



1 Introduction

This document provides a complete description of the R-CRISIS program, which has been developed to perform probabilistic seismic hazard analyses with the possibility to the user of selecting different seismicity and geometrical models and with a friendly graphical user interface (GUI). The document is structured as follows: first an introduction and description of the program is made together with the list of minimum hardware and software requirements and a description of the installing process. Second, a full description of the theoretical background of all the methodologies implemented in the program is presented, accompanied by the illustration of some key procedures with the objective of helping the user understand what is done during the computation process of the seismic hazard in a probabilistic manner. Third, a hands-on guide of the program is included using a hypothetical example which explores the main tools, menus and options besides showing the required input data, its format and where to add it in the project. Finally, a comprehensive set of validation and verification (V&V) tests are included to provide full details on the capability, accuracy and usefulness of the program. This last section allows also concluding that R-CRISIS is fully suitable for performing a wide range of seismic hazard analyses with different complexities, from simple cases with analytical solutions, to the development of specific studies for critical facilities such as nuclear infrastructure.

The methodologies explained in this document together with the user manual have been developed for the latest available version of the R-CRISIS program (v20 at the time of writing this document). Although some of the features have been implemented in previous versions, the validation and verification results of this document are applicable only to the latest releases.

This document has been assembled using contributions from several people that have been involved in the development of CRISIS in its different versions and at different stages. Also, this V&V document uses texts previously written for the purposes of the validation of the R-CRISIS code within the framework of the PEER project (phases 1 and 2) by M. Villani, E. Faccioli, M. Ordaz and A. Aguilar, together with their results and findings.

1.1 Description of R-CRISIS

R-CRISIS is a Windows based software with the capability of performing probabilistic seismic hazard analysis (PSHA) using a fully probabilistic approach, allowing the calculation of results in terms of outputs with different characteristics (i.e. exceedance probability curves, stochastic event sets). The first version of the program was launched on 1986 and since then, more than thirty years ago, several and continuous updates and improvements have been included to keep the program as a state-of-the-art tool. Originally developed using FORTRAN as programming language (Ordaz, 1991) and without a GUI, it developed later into CRISIS99 (Ordaz, 1999) which was a tool that first introduced a GUI written in Visual Basic but with the computation engine using a FORTRAN dynamic link library. Since 2007 the program was upgraded in view of the advantages offered by the object-oriented technologies (i.e. Visual Basic.NET). In that version, called CRISIS2007, both the GUI and the computation engine were written in the same programming language.



Different experts with multidisciplinary backgrounds (from civil engineers to seismologists) have worked in its development and today it is a worldwide well-known tool which has been used in the development of different projects at different scales and the seismic zonation for the definition of seismic design coefficients in more than 10 countries in the Latin America and the Caribbean region. R-CRISIS has been mainly written and developed by PSHA practitioners and therefore, the development loop has been relatively short where most of the modifications, improvements and upgrades have been made to satisfy the needs of the developers themselves.

R-CRISIS provides a friendly environment to perform seismic hazard calculations within a fully probabilistic framework. The program computes seismic hazard by considering earthquake occurrence probabilities, attenuation characteristics and the geographical distribution of earthquakes.

Seismic hazard results are mainly obtained, for each computation site, in terms of probabilities of exceeding a given intensity value within different time frames, whereas it is also possible to obtain the results in terms of both, non-exceedance probabilities and equivalent annual exceedance rates.

1.2 Hardware and software requirements

The minimum hardware requirements for the installation and use of R-CRISIS are fulfilled by almost any personal computer in the market today. These are:

- PC with a Pentium IV (or higher) and processor speed higher than 2.0 GHz
- A free hard drive capacity of 5.0 GB
- 512 MB of Extended Memory (RAM)
- 16 MB video card
- Internet connection

To ensure optimum system operation with high processing speed, it is recommended that the computer where R-CRISIS is being installed meets the following hardware requirements:

- PC with a Pentium IV (or higher) and processor speed higher than 3.5 GHz
- A free hard disk capacity of 10.0 GB
- 1GB of Extended Memory (RAM)

Since the latest versions of R-CRISIS include optimization procedures based on parallelization, computers with larger RAM memory and available processors can have a faster performance.

The software requirements for installing and running R-CRISIS are:

- *Windows operating system*: all software packages used in this document were designed to operate on Microsoft Windows 7, but newer versions can run without requiring any additional changes and without restrictions¹.
- *.NET Framework 4.0*: all software packages used in this document use Microsoft .NET Framework².

1.3 Installing R-CRISIS

To install R-CRISIS the user needs to double click on the executer (Setup.exe³) as shown in Figure 1-1.

