



# Considerations for ICRF-3

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# Overview



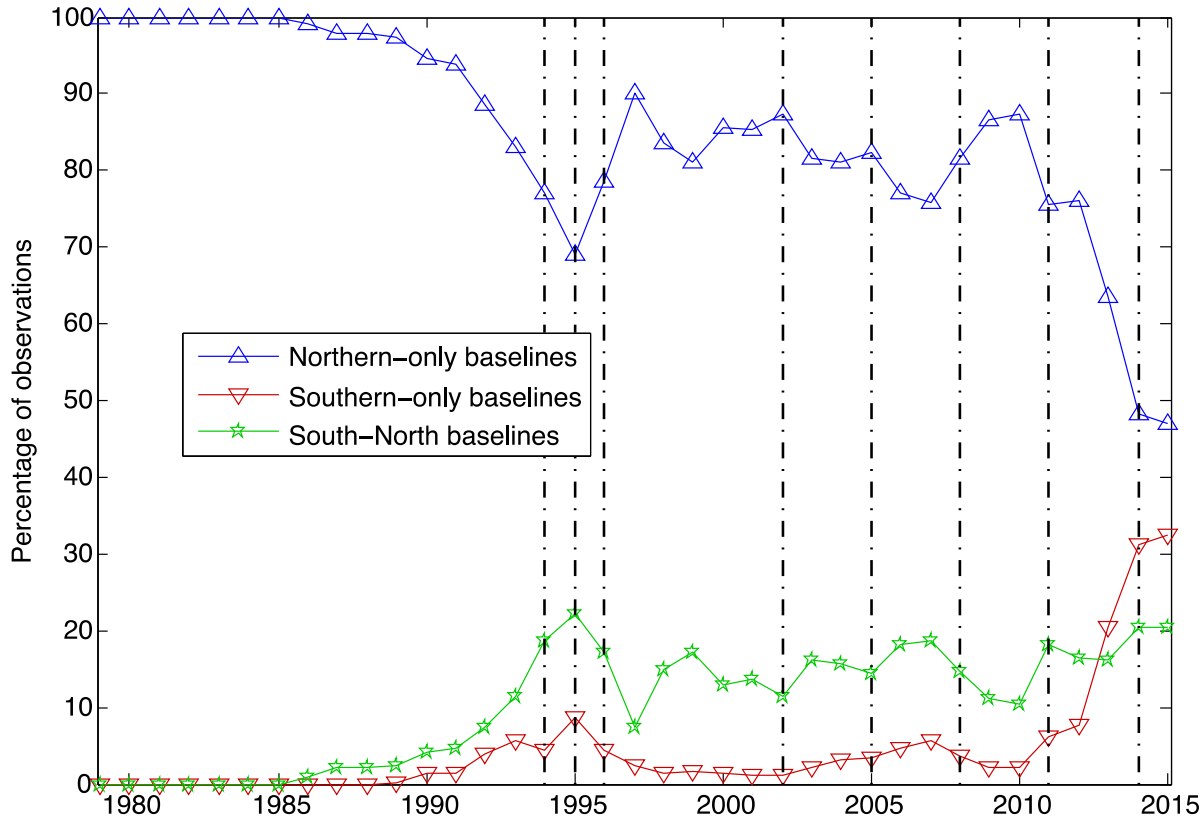
- Data Distribution
- Precision Improvement
- Systematic Effects



