# IAG WG "Integration of Dense Velocity Fields in the ITRF": Results and Lessons learned


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IAG Working Group "Integration of Dense Velocity Fields in the ITRF" http://iagvf.oma.be

## Introduction

The IAG WG "Integration of Dense Velocity Fields in the ITRF" (http://iagvf.oma.be) aims to densify the International Terrestrial Reference Frame (ITRF) by combining individual weekly solutions from several regional and global analysis centers to derive a cumulative solution (positions, velocities & their associated residual position time series).

The contributing analysis centers are representing the Regional Reference Frame sub-commissions **AFREF** (Africa), **APREF** (Asia & Pacific), **EUREF** (Europe), **NAREF** (North America) and **SIRGAS** (Latin America & Caribbean).

## Data Set

| | AC | Solution | Data span (year) | Antenna calibrations | # stations (raw) | # stations (selected) | # new stations wrt ITRF2008 |
|---|---|---|---|---|---|---|---|
| IGS | IGS | Global | 1996.0-2012.9 | igs05 | 1160 | 705 | 186 |
| AFREF | AFR | Global | 1996.0-2012.9 | igs08 | 197 | 132 | 72 |
| APREF | APR | Global | 2004.0-2012.9 | igs08 | 606 | 396 | 102 |
| EUREF | EUR | Regional | 1996.0-2012.9 | igs05 + indiv | 296 | 261 | 145 |
| NAREF | GSB | Global | 2000.0-2012.9 | igs05 | 600 | 553 | 444 |
| | NGS | Global | 2000.0-2012.9 | igs05 | 2830 | 1914 | 1519 |
| SIRGAS | SIR | Regional | 2000.0-2012.9 | igs05 | 329 | 256 | 189 |
| **Total** | | | **1996.0-2012.9** | | **4077** | **2812** | **2251** |

*Table1: List of the weekly solutions submitted to the WG*

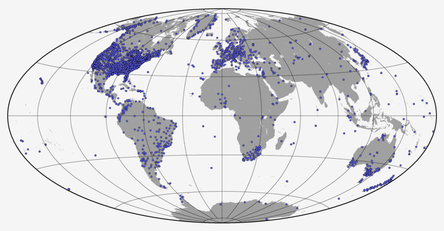


*Figure 1: Map of the network*
2812 Stations available in the current combination

Submitted solutions
- weekly SINEXs (cleaned or with a list of the outliers to be removed),
- cumulative solution and associated residual position time series,
- position and velocity discontinuities,
- station site logs (if available).

Metadata issues
- Station naming: DOMES number or 4-char id conflicts
- Large majority of stations with site log but site log information not consistently used during analysis, e.g. antenna height inconsistencies
- Non identical duplicate site logs

Initial selection of the stations
- Data span > 3 years
- present in at least 104 weekly SINEXs
- present in at least 50% of the weekly SINEXs within the data span

Remark: SIRGAS stations also available in other solutions are considered in order to stabilize the inclusion of the regional solution during the combination even if the data span is too short

Weaknesses of the dataset

The mix of the antenna calibration models (igs05.atx, igs08.atx and individual antenna calibrations) is the main drawback of this combination

## Combination of the Weekly Solutions

Individual weekly SINEXs are combined with CATREF [Altamimi et al. 2007]. Preliminary weekly combinations lead to a typical 3D weekly RMS which ranges from 2 mm to 5 mm.

Data cleaning: rejection of solutions with incorrect metadata

Step wise approach:

a) A priori re-weighting ($\sigma_1$) of covariance matrices based on formal errors in SINEXs
b) Weekly combinations (only common stations) to determine the transformation parameters (T) and the estimated variance factor ($\sigma_2$)
c) Final weekly combinations (full network) with fixed transformation parameters (T) and re-weighting based on variance factor ($\sigma_2$)

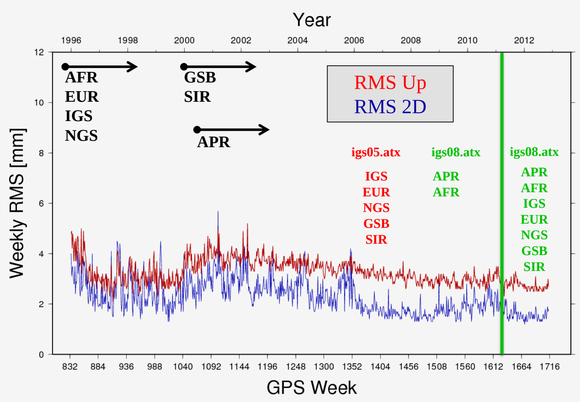



*Figure 2: RMS [in mm] of the weekly combinations as a function of time (Up in red and 2D horizontal in blue)*

## Cumulative Solution: Discontinuities

Discontinuities coming from individual solutions
- majority of common stations have different discontinuities e.g. EUREF vs IGS: only 40% stations were in full agreement
- reasons: different data span, approximate date, problem of metadata or antenna modeling affecting one or several solutions, different analyst, lack of standardization

Harmonization for ~1200 stations in at least 2 solutions
- keep only required discontinuities

Metadata check
- check all available site logs (material change: date of installation)

Next steps:
- check also the dates of displacements linked to earthquakes
- feedback to contributors

## Cumulative Solution

The cumulative solution is combined with CATREF Software and aligned to IGS08.

