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Noise Floor Variability: Analysis of long term spectrum records

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SALAMANDRE

Presentation Outline

- Measurements Characteristics
- Noise Level Estimation
- Day /Night Variability
- Season variability
- Frequency Variability
- Antenna variability
- Conclusion

Measurements Characteristics

Receiving antennas

- Multiple locations in metropolitan France
- Multiple directive antennas on each location

Measurement Period

- 8 consecutive years measurements
- HF spectrum recorded every couple hours for each location & direction

Spectrum

- Range : 2-30 MHz
- Relative levels:

  -> Analysis limited to noise variations

Noise Level Estimation (1/2)

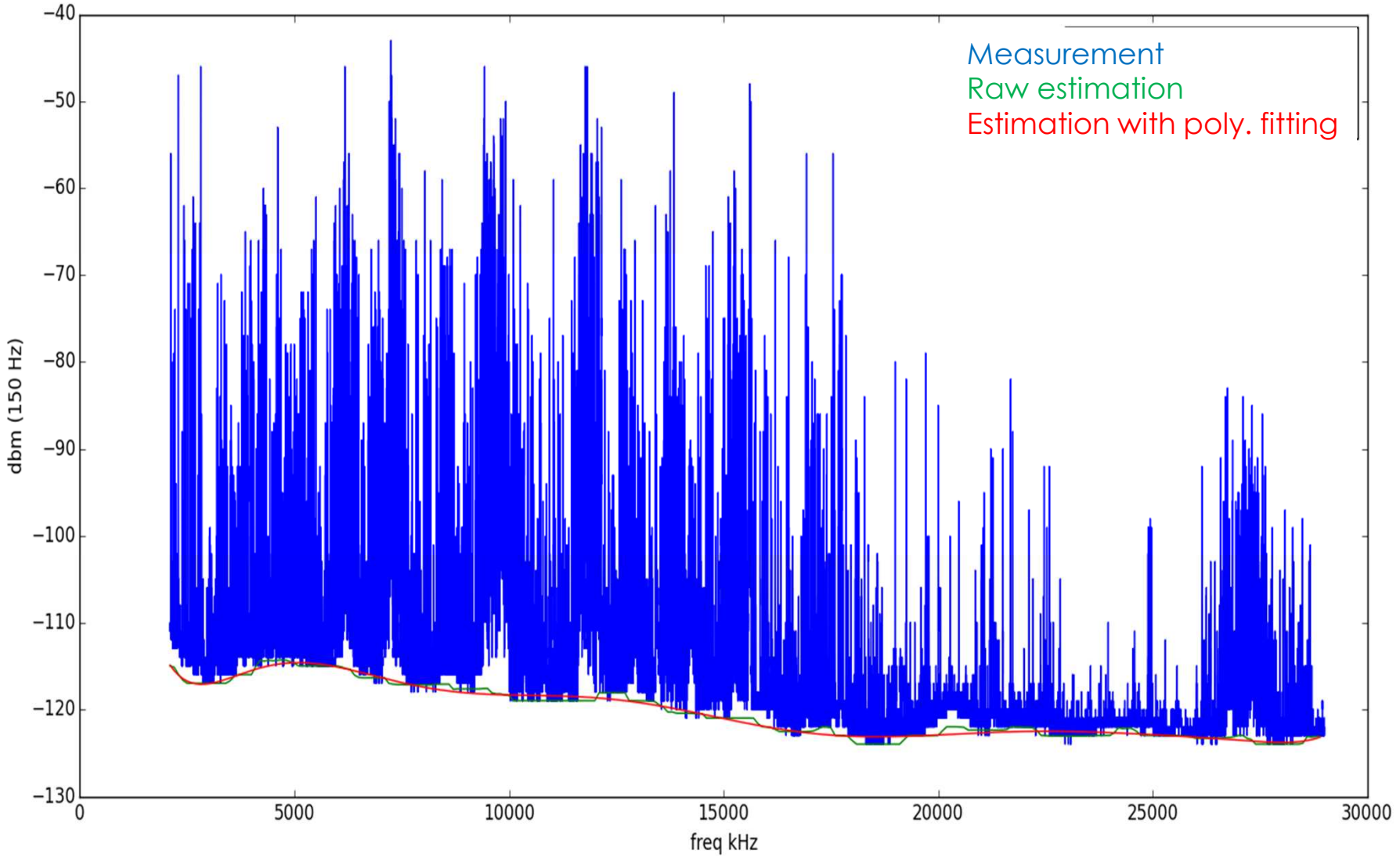
« Raw » Noise Level is estimated with a 1 MHz sliding window

