Results of an OPERA metadata survey

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1 Introduction

The NWP community is currently putting much effort in the assimilation of radar data (particularly radial velocities), and progress of the OPERA4 work package on quality information in polar data (OD1) depends on the availability of information on clutter identification/filtering. It is therefore very important to obtain information on how much information is provided by the national centers for these applications, and if some information is not provided, when this can be changed. For this purpose a web-based survey was conducted among the OPERA delegates using Webropol. The entire survey is given in Appendix A. The survey was sent out on April 4, 2013. In order to make optimal use of weather radar data that are sent to the OPERA Data Center (ODC), it is important that metadata as well as quality information are available from the originating centers. For assimilation of radial velocities in (short-range) Numerical Weather Prediction (NWP) models information on the Nyquist interval is vital. Questions 1 through 5 of the survey (see Appendix A) are related to this. For further processing at ODC (e.g. adding quality flags or making composites) information on which pixels have been removed by clutter identification schemes and/or how much filtering has been applied at the originating centers is essential. Currently

Figure 1: Map of Europe (including OPERA radar locations) with the countries that have responded to the query in gray.

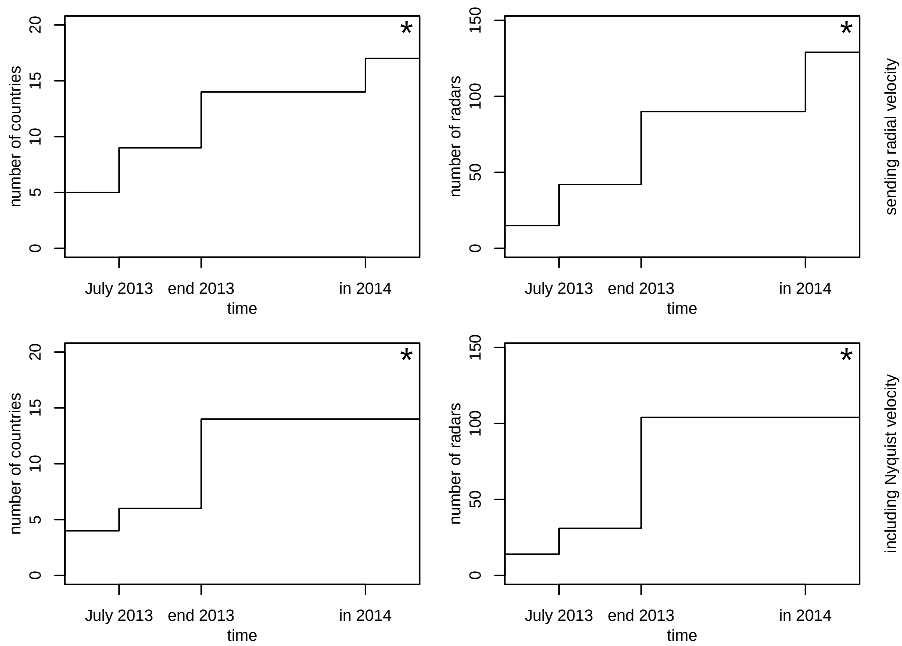

Figure 2: Time evolution of number of countries (left) and number of radars (right) sending radial velocity data (top) and using ODIM version 2.1 and including Nyquist velocity metadata (bottom). The stars at the top-right corners of the graphs indicate the total number of countries (left) and radars (right).

the representation of pixels identified as ground clutter is the same as that of pixels with returns below the noise level ("UNDETECT"). This leads to an ambiguity of the meaning of "UNDETECT", which could either mean that there is no precipitation or the there is no information because of (severe) ground clutter. Questions 6 and 7 of the survey (see Appendix A) are related to this.

This document describes the survey results. Answers to the short questions (questions 1, 2, 3, 4, 6, and 7) can be found in Appendix B, and descriptions of scan schedules of different countries are given in Appendix C.

2 Survey results

On June 14, 2013, twenty out of 27 countries (74%) have responded to the survey. These countries are: France, The Netherlands, Czech Republic, Finland, Denmark, Austria, Estonia, Croatia, Sweden, Ireland, Belgium, United Kingdom, Romania, Norway, Slovenia, Spain, Greece, Switzerland, Slovakia, and Germany (see Figure 1). The survey results are discussed in two groups: one related to radial velocity (Section 2.1) and one related to quality information (Section 2.2).

