SUPPLEMENTARY INFORMATION

Microscale light management and inherent optical properties of intact corals studied with optical coherence tomography

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Supplementary text

Monte Carlo simulations. Monte Carlo simulations are stochastic models that are used in medical tissue optics to simulate photon propagation and score physical quantities (diffuse reflectance, absorbance, transmittance) based on a set of optical properties. We developed a 2-layer Monte Carlo Simulation based on the well-known MCML program [1]. The top layer represents a homogenous tissue layer with a maximal thickness of 200 µm for *Stylophora pistillata [2]*. In reality, the tissue layer consists of several layers (including epidermal and gastrodermal layers), yet for the purpose of this example a simplified tissue geometry is assumed. The bottom layer represents the coral skeleton and was modelled as a semi-infinite medium (1.1 cm in thickness) with low light absorption (μ_a=0.01 cm^{-1})) [3] and the OCT based estimated scattering properties (Table1). To show the effect of the scattering coefficient and the anisotropy of scattering, we used the same source geometry and absorption coefficient for the *Hydnophora pilosa* model as in the *Stylophora pistillata* model. The model illustrates that coral-specific differences in the scattering properties (μ_s, g) can have a fundamental effect on the lateral spread of light and the overall efficiency by which incident light is absorbed by the living coral tissue (Fig. S2).

Supplementary figures

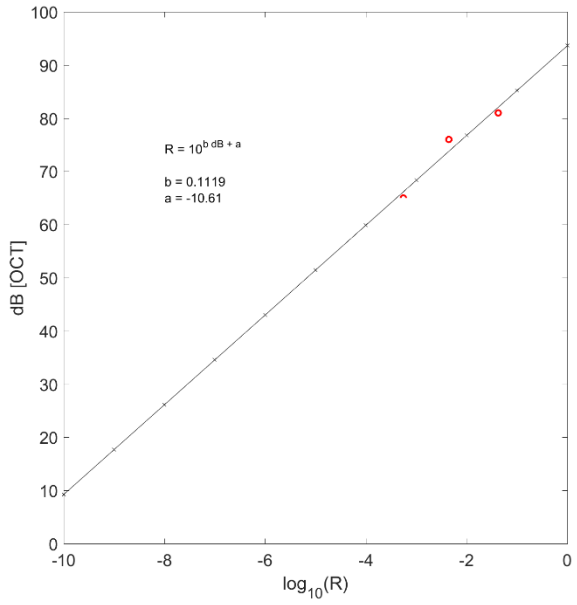

Fig. S1. Example of linear calibration from OCT (dB) data to reflectivity ($\log_{10}R$). Three known refractive index mismatches were measured (1) oil-glass interface, (2) water-glass interface, and (3) air-glass interface (red symbols).

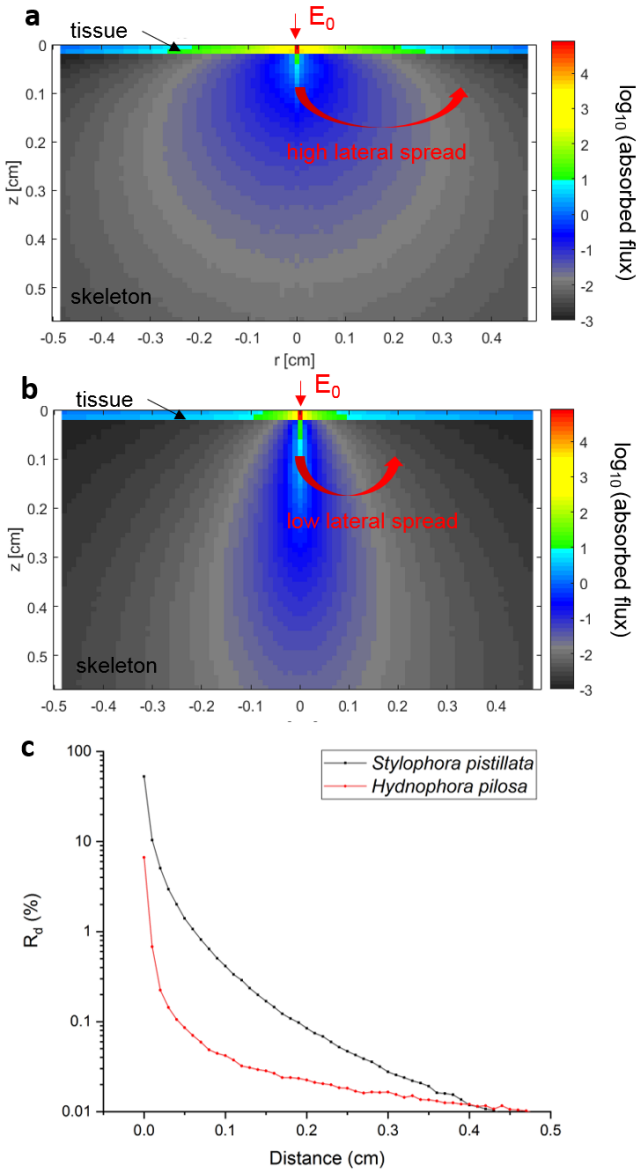

Fig. S2. Exemplary application of Monte Carlo simulation on extracted *in vivo* optical properties of corals. The absorbed flux is shown for *Stylophora pistillata* **(a)** and *Hydnophora pilosa* **(b)**. For both models the absorption coefficient and source geometry is identical. The lateral escape of light is shown (diffuse reflectance %) as a function of distance from the light source **(c)**.

Supplementary References:

[1] Wang, L., Jacques, S.L. & Zheng, L. 1995 MCML—Monte Carlo modeling of light transport in multi-layered tissues. *Computer Methods and Programs in Biomedicine* **47**, 131-146.

[2] Wangpraseurt, Larkum, A.W.D., Ralph, P.J. & Kühl, M. 2012 Light gradients and optical microniches in coral tissues. *Front Microbiol* **3**. (doi:10.3389/fmicb.2012.00316).

[3] Marcelino, L.A., Westneat, M.W., Stoyneva, V., Henss, J., Rogers, J.D., Radosevich, A., Turzhitsky, V., Siple, M., Fang, A. & Swain, T.D. 2013 Modulation of Light-Enhancement to Symbiotic Algae by Light-Scattering in Corals and Evolutionary Trends in Bleaching. *PLoS ONE* **8**, e61492.