Science and Technology Infusion Climate Bulletin
NOAA's National Weather Service
41st NOAA Annual Climate Diagnostics and Prediction Workshop
Orono, ME, 3-6 October 2016

Variations of Mid-Atlantic Trough and Associated American-Atlantic-Eurasian Climate Anomalies

Mengmeng Lu[1], Kaiqiang Deng[1], Song Yang[1, 2, 3], Guojun Zhou[4], and Yaheng Tan[1]

[1]*School of Atmospheric Sciences, Sun Yat-sen University, Guangzhou, China*

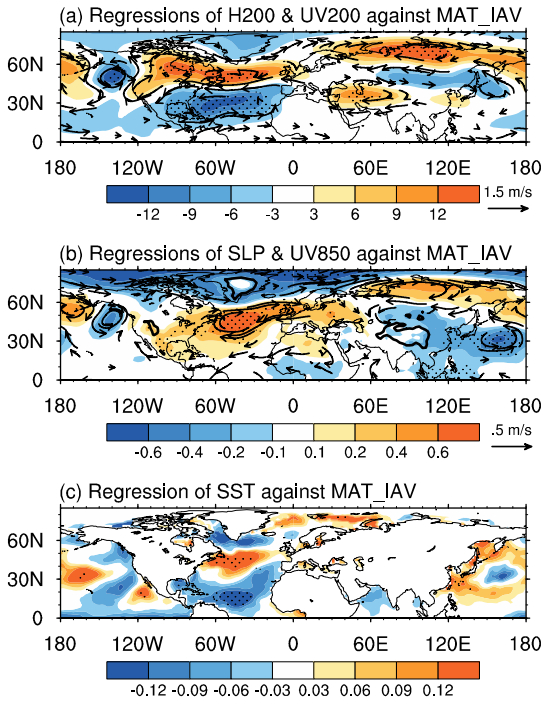
[2] *Guangdong Province Key Laboratory for Climate Change and Natural Disaster Studies, Sun Yat-sen University, Guangzhou, China*

[3]*Institute of Earth Climate and Environment System, Sun Yat-sen University, Guangzhou, China*

[4]*Xinhua College of Sun Yat-sen University, Dongguan, China*

ABSTRACT

The mid-Atlantic trough (MAT) is one of the most prominent circulation systems over the mid-Atlantic during the boreal summer, which is viewed as an atmospheric bridge linking the American-Atlantic-Eurasian climate. On interannual time scale, the variation of MAT is significantly associated with the North Atlantic Oscillation and a southeastward propagating stationary wave that originates from the northeastern Pacific (Fig. 1(a)-(b)). The associated sea surface temperature (SST) pattern shows a meridional quadripole structure over the tropical Atlantic and the North Atlantic, which is similar to the negative Atlantic meridional mode (AMM; Fig. 1(c)). Moreover, the correlation coefficient between the interannual variability of MAT (MAT_IAV) and the AMM index significantly exceeds the 99% confidence level. The strong trough is associated with the warmer surface temperature over central-northern North America and the North Atlantic, which might be related to the higher pressure over these regions. Similarly, corresponding to the lower pressure over the Arctic region, the subtropical North Atlantic and the northeastern Pacific, the colder surface temperature appears over these areas (Fig. 2(a)). When the trough is strong, significant negative precipitation anomalies occur over the north of the Mediterranean Sea and the Black Sea, as well as the northeastern Atlantic because of the low-level northeasterly winds over these areas (Fig. 2(b)). On interdecadal time scale, there exists a significant negative correlation between the MAT and the Atlantic Multidecadal Oscillation (AMO; Fig. 3). When the trough is weak, the warmer surface temperature appears over almost entire North Atlantic (the feature is similar to the AMO), South Europe, East Asia and the North Pacific (Fig. 4(a)). The weak trough is associated with a dipole structure of anomalous rainfall over the North Atlantic and the Greenland (Fig. 4(b)).



This work will be submitted to the Canadian journal *Atmosphere-Ocean* in 2017.

Fig. 1 (a) Regressions of 200-hPa geopotential height (shadings, units: m) and horizontal winds (vectors, units: m s^{-1}) against the MAT_IAV. (b) Same as (a), but for sea level pressure (shadings, units: hPa) and 850-hPa horizontal winds (vectors, units: m s^{-1}). (c) Same as (a), but for SST (units: °C). The dots indicate the values that are significantly above the 95% confidence level. The regressed winds smaller than 0.3 m s^{-1} and 0.1 m s^{-1} are masked out in (a) and (b), respectively. In (b), the topography higher than 2000 meters is marked with thick lines.

