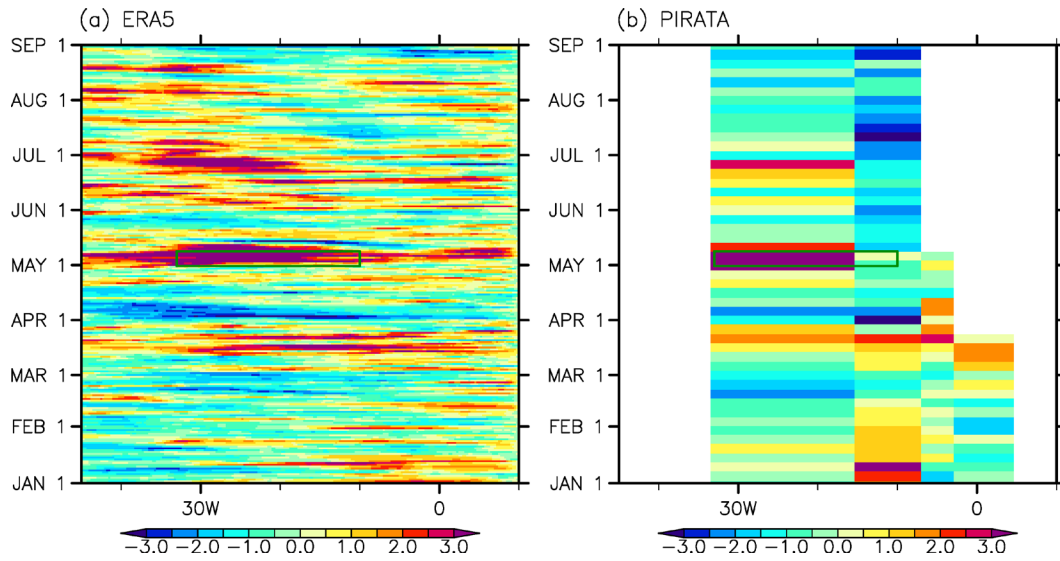
**Figure S1.** An example of MJO phase diagram for January 1 – April 30, 1997. Numbers along the MJO trajectory indicate calendar dates in corresponding months. Two black dots indicate the starting (January 1, 1997) and ending (April 30, 1997) of the MJO trajectory, which usually orbits the origin in a counter-clockwise direction.



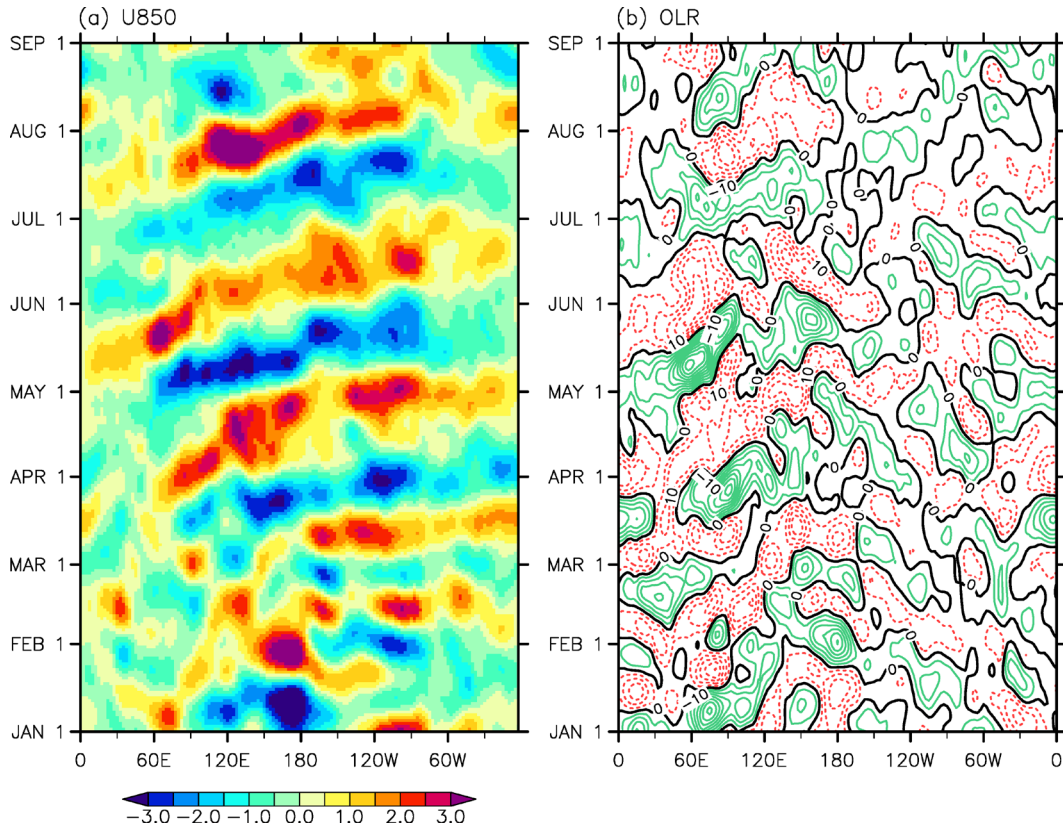
**Figure S2.** Low-level (850 hPa) wind (vectors) and OLR (shaded) anomalies during each of the eight MJO phases, derived from all MJO events during 1982-2021. During phase-8 and phase-1, the MJO convection is enhanced between the Atlantic Ocean and Africa. The center of the enhanced MJO convection is shifted to the Indian Ocean during phase-2 and phase-3, to the Maritime Continent during phase-4 and phase-5, and then to the western Pacific during phase-6 and phase-7. The units for low-level wind, and OLR are in  $\text{m s}^{-1}$ , and  $\text{W m}^{-2}$ , respectively.



