

WORLD METEOROLOGICAL ORGANIZATION

**JOINT MEETING OF
CBS EXPERT TEAM ON SURFACE-BASED
REMOTELY-SENSED OBSERVATIONS
(First Session)**

AND

**CIMO EXPERT TEAM ON REMOTE SENSING
UPPER-AIR TECHNOLOGY AND TECHNIQUES
(Second Session)**

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**EVALUATION OF THE SURVEY ON WEATHER RADARS AND PREPARATION OF A
COMPREHENSIVE WEB-BASED WEATHER RADAR DATABASE
(SUBMITTED BY OGUZHAN SIRECI)**

SUMMARY AND PURPOSE OF DOCUMENT

THE DOCUMENT PRESENTS QUESTIONNAIRE AND SPREAD SHEET PREPARED FOR ESTABLISHING A COMPREHENSIVE WEB-BASED WEATHER RADAR DATABASE AND EVALUATION OF FIRST RESPONSES.

ACTION PROPOSED

THE MEETING IS INVITED TO REVIEW THE FIRST RESULTS OF THE QUESTIONNAIRE ON WEATHER RADARS, TO DISCUSS ACTIONS REQUIRED TO ESTABLISH A WEB-BASED DATABASE AND TO DEFINE THE STRUCTURE OF THIS WEBPAGE.

1. Introduction

It has been already proven that, Doppler Weather Radar is an essential precipitation observing system in meteorology for very large scale areas. They have been and will continue to be a very important meteorological tool in severe weather warnings, precipitation estimation and its spatial distribution, air traffic management, disaster management, numerical weather prediction (verification and data assimilation), agriculture, hydrological, weather modification and climate applications.

Radar networks have developed in many countries and often have competing requirements resulting in multiple networks created by different internal agencies and not just NHMS's.

The fourteenth session of the Commission for Instruments and Methods of Observation (CIMO) requested the CIMO Expert Team on Remote-Sensing Upper-Air Technology and Techniques to establish a fully comprehensive database of the global use of weather radars.

Several reasons for establishing this database:

- Presenting a comprehensive web-based database for radar network planning information and resource allocation for all members
- The international exchange of radar data
- Radar information to protect radio-frequency spectrum allocation

