FACTORS IMPACT SAR BACKSCATTER

LECTURE 10

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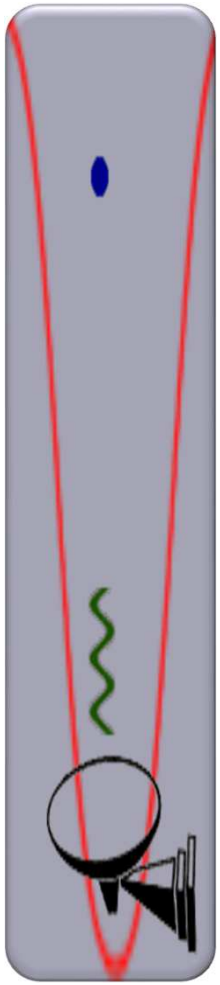
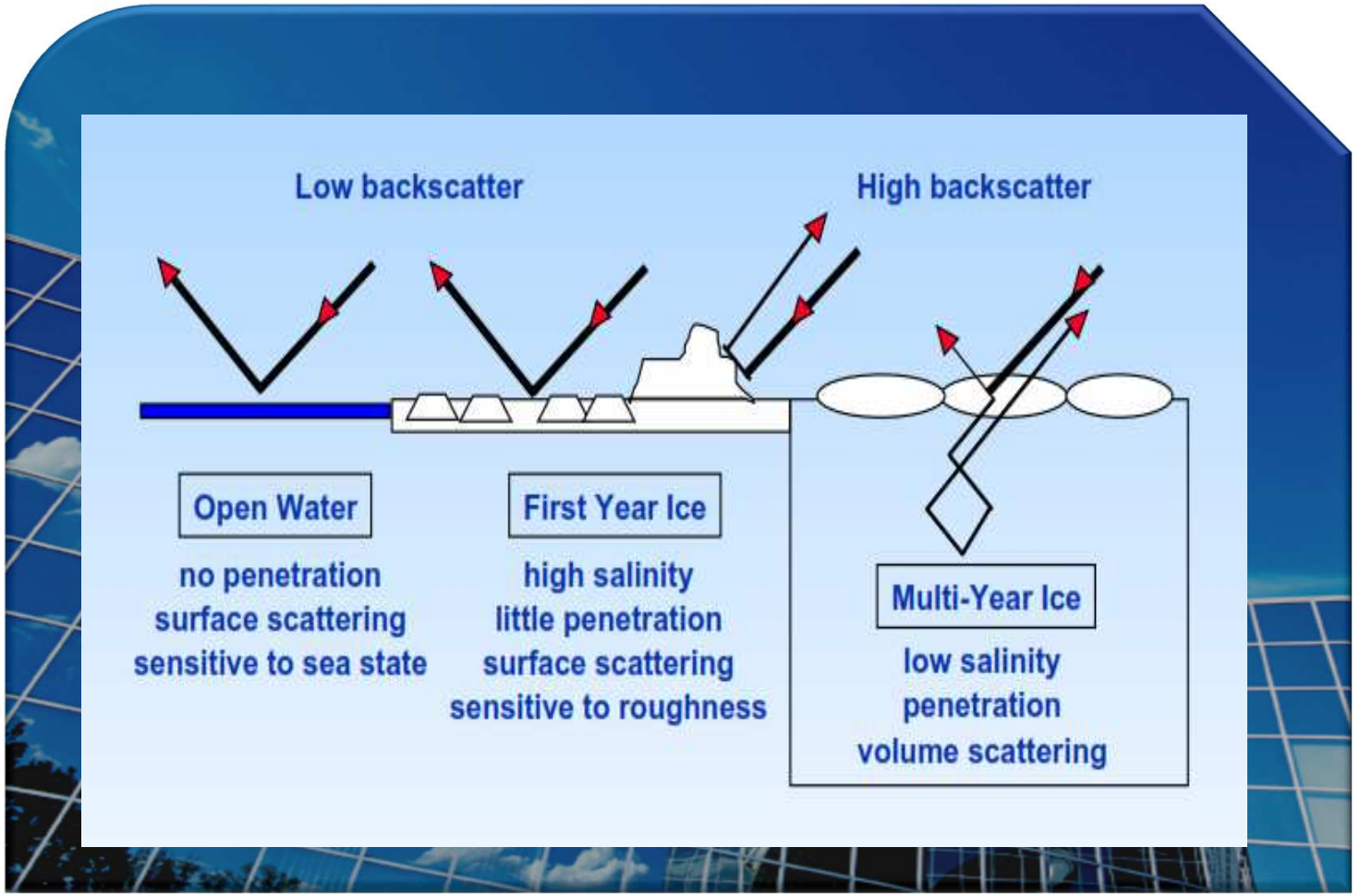


