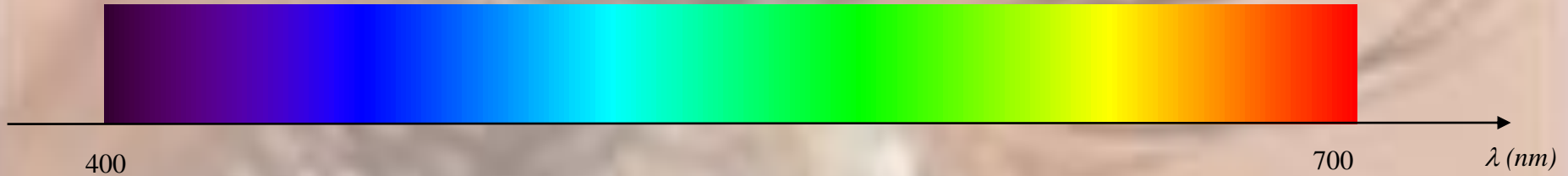


Color

pierre-louis.frison@u-pem.fr

Perception humaine



Œil: couleur grâce aux *cônes*:

65 % Rouge (575 nm)

33 % Vert (535 nm)

2% Bleu (445 nm)

→ *Couleurs primaires: R V B*

Perception humaine



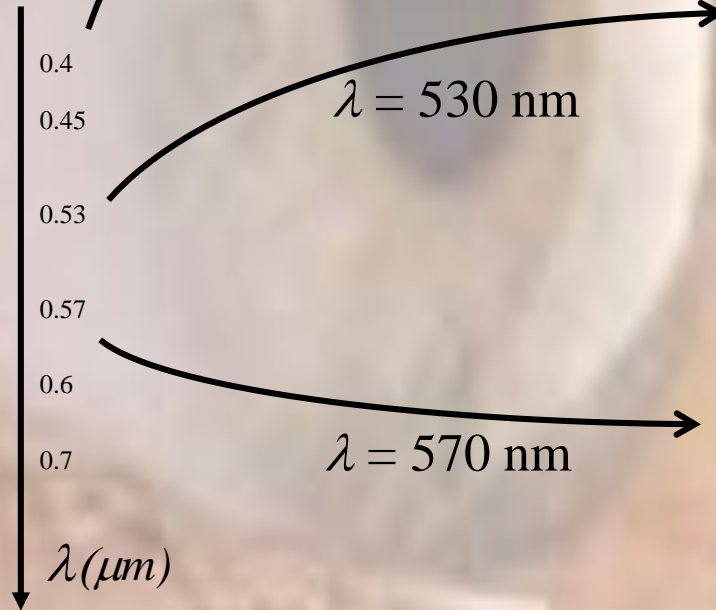
$\lambda = 430 \text{ nm}$



$\lambda = 530 \text{ nm}$



$\lambda = 570 \text{ nm}$



Perception humaine



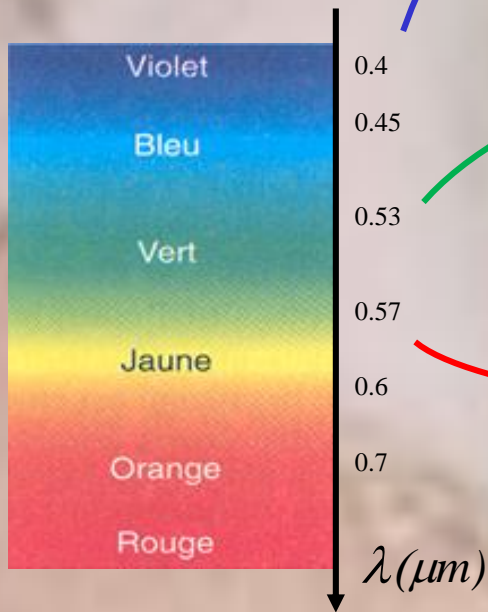
Cône B (5%): $\lambda = 430 \text{ nm}$



Cône V (35%): $\lambda = 530 \text{ nm}$

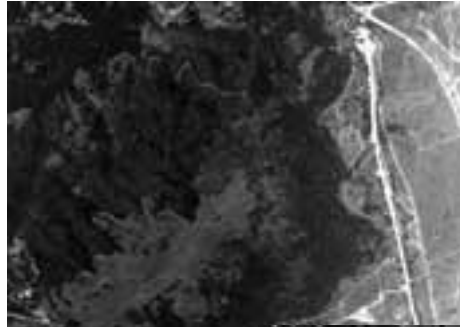


Cône R (60%): $\lambda = 570 \text{ nm}$

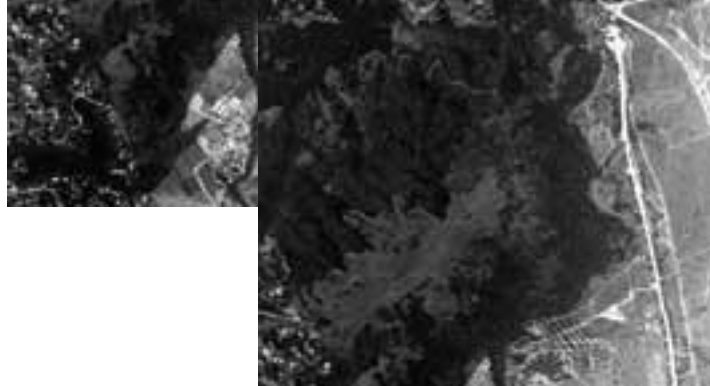


Acquisition (capteur)

Visualisation (logiciel)



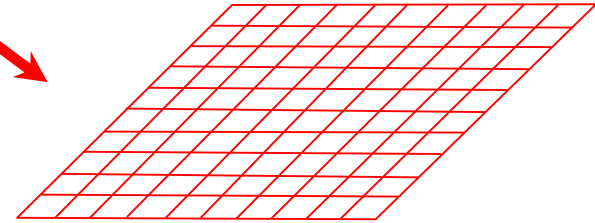
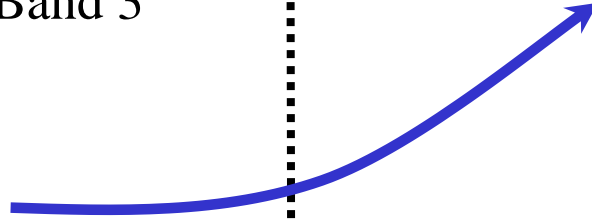
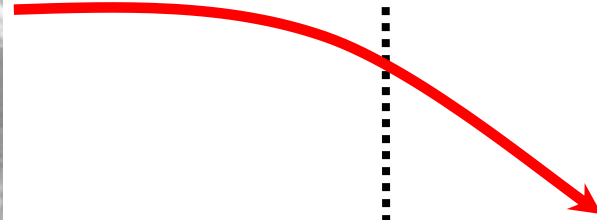
Band 1



