Geophysical Research Abstracts
Vol. 19, EGU2017-11273, 2017
EGU General Assembly 2017

Identifying Patterns in the Weather of Europe for Source Term Estimation

Iraklis Klampanos, Charalambos Pappas, Spyros Andronopoulos, Athanasios Davvetas, Andreas Ikonomopoulos, and Vangelis Karkaletsis

National Centre for Scientific Research "Demokritos", Agia Paraskevi, Greece (iaklampanos@iit.demokritos.gr)

During emergencies that involve the release of hazardous substances into the atmosphere the potential health effects on the human population and the environment are of primary concern. Such events have occurred in the past, most notably involving radioactive and toxic substances. Examples of radioactive release events include the Chernobyl accident in 1986, as well as the more recent Fukushima Daiichi accident in 2011. Often, the release of dangerous substances in the atmosphere is detected at locations different from the release origin. The objective of this work is the rapid estimation of such unknown sources shortly after the detection of dangerous substances in the atmosphere, with an initial focus on nuclear or radiological releases.

Typically, after the detection of a radioactive substance in the atmosphere indicating the occurrence of an unknown release, the source location is estimated via inverse modelling. However, depending on factors such as the spatial resolution desired, traditional inverse modelling can be computationally time-consuming. This is especially true for cases where complex topography and weather conditions are involved and can therefore be problematic when timing is critical. Making use of machine learning techniques and the Big Data Europe platform[1], our approach moves the bulk of the computation before any such event taking place, therefore allowing for rapid initial, albeit rougher, estimations regarding the source location.

Our proposed approach is based on the automatic identification of weather patterns within the European continent. Identifying weather patterns has long been an active research field. Our case is differentiated by the fact that it focuses on plume dispersion patterns and these meteorological variables that affect dispersion the most. For a small set of recurrent weather patterns, we simulate hypothetical radioactive releases from a pre-known set of nuclear reactor locations and for different substance and temporal parameters, using the Java flavour of the Euratom-supported funded RODOS (Real-time On-line DecisiOn Support) system[2] for off-site emergency management after nuclear accidents. Once dispersions have been pre-computed, and immediately after a detected release, the currently observed weather can be matched to the derived weather classes. Since each weather class corresponds to a different plume dispersion pattern, the closest classes to an unseen weather sample, say the current weather, are the most likely to lead us to the release origin.

In addressing the above problem, we make use of multiple years of weather reanalysis data from NCAR's version[3] of ECMWF's ERA-Interim[4]. To derive useful weather classes, we evaluate several algorithms, ranging from straightforward unsupervised clustering to more complex methods, including relevant neural-network algorithms, on multiple variables. Variables and feature sets, clustering algorithms and evaluation approaches are all dealt with and presented experimentally. The Big Data Europe platform allows for the implementation and execution of the above tasks in the cloud, in a scalable, robust and efficient way.

[1] https://www.big-data-europe.eu
[2] https://resy5.iket.kit.edu/JRODOS/
[3] http://rda.ucar.edu/datasets/ds627.0/
[4] http://www.ecmwf.int/en/research/climate-reanalysis/era-interim