



National Astronomical Research Institute of Thailand

Established since 1 January 2009

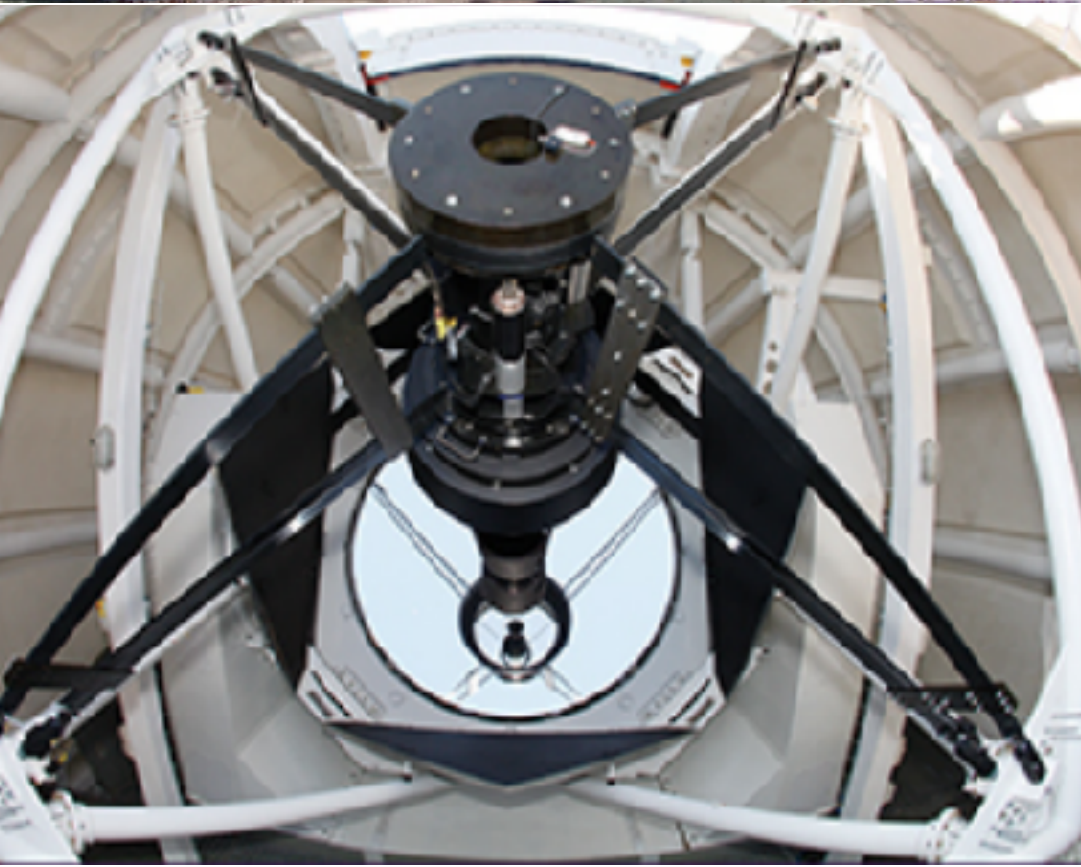
under the Ministry of Science and Technology

Research & Development — Education & Outreach — International networks

Research & Facilities



- Thai National Observatory (TNO) inaugurated in 2013
- 2.4m-diameter reflecting telescope
- Doi Inthanon national park: 2,457 metres altitude (Nov-Apr)
 - ULTRASPEC
 - Medium-resolution spectrograph: $R \sim 15,000$
 - 4k CCD camera
- Thai Robonet 60cm
- 7 researchers; 3 postdocs — CVs, exoplanets, cosmology, pulsars



Research & Facilities



Location: Don Kaew, Mae
Rim, Chiang Mai (22 Acres)
,Ground-breaking
Ceremony, 9 July 2015



South East Asia Regional Office of Astronomy
for Development, SEA-ROAD



The International Training Center in Astronomy
Under Auspices of the UNESCO



Radio Astronomy Network and Geodesy for Development (RANGD) 2017-2021

“Capacity Building Through Radio Astronomy”

Infrastructure

- Thai National Radio Observatory (**TNRO**)
 - 40m Thai Radio Telescope (**TNRT**)
 - 13m VGOS Telescope
- Advanced Laboratories

Human Expertise

- Workshops & Seminars
- Trainings & Staff exchange

Overview

- Multipurpose $\sim 40\text{m}$ RT — with flexibility
- (preferably) Existing Design — very limited experience
- Frequency $\sim$ UHF - $\sim 115\text{ GHz}$ — determined by Science area, RFI, weather conditions
- ‘Updated’ version of IGN’s 40m Yebes Radio Telescope
- 40m Paraboloid Antenna, Cassegrain-Nasmyth optics
- 150 μm (rms) overall surface accuracy
- Prime-focus receiver mechanism



Telescopes

Survey

...-2013

- 3m SRT Mk i
- 4.5m SRT Mk ii

- RFI U. of Malaya

2014

- Introduce the idea to MOST Minister for astronomy & geodesy

- Omni, 100-3300 MHz, @ 6 locations in Chiang Mai

2015

- visited NAOJ-Mitaka-KASI
- EAVN workshop 2015 (Hokkaido)
- AOV meeting @Hobart

- PTEC, 20 MHz - 26.5 GHz @AstoP. @Jomthong

2016

- **Proposal Submitted for 40m-class RT**
- Visit Tianma@SHAO
- KaVA meeting @Krabi
- CMU-eng, NECTEC, KMUTT, PTEC...
- visit Yebes
- **Project Approval!**
- **TVN Collaborative Workshop**

- RFI 20 MHz - 6 GHz @Chiang Rai, Phrae, Maejo, Doisaket
- RFI 20 MHz - 6 GHz @HHK
- **Site decision @ HHK**

