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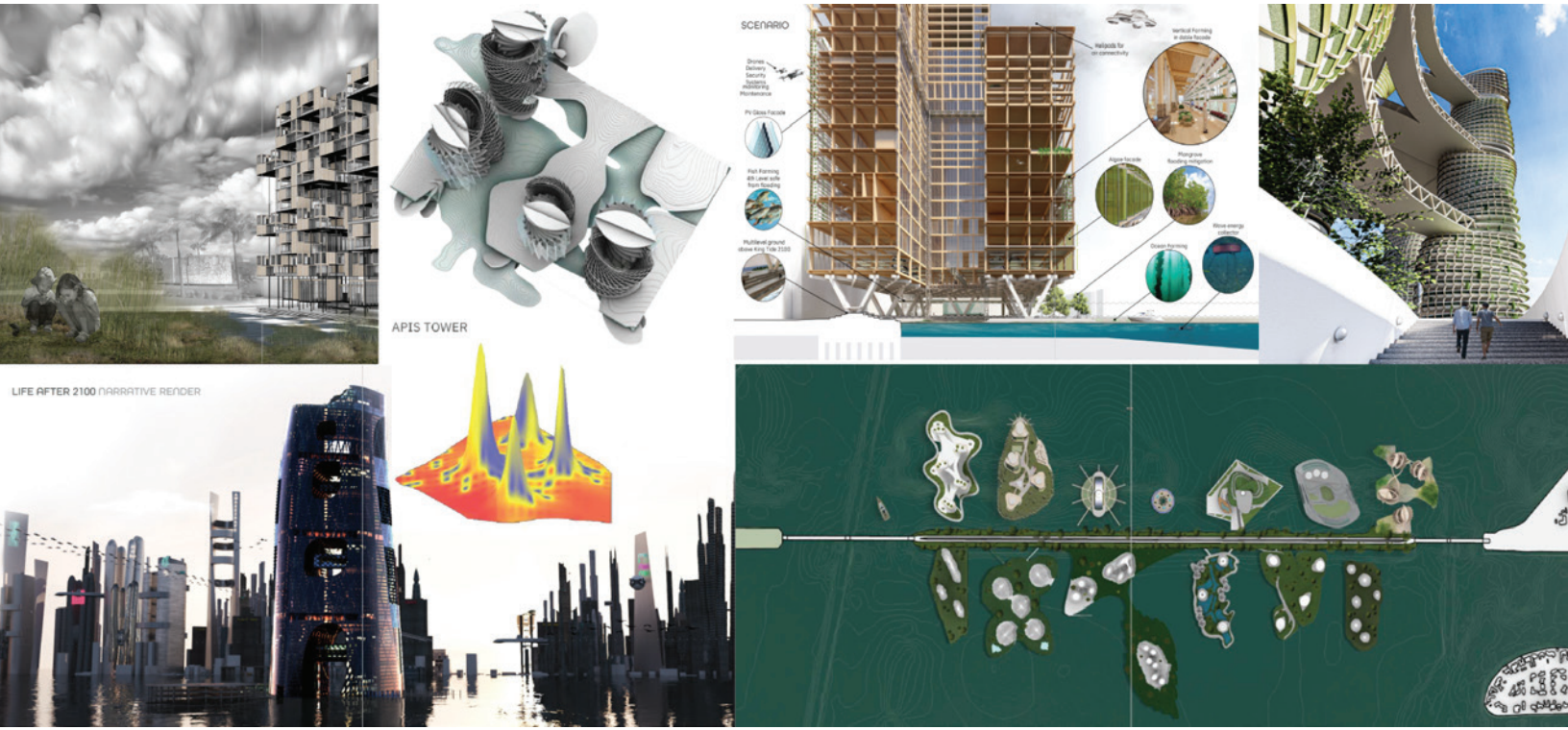

