

**Part A. PERSONAL INFORMATION**

**CV date: Oct21, 2017**

First and Family name	Álvaro Corral Cano		
ID number	33963203T	Age	49
Researcher numbers	Researcher ID	I-5590-2015	
	Orcid code	0000-0002-5280-2692	

**A.1. Current position**

Name of University/Institution	Centre de Recerca Matemàtica		
Department			
Address and Country	Edifici C, Campus UAB, Bellaterra, E-08193, Spain		
Phone number	93 5868521	E-mail:	<a href="mailto:acorral@crm.cat">acorral@crm.cat</a>
Current position	Permanent researcher	From	2008
UNESCO codes	220510, 221311, 120808		
Key words	Complex systems, criticality, scaling laws, power-law statistics, natural hazards, extreme events, statistical seimology, quantitative linguistics, Zipf's law.		

**A.2. Education**

PhD in Physics	University of Barcelona	1997
Bachelor in Physics	University of Barcelona	1991

**A.3. JCR articles, H Index, thesis supervised...**

51 publications indexed in ISI WoS, with 1586 citations, 30.5 citations/paper, H-index=22 (in ISI WoS)  
 (2558 citations and H-index=27 in Google Scholar).  
 4 book chapters, 8 papers in proceedings and non-indexed journals, 3 preprints (on ArXiv).  
 2 PhD theses supervised: Anna Deluca (Dec 2013) and Francesc Font-Clos (July 2015).  
 1 PhD theses ongoing: Víctor Navas-Portella (since Jan 2016).  
 3 master theses and 8 bachelor theses supervised.

**Part B. CV SUMMARY** (*max. 3500 characters, including spaces*)

Previous positions: PhD grant from UAB, 1991-1993; FPI grant at UB, 1994-1997; postdoc at Niels Bohr Institute, Copenhagen, 1997-1999; Assistant professor at Escola Industrial, Barcelona, 1999-2000; assistant professor at UPC, 2000-2001; Ramon-y-Cajal fellowship at UAB, 2001-2006; visiting professor at UAB, 2006-2007; senior researcher at CRM 2008-now.

My research has always been addressed to model, investigate, and try to predict the emergence of complexity in nature. The approach has been diverse: theoretical, computational, experimental, or based on observational data. I comment on the articles listed below in order to provide a summary of different aspects of my research:

**Article #1** is the first account of the deep relationships between synchronization phenomena and self-organized criticality, two important behaviors in complex systems, in particular in the modeling of earthquakes and biological oscillators. **Article #2** reports pioneering experimental results in transport in granular media, together with an explanatory model, called the Oslo model, which has become a standard in complexity and self-organization. **Article #3** models the transport process in the previous granular system by a peculiar kind of random walk, with fractal properties. Analytical solutions are found. In **article #4** important findings are reported when some particular competitive game is played on a network. Previous models were using global information, which is unrealistic to model markets. In **work #5**, I refine and provide an explanation of a previously proposed observational law unifying spatial fractal behavior, time between events, and energy release for earthquakes. In **#6** a law for the time between of earthquakes as a function of the released energy for regions with moderate activity is found, and the universality of the law is checked in many different places of the world. This is the most cited work of the author. In **#7** the previous law is shown here to be equivalent to the invariance under renormalization-group transformations found in thermodynamic phase transitions (heating liquids, magnetic systems, etc.). **Article #8** proposes a novel empirical law for the energy dissipated by tropical cyclones (i.e., hurricanes, typhoons...) and how this law is surprisingly similar to

what is found for earthquakes and some other complex systems. The law reflects the effect of the warming of the oceans. This is the publication of the author with the highest impact factor. 1859 downloads during the first year. In **#9**, the complexity of musical discourse is analyzed, finding similarities with written texts. It is shown that the succession of chords in a piece forms a complex network. This paper is the one having the broadest coverage by the media, see below, and has had more than 130000 page views since publication. The experimental work in **#10** shows that certain types of fracture experiments are remarkably similar to earthquakes. It constitutes the first time in which such a strong similarity is found. This resemblance is very promising, from an applied point of view. Editor's suggestion and *Physics Viewpoint* by Ian Main.

