



# AUTORIDAD REGULATORIA NUCLEAR



Autoridad Regulatoria  
Nuclear  
Presidencia de la Nación Argentina

# Emergency Preparedness and Response System for Nuclear Accidents in Argentina

Vienna, Austria. 20-24 April 2015

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Subgerencia Intervención en  
Emergencias Radiológicas y Nucleares



# EMERGENCY PREPAREDNESS

## INTRODUCTION

- The 24.804 Act, “The National Law On Nuclear Activities” establishes that the Nuclear Regulatory Authority (ARN) is the responsible of preparedness and response in case of nuclear and/or radiological emergency.

## REGULATORY FUNCTIONS

- The Regulatory Body request to the Responsible Organization an Internal and External Emergency Plan.
- This plan comprises aspects related to the strategy required to control and limit the accident consequences. It is required by the Regulatory Body to license the nuclear power plant operation.



## NUCLEAR EMERGENCY RESPONSE SYSTEM

The Nuclear Emergency Response System is the organizational scheme that the Regulatory Body uses to respond in cases of nuclear emergencies and interact with the national, state and local response organizations to manage effectively nuclear emergencies at preparedness, intervention and recovery stages.

**SIEN**

- Operatively 24 hours, 365 days.
- Convened by NPP licensee, civil organisations and IAEA.



## PROTECTIVE ACTIONS

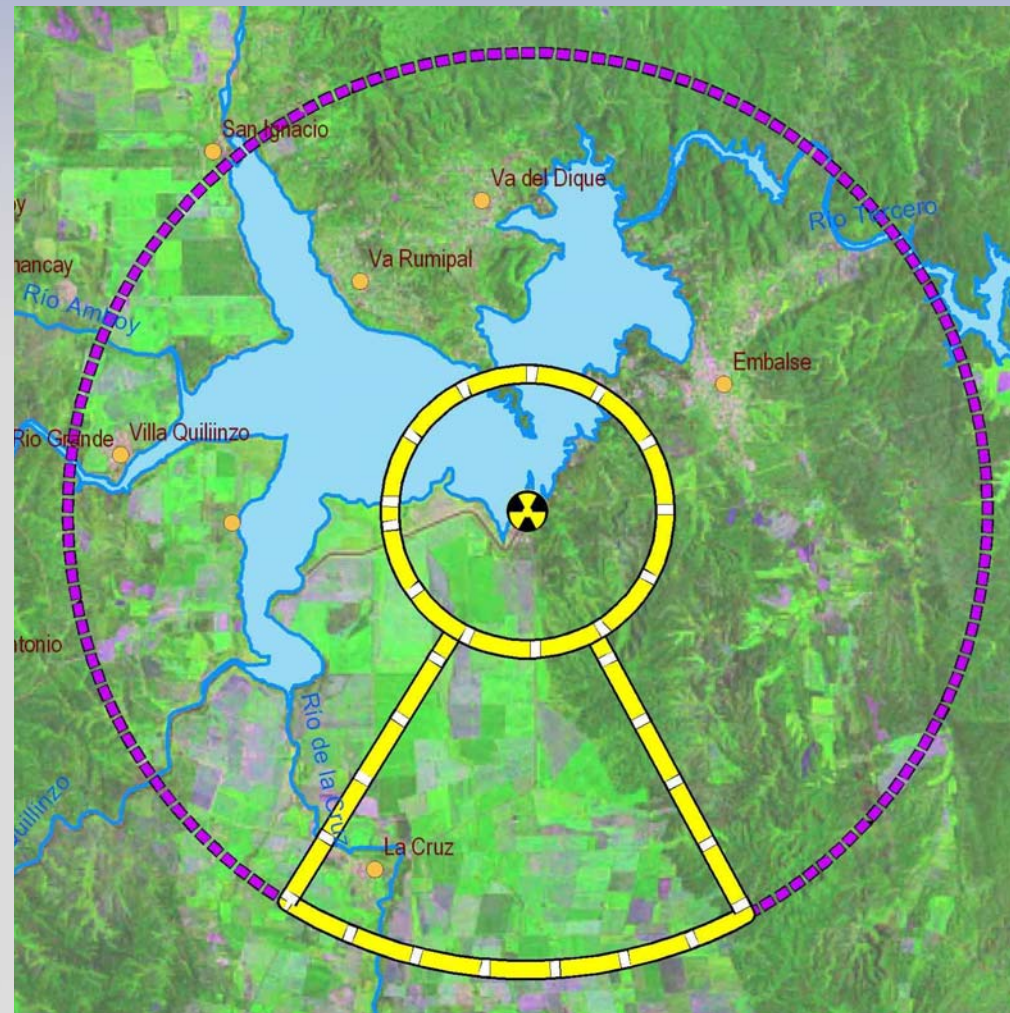
- The **urgent protective actions** are carried on the basis of **plant situation** and **meteorological conditions** without waiting for environmental monitoring data.
- The **goal** is to avoid the occurrence of **deterministic effects** in individuals and to reduce the occurrence of **stochastic effects** in the population.



## EMERGENCY ZONES

The **Precautionary Action Zone (ZAP)** defined as the area enclosed in a 3 kilometers radius in all directions around the NPP as well as an area up to 10 km within an angle of 60 degrees in the direction of the wind.

The **Urgent Protective Action Planning Zone (ZPU)** extends to the rest of the area of 10 kilometers.



## PROTECTIVE ACTIONS

Once the emergency is declared, protective actions consist in:

- Early evacuation of population in the area enclosed in a 3 km radius in all directions around the NPP;
- Access control in the 10 km radius area from the reactor site;
- Sheltering preparedness is implemented in both the ZAP and the ZPU, but only performed in ZAP;
- Iodine prophylaxis in the ZAP and the ZPU.
- Environmental monitoring is undertaken after the passage of the cloud to identify where longer term protective actions may be needed based on predefined intervention levels.

