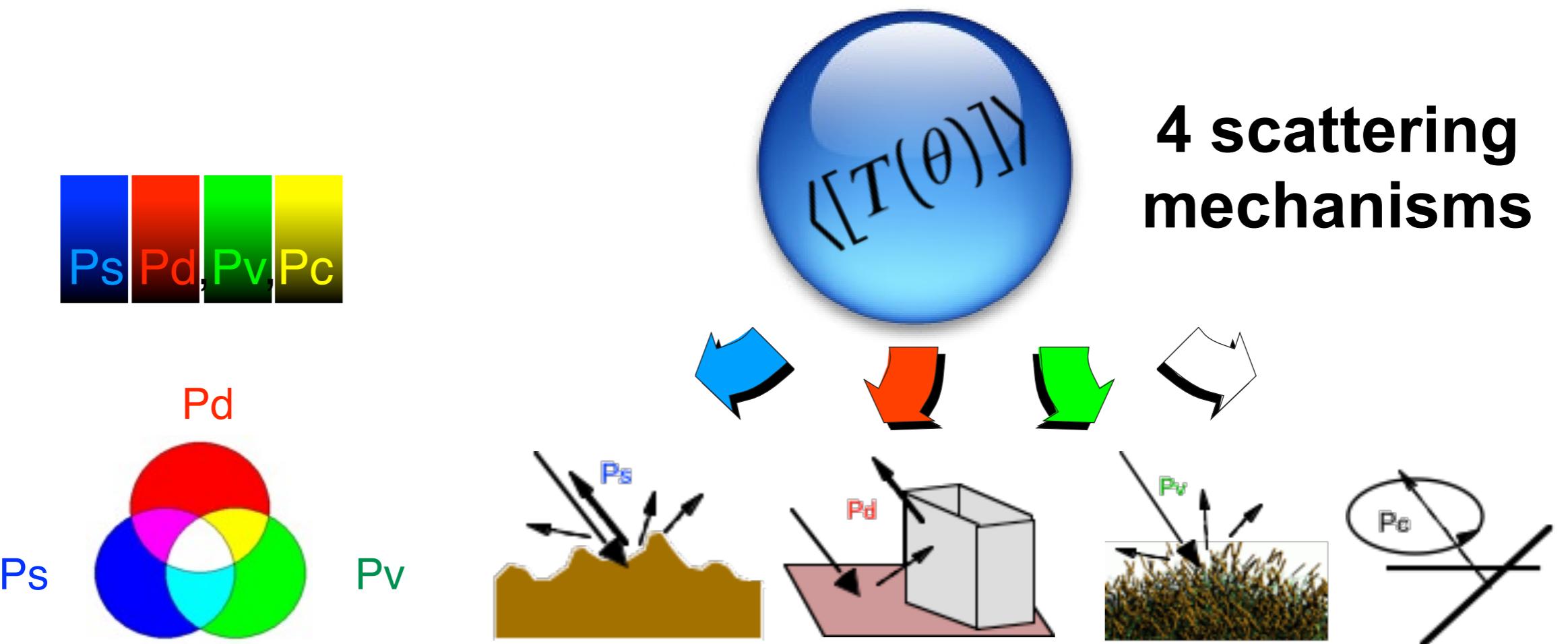


Fully polarimetric SAR data utilization



Niigata University

Yoshio Yamaguchi

ALOS-2

What is important ?



