

iMOD



iMOD v5.6.1

Release notes

Published and printed by:

Deltares
Boussinesqweg 1
2629 HV Delft
P.O. 177
2600 MH Delft
The Netherlands

telephone: +31 88 335 82 73
fax: +31 88 335 85 82
e-mail: info@deltares.nl
www: <https://www.deltares.nl>

For sales contact:

telephone: +31 88 335 81 88
fax: +31 88 335 81 11
e-mail: sales@deltares.nl
www: <http://oss.deltares.nl>

For support contact:

telephone: +31 88 335 81 00
fax: +31 88 335 81 11
e-mail: imod.support@deltares.nl
www: <http://oss.deltares.nl>

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1 Introduction

1.1 General information iMOD 5

iMOD 5 is an easy-to-use Graphical User Interface and an accelerated Deltares-version of MODFLOW with fast, flexible, and consistent sub-domain modelling techniques. iMOD facilitates very large, high resolution MODFLOW groundwater modelling and geo-editing of the subsurface.

Key features of iMOD 5 are:

- One expandable data set covering all possible future areas of interest.
- Flow model nesting, toggling between grid resolutions and moving to new areas of interest.
- Efficient numerical modelling.
- Fast interactive 2D- and 3D-analysis and visualisation.
- Interactive editing the geometry of the subsurface.
- Consistency between regional and sub-domain models.
- Leaving the era of building series of individual models behind.
- Modelling of water quantity and water quality (iMOD WQ).

To obtain a copy of the Deltares-executables of iMOD (free-of-charge), a request can be submitted on <http://oss.deltares.nl/web/imod/get-started>.

1.2 Release overview

In June 2024 a new version of iMOD 5 has been released: iMOD 5.6.1 (SVN 3798).

The new version of iMOD mainly contains bug fixes to prevent crashes, correct errors and unexpected behaviour and improves general stability. The changes in iMOD 5.6.1. compared to iMOD 5.6 are:

- Bugs related to the use of MODFLOW 6 have been fixed. Important fixes in the iMOD GUI are a better configuration of the auto-placement of the RIV and DRN packages, corrected permeability averaging and correction of the preprocessing of the HFB package. Furthermore, various smaller functionalities have been adjusted to support improved calculations with MODFLOW 6.
- Change in the option how to average conductance when the ANI package is absent, to account for the different approach in MODFLOW 6 compared to MODFLOW 2005.
- In a new version of MetaSWAP some bugs were fixed and checks are included for improved use of MetaSWAP.

For installation of iMOD 5.6.1 and support when getting started, please read the instructions on <https://oss.deltares.nl/web/imod>.

iMOD GUI, iMODFLOW and iMOD-WQ are released using the latest Visual Studio Environment (VS2017) and Intel Visual Fortran Compiler (v2019.1.144) in combination with an updated version of Winteracter 15.0 (only for iMOD 5).

The iMODFLOW executable and MODFLOW 6-executable are built with a new version of MetaSWAP. This is based on the latest MetaSWAP version (V8.1.2.4, svn2383).

The iMOD release uses the latest USGS executable for MODFLOW 6, MODFLOW6_v6.4.2 (see <https://water.usgs.gov/water-resources/software/MODFLOW-6>).

2 iMOD GUI and iMOD Batch

2.1 Bugfixes

General

- An unnecessary error related to missing **IMF files** has been resolved. Some adjustments have been made to handle BAT files more effectively.
- In the **Cross-Section tool** the handling of labels and formatting of IPF files have been fixed.

iMODBATCH

- Function **RUNFILE**

- Fixed an issue with the keywords **IDFLAYER** and **IDISTRCOND**. When these keywords were specified with constant values (a single number) iMOD interpreted that as a value of 0 instead. Using IDF files in these keywords avoids this problem.
- Previously, **HFB** files were sorted for layer number, in case 3D HFB files were used. This changes the order as therefore affects the effective resistance. This sorting behaviour has been disabled for HFB.
- Ensured that resistance values for **HFB** are correctly added to the available subsoil resistance when using MODFLOW6. Previously, high background resistance values led to incorrect net resistance values.
- Addressed an error related to intersection of **HFB** into a non-equidistant network.
- Corrected the reflection of measurements that do not exist in the **MES/OBS** package. Previously, unintended zero-values were present.
- When the ANI is inactive, the option to define how to average conductance in between cells was previously set to **ALTERNATIVE_CELL_AVERAGING AMT-HMK**. We discovered that this approach differs from MODFLOW 2005. Instead of averaging transmissivity, it harmonically averages permeability. As a result, in areas with significant contrast the simulation can be impacted. To maintain consistency, the keyword ANI has been removed, and the default behavior now aligns with MODFLOW 2005.
- If the **CHD** package is missing in the selected PRJ file, the content of the SHD package is copied into a CHD package. This correction ensures alignment with MODFLOW6's requirements for submodel usage.
- Resolved an issue where non-existing **GEN** files triggered an error message during model conversion. The process now continues without interruption.