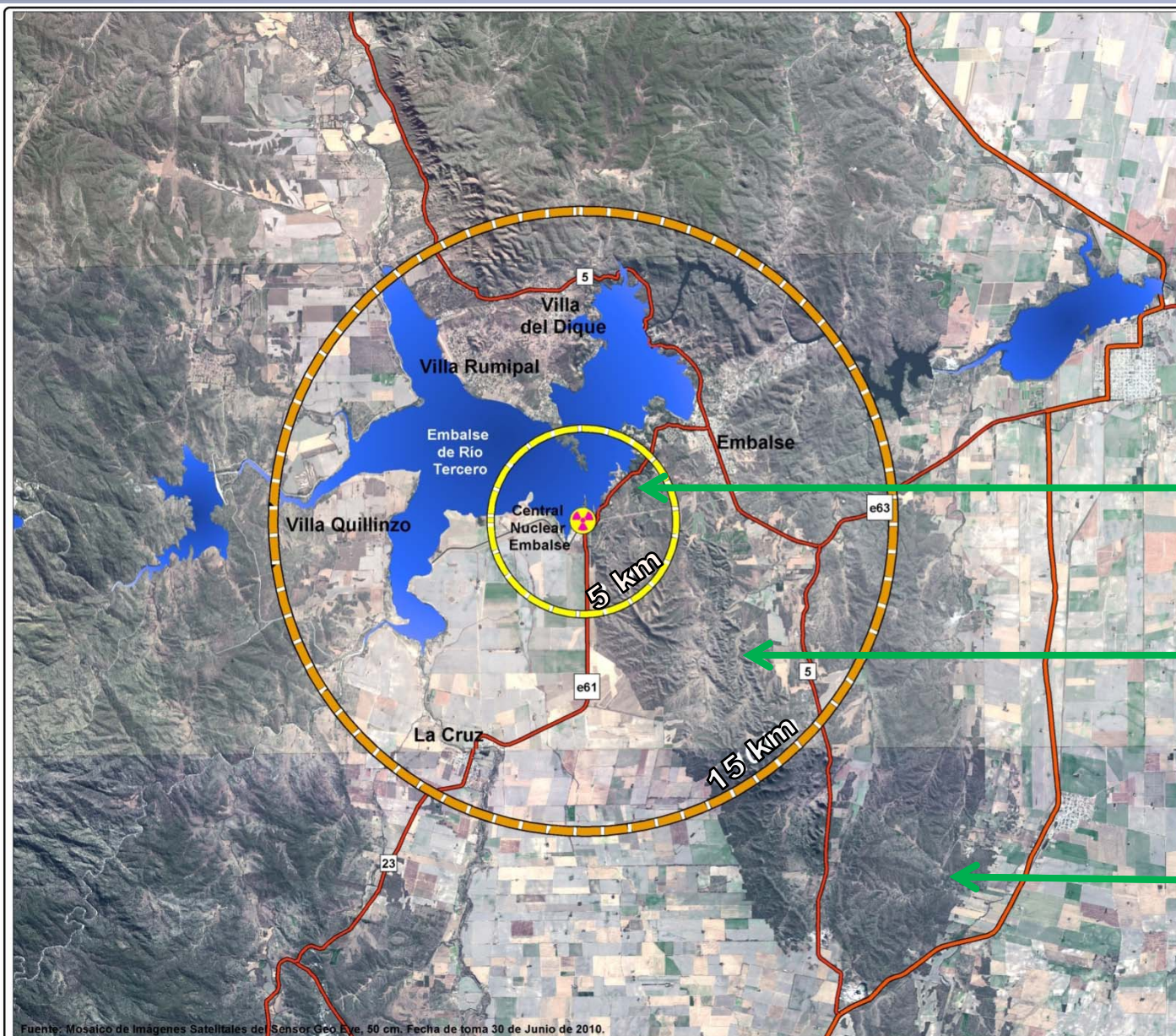
## PROTECTIVE MEASURES

### Longer Term Protective Actions

- Temporary relocation of the population due to high dose rates caused by radioactive deposition;
- Resettlement of evacuated areas;
- Restrictions on the consumption of foodstuffs in the affected areas;
- Soil decontamination (Only if largely justified).



## PROTECTIVE ACTIONS



Early evacuation in the 3 km radius

Access Control, sheltering, and Iodine prophylaxis in 10 km

Another protective actions (mitigation measures, restrictions on foodstuffs etc)

## ATMOSPHERIC DISPERSION MODELS

Are able to predict the evolution of radionuclides in the environment and the resulting dose to the public.

Input parameters for these models include source characteristics, release composition, and meteorological conditions at the moment of the emergency.

Tools:

- SEDA code: can calculate isodose and isoconcentration lines at a local scale (within 20 km);
- IXP (the International Exchange Program - NARAC). The IXP system provides rapid, three-dimensional, time-dependent computer model predictions of the concentrations, dose and health effects, caused by atmospheric releases of radioactive materials;
- WMO (World Meteorological Organization), to run models in several Regional Specialized Meteorological Centers (RSMC) around the world in case of global dispersions.





**Dosis totales [Gy eq] en ...**

médula ósea	4.41E-02
pulmón	5.3E-02
tiroides	6.35E-01
piel	1.55E+00
intestino delgado	5.24E-02
gónadas	5.25E-02
cristalino	1.55E+00

**Dosis por inhalación [Gy eq] en ...**

médula ósea	2.9E-04
pulmón	9.11E-04
tiroides	5.83E-01
piel	2.64E-04
intestino delgado	2.86E-04
gónadas	3.5E-04

