Results for EMRAS-Scenario 2: Mid-Range Dispersion Scenario for NPP Trillo

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EMRAS II
Environmental Modelling for Radiation Safety

- Start Jan.2009
- Working Goup 9 „Urban Areas“
- 3 Exercises: a) Atmospheric Dispersion – Short Range
  Field explosion experiments at SUJCHBO

  b) Atmospheric Dispersion - Mid Range
  Hypothetical severe accident at NPP Trillo

  c) Contaminant Transport and Countermeasures
  Radionuclide deposition at Seoul

Exercise Mid-Range atmospheric dispersion after a severe accident at NPP Trillo

- Releases due to steam generator tube rupture accident

- Objective: Testing model predictions for
  - Ground deposition (^{137}Cs, ^{131}I)
  - Time integrated air concentration (^{137}Cs, ^{131}I)
  - Contamination time series at selected locations (IP2, Guadalajara, Madrid)

Input - Release

- Steam generator tube rupture scenario by IRSN
- File releases.xls with release rates r_i [Bq/s]:

  17 nuclides: ^{85}Kr, ^{85m}Kr, ^{87}Kr, ^{133}Xe, ^{133m}Xe, ^{135}Xe, ^{138}Xe,
  ^{131}I, ^{132}I, ^{133}I, ^{135}I, ^{134}Cs, ^{135}Cs, ^{136}Cs, ^{137}Cs, ^{138}Cs,

  60 times for each minute during 1 hour

JRODOS: release timestep = 0,5 h

$$\Rightarrow \quad 60. \sum_{i=1}^{30} r_i \ [Bq]$$

Time [h]	^{131} I [Bq]	^{137} Cs [Bq]
0 – 0,5	7,7 E+11	1,5 E+11
0,5 -1	2,9 E+12	4,9 E+11

Release Height = 10 m due to calculated wind field

JRODOS Dispersion Calculation Parameters

Calculation Range	< 100 km
Grid Size	1,2 km
Time Step	1 h

JRODOS Dispersion Models

- ATSTEP
- RIMPUFF
- DIPCOT

ATSTEP

Gaussian model with properties of a simplified puff model
Dispersion parameters: high roughness – Karlsruhe-Jülich
moderate roughn. - Mol
Standard/Briggs plume rise formulas

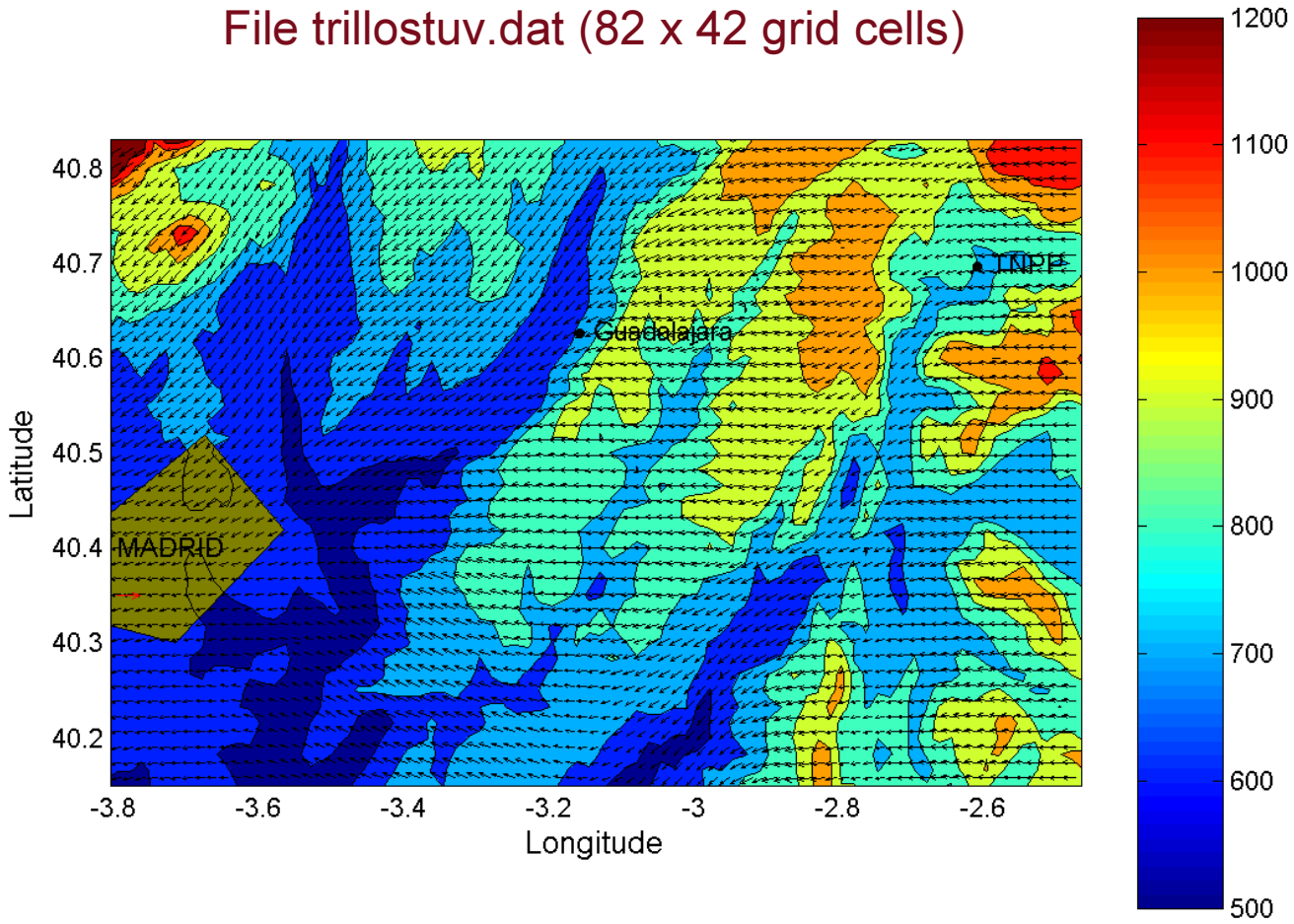
Meteorological Input per timestep:

