Deltares

Enabling Delta Life

Voortgangsoverleg TKI-2, 12 mei 2020

Govert Verhoeven, Arthur van Dam, Geert Prinsen, Rinske Hutten, Ruben Dahm

D-HYDRO RHU

Agenda voor vanochtend

1. Korte introductie
2. TKI-II: Stand van zaken pilots: (**HKV / RHDHV / HydroLogic**) 3 * 25 min
   a. Terugkoppeling van los georganiseerde sessies
   b. Update pilots door adviesbureaus en/of waterschappen
3. TKI-II: software ontwikkelingen
   a. Tijdsafhankelijke ruwheden (**Rinske**) 10 min
   b. Parallellisatie 1D2D (**Arthur**) 10 min
   c. GUI (**Govert**) 15 min
4. Relatie met TKI-III / update gedistribueerde hydrologie (**Geert**) 15 min
5. HYDROLIB (TKI-IV?) – (**Arthur**) 10 min
6. Planning en overige zaken (**Govert**) 10 min

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planning TKI-2

- Pilots: uiterlijk klaar voor eind oktober 2020
- Streven naar afronding van pilots voor 1 juli 2020

																							Einddatum TKI project
	2019				*DSD 2019*								**2020**					*DSD 2020*						
	jan	feb	mrt	april	mei	juni	juli	aug	sept	okt	nov	dec	jan	feb	mrt	april	mei	juni	juli	aug	sept	okt	nov	dec
Softwareontwikkeling (D-HYDRO)																								
Uitvoeren PILOTS																								

Releases D-HYDRO 1D2D Flooding bèta versie

Releases D-HYDRO 1D2D Flooding GA versie

DSD Delft Software Dagen

bug-fix, voor GA release

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Hands-on sessie 5 maart 2020

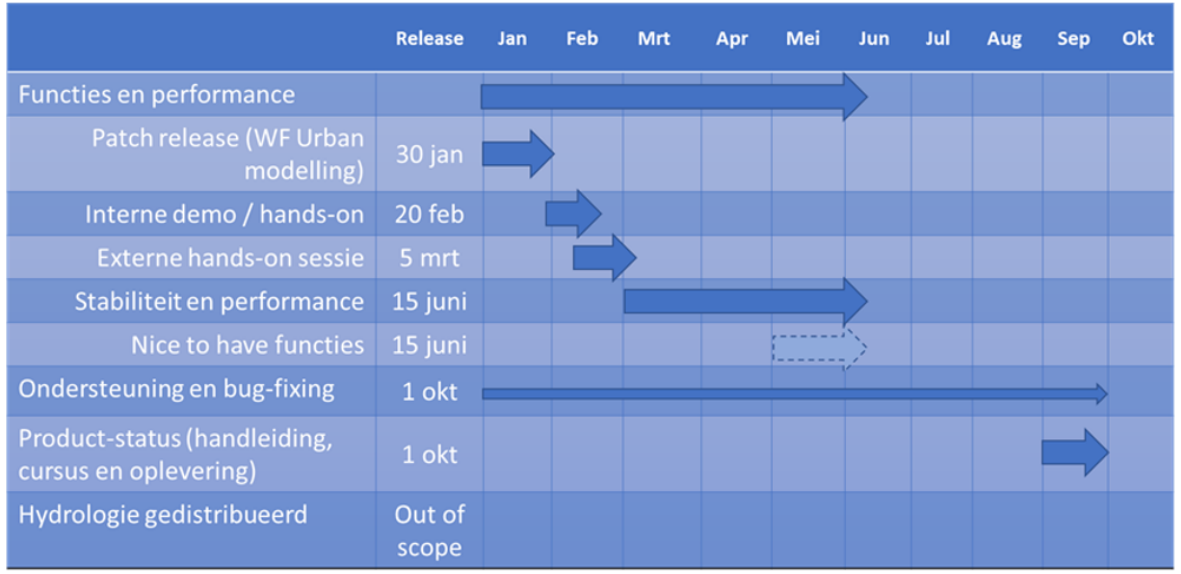
- Grote groep deelnemers (>40)
- Feedback verzameld, gedocumenteerd en geprioriteerd in issues

- the SOBEK 2 model importer implementation for 1D rural models;
- the GWSW-importer for Dutch sewer models;
- the implementation of the Dutch 'NWRW' Rainfall Runoff concept;
- the 1D2D coupling for rural and/or urban models;
- grid refinement;
- the side view functionality for 1D rural models; and
- the visualization of Map file results in the D-HYDRO GUI (both spatial and timeseries).

Planning softwareontwikkeling 2020

Planning Rekenhart

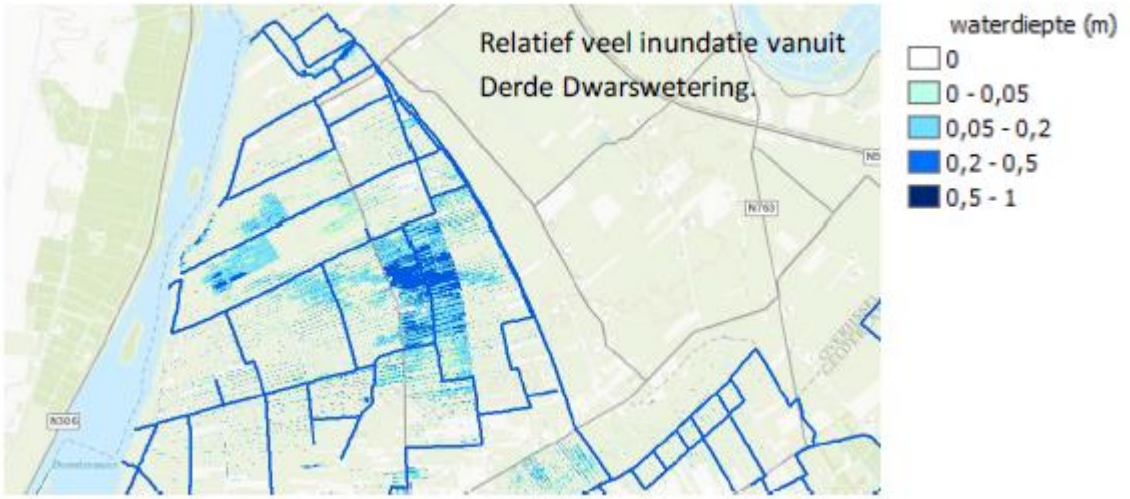
Planning GUI



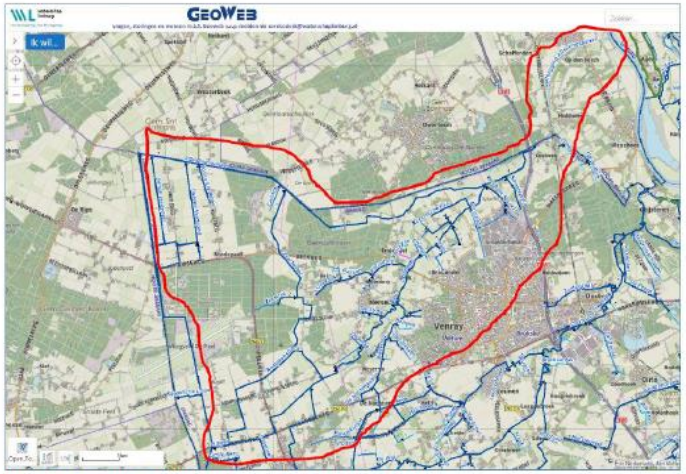
Pilots TKI-2

- Status update per pilot

Opzet en uitvoering pilots voor Waterschappen
- Pilot 1: WS Rivierenland (HKV)
- Pilot 2: WS Limburg (HKV)
- Pilot 3: V&V (RHDHV)
- Pilot 4: Visualisatie (HydroLogic)



polder Oosterwolde



Figuur 1 Ligging van het stroomgebied van de Loobeek

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D-HYDRO Regional Hydrology and Urban