# Data Distribution



## Baseline Observation Distribution

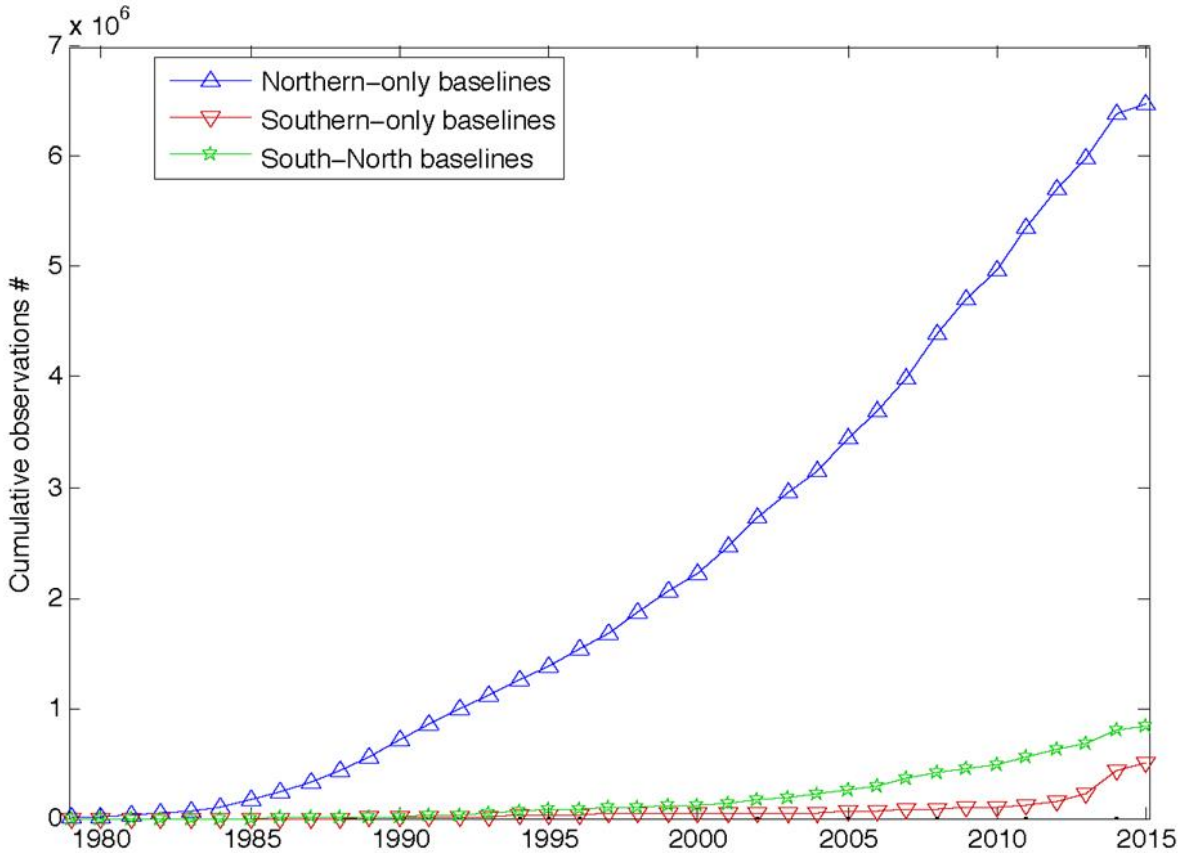




# Data Distribution



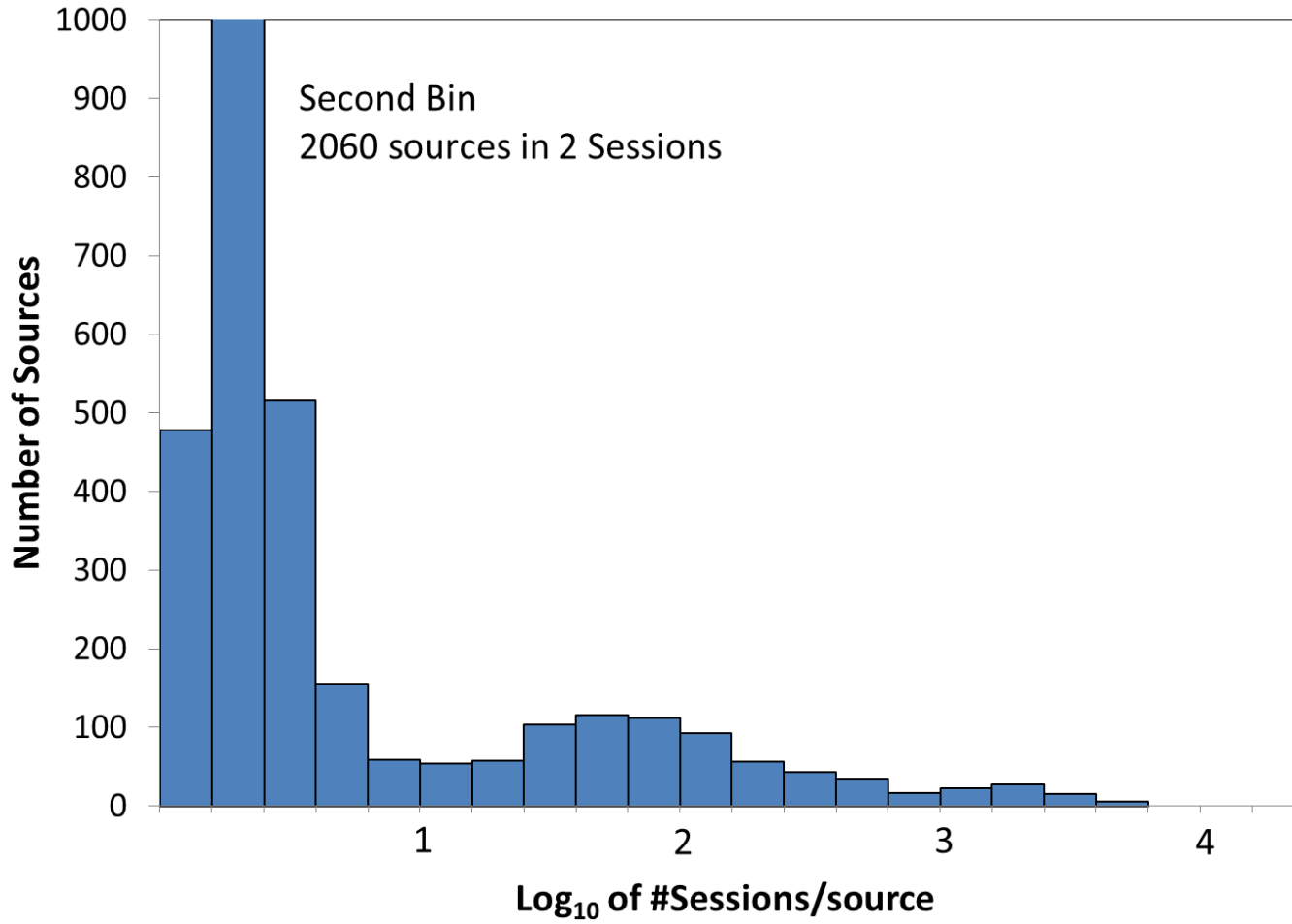
## Growth of Observations



<b>ICRF2</b>	~6.7 million obs
<b>2009</b>	4726 sessions
<b>Current</b>	~10 million obs
<b>2015</b>	5740 sessions



