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Interannual variability in the onset of the summer monsoon over the eastern Bay of Bengal

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Climatological characteristics associated with the summer monsoon onset over the eastern Bay of Bengal (BOB) are examined in terms of the westerly-easterly boundary surface (WEB). The vertical tilt of the WEB depends on the horizontal meridional temperature gradient (MTG) near the WEB under the constraint of the thermal wind balance. The switch of the WEB tilt firstly occurs between 90ąãand 100ąãE during the first pentad of May, with the 850-hPa ridgeline splitting over the BOB and heavy rainfall commencing over the eastern BOB, indicating the BOB summer monsoon (BOBSM) onset. The area-averaged MTG (200-500 hPa) is proposed as an index to define the BOBSM onset. A comparison of the onset determined by the MTG, 850-hPa zonal wind, and OLR shows that the MTG index is more effective in characterizing the interannual variability of the BOBSM onset. Strong precursor signals are found prior to an anomalous BOBSM onset. Composite results show that early (late) BOBSM onset follows excessive (deficient) rainfall over the western Pacific and anomalous lower tropospheric cyclonic circulation zonally extending from the northern Indian Ocean into the western Pacific, with the strong (weak) equatorial westerly anomalies in the preceding winter and spring. Prior to an early (late) BOBSM onset, significant positive (negative) thickness anomalies exist around the Tibetan Plateau, accompanied by anomalous upper tropospheric anticyclonic (cyclonic) circulation. The interannual variations of the BOBSM onset are significantly correlated with anomalous sea surface temperature relevant to ENSO through changing the walker circulation and local Hadley circulation, leading to the middle and upper tropospheric temperature anomalies over the Asian sector. The strong precursor signals around the Tibetan Plateau

may be partly caused by local snow cover anomalies, and an early (late) BOBSM onset is preceded by less (more) snow accumulation over the Tibetan Plateau during the preceding winter.