

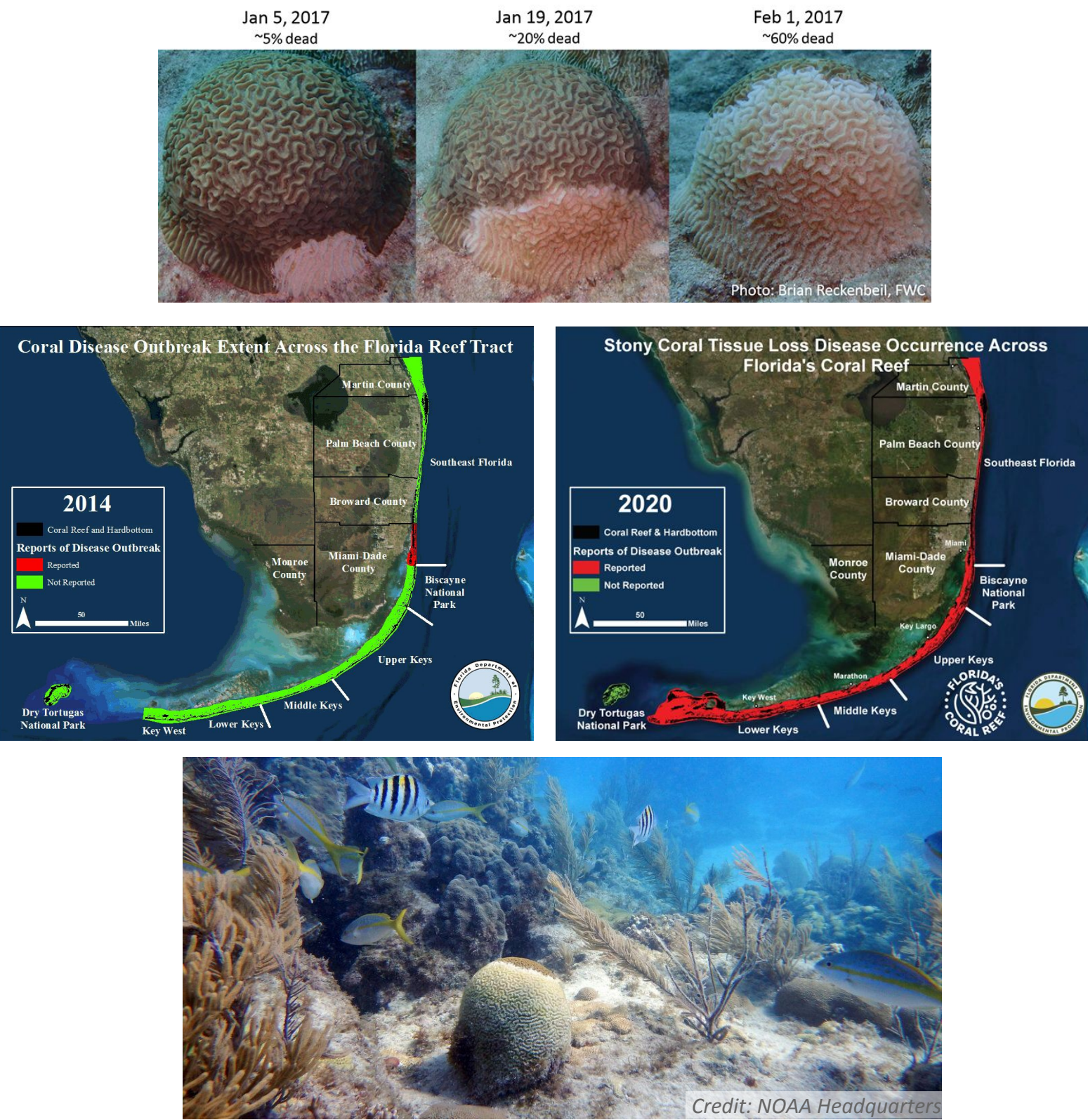
A high-resolution connectivity-based model for the spread of Stony Coral Tissue Loss Disease in the Florida Reef Tract

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Florida's corals are facing a multi-year outbreak

