

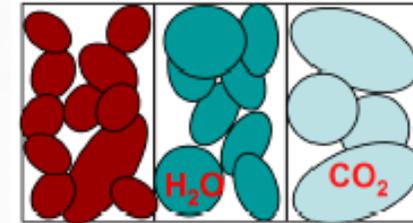
Séparation de source en aveugle appliquée aux images hyperspectrales OMEGA (ICA & mélange positif)

Frédéric Schmidt, Hafrun Hauksdottir, Saïd
Moussaoui, Christian Jutten, Jocelyn Chanussot.

Plan

- Séparation de source
- Mélanges de glaces
- Mélange de minéraux

Quantification : quels critères ?



- Représentation de surface :
- Automatique, sans a priori
- Diversité des observations :
⇒ Statistiques
- Redondance d'information
⇒ basée sur plusieurs canaux spectraux, sur plusieurs pixels.

Indépendance spatiale/spectrale

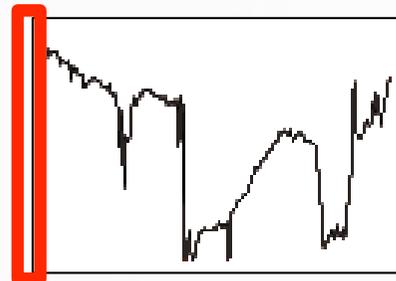
- Spatiale :

- Distributions des proportions de surface sont indépendantes
- Bien contraint



- Spectrale :

- Distributions des spectres sont indépendantes
- Mal contraint



Analyses en composantes indépendantes

- « JADE », indépendance spatiale :
⇒ Mauvaise estimation des spectres

Cardoso, J., *Signal Processing Letters*, 1997

- « BPSS », indépendance spectrale :

– Contraintes :

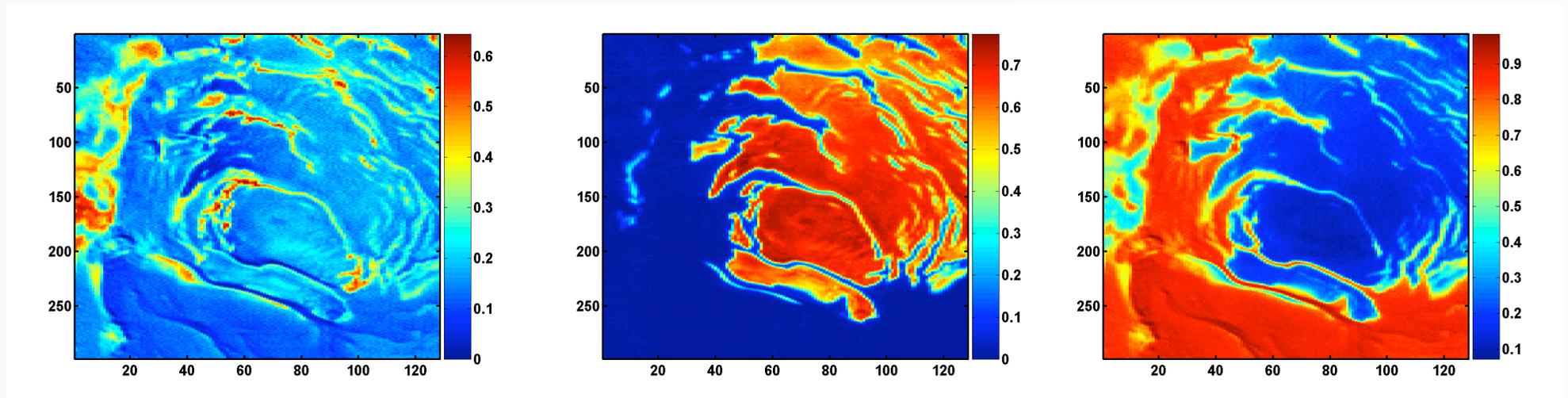
- sources et matrice de mélange positives (gamma)
- sources indépendantes entre elles

⇒ Prometteuse mais :

- Méthode Monte Carlo : temps de calcul long, très gourmand en mémoire

Moussaoui, S. et al. *Signal Processing*, 2006, 54, 4133-4145

Méthode JADE+BPSS : positivité et indépendance



On the Decomposition of Mars Hyperspectral Data by ICA and Bayesian Positive Source Separation, S. Moussaoui, H. Hauksdottir, F. Schmidt, C. Jutten, J. Chanussot, D. Brie, S. Douté, C. Benediksson, Neurocomputing, 2007

JADE + BPSS

1. ACI « JADE » spatial
2. Tirage de ~300 spectres représentatifs
3. ACI « BPSS » spectral

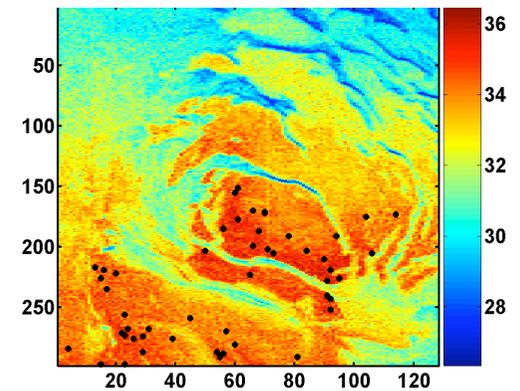
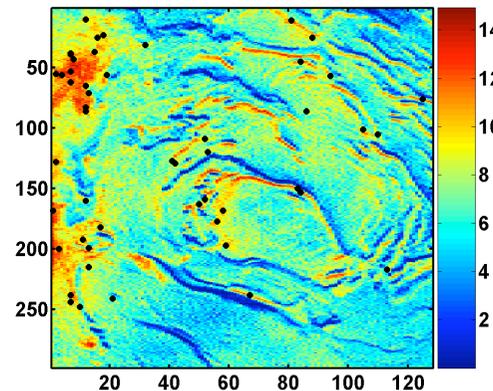
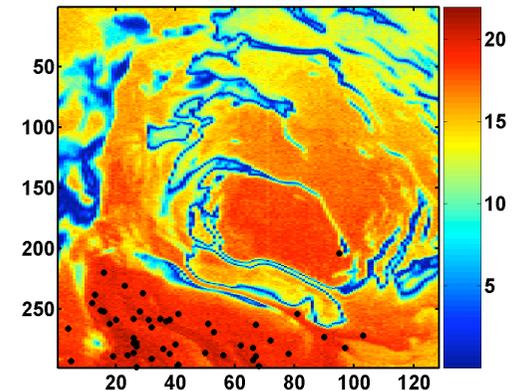
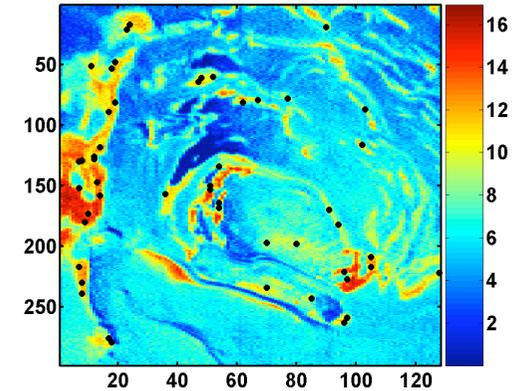
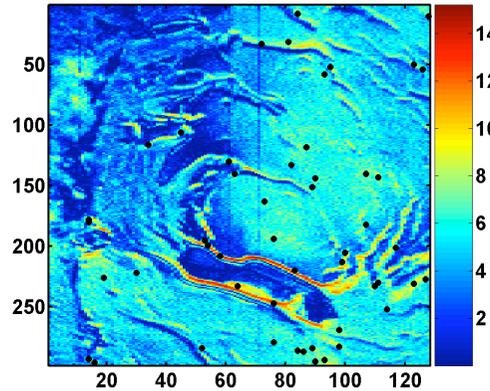
Détection de présence de glaces