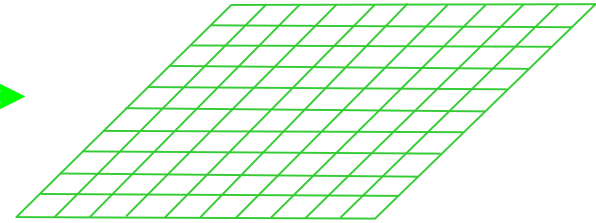
Band 2



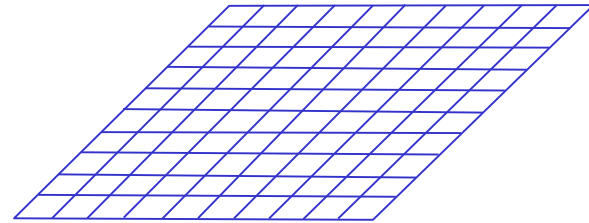
Band 3



Rouge



Vert

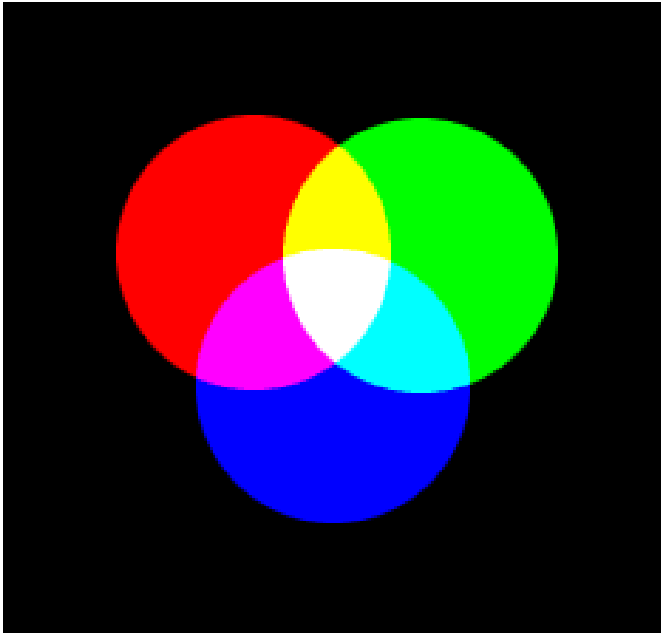


Bleu



Couleurs primaires: R V B

SYNTHESE ADDITIVE

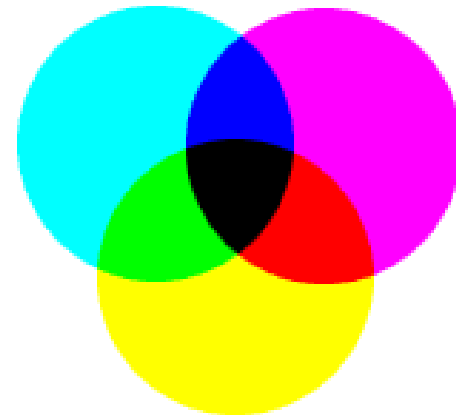


(PROJECTION sur écran)

$$R+C = B+J = V+M = \text{Blanc}$$

Couleurs secondaires: C M J

SYNTHESE SOUSTRACTIVE



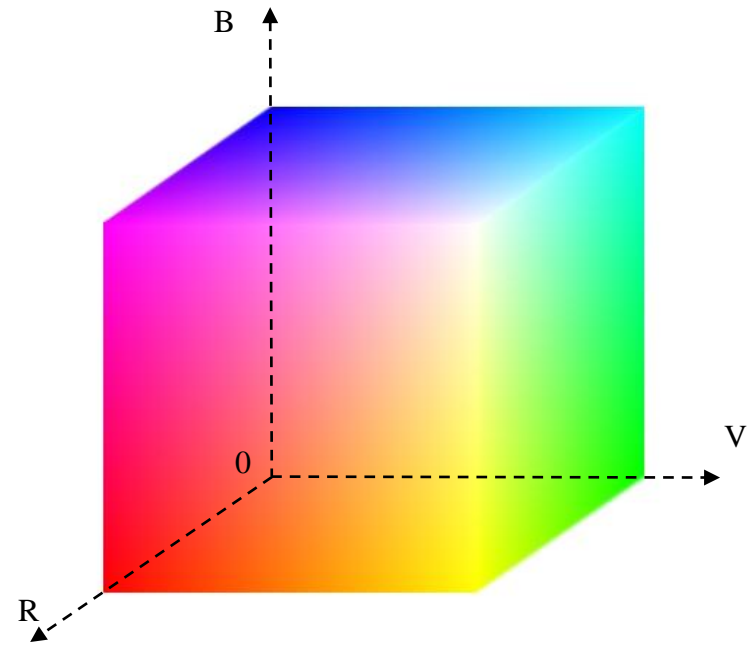
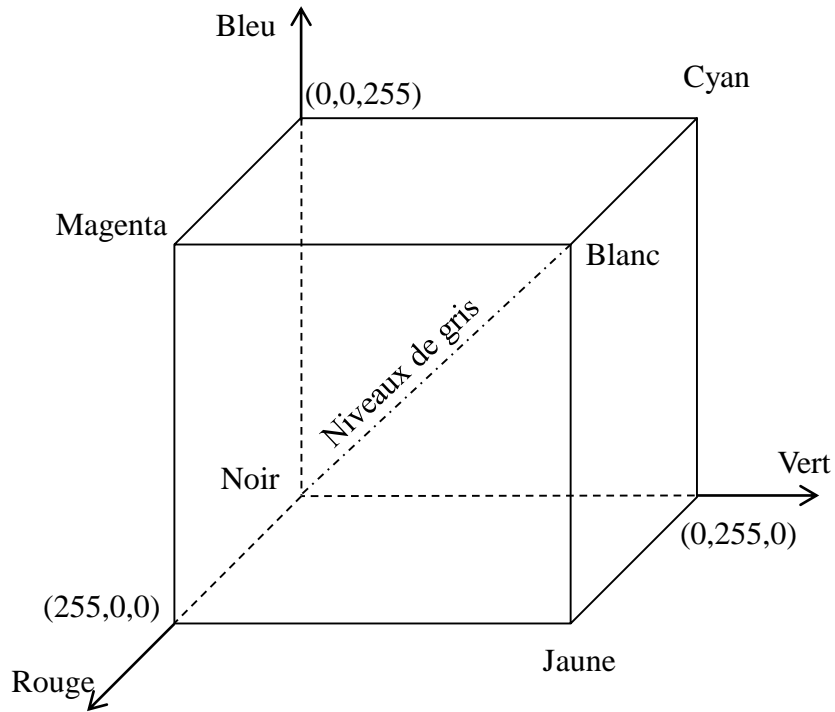
(IMPRIMERIE)

$$C = \text{Blanc} - R$$

$$M = \text{Blanc} - V$$

$$J = \text{Blanc} - B$$

Modèle RVB (RGB)

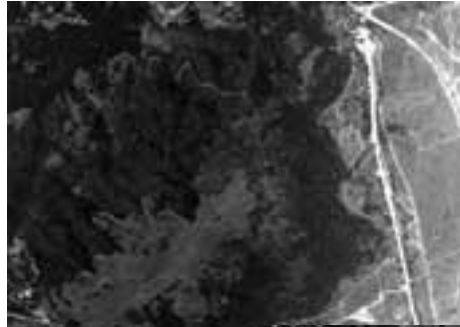


R V B

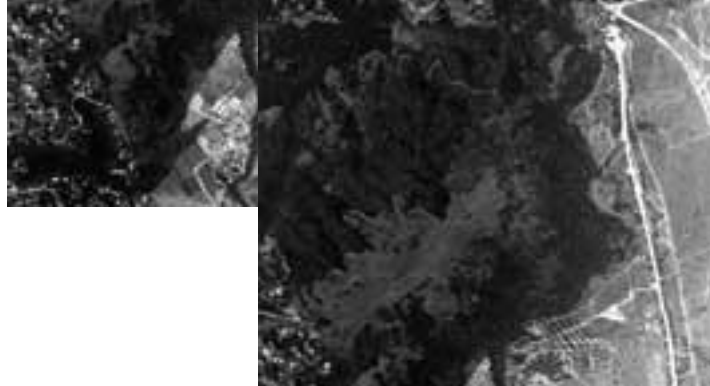
$2^8 \cdot 2^8 \cdot 2^8 = 2^{24} = 16\,777\,216$ couleurs

