Miocene shift of European atmospheric circulation

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The modern European climatic regime is peculiar, due to its unitary winter but diverse summer climates and a pronounced Mediterranean climate in the south. However, little is known on its evolution in the deep time. In this study, the Tortonian (11.62—7.246 Ma; million years ago) European summer climate conditions are reconstructed using plant fossil assemblages from 75 well-dated sites across Europe. The results clearly show that the Tortonian Europe mainly had humid to subhumid summers and no arid climate has been conclusively detected, indicating that the summer-dry Mediterranean-type climate has not yet been established along most of the Mediterranean coast at least by the Tortonian. More importantly, the reconstructed distribution pattern of summer precipitation reveals that the Tortonian European must have largely been controlled by westerlies, resulting in higher precipitation in the west and the lower in the east. The Tortonian westerly wind field appears to differ principally from the trade wind pattern of the preceding Serravallian (13.82—11.62 Ma), recently deduced from herpetofaunal fossils. Such a shift in atmospheric circulation, if ever occurred, might result from the development of ice caps and glaciers in the polar region during the Late Miocene global cooling, the then reorganization of oceanic circulation, and/or the Himalayan-Tibetan uplift.

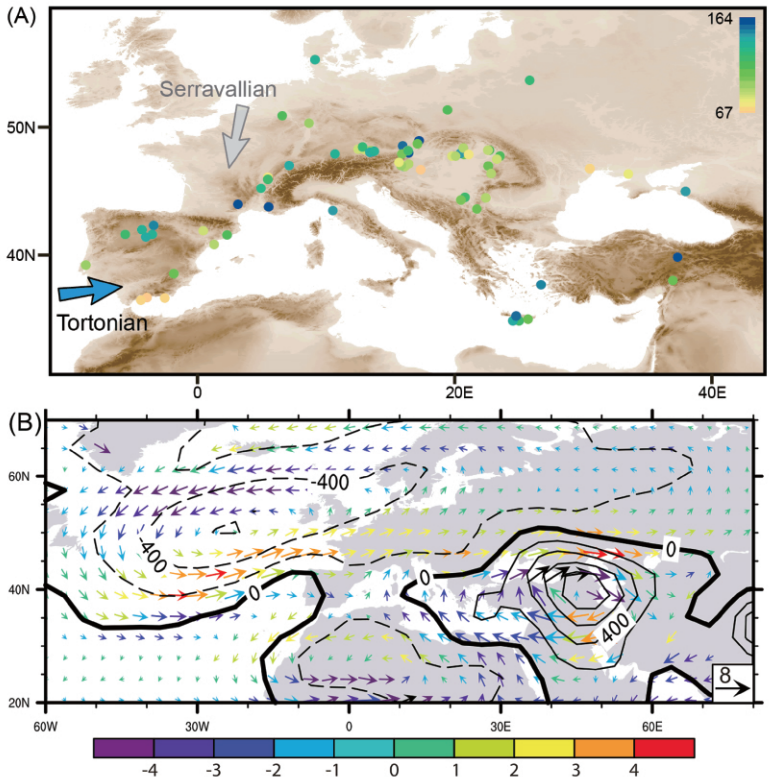

Figure 1 Reconstruction of the Tortonian climate of Europe. (A) Warmest month precipitation. The pink arrow denotes the Serravallian trade wind direction favored by European herpetofaunal data, while the blue arrow indicates the westerlies system inferred from the palaeobotanical data. (B) Difference of 850 hPa wind (vector; m/s) and sea level pressure (Pa) in July between the Tortonian and present-day global simulation.