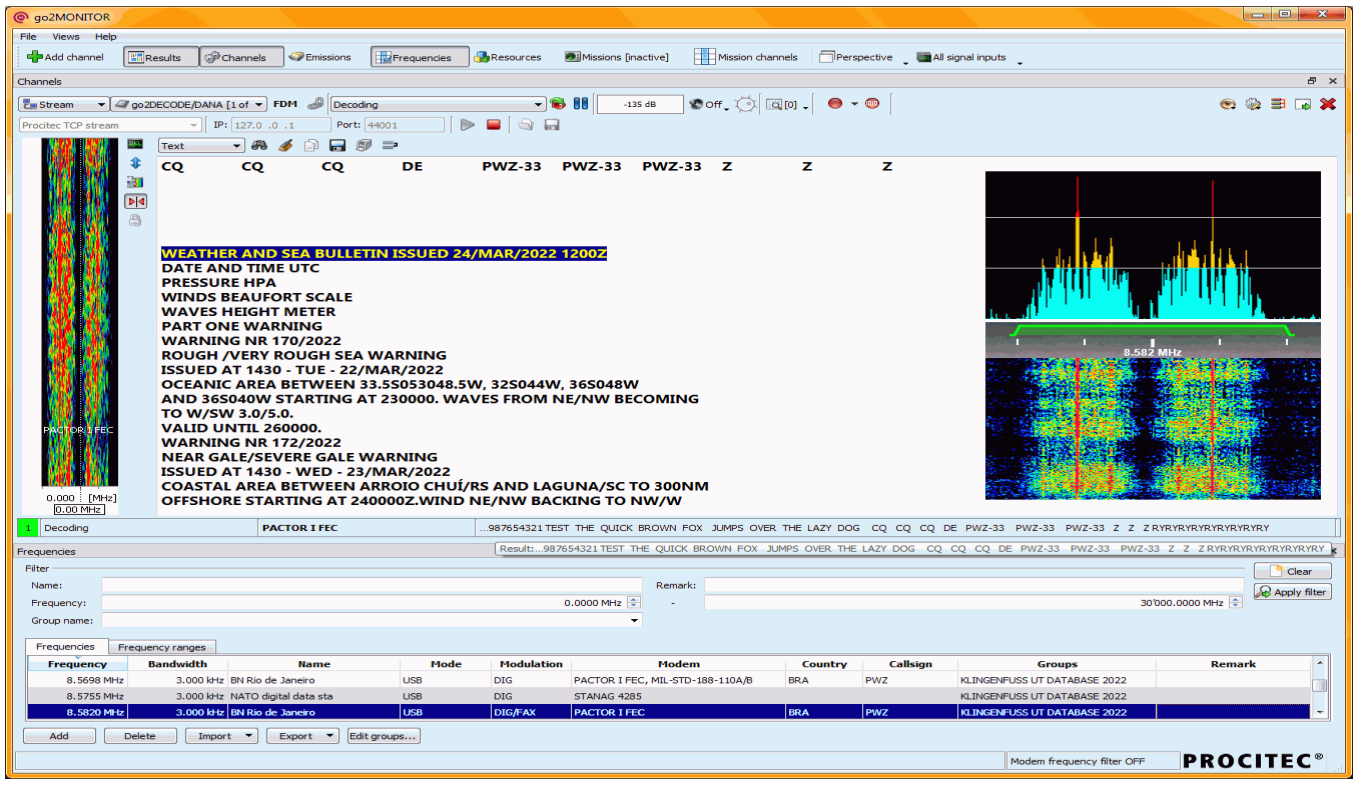
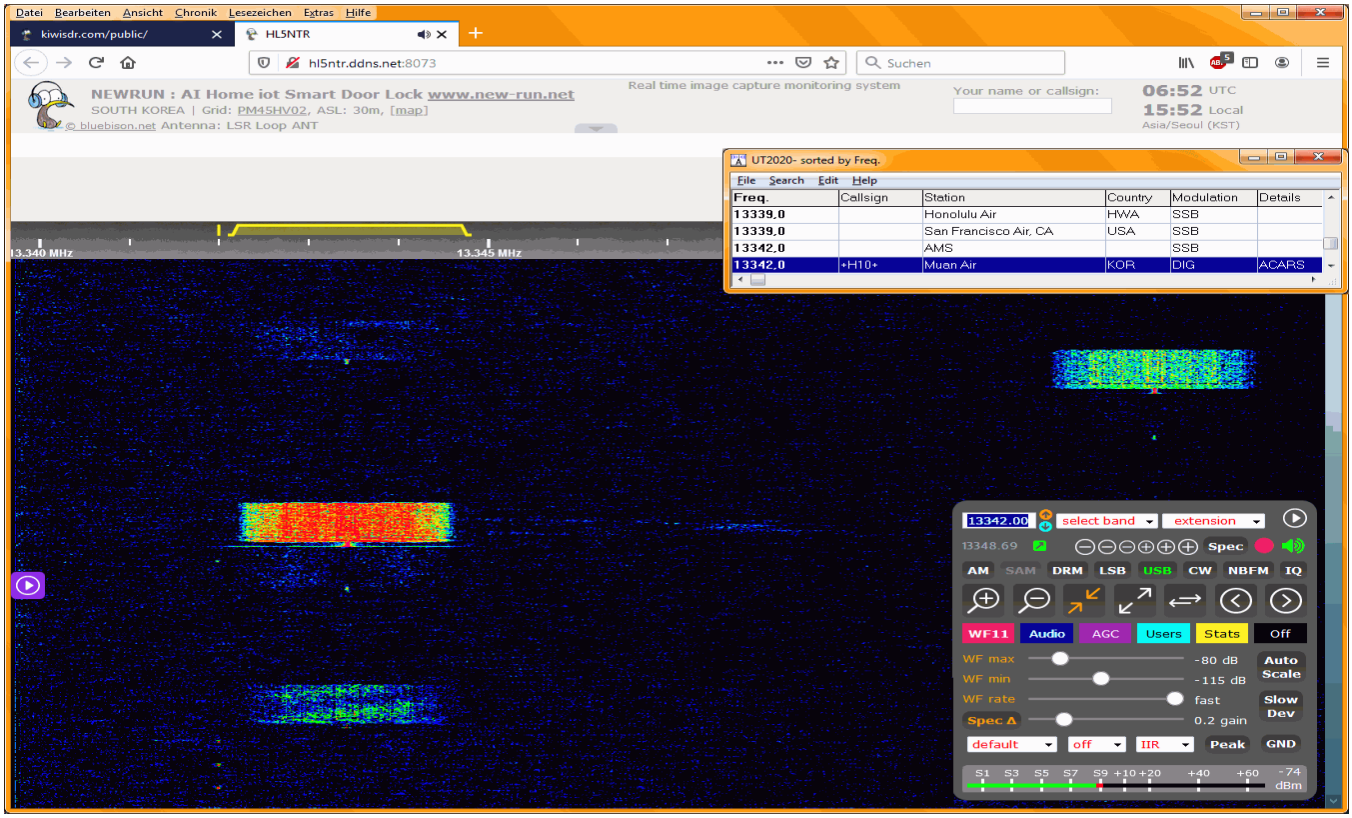
2.9 Internet-controlled Software-Defined Radios (Web-SDR)

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.

