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Potential impact of the coloured Amazon and Orinoco plume on tropical cyclone intensity

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The Amazon and the Orinoco river plumes modulate ocean stratification and colour in the tropical North Atlantic. This changes air-sea interactions and may thus be important for tropical cyclones. Using a regional ocean model, the potential impact of the rivers on ocean temperatures, stability, and tropical cyclone intensity is investigated.

The influence of riverine freshwater on the ocean is twofold: Firstly the freshwater plume stabilizes the water column, and secondly ocean colour in the plume modifies solar transmission. Within the Amazon and Orinoco plume the two mechanisms have opposing and effective cancelling effects on tropical cyclones. On the one hand the freshwater plume thickens the barrier layer, leading to increased stability and temperature inversions. This increases cooling inhibition and thus potentially reduces surface cooling feedbacks on passing storms. Ocean colour in the freshwater plume on the other hand, blocks the deeper ocean from sunlight, leading to moderate surface warming and substantial subsurface cooling. As a consequence cold water is more readily available to passing storms and cooling inhibition decreases, hence amplifying negative surface cooling feedbacks. Due to the near-cancellation of the two effects, the net impact of the coloured plume on surface cooling is negligible. Simple, idealized relationships between expected surface cooling and tropical cyclone intensity suggest that the river-induced barrier layer enhances strong tropical cyclones by up to -5 to -12hPa, while ocean colour may reduce intensity of strong storms by +8 hPa to +16 hPa. The net impact of the coloured plume is negligible for weak storms and a slight intensity reduction for stronger cyclones. Within the Amazon and Orinoco plume, the river freshwater effect may thus be substantially reduced or even offset by light absorbing particles.