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COMODORE V2007: Assessment doses for the public from atmospheric and liquid discharges

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Abstract. Protecting the environment and the public from radioactive hazard is a top priority for all companies operating in the nuclear domain. In order to quantify dose impact on members of the public due to annual discharges of its nuclear installations, AREVA developed the COMODORE code in collaboration with Institute of Radiation Protection and Nuclear Safety (IRSN).
COMODORE is a synthesis of 3 softwares validated by IRSN (ACADIE, COTRAM and AQUAREJ). ACADIE is a code elaborated by IRSN and the Treatment Business Unit of AREVA synthesizing the works of the GRNC (Nord-Cotentin Radioecology Group) created by the French government to deal with the estimation of exposure levels to ionizing radiation and associated risks of leukemia for populations in the Nord-Cotentin. COMODORE is a version of ACADIE designed to be adaptable to any other AREVA site. Thus, the operators of the south east of France (Pierrelatte, Marcoule and Romans sites) carried out the adaptation of COMODORE for theirs specificities (for instance, uranium in the terrestrial model).
At the moment, COMODORE is used in routine by the AREVA operators to assess the annual dosimetric impact and is also being adapted with SGN to model the radiological impact of uranium ore treatment residues repositories.

Protecting the environment and the public from radioactive hazard is a top priority for all companies operating in the nuclear domain.

According to the regulations, operators have to quantify the dose impact induced on members of the public due to annual discharges of its nuclear installations. This assessment must be exhaustive and should take into account all possible exposure pathways following from gaseous and liquid releases (figure 1).

In this scope, AREVA developed the COMODORE code (with Java computer system) in collaboration with Institute of Radiation Protection and Nuclear Safety (IRSN).

COMODORE is a synthesis of 3 softwares validated by IRSN (ACADIE, COTRAM and AQUAREJ). ACADIE is a code elaborated by IRSN and the Treatment Business Unit of AREVA synthesizing the works of the GRNC (Nord-Cotentin Radioecology Group) created by the French government to deal with the estimation of exposure levels to ionizing radiation and associated risks of leukemia for populations in the Nord-Cotentin.

COMODORE is a version of ACADIE designed to be adaptable to any other AREVA site. Thus, the operators of the south east of France (Pierrelatte, Marcoule and Romans sites) carried out the adaptation of COMODORE for theirs specificities. For instance, they integrated uranium in the terrestrial model and gave the possibility to edit a standard report.

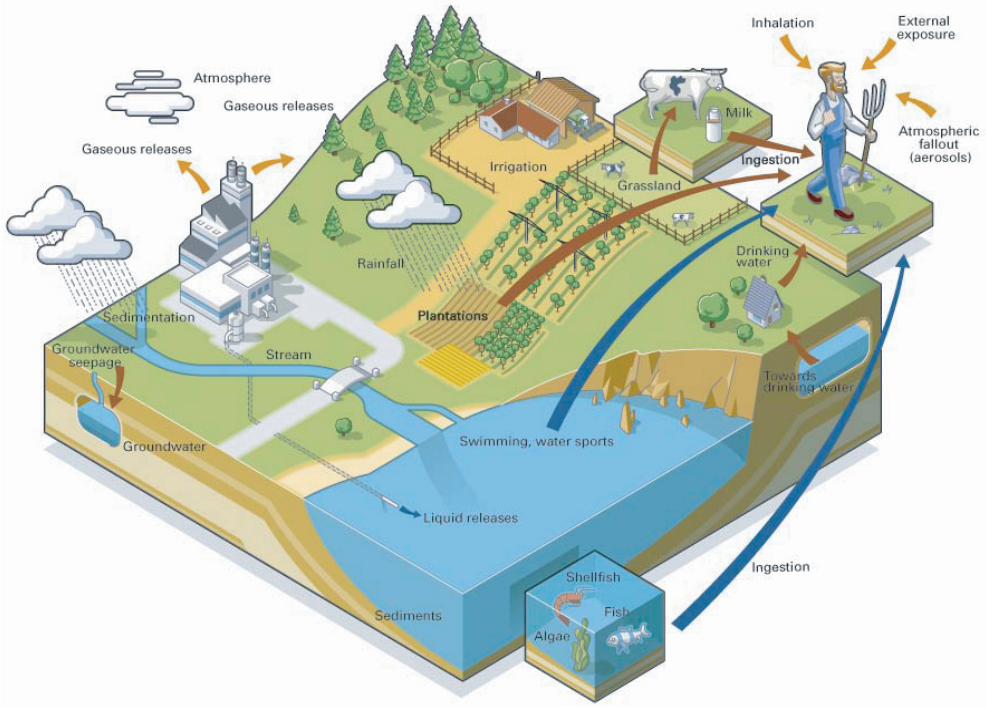

Figure 1. Exposure pathways to be considered.

