

Improvement of the Pluto orbit using additional new data

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in outlet

Introduction

Observations

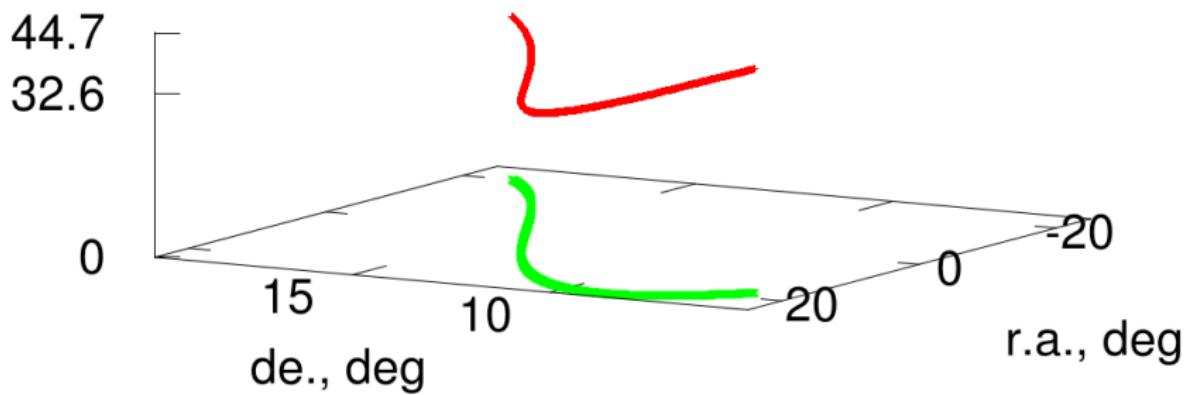
Pluto orbit parameters

Comparison

Summary

Pluto orbit 1913-2013, epoch is 19 June 1986

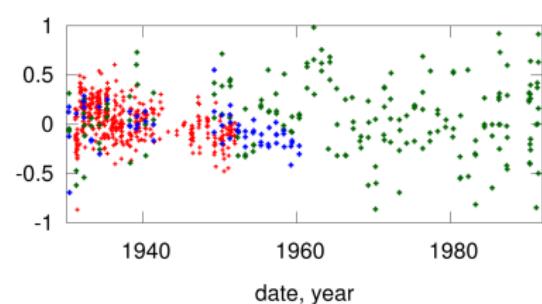
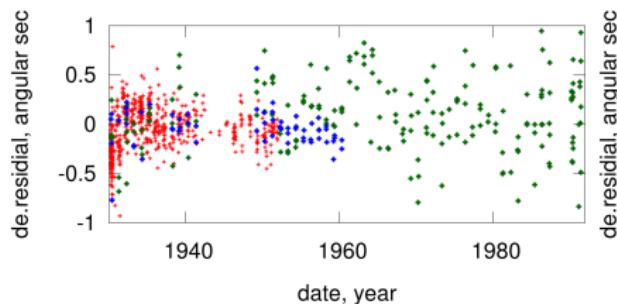
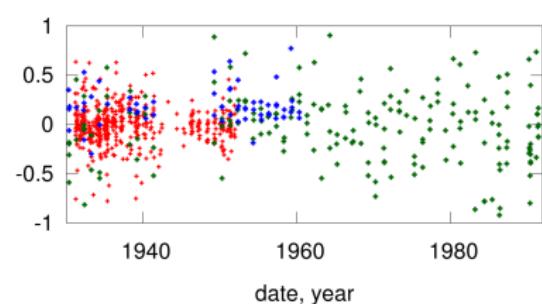
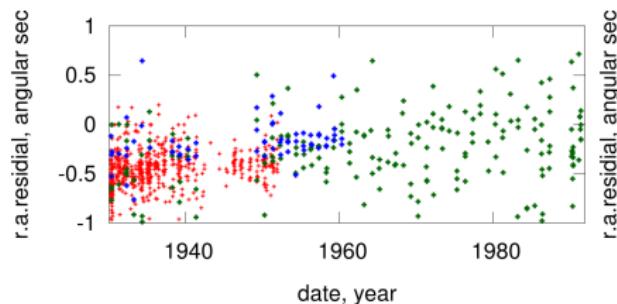
distance, a.u.