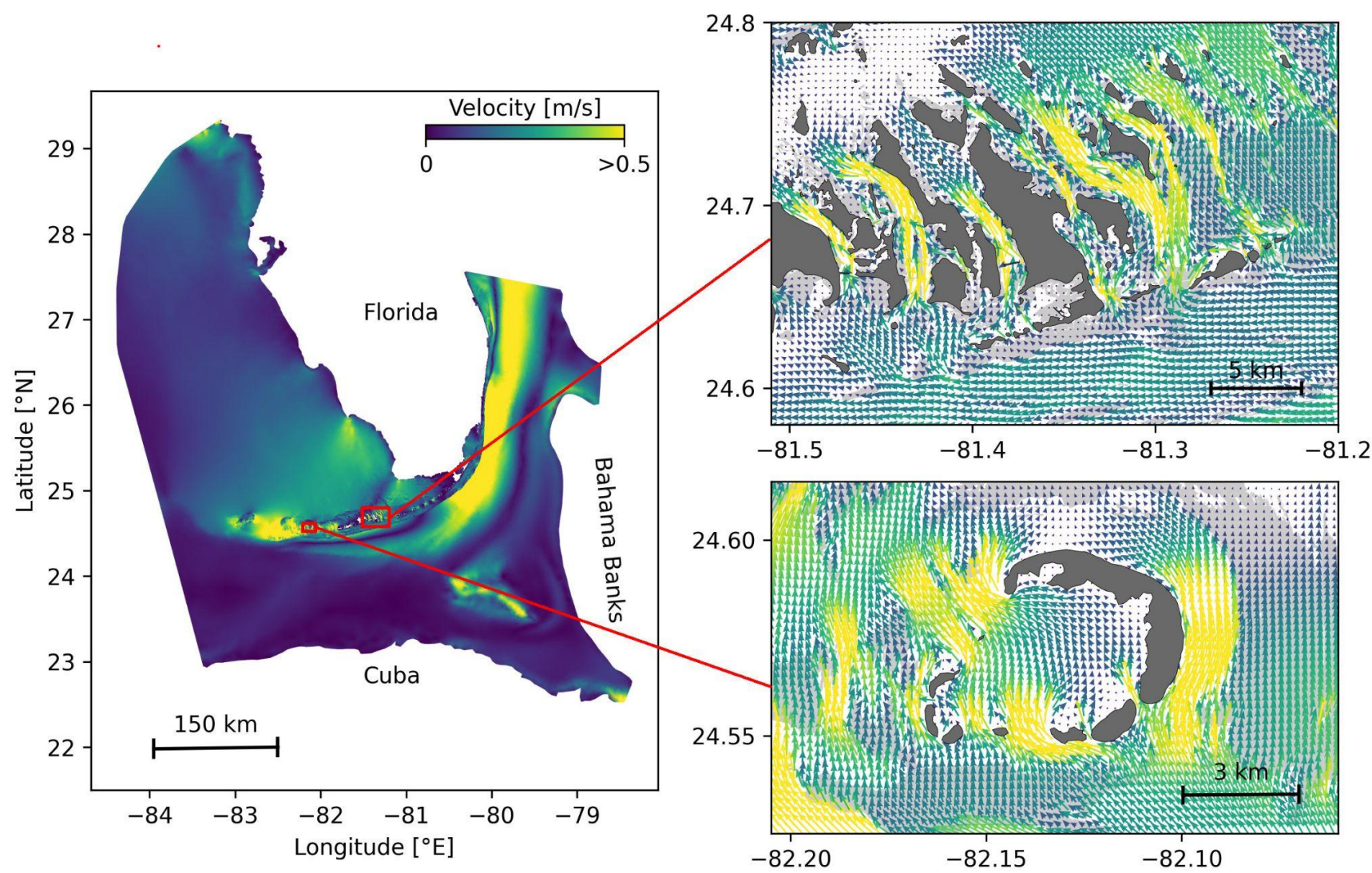
The Stony Coral Tissue Loss Disease (SCTLD) resulted in massive die-offs in approximately **21 coral species**, making it the largest coral disease outbreak on record. First observed near Virginia Key in late **2014**, the disease has since spread throughout the **entire Florida Reef Tract (FRT)** with the exception of the Dry Tortugas and is continuing to spread throughout the Caribbean. However, the **causative agent** for this outbreak remains **unknown**.



