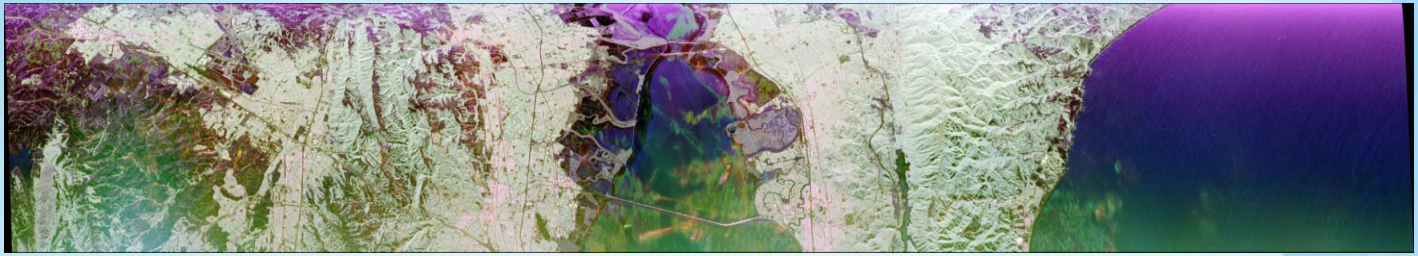

# Measuring and Enhancing the Visual Content of Polarimetric Synthetic Aperture Radar Decompositions

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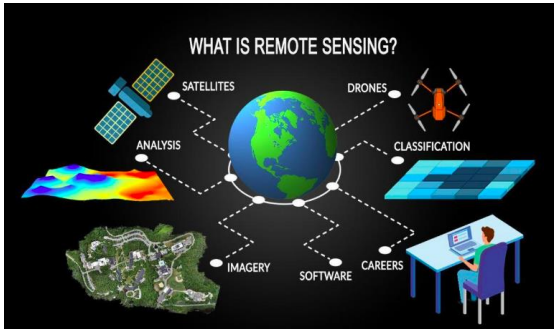
# Content

- *Introduction*
- *Methodology*
- *Results*
- *Conclusion*

# Introduction

## What is the SAR image?

- Image which obteined by remote sensing;
- It's the result of the scene in several combinations of transmitting and receiving polarization of the electromagnetic waves;
- Formed by 2D-array complex of values;



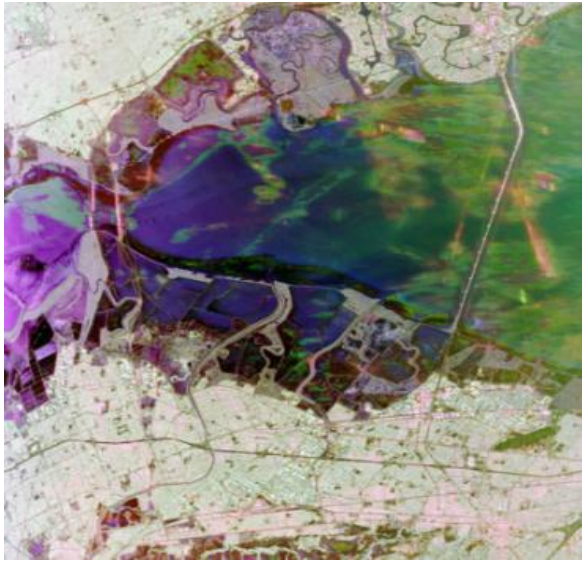

https://gisgeography.com/remote-sensing-earth-observation-guide/

# Introduction

## What is the SAR image?

- The observation in each pixel of a fully polarimetric image is a 2 × 2 complex-valued, that can be represented by the scattering matrix

$$\boldsymbol{S}' = \begin{pmatrix} S_{\mathrm{HH}} & S_{\mathrm{HV}} \\ S_{\mathrm{VH}} & S_{\mathrm{VV}} \end{pmatrix}$$



