Hillslope hydrology modifications for better representation of variable source areas: SWAT-Hillslope

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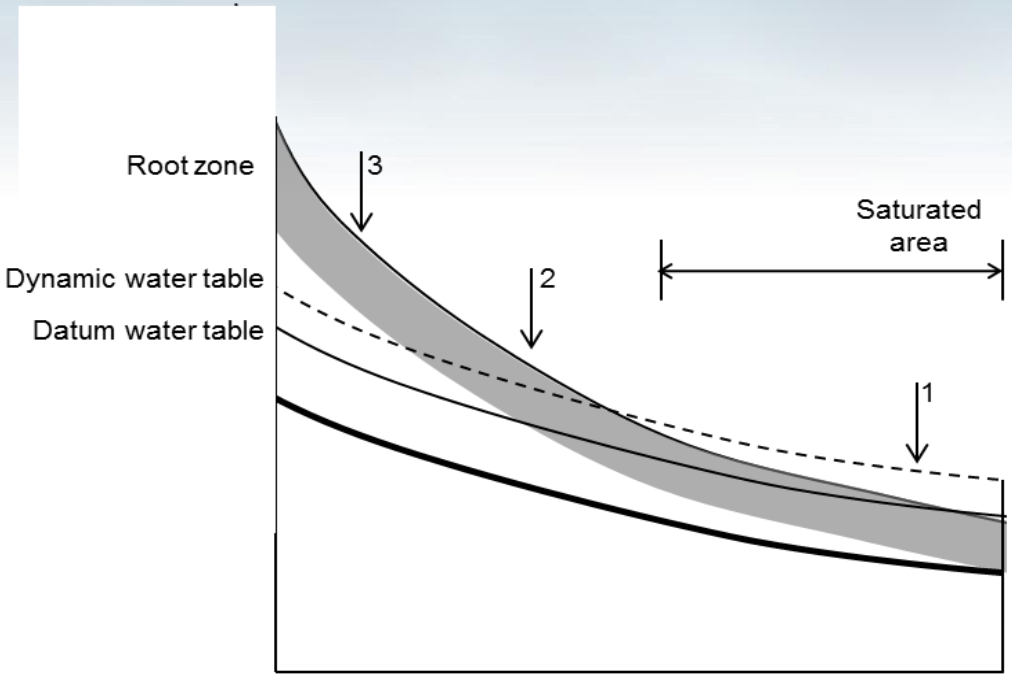
Introduction

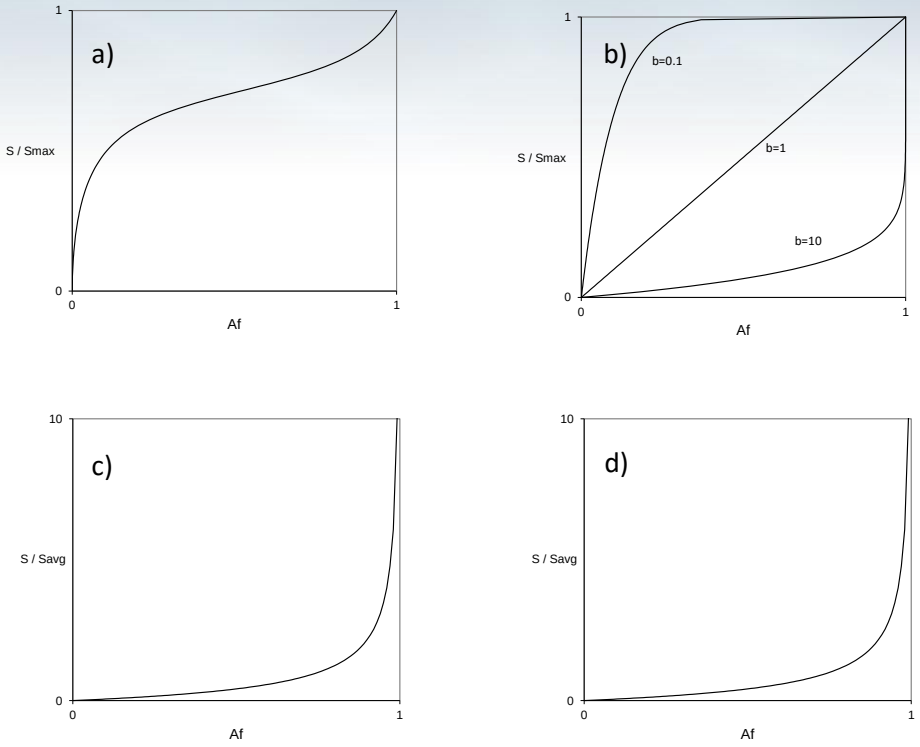
- Perched aquifer forming above a relatively impervious soil layer plays a major role in hillslope hydrology.
  - Transmits subsurface flow laterally through the hillslope.
  - Controls soil saturation as the perched water table approaches the surface.
  - Provides water for plant use.
  - Influences biogeochemical transformations related to saturated conditions in soils.