D-HYDRO RHU project – update softwareontwikkeling

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Tijdsafhankelijke ruwheid

TKI-2 overleg

Rinske Hutten

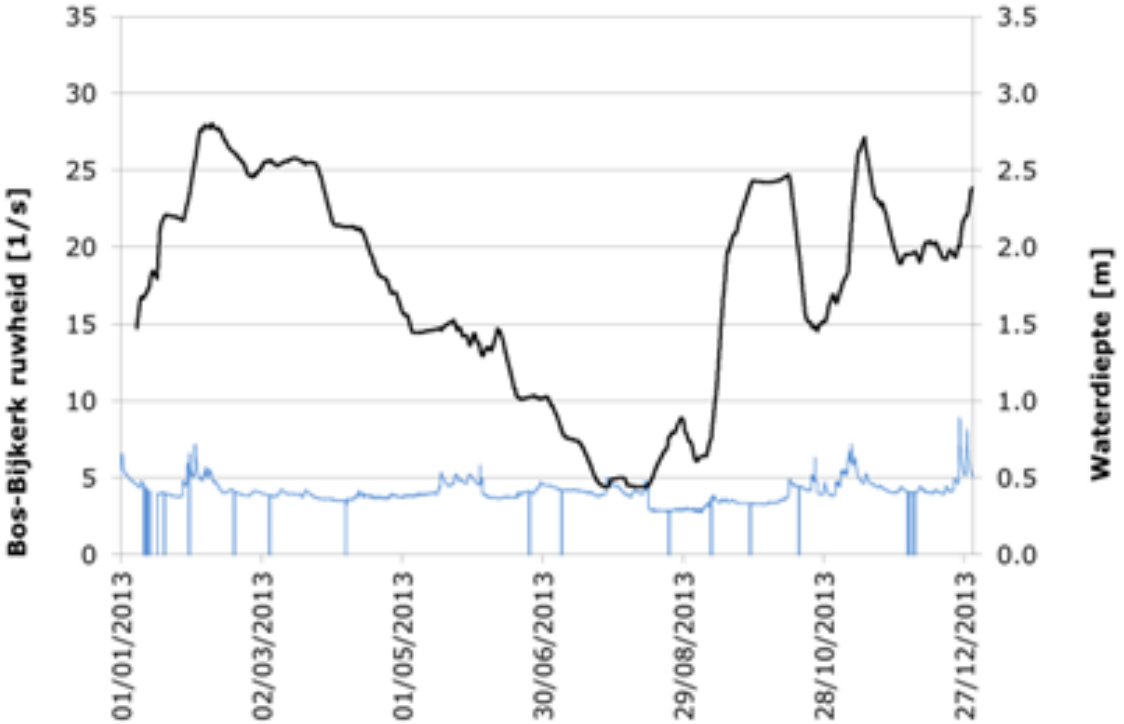
Govert Verhoeven

Arthur van Dam

12 May 2020

Tijdsafhankelijke ruwheden – waarom

From: HKV – Bertus de Graaff



Tijdsafhankelijke ruwheden – hoe (I)

- Tijdseries met ruwheden via <*.bc> file

In ruwheidsdefinitie:

- functionType = timeSeries
- timeSeriesId = *naam van tijdserie in <*.bc> file*

Table C.18: *Roughness definition.*

Keyword	Type	Default	Description
`[General]`			
`fileVersion`	String	`3.01`	File version. Do not edit this.
`fileType`	String	`roughness`	File type. Do not edit this.
`frictionValuesFile`	String		Name of <*.bc> file containing the time-series with friction values. Only needed for `functionType = timeSeries`.
`[Global]`			*One global block per file (see Remarks for an exception)*
`frictionId`	String		Name of the roughness variable
`frictionType`	String		The global roughness type for this variable which is used if no branch specific roughness definition is given. See the table at the beginning of this section for the encoding of the different roughness types.
`frictionValue`	Double		The global default value for this roughness variable
`[Branch]`			*Optional: one block per branch*
`branchId`	String		The name of the branch
`frictionType`	String		The roughness type to be used on this branch. See the table at the beginning of this section for the encoding of the different roughness types.
`functionType`	String	`constant`	Function type for the calculation of the value, possible values ◇ `constant`: Constant (in time) ◇ `timeSeries`: Time series (see remark below) ◇ `absDischarge`: Function of absolute discharge (not dependent on direction) ◇ `waterLevel`: Function of water level
`timeSeriesId`	String		Refers to a data block in the <*.bc> `frictionValuesFile`. Only if `functionType = timeSeries`.
`numLevels`	Int		Number of levels in table. Only if `functionType` is not `constant`.
`levels`	Double[]		Discharge (m^3/s) or water level [m AD] values. Only if `functionType` is not equal to `constant`.
`numLocations`	Int	0	Number of locations on branch. The default 0 value implies branch uniform values.

(continued on next page)

Tijdsafhankelijke ruwheden – hoe (II)

```
[General]
    fileVersion           = 3.01
    fileType              = roughness
    frictionValuesFile    = roughness_timeseries.bc

[Global]
    frictionId            = Main
    frictionType          = Chezy
    frictionValue         = 45.000

[Branch]
    branchId              = Channel3
    frictionType          = deBosBijkerk
    functionType          = timeSeries
    timeSeriesId          = rural_secondary
```

```
[Branch]
    branchId              = Channel9
    frictionType          = deBosBijkerk
    functionType          = timeSeries
    timeSeriesId          = rural_secondary
```

The accompanying <roughness_timeseries.bc>:

```
[General]
    fileVersion           = 1.01
    fileType              = boundConds

[Forcing]
    name                  = rural_secondary
    function              = timeSeries
    timeInterpolation     = linear
    quantity              = time
    unit                  = days since 2001-01-01
    quantity              = friction_coefficient_deBosBijkerk
    unit                  = s-1
    0  15
    31 21
    59 28
    90 25
    # ...
```

Tijdsafhankelijke ruwheden - status

- Tijdsafhankelijk ruwheden geimplementeerd voor alle profielen behalve YZ-profielen
- Implementatie voor YZ-profielen uitgevoerd in komende 2 weken
- Validatie van tijdsafhankelijke ruwheden via validatie testen moet nog beginnen