- Specific applications

- Environmental change

- Disaster monitoring

- land slide

- earthquake

- Agricultural applications

- crop production

- Civil engineering

- mapping

- Continuation of
ALOS-PALSAR
Polarimetric data

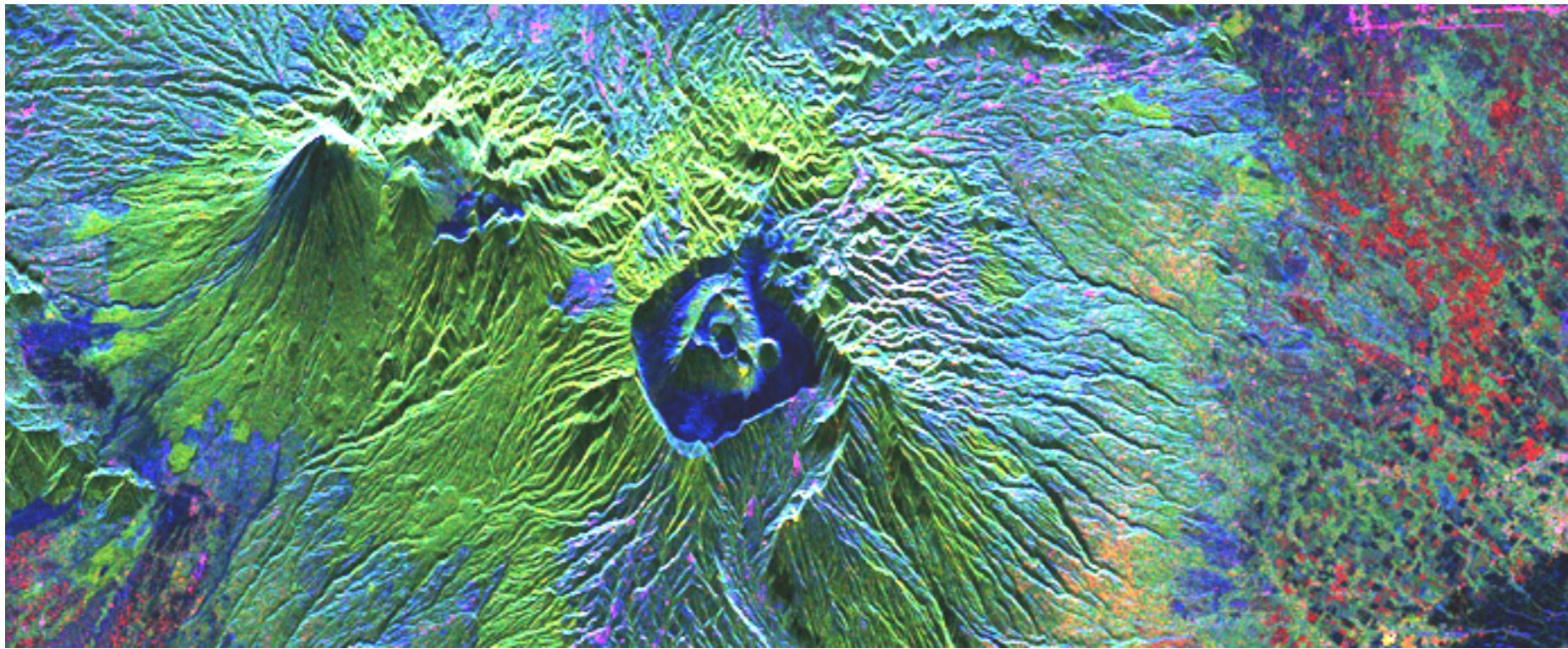
- Research
Education

- Provide images
Easy to understand
for everybody

At a glance! Example of 4-comp. decomposition

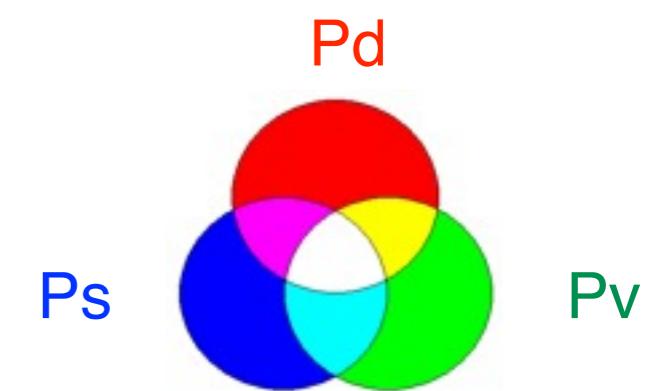


Google Earth Optical Image



ALOS-PALSAR Quad Pol Image

Ps: surface scattering
Pd: double bounce
Pv: volume scattering

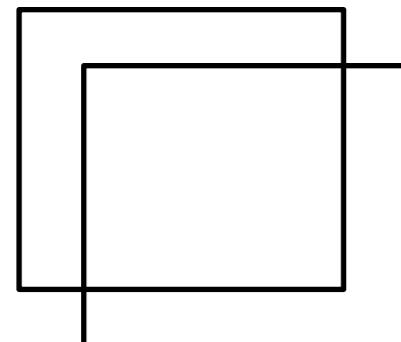


POLSAR image analyses

Scattering matrix
= Quad-Pol. data

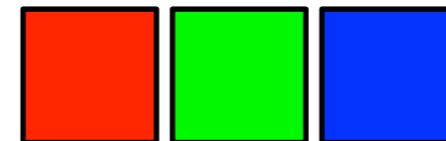


<Average>

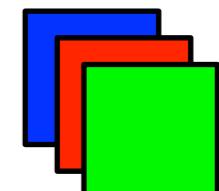


Covariance matrix
Coherency matrix

HV Basis



HH, 2HV, VV



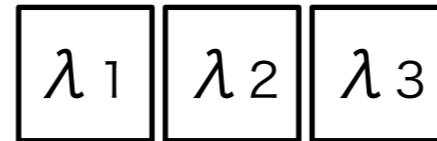
Pauli Basis



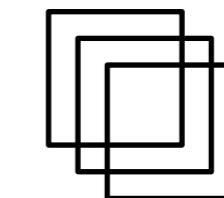
HH-VV, 2HV, HH+VV

Color-Composite

Eigenvalue



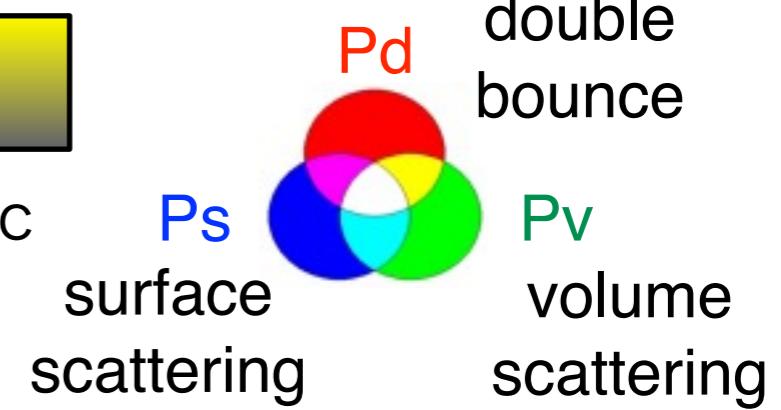
Entropy, Alpha-angle, Anisotropy



Scattering Power Decomposition



Pd, Pv, Ps, Pc



Pd
double
bounce

Ps
surface
scattering

Pv
volume
scattering

General 4-component scattering power decomposition with Unitary transformation

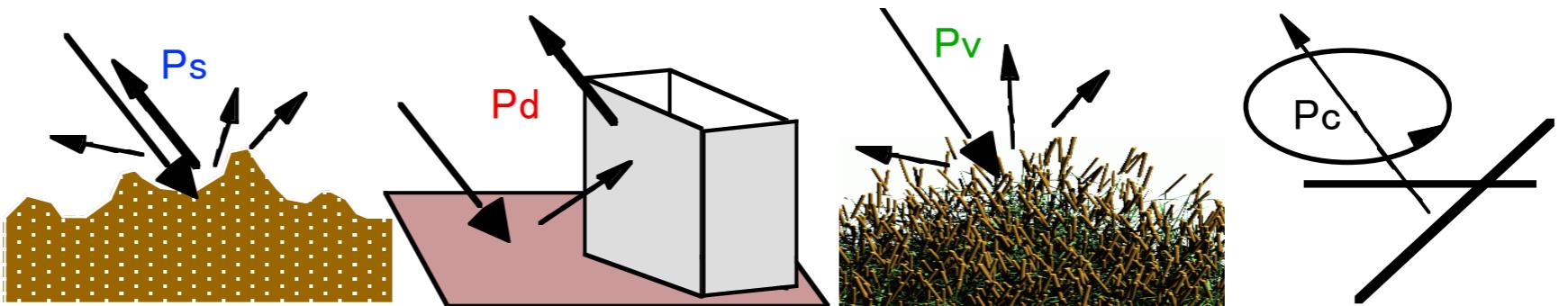
G. Singh, Y. Yamaguchi, et al, "Polarimetric SAR target decomposition with unitary transformation," 2nd Int'l POLSAR Workshop in Niigata 2011



unitary
transformation

with extended volume
scattering model

$$\langle [T(\theta)] \rangle = f_s \langle [T] \rangle_{surface} + f_d \langle [T] \rangle_{double} + f_v \langle [T] \rangle_{vol} + f_c \langle [T] \rangle_{helix}$$



dipole

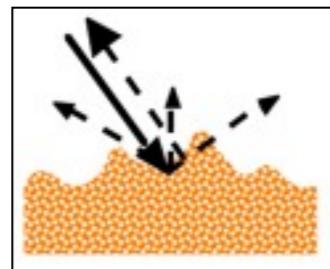
$$\langle [T] \rangle_{vol}^{hv} = \frac{1}{4} \begin{bmatrix} 2 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \text{ etc}$$

dihedral

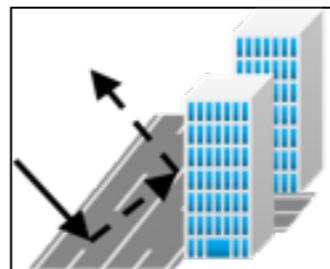
$$\frac{1}{15} \begin{bmatrix} 0 & 0 & 0 \\ 0 & 7 & 0 \\ 0 & 0 & 8 \end{bmatrix}$$

- all polarimetric parameters are accounted for the newly developed decomposition (**G4U**)

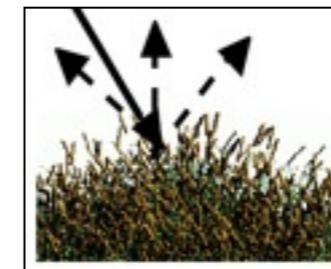
COLOR Code for Decomposed Image



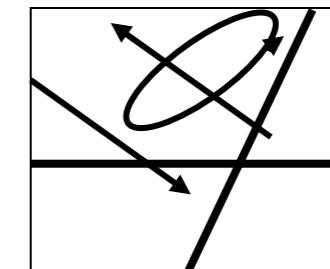
Surface(**Ps**)



Double bounce(**Pd**)



Volume(**Pv**)



Helix(**Pc**)



