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

CROM
An Introduction

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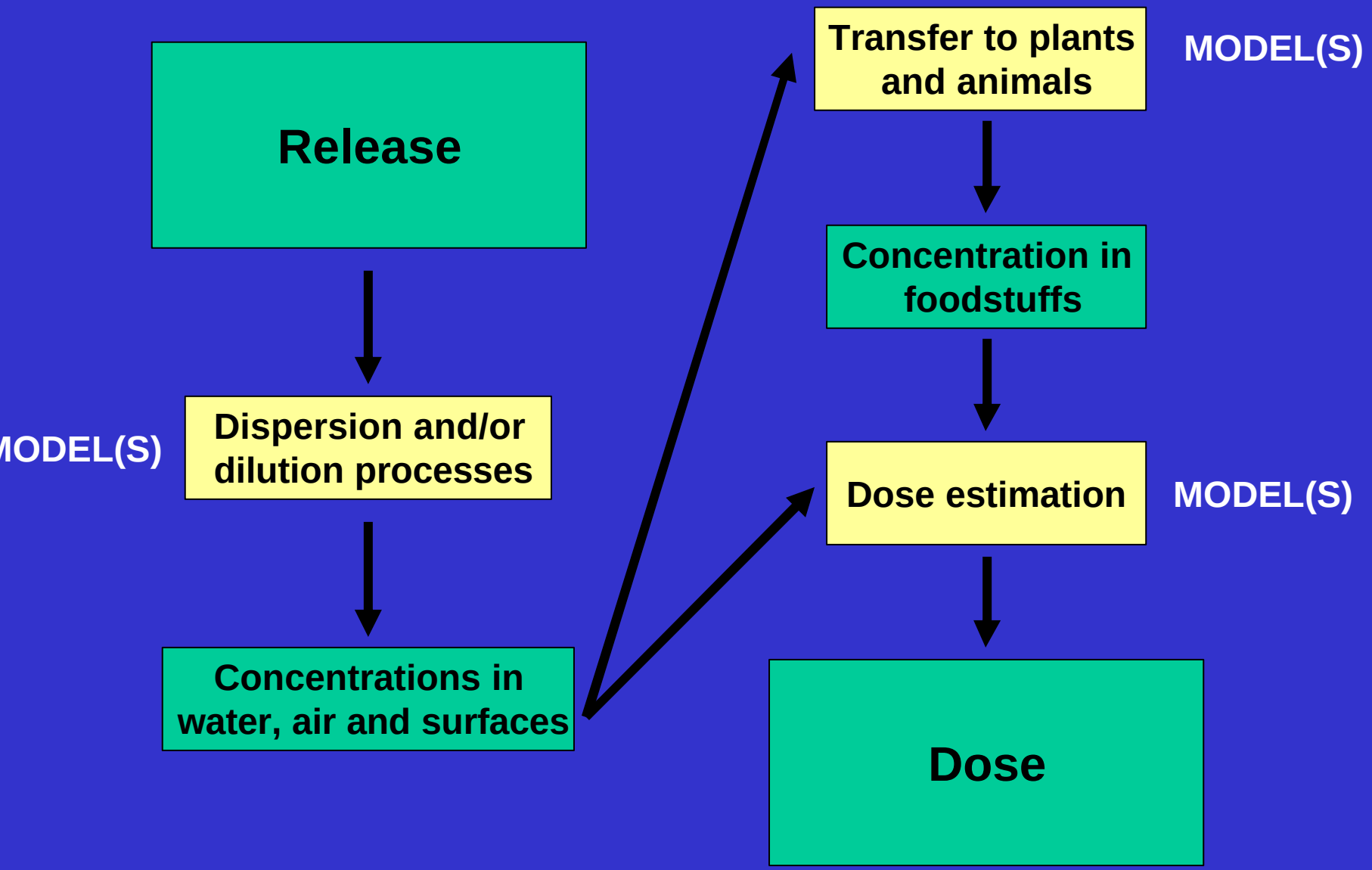
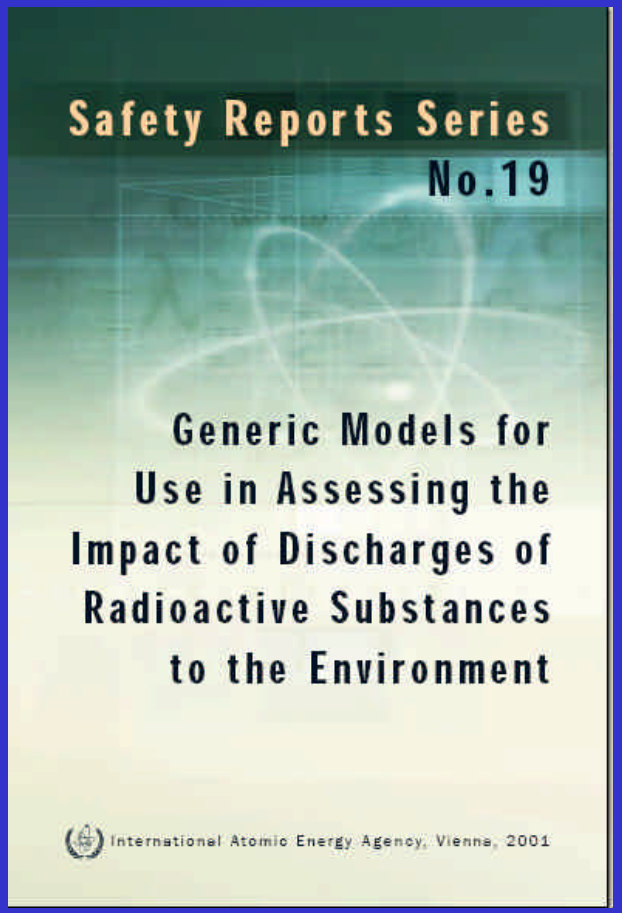
Radiation Protection for the Public and the Environment
CIEMAT

Vienna january 27th 2011

Environmental impact assessment



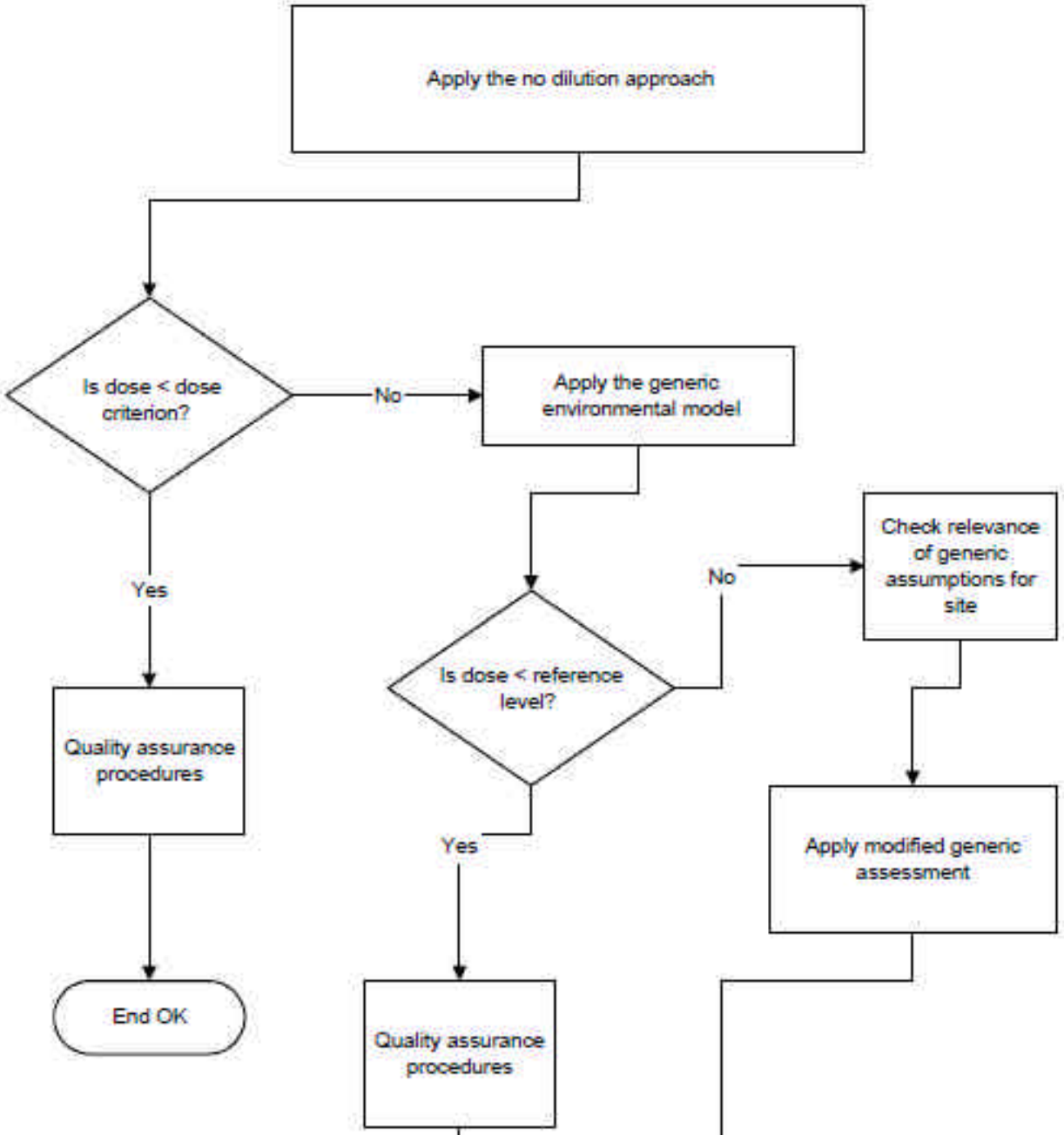
Safety Report Series No 19



Generic methods for use in assessing the impact of discharges

Screening approach - Iterative approach

- Step by step process - model complexity increases as predicted doses increase
  - 1st step = ‘no dilution model’
  - 2nd step = ‘generic environmental model
  - 3rd step = ‘modified generic assessment’
  - 4th step = ‘site specific assessment’


Apply the no dilution approach
Is dose < dose criterion?
No
Apply the generic environmental model
Yes
Check relevance of generic assumptions for site
No
Is dose < reference level?
Quality assurance procedures
Yes
Apply modified generic assessment
End OK
Quality assurance procedures

CROM

v. 6
DETERMINISTIC

v. 7
PROBABILISTIC

FREE
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

CROM

DEVELOPED BY

Center for Research of Energy, Environment and Technology (CIEMAT):
UPRPYMA

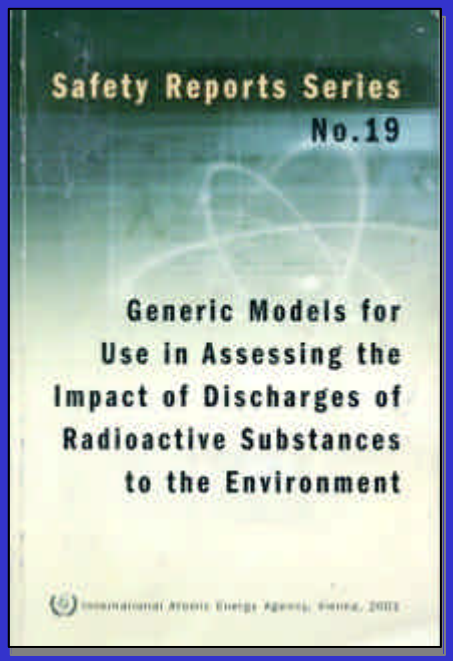
Polytechnic University of Madrid:
LAB. INFORMATICS ETSII

CROM

Models based in IAEA SRS-19 with "improvements" based in RP-72 (EUR-15760).

2001 IAEA - SRS 19 - "Generic Models for Use in Assessing the Impact of Discharges of Radioactive Substances to the Environment".

1995 UE - RP 72 – "Methodology for assessing the radiological consequences of routine releases of radionuclides to the environment".



CROM 6

QUALITY CONTROL

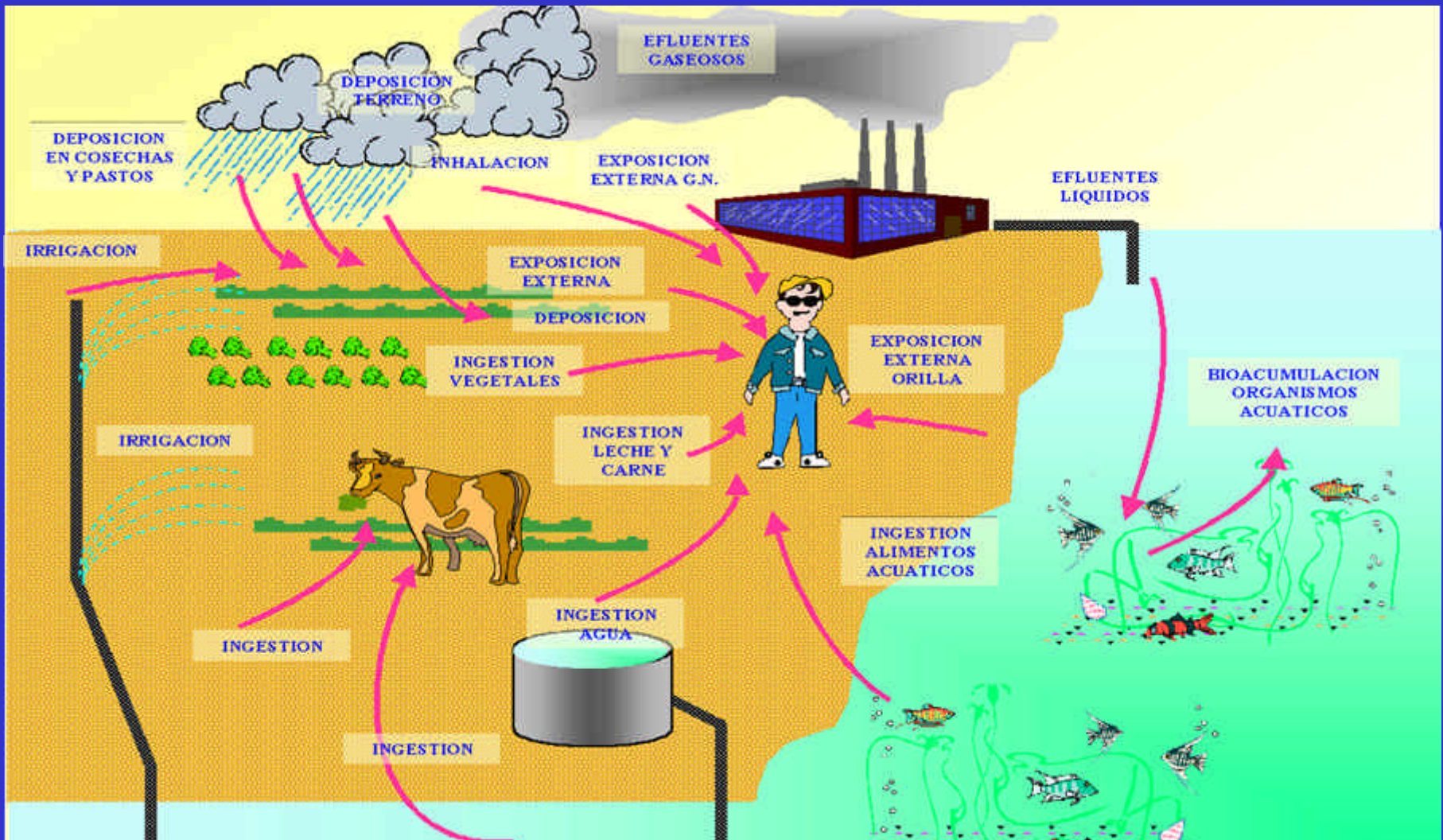
The software was quality controled by CIEMAT and RPD-HPA, formerly NRPB, (document RPD-EA-11-2005) for its adoption by the IAEA as the reference code for those models.

Other people acting as testers of CROM in different situations (EMRAS II)

TRANSFERED TO THE IAEA IN 2008 FOR ITS FREE DISTRIBUTION

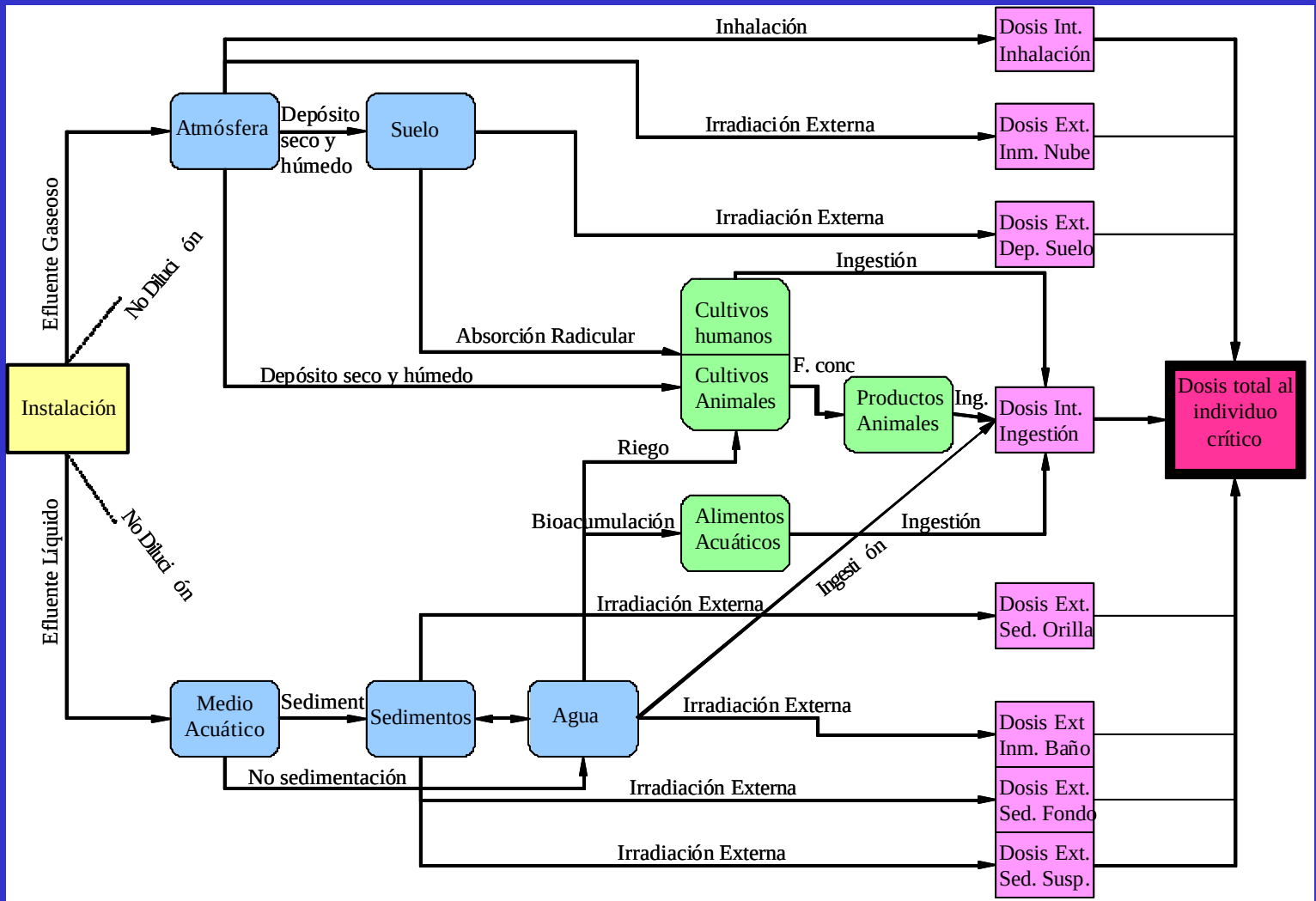
CROM

Conceptual model



CROM

Conceptual model



CROM

Models implemented

- Atmosphere discharges
  - Building affected models
  - Roughness affected wind profiles
- Aquatic discharges
  - River / Sewers
  - Small lakes
  - Sea / Great lakes
  - Estuaries
- Sedimentation
- Transfer to biota
- H3 & C14

CROM

Features of CROM code:

- Continuous (routine/controlled) releases
- Default Pasquill stability category D
- Groundwater not considered
- Effective height not calculated
- Irrigation considered
- Sedimentation in surface waters
- Bath considered
- Crustacean considered
- A lot of not default values can be used

CROM

Features of CROM code:

- Effective dose and concentration calc.
- 8 SRS 19 examples in the default DB
- Growth of daughter considered (transport and deposition)
- Today 151 radioisotopes in the default DB
- New radionuclides easily implementable
- External DCFs based in FGR 12
- Internal DCFs from IAEA’s BSS

CROM

Problems that can be solved

CROM

Problems that can be solved

CROM

Problems that can be solved

CROM

Problems that can be solved

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Problems that can be solved

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EXTERNAL EXPOSURE PATHWAYS

- IMMERSION IN THE GASEOUS PLUME
- DEPOSITION IN THE SOIL
- SUBMERSION IN WATER DURING THE BATH
- SHORE SEDIMENTS

CROM

INTERNAL EXPOSURE PATHWAYS

- INGESTION OF CONTAMINATED WATER
- INGESTION OF VEGETABLES CONTAMINATED BY ATMOSPHERE DEPOSIT OR IRRIGATION
- INGESTION OF ANIMAL MEAT CONTAMINATED BY CONTAMINATED WATER OR VEGETABLES
- INGESTION OF FRESHWATER FISHES AND CRUSTACEAN
- INGESTION OF MARINE FISHES AND CRUSTACEAN
- INHALATION

CROM

DOSE CONVERSION FACTORS

- EXTERNAL:
  - Based in Federal Guidance Report No 12 Considers the growth of the daughters using Bateman equations
- INTERNAL:
  - Based in BSS (IAEA No 115). Committed effective dose up to 70 y.
  - 6 age groups as defined in BSS.
  - Different absortion cathegories (F,M,S) considered.

CROM

Results

- SCREEN
- WORD BASED REPORT
- EXCEL BASED DATA

CROM

What CROM can do

The models implemented in Crom were designed for assessing doses due to releases from nuclear or radioactive installations provided that:

- ~ 30 YEARS EMMISSIONS.
- CONTINUOUS EMMISSIONS (In any single day is not emitted more than 1% of the annual release)
- NEUTRAL ATMOSPHERIC CONDITIONS (Pasquill D difussion category)

CROM

What CROM can do (with help)

Using some additional calculations Crom can be used for:

- ANY NUMBER OF YEARS EMMISSIONS.
- ANY ATMOSPHERIC CONDITIONS (Any Pasquill difussion category)
- Effective height considerations
- Resuspension of deposited material
- Other radioisotopes can be used calculating the DCFs and introducing them into the DB.
- H3 & C14
- Sewers

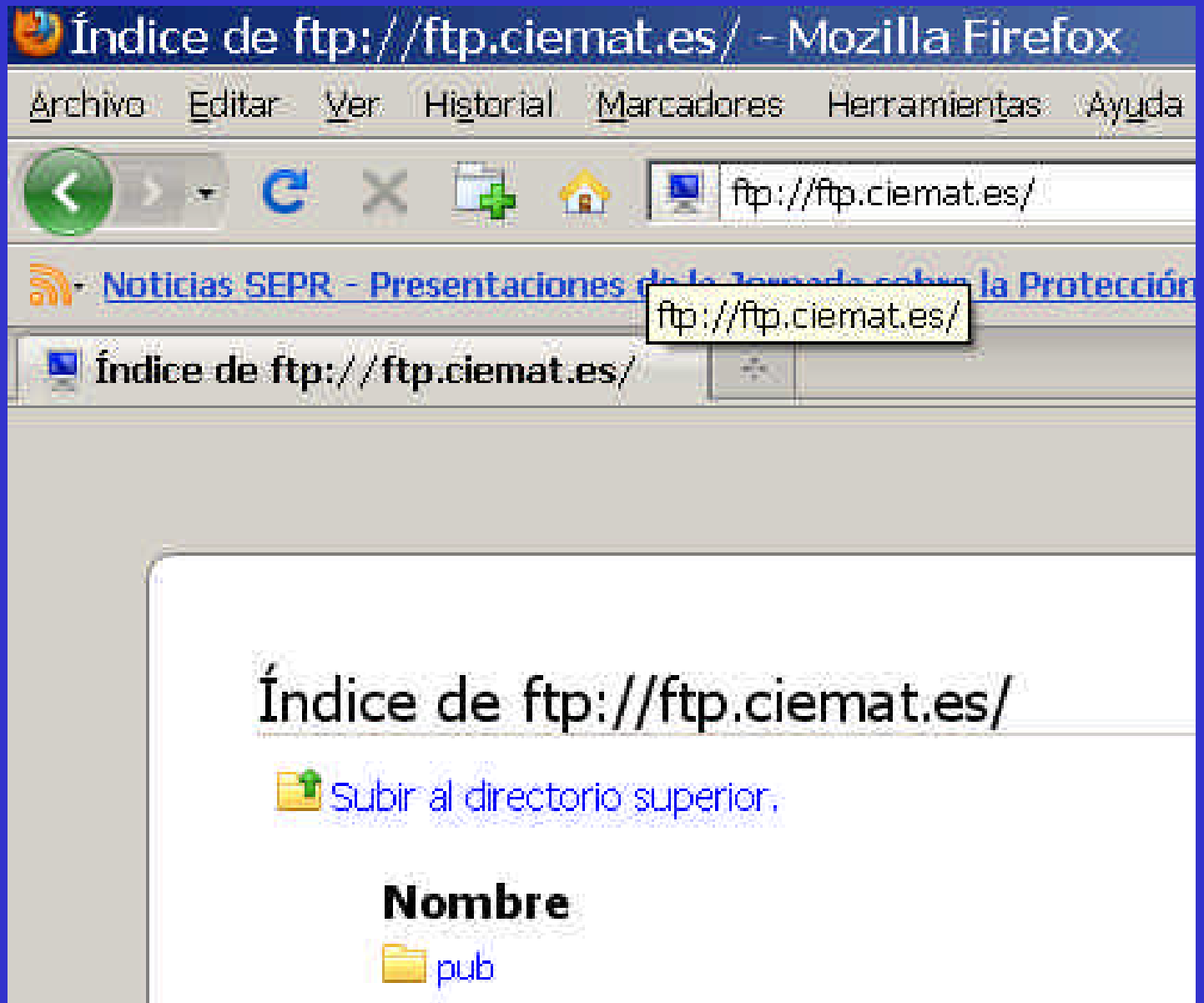
CROM

What CROM can’t do

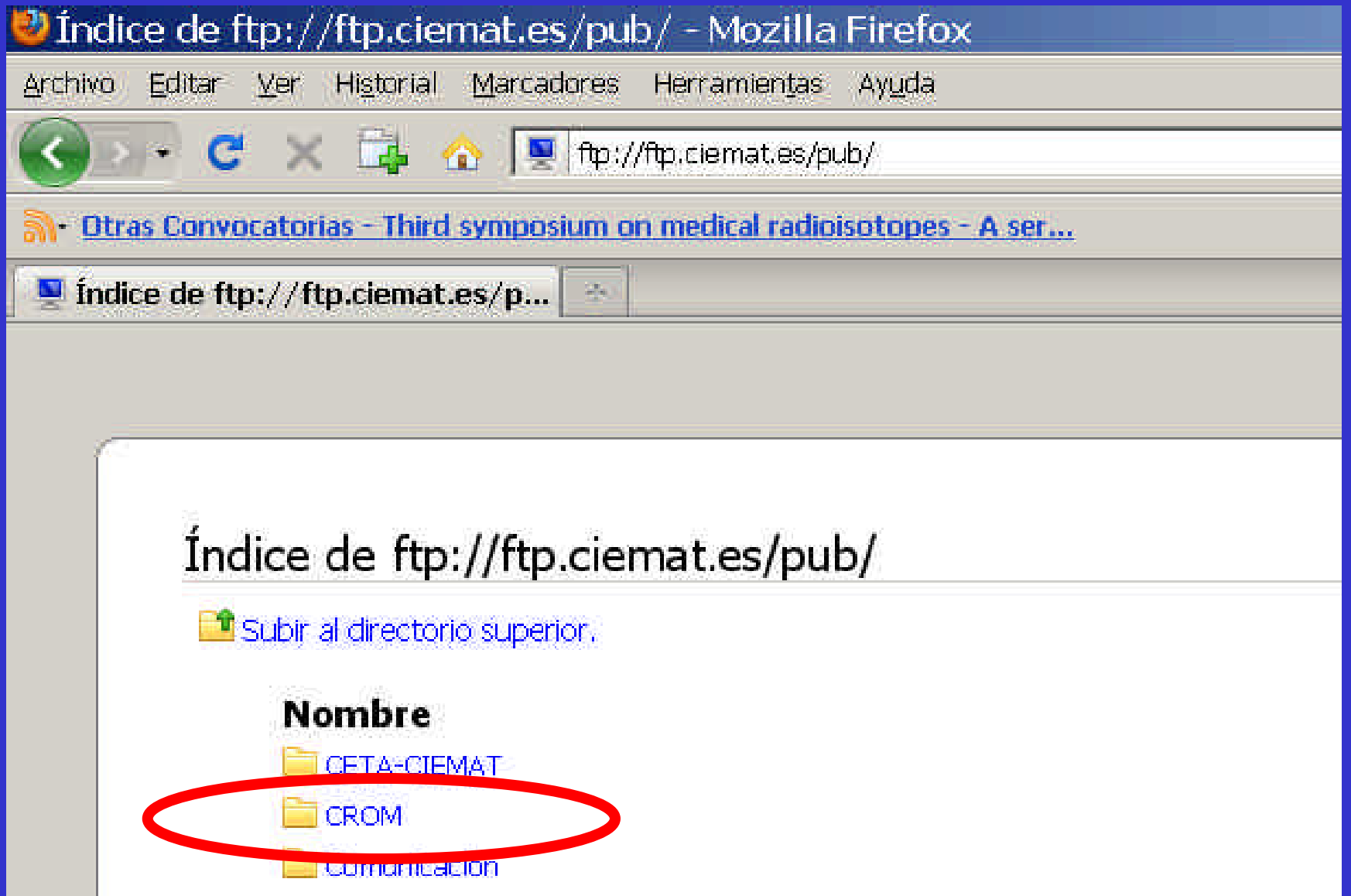
The models implemented in Crom are not valid for assessing doses in:

- **SHORT TIME EMMISSIONS (accidents)**
- **VERY LONG TIME EMMISSIONS (HLW repository)**
- **GROUNDWATER DISPERSION**

