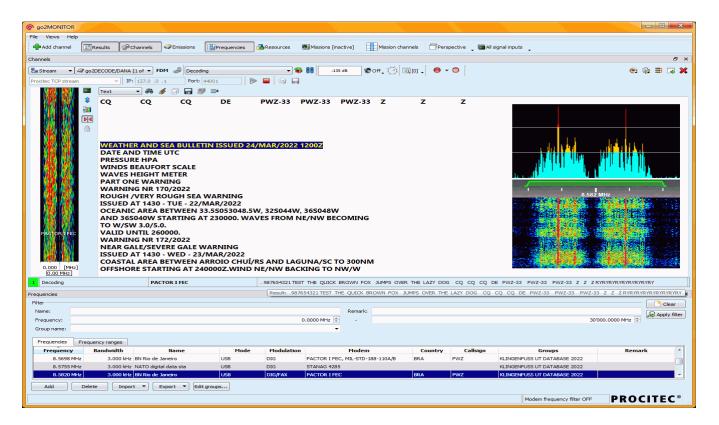
2.9 Internet-controlled Software-Defined Radios (Web-SDR)

In urban areas all over the world, shortwave radio listeners experience an increasing level of man-made noise by around-the-corner and in-house digital techniques such as cheap electronic goods from China, powerline communication (PLC), plasma television screens, and so on. The radio spectrum is polluted, and that makes HF reception impossible in certain places. Constructing a state-of-the-art listening post far away in the "quiet" countryside, and controlling it via the Internet, is the optimal solution to this problem that has been successfully adapted by e.g. Christoph Ratzer OE2CRM in Austria. His Remote DX Blog at *https://remotedx.wordpress.com* reports incredible receptions from far-away and weak shortwave (and mediumwave!) broadcast radio stations all over the world.

Fortunately, there's a much less expensive solution. Currently (2021), more than six hundred (!) Kiwi-SDRs worldwide covering the complete 0-30 MHz spectrum are linked at *kiwisdr.com* and *www.ve3sun.com/KiwiSDR*. This is the Open Web RX project of András Retzler HA7ILM with the superb Kiwi-SDR user interface for the Beagle Bone computer board. It is simply great for the reception of HF utility radio stations, and even NAVTEX on MF, from interesting locations all over the world. What's more, many radio amateurs, radio clubs, researchers, and universities have made available their SDRs via Internet. Dozens of such projects are linked e.g. at *www.websdr.org*. The frequency bands covered are usually certain amateur radio bands \pm a few kHz beyond. Consequently, the antennas used are optimized for these bands, and their performance decreases sharply for frequencies beyond. Anyway, a good starting point is the University of Twente's Web-SDR in the Netherlands that covers the entire MF and HF band from 0 to 29 MHz.



go2SIGNALS' superb DANA allows direct input of a Kiwi-SDR signal (here ex PT2FHC) into the go2MONITOR decoder • Up to 32 decoding channels are provided!
 A specially formatted sample Klingenfuss frequency database is perfectly integrated in the go2MONITOR GUI • 8582.0 kHz Brazilian Navy Rio de Janeiro, Brazil

👚 kiwisdr.com/public/ 💦 💙	k Lesezeichen Extras Hilfe								- 0 - 2
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				Eile Search E					
				Freq.	Callsign	Station	Country	Modulation	Details
				13339,0		Honolulu Air	HWA	SSB	
				13339,0		San Francisco Air, CA	USA	SSB	
.340 MHz		13.345 MHz		13342,0		AMS		SSB	
				13342,0	+H10+	Muan Air	KOR	DIG	ACARS
٥							$\ni \Theta \Theta \oplus$	extension ⊕⊕ spec sB CW NE ↔ ﴿	

Kiwi-SDR in Kobe, Japan (left: Muan on 13342.0 kHz - right: Auckland on 13351.0 kHz) Perfect HFDL PSK-aggregate data bursts - note the pilot tone at 1440 Hz!

