Report on the *RadioNet3* Networking Activities

Please fill out the fields below

Event

- **Title: "EGU and IVS Training School on VLBI for Geodesy and Astrometry"**
- **Date: 2013, March 1-4**
- **Location: Aalto University, Espoo (Finland) and Finnish Geodetic Institute, Masala (Finland)**

Participants number: **43 students, 13 teachers**

Home institutes: **Various different home institutes, see the list of participants and list of teachers.**

- Agenda and/or programme of the meeting
- Summary of the discussions and conclusions of the event
- Attendance list (incl. participant names, affiliation and country) signed by the participants and confirmed by the organizer
- Financial report detailing the use of *RadioNet3* funding

Presentations made at the meeting should be posted on the *RadioNet3* wiki (or a link to the meeting web page, if this is long-lived)

http://www.radionet-eu.org/radionet3wiki/doku.php?id=na:management:presentations

Rüdiger Haas, Markku Poutanen, Minttu Uunila, 2013-03-27
Signature of the event organizer name & date

Project supported by the European Commission (contract no. 283393)

0) General information

The “EGU and IVS Training School on VLBI for Geodesy and Astrometry” was held March 1-4, 2013, in Finland. It was organized by Rüdiger Haas, head of IVS Working Group 6 on VLBI Education, in collaboration with Markku Poutanen, head of the geodesy division at the Finnish Geodetic Institute (FGI), and Minttu Uunila from Aalto University, Metsähovi Radio Observatory, Finland. The main goal of the VLBI school was to educate and provide training for the next generation VLBI researchers that will work with the next generation VLBI system for Geodesy and Astrometry. For that purpose, four days of lectures and exercises were arranged, with the intention to cover the VLBI system for Geodesy and Astrometry as complete as possible.

The lectures covered technical aspects, scheduling and observations, details of the correlation process, modeling and data analysis, and interpretation of the results. There were in total 14 lectures and 3 hands-on exercises. The final session of the VLBI-school was held together with the 14th IVS Analysis Workshop.

The teachers that were giving lectures at the VLBI school are international experts in their fields and come from several research institutions worldwide:

- Thomas Artz (University of Bonn, Germany)
- Alessandra Bertarini (Max Planck Institute for Radioastronomy, Germany)
- Johannes Böhm (Vienna Technical University, Austria)
- Roger Cappallo (MIT Haystack Observtory, USA)
- Patrick Charlot (Bordeaux Observatory, France)
- John Gipson (NASA, NVI Inc., USA)
- Rüdiger Haas (Chalmers University of Technology, Sweden)
- Chris Jacobs (JPL, NASA, USA)
- Dan MacMillan (NASA, NVI Inc., USA)
- Axel Nothnagel (University of Bonn, Germany)
- Bill Petrachenko (National Resources Canada, Canada)
- Harald Schuh (GeoForschungsZentrum Potsdam, Germany)
- Manuela Seitz (DGFI, Germany)
- Alan Whitney (MIT Haystack Observatory, USA)

There were more than 60 applications for participation in the VLBI school, from interested students worldwide, including all continents. Finally, more than 50 students really could attend the VLBI-school, see the list of participants in Section 3. More than 50 % of the participants are active in educational programs on master’s or PhD level, while the rest were more senior researchers. More than 35 % of the participants were female. The lecture slides will be made available via the webpages of the European VLBI Group for Geodesy and Astrometry (EVGA, www.evga.org).

The VLBI-school received some financial support from the European Geosciences Union (EGU) that was entirely used to support parts of the travel expenses of the master’s and PhD students. The Onsala Space Observatory provided support for food in terms of coffee breaks and lunches during the VLBI-school. Aalto University provided the lecture room on Saturday, Monday and Tuesday, while the Finnish Geodetic Institute provided the lecture room on Sunday and some food. There is a small number of master’s and PhD students that will send claims to RadioNet3 to be refunded for travel expenses.

Figure 1: Students listening to a lecture during the VLBI-school in the lecture hall at Aalto University, Espoo.

Figure 2: Alessandra Bertarini giving a lecture for the VLBI-school at the Finnish Geodetic Institute, Masala.

Figure 3: Roger Cappallo (right) advising a student group during Exercise-2 on software correlation.

Figure 4: Axel Nothnagel (left) supervising a student group during Exercise-3 on data analysis.

1) Program of the "EGU and IVS Training School on VLBI for Geodesy and Astrometry"

Day-1 (Saturday, 2013-03-02, @ Aalto University, Espoo)
09:00-09:15 Welcome and practical information (R. Haas, M. Poutanen)
09:15-10:00 "General overview on geodetic and astrometric VLBI and the IVS" (H. Schuh)
10:00-10:30 --- coffee break ---
10:30-12:00 "Radio telescopes, feed horns and receivers" (B. Petrachenko)
12:00-13:00 --- lunch break ---
13:00-14:30 "Digital backends and data acquisition" (A. Whitney)
14:30-15:00 --- coffee break ---
15:00-16:30 "Experiment scheduling" (J. Gipson)
16:30-17:15 "Observing an experiment" (R. Haas)
17:15-18:00 Exercise-1 (theoretical calculations, B. Petrachenko)

Day-2 (Sunday, 2013-03-03, @ FGI, Masala)
08:30-09:00 bus leaves from Helsinki downtown to Radissson blu Otaniemi Espoo
09:00-09:30 bus leaves from Radiosson blu Otaniemi Espoo to FGI Masala
09:30-11:00 "Correlator Architectures and VLB2010" (R. Cappallo)
11:00-11:30 --- coffee break ---
11:30-13:00 "Correlation preparation and post-correlation analysis" (A. Bertarini)
13:00-14:00 --- lunch break ---
14:00-15:30 "Geophysical models" (D. MacMillan)
15:30-16:00 --- coffee break ---
16:00-17:30 Exercise-2 (software correlation) (A. Bertarini & R. Cappallo)
17:30-20:00 "VLBI-school dinner"
20:00-21:00 bus transport back to Radiosson blu Otaniemi Espoo & Helsinki downtown

Day-3 (Monday, 2013-03-04, @ Aalto University, Espoo)
09:00-10:30 "Atmospheric propagation" (J. Böhm)
10:30-11:00 --- coffee break ---
11:00-12:30 "Data modeling and analysis" (Th. Artz)
12:30-13:30 --- lunch break ---
13:30-15:00 "Terrestrial reference frame" (R. Haas on behalf of M. Seitz)
15:00-15:30 --- coffee break ---
15:30-17:00 Exercise-3 (data analysis) (Th. Artz et al.)

