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FLOOD MODELLING EFFICIENCY WITH DIGITAL AUTOMATION

Welcome

➔ Agenda

① Background

② Model setup

③ Model runs

④ Model result processing

⑤ Input data generation

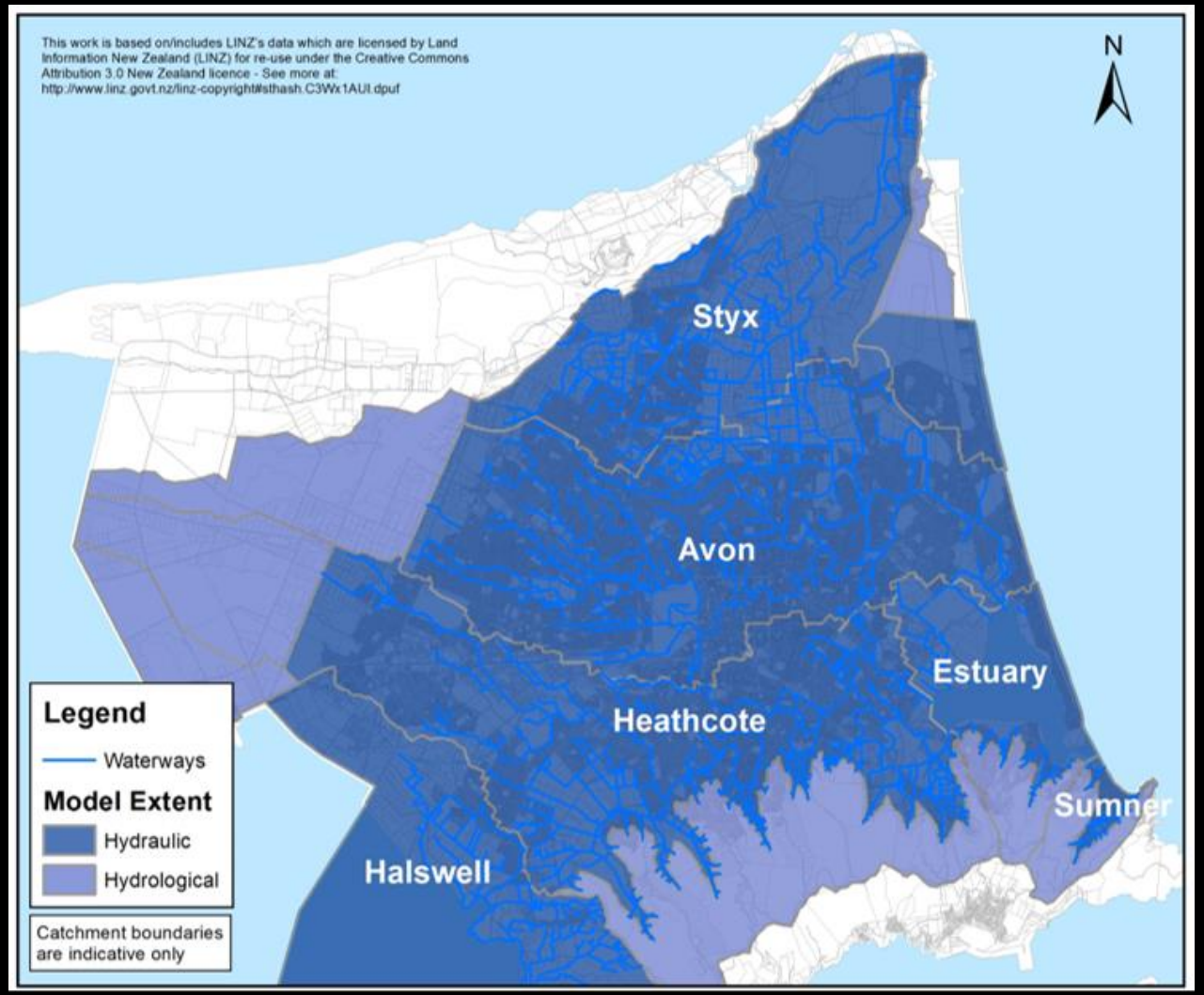
Automation tools

– Python scripting
– Excel spreadsheet
– Batch file
– DHI tools
– Visual Basics
– ArcPy
– ArcGIS Model Builder

Background – Avon Model

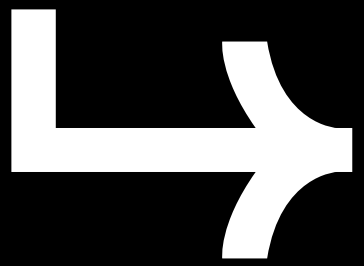
DHI Mike Flood Coupling Model

- Mike 11 – 1D River and Drains
- Mike Urban – 1D Pipe Network
- Mike 21 – 2D Flexible Mesh



Background – Model Scenarios

- Climate change rainfall increases
- Sea level and groundwater rises
- Future development
- Ground level changes due to future EQ
- Different ARIs and storm durations

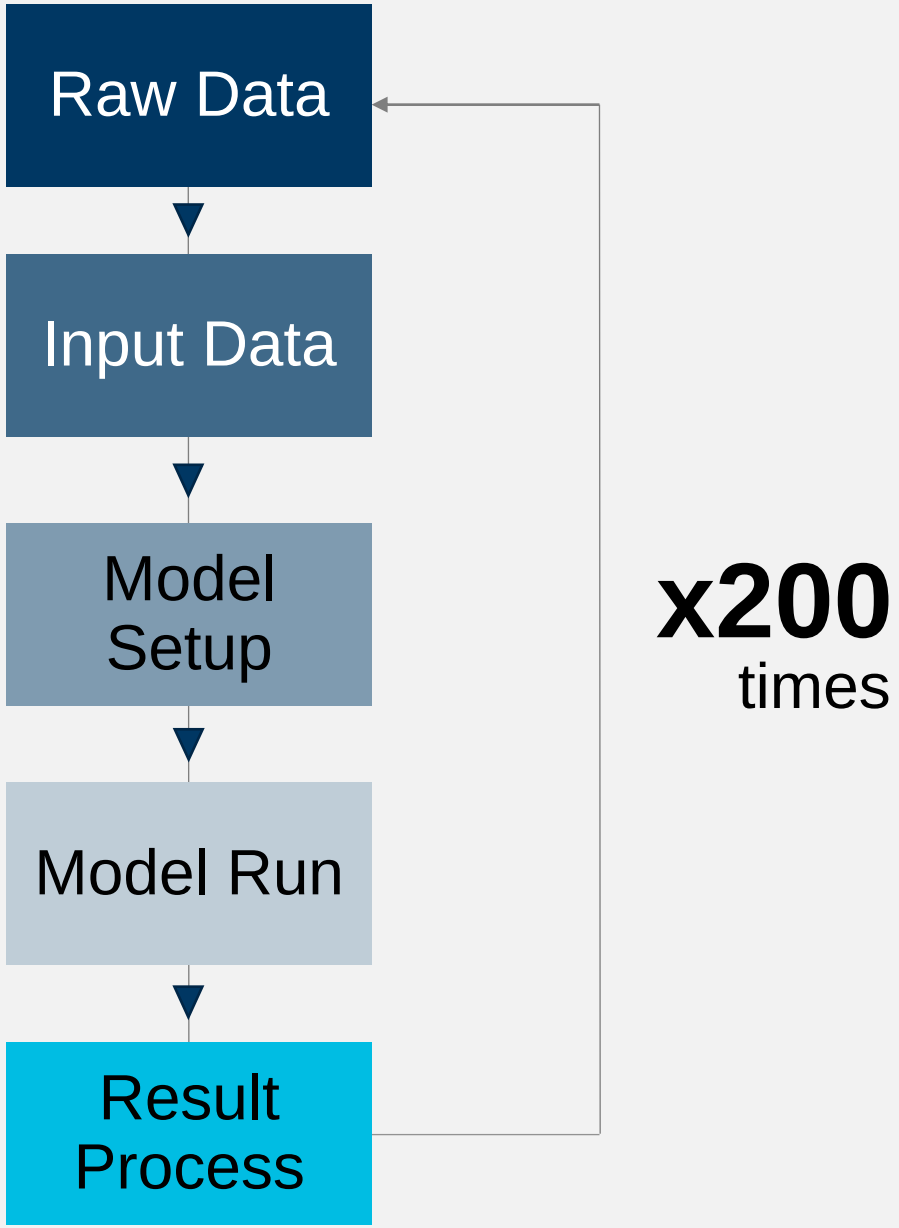


200+

Model Runs

Challenge

- Repetition
- Time required
- Human errors
- High cost



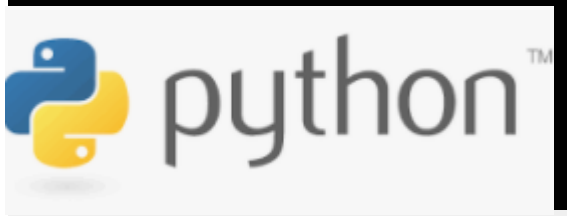
Automation Process

- Improve productivity
- Improve efficiency
- Improve quality
- Improve consistency

Automation Tools - Model Setups

– **Python scripting**
– **Excel spreadsheet**
– Batch file
– DHI tools
– Visual Basics
– ArcPy
– ArcGIS Model Builder

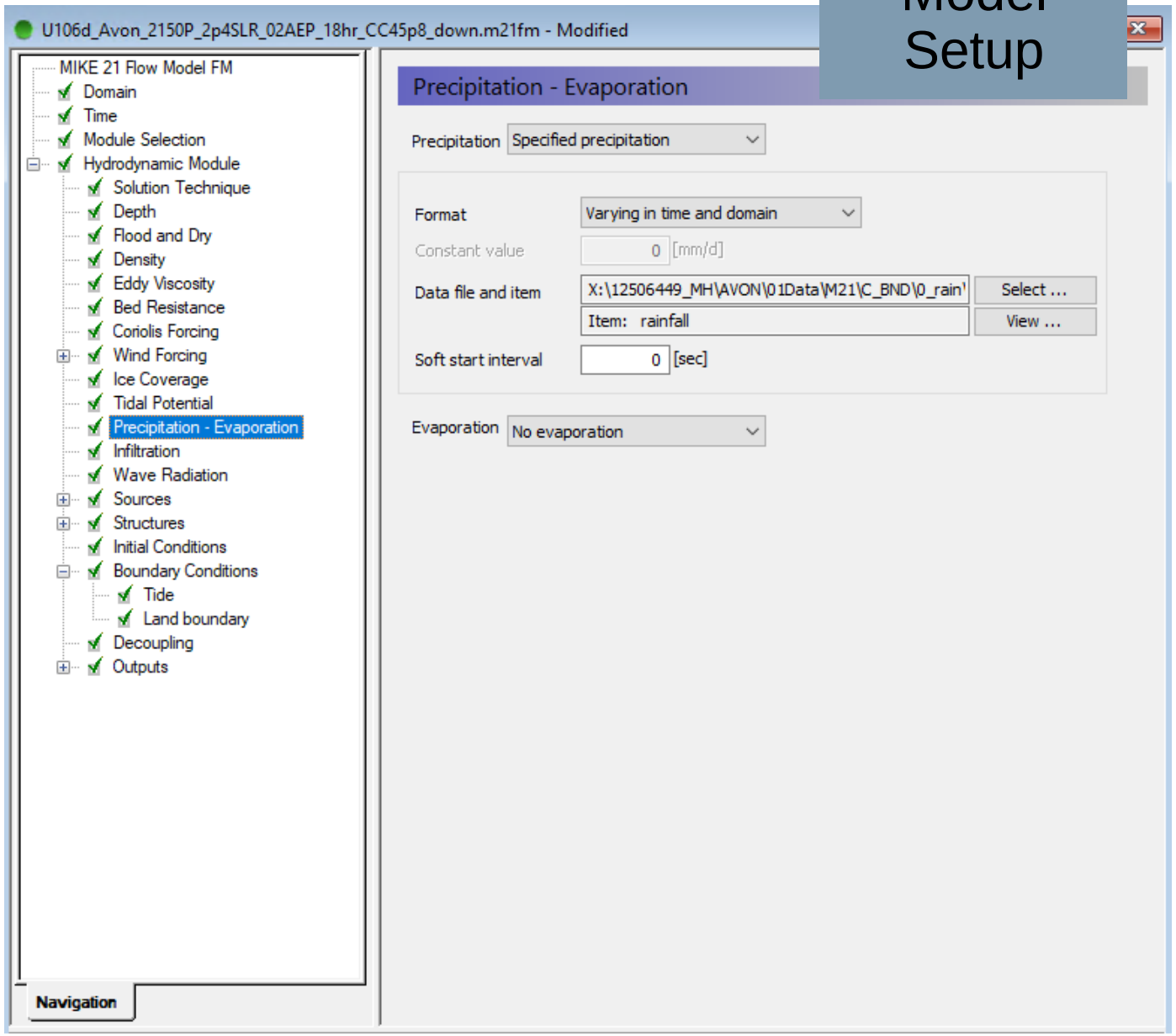
Model Setup



Windows Batch File

→ Identify Variables

Model Setup



Model Setup

Excel Spreadsheet - Database

- Populate and store model setups information
- Assign input files with consistent naming convention
- Easy to view and QA

C	H	L	N	BN	BO	BQ
ModelVer	Storm duration (hr)	Rain_CC	Setup and Result filenames	M21_rain_AEP	M21_precipitation	M21_infiltration
VXXX	9	3.3	VXXX_Avon_2030_0p19SLR_10AEP_09hr_CC3p3_down	10AEP	10AEP\Rain_2030_10AEP_09hr_0p3deg_CC3p3_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	18	2.8	VXXX_Avon_2030_0p19SLR_10AEP_18hr_CC2p8_down	10AEP	10AEP\Rain_2030_10AEP_18hr_0p3deg_CC2p8_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	36	2.4	VXXX_Avon_2030_0p19SLR_10AEP_36hr_CC2p4_down	10AEP	10AEP\Rain_2030_10AEP_36hr_0p3deg_CC2p4_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	3	4.0	VXXX_Avon_2030_0p19SLR_02AEP_03hr_CC4p0_dow	02AEP	02AEP\Rain_2030_02AEP_03hr_0p3deg_CC4p0_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	9	3.4	VXXX_Avon_2030_0p19SLR_02AEP_09hr_CC3p4_dow	02AEP	02AEP\Rain_2030_02AEP_09hr_0p3deg_CC3p4_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	18	2.9	VXXX_Avon_2030_0p19SLR_02AEP_18hr_CC2p9_down	02AEP	02AEP\Rain_2030_02AEP_18hr_0p3deg_CC2p9_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	36	2.5	VXXX_Avon_2030_0p19SLR_02AEP_36hr_CC2p5_dow	02AEP	02AEP\Rain_2030_02AEP_36hr_0p3deg_CC2p5_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	18	2.7	VXXX_Avon_2030_0p19SLR_20AEP_18hrT_CC2p7_dow	20AEP	20AEP\Rain_2030_20AEP_18hr_0p3deg_CC2p7_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2
VXXX	3	4.2	VXXX_Avon_2030_0p19SLR_00p5AEP_03hr_CC4p2_d	00p5AEP	00p5AEP\Rain_2030_00p5AEP_03hr_0p3deg_CC4p2_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_noMit.dfs2
VXXX	9	3.6	VXXX_Avon_2030_0p19SLR_00p5AEP_09hr_CC3p6_d	00p5AEP	00p5AEP\Rain_2030_00p5AEP_09hr_0p3deg_CC3p6_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_noMit.dfs2
VXXX	18	3.1	VXXX_Avon_2030_0p19SLR_00p5AEP_18hr_CC3p1_do	00p5AEP	00p5AEP\Rain_2030_00p5AEP_18hr_0p3deg_CC3p1_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_noMit.dfs2
VXXX	36	2.7	VXXX_Avon_2030_0p19SLR_00p5AEP_36hr_CC2p7_d	00p5AEP	00p5AEP\Rain_2030_00p5AEP_36hr_0p3deg_CC2p7_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_noMit.dfs2
VXXX	18	2.9	VXXX_Avon_2030_0p19SLR_05AEP_18hrT_CC2p9_dow	05AEP	05AEP\Rain_2030_05AEP_18hr_0p3deg_CC2p9_Flat.dfs2	Infiltration_MPD2041_GroundwaterD_0p19mSLR_Mit.dfs2

How do the model setups store information?

