ORKUSTOFNUN

Samanburður á HBV-líkönum í Norðurá, Norðurárdal, vhm 128, með tvenns konar veðurgögnum

Jón Sigurður Þórarinsson,
Jóna Finndís Jónsdóttir

Greinargerð JSTH-JFJ-2003-03

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Inngangur

Í þessari greinargerð verða bornar saman niðurstöður tveggja HBV-líkana af Norðurá í Norðurárdal, vhm 128, sem gerð voru með mismunandi veðurgögnum. Annars vegar er um að ræða líkan sem Pálína Gísladóttir (1997) [PG] gerði út frá venjulegum, mældum veðurgögnum, þ.e. sólarhringsúrkomu og –meðalhita í nágrenni vatnasviðsins, og hins vegar samanburðarlíkan sem styðst við reiknuð veðurgögn frá MM5-líkani (Ólafur Rögnvaldsson 2002). Við gerð samanburðarlíkansins var tekin stuðlaskrá frá líkani Pálínu og hún löguð að nýju veðurgögnunum. Á tímabilinu 1. september 1990 til 31. ágúst 1992 vantar rennslisgögn í gagnagrunn Vatnamælinga Orkustofnunar og var samanburðarlíkanið þess vegna aðlagað tímabilinu 1. september 1992 til 31. ágúst 1997 í stað tímabilsins 1. september 1990 til 31. ágúst 1997 eins og í fyrri samanburðarlíkönum. Tímabilið 1. september 1997 til 31. ágúst 2002 var haft til hliðsjónar.

Við gerð líkansins af Norðurá notaði Pálína gamla útgáfu af HBV sem er frábrugðin þeirri nýju í uppbyggingu og veldur það því að ekki er hægt að sýna niðurstöður hennar líkans í þessari greinargerð nema þær sem voru birtar í greinargerðinni hennar.

Aðlögun rennslislíkans MM5-veðurgögnum

Í samanburðarlíkaninu var tekin stuðlaskráin frá líkani Pálínu og hún aðlöguð nýju veðurgögnunum. Í fyrstu atrennu var margföldunarstuðlunum, sem leiðrétta mælingar á úrkomu (PKORR) og snjó (SKORR), gefið gildið einn þar sem ekki ætti að þurfa að leiðrétta úrkomuna úr MM5-líkaninu. Úrkomustigullinn (PGRAD) og hitastiglarnir fyrir daga án úrkomu (TTGRAD), daga með úrkomu (TVGRAD) og breytingar á hitastigli milli mánaða (TGRAD) voru reiknuð út frá veðurgögnunum. Til að vatnsjöfnuður vatnsáranna 1992-1996 yrði sem réttastur var úrkomustigullinn (PKORR) lækkaður í 0,84 og úrkoma þar með minnkuð um 16%.

Stuðlar sem lýsa snjóhluta líkansins og efri og neðri grunnvatnsgeymum voru stilltir af til að ná sem bestri fylgni milli mælds og reiknaðs rennslis. Samanburðarlíkanið var stillt af með rennslisgögnum frá vatnsárunum 1992-1996.

Niðurstöður

Þegar líkanið hafði verið stillt af með tilliti til vatnsáranna 1992-1996 voru niðurstöður þess bornar saman við líkan Pálínu, bæði fyrir tímabilið sem það var stillt inn á og einnig fyrir vatnsárin 1997-2001. Líkan Pálínu var skipt upp í tvö minni líkön vegna þess að skortur var á veðurgögnum sem náðu yfir allt tímabilið. Fyrra

líkanið var aðlagað tímabilinu 1. september 1972 til 31. ágúst 1985 og framlengt á tímabilið 1. september 1970 til 31. ágúst 1990. Seinna líkanið var aðlagað tímabilinu 1. september 1972 til 31. ágúst 1985 og framlengt á tímabilið 1. september 1950 til 31. ágúst 1985. Fylgnistuðla og yfirlit yfir vatnsjöfnuð samanburðarlíkansins er að finna í eftirfarandi töflum. Úrkoma frá MM5-líkaninu var minnkuð um 16% til að fá sem bestan vatnsjöfnuð á vatnsárunum 1992-1996. Í töflu 2 sést hins vegar að líklega hefði ekki þurft að minnka úrkomuna nema um 8% til að vatnsjöfnuðurinn passaði á seinna tímabilinu, vatnsárunum 1997-2001.

Vatnsár	Mælt [m^3/s]	Reiknað [m^3/s]	Hlutfallsl. mismunur	Reiknað rennsli [m^3/s] fyrir allt vatnsárið
1992/93	36,3	33,00	-0,091	26,70
1993/94	23,00	25,90	0,123	23,10
1994/95	27,20	29,50	0,086	24,50
1995/96	23,00	22,30	-0,031	20,50
1996/97	27,30	25,10	-0,080	21,10
meðal	26,70	26,70	0,000	23,20

Tafla 1: Yfirlit yfir vatnsjöfnuð í samanburðarlíkani, óháð tímabil, vatnsárin 1992-1996

Vatnsár	Mælt [m^3/s]	Reiknað [m^3/s]	Hlutfallsl. mismunur	Reiknað rennsli [m^3/s] fyrir allt Vatnsárið
1997/98	21,20	21,90	0,031	20,00
1998/99	26,20	22,90	-0,127	19,60
1999/00	36,20	34,00	-0,063	27,90
2000/01	15,90	15,30	-0,039	13,90
2001/02	28,10	24,10	-0,145	22,00
meðal	25,40	23,50	-0,075	20,70

Tafla 2: Yfirlit yfir vatnsjöfnuð í samanburðarlíkani, óháð tímabil, vatnsárin 1997-2001

Vatnasvið	Vhm	Tímabil (vatnsár)	R2	R2log	Vatnsjöfnuður
Norðurá	128	1992/93-1996/97	0,56	0,54	0,0%
Norðurá	128	1997/98-2001/02	0,47	0,58	-7,5%

Tafla 3: Niðurstöður HBV-samanburðarlíkans

Fylgnistuðlar beggja hlutlíkananna sem Pálína gerði er nokkuð hærri en í samanburðarlíkaninu. Aftur á móti er vatnsjöfnuður beggja hlutlíkananna ekki nógu góður en það skiptir miklu máli að hann sé sem bestur. Líklegt er að fylgnistuðlarnir í hlutlíkönunum hefðu lækkað hefði vatnsjöfnuðurinn verið lagaður. Líkön Pálínu voru aðlöguð öðrum tímabilum en samanburðarlíkanið og framlengd yfir á önnur tímabil svo það er því erfitt að bera þessi líkön saman. Niðurstöður líkans Pálínu, þ.e. beggja hlutlíkana er að finna í eftirfarandi töflu.

