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Mapping the development of Open Access in Latin America and Caribbean countries. An analysis of Web of Science Core Collection and SciELO Citation Index (2005–2017)

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Abstract
Open Access (OA) initiatives and knowledge infrastructure represent vital elements for both producing significant changes in scholarly communication and reducing limitations of access to the circulation of scientific knowledge in developing countries. The spreading of the OA movement in Latin America and Caribbean (LA&C) countries, exemplified by the growth of regional and national initiatives, such as the creation of OA digital journal libraries and the establishment of supportive governmental policies, provides evidence of the significant role OA is playing in improving the participation of LA&C countries in the so-called "global knowledge commons". In this paper, we map OA publications in LA&C countries through a bibliometric analysis of OA publications indexed by the Web of Science Core Collection and SciELO Citation Index during the period 2005–2017. Searches were done in the fields "Country", "Publication Year", "Language", and "Research Area" using WoS analytical tools, in order to map the evolution, distribution, and characteristics of OA publications in the LA&C region. The analysis is conducted on both the sub-regional and national levels. On the sub-regional level, trends in the four LA&C sub-regions (Southern Cone, Central America and Mexico, Andes, and the Caribbean) are identified and compared. On the national level, the analysis identifies as most representative and focuses on nine countries: Argentina, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, Mexico, and Peru. By doing so, it enriches the existing literature on the subject, where the prominent role played by some of these countries in supporting OA has been already underlined.

Keywords Open Access · LA&C countries · Scientific publications · Bibliometric analysis

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Introduction

Open Access (OA) initiatives and knowledge infrastructure represent vital elements for both producing significant changes in scholarly communication and reducing limitations of access to the circulation of scientific knowledge in developing countries. The spreading of the OA movement in Latin America and Caribbean (LA&C) countries, exemplified by the growth of regional and national initiatives, such as the creation of OA digital journal libraries (e.g. SciELO and RedALyC) and the establishment of supportive governmental policies, provides evidence of the significant role OA is playing in reducing the scientific gap between these countries and improving their participation in the so-called "global knowledge commons" (Chan et al. 2011).

We have observed a recent proliferation of studies focusing on large-scale analyses of the state of OA, where automated services, such as those provided by Web of Science (WoS), are employed to check and map the OA availability of scientific documents (Bosman and Kramer 2018; Piwowar et al. 2018; Science-Metrix 2018; van Leeuwen et al. 2017). The present paper draws on such large-scale studies but it instead focuses on the regional scale, with the more limited aim of mapping the status of OA in the LA&C region. Hence, our primary objective is contributing to the mapping of OA publications produced by LA&C countries, in order to observe how these countries are moving forward and becoming a leading force in widening access to scientific knowledge.

Our analysis focuses on OA publications indexed by WoS,[1] a pay-walled citation database supplied by Clarivate Analytics, which is recognized as one of the most important scientific databases, as well as on OA publications indexed by SciELO Citation Index, an index included in WoS that has been created in partnership with the regional digital journal library SciELO (Scientific Electronic Library Online),[2] which indexes OA journal content from Latin America, the Caribbean, Spain, Portugal, and South Africa (Repiso et al. 2017).

While we hope that our analysis might serve as a basis for scientific institutions of the LA&C region to implement policies and initiatives supporting OA models of scientific communication, our specific aim is to trace the development of OA scientific production in LA&C from the point of view of its temporal distribution, as well as by research and geographical areas and languages.

Open access in Latin America and the Caribbean

Knowledge in developing countries is not easily accessible or shared, and researchers have more limited access to it than their colleagues from developed countries. For instance, Numprasertchai and Igel (2005) observe that research units in developing countries have many disadvantages compared to newly industrialized countries and developed countries in terms of based knowledge, experts, researchers, and infrastructure. Inequality of access to information and technological advantages among researchers becomes a crucial factor in science. Many researchers, for one reason or another, cannot participate in the digitally mediated scientific networks. Molloy (2011) criticizes the current journal system that works against the dissemination of scientific data and its inherent barriers. Aguado-López

[1] https://apps.webofknowledge.com (accessed 7 September 2018).
[2] http://www.scielo.org/php/index.php (accessed 7 September 2018).

and Vargas-Arbeláez (2016) highlight how the dominant scientific communication model entails a form of colonialism of knowledge, based on North–South asymmetries and the geopolitical perspectives of knowledge (Chinchilla-Rodríguez et al. 2018; Sánchez-Tarragó et al. 2015). Harris (2004) states that merely transferring expertise and instrumentation is not enough to help developing countries build their research base. Such efforts must be tied to national and local needs to create trust and services for society in the long term. Scientists must have easy access to the digital tools from commercial and advanced research sectors (Atkins et al. 2003). Harnad (2001) argues that price levels of commercial publishers make most digital publications inaccessible to potential users, thus contributing to an increase in access barriers.

Many countries in the LA&C region have elaborated strategies and developed policies to eliminate the barriers linked to price and accessibility issues, as well as copyright restrictions. Alperin and Fischman (2015) offer one of the most representative study on the status of OA in the LA&C region. Specifically, Argentina has moved two essential steps in promoting OA: the creation, in 2010, of the National System of Digital Repositories (SNRD), coordinated by the Ministry of Science, Technology and Productive Innovation, and the law on OA of 2012, which requires institutions receiving public funds to create repositories of information and deposit copies of scientific documents (published and unpublished) (Red Clara and BID 2013).

Peru, in 2013, approved the OA law which regulates the national OA repository of science, technology and innovation, which contains the scientific, technological and innovation production of the country. Its use is for researchers affiliated with public agencies, researchers who have received public funds, or researchers who want their production made openly accessible (Red Clara and BID 2013).

Mexico created in 2011 the Mexican network of institutional repositories. It later approved an OA law, which establishes the creation of a National Repository of Scientific, Technological and Innovation Information (Diario Oficial de la Federación 2014). In addition to the laws approved to date, Brazil in 2007 proposed a national law for the development of OA policies that was modified in 2011 and is still pending at the Senate (Bill no. 1120 in 2007, then replaced by the Senate Bill no. 387 in 2011; see Costa and Leite 2016).

Chile, although it does not have any national law on OA, has been a pioneer in the development of institutional repositories, with the deployment in 1997 of SciELO Chile and the consortium acquisition of high-cost information resources since 2003. Likewise, as stated in the Red Clara and BID (2013) report, it emphasizes the importance of ensuring the quality control of available content and the production of documents in OA. As Chinchilla-Rodríguez et al. (2018) have observed, a similar trend orients the national strategies intended to foster the visibility of Chilean scientific research. Other countries, such as Colombia, Venezuela, and Ecuador are moving towards the promotion of OA at the institutional level through guidelines for the publication of publicly funded research results and their incorporation into OA international repositories (Red Clara and BID 2013).

Since the mid 2000s, the LA&C region has also witnessed a proliferation of declarations in favor of OA: the Brazilian Manifesto to Support Open Access to Scientific Information (*Manifesto Brasileiro de Apoio ao Acesso Livre à Informação Científica*), referring to ways of publication and conditions for OA and stressing out the importance of a national policy in support of OA (Instituto Brasileiro de Informação em Ciência e Tecnologia 2005); the Salvador Declaration on Open Access: The Perspective of Developing Countries (*Declaración de Salvador sobre Acceso Abierto: la Perspectiva del Mundo en Desarrollo*), which emphasizes the importance of OA for the development of emerging countries and for providing researchers from developing countries with the possibility of accessing scientific

literature (International Seminar on Open Access 2005); the São Paulo Letter (*Carta de São Paulo*), which underlines the essential role of access to scientific knowledge for scientific and social advancement (AA.VV. 2005); the Declaration of Florianópolis (*Declaração de Florianópolis*) (ANPEPP 2006) and the Declaration of Cuba in Favor of Open Access (*Declaración de Cuba en Favor del Acceso Abierto*) (Sociedad Cubana de Psicología de la Salud 2007), to cite only a few significant documents produced in LA&C during the mid 2000s.

The combined efforts of LA&C institutions and researchers have resulted in 13% of all Latin American journals being OA (compared to 3% in Canada/USA and 2% in Europe) and 51% of the proportion of online journals (Haider 2005). LA&C journals are adopting OA publishing models to increase the sense of public mission of LA&C universities and their commitment to knowledge sharing (Alperin et al. 2008). Gómez and Bongiovani (2012) have identified the increase of OA publications between 2007 and 2010 in Argentina (236%), Brazil (12%) and Chile (85%). Authors argue that the region is moving forward and becoming a leading force in widening access to scientific knowledge.

