3D Coral Reef Maps

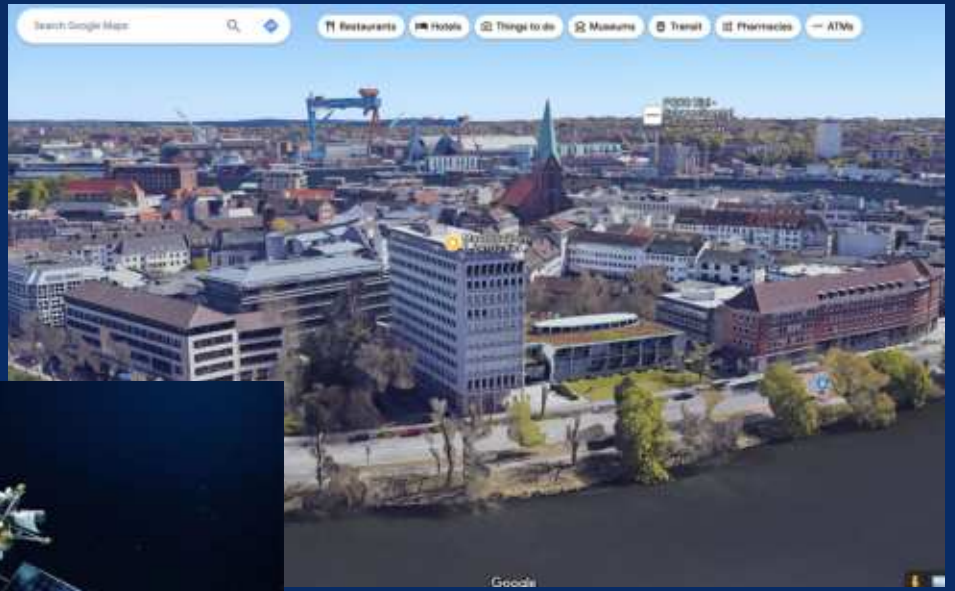
2 Oct 2025
ICRI #ForCoral

Sergei Nozdrenkov
wildflow

Data: UCL, LEC-REEFS, IPB...

Google Geo

Accuracy of spatial alignment of satellite imagery



2016

Google [X]