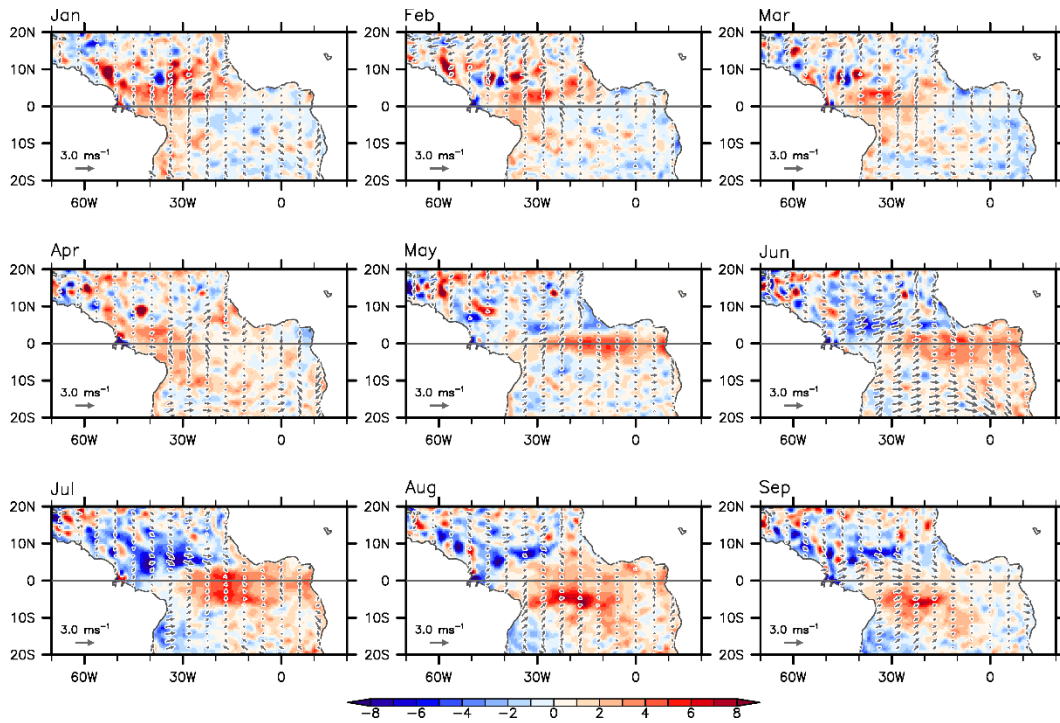
**Figure S3.** Time series of 10-m zonal wind averaged over (33°W-10°W, 3°S-3°N) from January 1 to September 1, 2021 derived from the NCEP reanalysis. The green line indicates the 7-day running-averaged climatology during 1993-2021.



