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FORECASTING THE RESTORATION OF A FREE-FLOWING EVERGLADES BASED ON LARGE-SCALE HIGH-FLOW EXPERIMENTS AND ECO-HYDRAULIC MODELING

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The Everglades “river of grass” is an expansive sub-tropical peatland in south Florida that supplies fresh drinking water for 7 million people, hosts a National Park, and is a Ramsar wetland of international distinction. The Everglades is the focus of a 20 billion dollar, congressionally authorized restoration to protect water and ecological resources. A century ago, the low-gradient floodplain had well-connected deep-water sloughs interspersed between slightly higher elevation and more densely vegetated ridges. The deeper and less densely vegetated and less shaded sloughs promoted higher aquatic productivity, water storage during droughts, and pathways for animal dispersal and abundant feeding and nursery habitats that supported iconic wildlife such as super colonies of wading birds. During the past century, flow has been halved and levees constructed to retain water, and deep-water sloughs have been substantially reduced or have disappeared altogether in some areas. Levee removal and rerouting of canal flows through the wetlands is beginning, but the amount of flow needed is still debated, in part because the ecological outcomes are difficult to forecast. To resolve how increased flow can restore deep-water sloughs, we combined a large-scale experimental approach with eco-hydraulic modeling. Multiple high-flow releases lasting days to months through an area that previously was isolated from flow by levees has provided indicators of fast-responding ecological benefits. Water flow velocity increased from 0.3 to approximately 6 cm/s, entraining sediment in sloughs and depositing it on ridges, in agreement with a hypothesis for self-sustaining sloughs and ridges that previously could only be tested by modeling. Furthermore, the field experiments revealed unexpected dynamics, particularly the elimination of water-column stratification at higher flows which increased organic sediment decomposition and decreased the potential for peat accretion in sloughs. Ongoing work is aimed at understanding the limits of slough restoration and whether it can exceed threshold of 40% aerial slough coverage that modeling indicates is needed for a well-functioning and self-sustaining Everglades landscape.