**Dosis efectivas [Sv]**

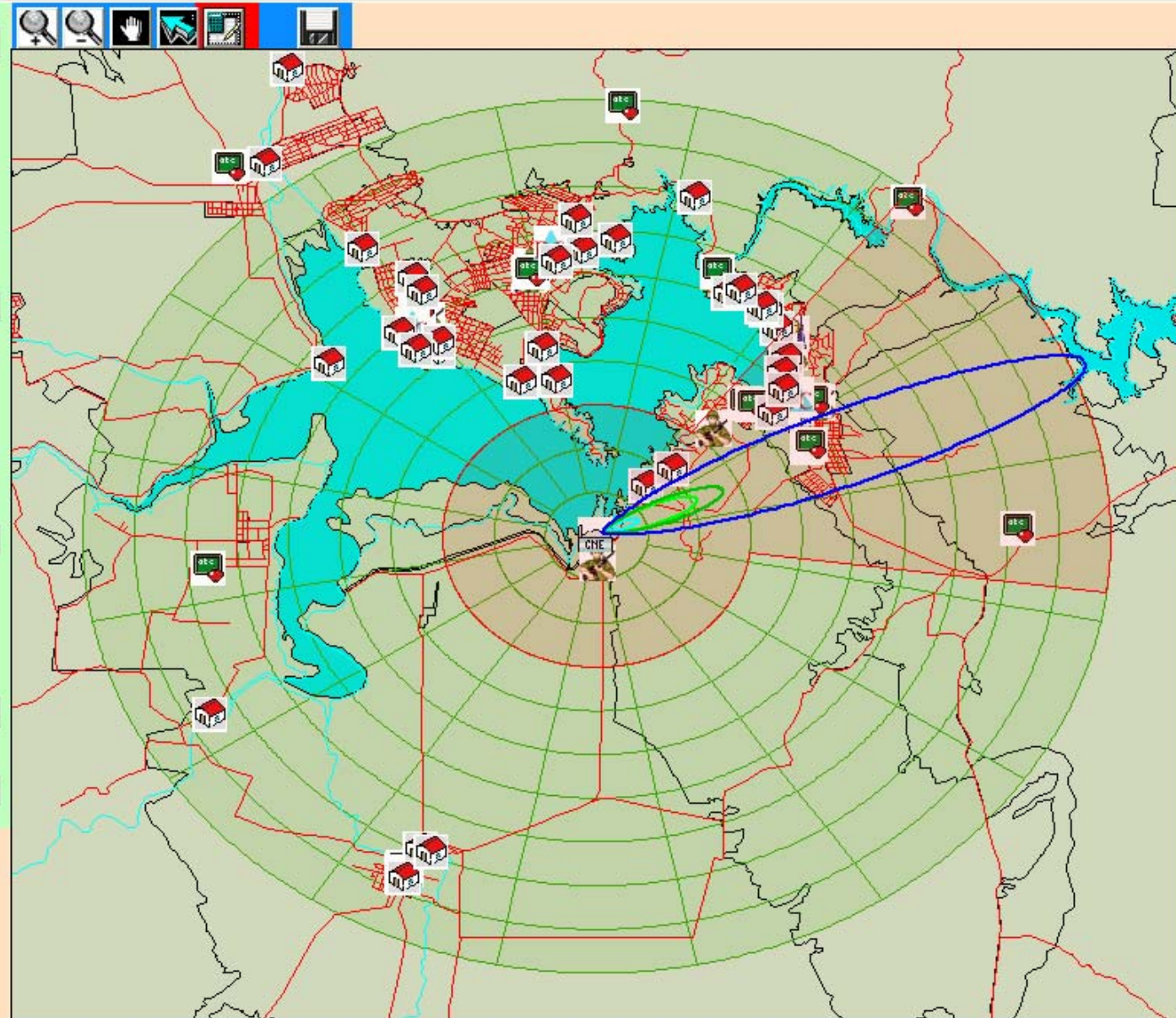
por inmersión en nube	2.79E-02
por inhalación	2.51E-02
por irradiación suelo	1.6E-02
total	6.89E-02

**Dosis por depósito [Sv]**

en piel	1.49E+00
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**Compromiso de dosis [Sv]**

en tiroides	1.15E+00
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Map Viewer - Windows Internet Explorer

https://lhp.llnl.gov/NaracWeb/jsp/vis/MapView/MapView.jsp

File Edit View Favorites Tools Help

Google Go Search Argentina W B L M P Bookmarks 35 blocked Check

AVG YAHOO! SEARCH Search Active Surf-Shield SearchShield AVG Info Get More

Deallo YAHOO! SEARCH Search Deals BocaWear - Save 40% off Select Women's Sweaters and Denim, posted 7 minutes ago

Map Viewer

100% Click to Recenter

DIGITAL GLOBE

©2005 Tele Atlas and/or LLNL  
MapSize: 27.83 km by 27.83 km  
Map Center: (32.124686 S, 64.468786 W)  
Scale: 46.379 m/pixel

### Total Deposition Effects and Actions

Description	(MBq/m <sup>2</sup> ) Extent Area	Population
No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>0.0010 1.7km 0.3km <sup>2</sup>	80
No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>0.0001 11.9km 14.1km <sup>2</sup>	1,060
No guidelines specified. Possibly contaminated area. Use to confirm with monitoring surveys.	>1.00E-5 24.9km 109km <sup>2</sup>	1,680

**Note:** Areas and counts in the table are cumulative.  
Population Source = LandScan2005.

Effects or contamination at August 15, 2008 11:35 UTC at or near ground level.

Layer Control: Map

Scale Bar: Lower Right

Show Center Marker ☐

Center Lat -32.124686

Center Lon -64.468786

Scale (m/pixel) 46.379

Image Width: 600

- MSN.com
- partes de tra...
- Policia Bona...
- PREFECTUR...
- Python - Wik...
- Radio Statio...
- Real Acade...
- rodos Realti...
- SCK-CEN - T...
- Secretaria de...
- Servicio Met...
- Spyware Do...
- Superintend...
- Symantec en...
- SYSTRAN - ...
- Terra Dicio...
- Universidad ...
- Varios\_Clud...

The screenshot shows a web browser window with a blue title bar. The address bar contains "ewer.jsp". The browser's toolbar includes various icons for search, home, and navigation. The main content area is divided into two sections. On the left is a map of a region in Argentina, showing a green shaded area representing a contaminated zone. The map includes labels for "RN", "Corralito", "Las Bajadas", "Almafuerte", "Embalse Ministro Juan Pistarini", "EMBALSE", and "Los Condores". A scale bar at the bottom indicates 25 km. On the right is a table titled "Total Effective Dose Equivalent Effects and Actions". The table has three columns: "Description", "(mSv) Extent Area", and "Population". It contains two rows of data. Below the table is a note: "Note: Areas and counts in the table are cumulative. Population Source = LandScan2005." Below the note is a paragraph: "Effects or contamination from August 11, 2008 11:35 UTC to August 15, 2008 11:35 UTC at or near ground level." Below this paragraph is a "Layer Control" section with a dropdown menu set to "Plume". It includes checkboxes for "Show Plume:" (checked), "Show Release Marker:" (checked), and "Show Centerline Data:" (unchecked). There are also sliders for "Contour Transparency:" (set to 50%) and "Contour Line Width:" (set to 1). At the bottom of the "Layer Control" section is a link "View Centerline Data".

ewer.jsp

Search the web

Bookmarks 35 Check 7% Translate AutoLink Settings

Surf-Shield Search-Shield AVG Info Get More

Coupons Save.com Coupon Code: AFLCANDY, Save.com Coupon: 30% Off SkullCandy Headphones, expires November 30, 2008

No Msgs

Welcome, Ivana Sadaaiowski - [Help](#) - [Sign Out](#)

Run View Runs My Profile Home

Click to Recenter

Map Center: (32.124686 S, 64.468786 W) Scale: 92.758 m/pixel

### Total Effective Dose Equivalent Effects and Actions

Description	(mSv) Extent Area	Population
Below health effect guidelines. Possibly contaminated area. Use to confirm with monitoring surveys.	>0.0001 7.1km 5.1km2	270
Below health effect guidelines. Possibly contaminated area. Use to confirm with monitoring surveys.	>1.00E-5 24.6km 82.1km2	1,600

**Note:** Areas and counts in the table are cumulative.  
Population Source = LandScan2005.

Effects or contamination from August 11, 2008 11:35 UTC to August 15, 2008 11:35 UTC at or near ground level.