Wind direction [°]	derived from WINMOD model data
Wind velocity [m/s]	derived from WINMOD model data (velocity vector components u and v on file trillostuv.dat supplied)
Rain intensity [mm/h]	0,0
Cloud amount	no
Diffusion category	E

Wind field 10m above ground, stable atmosphere

Calculated with WINMOD model (Univ.of North Wales)

File trillostuv.dat (82 x 42 grid cells)



AIT Approach (1)

1.Step: Estimation of cloud path:

Calculation of mean values for velocity vector components u and v

=> one single wind speed and one single wind direction as JRODOS-Input for the whole calculation

Input: v = 1,78 m/s Direction = 76,4 °

Result: Cloud arrival time at Madrid after 7 h.

AIT Approach (2)

2.Step: Introducing the changing wind:

Preparation of 7 subsequent meteorological inputs (1h each).

Trillo is located at cell 73/35
Madrid is located at cell 8/16

The area between these two cells divided into 7 almost equal areas covering approximately the way of the cloud.

For each of these 7 areas the mean values of the velocity vector components are determined resulting in 1 wind speed and 1 wind direction.

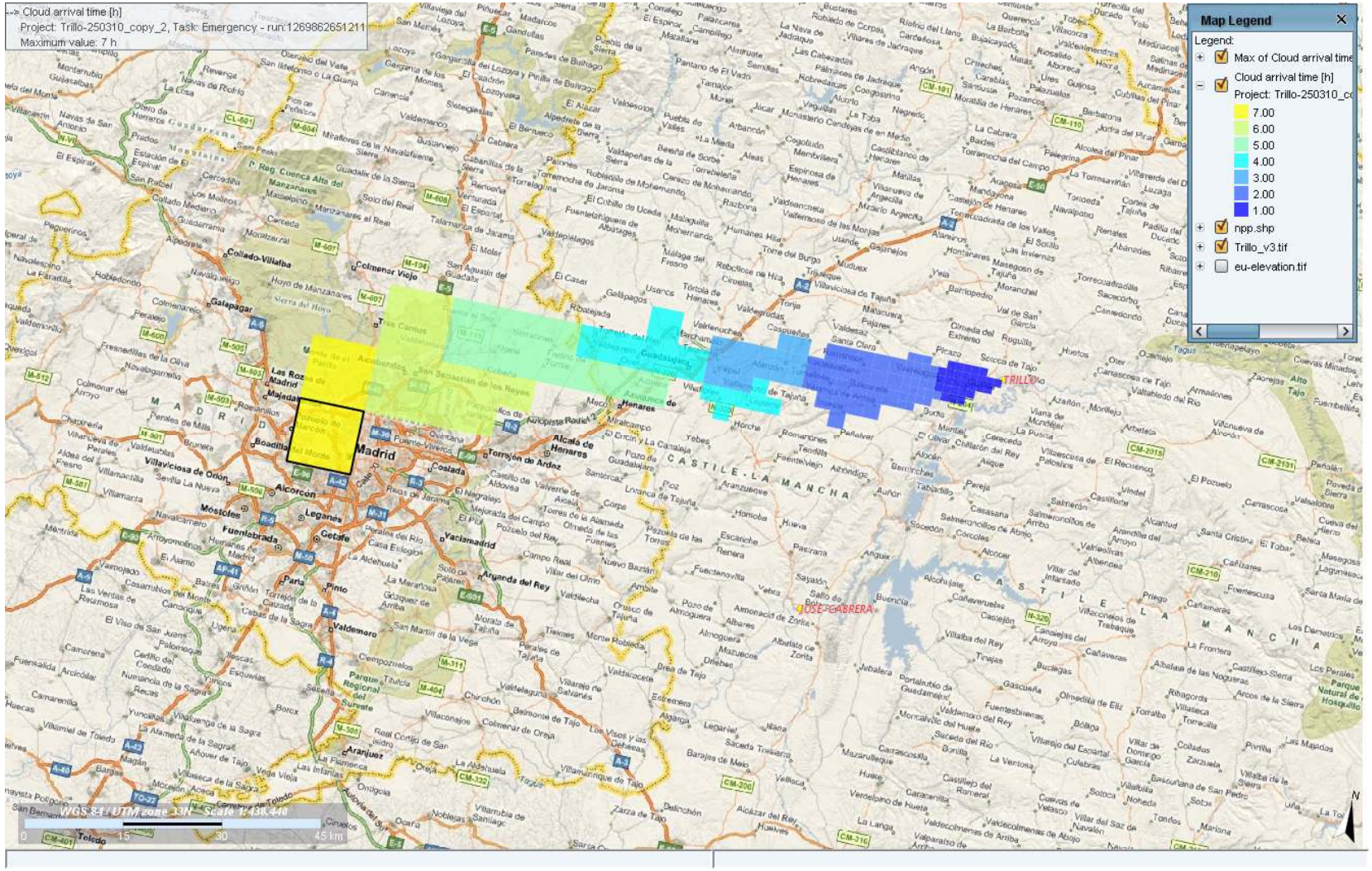
New JRODOS-calculation performed with 7 different wind speeds and 7 different wind directions.

AIT Approach (3)

