REPORT

A report for the BBROIPS workshop series in collaboration with

Florida International University, Miami-Dade County, Friends of Biscayne Bay, and the Florida Department of Environmental Protection

Biscayne Bay Reef, Observation, Interpretation, and Prediction System (BBROIPS): Creating an accessible system for comprehensive data collection of Biscayne Bay.

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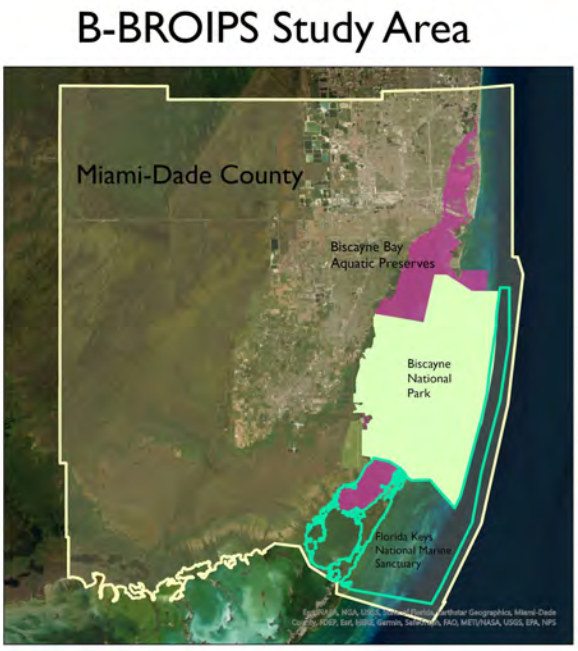
Overview

The Biscayne Bay Commission was established in June of 2021 to monitor the plan Governor Ron DeSantis created to address issues within the Bay. This commission is tasked with overseeing the financial plan to ensure projects and programs are being prioritized. Through this commission and in partnership with FDEP and Miami-Dade County, Florida International University was granted resources to conduct the Biscayne Bay and Reef Observation, Interpretation and Prediction System, also known as B-BROIPS. The study area of BBROIPS is defined by the boundaries of Miami-Dade County and extends to the reef zone where management questions are most crucial and pressing. This project will support Biscayne Bay water quality and restoration efforts by creating a comprehensive, accessible platform for accessing scientific data collected within Biscayne Bay. The platform will be characterized by fast access to a wide variety of data-types (including old digitized records as well as live/online auto-sampler type data), as well as the ability to perform complex analytical queries with high computational efficiency.

Introduction



Biscayne Bay is located in a highly urbanized area that has seen substantial growth in the past century, causing alterations of shoreline hydrology and subsidence, changes in overland flow patterns and water quality that have consequently impacted residential wildlife and vegetation. There are numerous studies covering the water quality of the Bay providing a snapshot of Bay's status; these datasets, however, are often limited both spatially and temporally. While this seems to be a recurring theme within scientific literature and is also echoed by the larger scientific community, it does not suggest that the type of data people need is nonexistent, but rather highlights issues related to data accessibility and centralization. Miami-Dade County currently manages a web page allowing users to request data, access spatial maps and applications, and an open data portal for community use. This, however, is limited to research funded, produced, and published on behalf of Miami-Dade County only. Similarly, the Florida Department of Environmental Protection operates a portal housing FDEP-sourced data. While large datasets have already been generated to address various Bay-related issues (including marine social science, tourism, land use and development, water quality, seagrass dynamics and coral reef ecology), this information is dispersed throughout various sources. This does not include data collected and supplied by private companies, research institutions , or non-profit organizations.

Aims/Goals

Our aim with this project is to facilitate unrestricted data and information for anyone interested in investigating Bay-related issues, including Managers, Advocates and scientists alike. This will create a “one-stop-shop” for Biscayne Bay data, that can be queried to answer relevant questions related to bay health. This will expand the public's ability to have effective communication and dialogue surrounding the issues facing the bay and provide a unified platform for data sharing.

Stakeholder Involvement

The B-BROIPS project is a collaboration between engineers, scientists, and various Bay experts, which will involve a 3-phase implementation over the course of 2 years. This report covers the first phase which is fully dependent on stakeholder involvement. In order for the subsequent phases to be “unlocked”, this initial phase relies on the assimilation of all available Bay data from natural resource managers, principal investigators, Bay activists and advocates, and students to participate.. Moreover, we need them to share our project within their networks to expand our outreach efforts and have as many people as possible contributing data within the study area (Figure 1). The first phase by hosting two work workshops: the fist one focusing on the *collection of all available data,* and the second one on *building tools to query* the data to answer questions posed by managers in an effort to restore the health of Biscayne Bay. For these workshops, we compiled a list of stakeholders within our network classified as either Scientist, Student, Manager, or Advocate. Each person was instructed to fill out a survey that addressed the following questions in order to formulate the workshop agenda:

1. Have you collected data on Biscayne Bay?
2. What type of data have you collected?
    a. If yes, have you made it public?
3. Are you willing to share data for this project?
4. Where do you think the data gaps are for Biscayne Bay?
5. How do you think we can best query the data?

Using these questions we were able to assess each stakeholder’s positions on the issue. It primed the attendees for the type of discussions they would face at the workshop, producing valuable insights ahead of the 3 main discussion questions:

1. What questions need to be answered for management?
2. What models are currently used or developed, and what data are required for each model (at what spatial and temporal resolution)?
3. Identify knowledge gaps. What new models need to be developed in the future, and what data are required? (i.e. Which data exists, and which are lacking?)