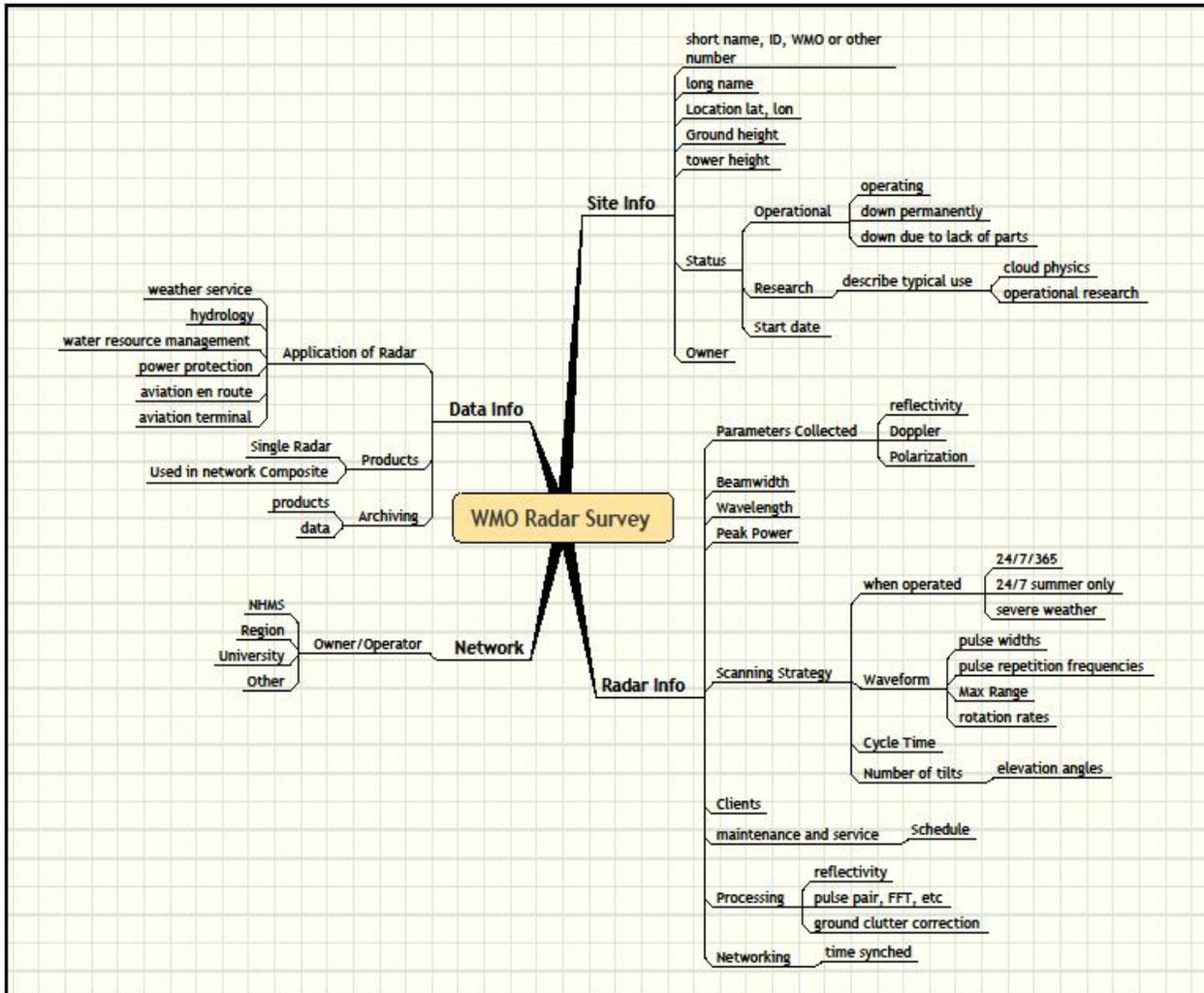
2. Overview of questionnaire

The survey has four main sections on the following themes:

- a. Radar site(s) information
- b. Radar hardware characteristics
- c. Owner information
- d. Data, products and applications

“**Questionnaire on Weather Radars**” is placed in **Annex I** and “**Spreadsheet**” (excel table) is placed in **Annex II** of this document.

Questionnaire content Diagram



3. Replies

Totally 65 countries have been replied the questionnaire. 11 countries including Bosnia Herzegovina, Chile, Egypt, Kazakhstan, Kyrgyzstan, Mauritius, Monaco, Seychelles, Sudan, Uruguay, and Zambia informed that they are not operating a weather radar. 7 countries including Algeria, Argentina, Botswana, China, Korea, Malaysia and Russia replied questionnaire due to they are operating weather radars, but their filled spread sheet haven't reached. There is no information regarding with the number and type of the radars operated by this countries for this reason. Totally 547 weather radar information have been sent by remaining 47 countries. The following table contains the list of this countries.

Country	Radar #	Country	Radar #	Country	Radar #
Austria	5	Hungary	3	Singapore	1
Azerbaijan	2	Indonesia	19	Slovakia	2
Bangladesh	5	Iran	5	Slovenia	1
Belarus	3	Israel	1	South Africa	24
Belgium	2	Italy	22	Spain	15
Belize	1	Japan	29	Sweden	12
Brazil	2	Jordan	1	Thailand	26
Bulgaria	3	Latvia	1	Trinidad& Tobago	1
Canada	31	Myanmar	1	Tunisia	1
Croatia	2	Netherlands	2	Turkey	10
Cyprus	1	New Zealand	6	Ukraine	7
Estonia	2	Norway	8	United Arab Emirates	6
Finland	8	Pakistan	7	United Kingdom	16
France	24	Panama	1	USA	159
Germany	16	Poland	8	Uzbekistan	1
Hong Kong	3	Serbia	14		

Many countries except of these 65 countries have not replied the questionnaire yet. These countries include Australia, Denmark, India, Greece, Portugal, Saudi Arabia an so on. It is expected that after completeing missing information, this number will be doubled. Especially, impact of the data which will be gathered from China, Australia, Russia, India, Korea and airports of USA can be expected to affect the numbers fairly.

