
RocPro3D - Release 7.0.0 - (2026/05/15)

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OPTIMIZATIONS

- Change from double to float of the following files (file size reduction):
  - Vimp (virtual impacts on protections).
  - Trst (only for Reduced storage RAM strategy : reach distance, travel time, stop points).
  - Note: the new Vimp and Trst files can no longer be read with earlier versions (up to versions 6.x.x).
- Option to save stop file in full CPU strategy -> choice moved to general preferences.
- Modification of the dialog update displayed when calculating trajectories and maps/ envelopes, resulting in a reduction in calculation time.
- Decrease of used RAM with the optimized RAM strategy.

NEW FEATURES

1) User interface

- Side walls in the 3D view:
  - They are now hidden by default, and optionally displayed with a transparency effect.
  - A DTM projection (horizontal plane) is now always displayed beneath the 3D model, in grey with a transparency effect. This provides a useful reference point for better understanding the orientation of the 3D model view.
- When opening files created with a version earlier than v7.0.0, old user PoV are removed.
- Removal of the “Map” tab in the “TOPO” panel: the ability to create a DTM from a map image has been deprecated. However, it is still possible to open former projects of this type.
- In the 3D view, the user-defined point of view (PoV) now works both in "Perspective" and "Parallel projection" display modes.
- The numbering of objects (points, soils, sources, protections, trajectories) displayed in the various tables and in the status bar now starts at 1 (previously 0).
- Improvement of the 3D scene manipulation:
  - Buttons added to get predefined planes view: map (xy), face (x,z), back (-x,z), left (-y,z), right (y,z),
  - A more natural visualization mode ("terrain") is now set (Z-axis remains vertical in the screen plane), which provides an easier scene manipulation with the mouse.
- To display Probability classes, several colour schemes can be chosen (light MEZAP, MEZAP or Reversed) from the "Advanced settings" dialog.
- For Probability maps, Energy Line angle maps, or Travel Line angle maps, when isolines are displayed:
  - Isolines are now displayed both in the 2D and 3D views.
  - A legend indicating isolines values is displayed in the 3D view.
  - When the maps are exported, the displayed isolines are exported to a DXF file.

2) Length units (import and DTM edition)

- Imported DTM with length unit in feet must be converted to meters, thanks to the "DTM edition" dialog (see the "Geometry scale change" radio button).
- When importing sources, protections or observed blocks data types, the unit of length of these data must now be specified (default: meter).
- It is possible to convert ft->m.
- Note: whatever the unit of length of the initial data, it will be converted to meters (SI-derived units are used for calculations and visual display).

3) DTM modification

3.1) New "Add point" button (TOPO panel, DTM tab)

- This tool is useful for:
  - Correcting possible artifacts when importing a DTM from level curves.
  - Adjusting DTM singularities which would not be adequately represented in the original DTM

3.2) New tool for removal of peaks/pits (TOPO panel, DTM tab)

- A tool has been added to the "Mesh Edition" dialog box, allowing peaks and/or pits to be

  removed. These artefacts may originate from meshes created for DTMs containing aberrations in terms of overhangs or vegetation.
- It is possible to process either peaks, pits, or both.
- Iterative correction of peaks/pits is based on:
  • Detection of topographically isolated points belonging to faces with a slope > MinAngle.
  • Removal of all faces with having of the isolated points as a vertex.
  • Removal of all isolated points.
  • Remeshing of the model with the new set of points.
- This correction is performed iteratively until a DTM without peaks or pits is obtained.

3.3) Improvements to Decimation

- After a decimation, it was possible that, at high decimation factors, the DTM would contain artifacts that prevented its use for trajectory calculations.
- Now, it is generally possible to obtain a consistent DTM by using the peak/pits correction tool (see §3.2) and the tool correcting self-intersecting faces.

4) New distance/angle tool (Ruler)

- Addition of a ruler tool for measuring distances and angles (see block "2D tools" of the toolbar).
- Right mouse-click on the Ruler polyline in the 2D view opens a dialog providing distances and angles.
- The Ruler can be deleted using the Minus (-) toolbar button.
- Once the ruler polyline has been created in the 2D view, combination of key Ctrl(L) and left mouse click on the line in the 2D view opens a dialog giving distances and angles of all polyline segments.

5) Observations (observed blocks on the field)

- A new functionality allows to include in the model blocks that may have been observed in the field.
- Import is done from the new pane "OBSERVATION" by importing as ascii file containing blocks x-coordinate, y-coordinate and volume or mass.
- The observed blocks are thus displayed in the 2D & 3D views (see the new checkbox in the "Displayed objects" box of the Study Manager).