CRUNCH DESIGN RESEARCH

FOOD - WATER - ENERGY NEXUS

VOLUME 3 - **CARBON POSITIVE 2020-2100**

Nuova serie di architettura
FRANCOANGELI

THOMAS SPIEGELHALTER

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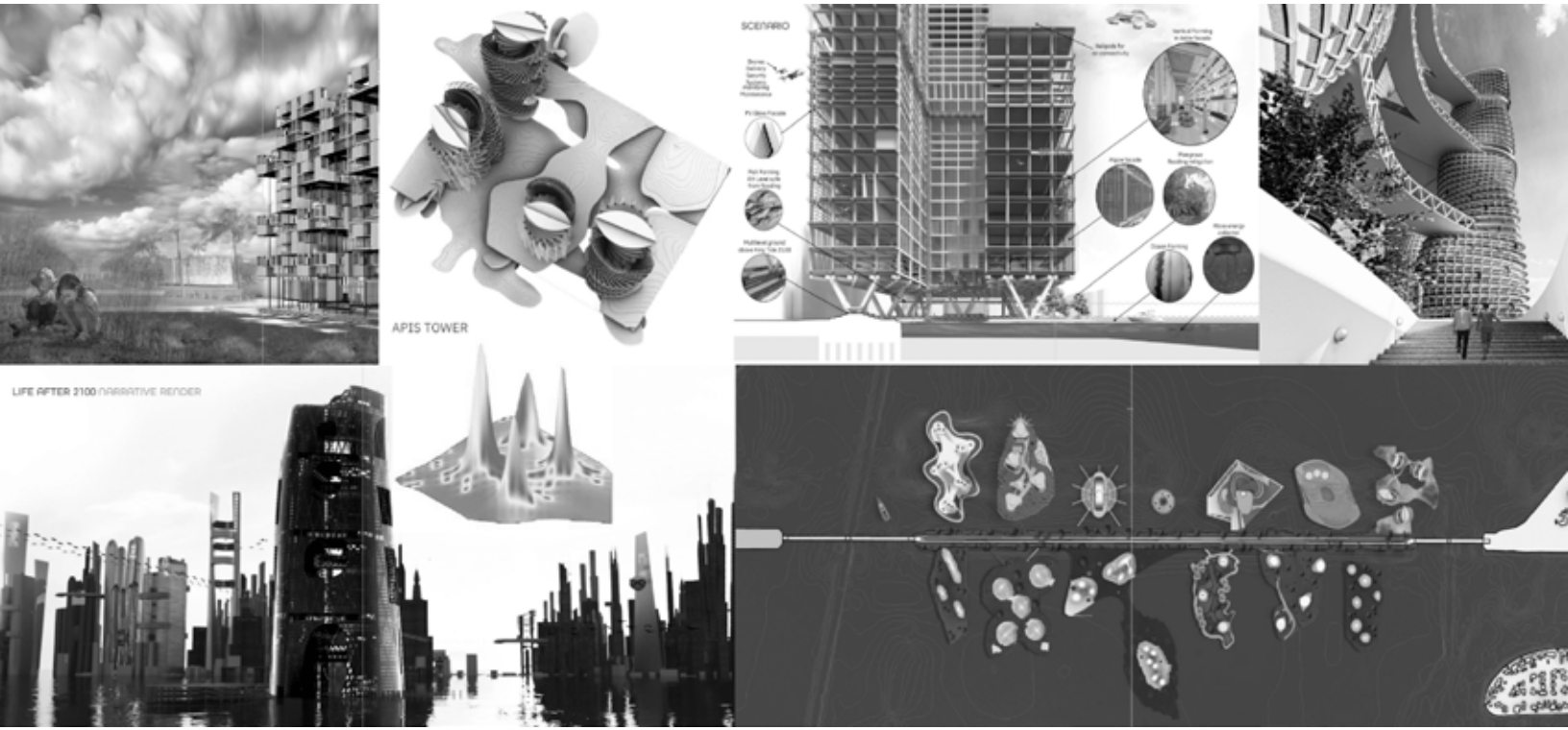

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PHOTO CREDIT: THOMAS SPIEGELHALTER

FORWARD PURA VIDA, EARTH?

