VEÐURSTOFA ÍSLANDS

Report
06010

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PREPARED – Management and resource usage summary

Months 25-30: February 1 - July 31, 2005

VÍ-ES-07
Reykjavík
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Contents

1.1 Objectives of the reporting period and summary

The central objective of the project is to apply large amount of geophysical and geological observations related to the two large earthquakes in the year 2000 in the South Iceland seismic zone to develop technology for improving earthquake preparedness and mitigating risk.

The start date of the project was February 1, 2003. The general objectives of the project are described in the 12 months Management and resource usage summary. A two days workshop, i.e. the PREPARED mid-term meeting was organized in Reykjavík, January 30-31, 2004, to sum up and discuss the first 12 months of the project, and pave the road for the last part of the project.

The next 12 months of the project were a direct continuation of the previous work and based on the discussions at the mid-term meeting, to fulfill the general objectives of the project. Months 13-18 and months 19-24 were described in earlier Management and resource usage summary reports.

The PREPARED project was originally planned as a 24 months project, starting February 1, 2003. However, 6 months extension of the project was accepted as well as a revised Description of Work (DOW). So the new end date of the project was July 31, 2005.

1.2 Scientific/Technical progress made in different WP´s according to the planned time schedule

Work on the project has been carried out during the last 6 months of the project, February 1 - July 31, 2005 in accordance with plans, i.e. with the revised DOW. Basically the work during these months has been finishing up workpackages which contained a fusion of this multidisciplinary project. The objective for the work during the last period has been aimed at creating methodology which is applicable for mitigating earthquake risk out of huge amount of significant scientific results. The state of this fusion work was described in the Third Periodic Report.

All the WP´s were successfully finalized during the last 6 months of the project, according to the revised DOW, and especially the so-called fusion packages WP2, WP3, WP4, WP5 and WP6 as appeares in the WP overview tables at the end of this report. The results of the project and especially of the fusion work has been brought into and are gradually being brought onto the Early Information and Warning System of Iceland (EWIS).

The coordinator (WP1) organized meetings during this period as detailed in Section 1.5. He also attended a meeting on Seismic Early Warnings in Zürich, Switzerland, June 15-16, 2005, held for preparing a proposal to EC in this field.

Open reports have been issued as planned, and in many cases papers have been submitted to peer-reviewed journals during the last period or are in preparation on basis of these reports. The overall milestones and deliverables compared to the revised DOW are shown in Section 1.3.

1.3 Milestones and deliverables obtained

List of deliverables expected during the project and how they have been fulfilled:

D1	Kick-off meeting for the project, minutes	M01 Re RE	**Finalized M01 Re RE**
D2	Project website, internal, external	M03 Re PU	**Finalized M01 Re PU**
D3	Brief progress report	M06 Re RE	**Finalized M06 Re RE**
D4	First annual scientific report and cost statements	M12 Re PU	**Finalized M12 Re PU**
D4A	Brief progress report	M18 Re RE	**Finalized M18 Re RE**
D5	Second annual scientific report and cost statements	M24 Re RE	**Finalized M24 Re RE**
D6	Final report, TIP and final cost statements	M30 Re PU	**Finalized M30 Re PU**
D7	Sessions at regular project meetings	M01 Re RE	**Finalized M01 Re PU**
D8	Sessions at regular project meetings	M10 Re RE	**Finalized M12 Re PU**
D9	A special report describing various patterns observed by the different methods	M22 Re PU	**Finalized M26 Re RE**
D10	Sessions at regular project meetings	M27 Re RE	**Finalized M29 Re PU**
D11	Procedures for describing the state of stress or Coulomb stress conditions in the SISZ	M24 Re PU	**Finalized M30 Re PU**
D12	A peer-reviewed paper describing the common results	M30 Re PU	**Finalized M30 Re PU**
D13	Application of PCA to SIL-data, emphasizing computational statistics	M10 Re PU	**Finalized M12 Re RE**
D14	Application of PCA to SIL-data, emphasizing computational statistics	M12 Re PU	**Finalized M12 Re RE**
D15	Application of PCA to SIL data, emphasizing seismology	M22 Re PU	**Finalized M22 Re PU**
D16	Application of PCA to SIL data, emphasizing seismology	M24 Re PU	**Finalized M24 Re PU**
D17	Release of software package for PCA analysis of seismicity	M24 O PU	**Finalized M26 O PU**
D18	Changes of seismicity rate	M12 Re PU	**Finalized M12 Re PU**
D19	Differences in b-values as a function of space (and possibly time), and the relationship of both of these parameters to the June 2000 main shocks	M24 Re PU	**Finalized M20 Re PU**
D20	Three-dimensional displacement field in a time-period prior to the June 2000 earthquakes	M12 Re PU	**Finalized M12 Re PU**
D21	Strain-field in the pre-seismic period	M12 Re PU	**Finalized M12 Re PU**
D22	Strain-field in the pre-seismic period, evaluation of earthquake precursors	M18 Re PU	**Finalized M18 Re PU**
D23	Estimates of the stress tensor in the SISZ during 1991 through 2001	M12 Re PU	**Finalized M12 Re RE**
D24	SAG analysis in the SISZ during 1991 through 2001	M12 Re PU	**Finalized M12 Re RE**
D25	Estimates of the stress regimes in the SISZ during the last 2-3 million years	M12 Re PU	**Finalized M12 Re RE**
D26	Results from statistical analysis of source parameters of the earthquakes in the SISZ during 1991 through 2001	M12 Re PU	**Finalized M12 Re RE**
D27	Stress changes based on microearthquake source information	M27 Re PU	**Finalized M30 Re PU**
D28	Plots of stress variations before earthquakes and volcanic eruptions	M12/24 Re PU	**Delivered to end user M08, M10, M11 Re PU**
D29	Stress-forecasts of impending large earthquakes issued to IMOR	Re CO	**Delivered to IMOR, Re CO**
D30	Report on stress changes estimates by SWS since 1996	M12 Re PU	**Finalized M12 Re RE**
D31	Reports in collaboration with other partners of imaging stress variations	M12/24 Re PU	**Finalized M12 Re RE**
D32	Reports on progress of ANN measurements of shear-wave splitting	M12 Re PU	**Finalized M12 Re RE**
D33	Reports on experience of selecting training sets for ANN	M12 Re PU	**Finalized M12 Re RE**
D34	Program for measuring SWS with ANN	M27 Re PU	**Finalized M27 Re PU**
D35	Publication of papers in international research journals	M27 Re PU	**Finalized M27 Re PU**
D36	Sessions at project meetings	M01 Re RE	**Finalized M01 Re PU**
D37	Sessions at project meetings	M10 Re RE	**Finalized M12 Re PU**
D38	Sessions at project meetings	M27 Re RE	**Finalized M29 Re PU**
D39	A report documenting and comparing multidisciplinary potential precursors of the June 2000 earthquakes	M28 Re PU	**Finalized M30 Re PU**
D40	Multidisciplinary warning algorithms will be implemented in the	M30 Re PU	**Finalized M30 Re PU**