# Data Distribution

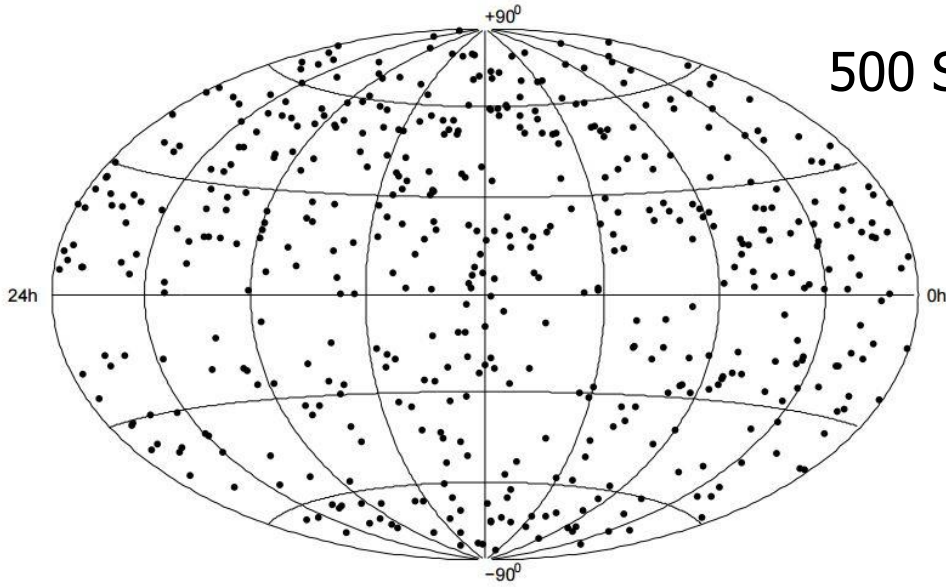




# Data Distribution



500 Sources NOT Re-Observed Since ICRF2



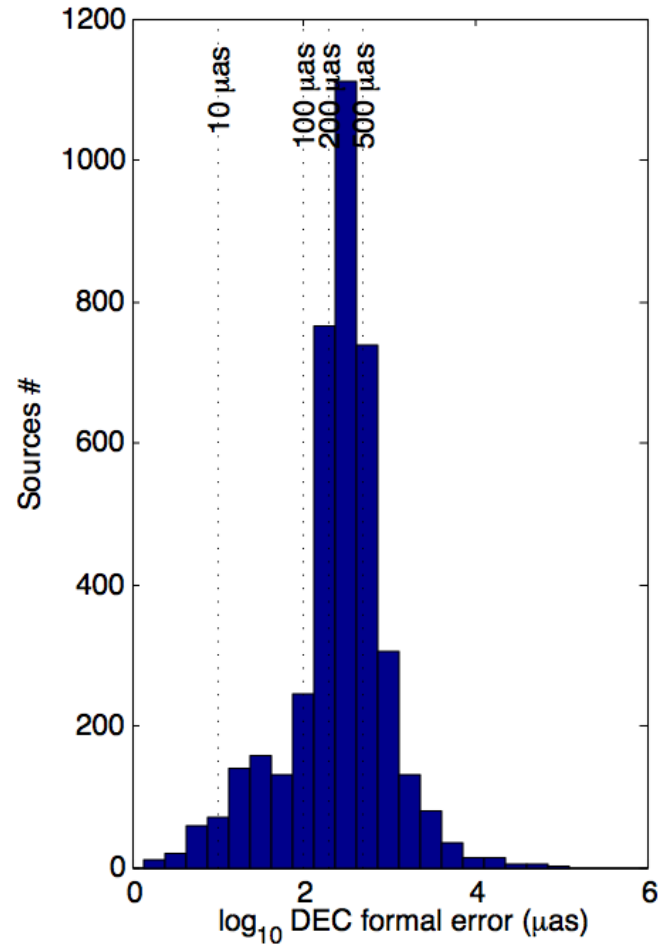
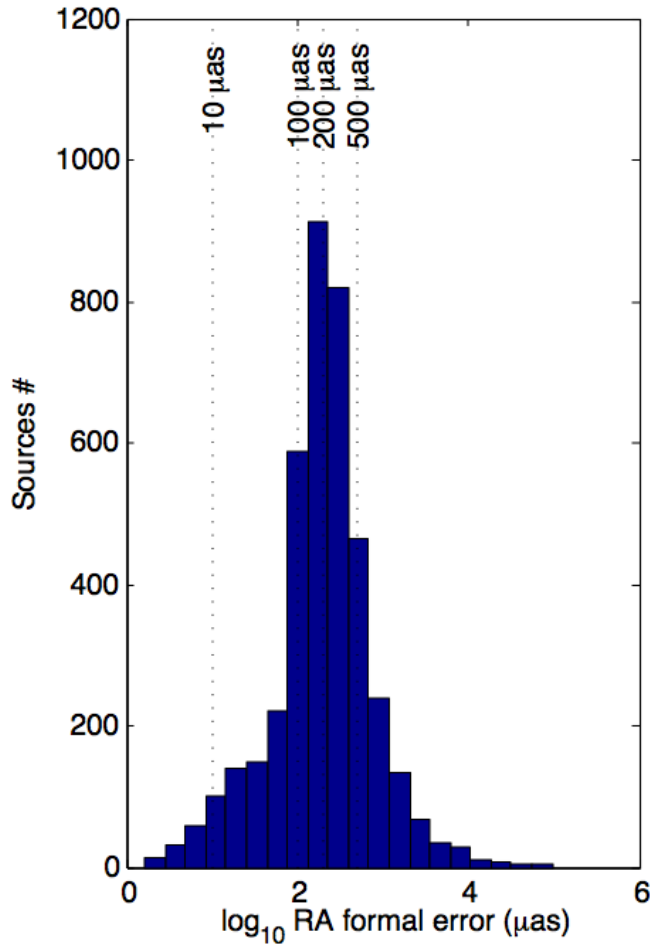
Average(Median)	RA-sig (mas)	Dec-sig (mas)	#sess/src	#obs/src
North 310 srcs	0.279 (0.153)	0.360 (0.226)	6.3 (3.0)	164 (111)
South 190 srcs	0.731 (0.305)	1.111 (0.612)	5.9 (3.0)	75 (33)
All 500 srcs	0.451 (0.203)	0.646 (0.315)	6.1 (3.0)	130 (79)