- Calotte permanente sud de Mars
- Présence des bandes atmosphériques

JADE + BPSS

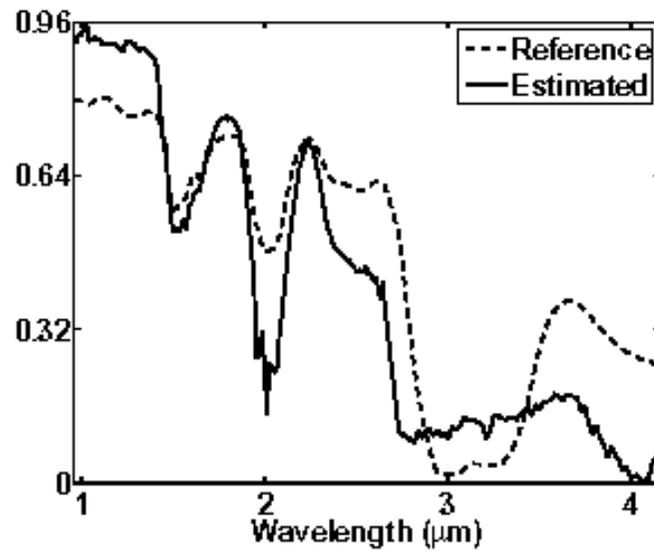
JADE + Bayésien

1. Classification JADE
2. Tirage de 50 spectres représentatifs
(parmi les 15% avec le plus grand SNR)

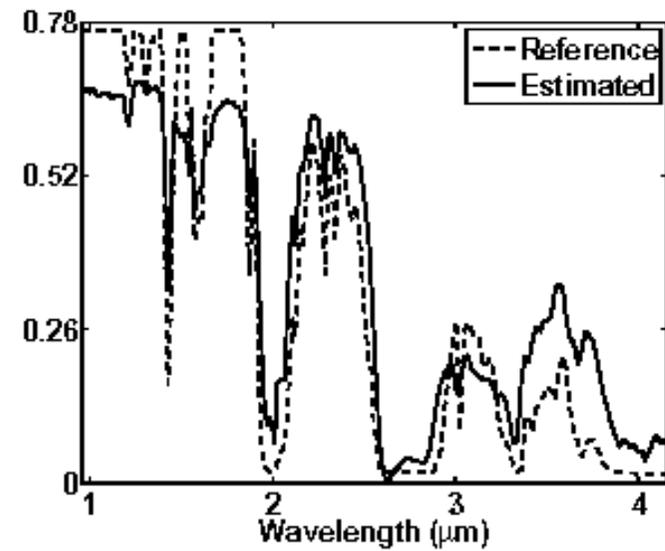


JADE + BPSS

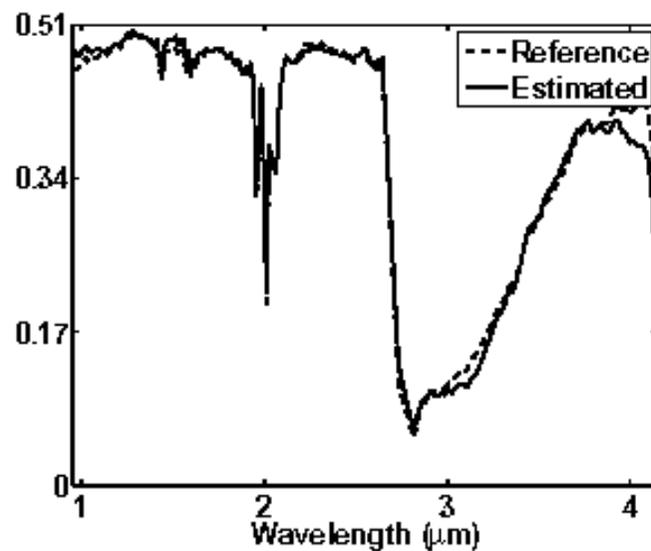
3. Méthode bayésienne



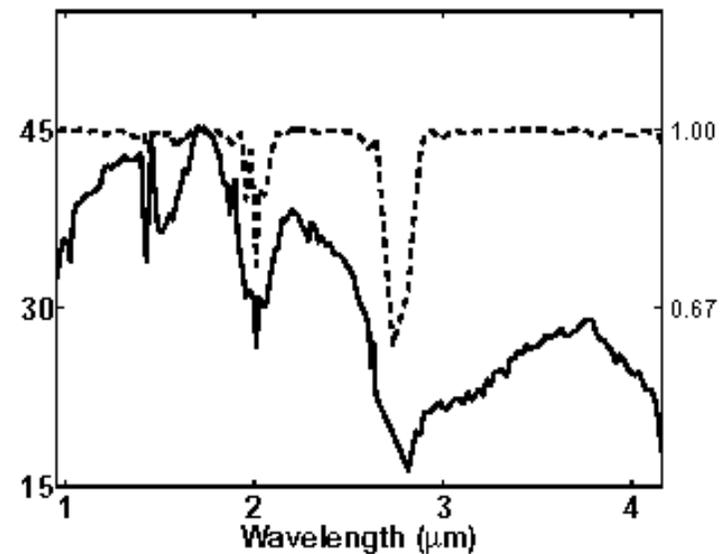
(a) H₂O ice



(b) CO₂ ice



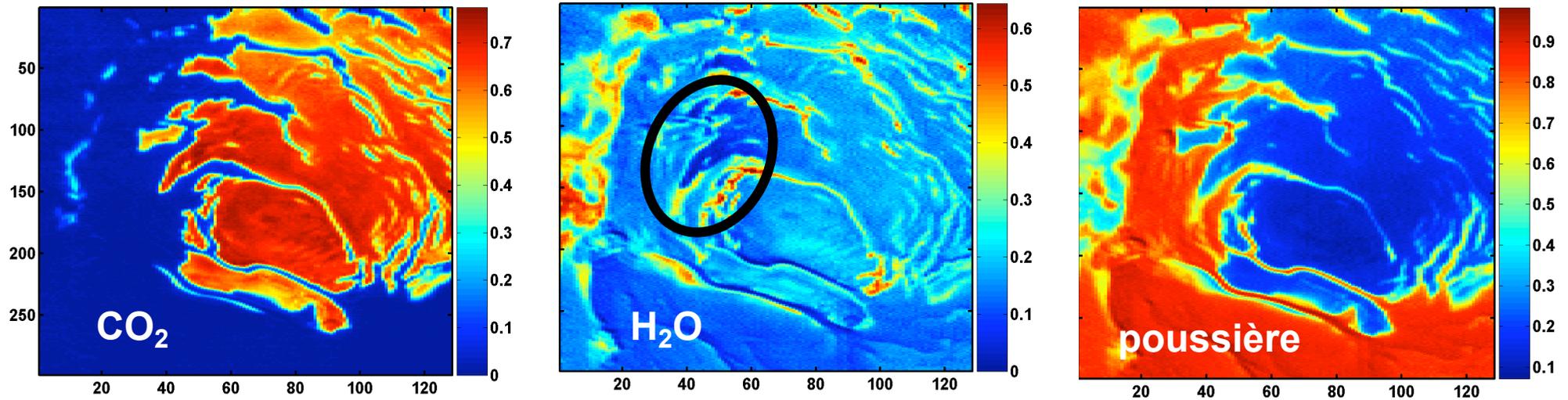
(c) dust



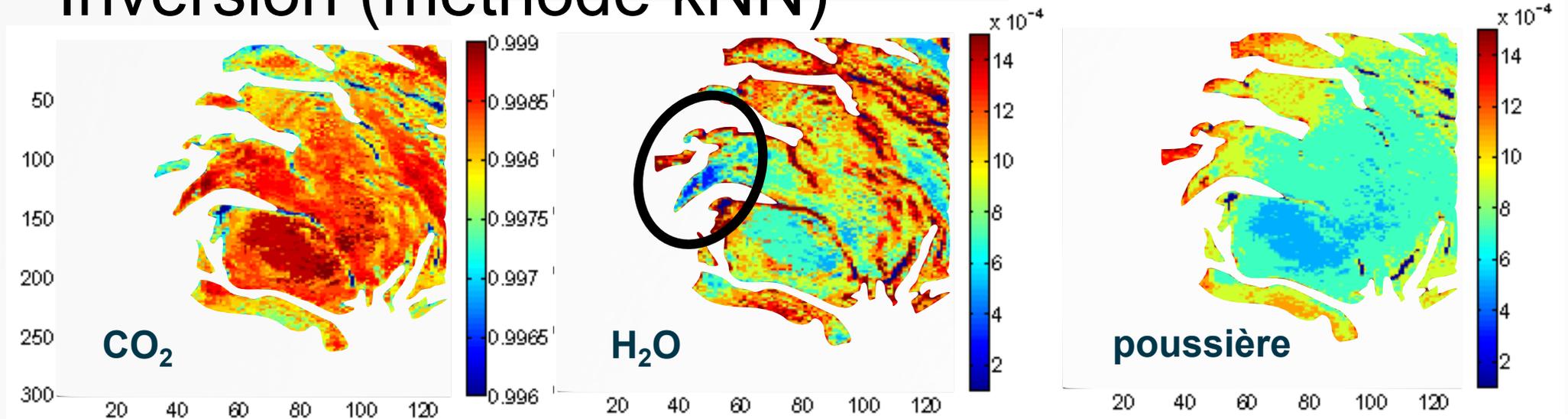
(d) Spectral SNR

Comparaison avec inversion

JADE+BPSS

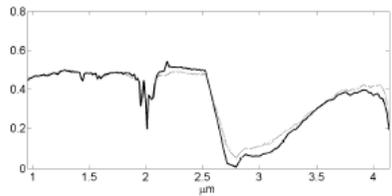


Inversion (méthode kNN)

