

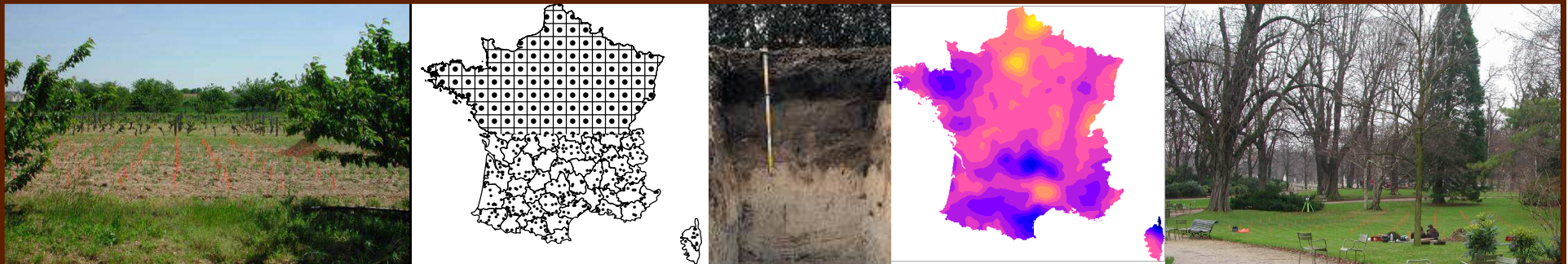
Cartographie des ETM dans les sols de France à l'aide du Réseau de Mesures de la Qualité des Sols (RMQS)

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Objectifs

- Peut-on cartographier des gradients ?
- Peut-on détecter des valeurs anormales ?
- Quelle est l'origine des ETMs ?
- Peut on la cartographier ?

Quels outils statistiques pour tenter de répondre à ces questions ?

Plan

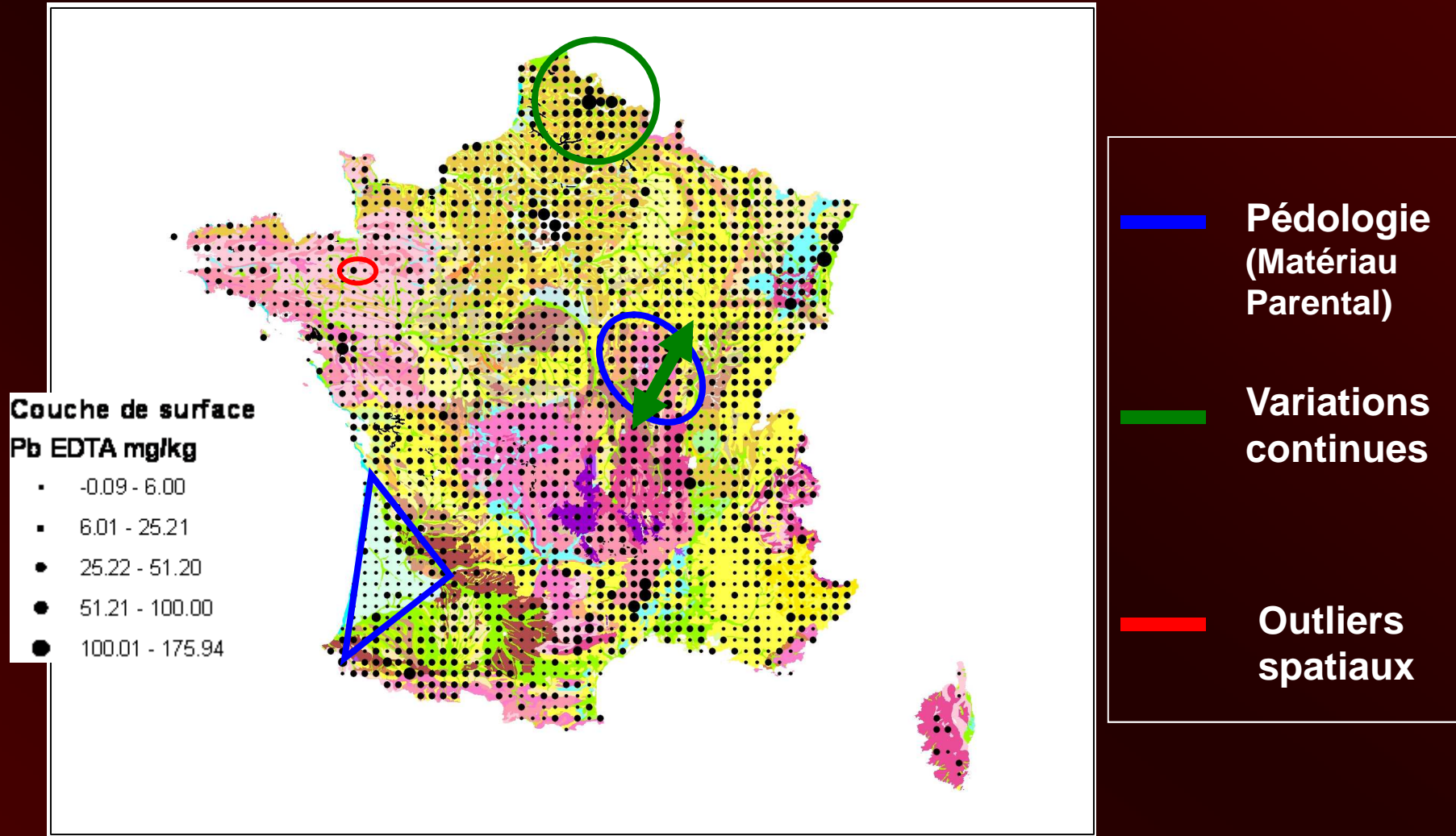
1. Les gradients :
Cartographie robuste des teneurs en Pb extractible de la couche de surface
2. L'origine :
ACP sous contraintes spatiales des teneurs en 8 éléments traces

Peut-on cartographier des gradients ? (Marchant et al., EJSS, 2009)

