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Subject: 3. Suggestion

Comments:

I suppose you are aware of the testing done on Celtic Sea Salt by Testmark laboratories that showed CSS to be higher in lead than the other salts tested.

I became curious and looked into the issue of water pollution in this area.

comment; (and feel free to post)

The name brand Celtic Sea Salt is a sea salt made in the Geurande region on the North-East Atlantic coast of France.

The salt evaporation ponds in that area are fed with sea water from the Bay of Biscay of the North Atlantic.

Adjacent to these salt marshes is the mouth of the Loire River which is a major river crossing France from east to west ending up in the Biscay Bay. Not far to the north of Geurande is the Vilaine river although not nearly as large as the Loire.

The waters from these two rivers mix into the water of the bay and the tides push this mixed water into the salt marshes to be evaporated resulting in the formation of a sea salt product. The beds of the ponds are lined with an indigenous clay which becomes part of the salt giving it a gray color and unusual flavor.

The problem here is that the waters used to make this sea salt are polluted. The Loire is polluted with a variety of well documented toxins, the Vilaine is also somewhat polluted and the waters of the Biscay Bay are polluted from a variety of sources from the North-East Atlantic.

A list of the pollutants would include lead, mercury, neurotoxins from agricultural chemical run-off, PCB's, plastics, and petrochemical contamination from numerous oil spills in the region. Also there is radioactive contamination discharged on a regular basis from the 14 nuclear reactors operating along the Loire river as well as additional radioactive contamination in the North Atlantic.

Descriptions of Celtic Sea Salt mention it is made from the "pristine" waters of the North Atlantic.

And here is a partial list of contamination in the the area.

This list is very complex and perhaps the least understood is the effects of tritium especially when ingested. Some scientists say there is no safe dose of radiation even those thought to have a level of radiation.

<http://worldwidescience.org/topicpages/l/loire+river+environmental.html#>

Organochlorine pesticides, polychlorinated biphenyls and trace elements in wild European sea bass (*Dicentrarchus labrax*) off European estuaries

Polychlorinated biphenyls (PCBs) and organochlorine pesticides like dichloro-diphenyl-trichloroethane (DDTs), hexachlorocyclohexanes (HCHs), aldrin, dieldrin and trace elements (Cd, Cu, Se, Pb, Zn and Hg) were analysed in the muscle of European sea bass (*Dicentrarchus labrax*) sampled in Atlantic coastal regions near several important European river mouths (Gironde, Charente, Loire, Seine and Scheldt). High contamination levels were measured in the muscles of European sea bass sampled in the coastal regions near those river mouths (e.g. ICES PCB=133-10,478mgkg⁻¹lw and Hg=250-2000mgkg⁻¹dw). The Scheldt and the Seine are still among the most contaminated estuaries in Europe. Each region presented their specific contamination patterns reflecting different sources due to the input of the re...

Severe and contrasted polymetallic contamination patterns (1900-2009) in the Loire River sediments (France).

The Loire River basin (117,800km²), France) has been exposed to multiple sources of metals during the last 150years, originating from major mining districts (coal and non-ferrous metals) and their associated industrial activities. Geochemical archives are established here from the analysis of a 4m sediment core in the downstream floodplain and then compared to stream bed sediments from pristine monolithological sub-basins and from bed and bank sediments in impacted tributaries. The contamination is assessed for 55 major and trace elements through their enrichment factors to Al (EF), normalized to the pre-anthropogenic background. Archives from 1900 to 2009 show enrichment (EFsediment load about 1.5Mt/year) is an additional cause of such severe contamination. After 1950, river eutrophication is well marked by the general increase of endogenic calcite (EF (Ca)=4), diluting all other elements by 20%. From 1980 to 2009, all contaminants, except Au (EF=100), decrease steadily.
PMID:22858537

<http://worldwidescience.org/topicpages//loire+river+environmental.html#>

Riverine discharge of perfluorinated carboxylates from the European continent.