A reef-scale connectivity-base model can provide insights on the disease agent

To deduce the probable **propagation mechanism** of the disease throughout the FRT, we developed an experimentally calibrated **epidemo-hydrodynamic model** :

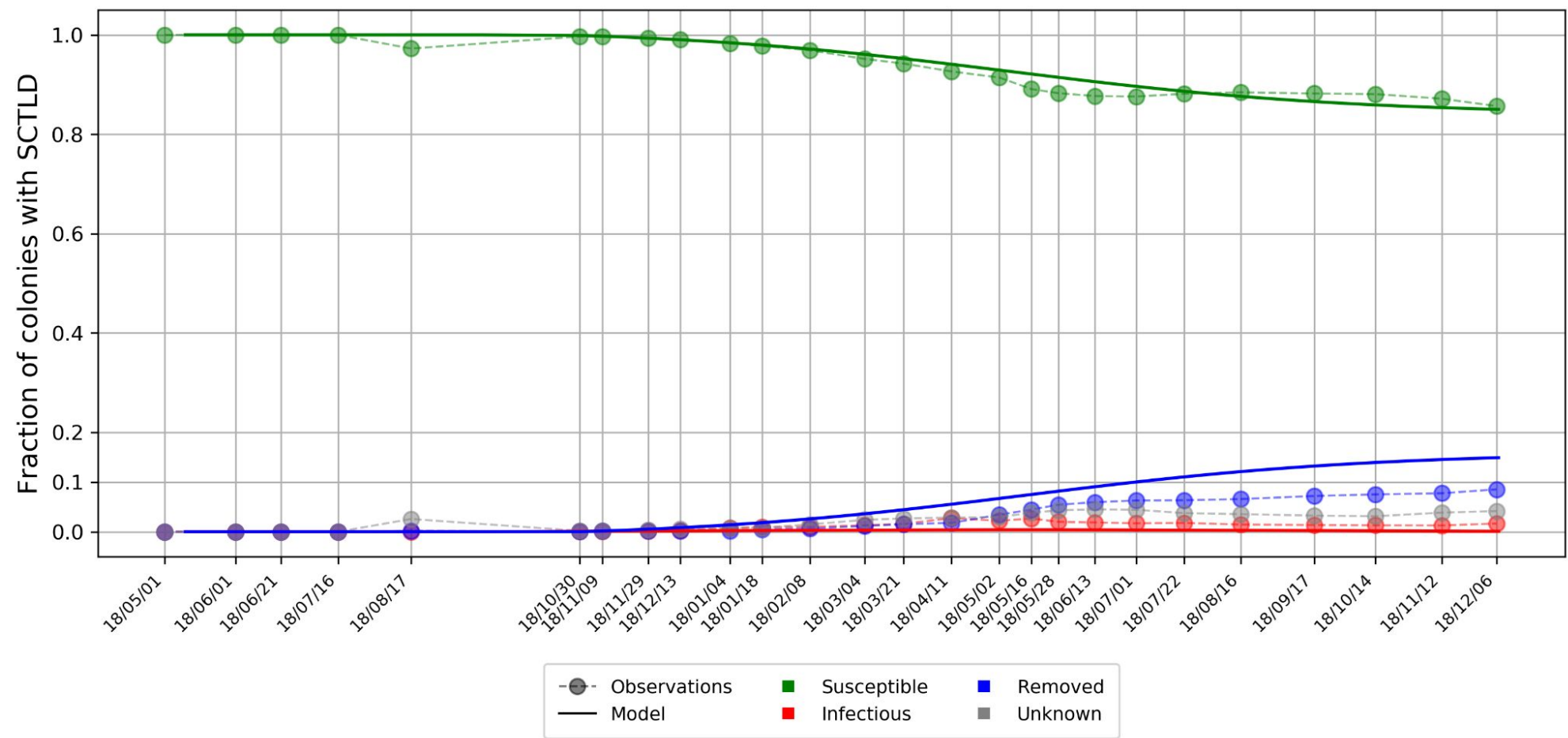
1. We built the **networks** of the potential **exchanges of disease agents between reefs** based on (i) bottom currents, (ii) mean depth-averaged currents and (iii) surface currents modeled by the high-resolution hydrodynamic model SLIM



2. These networks were then used to model the spread of the disease using a modified patch **Susceptible-Infectious-Removed (SIR)** model.
3. We finally compared the modeled spread of the disease with observations to identify the currents and sets of model parameters that best **reproduce the observed spread of the disease**.

Our model suggests that the disease causative agent is neutrally buoyant and weakly infectious

Field observations are accurately reproduced with a transmission rate of $\beta'_n = 1/6.45 \text{ days}^{-1}$ and a mortality rate $\sigma = 1/6.99 \text{ days}^{-1}$. This gives a **basic reproduction number** R_0 **slightly larger than 1** (1.0835).



Depth-averaged currents best reproduce the observed spread of the disease among reefs (92 m/day), suggesting that the causative agent is likely to be **transported within neutrally buoyant material** in the water column. Moreover, this propagation only occurs for a well-defined range of the “infection threshold”, suggesting that corals have **low resistance to the disease**.