2017

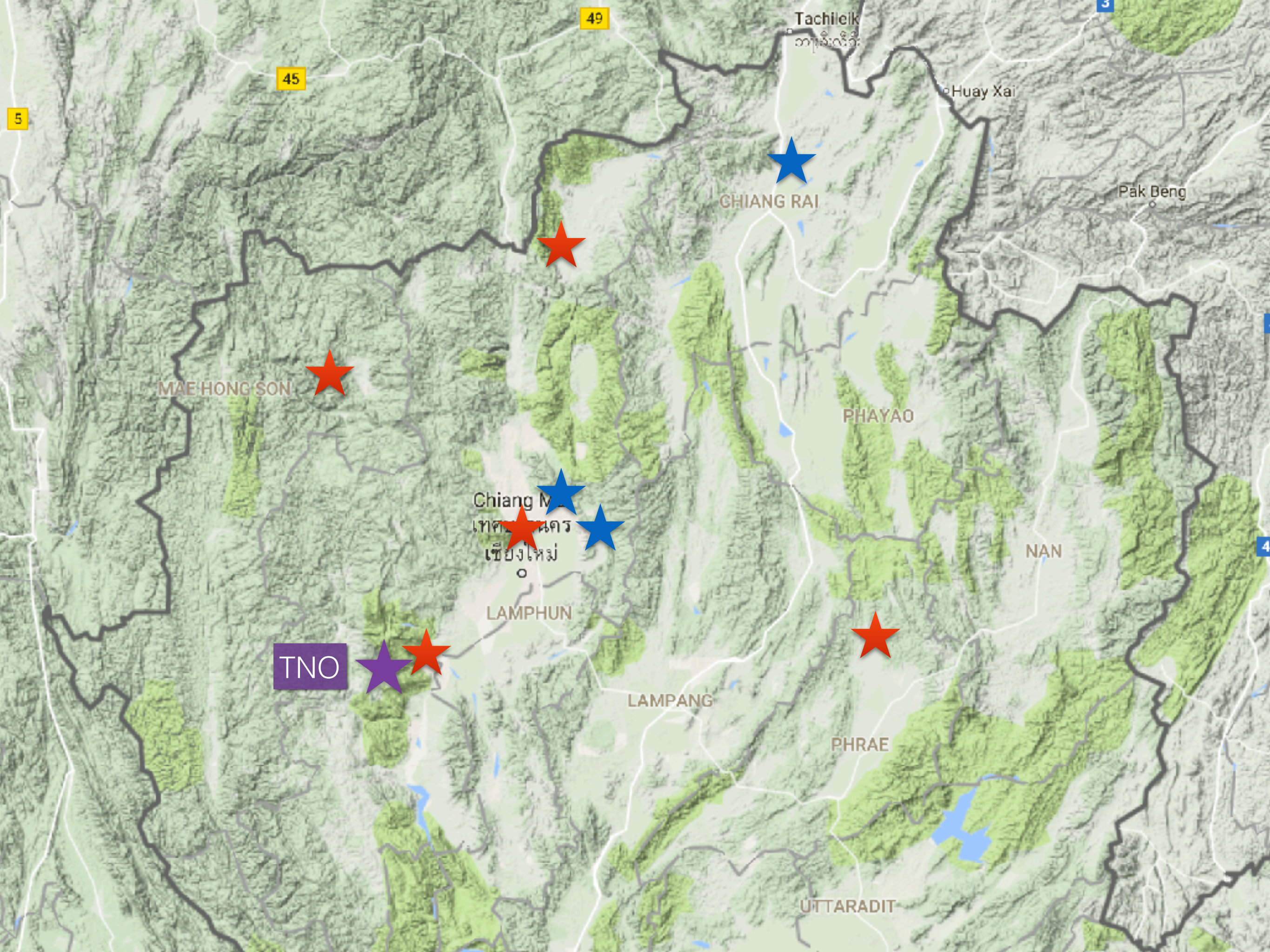
- Contract signing
- Receiver planning

- RFI monitoring system
- NBTC regional protection

Site (compromising) consideration

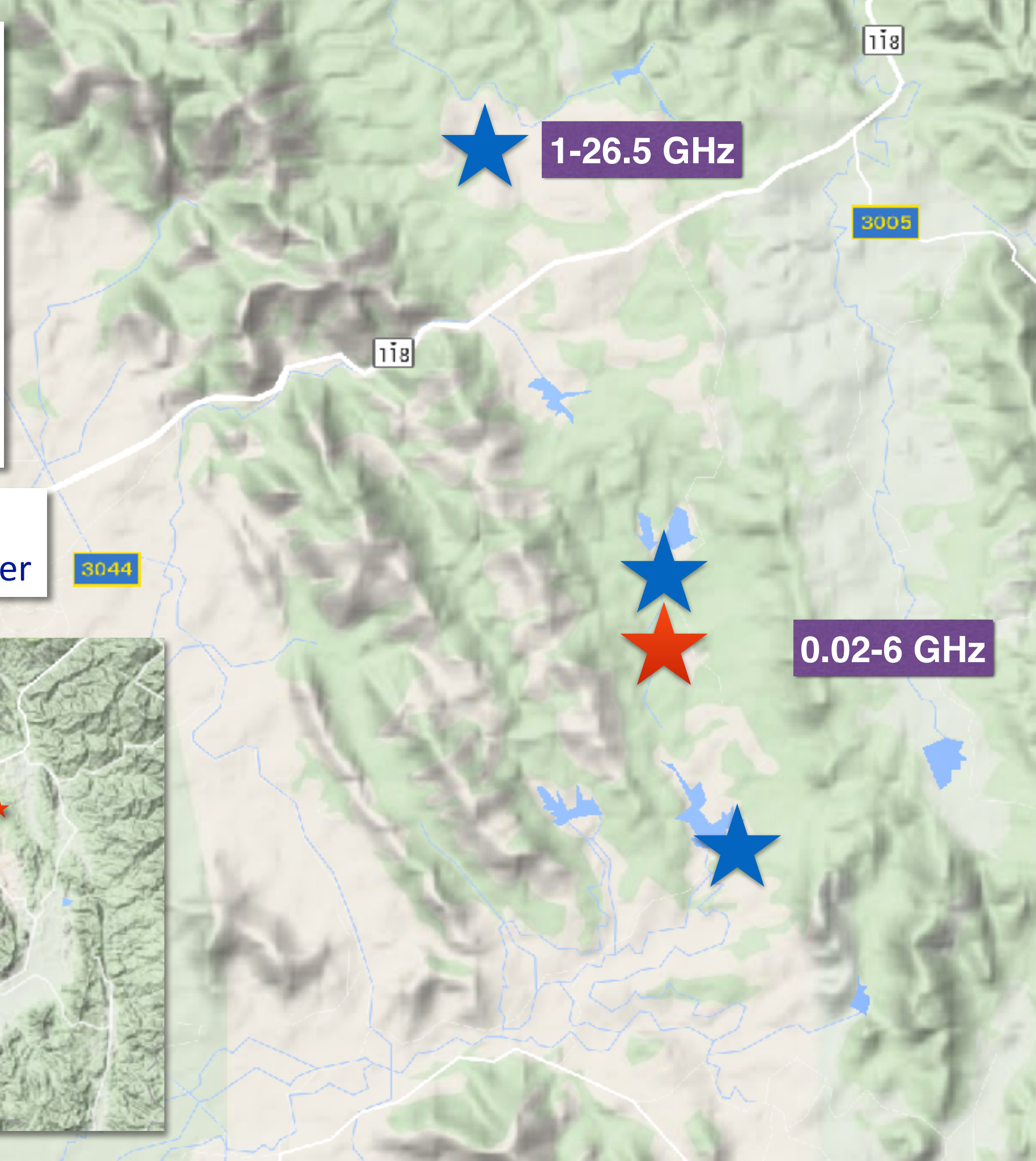
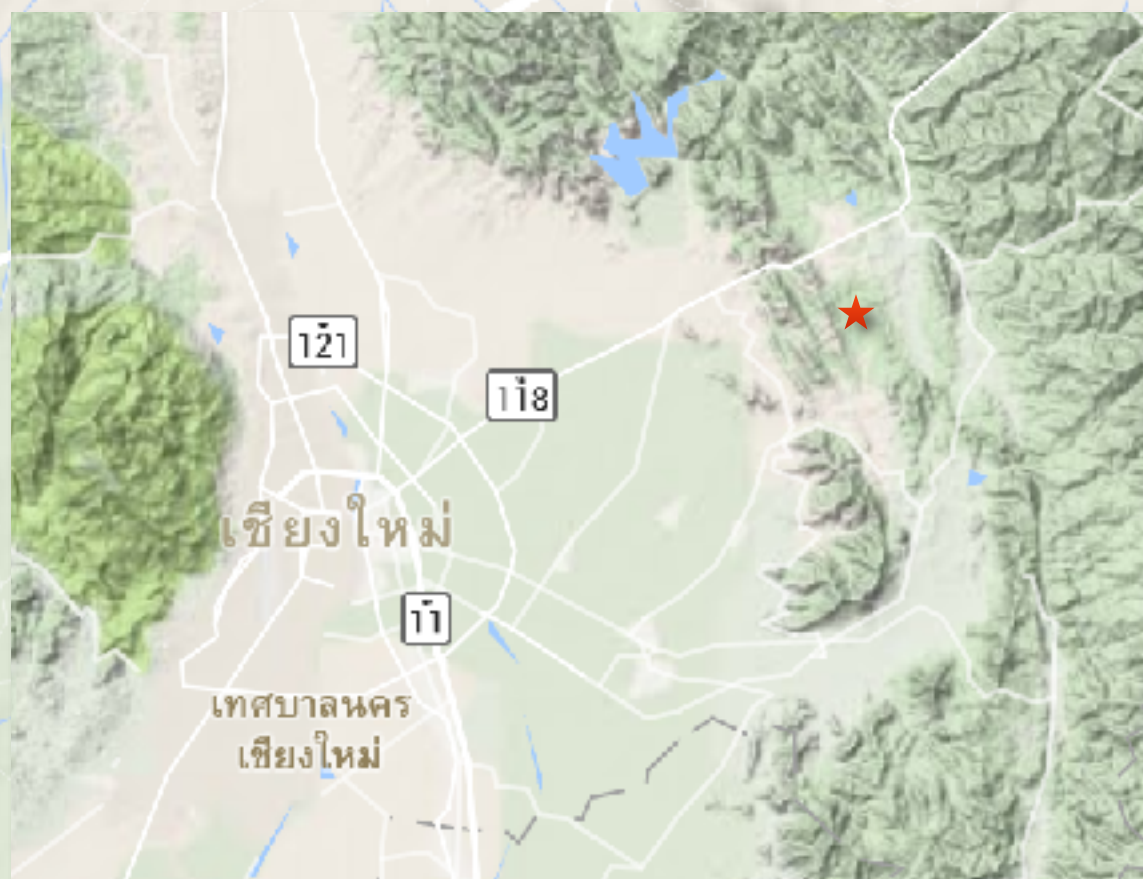