- Can be open, read and write in text editors
- Stored in computer memory in a plain text format

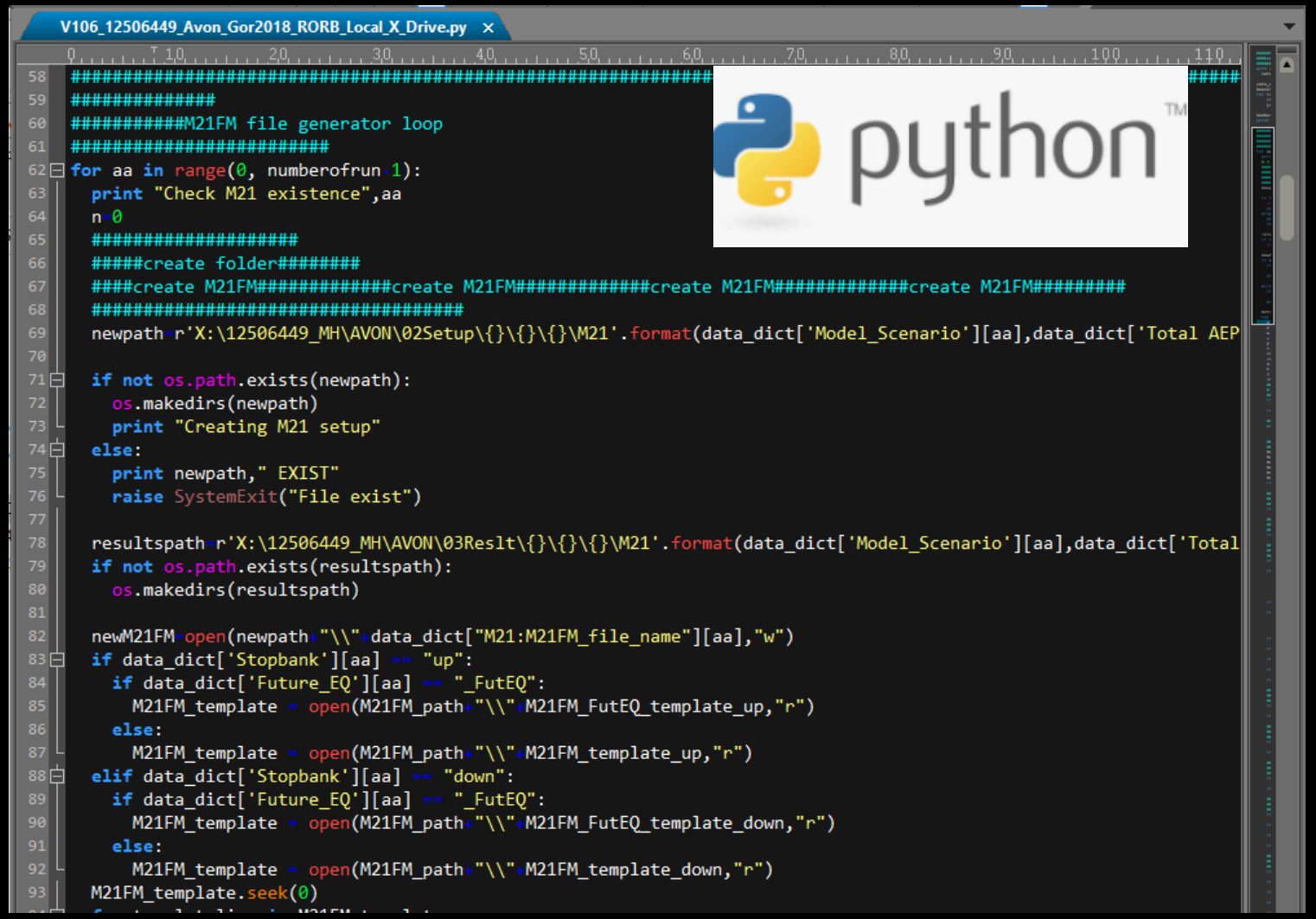
V105a_Avon_2100_1p06SLR_02AEP_36hr_CC12p1_up.m21fm - Notepad

File Edit Format View Help

```
    [PRECIPITATION_EVAPORATION]
       Touched = 1
       type_of_precipitation = 1
       type_of_evaporation = 0
       [PRECIPITATION]
          Touched = 1
          type = 1
          format = 3
          constant_value = 0
          file_name = |..\..\M21\C_BND\0_rain\02AEP\Rain_02AEP_36hr_2100_2p8deg_5th_CC12p1_Flat.dfs2|
          item_number = 1
          item_name = 'rainfall'
          type_of_soft_start = 2
          soft_time_interval = 0
          reference_value = 0
          type_of_time_interpolation = 1
       EndSect  // PRECIPITATION

       [EVAPORATION]
          Touched = 1
          type = 0
          format = 3
          constant_value = 0
          file_name = ||
          item_number = 1
          item_name = ''
          type_of_soft_start = 2
          soft_time_interval = 0
          reference_value = 0
          type_of_time_interpolation = 1
       EndSect  // EVAPORATION

    EndSect  // PRECIPITATION_EVAPORATION
```

