

Measurement of Natura 2000 forest areas - problems and solutions

Private Forest Centre

Determination of area in forest – defined measurement tolerance

- In the Estonian Rural Development Plan 2007-2013, the mentioned exception has been planned for Natura 2000 support for private forests: In the measurement of Natura 2000 private forest areas, the double tolerance provided in Article 15 (2) of Commission Regulation (EC) Nr 1975/2006 will be applied.
- For Natura 2000 forest support, the allowed tolerance for measurements is:
 - buffer of 3.0 m, applied to the perimeter of the agricultural (forest) parcel. The maximum tolerance with regard to each agricultural (forest) parcel shall not, in absolute terms, exceed 2.0 ha.

I. The results of test measurement by the method of averaging

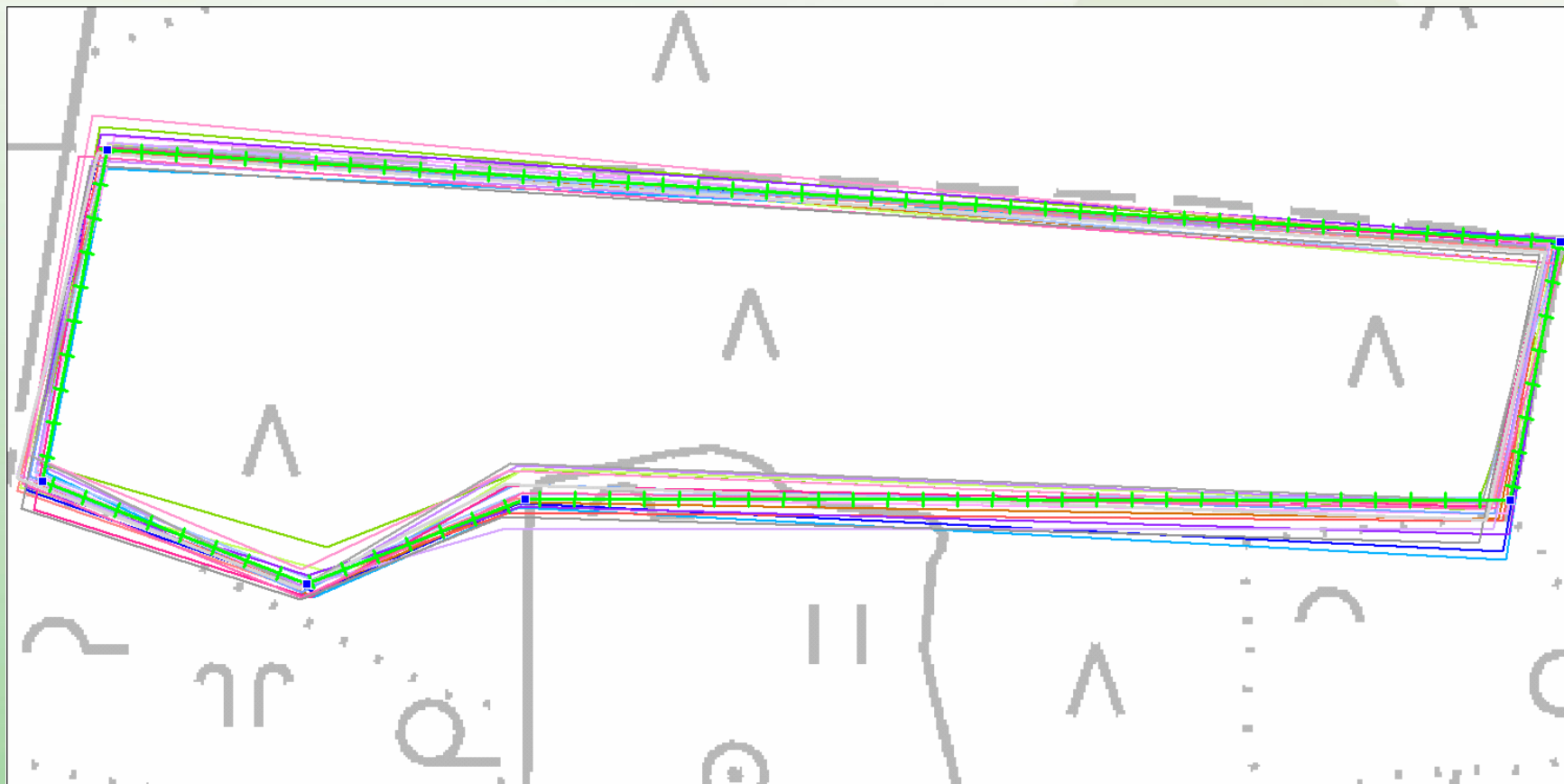
03.12.2007 (1)

