

Architecture Fringe Summer Assembly 2026

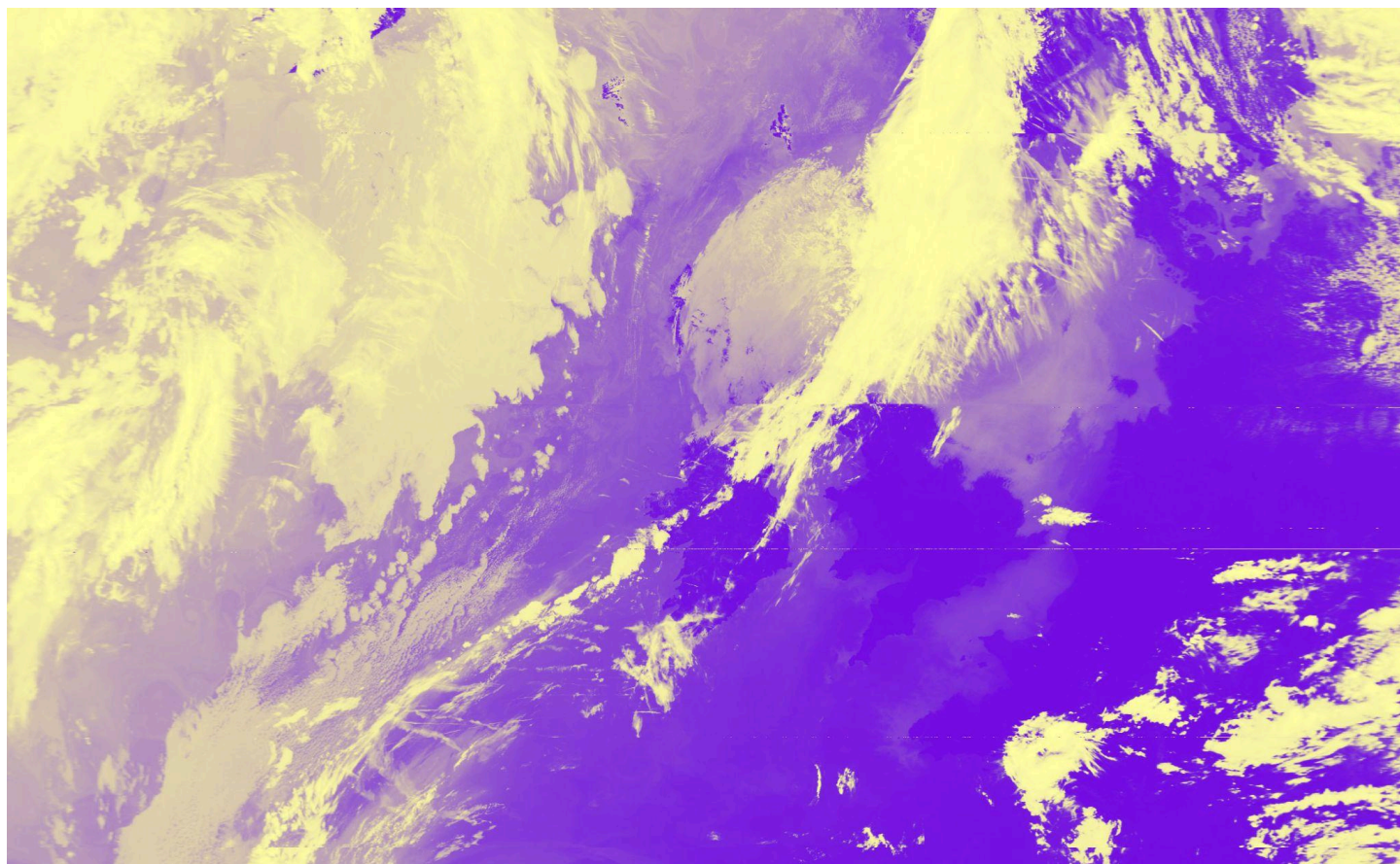
Insurgent Meteorologies

Handbook

So we are here in the weather, here in the singularity.

Here there is disaster and possibility.

Christina Sharpe, 'In The Wake: On Blackness and Being' (2016)



Metop B received at Hospitalfield on 11 July 2026 at 11:23

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Welcome

Welcome to the Insurgent Meteorologies crew! We are planning an exciting week together in the waves: radio waves, sound waves, sea waves. Our task is to build an expanded Earth Station at Hospitalfield and to use the signals it captures to create an experimental weather cast to be broadcast on dundee radio club and Wave Farm!

We will begin our journey with an introduction to each other and radio, before learning about the storied Dundee Satellite Receiving Station that is an inspiration. Mid-week, with help from special guests, we will tune out of the electromagnetic spectrum and into the world of field recording, and so sound waves. We will end by creating a communal weather cast!

But wait... what is insurgent meteorology? This is up to us. Our starting definition is borrowed from Iranian-American urbanist Faranak Miraftab who coined the term 'insurgent planning' to describe and call for grassroots practices that are transgressive, imaginative, and challenge dominant ideas. Additionally, we will engage with an emergent consensus in feminist and anticolonial scholarship and activism that weather and climate are more-than-meteorological!

This idea is intended as a common starting point, where we go next is up to us. Importantly, although we learn from theory, our week is practice-based. Over the next five days we will assemble skills, sounds, and ideas with which to ask: What are the weather 'forecasts' we want and need to live together in a climate-changing world?

Soph Dyer and Alison Scott



EUROPEAN SPACE AGENCY
EARTH STATION ARBROATH

Who are we?

Facilitators

Sophie 'Soph' Dyer is a designer, artist, and educator whose work explores feminist and anticolonial approaches to weather, climate, and social justice. As co-lead of open-weather, they built accessible tools and infrastructure for DIY satellite imagery reception and decoding. Beyond the arts, Soph's investigative work contributed to a lawsuit against the New York City Police Department for racial bias in surveillance, and numerous human rights reports through Amnesty International's Evidence Lab and Forensic Architecture. They teach the Critical Cartographies studio at Design Academy Eindhoven and are about to begin a practice-based PhD in weather literacies beneath the polar jet stream at the University of Westminster. Experiments in pedagogy and collective practice run throughout their work.

Alison Scott is an artist, writer and art-worker based in Angus. Often working collaboratively, her work responds to places, archives and histories, in writing, performance, and audio/video. Recent projects—drawing on encounters with weather, oil and land—engage with aspects of environmental politics on an everyday, situated level. Her work has recently happened in collaboration with Rachel McBrinn; with Rosie Roberts as ‘again+again’; and with ‘open-weather’. Alison’s work has been supported by organisations such as Travelling Gallery, St Andrews Botanic Gardens, Hospitalfield, Collective, Cove Park and Radiophrenia. She is currently a practice-based PhD researcher at Gray’s School of Art, Aberdeen, focussing on art, forestry and the commons. She has been a member of the Board at GENERATOR Projects, Dundee since 2023 and in 2025 started Feminist Bird Club Dundee with Cat MacLeod.

Crew

[illegible]

Brief for the week

We are not just critical of structures, we want to challenge them and transform them.

Yazan Khalili, Radio AlHara (2026)

Our brief is to build an Earth Station (also known as ground station or Earth terminal) at Hospitalfield and to use the satellite signals it captures to create an expanded, experimental weather cast to be broadcast on dundee radio club.

What is an Earth Station?

In meteorology, Earth Stations are sites for communication with orbiting satellites. Inside the station, downlink transmissions are decoded, analysed, stored or sent elsewhere. These operations are typically the domain of expert knowledge production, made possible by scientific teams, large infrastructures, government backing, and international cooperation.

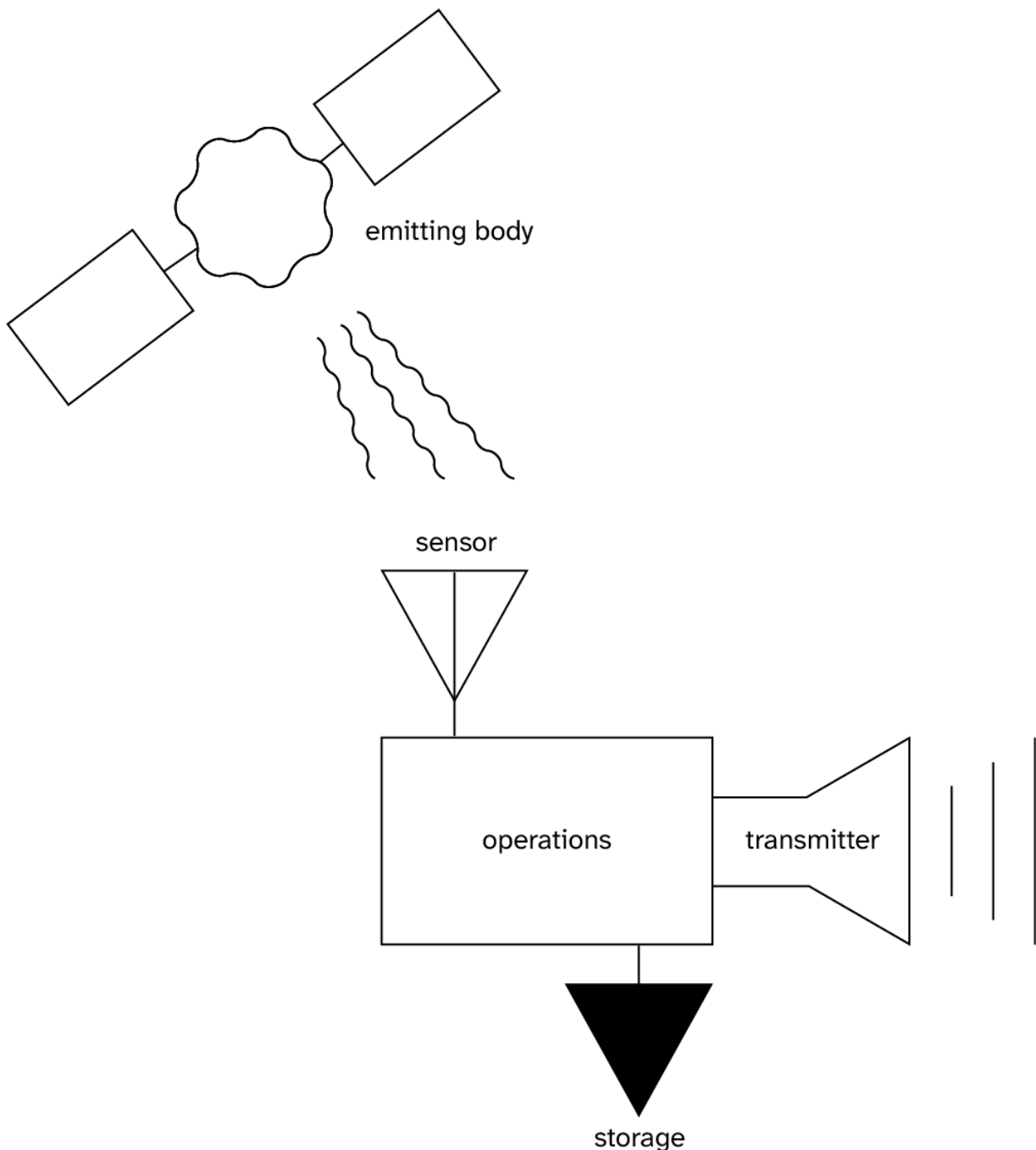
How is ours different?

Our Earth Station Arbroath (ESA) will exist as an anomaly: amateur, temporary, unsolicited, and uncoupled from the conventions of what an Earth Station can or should be. ESA will be made and operated by us (architects, artists, cultural workers) using low cost hardware, open-source software, and found materials.



Historical photograph of Wallops Command and Data Acquisition Station, Virginia.

Source: NOAA Photo Library



As insurgent meteorologists we will **learn together** and begin from an understanding that weather is **more-than-meteorological**, which is to say it is **social**, **political**, **historical**, and we are 'weather-makers', albeit differently positioned. This is not a metaphor. The excess heat we experience so unevenly today is the energetic afterlife of 400 years of extractivism. Reframing weather as more-than-meteorological makes clear that our relationship to weather cannot be separated from weather. This raises the question, what do we want this relationship to be? How can we influence it?

As we decide which signals to receive, sounds to record, and craft weather casts for our changing relationships to weather and climate, we will ask: What should they contain? At what scale? How should they be structured: forecast, backcast, nowcast, loop-cast?

Timetable

Mon	Tue	Wed	Thu	Fri
10 am – 12 noon Intros to each other and briefing	9:15 am – 1 pm Visit to Dundee Satellite Receiving Station (DSRS) archives Where: Dundee University 9:15 am Mini bus leaves Hospitalfield	9:30 am – 12 noon Sound workshop on the shoreline with dundee radio club! Learn about dundee radio club; Learn about field recording and listening; Record sounds to use in our weather casts.	9 – 1 pm Selection of tracks. What's missing? Last recordings? Where: Grounds of Hospitalfield and library	9 – 9:45 am Reflections and feedback Where: Weather dependent 10 – 12 noon Participant-led, completion of weathercasts and their activation ready for the afternoon
				
2 – 5 pm Intro to radio and remote sensing Where: Outside and in	2 – 5 pm Building up our own Arbroath Earth Station Where: Mostly outside Tasks:  Assemble L-Band dish  Build support for rotating the dish  Download SatDump Optional:  Assemble long wire radio for shortwave  Download Blackcat software		2 – 2:30 pm Experimental writing exercise. 2:30 – 5 pm Participant-led, creation of weathercasts continued. Ask together: How do we activate our station and weathercasts on Friday?	2 pm onwards Making public of our work and week. Transmission on dundee radio club!
	Listening session w/  Bex Šik  SHHE Where: AV room			

Days in detail

Might a new understanding of weather eventually change the weather?

