A high frequency flux monitoring station of suspended sediments, nutrients and pollutants at the lower Rhône River (SORA)

Station de surveillance et d'enregistrement haute fréquence des flux solides en suspension, des sels nutritifs et des polluants en transit dans les eaux du Rhône aval (Station SORA)

Eyrolle F.[1], Antonelli C.[1], Raimbault P.[2], Boullier V. [1], Fornier M.[2], Sivade E.[3]

[1] IRSN, Institut de Radioprotection et de Sûreté Nucléaire, Direction de l'Environnement et de l'Intervention, Service d'Etude et de Surveillance de la Radioactivité de l'Environnement, Laboratoire d'Etude Radioécologique en milieux Continental et Marin, Centre de Cadarache, BP 3, 13115 Saint Paul Lez Durance, France.
[2] Laboratoire de Microbiologie Géochimie et Ecologie Marines UMR 6117 – COM, Centre d'Océanologie de Marseille, case 901, 163 avenue de Luminy, 13288 MARSEILLE Cedex 9, France.
[3] Agence de l'Eau RMC, Agence de l'eau Rhône-Méditerranée et Corse, 2-4 allée de Lodz, 69363 Lyon Cedex 07.

RÉSUMÉ

La Station Observatoire du Rhône à Arles (SORA) a été conçue afin de permettre la quantification des flux sédimentaire en suspension en transit vers le milieu marin. Cette plateforme permet également de mesurer les flux de sels nutritifs et d'éléments traces potentiellement contaminants, tels que les radionucléides d'origine naturelle ou artificielle, transférés en phase dissoute ou particulaire. Cette instrumentation permet de réaliser des échantillonnages à haute fréquence et d'enregistrer ainsi les flux en transit lors des épisodes évènementiels de crue. Elle permet également la détection d'éléments potentiellement contaminants présents à l'état d'ultra traces dans les eaux du Rhône.

ABSTRACT

The Rhône River Observatory Station in Arles (SORA) has been designed to quantify suspended sediments fluxes flowing towards the marine environment as well as liquid and solid fluxes of nutrients and various pollutants such as natural and artificial radionuclides. This instrumented platform is especially devoted to the survey of flood events through high frequency flux monitoring and the detection of ultra trace level contaminants.

KEYWORDS

Fluxes, monitoring, Observatory station, Pollutants, Rhône, Suspended sediments.

Fluxes of suspended solids and associated potentially contaminating trace elements (PCTE) transferred by rivers towards the marine environment represent key environmental parameters that greatly influence or may impact on most biogeochemical cycles and marine ecosystem functioning at a large scale. This especially concerns the Rhône River deliveries into the Gulf of Lion (Raimbault et al., 2003). The heavy contribution of floods in sediment budgets is now basically known and has been demonstrated in case studies [Rolland et al, 2004; Radakovitch et al., 2007; Antonelli et al., 2008). Flood monitoring is therefore necessary to restrain uncertainties on fluxes. This requires high frequency samplings to be carried out in particular to register hazardous hydrological events (Moatar and Meybeck, 2007). The Rhône River Observatory Station (SORA) was developed by IRSN to quantify fluxes and particularly to register fluxes transferred during floods.

SORA is located at Arles on the right bank of the Grand Rhône River, 3.5 km downstream the diffluence between the Grand Rhône and the Petit Rhône and 45 km upstream the River mouth. The Grand Rhône branch exports to the Sea 85 to 90% of the liquid and solid Rhône river flows. Water is collected at a distance of 7 m from the bank and 0.5 m under the surface whatever the discharge and continuously supplies the Station.

High frequency monitoring is displayed into two main modes depending on the liquid flow rate of the River:

- Below 3000 m^3s^{-1}: Daily samplings for TSS and particulate and dissolved nutrients analyses result in 16 sub samples of 150 ml automatically collected each 90 minutes. Radionuclides activities within the dissolved and particulate phases are determined onto monthly integrated samples obtained through sub samples of 15 l automatically collected each hour.
- Above 3000 m^3s^{-1}: Samples for TSS analyses are collected each 4 hours resulting in 8 sub samples of 150 ml taken each 30 minutes. Particle bound radionuclides are measured onto samples taken each 8 hours through 24 sub samples of 5l automatically collected each 20 minutes.

The threshold flow rate of 3000 $m^3 s^{-1}$ was chosen on the basis of previous studies: Pont et al. (2002) observed a breakdown in the relation between liquid flow and TSS concentrations corresponding to the beginning of the sediment transport under flood condition. These observations were confirmed by Antonelli (2002) that furthermore observed higher TSS concentrations with depth.

Samples for TSS analysis are poisoned with HgCl2 and conserved at 5°C until they are filtrated on 1µm pre conditioned glass fiber filters (dried at 450°C for one hour). Uncertainty on TSS concentrations is estimated to 5 10-4 g.l-1. Daily and hourly liquid discharges in Arles are made available by the CNR (Compagnie Nationale du Rhône). These data allow quantifying liquid and solid fluxes associated with each sampling periods and especially with flood events.

Besides, additional samples are punctually collected to assess to the concentrations and fluxes of various organic or inorganic trace elements, including natural and artificial radionuclides. Furthermore, data acquired on radionuclides at ultra trace levels within the dissolved phase allow quantifying the dose associated to the ingestion of artificial or naturally occurring radionuclides from the consumption of the Rhône drinking waters.

Since the beginning of the operation of the station in 2005, the annual suspended solids flux recorded ranged from 1 Mt (2005) to 9.1 Mt (2008). Floods above 3000 m^3s^{-1} contribute to transfer of 25% (2007) 81% (2008) solid flow in a few days. The characterization of the heterogeneity of the solid fluxes in transit on the wet section in front of the station served to emphasize that the uncertainty on the quantified flow is below 15%.

LIST OF REFERENCES

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SORA: The Rhône River Observatory Station in Arles.