- RFI environment
 - (future) Science interest — decameter to millimeter
 - rural area
 - geographical protection
- Northern Provinces of Thailand
 - dry winter for high frequency observation
- Existing Facility & Practicality
- Legal & regulations
 - national reserved forrest





Huai Hongkhrai Royal
Development Study Center



20 MHz - 6 GHz

- R&S ZVL6 Spectrum Analyser
- R&S HE300 20 MHz to 6 GHz Directional Active Antenna
- low loss 2-feet cable
- H,V polarisation
- Full azimuth scan
- Maxhold & Average modes

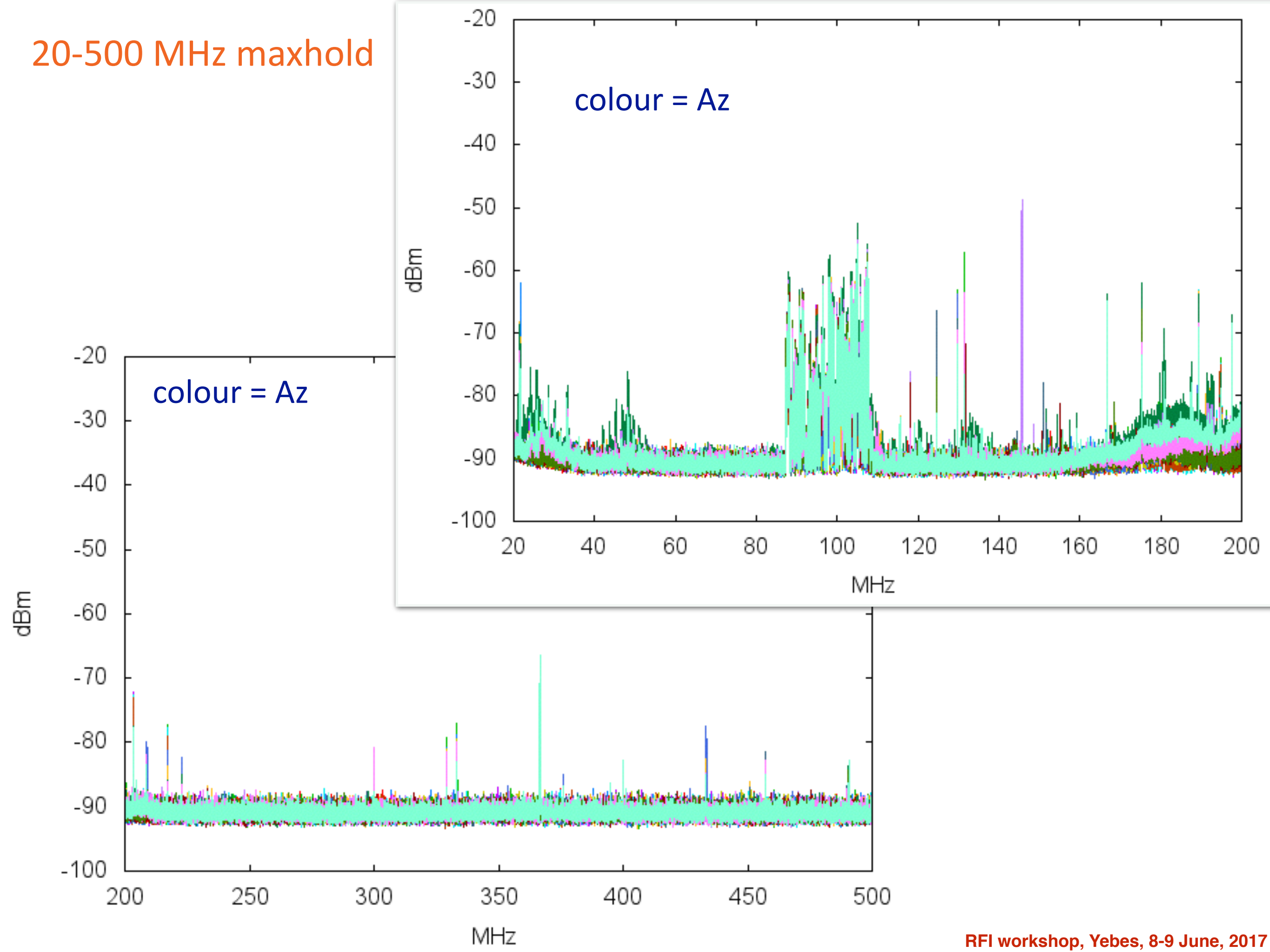


20 MHz - 6 GHz

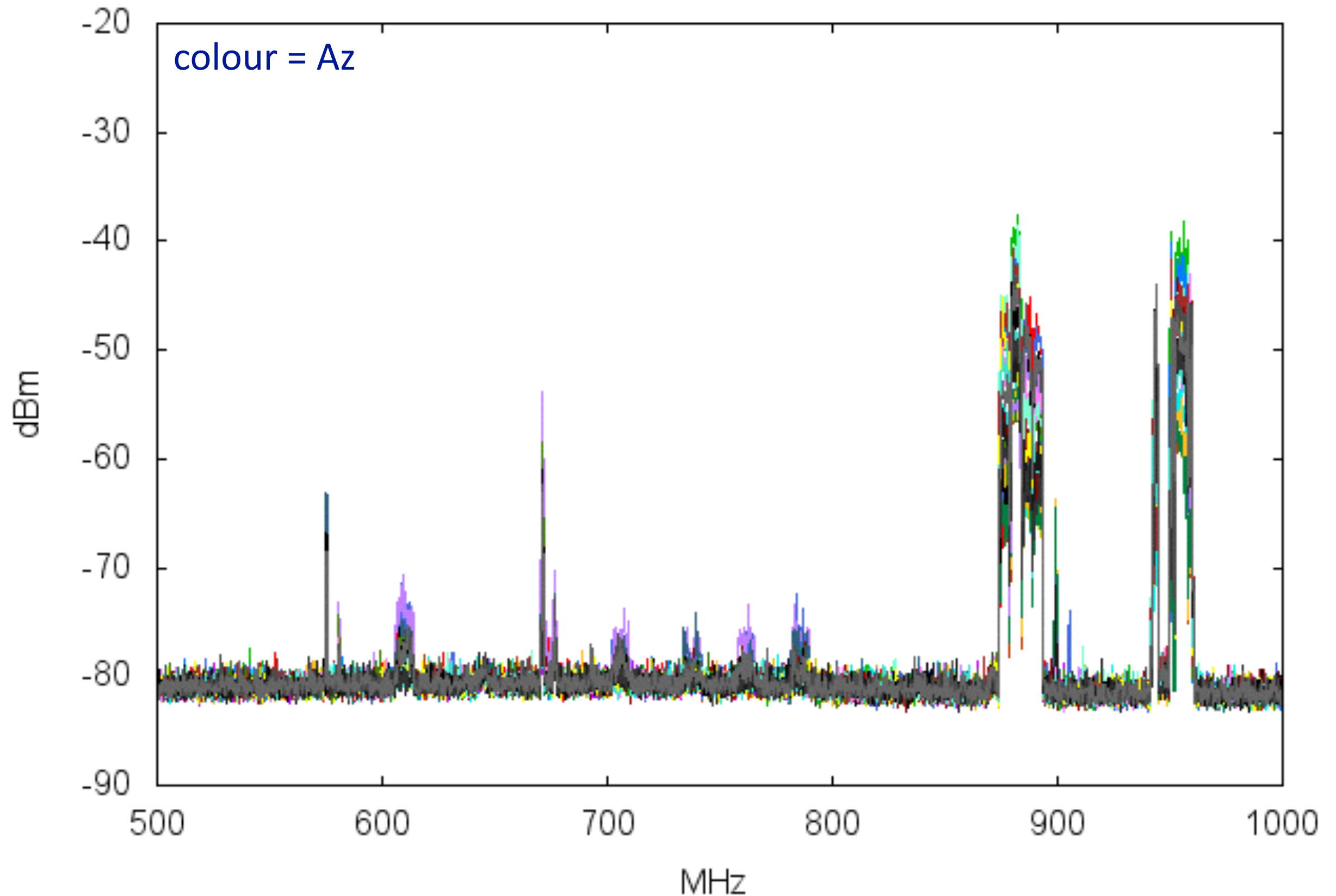
Frequency	RBW (kHz)	SWT (ms)	Sweep counts	Pointing time (s)	Antenna beam (deg)	number of pointing	session time (min)
20-200 MHz (LF)	30	220	532	117	45	8 x 2pol	31
200-500 MHz (MF)	30	330	355	117	45	8 x 2pol	31
500-6,000 MHz (HF)	300	95	355	32	30	12 x 2pol	13.5