Astria Neimanis and Jennifer Hamilton, 'How to Weather Together: Feminist Practice for Climate Change' (2016)

Monday

Group intros (60 mins) AS

First round

- Name
- Pronouns if you want
- How did you get here?

Second round

- What led you to apply?
- Share your image or object

Briefing (30 mins) SD

- What will we be doing?
- How will we do it?
- Questions

Intro to radio and remote sensing (45 mins) SD

The following section is reproduced and adapted from open-weather's ['DIY Satellite Ground Station Workshop Resource'](#). Credit: open-weather, 2025

What is radio?

- Radio is a **device** that traditionally contains an **oscillator**, **modulator** and **amplifier**.
- Radio is **electromagnetic waves** in the range of 300 Hz to 300 GHz or wavelengths of 1,000 Km to 1 mm.

Radio waves are a form of **electromagnetic radiation**. Electromagnetic radiation is all around us, in many forms. Sunlight, X-rays and radioactivity are other types of electromagnetic radiation.



Wave oscillation diagram. Source: bestanimations.com

Radio waves have **three properties** that we need to understand to manipulate:

1. Frequency

- Imagine a wave.
- The distance between two wave peaks is one 'cycle'.
- The number of cycles per second is measured in Hertz (Hz). This is the wave's frequency.

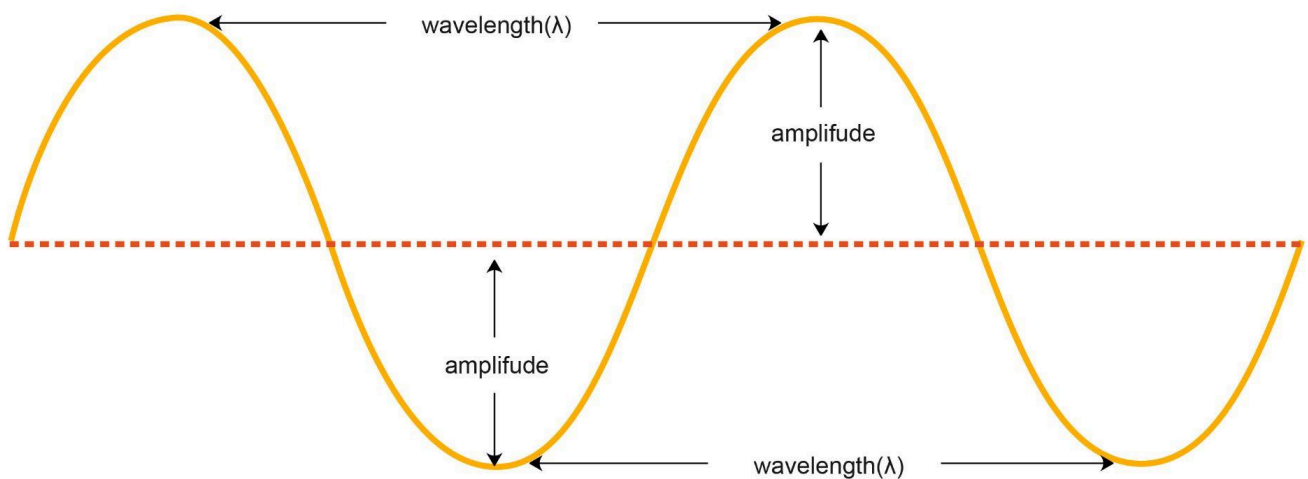


Diagram of a transverse wave showing the wavelength and amplitude. Source: Unknown

2. Wavelength

- Wavelength refers to the distance between two of the peaks in a wave.
- Wavelength has a direct relationship to frequency. The longer the wavelength the lower the frequency.

3. Amplitude

In radio, amplitude is the height or power of a transmitted electromagnetic wave. It determines the strength of the signal—like the volume of a sound or brightness of light.

Frequency and wavelength determine the **antenna** and **how a wave behaves** e.g. will it be blocked by trees or will it bounce off the Earth's atmosphere?

Modulation: How radio waves carry information

A radio wave can be **modulated** so that it contains information.

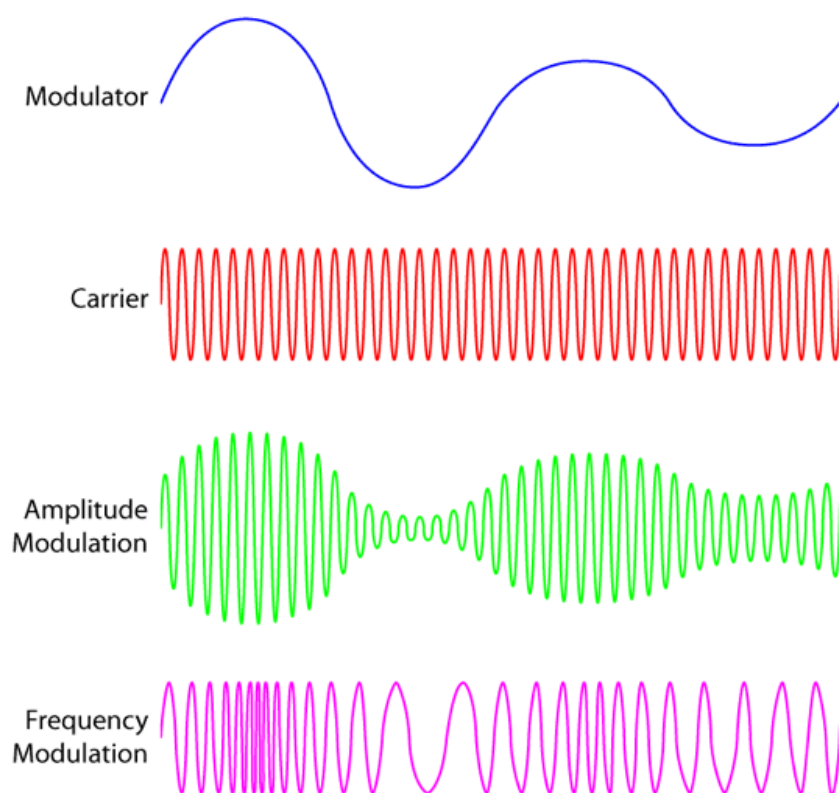
When receiving a radio transmission, it is important that you know how the wave has been modulated so that you can select the correct **demodulation** and access the information it is carrying, for example a song or a satellite image.

Frequency modulation

In FM the information is contained in the frequency of the wave.

Amplitude modulation

In AM the information is encoded in the amplitude of the wave.



AM and FM Modulation. Source: <http://mriquestions.com/signal-squiggles.html>

Acronym	Longhand	Example use
FM	Frequency Modulation	Public broadcast radio
AM	Amplitude Modulation	Pilots talking between aircrafts
USB	Upper Side Band	Amateur radio
LSB	Lower Side Band	Amateur radio
CW	Morse Code	Spies and amateur radio

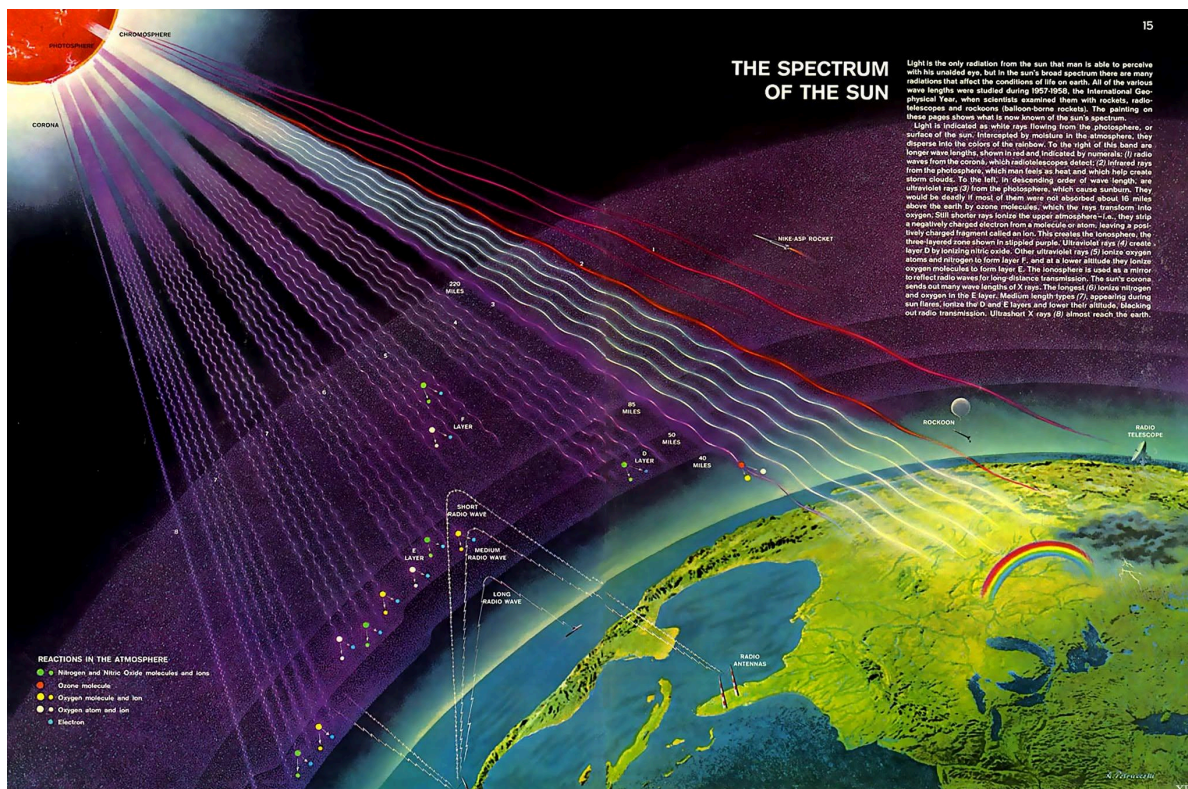
Transmission

Radio waves travel through space and the atmosphere at the **speed of light**. Many things transmit radio waves e.g. the sun, radioactive isotopes, lightning, the cosmos, including Jupiter at 40 MHz!

In this first workshop we are interested in radio waves transmitted by antennas, in particular at Very High Frequencies (see the table on radio bands).

Antennas can **transmit** and **receive** radio waves. In the same way a musical tuning fork resonates at a specific pitch, a radio antenna is designed to **resonate** (and so work best) at specific frequency and wavelength.

As some radio wavelengths are very long, an antenna can be designed to resonate at **half** or **quarter wavelength**. The principle is the same as **harmonics** in music.



Visualisation of radiation and radio waves made for Life Magazine, 07 September 1960

Propagation

Propagation refers to how a radio wave behaves as it travels through the atmosphere, Earth's crust or really anything in its path.

How radio waves propagate depends on the frequency, wavelength and amplitude.

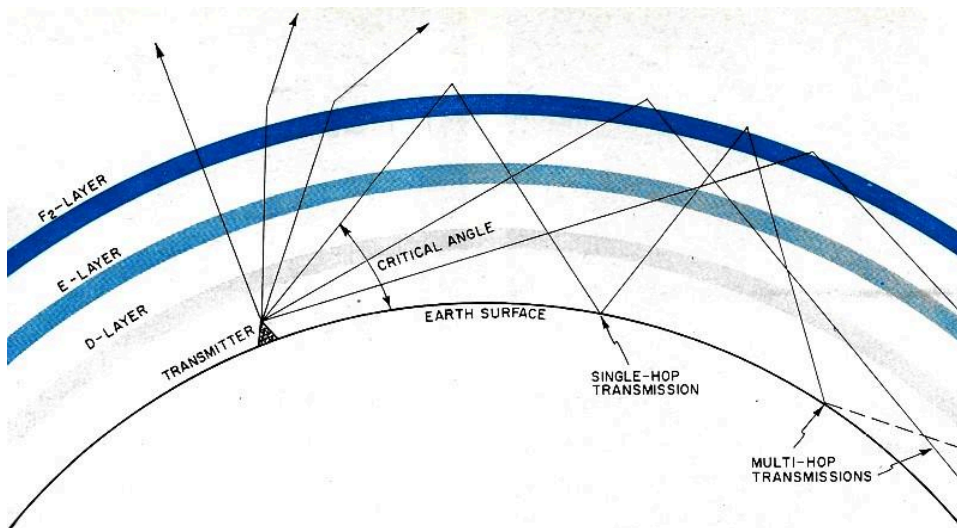
Line-of-Sight

- Radio waves travelling a straight line from antenna to antenna.
- As the name suggests, this is limited to the line-of-sight, and so depends on how high your transmitting and receiving antennas are positioned.

- Line-of-sight is used for medium range radio transmission including mobile phones, wireless networks, FM radio, TV and NOAA satellites.

Skywaves

- Radio waves that travel beyond the horizon by being bounced (refracted) off the earth's ionosphere – a layer of ionised particles between 70 and 400 km above the earth's surface.
- Skywave propagation is influenced by the time of day, seasons, weather, and the sunspot cycles, and so can be both unexpectedly useful and unreliable.



Skywave Propagation. Source: RF Cafe

Software-Defined Radio

Over the last 20 years, radio technology has become cheap and easy to combine with software. The resulting software-defined radio programmes and hardware have become low cost alternatives to conventional radios, transforming access to radio and space technology.

Software-defined radio or SDR, is a virtual radio. Just like a conventional radio, it contains an oscillator, de/modulator, and amplifier. It has all the functions of a physical radio and more!

Bandwidth

The last thing that you need to do before operating your software-defined radio is bandwidth. Bandwidth is the **range of frequencies a signal uses**.

For example, if a signal has a centre frequency of 100 MHz and a bandwidth of 200 kHz (0.2 MHz), it will span from 99.9 MHz to 100.1 MHz.

