

Accuracy of the International Terrestrial Reference Frame Origin – A Recent Validation

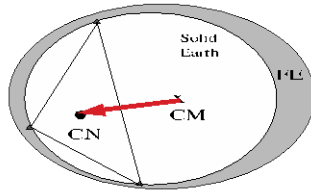
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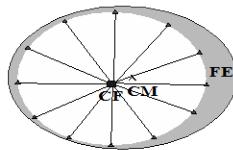




Accuracy of Realized ITRF Origin or Geocentric CN Coordinate and Velocity



- ITRF origin error = translational vector of the Helmert transformation between real and ideal ITRF solutions
- ITRF origin defined at CM with no error, but geocentric CN vector has an error $\Delta \vec{r}_{cn}$
- ITRF origin error = $-\Delta \vec{r}_{cn}$ with offset and drift components
- Systematic origin error important for mean and regional sea level, geocenter motion, satellite tracking,





Kinematic Secular Global Inverse Platform

- Degree-1 Present-Day surface Mass Trend (PDMT) and GIA drive geocenter velocity and degree-1 deformation
- **3-D Relative Velocities/GRACE/ECCO ocean model/A Priori GIA model** yielded precise geocenter velocity estimates due to PDMT and GIA

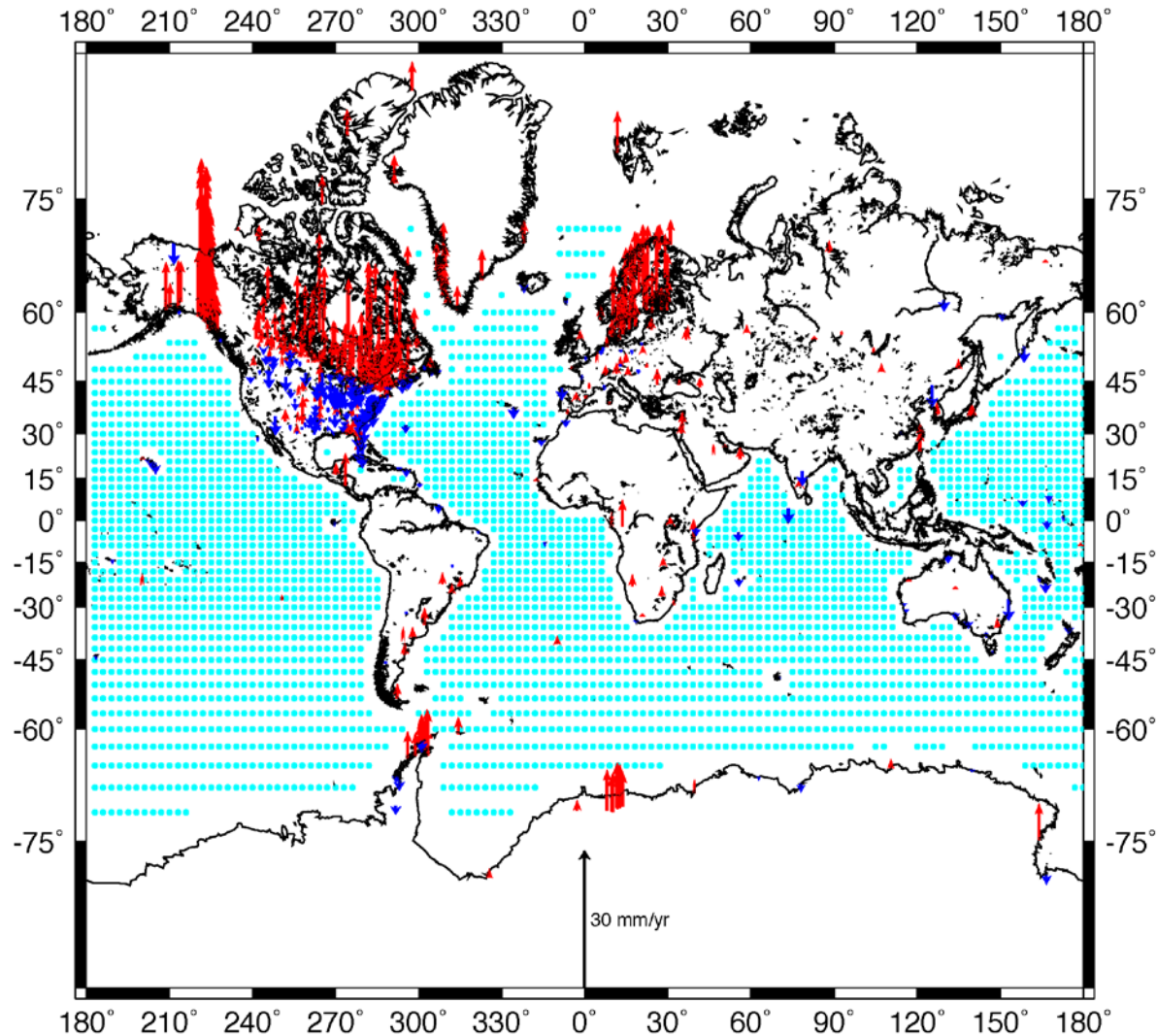
Component	PDMT Estimate	GIA Estimate
V_{Gx} (mm/yr)	-0.08 ± 0.04	-0.10 ± 0.01
V_{Gy} (mm/yr)	0.29 ± 0.05	0.11 ± 0.02
V_{Gz} (mm/yr)	-0.16 ± 0.07	-0.72 ± 0.06