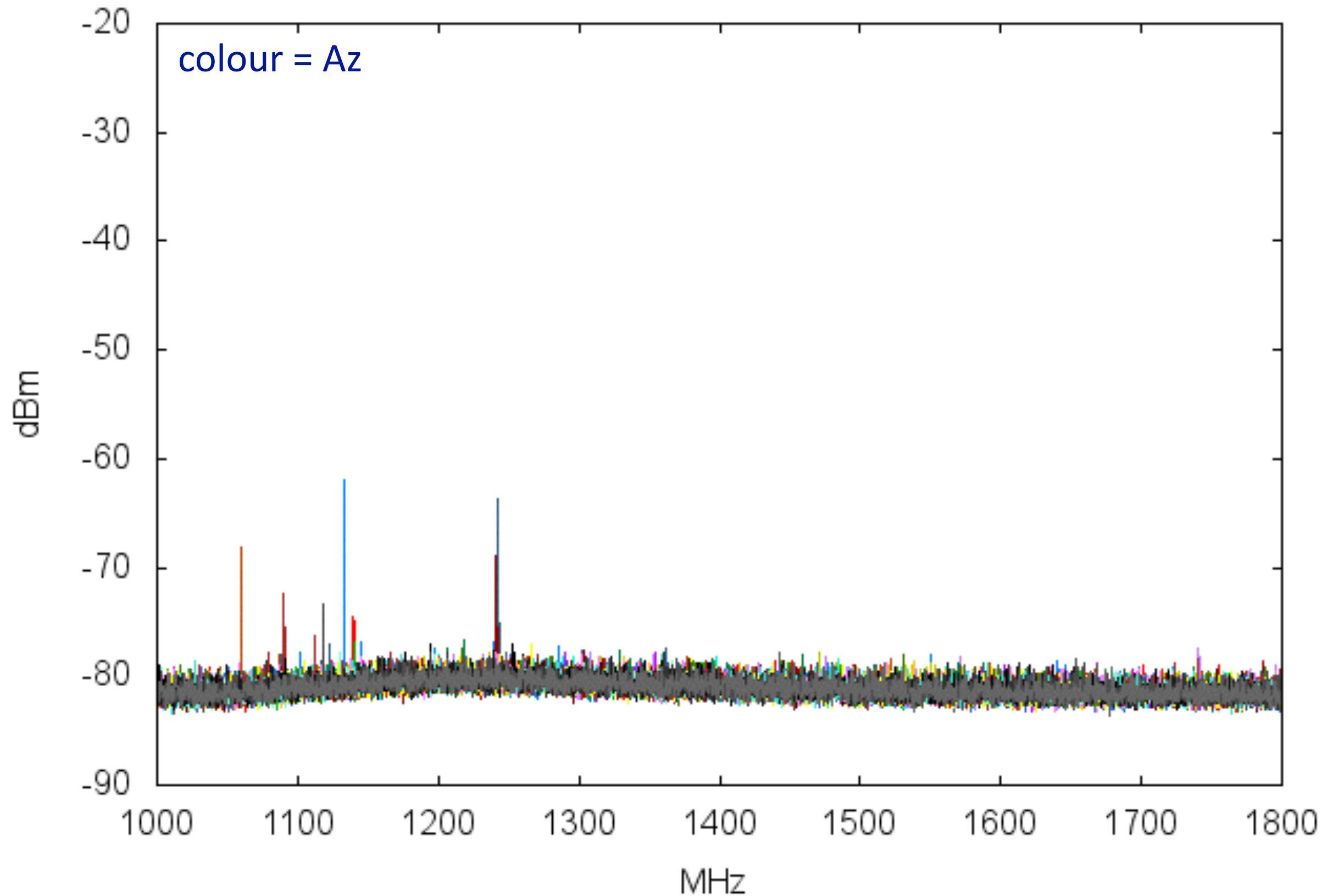
20-500 MHz maxhold



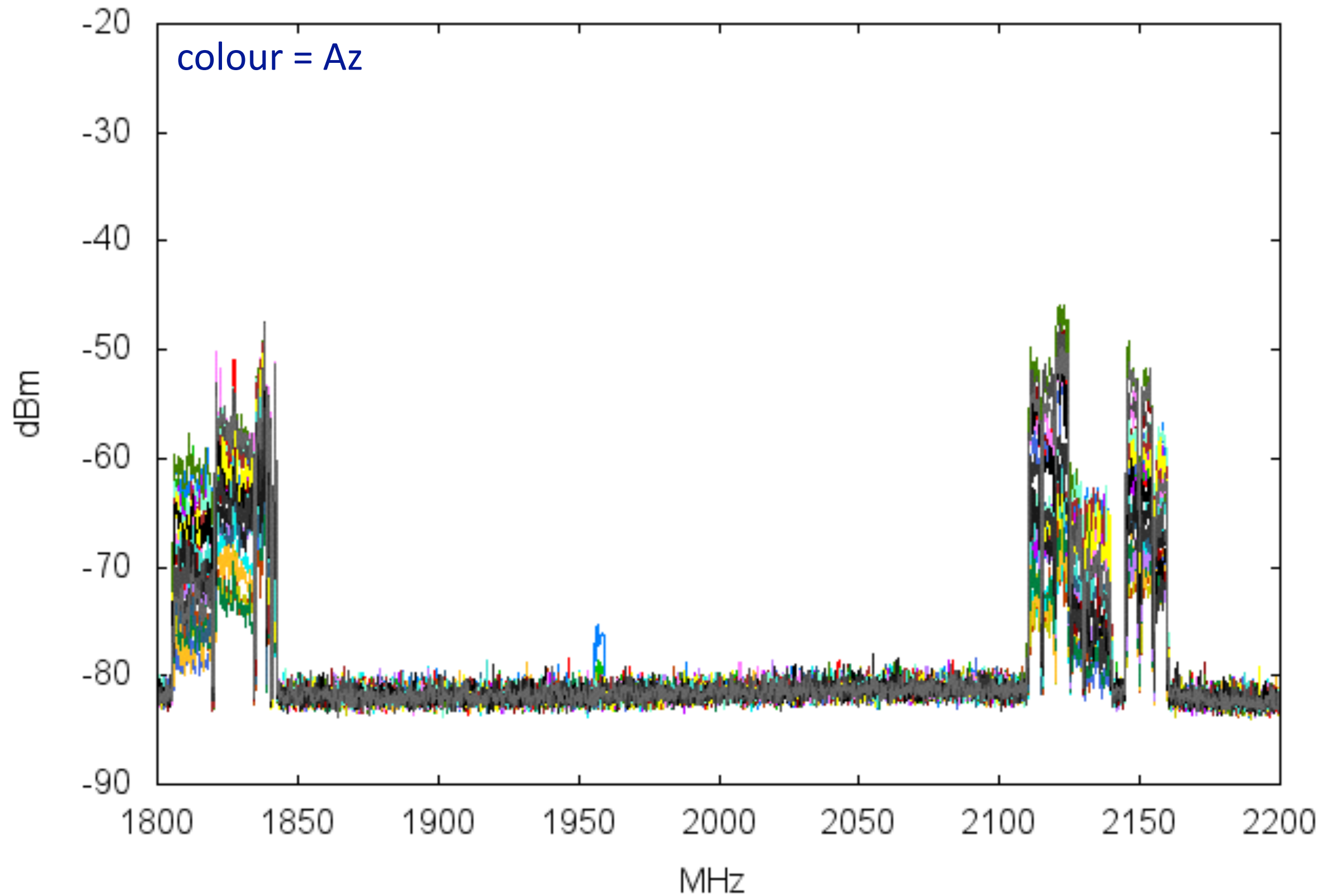