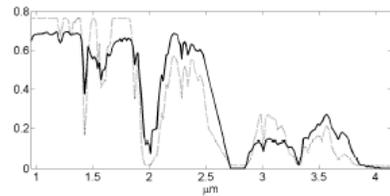


Utilisation en spectro-imagerie

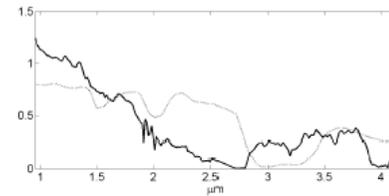
● Classification non-supervisée



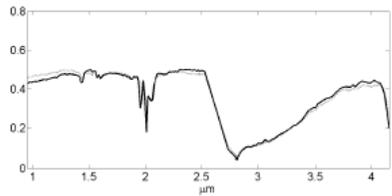
(a) Dataset 1.a



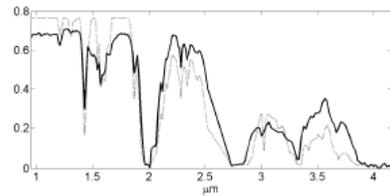
(a) Dataset 1.a



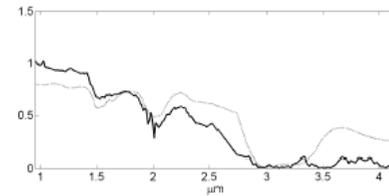
(a) Dataset 1.a



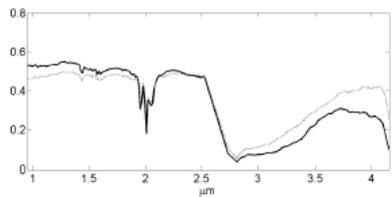
(b) Dataset 2.a



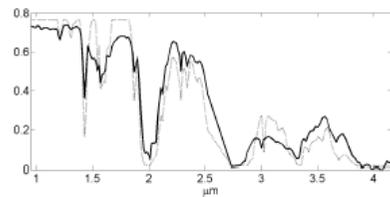
(b) Dataset 2.a



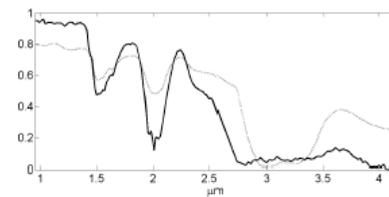
(b) Dataset 2.a



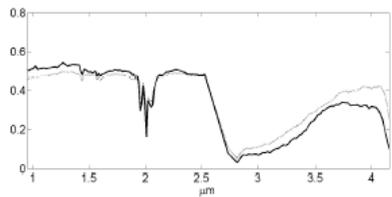
(c) Dataset 3.a



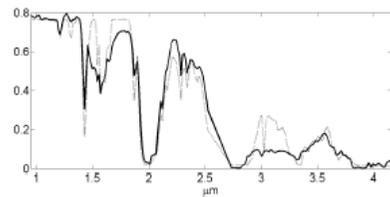
(c) Dataset 3.a



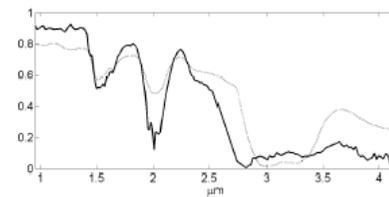
(c) Dataset 3.a



(d) Dataset 4.a



(d) Dataset 4.a



(d) Dataset 4.a

Image	Eau (%)	CO ₂ (%)
ORB0030_0	20,53	17,48
ORB0041_1	21,84	16,76
ORB0041_1.CUT	63,48	48,72
ORB0061_1	24,30	10,00
ORB0103_1	41,09	15,50

Détection de présence de minéraux

- Plus complexe (profondeur de bande)
- Nécessite une correction des bandes atmosphériques

