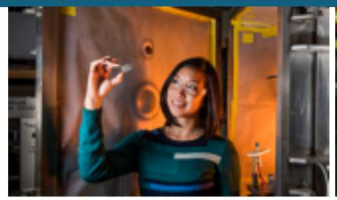
SAND2018-12062C

Sandia National Laboratories

The False Alarm Rate of the International Monitoring System Infrasound Network



PRESENTED BY

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Motivation

Earlier work has assessed the detection capability of the IMS network through simulations

- Design goal is met and possibly exceeded

What about the challenge of automatically processing the data to detect such events?

- What is the False Alarm Rate (FAR) of the network if we wish to ensure we detect such events?

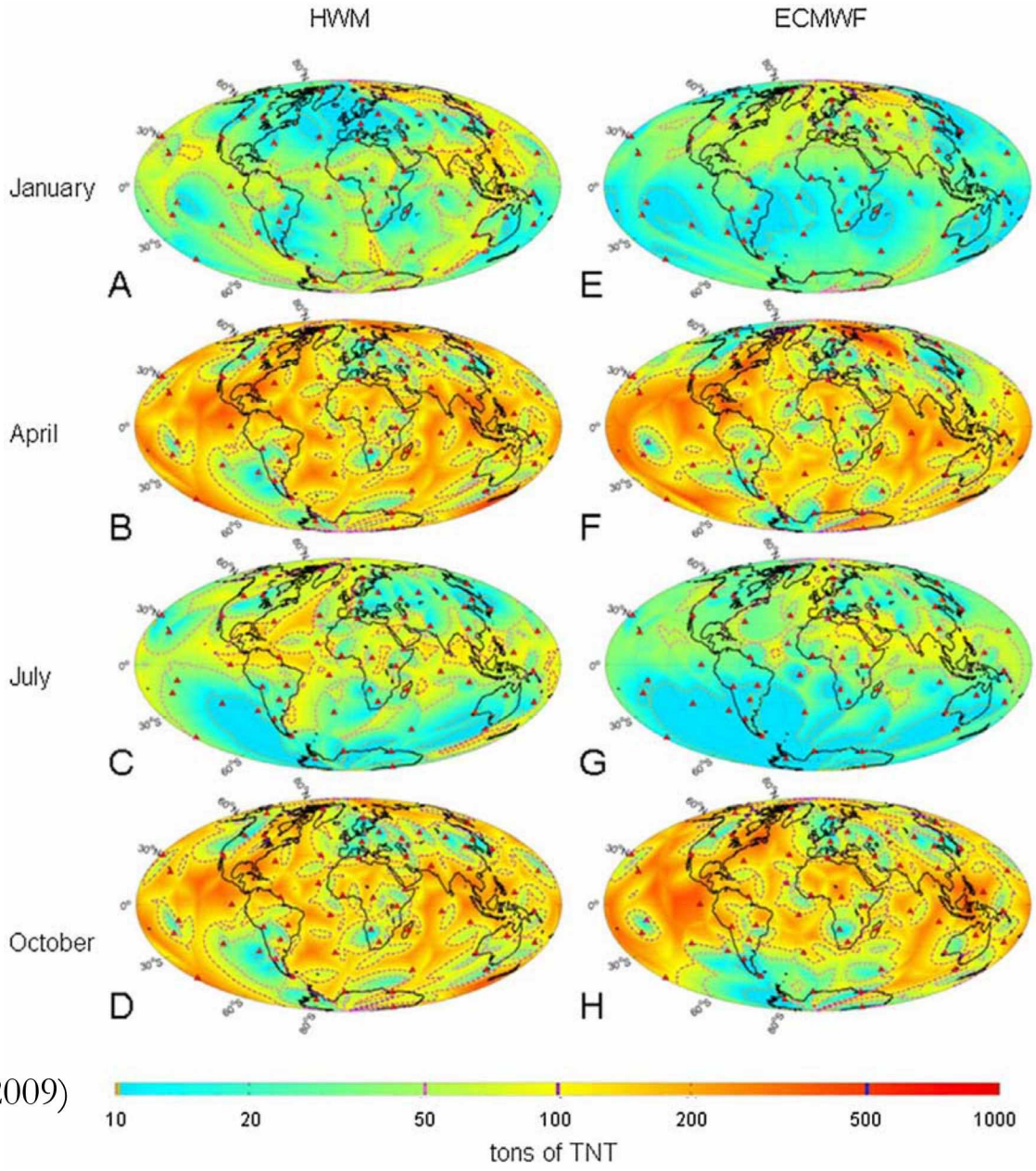


Figure from Le Pichon et al. (2009)

