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SOFTWARE FOR DISPERSION IN THE ATMOSPHERE AND HYDROSPHERE

Asian Nuclear Safety Network (ANSN)
Regional Workshop on Radiological Environmental Impact Assessment for Nuclear Installations
Hosted by the Government of the Philippines through the Philippine Nuclear Research Institute (PNRI)
Manila, Philippines, 24–28 October 2022

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International Atomic Energy Agency (IAEA)

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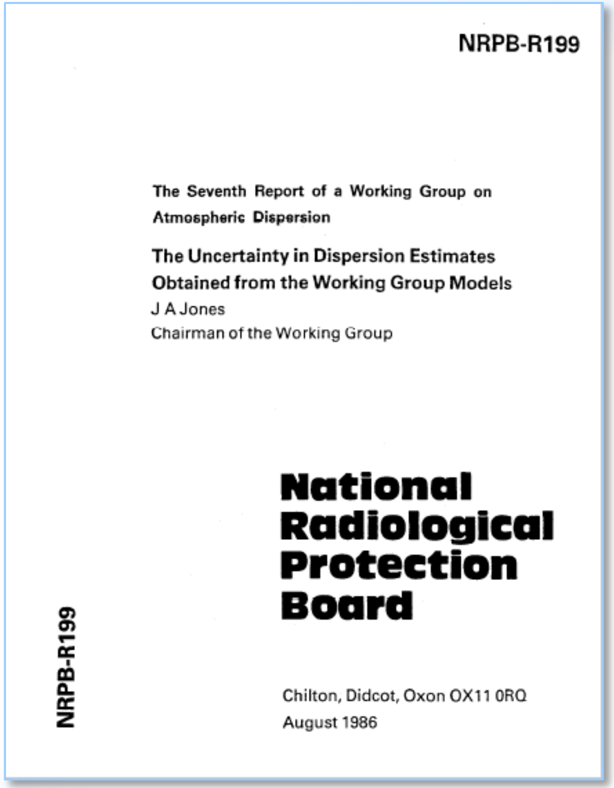
Accuracy and uncertainty of models

Uncertainty in dispersion estimates



NRPB-R199

The Seventh Report of a Working Group on Atmospheric Dispersion

The Uncertainty in Dispersion Estimates Obtained from the Working Group Models

J A Jones

Chairman of the Working Group

National Radiological Protection Board

Chilton, Didcot, Oxon OX11 0RQ

August 1986

NRPB-R199

https://admlc.com/publications/

Uncertainty in dispersion estimates

IAEA

Table 1 Estimates of uncertainty in Gaussian dispersion model predictions

Conditions	Range of predicted/observed concentration
Flat terrain, steady atmospheric conditions, peak air concentration along plume centre line at ground level within 10 km of low level release. Hourly average conc.	0.8 – 1.2
Flat terrain, steady atmospheric conditions, peak air concentration at specific time and receptor point within 10 km of release point. Hourly average conc.	0.1 – 10
Long term average air concentration at a specific point within 10 km of the release point, flat terrain.	0.5 – 2
Monthly and seasonal average air concentrations, 10 to 100 km from the site, in flat terrain	0.25 – 4

Comparison of Gaussian and Lagrangian Models

HPA-CRCE-029

Intercomparison of the 'R91' Gaussian Plume Model and the UK Met Office's Lagrangian Particle NAME III Model in the Context of a Short-duration Release

P Bedwell, J Wellings, S M Haywood, M C Hort*, A R Jones* and D J Thomson*

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ABSTRACT

This report compares the predictions of HPA's application of the 'R91' model with those of the UK Met Office's NAME III model. The study considers a simplified application of NAME and R91 to enable a fair model comparison. The comparison is centred upon analysis of model output generated from a single baseline run for a short duration release of the type often considered in emergency response assessments. Subsequent model runs are performed, scoping a range of model scenarios and commonly modified model input parameters. Differences in the predictions of the two models are investigated and explained. The quantitative assessment of differences in the baseline model output is used as part of a qualitative assessment of observed differences across a range of model runs and their associated output.

There is a disparity (of up to a factor of approximately 3) between time-integrated activity concentrations in air derived using NAME and those derived using R91, most notably in the near-field. R91 is more conservative in its approach, and estimates made by R91 are typically greater than those made by NAME. The cross-wind spread of the plume, vertical spread of the plume and wind-driven advection of the plume are identified as the primary sources of the observed differences between R91 and NAME model output.

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Centre for Radiation, Chemical and Environmental Hazards
Chilton, Didcot,
Oxfordshire OX11 0RQ

Approval: July 2011
Publication: November 2011
£21.00
ISBN 978-0-85951-710-2

This report from the HPA Centre for Radiation, Chemical and Environmental Hazards reflects understanding and evaluation of the current scientific evidence as presented and referenced in this document.

The intercomparison report concluded that:

- There is a disparity (of up to a factor of ~3) between the plume centre-line time-integrated activity in air concentrations (TIAC) of each model most notably in the near field
- The Gaussian model was conservative in that it estimated higher TIACs
- There are significantly larger differences in TIACs between the two models for Pasquill stability Category A and G conditions (low windspeeds) than there are for Category D.
- There are larger differences for large release heights (80 and 200 m) than for a 10 m release height.

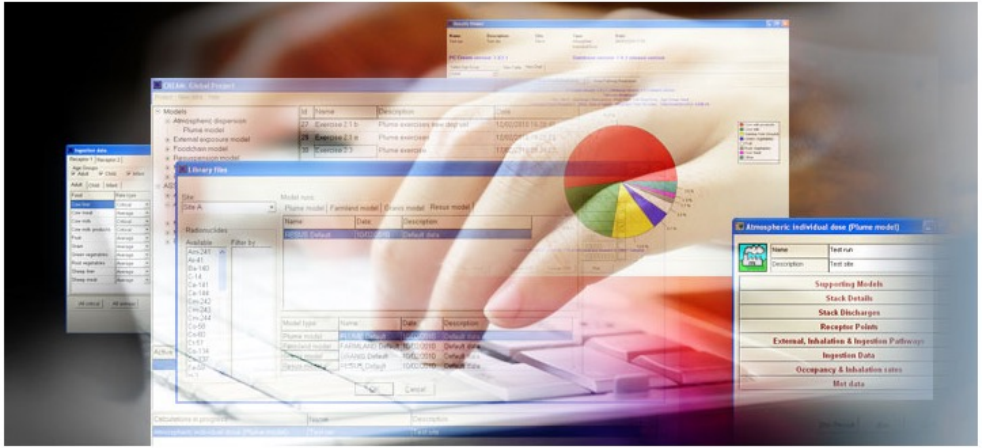
https://www.gov.uk/government/publications/r91-and-name-iii-models-an-intercomparison

Software for Atmospheric Dispersion

Normal operation

PC-CREAM

PC-CREAM Feature Overview



PC-CREAM 08® is an application for performing radiological impact assessments of routine, continuous discharges of radionuclides to the environment. PC-CREAM 08® is used to estimate individual and collective doses arising from discharges of radionuclides to the atmosphere and aquatic environments. It is particularly useful for performing prospective assessments as a key input to discharge authorisations and waste management decisions.

https://www.phe-protectionservices.org.uk/pccream/

PC-CREAM

PC CREAM 08 comprises a number of models and an assessment module (ASSESSOR).

The Terrestrial models within PC CREAM 08 are:

- PLUME The atmospheric dispersion model which predicts the air activity concentrations, deposition rates and external gamma dose rates from radionuclides in the cloud per unit discharge rate
- RESUS Estimate activity concentrations in air arising from the resuspension of previously deposited radionuclides per unit deposition rate
- GRANIS Models the external gamma dose from radionuclides deposited on the soil per unit deposition rate
- FARMLAND predicts the transfer of radionuclides into terrestrial foods following deposition on the ground. Activity concentrations are calculated for a unit deposition rate.