Layer Control: Plume

Show Plume: ☒

Which Plume: Total Effective Dose Equivalent

Show Release Marker: ☒

Show Centerline Data: ☐

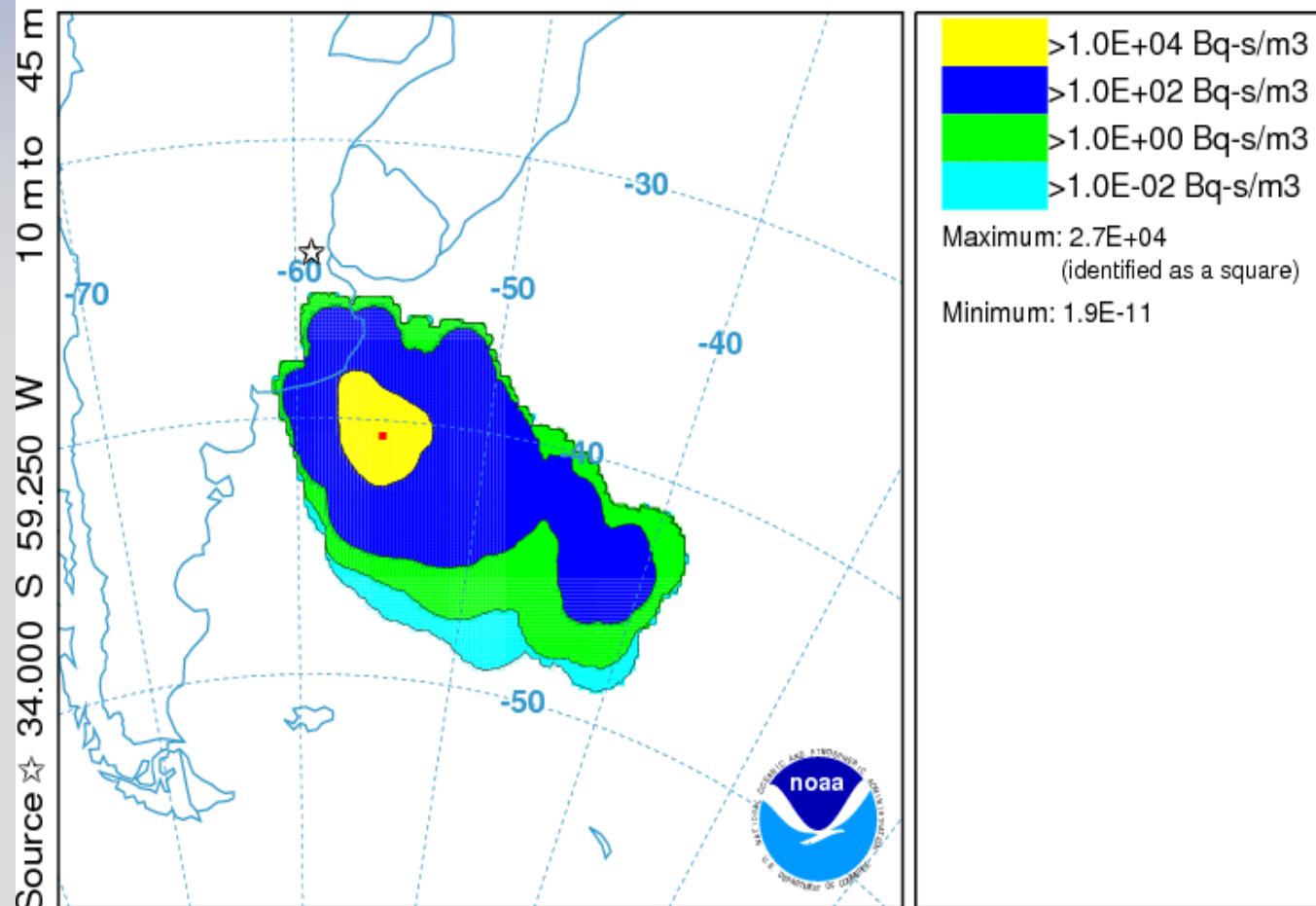
Contour Transparency: 50%

Contour Line Width: 1

[View Centerline Data](#)

## NOAA HYSPLIT MODEL

Exposure (Bq-s/m<sup>3</sup>) averaged between 0 m and 500 m  
Integrated from 1200 14 Nov to 1200 15 Nov 13 (UTC)  
C137 Release started at 1300 12 Nov 13 (UTC)

