

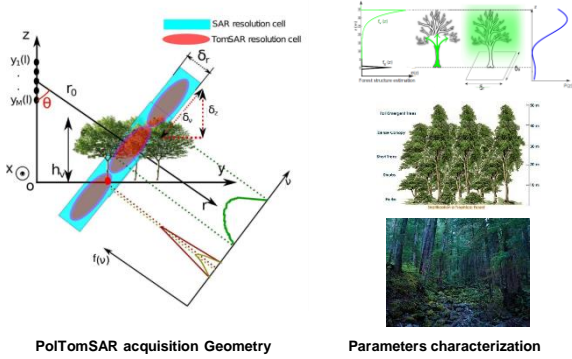
Ray ABDO, Laurent FERRO-FAMIL

ray.abdo@univ-rennes1.fr, University of Rennes 1

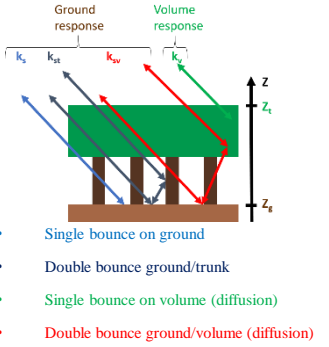
## Objectives

- Analyze coherent and incoherent double-bounce scattering mechanisms
- Separate double-bounce contributions from ground response
- Characterizing underlying ground (roughness, humidity).

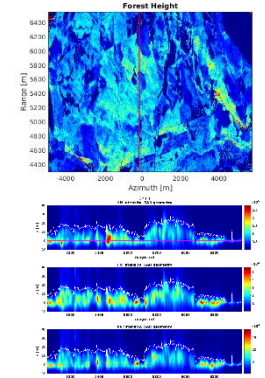
## SAR (Synthetic Aperture Radar) Tomography



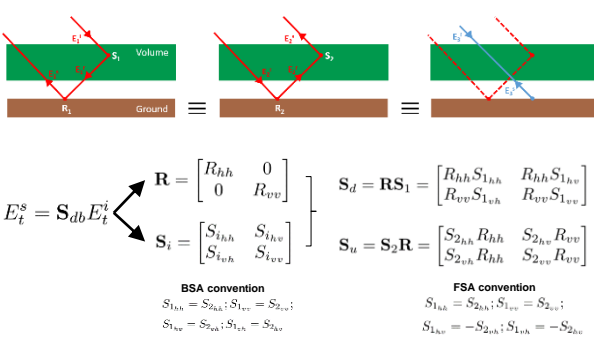
## Random Volume over Ground (RVoG) Modeling



## BioSAR II L Band



## Double-bounce scattering 2-D imaging

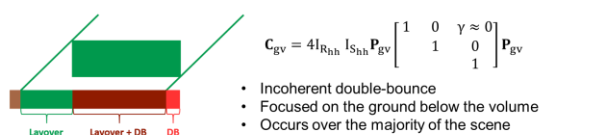


**Assumption:** The scene contains vegetation i.e. not homogeneous and speckle noise is present  
**Outcome:** R and S are Gaussian, centered, independent scattering mechanisms  $\rightarrow$  Intercorrelations null

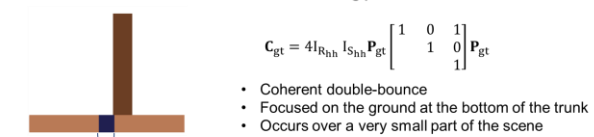
Covariance matrix as a function of  $4I_{Rhh}$ ,  $I_{Shh}$  and  $\alpha_{1pq} = \sqrt{\frac{I_{1pq}}{I_{hh}}}$

$$C_{db} = 4I_{Rhh} I_{Shh} \begin{bmatrix} 1 & \frac{1}{2} \alpha_{S_{vv}} \rho_{S_{hh} S_{vv}} (1 - \alpha_{R_{vv}} \rho_{R_{hh} S_{vv}}) & \alpha_{R_{vv}} \rho_{R_{hh} S_{vv}} \alpha_{S_{vv}} \rho_{S_{hh} S_{vv}} \\ \frac{1}{2} \alpha_{S_{vv}}^2 (1 + \alpha_{R_{vv}}^2 + 2Re(\alpha_{R_{vv}} \rho_{R_{hh} S_{vv}})) & \frac{1}{2} \alpha_{S_{vv}} \alpha_{S_{vv}} \rho_{S_{hh} S_{vv}} \alpha_{R_{vv}} (\rho_{R_{hh} S_{vv}} - \alpha_{R_{vv}}) \\ & \alpha_{R_{vv}}^2 \alpha_{S_{vv}}^2 \end{bmatrix}$$

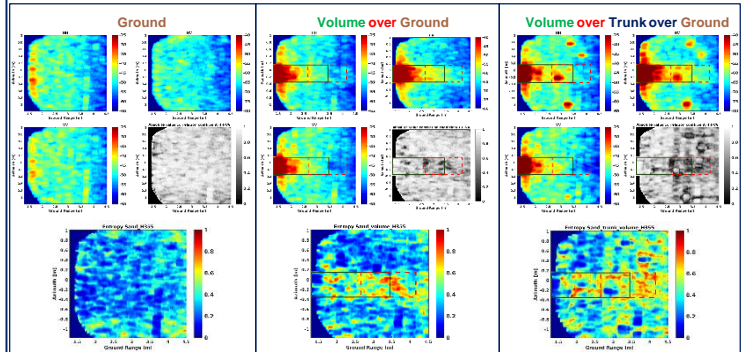
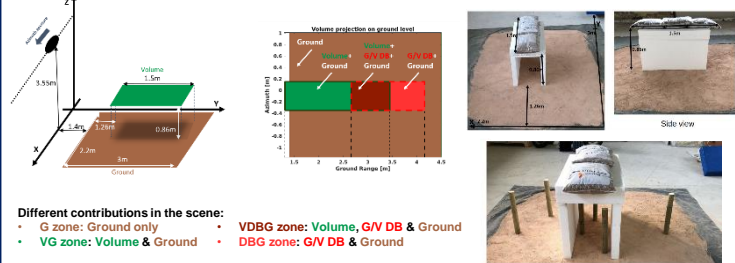
Ground/Volume scattering  $\gamma \approx 0$



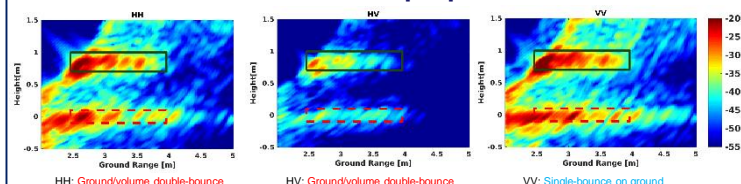
Ground/Trunk scattering  $\gamma \approx 1$



## Geometry acquisition & PolSAR results



## PoITomSAR results and proposed solution



$$W = C_G \otimes R_G + C_{GV} \otimes R_{GV} + C_V \otimes R_V = (C_G + C_{GV}) \otimes R_G + C_V \otimes R_V$$

SKP Decomposition  $\rightarrow$   $W = C_G + C_{GV} + C_V$

## Conclusion:

Double-bounce GT is coherent meaning that its contributions can be avoided.  
 Double-bounce GV is incoherent and cannot be avoided.  
 Pure ground contributions are retrieved by subtracting a portion of volume contributions.