# Precision Improvement



## Precision of Current Solution (June 2015)

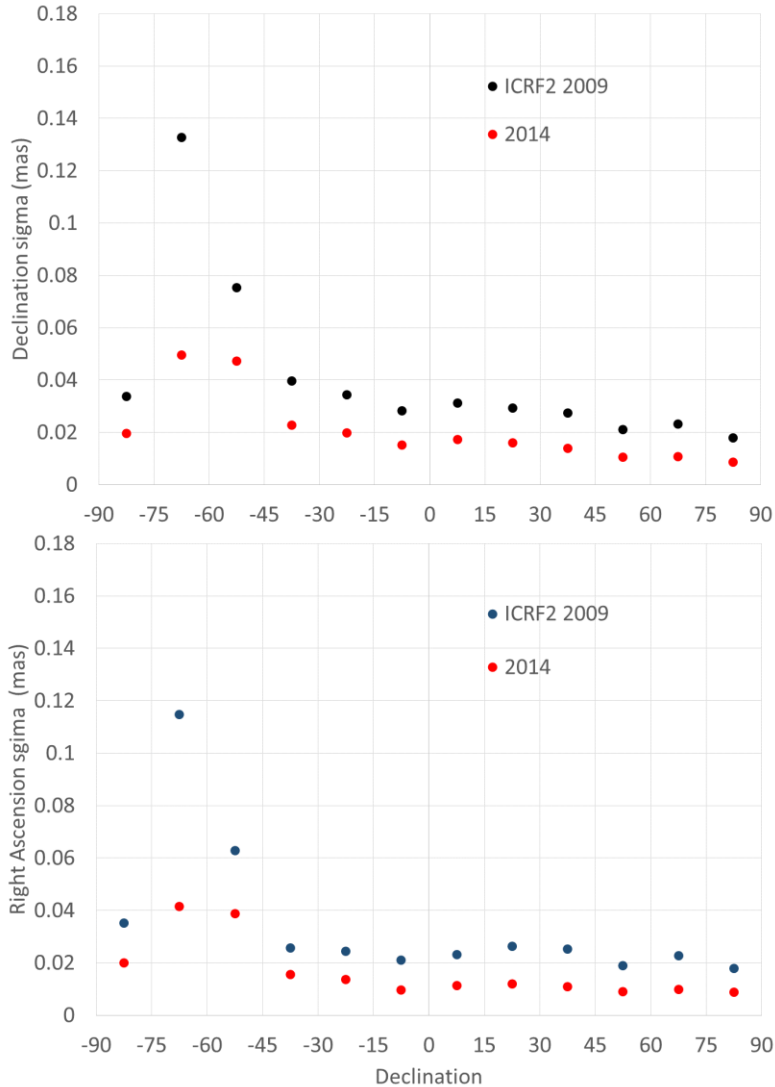




# Precision Improvement



## Non VCS Sources Re-Observed Since ICRF2 Formal Uncertainties







# Precision Improvement



## Average Source Position Uncertainty Improvement since ICRF2

NON-VCS	Right Ascension wrms ( $\mu\text{as}$ )	Declination wrms ( $\mu\text{as}$ )	Number of Sources
ICRF2 (1980-2009)	52	62	794
ICRF3 (test) (1980-2014)	32	43	883

Based on decimation tests for NON-VCS sessions:

- Sessions were divided chronologically into two groups (even and odd sessions)
- Solutions were performed for each set of sessions
- Variance of the differences in source position estimates from the 2 solutions  
=> Estimate of average source position noise (uncertainty)



# Precision Improvement

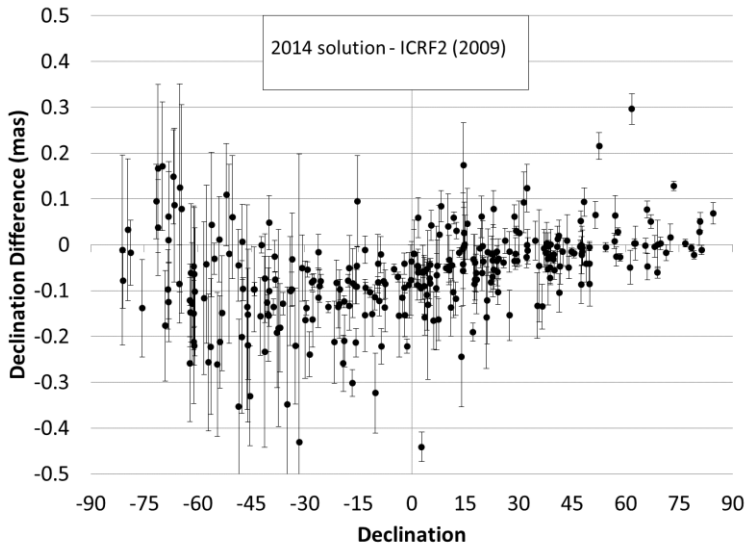


## ICRF2 Source Average Unscaled Formal Errors

- 2868 ICRF2 sources re-observed since ICRF2:  
1979-2009 RA 1.09 / Dec 1.85 mas  
1979-2015 RA .20 / Dec .34 mas
- 500 ICRF2 sources that have not been re-observed since ICRF2:  
RA 0.45 / Dec 0.64 mas
- All 3368 ICRF2 sources:  
1979-2009 RA 1.00 / Dec 1.67 mas  
1979-2015 RA .20 / Dec .34 mas
- 325 new VCS sources from VCS-II not observed in VCS-I
- 299 new sources observed since ICRF2
- 39 special handling sources
- Total of 4031 S/X sources for ICRF3