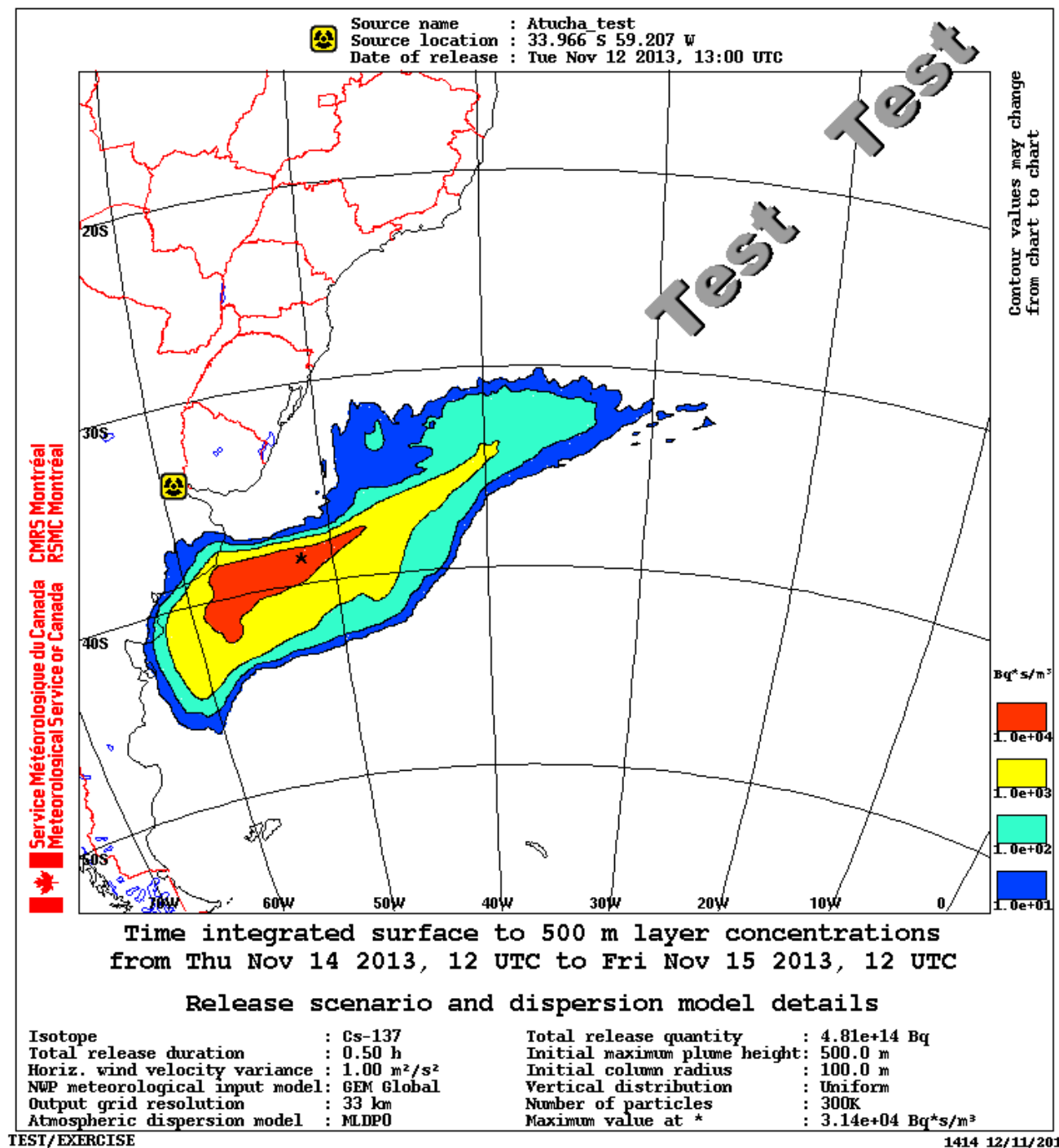


Created: 1614UTC 12/11/2013 (day/month/year) RSMC Washington - NOAA ARL / NCEP  
Source: ATUCHA-1 lat: -34.00 lon: -59.25 hgt: 10 to 45 m  
Release ID: C137 Rate: 9.62E+14 Bq/hr Duration: 0.5 hr Particles: 500  
Distribution: Uniform between 10 and 45 m AGL  
Dry Deposition: Yes Wet Removal: Yes  
Meteorology: 0600 UTC 12 Nov 2013 GFS  
Note: Contour values may change from chart to chart

Response: EXERCISE EXERCISE EXERCISE

Display of  
RSMC  
Washington,  
CNA 2013,  
Exercise.