	Early warning and information system		
D41	An article in an international scientific journal will be submitted before the end of the project	M30 Re PU	**Finalized M30 Re PU**
D42	Detailed documentation of the foreshock activity prior to the six largest earthquakes in Iceland during the last 10 years	M15 Re PU	**Finalized M26 Re RE**
D43	New short-term warning algorithms will be introduced in the Early warning and information system for testing, during the project time	M15 O PU	**Finalized M30 O PU**
D44	An article describing the foreshock character, the statistical significance and relation to the various source information	M15 Re PU	**Finalized M21 Re PU**
D45	A complete automatic earthquake warning algorithm based on the understanding acquired during PREPARED will be presented	M27 O PU	**Finalized M30 O PU**
D46	Input of the Early warning and information system for testing at the end of the project to P1	M27 O PU	**Finalized M30 O PU**
D47	Time series of radon at all radon stations in South Iceland since 1977	M12 Re PU	**Finalized M11 Re PU**
D48	Presentation of the radon results at international meetings	M12 Re PU	**Finalized M12 Re PU**
D49	Paper in a refereed journal on the radon anomalies identified	M20 Re PU	**Finalized M18 Re PU**
D50	Warning algorithm presented at a meeting	M24 Re PU	**Finalized M26 Re PU**
D51	Sessions at regular project meetings	M01 Re RE	**Finalized M01 Re PU**
D52	Sessions at regular project meetings	M10 Re RE	**Finalized M12 Re PU**
D53	Sessions at regular project meetings	M27 Re RE	**Finalized M29 Re PU**
D54	A report describing the overall model	M29 Re PU	**Finalized M30 Re PU**
D55	An article describing an overall model	M30 Re PU	**Finalized M30 Re PU**
D56	A point-source moment tensor solution and source-time function for the earthquakes of June 17 and June 21, 2000	M27 Re PU	**See below #**
D57	Article on the fault dimensions and finer details of possible subfaults, as outlined by the microearthquake distribution. Post-seismic slip-direction as a function of location on the two main faults	M30 Re PU	**Finalized M30 Re PU**
D58	Preliminary slip model of rupture on the fault of the first earthquake	M08 Re PU	**Finalized M08 Re RE**
D59	Best slip model of rupture on the fault of the first earthquake	M20 Re PU	**Finalized M18 Re PU**
D60	Inversion for slip related to the second earthquake	M24 Re PU	**Finalized M24 Re RE**
D61	Estimated acceleration field in selected localities for first event	M14 Re PU	**Finalized M28 Re RE**
D62	Preliminary slip model of rupture on the fault of the second event	M18 Re PU	**Finalized M12 Re RE**
D63	Best slip model of rupture on the fault of the second earthquake	M20 Re PU	**Finalized M24 Re RE**
D64	Estimated acceleration field in selected localities for a future event in SISZ and assessment of their damage potential	M25 Re PU	**Finalized M30 Re PU**
D65	Map of surface fractures in the eastern source area	M06 Re PU	**Finalized M06 Re RE** **Finalized M12 PU**
D66	Map of faulting during the June 2000 events	M06 Re PU	**Finalized M10 Re PU**
D67	Input into the gereral modelling of the June 2000 events	M06 Re PU	**Finalized M06 Re PU**
D68	Map of fractures in the western source area	M12 Re PU	**Finalized M12 Re PU**
D69	Presentations of results at international meetings	M12 Re PU	**Finalized M10 Re PU**
D70	Paper on surface fracturing during June 2000 events	M20 Re PU	**Finalized M20 Re PU**
D71	Three-dimensional co-seismic displacement field for June 17 and June 21, 2000 earthquakes	M06 Re PU	**Finalized M06 Re PU**
D72	Deformation model for the earthquakes	M18 Re RE	**Finalized M18 Re PU**
D73	Scientific paper with the deformation model results	M25 Re PU	**Finalized M25 Re PU**
D74	Sessions during project meetings	M01 Re RE	**Finalized M01 Re PU**
D75	Sessions during project meetings	M10 Re PU	**Finalized M12 Re PU**
D76	Sessions during project meetings	M27 Re RE	**Finalized M29 Re PU**
D77	New detailed hazard map of SW Iceland	M28 Re PU	**Finalized M30 Re PU**
D78	A paper in an international journal	M30 Re PU	**Finalized M30 Re PU**
D79	Catalog of relocated earthquakes	M20 Re PU	**Finalized M21 Re PU**
D80	A map of subsurface faults and slip directions on them	M24 Re PU	**Finalized M28 Re PU**
D81	Article about the mapping and correlations with surface mapping	M28 Re PU	**Finalized M30 Re PU**
D82	Hazard map of Reykjanes peninsula and accompanying report	M20 Re PU	**Finalized M22 Re PU**
D83	Attenuation of strong ground motion of the large earthquakes	M12 Re PU	**Finalized M12 Re PU**
D84	Near source effects, duration of ground shaking and soil amplifications	M18 Re PU	**Finalized M18 Re PU**

