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Determination of Current Velocity Field (Rate) of North Anatolian Fault in Izmit-Sapanca Segment

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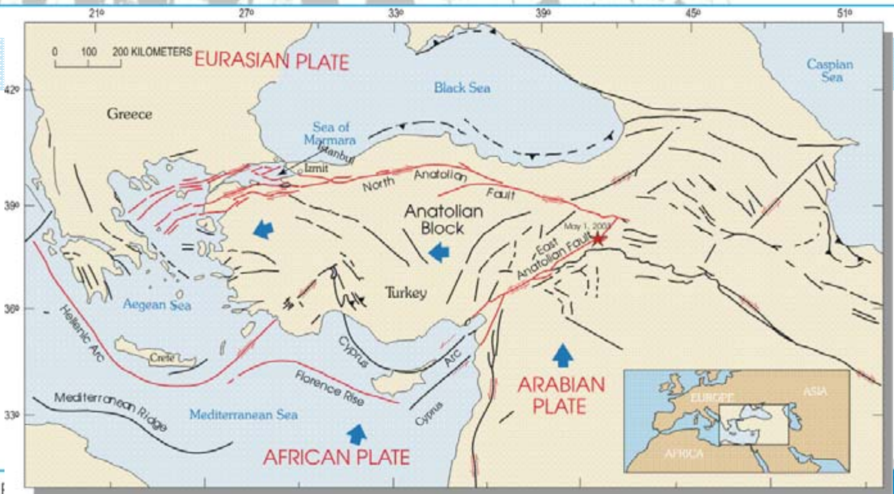

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Izmit-Sapanca Segment of NAF

- **NAFZ branches from 30.6º E westward into three active segments,**
- **the northern branch, the İzmit-Sapanca Fault, is not defined as a narrow shear zone, but is a complex deformation zone as wide as 5-8 kilometers.**
- **Studies monitoring horizontal crustal movements on this segment of NAFZ were started by the Geodesy Department of Kandilli Observatory and the Earthquake Research Institute of Bogazici University in 1990.**
- **After 4-year terrestrial geodetic measurements, GPS data have been continually collected since 1994**

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Sapanca Mikro-geodetic Network and Izmit-Sapanca fault segment of NAFZ.

Sapanca micro-geodetic network

- **The displacements in the Sapanca micro-geodetic network during the Izmit earthquake (Mw=7.5) on 17 August, 1999 were clearly monitored on SISL and SMAS points of the micro-geodetic work.**
- **It was determined that SISL and SMAS points were moved away from each other approximately 3 m as a result of the earthquake which can easily be seen from the curvilinear coordinate components, their mean errors and the correlation coefficient between East and North uncertainties given in Table 1 (Reilinger et al. ,2000).**

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GPS coseismic displacements and 1-sigma uncertainties. RHO is the correlation coefficient between the E (east) and N (north) uncertainties (Reilinger et al. ,2000).

Site	Long.(°)	Lat.(°)	E Disp.(mm)	N Disp.(mm)	E+/-(mm)	N +/-(mm)	RHO
SMAS	30.13	40.68	-1409.90	107.60	9.60	8.70	0.026
SISL	30.13	40.74	1635.30	-27.90	9.40	8.90	0.007

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GEODETIC OBSERVATIONS

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- This stu… results ob… aigns between the year…
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Receiver and antenna models used in GPS campaigns conducted in the Sapanca micro-geodetic network.

	2005	2006	2007	2009	2010
Receiver	4000SSi	4000SSE/SSi	4000SSi	4000SSE/SSi	4000SSE/SSi
Antenna	Perm. L1/L2	Perm. L1/L2	Perm. L1/L2 CompL1/L2wGP	Perm. L1/L2	Perm. L1/L2 CompL1/L2wGP

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- The processing of the GPS data is performed with the GAMIT / GLOBK software package using the International Terrestrial Reference Frame ITRF2005.
- 14 IGS stations, namely ANKR, BUCU, GRAZ, ISTA, KIT3, MATE, NICO, NSSP, ONSA, SOFI, TRAB, TUBI, WTZR, ZECK, are included in the process to calculate Earth Rotation Parameters more precisely and to associate the local network with the global network.
- Precise final orbits by the International GNSS Service (IGS) are obtained in SP3 (Standard Product 3) format from SOPAC.
- Earth Rotation Parameters (ERP) comes from USNO-Bulletin-B (United States Naval Observatory_Bulletin_B).
- The 9-parameter Berne model is used for the effects of radiation and the pressure.
- The IERS 2003 model (McCarthy and Petit, 2004) and FES2004 are used for the solid earth tide and the ocean tide loading effects.
- The Zenith Delay unknowns are computed based on the Saastamoinen a priori standard troposphere model with 2-h intervals.
- Iono-free LC (L3) linear combination of L1 and L2 carrier phases is used.
- Loosely constrained daily solutions obtained from GAMIT are included in the ITRF2005 reference frame by a 7 parameters (3 offset–3 rotation–1 scale) transformation with 34 global IGS stations.
- Station velocities are obtained from trend analysis by time series which formed by daily precise coordinates combined with Kalman analysis.

