SINCom - the new program package for combined processing of space geodetic observations

O. Brattseva, I. Gayazov, S. Kurdubov, V. Suvorkin

IAA RAS, Saint Petersburg, Russian Federation, ipa@ipa.nw.ru

The SINCom software package is developed for combined processing of different space geodesy observations. The main purpose of the software package is estimating EOPs and positions of stations carrying out observations by modern space geodesy techniques. As each technique has some advantages and weaknesses, more reliable estimation can be attained when combining all observational data.
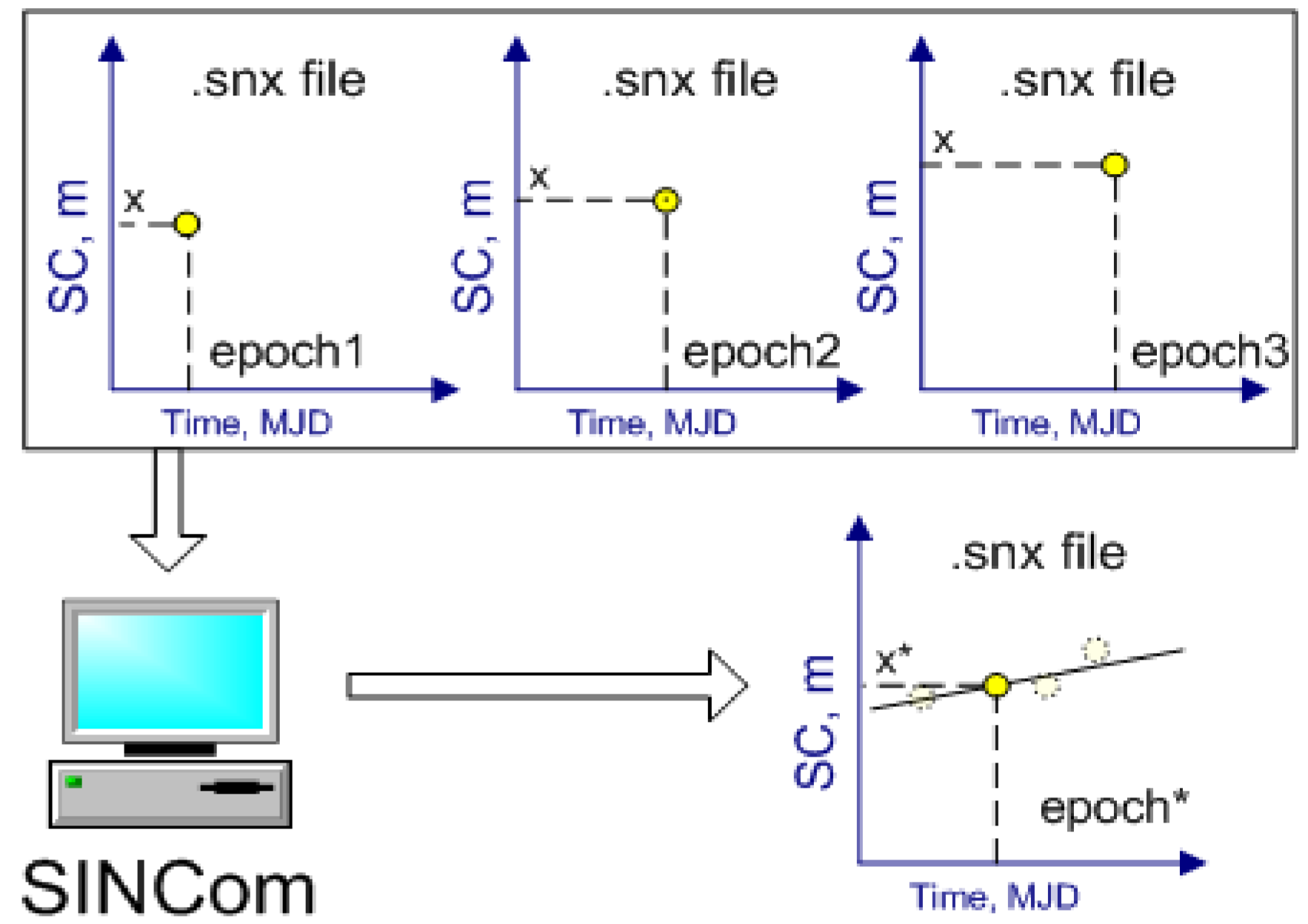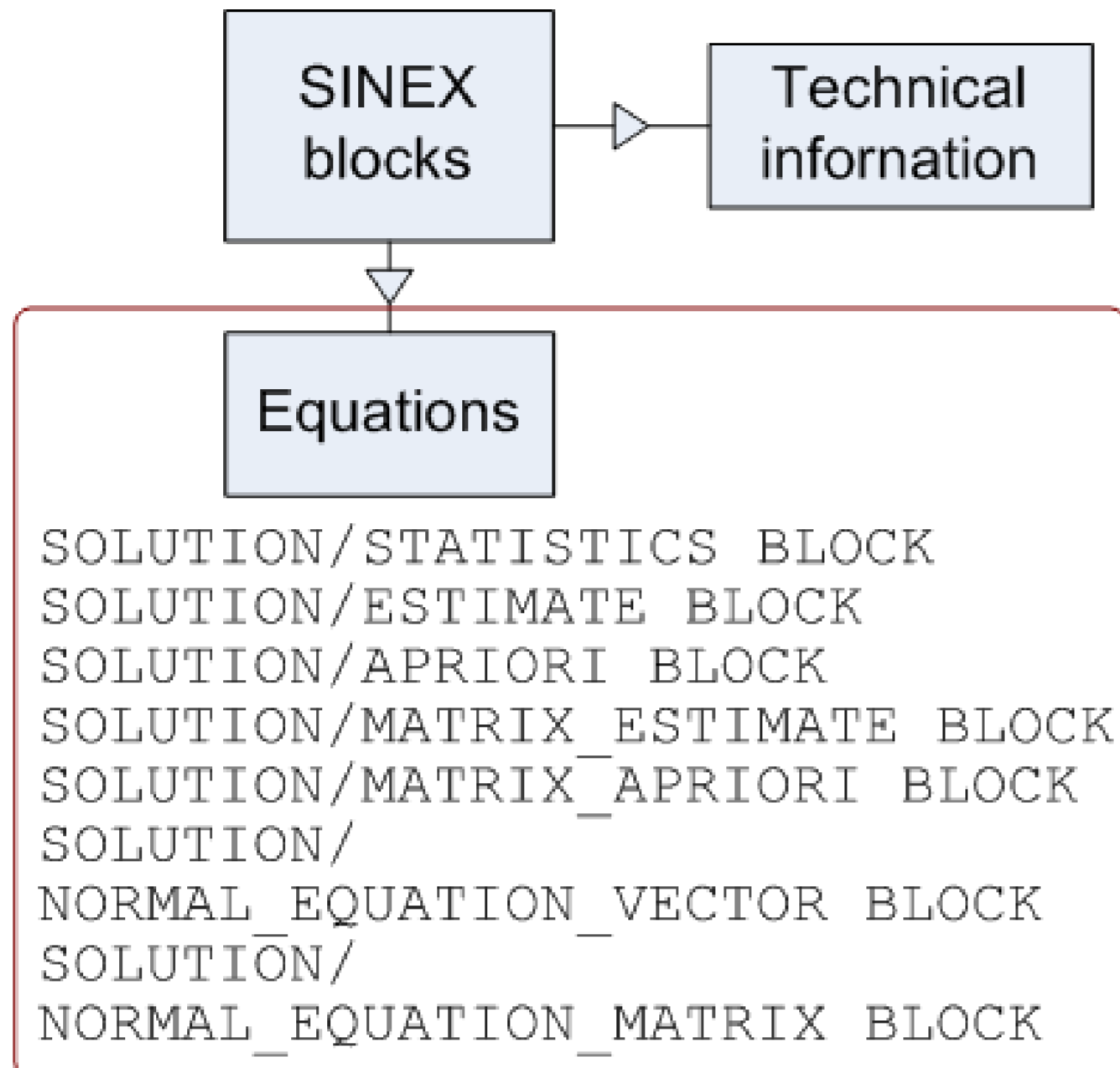
Nowadays there already exist several software packages for combined processing, such as Bernese GPS Software, CATREF, CoCos. We intend SINCom to be competitive, powerful and easy-to-use tool.

