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Role of friction and orography in the Asian-African monsoonal system

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The West African monsoon (WAM) originates in the Gulf of Guinea when the intertropical convergence zone (ITCZ) makes its landfall; whilst, the south Asian monsoon (SAM) originates in the Indian ocean when the ITCZ crosses the equator. The monsoonal dynamics are here studied after landfall using Gill's tropospheric model with an implanted Ekman frictional layer (EFL). Ekman pumping increases low level convergence, making the lower monsoonal cyclone deeper and more compact that the upper anticyclone, by transferring tropospheric vorticity into the EFL. In the upper troposphere, air particles spiral-out anticyclonically away from the monsoons, subsiding over the Tropical Atlantic, the Tropical Indian ocean, or transiting into the southern hemisphere across the equator. Whilst marine air particles spiral-in cyclonically towards the WAM or the SAM, the latter appears to be a preferred ending destination in the absence of orography. The Himalayas introduced as a barrier to the monsoonal winds, strengthen the tropospheric winds by tightening the isobars. The Somali mountains (SMs), introduced as a barrier to the Ekman winds, separates the WAM and the SAM catch basins; thus, the Atlantic air particles converge towards the WAM and the Indian ocean particles converge towards the SAM. The Indian Ghats (IGs), introduced as a semi-impermeable barrier to the Ekman winds, deflect the marine air particles originated in the western Indian ocean towards the south-eastern flank of the SAM. In short, an upper single anticyclone encircles both monsoons; the Himalayas strengthen the upper-level winds by increasing the pressure gradients; the SMs split the EFL cyclone, keeping the marine air particles to the west of SMs in the WAM basin and the particles to the east of SMs in the SAM basin; the IGs guides transmit the air particles, deflecting them towards Bangladesh.