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Revisiting the dose calculation methodologies in European decision support systems

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ARGOS and RODOS: current status

ARGOS or RODOS are used by practically all European countries for NPP accident decision support

They offer excellent features for scenario overview and consequence evaluation before, during and after a crisis situation

They enable estimation of doses received by persons living in different environment types and having different living habits

Their dose calculation endpoints will include residual dose, which has a special status in relation to introduction and lifting of counter-measures

However, parameterisation in some of the ecological models is old and needs update, and current applicability is largely restricted to NPP accident scenarios

Ongoing refinement example: ventilation rates (NERIS)

Ventilation rate is important: a fractional increase in ventilation rate can lead to an increase by the same fraction in dose contributions from inhalation and indoor surface contamination.

Ventilation rate under *natural* conditions must be used, as forced ventilation is assumed to be closed off. Air tightness investigations are generally performed at elevated pressure. This limits available relevant data.

At high windspeeds ventilation rate increases rather much.

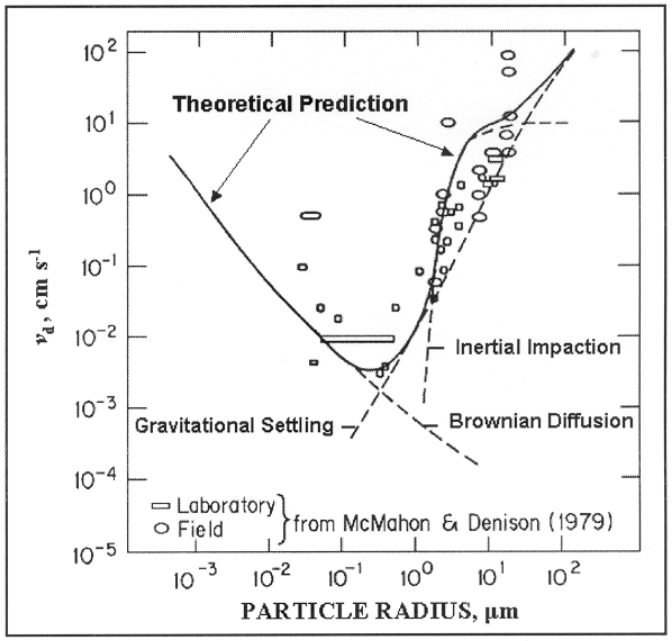
If a window is left open, ventilation rate in the room may increase tenfold.

Based primarily on datasets from 12 European countries, distinction was made between 3 horizontal bands in Europe: north, central and south, with mean natural ventilation rates of respectively 0.5, 1.0 and 1.8 ACH.

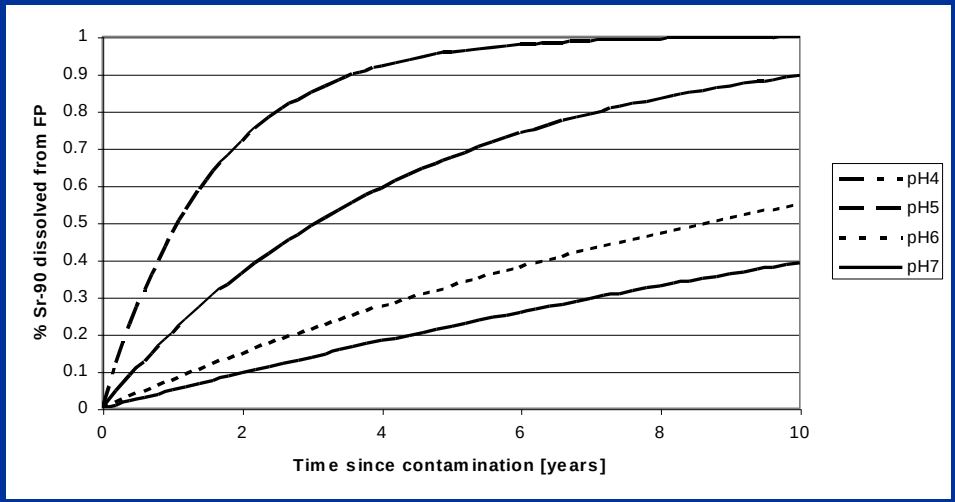
For the purpose of calculating dose to representative person, 95th percentiles were calculated. For north, central and south Europe these were respectively 0.9, 1.9 and 3.8 ACH.

Source terms from NPP accidents

Source term is so far generally only considered as a nuclide vector. Important to consider physicochemical forms of contaminants. The volatility of some contaminants, e.g., ruthenium, strongly depends on oxidising conditions during release process. Also inhalation dose needs to consider physicochemical forms.