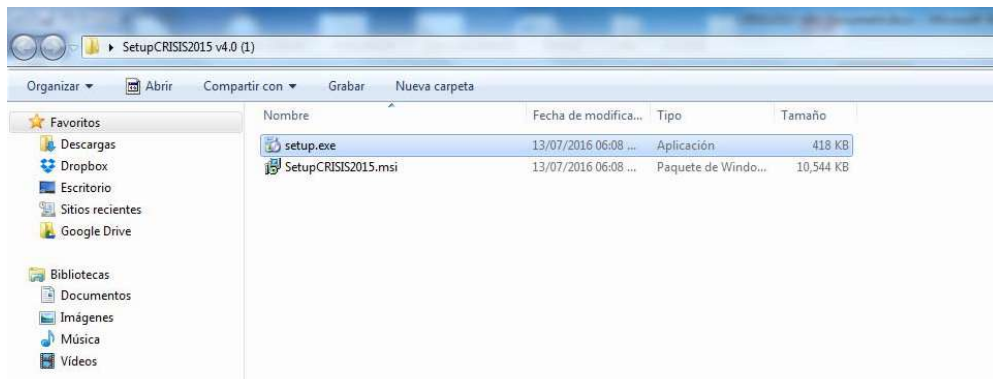


Figure 1-1 Launching the setup.exe of R-CRISIS

The *.exe file will start the R-CRISIS setup wizard (see Figure 1-2) which instructions are to be followed.

¹ R-CRISIS has been tested in Windows 8 and Windows 10 environments

² <http://www.microsoft.com/es-es/download/details.aspx?id=17851>

³ Available at: www.r-crisis.com

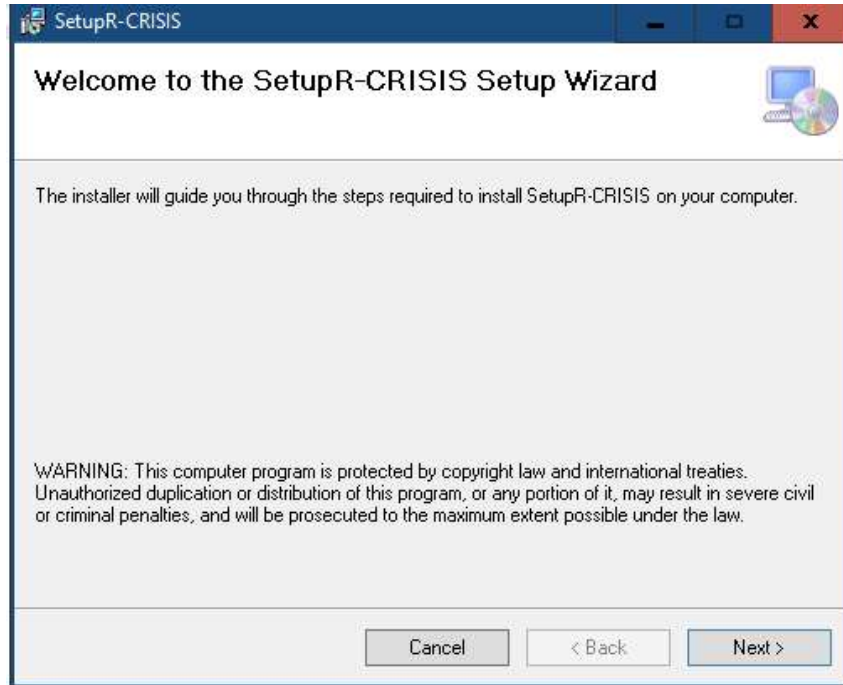


Figure 1-2 Initial screen of the R-CRISIS setup wizard

The user can modify the path where the program files will be stored as shown in Figure 1-3. By default, it is set to “C:\Program Files\ERN\R-CRISIS”. From this screen the user can grant permission on the installation of the program for only themselves and/or for other users of the same PC.