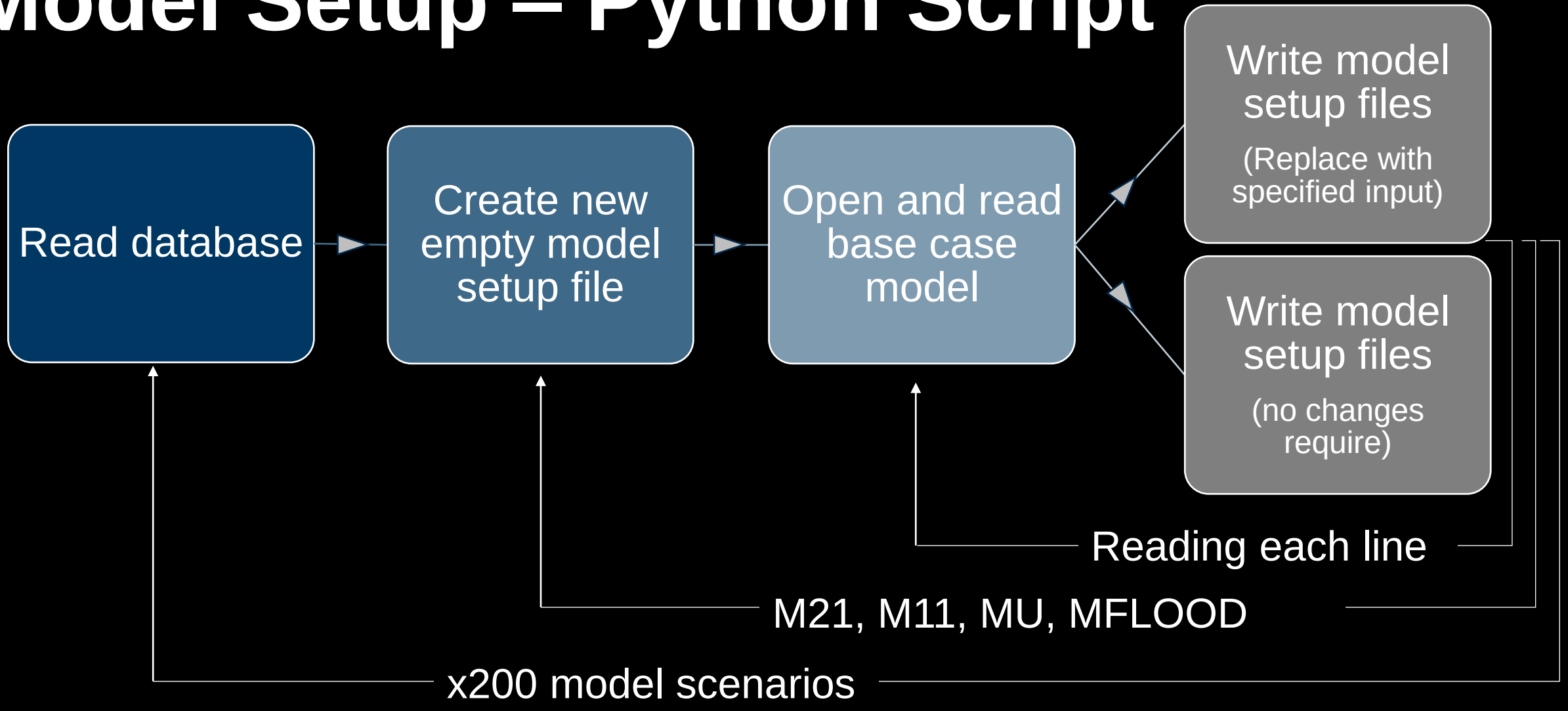
Model Setup – Python Script

- Reading files
- Writing files
- Creating files



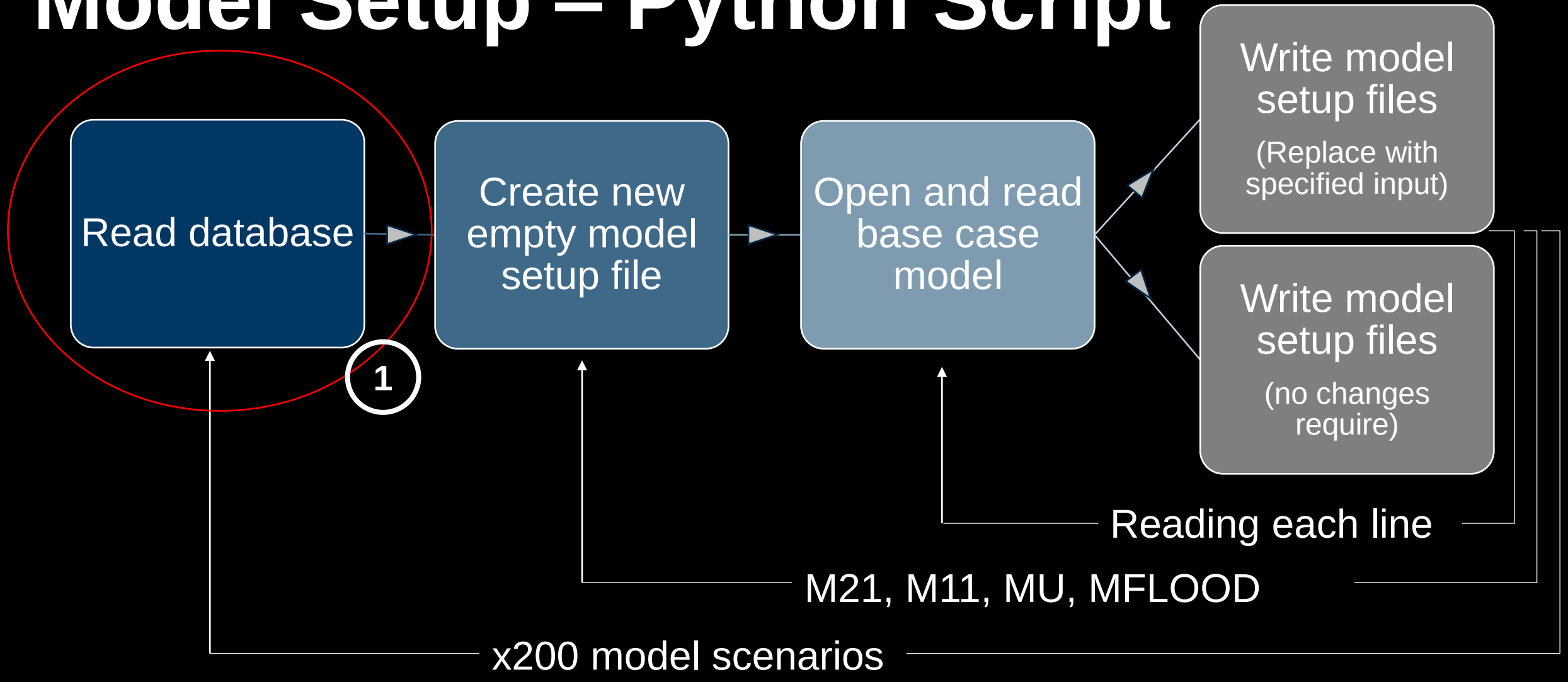
Model Setup

Model Setup – Python Script



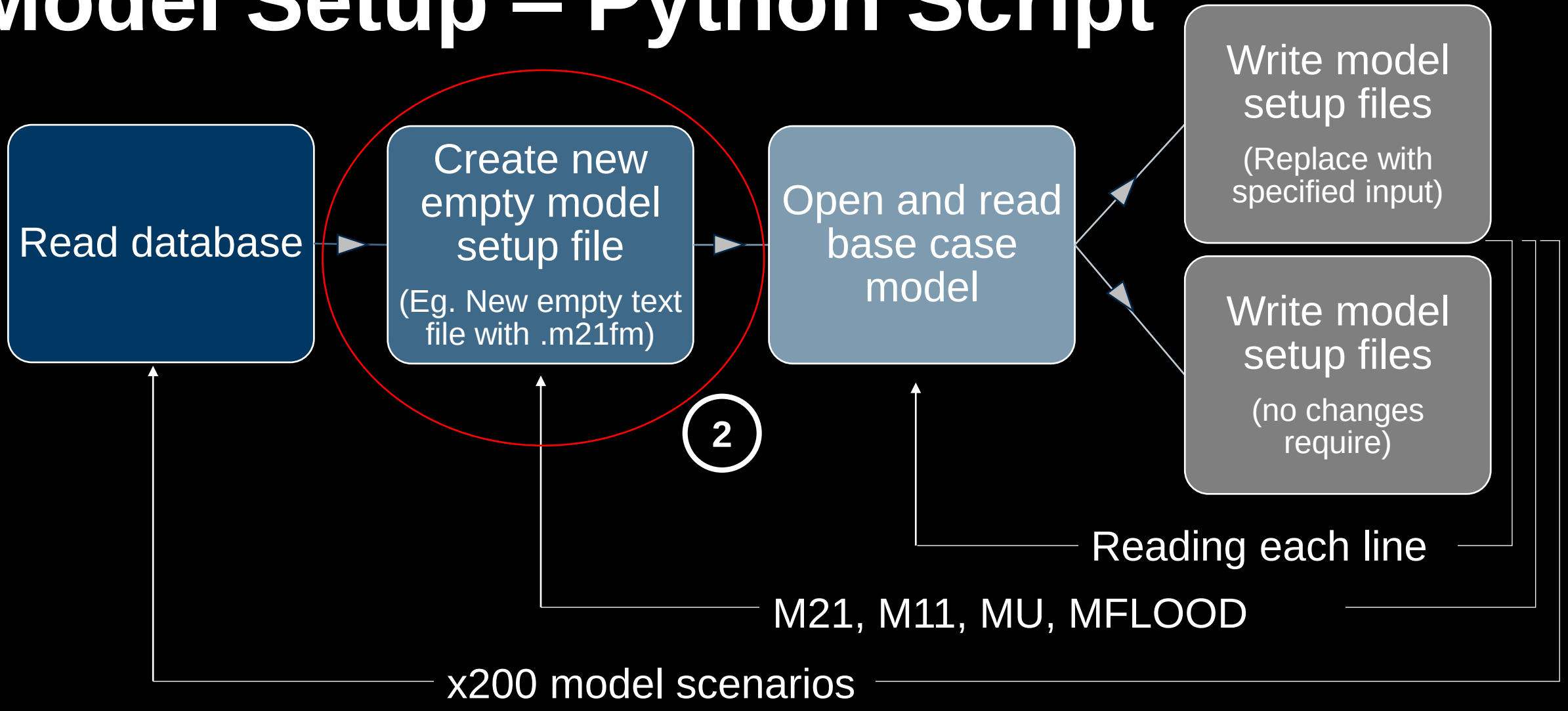
Model Setup

Model Setup – Python Script



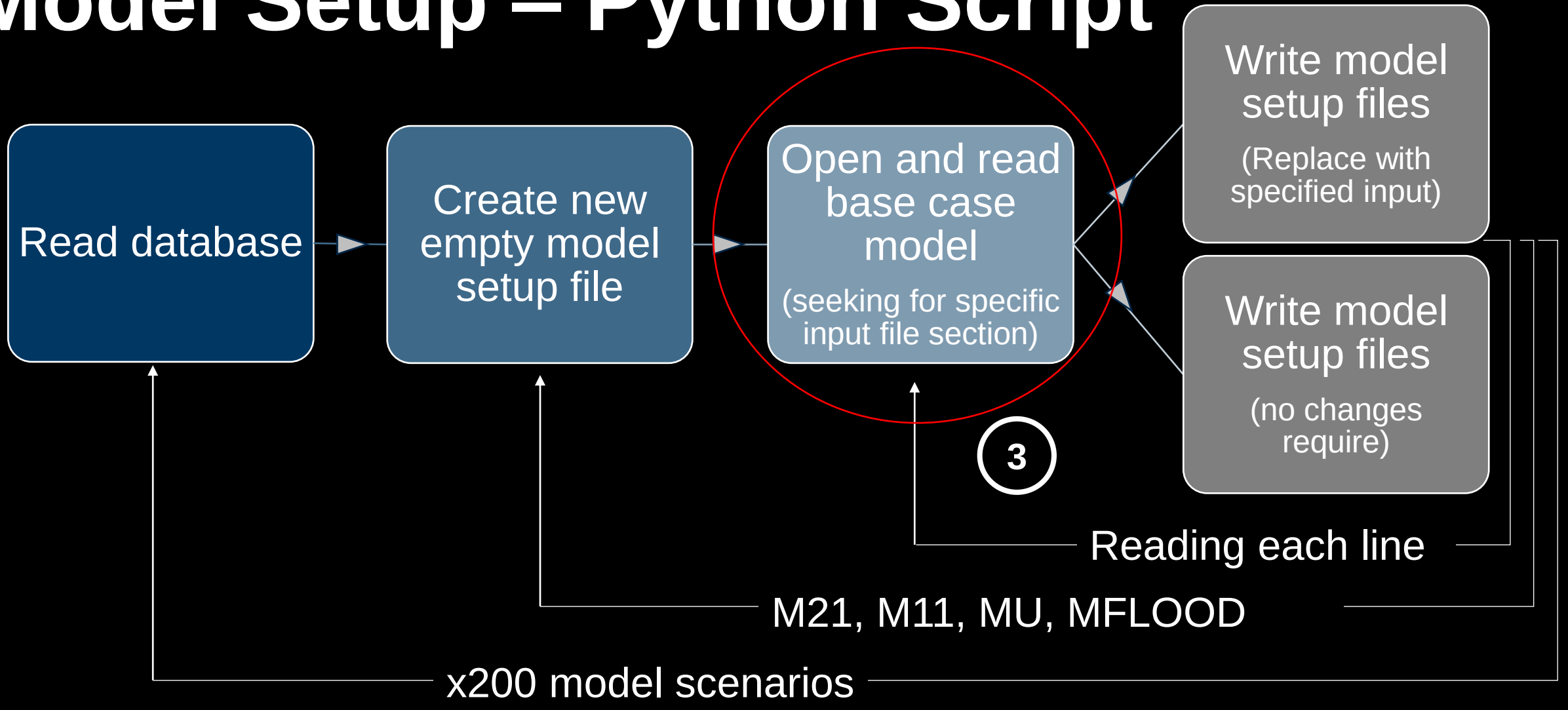
Model Setup

Model Setup – Python Script



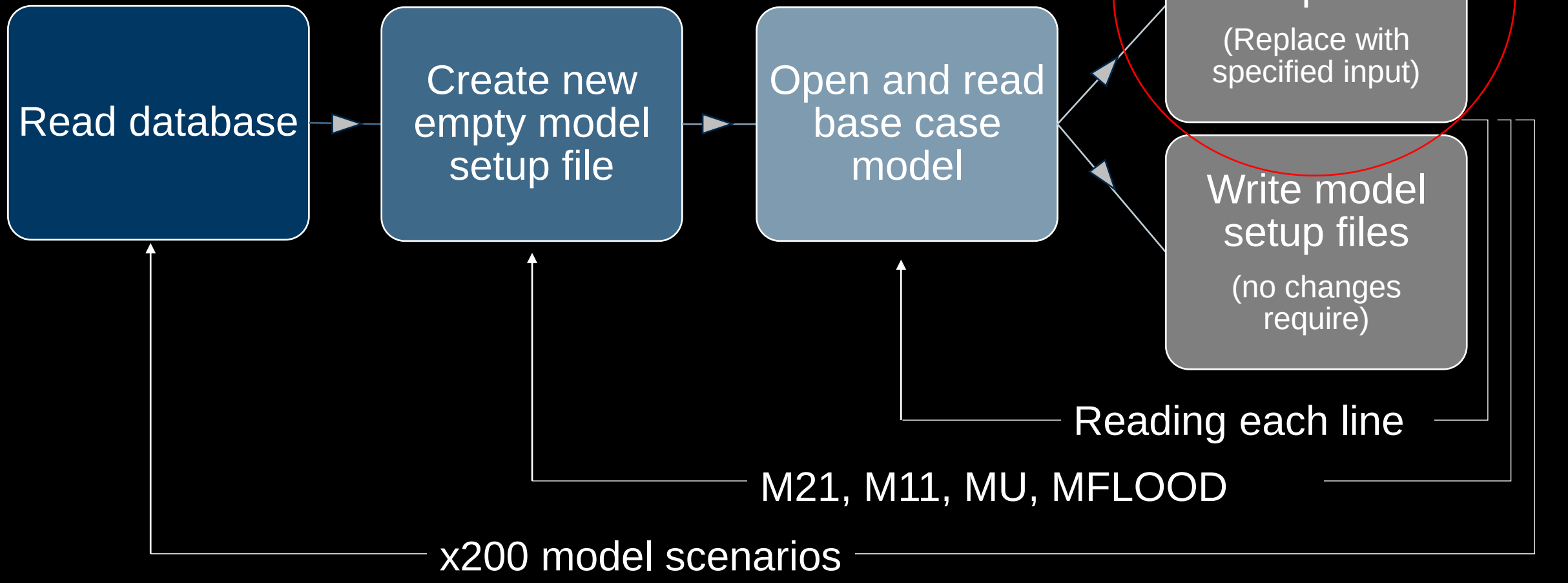
Model Setup

Model Setup – Python Script



Model Setup

Model Setup – Python Script



Model Setup

M21 Base case

V105a_Avon_2100_1p06SLR_02AEP_36hr_CC12p1_up_BASECASE.m21fm - Notepad

File Edit Format View Help

```
[PRECIPITATION_EVAPORATION]
   Touched = 1
   type_of_precipitation = 1
   type_of_evaporation = 0
   [PRECIPITATION]
      Touched = 1
      type = 1
      format = 3
      constant_value = 0
      file_name = |..\..\M21\C_BND\0_rain\02AEP\Rain_02AEP_36hr_2100_2p8deg_5th_CC12p1_Flat.dfs2|
      item_number = 1
      item_name = 'rainfall'
      type of soft start = 2
```

New model setup file

*V106d_Avon_2150_1p88SLR_00p5AEP_18hr_CC45p2_down.m21fm - Notepad

File Edit Format View Help

```
[PRECIPITATION_EVAPORATION]
   Touched = 1
   type_of_precipitation = 1
   type_of_evaporation = 0
   [PRECIPITATION]
      Touched = 1
      type = 1
      format = 3
      constant_value = 0
      file_name = |..\..\..\..\..\01Data\M21\C_BND\0_rain\00p5AEP\Rain_2150_00p5AEP_18hr_4p6deg_CC45p2_Flat.dfs2|
```

Replaced with assigned input

model files

e with input)

model files

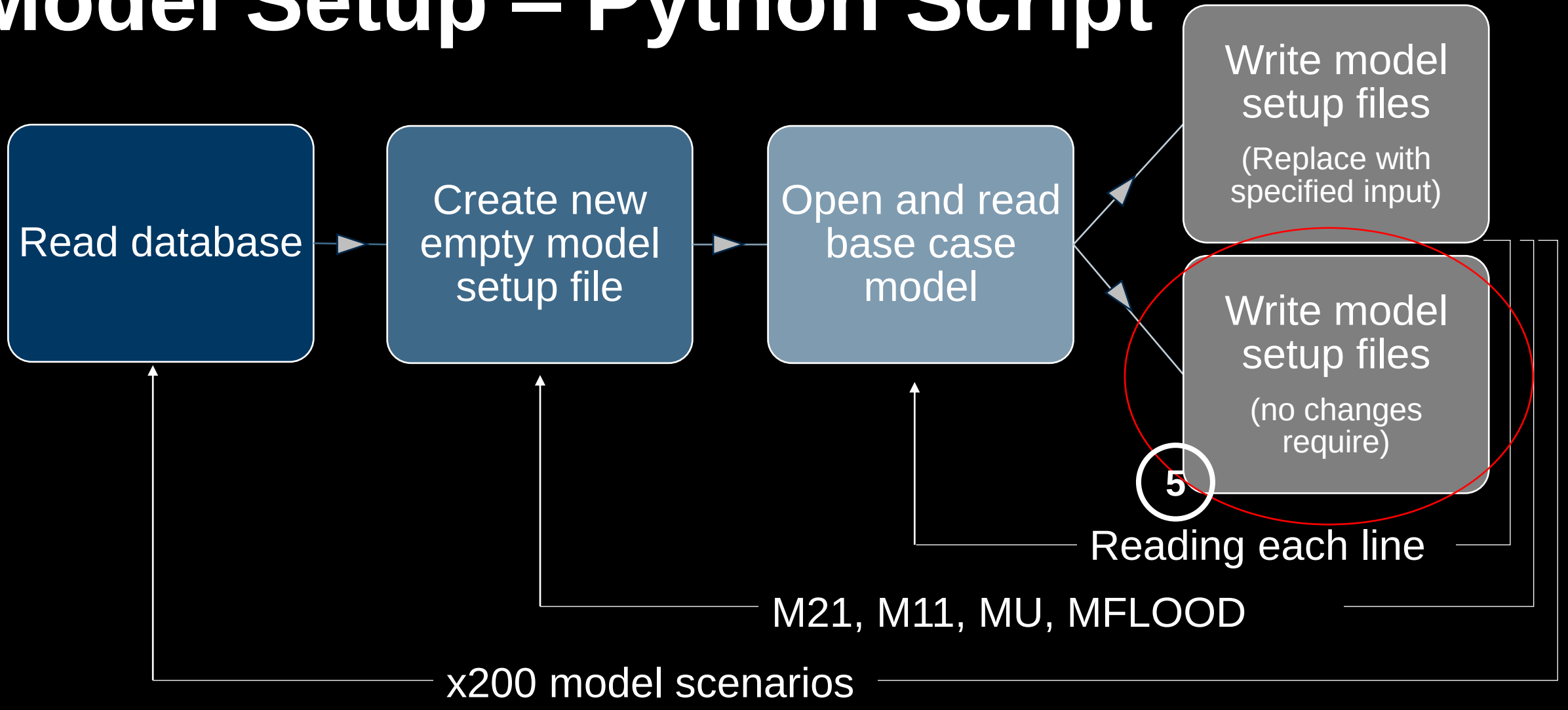
anges ire)

line

x200 model scenarios

Model Setup

Model Setup – Python Script



Model Setup

M21 Base case

V105a_Avon_2100_1p06SLR_02AEP_36hr_CC12p1_up_BASECASE.m21fm - Notepad

File Edit Format View Help

```
[PRECIPITATION_EVAPORATION]
   Touched = 1
   type_of_precipitation = 1
   type_of_evaporation = 0
   [PRECIPITATION]
      Touched = 1
      type = 1
      format = 3
      constant_value = 0
      file_name = |..\..\M21\C_BND\0_rain\02AEP\Rain_02AEP_36hr_2100_2p8deg_5th_CC12p1_Flat.dfs2|
      item_number = 1
      item_name = 'rainfall'
      type_of_soft_start = 2
      soft_time_interval = 0
      reference_value = 0
```

New model setup file

*V106d_Avon_2150_1p88SLR_00p5AEP_18hr_CC45p2_down.m21fm - Notepad

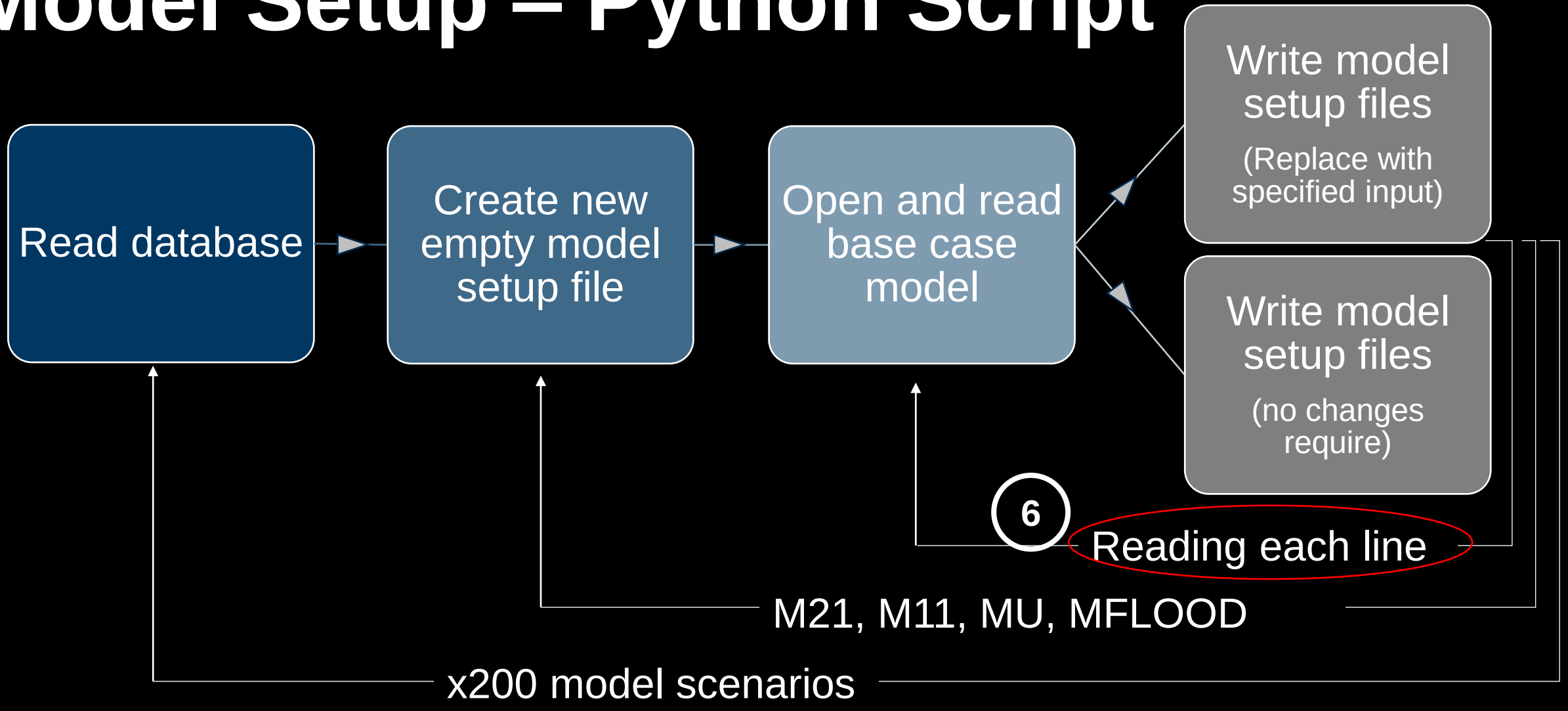
File Edit Format View Help

```
[PRECIPITATION_EVAPORATION]
   Touched = 1
   type_of_precipitation = 1
   type_of_evaporation = 0
   [PRECIPITATION]
      Touched = 1
      type = 1
      format = 3
      constant_value = 0
      file_name = |..\..\..\..\..\01Data\M21\C_BND\0_rain\00p5AEP\Rain_2150_00p5AEP_18hr_4p6deg_CC45p2_Flat.dfs2|
      item_number = 1
      item_name = 'rainfall'
      type_of_soft_start = 2
      soft_time_interval = 0
      reference_value = 0
      type_of_time_interpolation = 1
   EndSect  // PRECIPITATION
```

