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The Iterative Processing Framework

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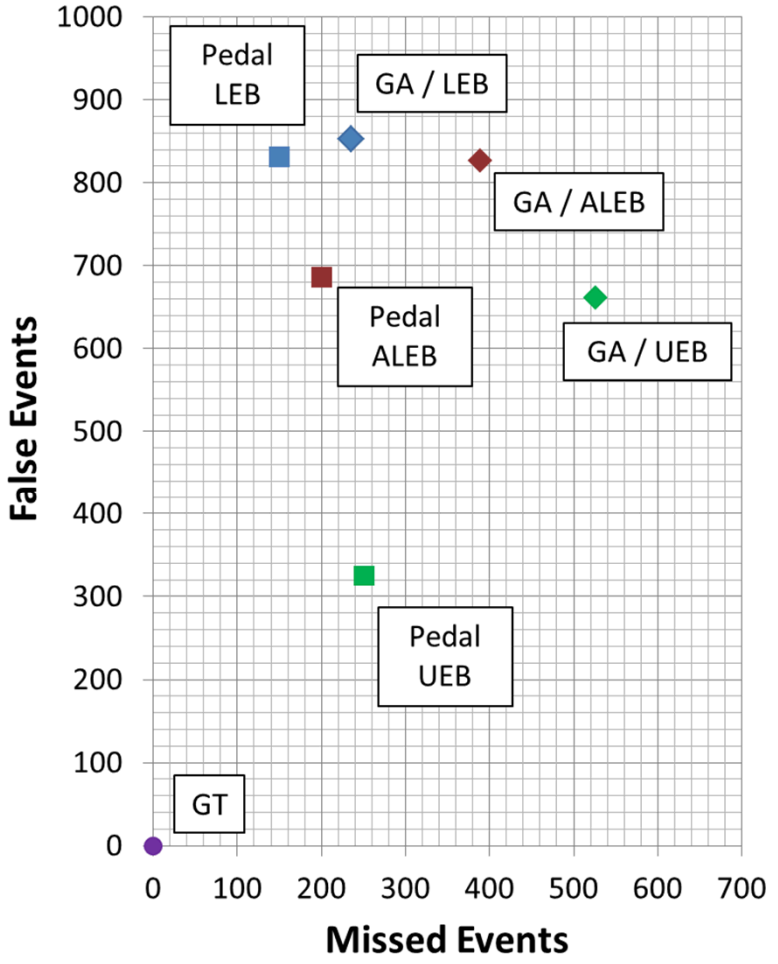
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company,
for the United States Department of Energy's National Nuclear Security Administration
under contract DE-AC04-94AL85000. SAND420108

The Iterative Processing Framework

- How can we further improve the quality of the automated bulletin?
- Current associators are limited by the fact that they only use picks and do not make use of additional information contained in the raw waveforms.
  - Use waveform correlation as integral part of automated bulletin production.
- Current associators are stuck with errors and omissions in the input data.
  - Allow the associator to reprocess waveform data to 'correct' errors in the input data or to search for expected data that is missing from the available picks.
- Basically, incorporate human analyst behaviors into production of the automated bulletin.



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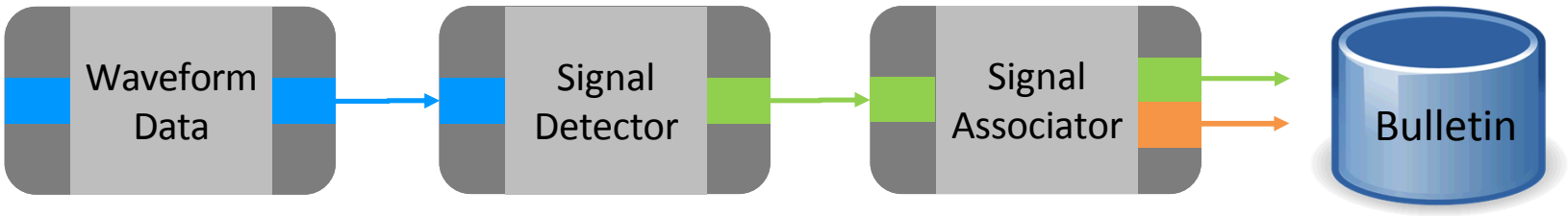
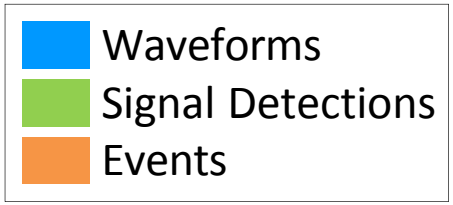
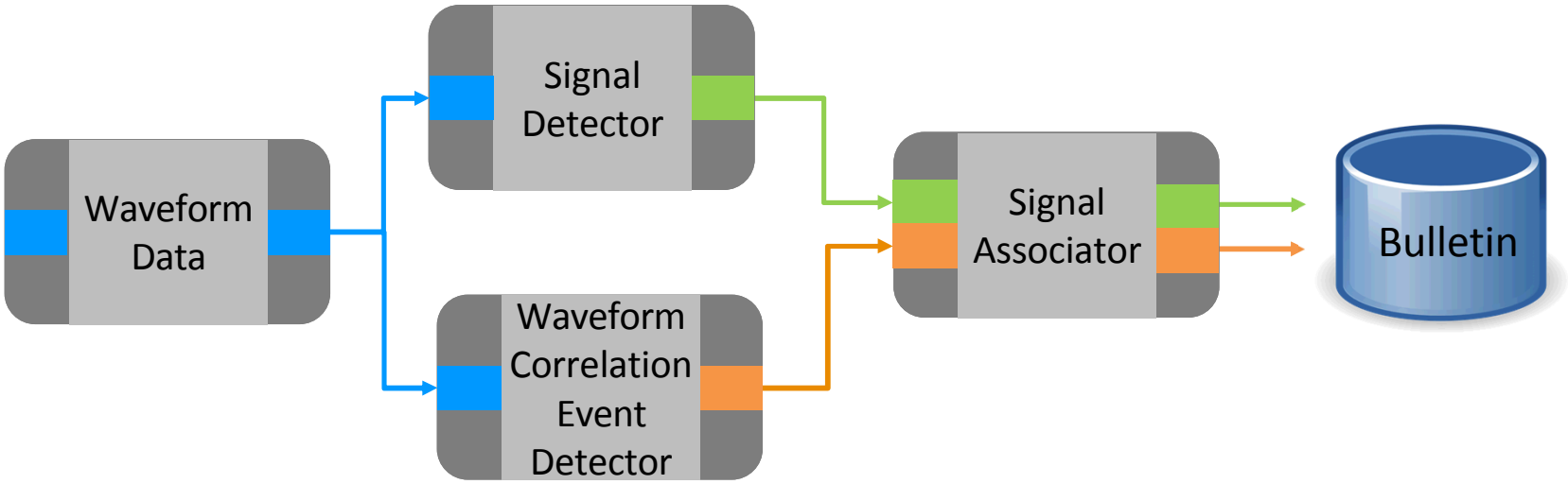
Traditional Pipeline



