Nigel Helyer
Sonus Maris, 2022

video with soundscore, 11:22 mins

Sonus Maris is the outcome of an artist residency undertaken by Dr. Nigel Helyer at UNSW Water Research Laboratory (WRL). The audio-video artwork features sonified data charting the changing coastlines of Durras Lake, Shoalhaven Heads, Smiths Lake, and Farquhar Inlet, four New South Wales estuaries known as intermittently closed and open lakes and lagoons (ICOLLs). Dr. Helyer collaborated with WRL postdoctoral researcher Dr. Tino Heimhuber, who developed the open-source InletTracker toolkit. InletTracker enables researchers to unpack nearly 35 years of satellite imagery tracking the coastal dynamics of all ICOLLs and tidal inlets worldwide. *Sonus Maris* pairs data visualisations from Dr. Heimhuber's InletTracker with a monophonic soundscore developed by Dr. Helyer that correlates the note's pitch with the flow of water; high and low notes correspond to open (high flow) and closed (low flow) entrance conditions. *Sonus Maris* demonstrates the capacity for sound to translate information into an immersive environment, presenting aural processes as a way to interpret scientific data.

Project Team:

Dr. Nigel Helyer; Artist-in-Residence, Water Research Laboratory, UNSW.

Dr. Valentin (Tino) Heimhuber; Research Fellow, Water Research Laboratory, UNSW.

Professor Ian Turner; School of Civil and Environmental Engineering, UNSW.

This project is supported by the NSW Government through Create NSW.

Nigel Helyer
Sonus Maris: Strange Attractor, 2022-2023
video with soundscore, 11:28 mins

Sonus Maris: Strange Attractor is a meditation on the recurrent patterns formed by channels linking coastal lakes and lagoons with the ocean. The channels constantly change in activity level, scale, and location. These changes are driven by known environmental variables interacting within specific parameters, thus producing similar but never identical outcomes. The accumulative traces visible in the video are shaped by these environmental *strange attractors*. The piano soundtracks accompanying each of the four sections are a direct musical translation of the water flow activity between the coastal lakes and the open water—the higher the flow, the higher the pitch. In this video, Dr. Helyer sets the monophonic series of notes parallel to an identical note sequence two octaves lower.

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Acknowledgment of Country

We acknowledge that this project encompasses the unceded territories of the Biripi, Jerrawangala, Jerrinja, Murramarang, Tharawal, Wandi Wandian, and Worimi peoples, who are the Traditional Owners of the lands and waters. We pay our respects to the Elders, both past and present, and extend that respect to other Aboriginal and Torres Strait Islanders attending this exhibition located on the unceded lands of the Bedegal peoples.

The estuarine systems featured in *Sonus Maris* are ecologically, economically, and culturally important. While this exhibition examines ICOLL changes over the past three decades, this is Aboriginal Land inscribed with more than 65,000-years of rich history and heritage. We recognise the longstanding and ongoing interdependent relationship the Traditional Owners have with these lands and waters.

(Left)
Map of Indigenous Australia
by Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS)
Credit: David R Horton (creator), © AIATSIS, 1996.

(Above right)
***The Dharawal and Dhurga Languages of the New South Wales South Coast,* 1976**
by Diana Kelloway Eades
Printed in Canberra by Australian Institute of Aboriginal Studies.
499.15/90

Landsat and Sentinel-2 Missions

InletTracker utilises Landsat 7, Landsat 8, and Sentinel-2 satellite imagery to chart changes to ICOLL estuaries. These satellites circumnavigate the globe, continuously recording data and imagery of the Earth's surface. The image archive captured by these satellites is in the public domain and available to scientists for their research and study. The data collected by the satellites reveal the long-term effects and environmental impacts of climate change. This information is vital in shaping government policy around land and water use, predicting extreme weather events, and responding to natural disasters.

(Above left)

Illustration of Landsat 7 satellite

Credit: NASA Goddard Space Flight Center.

(Above right)

***Landsat 7 [pre-launch],* 1999**

Credit: Landsat imagery courtesy of NASA Goddard Space Flight Center and U.S. Geological Survey.

(Above centre)

3D model of Landsat 9

Credit: National Aeronautics and Space Administration (NASA). Author/Origin: NASA/JPL-Caltech.

