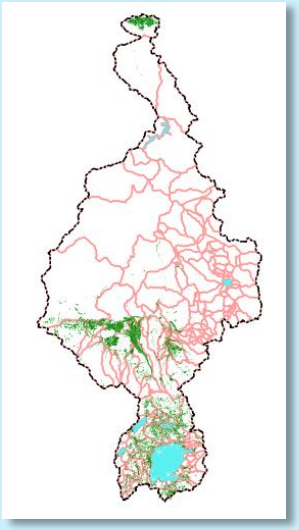
SWRA technical modellers sessions



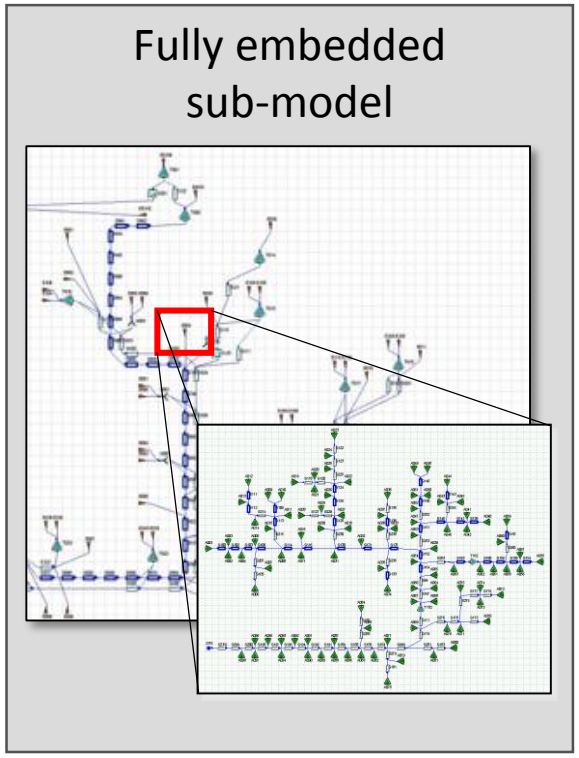
Nested simulation

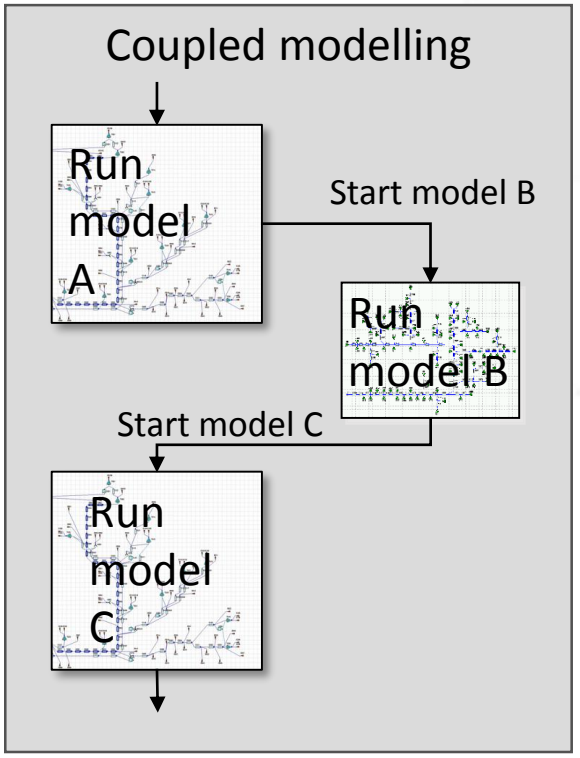
NILE-SEC, Strategic Water Resources Analysis

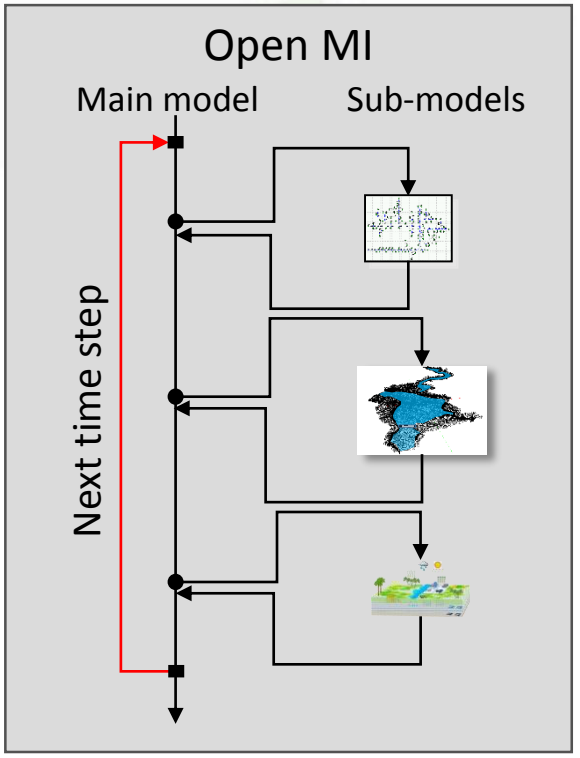
06-April-2022

What is nested simulation?