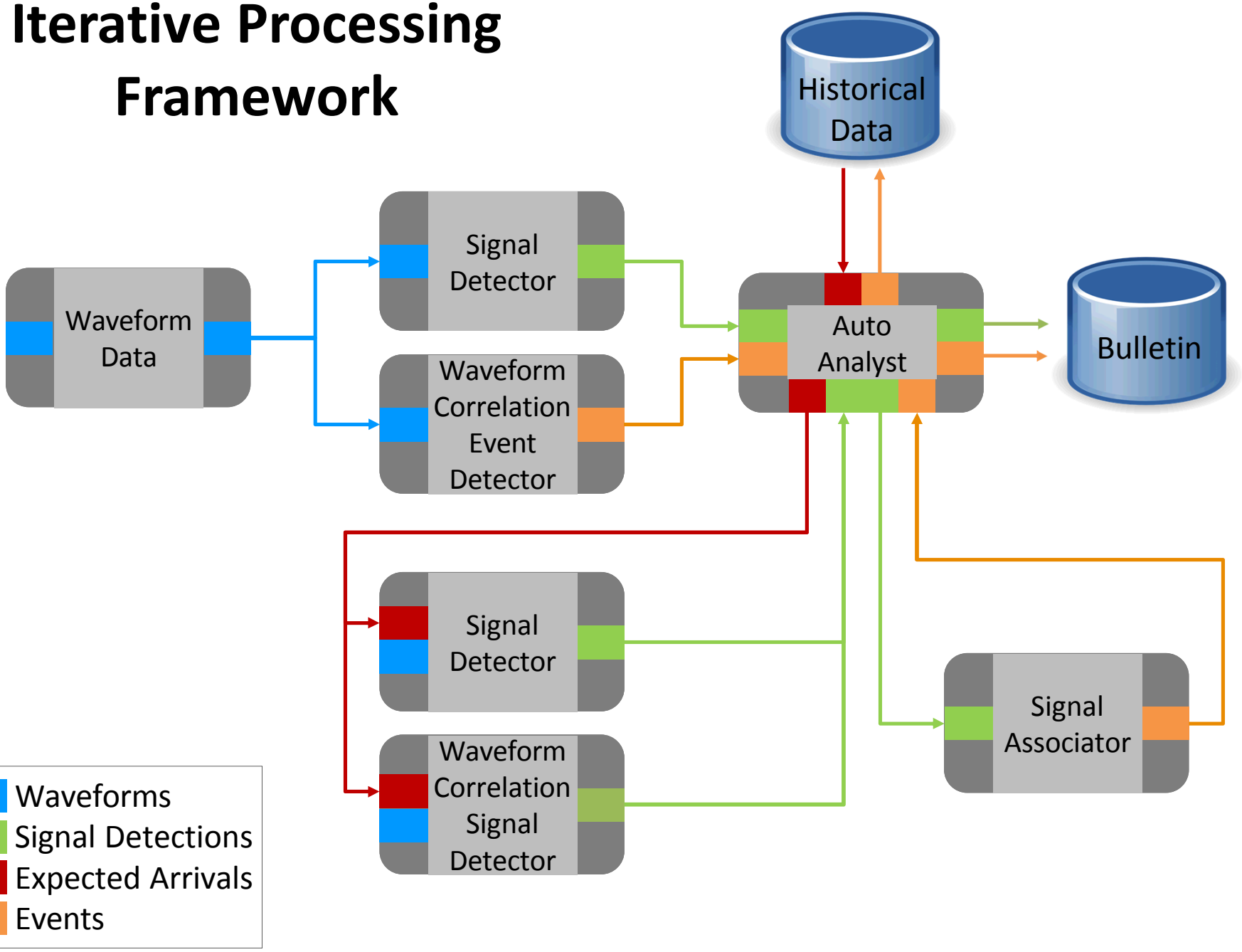


Traditional Pipelinewith Waveform Correlation

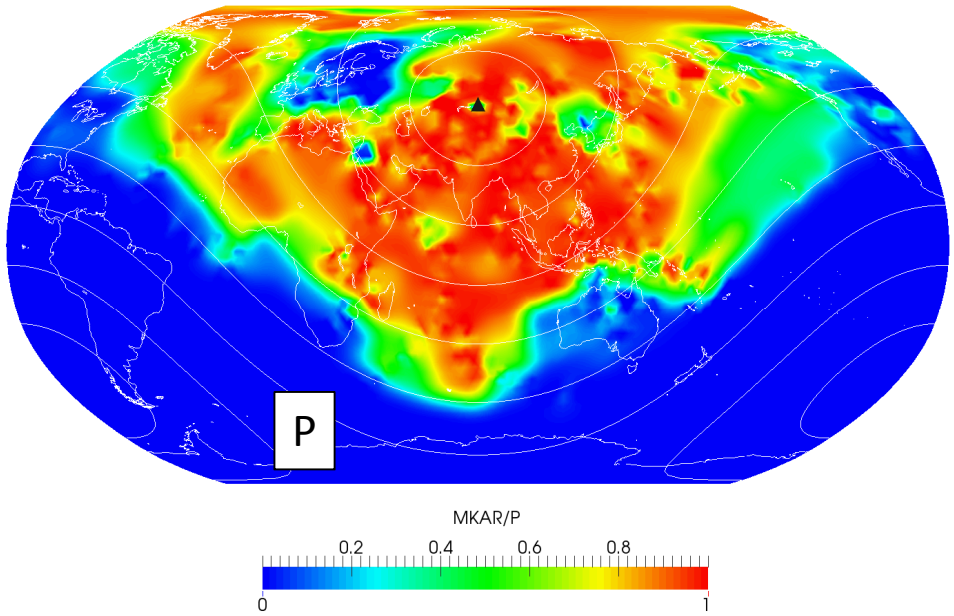


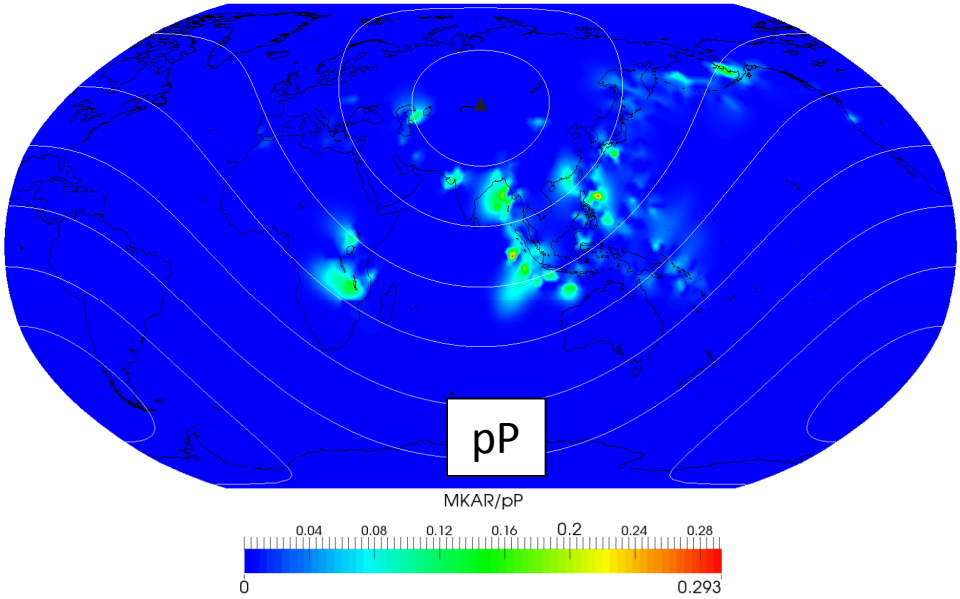
Waveforms
Signal Detections
Events

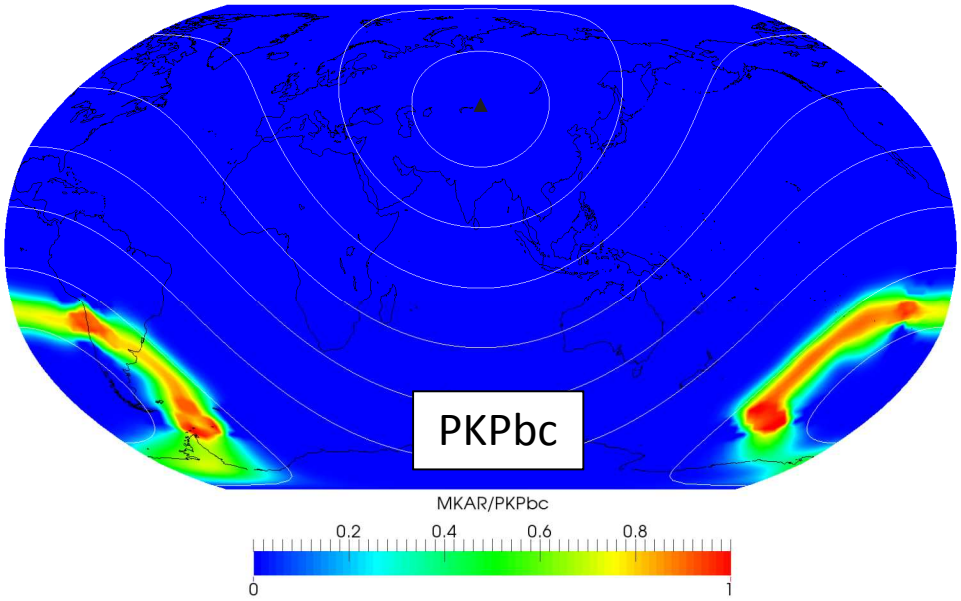
Iterative Processing Framework

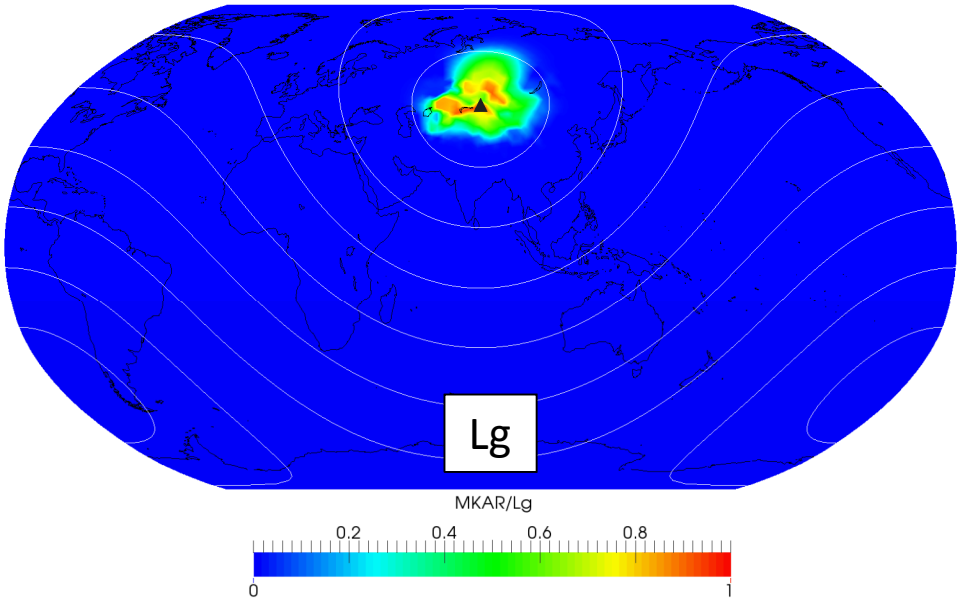


Probability of Detection for MKAR

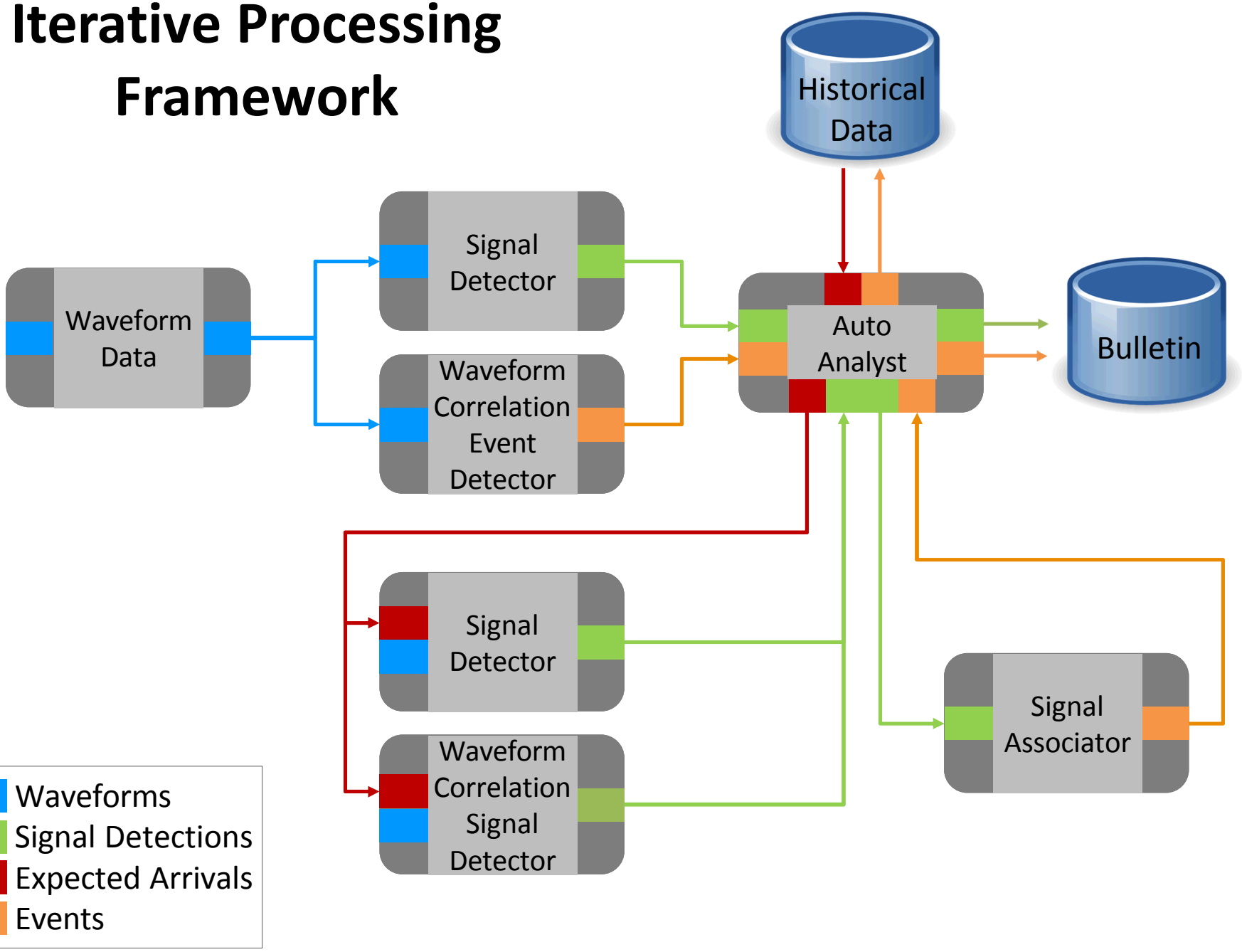


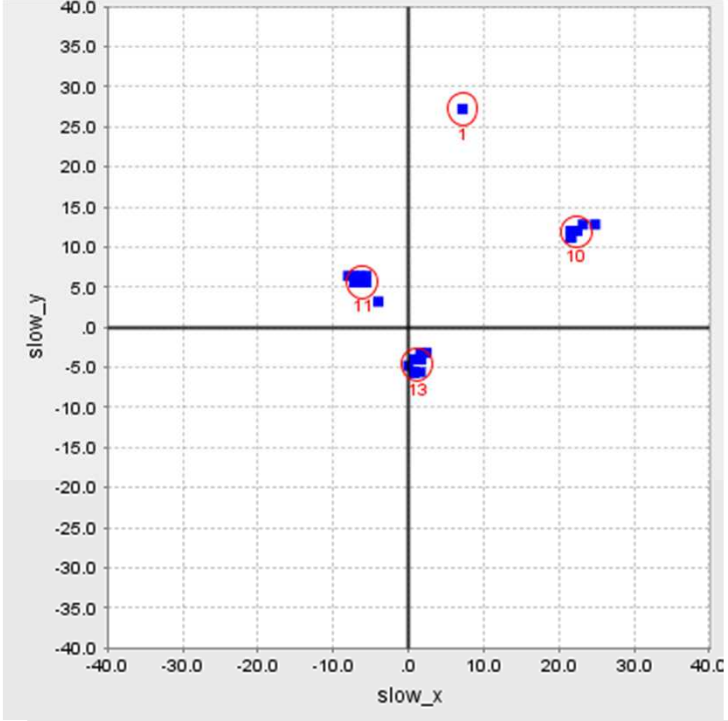


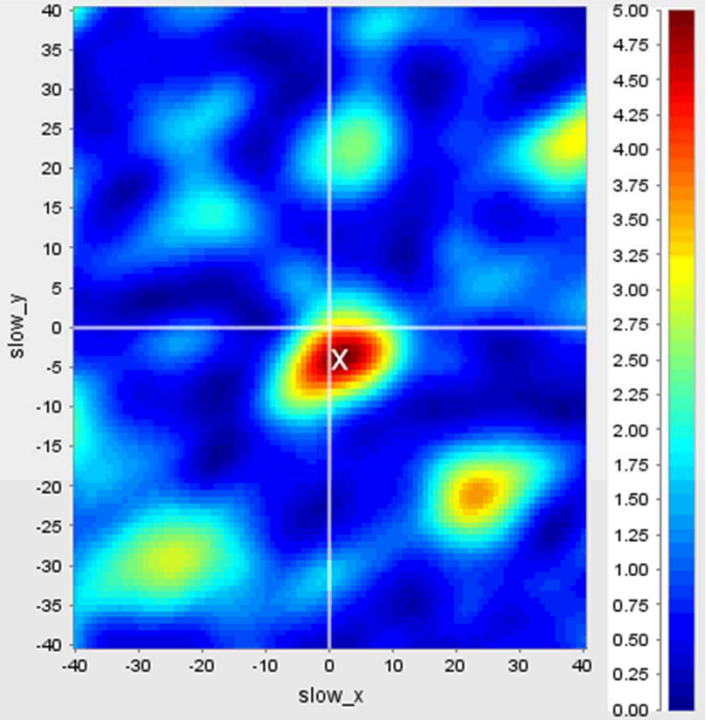


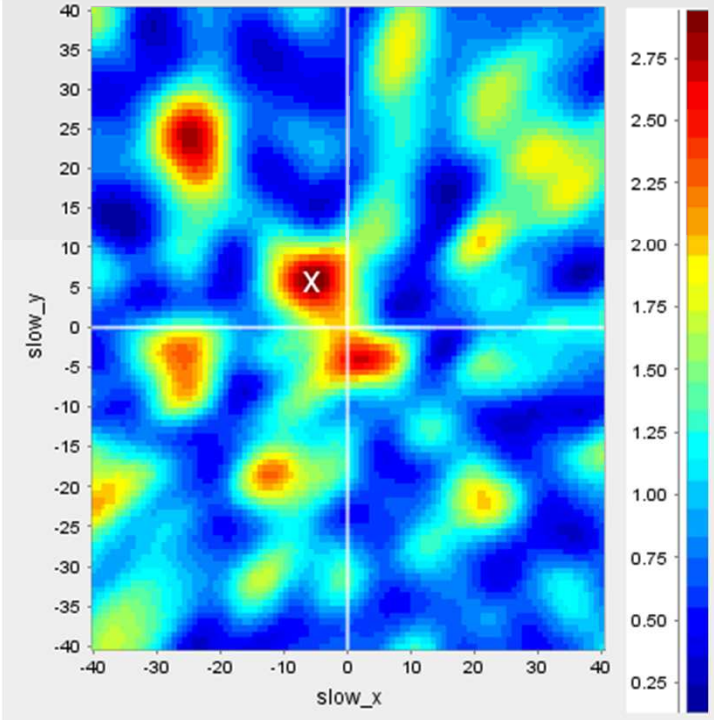