Motivation

A large number of automatic events are rejected by analysts at the IDC

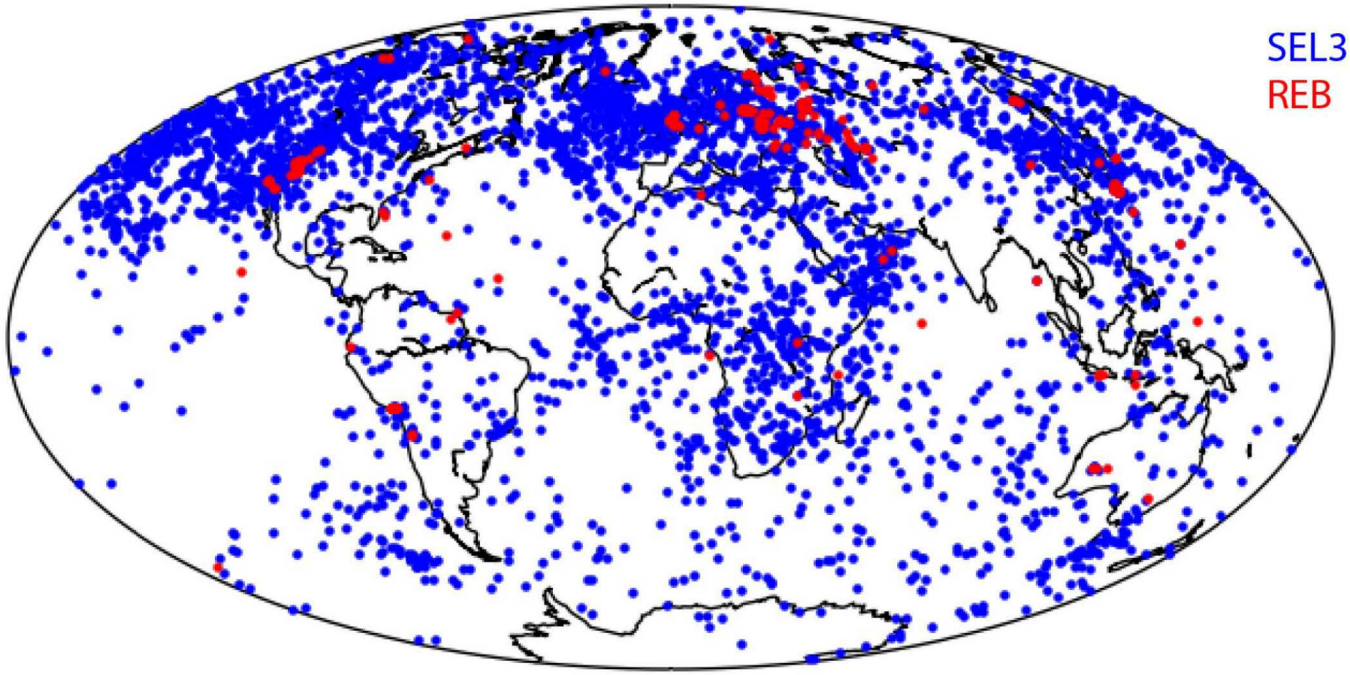
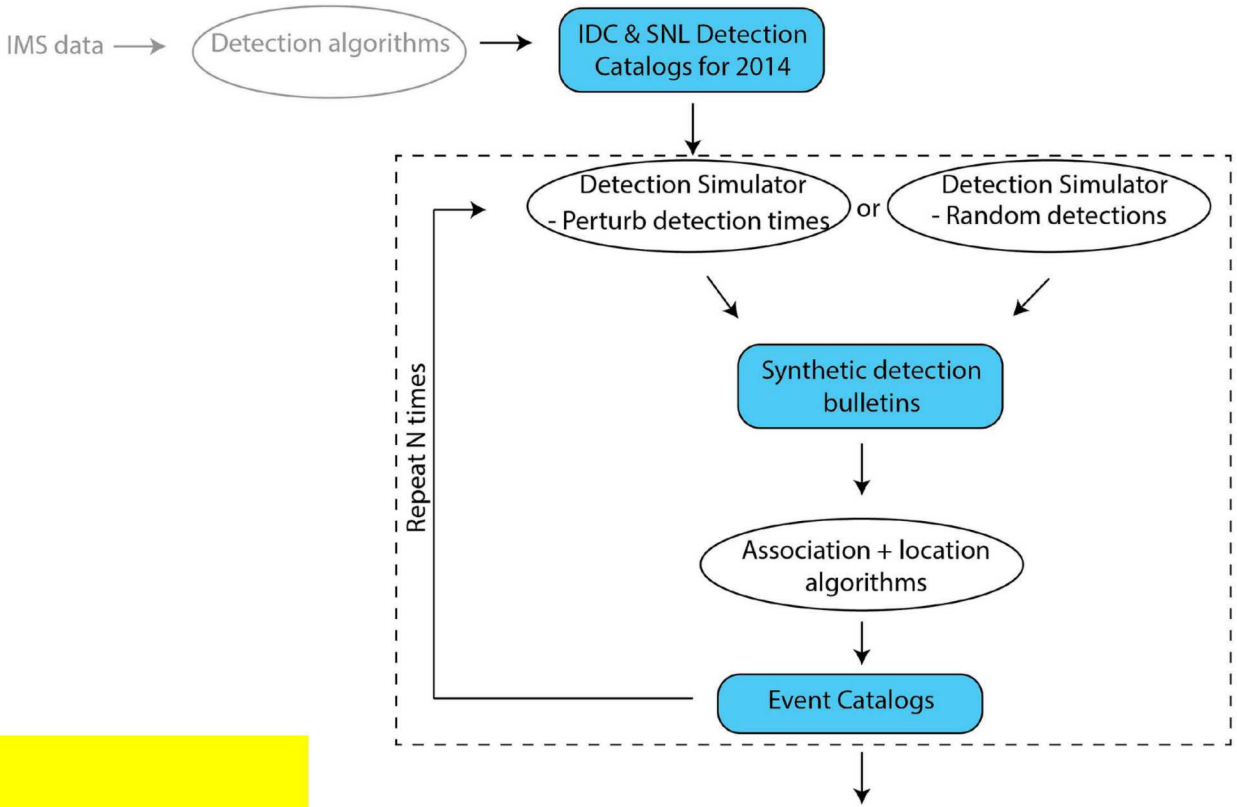