NHI
Nederlands Hydrologisch Instrumentarium

Deltares

D-HYDRO parallellisatie

Stand van zaken mei 2020

Arthur van Dam, Edwin Spee en Jing Zhao

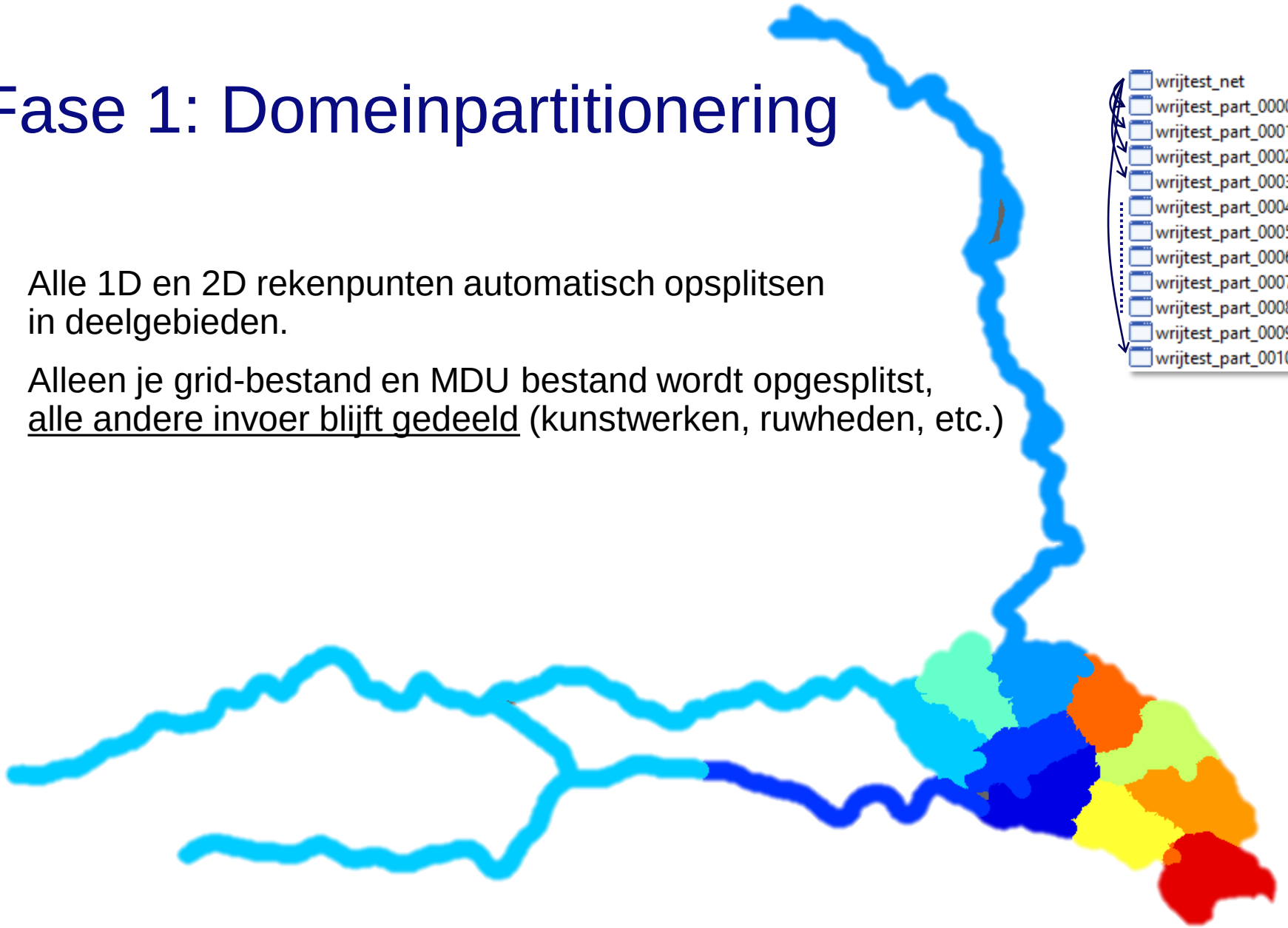
12 mei 2020

Doel parallellisatie D-HYDRO

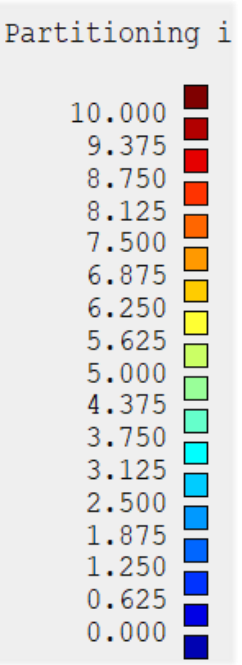
- Grote modellen doorrekenen op rekenclusters.
- Meerdere computers door domeinpartitionering.
- Volledige support voor 1D2D D-HYDRO modellen.

Fase 1: Domeinpartitionering

- Alle 1D en 2D rekenpunten automatisch opsplitsen in deelgebieden.
- Alleen je grid-bestand en MDU bestand wordt opgesplitst, alle andere invoer blijft gedeeld (kunstwerken, ruwheden, etc.)



wrijtest_net	nc	132,566,584
wrijtest_part_0000_net	nc	15,992,648
wrijtest_part_0001_net	nc	16,407,812
wrijtest_part_0002_net	nc	15,935,220
wrijtest_part_0003_net	nc	15,280,352
wrijtest_part_0004_net	nc	16,079,484
wrijtest_part_0005_net	nc	16,198,156
wrijtest_part_0006_net	nc	15,787,192
wrijtest_part_0007_net	nc	16,228,872
wrijtest_part_0008_net	nc	16,223,168
wrijtest_part_0009_net	nc	15,469,096
wrijtest_part_0010_net	nc	15,392,100



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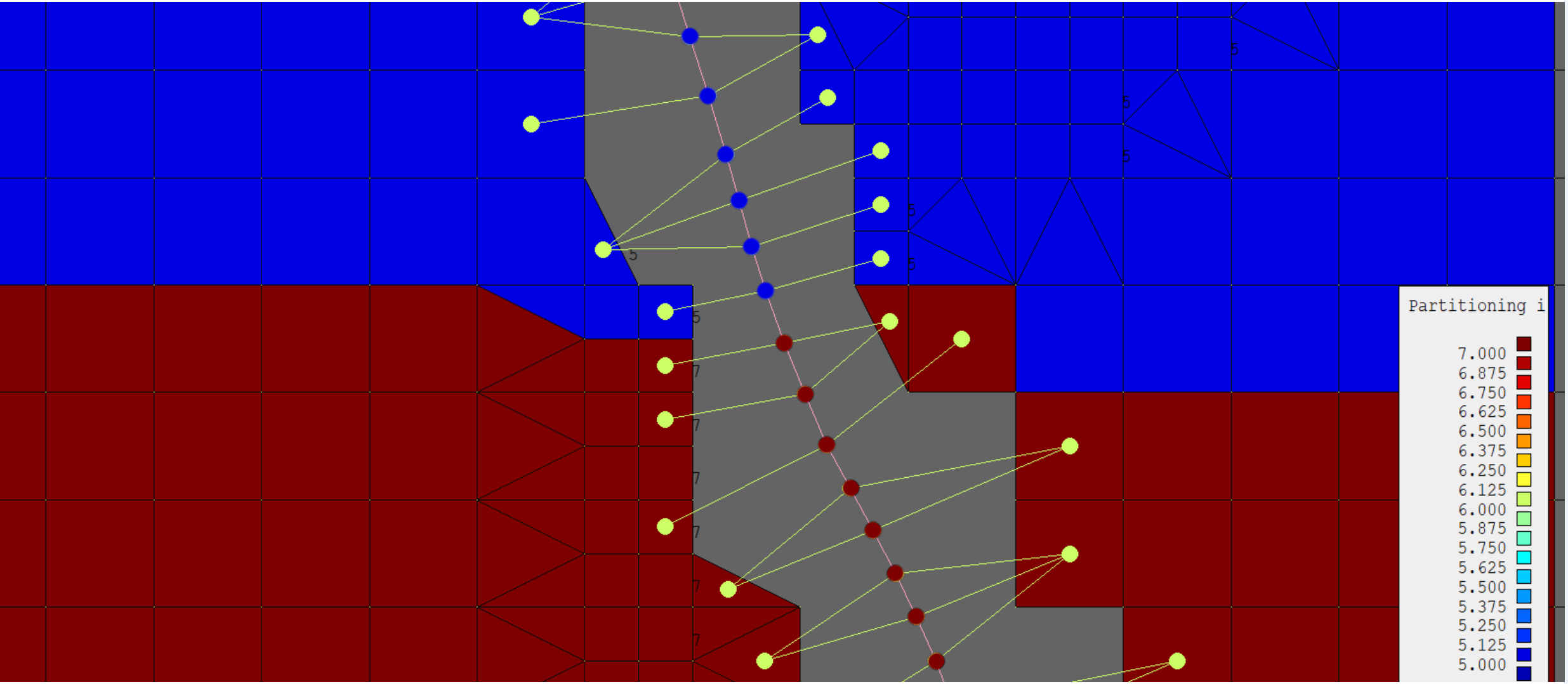
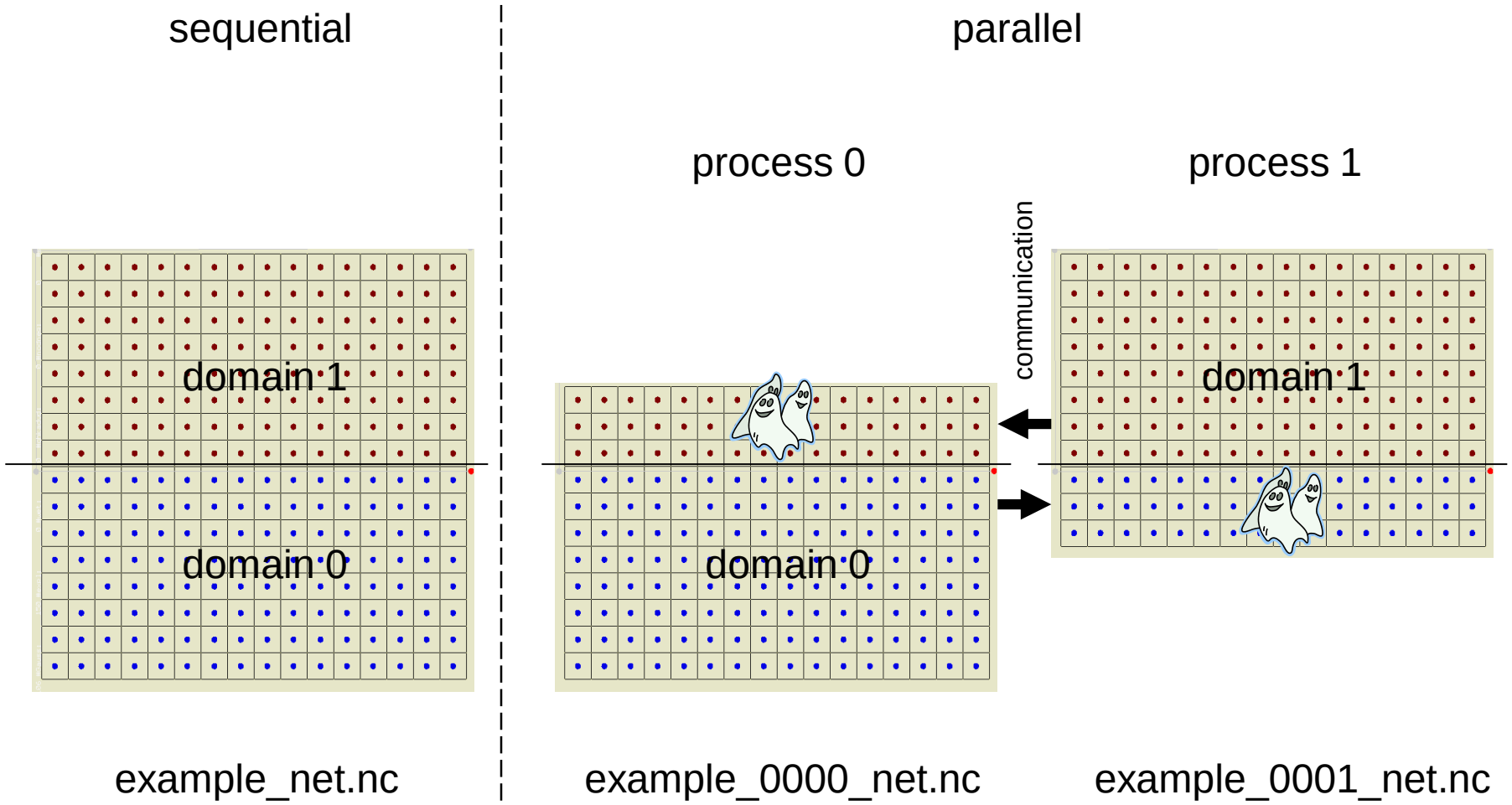
Fase 1: Domeinpartitionering