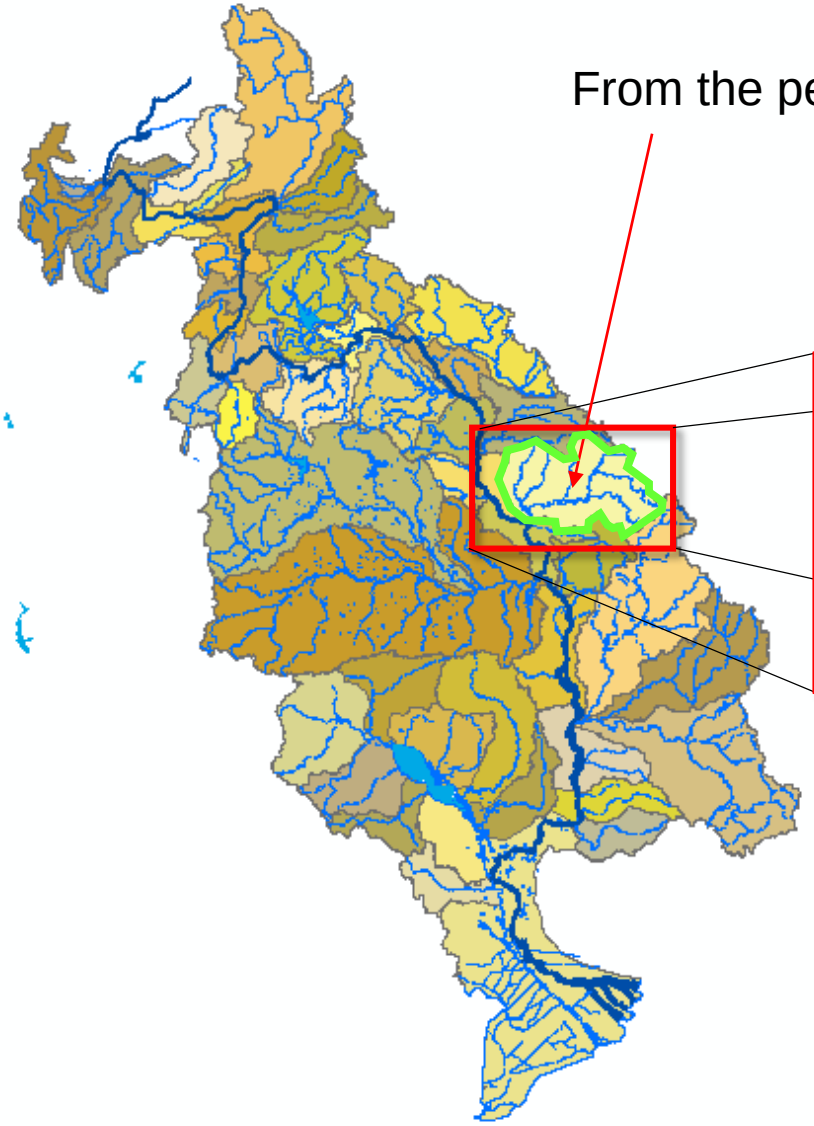
Running a model within a model





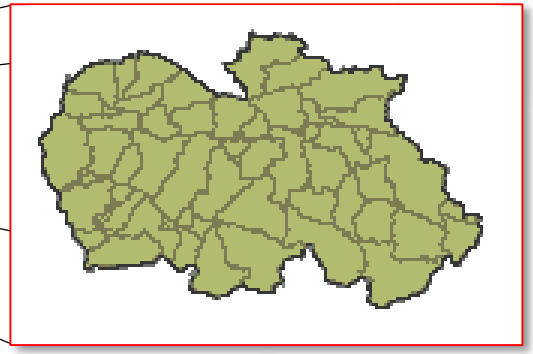


Fully embedded sub-model



From the perspective of the entire model: one sub-basin

From the perspective of the sub-basin:
A separate flow network exists within this sub-basin