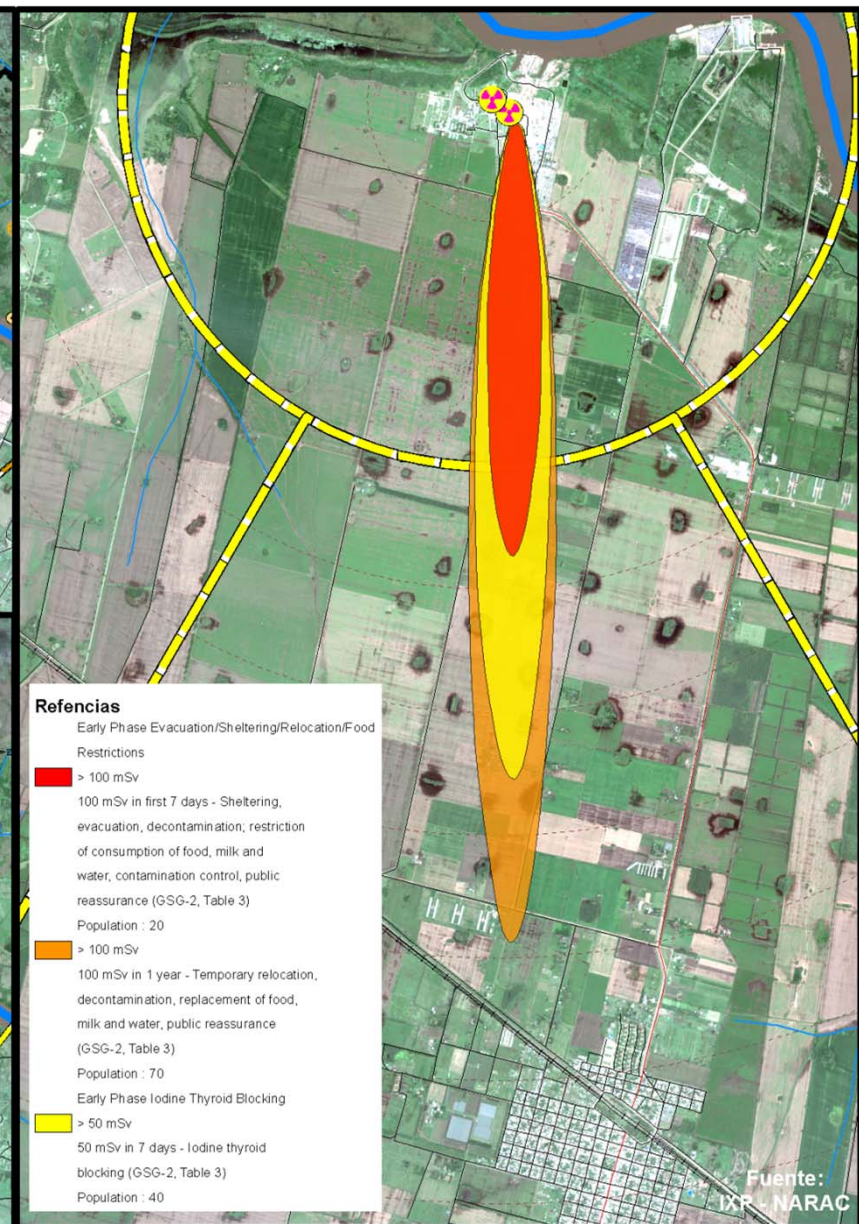
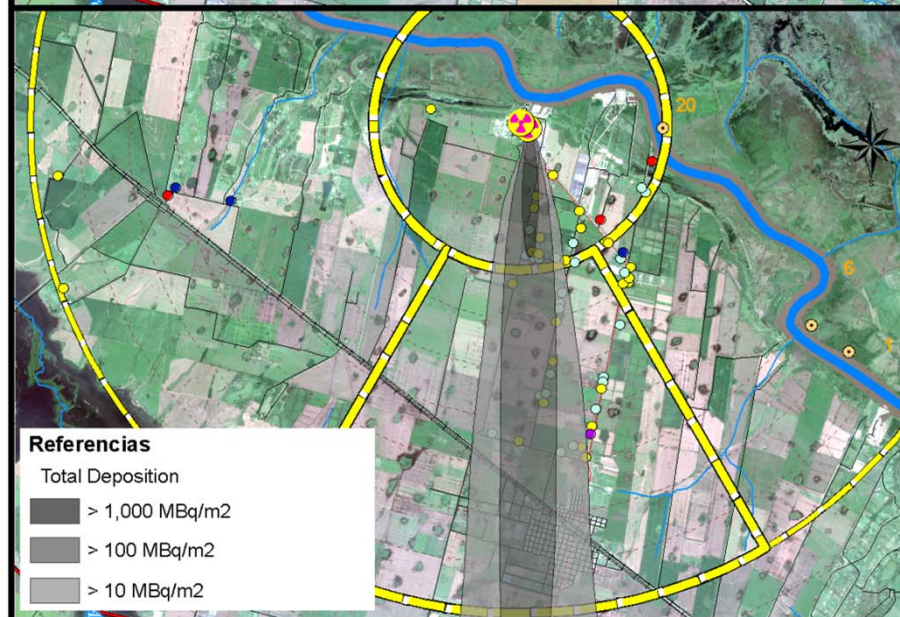
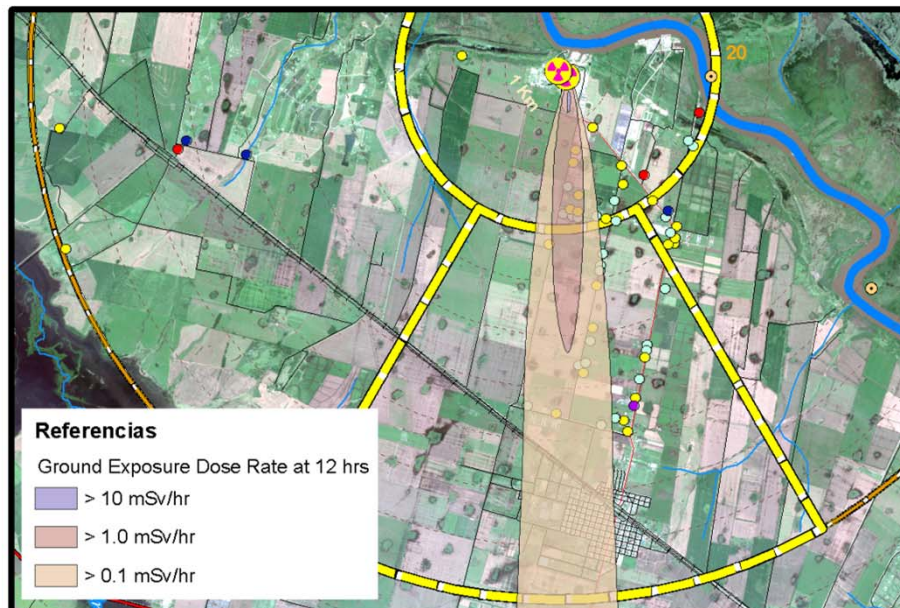


Display of  
RSMC  
Montreal, CNA  
2013,  
Exercise.



