



UNSW LIBRARY SPECIAL COLLECTIONS

# **Sonus Maris**

---

Large print  
Exhibition guide

## Introduction

*Sonus Maris* is an exhibition navigating the intersections between art and science emerging from an ongoing collaboration between artist Dr. Nigel Helyer and water engineers and scientists at the UNSW Water Research Laboratory (WRL). Working in close partnership with WRL postdoctoral researcher Dr. Tino Heimhuber, Helyer employs audio-visual media to reinterpret data charting the unique dynamics of intermittently closed and open lakes and lagoons (ICOLLS). ICOLLS are the most prominent type of estuaries found on the NSW coastline and are unique in that they alternate between open and closed oceanic entrance conditions, driven by the dynamic interplay between oceanic and land-based forces. Through data archaeology and a novel algorithm, Heimhuber extracts valuable information from a three-decade archive of public satellite imagery, drawing attention to long-term morphological and eco-hydrological variations in these crucial sites. Helyer interprets this detail-rich source material to compose a musical score translating the changeability of ICOLLS as a multisensory experience. Helyer's experimental music invites audiences to rethink knowledge systems by seeing, feeling, and hearing the flows and patterns of coastal environments.

## Acknowledgement of Country

We acknowledge that this project encompasses the unceded territories of the Biripi, Jerrawangala, Jerrinja, Murramarang, Tharawal, Wandjiman, 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

# GALLERY 1: Sonus Maris

**Nigel Helyer**

***Sonus Maris*, 2022**

video with soundscore, 11:22 mins

Credit: Reference visuals include Public Domain satellite footage courtesy of National Aeronautics and Space Administration (NASA). Google Earth imagery: © Google 2022.

*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.

## 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 twelve-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) **Nigel Helyer**

***Sonus Maris: four monophonic scores, 2022***

graphite and ink on paper, 21 x 30 cm

(Below left) **Nigel Helyer**

***Sonus Maris: data sonification sketch, 2022***

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



## GALLERY 2: ICOLL Sites

**35°38'21.18"S : 150°18'24.66"E**

Durras Lake, NSW

Located on the traditional lands and waters of the Jerrinja, Jerrawangala, and Murramarang peoples of the Yuin Nation

Durras Lake, located 20 kilometres north of Batemans Bay / Yangary (Walbunja) on the South Coast of NSW, is filled with near pristine water surrounded by tall gum trees in Murramarang National Park. The estuary has large areas of salt marsh, with the entrance periodically opened artificially during low tide when the water height exceeds a trigger level. Occasionally during high rainfall, the lake will self-open to the sea, with a subsequent dry spell causing it to re-close.

Image (left) ***Google Earth satellite imagery of Durras Lake, NSW (14.09.2019)***

Credit: Google © 2022, Image: CNES / Airbus, Maxar Technologies, TerraMetrics. Data: SIO, NOAA, U.S. Navy, NGA, GEBCO.

Image (top right) ***InletTracker processing of Sentinel-2 image of Durras Lake in an open state (14.01.2021)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).

Image (bottom right) ***InletTracker processing of Sentinel-2 image of Durras Lake in a closed state (10.4.2019)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).

**34°51'42.39"S : 150°44'54.31"E**

Shoalhaven Heads, NSW

Located on the traditional lands and waters of the Jerrinja, Tharawal, and Wandj Wandian peoples

The Shoalhaven is a barrier river estuary and is one of the largest catchments on the South Coast. It has two oceanic openings: Berrys Canal, constructed in 1822, which is always open, and the northern entrance, which is intermittently open during floods or other extreme weather events. The Shoalhaven River, originating in the Southern Tablelands, is joined by 34 tributary streams causing flowing freshwater to meet saltwater at the river's entrance to the sea.

Image (left) ***Google Earth satellite imagery of Shoalhaven Heads, NSW (24.02.2016)***

Credit: Google © 2022, Image: TerraMetrics, Data: SIO, NOAA, U.S. Navy, NGA, GEBCO.

Image (top right) ***InletTracker processing of Sentinel-2 image of Shoalhaven Heads in an open state (12.08.2021)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).

Image (bottom right) ***InletTracker processing of Sentinel-2 image of Shoalhaven Heads in a closed state (25.12.2021)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).

**32°23'36.07"S : 152°31'8.72"E**

Smiths Lake, NSW

Located on the traditional lands and waters of the Worimi peoples

Smiths Lake is a saline lagoon on the Mid North Coast of NSW. A large coastal dune separates the lake from the Tasman Sea. Periodically, when the lake reaches 2.1 metres above sea level, a wide trench is bulldozed across the sandbar to open it to the ocean. This recently occurred in September 2022 to prevent flooding to low-lying lands around the lake. The sudden opening often causes powerful water flows, including rips and currents that create dangerous conditions.

Image (left) ***Google Earth imagery of Smiths Lake, NSW (27.07.2021)***

Credit: Google © 2022, Image: CNES / Airbus.

Image (top right) ***InletTracker processing of Sentinel-2 image of Smiths Lake in an open state (22.10.2021)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).

Image (bottom right) ***InletTracker processing of Sentinel-2 image of Smiths Lake in a closed state (13.08.2021)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).

**31°57'16.81"S : 152°36'9.22"E**

Farquhar Inlet, NSW

Located on the traditional lands and waters of the Worimi and Biripi peoples

Farquhar Inlet, the southern entrance to the Manning River / Boolumbahtee (Birrpayi) on the Mid North Coast of NSW, is part of a unique double delta water system – the only one in the southern hemisphere. It is predominantly a closed oceanic entrance that is occasionally artificially opened. In 2021, the channel was dredged open in response to significant flooding upstream.

Image (left) ***Google Earth imagery of Farquhar Inlet, Oxley Island NSW (05.09.2022)***

Credit: Google © 2022, Image: Maxar Technologies, CNES / Airbus.

Image (top right) ***InletTracker processing of Sentinel-2 image of Farquhar Inlet in an open state (01.04.2021)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).

Image (bottom right) ***InletTracker processing of Sentinel-2 image of Farquhar Inlet in a closed state (21.11.2020)***

Credit: Public Domain image courtesy of the European Space Agency (ESA) / National Aeronautics and Space Administration (NASA).



## **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

# **GALLERY 3: *Sonus Maris:* *Strange Attractor***

**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.



## **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.

## **UNSW Library Special Collections and Exhibitions**

### **Curator**

Dr Megan Fizell

### **Exhibitions Coordinator**

Emily Morandini

### **Visual Communications & Publications Coordinator**

Jane Eliasson