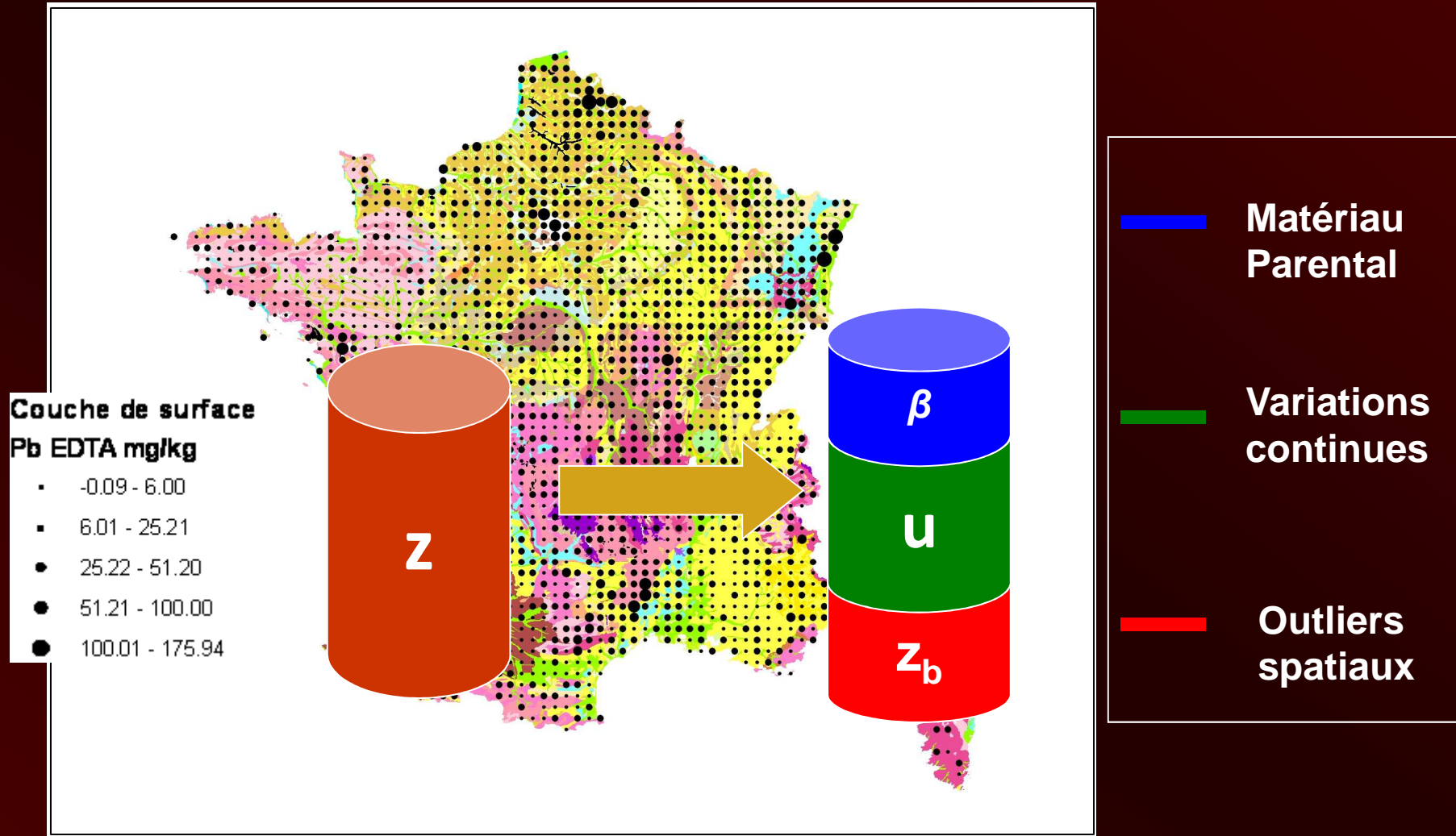
Partie 1



3 sources de variation spatiale

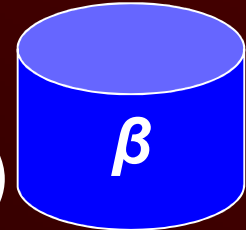


3 sources de variation spatiale



Modèle linéaire mixte robuste

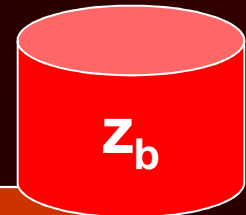
Effets fixes = matériau parental ($M\beta$)



Effets continus = géostatistique (u)