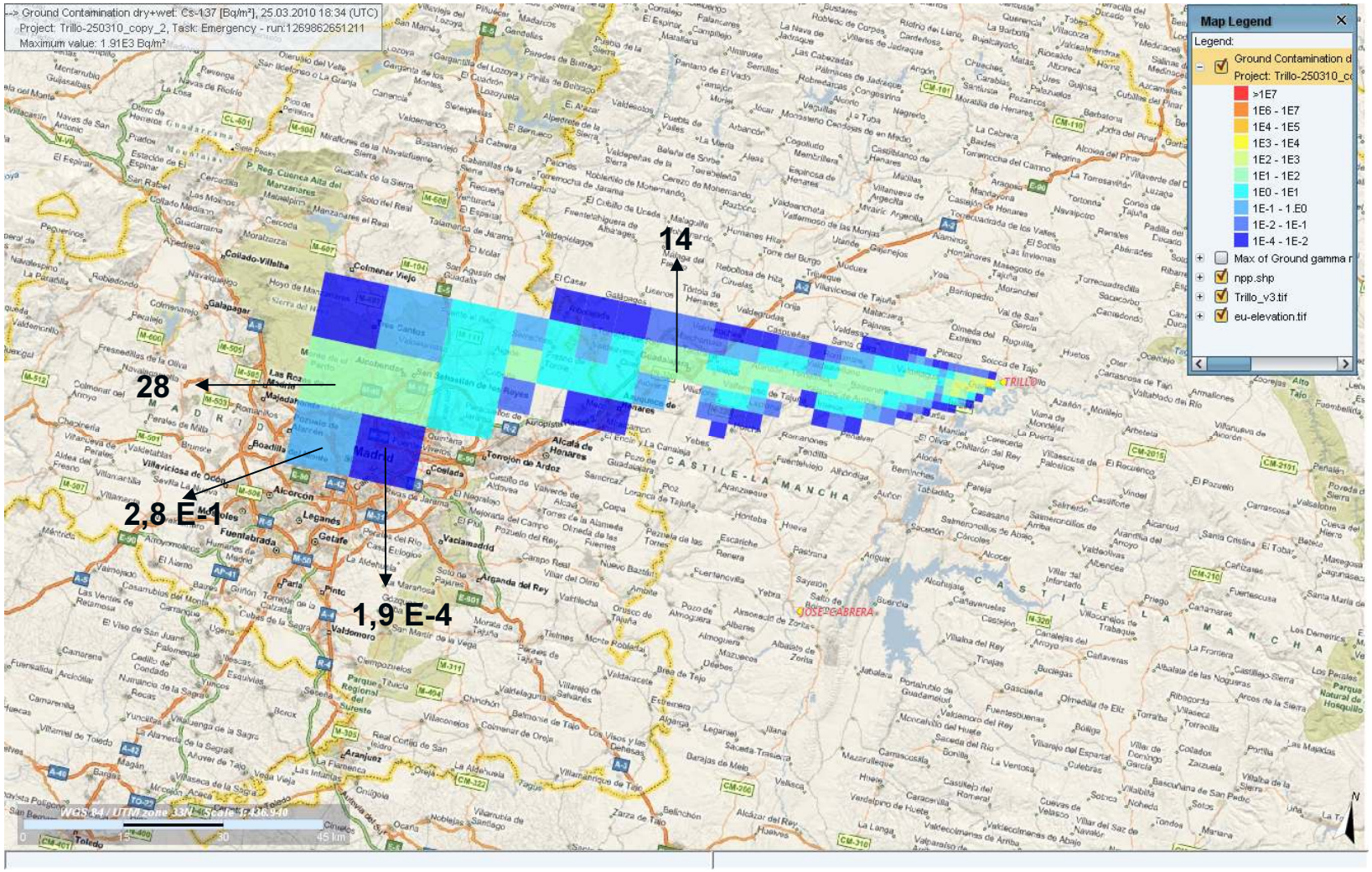
Input:

Area	Wind velocity [m/s]	Wind direction [°]
1	1,43	74,8
2	2,07	80,2