- Window width allows not to be biaised by very powerfull emissions
- Noise estimation = mean of the 2% lowest bins
- Ideally, a smaller frequency sliding window would be desirable (about 250 kHz)
- Reducing the window width requires a better dynamic to cope with powerful transmissions

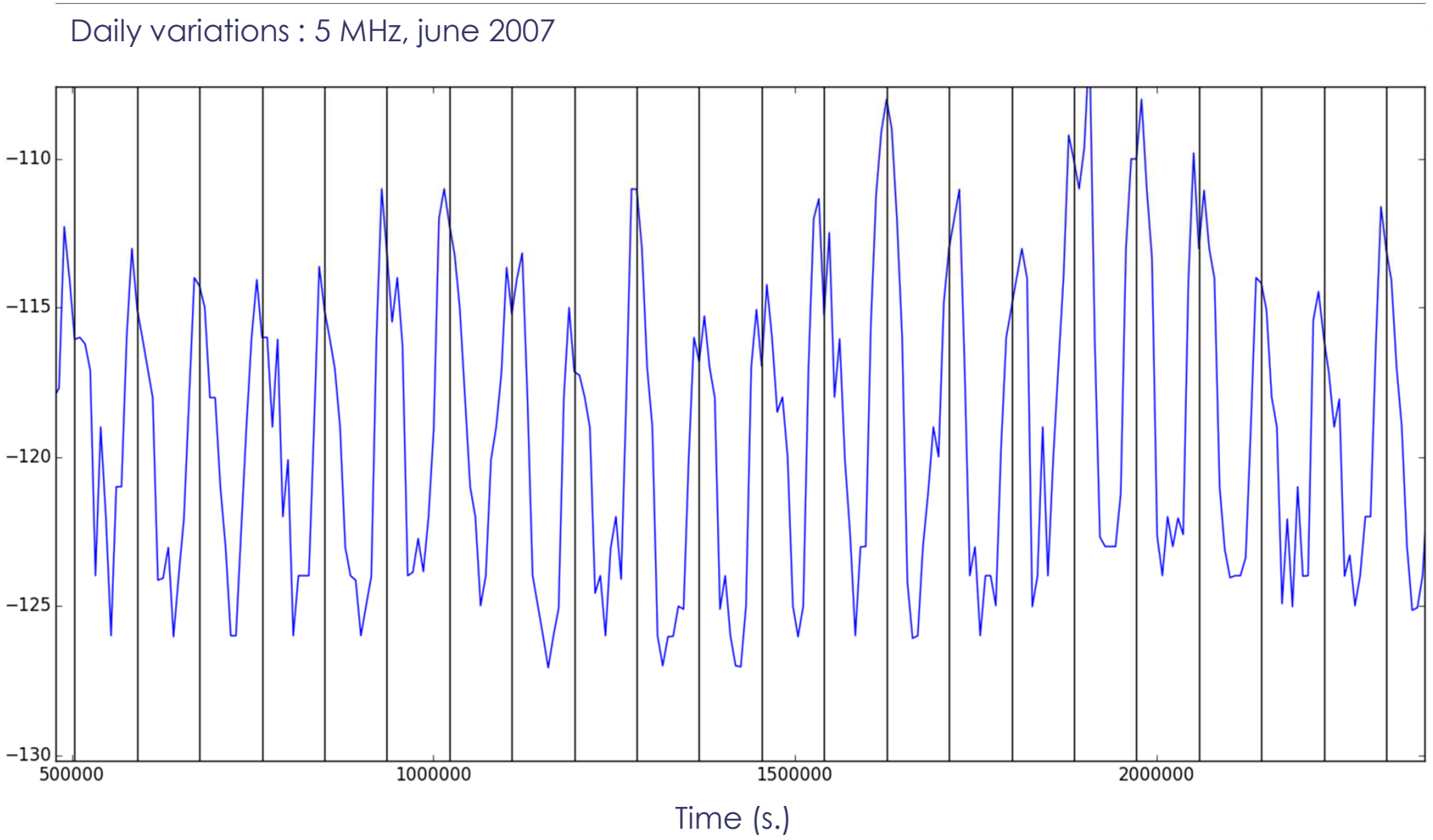
Frequency polynomial fitting is applied on « raw noise level »

