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TOWARDS A TYPOLOGY OF COUNTRIES ACCORDING TO THEIR GREENHOUSE GASES EMISSION BEHAVIOUR

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The starting point of this paper is the fact that greenhouse gases (GHG) emissions are determined by numerous socioeconomic variables, being a melting pot that brings together and reflects the behaviour of all of them. Consequently, it presents undeniable spatial variability and territorial extent, showing the same kind of disparities characterising the remaining socio-economic aspects. Moreover, in view of all those characteristics, it could even be ventured that GHG emissions can become a priority variable for showing complexities of the territories and it could therefore be used to build territorial classifications in an easier way than considering a great number of variables. The aim of our work is to go further along this line from the development of a countries typology according to their GHG emission behaviour and socio-economic variables causing these emissions.

To do that 12 variables have been selected (table 1). All of them have been provided by the World Resources Institute through the Climate Analysis Indicator Tool (CAIT), which can be accessed via web (http://cait.wri.org).

Main Component Analysis has been used to reduce information from the original data. As a result of the analysis the 12 original variables have been reduced to 3 components, explaining 74,4 % of the total variance: C1 (use of energy and carbon intensity of economy), C2 (development) and C3 (emissions related to land use changes) (table 2).

Table 1
USED VARIABLES

Indicator	Nº	Variables	Units	Year	Nº of countries
Emissions	1	Total GHG emissions per capita	tCO_2e	2000	185
	2	Energy CO_2 emissions per capita	tCO_2e	2004	131
	3	Industrial processes CO_2 emissions per capita	tCO_2e	2004	184
	4	Agriculture CH_4 emissions per capita	tCO_2e	2000	185
	5	Land-use change CO_2 emissions per capita	tCO_2e	2000	149
	6	Total CO_2 cumulative emissions per capita	tCO_2e	1850-2004	185
	7	Land-use change cumulative CO_2 emissions per capita	tCO_2e	1850-2000	149
Socio-economic	8	Energy use per capita	toe	2004	129
	9	Carbon intensity of economy	tCO_2 / Mill. Intl $	2004	183
	10	Carbon intensity of energy	tCO_2 / toe	2004	129
	11	Income per capita (GDP PPP)	Intl $	2004	183
	12	Governance index	Index (0-100)	2006	185

Table 2
CORRELATION COEFFICIENT BETWEEN ANALYZED VARIABLES AND SELECTED COMPONENTS

Variables	Components		
	C1 (41,4%)	C2 (21%)	C3 (12%)
GDP per capita	0,423	0,847	0,017
Energy use per capita	0,759	0,497	0,064
Governance index	0,124	0,894	-0,004
Total GHG emissions per capita	0,423	0,251	0,833
Energy CO_2 emissions per capita	0,813	0,447	0,055
Industrial processes CO_2 emissions per capita	0,644	0,383	-0,017
Agriculture CH_4 emissions per capita	0,028	0,354	-0,017
Land use change CO_2 emissions per capita	-0,149	-0,110	0,970
Total CO_2 cumulative emissions per capita	0,632	0,573	-0,001
Land use change CO_2 cumulative emissions per capita	-0,136	-0,080	0,972
Carbon intensity of economy	0,757	-0,403	0,028
Carbon intensity of energy	0,685	0,088	-0,107

The application of Cluster Analysis to the three selected components leads to a typology consisting of 12 types of countries that can be grouped into 5 main blocs. The average component scores of the 12 types can be seen in figure 1, and the countries belonging to each type in table 3.

The **first bloc** includes those countries with a clear dominance of the first component, which is positive in all cases and holds the highest value of them all, as a result of a high carbon intensity and/or a high energy consumption. Subsequently, nuances in the values of this component, together with variations in development levels, will establish different types within this bloc. The **second bloc** of countries is associated with wealth and high level of development, so the dominance of the second component is a common rule in all of