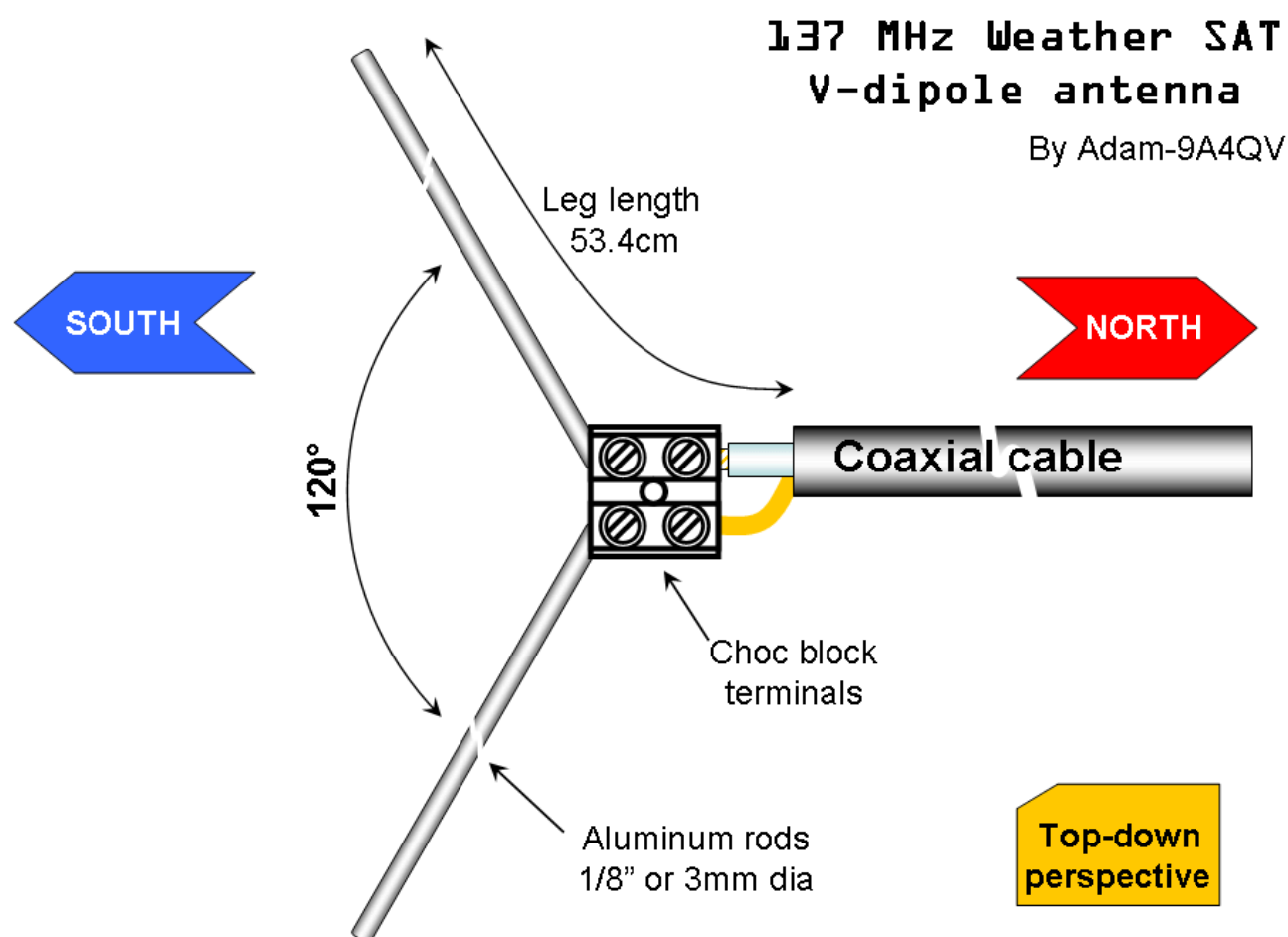
Adjusting the bandwidth of your software-defined radio to match the bandwidth of a transmission allows you to tune out of surrounding 'noise' and tune into the 'signal'. Thus, improving the Signal to Noise Ratio (SNR).

The radio spectrum is a congested and contested space!

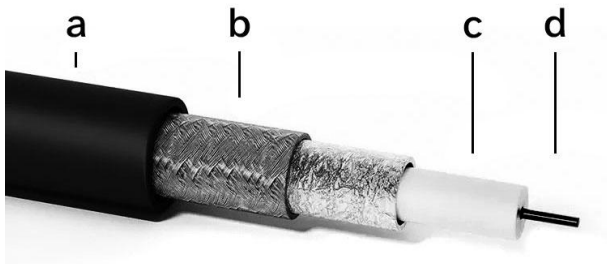
- Carefully remove the inner insulation to reveal the conductor wire.



- Cut approx 120 cm of aluminium wire and straighten using the drill.
- Cut to size your two antenna wires. Each wire should be 53.5 cm.
- Use a pair of pliers and your hands to bend the wires to create a 120° angle.



6. Use the chock block to secure the two wires in place.
7. Carefully, attach the two copper wires from your deconstructed coaxial cable.
8. Congratulations! You have built one of the oldest radio antenna designs! The antenna wire attached to the coaxial cable's shield has become a 'reflector'. Whereas the antenna wire attached to the conductor has become an 'active element'.



What is a coaxial cable?

A coaxial or coax cable is a type of electrical cable that consists of an outer insulating layer (a), braided metal shield (b), inner insulating layer (c), and conductor (d). It is commonly used for radio frequency (RF), video and data signals.



V-dipole antenna built by Matthias Hurlt



V-dipole antenna made on site by Alison and Soph.



Snail shell antenna by Matthias Hurlt

Software Defined Radio

We will be using the open-source software **SDR++**

1. Check your laptop's Operating System (and chip, if Mac) and download the correct build.
2. Download the version that is compatible with your devices's OS: www.sdrpp.org
3. Connect your antenna to your laptop (always do this **before** launching the software)
4. Unzip and open. You might need override your laptop's safety feature e.g. **right click + open**
5. Explore the ocean of static!
 - a. Try changing the **frequency, modulation, and bandwidth.**
 - b. Tune to **100 MHz** to hear broadcast radio. What is the modulation type?
 - c. Walk around. Where is **Radio Frequency (RF) interference** high?
Can you identify the source? Where is it low?
 - d. Can you hear **Dundee Airport** around **135 MHz**?
 - e. Is anyone speaking on the 2 m **Radio Amateur band** at **144 – 146 MHz**.

Record your experiments!

What is gain?

Software Gain

When the signal is received it is often weak and so requires amplification. Gain controls how much amplification is applied, measured in decibels (dB). Gain is applied before the signal is fed through the software's analog-to-digital converter (ADC).

Too much gain will amplify the signal as well as surrounding noise. Worse, if the gain is very high, the amplified signal exceeds the ADC's maximum input range and so is 'clipped'.

Antenna Gain

Antenna gain describes how effectively an antenna focuses (or concentrates) radio waves. An analogy is a light bulb (low gain) and a torch (high gain).

A high gain antenna (e.g. Yagi-Uda) focuses the transmission, maximising signal strength, but is highly directional and so needs to be pointed directly at the transmission source. A low gain antenna (e.g. v-dipole) is far less directional.

Tuesday

Study is what you do with other people.

'The Undercommons: Fugitive Planning and Black Study' (2013)

Dundee Satellite Receiving Station (1979–2019)



Bring a **notebook** and **pencil**. No pens are allowed in the archive and photographs must be taken without flash for personal use only. No food or drink is allowed in the archive.

The [Dundee Satellite Receiving Station](#) was based at University of Dundee from 1979 and closed at the end of April 2019 after 40 years due to funding being cut. The [archive](#) was donated to University of Dundee and former staff Neil Lonie and Paul Crawford went on to operate commercially as [Dundee Satellite Station Ltd](#), based at Errol.

Through the archive we can see weather satellite images across a period of technological and environmental change.



LEFT Installation of Dundee Satellite Receiving Station, University of Dundee c1979

Source: DSRS Facebook page. RIGHT Photo from Alison's previous visit to DSRS archive.

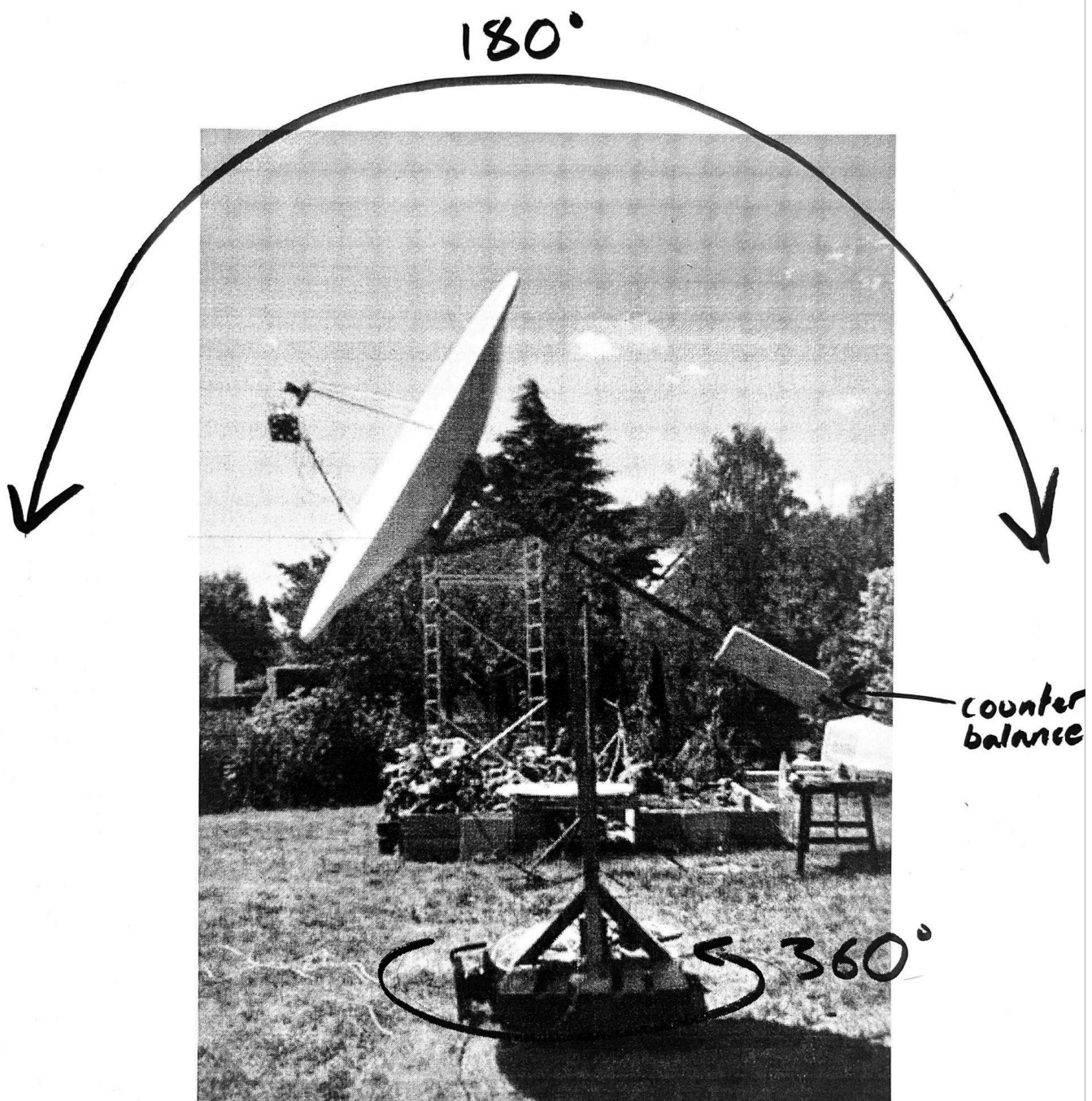
L-Band Afternoon

To know the weather through satellite meteorological data means to face the very settler colonial knowledges that have abstracted settlers from environments in the first place.

Sara J. Grossman, 'Immeasurable Weather: Meteorological Data and Settler Colonialism from 1820 to Hurricane Sandy' (2023)

Tasks

- Build a support for our L-Band antenna to make its operation accessible
- Install SatDump (if you haven't already and try to receive a pass)
- Optional: Shortwave antenna set-up and Weather Fax



Sketch for an L-Band antenna support

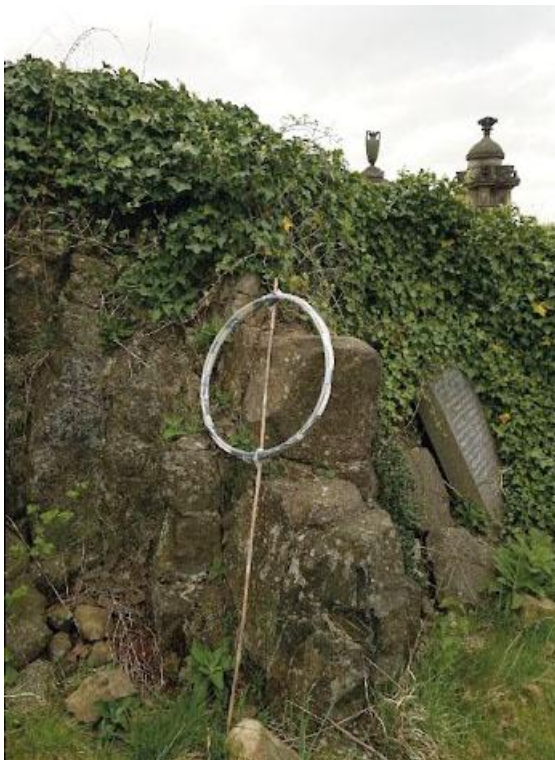
Evening Listening Session

The static's like the sound of thinking. Not of any single person thinking, nor even a group thinking, collectively. It's bigger than that, wider—and more direct. It's like the sound of thought itself, its hum and rush.