4. Evaluation

Replies from members have encouraged us to continue establishing a comprehensive database for weather radars. Even though there are some missing data in returned questionnaires, there is a positive tendency for collaboration on weather radars for several reasons.

Firstly, countries need to exchange radar data like other meteorological data with other countries for improving the capabilities for the services provided. Main areas of utilities from radars in developing countries are nowcasting, warning and surveillance. But some advanced usages like input into Numerical Weather Prediction (NWP) models may be one of the main usage in developed countries in future.

Secondly, weather radars are quite sophisticated and expensive observing systems. They are subject to continuous improvement with new technologies and planning radar network is a crucial issue. However, resources of countries for such expensive operations are limited. This kind of surveys and establishing a database would be a reference as a starting point, lead to establish some standards on weather radars and steer manufacturers to some goals.

Another important point based on the gathered data from the replies to questionnaire is training. It can be seen that there is a huge gap between countries in this area.

The experience of developed countries would be transferred to other countries by means of seminars, workshops and training activities organized by WMO. Some documents can be shared in web based database.

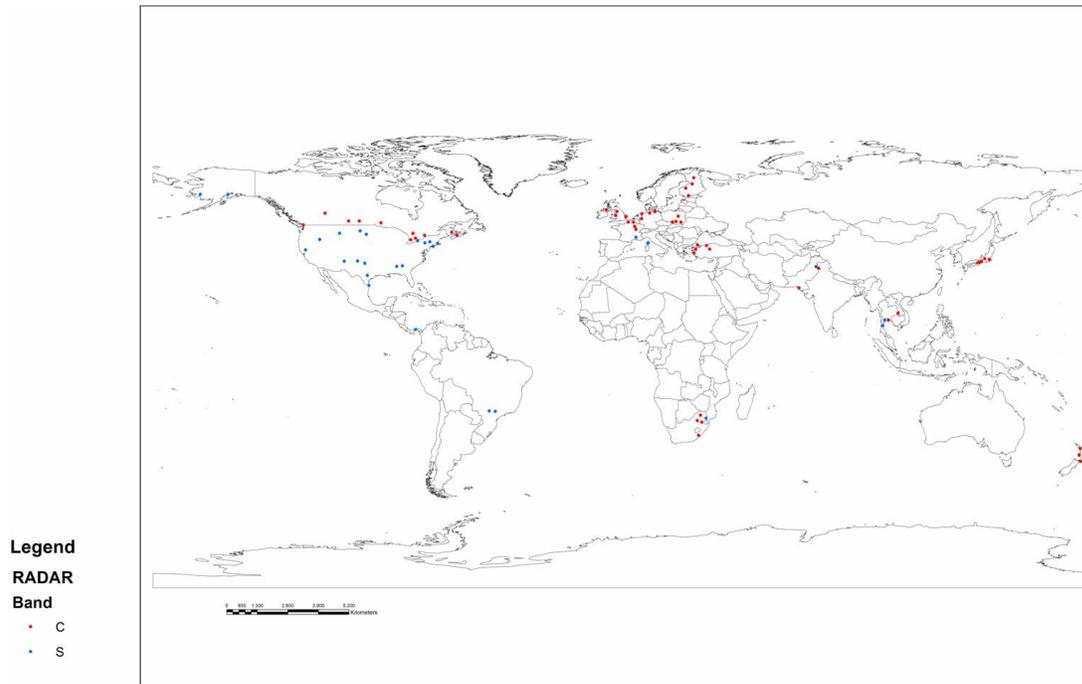
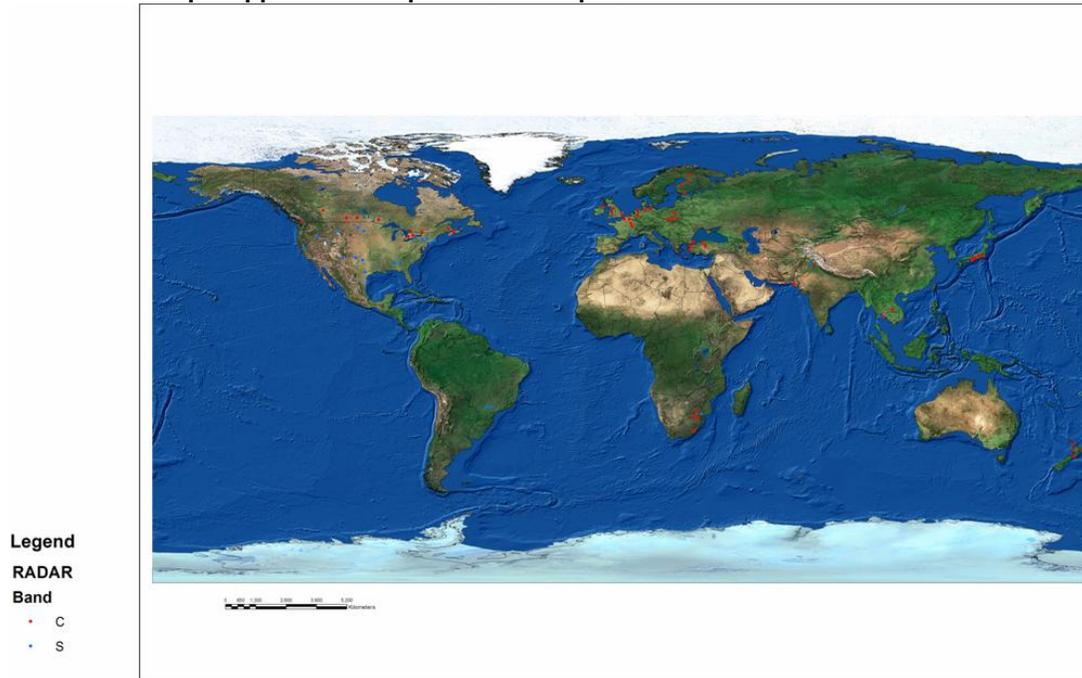
For instance, in USA in the 1990s, it took 7 years and \$8,000 per student to reach NWS forecasters with Doppler radar training. Using web-based distance learning technologies to deliver the training (and low-cost weather event simulators at every office to build forecaster expertise), they can now reach every forecaster in less than one year at a cost of about \$400 per student.

