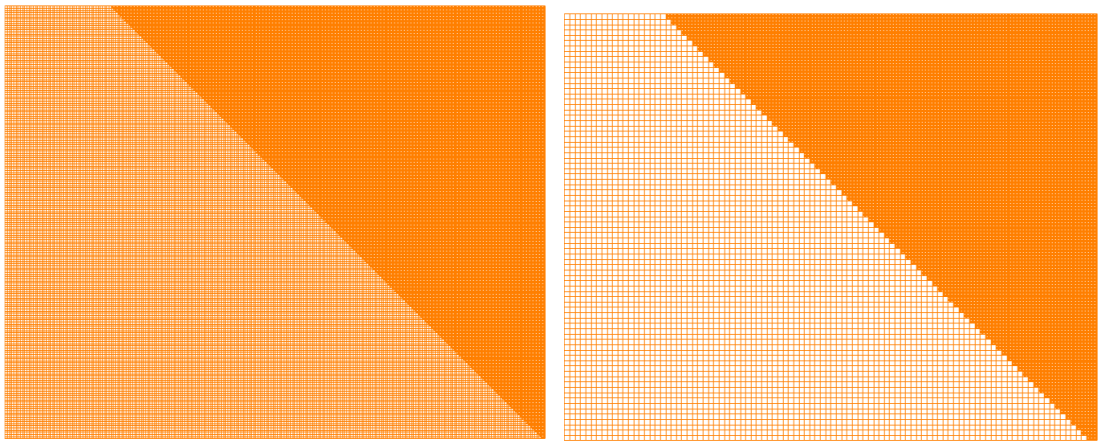
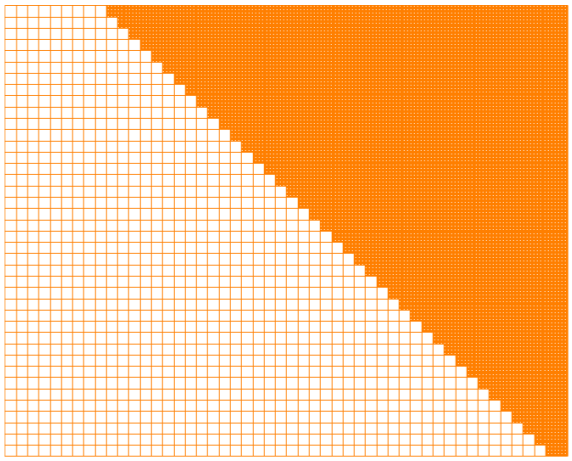
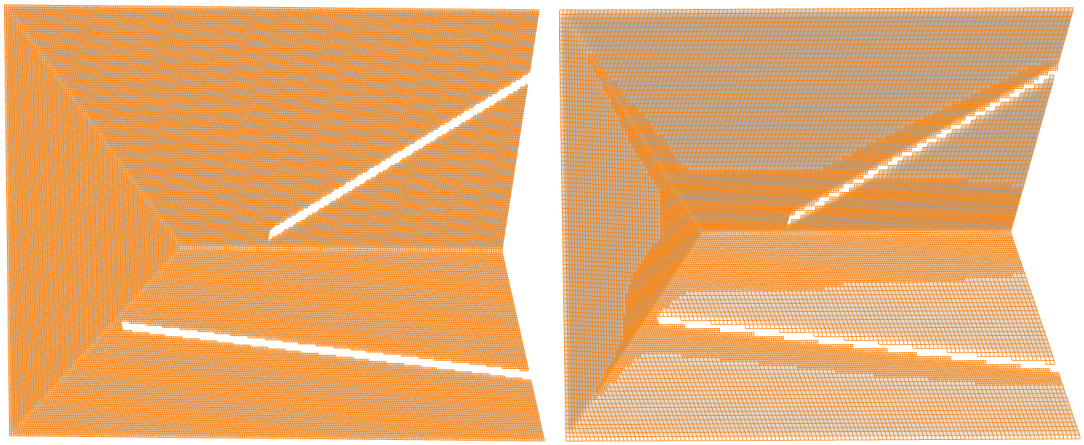


(a) (b)



(c)

Figure S1 Grid partition of the cases described in Section 3.1: (a) case12, (b) case15 and (c) case10



(a) (b)

Figure S2 Grid partition of the cases described in Section 3.2: (a) uniform grids and (b) multi-grids