2020

Freediving

Bad swimmer
→ sink quite well
→ leveraging my strength 💪

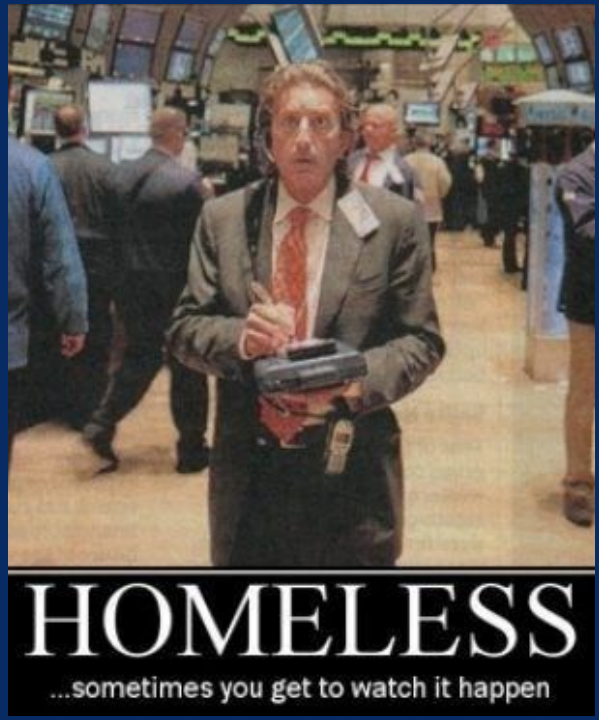
apnea.uk

Iceland 2019

Kenya 2018

Egypt 2023

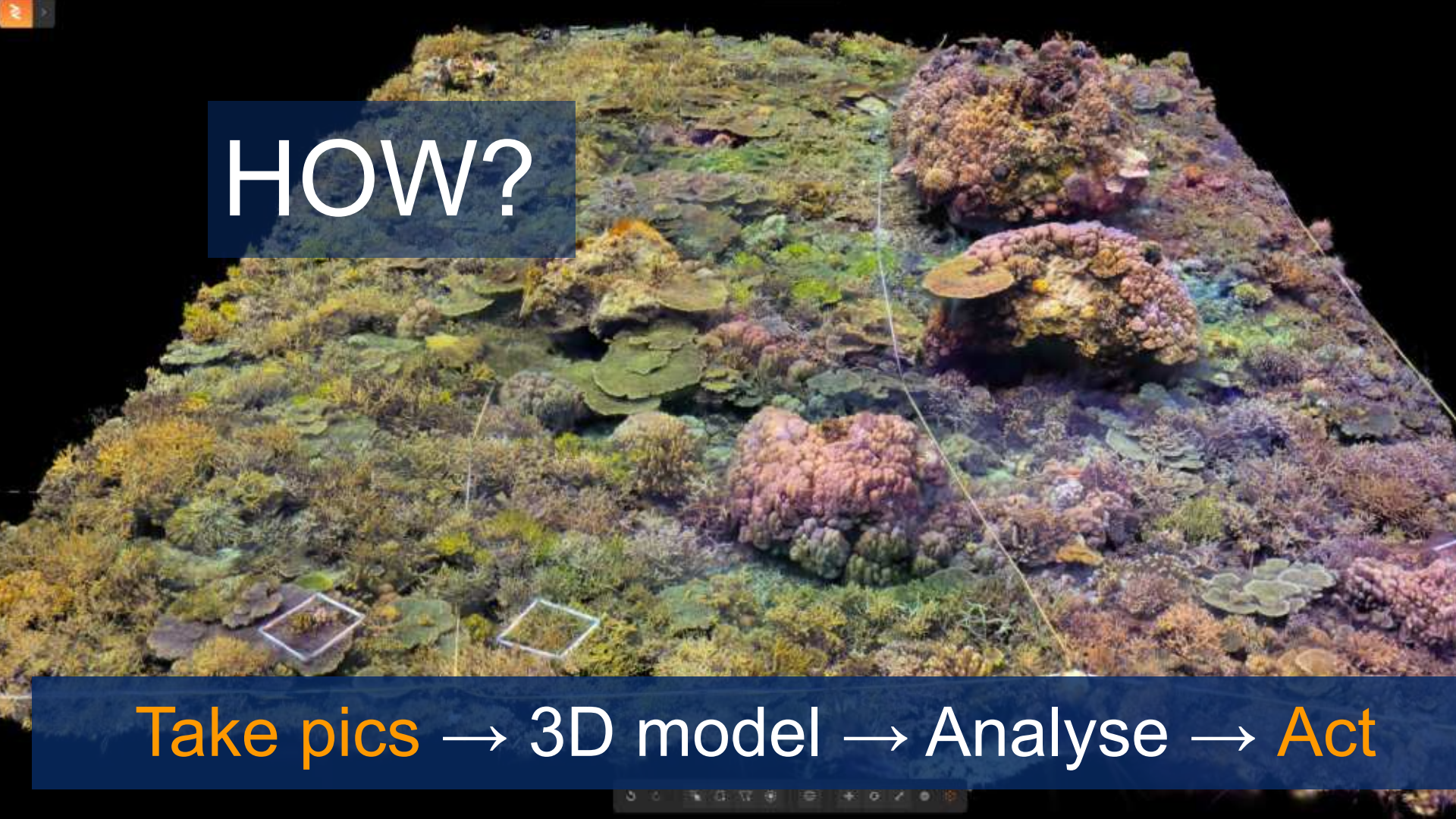
Leave Google X → start Wildflow



Google 2023 wildflow

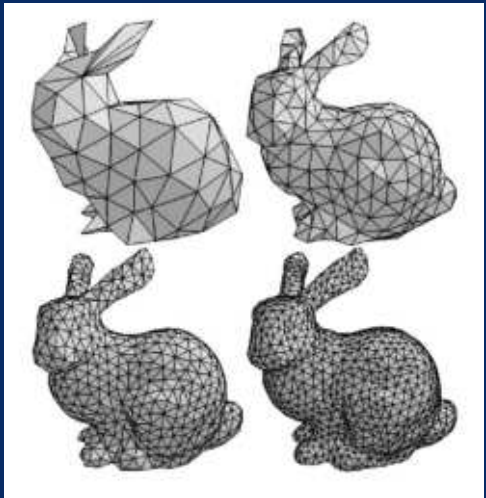

wildflow
WHY?
Data: UCL, LEC-REEFS, IPB...


Restoring corals is really hard!
“If you’re outplanting corals by hand,
you don’t care about fancy tech,
you just want to know if
what you’re doing is working!”
Data: UCL, LEC-REEFS, IPB...


HOW?
Take pics → 3D model → Analyse → Act

How to visualise 3D models?

- Polygonal Mesh: Google Earth, Cesium, Sketchfab



How to visualise 3D models?