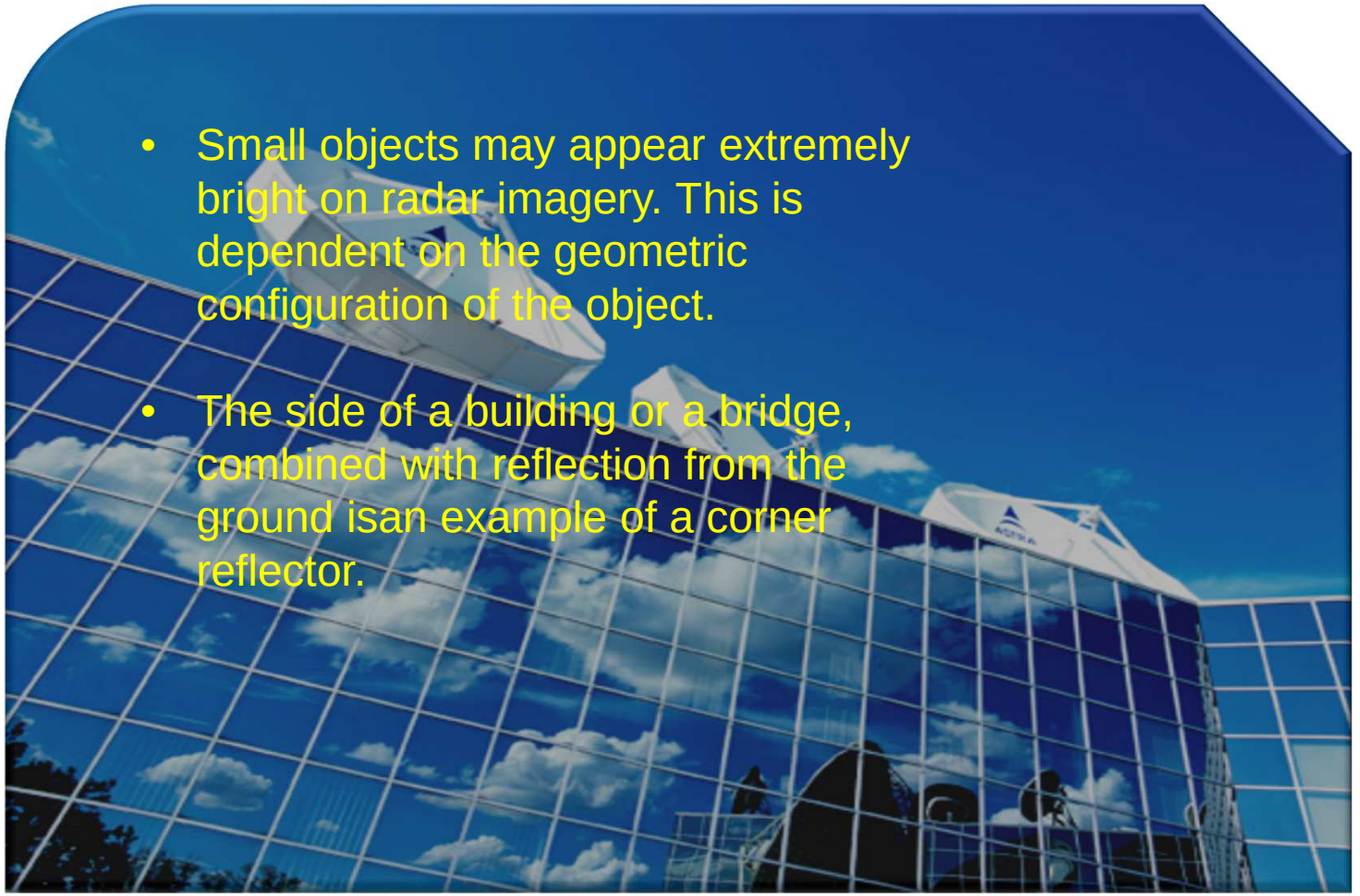
Large dielectric constant due to high salinity content
- no penetration into the FY ice volume
- sensitive primarily to surface roughness

Multi-year ice
- experiences one or more melt seasons
- lower salinity levels due to brine drainage
- lower dielectric constant

SAR - SEA ICE INTERACTION



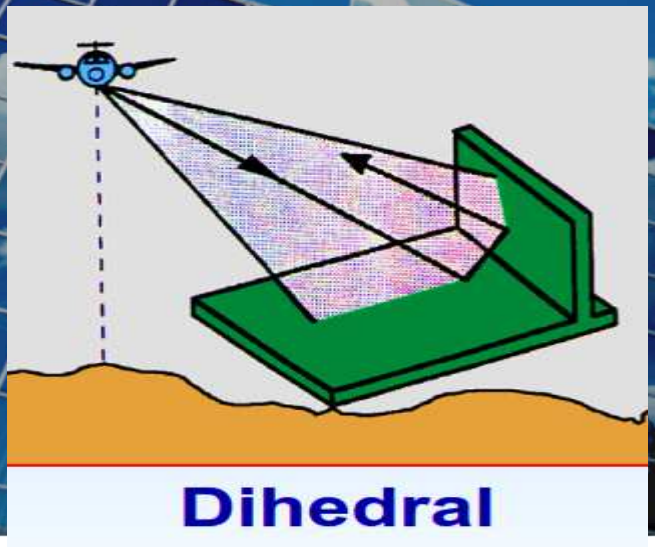
CORNER REFLECTORS



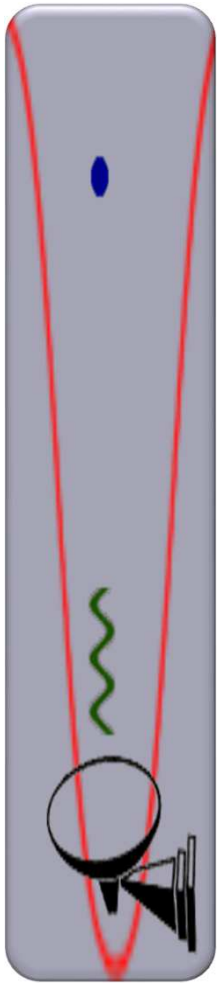
- Small objects may appear extremely bright on radar imagery. This is dependent on the geometric configuration of the object.
- The side of a building or a bridge, combined with reflection from the ground isan example of a corner reflector.