D85	A comprehensive reporting describing strong motion data, the theoretical modelling, attenuation of strong ground motion and near source effects	M20 Re PU	**Finalized M22 Re PU**
D86	A revised historical earthquake catalogue for SW Iceland	M26 Re PU	**Finalized M30 Re PU**
D87	Results from ongoing analytical and numerical modelling	M12 Re RE	**Finalized M12 Re PU**
D88	Algorithm for detecting possible preseismic signal	M28 Re PU	**Finalized M30 Re PU**
D89	Reports on the geometrical characters of faulting and stress regimes issued from inversion of fault slip data and focal mechanisms	M26 Da+RE PU	**Finalized M24 Da+RE**
D90	Reports on the numerical modelling experiments applied to the SISZ deformation.	M28 Re PU	**Finalized M28 Re PU**
D91	Sessions at project meetings	M01 Re RE	**Finalized M01 Re PU**
D92	Sessions at project meetings	M10 Re PU	**Finalized M12 Re PU**
D93	Sessions at project meetings	M27 Re RE	**Finalized M29 Re PU**
D94	Report on modelling progress	M30 Re PU	**Finalized M30 Re PU**
D95	Article on a new model for the SISZ and the RP fault zones	M30 Re PU	**See below ##**
D96	Inelastic model for the earthquake series (M>=6) in the SISZ since 1706	M12 Re PU	**Finalized M25 Re RE**
D97	Article and report: Probability increase of each of these 13 events compared to the model	M28 Re PU	**Finalized M30 Re PU**
D98	Original mathematical solutions for crack models in trans-tensional environment	M06 Re PU	**Finalized M06 Re PU**
D99	Crack models in viscoelastic media	M18 Re PU	**Finalized M18 Re PU**
D100	Crack model in poroelastic (12m) media	M12 Re PU	**Finalized M12 Re RE**
D101	Article and report on triggered seismicity in terms of dynamic fault interaction	M26 Re PU	**Finalized M26 Re PU**

D56: A Harvard solution for the point source moment tensor of the earthquakes was adopted to use with other data in modelling the earthquakes. So D56 is implicit in D54.

D95 which was planned in M30 is an article for a journal based on results presented in D94. The work on this article is already on the way.

1.4 Deviations from the work plan or/and time schedule and their impact to the project

There are no deviations from the revised DOW.

1.5 Communication between partners

This final work has involved intensive cooperation of scientists from 16 institutions responsible for 25 workpackages. It has been carried out on formal and informal meetings and by internet communication:

a) A special session was organized about the results of the project at the EGU General Assembly, Vienna, Austria, April 24-29, 2005.
b) After the EGU General Assembly a special PREPARED meeting was held in Vienna, April 30, 2005, for discussing and fusing results of the individual partners.
c) A results fusion meeting was held in Reykjavík, Iceland, July 12, 2005, attended by some of the partners.
d) A results fusion meeting was held in Reykjavík, Iceland, July 21, 2005, attended by a group of partners.