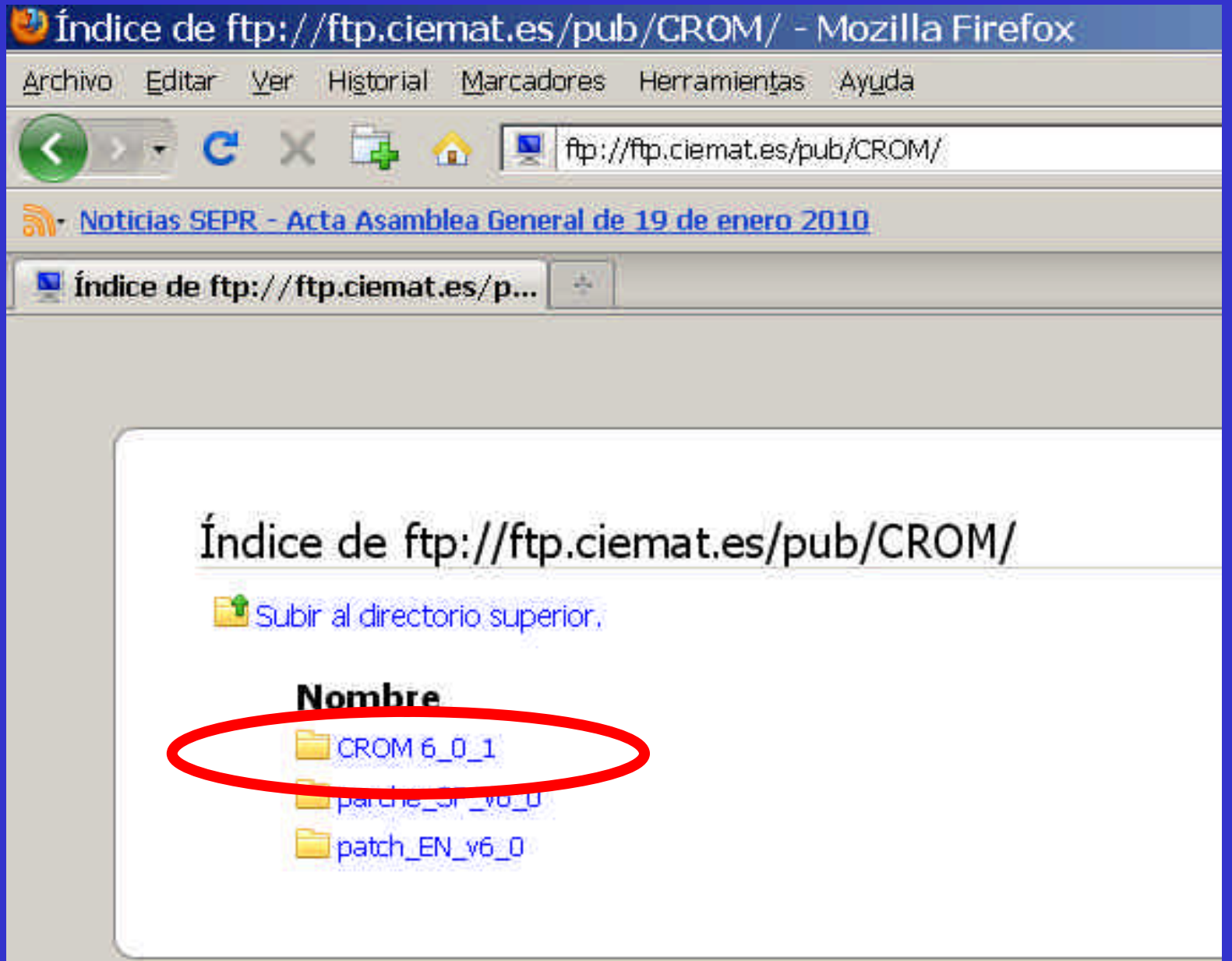
CROM - Installation



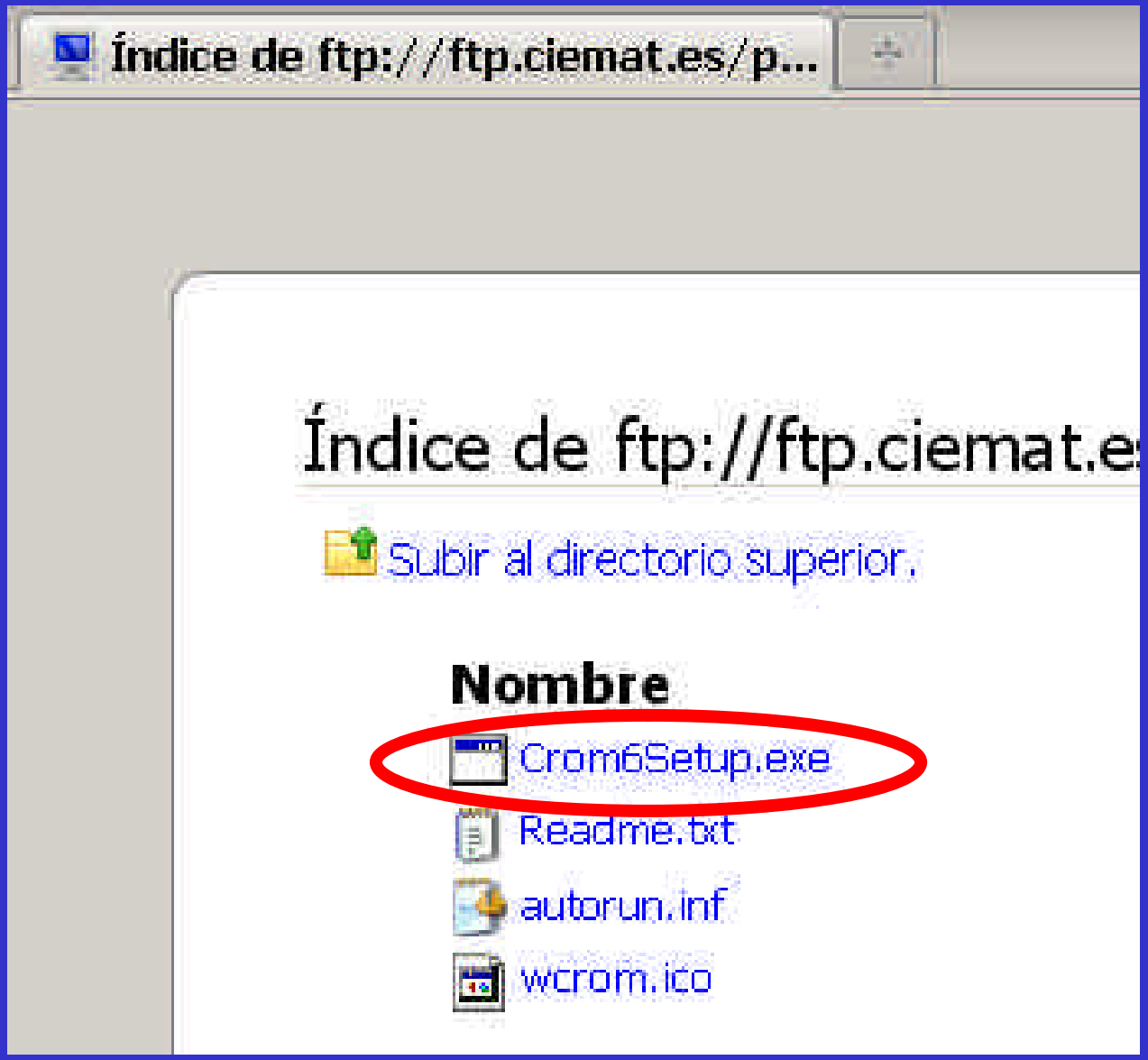
CROM - Installation



CROM - Installation

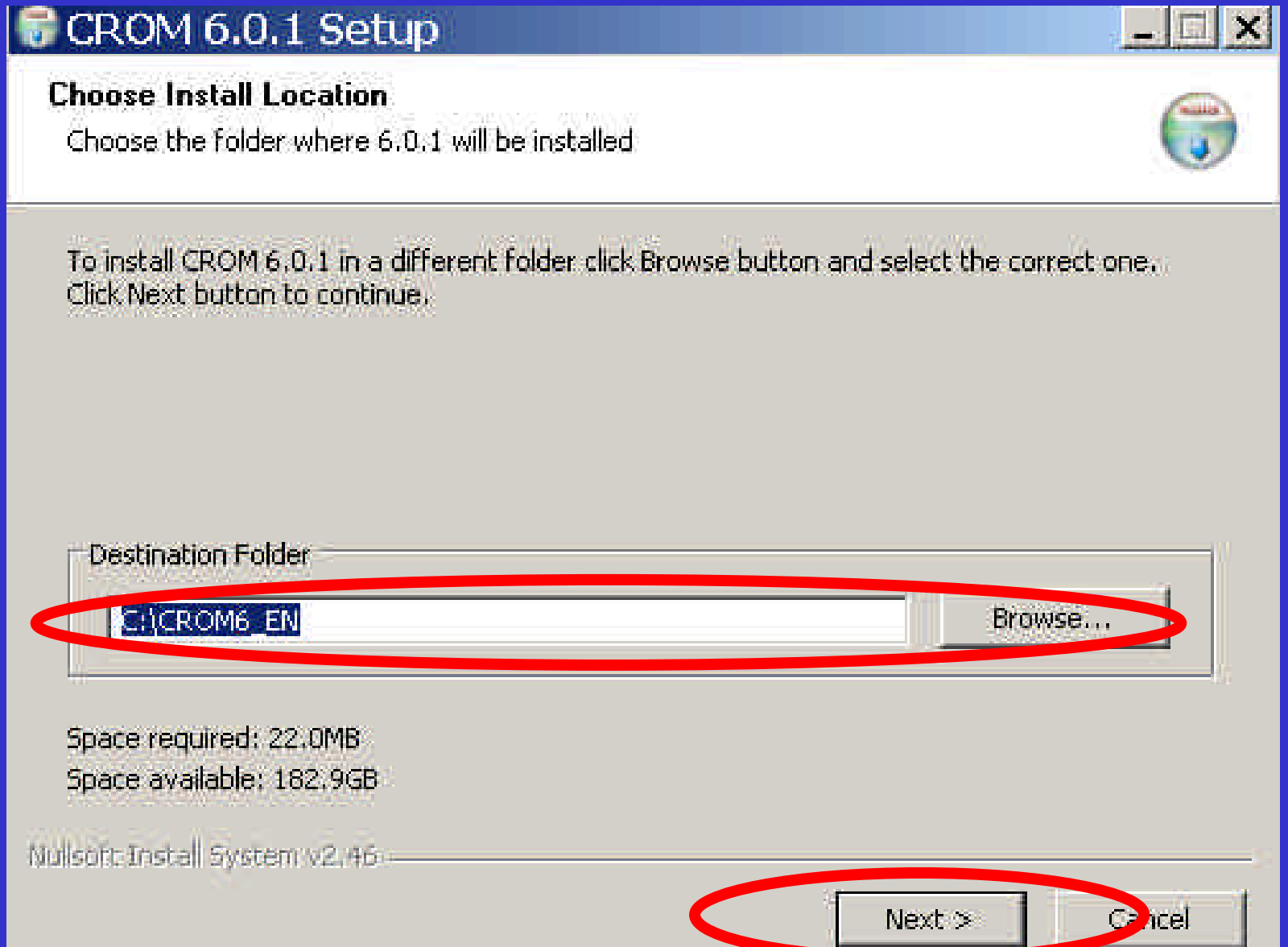


CROM - Installation

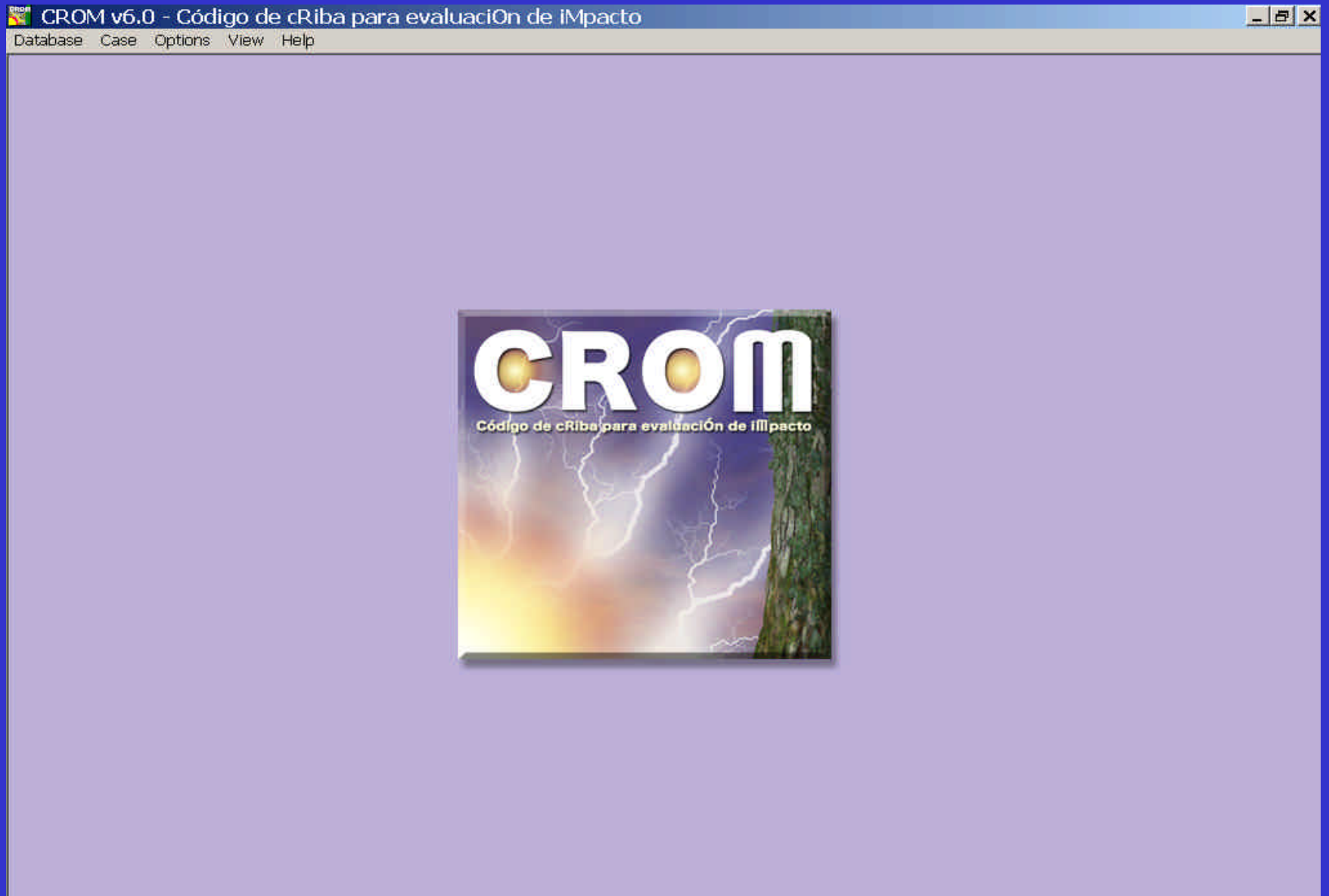


CROM - Installation

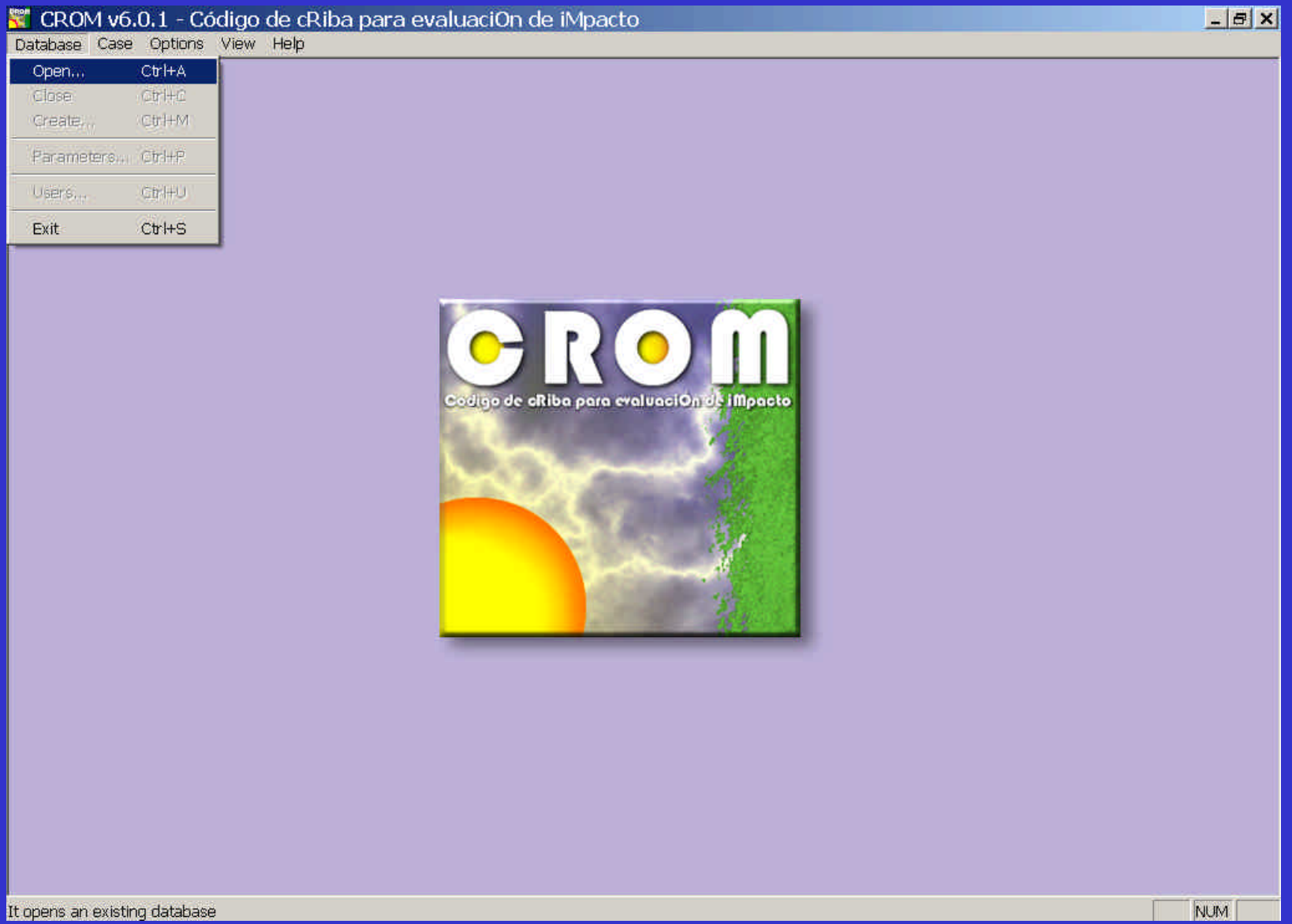
CROM - Installation



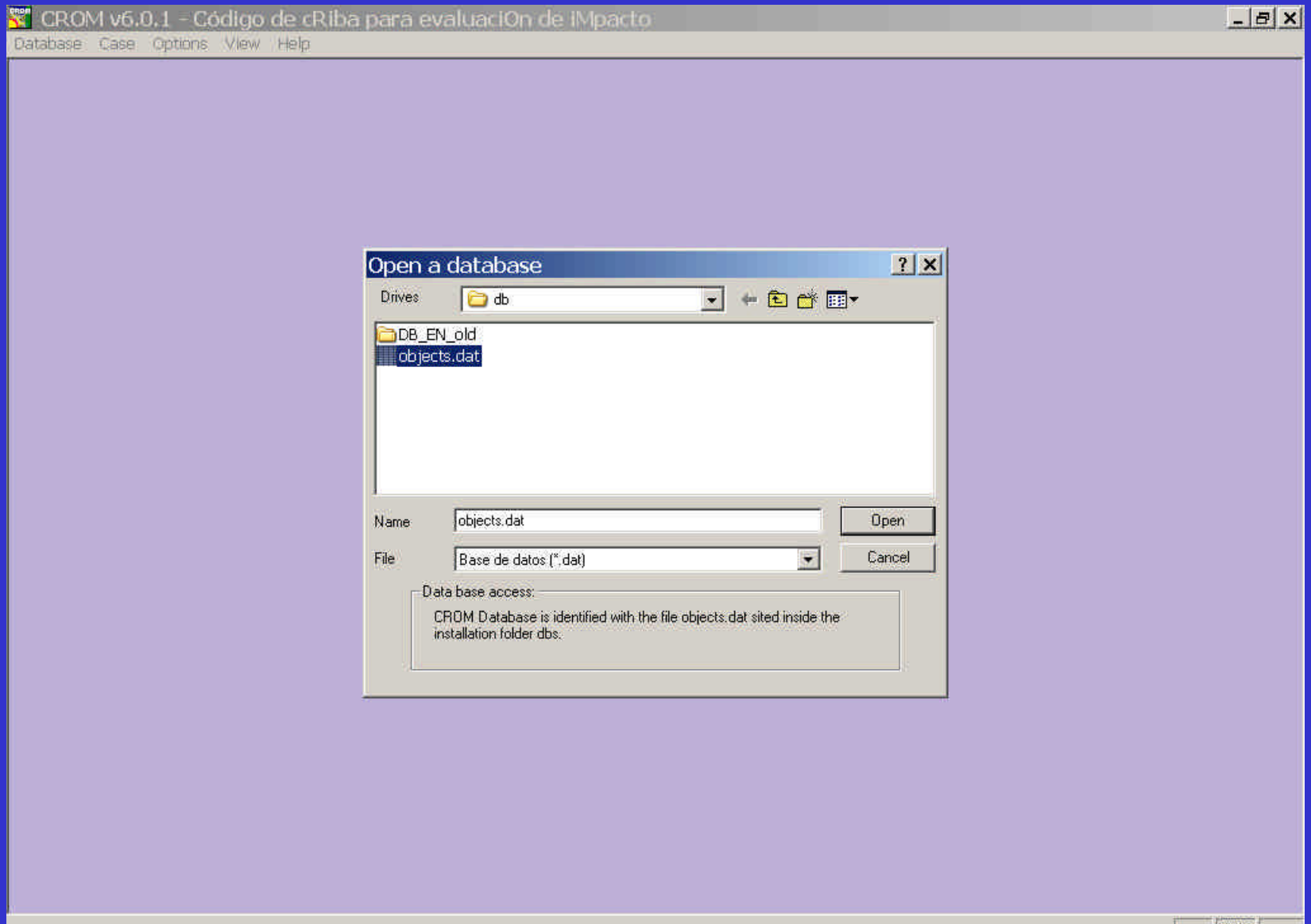
CROM - Installation



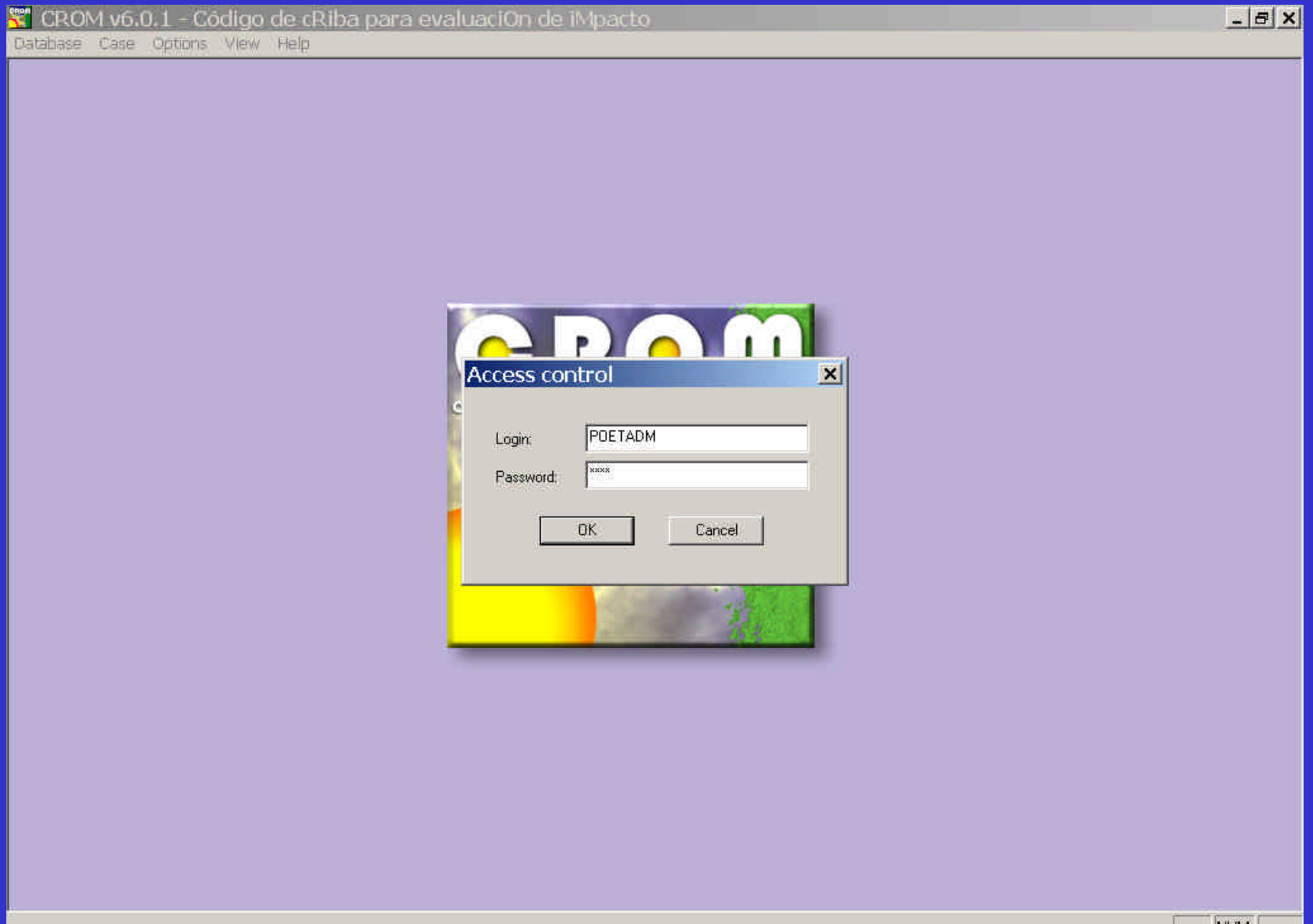
CROM - Use


CROM v6.0.1 - Código de cRiba para evaluaciOn de iMpacto
Database
Case
Options
View
Help
Open... Ctrl+A
Close Ctrl+C
Create... Ctrl+M
Parameters... Ctrl+P
Users... Ctrl+U
Exit Ctrl+S
CROM
Codigo de cRiba para evaluaciOn de iMpacto
It opens an existing database
NUM

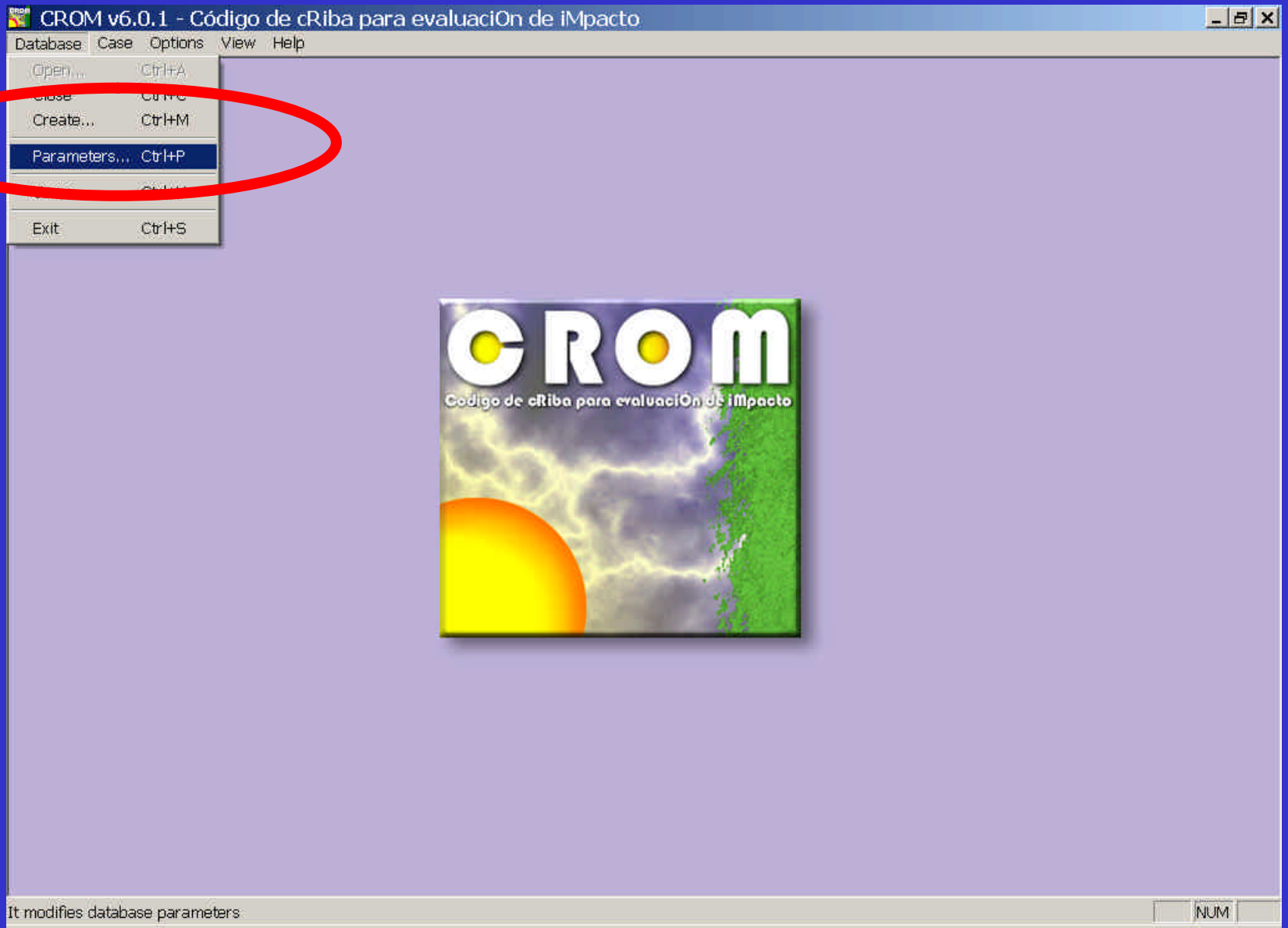
CROM - Use


CROM v6.0.1 - Código de cRiba para evaluaciOn de iMpacto
Database Case Options View Help
Open a database
Drives
db
DB_EN_old
objects.dat
Name
objects.dat
Open
File
Base de datos (*.dat)
Cancel
Data base access:
CROM Database is identified with the file objects.dat sited inside the installation folder dbs.

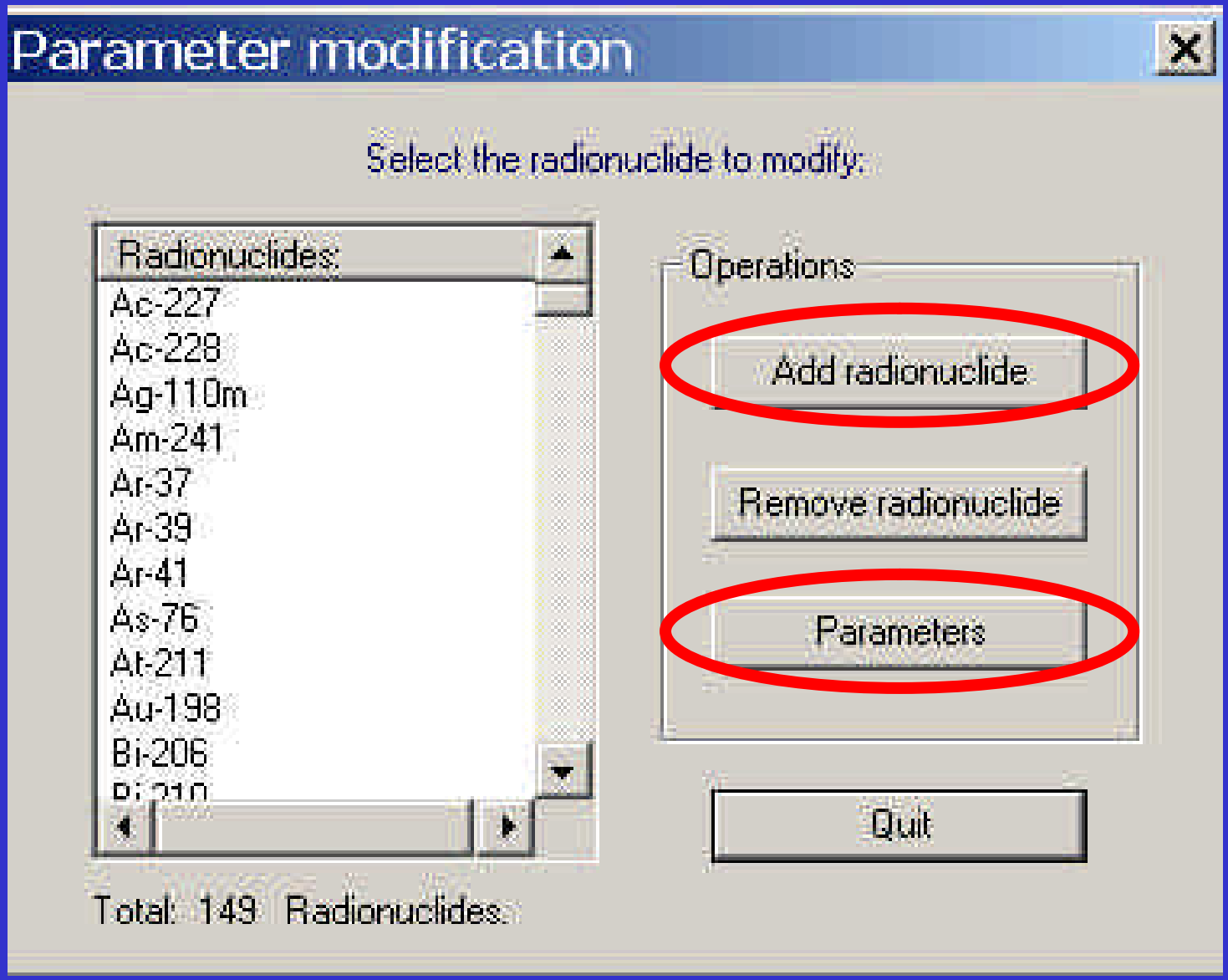
CROM - Use


CROM v6.0.1 - Código de cRiba para evaluaciOn de iMpacto
Database
Case
Options
View
Help
Access control
Login:
POETADM
Password:
****
OK
Cancel

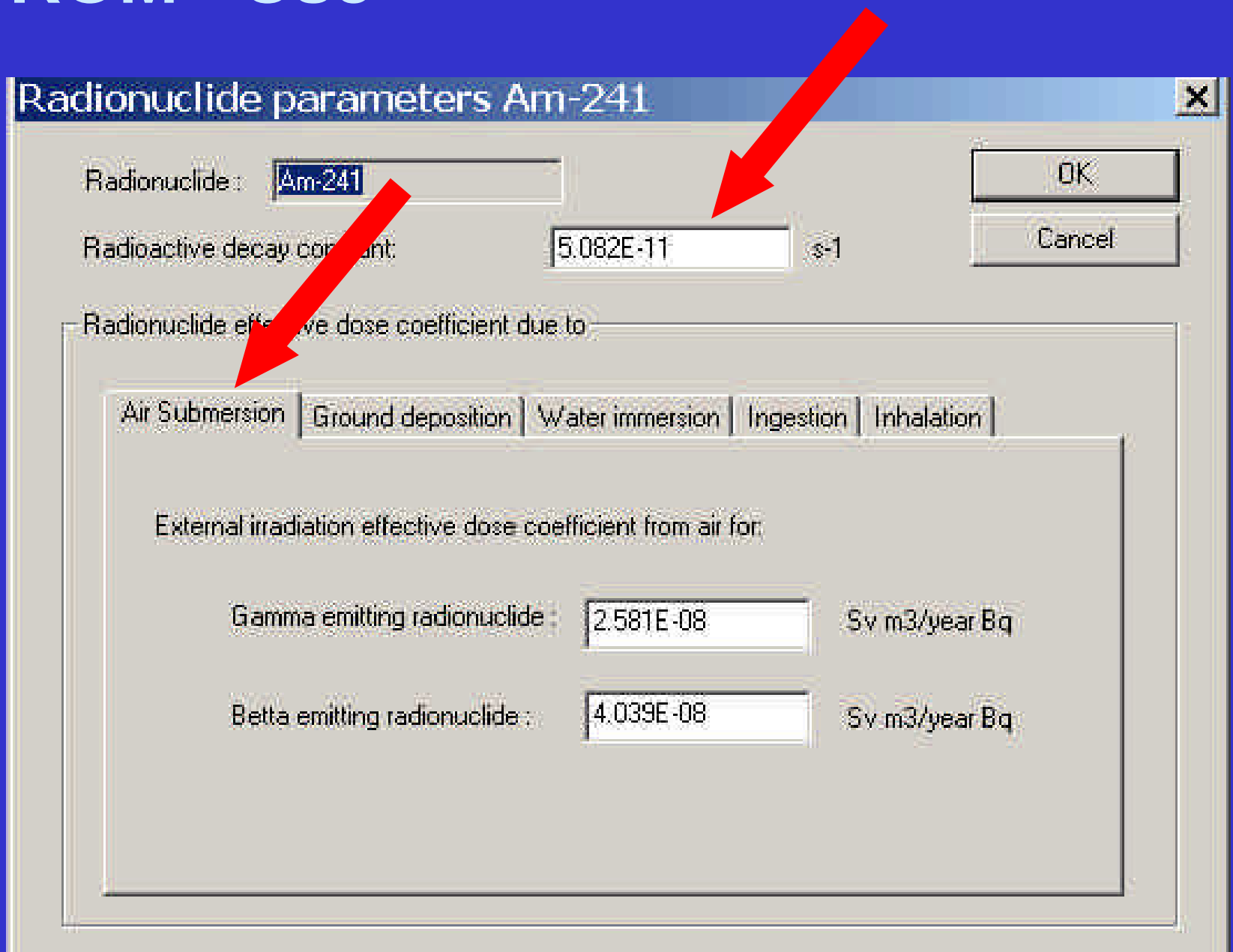
CROM - Use


CROM v6.0.1 - Código de cRiba para evaluaciOn de iMpacto
Database
Case
Options
View
Help
Open... Ctrl+A
Create... Ctrl+M
Parameters... Ctrl+P
Exit Ctrl+S
CROM
Código de cRiba para evaluaciOn de iMpacto
It modifies database parameters
NUM

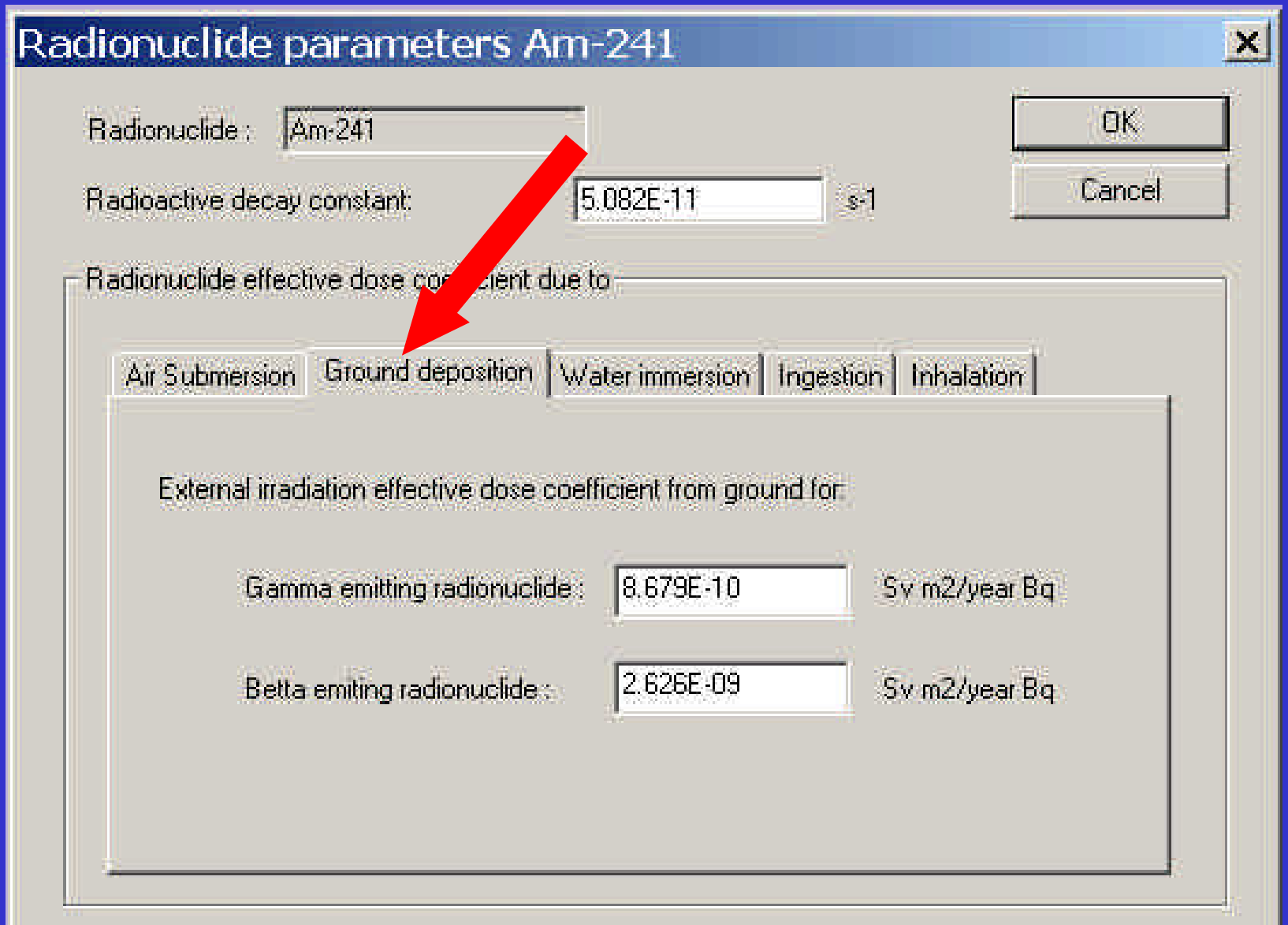
CROM - Use


Parameter modification
Select the radionuclide to modify:
Radionuclides:
Ac-227
Ac-228
Ag-110m
Am-241
Ar-37
Ar-39
Ar-41
As-76
At-211
Au-198
Bi-206
Operations
Add radionuclide
Remove radionuclide
Parameters
Quit
Total: 149 Radionuclides:

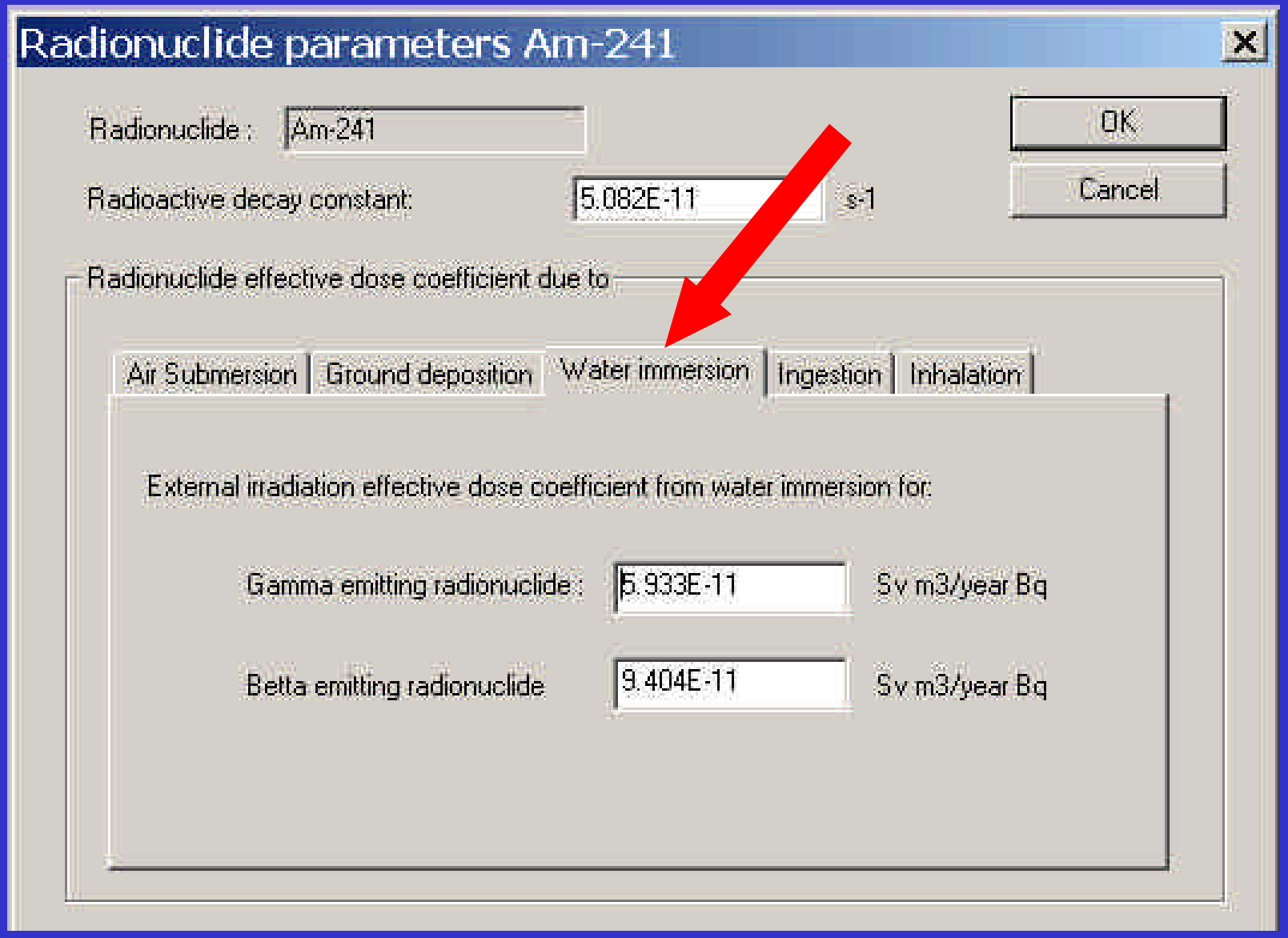
CROM - Use


Radionuclide parameters Am-241
Radionuclide :
Am-241
Radioactive decay constant:
5.082E-11
s-1
OK
Cancel
Radionuclide effective dose coefficient due to
Air Submersion
Ground deposition
Water immersion
Ingestion
Inhalation
External irradiation effective dose coefficient from air for:
Gamma emitting radionuclide :
2.581E-08
Sv m3/year Bq
Betta emitting radionuclide :
4.039E-08
Sv m3/year Bq

