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- -Instalar el programa con "HBVsetup.zip"
- -Crear siguiente estructura en el directorio:

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ChileHBV		19680614	0	12.7	0.1651764	171		229,2	
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📕 Nong Son		19680623	0	18.05	0.233470	88			
🎳 SAR8290_scenario1		19680624	0	17.45	0.2191764	171			
퉬 SAR8290_scenario2		19680625	3.5	12.8	0.2255294	12			
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퉬 Sarapiqui8290_lumped		19680627	0	19.05	0.2382352	294			
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-Superficie grafica del programa:



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File Settings Results Tools Help				
	Catch	hment: ChileRioGrande		▶
Snow Routine Veg. zone 1 TT 0.85	From: 01-05-1971 Previous Plot To: 30-04-1972 Next PTQ S 	ioil+E+Q GW+Q SubCatchm	nin/max for each period nent: SubCatchment_1 v Reset	
CFMAX 7.91	•	Model Settings	- • ×	
CFMAX 7.91 SFCF 0.81 CFR 0.05 CWH 0.21 Soil Moisture Routine Veg. zone 1 FC 43.5 LP 0.6 BETA 1.23 Response Routine PERC 69.3 Alpha 0.35 K1 0.047 K2 0.0086 Routing Routine MAXBAS 2.48	General Settings Efficiency Image: Solution of steps for plot: 365 Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Solution of the steps: Image: Solution of the steps: Image: Solution of the steps: Solution of the steps: Solution of the steps: Soluti	siency for specified season Compute efficiency for the season between	Model Structure Standard version Only snow routine distributed Distributed SUZ-box-calculations Three GW boxes Three GW-boxes, STZ distributed Three GW-boxes, STZ and SUZ distributed Different response function (delay) One GW-box Use UZL and K0 in SUZ-box Basic Model Use Aspects Include Glacier Start of warming-up period 14-Jun -1968 Table Start of simulation period O1-May-1971 Table Start of simulation period Apr-2013 Kator Start of simulation period 	
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- Snow Rou	tine Veg. zone 1	From: To:	01-05-1971 Previous Plot 30-04-1972 Next PTQ	◯ Soil+E+Q ◯ GV	/+Q SubCatch	min/max for each p ment: SubCatchme	eriod ent_1 ∨ F	leset			
TT	0.85										
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SFCF	0.81		Catchment properties	l ake properties		~			Sum areas		
CFR	0.05		Number of elevation zones 5	Lake properties	Elevation	Area	TT	SFCF	Juin aleas	Sum areas	
CWH	0.21		Number of vegetation zones 1	Subcatchment 1	0	0	0	0	Subcatchment 1	1	
Soil Moistu	ire Routine			Catchment Elevatio	ns and Areas						
	Veg. zone 1		Height increment variables		Mean	Subcatch, 1					
FC	43.5				elevation [m]	veg. zone 1					
LP	0.6			Elevation zone 1	1449	0.0042					
BETA	1.23		Elev. of P 1215	Elevation zone 2	1750	0.0595					
Response	Routine		Elev. of T 1215	Elevation zone 3	2250	0.1169					
PERC	69.3			Elevation zone 4	2750	0.1865					
Alpha	0.35			Elevation zone 5	3489	0.6329					
К1	0.047									ОК	
К2	0.0086										
Routing R MAXBAS Load parar	outine 2.48 meters Save parameters Run										

HBV-light

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Results Tools Help Settings File **|** ◆ | Catchment: ChileRioGrande Plot From: 01-05-1971 Previous Same min/max for each period Efficiency of the model: 0.3580 Snow Routine PTQ O Soil+E+Q O GW+Q SubCatchment: SubCatchment 1 Reset To: 30-04-1972 Next Mean difference [mm/vear]: 44 Veg. zone 1 0.85 25 Measured temperature [°C] -Qdiff [mm] TT ·25 20 CFMAX 7.91 15 -15 0.81 SFCF 10 CFR 0.05 -5 CWH 0.21 Soil Moisture Routine Measured precipitation (mm) Simulated snow [mm] 25 ·50 Veg. zone 1 20--40 FC 43.5 15--30 10-LP 0.6 -20 5--10 1.23 BETA Response Routine Observed discharge (mm/day) Simulated discharge [mm/day] 69.3 PERC 0.35- \sim Alpha 0.35 0.3-0.047 K1 0.25-K2 0.0086 0.2 -Routing Routine 0.15-MAXBAS 2.48 0.1 Load parameters Sa Run parameters 05-0. 01-05-1971 09-08-1971 17-11-1971 25-02-1972

