A new light on misclassification results on the SOMA district in San Francisco
due to the difficulty to predict entropy

Elise Colin Koeniguer (1)
Flora Weissgerber (1), (2)
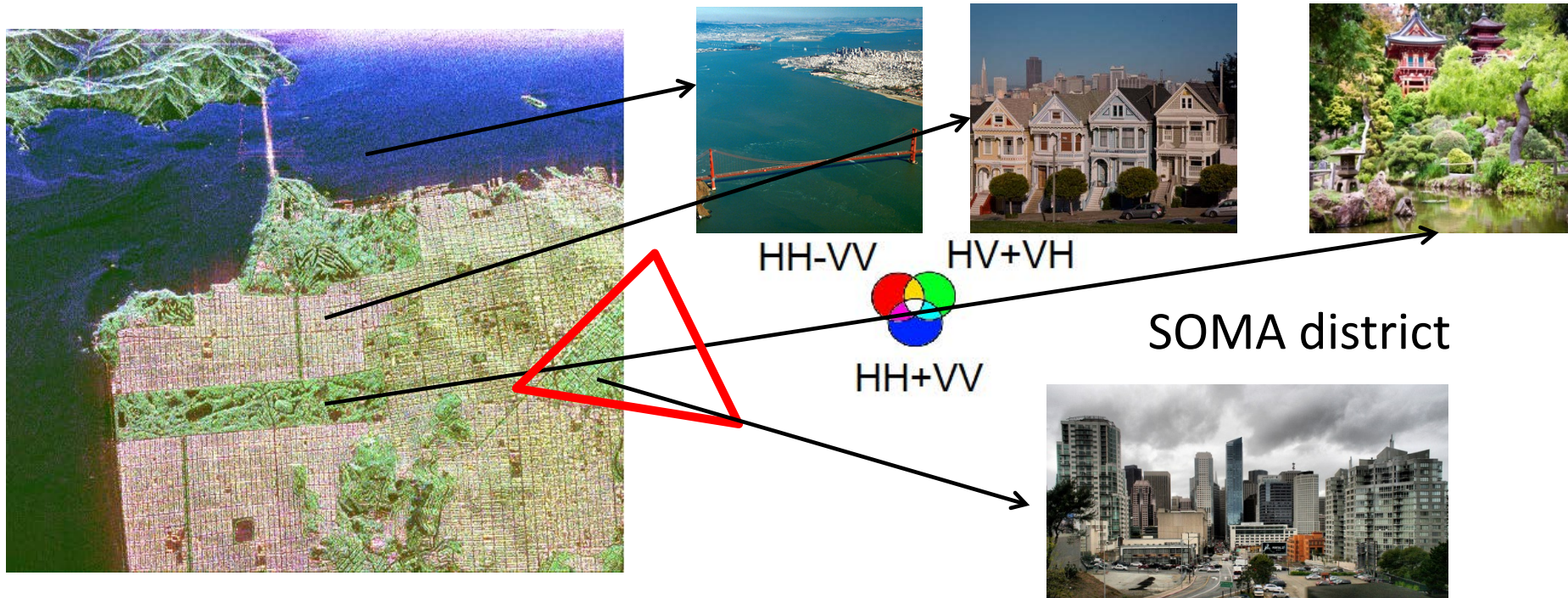**Nicolas Trouvé (1)**
Jean-Marie Nicolas (2)

ONERA
THE FRENCH AEROSPACE LAB

(1)

TELECOM ParisTech

(2)

European Space Agency

HH-VV   HV+VH

SOMA district

HH+VV
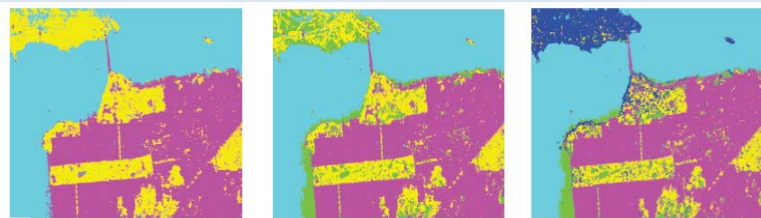
We know that HV signal is high because of orientation effects,