Figure shows the SEL3 and REB catalogs for 2014

Approach

The FAR is assessed using the output of two detection algorithms for one year of IMS data on 48 arrays

The FAR is assessed using Sandia association and location algorithms with random or perturbed detections as input



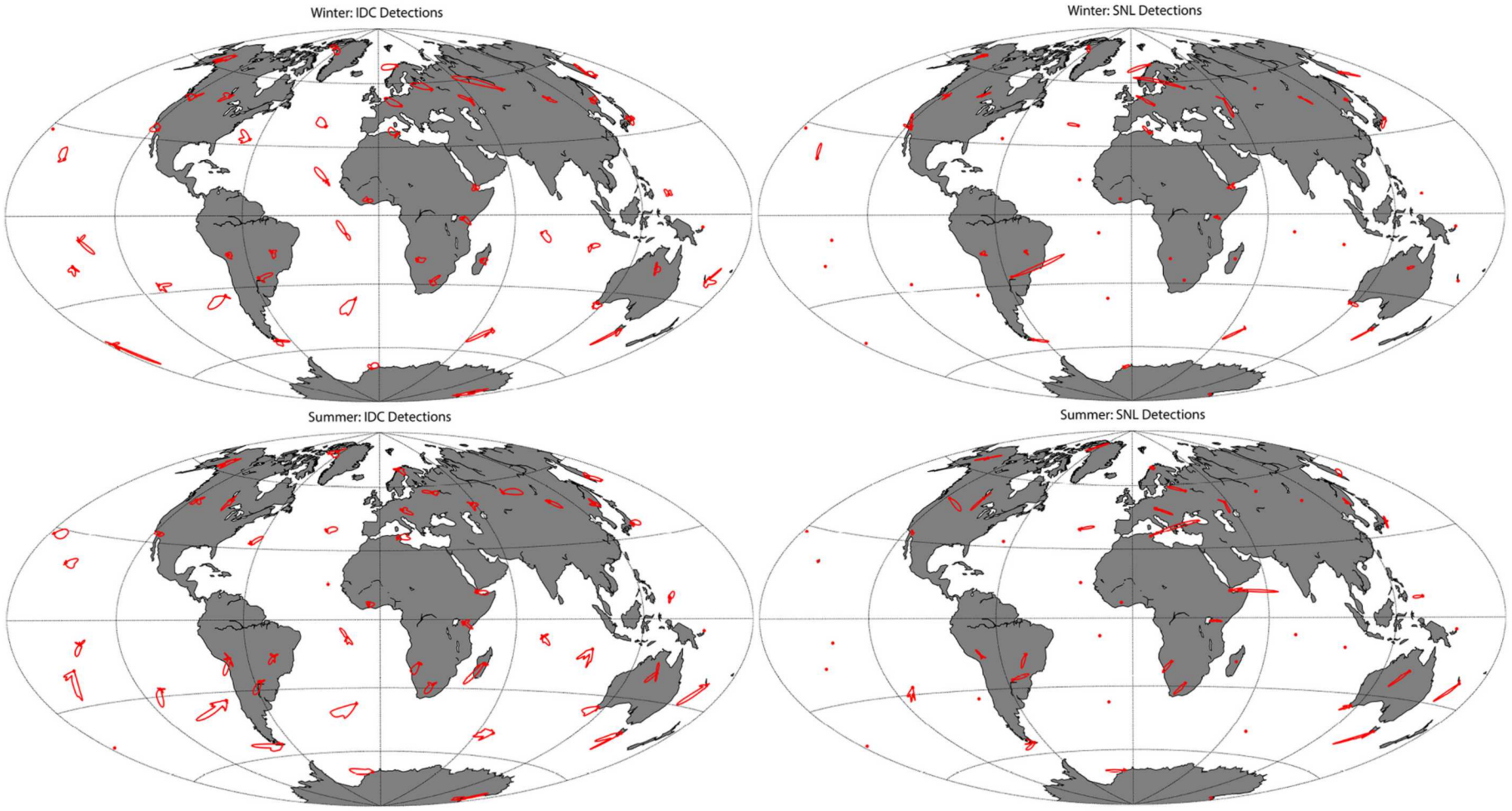
Definitions

Random detections: times and azimuths of detections sampled from uniform distributions U[0,365] and U[0,360]

