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Hydrological processes of a rainforest headwater swamp from natural chemical tracing in Nsimi watershed, Cameroon

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To cite this version:

Jean-Christophe Maréchal, Jean-Jacques Braun, Jean Riotte, Jean-Pierre Bedimo Bedimo, Jean-Loup Boeglin. Hydrological processes of a rainforest headwater swamp from natural chemical tracing in Nsimi watershed, Cameroon. Hydrological Processes, 2011, 25 (14), pp.2246-2260. 10.1002/hyp.7989 . hal-00662963

HAL Id: hal-00662963

https://hal.science/hal-00662963v1

Submitted on 25 Jan 2012

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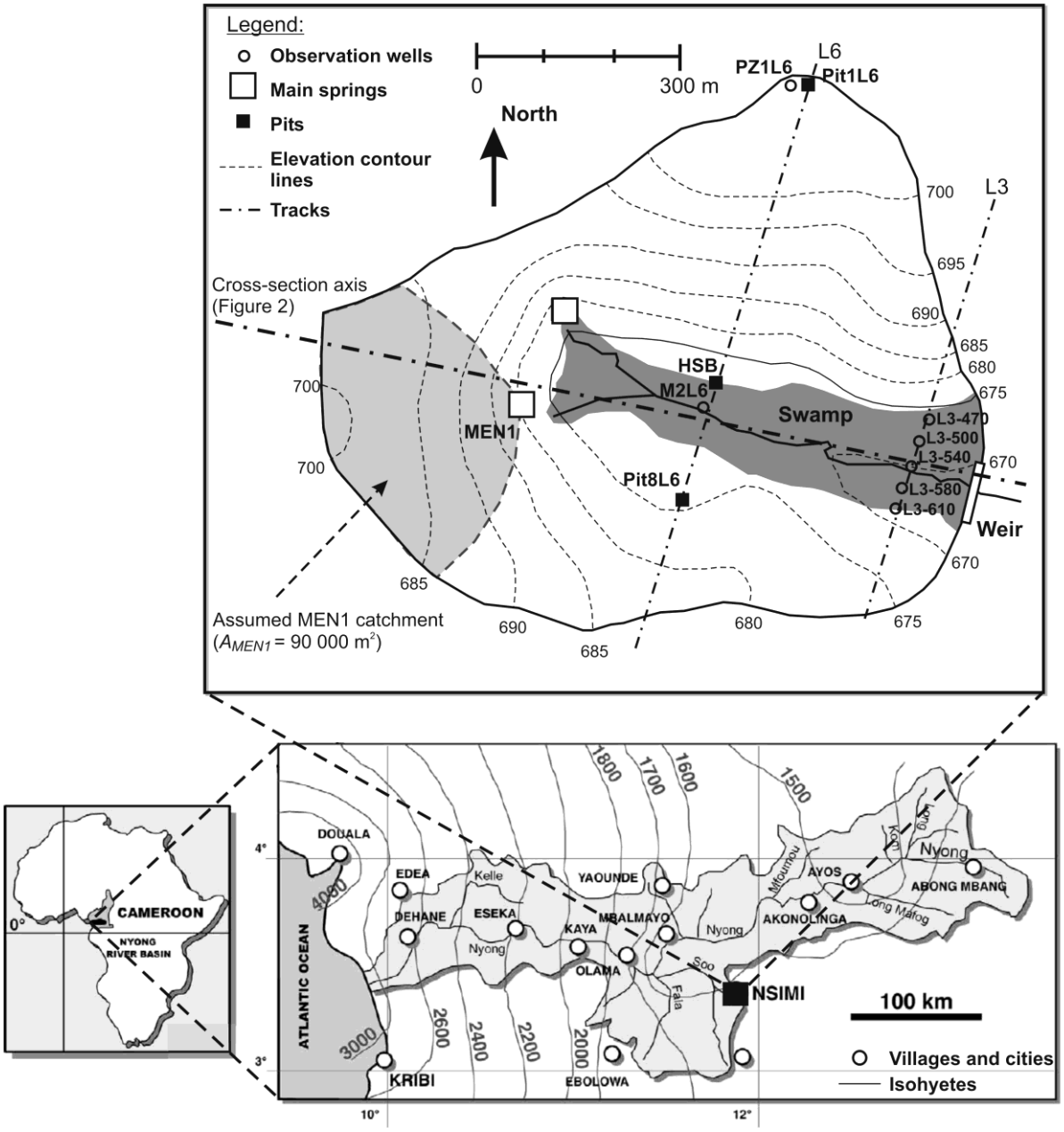