Voortgang parallellisatie

	Progress at end of sprint 29; 11 May 2020			
D-HYDRO Suite: Kernel: parallellization 1D	**file format design**	**code implementation**	**validated by test models**	**UM and Tech. Ref. documentation**
1 Partitioning: UGRID + 1D network storage	done	done	to do	to do
Partitioning: 1D ghostlevels	done	to do	to do	to do
Partitioning: 1D2D link validity	to do	to do	to do	to do
2 Parallel init: administration, grid snapping (structures, obs points, crs)	done	in progress	to do	to do
Parallel init: branch interpolation (crs)	done	to do	to do	to do
Parallel init: 1D ini fields	done	to do	to do	to do
Parallel timeloop: 1D update ghosts	to do	to do	to do	to do
Parallel timeloop: waterlevel/disch.dependent roughnesses	done	to do	to do	to do
3 Parallel output HIS: MPI reduction of hydraulic structures	done	to do	to do	to do
Parallel output MAP: mapmerge for 1D	done	to do	to do	to do
Parallel output MAP: mapmerge for 1D2D	to do	to do	to do	to do
			to do	= to do
			in progress	= in progress
			done	= done

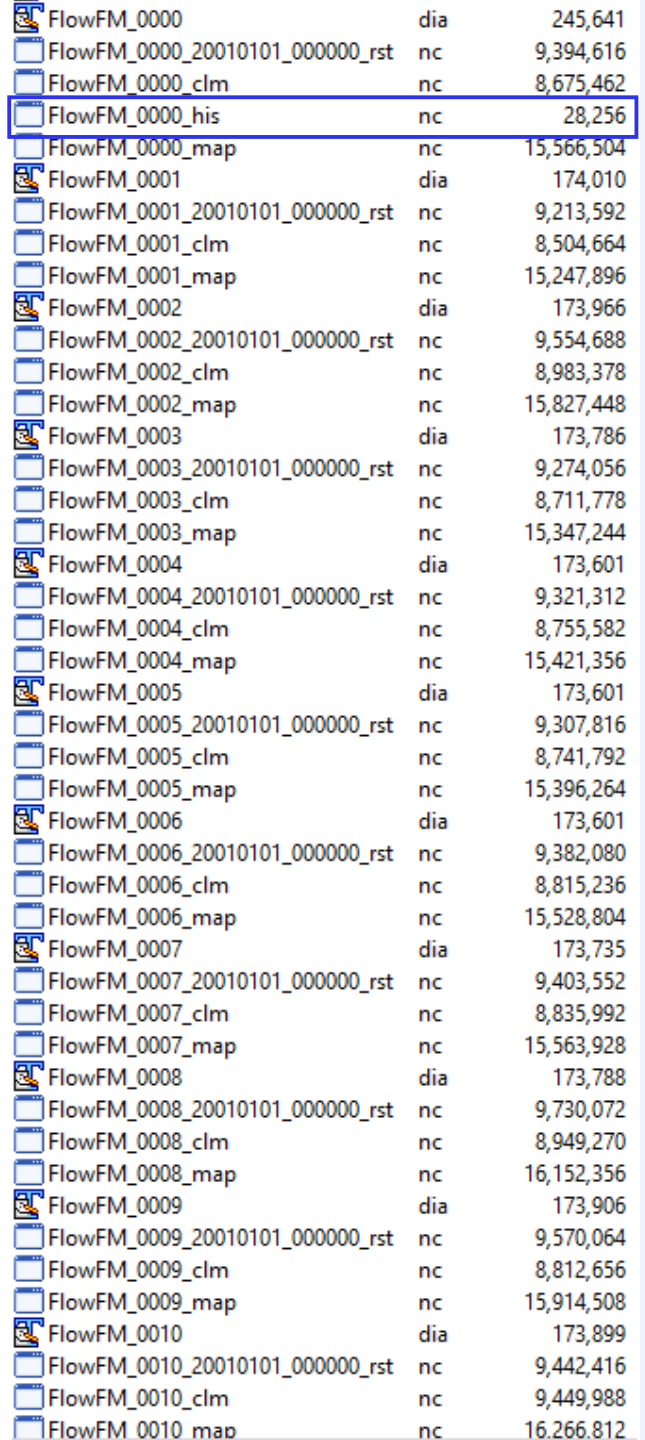
Parallellisatie Fase 2: communicatie en synchronisatie



Fase 3:Uitvoer parallelle D-HYDRO run

- History bestand met alle tijdseries en massabalansen:
  Is tijdens de berekening al automatisch als één bestand geschreven.

- Map bestanden met volledige grid-uitvoer:
  Eén uitvoer bestand per partitie.
  → mogelijk samenvoegen met “mapmerge” tool.



FlowFM_0000	dia	245,641
FlowFM_0000_20010101_000000_rst	nc	9,394,616
FlowFM_0000_clm	nc	8,675,462
FlowFM_0000_his	nc	28,256
FlowFM_0000_map	nc	15,566,504
FlowFM_0001	dia	174,010
FlowFM_0001_20010101_000000_rst	nc	9,213,592
FlowFM_0001_clm	nc	8,504,664
FlowFM_0001_map	nc	15,247,896
FlowFM_0002	dia	173,966
FlowFM_0002_20010101_000000_rst	nc	9,554,688
FlowFM_0002_clm	nc	8,983,378
FlowFM_0002_map	nc	15,827,448
FlowFM_0003	dia	173,786
FlowFM_0003_20010101_000000_rst	nc	9,274,056
FlowFM_0003_clm	nc	8,711,778
FlowFM_0003_map	nc	15,347,244
FlowFM_0004	dia	173,601
FlowFM_0004_20010101_000000_rst	nc	9,321,312
FlowFM_0004_clm	nc	8,755,582
FlowFM_0004_map	nc	15,421,356
FlowFM_0005	dia	173,601
FlowFM_0005_20010101_000000_rst	nc	9,307,816
FlowFM_0005_clm	nc	8,741,792
FlowFM_0005_map	nc	15,396,264
FlowFM_0006	dia	173,601
FlowFM_0006_20010101_000000_rst	nc	9,382,080
FlowFM_0006_clm	nc	8,815,236
FlowFM_0006_map	nc	15,528,804
FlowFM_0007	dia	173,735
FlowFM_0007_20010101_000000_rst	nc	9,403,552
FlowFM_0007_clm	nc	8,835,992
FlowFM_0007_map	nc	15,563,928
FlowFM_0008	dia	173,788
FlowFM_0008_20010101_000000_rst	nc	9,730,072
FlowFM_0008_clm	nc	8,949,270
FlowFM_0008_map	nc	16,152,356
FlowFM_0009	dia	173,906
FlowFM_0009_20010101_000000_rst	nc	9,570,064
FlowFM_0009_clm	nc	8,812,656
FlowFM_0009_map	nc	15,914,508
FlowFM_0010	dia	173,899
FlowFM_0010_20010101_000000_rst	nc	9,442,416
FlowFM_0010_clm	nc	9,449,988
FlowFM_0010_map	nc	16,266,812

