BWG

Biota Working Group

In total, 15 models and approaches have been applied to one or more of the exercises conducted by the BWG. The models/approaches applied encompass those being developed, and in some instances, used in a regulatory context, in Belgium, Canada, France, Lithuania, Russia, the UK and the USA, as well as the outputs of recent EC EURATOM programmes. The participating models included those readily available to any interested user (RESRAD-BIOTA, the ERICA Tool, England and Wales Environment Agency R&D 128 and FASSET) and in-house models being used/developed by various BWG participants for a description of all participating models). Group members included modellers, regulators, industry and researchers.

The BWG conducted two intercomparison exercises to enable an evaluation of the basic components of the models and subsequently two model-data comparisons:

- Dose conversion coefficients (DCCs) - participants were asked to estimate the unweighted absorbed dose rates for both internal and external exposure assuming an activity concentration of 1 Bq kg^1^ in the organism or surrounding media, respectively. A selection of freshwater and terrestrial geometries proposed by the ICRP for their Reference Animal and Plants (RAPs) were used for the exercises. Estimates were made for seven radionuclides ^{3}H, ^{14}C, ^{60}Co, ^{90}Sr, ^{137}Cs, ^{238}U and ^{241}Am) chosen to cover a range of energies and radiation types. The results of this exercise are described fully by Vives i Batlle et al (2007).
- Transfer - participants were required to estimate the whole-body activity concentration of eighteen radionuclides, in seven terrestrial organisms (grass/herb, shrub, earthworm, herbivorous mammal, carnivorous mammal, rodent, bird egg) and twelve freshwater organisms (phytoplankton, zooplankton, macrophyte, benthic mollusc, small benthic crustacean, large benthic crustacean, pelagic fish, benthic fish, fish egg, amphibian, duck and mammal) assuming an activity concentration of 1 Bq per unit (kg, L or m^{3}) of media (soil, water or air, respectively). The results of this exercise are evaluated in Beresford et al. (2008).
- Perch Lake - located on the AECL Chalk River Laboratories site (Ontario), Perch Lake has received chronic, low-level inputs of a number of radionuclides since the 1950s. Participants were supplied with ^{90}Sr, ^{3}H, ^{60}Co and ^{137}Cs activity concentrations in water and sediments for selected years to allow the comparison of predictions of whole-body activity concentrations in a range of biota, including different fish species, aquatic mammals, plants, aquatic reptiles, amphibians and a range of invertebrate species. Unweighted internal and external absorbed dose rates were also estimated. The Perch Lake scenario is reported by Yankovich et al. (2010).
- Chernobyl exclusion zone - participants were provided with soil activity concentrations (^{90}Sr, ^{137}Cs, ^{241}Am and Pu-isotopes) and requested to make predictions of whole-body activity concentrations, and internal and external unweighted absorbed dose rates. Results were compared to available data for a range of biota types including: graminaceous vegetation; invertebrates; birds; a wide range of mammal species (from small rodents to deer and carnivorous species) and amphibians. Results from thermoluminescent dosimeters attached to small mammals were also available allowing a comparison with predicted external gamma dose rates. This scenario is reported by Beresford et al. (2010).

Recommendations of the BWG

Whilst the need for a system to protect the environment from ionising radiation is now generally recognised many aspects including the discussion of protection goals, agreement of benchmark values and parameterisation of models applied in the work described here are still under development.

An aim of the BWG was to improve the models used by Members States. The collaborative exercises led to the sharing of parameters and re-parameterisation by some of the participating models. However, the model-model inter-comparisons and the scenario applications only compared a limited number of radionuclides. Additionally, whilst the scenarios considered sites for which extensive databases were available, these may not, especially Chernobyl, be typical of situations needing to be assessed within regulatory frameworks.A a suggested future direction for the activities of the BWG was outlined:

Transfer parameters The work of the BWG clearly demonstrated that the largest contribution to variability between model predictions, and comparison with available data, is the parameterisation of the models transfer components. Other studies are in agreement with this conclusion. There is a clear need to better share knowledge on the transfer of radionuclides to biota and to provide authoritative collations of those data which are available. It is suggested that a document for biota which is equivalent to the IAEA handbook on transfer parameters for human food chains should be produced.

ICRP framework Outputs of the ICRP should clearly be considered by the BWG and if possible the ICRP outputs should be evaluated in any future scenario applications and model intercomparisons.

Future scenarios Future scenarios should focus on situations which regulators/industry are having to consider (e.g. waste repositories, assessments for new power stations, sites contaminated by TeNORM). Such scenarios would enable the comparison of the available approaches within a regulatory context, and evaluation of the various tiers of assessment (from screening level through to detailed assessment) which the more comprehensive approaches contain. Consideration should also be given to involving more 'informed users' within the BWG rather than a predominance of model developers.

Radiation effects data The models used by the BWG predict dose rates to biota, but there is also a need to define benchmark dose rates for use within assessments and be able to determine the potential consequences of predicted dose rates. A large amount of data on the effects of ionising radiation on biota has recently been collated into the FREDERICA database. This compilation can be used to aid decision-making on the potential impact of predicted exposures to ionising radiation. However, the effects data available in the FREDERICA database cover only a proportion of the available scientific literature. Furthermore, to be of most use to decision-makers there is a need to better evaluate the quality of much of these data to ensure that they are applicable. It is suggested that this could be best achieved through a subgroup of the BWG.

Whilst approaches from chemical assessments (such as species sensitivity distributions) are being adopted in trying to define dose rate benchmarks for biota, these do not really inform us of the actual potential impact on a given species or ecosystem. It is suggested that the BWG should consider how population modelling techniques (from other fields) might be applied to aid setting thresholds against which the degree of environmental protection can be determined.