Figure 1
AVERAGE COMPONENT SCORES OF THE 12 COUNTRY TYPES

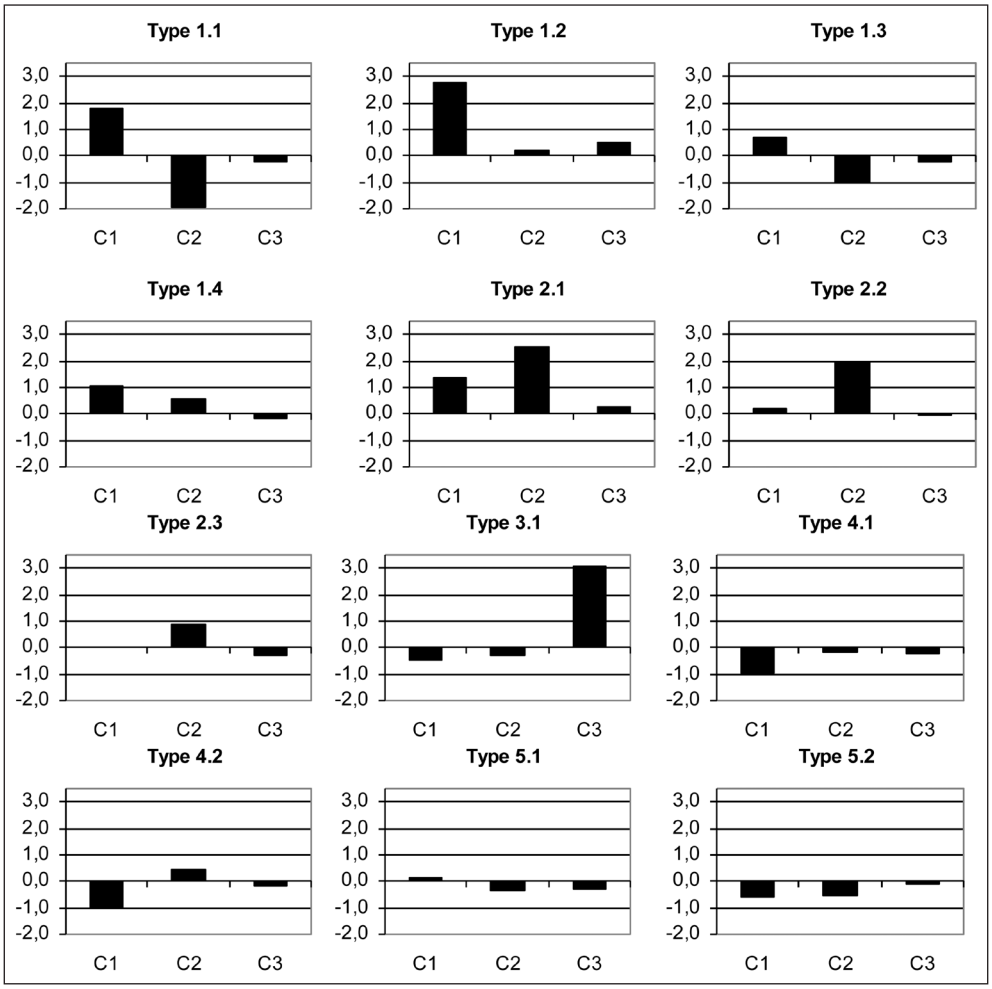

Table 3
TYPOLOGY OF COUNTRIES ACCORDING TO THEIR EMISSION BEHAVIOUR

Type	Country	Type	Country	Type	Country	Type	Country
1.1	Libya	2.2	Germany	4.1	Sao Tome and Principe	5.2	Myanmar
	Serbia		Netherlands		Tanzania		Dem. Republic Congo
	Kazakhstan		Denmark		Nepal		Benin
	Turkmenistan		United Kingdom		Laos		Cameroon
	Uzbekistan		Austria		Madagascar		Paraguay
	North Korea		Belgium		Cambodia		Guatemala
	Iraq		Singapore		Bhutan		Cote d'Ivoire
1.2	Trinidad and Tobago		Sweden		Fiji		Nigeria
	Saudi Arabia		Switzerland		Ghana		Zimbabwe
	Brunei		France		Lesotho		Pakistan
	Bahrain		Ireland		Tonga		Bangladesh
	United Arab Emirates		Norway	4.2	Bahamas		Haiti
	Kuwait		Ireland		Barbados		Togo
	Qatar		New Zealand		Saint Kitts and Nevis		Sudan
1.3	Tajikistan	2.3	Chile		Seychelles		Sierra Leone
	Kyrgyzstan		Latvia		Kiribati		Central African Rep.
	Angola		Lithuania		Vanuatu		Eritrea
	Syria		Malta		Cook Islands		Guinea-Bissau
	Moldova		Argentina		Grenada		Guinea
	Cuba		Hungary		Cape Verde		Chad
	Congo		Portugal		Samoa		Burundi
	Yemen		Slovenia		Mauritius		Palau
	Macedonia		Italy		Saint Lucia		Surinam
	Jordan		Spain		Saint Vincent and Grenadines		Colombia
	China						Namibia
	Ukraine		Taiwan		Dominica		Maldives
							Sri Lanka
			Uruguay		Brazil		Mauritania
	Byelorussia	3.1	Belize		Botswana		Kenya
	Iran		Guyana	5.1	Honduras		Niue
	Azerbaijan		Zambia		Vietnam		El Salvador
	Jamaica		Papua New Guinea		Albania		Filipinas
	Lebanon		Malaysia		Dominican Republic		Georgia
	Nauru						Senegal
	Venezuela		Nicaragua		India		
	Russia		Bolivia		Armenia		
			Indonesia		Morocco		
	Equatorial Guinea		Panama		Bosnia and Herzegovina		

Type	Country	Type	Country	Type	Country	Type	Country
1.4	Estonia	4.1	Antigua		Egypt		
	Oman		Costa Rica		Algeria		
	Czech Republic		Malawi		Ecuador		
			Mali		Mongolia		
	Cyprus		Uganda		Gabon		
	Israel		Rwanda		Bulgaria		
	Estonia		Mozambique		South Africa		
	South Korea		Gambia		Croatia		
	Greece		Burkina Faso		Tunis		
	Poland		Swaziland		Mexico		
2.1	Luxembourg		Djibouti		Romania		
	Canada		Salomon Islands		Turkey		
	Australia						
	United States		Ethiopia		Thailand		
2.2	Japan		Comoros	5.2	Liberia		
	Finland		Niger		Peru		

them. A typology is established here according to the C2 value and the energy consumption, which can be very variable from one country to another. The **third bloc** consists of all those countries where the third component, ie, the one associated with land use change, is the most significant; the two remaining components being slightly negative. The **fourth bloc** is composed of countries with a low energetic component, as results of a reduced energy use and, above all, low carbon and energy intensities. They also present a variable level of development, but with values next to zero, and slightly negative C3 values. The **fifth and last bloc** integrates most of underdeveloped countries. Energetic and, especially, development components present low values in these countries, and they do not even produce strong emissions from land use changes.

The results confirm the territorial importance currently acquired by the variables associated with GHG emissions, configuring a typology of countries which basis goes beyond the mere reality of these emissions.