SORA: A HIGH FREQUENCY FLUX MONITORING STATION AT THE LOWER RHÔNE RIVER

C. Antonelli [1], P. Raimbault [2], V. Boullier [1], M. Arnaud [3], F. Eyrolle [1]* and M. Arnaud [1]

[1] LERCM, Institut de Radioprotection et de Sûreté Nucléaire - Centre de Cadarache, BP 3, 13115 Saint Paul Lez Durance, France - frederique.eyrolle@irsn.fr

[2] Laboratoire de Microbiologie Géochimie et Ecologie Marines UMR 6117 – Centre d'Océanologie de Marseille, case 901, 163 avenue de Luminy, 13288 Marseille Cedex 9, France.

[3] 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 Mari

Abstract

The Rhône River Observatory Station in Arles (SORA) allow quantifying suspended sediment fluxes to the marine environment as well as liquid and solid fluxes of major nutrients and various natural and artificial radionuclides. This instrumented platform is especially devoted to the survey of flood events through high frequency flux monitoring

Keywords: Sediment Transport, Hydrology, Monitoring, Radionuclides, Rhone Delta

Riverine fluxes towards the marine environment of suspended solids and associated potentially contaminating trace elements (PCTE) represent key environmental data because rivers constitute the main link between continent and ocean in most biogeochemical cycles. This especially concern the Rhône River as its inputs affect primary production significantly in the North-Western Mediterranean area and play a leading role on the marine ecosystem functioning in the whole Gulf of Lions [1]. The importance of floods in annual sediment budgets is now basically known and has been demonstrated in case studies [2-4]. Flood monitoring is nevertheless sensitive as high frequency flux measurements have to be carried out to register such hazardous events [5]. The Rhône River Observatory Station (SORA) was developed by IRSN to register such episodic events. The Station 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: [6] 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 [7] that furthermore observed higher TSS concentrations with depth. Samples for TSS analysis are poisoned with $HgCl_2$ 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.

Acknowledgements

The SORA Station received the support of "Agence de l'eau Rhône-Méditérranée-Corse", the French National Research Agency (ANR) through the ANR-EXTREMA project (ANR-06-VULN-005, 2007-2010) and from the competitive poles "Mer PACA (Provence Alpes Côte d'Azur)" and "Gestion des Risques et Vulnérabilité des territoires". Additional funding supports are delivered by ORME program (Observatoire Régional Méditerranéen de l'Environnement). Liquid discharges values in Arles were made available thanks to the CNR (Compagnie Nationale du Rhône).

References

1 - Raimbault P., Durrieu de Madron X., 2003. Research activities in the Gulf of Lion (NW Mediterranean) within the 1997-2001 PNEC project. *Oceanol. Acta*, 26: 291-299.

2 - Rolland B., Antonelli C. and Eyrolle F., 2004. Fluxes of suspended material and associated radionuclides to the sea during flood events of the Rhône River. *In:* Proceedings of the ECORAD 2004 international symposium, 6-10 sept. 2004, Aix en Provence, France, P3: 35.

3 - Radakovitch O., Roussiez V., Ollivier P., Ludwig W., Grenz C. and Probst J.L., 2007. Input of particulate heavy metals from rivers and associated sedimentary deposits on the Gulf of Lion continental shelf. *Estuar. Coast. Shelf S.*, 77, 2: 285-295.

4 - Antonelli C., Eyrolle F., Rolland B., Provansal M. and Sabatier F., 2008. Suspended sediment and 137Cs fluxes during the exceptional December 2003 flood in the Rhone River, southeast France. *Geomorphology*, 95, 3-4: 350-360.

5 - Moatar F. and Meybeck M., 2007. Riverine fluxes of pollutants: Towards predictions of uncertainties by flux duration indicators. *Comptes Rendus Geosciences*, 339, 6: 367-382.

6 - Pont D., Simonnet J.P. and Walter A.V., 2002. Medium-term changes in suspended sediment delivery to the ocean : consequences of catchment heterogeneity and river management (Rhône River, France). *Estuar. Coast. Shelf S.*, 54: 1-18.

7 - Antonelli C. 2002. Flux sédimentaires et morphogenèse récente dans le chenal du Rhône aval. PhD thesis, Université Aix-Marseille I, 272 p.