2.1 Radial velocity

Figure 2 shows the time evolution of the number of countries sending radial velocity data to ODC, and the number of countries using ODIM version 2.1 and providing the Nyquist interval in the metadata. Also shown is the time evolution of the number of radars, based on the same survey results and the number of radars in each country. It is clear that the majority of the countries will send radial velocity data to ODC by the end of 2013. The majority of the remaining countries (and radars) will start sending these

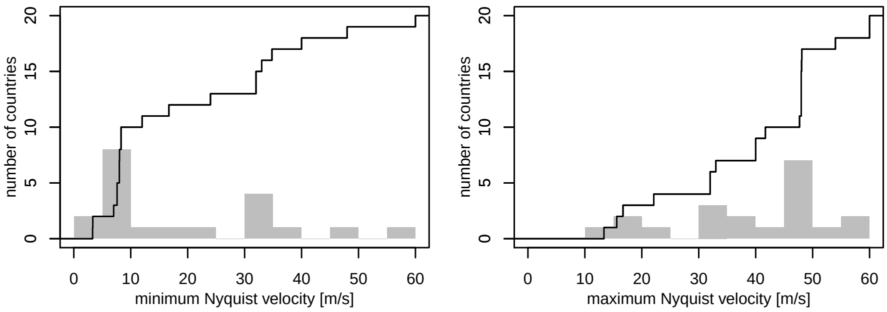

Figure 3: Distributions of minimum (left) and maximum (right) Nyquist velocities over countries. Grey bars show the distribution in classes of 5 m/s, and the black lines show the cumulative distribution.

data in 2014. The relatively large increase in the number of radars that will start sending radial velocity data in 2014 is because the corresponding countries are large (UK, Norway, and Spain; see Appendix B) and hence operate a large number of radars. Most countries will include information about the Nyquist interval at the same time as or shortly after starting sending radial velocities to ODC (see Appendix B). In case this metadata is not included (as is the case for Ireland, Spain, and Greece), radial velocity data are only useful if information on the Nyquist interval is available in another manner (e.g. through static metadata).

Figure 3 shows the distribution of minimum and maximum Nyquist velocities. For the minimum Nyquist velocities it should be noted that some of these are for elevation scans specifically designed for reflectivity measurement (such as in The Netherlands, Denmark, and Norway; see Appendix B), whereas others are based on scans specifically designed for velocity measurement (e.g. Belgium; see Appendix B). It is clear that the distribution is very wide for both the minimum and maximum Nyquist velocities. Furthermore, it is clear from Appendix C that the variation of Nyquist velocities with elevation is very heterogeneous across Europe.

2.2 Quality information

Figure 4 shows the time evolution of the number of countries that can change the representation of pixels affected by a clutter identification scheme or filter from “UNDETECT” to “NODATA”, and the time evolution of the number of countries that can provide uncorrected reflectivity data. Also shown are the time evolutions of the corresponding number of radars. It is clear from these graphs that not many countries can easily change the representation of pixels affected by clutter identification schemes or filters. Only 5 out of 20 countries have explicitly indicated that they can actually do this (before 2016). The number of countries that can provide uncorrected reflectivity data quickly becomes larger than those that can make this change. In fact, the only country that can make this change before starting sending uncorrected reflectivity data to ODC is the United Kingdom (see Appendix B). One of the reasons why this is so difficult to change is that it often requires changes in both the radar signal processor and the radar product processor (and of course in the communication between them). Both Belgium (personal communication) and Ireland (see Appendix B) have indicated that this change depends on whether SELEX can provide these updates.