CORNER REFLECTORS

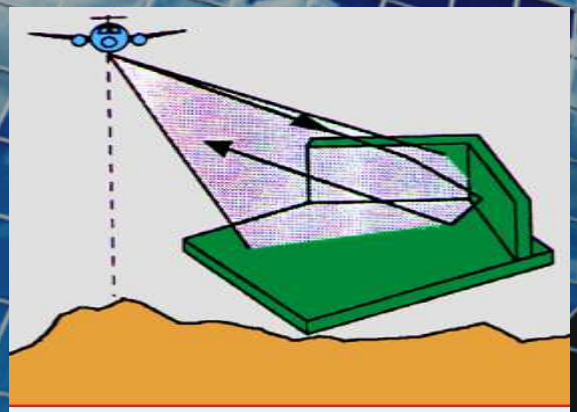
When two surfaces are at right angles and open to the radar, a dihedral corner reflector is formed. The return from a dihedral corner reflector is strong only when the reflecting surfaces are very nearly perpendicular to the illumination direction.



Dihedral

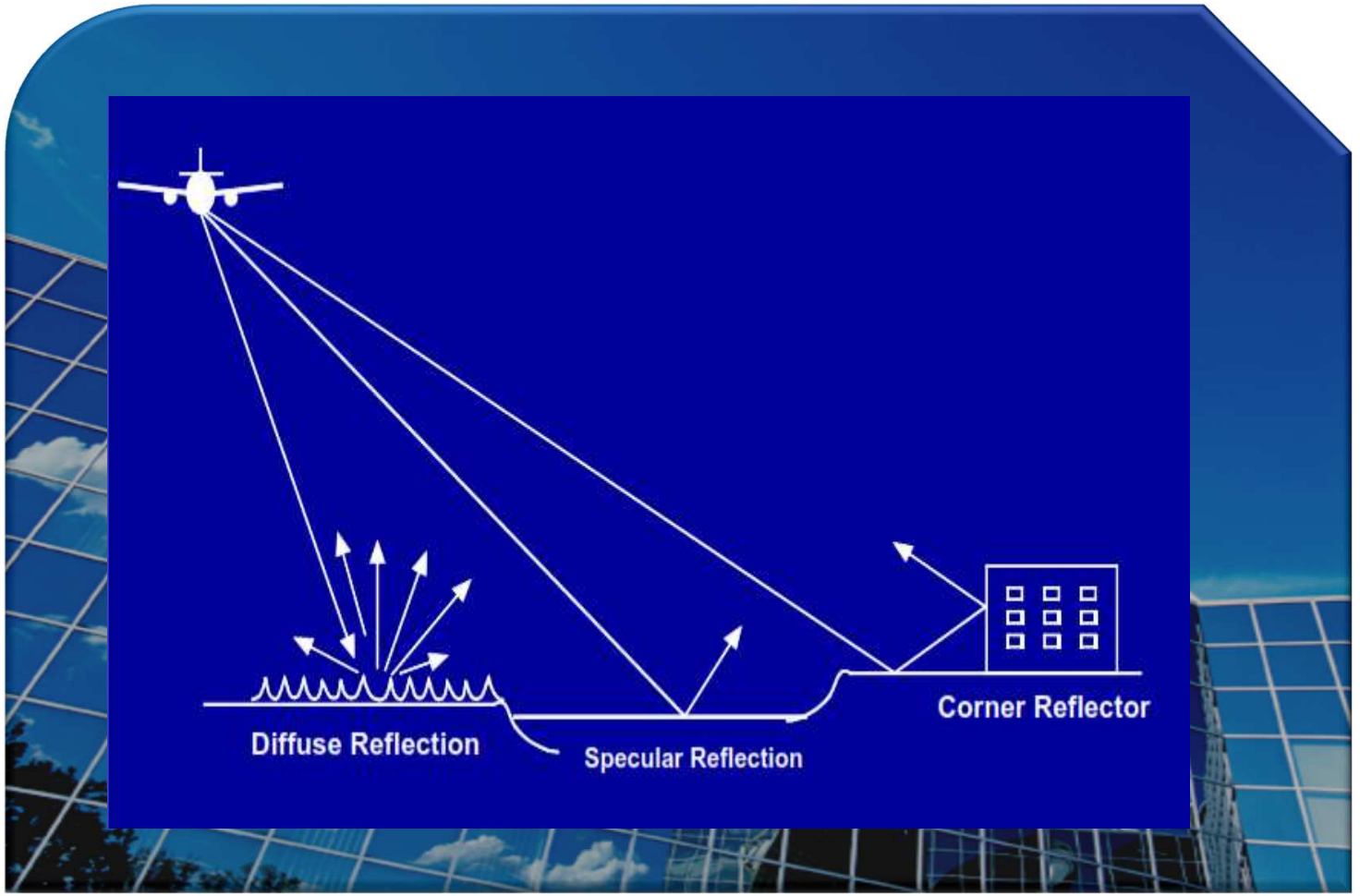


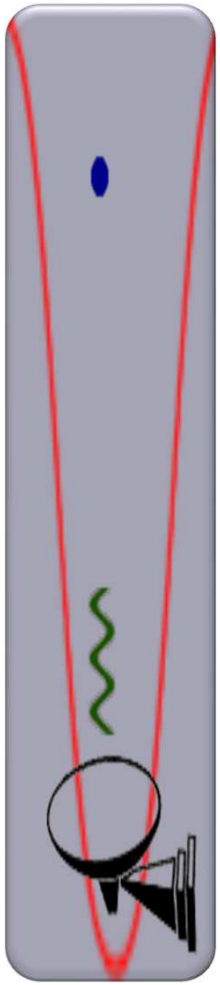
Strong reflections are caused by a trihedral corner reflector. These are formed by the intersection of three mutually perpendicular plane surfaces open to the Researchers often place corner reflectors at various ground locations to act as reference points on the radar imagery.