Platform overview

The platform utilizes TerraFly engine – a web-based digital library designed for access and visualization of remote sensing data and geospatial imagery. The system is geared towards professional scientists to facilitate data consolidation and provides functionality for solving

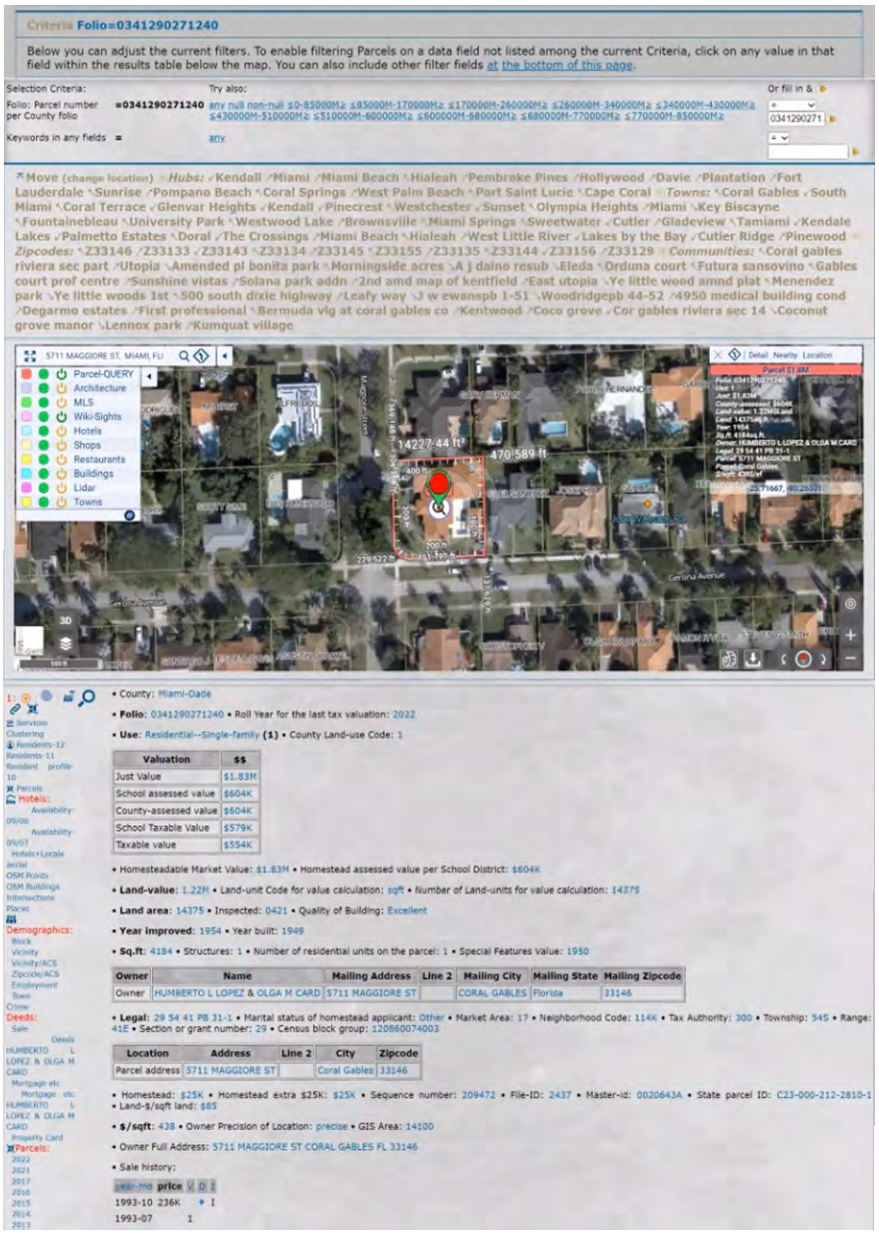
complex computational problems across various data types. Data submitted into B-BROIPS will be grandfathered into the Terrafly by importing additional data layers supplied by various researchers, managers and institutions working on Biscayne Bay problems.

DEMO: The example below utilizes 200 fields of data that are overlaid on the GIS-style map. In this case “Assessed Value” is the only layer of data (the only implicit criteria active is parcel location, data is not yet constrained by any parameter). Records are also tabulated below the map (only a subset of 200 fields was preselected to be displayed; all blue fields in the table are “clickable”). Once a particular record is triggered on the map - a polygon is highlighted (boundaries of the polygon are represented by the parcel boundaries), and a pop-up in the right top corner provides basic information relevant to the selected polygon (i.e. only a subset of 200 fields is displayed that have been determined to contain most utilized data/info).

links to locations & details	Folio	Use	Just Value	County-assessed value	Land-value ($Land)	Land area (sq ft)	Year improved	Sq.ft (sq ft)	Owner	Legal	Parcel address	Parcel city	$ / sqft ($ / sf)	Sale history
1: 67'	0141280420040		$9.49M	$4.48M	9.49M	88K			NATL TROPICAL BOTANICAL GARDEN	KAMPONG PLAT	4099 SW 37 AVE	Miami		
2: 100'	0141280420010		$44K	$44K	44K	26K			NATL TROPICAL BOTANICAL GARDEN	KAMPONG PLAT	4099 SW 37 AVE	Miami		
3: 197'	0141280280040	Residential--Single-family (1)	$4.11M	$2.47M	3.93M	36K	1955	1875	NATL TROPICAL BOTANICAL GARDE	PLAT OF HISSAR PB 85-4	3971 DOUGLAS RD	Miami	2190	year-mo: 1997-07, price: 1; 1996-12, price: 500K
4: 250'	0141280280030		$1.97M	$1.56M	1.97M	18222			FLA INTERNATIONAL UNIVERSITY	PLAT OF HISSAR PB 85-4	3965 SW 37 AVE	Miami		year-mo: 2015-03, price: 100, 11; 1995-08, price: 1

Zooming in on the parcel allows the user to view the selected polygon at a greater resolution, and information with linear dimensions and square footage of the parcel can be easily identified.