The international standardized SINEX format is chosen as the basic form for solution representation.

```
%=SNX......(Header line)

+(BLOCK TITLE)
   ...........
   ...........
   ...........
-(BLOCK TITLE)

   ...........

+(BLOCK TITLE)
   ...........
   ...........
   ...........
-(BLOCK TITLE)

%ENDSNX (Trailer line)
```

SINEX blocks → Technical information

Equations

```
SOLUTION/STATISTICS BLOCK
SOLUTION/ESTIMATE BLOCK
SOLUTION/APRIORI BLOCK
SOLUTION/MATRIX_ESTIMATE BLOCK
SOLUTION/MATRIX_APRIORI BLOCK
SOLUTION/
NORMAL_EQUATION_VECTOR BLOCK
SOLUTION/
NORMAL_EQUATION_MATRIX BLOCK
```
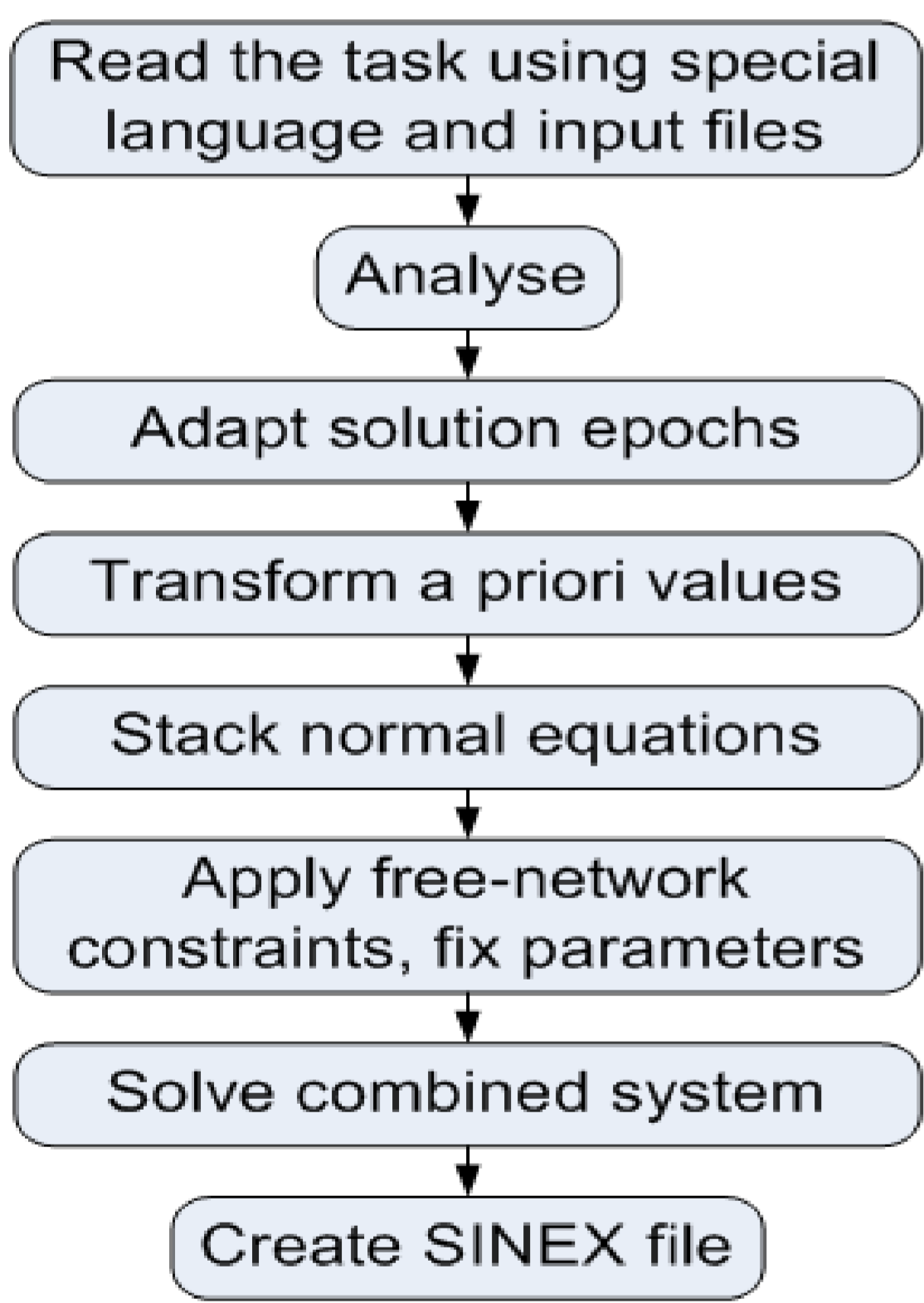
For sufficient solutions amount estimation of station velocities is available. Free network constraint should be also applied toward the stations velocities.