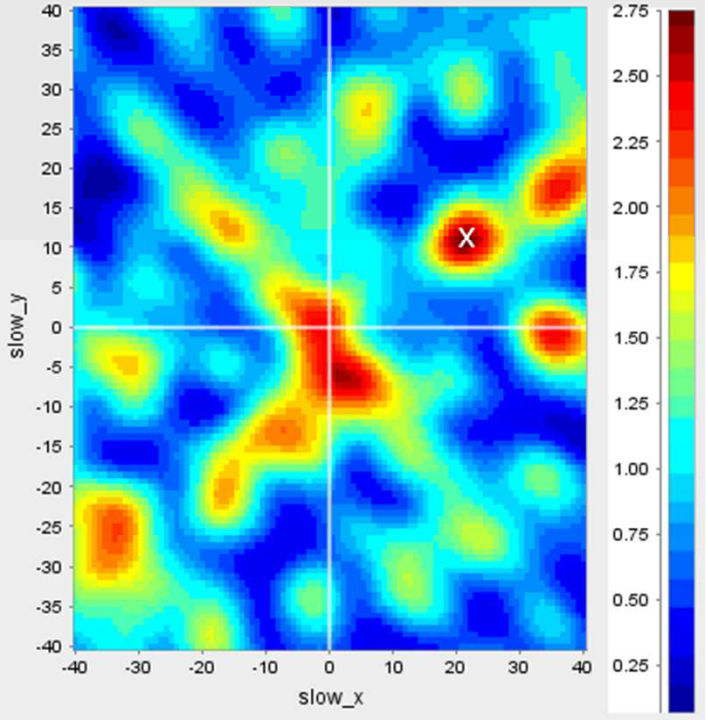
Iterative Processing Framework



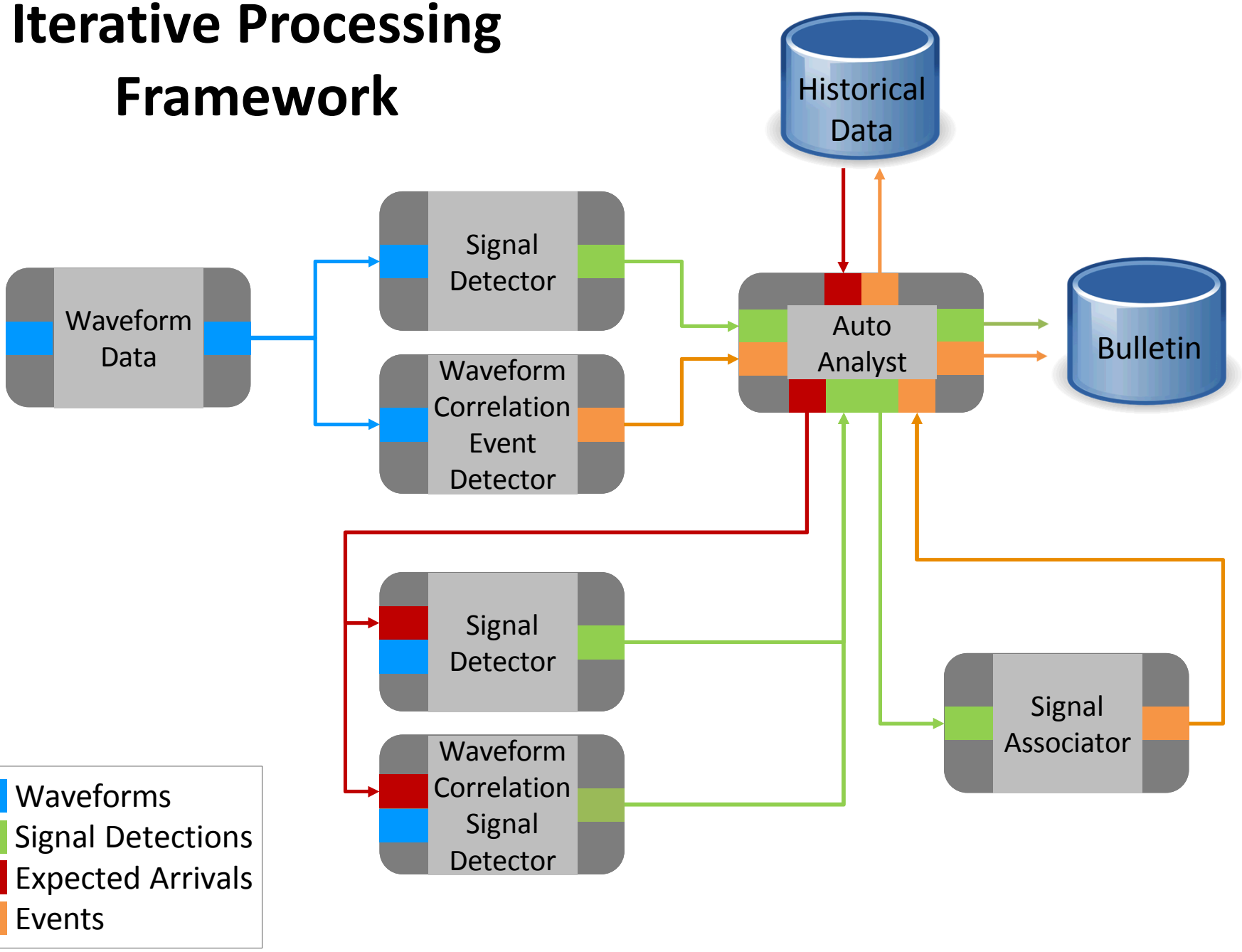

slow_y
slow_x
1
10
11
13


slow_y
slow_x
X


slow_y
slow_x
X

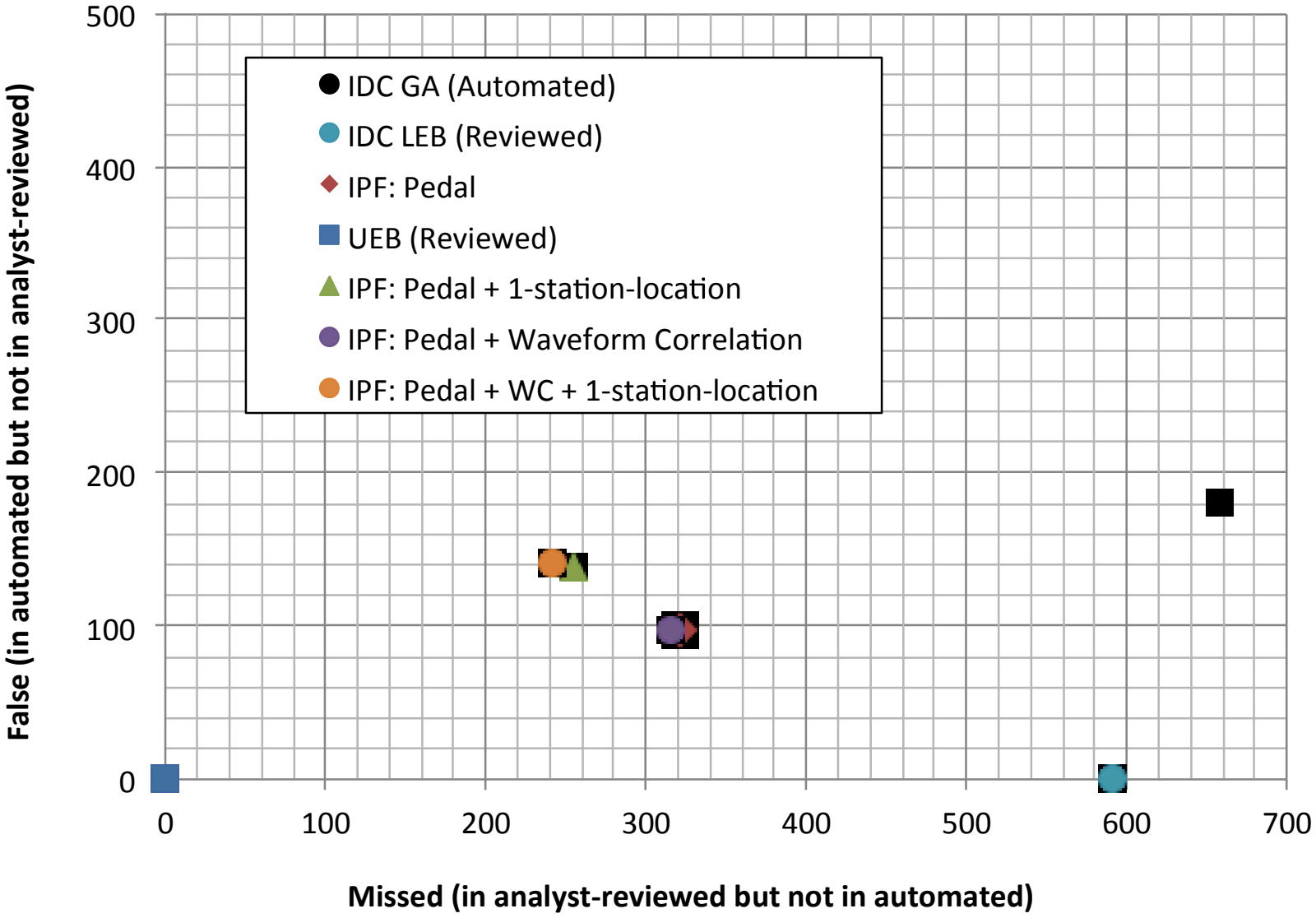

slow_y
slow_x
X

Iterative Processing Framework



AutoAnalyst Behaviors

- Waveform Correlation
  - Identify events detected using waveform correlation.
  - Associate automatically picked Arrivals with WC events.
  - Query historical information for expected arrivals, given the WC event.
