

DRIHMS

DISTRIBUTED RESEARCH INFRASTRUCTURE
FOR HYDRO-METEOROLOGY STUDY

Deliverable D2.2: Results of questionnaires HMR

DRIHMS (G.A. n° 246703) is co-Funded by the EC under 7th Framework Programme

Deliverable D2.2

Document Information Page

Contract Number	246703
Project Name	Distributed Research Infrastructure for Hydro-Meteorology Study
Project Acronym	DRIHMS
Deliverable Number	D2.2
Deliverable Name	Results of questionnaires HMR
Work Package Number	2
Work Package Name	HMR hot topics identification
Deadline	Month 6
Version	1.0
Dissemination Level	Public
Nature	Other
Lead Beneficiary	DLR

Table of Contents

1	Executive Summary	3
2	Introduction	3
3	Results discussion	4
3.1	<i>Geographical distribution.....</i>	4
3.2	<i>Expertise and Institution distributions</i>	6
3.3	<i>Survey analysis</i>	7
4	Conclusions.....	41
5	Abbreviations.....	41
6	List of figures.....	42
7	List of tables	44



1 Executive Summary

[This document provides a synthesis of the results of the HMR questionnaire. The goals of this survey was to identify “hot topics” of crucial interest to the hydrometeorological community, specify the associated ICT challenges, and collect information on current practices in the use of remote and distributed computing resources.

2 Introduction

The results discussion is divided in three parts: geographical distribution, expertise and Institutions distribution, survey analysis.

A total of 163 questionnaires were collected, with participation from 40 countries, mainly in Europe. Most of the respondents were from the fields of Hydrometeorology (40%) or Meteorology (43%), with a smaller but still significant contribution from Hydrometeorology (10%). About half of the respondents were from research institutions (47%), with the remainder from institutions with both research and operational responsibilities (38%) or purely operational institutions (15%).

Analysis of the surveys revealed clear choices of hot topics and accompanying ICT priorities. The most important hot topics for MHR research were identified as probabilistic forecasting (particularly among meteorologists) and model verification metrics (particularly among hydro-meteorologists and hydrologists). For probabilistic forecasting, the most important ICT challenges were the definition of common interchange formats, definition of libraries of tools for data handling and visualization, and the availability and reliability of high-performance computing resources. For model verification metrics, the key ICT challenges were availability of model outputs and observations in compatible formats, and the availability of libraries of well-documented verification metrics. The replies regarding current practices yielded a large variety of methods of working, clearly showing the central role of the processing and communication of large data sets in all aspects of hydrometeorological research. Interestingly, real-time data processing was given only a secondary priority by this research-oriented community, and accounting and billing issues seem to be regarded as insignificant.



3 Results discussion

3.1 Geographical distribution

In the framework of the DRIHMS HMR survey, based on web pooling, a total amount of 163 questionnaires has been collected.

At worldwide level, the 83% of questionnaires has been received from European Institutions, while the remaining 17% from overseas (mainly from USA).

At the European level, the leading countries for number of collected questionnaires are: Italy (22%), Germany (10%), France (10%), Spain (9%) and UK (4%). It is worth to mention that a good amount of questionnaires (10%) has been received from Institutions belonging to the Southern Eastern Europe (SEE) region, as a proof of the success of the efforts of the SEE-GRID eInfrastructure for regional eScience project for ensuring equal participation of the less-resourced countries of the region in European trends about ICT.

The following table and figure provide an immediate and effective description of the worldwide distribution of the HMR questionnaire results.

Country	Number	%
Italy	36	22.2%
France	16	9.9%
Germany	16	9.9%
USA	15	9.3%
Spain	14	8.6%
United Kingdom	6	3.7%
Austria	5	3.1%
Belgium	4	2.5%
Greece	3	1.9%
Israel	3	1.9%
Netherlands	3	1.9%
Romania	3	1.9%
Sweden	3	1.9%
Switzerland	3	1.9%
Albania	2	1.2%
Brasil	2	1.2%
Bulgaria	2	1.2%
Polonia	2	1.2%
Portugal	2	1.2%
Serbia	2	1.2%
Turkey	2	1.2%
Ukraine	2	1.2%
Argentina	1	0.6%
Australia	1	0.6%
Barbados	1	0.6%
Bosnia	1	0.6%
Botswana	1	0.6%
Canada	1	0.6%
Cech Rep.	1	0.6%
China	1	0.6%
Croatia	1	0.6%
Cyprus	1	0.6%
Denmark	1	0.6%
India	1	0.6%
Japan	1	0.6%
New Zealand	1	0.6%
Peru	1	0.6%
Tunisie	1	0.6%

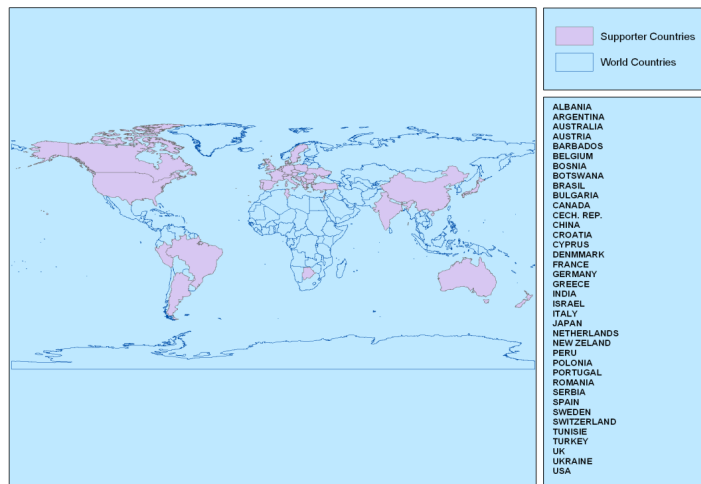


Figure 1: DRIHMS HMR questionnaires worldwide distribution.

3.2 Expertise and Institution distributions

The questionnaires have been also classified in terms of field of expertise of the person filling them, distinguished in Hydro-Meteorology, Hydrology, Meteorology and others (Oceanography, Ecology, etc): the results suggest a large predominance of questionnaires coming from the meteorology and hydro-meteorology audiences, while pure hydrologists represents a small subset of the audience.

Field of expertise	%
Meteorology	43
Hydro-Meteorology	40
Hydrology	10
Others	7

Table 1: Classification of people filling the questionnaires in terms of their field of expertise.

Furthermore a classification in terms of the mission of the Institution, covering Operational/Research, Operational, and Research, has been explored: in this case the leading group refers to Institutions whose main mission is undertaking fundamental and applied research.

However it is worth to highlight the interest for the DRIHMS topics and survey activities arising from Operational Institutions (National and Regional Meteorological Services) as a proof of the importance also for this community of the exchange and interfacing of methods and know-how available in both Grid and hydrometeorological communities.

Institution Mission	%
Research	47
Operational/Research	38
Operational	15

Table 2: Classification of people filling the questionnaires in terms of the mission of their Institution.



3.3 Survey analysis

The overarching purpose of the HMR questionnaire was to define important topics in Hydro-Meteorology Research (HMR) that can benefit from advances in Information and Communication Technologies (ICT), and thus set a joint HMR-ICT research and applications agenda.

In this respect a initial presentation, item by item, of the results collected for each question is provided for the full audience and for the aforementioned categories (Hydro-Meteorology, Meteorology, Hydrology, Others). This presentation does not have the aim of providing a full analysis of results or to derive consequences, strategies or priorities, but it is only aimed to assess the effectiveness of collected data. The full analysis and the derivation of strategies and priorities will be the scope of the second part of the project and the data so far collected will be the base for further brainstorming and discussion. Moreover a precise analysis will be carried out trying to catch from data effective information for further development in the design of a suitable HMR Infrastructure.

A. HMR hot topics: Score the importance of the following topics for the Hydro Meteorological Research in the next 3 years:

- a. Data merging/fusion
- b. Probabilistic forecasting
- c. Model verification metrics
- d. Precipitation downscaling
- e. Other: please specify

Based on weighted average of the collected scores (figure 2), the following rankings are provided depending on the audience considered:

Rank	Full audience	Meteorology	Hydro-Meteorology	Hydrology	Others
1	Probabilistic forecasting	Probabilistic Forecasting	Model verification metrics	Model verification metrics	Model verification metrics
2	Model verification metrics	Other	Data merging / fusion	Probabilistic forecasting	Probabilistic Forecasting
3	Data merging / fusion	Model verification metrics	Probabilistic forecasting	Precipitation downscaling	Precipitation downscaling
4	Precipitation downscaling	Precipitation downscaling	Precipitation downscaling	Data merging / fusion	Data merging / fusion

Table 3: Collected scores (figure 2) based on weighted average provided depending on the audience considered.

To summarize the questionnaire:

- Probabilistic forecasting is the top HMR topic considering the full audience and represents the most relevant argument within the Meteorology sub-community (the most populated one) where it scored 4.26;



- The model verification metrics appears to be the second reference topic for the full audience and the top one for the Hydro-Meteorology and Hydrology sub-communities;
- The data merging / fusion and precipitation downscaling, in contrast, obtained in general lower scores and correspondingly ranking, both among the full audience and within the different sub-communities.

To gain a deeper understanding of the results the scores distributions for each topic and community are now provided.

Visual inspection of figures 2, 3 and 5, referring to full audience and hydrometeorology and meteorology sub-communities (the most populated by far), suggest that the scores distributions for proposed HMR hot topics are always positively skewed with the mode located over the score equal to 4. The scores distribution for "Other" is almost flat and with a lower significance from a statistical standpoint since only a reduced portion of the audience provided a feedback about this section. Nevertheless, it is worth to mention that topics related to data assimilation in hydrometeorological models and society impacts of severe hydrometeorological events were among the most mentioned.

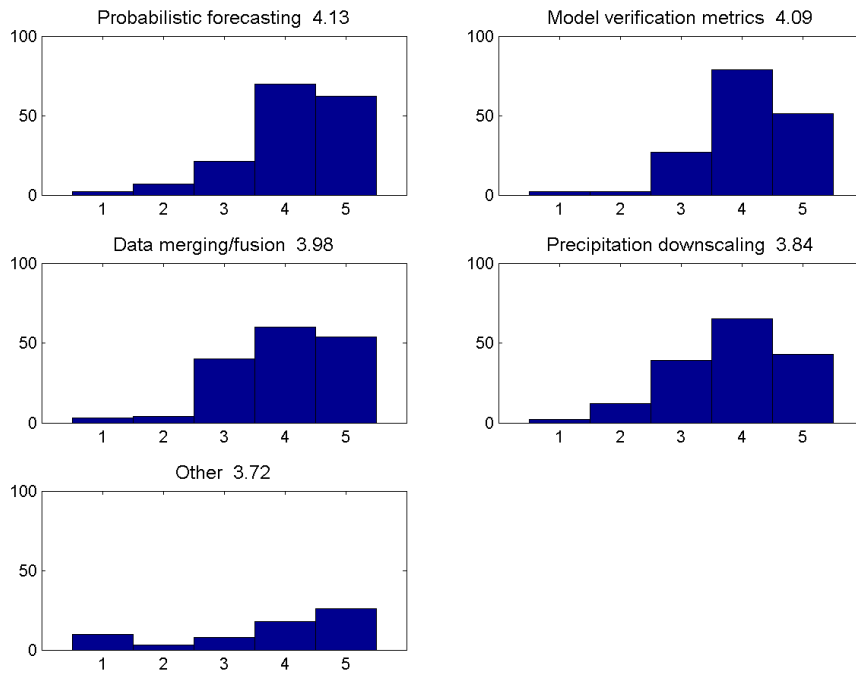


Figure 2: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (full audience).