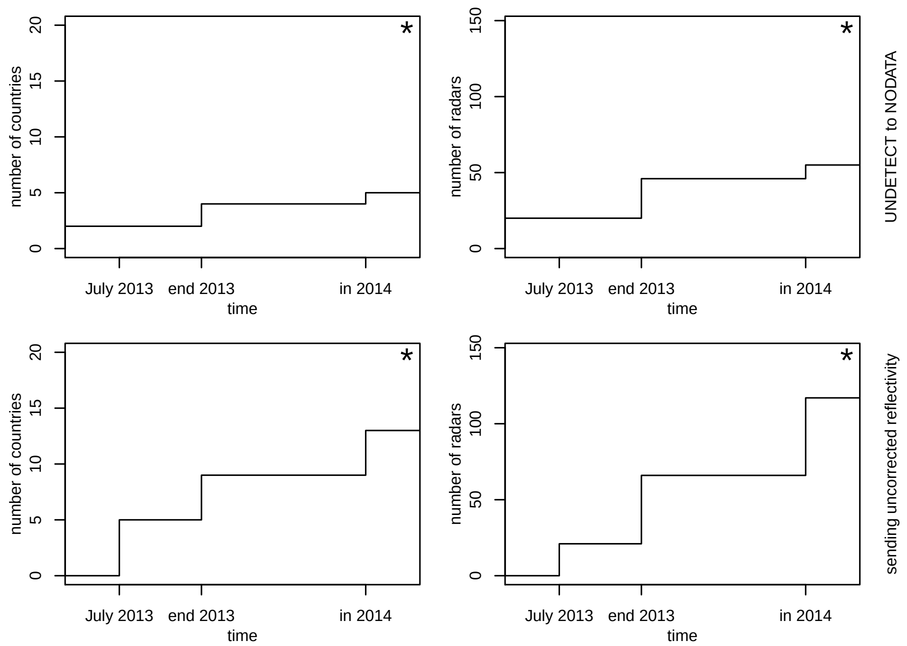

Figure 4: Time evolution of number of countries (left) and number of radars (right) representing clutter filtered/identified pixels as "NODATA" instead of "UNDETECT" (top) and sending uncorrected reflectivity data (bottom). The stars at the top-right corners of the graphs indicate the total number of countries (left) and radars (right).

3 Conclusions

Most countries will be able to start sending radial velocity data to ODC, and to include the Nyquist interval in the metadata (using ODIM version 2.1) relatively soon. This is an important achievement as most NWP consortia are now ready to start assimilating radial velocity data. It is very clear from the survey that there is a wide variety of practices regarding dealiasing (none, dual-PRF, triple-PRT) across Europe. The result is a wide spread of Nyquist velocities. On the longer term this may call for post-processing routines at ODC that carry out additional dealiasing. However, this should be thoroughly discussed with the NWP community.

Only 5 out of 20 countries will be able to change the representation of pixels affected by clutter identification schemes or clutter filters from "UNDETECT" to "NODATA". In contrast to this, most countries will be able to provide uncorrected reflectivity data in the relatively near future. This leads to the conclusion that it may be better to extract information from the difference between uncorrected and corrected reflectivity values about the amount of filtering that was applied than to wait for countries to have implemented a change in the representation of pixels affected by clutter identification schemes or filters. Of course the ideal situation would be to have quality flags sent with the data to ODC that indicate (among others) if a clutter identification scheme of filter was used. However, the desired quality flags need to be identified first, and a suitable representation of these flags in ODIM BUFR and ODIM HDF5 should be discussed.

A Metadata survey

The OPERA metadata survey was distributed to OPERA ET members using Webropol. The questions of this survey were the following:

1. When can you start sending radial velocity data to ODC?
   - we already do
   - by July 2013
   - by the end of 2013
   - in 2014
   - in 2015
   - later or not at all
   - we do not know yet
2. When can you start using version 2.1 or higher of the OPERA Data Information Model (ODIM) and specifying the Nyquist interval (NI)?
   - we already do
   - by July 2013
   - by the end of 2013
   - in 2014
   - in 2015
   - later or not at all
   - we do not know yet
3. What is the Nyquist velocity of the lowest elevation you're sending to ODC?
4. What is the largest Nyquist velocity in your scan schedule?
5. Please give a brief description (if possible including a reference to a more detailed description) of your scan strategy (PRF, Nyquist velocities, maximum range, Doppler filtering/identification applied, ...).
6. When can you change, in the reflectivity PPIs that you send to ODC, the representation of pixels identified as ground clutter from "UNDETECT" (current situation) to "NODATA"?
   - we already have
   - by July 2013
   - by the end of 2013
   - in 2014
   - in 2015
   - later or not at all
   - we do not know yet
7. When can you start sending reflectivity PPIs uncorrected for ground clutter and/or RLAN interference (i.e. exactly the same data that you send right now except that ground clutter and/or RLAN interference filtering/identification is not applied) to ODC, in addition to the corrected reflectivity PPIs?
   - we already do

- by July 2013
- by the end of 2013
- in 2014
- in 2015
- later or not at all
- we do not know yet