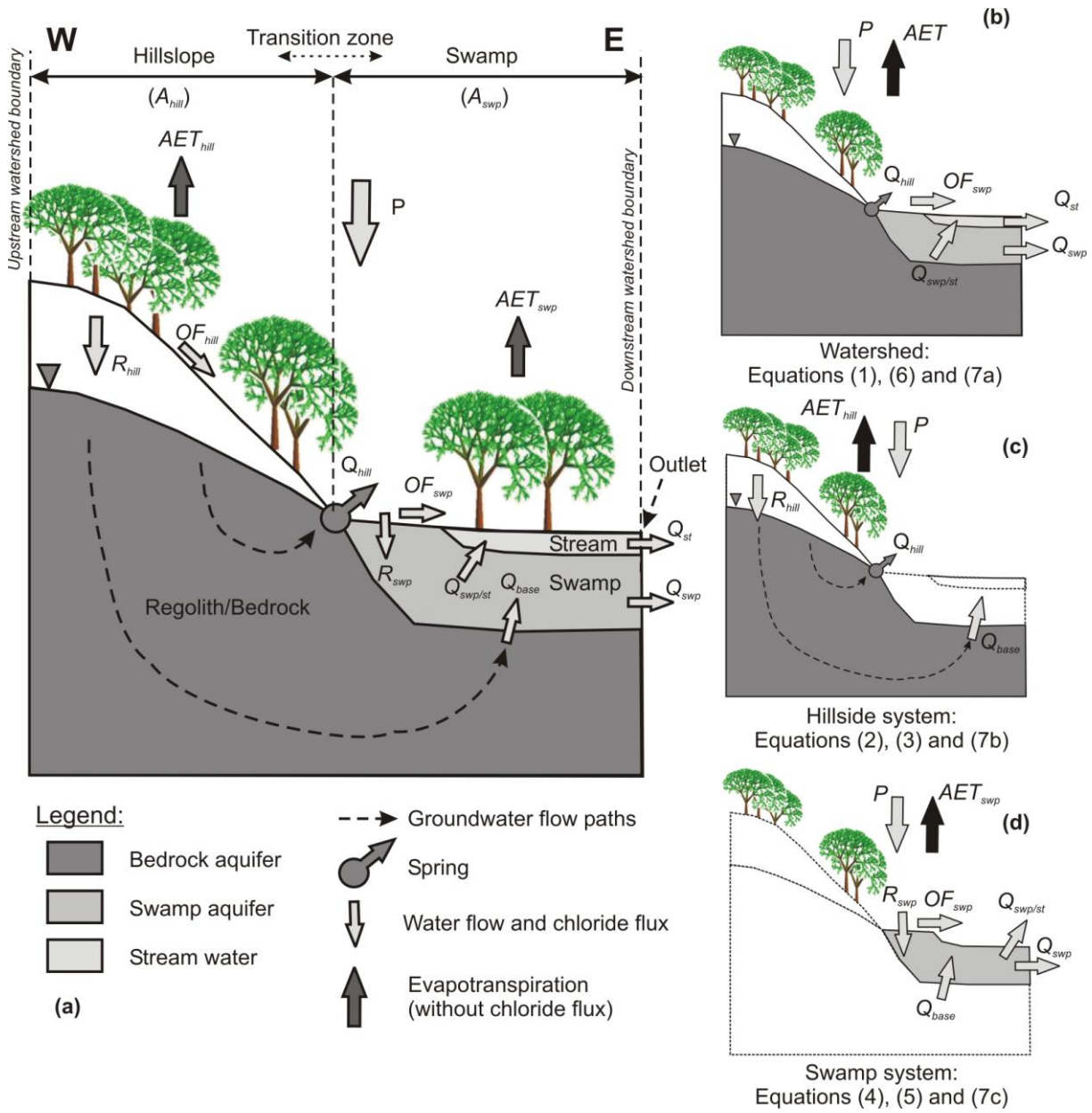
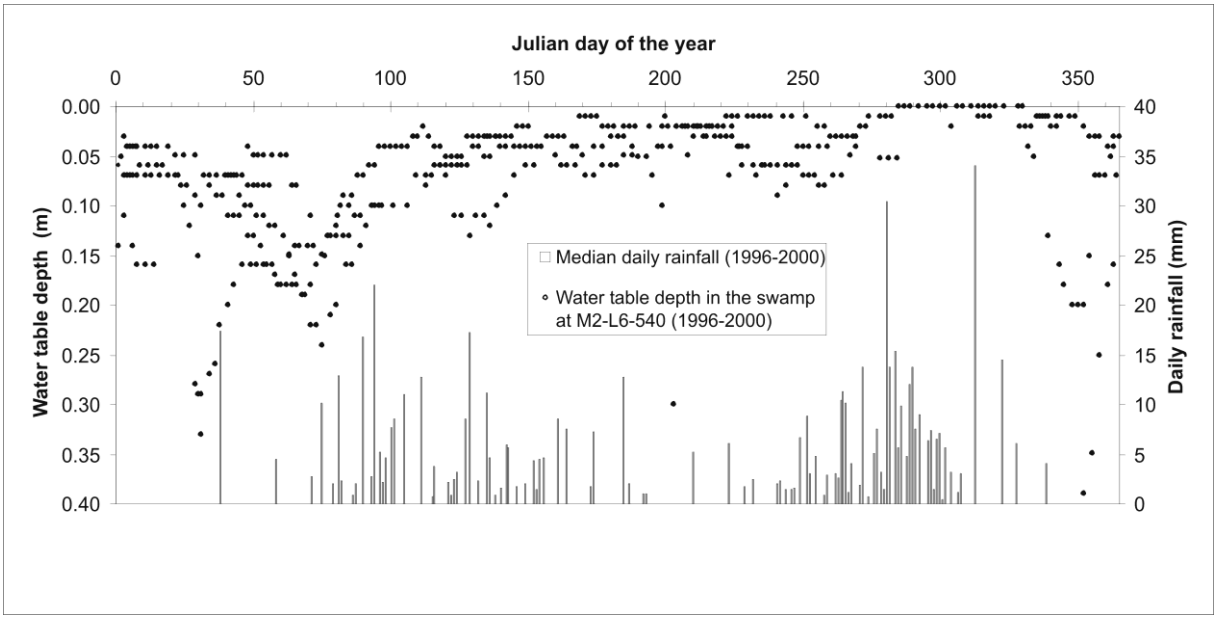
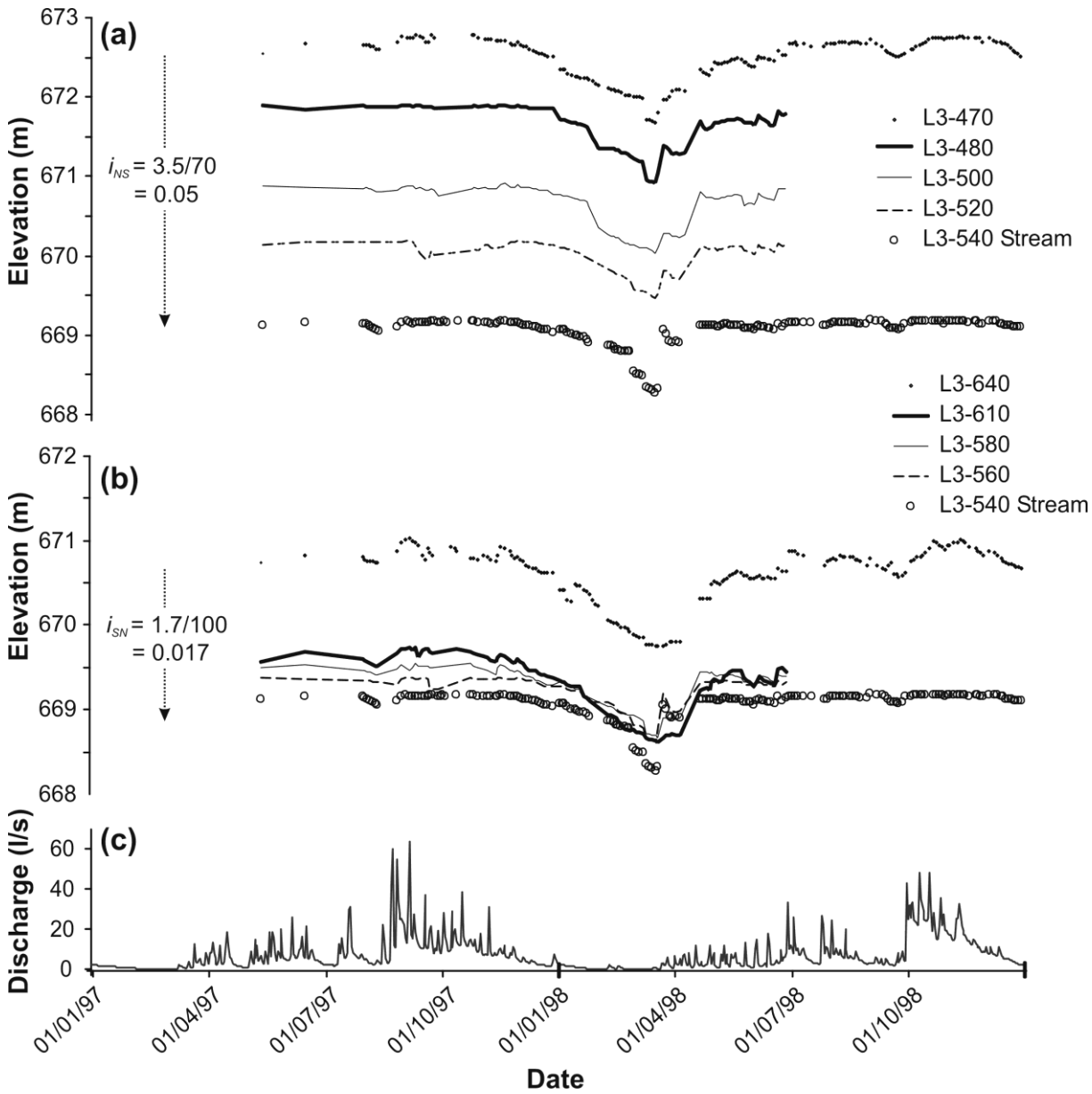
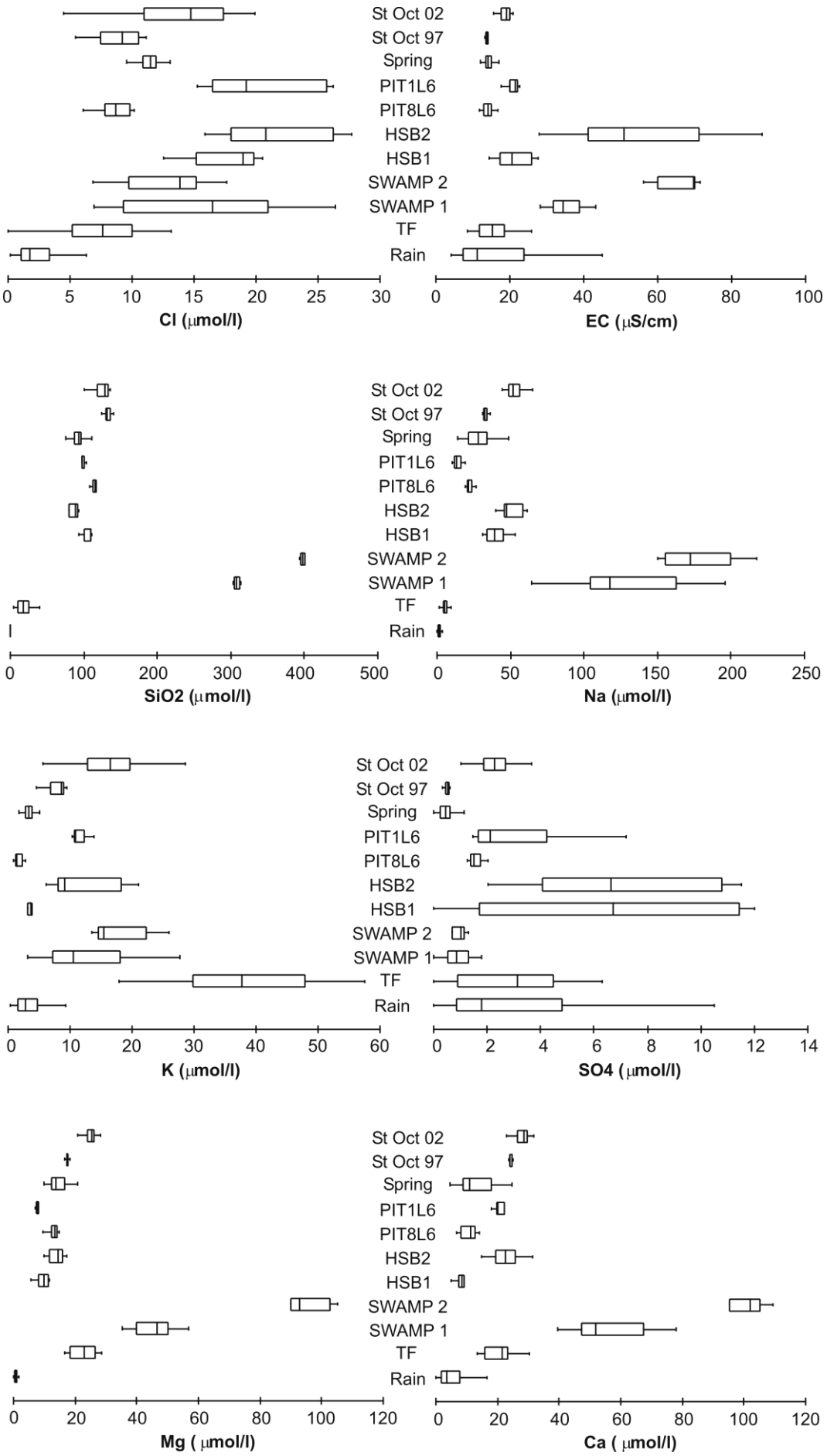
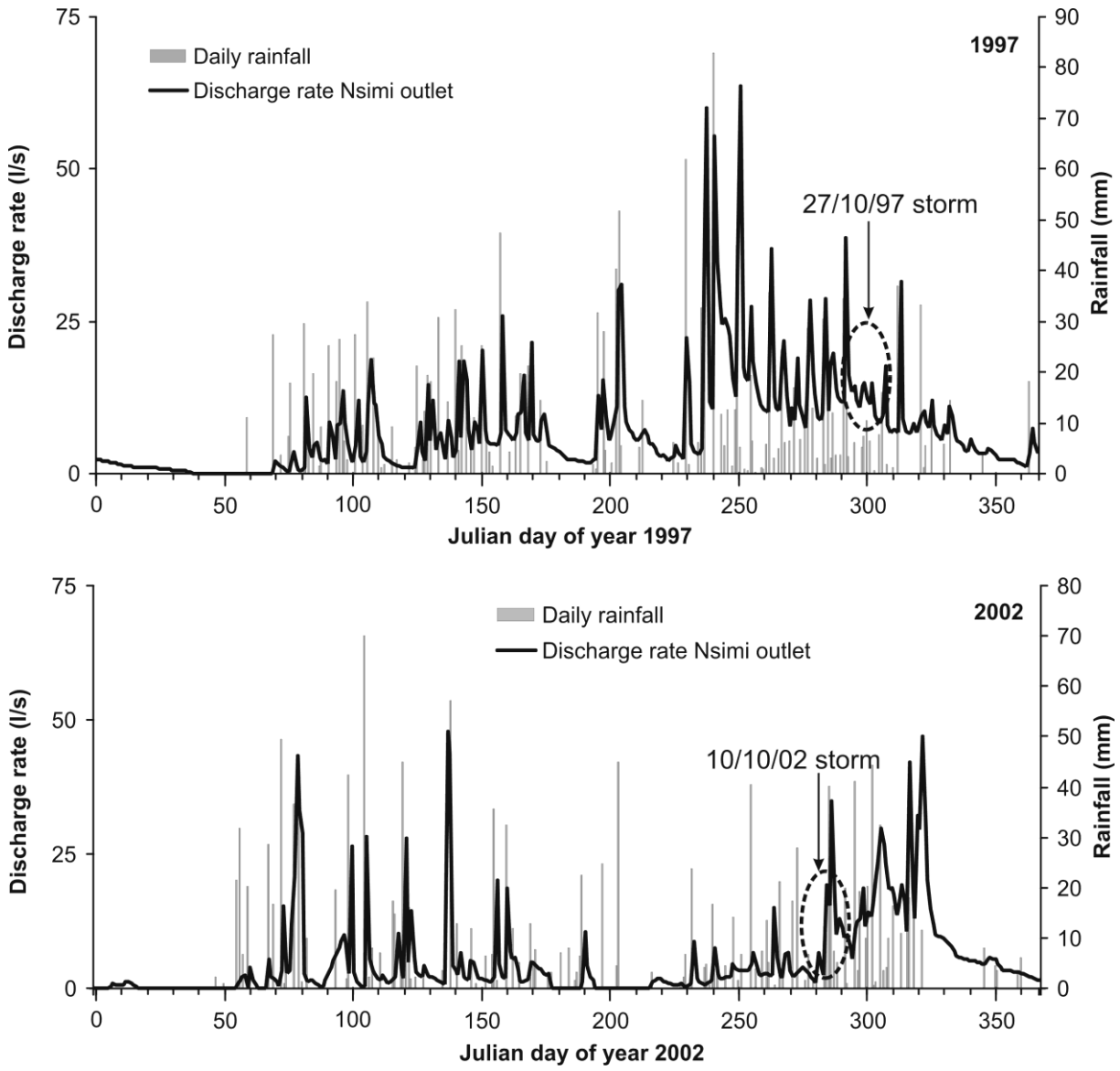