Acquisition (capteur)

Visualisation (logiciel)



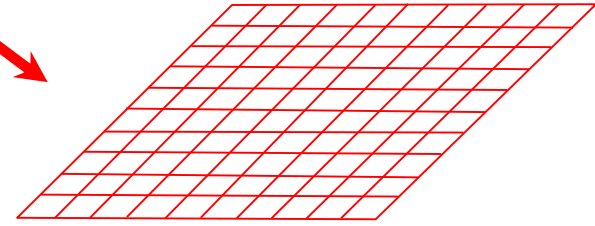
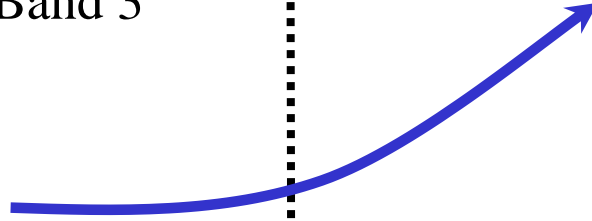
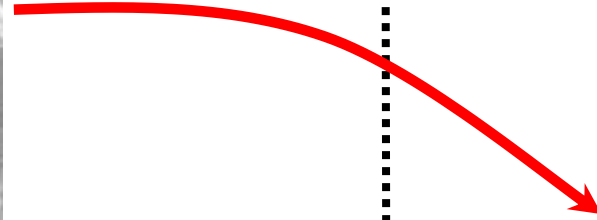
Band 1