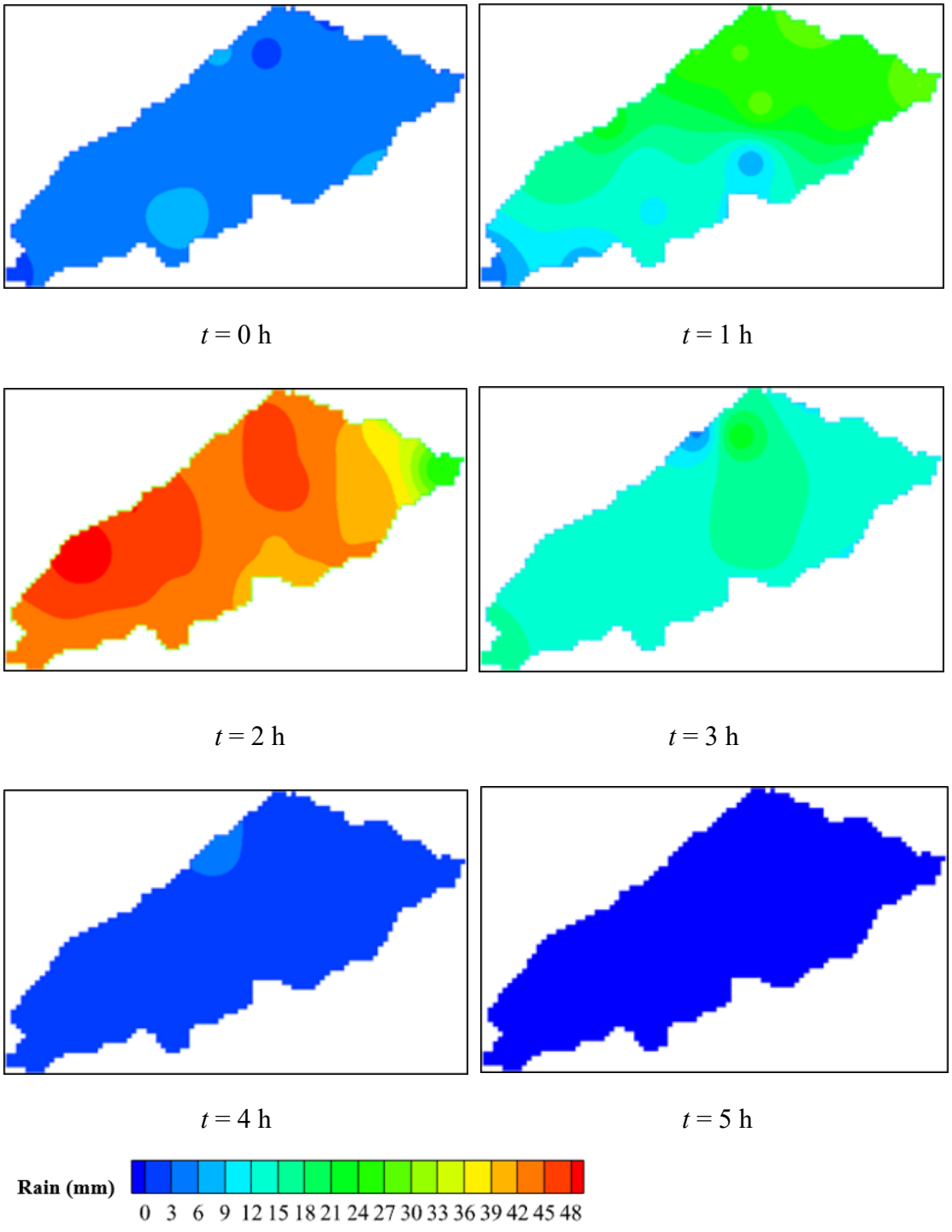
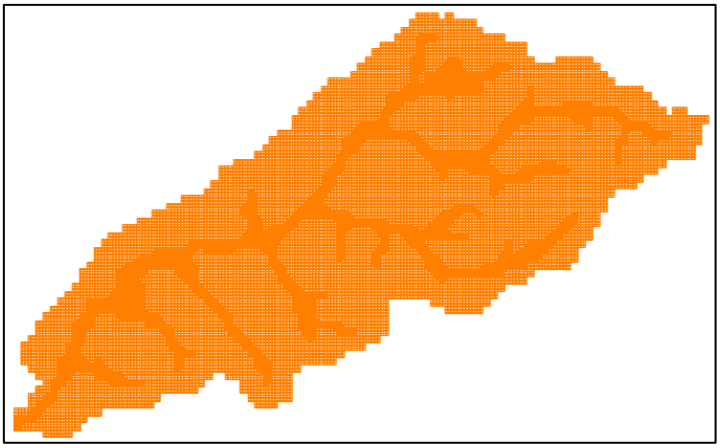
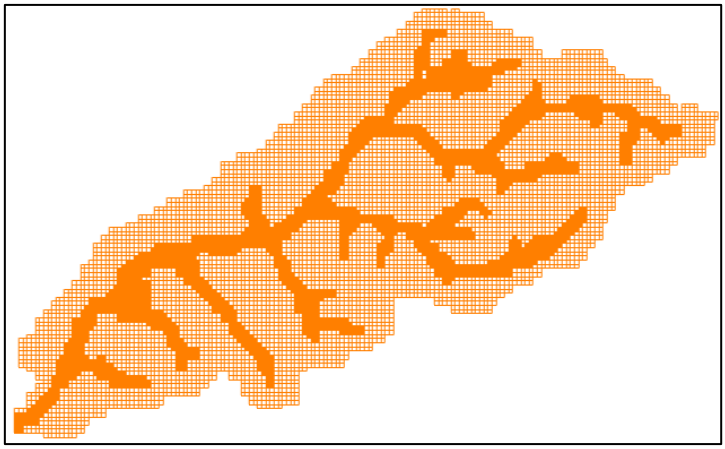


