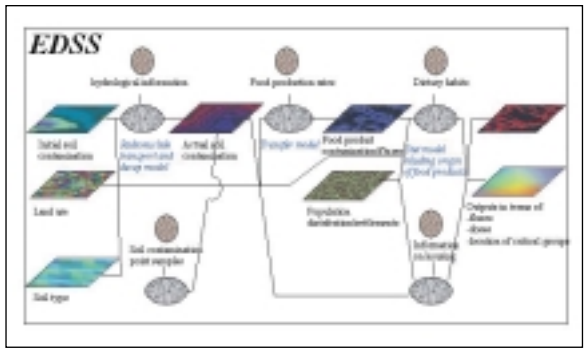
Objectives

Based on experimental data after the Chernobyl accident in the NIS the RESTORE project focused on the development of an environmental decision support system (EDSS) which can be applied to radioactive contaminated areas. The environmental management system is based upon a profound understanding of the nature of contamination, the processes and routes by which radioactivity is transferred in a variety of ecosystems, and on the extent of contribution to internal and external dose.

The RESTORE-EDSS can be used to assess and direct the use of countermeasures to reduce radiation doses to humans, taking into account minimisation of adverse socio-economic effects. Thus an important objective was the provision of strategies to enable the affected population to reduce their own dose.

Restoration Strategies For Radioactive Contaminated Ecosystems (RESTORE)

Problems to be solved



Significant economic and social disruptions arise after radioactive contamination of land as a result of the contamination and the measures carried out to minimise radiation doses to the public. Countermeasures are needed to reduce population exposure, at the same time minimising economic and social impacts. The effectiveness of countermeasures are not only highly dependent on factors which are connected to environmental transfer, but also to special consumption behaviours and food production systems. It is clearly desirable that countermeasures are implemented in the most effective way, targeting expensive resources to areas and/or food products for which they are most required.

A high potential of how spatial and temporal variation in radionuclide transfer and variations in food production and consumption habits can be addressed, is the use of geographical information systems (GIS). The application of GIS allows activity concentrations in food products, fluxes of radioactivity (the product of production rate and activity concentration (Bq y^{-1})) and dose to man to be accurately estimated. On the basis of such analyses it is possible to identify more reliable, cost-effective and practically feasible methods to reduce exposure. In addition, the system enables information to be presented to decision makers and simultaneously enable the population to understand and control their own radiation exposure. This, in turn, will allow the psychological problems associated with people living within contaminated environments to be addressed.

The EDSS developed was intended to be as robust and user friendly as possible, thus allowing for application to any other contaminated environment.

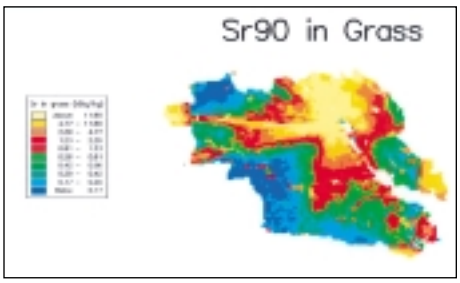
Achievements

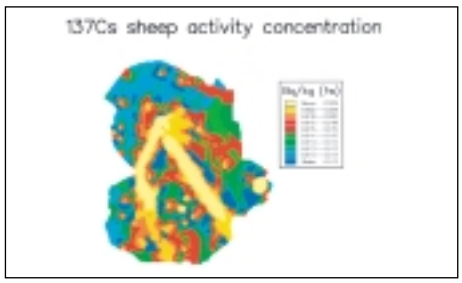
Based on spatial and temporal variations of radionuclides' transfer in environment and food chains, the RESTORE-EDSS developed is capable of identifying those areas which are more resilient or sensitive to radioactive contamination, either through its products or doses to the population. The major achievements can be summarised as follows:

RESTORE-EDSS and underlying ecological models

An EDSS for radiocaesium which can be applied on both a large (e.g. an oblast or region) or small (e.g. collective farm or field level) scale has been adopted. For this purpose different Cs transfer models have been implemented which can be used to predict activity concentrations in products: i) an empirical approach using soil classified transfer values and ii) a semi-mechanistic approach for which more detailed data on soil properties are necessary. Furthermore, the EDSS includes models to predict external dose and daily Cs intake based on dietary information. The potential users can interactively run the EDSS using default data sets or introduce personal data sets for parameters such as soil properties, fertilisation regimes, Cs depositions, to generate expected activity concentrations in defined products, providing an aid

or better directing countermeasure strategies.





A preliminary semi-mechanistic dynamic radiostrontium transfer model has also been developed. In addition to the inputs required for the radiocaesium model, this utilises exchangeable calcium levels in soil. The model was applied to the Ukrainian 30 km exclusion zone only because of the lack of available data for other areas.

Restoration strategies

Self-help advice to reduce dietary radiocaesium intake via the consumption of forest berries, fungi, freshwater fish and privately produced milk has been proposed and justified.

Food contamination in products from the 30 km zone in Ukraine has been predicted and the extent of land which would produce important agricultural foodstuffs with radiocaesium concentrations above Ukrainian intervention limits identified using the EDSS. Examples of how these concentrations could be reduced by use of potassium fertiliser and ferrocyn have been demonstrated and the effect of restriction of fungi and berry consumption following the provided advice has been predicted.

Model validation studies at the Semipalatinsk test site (STS, Kazakhstan)

An initial evaluation of the present radioecological situation of the STS was performed on the basis of literature reviews and available measurements. Using the EDSS Cs model, predictions for the total area were compared with the few available measurement data.

Concerning the radiation risk of the STS, preliminary conclusions are that, with the exception of a few small, but highly contaminated areas, ^{137}Cs contamination levels within the STS are low compared to areas which received radiocaesium deposition following the Chernobyl accident. Those areas should be removed from agricultural production by simply excluding their use.

Perspectives

The RESTORE EDSS is presently adapted for Chile (VW-Stiftung) and is implemented into an ISTC project K-414 *Development of a comprehensive data base on the Semipalatinsk test site* (DECODA). Research in the STS is continuing. Further wider applications of the RESTORE EDSS for the Amazon, Yenissei and the Irtysch river systems are in progress.

The partnership

RESTORE was an EC multi-national project co-ordinated by GSF-Institut fuer Strahlenschutz which was also in charge of the evaluation of the Semipalatinsk test site. Further partners were: Institute of Terrestrial Ecology with major responsibility for countermeasures, University of Barcelona focussing on remediation of natural meadows, Agenzia Nazional per la Protezione dell' Ambiente for flooding processes, and Norwegian Radiation Protection Agency for fluxes and consumption habits. Utrecht University and University of Nottingham developed the final EDSS and the underlying models.

The project was successfully linked to a variety of complementary INCO-Copernicus and ISTC projects which enabled interaction and collaboration with NIS partners in Russia, Ukraine, Belarus and Kazakhstan.

RESTORE Information Column

Title:
Restoration **S**trategies F**o**r **R**adioactive Contaminated **E**cosystems.
(RESTORE)

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