Triggering an hourglass icon provides all of the polygon-related available information.



Dataset can be constrained by every available criteria (field).

And results visualized:

Workshop Agenda

Agenda

BBROIPS Workshop 1

8:30am	Networking and Social with Continental Breakfast
9:00am	Introduction: Description and Importance of effort - ***Jim Fourquean***
9:15am	The Platform and Online Tool - ***Napthali Rishe***
9:35am	Why is this so important? What is needed today? **- *Laura Reynolds***
9:45am	Coffee Break- Report to Breakout groups
10:00am	**Break Out Sessions** Group 1- Conference Room Group 2- Classroom Group 3-Online
11:15am	Each Group Report Out (15 min for each group)
12:15am	Lunch and continue the discussion, upload data if you have it.
12:45pm	Closing Remarks and Our Take Home Assignment - ***Daniel Gann***
1:00pm	End, next workshop TBA

Attendees

The attendees were classified into 4 different groups: manager, scientist, student, and advocate. There were approximately 22 scientists, 3 students, 17 managers, and 8 advocates in attendance, either virtually or in person. Participants in person were placed in 3 different groups led by the project's investigators. The virtual groups were divided into two different groups that were moderated by one of the project investigators as well.

Workshop 1: Stakeholder reports

The following information was collected during the workshop breakout sessions. Each session contained a balanced mix of scientists, students, managers, and advocates to allow for various perspectives and feedback on each issue. During each breakout session, there was a moderator and a reporter that would condense information for this report.

Group 1~

General Comments:

- Piero: The first thing we need to address: who wants to come to the table and what data they have.
    - Going to question 1: what do we, as project leaders, want to have and how do we want to format the data to be able to make a data tool with.
- Alexandria Fine: Request a spreadsheet and communicate how to cite. If we want to share data, we need to be giving credit to each contributor. Many times, we see projects made from data publicly available, but the people/institutions who collected and formatted that data are nowhere in the references.
    - Need to come up with products that people are going to make from the data, show and be able to show the outcome of using the data.
- Piero: We need to be able to gauge how successful this project is going to be.
    - People usually come to the county asking for data. MDC just gives them data and never hears from the people working on the project.
    - This will provide a source for credibility
- General: People need to be credited to have the data provided. If anyone is using the data, they need to have the sources listed.
    - Recognize where the data is coming from and how it is being used.
    - Request a spreadsheet.
- Herve: Metadata comes with a query. This describes where it (data) comes from and when/how it was created.
- Peiro: Some websites already have a way to cite, but we need it in writing first.
    - Set up an alert if anyone is downloading your data.
    - It is better if we approach these questions from the last to first. By answering questions 2 and 3, we will be able to approach question 1 with the data needed for answering that question.

Question 3**:** Identify knowledge gaps. What new models need to be developed in the future and what new data are required? Which data exist, which are lacking?

- Alexandria Fine: More water quality data to know how it connects with biological data.
    - More data concentrated on the North of the Bay compared to the South.
    - Chemical data and bottom data to have a more comprehensive water quality data base on the whole water column.
    - Significant differences from top and bottom of the water column.
    - Many studies only focus on surface water quality data.
- Valentina: Trying to figure out who is collecting what and where.
    - Need to request that you need more water quality data on the specific metrics you are looking for.
    - Piero: Who is collecting?
- Herve: Density of data along the shore.
- Valentina: How much data overlaps? Can we collaborate to the point we can work on the same and/or different projects.
    - We have an issue where the density of the data is located.
    - Regulations and permits of each entity may differ, so we need to make sure the data is at least available for each party as they divide and conquer.

- Griffin: Coordinate with entities to sample at different times/areas. Still getting the same sites, at each agency's different standards, and still collecting data on areas needed.
- Mariana: Make sure we collect a base data standard for everyone to use.
    - Making data compatible, set a standard minimum of the data sets for seagrass, water quality, surveys, etc.
    - Maybe start with water quality à Start a data calibration.
    - If you do use data with limitations, state the limitations of the data.
    - Provide as much description to the managers of the data you did collect to answer Question 1. Methods, materials, limitations.
- Griffin: Gap between where Biscayne National Park ends and the Rickenbacker is.
    - Seagrass, benthic, shoreline assessments.
    - We definitely have a density issue.
    - Peiro: Flow (waterflow) data: BNP uses discrete data à is that enough for what we need?
        - Where and how, what kind is it?
- Peiro: No flow stations in Biscayne Bay, only on the southern portion of Biscayne Bay but we need to have it for the Northern part as well.
    - BBSEER people might be modeling this data, contact them?
- General: Products we generate:
    - Keeping track of the data that is being used.
    - What projects are using the data?
    - Naming a metric of success.

Question 2: What models are currently used or developed and what data are required for each model?

- Would be helpful to show what people can and cannot do.
- Simulations on how nutrients move would be helpful.
- Circulation models are important.
    - Conjoin all the different efforts.
- Asking scientists and management what we would benefit most from.
- Expanding the network we have.

Question 1: What questions need to be answered for management?

- What is causing the problems and what the problems are.
    - And what we can do about it.
- Get data from the past, look at long term trends.
- Talk to leaders: congress, commissioners, managers and tell them what the problem is and what we need. Only by effective communication will we be able to drive change.
    - In doing so, we advocate for the resources we need to manage Biscayne Bay.

