The Panama Canal vs the pressures of climate

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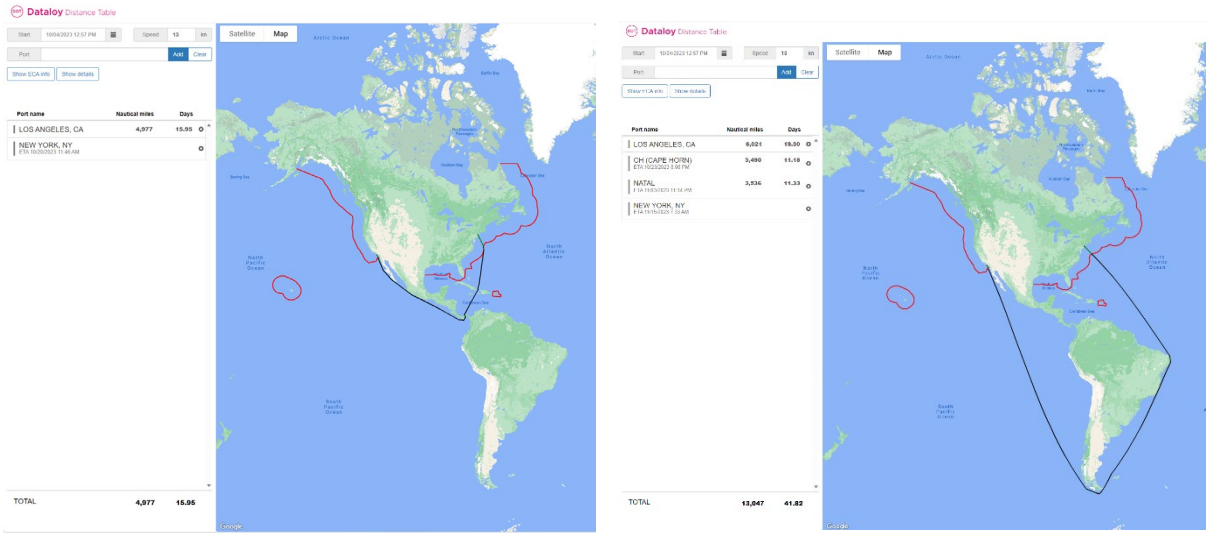
Background

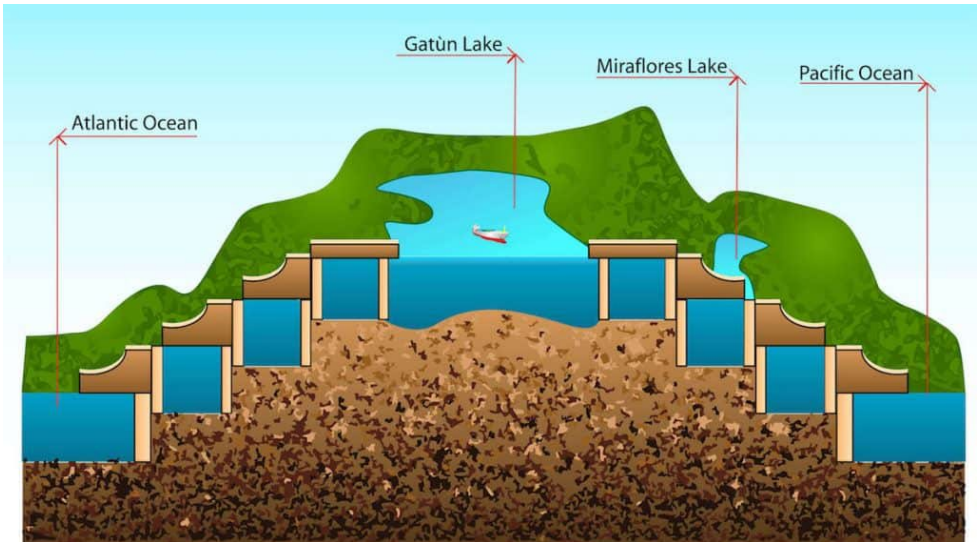
The Panama Canal, a man-made waterway inaugurated in 1914, allows vessels to shorten their voyage between the Pacific and Atlantic Oceans. On certain routes, it reduces travel distances by approximately 7,000 to 9,000 nautical miles, in some cases cutting the journey in half compared to alternative passages via Cape Horn or the Strait of Magellan at South America's southern tip. Figure 1 illustrates this difference by comparing the voyage from Los Angeles to New York using both routes.