0.5 - 1.0 GHz maxhold



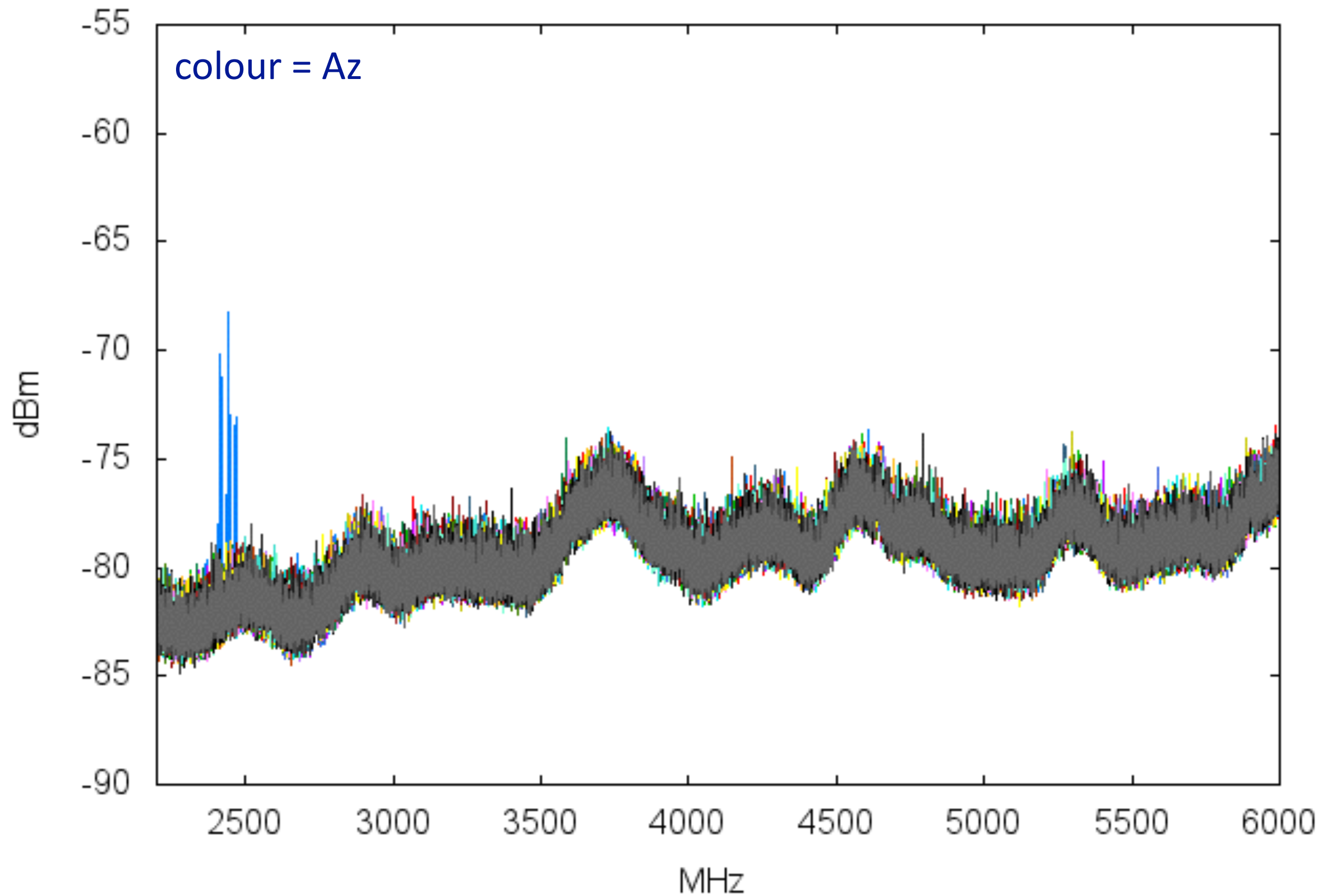
1.0 - 1.8 GHz maxhold