InletTracker

InletTracker is a free Google Earth Engine enabled python toolkit that draws on 35 years of public-domain satellite imagery, specifically from Landsat 5, 7, 8 and Sentinel-2 missions. This allows users to reconstruct the dynamics of coastal inlets over the last three decades by retro-analysing flow patterns and frequencies of water bodies. InletTracker uses the infrared component of the satellite imagery that is not visible to the human eye and applies a path-finding algorithm to trace the rapidly evolving inlet channels.

New South Wales is home to over 20% of intermittently closed and open lakes and lagoons (ICOLLs) found worldwide. Factors tied to climate change, including changes in rainfall, tidal currents, and waves, drive environmental shifts in coastal waterways. ICOLLs are considered the estuary type most vulnerable to climate change, yet there has been a distinct lack of data on their long-term behaviour. The dynamic nature of opening and closing water bodies to the ocean can have dramatic ecological impacts over time. Researchers at the UNSW Water Research Laboratory developed InletTracker to overcome this lack of long-term understanding and to address the future environmental challenges of maintaining these unique ecosystems.

(Above left)
Map of ICOLLs of Southeast Australia
by Dr. Valentin Heimhuber
Credit: Google © 2022, Data: SIO, NOAA,U.S. Navy, NGA, GEBCO Landsat / Copernicus.

(Below left)
***InletTracker algorithm,* 2021**
by Dr. Valentin Heimhuber

(Above right)
***Conceptual diagram illustrating the architecture and key processing steps of InletTracker,* 2021**
by Dr. Valentin Heimhuber

Cartography

Cartography is the science of generating a graphic representation of a place in the form of a map. Maps document and record important geographical features like mountains, bodies of water, and cities. Instruments, such as a compass, telescope, and sextant, enabled cartographers to measure the distance between objects and accurately record the information. Early surveyors utilised magnetic bearings to plot the map lines. Modern mapping techniques involve the use of satellites to precisely survey and chart the physical terrain and coastline. The above maps, from the late-18th and 21st centuries, chart the same segment of coastline and demonstrate the advancement of mapmaking technology.

(Above left)
***A new and accurate map of New South Wales with Norfolk and Lord Howes Islands, Port Jackson from actual surveys,* 1794**
Etched by Thomas Foot
Printed in London by Robert Wilkinson
UNSW Library Special Collections
VQ 912.94/43

(Above centre)
Australian Coastline with 4 ICOLLs: Durras Lake, Shoalhaven Heads, Smiths Lake, and Farquhar Inlet

(Above right)
***Atlas of the Settled Counties of New South Wales…*, 1872**
by Basch and Company
Printed in Sydney by Basch & Co.
UNSW Library Special Collections
VF 912.944/2

Composition and Musical Notation

The graphic charts and sketches reveal Dr. Nigel Helyer's process of assigning pitch to numerical data taken directly from the InletTracker toolkit. The data points on the graph correlate to an analysis of pixels in the legacy Landsat images, which Helyer translates to a musical note within the 12-tone chromatic scale in C major. The handwritten notes in the middle column illustrate his working method. He assigns a lower pitch to lower numeric values, ascending note-by-note to higher octaves with higher numeric values. Helyer's original handwritten scores for the four ICOLL sites encompass the final transposition of satellite data to music composition. The converted notes form a non-repeating 'melody' to be performed by a musician who was a pianist in the *Sonus Maris* soundscore.

In comparison, *24 Preludes* by 19th-century Polish composer Frédéric Chopin demonstrates how Helyer modifies the written score format. Chopin's sheet music includes the essential components of Western musical notation, a system of symbols used to visually represent tonal music. This includes the five-line staff with treble and bass clef to specify the range of notes relative to middle C and designate which hand typically plays the music; vertical bar lines to separate sections and measures of time; and the notes themselves, constructed with noteheads and stems signifying the duration which the note is to be held. Helyer sonifies data by manipulating this musical notation system, enabling audiences to encounter the coastal flows and changes captured in InletTracker through sound.

(Above left)
***Sonus Maris: four monophonic scores*, 2022**
by Nigel Helyer
graphite and ink on paper, 21 x 30 cm

(Below left)
***Sonus Maris: data sonification sketch*, 2022**
by Nigel Helyer
graphite and ink on paper, 30 x 130 cm

(Above right)
***24 Preludia (Preludes)*, 1951**
by Frédéric Chopin
Printed in Kraków by Polskie Wydawnictwo Muzyczne
UNSW Library Special Collections
VF 780/CHO/S-3