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- 3. Evaluación inicial de las incertidumbres de los resultados
 - Calibración manual del modelo ajustando los parámetros
 - Evaluación visual y con la ayuda de los criterios estadísticos NSE y InNSE

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- Estudio de caso: sub-cuenca Rio Grande, Limari
- 1. Aplicación del modelo básico con datos limitados
- 2. Calibración automática del modelo
- 3. Evaluación inicial de las incertidumbres de los resultados
 - Calibración automática (Monte Carlo) del modelo usando intervalos de parámetros
 - Evaluación con la ayuda de los criterios estadísticos NSE y InNSE

•		HBV-lig	nt		e Carlo Runs		_ 🗆 🗙	D ×
File Sett	ings Results Tools Help						^	
		Catchment: Chile	RioG	Monte Carlo Settings	- Vegetation zone Parameter	e parameters	Linner Limit	
Come Doub	·	From: 01-05-1971 Previous Plot		Number of model runs: 100000	TT	.2	2	
- Show Rout	Vec. repo 1	To: 30-04-1972 Next PTQ Soil+E+Q GW	/+Q	O Save all runs		-2		
	veg. zone i			○ Save only if obj. function > 0.6	CFMAX	0	4	05
TT	0.85	25 — Measured temperature [*C]		Save 100 runs with highest obj.	SFCF	0	1	-25
CFMAX	7.91			function value	CFR	0.05	0.05	-20
SFCF	0.81		η	Objective function:		0.1		-15
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СМН	0.21	5-		Reff V 0.5	FC	1	500	-5
		()		► LogReff V 0.5 V	LP	0.6	0.6	-0
Soil Moistu	re Routine	25 Measured precipitation [mm]			RETA	1	10	-50
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FC	43.5	15-10			Catchment para	meters		-30
LP	0.6	10-	Γ.		Parameter	Lower Limit	Upper Limit	-20
BETA	1.23	5			PERC	0	100	-10
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Response	Koutine	Observed discharge [mm/day]			K1	0.01	0.5	
PERC	69.3	0.35		Gaussian random numbers	K2	5E-05	01	
Alpha	0.35	0.3-		Multi Period	IV2			
К1	0.047			Divide simulation period into multiple parts	MAXBAS	1	5	
K2	0.0086	0.25-	A		PCALT	0	50	
112		0.2-	, / /		TCALT	0.6	0.6	
Routing Ro	outine	N C CLEWN	۷.		Elev of P	1215	1215	
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44	89.6362559919414	0.883149596808082	0.424619915133631	0.0652086342884268	4.23883520496955	32.3049641252984	0.6	1370
212	153.069389221756	0.986223923501663	0.493786813609203	0.0565463155241899	8.76843823248914	44.0193846449346	0.6	1370
297	392.610753192851	0.228139993840894	0.191277258489876	0.0989353902263266	1.84554897055288	29.7873936112911	0.6	1370
685	47.4572428462362	0.512237292021623	0.113186374638782	0.0670913365321659	2.91095928052019	21.5776266081154	0.6	1370
1111	242.726595137607	0.93110362623404	0.120499859559582	0.0019426760677447	8.72403095137516	33.8849805066758	0.6	1370
1354	431.603289333919	0.673820775781675	0.221825587466278	0.019780547323162	1.55269576355475	16.103110791232 0.6	1370	1370
1566	428.509466704218	0.0769597487882524	0.153312283006176	0.00525827355378227	9.10659926808746	42.7281029451304	0.6	1370
1758	205.604212541415	0.195151466501482	0.41555384487638	0.0316603614450713	1.56920810023751	16.6508459065346	0.6	1370
1786	461.849770422489	0.883485171889646	0.0763418105413866	0.0177614384175564	1.87746300402911	2.21416376028869	0.6	1370
1982	130.935117521759	0.177418997593885	0.342458096483004	0.0552846988452527	6.66366918788462	25.0956669352463	0.6	1370
2597	265.591142575066	0.958013689125894	0.487106648072184	0.0410306420342208	4.06806883498471	38.5617386468508	0.6	1370
2664	329.741204730115	0.100902969995934	0.419806060520842	0.0282326430209133	4.9938757186727 28.3679	9103927537 0.6	1370	1370