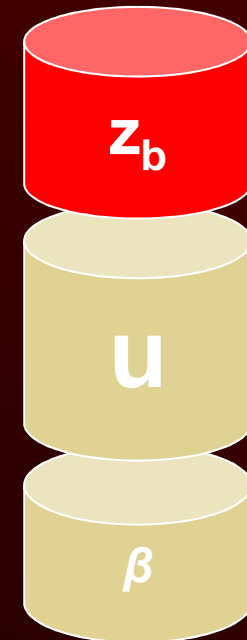
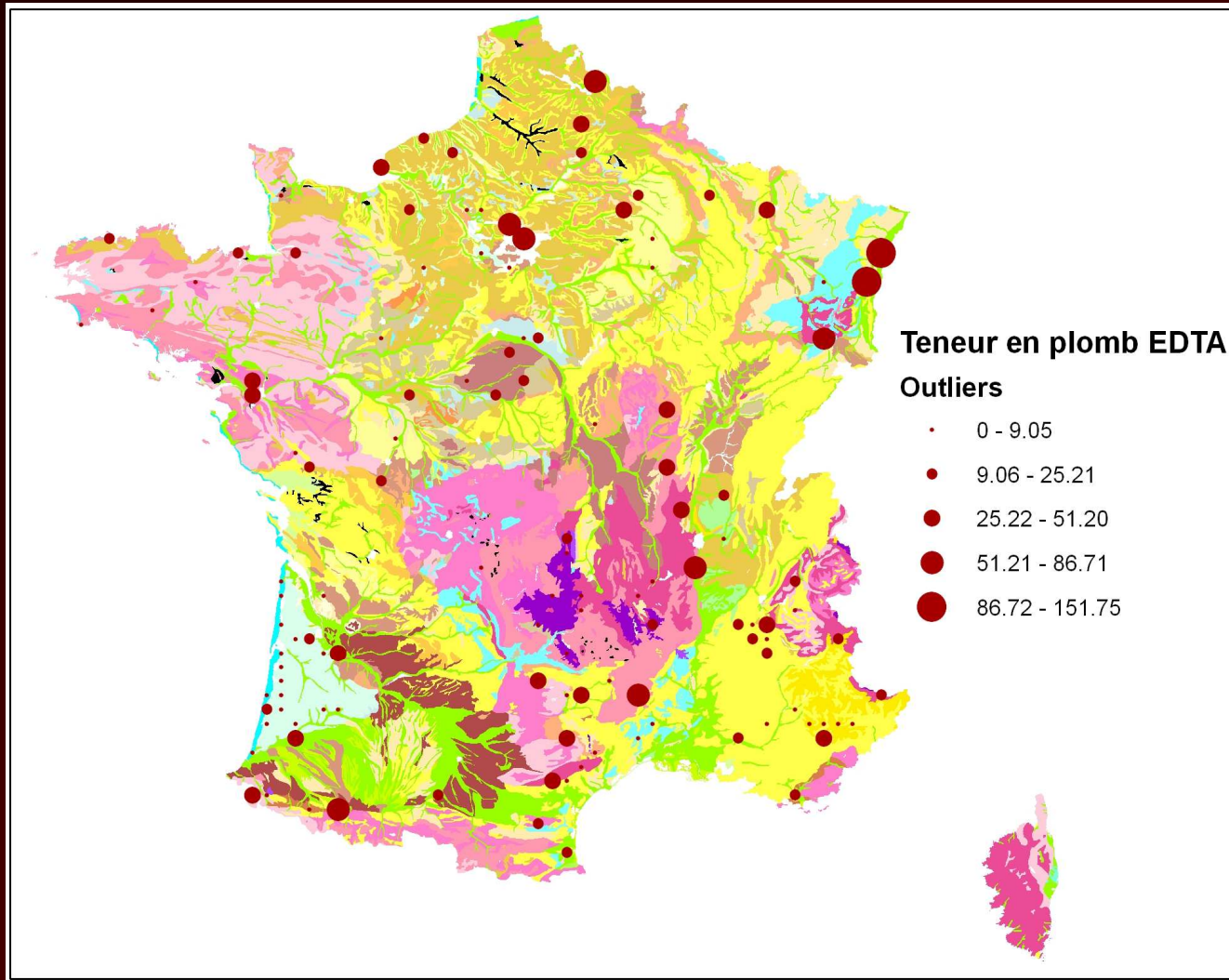


$$z = M\beta + u$$



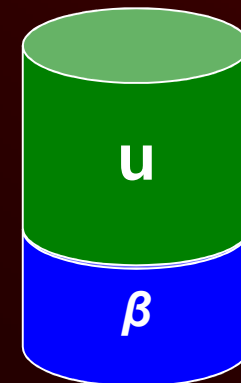
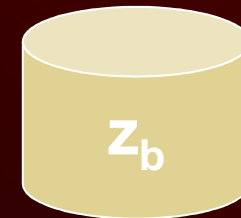
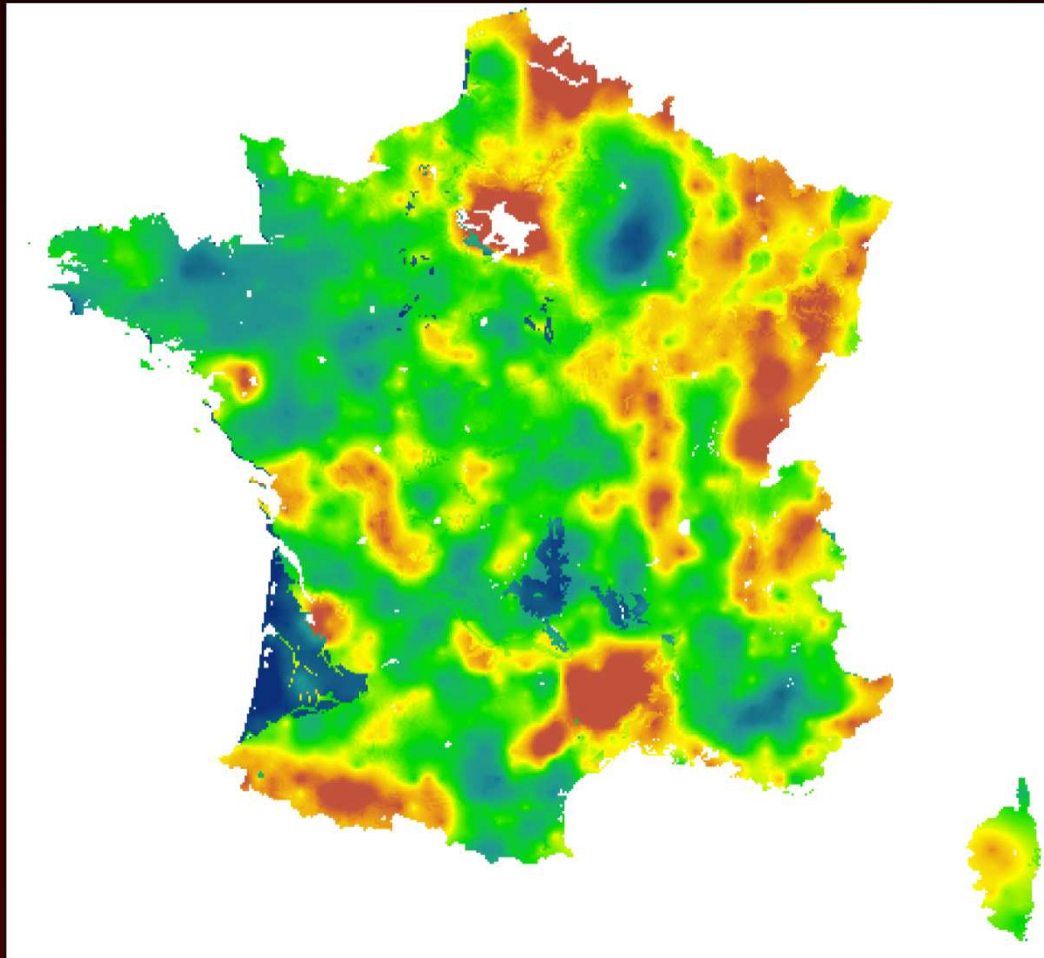
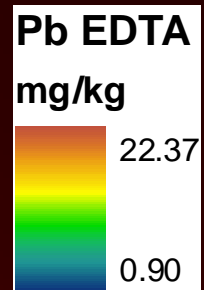
Krigeage robuste élimine l'effet des variations à courte distance