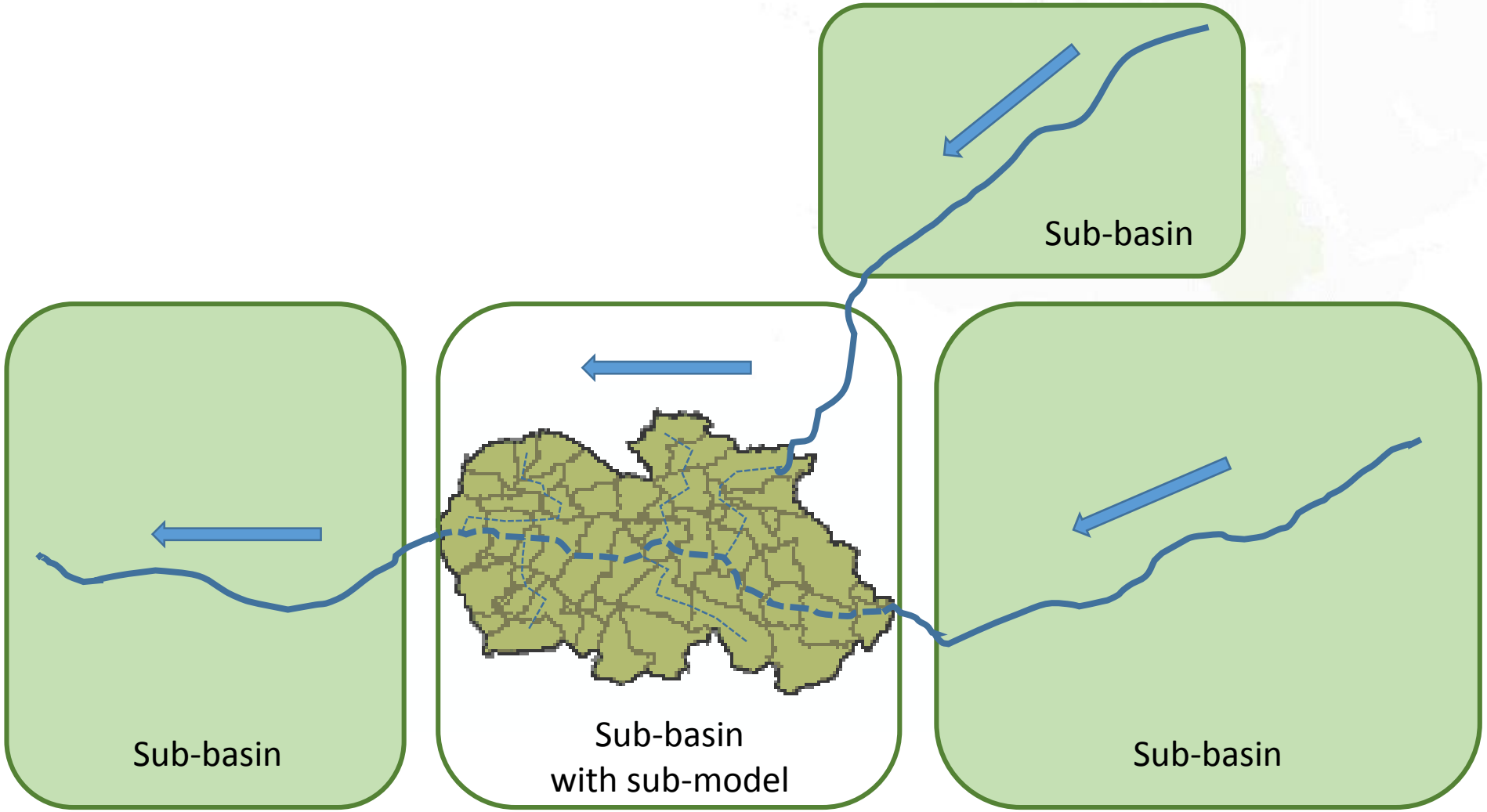


- Inner model can have smaller time step than the outer model
- Outer model can have multiple connection points to the inner model
- Inner model has exactly one outlet point = sub-basin outlet

(implemented in Talsim-NG)

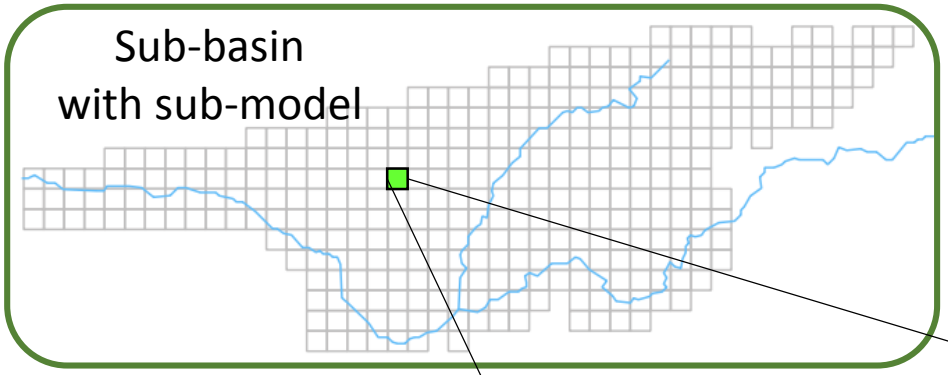
Fully embedded sub-model

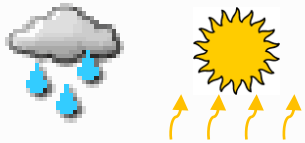
(implemented in Talsim-NG)