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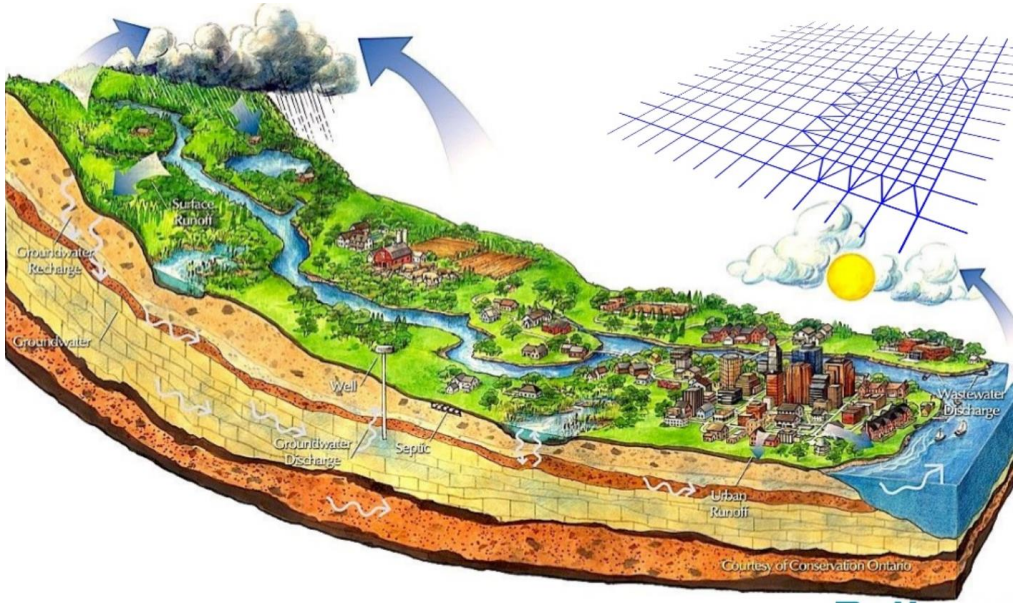
Planning parallellisatie 2020

- Al beschikbaar: 2D modellen draaibaar
- Juli release: 1D modellen draaibaar
- Oktober release: 1D2D modellen draaibaar

Hydrologie
(neerslag-afvoer modellering)
in D-Hydro

Mei 2020

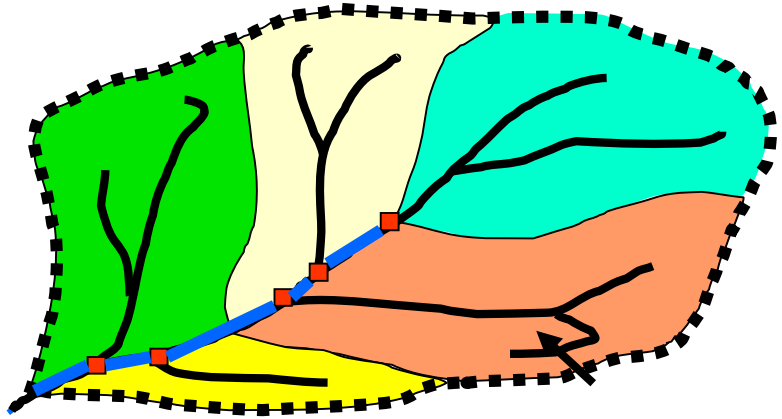


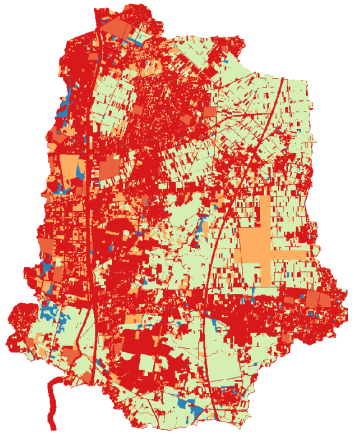
Opties

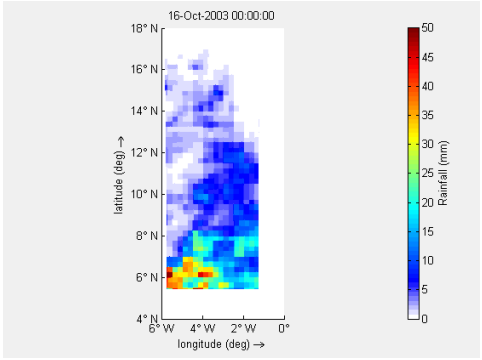
1. RR lumped

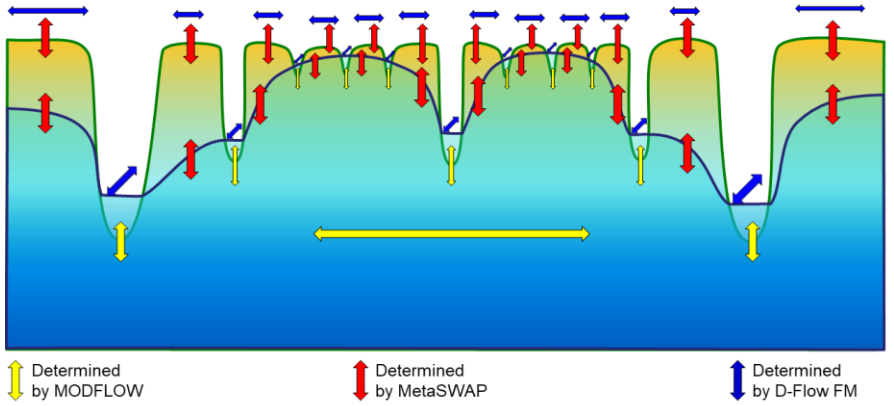
2. Hydrologie in FM

3. Lumbricus - FM gekoppeld met Modflow-MetaSwap









RR-lumped koppeling

- Op rekenhart niveau gerealiseerd
- Aanpassing in DIMR_Config.xml
  koppeling was eerst met 2 koppelingstabellen:
  - RR boundary -> Flow lateral (debiet)
  - Flow Observation station -> RR boundary (waterstand)

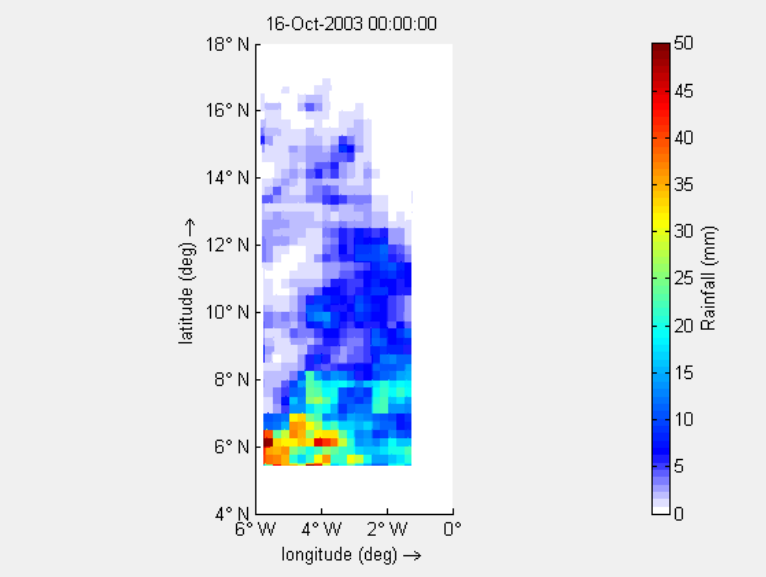
  Koppeling kan nu met de facto 1 koppelingstabel:
  - RR boundary -> Flow lateral (debiet)
  - Flow lateral -> RR boundary (waterstand)
- GUI: eerst 1D zo compleet mogelijk, net met RR begonnen