Add channel	Results 🕼 Channels 🖓 Emissions 🔡 Frequencies 🖓 Resources 💽 Missions (inactive)	Mission channels	Perspective	All signal inputs					
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		10081.0	+H01+	San Francisco Air. CA	USA	DIG	HFDL		
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1000	Max Bit rate 300 bps U(R) = 0 UR(R)vect = 0	10081,0	+H07+	Shannon Air	IBL	DIG	HFDL		
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	HACARS mode: 2 Aircraft reg: .B-326W Message label: 12 Block id: 4 Msg. no: M57A Flight id: CA0080	10084.0		AMS		SSB			
	Message label: 12 block ld: 4 Msg. no: M57A Flight ld: CA0080 Message content:-	10084,0	+H05+	Auckland Air	NZL	DIG	HFDL		
	WXR FS ZUUU"	10084.0		Arkhangelsk Air	RUS	SSB			
		10084.0		Beirut Air	LBN	SSB			
	.BJSAGCA 011914	10084.0		Berlin Air	GER	SSB			
	AGM	10084,0		Kivev Air	UKR	SSB			
	AN B-326W	10084.0		Moscow Air	RUS	SSB			
	TAF ZUUU 011507Z 0118/0218 33003MPS 6000 SCT050 TX19/0207Z TN Z=	10/0122 Content							
10	.BJSAGCA 011920	Decoded text							
1. 2. 11	AGM	L	Decode Text 18:31:20 - 18:31:25 [4.56], 20220301.183120.0402_10003_34.dec						
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0.000	- NO GATE NOW METAR ZUUU 011900Z 14002MPS 110V170 CAVOK 13/05 Q1019 NOSIG Flight-ID : SIA235 LAT: 19 9 16 S LON: 133 15 16 E UTC: 19:37:16 Ground Station ID : 05 - (AUCKLAND - NZ - LAT 37 0 55 S LON 174 48	(Allout1) /MELCA FANS-1/, 34 E Header: Msg ID Timesta CONTA Facility Facility	YA.AT1.9V A CPDLC M Jplink Mes : : 10 amp: 18:27 e data: CT [icaoun	SCI2549845D6D362C essage: sage: :17 Litname] [frequency] ELBOURNE center	C853EAD2	9D142F870	05263		

Perfect decoding of the Kiwi-SDR's signal above 10084.0 kHz Auckland Air, New Zealand



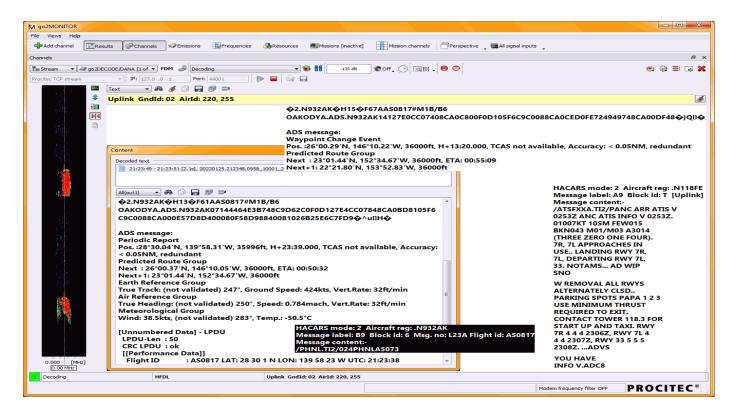
Web-SDRs Twente, Netherlands, and Crimea, Russian Federation

This screenshot - made 7 March 2015 at 1642 UTC - shows the difference between a professional project like Twente, above, and an amateur project elsewhere, below. The strong FSK signal in the centre of the spectrum is Hamburg Meteo on 10100.8 kHz. On the right is the amateur radio band with many digital signals. On the left is the aeronautical mobile band with HFDL aggregate bursts at 10081 kHz USB (Shannon), and 10087 kHz USB (Krasnoyarsk). On the other hand, Crimea is as deaf as a dodo: it receives just Hamburg and nothing else, neither in the amateur band nor in the aeronautical band where Krasnoyarsk would be just one propagation hop away ... What's more, the frequency displayed is 3 kHz too high!