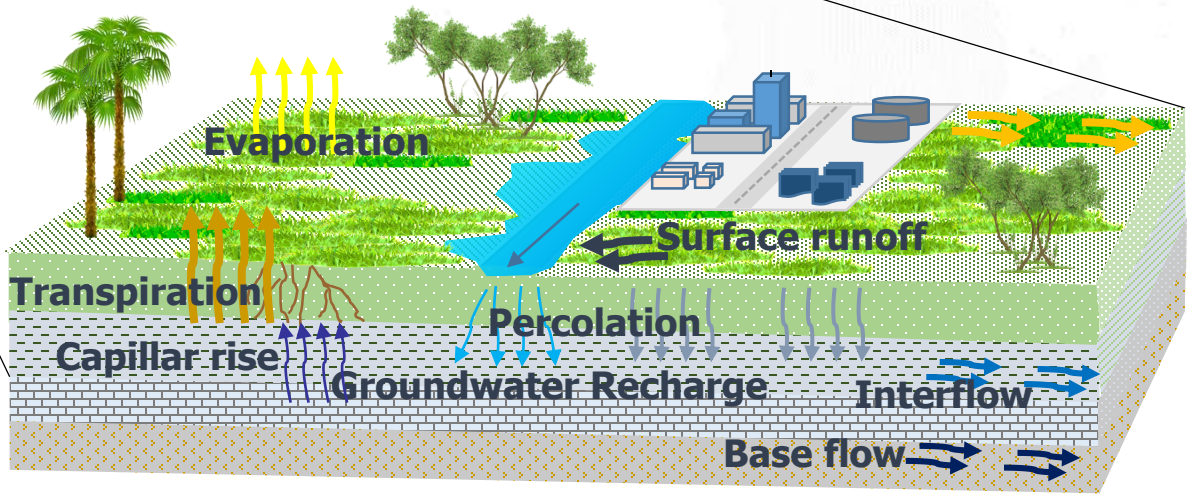
Fully embedded sub-model

(implemented in Talsim-NG)