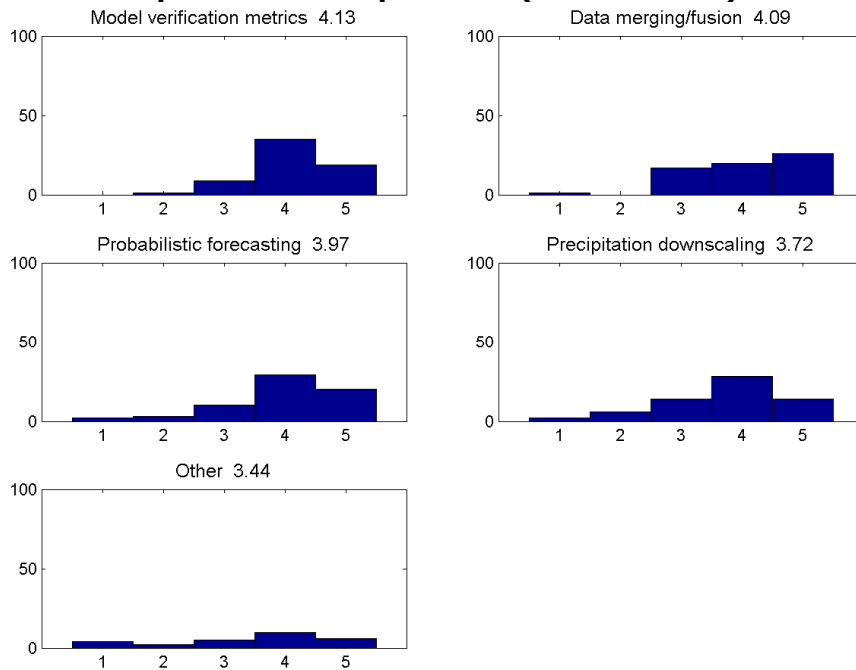


Figure 3: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (Hydro-Meteorology).

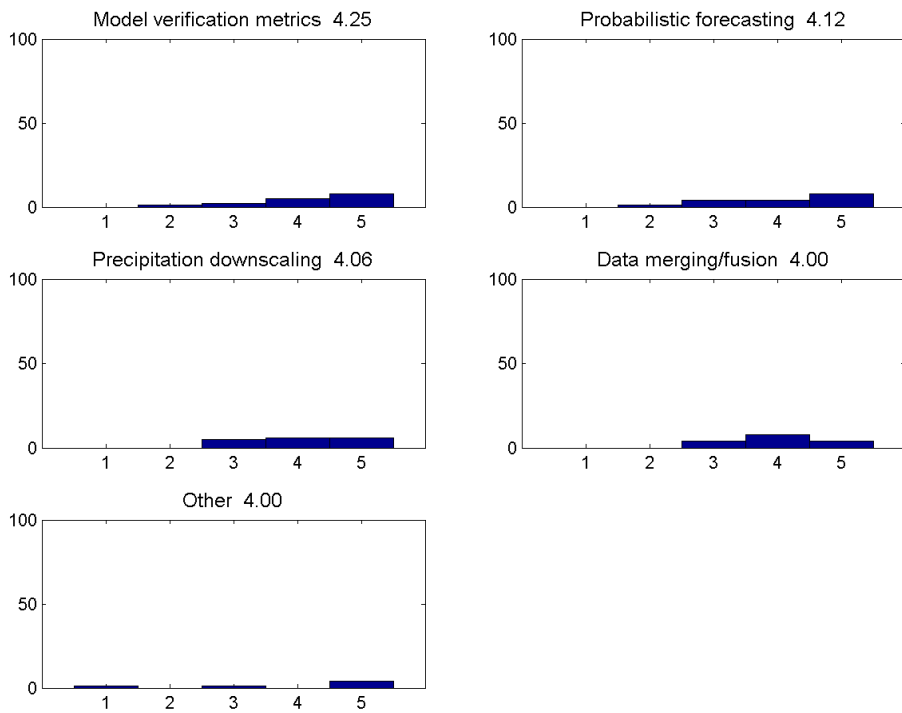


Figure 4: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (*Hydrology*).

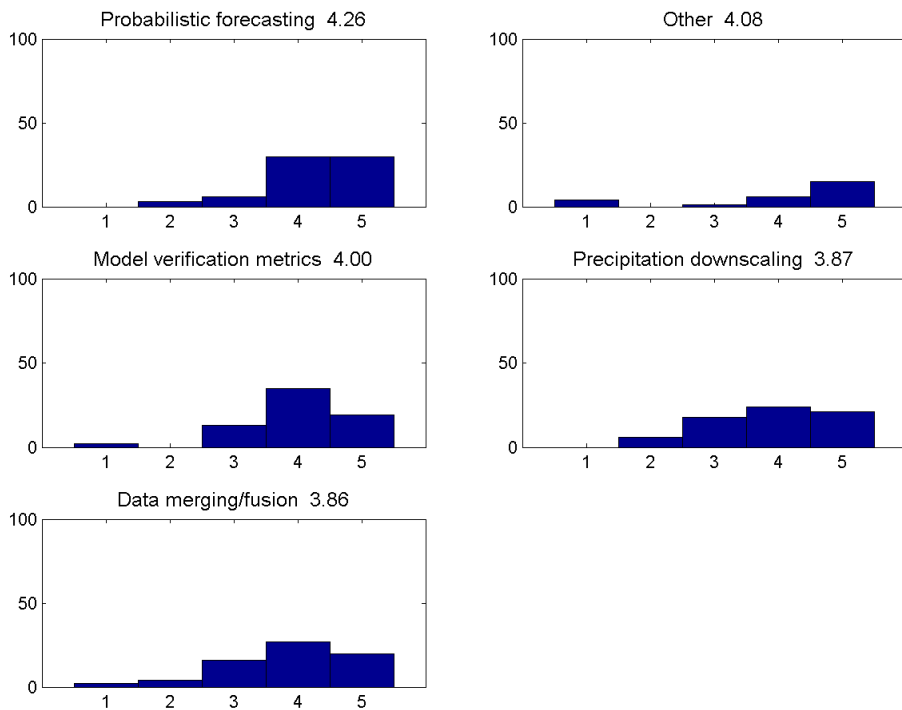


Figure 5: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (*Meteorology*).

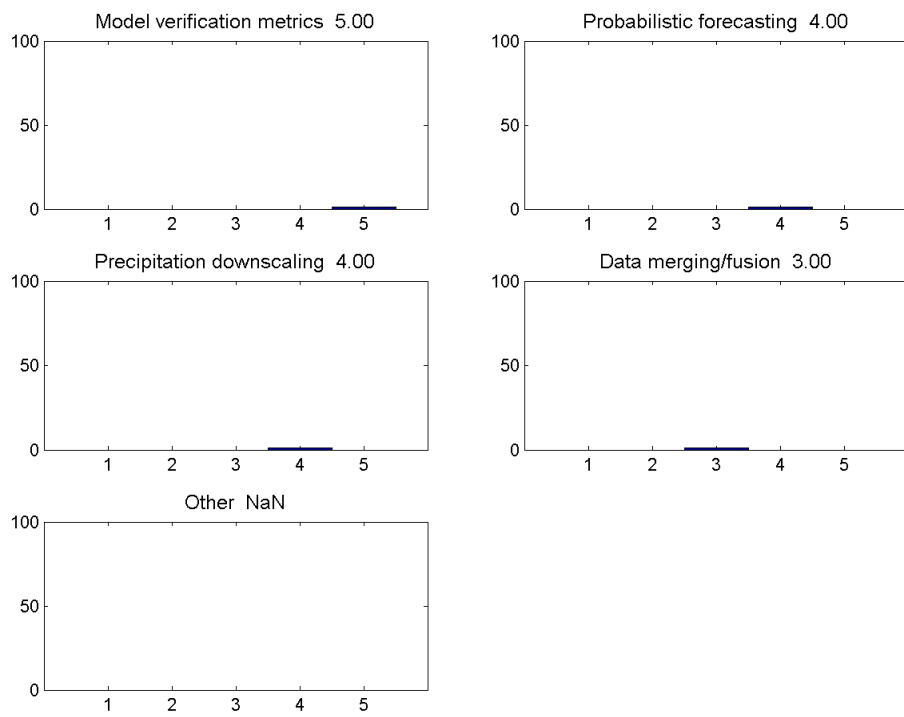


Figure 6: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (Other).



B. ICT challenges

With regard to the ICT challenges the audience was requested to:

“For each one of the above topics a list of related issues and ICT challenges has been identified. Please select the topics that are closer to your experience and score the most important items, using again the range 1-5.”

B1 Data fusion: merging observations from different sensors, different scales, merge model outputs and observations, etc.

- A. Definition and dependability of catalogues of available data
- B. Accessibility of the data: how to protect the ownership/rights of the data
- C. Have easy access to these data in formats that are easy to handle: definition of common interchange data formats (like netcdf, grib, bufr)
- D. Definition of libraries for merging and analyzing data from multiple sources
- E. Availability and reliability of high capacity communication channels from/to data sources
- F. Availability and reliability of high capacity storage for huge volumes (i.e., 100TB)
- G. Availability of tools for automatizing the data fusion workflows
- H. Availability of information to improve reproducibility and validation of the process
- I. Implementation of economic accounting and billing procedures
- J. Availability of lineage and provenance information
- K. Other

Based on weighted average of the collected scores, the following rankings are provided depending on the audience considered:

Rank	Full audience	Meteorology	Hydro-Meteorology	Hydrology	Others
1	C	C	C	C	C
2	D	E	E	D	H
3	E	G	D	A	D
4	H	D	A	H	G
5	A	F	H	B	E
6	G	A	G	G	F
7	F	H	F	E	A
8	B	B	B	J	B
9	J	J	J	F	J
10	K	K	K	K	K
11	I	I	I	J	I

Table 4: B1.Data fusion. Collected scores based on weighted average provided depending on the audience considered.

The definition of common interchange data formats (topic A) is the 'hottest' topic for all communities.

The definition of libraries for merging and analyzing data from multiple sources (topic D) is among the most relevant for all the sub-communities and it is ranked second when the full audience is addressed.

The third topic in the rank (topic E) is complementing the first two and confirms the driving role of data related issues for the scientists interested in data fusion.

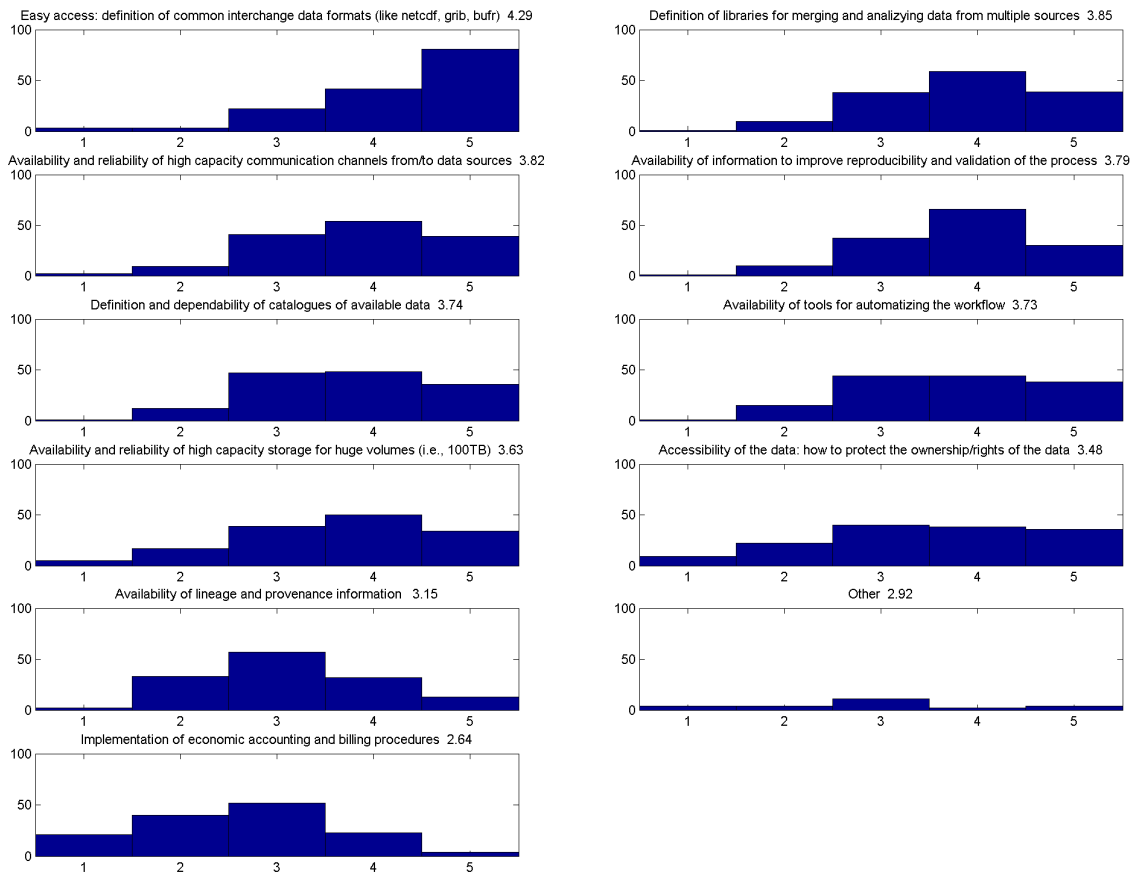


Figure 7: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (full audience).

