

# Objectives and Challenges of the IAG Working Group "Regional Dense Velocity Fields"

C. Bruyninx, Z. Altamimi, M. Becker, M. Craymer, L. Combrinck,  
A. Combrink, R. Fernandes, R. Govind, T. Herring, A. Kenyeres, B. King,  
C. Kreemer, D. Lavallée, J. Legrand, M. Moore, L. Sanchez, G. Sella, G. Woppelmann

## 1. Introduction

Because of its accuracy and ability to provide results in a global reference frame, GNSS is presently the main sensor of the Earth's surface deformation. Consequently, GNSS networks have been installed all over the world and repeated GNSS campaigns are conducted to monitor ground deformations. In addition, a large number of Continuous Operating GNSS Reference Stations (CORS) are operating today for multi-disciplinary applications ranging from surveying to numerical weather prediction. The regional sub-commissions within IAG sub-commission 1 "Regional Reference Frames" have already made a first step in coordinating these activities in order maintain their regional reference systems.

The Working Group "Regional Dense Velocity Fields" was created at the IUGG meeting in Perugia in 2007. It is part of IAG Sub-Commission 1.3 'Regional Reference Frames' which is imbedded in IAG Commission 1 on Reference Frames (Figure 1). The Working Group aims at using the large amount of available GNSS CORS and campaign data to produce dense velocity fields.

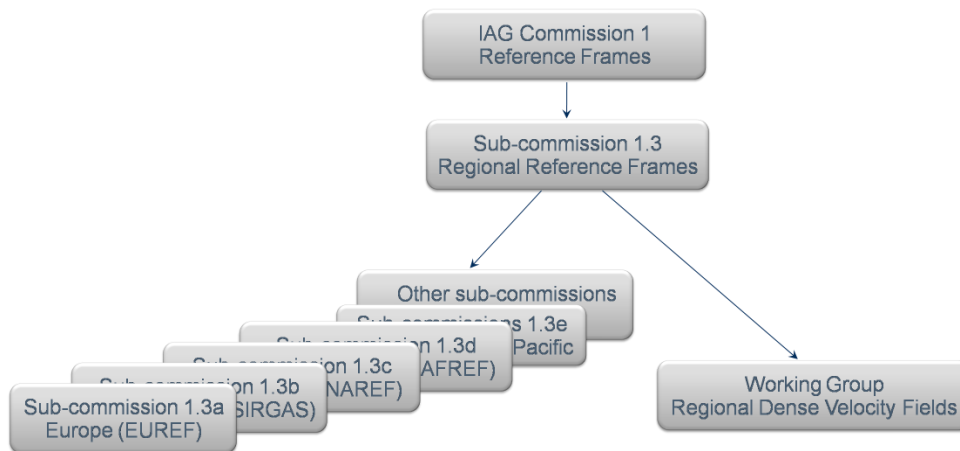


Figure 1 – Role of the Working Group “Regional Dense Velocity Fields” in the IAG

## 2. Objectives

The Working Group (WG) aims at joining the efforts of the regional IAG sub-commissions together with the groups processing local/regional CORS or repeated GNSS campaigns with the following goals:

- Define specifications and quality standards for the regional SINEX solutions and relevant meta-data,
- Collect SINEX solutions and their meta-data,

- Study in-depth the individual strengths and shortcomings of local/regional and continuous/epoch GNSS solutions to determine site velocities,
- Define optimal strategies for the combination of regional and global SINEX solutions,
- Provide dense regional velocity fields,
- Provide the densification of the ITRF2005 (or its successor),

### 3. Cumulative versus weekly SINEX contributions

The regional densification targeted in this Working Group can be achieved in two different ways:

1. *Densification by weekly combination*: weekly solutions are submitted to the Working Group, which first combines all weekly solutions and then stacks the weekly solutions to produce a velocity solution tied to the ITRS (IGS approach). This approach requires consistency of the weekly solutions with respect to corrections and processing options: antennae, tides, loading, 2<sup>nd</sup> order ionospheric effect, tropospheric mapping function,... In addition, solutions since week1400 are incompatible with older ones because of the IGS adoption of absolute antenna phase center variation models since week 1400. Other difficulties when combining weekly solutions are the covariance matrix scaling and the need for outlier detection requiring detailed station meta-data.
2. *Densification by combination of cumulative solutions*: cumulative solutions are submitted to the Working Group, which combines the cumulative solutions and ties it to the ITRS. The advantage of using this approach is that SINEX files containing site coordinates and velocities are submitted to the Working Group. Consequently, consistency issues can be dealt with at the regional level, as well as outlier rejection. The disadvantage of this approach is that no coordinate time series will be available to the WG.

The Working Group has decided to go for approach 2. meaning that in a first step cumulative regional solutions will be created and in a second step these regional solutions will be combined with the global IGS solution.

### 4. Role of the Regional Sub-commissions

Starting from the principle to perform densification by combining cumulative solutions, the basic idea of the WG is to divide the world in different regions and to, in a first step, provide combined cumulative SINEX solutions for each region. In a second step, the different regional cumulative solutions will be included in the ITRF densification.

The working group will base its activities as much as possible on the regional sub-commissions within IAG sub-commission 1 “Regional Reference Frames” (AFREF, NAREF, SIRGAS, EUREF, ...). Their expertise, coordination role for their region, and their capability to generate a unique cumulative solution for their region including velocity solutions from third parties (even campaigns) is essential for the WG.

Different Working Group members will coordinate the WG activities related to a specific world region. The task of these region coordinators is to gather as much as possible velocity solutions for their region (in accordance with the WG requirements) and to combine these solutions with the regional solutions from sub-commissions to produce a regional cumulative combined solution. The following region coordinators have been appointed:

- Africa: R. Fernandes, L. Combrinck

- Antarctica: M. Becker
- Asia: D. Lavallée
- Australia & South Pacific: M. Moore
- Europe: A. Kenyeres
- Middle East: B. King
- North America: M. Craymer
- South America: L. Sanchez

In addition to the individual world regions, cumulative SINEX solutions from global networks as TIGA will be included.

As soon as the first regional SINEX solution become available, combinations on these preliminary regional submissions will be done anticipating a preliminary solution of the Working Group for the IAG 2009. The purpose of multiple coordinators is to evaluate both the results and different approaches. To assist in this task regional coordinators will solicit discontinuity tables in addition to the weekly SINEX solutions.

## 5. Requirements for contributing Solutions

The following preliminary minimal requirements for velocity solutions contributing to the working group have been agreed:

- Minimally 3 epochs for campaigns, 3 years for continuous GNSS
- Format: SINEX preferred, software-dependent format accepted where possible (Bernese/GIPSY/GAMIT/CATREF) (to be converted to SINEX by WG members), the inclusion of meta-data is strongly recommended.
- Constraints (in order of preference): free, minimally constrained, loosely constrained (with documentation of applied constraints) solutions are accepted. If constraints are applied, they should be removable.
- Orbits/EOPs: solutions with fixed IGS orbits and EOPs are preferred

Detailed guidelines will be issued by the Working Group in a later stage.

## Summary

The IAG WG “Regional Dense Velocity Fields” aims at joining the efforts of the regional sub-commissions within IAG sub-commission 1.3 together with the groups processing local/regional CORS or repeated GNSS campaigns through a step-wise combination of global and regional cumulative SINEX solutions. Solutions contribution to the WG must minimally contain 3 epochs for campaigns, and 3 years for continuous GNSS.

First results of the Working Group are expected for the IAG meeting in Rio de Janeiro in the summer of 2009. More information about the WG is available from <http://www.epncb.oma.be/IAG/>.