DORIS: The marine dispersion model

River models: Two models for calculating the dispersion of radionuclides released to rivers

Future models will include exposure of fauna and flora

CROM

CROM CODE

Código de cRiba para evaluaciÓn de iMpacto

Screening Model for Environmental Assessment

Juan Carlos Mora, Beatriz Robles, David Cancio

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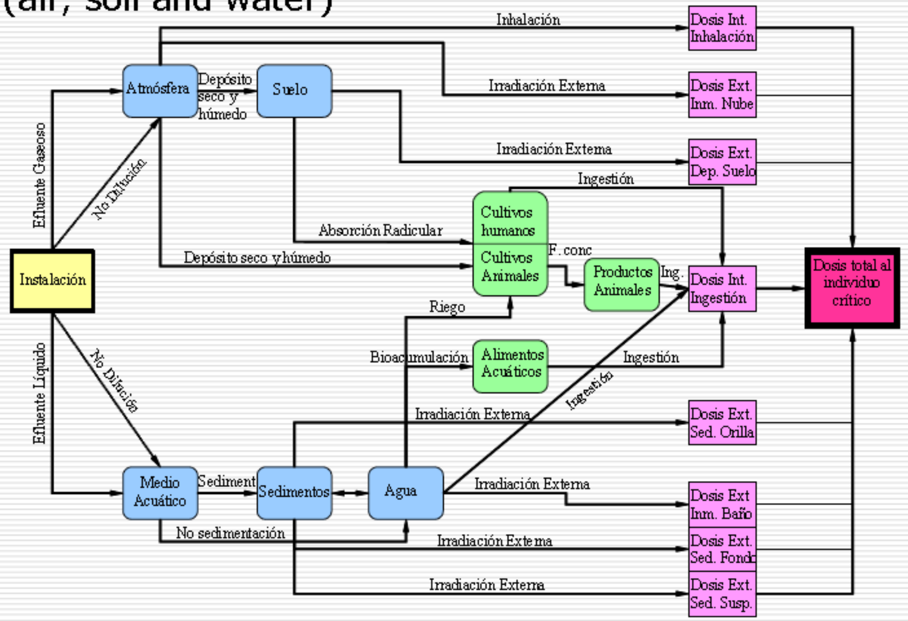
GOBIERNO DE ESPAÑA | MINISTERIO DE CIENCIA E INNOVACIÓN | Ciemat Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas

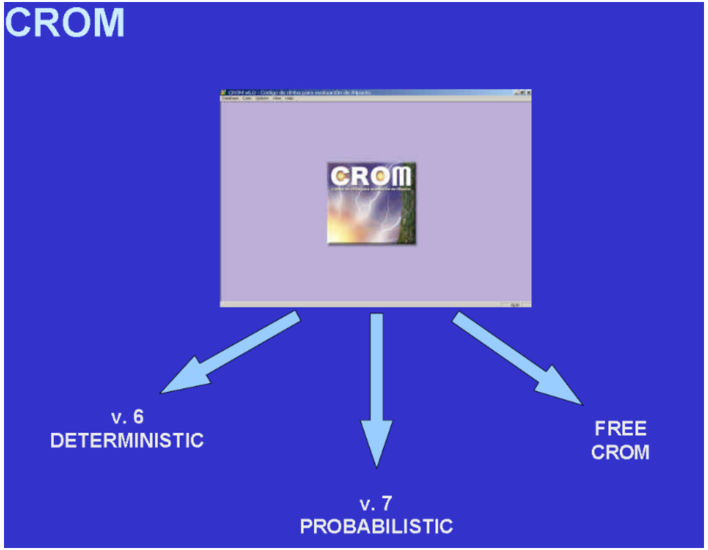
CROM

CONCEPTUAL MODEL

The Code allows for two types of input source term data, rates of discharge in air and water concentrations in the media (air, soil and water)



CROM



CROM

DEVELOPMENT

- Deterministic CROM is being maintained, focusing mainly on the English version
- Probabilistic CROM under development (launch in 2011?)
- Free CROM → community developed

Atmospheric Dispersion – ADMS model

ADMS is a new generation Gaussian plume air dispersion model

Atmospheric boundary layer properties are characterised by two parameters:

- the boundary layer depth, and
- the Monin-Obukhov length

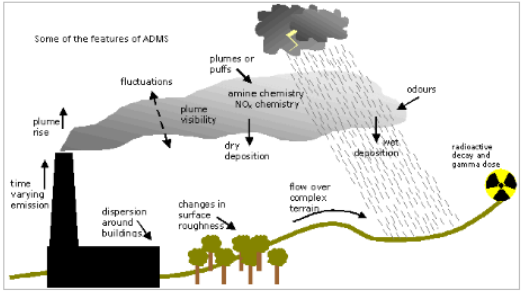
rather than in terms of the single parameter Pasquill-Gifford class

Dispersion under convective meteorological conditions uses a skewed Gaussian concentration distribution (shown by validation studies to be a better representation than a symmetrical Gaussian expression)

▶ Model options

ADMS 5 include the following options:

- Plume rise, buoyancy and momentum
- Dry and wet deposition
- Plumes or puffs
- Time varying emissions
- Dispersion around buildings
- Odours
- Fluctuations
- Plume visibility
- NO_x chemistry
- Amine chemistry
- Radioactive decay and γ-ray dose
- Dispersion in coastal areas
- Dispersion in offshore areas
- Flow over complex terrain
- Changes in surface roughness
- Temperature and humidity output
- Calm conditions
- Combine flues into a single stack
- Advanced meteorological options
- Impact of wind turbines on dispersion
- Link to AERMOD
- Comprehensive Output Processor (COP)



http://www.cerc.co.uk/environmental-software/ADMS-model.html

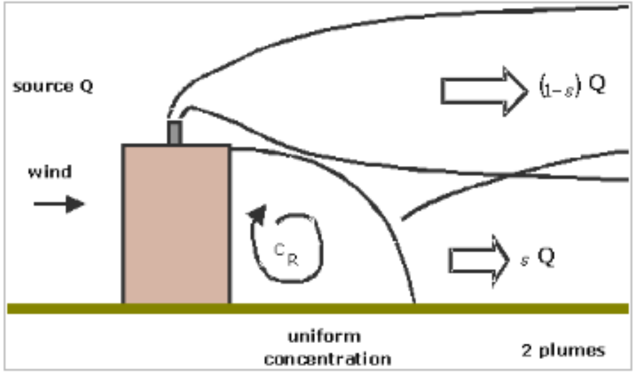
Atmospheric Dispersion – ADMS model

Dispersion around buildings [top]

The building effects module in ADMS 5 includes the following features.

Up to 25 buildings can be included in each model run with a *Main Building* being defined for each source. For each wind direction, a single effective wind-aligned building is defined, around which the flow is modelled.

The flow field consists of a recirculating region (or cavity), with a diminishing turbulent wake downstream.



Concentrations within the cavity, C_R, are uniform, and based on the fraction of the release that is entrained. The concentration at a point further downwind is the sum of contributions from two plumes: a ground-based plume from the recirculating flow region and an elevated plume from the non-entrained remainder. The concentration and deposition are set to zero within the user-defined buildings.

Can be used to determine optimum stack height

Cavity concentration can be used to determine intake into Control Room for example

Gaussian model would have to assume either

- Full entrainment in building wake – could be quite pessimistic
- No entrainment in building wake – non-conservative for ground-level or cavity/wake concentrations

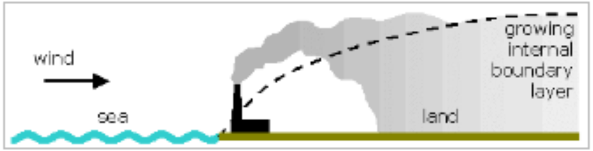
Also plume visibility for visual impact in Environmental Impact Assessment

Atmospheric Dispersion – ADMS model

Dispersion in coastal areas [top]

For air dispersion modelling in coastal areas, ADMS 5 includes a coastline module that may be invoked when the following conditions are satisfied:

- the sea is colder than the land;
- there are convective meteorological conditions on land;
- there is an onshore wind.