Vatnasvið	Vhm	Tímabil (vatnsár)	R2	R2log	Vatnsjöfnuður
Norðurá	128	1972/73-1984/85	0,70	0,75	8,6%
Norðurá	128	1970/71-1989/90	0,66	0,70	2,8%
Norðurá	128	1972/73-1984/85	0,72	0,73	7,9%
Norðurá	128	1950/51-1984/85	0,71	0,72	8,8%

Tafla 4: Niðurstöður hlutlíkana Pálínu

Samantekt

Í þessari greinargerð eru bornar saman niðurstöður HBV-líkans sem er annars vegar keyrt með gögnum úr nágrenni vatnasviðsins og hins vegar með gögnum frá MM5-líkankeyrslum. MM5-gögnin voru notuð til að ákvarða hita og hitastigul í líkaninu, en úrkoma var minnkuð til að bæta vatnsjöfnuð vatnasviðsins. Úrkomustigull var reiknaður út frá veðurgögnum.

Samkvæmt upplýsingum um vatnsjöfnuð tekst MM5-líkaninu ekki nógu vel að líkja eftir heildarmagni úrkomu á vatnasviðinu. Samkvæmt rennslisgögnum sem eru fengin út frá þeim rennslislyklum sem í gildi eru, munar 16% á þeirri úrkomu sem fellur og þeirri úrkomu sem þarf til þess að vatnsjöfnuðurinn haldist réttur að meðaltali. Á milli ára sveiflast mismunur mælds og reiknaðs rennslis til um allt að 14% en á seinna tímabilinu, vatnsárunum 1997-2001, hefði ekki þurft að minnka úrkomuna nema um 8% til að vatnsjöfnuðurinn héldist réttur að meðaltali.

Fylgnistuðlar milli mælds og reiknaðs rennslis, þar sem notuð eru úrkoma og hiti frá MM5-líkaninu, eru fínir vatnsárin 1992-1996 og 1997-2001, en nokkuð lægri en í hlutlíkönum Pálínu. Á vatnsárunum 1997-2001 er vatnsjöfnuðurinn hins vegar ekki nógu góður, en þó betri en í líkönum Pálínu. Hafa ber í huga að samanburðarlíkanið og líkön Pálínu er aðlöguð mismunandi tímabilum. Erfitt er að bera saman líkönin sökum þess og svo virðist sem líkön Pálínu hafi ekki verið vel stillt af með tilliti til vatnsjafnaðarins. Einnig er möguleiki að á tímabilinu sem samanburðarlíkanið var aðlagað og framlengt á hafi verið ólík veðurskilyrði. Það getur skekkt samanburðinn enn frekar.

Heimildir

Pálína Gísladóttir. 1997. Norðurá. Orkustofnun, Vatnamælingar**.**

Ólafur Rögnvaldsson, Haraldur Ólafsson. 2002. *Downscaling experiments with the MM5 model : determining an optimal configuration for climatological downscaling studies of precipitation in Iceland.* http://www.os.is/~or/rev/urkoma.pdf.