but we are not able to fully compensate them

Misclassification results

Recent Polarimetric classification results using machine learning

Poor detection results

Results obtained during POLSARAP
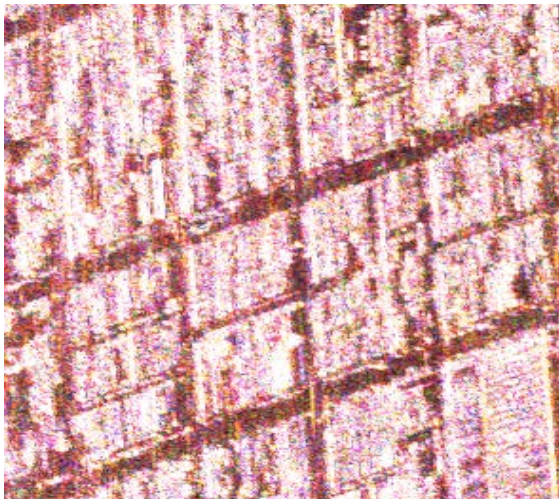*Built-up areas detection*

What here?

- Further insights into urban effects
  - About HV signal and orientation of streets
  - About Entropy and its spatial estimation
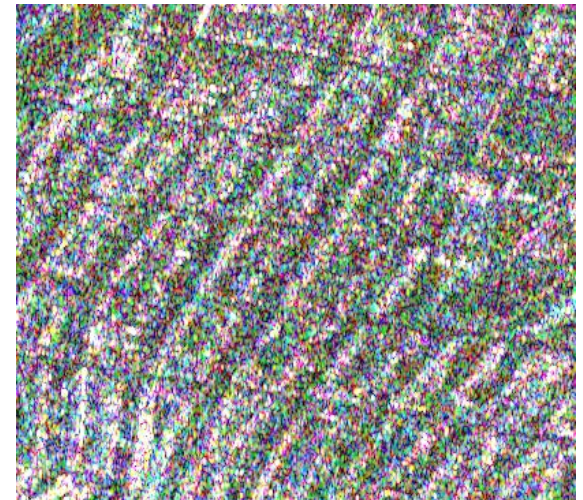
Streets aligned with the trajectory	Streets not aligned with the trajectory

HV is low
entropy is low

HH-VV   HV+VH

HH+VV

HV is high
entropy is high

How ?
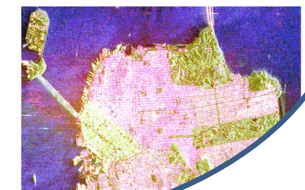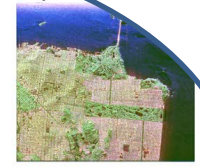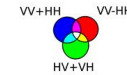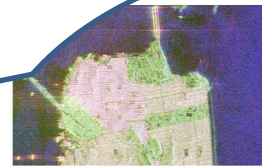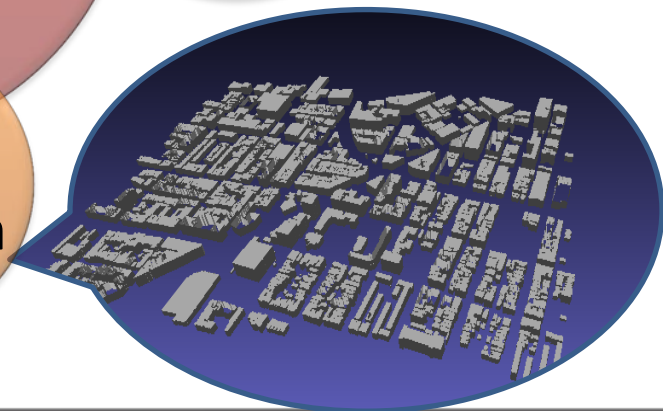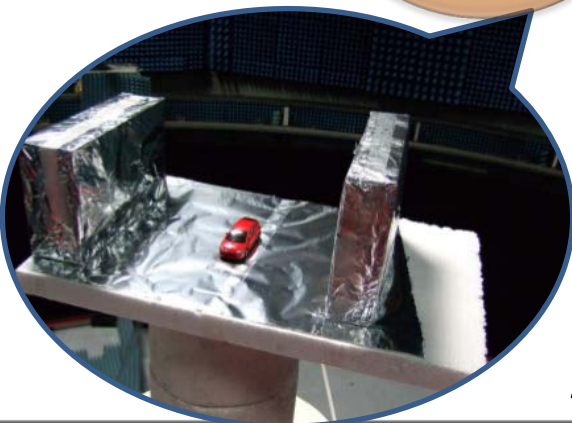
The problem with HV

