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Very Long Distance Propagation in the 144 MHz Band

Part 2: Dx Opportunities in the European Sector

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Abstract. The analysis of the May 20, 2003 dx opening between the Canary Islands and central Europe motivates the assumption of double hop sporadic E radio propagation supported by inland lakes and major rivers. Extrapolating the results from May 20, 2003 to alternative regions in Europe, a series of *dx target maps* is obtained which allow radio amateurs identification of dx opportunities in double hop sporadic E.

1. Introduction

The analysis of the May 20, 2003 dx opening between the Canary Islands and central Europe motivates the assumption of double hop sporadic E propagation supported by inland lakes and major rivers [1]. This assumption results from the geographical position of the corresponding path centers which appear to correlate to the location of inland water areas, see Fig. 1.1. The path midpoints are calculated geometrically and are considered the radiowaves' footprint on the Earth's surface resulting from the zigzag propagation path between ground and the E layer of the ionosphere.

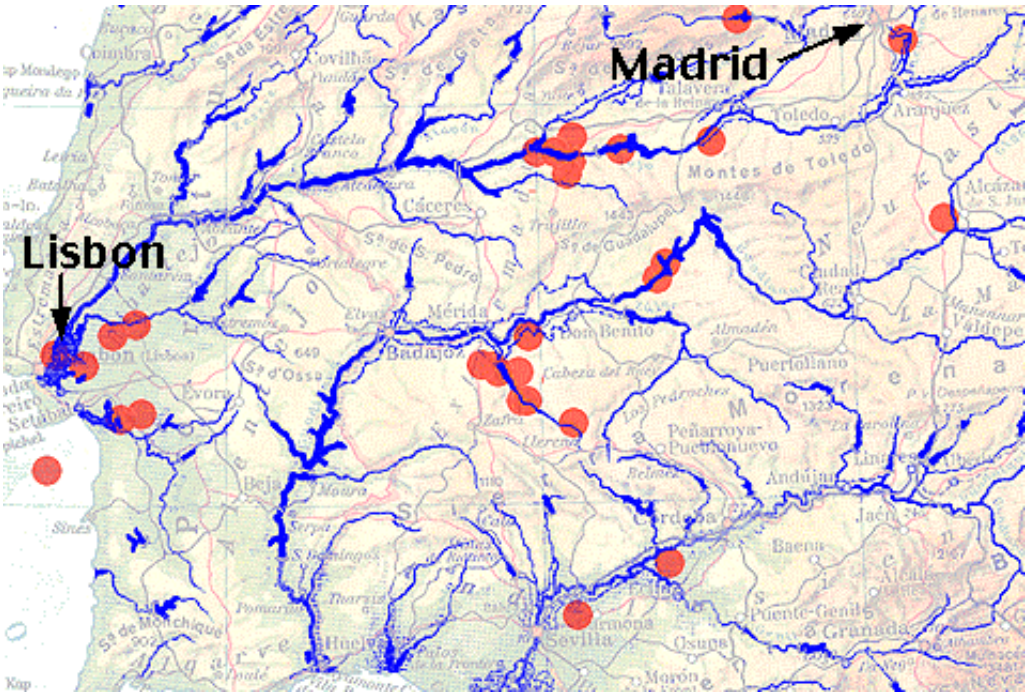

Fig. 1.1. In the May 20, 2003 dx opening, sixty percent of the radio paths between the Canary Isles and central Europe show midpoints which appear to correlate to the position of lakes and major rivers in Spain and Portugal [1].