SWAT-*Hillslope*



Idealized hillslope profile according to SD approach. Water table saturates location 1, intersects the root zone at location 2, and is below the root zone at location 3.

SWAT-*Hillslope*

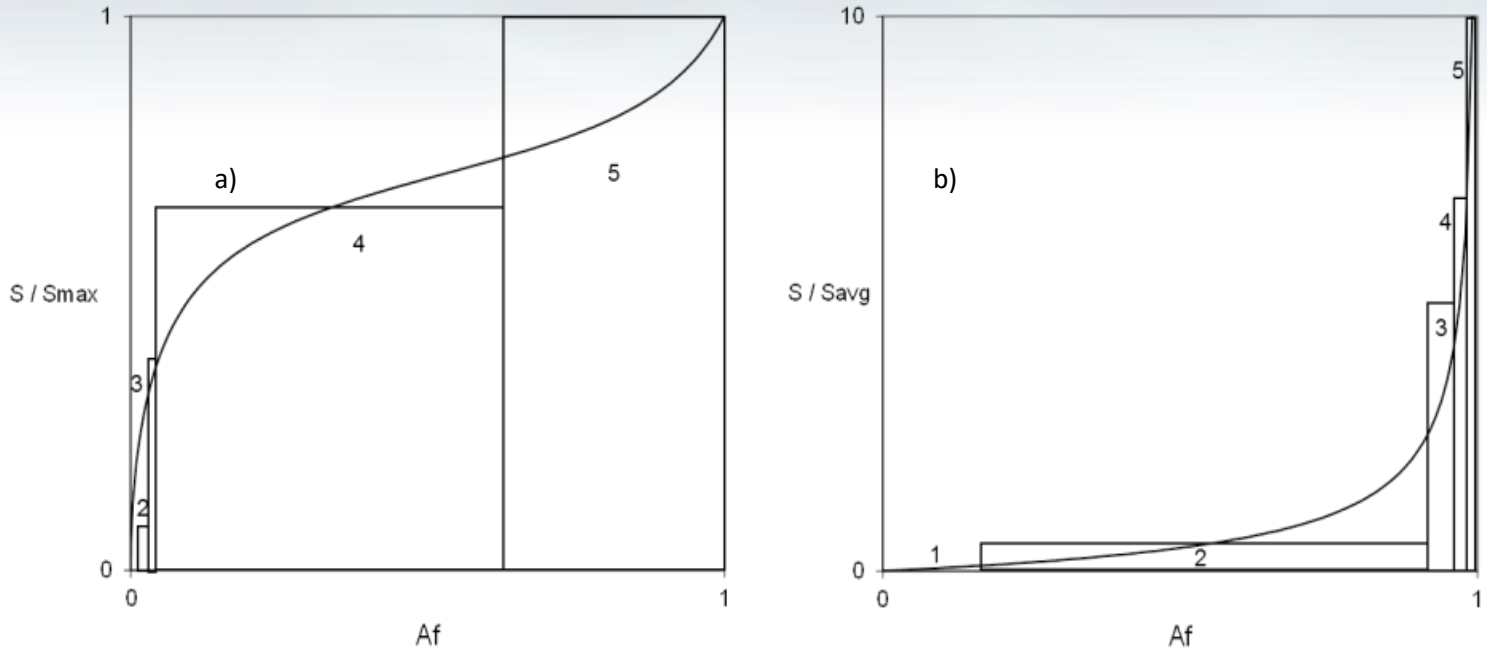


Moisture Storage Capacity distribution functions commonly used in saturation-excess runoff models. Af (x-axis) is fraction of area of watershed with normalized storage capacity less than or equal to corresponding y-axis value. a) based on TOPMODEL topographic index. b) Pareto distributions with b=0.1, 1, and 10. c) based on USDA Curve number equation. D) empirical distribution as in AWBM model.