Perturbed detections: times of actual detections are randomized within 1 week

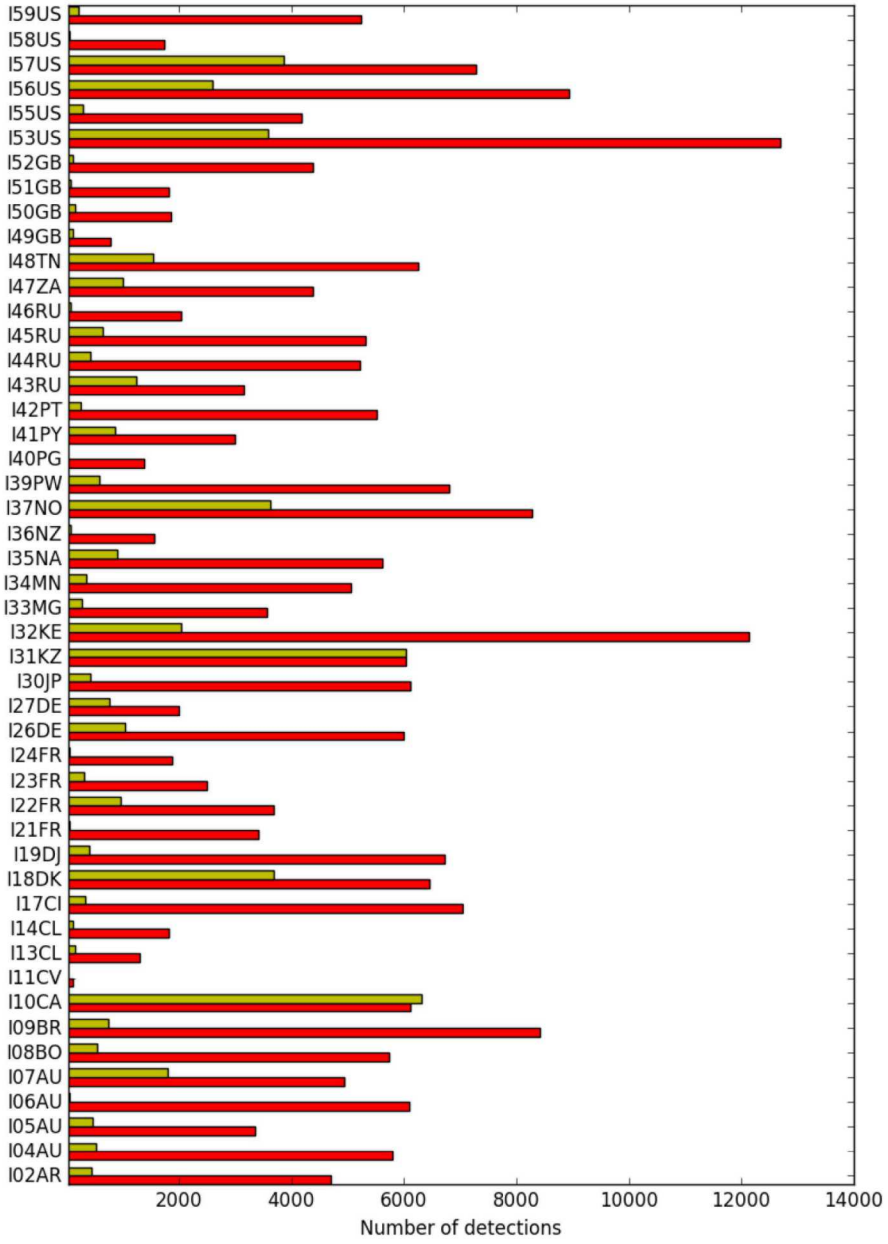
Data

The input data are the output of two different detection algorithms (arrivals from IDC detection algorithm, and arrivals from Sandia detection algorithm)



Azimuthal distributions of detections in the northern hemisphere winter and summer