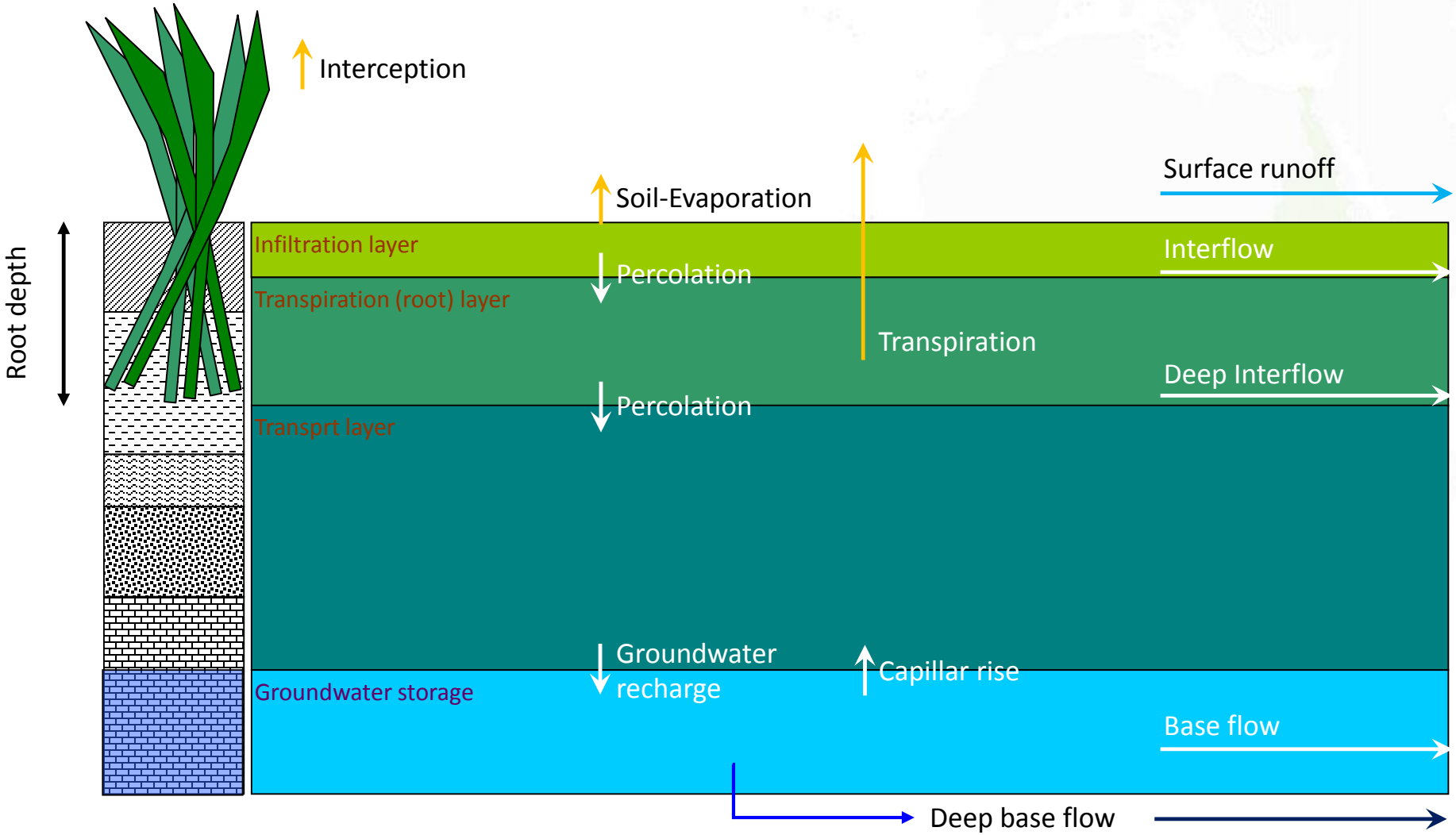


Meteorological stress from the sub-basin



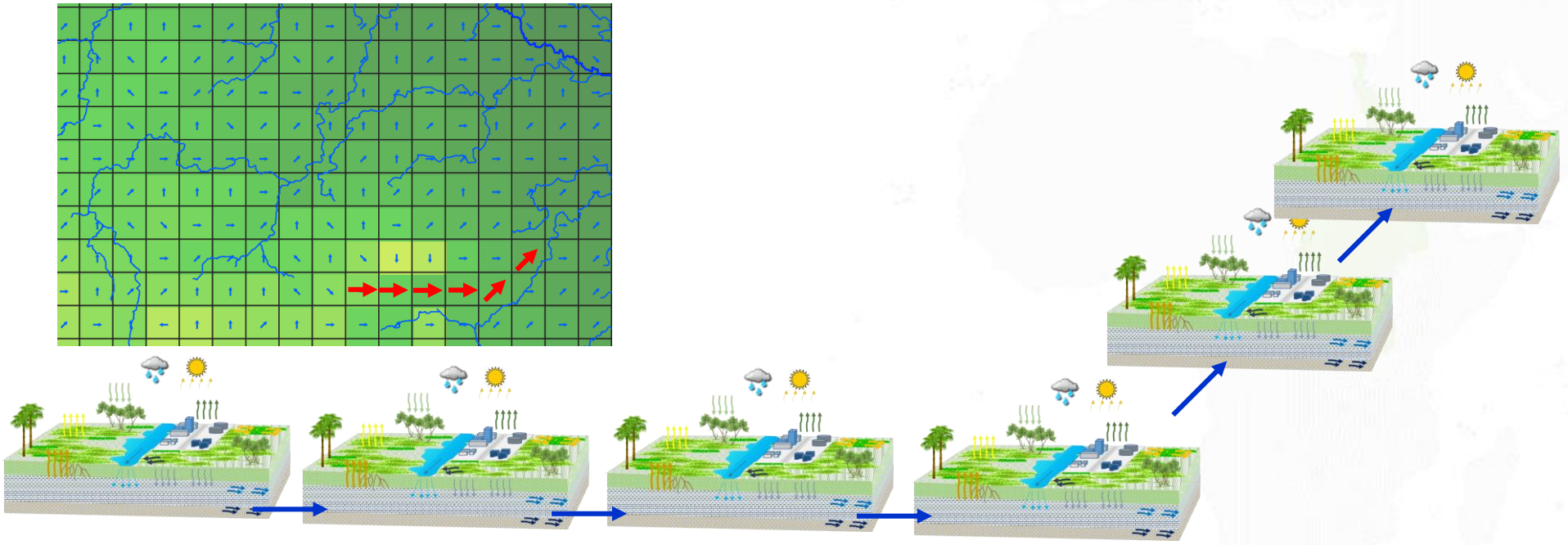
Fully embedded sub-model

(implemented in Talsim-NG)



Fully embedded sub-model

(implemented in Talsim-NG)



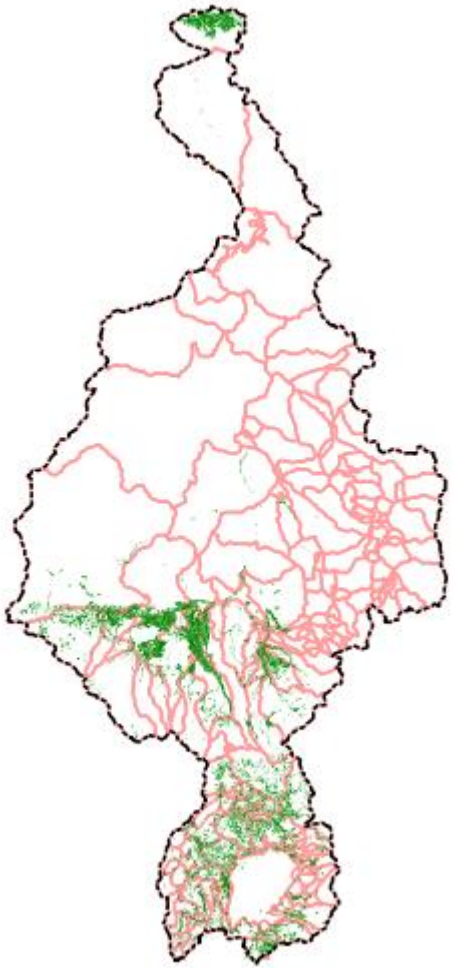
Flow components between cells can be interconnected. If soil downstream is saturated, flow from the upstream cell is impeded