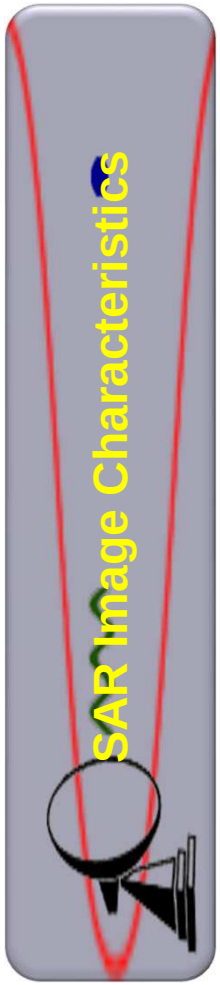
Trihedral

Diffuse and Specular Reflectance





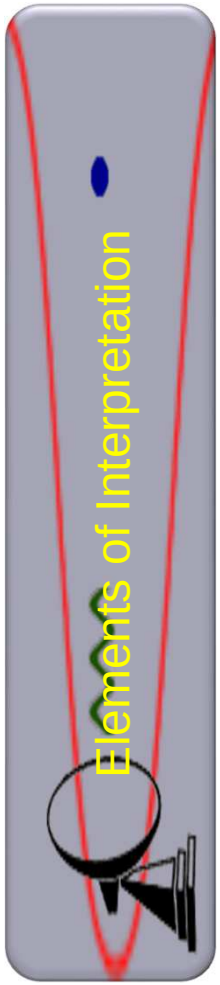
In general, only a pixel with a strong corner reflector does not exhibit speckle


SAR Image Characteristics


Elements of interpretation
Tone
Texture
SAR image artifacts
Ambiguities

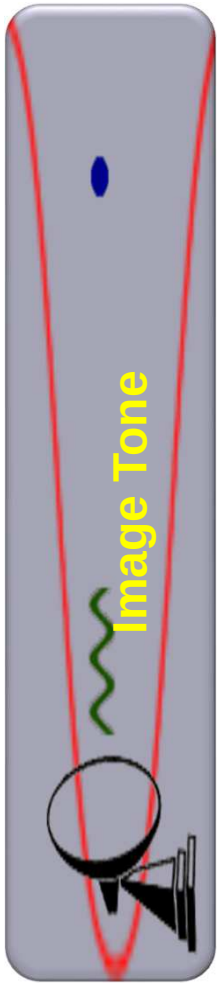
Image Brightness Variations and Interpretation

- Two major types of brightness variations observable in a radar image:
- variations in tone
- variations in texture
- Though uncommon, radar artifacts are a potential source of unwanted brightness variation as well
- Computers are used to supplement and/or extend our visual interpretation of these brightness variations



Interpretation Element		*Example of computer interpretation technique*
❖ tone	→	density slicing
❖ colour	→	multispectral classification
❖ texture	→	texture analysis
❖ pattern	→	spatial transforms / classification
❖ size	→	size feature classification
❖ shape	→	syntactic classification
❖ association	→	contextual classification

Source: Manual of Remote Sensing, 1983



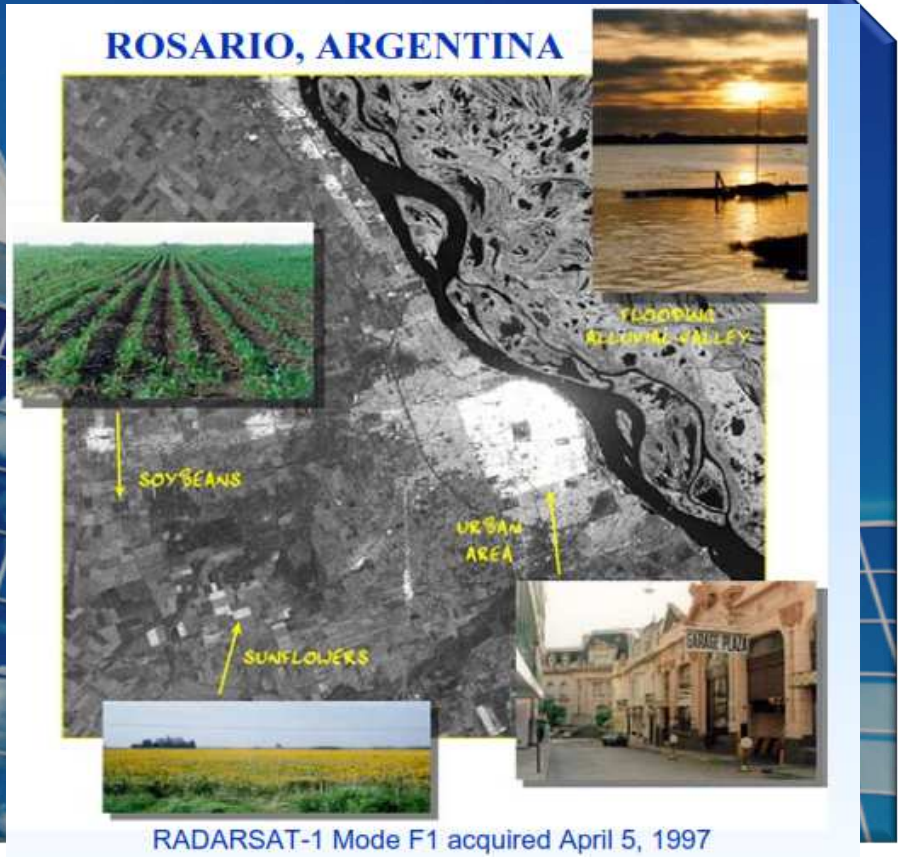
- Refers to each distinguishable grey level from black to white
- Proportional to strength of radar backscatter
- Relatively smooth targets like calm water appear as dark tones
- Diffuse targets like some vegetation appear as intermediate tones
- Man-made targets (buildings, ships) may produce bright tones, depending on their shape, orientation and/or constituent materials