- Smooth « raw » noise level
- Provides a compact & continuous model as a function of frequency

Noise Level Estimation (2/2)

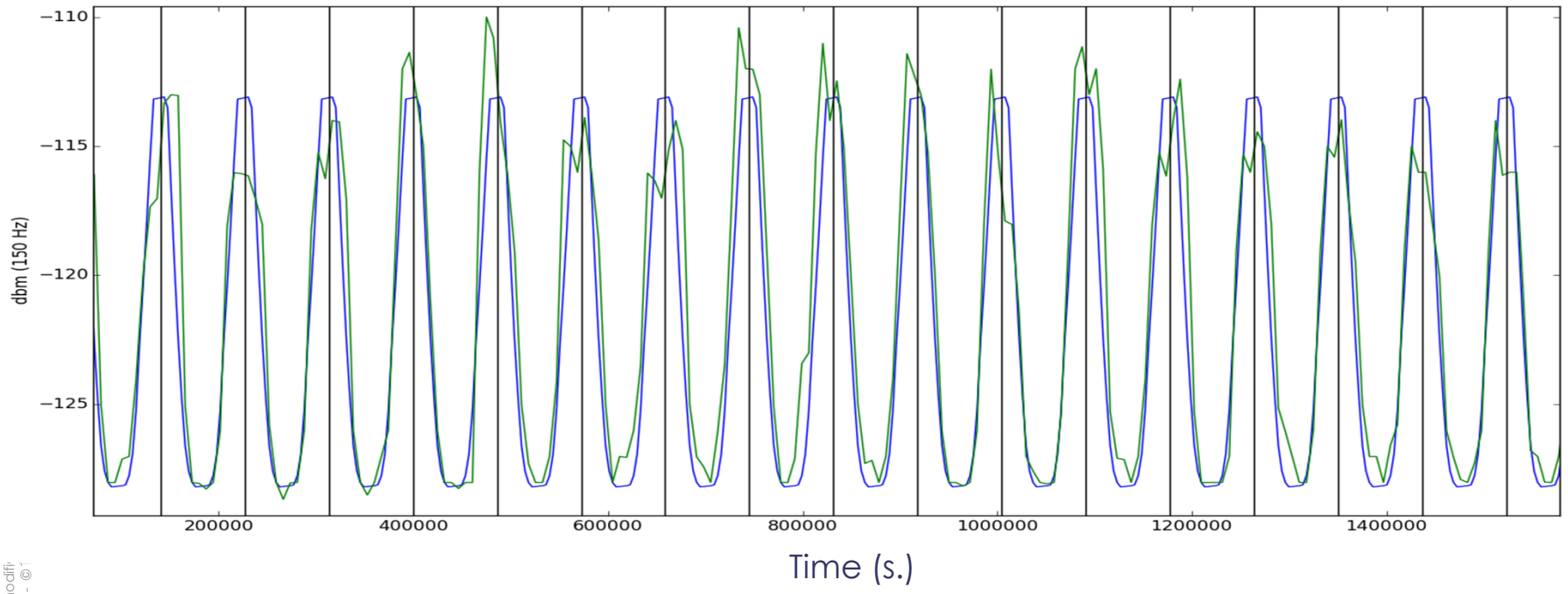


Daily variations



Comparison with UIT recommadations (SATIS software)