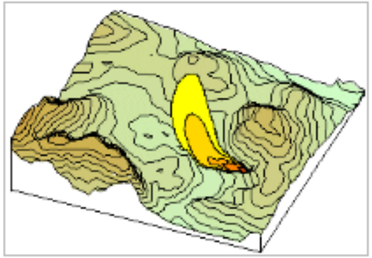


Flow over complex terrain [top]

ADMS 5 uses CERC's complex terrain model, FLOWSTAR, to calculate the flow and turbulence fields that are then used to enhance the calculation of dispersion.

The model predicts a three-dimensional flow and turbulence field over the region of interest, dependent on both input values of terrain height and roughness, as well as the local meteorological conditions.

In ADMS 5, the plume is subjected to these varying flow and turbulence fields, which results in ground level concentrations that may be higher or lower than the corresponding predictions for flat terrain.



It is recommended that the complex terrain option in ADMS 5 be used in regions where the gradient exceeds 1:10, but is less than about 1:3.

Methodology for assessing short term discharges to atmosphere

NRPB-W54

A Methodology for Assessing Doses from
Short-Term Planned Discharges to Atmosphere

J G Smith, P Bedwell, C Walsh and S M Haywood

ABSTRACT

When the radiological impact of discharges from sites are assessed it is normally assumed that discharges occur continuously and uniformly over a year. However, during normal operations at sites which discharge radionuclides to the atmosphere, it is possible to have short-term enhanced releases due to routine maintenance operations or particular features of the operations undertaken. It is possible that such short-term discharges may lead to doses that are higher, or lower, than would be expected if it were assumed that the site discharges are continuous over a year. This report presents a generic assessment methodology for short-term planned discharges which can be applied to a variety of release conditions. It addresses the issues of variability in model input parameters and discusses how these may influence the dose received by the critical group. The aim of the methodology is to provide realistically cautious, rather than exceedingly cautious, predictions of the dose to members of the critical group.

This study was funded jointly by the Environment Agency (Project P3-092) and NRPB

Environment Agency

This work was undertaken under the Environmental Assessments Department and Emergency Response Group Quality Management System, which has been approved by Lloyd's Register Quality Assurance to the Quality Management Standards ISO 9001:2000 and TickIT Guide Issue 5, certificate number 956546.

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Chilton
Didcot
Oxon OX11 0RQ

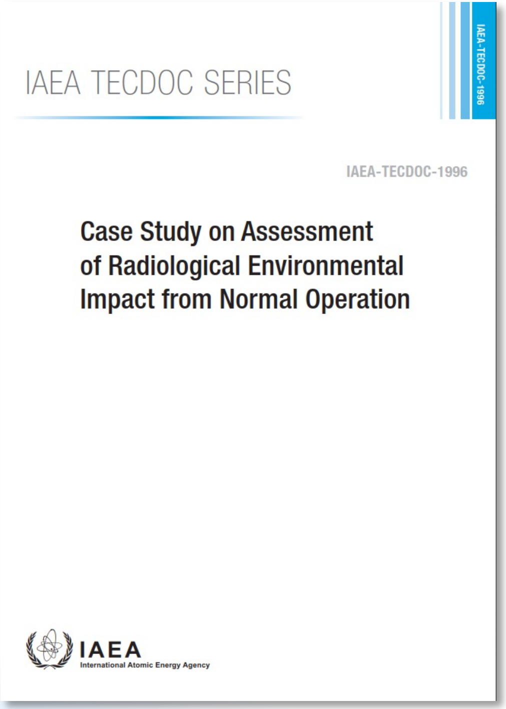
Approval: March 2004
Publication: March 2004
£30.00
ISBN 0 85951 534 6

This NRPB report reflects understanding and evaluation of the current scientific evidence as presented and referenced in this document.

Compares ADMS and Gaussian models

http://webarchive.nationalarchives.gov.uk/20110321072646/http://www.hpa.nhs.uk/web/HPAweb&Page&HPAwebAutoListName/Page/1158945066506

Case Studies: TECDOC-1996 – Normal operation



Summarizes approach in a number of Member States to assessing the radiological consequences of from normal operation

The results using different tools by each MS for three atmospheric cases, two marine cases, and two riverine cases

MSs participating in Study

- Belarus
- France
- India
- Indonesia
- Republic of Korea
- Russian Federation
- Ukraine

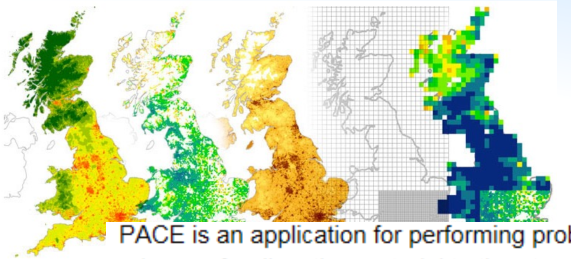
Software for Atmospheric Dispersion

Accidental releases

Accident Consequence Assessment tools

- MACCS (Sandia National Laboratories)
- COSYMA (PC COSYMA)
  - Probabilistic risk assessments (Level 3 PSA)
  - Developed through EC MARIA Project
  - See report ‘PC Cosyma (Version 2): An assessment consequence package for use on a PC’, EUR 16239
- PACE (Probabilistic Accident Consequence Evaluation)
  - A tool for assessing the ranges of accident consequences at new nuclear power stations
  - Can use Gaussian or Lagrangian atmospheric dispersion models
  - Economic consequence models
  - Developed by the UK HSA (Health Security Agency) as an update to PC COSYMA
  - Available from https://www.ukhsa-protectionservices.org.uk/pace

PACE



PACE is an application for performing probabilistic assessments of the off-site consequences of accidental release of radioactive material to the atmosphere (otherwise termed level-3 PSA) . PACE is used to estimate the probability distributions of such consequences as

- Individual doses from exposure to radioactive material in the air and on the ground and collective doses from ingestion of contaminated terrestrial food.
- Numbers of health effects both fatal and non-fatal arising from exposure.
- Costs of disruption on agriculture, industry and society.

Consequences can be mitigated by countermeasures and PACE considers the following:

- Evacuation
- Sheltering
- Stable iodine prophylaxis
- Long term population relocation
- Decontamination of the environment
- Restriction of food

PACE incorporates both a Gaussian dispersion model and the UK Met Office NAMEIII lagrangian particle model. PACE is embedded within the ArcGIS(TM) Geographic Information System software enabling high quality map output to be produced.

https://www.ukhsa-protectionservices.org.uk/pace

PACE

Features

- Ability to handle short and long duration multi-phase releases
- Embedded within ArcGIS(TM) software to allow sophisticated spatial data handling functionality and high quality map production.
- Incorporates the advanced UK Met Office NAMEIII lagrangian particle model. This model can use 3-D Numerical weather prediction (NWP) data or single site meteorological data.
- A complete set of default input data for the UK

Licensing example

For the planning process a typical PACE analysis would follow from a Level-2 analysis which looks at accident sequences that might breach the containment of the facility. The Level-2 analysis would establish a suitable source term (the quantities of different radionuclides released) which would be used as the input to the PACE Level-3 analysis. By running PACE you can establish the probability of certain consequences such as fatalities and compare these against the regulatory licensing criteria.

Emergency planning example

Given a source term, PACE can indicate the likely extent of evacuation, sheltering and stable iodine administration and how many people might be affected. It can estimate the likely duration of relocation and restriction on food marketing. This information can then be used as a basis for a review of the adequacy of existing emergency plans. It also allows you to quantify when the limits of current emergency planning may be exceeded, for example when urgent countermeasures may be required outside the existing emergency planning zone.

