A new mineralogical database for atmospheric dust to estimate soluble iron fluxes to Surface Ocean

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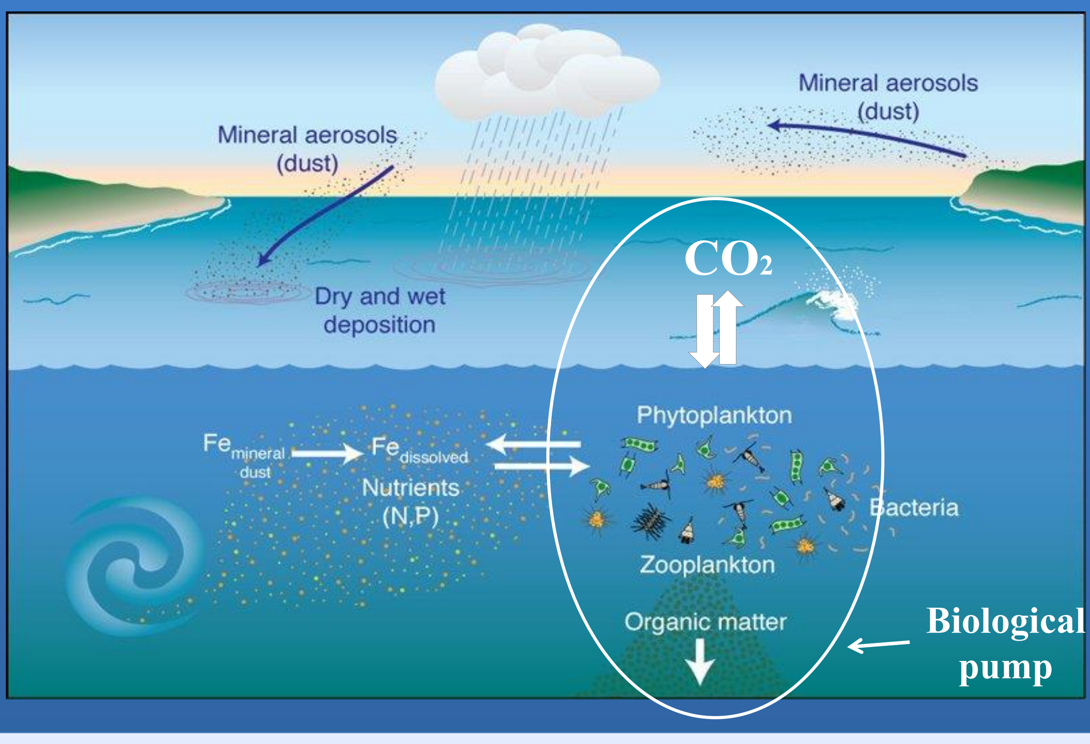
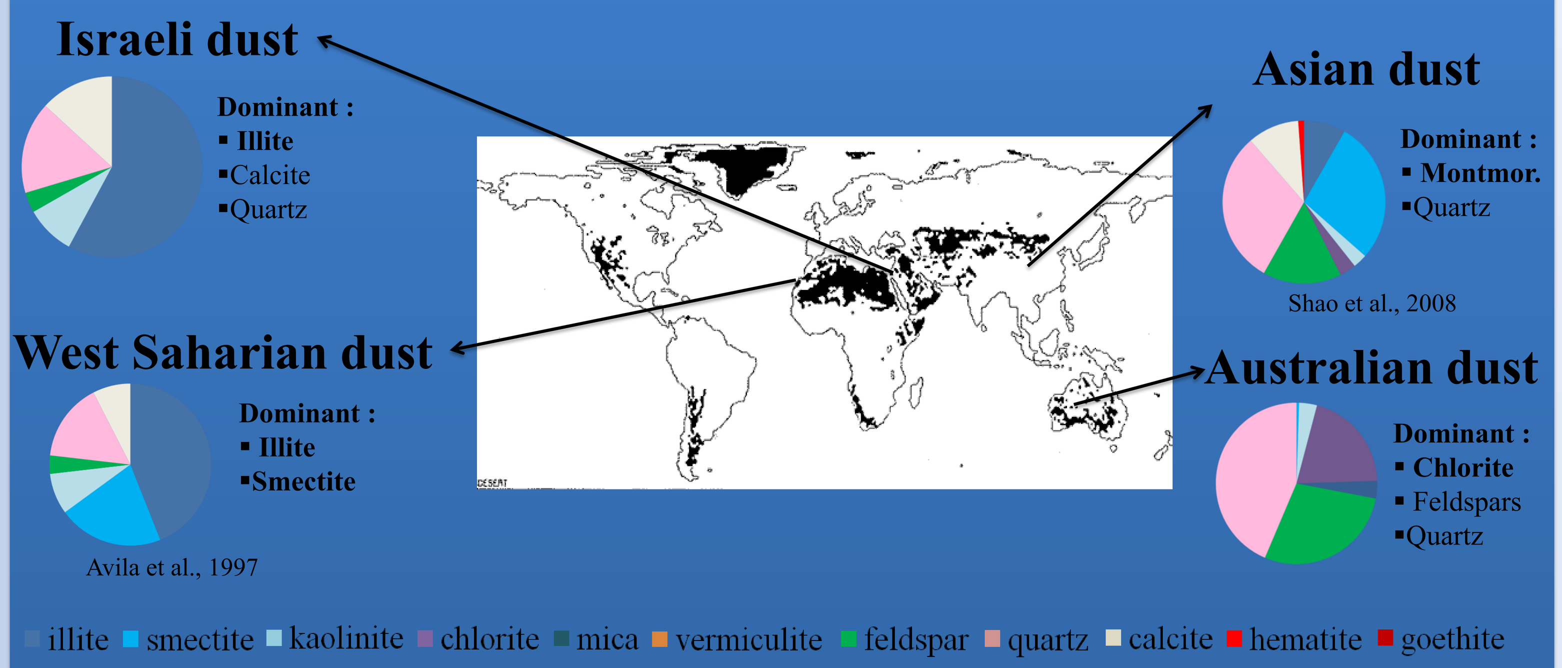
I Desert dust, ocean productivity and atmospheric pCO_2