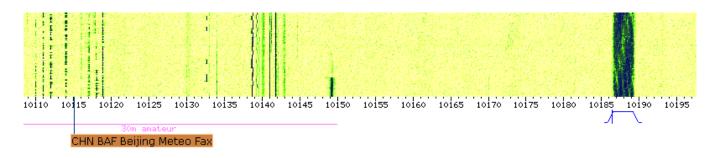
Twente is often accessed by 400+ users at the same time. It allows perfect decoding of sophisticated digital data signals, even if your Internet connection delivers only a real-life data rate of 400-500 kB/s. A chatbox allows a discussion of the project, and comments on the stations received. At *http:// websdr.ewi.utwente.nl:8901/m.html*, there is a Web-SDR version for mobile devices such as smartphones and tablet computers. Be sure to use the latest versions of modern browsers such as Chrome, and select HTML5 instead of Java.

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FORWM PHAM VI: KHUNKDIEN TAP QUAN SU HAN CHE HOAT DONG HANG HAI						
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M A3: 11-49.70N 109-21.00E	4209,5	L2C	ACG Buenos Aires	ARG	DIG	SITOR
VI A4; 11-30.00N 109-17.00E	4209,5	SUZ	Serapeum R	EGY	DIG	SITOR
HOI GIAN:	4209.5	SVH	Iraklion B	GRC	DIG	SITOR
- 17/4 DEN NGAF 21/4/2022	4209.5	SVO	Olympia R. Athens	GRC	DIG	SITOR
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I TIN DOF QUAN CHUOX HAI QUAN CUNG CAP.	4209,5	×sa	Guangzhou R	CHN	DIG	SITOR
	4209,5	XSV	Tianjin R	CHN	DIG	SITOR
IN CONTRACTOR OF CONTRACTOR	4209.5	XVG	Hai Phong R	VTN	DIG	SITOR
	4209,5	XVN	Nha Trang R	VTN	DIG	SITOR
		NYIN .	INITIAL ITALIG PA	VIIN	Dia	BHOR
						,

Kiwi-SDR Hanoi, Viet Nam 4209.5 kHz Hai Phong Radio, Viet Nam



Kiwi-SDR Keelung, Taiwan, Democratic Republic of China 13324.0 kHz Hoolehua Air, Molokai, Hawaii Periodic Report and Waypoint Change Event and Honolulu ATIS request downlink from aircraft N932AK (Alaska Airlines Boeing B737-9 Max/NG) Anchorage ATIS uplink to aircraft N118FE (FedEx Boeing B767-3S2F Freighter) Just for the record ... the "Station information" from certain databases displayed in some Web-SDR's "Frequency labels" is totally outdated and misleading. It includes hundreds and thousands of users that ceased transmissions on HF several decades ago. What's more, most radio amateurs simply do not know even the most common professional digital data modes, stations, and frequencies ...



"CHN BAF Beijing Meteo Fax" on 10117 (not 10115!) kHz closed way back in 2002 ... while real-time data such as the strong FUG PSK aggregate on 10187.9 kHz is listed only in up-to-date publications such as our GUIDE TO UTILITY RADIO STATIONS - Professional HF Communication Today and on our SUPER FREQUENCY LIST ON CD!

For standard digital data transmission systems, the required data rates on your e.g. SDR \leftrightarrow PC \leftrightarrow Internet \leftrightarrow WebSDR connection are not too demanding. Example 1: Recording WAV files from a SDR such as Microtelecom's PERSEUS. With the sampling rate set to 125 kHz, which is more than sufficient for several adjacent PSK signals, the data amounts to 17 GB in 6:45 hours, that is roughly 700 kB/s.

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🤏 C	07042015-21982-www-klingenfuss.org_002	07.04.2015 09:51	659.179 KB	Wavesound	
9 <u>9</u> z	07042015-21982-www-klingenfuss.org_003	07.04.2015 10:06	659.179 KB	Wavesound	
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🥽 Bib	07042015-21982-www-klingenfuss.org_005	07.04.2015 10:36	659.179 KB	Wavesound	
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-> N	07042015-21982-www-klingenfuss.org_008	07.04.2015 11:21	659.179 KB	Wavesound	
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	07042015-21982-www-klingenfuss.org_020	07.04.2015 14:21	659.179 KB	Wavesound	
	07042015-21982-www-klingenfuss.org_021	07.04.2015 14:36	659.179 KB	Wavesound	
	07042015-21982-www-klingenfuss.org_022	07.04.2015 14:51	659.179 KB	Wavesound	
	07042015-21982-www-klingenfuss.org_023	07.04.2015 15:06	659.179 KB	Wavesound	
	07042015-21982-www-klingenfuss.org_024	07.04.2015 15:21	659.179 KB	Wavesound	
	07042015-21982-www-klingenfuss.org_025	07.04.2015 15:36	659.179 KB	Wavesound	
-					