The consensus of this group's approach on data gaps and accessibility largely focused on identifying how and where people are collecting data. Many emphasized that the same data is being collected at the same sites, but with different methods. This issue opened the conversation to establishing better communication among research groups in order to "divide and conquer" the work on Biscayne Bay. Additionally, they spoke heavily on establishing one set

standard for data collection and a preferred citation to be included by the research group when sharing data. Another interesting point the group mentioned is to keep track of the data and what is happening with the data being collected. Primarily, the managers of this group have concerns when they are in charge of allocating funds for research, but do not see the products of the work completed. These conversations ultimately led to the stakeholders asking themselves, “how can we address these problems?”. Some suggested talking with leaders and advocating for the resources needed to manage Biscayne Bay, emphasizing the different permits and regulations of each agency, hence looping back to the conversation of setting one standard for data collection methods. In establishing a “floor” of methods to use, it allows the platform we are currently trying to build to work more effectively. Others preferred to communicate among field technicians in order to not repeat the same work. Overall, the outcome this group agreed on was to have more communication among everyone working on issues related to Biscayne Bay.

Group 2 ~

Question 1: What questions need to be answered for management?

- What are the most pressing needs?
- Number one is data gaps FWRI recently put out an assessment to look at primarily coral transect but also gap analysis for south florida reef tract.
- One of the issues we’ve always had is when we’re not allocating enough. We can't do whole ecosystem analysis because data isn’t sufficiently allocated.
    - We later explored the example of fisheries independent data as a huge data gap as well.
- What do you think is the top issue in the bay to address?
- Laura E: One question we need to see answered in the bay is nutrient loading.
- Sara Tanner: need to see where it’s coming from so it can be reduced.
- Laura E: Nitrogen and Phosphorus biggest issues. We use chlorophyll because P doesn’t reach detection/doesn’t last long enough.
- Jan Lara: We have 17 sites close to canals, but no sensors/instruments to collect nitrogen levels.

Dan: So I see nutrient loading as a theme, what is the main issue?

- All parties: how much time do you have? Listed several issues w/ nutrient pollution.
- Laura E: Discharge related to flooding is an issue, which has multiple overlapping complicated factors.
- Sara Tanner Need to get better assessment of source
- Laura E: need downstream monitoring. Need to get data to do comparative analyses.
- General: Transparency and the speed of transparency has also always been an issue. Getting data to the public, electeds, partners, etc. can take months due to protocols.
    - Not getting in and out as fast as we would like to.
- Dan: Hopefully this will help that.
- Jan Lara: our project is more everglades but we have two stations in BB to get saline/temp data
- Dan: How do you feel only having 2?
- Jan: We have 17 nearshore sites, but the 2 in bay we have to pick up instruments, download, put back, etc. time consuming. Swap instruments every 30 days. Divide the 44 sites into zones.
- Katey L: We need to focus on the short and long term.

    - In the long term we need to reduce nutrient load.
    - For the short term, we need to answer the question of where we can start restoration projects with a relatively good chance of success.
    - Water quality is an important factor in that.

- Laura E: Miami Dade County currently working on a reasonable assurance plan. Described RAP and how designation mandates a restoration through TMDL or BMAP plan. Another is stakeholder led process w/smaller nut. Load reduction. Try to designate areas. Not designated by EPA so now we have to do a county-wide plan with the goal of nutrient reduction. Dioxin is also included.
    - County has over 140 sites we've been sampling since 1979.

Dan: TO what you said, what models are being used or developed?

- Laura E: We don't really conduct modeling now. We want to, but we mainly contribute data. Data from NOAA water quality, working to fund our own modeling through RAP. Havent really talked about bacteria but there's a lot of bacteria work being done as well. A lot of work our partners are doing, so we're taking an interagency approach providing data. WASD does its own modeling.
- Jan Lara: For salinity in the canals its BBSEER doing salinity.
- Sara Tanner: Need for a collection of groundwater data.
- Laura E: GW contribution showing to be more and more important towards fish kills.

Zac: explain more?

- Laura E: Charles master's thesis examines surgents released through sediment layer may contribute to fish kills. People forget the little river area is historically a slough/ GW moves down to that area. Canals are deep enough that they connect to GW.
- Sara Tanner: GW is anoxic as well, so contributes to the low DO problems.
- Jan Lara: Problem w/ high temperatures and salinity recently, wanted to open gates to canals. We're worried about all the water flooding out.

Dan: In order to make decisions the way you're describing what is a good time to flush?

- Jan Lara: We use heat maps, compare dry season and wet season. Showed copy of heat map. We can see which seasons are better for opening gates. Now we're seeing dry season openings are better.
- General: Rain and flooding levels are the biggest factors in district decisions.

5. SO it's not that the data isn't there, its that overriding decisions are being made for other reasons

- General: Correct.
- Jan Lara: I think it's also a question on water allocation.
- Laura E: A lot of the gates are operated by gravitational flow, but they're going to put pumps on all the gates to allow more control to force water through, which could help freshwater distributions.

Dan: fair to say that management question depends on what we're managing. What do you need to help facilitate the process of convincing water managers to

- Sara Tanner: showing alternatives, ecosystem benefits
- Laura E: ecosystem benefits are important. Ecosystem contribution has not been part of their modeling efforts for BBSEER or other projects.

Dan: SO BBSER is a model…

- Laura E: multiple models, 10 working groups

Dan: So what kind of data would we need (spatial res, temporal res.) to feed those models? Challenge for us is to find which models we need to focus on to push information to decision makers? How do we reduce that bottleneck of data ?

- Jan Lara: They use out data
- Laura E: Primary discussion there is “what is the intent of the data”?
- Jan Lara: We have the data, but it isn’t really being heeded.

Dan: What kind of visualization tool using your data would be ideal for getting your data out there?

