

# DGFI report on the combination of the weekly solutions delivered by the SIRGAS Processing Centres for the SIRGAS-CON network



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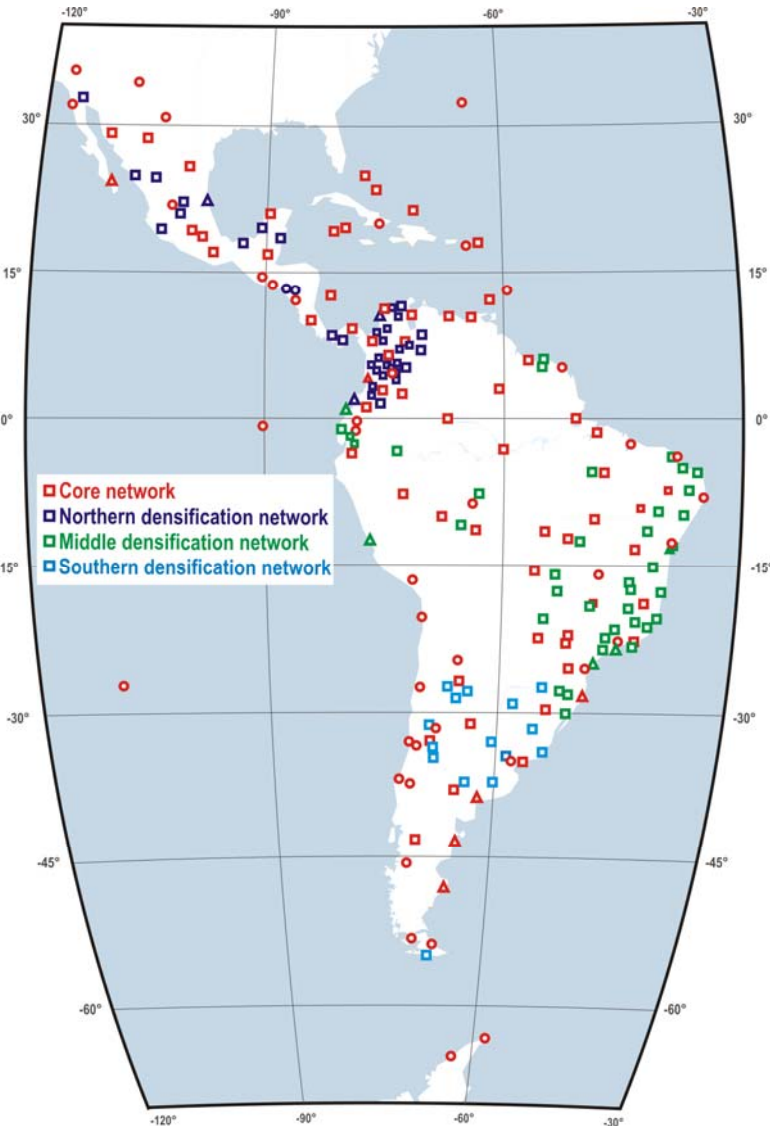
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# SIRGAS Reference Frame (SIRGAS-CON)