However, there remain many open questions and, in consequence, alternative interpretations need to be considered too at this stage of investigation (see the detailed discussion in [1]):

- the findings in Fig. 1.1 may be considered accidental results, i.e. VHF double hop propagation supported by lakes and rivers does not exist at all
- the red circles in Fig. 1.1 may be interpreted geographical footprints of ionospheric skip propagation, i.e. radiowaves in grazing incidence were reflected by the surface of inland water expanses which finally extended single hop sporadic E into double hop propagation ("radioglint" in inland lakes and major rivers)
- alternatively, the red circles in Fig. 1.1 may be interpreted reflection points on the topside of tropospheric inversion layers, i.e. the radiowaves were actually not reflected at ground level but in a height of a few hundred meters above ground; those inversion layers are assumed local features above lakes, dams and major rivers enabled by high ground temperature, calm winds and by relatively low water surface temperature

Evidently, there is a need for further studies and investigations to clearify the possible importance of large inland water expanses in VHF double hop propagation. In this paper, the results in [1] are extrapolated to other European regions to identify potential dx opportunities in very long distance propagation and to encourage experimental studies by other radio amateurs.

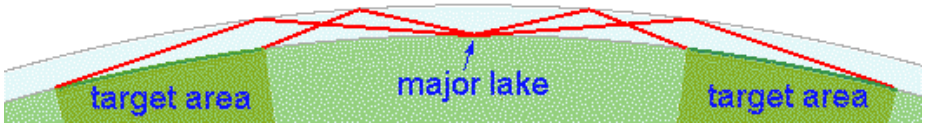

Fig. 1.2. Schematic view of the double hop analysis.

In the following, the geographical position of major lakes and rivers is assumed the path center in double hop sporadic E. Using the BeamFinder analysis software [2], dx target areas are calculated corresponding to a distance of 1.300 to 1.900 kilometers, i.e. we actually identify potential dx QSOs ranging from 2.600 to 3.800 kilometers with the corresponding lake in the path center, see Fig. 1.2. We finally obtain dx target maps similiar to Fig. 1.3 which allow radio amateurs identification of their individual dx opportunities in double hop sporadic E. First, the user identifies his or her personal geographical position with respect to the shown circles and radials. In the next step, the user identifies the corresponding dx target on the same circle but in opposite direction. Note that the geographical position of the corresponding sporadic E clouds is not shown in this example but will appear in the following dx target maps.