PERSEUS memorizes roughly 660 MB every 15 minutes

Example 2: Recording WAV files from a Web-SDR. With the channel bandwidth set to around 3 kHz for e.g. PACTOR-FEC, the data amounts to approximately 930 kB/min or 16 kB/s. This means that even complex PSK aggregate signals such as STANAG 4285 do require just a few dozen kB/s which is easily achieved with even those "slow" DSL connections somewhere in the countryside.

Name websdr_recording_2015-04-10T09_11_55Z_6449.0kHz websdr recording 2015-04-10T09 11 55Z 6449.0kHz Typ: VLC media file (.wav) Bitrate: 128 kBit/s Größe: 2,18 MB

2:23 minutes Web-SDR recording Brazil ↔ Germany

Many Web-SDRs are slightly off frequency. In the following example, a Romanian Web-SDR is 54 Hz off and, consequently, receives the pilot tones of HFDL transmissions somewhat lower than expected, i.e. on 1386 Hz instead of the standard 1440 Hz. For optimal decoding of critical digital transmission systems, either the receiving frequency or the decoder should be set accordingly.



2.10 Automatic monitoring using wide-band SDRs

State-of-the-art radio monitoring tools now allow continuous automatic classification of emissions monitored over a wide frequency spectrum.

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-1	50	м итала (8.42 <u>МојF5</u>	8.43 K2: MF5Morse	8.44		B.45	8.46 (STANAG 4	8.47 285/4481 (P5K)	through the	8,48 8,49 OFDM jrse Morse IAG 4285/4481 (PSK)	8.50 81 (PSK)	8.51 Morse [MHz]
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ceiver active [I activity ID 100452	8.41 8 FSK2 Range: 8410.00 - 8510 Name OFDM CP	Mo <u>řFS</u> .00 kHz, Ban Type Search	K2 MFSMorse dwidth: 100 kHz] Active 0) <u>fiv(7ch PSI</u> Triggered 9	Started	TANAG 4285/4481 6 Dropped 0	(STANAG 4	285/4481 (PSK)		OFDM prse NMorse IAG 4285/4481 (PSK)	31 (PSK) 1	Morse (MHz)
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eceiver active [I k activity	8.41 8 F5K2 Range: 8410.00 - 8510 Name OFDM CP Voice	MolFS	K2 MF5Morse dwidth: 100 kH2 Active 0 0	Triggered 9 4081	Started 9 6	IANAG 4285/4481 5 Dropped 0 4042	KSTANAG 4	285/4481 (PSK) ns		OFDM prse) Morse JAG 4285/4481 (PSK) 1	31 (PSK) 1	
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PROCITEC go2MONITOR displays a 100 kHz wide sonagram between 8410 and 8510 kHz and continuously classifies all emissions in realtime

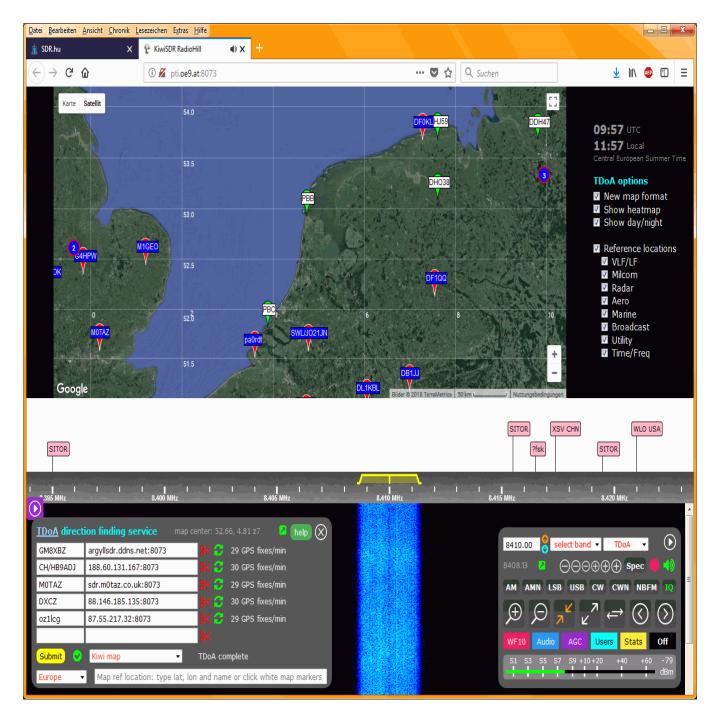
All those fascinating digital data signals visible here in the sonagram are perfectly identified and listed in our latest publications!