2926	240.558050797581	0.645678525625578	0.116580346523123	0.0801563037326822	7.26030555333025	49.6179108343171	0.6	1370
3512	43.5872345029317	0.803895740678485	0.443067197982719	0.0310581175126406	8.98392833815139	17.0875092805771	0.6	1370
3869	287.311729552369	0.644318480810299	0.426683197518198	0.0398988359618461	9.54994518801102	21.4348186200647	0.6	1370
4013	154.81506716917 0.34986	8019274375 0.48664	3318113239 0.0051	4617192128029 1.23153	3774963298 4.98519	9897786211 0.6	1370	1370
4072	327.65418796784 0.374203	1249505487 0.09134	23729181953 0.0524	110682792082 5.82451	1800248796 32.6428	829855272 0.6 1370	1370	1.70371
4139	207.406188573877	0.565157234931904	0.374152701741156	0.0193267909038937	5.22704289771013	20.5499899841612	0.6	1370
4242	286.756085161472	0.590873242165369	0.427176123474341	0.0124060199349681	8.15654052940967	18.8420621616962	0.6	1370
4549	282.886667025223	0.795134071165293	0.232660547235357	0.0373156545183229	3.84413089409663	44.652030322073 0.6	1370	1370
4617	478.488605174929	0.372714021416714	0.157381846936132	0.0879339870954091	3.3205265036414 20.3862	2978431332 0.6	1370	1370
5177	182.765564504902	0.498142952331408	0.146881728906595	0.0805978475572531	2.59869659068002	3.33279034650549	0.6	1370
5587	250.106746316937	0.974896090559147	0.121716143512966	0.0401034339293388	4.25451904500579	28.8370284651579	0.6	1370
5885	274.372628407726	0.657450405721297	0.037192141342532	0.0650340543247452	1.27018710331534	11.7429525841693	0.6	1370
6263	234.7962831486 0.261444	47140421 0.1554801418844	0.029239291512	1.5229592982320	31.73100512834	78 0.6 1370	1370	0.46602
6856	187.599430463556	0.493965187805689	0.324611571442621	0.0137662787878729	7.14641040477269	26.8646935568492	0.6	1370
6921	216.287799083296	0.668418829174907	0.113198470600507	0.0021670667135469	6.36132293490755	24.9348575221071	0.6	1370
6950	387.586877973092	0.0762217096407999	0.186120279648397	0.088400578401564	5.28890211847094	4.85316447767111	0.6	1370
6975	134.410611253423	0.244804325627538	0.0330736363646917	0.0428818449982357	2.11170681757466	17.0748594263917	0.6	1370
7106	455.912462415133	0.930180647843601	0.498994616618843	0.0485487342354603	8.99157648114095	15.5325437153375	0.6	1370
8276	466.510491938102	0.859296686416164	0.0472811983792489	0.0767047085382532	8.28309783771778	11.5671496501039	0.6	1370
8397	362.997372108976	0.597976903709572	0.0503234892805682	0.0762176178285934	4.03771671887381	30.8372100516396	0.6	1370
8404	41.2499643723713	0.238206389936715	0.284848874832899	0.0768277180312796	8.51966136811285	27.5723465637175	0.6	1370
8551	77.7604900029304	0.196278296036775	0.430346024809566	0.00148898826483124	9.85440150129348	2.80169359026556	0.6	1370
8603	321.063532600675	0.24574883945554	0.215484115930965	0.0579779069627067	5.96434936624223	14.6393539843333	0.6	1370

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 - Renombrar el archivo "multi.txt" en "batch.txt" y copiarlo a la carpeta "data"
 - Aplicar un "batchrun"
 - Evaluar la distribución de los parámetros comparado con el intervalo inicial
 - Usar todas las simulaciones aceptadas como indicador de incertidumbre en forma de bandas



Calcular bandas que representan la incertidumbre del modelo:

- Importar las simulaciones a EXCEL y calcular los percentiles 5% y 95%
- Los percentiles de las simulaciones sirven para visualizar bandas.



Estimar la identifiabilidad de los parámetros del modelo:

 Importar los parámetros a EXCEL y graficar contra un criterio estadístico de eficiencia (p.e. NSE).

