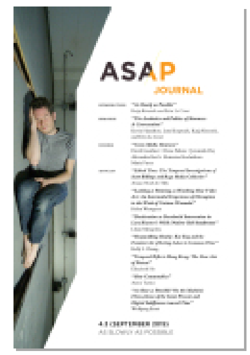
Phase to Phase: On Oceanic Oscillations, Measurements, Predictions, and Chronographs



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PHASE TO PHASE: ON OCEANIC OSCILLATIONS, MEASUREMENTS, PREDICTIONS, AND CHRONOGRAPHS

DAVID GAUTHIER

> Measuring time is essentially such that it is necessary to say "now"; but in obtaining a measurement, we, as it were, forget what has been measured as such, so that nothing is to be found except a number and a stretch.
>
> —Martin Heidegger[1]

Those who live near the sea know how well the tides clock an afternoon, a day, a week; anyone who has captained a boat at sea knows how important reading tide tables is to schedule departure and arrival from one port to another; and even a casual observer knows how different landscapes at high tide look in comparison to low tide—just think of Mont Saint-Michel or even the banks of the Thames, whose uncanny treasures are revealed along its shoreline only at low tide. Strange the rhythms of these tides, and very slow, too.

The ups and downs of tides are some of the slowest earthly oscillations one can observe with the naked eye. I say oscillation here because that is what they are: sinusoidal waves. Tides are primarily caused by the gravitational pull of the moon around the planet, which literally and relentlessly moves oceans and, in so doing, distorts the entire shape of the earth. Lunar tides occur twice a day and are thus termed semi-diurnal, with a period of 12 hours, 25 minutes, and 12 seconds—a strange half diurnal cycle, a little off the full diurnal cycle of the sun's twenty-four hours.

The movement of the tides was the starting point for two commissioned sound art installations that I produced for the group exhibition *The New Observatory* at FACT (Foundation for Art and Creative Technology), in Liverpool in the summer of 2017. The works address oceanographic instrumentation used to measure and/or predict the diverse periodic oscillations of the sea.

The first piece, an installation entitled *Measure for Measure for Measure*, explores the phenomenon of oceanic tides in their relation to simulations and reflects the ways in which traditional tide-level measurements have been replaced by predictive mathematical models that are able to accurately forecast what sea levels should be at any given time and any given place.[2] The second piece, *53°32′.01N, 003°21′.29W from the Sea*, a dual-channel video featuring a lone waverider buoy deployed at sea that measures the height, period, and direction of waves, foregrounds the elements of information-gathering that are lost by numerical and geographical data depictions:

the wild forces of the world and the angst of the instruments that face them.[3]

Using these works as vantage points, in this article I focus on possible strategies in producing artwork with earthly temporalities—that is, tempos that are slower than human perceivable registers—to discuss the juxtaposition and articulation of different times and intervals that prevail between physical phenomena, instruments, and human perception.

THE SPECTRUM OF NONPERCEPTION

During the research phase of the project, I was enticed by the devices, numbers, and science that are used in observing and predicting the movements of the sea. I came across bewildering tide table almanacs, books composed of only numbers that forecast the tide levels of a given port hour-by-hour, day-by-day, month-by-month, and year-by-year. As a sound artist, what fascinated me was that this numbering described sinusoidal waveforms, which are similar to sound waves, although significantly slower.

This brought to mind a seemingly ridiculous question that has always plagued me: What if you could slow down the playback of sound to an almost standstill?[4] Absurd indeed, yet in looking at the tides I was faced with an oscillation that moves in a wavelike manner at a decelerated speed that, for humans, might resemble just that: an almost standstill.

Early during the project, I contacted the National Oceanographic Centre (NOC) in Liverpool, an internationally renowned center for the studies of tides. The NOC oceanographers showed me a fascinating diagram depicting how waves and tides, as periodic waveforms, relate to each other and have different energy (power) constituencies depending on their respective periods (frequencies) (Fig. 1). The thing that captivated me in the diagram is its bandwidth, which spans periods from a single second (the left side, with rapid yet weak capillary/surface waves) up to hours (the right side, with very slow but powerful tides).

