Table S1: Application of HEC-RAS/HMS in flood hazard assessment in the urban area of South Asian cities

Author	Location	Objective of Study	Models/method/software	Data used	Findings
(Pathak et al., 2020); (Zope et al., 2016); (Zope et al., 2015); (Zope et al., 2017)	Mumbai city, India	Investigated the impact of LULC and urbanization on floods	HEC-HMS and HEC-RAS, SCS-CN, GIS, and remote sensing	Daily time series of precipitation and temperature, land use, soil map, DEM	Develop flood hazard maps of the city
(Suriya & Mudgal, 2012)	Thirusoolam sub watershed in Chennai, India	To develop the flood hazard map	1D HEC- RAS, HEC-HMS, weighted curve number, Google Earth image, RS, and GIS	Land use, hydrologic soil group data	Urbanization has increased the flooded area and depth
(Devi et al., 2019)	Adyar River basin, Chennai, India	Flood simulations using freely available hydrologic-hydraulic models	HEC-HMS, 2D HEC-RAS, CA-based model, Artificial Neural Network model	Landsat images, one-day maximum rainfall data, SRTM DEM 30m,	Developed Flood inundation and hazard zonation for the future extreme event
(Vinay Ashok Rangari, Umamahesh, et al.,	Hyderabad, India	Developing flood zone map for urban catchment	HEC-HMS, HEC-RAS, SCS CN method, AutoCAD, ArcGIS 10.1, Google Maps	Hourly rainfall & evaporation data, drainage	Development of flood hazard risk map for different

2021)				network, SRTM 30 m DEM, DTM, hydrologic soil group	climate change scenarios
(Vinay Ashok Rangari, Bhatt, et al., 2021)	Hyderabad, India	Analyze the urban floods of October 2020 from a geospatial perspective	HEC-RAS 1D–2D, HEC-HMS, ArcGIS 10.1	Rainfall data, stream–drainage network, Cartosat DEM 10 m, Landsat 30 m and Sentinel-2 (10 m resolution) image	Haphazard urbanization ignoring the hydrologica l landscape has worsen the flooding severity.
(Surwase & Manjusree, 2019)	Hyderabad, India	Assessing three different modeling approaches for the simulation of urban flooding	PCSWMM, HEC-RAS 2D, HAND, Dynamic Wave (DW) model, Curve Number (CN) method	CARTODE M 10-meter resolution, hourly rainfall data, discharge data	Delineation of flood plains and risk zones for protection from flooding
(Azazkhan I. Pathan & Agnihotri, 2020), (Azazkhan Ibrahimkha	Navasari city of Gujarat, India	Assessment of flood inundation in an urban coastal area	HEC-RAS 1D, HEC-RAS 2D, Arc GIS	Cartosat-1 DEM, SRTM 30 m DEM, Discharge data, SAR images	Generated flood map shows low-lying areas of the city are prone to

n Pathan et al., 2021)					flooding.
(Saini et al., 2016)	Ambala city, India	Examine the issues and causes of flooding in the urban area	HEC- RAS v4.1, Google Earth, GIS	Cartosat-1 (30 m) DEM, flow data, land use map	Flooding impact starts at a maximum discharge of 1000 m^3/s against a 5-year return period.
(Pandey & Dugar, 2019)	Bhaktapur, Nepal	Flood hazard and inundation mapping	HEC-RAS v5.0.7, ARCGIS	DEM, survey data, daily precipitation, and discharge data	Flood hazard maps created using hydraulic and topographic modeling
(Basnet, 2020)	Tulsipur city, Nepal	Prepare floodplain mapping	HEC RAS, Google Earth, ArcGIS	30m DEM, Landsat images, flow, and cross sections data	Flooding in the buildup area has increased with urbanization along the river
(Basnet & Acharya, 2019)	Pokhara, Nepal	To conduct the flood analysis of	HEC-RAS modeling, Google Earth Map, ArcGIS, photographs	30 m resolution DEM,	Flood plain maps are prepared