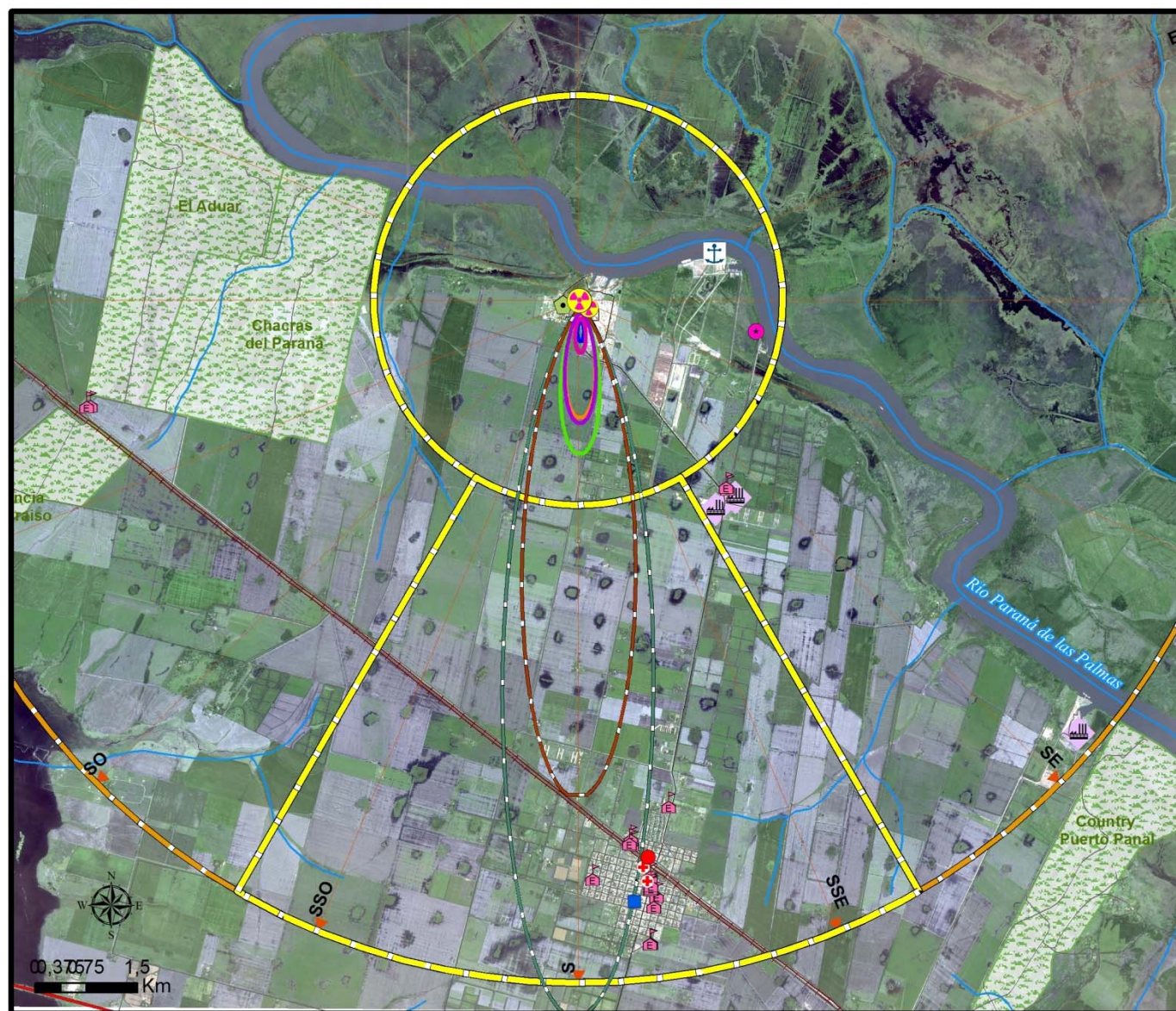


- The Geographical Information System (GIS) supports planning, training and enforcement of protection actions in case of a nuclear emergency.
  - Provides the georeferenced cartographic data;
  - Incorporates the results of forecast consequences models and environmental measurements during an emergency;
  - Allows the information analysis at real time and helps the decisions making;



Display of IXP - GIS integration, CNA 2013 Exercise.





## CENTRAL NUCLEAR ATUCHA

### Ejercicio de Aplicación del Plan de Emergencia - 2013

#### Isodosis

#### Contramedidas a implementar en el Ojo de Cerradura

Reparto de pastillas de Yodo

0.1 Sv

Evacuación de embarazadas

0.1 Gy eq

Puesta a cubierto

0.01 Sv

#### Efectos Determinísticos

Cataratas

2 Gy eq

Hipotiroidismo

5 Gy eq

Eritema

3 Gy eq

Radiodermatitis

12 Gy eq

Vómitos

0.5 Gy eq

Diarrea

1 Gy eq

Daños al feto

0.1 Gy eq

#### Referencias

- Central Nuclear
- Bomberos Voluntarios de Lima
- Defensa Civil de Lima
- Policía de la Provincia de Bs. As.
- Gendarmería Nacional
- Centros médicos
- Medios de difusión
- Club de Pesca Lima
- Delta Doc y Puerto Noble
- Industrias
- Ojo de cerradura: dirección viento Norte

- Cursos de Agua
- Radio 10 km
- Ferrocarriles
- Barrios Cerrados

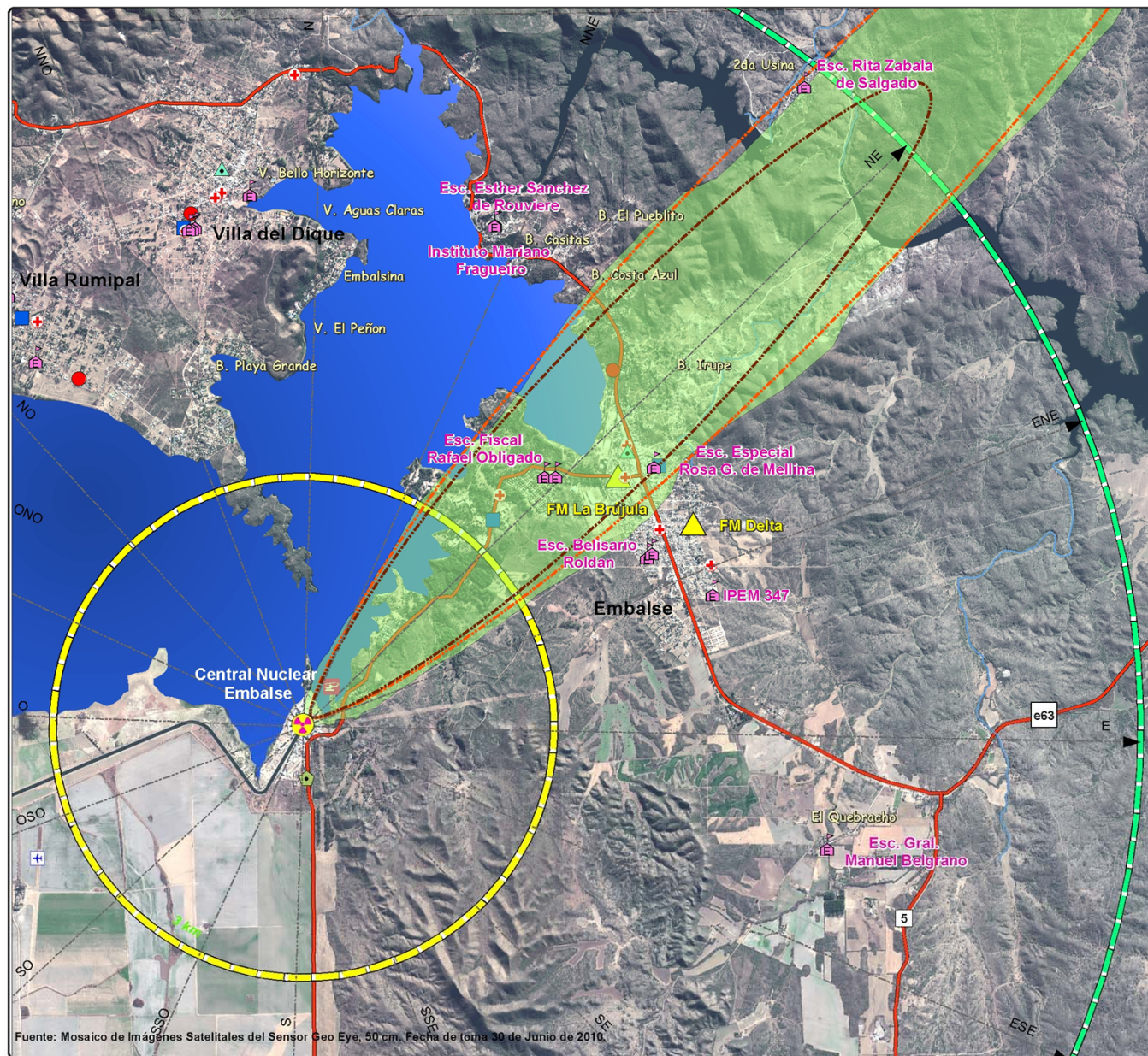
Fotografía Aérea, Armada Argentina, 2001.  
Imagen Satelital GeoEye, 2009.