BY ÁLVARO ROJAS
ARCHITECT, EDUCATOR

Pura vida, Earth? (How are you doing, Earth?). The inference in this Costa Rican informal friendly salutation is “You’re doing really well, aren’t you? Pura vida literally translates into pure life, meaning that one is full of life! And EARTH is full of life! But the planet is in danger!

Earlier this year 2020, I was honored to have been invited by Prof. Thomas Spiegelhalter, first in February to Architectural Design 9-Sustainable Practices, and to Master of Architecture Thesis project reviews; then again in March to the final presentations of student’s proposals for buildings that are to respond to the climate change effects on the City of Miami, especially sea level rise (SLR) as expected by the year 2100.

Naturally, SLR is just one of the effects that derive from climate change, not the only one. Miami and the Greater Islands seem to be one of the most vulnerable to SLR on Planet Earth. On the other hand, places like Costa Rica, located in the tropical region, are expected to suffer from a reduction in rainfall and rise in temperature which causes forest fires with the consequent forest degradation and an increase in shortage of food. So much for environmental protection!

This reminds us of the “Butterfly Effect” (“Does the flap of a butterfly in Brazil set a tornado in Texas?”) that initiated with a concept in meteorology by Edward Lorenz, which suggests that Planet Earth (and the entire Cosmos, for that matter) is a system and everything is intertwined. Climate and climate change are exactly parts of the system. Architecture and urbanism are rooted in climate no matter their latitudes. Thus, focusing on the upcoming effects of climate change, such as SLR, within the program of studies and research in a school of architecture, any and all schools, is not only relevant and pertinent, but essential and necessary.

I applaud the school’s and Prof. Spiegelhalter’s genuine interests in these environmental issues, and the superb investigations and beautiful design solutions included in this version of CRUNCH, proposed by FIU Architecture students for buildings that should face the gargantuan demands that will be imposed by a horribly threatening future in Miami and in other parts of the world.

¡Pura Vida, estudiantes de FIU!

FORWARD ON OBSERVING NATURE DELICATELY

BY SYLVIA FOURNIER

ARCHITECT, VISUAL ARTIST, DESIGNER, PHOTOGRAPHER

When you observe Nature closely you see a universe. Everything in Nature, from a tiny flower or an insect to a huge tree has perfect design that conjugates form, function and beauty. The colors, the shapes, the structure and the textures are harmonious, proportioned, beautiful and at the same time have a practical purpose.

In the natural environment everything is intertwined in an inseparable unit. As the American conservationist John Miur said, “when one tugs a single thing in nature, he finds it attached to the rest of the world.”

Designers should turn their eyes to nature for inspiration.

All elements in nature are a perfect fusion between aesthetics, and practicality.

PHOTO CREDITS: SYLVIA FOURNIER

PHOTO CREDIT: THOMAS SPIEGELHALTER

INTRODUCTION

BY THOMAS SPIEGELHALTER
ENGINEER, ARCHITECT, CRUNCH PRINCIPAL INVESTIGATOR, FIU PROFESSOR

In less than 150 years, our carbon society transformed planet earth. Today more than 50% of ecologies in the world are determined by unsustainable industrialisation processes. The latest United Nations Intergovernmental Panel on Climate Change (IPCC) reports showing that we are quickly arriving at points of no return in the warming of our planet. For example, Greater Miami and the Islands is one of the most climate-vulnerable zones. We cannot afford to continue in the same direction; we need new ideas and solutions. In the coming decades, the low-lying areas of Miami are set to be swallowed by sea-level rise combined with increased yearly threats of hurricanes, king tides, tropical storm surges, bay contaminations, coral bleaching and heatwaves. Not far away from Miami, the strongest Hurricane named Dorian on record hit the Bahamas, wreaking massive devastation on the islands and loss of life with maximum sustained winds of 297 km/h. The storm surge topped 7 meters above normal tide levels in September 2019. For Miami 2,5 to 3 meters of sea-level rise by 2100 is possible and catastrophic with storm surges up to 7 to 10 meters. Inundations of this magnitude would physically displace some 800,000 to 1,000,000 residents of Miami-Dade County. A large portion of the urban settlements will be uninhabitable if decision-makers continue building as usual. Besides, most of the infrastructure in Miami is over 80 years old. Out of control runoffs, contaminants and thousands of leaking septic tanks pollute and spill yearly millions of gallons sewage into the bay. On top of all of this, the porous limestone rocks its residents live and work on every day means. There is no stopping sea-level rise, changing ocean currents, storm surges and the intrusion of saltwater and contaminants into the drinking water aquifers.