Oriented target = signal in HV channel

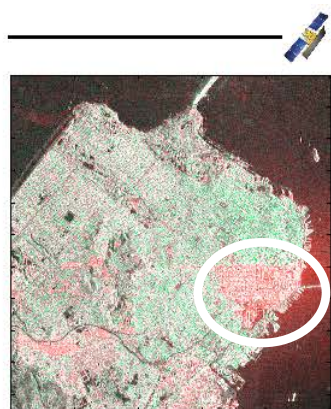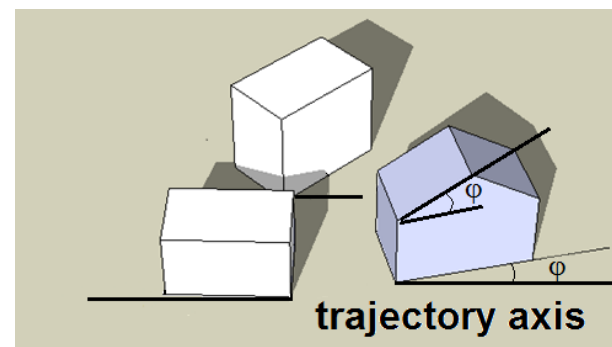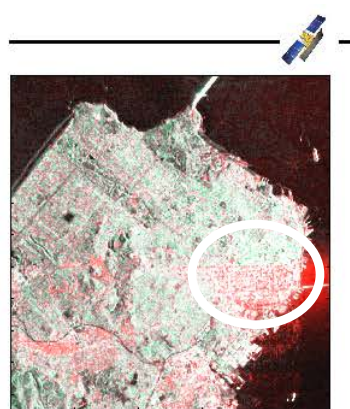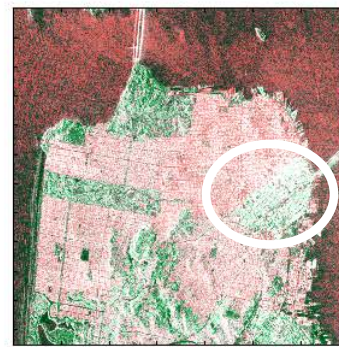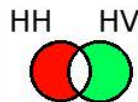Many oriented targets in urban areas: roofs, dihedral corner non oriented along trajectory axis
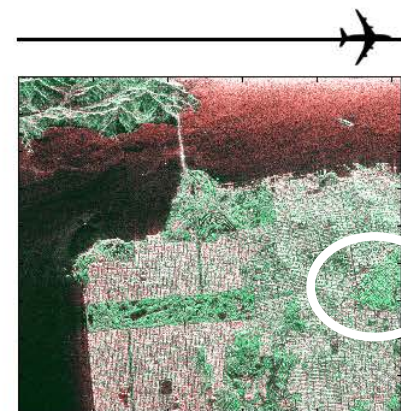
trajectory axis

HH   HV

L-band, SIR-C

C-band, SIR-C

C-band, RADARSAT-2

L-band, AIRSAR

Deorientation :
rotation around the wave direction to align the target axis along H-axis
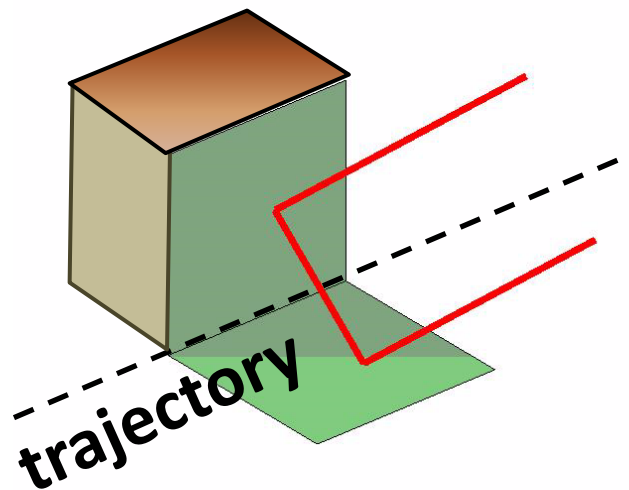
Difficulty to compensate orientations

Not so simple

- A dielectric corner is not a metallic corner
- The axis orientation is projected from a 3D element onto a 2D plane

