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Influence of Land–Sea Breeze Circulation and Ocean–Atmosphere Interactions on Surface Thermal Variations in Coastal Karnataka

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ABSTRACT

Coastal Karnataka experiences significant surface thermal variations due to the combined influence of land–sea breeze circulation and ocean–atmosphere interactions. The region, which includes Dakshina Kannada, Udupi, and Uttara Kannada districts, is characterized by a tropical climate, high humidity, and seasonal monsoon rainfall. Land–sea breezes develop because land and sea surfaces heat and cool at different rates. During the daytime, land generally heats faster than the Arabian Sea, creating a pressure gradient that drives cooler marine air towards the coast. This sea breeze moderates daytime surface temperatures and influences local humidity, cloud formation, and atmospheric stability. During nighttime, land cools more rapidly than the sea, potentially producing a land breeze directed towards the ocean. These circulation patterns interact with regional wind systems and seasonal monsoon conditions, influencing the spatial and temporal distribution of surface temperatures. Ocean–atmosphere interactions also play an important role through sea surface temperature, evaporation, sensible and latent heat exchange, and moisture transport. During the southwest monsoon, strong winds, extensive cloud cover, and heavy rainfall modify surface heating and reduce incoming solar radiation. In contrast, pre-monsoon conditions may produce stronger daytime heating and greater thermal contrasts between land and sea. Understanding these physical mechanisms is essential for interpreting coastal temperature patterns, assessing local climate variability, and improving weather forecasting and climate adaptation strategies in Coastal Karnataka.