Viðauki I
Stuðlaskrár

Stuðlaskrá samanburðarlíkans
(skrá: /vm/hbv/jsth/MM5/vhm128/param.dat)

```
START  2V128
  2    0           16    PNO       Number of precipitation stations
  2    0   49-44         PID1      Identification for precip station 1
  2    0       133.3     PHOH1     Altitude precip station 1
  2    0      0.0322     PWGT1     Weight precipitation station 1
  2    0   49-45         PID2
  2    0       349       PHOH2
  2    0      0.0376     PWGT2
  2    0   49-46         PID3
  2    0       465.4     PHOH3
  2    0      0.0126     PWGT3
  2    0   50-44         PID4
  2    0        99.2     PHOH4
  2    0      0.0206     PWGT4
  2    0   50-45         PID5
  2    0       225.2     PHOH5
  2    0      0.1239     PWGT5
  2    0   50-46         PID6
  2    0       356.8     PHOH6
  2    0      0.0774     PWGT6
  2    0   50-47         PID6
  2    0       386.8     PHOH6
  2    0      0.0034     PWGT6
  2    0   51-45         PID6
  2    0       215       PHOH6
  2    0      0.0527     PWGT6
  2    0   51-46         PID6
  2    0       308.6     PHOH6
  2    0      0.1326     PWGT6
  2    0   51-47         PID6
  2    0       404.7     PHOH6
  2    0      0.0987     PWGT6
  2    0   52-45         PID6
  2    0       298.2     PHOH6
  2    0      0.0145     PWGT6
  2    0   52-46         PID6
  2    0       363.3     PHOH6
  2    0      0.1294     PWGT6
  2    0   52-47         PID6
  2    0       397.6     PHOH6
  2    0      0.1329     PWGT6
  2    0   52-48         PID6
  2    0       378.9     PHOH6
  2    0      0.0208     PWGT6
  2    0   53-46         PID6
  2    0       403.8     PHOH6
  2    0      0.08       PWGT6
  2    0   53-47         PID6
  2    0       388.1     PHOH6
  2    0      0.0308     PWGT6
  2    0           4     TNO       Number of temperature stations
  2    0    49-44        TID1      Identification for temp station 1
  2    0       133.3     THOH1     Altitude temp station 1
  2    0       0.054     TWGT1     Weight temp station 1
  2    0    50-45        TID2
  2    0       225.2     THOH2
  2    0       0.236     TWGT2
  2    0    51-46        TID3
  2    0       308.6     THOH3
  2    0       0.326     TWGT3
  2    0    52-47        TID3
  2    0       397.6     THOH3
  2    0       0.384     TWGT3
  2    0           1     QNO       Number of discharge stations
  2    0  vhm128         QID       Identification for discharge station
  2    0         1.      QWGT      Scaling factor for discharge
  2    0      506.72     AREAL     Catchment area                        [km2]
  2    4       0.000     MAGDEL    Regulation reservoirs                 [1]
  2    5      19.000     HYPSO ( 1,1), low point              [m]
  2    6     120.000     HYPSO ( 2,1)
  2    7     200.000     HYPSO ( 3,1)
  2    8     270.000     HYPSO ( 4,1)
  2    9     310.000     HYPSO ( 5,1)
  2   10     320.000     HYPSO ( 6,1)
  2   11     330.000     HYPSO ( 7,1)
  2   12     355.000     HYPSO ( 8,1)
  2   13     395.000     HYPSO ( 9,1)
  2   14     545.000     HYPSO (10,1)
  2   15     940.000     HYPSO (11,1), high point
  2   16       0.000     HYPSO ( 1,2), Part of total area below HYPSO (1,1) = 0
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2   17        0.100    HYPSO ( 2,2)
2   18        0.200    HYPSO ( 3,2)
2   19        0.300    HYPSO ( 4,2)
2   20        0.400    HYPSO ( 5,2)
2   21        0.500    HYPSO ( 6,2)
2   22        0.600    HYPSO ( 7,2)
2   23        0.700    HYPSO ( 8,2)
2   24        0.800    HYPSO ( 9,2)
2   25        0.900    HYPSO (10,2)
2   26        1.000    HYPSO (11,2), Part of total area below HYPSO (11,1) = 1
2   27        0.000    BREPRO( 1), Glacier area, part of total area, below HYPSO( 1,1) (=0.0)
2   28        0.000
2   29        0.000
2   30        0.000
2   31        0.000
2   32        0.000
2   33        0.000
2   34        0.000
2   35        0.000
2   36        0.000
2   37        0.000    BREPRO(11), Glacier area, part of total area, below HYPSO(11,1)
2   38
2   39      270.000    NDAG      Day no for conversion of glacier snow to ice
2   40       -1.000    TX        Threshold temperature for snow/ice            [C]
2   41       -1.000    TS        Threshold temperature fo no melt              [C]
2   42        5.000    CX        Melt index                          [mm/deg/day]
2   43        0.048    CFR       Refreeze efficiency                           [1]
2   44        0.003    LV        Max rel. water content in snow                [1]
2   45        0.840    PKORR     Precipitaion correction for rain              [1]
2   46        1.000    SKORR     Additional precipitation corection for snow at gauge [1]
2   47      188.50     GRADALT   Altitude for change in prec. grad.            [m]
2   48        0.16     PGRAD1    Precipitation gradient above GRADALT          [1]
2   49        0.00     CALB      Ageing factor for albedo                [1/day]
2   50        0.010    CRAD      Radiation melt component                      [1]
2   51        0.880    CONV      Convection melt component                     [1]
2   52        0.110    COND      Condensation melt component                   [1]
2   60         1.1     CEVPL     lake evapotranspiration adjustment fact       [1]
2   61         0.0     ERED      evapotranspiration red. during interception   [1]
2   62        30.0     ICEDAY    Lake temperature time constant                [d]
2   63       -0.96     TTGRAD    Temperature gradient for days without precip [deg/100 m]
2   64       -0.66     TVGRAD    Temperature gradient for days with precip    [deg/100 m]
2   65        0.164    PGRAD     Precipitation altitude gradient              [1/100 m]
2   66        1.200    CBRE      Melt increase on glacier ice                  [1]
2   67        0.100    EP        EP( 1), Pot evapotranspiration, Jan    [mm/day] or [1]
2   68        0.900    EP        EP( 2), Pot evapotranspiration, Feb    [mm/day] or [1]
2   69        0.100    EP        EP( 3)
2   70        1.200    EP        EP( 4)
2   71        2.100    EP        EP( 5)