Workpackage number and name	Month																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
WP 1 Coordination.																													
WP 2 Analysis of trends in geophysical data approaching June 2000 earthquakes.																													
WP 2.1 Pattern search in multiparameter seismic data, PCA.																													
WP 2.2 Analysis of seismic catalogue, homogeneity, quiescence, b-values.																													
WP 2.3 Long-term deformation based mainly on GPS, InSAR and strain.																													
WP 2.4 Stress changes based on microearthquake sources and from geology.																													
WP 2.5 Shear-wave splitting above small earthquakes to monitor stress changes.																													
WP 3 Short-term changes before large earthquakes, short-term warning algorithms.																													
WP 3.1 Foreshocks. Detailed study and development of new warning algorithms.																													
WP 3.2 Radon anomalies. Detailed study and development of warning algorithms.																													
WP 4 Detailed model of the two large earthquakes. A group work.																													
WP 4.1 Focal mechanism, based on teleseismic and microearthquake information.																													
WP 4.2 Inversion of near field strong motion data. Slip distribution.																													
WP 4.3 Interpretation of surface fractures related to the two large earthquakes.																													
WP 4.4 Deformation associated with the two large earthquakes, GPS, InSAR, strain.																													
WP 5 New methods for improving assessment earthquake effects. A group work.																													
WP 5.1 Detailed mapping of distant faults by microearthquakes.																													
WP 5.2 Detailed geological mapping of surface effects in a large area.																													
WP 5.3 Study of the strong motion records, intensities, from the large earthquakes.																													
WP 5.4 Reevaluations of historical earthquakes in light of the new observations.																													
WP 5.5 Hydrological changes in a large area related to the earthquakes.																													
WP 5.6 Analysis of paleo-stress fields and mechanism.																													
WP 6 Integration of the modelling work. A new general model.																													
WP 6.1 Model stress changes in Iceland based on historical activity.																													
WP 6.2 Model stress in the solid matrix and pressures in fluids permeating the crust.																													

Table 1*. Timetable for the project. For each WP the red boxes show planned efforts and the yellow ones executed efforts.*

Workpackage number	IMOR		UU		UEDIN		NVI		SIUI		UPMC		DF. UNIBO		GFZ POTSDAM		CNRS-UMR 5562		UNIVTS-DST		CAU		WAPMERR		UI		UGOE	
		%		%		%		%		%		%		%		%		%		%		%		%		%		%
WP1	11	130																										
WP2	2,5	355	0,5	80	1	100	1	100													1	100	1	100				
WP2.1																					9,5	100						
WP2.2																							9	100				
WP2.3							21	125									4	125										
WP2.4			21	100							0,5	100																
WP2.5	1,5	0			15	105																						
WP3	2,5	50	0,5	80					1	50																		
WP3.1	1	0	12,5	105																								
WP3.2									10	130																		
WP4	2,5	40					0,5	100	1	50									0,5	50								
WP4.1	13	110	0,5	20																								
WP4.2	1	0																	15	110					2,5	100		
WP4.3							1	300	13	110																		
WP4.4	1	15					11	110	0,5	100							1	150										
WP5	2,5	40					0,5	100			1	100							0,5	50					0,5	50	1	50
WP5.1	11,5	165																										
WP5.2	0,5	10					11	90																				
WP5.3	1	0																							16	105		
WP5.4	8,5	170																							1	0		
WP5.5											0,5	100	2	50													17	105
WP5.6											7,5	115	1	500														
WP6	2	70							1,5	100			4	125	1	450	1	50										
WP6.1													2	100	15,5	105	4	100										
WP6.2													29	140			1	100										
Total	62	125	35	100	16	105	46	115	27	110	9,5	110	38	140	16,5	125	11	110	16	105	10,5	100	10	100	20	100	18	100

Table 2. *Planned and used manpower: The yellow columns show planned manpower for months 1-30 (both permanent and temporary) for each partner in individual WPs in man-months. The green columns show the used manpower in each case for months 1-30 as percentage of the planned one.*