COMODORE deals with gaseous and aqueous discharges. Calculation classically involves 3 steps: dispersion in the environment is first characterized, activities in the different compartments of the biosphere are calculated then radiological impact is evaluated.

The dose induced by atmospheric discharges is calculated by using the COTRAM code which implements the DOURY Gaussian puff model. This model is used to calculate atmospheric concentration and deposit at different distances from the point of discharge by taking into account the annual meteorological pattern (figure 2).

Atmospheric Transfer Coefficient and the deposit rates can be also directly entered in the dose calculation module without using COTRAM dispersion model. Classically, the four potential exposure pathways are considered for the public:

- ➢ From plume: internal and external exposure,
- ➢ From deposit: external exposure and ingestion.

The dispersion in rivers is characterized by using the AQUAREJ model which evaluates the dispersion of radionuclides in rivers; then the contamination of the different compartments of the biosphere and the radiological impact due to the ingestion of contaminated animal and vegetal products are calculated.

COMODORE is much more than a simple interface encompassing the previous codes. It is totally flexible. A simple click allows the user to modify the value of any parameter used for dispersion and impact assessment such as:

- Radionuclides parameters: period, absorption type
- Dose coefficients for different age classes, respiratory rates
- Food consumption, local production rates, farming habits, time budgets
- Transfer coefficients through biosphere compartments. . . .

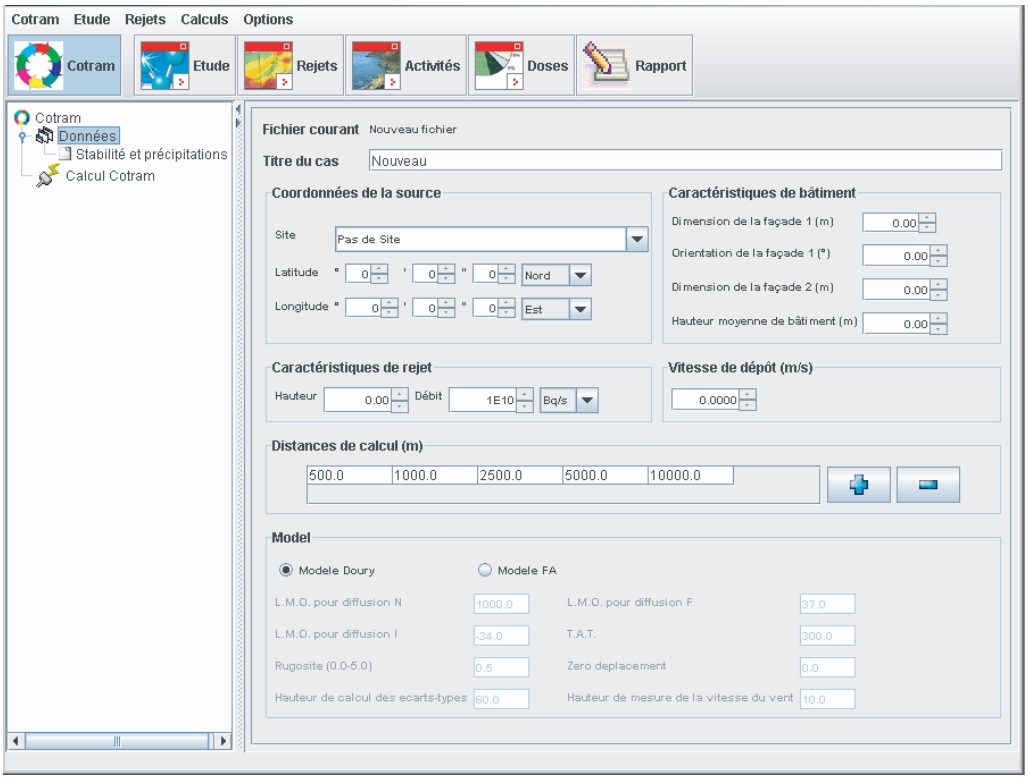

Figure 2. COTRAM atmospheric dispersion interface.