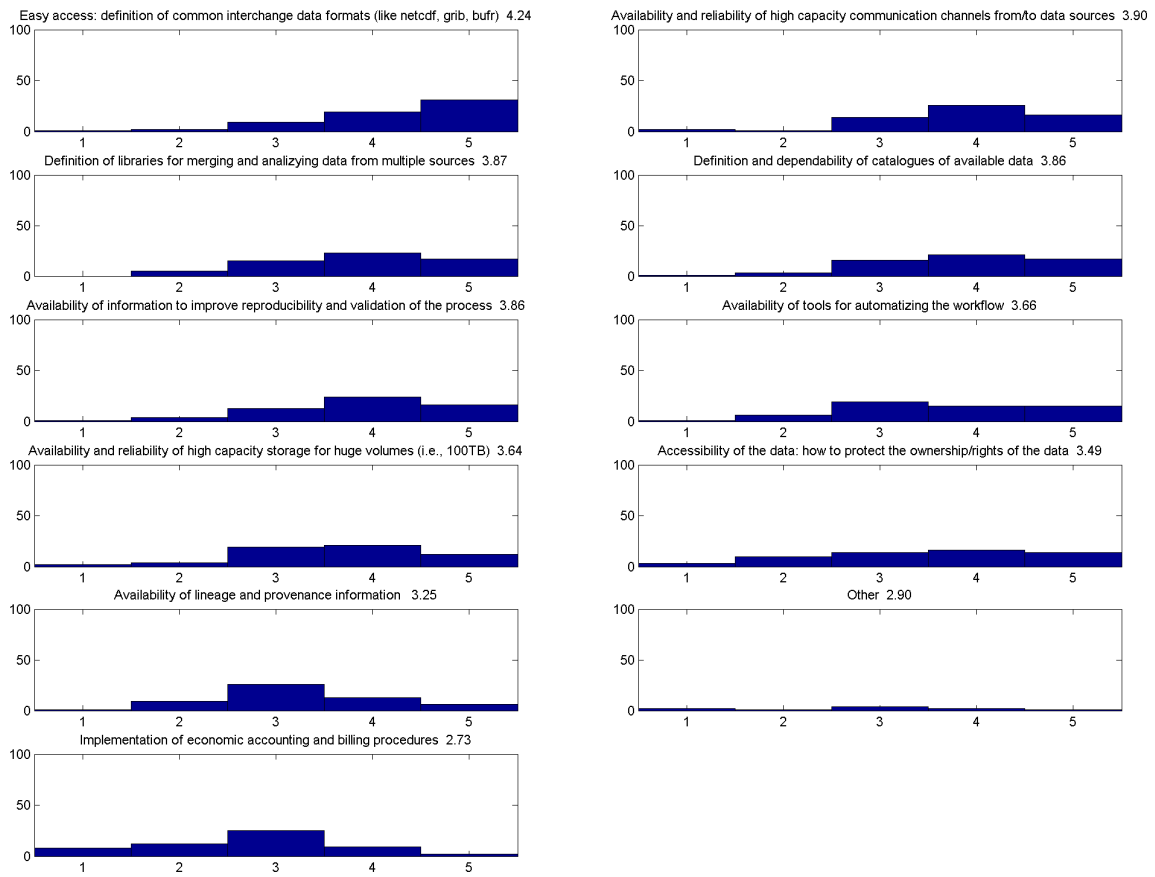


Figure 8: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (Hydro-Meteorology).

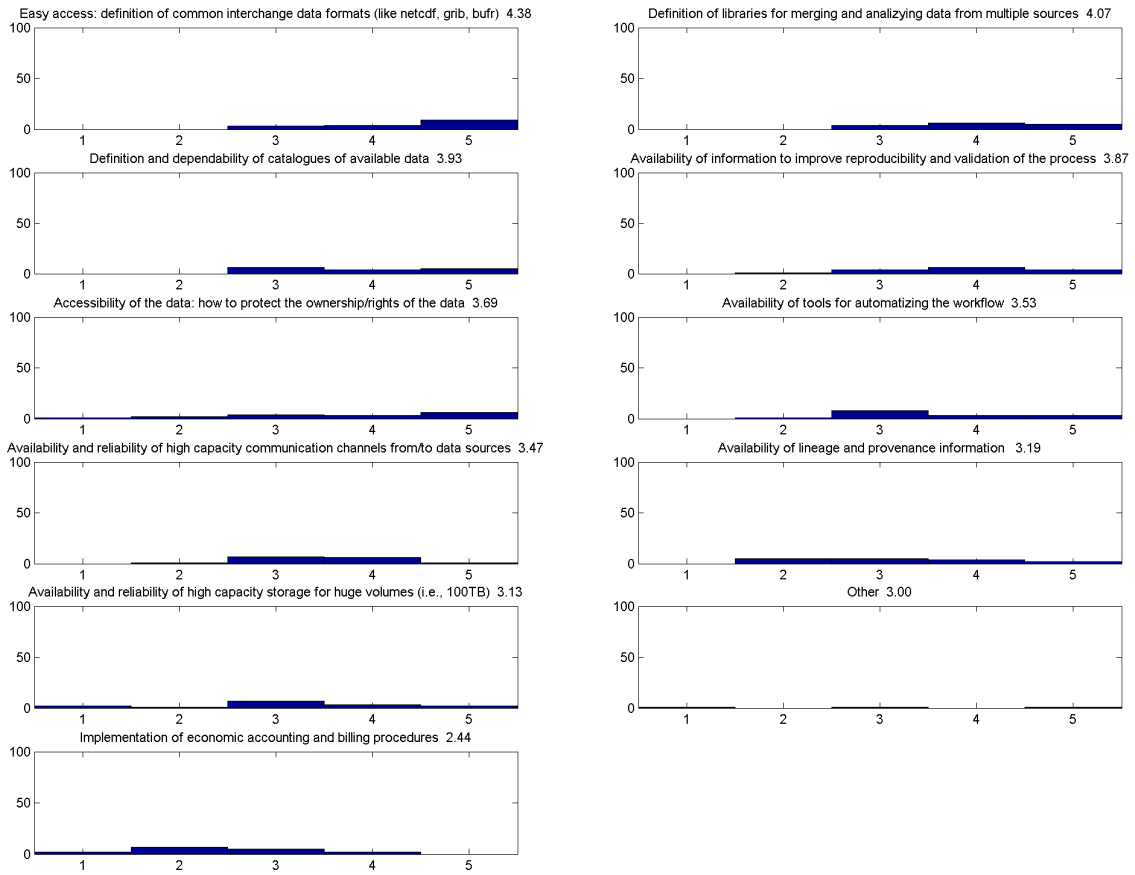


Figure 9: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (Hydrology).

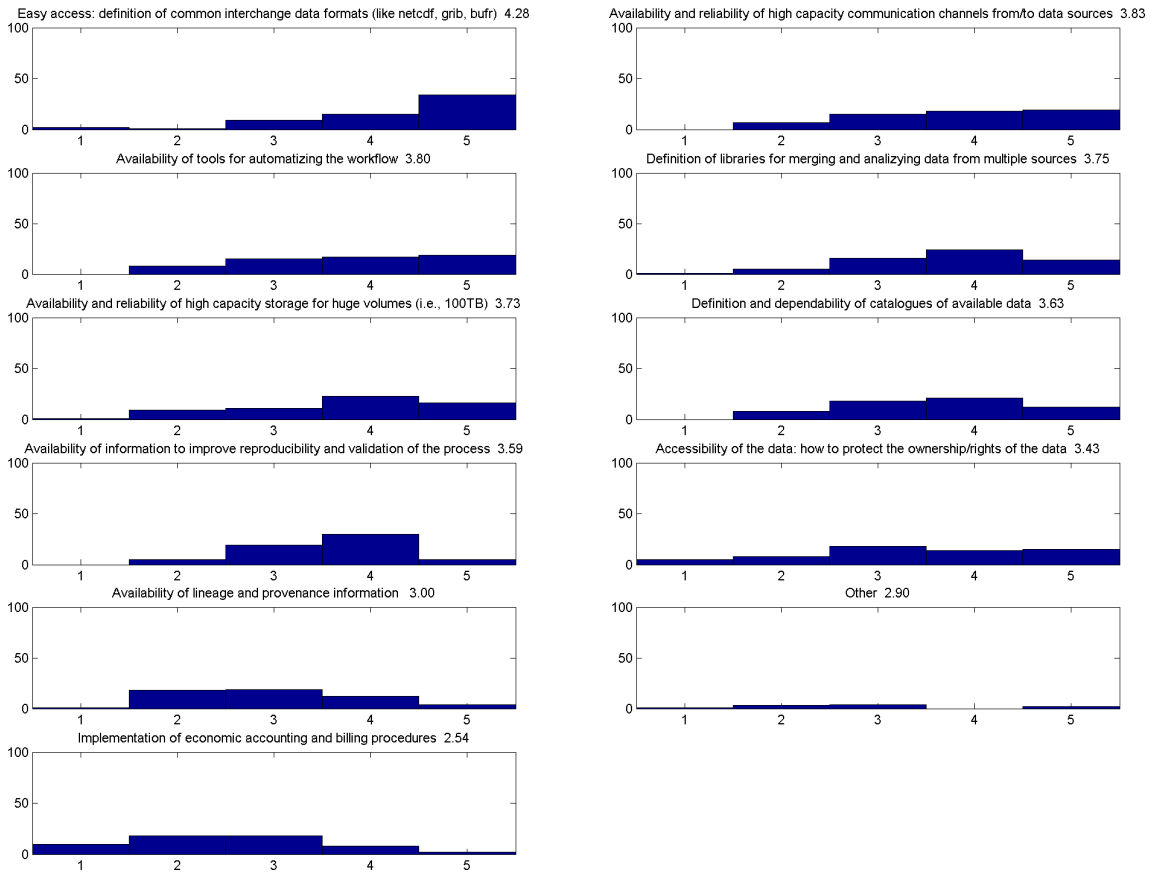


Figure 10: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (Meteorology).

B2 Probabilistic forecasting

- A. Definition and dependability of catalogues of available data
- B. Definition and dependability of catalogues of available atmospheric and hydrologic models
- C. Accessibility of the model output: how to protect the ownership/rights of the data
- D. Accessibility of the model code: how to protect the ownership/rights of the models
- E. Definition of common interchange data formats (like netcdf, grib, bufr) and protocols (e.g., atmospheric-hydrologic models coupling/interfaces)
- F. Definition of libraries of tools for handling, processing and visualizing data (like tools for data conversion and processing, georeferencing)
- G. Definition of libraries for analyzing data and output from multiple sources (e.g. statistically analyze the ensemble forecasts: mean, variance, whole pfd)
- H. Availability and reliability of high performance computing resources for probabilistic forecasting
- I. Availability and reliability of high capacity storage for huge volumes (i.e., 100TB)

Availability of a standard framework to perform probabilistic forecasting (multi-model ensembles, prototype of meteorological and hydrological forecasting chain, etc.)