Legend:
Observation wells
Main springs
Pits
Elevation contour lines
Tracks
0
300 m
North
PZ1L6
L6
Pit1L6
L3
700
695
690
685
680
675
670
Cross-section axis (Figure 2)
HSB
M2L6
MEN1
Swamp
L3-470
L3-500
L3-540
L3-580
L3-610
Pit8L6
Weir
Assumed MEN1 catchment
(A_{MEN1} = 90 000 m^2)
CAMEROON
NYONG RIVER BASIN
ATLANTIC OCEAN
DOUALA
EDEA
DEHANE
ESEKA
YAOUNDE
MBALMAYO
KAYA
OLAMA
AYOS
AKONOLINGA
ABONG MBANG
NSIMI
KRIBI
EBOLOWA
Nyong
Kelle
Mfoumou
Long Malog
Soo
Fala
1800
1700
1600
1500
4000
3000
2600
2400
2200
2000
100 km
Villages and cities
Isohyetes
4°
3°
0°
10°
12°

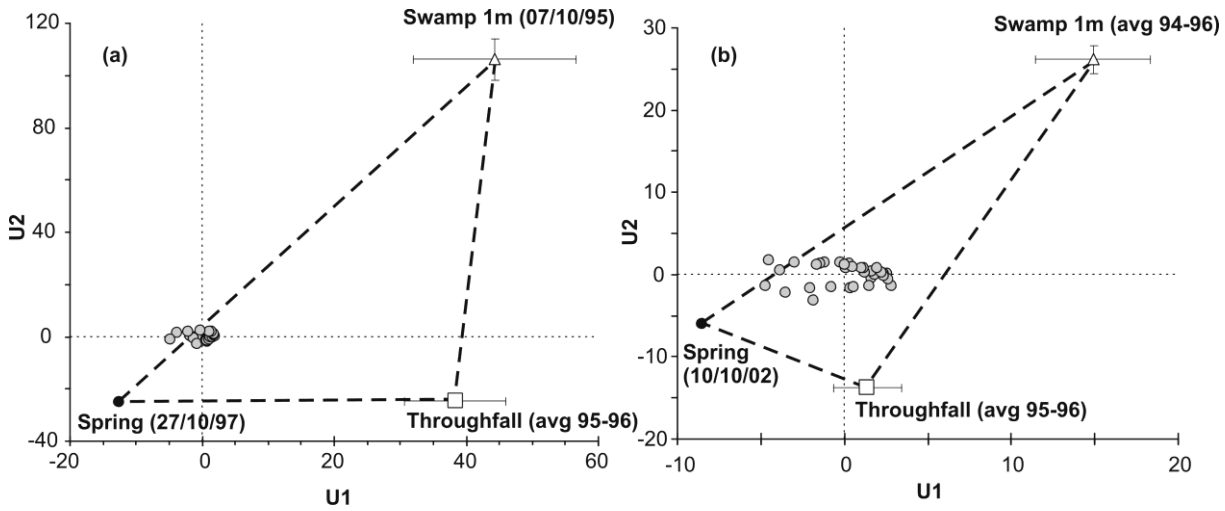

W
E
Hillslope
Transition zone
Swamp
(A_{hill})
(A_{swp})
Upstream watershed boundary
Downstream watershed boundary
AET_{hill}
P
AET_{swp}
R_{hill}
OF_{hill}
Q_{hill}
OF_{swp}
Outlet
Q_{st}
Stream
R_{swp}