Orientation of a dihedral corner ɸ
≠ polarimetric orientation angle

Example : what does a street becomes after a 45° polarimetric basis rotation?
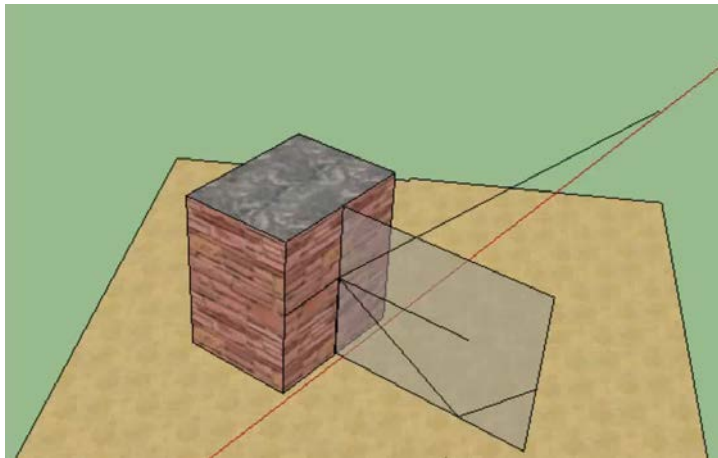
Difficulty to compensate orientations

A street along trajectory

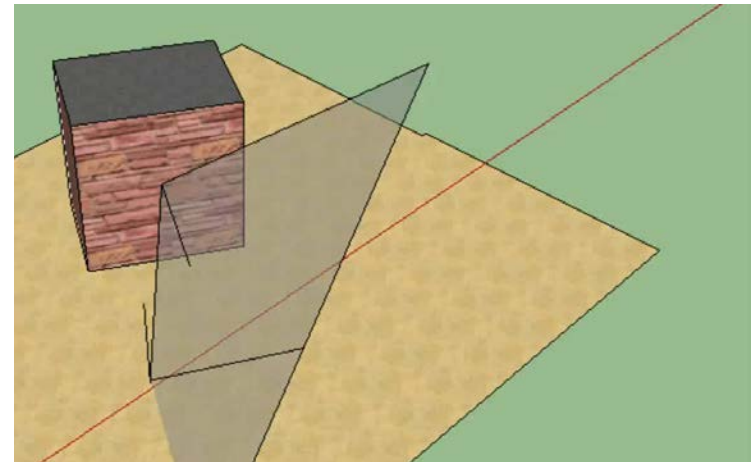The double bounce mechanism for a wall oriented along the trajectory involves two specular reflections

Any street orientation

Only one possible specular reflection

HH-VV very high !

HH-VV lower, no principal mechanism

Results of exact modelling / indoor measurement

- When orientation increases
  - The double bounce effect is not more predominent
  - All mechanisms contribute, and entropy increases because the mixture becomes spatially random
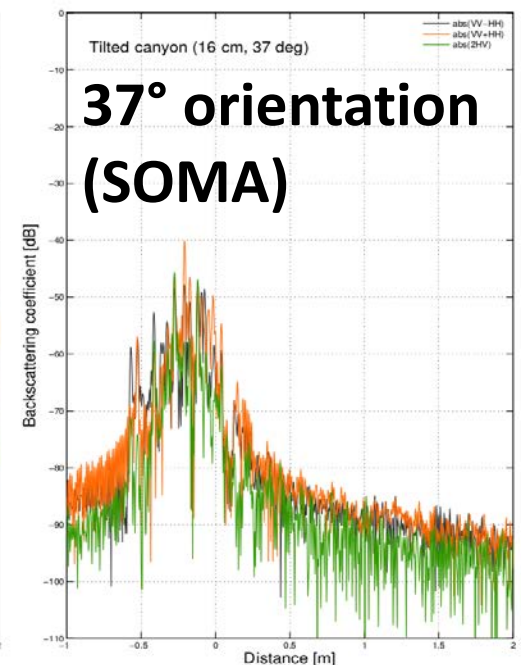
Results presented in EUSAR 2014
[Thirion Lefevre et al.]

