Comparison of KIGAM and IDC REB Analysis Results for Earthquakes Around the Korean Peninsula

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INTRODUCTION AND MAIN RESULTS

We compared earthquake locations (mb or Ml ≥ 3.0) around the Korean Peninsula from January 1, 2010, to April 30, 2024, using catalogs from KIGAM (Korea Institute of Geoscience and Mineral Resources) and the CTBTO/IDC REB. Initially, 425 event pairs were selected based on magnitude, location, and origin time using **BulCMP**. From these, 43 high-confidence events within the region N 33~39, E 124.5~130.5 were reselected. These showed a **southwestward bias** in IDC REB locations compared to KIGAM, especially for inland events.

RSTT_SSSC was applied to relocate IDC REB 34 events (from January 1, 2010, to August 12, 2020) using **EvLoc**. After applying RSTT_SSSC, the **error ellipse area (EEA)** decreased, with **75% of cases below 1,000 km²**. Epicenter differences also became smaller, typically shifting **eastward and northward**. These results indicate that **RSTT_SSSC improves epicenter location accuracy**.

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Matched Earthquakes Around the Korean Peninsula Using BulCMP

- Earthquakes (2010/1/1 ~ 2024/4/30, mb or ML ≥ 3.0)
  (Lat. 30 to 44, Lon. 115 to 136, Mag. ≥ 3.0 (mb or ML),
  Smajax 0~100 km, Sminax ≥ 0, RMS < 100 sec, Ndef ≥ 5)
  - KIGAM: 1,030 events, IDC REB: 2,511 events
  - **Matched events among them: 425**

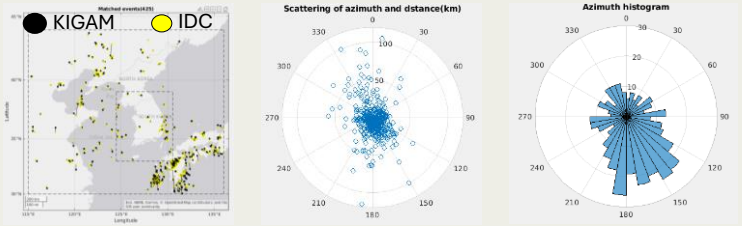

Figure 1. Matched events and the azimuth/distance differences <= 150 km

- **For earthquakes of lat. (33~39°) and lon. (124.5~130.5°) indicated by dash lines**
  - The number of events was **43**
  Relative location vectors based on KIGAM predominantly pointed in the southwest direction.
  This indicates that for earthquakes occurring in the **South Korean inland region**, the **IDC location results tend to be biased southwest** compared to the actual locations (as determined by KIGAM).

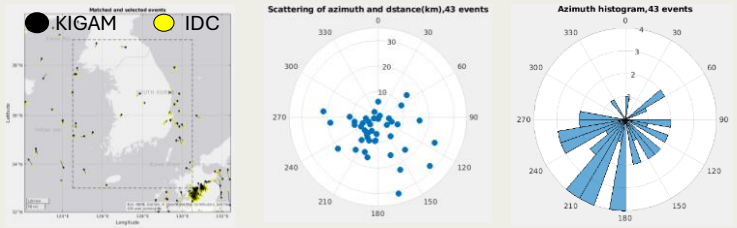

Figure 2. Reselected pairs and the azimuth/distance differences <= 50 km

Comparison of IDC REB Locations (Pre/Post RSTT_SSSC) Referenced to KIGAM

- **IDC began applying RSTT-based station corrections (RSTT_SSSC) from August 13, 2020.**
  From **2010 to August 12, 2020**, **34 events** were matched between KIGAM and IDC REB.
  Each event was compared **before and after RSTT_SSSC** to assess its impact.
- **EvLoc & UDB setup to recalculate events.**
  EvLoc is a module that uses libLoc
  To recalculate locations with EvLoc, key **REB schema tables** copied into a user DB (**UDB**)
- **Epicenter and Station Path Visualization Tool**
  Uses **Dbtools (by Saragiotis)** to query IDC DB via SQL
- **Applying RSTT_SSSC, epicenter locations were recalculated for 34 events**, and results were compared before and after RSTT using data from UDB.