- Katey L: Shared chansmodels.org Biscayne bay data map as example. http://45.55.215.153/midas/index.php?biscayne#
    - Discussion of how it is a good format for displaying data which can be built upon. (notes suspended while showing map to group)

Dan: Circling back on RAP, what are some of the most important pieces of data to collect?

- General: Work on sediment understanding. Assessing the need to dredge canals for legacy segments.
    - Originally focused on the Little River area, now that same level of data gathering has to be conducted in other areas throughout the county.

Dan: We didn't talk about data structure at all. Let’s get into that.

- Laura E: Groundwater, sediments, sulfites. A lot of it is correlating the silos. We aren’t talking to each other enough.
- Gautham: Need environmental parameters

Dan: Would you rather have the transposed or raw data?

- General: Both!
- Laura E: Raw data has advantages, but both would be helpful. We could consider a phase 2 which allows for multivariable analyses. Although raw data is a priority, both would be helpful. SECART is a good example of a system which connects data that does not typically talk to each other.

Dan: value to spectral reflectance values or time series?

- General: Both.
- Laura E: work out of Kent State University using spectral reflectance to get down to benthic level. Less variance within data. We can look at clean seagrass vs epiphytically burdened seagrass, tease out components of chlorophyll a, etc. Depths and lidar as well.
    - When We’re thinking about spatial resolution we have to think in terms of 3d and depth. We have FIU doing only surface, Feds doing bottom, etc.

Group 2 initiated this discussion on themes surrounding nutrient loading, the importance of localizing point source pollutants, and the allocation of data. They emphasized these themes are not effectively explored because of the lack of transparency between agencies carrying out monitoring and sampling. Another major issue is the lack of funding sources, stating that Miami-Dade County’s RAP program is working on assisting FDEP. On data structure, they mentioned the importance of having a set of environmental parameters for agencies to follow and once again stated the importance of communication among all partners.There was also

mention of the benefits of having raw data available in comparison to transposed. Lastly, the group agreed that there is data available to separate issues, but it is not being heeded.

Group 3 ~

Question 1: What questions need to be answered for management?

- Stormwater runoff: how does it affect water quality and benthic habitats across the watersheds
- Septic Tanks: ditto
- Wastewater: goes into the ground and into the surface water.
- Groundwater
- Water budget (quantity and flows) rainfall, runoff, water management activities: 3-4 years of low rain hurts Biscayne Bay (explanation pending)
- Water Quality and Water Quantity
    - How parameters/models are changing with climate change? SLR, salinity, evaporation, temperature

Morgan Elmer, NPS: What we want to know for managers: status, trends, species, populations of my resources.

- Density, presence / absence and how is it doing? Resources for the Park: Corals, benthic cover, key fishes (bias towards recreational fishes), other invertebrates, invasives/marine debris (removal).
- What model do we use: wastewater budget, quality/quantity; climate change; SLR.
- Reason – **what do we protect**? Which is in worse shape and which to protect with a cost/benefit. This from the National Park Service Perspective.

Jim Fourquean. FIU

- Status and trends of living resources need data.
- Model how does stormwater runoff affect those resources? Groundwater etc.
- Human use – land use; zoning
    - Human use in the water - recreational, shrimping what damage is happening to the seagrass and other aspects of the ecosystem. Boat grounding, prop scars.
    - Half of the grass loss in Haulover Bay is related to people pulling in their boats. Boat groundings. Note: fireworks show on the Bay (example, Rusty Pelican). How do we get data on something like this?
    - County interested in data that address debris, plastics, and trash. Data question – gap. Is NPS a sink or a source for data in the Bay? The Park removes 60 tons of marine debris every year.
- Is it local recreation or is it coming up from the Gulf Stream?
- Pressing for the county in the northern part of the Bay vs. Southern part of the Bay. Morgan – do we know that difference exists? Less debris down south. 500k – 750k visitors to the park – 90% by boat. What is going on? We don't have a map where the debris is? How to quantify. What is the amount of debris and where is it worse?
- Two issues: Human Use of BB system
- Spatial component to that – aerial surveys done around the world and count boats. Our Aerial survey is from 2017 (Park Service). Data gap quantifying human use

- Permits are one data layer
- Repeat fly overs to count boats and identify where they gather.
- Aerial to see flows of pollution / discharge, boats (need to do boat counts and locations), and manatees - data gap.
    - Boats can be surveyed with fixed wings. Helicopter for manatees. Company Planet Imagery generates 20 cm resolution every 2-3 days. Idea, contract with Planet Imagery to get data re: location of boats.
- Policy solutions - Gary Milano – Bay being abused. Protect shoal areas, spoil islands. Make them protected areas. Better about conservation measures to protect resources. Julia Tuttle Causeway. No Zoning on Bay.
- Marine Patrol which is conservation-based as opposed to other types of crime.
- Policy recommendation - Conservation zoning, education and enforcement.
- Social Science project to understand the culture of people who use the Bay and figure out how to get to the bottom of the culture and make effective campaigns to change behavior.
    - [Note: let's hire a PhD team to do a study of this and make recommendations]
    - Social science research before implementing zoning restrictions or boating permit limits.
    - Need data too before trying to make these changes.
    - Policy solutions - Declare an emergency on BB?
    - Experience from NPS – 14 years to implement restrictions and zoning.
    - 2015 General Management Plan.
    - Political perspectives have changed due to the crisis nature of the Bay.

Question 2: Models:

- IBEAM, Sea Level Rise, Back Bay, bbseer, climate change. Things that need to be modeled.

Question 3: Identify knowledge gaps. Which data exists? What new models need to be developed.