Visual interpretation of single date image

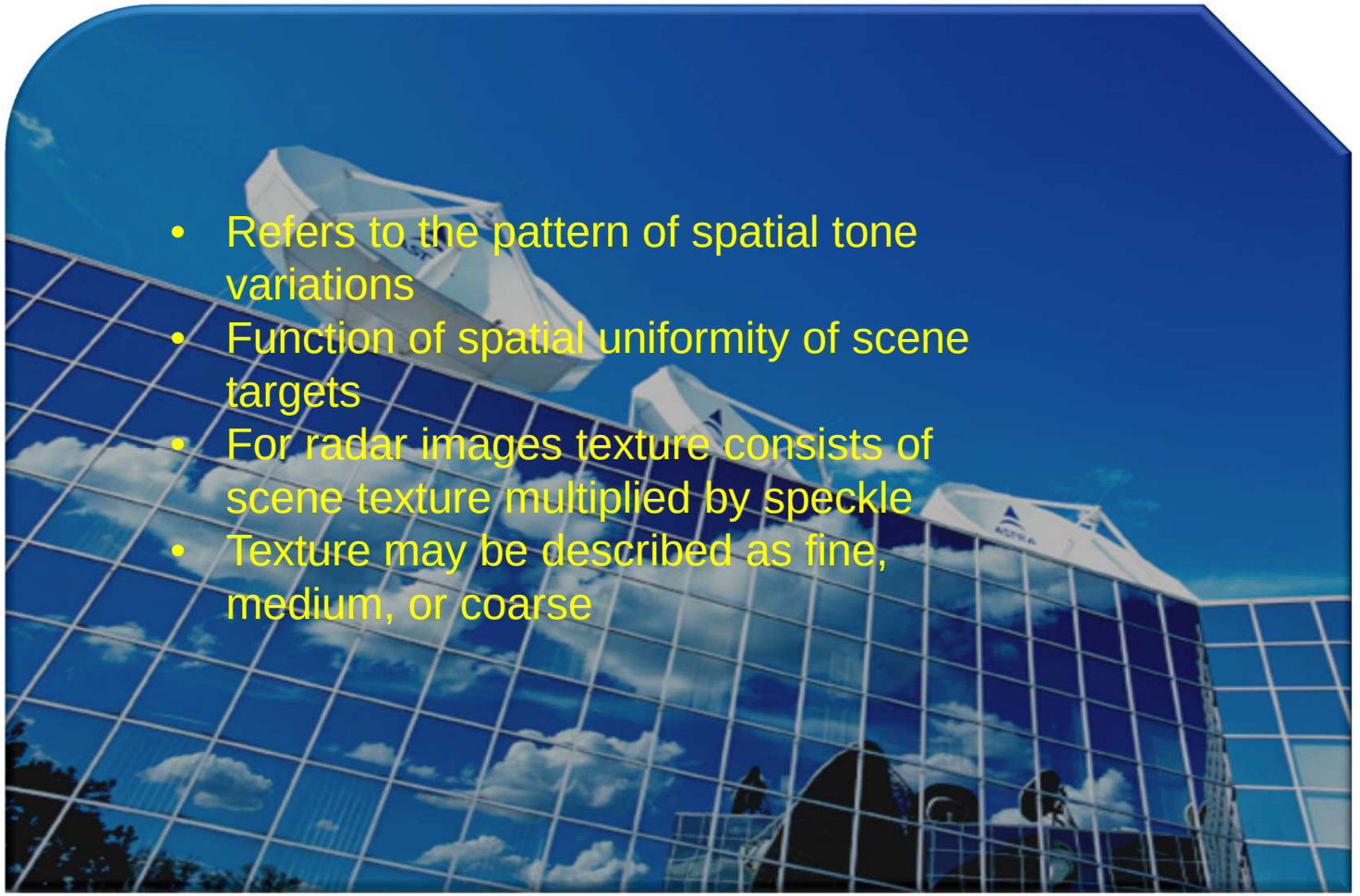
In the wetland complex,
- water, flooded vegetation, wetland associations, and upland vegetation

In the urban area,
- very bright returns, due to corner reflections which occur when the radar beam is orthogonal to the street direction
- variations in tone can also indicate differences in construction material and housing density

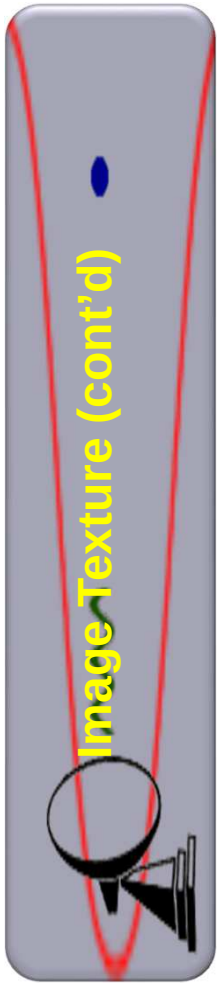
In the dryland agricultural areas
- dark tones -> bare, dry fields such as pasture or harvested crops
- intermediate tones -> forage and grain crops such as wheat or soybeans
- bright tones -> broad-leafed high biomass crops like canola.