$Q_{swp/st}$
Q_{base}
Swamp
Q_{swp}
Regolith/Bedrock
Legend:
Bedrock aquifer
Swamp aquifer
Stream water
(a)
Groundwater flow paths
Spring
Water flow and chloride flux
Evapotranspiration
(without chloride flux)
(b)
P
AET
Q_{hill}
OF_{swp}
Q_{st}
Q_{swp}
$Q_{swp/st}$
Watershed:
Equations (1), (6) and (7a)
AET_{hill}
P
(c)
R_{hill}
Q_{hill}
Q_{base}
Hillside system:
Equations (2), (3) and (7b)
P
AET_{swp}
(d)
R_{swp}
OF_{swp}
$Q_{swp/st}$
Q_{swp}
Q_{base}
Swamp system:
Equations (4), (5) and (7c)

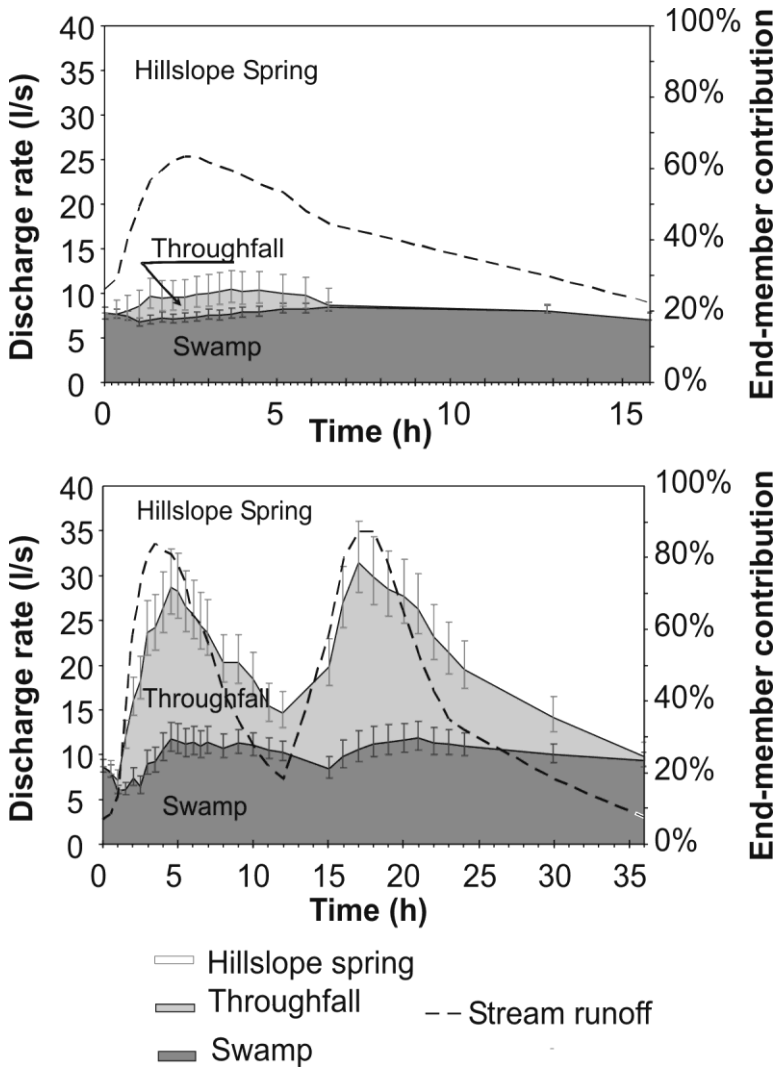

Julian day of the year
0
50
100
150
200
250
300
350
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0.35
0.40
Water table depth (m)
40
35
30
25
20
15
10
5
0
Daily rainfall (mm)
Median daily rainfall (1996-2000)
Water table depth in the swamp at M2-L6-540 (1996-2000)