- Data gap re: human use of BB and where people go and what they do in BB. 2017, last aerial survey from Park.
- Land use and relationship to Bay negative impacts.
- Gaps in understanding, permitters, registered businesses,
- WQ data gaps – DERM, FIU and SFWMD. Need to obtain their samples of WQ data.
- Contaminants = some grab samples
- NPS = salinity, temperature etc. But not contaminants. (physical parameters)
- Huge spatial data gap from beach to the reef. Mid-Bay to the Keys. USGS water quality station getting it back up by Fowey Rocks.
- Resource coverage – hard bottom, soft bottom, seagrasses, bare bottom, corals. Do we have quality data on this? No.
- Data gaps in water quality = many.
    - Chemical methodology for analysis; different agencies, (due to budget cuts);
    - Spatial distribution of the stations is not based on a monitoring program on the Bay. Combined with NDPS.

- How to get this data into the database? Data collected every 5 years? Need to get it digitized and included in the database. Where are the copies? May be lost. Gary says go forward. Let's map the Bay right now.

Much like the other groups, this group focused largely on water quality, nutrient pollution, and recreational use for the data that is needed and that overlaps with other agencies. One interesting point they brought up was surveying the northern part of Biscayne Bay in comparison to the southern area, linking how there are differences in human use in either part. Policy and social perspectives were credited as major issues in regulating and protecting Biscayne Bay and there was an emphasis by the advocate to have this data incorporated into the scientific findings. In regards to modeling, the addressed IBEAM, sea level rise, and BBSEER as items that need to be modeled. The main data gaps identified by the group were human use, land use relations to Biscayne Bay, permitting factors, water quality data gaps from DERM, FIU, and SFWMD, and physical data gaps from the shore to the Florida Reef Tract.

Group 4 ~ (Virtual)

Question 1: What questions need to be answered for management?

(N. Cortez) From SFWMD's resiliency standpoint: working for an operational agency, i.e. making decisions on activity (canal discharge/canal structure closure) a lot of the questions directed to management are for operational purposes: what is the current state of the system. Of course the District is immense – 16 counties, Orlando – MDC; For MDC, and Biscayne Bay it's always important to know the conditions of the system pre-, during- and post- any release/discharge. Additionally, from the larger perspective – upstream water quality is an important aspect, to deal with non-point source pollutants. Knowing conditions for operational purposes is not just limited to the bay.

(R. Santos) Questions around living resources (fisheries, seagrass, corals, mangroves, oysters) are important. How water quality can influence stability of resources that can offer any given ecosystem service(s). Example: how WQ well influences fisheries resources (presence/absence/abundance) which are very valuable for the region.

(T. Troxler) Understanding the interactions between WQ/discharges and effects on living resources?

(R. Boucek) Indicator species are important. Some integration of WQ, habitat, marine use impacts. If we design a list of indicator species and their interactions with habitat and water quality and use them as system status indicators.

(N. Cortez) works with long-term trend monitoring and a lot of the events tracked within the BB comprises micro-events, i.e. a large rain-event and associated dilution of certain WQ parameters. But in the context of CC, SLR and changing precipitation and overland flow patterns perhaps introduction of "climate indicators" (conceptually analogous to indicator species") to have an outlook in mind as to how the system might respond as this is also part of operations.

(C. Groppe) From the data perspective – a lot of what is seen is point-source locations. Ideally, polygons would be very useful, but the ability to navigate and identify spatial areas and then

being able to take it a step further and see it evolve over time v. other areas is the question that gets asked the most.

(N. Cortez) emphasizes the importance of the ability to have a historical perspective on data (temporal extent). Establishment of a “true baseline”. Accessing more institutional knowledge

(R. Boucek) re baseline data: adds that R. Santos has done a lot of work on incorporation of local ecological knowledge and fisher interviews, which gives a decent perspective on the historic distribution and dynamics of seagrasses. Important to include institutional data not only from institutions but also stakeholders.
Additionally – what are the potential ways (hypotheses) as to how BB could collapse? I.e. could it be a response to extreme drivers v. gradual response to poor WQ and slow approach to some failure threshold. Early indicators we could identify, i.e. seagrass coverage, nutrient concentrations etc.

(Santos) Extremely important to have some sense of what could be the outcome under different scenarios of environmental change?

(Omar Abdelrahman) What are the specific sources of threats to our local resources? They need to be identified, quantified and fates determined.

Q2: What models are currently used or developed and what data are required for each model?

(H O Briceno) Hydrodynamic and salinity models for BB are already operational. References a talk/presentation that was given approx 1.5months ago (in-person only). Workshop on the model is in preparation for people interested in learning how to use the model. New project involves use of the hydrodynamic model to model plastic transport within the bay. Idea is to track how macroplastics travel within the bay (routes, “residence times, sources, what sinks, what floats etc). References RiverFlow2D. The hydrodynamic model utilizes WMD data. Model is easily interfaced with other models (e.g. from the EPA). It’s a Q-GIS model, which is very dynamic and computationally efficient.

Mentions a modeling partnership between Tulane University and SFWMD – WQ modeling

Links for H. Briceno’s DATABASES:
monitoring data - http://serc.fiu.edu/wqmnetwork/

Old Biscayne Bay data - http://serc.fiu.edu/wqmnetwork/sfwmd-cd/index.htm

detailed report on Biscayne Bay with maps + data -
http://serc.fiu.edu/wqmnetwork/BNP/Final%20Report%20BNP.pdf

(N. Cortez) – references WQ model by Northern Gulf Institute + NOAA + CIMAS – water quality modeling for BB (potential PIs: Vladimir Alarcon/Chris Kelble/Alexandra Fine/Paul Mickle/.
Re Tulane University – SFWMD partnership: references FPLOS program which looks for vulnerabilities in the system, mainly infrastructure. Due to general concerns re impact of discharges from the district, it was the FPLOS initiative to engage in the partnership and incorporate groundwater modeling to understand effects of flows and discharges. So while it technically is a WQ model, the emphasis here is mostly on understanding different discharge scenarios and considerations for SLR.