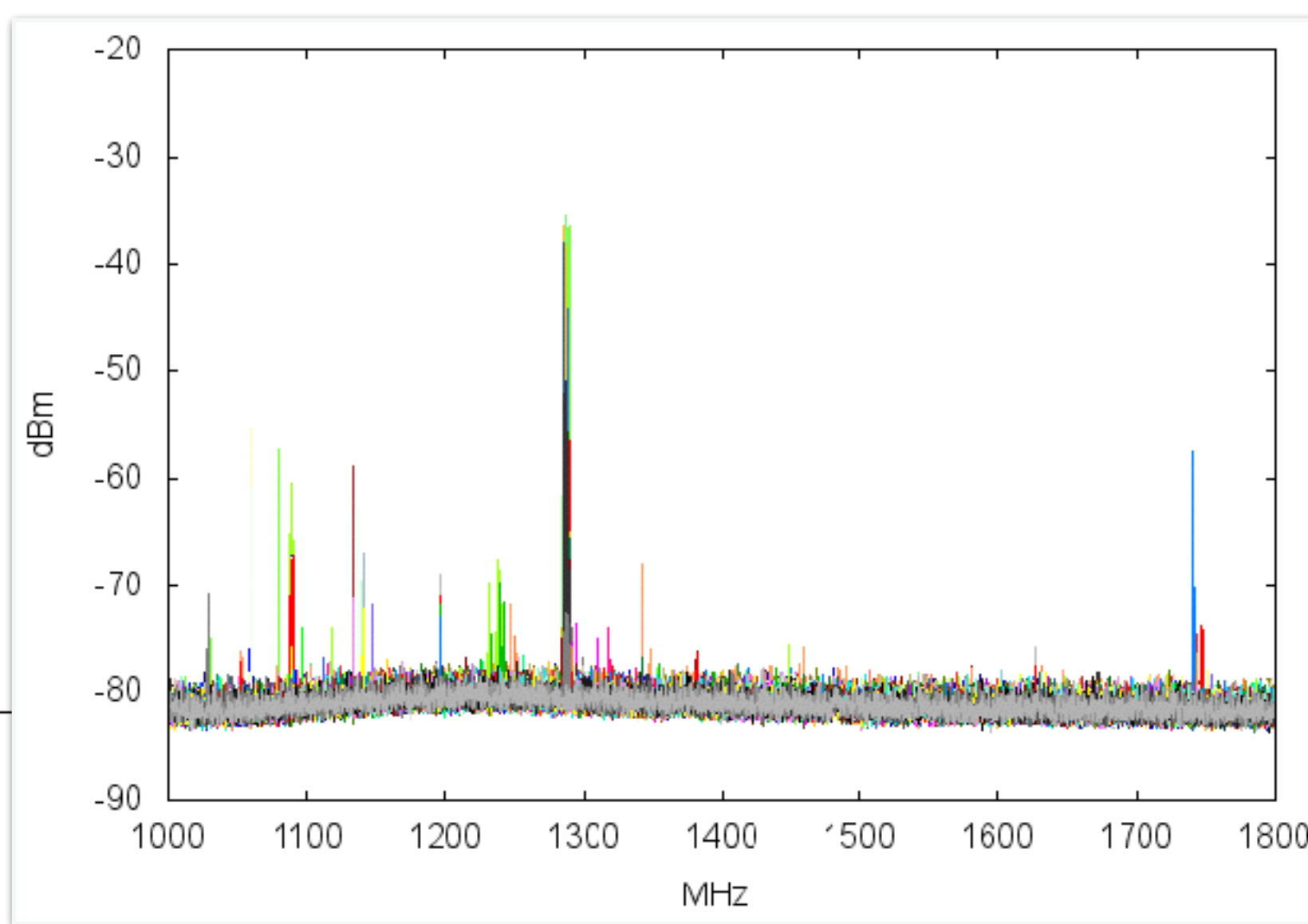
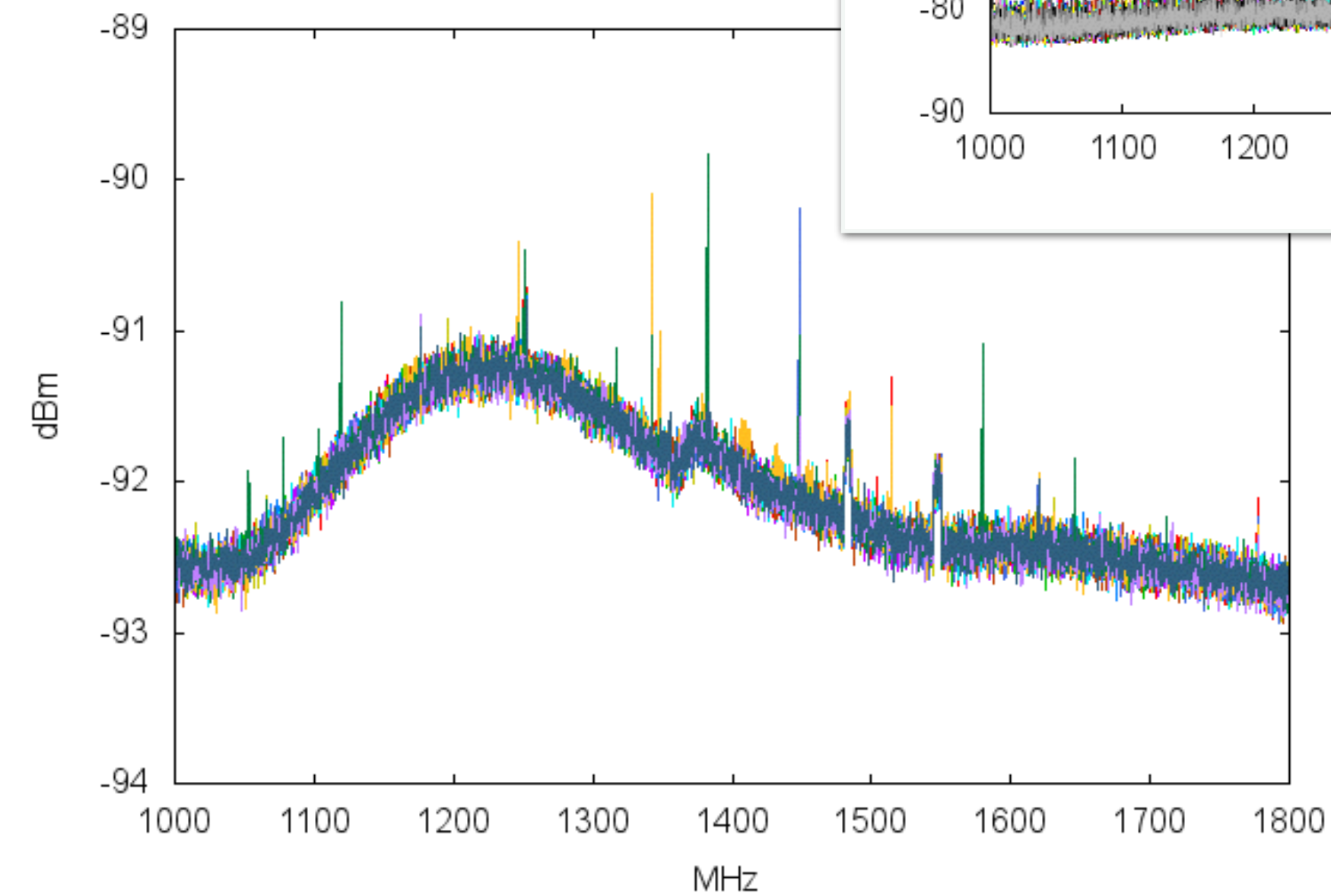
1.8 - 2.2 GHz maxhold