× M Edit task Summary Task overview General Type: Wideband-classifier based search Name: P2-FEC scan Description: Priority: Normal Enabled: Yes Activation Time: 06.04.2015 21.00.00 - 13.04.2015 21.00.00, continuous Region: 0 regions defined Frequencies: 13 MHz, 12.95 - 13.2 MHz, Search Frequency Range Start Trigger MODULATION: FSK BAUDRATE FROM 96 TO 104 SHIFT FROM 180 TO 220 TONECOUNT FROM 2 TO 2 Actions Recording: No Classification: Yes [FSK] Recognition and decoding: Yes [Baudot async 1,5 Stopbit 50Bd 450Hz,PACTOR II FEC] End Trigger Maximum duration: 30 s Idle duration: -Expire time: 10 s Block frequency for: 60 s Alert: Positive action result < <u>B</u>ack Einish

Mission activation and task definition with the go2MONITOR decoder allows specified search for e.g. strange PACTOR-2-FEC signals monitored only recently in certain maritime bands

2.11 Direction-finding using the Kiwi-SDR system

The location of unidentified radio stations can be now be measured with a precision of up to 5 - 10 kilometres. This new Kiwi-SDR software feature is called Time Difference on Arrival (TDOA). Similar to the established GPS system, it measures the time-difference of signals received from at least three radio stations and, via cross correlation, calculates the geographical location on the Earth's surface by simple triangulation. (Note that GPS requires at least four satellites for calculating the <u>altitude</u> as well.) The following screenshots demonstrate the complete workflow.



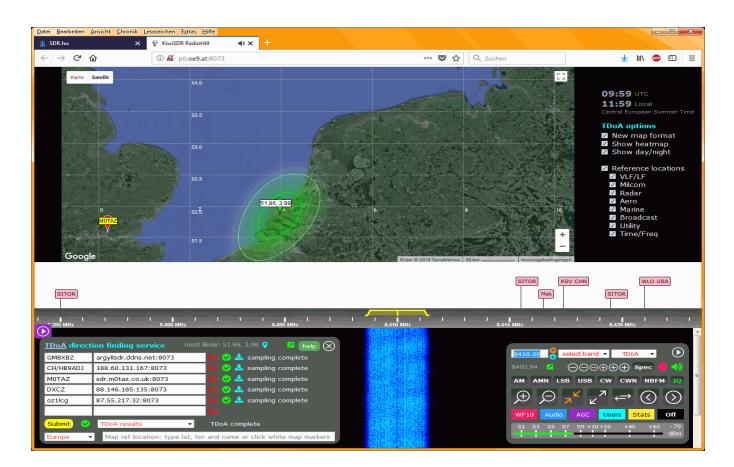
Select In-Phase-and-Quadrature (I/Q) demodulation Select at least three GPS-locked Kiwi-SDRs around the presumed location Each of these must provide good reception of the desired signal!



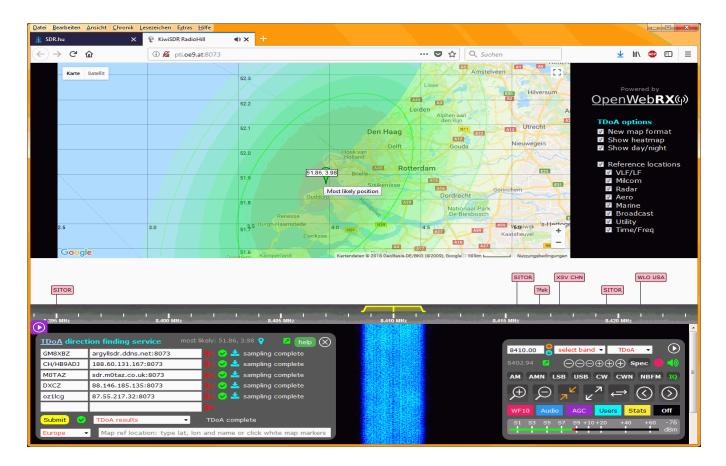
The I/Q data stream sampling process takes around 30 seconds ...

