

Determination of the runoff coefficient (C) in catchments based on analysis of precipitation and flow events

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Table 1. Information about the data of meteorological and flow measurement stations, including periods of measurement, source of data, and selection of storm data.

Catchments	Sensors of rain	Records	Flow sensors	Records	Periods	Source of data
Tinga	bascule model	15 min	pressure transducer	15 min	2011-2014	ESALQ/USP
PEG	bascule model	10 min	pressure transducer	30 min	2011-2013	IAG/USP
SVG	bascule model	10 min	pressure transducer	30 min	2011-2013	IAG/USP
Marins	bascule model	15 min	pressure transducer	60 min	1999-2001	DAEE
Mineirinho	bascule model	5 min	Acoustic probe (ADCP)	2 min	2014-2015	LabSin (EESC)

Table 2. Land use in the Tinga catchment.

Land use classes	Area (ha)	Area (%)
Acacia	0.61	0.73
Araucaria	0.93	1.12
Corridor	4.44	5.31
Eucalyptus	65.96	78.94
Pinus	4.38	5.24
Native vegetation	7.25	8.67
Total	83.57	100

Table 3. Land use and occupation in the area of the Marins catchment.

Land use classes	Area (ha)	Area (%)
Reforestation	1.81	0.08
Sugarcane	1488.81	67.62
Pasture	481.20	21.85
Native vegetation	230.03	10.45
Total	2201.85	100

Table 4. Types of soil in the Marins catchment area.

Pedology	Area (ha)	Area (%)
Red-Yellow Latosols	18.55	0.84
Litholic Neosols	1267.07	57.51
Red-Yellow Argisols	917.45	41.64
Total	2203.07	100

Table 5. Land use and occupation in the area of the Mineirinho catchment (Martins, 2017).

Land use classes	Area (ha)	Area (%)
Agriculture	58.9	10.1
Forest	75.8	12.9
Grass	149.4	25.5
Open spaces	24.3	4.1
Pinus	26.2	4.5
Urban area	250.9	42.9
Total	585.5	100.0

Table 6. (N) number of events, (MAX) maximum, (MIN) minimum, (A) average, (SD) standard deviation and period of events analyzed for the Tinga, Pé de Gigante, Santa Virgínia, Marins and Mineirinho catchments.

Catchments	N	MAX	MIN	A	SD	Period
Tinga	80	0.02	0.003	0.008	0.003	2011-2014
PEG	64	0.023	0.004	0.008	0.003	2011-2013
SVG	70	0.20	0.02	0.08	0.03	2011-2013
BHRM	24	0.35	0.011	0.12	0.10	1999-2000
Mineirinho	12	0.15	0.06	0.09	0.03	2014-2015

Table 7. Calculated runoff coefficients of the study areas and their respective tabulated coefficients (C_T).

Catchments	C_1	C_2	C_3	C_4	C_5	C_6	C_T
Tinga	0.01	0.007	0.008	0.007	0.024	0.008	0.39
PEG	0.012	0.038	0.033	0.011	0.02	0.015	0.35
SVG	0.000	0.000	0.0001	0.000	0.0000	0.000	0.25
BHRM	0.30	0.21	0.36	0.13	0.06	0.15	0.31
Mineirinho	0.11	0.10	0.08	0.07	0.15	0.09	0.61

Dates* Tinga – C₁: 07/01/2011 – C₂: 10 and 11/01/2011 – C₃: 27/01/2011 – C₄: 12/03/2011 – C₅: 12/04/2011 – C₆: 27 and 28/04/2011. PEG – C₁: 18 and 19/01/2012 – C₂: 17 and 18/01/2012 – C₃: 21/03/2013 – C₄: 17 and 18/09/2013 – C₅: 02 and 03/10/2013 – C₆: 28 and 2/12/2013. SVG – C₁: 06/01/2011 – C₂: 09/01/2011 – C₃: 11/01/2011 – C₄: 12 and 13/01/2011 – C₅: 14/02/2011 – C₆: 28/02/2011. BHRM – C₁: 08 and 08/01/1999 – C₂: 26 and 27/01/1999 – C₃: 01, 02 and 03/02/1999 – C₄: 21/02/2000 – C₅: 07 e 08/01/2000 – C₆: 26 and 27/03/2000. Mineirinho – C₁: 12/03/2014 – C₂: 31/03/2014 – C₃: 08/11/2014 – C₄: 11/12/2014 – C₅: 22/12/2014 – C₆: 01/02/2015

Table 8. Percentage of the flows of hydrographs and C of Tinga catchment.

Runoff	2011					
	January		March	April		
	Days					
	7	10, 11	27	12	12	27, 28
	Percentage (%)					
Observed	100	100	100	100	100	100
Direct	52.0	47.2	56.8	49.2	37.3	29.6
Base	48.0	52.8	43.2	50.8	62.7	70.4
C	0.01	0.007	0.008	0.007	0.024	0.008

Table 9. Percentage of the hydrograph flows and C of PEG catchment in 2012 and 2013.

Runoff	2012		2013			
	Jan	Oct	March	Sep	Oct	Dec
	Days					
	18, 19	17, 18	21	17, 18	2, 3	28, 29
	Percentage (%)					
Observed	100	100	100	100	100	100
Direct	30.7	23.8	34.6	25.8	25.8	29.8
Base	69.3	76.2	65.4	74.2	74.2	70.2
C	0.012	0.038	0.033	0.011	0.02	0.015

Table 10. Percentage of the flows of hydrographs and C of SVG catchment in 2011.

Runoff	2011					
	January		January	February		
	Days					
	06	09	11	12, 13	14	28
	Percentage (%)					
Observed	100	100	100	100	100	100
Direct	55.8	44.5	47.0	45.5	38.3	56.5
Base	44.2	55.5	53.0	54.5	61.7	43.5
C	0.0001	0.0001	0.00015	0.0001	0.00009	0.0003

Table 11. Percentage of the hydrograph flows and C of BHRM catchment in 1999 and 2000.

Runoff	1999				2000	
	January		February		January	March
	Days					
	08, 09	26, 27	01, 02, 03	21	07, 08	26, 27
	Percentage				(%)	
Observed	100	100	100	100	100	100
Direct	63.4	69.8	64.3	62.0	23.9	30.2
Base	36.6	30.2	35.7	38.0	76.1	69.8
C	0.30	0.21	0.36	0.13	0.06	0.15

Table 12. Percentage of the flows of hydrograph and C of Mineirinho catchment in 2014 and 2015.

Runoff	2014			2015		
	March	November	December	February		
	Days					
	31	08	11	22	01	25
	Percentage			(%)		
Observed	100	100	100	100	100	100
Direct	64.7	60.6	62.2	61.7	67.3	66.4
Base	35.3	39.4	37.8	38.3	32.7	33.6
C	0.10	0.08	0.07	0.15	0.09	0.11