Hydrol. Earth Syst. Sci. Discuss., 7, C2004–C2013, 2010
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Hydrology and Earth System Sciences Discussions

Interactive comment on "Modelling the hydrologic response of a mesoscale Andean watershed to changes in land use patterns for environmental planning" *by* A. Stehr et al.

A. Stehr et al.

astehr@udec.cl

Received and published: 27 August 2010

Comment 1. How forest plantation was parametrized in SWAT? Which parameters differ from those for the native forest? This should be explained, and maybe a Table with parameters could be added.

Reply 1. In SWAT, land uses are classified according to the land cover database proposed by Neitsch et al. (2002). The land cover database includes the description of 97 different land uses. Each land use is identified with a code. In the particular study case, the observed land uses where compared with those described by Neitsch et al.

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Interactive Discussion
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(2002). It was found that all the observed land uses are present in the database by Neitsch et al. (2002). Thus, the observed landuses were codified following the standard database.

The differences between (introduced) forest plantation and native forest are mainly the corresponding curve number and the Manning roughness coefficient for overland flow. In the text, we added a briefly explanation on land uses parametrization and a table showing the curve number and the Manning roughness coefficient for overland flow for the main land use in the Vergara watershed.

Table R-1. Curve number and Manning's coeficient for the main land uses in the Vergara watershed.

Note that as expected and according to the curve number method, forestry plantation consumes more water than native forest and native forest consumes more water than agriculture, while initial abstraction, i.e. retention, decreases with curve number (see reply #5 referee #2).

Comment 2. It seems like Figs. 7-9 show monthly discharges, and NOT daily, how it is stated in the figure captions. It is also not clear, whether the criteria of fit in tables 5-7 were calculated for the daily or monthly values? This should be clarified.

Reply 2. The reviewer is right: Figs. 7-9 show monthly discharges. Figure captions will be corrected. Nevertheless, the fit criteria and analysis in tables 5-7 were calculated using the monthly discharges. In the text, we corrected:

Computed and measured discharges were compared at Tijeral, Rehue, Renaico, Mininco and Malleco... By Computed and measured monthly discharges were compared at Tijeral, Rehue, Renaico, Mininco and Malleco.

Comment 3. Discussion of the scenario results should be extended by including an explanation of scenarios 2 and 4. Why the direction of change is not the same for all subbasins: scenario 2 for Rehue, and scenario 4 for Malleco? As the current land

HESSD

7, C2004–C2013, 2010

use is described with numbers for the total drainage area, but not for the subbasins, and land use map in b&w does not allow to easily recognize the current status for subbasins, it is difficult to interpret the obtained results.

Reply 3. We agree with referee #1, nevertheless according to comment 3 of referee #2 we eliminate scenarios 2 and 4. Additionally, analysis of the changes for each subbasin and the overall change of the Vergara watershed has been included. Table R-2 indicates the percentage of area covered by the different land uses for the Vergara watershed and its subbasins: Tijeral, Rehue, Mininco, Renaico and Malleco in baseline and scenarios 1, 2, and 3.

Table R-2. Percentage of area covered by the different land uses for the Vergara watershed and its subbasins: Tijeral, Rehue, Mininco, Renaico and Malleco in baseline and scenarios 1, 2, and 3.

To facilitate the interpretation of results land use maps in b&w have been changed to color ones as follows:

Fig. 10 Land use maps according to observed scenario in year 1994 (a) baseline, (b) scenario 1, (c) scenario 2, (d) scenario 3.

Fig. 11 Changes of mean annual discharges at Tijeral, Rehue, Renaico, Mininco and Malleco under land use scenarios respect to the baseline.

Comment 4. It would be good to add a comparison of average seasonal dynamics of calculated and observed discharges in two periods: 1977-82 and 1992-98 for 3 gauges (based on data in Figs. 8 and 9).

Reply 4. We think that the addition of a comparison of average seasonal dynamics of calculated and observed discharges in the two periods: 1977-82 and 1992-98 for 3 gauges (based on data in Figs. 8 and 9), as suggested by referee #1 is out of the scope of the paper. The primary interest is to analyse the effect of changes in landuse patterns on mean annual discharge. Nevertheless, we performed the suggested anal-

HESSD

7, C2004–C2013, 2010

ysis on a seasonal basis, distinguishing the year, the wet and the dry season. Table R-3 shows the mean discharge [m3/s] of the yearly cycle, the wet and dry season, calculated using the data of 1977-82 and 1994-99 for the subbasins Tijeral, Mininco and Malleco (i.e. subbasins with measured data).