SINCom flowchart

- Read the task using special language and input files
- Analyse
- Adapt solution epochs
- Transform a priori values
- Stack normal equations
- Apply free-network constraints, fix parameters
- Solve combined system
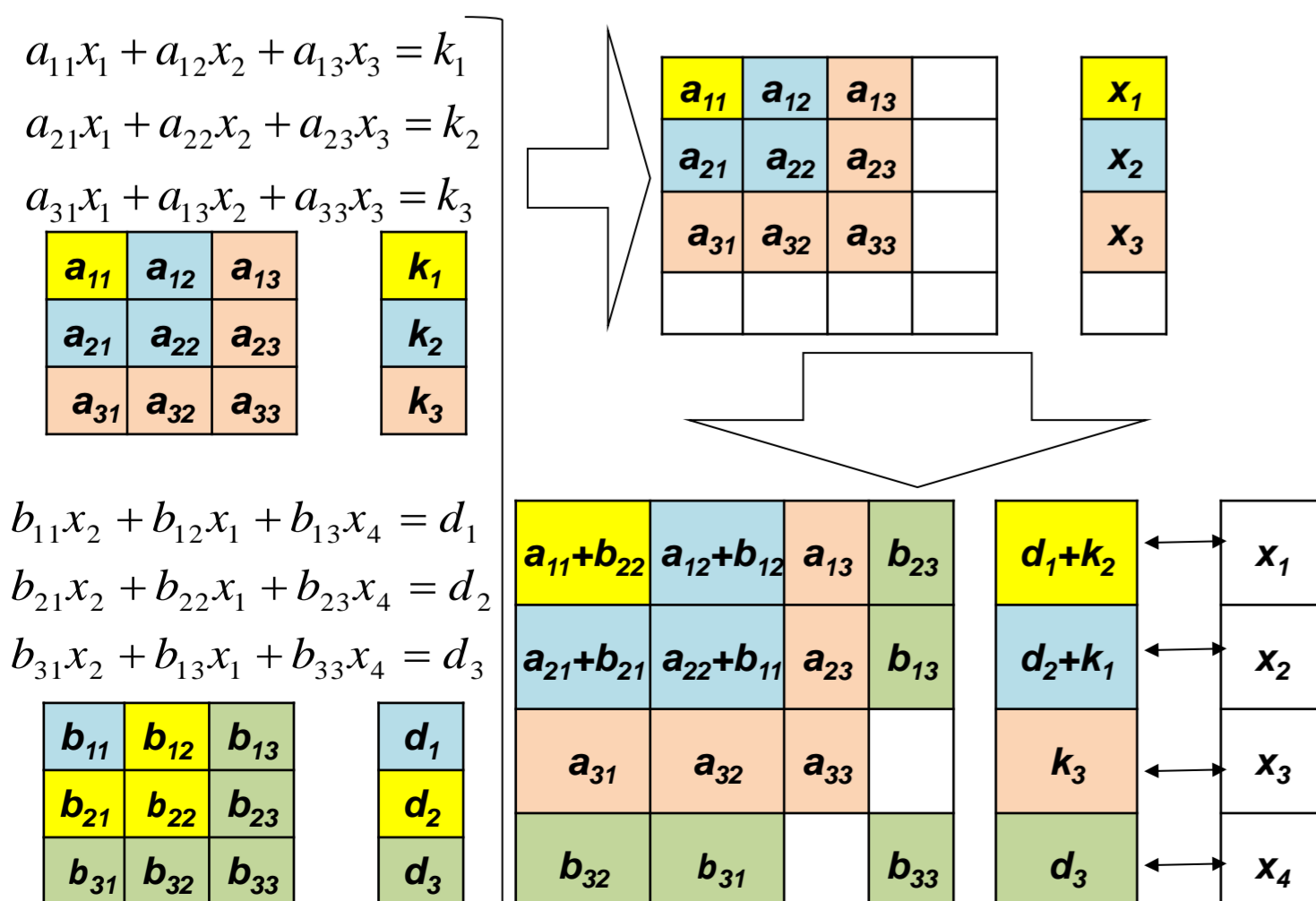- Create SINEX file

The SINEX combine processing allows obtaining two types of solutions:
- combined solution including observations of different techniques related to the same epoch ("vertical" scheme). The final solution provides more precise EOPs. Further iterative improvement of satellite orbit parameters is also possible
- single-technique combination ("horizontal" scheme) of daily solutions. The final solution can be used to obtain weekly solutions based on global networks observations.