- 3D Gaussian Splatting

HOPE reef

by MARS

wildflow.ai/protocol

Photogrammetry

Protocol G503

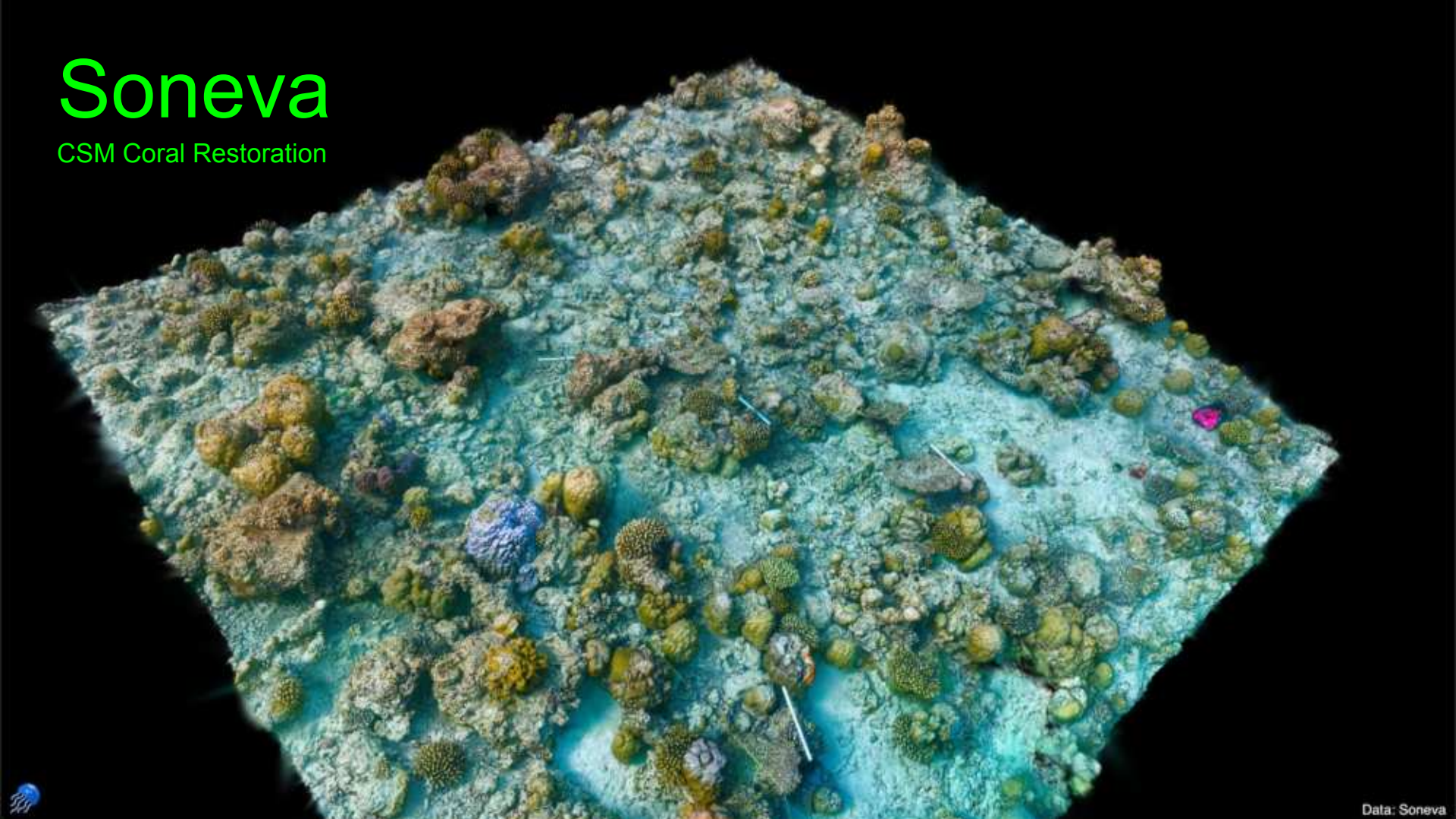
Capture a 3D model of a coral reef with two GoPros