PACE

Atmospheric dispersion modelling

The heart of a Level-3 probabilistic safety analysis is the repetitive consequence calculation for different weather sequences drawn by sampling from an historical meteorological database. In this way the ranges of possible consequences can be ascertained. PACE has been designed to use the UK Met Office model NAMEIII which is a sophisticated lagrangian particle model that can use either 3-D numerical weather prediction (NWP) or single site meteorological data. Alternatively PACE incorporates a simple Gaussian dispersion model.

PACE

Consequence calculation

For each grid square PACE calculates such consequences as:

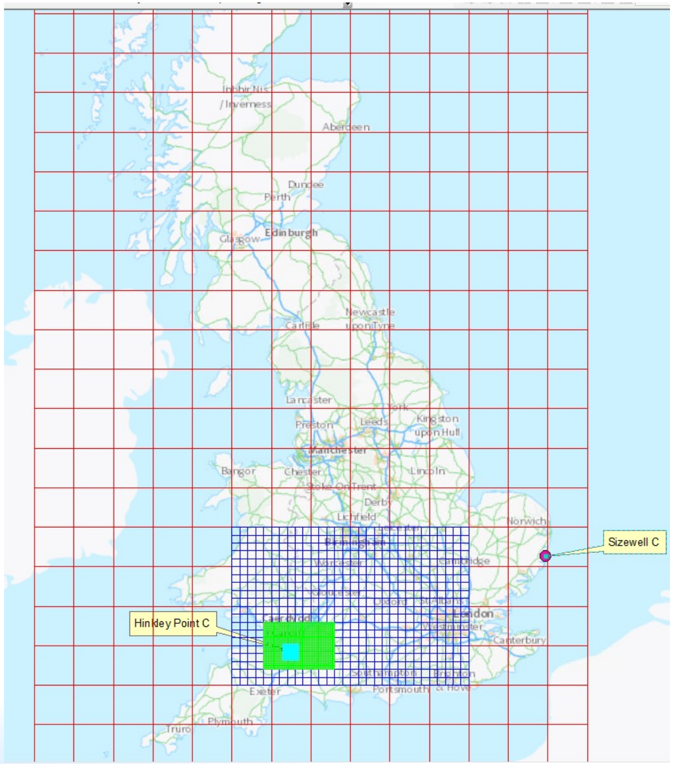
- Individual doses from exposure to radioactive material in the air and on the ground and collective doses from ingestion of contaminated terrestrial food.
- Numbers of health effects both fatal and non-fatal arising from exposure. PACE considers stochastic, i.e. cancers and hereditary effects and deterministic, i.e. skin burns, cataracts and other early injuries and diseases.
- Costs of disruption on agriculture, industry and society.

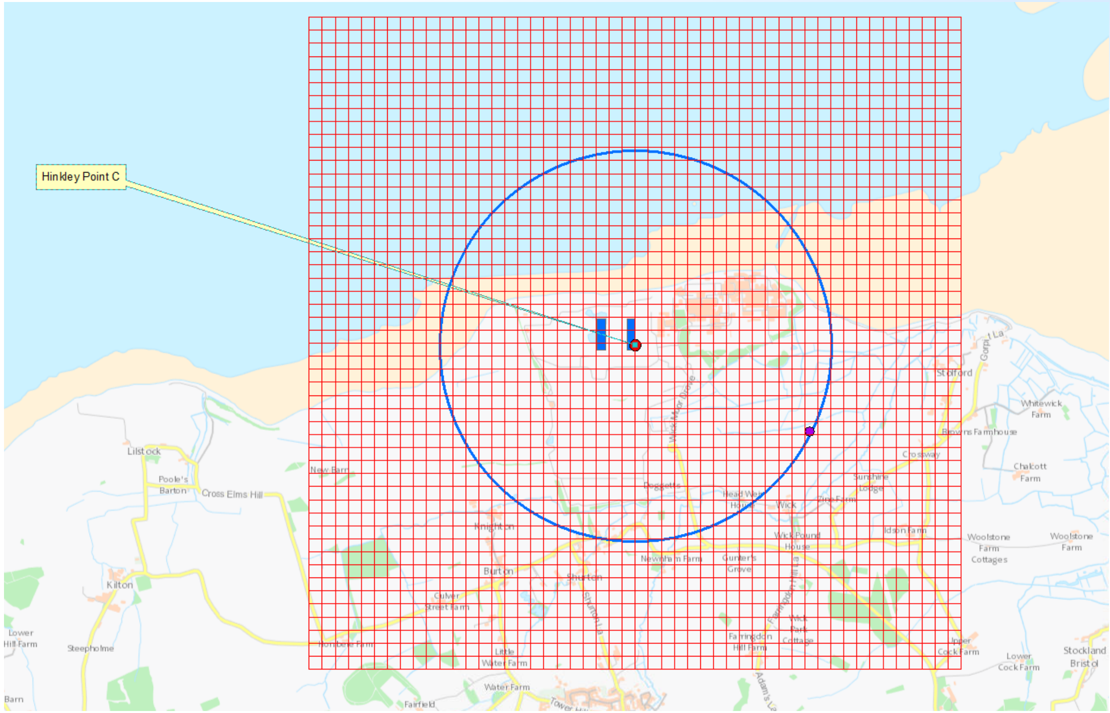
Consequences can be mitigated by countermeasures and PACE allows you to consider the following protective measures:

- Evacuation
- Sheltering
- Stable iodine prophylaxis
- Long term population relocation
- Decontamination of the environment
- Restriction of food sales

Results of calculations are stored for each grid square within an ArcGIS(TM) database and can be queried and plotted on maps.