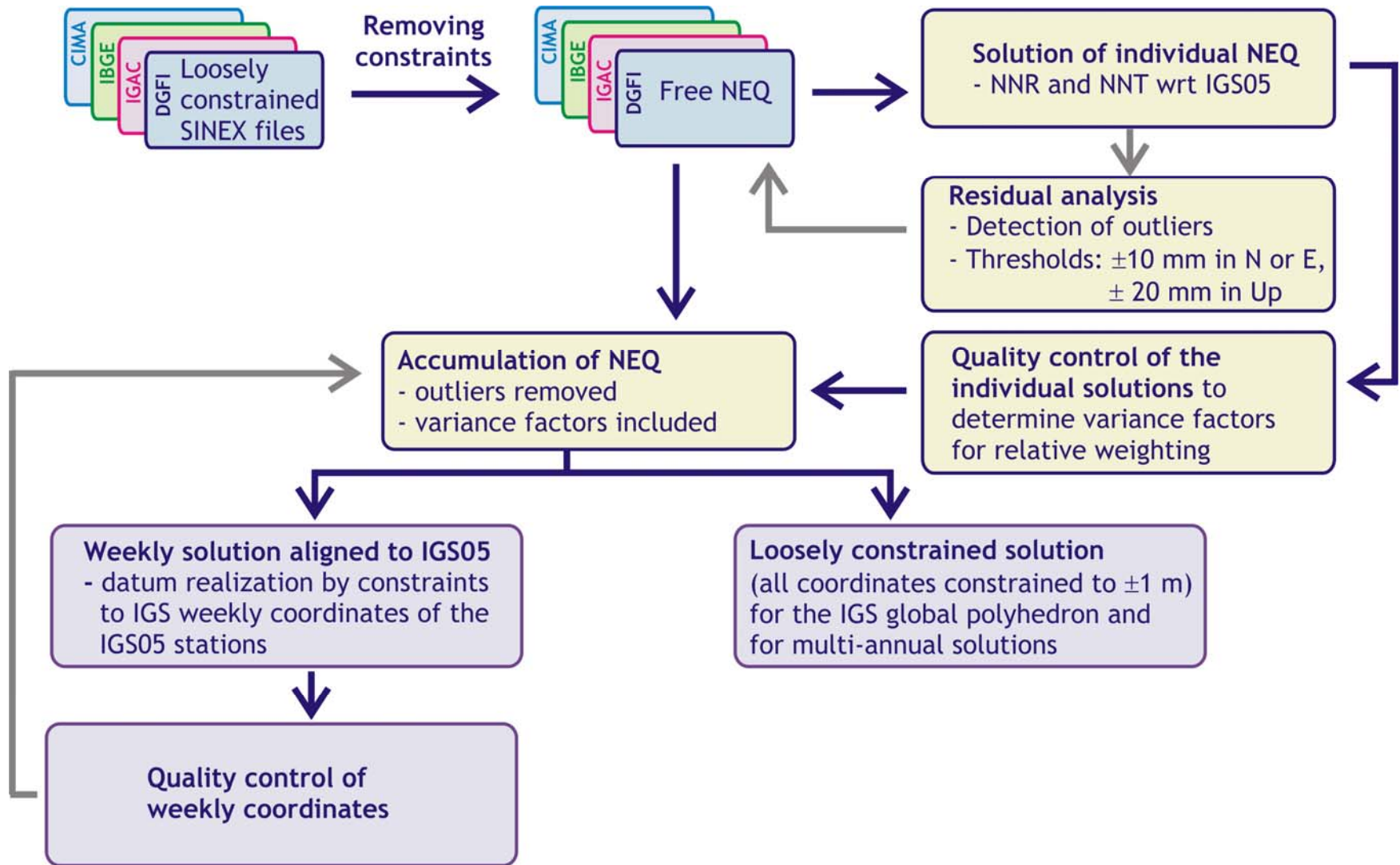
- 208 continuously operating stations (48 IGS global stations);
- Classified in four sub-networks, individually processed by the SIRGAS Processing Centres:

Sub-network	Processing Centre	DGF	IGA	IBG	CIM
Core (continental)	DGFI (Germany)	108	56	49	37
Northern	IGAC (Colombia)		95	17	15
Middle	IBGE (Brazil)			96	21
Southern	CIMA (Argentina)				52

- Individual solutions are combined by DGFI and IBGE to a unified weekly solution for the entire network.



# DGFI strategy for the combination of the SIRGAS-CON sub-networks



# Quality control of the individual solutions (1)

**Objective:** Determination of variance factors for relative weighting of the individual solutions to compensate possible differences in the stochastic models.