This page: **wildflow.ai/protocol**

CONFLICT ISLANDS CONSERVATION INITIATIVE

Soneva

CSM Coral Restoration

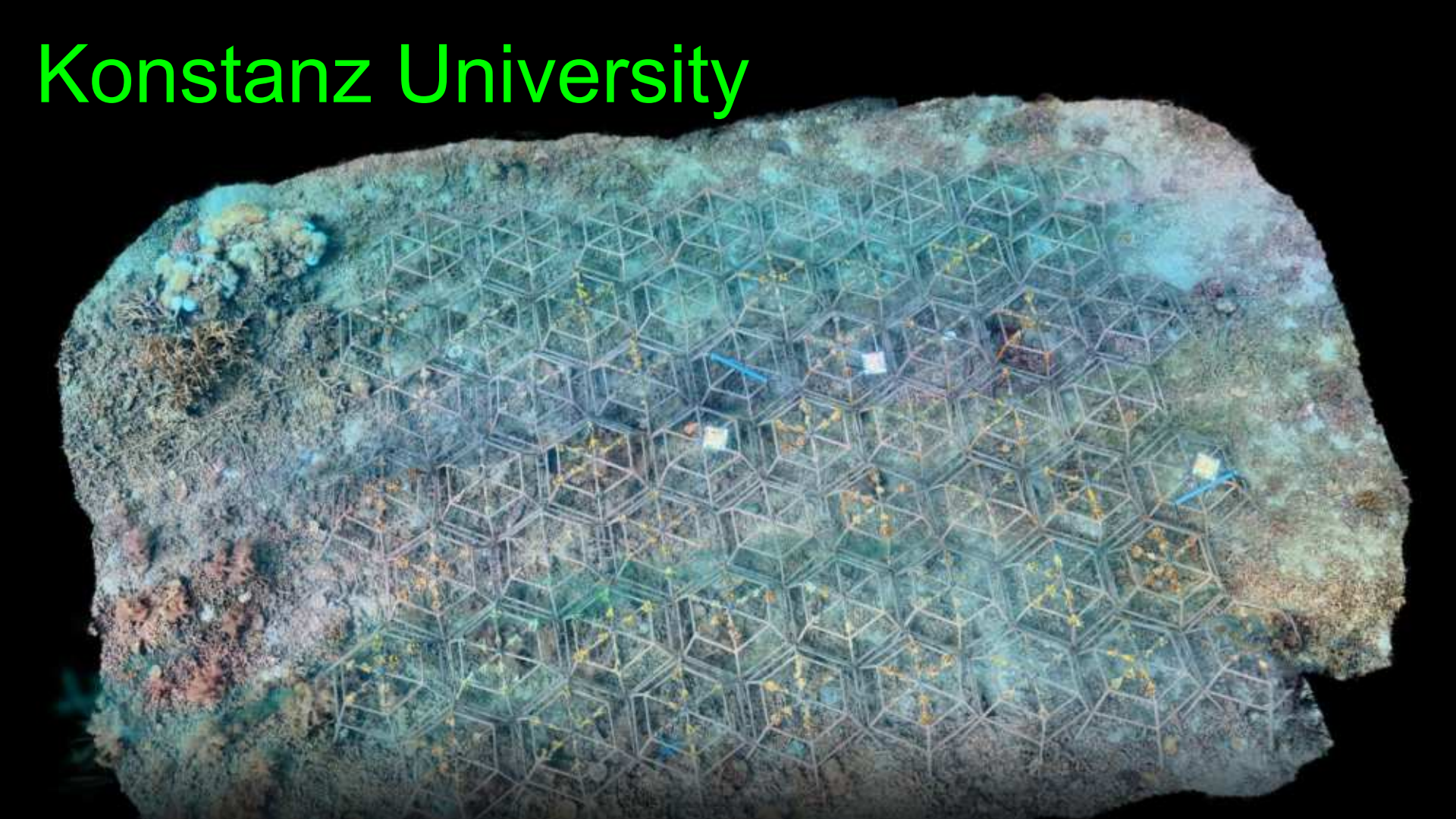


Data: Soneva

Konstanz University

Low-viz
not a problem!

Konstanz University



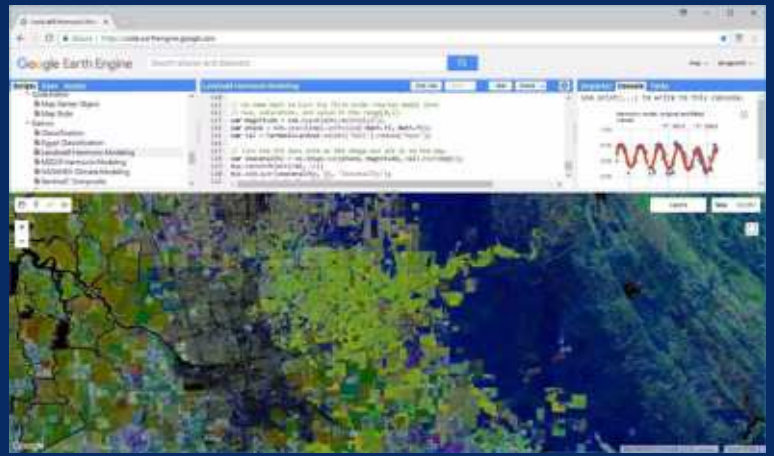

HOPE reef
Data: UCL, LEC-REEFS, IPB...

