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(5) AWE Blacknest; (6) UC Berkeley

# SnT 2019

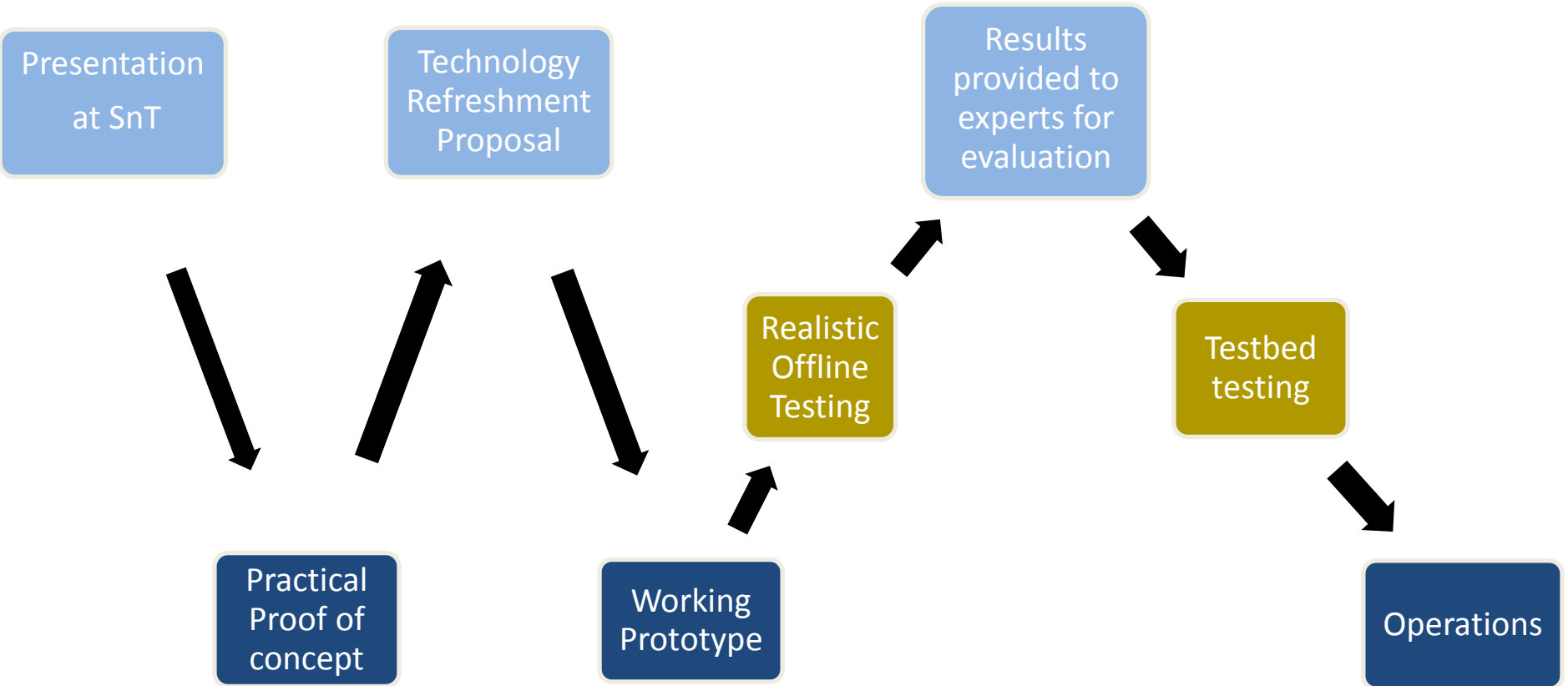
CTBT: SCIENCE AND TECHNOLOGY CONFERENCE

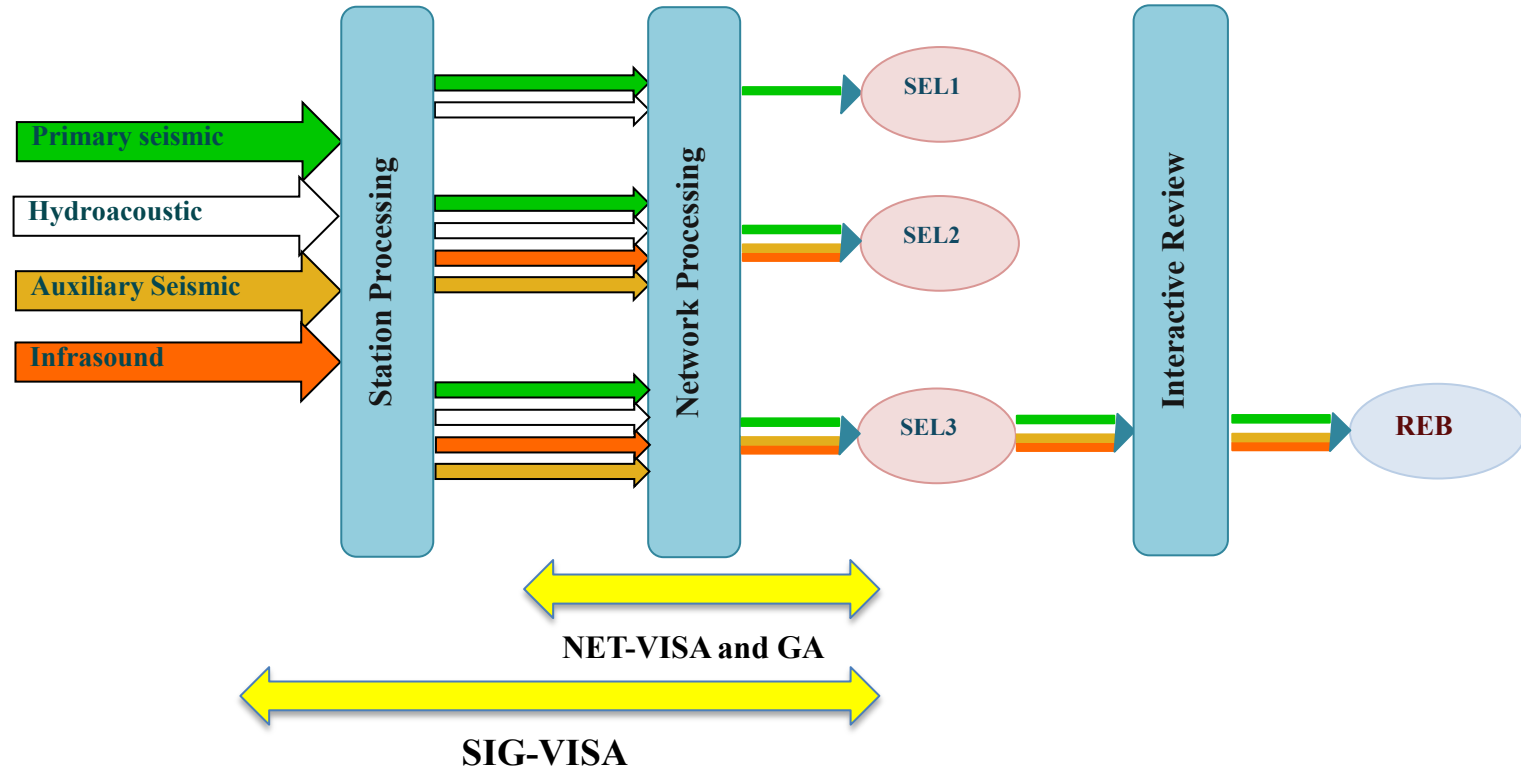


T2.5-O14. The machine-learning tool  
NET-VISA from cradle to adulthood  
The next generation system  
of the IDC and the SnT process

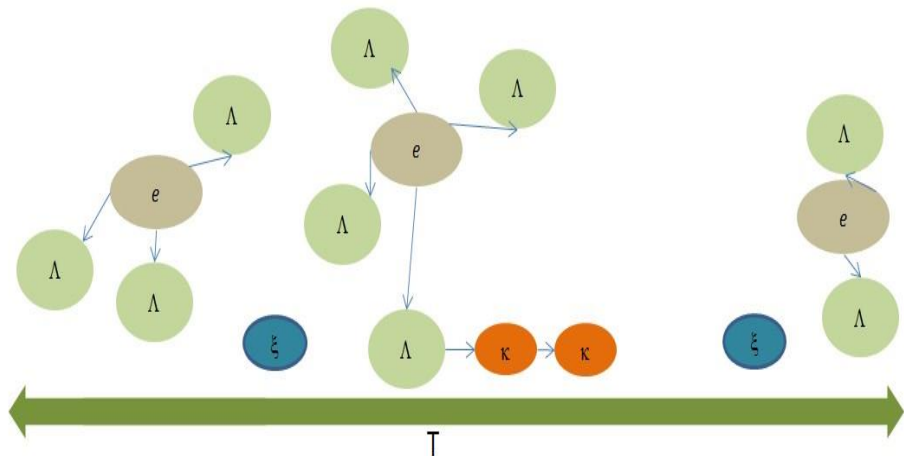
*The views expressed in this presentation are those of the authors and do not necessarily reflect the view of the CTBTO*