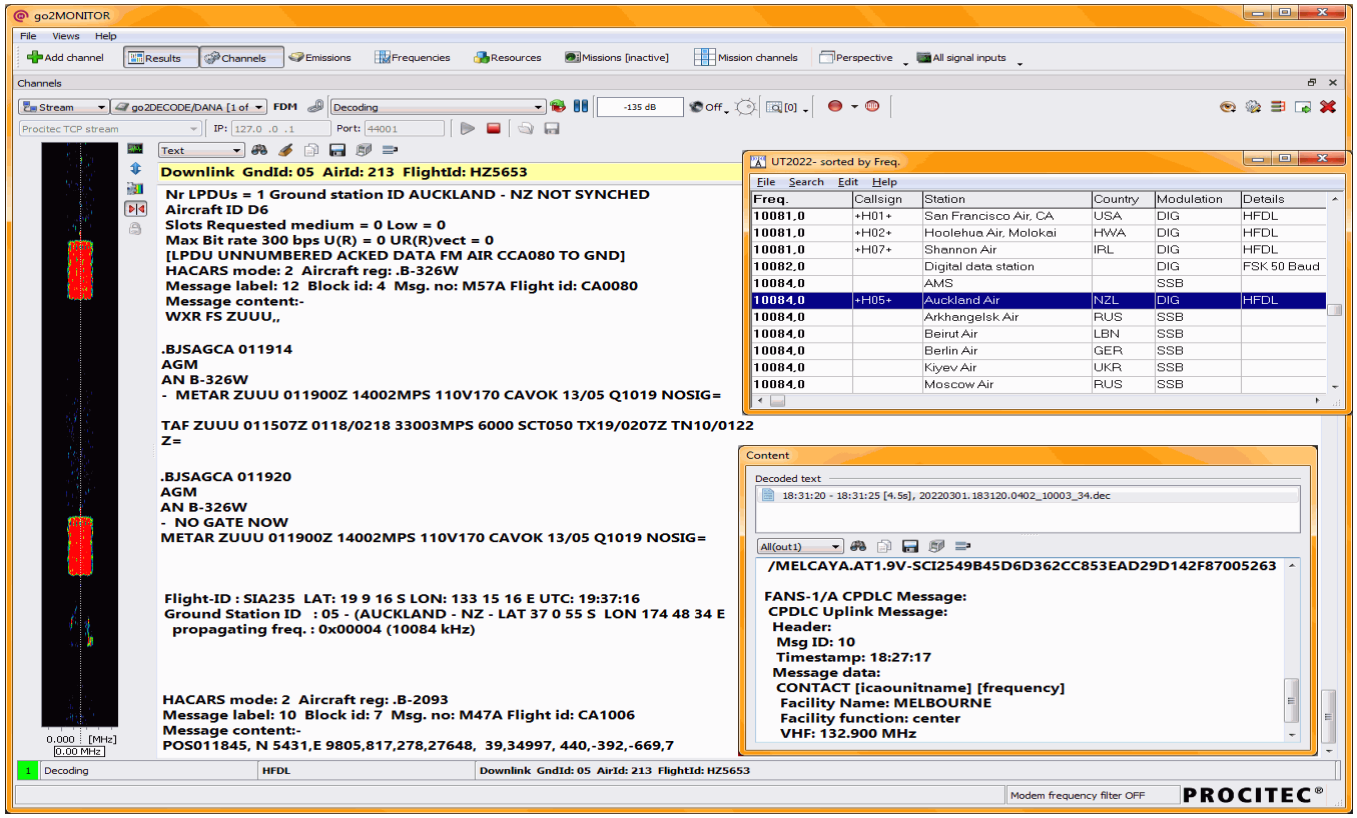
Fortunately, there's a much less expensive solution. Currently (2021), **more than six hundred (!) Kiwi-SDRs worldwide covering the complete 0-30 MHz spectrum are linked at *kiwisdr.com*** and ***www.ve3sun.com/KiwiSDR*** . This is the Open Web RX project of András Retzler HA7ILM with the superb Kiwi-SDR 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 ± 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.



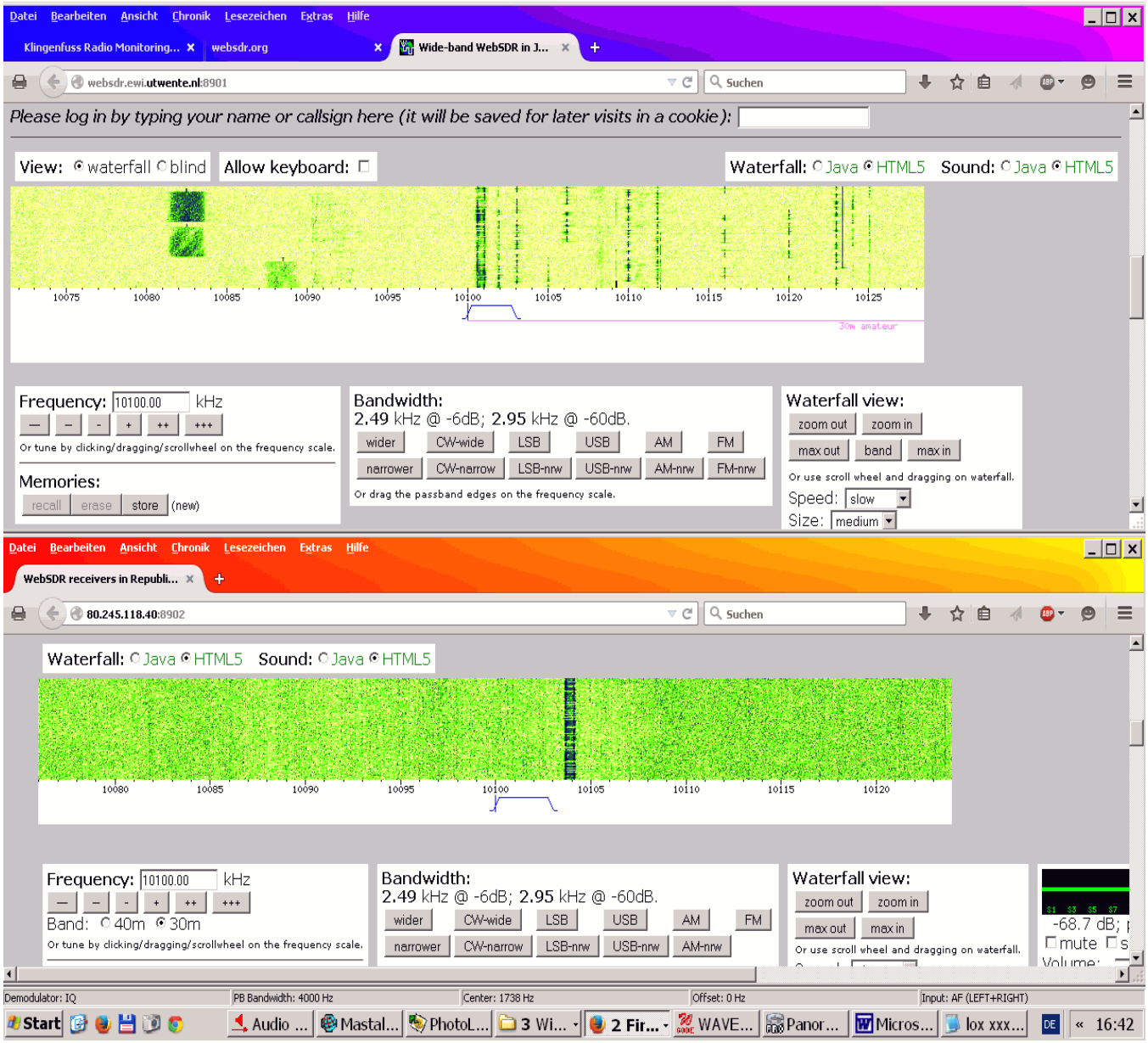
go2SIGNALS' superb DANA allows direct input of a Kiwi-SDR signal (here ex PT2FHC) into the go2MONITOR decoder • Up to 32 decoding channels are provided! A specially formatted sample Klingenfuss frequency database is perfectly integrated in the go2MONITOR GUI • 8582.0 kHz Brazilian Navy Rio de Janeiro,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



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!



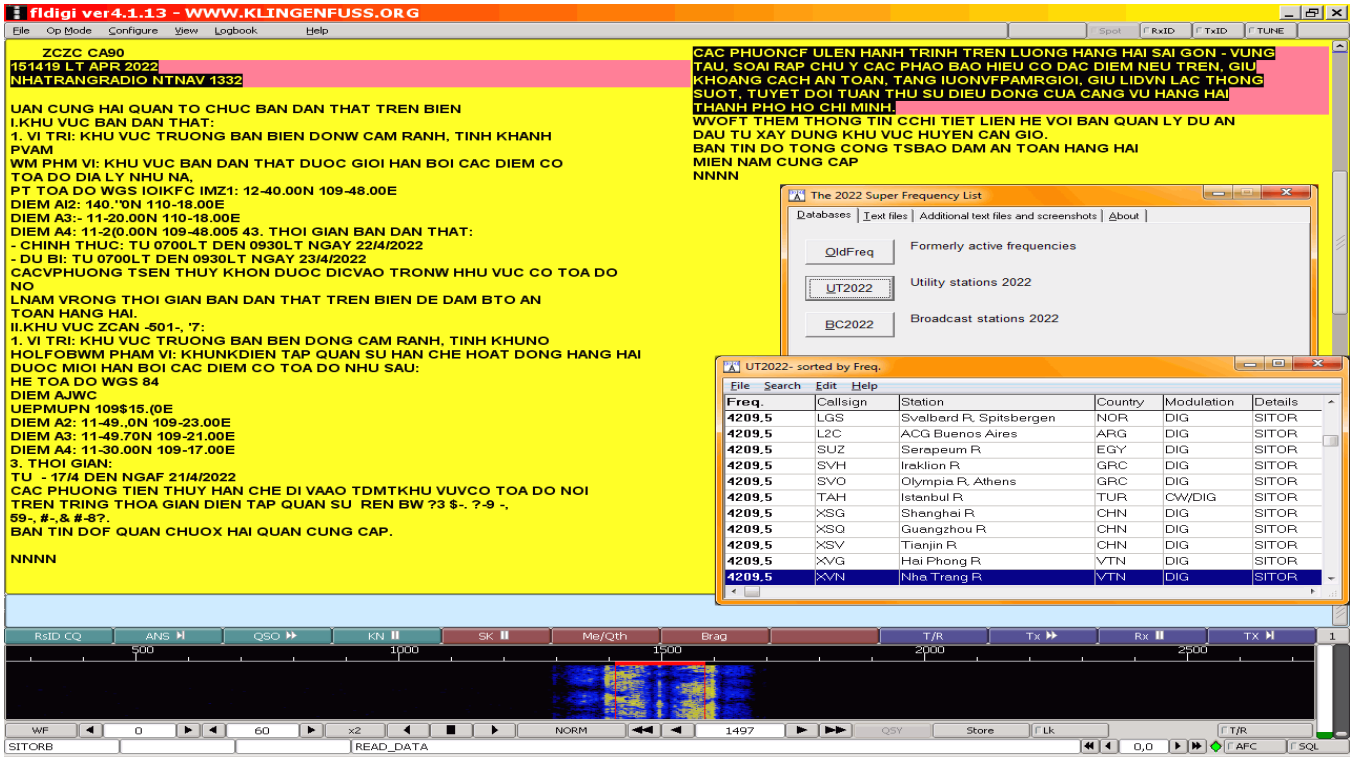
Perfect decoding of the Kiwi-SDR's signal above
10084.0 kHz Auckland Air, New Zealand



