ADRIATIC TECTONICS:
RIGOROUS TESTS OF PRESENT-DAY PLATE MOTION USING CONTINUOUS GPS

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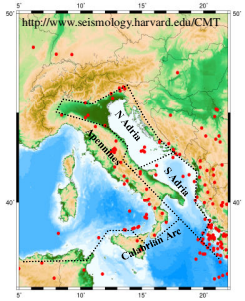
Introduction

The Adriatic microplate lies within a collisional environment caused by the northward motion of the African tectonic plate and its subduction under the Eurasian plate.

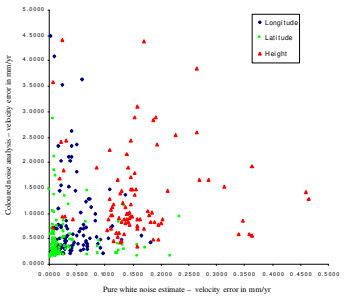


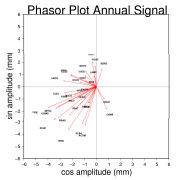
- 113 global and European GPS sites, have been processed for the period 1999-2004 using GIPSY Precise Point Positioning.
- We have obtained rigorous estimates of the ITRF2000 velocities and their confidence limits using the CATS software[1].

Figure 1 Earthquakes in the Adriatic Region since 1976. Dotted lines show block boundaries[2].

Time Series Analysis

- There are two types of noise that are pertinent in this study; time-independent noise known as white noise and time-correlated, or coloured noise. The assumption that purely time-independent noise occurs can lead to greatly underestimated velocity errors[1,3].
- Time series analysis software (CATS) uses the Maximum Likelihood technique to estimate noise parameters and the amplitude and phase of seasonal signals[1].
- Mean inflation factors of velocity errors after coloured noise analysis are 29.9(Lat), 36.3(Lon) and 21.0(Hgt).
- Mean spectral indices are -0.97(Lat), -1.00(Lon) and -1.16(Hgt).





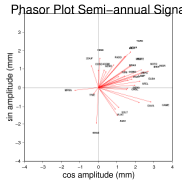


Figure 2 **A** – Scatter-plot of velocity errors with white noise versus coloured noise analysis. Note vertical exaggeration ×10. **B** - Annual and semi-annual vertical signals for selected Italian sites [by convention $h(t) = A_{cos}\cos(\omega t) + A_{sin}\sin(\omega t)$].

Euler Pole Estimation

Site selection was based on the following criteria:

- Time series longer than 2.5 years.
- No major offsets, data gaps or tectonic events.
- Sites in northern Scandinavia eliminated due to the presence of strong seasonal signals.
- 1-sigma horizontal component formal errors less than 1 mm.

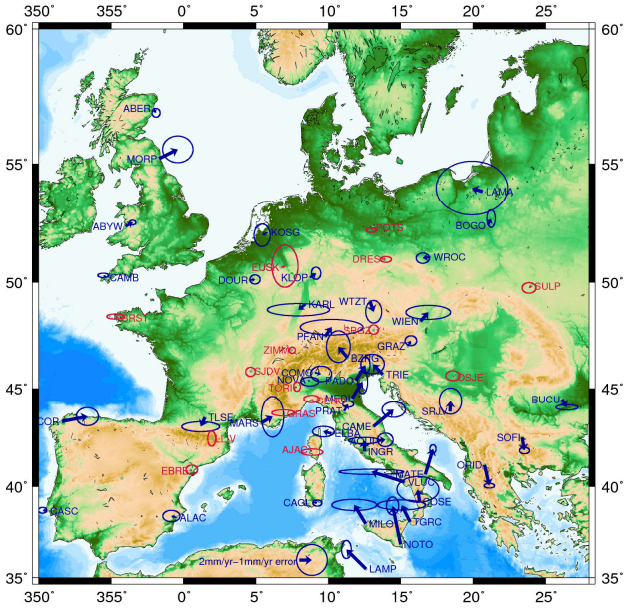


Figure 3 Plot showing the sites used in the Euler pole estimation for Eurasia (red). Vectors in blue are residuals to the pole with 95% confidence error ellipses.

Defining Adriatic motion

Defining the motion of the Adriatic plate is difficult due to the paucity of available sites in this region. Many of the sites processed are in deformation zones at the plate boundaries and are not representative of rigid plate motion.

One aim of this study was to test the existence of northern and southern Adriatic plates that are moving differentially to Eurasia.

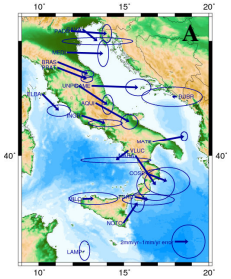


Figure 4 **A** – Adriatic residuals w.r.t. Africa (blue). **B** - Residuals to northern Adriatic plate model (purple) and residuals to the southern Adriatic model (orange). Sites named are those used in Euler pole generation. DUBR error ellipse scaled by 0.5 in both plots.

Model	Lat	Lon	Angular Velocity	S-maj	S-min	Azimuth
Eurasia Absolute (This Study)	54.13	258.15	0.247 ± 0.001	0.97	0.12	31.1
Eurasia Absolute [4]	*55.80*	*257.90*	*0.250 ± 0.003*	*0.91*	*0.14*	*30.3*
Northern Adriatic-Eurasia (This Study)	47.10	6.67	0.315 ± 0.050	1.20	0.24	-19.0
Adriatic-Eurasia [4]	*45.36*	*9.10*	*0.520*	~	~	~
Adriatic-Eurasia [5]	*46.80*	*6.30*	*0.300 ± 0.060*	~	~	~
Northern Adriatic Absolute (This Study)	63.24	357.52	0.483 ± 0.040	7.33	0.18	-6.9
Southern Adriatic-Eurasia (This Study)	-5.27	-40.22	0.034 ± 0.003	8.33	3.63	49.8
Southern Adriatic Absolute (This Study)	50.26	268.76	0.256 ± 0.002	1.33	0.49	16.9
Nubia-Eurasia* (This Study)	-14.93	-22.72	0.046 ± 0.002	4.73	1.36	58.3
Nubia-Eurasia [6]	*-22.46*	*-28.73*	*0.050 ± 0.003*	*6.80*	*3.40*	*30.5*

Table 1 - Relative and absolute Euler poles for Africa, Eurasia and Adriatic – Plate 1 relative to Plate 2. (latitude, longitude, S-maj, S-min and azimuth in degrees, angular velocity in degrees per Myr)
* Sites used in Euler pole Calculation for Nubia – LAMP, RABT, GOUG, HRAO, NKLG.

Conclusions

- Analysis of time-dependent noise in the dataset has increased the 1-sigma formal errors by over an order of magnitude.
- Velocity residuals in the southern Italian and Calabrian regions indicate differential tectonic motion between north and south Adria. Further tests are to be carried out to determine what combination of rigid and distributed deformation is occurring in this region.

References and Acknowledgments

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