Day-4 (Tuesday, 2013-03-05, @ Aalto University , Espoo)
09:00-10:30 "Radio sources" (P. Charlot)
10:30-11:00 --- coffee break ---
11:00-12:30 "Celestial Reference Frames" (Ch. Jacobs)
12:30-13:30 --- lunch break ---
13:30-15:00 "Earth rotation and orientation" (A. Nothnagel)
15:00-15:30 --- coffee break ---

15:30-18:00 14th IVS Analysis Workshop (A. Nothnagel et al.)

2) Summary of the discussions and conclusions of the event

The event was a Training School on VLBI for Geodesy and Astrometry with in total 14 lectures and 3 exercises. All lectures were 90 minutes long, except one that was only 45 minutes long. The exercises were between 45 and 90 minute long, and very much appreciated by the students. The first exercise covered purely technical aspects and focused on aspects like the calculation of sensitivity of radio astronomical systems. The students worked individually and had to solve several small tasks. The second exercise was on software correlation. The students worked in small groups of 4-5 persons and used the DiFX software correlator and the Haystack fringe-fitting software to derive VLBI group delay observables for the baseline Wettzell-Onsala of a real experiment. The third exercise then concentrated on the analysis of geodetic VLBI data. The students worked again in small groups of 4-5 people and performed the necessary ambiguity resolution and ionospheric corrections, and the final parameter estimation.

There was plenty of opportunity for the students to ask questions after the lectures, and there were lively discussions in the coffee breaks and lunch breaks. The students had access to all teachers and could ask questions and discuss various topics.

At the end of the last day an evaluation questionnaire was handed out to the students and they were asked to evaluate the VLBI Training School. Copies of the original answers can be provided on request. A summary of the results of the evaluation is presented below.

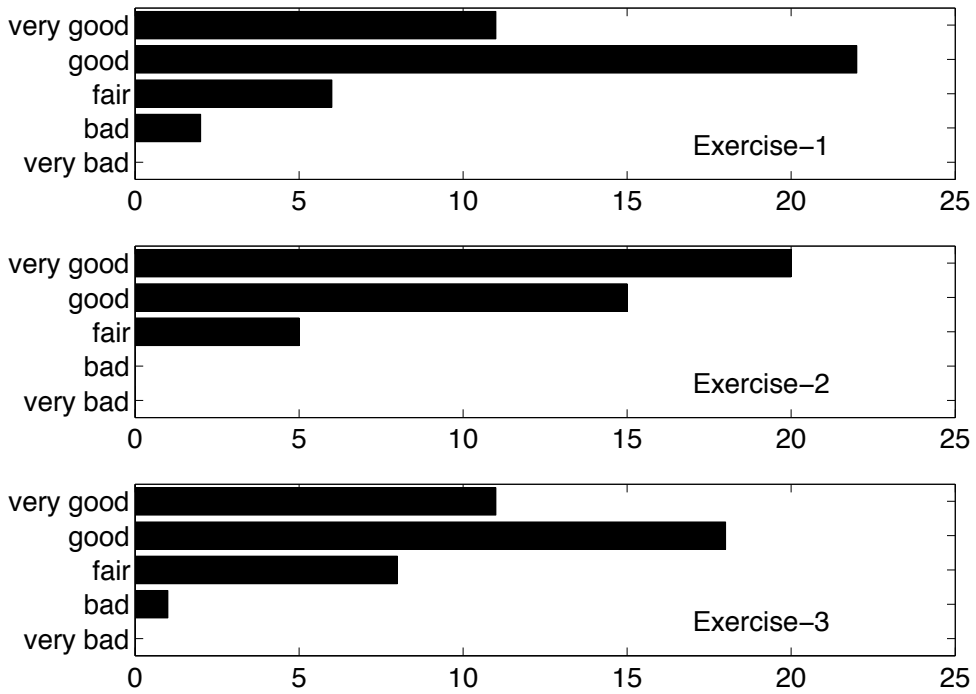

Figure 5: Question: "What is your impression on the exercises '*technique*' (Exercise-1), '*correlation*' (Exercise-2) and '*analysis*' (Exercise-3) that we did during the VLBI school"?