Copied lines without changes

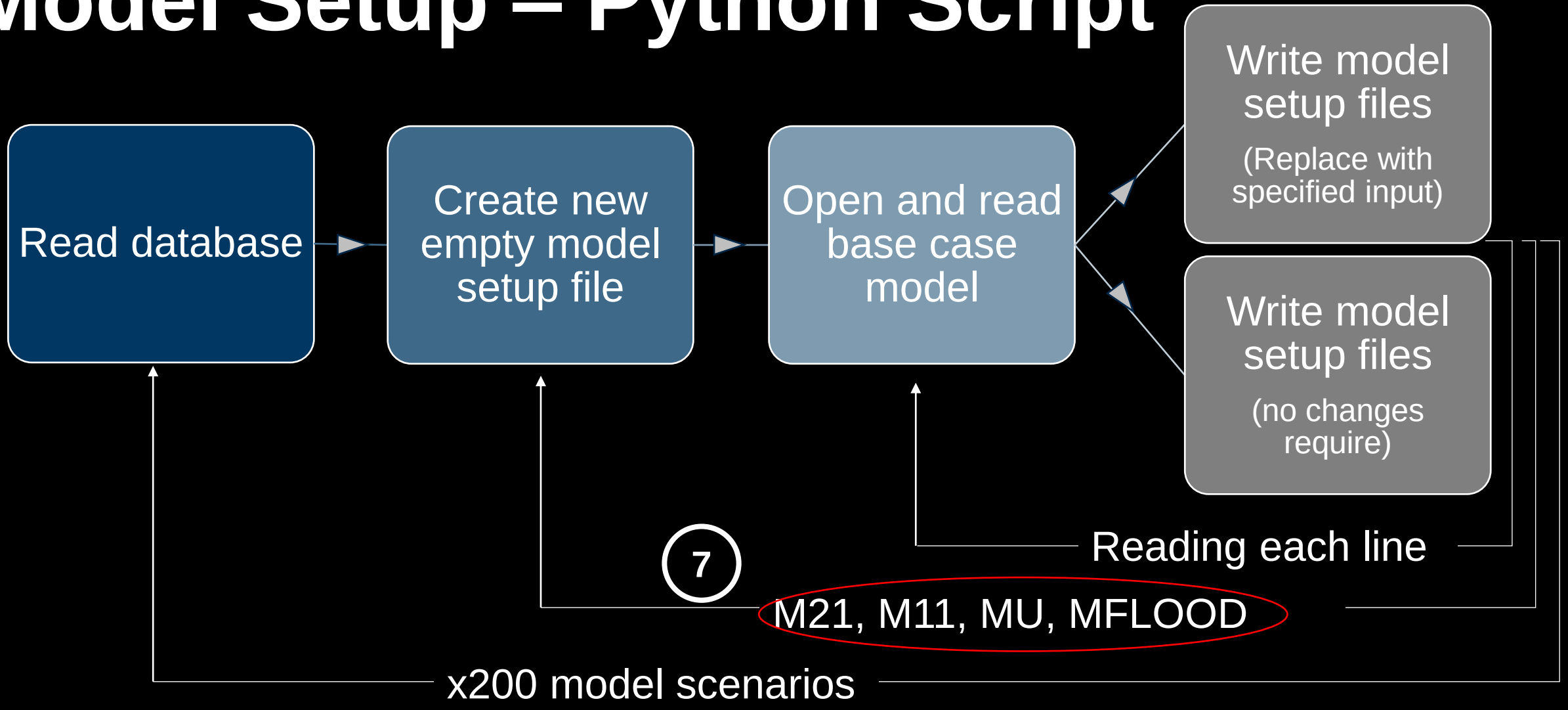
Model Setup

Model Setup – Python Script



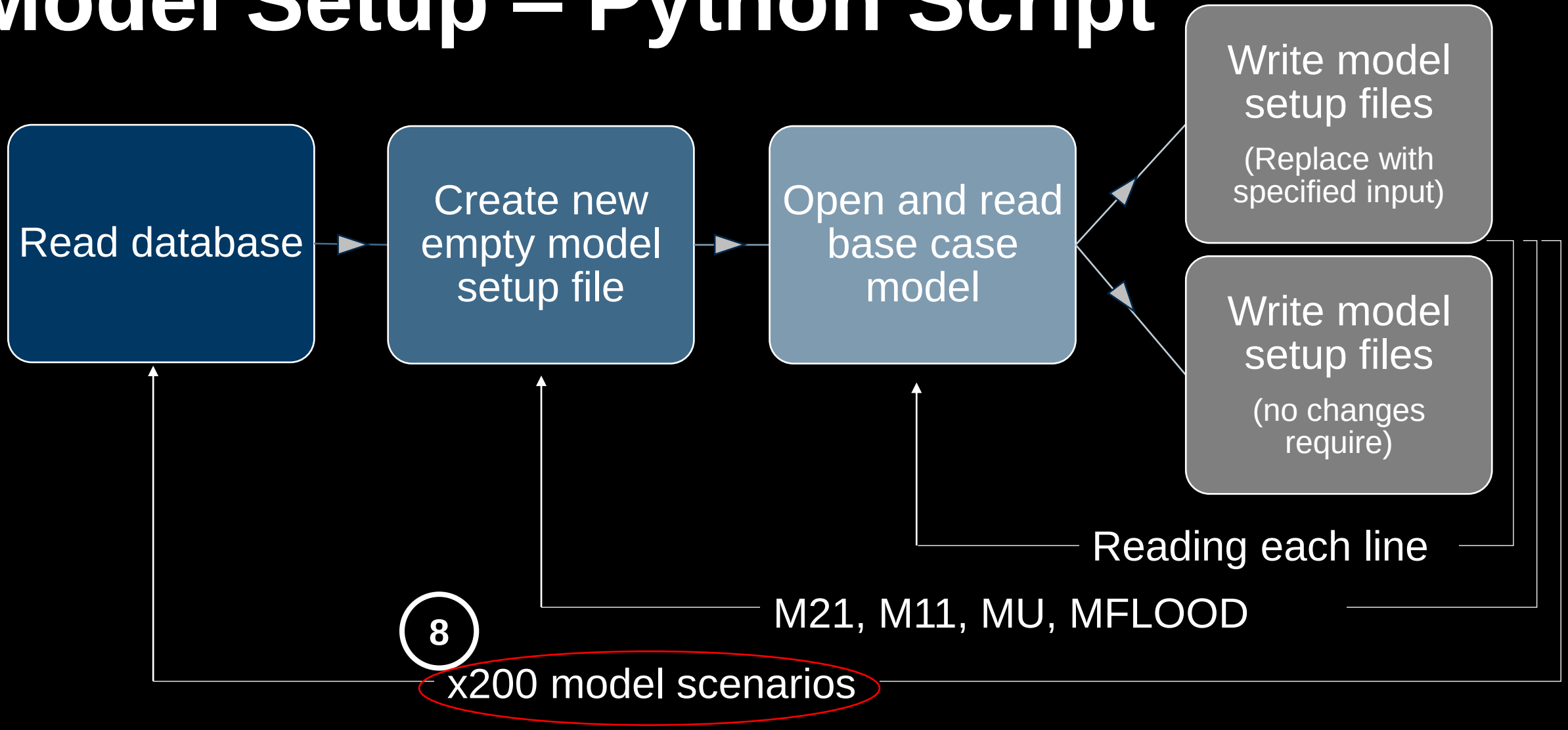
Model Setup

Model Setup – Python Script



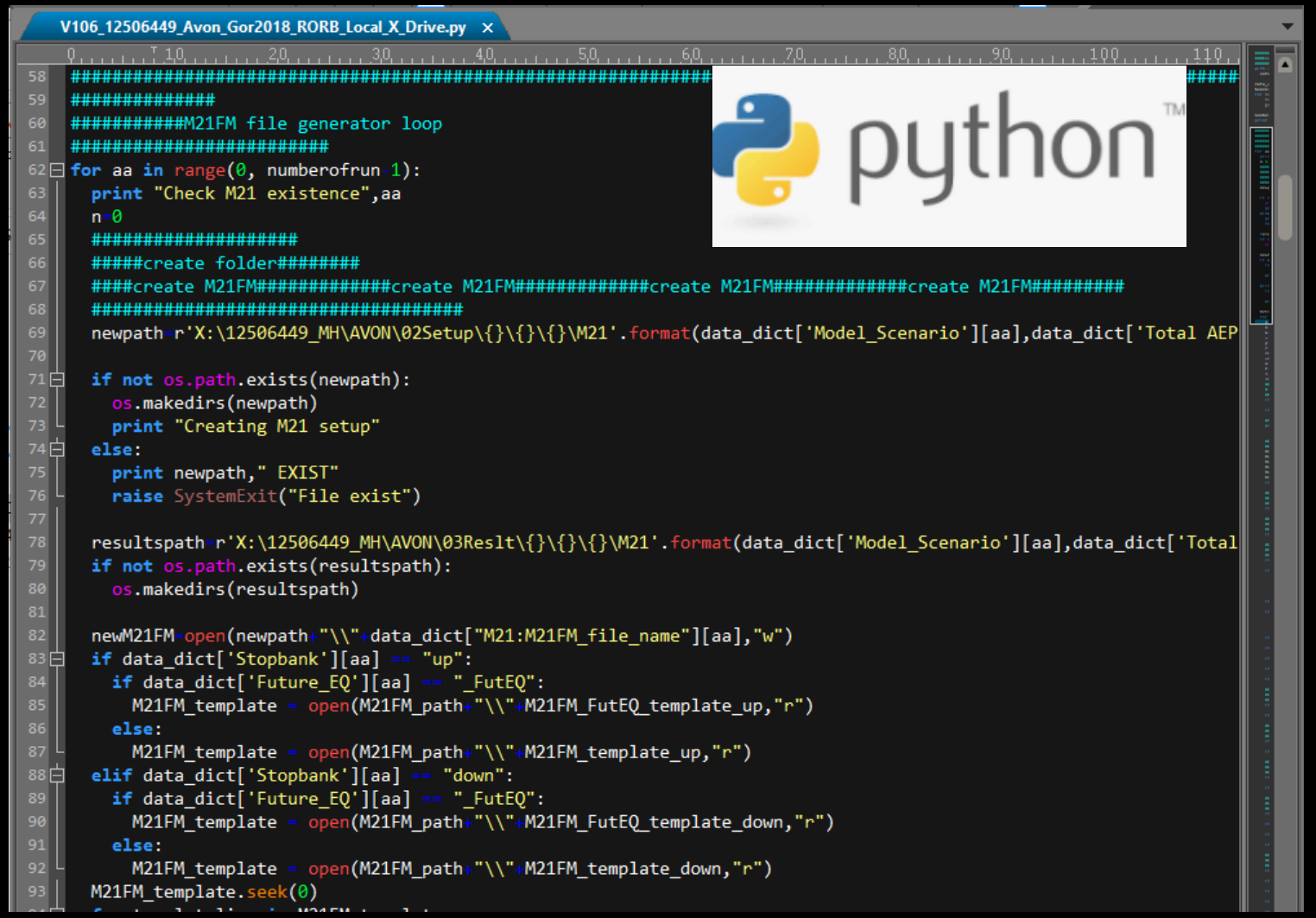
Model Setup

Model Setup – Python Script



Model Setup – Python Script

- Setup the model setups files in a short time
- Automated process can reduce the risk of human errors



Automation Tools - Model Runs & Model Runs Status Check

– Python scripting
– **Excel spreadsheet**
– **Batch file**
– DHI tools
– **Visual Basics**
– ArcPy
– ArcGIS Model Builder

Model Computations – Batch File

- Text file with .bat extension
- Load programs
- Run multiple processes
- Perform repetitive tasks
- Multiple commands and run them in sequence

Windows Batch File

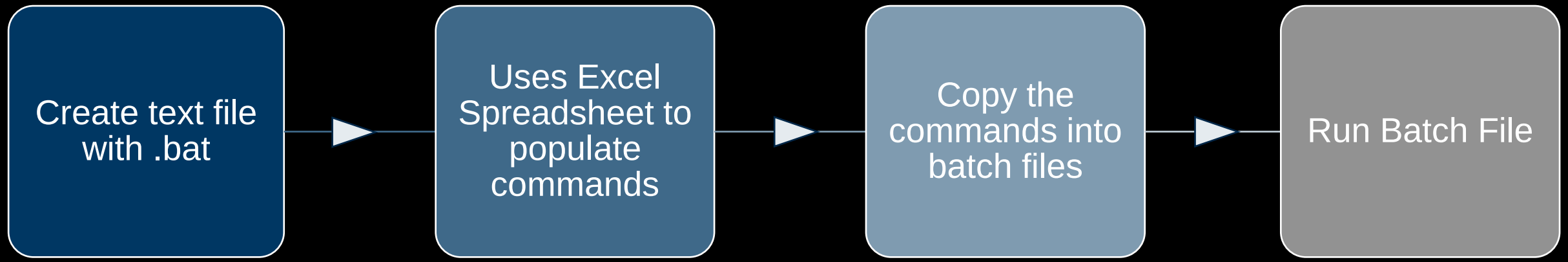
Batch_2GPU_2510_2_1_20200522.bat - Notepad

File Edit Format View Help

```
REM specify MIKEZERO path
set PATH=%PATH%;C:\Program Files (x86)\DHI\2016\bin\x64
set subdomains=2rem start /w MzLaunch.exe
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\0
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\0
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\0
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\1
Pause
```

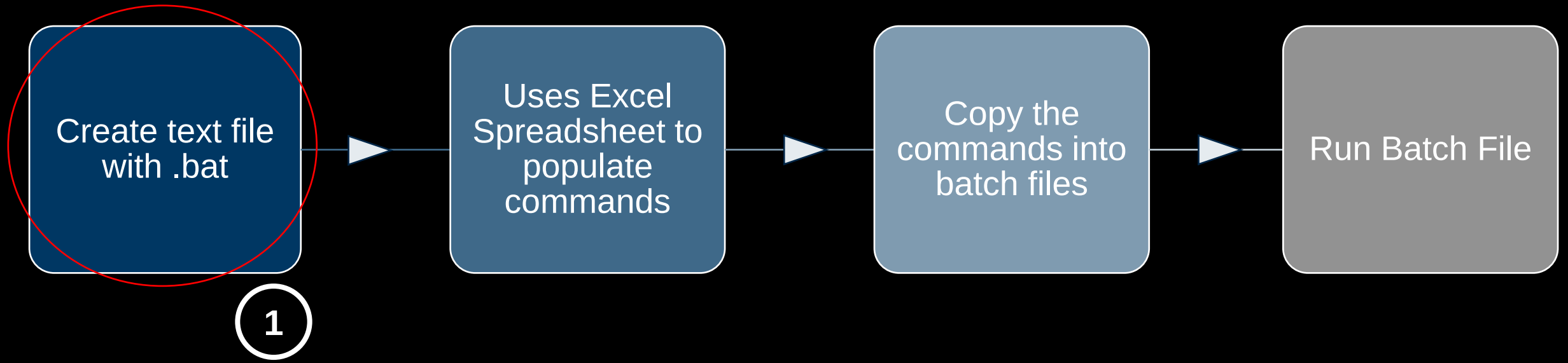
Model Run

Model Computations – Batch File



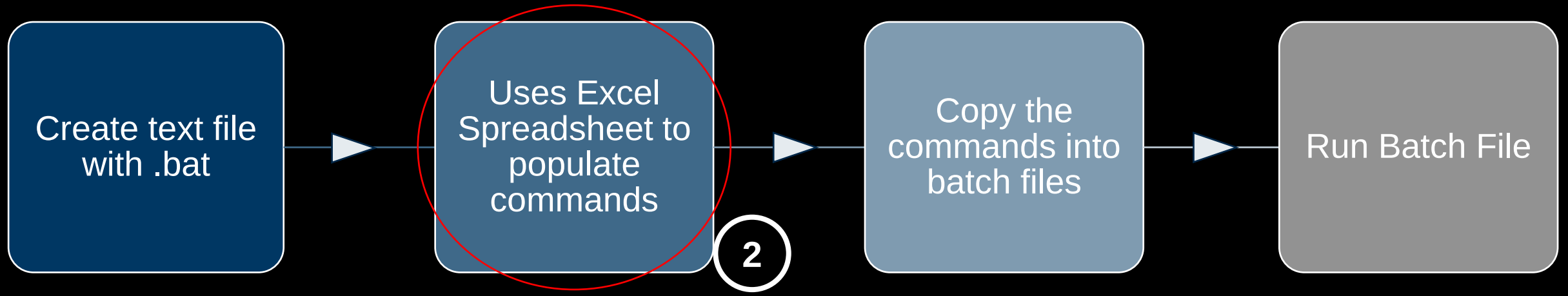
Model Run

Model Computations – Batch File



Model Run

Model Computations – Batch File



DG

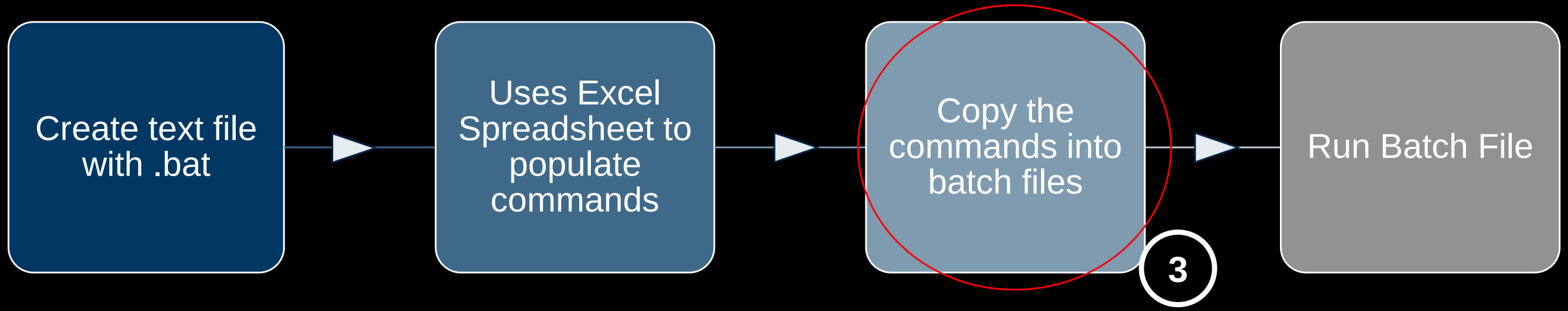
Batch_Run_Command

```
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150\00p5AEP\V106d_00p5AEP_18hr_down\MFLOOD\V106d_Avon_2150_1p88SLR_00p5AEP_18hr_CC45p2_down.couple" -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\00p5AEP\V106d_05AEP_18hrT_down\MFLOOD\V106d_Avon_2150P_2p4SLR_05AEP_18hrT_CC44p8_down.couple" -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\00p5AEP\V106d_00p5AEP_09hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_00p5AEP_09hr_CC56p0_down.couple" -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\00p5AEP\V106d_00p5AEP_36hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_00p5AEP_36hr_CC41p8_down.couple" -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\00p5AEP\V106d_00p5AEP_03hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_00p5AEP_03hr_CC64p8_down.couple" -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\00p5AEP\V106d_00p5AEP_18hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_00p5AEP_18hr_CC48p8_down.couple" -gpu 2 -x
```