Data



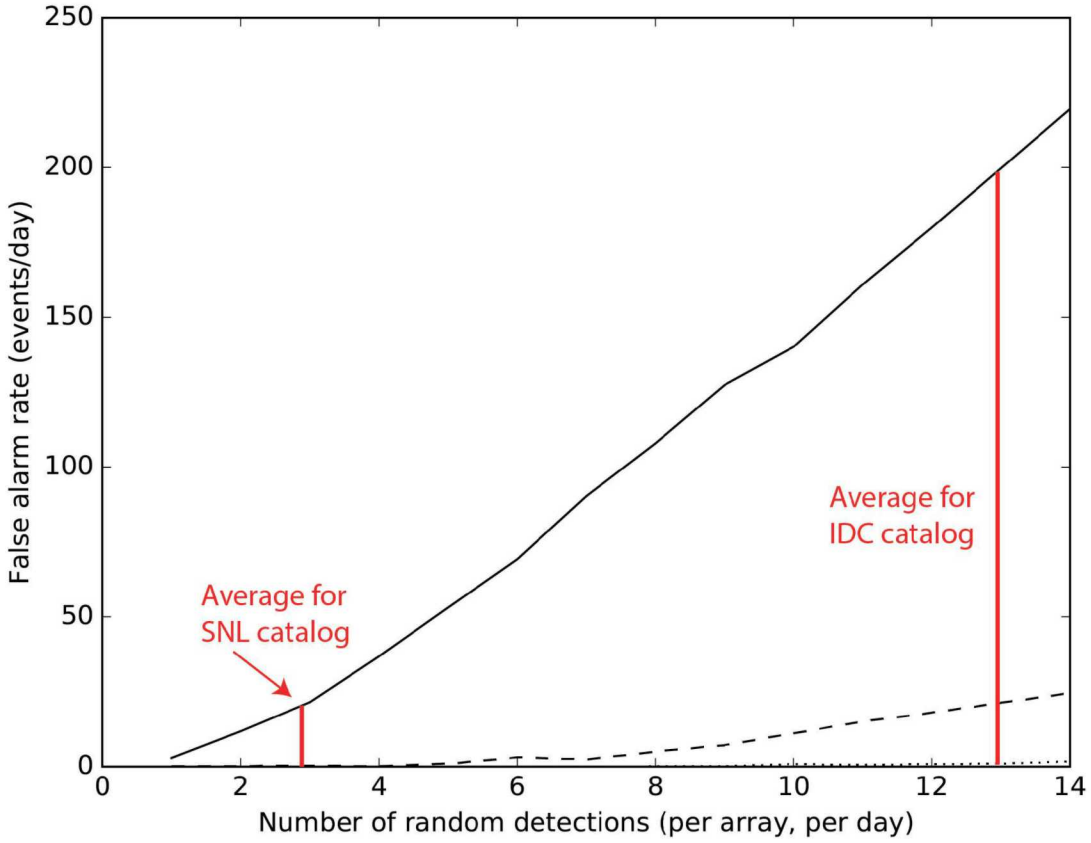
Numbers of detections in 2014 from IDC (red) and Sandia (yellow)

Results

We test how the number of random detections affects the number of false events

Two-array events result in very large numbers of false alarms given the numbers of detections

Three-array and larger events have much lower false alarm rates



Definitions

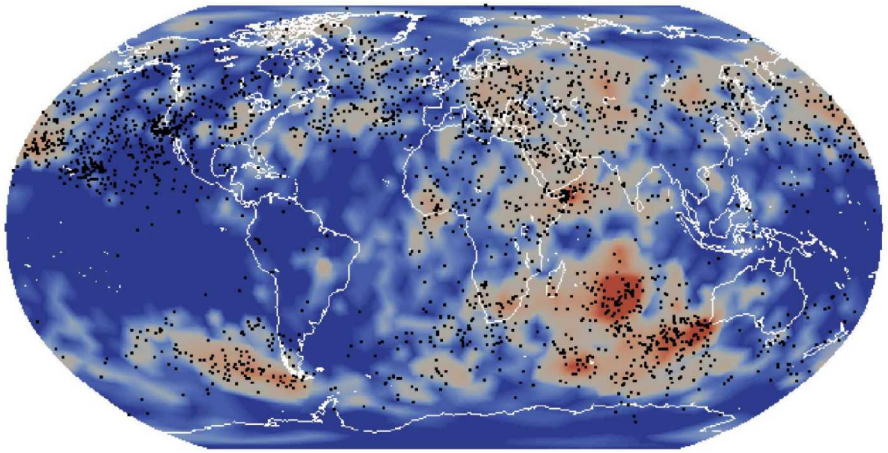
N-array event: An event formed from detections at *N* different arrays

Results

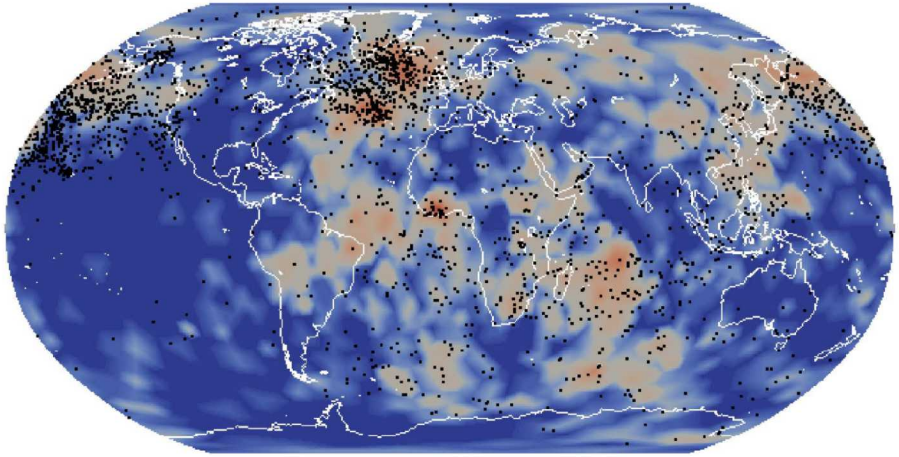
We test where and when false three-array events form based on perturbed IDC detections