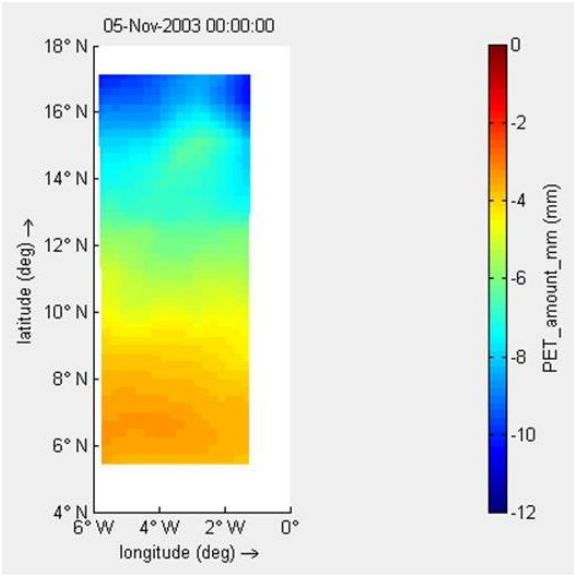
RR-lumped koppeling – DIMR_config.xml

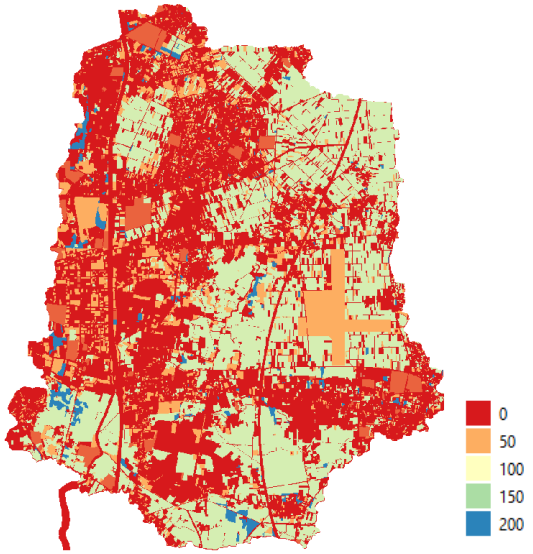
```
……
<coupler name="flow2rr">
      <sourceComponent>myNameDFlowFM</sourceComponent>
      <targetComponent>myNameRR</targetComponent>
      <item>
         <sourceName>laterals/lateralsource1/water_level</sourceName>
         <targetName>catchments/Catchment1_boundary/water_level</targetName>
      </item>
      <logger>
        <workingDir>.</workingDir>
        <outputFile>dflowfm_to_rr.nc</outputFile>
      </logger>
   </coupler>
   <coupler name="rr2flow">
      <sourceComponent>myNameRR</sourceComponent>
      <targetComponent>myNameDFlowFM</targetComponent>
      <item>
        <sourceName>catchments/Catchment1_boundary/water_discharge</sourceName>
        <targetName>laterals/lateralsource1/water_discharge</targetName>
      </item>
      <item>
        <sourceName>catchments/Catchment2_boundary/water_discharge</sourceName>
        <targetName>laterals/lateralsource2/water_discharge</targetName>
      </item>
      <logger>
        <workingDir>.</workingDir>
        <outputFile>rr_to_dflowfm.nc</outputFile>
      </logger>
   </coupler>
…..
```

Hydrologie op het grid – standard beschikbaar

- Neerslag (uniforme tijdreeks of variabel in ruimte en tijd)
- Verdamping (uniforme tijdreeks of variabel in ruimte en tijd)
- Infiltratie (ruimtelijk variabel, constant in de tijd)







Progress

	Progress at end of sprint 29; 11 May 2020 (preliminary)			
D-HYDRO Suite: Distributed hydrology	**file format design**	**code implementation**	**validated by test models**	**UM and Tech. Ref. documentation**
- Horton infiltration	●	●	●	●
- *Snow melt*				
- formulering conform wflow (en HBV), temperatuurgrid/tijdreeks	*nicetohave*	*nicetohave*	*nicetohave*	*nicetohave*
- *interception*				
- basic optie (grid met capaciteit interceptiebakje als input)	●	●	●	●
- Gash (conform wflow: interceptiecapaciteit op basis Leaf Area Index, land use)	*nicetohave*	*nicetohave*	*nicetohave*	*nicetohave*
- Rutter (conform wflow)	*nicetohave*	*nicetohave*	*nicetohave*	*nicetohave*
- *Evaporation*				
- input pot. Evaporation	●	●	●	●
- verdamping uit interceptiebakje	●	●	●	●
- verdamping oppervlak/bodem; 'crop factor' paved, unpaved, open water (land use koppeling)	*nicetohave*	*nicetohave*	*nicetohave*	*nicetohave*
- *Bodem: unsaturated zone balance*				
- wflow Brooks-Corey (default 3 lagen)	*nicetohave*	*nicetohave*	*nicetohave*	*nicetohave*
- infiltration limitation	*nicetohave*	*nicetohave*	*nicetohave*	*nicetohave*
- evaporation reduction	*nicetohave*	*nicetohave*	*nicetohave*	*nicetohave*
- *Bodem: verzadigd grondwater*				
- pm koppeling Modflow uit te werken	●	●	●	●
			●	= to do
			●	= in progress
			●	= done

Horton infiltratie (variabel in de tijd)

13.3.1 Horton's equation

Horton's infiltration equation (Horton, 1933) is an empirical formula which describes the trend of the infiltration capacity. A decreasing infiltration capacity is described by

$$f_t = f_e + (f_b - f_e)e^{-k_a t}, \text{ if the surface is wet}$$

and a recovering infiltration capacity is described by

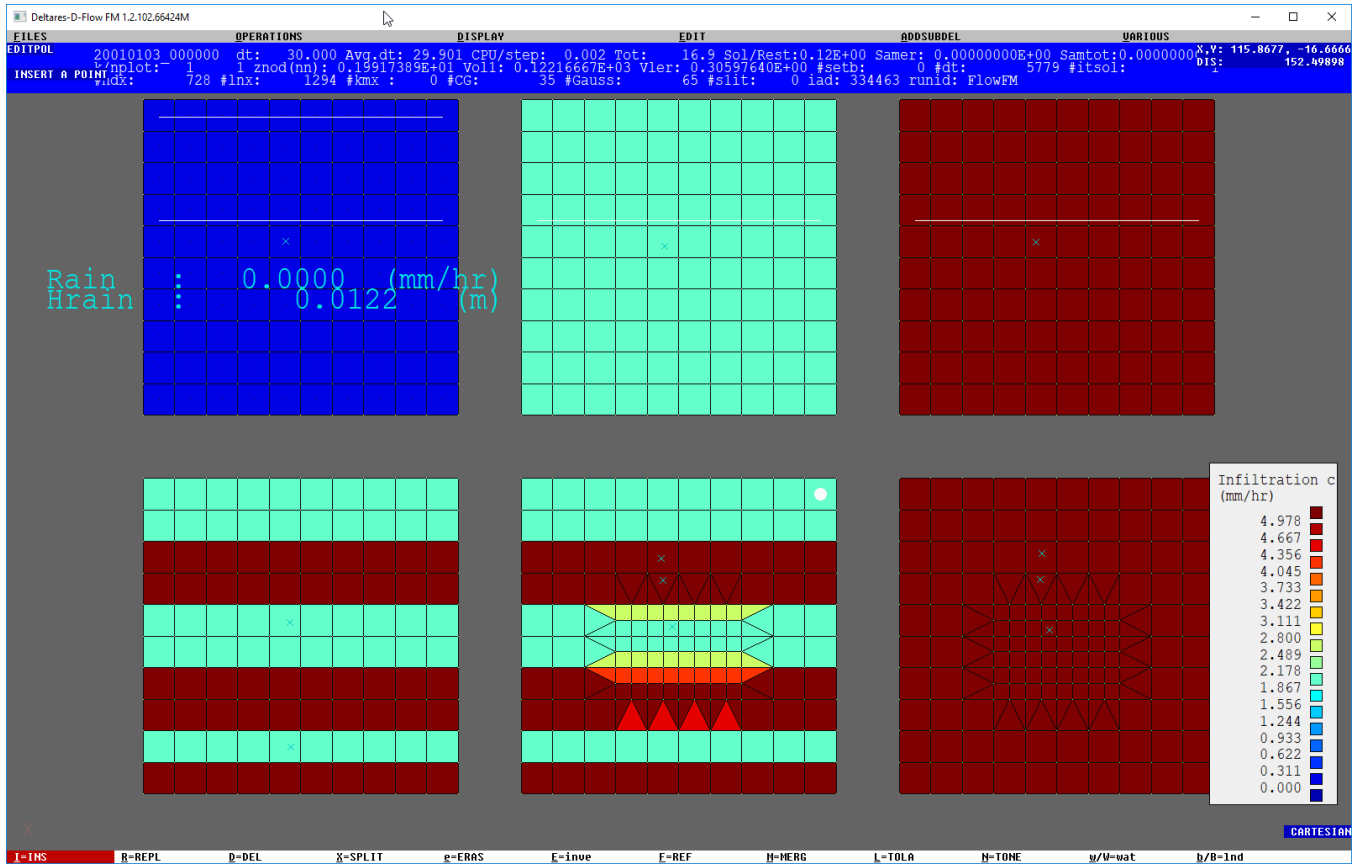
$$f_t = f_e - (f_b - f_e)e^{-k_h t}, \text{ if the surface is dry,}$$

where the symbols used are:

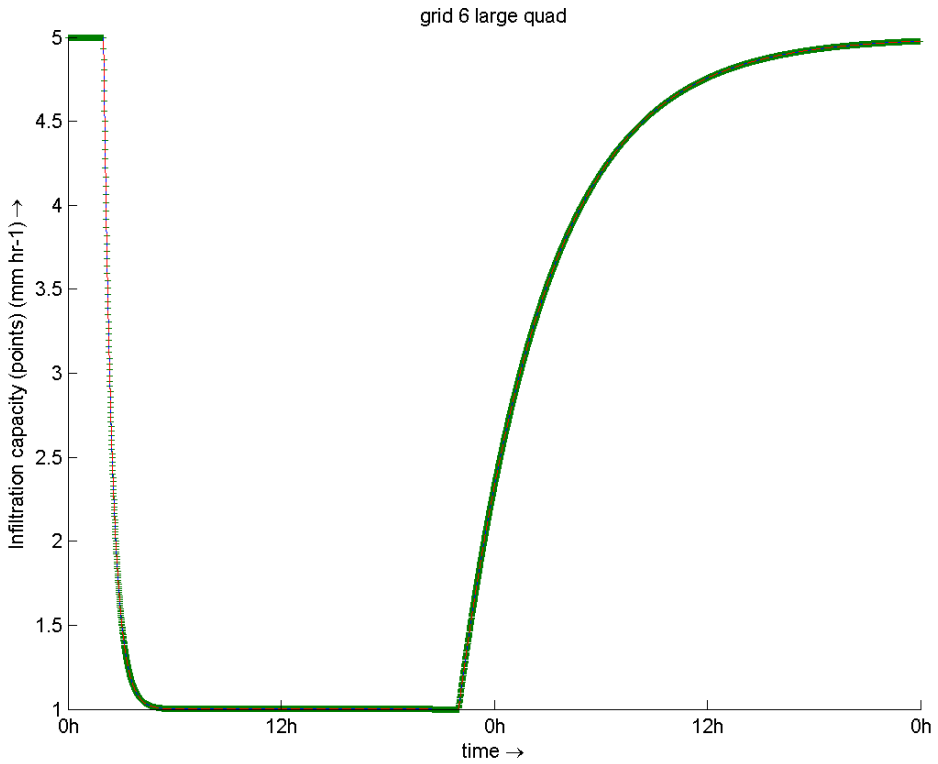
t	Time [hr]
f_t	Infiltration capacity at t [mm/hr]
f_b	Maximum infiltration capacity at $t = 0$ [mm/hr]
f_e	Minimum infiltration capacity [mm/hr]
k_a	Time factor of decreasing infiltration capacity [1/hr]
k_h	Time factor of recovering infiltration capacity [mm/hr]

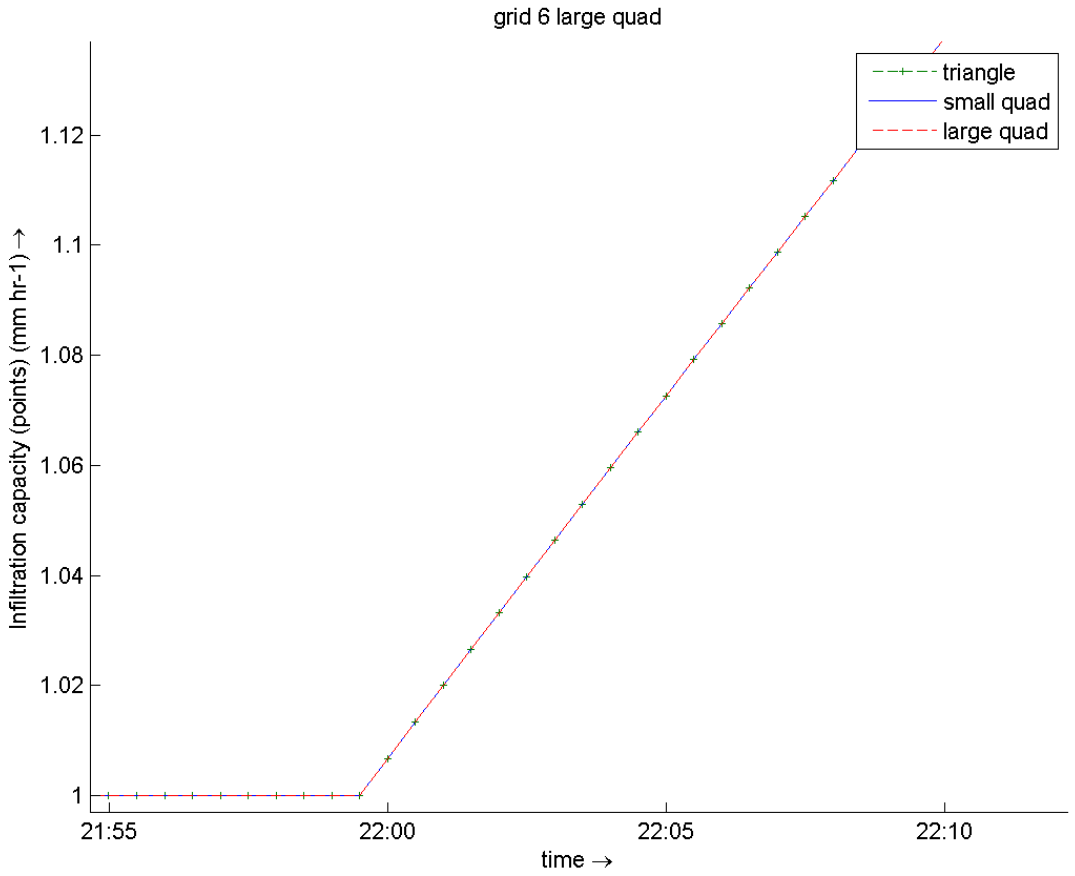
It is assumed that at the beginning of each rainfall event, the infiltration capacity is at its maximum f_b. The infiltration capacity is decreasing as long as there is water stored on the surface. If the infiltration capacity is at its the maximum value $f_t = f_b$ and there is no water on the surface, it will remain at its maximum value. Vice versa, if the infiltration capacity is at its minimum value $f_t = f_e$, and there is still water on the surface, it will remain at its minimum value. The infiltration capacity will recover again as soon as the surface is dry and it is not raining.

13.4 Evaporation



1e testplaatjes Horton

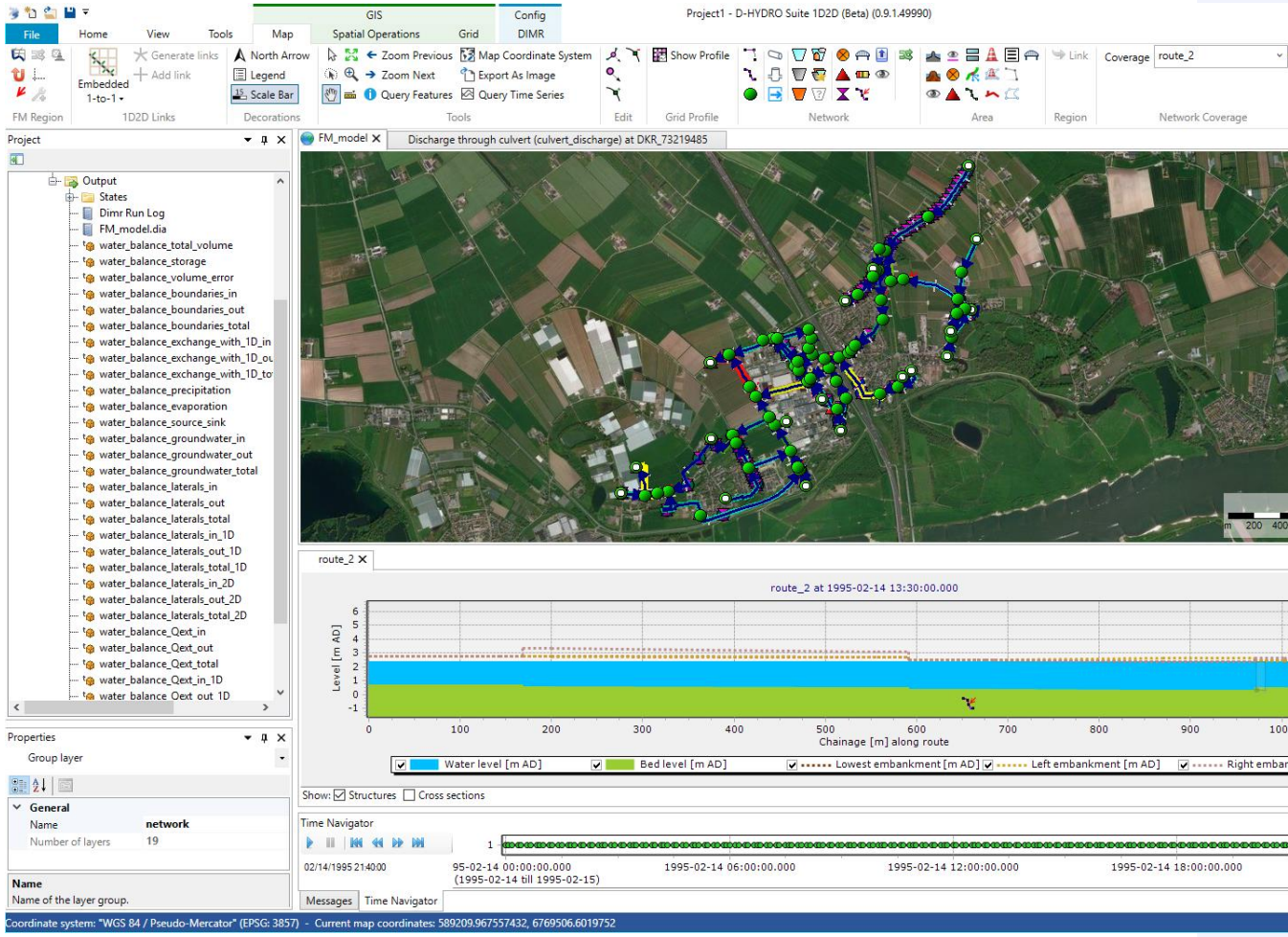




GUI: status

Afgelopen tijd oa gewerkt aan:

- 1D Roughness
- 1D Initial conditions
- SOBEK-2 importer voor Urban
- Performance & robuustheid
- 2D Grid Editor
- Acceptatiemodellen
- Oplossen van bugs



Volgende week verwachten we een nieuwe patch uit te brengen van GUI voor TKI-partners.