Exemples de spectres

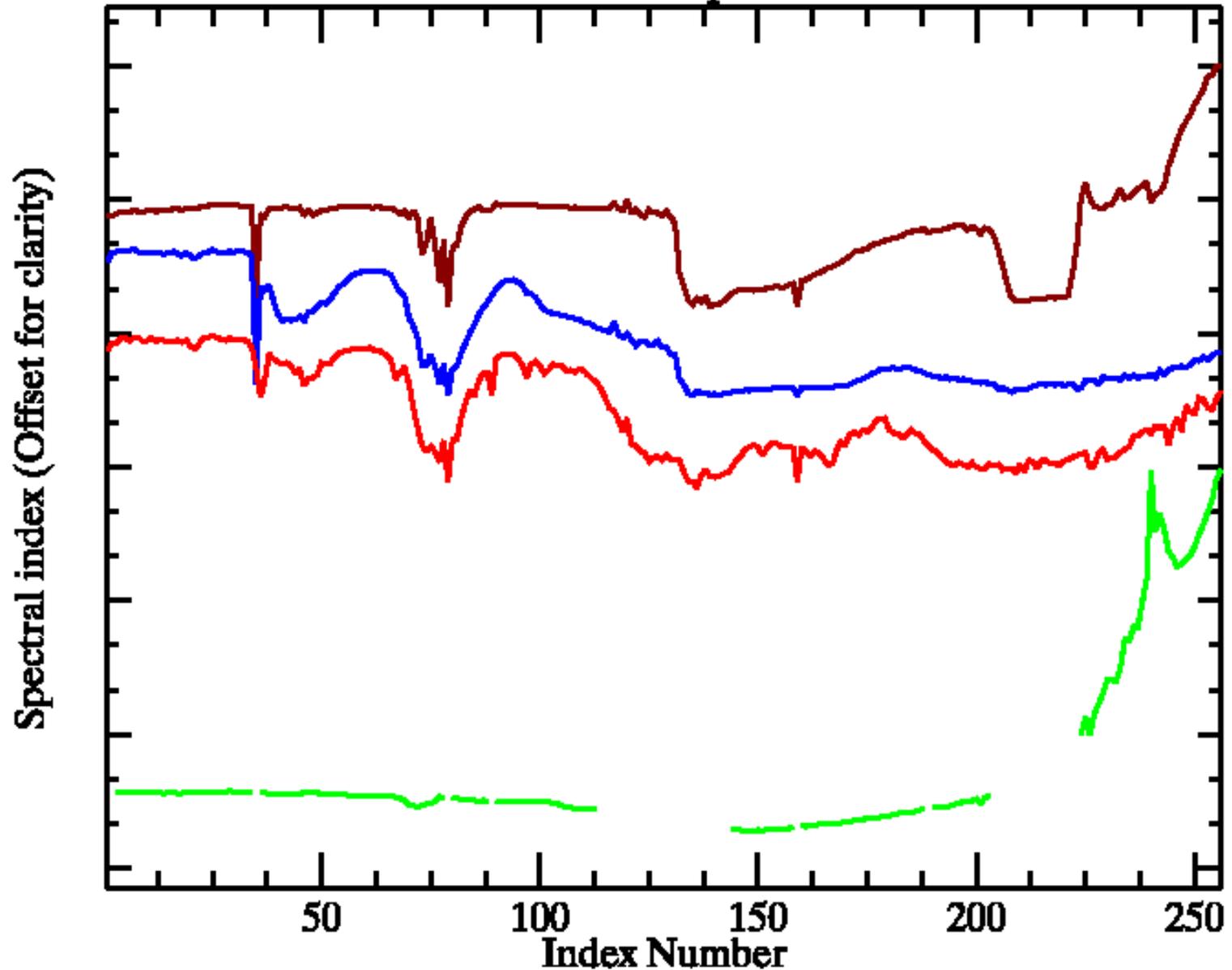
OMEGA spectra

Poussière

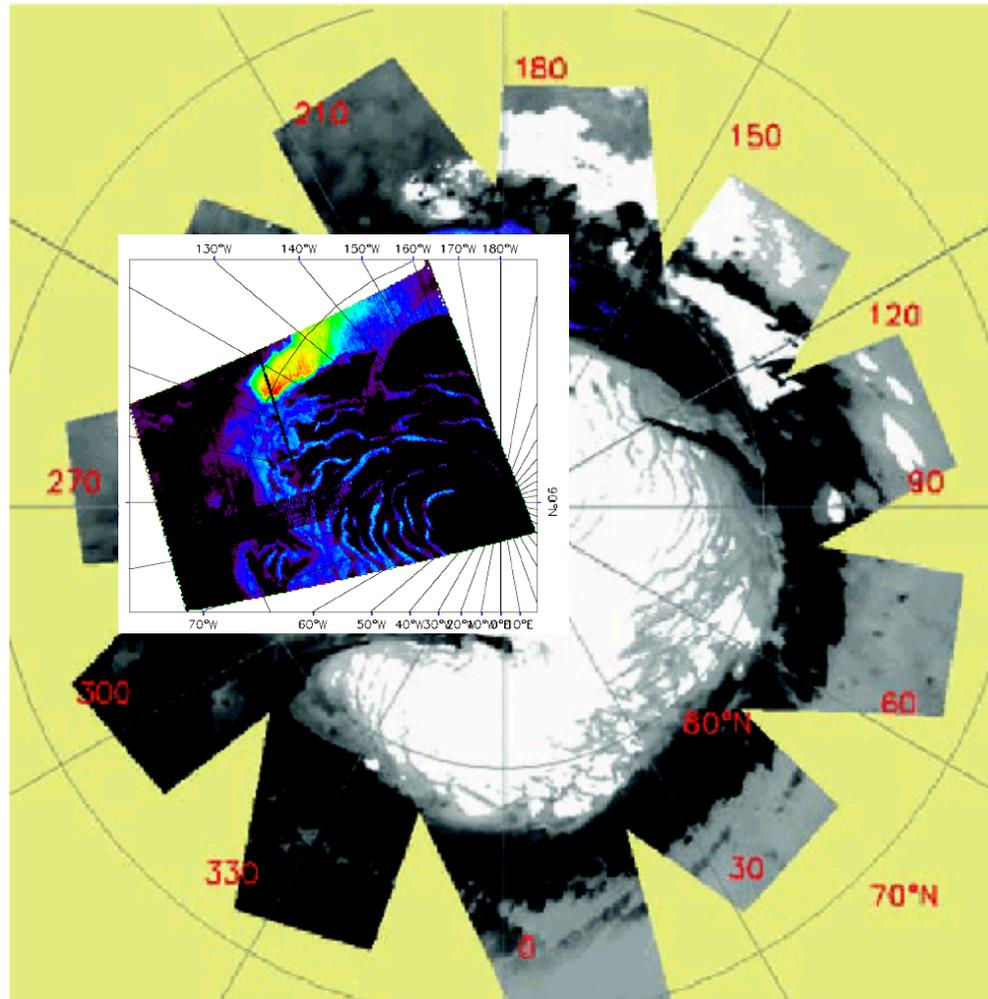
H₂O

CO₂

gypse



Sulfates dans la zone polaire Nord

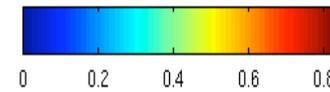
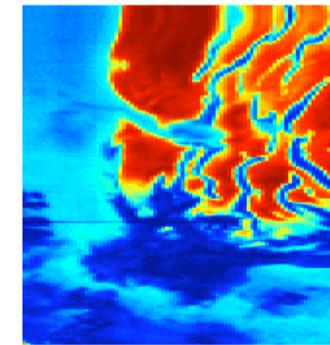
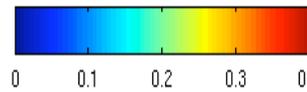
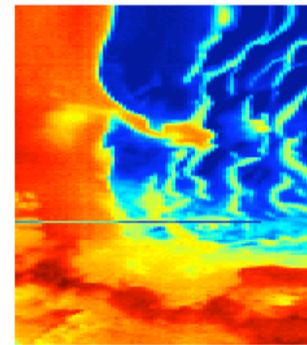
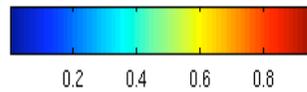
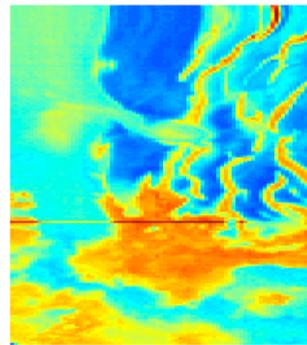
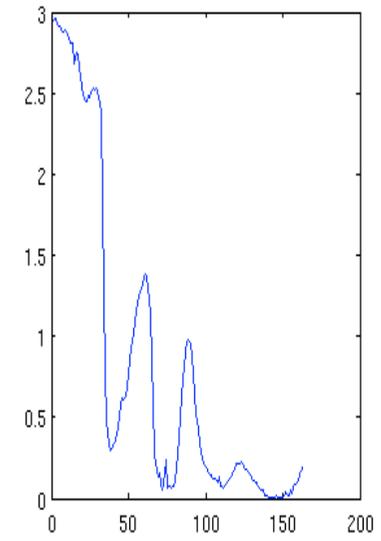
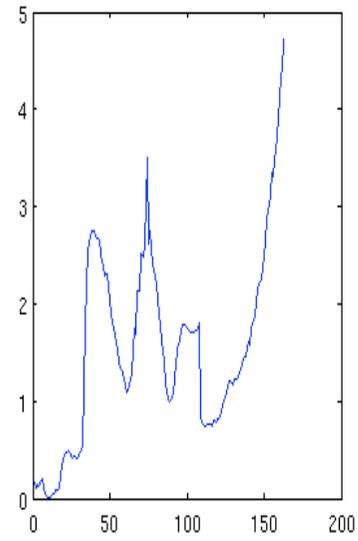
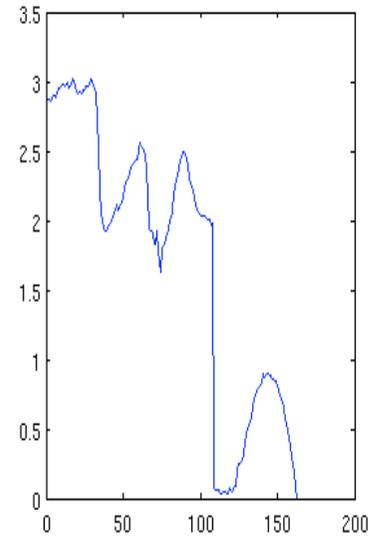
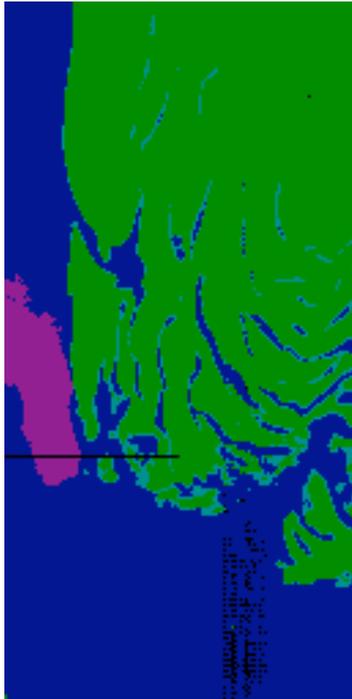