2   72        2.000    EP        EP( 6)
2   73        0.800    EP        EP( 7)
2   74        0.900    EP        EP( 8)
2   75        1.100    EP        EP( 9)
2   76        0.900    EP        EP(10>
2   77        0.400    EP        EP(11)
2   78        0.900    EP        EP(12)), Pot evapotranspiration, Dec    [mm/day] or [1]
2   79       52.00     FC        Maximum soil water content           [mm]
2   80        0.36     FCDEL     Pot.evapotr when content = FC*FCDEL  [1]
2   81        1.974     BETA      Non-linearity in soil water zone     [1]
2   82       30.00     INFMAX    maximum infiltration capacity        [mm/day]
2   83
2   84
2   85        0.45     KUZ2      Quick time constant upper zone       [1/day]
2   86       56.00     UZ1       Threshold quick runoff               [mm]
2   87        0.575    KUZ1      Slow time constant upper zone        [1/day]
2   88        7.075    PERC      Percolation to lower zone            [mm/day]
2   89        0.12     KLZ       Time constant lower zone             [1/day]
2   90        2.50     ROUT      (1), Routing constant (lake area, km2)
2   91        0.00     ROUT      (2), Routing constant (rating curve const)
2   92        0.00     ROUT      (3), Routing constant (rating curve zero)
2   93        0.00     ROUT      (4), Routing constant (rating curve exp)
2   94        0.00     ROUT      (5), Routing constant (drained area ratio)
2   95        0.00     DECAY     (1), Feedback constant
2   96        0.00     DECAY     (2), Feedback constant
2   97        0.00     DECAY     (3), Feedback constant
2   98        0.20     CE        Evapotranspiration constant          [mm/deg/day]
2   99        0.13     DRAW      "draw up" constant                   [mm/day]
2  100        64.5     LAT       Latitude                             [deg]
2  101       -0.66     TGRAD(1)  Temperature gradient Jan              [deg/100m]
2  102       -0.64     TGRAD(2)  Temperature gradient Feb              [deg/100m]
2  103       -0.61     TGRAD(3)  Temperature gradient Mar              [deg/100m]
2  104       -0.89     TGRAD(4)  Temperature gradient Apr              [deg/100m]
2  105       -1.09     TGRAD(5)  Temperature gradient May              [deg/100m]
2  106       -0.93     TGRAD(6)  Temperature gradient Jun              [deg/100m]
2  107       -1.00     TGRAD(7)  Temperature gradient Jul              [deg/100m]
2  108       -0.70     TGRAD(8)  Temperature gradient Aug              [deg/100m]
2  109       -0.80     TGRAD(9)  Temperature gradient Sep              [deg/100m]
2  110       -0.64     TGRAD(10) Temperature gradient Oct              [deg/100m]
2  111       -0.64     TGRAD(11) Temperature gradient Nov              [deg/100m]
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  2  112       -0.60     TGRAD(12) Temperature gradient Dec            [deg/100m]
  2  113        11.0     SPDIST    Uniformly distributed snow acc      [mm]
  2  114        80.0      SMINI     Inital soil moisture content        [mm]
  2  115         0.0      UZINI     Initial upper zone content          [mm]
  2  116        30.0      LZINI     Initial lower zone content          [mm]
  2  121           1      VEGT(1,1) Vegetation type 1, zone 1
  2  122           0      VEGT(2,1) Vegetation type 2, zone 1
  2  123         0.0      VEGA(1)   Vegetation 2 area, zone 1           [1]
  2  124         0.003    LAKE(1)   Lake area,         zone 1           [1]
  2  125           1      VEGT(1,2) Vegetation type 1, zone 2
  2  126           0      VEGT(2,2) Vegetation type 2, zone 2
  2  127         0.0      VEGA(2)   Vegetation 2 area, zone 2           [1]
  2  128         0.0      LAKE(2)   Lake area,         zone 2           [1]
  2  129           3      VEGT(1,3) Vegetation type 1, zone 3
  2  130           0      VEGT(2,3) Vegetation type 2, zone 3
  2  131         0.0      VEGA(3)   Vegetation 2 area, zone 3           [1]
  2  132         0.006    LAKE(3)   Lake area,         zone 3           [1]
  2  133           4      VEGT(1,4) Vegetation type 1, zone 4
  2  134           0      VEGT(2,4) Vegetation type 2, zone 4
  2  135         0.0      VEGA(4)   Vegetation 2 area, zone 4           [1]
  2  136         0.004    LAKE(4)   Lake area,         zone 4           [1]
  2  137           4      VEGT(1,5) Vegetation type 1, zone 5
  2  138           0      VEGT(2,5) Vegetation type 2, zone 5
  2  139         0.0      VEGA(5)   Vegetation 2 area, zone 5           [1]
  2  140         0.0      LAKE(5)   Lake area,         zone 5           [1]
  2  141           4      VEGT(1,6) Vegetation type 1, zone 6
  2  142           0      VEGT(2,6) Vegetation type 2, zone 6
  2  143         0.0      VEGA(6)   Vegetation 2 area, zone 6           [1]
  2  144         0.0      LAKE(6)   Lake area,         zone 6           [1]
  2  145           4      VEGT(1,7) Vegetation type 1, zone 7
  2  146           0      VEGT(2,7) Vegetation type 2, zone 7
  2  147         0.0      VEGA(7)   Vegetation 2 area, zone 7           [1]
  2  148         0.0      LAKE(7)   Lake area,         zone 7           [1]
  2  149           4      VEGT(1,8) Vegetation type 1, zone 8
  2  150           0      VEGT(2,8) Vegetation type 2, zone 8
  2  151         0.0      VEGA(8)   Vegetation 2 area, zone 8           [1]
  2  152         0.0      LAKE(8)   Lake area,         zone 8           [1]
  2  153           4      VEGT(1,9) Vegetation type 1, zone 9
  2  154           0      VEGT(2,9) Vegetation type 2, zone 9
  2  155         0.0      VEGA(9)   Vegetation 2 area, zone 9           [1]
  2  156         0.0      LAKE(9)   Lake area,         zone 9           [1]
  2  157           4      VEGT(1,10) Vegetation type 1, zone 10
  2  158           0      VEGT(2,10) Vegetation type 2, zone 10
  2  159         0.0      VEGA(10)   Vegetation 2 area, zone 10          [1]
  2  160         0.0      LAKE(10)   Lake area,         zone 10          [1]
FINIS
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Stuðlaskrá hlutlíkans 1 frá Pálínu (skrá: /vm/hbv/pg/hbvold/nordura/nord7090.par)