+



+



+



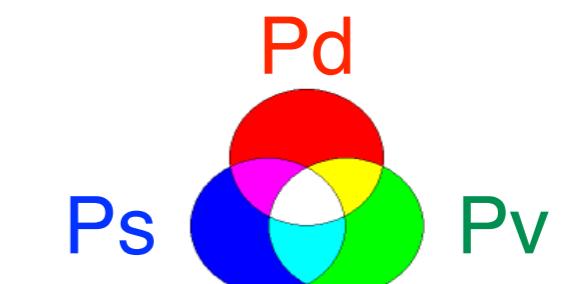
+

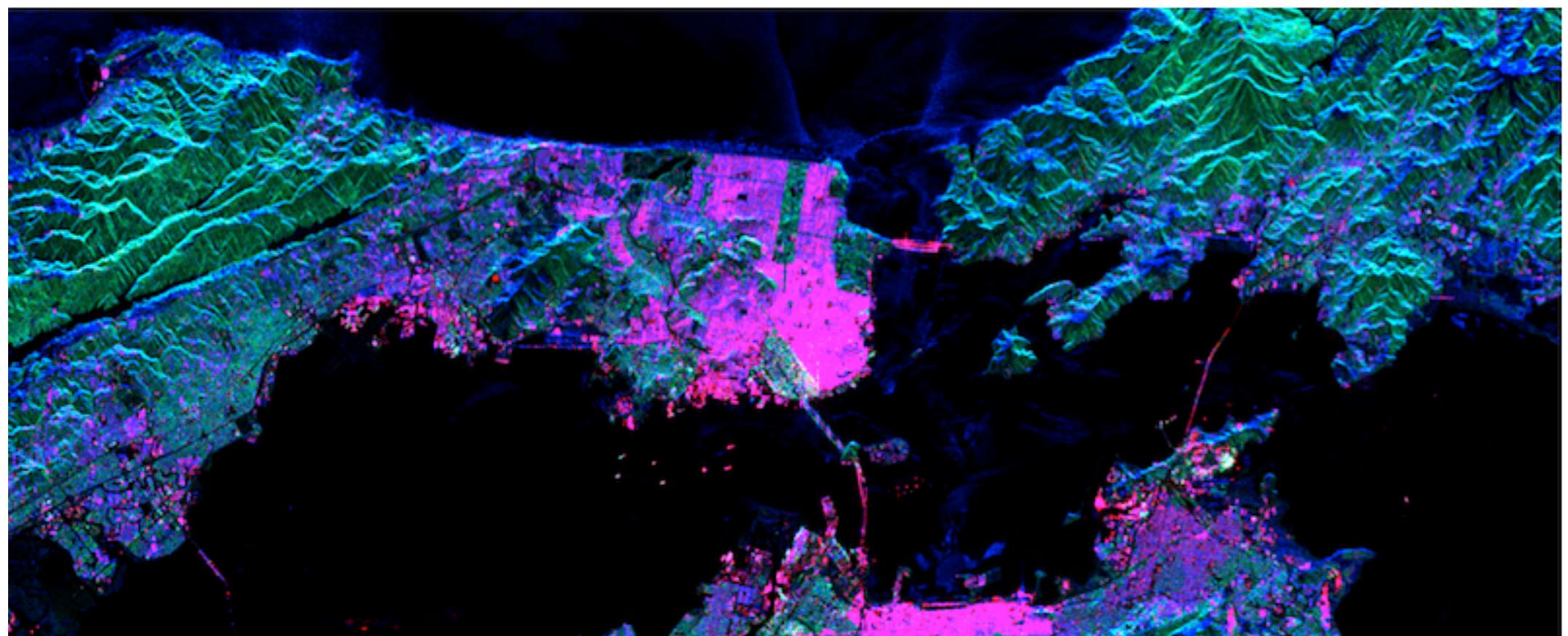
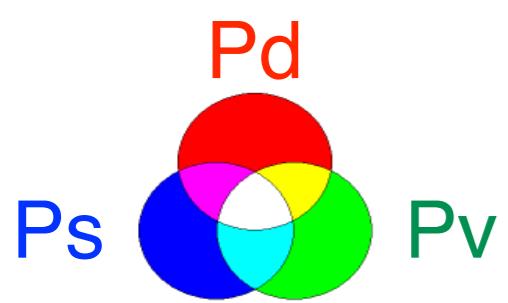
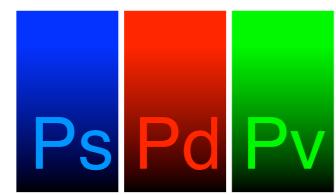
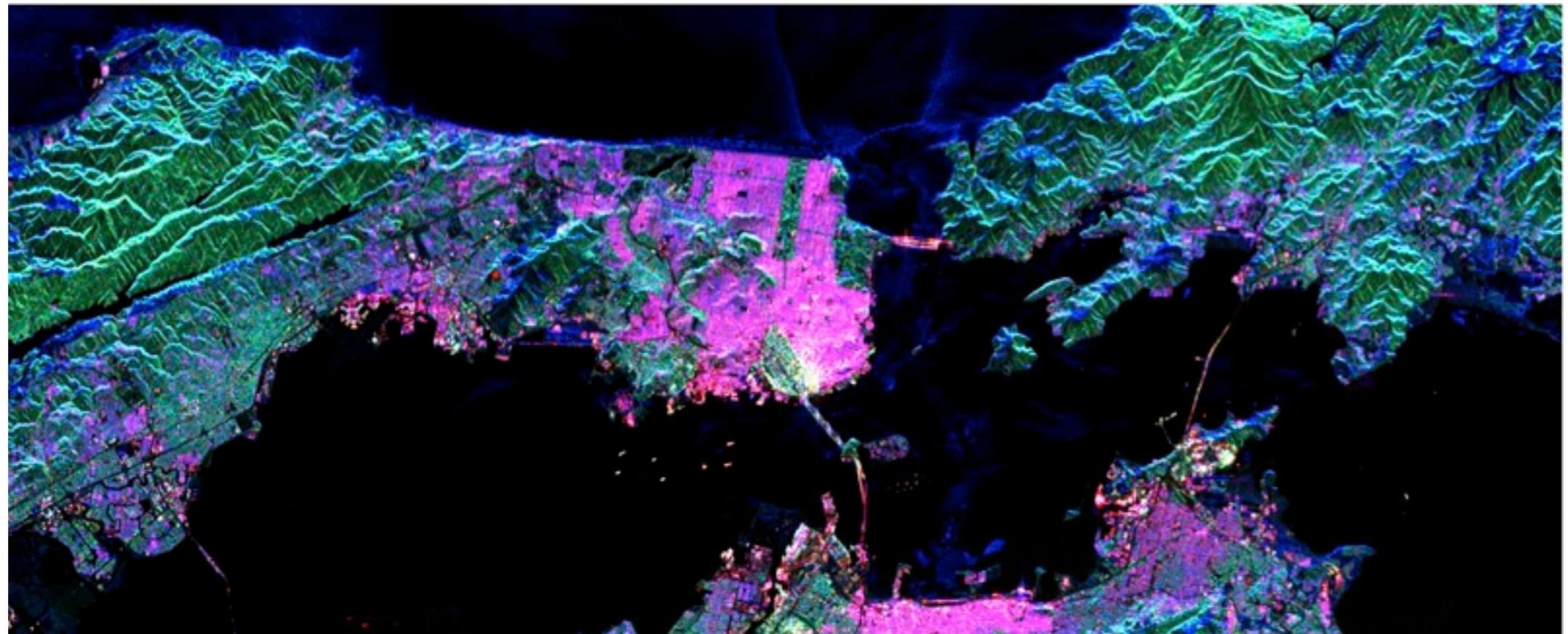
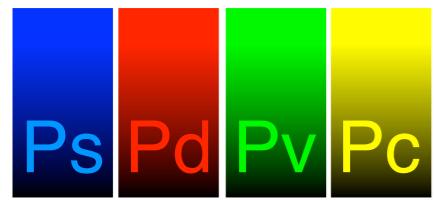


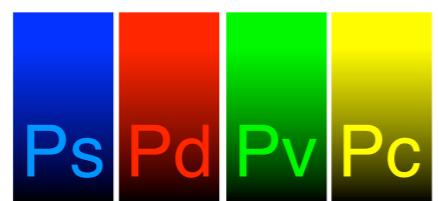
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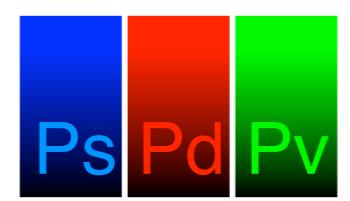
=



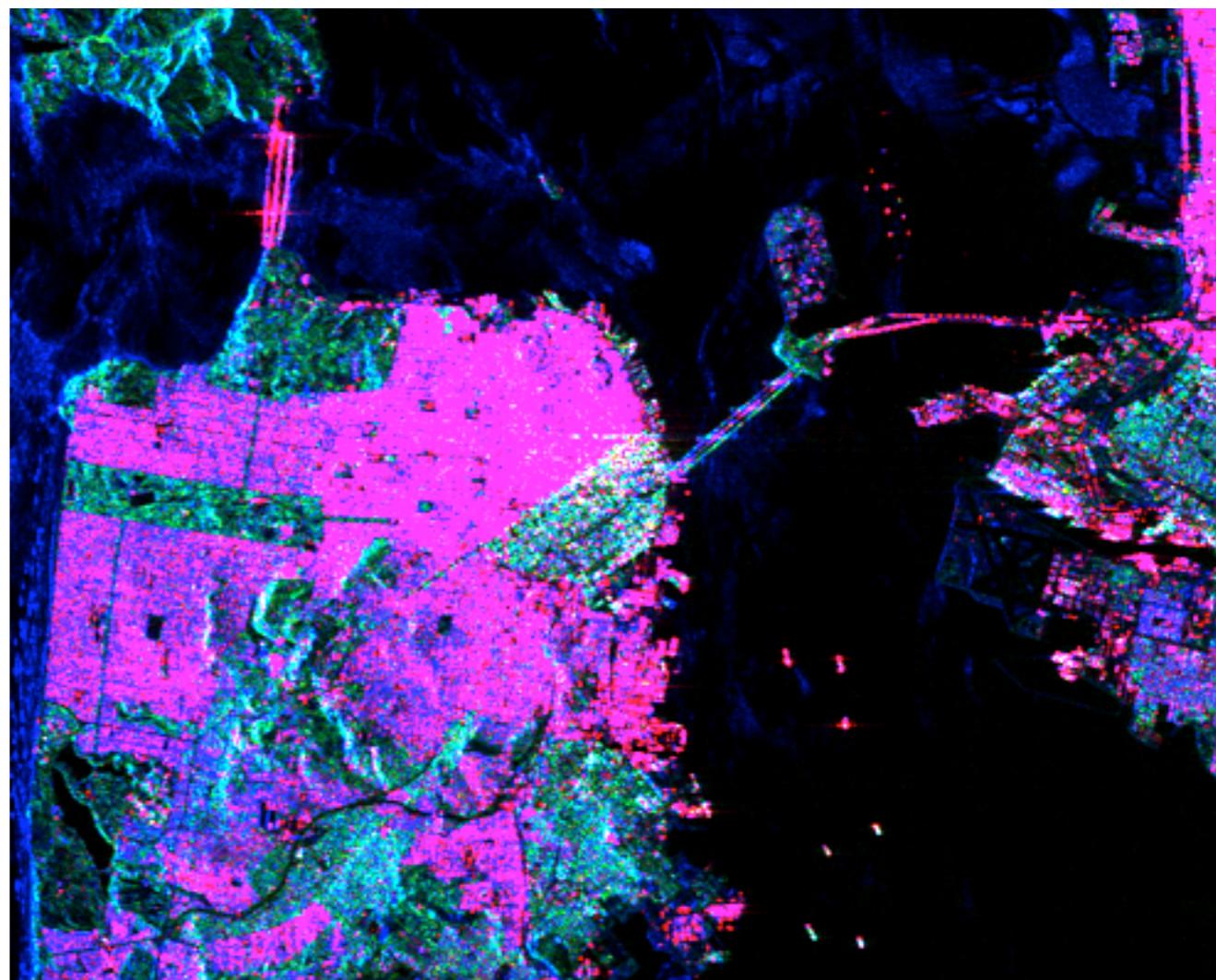
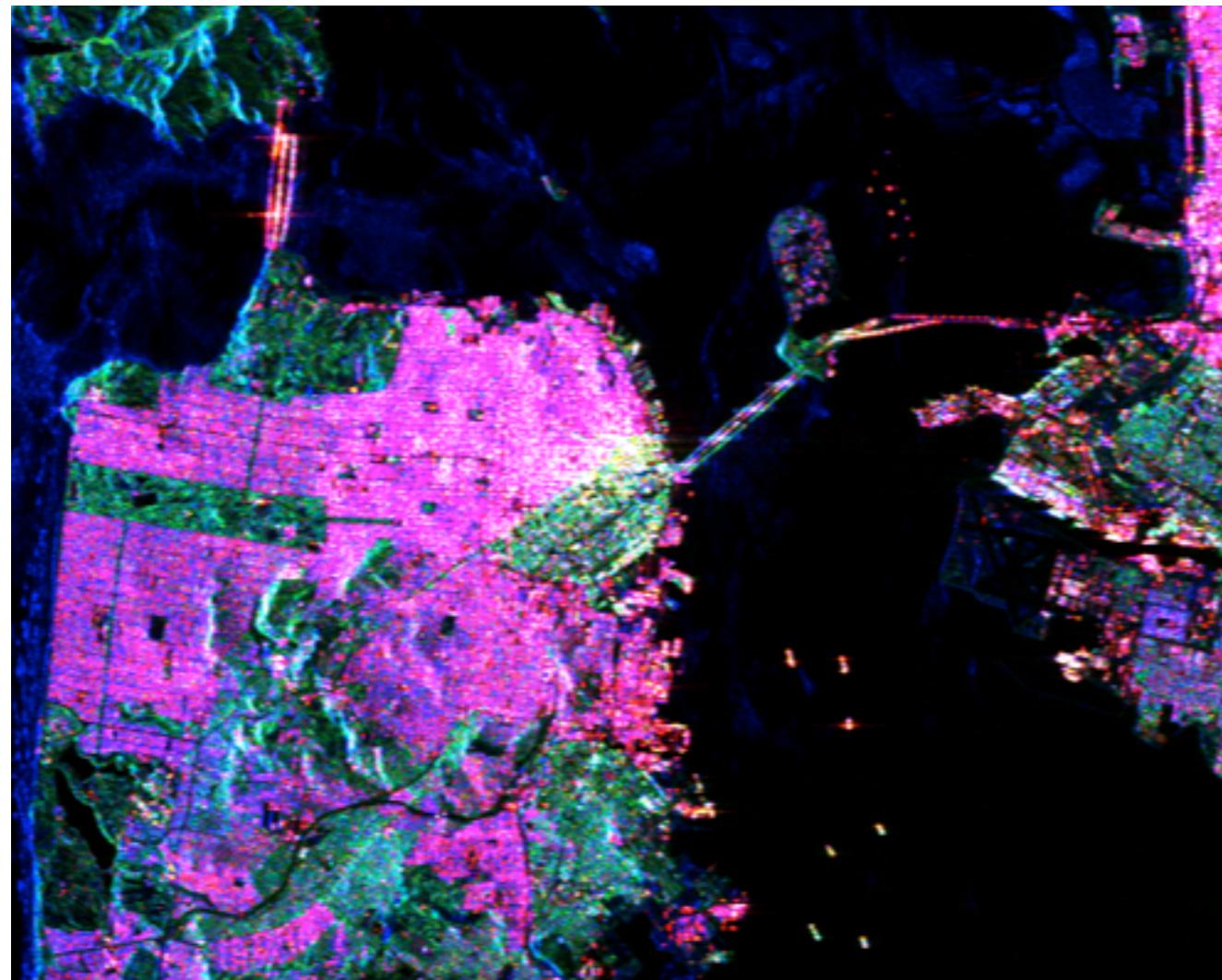
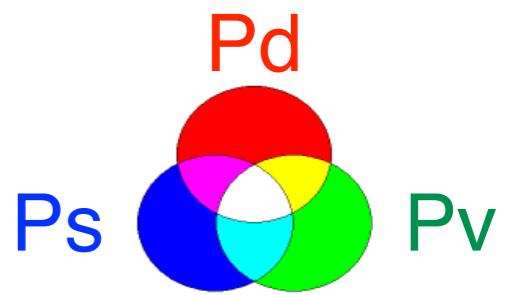