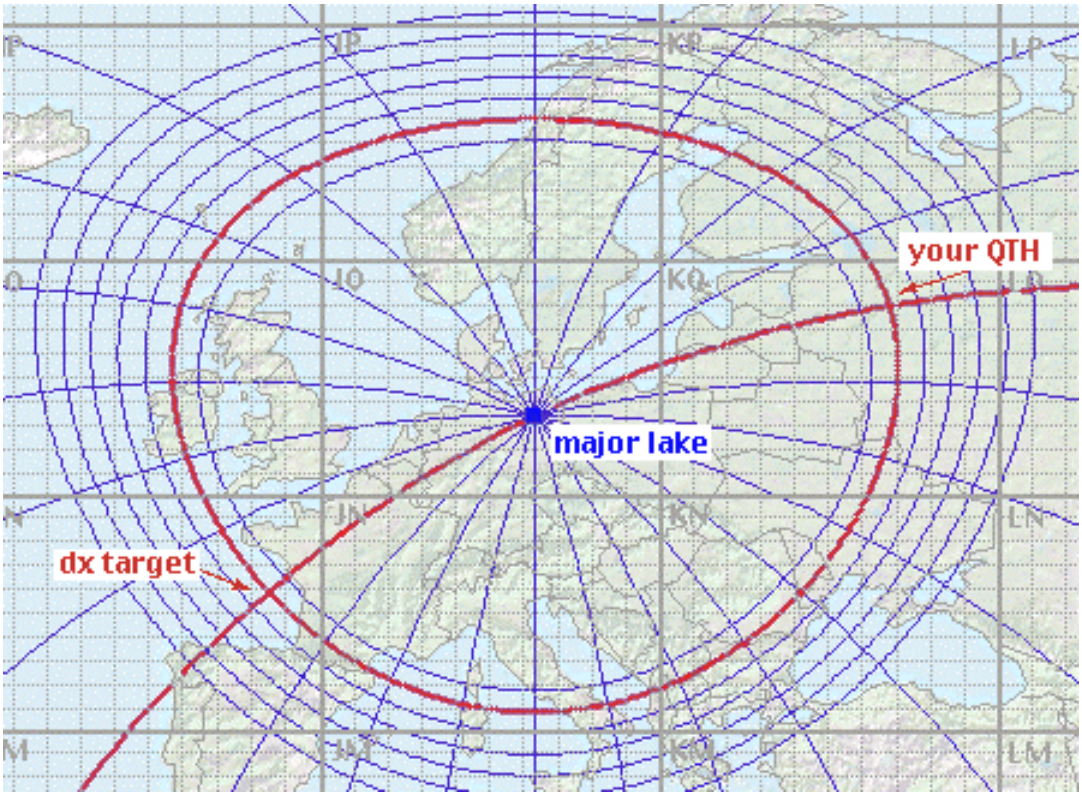

Fig. 1.3. Dx target map: the circles range from 1.300 to 1.900 kilometers in steps of 100 kilometers corresponding to dx QSOs of 2.600 to 3.800 kilometers with the lake at the path center. The radials denote multiples of 15° azimuth.

2. Dx target maps

2.1 The Lake Balaton in Hungary

Providing a surface of 591 square-kilometers, the Lake Balaton is considered an interesting candidate for supporting watersurface reflection in double hop propagation, see Fig. 2.1. Note, for example, possible dx QSOs between the southern tip of Norway and the island of Crete. The corresponding sporadic E clouds are found above east Germany and Macedonia (see the corresponding green areas). Udo, DK5YA, reports this type of dx event in 144 MHz when attending a 1444 MHz dxpedition to Crete in 1998 [5].

Alternative dx opportunities are identified between south-west France and the Crimea Peninsula, north-west Spain and the eastern Ukraine, north-western Russia and Tunisia and even, corresponding to very long dx QSOs, from Northern Ireland and the Isle of Man to Cyprus.