Nested Rectangular Grids used by PACE for conditional risk calculations



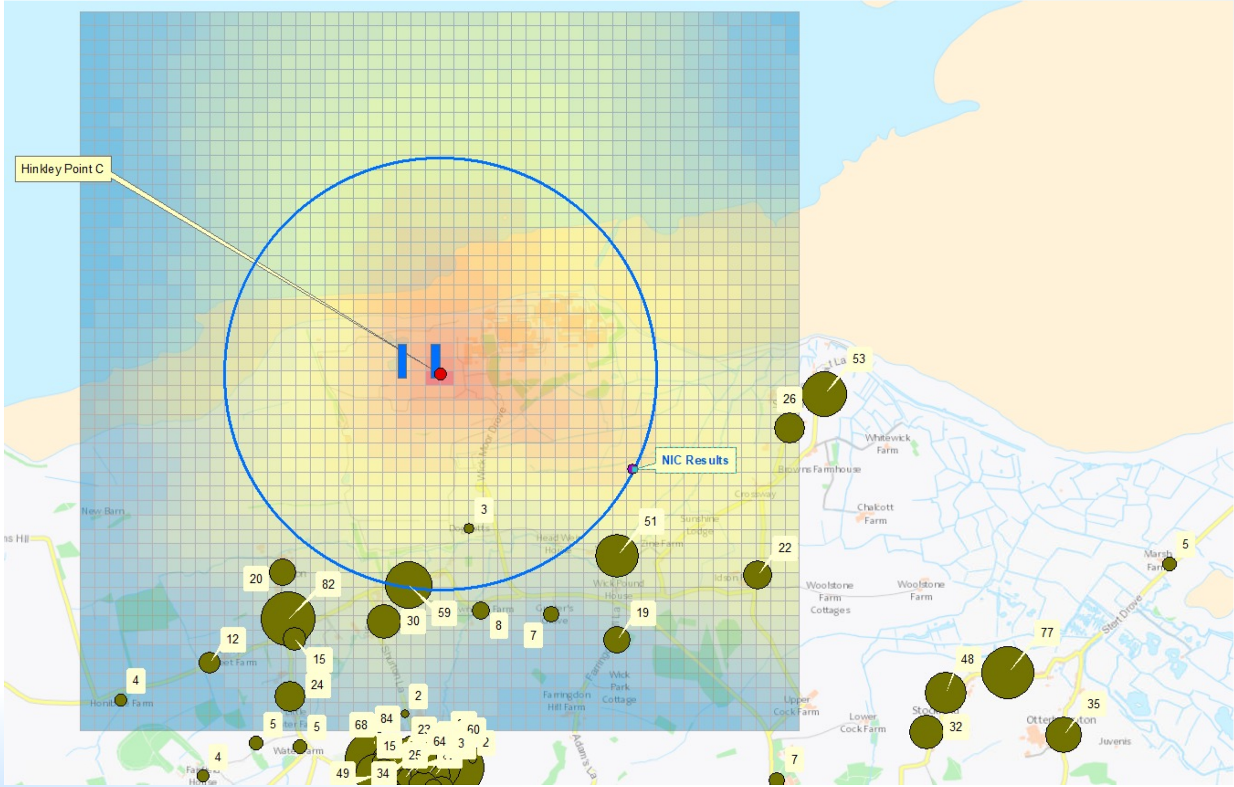


Societal risk grid:1km, 2km, 10km, 50 km grid squares

Individual risk grid:100m grid squares

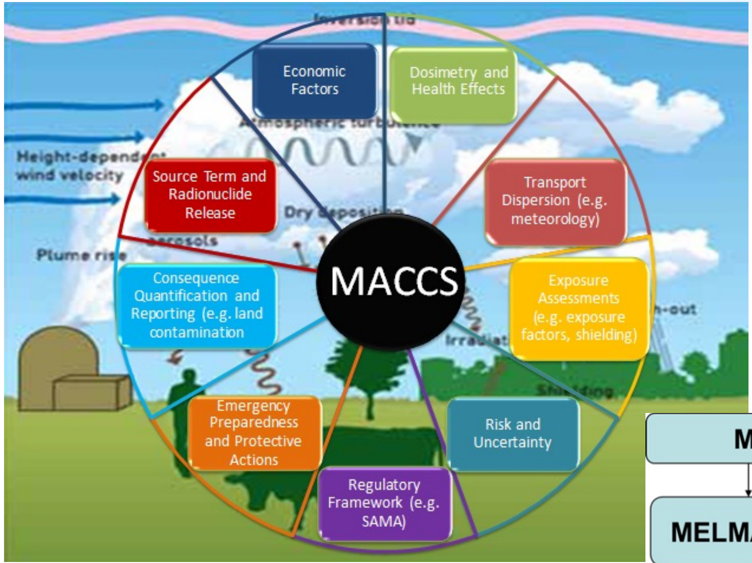
Level 3 PSA Results – Individual Risk

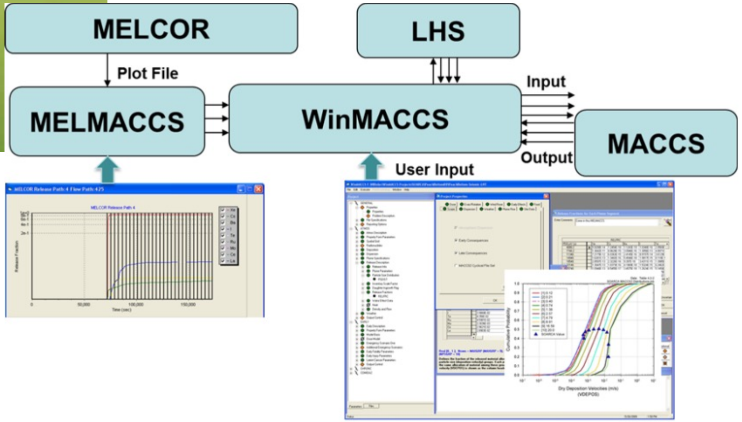
PACE Grid for individual risk showing relative conditional risk contours and population around site (RC30)



Blue circle – 1.5km radius
100m grid squares
Green bubbles are population numbers at each post code

MACCS





http://maccs.sandia.gov/maccs.aspx

Recent IAEA Comparison Exercise (TECDOC-1914)

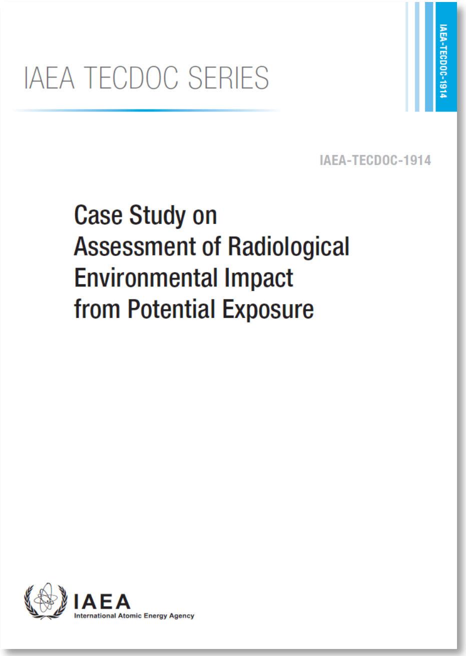
TABLE 8. MODELS AND CODES USED BY ENV-PE EXERCISE PARTICIPANTS

Participant	Deterministic		Probabilistic	
	Type of model	Code	Type of model	Code
Argentina			Gaussian	WinMACCs
Belarus			Gaussian + Gaussian puff/ Lagrangian	InterRAS
France	Gaussian multi-puff	MITHRA® software of the CERES® platform		
Germany			Gaussian/ Gaussian puff	Mainframe COSYMA v90/1
India	Simple Gaussian [1]	In-house		
Israel	Simple Gaussian	HOTSPOT		
Russia	Simple Gaussian	Express/RECASS		
Spain	Lagrangian puff/particle model	JRODOS	Gaussian	WinMACCs
Ukraine	Simple Gaussian	In-house	Gaussian puff	SOARS
UK	Simple Gaussian [1, 2]	In-house	Gaussian puff	PC-COSYMA v2.03

[1] modified to account for plume depletion by wet and dry deposition

[2] modified to account for wet and dry deposition and building wake effects [30, 34-36]

Case Studies: TECDOC-1914 – Accidental releases



Summarizes approach in a number of Member States (Level 3 PSA or otherwise) to assessing the radiological consequences of a severe accident

Case study used the source term for short-term station blackout in the SOARCA Surry study at an imaginary site

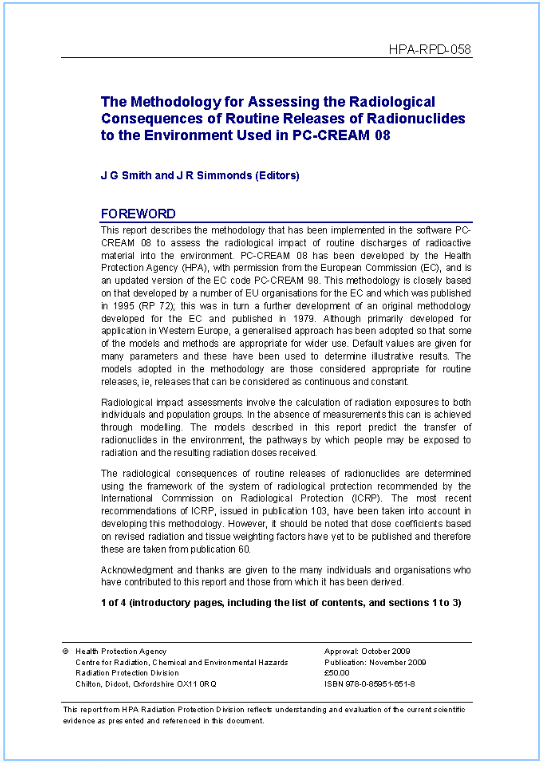
MSs participating in Study

- Argentina
- Belarus
- France
- Germany
- India
- Israel
- Russian Federation
- Spain
- Ukraine
- United Kingdom