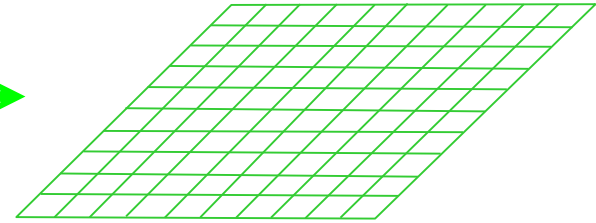
Band 2



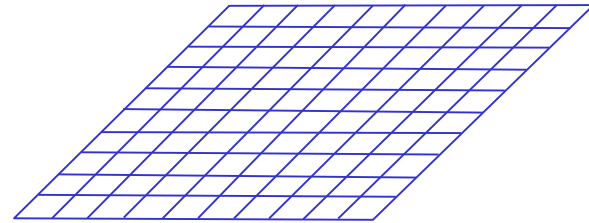
Band 3



Rouge

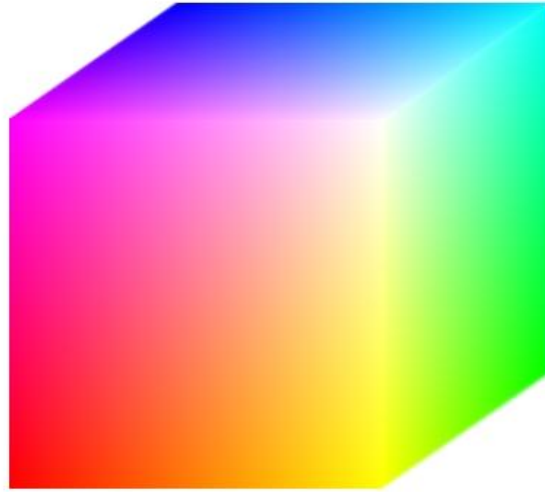


Vert

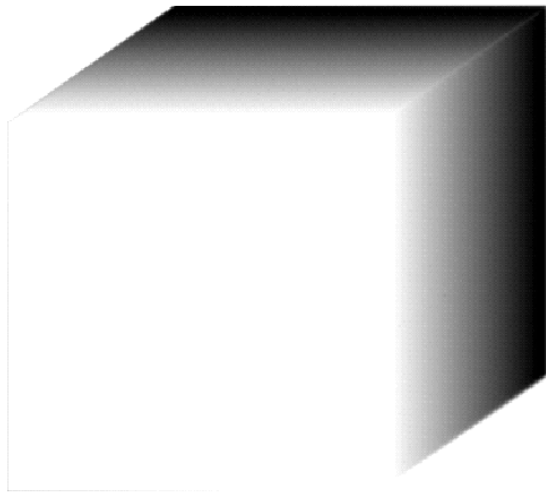


Bleu

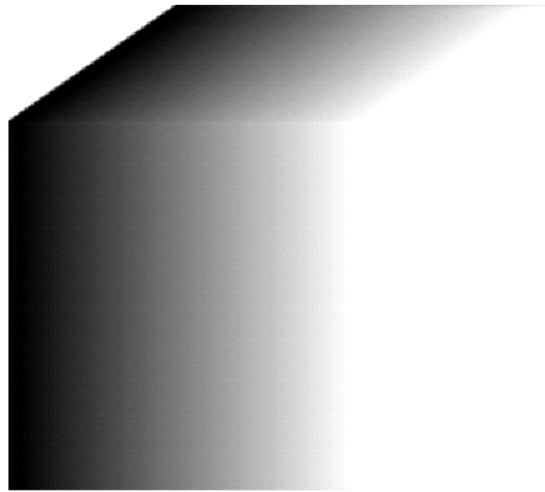
image originale



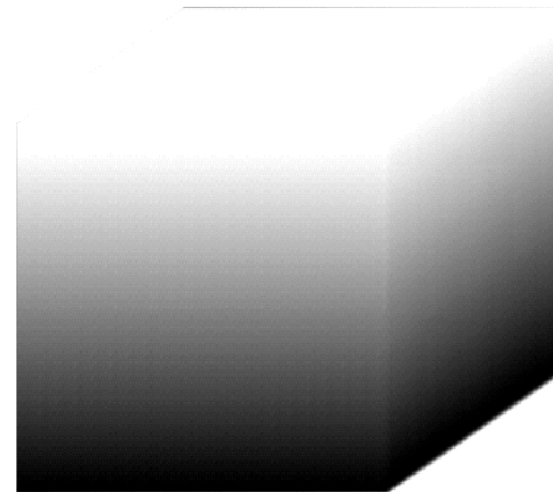
canal rouge



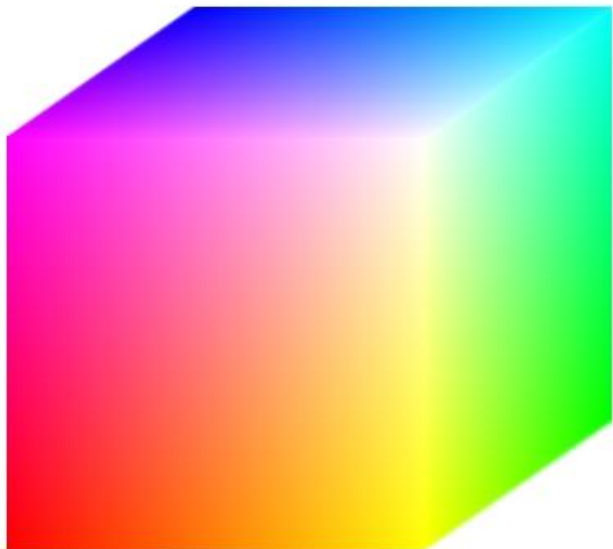
canal vert



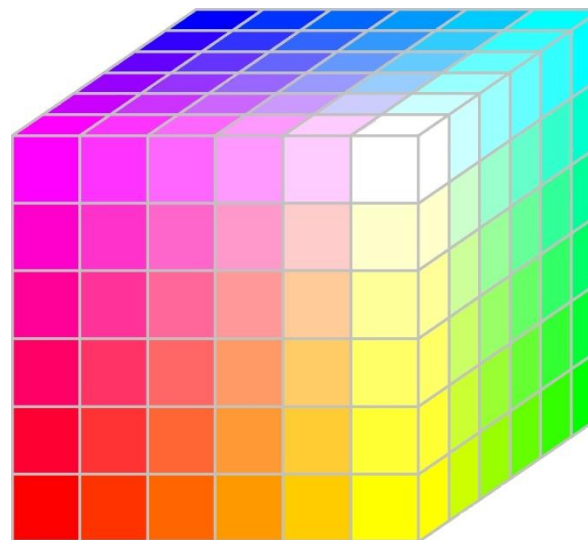
canal bleu



Modèle RVB (RGB)



16 777 216 couleurs



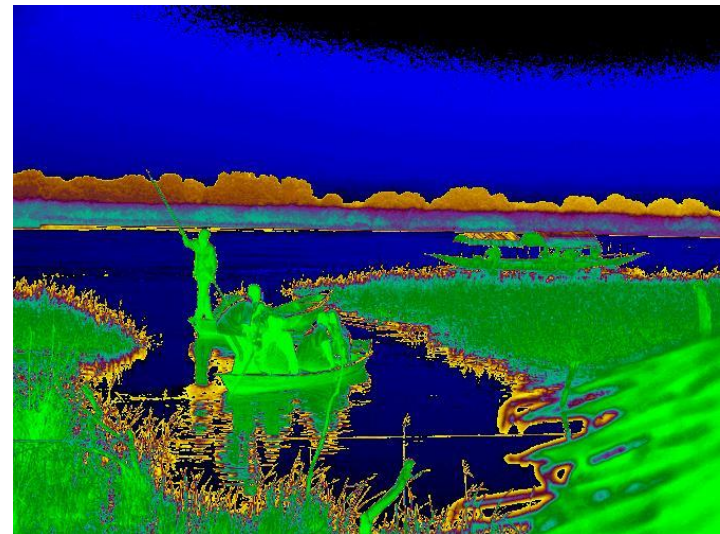
216 couleurs

image originale



Pseudo-couleur

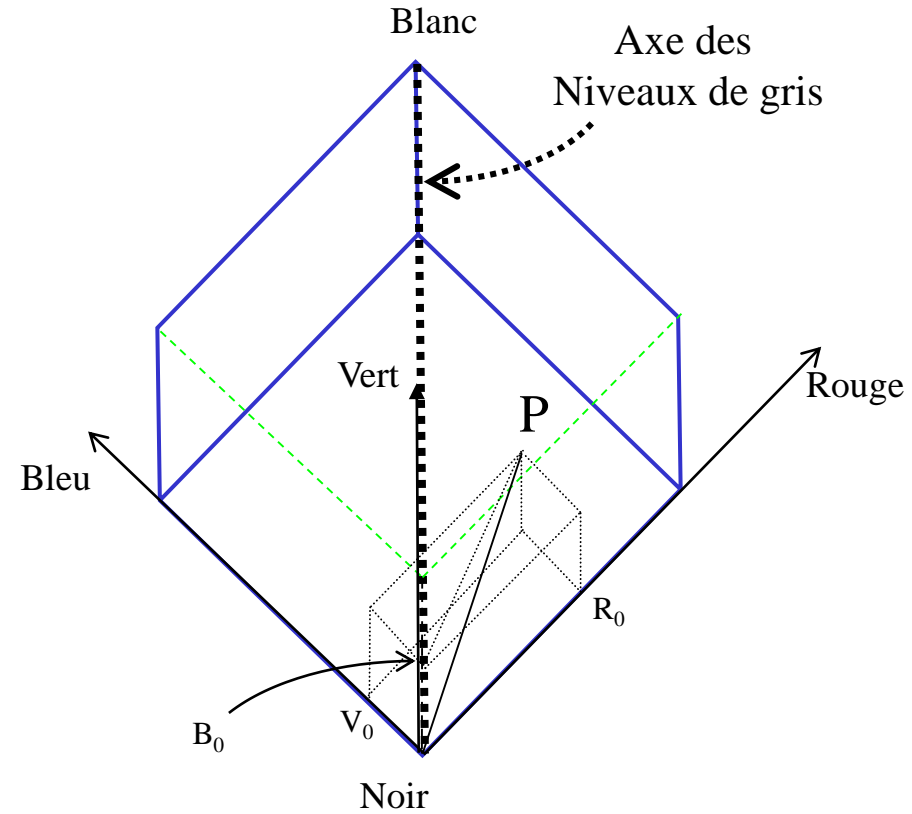
Assigner des couleurs à des niveaux de gris



Conversion couleur \rightarrow Noir&Blanc

Projection orthogonale du point P $\begin{pmatrix} R_0 \\ V_0 \\ B_0 \end{pmatrix}$

sur l'axe des niveaux de gris: $NG \begin{pmatrix} R = a \\ V = a \\ B = a \end{pmatrix}$

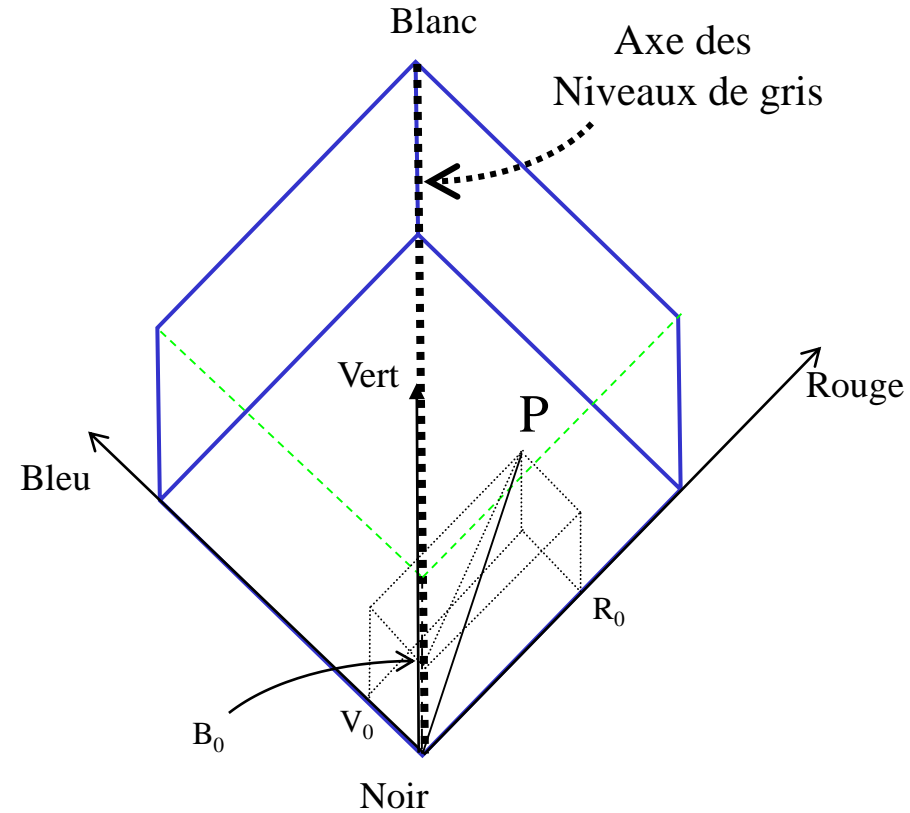


Conversion couleur \rightarrow Noir&Blanc

Projection orthogonale du point P $\begin{pmatrix} R_0 \\ V_0 \\ B_0 \end{pmatrix}$