Open access documents in Latin American and Caribbean countries: an analysis of Web of Science Core Collection and SciELO Citation Index (2005–2017)

Objectives and method We offer a bibliometric analysis of OA publications in LA&C countries indexed by the Web of Science Core Collection (WoS) and Scientific Electronic Library Online Citation Index (SciELO CI), both accessible via the WoS website. The bibliometric analysis of WoS database aims at mapping the use and distribution of OA in LA&C countries. The result integrates and enriches the pre-existing analyses of the development of OA in LA&C countries. Through a comparison between WoS and SciELO CI records, we aim at identifying some patterns through which OA has been developing in LA&C countries in the last 12 years. A bibliometric analysis is helpful to map the scientific activities carried out and identify patterns in the current status of OA in emerging countries (Chinchilla-Rodríguez et al. 2018).

On the one hand, the analysis of WoS and SciELO CI provides a biased and partial representation of the distribution and development of OA in LA&C, which ignores many of the publications indexed by other regional and global open digital journal libraries such as RedALyC and the Directory of Open Access Journals (DOAJ), as well as those included in the Scopus database (which, differently from WoS, only from February 2018 does offer tools for automatically identifying OA publications within the overall volume of indexed documents). Specifically, we can only observe Gold OA journals that publish all their articles as OA, and Hybrid OA journals that give authors the choice to openly circulate their article, paying an Article Processing Charge (APC) (Prosser 2003; Walker 1998). On the other hand, it offers the advantage of providing readers with a depiction of the distribution of OA in the LA&C region that is not limited to the number of open journals or the countries with a higher scientific development but appears more extensive, including almost every LA&C country. In this respect, it is worth noting that SciELO and RedALyC overrepresent the scientific production of the countries from which they were originated (Brazil and Mexico, respectively). They also mutually exclude several other countries (Bolivia and Paraguay only appear in SciELO, while Dominican Republic, Ecuador, and Puerto Rico only appear in RedALyC), and do not include any publication from

Caribbean English-speaking countries such as Guadeloupe, Jamaica, and Trinidad and Tobago, as well as Spanish-speaking small countries like El Salvador, Honduras, Nicaragua, and Panama (Delgado Troncoso 2011). Similarly, DOAJ contains publications from only 20 LA&C countries (González Alonso and Pérez González 2015; in 2011 it included publications from only 18 LA&C countries as reported by Delgado Troncoso 2011). In this regard, our analysis of WoS and SciELO CI intends to provide useful insights to complement the existing literature on the subject rather than offer an omni-comprehensive picture of the distribution and development of OA in LA&C.

Data source and search strategies We have searched all types of documents (articles, meeting abstracts, reviews, proceeding papers, etc.) published by LA&C countries in all languages during the period 2005–2017 to map their participation in OA scientific publishing. Searches were executed during September–December 2017.

The sample contains all documents published by LA&C countries in the selected period and indexed by the SciELO Citation Index and Web of Science Core Collection, which includes Thomson Reuters' Science Citation Index (SCI-EXPANDED), Social Science Citation Index (SSCI), Arts & Humanities Citation Index (A&HCI), and Emerging Sources Citation Index (ESCI). The sample includes 983,020 documents published by LA&C countries and indexed by WoS, within which we find 212,139 OA documents (21.58% of the total LA&C documents), and 387,172 OA documents published by LA&C countries and indexed by SciELO CI. Searches were done in the fields "Country", "Publication Year", "Language", and "Research Area" using WoS analytical tools.

Timespan The decision of limiting our search to the timespan 2005–2017 has been made in order to focus on the period that from a historical perspective is considered one of significant consolidation of OA both at global and regional levels. This period could be defined as *post-Budapest Open Access Initiative* (*BOAI*), referring to the landmark meeting held in Budapest in 2001 after which the first document mentioning the expression "open access" was produced (Budapest Open Access Initiative 2002). This periodization has been adopted by previous comprehensive studies of the development of OA in LA&C, such as the bibliographic research conducted by Costa and Leite (2016), who distinguish three periods of OA development: before BOAI, BOAI, and after BOAI (Costa and Leite 2016, 35).

As a matter of fact, though in LA&C initiatives and discussions around OA have taken place long before the BOAI, it is in the post-BOAI period that we witness a proliferation of initiatives in favor of OA, as well as the approval of national laws on OA in Argentina, Peru and Mexico (Costa and Leite 2016).

Geographical considerations We analysed the sample both at sub-regional and national levels. To conduct the sub-regional analysis, LA&C countries have been grouped following the criteria adopted by Russell and Ainsworth (2014). LA&C countries have been divided into four sub-regions adapting the classification employed in the Ranking Web of World Universities[3]: (1) Southern Cone; (2) Central America and Mexico; (3) Andes; (4) Caribbean (including Cuba and the Dominican Republic). The decision was made to treat the Caribbean separately and not as part of Central America as does the Ranking Web of

[3] http://www.webometrics.info/index.html (accessed 18 December 2017).

Table 1 Percentage of open access documents by geographical aggregate in Web of Science Core Collection and SciELO Citation Index, 2005-2017

Sub-region	WOS (%)	SCIELO CI (%)
Southern Cone	81.04	69.68
Central America and Mexico	11.47	10.43
Andes	8.89	15.78
Caribbean	1.61	6.07

World Universities, to facilitate the analysis of its behavior (Russell and Ainsworth 2014). The geographical grouping of LA&C sub-regions was thus conducted as follows:

1. Southern Cone: Argentina, Brazil, Chile, Paraguay, Uruguay;
2. Central America and Mexico: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama;
3. Andean sub-region: Bolivia, Colombia, Ecuador, Peru, Venezuela;
4. Caribbean sub-region: Anguilla, Antigua and Barbuda, Aruba, Bahamas, Barbados, British Virgin Islands, Cayman Islands, Cuba, Curacao, Dominica, Dominican Republic, Falkland Islands, Grenada, Guadeloupe, Haiti, Jamaica, Martinique, Montserrat, Netherlands Antilles, Puerto Rico, Saint Barthélemy, Saint Kitts and Nevis, Saint Lucia, Saint Martin, Saint Vincent and the Grenadines, Sint Maarten, Trinidad and Tobago, Turks and Caicos Islands, United States Virgin Islands.

Results and discussion

Descriptive analysis by sub-region

Table 1 shows the percentage of OA documents within both Web of Science Core Collection (WoS) and SciELO Citation Index (SciELO CI) by geographical aggregates (Southern Cone, Central America and Mexico, Andes, and the Caribbean). The Web of Science Core Collection includes 212,139 OA documents published by LA&C countries between 2005 and 2017. In the same period the SciELO Citation Index, which includes only OA publications, indexed a total of 387,172 documents participated by LA&C countries. Since part of the published documents is participated by countries of different sub-regions the total percentage value results greater than 100%. Sub-regional percentage thus just represents the participation of each geographical aggregate in the samples of OA documents indexed by the two databases.

Data show that the Southern Cone is the most productive sub-region in both databases, participating in 81.04% of the WoS sample and 69.68% of the SciELO CI sample. In the WoS sample, the Southern Cone is followed by Central America and Mexico (11.47%), Andes (8.89%), and the Caribbean (1.61%), while the degree of participation of these three sub-regions differs in the SciELO CI sample, where the Andean sub-region results to be the second contributor (15.78%), followed by Central America and Mexico (10.43%) and the Caribbean sub-region (6.07%). It is thus worth noting how the Andean and Caribbean degree of participation is significantly higher in the SciELO CI sample than the WoS one, while Central America shows a similar degree of participation in both samples.