Dispersion in the Hydrosphere

PC-CREAM

EXAMPLE: PC-CREAM aquatic dispersion modelling and dose assessment for continuous discharges



HPA-RPD-058

The Methodology for Assessing the Radiological Consequences of Routine Releases of Radionuclides to the Environment Used in PC-CREAM 08

J G Smith and J R Simmonds (Editors)

FOREWORD

This report describes the methodology that has been implemented in the software PC-CREAM 08 to assess the radiological impact of routine discharges of radioactive material into the environment. PC-CREAM 08 has been developed by the Health Protection Agency (HPA), with permission from the European Commission (EC), and is an updated version of the EC code PC-CREAM 98. This methodology is closely based on that developed by a number of EU organisations for the EC and which was published in 1995 (RP 72); this was in turn a further development of an original methodology developed for the EC and published in 1979. Although primarily developed for application in Western Europe, a generalised approach has been adopted so that some of the models and methods are appropriate for wider use. Default values are given for many parameters and these have been used to determine illustrative results. The models adopted in the methodology are those considered appropriate for routine releases, ie, releases that can be considered as continuous and constant.

Radiological impact assessments involve the calculation of radiation exposures to both individuals and population groups. In the absence of measurements this can is achieved through modelling. The models described in this report predict the transfer of radionuclides in the environment, the pathways by which people may be exposed to radiation and the resulting radiation doses received.

The radiological consequences of routine releases of radionuclides are determined using the framework of the system of radiological protection recommended by the International Commission on Radiological Protection (ICRP). The most recent recommendations of ICRP, issued in publication 103, have been taken into account in developing this methodology. However, it should be noted that dose coefficients based on revised radiation and tissue weighting factors have yet to be published and therefore these are taken from publication 60.

Acknowledgment and thanks are given to the many individuals and organisations who have contributed to this report and those from which it has been derived.

1 of 4 (introductory pages, including the list of contents, and sections 1 to 3)

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Centre for Radiation, Chemical and Environmental Hazards
Radiation Protection Division
Chilton, Didcot, Oxfordshire OX11 0RQ

Approval: October 2009
Publication: November 2009
£50.00
ISBN 978-0-85951-651-8

This report from HPA Radiation Protection Division reflects understanding and evaluation of the current scientific evidence as presented and referenced in this document.

PC-CREAM has simple dilution and semi-empirical models (Schaeffer model)

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/434637/HPA-RPD-058_June_2015.pdf

PC-CREAM: Schaeffer semi-empirical model

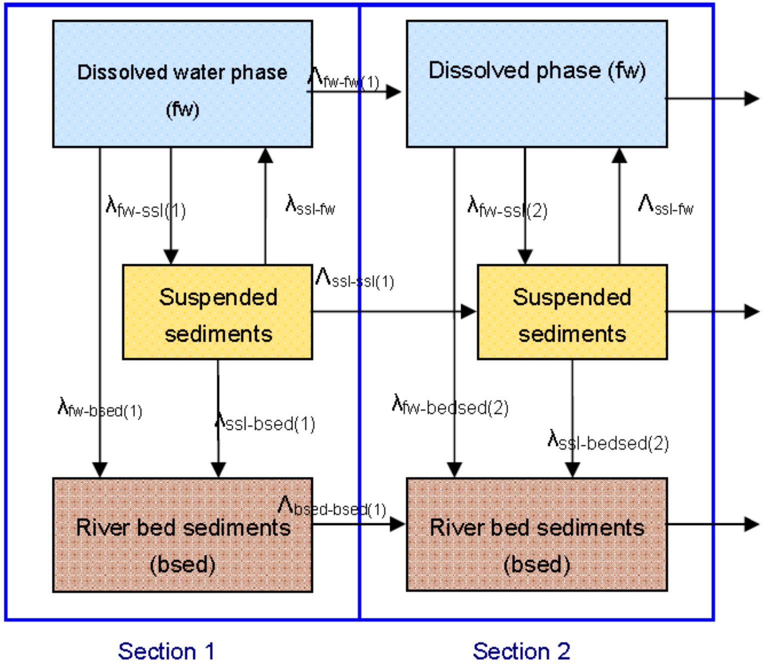


Diagram 1 The Schaeffer river compartmental model used in PC-CREAM 08

PC-CREAM: Schaeffer semi-empirical model

River is divided into sections with homogeneous hydrological characteristics

Activity moves downstream in water column and bed sediments

Transfer between dissolved and suspended sediments is modelled using nuclide dependent distribution coefficients (K_d)

Sedimentation is modelled using Schaeffer k’ parameter

PC-CREAM River Parameters

Table C3.4 – Parameters used in PC-CREAM 08 for the River Thames and tributaries with discharging sites, (Hilton et al, 2002).

River section		Flow ($m^3 s^{-1}$)*	Width (m)	Depth (m)	Length (m)	Volume (m^3)	Sediment flow *($m^3 s^{-1}$)	Suspended sediment load $t\ m^{-3}$	Discharging sites
1	Ray confluence to Cherwell confluence	$1.35\ 10^1$	$2.42\ 10^1$	$1.00\ 10^0$	$6.96\ 10^4$	$1.69\ 10^6$	$4.04\ 10^{-4}$	$2.50\ 10^{-5}$	
2	Cherwell confluence to Sutton Courtenay	$2.57\ 10^1$	$5.00\ 10^1$	$2.23\ 10^0$	$1.75\ 10^4$	$1.95\ 10^6$	$3.45\ 10^{-4}$	$2.50\ 10^{-5}$	
3	Sutton Courtenay to 1 km below	$2.57\ 10^1$	$4.90\ 10^1$	$2.15\ 10^0$	$1.00\ 10^3$	$1.05\ 10^5$	$3.58\ 10^{-4}$	$2.50\ 10^{-5}$	Harwell
4	1 km below Sutton Courtenay confluence to Kennet confluence	$3.54\ 10^1$	$5.45\ 10^1$	$2.27\ 10^0$	$4.85\ 10^4$	$6.00\ 10^6$	$4.67\ 10^{-4}$	$2.50\ 10^{-5}$	Aldermaston
5	Kennet confluence to Loddon confluence	$5.21\ 10^1$	$6.00\ 10^1$	$2.04\ 10^0$	$8.00\ 10^3$	$9.79\ 10^5$	$7.67\ 10^{-4}$	$2.50\ 10^{-5}$	Aldermaston **
6	Loddon confluence to Colne confluence	$5.67\ 10^1$	$5.00\ 10^1$	$1.79\ 10^0$	$5.80\ 10^4$	$5.19\ 10^6$	$9.50\ 10^{-4}$	$2.50\ 10^{-5}$	
7	Colne confluence to Wey confluence	$5.41\ 10^1$	$5.05\ 10^1$	$2.14\ 10^0$	$1.05\ 10^4$	$1.13\ 10^6$	$7.59\ 10^{-4}$	$2.50\ 10^{-5}$	Amersham ***
8	Wey confluence to Teddington Lock	$7.78\ 10^1$	$7.80\ 10^1$	$2.97\ 10^0$	$2.05\ 10^4$	$4.75\ 10^6$	$7.85\ 10^{-4}$	$2.50\ 10^{-5}$	

* Flow is calculated from the velocity x depth of water or sediment x width of river. The sediment velocity is $1\ 10^{-4}$ of water velocity.