1 2 3

Model Run

Model Computations – Batch File



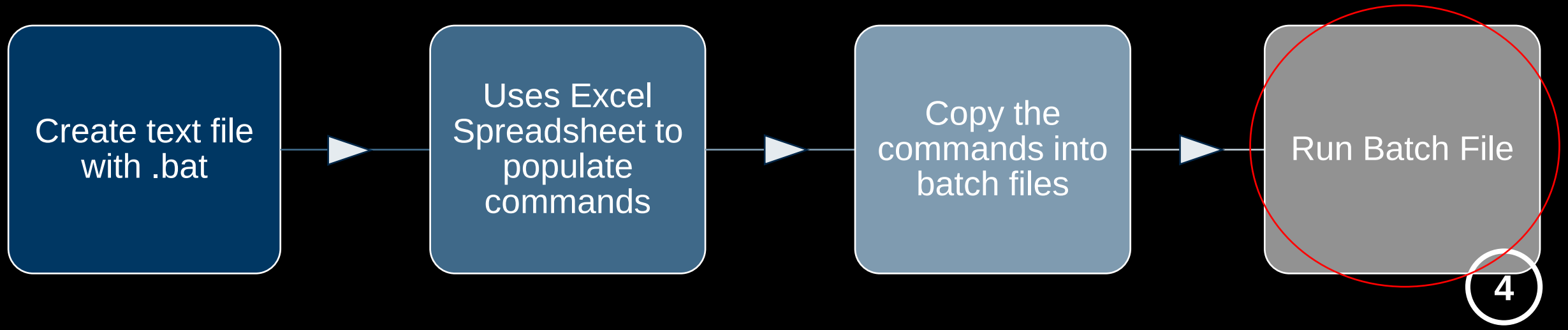
*Batch_2GPU_2510_1.bat - Notepad

File Edit Format View Help

```
set PATH=%PATH%;C:\Program Files (x86)\DHI\2016\bin\x64
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\02AEP\V106d_02AEP_09hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_02AEP_09hr_CC53p0_down.couple"  -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\10AEP\V106d_10AEP_18hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_10AEP_18hr_CC44p0_down.couple"  -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\02AEP\V106d_02AEP_18hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_02AEP_18hr_CC45p8_down.couple"  -gpu 2 -x
```

Model Run

Model Computations – Batch File



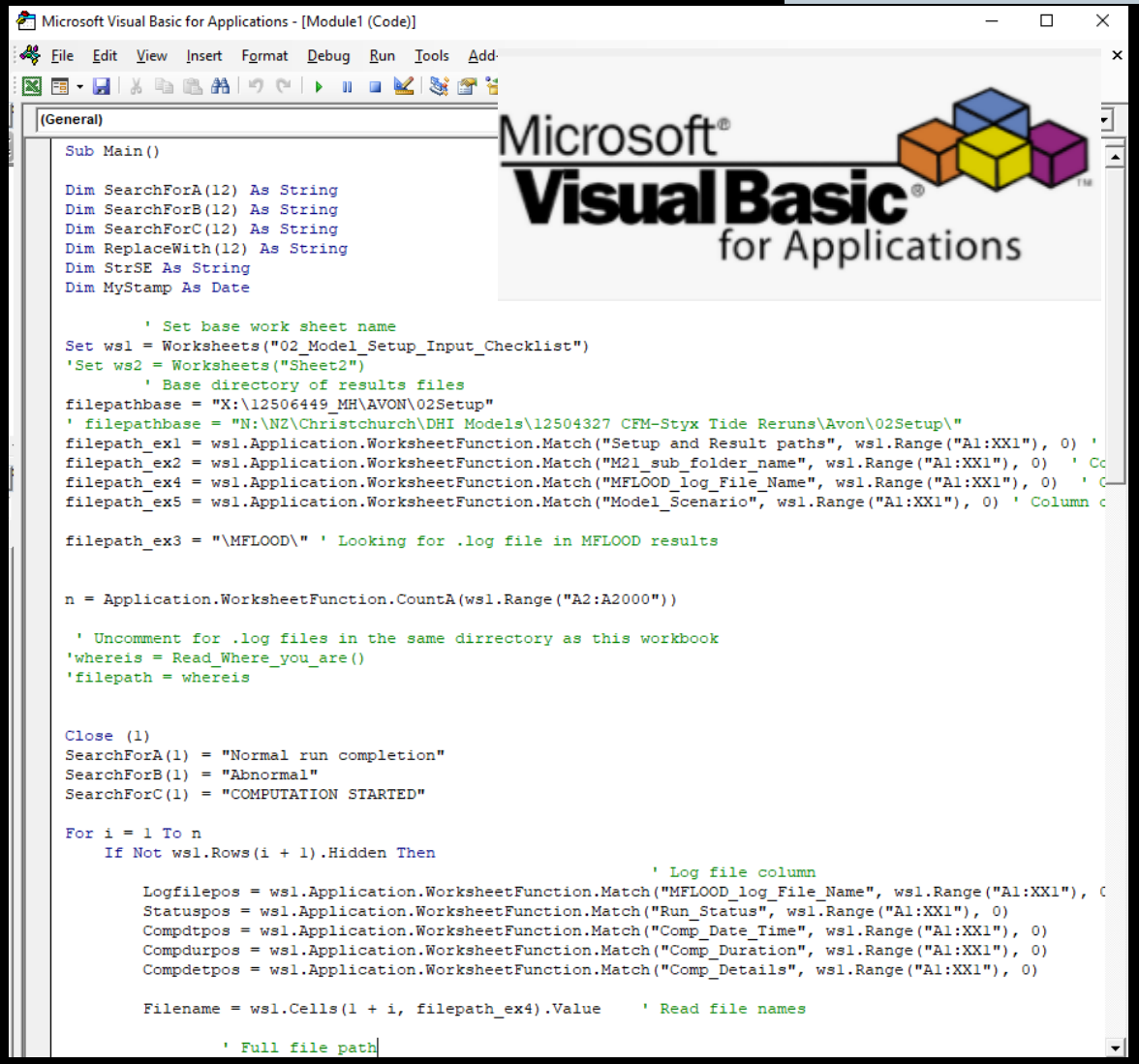
*Batch_2GPU_2510_1.bat - Notepad

File Edit Format View Help

```
set PATH=%PATH%;C:\Program Files (x86)\DHI\2016\bin\x64
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\02AEP\V106d_02AEP_09hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_02AEP_09hr_CC53p0_down.couple"  -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\10AEP\V106d_10AEP_18hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_10AEP_18hr_CC44p0_down.couple"  -gpu 2 -x
start /w MzLaunch.exe "X:\12506449_MH\AVON\02Setup\2150P\02AEP\V106d_02AEP_18hr_down\MFLOOD\V106d_Avon_2150P_2p4SLR_02AEP_18hr_CC45p8_down.couple"  -gpu 2 -x
```

Model Run Status Check – Visual Basic

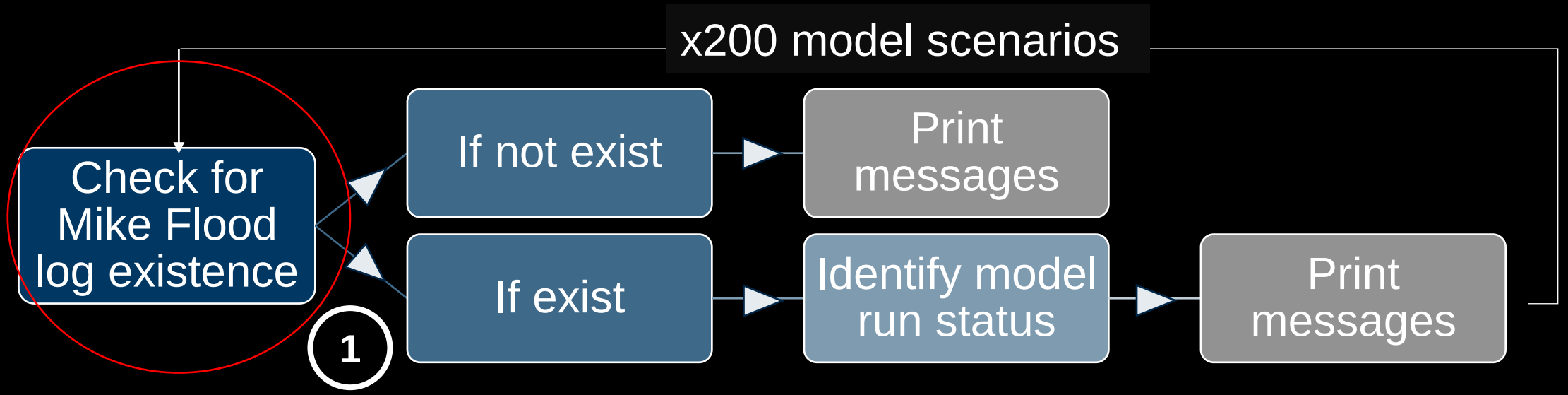
- Normally used in excel to write macros
- Can be used to automate a series of manual operations




```
Sub Main()

Dim SearchForA(12) As String
Dim SearchForB(12) As String
Dim SearchForC(12) As String
Dim ReplaceWith(12) As String
Dim StrSE As String
Dim MyStamp As Date

        ' Set base work sheet name
Set ws1 = Worksheets("02_Model_Setup_Input_Checklist")
'Set ws2 = Worksheets("Sheet2")
        ' Base directory of results files
filepathbase = "X:\12506449_MH\AVON\02Setup"
' filepathbase = "N:\NZ\Christchurch\DHI Models\12504327 CFM-Styx Tide Reruns\Avon\02Setup\"
filepath_ex1 = ws1.Application.WorksheetFunction.Match("Setup and Result paths", ws1.Range("A1:XX1"), 0) '
filepath_ex2 = ws1.Application.WorksheetFunction.Match("M21_sub_folder_name", ws1.Range("A1:XX1"), 0)  ' Co
filepath_ex4 = ws1.Application.WorksheetFunction.Match("MFLOOD_log_File_Name", ws1.Range("A1:XX1"), 0)  ' C
filepath_ex5 = ws1.Application.WorksheetFunction.Match("Model_Scenario", ws1.Range("A1:XX1"), 0) ' Column c

filepath_ex3 = "\MFLOOD\" ' Looking for .log file in MFLOOD results


n = Application.WorksheetFunction.CountA(ws1.Range("A2:A2000"))

 ' Uncomment for .log files in the same dirrectory as this workbook
'whereis = Read_Where_you_are()
'filepath = whereis


Close (1)
SearchForA(1) = "Normal run completion"
SearchForB(1) = "Abnormal"
SearchForC(1) = "COMPUTATION STARTED"

For i = 1 To n
    If Not ws1.Rows(i + 1).Hidden Then
                                                    ' Log file column
        Logfilepos = ws1.Application.WorksheetFunction.Match("MFLOOD_log_File_Name", ws1.Range("A1:XX1"), 0
        Statuspos = ws1.Application.WorksheetFunction.Match("Run_Status", ws1.Range("A1:XX1"), 0)
        Compdtpos = ws1.Application.WorksheetFunction.Match("Comp_Date_Time", ws1.Range("A1:XX1"), 0)
        Compdurpos = ws1.Application.WorksheetFunction.Match("Comp_Duration", ws1.Range("A1:XX1"), 0)
        Compdetpos = ws1.Application.WorksheetFunction.Match("Comp_Details", ws1.Range("A1:XX1"), 0)

        Filename = ws1.Cells(1 + i, filepath_ex4).Value    ' Read file names

                ' Full file path
```

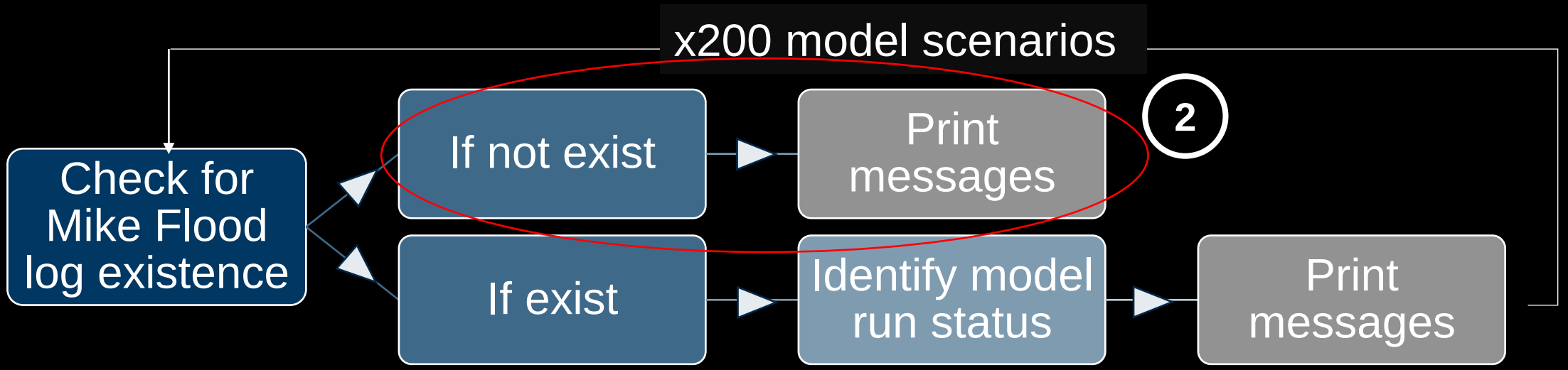
Model Run

Model Run Status Check – Visual Basic



Setup and Result filenames	Run_Status Run Check	Comp_Date_Time	Comp_Duration	Comp_Details
V106_Avon_2020_0SLR_00p5AEP_36hr_down	ABNORMAL COMP.	14/04/2020 11:22	2:25	Abnormal completion; An error occurred during the River model calculation.
V106_Avon_2100_1p06SLR_00p5AEP_03hr_CC36p8_down	ABNORMAL COMP.	10/04/2020 12:16	0:56	Abnormal run completion; An error occurred during the Urban model calculation.;
V106_Avon_2020_0SLR_00p5AEP_03hr_down	DONE	14/04/2020 17:56	5:09	Normal run completion; ;
V106_Avon_2020_0SLR_00p5AEP_09hr_down	LOG NOT FOUND			
V106_Avon_2020_0SLR_00p5AEP_18hr_down	LOG FOUND			========== COMPUTATION STARTED ==========; ;

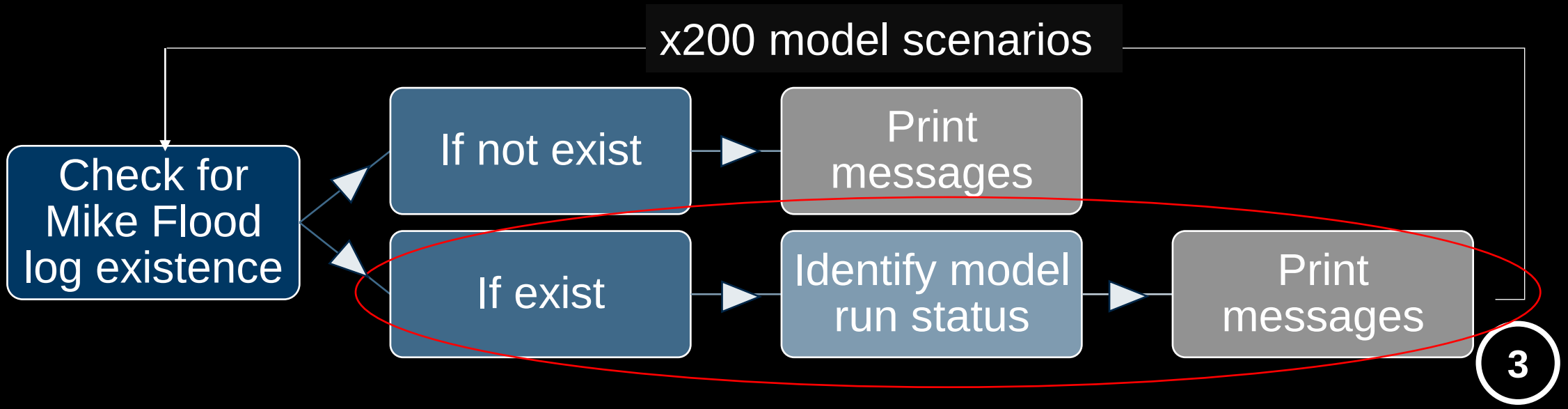
Model Run Status Check – Visual Basic



Setup and Result filenames	Run_Status	Comp_Date_Time	Comp_Duration	Comp_Details
	Run Check			
V106_Avon_2020_0SLR_00p5AEP_36hr_down	ABNORMAL COMP.	14/04/2020 11:22	2:25	Abnormal completion; An error occurred during the River model calculation.
V106_Avon_2100_1p06SLR_00p5AEP_03hr_CC36p8_down	ABNORMAL COMP.	10/04/2020 12:16	0:56	Abnormal run completion; An error occurred during the Urban model calculation.;
V106_Avon_2020_0SLR_00p5AEP_03hr_down	DONE	14/04/2020 17:56	5:09	Normal run completion; ;
V106_Avon_2020_0SLR_00p5AEP_09hr_down	LOG NOT FOUND	2		
V106_Avon_2020_0SLR_00p5AEP_18hr_down	LOG FOUND			========== COMPUTATION STARTED ==========; ;

Model Run

Model Run Status Check – Visual Basic



Setup and Result filenames	Run_Status	Comp_Date_Time	Comp_Duration	Comp_Details
	Run Check			
V106_Avon_2020_0SLR_00p5AEP_36hr_down	ABNORMAL COMP.	14/04/2020 11:22	2:25	Abnormal completion; An error occurred during the River model calculation.
V106_Avon_2100_1p06SLR_00p5AEP_03hr_CC36p8_down	ABNORMAL COMP.	10/04/2020 12:16	0:56	Abnormal run completion; An error occurred during the Urban model calculation.;
V106_Avon_2020_0SLR_00p5AEP_03hr_down	DONE	14/04/2020 17:56	5:09	Normal run completion;
V106_Avon_2020_0SLR_00p5AEP_09hr_down	LOG NOT FOUND			
V106_Avon_2020_0SLR_00p5AEP_18hr_down	LOG FOUND			========== COMPUTATION STARTED ==========; ;

3b

3a

3c

Model Run Status Check – Visual Basic

- Identify the model run progress in one click.
- Give us the opportunity to investigate model failures earlier and make model stability adjustments before the batch is completed.