sur l'axe des niveaux de gris: $NG \begin{pmatrix} R = a \\ V = a \\ B = a \end{pmatrix}$

$$a = \frac{1}{3}(R_0 + V_0 + B_0)$$

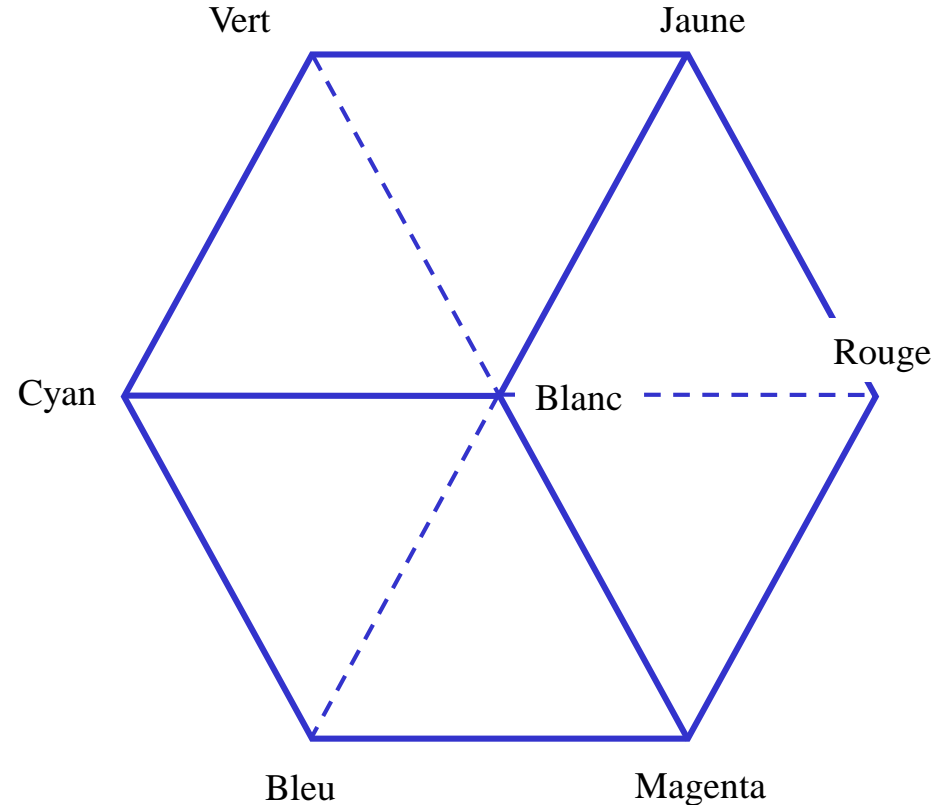
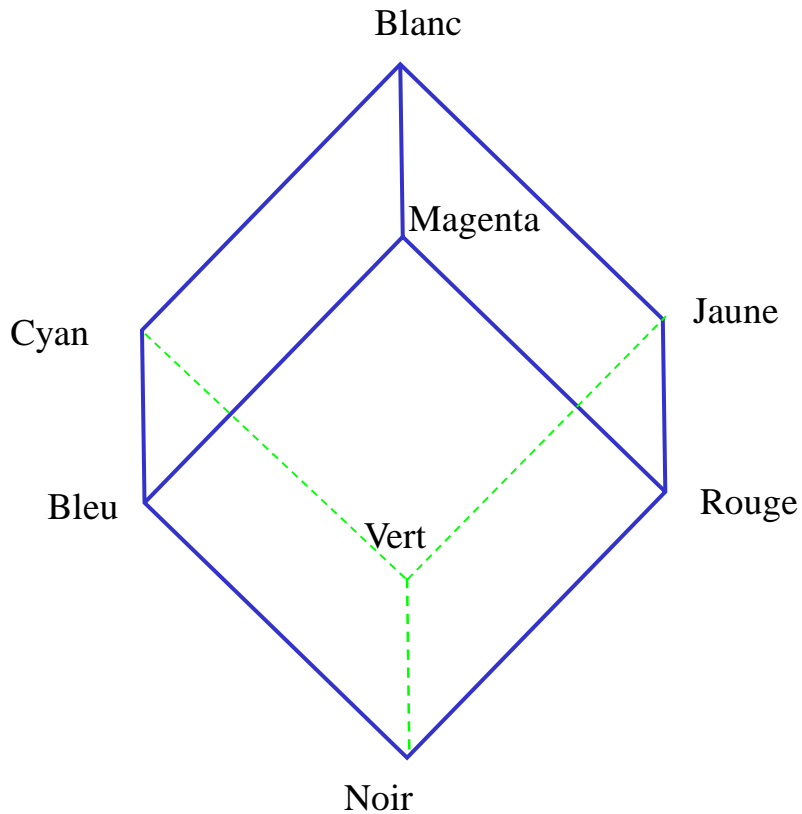


Modèle TSI (HSI)