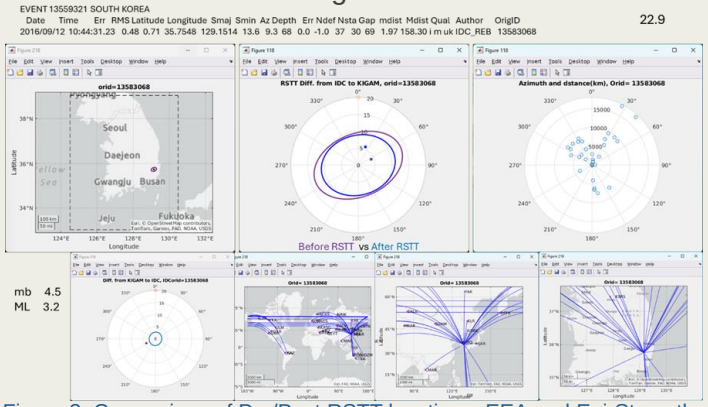

Figure 3. Comparison of Pre/Post RSTT locations, EEA and Epi-Sta paths

- **Post RSTT**, ellipses became smaller.
- **Epicenters shifted eastward after RSTT** for events with **high KIGAM accuracy** (ellipse ≤ 100 km²).

- **Figure 4** shows a box plot of Error Ellipse Area (EEA = Smajax × Sminax × π) at 95% confidence, from catalogs.
  - Horizontal dashed line marks **1,000 km².**
  - Event Groups recalculated with fixed depth using EvLoc.
    - All events (left), EEA < 200 km² (center, 24 events), EEA < 100 km² (right, 14 events)
  - **EEA decreased after RSTT**, and **75% of events** met CTBTO's <1,000 km² guideline.

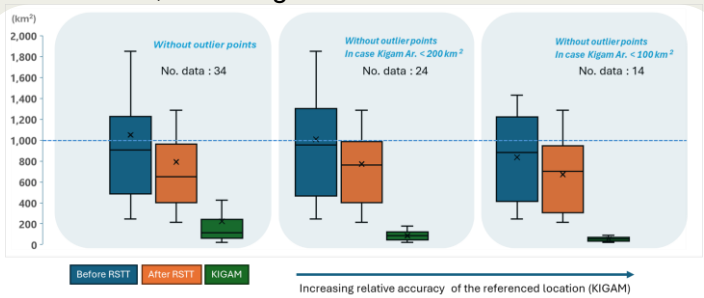

Figure 4. Comparisons of the Error Ellipse Area(Pre/Post RSTT)

- **Figure 5** shows pre/post epicenters in polar coordinates relative to KIGAM (**Blue dots** = before RSTT, **Orange triangles** = after RSTT, **Arrows** connect both positions)
  Left plot: arrows mostly point **east** (EEA < 100 km²)
  Middle plot: similar eastward trend (EEA 100–500 km²)
  Right plot: low confidence, **no clear pattern**

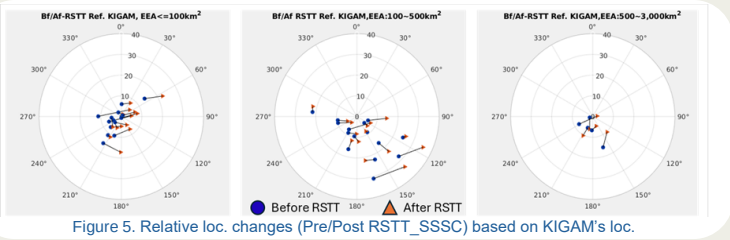

Figure 5. Relative loc. changes (Pre/Post RSTT_SSSC) based on KIGAM's loc.