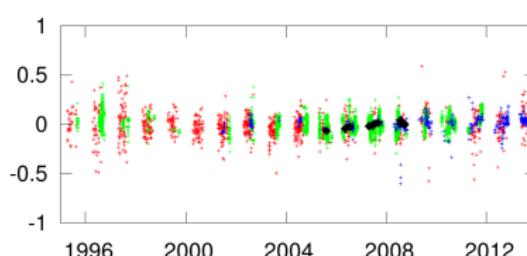
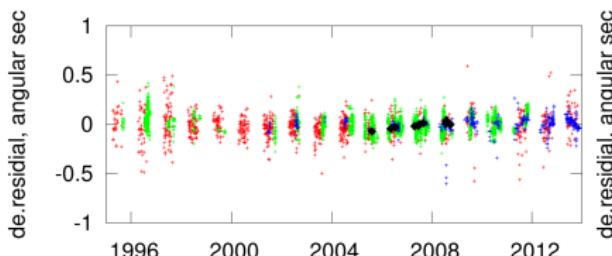
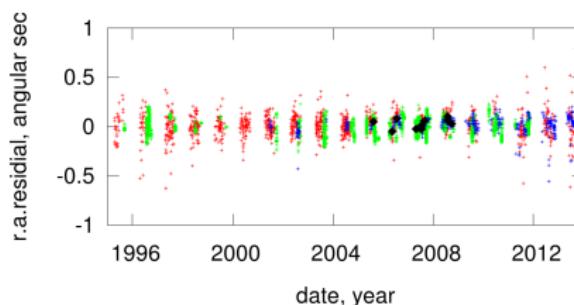
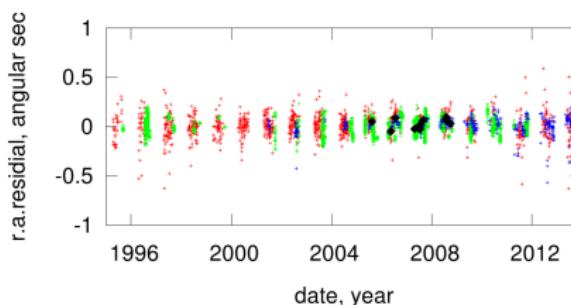
Residuals (α, δ) of EPM2013 and EPM2014a, photo

* digitized Pulkovo	photographic plates	63	1930-1960
* USNO/Lowell		469	1931-1951
* review other Pulkovo		193	1930-1992



Residuals (α, δ) of EPM2013 and EPM2014a, CCD

* Pico dos Dias	CCD	5489	1995-2011
* USNO/Flagstaff		1197	1995-2013
* Table Mountain		695	2001-2013
◆ ESO/La Serena, occultations		11	2005-2008



Lagrangian elements

cross-platform software ERA-8

epoch = 19 June 1986 (JD = 2446600.5)

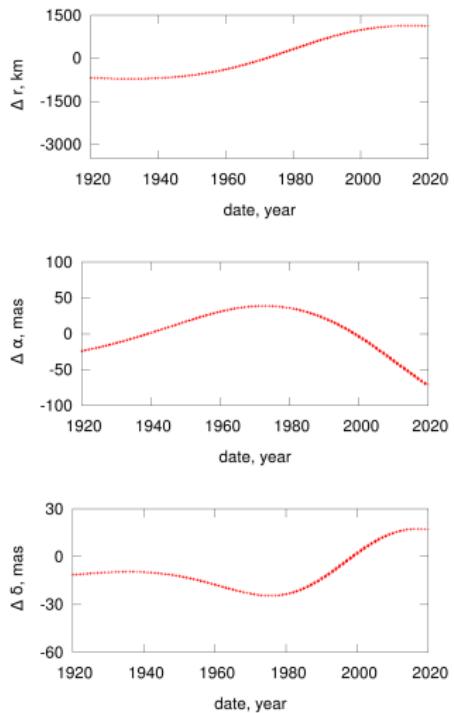
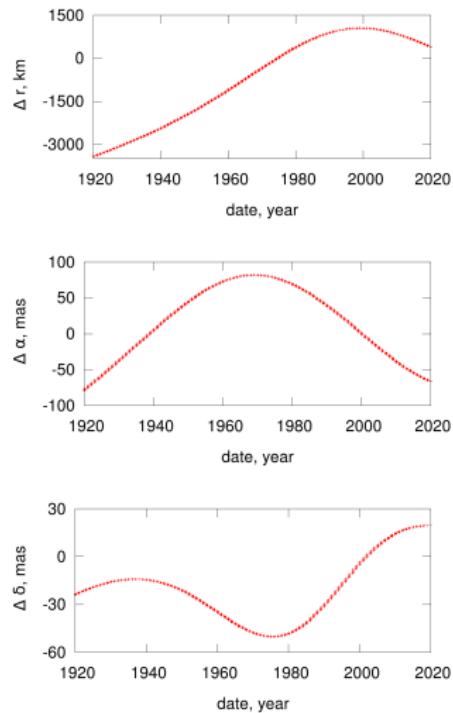
element	EPM2014a	standard deviation of the elements	
		of the EPM2013	of the EPM2014a
a	39.713 a.u.	1316.116 km	563.306 km
$\sin i \cos \Omega$	0.285	0.816 mas	0.865 mas
$\sin i \sin \Omega$	0.276	4.516 mas	3.312 mas
$e \cos \pi$	-0.170	27.453 mas	12.900 mas
$e \sin \pi$	-0.187	21.417 mas	8.384 mas
I	-2.435	13.299 mas	4.870 mas