B Answers to short questions

Country	Q1	Q2	Q3	Q4	Q6	Q7
France	end 2013	end 2013	60 m/s	60 m/s	end 2013	end 2013
The Netherlands	now	end 2013	3.3 m/s[1]	48.0 m/s	end 2013	July 2013
Czech Republic	end 2013	end 2013	7.6 m/s	15.6 m/s	don't know	don't know
Finland	now	now	7.6 m/s	48.1 m/s	don't know	July 2013
Denmark	July 2013	end 2013	8.3 m/s[2]	48 m/s	don't know	don't know
Austria	don't know	don't know	8 m/s[3]	32 m/s	don't know	don't know
Estonia	end 2013	end 2013	40 m/s	40 m/s	don't know	don't know
Croatia	now	now	16.7 m/s	16.7 m/s	don't know	end 2013
Sweden	July 2013	end 2013	24 m/s	48 m/s	later/never	in 2014
Ireland	now	don't know[4]	34.8 m/s[5]	47.7 m/s[5]	don't know	end 2013
Belgium	end 2013	now	32 m/s[6]	54 m/s[6]	don't know	don't know
UK	in 2014	July 2013	48 m/s	48 m/s	now	in 2014
Romania	don't know	don't know	33 m/s	33 m/s	don't know	don't know
Norway	in 2014	end 2013	7 m/s[7]	60 m/s[8]	in 2014	in 2014
Slovenia	now	now	8 m/s	40 m/s	don't know	July 2013
Spain	in 2014	don't know	3.34 m/s	48.06 m/s	don't know	in 2014
Greece	July 2013	don't know	12.0 m/s	22.1 m/s	don't know	July 2013
Switzerland	don't know	don't know	3.8 m/s	41.7 m/s	now	don't know
Slovakia	July 2013	July 2013	8.03 m/s[9]	13.35 m/s[10]	don't know	July 2013
Germany	end 2013	end 2013	32.0 m/s	32.0 m/s	later/never	end 2013

[1]This value is for the lowest elevation only (single PRF); lowest value for higher elevations is 24 m/s.
[2]This value is for the reflectivity scans.
[3]Austria does not send data to ODC.
[4]Implementation of ODIM 2.1, NODATA/UNDETECT is dependent on software updates from SELEX.
[5]Dublin: 34.8 m/s; Shannon: 47.7 m/s.
[6]Wideumont: 46 m/s, Zaventem: 32 m/s, Jabbeke: 54 m/s; single-PRF scans not considered.
[7]This value is for the reflectivity scans; it is 60 m/s for velocity scans.
[8]This value is for velocity scans; it is 16 m/s for reflectivity scans.
[9]Maly Javornik: 8.03 m/s; Kojsovska hola: 9.96 m/s.
[10]Maly Javornik: 8.03 m/s; Kojsovska hola: 13.35 m/s.

C Descriptions of scan strategies

The descriptions of the scan strategies in response to question 5 of the survey (see Appendix A) are given in this appendix.

C.1 Météo France (France)

All French operational radars (whatever their wavelength) provide simultaneously reflectivity and radial velocity up to 256 km for all elevation angles. The Nyquist velocity is always around 60 m/s. This is achieved by means of a triple-PRT Doppler transmission scheme. The drawback of the French triple-PRT scheme is that it leads to some 10–20% dealiasing error rate. Correction for those errors can be done by applying a moving median filter as a post-processing (though at the expense of a loss of spatial resolution). Ground-clutter filtering is not trivial with triple-PRT and is currently not applied on French radars.

C.2 KNMI (The Netherlands)

The table below gives information on the KNMI scan strategy. The clutter filter is a Doppler notch filter, and the clutter identification scheme is based on signal statistics within a measurement volume. More information can be found on `http://www.knmi.nl/~beekhuis/documents/publications/ERAD2008_0120_EA_PulseToProduct.pdf`

scan	elev. (deg)	PRF (Hz)	NI (m/s)	clutter
1	0.3	250	3.3	identification
2	0.4	450/600	24.0	filter
3	0.8	450/600	24.0	filter
4	1.1	450/600	24.0	filter
5	2.0	450/600	24.0	filter
6	3.0	600/800	32.0	filter
7	4.5	600/800	32.0	filter
8	6.0	750/1000	40.0	filter
9	8.0	750/1000	40.0	filter
10	10.0	900/1200	48.0	filter
11	12.0	900/1200	48.0	filter
12	15.0	900/1200	48.0	filter
13	20.0	900/1200	48.0	filter
14	25.0	900/1200	48.0	filter