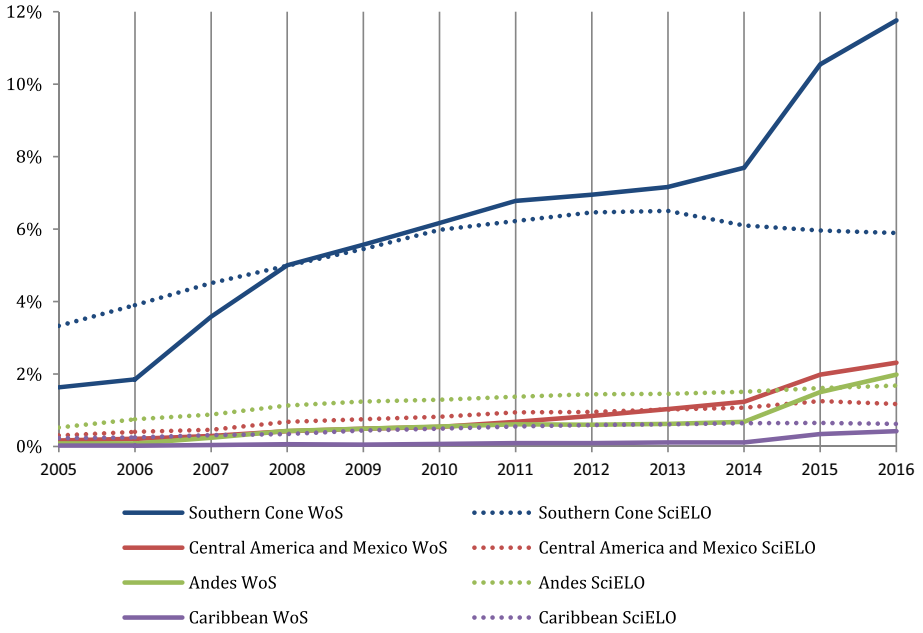

Fig. 1 Growth of open access documents by geographical aggregate and by yearly additions to Web of Science Core Collection and SciELO Citation Index, 2005–2016

To evaluate the growth of OA documents within each LA&C sub-region, and with the more general aim of fulfilling the need of empirical research regarding the longitudinal development of OA publishing highlighted by other authors (e.g. Laakso et al. 2011), we analysed the sub-regional samples by "Publication Year" within both WoS and SciELO CI. Figure 1 shows the growth of OA documents by geographical aggregate and by yearly additions to WoS and SciELO CI, expressed as a percentage over the sub-regional OA production. Data referred to 2017 have been excluded due to their incompleteness.

It is worth noting the significant growth of OA publishing indexed by WoS and produced by all the four sub-regions, especially between 2014 and 2016. This increment is likely due to the increased indexing of OA journals by WoS, but data also show a parallel decrease of the publications indexed by SciELO CI, in particular in the Southern Cone and Central America, probably signalling an increased interest in publishing OA contributions within journals indexed by global databases such as WoS rather than journals indexed only by regional digital journal libraries like SciELO CI.

Since the Web of Science Core Collection, differently from SciELO Citation Index, includes both "open" and "closed" documents, it is possible to calculate the proportion that OA documents constitute from the overall document volume. The Collection included 983,020 total documents published by LA&C countries between 2005 and 2017, amongst which we find 212,139 OA documents, with OA publications thus representing the 21.58% of total LA&C documents. Table 2 shows the distribution of total and OA documents amongst the LA&C sub-regions. Besides the presentation of the absolute numbers of (1) total and (2) OA documents participated by each sub-region, the table also shows (3) the proportion that OA documents constitute from the overall production of each sub-region.

Table 2 Distribution of total and open access documents by geographical aggregate in Web of Science Core Collection, 2005–2017

Sub-region	Total documents	Open access documents	Proportion (%)
Southern Cone	726,067	171,908	23.68
Central America and Mexico	179,117	24,334	13.58
Andes	88,511	18,868	21.32
Caribbean	23,182	3411	14.71

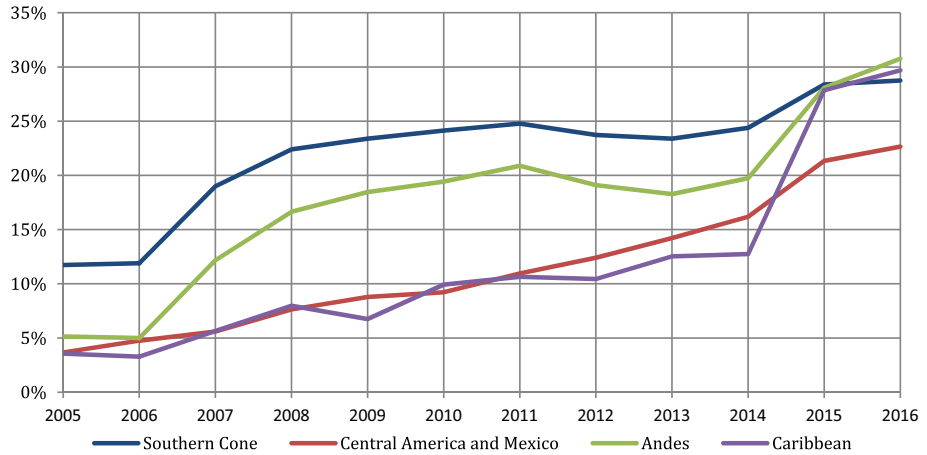

Fig. 2 Proportion of open access documents over time by LA&C sub-regions. Percentages by sub-regional yearly additions to the Web of Science Core Collection, 2005–2016

According to this figure, the region with the highest proportion of OA publications over the total production is the Southern Cone (23.68%). OA publications also have a high relative weight in the Andean sub-region (21.32%), while the other sub-regions present lower values. In the Caribbean sub-region OA publications count for the 14.71% of the total sub-regional production. In Central America this proportion adds up to 13.58%.

In order to compare the relative weight of OA over time amongst the LA&C sub-regions, Fig. 2 visualizes the trends shown by the proportion of OA documents over the total documents produced on a sub-regional basis and calculated on the number of documents added yearly, also excluding incomplete data referred to 2017. Data show that in the two sub-regions where OA documents have higher relative weights on the overall document volumes, the Southern Cone (23.68%) and the Andes (21.32%), the proportion of OA documents has constantly increased since 2006 until 2011. It has slightly decreased between 2012 and 2013, to then increase again and by significant rates in 2015 and 2016, when the OA proportion in the Andean sub-region (30.76%) also surpassed that of the Southern Cone (28.75%). In Central America and Mexico the proportion has increased constantly over the whole period, yet maintaining lower values and trespassing the threshold of 20% only in 2015 and 2016. On the contrary, the Caribbean sub-region shows a fluctuant trend until 2014, but the proportion of OA documents there reached a significant peak in 2015 and 2016, with percentages more than double

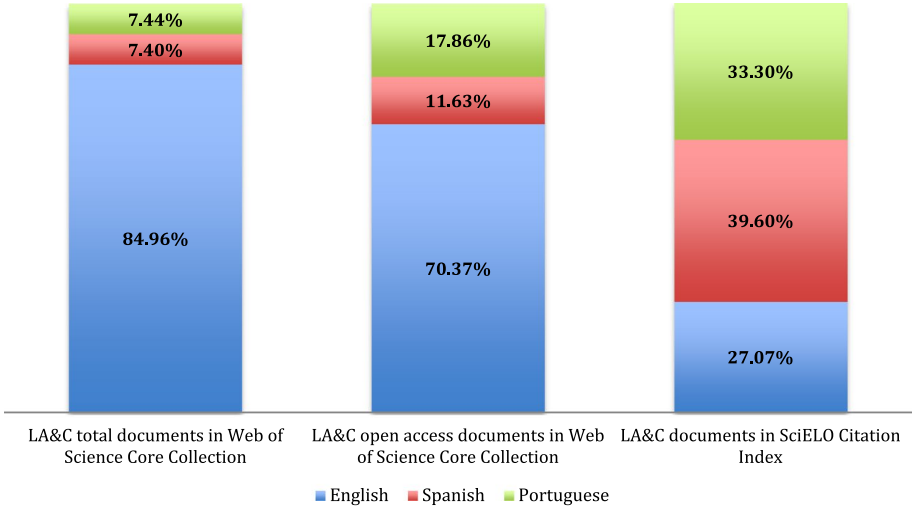

Fig. 3 **a** Languages of LA&C total documents indexed by Web of Science Core Collection; **b** languages of LA&C open access documents indexed by Web of Science Core Collection; **c** languages of LA&C documents indexed by SciELO Citation Index, 2005–2017

than those of the previous years (27.85% and 29.68% respectively, while they had never reached 13% until 2014).

Languages of open access publications OA documents indexed by WoS are mostly published in English (70.37%), followed by Portuguese (17.86%) and Spanish (11.63%). Other languages such as French, Italian, and German count for 0.19% only. If compared with the distribution of languages within the total LA&C publications indexed by WoS, the presence of Spanish and especially Portuguese is significantly higher in the OA sample (11.63% and 17.86% against 7.40% and 7.44%, respectively), while English dominance is consequently reduced (70.37% against the 84.96% in the total sample).

On the contrary, documents indexed by SciELO CI are mostly published in Spanish (39.60%), followed by Portuguese (33.30%) and English (27.07%). Other languages count for 0.03% only.

Hence, data show that the predominance of English-language documents is limited to WoS. Within WoS, Portuguese results to be the second most important language of publication, while Spanish has a lower but still significant weight. It is thus interesting to note that the distribution of publication languages is completely different within SciELO CI, where Spanish dominates, accounting for about 40% of the documents, and the presence of Portuguese is more consistent than that of English. The dominance of Spanish surprises since SciELO originated in Brazil, and Brazil is the country with the highest number of journals in the database, as it could be expected (Delgado Troncoso 2011).