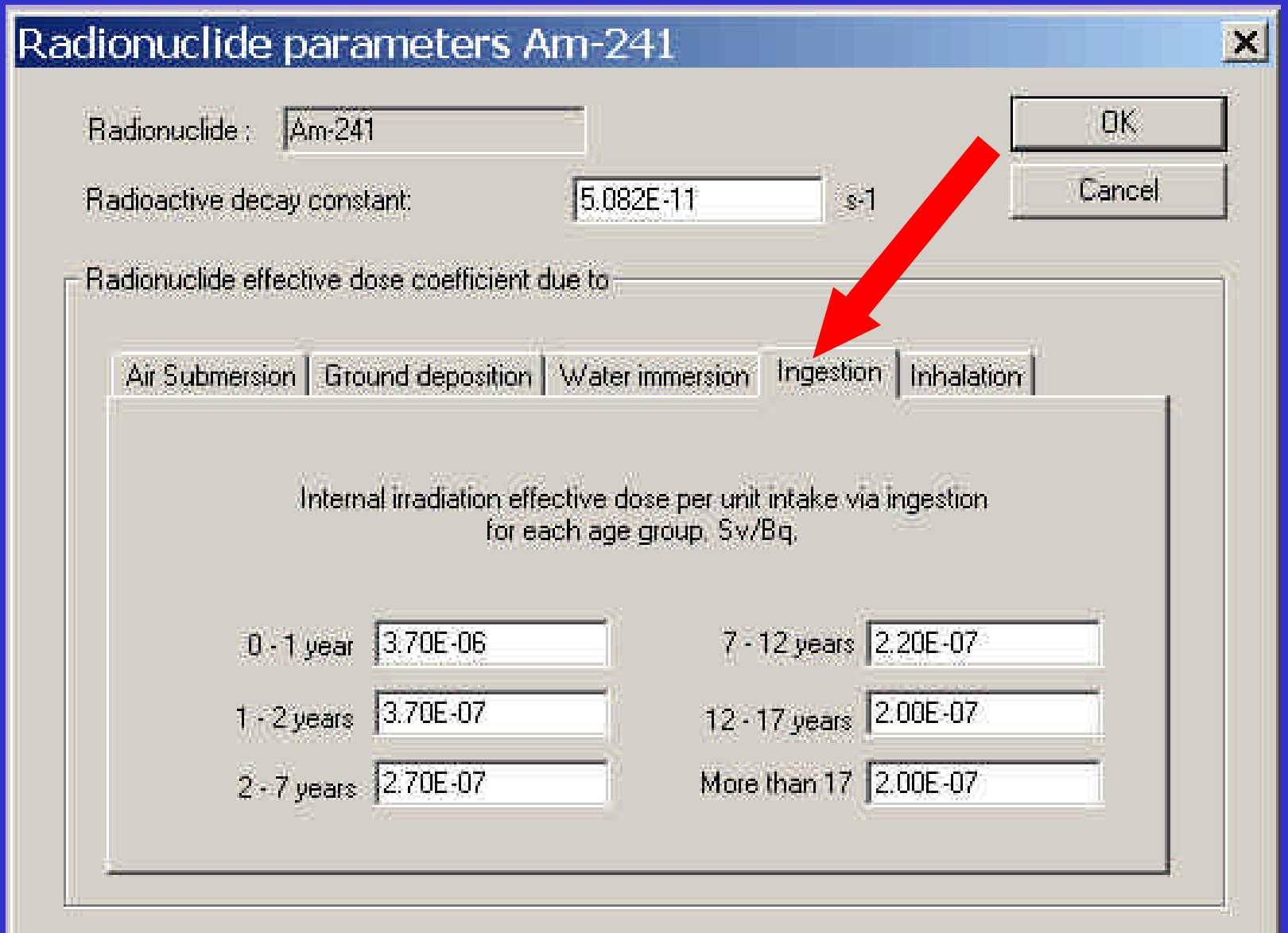
CROM - Use


Radionuclide parameters Am-241
Radionuclide :
Am-241
OK
Radioactive decay constant:
5.082E-11
s-1
Cancel
Radionuclide effective dose coefficient due to:
Air Submersion
Ground deposition
Water immersion
Ingestion
Inhalation
External irradiation effective dose coefficient from ground for:
Gamma emitting radionuclide :
8.679E-10
Sv m2/year Bq
Betta emiting radionuclide :
2.626E-09
Sv m2/year Bq

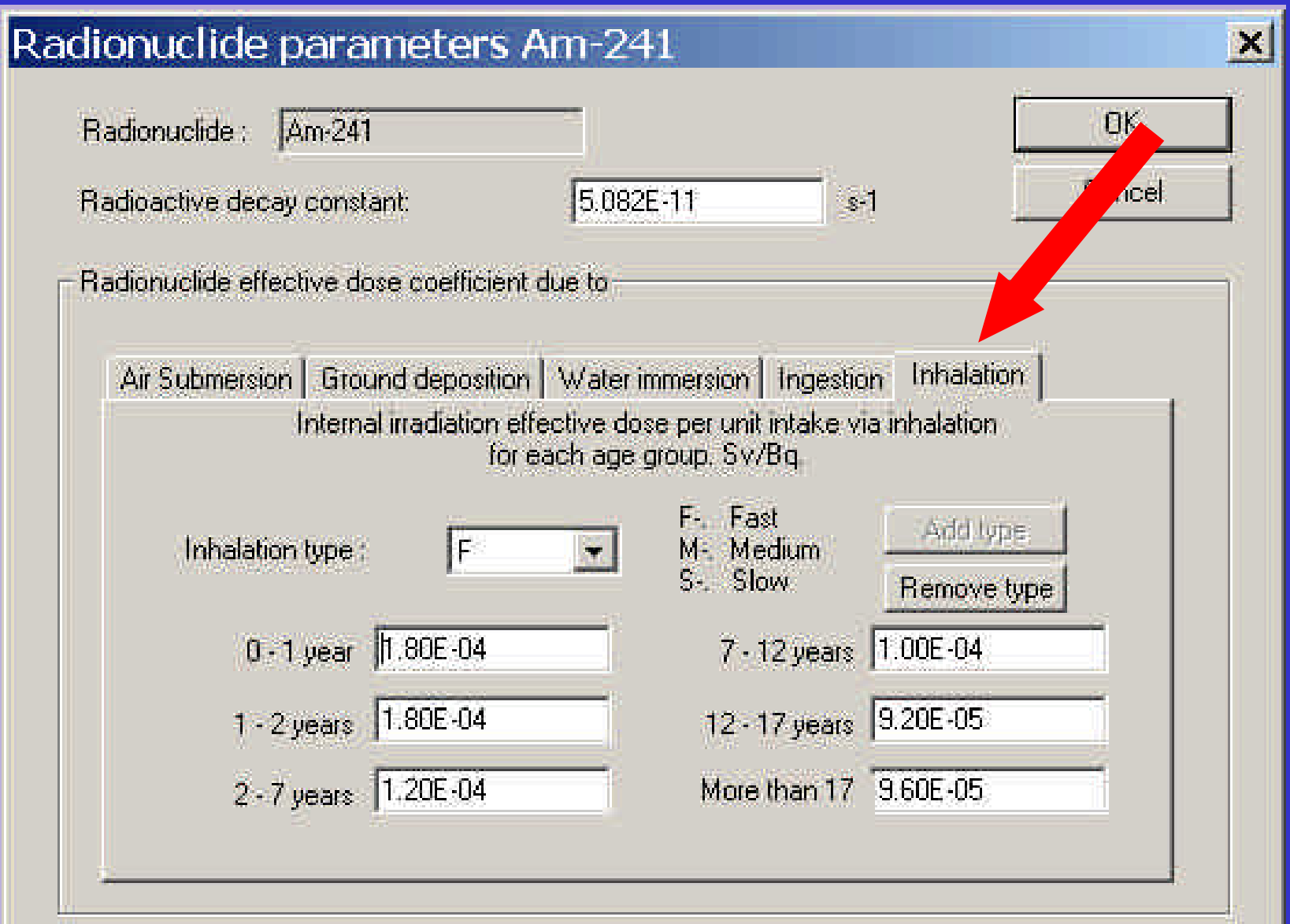
CROM - Use


Radionuclide parameters Am-241
Radionuclide :
Am-241
Radioactive decay constant:
5.082E-11
s-1
OK
Cancel
Radionuclide effective dose coefficient due to
Air Submersion
Ground deposition
Water immersion
Ingestion
Inhalation
External irradiation effective dose coefficient from water immersion for:
Gamma emitting radionuclide :
5.933E-11
Sv m3/year Bq
Betta emitting radionuclide
9.404E-11
Sv m3/year Bq

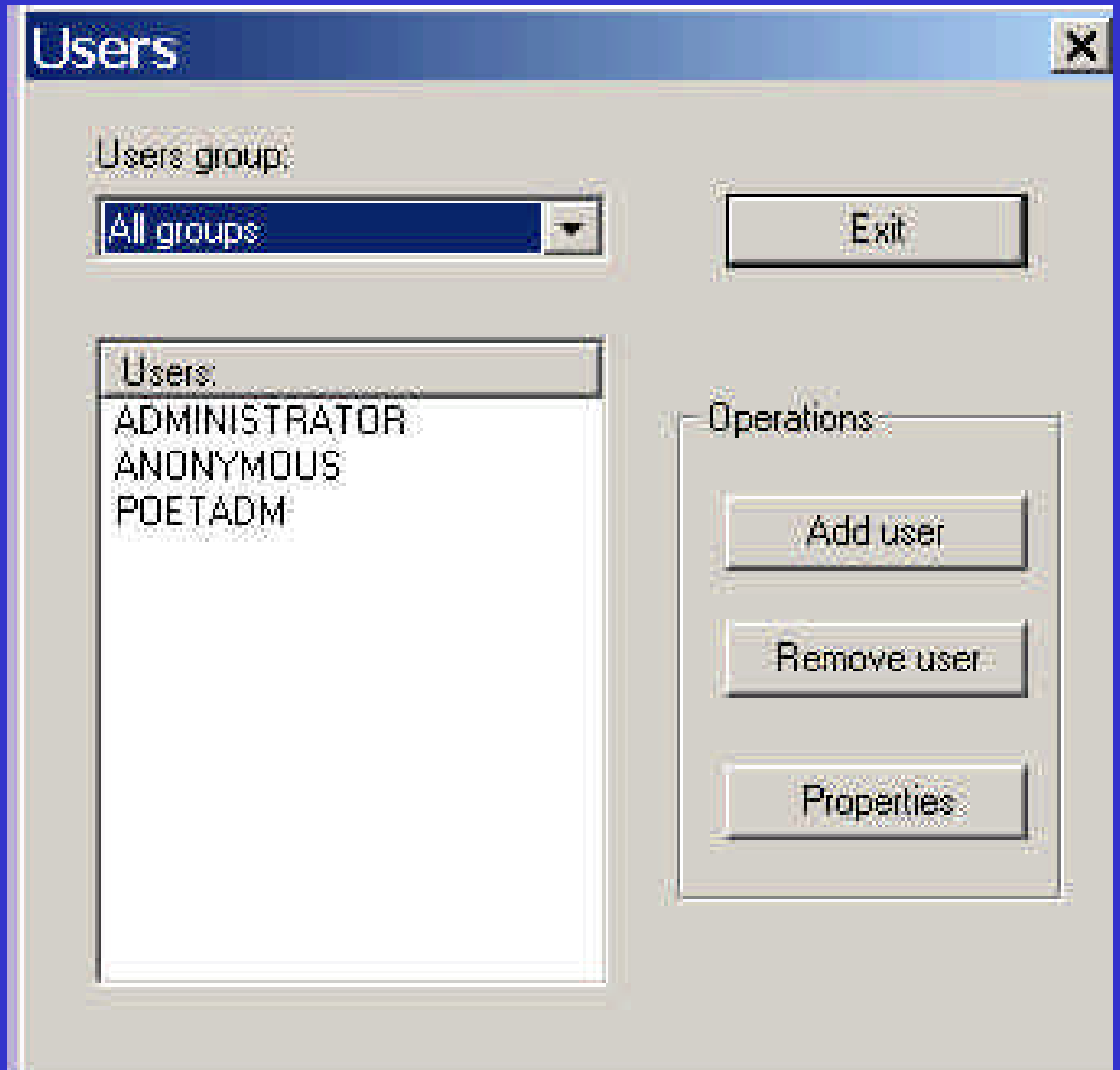
CROM - Use


Radionuclide parameters Am-241
Radionuclide :
Am-241
OK
Cancel
Radioactive decay constant:
5.082E-11
s-1
Radionuclide effective dose coefficient due to
Air Submersion
Ground deposition
Water immersion
Ingestion
Inhalation
Internal irradiation effective dose per unit intake via ingestion
for each age group, Sv/Bq.
0 - 1 year
3.70E-06
1 - 2 years
3.70E-07
2 - 7 years
2.70E-07
7 - 12 years
2.20E-07
12 - 17 years
2.00E-07
More than 17
2.00E-07

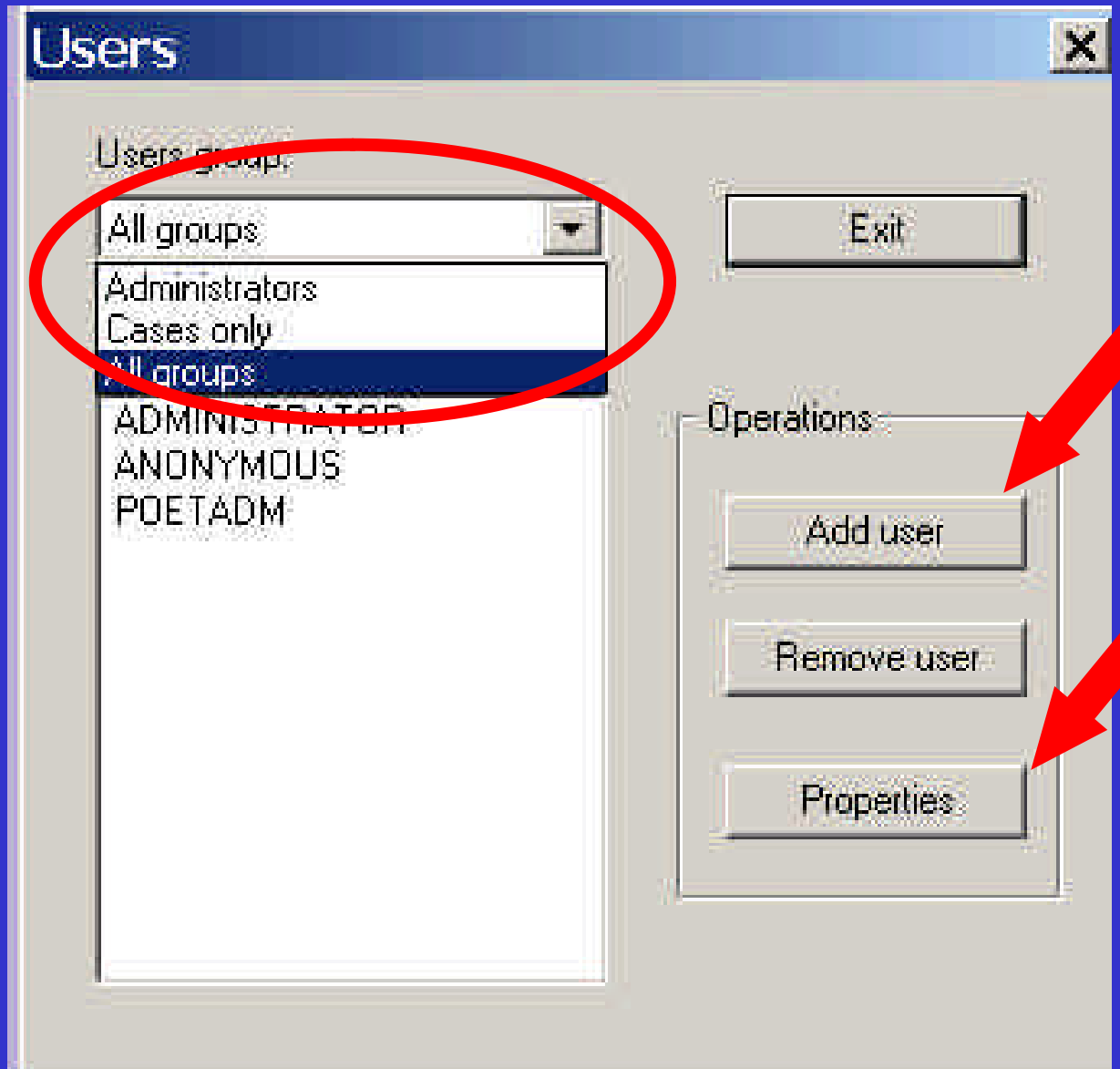
CROM - Use


Radionuclide parameters Am-241
Radionuclide :
Am-241
OK
Radioactive decay constant:
5.082E-11
s-1
Radionuclide effective dose coefficient due to
Air Submersion
Ground deposition
Water immersion
Ingestion
Inhalation
Internal irradiation effective dose per unit intake via inhalation for each age group. Sv/Bq
Inhalation type :
F
F-. Fast
M-. Medium
S-. Slow
Add type
Remove type
0 - 1 year
1.80E-04
1 - 2 years
1.80E-04
2 - 7 years
1.20E-04
7 - 12 years
1.00E-04
12 - 17 years
9.20E-05
More than 17
9.60E-05

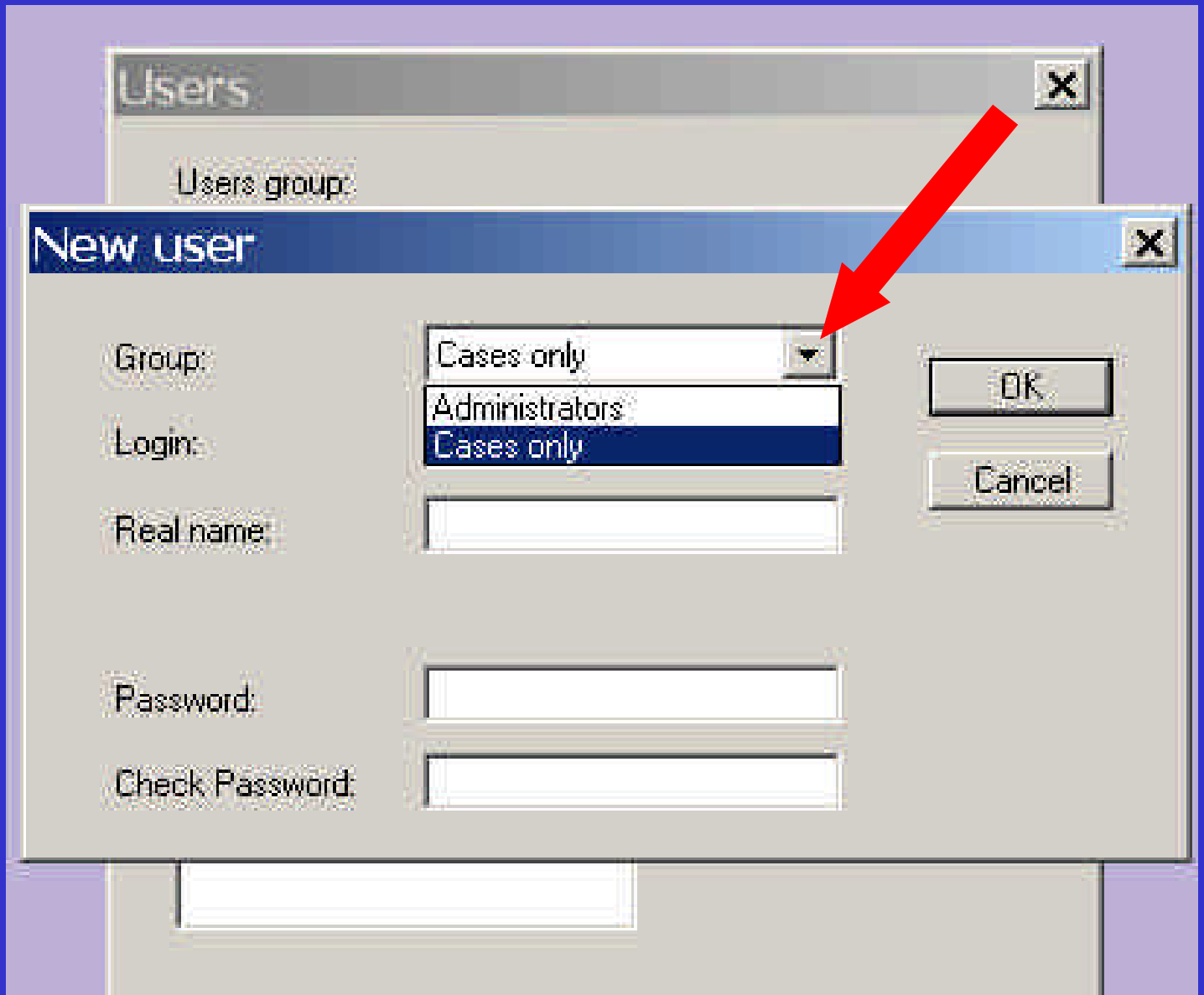
CROM - Use


Users
Users group:
All groups
Exit
Users:
ADMINISTRATOR
ANONYMOUS
POETADM
Operations
Add user
Remove user
Properties

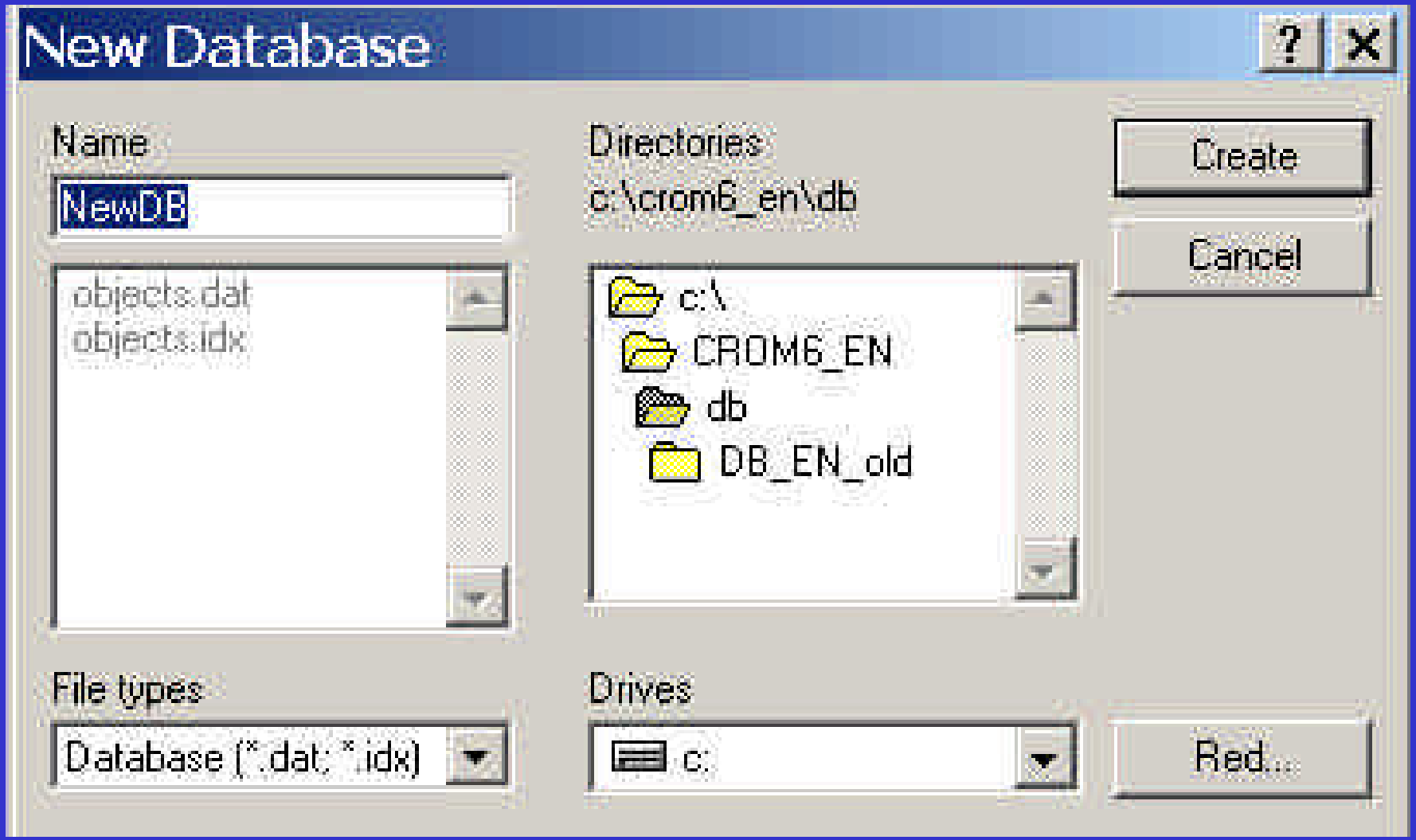
CROM - Use


Users
All groups
Administrators
Cases only
All groups
ANONYMOUS
POETADM
Exit
Operations
Add user
Remove user
Properties

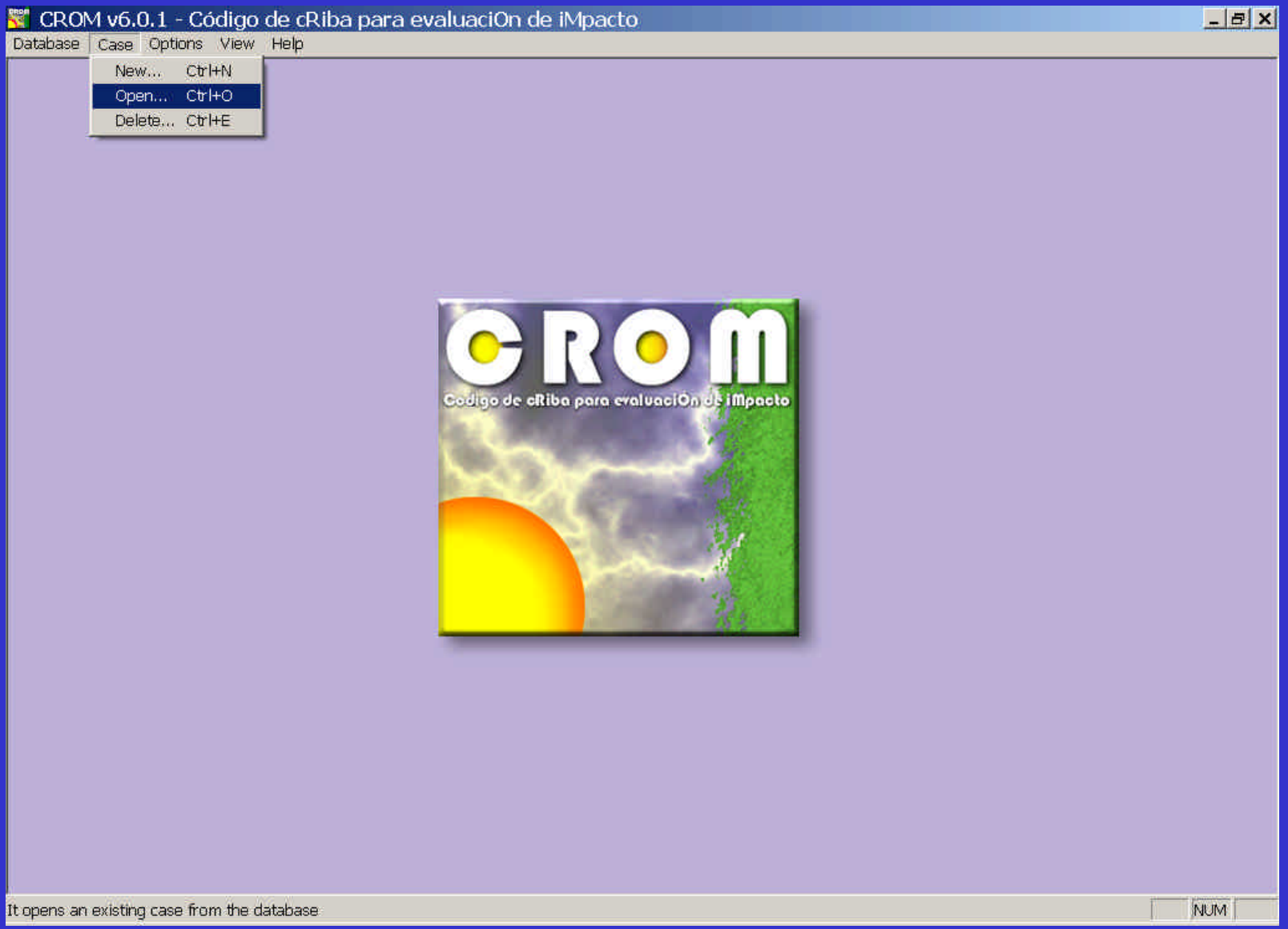
CROM - Use


Users
Users group:
New user
Group:
Cases only
Administrators
Cases only
Login:
Real name:
Password:
Check Password:
OK
Cancel

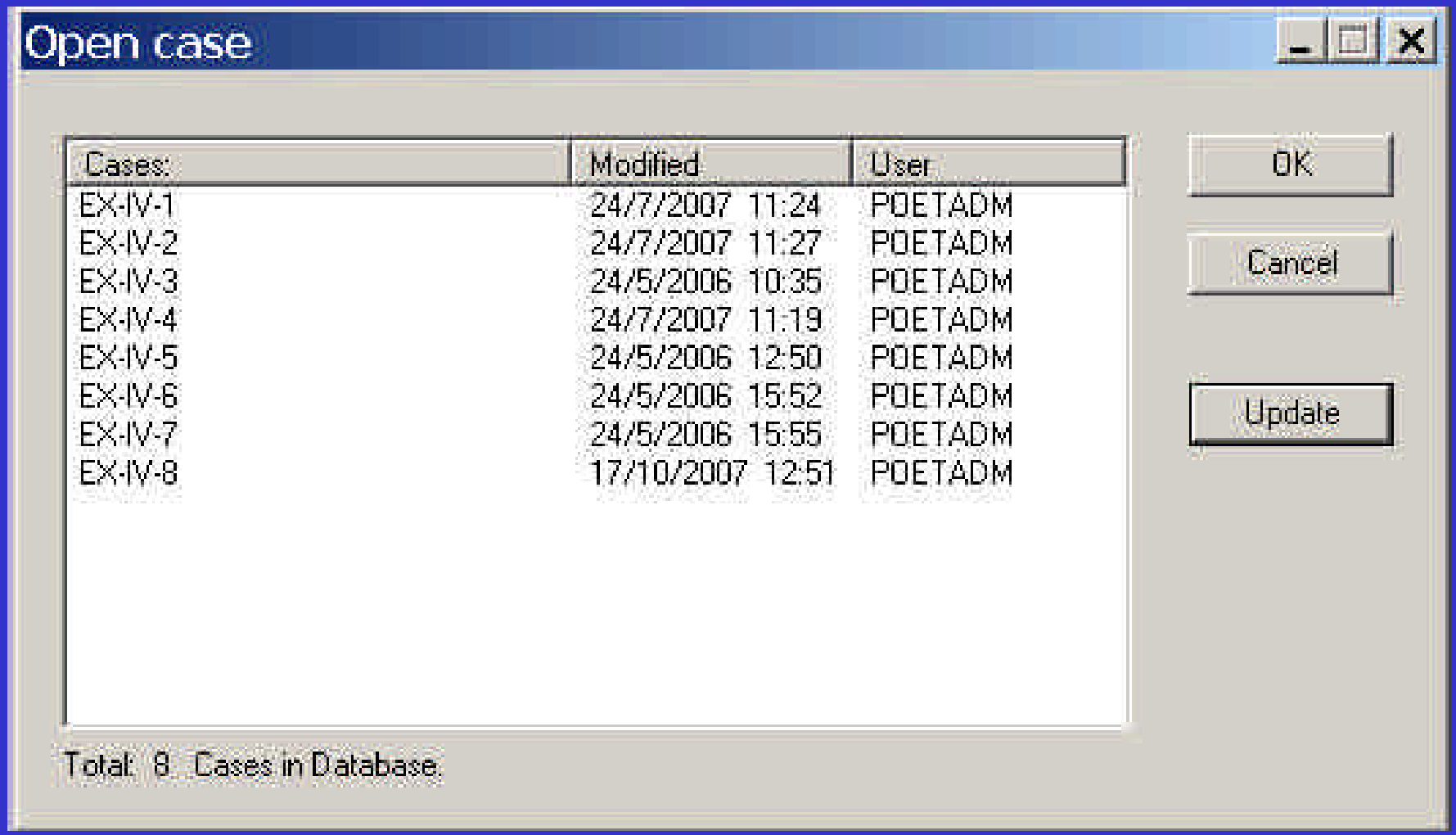
CROM - Use


New Database
Name
NewDB
objects.dat
objects.idx
Directories
c:\crom6_en\db
c:\
CROM6_EN
db
DB_EN_old
Create
Cancel
File types
Database (*.dat; *.idx)
Drives
c:
Red...

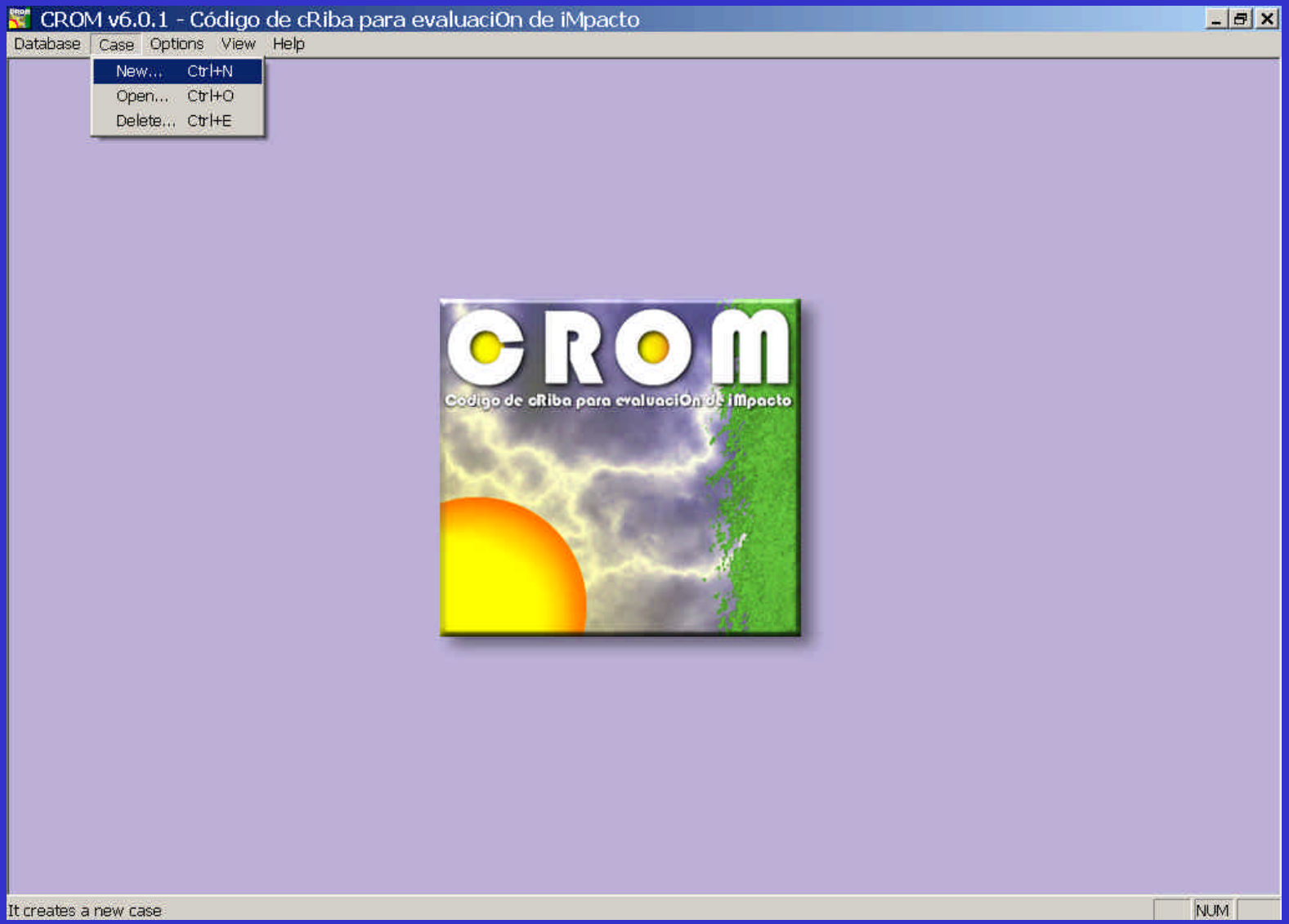
CROM - Use


CROM v6.0.1 - Código de cRiba para evaluaciOn de iMpacto
Database
Case
Options
View
Help
New... Ctrl+N
Open... Ctrl+O
Delete... Ctrl+E
CROM
Código de cRiba para evaluaciOn de iMpacto
It opens an existing case from the database
NUM

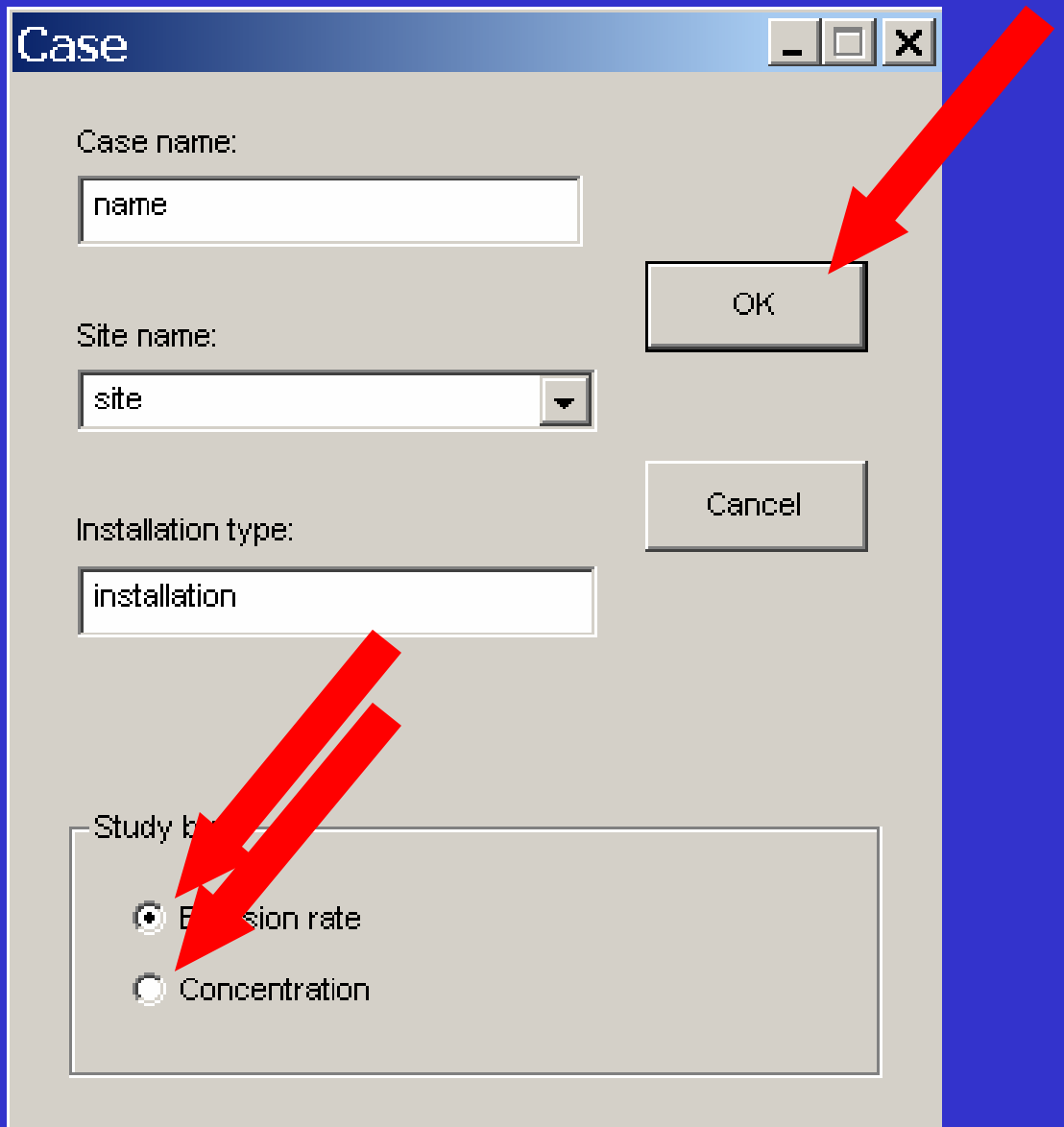
CROM - Use


Open case
Cases:
Modified
User
EX-IV-1 24/7/2007 11:24 POETADM
EX-IV-2 24/7/2007 11:27 POETADM
EX-IV-3 24/5/2006 10:35 POETADM
EX-IV-4 24/7/2007 11:19 POETADM
EX-IV-5 24/5/2006 12:50 POETADM
EX-IV-6 24/5/2006 15:52 POETADM
EX-IV-7 24/5/2006 15:55 POETADM
EX-IV-8 17/10/2007 12:51 POETADM
OK
Cancel
Update
Total: 8 Cases in Database.