Tom McCarthy, 'C' (2010)

Bex Šik

Bex Šik is a Glasgow-based artist and educator whose recent work explores echoes, electromagnetic phenomena, invisible forces that shape the body's relationship to time and state. Their work spans moving image, installation, sound, music, writing and publishing.



Loop antenna by Bex Šik used in *Light Sown in Memoriam*

Part of 'Light Sown in Memoriam', an experimental audio tour, set within Glasgow Necropolis, produced by Listen Gallery for Glasgow international 2026.

Unhold. We begin amongst cherry blossoms, in love and fertility.

As we walk around the corner and across the site we come to rest with our backs to the rock face – 273 million year old Dolerite Sill — we look out over the city. I began my research here reading about Harry Bell's secret geometry; he believed the Necropolis was at the convergence point of a number of leylines or as he called them, prehistoric site alignments. His research began at the Devil's Plantation seven miles south of Glasgow. [...]

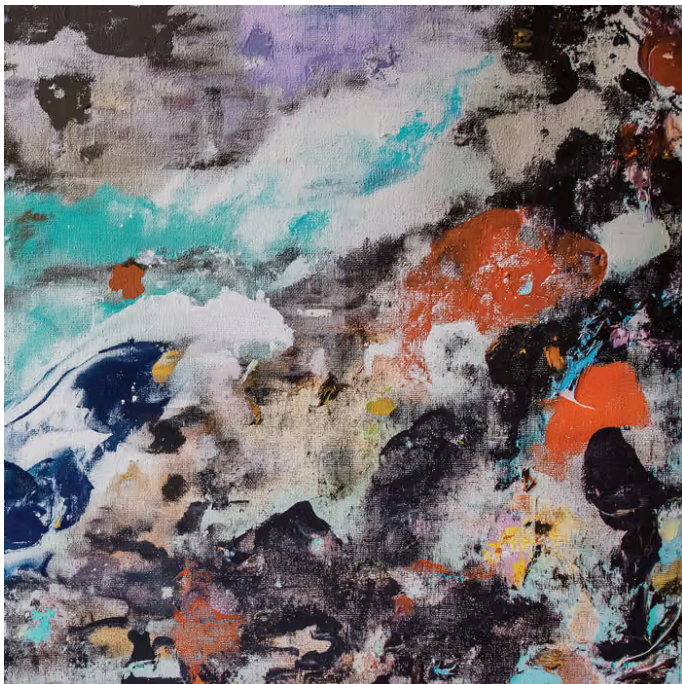
Ludovic Maclellan Mann, an amateur archaeologist, believed the site of the Necropolis, Dun Chattan, as it was called then, to be a temple of moon worship. He wrote a book called 'Earliest Glasgow: A Temple of The Moon', which in some ways is a speculative, playful, and in parts maybe fantastical proposition of

Glasgow's history, but I loved the way it played with words and etymology and so, in parts of the work, you hear my child trying to read these moon words. In other parts, I sing these words in several phrases and phases, which echo and repeat through reel to reel tape loops, each 29.5 seconds long — a lunar cycle and nod to a metrology of relationships between sites and time. My child accompanies my singing with their balloon oboe, a simple pipe with a balloon attached to the end. There is joy in death too.

I like to make tools, objects and instruments that help me connect myself and my understanding with things out of reach, invisible or inaudible, so I made several attempts at a VLF receiver, a device which picks up the sferics of the ionosphere, solar activity and the northern lights. In the piece you hear these tweeks and crackles of far off space wrestle with interference from the electrical grid, and the music and talking from radio stations. Sound evolves as I walk and turn, changing and rotating my position to land and the cosmos.

SHEE

Scottish-Portuguese sound artist and producer SHHE (Su Shaw) releases her new album 'THALASSA' on May 15th, a six-part ambient work that gives voice to the Mediterranean Sea at a moment of ecological, political, and existential crisis.



THALASSA album artwork

[THALASSA](#) takes its name from the primordial Greek sea goddess, the personification of the sea itself, and unfolds as a sonic dive from submergence to emergence. Journeying through six stages of descent and ascent, the album is built around breath and transformation, drawing on Shaw's time spent in Alexandria, Egypt, where she was "Musician in Residence" at B'sarya, a project supported by British Council in 2022. Originally commissioned to record the Mediterranean using hydrophones, Shaw found herself unable to capture the sea directly; Alexandria's heavily militarised coastline prohibited sound recording, above and below the surface. 'THALASSA' is an attempt to give voice to a momentous sea that is often rendered silent, or actively silenced.

Wednesday

The language we have at the moment is weak: we might speak vaguely of global connections; of the emission and circulation of gases; of impacts. And yet, at some microscopic level or intangible scale, bodies are breaking into one another.

Daisy Hildyard, 'Second Body' (2017)

Morning workshop with dundee radio club!

weather/whether listening



Bring a mobile phone with a **Lightning port**, if possible.

an informal, peer-supported workshop to introduce attentive listening and basic field-recording as ways of noticing and documenting place. together, we'll wander down to the arbroath coastline, exploring how wind, water, infrastructure, wildlife, and human activity shape the auricular atmosphere.

we'll begin with a simple listening exercise before introducing portable recording equipment and a few practical techniques for capturing environmental sound. continuing in the orbit of the week's trajectory, we'll consider how recording can become a form of observation – attending to weather beyond data, thinking of the sensorial and sound qualities, as something expanded through movement, vibration, and relation.



dundee radio club [ddrc]

dundee radio club is a space for sonic exploration; a space for gathering, for listening, for sharing sounds + opening ears. Through an annual marathon listening festival + ad-hoc online broadcasting, ddrc seek auricular connection through amplifying local voices + tuning to global vibrations. A quiet space for sounding out + an invitation for longer listening together. dundee radio club was founded in 2023 and is co-hosted/produced by **Becca Clark** + **Su Shaw**.

Thursday

Climate isn't just the weather, it's how we think. It's how we name ourselves, it's how we perform technology, it's how we travel, it's how we eat, it's how we make love, it's how we tell stories, it's all of this.

Bayo Akomolafe, 'Climate Grief and Hope' (2023)

Hospitalfield and Meteors (20 mins)

Writing and speaking exercises with Alison!

μετα, trans; and

in imitation of
migration of souls.

μεσις, in the an-
of the soul of a
imal. See SOUL.
; and ἐμψυχω,

death mens souls
according to the
en vicious, they
ts, there to do
hereof, they re-
ived virtuously,
was to be their

ne persuasion he
re: whence he
body, upon its
a kind of offi-
n of death, by
lodging; and

hat the metem-
an a similitude
ing in some per-
—Thus, when
goras, no more
h had shone in
as now in some
ie great respect
ing how a phi-
the sword, he
uphorbus, i. e.
vived in him.
phorbus's soul,
grated into Py-

migration of a
lv. and to be

METEOR *, in physiology, a changeable, moveable, imper-
fect mixt body, or resemblance of a body, appearing in the at-
mosphere, and formed out of the matter of the common ele-
ments, altered a little by the action of the heavenly bodies,
but not transformed.

* The Greeks call them μετεωρα, q. d. *sublimia*, or high-raised;
the Latins *impressione*, as making signs or impressions in the air.

Meteors are of three kinds:

Igneous or *fiery* METEORS, consist of a flat sulphurous smoke set
on fire; such are lightning, thunder, ignis fatuus, draco vo-
lans, falling stars, and other fiery phænomena appearing in the
air. See THUNDER, FATUUS, &c.

Aerial or *airy* METEORS, consist of flatulent and spirituous ex-
halations; such are winds, whirlwinds, and hurricanes. See
WIND, HURRICANE, &c.

Aqueous or *watery* METEORS, are composed of vapours, or wa-
tery particles variously separated and condensed by heat and
cold; such are clouds, rainbows, hail, snow, rain, dew, and
the like. See CLOUDS, RAINBOW, HAIL, SNOW, RAIN,
DEW, &c.

The formation of *meteors* is explained pretty largely by Des
Cartes, in a treatise express. Aristotle and Gassendus have
also handled the same subject. Dr. Woodward's opinion is,
That the matter of *meteors* is in great measure of a mineral
nature: That the mineral particles contained in the strata of
the earth, are raised by the subterraneous heat, together with
the vapours ascending from the abyss, and pervading those
strata; especially at such times as the sun's heat is sufficient to
penetrate the exterior parts of the earth, and to make room for
their escape into the atmosphere. This sulphurous, nitrous,
and other active, and volatile mineral particles, form various
meteors, according to the various fate they meet with in the
air. See VAPOUR, EXHALATION, MINERAL, AIR, &c.

METEOROLOGY, the doctrine of meteors; explaining
their origin, formation, kinds, phænomena, &c. See METEOR.

METEOROSCOPE *, a name which the ancient mathe-
maticians gave to such instruments as they used for observing,
and determining the distances, magnitudes and places of the
heavenly bodies.

* From the Greek μετεωρῶ, *high*; and σκοπος of σκοπτομαι,
I view, observe.

Friday

Reflections and feedback

Reflections

Initial prompt: What will you take with you from this week?

Feedback

Please tear of this sheet and give it to Soph or Alison)

- What would you have liked more of?
- What would you have liked to be different?
- Do you have any suggestions?

End of the week broadcast!

On Friday afternoon, we will broadcast our collective weather cast or a 30 minute extract on dundee radio club and Wave Farm's Standing Wave Radio!

Wave Farm

Based in New York's Upper Hudson Valley, Wave Farm is an international transmission arts organization driven by experimentation with the electromagnetic spectrum. The organisation cultivates creative practices in radio and supports artists and nonprofit organizations in their cultural endeavors.

Wave Farm's Standing Wave Radio is a dedicated online radio channel featuring Transmission Arts and Experimental Sound programming around the clock available at wavefarm.org/listen and on the Wave Farm Radio app. Wave Farm also runs WGXC-FM, a full-power, non-commercial, listener-supported station operating out of dedicated studios in Acra and Catskill. With a station motto of "Radio for Open Ears," WGXC transmits 3,300 watts to more than 78,000 listeners on 90.7 FM.

Reference section

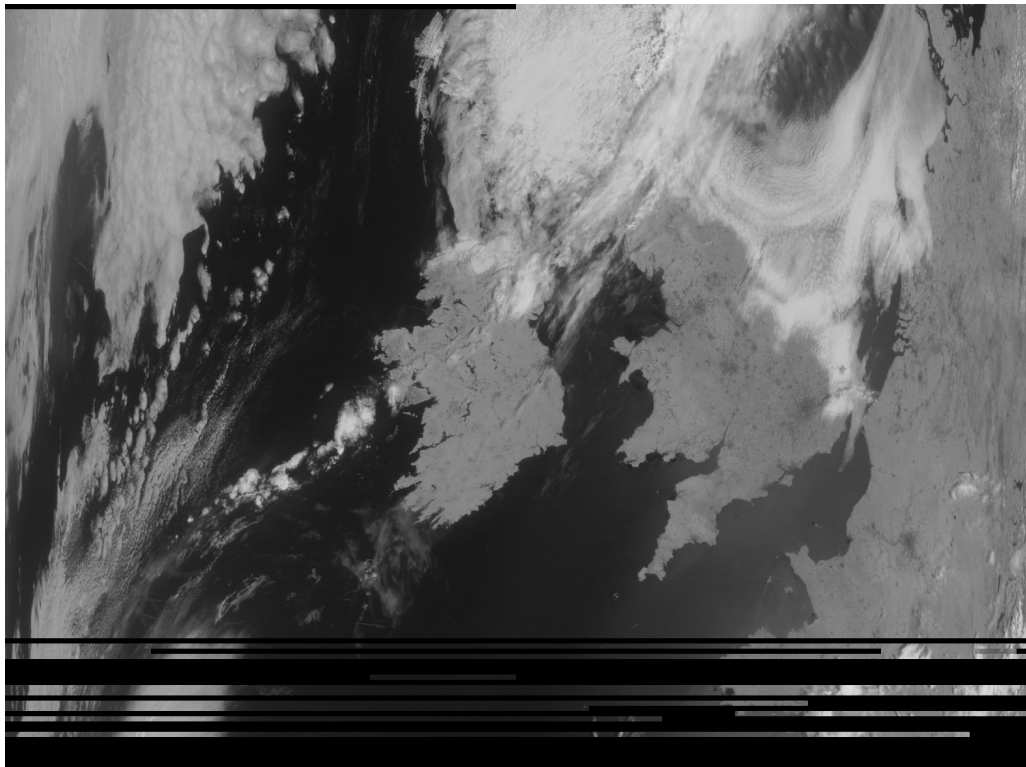
Meteor Guide

The Meteor satellites are the last fleet to transmit on 137 MHz (VHF) after the US National Oceanic and Atmospheric Administration (NOAA) decommissioned its polar orbiting weather satellites (NOAA-15, NOAA-18, NOAA-19) in summer 2025. Meteor are operated by Roscosmos and Roshydromet, the Federal Service for Hydrometeorology and Environmental Monitoring.

Compatible antennas include V-dipole, Yagi-Uda, turnstile or Quadrifilar Helical (QFH)
An RTL-SDR will work.

Transmission	Frequency (MHz)	Signal	Modulation	Bandwidth	Operational status
METEOR M2-4	137.9	LRPT	OQPSK 72K	100 kHz*	
METEOR M2-3	137.9	LRPT	OQPSK 72K	100 kHz*	Antenna issue causes intermittent reception, weak signal, occasional pixelation and banding

LRPT = Low-Rate Picture Transmission
OQPSK = Offset Quadrature Phase Shift Keying modulation



Meteor M2-3 received at Hospitalfield on 11 July 2026 at 11:23

V-dipole height and orientation

When using a v-dipole antenna the open V of the antenna should be on a **North-South** axis.