I was accustomed with such spectrographic diagrams for soundlike signals but had never seen one with such low frequencies. The human auditory sensorium has its own spectrum of perception (20Hz-0.05sec to 2kHz-0.0005sec), which would sit at the very far left of the diagram below. Our ears are innately tuned to certain oscillation speeds, though these are far faster than the periodic signals depicted below. The idea of a standstill is, after all, relative to our human sensorium. While we might see the water of the sea, it is rather difficult to synchronously feel the perpetual oscillation of the tides.

AS SLOW (AND SYNTHETIC) AS THE TIDES

I had long discussions with oceanographers from the NOC about the science of tides and the history of their prediction. Tide analysis

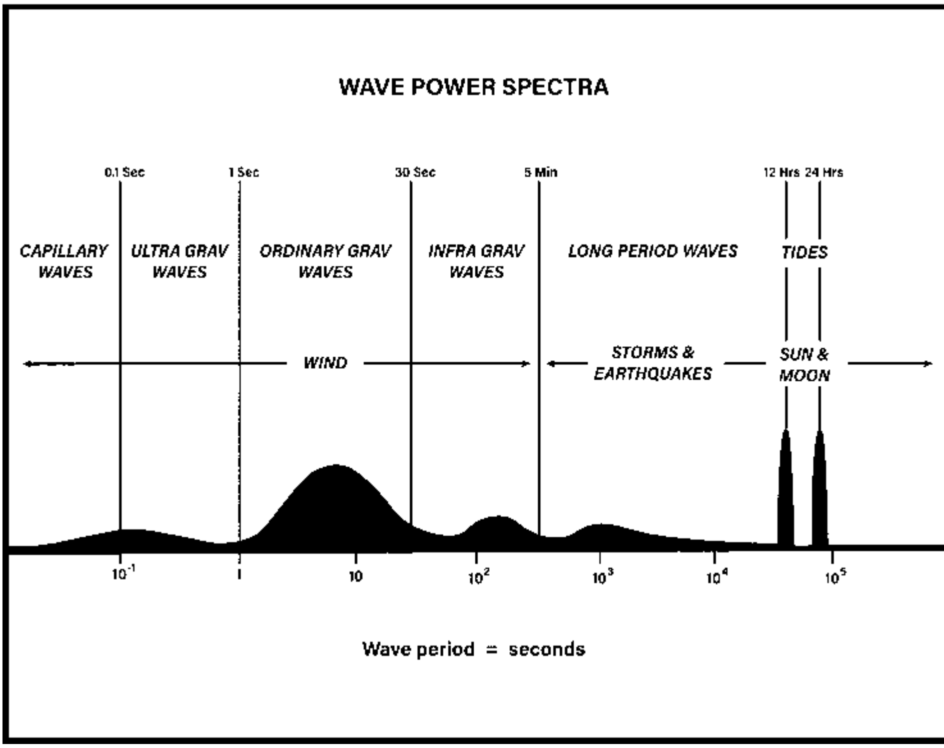

Figure 1.
Power spectra of oceanic waves.

relates to the science of harmonics just as the analysis of sound does. Tide and sound analyses are both based on the Fourier Analysis, a mathematical technique that decomposes a given signal into various sinusoidal constituents—its harmonics—which feature different frequencies and amplitudes. From the vantage point of a given location on earth, the gravitational pull of the moon and the sun become waveforms themselves, both being harmonic constituents of the tide's oscillations at a given locale. Geography also greatly influences tide patterns as water rushes in or out of a certain location, hence tides also have geographical harmonic constituents that vary considerably from once place to another.