- Background
- History of R&D and Operations
- Accomplishments
- Plans

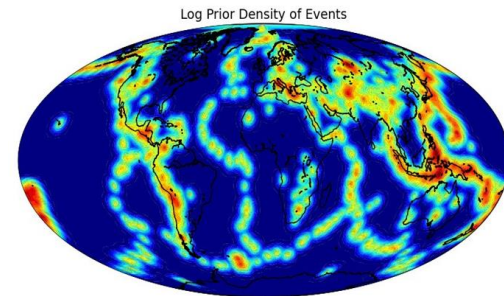




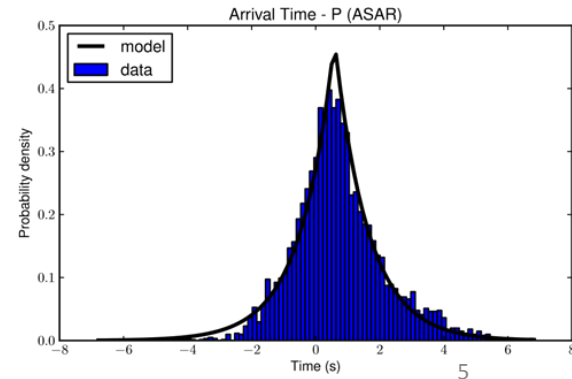
A hypothetical world. Events are denoted as  $e$ , arrivals associated with events are denoted  $\Lambda$ , detections not associated are denoted  $\zeta$ , and coda arrivals are denoted  $\kappa$ . Arrows indicate dependence. The job of NET-VISA is to figure out the structure of this graph by finding the events and the arrows that connect events to detections within time interval  $T$ . It will find the most probable set of events according to a prescribed probability model, which can be refined as more is learned from the reviewed bulletin.



Examples of probability distributions used in the NET-VISA model



The top figure shows the seismicity prior and the bottom the arrival residual prior for phase P at station ASAR. These distributions are learned from the reviewed bulletins.





March 23-27, 2009  
“Boot Camp” for  
Seismology



June 10-12, 2009  
Presentation and poster  
in Data Mining session



November 9-11, 2009  
Technical Meeting on  
Multi-sensor Data Fusion

## WGB 34



February 15 – March 5, 2010  
Prof. Stuart Russell.  
Technology Refreshment



September 6-10, 2010  
Montpellier, France  
Workshop on Machine  
Learning and Earth Structure



June 6-7, 2011  
Technical Meeting on Machine  
Learning and large event  
sequences processing  
June 8-10, 2011  
S&T 2011