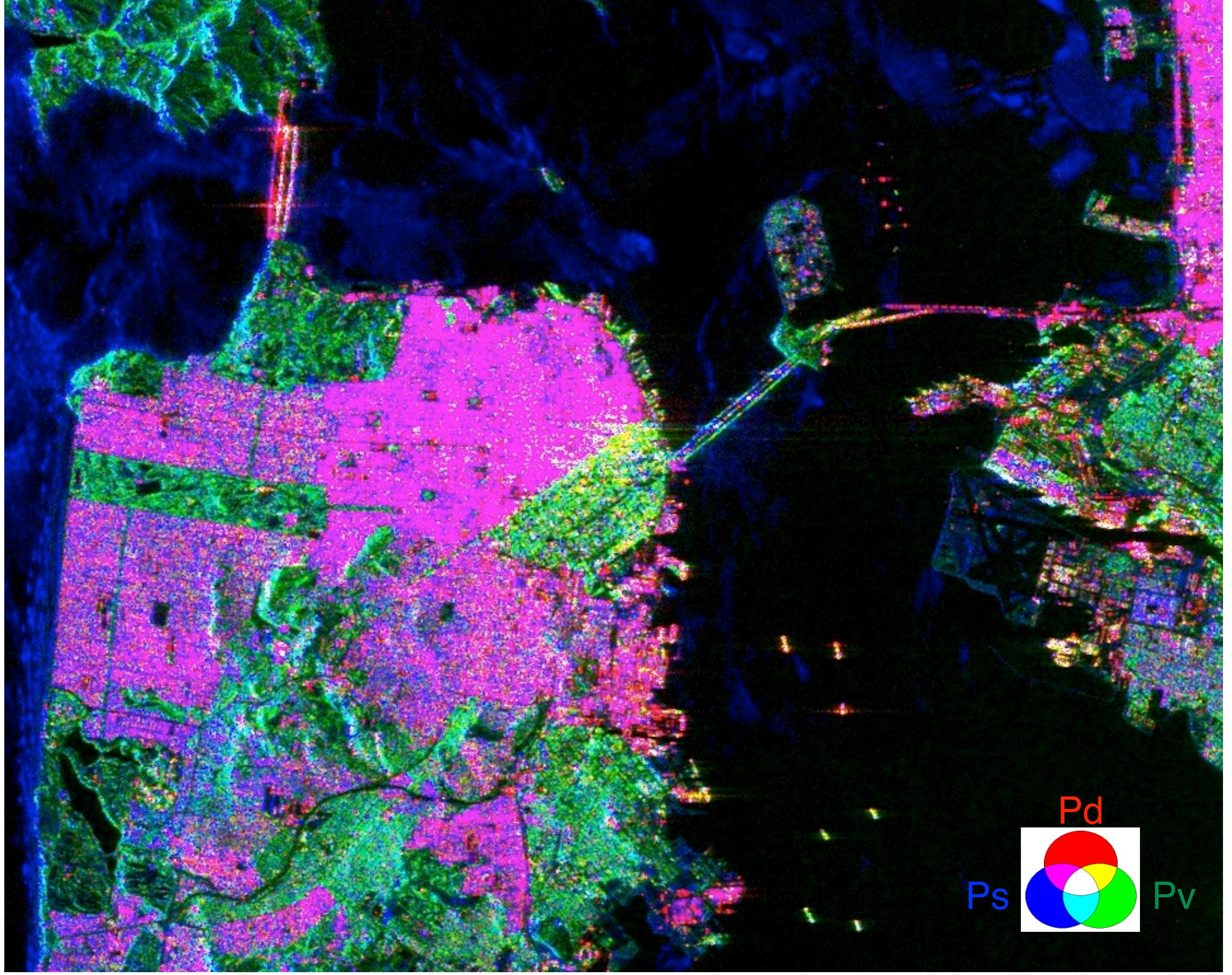


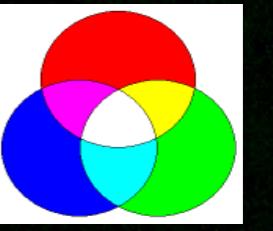
G4U-4C (Pd,Pv,Ps,Pc)