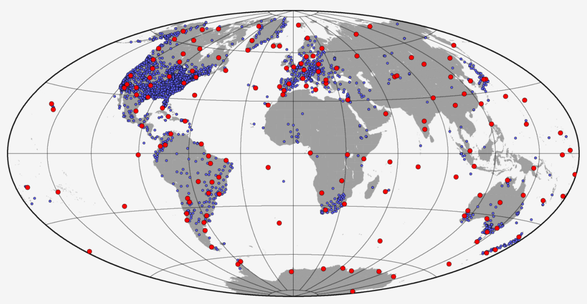
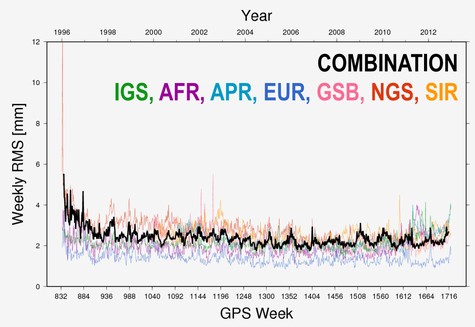


*Figure 3: Map of the network.*
Stations available in the current combination (2812 stations)
Sub-network used to mitigate the aliasing effect [Collilieux et al. 2011]
(igs08 core network + good stations with more than 10 years of data)

*Figure 4: 3D Weekly RMS [in mm] as a function of time*



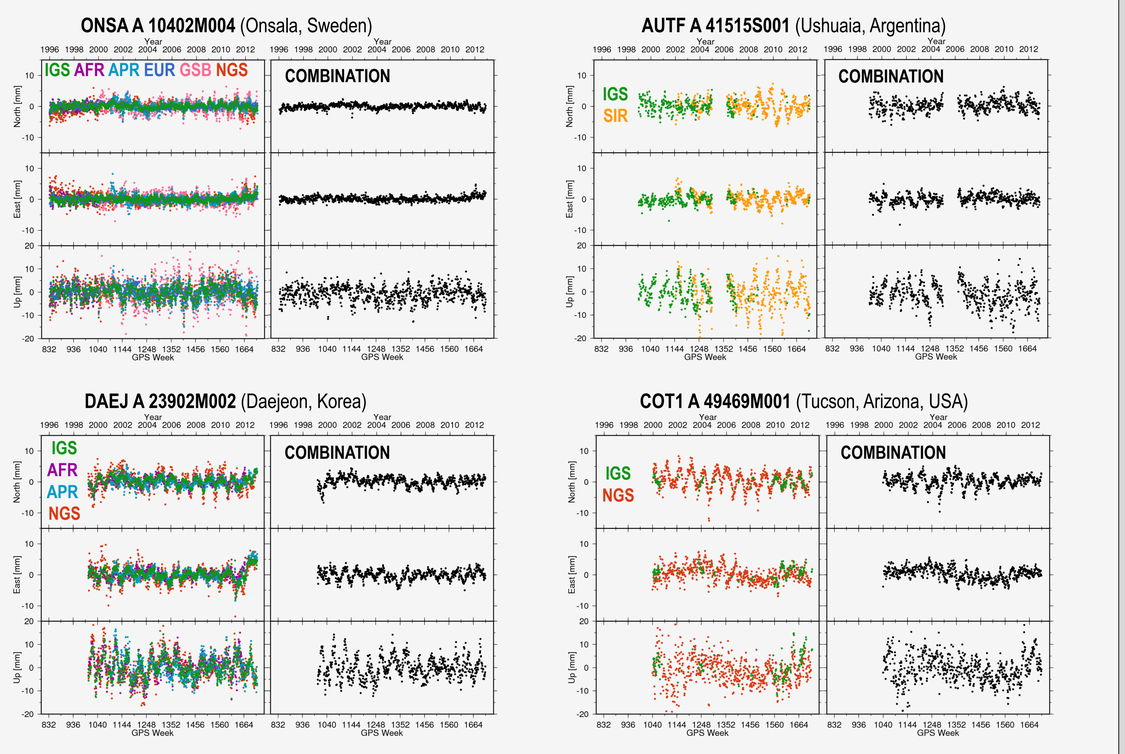




*Figure 5: Residual position time series with respect to cumulative solution of individual weekly regional solutions (left) and weekly combined solution (right).*

## Preliminary Velocity Field

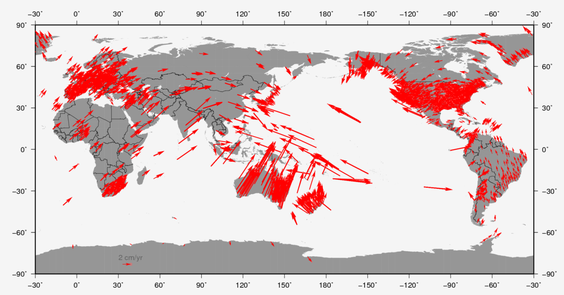



*Figure 6: Preliminary horizontal velocity field*

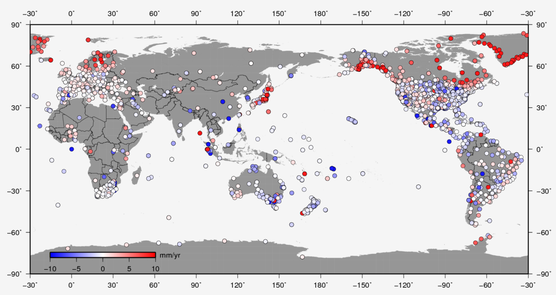



*Figure 7: Preliminary vertical velocity field*

## Conclusion/Perspectives

This poster focused on a combination of regional densification solutions in order to derive a cumulative position and velocity solution for 2812 stations as well as their associated residual position time series.

This preliminary combination was successful:
- Longer, more populated time series
- Increased reliability thanks to redundancy

Next step: improve consistency of discontinuities

Main drawback: mix of igs05.atx, igs08.atx and individual antenna calibration models

⇒ All contributors will submit new weekly solutions compliant with IGS repro2 in 2014. A new combination will be done in 2014-2015.

## References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