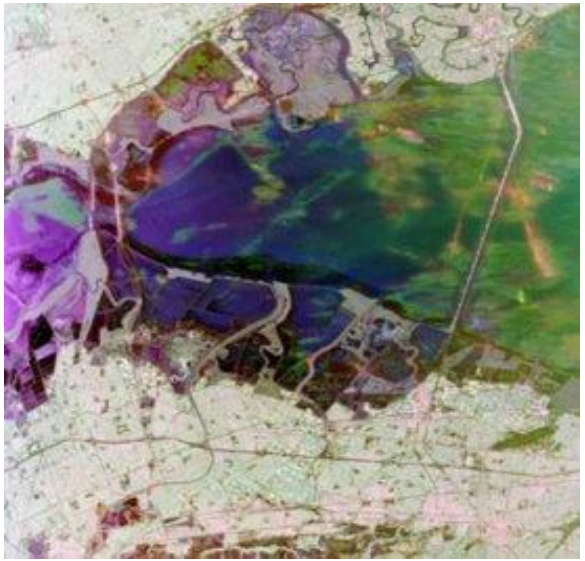
http://uavsar.jpl.nasa.gov/cgi-bin/product.pl?jobName=Hayw rd_05523_21060_006_211020_L090_CX_01

# Introduction

## What is the SAR image?

- Under the reciprocity principle, HV=VH, so the information in the scattering matrix can be encoded in the scattering vector, as follow

$$\boldsymbol{S} = \begin{pmatrix} S_{\mathrm{HH}} \\ S_{\mathrm{HV}} \\ S_{\mathrm{VV}} \end{pmatrix}$$



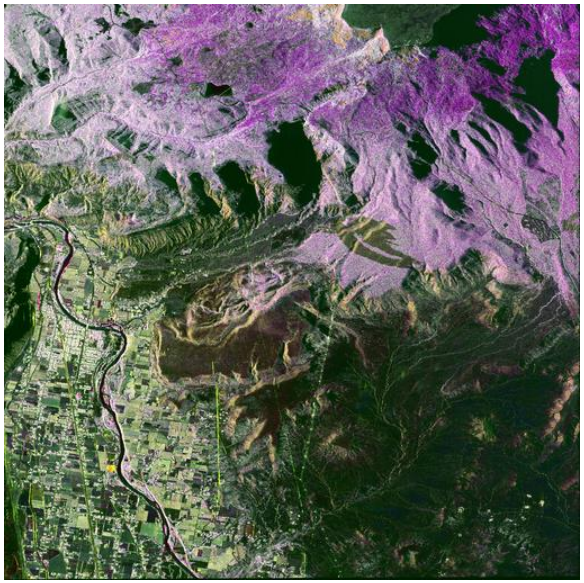
# Introduction

## Decomposition process

- The decomposition theorems allow us to deal with several visualization types, such as:
  - Pauli decomposition;
  - Krogager decomposition;
  - Hyunem decomposition;