RADARSAT-1 Mode F1 acquired April 5, 1997

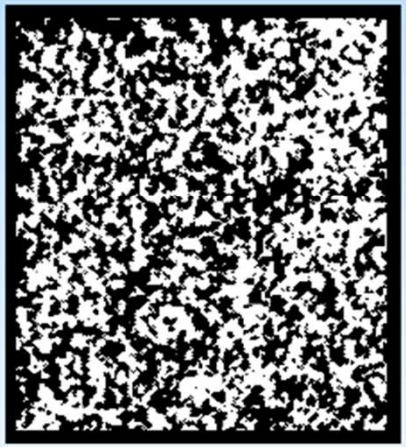


- Refers to the pattern of spatial tone variations
- Function of spatial uniformity of scene targets
- For radar images texture consists of scene texture multiplied by speckle
- Texture may be described as fine, medium, or coarse



Corn Field

Spatially Uniform Target
Fine Texture

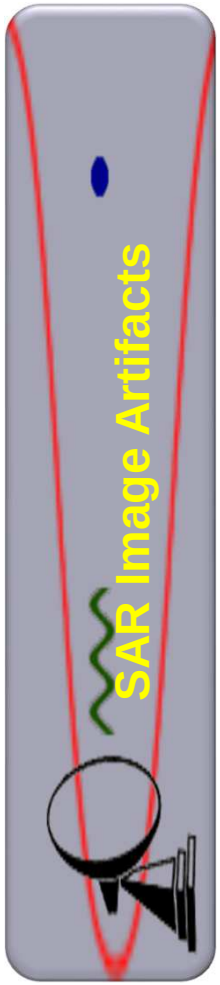


300 m

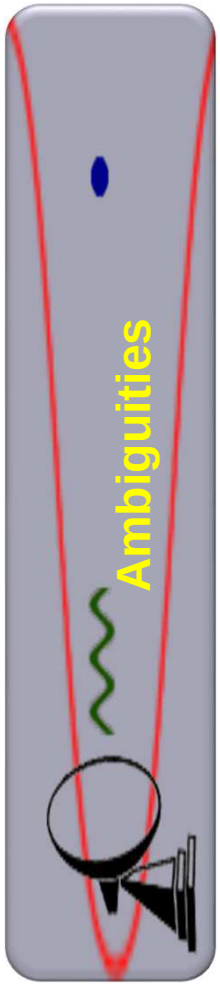
Forest

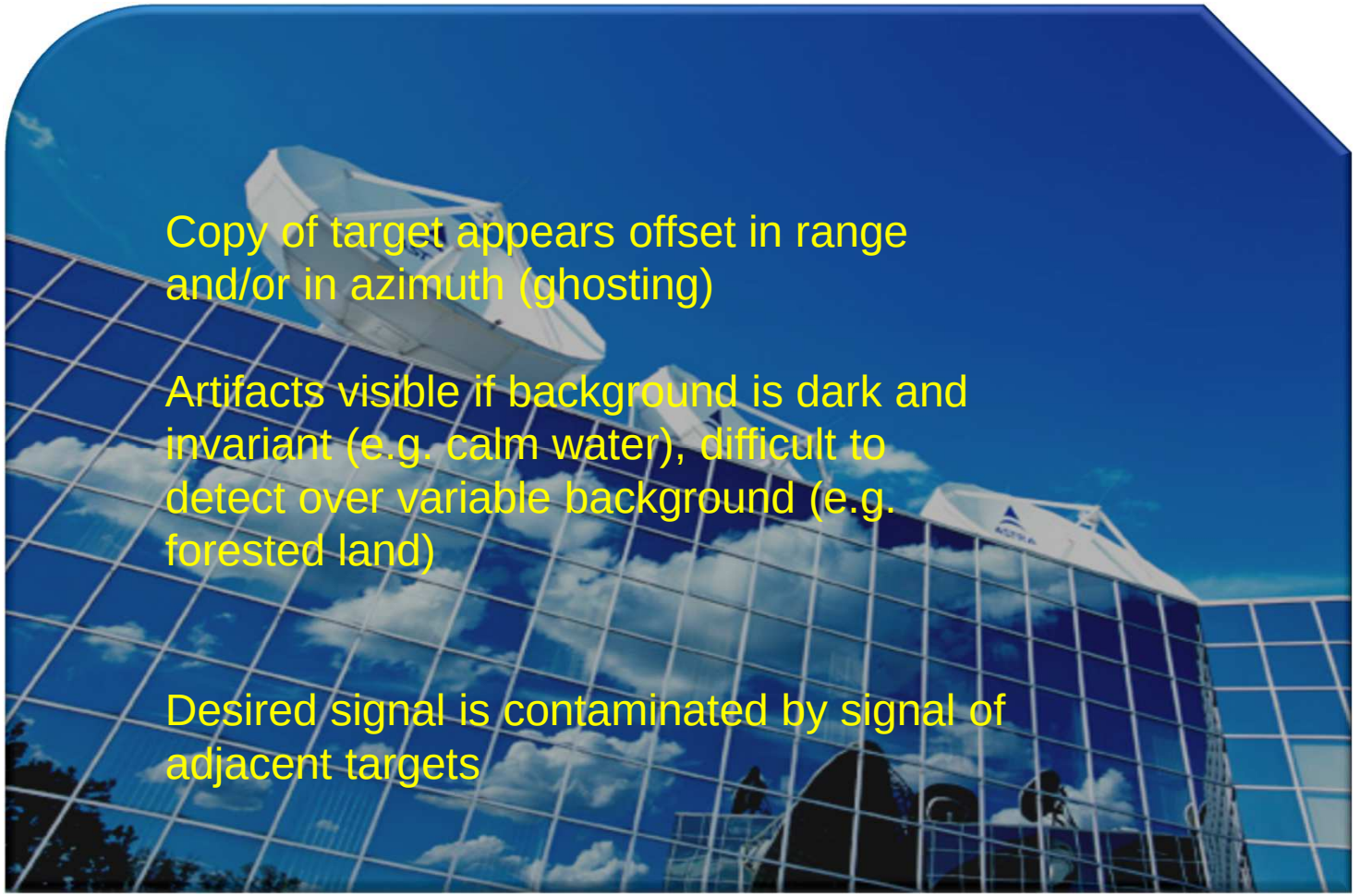
Spatially Non-Uniform Target
Coarse Texture

