State of the GPS network and velocity solution across the entire East African Rift

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Abstract

We present the latest GPS velocity solution for the entire East African Rift, processed by the Geodesy and Geodynamics Group at MIT. The network consists of both continuously operating and survey-mode GPS sites, and is processed completely to the beginning of 2016. This will be updated periodically as new surveys are performed and continuous GPS data becomes available. The geodetic velocity solution provides constraints on the large-scale kinematics of surface motions as well as more local effects both within and outside of the rift structures.

Existing velocity solution

King et al. (2015) presented the GPS velocity solution generated at MIT using the GAMIT/GLOBK processing software with available data through to the end of June 2013 (2013.5). This velocity solution was made available to the scientific community and beyond through the GeoPRISMS Data Portal hosted by the Marine Geoscience Data System (MGDS) and formed the basis of Birhanu et al.'s (2016) study of deformation around the Main Ethiopian Rift.

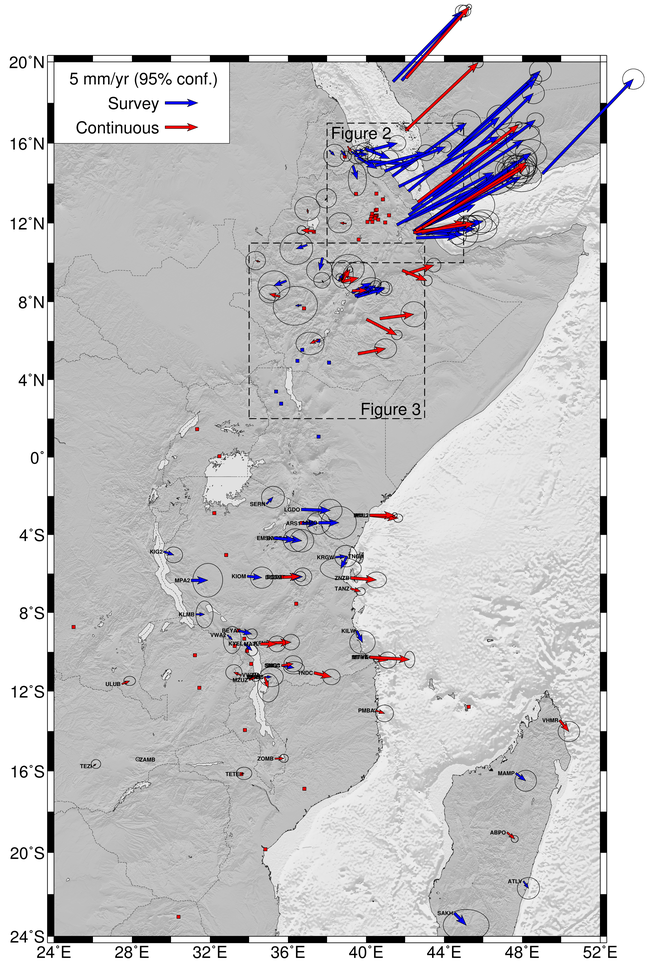
New velocity solution

Here we present the updated GPS velocity solution generated at MIT using available data through to the end of December 2015 (2016.0), shown in Figures 1, 2 and 3. More sites have been added and time series have been extended for better precision (Figure 4). This velocity solution is likewise being made available through the GeoPRISMS Data Portal hosted by the Marine Geoscience Data System (MGDS).

References

Birhanu, Y., R. Bendick, S. Fisseha, E. Lewi, M. Floyd, R. King, and R. Reilinger (2016), GPS constraints on broad scale extension in the Ethiopian Highlands and Main Ethiopian Rift, *Geophys. Res. Lett.*, *43*, doi: 10.1002/2016GL069890.

King, R., M. Floyd, R. Reilinger, and R. Bendick (2015), Preliminary GPS velocity field for the East African Rift System generated by King et al., *Integrated Earth Data Applications (IEDA)*, doi:10.1594/IEDA/321764.



← Figure 1

The latest version of the East African Rift GPS velocity solution, relative to Nubia. Only velocities with horizontal component uncertainties (1σ) less than 1.5 mm/yr are considered useful and shown here. Blue vectors are survey GPS sites, red vectors are continuous GPS sites. Red squares are continuous GPS sites for which we have available data but whose time series are not yet long enough to produce a reliable solution or otherwise do not fulfil our 1.5 mm/yr horizontal velocity uncertainty criteria. Blue squares are new survey measurement sites undertaken as part of former and current GeoPRISMS project grants in the Turkana region.