Start the satellite pass with your antenna held **high**. Then slowly **lower** the antenna until it's about 30 cm from the ground mid-pass. Then slowly raise it again.

The V should always be **horizontal** (on the same plane)

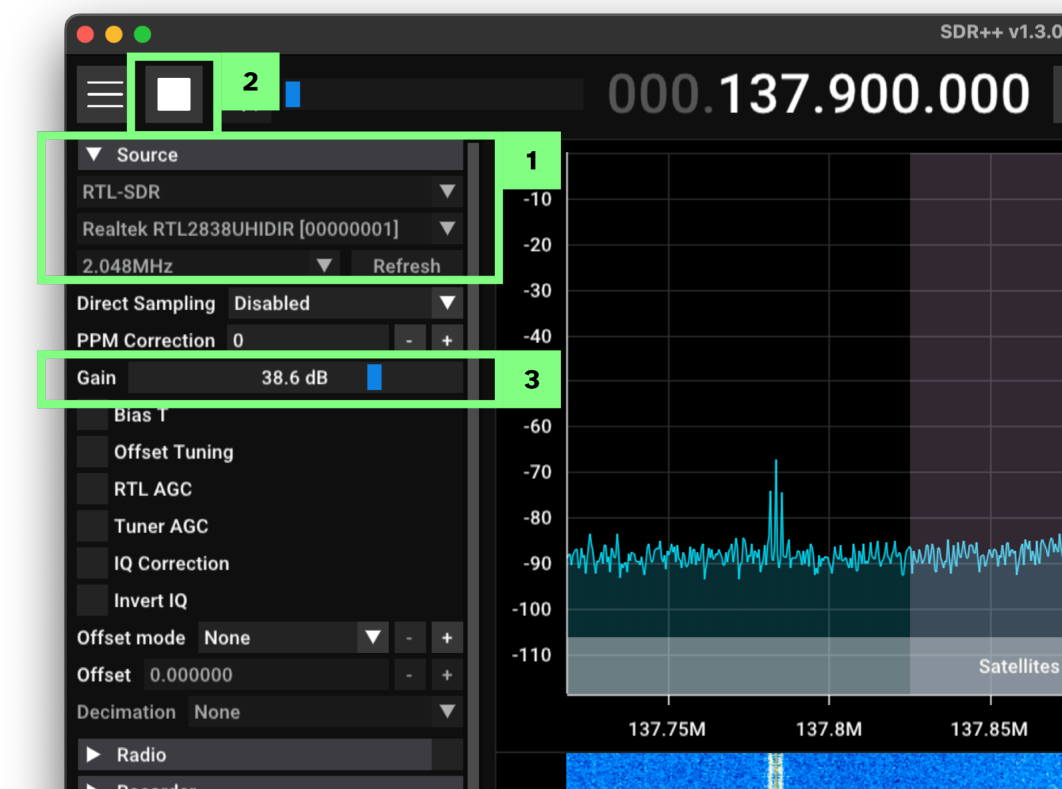
Recording and demodulating in SDR++

Plug your antenna into your device and open SDR++

Adjust the settings as follows:

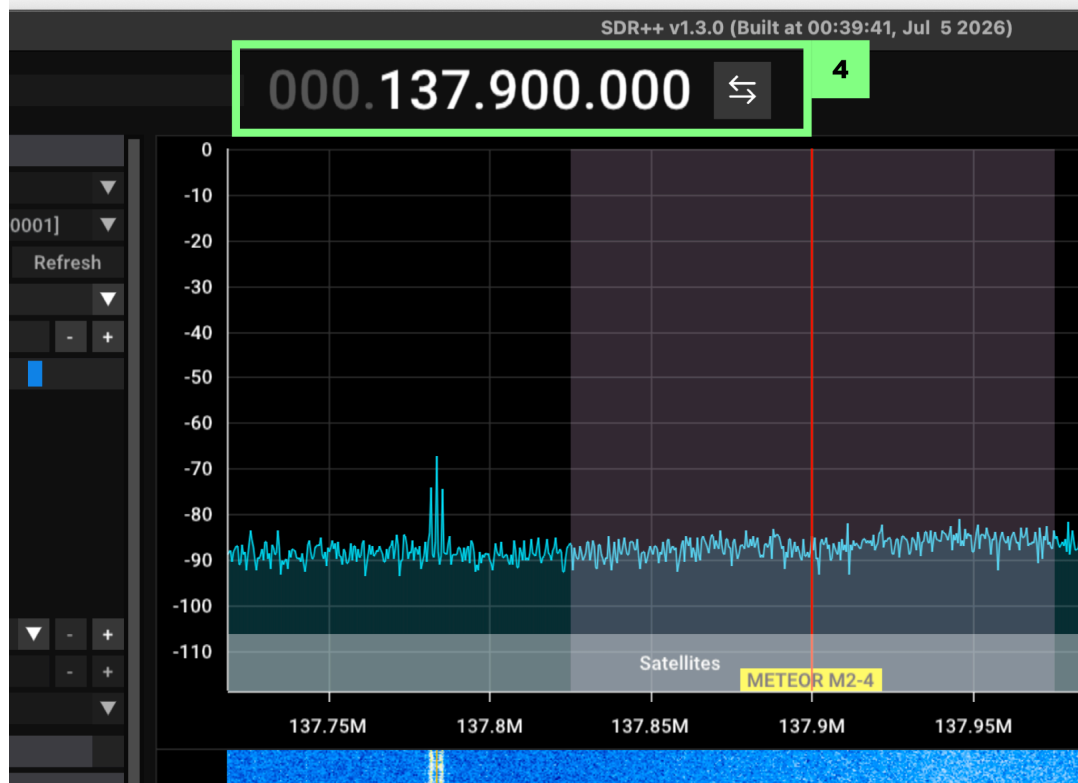
▼ Source

1. Select your dongle (you may need to select **Refresh**)
Set the **Sample Rate** **2.048 MHz**
2. Press the **Play** button
3. Increase the gain to anywhere between approx **28 – 38 dB**
You can fine tune it later.



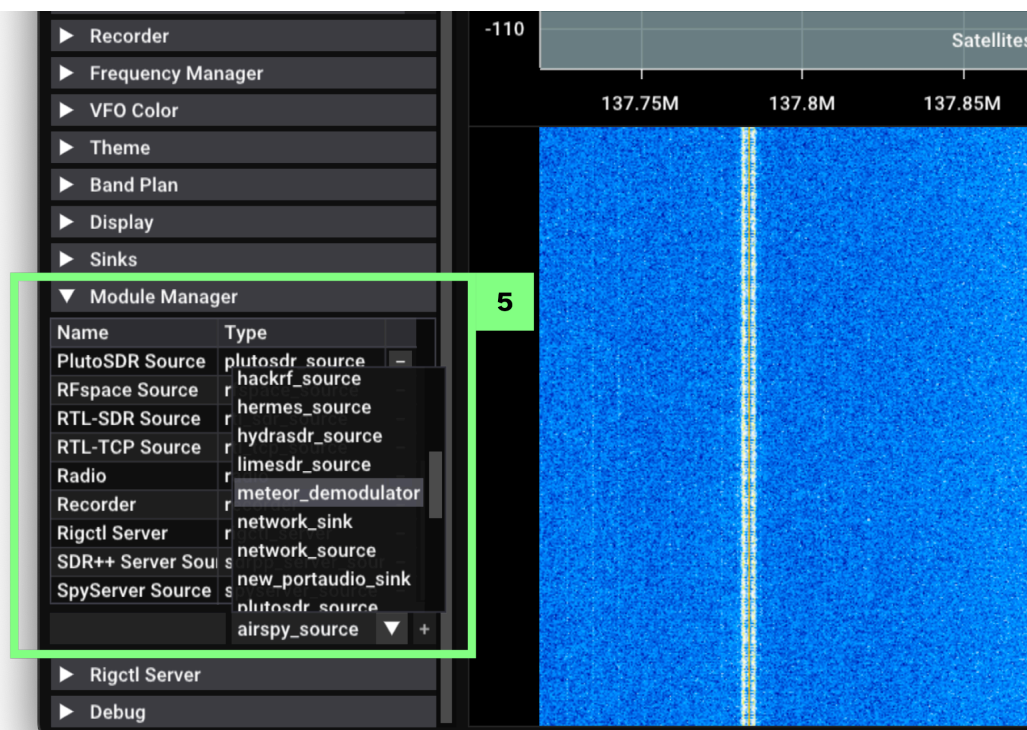
Waterfall

4. Set the **Frequency** to **137.9 MHz**. This is the centre frequency of the transmission.

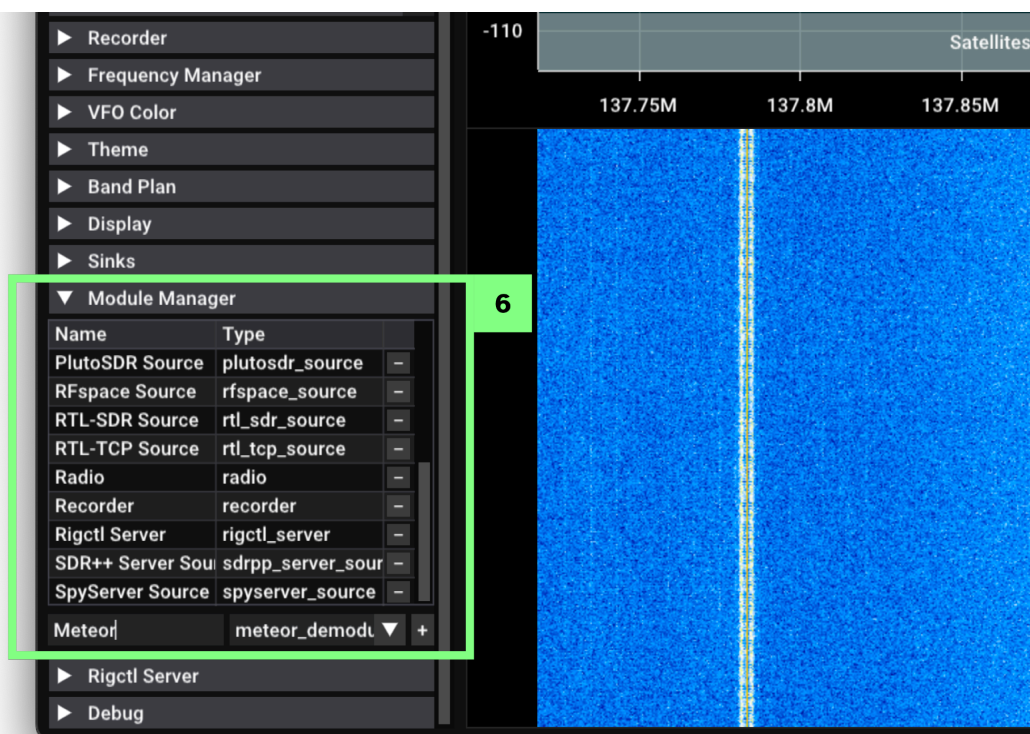


▼ Modular Manager

5. Use the drop down (bottom right) to select **meteor_demodulator**

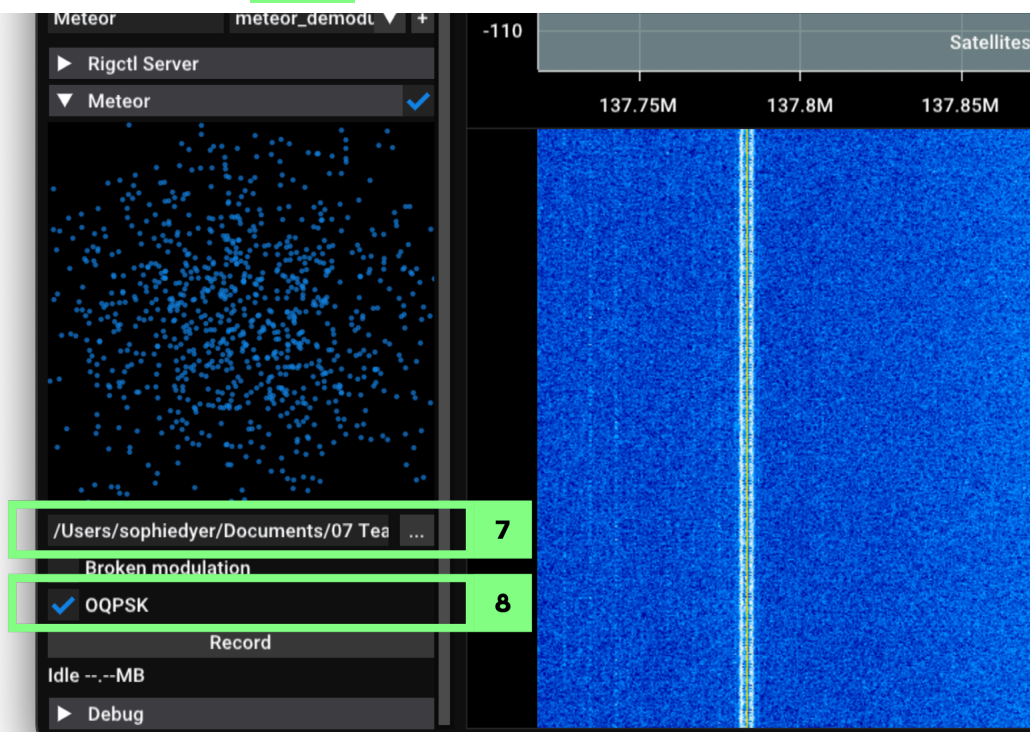


6. **Type a custom label** e.g. 'METEOR' and select the **+** symbol
This should open a new module!