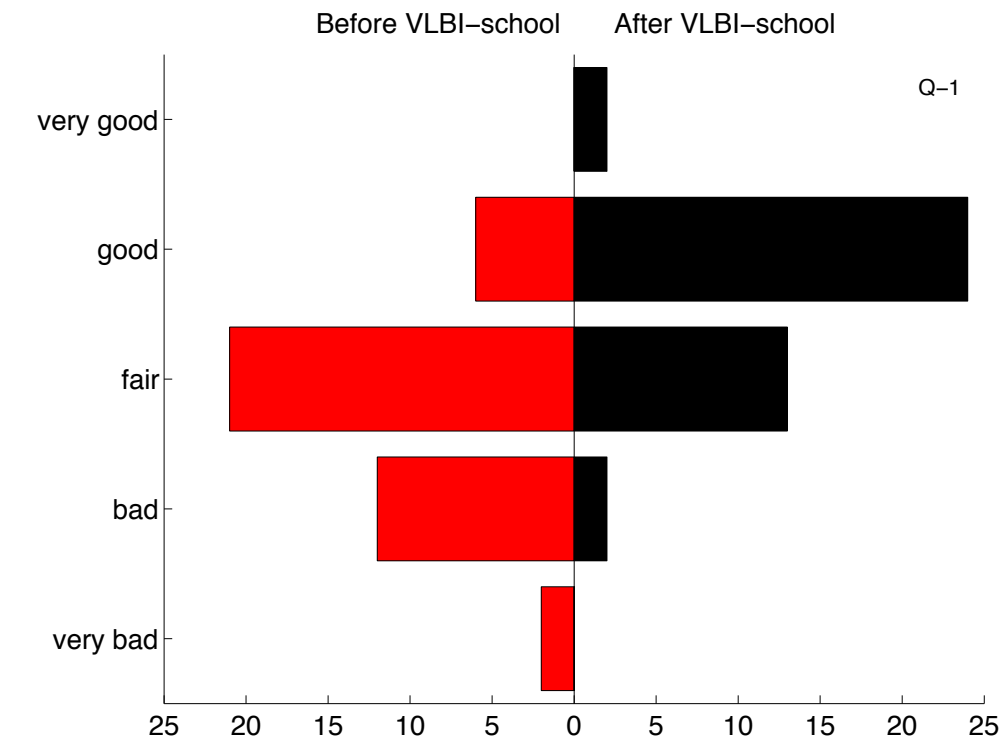

Figure 6: Question: "What was/is your knowledge on '*radio telescopes, feed horns and receivers*' before and after the VLBI school"?

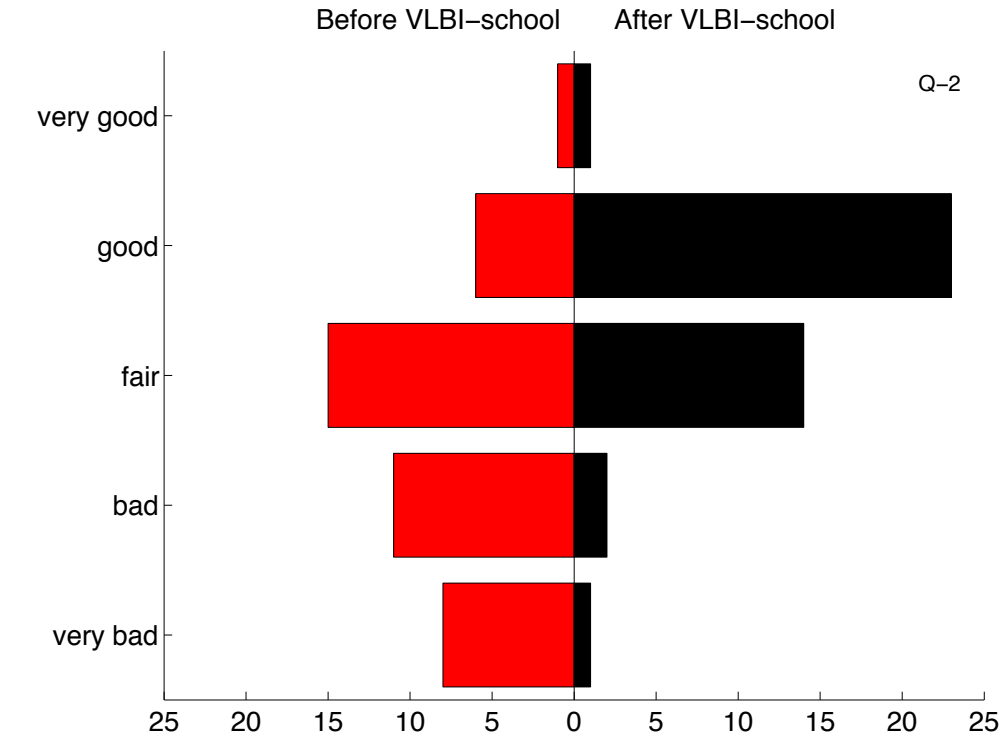

Figure 7: Question: "What was/is your knowledge on '*digital backends and data acquisition*' before and after the VLBI school"?

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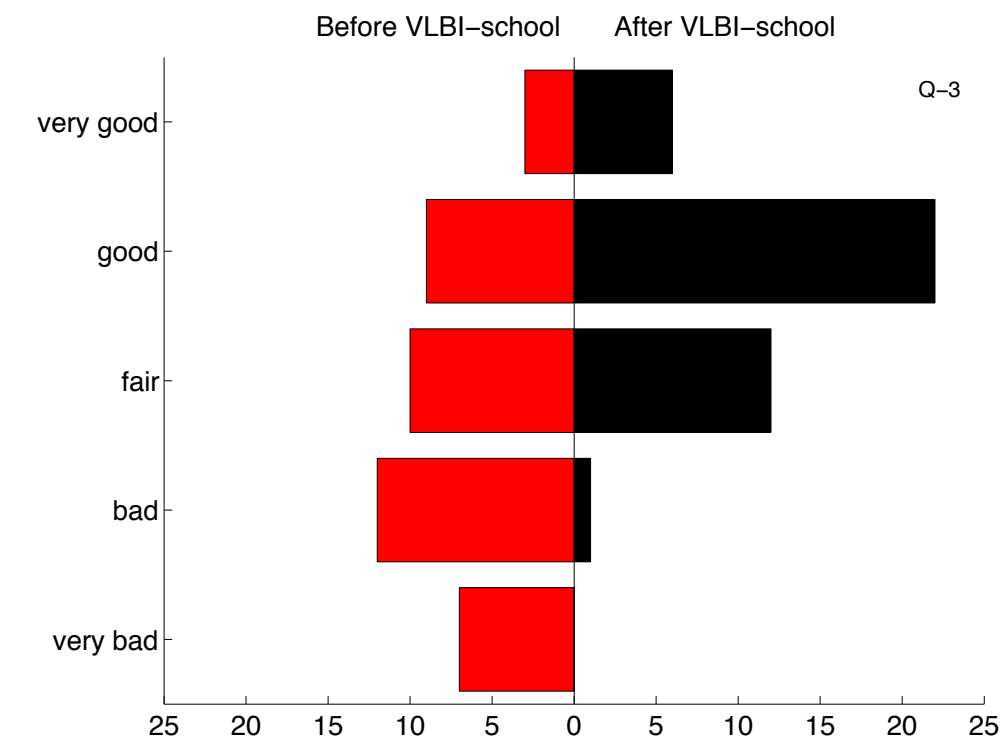

Figure 8: Question: "What was/is your knowledge on '*experiment scheduling*' before and after the VLBI school"?