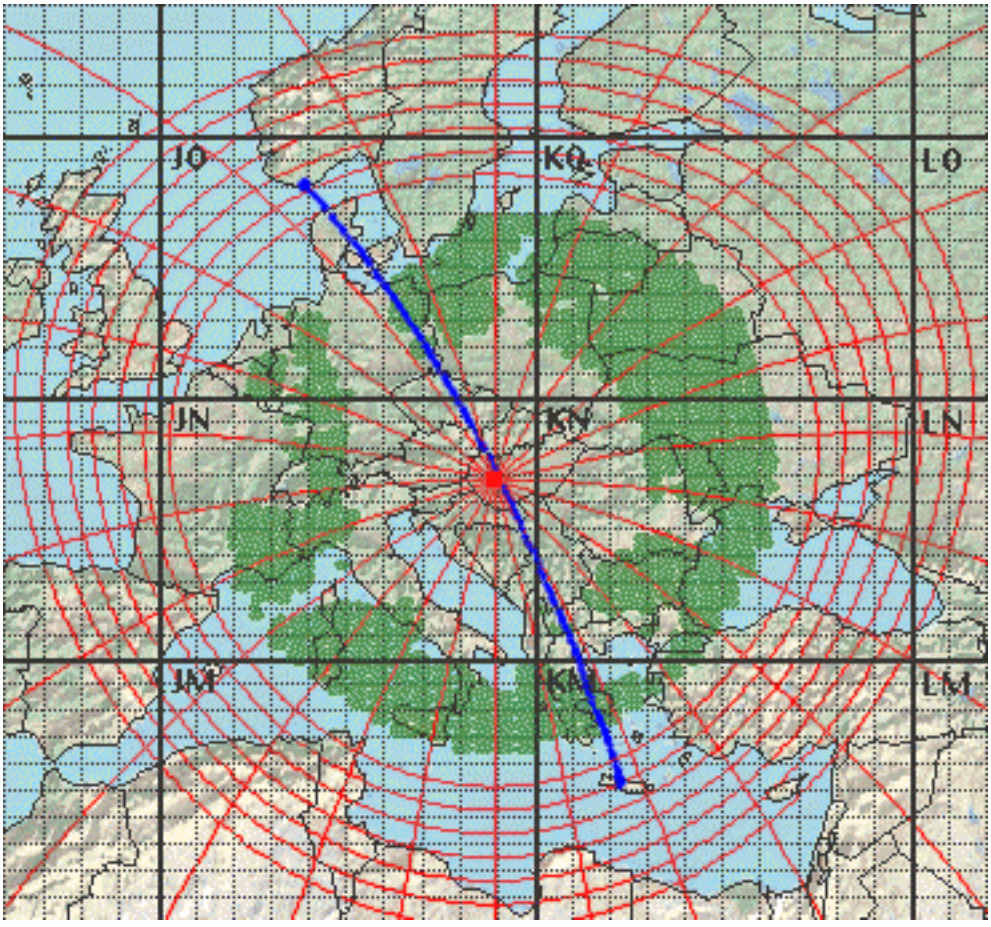

Fig. 2.1. Dx target map corresponding to the Lake Balaton, Hungary. The green area denotes the reflection points in the E layer of the ionosphere (105 km).

2.2 The Lake Constance (Germany, Switzerland, Austria)

In double hop sporadic E, elevation angles lower than, say, seven or five degree are required to support *maxium-usable-frequencies* around 144 MHz. The Lake Constance between Germany, Switzerland and Austria (Fig. 2.2) still represents a surface of 539 square-kilometers but is located close to the Alpes which might result in blanking of certain directions and azimuths. The author however speculates, that potential dx QSOs are available from north-western Spain and Portugal to the Ukraine. The path from Ireland to Greece appears very attractive but the Alps may already represent an obstacle in this example. The same is true when considering possible double hop QSOs from Scandinavia to northern Africa.

The Lake Geneva in Switzerland was considered as well but it appears that this lake can hardly play a major role in double hop sporadic E because of the adjacent mountains.