Atmospheric iron supply can stimulate productivity in many regions of the world ocean, but only if it exists in a readily dissolvable form.
=> We need to estimate **iron solubility (SFe)** for mineral dust particles.

III How inform the mineralogy of dust particles ?

Very few measures for a high variability

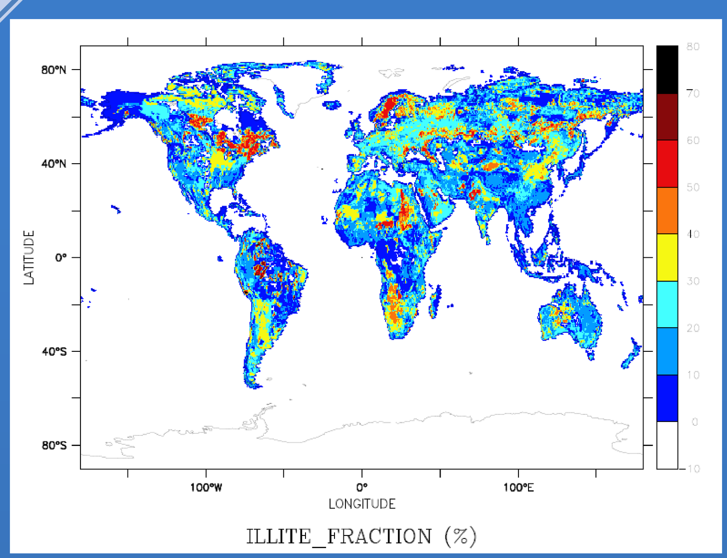


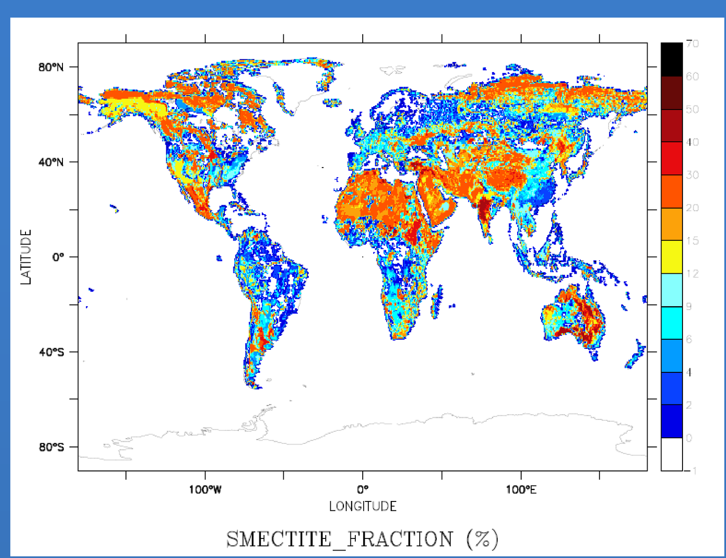
The variability of the mineralogical composition reflects **the diversity of source soils**

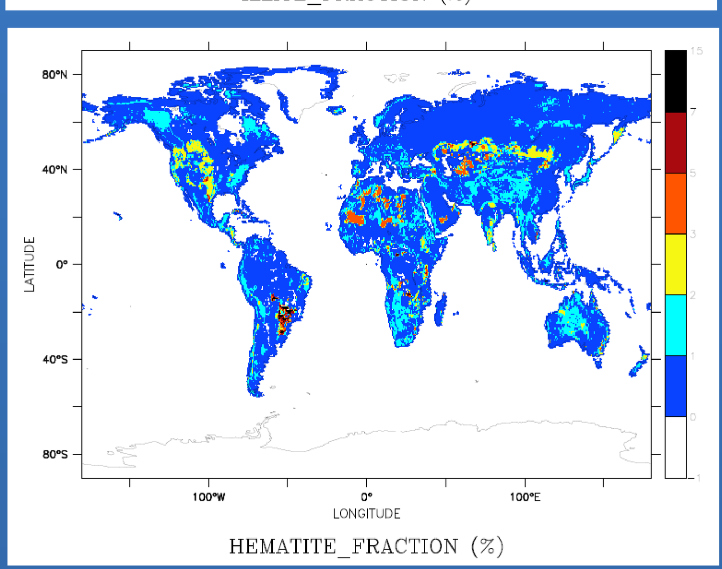
The method consist to document **the size-resolved mineralogy of soils** and to transport each mineral from the database, constitutive of the dust, in a General Circulation Model (GCM)