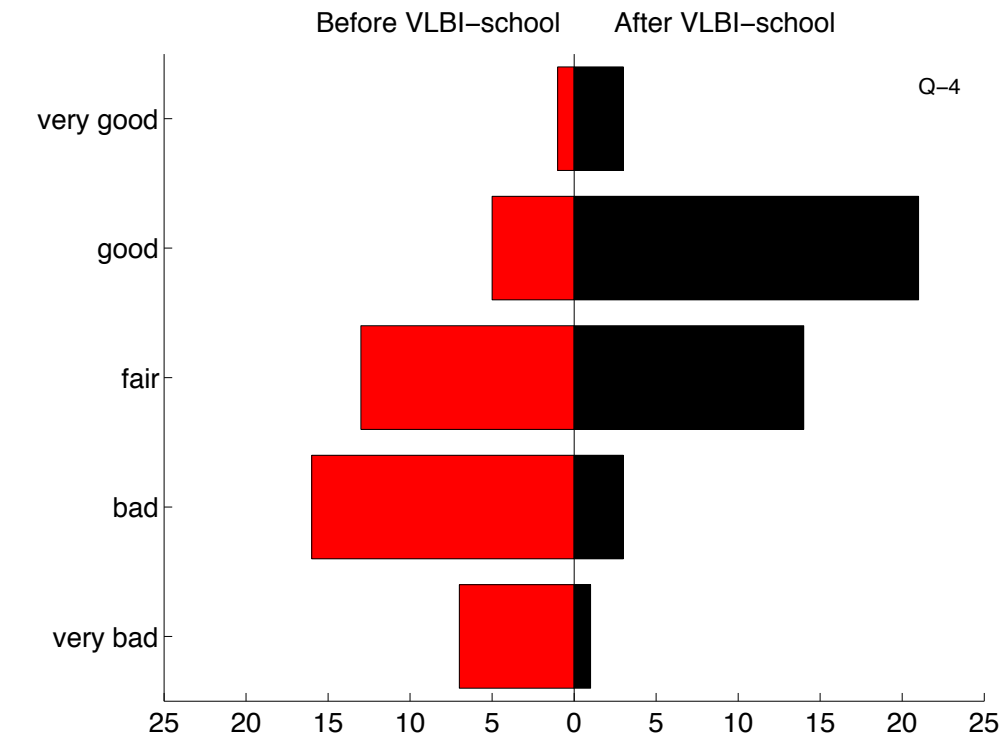

Figure 9: Question: "What was/is your knowledge on '*correlator architecture*' before and after the VLBI school"?

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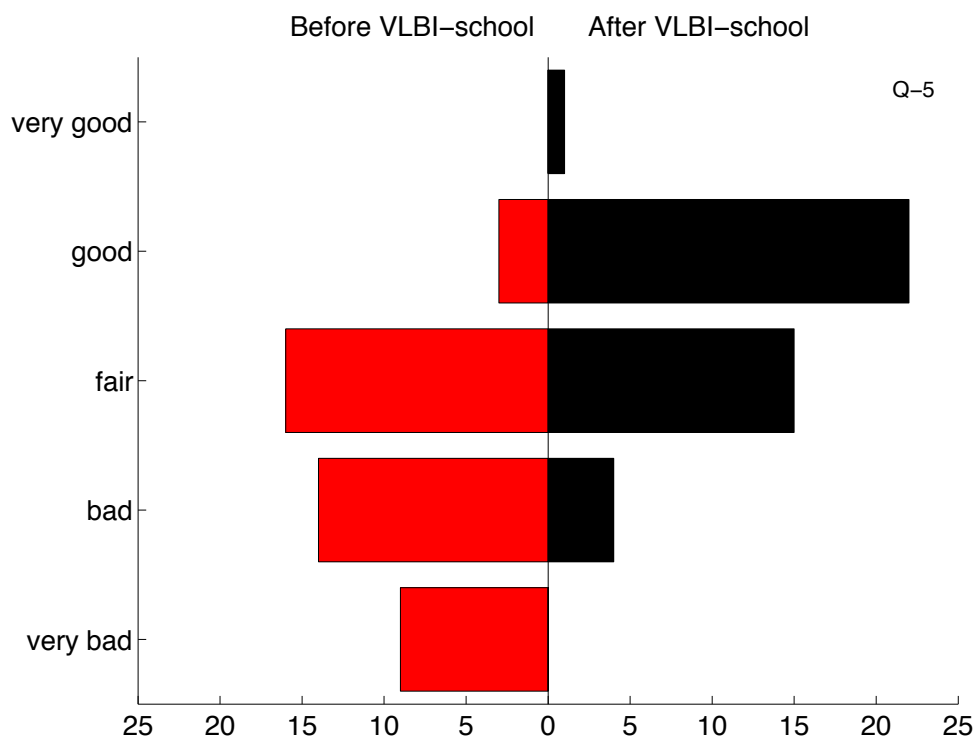

Figure 10: Question: "What was/is your knowledge on '*correlation and post-correlation analysis*' before and after the VLBI school"?