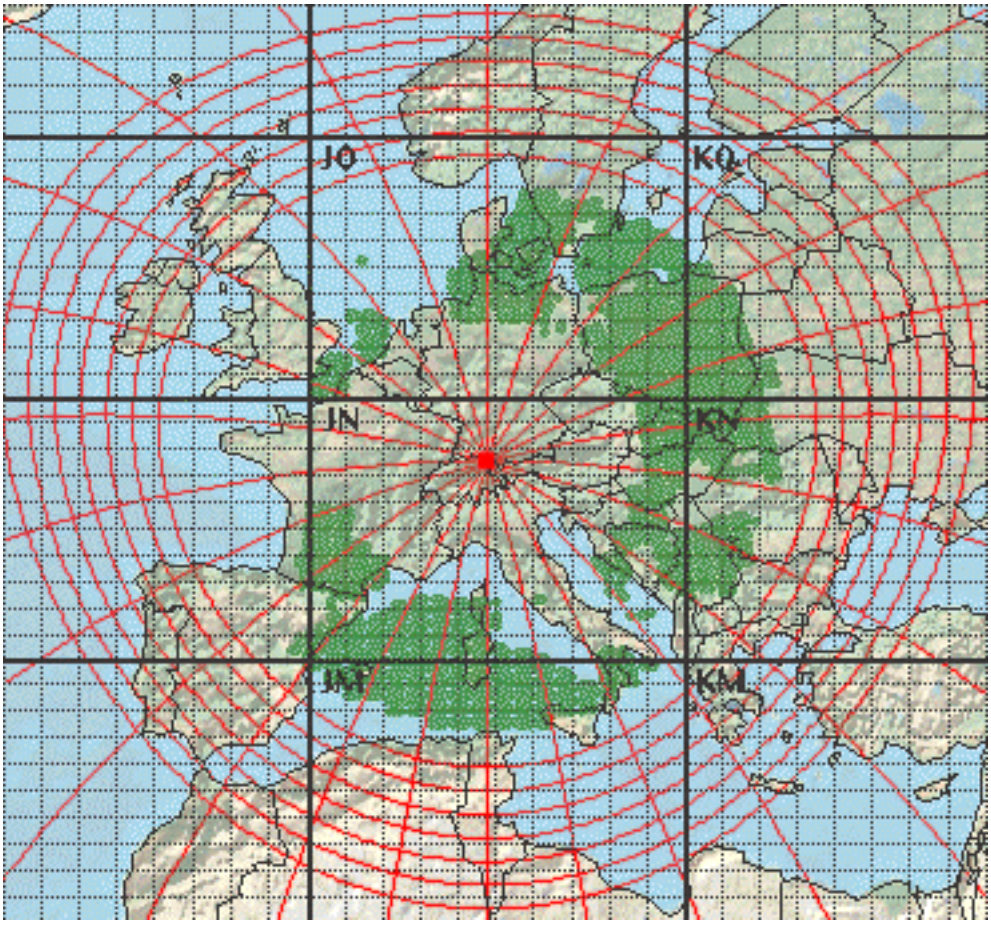

Fig. 2.2. Dx target map corresponding to the Lake Constance.

2.3 The river Dnieper in the Ukraine

About 200 kilometers south-east from Kiev, the river Dnieper extends into large water areas providing a very attractive scenario in double hop sporadic E, see Fig. 2.3. In fact, we may find dx opportunities, for example, from northern Germany and southern Denmark towards the Caspian Sea. Reinhard, DK1KO (JO53), reports this type of long distance sporadic E QSOs in 1989 (to UD6DE, LN40) and also in 1990 (to UD70DE, LN40) [3]. Apparently, there is indeed a quite

large number of radio amateurs in northern Germany and southern Denmark reporting similar QSOs to the city of Baku at the west coast of the Caspian Sea [4].

It is perhaps worth to mention that the river Dnieper provides even more dx opportunities because large water expanses exist in many places along its course from Kiev towards the river's mouth at the Black Sea.