		the Seti River in Ramghat			
(Dangol & Bormudoi, 2015)	Bishnumati, Kathmandu	To prepare a flood hazard map	1D HEC-RAS, ArcView	30 m ASTER DEM, Daily maximum river discharge, GIS data, socioeconomic data	Flood area increases with flood intensity
(Zafar & Zaidi, 2019)	Karachi, Pakistan	Identify the impact of land-use changes on associated flood risk	1D HEC-RAS HEC-HMS, SCS-CN, ArcGIS, Google Earth	Landsat images, SRTM 30m DEM, Topographic maps, daily rainfall data	Maps of blockages and flood extent were prepared
(Masood & Takeuchi, 2012)	Dhaka, Bangladesh	Assessment of flood hazards by developing a flood hazard map	1D HEC-RAS, ArcGIS, Google Earth	DigitalGlobe image, SRTM 90 m DEM, discharge and water level data	A flood hazard, vulnerability, and risk map were prepared
(Tenzin & Bhaskar, 2017)	Sarpang town, Bhutan	Modeling the flash flood concerning rainfall	HEC-RAS 5.0.1, ArcGIS 9.2	SRTM DEM, Landsat images, the daily average rainfall	The modeling method adopted can be used for mountain

					terrain
(Manawi et al., 2020)	Kabul Afghanistan	Hydrological modeling for the identification of the factors causing the floods	HEC-HMS, ArcGIS	CHIRPS rainfall data, daily rainfall data, CORONA image	Large changes in land use generates floods in recent years

Table S2: Application of SWMM/PCSWMM in flood hazard assessment in the urban area of South Asian cities

Author	Location	Objective of Study	Models/method/ software	Data used	Findings
(V. A. Rangari et al., 2018)	Hyderabad city, India	Identifying highly affected areas during extreme rainfalls event	1D-SWMM, ArcGIS 10.1	10m Cartosat Dem, details of drain network	Flood inundation maps identify the low-lying areas which need immediate attention.
(Vemula et al., 2018)	Hyderabad City, India	Assess conveyance capacity of urban sewerage network under climate	SWMM 5.1, 2D PCSWMM, ARCGIS, Google Earth maps, InpPINS	CMIP5, RCPs 2.6, 4.5, 6.0, and 8.5, daily rainfall, Storm Water Network, Cartosat 30M DEM	Drainage conveyance capacity can be increased by desilting

		change scenario			drains and outlets
(Vinay Ashok Rangari et al., 2018)	Warangal, Telangana, India	Analyzing and designing a suitable stormwater drainage system	SWMM model, IDF curves, ArcGIS	Cartosat 30 m DEM, LULC maps, drainage details	By enlarging the drainage system, water surcharge conditions at intersections can be decreased.
(Avinash et al., 2018)	Bangalore city India	Develop flood forecast and early warning system	SWMM, InpPINS tool	2 m resolution DEM, Land use land cover map, real-time hydro-meteorological data	The flood extent maps with forecast rainfall are generated
(Harsha et al., 2020a, 2020b)	Vijayawada city, India	To model flood using extreme rainfall events for historical and future climate scenario	SWMM model, AutoCAD, GIS, RCP 4.5 scenario	Junctions and conduits of sub-catchments, data of extreme rainfall events for historical and future, Sentinel and Landsat images	Prepared flood map help to understand the flood extend area

(Bhattacharjee et al., 2021)	Bhubaneswar City, India	To assess urban flood risks based on hydro-dynamic set-up and level of urbanization	NRCS-SCS CN method, SWMM model	LiDAR data (1 m), LULC, 1m CartoDEM, hourly and daily rainfall, SWD network data, IDF curves	Model simulations indicate the severity of urban floods in the city
(Bisht et al., 2016)	IIT Kharagpur, India	Providing a solution to stormwater management problem in an urbanized area	1D SWMM and 2D MIKE URBAN models, ARCGIS	Daily rainfall data, land use/land cover, topographic map, dem 10M	Extreme rainfall for short period is supposed to result in flooding from any drainage system
(Sonavane et al., 2020)	Pune city, India	Develop and simulate urban floods using critical rainfall events	SWMM 5.1 model, ArcGIS	Hourly rainfall data, 30m DEM SRTM, drainage and catchment data	Extreme rain intensities cannot be handled by the current drainage system.
(Akter et al., 2019)	Chittagong city, Bangladesh	Model urban flood hazards and map the estimated inundation	2D PCSWMM, ArcGISv10.1	30 m DEM, drainage details, landuse, daily rainfall data	Model simulated flood depths were used