300 m



- SAR image artifacts can occur due to platform, sensor, and/or processing problems
  - **Ambiguities**
    - Azimuth Ambiguity
    - Range Ambiguity
    - Nadir Ambiguity
  - **Scalloping**
  - **Automatic Gain Control effects for RADARSAT-1**
- Image radiometrics & geometrics can be affected
- Sometimes reprocessing can improve
- Sometimes incorrigible



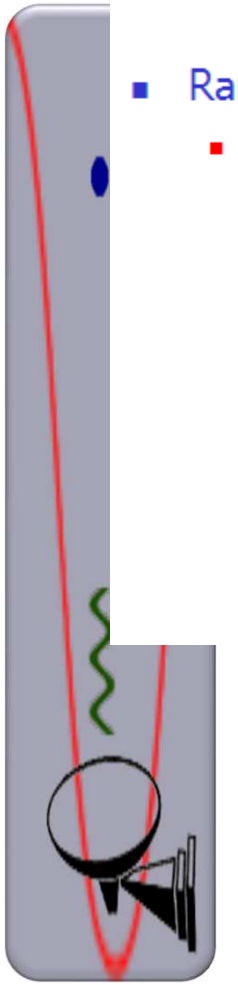


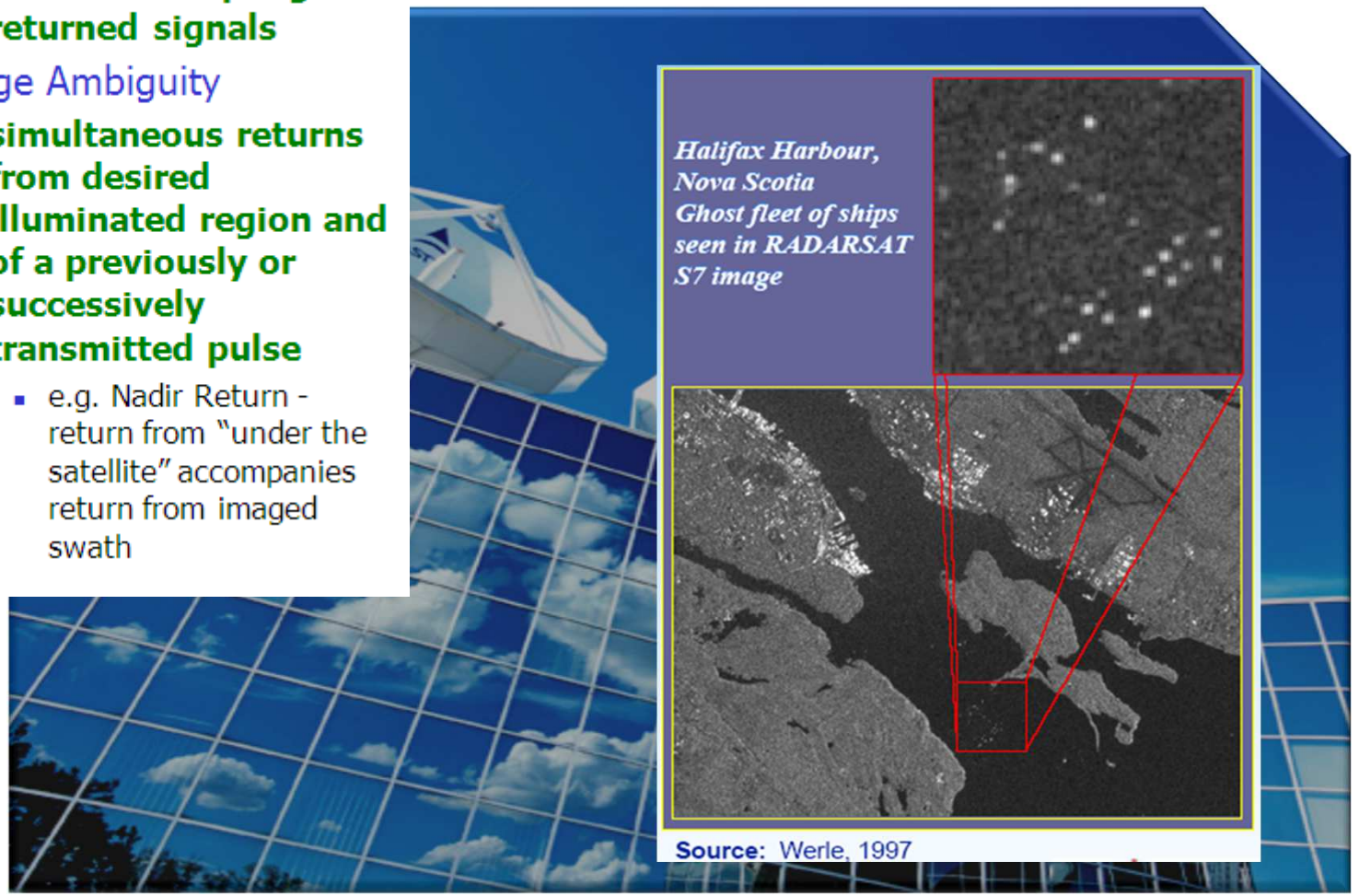
Copy of target appears offset in range and/or in azimuth (ghosting)