Figure 3 compares the distribution of the three main languages of publication (English, Spanish, and Portuguese) within the three samples: (a) LA&C total documents indexed by WoS; (b) LA&C OA documents indexed by WoS; and (c) LA&C OA documents indexed by SciELO CI.

If we consider the sub-regional OA production indexed by WoS, data show that the presence of Portuguese is significant only in the Southern Cone (22.67% of the

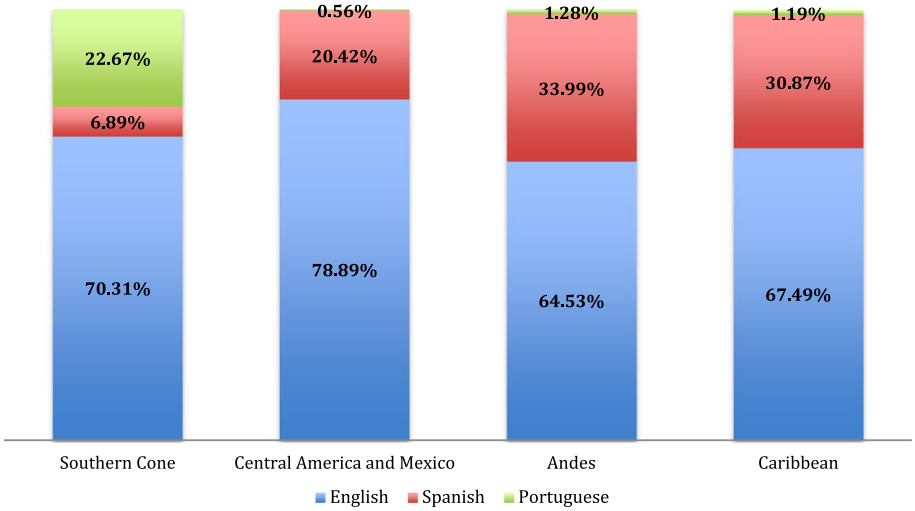

Fig. 4 Languages of LA&C sub-regional open access documents indexed by Web of Science Core Collection, 2005–2017

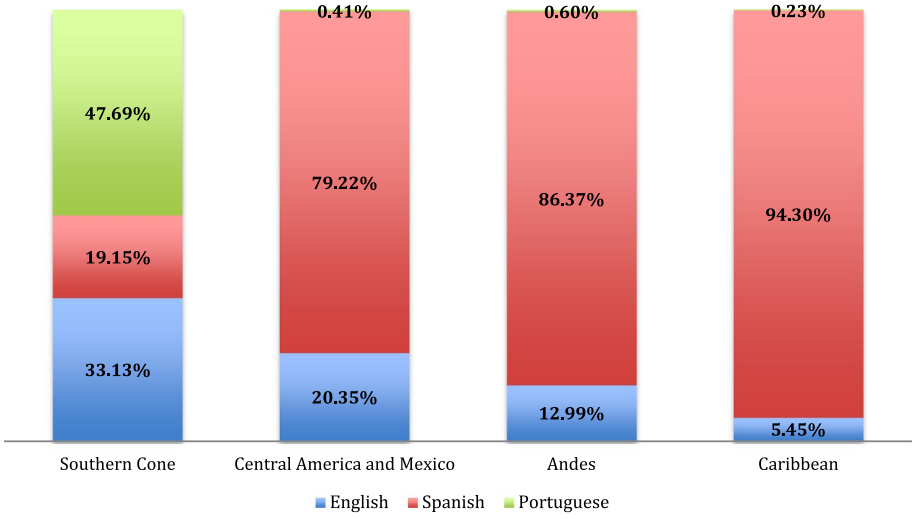

Fig. 5 Languages of LA&C sub-regional documents indexed by SciELO Citation Index, 2005–2017

sub-regional OA production), while that of Spanish is particularly important in the Andes (33.99%) and the Caribbean (30.87%), followed by Central America (20.42%) and the Southern Cone, where its occurrence is more limited (6.89%) (Fig. 4).

Within the SciELO CI sample, the distribution of publication languages is different (Fig. 5). The presence of Portuguese is significant only in the Southern Cone, like in the WoS sample, but the percentage of Portuguese-language documents is more than double when compared with the WoS database (47.69% of the sub-regional production indexed

by SciELO CI, against the 22.67% of the production indexed by WoS); also Spanish results to be more important within the SciELO CI sample (19.15% against 6,89%), while the presence of English, which is the second most diffused language amongst the sub-regional documents indexed by SciELO CI, is significantly reduced (33.13% against 70.31%).

In the other three sub-regions Spanish overtly dominates, accounting for 94.30% of the documents produced by the Caribbean (against 30.87% of the sub-regional OA production indexed by WoS), 86.37% of the Andean publications (against 33.99%), and 79.22% of the documents participated by Central America and Mexico (against 20.42%). The presence of English is proportionately reduced, accounting for 5.45% of the documents participated by the Caribbean (against 67.49%), 12.99% of the documents participated by the Andean countries (against 64.53%), and 20.35% of those participated by Central America and Mexico (against 78.89%).

In general, it can be concluded that the use of regional languages such as Spanish and Portuguese is more associated with the publishing of OA documents within journals indexed by SciELO CI, as it could be expected given the regional origin of the SciELO digital journal library. On the contrary, a global database such as WoS results to be characterized by the dominance of English. Yet, it presents a higher percentage of Spanish- and Portuguese-language documents within the OA sample than the total sample, thus showing an association between the OA character of scientific publications and the use of regional languages.

Research areas of open access publications We have launched searches using the code "Research Areas" offered by WoS analytical tools. In this section we take into consideration and compare the Top Five Research Areas within the three samples: (1) LA&C total documents indexed by WoS; (2) LA&C OA documents indexed by WoS; and (3) LA&C OA documents indexed by SciELO CI (Table 3).

Within LA&C total production indexed by WoS, documents related with Chemistry dominate and account for the 7.43% of the sample. Chemistry is followed by Physics (6.60%), Engineering (6.16%), Agriculture (5.87%), and Environmental Sciences Ecology (4.39%).

Differently, within LA&C OA production indexed by WoS, documents related to Agriculture dominate and account for the 12.97% of the sample. Agriculture is followed by Science Technology Other Topics (7.39%), Public Environmental Occupational Health (5.87%), Chemistry (4.17%), and Veterinary Sciences (4.07%).

Amongst the LA&C documents indexed by SciELO CI, Agriculture is also the most diffused Research Area, accounting for the 10.95% of the documents. It is followed by General Internal Medicine (6.30%), Public Environmental Occupational Health (5.56%), Engineering (5.05%), and Education Educational Research (4.15%).

It is thus worth noting the dominance of Agriculture within both the OA samples, as well as the reduced weight of other Research Areas such as Chemistry and Engineering, which result to be more diffused within the LA&C total production indexed by WoS and less associated with OA. Both the OA samples also show the common presence of Public Environmental Occupational Health, which accounts for similar percentages within the two samples.

We have also examined the distribution of Research Areas within the production of the four LA&C sub-regions (Table 4). Amongst the documents participated by the Southern Cone, the distribution of Research Areas broadly reflects their distribution

Table 3 Top five research areas of (1) LA&C total documents indexed by Web of Science Core Collection, (2) LA&C open access documents indexed by Web of Science Core Collection, and (3) LA&C open access documents indexed by SciELO Citation Index, 2005–2017

WOS total		WOS OA		SCIELO CI	
Chemistry	7.43%	Agriculture	12.97%	Agriculture	10.95%
Physics	6.60%	Science technology other topics	7.39%	General internal medicine	6.30%
Engineering	6.16%	Public environmental occupational health	5.87%	Public environmental occupational health	5.56%
Agriculture	5.87%	Chemistry	4.17%	Engineering	5.05%
Environmental sciences ecology	4.39%	Veterinary sciences	4.07%	Education educational research	4.15%

Table 4 Top five research areas by sub-region: (1) total documents indexed by Web of Science Core Collection, (2) open access documents indexed by Web of Science Core Collection, and (3) open access documents indexed by SciELO Citation Index, 2005-2017