Daily variations : 5 MHz – june 2007 : UIT model / Measurements



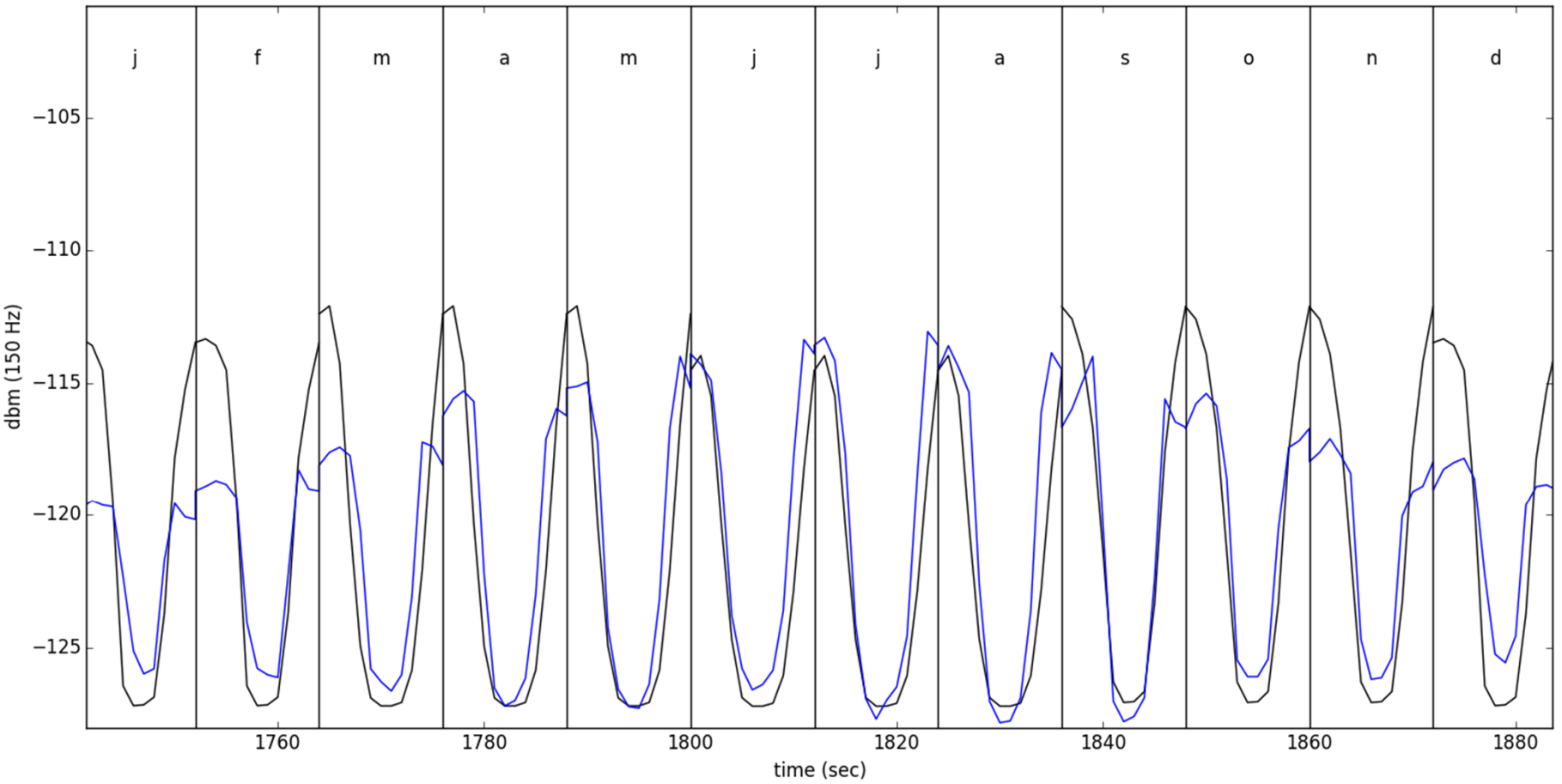
Notes:

