Abstract Submitted
for the DFD14 Meeting of
The American Physical Society

Mixing it up: Corals take an active role in mass transport VICENTE FERNANDEZ, Massachusetts Insitute of Technology, ORR SHAPIRO, Weizmann Institute of Science, DOUGLAS BRUMLEY, MELISSA GARREN, Massachusetts Insitute of Technology, JEFFREY GUASTO, Tufts University, ESTI KRAMARSKI-WINTER, ASSAF VARDI, Weizmann Institute of Science, ROMAN STOCKER, Massachusetts Insitute of Technology — The growth and health of reef-building corals are limited by corals' ability to exchange nutrients and oxygen with the surrounding, sometimes quiescent, seawater. Mass transport in coral systems has long been considered to occur passively as a result of molecular diffusion and the ambient fluid flow over the coral. Through a combination of microscale visualization experiments and numerical modeling, we demonstrate instead that motile cilia densely covering the coral surface – previously thought to serve cleaning and feeding purposes– actively stir the coral boundary layer by generating persistent vortices above the coral surface. This active mixing was observed over a variety of corals with differing surface geometries. We have quantified the contribution of ciliary surface vortices to mass transport, finding oxygen flux enhancements of 2 to 3 orders of magnitude under environmentally relevant ambient flow conditions. These results reveal a new, active role of the coral animal in regulating its mass transport by engineering its local hydrodynamic environment, an ability that may have an important role in the evolutionary success of reef corals.

Vicente Fernandez
Massachusetts Insitute of Technology

Date submitted: 02 Aug 2014 Electronic form version 1.4