SnT 2025 8 SEPTEMBER ONLINE DAY 9 TO 12 SEPTEMBER AT HOFBURG PALACE, VIENNA & ONLINE
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE



# Empirical Evaluation of the International Monitoring Systems Detection Capability

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## INTRODUCTION AND MAIN RESULTS

We estimate detection capability of the currently deployed seismic components of the International Monitoring System using an empirical method. We find that the network has a 90% probability of detection at M ≥ 4.0 with the Auxiliary improving the estimate to a minor degree.

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC LLNL-CFPRES-2008794

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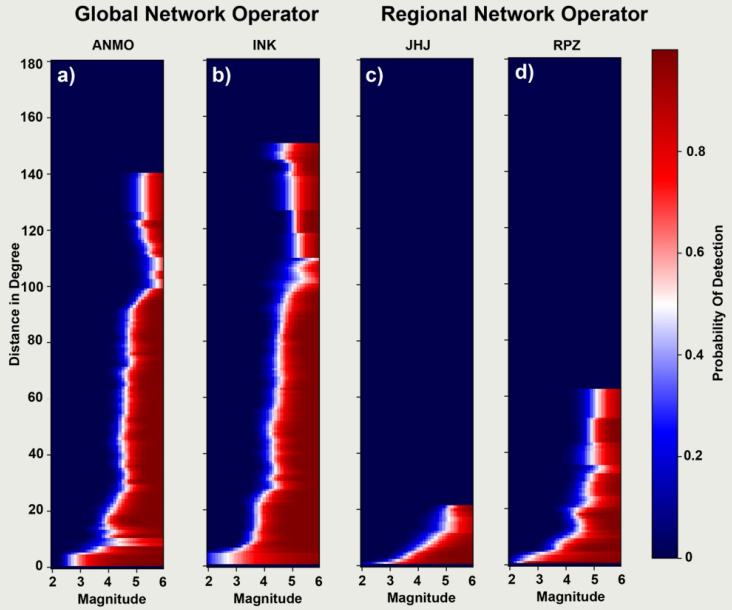
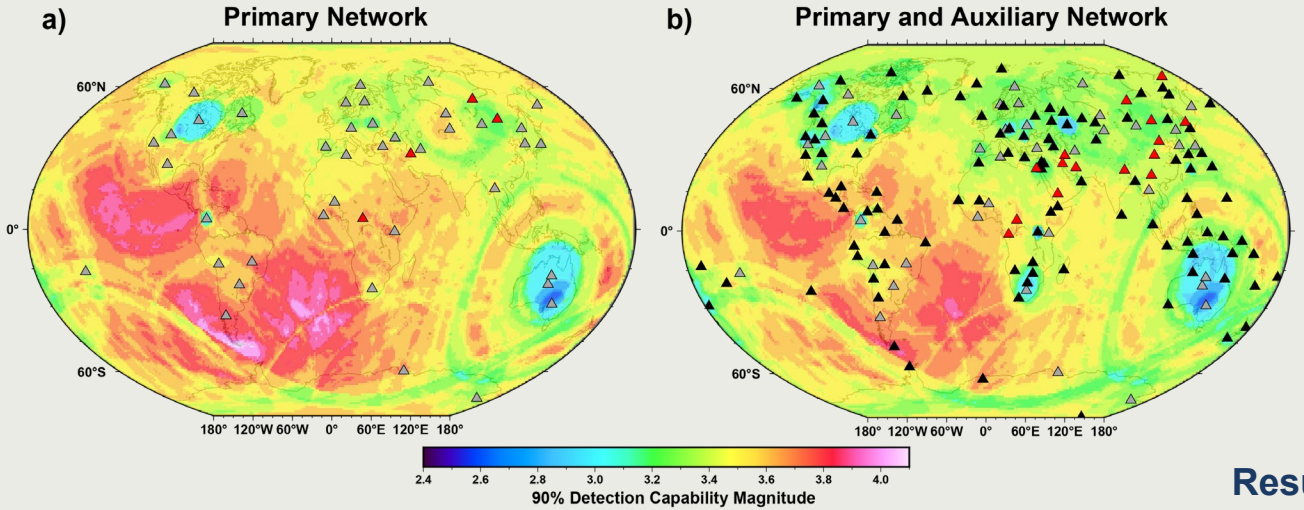
## Introduction

We estimate detection capability of the currently deployed seismic components of the International Monitoring System using an empirical method. Previously the primary network's detection capability was calculated using theoretical methods. The capability estimates are derived from phase picks from earthquake catalog. Using an earthquake catalog allows for the behavior of the analysts and their assessment of whether an arrival should be included in the analysis.




Combined probability of detection plot for all distance ranges a-b) Are stations that are operated, maintained and often picked by an organization that focuses on detecting seismicity around the world. c-d) Are stations that are operated and maintained and picked the most often by organizations that are focused on their specific country or region. You can see how these different focuses effect reported detection capability.




Detection capability map for the currently operational primary network (gray triangles). (b) Detection capability map for the currently operational primary network and all currently operating auxiliary stations (black triangles) based upon the requirement that a magnitude have a detection probability of 90% on 3 stations.

## Methods/Data

To evaluate the detection capability of each station we need a catalog that contains events not detected by the IDC the most comprehensive global catalog available is that of the International Seismological Center (ISC) so events in that catalog represent all known events.

- For each station we compute the detection probability (ratio of missed vs non-missed earthquakes) as a function of magnitude and distance.
- The obtained detection-probability distributions of each station are then used to compute the joint probability of these stations detecting an event of magnitude M at location X on the globe.
- We then search for the smallest magnitude that can be detected at location X by 3 stations with a probability level at or above 90%.

## Results

- Currently even the incomplete network has a 90% probability of detection at M ≥ 4.0 in most parts of the world.
- The inclusion of the Auxiliary network improves does not produce significant improvement in areas with the highest thresholds.
- This is due to the IDC detection pipeline solely using the Primary stations for detection with Auxiliary stations only used to improve location of events. We would see greater improvement if Auxiliary stations were picked similarly to Primary stations.

## Conclusions

Currently the network has a 90% probability of detection at M ≥ 4.0 with the Auxiliary improving to a minor degree. Our estimate is conservative since it relies on reported picks and many picks are often left out of published bulletins following analyst review.

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