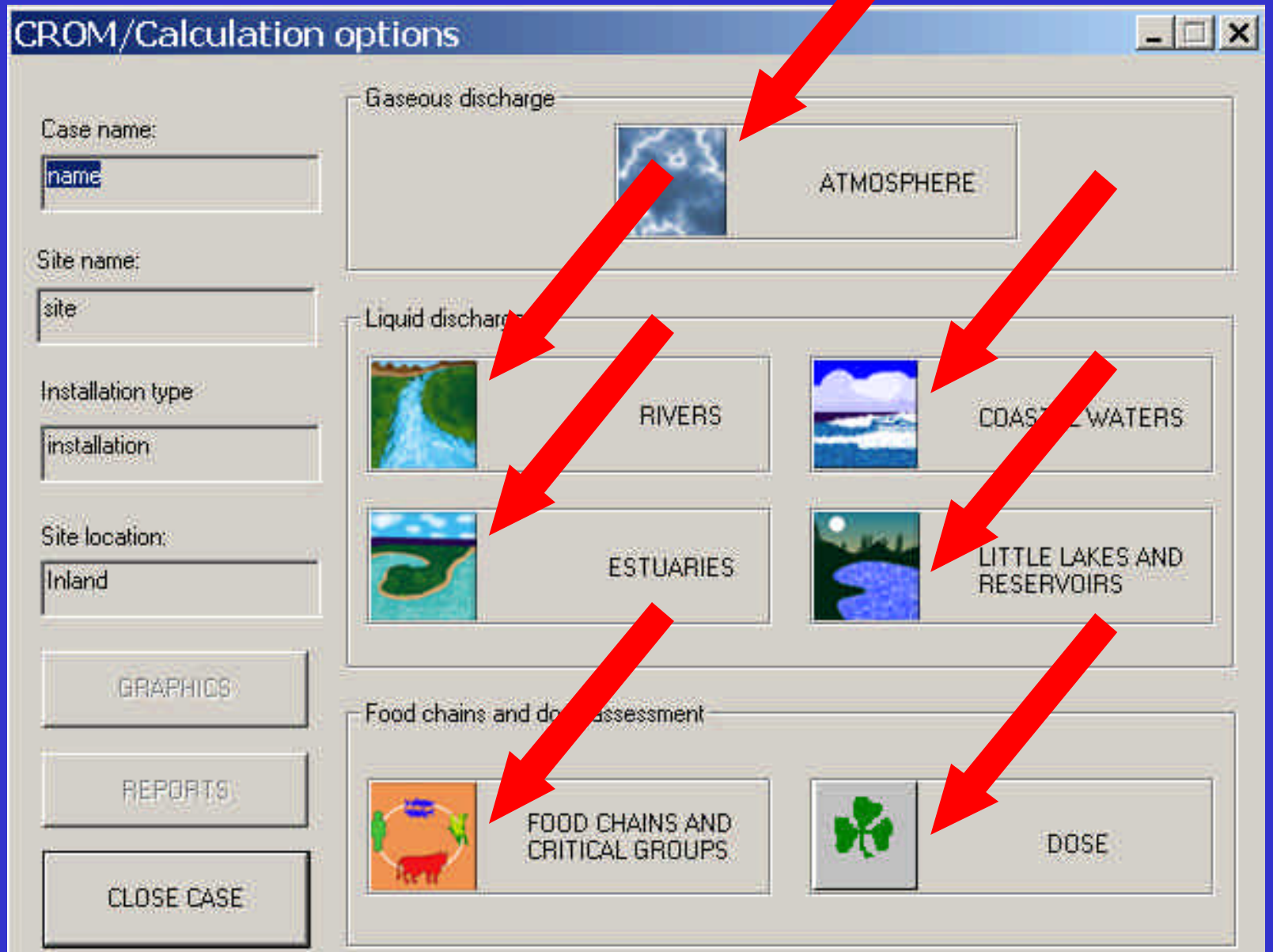
CROM - Use


CROM v6.0.1 - Código de cRiba para evaluaciOn de iMpacto
Database
Case
Options
View
Help
New... Ctrl+N
Open... Ctrl+O
Delete... Ctrl+E
CROM
Código de cRiba para evaluaciOn de iMpacto
It creates a new case
NUM

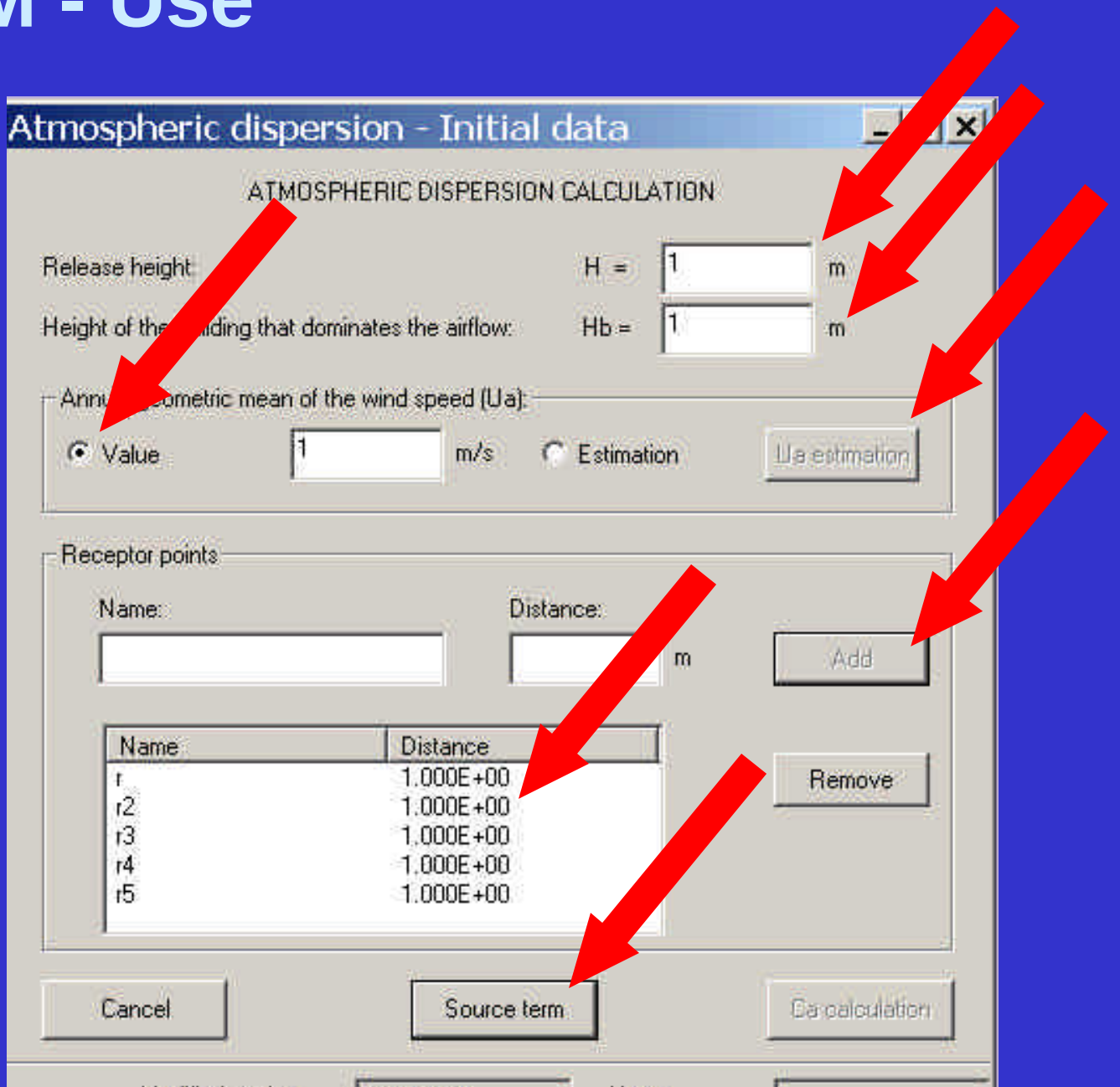
CROM - Use


Case
Case name:
name
OK
Site name:
site
Cancel
Installation type:
installation
Study b
sion rate
Concentration

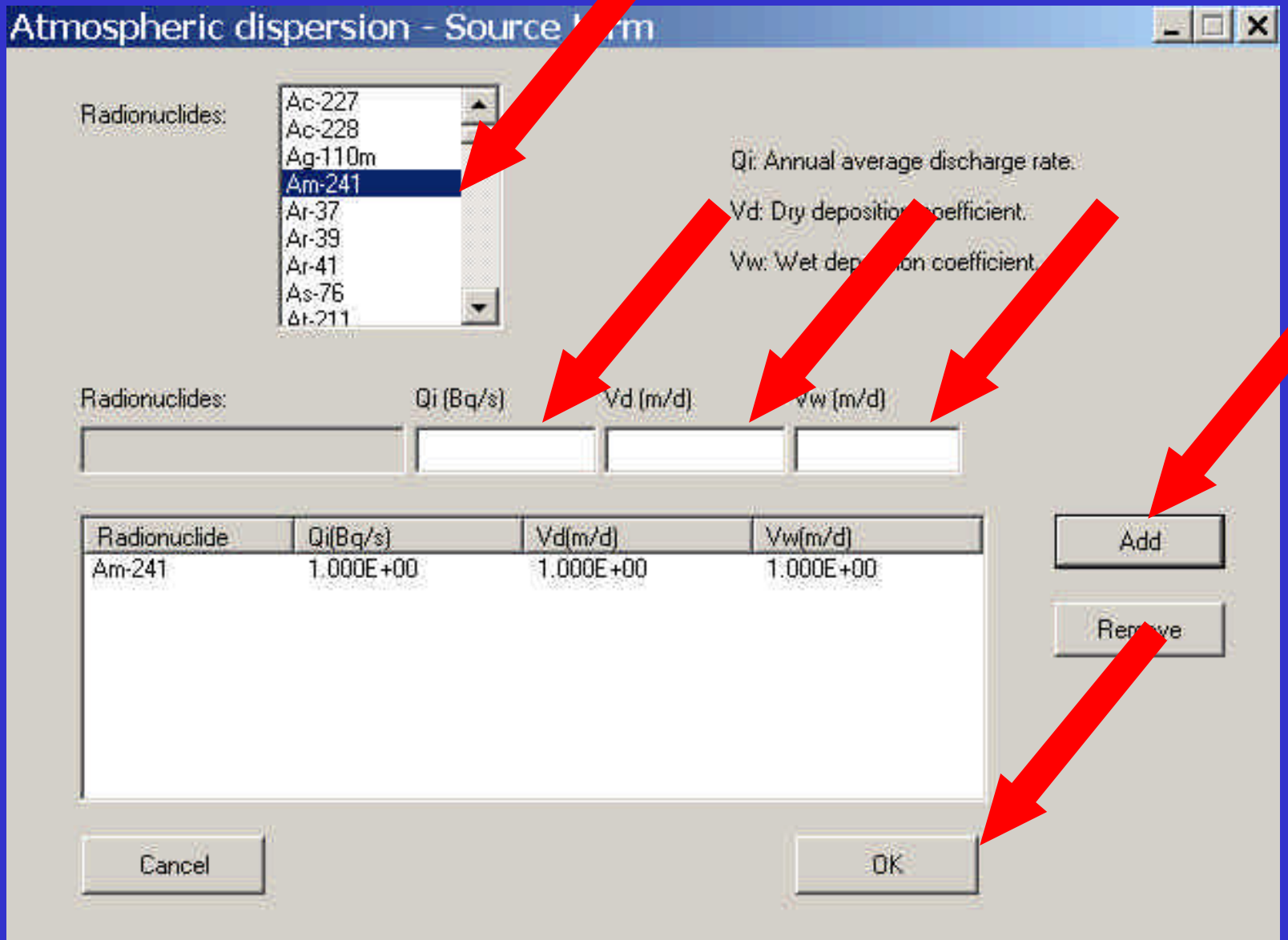
CROM - Use


CROM/Calculation options
Case name:
name
Site name:
site
Installation type
installation
Site location:
Inland
GRAPHICS
REPORTS
CLOSE CASE
Gaseous discharge
ATMOSPHERE
Liquid discharg
RIVERS
COAS WATERS
ESTUARIES
LITTLE LAKES AND RESERVOIRS
Food chains and do assessment
FOOD CHAINS AND CRITICAL GROUPS
DOSE

CROM - Use


Atmospheric dispersion - Initial data
ATMOSPHERIC DISPERSION CALCULATION
Release height
H =
1
m
Height of the
ilding that dominates the airflow:
Hb =
1
m
Anni
ometric mean of the wind speed (Ua):
Value
1
m/s
Estimation
Ua estimation
Receptor points
Name:
Distance:
m
Add
Name
Distance
r
1.000E+00
r2
1.000E+00
r3
1.000E+00
r4
1.000E+00
r5
1.000E+00
Remove
Cancel
Source term
Ca calculation

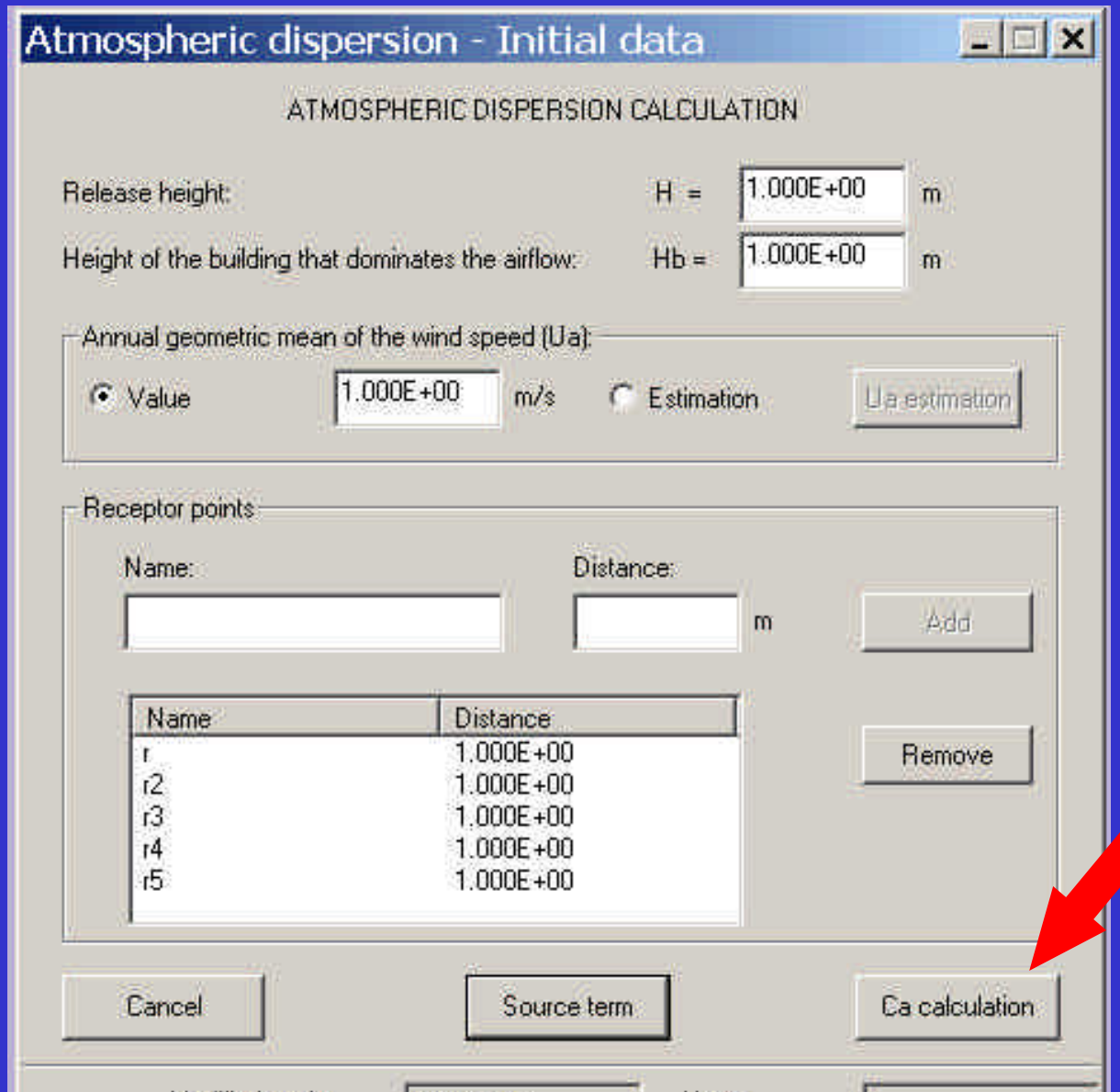
CROM - Use


Atmospheric dispersion - Source
Radionuclides:
Ac-227
Ac-228
Ag-110m
Am-241
Ar-37
Ar-39
Ar-41
As-76
Qi: Annual average discharge rate.
Vd: Dry deposition coefficient.
Vw: Wet deposition coefficient.
Radionuclides:
Qi (Bq/s)
Vd (m/d)
Vw (m/d)
Radionuclide
Qi(Bq/s)
Vd(m/d)
Vw(m/d)
Am-241
1.000E+00
1.000E+00
1.000E+00
Add
Remove
Cancel
OK

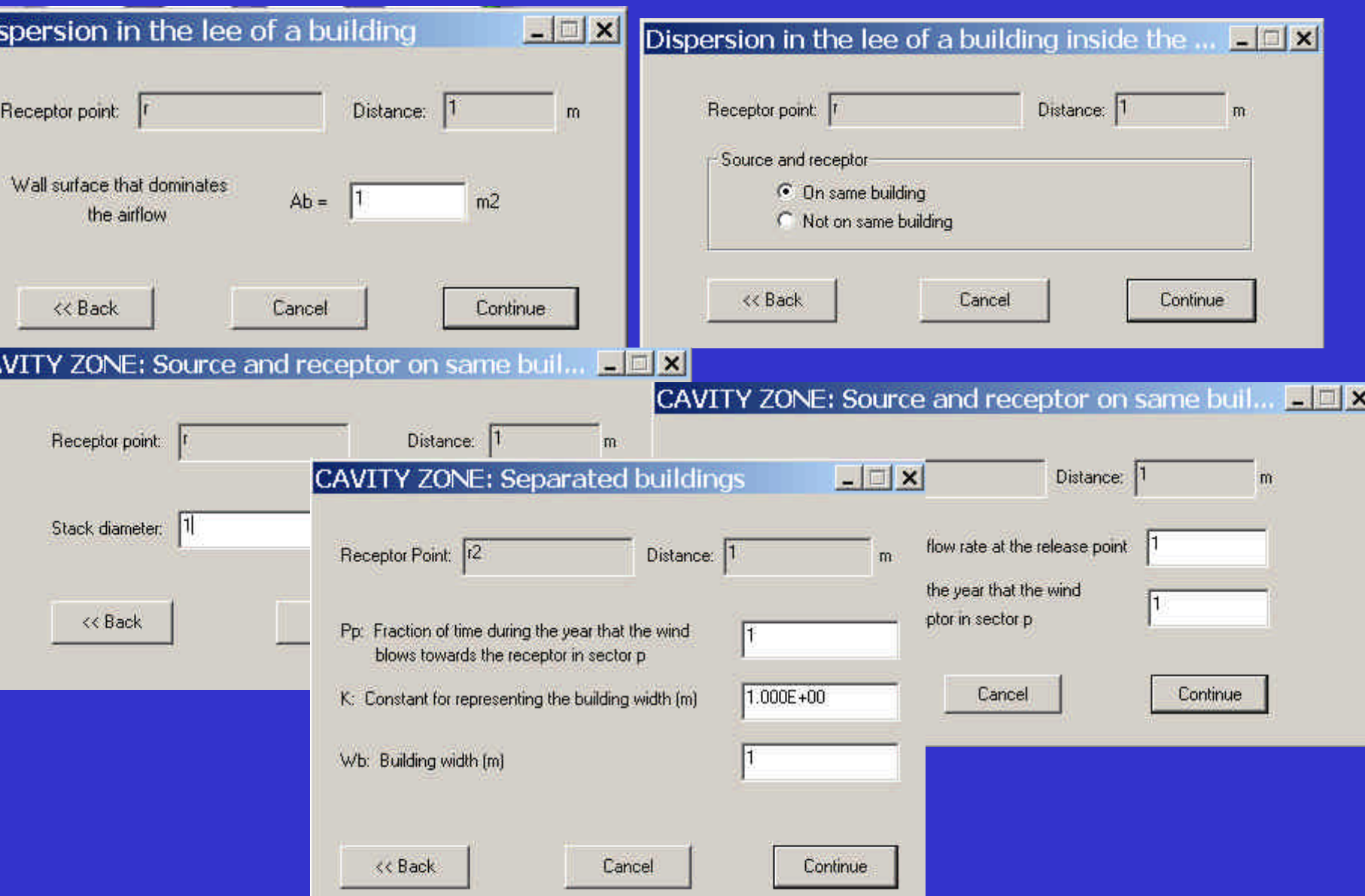
CROM - Use

- 5 receptor point
- More than 20 radionuclides in the source term

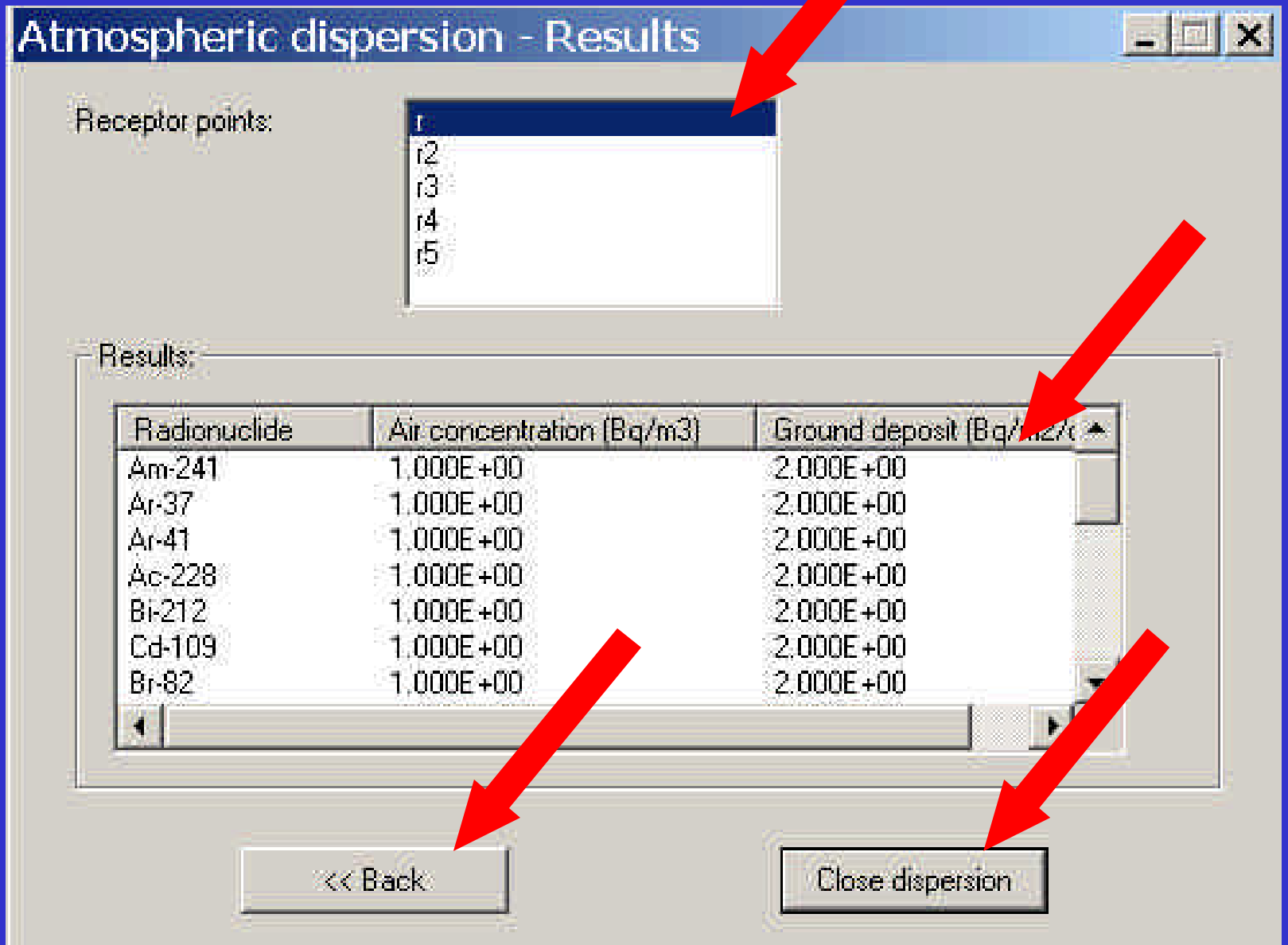
CROM - Use


Atmospheric dispersion - Initial data
ATMOSPHERIC DISPERSION CALCULATION
Release height:
H =
1.000E+00
m
Height of the building that dominates the airflow:
Hb =
1.000E+00
m
Annual geometric mean of the wind speed (Ua):
Value
1.000E+00
m/s
Estimation
Ua estimation
Receptor points
Name:
Distance:
m
Add
Name
Distance
r
1.000E+00
r2
1.000E+00
r3
1.000E+00
r4
1.000E+00
r5
1.000E+00
Remove
Cancel
Source term
Ca calculation

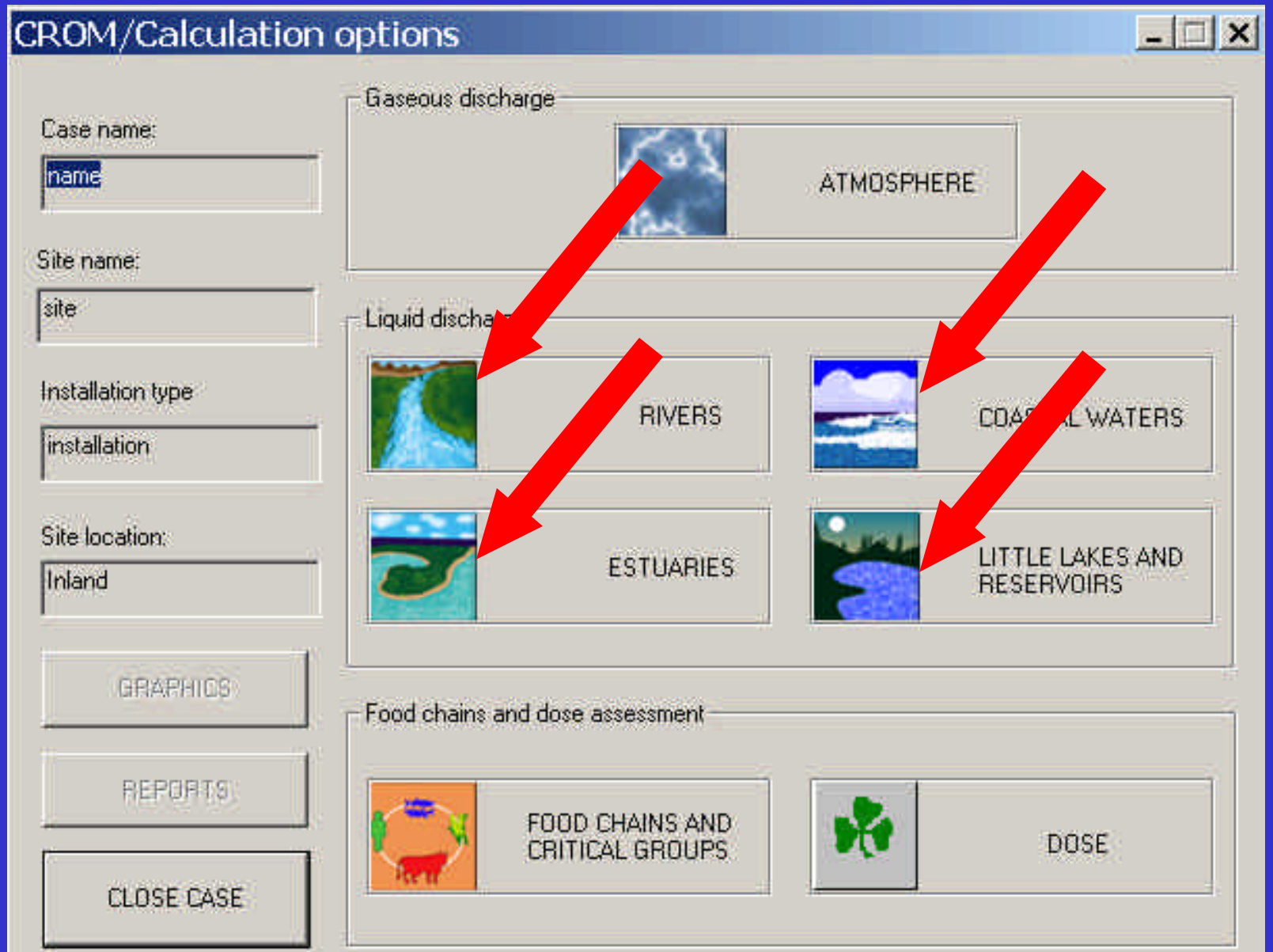
CROM - Use


spersion in the lee of a building
Receptor point: r
Distance: 1 m
Wall surface that dominates the airflow
Ab = 1 m2
<< Back
Cancel
Continue
Dispersion in the lee of a building inside the ...
Receptor point: r
Distance: 1 m
Source and receptor
On same building
Not on same building
<< Back
Cancel
Continue
VITY ZONE: Source and receptor on same buil...
Receptor point: r
Distance: 1 m
Stack diameter: 1
<< Back
CAVITY ZONE: Source and receptor on same buil...
CAVITY ZONE: Separated buildings
Distance: 1 m
Receptor Point: r2
Distance: 1 m
Pp: Fraction of time during the year that the wind blows towards the receptor in sector p
1
K: Constant for representing the building width (m)
1.000E+00
Wb: Building width (m)
1
<< Back
Cancel
Continue
flow rate at the release point
1
the year that the wind
ptor in sector p
1
Cancel
Continue

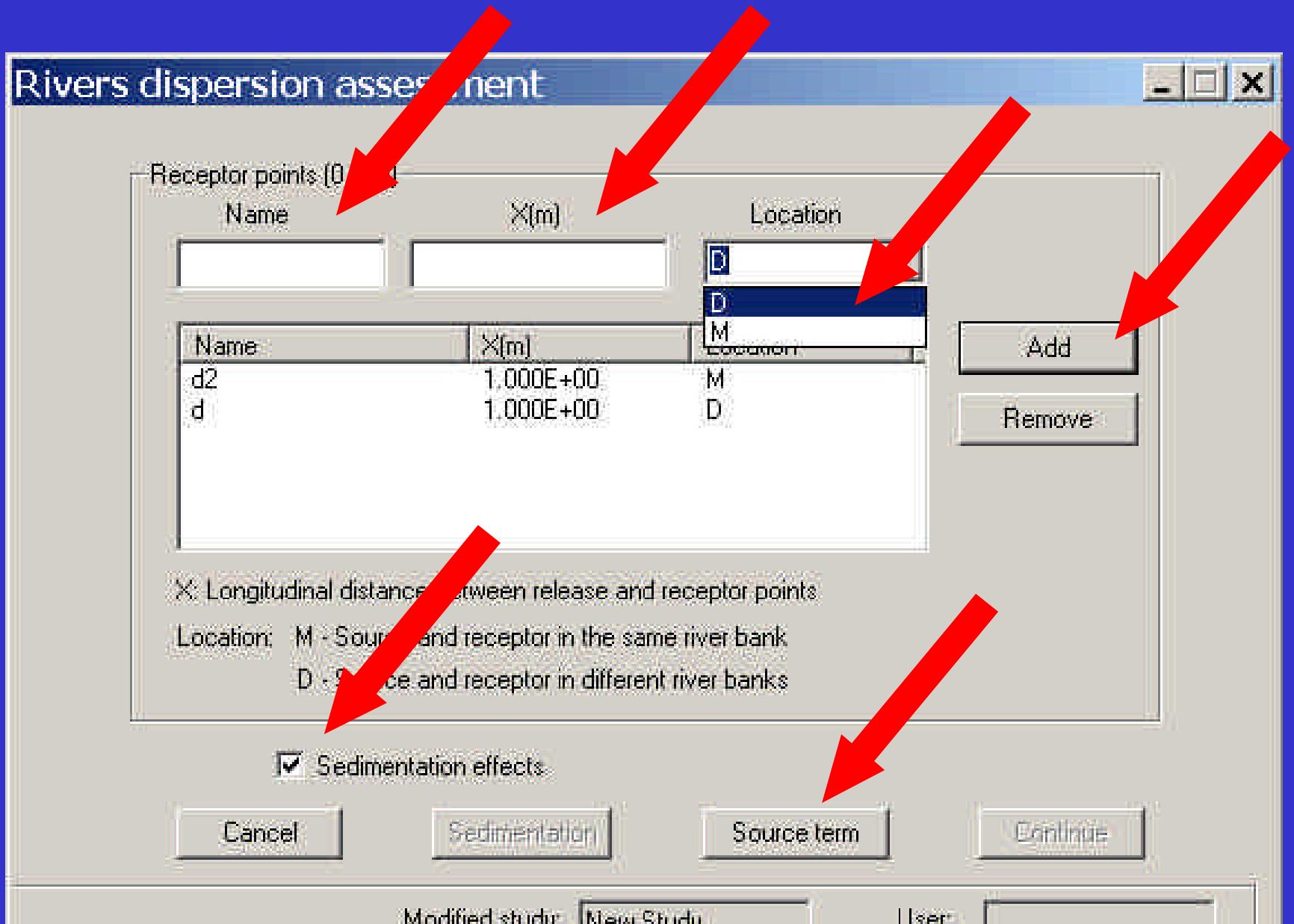
CROM - Use


Atmospheric dispersion - Results
Receptor points:
r
r2
r3
r4
r5
Results:
Radionuclide
Air concentration (Bq/m3)
Ground deposit (Bq/
Am-241 1.000E+00 2.000E+00
Ar-37 1.000E+00 2.000E+00
Ar-41 1.000E+00 2.000E+00
Ac-228 1.000E+00 2.000E+00
Bi-212 1.000E+00 2.000E+00
Cd-109 1.000E+00 2.000E+00
Br-82 1.000E+00 2.000E+00
<< Back
Close dispersion

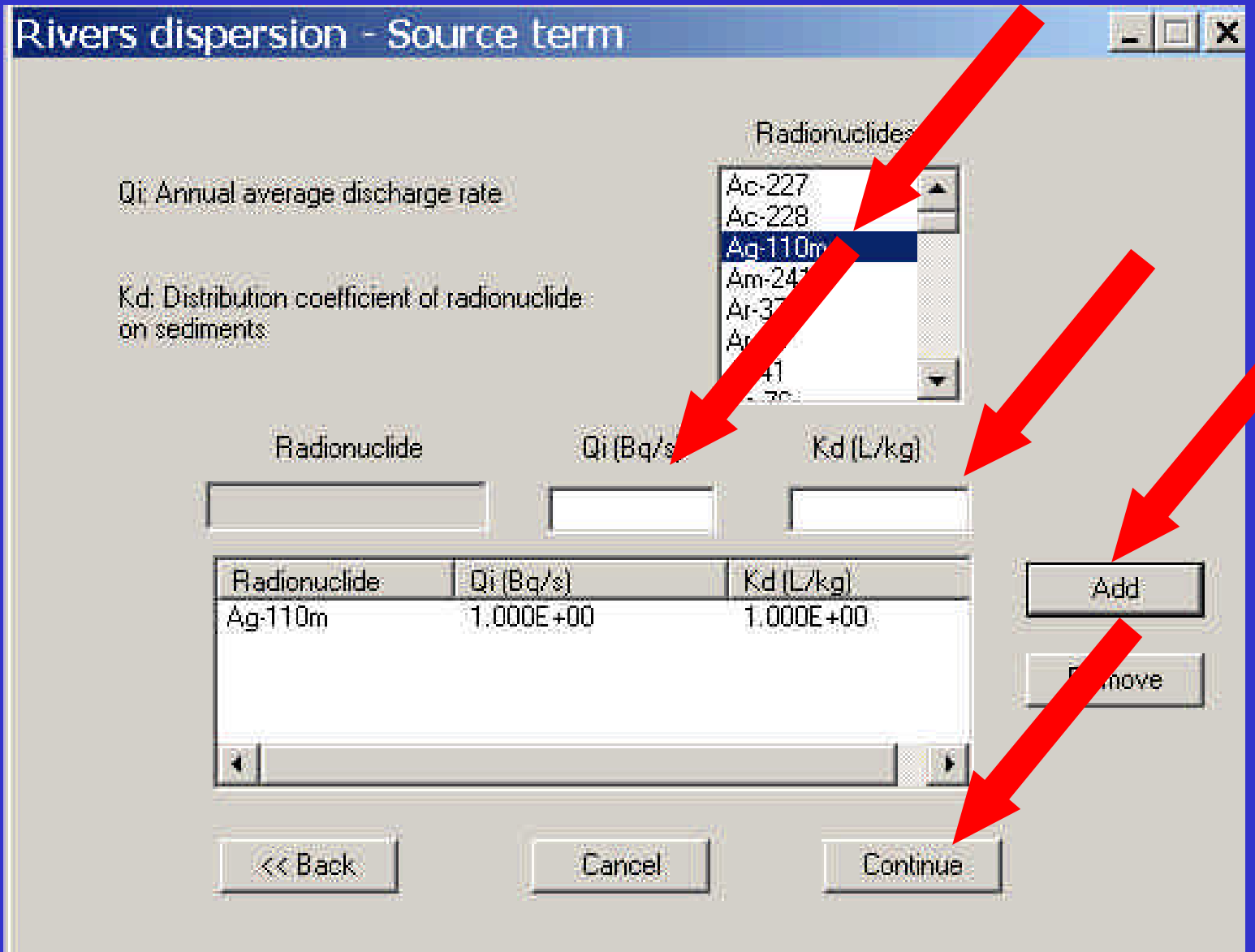
CROM - Use


CROM/Calculation options
Case name:
name
Site name:
site
Installation type
installation
Site location:
Inland
GRAPHICS
REPORTS
CLOSE CASE
Gaseous discharge
ATMOSPHERE
Liquid discha
RIVERS
COA L WATERS
ESTUARIES
LITTLE LAKES AND RESERVOIRS
Food chains and dose assessment
FOOD CHAINS AND CRITICAL GROUPS
DOSE