- These are derived through degree-1 surface mass and degree-1 deformation without using any translational info from ITRF
- Use **absolute** ITRF velocities with GRACE/ECCO/OMCT/A Priori GIA to estimate the origin drift vector

$$\mathbf{Y} = \mathbf{A}\dot{\mathbf{M}}_{nmq} + \mathbf{B}\dot{\mathbf{M}}_{nmq}^{v,l} + \mathbf{C}\dot{\mathbf{M}}_{nmq}^{v,h} + \mathbf{D}\dot{\mathbf{M}}_{nmq}^{v,k} + \mathbf{E}\omega + \mathbf{Fb}$$



Site Distribution and Vertical Velocities





Origin Drift and Earth Expansion Results

Component	Symbol	ITRF2008 +GRACE+ECC O	ITRF2008 +GRACE+OMC T	ITRF2008 +GRACE+ECC O+OMCT
Origin Drift	d_x mm/y	-0.3 ± 0.1	-0.4 ± 0.1	-0.3 ± 0.1
	d_y mm/y	-0.3 ± 0.1	-0.2 ± 0.1	-0.2 ± 0.1
	d_z mm/y	-0.3 ± 0.2	-0.6 ± 0.2	-0.5 ± 0.2
Earth Expansion	$\dot{R}$ mm/y	$0.1 \pm 0.2^*$	$0.1 \pm 0.2^*$	$0.1 \pm 0.2^*$

* Earth expansion uncertainty includes a scale drift error of 0.16 mm/y or 0.025 ppb by comparing VLBI and SLR