June 17-21, 2013  
SnT 2013



June 22-26, 2015  
S&T 2015



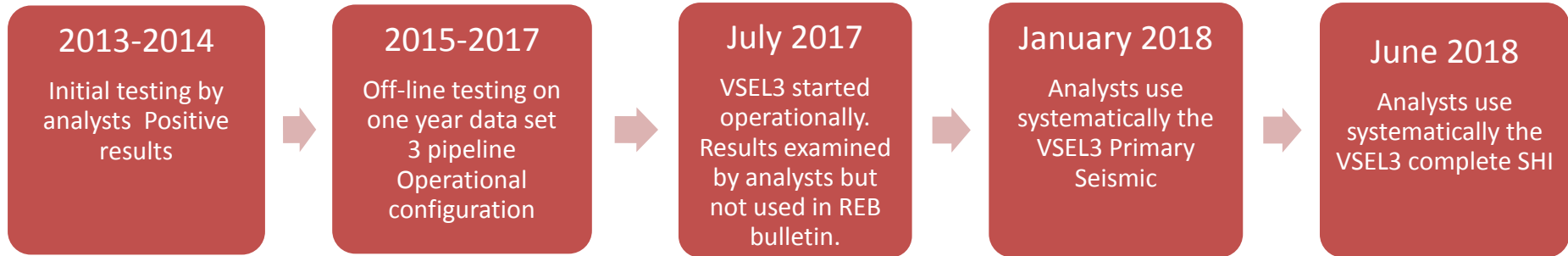
June 26-30, 2017  
S&T 2017

Arora et al., 2013 Paper published