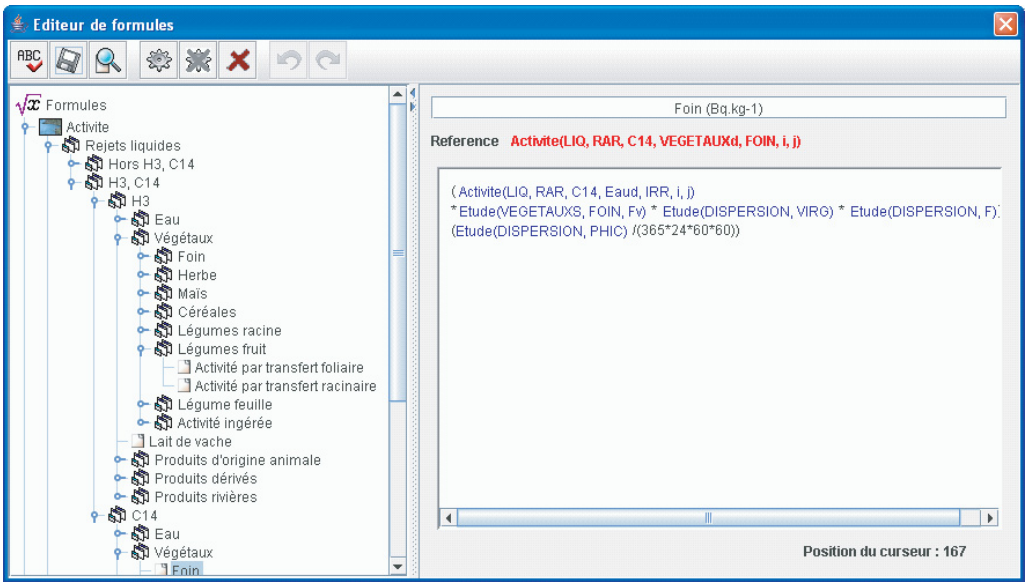

Figure 3. Equation editor.

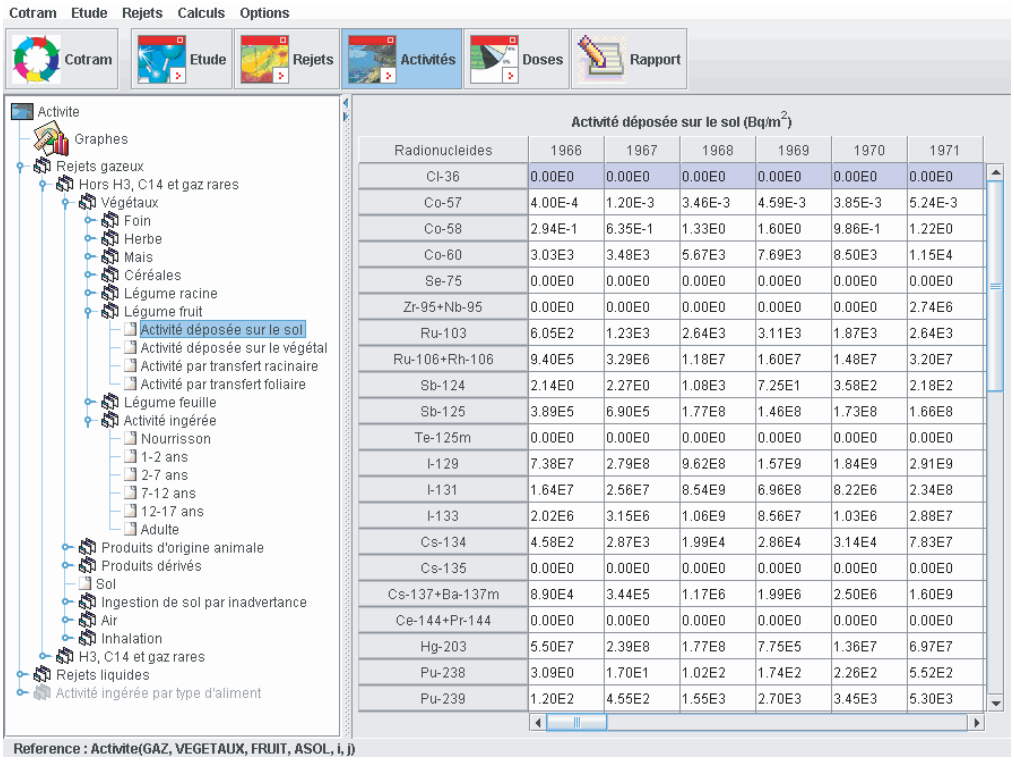

Figure 4. Activities in biosphere compartment.

