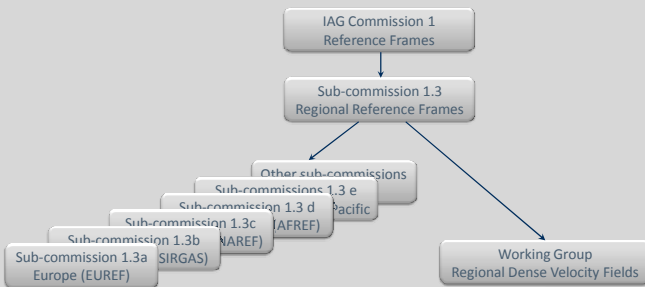# IAG Working Group "Regional Dense Velocity Fields": Objectives and Future Plans

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Introduction

Due to its accuracy, low cost of receivers, versatility and the ability to provide results in a global reference frame, Global Navigation Satellite Systems (GNSS) are 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 in use today for multi-disciplinary applications ranging from surveying to numerical weather prediction.

- IAG Commission 1 Reference Frames
- Sub-commission 1.3 Regional Reference Frames
- Other sub-commissions
- Sub-commissions 1.3 e
- Sub-commission 1.3 d Pacific
- Sub-commission 1.3c (AFREF)
- Sub-commission 1.3b (NAREF)
- Sub-commission 1.3a (SIRGAS)
- Sub-commission 1.3a Europe (EUREF)
- Working Group Regional Dense Velocity Fields

The regional sub-commissions within IAG sub-commission 1 "Regional Reference Frames" have already made a first step in coordinating these activities in order to maintain their regional reference systems compatible with the ITRF.
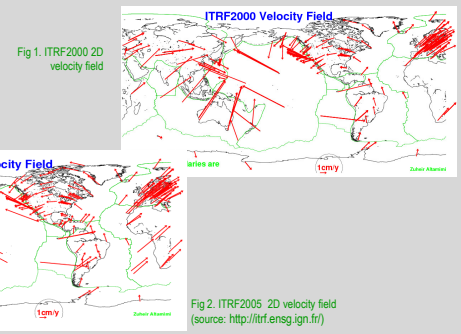
Objectives

This working group on Dense Regional 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 with the following goals:
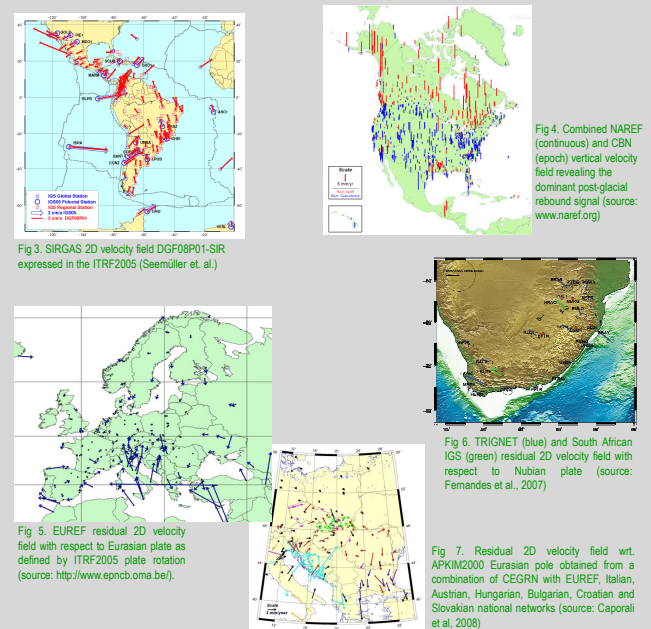
- ❑ Define specifications and quality standards for the regional SINEX solutions and relevant meta-data,
- ❑ Collect SINEX solutions and their meta-data,
- ❑ Study in-depth the individual strengths and shortcomings of local/regional and continuous/epoch GNSS solutions to determine site velocities,
- ❑ 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),
- ❑ Encourage participation in related symposia,
- ❑ Implement a web site in order to provide information on the activities and access to the products of the WG,
- ❑ Prepare recommendations and a comprehensive final report on the WG activities.

ITRF Velocity Field

Frame	# GNSS Stations	# GNSS solutions
ITRF97	±200	6
ITRF2000	±360	6
ITRF2000 Densification	±400	18
ITRF2005	±300	1 (IGS)

Fig 1. ITRF2000 2D velocity field

Fig 2. ITRF2005 2D velocity field (source: http://itrf.ensg.ign.fr/)

Regional Networks

Fig 3. SIRGAS 2D velocity field DGF08P01-SIR expressed in the ITRF2005 (Seemüller et. al.)

Fig 4. Combined NAREF (continuous) and CBN (epoch) vertical velocity field revealing the dominant post-glacial rebound signal (source: www.naref.org)

Fig 5. EUREF residual 2D velocity field with respect to Eurasian plate as defined by ITRF2005 plate rotation (source: http://www.epncb.oma.be/).

Fig 6. TRIGNET (blue) and South African IGS (green) residual 2D velocity field with respect to Nubian plate (source: Fernandes et al., 2007)

Fig 7. Residual 2D velocity field wrt. APKIM2000 Eurasian pole obtained from a combination of CEGRN with EUREF, Italian, Austrian, Hungarian, Bulgarian, Croatian and Slovakian national networks (source: Caporali et al, 2008)

Future Plans and Open Questions

Cumulative or weekly SINEX contributions ?

Densification by **weekly** combination
- – Consistency in corrections and processing options: antennae, tides, loading, 2nd order ionospheric effect, tropospheric mapping function
- – Solutions since week 1400 are incompatible with older ones because of IGS adoption of absolute PCV since week 1400
- – Covariance matrix scaling
- – Outlier detection and need for detailed meta-data
- – Link with IGS Global Network Associate AC combination

Densification by combination of **cumulative** solutions
- + SINEX contain coordinates and velocities
- + Consistency issues dealt with at regional level
- + Outlier detection is done at regional level
- – No coordinate time series
- + Step-wise combination of global and regional solutions

Role of non-continuous GNSS ?
- ❑ Precision of estimated velocities, influence of periodic signals
- ❑ Marker stability and antenna offsets

Documentation and meta-data ?
- ❑ Need for proper management of meta data : duplicate station names, missing domes numbers
- ❑ Documentation of conventions used in analysis

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