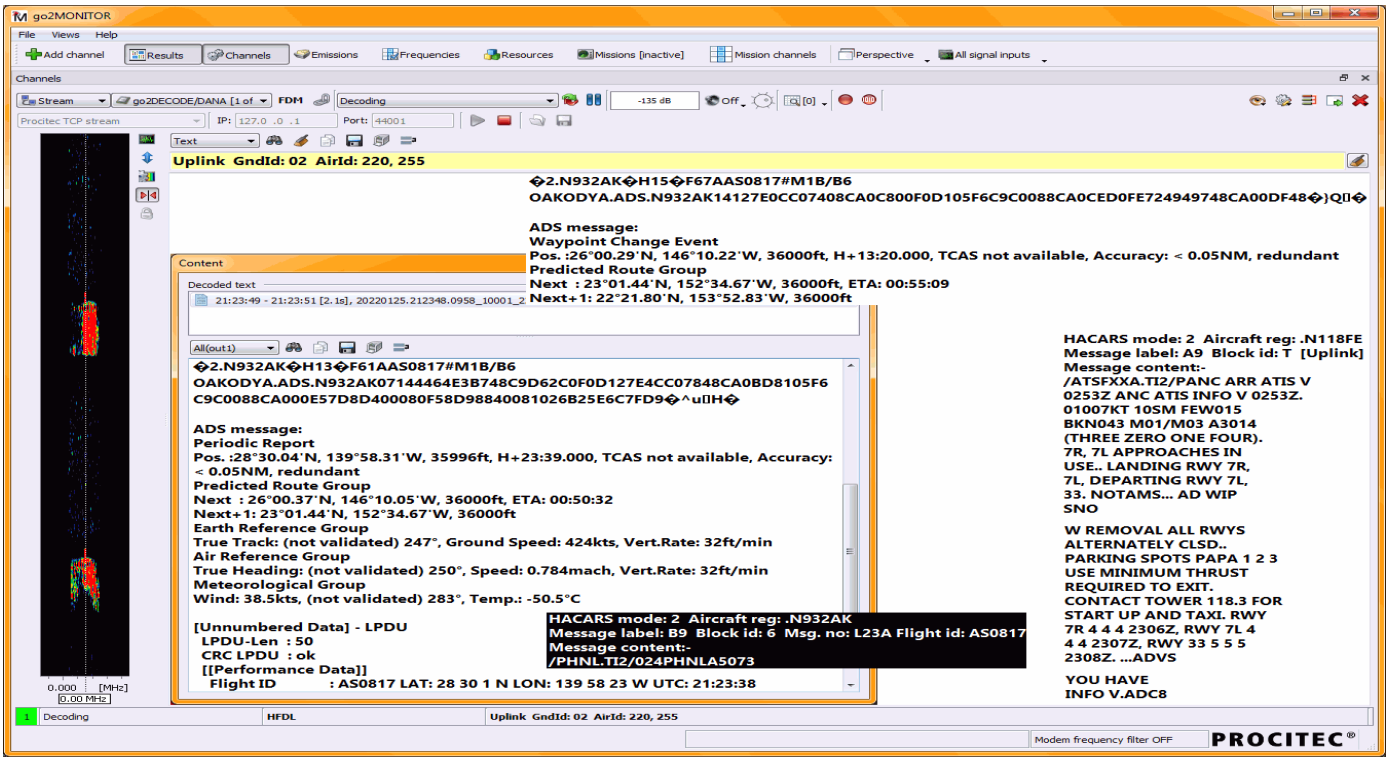
Web-SDRs Twente, Netherlands, and Crimea, Russian Federation

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.

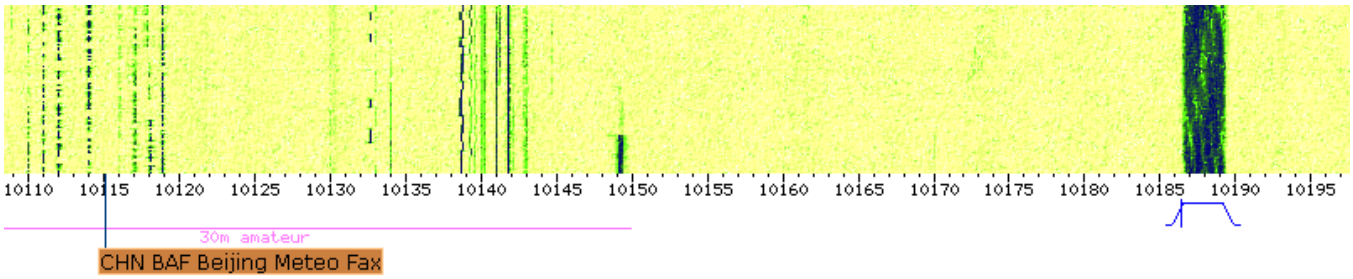


Kiwi-SDR Hanoi, Viet Nam
4209.5 kHz Hai Phong Radio, Viet Nam



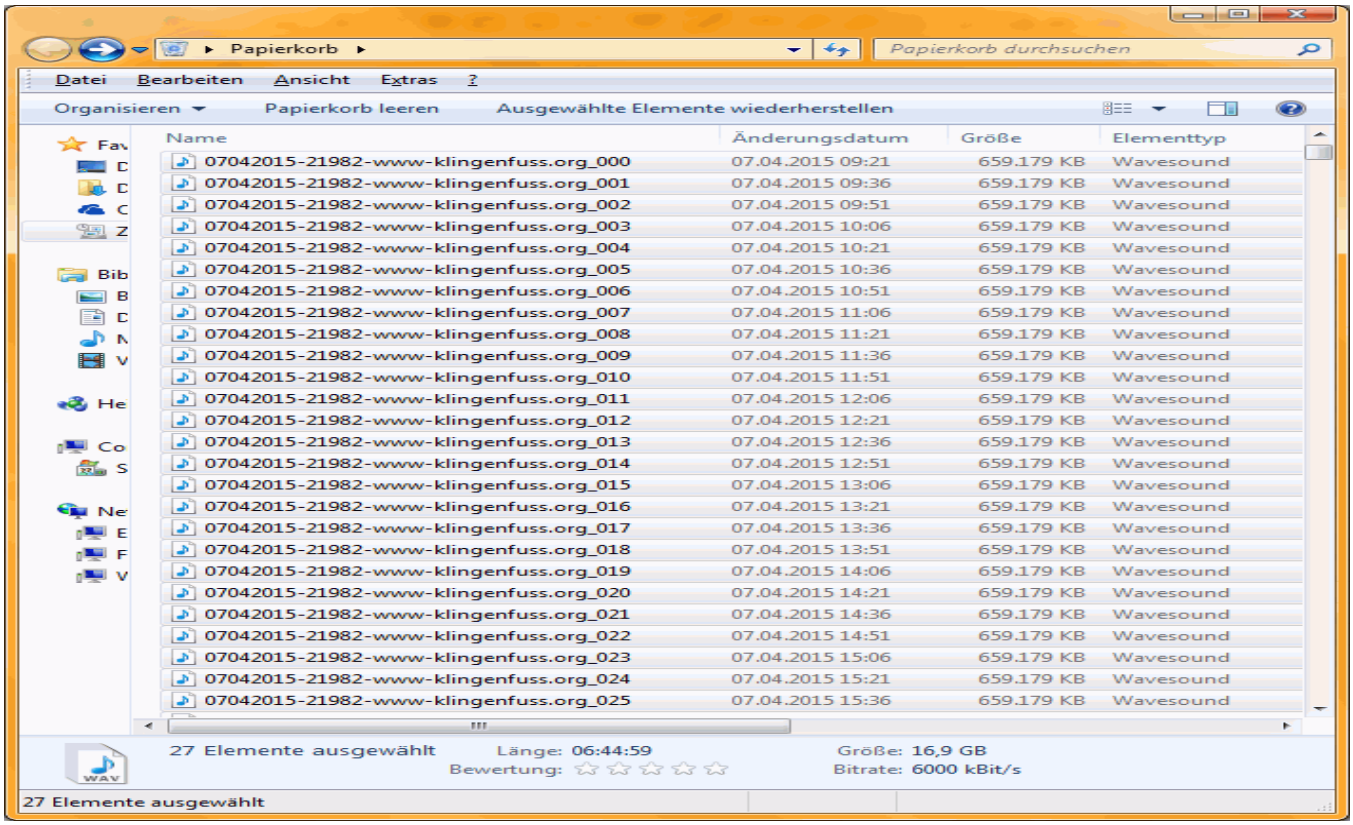
Kiwi-SDR Keelung, Taiwan, Democratic Republic of China
13324.0 kHz Hoolehua Air, Molokai, Hawaii
Periodic Report and Waypoint Change Event and Honolulu ATIS request downlink from aircraft N932AK (Alaska Airlines Boeing B737-9 Max/NG)
Anchorage ATIS uplink to aircraft N118FE (FedEx Boeing B767-3S2F Freighter)