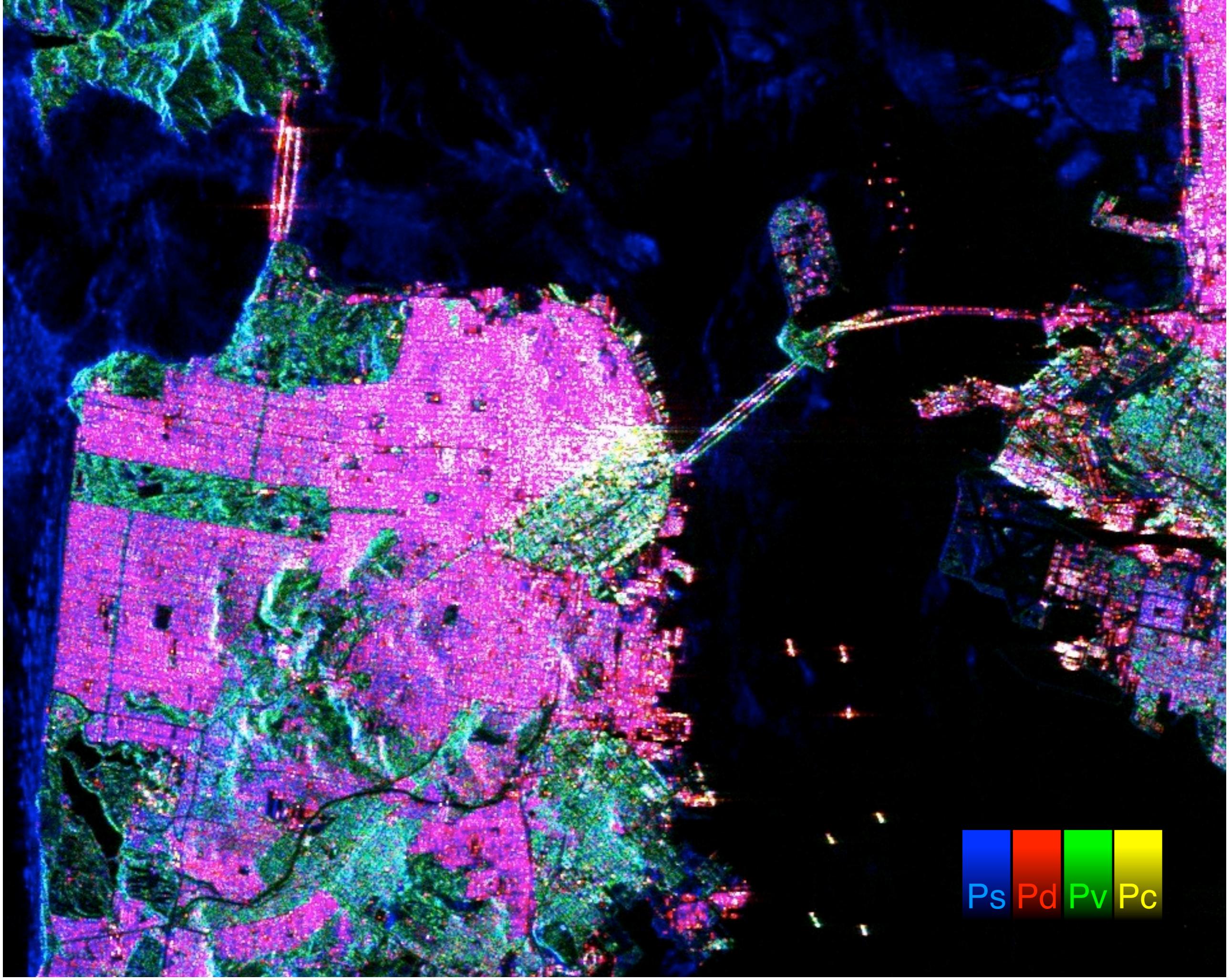


G4U-3C (Pd,Pv,Ps)