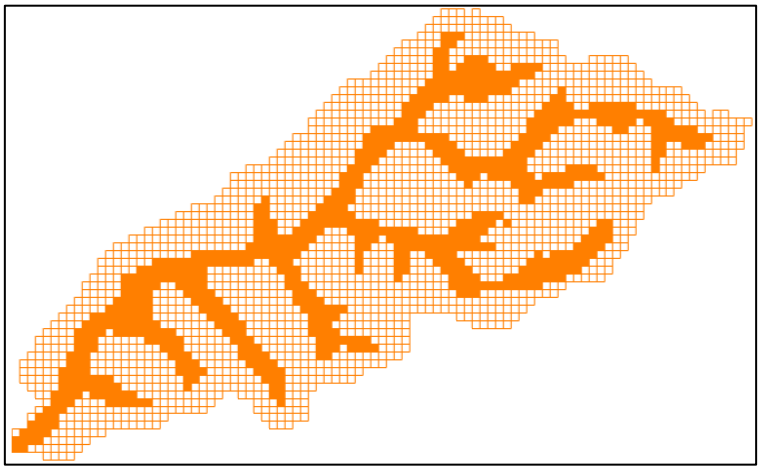
Figure S3 Spatially distribution of rainfall at different times in Section 3.2



(a)



(b)



(c)

Figure S4 Grid partition of the Goodwin Basin: (a) case12, (b) case15 and (c) case10

Table S1 Locations of six stations in Goodwin Creek Watershed

Stations	Longitude and latitude		UTM projection	
	Latitude (N)	Longitude (W)	X	Y
P1	34.23	89.91	231568.71	3791553.74
P4	34.26	89.87	235367.35	3794280.52
P6	34.27	89.86	236459.33	3795732.93
P7	34.25	89.86	236662.95	3793699.88
P8	34.27	89.84	238577.96	3795483.81
P14	34.25	89.88	234644.40	3793655.02

Table S2 Acronyms and Abbreviations

Abbreviation	Full name
IM-DBCM	Improved Multigrid Dynamical Bidirectional Coupled hydrologic-hydrodynamic Model
OM-DBCM	Original Multigrid Dynamical Bidirectional Coupled hydrologic-hydrodynamic Model
DBCM	Dynamical Bidirectional Coupled hydrologic-hydrodynamic Model
NLR	Non-Linear Reservoir
1D	One-Dimensional
2D	Two-Dimensional
SWMM	Storm Water Management Model
AMR	Adaptive mesh refinement
CMI	coupling moving interface

VII	Variable Interpolation Interface
SWE	shallow water equations
HLLC	Harten-Lax-van Leer contact
MUSCL	Monotone Upstream-centered Schemes for Conservation Laws
NSE	Nash-Sutcliffe efficiency