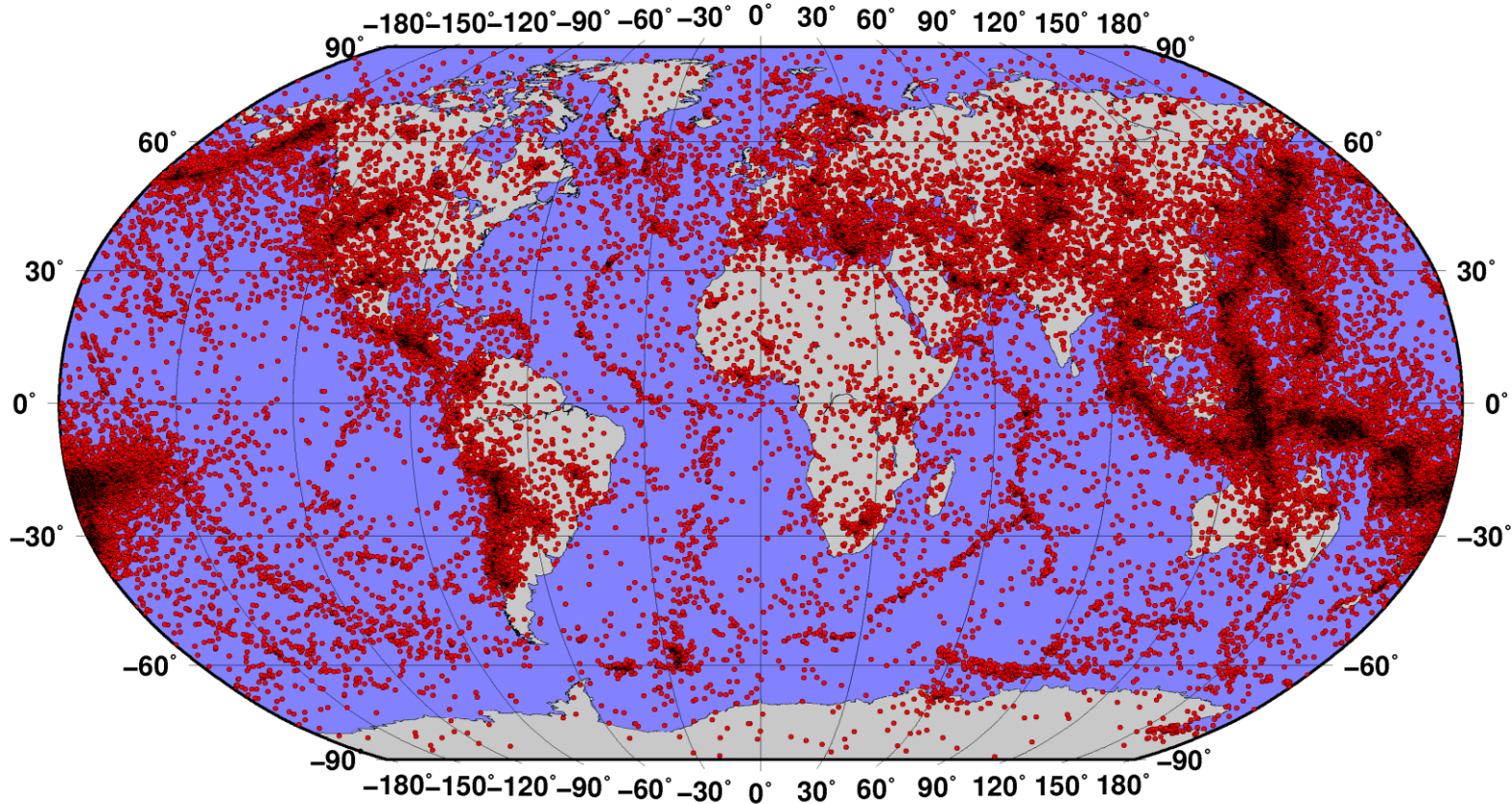
## Feature additions and improvements



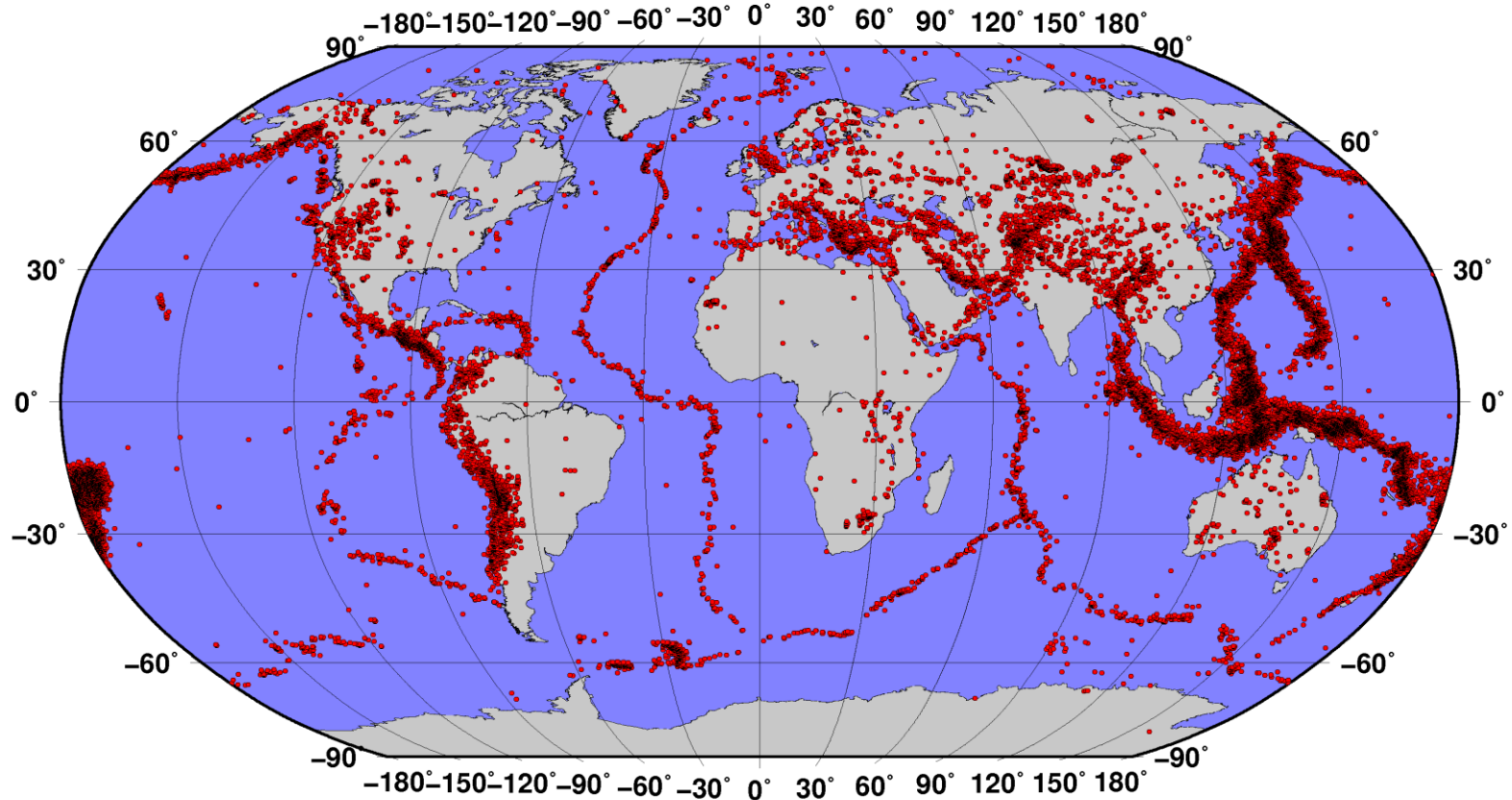
## Testing and Operational implementation