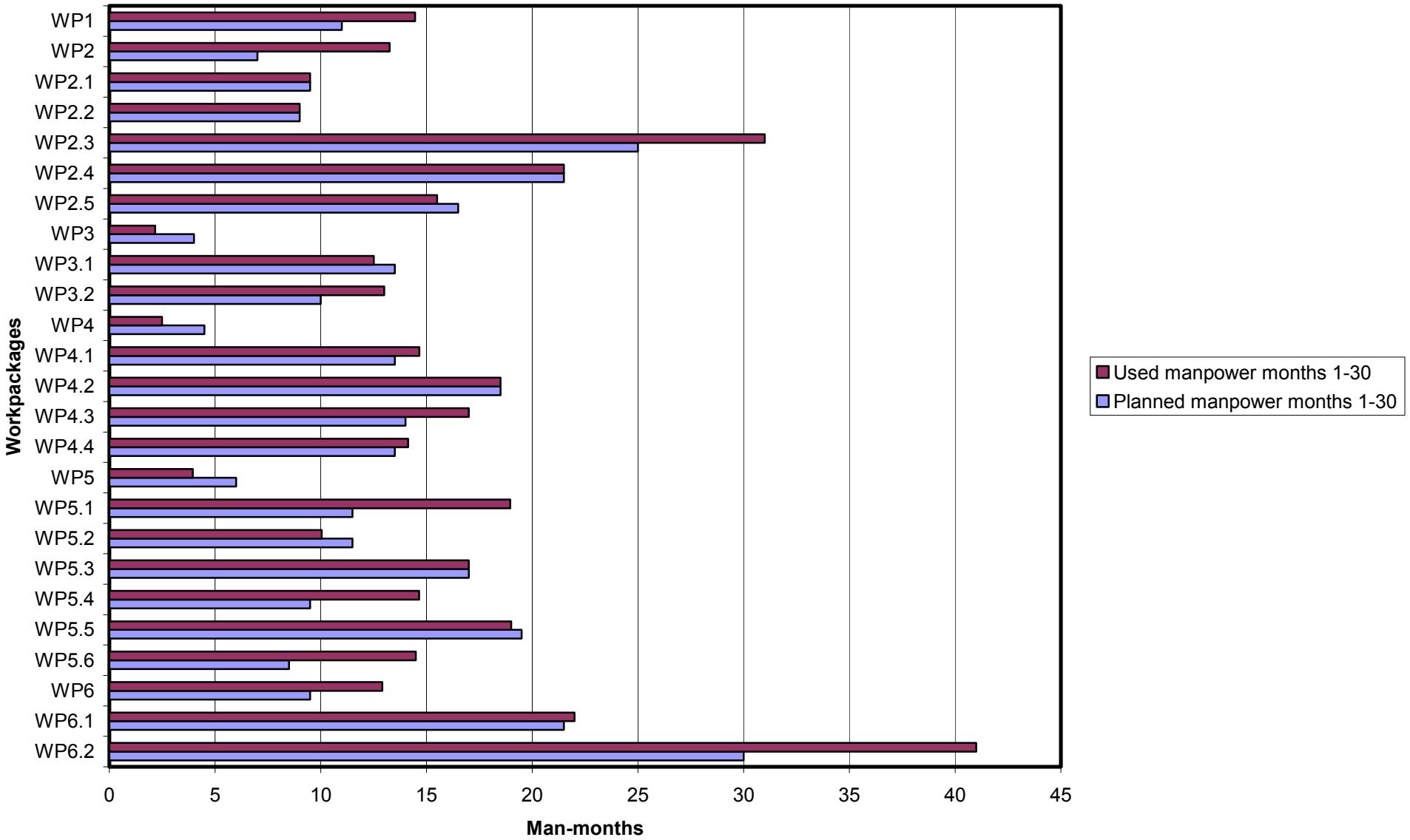

Table 3. *Planned and used manpower (both permanent and temporary) in each WP.*

no.	Institution	Name of scientific person in charge	Telephone no. 1	Telephone no. 2	Fax no.	E-mail
Partner 1	Icelandic Meteorological Office	Ragnar Stefansson	+354 522 6000	+354 466 3125	+354 522 6001	ragnar@vedur.is
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Partner 3	University of Edinburgh	Stuart Crampin	+44 131 650 4908		+44 131 668 3184	scrampin@ed.ac.uk
Partner 4	Nordic Volcanological Institute	Freysteinn Sigmundsson	+354 525 4491		+354 562 9767	fs@hi.is
Partner 5	University of Bergen					
Partner 6	Science Institute, University of Iceland	Pall Einarsson	+354 525 4816		+354 552 1347	palli@raunvis.hi.is
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Table 4. *Participants information, July 31. 2005.*