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Analysis of Winds Affecting Air Pollutant Transport atLa Plata, Argentina

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ABSTRACT
An hourly wind analysis for the populated area of La Plata city (with high industrial, power station and vehicular activities) is presented and discussed. Euclidean distance and minimum covariance determinant (a robust correlation coefficient) are employed, as similarity approaches, in order to compare observed wind direction frequency patterns at two monitoring sites during 1998-2003. A preliminary assessment of two sectors, namely Sector 1 (NNW-N-NNE-NE) and Sector 2 (ENE-E-ESE), relevant for the transport of industrial air pollutants towards population exposed, is discussed taking variances into account and employing a locally weighted smoothing approach (LOESS). Both similarity approaches allowed gain insight of wind patterns. The distance approach showed good similarity between sites while the correlation approach showed an uneven picture depending on the wind direction. Most of the differences are explained in terms of the sea-land breeze effect but also differences in terrain roughness and data quality are taken into account. Winds from sectors 1 or 2 (analyzed during 1998-2009) may occur more than 50% of the time, most of the differences regarding the influence of the day and the season on these sectors are attributable to sea-land breeze phenomena. The LOESS proved to be appropriate to analyze the stability with time of both sectors and to discard possible remaining patterns; results are in accordance with studies that assess the interannual variability for different variables in La Plata river area. The robust correlation coefficient revealed, as an example, the linear character of dependence between winds from sector 2 and sulfur dioxide concentrations. Wind velocities and calms are also discussed.

KEYWORDS

Cite this paper

References
[1]   N. A. Mazzeo, L. E. Venegas and H. Choren, " Analysis of NO, NO2, O3 and NOx Concentrations Measured at a Green Area of Buenos Aires City during Wintertime," Atmospheric Environment, Vol. 39, No. 17, 2005, pp. 3055-3068. doi:10.1016/j.atmosenv.2005.01.029

[2]   M. I. Glassmann and N. A. Mazzeo, " Air Pollution Potential: Regional Study in Argentina," Environmental Management, Vol. 25, No. 4, 2000, pp. 375-382. doi:10.1007/s002679910029

[3]   C. Bilos, J. C. Colombo, C. N. Skorupa and M. J. R. Presa, " Sources, Distribution and Variability of Airborne Trace Metals in La Plata City Area, Argentina," Environ- mental Pollution, Vol. 111, No. 1, 2001, pp. 149-158. doi:10.1016/S0269-7491(99)00328-0

[4]   L. Massolo, A., Müller, M., Tueros, M., Rehwagen, U. Frank, A. Ronco and O. Herbarth, " Assessment of Mutagenicity and Toxicity of Different-Size Fractions of Air Articulates from La Plata, Argentina, and Leipzig, Germany," Environmental Toxicology, Vol. 17, 2002, pp. 219-231. doi:10.1002/tox.10054

[5]   L. Massolo, A. Müller, O. Herbarth, A. Ronco and A Porta, " Air Pollution and Children' s Health in Urban and Industrial Areas of La Plata, Argentina," Acta Bioquímica Clínica Latinoamericana, Vol. 42,

No. 4, 2008, pp. 567-574.

[6] D. S. Nitiu, "Aeropalynologic Analysis of La Plata City (Argentina) during 3-Year Period," Aerobiologia, Vol. 22, 2006, pp. 79-87. doi:10.1007/s10453-005-9009-4

[7] M. M. Negrin, M. T. Del Panno and A. E. Ronco, "Study of Bioareosols and Site Influence in the La Plata Area (Argentina) Using Conventional and DNA (Fingerprint) Based Methods," Aerobiologia, Vol. 23, No. 4, 2007, pp. 249-258. doi:10.1007/s10453-007-9069-8

[8] G. Ratto, R. Maronna and G. Berri, "Analysis of Wind Roses Using Hierarchical Cluster and Multidimensional Scaling Analysis at La Plata, Argentina," Boundary Layer Meteorology, Vol. 137, No. 3, 2010, pp. 477-492. doi:10.1007/s10546-010-9539-3

[9] C. Romesburg, "Cluster Analysis for Researchers," Lulu Press, Raleigh, 2004.

[10] P. J. Rousseeuw, "Multivariate Estimation with High Breakdown Point," In: W. Grossmann, G. Pflug, I. Vincze and W. Wertz, Eds., Mathematical Statistics and Applications, Reidel, Dordrecht, 1985, pp. 283-297. doi:10.1007/978-94-009-5438-0_20

[11] A. D. Gordon, "Classification," 2nd Edition, Chapman and Hall/CRC, Boca Raton, 1999.

[12]] G. Ratto, F. Videla and R. Maronna, "Analyzing SO2 Concentrations and Wind Directions during a Short Monitoring Campaign at a Site Far from the Industrial Pole of La Plata, Argentina," Environmental Monitoring and Assessment, Vol. 149, No. 1-4, 2009, pp. 229-240. doi:10.1007/s10661-008-0197-6

[13] Y. Qian, K. Migliaccio, Y. Wan and Y Li, "Trend Analysis of Nutrient Concentrations and Loads in Selected Canals of the Southern Indian River Lagoon, Florida Trend Analysis of Surface Water Nutrients," Water Air and Soil Pollution, Vol. 186, No. 1-4, 2007, pp. 195-208. doi:10.1007/s11270-007-9477-y

[14] X. Fan, B. Gu, E. Hanlon, Y. Li, K. Migliaccio and T. Dreschel, "Investigation of Long-Term Trends in Selected Physical and Chemical Parameters of Inflows to Everglades National Park 1977-2005," Environmental Monitoring Assessment, Vol. 178, No. 1-4, 2011, pp. 525-536. doi:10.1007/s10661-010-1710-2

[15] G. Ratto, F. Videla, J. R. Almandos, R. Maronna and D. Schinca, "Study of Meteorological Aspects and Urban Concentration of SO2 in Atmospheric Environment of La Plata, Argentina," Environmental Monitoring and Assessment, Vol. 121, No. 1-3, 2006, pp. 327-342. doi:10.1007/s10661-005-9127-z

[16] C. W. Thornthwaite, "An Approach toward a Rational Classification of Climate," Geographical Review, Vol. 38, No. 1, 1948, pp. 55-94. doi:10.2307/210739

[17] J. C. Gianibelli, J. K?hn and E. E. Kruse, "The Precipi- tations Series in La Plata, Argentina and Its Possible Relationship with Geomagnetic Activity," Geofísica International, Vol. 40, No. 4, 2001, pp. 309-314.