3	2,03	82,6
4	1,98	87,5
5	1,94	81,8
6	1,47	76,1
7	1,36	70,5

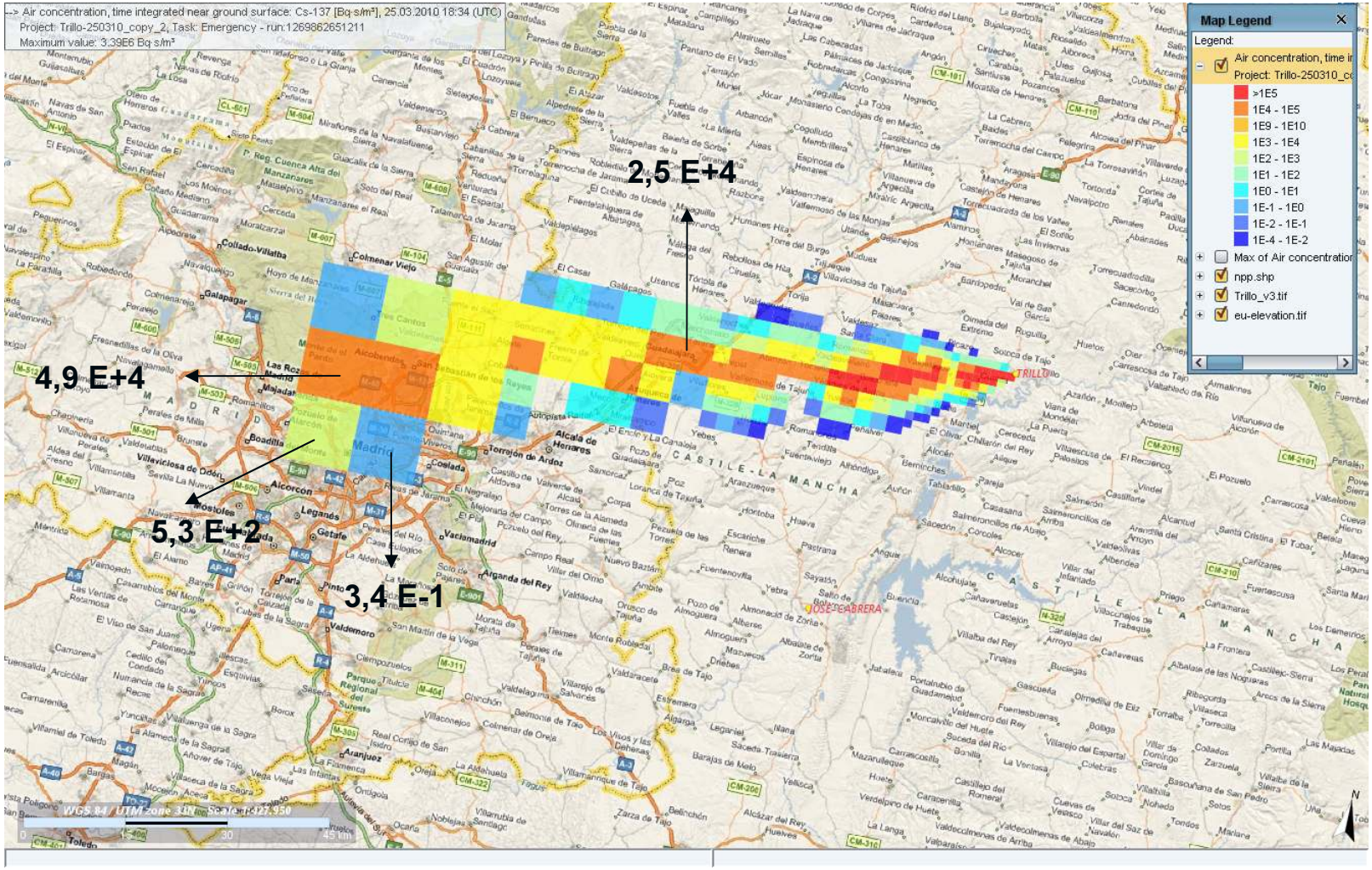
Cloud Arrival Time [h]