Tide prediction machines were built around such notions and concepts, the first of which was devised by Lord Kelvin in 1872. These prediction machines were built using mechanical cogs and pulleys that were tuned to the various harmonic constituents of a given geographically located tide. The predictions of the harmonically modeled tide could be integrated by the machine whose sinusoidal output would be drawn directly onto a roll of paper. The poster-sized drawings it rendered would then be minutely sampled and transformed into the aforementioned tide table almanacs.[5]

Today, such almanacs are generated quasi-instantly using advanced computer models; having up to hundreds of harmonic constituents, they produce utterly accurate tide predictions. The advent of these highly precise machines, however, presents a topical, albeit peculiar, dilemma: do we entrust the synthetic computed prediction or the physical measurement? In other words, do we trust the map or the territory? The answer, in a sense, is neither and both; tides are still physically measured today, but these measurements are usually read against machine predictions, that is, they are used as correcting devices for the computerized mathematical models. Such an interplay between physical tide measurements and their twin mathematical predictions is not entirely new—it dates back to the aforementioned tide prediction machines of the late nineteenth century, which can be seen as one of the earliest forms of analog computers used to model physical phenomena.

The notions of synthesis and the synthetic became central frames for *Measure for Measure for Measure*. Because mathematical concepts, notions, and operators do indeed travel from one domain (tide predictions) to another (sound synthesis), tide prediction machines (analog or digital) can be seen as synthesizers producing precise, synthetic waveforms. Thus, to address the question of slowing down sound to a standstill, I had to invert it: would it be possible to hear the tides by (re-)synthesizing the almanac?

For the project, I obtained four months' worth of tide predictions (in fifteen-minute samples) from the NOC for Liverpool's Gladstone dock. With these predictions, I produced a wavetable sound sample that I could play using some of my custom-built sound synthesizers. Although the raw tide data spanned months of predictions, the sound sample I produced with it amounted to less than a second-long sound—the fifteen-minute interval between predictions had to be reduced to tens of milliseconds for my synthesizer to produce any sound at all. In varying and playing with this interval, I was able to time-stretch the playback of the sound sample as I wished.

The installation featured a tide hut and free-standing antennas, built to look like the ones found in various locations around the globe where physical tide measurements are typically recorded before being sent to remote databases via wireless data links. As part of the installation, and in accordance with the data I had obtained, every fifteen minutes the tide-level prediction for that time was read aloud in the gallery, ultimately reading all the data during the four-month-long exhibition. The predictions' synthesized sound sample was played when someone entered the hut, while the actual numerical value of the current

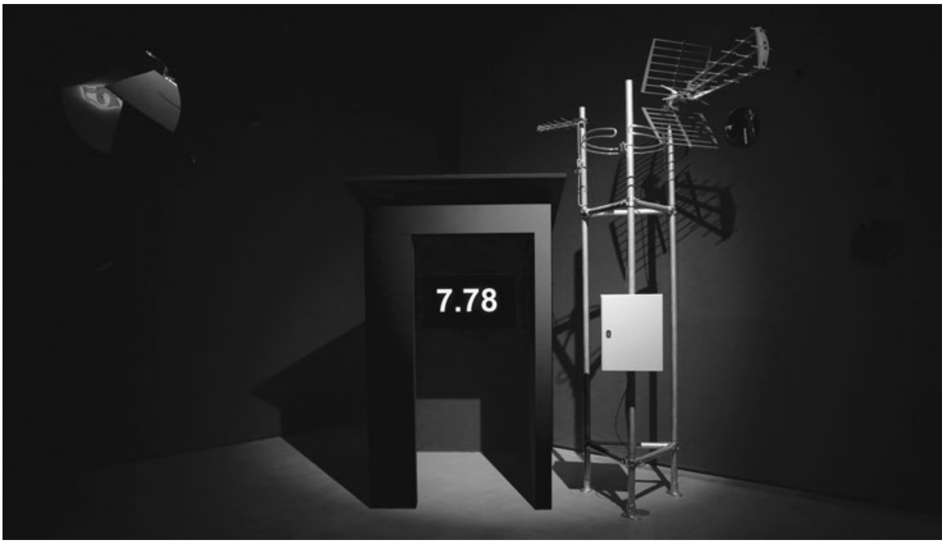

Figure 2.
David Gauthier, Measure for Measure for Measure *installation (2017). Image courtesy of the author.*

prediction would appear on a monitor atop a 3D model of a synthetic sea (Fig. 2).

