Station design

A station consists of sensors. Typically the design depends on two parameters:

- the aperture which is defined by the radius of the smallest circle containing the station,
- the locations of the sensors, which is more difficult to characterize by only one number. Two aspects are of interest:
  - the uniformity of the interdistances which could be useful in the case of loss of coherence.
  - the isotropy which means that the accuracy is almost independent of the direction of arrivals.

We consider a plane wave "not fully spatially coherent" and 2 points distant of d: We assume that the loss of coherence (LOC) is given by

$$\log \mathsf{MSC}(f) \approx -\beta f^2 \times d^2$$

where f is the frequency. β characterize the LOC.

- Cramer-Rao bound (CRB) gives the minimum variance we can expect in the estimation of a parameter of interest (POI). To summarize we can use the product of the eigenvalues.
- In our case the two POIs are the azimuth and horizontal velocity of the arrival. Then the CRB is a 2 by 2 positive matrix whose diagonal elements are the minimal variances on the 2 parameters of interest and the 3rd the correlation between them.
- CRB is a function of the true azimuth and the true horizontal velocity, the LOC parameter β, the SNR, the geometry of the station.

IS37, with 10 sensors then 45 interdistances

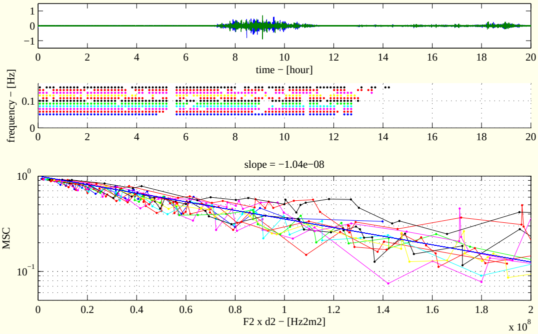

Figure: *Top: signals on about 20 hours. Middle: the 11 selected frequencies. A dot means that the MSC on the 3 nearest sensors if over 0.8 for the time window. Bottom: the 11 curves of the MSCs as a function of the interdistances.*

- for a given frequency in the selected band of interest, if the MSCs on the 3 nearest sensors are over 0.8, we keep this time slot for all combinations of interdistances.
- we average on the full duration.

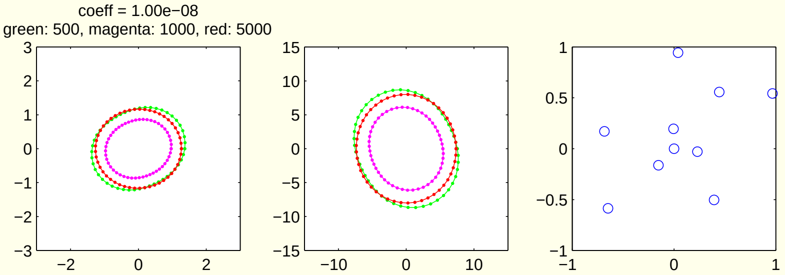

Figure: *500, 1000, 5000 are the aperture multiplicative factor of the template reported in meter on the RHS of the figure.* $\beta = 1e^{-8}$.

We see that the precision passes by a optimum for $R = 1000$.