Release Notes

Deltares

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iMOD v5.5

Release notes

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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 March 2023 a new version of iMOD 5 has been released: iMOD 5.5.

The new version of iMOD contains the following added or improved functionalities and some bug fixes for:

- iMOD GUI, iMOD Batch and iPEST.
- iMODFLOW.
- iMOD coupler.
- iMOD-WQ.

For the use of iMOD 5.5 in Dutch applications, also in combination with MetaSWAP, special attention is drawn to changes mentioned in the beginning of section 2.1.1.

For installation of iMOD 5.5 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 14.0 (only for iMOD 5).

2 Changes in iMOD 5.5

2.1 iMOD GUI, iMOD Batch and iPEST

2.1.1 Modified and improved functionalities

First, some general remarks for the use of iMOD 5.5 in Dutch applications, also in combination with MetaSWAP, are made:

1. Pre-processing of MetaSWAP in iMOD 5 does not correct input, e.g. land use number 18 (Urban Area) is NOT changed into land use number 1 (grass). To add urban areas to the model input in iMOD 5, a user needs to change the land use map into grass for urban areas and use the SOPP (Urban Area Surface). See also chapter 2.2.1.
2. Computation of the GVG (Average Spring Groundwater level) is not determined by the three observations closest to the 1st of April as mentioned in the manual. The equation GVG=0.05+0.8GHG+0.2GLG is used instead. It is modified in case the GVG is computed according to sea level as -0.05+0.8GHG+0.2GLG. This modification might yield ~0.10m differences in results.
3. iMOD 5.5 runs with the updated iMOD Coupler and is not backwards compatible with the previous iMOD Coupler.
4. iMOD 5.5 supports the use of a combination of MetaSWAP, UZF and MODFLOW 6, for more information see the manual and description of added functionalities.

Further description of changed functionalities:

General

- The overall time configuration in iMOD is extended to support [**YYYYMMDDHHMM**] and [**YYYYMMDDHH**] as well. Missing hours, minutes and/or seconds are set to 0 if not specified.
- In case iMOD reads or writes an **irregular** IDF that contains constant cellsize, it is set to a regular IDF file.

iMODBATCH

- **GXG**
  - Computation of the GvG is defined as 0.05+0.8GHG+0.2GLG. In the situation that the GvG needs to be computed in m+MSL, the equation is set to -0.05+0.8GHG+0.2GLG.
- **ISGGRID**
  - Improved functionality to grid 2D cross-sections in case their resolution is larger than the used simulation network.
- **General**
  - Extended usage of time definition can be used for the keywords **SDATE** and **EDATE** throughout iMOD Batch-functions.
- **MF6TOIDF**
  - Added the keyword **DATEFORMAT** to be able to steer optionally whether short- of long date formats are required.

iMODBATCH

- Function **RUNFILE**
  - Usage of **ILCOL** in PRJ file is not the same as usage of **LAYER** in a PRJ file.
  - Volumes for the **WEL** and **MNW** packages are set to 0.0 for periods before the first definition in the TXT files. This affects the computation of an average value per stress period that overlap with the non-defined time periods in the TXT files.

  - An additional value -1 is added to the keyword **CMDHIDE**. After each simulation the specific model is paused. This was done in previous version with CMDHIDE=0.
  - The keyword **ISAVEENDDATE** is set to 1 for all simulations with iMOD-WQ. This cannot be changed.
  - Added keyword **UZFDEPTH** to enter the depth of the unsaturated zone simulated with the UZF package.
  - No **irregular** network is created whenever the size of the buffer is zero and/or the buffer cell size is equal to the cell size in the area of interest.
  - There is a check whether the packages **PST** and/or **IES** are active in case iPESTP or IIES is activated.
  - It is not allowed anymore to have duplicate labels for different groups in **iPESTP.**
  - Export to the **UZF** packages allows to assign precipitation to the first active model layer whenever LAYER=-1 in the PRJ file.
  - **HFB** gridding of 3D GEN files is improved as in some cases the gridded line became hatched and “puzzling” of HFB elements is discarded as it was too time consuming and not necessary.
  - **SURFDEP** of UZF is trimmed to be at least thickness of appropriate model layer, otherwise equal to 0.5m.
  - **ICONSISTENCY** is default 1 instead of 2.
  - The usage of **KVV** in combination with MODFLOW6 does not stop the simulation but gives a warning as it is NOT using KVV.
  - The option **ISOLVE** generates the RUN.BAT in all cases, only whenever ISOLVE=1, the model starts running.
- Function **IPFSPOTIFY**
  - Assigned fraction to layers only whenever they are more than 1% of the total volume of the **FORMATION**.
- Function **MKWELLIPF**
  - Question whether the file **IMOD_MKIPF_WELLS.IPF** may be overwritten is removed. It is overwritten automatically.
  - **Quotes** in the output files of this function are removed as they are obsolete.
  - **Extractions** are extended in time before and after the definitions in the TXT files. This was only carried out for periods after the latest definition, now, 0.0 volume is assumed for the period before the first definition.