Measure for Measure for Measure thus affirms a juxtaposed "now" through a synthesis (sound) of a synthesis (tide predictions). The first, albeit more comprehensible, "now" was the tide predictions readings that were read aloud every fifteen minutes. These were accurate, numerical, and synthetic depictions of what the tide level at Liverpool's Gladstone dock should be on that precise date and time of day. The second "now" relates to the duration of the exhibition, which lasted four months, for which the entire tide predictions were heard at once—not as narrated numbers in this case, but as sound synthesis when visitors entered the hut and triggered the sound sample to play. The juxtaposed voice readings and synthesized sound were complementary, both reciting the same tide predictions datum, though they did so at very different speeds: one took four months to read all the predictions while the other took less than a second to do so. In a way, the idea of a standstill was approached by means of manipulating the tidal waveform's time axis, time-stretching the ultralow sampling frequencies of the tide datum (minutes) to faster auditory frequencies (milliseconds), producing a comparative reading where one instance is uncannily faster (or slower) than another.

While working on this temporal "synthesis of synthesis," it became clear the project was grappling with a "deterritorialization of a deterritorialization." The first deterritorialization is achieved in rendering the tides' phenomena into graded levels and numbers that in turn escape the premises of the measuring apparatus (the tide hut with its wireless data links) and end up in remote databases to be analyzed. The second deterritorialization is the predictive tide model that, based on the recorded measurements and the various mathematical qualities of the waveform they describe, is used to produce tide readings that have yet to come. In this sense, predictions are operations of preemption and dislocation. While able to affirm, with precision, a synchronous "now," they erase the "here" of what they denote. Predictions do not have a specific territory—they might refer to one, but they inherently have none; or rather, they do have a generic territory (typically a computing machine) that does not require a sharing of the same situated milieu of the phenomenon the predictions refer to. With the next project, I wanted to contrast these synthetic deterritorializations by getting closer to the act of measuring phenomena, that is, getting closer to the "here" of the territory.

PRESENT YET ALWAYS LAGGING BEHIND

For more than sixteen years, a lone buoy deployed in the Liverpool Bay (53°32′.01N, 003°21′.29W) has been measuring waves and providing data to the British Centre for Environment Fisheries and Aquaculture Science (Cefas). A mere point on the UK's map of buoys operated by Cefas, the Liverpool Bay waverider buoy was constructed to be completely autonomous and is capable of withstanding the harshest sea conditions. It has many interesting features: its diameter is 0.9 meters, it weighs more than 225kg, and it is equipped with an antenna to transmit logged wave measurements to near shore data links (or satellites).

It is easy to forget the physical situatedness of such instruments; we barely see these measuring apparatuses behind the numbers and data sets they produce. It is as if the dynamics of their physical context are violently neutralized by the stillness of a map. A 225kg buoy riding waves of 2.1 meters high, for instance, comes to our attention as nothing more than a single number next to a red arrow somewhere on a map of the sea, alongside many other anonymous red, green, or blue arrows (Fig. 3).

Something gets lost in numerical data depictions and rational interpretations: the force of the world and the angst of the instruments that face it. Numbers neutralize what it is that is numbered. Yet there is a "here" and "now" of numbering, a moment and a place when and where a physical phenomenon is transformed into a digit. *53°32′.01N, 003°21′.29W from the Sea* looks at the "here" and "now" of oceanographic measurement, turning away from the neutral, bland arrows of the Cefas map. With the work, I wanted to draw attention to the forces of the ocean and the operational milieu of the measuring devices that depict them, so I decided to go out to sea to film the lone waverider buoy in the Liverpool Bay.