- Ensured that the **NODATA** value in the # DIMENSION block of ARR-files is consistent with IDF files in single- of double-precision.
- Removed the **UZF** package after conversion to MODFLOW6 if no UZF elements are active.
- When exporting to MODFLOW6 in combination with TOPMODEL, the EXG package requires the auxiliary variable **ANGLDEGX**. Therefore, a default value of zero is assigned.
- Corrected the non-functionality of the keyword **IDEFLAYER**<>0 for ISG-files.
- Resolved duplicate connections in the export of the **RDI** option combined with MODFLOW6, occurring when the RDI unit aligned with a regular location of an artificial extraction.
- Fixed the non-working **ISAVE** option of a **TIM**-file.
- The usage of **REGULARISATION** with PilotPoints was not implemented correctly. Now, the correct weight-matrix from the Kriging interpolation is used in iPESTP.
- **DOWNSCALING** of permeability yields in zero-values due to log-scaling around areas surrounded by zero-values (e.g. thin out of aquitards). The scaling algorithm is adjusted to allow for an enlarged area around the active cells to receive an interpolated value.
- After export of packages, iMOD cleans the **NAM** for empty packages as MODFLOW6 does not allow them. This process was not carried out in case a “#”-sign appears in the path of the model.
- Export to iMOD-WQ (**SIM_TYPE=6**) did not export the **STO** to a specific STO which should be.
- Function **ISGIMPORT**
 - Fixed a bug that caused crashes.
- Function **GXG**
 - Resolved an issue where the use of **SURFACEIDF** did not function correctly in combination with multiply given entries for ILAYER.
- Function **IDFMERGE**
 - Resolved an error related to the **MASKIDF** keyword.
- Function **PLOT**
 - Corrected behaviour of **IPFLEGCOL** and **IFFLEGCOL**, that did not trigger to plot a legend, only IDFLEGCOL did.
- Function **MF6TOIDF**
 - Ensured correct passing of nodata values into the output IDF-file when using **IFILLHEAD=1** nodata.
- Function **IDFMATH**
 - Fixed an undesired error related to the “>” operator.
- Function **IMPORTMODFLOW**
 - Addressed the issue where importing a model with different but constant cell sizes along the x- and y-axes resulted in a regularly spaced IDF file.

PROJECTMANAGER

- Switching to a **MODFLOW6** configuration no longer causes crashes.

ISGEDIT

- Corrected crashes related to sorting connected segments.

STARTPOINTS

- Rectified particle position in aquitards. Previously, particles were incorrectly placed at the bottom instead of the top of an aquitard. Additionally, when particles were positioned exactly at the interface of an aquifer and aquitard, they appeared twice the list of particles.

2.2 Improved functionalities

General

- Added the item **Transf.** to give the applied transformation from an IDF in the **IDFGet-value** function.
- Two displays for IPF Analyse were plotted on top of each other. Now, they are displayed side by side as a standard.

iMODBATCH

- Function **RUNFILE**
 - When writing the **PARA_SIM.INP** for MetaSWAP, checks are performed and necessary modifications are made to ensure that **IDBG**, **TDBG** and **YBDG** are correct aligned with the simulation time specified by **SDATE**.
 - When **exporting** a model to **MODFLOW6**, iMOD now modifies the export file name from **DIS6\BND_L*.ARR** into **DIS6\IDOMAIN_L*.ARR**.
 - In case the keyword **COMPLEXITY** is use, all associated default values for that chosen complexity are written in the IMS-file for transparency purposes.
 - Added the option **PCKACTIVE**, to include boundary conditions (RIV, GHB and DRN) along inactive cells that penetrate the model vertically.
 - Added the iPEST parameter **AH**, **AF**, **ER** and **ED** for MODFLOW6 optimization.
 - Added the option **DBOTDEPTH** to specify **DBOTDEPTH** as an IDF rather than a constant value. Also modified the option that **DBOTDEPTH** is used discarding the usage of **TOPMODEL**.
 - Added the option **DEFUNCONF** for which an IDF can be specified to spatially define how the configuration set by **UNCONFINED** is applied.
 - **DATEFORMAT** has been added as a keyword to enforce specific data format when MODFLOW6 is used. This keyword is eventually passed to the **MF6TOIDF** function.
 - Added **IFILLHEAD**, which allows manipulation of this keyword as used in the **MF6TOIDF** function.
 - Added **PRJTOMF6** to convert a project file that describes a QUASI-3D model used for MODFLOW2005/IMOD-WQ into a 3-D model in MODFLOW6, by conversion of existing aquitards (semi-confined layers) into active model layers with KHV ad KVA.
- Function **GEN2GEN3D**
 - An error message occurs when a binary GEN-file is used that is not allowed.
- Function **MF6TOIDF**
 - MODFLOW6 does not save vertical fluxes in the **BDGFLF** for non-existing layers. **MF6TOIDF** saves the overlying fluxes for underlying empty layers

