iLoc: New Developments on the ISC Locator
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Abstract
The new location algorithm developed for the International Seismological Centre (ISC) has been operational since January 2011. By providing improved hypocentre location and magnitude estimates, the ISC locator has increased the efficiency and productivity of the ISC review process to generate the reviewed ISC bulletin. A new development branch has spun off the ISC locator in 2014, the iLoc locator, iLoc by default supports local and regional travel-time predictions provided by the Regional Seismic Travel Time (RSTT) software package developed by the US DoE National Laboratories. Albeit not fully integrated with SeisComp3, iLoc can communicate with the SeisComp3 database. It also supports the new International Seismic Format (ISF2) as well as the new standards for the International Registry of Seismographic Stations conventions.

The iLoc Location Algorithm
The iLoc location algorithm is the successor of the ISC location algorithm (Bondár and Storchak, 2011) with new features focusing on the needs of local and regional network operators, as well as global location studies. iLoc is open source, and can be downloaded from the ORFEUS seismological software library. http://www.orfeus-eu.org/software/seismo_softwarelibrary.html

Features inherited from the ISC locator
- Travel-time predictions for ak135 (Kennett et al., 1995) phases used in location
- Elevation, ellipticity (Dziewonski and Gilbert, 1976; Kennett and Gudmundsson, 1996) and depth-phase bounce point corrections (Engdahl et al., 1998)
- Correlated travel-time prediction errors are accounted for
- Initial guess from Neighbourhood Algorithm search (Sambridge 1999; Sambridge and Kennett, 2001)
- Linearised inversion using a priori estimate of the full data covariance matrix (Bondár and McLaughlin, 2009)
- Attempt for free-depth solution only if there is depth resolution
- Default depth is derived from historical seismicity
- Independent depth estimate from depth-phase stacking (Murphy and Barker, 2006)
- Robust body and surface wave magnitude estimates with uncertainties
- Support for the ISC database schema
- Support for IMS1.0 and ISF1.0 bulletin formats

New features
- Integrated RSTT regional travel-time predictions RSTT (Myers et al., 2010)
- Pn/Sn and Pg/Lg travel time predictions can be turned on and off
- Support for local velocity models
- Travel-time predictions for local phases are calculated from the local velocity model up to a distance (3 degrees by default), beyond iLoc switches to ak135/RSTT predictions
- Local velocity model can be extracted from the RSTT model or specified separately
- Support for the SeisComp3 database schema
- iLoc reads and writes SeisComp3 MySQL database tables
- Support for the new International Registry of Seismographic Stations conventions
- Support for the new International Seismic Format (ISF2)
- Improved phase identification

NEIC PDE Relocations with iLoc
The performance of iLoc was tested on the NEIC PDE bulletin from 2013-07-23 to 2014-05-21, altogether 10 months worth of data with more than 20 thousand events. The PDE bulletin was relocated with ak135 travel-time predictions (NEIC also uses ak135) to compare the performance of iLoc and the NEIC locators, as well as with RSTT Pn/Sn predictions to see the improvements due to a 3D velocity model. In general, iLoc makes the seismicity tighter and better resolves the geometry of subducting slabs. RSTT, where it is well defined (Americas, Eurasia) provides further, albeit marginal refinements.

iLoc with Local Velocity Models – Seismicity in the Pannonian Basin
iLoc provides support for local velocity models from which the travel times of local phases (Pg, Pn, P, PpGg, PpPh, PnPh, Pp, pSn, sPb, sPb, sPb) are calculated up to 3 degrees. Local velocity models can also be extracted from RSTT (currently RSTT incorporates CRUST2.0).

References