N	AA	AB	AC	
Setup and Result filenames	Run Check	Comp_Date_Time	Comp_Duration	Comp_Details
V106_Avon_2020_0SLR_00p5AEP_03hr_down	DONE	14/04/2020 17:56	5:09	Normal run completion; ;
V106_Avon_2020_0SLR_00p5AEP_09hr_down	DONE	14/04/2020 21:54	12:56	Normal run completion; ;
V106_Avon_2020_0SLR_00p5AEP_18hr_down	DONE	15/04/2020 6:19	21:21	Normal run completion; ;
V106_Avon_2020_0SLR_05AEP_18hrT_down	DONE	15/04/2020 3:47	18:50	Normal run completion; ;
V106_Avon_2020_0SLR_00p5AEP_36hr_down	ABNORMAL COMP.	14/04/2020 11:22	2:25	Abnormal completion; An error occurred during the River model calculation.; Illegal storage access
V106_Avon_2060_0p45SLR_00p5AEP_03hr_CC18p2_down	ABNORMAL COMP.	11/04/2020 0:40	0:29	Abnormal completion; An error occurred during the River model calculation.; Illegal storage access
V106_Avon_2060_0p45SLR_00p5AEP_09hr_CC15p7_down	DONE	10/04/2020 5:16	10:30	Normal run completion; ;
V106_Avon_2060_0p45SLR_00p5AEP_18hr_CC13p7_down	DONE	11/04/2020 0:11	18:54	Normal run completion; ;
V106_Avon_2060_0p45SLR_05AEP_18hrT_CC12p5_down	DONE	13/04/2020 3:49	18:31	Normal run completion; ;
V106_Avon_2060_0p45SLR_00p5AEP_36hr_CC11p7_down	DONE	12/04/2020 9:18	8:37	Normal run completion; ;
V106_Avon_2100_1p06SLR_00p5AEP_03hr_CC36p8_down	ABNORMAL COMP.	10/04/2020 12:16	0:56	Abnormal run completion; An error occurred during the Urban model calculation.;
V106_Avon_2100_1p06SLR_00p5AEP_09hr_CC31p8_down	ABNORMAL COMP.	10/04/2020 13:00	0:43	Abnormal run completion; An error occurred during the Urban model calculation.;
V106_Avon_2100_1p06SLR_05AEP_18hrT_CC25p4_down	DONE	12/04/2020 17:42	19:00	Normal run completion; ;
V106_Avon_2100_1p06SLR_00p5AEP_36hr_CC23p7_down	DONE	11/04/2020 22:41	9:40	Normal run completion; ;
V106_Avon_2100_1p06SLR_00p5AEP_18hr_CC27p7_down	ABNORMAL COMP.	10/04/2020 11:19	18:29	Abnormal completion; An error occurred during the River model calculation.; Illegal storage access
V106_Avon_2150P_2p4SLR_10AEP_18hr_CC44p0_down	ABNORMAL COMP.	9/04/2020 18:00	0:32	Abnormal completion; An error occurred during the River model calculation.; Illegal storage access
V106_Avon_2150P_2p4SLR_10AEP_03hr_CC60p8_down	ABNORMAL COMP.	10/04/2020 1:19	0:48	Abnormal run completion; An error occurred during the Urban model calculation.;
V106_Avon_2150P_2p4SLR_10AEP_09hr_CC50p8_down	ABNORMAL COMP.	10/04/2020 0:30	6:28	Abnormal completion; An error occurred during the River model calculation.; Illegal storage access

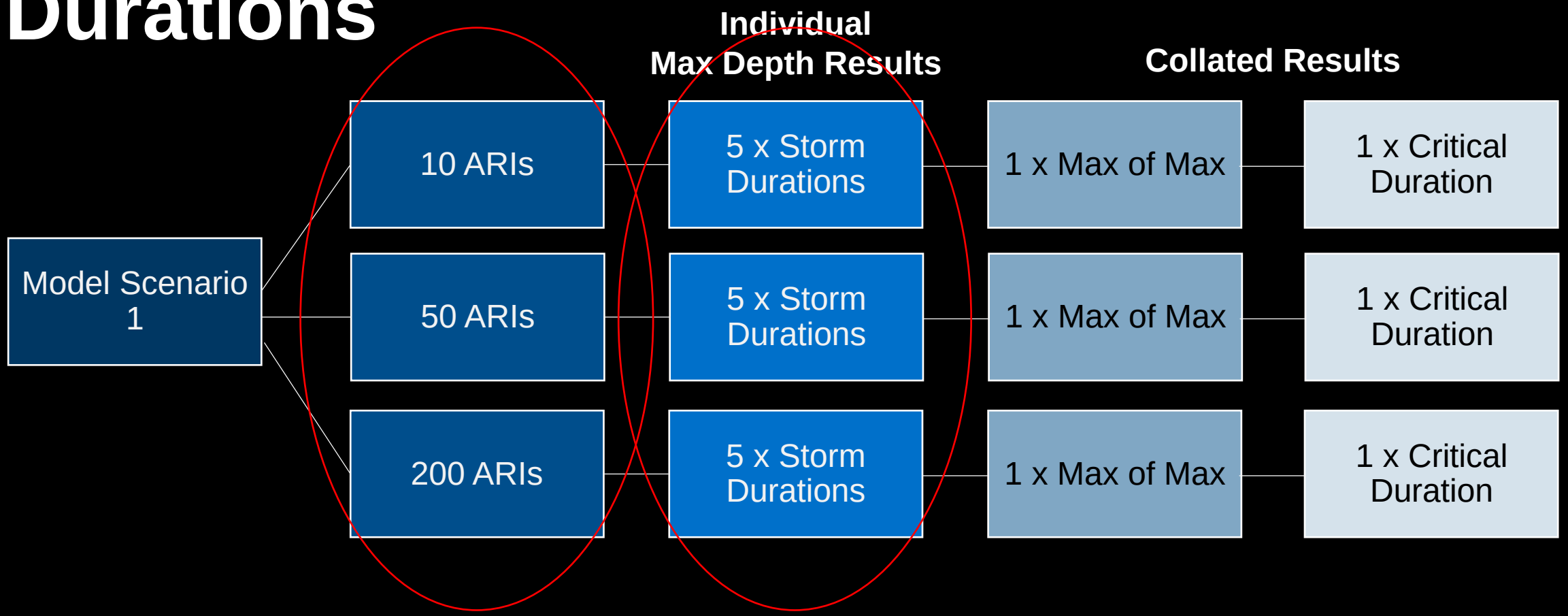
Automation Tools - Result Post Process

- **Python scripting**
- **Excel spreadsheet**
- **Batch file**
- DHI tools
- Visual Basics
- **ArcPy**
- ArcGIS Model Builder