** Aldermaston discharges into the River Kennet

*** Amersham discharges into the River Colne.

Marine compartment models

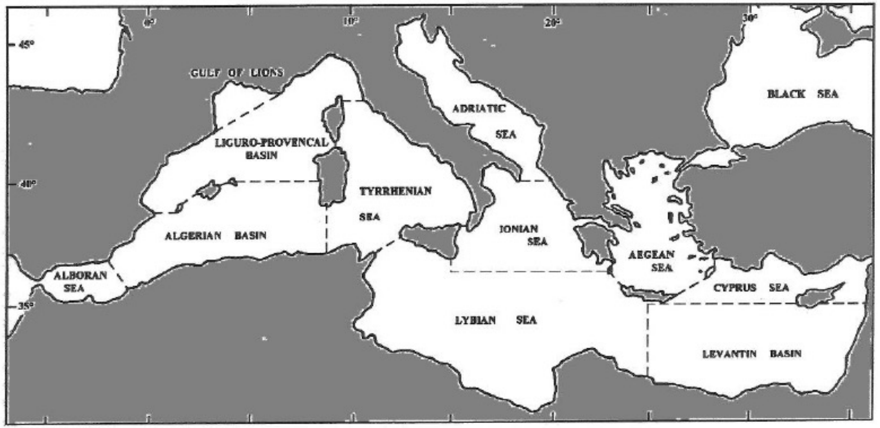
- EC assessment methodology
  - PC CREAM
  - MARINA
- MARINA II
  - Increased extent of model
  - Improved remobilisation
- CSERAM
  - More detailed approach
  - Limited to Irish Sea

PC-CREAM Mediterranean Sea Model

Table D3.1 - Parameter values for the Mediterranean marine model compartments as implemented in PC-CREAM 08

Compartment number	Compartment name	Volume (m^3)	Depth (m)
1	Other oceans	$8.98\ 10^{17}$	$3.80\ 10^{3}$
2	Northern Europe	$4.65\ 10^{17}$	$2.94\ 10^{3}$
3	Gulf Of Cadiz	$2.30\ 10^{14}$	$1.70\ 10^{3}$
4	Alboran Sea (surface)	$5.00\ 10^{12}$	$1.00\ 10^{2}$
5	Alboran Sea (deep)	$2.43\ 10^{13}$	$4.85\ 10^{2}$
6	Liguro - Provencal Basin	$2.81\ 10^{13}$	$1.00\ 10^{2}$
7	Algerian Basin	$2.69\ 10^{13}$	$1.00\ 10^{2}$
8	Tyrrhenian Sea	2.40	
9	Gulf of Lions	5.36	
10	Western Basin	1.11	
11	Adriatic Sea	1.38	
12	Ionian Sea	2.64	
13	Libyan Sea	6.34	
14	Aegean Sea	1.70	
15	Levantin Basin	3.43	
16	Cyprus Sea	1.11	
17	Eastern Basin	2.20	
18	Black Sea (surface waters)	4.53	
19	Black Sea (deep waters)	4.98	

FIGURE D4.1 Surface compartments of the Mediterranean Sea Model



PC-CREAM Mediterranean Sea Model

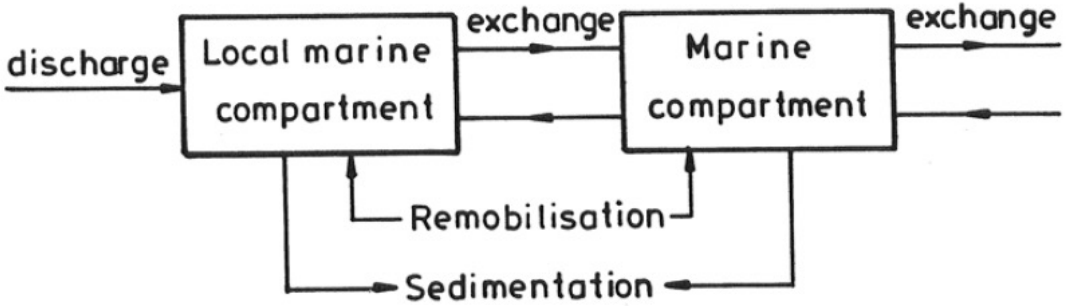
Table D3.2 - Exchange rates for Mediterranean regional marine model as implemented in PC-CREAM 08

From compartment no	Compartment name	To compartment no	Compartment name	Exchange rate (m^3 y^{-1})
11	Adriatic Sea	17	Eastern Basin	$2.73\ 10^{13}$
14	Aegean sea	17	Eastern Basin	$5.36\ 10^{12}$
14	Aegean sea	12	Ionian sea	$4.70\ 10^{13}$
14	Aegean sea	18	Black sea (surface)	$1.89\ 10^{11}$
4	Alboran sea surface	5	Alboran sea deep	$1.58\ 10^{12}$
4	Alboran sea surface	7	Algerian Basin	$5.19\ 10^{13}$
5	Alboran sea deep	4	Alboran sea surface	$1.58\ 10^{12}$
5				

Table D3.3 - Sediment model parameters common to all compartments used in the Mediterranean Sea model as implemented in PC-CREAM 08 (Simmonds et al, 2002)*

Parameter	Default value	Description
Lt	0.1 m	Thickness of top sediment layer
Lm	1.9 m	Thickness of middle sediment layer
P	2.6 t m^{-3}	Sediment mineral density
RW	$5\ 10^{-3}$ m y^{-1}	Sediment reworking rate for shallow seas up to 200m, also local compartment.
	$5\ 10^{-4}$ m y^{-1}	Sediment reworking rate for deep seas greater than 200m.
RT	1 y^{-1}	Pore water turn over rate for shallow seas up to 200m, also local compartment.
	0.1 y^{-1}	Pore water turn over rate for deep seas greater than