Pauli components

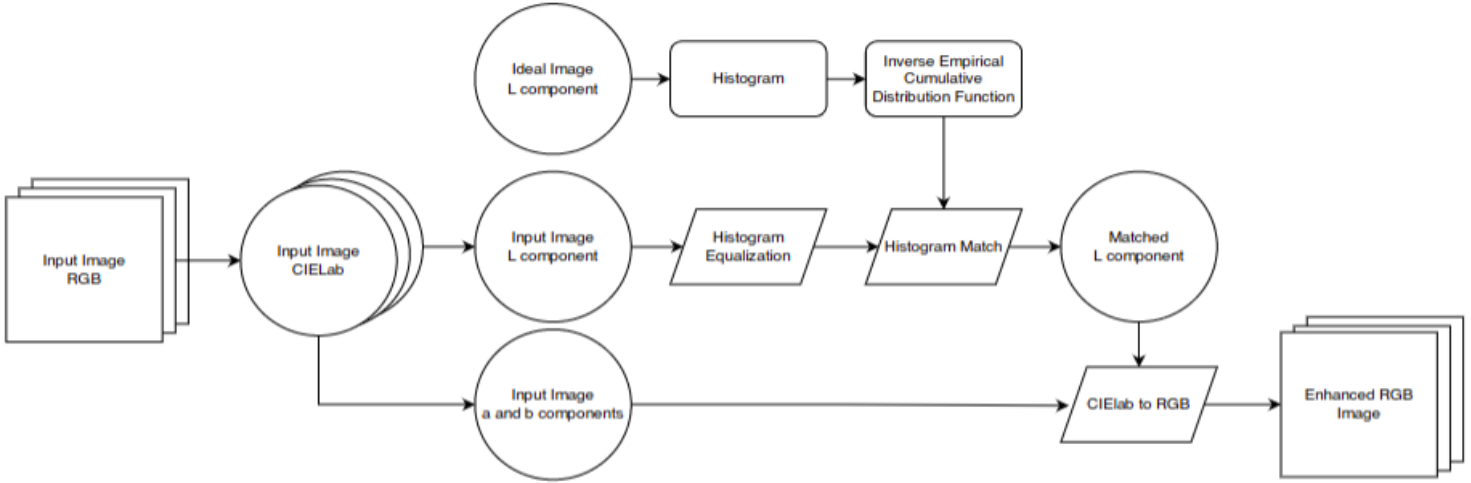
$$a = \frac{S_{hh} + S_{vv}}{\sqrt{2}}, b = \frac{S_{hh} - S_{vv}}{\sqrt{2}}, c = \sqrt{2}S_{hv}$$



Visualization in pauli decomposition

# Methodology

## Matching histogram




$$\boldsymbol{F}^{-1}({}_{e}H_{L_O}, H_{L_I})$$

# Methodology

## Metric

Hellinger distance

$$H(p,q) = \frac{1}{2}\sqrt{\sum_{j=1}^{k}\left(\sqrt{p_j} - \sqrt{q_j}\right)^2}$$

# Results

Original Pauli Decomposition

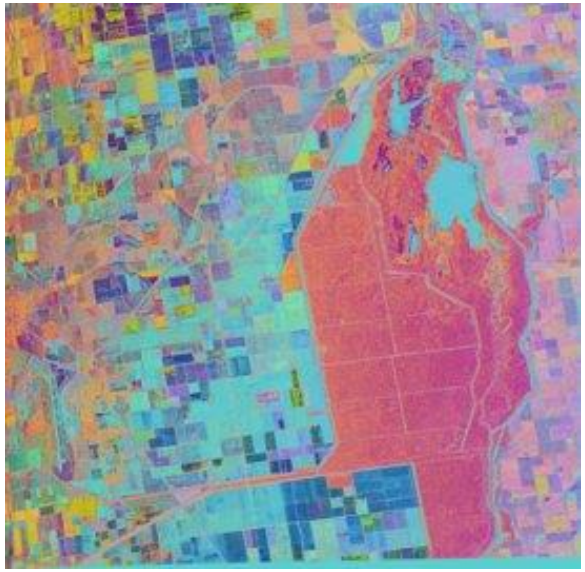
a)

Pauli Decomposition improved by Equalization method

b) H(Ideal, Equalized) = 0.186

# Resuts

Pauli Decomposition improved by Decorrelation method



c) H(Ideal,Decoralation) = 0.299

Pauli Decomposition improved by Matching histogram method

d) H(Ideal, Improved) = 0.330

# Conclusion

- The presented technique improves the image, preserving the properties;
- Improved image by matching histogram is more realistic than others;
- The three first have crisp and highly saturated colors;
- The c) produces colors which are not interpretable in terms of a Pauli decomposition;

**Future works**

- Object and region classification;