Geophysical Research Abstracts
Vol. 19, EGU2017-15910-1, 2017
EGU General Assembly 2017

Recirculation, stagnation and ventilation: The 2014 legionella episode

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Legionella transmission through the atmosphere is unusual, but not unprecedented. A scientific paper published in 2006 reports a surge in Pas-de-Calais, France, in which 86 people have been infected by bacteria released by a cooling tower more than 6 km away [3]. Similarly, in Norway, in 2005, there was another case where contamination spread beyond 10 km, although more concentrated within a radius of 1 km from an industrial unit [2]. An unprecedented large Legionella outbreak occurred in November 2014 nearby Lisbon, Portugal. As of 7 November 2014, 375 individuals become hill and 12 died infected by the Legionella pneumophila bacteria, contracted by inhalation of steam droplets of contaminated water (aerosols). These droplets are so small that can carry the bacteria directly to the lungs, depositing it in the alveoli.
One way of studying the propagation of legionella episodes is through the use of aerosol dispersion models. However, such approaches often require detailed 3D high resolution wind data over the region, which isn't often available for long periods. The likely impact of wind on legionella transmission can also be understood based on the analysis of special types of flow conditions such as stagnation, recirculation and ventilation [1, 4]. The Allwine and Whiteman (AW) approach constitutes a straightforward method to assess the assimilative and dispersal capacities of different airsheds [1,4], as it only requires hourly wind components. Thus, it has the advantage of not needing surface and upper air meteorological observations and a previous knowledge of the atmospheric transport and dispersion conditions.
The objective of this study is to analyze if the legionella outbreak event which took place in November 2014 had extreme potential recirculation and/or stagnation characteristics.
In order to accomplish the proposed objective, the AW approach was applied for a hindcast time-series covering the affected area (1989-2007) and then for an independent period covering the 2014 event (7-25 November 2014). Hourly zonal (u) and meridional (v) wind components were retrieved from hindcast regional climate simulation covering the whole Iberian Peninsula (IP) with a spatial resolution of 9 km. This simulation was performed with the WRF model and for this study, the u and v components were extracted for a set of 12 points of the simulation grid around Lisbon.
The preliminary results regarding the average daily critical transport indices for the 1989-2007 period clearly indicate that the airshed is prone to ventilation as these events have a dominant presence through most of the study period (72%), relatively to the occurrence of recirculation (10%) and stagnation (<2%) events. Comparatively to the 1989-2007 period, the 2014 episode is truly exceptional.

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