Approach

- Uses variable bucket approach for modeling soil water storage capacity
- Up to 10 subareas (wetness classes) of increasing capacity (represent the parameterization of storage capacity districution for the catchment)
- Basic wetness classification scheme: 1) perennial stream channel; 2) perennial wetland; 3) seasonally saturated wetlands; 4) intermittent saturated ares; 5) rarely or never saturated areas

SWAT-*Hillslope*



Varying water capacity distribution functions for different combinations of catchment wetness classes. a)catchment dominated by dry or intermittently saturated areas – storage capacity distribution like Topmodel. b)catchment dominated by perennial wetlands – storage capacity distribution like pareto distribution (b>1) or USDA CN equation.

SWAT-*Hillslope*

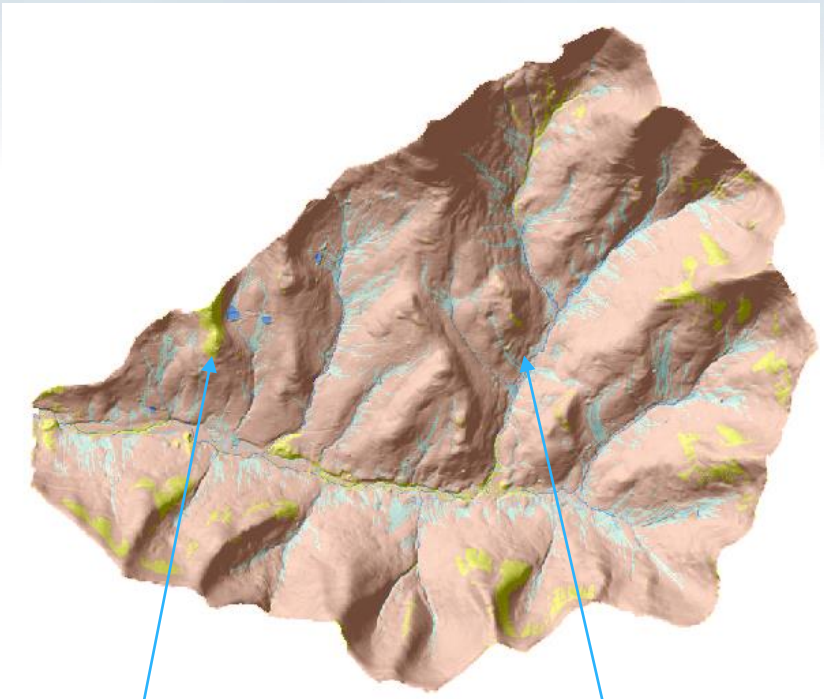
NAME	UNITS	DEFINITION	USED IN…
New Parameters: Infiltration Excess runoff			
fsfactor	None	Frozen Soil adjustment factor for hydraulic conductivity in Green Ampt	readbsn.f, surq_greenampt.f
hcfactor(mhru)	None	Adjustment factor for hydraulic conductivity in Green Ampt equation	readbsn.f, readhru.f surq_greenampt.f
sstmaxd	mm H20	Static depressional storage used in Green-ampt algorithm	readbsn.f, surq_greenampt.f
New Parameters: Saturation Excess Runoff			
edc(weti)	mm H20	Effective Depth Coefficient: Maximum drainable water storage capacity. Defined at wetness class level. Input in basins.bsn	readbsn.f, hydroinit.f
edc_factor	None	Calibration factor adjusts all edc values	readbsn.f, satdef.f, wtdepth.f
effporfactor	None	Fraction of effective porosity that can hold water under saturated conditions. Adjusts effective porosity.	readbsn.f, wtdepth.f, tileflow.f
latA		Perched aquifer non-linear reservoir coeff	Latflow.f
latB		Perched aquifer non-linear reservoir coeff	Latflow.f
perchst_datum	Mm H2O	mean depth of perched aquifer drawn down just to point where lateral flow from aquifer ceases	readbsn.f, hydroinit.f, latflow.f
rechg_paf	none	Fraction of root zone percolation that recharges the perched aquifer	readbsn.f, percmain.f, gwmod.f, gw_no3.f
weti(mrhu)	None	Wetness index class (01-10) assigned to each HRU. Read from .sol, embedded as characters 4 and 5 of soil name	readsol.f, hydro_init.f
New Parameters: Penman Monteith Evapotranspiration			
leaflngth	m	average leaf/stem length in direction of wind to calc boundary layer resistance in canevmax	readbsn.f, etpot.f
saimax	m^2/m^2	maximum stem area index for HRU	readbsn.f, canopyint.f, grow.f
waco	none	Wind attenuation coefficient for vegetation with complete canopy cover	readbsn.f, etpot.f
New Parameters: Other			
Iveno	None	Flag; if flag=1, use alternate format and output variables in output files (.bsn,.sub,hru,.rch); .std output also to output.bsn	readfile.f,header.f, headout.f, hruday.f, subday.f, rchday.f, bsnday.f, writed.f