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 ...



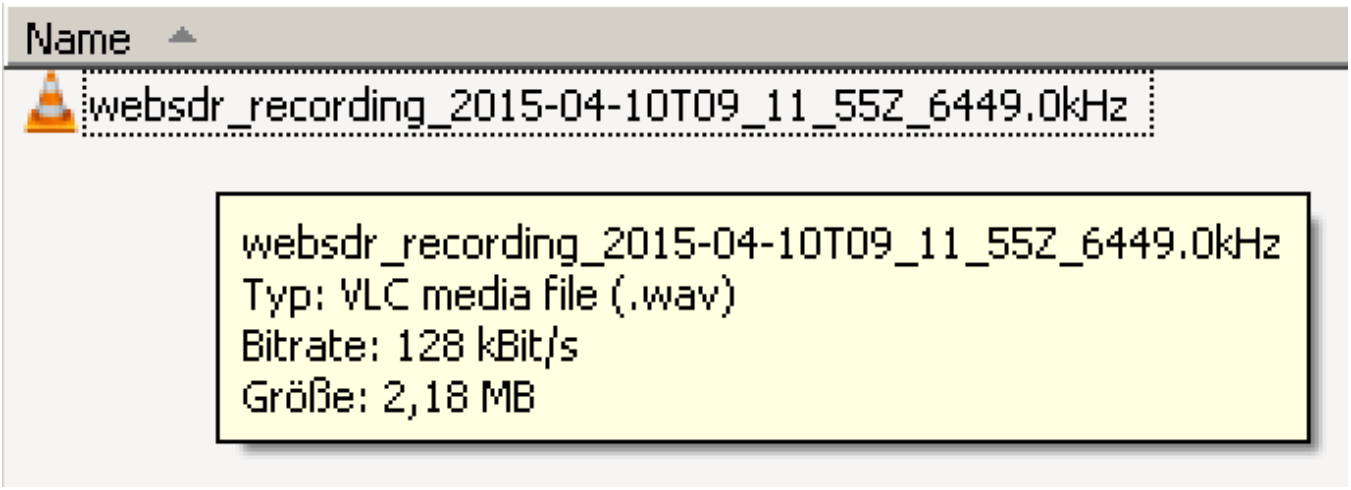
"CHN BAF Beijing Meteo Fax" on 10117 (not 10115!) kHz closed way back in 2002 ...
while real-time data such as the strong FUG PSK aggregate on 10187.9 kHz
is listed only in up-to-date publications such as our
GUIDE TO UTILITY RADIO STATIONS - Professional HF Communication Today
and on our SUPER FREQUENCY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

For standard digital data transmission systems, the required data rates on your e.g. SDR ↔ PC ↔ Internet ↔ 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.



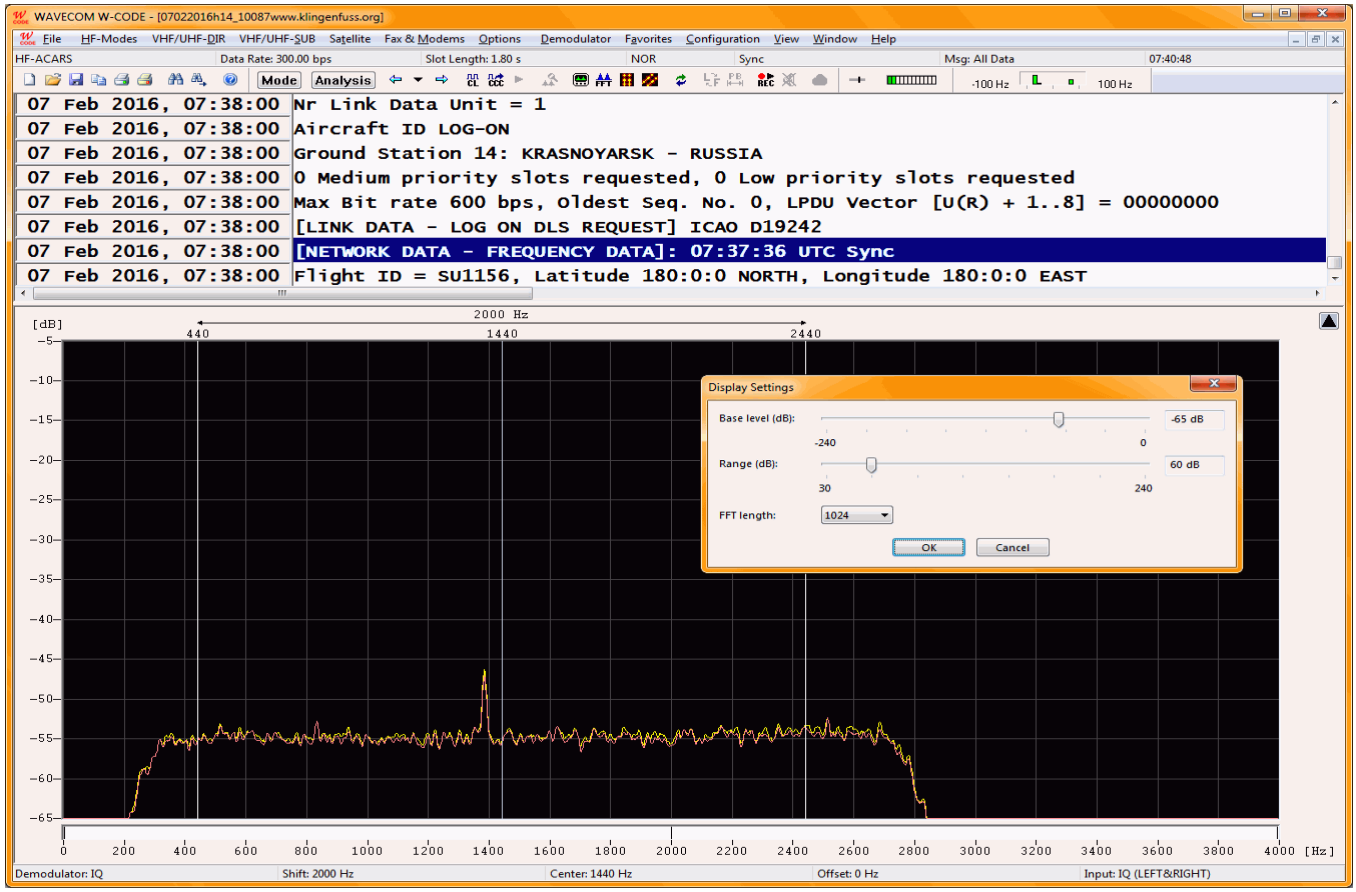
PERSEUS memorizes roughly 660 MB every 15 minutes

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.