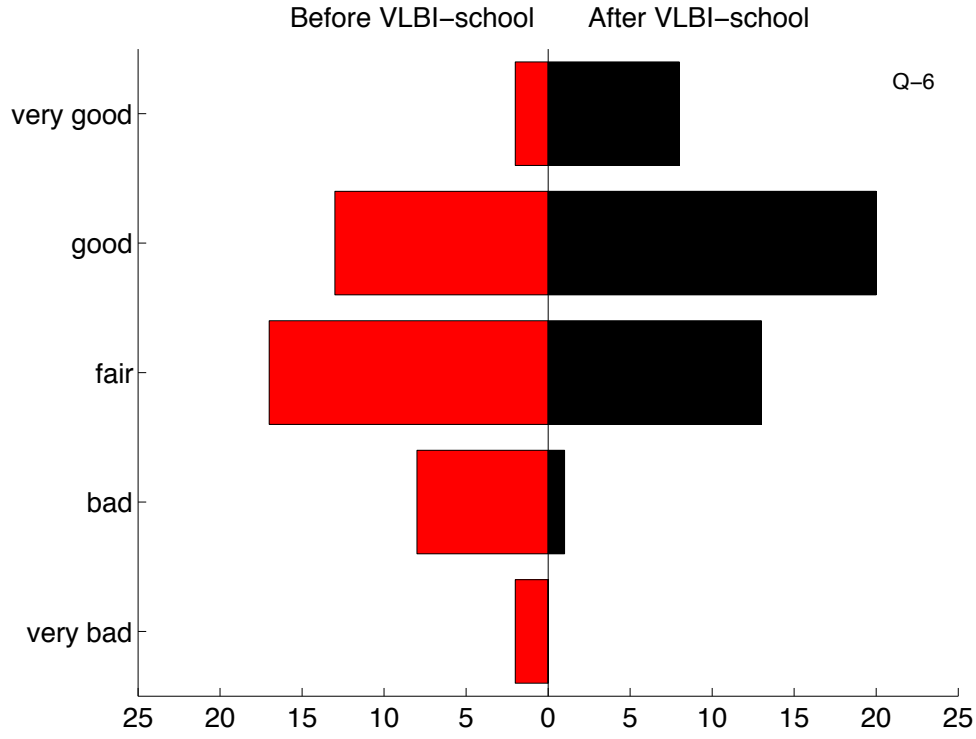

Figure 11: Question: "What was/is your knowledge on '*geophysical models*' before and after the VLBI school"?

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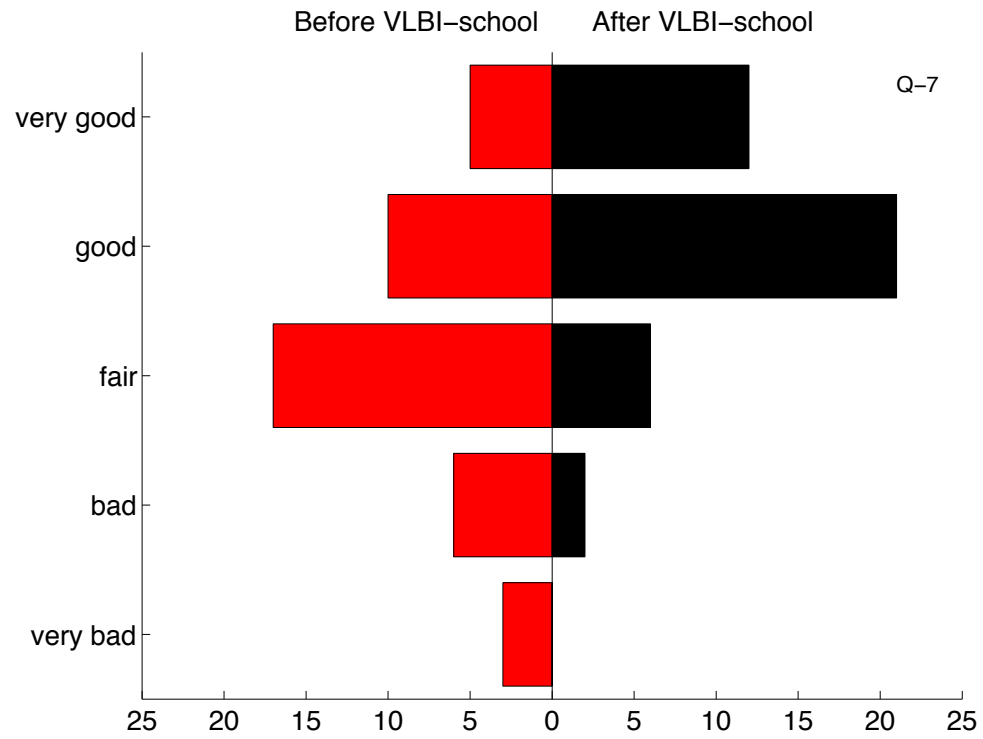

Figure 12: Question: "What was/is your knowledge on '*atmospheric propagation*' before and after the VLBI school"?