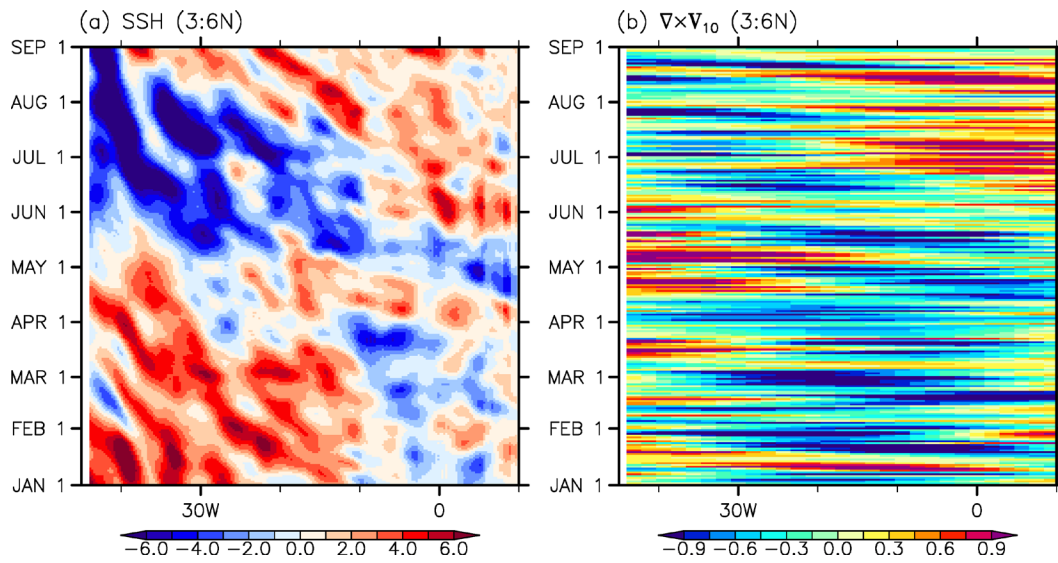
**Figure S4.** Time-longitude plots of 10-m zonal wind anomalies from January 1 to September 1, 2021 derived from (a) the European Center for Medium-Range Weather Forecasts reanalysis-5 (ERA5), and from (b) four PIRATA mooring sites at 23°W, 10°W, 3°W and 0°E along the equator. The green boxes in (a) and (b) indicate the zonal extent (33°W-10°W) and the timing (May 1-7, 2021) of a strong WWB event. The unit for 10-m zonal wind is in  $\text{m s}^{-1}$ .



**Figure S5.** Time-longitude plots of (a) low-level (850 hPa) zonal wind and (b) OLR anomalies averaged between  $15^{\circ}\text{S}$  and  $15^{\circ}\text{N}$  for the entire longitude range from January 1 to September 1, 2021. Red dashed contour lines in (b) indicate positive OLR anomalies whereas green solid lines in (b) indicate negative OLR anomalies. The units for low-level wind, and OLR are in  $\text{m s}^{-1}$ , and  $\text{W m}^{-2}$ , respectively.