iPESTP

- In case a simulation and/or residual extraction goes wrong there is a pause and by pressing the return, the process tries to re-run the model and/or recompute the residuals. Added is a question whether to continue or quit (pressing ‘Q’ or ‘q’ to quit).
- For iMOD-WQ, observations in the **HOB** package that are in an active cell but are surrounded by inactive cells are excluded in case spatial interpolation is active.
- In case the model does not converge, iMOD **restarts** the simulation in 100 seconds or earlier when the user agrees upon a restart.

2.1.2 Added functionalities

iMODBATCH

- General
  - Reading **INI-files** with tab-characters gave incorrect results, this is resolved, tabs are internally removed.
- Function **IPFLUMP**
  - This function is added to aggregate different IPF files.
- Function **RUNFILE**

    - Added the keyword **TOPMODEL** to create a 2-layered dummy model to support the combination of MetaSWAP and the UZF package.
    - Added the keyword **ICLEAN** to remove all sensitivity simulations after iPESTP is finished.
    - Added the keyword **APPLYCHD** to suppress the assignment of constant head boundaries around a sub model.
    - Added the **OBS** package.
    - Export to **ARR**-files contains a #-symbol at the bottom part of the ARR files such that MODFLOW6 can handle these appropriately.
- Function **XYZTOIDF**
    - Added **GRIDFUNC=SUM** to grid the sum of values.
- Function **MF6TOIDF**
    - Added keyword **ISTEADY** to specify that the first entry in the output files is a steady-state solution.
    - Added the keyword **BDGUZF** to convert CBC files that are saved from the UZF package of MODFLOW6.
    - Added the keyword **WC_UZF** to convert WC-files with water content from the UZF package to IDF files.
- Function **CREATEIZONE**
    - Added the keyword **LAYER** to be able to process specific layers only.
    - Modified the usage of **NLAY** to be able to generate zones for other types of FORMATION files.
    - Added the keyword **SUBDIVIDE** to subdivide parameters in multiple zones from the IDF given for this keyword.
    - Added the keyword **GRPNAME{i}** to be able to specify the name of the group for a parameter.
- Function **PLOTRESIDUAL**
    - Added the keyword **IRDATE** to be able to calculate statistics for a list of dates from the IPEST_RESIDUAL*.TXT files from iPESTP.

iPEST

- The keywords **IZ1CL** and **IZ2CL** were added to be able to specify the column with top and bottom elevation for measurements, to assign them to model layers.

2.1.3 Bugfixes

General

- To reading single precision IDF files, iMOD creates a temporary file called **TMP_IFORT.F{number}** in the users TMP folder. Those files are deleted after usage except in cases where double precision IDF files were read.

MetaSWAP-Analyser

- iMOD could not find MetaSWAP input files to load into the Analyser. This was caused by changed folder names by the pre-processing for iMODFLOW MetaSWAP. From version 5.5 iMOD searches for folder MSWAPINPUT (instead of MetaSWAP) and MODELINPUT (instead of mf2005_tmp).

iMODBATCH

- Function **RUNFILE**.
    - A crash resulted from the combination of **MODFLOW6** and **iPESTP** whereby the option **IMCOL**<0. In that case GxG's were computed for the residuals. This has been fixed.

- No measurements were saved in case no **WINDOW** keyword was specified.
- Converting a steady-state input for **ISG**/**WEL** package tried to evaluate transient input data in case a transient time-step was concerned.
- Multiply definitions of the **ISG** package for transient entries did not work correctly as dates were overwritten. Normally ISG does not have to be defined for different periods, that's why this problem did not arise earlier.
- Reading **FHB** package gave a memory issue while reading input IDF files.

iPEST

- **Acceptable Error** (default is 0.0) is always written in the resulting IPF file.
- Entered **STDEV** is always converted to weights and writing as **WEIGHT** values in the IPF file(s). The attribute in the IPF shows whether the entry is converted as **WEIGHT_CONVERTED_FROM_STDEV** otherwise it is called **WEIGHT**.
- **Zones** that are read as constant were converted to integers which is incorrect as given fraction are removed, unintended.

iPESTP

- The parameter **VA** was configured in iPESTP as KVA instead of VKA and as a result was not modified. This affects MODFLOW6 and/or iMOD-WQ optimizations only.
- iPESTP was sensitive to **lower case** parameter names, this is altered is such a way that both lower- and uppercase are recognized.
- **Zones** that are read as constant were converted to integers which is incorrect as given fractions are removed, unintended.