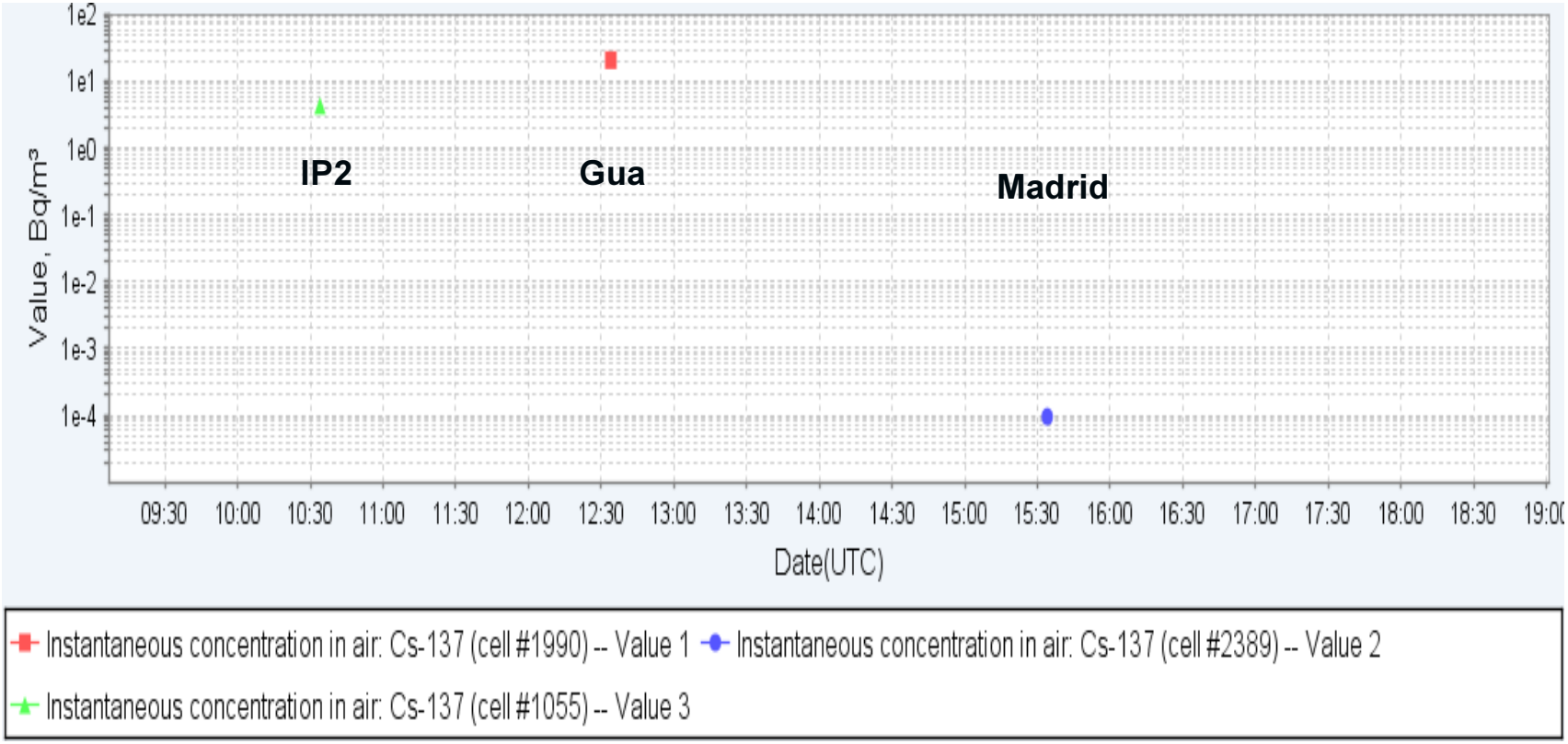
Ground Contamination for ^{137}Cs [Bq/m^2]