- "Quiet rural" model
- Mean values alignment (measured levels are relative levels)

Seasonal Variation – 5 MHz (2007)

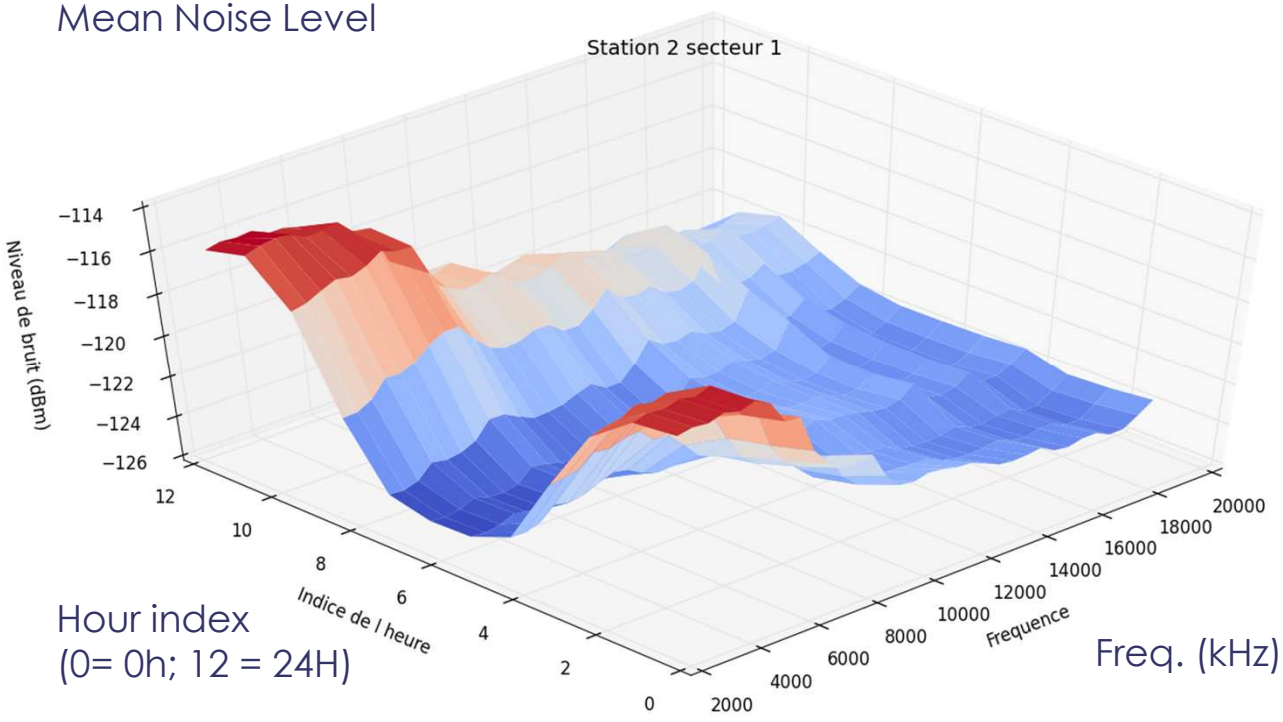
- Mean day : average over the current month at a given hour
- ->Day/night variations overestimated by UIT model during winter

« Mean day » variation – 1 year period (**ITU** / **Measurements**)



Noise variability w.r.t. frequency

Mean Noise Level



Hour index
(0= 0h; 12 = 24H)