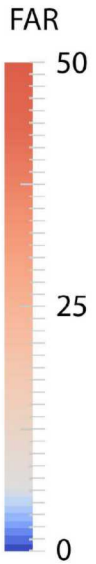
Large numbers of false three-array events form in the oceans and are found to be related to microbaroms

Summer: IDC detections



Winter: IDC detections





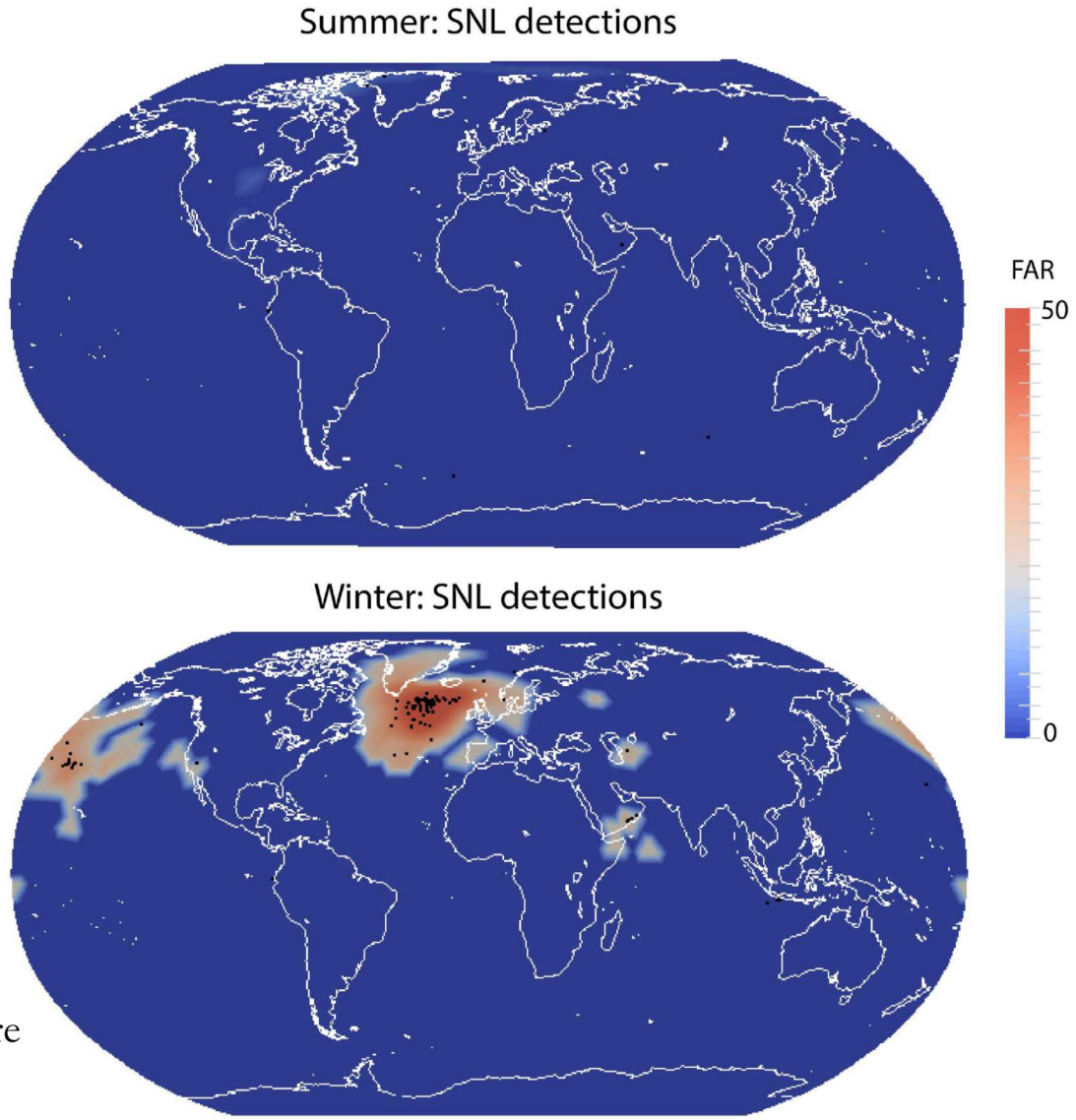
Maps show the number of false events per 3 months and 6.8 square degrees