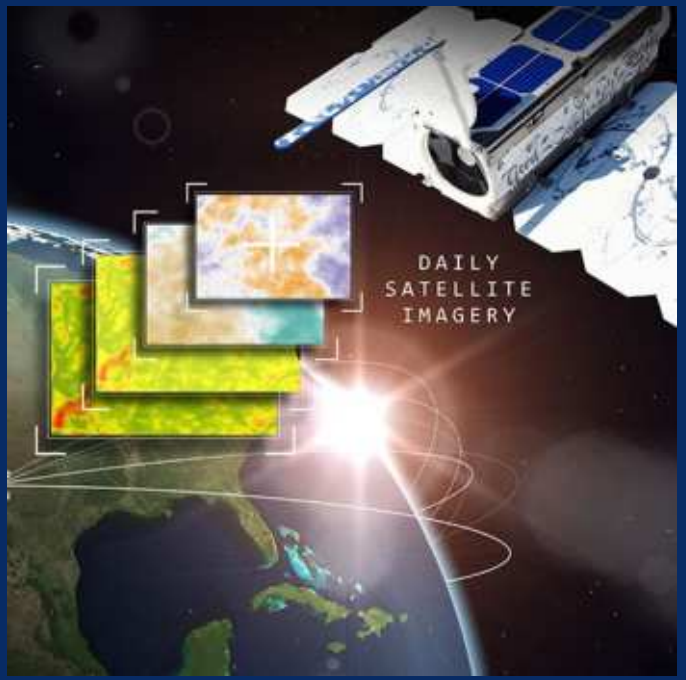
Orthos

HOPE reef

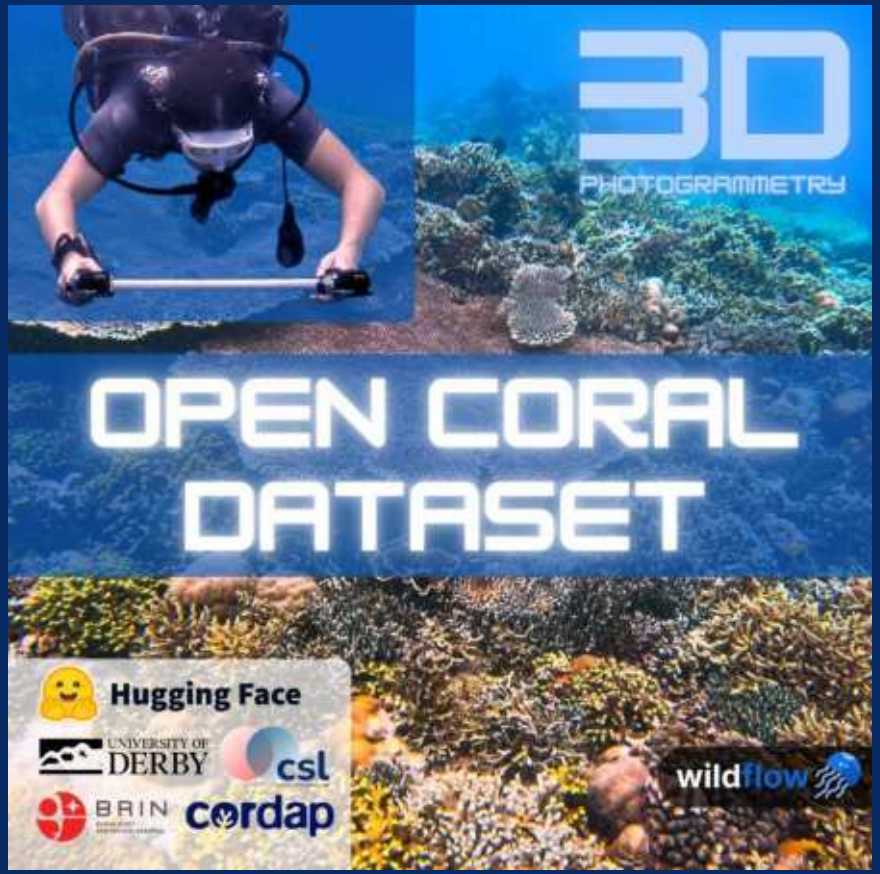
Learn from satellite data

- People process satellite data in the cloud
- 3D heavier per 1sq metre
- Yet everyone doing 3D locally