Figure 2 →

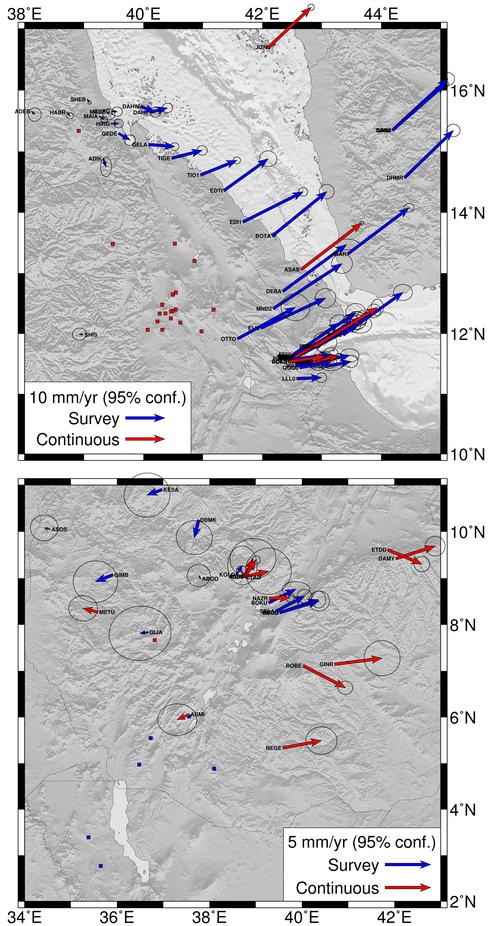
Close-up view of the Afar triple junction and Danakil region adjacent to the Red Sea. Velocity uncertainty limits, vectors and squares are as described for Figure 1, but note the change of scale.

Figure 3 →

Close-up view of the Main Ethiopian Rift region. Velocity uncertainty limits, vectors and squares are as described for Figure 1, but note the change of scale.

Collaborators and contributors

The GeoPRISMS EARS GPS Working Group includes the following institutions: Addis Ababa University, Ethiopia; Ardhi University, Tanzania; Australian National University; Ecole Normale Superieure (ENS), France; Eritrean Institute of Technology; King Abdulaziz City for Science and Technology (KACST), Saudi Arabia; King Abdullah University of Science and Technology (KAUST), Saudi Arabia; Massachusetts Institute of Technology; National Institute of Astronomy and Geophysics (NRIAG), Egypt; Purdue University; Saudi Geological Survey; SEGMENT consortium (http://www.ldeo.columbia.edu/~djs/segment); University of Montana; Virginia Tech.



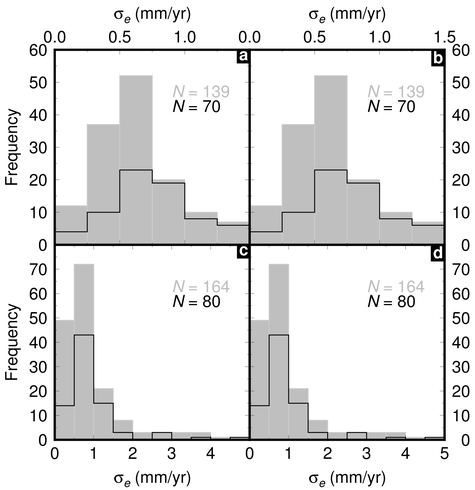


Figure 4

Histograms of east (a,c) and north (b,d) velocity uncertainties for the existing (black stair-step) and new (gray bars) solutions. Numbers indicate the sites from each solution with velocity uncertainties within the range of the *x*-axes. (a) and (b) correspond to the precise velocities shown in Figures 1, 2 and 3. (c) and (d) show all velocities in the new solution, including those with large uncertainties.

Data sources

RINEX files for all of the reference cGPS stations are available from one of the IGS Data Centers: NASA Crustal Dynamics Data Information System (CDDIS) (http://cddis.gsfc.nasa.gov); Institut Geographique National (IGN) (http://webigs.ign.fr/en/gdc); or Scripps Orbit and Permanent Array Center (SOPAC) (http://sopac.ucsd.edu). Additional cGPS data for the South African TrigNET are available from http://www.trignet.co.za. EARS RINEX files are available from the UNAVCO archive (observed and delivered by one or more of the institutions listed in "Collaborators and contributors", left) or from the CNRS Institut National des Sciences de l'Univers (https://gpscope.dt.insu.cnrs.fr/spip/spip.php?article156 for survey-mode data and https://gpscope.dt.insu.cnrs.fr/chantiers/afar/ for continuous data). Use of these data should be accompanied by a citation given by the DOI (available for UNAVCO data sets) or other appropriate publication reference.