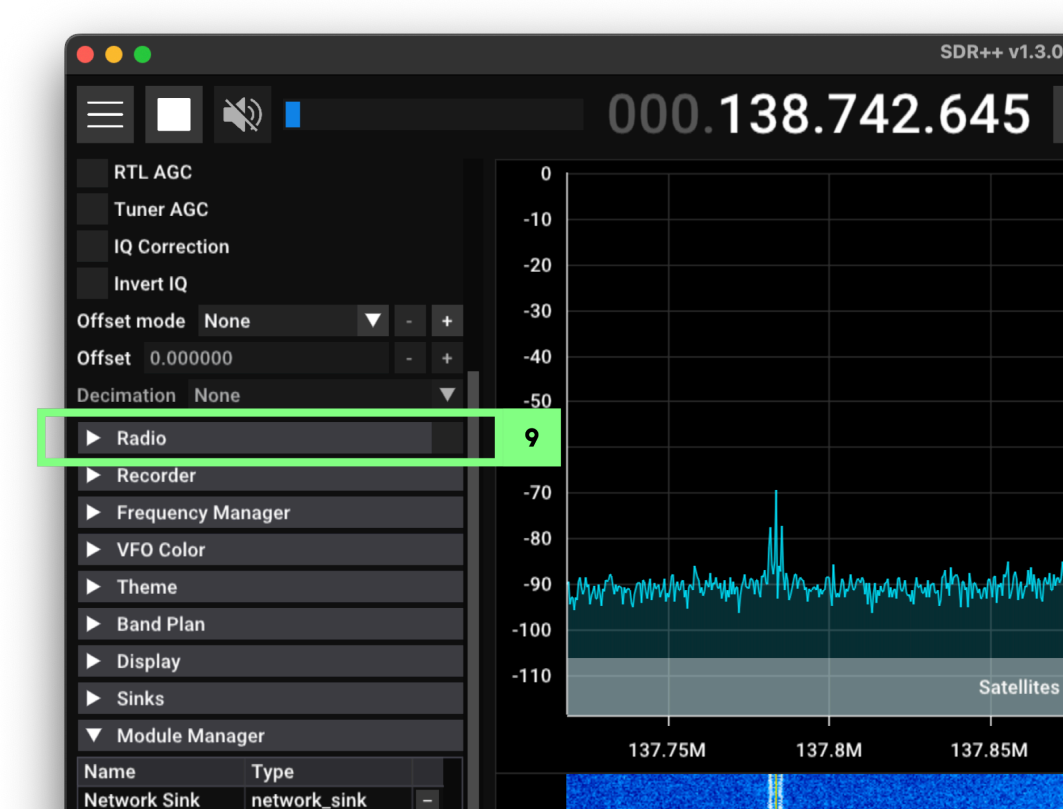
▼ Meteor demodulation module

7. Set **file pathway** (this where the file will save on your device)
8. Check the box **OQPSK**



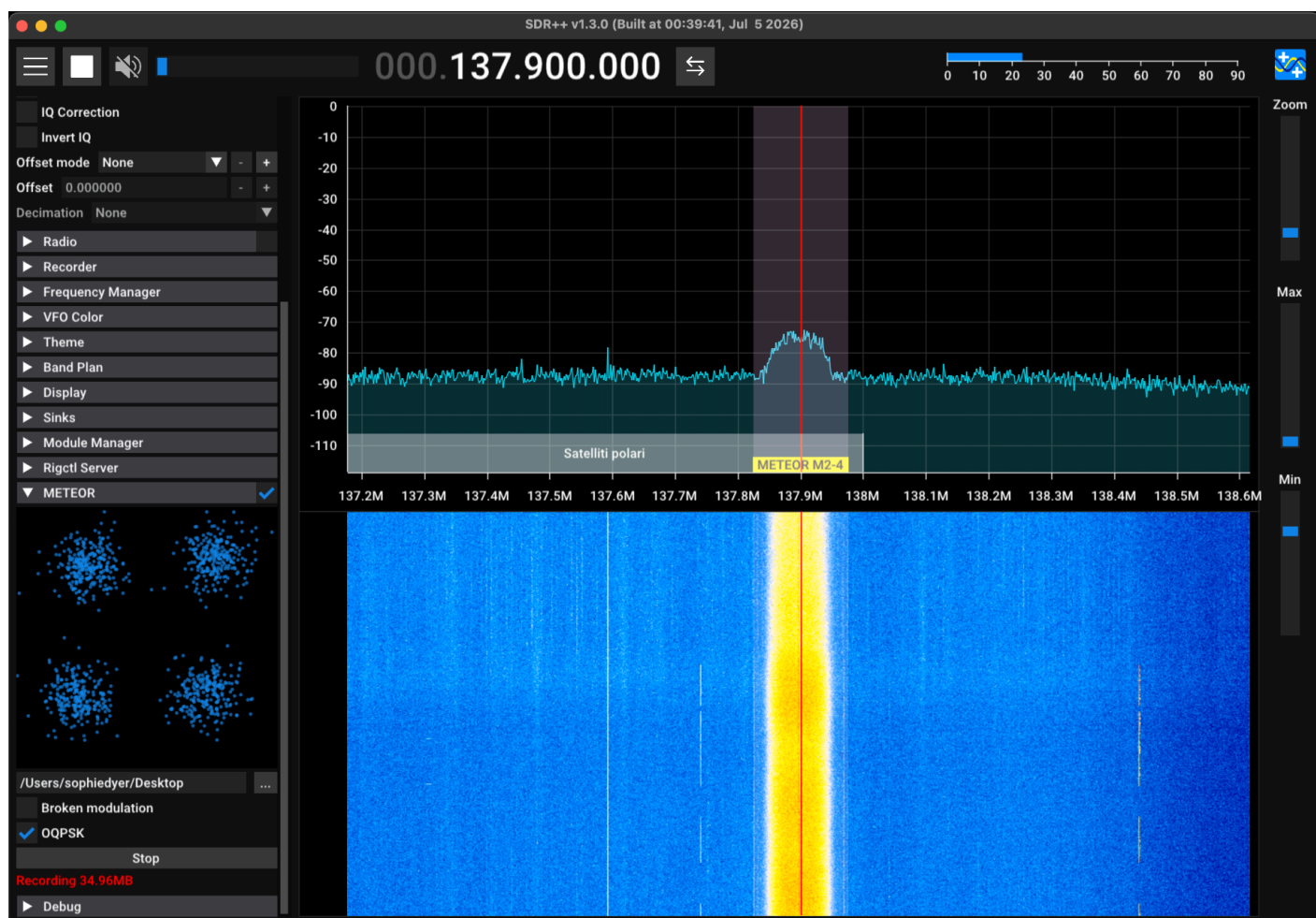
▼ Radio

1. Uncheck **Radio** (This is optional. Disabling radio reduce CPU usage)



At the start of the satellite pass

1. Watch the **waterfall** and **constellation diagram** when you see a signal. A signal will appear as a bump on the waterfall and four dots in the constellation diagram.
2. Press **Record** in the **Meteor demodulation module**



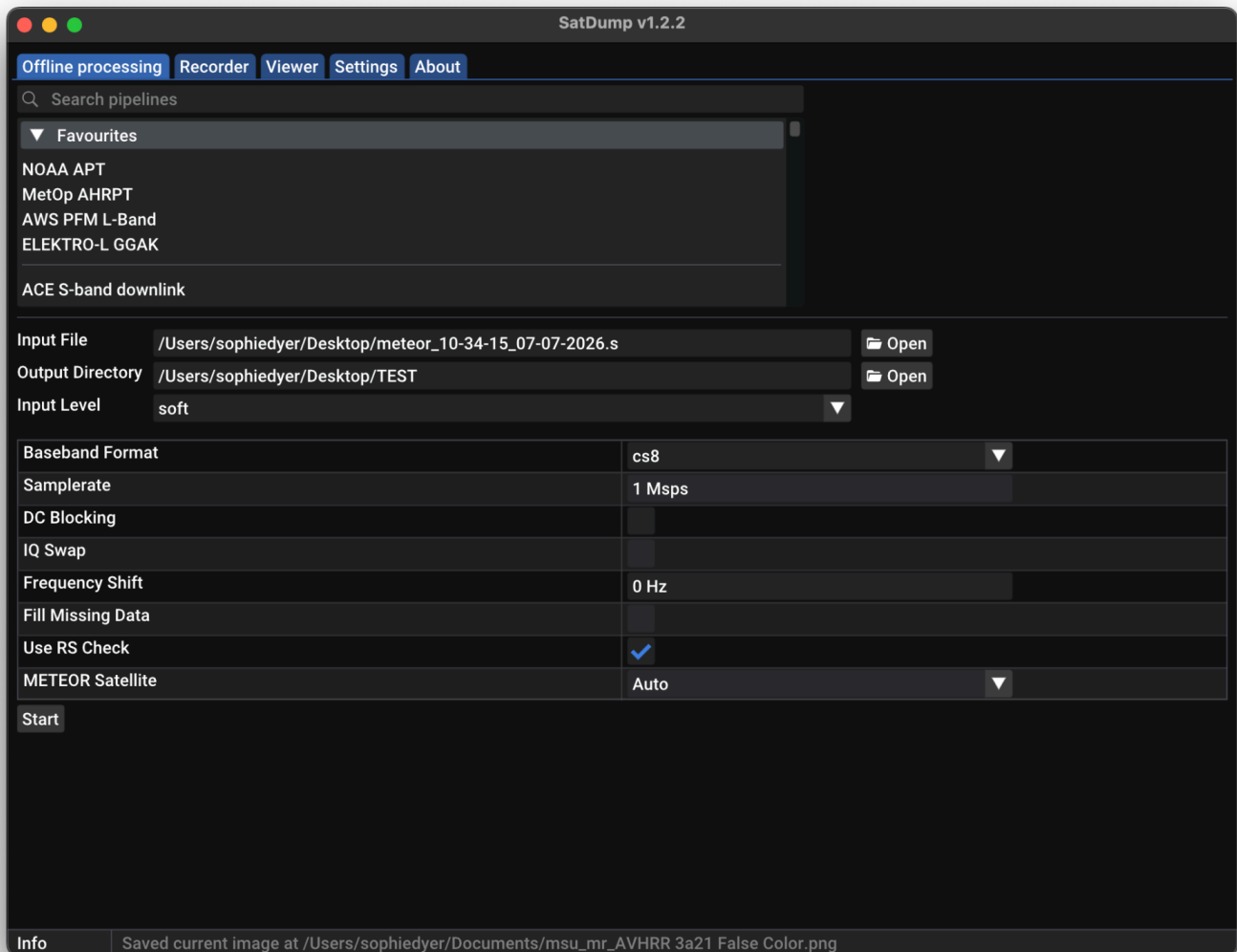
SDR++ v1.3.0 during the reception of a METEOR satellite's LRPT signal, midpass.

Notes

- Do not use **RTL AGC** or **Tuner AGC**. These AGCs are designed for wide signals such as DVB-T. The gain control will not 'see' the LRPT signal as it is relatively narrow, which will result in much higher gain than normal being applied, reducing the signal.
- The back-up frequency for METEOR is 137.1 MHz
- METEOR satellites also transmit a HRPT on L-Band

Use SatDump to decode

1. **Open** SatDump
2. Go to the **Offline processing** tab
3. In the field **Search pipeline**, search and select **METEOR-M2-x LRPT 72k**
4. In the **Input File** field, Open the **.s** file you generated in SDR++
5. In the **Output File** field, select where you want SatDump to save the files it generates. SatDump automatically generates many files 😞, so it is worth creating a new folder. Tip: Name your folders with the satellite, pass date and time.
6. In the **Input Level** dropdown select **soft**
7. Leave the rest of the settings as default
8. Press **Start!**

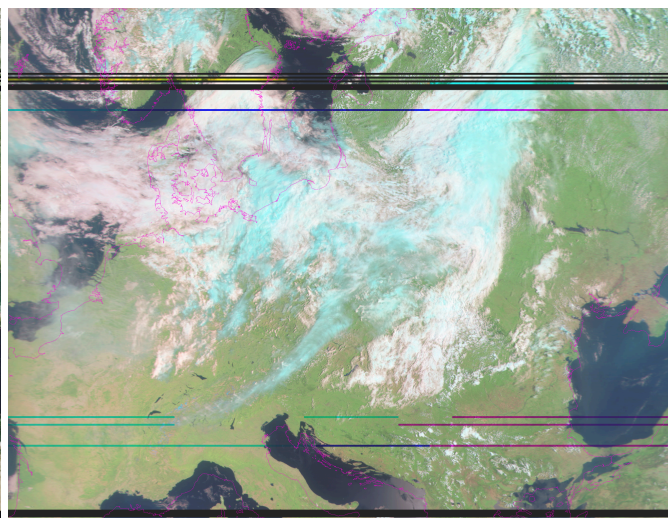
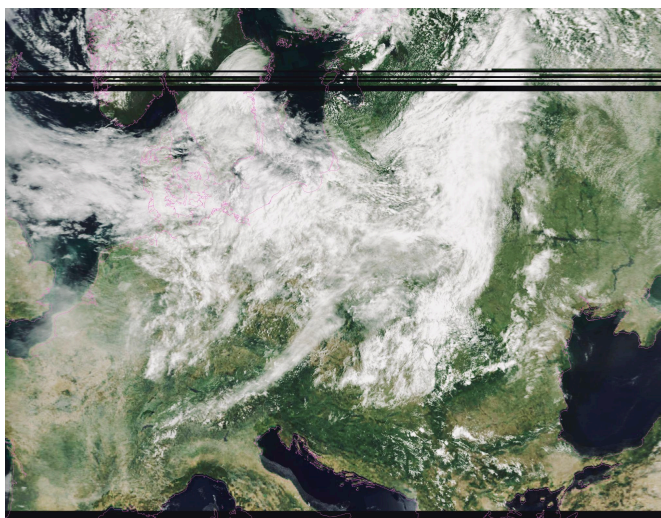


Use the **Viewer** tab to adjust the image, combine channels, and map the greyscale pixel brightness values to colours.