→ Backwater effects

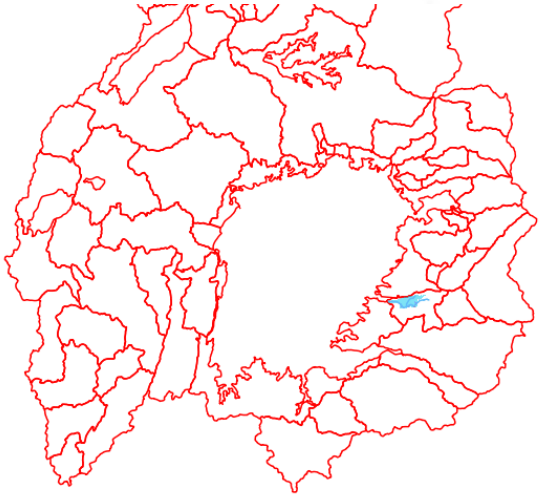
→ Surface flow accumulates from cell to cell

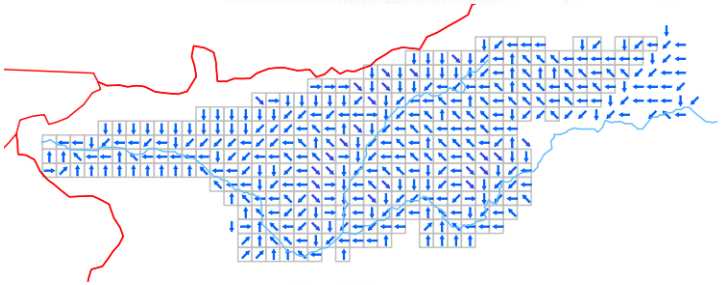
Fully embedded sub-model

Application within the SWRA

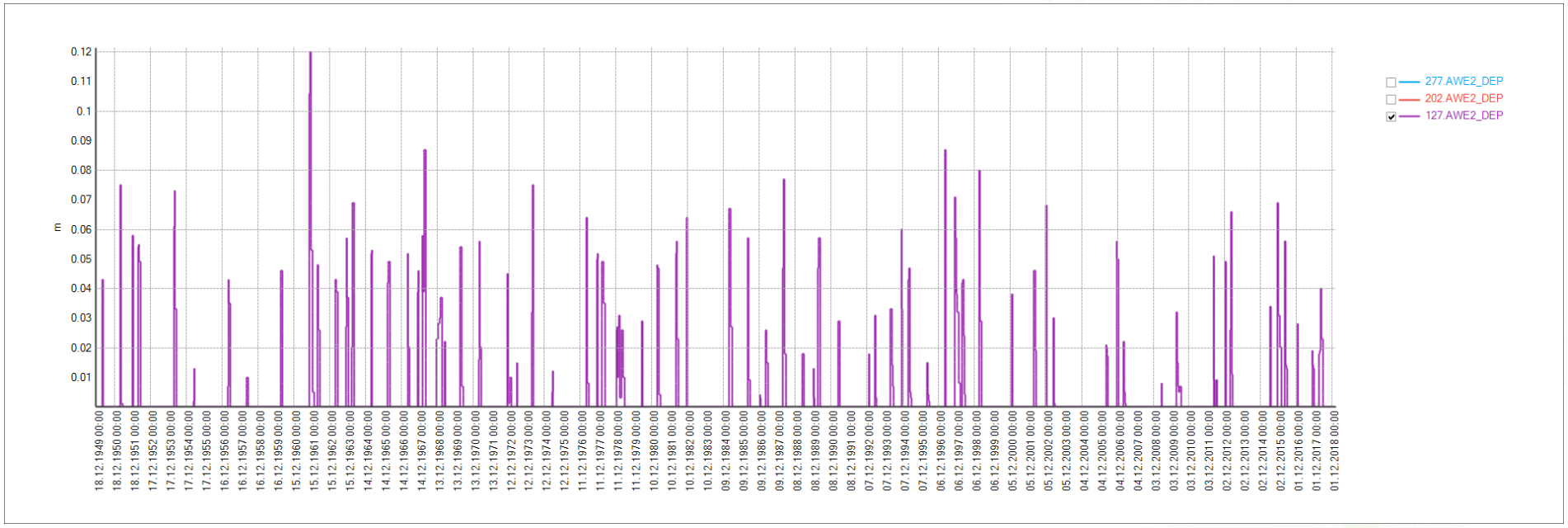


Modelling of wetlands as sub-models



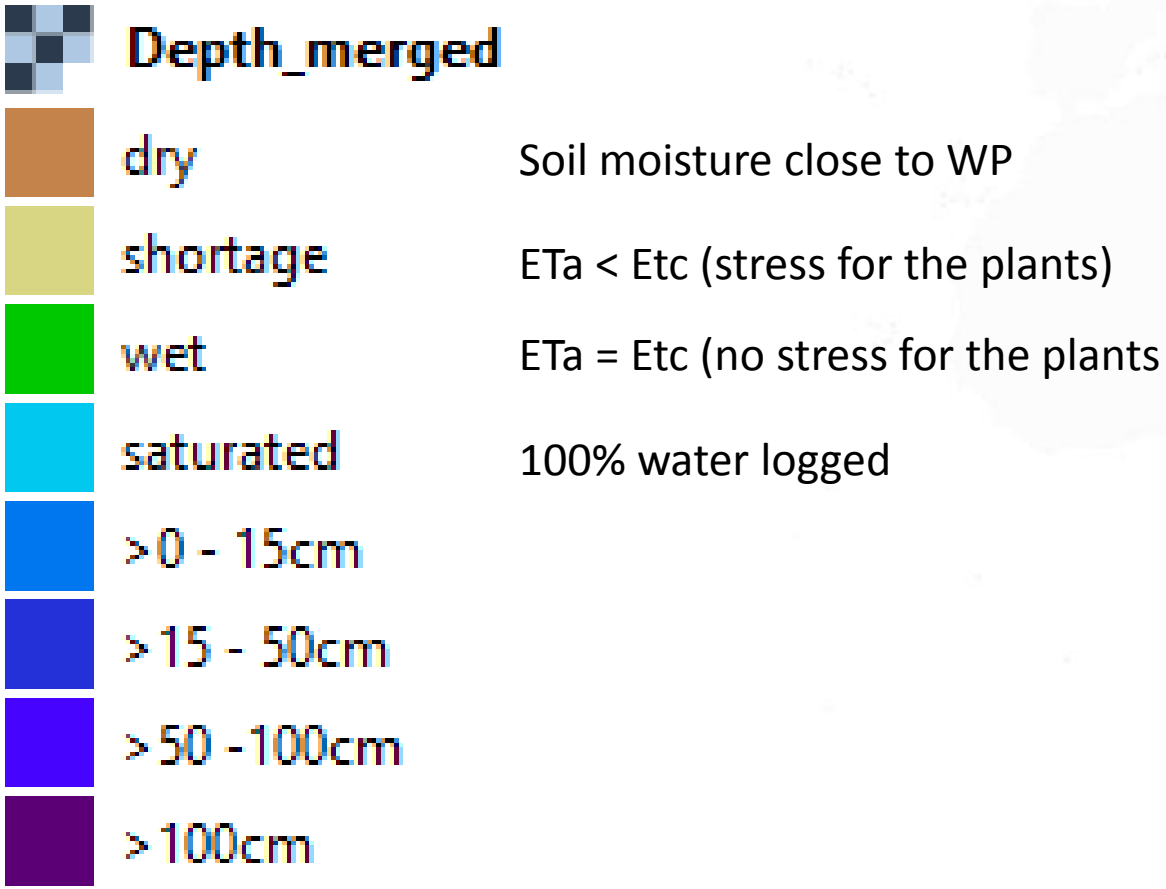


Nested Simulation – HRU Flow Network



Response Rule Matrix	Inundation Duration (% Year)																			
Depth (max flood)	<=5	<=10	<=15	<=20	<=25	<=30	<=35	<=40	<=45	<=50	<=55	<=60	<=65	<=70	<=75	<=80	<=85	<=90	<=95	<=100
0	TR	TR	TR	TR	TR	TR	TR	TR	TR	TR	GR	GR	GR	GR	GR	GR	GR	GR	RE	PA
0.25	TR	TR	TR	TR	TR	TR	TR	TR	TR	TR	GR	GR	GR	GR	GR	GR	GR	RE	RE	PA
0.5	TR	TR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	RE	RE	RE	PA
0.75	TR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	GR	RE	RE	PA	PA	PA
1	TR	GR	GR	GR	GR	RE	RE	RE	RE	RE	RE	RE	RE	RE	PA	PA	PA	PA	FR	FR
1.25	GR	GR	GR	GR	GR	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	PA	FR	FR	AQ
1.5	GR	GR	GR	RE	RE	PA	PA	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR	FR	AQ	OW
1.75	GR	GR	GR	PA	PA	PA	PA	PA	PA	PA	PA	FR	FR	FR	FR	FR	AQ	AQ	OW	OW
2	GR	RE	RE	PA	PA	PA	FR	FR	FR	FR	FR	FR	AQ	AQ	AQ	AQ	AQ	OW	OW	OW
2.25	GR	RE	RE	PA	PA	FR	FR	FR	FR	AQ	AQ	AQ	OW	OW	OW	OW	OW	OW	OW	OW
2.5	RE	RE	PA	PA	FR	FR	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
2.75	RE	PA	PA	PA	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
3	RE	PA	PA	PA	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW	OW
Days	18	37	55	73	91	110	128	146	164	183	201	219	237	256	274	292	310	329	347	365