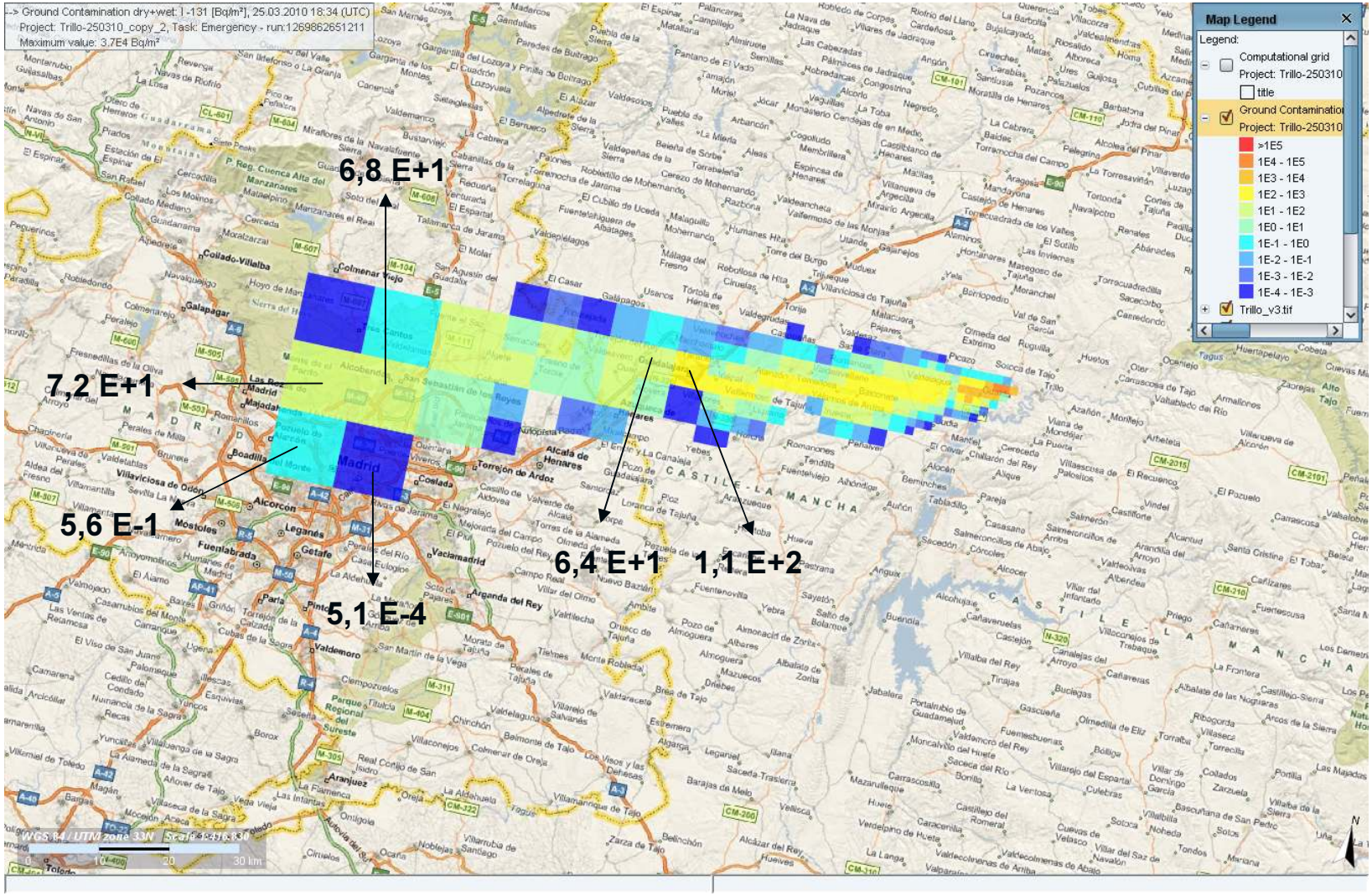
Time Integrated Air Concentration for ^{137}Cs [Bq.s/m^3]