## Part C. RELEVANT MERITS

### C.1. Publications (including books)

Most representative publications (in the sense that include most of the research topics, citations are from ISI WoS):

1. A. Corral, C. J. Pérez, A. Díaz-Guilera and A. Arenas, **Self-Organized Criticality and Synchronization in a Lattice Model of Integrate-and-Fire Oscillators**, *Physical Review Letters* 74, 118-121 (1995). Impact factor: 6.297 Citations: **79**
2. K. Christensen, A. Corral, V. Frette, J. Feder and T. Jøssang, **Tracer Dispersion in a Self-Organized Critical System** *Physical Review Letters* 77, 107-110 (1996). Impact factor: 6.477 Citations: **157**
3. M. Boguñá and A. Corral, **Long-Tailed Trapping Times and Lévy Flights in a Self-Organized Critical Granular System** *Physical Review Letters* 78, 4950-4953 (1997). Impact factor: 6.140 Citations: **50**
4. M. Paczuski, K. E. Bassler and A. Corral, **Self-Organized Networks of Competing Boolean Agents** *Physical Review Letters* 84, 3185-3188 (2000). Impact factor: 6.462 Citations: **78**
5. A. Corral, **Local distributions and rate fluctuations in a unified scaling law for earthquakes** *Physical Review E* 68, 035102 (2003). Impact factor: 2.202 Citations: **122**
6. A. Corral, **Long-term clustering, scaling, and universality in the temporal occurrence of earthquakes** *Physical Review Letters* 92, 108501 (2004). Impact factor: 7.218 Citations: **289**
7. A. Corral, **Renormalization-Group Transformations and Correlations of Seismicity** *Physical Review Letters* 95, 028501 (2005). Impact factor: 7.489 Citations: **49**
8. A. Corral, A. Ossó and J. E. Llebot, **Scaling of Tropical-Cyclone Dissipation** *Nature Physics* 6, 693-696 (2010). Impact factor: 18.423 Citations: **22**
9. J. Serrà, A. Corral, M. Boguñá, M. Haro and J. Ll. Arcos **Measuring the Evolution of Contemporary Western Popular Music** *Scientific Reports* 2, 521 (2012). Impact factor: 2.927 Citations: **30**
10. J. Baró, A. Corral, X. Illa, A. Planes, E. K. H. Salje, W. Schranz, D. E. Soto-Parra and E. Vives. **Statistical Similarity between the Compression of a Porous Material and Earthquakes** *Physical Review Letters* 110, 088702 (2013). Impact factor: 7.728 Citations: **69**

Other representative publications:

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|---|--|---------|
| 11. A. Corral, C. J. Pérez, et al.,         | <i>Phys. Rev. Lett.</i> 75, 3697 (1995).     | 23 cit. |
| 12. C. J. Pérez, A. Corral, et al.,         | <i>Int. J. Mod. Phys. B</i> 10, 1111 (1996). | 39 cit. |
| 13. A. Corral, C.J. Pérez, A. Díaz-Guilera, | <i>Phys. Rev. Lett.</i> 78, 1492 (1997).     | 20 cit. |
| 14. A. Corral, M. Paczuski,                 | <i>Phys. Rev. Lett.</i> 83, 572-575 (1999).  | 40 cit. |