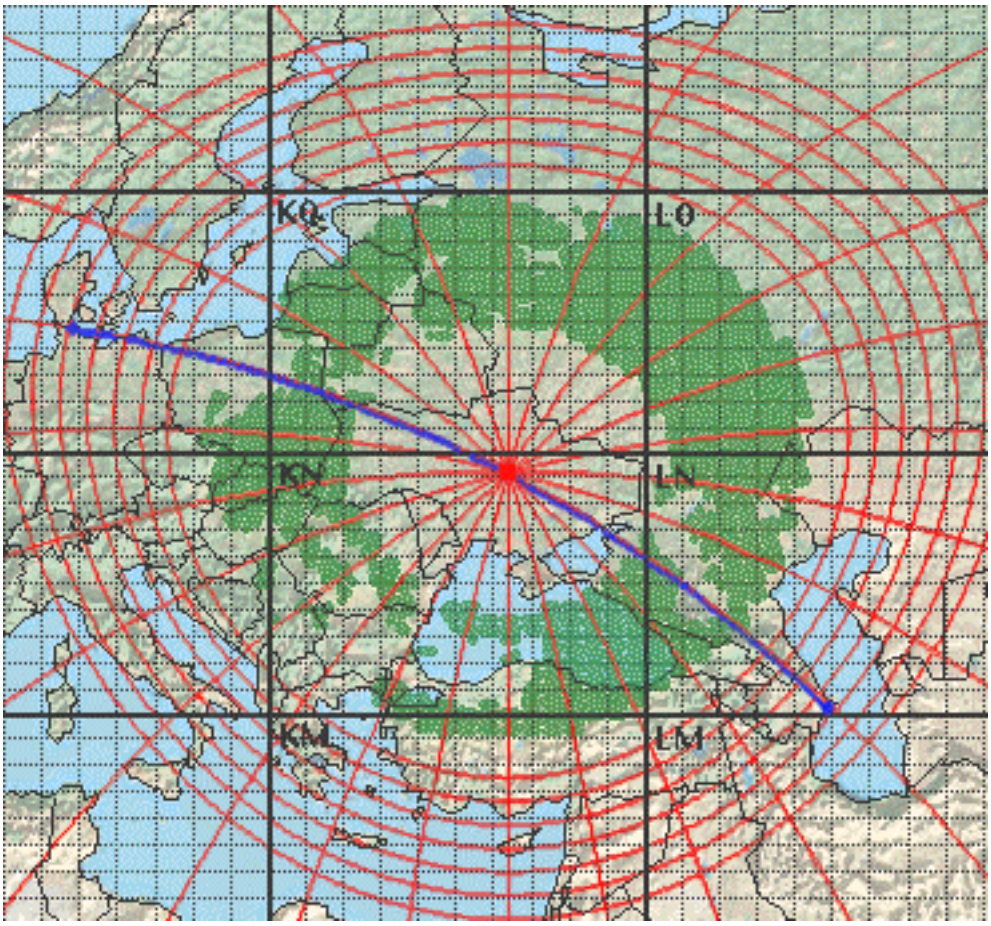

Fig. 2.3. Dx target map corresponding to the river Dnieper in the Ukraine.

2.4 More examples

More examples of dx target maps are displayed in the figures Fig. 2.4 (Lake Müritz in Germany), Fig. 2.5 (the Vänern in Sweden) and in Fig. 2.6 (river Don in Russia), respectively.

However, this examples are probably less relevant for dx opportunities in double hop sporadic E. The Lake Müritz (which is rather small, actually) and the Vänern are located in relatively high latitudes which reduces the availability of sporadic E. The river Don south-east of the city of Wolgograd represents another large water area but, on the other hand, the resulting dx targets are all found in geographical regions where only few VHF amateur radio stations appear available, unfortunately. The following examples are presented without providing further comments and discussions.

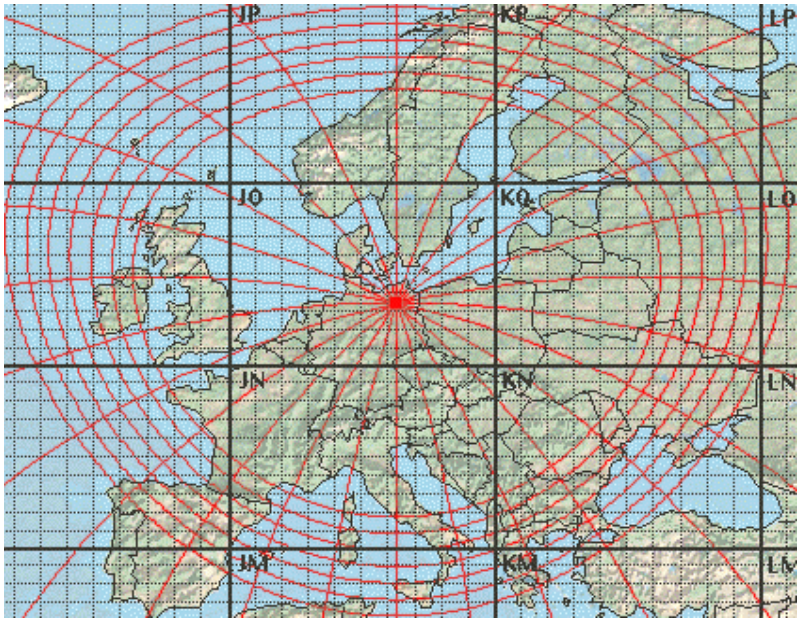

Fig. 2.4. Lake Müritz (117 square-kilometers) north of Berlin, Germany.