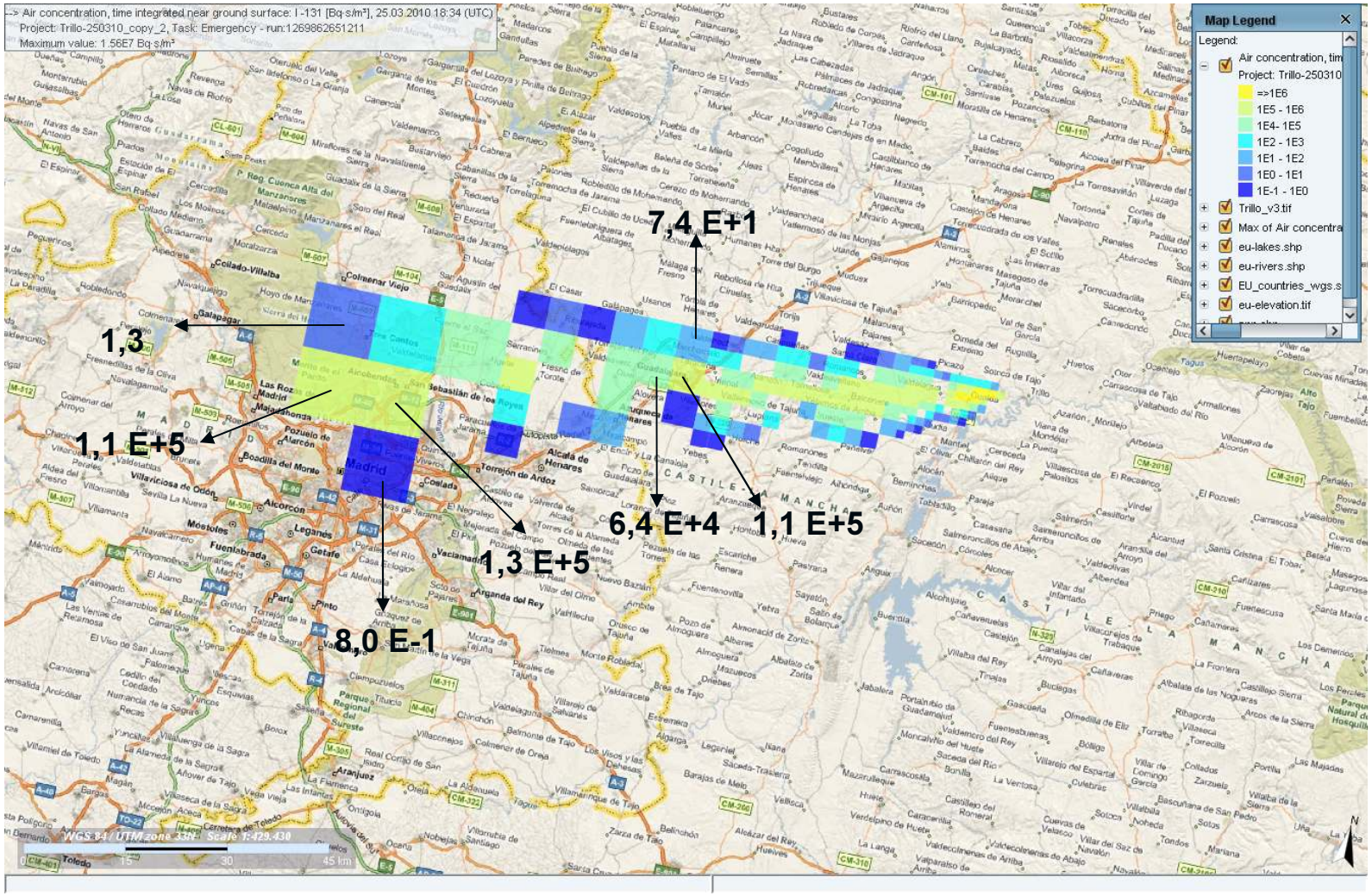
Time Series for ^{137}Cs



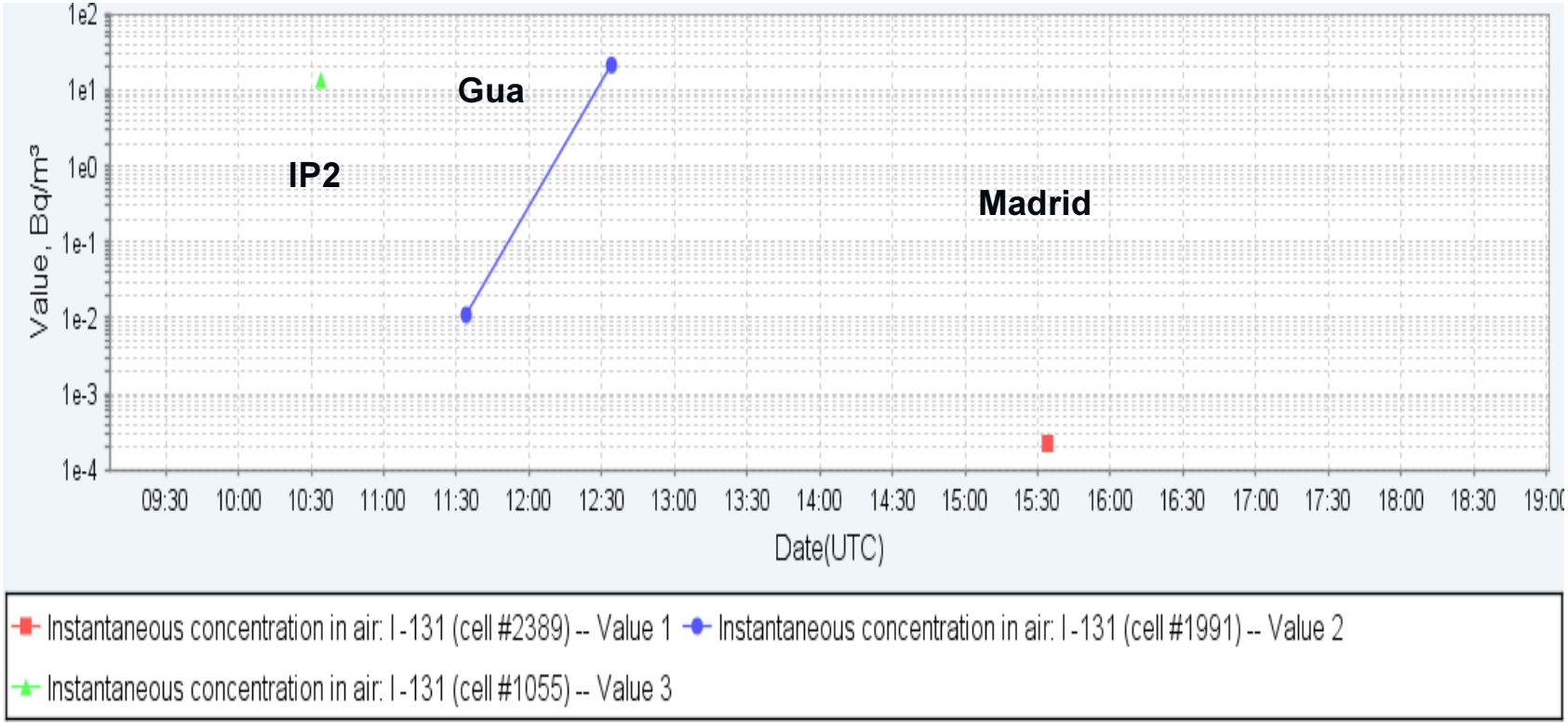
Ground Contamination for ^{131}I [Bq/m^2]



Time Integrated Air Concentration for ^{131}I [Bq.s/m^3]



Time Series for ^{131}I



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