- J. Availability of lineage and provenance information
- K. Other

Based on weighted average of the collected scores, the following rankings are provided depending on the audience considered:

Rank	Full audience	Hydro-Meteorology	Hydrology	Meteorology	Others
1	E	E	A	E	G
2	H	F	B	H	H
3	F	H	H	I	F
4	J	G	E	F	B
5	G	B	F	J	E
6	B	A	J	G	J
7	I	J	G	A	I
8	A	I	I	B	A
9	C	C	K	L	C
10	D	D	L	D	D
11	K	K	D	C	K
12	L	L	C	K	L

Table 5: B2 Probabilistic forecasting. Collected scores based on weighted average provided depending on the audience considered.

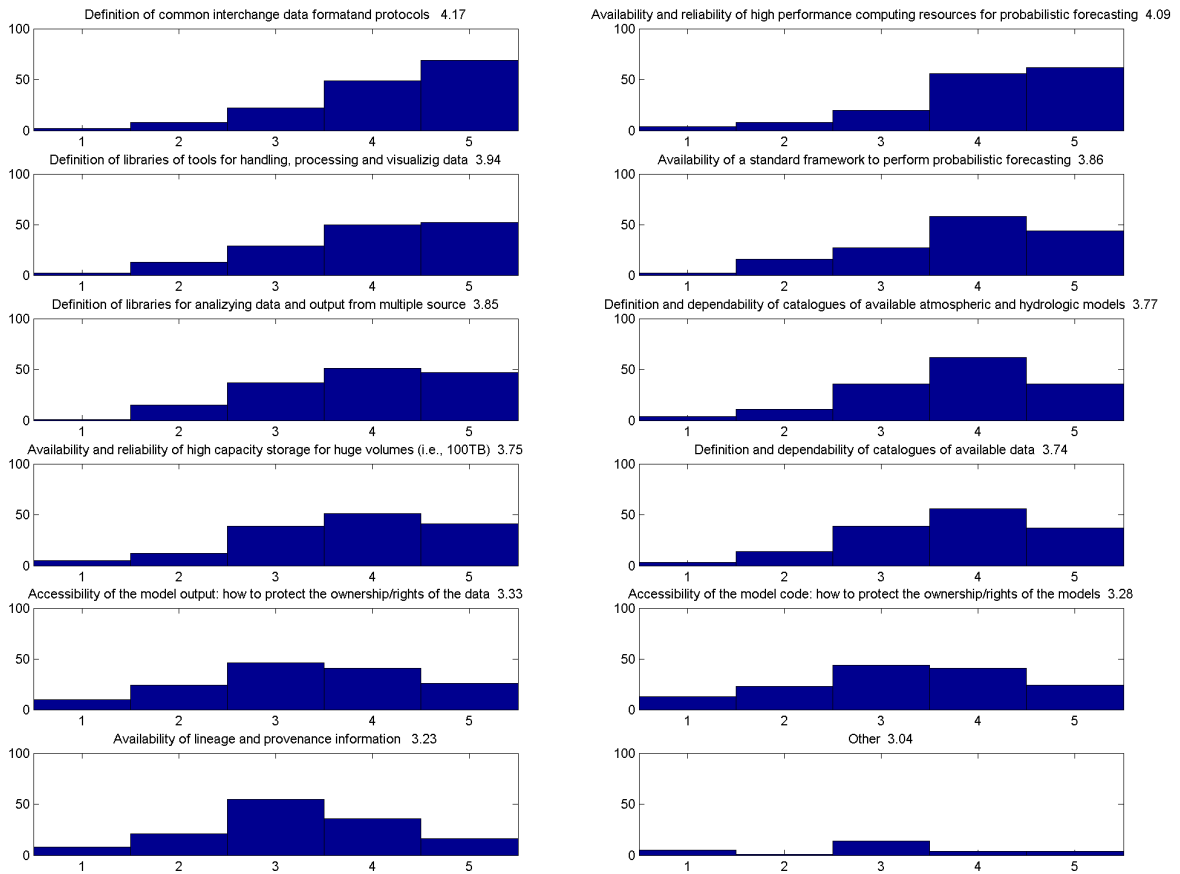


Figure 11: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (full audience).

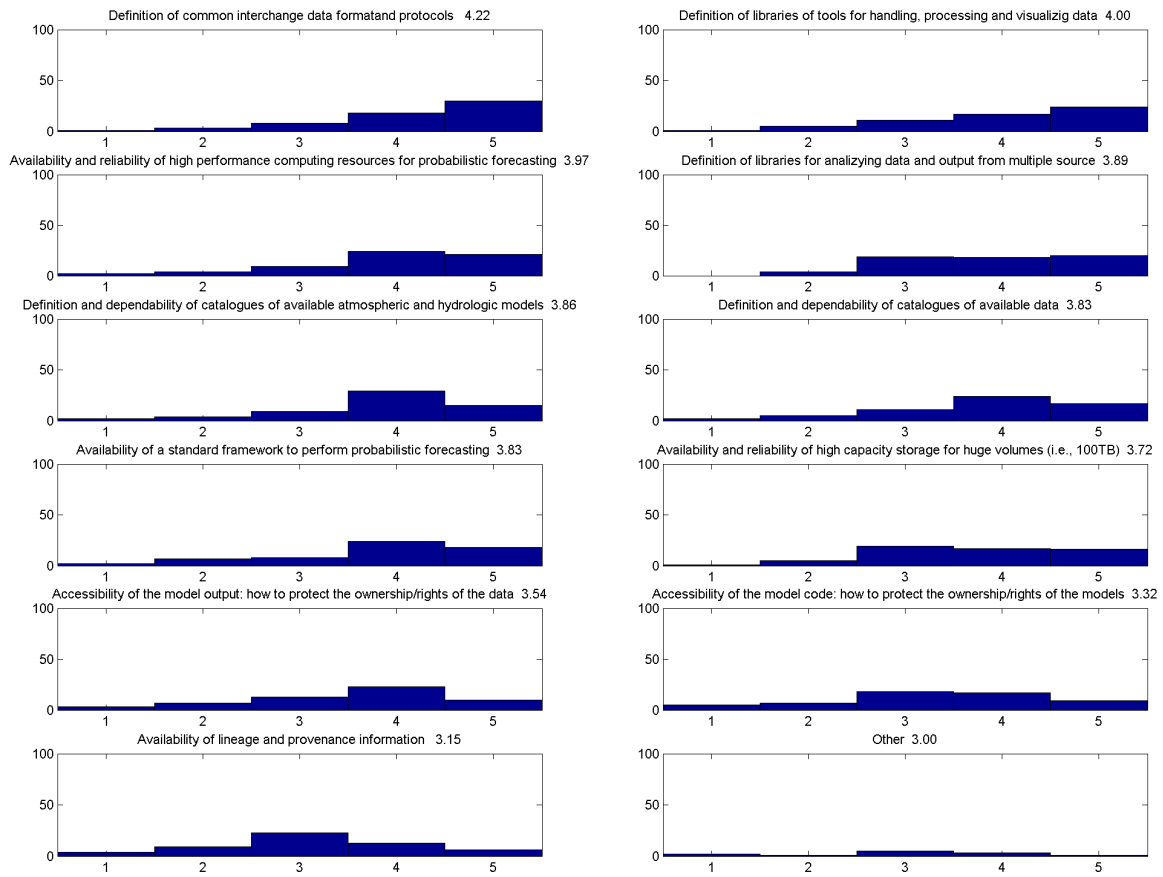


Figure 12: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (Hydro-Meteorology).

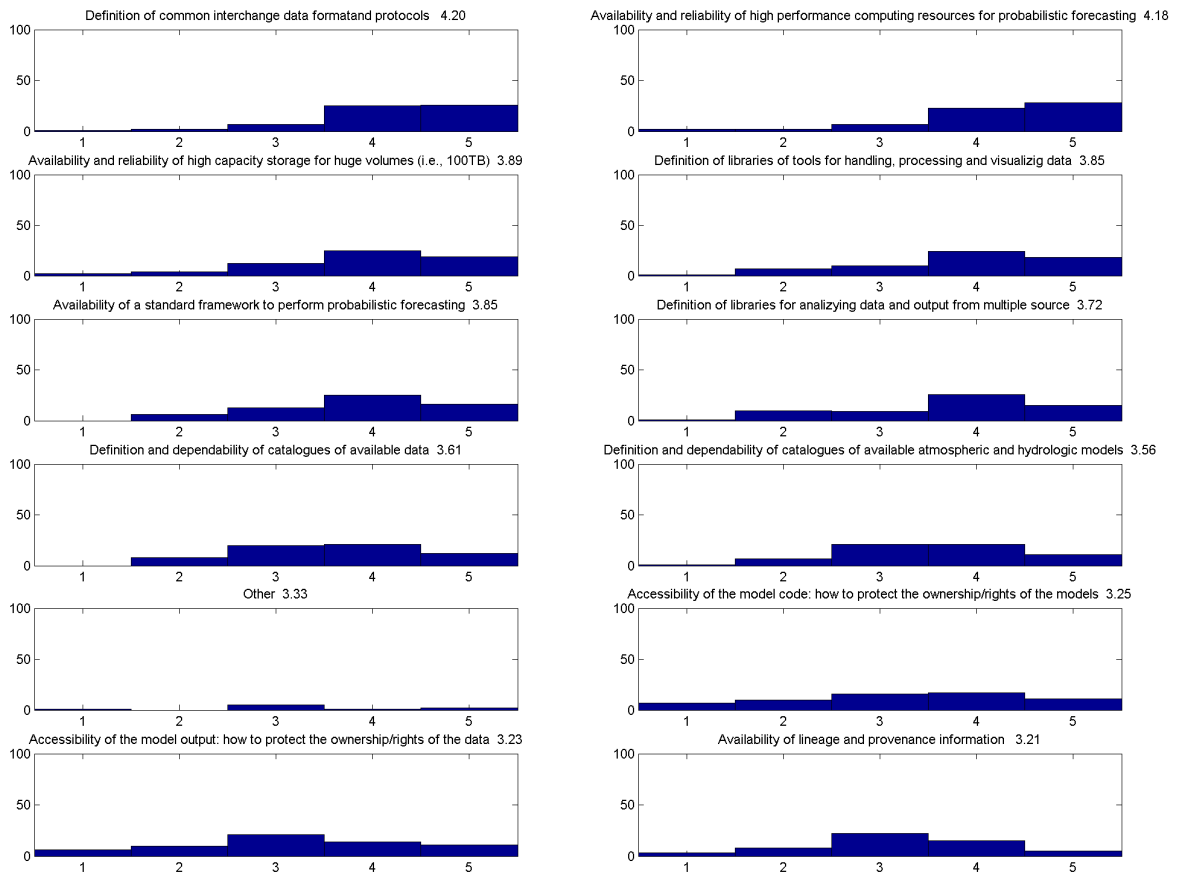


Figure 13: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (Meteorology).