Figure 1
Comparison of the route Los Angeles to New York via Panama Canal (left) and via Cape Horn (right)



As depicted in Figure 2, the Panama Canal operates using a system of locks that raise and lower vessels through chambers filled with water. This water is sourced from rain, collected via rivers, and stored in two artificial lakes situated 26 meters above sea level: Gatun Lake and Alajuela Lake. In addition to facilitating the operation of the canal, these lakes also supply drinking water to half of the population of Panama, including the three most populated cities of Panama City, Colon, and Panama Oeste (West Panama).

Figure 2
General description of Panama Canal locks system



Source: Maritime Insight

In 2016, the Canal inaugurated a new set of locks, such as to accommodate larger vessels but at the same time increase the number of transits handled per day. An average of 36 transits could pass through the Canal in both directions. The new set locks were constructed to save approximately 60% of water used on a lockage, signaling the importance of proper water usage due to strain pressure on transits and the drinking water of a large part of the country's population.

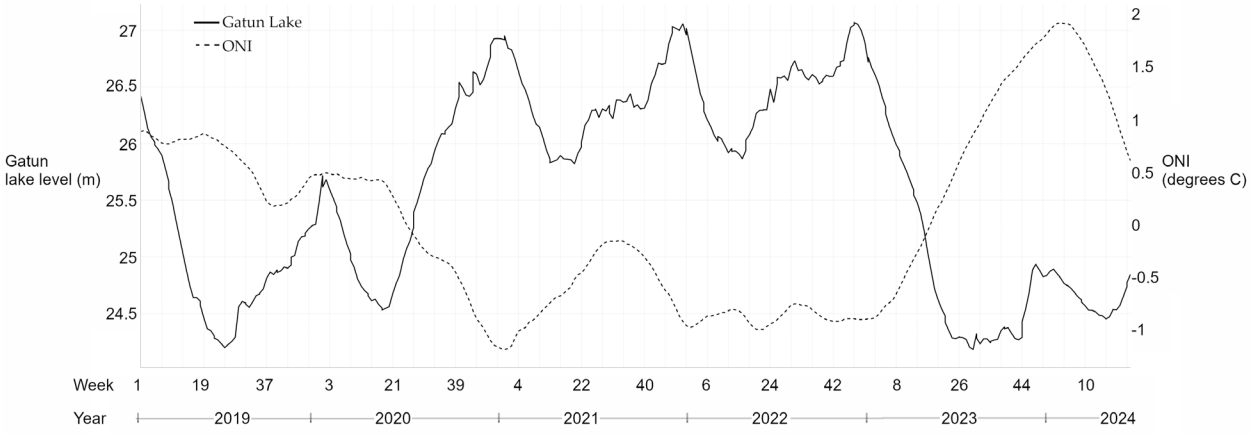
Panama Canal

Figure 3
Vessel transiting Miraflores locks

It is April 2023, the sustainability officer of the Panama Canal Authority (PCA) is on a visit to the Miraflores locks in the Pacific entrance of the Panama Canal. As she observed, a vessel transitioned through, releasing substantial black exhaust gases, such as the shown in the Figure 3.

It immediately comes to mind the strong pressure they are having from industry and media. Recent reductions in transit slots, aimed at preserving water during the severe droughts caused by El Niño, had led to notable queues and delays. El Niño, a quasi-seasonal climatic event occurring every 2 to 7 years, drastically reduces rainfall in Panama, reducing the lake levels as seen in Figure 4. Intensified El Niño (longer and more severe) are among the likely consequences of climate change.

Figure 4
Gatun lake levels and ONI from January 2019 to April 2024



Source: Fuentes and Adland, 2023
*ONI: Oceanic Niño Index

She knows that the Canal poses one of those strange connections where climate change could be reflected on the impact it has on world commerce in a relatively short time. The

exhaust gases remind her of the challenges the maritime industry has in terms of making shipping net zero by 2050 as per the 2023 International Maritime Organization (IMO) strategy on reduction of GHG emissions from ships.