6) Sources

- Baseline projection "Horizontal" renamed "Oblique".
- A label is automatically defined for each source, and it can be modified by user for easier QA/QC.
- Each source is now assigned a probability of start Pd(start) for its blocks:
  • This probability Pd is defined from the "Source settings" dialog.
  • Unit of Pd depends on the source type:
    • /year/hm (by year and by source length) for lineic sources,
    • /year/hm^2 (by year and by source area) for surfacic sources.
  • The P(start) is specific to each source and can have different values between sources.
  • Default value is 1.0, it can be lower or larger than 1.0
  • This probability is needed to compute the P(reach) map, see section 12.2).
- SHP import of sources: all properties of sources can be integrated in the dbf file, and are read when importing shapefile. Attributes must comply with the following fields (without ""):

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  • "LABEL" (string)     optional
  • "NUMBLOCKS" (int)    mandatory
  • "PRSTARTN" (real)    mandatory
  • "GEOMTYPE" (int)     mandatory (0 -> sphere, 1 -> disk)
  • "DIAMETER" (real)    mandatory
  • "SLENDERNES" (real)  if GEOMTYPE = 1
  • "ROCKDENSIT" (real)  mandatory
  • "MASSVAR" (real)     mandatory
  • "INICONDTYP" (int)   mandatory (0 -> initial velocity, 1 -> initial height)
  • "INIVELTYP" (int)    if INICONDTYP = 0
  • "INIVX" (real)       if INIVELTYP = 0
  • "INIVY" (real)       if INIVELTYP = 0
  • "INIVZ" (real)       if INIVELTYP = 0
  • "INIVR" (real)       if INIVELTYP = 0
  • "INIVELNORM" (real)  if INIVELTYP = 1
  • "INIVELVAR" (real)   if INICONDTYP = 0
  • "INIHEIGHT" (real)   if INICONDTYP = 1
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  - "INIHEIGVAR" (real) if INICONDTYP = 1
  - "INICONDMIX" (int)   mandatory (0 -> simple initial condition INICONDTYP,
                                    1 -> mixed condition)
- Possibility to enter values globally (or by source) for the number of blocks and normalised release probabilities for the 3 source types (linear, area, point), with units standardised according to source type.
- Automatic calculation of the 'total' release probability for each source. This value is used for the calculation in the P(reach) map and is expressed in [/year], regardless of the source type.

7) Protections (all types)
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- Baseline projection "Horizontal" renamed "Oblique".
- A label is automatically defined for each protection, and it can be modified by user for easier QA/QC.
- SHP import of protections: all properties of protections can be integrated in the dbf file, and they are read when importing shapefile. Attributes must comply with the following fields (without ""):
  - "LABEL" (string)   optional
  - "PROTTYPE" (int)   mandatory (0 -> fictitious, 1 -> net, 2 -> embankment)
  - "HEIGHT" (real)   mandatory
  - "NET_REF" (int)   if PROTTYPE = 1 (0 : None; 1 : NF P 95-308; 2 : ETAG27 (MEL);
                                          3 : ETAG 27 (SEL))
  - "NET_TYPE" (int)   if PROTTYPE = 1
  - "NET_CAPACI" (real) if PROTTYPE = 1
  - "NET_EFFECT" (real) if PROTTYPE = 1 and NET_REF = 0

8) Protections of net type
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- In previous versions (up to 6.x.x), for a protection of type net (i.e. with 0<Capacity<inf), any block that was reaching a net with an Energy higher than Capacity was not stopped by this net, but the block energy was decreased by the entire net capacity. This assumption is ideal and optimistic.
- From version 7, the user controls which amount of energy should be dissipated in such cases via an Overcapacity Efficiency Coefficient (OEC), ranging between 0 and 1. The out block energy is given by Eout = Ein - OEC * Capacity, i.e.:
  - If OEC = 1, the full net capacity is removed from the block energy (as this was the case in previous versions),
  - If OEC = 0, no energy is removed from the block,
  - Intermediate OEC values allow partly removing net capacity to the block energy.
- This choice is available from the "Protection settings" dialog.