```
START  2NORDURA
  2    0           6    PNO       Number of precipitation stations
  2    0    S  umüli     PID1      Identification for precip station 1
  2    0         78.     PHOH1     Altitude precip station 1
  2    0         .0      PWGT1     Weight precipitation station 1
  2    0    Brekka       PID2
  2    0         80.     PHOH2
  2    0         .0      PWGT2
  2    0 Stykkish lmur   PID3
  2    0         16.     PHOH3
  2    0         .0       PWGT3
  2    0  Hamraendar     PID4
  2    0         55.     PHOH4
  2    0         .40     PWGT4
  2    0  Aukast”Œ       PID5
  2    0         78.     PHOH5
  2    0         .35     PWGT5
  2    0  Andark¡ls rv   PID6
  2    0         10.     PHOH6
  2    0         .25     PWGT6
  2    0           3     TNO       Number of temperature stations
  2    0    S  umüli     TID1      Identification for temp station 1
  2    0         78.     THOH1     Altitude temp station 1
  2    0         .0      TWGT1     Weight temp station 1
  2    0 Stykkish lmur   TID2
  2    0         16.     THOH2
  2    0        0.5      TWGT2
  2    0  Hamraendar     TID3
  2    0         55.     THOH3
  2    0         .5      TWGT3
  2    0           1     QNO       Number of discharge stations
  2    0  vhm128         QID       Identification for discharge station
  2    0          1.     QWGT      Scaling factor for discharge
  2    0       506.72    AREAL     Catchment area                      [km2]
  2    4        0.000    MAGDEL    Regulation reservoirs               [1]
  2    5       19.000    HYPSO ( 1,1), low point             [m]
  2    6      120.000    HYPSO ( 2,1)
  2    7      200.000    HYPSO ( 3,1)
  2    8      270.000    HYPSO ( 4,1)
  2    9      310.000    HYPSO ( 5,1)
  2   10      320.000    HYPSO ( 6,1)
  2   11      330.000    HYPSO ( 7,1)
  2   12      355.000    HYPSO ( 8,1)
  2   13      395.000    HYPSO ( 9,1)
  2   14      545.000    HYPSO (10,1)
  2   15      940.000    HYPSO (11,1), high point
  2   16        0.000    HYPSO ( 1,2), Part of total area below HYPSO (1,1) = 0
  2   17        0.100    HYPSO ( 2,2)
  2   18        0.200    HYPSO ( 3,2)
  2   19        0.300    HYPSO ( 4,2)
  2   20        0.400    HYPSO ( 5,2)
  2   21        0.500    HYPSO ( 6,2)
  2   22        0.600    HYPSO ( 7,2)
  2   23        0.700    HYPSO ( 8,2)
  2   24        0.800    HYPSO ( 9,2)
  2   25        0.900    HYPSO (10,2)
  2   26        1.000    HYPSO (11,2), Part of total area below HYPSO (11,1) = 1
  2   27        0.000    BREPRO( 1), Glacier area, part of total area, below HYPSO( 1,1) (=0.0)
  2   28        0.000
  2   29        0.000
  2   30        0.000
  2   31        0.000
  2   32        0.000
  2   33        0.000
  2   34        0.000
  2   35        0.000
  2   36        0.000
  2   37        0.000    BREPRO(11), Glacier area, part of total area, below HYPSO(11,1)
  2   38
  2   39      270.000    NDAG      Day no for conversion of glacier snow to ice
  2   40        0.345    TX        Threshold temperature for snow/ice            [C]
  2   41        0.580    TS        Threshold temperature fo no melt              [C]
  2   42        4.860    CX        Melt index                          [mm/deg/day]
  2   43        0.036    CFR       Refreeze efficiency                           [1]
  2   44        0.012    LV        Max rel. water content in snow                [1]
  2   45        1.250    PKORR     Precipitaion correction for rain              [1]
  2   46        1.000    SKORR     Additional precipitation corection for snow at gauge [1]
  2   47      370.000    GRADALT   Altitude for change in prec. grad.            [m]
  2   48        0.310    PGRAD1    Precipitation gradient above GRADALT          [1]
  2   49        0.050    CALB      Ageing factor for albedo                 [1/day]
  2   50        0.010    CRAD      Radiation melt component                      [1]
  2   51        0.880    CONV      Convection melt component                     [1]
  2   52        0.110    COND      Condensation melt component                   [1]
  2   60         1.1     CEVPL     lake evapotranspiration adjustment fact       [1]
  2   61         0.0     ERED      evapotranspiration red. during interception   [1]
  2   62        30.0     ICEDAY    Lake temperature time constant                [d]
```

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2   63       -0.655    TTGRAD    Temperature gradient for days without precip [deg/100 m]
2   64       -0.570    TVGRAD    Temperature gradient for days with precip    [deg/100 m]
2   65        0.096    PGRAD     Precipitation altitude gradient              [1/100 m]
2   66        1.200    CBRE      Melt increase on glacier ice                  [1]
2   67        0.100    EP        EP( 1), Pot evapotranspiration, Jan    [mm/day] or [1]
2   68        0.900    EP        EP( 2), Pot evapotranspiration, Feb    [mm/day] or [1]
2   69        0.100    EP        EP( 3)
2   70        1.200    EP        EP( 4)
2   71        2.100    EP        EP( 5)
2   72        2.000    EP        EP( 6)
2   73        0.800    EP        EP( 7)
2   74        0.900    EP        EP( 8)
2   75        1.100    EP        EP( 9)
2   76        0.900    EP        EP(10)
2   77        0.400    EP        EP(11)
2   78        0.900    EP        EP(12)), Pot evapotranspiration, Dec    [mm/day] or [1]
2   79       52.00     FC        Maximum soil water content           [mm]
2   80        0.36     FCDEL     Pot.evapotr when content = FC*FCDEL  [1]
2   81        0.50     BETA      Non-linearity in soil water zone     [1]
2   82       30.00     INFMAX    maximum infiltration capacity        [mm/day]
2   83
2   84
2   85        0.74     KUZ2      Quick time constant upper zone       [1/day]
2   86       34.50     UZ1       Threshold quick runoff               [mm]
2   87        0.07     KUZ1      Slow time constant upper zone        [1/day]
2   88        0.02     PERC      Percolation to lower zone            [mm/day]
2   89        0.18     KLZ       Time constant lower zone             [1/day]
2   90        2.50     ROUT      (1), Routing constant (lake area, km2)
2   91        0.00     ROUT      (2), Routing constant (rating curve const)
2   92        0.00     ROUT      (3), Routing constant (rating curve zero)
2   93        0.00     ROUT      (4), Routing constant (rating curve exp)
2   94        0.00     ROUT      (5), Routing constant (drained area ratio)
2   95        0.00     DECAY     (1), Feedback constant
2   96        0.00     DECAY     (2), Feedback constant
2   97        0.00     DECAY     (3), Feedback constant
2   98        0.20     CE        Evapotranspiration constant          [mm/deg/day]
2   99        0.13     DRAW      "draw up" constant                   [mm/day]
2  100        64.5     LAT       Latitude                             [deg]
2  101       -0.90     TGRAD(1)  Temperature gradient Jan              [deg/100m]
2  102       -0.84     TGRAD(2)  Temperature gradient Feb              [deg/100m]
2  103       -0.95     TGRAD(3)  Temperature gradient Mar              [deg/100m]
2  104       -0.67     TGRAD(4)  Temperature gradient Apr              [deg/100m]
2  105       -0.53     TGRAD(5)  Temperature gradient May              [deg/100m]
2  106       -0.49     TGRAD(6)  Temperature gradient Jun              [deg/100m]
2  107       -0.96     TGRAD(7)  Temperature gradient Jul              [deg/100m]
2  108       -0.81     TGRAD(8)  Temperature gradient Aug              [deg/100m]
2  109       -1.00     TGRAD(9)  Temperature gradient Sep              [deg/100m]
2  110       -0.82     TGRAD(10) Temperature gradient Oct              [deg/100m]
2  111       -1.07     TGRAD(11) Temperature gradient Nov              [deg/100m]
2  112       -0.64     TGRAD(12) Temperature gradient Dec              [deg/100m]
2  113        11.0     SPDIST    Uniformly distributed snow acc       [mm]
2  114         80.0     SMINI     Inital soil moisture content         [mm]
2  115          0.0     UZINI     Initial upper zone content           [mm]
2  116         30.0     LZINI     Initial lower zone content           [mm]
2  121            1     VEGT(1,1) Vegetation type 1, zone 1
2  122            0     VEGT(2,1) Vegetation type 2, zone 1
2  123          0.0     VEGA(1)   Vegetation 2 area, zone 1            [1]
2  124          0.003   LAKE(1)   Lake area,         zone 1            [1]
2  125            1     VEGT(1,2) Vegetation type 1, zone 2
2  126            0     VEGT(2,2) Vegetation type 2, zone 2
2  127          0.0     VEGA(2)   Vegetation 2 area, zone 2            [1]
2  128          0.0     LAKE(2)   Lake area,         zone 2            [1]
2  129            3     VEGT(1,3) Vegetation type 1, zone 3
2  130            0     VEGT(2,3) Vegetation type 2, zone 3
2  131          0.0     VEGA(3)   Vegetation 2 area, zone 3            [1]
2  132          0.006   LAKE(3)   Lake area,         zone 3            [1]
2  133            4     VEGT(1,4) Vegetation type 1, zone 4
2  134            0     VEGT(2,4) Vegetation type 2, zone 4
2  135          0.0     VEGA(4)   Vegetation 2 area, zone 4            [1]
2  136          0.004   LAKE(4)   Lake area,         zone 4            [1]
2  137            4     VEGT(1,5) Vegetation type 1, zone 5
2  138            0     VEGT(2,5) Vegetation type 2, zone 5
2  139          0.0     VEGA(5)   Vegetation 2 area, zone 5            [1]
2  140          0.0     LAKE(5)   Lake area,         zone 5            [1]
2  141            4     VEGT(1,6) Vegetation type 1, zone 6
2  142            0     VEGT(2,6) Vegetation type 2, zone 6
2  143          0.0     VEGA(6)   Vegetation 2 area, zone 6            [1]
2  144          0.0     LAKE(6)   Lake area,         zone 6            [1]
2  145            4     VEGT(1,7) Vegetation type 1, zone 7
2  146            0     VEGT(2,7) Vegetation type 2, zone 7
2  147          0.0     VEGA(7)   Vegetation 2 area, zone 7            [1]
2  148          0.0     LAKE(7)   Lake area,         zone 7            [1]
2  149            4     VEGT(1,8) Vegetation type 1, zone 8
2  150            0     VEGT(2,8) Vegetation type 2, zone 8
2  151          0.0     VEGA(8)   Vegetation 2 area, zone 8            [1]
2  152          0.0     LAKE(8)   Lake area,         zone 8            [1]
2  153            4     VEGT(1,9) Vegetation type 1, zone 9
2  154            0     VEGT(2,9) Vegetation type 2, zone 9
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  2  155          0.0     VEGA(9)   Vegetation 2 area, zone 9           [1]
  2  156          0.0     LAKE(9)   Lake area,         zone 9           [1]
  2  157            4     VEGT(1,10) Vegetation type 1, zone 10
  2  158            0     VEGT(2,10) Vegetation type 2, zone 10
  2  159          0.0     VEGA(10)   Vegetation 2 area, zone 10          [1]
  2  160          0.0     LAKE(10)   Lake area,         zone 10          [1]
FINIS
```