Improving *data quality of operational radars* should be taken into consideration also. This can be achieved by widespreading applications of correction algorithms like ground clutter filtering, beam blockage correction, attenuation correction, Z-R relation studies, calibration methods and maintenance studies.

5. Gap/Next Steps

- Another point is to spread the questionnaire to the operator's of weather radars except of NHMSs (like universities, airports, tv stations). Methods for collecting the required data from these operators should be developed.
- Spreading the questionnaire in WMO courses is another option to keep the data up-to-date.
- Gathering filled questionnaires or tables from both the countries have not responded the questionnaire and the countries replied the questionnaire but not completed spread sheet.
- The study could be divided into phases like gathering data, establishing webpage, improving content of webpage.
- Methods of gathering data continuously should be developed to keep the database up-to-date
- Web page design
 - ✓ it might be necessary to study together with WMO's web designers to prepare a website that will present gathered data according to the categories.
 - ✓ Service purchase for website design is another option.
 - ✓ Collected data can be put together in excel tables according to some categories (for example band) for web database. If possible this data can be inserted to a GIS software (like Arc GIS) to get visual maps of distribution of these categories.
 - ✓ Excel charts which are present result of the questionnaire can be used in web site as well.
 - ✓ During webpage design similar studies can be examined like European Radar Network (EUMETNET OPERA).
 - ✓ Web-based GIS Softwares can be used for publishing radar database.

Sample application output based on questionnaire data





WORLD METEOROLOGICAL ORGANIZATION
Commission for Instruments and Methods of Observation
CIMO-OPAG on Upper-air Observation Technologies
Remote Sensing Upper-Air Technology and Techniques Expert Team



QUESTIONNAIRE

On

WEATHER RADARS

The several objectives for this survey. Primarily, it is to assess the global state of weather radars. Weather radars have traditionally been used for local or regional applications but with long term climate studies, use of radar for validation of high resolution Numerical Weather Prediction, use in assimilation into NWP models and distributed hydrological models, cross-border data exchange, their use and the quality of the radar data is now a global resource. The purpose of the survey is to begin to assess the availability, the uses and the quality of the radar data and the practices of radar maintenance and support.