Under the three year umbrella of CRUNCH (Climate Resilient Urban Nexus CHoices), and the Food-Water-Energy (FWE) Nexus research, this Third Volume looks at designing adaptive, resilient, biology-inspired, and carbon-positive green-blue infrastructures and buildings, self-growing coastal barrier islands on a timeline from 2019 to 2100. These systems and structures act as dynamic self-powered hybrids that are floating, sitting in, out, or under the water with the ability to be completely self-sufficient, all benchmarked against 100% carbon-neutrality and the FWE nexus. All research designs are based on approximately 80-year scenarios in which modeling by NOAA, NASA, and reinsurance companies placed much of the low-lying areas underwater. The studies include design studio strategies from studio professors Thomas Spiegelhalter and Alfredo Andia, Claudia Busch, Albert Elias and Claudio Salazar to identify future climate change impacted sites, disruptive building technologies and systems with dynamically changing cultural identities. This includes anticipating future adaptation potentials, and mitigate the aforementioned environmental issues through the lens of ongoing transformations in the geo-specific social, cultural, and ecological context of Miami Beach and the City of South Miami between now and 2100.

SITE CONDITIONS 2021

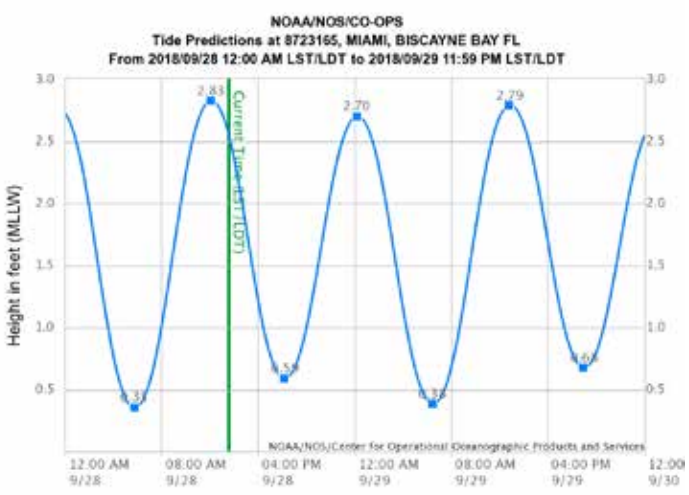
The average elevation for the City of Miami Beach is 4.5 feet sitting atop a permeable limestone/sand base. This puts the city in a vulnerable position with regards to sea level rise. Unlike cities such as Amsterdam which have the luxury of an impermeable bedrock, the foundation of Miami Beach will allow water to seep up through the limestone preventing any long-term attempts at building defensive seawalls moot.

The climate in Miami is hot and humid during the monsoon season (June-November) and mild and dry during the rest of the year and is prone to tropical cyclones with a history of land-falling major hurricanes.

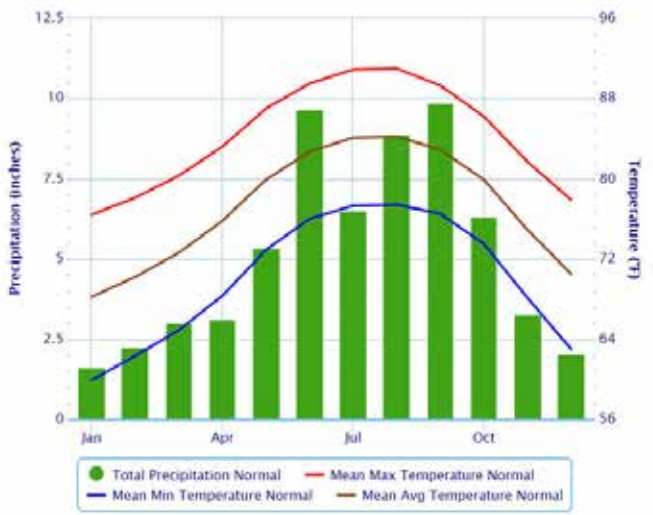
King Tides exasperate the risk of flooding, particularly during the months of September to November, with high tides that can be several feet above normal high tides. Add to this tropical downpours that can produce 7+ inches an hour and it is clear that Miami Beach faces many hydrological challenges.