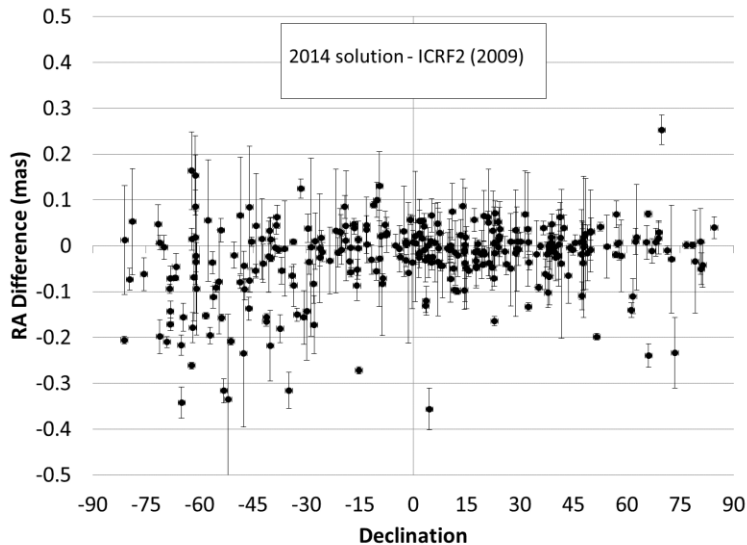
# Systematic Effects



## Current ICRF solution vs. ICRF2

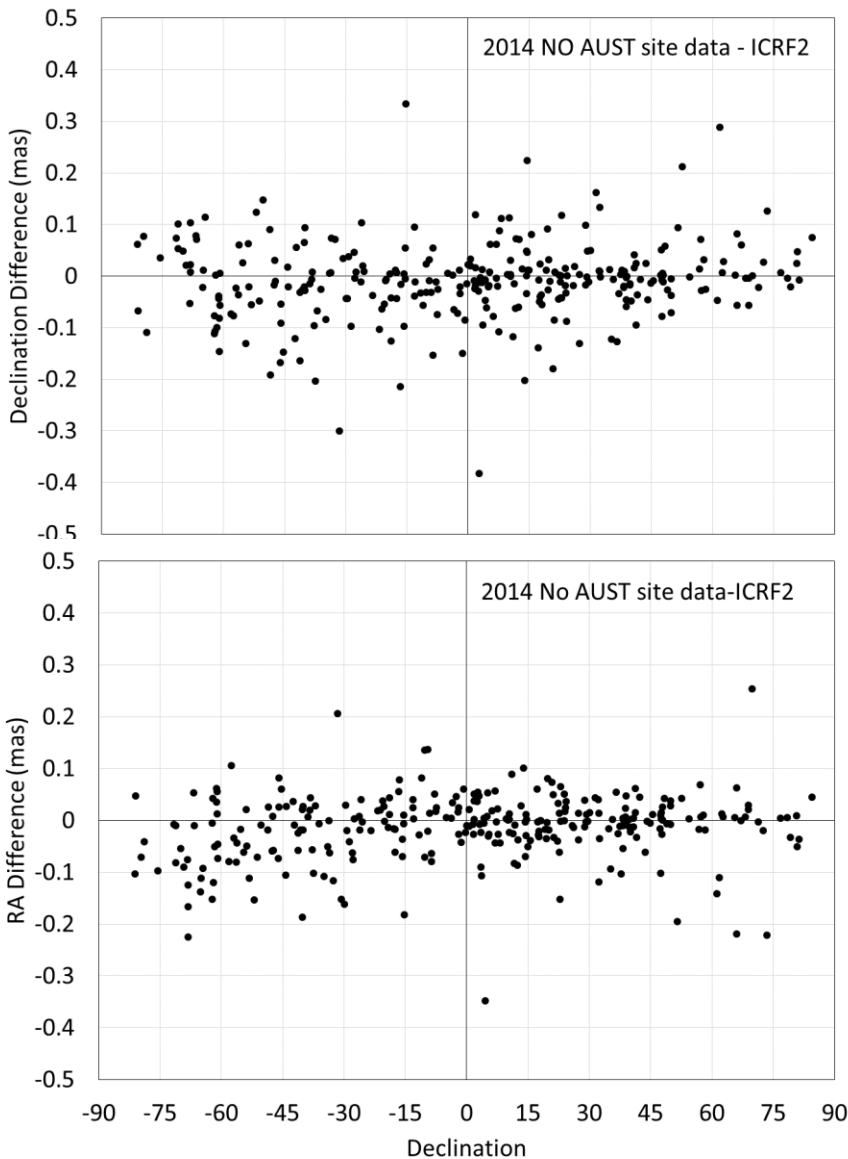
Compare 1980-2014 solution with the ICRF2 solution (1980-2009)

⇒ Zonal systematic in declination estimates with peak of  $\sim 0.1$  mas at 20-30 S