Stuðlaskrá hlutlíkans 2 frá Pálínu (skrá: /vm/hbv/pg/hbvold/nordura/nord5085.par)

```
START  2NORDURA
  2    0           6    PNO       Number of precipitation stations
  2    0    S  umüli     PID1      Identification for precip station 1
  2    0         78.     PHOH1     Altitude precip station 1
  2    0         .15     PWGT1     Weight precipitation station 1
  2    0    Brekka       PID2
  2    0         80.     PHOH2
  2    0         .0      PWGT2
  2    0 Stykkish lmur   PID3
  2    0         16.     PHOH3
  2    0         .35     PWGT3
  2    0  Hamraendar     PID4
  2    0         55.     PHOH4
  2    0         .0      PWGT4
  2    0  Aukast”Œ       PID5
  2    0         78.     PHOH5
  2    0         .50     PWGT5
  2    0  Andark¡ls rv   PID6
  2    0         10.     PHOH6
  2    0         .0      PWGT6
  2    0           3     TNO       Number of temperature stations
  2    0    S  umüli     TID1      Identification for temp station 1
  2    0         78.     THOH1     Altitude temp station 1
  2    0         .50     TWGT1     Weight temp station 1
  2    0 Stykkish lmur   TID2
  2    0         16.     THOH2
  2    0         .50     TWGT2
  2    0  Hamraendar     TID3
  2    0         55.     THOH3
  2    0         .0      TWGT3
  2    0           1     QNO       Number of discharge stations
  2    0  vhm128         QID       Identification for discharge station
  2    0          1.     QWGT      Scaling factor for discharge
  2    0       506.72    AREAL     Catchment area                      [km2]
  2    4        0.000    MAGDEL    Regulation reservoirs               [1]
  2    5       19.000    HYPSO ( 1,1), low point             [m]
  2    6      120.000    HYPSO ( 2,1)
  2    7      200.000    HYPSO ( 3,1)
  2    8      270.000    HYPSO ( 4,1)
  2    9      310.000    HYPSO ( 5,1)
  2   10      320.000    HYPSO ( 6,1)
  2   11      330.000    HYPSO ( 7,1)
  2   12      355.000    HYPSO ( 8,1)
  2   13      395.000    HYPSO ( 9,1)
  2   14      545.000    HYPSO (10,1)
  2   15      940.000    HYPSO (11,1), high point
  2   16        0.000    HYPSO ( 1,2), Part of total area below HYPSO (1,1) = 0
  2   17        0.100    HYPSO ( 2,2)
  2   18        0.200    HYPSO ( 3,2)
  2   19        0.300    HYPSO ( 4,2)
  2   20        0.400    HYPSO ( 5,2)
  2   21        0.500    HYPSO ( 6,2)
  2   22        0.600    HYPSO ( 7,2)
  2   23        0.700    HYPSO ( 8,2)
  2   24        0.800    HYPSO ( 9,2)
  2   25        0.900    HYPSO (10,2)
  2   26        1.000    HYPSO (11,2), Part of total area below HYPSO (11,1) = 1
  2   27        0.000    BREPRO( 1), Glacier area, part of total area, below HYPSO( 1,1) (=0.0)
  2   28        0.000
  2   29        0.000
  2   30        0.000
  2   31        0.000
  2   32        0.000
  2   33        0.000
  2   34        0.000
  2   35        0.000
  2   36        0.000
  2   37        0.000    BREPRO(11), Glacier area, part of total area, below HYPSO(11,1)
  2   38
  2   39      270.000    NDAG      Day no for conversion of glacier snow to ice
  2   40        0.250    TX        Threshold temperature for snow/ice            [C]
  2   41        0.160    TS        Threshold temperature fo no melt              [C]
  2   42        4.750    CX        Melt index                          [mm/deg/day]
  2   43        0.010    CFR       Refreeze efficiency                           [1]
  2   44        0.050    LV        Max rel. water content in snow                [1]
  2   45        1.550    PKORR     Precipitaion correction for rain              [1]
  2   46        1.050    SKORR     Additional precipitation corection for snow at gauge [1]
  2   47      260.000    GRADALT   Altitude for change in prec. grad.            [m]
  2   48        0.130    PGRAD1    Precipitation gradient above GRADALT          [1]
  2   49        0.070    CALB      Ageing factor for albedo                  [1/day]
  2   50        0.100    CRAD      Radiation melt component                      [1]
  2   51        0.800    CONV      Convection melt component                     [1]
  2   52        0.100    COND      Condensation melt component                   [1]
  2   60         1.1     CEVPL     lake evapotranspiration adjustment fact       [1]
  2   61         0.0     ERED      evapotranspiration red. during interception   [1]
  2   62        30.0     ICEDAY    Lake temperature time constant                [d]
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2   63       -0.730    TTGRAD    Temperature gradient for days without precip [deg/100 m]
2   64       -0.570    TVGRAD    Temperature gradient for days with precip    [deg/100 m]
2   65        0.100    PGRAD     Precipitation altitude gradient              [1/100 m]
2   66        1.200    CBRE      Melt increase on glacier ice                  [1]
2   67        0.100    EP        EP( 1), Pot evapotranspiration, Jan    [mm/day] or [1]
2   68        1.300    EP        EP( 2), Pot evapotranspiration, Feb    [mm/day] or [1]
2   69        0.000    EP        EP( 3)
2   70        1.200    EP        EP( 4)
2   71        2.100    EP        EP( 5)
2   72        2.000    EP        EP( 6)
2   73        0.800    EP        EP( 7)
2   74        0.900    EP        EP( 8)
2   75        1.100    EP        EP( 9)
2   76        0.900    EP        EP(10)
2   77        0.400    EP        EP(11)
2   78        0.900    EP        EP(12)), Pot evapotranspiration, Dec    [mm/day] or [1]
2   79       80.00     FC        Maximum soil water content           [mm]