Parameters added to SWAT

Model Parameter changed in basin file

Bacteria Parameter	New Parameter
WDPQ	EDC_FACTOR
WGPQ	RCHRG_PAF
WDLPQ	ALPHA_BF (basin-wide)
WGLPQ	GW_DELAY (basin-wide)
WDPS	LATA
WGPS	LATB
WDLPS	HCFACTOR
WGLPS	FSFACTOR
BACTKDQ	CANMX (basin-wide)
THBACT	WACO
WOF_P	EFFPORFACTOR

SITE



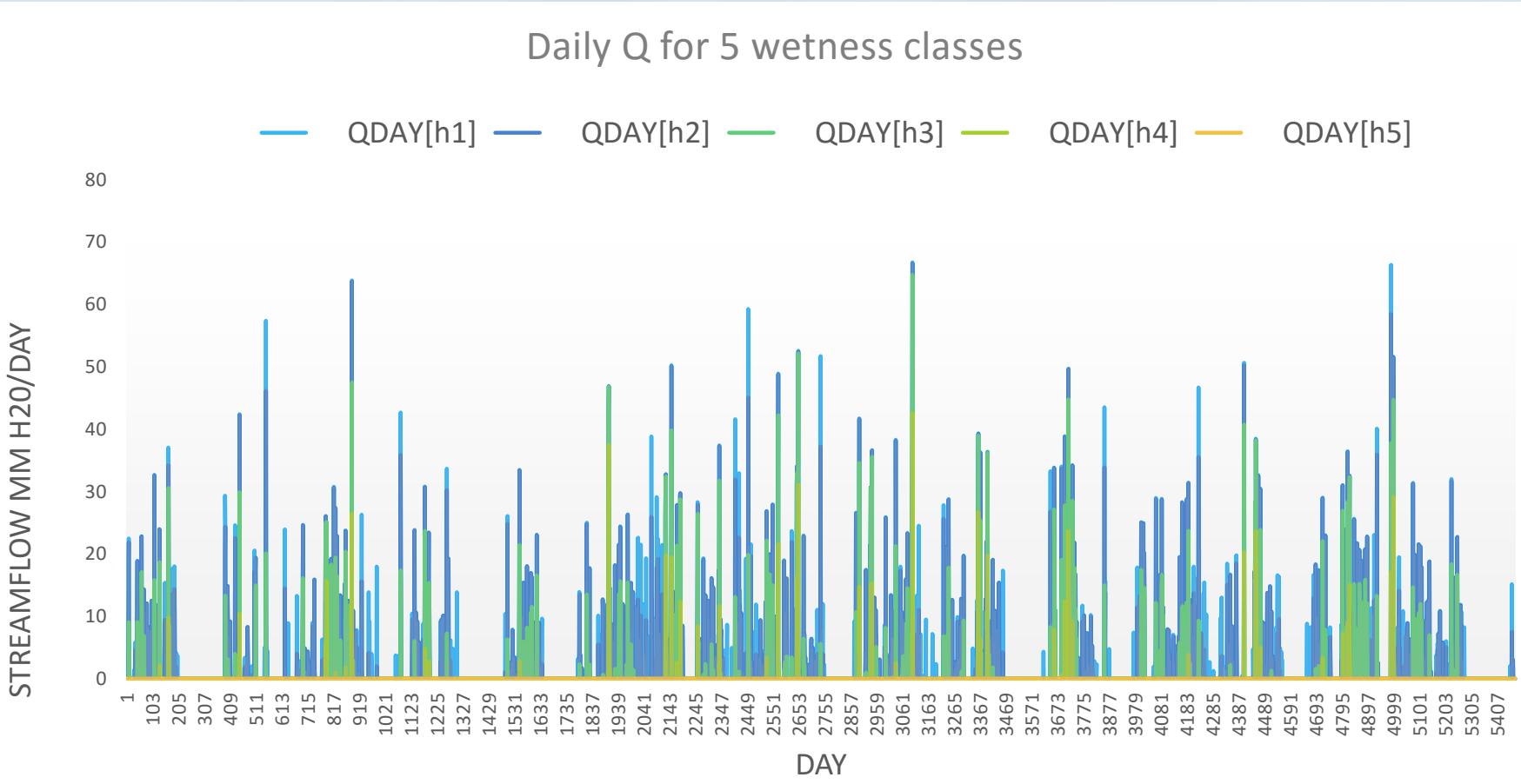