9) Run
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- A new functionality allows to create charts of reached (or travel) angles vs. normalized area.
- Two options are available, from the "Computation settings" dialog:
  - Normalized Linear Area (NLA) versus Reach Angle (RA),
  - Normalized Curvilinear Area (NCA) versus Travel Angle (TA).
- This allows producing ELANA-type of chart, see section 10).
- Notes:
  - This is available for both RAM strategy options (Full or Reduced),
  - Activating these options will increase simulation duration. These options should thus be activated only if these types of output are needed.

10) Analysis of Trajectories
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- Charts of reach angles (RA) vs. normalized area (NA) are now available, see section 9) above.
- This allows plotting all simulated block trajectories in an ELANA-type of chart, from the "Analysis" Pane (tab "Trajectories", sub-tab "RA-NA").
- It is also possible to add to the plot field data from the Rock_The_Alps database.

11) Analysis of Protections
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Two new results can be analysed at the protection level from the the Chart view (histogram, experimental cumulative distribution and CDF).

11.1) Impact Angle

- The impact angle (with respect to horizontal plane) of blocks arriving in the protection is now computed.
- This impact angle is:
  - Positive for blocks with an upward incident velocity,
  - Negative for blocks with a downward incident velocity.

11.2) Position of blocks

- The position of the blocks in the protections, i.e. their curvilinear coordinates L(X,Y), can now be analysed.
- This makes it possible to locate the areas where the protection will be most stressed (in terms of number of blocks).

12) Analysis of Maps

12.1) Major improvement of the P(propag) map calculus

- In previous versions (From 5.0.0 up to 6.x.x), the P(propag) map was computed using an approximated formula, which use was strictly correct only in cases:
  - of a single point source,
  - of several distinct point sources, such that blocks from any source do not share any grid cells with blocks from any other source.
- From version 7.0.0, thanks to recent theoretical work by Rossignol et al. (2024), the generalized exact formula is now used to compute the P(propag) map, as given in reference (in French):

  A.F. Rossignol, R. Martin, F. Bourrier (2024).
  Vers une nouvelle approche quantitative pour l'évaluation de l'aléa de chute de blocs.
  Towards a novel quantitative approach for rockfall hazard assessment.
  Revue Française de Géotechnique, 2024, 179(2), 32 pages.
  DOI : https://doi.org/10.1051/geotech/2024016

- Notes for old projects computed with previous versions:
  - There is no possibility to compute the new exact P(propag) maps from the old approximate P(propag) maps.
  - Few P(propag)Old maps (computed with versions up to 6.x.x) have been compared to exact P(propag) maps, and this tends to show that:
    - Previous approximate P(propag) maps are more optimistic (i.e. less safe) in terms of extent. Thus, for any grid cell [i,j] above which blocks pass:
      P(propag)Old[i,j] >= P(propag)[i,j]
    - Difference between P(propag)Old and P(propag) tends to decrease as probabilities decreases.
    - Differences between P(propag)Old and P(propag) somehow decrease when they are converted in terms of classes of P(propag), due to the log scale used to build between classes.

12.2) New maps for the probability of reach P(reach)

- These two new maps are:
  - P(reach) = Map of reach probability (MEZAP, 2022) + corresponding isolines,
  - Classes-P(reach) = Map of reach probability classes.
- It allows considering block probability of departure for each source, possibly with different P(start) values between sources, see section 6).
- It also now properly handles the case where several sources are disposed along the slope, i.e. some sources "seeing" blocks from upper sources.
- In details, the generalized exact formulation by from Rossignol et al. (2024) used here implies:
  - Several imbricated loops, and uses the partial probability pd for any SrcCell, which is computed from its originating main source as:
    - Case of lineic sources: pdSrcCell = PdFullSrc * SrcCellLength / FullSrcLength
    - Case of surfacic sources: pdSrcCell = PdFullSrc * SrcCellArea / FullSrcArea
  - Iteratively at the level of each source cell, partial probability p(reach) is then computed from partial probability p(propag):
    p(reach) = 1 - pdSrcCell * p(propag)
    which finally allows computing the total probability P(reach) taking into account all source cells of all sources.
  - For the full calculation details, refer to Rossignol et al. (2024).