Table R-3. Observed and calculated mean discharge [m3/s] of the yearly cycle, the wet and dry season, corresponding to years 1977-82 and 1994-99 for the subbasins Tijeral, Mininco and Malleco (i.e. subbasins with measured data).

As in Figs. 8 and 9, it is observed that the model tend to slightly underestimate the observed discharges. Overall, the performance of the model is good, as indicated in Tables 6 and 7.

Comment 5. It would be good to improve the quality of land use maps (Figs. 3 and 10), because different land use types are hardly distinguishable now.

Reply 5. According to the suggestion of referee # 1, Figs. 3 and 10 have been improved. Modification makes the different land use types more distinguishable.

Fig. 3 Land cover in 1979 (left) and 1994 (right)

Fig. 10 Land use maps according to observed scenario in year 1994 (a) baseline, (b) scenario 1, (c) scenario 2, (d) scenario 3

Comment 6. Language has to be additionally checked by authors and a native speaker. There are many places that need correction:

Reply 6. According to the suggestion of referee # 1, the language has been additionally checked, and corrected by a native speaker.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 3073, 2010.

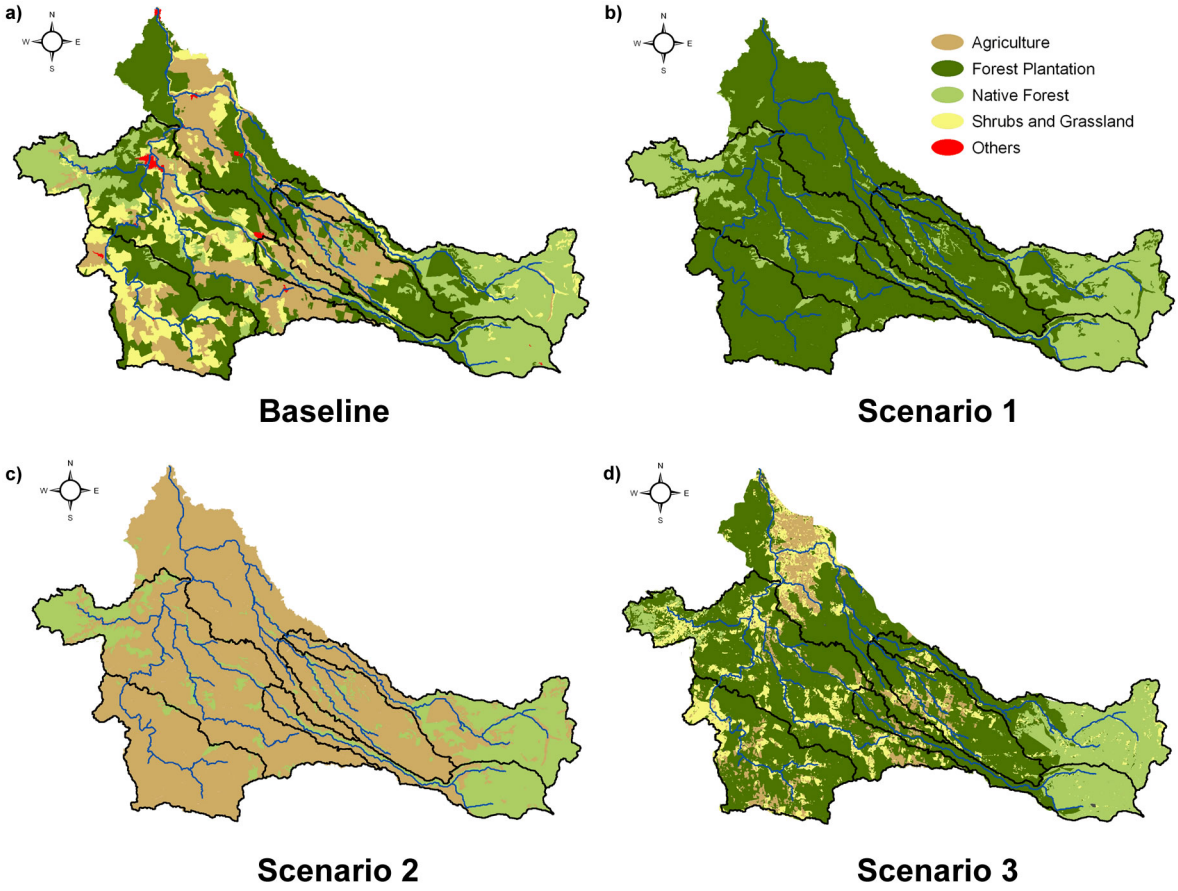

Fig. 1. Fig. 10 Land use maps according to observed scenario in year 1994 (a) baseline, (b) scenario 1, (c) scenario 2, (d) scenario 3

