1. Introduction and objectives

- Attenuation data from microwave communication links can be used to retrieve rainfall fields, for instance by applying tomographic inversion algorithms.
- The relation between specific attenuation $K$ [dB/km] and frequency is non-linear, this complicates the tomographic inversion algorithm.

$$ K = aR^b $$

2. HF - Tomographic reconstruction algorithm

- 2.1 At different frequencies power attenuation levels are experienced for the same rain intensity, we opted to reconstruct the rainfall field.
- 2.2 We take advantage of particular spatial functions called Basis Functions $BF_i$.
- 2.3 The BFs have to represent spatial distributions of rain rate $R(x,y)$ (sub-kilometer scales).

$$ R(x,y) = \sum_i BF_i $$

- From previous studies on rain cell characterization [2], we opted for negative exponential basis functions:

$$ BF_i(R_m, \rho_0, X_i, Y_i) = R_m e^{-\frac{(x-x_i)^2+y(y_i)^2}{\rho_0^2}} $$

- The 4N unknowns (where N is the total number of basis functions) are determined by minimizing the following error function, using a simulated annealing algorithm [3]:

$$ err(R_m, \rho_0, X_i, Y_i) = \sum_i (k_i - \hat{k}_i)^2 $$

3. Simulations and results

- A set of high-resolution rain radar maps are selected; they will be the “ground truth”.
- A set of radio links, operating at 25 GHz, is positioned over the radar map.
- Specific attenuation is estimated from local point rain rate (defined in each radar pixel).

4. Conclusions

- For each link, total path attenuation is computed by numerical integration of eq.(1) over the corresponding path.
- The computed values of attenuation are used as input for the tomographic reconstruction algorithm.
- The reconstructed rain maps are compared to the corresponding radar rain maps and some statistical performance indices are evaluated.

5. Acknowledgments

We all thank Fondazione Cariplo for funding the MOPRAM project.