Sub-region	WOS total		WOS OA		SCIELO CI	
Southern Cone	Chemistry	7.30%	Agriculture	10.77%	Agriculture	12.06%
	Agriculture	6.37%	Science technology other topics	5.09%	Public environmental occupational health	5.47%
	Physics	6.33%	Public environmental occupational health	4.74%	General internal medicine	4.49%
	Engineering	5.42%	Chemistry	3.91%	Nursing	4.29%
	Biochemistry molecular biology	4.46%	Veterinary sciences	3.80%	Education educational research	4.11%
Central America and Mexico	Physics	9.01%	Science technology other topics	7.38%	Agriculture	10.26%
	Chemistry	7.98%	Astronomy astrophysics	5.61%	Engineering	6.71%
	Engineering	7.44%	Public environmental occupational health	5.33%	Biodiversity conservation	6.02%
	Environmental sciences ecology	5.93%	Physics	4.74%	Education educational research	5.63%
	Materials science	4.48%	Environmental sciences ecology	4.06%	Sociology	5.49%
Andes	Engineering	8.73%	Engineering	6.99%	Engineering	11.68%
	Physics	6.78%	Physics	6.36%	General internal medicine	11.03%
	Chemistry	5.62%	Science technology other topics	6.24%	Agriculture	8.03%
	Environmental sciences ecology	5.18%	Tropical medicine	6.05%	Public environmental occupational health	7.83%
	Public environmental occupational health	4.39%	Infectious diseases	5.02%	Health care sciences services	6.65%
Caribbean	Chemistry	7.22%	Education educational research	7.59%	General internal medicine	23.02%
	General internal medicine	6.87%	Public environmental occupational health	7.00%	Health care sciences services	20.25%
	Physics	5.77%	Infectious disease	6.80%	Research experimental medicine	8.96%
	Public environmental occupational health	5.71%	General internal medicine	5.81%	Pediatrics	8.08%
	Neurosciences neurology	5.12%	Science technology other topics	5.65%	Ophthalmology	8.03%

within the regional production. Hence, Chemistry dominates also within the sub-regional total production indexed by WoS, accounting for 7.30% of Southern Cone's publications. Similarly, also in the sub-regional sample Chemistry is followed by Agriculture, Physics, and Engineering, in a slightly different order than in the whole LA&C sample.

As in the regional production, within the Southern Cone's OA production indexed by both WoS and SciELO CI Agriculture is the most diffused Research Area, accounting for the 10.77% of the WoS OA sample and 12.06% of the SciELO CI sample, respectively. Amongst the sub-regional OA production indexed by WoS, Agriculture is followed by Science Technology Other Topics, Public Environmental Occupational Health, Chemistry, and Veterinary Sciences, which perfectly reflects the distribution of Research Areas in the whole LA&C sample. Also the sub-regional production indexed by SciELO CI reproduces the distribution of Research Areas in the LA&C sample, with the only exception of Nursing, which supplants Engineering amongst the Top Five areas.

Amongst the documents participated by Central America and Mexico, the most diffused area within the WoS sample is Physics (9.01%), followed by Chemistry, Engineering, Environmental Sciences Ecology, and Materials Science. Hence, the sub-regional production significantly reflects the distribution of Research Areas in the regional sample, with the presence of Materials Science as the only exception.

Amongst the OA documents participated by the sub-region and indexed by WoS, Science Technology Other Topics dominates and accounts for the 7.38% of the sample. The significant presence of Science Technology Other Topics and Public Environmental Occupational Health amongst the Top Five Research Areas is consistent with the regional sample, from which the sub-regional one differs due to the occurrence of Astronomy Astrophysics, Physics, and Environmental Sciences Ecology, as well as the absence of Agriculture as the dominant area.

In the SciELO CI sample the most diffused area is Agriculture (10.26%), followed by a couple areas that are also present in the regional sample (Engineering and Education Educational Research) and other areas that are not (Biodiversity Conservation and Sociology). The analysis of the production of Central America and Mexico thus confirms the association between Agriculture and Science Technology Other Topics with OA publishing, while Physics, Chemistry, and Engineering are most diffused when preference is accorded to proprietary models of publishing.

When we examine the production of the Andean countries we find that, unlike the other sub-regions, Engineering dominates within all the three samples, followed by Physics, which is the second most diffused Research Area amongst both the Andean total and OA publications indexed by WoS. The presence of documents related to Agriculture remains significant but only within the SciELO CI sample, in which it is the third most diffused area.

Within the Andean WoS total sample, Engineering thus dominates and accounts for the 8.73% of the documents. It is followed by other areas that are also consistent with the LA&C regional sample (Physics, Chemistry, and Environmental Sciences Ecology). Within the Andean WoS OA sample, Engineering accounts for the 6.99% of the documents, but here it is followed by areas that are different from the regional sample. Amongst the Top Five Research Areas, only Science Technology Other Topics has a significant presence in both the regional and sub-regional samples.

Also within the Andean SciELO CI sample Engineering is the most diffused area, accounting for 11.68% of the documents. As in the regional sample, General Internal Medicine is the second most diffused area amongst the sub-regional documents indexed by the regional

digital library, accounting for the 11.03% of the publications. Agriculture results to be slightly less important than in the LA&C regional sample, while Public Environmental Occupational Health presents a higher value and confirms to be an area that is highly associated with OA publishing.

When we consider the Top Five Research Areas amongst the documents participated by the Caribbean sub-region, we find that their distribution only partly reflects that of the LA&C regional sample, but it is instead more focused on areas related to the medical fields. Within the Caribbean total production indexed by WoS, documents related to Chemistry dominate like in the regional sample, accounting for 7.22% of the documents. The presence of General Internal Medicine is more important than in other sub-regions, and documents related to it are the second most diffused ones (6.87%). Physics confirms its significance within the total production indexed by WoS, while Public Environmental Occupational Health and Neurosciences Neurology result to be more diffused in the Caribbean sub-region.

Caribbean WoS OA sample is instead dominated by Education Educational Research (7.59%), which is predominant only in this sub-region. Public Environmental Occupational Health and Science Technology Other Topics confirm their significance when the OA production indexed by WoS is considered, while the presence of Infectious Disease and General Internal Medicine is wider than in the other sub-regions.

Differently from other sub-regions' productions, the Caribbean's production indexed by SciELO CI is almost entirely dominated by Research Areas related to Medicine. This focus on medical issues is consistent with the original aim of SciELO, which has been created with the purpose of sharing knowledge related to the medical fields (Aguirre-Pitol and Leal-Arriola 2013)—although, as we already discussed, in many LA&C sub-regions other areas such as Agriculture and Science Technology Other Topics have emerged as significant areas for publishing in OA within journals indexed by SciELO CI. Hence, within the SciELO CI sample, documents related to General Internal Medicine account for the 23.02% of the Caribbean indexed publications. The second most diffused area is Health Care Sciences Services, which accounts for the 20.25% of the sample. These areas are followed by Research Experimental Medicine, Pediatrics, and Ophthalmology.

Besides considering SciELO's original focus on the medical fields, it could be worth noting how in Cuba, which is the most productive amongst the Caribbean countries, a strong movement towards OA has been promoted by several initiatives in the area of health science (Sánchez-Tarragó et al. 2012). For instance, in 2001 members of the Virtual Health Library (VHL), which has been established in 1998 with the aim of increasing access to information in the field of health science, signed the Declaration of Havana towards Equitable Access to Health Information (*Declaración de la Habana hacia el Acceso Equitativo a la Información en Salud*) to promote equitable access to health information and highlight its status as a global public good (Duperet Cabrera et al. 2015).

Descriptive analysis by country

The analysis of LA&C OA publications indexed by WoS and SciELO CI confirms the importance gained by OA publishing models in the LA&C region. In this section, we analyse the two OA samples (WoS and SciELO CI) by country. Within the WoS sample, the most productive LA&C country in absolute numbers results to be Brazil, whose OA publications represent the 69.70% of the total LA&C OA documents indexed by WoS. Mexico follows with its 10.23% of total LA&C OA publications. Argentina, Colombia, and Chile

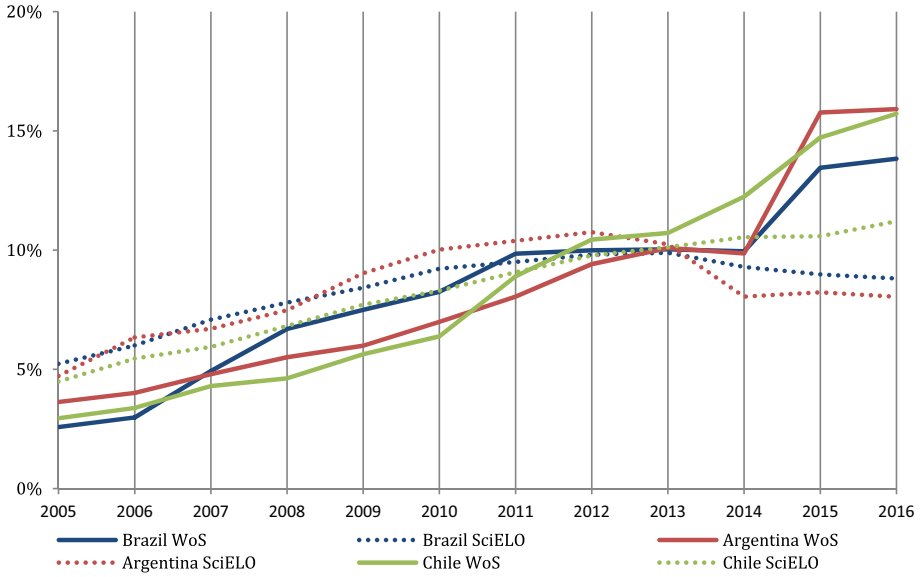

Fig. 6 Growth of open access documents participated by Brazil, Argentina, and Chile during the period 2005–2016, expressed as percentage of the yearly additions to Web of Science and ScieLO Citation Index over the national open access production indexed by each database

are also significant contributors, participating in the 6.84%, 6.05%, and 5.12% of the WoS OA sample, respectively.