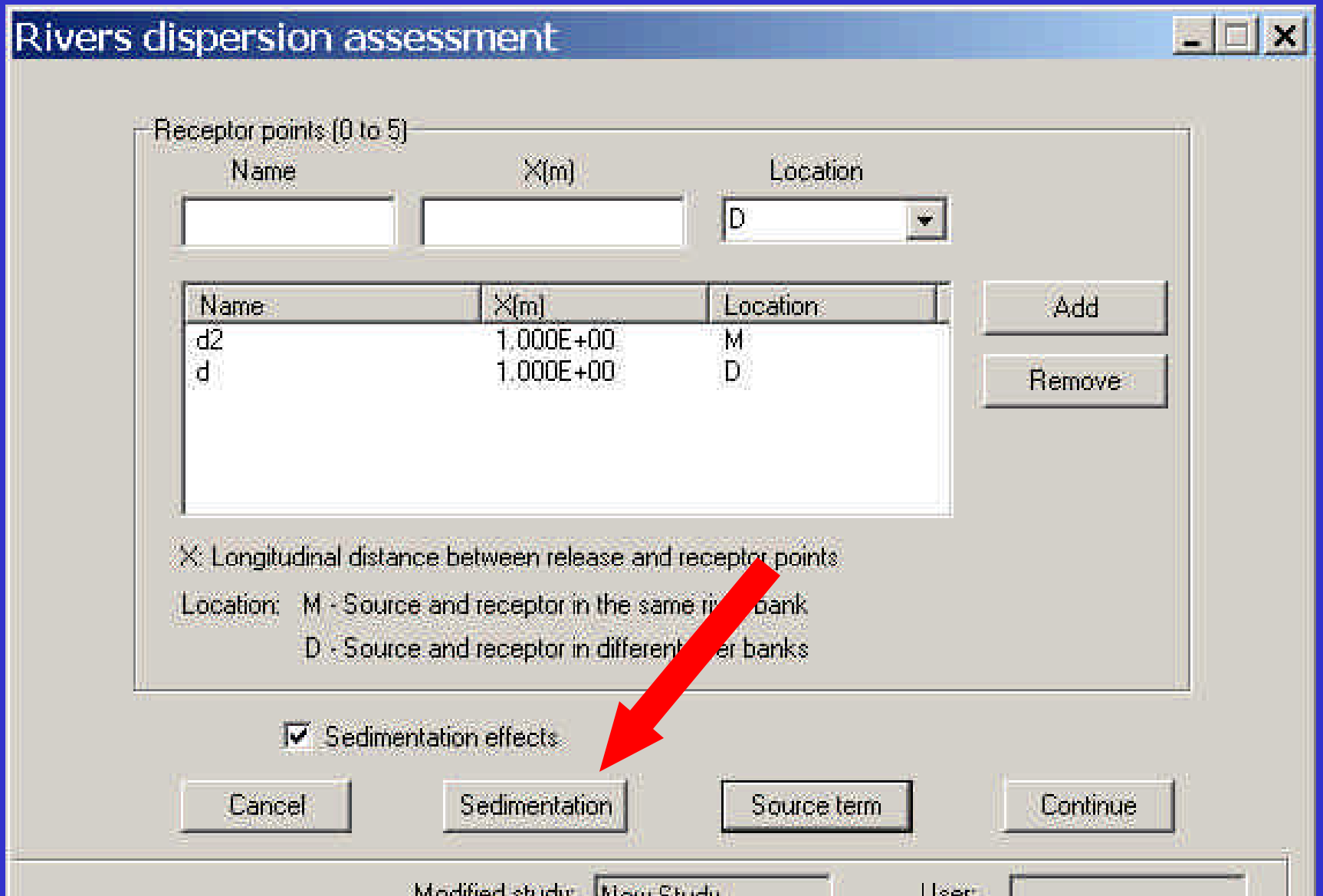
CROM - Use


Rivers dispersion assessment
Receptor points (0
Name
X(m)
Location
D
D
M
Name
X(m)
d2
1.000E+00
M
d
1.000E+00
D
Add
Remove
X: Longitudinal distance between release and receptor points
Location: M - Source and receptor in the same river bank
D - Source and receptor in different river banks
Sedimentation effects
Cancel
Sedimentation
Source term
Continue
Modified study:
New Study
User:

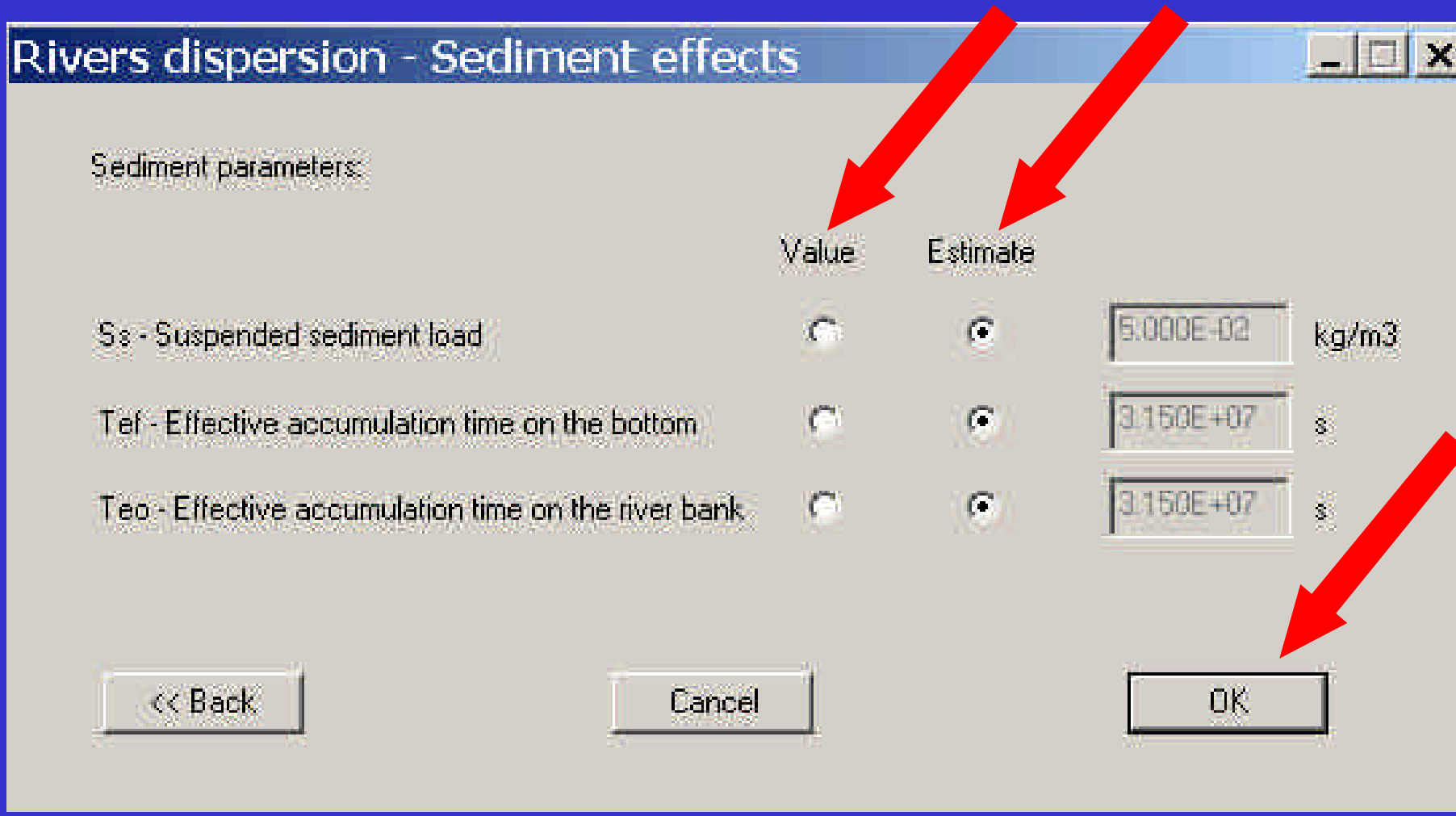
CROM - Use


Rivers dispersion - Source term
Radionuclides
Qi: Annual average discharge rate
Kd: Distribution coefficient of radionuclide on sediments
Ac-227
Ac-228
Ag-110m
Radionuclide
Qi (Bq/s)
Kd (L/kg)
Radionuclide
Qi (Bq/s)
Kd (L/kg)
Ag-110m
1.000E+00
1.000E+00
Add
<< Back
Cancel
Continue

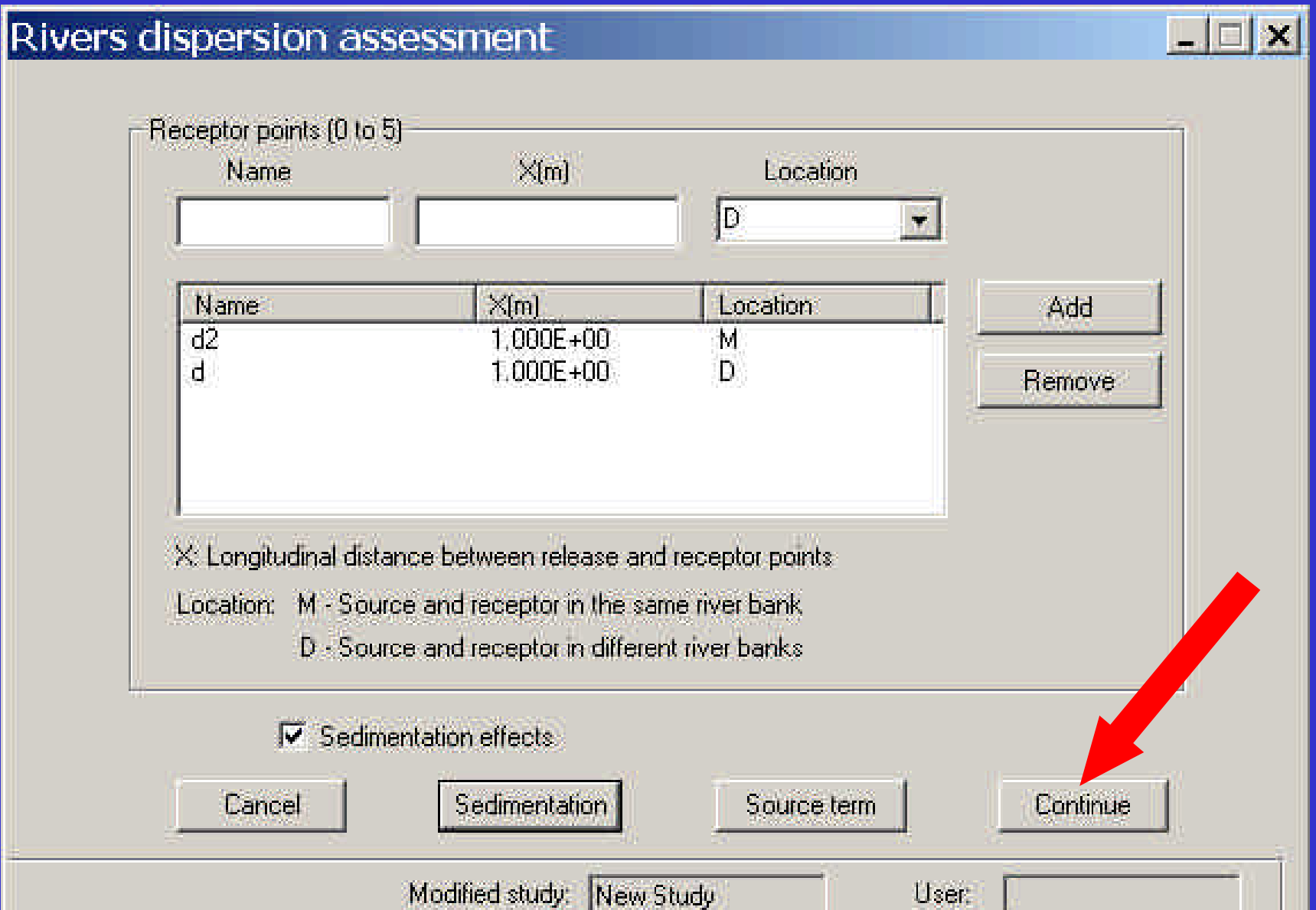
CROM - Use


Rivers dispersion assessment
Receptor points (0 to 5)
Name
X(m)
Location
D
Name
X(m)
Location
d2
1.000E+00
M
d
1.000E+00
D
Add
Remove
X: Longitudinal distance between release and receptor points
Location: M - Source and receptor in the same
bank
D - Source and receptor in differen
er banks
Sedimentation effects
Cancel
Sedimentation
Source term
Continue

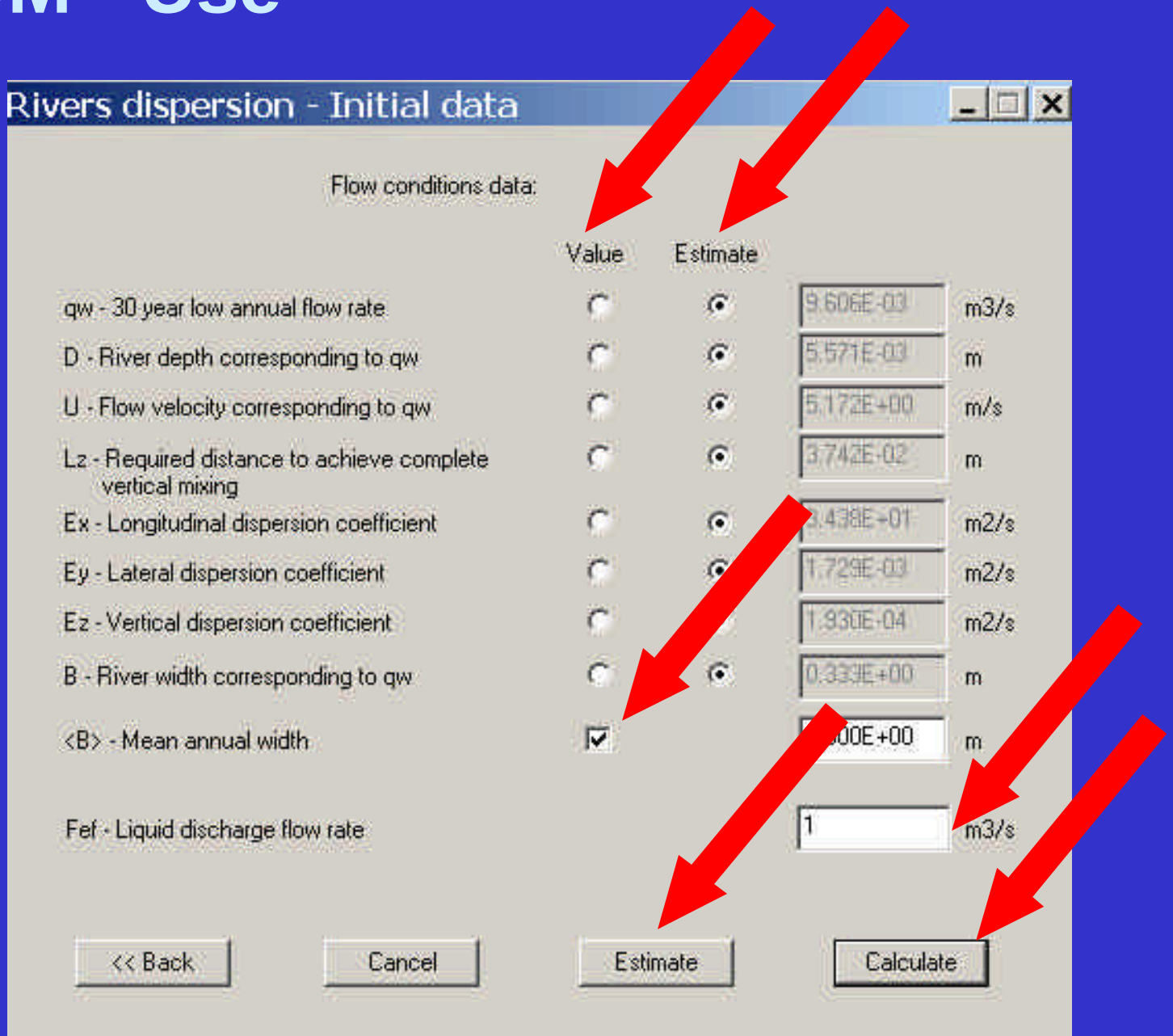
CROM - Use


Rivers dispersion - Sediment effects
Sediment parameters:
Value
Estimate
Ss - Suspended sediment load
5.000E-02
kg/m3
Tef - Effective accumulation time on the bottom
3.150E+07
s
Teo - Effective accumulation time on the river bank
3.150E+07
s
<< Back
Cancel
OK

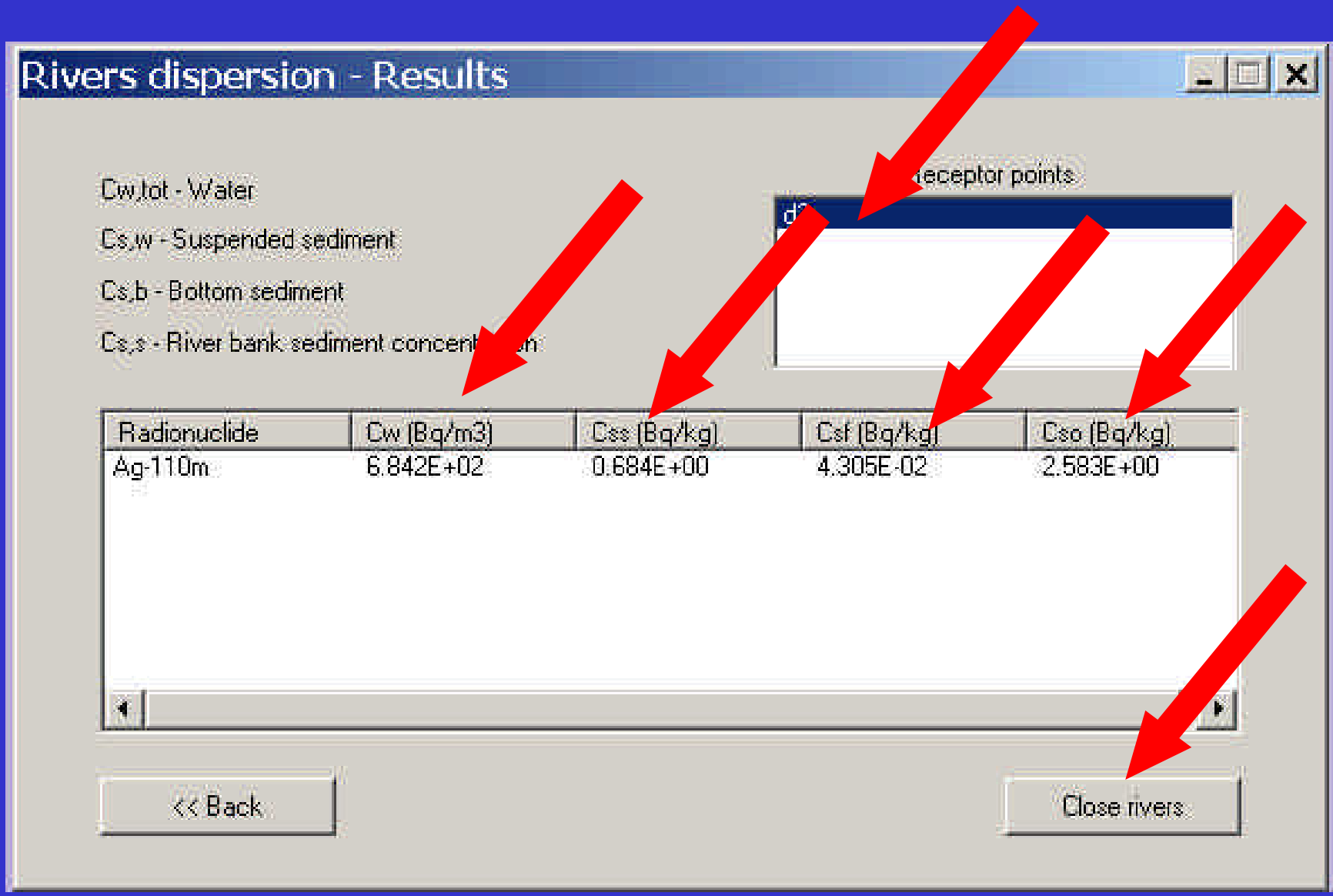
CROM - Use


Rivers dispersion assessment
Receptor points (0 to 5)
Name
X(m)
Location
D
Name
X(m)
Location
d2
1.000E+00
M
d
1.000E+00
D
Add
Remove
X: Longitudinal distance between release and receptor points
Location: M - Source and receptor in the same river bank
D - Source and receptor in different river banks
Sedimentation effects
Cancel
Sedimentation
Source term
Continue
Modified study:
New Study
User:

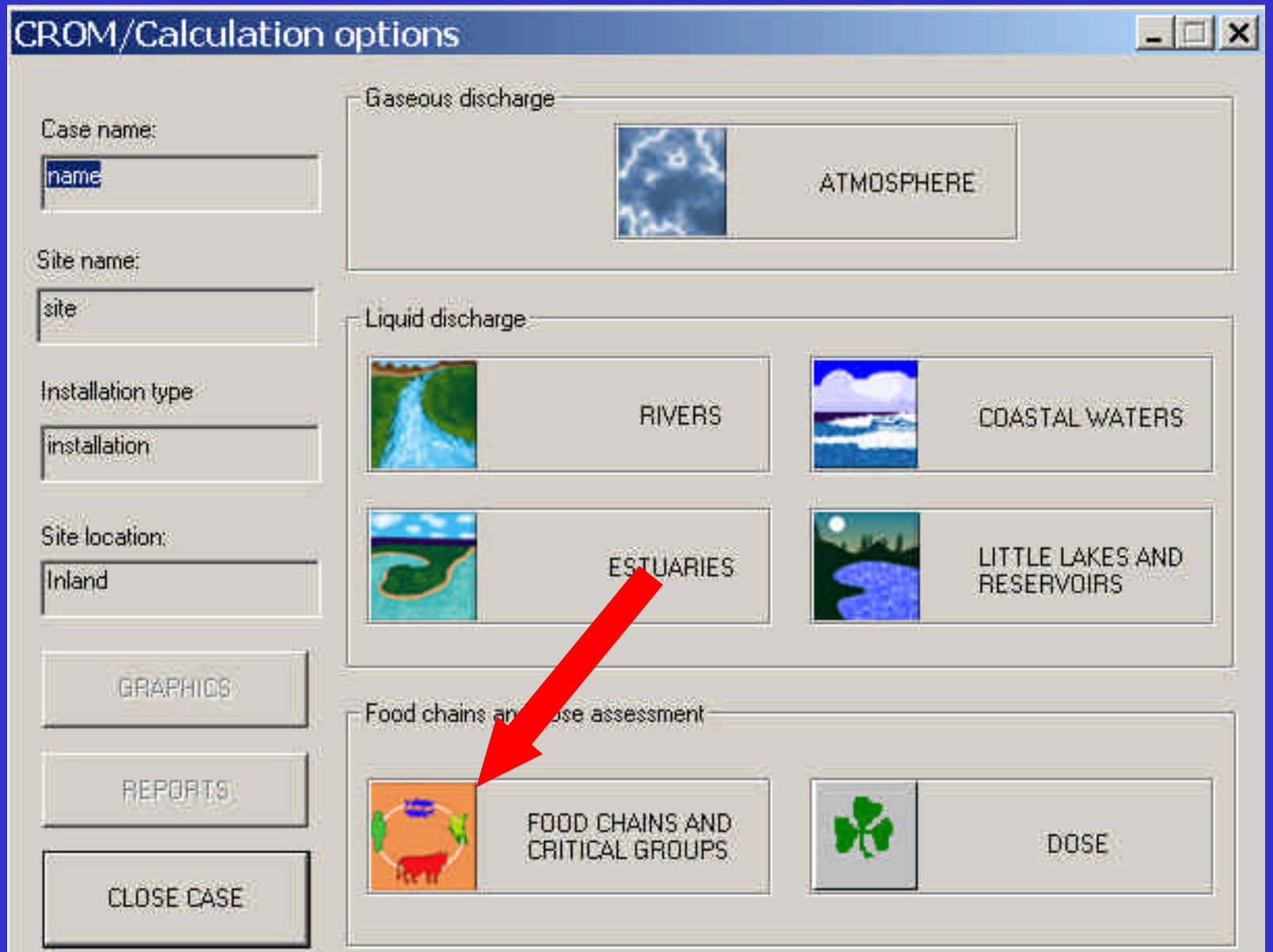
CROM - Use


Rivers dispersion - Initial data
Flow conditions data:
Value
Estimate
qw - 30 year low annual flow rate
9.606E-03
m3/s
D - River depth corresponding to qw
5.571E-03
m
U - Flow velocity corresponding to qw
5.172E+00
m/s
Lz - Required distance to achieve complete vertical mixing
3.742E-02
m
Ex - Longitudinal dispersion coefficient
2.438E+01
m2/s
Ey - Lateral dispersion coefficient
1.729E-03
m2/s
Ez - Vertical dispersion coefficient
1.930E-04
m2/s
B - River width corresponding to qw
0.333E+00
m
<B> - Mean annual width
00E+00
m
Fef - Liquid discharge flow rate
1
m3/s
<< Back
Cancel
Estimate
Calculate

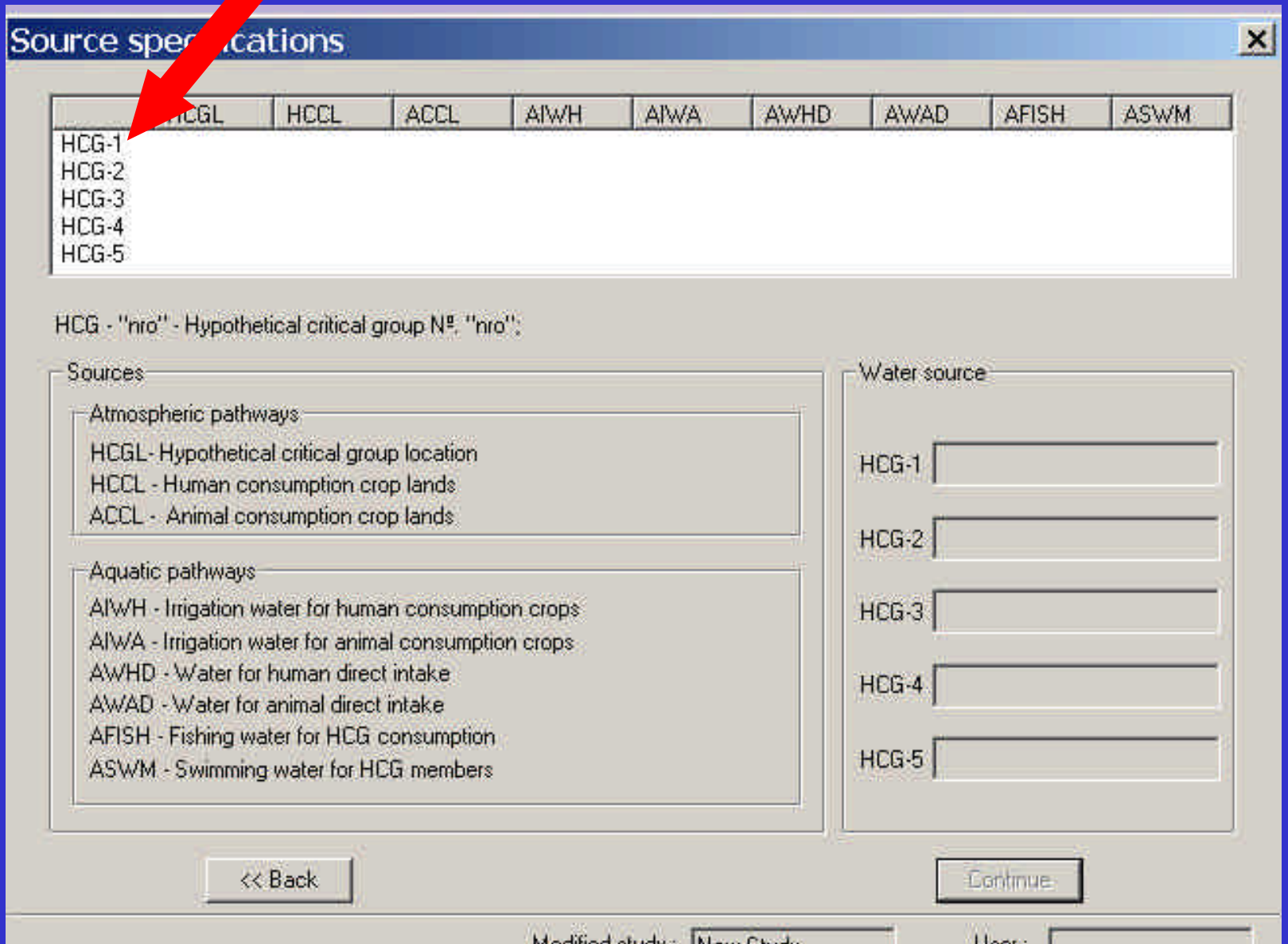
CROM - Use


Rivers dispersion - Results
Cw,tot - Water
Cs,w - Suspended sediment
Cs,b - Bottom sediment
Cs,s - River bank sediment concent
ieceptor points
Radionuclide
Cw (Bq/m3)
Css (Bq/kg)
Csf (Bq/kg)
Cso (Bq/kg)
Ag-110m
6.842E+02
0.684E+00
4.305E-02
2.583E+00
<< Back
Close rivers

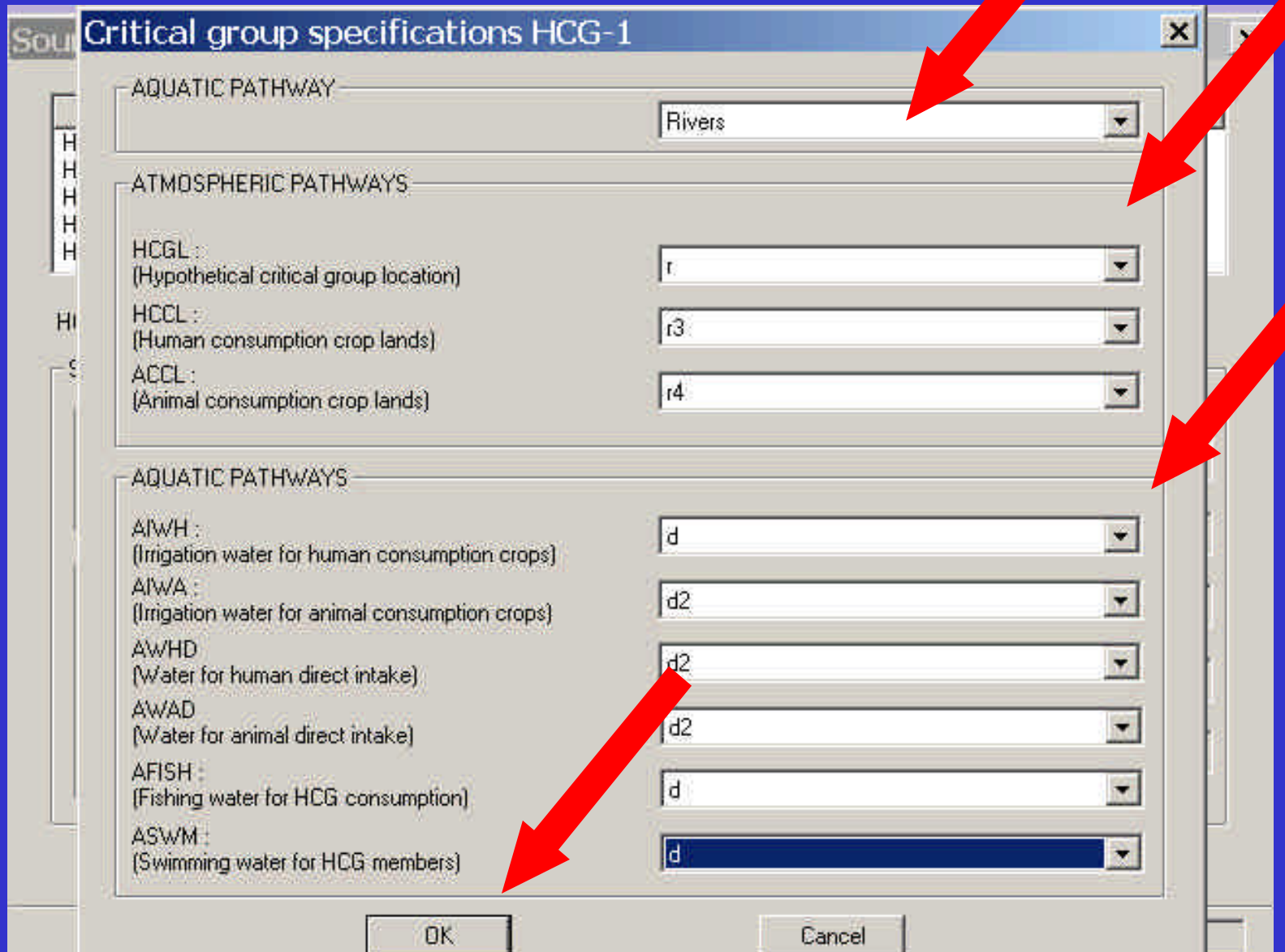
CROM - Use


CROM/Calculation options
Case name:
name
Site name:
site
Installation type
installation
Site location:
Inland
GRAPHICS
REPORTS
CLOSE CASE
Gaseous discharge
ATMOSPHERE
Liquid discharge
RIVERS
COASTAL WATERS
ESTUARIES
LITTLE LAKES AND RESERVOIRS
Food chains
FOOD CHAINS AND CRITICAL GROUPS
DOSE

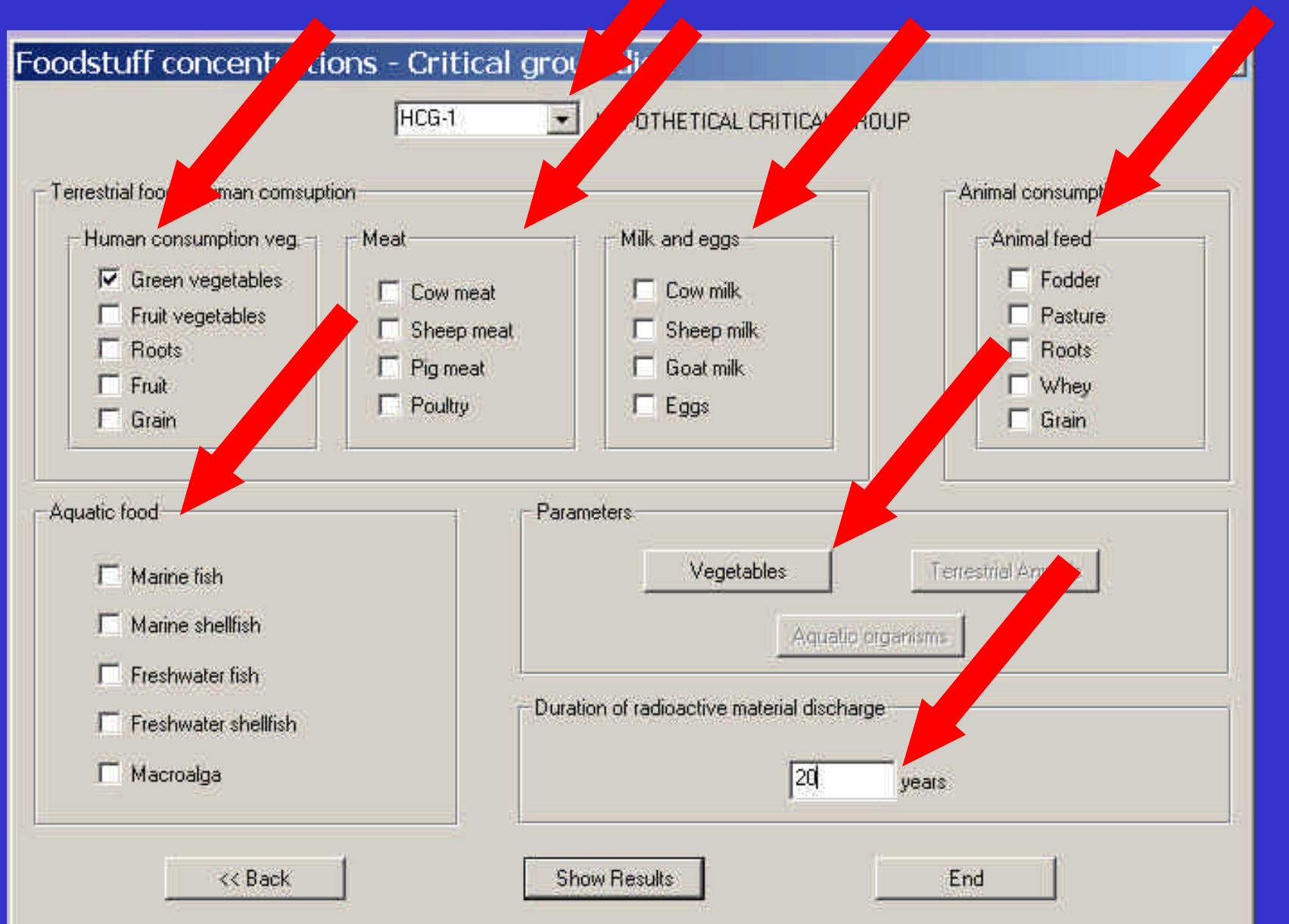
CROM - Use


Source specifications
HCGL
HCCL
ACCL
AIWH
AIWA
AWHD
AWAD
AFISH
ASWM
HCG-1
HCG-2
HCG-3
HCG-4
HCG-5
HCG - "nro" - Hypothetical critical group Nº. "nro":
Sources
Atmospheric pathways
HCGL- Hypothetical critical group location
HCCL - Human consumption crop lands
ACCL - Animal consumption crop lands
Aquatic pathways
AIWH - Irrigation water for human consumption crops
AIWA - Irrigation water for animal consumption crops
AWHD - Water for human direct intake
AWAD - Water for animal direct intake
AFISH - Fishing water for HCG consumption
ASWM - Swimming water for HCG members
Water source
HCG-1
HCG-2
HCG-3
HCG-4
HCG-5
<< Back
Continue