  - Reprocess waveforms searching for missing expected arrivals.
- Scan Unassociated Arrivals
  - After running associator, identify unassociated arrivals from arrays that have slowness of a first P phase and significant SNR.
  - Compute a single-station location.
  - Query historical information for expected arrivals.
  - Reprocess waveforms searching for missing expected arrivals.
  - Rerun the associator with any new detected arrivals
- Evaluate low NDEF events
  - For arrivals associated to low-ndef events that are from arrays, run the multi-fk tool and reassess the associations. If any arrivals are modified in this process, rerun the associator


IDC GA (Automated)
IDC LEB (Reviewed)
IPF: Pedal
UEB (Reviewed)
IPF: Pedal + 1-station-location
IPF: Pedal + Waveform Correlation
IPF: Pedal + WC + 1-station-location
False (in automated but not in analyst-reviewed)
Missed (in analyst-reviewed but not in automated)
0
100
200
300
400
500
600
700

The Iterative Processing Framework

Summary

- We can improve the performance of the automated bulletin by incorporating human analyst behaviors into automatic processes.
  - Waveform correlation.
  - Single-station location of unassociated arrivals.
  - Review of low-ndef events.

Future Work

- Expand the waveform correlation template library
- Implement ANN Waveform Similarity Search algorithm
- Waveform correlation as a signal detector
- Low-NDEF arrival re-evaluation
- False event screening
- Identify and implement additional human analyst behaviors.
- Demonstrate at the USNDC and/or the IDC