[18] SMN, "Estadísticas Climatológicas. Servicio Meteoro- lógico Nacional 1981-1990," Serie B, No. 37. SMN, Buenos Aires, 1992.

[19] SMN, "Estadísticas Climatológicas. Servicio Meteorológico Nacional 1991-2000," SMN, Buenos Aires, 2000.

[20] SMN, "Estadísticas Climatológicas. Servicio Meteorológico Nacional 2001-2010," SMN, Buenos Aires, 2011.

[21] V. Conrad and L. W. Pollak, "Methods in Climatology," Harvard University Press, Cambridge, 1950.

[22] C. Cuadras, "Métodos de Análisis Multivariante," EUB S.L., Barcelona, 1996.

[23] D. S. Wilks, "Statistical Methods in the Atmospheric Sciences," 2nd Edition, Elsevier, New York, 2006.

[24] S. Chatterjee and A. S. Hadi, "Regression Analysis by Example," 4th Edition, John Wiley and Sons, Hoboken, 2006. doi:10.1002/0470055464

[25] C. Croux and G. Haesbroeck, "Influence Function and Efficieny of the Minimum Covariance Determinant Scatter Matrix Estimator," Journal of Multivariate Analysis, Vol. 71, No. 2, 1999, pp. 161-190. doi:10.1006/jmva.1999.1839

[26] P. J. Rousseeuw and A. M. Leroy, " Robust Regression and Outlier Detection," John Wiley and Sons, New York, 1987. doi:10.1002/0471725382

[27] P. J. Rousseeuw, " Least Median of Squares Regression," Journal of the American Statistical Association, Vol. 79, 1984, pp. 871-880. doi:10.2307/2288718

[28] P. J. Rousseeuw and K. Van Driessen, " A Fast Algorithm for the Minimum Covariance Determinant Estimator," Technometrics, Vol. 41, No. 3, 1999, pp. 212-223. doi:10.2307/1270566

[29] US EPA, " Scout 2008 Version 1.0 User Guide Second Edition," EPA/600/R-08/038, 2009. http://www.epa.gov/esd/databases/scout/abstract. htm#Scout2008v101

[30] R. A. Maronna, R. D. Martin and V. J. Yohai. " Robust Statistics. Theory and Methods," John Wiley and Sons Ltd., West Sussex, 2006. doi:10.1002/0470010940

[31] M. Hubert and M. Debruyne, " Minimum Covariance Determinant," Computational Statistics, Vol. 2, No. 1, 2010, pp. 36-43.

[32] M. Hubert, P. J. Rousseeuw and T. Verdonck, " A Deterministic Algorithm for the MCD," Technical Report TR-10-01, Department of Mathematics Katholieke, Universiteit Leuven, Leuven, 2010.

[33] C. Fauconnier and G. Haesbroeck, " Outliers Detection with the Minimum Covariance Determinant Estimator in Practice," Statistical Methodology, Vol. 6, No. 4, 2009, pp. 363-379. doi:10.1016/j.stamet.2008.12.005

[34] L. F. Escudero, " Reconocimiento de Patrones," Paraninfo, Madrid, 1977.

[35] W. S. Cleveland, " Robust Locally Weighted Regression and Smoothing Scatterplots," Journal of the American Statistical Association, Vol. 74, No. 368, 1979, pp. 829-836. doi:10.2307/2286407

[36] W. S. Cleveland and S. J. Devlin, " Locally Weighted Regression: An Approach to Regression Analysis by Local Fitting," Journal of the American Statistical Association, Vol. 83, No. 403, 1988, pp. 596-610. doi:10.2307/2289282

[37] G. Box, G. M. Jenkins and G. Reinsel, " Time Series Analysis: Forecasting & Control," 3rd Edition, Wiley, New York, 2008.

[38] S. P. Arya, " Introduction to Micrometeorology," 2nd Edition, Academic Press, San Diego, 2001.

[39] J. H. Seinfeld and S. N. Pandis, " Atmospheric Chemistry and Physics. From Air Pollution to Climate Change," 2nd Edition, John Wiley & Sons, Hoboken, 2006.

[40] K. Wark, C. Warner and W. Davis, " Air Pollution. Its Origin and Control," 3rd Edition, Addison Wesley Longman, Berkeley, 1998.

[41] V. Barros, A. Menéndez and G. Nagy, " El Cambio Climático en el Río de la Plata," CIMA, Buenos Aires, 2005.

[42] G. J. Berri, L. Sraibman, R. Tanco and G. Bertossa, " Low-Level Wind Field Climatology over the La Plata River Region Obtained with a Mesoscale Atmospheric Boundary Layer Model Forced with Local Weather Observations," Journal of Applied Meteorology and Climatology, Vol. 49, No. 6, 2010, pp. 1293-1305. doi:10.1175/2010JAMC2370.1

[43] J. E. Simpson, " Sea Breeze and Local Wind," Cambridge University Press, Cambridge, 2006.