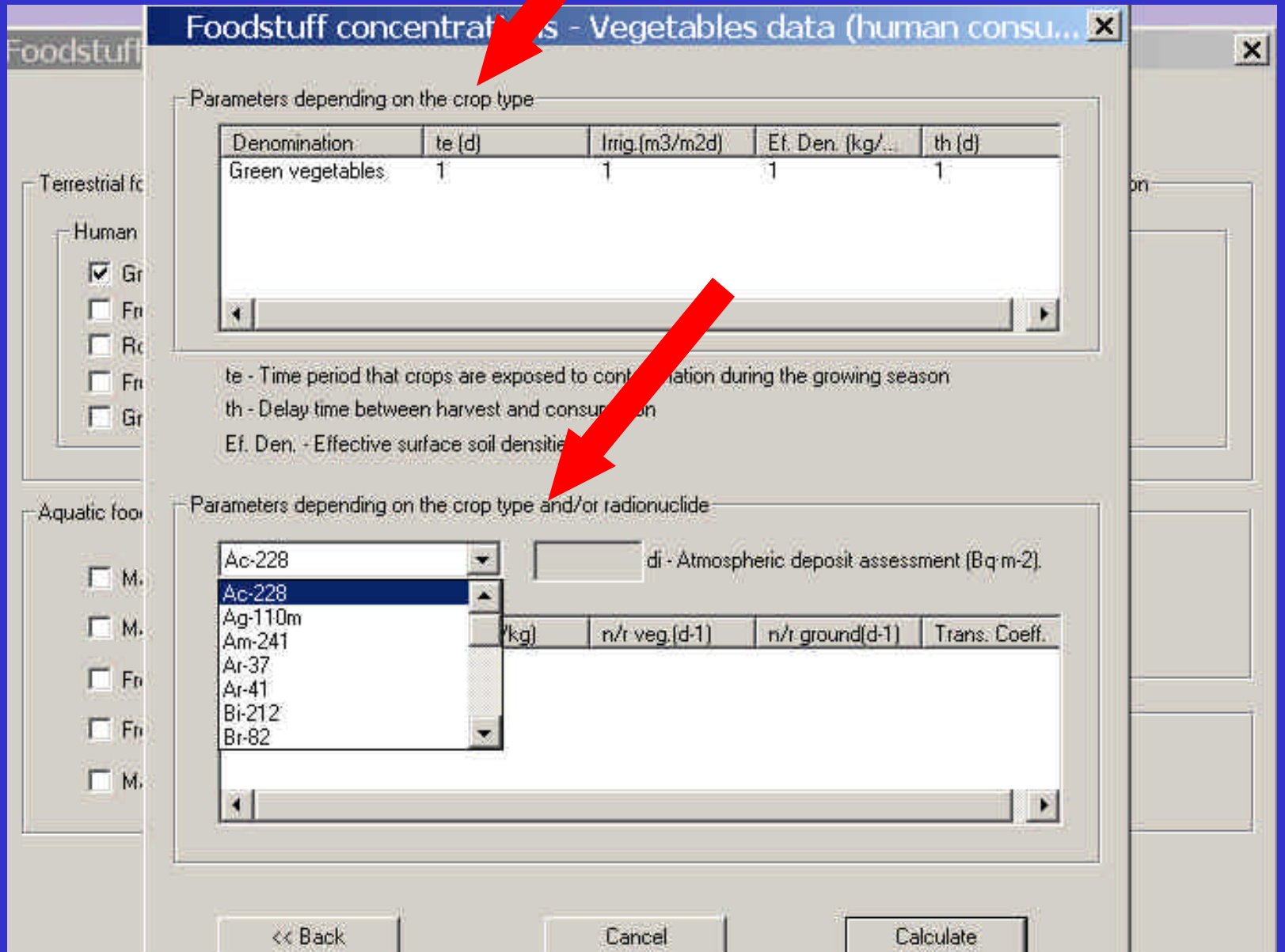
CROM - Use


Critical group specifications HCG-1
AQUATIC PATHWAY
Rivers
ATMOSPHERIC PATHWAYS
HCGL :
(Hypothetical critical group location)
r
HCCL :
(Human consumption crop lands)
r3
ACCL :
(Animal consumption crop lands)
r4
AQUATIC PATHWAYS
AIWH :
(Irrigation water for human consumption crops)
d
AIWA :
(Irrigation water for animal consumption crops)
d2
AWHD
(Water for human direct intake)
d2
AWAD
(Water for animal direct intake)
d2
AFISH :
(Fishing water for HCG consumption)
d
ASWM :
(Swimming water for HCG members)
d
OK
Cancel

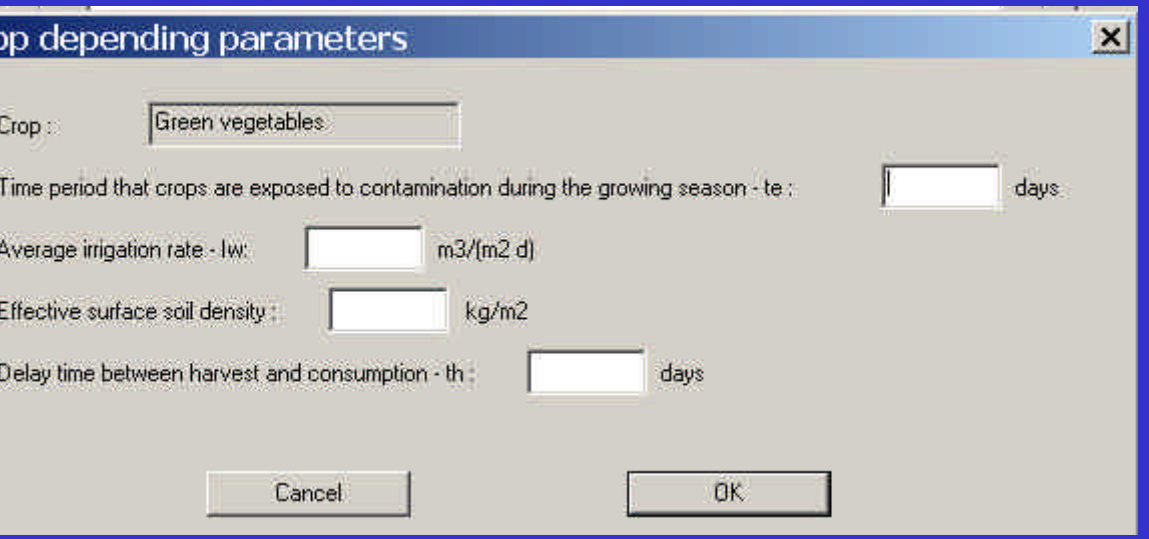
CROM - Use

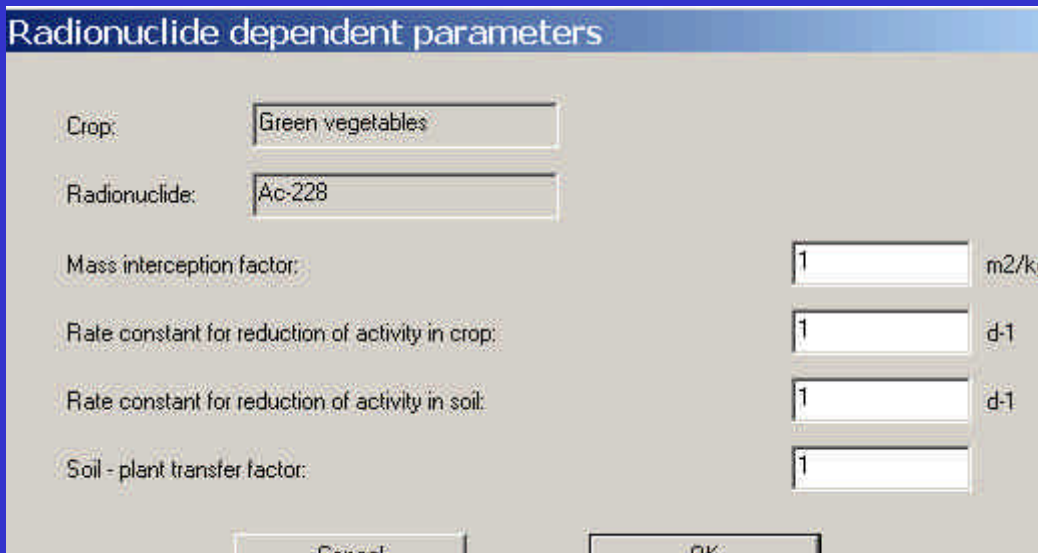

Foodstuff concentrations - Critical group
HCG-1
Terrestrial food - human comsuption
Human consumption veg
Green vegetables
Fruit vegetables
Roots
Fruit
Grain
Meat
Cow meat
Sheep meat
Pig meat
Poultry
Milk and eggs
Cow milk
Sheep milk
Goat milk
Eggs
Animal consumption
Animal feed
Fodder
Pasture
Roots
Whey
Grain
Aquatic food
Marine fish
Marine shellfish
Freshwater fish
Freshwater shellfish
Macroalga
Parameters
Vegetables
Terrestrial Animals
Aquatic organisms
Duration of radioactive material discharge
20
years
<< Back
Show Results
End

CROM - Use

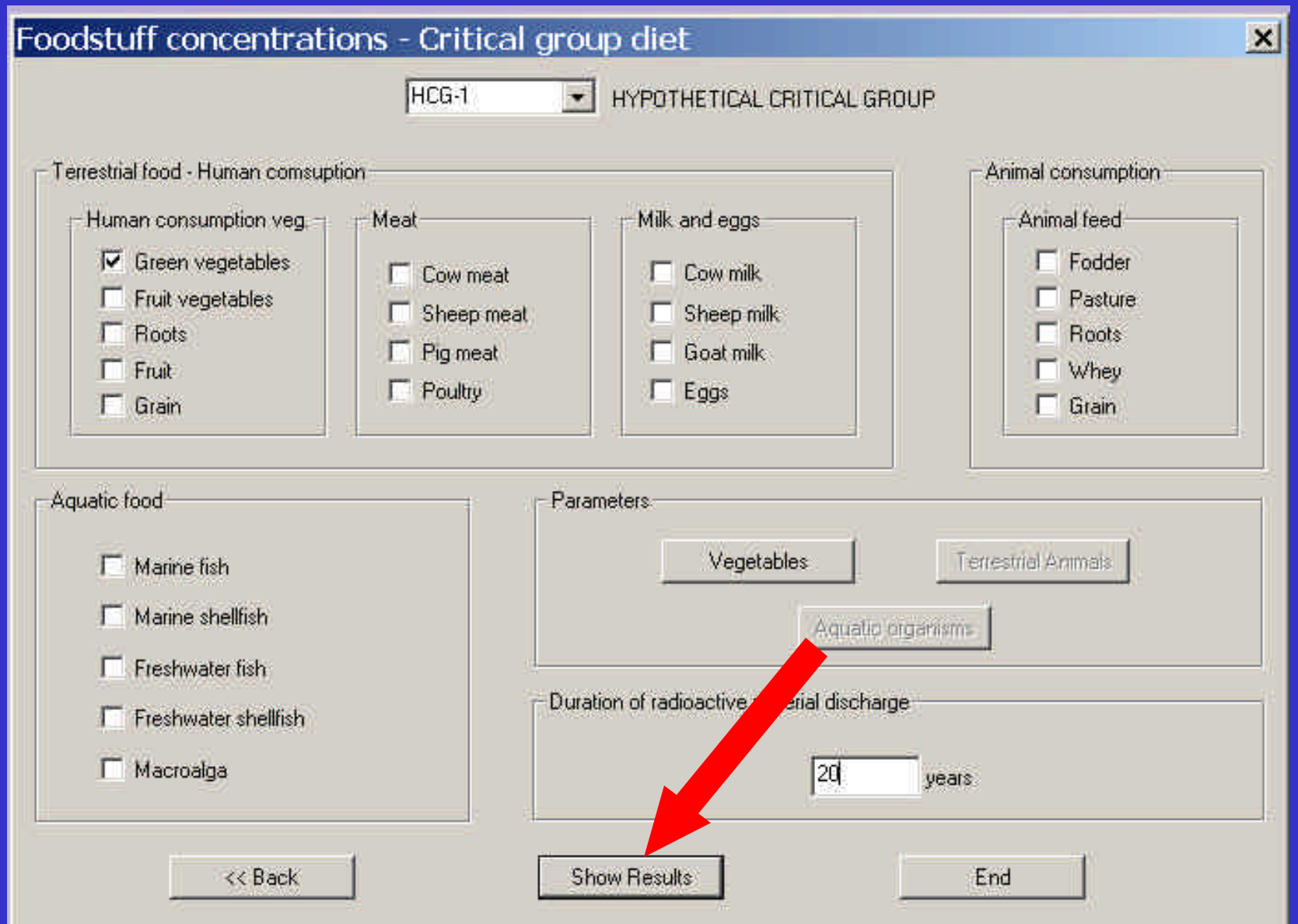

Foodstuff concentrat s - Vegetables data (human consu...
Parameters depending on the crop type
Denomination
te (d)
Irrig.(m3/m2d)
Ef. Den. (kg/...
th (d)
Green vegetables
1
1
1
1
te - Time period that crops are exposed to cont nation during the growing season
th - Delay time between harvest and consum on
Ef. Den. - Effective surface soil densitie
Parameters depending on the crop type and/or radionuclide
Ac-228
Ac-228
Ag-110m
Am-241
Ar-37
Ar-41
Bi-212
Br-82
di - Atmospheric deposit assessment (Bq·m-2).
/kg)
n/r veg.(d-1)
n/r ground(d-1)
Trans. Coeff.
<< Back
Cancel
Calculate

CROM - Use

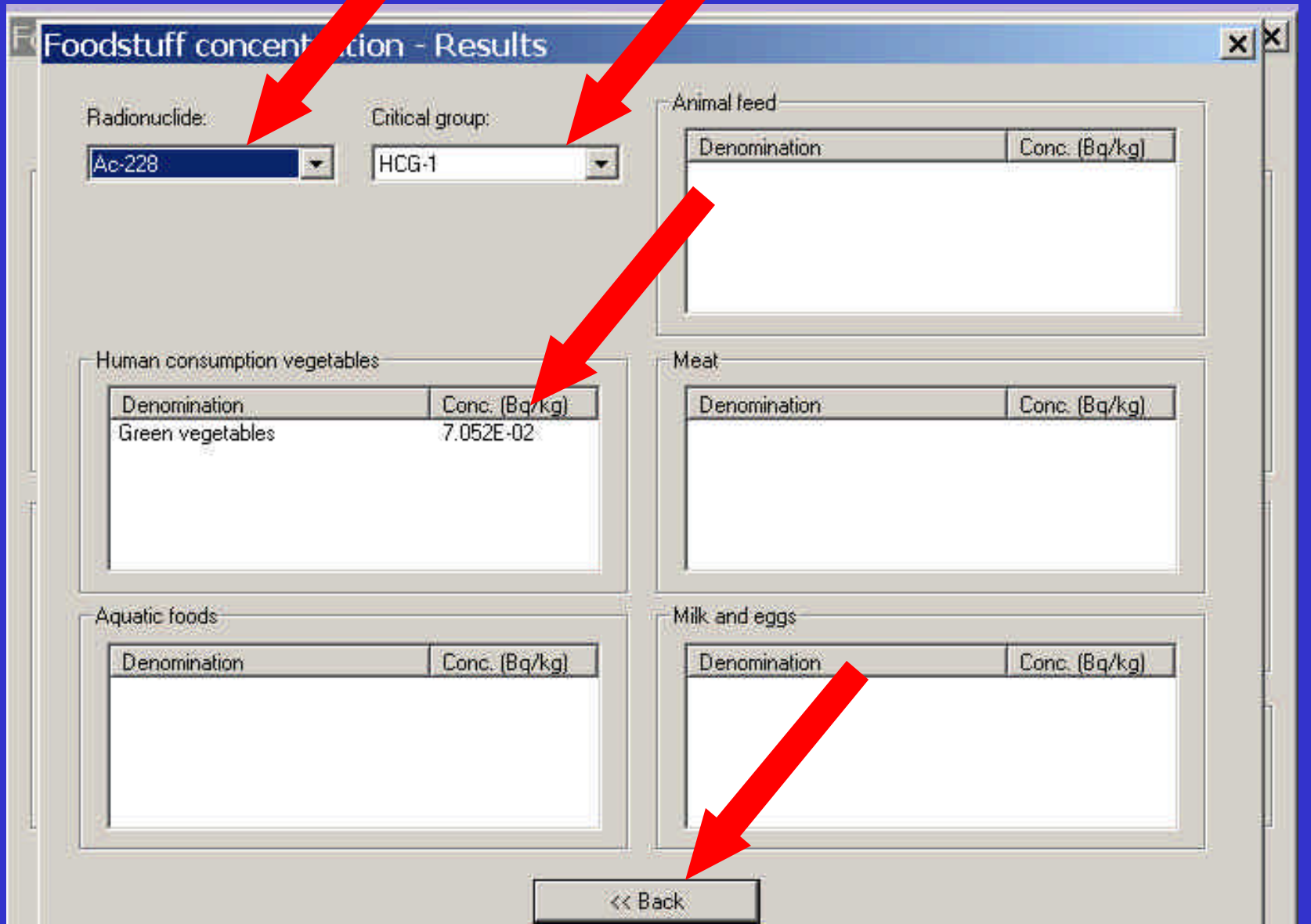

op depending parameters
Crop :
Green vegetables
Time period that crops are exposed to contamination during the growing season - te :
days
Average irrigation rate - Iw:
m3/(m2 d)
Effective surface soil density :
kg/m2
Delay time between harvest and consumption - th :
days
Cancel
OK


Radionuclide dependent parameters
Crop:
Green vegetables
Radionuclide:
Ac-228
Mass interception factor:
1
m2/k
Rate constant for reduction of activity in crop:
1
d-1
Rate constant for reduction of activity in soil:
1
d-1
Soil - plant transfer factor:
1

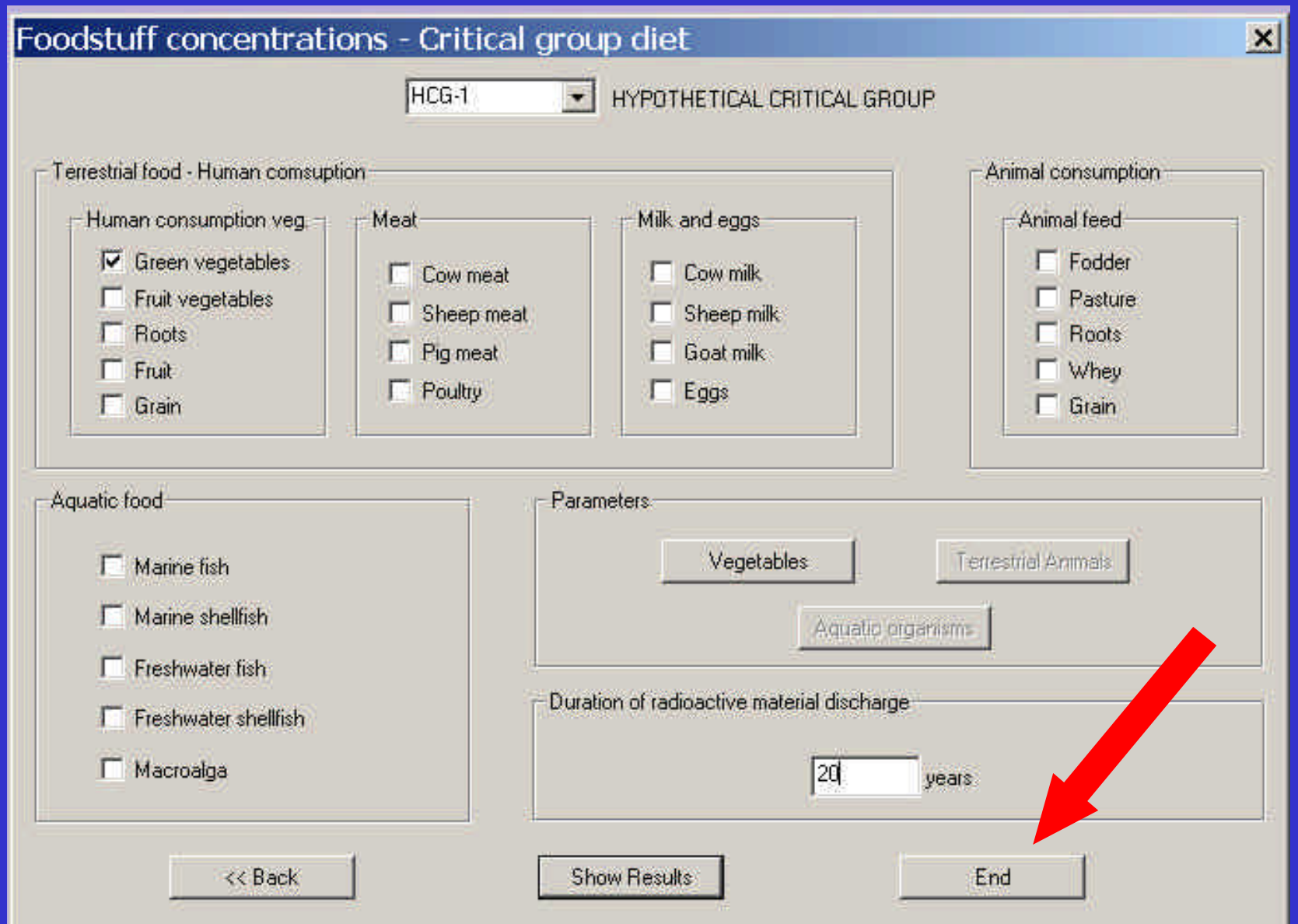
CROM - Use


Foodstuff concentrations - Critical group diet
HCG-1
HYPOTHETICAL CRITICAL GROUP
Terrestrial food - Human comsuption
Human consumption veg
Green vegetables
Fruit vegetables
Roots
Fruit
Grain
Meat
Cow meat
Sheep meat
Pig meat
Poultry
Milk and eggs
Cow milk
Sheep milk
Goat milk
Eggs
Animal consumption
Animal feed
Fodder
Pasture
Roots
Whey
Grain
Aquatic food
Marine fish
Marine shellfish
Freshwater fish
Freshwater shellfish
Macroalga
Parameters
Vegetables
Terrestrial Animals
Aquatic organisms
Duration of radioactive
erial discharge
20
years
<< Back
Show Results
End

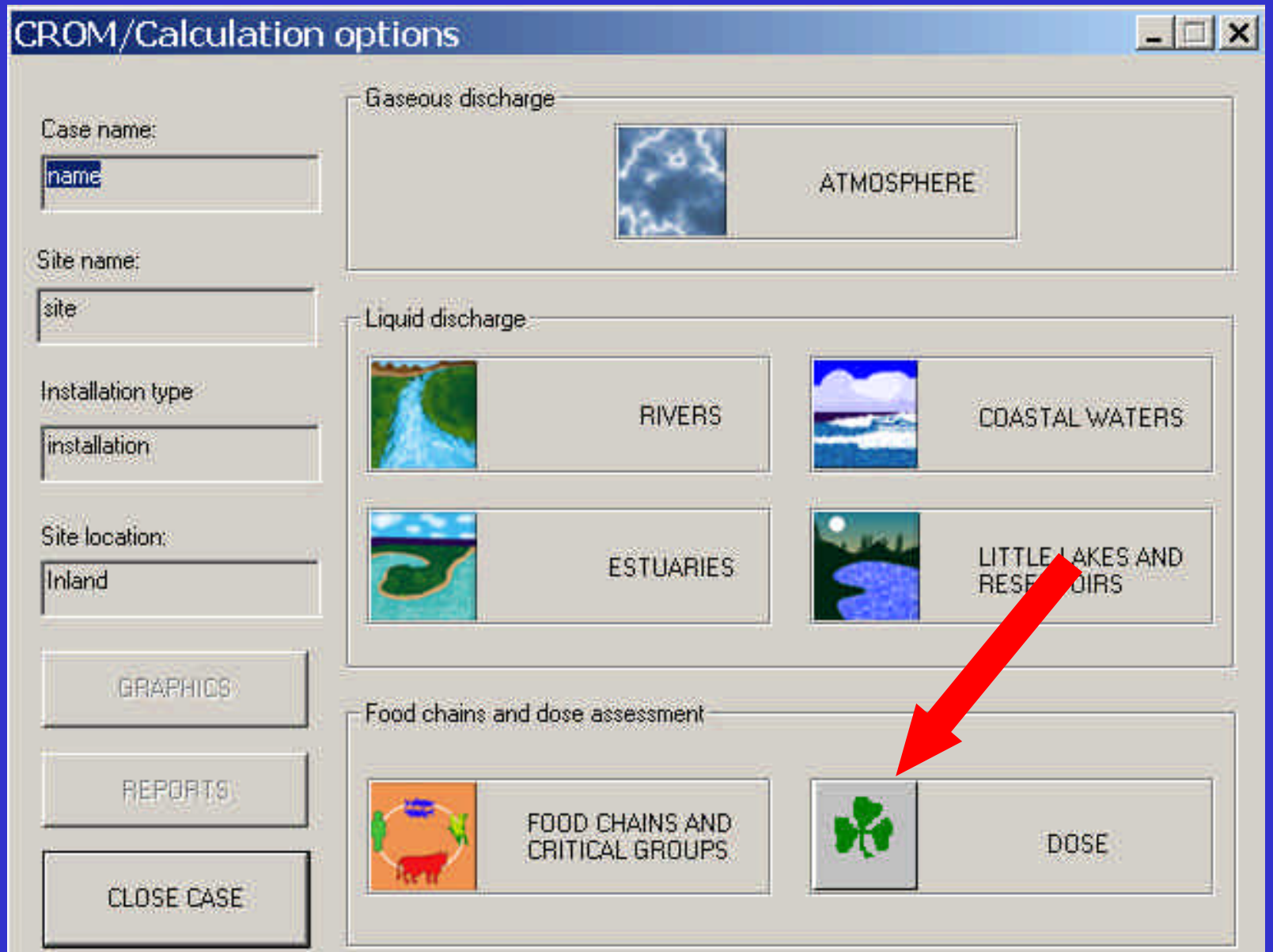
CROM - Use


Foodstuff concentration - Results
Radionuclide:
Ac-228
Critical group:
HCG-1
Animal feed
Denomination
Conc. (Bq/kg)
Human consumption vegetables
Denomination
Conc. (Bq/kg)
Green vegetables
7.052E-02
Meat
Denomination
Conc. (Bq/kg)
Aquatic foods
Denomination
Conc. (Bq/kg)
Milk and eggs
Denomination
Conc. (Bq/kg)
<< Back

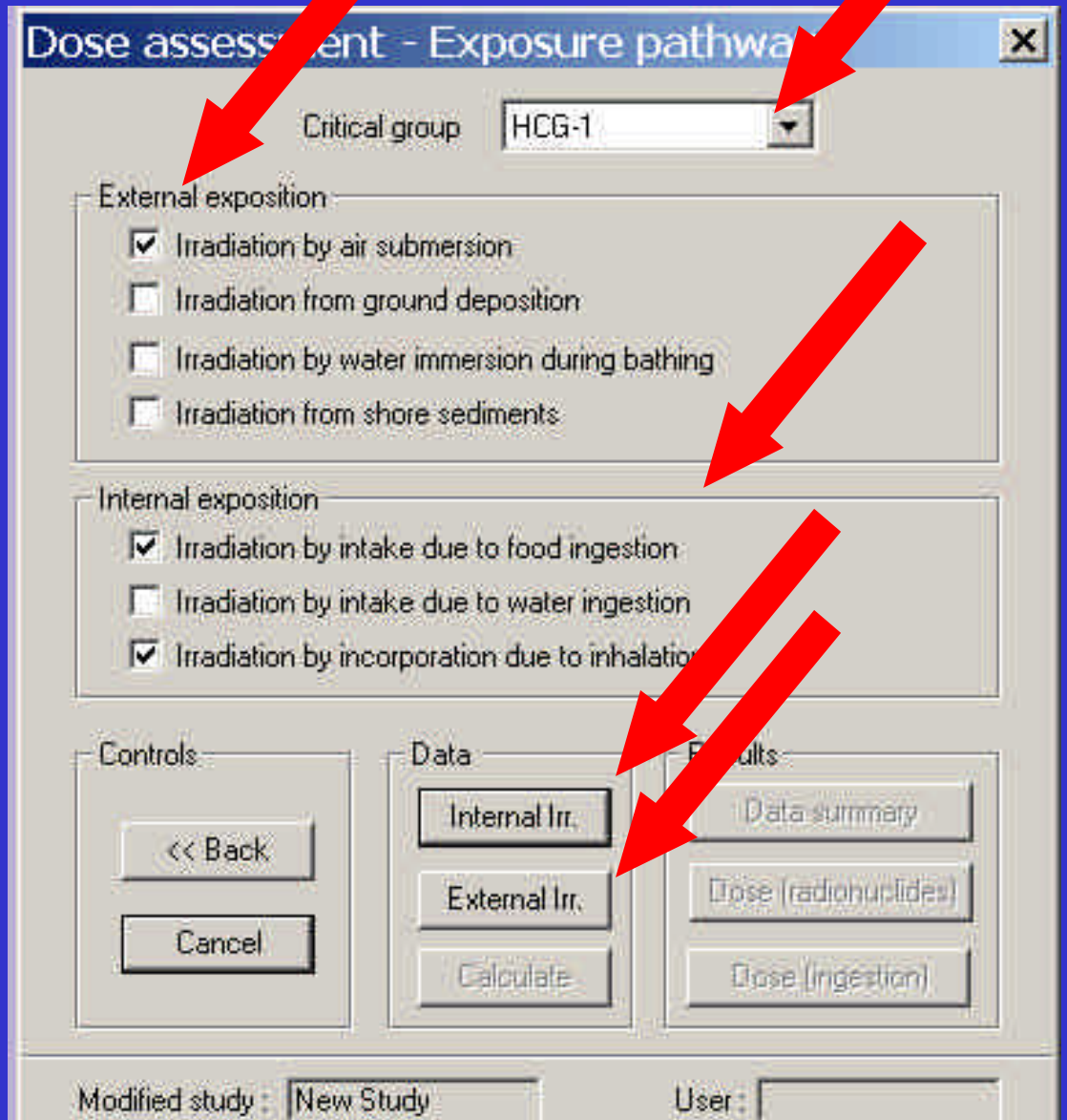
CROM - Use


Foodstuff concentrations - Critical group diet
HCG-1
HYPOTHETICAL CRITICAL GROUP
Terrestrial food - Human comsuption
Human consumption veg
Green vegetables
Fruit vegetables
Roots
Fruit
Grain
Meat
Cow meat
Sheep meat
Pig meat
Poultry
Milk and eggs
Cow milk
Sheep milk
Goat milk
Eggs
Animal consumption
Animal feed
Fodder
Pasture
Roots
Whey
Grain
Aquatic food
Marine fish
Marine shellfish
Freshwater fish
Freshwater shellfish
Macroalga
Parameters
Vegetables
Terrestrial Animals
Aquatic organisms
Duration of radioactive material discharge
20
years
<< Back
Show Results
End

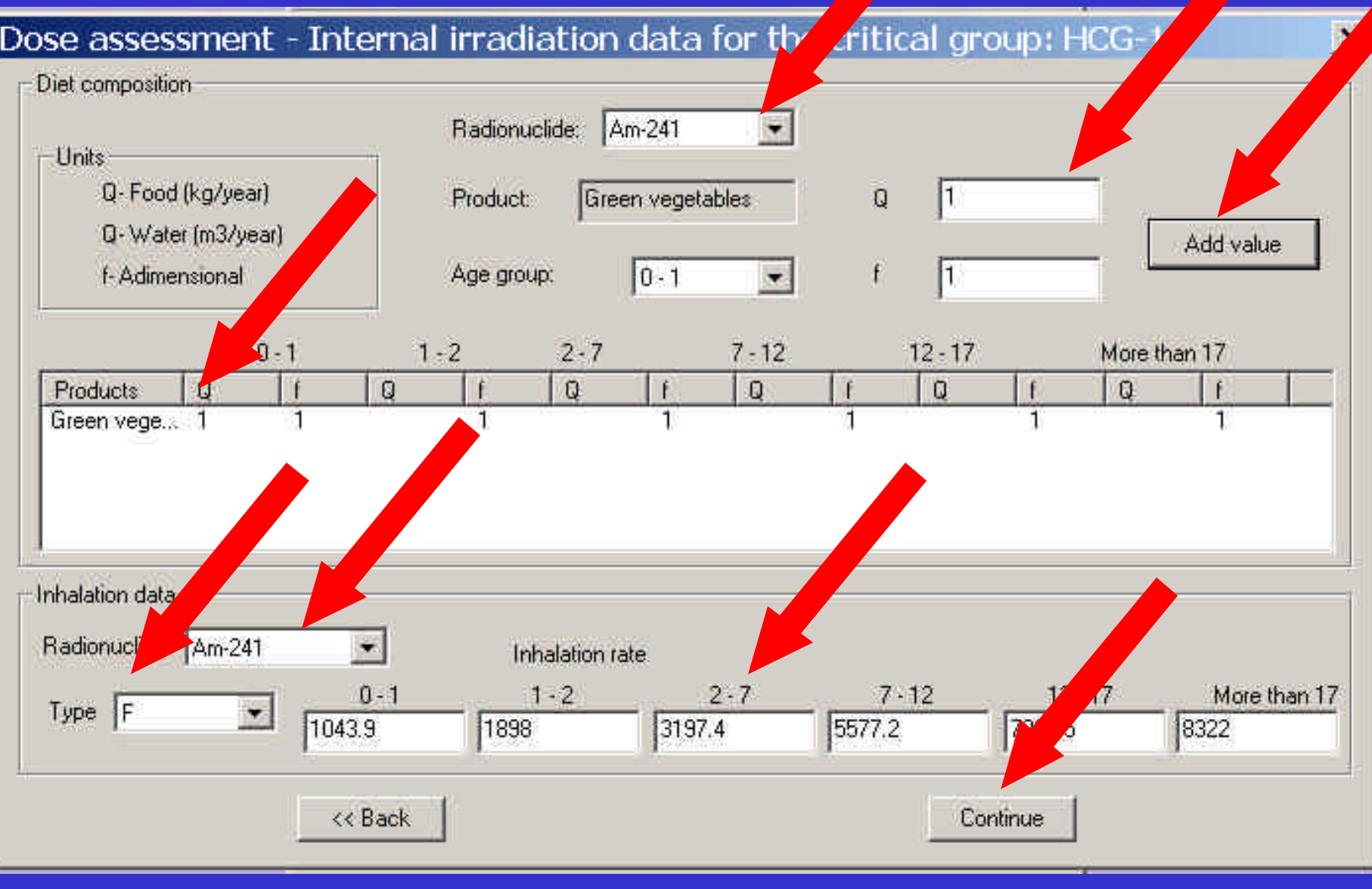
CROM - Use


CROM/Calculation options
Case name:
name
Site name:
site
Installation type
installation
Site location:
Inland
GRAPHICS
REPORTS
CLOSE CASE
Gaseous discharge
ATMOSPHERE
Liquid discharge
RIVERS
COASTAL WATERS
ESTUARIES
LITTLE LAKES AND RESERVOIRS
Food chains and dose assessment
FOOD CHAINS AND CRITICAL GROUPS
DOSE

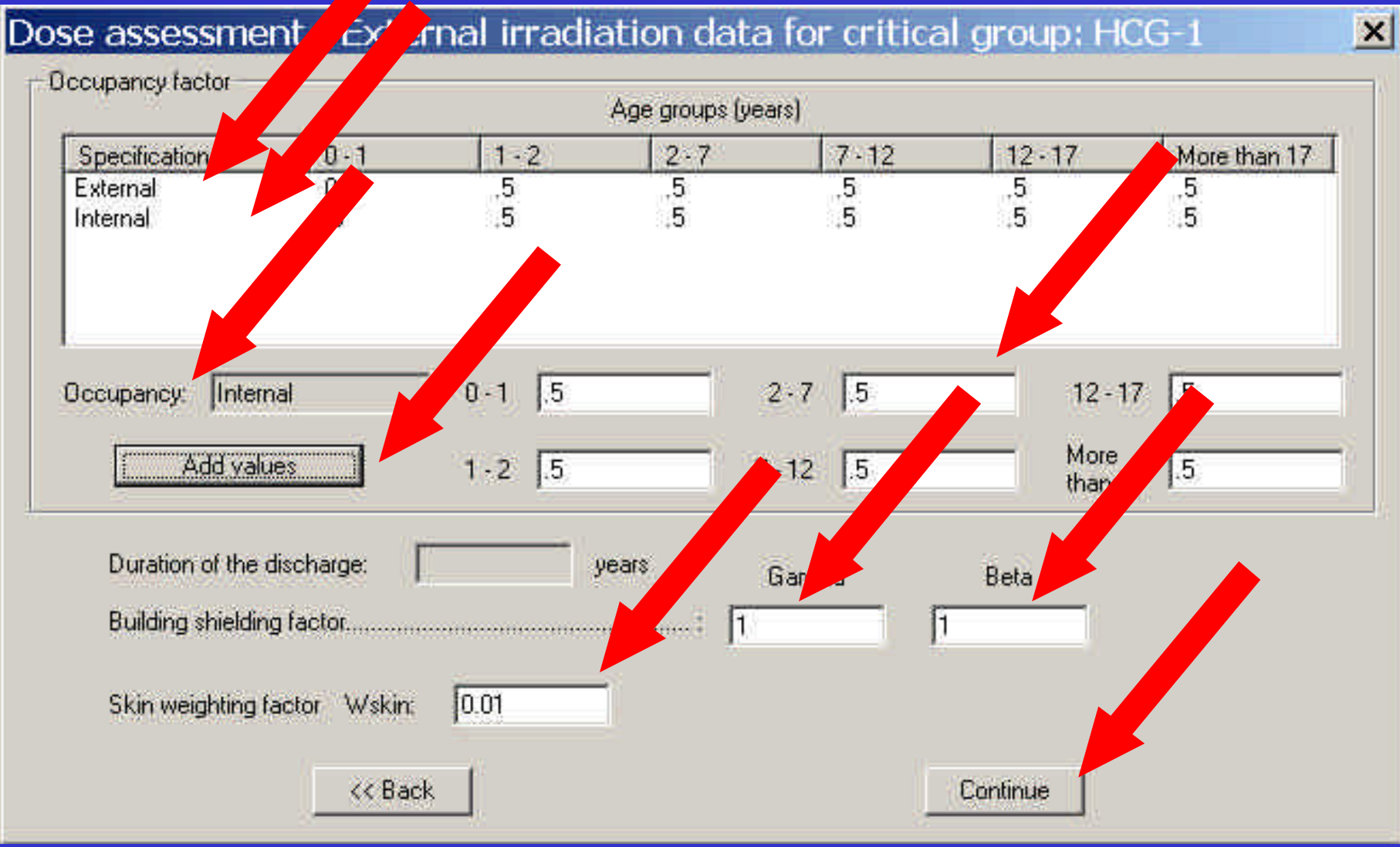
CROM - Use


Dose assess ent - Exposure pathwa
Critical group
HCG-1
External exposition
Irradiation by air submersion
Irradiation from ground deposition
Irradiation by water immersion during bathing
Irradiation from shore sediments
Internal exposition
Irradiation by intake due to food ingestion
Irradiation by intake due to water ingestion
Irradiation by incorporation due to inhalatio
Controls
<< Back
Cancel
Data
Internal Irr.
External Irr.
Calculate
ults
Data summary
Dose (radionuclides)
Dose (ingestion)
Modified study :
New Study
User :