V Examples of some mineralogical maps

Clay fraction of soils



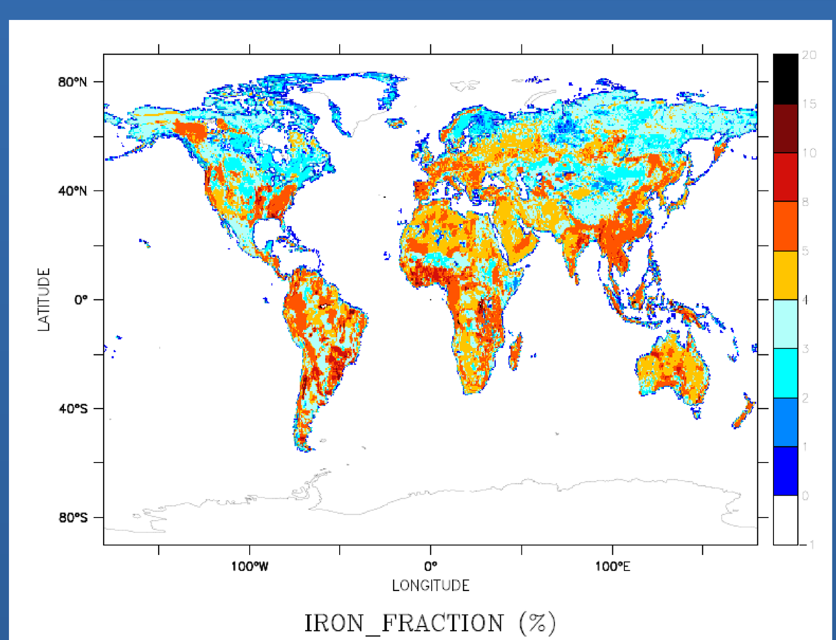




➢For the clay fraction : 10 minerals
Illite, montmorillonite, chlorite, vermiculite, kaolinite, calcite, quartz, feldspars, hematite and goethite

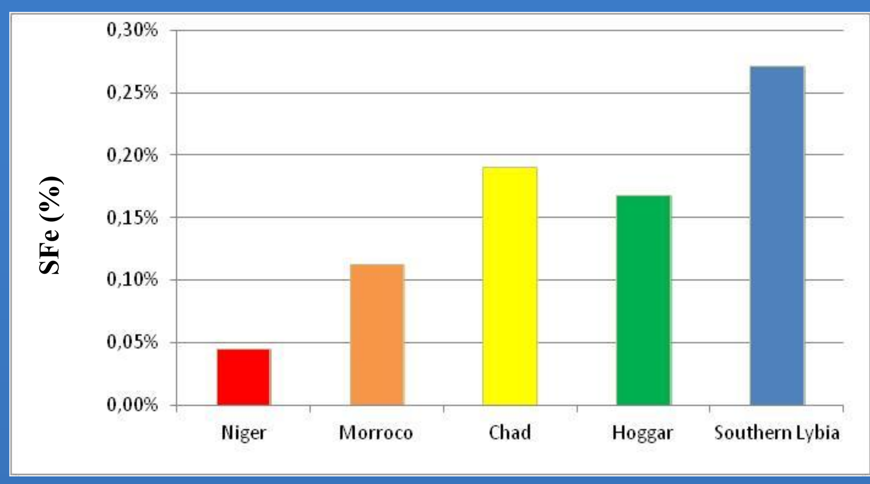
➢For the silt fraction :7 minerals
mica, chlorite, calcite, gypsum, quartz, feldspars and hematite.

Derived product:
Iron content in the clay fraction of soils



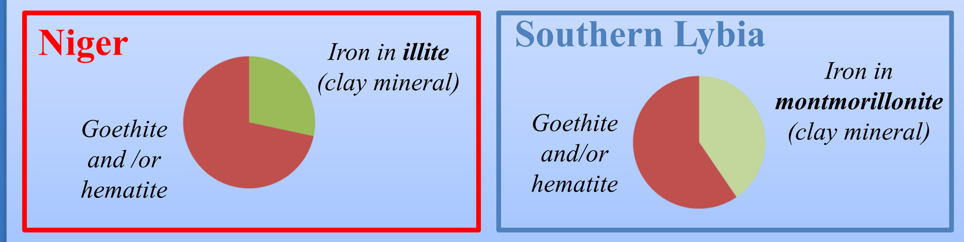
II Iron solubility driven by dust mineralogy

1- Iron solubility measured in African dust collected close to the source:

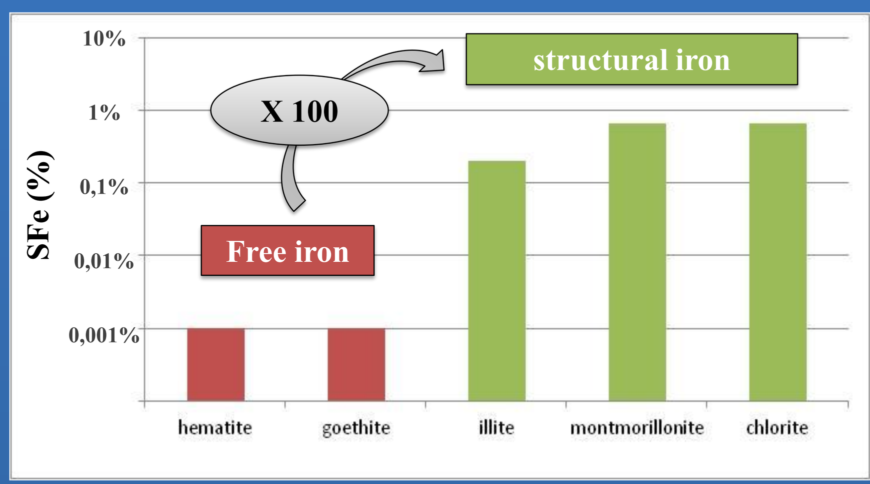


The observed **variability is associated with mineralogical speciation of iron** which vary according to location of the source

Examples: Mineralogical speciation of iron in two samples



2- Iron solubility measured in individual minerals :



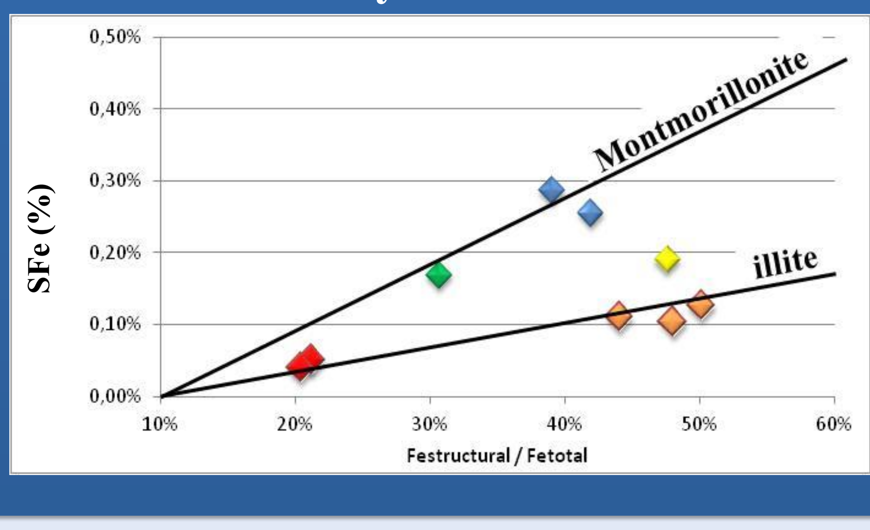
Two kind of iron , two kind of solubility :

➢ **Free iron = "insoluble" iron oxides**

➢ **Structural iron = "soluble" clay minerals**

Soluble iron is primarily derived from **illite** and **montmorillonite** as they are the most common clay minerals found in African dust.

3- Iron solubility in dust vs iron mineralogy



Knowing the mineralogical composition, iron solubility can be estimated from those measured on individual minerals :

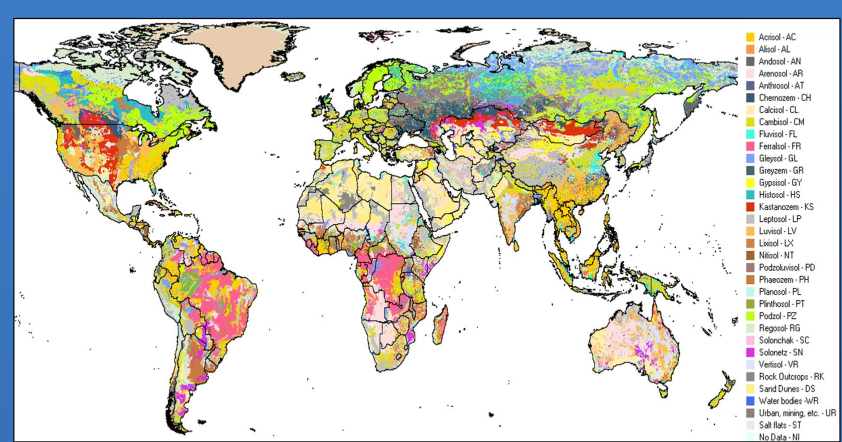
SFe = 0,20% * % Fe_{illite} + 0,65% * % Fe_{mont}