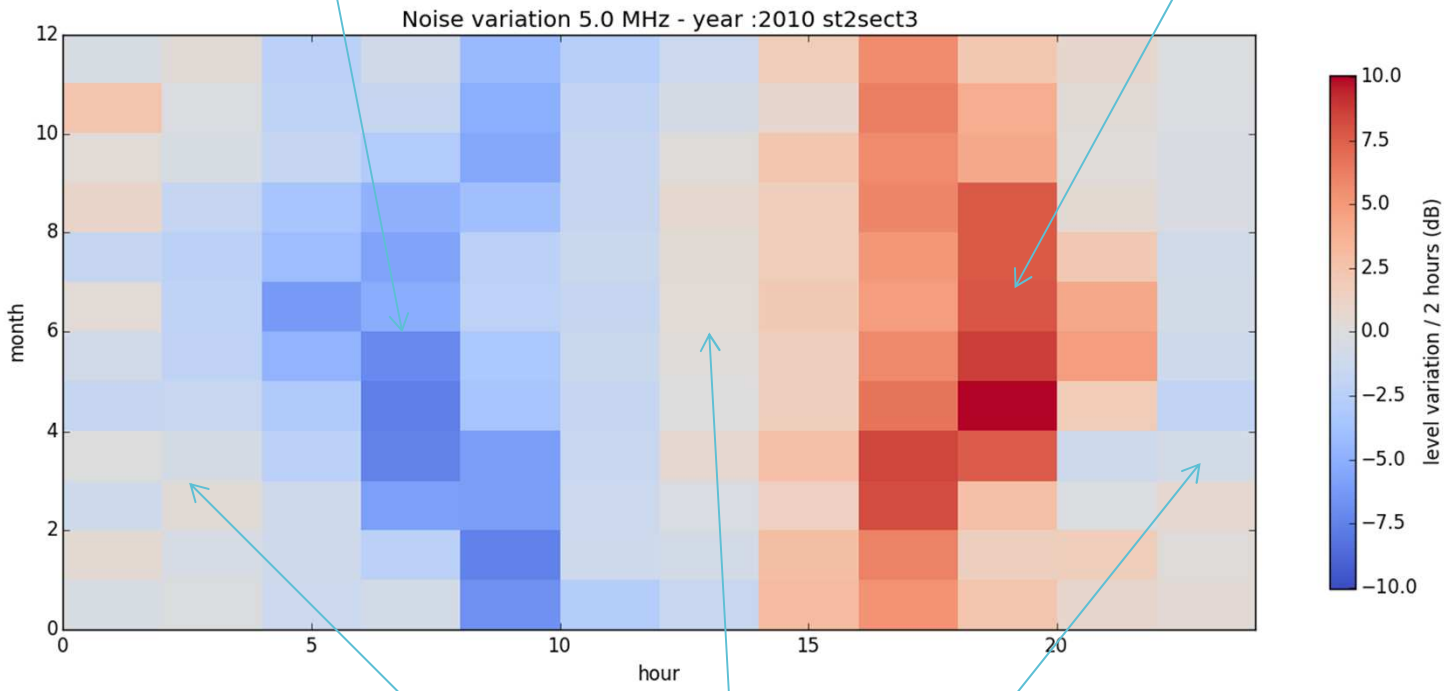
Freq. (kHz)

- Globally consistent with UIT model
- Similar to measurements made by R.K. Potter (USA, 1930)

