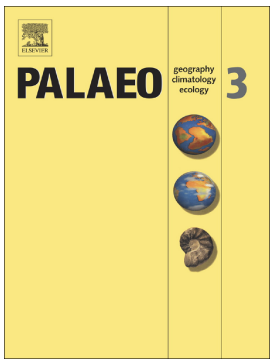

Impacts of the uplift of four mountain ranges on the arid climate and dust cycle of inland Asia

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Impacts of the uplift of four mountain ranges on the arid climate and dust cycle of inland Asia

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Abstract: Although some studies have shown that the uplift of the northern Tibetan Plateau (NTP) has an important influence on the climate of inland Asia, the respective roles played by different parts of the NTP in controlling regional aridification and dust cycling remains unclear. In this study, based on the geological facts that the NTP and its surrounding mountains have uplifted to a certain altitude since the Miocene, we used the dust-coupled regional climate model RegCM4.1 to explore the different impacts of the uplift of four mountain ranges (the Altai Mountains–Mongolian Plateau, the Tian Shan Mountains, the Pamir Mountains, and the Qilian Mountains) on the arid climate and dust cycle of inland Asia. The results showed distinct contributions of these different mountain ranges. With respect to aridity, the uplift of the Pamirs played a leading role in the aridification of inland Asia, causing the annual mean precipitation to decrease by 200 % across a wide area of Northwest China owing to the "rain shadow" effect (a rain shadow is a dry area on the leeward side of a mountainous area). In terms of dust cycling, dust emissons and deposition increased in the Taklimakan Desert mainly due to the uplift of the Tian Shan Mountains and the Pamirs, the increase in magnitude of which was 10–20 times larger than that induced by the uplift of the Altai Mountains–Mongolian Plateau or Qilian Mountains. Besides, a narrow passage formed between the uplifted Altai Mountains–Mongolian Plateau and Tian Shan Mountains that accelerated the northwesterly air flow between them, thus increasing dust emissions in northern Xinjiang and the Gobi Desert. The increase in dust emissions in these two regions induced by the uplift of the Altai Mountains–Mongolian Plateau was 7–20 times greater than that induced by the uplift of the three other mountain ranges. Results also showed that the uplift of the Qilian Mountains not only controlled the dust emissions and deposition on the Loess Plateau, but also blocked the transportation of dust from Northwest China to the middle and lower reaches of the Yangtze River, leading to the dust loading being reduced by 10–20 % in South China. The findings of this study

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