Les outliers



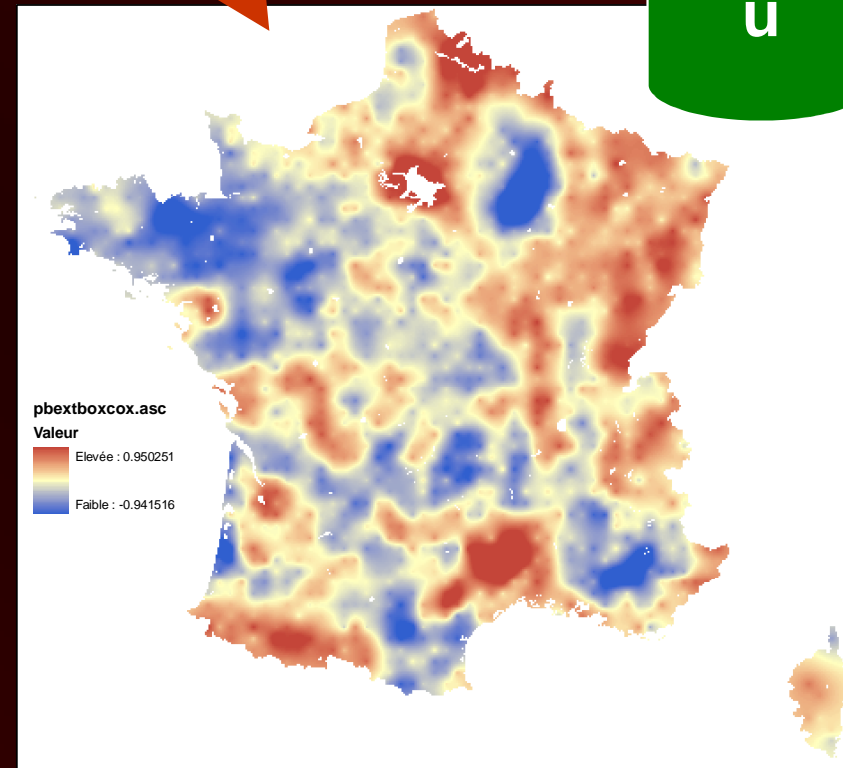
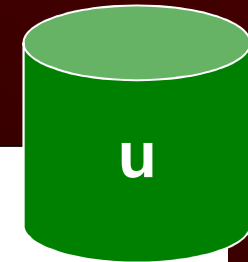
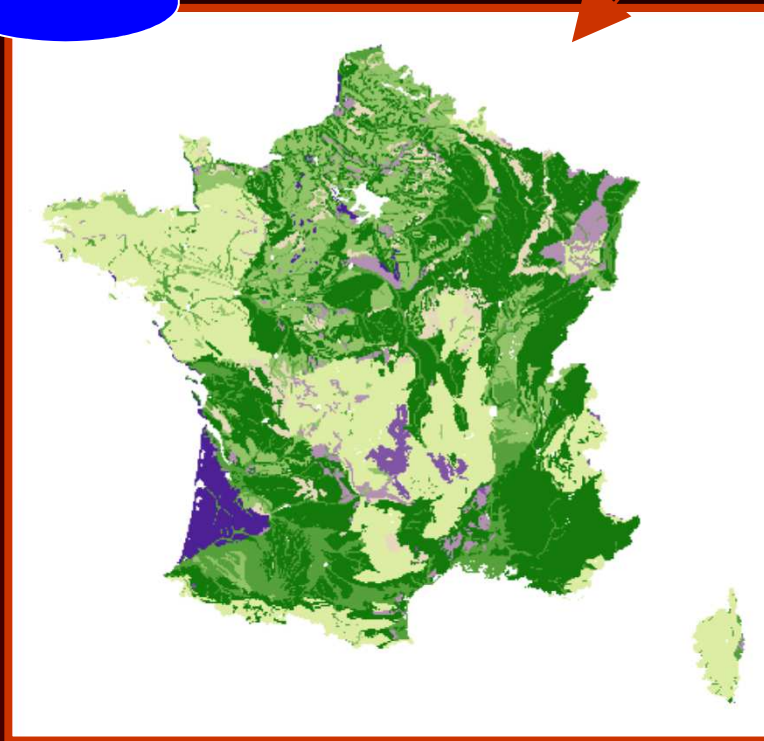
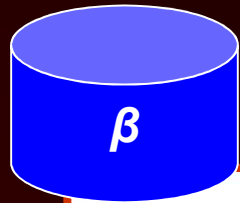
Cartographie

$$z = M\beta + u$$



Séparer les effets

$$z = M\beta + u$$



Peut-on cartographier l'origine des ETM ? (Saby et al, Stoten 2009)