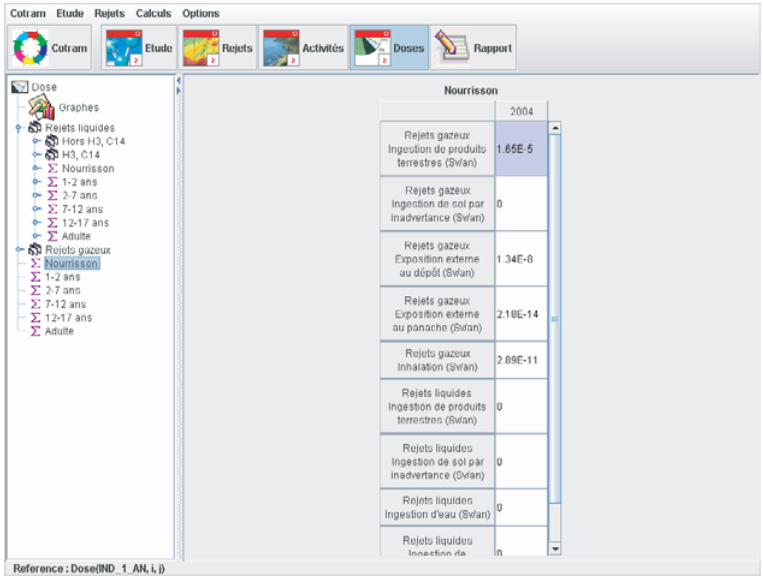

Figure 5. Dose assessment.

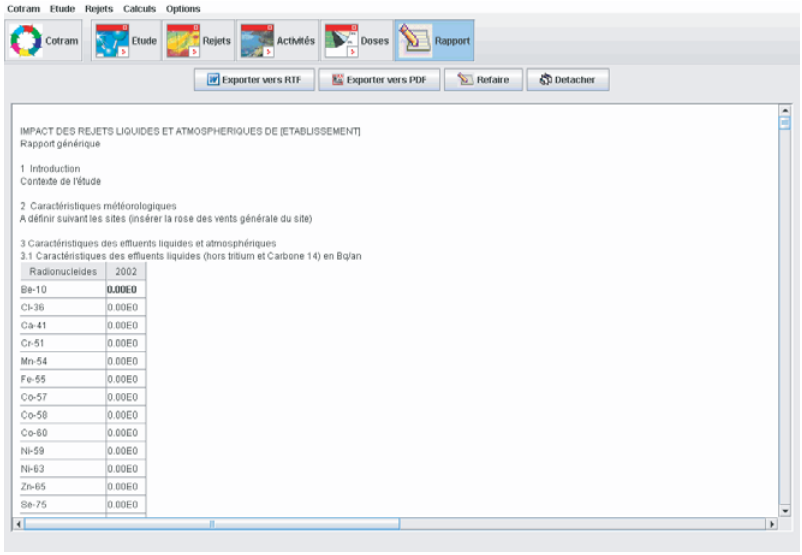

Figure 6. Reports.

In addition, all the equations used in COMODORE are editable allowing the user to adapt its own calculation scheme (figure 3). In this scope, the user can even add new parameters. This gives a perfect adaptation to the local specificities of the site. At last, the equation editor can be used in order to check all intermediate results.

The three last thumbnails are relative to the calculation step. By clicking on the next thumbnail, COMODORE calculate the activities of each radionuclide in each compartment of the biosphere (figure 4). All activities are available for consultation.

By clicking on the “Doses” thumbnail, exposure is assessed for the different age classes. As previously, all the details are directly available for consultation (figure 5). All input data and output results, which are reported on the last thumbnail, can be exported in the classic formats (figure 6).

For the traceability, the current equation leading to the edited result is exposed at the bottom of these thumbnails.

Particularly well adapted to the uranium cycle installations, COMODORE is now used in routine AREVA to assess the annual dosimetric impact. Flexible, it is also adapted with SGN to model the radiological impact of different problematic such as uranium ore treatment residues repositories.

This tool contributes to the transparency by giving stakeholders environmental data they need.