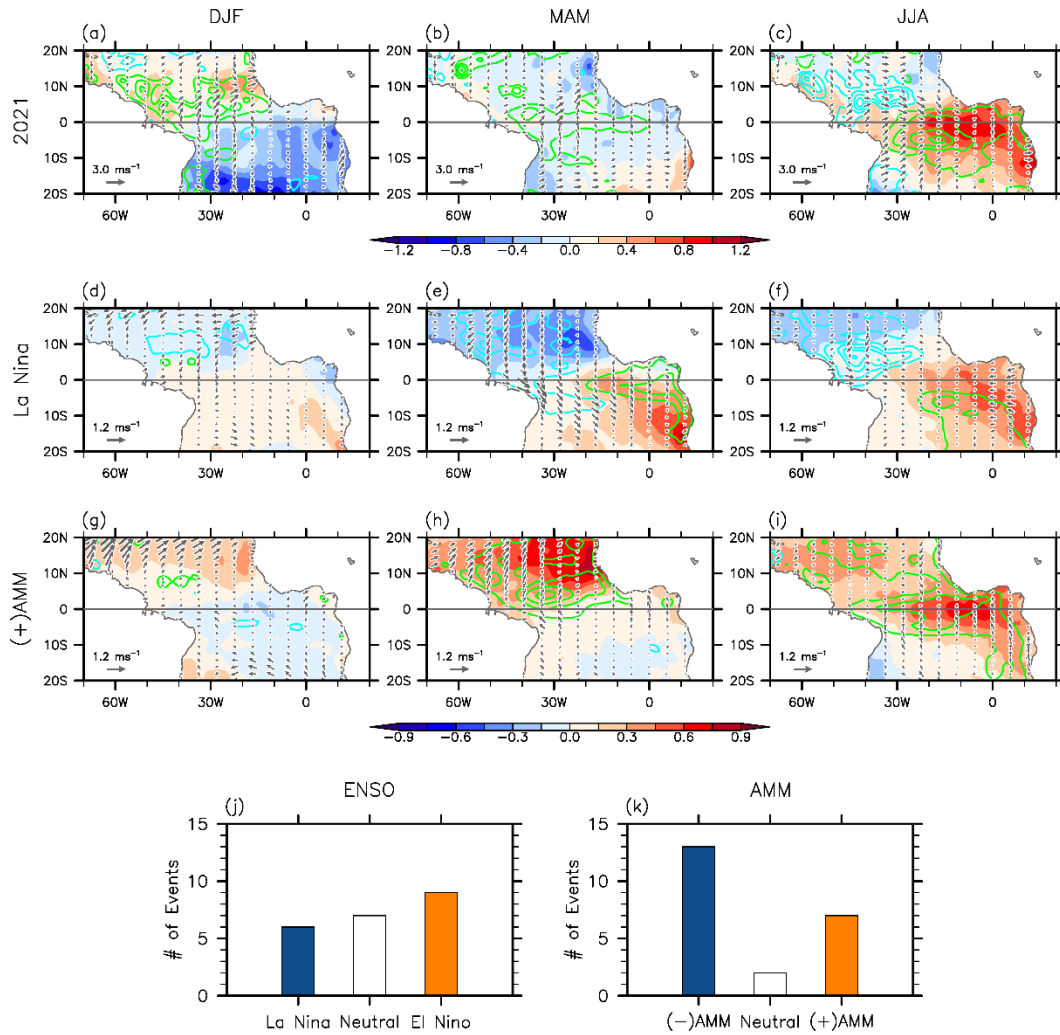


**Figure S6.** Tropical Atlantic SSH (shades) and 10-m wind (vectors) anomalies during January – September 2021. The units for SSH and 10-m wind are in cm and  $\text{m s}^{-1}$ , respectively.



**Figure S7.** Time-longitude plots of (a) SSH anomalies in the latitude band of 3° - 6°N, and (b) differences in daily 10-m wind curl anomalies in the latitude band of 3° - 6°N from January 1 to September 1, 2021. The units for SSH and 10-m wind curl anomalies are cm and  $10^{-6} \text{ s}^{-1}$ , respectively.





**Figure S8.** (a-i) Tropical Atlantic SST (shades), SSH (contours) and 10-m wind (vectors) anomalies during (a,d,g) December-February (DJF), (b,e,f) March-May (MAM) and (c,f,i) JJA for (a-c) 2021, (d-f) La Niña, and (g-i) (+) AMM. Positive and negative SSH anomalies are indicated by green and cyan contour lines, respectively in (a-i). (j,k) Number of Atlantic Niño events (j) following La Niña, ENSO-neutral, and El Niño winter, and (k) following (-) AMM, neutral-AMM, and (+) AMM winter or spring. The units for SST, SSH, and 10-m wind are in  $^{\circ}\text{C}$ , cm, and  $\text{m s}^{-1}$ , respectively. The contour interval for SSH anomalies is 1.25 cm in (a-c) and 1.0 cm in (d-i).

**Table S1.** 23 Atlantic Niño events that developed during 1948-2021 are grouped by ENSO conditions (i.e., La Niña, ENSO-neutral, and El Niño) in the prior winter (December-February) and by AMM conditions in the prior winter (December-February) or spring (March-May).

ENSO \ AMM	(-) Phase	Neutral	(+) Phase	All
La Niña	1974;1984;1996; 1999;2008;2018 (6)	(0)	<b>2021</b> (1)	1974;1984;1996; 1999;2008;2018; <b>2021</b> (7)
Neutral	1949;1968;1991 (3)	1993 (1)	1951;1963;1981 (3)	1949;1951;1963; 1968;1981;1991; 1993 (7)
El Niño	1973;1995;2016; 2019 (4)	1988 (1)	1966;1987;1998; 2010 (4)	1966;1973;1987; 1988;1995;1998; 2010;2016;2019 (9)
All	1949;1968;1973; 1974;1984;1991; 1995;1996;1999; 2008;2016;2018; 2019 (13)	1988;1993 (2)	1951;1963;1966; 1981;1987;1998; 2010; <b>2021</b> (8)	1949;1951;1963; 1966;1968;1973; 1974;1981;1984; 1987;1988;1991; 1993;1995;1996; 1998;1999;2008; 2010;2016;2018; 2019; <b>2021</b> (23)