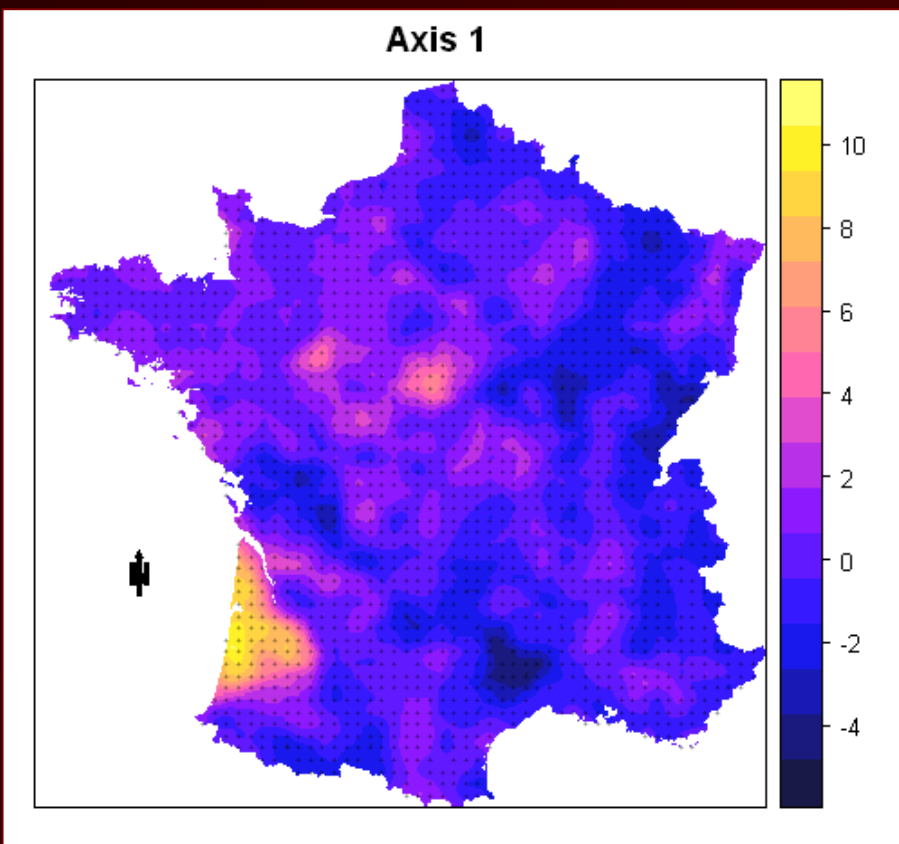
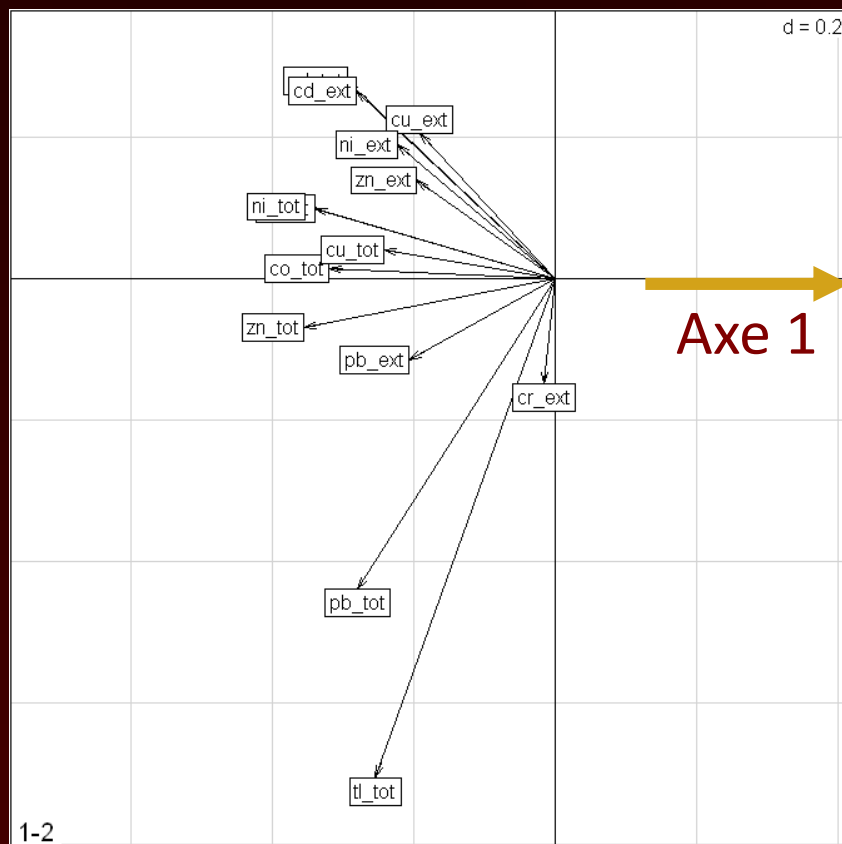
Partie 2