		depth for a data-scarce city			to prepare the flood hazard map
(Ahammad et al., 2018)	Begunbari canal catchment, Dhaka, Bangladesh	To find the requirement of pumping and retention area capacity for a different storm event	GeoSWMM, GIS	10 m DEM, Land use, Canal cross sections, Water Level, Discharge, and 3-hourly precipitation data	To maintain the specified water level, 55 cumec capacity pumps with a 1.5 square kilometer retention area are needed.
(Pradhan-Salike & Raj Pokharel, 2017)	Kathmandu, Nepal	Investigates the link between climate change-related extreme rainfall events and rising urban flooding caused by	PCSWMM, RClimdex, IDF curve, GIS	Precipitation and land use data, map of urban drainage, geology	Future climate change conditions with present urbanizatio n will increase pluvial flooding

		increased imperviousness.			
(Kc et al., 2021)	Kathmandu, Nepal	to access the impact of climate change and urbanization on urban pluvial flooding	PCSWMM 2D, Regional Climate Models (RCMs), GIS	IDF curve, daily and hourly rainfall, 5m DEM, 1m contour	Urbanization contributes less to urban pluvial flood

Table S3: Application of MIKE in flood hazard assessment in the urban area of South Asian cities

Author	Location	Objective of Study	Models/method/software	Data used	Findings
(Pervin et al., 2020)	Bharatpur, Nepal and Sylhet, Bangladesh	Understand the risks of flooding due to inadequate drainage capacity and unplanned solid waste dumping.	MIKE11, CNRM ARPEGE climate model	Drainage networks, rainfall and water level data, surveyed cross-sections of canals	A structural solution and proper solid waste management are required to reduce the flooding risk.
(Wagenaar et al., 2019)	Colombo, Sri Lanka	Risk analysis techniques are combined to evaluate adaptation	MIKE, Unit Hydrograph method, SCS-CN method, IDF curve	Land use map, rainfall data, DEM, cross sections, road and	The effect of stopping wetland encroachment was found to

		measures		embankment data	be larger than the effect of the structural adaptation measures
(Moufar & Perera, 2018)	Colombo, Sri Lanka	To assess the flood level and extent of inundations for design rainfalls	MIKE11, MIKE21, and MIKE FLOOD	Rainfall data of 15 min, Water level, 30 m DEM	2.0 MSL is the safety flood level in the basin and was satisfied only with the 10-year rainfall event under favorable conditions.
(Mark et al., 2018)	Central Dhaka, Bangladesh	Linking dynamic urban flood modeling with quantitative microbial risk assessment	MIKE, time area model	Grid size 10m, storm sewer pipes, and box culverts	to understand the interaction between urban flood and health risks caused by direct human contact with the flood water

(Khan et al., 2018)	Dhaka, Bangladesh	To investigates the consequences of the 2004, flood that would take place in 2050 under rapid urban development.	MIKE flood, time–area method	LULC, DEM 25m, primary drainage system data, cross sections of the open channels	The damage will increase significantly if the 2004 flood event occurs in 2050.
(A. S. Chen et al., 2016)	Dhaka, Bangladesh	To assesses the flood hazard and damage due to current and future urbanization.	MIKE Urban, MOUSE, and MIKE FLOOD	Rainfall, water level, land use data	The modeling results demonstrate the capability of the damage assessment tools to evaluate the impact of flooding on the current and future urban growth scenarios.