The survey will also help in the global protection of radio-frequencies used by weather radar. The information requested in the spread sheet will help demonstrate the widespread use of weather radar and the technical specification. Even partial information would be useful.

This is an important time in weather radar and we appreciate the time to fill out the survey. It should not take long to fill out.

1. Member

1.1 Institute/Organisation:

1.2 Do you use weather radar systems or do you plan to apply such systems?

Yes..... No.....

(If your answer is Yes, you are invited to answer following questions)

1.3 How long has your organization been operating Radar:

2. Please indicate main requirements of your organization of your radars? (Please Specify

Below, e.g., severe weather warnings, hydrology, weather modification, NWP, etc)

3. Have you hired Consultancy Service regarding radar? Yes No

If you checked yes, what kind of Consultancy Service did you hire?

(Please Specify Below)

4. The main criteria considered for the site selection for radars (select only one criteria)

- Radar coverage area.....
- Radar type.....
- Radar utilization type (e.g. occurrence of meteorological phenomena to be monitored).....
- Infrastructure (Power, Access road, communication, etc.).....
- Other.....

(Please List)

5. The communication type for data transmission between remote radars and the operating centre

- Satellite.....
- Terrestrial line (Leased line/Dial-up).....
- Radio link.....
- Other.....

(Please List)

5.1. Communication data rates (e.g. 128 kbps, etc.)?

5.2. Any back-up method available for the communication?

Yes.....

(Please write down the type)

No.....

6. Which method is being used for data quality checking that is done in the signal or data processor? Please Specify:

6.1. What type of correction algorithms improving data quality do you have in your system?

Ground Clutter Filtering

Beam blockage correction.....

Attenuation correction.....

Other.....

6.2. What is the average number of rain gauges for each radar?

6.3. Do you use distrometer for data comparison? If your answer is yes, how many have been installed?

7. What is the frequency of Preventive Maintenance for the main parts of the radars?

7.1 Who carries out the maintenance of your radars after warranty period?

Manufacturer.....

Local Maintenance Company.....

Owner.....

7.2 What are the main problems faced by your radar engineers in operating radars and solution methods? (Mechanical, lightning, electronically, communication, etc)

7.3. Have you ever upgraded or are you planning to upgrade your radars? If you upgraded, Could you please give information about the upgrade process.

7.4. Which countermeasures have been taken for lightning?

7.5. Do you carry out any calibration on your radar(s)?

Yes.....

No.....

7.6. If answer to above question is Yes, please specify which calibration and how frequently you carry.

8. What types of training have been carried out for operating radars? Do you collaborate with other countries or manufacturers?

8.1 Do you have any recommendation about “training” of radar engineers and operators?

8.2 The mission, the education level and the number of the staff working on radar related works.

Mission

Education

Number

9. Operation procedures

- Only during normal daily working hours.....
- 24-hour a day.....
- Changes depending on weather conditions.....
- Only for extreme weather conditions.....
- Other.....

(Please list)

10. Prioritize utilization of weather radars in your Organization (if more than one, please mark with priority of each item as 1, 2, 3 ...)

- Large scale weather monitoring.....
- Hurricane or tornado warning.....
- Now casting.....
- Input to the numerical model.....
- Flood warning.....
- Wind warning.....
- Hail warning.....
- Other warnings for general public.....
- Air terminal surveillance.....

- En route surveillance for general aviation.....
- Road and other transports.....
- Rural quantitative hydrology.....
- Urban quantitative hydrology.....
- Research.....
- Other.....

(Please list)

10.1 Monitoring of the radar (time basis)

- Automatic/continuous monitoring.....
- Daily monitoring.....
- Weekly monitoring.....
- Monthly monitoring.....
- Other.....

(Please list)

10.2 The number of remote terminals used (by the remote users) (if more than one, please mark with priority of each item as 1, 2, 3 ...)

- Disaster Management.....
- Local Authorities.....
- Hydrological Works.....
- Aviation.....
- Agriculture.....
- Construction.....
- Navigation.....
- Military.....
- Research Institutes.....
- Universities.....

- Visual Press.....
- Written Press.....
- Other.....

(Please list)

10.3 Advanced use of radar data

- As an input to the numerical model.....
- As an input to your nowcasting model.....
- As an input to hydrological model.....
- As an input to hydrometeor classification method.....
- Other.....