As expected, the raw video footage of the buoy was jittery: the waves moved both the buoy

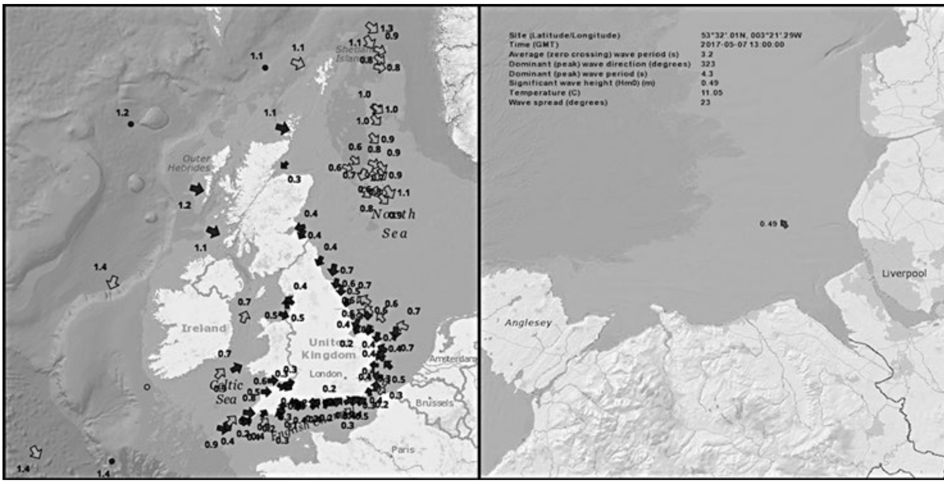

Figure 3.
Map of the waverider buoys deployed in the UK (left) and map of the Liverpool's buoy as depicted in 01N, 003°21°32′.29W from the Sea *(right).*

during the filming and the boat from which the video was shot. This dually constructed jitteriness gave the video an interesting hypnotic character and allowed me to transpose the dynamics of the video so that the wavelike movement of the camera became both a cue for sound production and a way to inverse the viewing perspective; rather than looking at the buoy through the jittery camera, the buoy would "look" at the world around it. This transposition was achieved in post-production by stabilizing the location of the buoy and the horizon in the video frame so that the frame itself would move around in order to keep both visual elements in place (Fig. 4). The frame-by-frame rotation and translation information produced by the stabilization algorithm was then mapped onto the frequency-modulating (FM) parameters of my sound synthesizers, creating sound signals synchronized with the movements of the frame, which added to the hypnotic character of the video. By stabilizing the buoy in the jittery video, the wave dynamics that moved the buoy and the boat were thus transferred to the frame and its concurring sound. The video synthesis of the frame stabilization algorithm was thus transformed into sound synthesis, remediating the mediation so to speak.

The work was exhibited as a dual-channel video, contrasting the highly dynamic video footage of the buoy (Fig. 4) against the stillness of the Cefas map showing the location of the instrument (Fig. 3). An actual waverider buoy, similar to the one filmed in Liverpool Bay, was also part of the gallery display. I did not directly use the measurements produced by the waverider buoy for the installation. While this data is freely available on the Cefas website, it was too slow for the video effect

Figure 4.
David Gauthier, Still image from the 01N, 003°21°32′.29W from the Sea *video. Image courtesy of the author.*

I was looking for since the buoy only sends punctual data in fifteen-minute intervals. Averaging waves' measurements over certain time intervals makes sense since waves are periodic and capturing this periodicity is not instantaneous—it does indeed take time.