Initial positions and velocities

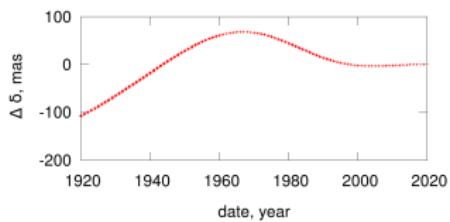
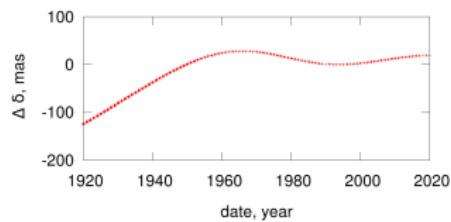
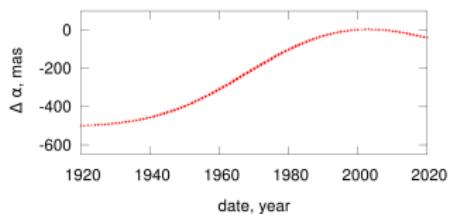
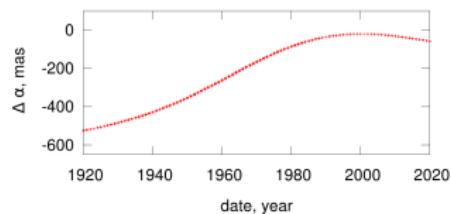
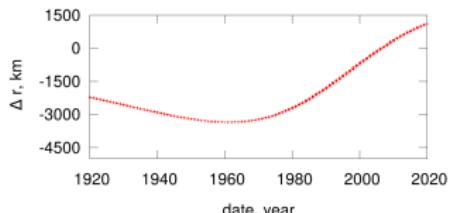
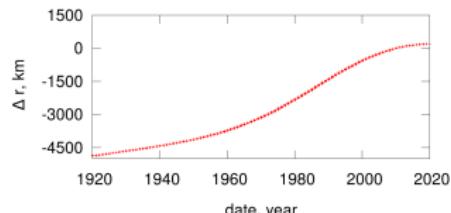
epoch = 19 June 1986 (JD = 2446600.5)

a.u.	x	y	z
EPM2013	-24.112071	-17.403037	1.833799
EPM2014a	-24.112064	-17.403020	1.833803
a.u./d	v_x	v_y	v_z
EPM2013	0.0019439712	-0.0025828344	-0.0013916896
EPM2014a	0.0019439695	-0.0025828371	-0.0013916900

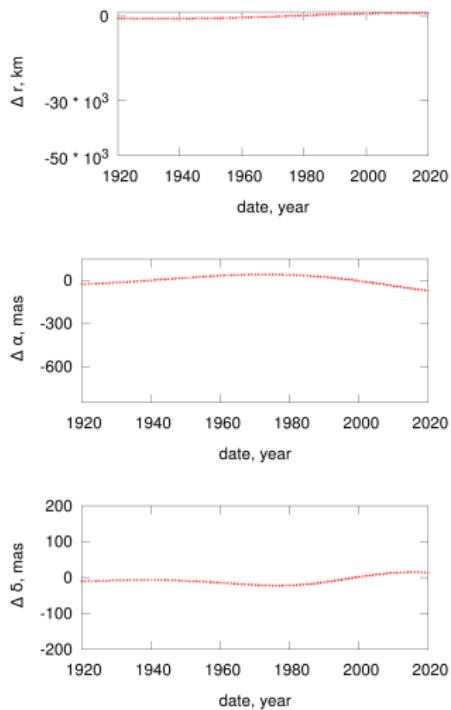
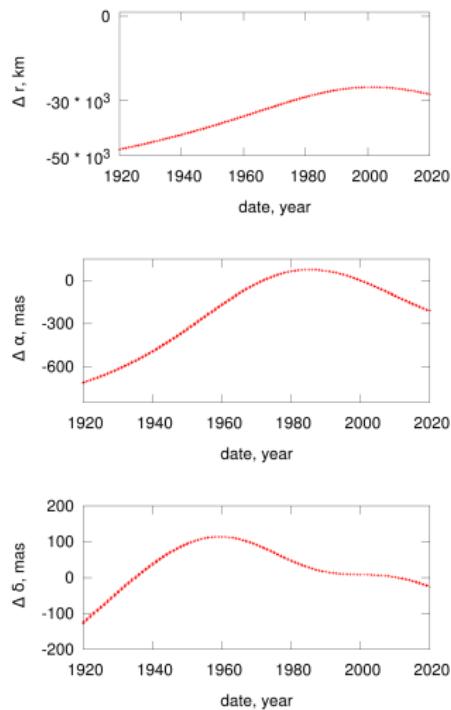
Comparison testing ephemerides to DE430, DE432



Comparison EPM2014a to EPM2011, EPM2013



Comparison EPM2014a to INPOP13c and DE432



Conclusion

- ▶ Improving ephemerides appears in residual observations and standard deviation of the Lagrangian elements
- ▶ The ephemerides EPM2014a of Pluto is close to the last ephemerides DE432
- ▶ The ephemerides EPM2014a corresponds to modern working ephemerides

Thank you for your attention!