The images opposite show the NOAA Intermediate High Scenario for sea level rise in Miami Beach. By 2100, much of the island's infrastructure will be touched by ocean water.

TYPICAL DAILY TIDAL PATTERN

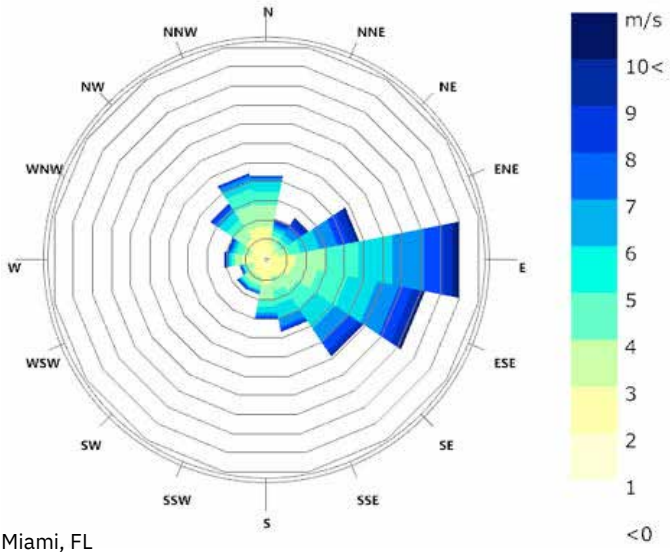


NORMAL TEMPERATURES & PRECIPITATION



SOURCE: NOAA

ANNUAL WIND ROSE



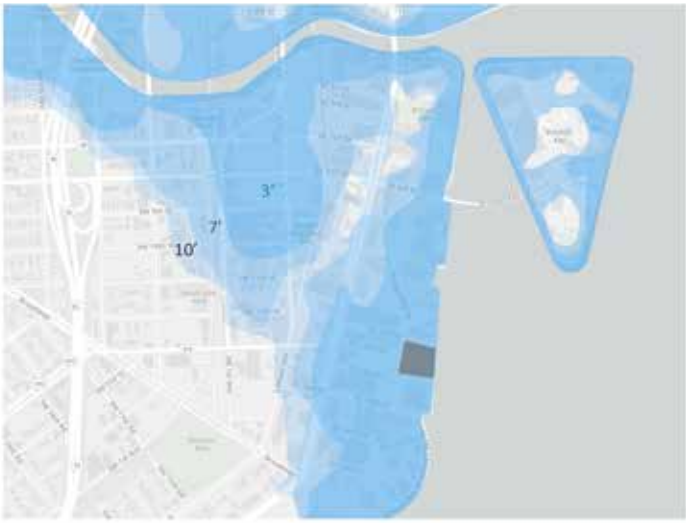
Miami, FL
1 Jan - 31 Dec
Hourly Data: Wind Speed (m/s)
Calm for 2.09% of the time = 183 hours