- Dans les plaines sombres

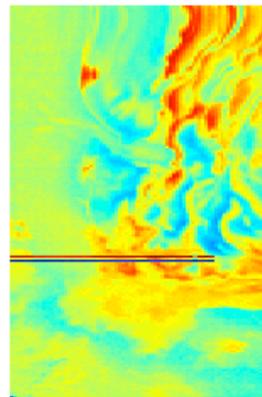
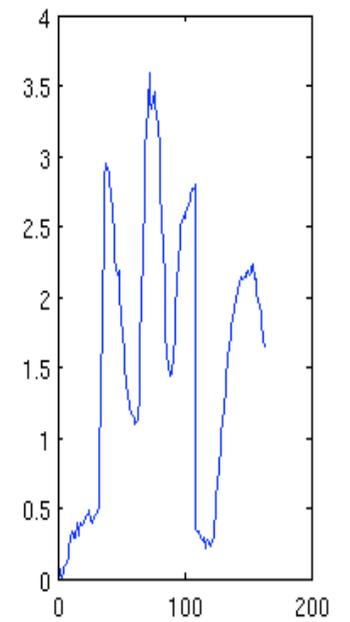
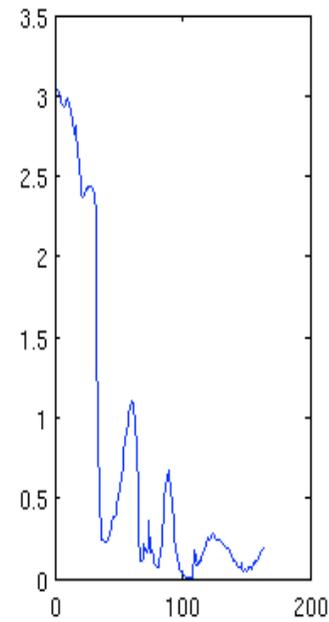
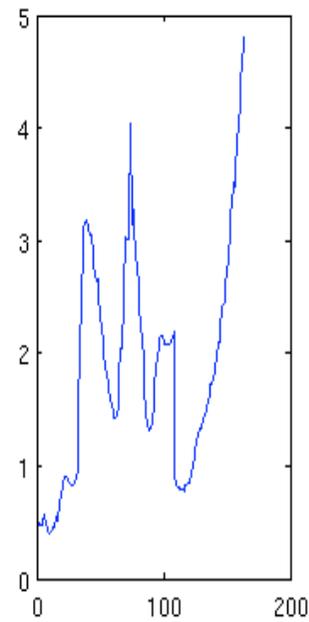
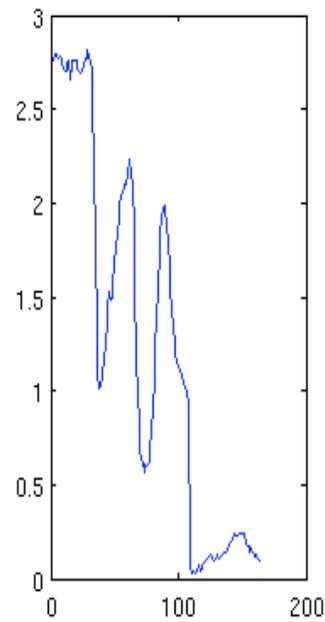
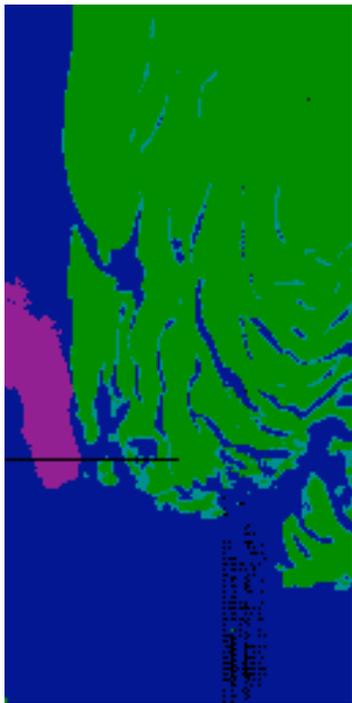
Méthode Wavanglet