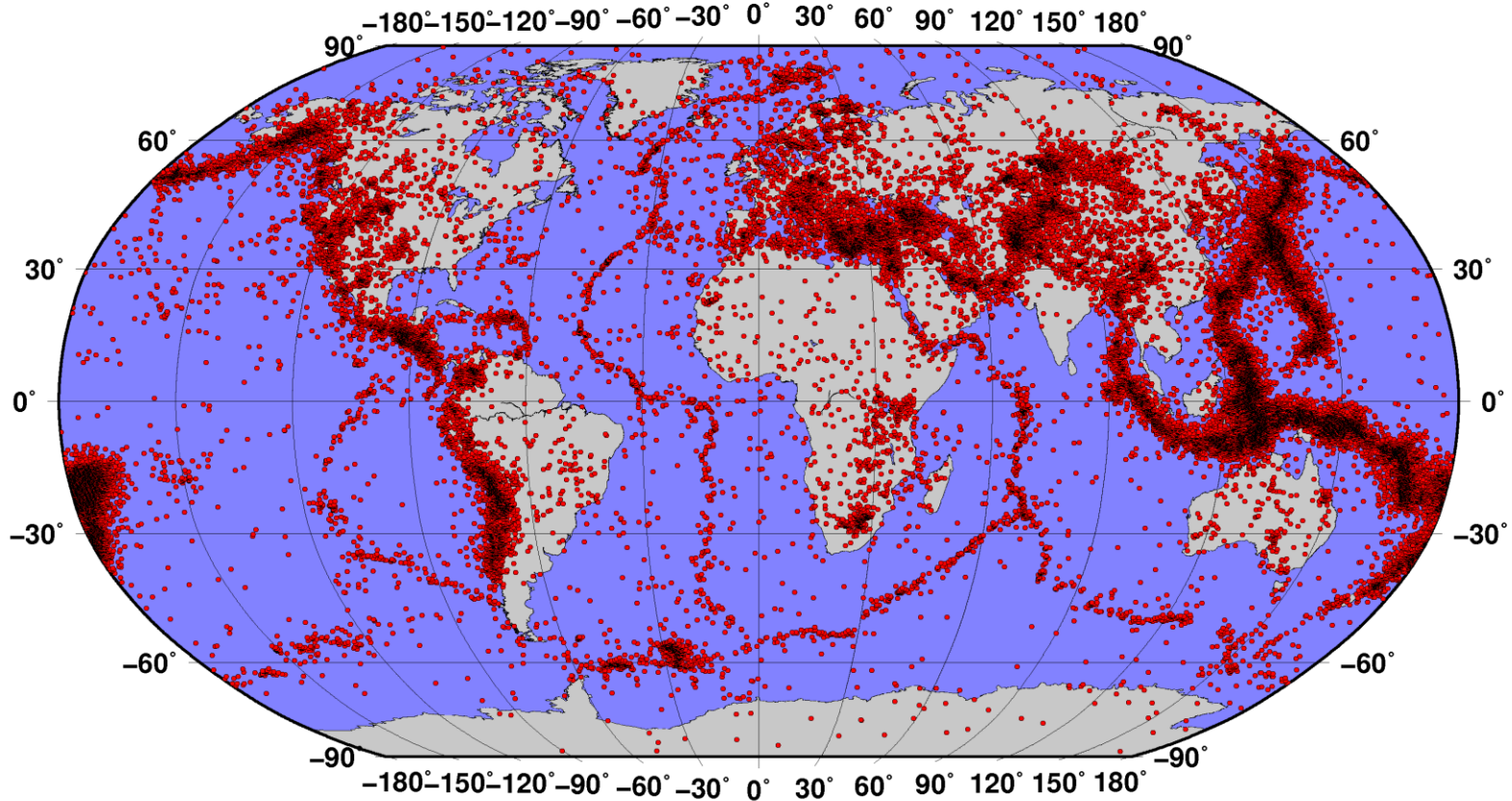
# Offline automatic test One year (2013) of data - SEL3