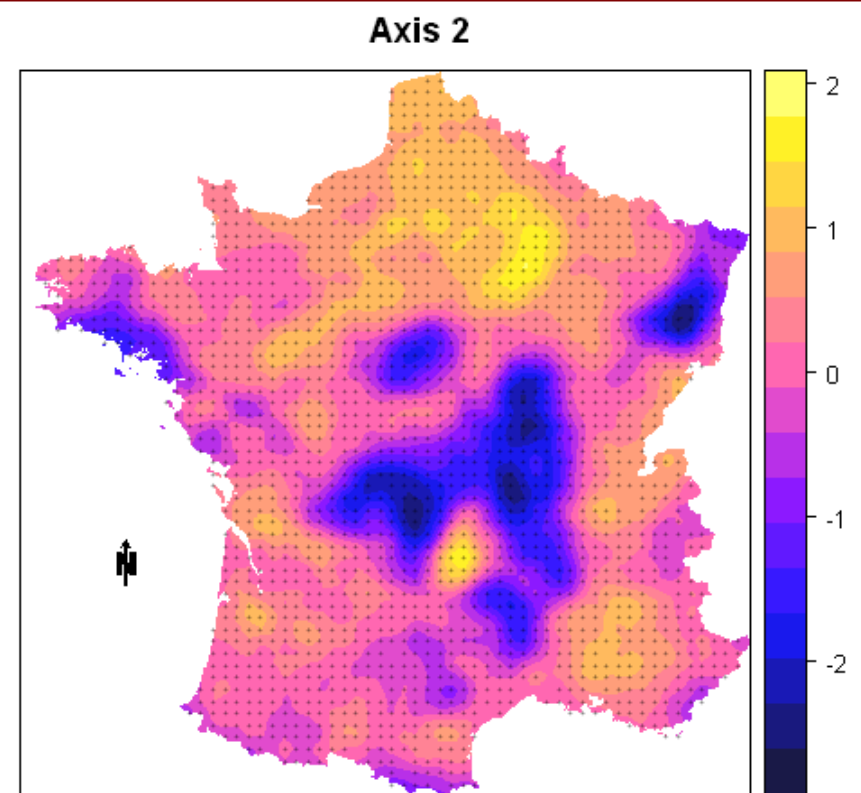
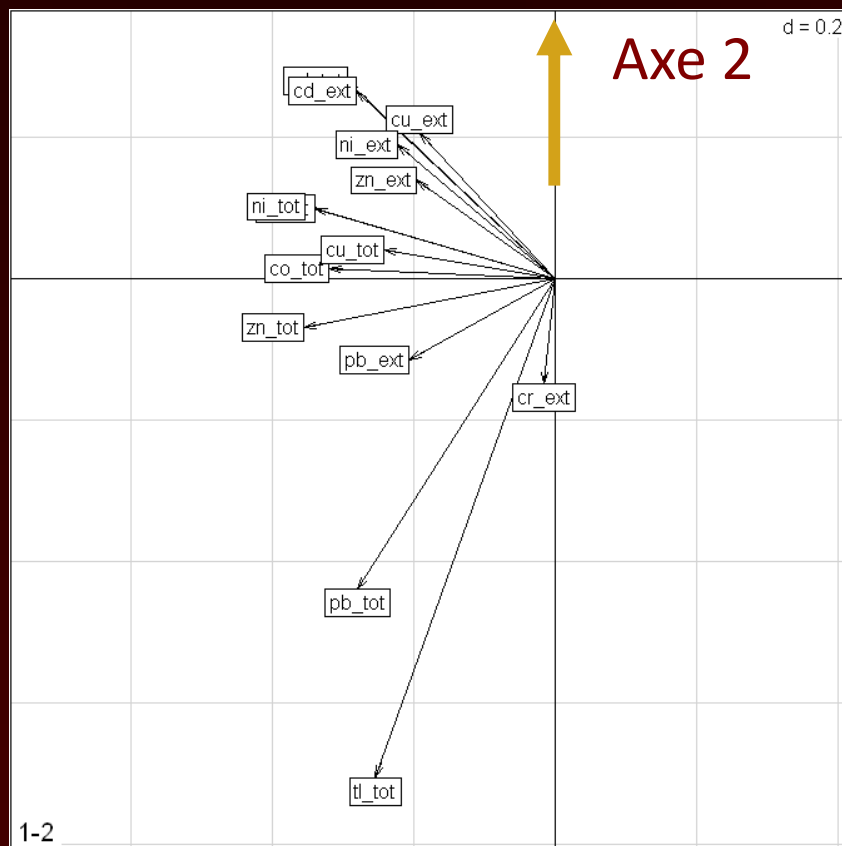
Objectifs

- **8 ETMs (extraction totale HF):
Cd, Cu, Cr, Co, Ni, Pb, Tl, Zn**
- **4 ETMs (extraction partielle EDTA)
Cd, Cu, Pb, Zn**
- **Cartographie des coordonnées des individus sur les axes d'une ACP spatiale**

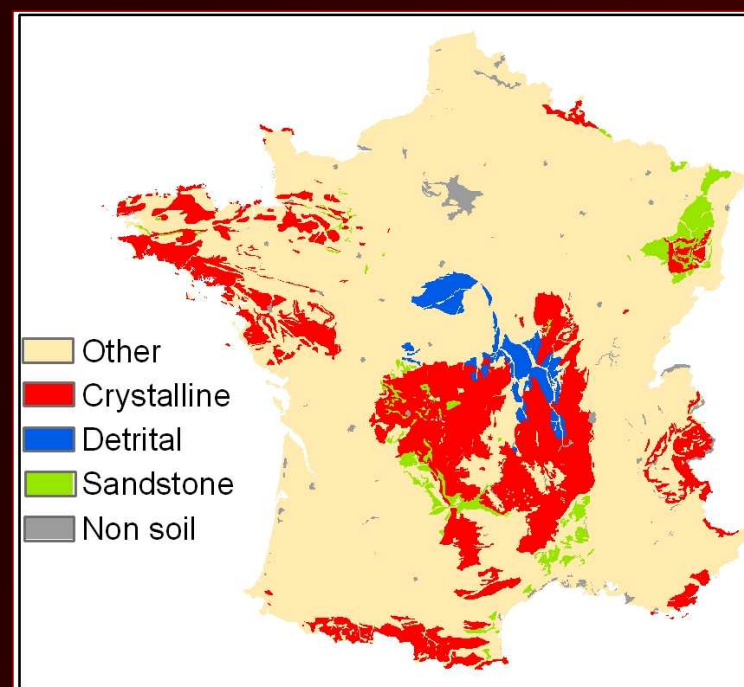
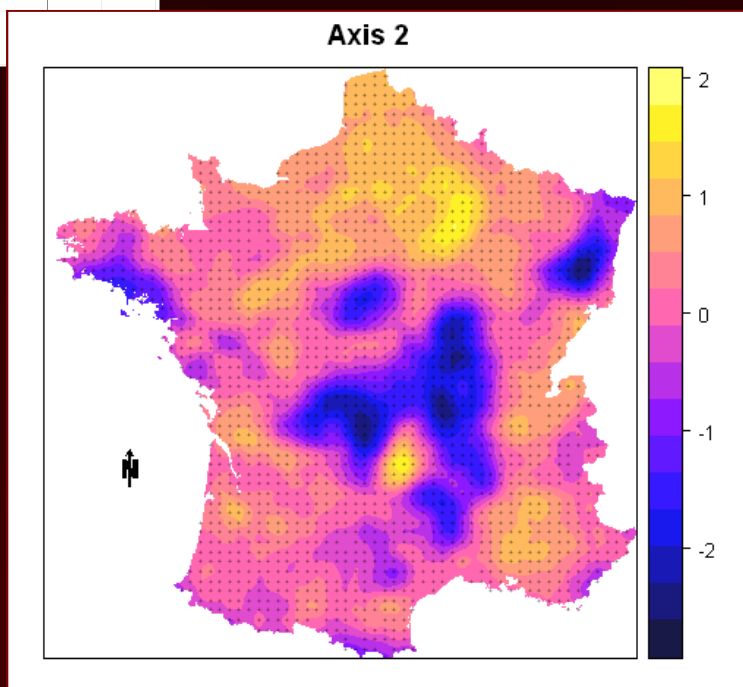
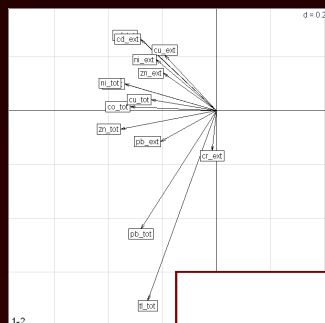
Axe 1 : richesse globale en ETMs