https://huggingface.co/datasets/wildflow/sweet-corals

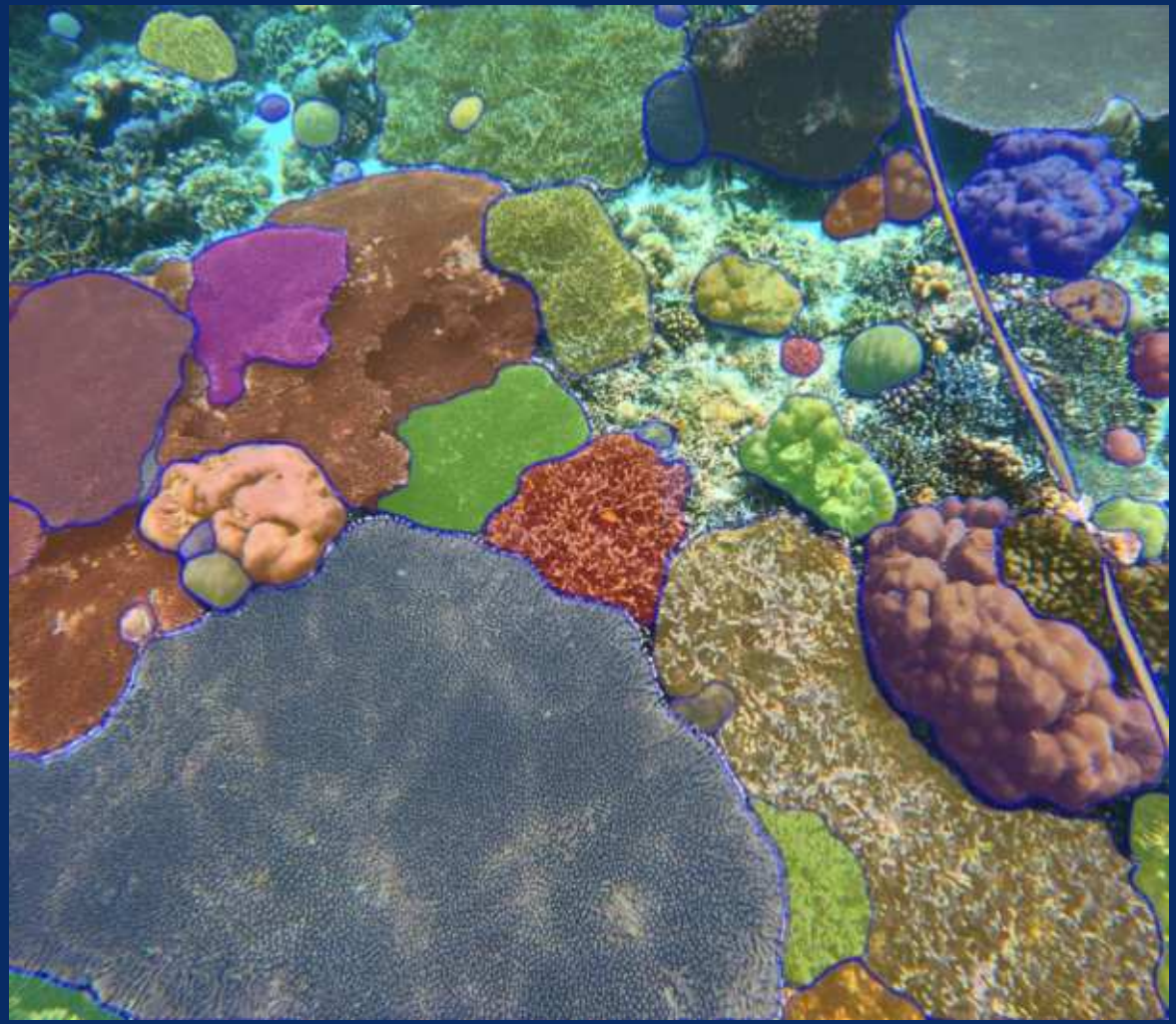


What 3D for corals enables?

- Looks awesome! Haha
- structural complexity: rugosity, fractal dimension, vertical relief
- outplant survival & growth: track success
- benthic cover: % sand, rubble, live coral
- species ID: down to genus and growth form
- community composition: % of each species
- early warnings: spot disease, bleaching, algae, sponges, COTS

Training our own models

Integrating with others



What 3D for corals enables?