C.3 Czech Hydrometeorological Institute (Czech Republic)

el. [deg]	PRF [Hz]	$v_{\max}$ [m/s]	$r_{\max}$ [km]	Doppler filter applied
0.1	576	7.6	0.0576	YES
0.5	576	7.6	0.288	YES
0.9	576	7.6	0.5184	YES
1.3	576	7.6	0.7488	YES
1.7	576	7.6	0.9792	YES
2.2	576	7.6	1.2672	YES
3.2	576	7.6	1.8432	YES
4.5	576	10.6	2.592	YES
6.3	576	10.6	3.6288	YES
8.7	576	15.6	5.0112	YES
13.7	576	15.6	7.8912	YES
21.6	576	15.6	12.4416	YES

C.4 FMI (Finland)

Saltikoff et al., 2010: Quality assurance in the FMI Doppler Weather Radar Network. Boreal Env. Res.

15: 579–594.
scanning schedule:

- **00-05 min:**
  - el 0.3, 0.7, 1.5, 3, 5, 9 deg, PRF 570, range 249.9 km, 7.6 m/s, gg filtering applied, dual-pol mode
  - el 2, 7, 11, 15, 25, 45 deg, dual PRF 1200/900 Hz, range 123.9 km, 48.1 m/s, gg filtering applied
- **05-10 min:**
  - el 0.3, 0.7, 1.5, 3, 5, 9 deg, PRF 570, range 249.9 km, 7.6 m/s, gg filtering applied, dual-pol mode
  - el 4, 2, 0.4 deg, dual PRF 1200/900 Hz, range 123.9 km, 48.1 m/s, gg filtering applied
- **10-15 min:**
  - el 0.3, 0.7, 1.5, 3, 5, 9 deg, PRF 570, range 249.9 km, 7.6 m/s, gg filtering applied, dual-pol mode
  - el 4, 2, 0.4 deg, dual PRF 1200/900 Hz, range 123.9 km, 48.1 m/s, gg filtering applied

C.5 DMI (Denmark)

We do interleaved velocity (dual PRF 1180 Hz, unfolding ratio=3) and reflectivity (single PRF=625 Hz). Scanning angles: 0.5, 0.7, 1.0, 1.5, 2.4, 4.8, 8.0, 13.0, 15.0

C.6 Austrocontrol (Austria)

`http://www.meteo.fr/cic/meetings/2012/ERAD/extended_abs/NET_166_ext_abs.pdf`

C.7 EMHI (Estonia)

Harku long-range scan PRF: 570 Hz
Harku short-range scan PRF: 1000/750 Hz
Sürgavere long- range scan PRF: 500 Hz
Sürgavere short-range scan PRF: 1000/750 Hz

Velocity data is available only for short-range scans. Nyquist velocity for both Sürgavere and Harku radars is the same: 40 m/s.

Maximum range for both Harku and Sürgavere radars long-range scan: 249.9 km.
Maximum range for both Harku and Sürgavere radars short-range scan: 129.9 km.

C.8 Meteo Office of Croatia (Croatia)

Volume scan with 15 minutes repeat time, 13 elevations from 0.5 to 26.5 degrees, PRF 620, no unfolding (staggered) PRF, Nyquist velocity 16.7 m/s, max range 240 km, Doppler filter 3. S band radar, antenna beam 2.1 degrees. Running on Vaisala-Sigmet IRIS software.

C.9 SMHI (Sweden)

- **VOL-A:**
  - Elevation angle: 0.5 deg
  - PRF: 450/600 Hz
  - Pulse duration: 2 microsec
  - Pulse length: 600 m
  - Radial resolution: 2 km
  - Maximum range: 240 km
  - Azimuthal resolution: 0.86 deg
  - Nyquist velocity: 24 m/s
  - Doppler filter: in-built (signal processor)
  - Update: Every 5 minutes
- **VOL-B:**
  - Elevation angle: 1.0, 1.5, 2.0 deg
  - PRF: 450/600 Hz
  - Pulse duration: 2 microsec
  - Pulse length: 600 m
  - Radial resolution: 2 km
  - Maximum range: 240 km
  - Azimuthal resolution: 0.86 deg
  - Nyquist velocity: 24 m/s
  - Doppler filter: in-built (signal processor)
  - Update: Every 15 minutes
- **VOL-C:**
  - Elevation angles: 2.5, 4, 8, 14, 24, 40 deg
  - PRF: 900/1200 Hz
  - Pulse duration: 0.5 microsec
  - Pulse length: 150 m
  - Radial resolution: 1 km
  - Maximum range: 120 km
  - Azimuthal resolution: 0.86 deg
  - Nyquist velocity: 48 m/s
  - Doppler filter: in-built (signal processor)
  - Update: Every 15 minutes"