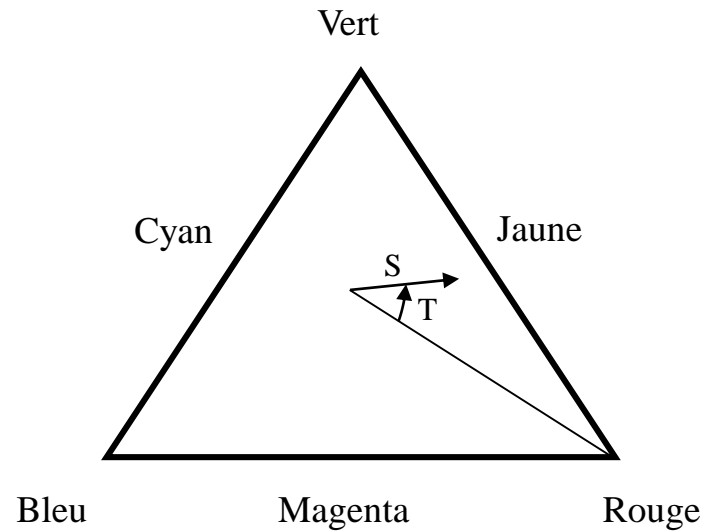
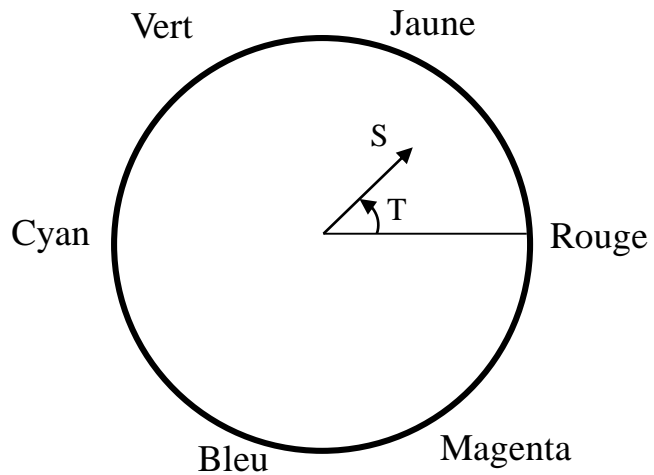
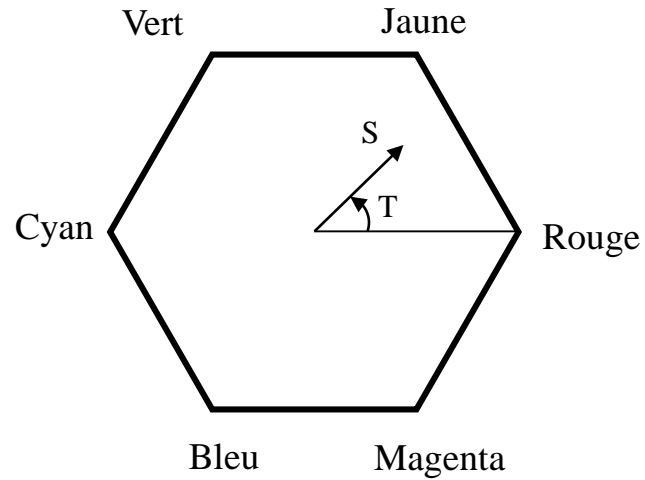
Teinte (Hue): couleur (longueur d'onde)

Saturation: degré de dilution de couleur par blanc

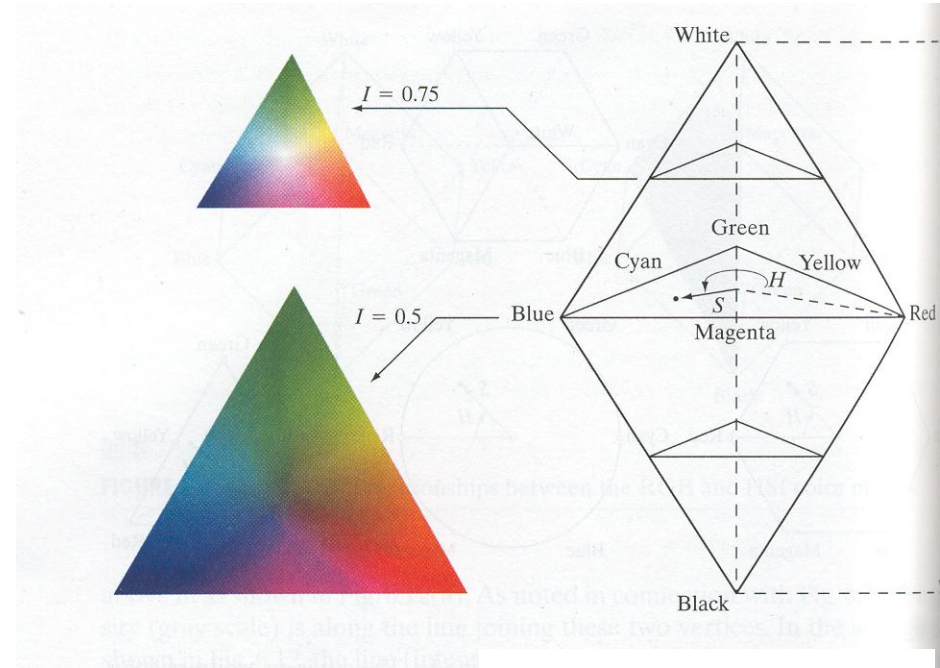
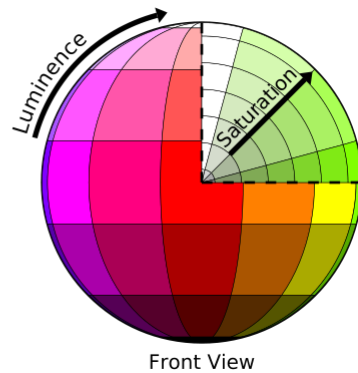
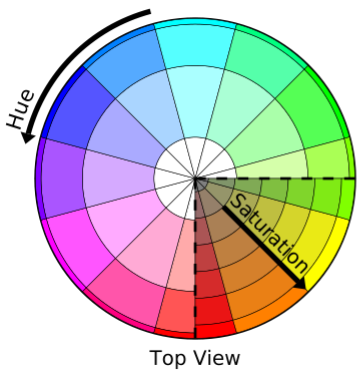
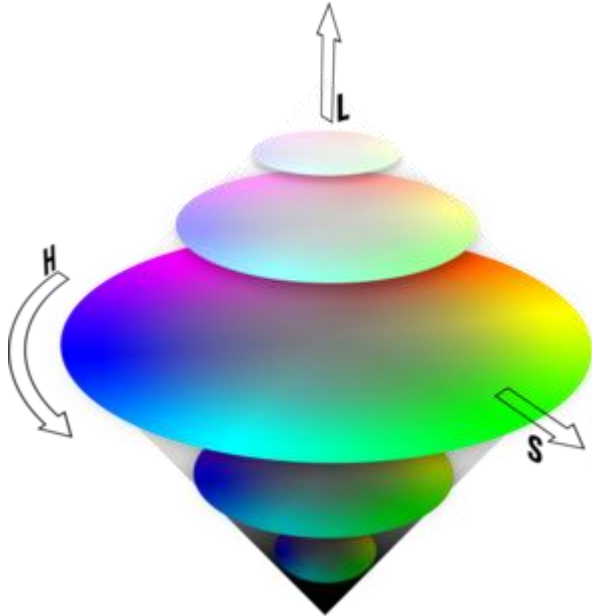
Intensité: niveau de gris associé au canal monochromatique



Modèle TSI (HSI)

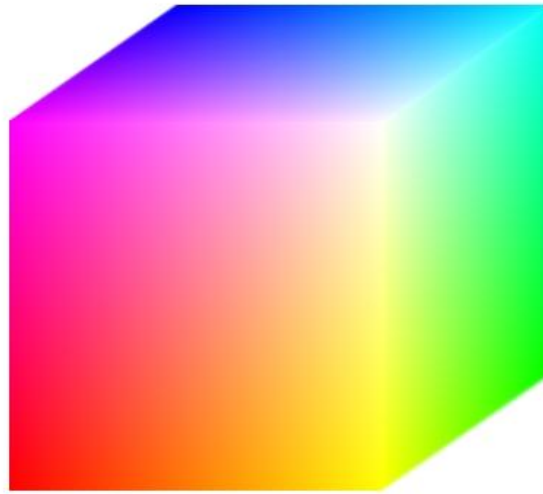


Modèle TSL (HSL) TSI (HSI)