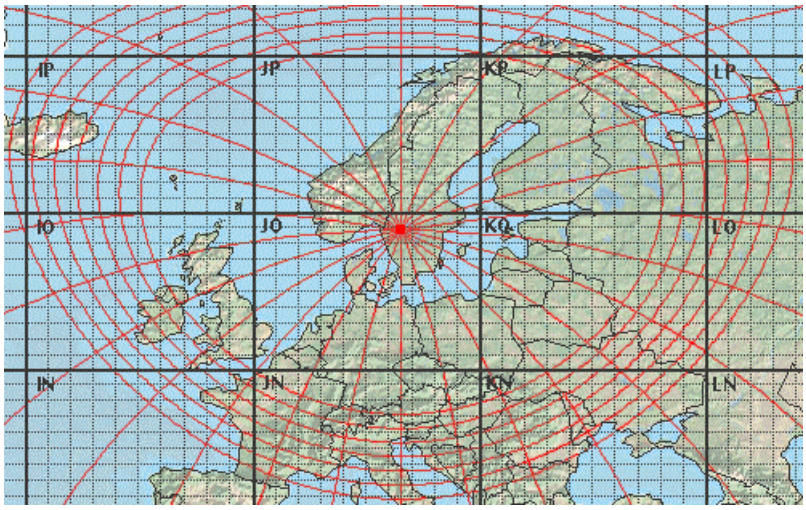

Fig. 2.5. The Lake Vänern (5.585 square-kilometers) in Sweden.

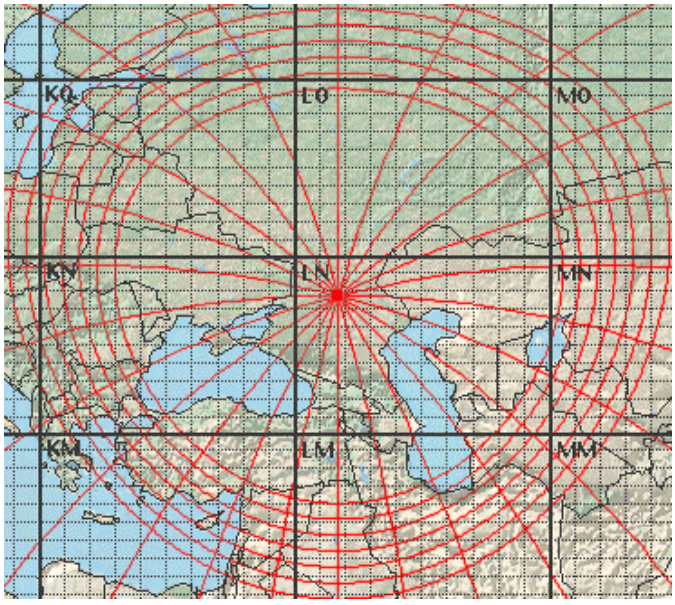

Fig. 2.6. The river Don in Russia.

3. Concluding comments

The dx target maps may be used in various applications, for example:

- analysing very long distance QSOs from recent years and decades
- modifying our strategy in sporadic E radio operation by keeping an eye on antenna directions which correspond to the azimuth of large lakes, water reservoirs and major rivers
- finding attractive geographical positions when deploying radio beacons in remote areas
- planning dxpeditions in the high season of sporadic E

Reviewing the results in [1], sixty percent of the claimed double hop QSOs from May 20, 2003 appear to correlate to the position of inland lakes and large rivers, see Fig. 1.1. On June 22, at least two supporting examples are found from a total number of five QSOs (see fig. 9.2 and 9.3 in [1]). The QSO from July 8 provides little support to the hypothesis of *radioglint* in inland lakes but the July 9 dx opening strongly supports this model because two QSOs are almost perfectly aligned to the position of lakes (associated with dams), another one hits a major river and only one QSO provides no or little support to the hypothesis (see fig. 9.8 in [1]). In this paper, we finally identified three historical examples of double hop sporadic E with path centers corresponding to the position of the lake Balaton and to the river Dnieper, respectively.

All this results indeed provide indications but cannot provide reliable verification of the hypothesis. More very long distance QSOs beyond 3.000 kilometers need to be analysed in more detail. Surprisingly, nine percent of the radio amateurs listed in the *Dubus 144 MHz Toplist* report sporadic E QSOs exceeding 3.000 kilometers (see [1] and the references therein), i.e. observation data seems to be available but detailed information on this QSOs is not available to the author, unfortunately. Do we chase a phantom or is there an interesting phenomenon in 144 MHz very long distance propagation, we haven't identified in full detail? Perhaps, the sporadic E saison 2004 can provide some answers.

4. References

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