# Systematic Effects



## Effect of AUST Station Data

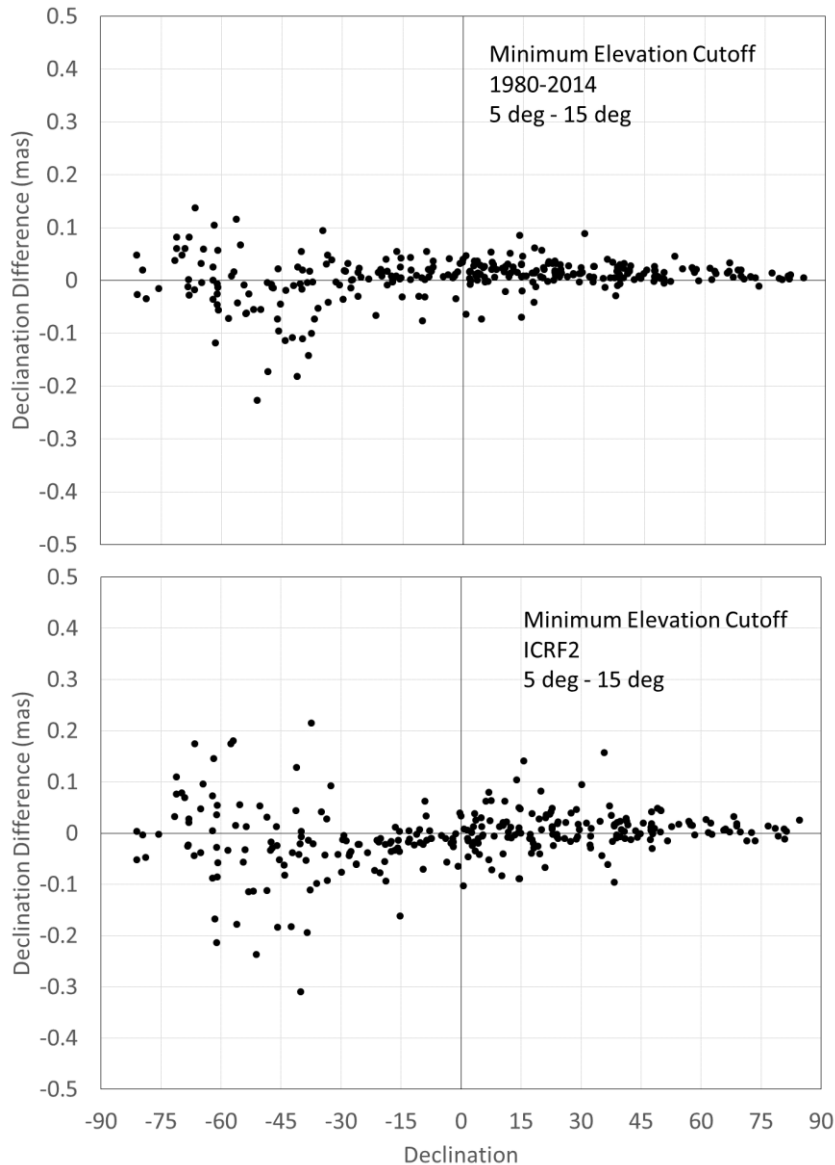
Exclude all data from 4 AUST stations in 1980-2014 solution:

- AUST network sessions
  - AUST observations in other networks
- 1980-2014 analysis

⇒ Zonal systematic in declination estimates is removed



# Systematic Effects

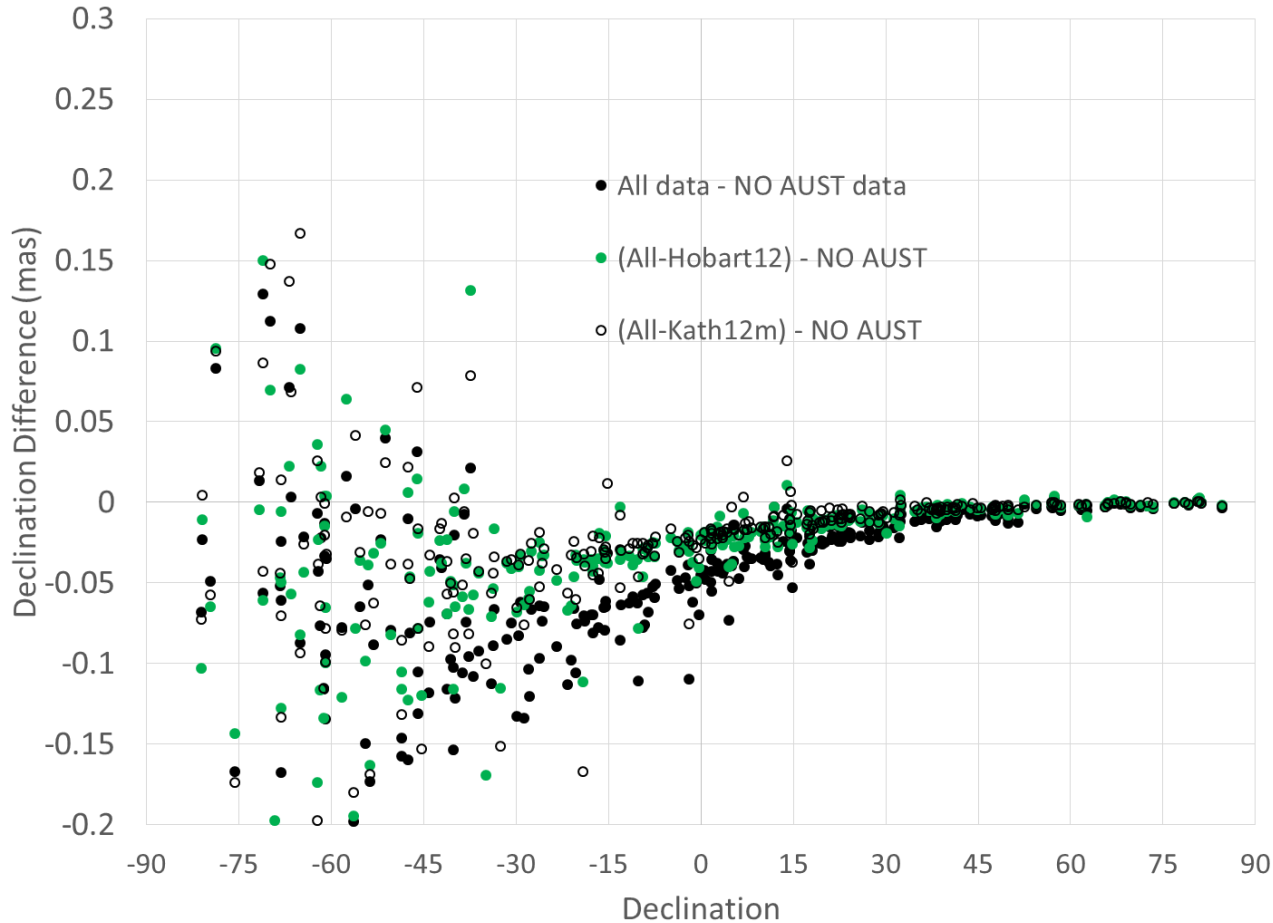


## Minimum Elevation Cutoff Test

- Run 15 and 5 deg cutoff solutions
- Difference in estimated parameter from solutions => measure of troposphere model error
- Cutoff Test => No clear systematic difference between 15 and 5 deg