12.3) New option for unit of probability maps

- The following maps express a quantity that implies some counting at cell level (at least number of trajectories crossing the cells):
  • P(propag)
  • Classes of P(propag)
  • P(reach)
  • Classes of P(reach)
- In previous versions (up to 6.x.x), these maps were always expressed without unit [-], i.e. with values implicitly corresponding to "per cell area".
- From RocPro3D version 7, it is possible to normalize these maps by the effective area of cells (default choice).
  The maps units then become:
  • [/m^2] for density, p(propag) and p(propag) classes.
  • [/year/m^2] for p(reach) and p(reach) classes.
- This can help comparing several scenarios with different grid sizes used for the statistical analysis.
- Depending on the RAM strategy:
  • with Full RAM one, see the "Computation settings" dialog (from the "RUN" panel),
  • Reduced RAM one, see the "Envelope/Maps settings" dialog (from the "ANALYSIS" panel, "Maps" tab).

12.4) Removed maps

Three maps are no longer available:
- The Density map has been removed in version 7 because it only makes sense in the following cases:
  • a single point source,
  • several distinct point sources, such that blocks from one source do not share any grid cell with blocks from another source.
  However, in these cases, the Density and P(propag) maps are identical.
  Conversely, the P(propag) map is valid for any source configuration, which therefore justifies the removal of the Density map.
- The NumTraj map display has been removed because this map was only useful for calculating the Density map.
- The NumTrajSrcCell map display has also been removed because this map was only useful for calculating the old P(propag) map.

12.5) Modified map

The Impacts map has been modified:
- In previous versions, this map considers all impacts (i.e. dissipative and non-dissipative).
- From version 7, only dissipative impacts are taken into account (i.e. impacts with for which blocks arrive from a parabolic flight portion). This is consistent with the default display mode of impacts in the 2D and 3D views.

12.6) New map for the energy and travel line angles

- These new maps converts the calculated trajectories in terms of energy line angle or travel line angle maps (min value in each grid cell). Only trajectories that have been fully computed are taken into account.
- They facilitates the comparison of simulation results with energy line concepts (A. Heim, 1932) or travel line ones that can be obtained from a simple topographic analysis of the DTM (M. Jaboyedoff & V. Labiouse, 2003).

12.7) Source cells

- Once maps/envelopes have been computed, so-called "Source cells" can be visualized, at user's choice (see the new checkbox "Source cells" in the "Displayed objects" block).
  They are also saved on a specific file (*.srcc).
- Notes:
  • These source cells refer to analysis grid cells from which at least 1 trajectory started.
  • These source cells are post-processed and required to carry out the statistical analysis at the grid level to produce probability of propagation and probability of reach maps (see further).
  • If either a lineic source or a surfacic source is not fully covered with source cells, it probably means you did not launch enough blocks from this source.

13) Analysis of Envelopes

13.1) Optimized envelopes

- In addition to the "full" and "reduced" envelopes, a new type of envelope is available: "optimized" envelopes.
- Unlike the previous two, these allow approximate quantiles to be obtained, calculated from statistical summaries (tDigests) at the level of each grid cell, from the t-digest algorithm:
  T. Dunning (2021) The t-digest: Efficient estimates of distributions. Software Impacts 7, 100049
- Notes:
  • This approximate calculation requires a fixed amount of memory for each calculation (i.e. it does not depend on the number of blocks calculated), depending on the size of the analysis grid and the compression factor of the t-digest algorithm.
  • The compression factor can be decreased to reduce the memory footprint.
  • The compression ratio for tDigests can be set between 10 and 100, the accuracy of the quantiles approximation increases as the compression ratio increases.
  • The amount of memory varies with the square of the cell size of the analysis grid.

13.3) Analysis of optimized envelopes at cell level

- In previous versions, when the simplified envelopes were selected, analysis at cell level did not allow obtaining the experimental cumulative distribution.
- From 7.0.0, the (approximated) cumulative distribution is available in the chart view for optimized envelopes, and it is also computed at cell level from the t-digest algorithm.

14) Metrics to compare simulations vs. observations

- This requires firstly that observed blocks have been imported in the model, as detailed in section 5).
- This functionality computes the minimum distance (MinDist) array between each observed block and all simulated stopping points.
- Several significative values are computed (mean, quantiles) and the full CDF can be displayed.
- These metrics can be used to compare several simulations against field data, and to decide which simulation best fits observations. An example is given in:
  J.D. Barnichon, C. Chautard (2024).
  Modelling a rockfall field experiment using the stochastic RocPro3D software: effects of the DTM resolution.
  In: XIVth International Symposium on Landslides, Book of Abstracts, 157-160.
  ISBN 978-2-9585706-1-3. https://isl2024.com
- This allows realizing sensitivity analyses or soil parameters fitting between observations and several simulation sets.
- This new option is available from the new "Observ." tab in the ANALYSIS pane.