0° orientation

37° orientation (SOMA)
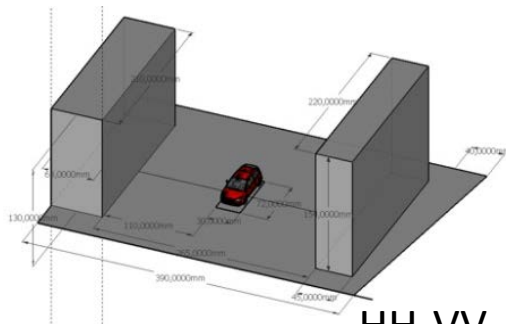
HH-VV

HH+VV

HV+VH
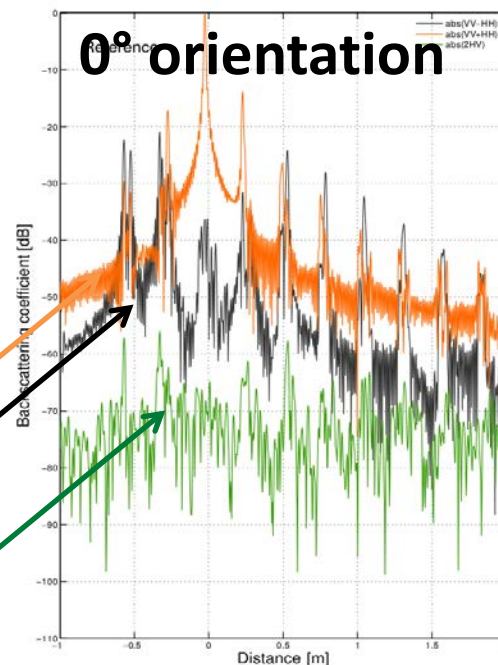
Courtesy of UAVSAR,
New Orleans

Polarization Orientation angle

- When orientation increases, entropy rapidly increases
- Saturation effect from 20°

- 3 TerraSAR-X images

TerraSAR-X, X-band
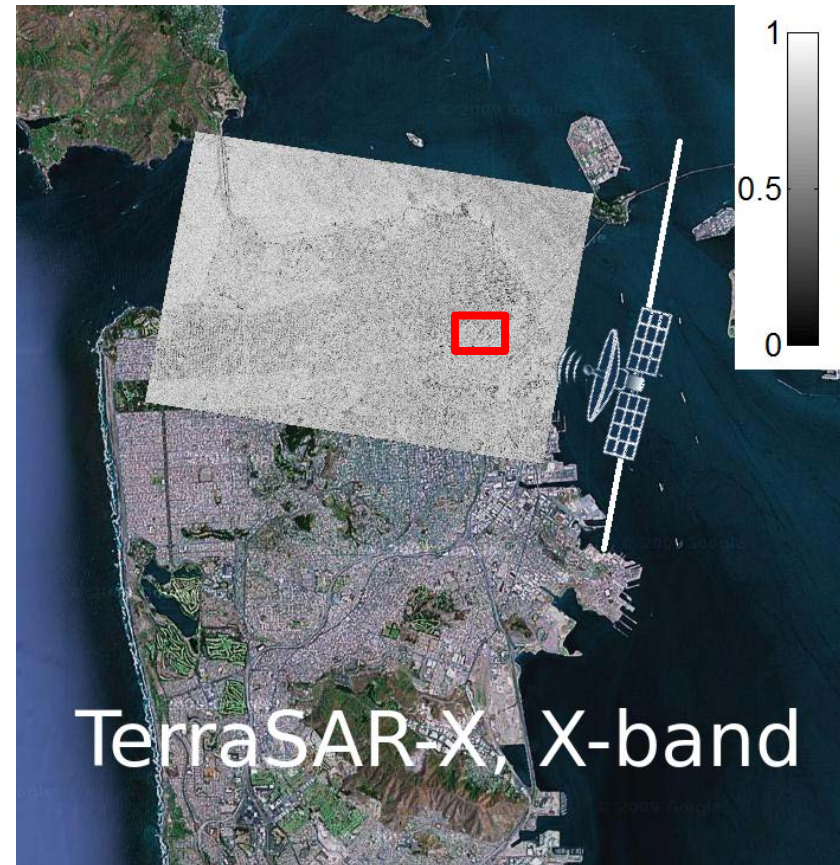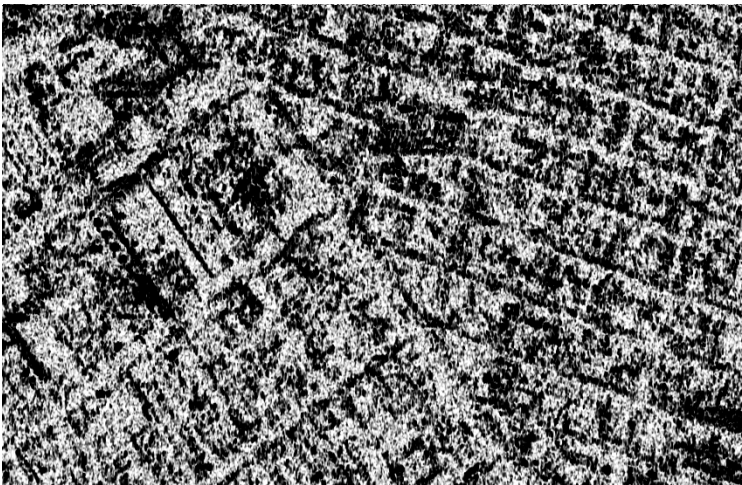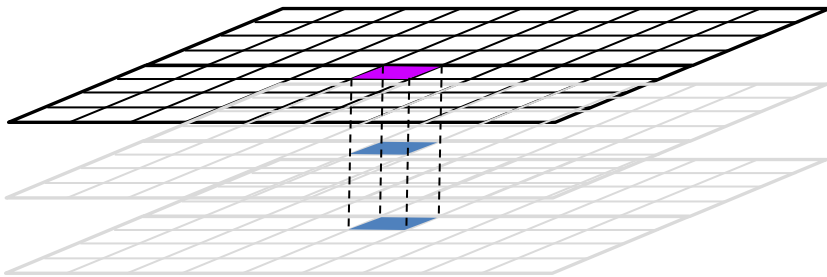
Entropy and resolution

