Realtime detection and location of very local seismicity using SeisComp3

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We put SeisComp3 to test by using it to analyze a very dense (9 squared kilometers) local network of 712, four components sensors (stations). Each station had a 3-component accelerometer and a pressure sensor deployed at the ocean bottom, close to the Brazilian platform near an oil exploration field. Noise levels were extreme. During the two months of the operation time, the network recorded an earthquake swarm sequence, and later analysis indicated more than 1000 earthquakes detected in a one-hour interval employing a coherency stacking method. While still not a common practice, real-time earthquake detection and location in this situation would be beneficial since this could support decisions while drilling or oil recovering is in place. Traditional tools as SeisComp3 are routinely used and allows for real-time detection and location along with the rapid revision of regional and teleseismic events, but are not widely adapted to work in a very local environment. Our experience so far showed that SeisComp3 efficiently handled the data volume (4 components at 500 samples per second times 712 stations) with a modern average workstation. Traditional SEG-Y data can be routinely converted and fed in real-time to SeedLink FIFO using ObsPy. Still, data must be correctly rotated since SeisComp3 needs at least a vertical component. Processing workflow included parallel picking using scautopick with STA/LTA, nucleation of origins using scautoloc, and location using Locsat and Hypo71 tools. In this harsh environment, the optimal window size for STA is about the size of the P-wave (0.05-0.1 s) and, LTA is about 30-60 times the S-P times (60-120 s). Using those parameters, SeisComp3 managed to generate from 400-1200 readings per data channel. We fed all picks into scautoloc that handled origin nucleation and location. Despite parameters supplied to scautoloc, the tool has many limits and relations hardcoded that inhibit it from respecting maximum requested residuals. In other words, its nucleation algorithm is adapted to work on the teleseismic and regional scale. Actual results indicate that we were able to nucleate and locate only 10-20% of known origins. Due to the flexibility of the tool, we also developed a pipeline using S-waves only. S-waves had a higher SNR for the events of interest and, due to lower velocities, presents a larger moveout on the small array easing the location. Manually picked and relocated detections returned an RMS lower as 0.04 s. Additional tests performed using the Scanloc module (GEMPA closed source nucleator) showed a higher performance during the nucleation of new origins. In this case, Hypo71 was the used locator. We did not observe any clear difference between LocSat and Hypo71 performance once the earthquake source is nucleated, and a proper velocity model is supplied.