- Virtual fieldwork
- Map before/during/after bleaching event
- If a teammate left, all that knowledge lost…

Coral interventions

Intervention type	Controllability		State factors impacted	Examples
	Reef	Ark		
Herbivore stocking (i.e., parrotfish, *Diadema*)	Low	High	calcification aesthetic score VMR chem diversity	(Bellwood et al. 2004; Hughes et al. 2007; Macia et al. 2007; Abelson et al. 2016; Obolski et al. 2016; Neilson et al. 2018; Shantz et al. 2020; Cortés-Useche et al. 2021; Manuel et al. 2021)
Sexual propagation (assisted larval fertilization & recruitment)	High	High	calcification aesthetic score	(Nakamura et al. 2011; Chamberland et al. 2017; Cruz and Harrison 2017; Randall et al. 2020; Sellares-Blasco et al. 2021; Banaszak et al. 2023)
Assisted adaptation & evolution	Low	Medium	calcification aesthetic score biodiversity	(van Oppen et al. 2015; Levin et al. 2017; Chan et al. 2018; Baums et al. 2019; Humanes et al. 2021; Quigley et al. 2021; Voolstra et al. 2021)
Managed relocation & assisted gene flow	Low	High	aesthetic score biodiversity	(Hoegh-Guldberg et al. 2008; Aitken and Whitlock 2013; van Oppen et al. 2017)
Asexual propagation (coral gardening, direct transplantation, & microfragmentation)	Medium	High	calcification fish biomass aesthetic score biodiversity	(Rinkevich 2005, 2019, 2021; Lirman et al. 2010; Horoszowski-Fridman et al. 2015; Lirman and Schopmeyer 2016; Page et al. 2018; Knapp et al. 2022)
Trophic control (predator addition or removal)	Medium	High	fish biomass biodiversity	(Rivera-Posada et al. 2013; Williams et al. 2014; Ladd et al. 2016; Delgado and Sharp 2020; Fletcher et al. 2020; Plagányi et al. 2020; Kroon et al. 2021)
Microbiome engineering/transfer	Low	High	calcification VMR biodiversity	(Peixoto et al. 2017; Epstein et al. 2019; Rosado et al. 2019; Santoro et al. 2021; Voolstra et al. 2021)
Fish biomass enhancement (fisheries management)	Low	Medium	fish biomass aesthetic score biodiversity	(Bellwood et al. 2004; Pikitch et al. 2004; Cox et al. 2013; Mcclanahan et al. 2015; Bozec et al. 2016; Mualili et al. 2019)
Cryptobenthic translocation (water filtering, nutrient remineralization, zooplankton)	Low	High	calcification fish biomass biodiversity VMR chem. diversity	(Shafir et al. 2006; Cabaitan et al. 2008; Enochs 2012; Biggs 2013; Champion et al. 2015; Wee et al. 2019; Ladd and Shantz 2020)
Larval recruitment using acoustic enrichment (sound) and light (light traps)	Medium	High	calcification fish biomass biodiversity	(Simpson et al. 2004; Vermeij et al. 2010; Alldredge et al. 2013; Lillis et al. 2015; Gordon et al. 2019; McAfee et al. 2023)
Reoxygenation of hypoxic zones (mechanical mixing, pumping, bubbling)	Low	Medium	calcification VMR biodiversity	(Stigebrandt and Gustafsson 2007; Conley et al. 2009; Visser et al. 2016; Liu et al. 2020)
Artificial upwelling (temperature mitigation)	Low	High	calcification biodiversity	(Pan et al. 2016; Feng et al. 2020; Sawall et al. 2020; Zhang et al. 2022)
Organic matter mitigation (reduce pollution & sedimentation)	Medium - High	High	calcification chem. Diversity biodiversity VMR	(Diaz and Rosenberg 2008; Kemp et al. 2009; Jiao et al. 2011; DeMartini et al. 2013; Shelton III and Richmond 2016; Suárez-Castro et al. 2021)
Alkalinity enhancement	Low	High	calcification aesthetic score	(Albright et al. 2016; Feng et al. 2016; Renforth and Henderson 2017; Mongin et al. 2021; Zhang et al. 2022)
Flow enhancement	Low	Medium	calcification fish biomass aesthetic score	(Comeau et al. 2014; Baer et al. 2023)
Artificial reefs	Medium	High	fish biomass aesthetic score biodiversity	(Shafir et al. 2006; Amar and Rinkevich 2007; Reguero et al. 2018; Brathwaite et al. 2022; Higgins et al. 2022)
Fish aggregating devices (FADs)	Medium	High	fish biomass biodiversity	(Buckley et al. 1989; Bell et al. 2013, 2015; Albert et al. 2014)
Engineering of new materials, geometries, & 3D printing	Low	High	calcification fish biomass biodiversity aesthetic score chem. diversity	(Chamberland et al. 2017; Levenstein et al. 2021; Leonard et al. 2022; Levy et al. 2022; Berman et al. 2023)
Substrate stabilization & manipulation	Low	High	calcification fish biomass biodiversity aesthetic score	(Fox et al. 2005, 2019; Williams et al. 2019; Yanovski and Abelson 2019; Ceccarelli et al. 2020; Jayanthi et al. 2020)
Substrate enhancement (electrolysis)	Low	High	calcification fish biomass biodiversity aesthetic score	(Goreau and Prong 2017; Hein et al. 2020)