C.10 Met Éireann (Ireland)

ieDUB: PRF 875/656 Nyquist: 34.8
ieSHA: PRF: 1200/900 Nyquist 47.7

10 elevations
max range 120 km

IIR Doppler filter, width 3.18 m/s

RLAN filter applied to lowest 4 elevations. Not possible to provide data without RLAN.

C.11 RMI (Belgium)

It is different for each of the three Belgian radars. Velocity data are collected from PPI/slices with dual PRF:
1153/864 for Wideumont
1200/800 for Zaventem
1000/800 for Jabbeke

Doppler filtering is applied for the three radars:
Time-domain filtering for Wideumont.
Frequency-domain (FFT) for Zaventem and Jabbeke.

C.12 Met Office (United Kingdom)

dual PRF 900/1200Hz up to 120km
No Doppler filtering at present - plans to introduce Doppler filter early 2014.

C.13 National Meteorological Administration (Romania)

NEXRAD VCP21 scan strategy

C.14 MET (Norway)

Until now we have run two separate scans, one optimized for dBZ and one optimized for reflectivity. We are about to change our scan setup, and the new scan will be a mix of elevations tuned for dBZ data and elevations tuned for velocity data. Details will be available at the next OPERA meeting.

C.15 Environment Agency of Slovenia (Slovenia)

horizontal polarization only

- **VOL_A** (elevations 1-8; 0.5 - 8.6°):
  - single PRF 600 Hz,
  - V_{Ny}=8.01 m/s,
  - max-range=249.9 km
- **VOL_B** (elevations 9-12; 11.5 - 28.4°):
  - dual PRF 1000/750 Hz,
  - V_{Ny}=40.05m/s,
  - max-range=124.9 km

C.16 AEMET (Spain)

Repeat cycle: 10 minutes

Five different tasks used operationally:

1. three elevations: from 0.5 to 2.3, 250 pps, 3.34 m/s, 240 km
2. five elevations: from 3.2 to 6.8, 250 pps, 3.34 m/s, 240 km
3. six elevations: from 7.7 to 13.4, 900/1200 pps, 48.1 m/s, 120 km
4. five elevations: from 15.0 to 25.0, 900/1200 pps, 48.1 m/s, 120 km
5. two elevations: 1.4 and 0.5, 900/1200 pps, 48.1 m/s, 120 km

C.17 Hellenic National Meteorological Service (Greece)

Two scans:

- **Short range:** 14 elevation angles (0.50, 1.00, 2.00, 3.00, 4.00, 5.00, 7.50, 9.00, 12.00, 16.00, 20.00, 24.00, 28.00, 32.00 degrees)
- **Long range:** 5 elevation angles (0.50, 1.00, 2.00, 3.00, 4.00, 5.00 degrees)

Short range scan:

Radar	Band	PRF (Hz)	V_{Ny} (m/s)	$r_{\max}$ (km)	Doppler filter
Astypalaia	C	553/830	22.1	175.0	FFT
Aktio	C	553/830	22.1	175.0	FFT
Xrysoupoli	C	466/700	18.7	175.1	Pulse-pair
Ymittos	C	900	12.0	150.0	FFT
Larissa	S	800	21.4	150.0	FFT
Thessaloniki	S	600	16.0	170.0	FFT
Andravida	C	900	12.0	150.0	FFT

C.18 MeteoSwiss (Switzerland)