NNSA National Nuclear Security Administration

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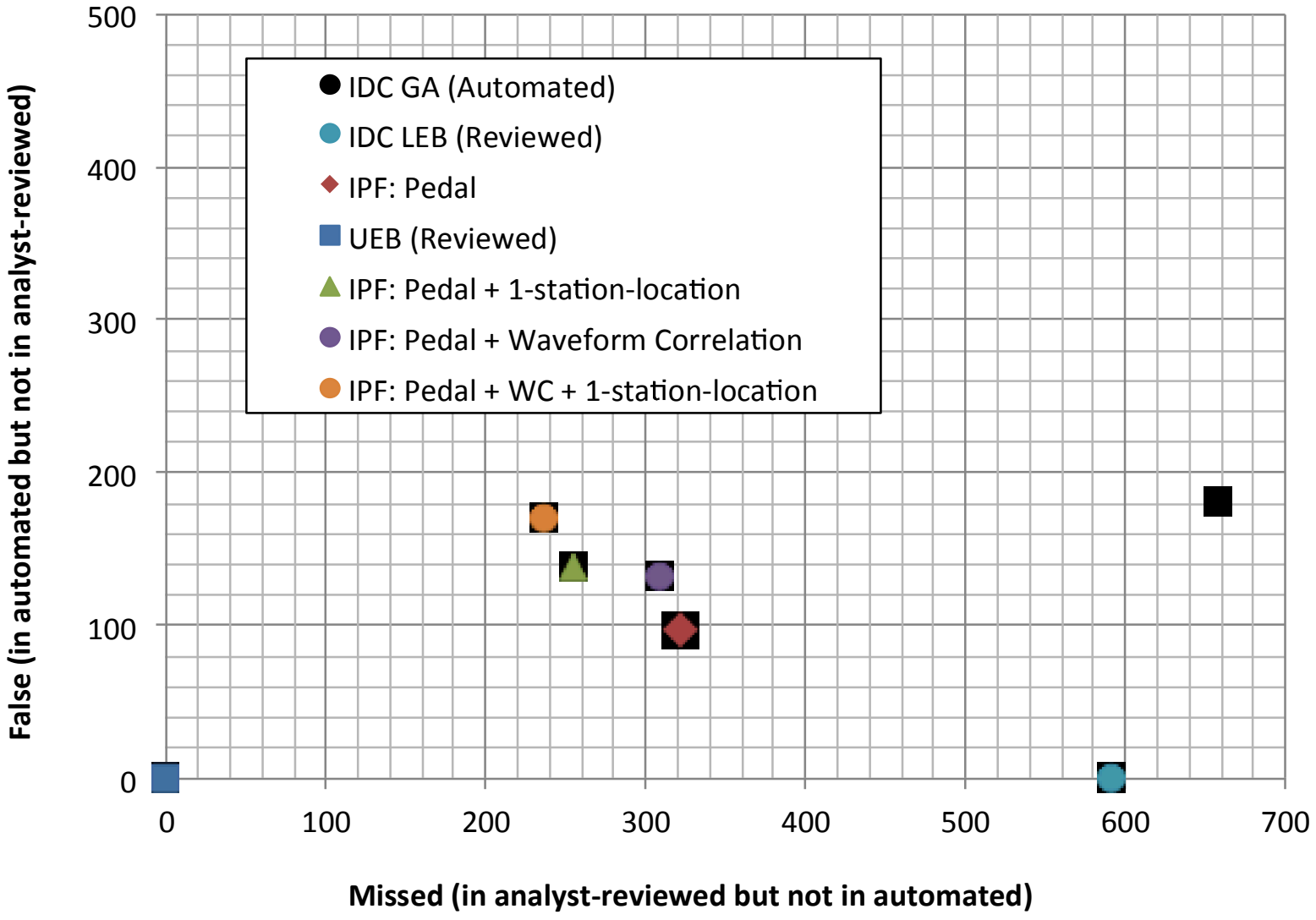
END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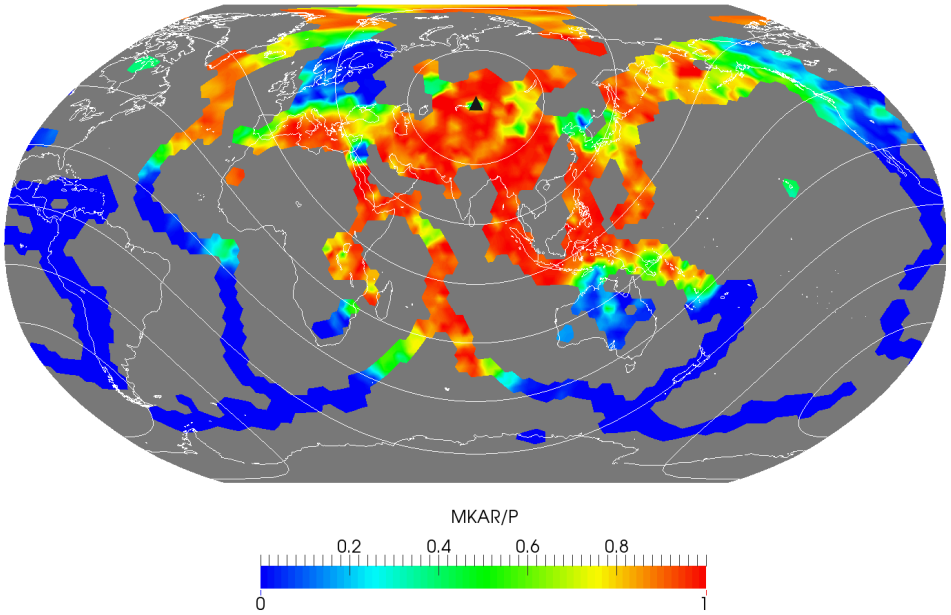