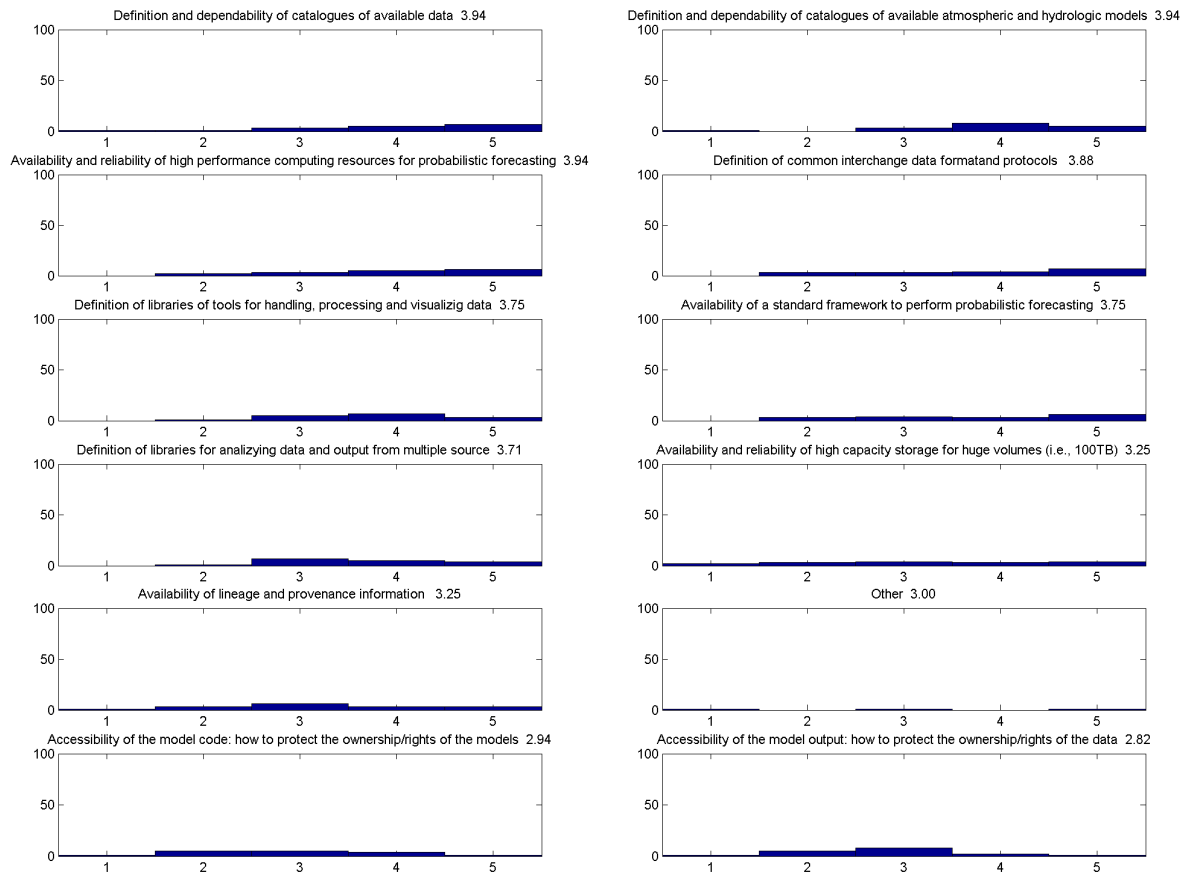


Figure 14: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (Hydrology).

B3 Model verification

- A. Availability of well documented metrics of verification (single output or ensemble) and codes for computation of those metrics
- B. Availability of model output and observations in compatible formats for easy verification
- C. Definition of libraries for verifying data and output from multiple sources (e.g. statistically analyze the ensemble forecasts: mean, variance, whole pfd)
- D. Availability and reliability of high performance computing resources for model verification
- E. Availability and reliability of high capacity storage for huge volumes (i.e., 100TB)
- F. Availability of a standard framework to perform model verification
- G. Availability of lineage and provenance information
- H. Other

Based on weighted average of the collected scores, the following rankings are provided depending on the audience considered:

Rank	Full audience	Meteorology	Hydro-Meteorology	Hydrology	Others
1	B	B	B	A	B
2	A	A	A	B	F
3	F	F	C	F	A
4	C	C	D	C	C
5	D	E	F	D	D
6	E	D	E	G	E
7	G	G	H	E	G
8	H	H	G	H	H

Table 6: B3 Model verification. Collected scores based on weighted average provided depending on the audience considered.

The availability of model output and observations in compatible formats for easy verification (*topic B*) is the topmost topic for the full audience and for the Hydro-Meteorology and Meteorology sub-communities, while it ranks second for the Hydrology one.

Furthermore not surprising, since we are dealing with model verification, the availability of well documented metrics of verification (single output or ensemble) and codes for computation of those metrics (namely *topic A*) is perceived as very important.

Finally once more the availability of standards (*topic F*), in this case to perform model verification, is recognized as an important issue at the full audience scale and also by many sub-communities.

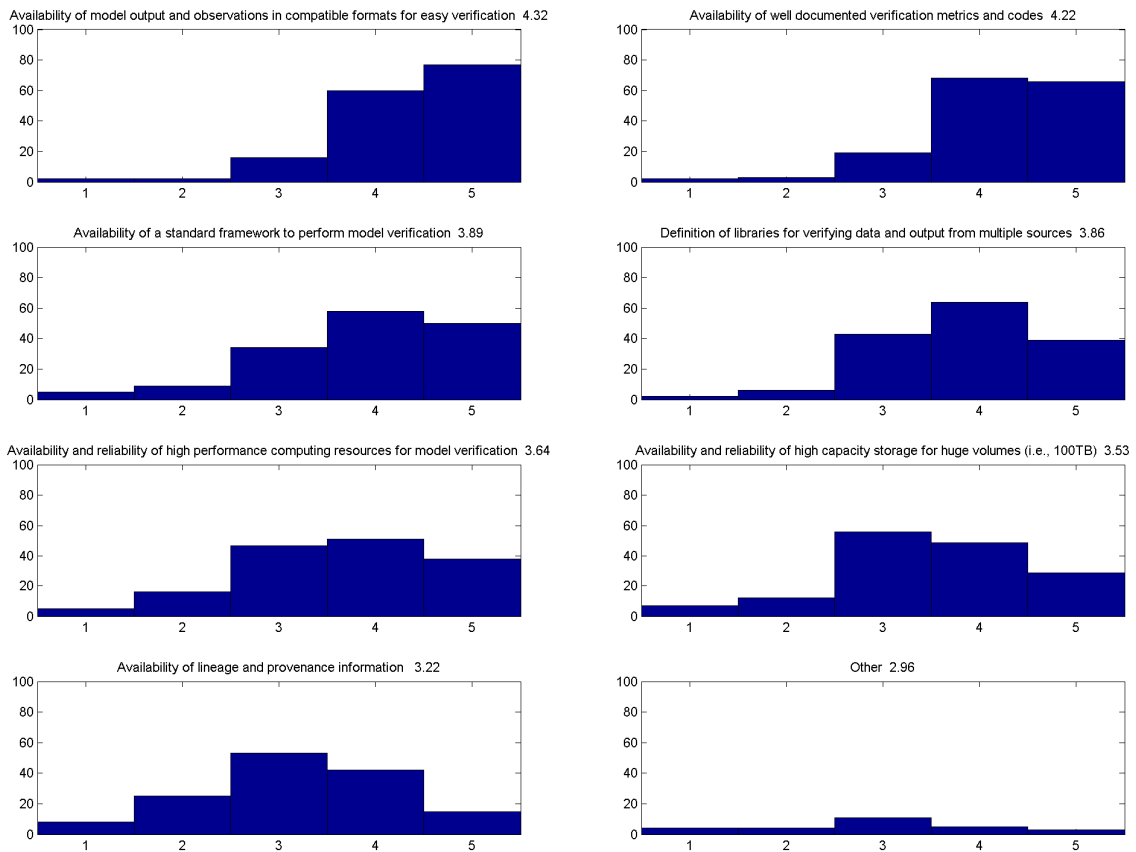


Figure 15: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (full audience).

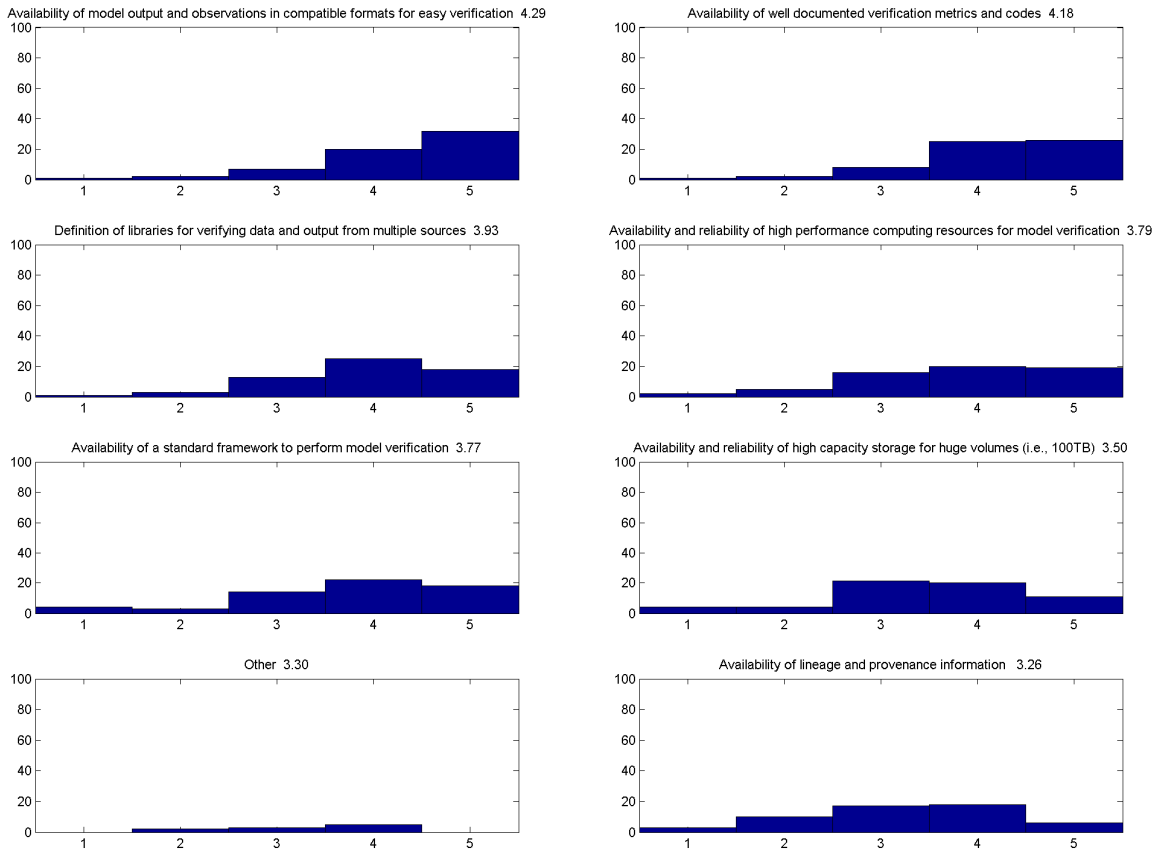


Figure 16: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (Hydro-Meteorology).

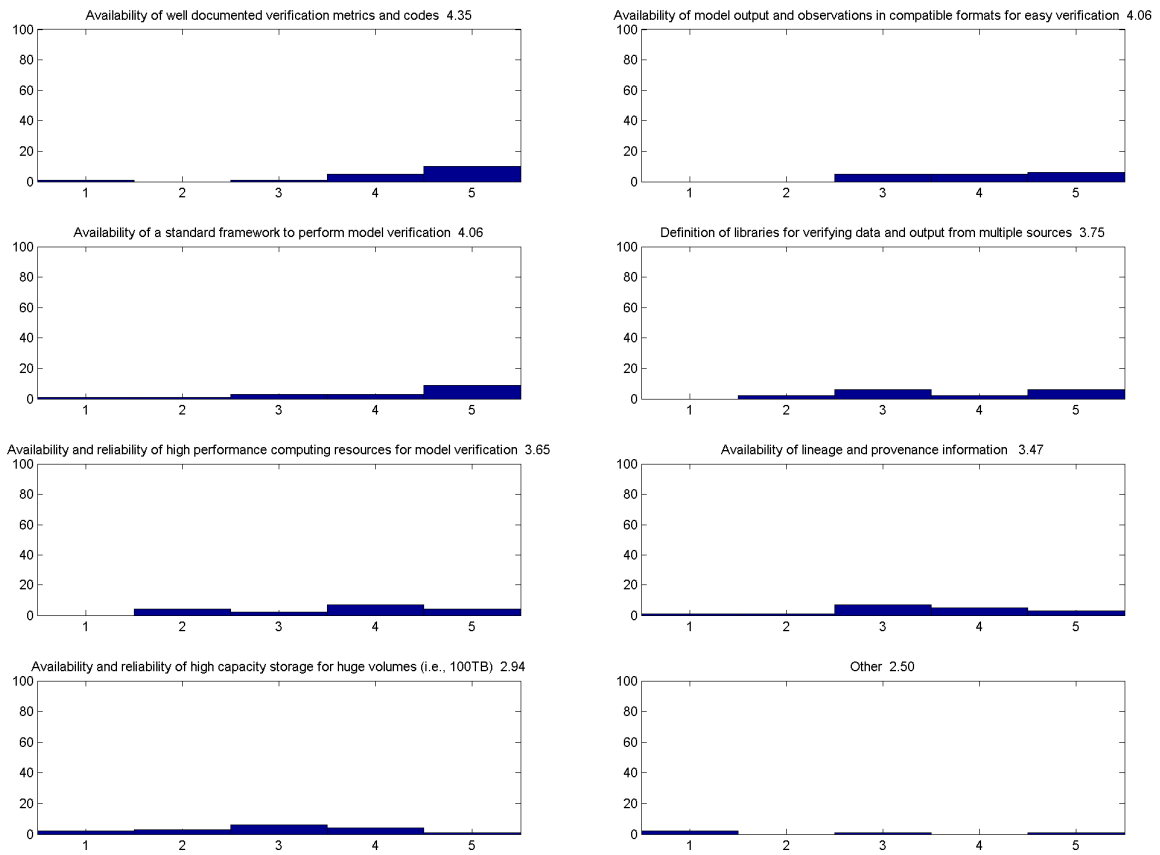


Figure 17: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (Hydrology).