IV Building Database of soils mineralogy

(updated from Claquin et al., 1999)

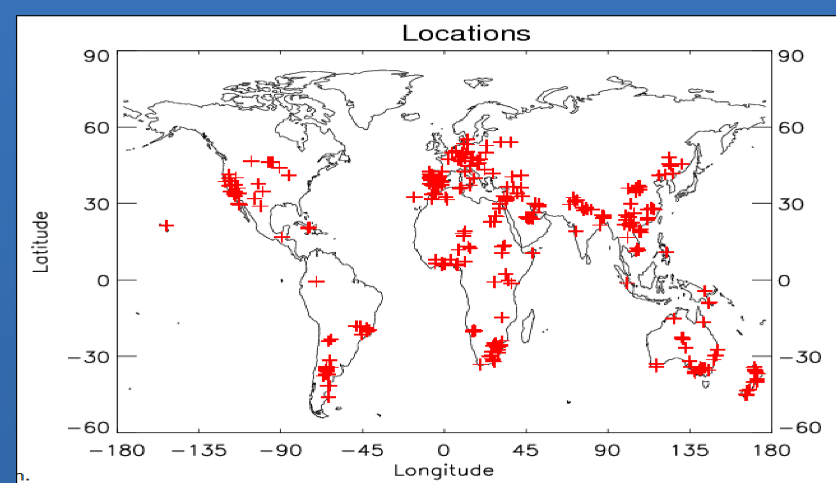
The method is based on a quantitative description of the mineralogical composition of the erodible fraction of each soil units of the FAO classification

1. Soil types distribution issue from the Harmonized World Soil Database



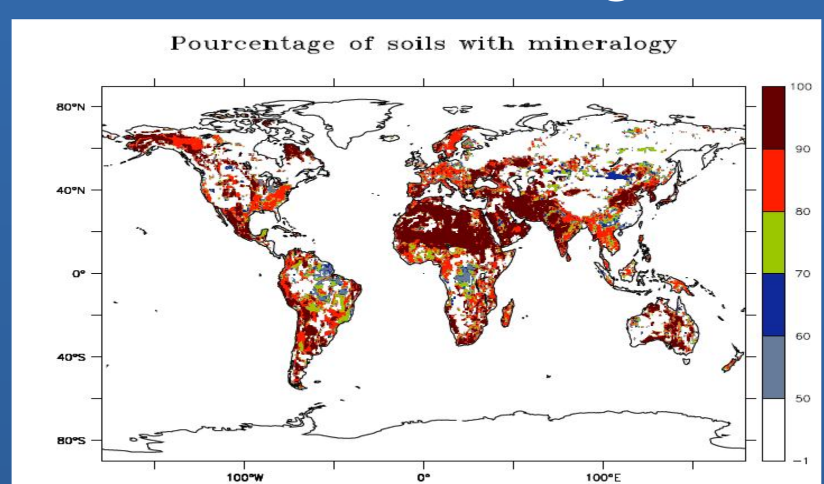
HWSD = Only existing database that provides a global distribution of FAO soil units
✓ 28 soil classes
✓ 230 soil units to describe !

2. Localization of the data



The selection criteria:
✓Size-resolved mineralogical information
✓Surface horizon
➢ **594 soil descriptions** in the database with more than120 references

3. Database coverage



Good coverage between latitudes 0 and 30°N .

To obtain a full coverage, assumptions have been issued to assign a mineralogical composition to each soil units.

VI Outlooks:

➢ **Simulation is running in order to simulate total and dissolved iron fluxes to surface ocean.**
➢ **These fluxes will be compared with those obtained without taking into account the differences in soil mineralogy.**

Conclusion:

The database is global in extent : it not only cover actual erodible areas but also covers areas that are not potential sources in present climate. This open the path to study :
➢ **Impact of mineral dust (solar radiation, cloud nucleation, ocean productivity and health)**
➢ **Past and future scenarios**