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Surface energy exchanges over contrasting vegetation types on a subtropical sand island

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The surface energy balance of subtropical coastal vegetation communities has thus far received little attention. Here we present a multi-year observational data set using the eddy covariance method to quantify for the first time the surface energy balance over three contrasting vegetation types on a subtropical sand island in eastern Australia: a periodically inundated sedge swamp, an exotic pine plantation and a coastal heath. Maximum daily sensible heat flux varied between sites but was typically > 280 Wm^{-2} in the coastal heath and pine plantation but no more than 250 Wm^{-2} in the swamp when dry and < 110 Wm^{-2} when inundated. Maximum daily latent heat flux was up to 300 Wm^{-2} in the coastal heath and pine, but in the swamp it was up to 250 Wm^{-2} when dry and 209 Wm^{-2} when inundated. On seasonal timescales, the coastal heath and swamp were both found to be dominated by latent heat flux, with Bowen ratio (β) < 1, whereas the pine plantation typically exhibited $\beta > 1$. The partitioning of energy, as represented by β, is similar to a variety of Australian ecosystems, and a range of coastal vegetation types in other latitudes, but differs from other tropical or subtropical locations which have strongly seasonal rainfall patterns and therefore a switch from $\beta > 1$ before rainfall to $\beta < 1$ afterwards.

The energy fluxes over the three vegetation types responded to seasonal changes in background meteorology with the most important influences being net radiation, absolute humidity, and rainfall. The main factor differentiating the sites was soil water content, with the remnant coastal heath and swamp having ready access to water but the exotic pine plantation having much drier soils. Should the current balance between remnant vegetation and the pine plantation undergo changes there would be a corresponding shift in the surface energy balance of the island as a whole, and altered plant water use may lead to reduced water table depth, important because the groundwater of the local islands is used as part of a regional water grid. A better understanding of the response of coastal vegetation to atmospheric forcing will enable more informed decision making on land use changes, as coastal regions the world over face development pressure.