Open Water
Aquatic Veg
Fringe
Papyrus
Reeds
Grass Floodpl
Trees Shrubs



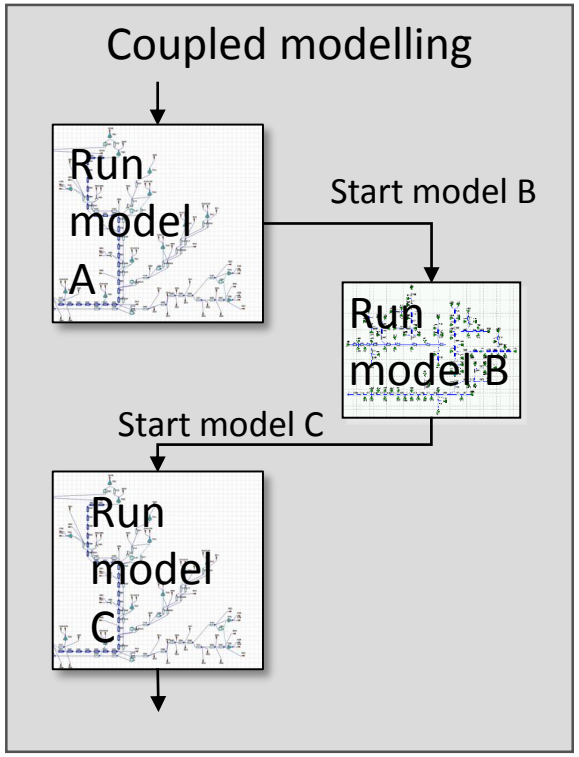
Soil moisture close to WP

ETa < Etc (stress for the plants)

ETa = Etc (no stress for the plants

100% water logged

Coupled modelling



Batch model run

configured to:
convert flow from Model A as inflow to model B
flow from Model B as inflow for model C

Model A:
hydrological model producing the inflow for a hydraulic model

↓

Model B:
hydraulic model calculation

↓

Model C:
Hydrological model uses outflow of hydraulic model

No real interaction between the models!

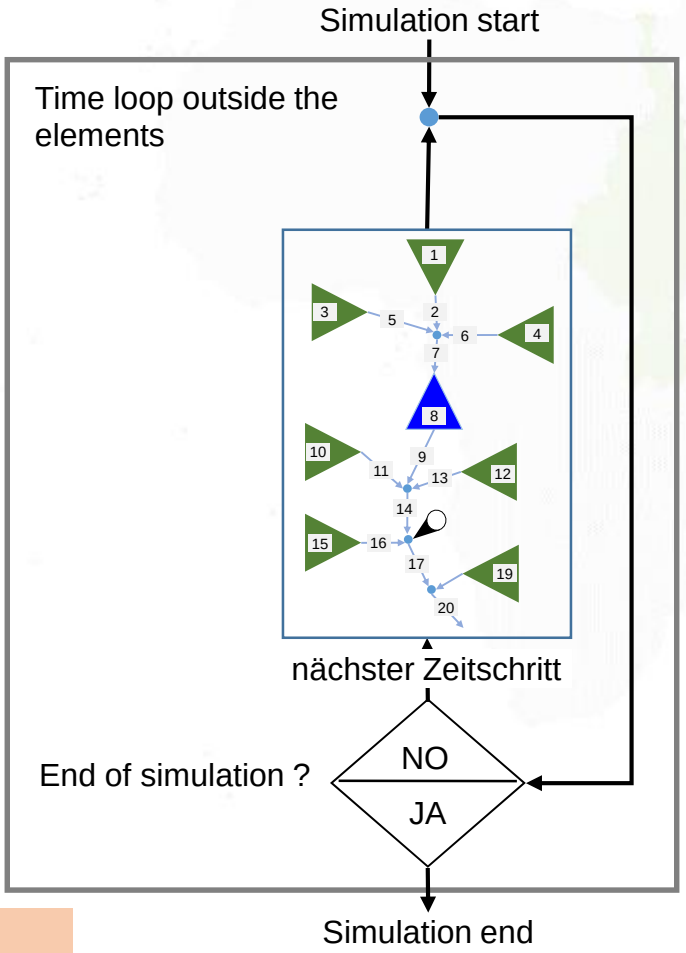
Open MI

- A model must provide a standardized interface
- A master model calls the sub-models as Dynamic Link Libraries
- The interface must provide parameters for time, states, etc.

The OpenMI provides a ***standardized interface*** to
define, describe and transfer data on a time basis between software components that run simultaneously.

Feedback between the modelled processes is possible necessary in order to achieve physically sound results.

The OpenMI is designed to accommodate the easy migration of existing modelling systems, since their re-implementation may not be economically feasible



Performance is an issue!