Langevin et al., 2005

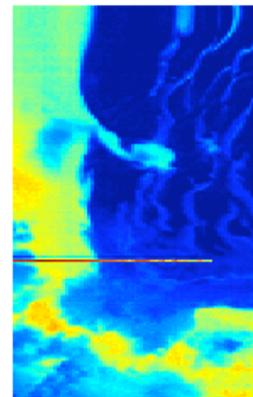
3 sources



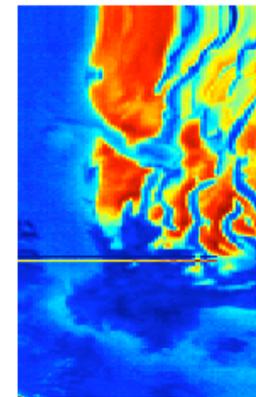
4 sources



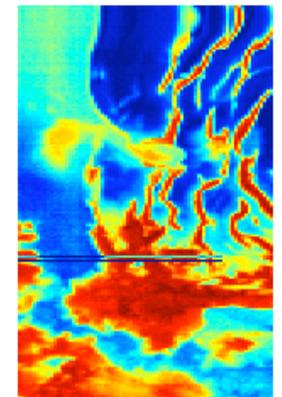
0.2 0.4 0.6 0.8



0 0.2 0.4

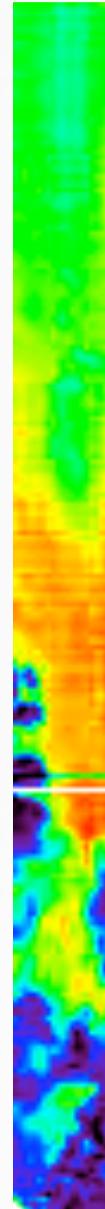
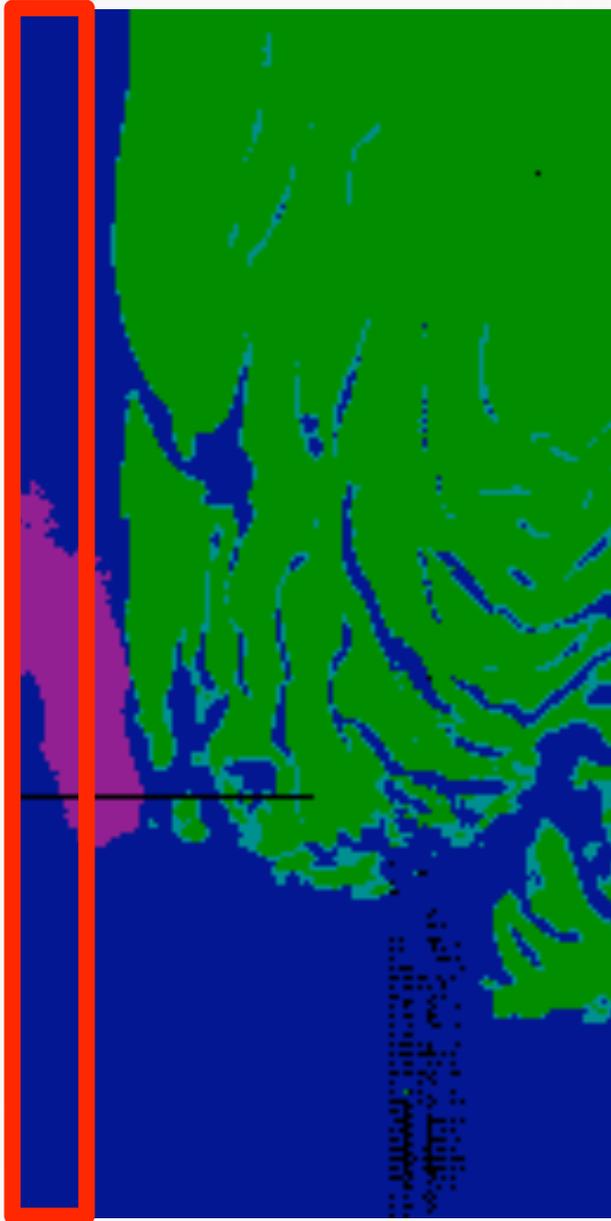