2   80        0.50     FCDEL     Pot.evapotr when content = FC*FCDEL  [1]
2   81        1.00     BETA      Non-linearity in soil water zone     [1]
2   82       30.00     INFMAX    maximum infiltration capacity        [mm/day]
2   83
2   84
2   85        0.94     KUZ2      Quick time constant upper zone       [1/day]
2   86       34.50     UZ1       Threshold quick runoff               [mm]
2   87        0.09     KUZ1      Slow time constant upper zone        [1/day]
2   88        0.02     PERC      Percolation to lower zone            [mm/day]
2   89        0.18     KLZ       Time constant lower zone             [1/day]
2   90        2.50     ROUT      (1), Routing constant (lake area, km2)
2   91        0.00     ROUT      (2), Routing constant (rating curve const)
2   92        0.00     ROUT      (3), Routing constant (rating curve zero)
2   93        0.00     ROUT      (4), Routing constant (rating curve exp)
2   94        0.00     ROUT      (5), Routing constant (drained area ratio)
2   95        0.00     DECAY     (1), Feedback constant
2   96        0.00     DECAY     (2), Feedback constant
2   97        0.00     DECAY     (3), Feedback constant
2   98        0.20     CE        Evapotranspiration constant          [mm/deg/day]
2   99        0.13     DRAW      "draw up" constant                   [mm/day]
2  100        64.5     LAT       Latitude                             [deg]
2  101       -0.35     TGRAD(1)  Temperature gradient Jan            [deg/100m]
2  102       -0.79     TGRAD(2)  Temperature gradient Feb            [deg/100m]
2  103       -0.95     TGRAD(3)  Temperature gradient Mar            [deg/100m]
2  104       -0.77     TGRAD(4)  Temperature gradient Apr            [deg/100m]
2  105       -0.52     TGRAD(5)  Temperature gradient May            [deg/100m]
2  106       -0.35     TGRAD(6)  Temperature gradient Jun            [deg/100m]
2  107       -0.78     TGRAD(7)  Temperature gradient Jul            [deg/100m]
2  108       -0.78     TGRAD(8)  Temperature gradient Aug            [deg/100m]
2  109       -0.95     TGRAD(9)  Temperature gradient Sep            [deg/100m]
2  110       -0.89     TGRAD(10) Temperature gradient Oct            [deg/100m]
2  111       -1.17     TGRAD(11) Temperature gradient Nov            [deg/100m]
2  112       -0.70     TGRAD(12) Temperature gradient Dec            [deg/100m]
2  113        11.0     SPDIST    Uniformly distributed snow acc      [mm]
2  114         80.0     SMINI     Inital soil moisture content        [mm]
2  115          0.0     UZINI     Initial upper zone content          [mm]
2  116         30.0     LZINI     Initial lower zone content          [mm]
2  121            1     VEGT(1,1) Vegetation type 1, zone 1
2  122            0     VEGT(2,1) Vegetation type 2, zone 1
2  123          0.0     VEGA(1)   Vegetation 2 area, zone 1           [1]
2  124          0.003   LAKE(1)   Lake area,         zone 1           [1]
2  125            1     VEGT(1,2) Vegetation type 1, zone 2
2  126            0     VEGT(2,2) Vegetation type 2, zone 2
2  127          0.0     VEGA(2)   Vegetation 2 area, zone 2           [1]
2  128          0.0     LAKE(2)   Lake area,         zone 2           [1]
2  129            3     VEGT(1,3) Vegetation type 1, zone 3
2  130            0     VEGT(2,3) Vegetation type 2, zone 3
2  131          0.0     VEGA(3)   Vegetation 2 area, zone 3           [1]
2  132          0.006   LAKE(3)   Lake area,         zone 3           [1]
2  133            4     VEGT(1,4) Vegetation type 1, zone 4
2  134            0     VEGT(2,4) Vegetation type 2, zone 4
2  135          0.0     VEGA(4)   Vegetation 2 area, zone 4           [1]
2  136          0.004   LAKE(4)   Lake area,         zone 4           [1]
2  137            4     VEGT(1,5) Vegetation type 1, zone 5
2  138            0     VEGT(2,5) Vegetation type 2, zone 5
2  139          0.0     VEGA(5)   Vegetation 2 area, zone 5           [1]
2  140          0.0     LAKE(5)   Lake area,         zone 5           [1]
2  141            4     VEGT(1,6) Vegetation type 1, zone 6
2  142            0     VEGT(2,6) Vegetation type 2, zone 6
2  143          0.0     VEGA(6)   Vegetation 2 area, zone 6           [1]
2  144          0.0     LAKE(6)   Lake area,         zone 6           [1]
2  145            4     VEGT(1,7) Vegetation type 1, zone 7
2  146            0     VEGT(2,7) Vegetation type 2, zone 7
2  147          0.0     VEGA(7)   Vegetation 2 area, zone 7           [1]
2  148          0.0     LAKE(7)   Lake area,         zone 7           [1]
2  149            4     VEGT(1,8) Vegetation type 1, zone 8
2  150            0     VEGT(2,8) Vegetation type 2, zone 8
2  151          0.0     VEGA(8)   Vegetation 2 area, zone 8           [1]
2  152          0.0     LAKE(8)   Lake area,         zone 8           [1]
2  153            4     VEGT(1,9) Vegetation type 1, zone 9
2  154            0     VEGT(2,9) Vegetation type 2, zone 9
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  2  155          0.0     VEGA(9)   Vegetation 2 area, zone 9           [1]
  2  156          0.0     LAKE(9)   Lake area,         zone 9           [1]
  2  157            4     VEGT(1,10) Vegetation type 1, zone 10
  2  158            0     VEGT(2,10) Vegetation type 2, zone 10
  2  159          0.0     VEGA(10)   Vegetation 2 area, zone 10          [1]
  2  160          0.0     LAKE(10)   Lake area,         zone 10          [1]
FINIS
```
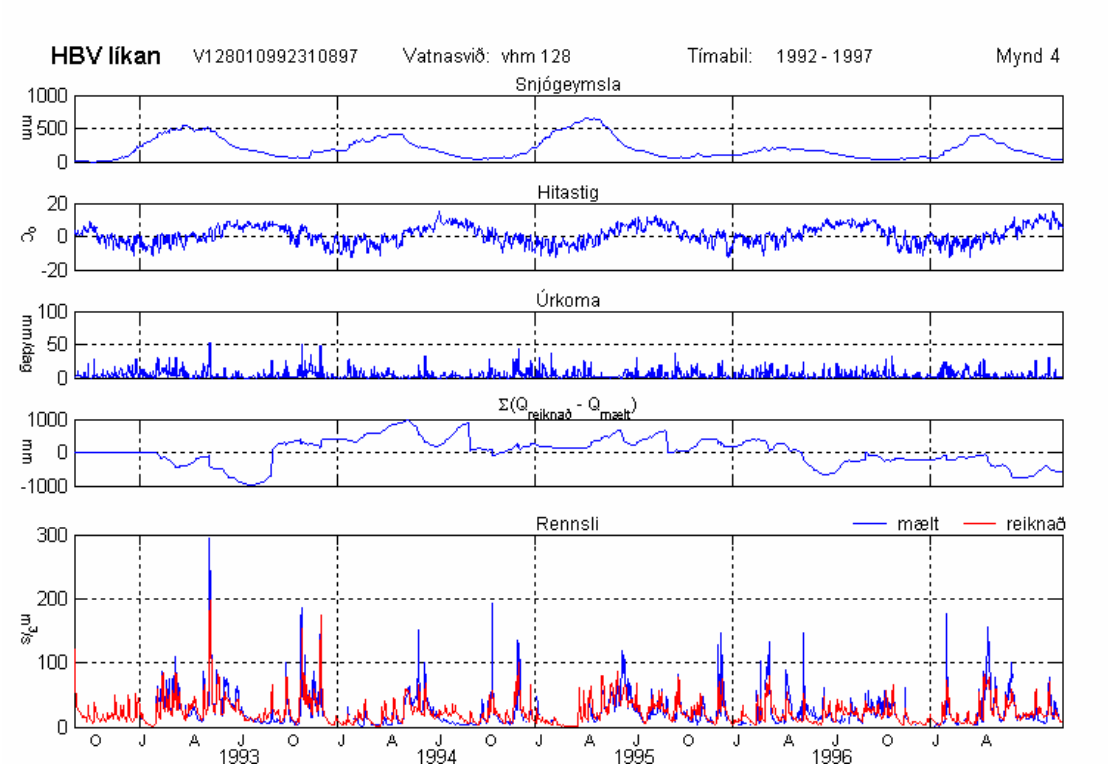
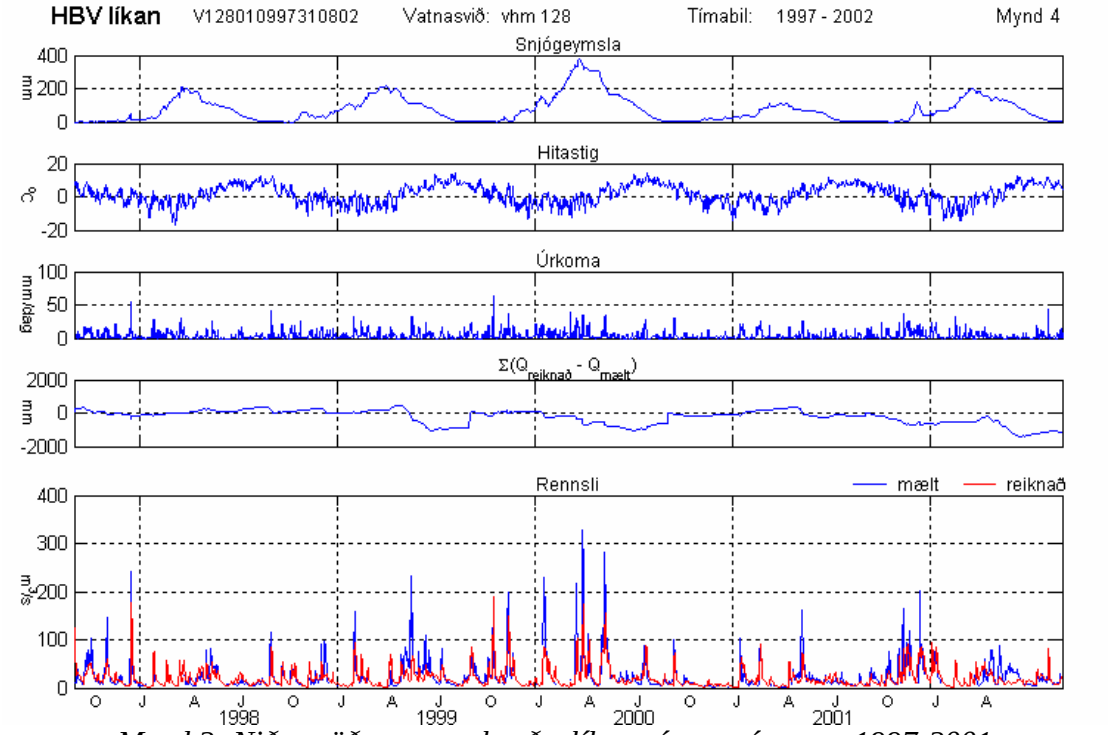