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Network points in detail

The network points SISL, SESM and SASK were chosen to be on the northen part of the fault while the points SMAS and SYNK to be on the southern part of the fault.

Employing GPS observation techniques has led us to concentrate on two network points, one on each side of the fault, chosen for their best descriptive characteristics of the fault, namely SISL and SMAS.
Besides, SESM and SYNK points have attained narrow signal clearance sight to GPS satellites over the years because of overgroving vegetation and trees

- Moreover, SESM point has produced a velocity vector which may be contributed to local movements of the point.
- SASK point, on the other hand, is closer to the fault line than the rest of the points, which might be affected by the fault's local movements.
- Table lists the Eurasia-fixed velocity field of the points in the network for the period of years 2005-2010 and Figure 4 their horizontal velocities.

Site	Lon. (deg)	Lat. (deg)	E_{vel} (mm/yr)	N_{vel} (mm/yr)	E_{sig} (mm/yr)	N_{sig} (mm/yr)
SASK	30.159	40.730	-12.17	-0.71	0.65	0.76
SESM	30.181	40.735	-7.50	-8.01	1.28	1.55
SISL	30.130	40.745	-6.35	-1.20	0.75	0.89
SMAS	30.134	40.690	-19.58	-0.02	0.86	1.00
SYNK	30.176	40.691	-16.82	-0.88	3.45	4.05

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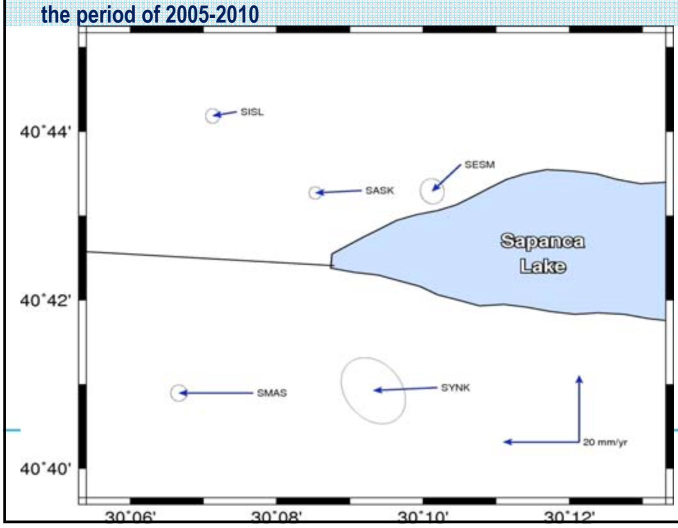
GPS horizontal velocities and their %95 confidence ellipses in a Eurasia-fixed reference frame for the period of 2005-2010



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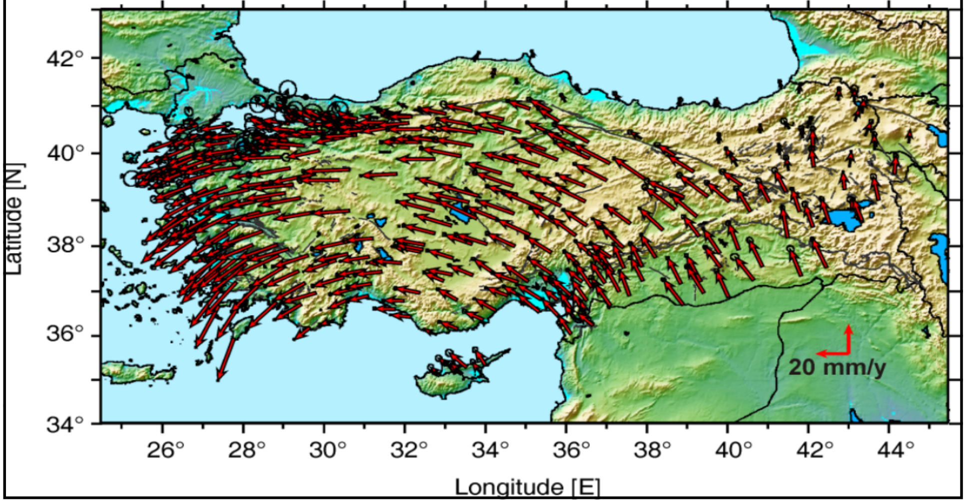
The directions of horizontal velocities from the Sapanca micro-geodetic network are in coherence with the results obtained for the horizontal velocities of the same area found by [Aktug et al, 2009]



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CONCLUSIONS

- After the analyses of the GPS observation periods it has been found that the point SISL on the northern part of the fault moved 6.5mm per year while the point SMAS on the southern part of the fault 19.6mm per year in a Eurasia-fixed frame.
- This finding appears to be in conformity with the known behavior of the North Anatolian Fault Zone.
- The anomaly observed at the point SESM is considered to stem from the individual movement of the point which is not attributed to the seismic origin.
- Furthermore, the point SYNK has a diminishing signal clearance to visible satellites of its horizon owing to fast growing vegetation and trees around the site over the years, hence its elevated sigma values and large error ellipse
- It is our assessment that the results ought to be improved by repeating GPS observations in this network.

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Thank you for attendance

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