0 0.2 0.4 0.6



0 0.1 0.2 0.3

Abondances

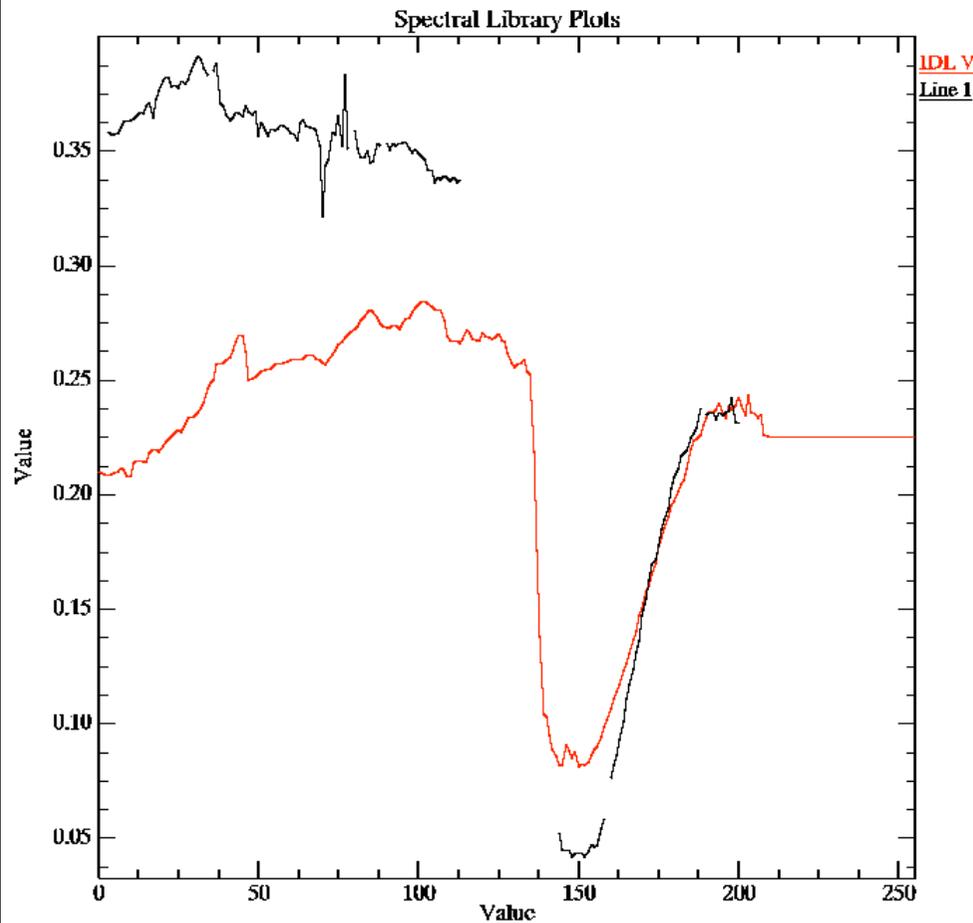


Source 1

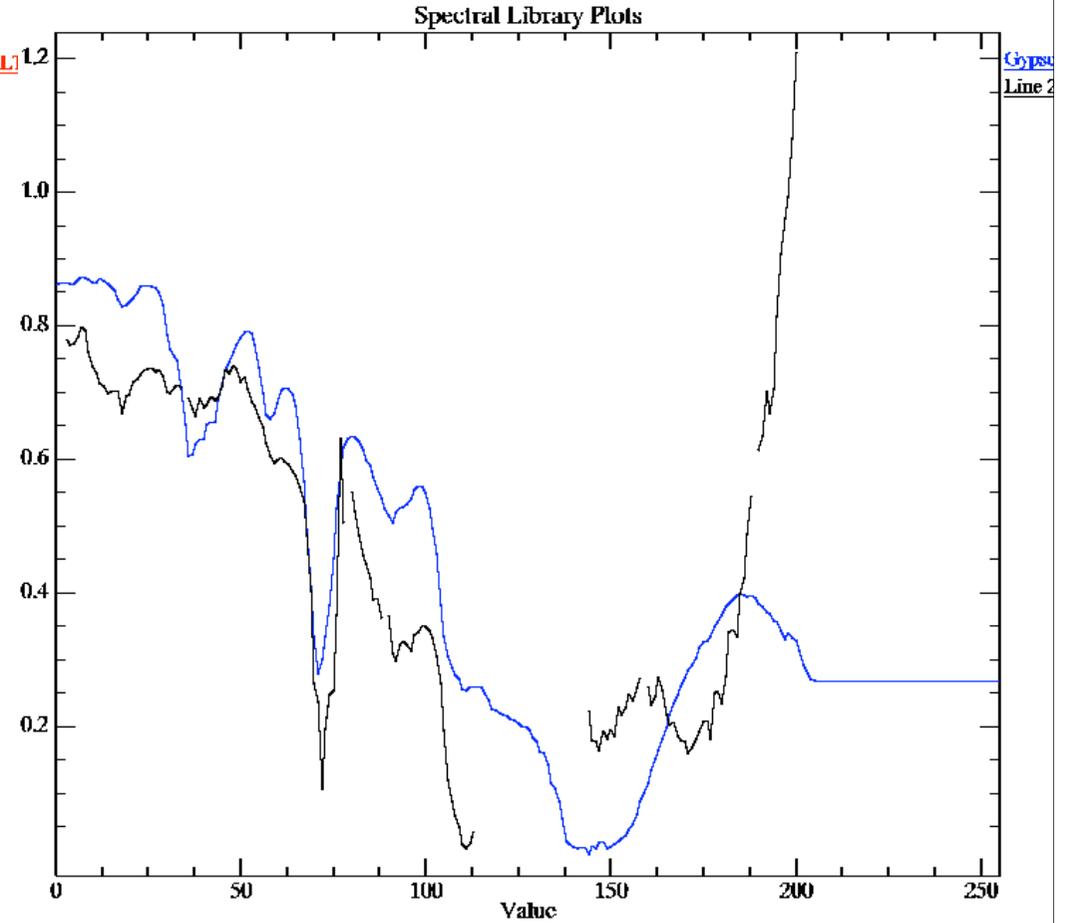


Source 2

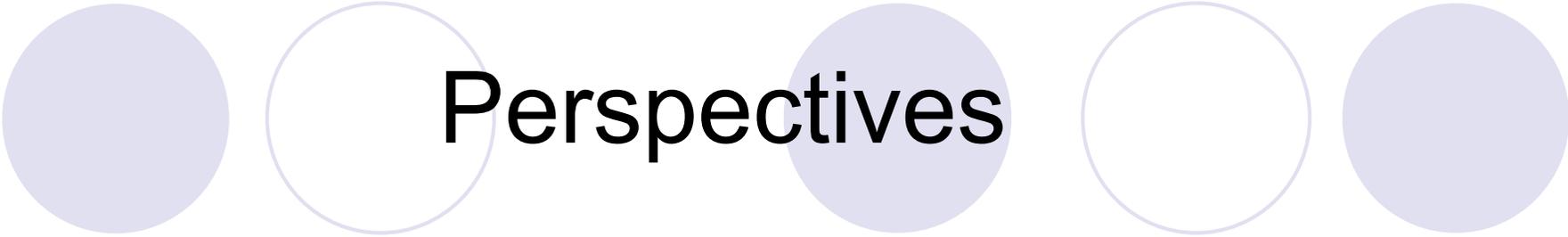
Spectres



Source 1
basalte (LPG, A. Pommerol)

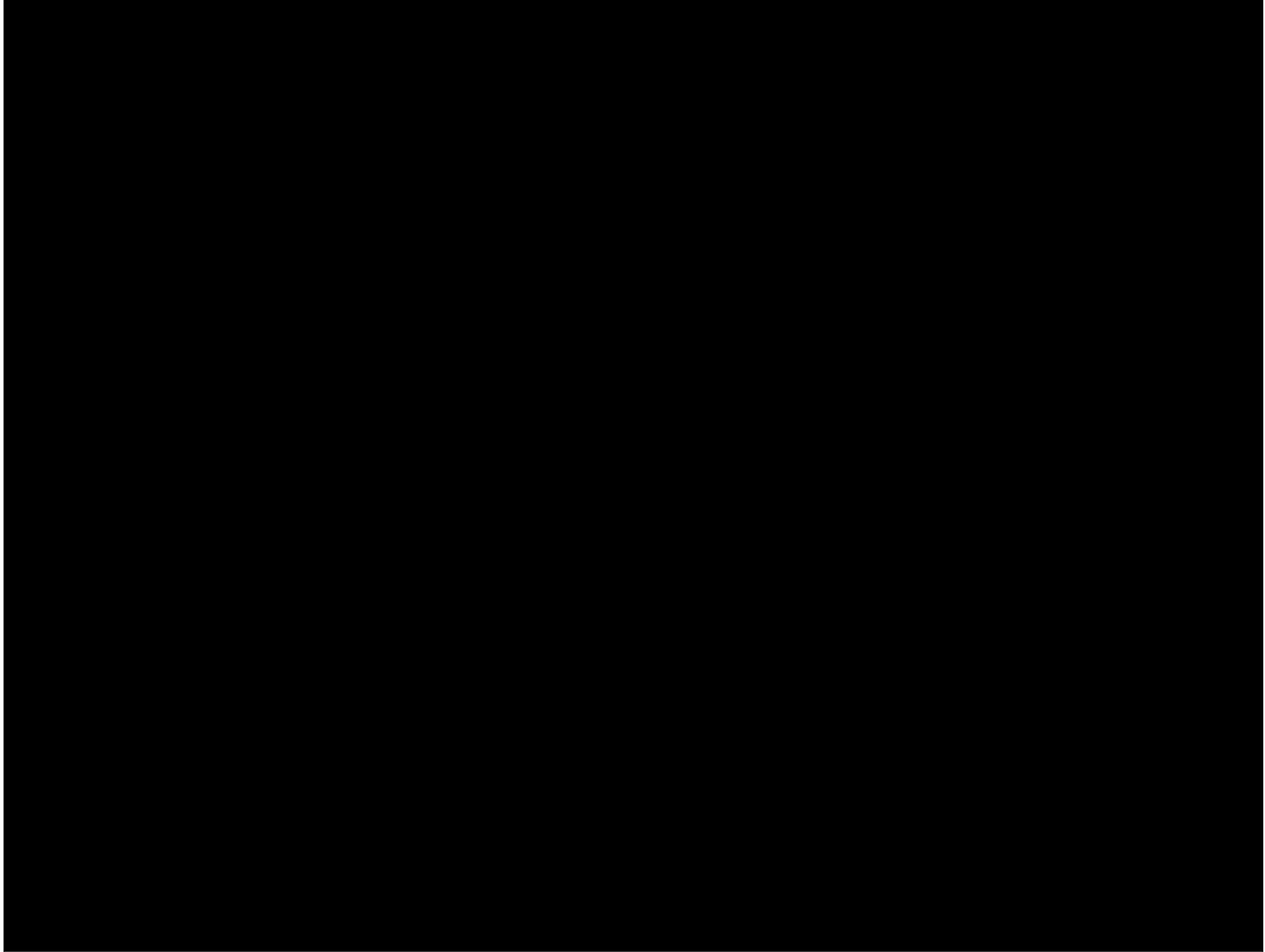


Source 2
gypse (LPG, A. Pommerol)



Perspectives

- Conclusion
 - Estimation des spectres des corps chimiques purs
- Amélioration
 - Nombre de source (JADE et BPSS)
 - Dépendance du nombre de pixel par classe
 - Présence de glace



Sulfates dans Valles Marineris