- 3 UAVSAR images

UAVSAR, L-band
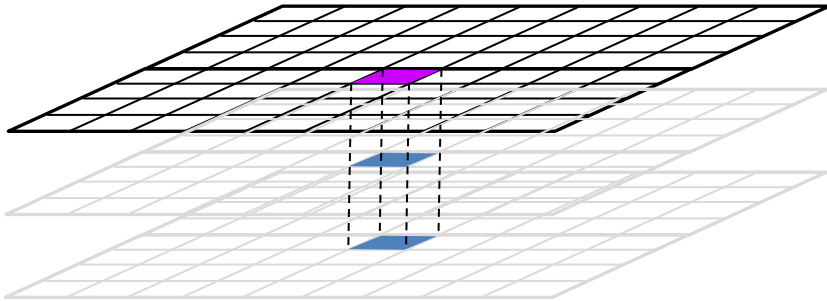
- ## 12 UAVSAR multilook images

1 multilook pixel
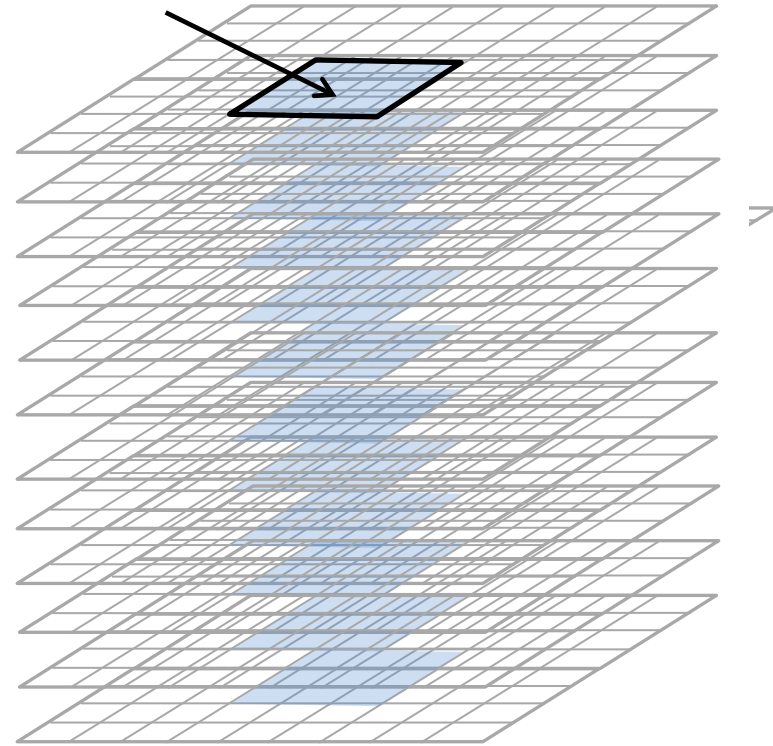
12 images

Misclassification linked to first order parameters

- When orientation of street increases, the double bounce mechanism is completely different from the well oriented ones
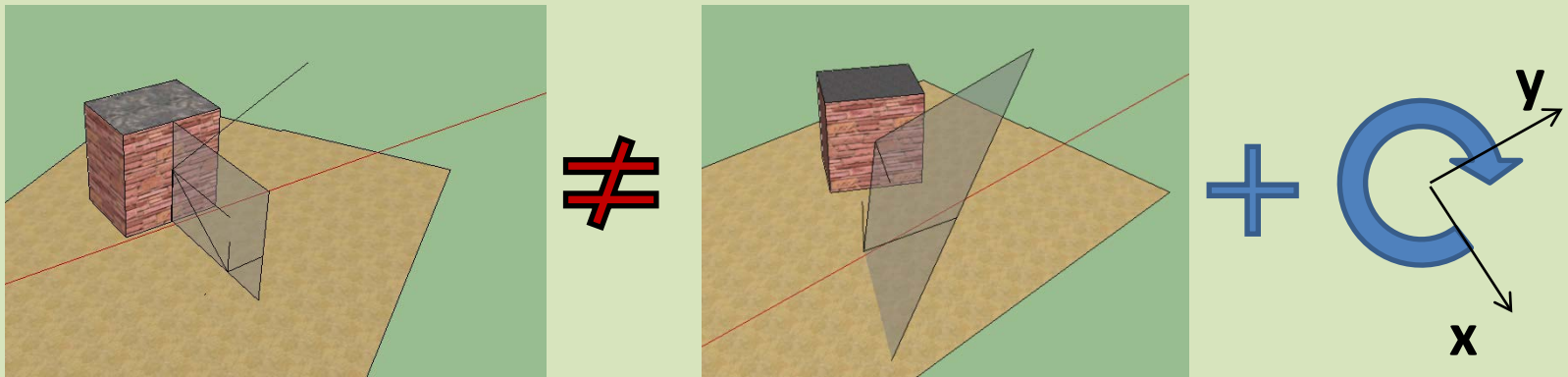
- Deorientation does not mean we are able to retrieve the signal when the scattering plane is colinear to the symmetry plane

Recommandations

- Specific modelling and specific reprensentations in decompositions

Summary

Misclassification linked to statistical estimation

- **When orientation of street increases, entropy increases**, because amplitude of a dihedral desoriented effect is not as strong as the well oriented ones