Deposition velocities and aerosol sizes



Post deposition migration: ^{90}Sr dissolved from fuel particles in the areas contaminated by the Chernobyl accident

Food dose model (ECOSYS)

ECOSYS was developed in the 1980's and parameterised for South German local conditions – very often not changed

Comparison between ECOSYS default deposition velocities to agricultural crops (e.g., lettuce, grain crops) and a new dataset derived from the Nordic NKS PARDNOR project results.

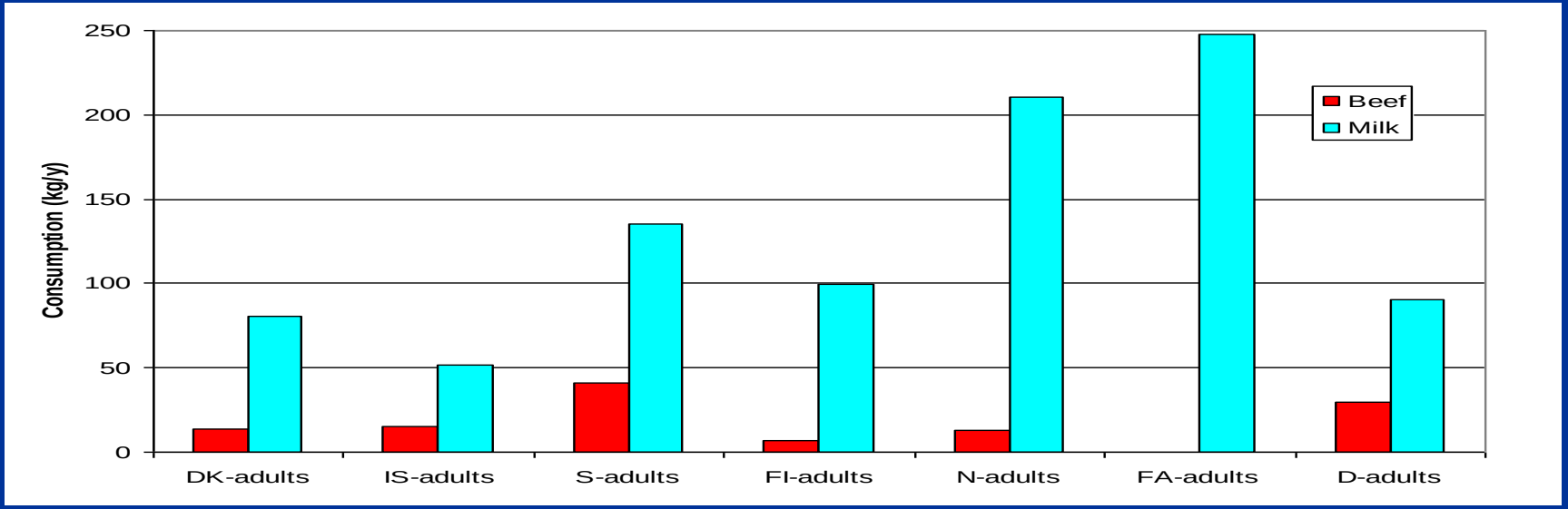
Dataset	V_d (1 µm aerosol), mm/s	V_d (4 µm aerosol), mm/s	V_d (20 µm aerosol), mm/s	V_d (elemental iodine gas), mm/s	V_d (organic iodine gas), mm/s
PARDNOR revision	0.3	1.5	35	5	0.02
ECOSYS defaults	2	2	-	20	0.2

Food dose model (ECOSYS)

Numerous other generic ECOSYS parameter refinements are suggested. E.g., based on IAEA TECDOC1616 (IAEA EMRAS project, 2009) for soil-to-plant transfer for different crops in different soil types.

For all soil types, some 'best estimate' transfer factors are more than a factor of 10 different from the generic defaults in ECOSYS.

Location specific parameterisation example: Annual Nordic intake of beef and milk (kg)



Use for terror preparedness ('dirty bomb')

'Dirty bomb' particle size distributions depend on elemental properties of the contaminants, their physicochemical forms, and the bomb construction (needs integration in RODOS/ARGOS).

For instance a bomb with a liquid contaminant may produce large amounts of submicron particles with low deposition velocity, whereas some solid contaminants will only produce large particles (very different contamination pattern and distribution on different types of surfaces of different orientation).

A new high resolution urban dispersion (not deposition) model, URD, has already been developed for integration in ARGOS.

Migration and weathering parameters are in ARGOS and RODOS currently based on radiocaesium measurements (not applicable for other contaminants due to selective Cs fixation in many surfaces).

Conclusions

A number of efforts are needed to improve dose prognoses in European decision support systems for NPPs.

Part of this is being done in work supported by EU (NERIS TP), and applications to EU are out for more.

European decision support systems are currently not equipped for estimation of doses from terror attacks like 'dirty bombs'.