Within the SciELO CI sample, Brazil also dominates with its documents accounting for the 58.47% of the indexed LA&C publications. Colombia is the second major contributor with its 10.91% of indexed documents. Mexico, Chile, Argentina, and Cuba follow, participating in the 9.54%, 7.92%, 6.57%, and 5.97% of the sample, respectively.

By switching from the volume of OA documents participated by each LA&C country to the proportion that OA documents constitute of the overall national article volume, it is possible, through the analysis of the WoS sample, to identify the countries where OA models have higher relative weights. In this respect, Brazil plays a leading role in supporting OA in the region, with 28.11% of its publications between 2005 and 2017 being OA publications. Amongst the bigger LA&C countries where scientific production is concentrated, Brazil is followed by Colombia, whose OA publications amount to the 26.53% of its national production indexed by WoS. Brazil and Colombia are followed by Costa Rica (20.82%), Ecuador (19.62%), Peru (17.81%) and Cuba (17.36%). The relative weight of OA publications is instead more limited in Mexico, Chile, Argentina, Venezuela, and Uruguay, whose national productions include between 11 and 13% of OA publications in the same period.

In this section we thus examine the OA production of nine LA&C countries, including the most productive countries in absolute numbers and the countries where OA has a high relative weight: Brazil, Mexico, Argentina, Colombia, Chile, Cuba, Costa Rica, Ecuador, and Peru. To evaluate the growth of OA documents within LA&C countries, we analysed the SciELO CI and WoS OA samples by "Publication Year". Figures 6, 7 and 8 show the growth of OA documents by country and by yearly additions to WoS and SciELO CI, expressed as percentage over the national OA production.

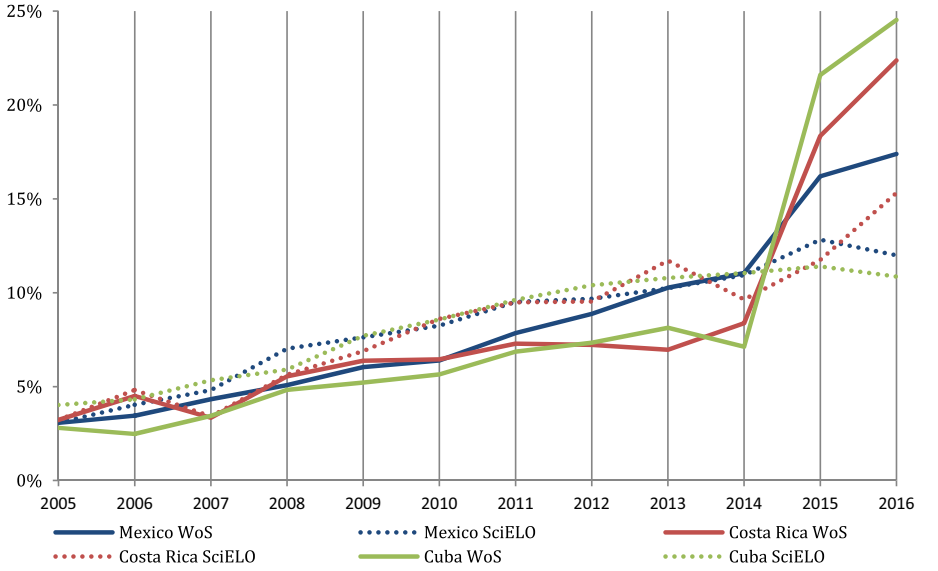

Fig. 7 Growth of open access documents participated by Mexico, Costa Rica, and Cuba during the period 2005–2016, expressed as percentage of the yearly additions to Web of Science and SciELO Citation Index over the national open access production indexed by each database

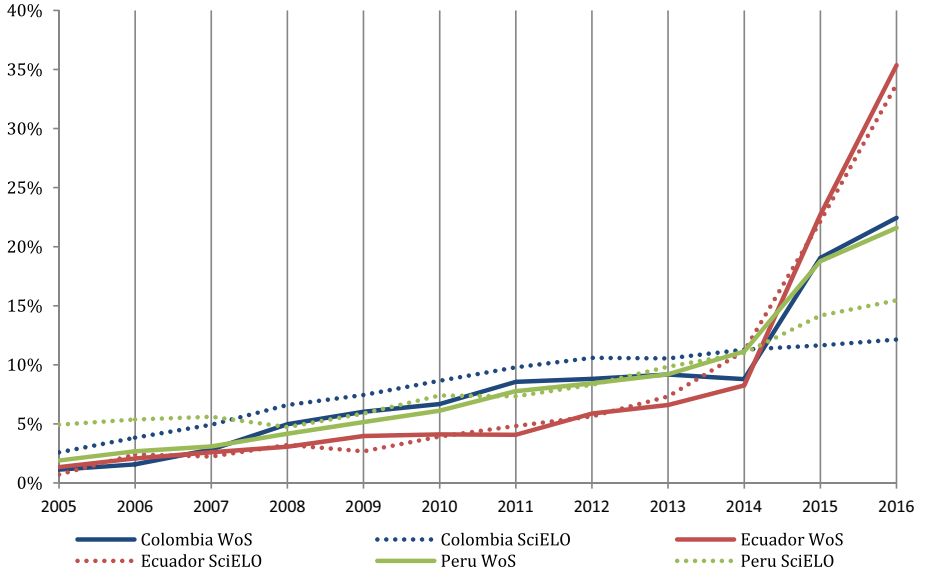

Fig. 8 Growth of open access documents participated by Colombia, Ecuador, and Peru during the period 2005–2016, expressed as percentage of the yearly additions to Web of Science and SciELO Citation Index over the national open access production indexed by each database

As already noted in the sub-regional analysis, Southern Cone countries show a significant growth of OA documents indexed by WoS, especially between 2014 and 2016, and a parallel decrease of the publications indexed by SciELO CI. The analysis by country shows that Chile represents an exception, since the volume of its additions to both WoS and SciELO CI has regularly increased on a yearly basis over the whole period (Fig. 6).

In the WoS sample, OA documents produced by Brazil and Argentina have constantly grown until 2013, when their yearly additions accounted respectively to 10.03% and 10.09% of their national OA production indexed by WoS. In 2014, instead, their yearly additions slightly decreased to 9.95% and 9.86% of their production, to then increase significantly between 2015 and 2016, when they reached the peak of 13.83% and 15.91%, respectively. On the contrary, documents participated by Chile have grown every year, reaching the peak of 15.72% in 2016.

Within the SciELO CI sample, documents participated by Brazil and Argentina have grown yearly until 2014 and 2013, respectively, to then decrease in the following years, while the volume of documents participated by Chile has kept growing on a yearly basis, reaching the peak of 11.21% in 2016.

When we examine the OA production of Mexico, Costa Rica, and Cuba, we note a significant increase of their yearly additions to WoS between 2015 and 2016, which is not paralleled by their additions to SciELO CI (Fig. 7). Mexico's yearly additions to WoS increased from 11.05% in 2014 to 16.20% in 2015, to then reach a peak in 2016, when they accounted for the 17.39% of Mexico's OA production indexed by WoS. Mexico's yearly contributions to SciELO CI, instead, have grown by higher rates than those of WoS until 2012, then they increased by similar rates in 2013 and 2014, reached the peak of 12.82% in 2015, and eventually decreased to 11.99% in 2016.

Costa Rica's yearly additions to WoS show a fluctuant trend until 2014. During the period 2005–2014, OA documents participated by this country have never trespassed the threshold of 10%. Yet, their volume increased impressively by more than two times in 2015 (18.35%) and reached a peak in 2016 (22.37%). Interestingly, Costa Rica's additions to SciELO CI have increased by higher rates than those of WoS until 2014, showing a major interest in publishing OA documents within journals indexed by the regional digital library. This interest has kept growing until 2016, when, differently from other countries, Costa Rica's volume of OA publications accounted for the 15.31% of its production indexed by SciELO CI, notwithstanding the parallel increase of its contributions to WoS.