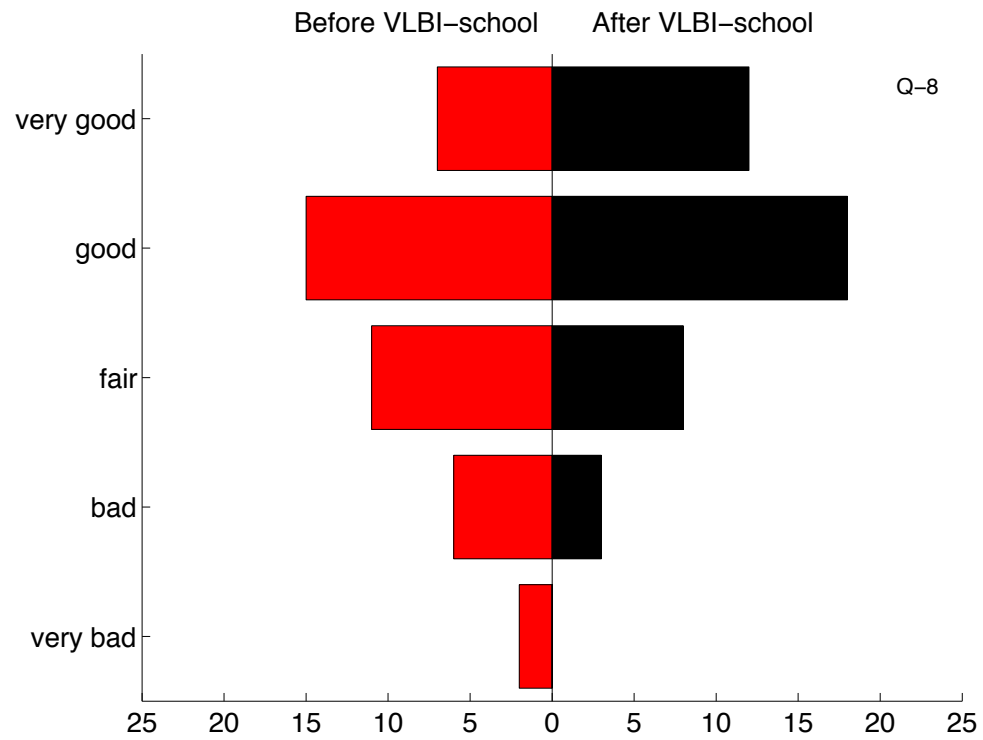

Figure 13: Question: "What was/is your knowledge on '*data modeling and analysis*' before and after the VLBI school"?

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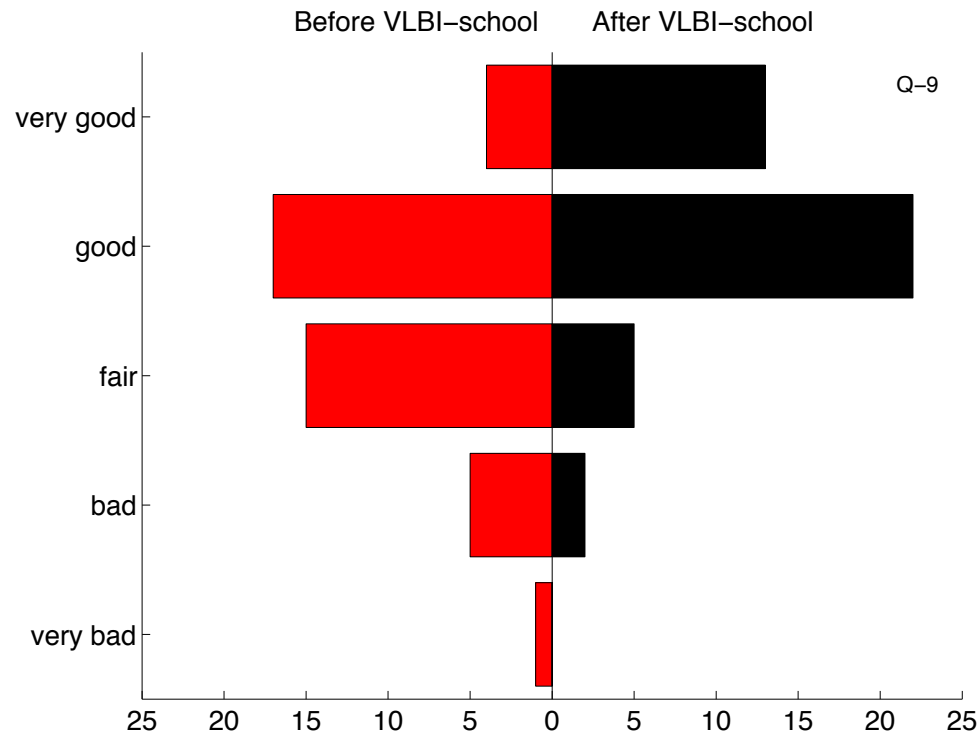

Figure 14: Question: "What was/is your knowledge on '*terrestrial reference frames*' before and after the VLBI school"?

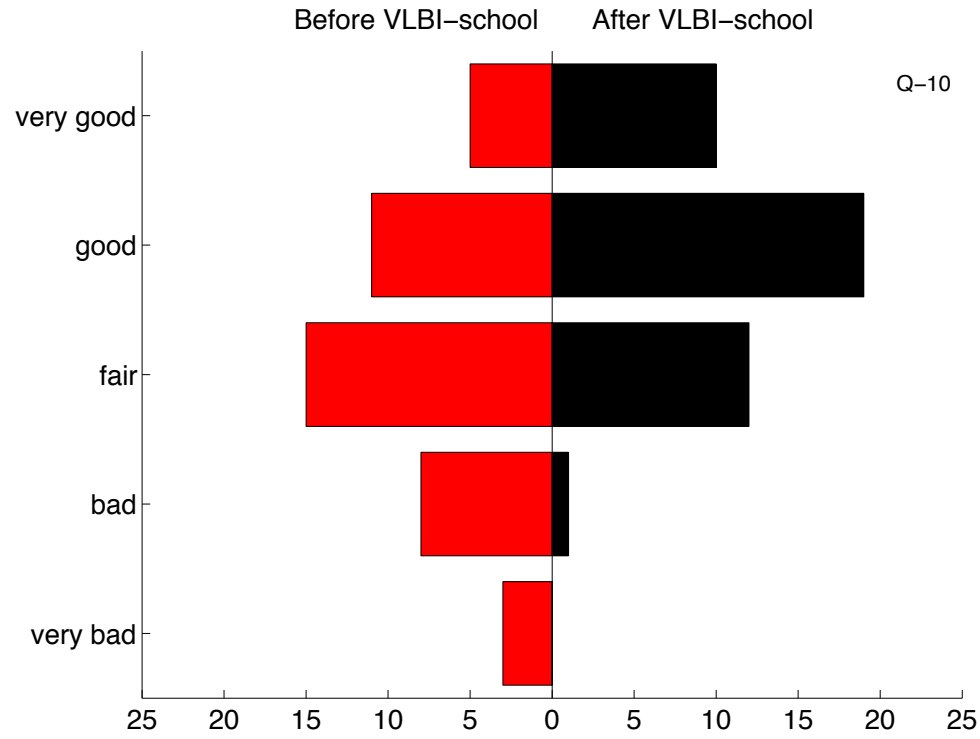

Figure 15: Question: "What was/is your knowledge on '*radio sources*' before and after the VLBI school"?