(Please list)

10.4 Operating system running on your radar servers?

- UNIX.....
- Linux.....
- Windows.....
- Other.....

(Please list)

10.5 What is the name of the radar control and data acquisition software?

10.6 What is the name of the product generation software?

10.7 How is radar products displayed?

10.8 The user interface of your radar control/data acquisition software

- GUI.....

- Command based.....

- Other

(Please list)

10.9 The method used for controlling the radar network, task schedule and product schedule.

- Central.....

- Separate (from the radar location).....

- Other.....

(Please list)

10.10. What is the assumed radar-coverage area of your country? km²

10.11. What is the approximate percentage of radar-coverage area to your country's area? %

10.12. Number of radar systems integrated in network?

10.13. How many kind of products (approximately) are generating in operating centre?

10.14. Is there any system back-up?

- Yes

(Please write down the system that has back up)

- No

11. Please indicate if you exchange/disseminate radar data with other countries and/or organizations?

Exchange/Dissemination Name of the Country/Organization Type of Data

11.1. The telecommunication method used for international data exchange/dissemination.

- Internet
- GTS
- Teletype.....
- Telephone.....
- Radio telegraph.....
- Radio teletype.....
- Microwave.....
- Satellite.....
- Other.....

(Please list)

11.2. What is your exchange format (s) – please list?

11.3. The data type archived

- Raw.....
- Product.....

(Please list the product types)

- Other.....

(Please list)

11.4. Raw Data Archive strategy

- None.....
- Continuously.....
- Intermittent.....
- Depending on user requests.....

- Depending on research interest.....
- Other.....

(Please list)

11.5. Product Archive strategy

- None.....
- Continuously.....
- Intermittent.....
- Depending on user requests.....
- Depending on research interest.....
- Other.....

(Please list)

11.6. The archiving media type and capacity (for each one/total) (please write in details as dds-3 24 GB, 500 GB disk)

- Mass On-Line Storage.....
- Tape.....
- Disk.....
- CD/DVD.....
- Database.....
- Other.....

(Please list)

11.7. If you are using a database, your archived radar data stored in

- Flat Files
- A proprietary database used for radar data only.....
- A common database used for all meteorological data.....
- Other.....

(Please list)

11.8. Is your archiving software

- Included in your radar application software.....
- A third party's software.....
- Your own software/script developed for that purpose.....
- Other.....

(Please list)

11.9. Parameters recorded and/or archived

- Total reflectivity.....
- Corrected reflectivity.....
- Radial velocity.....
- Spectral width.....
- Zdr.....
- RhoHV.....
- Other.....

(Please list)

11.10. Data formats supported in radar data production

- Grib.....
- Bufr.....
- Hdf (4/5)
- Netcdf.....
- Jpg.....
- Bmp.....
- Gif.....
- Other.....

(Please list)

12. **Please indicate number of data bits for archiving.**

13. **Can you describe your synergetic usage of radars with other instruments and data sources (satellite images, lightning detector etc.)?**

14. **Do you have mobile weather radar? If you have, please specify in which cases do you use it?**

15. **Please write your opinion, experiences and recommendation on weather radar operations.**

16. **Please, write your opinion on quality of this questionnaire.**

a. Please, grade this questionnaire respect to its quality.

1 2 3 4 5

(Quality increases from 1 to 5. For example if you think, this questionnaire is very good, choose 5 or if you think it is very bad, choose 1)

17.

Title

First Name

Family Name

Institution :

Position :

Address :

Telephone :

Telefax :

E-mail :

URL / http :

18. Please nominate an expert person for further contact:

Title

First Name

Family Name

Institution :

Position :

Address :

Telephone :

Telefax :

E-mail :

URL / http :

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Pulse width	PRF	Signal processor	TX Type / Power	RX Type	Polarization	Manufacturer	Lowest Angle	Highest Angle	Cycle Time
Range (μ Sec)	Range (Hz)	(DRX, Aspen, RVP etc)	(Magnetron, Klystron etc.)	(Analog or Digital)	(Single or Dual)		deg	deg	minutes

MDS	Z-R (summer)	Z-R (winter)	Z-R (others)
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dBZ/range of a	b	a	b
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