The discharge of C6-C9 perfluorinated carboxylates (PFCAs) from major European rivers was studied and employed to assess European emissions of these compounds. Water samples were collected close to the mouths of 14 major rivers including the Rhine, Danube, Elbe, Oder, Seine, Loire, and Po. PFCA concentrations were determined using LC-MS/MS and used together with the mean annual water flow to estimate the riverine discharge of the PFCAs. The highest concentration measured was 200 ng/L for perfluorooctanoate (PFOA) in the Po River. The Po accounted for two-thirds of the total PFOA discharge of all the rivers studied, suggesting a major industrial source of

PFOA in the Po watershed. All other nonremote rivers showed PFOA concentrations in the lower ng/L range, which indicates that widely distributed sources are also significant contributors to PFOA emissions in Europe. The total discharge of PFOA from the European rivers was estimated to be 14 tonnes/year, which is in reasonable agreement with reported emissions estimates. However, the total riverine discharge of perfluorohexanoate (PFHxA) of 2.8 tonnes/year estimated in this study was three times greater than the reported global emissions estimate, suggesting that there are significant, as yet unidentified sources of this compound. PMID:18044497

Organochlorine pesticides, PCBs, heavy metals and anticoagulant rodenticides in tissues of Eurasian otters (*Lutra lutra*) from upper Loire River catchment (France)

In this study, tissues of the Eurasian otter (*Lutra lutra*) from a naturally expanding population along upper Loire River (France) catchment were used for contaminants analyses. nine organochlorine pesticides, 16 PCB congeners, five heavy metals (lead, cadmium, mercury, copper and arsenic) and three anticoagulant rodenticides were quantified in livers of road-traffic killed otters. Organochlorine compounds and heavy metals were found in 100% of the samples, and occasional contamination by anticoagulant rodenticides was confirmed. Total organochlorine pesticides reached a maximum of 9.4mgkg⁻¹ lipid weight. Higher data were observed for other contaminants, especially total PCBs and mercury. Maximal total PCBs values reached 64.8mgkg⁻¹ lipid weight, and maximal measured mercury concentration w...

Caesium-137 in sandy sediments of the River Loire (France): Assessment of an alluvial island evolving over the last 50years

Recent sedimentological and morphological evolution of an island in the River Loire (France) was investigated using the ¹³⁷Cs method. This study describes the morphological adjustment of the island in the last 50years, which corresponds to the increased bed incision of this sandy, multiple-channel environment because of, among other things, the increase in sediment extraction up to 1995. The results show that some ¹³⁷Cs can be retained by sandy particles, potentially in clay minerals forming weathering features included in detrital sand grains. From a morphological perspective, significant lateral erosion can be observed in the upstream part of the island, while a weak lateral accretion occurs in its downstream section. Data about ¹³⁷Cs and aerial photographs show that the morphology of th...

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Radioactivity monitoring within the environment of the Loire basin. A partnership between the IRSN and the Dampierre-en-Burly and Saint-Laurent CLIs at the service of citizen vigilance; Surveillance de la radioactivite dans l'environnement du bassin de la Loire. Un partenariat entre l'IRSN et les CLI de Dampierre-en-Burly et de Saint-Laurent-des-Eaux au service de la vigilance citoyenne

The first part of this report presents the Loire basin and its environment, discusses the physical-chemical quality control of its waters and the main usages of the Loire waters. It also presents the nuclear installations present in the Loire basin (electricity production nuclear power stations and other installations), the actors involved in radioactivity measurement in the Loire basin environment (IRSN, EDF, AREVA, associations for the monitoring of water quality, public services), and the national network for radioactivity measurement in the environment. The second part describes and reports the radioactivity monitoring of the environment in the Loire basin, i.e. in the atmosphere, in rain waters and in continental waters, and in the food chain. Addressing this monitoring activity, a last part discusses the evolution of measurements, the importance of the plurality of actors involved in sampling and measurement (in order to guarantee the monitoring system transparency), the variety of sources, the assessment of health impact

Compared performances of different algorithms for estimating annual nutrient loads discharged by the eutrophic River Loire

Good estimates of pollutant fluxes are required for Earth systems sciences and water quality management. The gradual accumulation of water quality data records over the past few decades has increased the value of these data for examining long-term trends. On many major rivers, however, infrequent sampling of most pollutants makes flux estimates and their analysis difficult. This paper explores the performance of different methods for estimating nutrient fluxes. The objective is to assess the accuracy (bias) and precision (dispersion) of annual nutrient fluxes based on monthly sampling, which is the frequency with which 80% of French water quality surveys have been carried out since 1971. The study is based on a data set of nutrient concentrations surveyed at high frequency during a 5 year pilot study (1981-85) at the Orlières station in the middle reaches of the River Loire, France. The mean specific fluxes were 641 (nitrate-N), 96 (total-P) and 37 kg year⁻¹ km⁻² (orthophosphate-P).

