Supplementary materials

Table S1 The parameters of the surface runoff module of IUFM (integrated urban flood model).

Class	Parameter	Value		Reference
		Grassland	Woodland	
Vegetation	Maximum water holding depth over the leaf surface / m	0.00035	0.00045	[33,42,43]
	Precipitation interception rate (fraction of total precipitation represented by canopy rain interception) / %	Related to leaf area index		[42-44]
	Latent heat of evaporation / MJ m^{-3}	2500	2500	[33,43]
	Foliage clumping index	0.9	0.65	[45,46]
	Maximum leaf stomatal conductance / m s^{-1}	0.019	0.003	[33,43]
	Minimum leaf stomatal conductance / m s^{-1}	0.000793	0.000366	[33,43]
	Leaf cuticular conductance in the case of sufficient water / m s^{-1}	0.00004	0.00006	[33,43]
	Leaf cuticular conductance in the case of insufficient water / m s^{-1}	0.00001	0.00002	[33,43]
	Vapor pressure deficit at stomatal opening / mbar	0.75	0.75	[33,43]
	Vapor pressure deficit at stomatal closure / mbar	0	0	[33,43]
	Leaf water potential at stomatal opening / MPa	-1	-1	[33,43]
	Leaf water potential at stomatal closure / MPa	-3.5	-1.8	[33,43]
	Average canopy height / m	0.6	4.4	[43,47]
	Leaf characteristics width / m	0.015	0.02	[33,43]
Soil	Soil field capacity / %	20–30[a] (24[b])		[47, 48]
	Soil wilting coefficient / %	9		[43,48,49]
	Soil water holding capacity at saturation / mm	Soil field capacity×2/1.1		[33,43]
	Soil saturated hydraulic conductivity / cm day^{-1}	20		[10,50,51]

	Soil characteristic parameter	11.96	[43,50,51]
	Soil bulk density / g cm^{-3}	1.35–1.40[a] (1.35[b])	[50], Field measurement
	Maximum (or initial) infiltration rate / mm h^{-1}	50–155[a] (70.2[b])	[10,52]
	Minimum (or ultimate) infiltration rate / mm h^{-1}	1.32–5[a] (3.81[b])	[10,50]
	Infiltration capacity recovery coefficient / day^{-1}	3.91/Antecedent dry days	[10,33]
	Infiltration capacity decay coefficient / h^{-1}	2–7[a] (5[b])	[10]
Land cover	Depression storage / mm	0–15	[10]
	Manning's roughness coefficient / $m^{-1/3}$ s	0–0.8	[10]
	Runoff curve number 1 (CN1) [c]	41–94	[53,54]
	Runoff curve number 2 (CN2) [c]	60–98	[53,54]

[a] The values represent the possible ranges. [b] The values represent the calibrated values based on the actual flood data during the rainstorm event on August 6, 2007. [c] The runoff curve number (CN) is a comprehensive parameter in the soil conservation service curve number (SCS-CN) method [53,54]. CN1 and CN2 refer to the curve number when the soil moisture conditions are dry and normal, respectively. The CN reflects the underlying surface and soil characteristics of the watershed before rainfall and can be used to determine the surface runoff pattern (infiltration excess runoff or saturation excess runoff).

Table S2 The parameters of the pipe convergence module of IUFM (integrated urban flood model).

Type	Parameter	Description	Value[a]
Node	EI / m	Invert (channel or utility hole bottom) elevation	44.0–48.4
	Max. Depth / m	Height between invert and ground surface	3–5
	Ponded area / m^2	Ponded surface area when flooded. If the ponding analysis function is enabled and the parameter value is not zero, the overflow will occur. When the drainage capacity of the pipe network is restored, the overflow returns to the pipes.	>0
Conduit	Inlet node	Identities of the inlet nodes	/
	Outlet node	Identities of the outlet nodes	/
	Length / m	Conduit length	44.8–550.8
	Shape	Cross-section shape	Circular
	Geom / m	Cross-section diameter	0.3–0.9
	Roughness	Manning's roughness coefficient	0.014

Table S3 Loss coefficients for different land-cover types in the inundation module of the IUFM (integrated urban flood model).

Land-cover type	Value
Asphalt road	0.011-0.013[a] (0.011[b])
Concrete road	0.011-0.013[a] (0.011[b])
Concrete roof	0.011-0.013[a] (0.011[b])
Grassland	0.15-0.41[a] (0.25[b])
Woodland	0.4-0.8[a] (0.45[b])
Brick pavement	0.011-0.11[a] (0.11[b])

[a] The values are from Manning's roughness coefficient for different land-cover types [51]. [b] The values represent the calibrated values based on the actual flood data during the rainstorm event on August 6 2007.

Table S4 Spatial composition and configuration metrics for the impervious cover types from the landscape pattern analysis package FRAGSTATS 4.2 [58].

Landscape metrics		Definition	Equation
Area	PLAND	Percentage of landscape (%)	$\text{PLAND} = \frac{\sum_{j=1}^{n} a_{ii}}{A} \times 100$
	LPI	Percentage of the landscape comprised by the largest patch of a cover type (%)	$\text{LPI} = \frac{\max(a_{ij})}{A} \times 100$
Aggregation	PLADJ	Percentage of the number of like cell adjacencies for a cover type in the total number of cell adjacencies in the landscape (%)	$\text{PLADJ} = \frac{g_{ii}}{\sum_{k=1}^{m} g_{ik}} \times 100$
Connectivity	COHESION	Patch cohesion index	$\text{CONHESION} = \frac{\left[1 - \frac{\sum_{j=1}^{n} p_{ij}^{*}}{\sum_{j=1}^{n} p_{ij}^{*} \sqrt{a_{ij}^{*}}}\right]}{\left[1 - \frac{1}{\sqrt{Z}}\right]} \times 100$

a_{ij} is the area (m^2) of patch ij; A is the total landscape area (m^2); g_{ii} is the number of like adjacencies (joins) between pixels of patch type (class) i based on the double-count method; g_{ik} is the number of adjacencies (joins) between pixels of patch types (classes) i and k based on the double-count method; p_{ij}^{*} is the perimeter of patch ij in terms of number of cell surfaces; a_{ij}^{*} is the area of patch ij in terms of number of cells; Z is the total number of cells in the landscape.

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