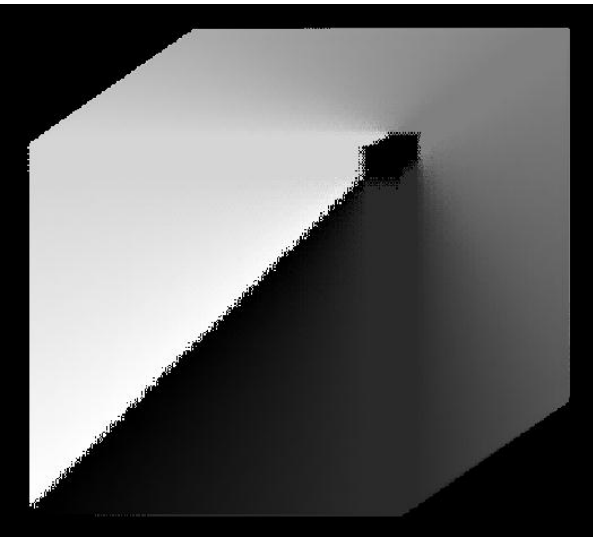


Source: Gonzales & Woods

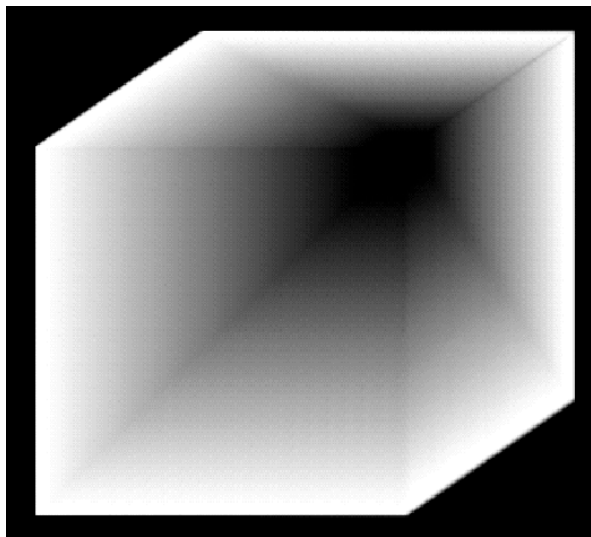
image originale



canal teinte (hue)



canal saturation



canal intensité

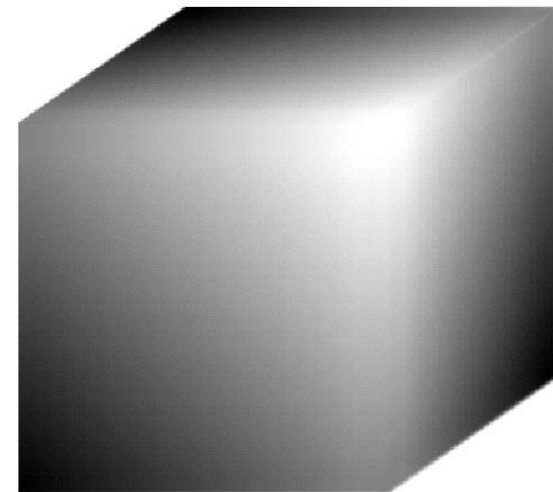


image originale



canal rouge



canal vert



canal bleu



canal teinte



canal saturation

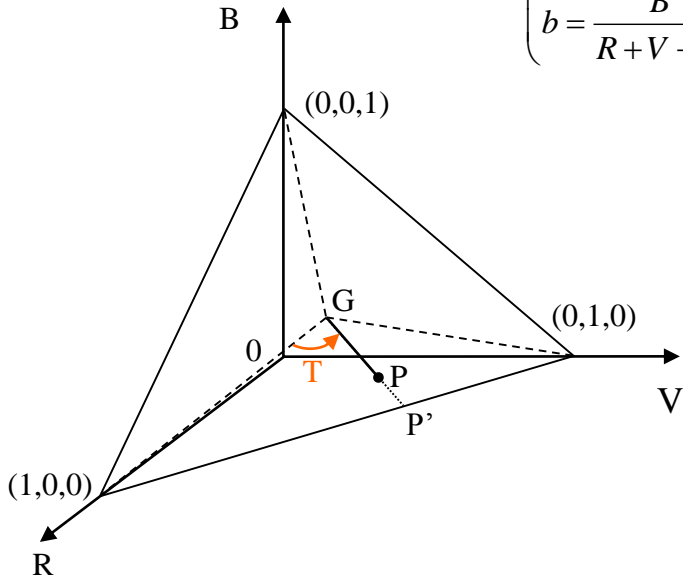


canal intensité



Conversion RGB \rightarrow HSI

$$P \begin{pmatrix} r = \frac{R}{R+V+B} \\ v = \frac{V}{R+V+B} \\ b = \frac{B}{R+V+B} \end{pmatrix}$$

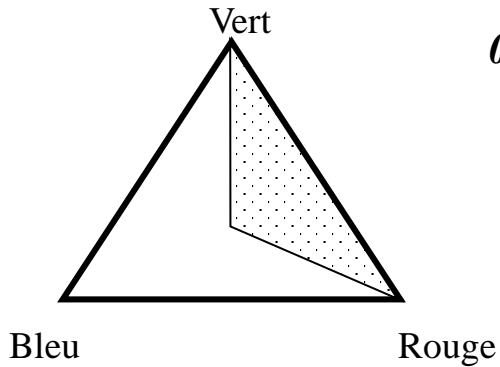


$$\cos(H) = \frac{\overrightarrow{GR_M} \cdot \overrightarrow{GP}}{\|\overrightarrow{GR_M}\| \|\overrightarrow{GP}\|} = \frac{[(R-V) + (R-B)]}{2[(R-V)^2 + (R-B)(V-B)]^{\frac{1}{2}}}$$

$$S = \frac{GP}{GP'} = 3 \left(\frac{1}{3} - b \right) = 1 - \frac{3 \min(R, V, B)}{R+V+B}$$