Possible composites in SatDump and what they mean

RGB Composite	Description	Use
AVHRR 221 False Color	R = Channel 2 (0.7–1.1 μm , near-IR), G = Channel 2, B = Channel 1 (0.5–0.7 μm , visible).	Stylised 'natural' render for general viewing. Note that as there is no 'true green' the composite uses the near-IR channel (2) for both red and green.
AVHRR 3a21 False Color	R = Channel 3 (1.6–1.8 μm SWIR or Short-Wave Infrared Band i.e. reflective sunlight) G = Channel 2 (near-IR) B = Channel 1 (visible).	Tell ice and snow from water. Ice and snow clouds absorb SWIR and are rendered cyan . Useful for identifying storms (ice clouds) and differentiating cloud cover from snowy land.

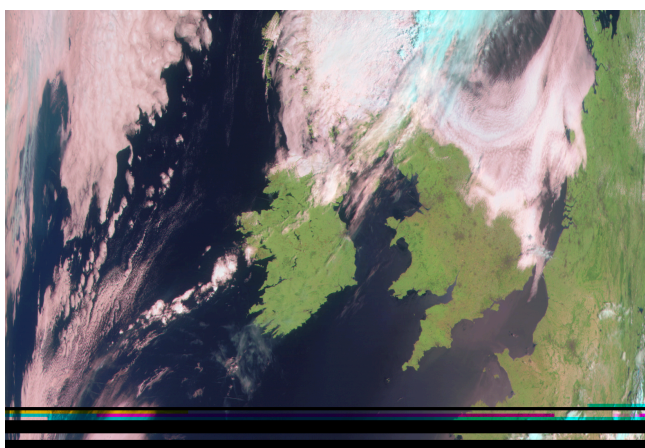
MSA (Multispectral Analysis)	A single-channel LUT (Look-Up Table) using channels 1 or 2	Stylised 'natural' render for general viewing.
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LEFT MSA

RIGHT AVHRR 3a21 False Color with shorelines map

7 July 2026 at 10:30 am, Türkenschanzpark, Vienna



11 July 2026 at 11, Hospitalfield 23AVHRR 3a21 False Color

Do it all in SatDump (fewer stages, more blackboxed)

1. Open SatDump and go to the **Recorder** tab.
 - Select the correct **SDR dongle**
 - Adjust the **Gain** to near maximum.
2. Adjust the sample rate to **1.024 Msps**
3. Select on **Start**
4. Open the **Processing** panel
 - Search for **LRPT**. Select **METEOR M2-x LRPT 72k**
 - Select the **DC Blocking box**.
5. Select **Primary** for **137.9 MHz**, and **Backup** for **137.1 MHz**.

Source: a-centauri.com/articoli/meteor-satellite-reception

L-Band Weather Satellites

L-Band is 1.6 – 1.7 GHz in the microwave range. Compatible antennas include a parabolic dish or helix antenna.

Transmission	Frequency (MHz)	Bandwidth	Signal Type	Modulation	Notes
METOP-B	~1701.3		AHRPT	QPSK	Operated by EUMETSAT (European Organisation for the Exploitation of Meteorological Satellites). Developed and launched by ESA on a Soyuz rocket in 2012. Expected to be operational until at least 2027.
Arctic Weather Satellite	~1701.3		Direct Data Broadcast	QPSK	Weak signal and so challenging to receive! Launched in August 2024, it is a prototype for the Sterna fleet planned for 2030. The satellite is owned by the European Space Agency and operated by Kongsberg Satellite Services in Tromsø, Norway.
Elektro-L fleet* *Specifically Elektro-L N3 for the UK and Ireland	1691		LRIT and HRIT	QPSK	A geostationary satellite fleet operated by Russian agencies including ROSKOSMOS. In February, Roscosmos launched Elektro-L N5. When L5 is operational, Elektro-L N3 is expected to drift West to 14.5°W to replace Elektro-L N2, restoring an unencrypted geostationary L-band downlink to the UK, Ireland, Iceland, Portugal, western France and Spain for the first time since 2018 when EUMETSAT switched off Meteosat HRIT. rtl-sdr.com

AHRPT = Advanced High Resolution Picture Transmission

LRIT = Low Rate Information Transmission

HRIT = High Rate Information Transmission

QPSK = Quadrature Phase-Shift Keying. This is a type of digital modulation.

METOP-B Guide

Kit

- L-Band discovery dish (or similar)
- Airspy dongle and USB cable
- Compass
- UBC-A → USB-C converter

Steps

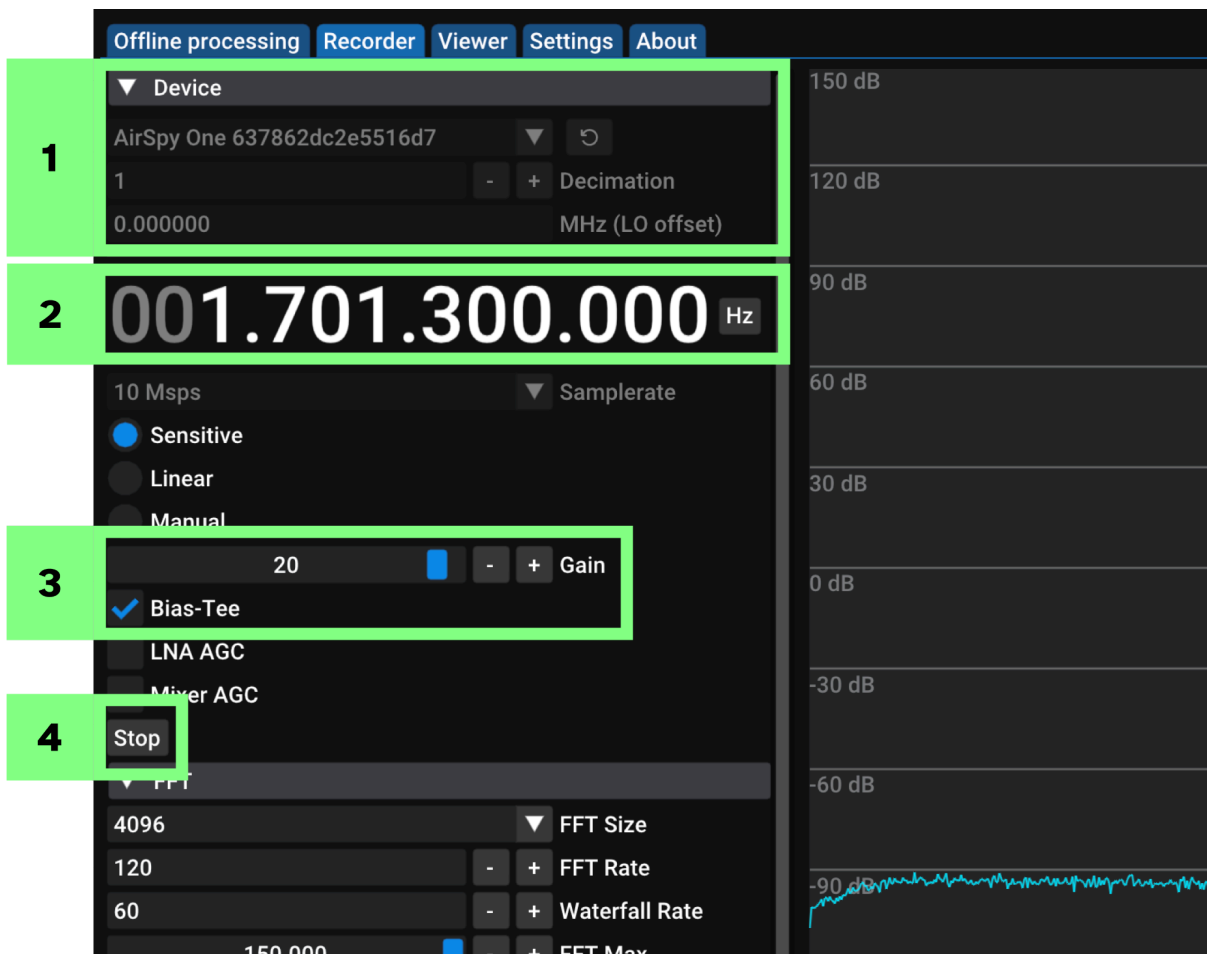
Plug the dongle into your laptop.

Open SatDump.

Open the **Recorder** tab.

In the ▼ **Device** module:

1. Refresh or manually select '**Airspy One...**'
2. Change the frequency to **1701.3 MHz**
3. Increase the **Gain** to **20 dB**
Check the **Bias-Tee**
4. Click **Start**

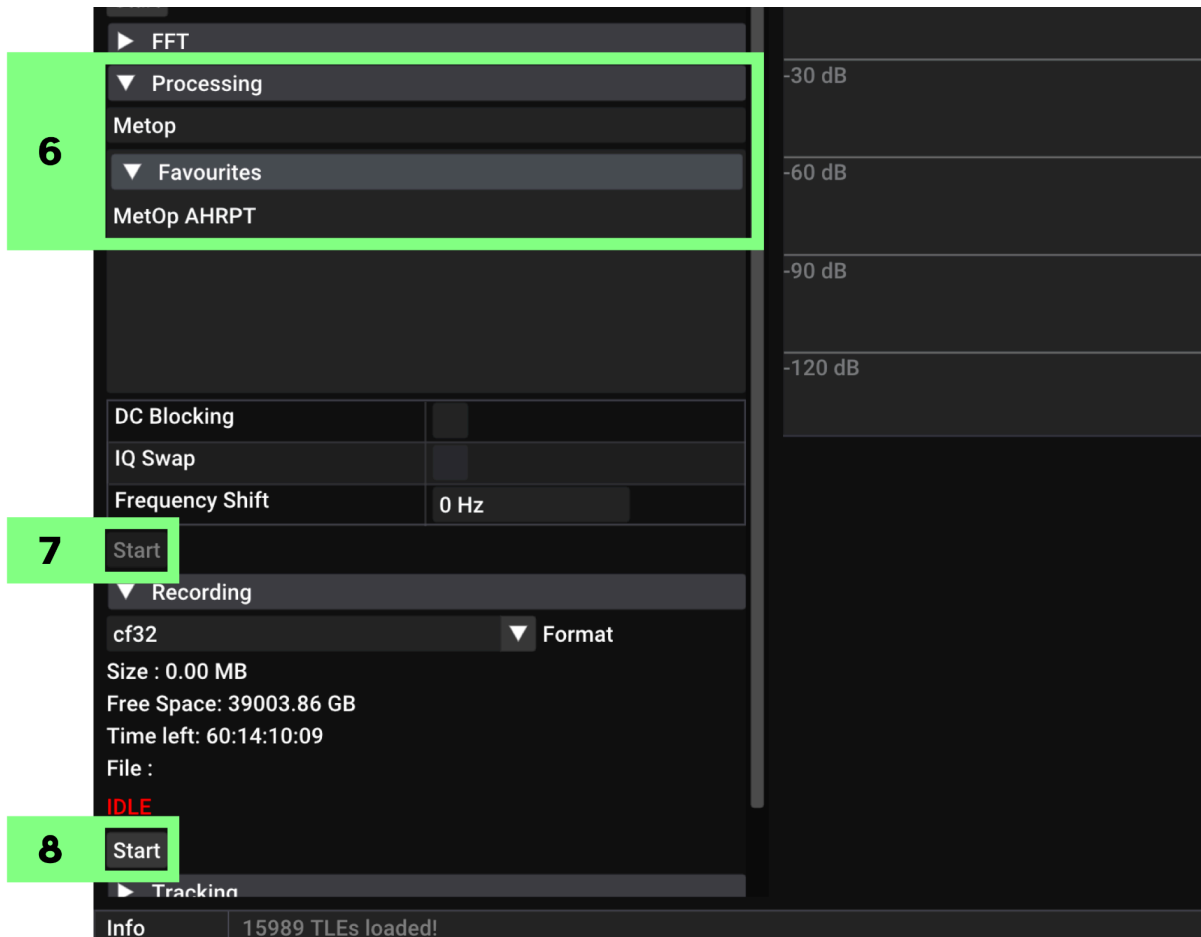


In the ▼ **Processing** and ▼ **Favourites** modules:

6. Select **MetOp AHRPT**
7. Click **Start**

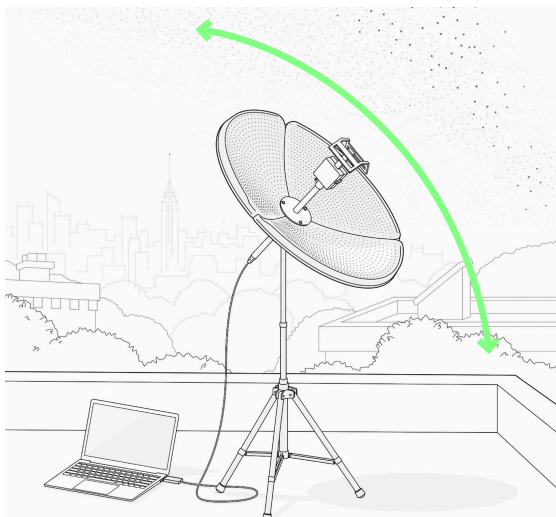
In the ▼ **Recording** module:

8. Click **Start**



Catching a signal

- The antenna feedhead must be **parallel to the satellite's path**
- The antenna is highly direction, so you must **track the position of the satellite** as it moves from North → South (morning) or South → North (afternoon)



Do I have a signal? What strength is it?