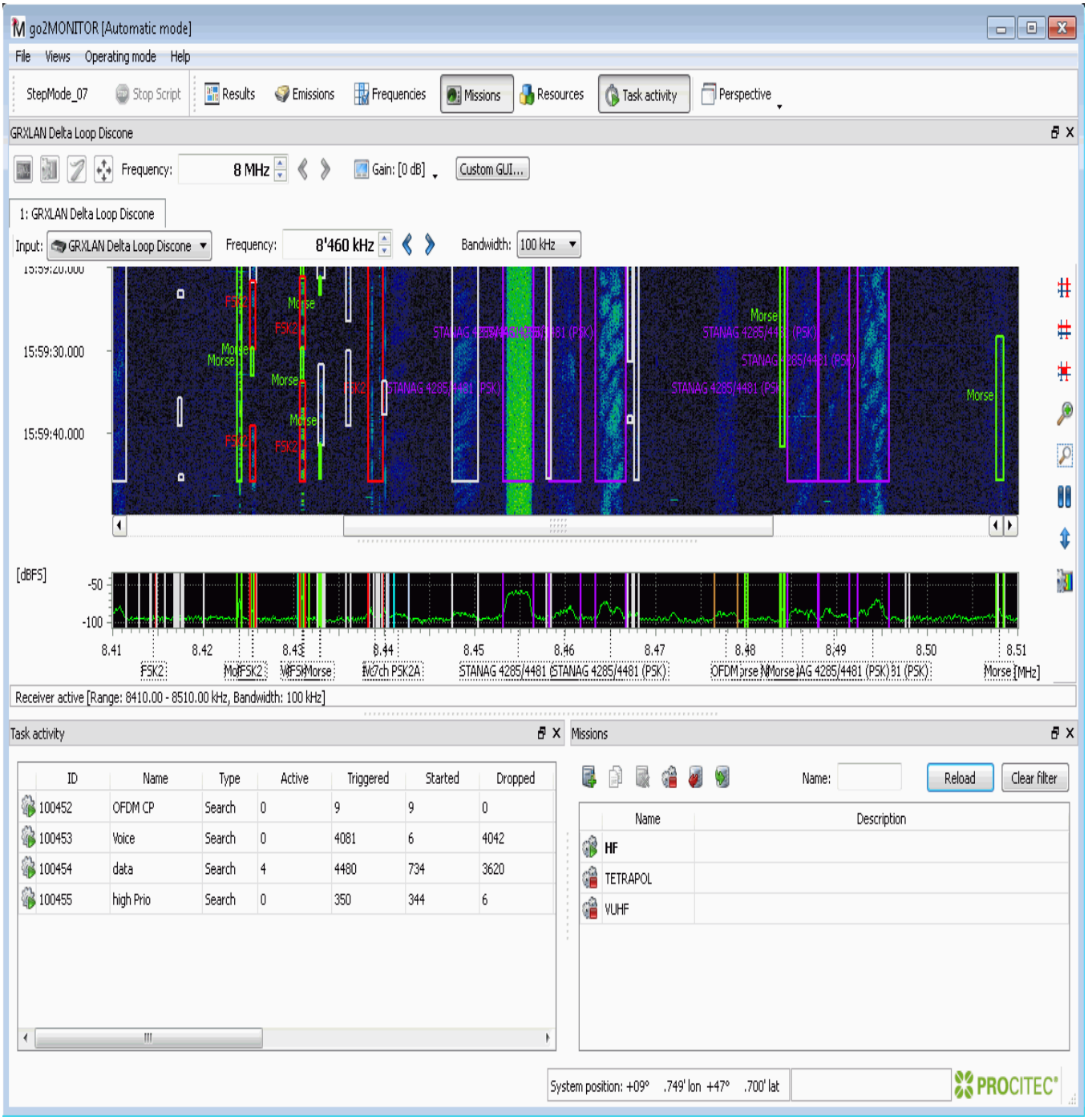
2:23 minutes Web-SDR recording Brazil ↔ Germany

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.



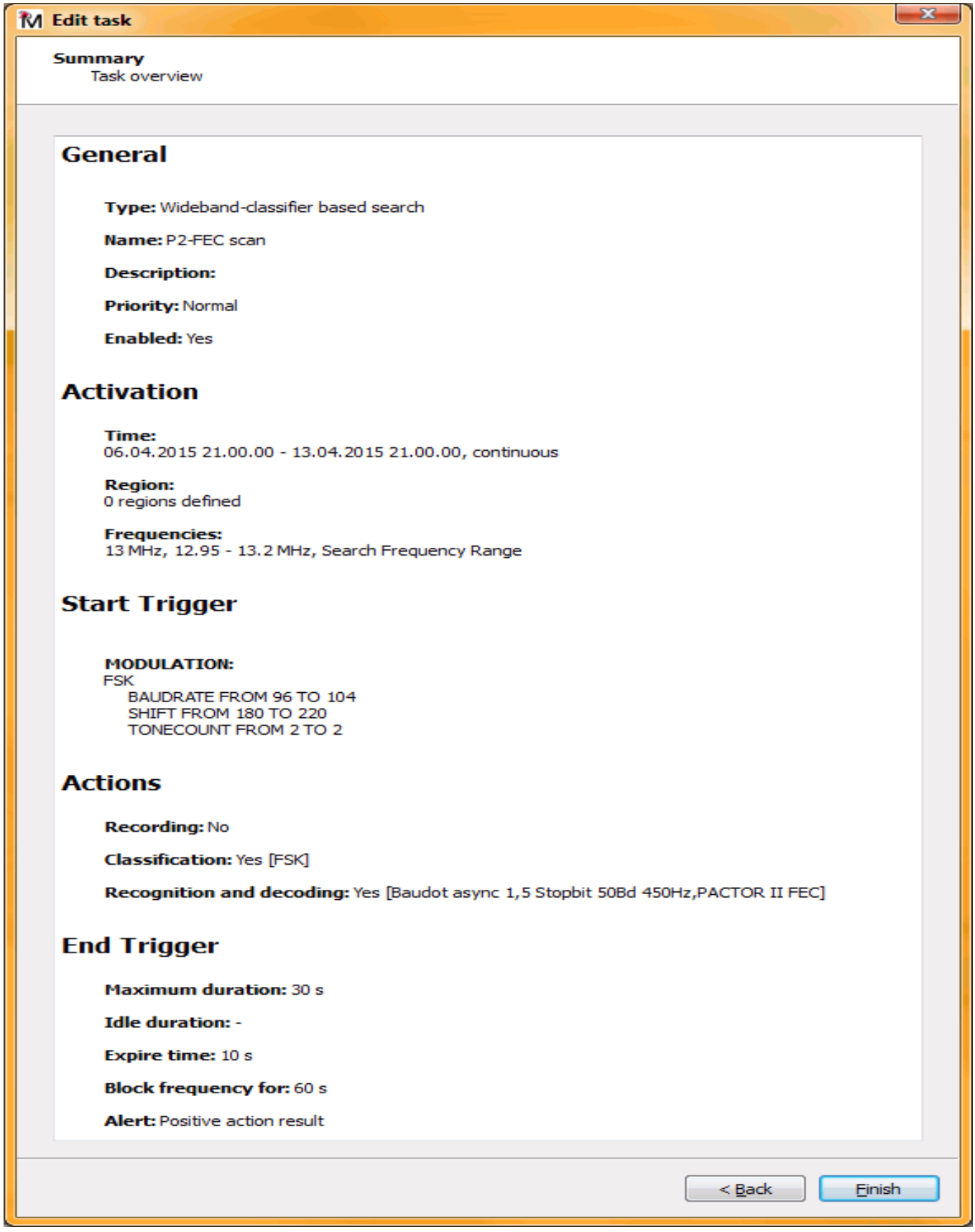
2.10 Automatic monitoring using wide-band SDRs

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



PROCITEC go2MONITOR displays a 100 kHz wide sonagram between 8410 and 8510 kHz and continuously classifies all emissions in realtime