PC-CREAM: Marine Dispersion Model



PC-CREAM: Marine Sediment Model

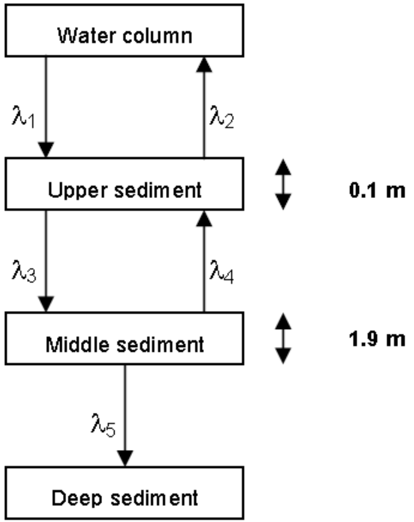
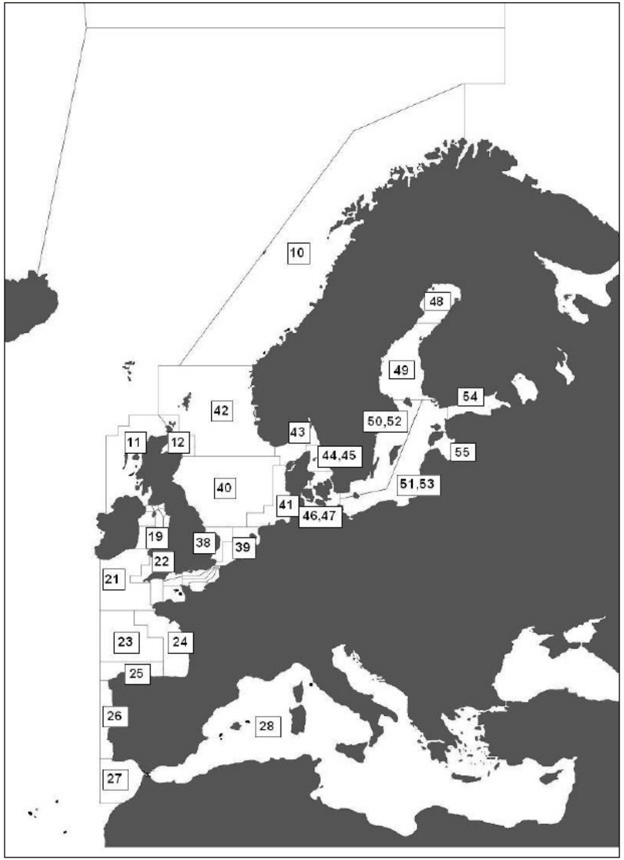
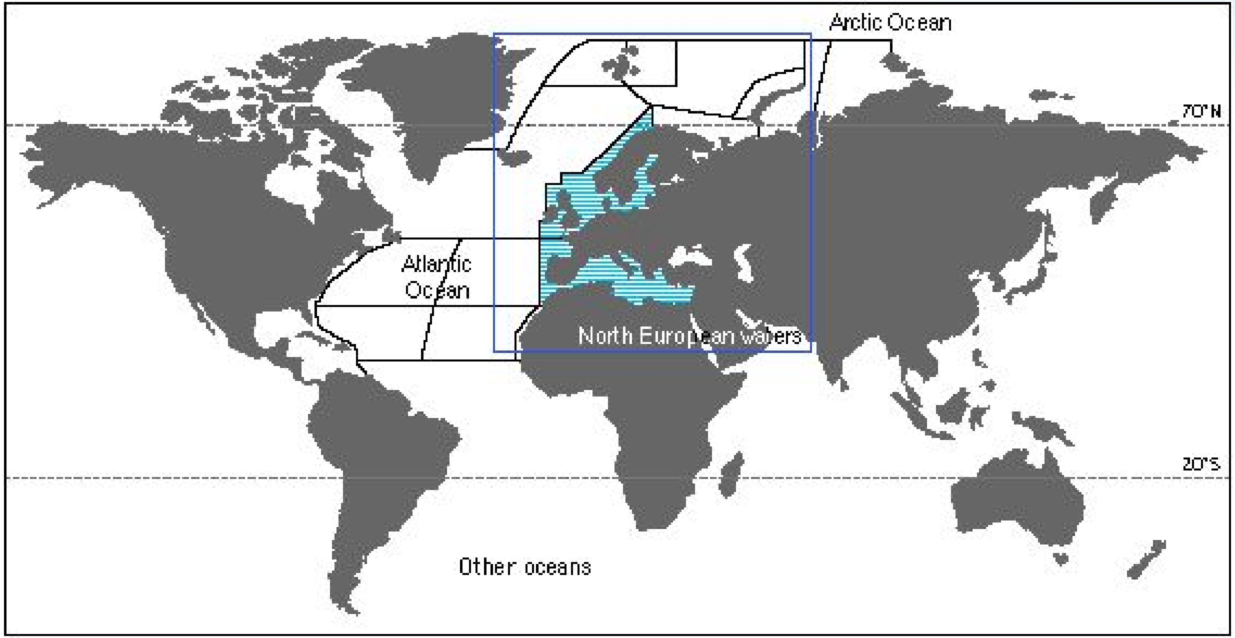


Diagram 2 Generic structure for the water–sediment compartment model

Figure 4.4 – Northern European regional compartments included in the marine dispersion model as modified for PC-CREAM 08



MARINA II Model Compartments



Further information

ADMLC

Atmospheric Dispersion Modelling Liaison Committee

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Publications

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Publications of the ADMLC and its Earlier Working Group on Atmospheric Dispersion

Atmospheric Dispersion Modelling Liaison Committee. ADMLC-R14. (September 2021): Link to main text

- A Review of Approaches to Dispersion Modelling of Odour Emissions and Intercomparison of Models and Odour Nuisance Assessment Criteria. Link to report

Atmospheric Dispersion Modelling Liaison Committee. ADMLC-R13. (July 2021): Link to main text

- Review of dense-gas dispersion for industrial regulation and emergency preparedness and response. Link to report
- Annex I (ANNEX_I_Summary_tables_incidents_experiments.xlsx), this Excel spreadsheet (34 KB) summarises the incidents and experiments referenced in the review. Link to spreadsheet
- Presentation made by Rachel Batt (HSE) to ADMLC. Link to presentation

Atmospheric Dispersion Modelling Liaison Committee. ADMLC-R12. (February 2021):

- Guidelines for the Preparation of Short Range Dispersion Modelling Assessments for Compliance with Regulatory Requirements – An Update to the ADMLC 2004 Guidance. (Link to report)

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Meetings and Events

Meeting Dates:
Next meeting: 7th July 2022

Future meeting(s): tba

Seminar: None planned

Hunt JCR, Holroyd JR and Carruthers DJ (1988). Preparatory studies for a complex dipsersion model. Cambridge Environmental Research Consultants, Ltd. Link to report.

Jones, J A (1986). The seventh report of a Working Group on Atmospheric Dispersion: The uncertainty in dispersion estimates obtained from the Working Group models. Chilton, NRPB-R199. Link to report.

Jones, J A (1986). The sixth report of a Working Group on Atmospheric Dispersion: Modelling wet deposition from a short release. Chilton, NRPB-R198. Link to report.

Jones, J A (1983). The fifth report of a Working Group on Atmospheric Dispersion: Models to allow for the effects of coastal sites, plume rise and buildings on dispersion of radionuclides and guidance on the value of deposition velocity and washout coefficients. Chilton, NRPB-R157. Link to report.

Jones, J A (1981). The fourth report of a Working Group on Atmospheric Dispersion: A model for long range atmospheric dispersion of radionuclides released over a short period. Chilton, NRPB-R124. Link to report.

Jones, J A (1981). The third report of a Working Group on Atmospheric Dispersion: The estimation of long range dispersion and deposition of continuous releases of radionuclides to atmosphere. Chilton, NRPB-R123. Link to report.

Jones, J A (1981). The second report of a Working Group on Atmospheric Dispersion: A procedure to include deposition in the model for short and medium range dispersion of radionuclides. Chilton, NRPB-R122. Link to report.

Clarke, R H (1979). The first report of a Working Group on Atmospheric Dispersion: A model for short and medium range dispersion of radionuclides released to the atmosphere. Harwell, NRPB-R91. Link to report.

https://admlc.com/publications/

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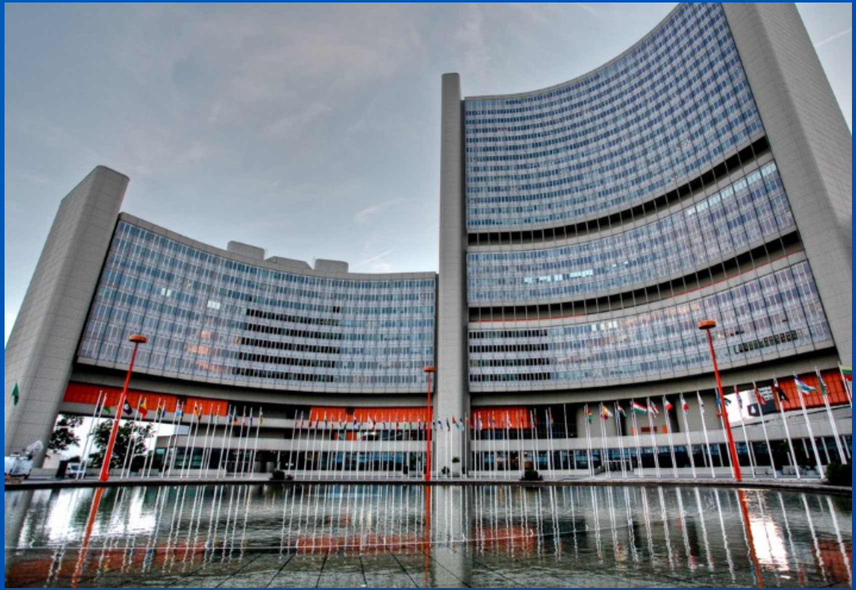

Thank you!
Questions?