Pd
Ps  Pv

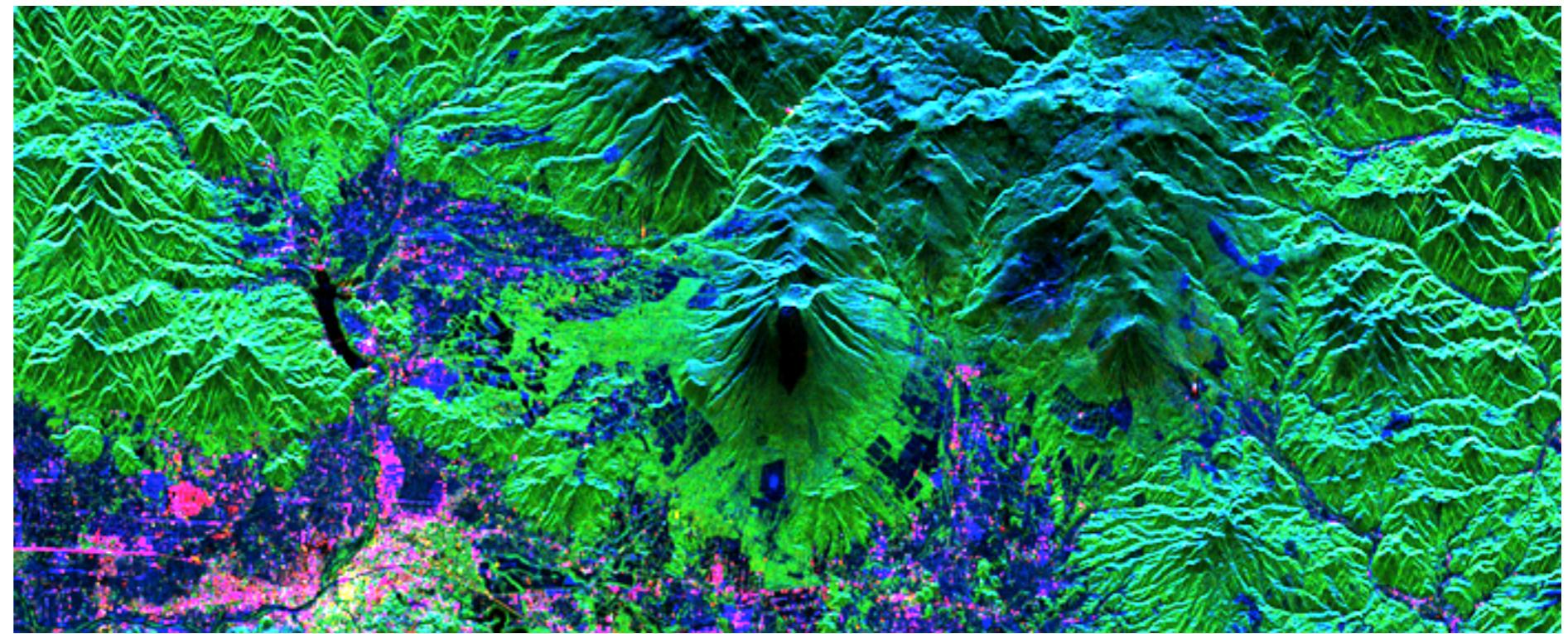


Ps Pd Pv Pc

Mt. Iwate
Morioka
Japan

39.747N
140.976E

ALPSRP062500790-1.1A



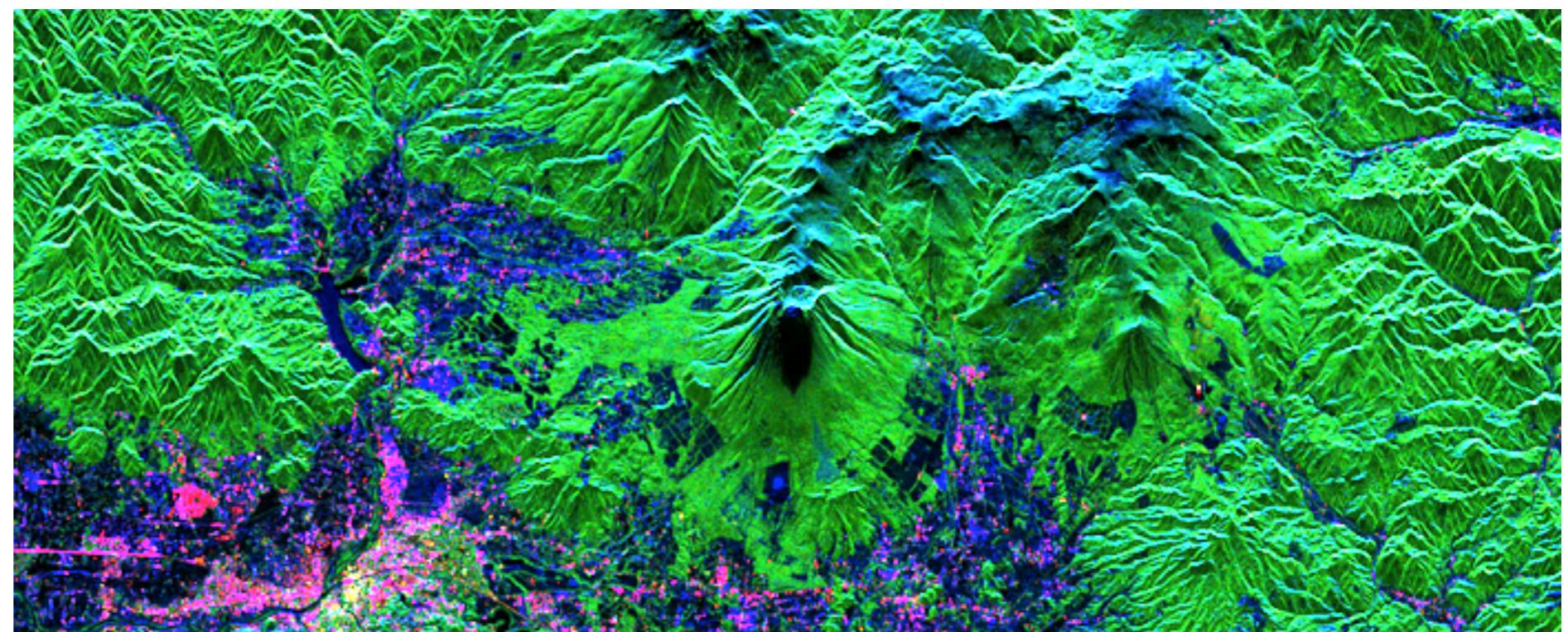
2007/3/28

N

ALPSRP069210790-1.1A

©JAXA, METI

Scattering power
Decomposition



2007/5/13

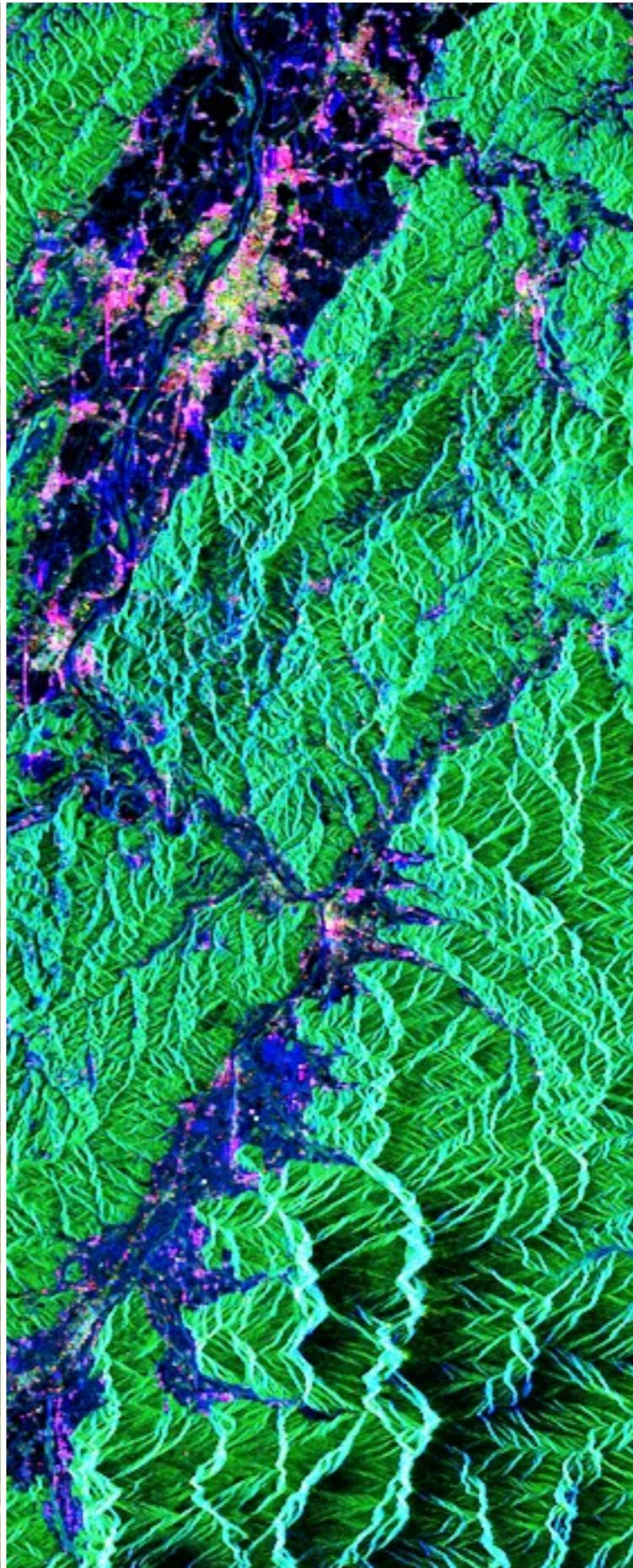
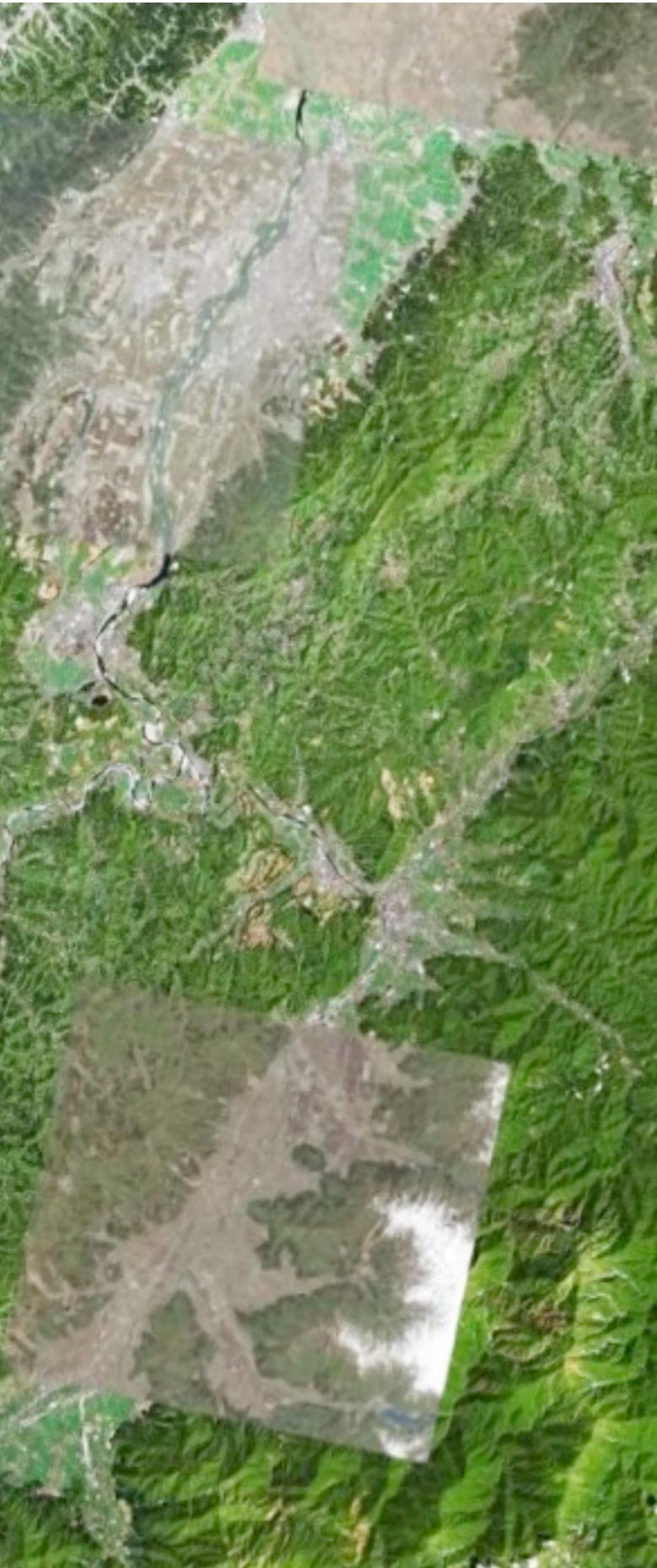
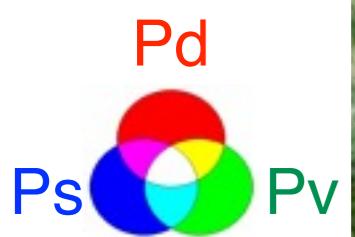
Decomposed image by (Ps, Pd, Pv, 2x12 pixels, Re(T₂₃)=0 rotation)

ALOS
PALSAR
Quad-
Pol.