SEA LEVEL RISE 2021

SEA LEVEL ON THE RISE

2050 3'-0"+ SEA LEVEL RISE

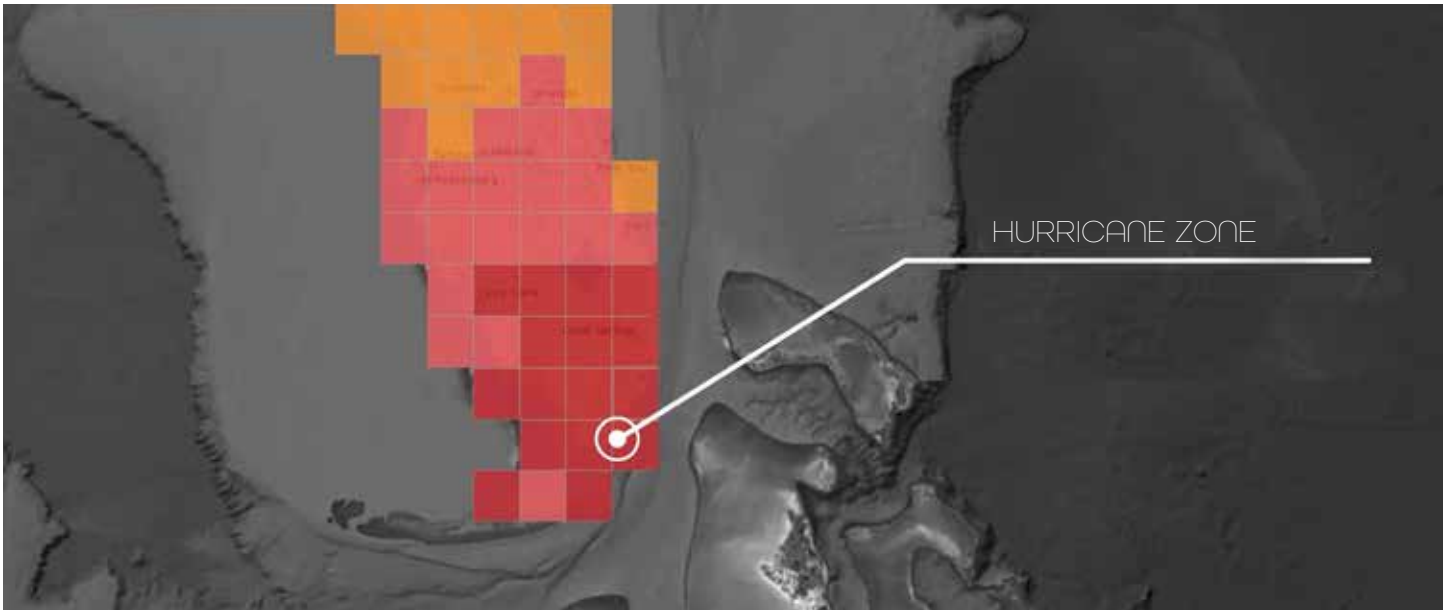
2100+ 7'-0"+ SEA LEVEL RISE



WORST CASE SCENARIO - 23'-0"+ STORM SURGE

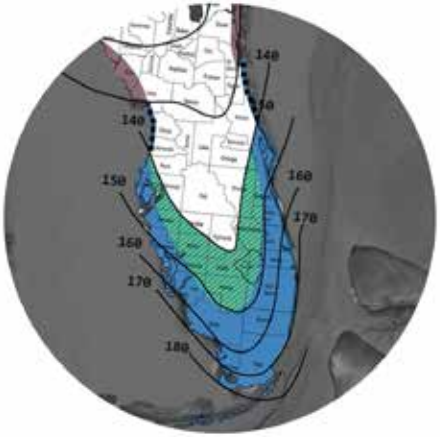
CREDIT: AMALIA TOMEY

SOUTH FLORIDA'S FATE 2021
SEA LEVEL ON THE RISE



MASTER THESIS VIDEO
AMALIA TOMEY

The Sites illustrated through out this booklet all fall within hurricane zones. Statistically Southern Florida experiences 1 hurricane every 3.2 years, and one category 4 or 5 hurricane with absolutely devastating affects each 10-11 years.



WIND BORN DEBRIS ZONE

Florida has regions designated as wind born debris zones, in order to characterize both coastal plots of land, along with inland areas where wind speeds may reach 130-140 mph. These are hurricane prone regions where wind speeds may wreak havoc.