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Interactive Discussion
Discussion Paper

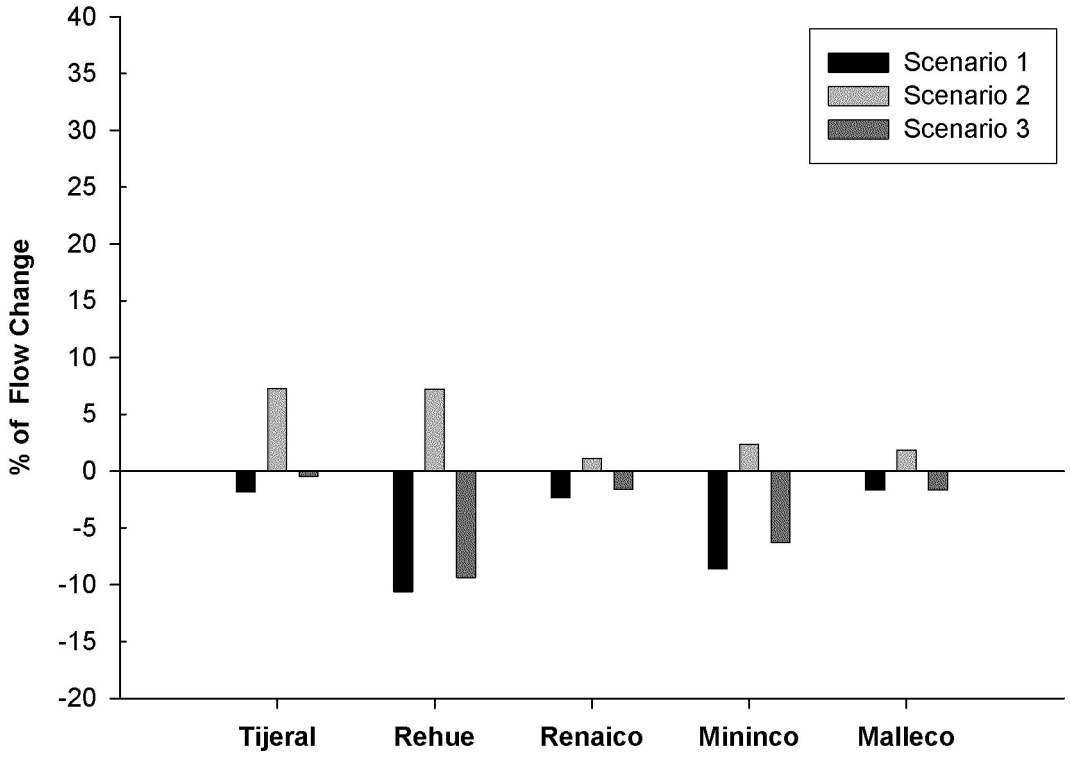

Fig. 2. Fig. 11 Changes of mean annual discharges at Tijeral, Rehue, Renaico, Mininco and Malleco under land use scenarios respect to the baseline

HESSD
7, C2004–C2013, 2010

Interactive Comment

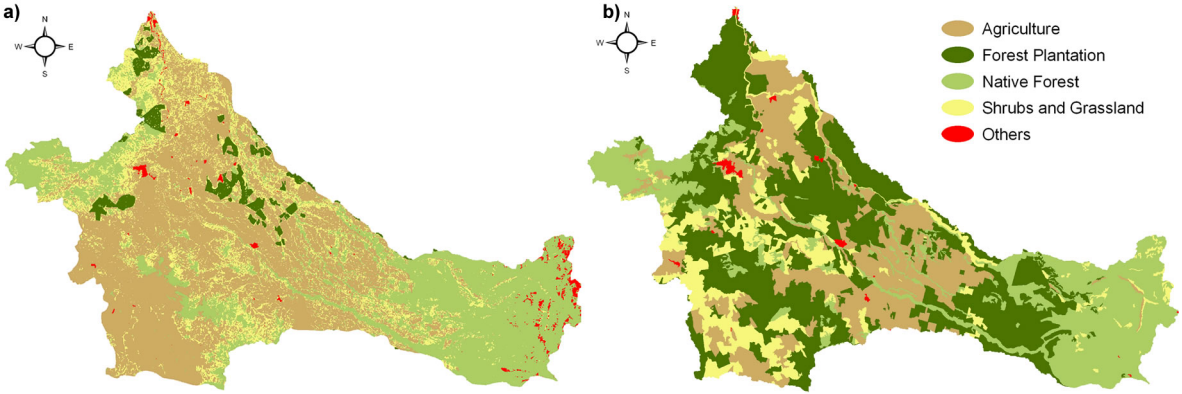

Fig. 3. Fig. 3 Land cover in 1979 (left) and 1994 (right)