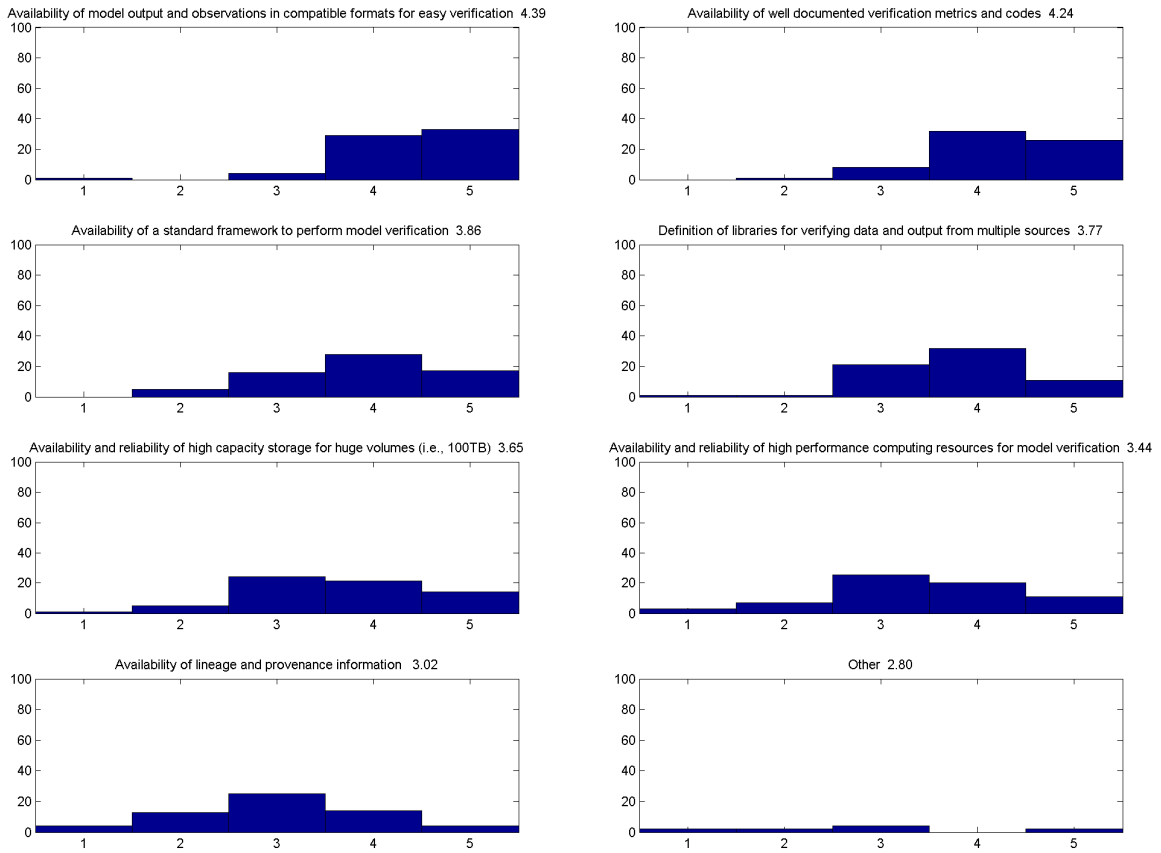


Figure 18: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (Meteorology).

B4 Precipitation downscaling

- A. Definition and dependability of catalogues of available data
- B. Definition and dependability of catalogues of available algorithms and codes for downscaling
- C. Accessibility of the model output: how to protect the ownership/rights of the data
- D. Accessibility of the model code: how to protect the ownership/rights of the models
- E. Definition of common interchange data formats (like netcdf, grib, bufr) and protocols
- F. Definition of libraries of tools for handling, processing and visualizing data (like tools for data conversion and processing, georeferencing)
- G. Definition of libraries for downscaling data and output from multiple sources
- H. Availability and reliability of high performance computing resources for precipitation downscaling
- I. Availability and reliability of high capacity storage for huge volumes (i.e., 100TB)
- J. Availability of a standard framework to perform probabilistic forecasting (multi-model ensembles, prototype of meteorological and hydrological forecasting chain, etc.)
- K. Implementation of economic accounting and billing procedures
- L. Availability of lineage and provenance information
- M. Other

Based on weighted average of the collected scores, the following rankings are provided depending on the audience considered:

Rank	Full audience	Meteorology	Hydrometeorology	Hydrology	Others
1	E	E	E	E	F
2	B	B	F	G	B
3	F	F	B	B	H
4	J	J	J	J	J
5	H	H	A	A	E
6	A	A	H	F	G
7	G	G	G	H	A
8	I	I	I	I	I
9	C	C	C	D	C
10	D	D	D	L	D
11	L	L	L	C	L
12	M	M	K	K	K
13	K	K	M	M	M

Table 7: B4 Precipitation downscaling. Collected scores based on weighted average provided depending on the audience considered.



Also for topic B4, the definition of common interchange data formats and protocols is the reference topic for the full audience and a large amount of the sub-communities here considered. Along the same lines, the definition and dependability of catalogues of available algorithms and codes for downscaling is perceived among the most important aspect both at the full audience scale and for reference sub-communities as hydrometeorology and meteorology.

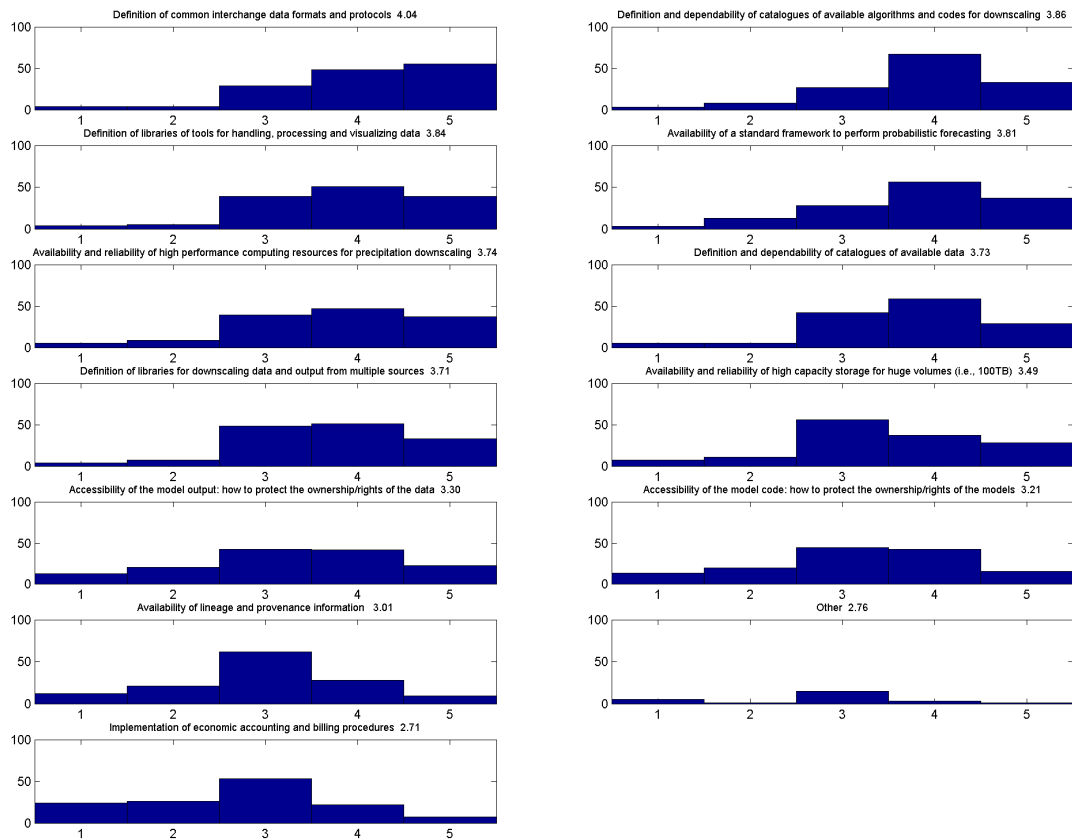


Figure 19: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (full audience).

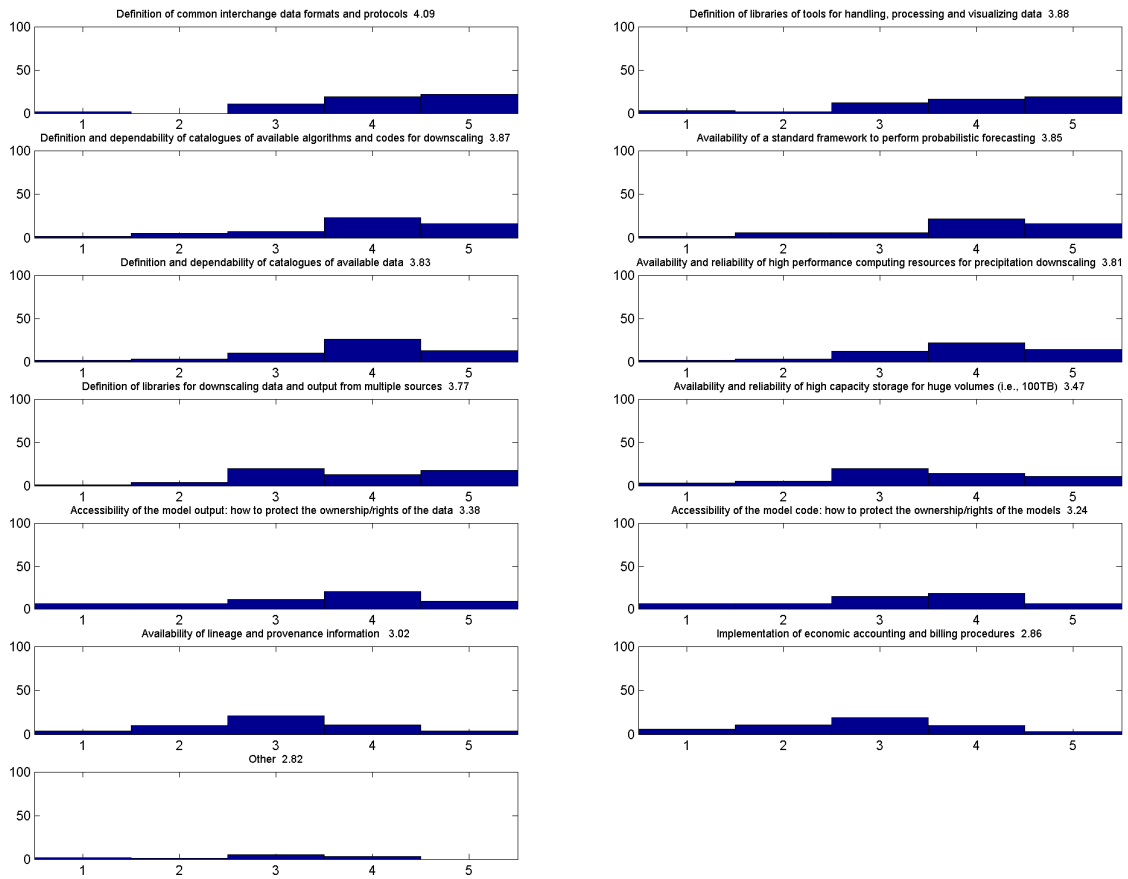


Figure 20: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (Hydro-Meteorology).