- (IDOMAIN=-1). This allows particle tracking in IMODPATH and water balance simulations.
 - Added the keyword **IDOUBLE** to allow writing of single- or double precision IDF-files.
 - Added the keyword **IFILLHEAD** which allows filling non-existing locations with an appropriate head value after the simulation, matching the existing layer above.
- Function **XYZTOIDF**
 - Improved **Kriging** by addressing the incorrect inclusion of a limited number of points during individual interpolation. While the impact is minimal, the resulting interpolation is smoother and more continuous. This also effects the PilotPoints.

IPESTP

- Added the scaled sensitivity **SCORE** to compute the reliability of a parameter, ranging from 0-100%, in order to estimate whether parameters have a significant contribution.

2.3 Known issues

For actual known issues, check the iMOD website:

<https://oss.deltares.nl/web/imod/known-issues>.

3 iMODFLOW

The iMODFLOW executable is built with a new version of MetaSWAP, with some bugfixes. For more information about MetaSWAP see chapter 4.2.

3.1 Bug fixes

- Automatic assignment of measurements for iPEST did not work, these are the keywords **IZ1CL** and **IZ2CL** in combination with ILCOL=0
- Translation of **EVT** output did not work from a RUN-file.
- Crash after convergence at deallocating memory with **PKS** for submodels without DRN or RIV package

3.2 Improved/modified functionalities

- **Kriging** used for pilot points, saves the variance of the kriging field.

3.3 Known issues

For actual known issues, check the iMOD website:

<https://oss.deltares.nl/web/imod/known-issues>.

4 Coupling MODFLOW 6 and MetaSWAP

4.1 iMOD Coupler

For detailed information about the iMOD Coupler, the coupling files and coupling methods see the iMOD User Manual, Appendix section A.4. For the coupling between MODFLOW 6 and MetaSWAP use the iMODBATCH function RUNFILE described in chapter 8.7.6 of the iMOD User Manual.

4.1.1 Bugfixes and improved functionalities

- None. The same Coupler version is released as in iMOD 5.6.

For actual known issues, check the iMOD website: <https://deltares.github.io/iMOD-Documentation/coupler.html#known-issues>

4.2 MetaSWAP

A new version of MetaSWAP (v8.1.2.4, svn 2383) is introduced in the coupling with Modflow.

In the version of MetaSWAP bugs were fixed, addressing the following issues:

- Improved handling of MetaSWAP when using groundwater time steps (dtgw) larger than 1.
- Fixes for 'floating invalid errors' encountered during model runs on virtual machines.
- Ponding evaporation: correction of an error related to Penman Monteith evaporation during ponding.

Additionally, MetaSWAP now includes the following checks;

- Water balance check; warns the user when input files might not be compatible.
- Upper bound check (timestep dtsw): ensures accurate simulated interception.
- Error checks for meteorological input files (mete_grid.inp).
- Checks for compatibility of hot start initialization.

For more details, refer to the MetaSWAP v8.1.2.4 release notes and the "Input and output reference manual", available at <https://nhi.nu/modelcode/metaswap>.

The coupling of the new MetaSWAP version and Modflow is realized in two executables:

- For coupling with Modflow 2005 the code is incorporated in the iMODFLOW-MetaSWAP executable (see chapter 3).
- For coupling with MODFLOW 6 the code is built as a library file (MetaSWAP DLL). During a model run this dll file, together with the MODFLOW 6 dll file, is controlled by the iMOD Coupler executable.

4.3 MODFLOW 6

In this release, the latest USGS version of MODFLOW6 is included: version 6.4.2. Both the stand-alone version is included (*.exe) and the library version (*.dll) as part of the Coupler.

For more information on this release, visit <https://water.usgs.gov/water-resources/software/MODFLOW-6>.

5 iMOD-WQ

5.1 Bugfixes

- None. The same version as in iMOD 5.6 is released (svn417)

5.2 Improved functionalities

- None

5.3 Known issues

For current known issues, check the iMOD website:

<https://oss.deltares.nl/web/imod/known-issues>.

6 iMOD Manual and Tutorials

6.1 iMOD Manual

- Updated Create Timeseries Tool to support the renewed functionality

6.2 iMOD Tutorials

- None

7 Release status and future

iMOD 5 is at the end of its lifecycle. New features will be developed in the successor software; iMOD Suite. In the end of 2024 a new release of iMOD Suite is expected, which enables further use of MODFLOW 6.



Deltares

PO Box 85467
3508 AL Utrecht
Daltonlaan 600
3584 BK Utrecht
The Netherlands

+31 (0)88 335 81 00
imod.support@deltares.nl
www.deltares.nl