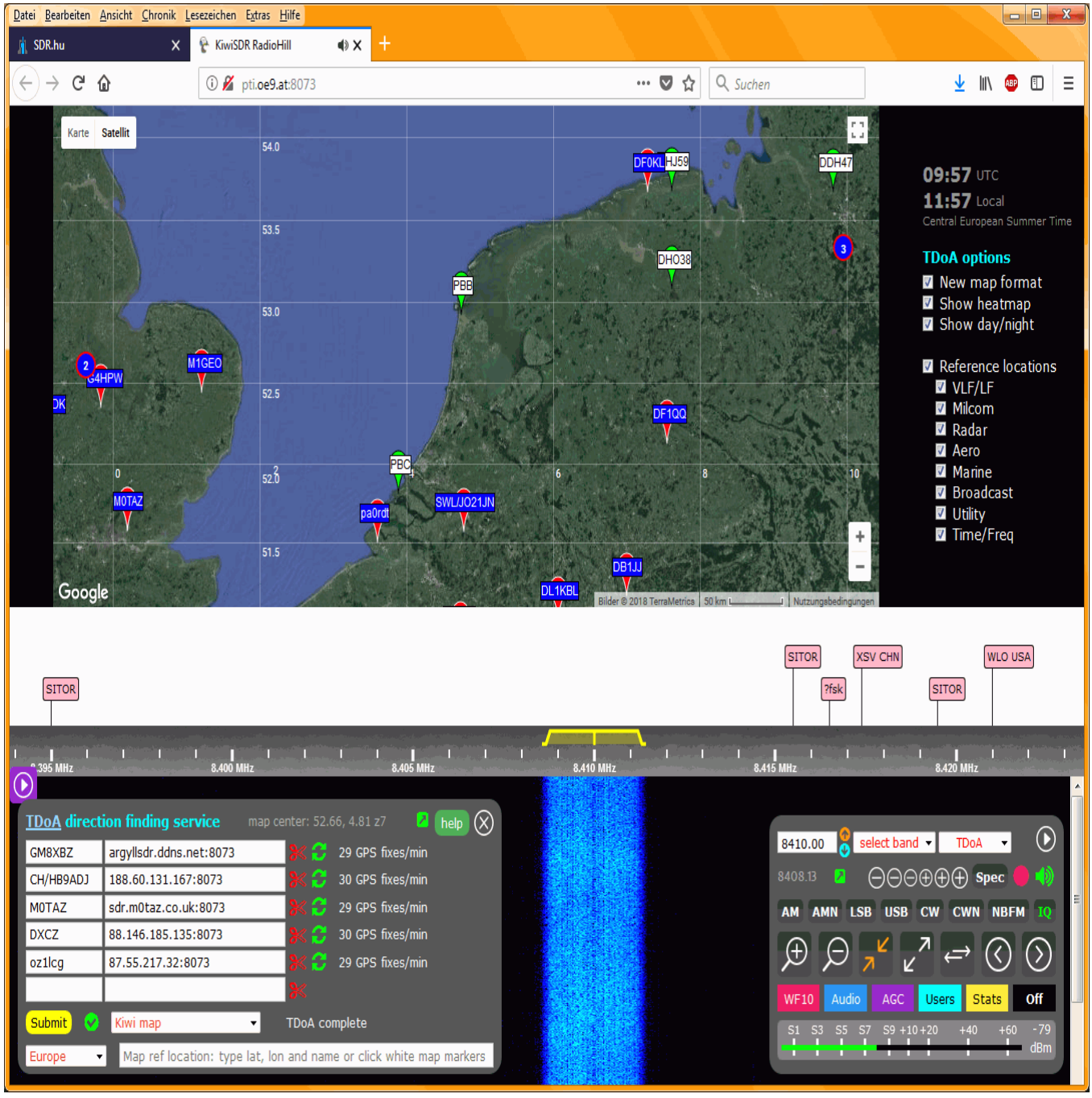
All those fascinating digital data signals visible here in the sonagram are perfectly identified and listed in our latest publications!



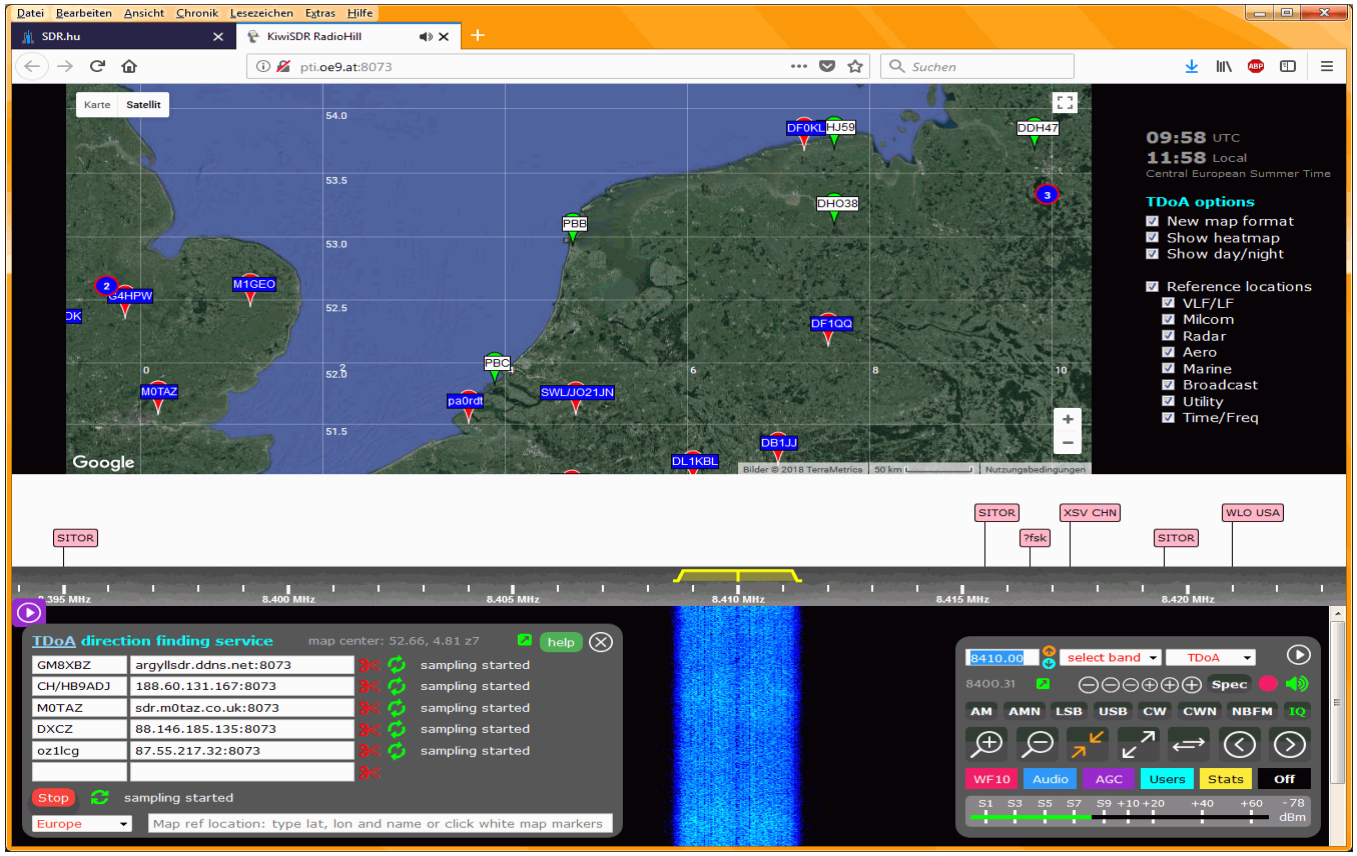
Mission activation and task definition with the go2MONITOR decoder allows specified search for e.g. strange PACTOR-2-FEC signals monitored only recently in certain maritime bands