The calibrated slowness of the buoy's periodic wave measurement raises interesting questions relating to the different temporal dimensions of the aforementioned distinction between map and territory. As high resolution as it might be intended to be, a map assembled by means of measuring phenomena will always lag behind the "nowness" of the territory. A datum can only be produced by an instrument after the fact, that is, after a certain time interval. Measuring can be seen as a quantization process that introduces a temporal lag between the advent of the measured phenomena and the measure itself. The simultaneity of phenomena and its measure is a lure; while measuring might affirm a "now," as Heidegger suggests in this article's opening quote, it is a now that lags behind, a now that has already passed.

WHERE IS "HERE" AND WHEN IS "NOW"?

So this brings me to the question: Where is "here" and when is "now"? A prediction is a preemptive "now" and a displaced "here," while a measurement is a co-situated "here" and a lagged "now." In other words, the "where" of prediction is not the same as the "where" of the predicted phenomenon, as predictions are typically produced by (computing) machines that do not necessarily need to share the same situated context or medium as the phenomenon itself. On the contrary, measuring instruments do share the "where" of the phenomenon, as most processes of measuring are materially transitive in that physical signals are captured and transduced from one form to another (e.g., wave to electric digit, etc.). In short, a prediction is a "no-where" that must be asserted simultaneously with the "now" of the phenomenon (e.g., a tide prediction at *this* specific time), while a measurement is a co-situated "here" that arrives after the fact, even if this "after" amounts to very short time interval.

These are the temporalities and ideas I grappled with while producing the works presented here, for which I always had to relate the "here" and "now" of both the nonhuman instruments and earthly temporalities I was looking at with my own bodily, affective, and peculiar "here" and "now." Our human sensorium is bound to certain phenomenological and physiological speeds that can be fast or slow depending on the type of materials, techniques, or phenomena one is working with. Making artworks is to attend to these reciprocal speeds. It is also to devise tactics to capture and synthesize nonhuman temporalities so that they can be sensed in one form or another during the "here" and "now" that is an exhibition. And indeed, an exhibition might, in turn, be regarded as an observation device conjugating various levels of reality, articulating various temporalities and locales. Surely an exhibition must follow its own dramaturgy, but, just like an instrument, it must also calibrate, capture, synthesize, and feed forward realities that do not necessarily share the same original "here" and "now." Indeed, there are genuine and intricate questions as to where is the "here" and when is the "now" of exhibition—questions, I believe, that are necessarily imbricated in any artwork if not directly addressed as such.

Notes

[1] Martin Heidegger, *Being and Time*, trans. John Macquarrie and Edward Robinson (1927; Malden, MA: Blackwell, 2013), 471.

[2] David Gauthier, "Measure for Measure for Measure," *davidgauthier.info*, 2017, https://davidgauthier.info/measure-for-measure-for-measure/.

[3] David Gauthier, "53°32′.01N, 003°21′.29W from the Sea," *davidgauthier.info*, 2017, https://davidgauthier.info/533201N0032129W-from-the-Sea/.

[4] Sound is a vibration, and thus a nonvibration, or complete standstill, would not be audible.

[5] For more information about tide predicting machines, see "Tide Predicting Machines," *Tide & Time*, 2019, http://www.tide-and-time.uk/tide-predicting-machines.

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DAVID GAUTHIER *is an artist and an academic affiliated with the Amsterdam School for Cultural Analysis (ASCA). His work addresses the various regimes of legibility/illegibility of modern technological and computational equipment. In exploring these regimes from vantage point of mathematics' contemporaneous relation with materialisms, his work elucidates questions of human and nonhuman processes of sense-making, inquiring how modern mathematics and new materialisms affect age-old notions of sense. His art practice is primarily sound-oriented and his installations have been commissioned by various arts institutions and exhibited in diverse places across Europe. He is currently a Senior Lecturer in New Media at the University of Amsterdam and was a doctoral fellow of the Netherlands Institute for Cultural Analysis (NICA).*