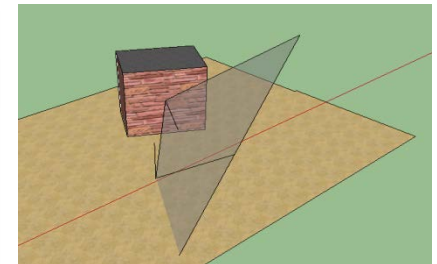
- When statistical estimation is required, **spatial estimation is not effective in urban**, especially for some resolutions (around 1 m) because mixes different polarimetric parameters

Recommandations

Towards temporal estimation.

There are very **promising results** using only 3 images.
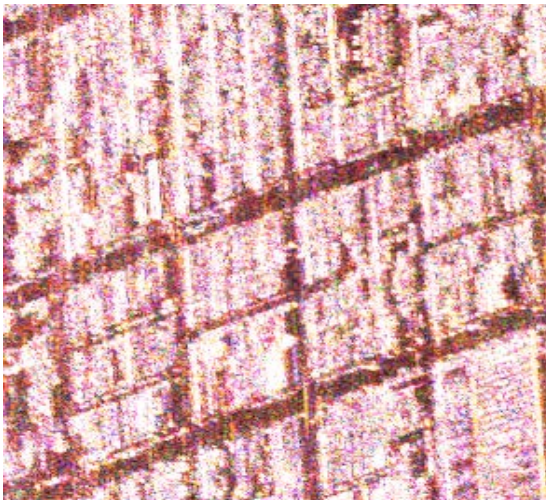
**Any help for UAVSAR SLC processing data request ?**

Summary

Streets aligned with the trajectory

- Double bounce effects are higher than other contributions. They are predominant
- If the entropy is estimated spatially, the strong intensity makes the double bounce mechanism dominant
- As the main mechanism remains the same entropy is low