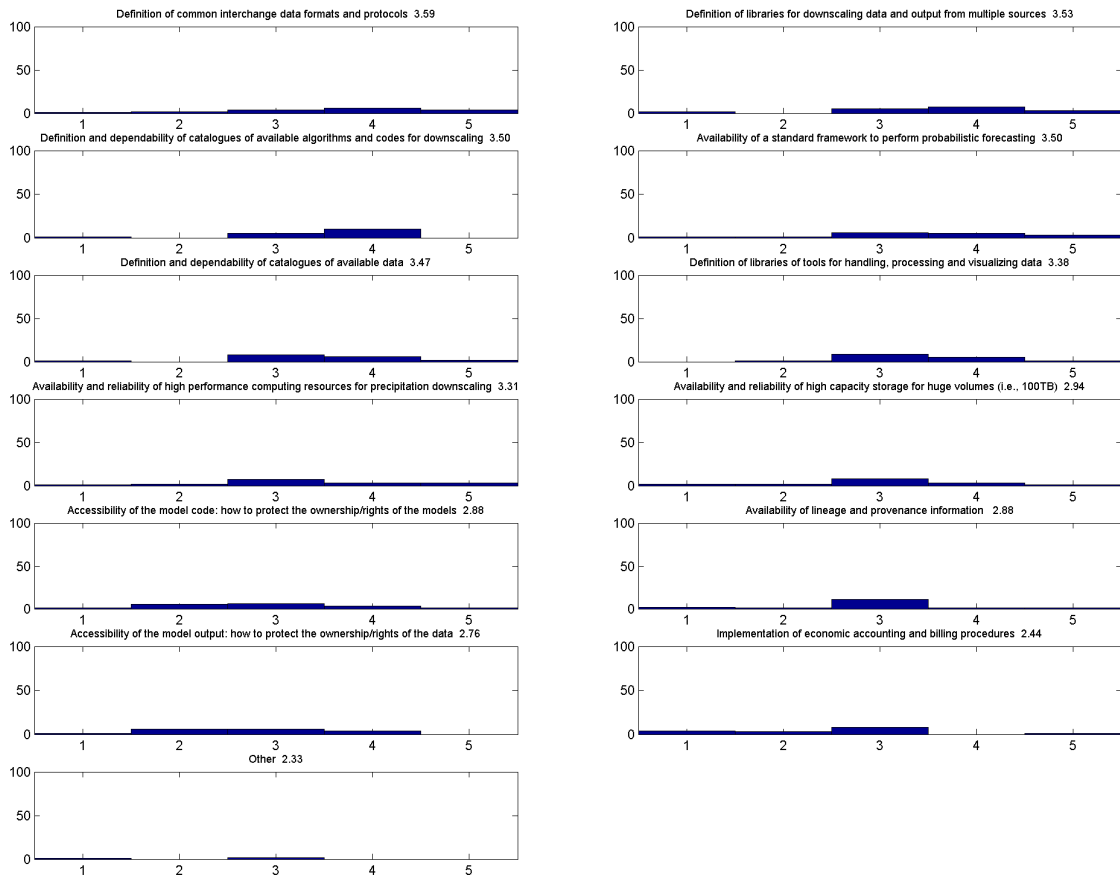


Figure 21: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (Hydrology).

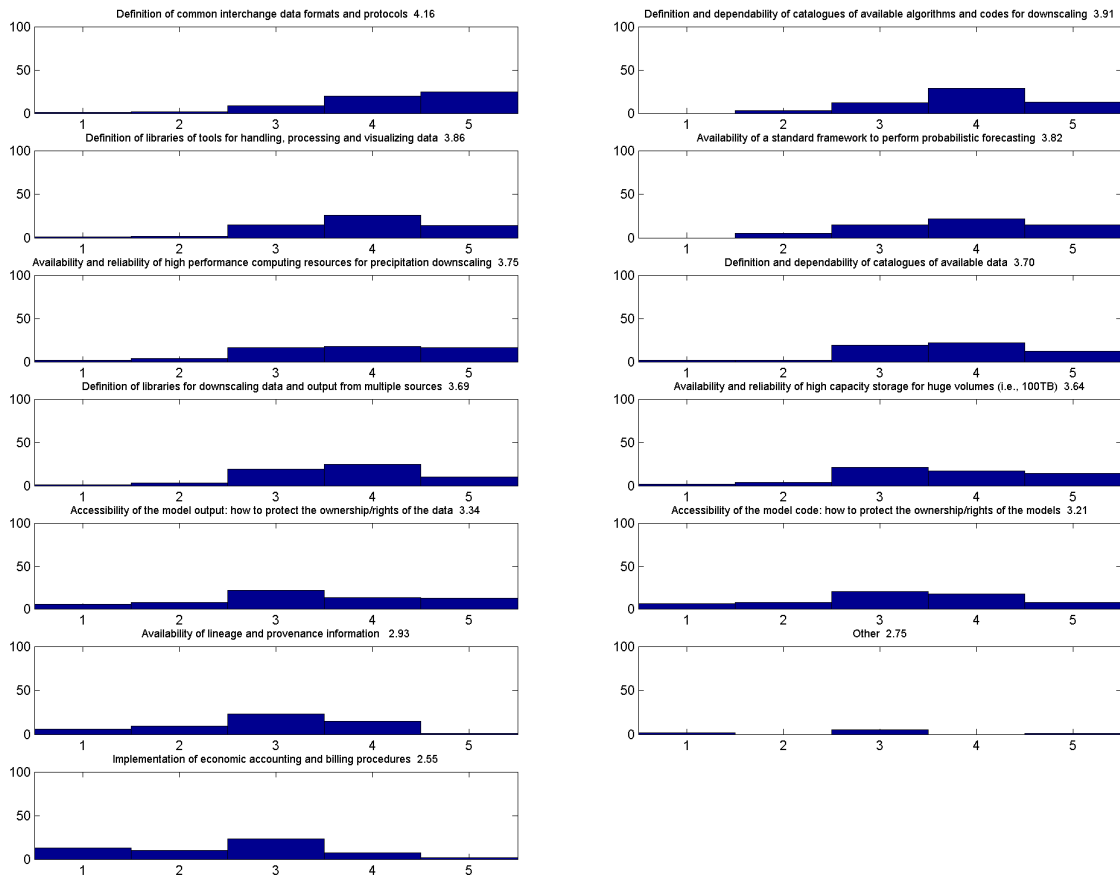


Figure 22: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (Meteorology).

B5 Real time Activities

Here three questions were asked:

- A. How often do you need data fusion output in real time?

- B. How often do you need probabilistic forecasting output in real time?

- C. How often do you need precipitation downscaling output in real time?

Scoring: Never = 1

Seldom = 2

Often = 3

Always = 4

Rank	Full audience	Meteorology	Hydrometeorology	Hydrology	Others
A	2.37	2.33	2.48	2.24	2.55
B	2.54	2.60	2.43	2.35	2.87
C	2.35	2.42	2.39	2.00	2.27

Table 8: B5 Real time Activities. Collected scores based on weighted average provided depending on the audience considered.

As general comment, the audience seems to be more interested in research or mixed research/operational activities than pure operational efforts by using data fusion, probabilistic forecasting and precipitation downscaling respectively: this is clearly reflected in the scores (between *seldom* and *often*) given for each question independent of the audience. Only for probabilistic forecasting a trend towards a more intensive usage can be seen.

However it is worth mentioning that the full audience and the meteorology community consider the use of probabilistic forecasting output in real time more important than other user groups. In contrast, the Hydro-Meteorology community prefers the data fusion, while the Hydrology one is more focused on the use of probabilistic forecasting output in real time.

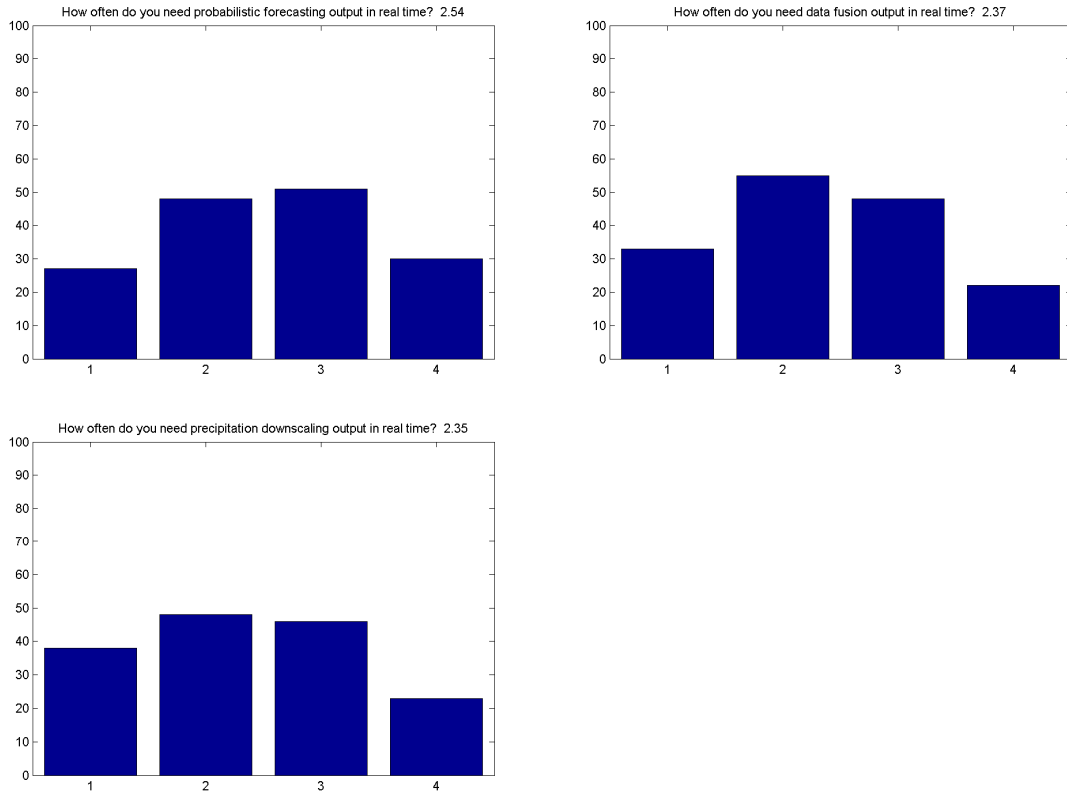


Figure 23: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (full audience).

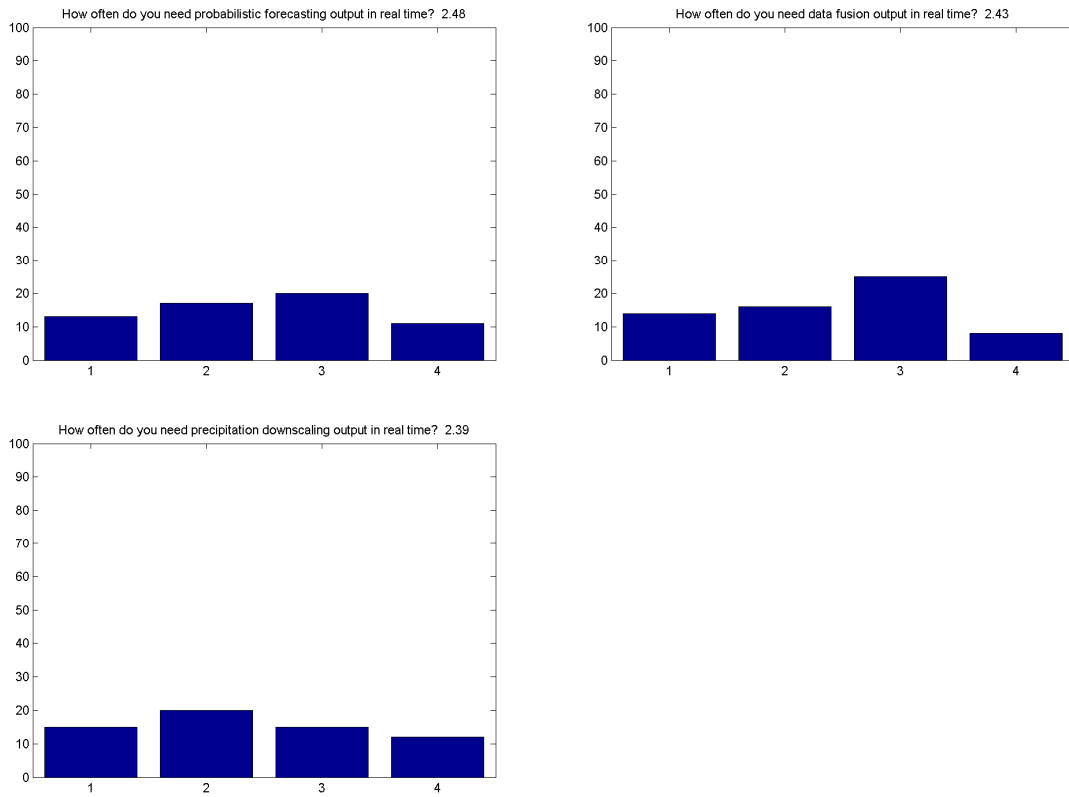


Figure 24: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (Hydro-Meteorology).