Seasonally saturated wet areas

Perennial stream channel

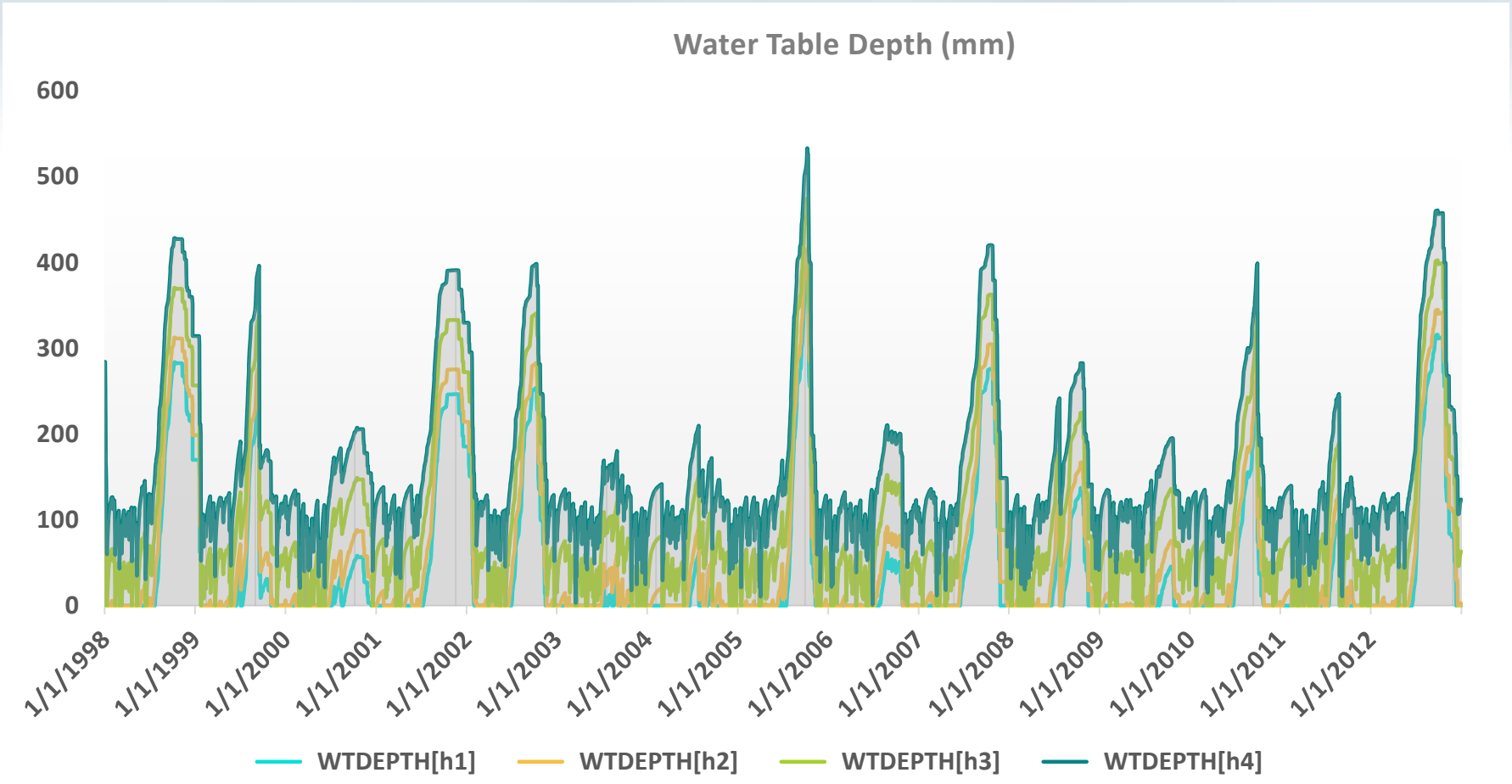
Streamflow Simulations

Time Scale	NSE	R^2
Daily	0.67	0.68
Monthly	0.83	0.86

Streamflow Simulations



Streamflow Simulations



More Studies?

range of watersheds that have variable source hydrology

Acknowledgements

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