Correspondence to: Song Yang, School of Atmospheric Sciences, Sun Yat-sen University, 135 West Xingang Road, Guangzhou 510275, China; E-mail: yangsong3@mail.sysu.edu.cn

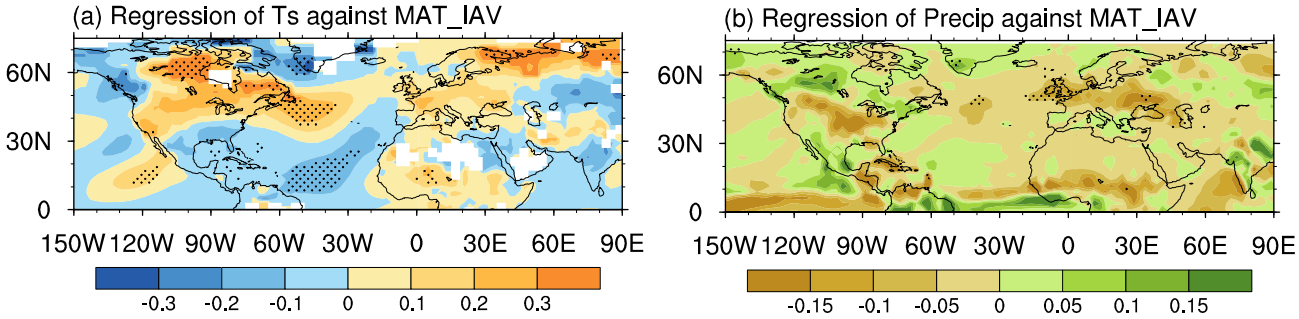


Fig. 2 Same as Fig. 1, but for (a) surface temperature (units: °C) and (b) precipitation (units: mm day^{-1}). The dots indicate the values that are significantly above the 95% confidence level.

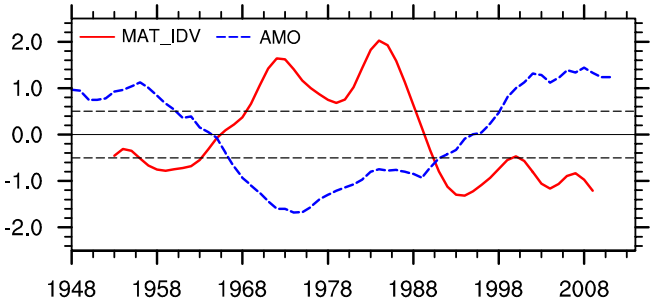


Fig. 3 Standardized interdecadal variation of MAT (MAT_IDV; red curve) that is calculated by a 10-year low-pass filter and standardized AMO index (blue curve). The dashed black lines represent the values of 0.5 standard deviations.

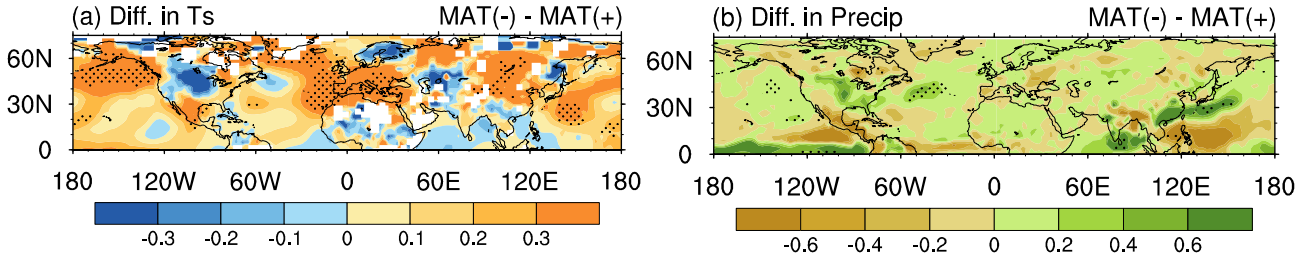


Fig. 4 (a) Composite differences of surface temperature (units: °C; in which the long-term trend is removed) between the negative phase (1991-2009) and the positive phase (1969-1988) of MAT. (b) Same as (a), but for precipitation (units: mm day^{-1}). The dots indicate the values that are significantly above the 95% confidence level.