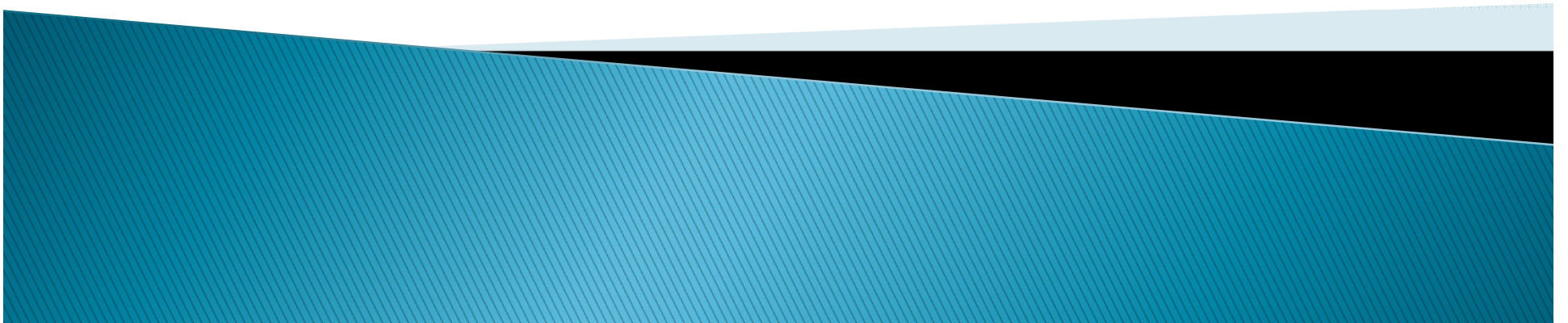


# Transformação de coordenadas

Laboratório II, Geodesia II



# Transformação de Coordenadas entre ITRFs

- ▶ Conversão ITRF2008(I08) para ITRFYYYY(IYY)

$$\begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{IYY} = \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{I08} + \begin{bmatrix} T_X \\ T_Y \\ T_Z \end{bmatrix} + \begin{bmatrix} D & -R_Z & R_Y \\ R_Z & D & -R_X \\ -R_Y & R_X & D \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{I08}$$

$T_X, T_Y, T_Z$  = translações

$D$  = fator de escala

$R_X, R_X, R_X$  = rotações

Parâmetros de transformação (P) atualizados  
à época de observação (t)

$$P(t) = P(t_0) + \dot{P}(t-t_0)$$



# Transformação de Velocidades entre ITRFs

- ▶ Conversão ITRF2008(I08) para ITRFYYYY(IYY)

$$\begin{bmatrix} \dot{X} \\ \dot{Y} \\ \dot{Z} \end{bmatrix}_{IYY} = \begin{bmatrix} \dot{X} \\ \dot{Y} \\ \dot{Z} \end{bmatrix}_{I08} + \begin{bmatrix} \dot{T}_X \\ \dot{T}_Y \\ \dot{T}_Z \end{bmatrix} + \begin{bmatrix} \dot{D} & -\dot{R}_Z & \dot{R}_Y \\ \dot{R}_Z & \dot{D} & -\dot{R}_X \\ -\dot{R}_Y & \dot{R}_X & \dot{D} \end{bmatrix} \begin{bmatrix} X \\ Y \\ Z \end{bmatrix}_{I08}$$

$\dot{T}_X, \dot{T}_Y, \dot{T}_Z$  = variação das translações

$\dot{D}$  = variação do fator de escala

$\dot{R}_X, \dot{R}_Y, \dot{R}_Z$  = variação das rotações



# Parâmetros de Transformação ITRF2008 → ITRFYYYY

SOLUTION	Tx	Ty	Tz	D	Rx	Ry	Rz	EPOCH
UNITS----->	mm	mm	mm	ppb	.001"	.001"	.001"	
RATES	Tx	Ty	Tz	D	Rx	Ry	Rz	
UNITS----->	mm/y	mm/y	mm/y	ppb/y	.001"/y	.001"/y	.001"/y	
ITRF2005	-2.0	-0.9	-4.7	0.94	0.00	0.00	0.00	2000.0
rates	0.3	0.0	0.0	0.00	0.00	0.00	0.00	
ITRF2000	-1.9	-1.7	-10.5	1.34	0.00	0.00	0.00	2000.0
rates	0.1	0.1	-1.8	0.08	0.00	0.00	0.00	
ITRF97	4.8	2.6	-33.2	2.92	0.00	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	
ITRF96	4.8	2.6	-33.2	2.92	0.00	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	
ITRF94	4.8	2.6	-33.2	2.92	0.00	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	
ITRF93	-24.0	2.4	-38.6	3.41	-1.71	-1.48	-0.30	2000.0
rates	-2.8	-0.1	-2.4	0.09	-0.11	-0.19	0.07	
ITRF92	12.8	4.6	-41.2	2.21	0.00	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	
ITRF91	24.8	18.6	-47.2	3.61	0.00	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	
ITRF90	22.8	14.6	-63.2	3.91	0.00	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	
ITRF89	27.8	38.6	-101.2	7.31	0.00	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	
ITRF88	22.8	2.6	-125.2	10.41	0.10	0.00	0.06	2000.0
rates	0.1	-0.5	-3.2	0.09	0.00	0.00	0.02	