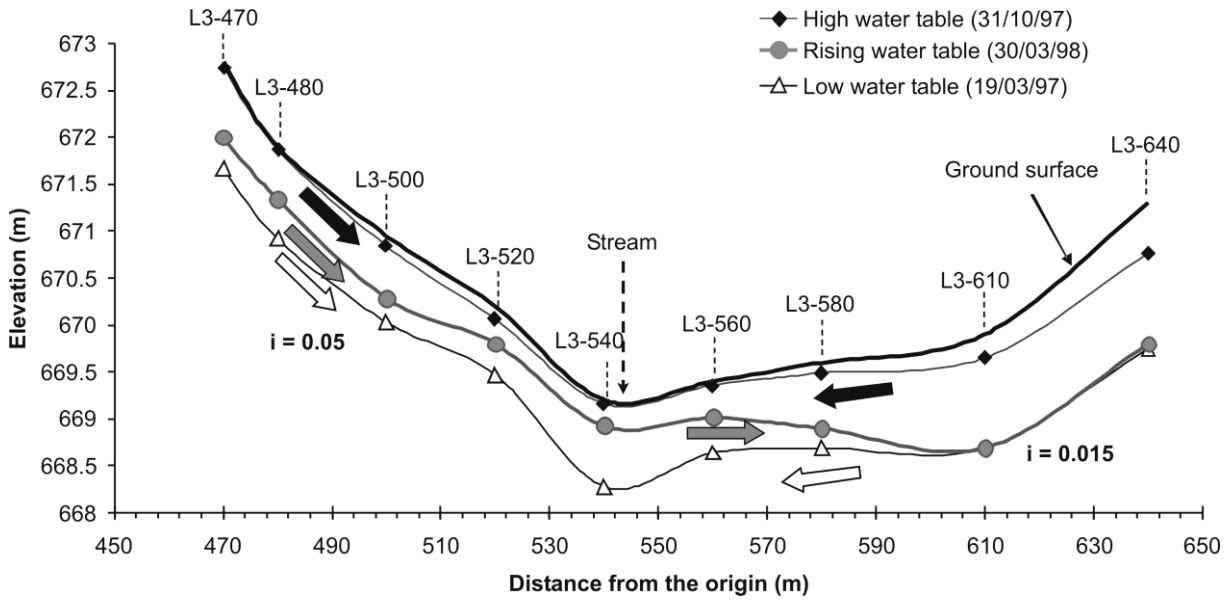

(a)
Elevation (m)
673
672
671
670
669
668
i_{NS} = 3.5/70
= 0.05
L3-470
L3-480
L3-500
L3-520
L3-540 Stream
(b)
Elevation (m)
672
671
670
669
668
i_{SN} = 1.7/100
= 0.017
L3-640
L3-610
L3-580
L3-560
L3-540 Stream
(c)
Discharge (l/s)
60
40
20
0
01/01/97
01/04/97
01/07/97
01/10/97
01/01/98
01/04/98
01/07/98
01/10/98
Date


St Oct 02
St Oct 97
Spring
PIT1L6
PIT8L6
HSB2
HSB1
SWAMP 2
SWAMP 1
TF
Rain
0 5 10 15 20 25 30
Cl (μmol/l)
0 20 40 60 80 100
EC (μS/cm)
0 100 200 300 400 500
SiO2 (μmol/l)
0 50 100 150 200 250
Na (μmol/l)
0 10 20 30 40 50 60
K (μmol/l)
0 2 4 6 8 10 12 14
SO4 (μmol/l)
0 20 40 60 80 100 120
Mg (μmol/l)
0 20 40 60 80 100 120
Ca (μmol/l)


1997
Daily rainfall
Discharge rate Nsimi outlet
27/10/97 storm
Discharge rate (l/s)
Rainfall (mm)
Julian day of year 1997
2002
Daily rainfall
Discharge rate Nsimi outlet
10/10/02 storm
Discharge rate (l/s)
Rainfall (mm)
Julian day of year 2002


(a)
Swamp 1m (07/10/95)
Spring (27/10/97)
Throughfall (avg 95-96)
U1
U2
(b)
Swamp 1m (avg 94-96)
Spring
(10/10/02)
Throughfall (avg 95-96)
U1
U2


Hillslope Spring
Throughfall
Swamp
Discharge rate (l/s)
End-member contribution
Time (h)
Hillslope Spring
Throughfall
Swamp
Discharge rate (l/s)
End-member contribution
Time (h)
Hillslope spring
Throughfall
Swamp
Stream runoff


High water table (31/10/97)
Rising water table (30/03/98)
Low water table (19/03/97)
L3-470
L3-480
L3-500
L3-520
L3-540
L3-560
L3-580
L3-610
L3-640
Stream
Ground surface
i = 0.05
i = 0.015
Elevation (m)
Distance from the origin (m)
673
672.5
672
671.5
671
670.5
670
669.5
669
668.5
668
450
470
490
510
530
550
570
590
610
630
650