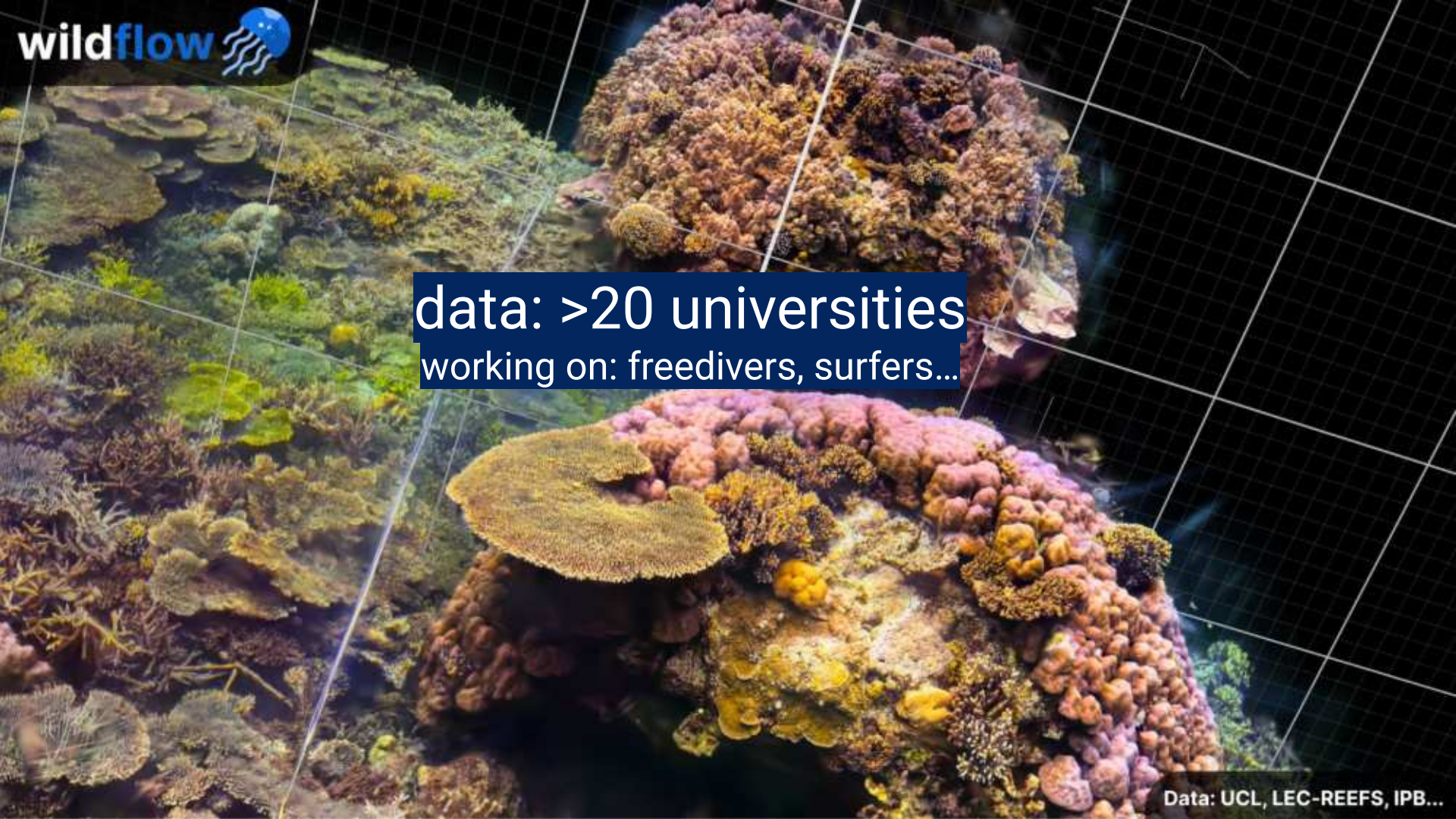
from Prof Forest Rohwer, Dr Jason Baer

3D molecular cartography

National Geographic Pristine Seas

What 3D for corals enables?

- What works? What doesn’t work?
- Quality decisions about protecting and restoring coral reefs!
- Transparency! And accountability
- Money flow into restoration
- Fastest way of putting together in one place other modalities (DNA, acoustics, etc)


wildflow
data: >20 universities
working on: freedivers, surfers...
Data: UCL, LEC-REEFS, IPB...

Thank you!

Let’s connect!

sergei@wildflow.ai

wildflow.ai

@nozdrenkov

Data: UCL, LEC-REEFS, IPB...