Cuba's yearly additions to WoS also grew impressively in 2015, when they increased from 7.12 to 21.60%, to then reach a peak in 2016, when they accounted for the 24.53% of Cuban OA production indexed by WoS. Similarly to Mexico, Cuba's yearly contributions to SciELO CI have grown by higher rates than those of WoS until 2014, then they slightly increased in 2015, reaching the peak of 11.40%, and eventually decreased to 10.86% in 2016.

By analysing the OA production of Colombia, Ecuador, and Peru, it emerges that all the three Andean countries have increasingly participated in both WoS and SciELO CI during the period 2005–2016 (Fig. 8). Colombia's yearly additions to WoS more than doubled in 2015, when they increased from 8.79 to 19.05%, and reached the peak of 22.44% in 2016. Colombia's contributions to SciELO CI have grown by higher rates than those of WoS until 2012, then they increased by similar rates in 2013 and 2014, reached the peak of 12.82% in 2015, and eventually decreased to 11.99%.

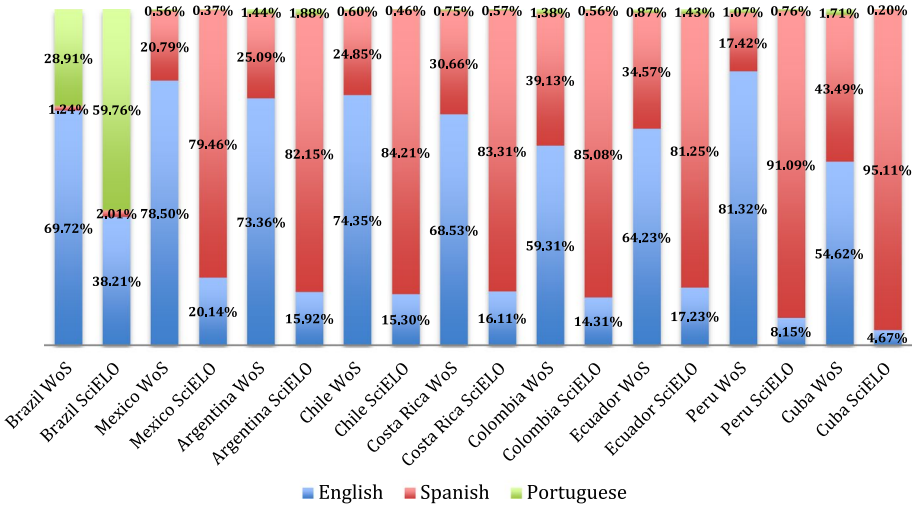

Fig. 9 Languages of open access documents indexed by Web of Science Core Collection and SciELO Citation Index, 2005–2017, by country

Of the nine countries examined here, Ecuador shows the highest growth rate of OA documents indexed by both WoS and SciELO CI between 2015 and 2016. Its additions to WoS nearly tripled in 2015, growing from 8.25 to 22.69%, and reached the peak of 35.37% in 2016. Within SciELO CI, Ecuadorian OA documents doubled in 2015, growing from 11.16 to 22.14%, and in 2016 they accounted for 33.75% of the total national production indexed by the database.

Peru's yearly additions to both WoS and SciELO CI have constantly increased during the period 2005–2016, with the most significant growth occurring in 2015, when its contributions raised from 11.14 to 18.77% and from 10.99 to 14.17% within WoS and SciELO CI, respectively. In 2016, Peru's additions kept growing and accounted for 21.60% of the national OA production indexed by WoS and 15.46% of the production indexed by SciELO CI.

Languages of open access publications The analysis by country confirms the result of subregional analysis when we examine the languages of OA publications. Documents indexed by WoS are mostly published in English, whilst regional languages (Spanish and Portuguese) predominate amongst the documents indexed by SciELO CI. Figure 9 compares the distribution of the three main languages (English, Spanish, and Portuguese) within the national productions indexed by WoS and SciELO CI.

Within WoS, English dominates in every country. Peru leads with 81.32% of the documents published in English, followed by Mexico (78.50%), Chile (74.35%), Argentina (73.36%), Brazil (69.72%), Costa Rica (68.53%), Ecuador (64.23%), Colombia (59.31%), and Cuba (54.62%). As it could be expected, Portuguese is the second most diffused language in Brazil (28.91%), while Spanish has a significant weight in all the other countries. Cuba shows the highest percentage of documents published in Spanish (43.49%), and it is followed by Colombia (39.13%), Ecuador (34.57%), Costa Rica (30.66%), Argentina (25.09%), Chile (24.85%), Mexico (20.79%), and Peru (17.42%).

Within SciELO CI, Portuguese is dominant amongst Brazilian publications, accounting for 59.76% of the national indexed production, while Spanish results to be the most diffused language in all the other countries. In this respect, Cuba leads with 95.11% of the documents written in Spanish, and it is followed by Peru (91.09%), Colombia (85.08%), Chile (84.21%), Costa Rica (83.31%), Argentina (82.15%), Ecuador (81.25%), and Mexico (79.46%). English is the second most diffused language within the national productions indexed by SciELO CI, with a limited yet significant presence amongst the documents participated by Brazil (38.21%). Brazil is followed by Mexico (20.14%), Ecuador (17.23%), Costa Rica (16.11%), Argentina (15.92%), Chile (15.30%), Colombia (14.31%), Peru (8.15%), and Cuba (4.6%).

Research areas of open access publications In this section, we take into consideration and compare the Top Five Research Areas within the WoS and SciELO CI OA samples by country (Table 5).

Amongst the documents participated by Brazil, Agriculture is the most diffused Research Area within both national samples, accounting for 13.86% of the OA documents indexed by WoS and 13.74% of the documents indexed by SciELO CI. Public Environmental Occupational Health is the second most diffused area, accounting for 5.54% of the WoS sample and 6.49% of the SciELO CI sample. Veterinary Sciences have also a significant presence in both samples (4.52% and 4.71% of the indexed documents, respectively).

Differently from Brazil, whose OA production indexed by both WoS and SciELO CI is dominated by Agriculture and Public Environmental Occupational Health, and characterized by other areas that present similar values (Veterinary Sciences), Argentina's participation in the WoS and SciELO CI databases is very different in terms of Research Areas. Within WoS, the most diffused area is Science Technology Other Topics (6.26%), while the SciELO CI sample is again dominated by Agriculture (6.18%). In general, Argentina's OA production indexed by WoS appears to be more focused on hard sciences such as Physics, Biology, and Medicine, while its publications indexed by SciELO CI focus more on social sciences and humanities, though Agriculture remains the most diffused area in the sample.

Similarly, the OA production of Chile appears to be characterized by an orientation to hard sciences when we examine the documents indexed by WoS, while the production indexed by SciELO CI results to be more varied, including main areas ascribable to the medical sciences as well as social sciences and humanities. Within the WoS sample, Astronomy Astrophysics is highly predominant, accounting for 19.74% of the OA documents participated by Chile, while the other Research Areas present consistently lower values. Differently, in the SciELO CI sample General Internal Medicine and Government Law are predominant, accounting respectively for 9.05% and 8.06% of the documents participated by Chile.

The distribution of Research Areas within Mexico's OA production is also different in the two samples, similarly to the case of Chile: the WoS sample is dominated by hard sciences, while the SciELO CI sample is more varied and includes areas related to the social sciences and humanities. In the former, Science Technology Other Topics predominates and accounts for 6.56% of the indexed documents. In the SciELO CI sample, the most diffused Research Area is Agriculture, which accounts for 9.95% of the indexed documents.