For each year, the data set was then resampled by randomly simulating 12 sampling dates. 100 simulated monthly samplings were generated, upon which seven estimation methods were tested. The evaluations indicate that, when concentrations of specific substances in large rivers exhibit seasonal variation, a simple method based on linear interpolation between samples taken at approximately monthly intervals is advocated. With the monthly sampling interval, the precision (confidence level of 95%) of annual nutrient fluxes obtained by the appropriate methods was 13% for nitrates, 20% for total-P, 26% for orthophosphates, and 34% for particulate-P. The frequency of water quality surveys required to obtain an annual nutrient flux with 10% precision was around 15 days for nitrate, 10 days for orthophosphate-P and total-P, and about 5 days in the case of particulate-P.

Triazine herbicide residues in central European streams.

Triazine herbicide residues were monitored in the rivers Adour, Danube, Garonne, Hérault, Loire, Marne, Oise, Rhine, and Rhône from spring 1976 to fall 1977 to determine whether the continued use of the compounds resulted

in accumulations of undesirable residues in the streams. Samples were generally collected monthly or bimonthly and analyzed for the parent compounds atrazine, simazine, terbutometon, terbuthylazine, and dealkylated metabolites GS 26571 (2-amino-4-tert-butylamino-6-methoxy-1,3,5-triazine) and G 30033 (2-amino-4-chloro-6-ethylamino-1,3,5-triazine). The compounds were extracted into dichloromethane and quantitated by gas chromatography (GC) with nitrogen-specific detection. Selected results were verified by GC with mass fragmentographic detection. Limit of detection was usually 0.4 mg/m³; 80 percent of all results were below 0.4 mg/m³, 14 percent were 0.4-1 mg/m³, 6 percent were 1-10 mg/m³, and 0.3 percent were higher than 10 mg/m³. Detectable residues were mainly atrazine from the downstream sampling sites. Residues usually peaked during June. PMID:537864

<http://worldwidescience.org/topicpages//loire+river+environmental.html#>

Biochemical, physiological and behavioural markers in the endobenthic bivalve *Scrobicularia plana* as tools for the assessment of estuarine sediment quality

The aim of this study was to link the responses at different levels of biological organisation of the endobenthic bivalve *Scrobicularia plana* differentially exposed to anthropogenic pressure. Clams were collected in April 2008 from three estuaries along a pollution gradient (Goyen<LoireLoire and the Seine. Biomarkers of damage revealed neurotoxicity (decreased AChE activity) and impairment of digestive enzyme activities (cellulase or amylase) in these estuaries. The highest lactate dehydrogenase activity was registered in the Loire estuary, in parallel with enhanced levels of vanadium (a metal present in petroleum), likely as a consequence of a small o...

Seasonal and decadal variations in lead sources to eastern North Atlantic mussels.

The concentration of Pb and its stable isotope composition were measured in 216 composite samples of 50 blue mussels (*Mytilus edulis* (*M. edulis*)) collected quarterly between 1985 and 2005 at three sites along the French Atlantic coast, one in the La Fresnaye Bay and the others in the Loire and Seine River estuaries. Depending on the sites and time periods, Pb concentrations were 5-66 times higher than the natural background value for the North Atlantic. Even for the samples with the lowest Pb concentrations, the isotopic signature of Pb is very different than that of the regional natural Pb, suggesting that most of the bioaccumulated Pb is anthropogenic in origin. Stable Pb isotope ratios measured in the mussels differ markedly from that of Pb emitted in Western Europe as a result of leaded gasoline combustion, which was still a dominant source of contaminant Pb to the atmosphere during most of our study period. The isotope composition of Pb in the mussels was instead more typical of that of the Pb released to the environment by wastewater treatment plants, municipal waste incinerators, and industries such as metal refineries and

smelters. Continental runoff, rather than atmospheric deposition, is therefore identified as the leading transport pathway of Pb along the French Atlantic coast. From the strong seasonal variations in $(^{206}\text{Pb})/(^{208}\text{Pb})$ ratios in the mussels from the Seine Estuary site we also conclude that the resuspension of contaminated sediments, triggered by high river runoff events, is a chief factor affecting the bioaccumulation of Pb in *M. edulis*. The value of this organism as a biomonitor of coastal contamination is thus further demonstrated. PMID:20088586

<http://worldwidescience.org/topicpages//loire+river+environmental.html?type=RESULT&redirectUrl=http://direct.bl.uk/bld/PlaceOrder.do?/bld/OrderDetails.do?did=43&UIN=223773872&ETOC=RN&from=searchengine>

I could not get into the full text to see the results but this is a concern. The nuclear industry claims that low-level radiation is not a serious issue but a lot of scientists would disagree. Ingested, all radiation is destructive.