<p>15. A. Corral,          16. A. Corral,          17. A. Corral,          18. A. Corral,          19. A. Corral, K. Christensen,          20. A. Corral,          21. A. Corral,          22. A. Corral, L. Telesca, R. Lasaponara,          23. O. Peters, A. Deluca, A. Corral, et al.,          24. A. Deluca, A. Corral,          25. F. Font-Clos, G. Boleda, A. Corral,          26. B. Gomez, A. Corral, A. R. Orpin, et al.          27. F. Font-Clos, A. Corral,          28. I. Serra, A. Corral</p>	<p><i>Physica A</i> 340, 590-597 (2004). 56 cit  <i>Nonlin. Proc. Geophys.</i> 12, 89 (2005). 22 cit.  <i>Phys. Rev. Lett.</i> 95, 159801 (2005). 22 cit.  <i>Phys. Rev. E</i> 71, 017101 (2005). 34 cit.  <i>Phys. Rev. Lett.</i> 96, 109801 (2006). 28 cit.  <i>Tectonophysics</i> 424, 177-193 (2006). 42 cit.  <i>Phys. Rev. Lett.</i> 97, 178501 (2006). 52 cit.  <i>Phys. Rev. E</i> 77, 016101 (2008). 30 cit.  <i>J. Stat. Mech.</i> P11030 (2010). 20 cit.<sup>1</sup>  <i>Acta Geophys.</i> 61, 1351-1394 (2013). 37 cit.  <i>New J. Phys.</i> 15, 093033 (2013). 20 cit.  <i>Geology</i> 43(2), 103-106 (2015).  <i>Phys. Rev. Lett.</i> 114, 238701 (2015).  <i>Sci. Rep.</i> 7, 40045 (2017).</p>
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23 more papers indexed by ISI JCR:

10 in *Phys. Rev. E* (1997, 2002, 2004, 2011, 2012, 2015a, 2015b, 2016a, 2016b, 2017); 4 in *Plos ONE* (2012, 2015a, 2015b, 2016); 1 in *Physica D* (1997); 1 in *Lecture Notes in Physics* (2006); 1 in *Terra Nova* (2007); 1 in *J. Stat. Mech.* (2009); 1 in *Int. J. Mod. Phys. B* (2009); 1 in *Extreme Events and Natural Hazards* (2012); 1 in *Nonlin. Proc. Geophys.* (2014); 1 in *Chaos, Solitons & Fract.* (2015); 1 in *Expert Systems with Applications* (2016).

Articles in 1st quartile: 41 (79 %).

## C.2. Research projects and grants

Principal investigator of:

- **Project from the Spanish “Plan Nacional”**, Ministerio de Ciencia e Innovación, *Complejidad y leyes de escala en fenómenos meteorológicos, desastres naturales y lenguaje humano*, FIS2009-09508; *Modalidad Jóvenes Investigadores*, 2010-2012, 3 participants, 43,560 euros.
- **Project from the Spanish “Plan Estatal”**, MINECO, *Scaling, complejidad y predictibilidad en fenómenos atmosféricos y formas de comunicación*, FIS2012-31324, 2013-2015, 4 participants, 24,570 euros.
- **Project from the Spanish “Plan Estatal”**, MINECO, *Sistemas invariantes de escala: herramientas, evidencia empírica, modelos y limitaciones*, FIS2015-71851-P, 2016-2018, 2 participants (“equipo de investigación”), 22,000 euros.
- **Project from the Catalan SGR**, AGAUR, *Grup de Recerca en Matemàtica Col·laborativa del CRM*, SGR-01307, 2014-2016, 18 participants, 25,800 euros.

Participation in: **Five projects of the Spanish “Plan Nacional”**, through different Science Ministries (PIs: M. T. Mora, A. Díaz Guilera, C. J. Pérez, and D. Jou). **Three “Grupos Consolidados” (SGR)** from the *Generalitat de Catalunya* (PIs: J. Casas Vázquez and D. Jou). **One project from the European Union**, FP4-TMR (PI: L. Pietronero, P. Bak (Danish node)). **One EXPLORA-INGENIO 2010**, from the Spanish *Ministerio de Ciencia e Innovación* (PI: J. E. Llebot). **One CONSOLIDER**, from the Spanish *Ministerio de Ciencia e Innovación* (PI: M. A. López Cerdá). **One María de Maeztu**, from the Spanish *MINECO* (PI: Marcos Noy; PI of the Modeling Area: A. Corral). **One Red de Excelencia** from the Spanish *MINECO* (PI: Eduard Vives).