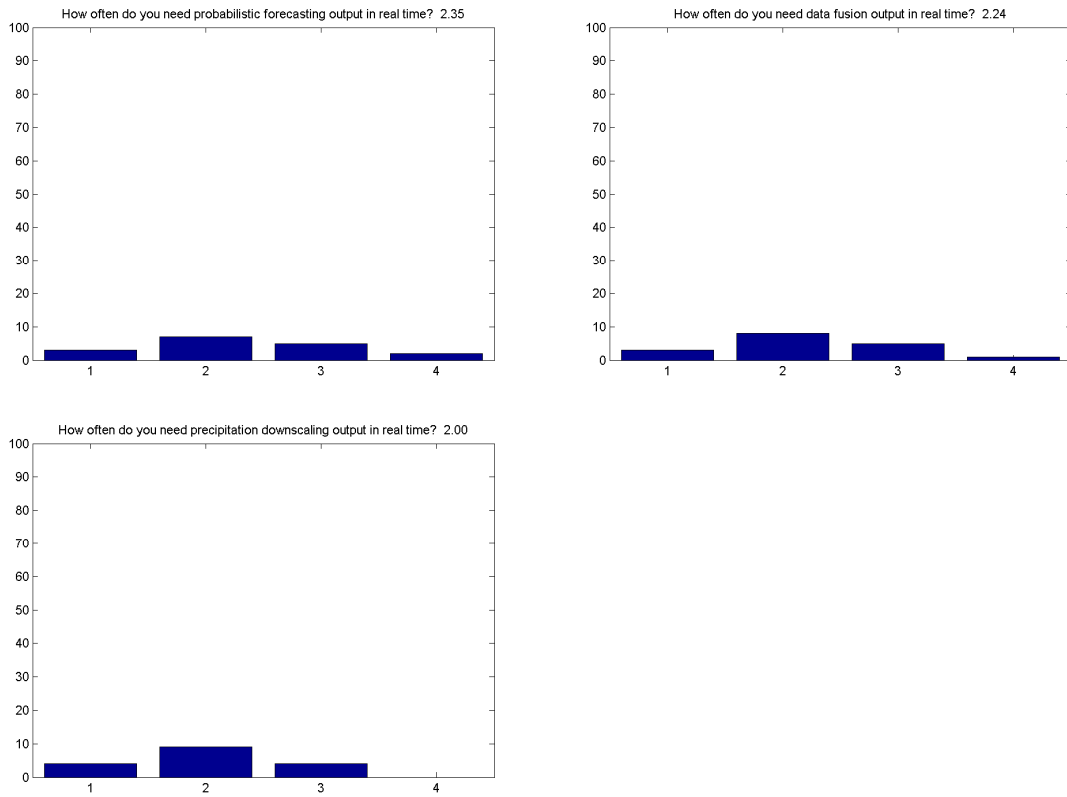


Figure 25: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (Hydrology).

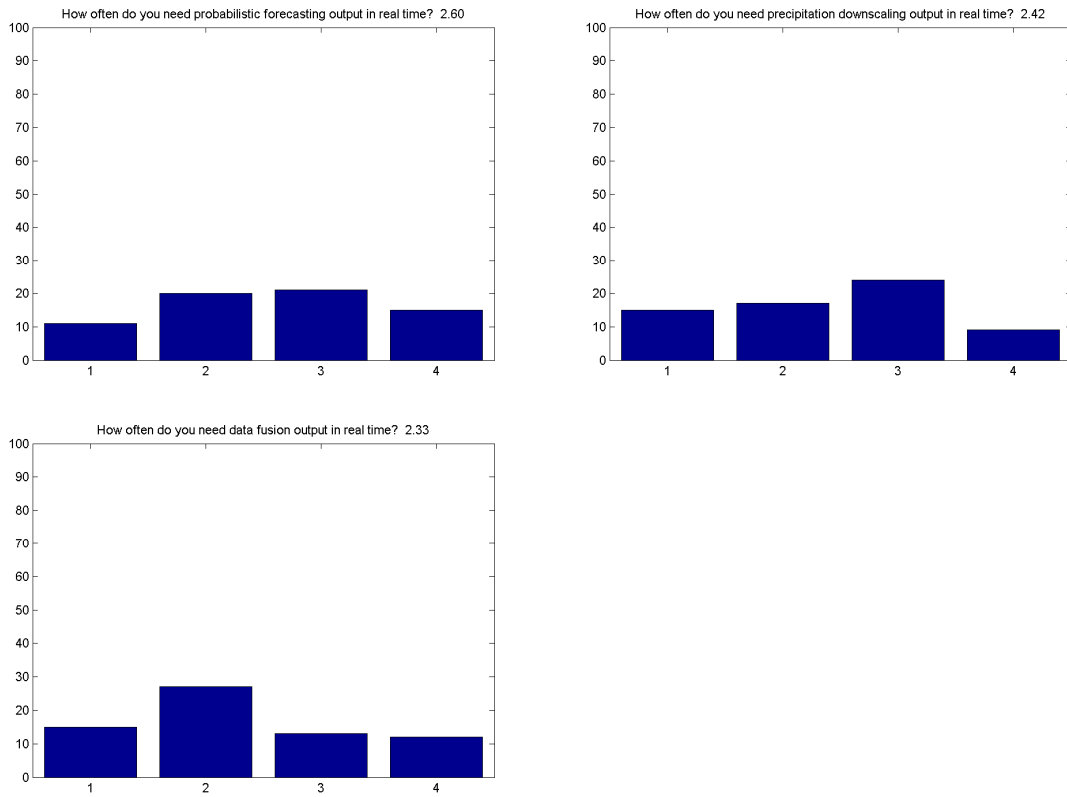


Figure 26: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (Meteorology).

C Current practice and opportunities

The audience was also requested to address the following aspects:

“In your day by day research activity you are likely to use remote and distributed data/resources/services in order to carry on different tasks such data analysis or simulation. ”

C1 Please, shortly describe your current practice of use remote and distributed resources, possibly pointing out difficulties, bottlenecks and problems that you find.

Generally speaking the main outcomes can be summarized as:

- accessibility to and dependability of data
- format heterogeneity, storage resource heterogeneity
- transmission bandwidth and transport protocols
- data precision
- data availability
- access rights
- data management and meta data
- suitability of models

C2 Improving ICT technologies for HMR research may lead only to optimize your activity or may open new opportunities. Please shortly provide your opinion about it.

Generally speaking the main outcomes can be summarized as:

- improved access to data and models
- increase the communication and the cooperation between the research communities
- easier comparison and interplay between hydrological and meteorological models
- easier sharing of post-processing tools and of visualization tools
- standartization of working platforms (operating system etc.), tools, programming languages, data formats

C3 Anything you want to speak about.

Most of the suggestions are about standartization of working platforms (operating system etc.), tools, programming languages, data formats



D Provide a short description of your field of activity

See section "Expertise and Institution distributions" (Section 1.2.2).

4 Conclusions

Looking at the results from HMR questionnaire various limitations and issues for future HMR ICT collaboration appear. These issues very well reflect the user needs of the involved communities, mostly from the perspective of ICT application for hydrometeorology and related Earth science research. In some cases the limitations are purely technological in nature:

- interoperability issues (models, formats, meta data, ...);
- dependability issues (availability, integrity, reliability, ...) of data and of infrastructures
- volume issues: amount of data and bandwidth

Other aspects concern issues like communication, participation, motivation and usability:

- integration with other communities: need sophisticated VO management;
- integration of other phenomena: need sophisticated workflow management;

It is also interesting to mention that real-time processing seems to be of secondary importance and privacy and accounting / billing are hardly mentioned at all.

5 Abbreviations

DRIHMS	Distributed Research Infrastructure For Hydro-Meteorology Study
HMR	Hydro-Meteorology Research
ICT	Information and Communication Technology
VO	Virtual Organization



6 List of figures

Figure 1: DRIHMS HMR questionnaires worldwide distribution.....	5
Figure 2: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (full audience).	10
Figure 3: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (Hydro-Meteorology).	10
Figure 4: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (<i>Hydrology</i>).....	11
Figure 5: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (<i>Meteorology</i>).....	11
Figure 6: ranking and scores distribution for HMR hot topics: in y-axis the number of preferences is provided (Other).....	12
Figure 7: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (full audience).	15
Figure 8: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (Hydro-Meteorology).	16
Figure 9: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (Hydrology).....	17
Figure 10: ranking and scores distribution for B1 question: in y-axis the number of preferences is provided (Meteorology).....	18
Figure 11: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (full audience).	20
Figure 12: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (Hydro-Meteorology).	21
Figure 13: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (Meteorology).....	22



Figure 14: ranking and scores distribution for B2 question: in y-axis the number of preferences is provided (Hydrology)..... 23

Figure 15: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (full audience). 25

Figure 16: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (Hydro-Meteorology). 26

Figure 17: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (Hydrology)..... 27

Figure 18: ranking and scores distribution for B3 question: in y-axis the number of preferences is provided (Meteorology)..... 28

Figure 19: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (full audience). 31

Figure 20: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (Hydro-Meteorology). 32

Figure 21: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (Hydrology)..... 33

Figure 22: ranking and scores distribution for B4 question: in y-axis the number of preferences is provided (Meteorology)..... 34

Figure 23: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (full audience). 36

Figure 24: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (Hydro-Meteorology). 37

Figure 25: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (Hydrology)..... 38

Figure 26: ranking and scores distribution for B5 question: in y-axis the number of preferences is provided (Meteorology)..... 39



7 List of tables

Table 1: Classification of people filling the questionnaires in terms of their field of expertise. .6	.6
Table 2: Classification of people filling the questionnaires in terms of the mission of their Institution.....6	6
Table 3: Collected scores (figure 2) based on weighted average provided depending on the audience considered.8	8
Table 4: B1.Data fusion. Collected scores based on weighted average provided depending on the audience considered..... 14	14
Table 5: B2 Probabilistic forecasting. Collected scores based on weighted average provided depending on the audience considered. 19	19
Table 6: B3 Model verification. Collected scores based on weighted average provided depending on the audience considered. 24	24
Table 7: B4 Precipitation downscaling. Collected scores based on weighted average provided depending on the audience considered. 29	29
Table 8: B5 Real time Activities. Collected scores based on weighted average provided depending on the audience considered. 35	35



Author: Prof. George C. Craig
Deutsche Zentrum für Luft und Raumfahrt
Muenchner Strasse 20
82234 Wessling
Germany

george.craig@dlr.de
george.craig@lmu.de

Tel. +498153280

www.dlr.de

Approval: Antonio Parodi, Ph.D.
CIMA Research Foundation
International Centre on Environmental Monitoring
University Campus
Via Armando Magliotto, 2
I - 17100 Savona
Italy

antonio.parodi@cimafoundation.org

Tel. +39019230271

www.cimafoundation.org