2.2 - 6.0 GHz maxhold



maxhold vs. average



1-6



Pre-amplifier
Frequency 1 to 26.5 GHz

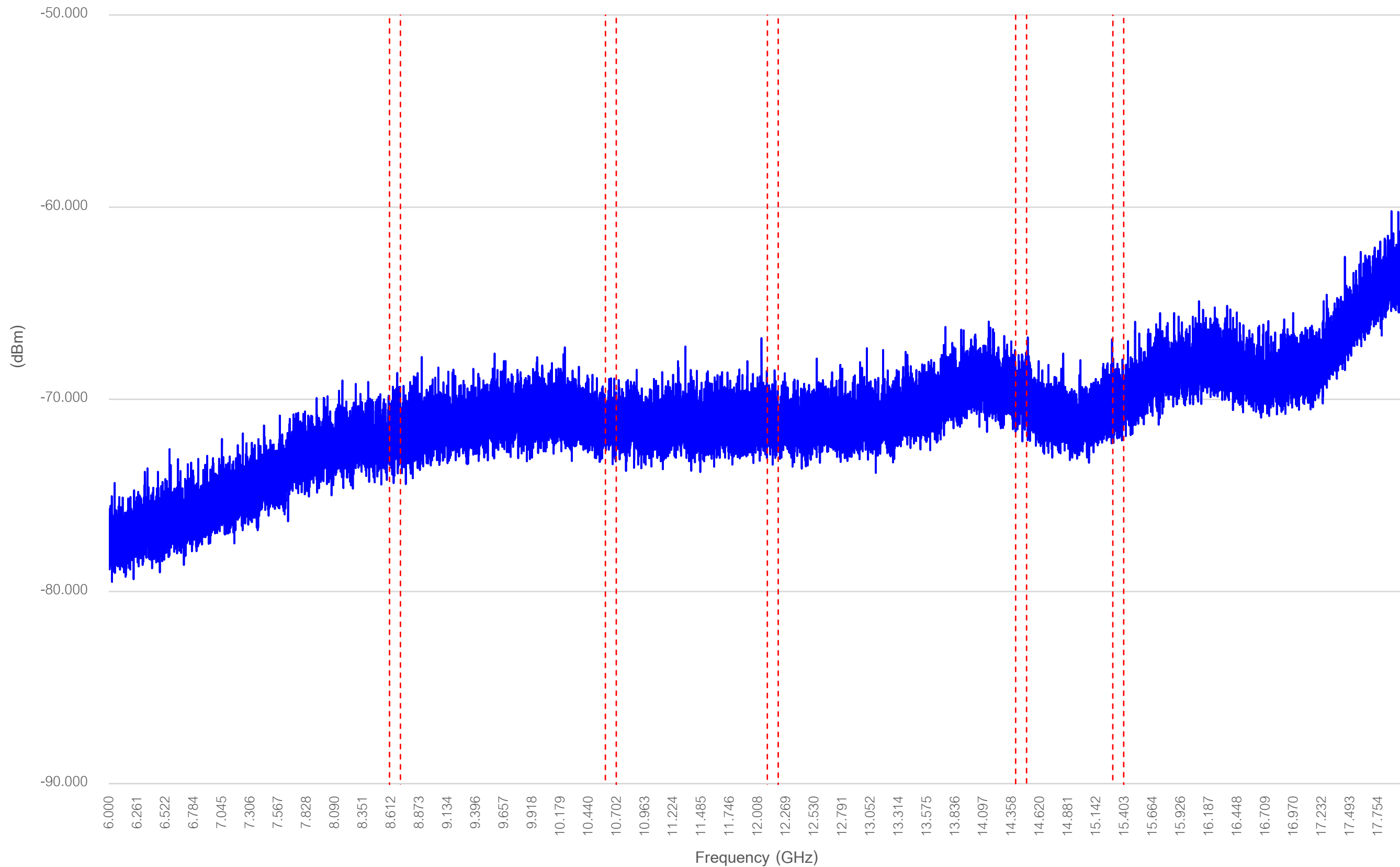
10 m

Spectrum analyzer
Frequency 9kHz to
26.5 GHz



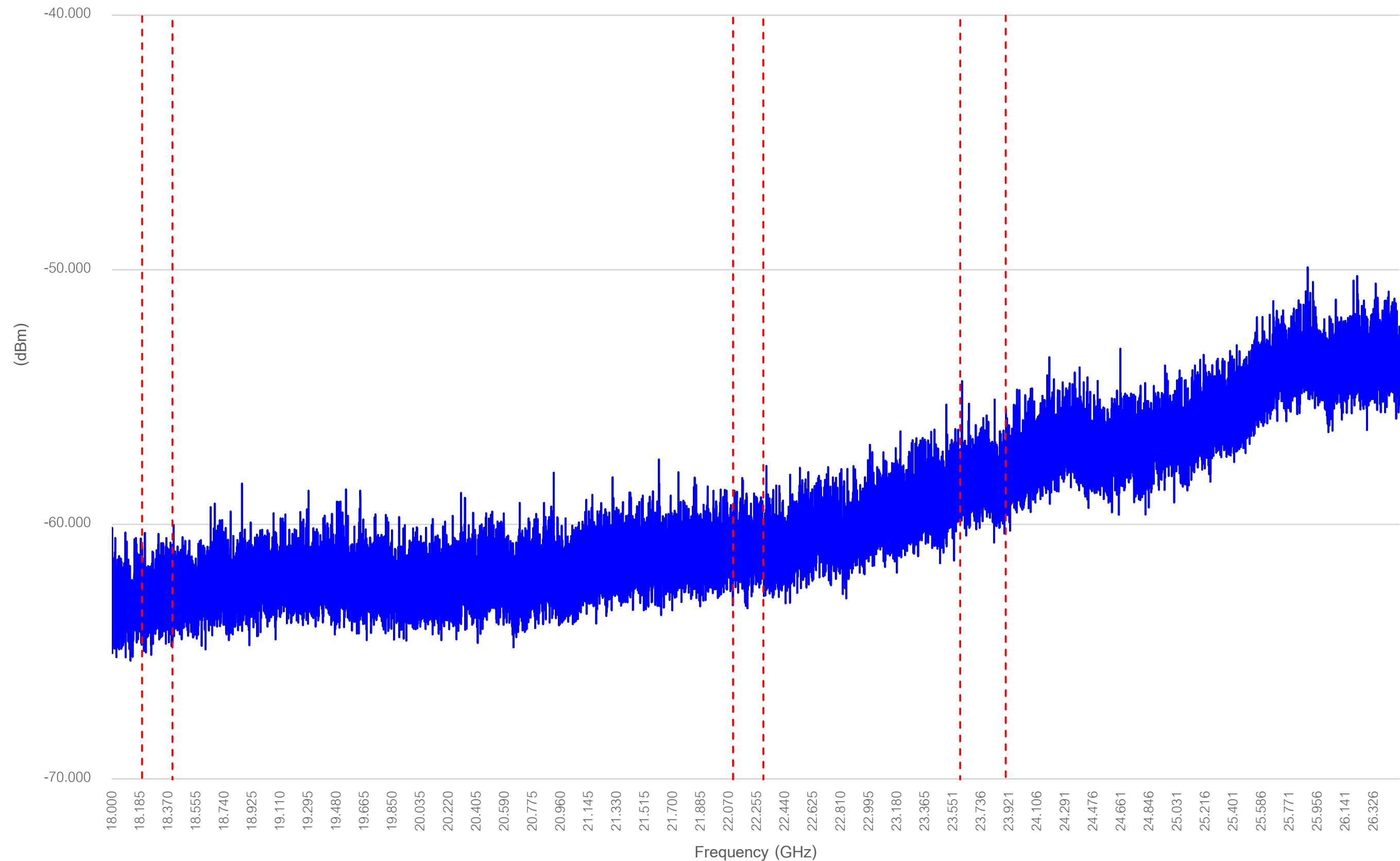
6-18 GHz

ค่าสูงสุดของผลการวัดความแรงสนามแม่เหล็กไฟฟ้าช่วงความถี่ 6 GHz ถึง 18 GHz รอบการวัดที่ 3