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<sup>1</sup> The correct number of citations in ISI WoS is 36.

## C.3 Institutional responsibilities

- Representative of Ramón-y-Cajal Researchers from Catalonia in front of the *Comissionat d'Universitats i Recerca* of the *Generalitat de Catalunya*, from June 2005 to December 2007, with a number of meetings with the *Director General de Recerca de la Generalitat de Catalunya*, Ramon Moreno, the *Comisionada d'Universitats i Recerca*, Blanca Palmada, and the *Rector* of the *Universitat Autònoma de Barcelona*, Lluís Ferrer, among others.
- Member of the Executive Committee of the *Centre de Recerca Matemàtica*, from June 2011 to December 2015.
- Coordinator of the Doctoral Training Unit of the Centre de Recerca Matemàtica since April 2016.
- Member of the Doctoral Committee of the Mathematics Department of the UAB, since June 2016.

## C. 4 COMMITTEES

- Chairman of the scientific committee of the *Catalan Network of Complex Systems*, *complexitat.cat*, since September 2010.
- Co-organizer of the series of seminars *Més Enllà de la Física: Reptes Multidisciplinaris*, from November 2010 to April 2015.
- Member of the scientific committee of the international Intensive Program *Mathematical Models in Seismology*, SeisMath IP, L'Aquila, Italy, February 2011 to June 2013.
- Member of the scientific committee of GEFENOL's *Summer School*, since September 2012.
- Co-chairman of the organizing committee of the *Joint CRM Imperial College School and Workshop in Complex Systems*, CRM, Barcelona, April 2013.
- Chairman of the organizing committee of the *European Conference on Complex Systems, ECCS13*, Barcelona, September 2013 (with more than 600 participants).
- Member of the Lorenz Lecture Committee of the American Geophysical Union, from May 2013 to May 2016.
- Secretary of the *Associació Catalana per a l'Estudi dels Sistemes Complexos*, since June 2014 to May 2017. President since May 2017.
- Co-organizer of the *V Summer School on Statistical Physics of Complex and Small Systems* of the GEFENOL Group of the RSEF, CRM, Barcelona, July 2015.
- Co-organizer of the Workshop *Avalanche Processes in Condensed Matter and Beyond*, CRM, Barcelona, January 2017.

## C. 5 REFEREE

**Multidisciplinary science journals:** *Proceedings of the National Academy of Sciences of the USA*, *Scientific Reports*, *PLoS ONE*, *Arabian Journal of Science and Engineering*.  
**Physics journals:** *Physical Review Letters*, *Physical Review E*, *Nature Physics*, *Journal of Physics A*, *Physics Letters A*, *Europhysics Letters*, *European Physical Journal B*, *Journal of Physics D: Applied Physics*. **Geoscience journals:** *Nonlinear Processes in Geophysics*, *Geophysical Research Letters*, *Geophysical Journal International*, *Tectonophysics*, *Physics of Earth and Planetary Interiors*, *Computers and Geoscience*, *Pure and Applied Geophysics*, *Journal of Seismology*, *Journal of Geophysical Research*, *Atmospheric Chemistry and Physics*, *Journal of Earth System Science*. **Data analysis journals:** *Journal of Applied Statistics*, *Computational Statistics and Data Analysis*, *Statistics and Operations Research Transactions*. **Reviewer of book proposals:** Wiley VCH.

**C. 6 TALKS** 26 invited talks at international conferences and workshops, including the 2011 *Lorenz Lecture* at the *American Geophysical Union Fall Meeting*. 16 invited seminars and talks at different universities and research centers.