SINCom → Inter-technique ("vertical") combination schema / Single-technique ("horizontal") combination schema
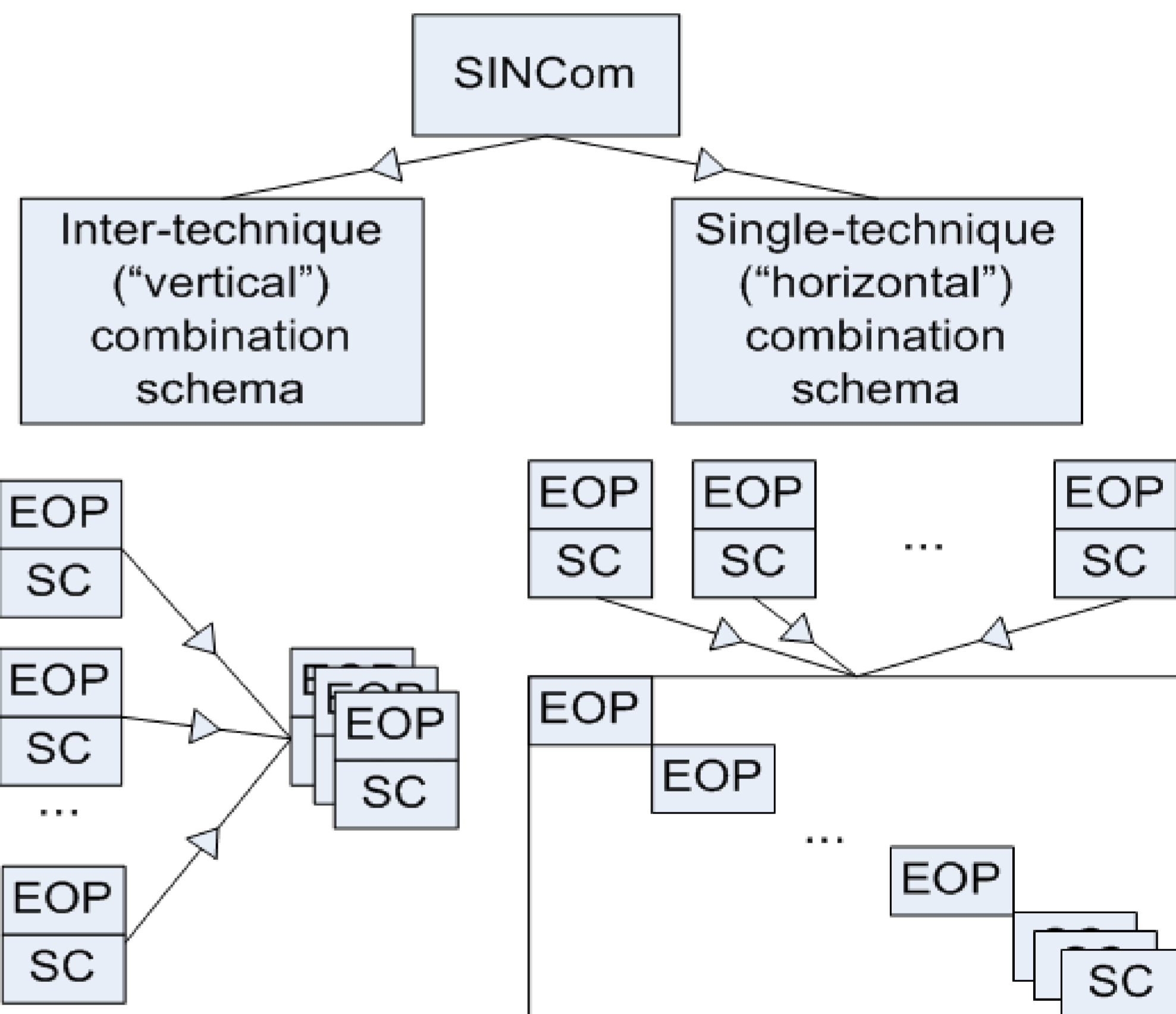
Scheme of parameter stacking

The program SINCom analyzes input files and sorts the parameters in accordance with identification of type of parameter. The quadruple of fields in the SOLUTION blocks: Site Code, Point Code, Parameter Type and (for local parameters) Solution ID forms unique name of a variable. The MATRIX Row/Column Number correspond to the Estimated Parameters Index in the SOLUTION block.

$$a_{11}x_1 + a_{12}x_2 + a_{13}x_3 = k_1$$
$$a_{21}x_1 + a_{22}x_2 + a_{23}x_3 = k_2$$
$$a_{31}x_1 + a_{13}x_2 + a_{33}x_3 = k_3$$

$$b_{11}x_2 + b_{12}x_1 + b_{13}x_4 = d_1$$
$$b_{21}x_2 + b_{22}x_1 + b_{23}x_4 = d_2$$
$$b_{31}x_2 + b_{13}x_1 + b_{33}x_4 = d_3$$

Combination results.

The horizontal combination scheme was applied to the SINEX files got from SLR observations during 2012-2013 years. Coordinates of SLR stations of the QUASAR network (SVEL, ZELL, BADL) and their velocities were estimated.