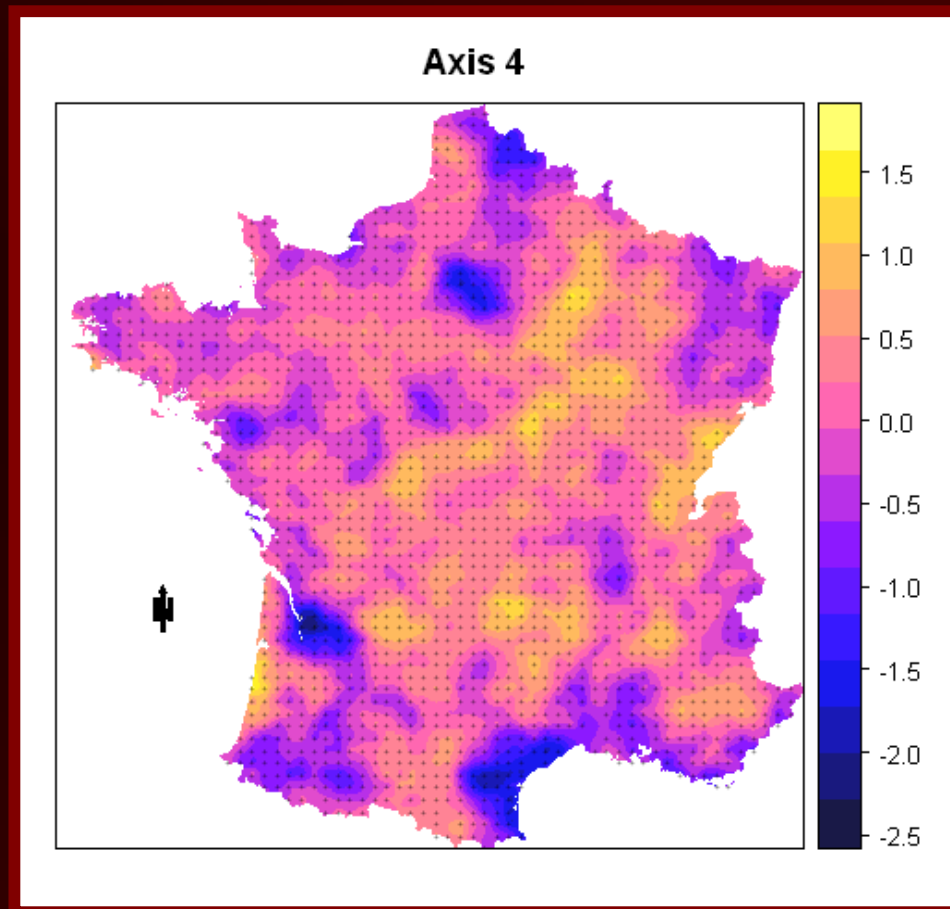
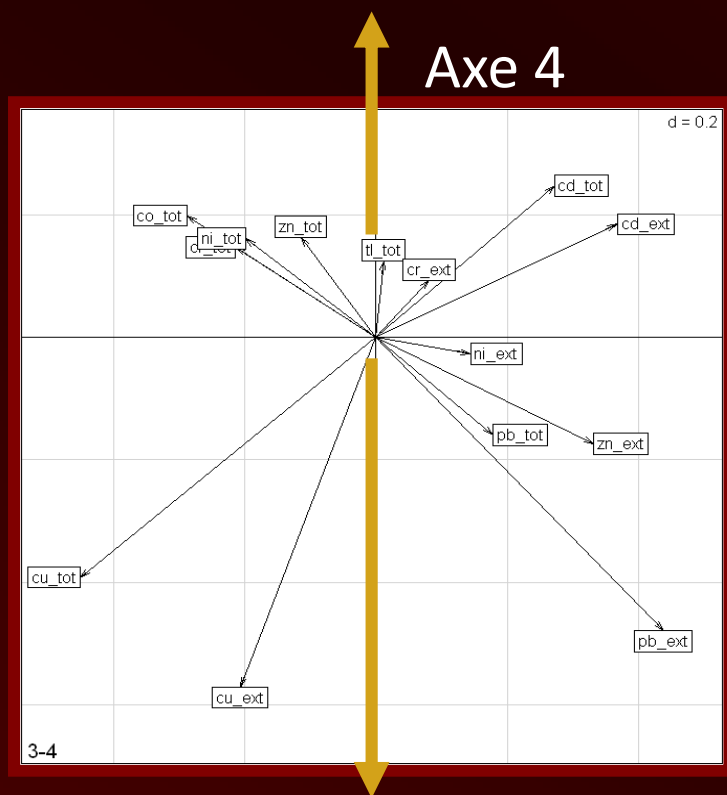
Axe 2 : origine naturelle en Pb et Tl