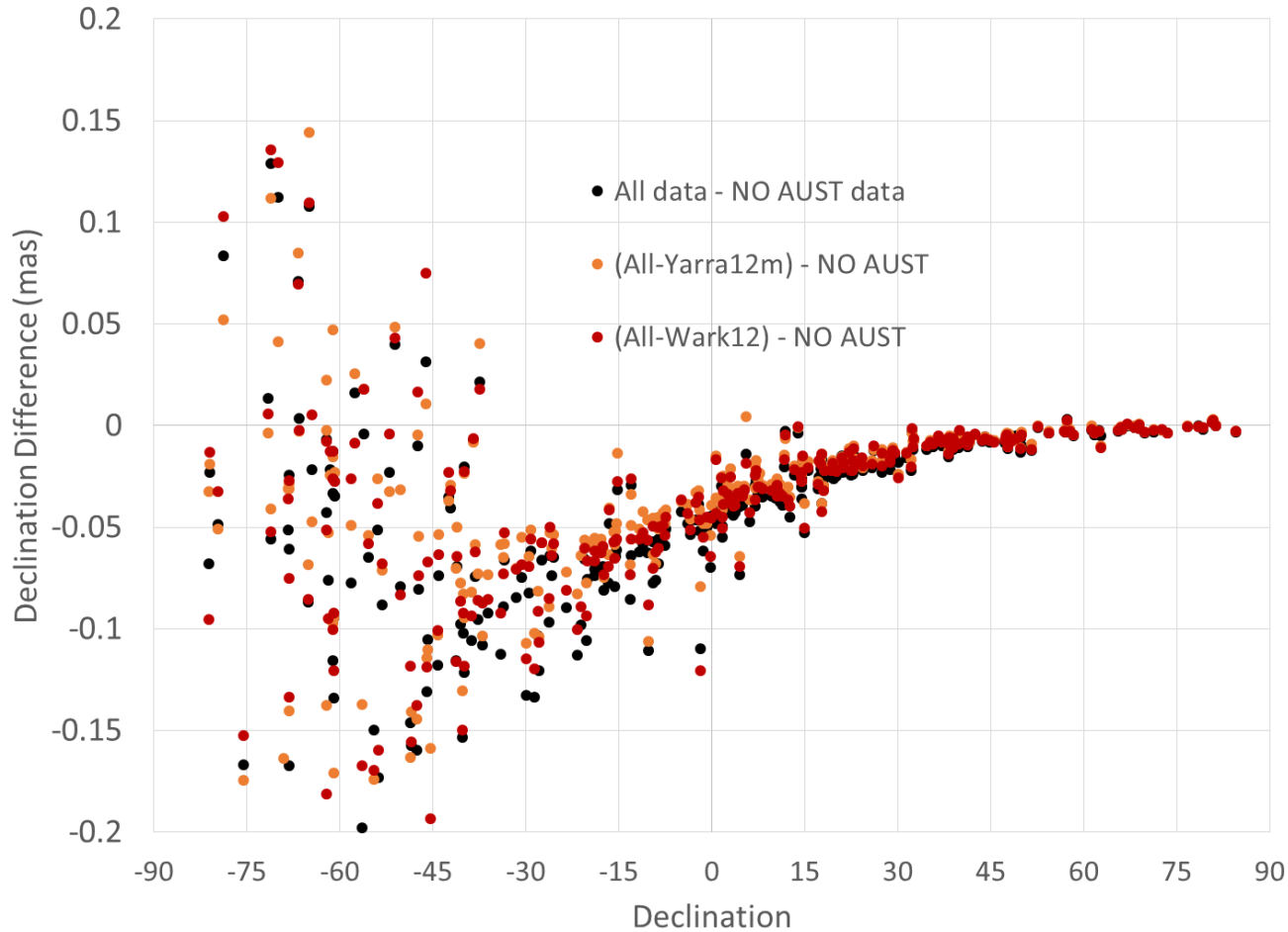
# Systematic Effects



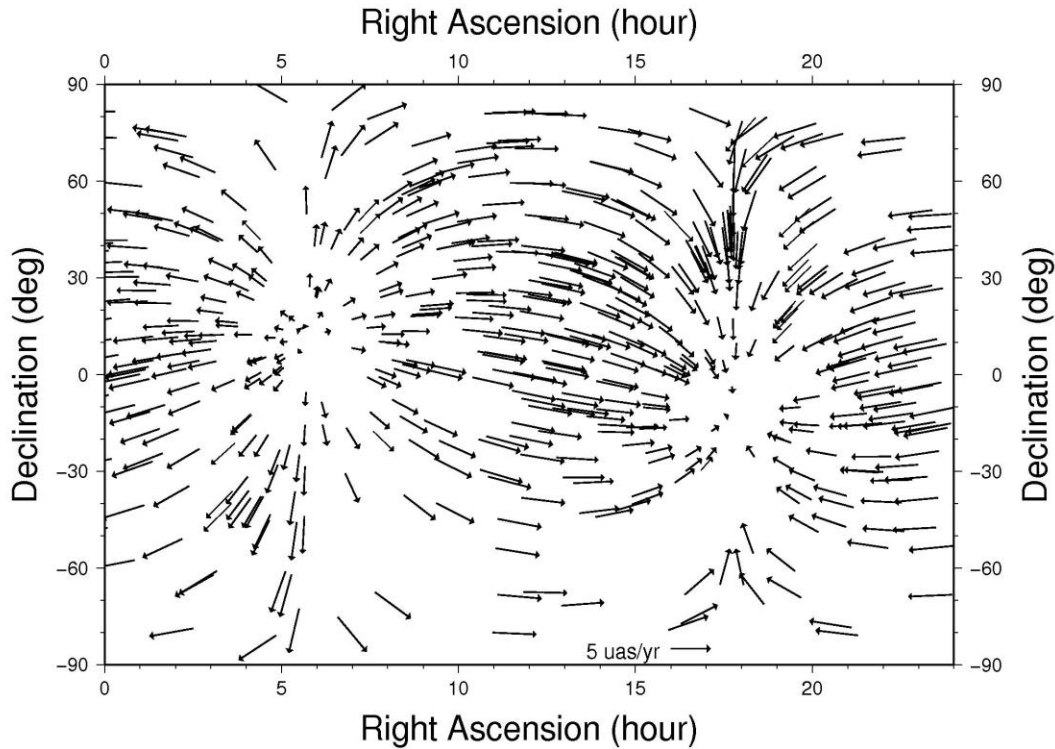
Removing either Kath12m or Hobart12 remove a significant part of the zonal systematic (black points)