A dynamic model for assessing radiological consequences of tritium routinely released in rivers. Application to the Loire River.

A dynamic model for assessing the transfer of tritium in a food chain was applied to the Loire River, where 14 nuclear power plants situated on five different sites operate. The model considers several potential exposure pathways in the aquatic and terrestrial ecosystems: transfer of tritium through the aquatic food chain (especially fish); use of river water for agricultural purposes (irrigation) and transfer of radionuclides through the terrestrial food chain (vegetables, meat, milk); subsequent internal exposure of humans due to ingestion of contaminated foodstuffs. For biological environmental compartments, the transfer of tritium to organic matter (i.e. OBT) was simulated. For each of the parameters introduced in this model, a probability density function, allowing further uncertainty and sensitivity analyses, was proposed. Uncertainty/sensitivity analyses were performed to determine a confidence interval for the mean annual dose to critical groups and to identify the parameters responsible for the uncertainty and subsequent research priorities. PMID:16939696

AND: 14 nuclear reactors are along the Loire River upstream from the Celtic Salt evaporation ponds. The tritium discharge is a regular and deliberate part of the reactor operations, not a rare spill of some kind. The river water is also used for cooling the reactors and becomes somewhat radioactive in addition to the tritium discharges. The tritium can transport itself in many ways and there is no safe level for ingested radioactive nucleotides. Tritium will attach to both organic and inorganic materials.

www-ns.iaea.org/.../presentation-6th-wg7-aquatic-pathways.pdf

Tritium Modeling in Aquatic Systems

A. Melintescu, F. Siclet, D. Galeriu

I. Introduction

Tritium (^3H) is released from some nuclear facilities in relatively large quantities.

It is a ubiquitous isotope because it enters straight into organisms, behaving essentially identically to its stable analogue (hydrogen). Tritium is a key radionuclide in the aquatic environment, in some cases contributing significantly to the doses received by aquatic, non-human biota and by humans.

Models commonly used in tritium dose assessment are steady state specific-activity models based on the assumption of complete isotopic mixing with the stable element, and isotopic equilibrium between all environmental compartments (IAEA, 2010). These models may not be adapted to situations with fluctuating tritium levels in rivers, resulting from discontinuous radioactive discharges or accidental release. To take into account these variations in radioactive discharges, dynamic river, lakes and coastal waters models have been developed (IAEA 2008a, SisBAHIA[®], TELEMAC (ref), Mascaret (ref), RIVTOX (Zheleznyak et al., 2000), POSEIDON (Heling et al., 2000)) supplemented by time-dependent food chain models (Ciffroy et al 2005; Galeriu et al 2005; Melintescu and Galeriu, 2011).

Tritium migration in water bodies is governed by two important processes:

(i) the advection of the pollutant by river flow that defines the position of the pollution peak in time and space (advection is fully defined by the river flow velocities), and (ii) the eddy diffusion of the pollutant due to river turbulence, that influences the magnitude of the pollution peak and its spatial spreading (IAEA 2008a).

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Tritium interaction with bottom sediments and suspended matter is generally ignored, but some cases were emphasized in case of tritiated water (Turner et al., 2009) or organic matter (Hunt et al., 2010). A minor pathway in terms of dose impact to the population is the tritium transfer between surface water and atmosphere (Marang et al., 2011). For liquid releases, an important pathway is irrigation, but the irrigation effect can be assessed like a precipitation event in terrestrial food chain and it is not included in this document (include a reference to a documents on this pathway). A review of organic tritium in fresh water sediment, animal and plants has been conducted in France (Gontier and Siclet, 2011), it shows that organic tritium from soils (formed over several decades from exposure of vegetation and soil to atmospheric tritium) is the main OBT contributor to the sediments and suspended matter. Recently, the case of dissolved organic tritium (DOT) was treated as a separate pathway of concern for radiopharmaceutical production (Melintescu and Galeriu, 2011). "

Another study:

su.diva-portal.org/smash/get/diva2:575585/FULLTEXT03

"Current protection of the marine environment from radiation is based largely on measuring, estimating and modelling accumulation and impact(s) of radionuclides in a few marine species. Using a relevant marine organism, this thesis focusses on investigating some poorly described phenomena that could cause deviations from predicted measurements.