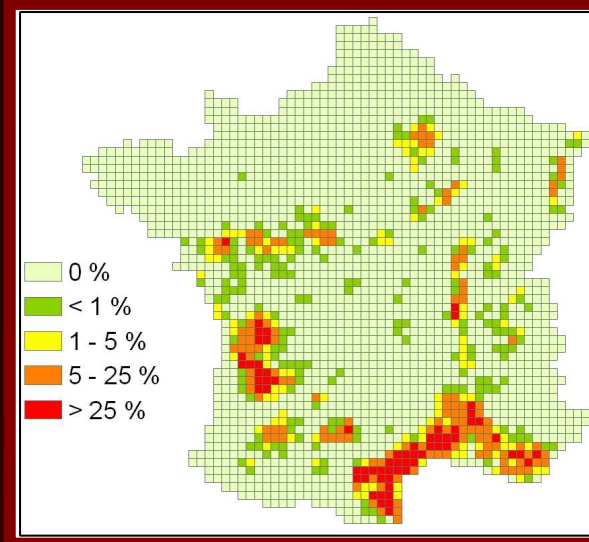
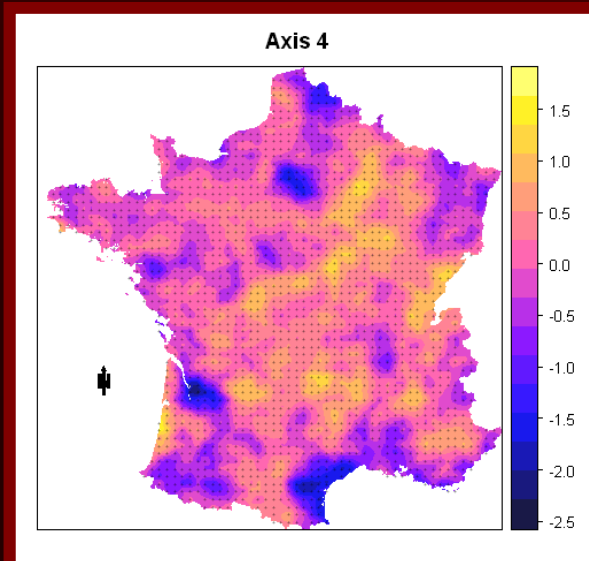
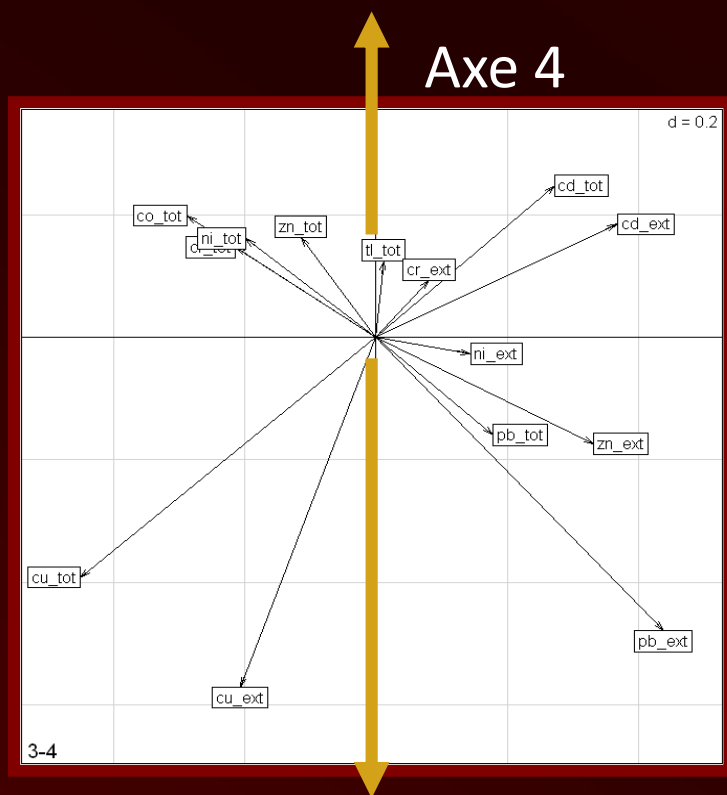
Axe 2 : origine naturelle en Pb et Tl



Axe 4: Origine anthropique du Pb et Cu

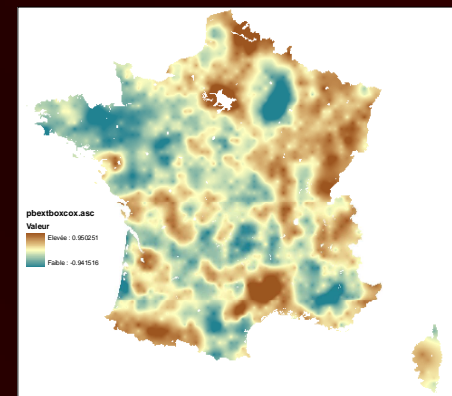


Axe 4: Origine anthropique du Pb et Cu



Conclusions

- Modèle linéaire mixte robuste qui sera appliqué à l'ensemble des ETMs
- Corrélations entre ETM permettent d'identifier des origines
- Efficience du RMQS



Merci de votre attention



1er Décembre 2009 Séminaire IGCS Poitiers