2.1.4 Known issues

For actual known issues, check the iMOD website: https://oss.deltares.nl/web/imod/known-issues.

2.2 iMODFLOW

2.2.1 Modified and improved functionalities

iMODFLOW

- Usage of an **IPF** with transient information (IEXT>0 and thus having associated TXT-files) can be used for a steady-state model. iMODFLOW computes average values for Q in that case.
- Corrections for MetaSWAP are not carried out, this has been implemented in v5.4 in the RUNFILE function of iMOD but not in iMODFLOW. In the export to **MetaSWAP** files the following pre-processing is altered:
  - physical soil unit number 22 and 23 (sands) were changed into number 9 (peat). This is **not** done anymore.
  - The following land use codes were changed into land use 1, this is **not** done anymore:
    - land use type 8 (greenhouse horticulture)
    - land use type 18 (paved area)
    - land use type 19 (dark coniferous forest)
    - land use type 20 (heathland vegetation)
    - land use type 21 (fruit yards)

- land use type 22 (sport fields)
- land use type 23 (unfertilized grassland)
- land use type 24 (maize with green)
- land use type 25 (potatoes early)
- land use type 26 (urban grassland).

2.2.2 Known issues

For actual known issues, check the iMOD website: https://oss.deltares.nl/web/imod/known-issues.

2.3 Coupling MODFLOW 6 and MetaSWAP

For detailed information about the iMOD Coupler, the coupling files and coupling methods see the iMOD 5.5 User Manual, Appendix section A.4 (https://oss.deltares.nl/web/imod/user-manuals).

For the coupling between MODFLOW 6 and MetaSWAP use the iMODBATCH function RUNFILE described in chapter 8.7.6 of the iMOD 5.5 User Manual.

2.3.1 Modified functionalities

- In release iMOD5.5 the iMOD Coupler contains new binaries for MetaSWAP (svn 2129). The binaries for MODFLOW6 are unchanged (version 6.3.0).
- The iMOD Coupler now has a new configuration file that is not backwards compatible with the previous iMOD Coupler.file. A detailed description is available on: https://deltares.github.io/imod_coupler/configuration.html.

2.3.2 Known issues

iMOD coupler

- An exception with the message:
  FileNotFoundError: Could not find module "\path\to\MetaSWAP.dll" (or one of its dependencies). Try using the full path with constructor syntax.

  This is likely caused by not having the Intel redistributable libraries available. They can be installed from https://software.intel.com/content/www/us/en/develop/articles/intel-compilers-redistributable-libraries-by-version.html. Make sure to choose the correct platform and the version for 'Parallel Studio XE 2018'. We are working on removing this dependency for future releases.

- iMOD_Coupler does currently not print the used library versions for MetaSWAP and MODFLOW when running the applications. We anticipate adding that functionality in the next release.

2.4 iMOD-WQ

2.4.1 Added functionalities

- With iMOD 5.5, the Parallel Krylov Solver (PKS) is released for iMOD-WQ.
- Addition of the horizontal anisotropy (ANI) package.

- Implementation of the horizontal flow boundary (HFB) package in the runfile. Before, this package could only be used in combination with a NAM file.
- iMOD-WQ now accepts spaces and commas in data file paths.

2.4.2 Bugfixes

- iMOD-WQ (in MT3DMS model) did not correctly read the RCH fluxes in the FTL package if the recharge was not assigned to the upper model layer.
- Subtraction and addition factors in the runfile were inadvertently ignored when they were exactly 1.

2.4.3 Known issues

It has been found that when applying operators to the input data in the runfile, the operator is always ignored if it has a value of (exactly) 1. This is unexpected behaviour in case the operator is not a multiplication or a division.

For current known issues, check the iMOD website: https://oss.deltares.nl/web/imod/known-issues.

2.5 iMOD Manual and Tutorials

2.5.1 iMOD Manual

- Many updates which are recognizable as these sections are printed in green.

2.5.2 iMOD Tutorials

- Added a tutorial 18 using iMOD Batch

3 Preview next release

In the summer of 2023 Deltares plans a new release of iMOD Suite, which enables further use of MODFLOW 6.

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