Streets not aligned with the trajectory

- All mechanisms have comparable amplitudes
- Rotation cannot change this feature
- If entropy is performed by a boxcar filtering, it is high
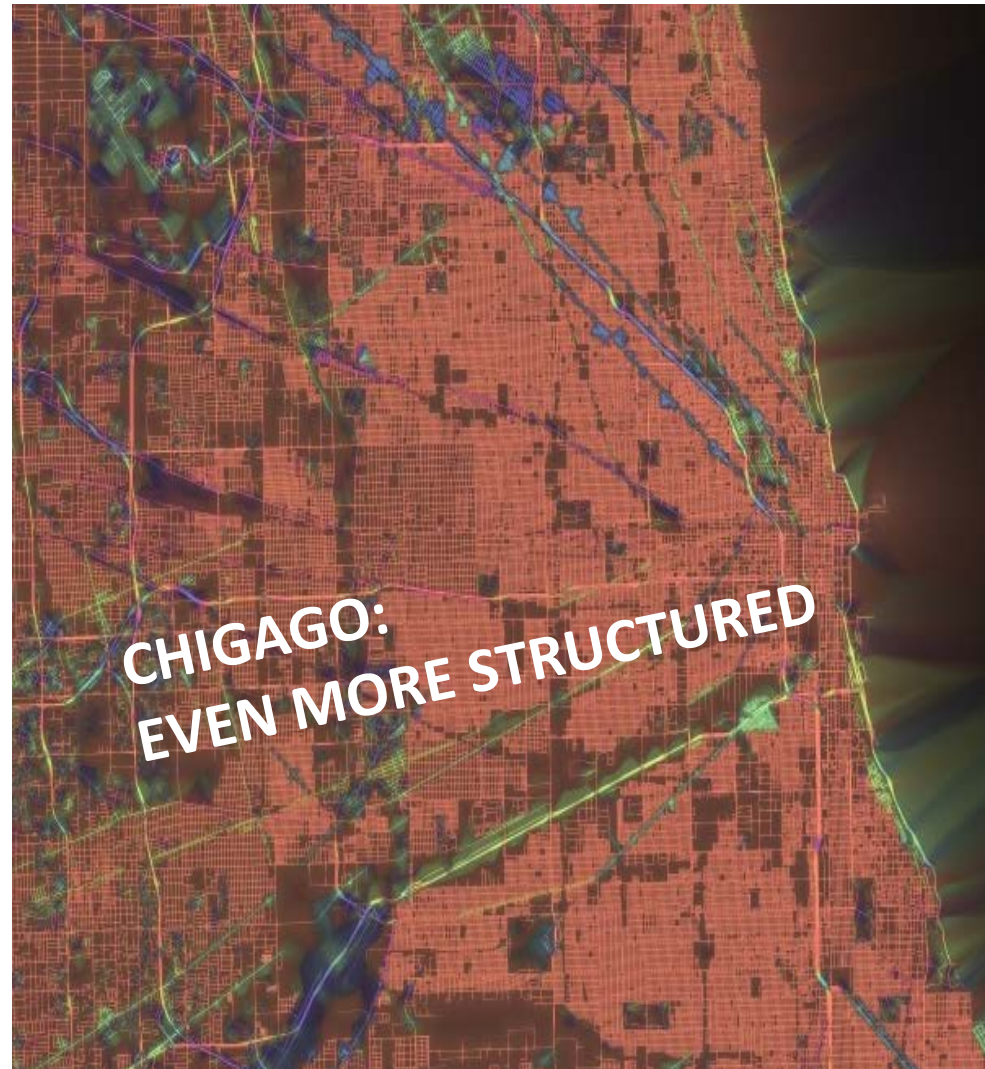

HH+VV
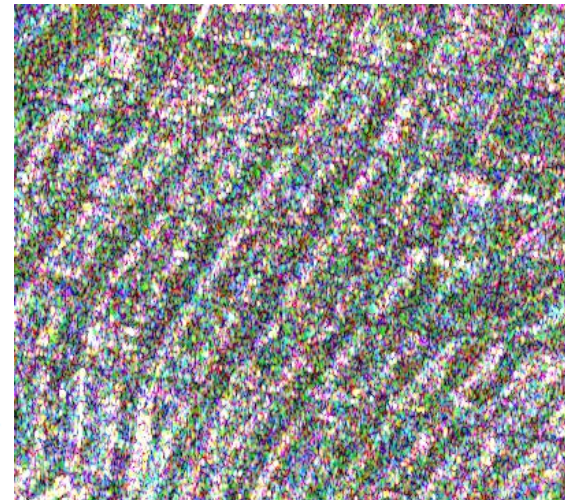
Each city has its character

Street patterns can often be very different

Here are given some representations where color codes street orientation

Extracted from:
http://www.datapointed.net/2014/10/maps-of-street-grids-by-orientation/

CHIGAGO: EVEN MORE STRUCTURED

That is why
Paris is different
from so many other cities

A common test site?