Artifacts visible if background is dark and invariant (e.g. calm water), difficult to detect over variable background (e.g. forested land)

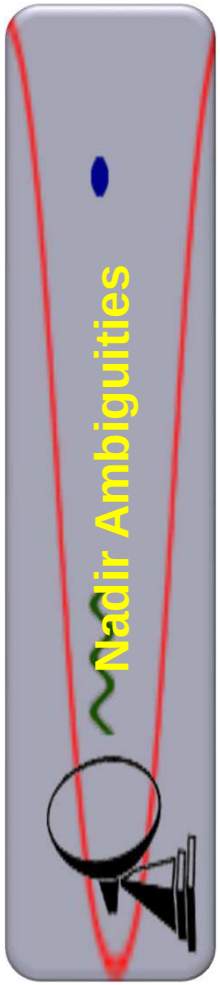
Desired signal is contaminated by signal of adjacent targets

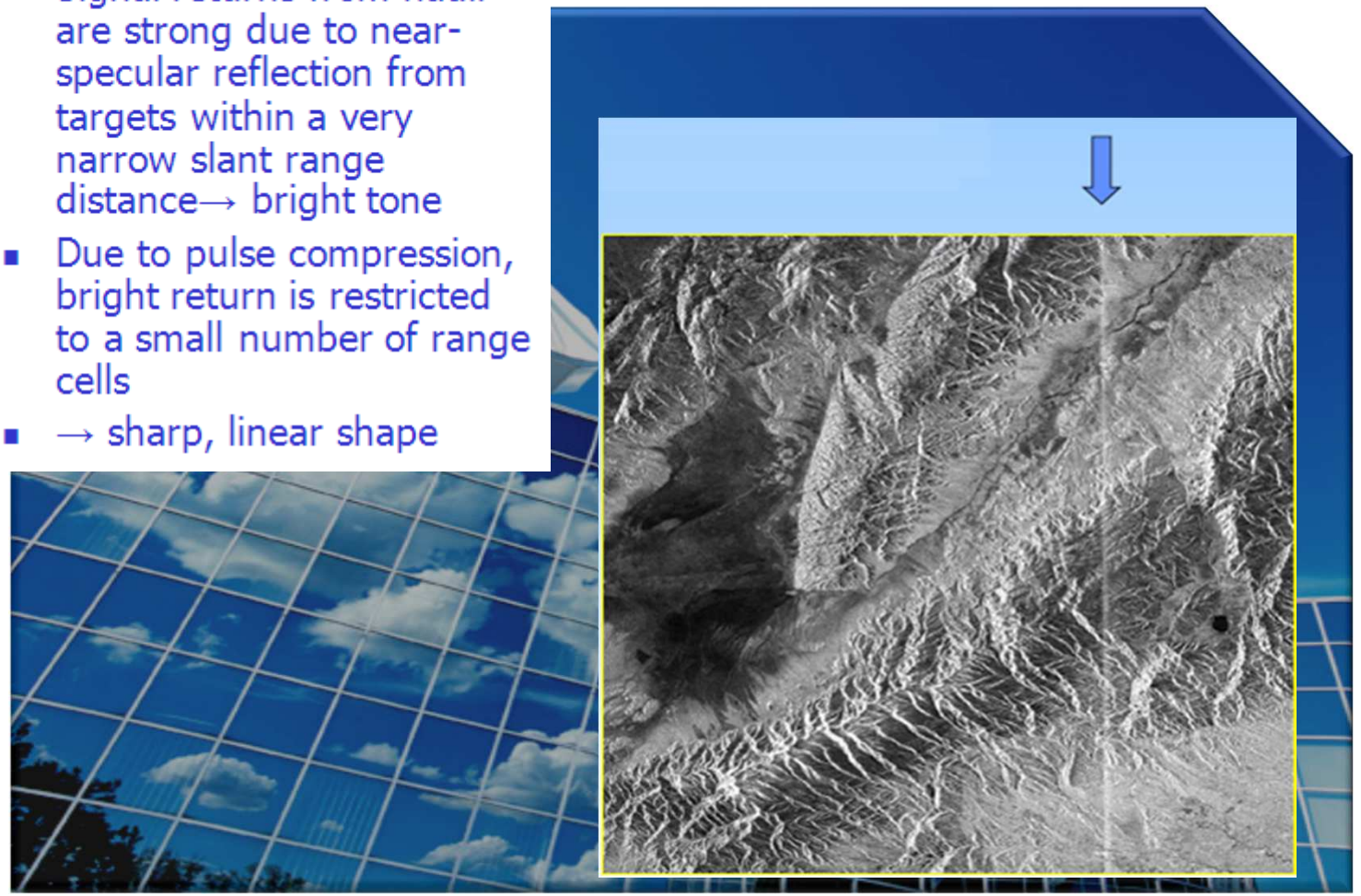
- Azimuth Ambiguity
  - **too slow sampling of returned signals**
- Range Ambiguity
  - **simultaneous returns from desired illuminated region and of a previously or successively transmitted pulse**
    - e.g. Nadir Return - return from "under the satellite" accompanies return from imaged swath





- These bright linear features appear at approximately constant range
- Signal returns from nadir are strong due to near-specular reflection from targets within a very narrow slant range distance→ bright tone
- Due to pulse compression, bright return is restricted to a small number of range cells
- → sharp, linear shape





RADARSAT-1 SAR BACKSCATER

- 10 * LOG10 (($n2_radarsat_image ** 2) / 5695770.5) + 10 * LOG10 (0.726814465)