2.11 Direction-finding using the Kiwi-SDR system

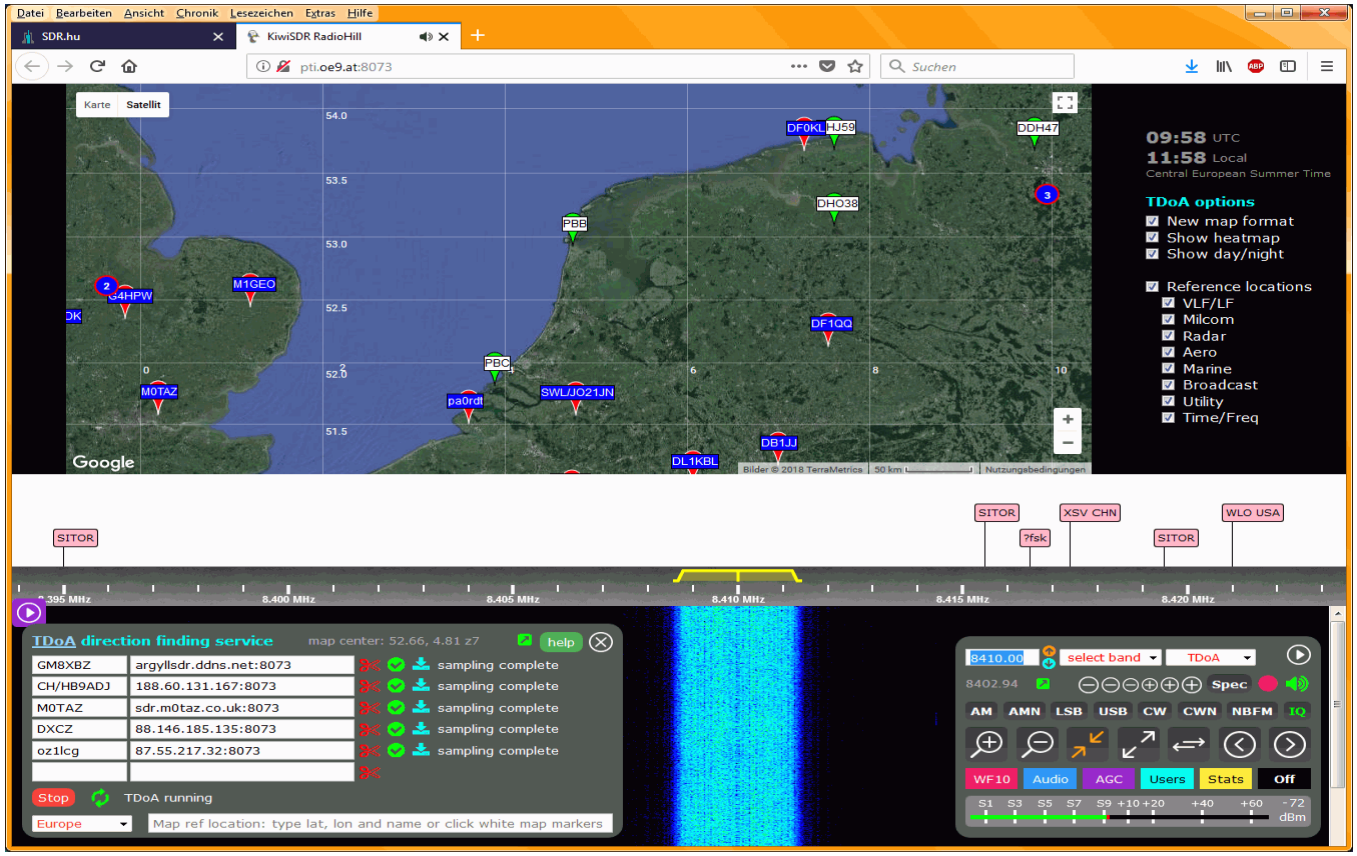
The location of unidentified radio stations can be now be measured with a precision of up to 5 - 10 kilometres. This new Kiwi-SDR software feature is called Time Difference on Arrival (TDOA). Similar to the established GPS system, it measures the time-difference of signals received from at least three 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 altitude as well.) The following screenshots demonstrate the complete workflow.



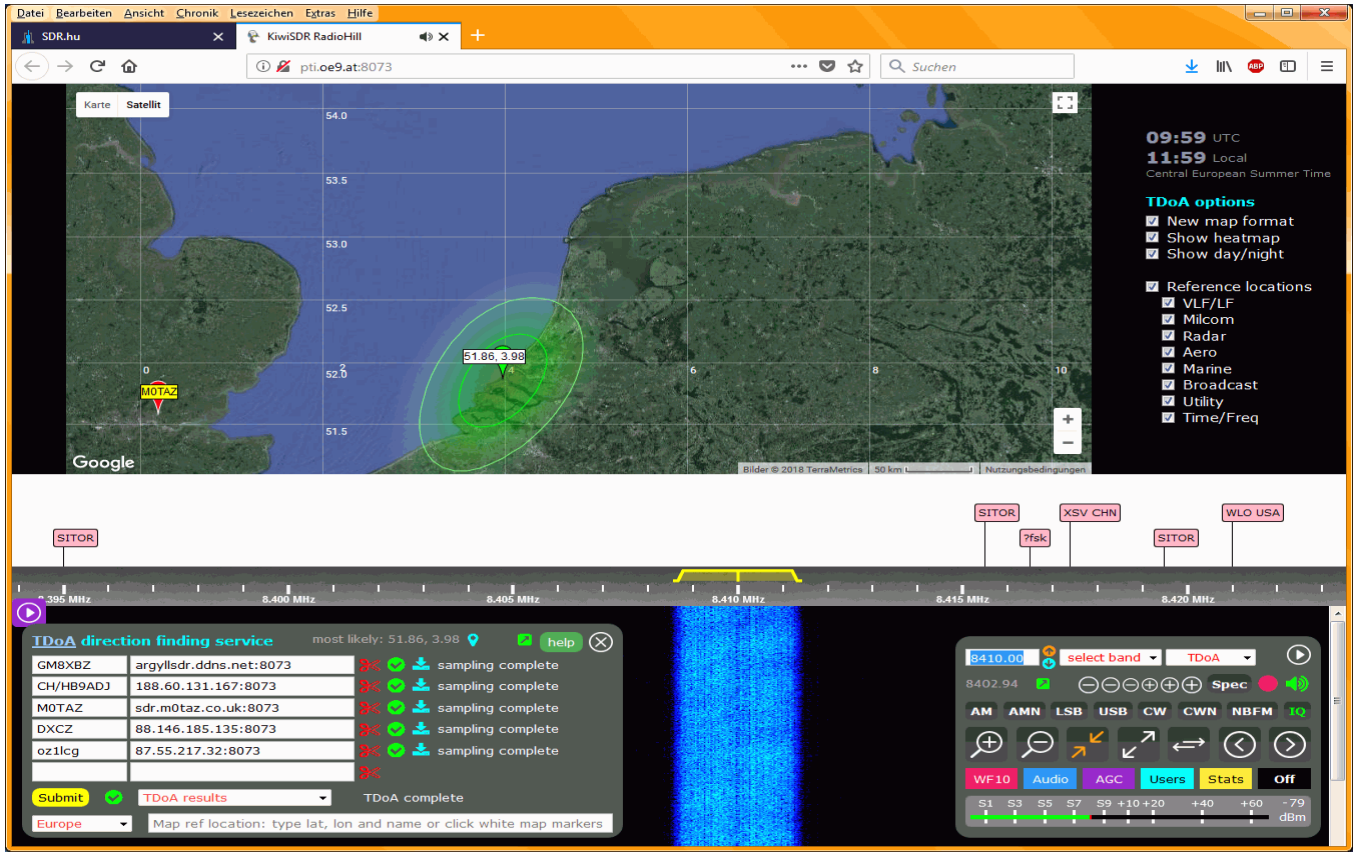
Select In-Phase-and-Quadrature (I/Q) demodulation
Select at least three GPS-locked Kiwi-SDRs around the presumed location
Each of these must provide good reception of the desired signal!



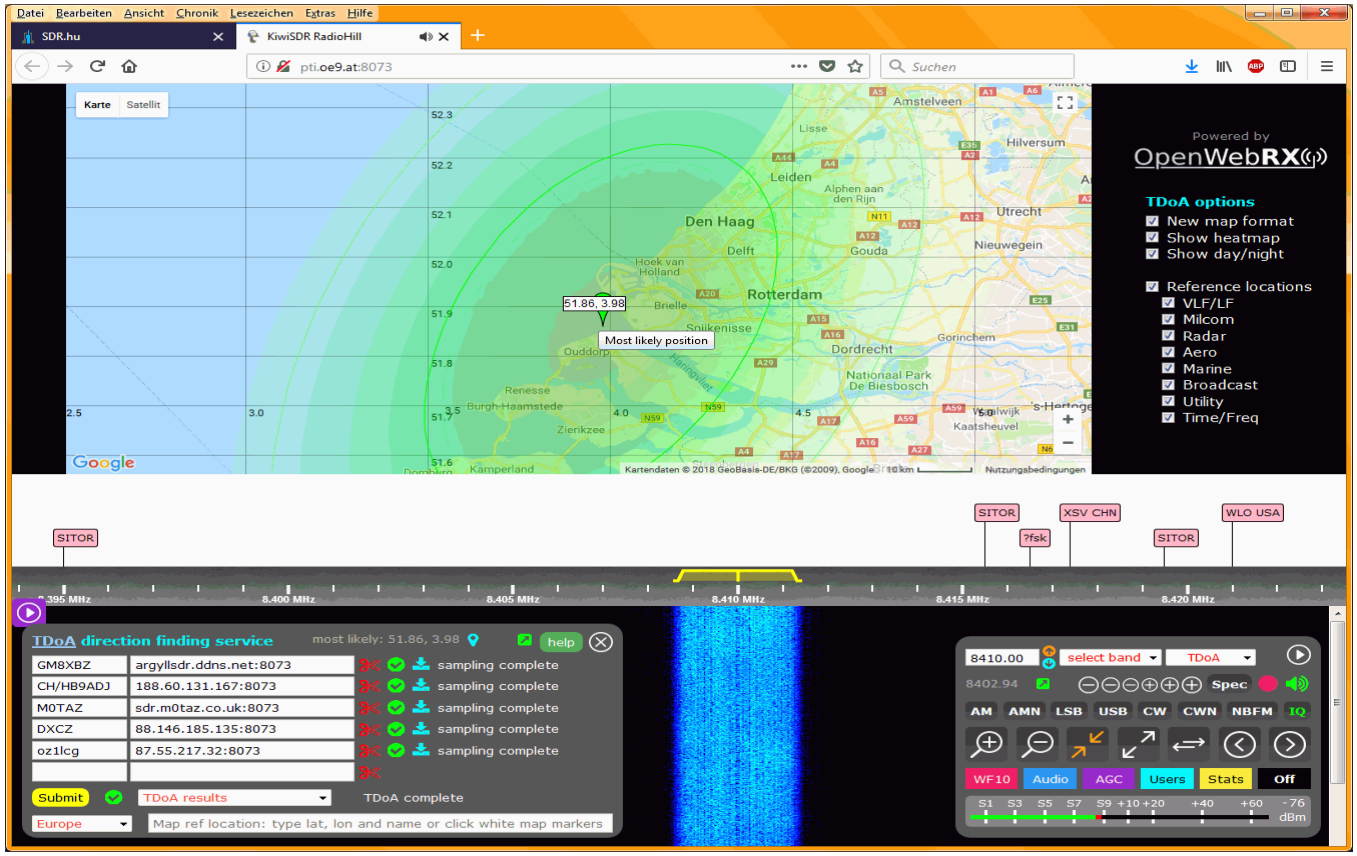
The I/Q data stream sampling process takes around 30 seconds ...