Results

The equivalent maps for the SNL detections show much lower overall FAR, reflecting the more conservative detection threshold

High FAR is still observed in the North Atlantic during the winter months

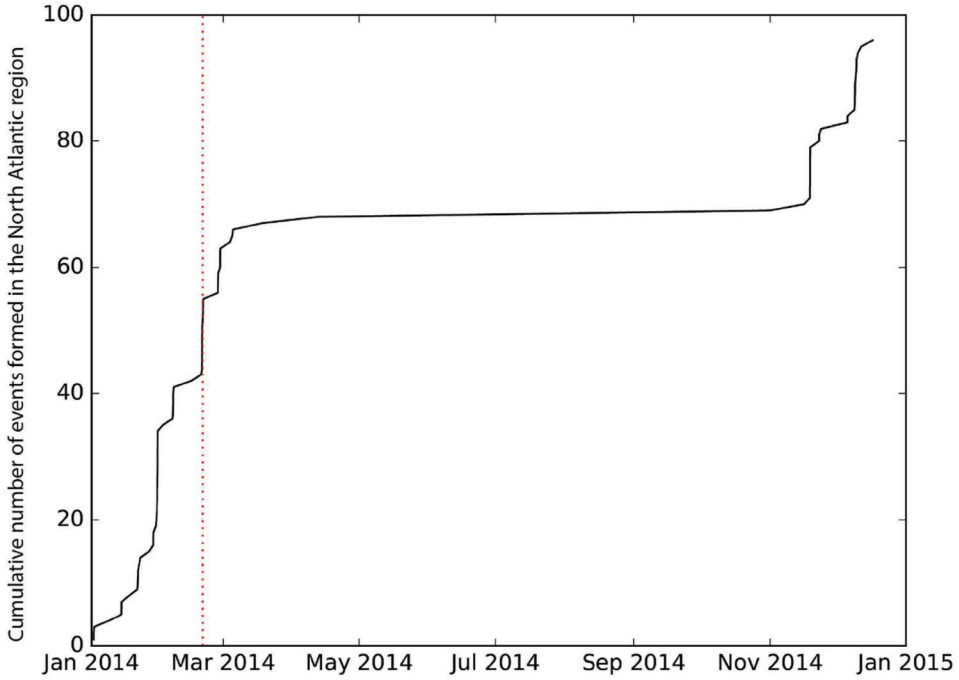
Maps show the number of false events per 3 months and 6.8 square degrees



Microbaroms

False three-array (and larger) events occur at specific time periods when the microbarom signal is particularly strong

The spatiotemporal distribution of. microbaroms should enable their removal via post-processing event catalogues



Cumulative number of events from the North Atlantic as a function of time

Summary

The availability of data from 80% of the final IMS infrasound network (48/60 arrays) provides an opportunity to assess the FAR as a function of time and location

Our results suggest the infrasound network may be too sparse to build two-array events automatically without an intractable FAR, unless significant advances in detection and association methods can occur

Our results further show that the generation of most false events is likely due to the detection of microbarom signals, although repeating signals also cause challenges

Finally, our results highlight how minimizing detections from sources that are not of interest to explosion monitoring can dramatically reduce the FAR

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