Result Process

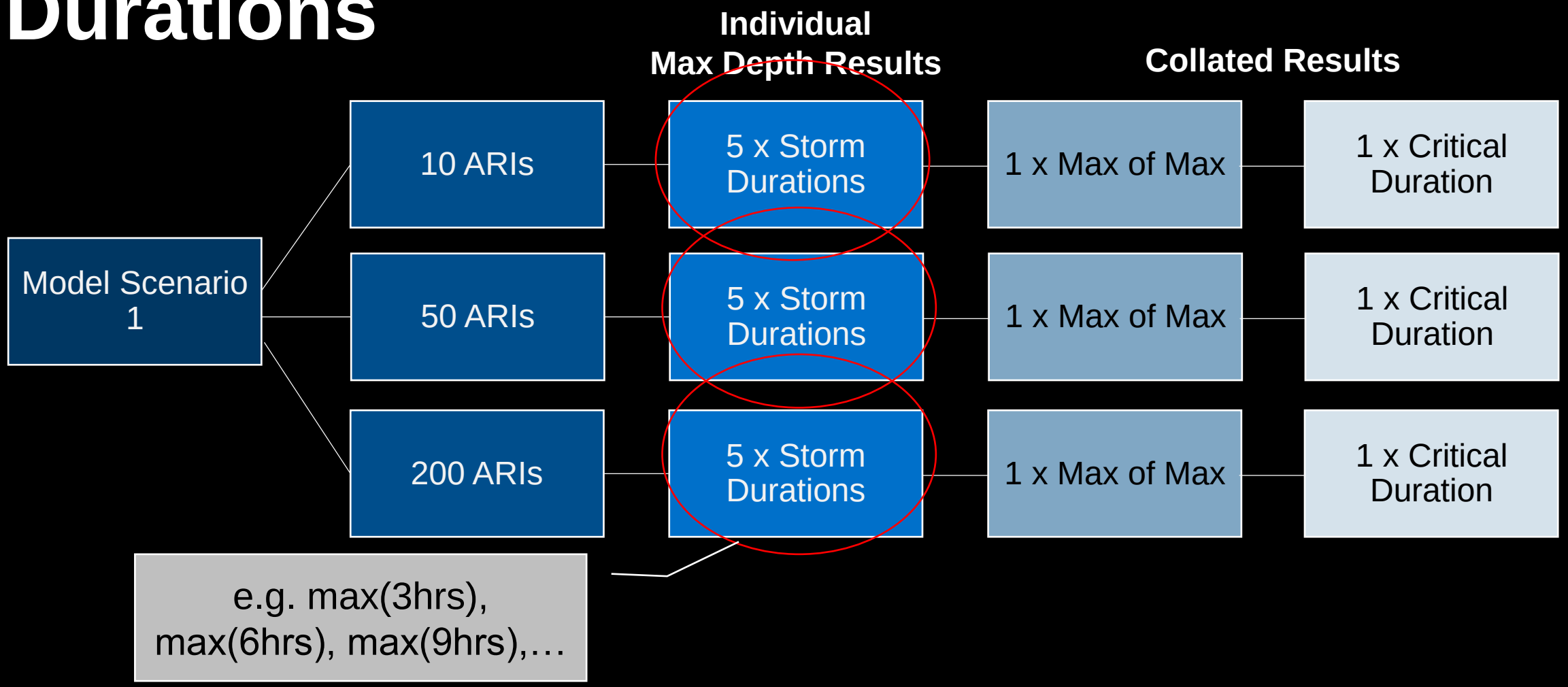
Result Process

Result Post Process – Max of Max & Critical Durations



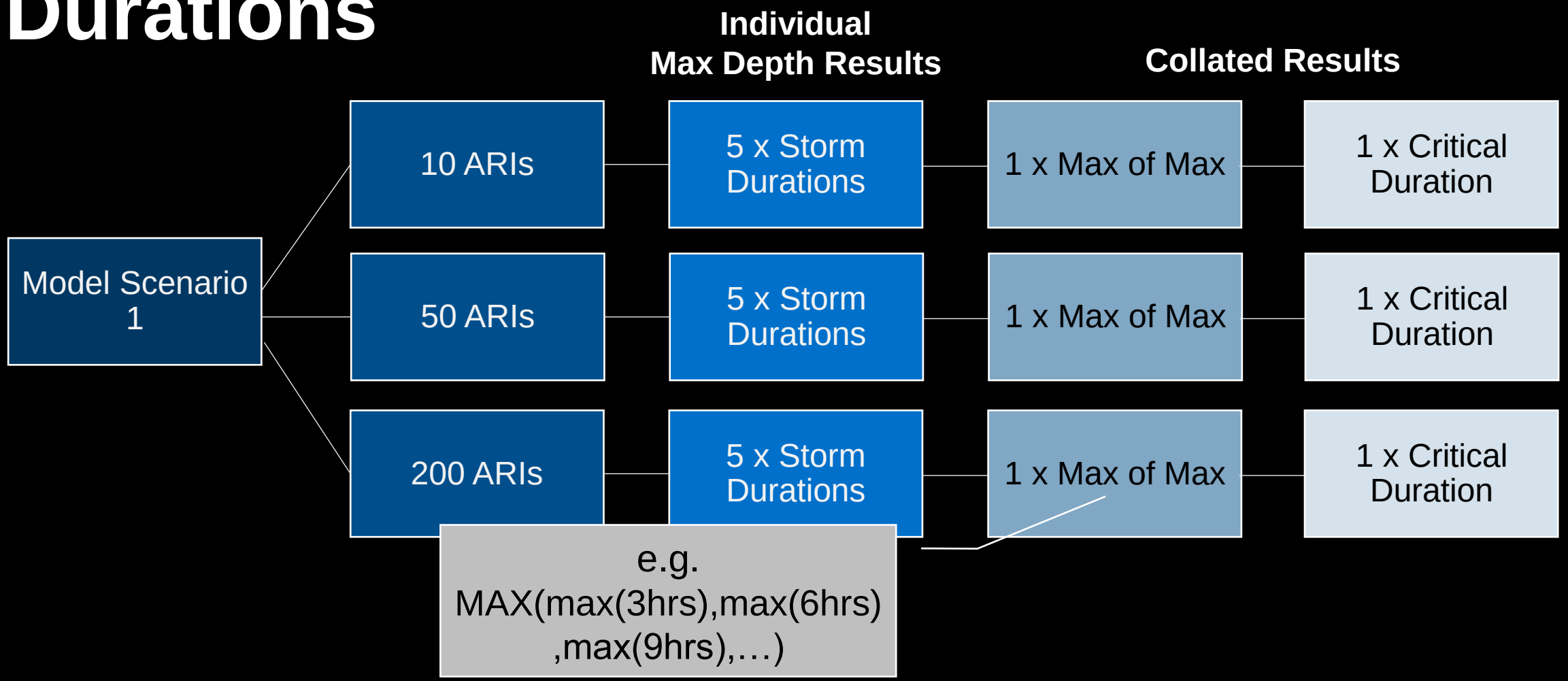
Result Process

Result Post Process – Max of Max & Critical Durations



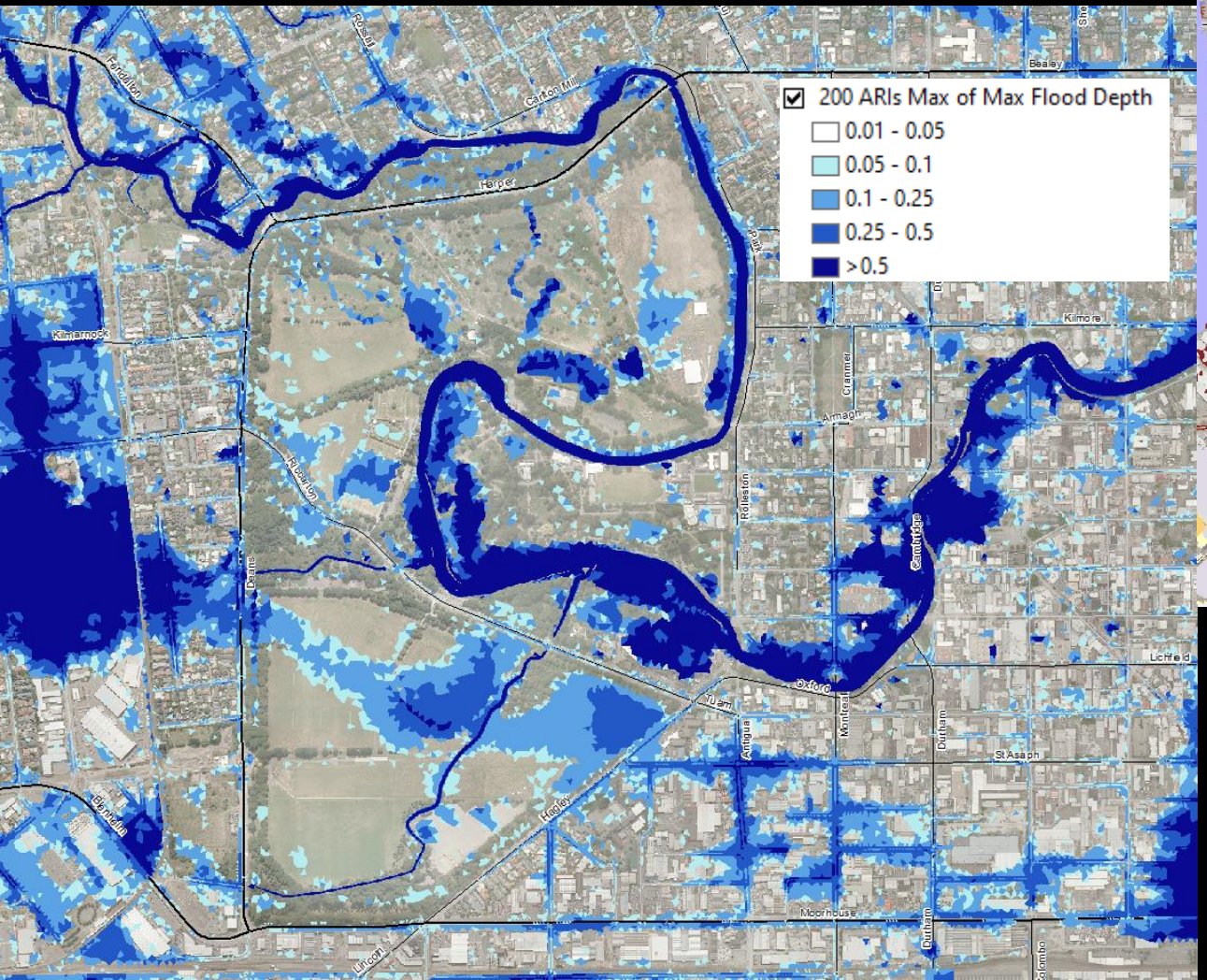
Result Process

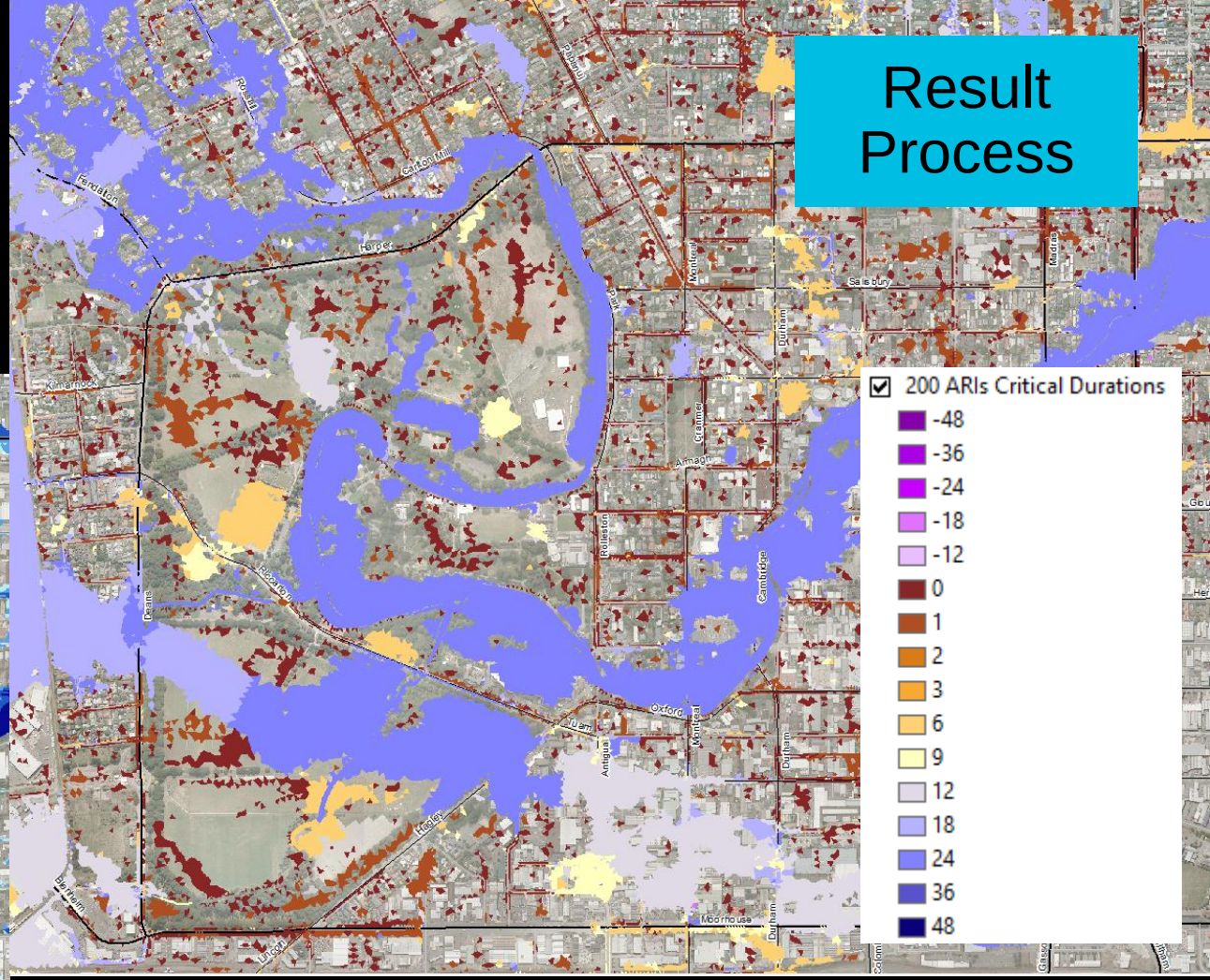
Result Post Process – Max of Max & Critical Durations



Result Process

MAX OF MAX FLOOD DEPTH RESULT ↓

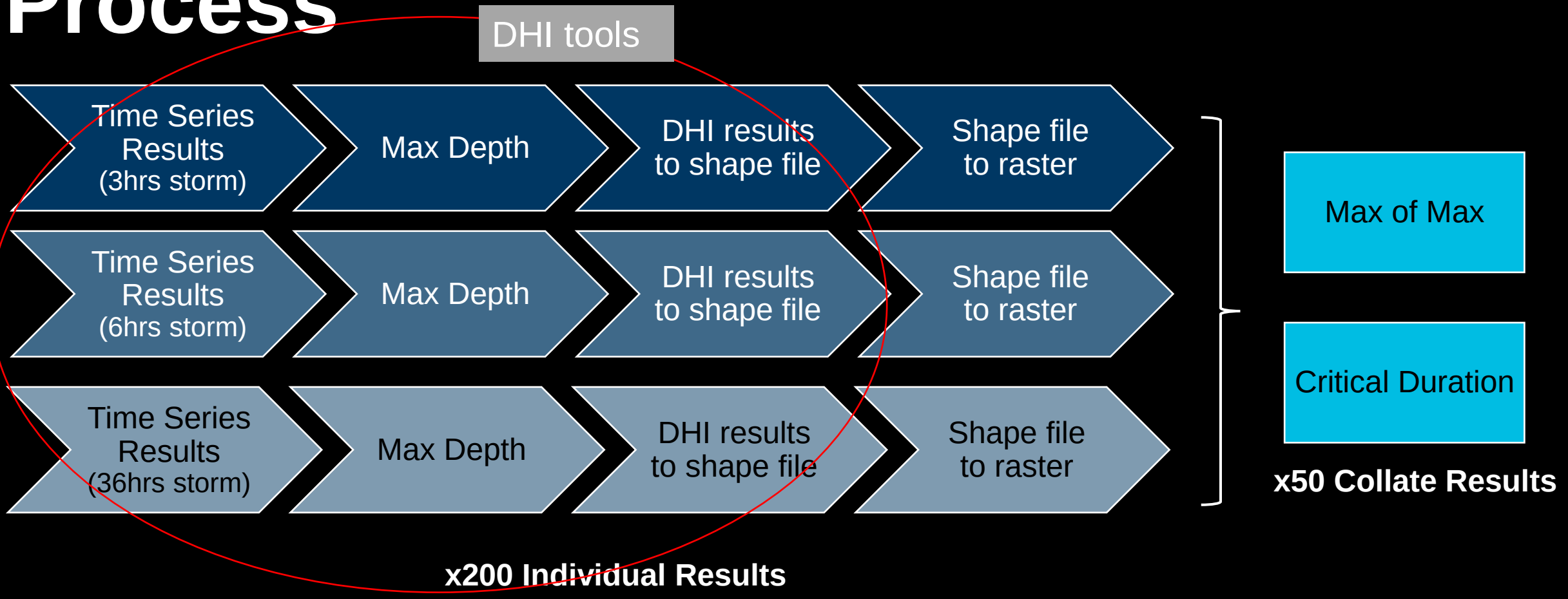




CRITICAL DURATION RESULT ↑

Result Process

Automation Tools - Result Post Process



Automation Tools - Result Post Pr

Result Process

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Max_Stat_Master.pfs - Notepad

File Edit Format View Help

```
// Created     : 2017-05-11 10:32:7
// DLL id      : C:\Program Files (x86)\DHI\2016\bin\x64\pfs2004.dll
// PFS version : Nov 16 2016 19:57:46

[DataStatisticsFM]
   [INPUT]
      file_name = |fileinputname.dfsu|
   EndSect  // INPUT

   [OUTPUT]
      file_name = |fileoutputname.dfsu|
      title = 'Max_Stats_Calculation'
      item_number = itemnumberselection
      maximum = 1
      minimum = 0
      mean = 0
      exeedance = 0
      exeedance_level = 0
      minimum_exeedance_level = 0
      maximum_exeedance_level = 0
      event_level = 0
      Event_length = 0
      first_step = 0
      last_step = lasttimestep
   EndSect  // OUTPUT

EndSect  // DataStatisticsFM
```

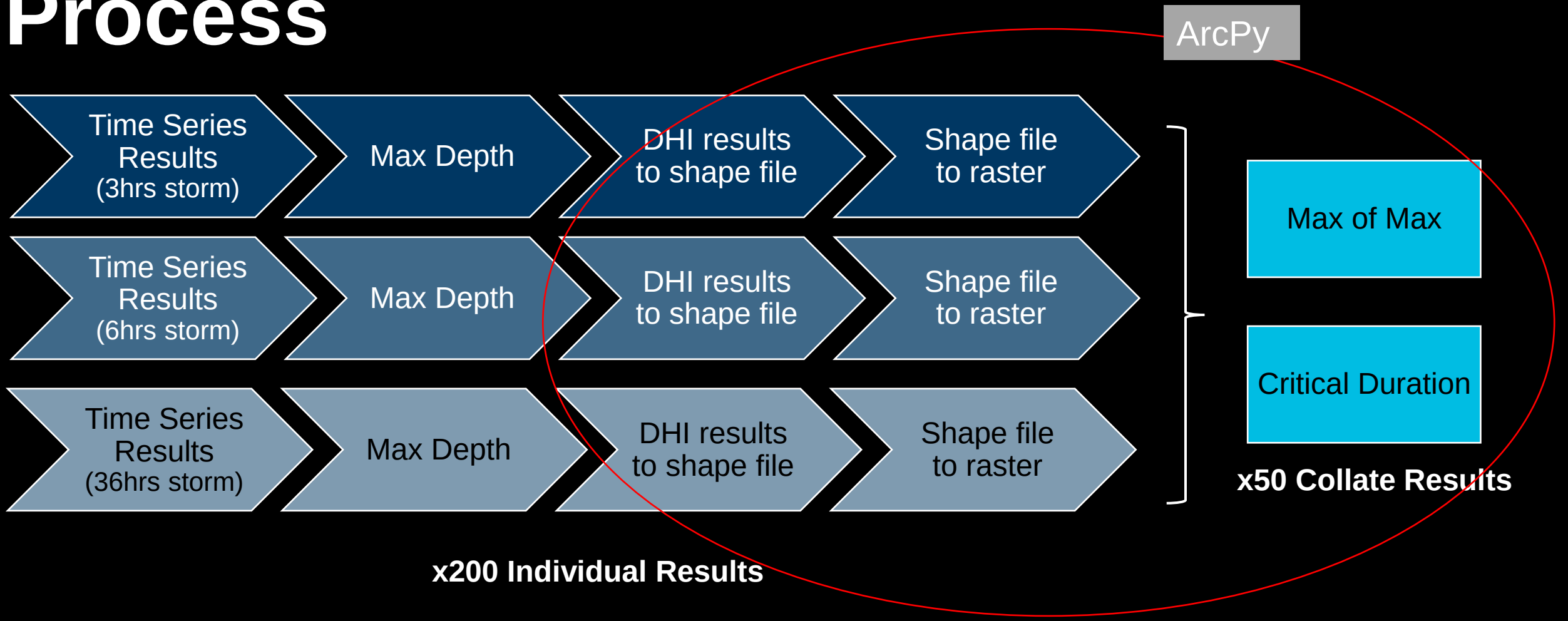
DFSU_To_SHP_Master.pfs - Notepad

File Edit Format View Help

```
// Created     : 2017-07-5 17:32:16
// DLL id      : C:\Program Files (x86)\DHI\2016\bin\x64\pfs2004.dll
// PFS version : Nov 16 2016 19:57:46

[Mike2Shp]
   CLSID = '{6B2982F8-537F-454E-83CD-D4648B7B6369}'
   TypeName = 'Mike2Shp'
   CREATEDTIME = '2017-07-05T17:24:05'
   MODIFIEDTIME = '2017-07-05T17:25:24'
   NOTES = ''
   [Setup]
      Name = 'Mike to Shp'
      InputFileName = |fileinputname.dfsu|
      InputFileType = 2
      Items = 1
      Xmin = 0
      Xmax = 0
      Ymin = 0
      Ymax = 0
      TimeSteps = 0
      UTM = 'PROJCS["NZGD_2000_New_Zealand_Transverse_Mercator",GEOGCS["GCS_NZGD_2000",DATUM
["D_NZGD_2000",SPHEROID["GRS_1980",6378137.0,298.257222101]],PRIMEM["Greenwich",0.0],UNIT
["Degree",0.0174532925199433]],PROJECTION["Transverse_Mercator"],PARAMETER
["False_Easting",1600000.0],PARAMETER["False_Northing",10000000.0],PARAMETER
["Central_Meridian",173.0],PARAMETER["Scale_Factor",0.9996],PARAMETER
["Latitude_Of_Origin",0.0],UNIT["Meter",1.0]]'
      GeoCoorSystem = ''
      GeoShortName = 'PROJCS["NZGD_2000_New_Zealand_Transverse_Mercator",GEOGCS
["GCS_NZGD_2000",DATUM["D_NZGD_2000",SPHEROID["GRS_1980",6378137.0,298.257222101]],PRIMEM
["Greenwich",0.0],UNIT["Degree",0.0174532925199433]],PROJECTION
["Transverse_Mercator"],PARAMETER["False_Easting",1600000.0],PARAMETER
["False_Northing",10000000.0],PARAMETER["Central_Meridian",173.0],PARAMETER
["Scale_Factor",0.9996],PARAMETER["Latitude_Of_Origin",0.0],UNIT["Meter",1.0]]'
      OutputFileName = |fileoutputname.shp|
   EndSect  // Setup

EndSect  // Mike2Shp
```

Result Process

Automation Tools - Result Post Process



Result Process

Max of Max & Critical Duration ArcPy

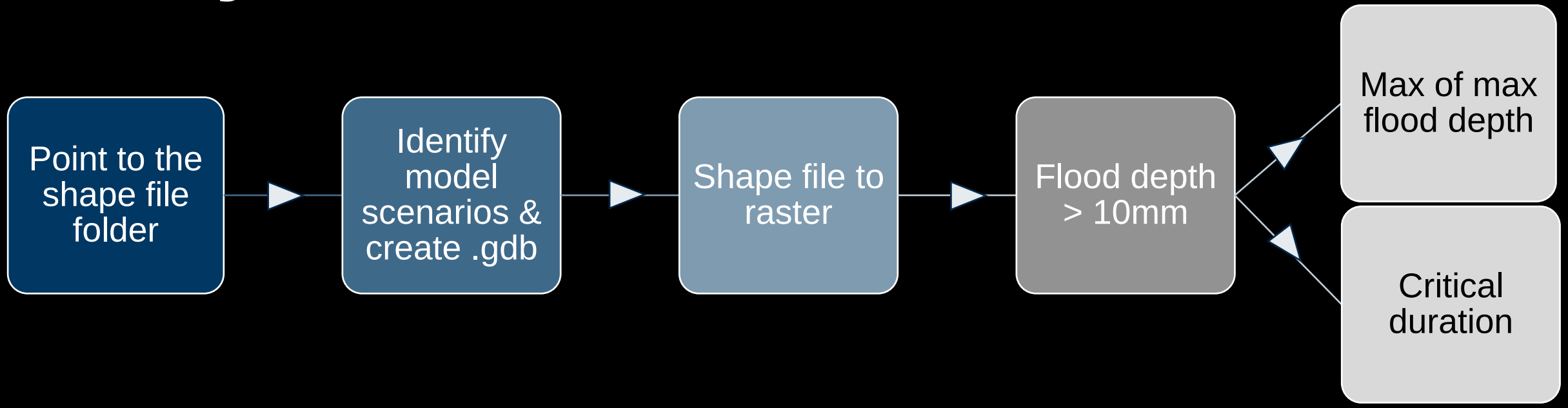
- Python site package
- Geographic data analysis
- Geographic data management
- Geographic map automation

ccwfs_002_maxmax.py

```
'''
# %%
import os
from time import ctime
import arcpy
import ccwfs_003_qa
arcpy.SetLogHistory = True
# %%


def crit_duration(surfs, crit_dur_surf, prj):

    print "\n\tDetermining Critical Duration..."

    temp_ws = "in_memory"
    arcpy.env.snapRaster = surfs[0].split(",")[0]

    null_surfs = []
    hpos_surfs = []

    sname = os.path.basename(crit_dur_surf)

    # prepare critical duration inputs
    input_surfs = [r.split(",")[0] for r in surfs]
    for surf in input_surfs:
        null_surf = os.path.join(temp_ws, "IsNull_{0}".format(os.path.basename(surf)))
        arcpy.gp.IsNull_sa(surf, null_surf)
        null_surfs.append(null_surf)

        # explicitly set null value to -999.999
        dur_surf = os.path.join(temp_ws, "Con_{0}".format(os.path.basename(surf)))
        arcpy.gp.Con_sa(null_surf, -999.999, dur_surf, surf, "Value =1")
        hpos_surfs.append(dur_surf)

    # combined wet extent mask
    cd_mask = os.path.join(temp_ws, "CDMASK_{0}".format(sname))
    arcpy.gp.CellStatistics_sa(null_surfs, cd_mask, "MINIMUM", "DATA")
```

