1.4) Excentricites

The excentricities used for ITRF89 are given in Table T5 of the appendix.

2) DATA ANALYSIS

The ITRF89 solution consists of:

a) a combined adjustment of station positions and transformation parameters for the epoch 1988.0

b) estimation of possible secular variations in orientation parameters.

The adjustment were performed using the S9CMIX software developed by IGN. The options used were:

- reduction of individual data sets at a common epoch,
- least square estimation of station coordinates and 7 transformation parameters for each solution,
- local surveys used with a priori variances (see 1.4)
- station coordinates used with a priori variances (see 1.3)

Test computations (ITRF89A and B) were performed with partial data and presented at the IERS Workshop held in Paris (23-27 April 1990).

It was decided that:

- origin should come from SLR
- scale should also come from SLR as there is still some possible questions about VLBI scale, and that when it is apparently consistent with SLR, the scale parameter is close to zero,
- orientation should be such that no global rotation should exist with respect to ITRF88.

To ensure that, a first global adjustment of all selected data was done, holding the LC transformation parameters fixed to their ITRF88 value. The solution was labelled ITRF89C.

Then ITRF89C was compared to ITRF88 in order to estimate corrections to rotation angles.

Several tests were done (all points, one point per site, 6 points covering the Earth, changes in weighting). Table 2 summarizes these tests. Solution (6) was finally used to repeat the global adjustment with LC translation and scale put to zero and rotation angles fixed to the values derived from the previous computation.
Table 2
Comparison ITRF89C - ITRF88

<table>
<thead>
<tr>
<th></th>
<th>T1 cm</th>
<th>T2 cm</th>
<th>T3 cm</th>
<th>D-8</th>
<th>R1 0.001&quot;</th>
<th>R2 0.001&quot;</th>
<th>R3 0.001&quot;</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Sigmas 1m All points</td>
<td>0.6</td>
<td>1.0</td>
<td>1.4</td>
<td>-0.1</td>
<td>0.5</td>
<td>0.3</td>
<td>-0.5</td>
<td>0.049</td>
</tr>
<tr>
<td>(2) Sigmas 1m 1 point per site</td>
<td>-0.2</td>
<td>0.7</td>
<td>0.4</td>
<td>-0.1</td>
<td>0.1</td>
<td>0.5</td>
<td>-0.5</td>
<td>0.043</td>
</tr>
<tr>
<td>(3) Sigmas 1m 6 points</td>
<td>4.0</td>
<td>1.4</td>
<td>5.6</td>
<td>-1.0</td>
<td>0.3</td>
<td>0.4</td>
<td>-0.2</td>
<td>0.053</td>
</tr>
<tr>
<td>(4) Sigmas scaled All points</td>
<td>0.1</td>
<td>1.6</td>
<td>1.3</td>
<td>0.0</td>
<td>0.6</td>
<td>0.2</td>
<td>-0.1</td>
<td>0.261</td>
</tr>
<tr>
<td>(5) Sigmas unscaled All points</td>
<td>0.3</td>
<td>1.5</td>
<td>1.3</td>
<td>0.0</td>
<td>0.6</td>
<td>0.2</td>
<td>-0.2</td>
<td>1.069</td>
</tr>
<tr>
<td>(6) Sigmas unscaled 1 point per site</td>
<td>0.3</td>
<td>1.5</td>
<td>1.0</td>
<td>0.0</td>
<td>0.5</td>
<td>0.2</td>
<td>-0.2</td>
<td>0.778</td>
</tr>
<tr>
<td>(7) Sigmas unscaled 6 points</td>
<td>2.8</td>
<td>1.4</td>
<td>3.9</td>
<td>-0.6</td>
<td>0.5</td>
<td>-0.1</td>
<td>-0.5</td>
<td>2.406</td>
</tr>
<tr>
<td>(8) Sigmas unscaled 88 Sigmas scaled 89 All points</td>
<td>0.3</td>
<td>1.5</td>
<td>1.4</td>
<td>0.0</td>
<td>0.6</td>
<td>0.1</td>
<td>-0.2</td>
<td>0.979</td>
</tr>
<tr>
<td>(9) Sigmas unscaled 88 Sigmas scaled 89 1 point per site</td>
<td>0.3</td>
<td>1.4</td>
<td>1.1</td>
<td>0.0</td>
<td>0.4</td>
<td>0.2</td>
<td>-0.2</td>
<td>0.707</td>
</tr>
</tbody>
</table>
As some solutions have derived velocities or used an other model than AMO-2, we have repeated the adjustment at the epoch 1984.0 for these solutions. We fixed the LC rotation parameters for 1984 at their values of 1988 plus rotation correction from AM1-2/AM0-2 angular velocities. We then estimated annual rates of rotation for RG, LD and LU.

3) RESULTS

3.1) Values

We have adjusted combined coordinates in the ITRF89 solution for epoch 1988.0. They are given in Table T6 under the label SSC(IERS) 90 C 01.

As no global velocity field has been adjusted, the AMO-2 model is still valid to estimate positions at other epochs.

The adjusted transformation parameters and rates were published in Table T-2 of the IERS Annual Report for 1989. It is also available in Table T7 of the appendix.

We have also computed for a practical point of view positions for epochs 1984, 1986, 1988, 1990, for both the combined and some individual solutions. For the last solutions, the procedure used is:

a) to compute position at the epoch using values of the individual solution, namely positions at the reference epoch and corresponding velocity.

b) to compute transformation parameters at the epoch from table T7 values. For this case, only corrections exist for some rotation angles.

c) to convert positions to IERS values using this formula.

This is done for:

\[
\begin{align*}
\text{RG} & \quad \text{SSC(IERS) 90 R 01} \ (84, 86, 88, 90) \\
\text{RN} & \quad \text{SSC(IERS) 90 R 02} \ (88) \\
\text{LC} & \quad \text{SSC(IERS) 90 L 01} \ (84, 86, 88, 90) \\
\text{LG} & \quad \text{SSC(IERS) 90 L 02} \ (84, 86, 88, 90) \\
\text{LD} & \quad \text{SSC(IERS) 90 L 03} \ (84, 86, 88, 90) \\
\text{LU} & \quad \text{SSC(IERS) 90 L 04} \ (84, 86, 88, 90)
\end{align*}
\]

For RN only 1988 values have been computed as velocities were not available at IFTS.

3.2) Analysis of results

The factor of unit variance is 1.3. Although it is close to 1, the proper weighting in the combined adjustment is a rather critical and delicate problem.

As presented in the IERS Technical Note 4 for past BIH/IERS solutions, a sample of 6 stations is given in Tables 3 and 4, where we have also repeated ITRF88 solutions. See also Figures 1 to 6.