	Ansicht Chronik Lesezeichen Extras Hilfe				
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Karte	Satellin 54.0 53.5 53.0 53.0 53.0 53.0 53.0 52.5 52.5 52.5 52.5 51.5 16				09:58 UTC 11:58 Local Central Europeen Summer Time TDOA options New map format Show heatmap Show day/night Reference locations VLF/LF Milcom New Radar Aero Mairne Broadcast Utility Time/Freq
SITOR	I I I <mark>I</mark> I I 8.400 МН2	1 1 1 1 1 3.405 MHz 1 1 1	1 8.410 MHz	SITOR XSV C	
GM8XBZ CH/HB9ADJ MOTAZ DXCZ oz1lcg Stop	188.60.131.167:8073 sdr.m0taz.co.uk:8073 88.146.185.135:8073 87.55.217.32:8073	 sampling complete sampling complete sampling complete sampling complete sampling complete 		8402.94 AM AMN LSB	$\begin{array}{c c c c c c c c c c c c c c c c c c c $

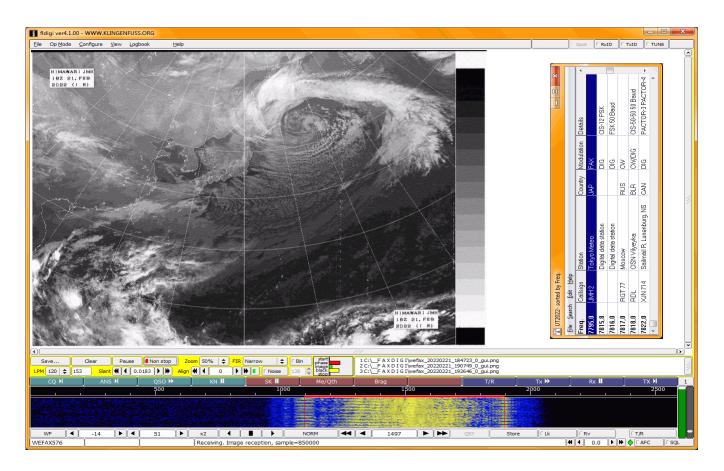
The TDOA calculation process takes 1-2 minutes ...



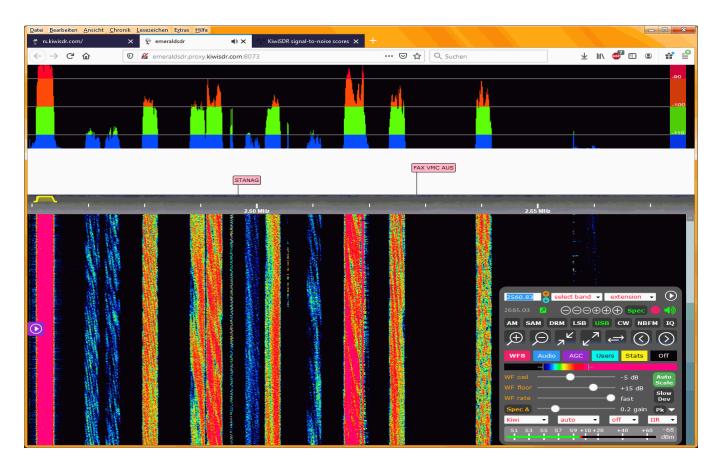
The possible location is shown on the map ...



... and identified as the Dutch Navy on Goeree Island, Netherlands!



7795.0 kHz Tokyo Meteo, Japan • Satellite image



2615 ± 50 kHz • many STANAG 4285 signals on a Kiwi-SDR • 24 JAN 2021, 1825 UTC ©