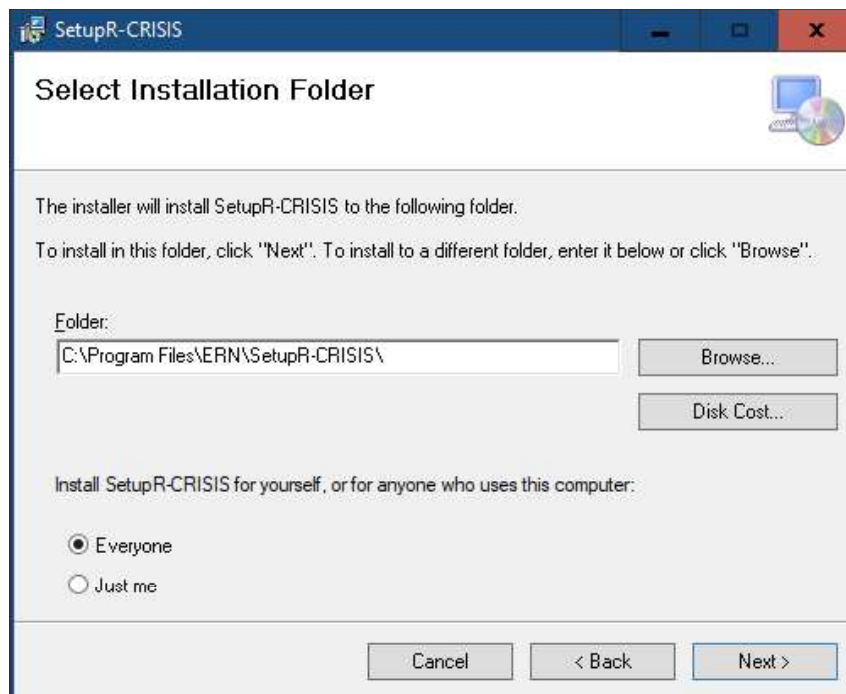


Figure 1-3 Storage path and access restrictions of R-CRISIS

Once all the steps of the setup wizard have been completed, the program will be installed, and a shortcut will be available in the desktop⁴.

Note: for a correct functioning of the program, it is mandatory that the decimal symbol is set to period “.” and that negative values are preceded by a minus “-” sign. These changes can be made in the control panel of windows in the regional setting options. This change must be done before launching the program accessing the control panel and making the appropriate selection at the regional settings.

1.4 Launching R-CRISIS

Once the program has been installed, by double clicking in the shortcut available at the desktop, R-CRISIS can be launched and the initial screen, as the one shown in Figure 1-4, will appear showing the version of the program as well as the developers’ team. To move forward to the main screen of the program click once on the “OK” button (bottom right).

Note: this screen will be displayed every time that the user launches the program.



Figure 1-4 Welcome of R-CRISIS

After this, the main screen of R-CRISIS will be displayed, as shown in Figure 1-5. This screen allows selecting the different options as well as using the different tools available in the program. For more details on how to create a seismic hazard project in R-CRISIS, see Chapter 3 of this V&V document.

⁴ If the desktop shortcut does not automatically appear, look for the *.exe file at the installation path

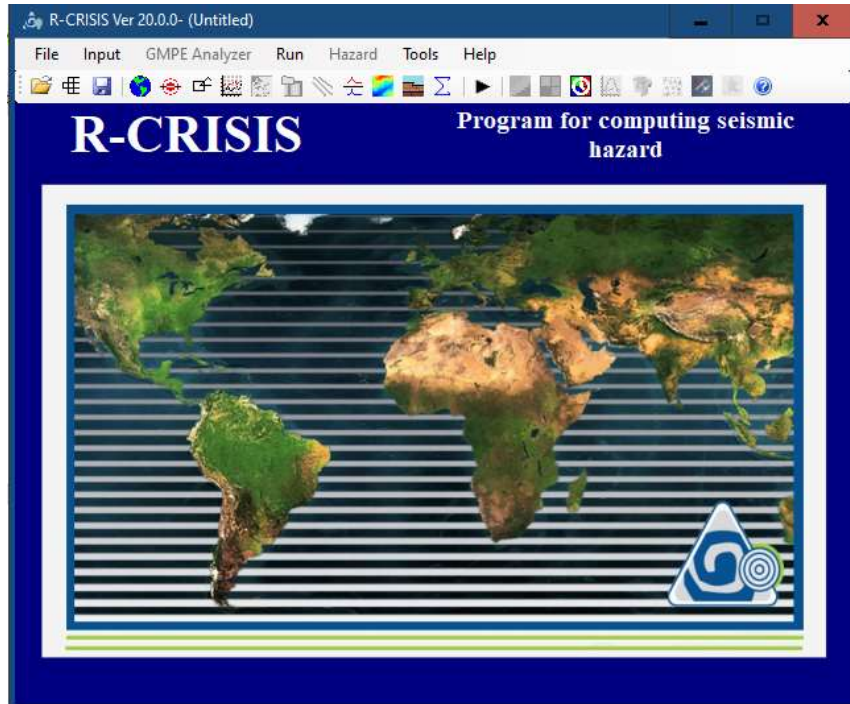


Figure 1-5 Main screen of R-CRISIS