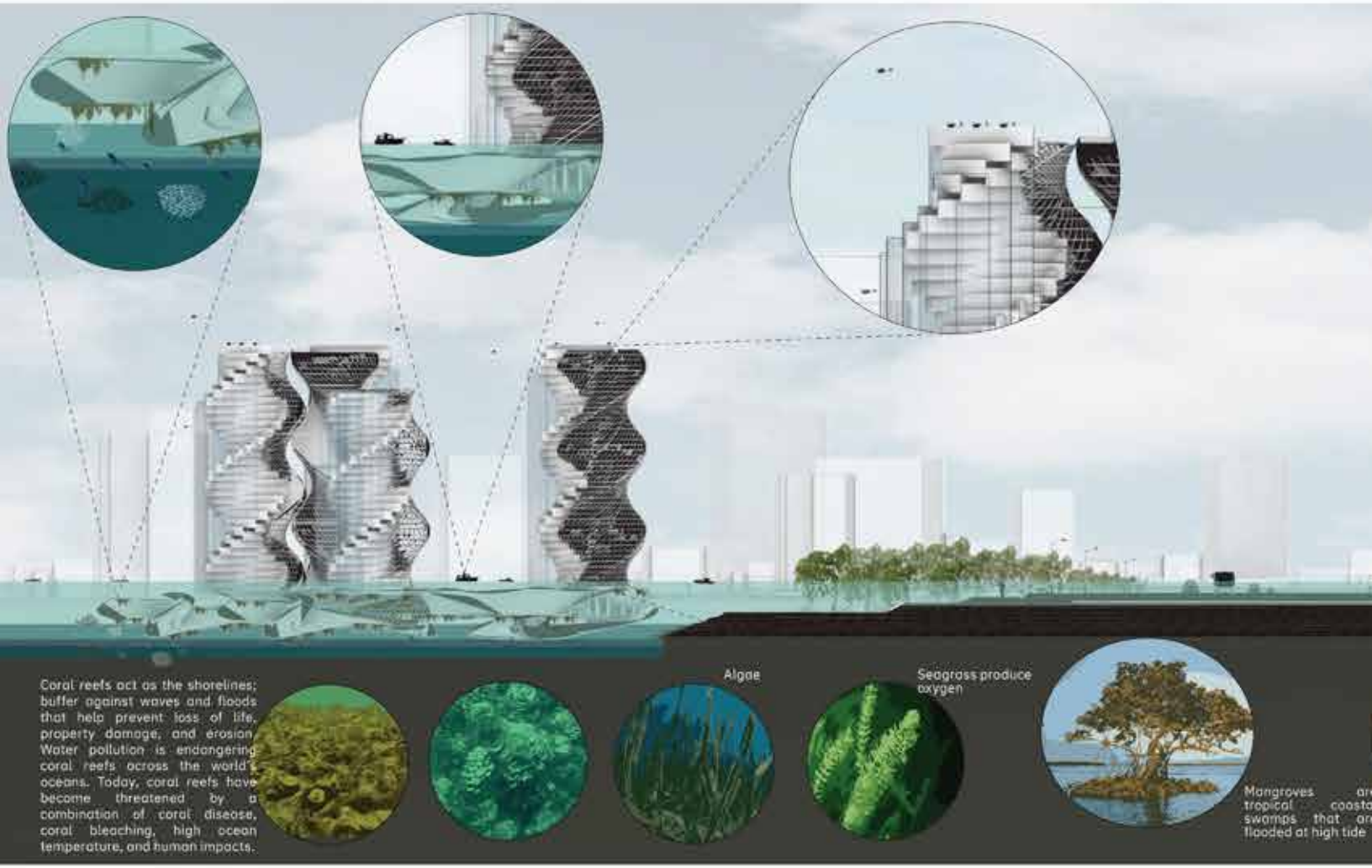
CORNER OF BERMUDA TRIANGLE

Although South Florida exists as a heavily visited and idolized tourist destination, it also sits on the corner of the Bermuda Triangle, a location within the Northern Atlantic, notorious for an abundance of hurricanes and tropical storms