#	rank	Elev. deg	Dmax km	RPM	time s	Step s	Elapsed s	PRF Hz	Samples 1/deg	Nyquist m/s	Hmax km
1	09	6.5	140	6	10	1.4	11.4	1000	27.8	13.8	18.0
2	07	4.5	146	6	10	1.4	22.8	1000	27.8	13.8	13.7
3	05	2.5	183	4	15	1.4	39.2	800	33.3	11.0	11.0
4	03	1	246	3	20	1.3	60.5	600	33.3	8.3	9.0
5	01	-0.2	246	3	20	4.2	84.7	600	33.3	8.3	3.8
6	19	35	30	6	10	2.5	97.2	1500	41.7	20.6	18.1
7	17	25	41	6	10	2.4	109.6	1500	41.7	20.6	18.3
8	15	16	62	6	10	2	121.6	1500	41.7	20.6	18.2
9	13	11	87	6	10	1.5	133.1	1500	41.7	20.6	18.0
10	11	8.5	111	6	10	1.3	144.4	1200	33.3	16.5	18.1
11	10	7.5	121	6	10	1.4	155.8	1200	33.3	16.5	17.6
12	08	5.5	162	4	15	1.4	172.2	900	37.5	12.4	18.0
13	06	3.5	162	4	15	1.4	188.6	900	37.5	12.4	12.4
14	04	1.6	162	4	15	1.3	204.9	900	37.5	12.4	7.1
15	02	0.4	210	3	20	4.5	229.4	700	38.9	9.6	5.1
16	20	40	27	6	10	2.5	241.9	1500	41.7	20.6	18.3
17	18	30	34	6	10	2.5	254.4	1500	41.7	20.6	18.0
18	16	20	50	6	10	2.2	266.6	1500	41.7	20.6	18.1
19	14	13	75	6	10	1.7	278.3	1500	41.7	20.6	18.1
20	12	9.5	100	6	10	1.6	289.9	1200	33.3	16.5	18.0

C.19 SHMI (Slovakia)

Maly Javornik:
Pulse width: 0.8 us
PRF: 600 Hz
Max. range: 240 km
Nyquist velocity: 8.03 m/s
Range step: 1000 m
Range samples: 1
Doppler filtering
Clutter filter bandwidth: 11 of 16
CCOR threshold: -3 dB
Noise threshold: 3 dB
Speckle filtering: Z, V, W
SQI filtering: V, W
SQI threshold: 46%

Scan	Elev. deg.	Azim. speed deg./s	Azim. samples
1	0.2	9	65
2	0.7	10	60
3	1.4	15	38
4	2.5	15	38
5	3.8	15	38
6	5.4	15	38
7	7.3	25	20
8	9.5	25	20
9	13.0	25	20
10	17.0	25	20
11	25.0	30	20

Kojsovska hola:
Pulse width: 0.8 us
Range step: 125 m
Range samples: 4
Doppler filtering
CCOR threshold: -20 dB
CCOR filtering: Z, V, W
SQI filtering: Z, V, W
Noise threshold: 1.5 dB
Azimuth synchronization: 1 deg.

Scan	Elev. deg.	Azim. speed deg./s	PRF Hz	Max. range km	Nyquist m/s	Clut. filt. bandw.	SQI thres. %
1	-0.5	10	746	200	9.96	6 of 7	33
2	0.0	10	746	200	9.96	3 of 7	17
3	0.5	10	746	200	9.96	3 of 7	17
4	1.0	10	746	200	9.96	3 of 7	17
5	1.5	15	746	200	9.96	2 of 7	17
6	2.5	20	746	200	9.96	2 of 7	17
7	4.0	20	746	200	9.96	2 of 7	17
8	6.0	22	900	165	12.02	2 of 7	17
9	10.0	25	900	101	12.02	2 of 7	17
10	20.0	25	1000	50	13.35	2 of 7	17

C.20 DWD (Germany)

5.5°	800/600Hz	32.0m/s	180km	Filter#5	SpeckleRemover	0.8μsec
4.5°	800/600Hz	32.0m/s	180km	Filter#5	SpeckleRemover	0.8μsec
3.5°	800/600Hz	32.0m/s	180km	Filter#5	SpeckleRemover	0.8μsec
2.5°	800/600Hz	32.0m/s	180km	Filter#5	SpeckleRemover	0.8μsec
1.5°	800/600Hz	32.0m/s	180km	Filter#5	SpeckleRemover	0.8μsec
0.5°	800/600Hz	32.0m/s	180km	Filter#5	SpeckleRemover	0.8μsec
8.0°	1200/800Hz	32.0m/s	125km	Filter#5	SpeckleRemover	0.8μsec
12.0°	2410Hz	32.0m/s	60km	Filter#5	SpeckleRemover	0.4μsec
17.0°	2410Hz	32.0m/s	60km	Filter#5	SpeckleRemover	0.4μsec
25.0°	2410Hz	32.0m/s	60km	Filter#5	SpeckleRemover	0.4μsec