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Display of SEDA - GIS integration, CNA 2013 Exercise.







## Modelos de Dispersión: IXP y SEDA

Ejercicio de Aplicación del  
Plan de Emergencia de CNE

Reparto de comprimidos de Iodo

### Referencias

Resultados IXP - NARAC

> 50 mSv

50 mSv in 7 days - Iodine thyroid  
blocking (GSG-2, Table 3)

Resultados SEDA - ARN

Puesta a cubierto: 0.01Sv

Reparto de comprimidos de Iodo: 0.1 Sv



0 0.5 1 2 Km

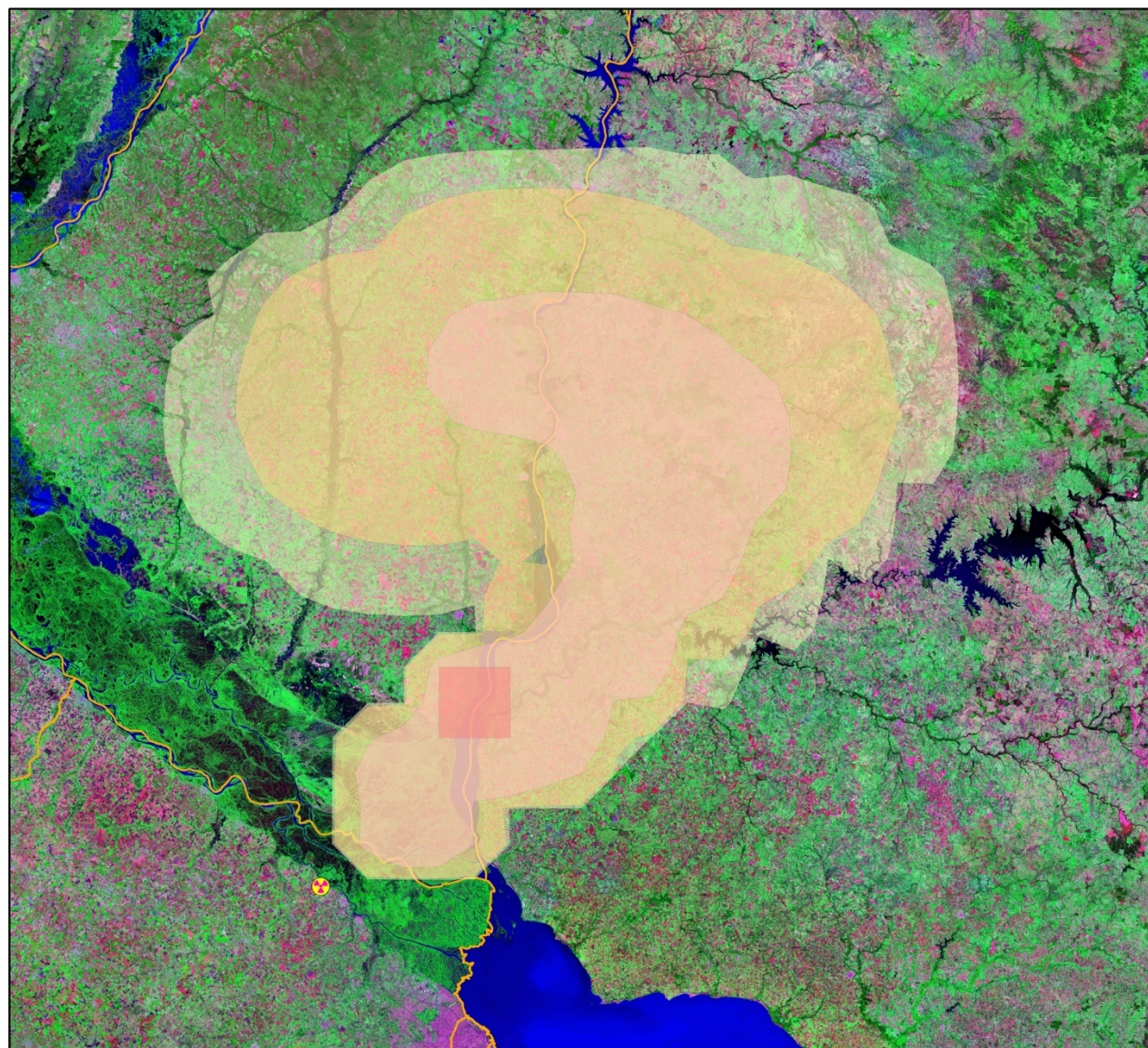


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Display of IXP - SEDA - GIS integration, CNE 2014 Exercise.







### Visualización de los resultados de los modelos de RSMC Washington - WMO

Datos provenientes del modelo Hysplit del  
RSMC Washington, como parte del  
Ejercicio de Aplicación del Plan de  
Emergencia de la Central Nuclear Atucha,  
Año 2013.

#### Referencia:



CNA - Unidades I y II



Límite de provincias

Concentración integrada:



$1 \cdot E+05$  Bq-s/m<sup>3</sup>



$1 \cdot E+04$  Bq-s/m<sup>3</sup>



$1 \cdot E+03$  Bq-s/m<sup>3</sup>



Máximo - definido como  
un cuadro



0 20 40 80 km



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Display of WMO RSMC Washington results - GIS integration, CNA 2013  
Exercise.



## CONCLUSIONS

- The models used by ARN(SEDAR, IXP, WMO) covers the different geographic scales (local, regional and global) which must be taken into account during emergencies response;
- The integration of the models result and GIS allows the information analysis at real time and helps the decisions making;
- The results of monitoring are key to validate the models and determine whether to modify the planned strategy;



**Thank you for your attention**

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