The top screenshot shows no signal. The bottom screenshot shows a strong signal.



METOP's AVHRR (Advanced Very High Resolution Radiometer)

Channel	Wavelength (µm)	What is it used for?
1	0.58 – 0.68 (visible, red light)	Daytime pictures of clouds, snow, and ice — the classic "visible" satellite image
2	0.725 – 1.00 (near-infrared)	Telling the difference between land, water, and vegetation; also helps spot clouds
3A	1.58 – 1.64 (near-infrared)	Daytime only — helps distinguish snow and ice from clouds
3B	3.55 – 3.93 (mid-infrared)	Night-time cloud detection and picking out fires or very hot spots
4	10.30 – 11.30 (thermal infrared)	Measures temperature of clouds, land, and sea — works day or night
5	11.50 – 12.50 (thermal infrared)	Works with Channel 4 to give a more accurate temperature reading by correcting for moisture in the air

Weather Fax and Volmet

These High Frequency (Shortwave) transmissions can be received using a long wire antenna!

Transmission	Frequencies (kHz)	Frequencies (MHz)	Signal	Notes
UK Met Office Weather Fax (WEFAX)	2618.5 4610 8040 11086.5	2.6185 4.610 8.040 11.0865	USB	Tune to approx. 1.9 kHz below nominal frequency. There is no tone between transmissions.
Shannon Volmet	3413 5505 8957 13264	3.413 5.505 8.957 13.264	USB voice	Continuous broadcast. Also useful as a general HF propagation check.

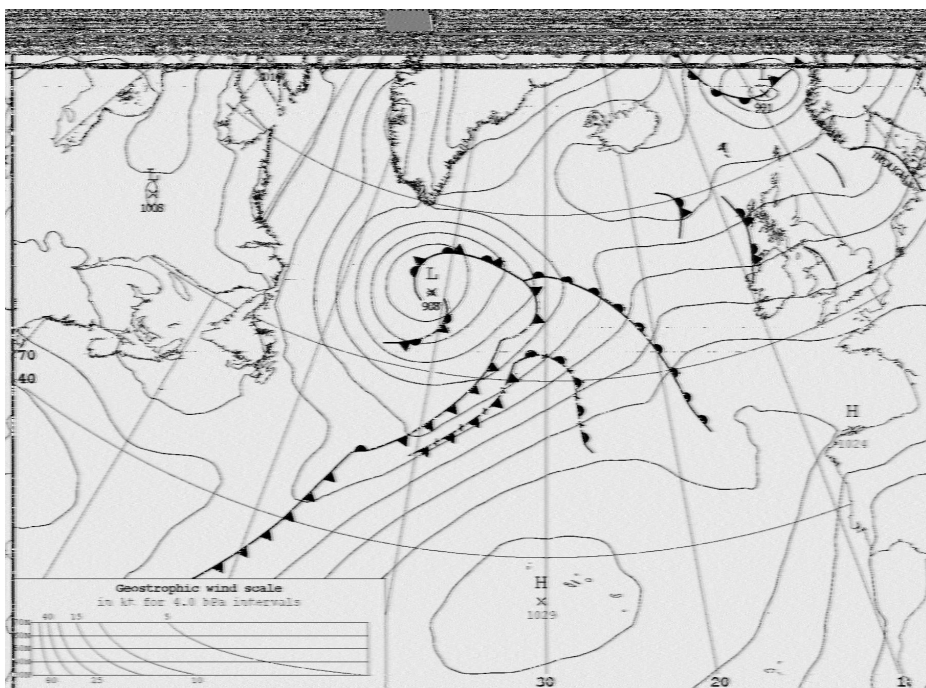
Weather Fax

A weather Fax (radiofax or WEFAX) contains weather charts, usually forecasts and nowcasts.

In the UK, **Northwood** transmits weather fax by the **Met Office** over **Medium Frequency (MF)** and **High Frequency (HF)** maritime bands.

Software

- SDR++
- [Black Cat HF Weather Fax](#) (free trial)



Weatherfax from Northwood received over WebSDR and decoded using Black Cat

Northwood schedule

Go to [webpage](#) and [online PDF](#)

NORTHWOOD, UNITED KINGDOM

JOMOC HF-Fax Schedule (North Atlantic)

CALL SIGNS	FREQUENCIES	TIMES	EMISSION	POWER
GYA	2618.5kHz	2200Z-0500Z	J3C	10 kw
GYA	4610.0kHz	24 hours	J3C	10 kw
GYA	8040.0kHz	Alternative 24 hour	J3C	10 kw
GYA	11086.5kHz	0600Z-2000Z	J3C	10 kw

Product	Broadcast Time (Z)	Product	Broadcast Time (Z)
18Z SFC ANALYSIS	0000	06Z SFC ANALYSIS	1200
18Z SFC PROGNOSIS T+24	0012	06Z SFC PROGNOSIS T+24	1212
18Z PRECIPITATION AND REDUCED VIS T+12	0024	06Z PRECIPITATION AND REDUCED VIS T+12	1224
18Z PRECIPITATION AND REDUCED VIS T+24	0036	06Z PRECIPITATION AND REDUCED VIS T+24	1236
18Z SFC ANALYSIS	0048	06Z SFC ANALYSIS	1248
18Z SFC PROGNOSIS T+24	0100	06Z SFC PROGNOSIS T+24	1300
18Z SEA AND SWELL T+48	0112	06Z SFC WINDS T+24	1312
18Z SEA AND SWELL T+72	0124	06Z GALE WARNING	1324
OCEAN FRONTS	0136	OCEAN FRONTS	1336
18Z SEA AND SWELL T+24	0148	06Z SEA AND SWELL T+24	1348
18Z SFC ANALYSIS	0200	00Z SEA SURFACE TEMP	1400
00Z SEA SURFACE TEMP	0212	06Z SFC ANALYSIS	1412
18Z SFC PROGNOSIS T+24	0224	06Z SFC PROGNOSIS T+24	1424
00Z SFC ANALYSIS	0236	12Z SFC ANALYSIS	1436
	0248		1448
00Z SFC ANALYSIS	0300	12Z SFC ANALYSIS	1500
	0312	00Z ANPS PROGNOSIS T+24	1512
18Z SFC WINDS T+24	0324	00Z ANPS PROGNOSIS T+120	1524
00Z ANPS PROGNOSIS T+24	0336	06Z SEA AND SWELL T+48	1536
00Z ANPS PROGNOSIS T+72	0348		1548
00Z SFC ANALYSIS	0400	12Z SFC ANALYSIS	1600
	0412		1612
18Z SFC WINDS T+24	0424	06Z SFC WINDS T+24	1624
00Z SFC PROGNOSIS T+24	0436	12Z SFC PROGNOSIS T+24	1636
18Z SFC WINDS T+48	0448	06Z SFC WINDS T+48	1648
00Z SFC ANALYSIS	0500	12Z SFC ANALYSIS	1700
00Z SFC PROGNOSIS T+24	0512	12Z SFC PROGNOSIS T+24	1712
00Z SFC PROGNOSIS T+48	0524	12Z SFC PROGNOSIS T+48	1724
	0536		1736
06Z GALE WARNING	0548	06Z SEA AND SWELL T+72	1748
	0600	12Z SFC ANALYSIS	1800
00Z SFC ANALYSIS	0612	12Z SFC PROGNOSIS T+24	1812
00Z SFC PROGNOSIS T+24	0624	12Z SFC ANALYSIS	1824
00Z SFC ANALYSIS	0636	12Z SFC PROGNOSIS T+24	1836
00Z SFC PROGNOSIS T+24	0648	12Z SFC ANALYSIS	1848
00Z SFC ANALYSIS	0700	12Z SFC PROGNOSIS T+24	1900
00Z SFC PROGNOSIS T+24	0712		1912
00Z SFC PROGNOSIS T+48	0724	12Z SFC PROGNOSIS T+48	1924
00Z SFC PROGNOSIS T+72	0736	12Z SFC PROGNOSIS T+72	1936
00Z SFC PROGNOSIS T+96	0748	12Z SFC PROGNOSIS T+96	1948
00Z SFC PROGNOSIS T+120	0800		2000
00Z SFC PROGNOSIS T+48	0812	12Z SFC PROGNOSIS T+120	2012
00Z PRECIPITATION AND REDUCED VIS T+12	0824	12Z SFC PROGNOSIS T+48	2024
00Z PRECIPITATION AND REDUCED VIS T+24	0836	12Z PRECIPITATION AND REDUCED VIS T+12	2036
00Z SFC PROGNOSIS T+24	0848	12Z SFC PROGNOSIS T+24	2048
06Z SFC ANALYSIS	0900	18Z SFC ANALYSIS	2100
	0912	12Z PRECIPITATION AND REDUCED VIS T+24	2112
00Z ANPS PROGNOSIS T+24	0924	00Z ANPS PROGNOSIS T+24	2124

00Z ANPS PROGNOSIS T+120	0936	00Z ANPS PROGNOSIS T+120	2136
	0948		2148
06Z SFC ANALYSIS	1000	18Z SFC ANALYSIS	2200
06Z SFC PROGNOSIS T+24	1012	18Z SFC PROGNOSIS T+24	2212
	1024		2224
00Z ANPS PROGNOSIS T+24	1036	00Z ANPS PROGNOSIS T+24	2236
	1048		2248
06Z SFC ANALYSIS	1100	18Z SFC ANALYSIS	2300
06Z SFC PROGNOSIS T+24	1112	18Z SFC PROGNOSIS T+24	2312
06Z SEA AND SWELL T+24	1124	18Z SEA AND SWELL T+24	2324
06Z SFC PROGNOSIS T+24	1136	18Z SFC PROGNOSIS T+24	2336
06Z SEA AND SWELL T+24	1148	18Z SEA AND SWELL T+24	2348

All MAPS 54°N.82°W 26°N.45°W

54°N.51°E 28°N.12°

Abbreviations

GPH

Geopotential Height

OAT

Outside Air Temperature

PPTN

Precipitation

SCEXAS TAFS

South Coast Exercise Areas Terminal Aerodrome Forecasts

TD

Dewpoint Temperature

WBPT

Wet Bulb Potential Temperature

(INFORMATION DATED Jan 05, 2022)

Popular UK Amateur Bands

Wavelength	Frequency (MHz)	Band	Typical use	Most active
80 m	3.5 – 3.8	HF	CW, SSB, digital	Busiest at dawn and dusk for long distances, also used during the night
40 m	7 – 7.2	HF	CW, SSB, digital	Similar to the 80 m band but can also be used during the day
20 m	14 – 14.35	HF	CW, SSB, digital	Daytime
10 m	28.0 – 29.7		AM	
2 m	144 – 146	VHF	FM, SSB, AM, CW, digital, satellite	Anytime. Used by repeaters.
70 cm	430 – 440	UHF	FM, SSB, digital, ATV	Anytime

FM = Frequency modulated

CW = Morse code

SSB = Single side band

ATV = Amateur TV

Other local transmissions

Complete based on your location

Frequency	Mode	Notes
118 – 137 MHz	AM	'Airband voice' e.g. Dundee Airport
446 MHz	FM	Walkie Talkies

Radio spectrum

Bands

Band	Abbv	Frequency	Wavelength	Example applications
Extremely Low Frequency	ELF	3–30 Hz	100,000–10,000 km	Sferics (e.g. whistler, tweet, chorus), communication with submarines
Super Low Frequency	SLF	30–300 Hz	10,000–1,000 km	Sferics, communication with submarines
Ultra Low Frequency	ULF	300–3,000 Hz	1,000–100 km	Sferics, communication with submarines, fiber-optic communication
Very Low Frequency	VLF	3–30 kHz	100–10 km	Time signals, communication with submarines, wireless, geophysics
Low Frequency	LF	30–300 kHz	10–1 km	Longwave broadcasts on AM (Europe and parts of Asia), amateur radio, RFID tags, time signals
Medium Frequency	MF	300–3,000 kHz	1,000–100 m	Medium wave broadcasts on AM, amateur radio, magnetic resonance imaging
High Frequency	HF	3 – 30 MHz	100–10 m	Shortwave broadcasts, citizens band radio, amateur radio, over-the-horizon radar and aviation communications, RFID, marine communications (telephony), CT

				scan, magnetic resonance imaging, ultrasound
Very High Frequency	VHF	30–300 MHz	10–1 m	FM broadcasts, amateur radio, television broadcasts, radar, AM line-of-sight aircraft communications, AM aircraft-to-aircraft communications, mobile and maritime communications, emergency services
Ultra High Frequency	UHF	300–3,000 MHz	100–10 cm	L-Band, mobile phones, TV broadcast, microwave ovens and communications (including the licence exempt 2.4 Hz band that is used by the protocols for WiFi, Bluetooth, Zigbee), GPS, radio astronomy,, amateur radio, LoRa Networks (ISM band), emergency services, TV white space (TVWS)
Super High Frequency	SHF	3–30 GHz	10–1 cm	L Band, radio astronomy, microwave devices and communications, wireless LAN (WiFi), most modern radars, communications satellites, satellite television, amateur radio, satellite broadcasting, communication satellites, weather satellites
Extremely High Frequency	EHF	30–300 GHz	10–1 mm	Radio astronomy, satellite broadcasting, communication satellites, weather satellites, high-frequency microwave radio relay (e.g. financial trading), microwave remote sensing, millimeter wave scanners at airports, Wireless Lan 802.11ad, internet.
Terahertz Or Tremendously High Frequency	THF	300–3,000 GHz	1–0.1 mm	Experimental medical imaging to replace X-rays, ultrafast molecular dynamics, condensed-matter physics, terahertz computing.

Source: Adapted from Wikipedia, 29 June 2026