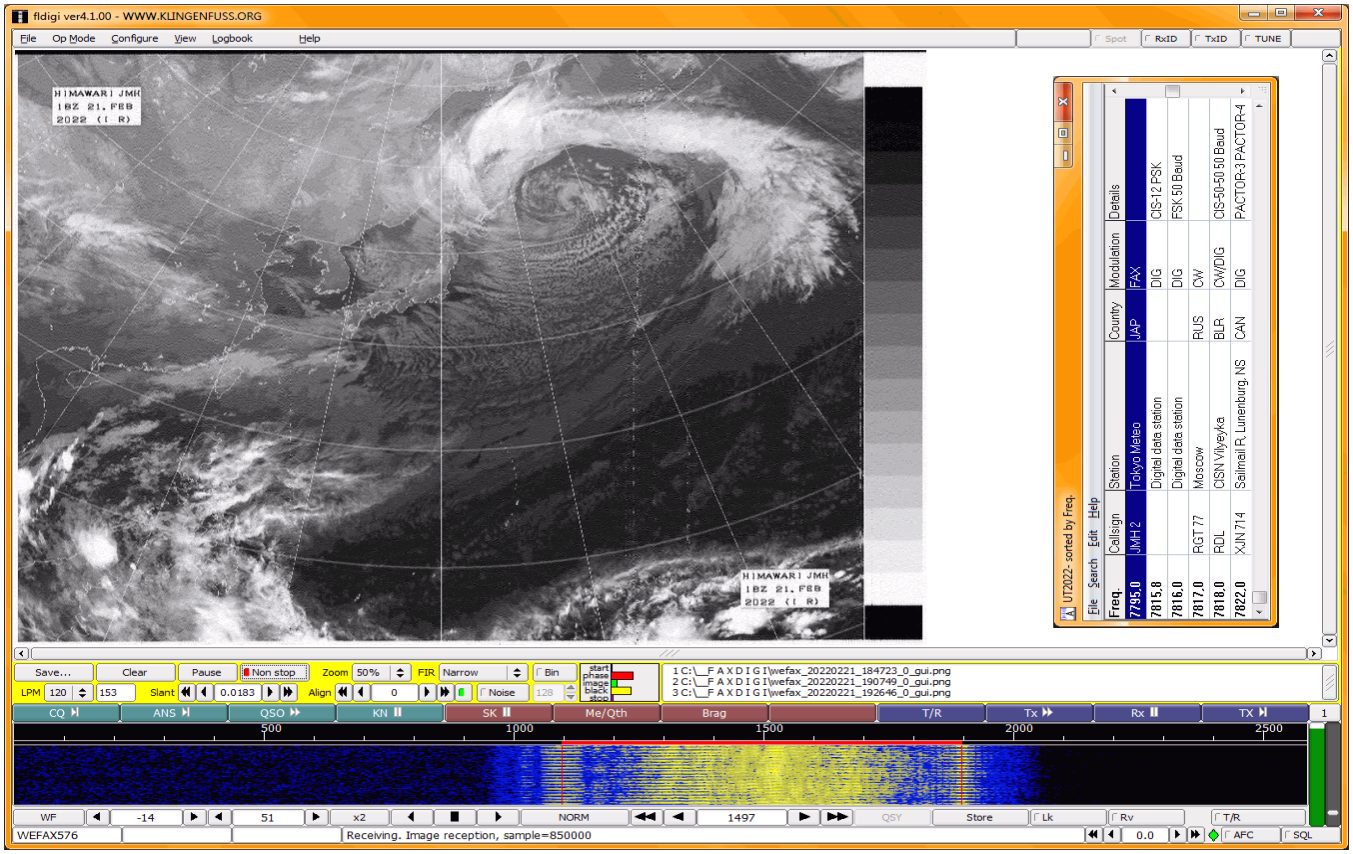
The TDOA calculation process takes 1-2 minutes ...



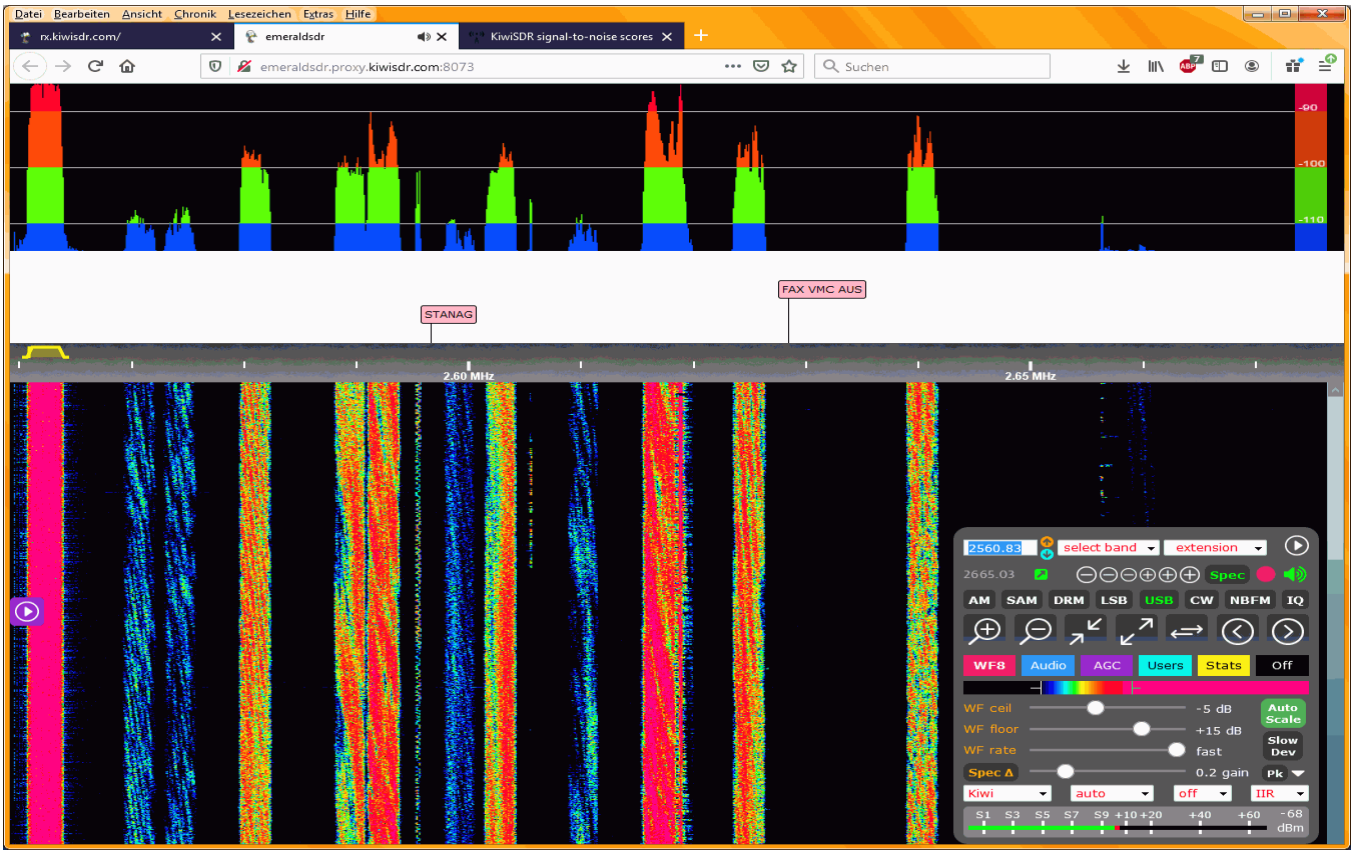
The possible location is shown on the map ...



... 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 ☺