Viðauki II
Línurit með niðurstöðum HBV-líkananna

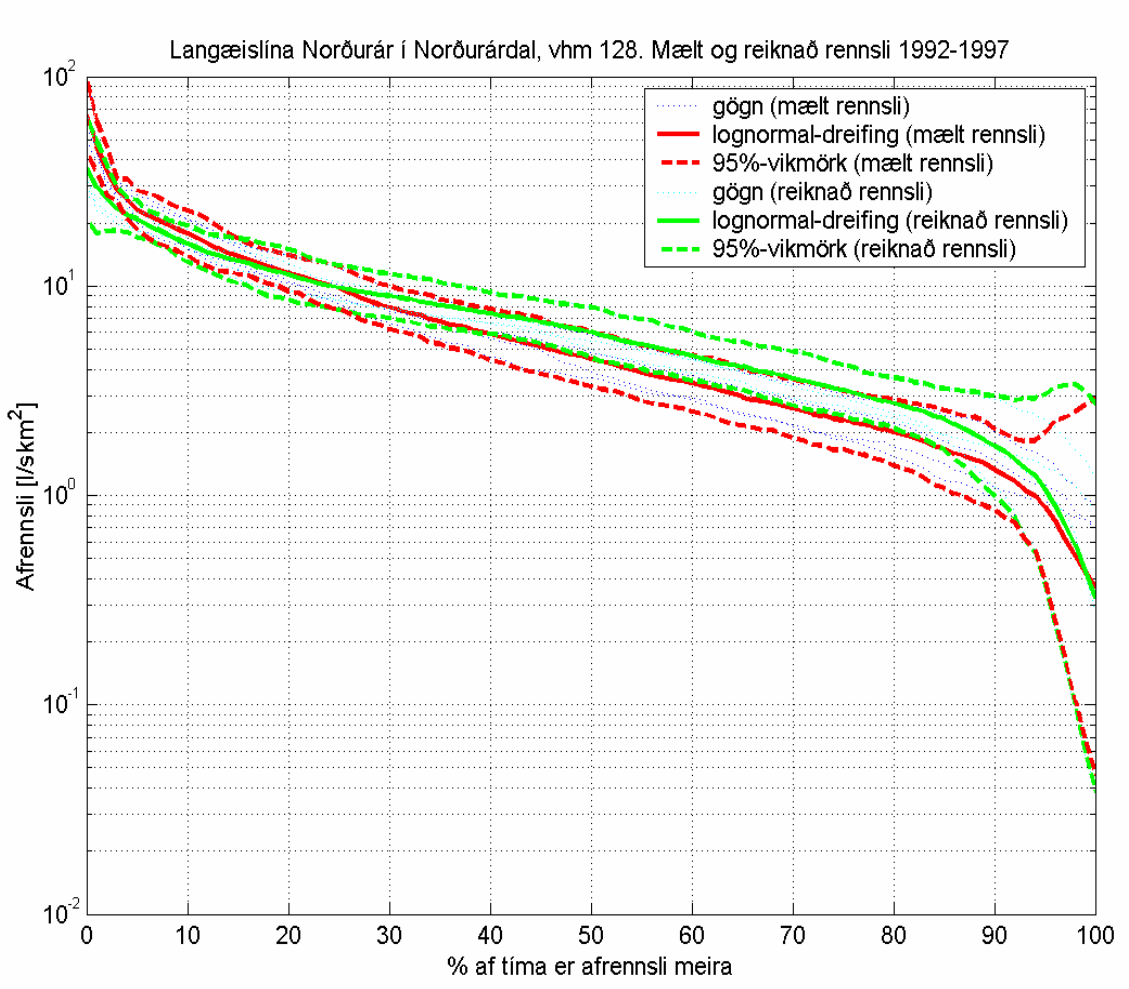


Mynd 1: Niðurstöður samanburðarlíkans á vatnsárunum 1992-1996



Mynd 2: Niðurstöður samanburðarlíkans á vatnsárunum 1997-2001

Viðauki III
Langæislínur reiknaðs og mælds rennslis HBV-líkananna



Lykilorð: Vatnamælingar, HBV-líkan, MM5-líkan, samanburðarlíkan, sólarhringsúrkoma, sólarhringsmeðalhiti, vatnsjöfnuður, fylgnistuðlar, úrkomustigull, hitastigull, langæislína, vhm 128, Norðurá.