Diurnal Cycle of Coastal Convection in South China Sea and Modulation by Intraseasonal Oscillation Observed by TRMM and GPM

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One intriguing feature of the Asian Summer Monsoon (ASM) is that when monsoon winds impinge upon
the coastal mountains, the precipitation preferentially falls off shore, rather than directly over the
mountains where orographic enhancement is the strongest. Several mechanisms have been proposed in
the literature closely tied to the diurnal cycle, pinpointing diurnal cycle’s potential role in regulating the
offshore rainfall maxima. Also, interactions between the large-scale circulation and the diurnal cycle are
thought to influence the development and propagation of the boreal summer intraseasonal oscillation
(BSISO), a dominant intraseasonal mode within the ASM. Motivated by these outstanding problems, this
study has investigated the diurnal cycles of coastal precipitation and clouds in the South China Sea (SCS)
region and their modulations by the BSISO. As such, over 20 years of three-dimensional radar
observations from TRMM and GPM are used, as well as scatterometer-based surface winds (CCMP
product). Our results show that offshore rainfall over the Philippines maximize during the active phases of
BSISO, whereas offshore rain maximum over Borneo occurs during inactive BSISO periods. Offshore
precipitation in the SCS region usually peaks in early morning. However, over Luzon and central
Philippines, it rains off shore round the clock during active BSISO periods, possibly caused by local
convergence due to substantial weakening of large-scale westerlies/southwesterlies when impinging on
coasts. Analyses further show that off-shore rainfall are largely contributed by large systems with high
fraction of stratiform rain, originated from off-shore propagating MCSs. On the other hand, diurnal cycle
over land/island is still strong (peaking at afternoon) during active BSISO periods, although precipitation
gets much extended by long-living large MCSs. It looks like surface heating and flux over land still strong
enough to trigger intense afternoon convection, provided the enhanced cloud shading during active
BSISO phases. During the nighttime, onshore (or downstream) propagating convection may not survive
because of precipitation cold pool, mesoscale descending in the wake of afternoon intense convection,
and radiative cooling over land, leading nocturnal heavy rain to mainly fall off shore. Lastly, vertical radar
cross sections perpendicular to the coast show salient features of precipitation vertical structures for
propagating and non-propagating convection, and their diurnal variations.

Keywords: Precipitation Radar, Global Precipitation Mission, Coastal Convection, Diurnal Cycle