The PCA had made strides by introducing the Green Connection Environmental Recognition Program. This ranking system reward cleaner vessels, providing incentives like passage priority. Separate from this system, they evaluate vessels based on their environmental performance, highlighting the emissions they saved by opting for the Canal route versus longer alternatives. Furthermore, PCA aimed to make its operations net-zero, incorporating measures like using electric cars and tugboats. Notably, Panama is one of the three carbon-neutral countries, as declared by the Panamanian government.

However, the Canal faces mixed challenges:

- **Operational Efficiency:** The Canal's daily earnings directly correlate with lake levels. More water availability means more transit.
- **Resource Competition:** Panama's populace competes for the same water that fuels the Canal's operations. The canal has the responsibility to provide water for human consumption.
- **Sustainability Scope:** The Canal has developed its 2023 baseline GHG inventory including all scopes and is working on its Sustainability Strategy which includes a decarbonization plan to reduce emissions in scopes 1,2 and 3.

The Panama Canal response

During an internal discussion at the Panama Canal Authority (PCA), the sustainability officer shared statistics on emissions generated by vessels passing through the Canal. The results are outlined in Table 1.

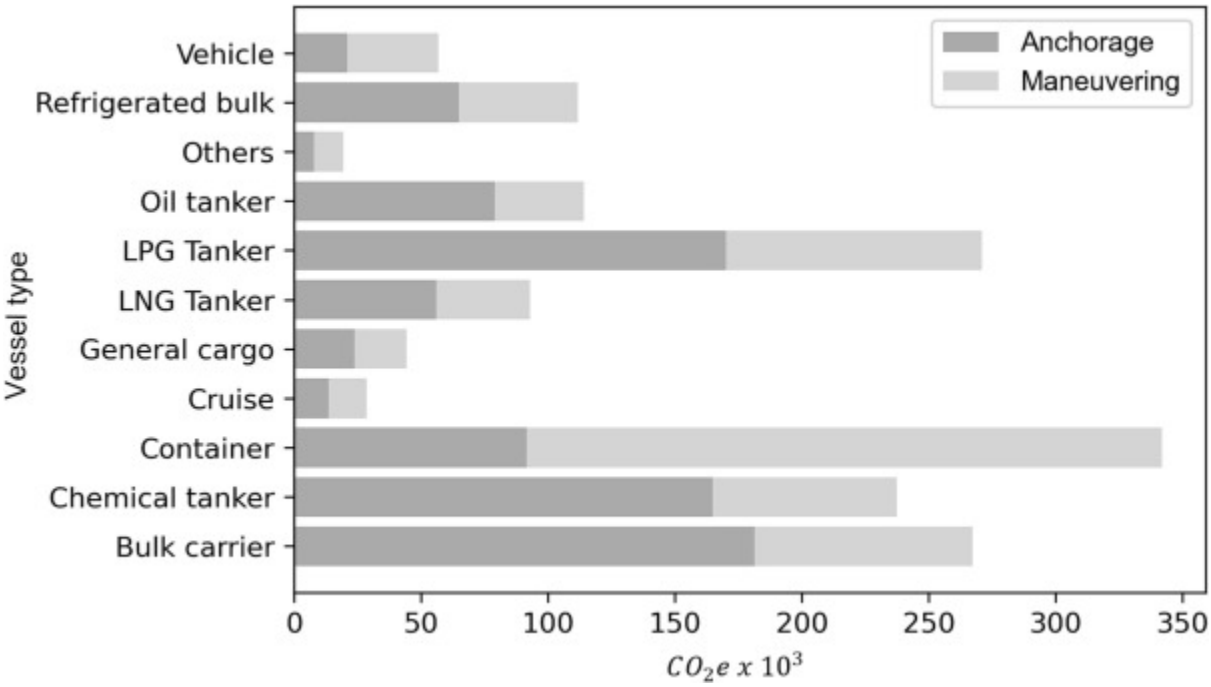
Table 1
Emissions for vessels transiting the Canal and legs before and after transiting (Jan. 2019 to Dec. 2021)

	CO_2 $x10^3$ (tonnes)			CH_4 $x10^3$ (tonnes)			N_2O $x10^3$ (tonnes)		
	Before	Canal	After	Before	Canal	After	Before	Canal	After
2019	15,081.6	375.70	14,713.5	6.387	0.261	7.693	0.863	0.022	0.840
2020	16,446.2	468.81	15,543.0	8.155	0.324	8.251	0.942	0.027	0.888
2021	17,585.7	689.19	18,008.2	9.811	0.449	11.265	1.003	0.040	1.026
Total	49,113.6	1,533.7	48,264.7	24.353	1.034	27.209	2.808	0.089	2.755

A stark contrast was observed between emissions within Canal waters and those outside. Indicating that the largest effect may be realized with vessels out of the canal waters.