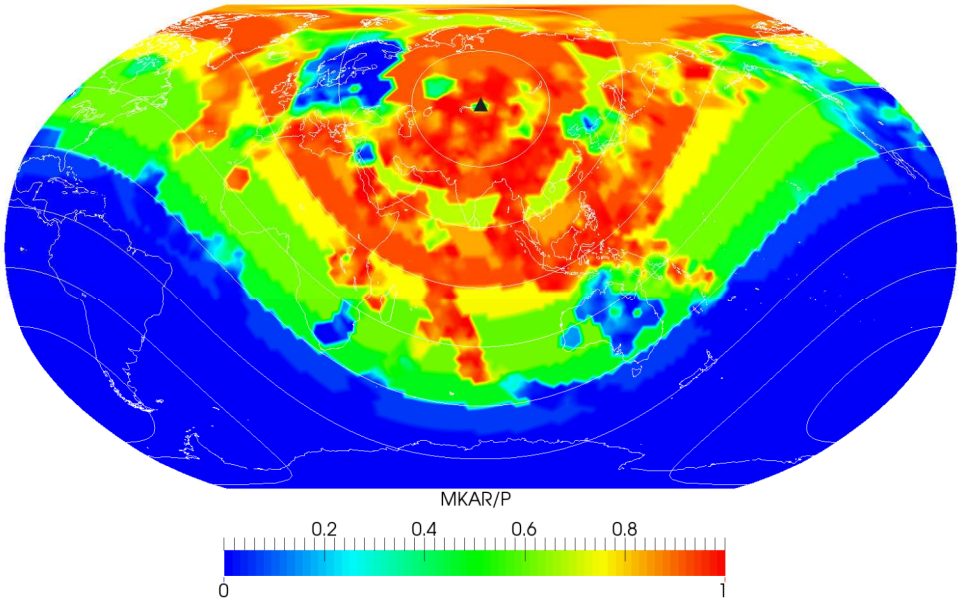

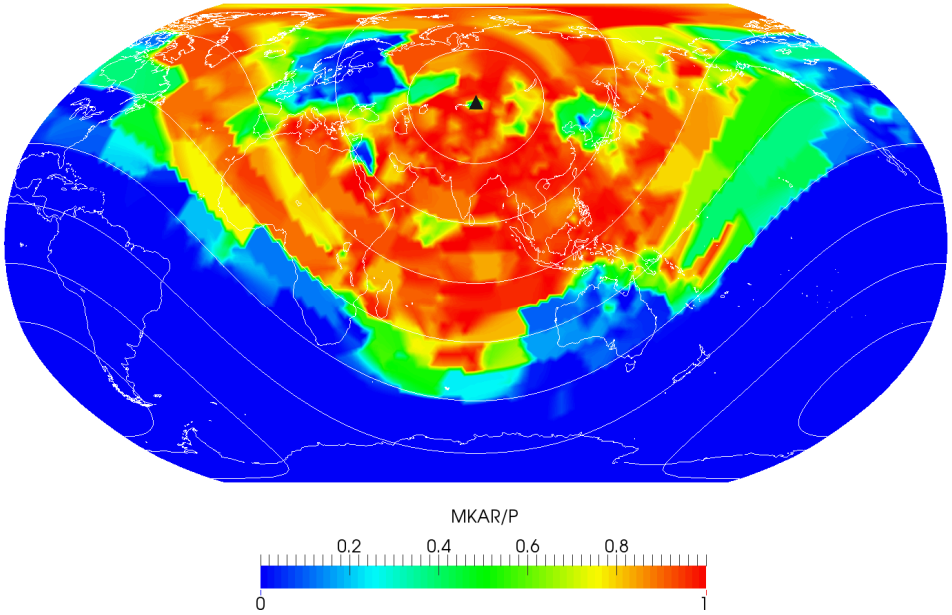

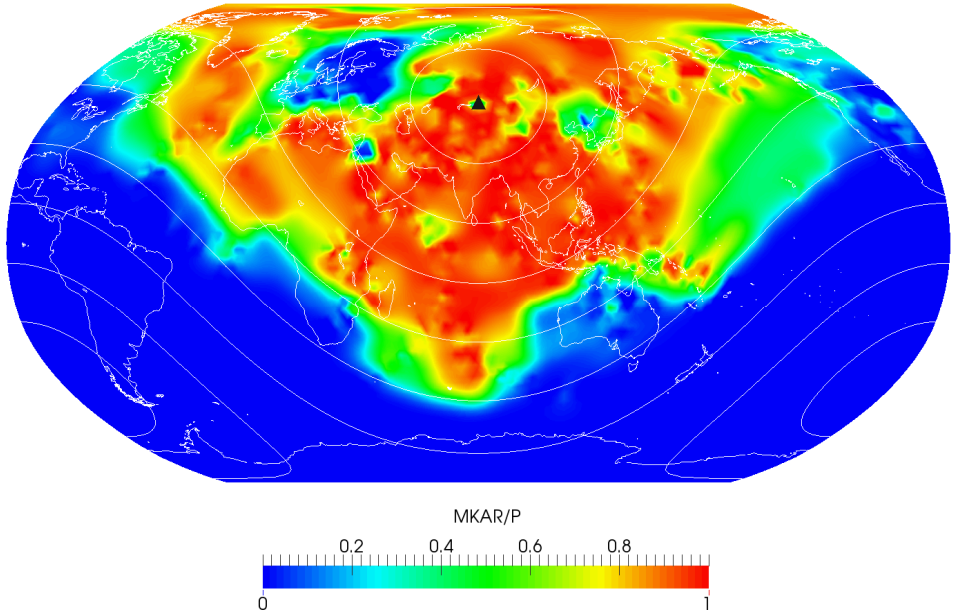

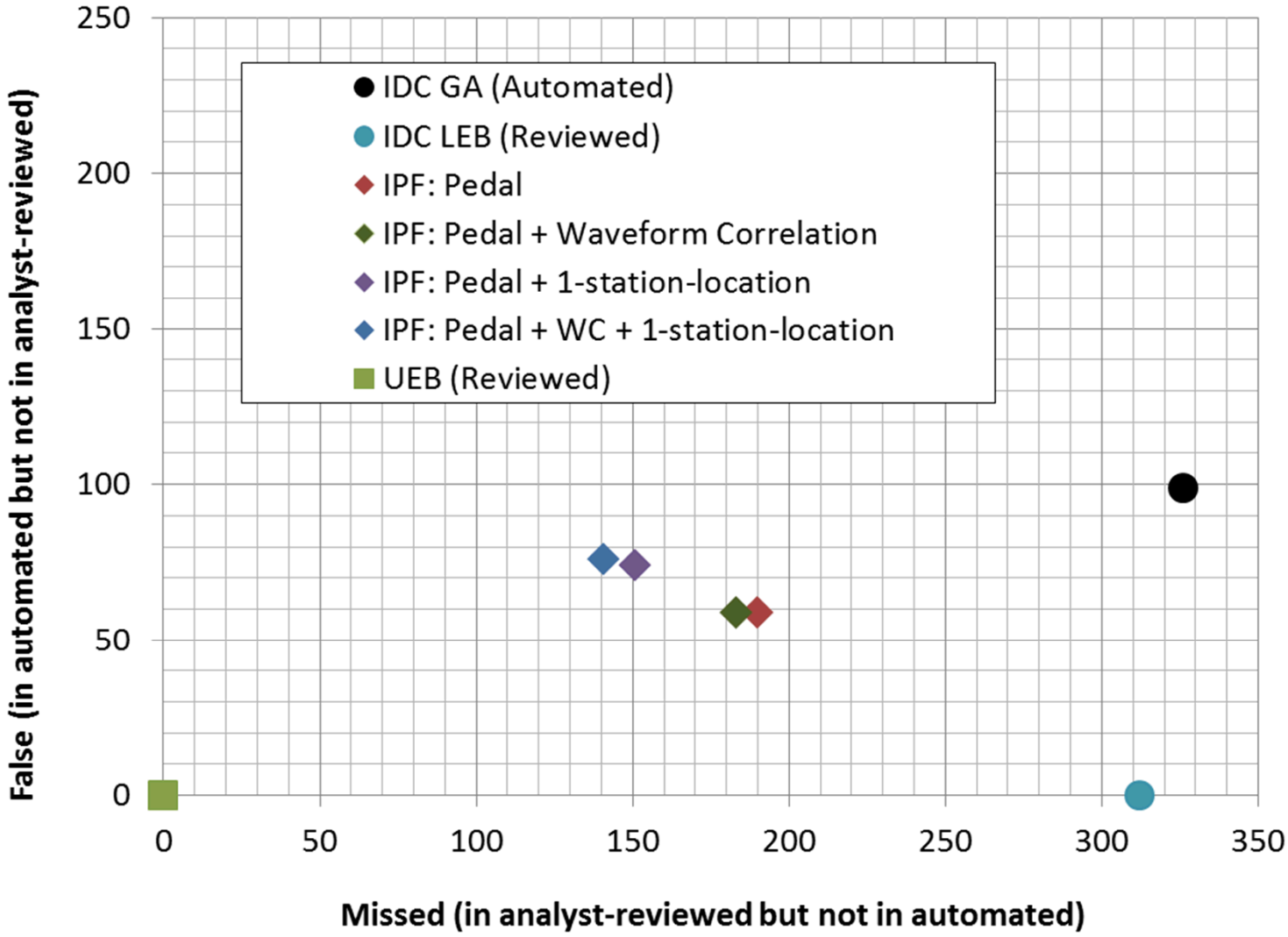
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