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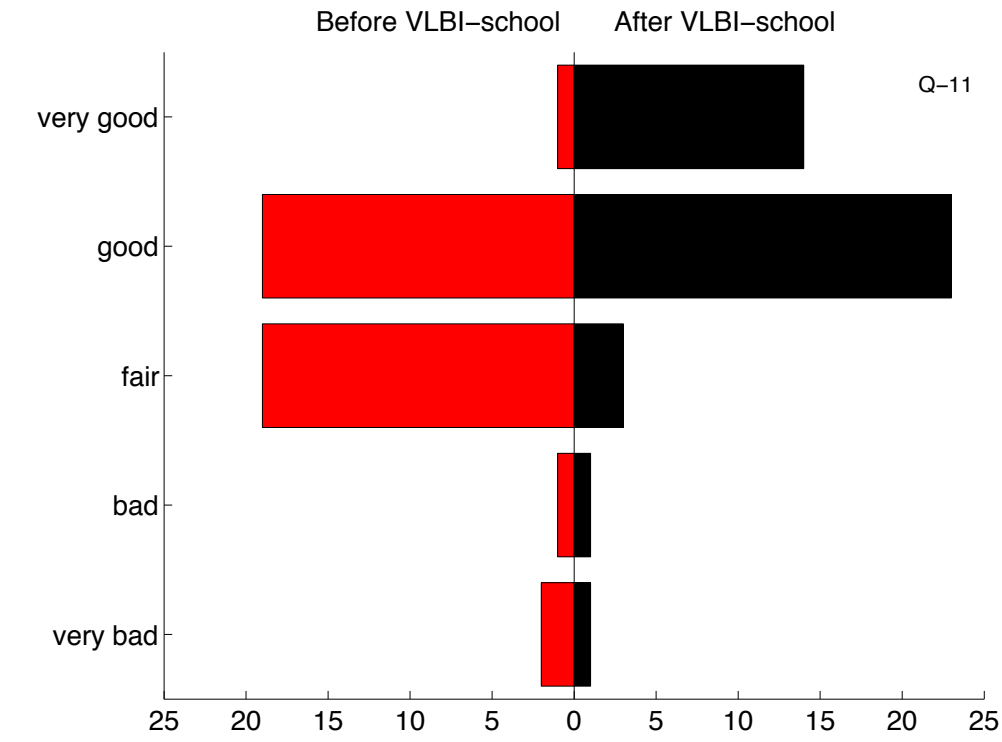

Figure 16: Question: "What was/is your knowledge on '*celestial reference frames*' before and after the VLBI school"?

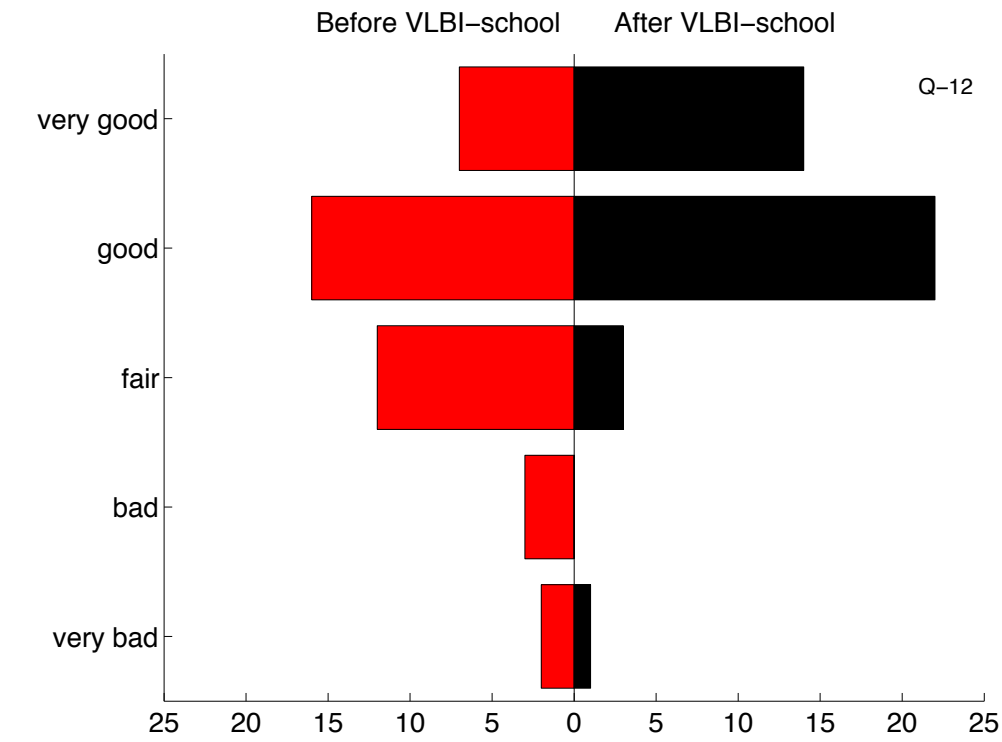

Figure 17: Question: "What was/is your knowledge on '*earth rotation and orientation*' before and after the VLBI school"?

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The evaluation shows that the three exercises were appreciated by the students and evaluated as '*good*' to '*very good*'. Several participants answered in the free-text comments of the evaluation questionnaire that the practical exercises were the best part of the VLBI Training School. There was however also some concern that the time was too short to work on some of the exercises. Some participants thought that there should be even more exercises during potential future VLBI Training Schools.

The evaluation also shows that the personal impression of the participants is that they know more on the particular topics after the VLBI Training School than before. More people feel that they have '*good'* and '*very good*' knowledge after the VLBI Training School. So there appears to be again in knowledge and the goal to provide education and training has been achieved to a large extend. Many of the free-text comments on the lectures said that the lectures gave a very good overview of all features of VLBI.