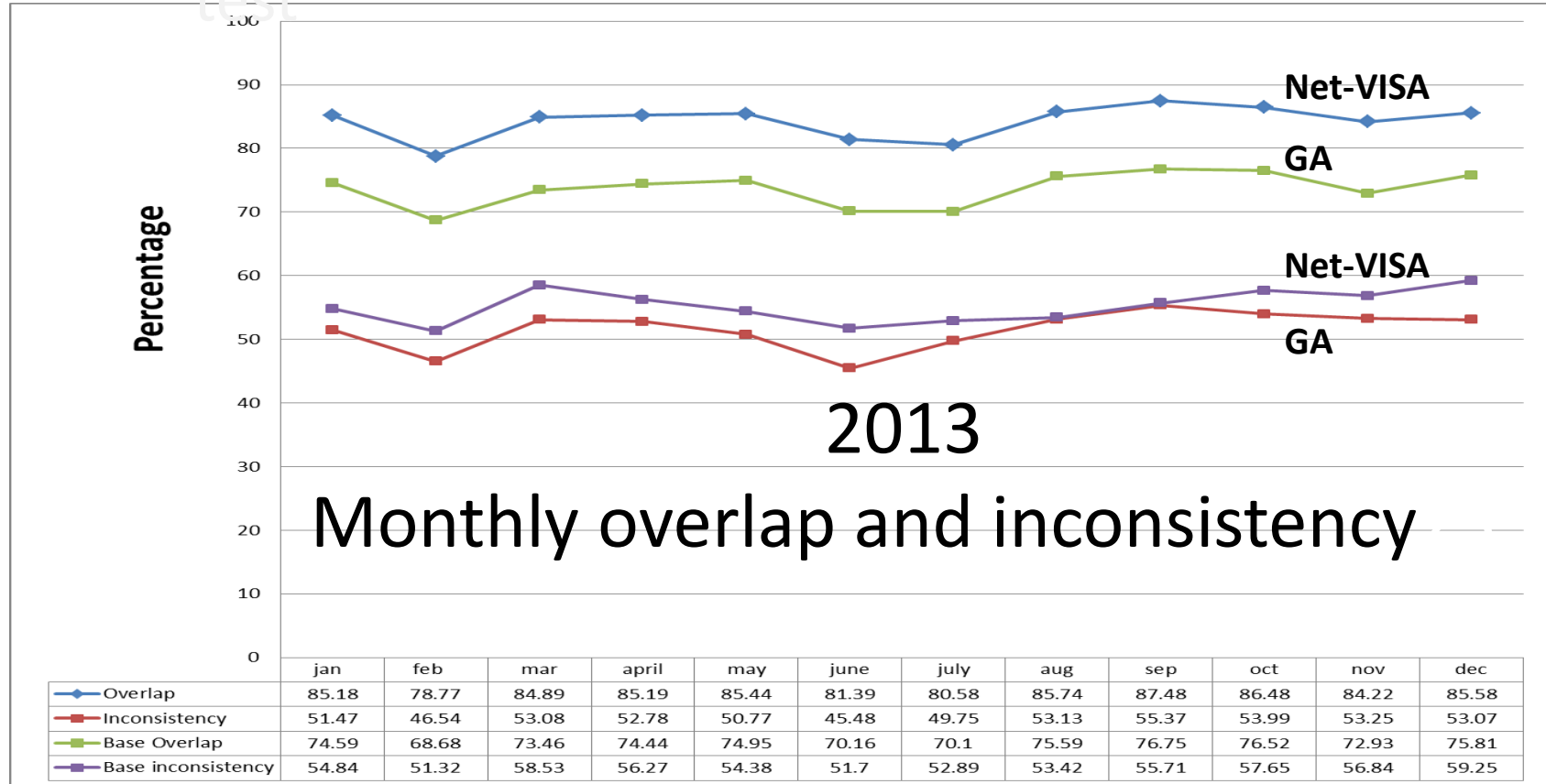


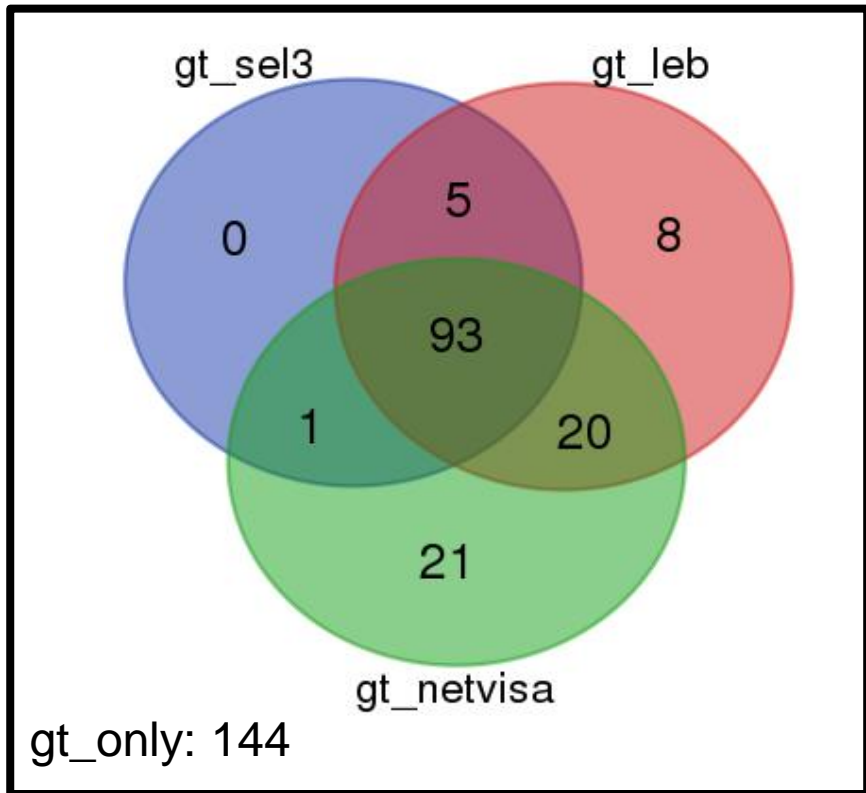
# Offline automatic test One year (2013) of data - LEB



# Offline automatic test One year (2013) of data – NET-VISA







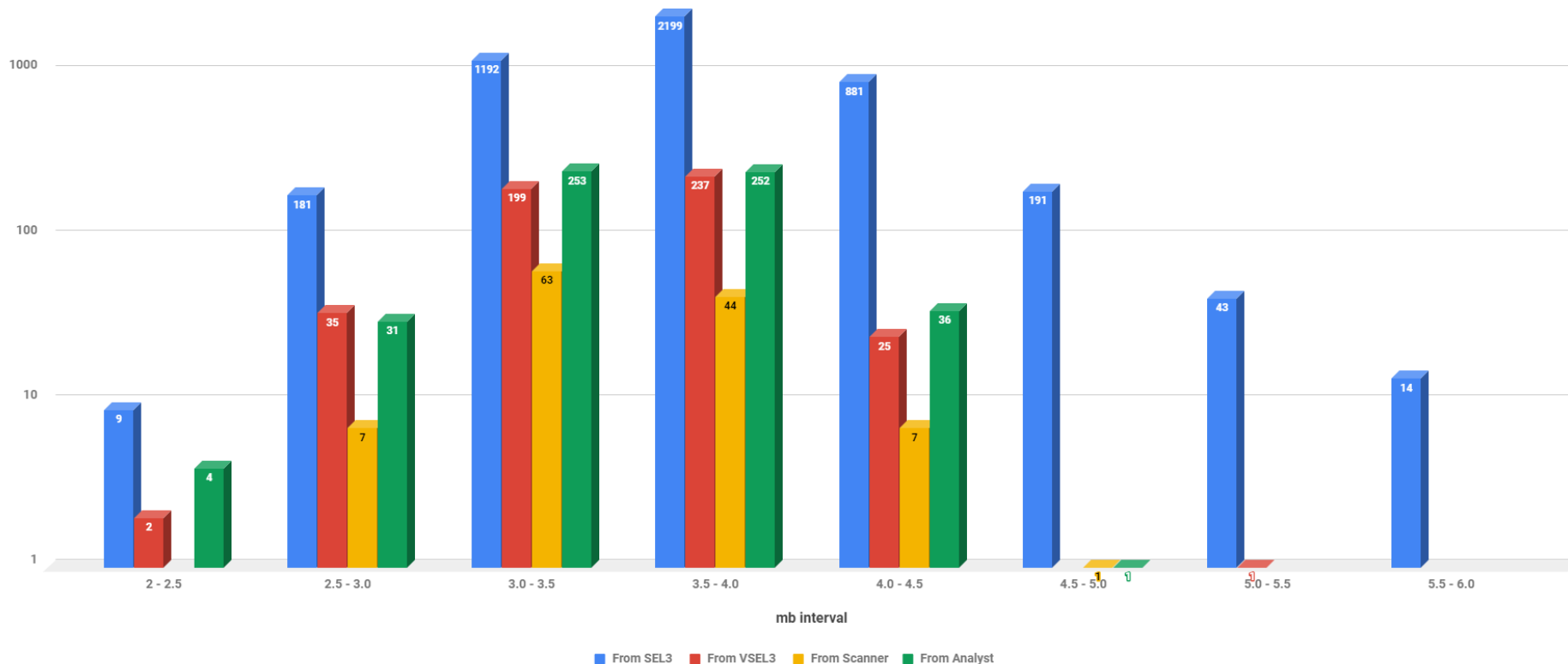
Matching criterion:

Time: 2 min; Lat: 5 degrees; Lon: 5 degrees

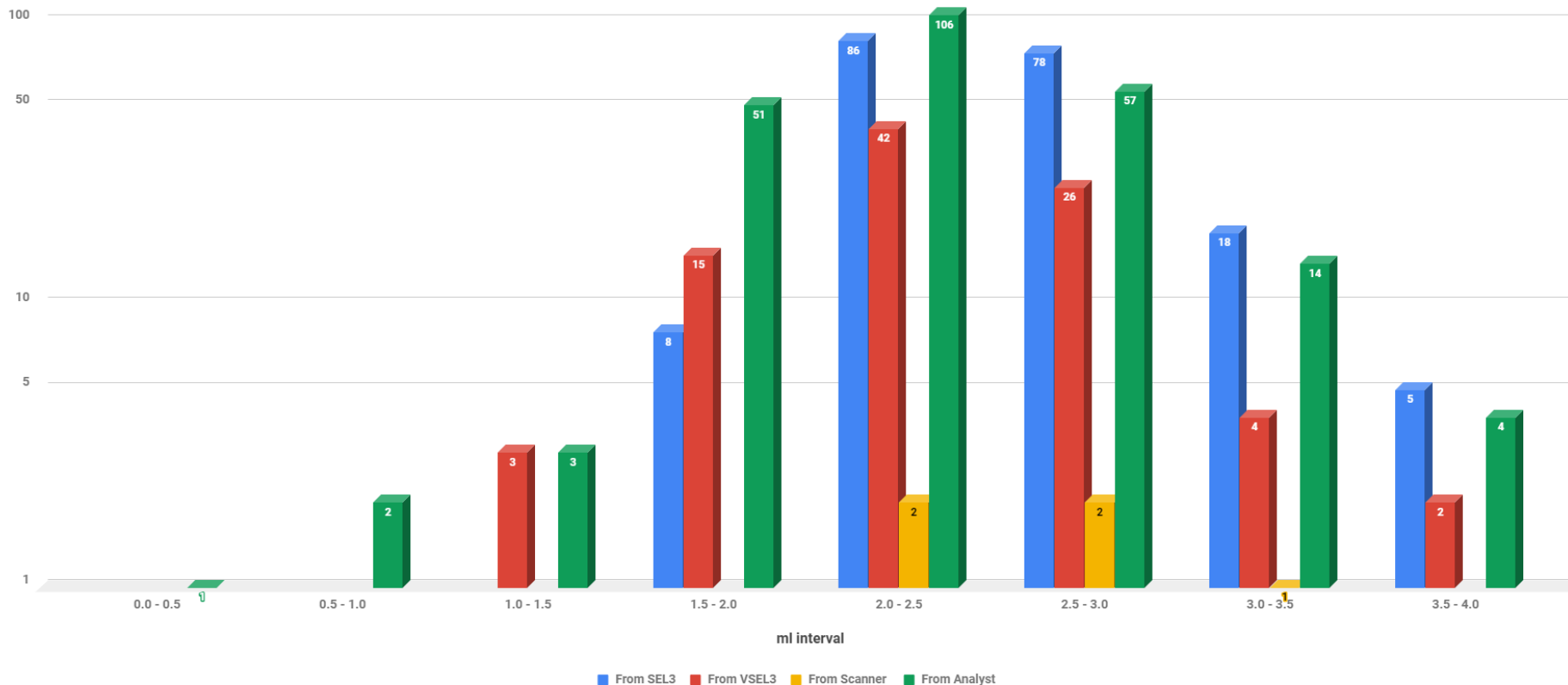
	Number	Average distance (km)	Average distance of 93 events in common (km)
Total GT	292		
GT in LEB	126	21	19
GT in NET-VISA	135	98	90
GT in SEL3	99	81	75
GT only	144		

Venn diagram showing the number of ISC 2013 GT events obtained in the LEB, SEL3, and Net-VISA bulletins.

Provenance (from evid) SEL3, VSEL3, Scanner, or Analysts



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- Full replacement of GA. Test the three-pipeline processing (SEL2/SEL2/SEL3) for NET-VISA in the development environment and propagate the configuration to operations.
- Upgrade to a newer version of NET-VISA (2.3.11) which is compatible with the NDC-in-Box version and contains improvements for regional events and aftershock processing.
- Setup synthetic test cases for stress-testing of NET-VISA (e.g. Explosion during a large aftershock sequence in the immediate proximity of the sequence; Explosion in an area of the Earth where IMS network detectability level is lowest.)