



The variability of the Tibetan summertime tropospheric temperature and associated precipitation anomalies over the Sahel

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The relationship between the Tibetan tropospheric thermal condition and West African monsoon precipitation during boreal summer, and the associated physical mechanisms, are investigated. A significant positive correlation exists between the summertime Tibetan tropospheric temperature (TTT) and central-eastern Sahel precipitation. When the TTT increases, higher-than-normal precipitation occurs over the central-eastern Sahel, and vice versa. The increased tropospheric temperature over the western Tibetan Plateau (TP) [U+F02D] Mediterranean Sea region associated with a high TTT forms a tropospheric temperature gradient from the middle latitudes to the subtropics, which is accompanied by an anomalous zonal-vertical circulation from the western TP to the Mediterranean Sea. The tropospheric temperature distribution associated with a high TTT over the western TP [U+F02D] Mediterranean Sea region contributes to a tropospheric temperature gradient from the eastern Mediterranean and West Asia to the western Mediterranean, which is accompanied by an anomalous meridional-vertical circulation cell over the Mediterranean Sea [U+F02D] Africa region. The meridional-vertical circulation cell is accompanied by a deepened African continental low, and enhanced low-level westerly and southwesterly winds from the tropical and eastern Atlantic to inland Africa. These conditions favor an increase in precipitation over the central-eastern Sahel. Thus, the relationship between the summer TTT and precipitation over the central-eastern Sahel is explained by the anomalous zonal-vertical circulation between the western TP and the Mediterranean Sea, and the anomalous meridional-vertical circulation cell over the Mediterranean Sea–Africa region. The zonal and meridional circulations are connected by the vertical motion over the Mediterranean Sea. Sensitivity experiments with an atmospheric model, in which the surface vegetation type is adjusted, demonstrate the impacts of an increase in the summertime TTT on the anomalous zonal-vertical circulation between the western TP and the Mediterranean Sea, the anomalous meridional-vertical circulation cell over the Mediterranean Sea [U+F02D] Africa region, the deepened African continental low, and the enhanced low-level westerly winds from the tropical and eastern Atlantic to inland Africa. Thus, the relationship between the summertime TTT and central-eastern Sahelian precipitation reflects an impact of the TTT on central-eastern Sahelian precipitation.