NHI
Nederlands Hydrologisch Instrumentarium

Deltares

HYDROLIB

Betrouwbare hydro software voor geautomatiseerd modelleren en rekenen

Deltares i.s.m. diverse partijen

Arthur van Dam, Ruben Dahm, Rinske Hutten

Joost Heijkers

12 mei 2020

Doel van dit verhaal

- Wat gaat HYDROLIB zijn?
- Welke interesse hebben jullie?
- Wie wil er meedoen?

D-HYDRO Suite ← ? → HYDROLIB

- **D-HYDRO Suite**: de nieuwe hydrodynamische en hydrologische Deltares software (rekenhart+GUI), inmiddels uitgebreid voor regionale, hydrologische en urban toepassingen.
  - Release in zomer en najaar 2020. “General Availability” release.

Nu komt de volgende fase: van pilots naar implementatie in werkprocessen, gebruik in adviesprojecten.

- **HYDROLIB** bevat data- en softwaretools voor:
  - Consistentie brondata en modelinvoer. Automatisering maakt proces sneller en voorkomt fouten.
  - Snel en automatisch simuleren.
  - Reproduceerbare en naspeurbare uitkomsten en nabewerking.
  - Dit alles rondom D-HYDRO modellen.

Geïnspireerd door GEOLIB (TKI, 2020-2021)

Kerngroep (KG)

- Antea
- Arcadis
- BAM
- Ballast Nedam
- Boskalis
- Dura Vermeer
- Heijmans
- Lievense
- Mobilis
- Movares
- RHDHV
- Sweco
- Volker Wessels
- Waternet
- Fugro
- WSRL
- Van Oord

Deltares
Enabling Delta Life

Naast Robots ook Cobots

Volledige automatisering van hydro modelleren is een mooi streven, maar:

- Gebruikers moeten (soms) kunnen ingrijpen in modelschematisaties, hydrologische modelkeuzes, analyse-opties.

Dus:

- Automatische componenten, die de gebruiker helpen.

Herbruikbare software tools

Core scripts & tools voor interactie met D-HYDRO

- Centraal beschikbaar stellen, online.
- Ondersteund,
  Gedocumenteerd, en
  onderhouden,

  ook voor nieuwe releases.
- Open source, ook bereikbaar via NHI site.

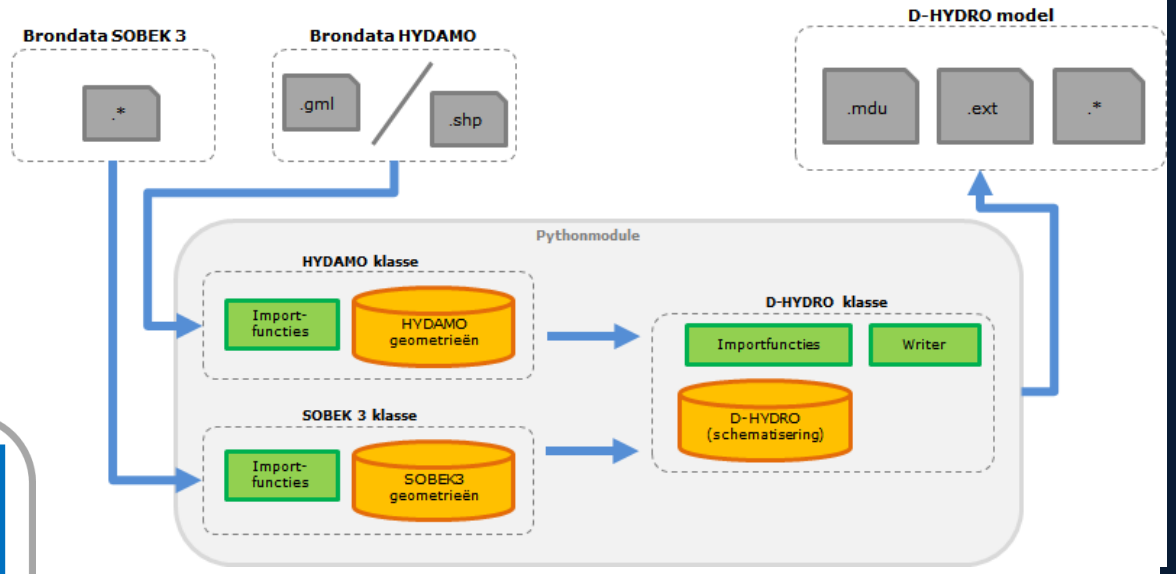
D-HYDRO gebruikers kunnen concentreren op hun specialistische/afgeleide hydrologische tools en diensten.

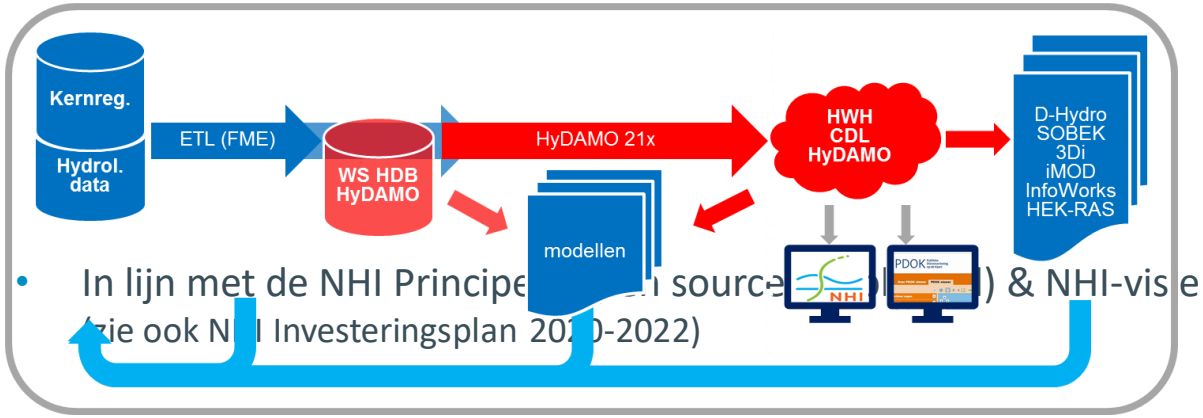
Door bovenop de core scripts te bouwen.

Positie D-Hydamo

D-Hydamo inspireerde ons voor HYDROLIB

- Ontwikkeld door HKV, geadviseerd door Deltares.
- Ontwikkeld in TKI-1 en -2 projecten.
- Wordt één van de tools onder HYDROLIB.





- In lijn met de NHI Principe[illegible] source[illegible]) & NHI-visie rond HyDAMO.
  (zie ook NHI Investeringsplan 2020-2022)

HYDROLIB

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Er is meer…

Automatische preprocessing:

- D-Hydamo
- DAMO-GML converter van RHDHV.

Automatisch simuleren:

- Meteo, radar import voor event-analyse & langjarige runs; koppeling Meteobase, radar, API
- Toetsing aan Wateroverlast Normen Instrumentaria (bijv. Siebe Bosch)

Automatisch analyseren/postprocessen:

- Visualisatie (bijv. DFX)
- Statistieken
- Schade-Slachtoffer-Module (SSM/FIAT)
- Waterschadeschatter

Geautomatiseerd rekenen

- En nu dan echt D-HYDRO gebruiken in de cloud?

- Rekenharten aanbieden als bibliotheek met Python-schil: geautomatiseerd aanspreekbaar.

Wie doet er mee?

Interesse?

- Wordt dit “TKI-4”?

Al gesproken met:

- Bertus de Graaf, HKV
- Annemarleen Kersbergen, Hydrologic
- Joost Heijkers, NHI programmateam
- Timo Kroon, NHI uitvoeringsteam
- Rijkswaterstaat
- Daniel Tollenaar (D2HYDRO)