Another element of interest, illustrated in Figure 5, is the significant portion of emissions originates from vessels anchored while awaiting transit. Although this pattern may have changed with the introduction of a system where customers are requested to book their transits, further study is needed to assess the extent of this reduction.

Figure 5
Emissions for vessels inside Canal waters (2019 to 2021)



Source: Fuentes and Adland, 2023

This reveals two critical implications:

- The majority of emissions in Canal waters arise from vessels in waiting.
- The anchoring period could be optimized to reduce emissions prior to the transit phase. In short, the waiting time is directly connected to the emissions of vessels in their way to the canal.

Based on the discussion, the following strategies were proposed to combat these emissions:

Partnering with the Blue Visby Solution: Upon information sharing, the initiative aims to slow the speed of vessels, reduce fuel consumption and emissions, and reduce waiting time at Canal.

Dedicated slots for low carbon intensity vessels: The PCA is working to introduce slots for low carbon intensity vessels and technologies. This is an incentive aiming to promote the transit of more low carbon fueled ships.

However, the proposed strategies are not without challenges:

- Risk of vessels opting for alternative routes due to the unpredictability introduced by the new scheduling system.
- Ensuring that market dynamics, such as those for container vessels demanding rapid transit, are preserved.
- Canal’s motivation in this endeavor, given it isn't bound by IMO regulations.

The strategies ideas were circulated among customers for their observations and analysis. From the responses there were two very contrasting positions.

Captain Pratichi Malik represents a prominent containers’ company with the most transits per company and the highest emissions profile of those transiting the Canal. He stands firmly against the proposed strategies. Currently, his company's container vessels benefit from transit priority, and many still rely on dirty Heavy Fuel Oil. While they acknowledge potential savings from reduced waiting times, the benefits do not outweigh the drawbacks. The proposed system would necessitate substantial retrofitting of their vessels, a prospect they're unenthusiastic about, especially combined with their reluctance to share data for the central scheduling system.

Drawing from his extensive experience as a vessel captain, Captain Malik is skeptical about the viability of the central scheduling system. Predicting a vessel's arrival is inherently challenging due to weather unpredictability. Furthermore, he emphasizes the importance of anchorage periods for activities like bunkering, receiving supplies, and crew changes. Switching to a new fuel source presents its own set of challenges; there's the potential for inadequate supply to sustain their operations and the resultant price hikes

from demand outstripping supply. Like many in the industry, Captain Malik's company adopts a "wait and see" stance on fuel selection.

On the other hand, Mrs. Mette Anne Olsen, who operates tankers for a Norwegian company specializing in time charter vessels, is supportive of the initiative. Her company has been planning to retrofit their fleet, and they're adversely affected by the prolonged waiting times caused by the ongoing drought. She perceives this as a dual opportunity: a chance to decrease operational costs and to streamline voyage planning, which currently faces uncertainties because of the Canal's waiting times. Historically, tankers have always been proactive in environmental measures, especially recalling the 1970s to 1990s era when they often made headlines for oil spills.

Conclusion

The sustainability officer saw this as an opportunity for the PCA to be at the forefront of the efforts to avoid climate change. The idea makes her proud, but she knew that they must first overcome the traditional setup of the maritime industry and she was afraid that it would not make it through. In any case, these same barriers (i.e., adverse to digitalization and data sharing) show up in different contexts, so it wouldn’t be a surprise if it doesn’t pass.

For her surprise, she received a call informing about the approval of the first pilot that is going to implement a scheduling system for vessels transiting the top 3 most emitting routes. A concept that aims to promote the development of Green Shipping Corridors. It seemed they had underestimated the industry's readiness for change.

References

Fuentes, G., & Adland, R. (2023). Greenhouse gas mitigation at maritime chokepoints: The case of the Panama Canal. *Transportation Research Part D: Transport and Environment*, *118*, 103694.