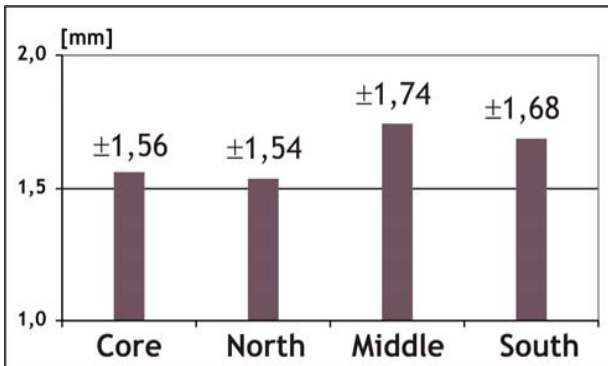
## Criteria:

- Mean standard deviations of coordinates based on minimum datum conditions (NNR and NNT) wrt IGS05 (**formal errors of the individual solutions**);
- Weekly repeatability of station coordinates for each Processing Centre (**individual precision of the weekly coordinate solutions**);
- Comparison with the IGS weekly coordinates for common stations (**reliability of the individual solutions**).

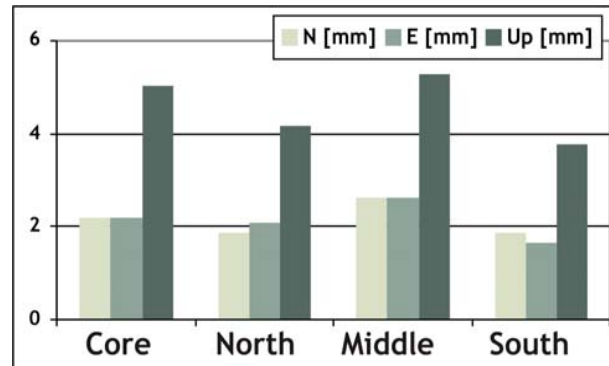
# Quality control of the individual solutions (2)

Mean values of weekly solutions between August 31, 2008 and July 4, 2009 (44 weeks)

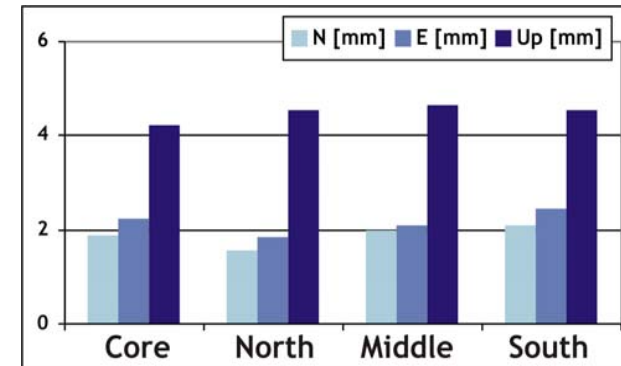
Formal errors of the individual solutions



Consistency of the weekly coordinates in the individual solutions



Reliability of the individual solutions (comparison with IGS)



- Individual standard deviations agree quite well ( $\sim\pm 1,6$  mm);
- Individual solutions present a homogeneous precision (internal consistency) of  $\sim\pm 2$  mm for the horizontal position and  $\sim\pm 4$  mm for the vertical one;
- Reliability (external accuracy) of the individual solutions is also very similar, it is  $\sim\pm 2$  mm for the horizontal components and  $\sim\pm 4$  mm for the vertical one.

# Variance factors for the individual solutions

Mean values of weekly solutions between August 31, 2008 and July 4, 2009 (44 weeks)

Processing centre	Sub-network	Variance factors wrt core network			
		Consistency of weekly coordinates	Accuracy of weekly coordinates	Mean	Standard deviation
DGFI	Core	1,0	1,0	1,0	1,0
IGAC	North	1,2	1,0	1,1	1,0
IBGE	Middle	0,9	0,9	0,9	0,9
CIMA	South	1,3	0,9	1,1	0,9

The mean variance factors derived from internal consistency and accuracy of the coordinates are very close to those obtained from the formal standard deviations. This indicates that the parameters estimated by each of the contributing solutions are at the same accuracy level and a relative weighting is not necessary.