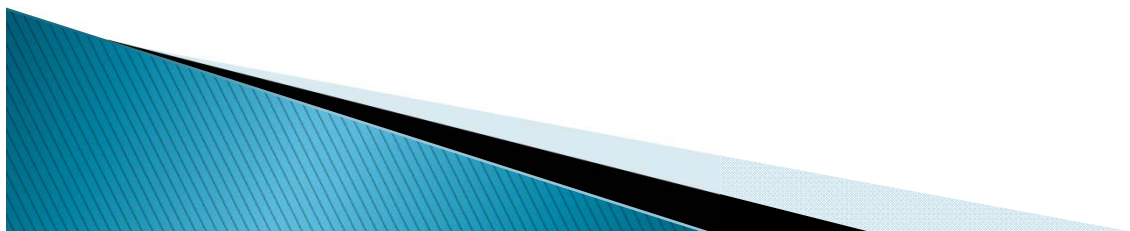
# Parâmetros de Transformação ITRF2014 → ITRF2008 (à época 2010.0)

	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>D</b>	<b>R1</b>	<b>R2</b>	<b>R3</b>
	<b>mm</b>	<b>mm</b>	<b>mm</b>	<b>10-9</b>	<b>mas</b>	<b>mas</b>	<b>mas</b>
	<b>1.6</b>	<b>1.9</b>	<b>2.4</b>	<b>-0.02</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
<b>+/-</b>	<b>0.2</b>	<b>0.1</b>	<b>0.1</b>	<b>0.02</b>	<b>0.006</b>	<b>0.006</b>	<b>0.006</b>
<b>Rates</b>	<b>0.0</b>	<b>0.0</b>	<b>-0.1</b>	<b>0.03</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>
<b>+/-</b>	<b>0.2</b>	<b>0.1</b>	<b>0.1</b>	<b>0.02</b>	<b>0.006</b>	<b>0.006</b>	<b>0.006</b>



# Parâmetros de Transformação ITRF2005 → ITRF2000, à época 2000.0

	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>D</b>	<b>R1</b>	<b>R2</b>	<b>R3</b>
	mm	mm	mm	10-9	mas	mas	mas
	0.1	-0.8	-5.8	0.40	0.000	0.000	0.000
<b>+/-</b>	0.3	0.3	0.3	0.05	0.012	0.012	0.012
<b>Rates</b>	-0.2	0.1	-1.8	0.08	0.000	0.000	0.000
<b>+/-</b>	0.3	0.3	0.3	0.05	0.012	0.012	0.012





# Parâmetros de Transformação ITRFYYYY → ETRFYyyy (Memo Boucher & Altamimi, v. 8)

**Table 5:** Transformation parameters from ITRF<sub>yy</sub> to ETRF2000 at epoch 2000.0 and their rates/year

ITRF Solution	T1 mm	T2 mm	T3 mm	D 10 <sup>-9</sup>	R1 mas	R2 mas	R3 mas
ITRF2008	52.1	49.3	-58.5	1.34	0.891	5.390	-8.712
Rates	0.1	0.1	-1.8	0.08	0.081	0.490	-0.792
ITRF2005	54.1	50.2	-53.8	0.40	0.891	5.390	-8.712
Rates	-0.2	0.1	-1.8	0.08	0.081	0.490	-0.792
ITRF2000	54.0	51.0	-48.0	0.00	0.891	5.390	-8.712
Rates	0.0	0.0	0.0	0.00	0.081	0.490	-0.792
ITRF97	47.3	46.7	-25.3	-1.58	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF96	47.3	46.7	-25.3	-1.58	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF94	47.3	46.7	-25.3	-1.58	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF93	76.1	46.9	-19.9	-2.07	2.601	6.870	-8.412
Rates	2.9	0.2	0.6	-0.01	0.191	0.680	-0.862
ITRF92	39.3	44.7	-17.3	-0.87	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF91	27.3	30.7	-11.3	-2.27	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF90	29.3	34.7	4.7	-2.57	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812
ITRF89	24.3	10.7	42.7	-5.97	0.891	5.390	-8.772
Rates	0.0	0.6	1.4	-0.01	0.081	0.490	-0.812