(Omar Abdelrahman) References a 3D hydrodynamic model that will be developed with Maria Olascoaga, RMSAS.

Q3: Identify knowledge gaps. What new models need to be developed in the future and what new data are required? Which data exist, which are lacking?

(H O Briceno)
1) Cites lack of ANY reliable groundwater data, which has been a persistent issue for years. Do not know quantity or composition.
2) Currently all the monitoring stations are too far away from river mouths (6+ miles) meaning that they are not accounting for contributions of the urban area (urban runoff) that happen downstream of the station. Current flow data available is not a realistic representation of reality. References funding request to FDEP to install some ADCPs at the mouths of the most important tributaries.
Additional challenge – for SF environment sampling is required as it is a low-nutrient environment and hard to employ sensors capable of measuring down into low DLs required. Not many institutions are performing regular sampling, mostly just DERM (some stations), and it is done for the purposes of regulation & compliance rather than research. Suggests that Universities should have monitoring programs to aid in collection of better-quality data with better detection limits, higher sampling frequency etc). Additionally, while some conditions/state of the system can be inferred from other collected data (correlations, PCA etc.) some variables are critical and require direct high-frequency testing. Some areas are “confidential”, and data is almost impossible to get e.g. Turkey Point). Additionally, data coverage is also an issue, e.g. stations from SFWMD and NPS are often located very close to shore as they are interested in the estuarine WQ (limited mostly to 100m), but data further E is equally critical for accurate modeling.

(N. Cortez) Regulatory data that is collected is often synoptic, despite the fact that there should be regular on-going sampling. It forms a sort of patchy collection of data with the absence of any comprehensive long-term monitoring. Ideally, you would want to have a defined set of parameters monitored on a grid of sampling locations over a long period of time so long-term trend analysis can be performed, including influence of climatic forcings/indicators (inc. shift in precipitation patterns and intensity, SLR, overland flow pattern changes etc). It is critical that the monitoring efforts are increased as modeling and trend analysis is only as good as the quality of the input and baseline data. Another issue – absence of historical/baseline data).

(R. Santos) Comments re Lidar data (un)availability, which is critical for seagrass modeling.

(C. Groppe) FDEP is trying to add light monitoring at their Sonde locations as light availability has been a major issue in the northern BB as sondes were developed to track flow from the Miami River into the Rickenbacker Basin and out of Little River into the Julia Tuttle Basin – this may be contributed to the model from Tulane.

(Omar Abdelrahman) Emphasizes that light collection methods need to be standardized, there are still inconsistencies between agencies.

Sub-summary of Virtual Group 4 discussion:
Q1: What questions need to be answered for management?
N. Cortez opened the discussion by providing a perspective from the SFWMD resiliency standpoint emphasizing that a lot of the questions posed to the SFWMD managers are concerned with operational decisions, which highlights the importance of knowing the sate of

the system pre-, during- and post- any discharge event. She then expanded on this point by acknowledging the importance of viewing the system from a holistic perspective, emphasizing that upstream water quality is crucial to any operational decisions. In the course of the subsequent discussion N. Cortez also highlighted the lack of long-term consistent monitoring effort within the Bay and adjacent areas, and by extension lack of reliable baseline data; she further comments that most data collection within the Bay is episodic, typically happening as a part of a permitted project, providing an incomplete picture of Bay's status and making long-term trend analysis (in part for the purposes of understanding climatic forcings) impossible.

C. Groppe and N. Cortez also point out the issue of identifying point-sources (of e.g. P or N) and necessity to be able to track the evolution of these sources over time.

R. Santos promoted the importance of living resources and associated ecosystem services they provide, and highlighted the importance of understanding how shifts in water quality can affect the status of said resources (i.e. presence/absence and abundance). This sentiment is echoed by R. Boucek, who also brings up value of local (non-institutional knowledge) knowledge (and references O. Santos's work in assimilating local ecological knowledge), and adds that potentially useful criterion could be the utilization of indicator species to use as proxies for water quality.

Q2: What models are currently used or developed and what data are required for each model?
Most of this discussion was lead by Henry Briceno, who is the PI for a Q-GIS style hydrodynamic salinity model developed specifically for modelling of the Biscayne Bay basin; Briceno comments on model's computational efficiency and ability to interface with other model. Briceno's group is also currently involved in applying the same core model to understand and map movement of microplastics within the Bay. Henry Briceno also provides links to his own monitoring data collected throughout his tenure:

Monitoring data - http://serc.fiu.edu/wqmnetwork/
Old Biscayne Bay data - http://serc.fiu.edu/wqmnetwork/sfwmd-cd/index.htm
Detailed report on Biscayne Bay with maps/data - http://serc.fiu.edu/wqmnetwork/BNP/Final%20Report%20BNP.pdf
Additional model data to be collected for B-BROIPS included references to Tulane University – SFWMD partnership, which attempts to incorporate some groundwater modeling to understand different discharge scenarios as well as examine the effects of sea level rise (N. Cortez).

O. Abdelrahman References a 3D hydrodynamic model that will be developed with Maria Olascoaga from RMSAS, UM (grant recently awarded).

Q3: Identify knowledge gaps. What new models need to be developed in the future and what new data are required? Which data exist, which are lacking?
Discussion was once again spearheaded by H. Briceno, who expressed frustration with persistent lack of any groundwater data, both in terms of flow/volume contributions and chemical composition (this was further echoed by every participant of the discussion). Additionally, H. Briceno highlighted inadequacies in current placement of monitoring stations which are often located 6+ miles away from river mouths, eliminating any ability to assess urban contributions downstream of the monitoring stations. Furthermore he comments on the limited spatial extent of data from estuarine regions which are restricted to ~100m of the shoreline, without any regard given to water quality further upstream, which is a crucial component of nearshore modeling.