# Quality control of the final weekly coordinates

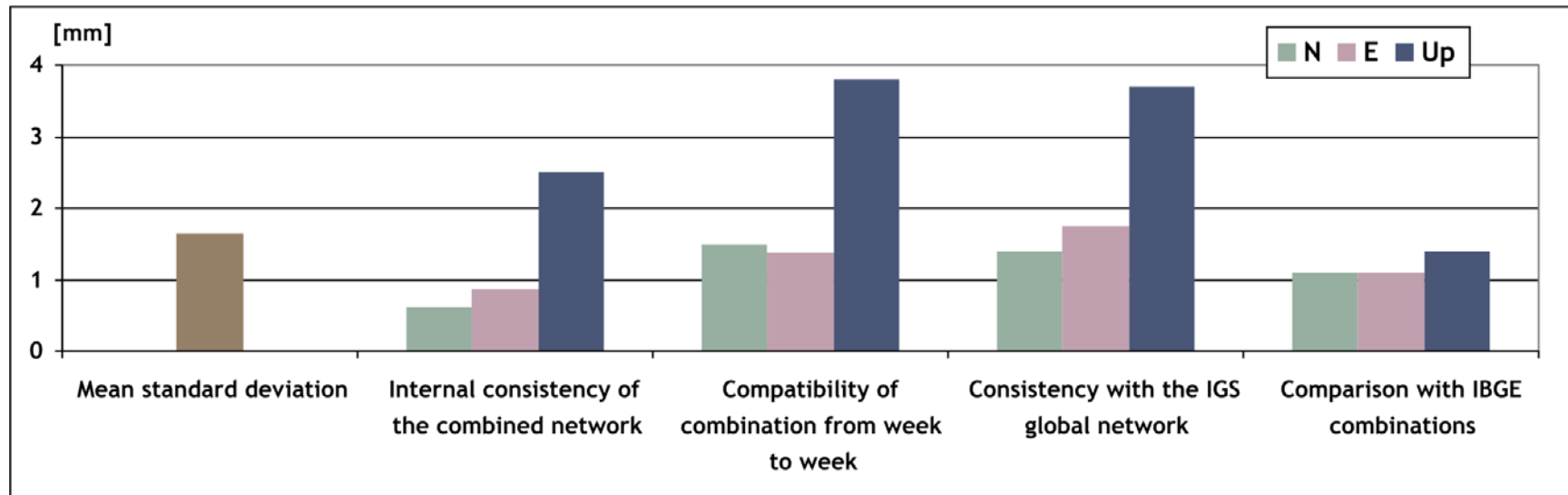
**Objective:** to ascertain the accuracy and reliability of the weekly solutions for the entire SIRGAS-CON network (combination of core, northern, middle, and southern sub-networks).

## Criteria:

- Mean standard deviation for station positions after aligning the network to the IGS05 reference frame (**formal error of the final combination**);
- Residual analysis after combining the individual solutions (**internal consistency of the combined network**);
- Time series analysis for station coordinates (**compatibility of the combined solutions from week to week**);
- Comparison with the weekly IGS coordinates (**consistency with the IGS global network**);
- Comparison with the IBGE weekly combination (**required redundancy to generate the final SIRGAS products**).

# Quality control of the final weekly coordinates

Mean values of weekly solutions between August 31, 2008 and July 4, 2009 (44 weeks)



- Agreement between standard deviations (of individual solutions and combination) indicates that the quality of the individual solutions is maintained and their combination does not deform or damage the internal precision of the entire SIRGAS-CON network;
- Precision (internal consistency) of the weekly combinations is  $\sim\pm 0,8$  mm in the horizontal component and  $\sim\pm 2,5$  mm in the vertical one;
- Reliability of the final coordinates (external accuracy) is  $\sim\pm 1,5$  mm in the horizontal position and  $\sim\pm 3,8$  mm in the height.



# Closing remarks

1. The existing SIRGAS Processing Centres satisfy administrative and quality processing requirements defined by SIRGAS;
2. Their weekly solutions are at the same level of precision with respect to each other and with respect to the final weekly combinations;
3. The weekly coordinates of the SIRGAS-CON network present an internal consistency of  $\sim\pm 0,8$  mm in N and E, and  $\sim\pm 2,5$  mm in Up. Their reliability (external accuracy) is estimated to be  $\sim\pm 1,5$  mm in N and E, and  $\pm 3,8$  mm in Up;

## Aspects to improve:

1. The SIRGAS-CON stations are unequally weighted in the weekly combinations, because not all of them are included in the same number of individual solutions;
2. All the four operative Processing Centres apply at present the Bernese Software, it is desirable to use other software for control.