Paper I investigated the biological transformation of tritium (radioactive hydrogen) into an organic compound. The resulting organically bound tritium (OBT) showed increased accumulation in mussels, unique incorporation into a key biological molecule (DNA), extended persistence in tissues, and greater toxicity than the inorganic form. Paper II demonstrated significant disparity in OBT accumulation between functionally similar microalgae species and that OBT in algae is readily transferred to a consumer. "

In addition the Cap De La Hague nuclear reprocessing plant is only 150 miles north of the Geurande Celtic Salt marshes on land but farther by seacoast.

"There has been insufficient research into the connectivity of marine environments regarding the dispersal of radioisotopes. Releases of technetium-99 from Sellafield and Cap de la Hague nuclear facilities have been traced throughout the NE Atlantic and even into the Baltic Sea (Dahlgaard et al., 1995; HELCOM, 2009), demonstrating the widespread

dispersion potential of some radioactive wastes."

"The impacts of low doses of radiation at the population level are not thoroughly understood. Identifying direct responses at the population level, to a radioactive exposure is very difficult or impossible (Woodhead, 2003), therefore it is likely necessary to extrapolate the impacts at organismal or sub-organismal level to those of the population. It would be incorrect to assume that populations are more resistant to the impacts of radiation than an individual; for example doses sufficient to impact fertility and fecundity are typically nonfatal. Indeed, the degree of protection required to prevent a significant impact on a population may in fact be more than required to prevent a significant effect in an individual. While very low doses of radiation may not observably impact an organism's health, development, fertility or fecundity, genetic damage in the gametes may adversely affect a population. Radiation induced mutation in the DNA or genome can cause genetic instability that can be passed on to the progeny (Kadhim et al., 1992; Karotki and Baverstock, 2012; Prise, 2006). This instability can transfer recessive or deleterious genes to offspring and over long periods of time may lead to a higher frequency in the species genome (Hertel-Aas et al., 2007; Trabalka and Allen, 1977).

While the transformation of tritium in inorganic forms, such as tritiated water, into organic forms can be expected in photosynthesising organisms (Paper II; Baeza et al., 2009; Boyer et al., 2009; Choi et al., 2002; FiÅ©vet et al., 2006; Moses and Calvin, 1959) the phenomena appears to occur spontaneously within the tissues of any exposed organism including animals and humans (Paper I; Paper II; Baeza et al., 2009; Jha et al., 2005; Trivedi et al., 1997; Tucker and Harrison, 1974). This "organic" tritium is more biologically relevant and therefore has greater potential for accumulation and persistence in biological compartments (Baumgaertner et al., 2009; Ciffroy et al., 2006; DiabatÅ© and Strack, 1993; McCubbin et al., 2001; Pointurier et al., 2003; Trivedi et al., 1997)."

The clay lining the Celtic Sea Salt evaporation ponds are like any other sediment that can absorb elements from the water. The clay is what gives Celtic Salt its color and unique taste.

"Hot particles can be ingested from the sediment or suspended in the water column, particularly by filter-feeders which very efficiently extract particles from the seawater (Paper III; Dahlgard et al., 2001). Paper III demonstrated that not only were particles collected by filter-feeders, but they could also be incorporated permanently into the tissues, giving high doses of radiation throughout the life of the organism, with the potential of transfer to a consuming organism. The particles not only deliver a large, concentrated dose of ionising radiation to surrounding tissue but will become a potent local source of radioactive material if they dissolve or are broken down mechanically (Salbu, 2001), particularly as they can remain in the body for

long periods of time (Paper III, Salbu et al., 2004)."

conclusion:

"There is much more left to be discovered.

For accurate assessment of the impact of radioactive releases on the environment, the most important areas of information still lacking are those regarding the impacts of chronic low-dose exposure, the effects across multiple generations of organisms, and the interactive effects of abiotic and

biotic factors within an environment (Hinton et al., 2013). There is no question that these are very ambitious goals, and the lack of understanding to

date reaffirms the difficulty, complexity and cost (in resources, and especially in time) that such research entails. To make any kind of accurate input into these fields, let alone a significant scientific breakthrough in understanding, will take years of focussed research by whole research groups dedicated to these tasks. These areas are by no means all that is left to be understood, but rather represent the most lacking areas of knowledge, and will provide the most relevant information with which to protect our environment, and by extension, ourselves."