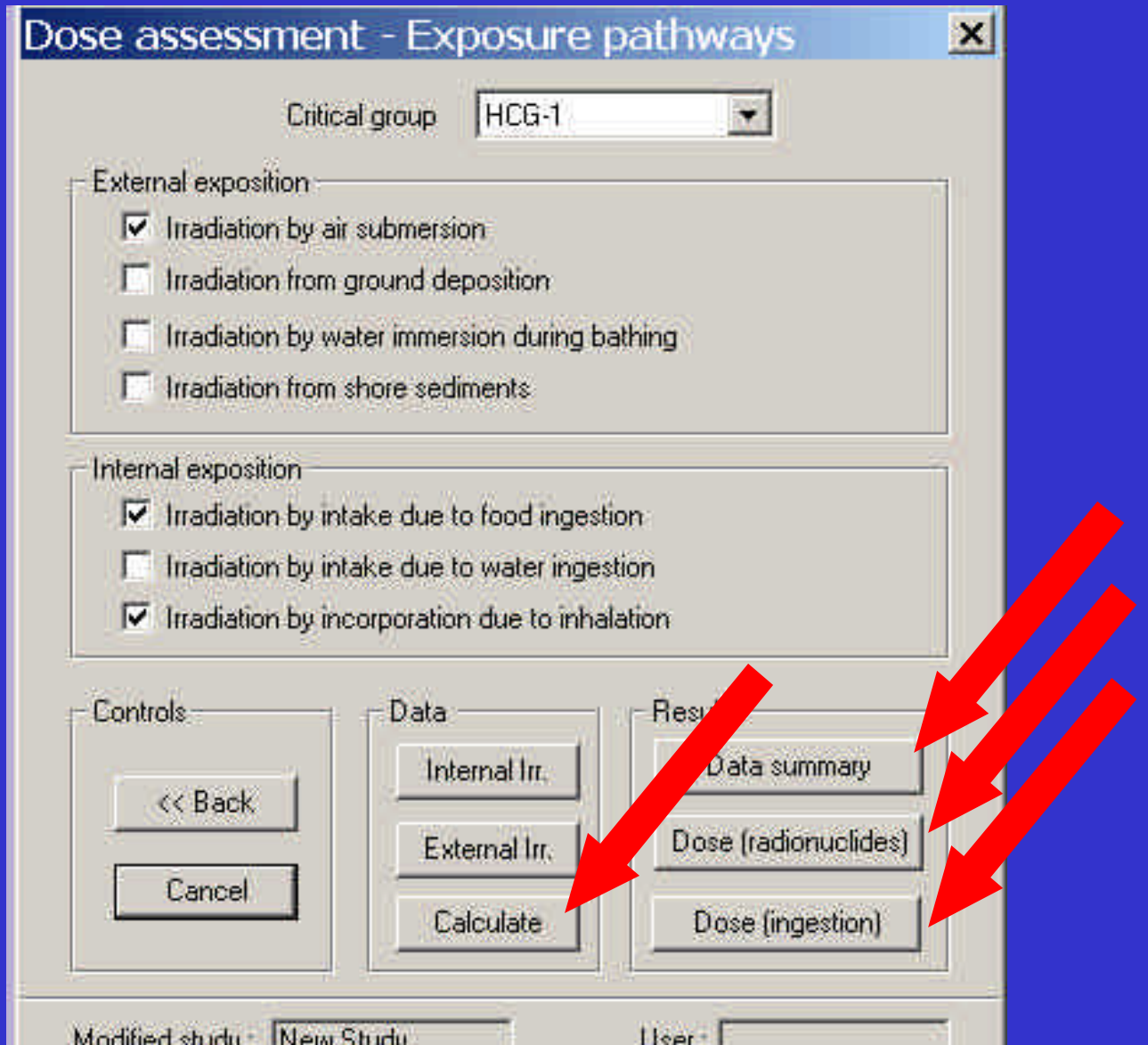
CROM - Use


Dose assessment - Internal irradiation data for th critical group: HCG-
Diet composition
Radionuclide:
Am-241
Units
Q- Food (kg/year)
Q- Water (m3/year)
f- Adimensional
Product:
Green vegetables
Q
1
Add value
Age group:
0 - 1
f
1
0 - 1
1 - 2
2 - 7
7 - 12
12 - 17
More than 17
Products
Q
f
Green vege...
1
Inhalation data
Radionucl
Am-241
Inhalation rate
Type
F
0 - 1
1 - 2
2 - 7
7 - 12
More than 17
1043.9
1898
3197.4
5577.2
8322
<< Back
Continue

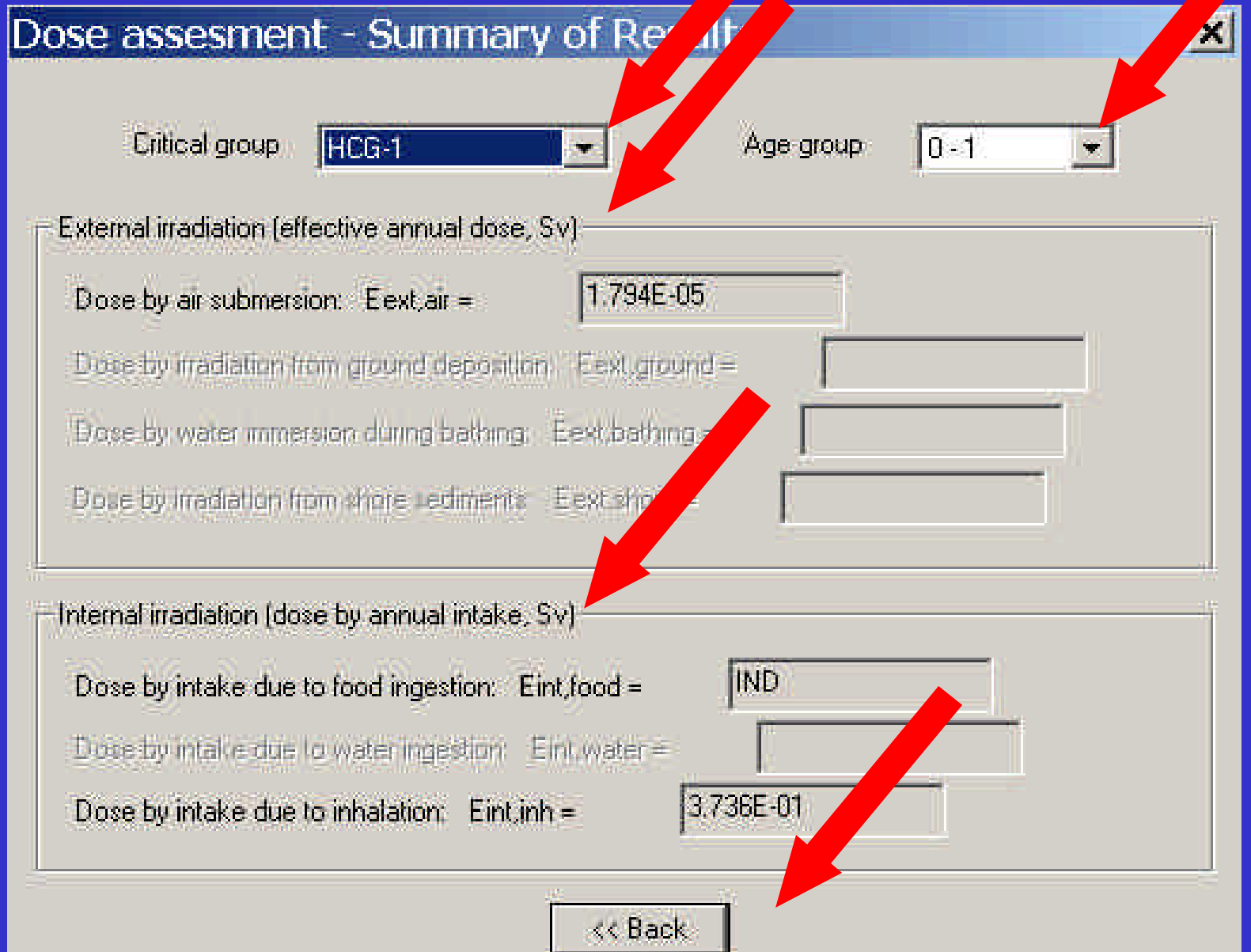
CROM - Use


Dose assessment External irradiation data for critical group: HCG-1
Occupancy factor
Age groups (years)
Specification
0 - 1
1 - 2
2 - 7
7 - 12
12 - 17
More than 17
External
Internal
.5
Occupancy:
Internal
Add values
0 - 1
1 - 2
2 - 7
12 - 17
More than
Duration of the discharge:
years
Beta
Building shielding factor
1
Skin weighting factor Wskin:
0.01
<< Back
Continue

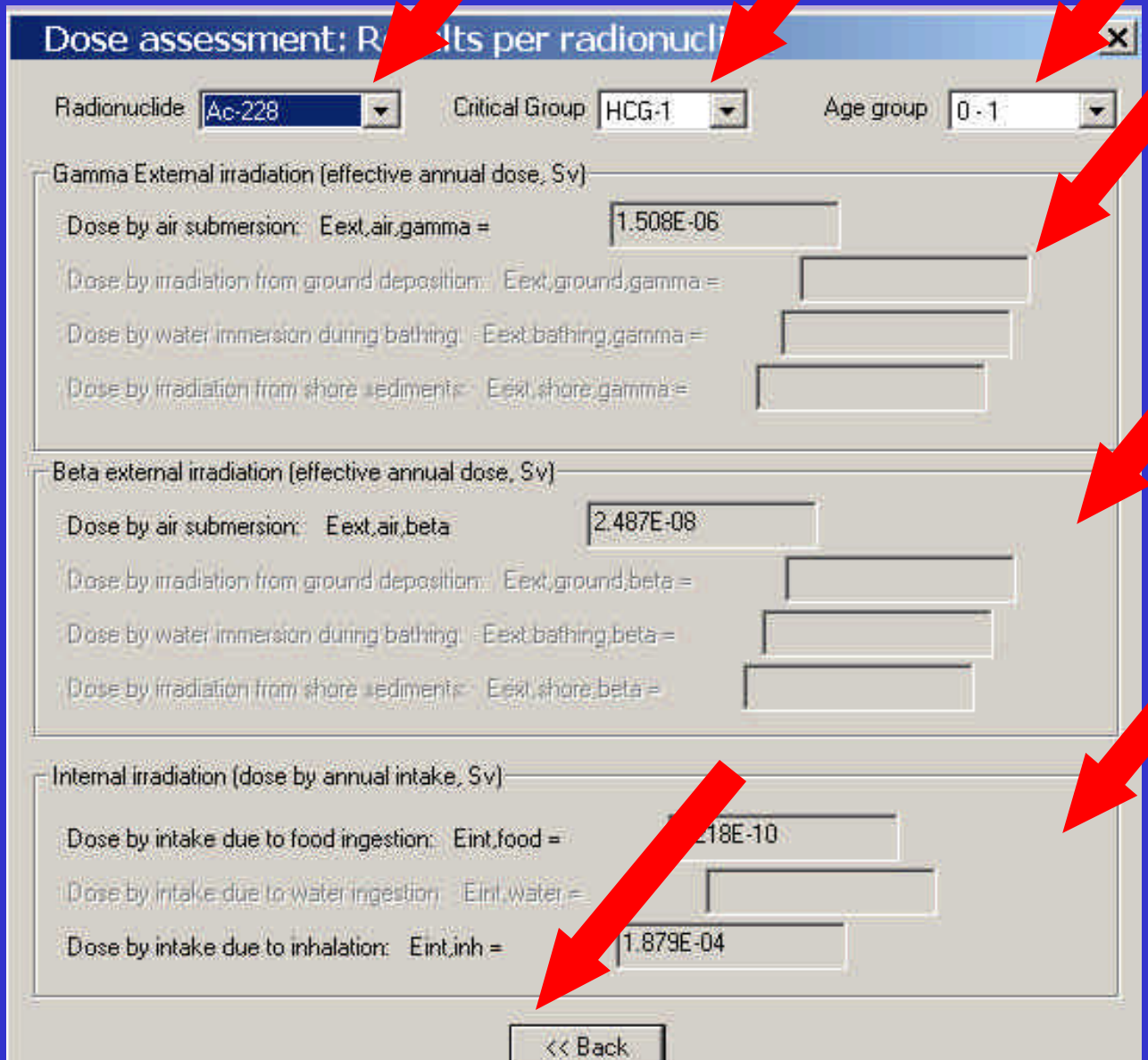
CROM - Use


Dose assessment - Exposure pathways
Critical group
HCG-1
External exposition
Irradiation by air submersion
Irradiation from ground deposition
Irradiation by water immersion during bathing
Irradiation from shore sediments
Internal exposition
Irradiation by intake due to food ingestion
Irradiation by intake due to water ingestion
Irradiation by incorporation due to inhalation
Controls
<< Back
Cancel
Data
Internal Irr.
External Irr.
Calculate
Data summary
Dose (radionuclides)
Dose (ingestion)

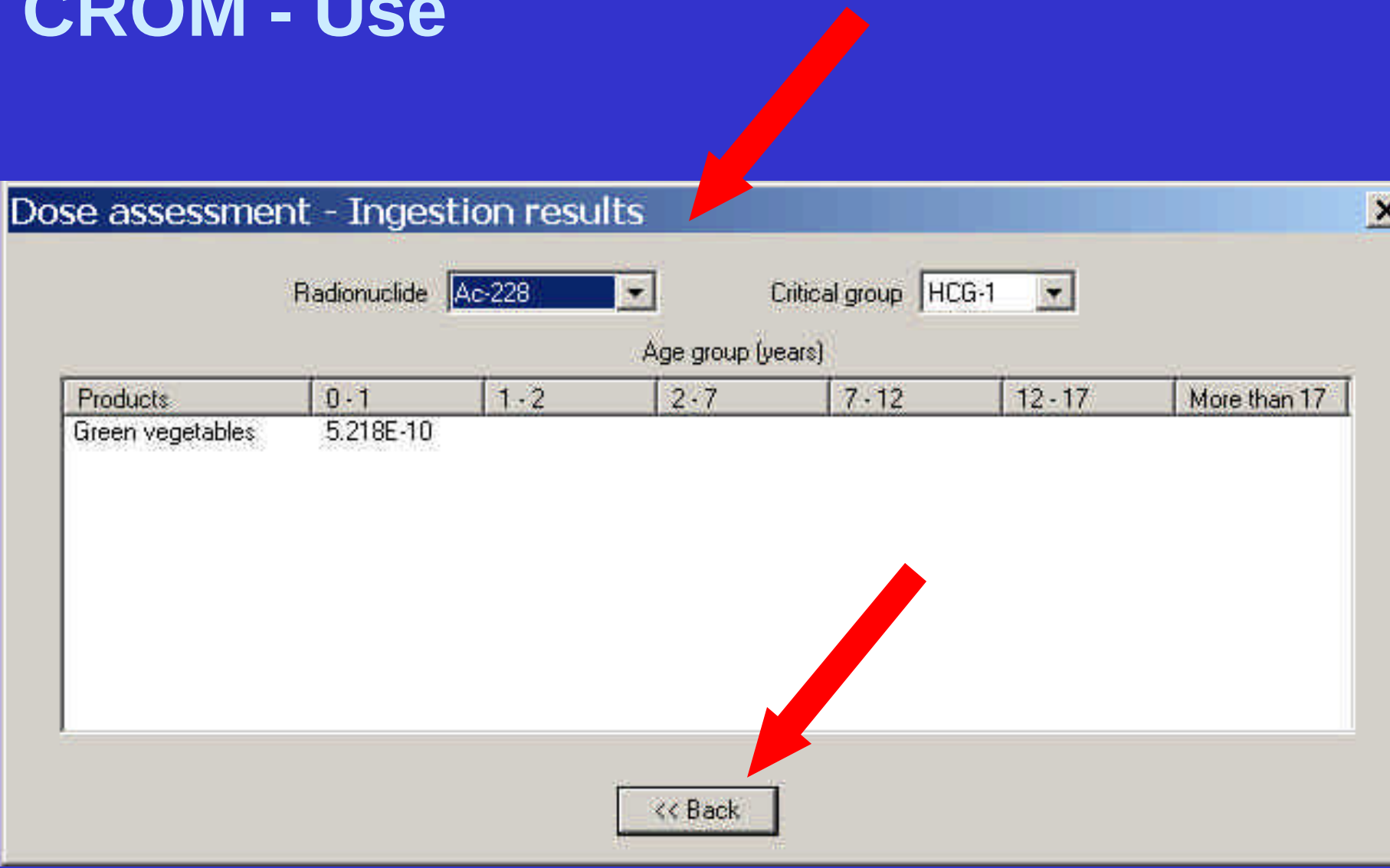
CROM - Use


Dose assesment - Summary of Result
Critical group
HCG-1
Age group
0 - 1
External irradiation (effective annual dose, Sv)
Dose by air submersion: Eext,air =
1.794E-05
Dose by irradiation from ground deposition: Eext,ground =
Dose by water immersion during bathing: Eext,bathing =
Dose by irradiation from shore sediments: Eext,shore =
Internal irradiation (dose by annual intake, Sv)
Dose by intake due to food ingestion: Eint,food =
IND
Dose by intake due to water ingestion: Eint,water =
Dose by intake due to inhalation: Eint,inh =
3.736E-01
<< Back

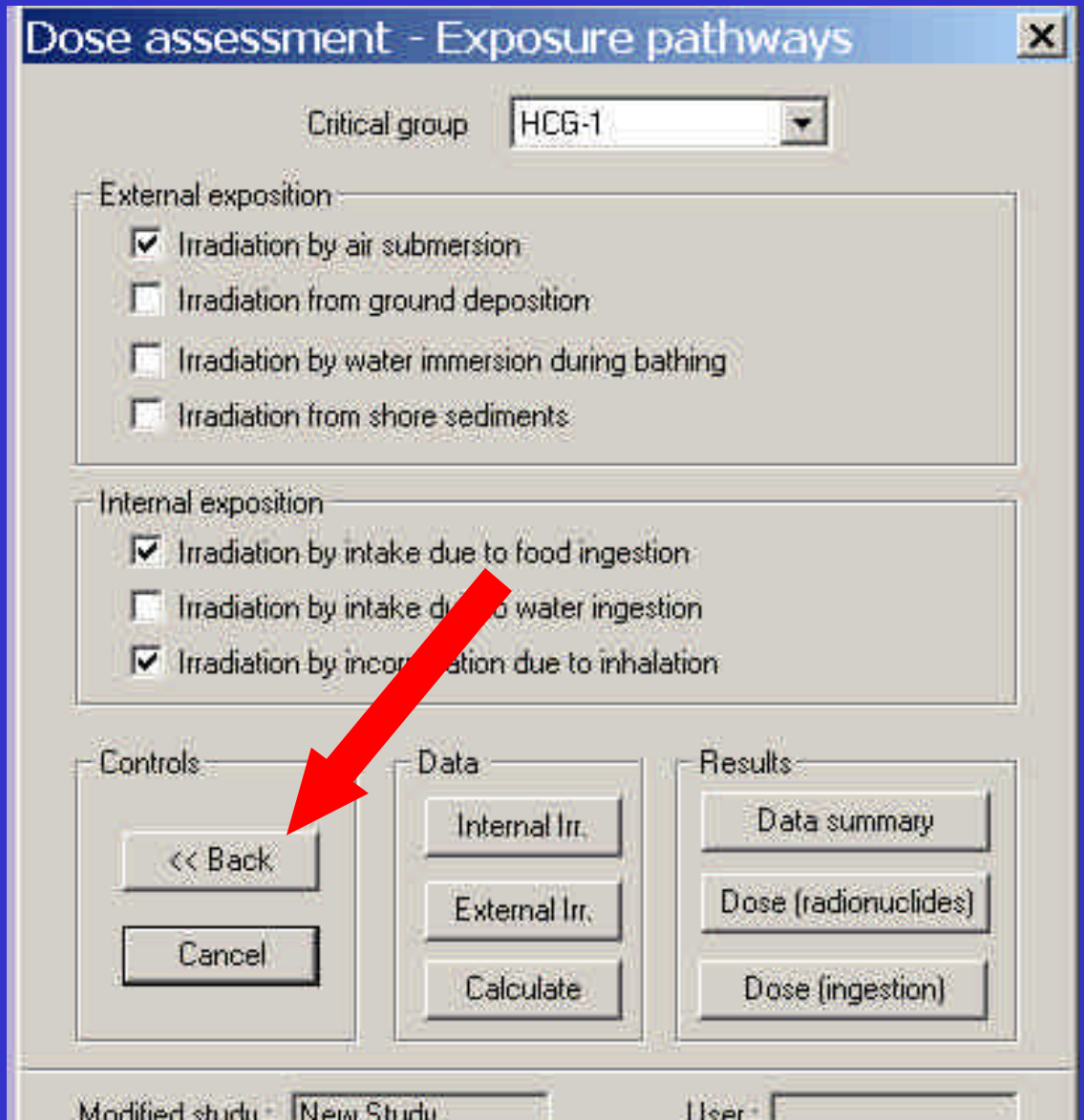
CROM - Use


Dose assessment: Results per radionuclide
Radionuclide Ac-228
Critical Group HCG-1
Age group 0 - 1
Gamma External irradiation (effective annual dose, Sv)
Dose by air submersion: Eext,air,gamma = 1.508E-06
Dose by irradiation from ground deposition: Eext,ground,gamma =
Dose by water immersion during bathing: Eext,bathing,gamma =
Dose by irradiation from shore sediments: Eext,shore,gamma =
Beta external irradiation (effective annual dose, Sv)
Dose by air submersion: Eext,air,beta 2.487E-08
Dose by irradiation from ground deposition: Eext,ground,beta =
Dose by water immersion during bathing: Eext,bathing,beta =
Dose by irradiation from shore sediments: Eext,shore,beta =
Internal irradiation (dose by annual intake, Sv)
Dose by intake due to food ingestion: Eint,food = 18E-10
Dose by intake due to water ingestion: Eint,water =
Dose by intake due to inhalation: Eint,inh = 1.879E-04
<< Back

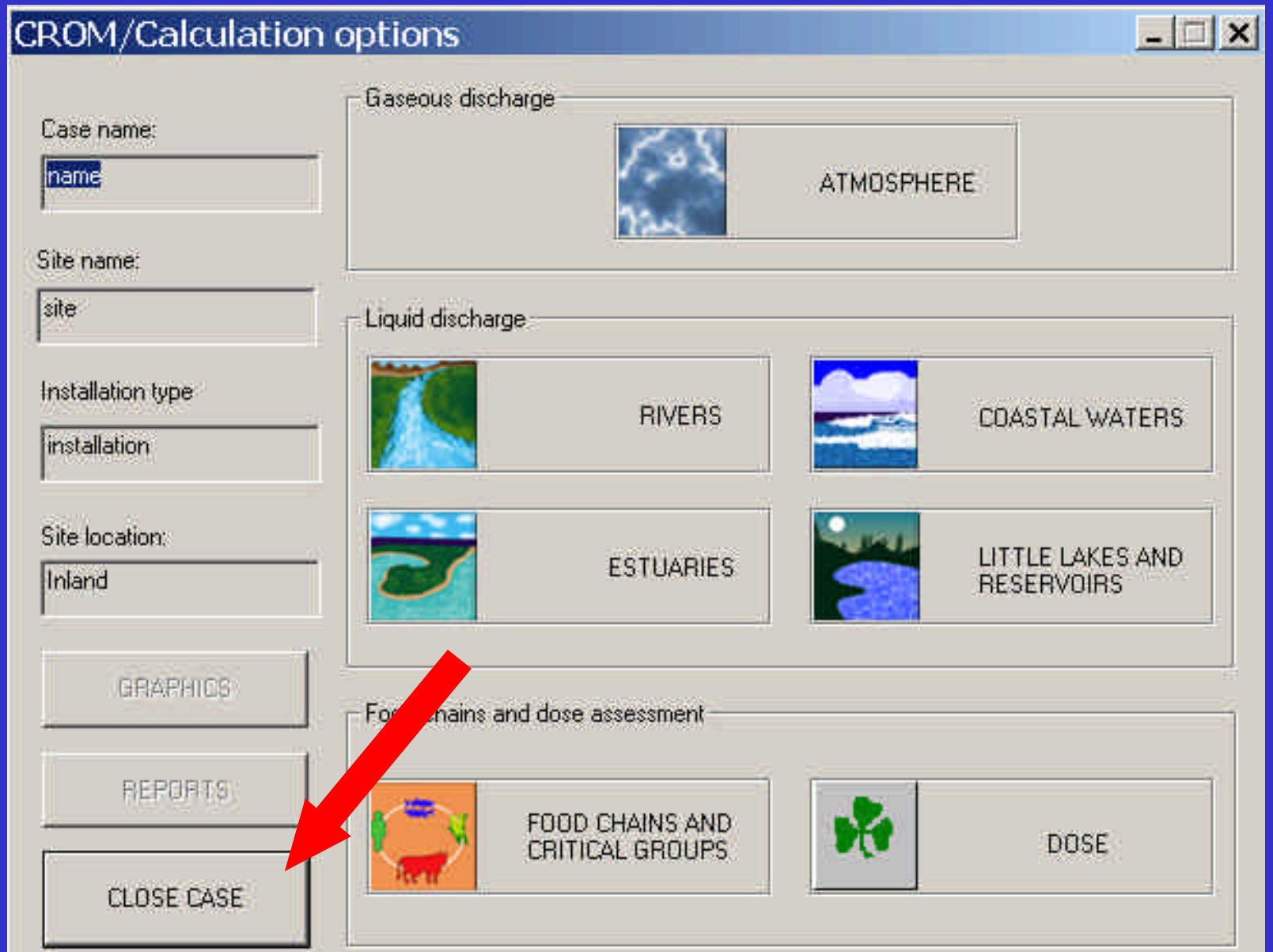
CROM - Use


Dose assessment - Ingestion results
Radionuclide
Ac-228
Critical group
HCG-1
Age group (years)
Products
0 - 1
1 - 2
2 - 7
7 - 12
12 - 17
More than 17
Green vegetables
5.218E-10
<< Back

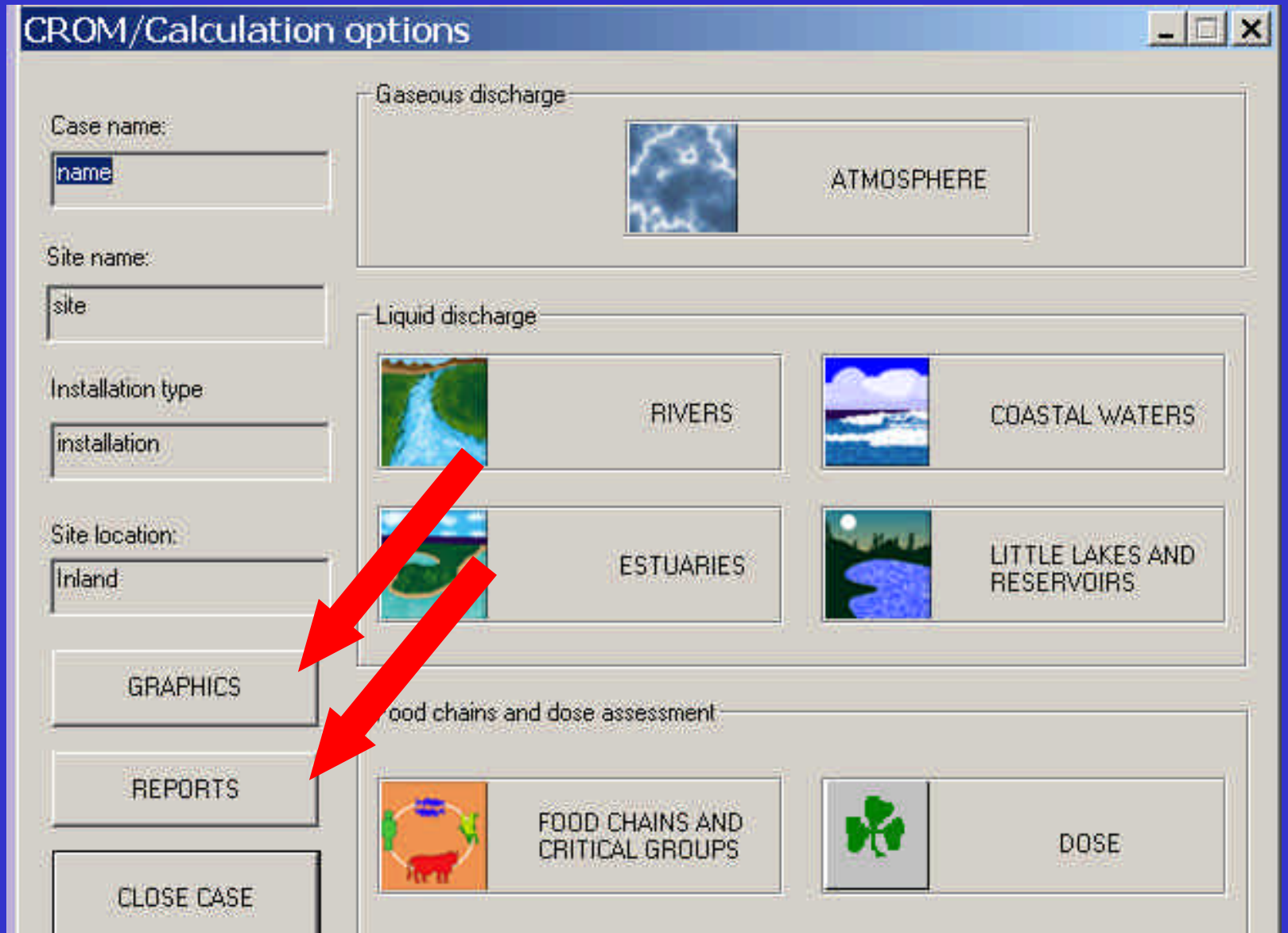
CROM - Use


Dose assessment - Exposure pathways
Critical group
HCG-1
External exposition
Irradiation by air submersion
Irradiation from ground deposition
Irradiation by water immersion during bathing
Irradiation from shore sediments
Internal exposition
Irradiation by intake due to food ingestion
Irradiation by intake d o water ingestion
Irradiation by incor ation due to inhalation
Controls
<< Back
Cancel
Data
Internal Irr.
External Irr.
Calculate
Results
Data summary
Dose (radionuclides)
Dose (ingestion)
Modified study :
New Study
User :

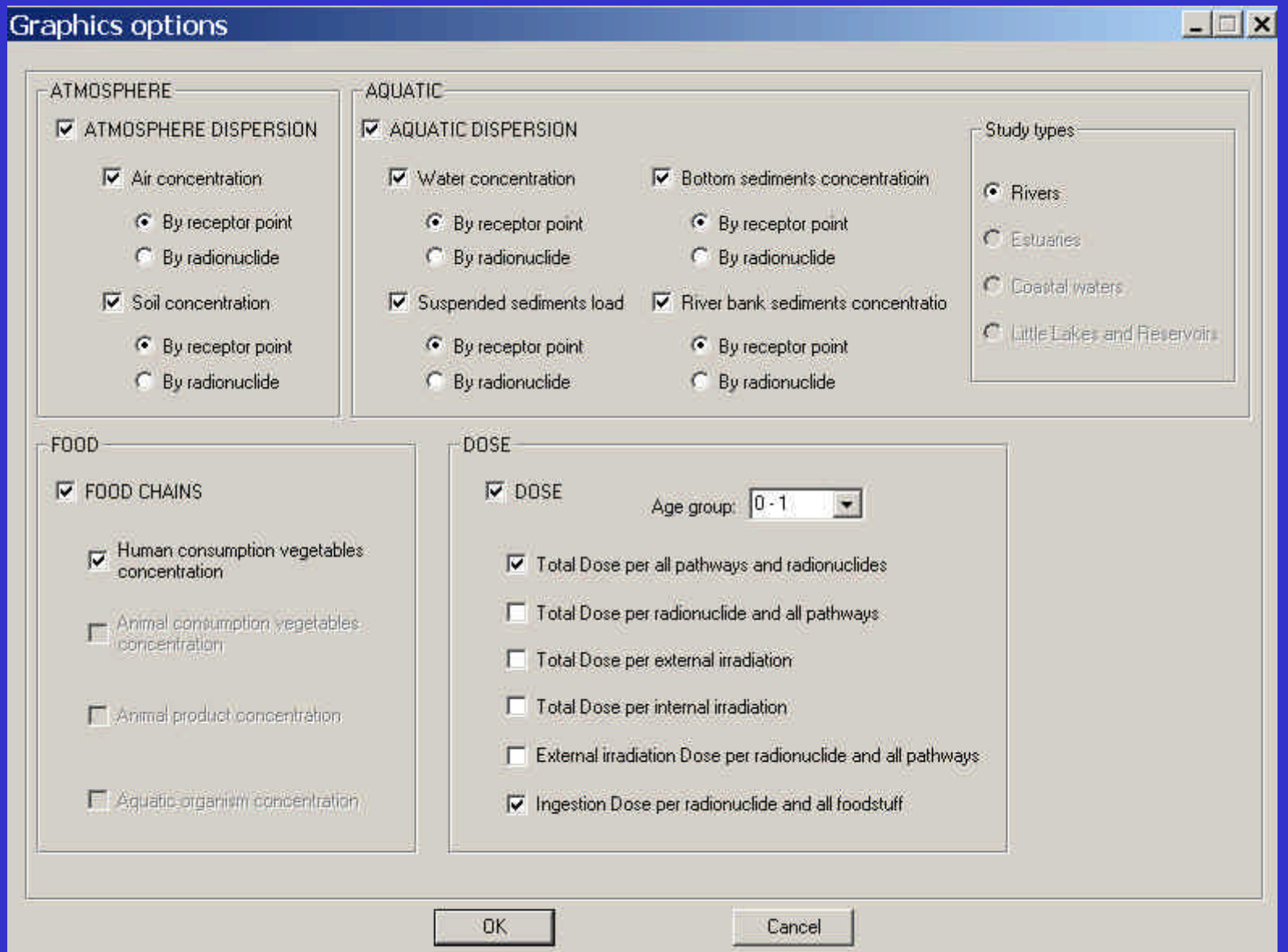
CROM - Use


CROM/Calculation options
Case name:
name
Site name:
site
Installation type
installation
Site location:
Inland
GRAPHICS
REPORTS
CLOSE CASE
Gaseous discharge
ATMOSPHERE
Liquid discharge
RIVERS
COASTAL WATERS
ESTUARIES
LITTLE LAKES AND RESERVOIRS
FOOD CHAINS AND CRITICAL GROUPS
DOSE

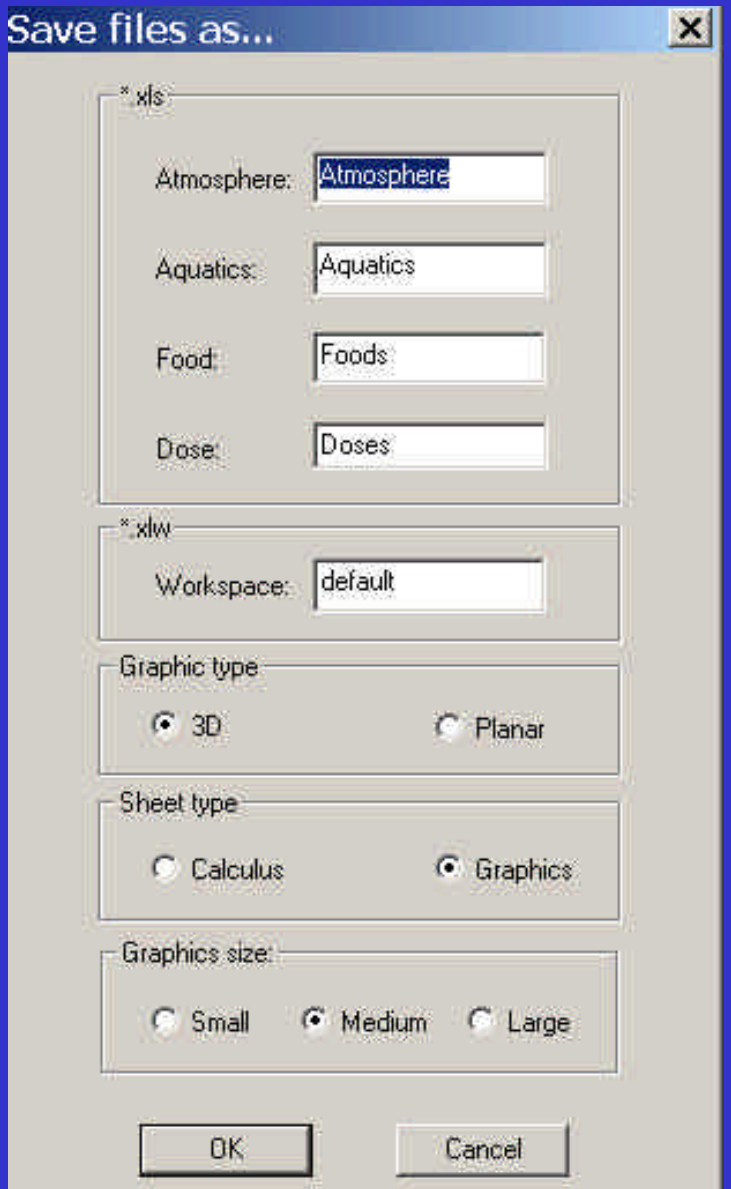
CROM - Use


CROM/Calculation options
Case name:
name
Site name:
site
Installation type
installation
Site location:
Inland
GRAPHICS
REPORTS
CLOSE CASE
Gaseous discharge
ATMOSPHERE
Liquid discharge
RIVERS
COASTAL WATERS
ESTUARIES
LITTLE LAKES AND RESERVOIRS
ood chains and dose assessment
FOOD CHAINS AND CRITICAL GROUPS
DOSE

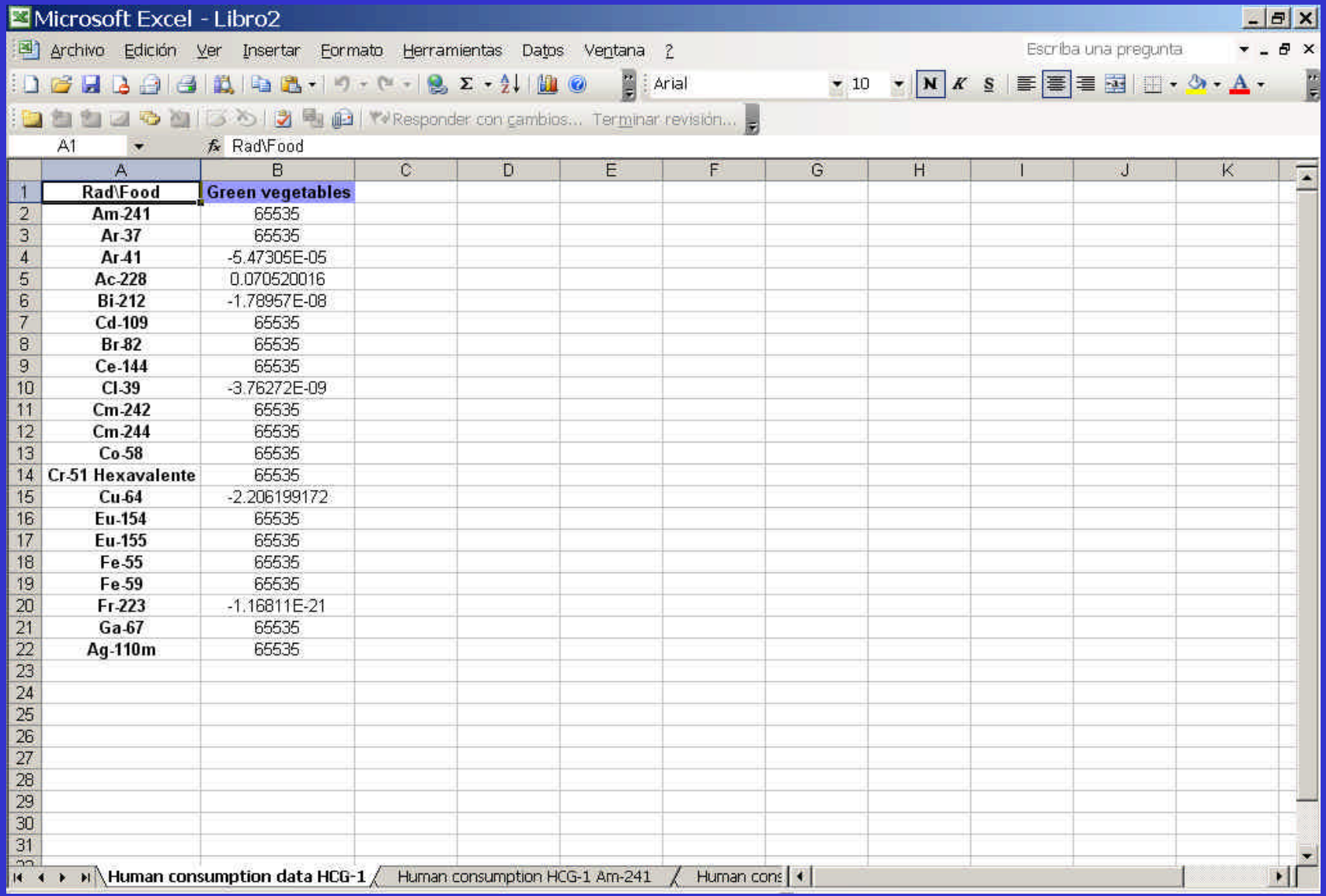
CROM - Use


Graphics options
ATMOSPHERE
ATMOSPHERE DISPERSION
Air concentration
By receptor point
By radionuclide
Soil concentration
By receptor point
By radionuclide
AQUATIC
AQUATIC DISPERSION
Water concentration
By receptor point
By radionuclide
Bottom sediments concentratioin
By receptor point
By radionuclide
Suspended sediments load
By receptor point
By radionuclide
River bank sediments concentratio
By receptor point
By radionuclide
Study types
Rivers
Estuaries
Coastal waters
Little Lakes and Reservoirs
FOOD
FOOD CHAINS
Human consumption vegetables concentration
Animal consumption vegetables concentration
Animal product concentration
Aquatic organism concentration
DOSE
DOSE
Age group: 0 - 1
Total Dose per all pathways and radionuclides
Total Dose per radionuclide and all pathways
Total Dose per external irradiation
Total Dose per internal irradiation
External irradiation Dose per radionuclide and all pathways
Ingestion Dose per radionuclide and all foodstuff
OK
Cancel

CROM - Use


Save files as...
*.xls
Atmosphere:
Atmosphere
Aquatics:
Aquatics
Food:
Foods
Dose:
Doses
*.xlw
Workspace:
default
Graphic type
3D
Planar
Sheet type
Calculus
Graphics
Graphics size:
Small
Medium
Large
OK
Cancel

CROM - Use



Microsoft Excel - Libro2

Archivo Edición Ver Insertar Formato Herramientas Datos Ventana ?