The OA production of Costa Rica appears to be more oriented to the medical sciences, which predominate in both samples. Within WoS, Life Sciences Biomedicine Other Topics

Table 5 Top five research areas by country: (1) open access documents indexed by Web of Science Core Collection, and (2) open access documents indexed by SciELO Citation Index, 2005–2017

Country	WOS OA		SCIELO CI	
Brazil	Agriculture	13.86%	Agriculture	13.74%
	Public environmental occupational health	5.54%	Public environmental occupational health	6.49%
	Science technology other topics	4.94%	Nursing	5.16%
	Veterinary sciences	4.52%	Veterinary sciences	4.71%
	Chemistry	4.29%	Education educational research	4.28%
Argentina	Science technology other topics	6.26%	Agriculture	6.18%
	Astronomy astrophysics	5.19%	Anthropology	5.69%
	Physics	4.96%	Arts humanities other topics	5.51%
	Biochemistry molecular biology	4.60%	General internal medicine	5.22%
	Microbiology	4.57%	Psychology	4.88%
Chile	Astronomy astrophysics	19.74%	General internal medicine	9.05%
	Science technology other topics	4.94%	Government law	8.06%
	General internal medicine	4.54%	Surgery	5.30%
	Physics	4.37%	Arts humanities other topics	4.75%
	Environmental sciences ecology	4.25%	Agriculture	4.07%
Mexico	Science technology other topics	6.56%	Agriculture	9.95%
	Astronomy astrophysics	6.28%	Engineering	6.92%
	Physics	5.27%	Sociology	6.16%
	Public environmental occupational Health	5.02%	Social sciences other topics	5.47%
	Biochemistry molecular biology	4.04%	Biodiversity conservation	5.36%
Costa Rica	Life sciences biomedicine other topics	14.06%	Health care sciences services	16.67%
	Science technology other topics	13.13%	Life sciences biomedicine other topics	15.81%
	Environmental sciences ecology	5.81%	Education educational research	14.71%
	Public environmental occupational health	4.41%	Biodiversity conservation	13.24%
	Plant sciences	3.41%	Agriculture	12.94%
Cuba	Education educational research	11.63%	General internal medicine	23.34%
	Agriculture	6.24%	Health care sciences services	20.50%
	Physics	5.91%	Research experimental medicine	9.07%
	General internal medicine	4.14%	Pediatrics	8.20%
	Public environmental occupational health	3.95%	Ophthalmology	8.13%
Colombia	Engineering	9.69%	Engineering	13.29%
	Physics	8.70%	General internal medicine	8.09%
	Tropical medicine	5.98%	Agriculture	7.10%
	Science technology other topics	5.21%	Public environmental occupational health	6.75%
	General internal medicine	4.65%	Business economics	5.52%

Table 5 (continued)

Country	WOS OA		SCIELO CI	
Ecuador	Social sciences other topics	7.92%	Engineering	12.61%
	Physics	7.51%	Agriculture	11.39%
	Science technology other topics	7.41%	Health care sciences services	6.64%
	Environmental sciences ecology	7.28%	General internal medicine	6.24%
	Education educational research	6.75%	Education educational research	5.83%
Peru	Infectious diseases	13.53%	Health care sciences services	47.65%
	Public environmental occupational health	10.04%	General internal medicine	44.58%
	Science technology other topics	9.65%	Medical ethics	42.57%
	Tropical medicine	7.73%	Legal medicine	37.05%
	Immunology	6.80%	Research experimental medicine	31.48%

is the most diffused area, accounting for 14.06% of the documents, yet Science Technology Other Topics keeps being a relevant area as in other LA&C countries, accounting for 13.13% of the documents. They are followed by a group of different areas presenting consistently lower values. In the SciELO CI sample, Health Care Sciences Services and Life Sciences Biomedicine Other Topics are the most diffuse Research Areas, accounting respectively for 16.67% and 15.81% of the documents. Also consistent is the presence of other areas, such as Education Educational Research (14.71%), Biodiversity Conservation (13.24%), and Agriculture (12.94%).

In the case of Cuba, the WoS sample is highly predominated by the area of Education Educational Research (11.63%), while the SciELO CI sample is consistently dominated by different areas related to the medical sciences. In the SciELO CI sample, most documents relate to General Internal Medicine and Health Care Sciences Services, which account respectively for 23.34% and 20.50% of the indexed publications. They are followed by other areas related to the medical sciences, whose presence is more limited yet significant.

Differently from other countries, Colombia mostly produces OA documents related to Engineering. Engineering results to be the most diffused Research Area in both samples, accounting for 9.69% of the documents indexed by WoS and 13.29% of those indexed by SciELO CI. General Internal Medicine also has a significant presence in both samples (4.65% and 8.09% of the documents, respectively), while the other Research Areas vary amongst them.

The OA production of Ecuador presents some interesting differences between the two samples. The WoS sample is dominated by Social Sciences Other Topics (7.92%) and confirms the relevance of hard sciences such as Physics (7.51%) and Science Technology Other Topics (7.41%). The SciELO CI sample is instead dominated by Engineering (12.61%) and Agriculture (11.39%), but it also includes medical and social sciences. Education Educational Research results to be the only common area amongst the Top Five Research Areas of the samples, and it accounts for 6.75% of the OA documents indexed by WoS and 5.83% of those indexed by SciELO CI.

The distribution of Research Areas amongst the documents participated by Peru appears to be heavily oriented to medical sciences within both WoS and SciELO CI. In the WoS sample, Infectious Diseases dominates and accounts for 13.53% of the indexed documents. Public Environmental Occupational Health and Science Technology Other Topics also

have a significant presence, accounting respectively for 10.04% and 9.65% of the sample. These areas are followed by other ones mainly relating to the medical sciences, such as Tropical Medicine, Immunology, and Microbiology. Also in the SciELO CI sample most documents relate to the medical sciences: 47.65% of the sample is categorized as Health Care Sciences Services; 44.58% relates to General Internal Medicine; Medical Ethics accounts for 42.57% of the documents; Legal Medicine for 37.05%; Research Experimental Medicine for 31.48% of the sample.

Conclusions and limitations

In the present paper, we have analysed and mapped the OA publications produced by LA&C countries over the period 2005–2017 and indexed by WoS and SciELO CI, observing how these countries are moving forward in supporting OA publishing. The analysis has confirmed that the presence of OA publications in the LA&C region has strongly intensified over the examined period. We have identified Southern Cone as the most productive sub-region in both databases, and Argentina, Brazil, Chile, Colombia, and Mexico as the countries with the largest amount of OA publications indexed by WoS and SciELO CI. By considering the proportion that OA documents constitute from the overall document volume indexed by WoS, we have also highlighted the prominent role played by the Andean sub-region, as well as by other LA&C countries (Costa Rica, Cuba, Ecuador, and Peru).

As we remark at the beginning of the article, only Argentina, Mexico and Peru have approved national laws on OA. However, the results show that, although Argentina and Mexico are amongst the five countries with the highest number of OA scientific publications, the magnitude of their publications does not translate into a greater relative weight of the OA over the total number of publications.

Comparing our study with other previous works (Abadal 2012, 2017; Delgado and Weidman 2012; González Alonso and Pérez González 2015), it is worth noting how our analysis confirms the prominent role played by Brazil and Colombia in supporting OA. Though they have not approved any law to promote OA to date, they have developed significant institutional actions whose purpose is to contribute to the growth of OA in scientific publishing. The presence of the Brazilian Institute of Information in Science and Technology and the National System of Open Access to Knowledge in Colombia is a key element that demonstrates the commitment of public institutions to promote OA in the LA&C region.

The OA movement had a very strong impact in Brazil, which is the most active Latin American country in the implementation of OA. Examples of the constant initiatives towards the OA of Brazil are the robust trajectory of SciELO, which has been present in Brazil since 1998, and the Electronic Journal Edition System (SEER).

We have also highlighted the strength of Cuba in the production of OA strategies, especially regarding medical sciences (Duperet Cabrera et al. 2015). Although Cuba does not have a specific law on OA, its initiatives to promote universal access to knowledge had originated before the spreading of the OA movement and are based on the structural policies of the country (Sánchez-Tarragó et al. 2012).

This type of study allows to imagine and build future scenarios for OA, creating a "common vision" and supporting evidenced-based policies that aim at improving the amount of OA publications in the region. We think that funders, libraries, publishers, researchers, and other institutional actors might benefit from this analysis. Nonetheless, several limitations affect this study. The first one is the limitation of the databases that we have used, WoS and

SciELO CI, due to the biases that we have mentioned in the methodology section. We think it would be useful to compare the WoS results with Scopus results, where more journals in other languages are indexed, as well as with other databases.

The second limitation is that as of 2018, WoS (as well as Scopus) has introduced new tools to identify and classify OA publications, which have not been used in our analysis. We suggest future researchers use these new tools for the future research on OA. For example, since 2018 WoS started offering the possibility to identify four types of OA publications.[4]

Through our analysis we have offered a map of OA publishing in LA&C in the post-BOAI period to show how accessibility to scientific knowledge has been being improved in the region. This stocktaking of regional OA publications might have some important implications for the governance of science, because the identified dynamics allow the elaboration of future strategies to improve the adoption of OA in the region.

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[4] Hybrid Gold: articles published in OA in otherwise subscription-based journals; Delayed Gold: where archival content may be open access at the journal website; Green Published: final published articles available without charge from a repository; Green Accepted: peer-reviewed accepted manuscripts available without charge from a repository.

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