# Systematic Effects



Yarra12m and Wark12m do not contribute as significantly to the zonal systematic as Hobart12 and Kath12m



Component of acceleration vector towards the Galactic center

VLBI solution: MacMillan (2014)  $5.3 \pm 0.3 \mu\text{as/yr}$

Parallax measurements:

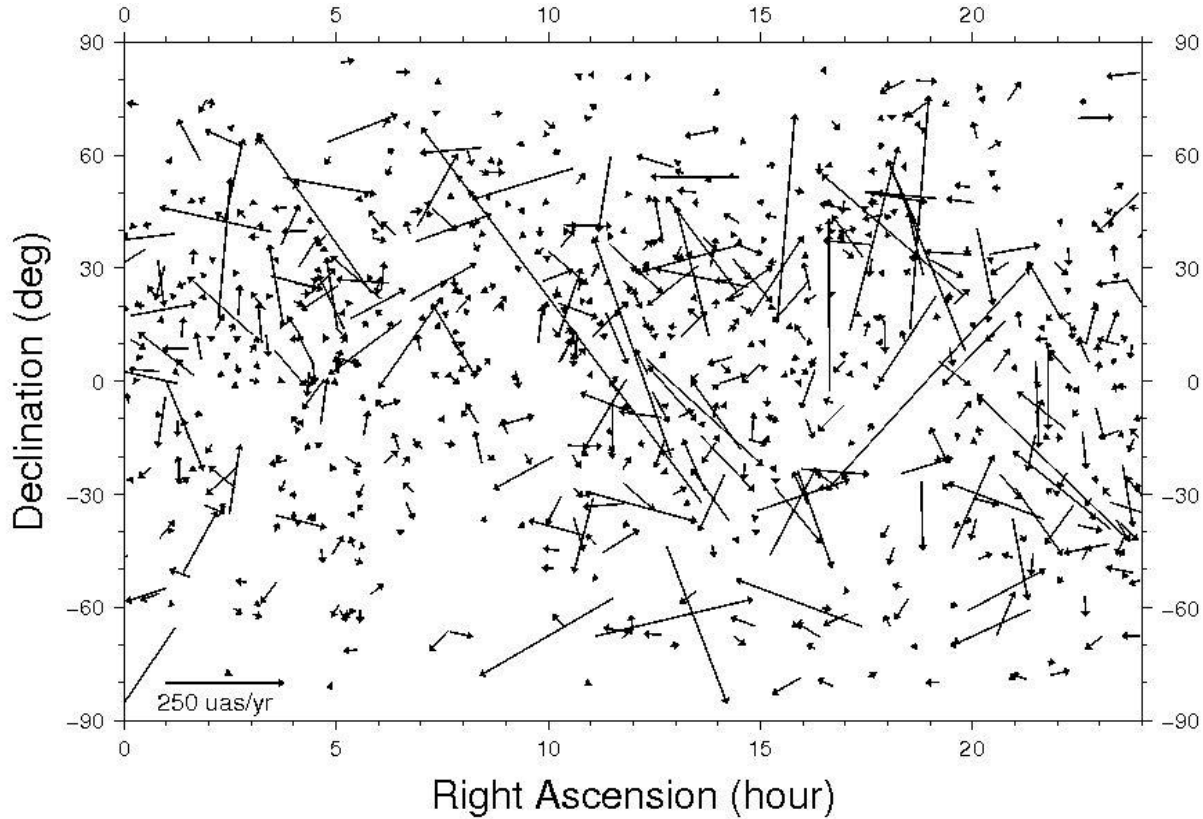
Reid et al. (2009)  $5.4 \pm 0.7 \mu\text{as/yr}$

Reid et al. (2014)  $4.9 \pm 0.4 \mu\text{as/yr}$





# Systematic Effects



Raw proper motion field (uncertainties < 250 uas/yr)



# Precision Improvement



## Improvement in Precision of Gaia Transfer Sources

Average	RA in mas (not corrected from cos(dec))		DEC in mas	
	2011b	2015a	2011b	2015a
Cat. 1 (89 sources)	0.017	0.011	0.017	0.011
Cat. 2 (66 sources)	0.032	0.022	0.032	0.021
Cat. 3 (16 sources)	0.052	0.035	0.080	0.041
Cat. 4 (24 sources)	<b>0.869</b>	0.136	<b>1.903</b>	0.178

Median	RA in mas (not corrected from cos(dec))		DEC in mas	
	2011b	2015a	2011b	2015a
Cat. 1 (89 sources)	0.011	0.007	0.013	0.008
Cat. 2 (66 sources)	0.020	0.015	0.027	0.018
Cat. 3 (16 sources)	0.053	0.034	0.064	0.039
Cat. 4 (24 sources)	<b>0.251</b>	0.068	<b>0.345</b>	0.101

Current solution does not include the 3 Gaia sessions from 2015