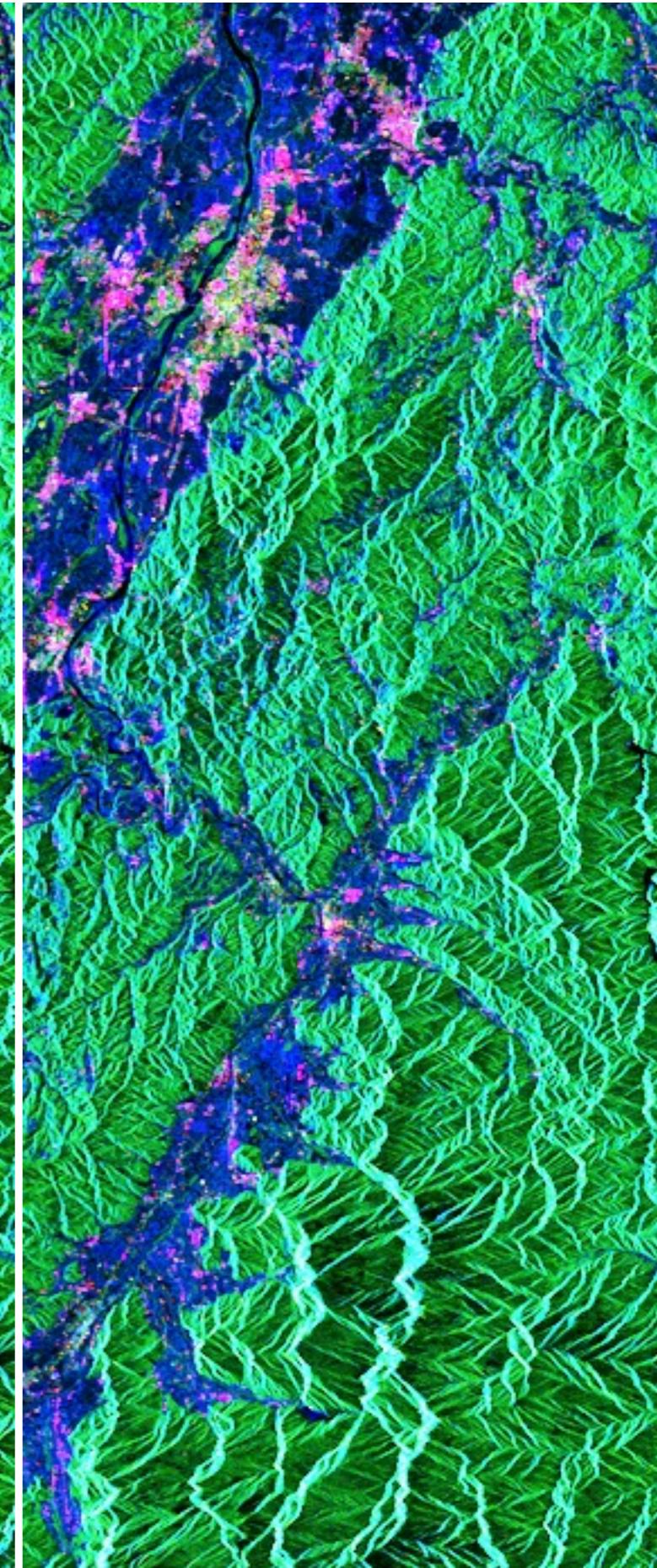
Chuetsu
Niigata
Japan

Rotation
2x12
pixel

Scattering
power
Decom-
position



2007/5/6



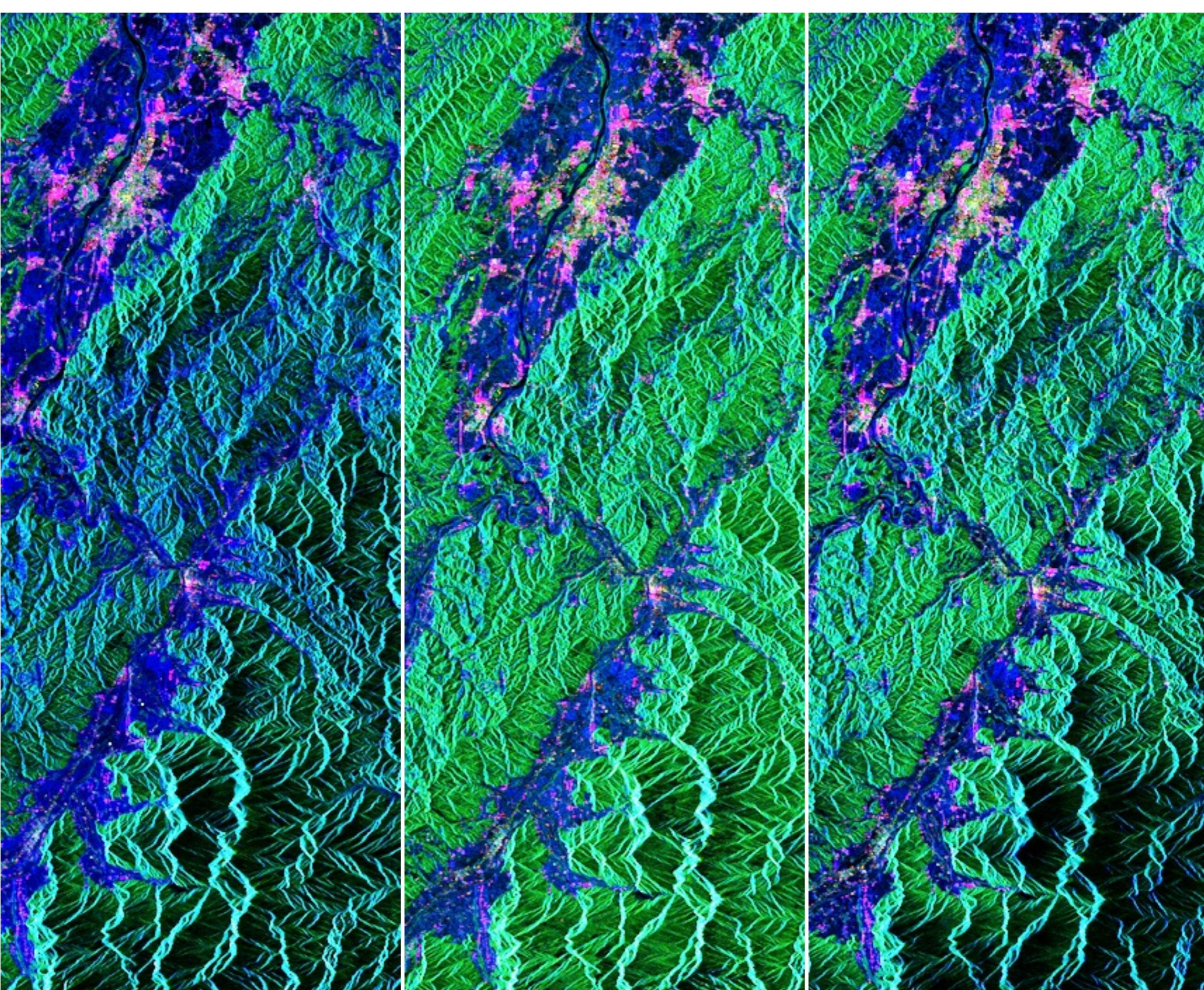
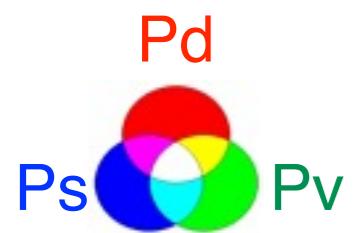
2007/11/6

ALOS
PALSAR
Quad-
Pol.

Chuetsu
Niigata
Japan

T₃₃
Rotation
2x12
pixel

Scattering
power
Decom-
position



2008/2/6

2008/11/8

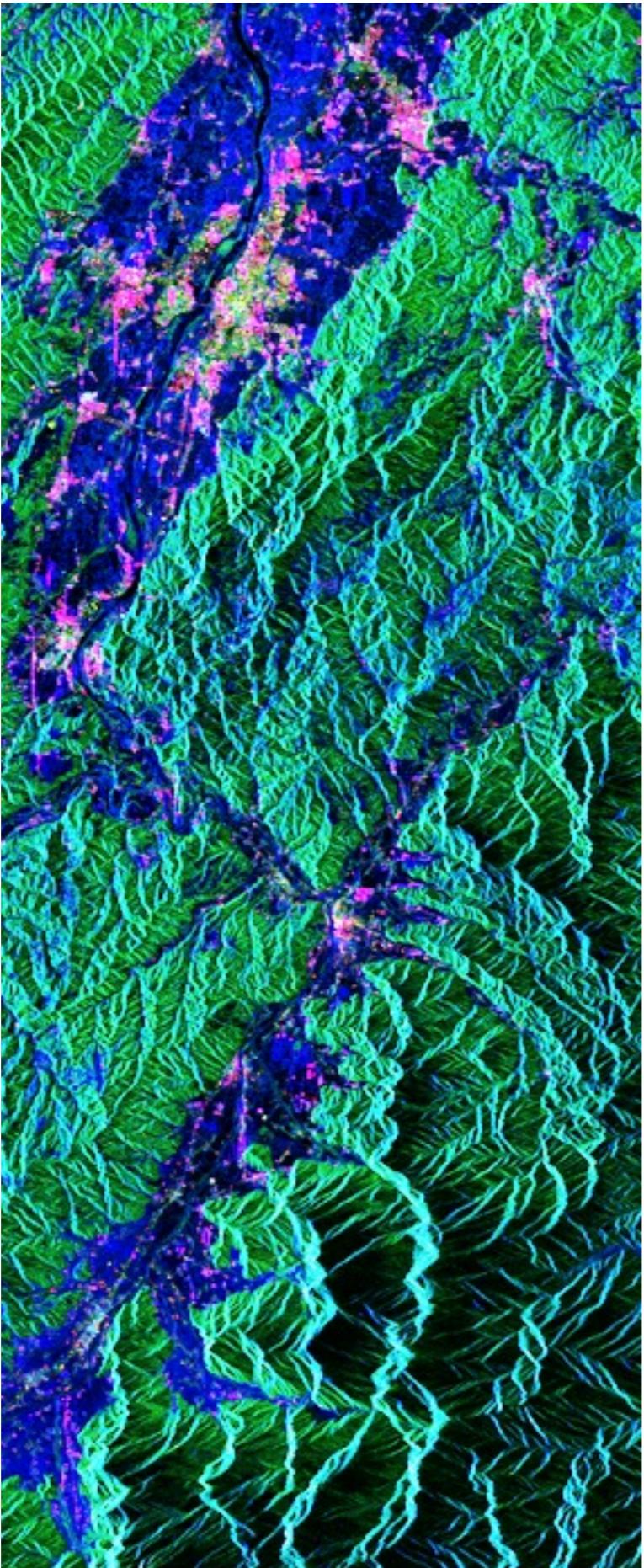
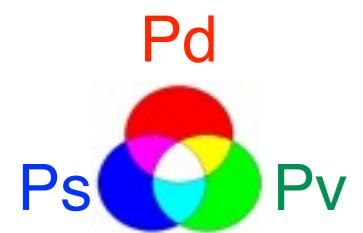
2009/3/26

ALOS
PALSAR
Quad-
Pol.