Work & Research Generated by Amalia Tomey

PHOTO CREDIT: THOMAS SPIEGELHALTER

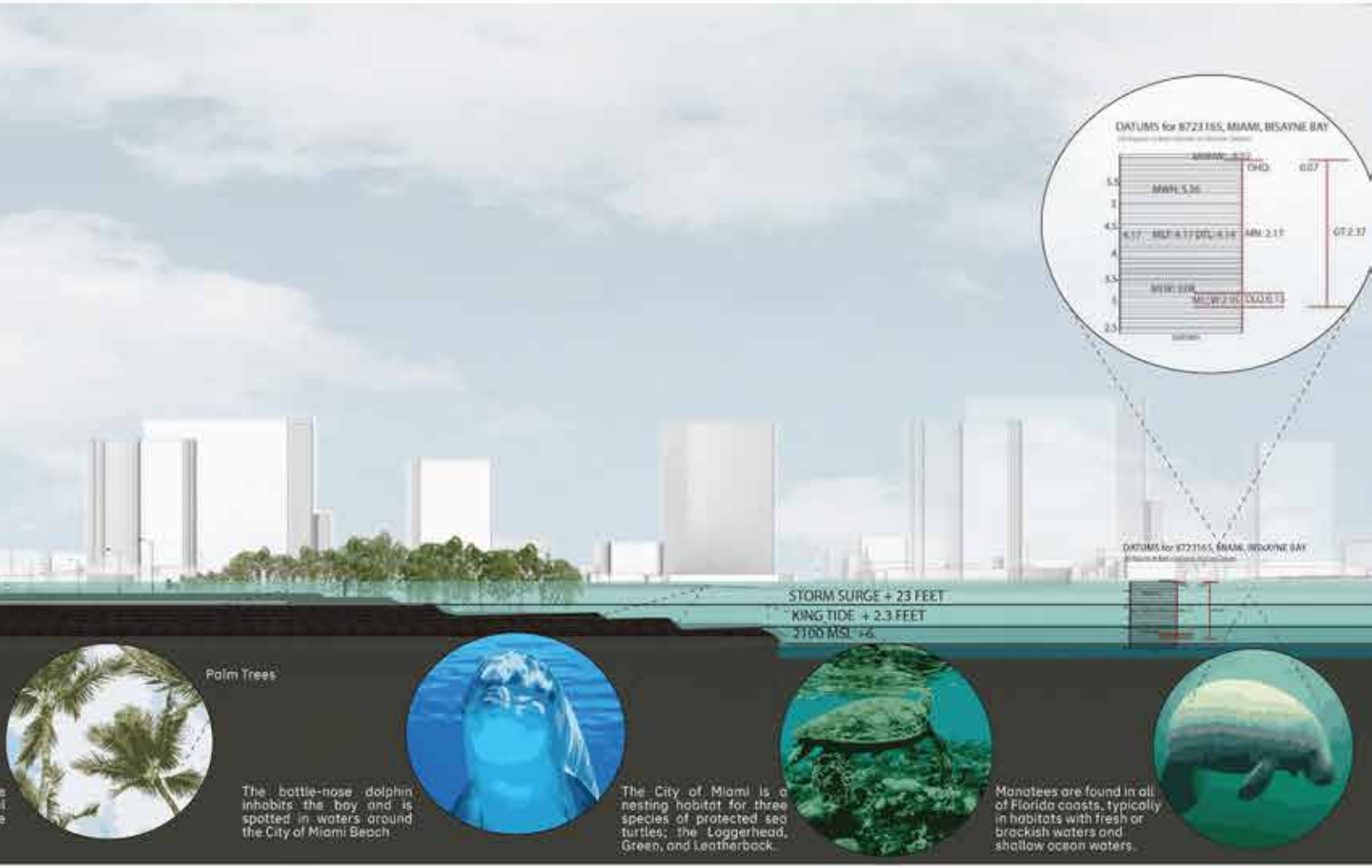
SITE CROSS SECTION 2021



LOOKING TOWARD MIAMI BEACH

CREDIT: Sophia Neves

Section created with documentation from City of Miami Beach



N

50' 800' 1520'

https://coast.noaa.gov/digitalcoast/tools/slr.html