$$I = \frac{1}{3}(R+V+B)$$

Conversion HSI \rightarrow RGB

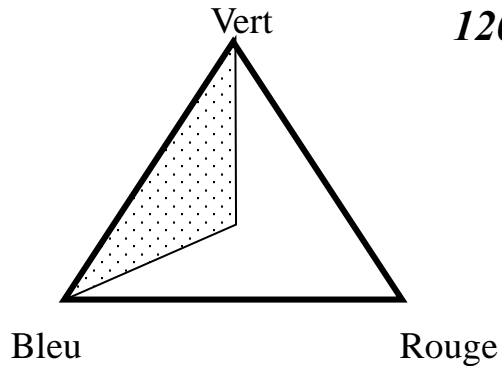


$$0 \leq H \leq 120$$

$$B = I \cdot (1 - S)$$

$$R = I \cdot \left(1 + \frac{S \cdot \cos H}{\cos(60^\circ - H)} \right)$$

$$V = 1 - (R + B)$$



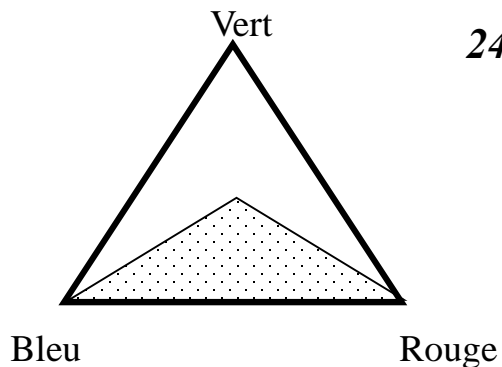
$$120 \leq H \leq 240$$

$$H = H - 120^\circ$$

$$R = I \cdot (1 - S)$$

$$G = I \cdot \left(1 + \frac{S \cdot \cos H}{\cos(60^\circ - H)} \right)$$

$$B = 1 - (R + B)$$



$$240 \leq H \leq 360$$

$$H = H - 240^\circ$$

$$V = I \cdot (1 - S)$$

$$B = I \cdot \left(1 + \frac{S \cdot \cos H}{\cos(60^\circ - H)} \right)$$

$$R = 1 - (R + B)$$



SPOT - Panchro
rés. spatiale: 10 m

Brest, France

SPOT - XS

Brest, France - 20 m rés. spatiale



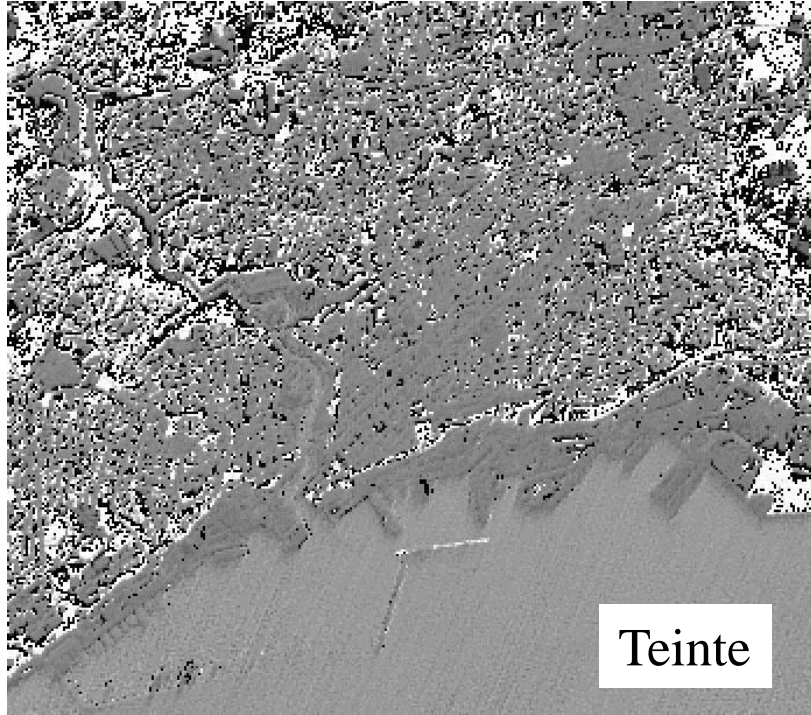
SPOT - XS

20 m rés. spatiale: rééchantillonnage x 2

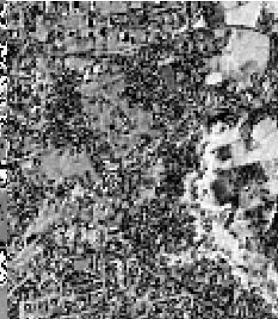


SPOT - XS

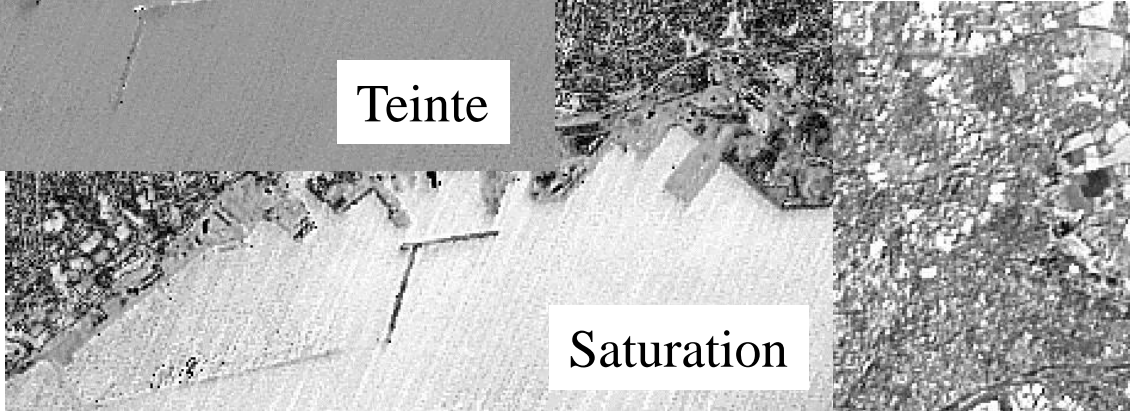
20 m rés. spatiale: rééchantillonnage x 2



Teinte



Saturation

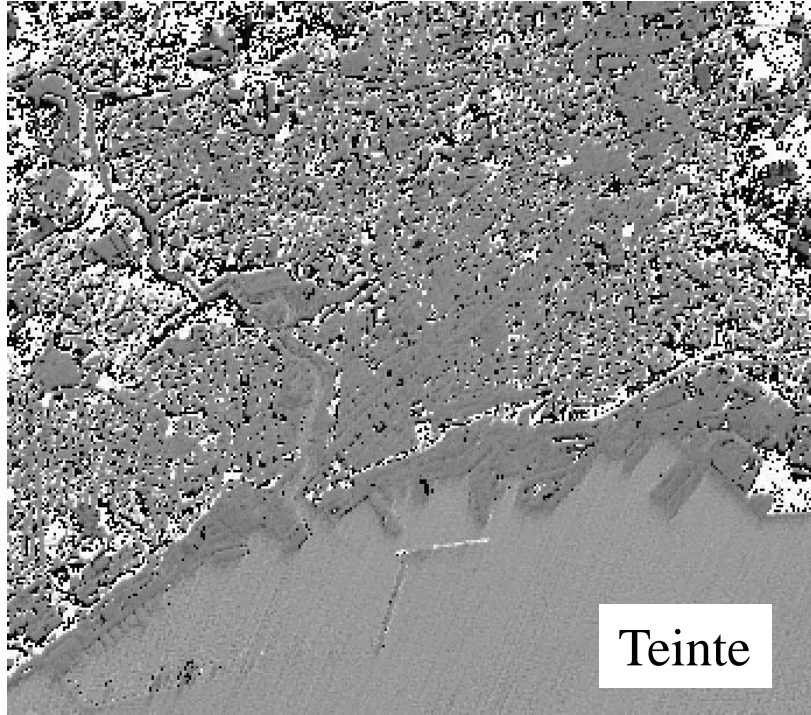


Intensité

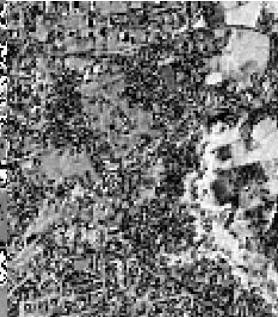
RGB → HSI

SPOT - XS

20 m rés. spatiale: rééchantillonnage x 2



Teinte



Saturation



Spot_Panchro

HSI → RGB.....



FUSION
XS - PANCHRO

HSI → RGB

3 canaux - 10 m

Autre méthode: Algorithme de BROVEY

$$CNp_i = CNi / (\text{somme } (CNi) * C\text{panchro})$$