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Table R-1. Curve number and Manning´s coeficient for the main land uses in the Vergara watershed

Parameter		Description	Forestry Plantation	Native Forest	Agriculture	Shrubs and Grassland
CN2	A	Initial SCS CN II value, Soil Hydrologic Group A	35	45	62	49
	B	Initial SCS CN II value, Soil Hydrologic Group B	55	66	73	69
	C	Initial SCS CN II value, Soil Hydrologic Group C	70	77	81	79
	D	Initial SCS CN II value, Soil Hydrologic Group D	77	83	84	84
OV_N		Manning's "n" value for overland flow.	0.4	0.8	0.15	0.4

Fig. 4. Table R-1. Curve number and Manning′s coeficient for the main land uses in the Vergara watershed

HESSD

7, C2004–C2013, 2010

Table R-2. Percentage of area covered by the different land uses for the Vergara watershed and its subbasins: Tijeral, Rehue, Mininco, Renaico and Malleco in baseline and scenarios 1, 2, and 3.

	Land use	Vergara	Tijeral	Rehue	Mininco	Renaico	Malleco
Baseline	Agriculture	21.11	20.92	22.22	39.12	6.48	11.89
	Native Forest	23.37	22.64	3.07	9.49	61.03	60.25
	Forestry Plantation	39.44	35.99	40.45	49.07	23.95	23.81
	Shrubs and Grassland	14.46	19.72	33.90	2.31	5.33	3.79
	Others	1.62	0.74	0.36	0.00	3.21	0.25
Scenario 1	Agriculture	0.00	0.00	0.00	0.00	0.00	0.00
	Native Forest	23.37	22.64	3.07	9.49	61.03	60.25
	Forestry Plantation	76.63	77.36	96.93	90.51	38.97	39.75
	Shrubs and Grassland	0.00	0.00	0.00	0.00	0.00	0.00
	Others	0.00	0.00	0.00	0.00	0.00	0.00
Scenario 2	Agriculture	76.63	77.36	96.93	90.51	38.97	39.75
	Native Forest	23.37	22.64	3.07	9.49	61.03	60.25
	Forestry Plantation	0.00	0.00	0.00	0.00	0.00	0.00
	Shrubs and Grassland	0.00	0.00	0.00	0.00	0.00	0.00
	Others	0.00	0.00	0.00	0.00	0.00	0.00
Scenario 3	Agriculture	7.70	5.71	7.80	0.54	8.73	2.41
	Native Forest	16.03	11.53	0.99	60.40	0.00	51.93
	Forestry Plantation	62.87	67.53	81.29	32.92	72.84	42.94
	Shrubs and Grassland	13.26	15.12	9.86	6.10	18.30	2.47
	Others	0.15	0.12	0.07	0.04	0.13	0.24

Fig. 5. Table R-2. Percentage of area covered by the different land uses for the Vergara watershed and its subbasins: Tijeral, Rehue, Mininco, Renaico and Malleco in baseline and scenarios 1, 2, and 3

HESSD

7, C2004–C2013, 2010

Table R-3. Observed and calculated mean discharge [m^3/s] of the yearly cycle, the wet and dry season, corresponding to years 1977-82 and 1994-99 for the subbasins Tijeral, Mininco and Malleco (i.e. subbasins with measured data).

		Subbasin					
		Tijeral		Mininco		Malleco	
		Obs. [m^3/s]	Cal. [m^3/s]	Obs. [m^3/s]	Cal. [m^3/s]	Obs. [m^3/s]	Cal. [m^3/s]
1977 - 1982	Year	68.00	60.55	18.82	15.15	29.28	24.26
	Wet	119.07	106.37	33.48	27.56	47.92	40.24
	Dry	18.34	16.00	5.41	3.81	10.64	8.28
1994 - 1999	Year	44.07	42.85	12.35	11.22	21.00	18.82
	Wet	75.96	73.22	21.48	21.06	35.51	30.66
	Dry	11.24	11.59	3.76	1.96	6.49	6.99

Fig. 6. Table R-3. Observed and calculated mean discharge [m3/s] of the yearly cycle, the wet and dry season, corresponding to years 1977-82 and 1994-99 for the subbasins Tijeral, Mininco and Malleco (i.e. su

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