Conclusions

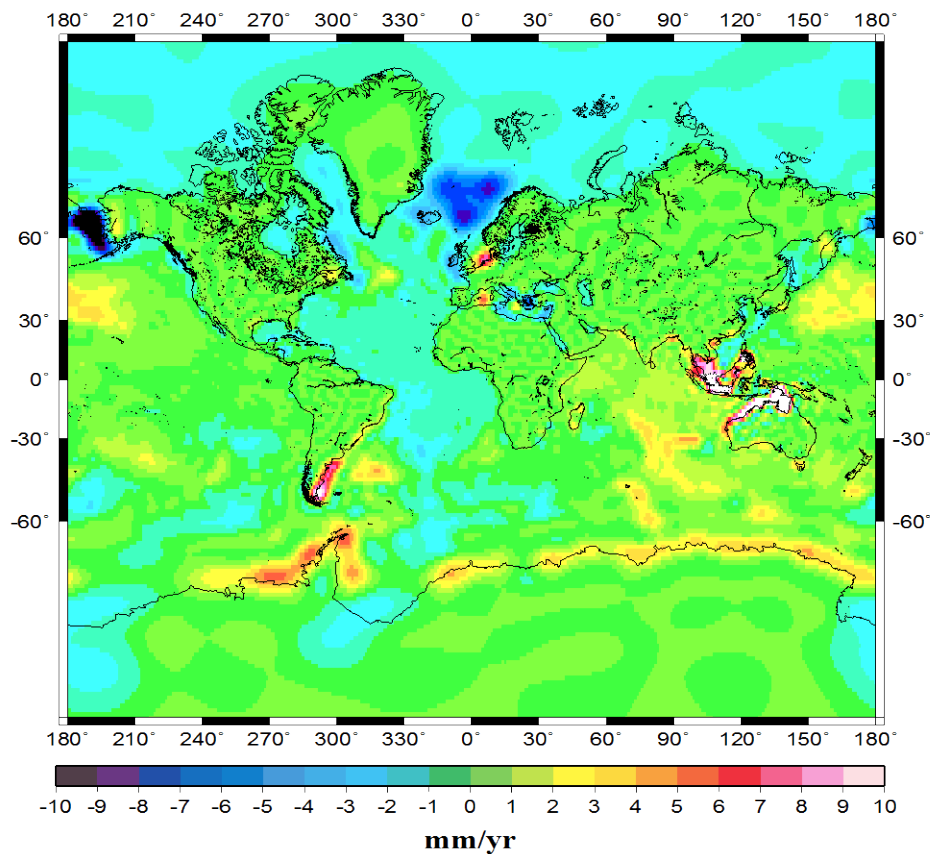
- **Validation of ITRF origin depends on ocean models**
- **ECCO model assimilates altimeter and other data, presumably better, but problems remain**
- **Each drift component in realized ITRF2008 origin < 0.5 mm/y**
- **Hopefully, GPS and DORIS systems will be able to provide competitive geocenter information in the future**



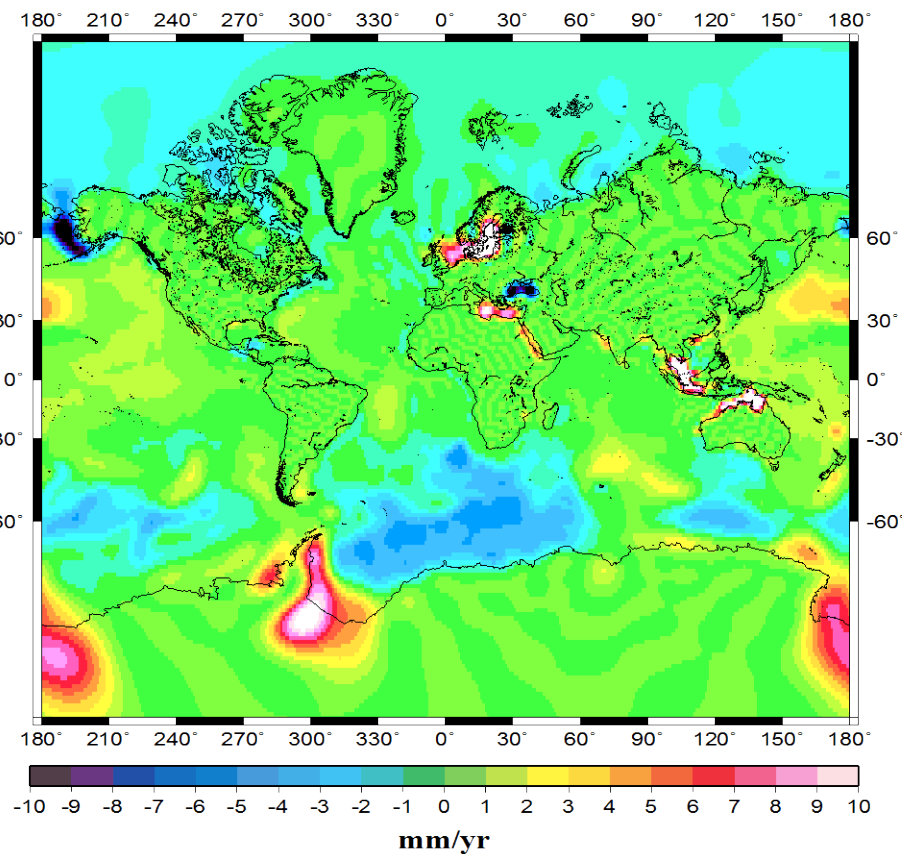
Ocean Bottom Pressure Trends from ECCO and OMCT Models

ECCO

OMCT



ECCO OBP Trend



OMCT OBP Trend