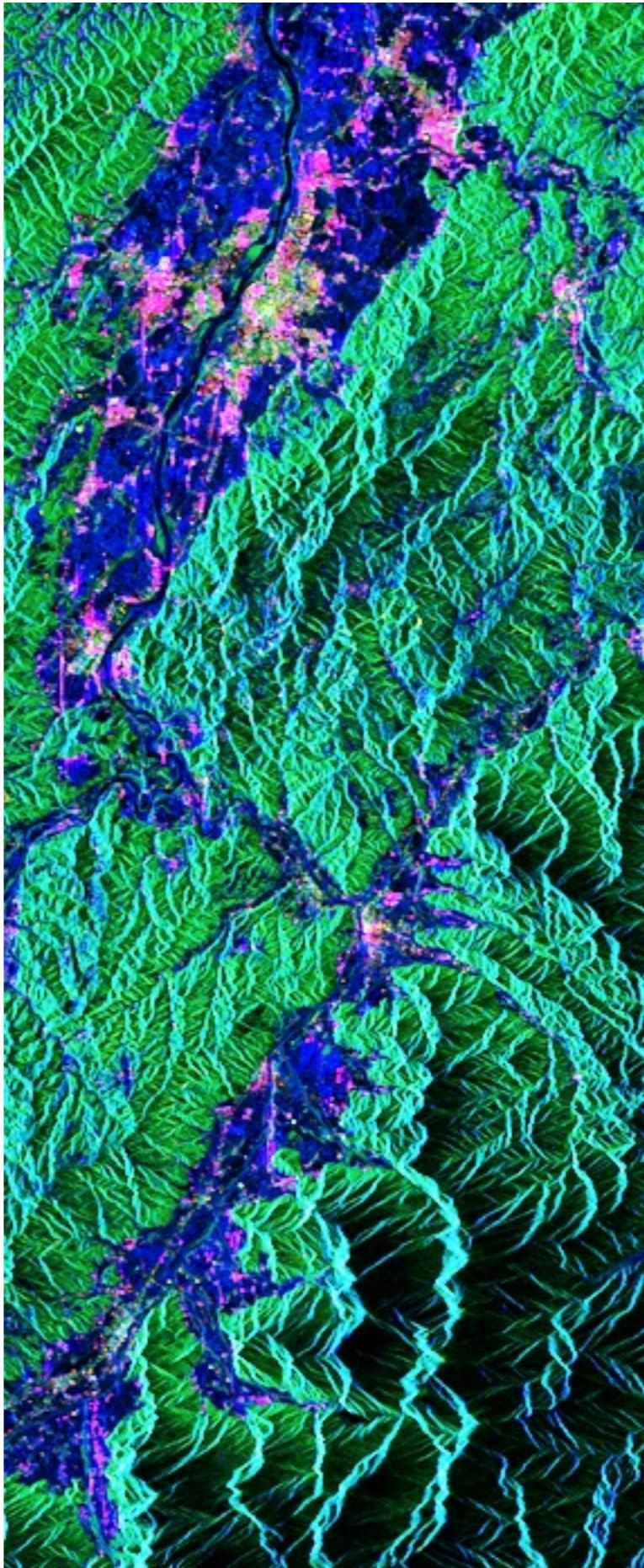
Chuetsu
Niigata
Japan

T₃₃
Rotation
2x12
pixel

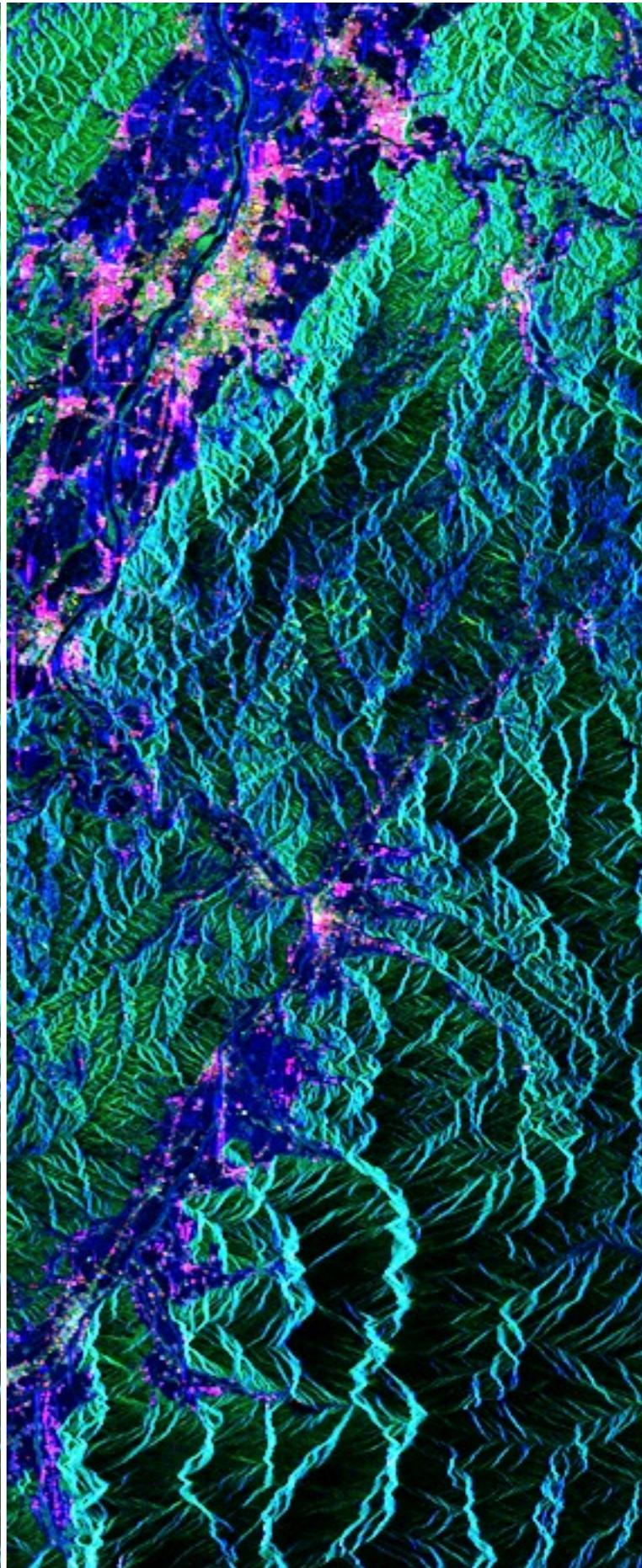
Scattering
power
Decom-
position



2007/3/21



2009/3/26

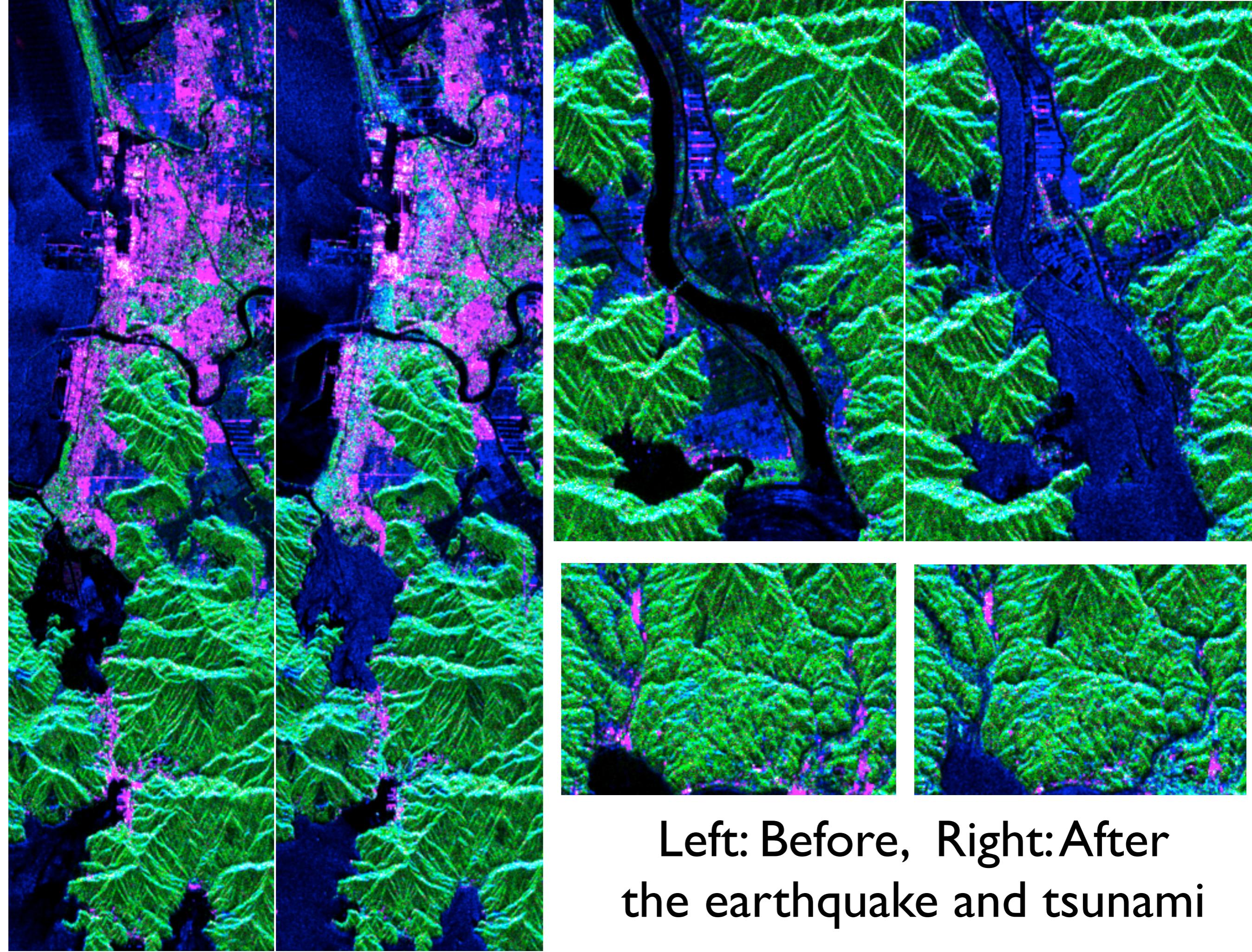


2010/3/19

Yunotani, Niigata



2011.1.23



Left: Before, Right: After
the earthquake and tsunami

Conclusion for ALOS-2

- It is very important to keep PLR as a routine mode
 - The polarimetric data provides all necessary information that cannot be achieved elsewhere
 - Continuation of ALOS-PALSAR Polarimetric data
 - Provide images, easy to understand for everybody
 - Full utilization method for PLR data is now established