Hour and month variability – 5 MHz

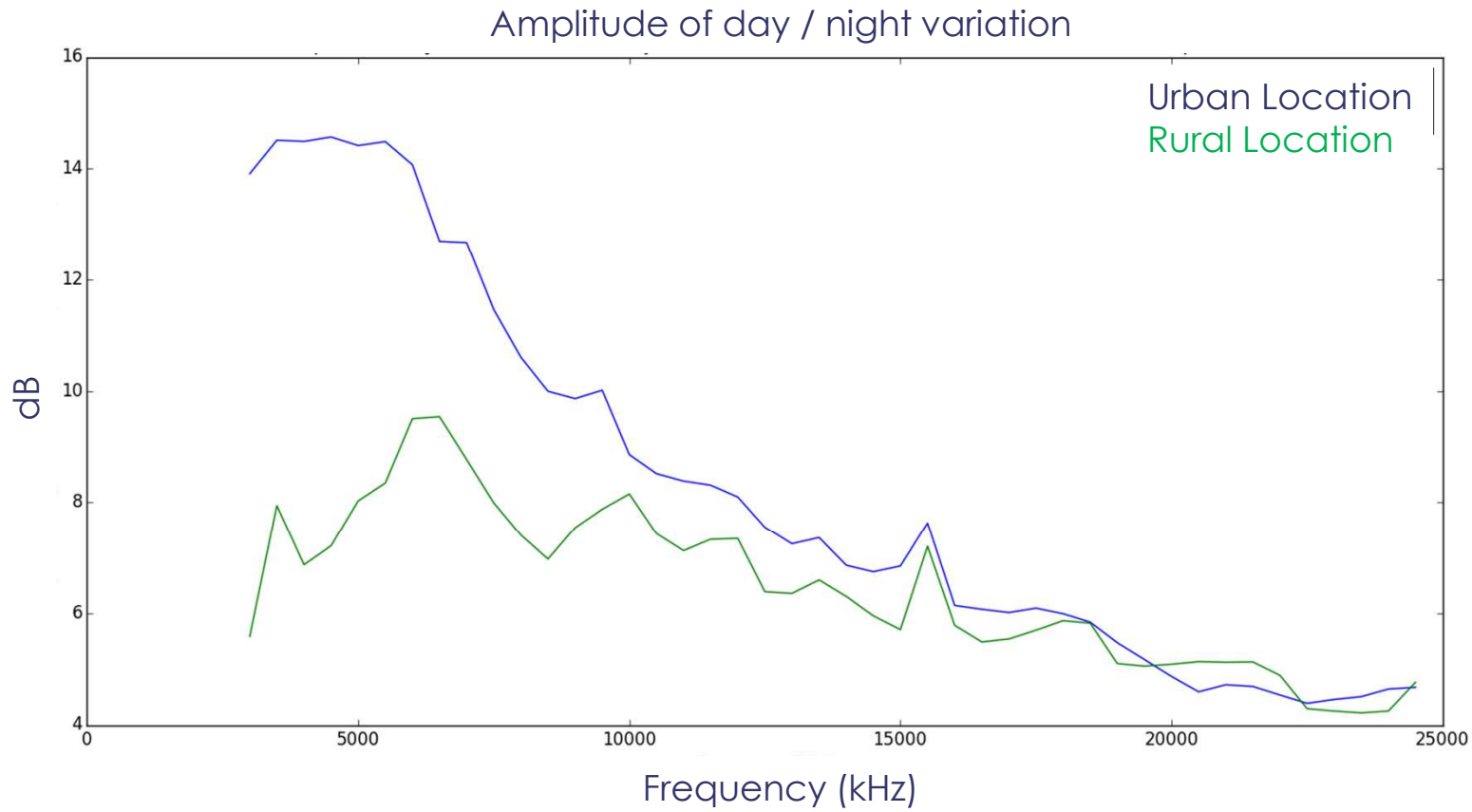
Night-> Day Transition

Day -> Night Transition



No transition period

Location Variability



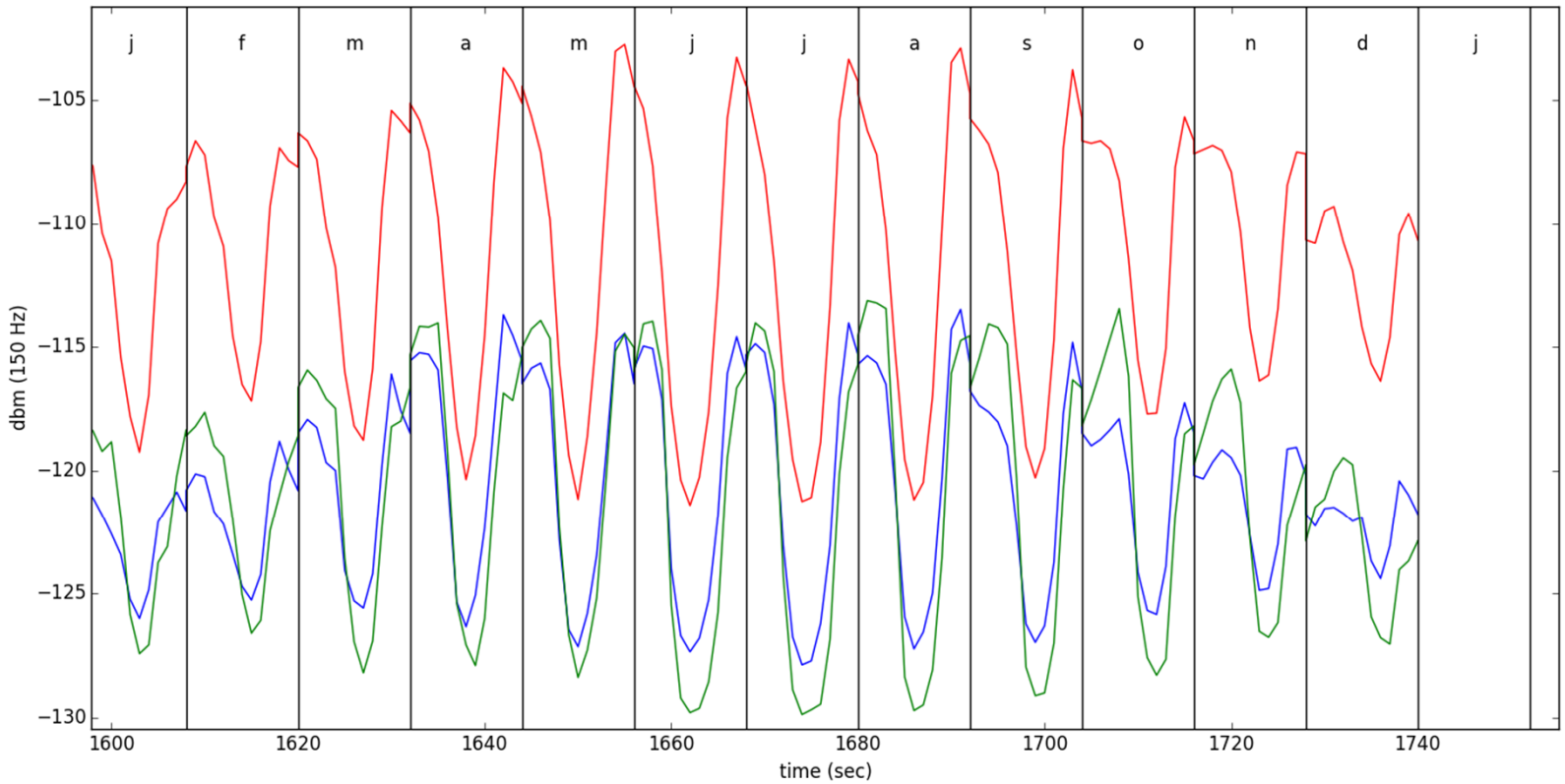
Higher industrial Noise reduces day / night variations

- Consistent with UIT model

Antenna Variability : different directions at same receiving location

Noise value and its evolution differs from one direction to another one

Year 2011 - directions 1 / 2 / 3 – 6.8 MHz



Conclusions

Noise level variation can be estimated for short term (few hours), daily and seasonal periods

Atmospheric noise variation relatively consistent with UIT model

- Considering, this measurement data base, UIT model overestimates daily variations during winter

Noise level and noise evolution differs for directive antennas pointing in different directions (on the same receiving location)

- Atmospheric / industrial noise cannot be modelled as isotropic

Improving UIT models would benefit to better budget link evaluation

- Influence of the antenna on noise level
- Especially directivity / polarisation
- Requires rigorous experimental protocol and long term measurements

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If you have any questions

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