Escriba una pregunta

Arial 10

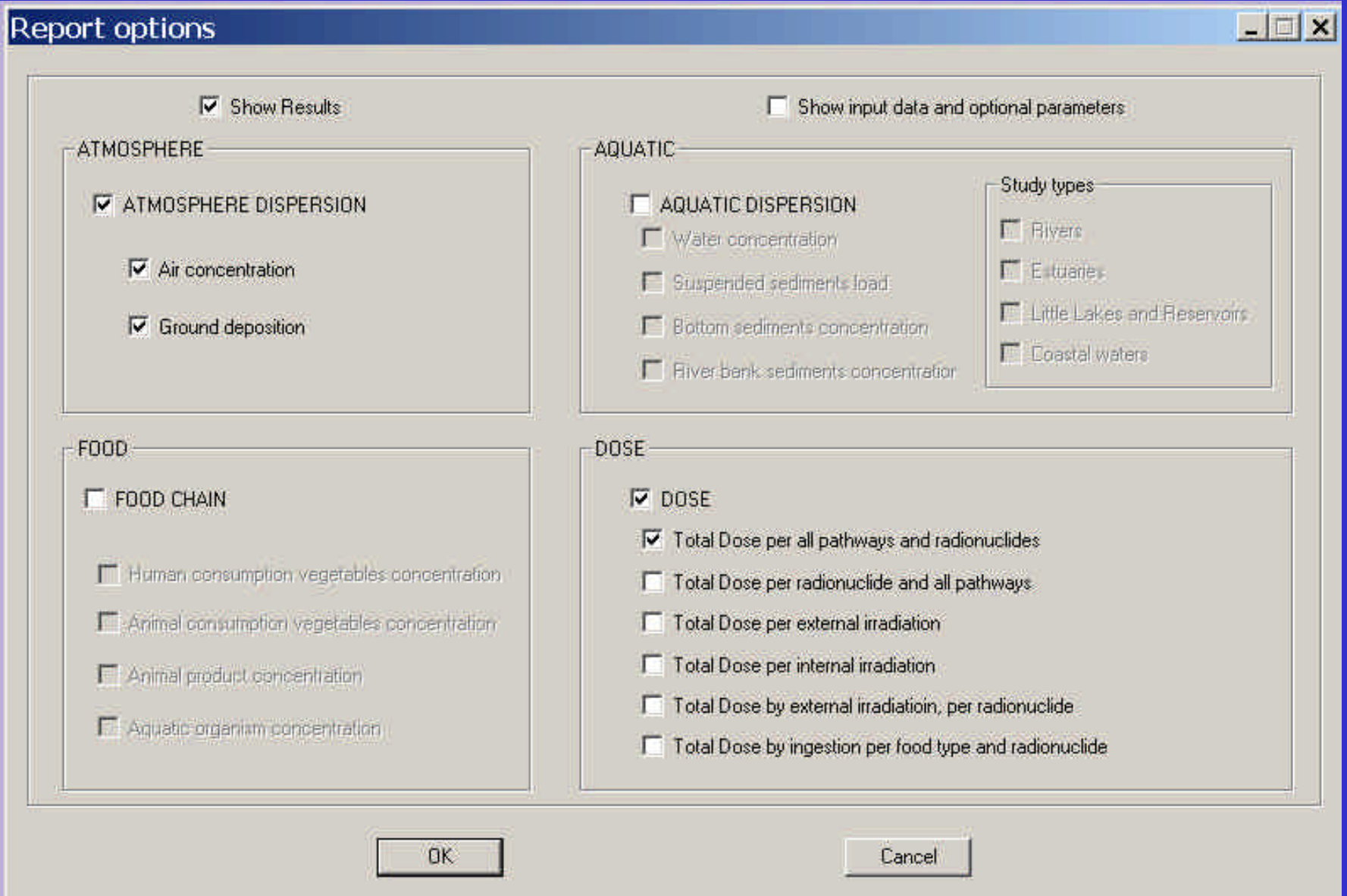
Responder con cambios... Terminar revisión...

A1 Rad\Food

	A	B	C	D	E	F	G	H	I	J	K
1	Rad\Food	Green vegetables									
2	Am-241	65535									
3	Ar-37	65535									
4	Ar-41	-5.47305E-05									
5	Ac-228	0.070520016									
6	Bi-212	-1.78957E-08									
7	Cd-109	65535									
8	Br-82	65535									
9	Ce-144	65535									
10	Cl-39	-3.76272E-09									
11	Cm-242	65535									
12	Cm-244	65535									
13	Co-58	65535									
14	Cr-51 Hexavalente	65535									
15	Cu-64	-2.206199172									
16	Eu-154	65535									
17	Eu-155	65535									
18	Fe-55	65535									
19	Fe-59	65535									
20	Fr-223	-1.16811E-21									
21	Ga-67	65535									
22	Ag-110m	65535									
23											
24											
25											
26											
27											
28											
29											
30											
31											

Human consumption data HCG-1 | Human consumption HCG-1 Am-241 | Human cons

CROM - Use


Report options
Show Results
Show input data and optional parameters
ATMOSPHERE
ATMOSPHERE DISPERSION
Air concentration
Ground deposition
AQUATIC
AQUATIC DISPERSION
Water concentration
Suspended sediments load
Bottom sediments concentration
River bank sediments concentration
Study types
Rivers
Estuaries
Little Lakes and Reservoirs
Coastal waters
FOOD
FOOD CHAIN
Human consumption vegetables concentration
Animal consumption vegetables concentration
Animal product concentration
Aquatic organism concentration
DOSE
DOSE
Total Dose per all pathways and radionuclides
Total Dose per radionuclide and all pathways
Total Dose per external irradiation
Total Dose per internal irradiation
Total Dose by external irradiatioin, per radionuclide
Total Dose by ingestion per food type and radionuclide
OK
Cancel

CROM - Use

CROM

Código de cálculo para evaluación de dispersión

Case name: La Hegra

Site name: Capilla la Hegra

Installation type: Ins. Especiales

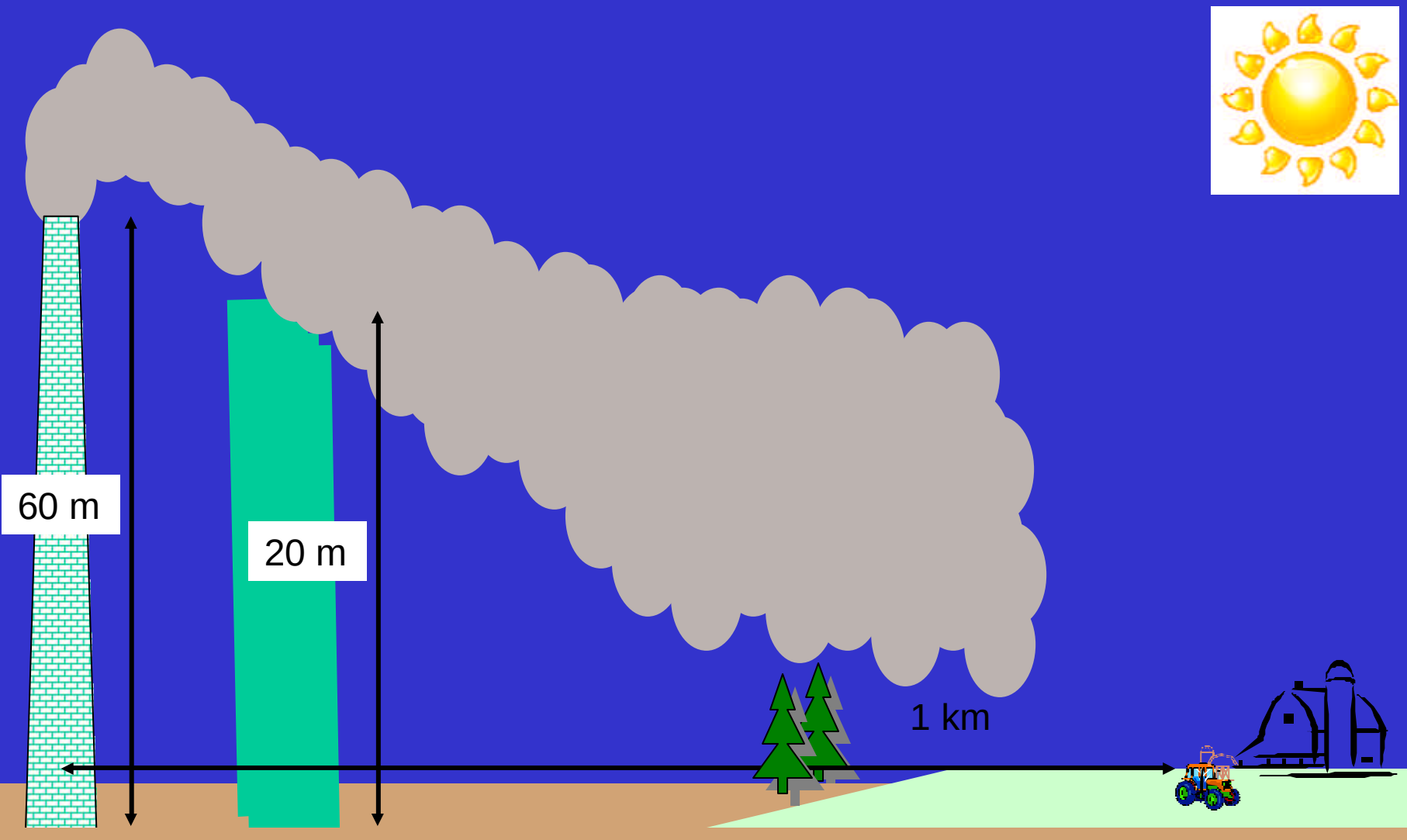
Report date: 04 - 12 - 2010

ATMOSPHERIC DISPERSION Intermidate

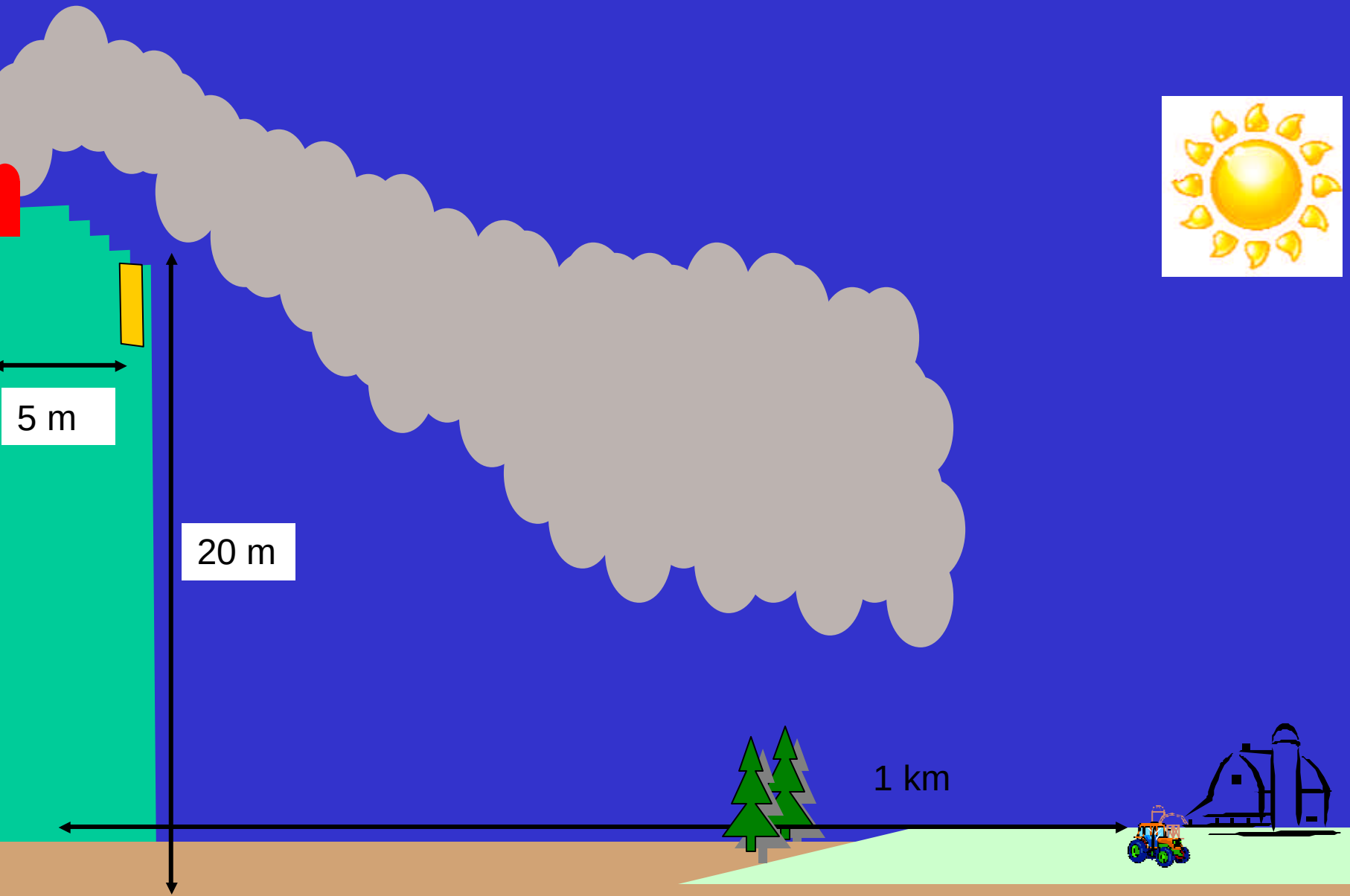
SOURCE TERM

	3.141E-01	1.000E+00	1.000E+00	1.000E+00
	2.291E-07	1.000E+00	1.000E+00	1.000E+00
	8.147E-11	1.000E+00	1.000E+00	1.000E+00
	2.449E-01	1.000E+00	1.000E+00	1.000E+00
	1.729E-08	1.000E+00	1.000E+00	1.000E+00
	2.448E-07	1.000E+00	1.000E+00	1.000E+00
	4.928E-08	1.000E+00	1.000E+00	1.000E+00
	9.550E-13	1.000E+00	1.000E+00	1.000E+00
	5.299E-04	1.000E+00	1.000E+00	1.000E+00
	8.090E-04	1.000E+00	1.000E+00	1.000E+00
	1.334E-07	1.000E+00	1.000E+00	1.000E+00
	1.141E-04	1.000E+00	1.000E+00	1.000E+00
	5.332E-03	1.000E+00	1.000E+00	1.000E+00
	2.547E-08	1.000E+00	1.000E+00	1.000E+00
	1.024E-14	1.000E+00	1.000E+00	1.000E+00
	3.379E-13	1.000E+00	1.000E+00	1.000E+00
	1.525E-09	1.000E+00	1.000E+00	1.000E+00
	3.820E-09	1.000E+00	1.000E+00	1.000E+00
	7.929E-09	1.000E+00	1.000E+00	1.000E+00
	1.031E-13	1.000E+00	1.000E+00	1.000E+00

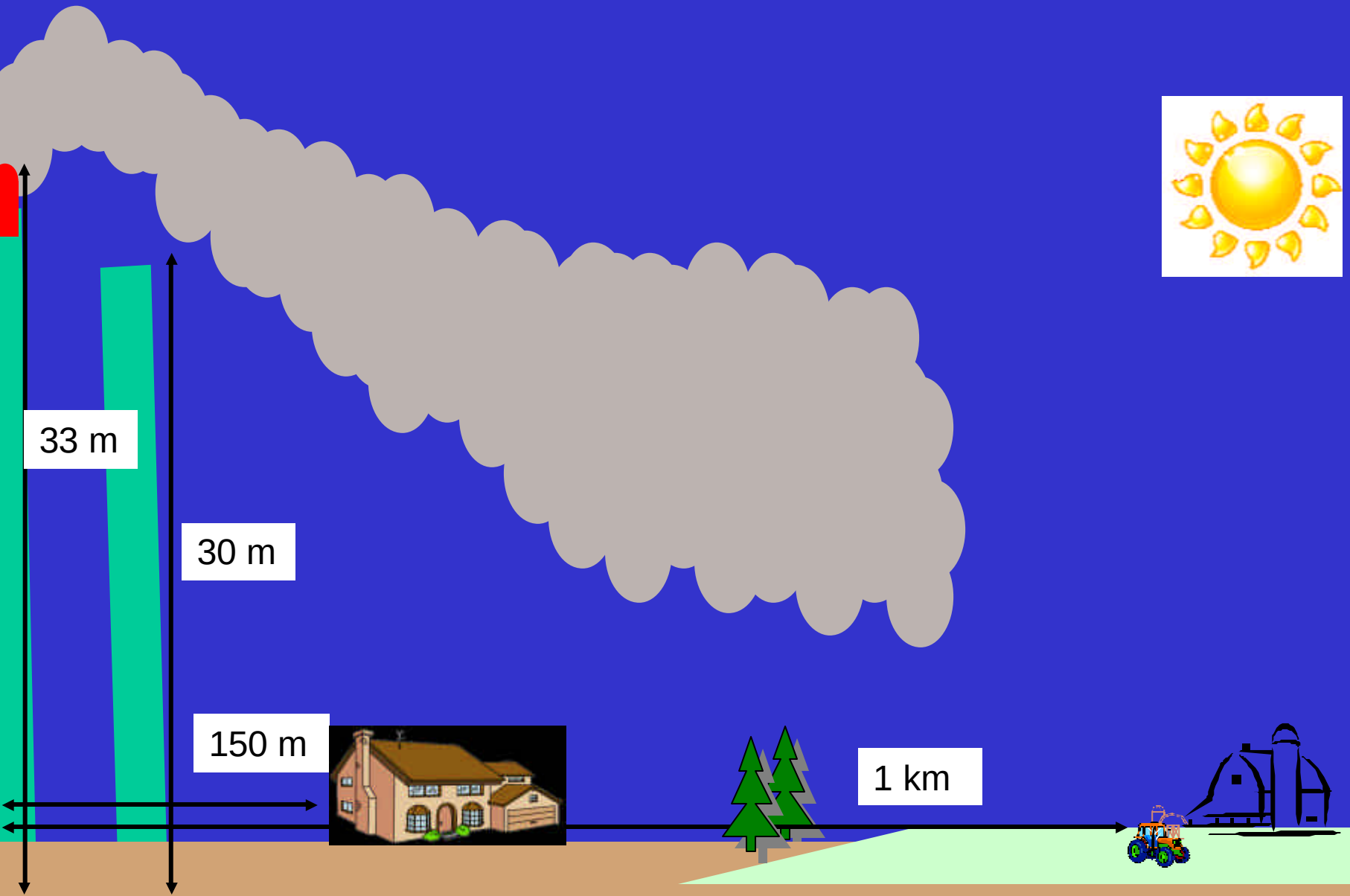
CROM - Examples



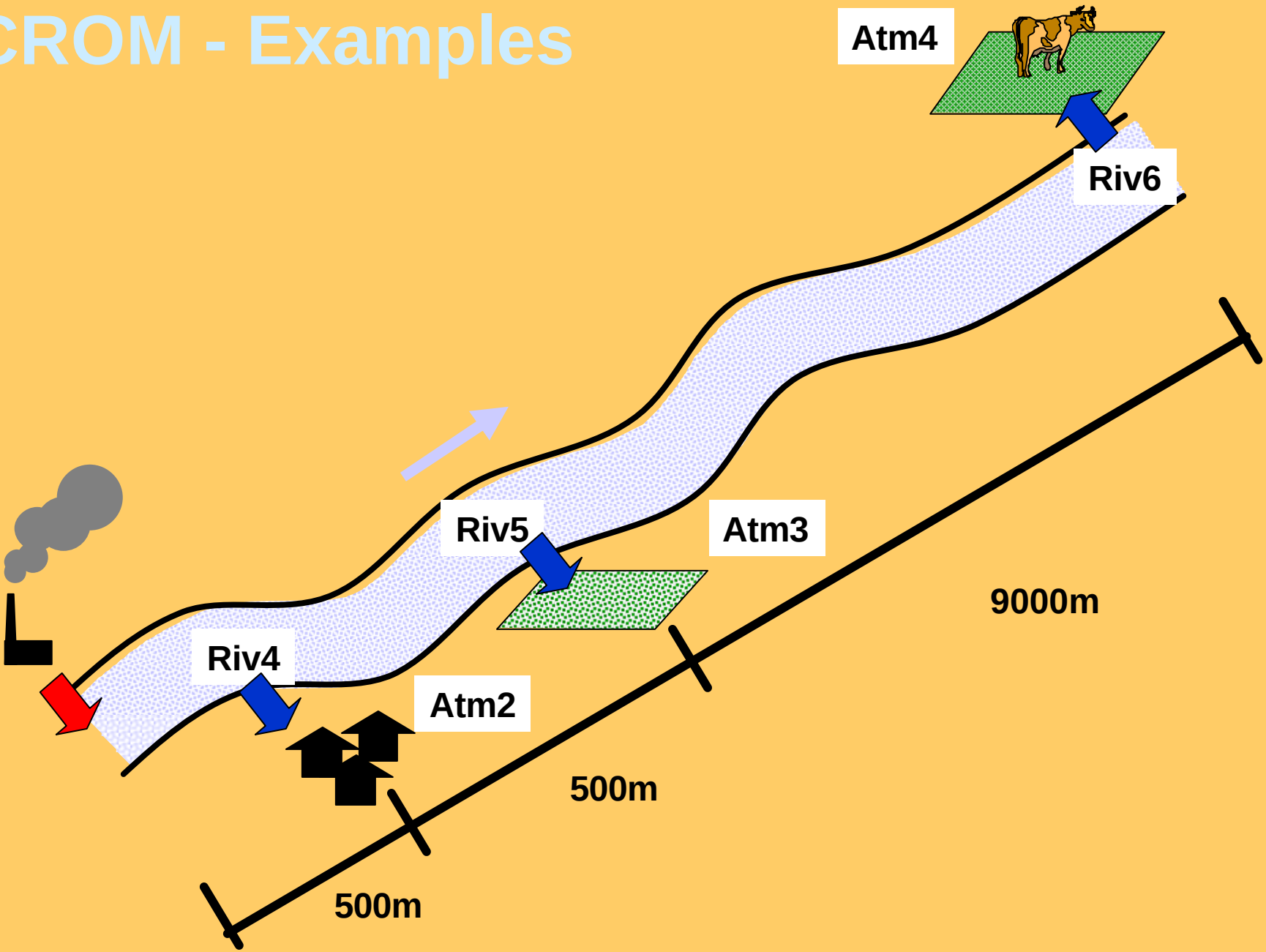
CROM - Examples



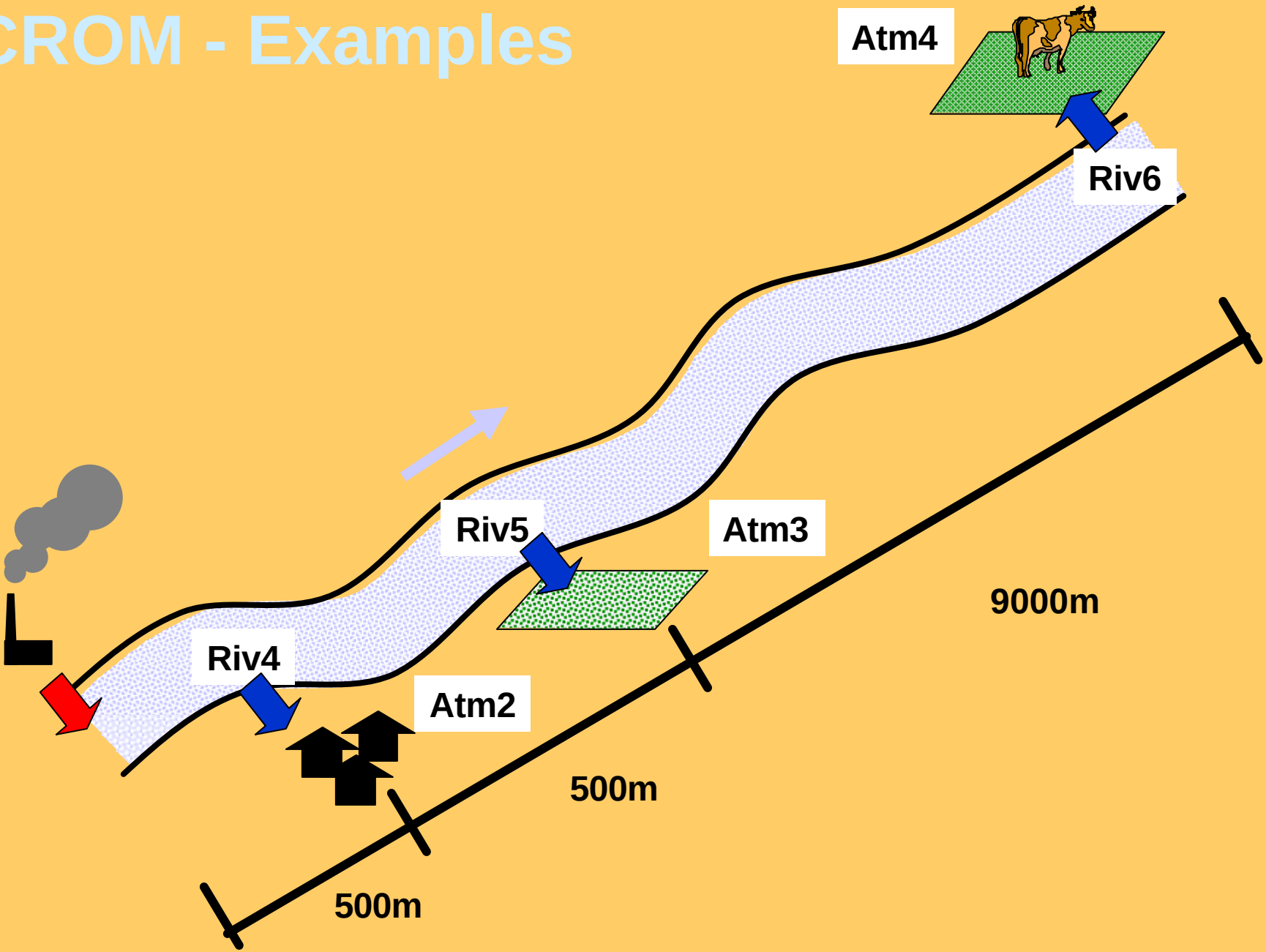
CROM - Examples



CROM - Examples

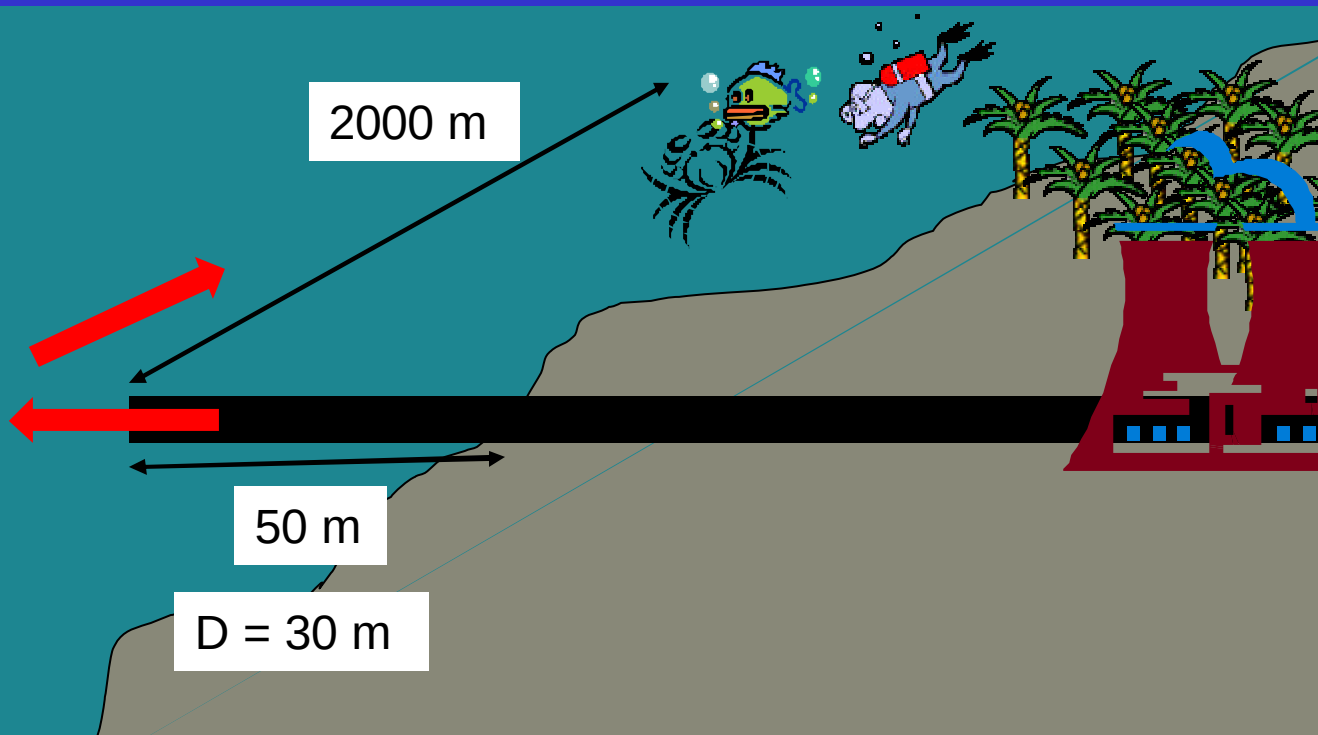


CROM - Examples

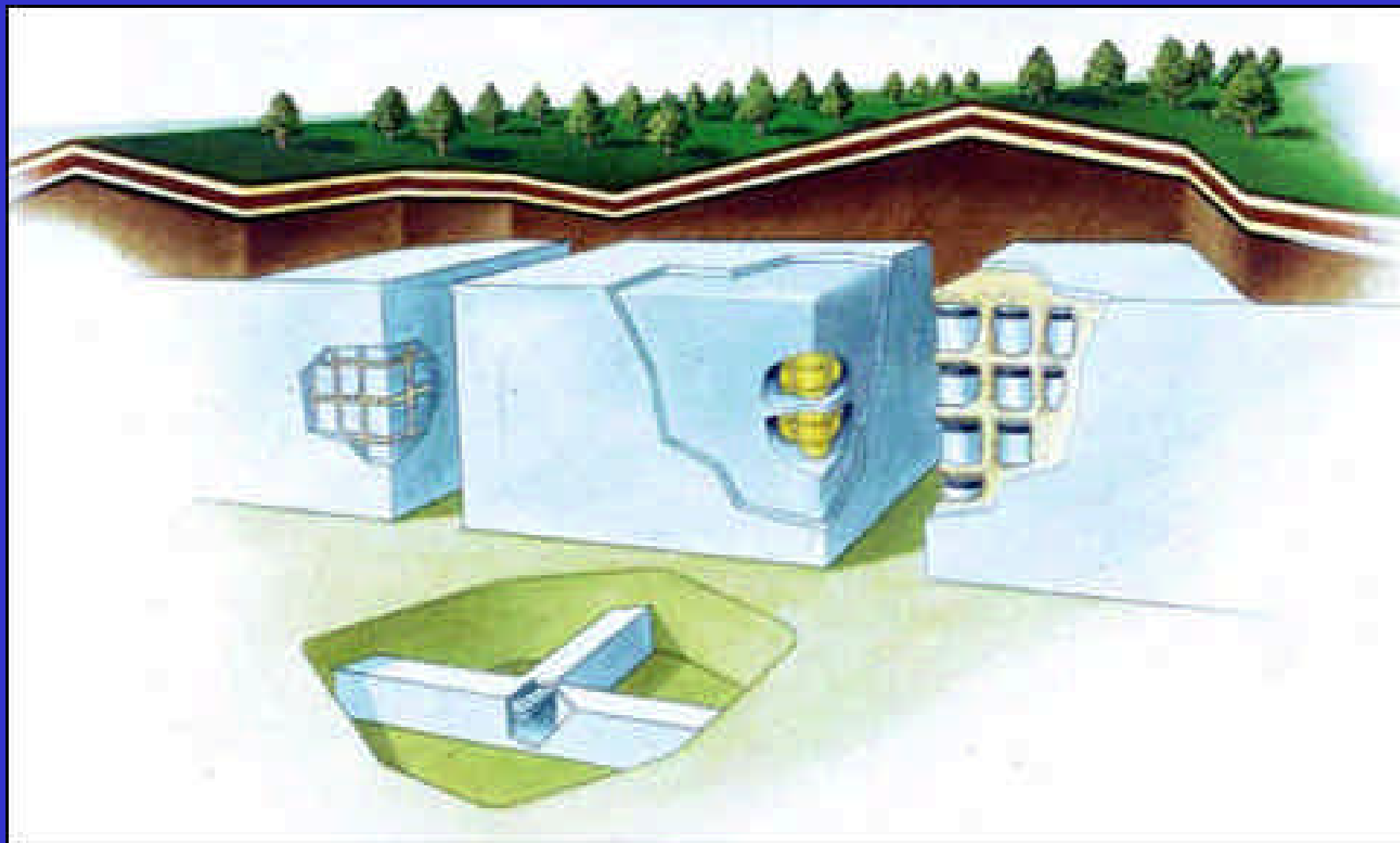


CROM - Examples

CROM - Examples



CROM - Examples



CROM - Examples

CROM - Examples

CROM - Examples

CROM - Examples

FIG. 29. Remediation of contaminated land after drying the lagoon (courtesy: Atomic Energy Commission of Syria)

CROM - Aplications

- Control of releases
- Optimization of new installations
- Derivation of authorized discharge limits
- ...

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

Thank you for your attention

Jc.mora@ciemat.es