N. Cortez follows this discussion once again emphasizing the lack of consistent monitoring in the Bay, and highlighting the importance of measuring a defined set of criteria across a uniform grid of sampling locations for the purposes of establishing Bay's biogeochemical background/"baseline" conditions, which would them facilitate identification of stressors/point sources and evaluation of impacts.

O. Abdelrahman stresses importance of having a standardized set of techniques for all sampling activities.

R. Santos and C. Groppe also discuss importance of utilization of Sonde and Lidar data.

Group 5 ~ (Virtual; limited, only ~50% of discussion available via video, most of the discussion is not on topic).

Question 1: What questions need to be answered for management?
(R. Alhale) Works in a regulatory position (coastal management), and for mitigation projects the main question revolves around water quality impacts on seagrasses and what management steps are most preservative towards seagrasses. These are crucial questions when it comes to project regulation and permitting.

(S. Tiffany) Echoes the point, coming from the perspective of the City. Main question: what can we do as a city to protect the BB: e.g. what ordinances should be implemented, how ordinances should be updated, what projects should be permitted, infrastructure upgrades etc.

(L. Reynolds) Makes a point re surface permeability and land use being a key factor in WQ management.

(R. James) Inquires re data on baseline conditions across the BB, notes that there are a lot of project which deal with specific issues and therefore concerned with discreet "diagnostic" sampling resulting in data snapshots rather than continuous on-going characterization. There are many lessons to be learned from historical data, and data coverage is crucial.

(L. Reynolds) Concurs re presence of data gaps, and adds that statistical treatment of data is likely skewing values as near-shore datapoints end up being averaged together with off-shore data points. Better statistical methodology is required, along with higher volume of observational/monitoring data. Additionally data collected for regulatory purposes ≠ data collected for research purposes.
Additional issue – identification of hotspots (e.g. of P). These requires groundwater collection and analysis to determine the composition – not currently done, which severely constraints the ability to comprehensively analyze and understand the entire system. This data USED to be collected, so some historical data exists – these monitoring efforts need to be re-established.

(K. Ishtiaq) brings up currently active projects (e.g, BBSEER and Back Bay) and how should Bay managers integrate these "data sources" into management decisions.

Q2: What models are currently used or developed and what data are required for each model?
(L. Deng) discusses data availability(?). Talks about buoy data in the BB (T, salinity, wind speed), and iterates that the objective of the workshop is to add to that collection of data for BB. Currently there is a very basic tool for rendering the timeseries data designed/developed for this purpose, but the main goal is to essentially build a massive data warehouse to present/make data available. There is no manipulation of data on the part of Project-associated data scientists; they are there just to ensure format compatibility and readability.
(L. Deng <-> K. Ishtiaq) development of a "data-quality check" took may be considered. But generally any operation with data is only up to the end-user. Deng gives an example where data outliers may be a nuisance to one researcher but represent an important piece of information for another).
(K. Ishtiaq) From a modeler's perspective: modelers prefer data sources that combine all desired variables (i.e. one-stop-shop v digging for data from different sources – calibration issue). [I think Dr. Ishtiaq is referencing data-interfacing, as he wants most data possible in one place]
(L. Deng) This is the objective of this project -> it's a platform that will house all the potentially possible data for BB – this is why these workshops are oriented towards searching for data sources to be incorporated into the platform. Current questions to participants is what data do you have, and what data would you like to have. Generally: any data is good data.

Q3: Identify knowledge gaps. What new models need to be developed in the future and what new data are required? Which data exist, which are lacking?
/little relevant commentary is provided, notes are therefore limited/

(L. Deng) this is a central question of the workshop – what data is currently lacking from PI and field scientist perspective that is crucial to more representative modeling.

(S. Tiffany) idea is to be able to get an overlook of the conditions in the BB. WQ parameters: P, N, DO.

(L. Reynolds) suggests diving WQ data by watersheds in an attempt to try and identify sources/hotspots of N and P. Shows the map that breaks down MDC by watersheds, within each watershed canals are being sampled. Breakdown of data by watershed may in fact be helpful in determining seagrass distribution patterns and aligning them to N/P ratios and N+P (and other pollutant) sources. Together with analyzing data from groundwater inputs may help pinpoint the culprit of seagrass die-offs. Same principle can be applied to other variables, e.g. land use – further allowing determination of impact of various land use scenarios on biogeochemical changes in water composition.

Sub-summary of Virtual Group 5 discussion: *(compiled from presented summary rather than breakout group discussion)*
Q1: What questions need to be answered for management?
What is the baseline for the Bay?

Q2: What models are currently used or developed and what data are required for each model?
Q3: Identify knowledge gaps. What new models need to be developed in the future and what new data are required? Which data exist, which are lacking?
The main objective of the project is to make wide variety of quality data available for ANY user to utilize and eliminating the issue of data accessibility as certain data is just hard to retrieve and assimilate. Types of data that have been mentioned as critical, rare and potentially un-retrievable are: soil type data, seagrass health/status data, variety of hydrological data.
-Platform improvements: (1) Suggestions were made for inclusion of a QC tool to allow for filtration of "bad data"; (2) addition of a functionality for data aggregation (e.g. breakdown by watersheds); (3) ability of multiple-window operation for data comparison (e.g. source data comparison, display two side-by-side windows with data from different sources to visualize/expose potential calibration issues?).

Contact Sheet: In-person and virtual registered attendees

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