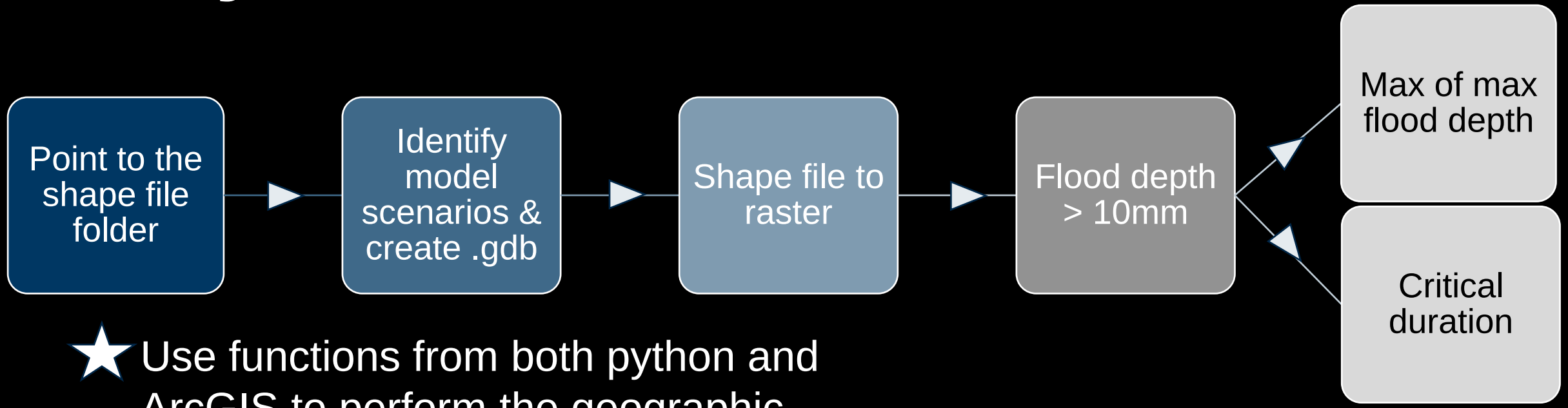
Result Process

Max of Max & Critical Duration - ArcPy



Result Process

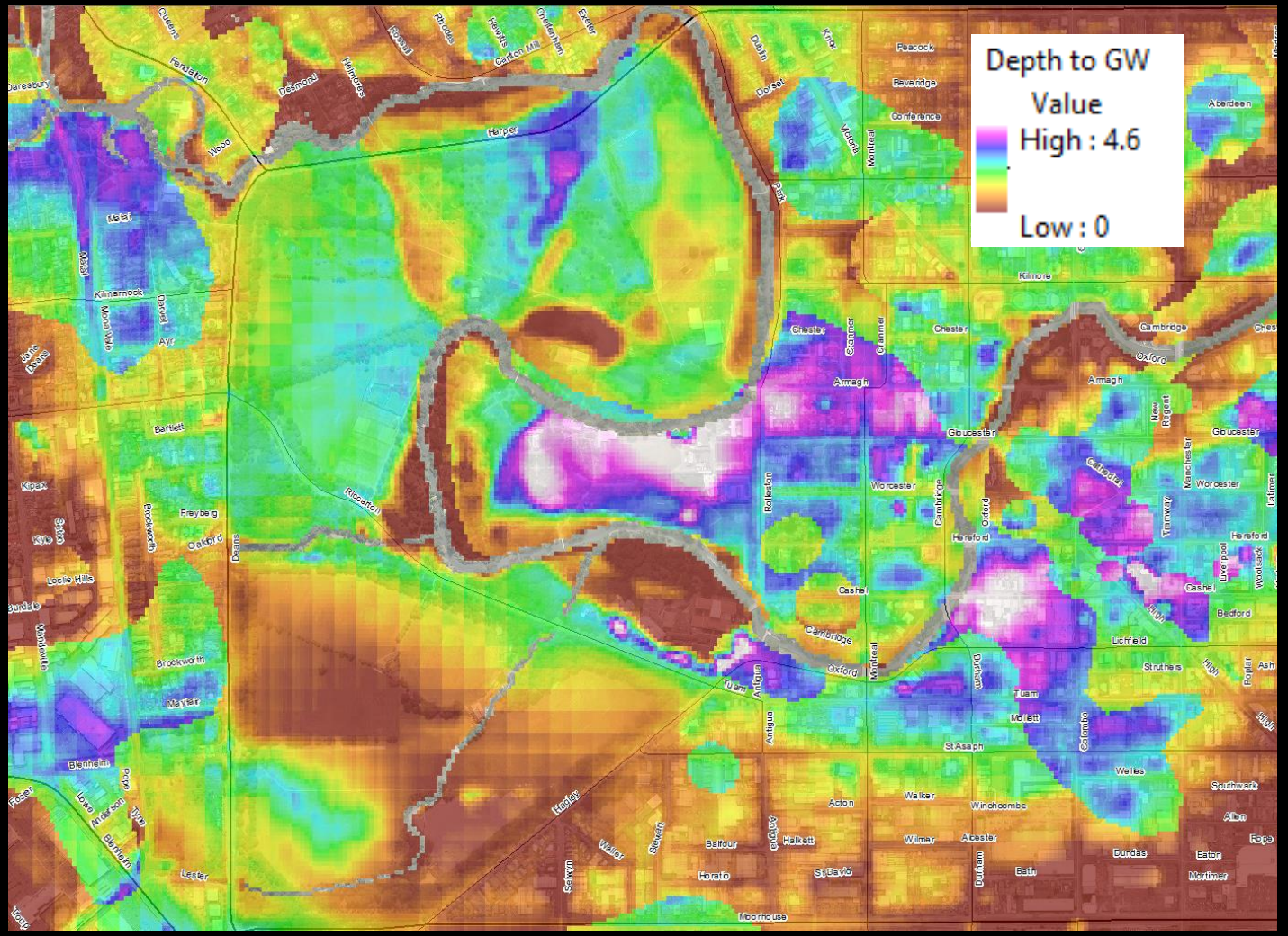
Max of Max & Critical Duration - ArcPy



★ Use functions from both python and ArcGIS to perform the geographic data analysis

Input Data Generation

→ Depth to groundwater



Automation Tools – Input Data Generation

– Python scripting
– Excel spreadsheet
– Batch file
– DHI tools
– Visual Basics
– ArcPy
– **ArcGIS Model Builder**

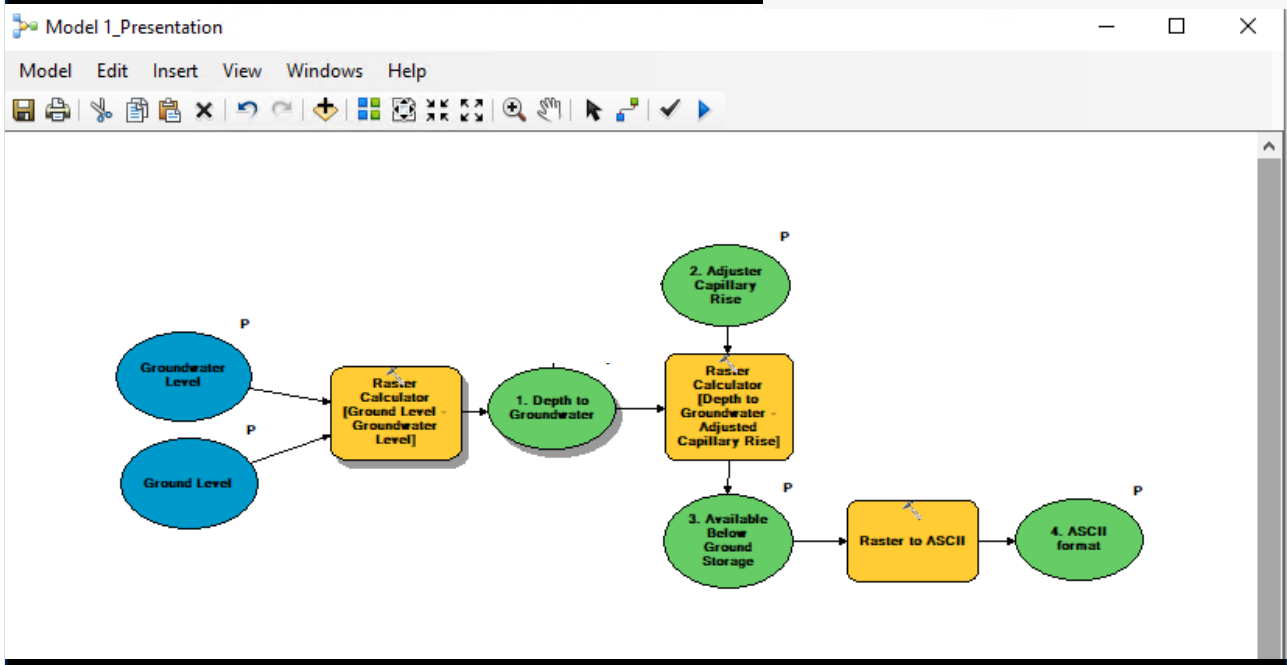
Input Data Generation- Model Builder

- Allow us to visualize workflow sequence in a diagram
- Chains together a series of processes and use one output from one process as the input to another process
- Make a model into a geoprocessing tool that can be shared or used in Python scripting.

Input Data

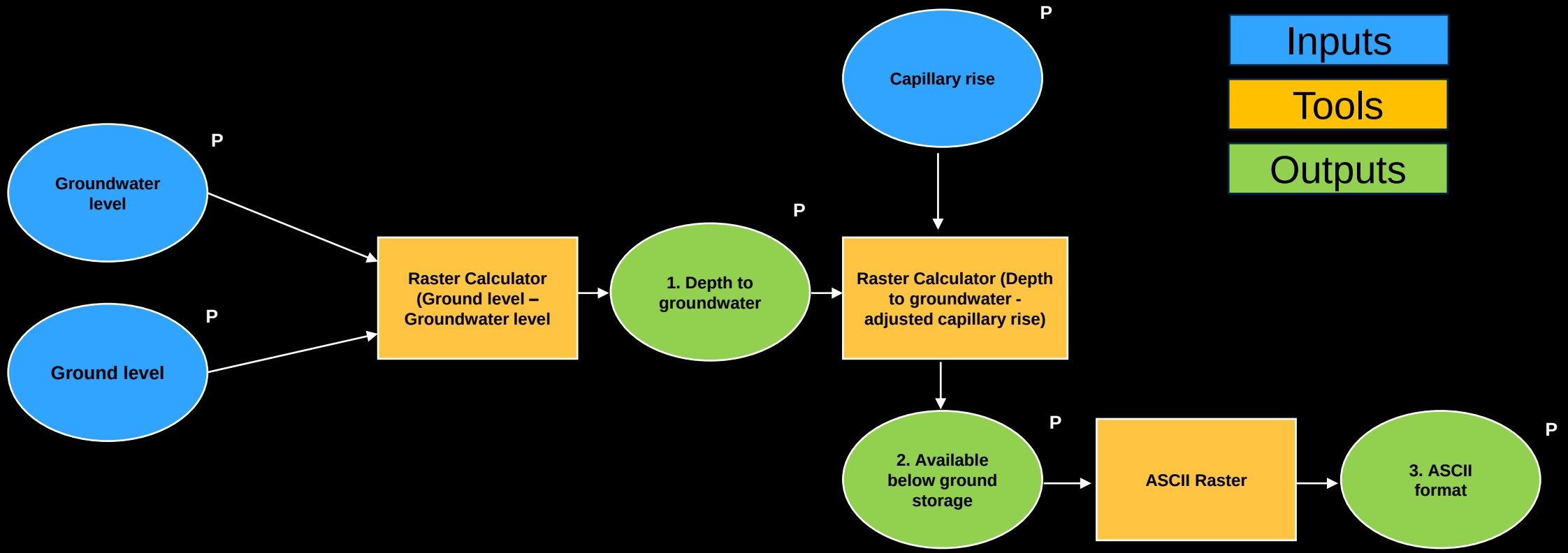
ArcGIS

ESRI



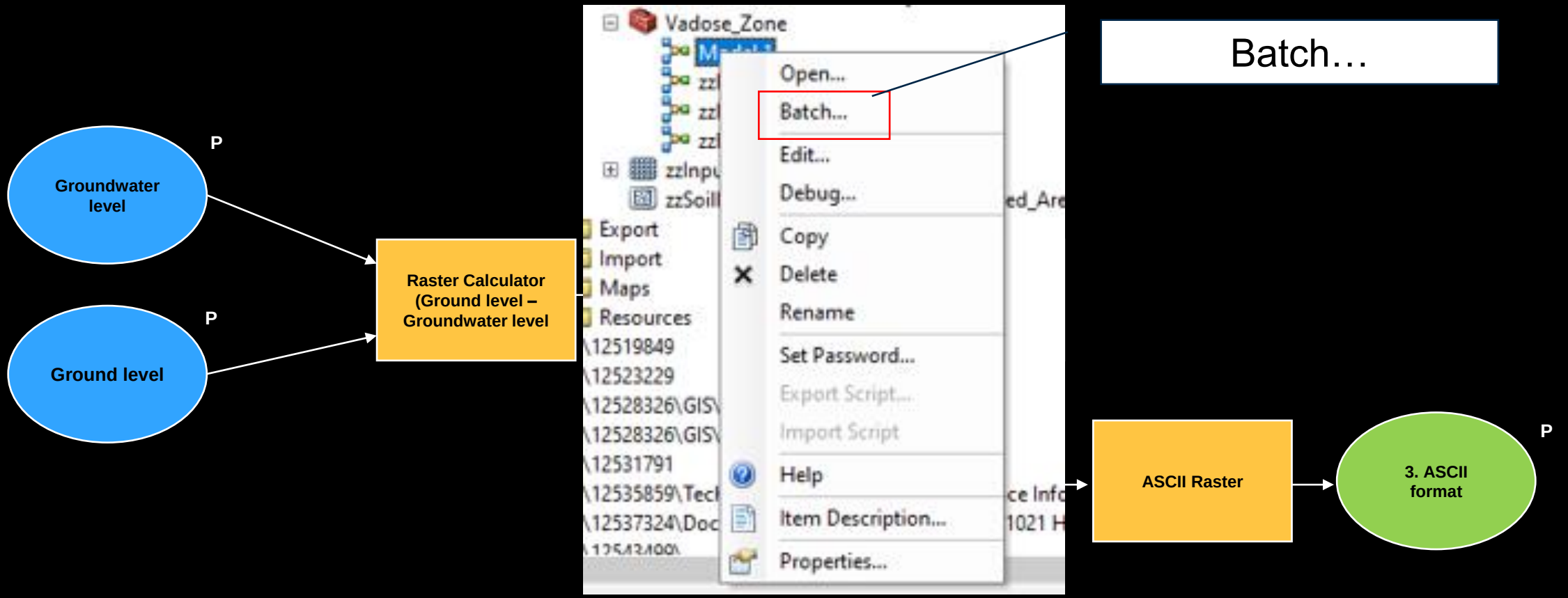
Input Data

ArcGIS model builder - Depth to Groundwater



Input Data

ArcGIS model builder - Depth to Groundwater



Input Data

ArcGIS model builder - Depth to Gr

Model 1_Presentation

	Groundwater Level	Ground Level	Capillary Rise per Soil Type	1. Depth to Groundwater	2. Adjuste
1	B__85ile0_00m_GWSurface_10m_CDD	A0_2100_Z_20191114	Input_Capillary_85th	Y:\GIS\Data\ModelBuild_ValdoseZone.g	Y:\GIS\Data\Mode
2	B__85ile1_00m_GWSurface_10m_CDD	A0_2100_Z_20191114	Input_Capillary_85th	Y:\GIS\Data\ModelBuild_ValdoseZone.g	Y:\GIS\Data\Mode
3	B__85ile1_88m_GWSurface_10m_CDD	A0_2100_Z_20191114	Input_Capillary_85th	Y:\GIS\Data\ModelBuild_ValdoseZone.g	Y:\GIS\Data\Mode
4	B__85ile2_40m_GWSurface_10m_CDD	A0_2100_Z_20191114	Input_Capillary_85th	Y:\GIS\Data\ModelBuild_ValdoseZone.g	Y:\GIS\Data\Mode

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Conclusion

Automation Tools	Functions
Excel Spreadsheet	To populate and store information using formulas
Python Scripting	To read, modify & create files that are stored in a plain text format
Batch Files	To execute programs
DHI Tools	To carry out process within DHI programs
Visual Basics	To automate process and return results in excel
ArcPy	To carry out geographic analysis
ArcGIS Model Builder	To carry out geographic analysis

- Improve productivity
- Improve efficiency
- Improve quality
- Improve consistency

Acknowledgment

- Christchurch City Council
- DHI

* Thank You

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