



Development of distinct foredune morphologies along a prograding macrotidal shoreline, Northern France

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Along the French coast of the Dover Strait, east of Calais harbor, macrotidal beaches are characterized by abundant sediment supply from the shoreface related to the onshore welding of a nearshore sand bank. Continuing beach accretion resulted in rapid seaward development of incipient foredunes. In this paper, we examine the development of two different types of incipient foredunes that developed along this rapidly prograding shoreline based on the analysis of a series of aerial photographs as well as recent LiDAR and topographic data. To the west, a hummocky foredune field facing the dominant winds developed, inducing a shoreline progradation at a rate of 5 m a⁻¹. The morphology of individual mounds, colonized by a sparse vegetation cover, tended to remain remarkably stable through time. In this area of high sediment supply, the formation of a hummocky dunefield is probably due to the fact that the incipient foredune do not have enough time to coalesce and to merge into a continuous foredune ridge as they rapidly become disconnected from their main sediment source. To the east, large nebkhas, up to 4 m high and 14 m wide, developed on the very upper beach, close to the highest astronomical tide limit, forming hemispheric to oval-shaped mounds only reached by spring tides and/or storm surges. These scattered nebkhas do not form an incipient foredune zone, but mounds that grew vertically and remained in the form of isolated huge nebkhas disconnected from the incipient foredune by a swale. The formation of these two unusual types of incipient foredunes over a short stretch of coastline is thought to be related to high sediment supply and to a change in coastal orientation resulting in different exposure to dominant winds.