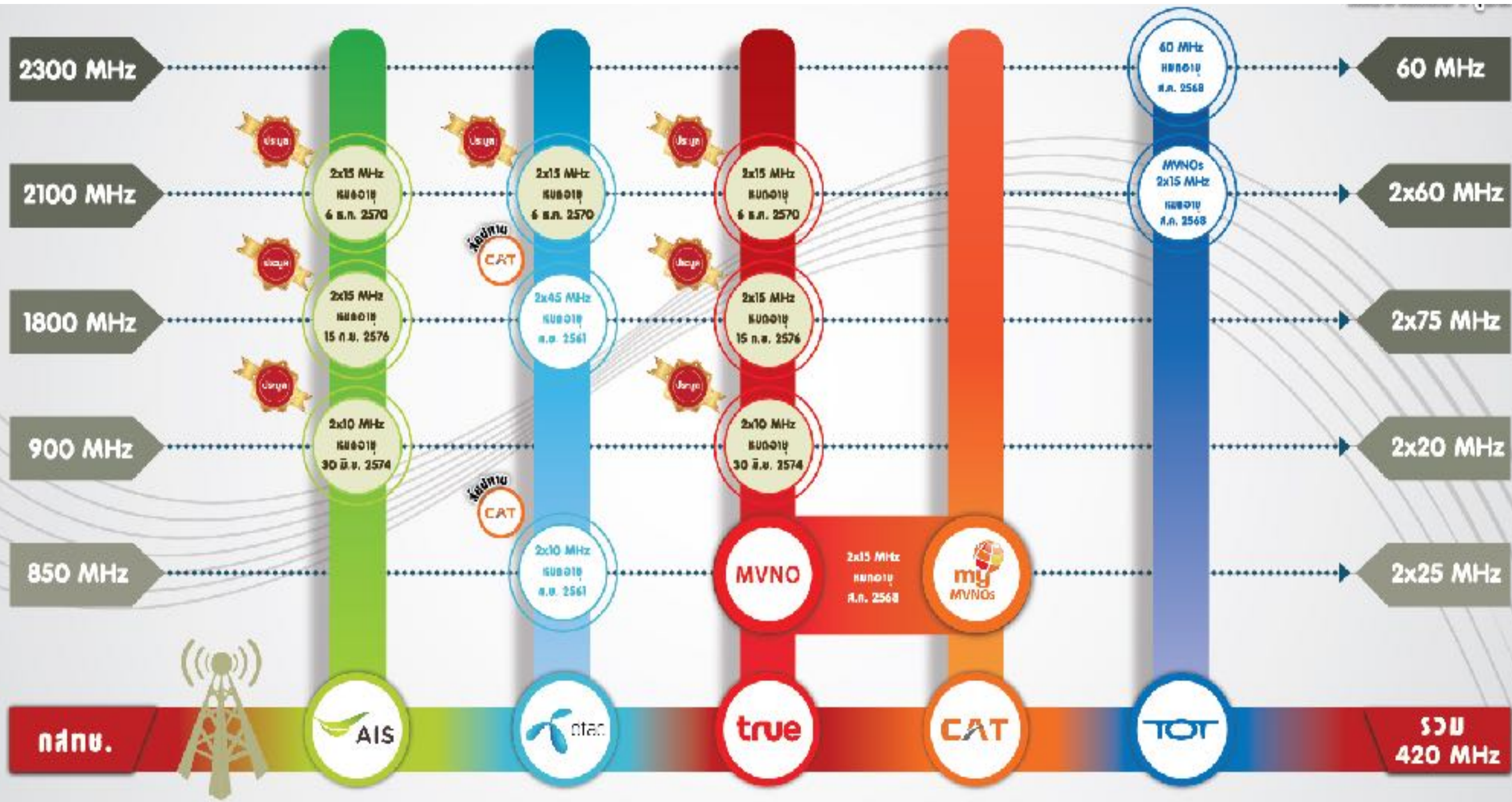
18-26.5 GHz

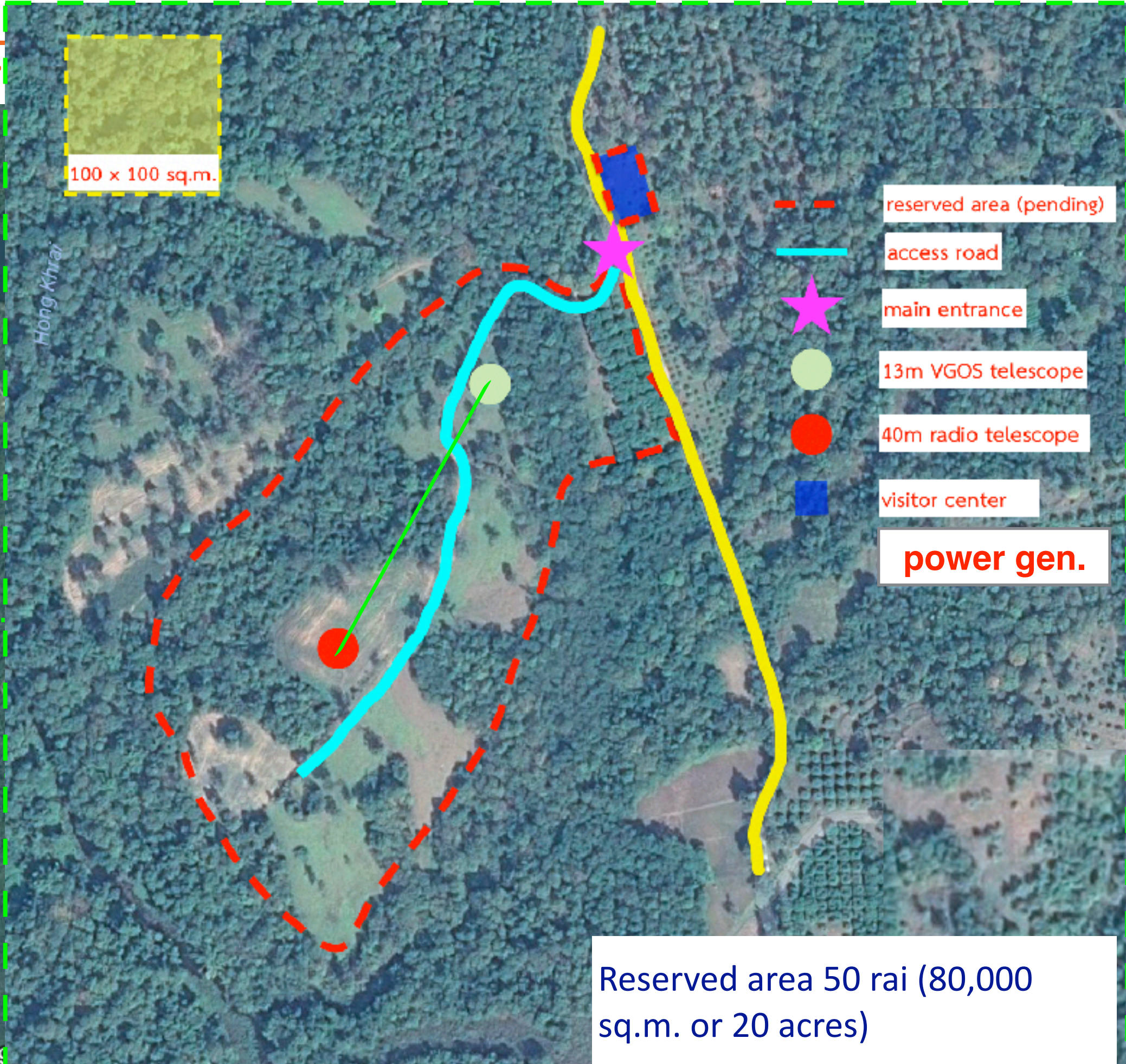
ค่าสูงสุดของผลการวัดความแรงสนามแม่เหล็กไฟฟ้าช่วงความถี่ 18 GHz ถึง 26.5 GHz รอบการวัดที่ 3



Spectrum management

- National Broadcasting and Telecommunications Commission (NBTC)
- Preferred frequency bands for radio astronomical measurements, Recommendation ITU-R RA.314-10. (ITU 2003)
- Compiled with ITU
- Radio quiet zone around the observatory







N



- Apart from the mobile/WiFi/BT services, L-S bands are 'polluted' with aeronautics and satellites radiation.
- The noise floor of our results is ~100 dB higher than ITU-R RA.769-2
- Living with RFI?
 - Feed design, wide-vs-narrow band, multibeam/PAF
 - Receiver design
 - Data processing
 - NBTC—RFI-protected zone
- Traditional/Sweeping spectrum analyser may not be suitable for obtaining RFI statistics.

Todo

- RFI monitoring system, FFT analyser
- MOU with NBTC — site protection/ITU representative
- implemented Faraday room