The lecture slides will be made available via the webpages of the European VLBI Group for Geodesy and Astrometry (EVGA, www.evga.org). The intention is that they can be used as a basis for teaching at educational institutes.

The IVS Directing Board had a directing board meeting in Metsähovi on March 8, after the "EGU and IVS Training School on VLBI for Geodesy and Astrometry". The IVS DB regarded that the "EGU and IVS Training School on VLBI for Geodesy and Astrometry" held in Espoo and Masala was a success. For the next IVS DB in the fall of 2013 a final report of the IVS WG 6 needs to be prepared, so that IVS WG 6 can be closed down. However, then an IVS Committee on Training and Education shall be established, with the task to continue the work started by IVS WG 6. It is anticipated to organize VLBI Training Schools on a regular basis, preferably every third year alternating in connection with the IVS General Meetings and the European VLBI meetings.

3) Attendance list

There were 43 participants in the VLBI Training School coming from 16 different countries. The countries with more than 1 participant were Germany (10), Finland (7), Austria (6), France (3), China (3), Norway (2), Australia (2) and the Netherlands (2). The distribution of the countries is presented in Figure 18. Figure 19 shows a group photo taken on the second day of the VLBI Training School when lectures and exercise were held at the headquarters of the Finnish Geodetic Institute (FGI) in Masala.

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Contract no. 283393

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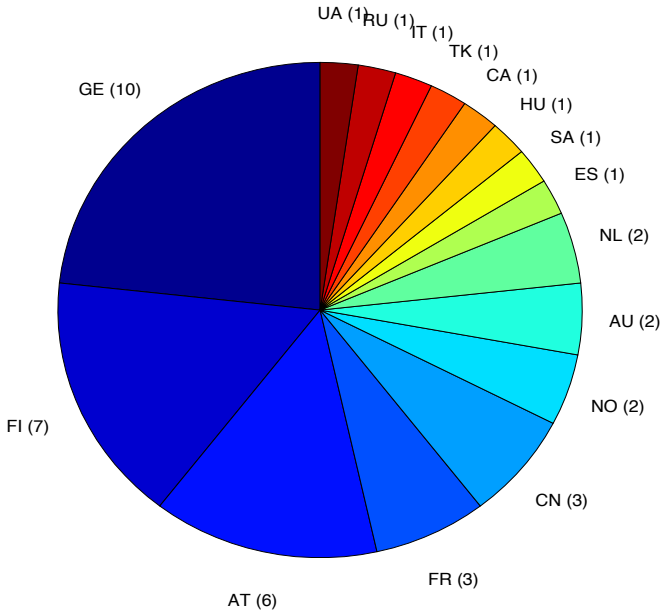

Figure 18: Distribution of participants of the "EGU and IVS Training School on VLBI for Geodesy and Astrometry" per country.

Figure 19: The participants of the "EGU and IVS Training School on VLBI for

The organizers of the VLBI Training School hereby certify that the above listed people

attended the VLBI Training School.

(Rüdiger Haas)

(Markku Poutanen)

(Minttu Uunila)

4) Financial report detailing the use of *RadioNet3* funding

RadioNet3 promised to provide a support for student travel of in total up to **2000 €**. Some students could not get full a full cover of their travel expenses, either because they do not have any home institution yet (i.e. they are still MSc. students) or since their home institutions could not refund them due to budgetary problems. These students have been asked to send original receipts to Anita Richards, Outreach and Training Coordinator of RadioNet3, to ask for refunding. The e**ight** students in question and the maximum amount to be refunded per student are:

1 - García-Espada, Susana (**max 50 €**). Engineer at Yebes Observatory and PhD at Chalmers University of Technology, Sweden. Adress: Centro de Desarrollos Tecnológicos, Subdirección General de Astronomía, Geodesia y Geofísica, D.G.IGN (Ministerio de Fomento), Cerro de la Palera s/n, ES-19141 Yebes (Guadalajara), Spain, (s.gespada@oan.es)
2 - Kunkel, Annemarie (**max 250 €**). MSc student University of Bonn. Address: Institut für Geodäsie und Geoinformation, Nußallee 17, DE-53115 Bonn, Germany, (s6ankunk@uni-bonn.de)
3 - Mishra, Aum Niranjana (**max 275 €**). MSc student at Technical University in Berlin. Address: Franz-Mehring-Platz 3, Zi. Nr. 27.30.16.82, DE-10243 Berlin, Germany, (niranjana.mishra@yahoo.com)
4 - Orosz, Gábor (**max 250 €**). MSc student at Budapest University of Technology and Economics. Address: Department of Geodesy and Surveying, Budapest University of Technology and Economics, Müegyetem rkp. 3, HU–1111 Budapest, Hungary, (gabor.orosz@gmail.com)
5 - Soja, Benedikt (**max 275 €**). MSc student at Vienna Technical University. Address: Forschungsgruppe Höhere Geodäsie / E-120-4, Department für Geodäsie und Geoinformation, Technische Universität Wien, AT-1040 Wien, Austria, (b.soja@gmx.at)
6 - Schönberger, Caroline (**max 275 €**). MSc student at Vienna Technical University, currently doing her MSc thesis at Chalmers University of Technology, Sweden. Address: Josef-Gall-Gasse 3/5, AT-1020 Wien, Austria, (casch@gmx.at)
7 - Trofimov, Dmitrii (**max 275 €**). MSc student at St. Petersburg State University. Address: Astronomical Institute St. Petersburg State University, Universitetskaya nab 7-9, St. Petersburg, Russia, (dm.trofimov@gmail.com)
8 - Tkachuk, Vadym (**max 350 €**). MSc student at University of Kyiv. Address: Taras Shevchenko National University of Kyiv, Glushkova ave. 4, UA-03127 Kyiv, Ukraina, (vadimol92@gmail.com)

The total sum to be refunded by RadioNet3 is **2000,- €.**