- The purpose of the test measurement was to test the measuring capabilities and accuracy of GPS devices within the conditions of a limited horizon. The plot was covered mainly by thick spruce stand.
- Measuring was performed by the method of averaging (It is a software based function that allows us to take the average of measurements made in every point from up to 150 recordings in one point (and the most extreme recordings are been eliminated).
- The following GPS devices were used for measuring: a Tablet PC iX104C3V AllVue computer together with xGPS module.
- Tolerance was calculated by the rule: $\text{Tolerance} = 1.5 \times \text{circumference of the area (m)} \times 0.0001$.

I. The results of test measurement by the method of averaging (2)

Calculation results of allotment no. 1								
Measure ment no.	Measurement date	GPS device	Area (ha)	Circumference (m)	Difference from actual area (%)	Difference from actual area (ha)	Tolerance (ha)	2xToleranc e (ha)
Area that serves as bases (real)			3,01	905				
1	4.10.2007	Tablet PC	2,83	908	6,51	0,18	0,14	0,27
2	4.10.2007	Tablet PC	2,96	905	1,79	0,05	0,14	0,27
3	25.11.2007	Tablet PC	3,23	925	-6,75	-0,22	0,14	0,28
4	25.11.2007	Tablet PC	3,17	914	-4,96	-0,16	0,14	0,27
5	28.11.2007	Tablet PC	3,11	907	-3,09	-0,10	0,14	0,27
6	28.11.2007	Tablet PC	3,01	902	0,13	0,00	0,14	0,27
7	28.11.2007	Tablet PC	3,02	911	-0,46	-0,01	0,14	0,27
8	28.11.2007	Tablet PC	3,08	908	-2,27	-0,07	0,14	0,27
9	29.11.2007	Tablet PC	2,99	910	0,57	0,02	0,14	0,27
10	29.11.2007	Tablet PC	2,90	896	3,97	0,12	0,13	0,27
11	29.11.2007	Tablet PC	2,82	903	6,89	0,19	0,14	0,27
12	29.11.2007	Tablet PC	3,26	912	-7,78	-0,25	0,14	0,27
13	29.11.2007	Tablet PC	3,26	923	-7,78	-0,25	0,14	0,28
14	29.11.2007	Tablet PC	3,06	912	-1,57	-0,05	0,14	0,27
15	29.11.2007	Tablet PC	2,95	913	2,10	0,06	0,14	0,27
16	29.11.2007	Tablet PC	3,02	913	-0,20	-0,01	0,14	0,27
17	29.11.2007	Tablet PC	2,83	900	6,29	0,18	0,14	0,27
18	29.11.2007	Tablet PC	2,97	910	1,24	0,04	0,14	0,27
19	29.11.2007	Tablet PC	3,13	912	-3,68	-0,12	0,14	0,27
		Average area	3,03					
		Deviation (max- min)	0,45					
Deviation constitutes 14.8% of the average surface area.								

I. The results of test measurement by the method of averaging (3)



I. The results of test measurement by the method of averaging (4)

Test results:

1. According to test measurements, surface differences constituted up to $\pm 7.8\%$ of the area;
2. According to test measurements, they were within the allowed double margin of tolerance (3 m) (for the measurement of Natura 2000 private forestlands double measurement of deviation is used, as provided by Committee regulation (EU) no. 1975/2006 article 15, clause 2;
3. The negative side of the method is that the object border has to be divided into straight sections; when measuring the borders of a winding road or a ditch or some other curvilinear object, there could be many conditional angle points, in which measurement by averaging method could prove to be time costly.

II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk 15.12.2007 (1)

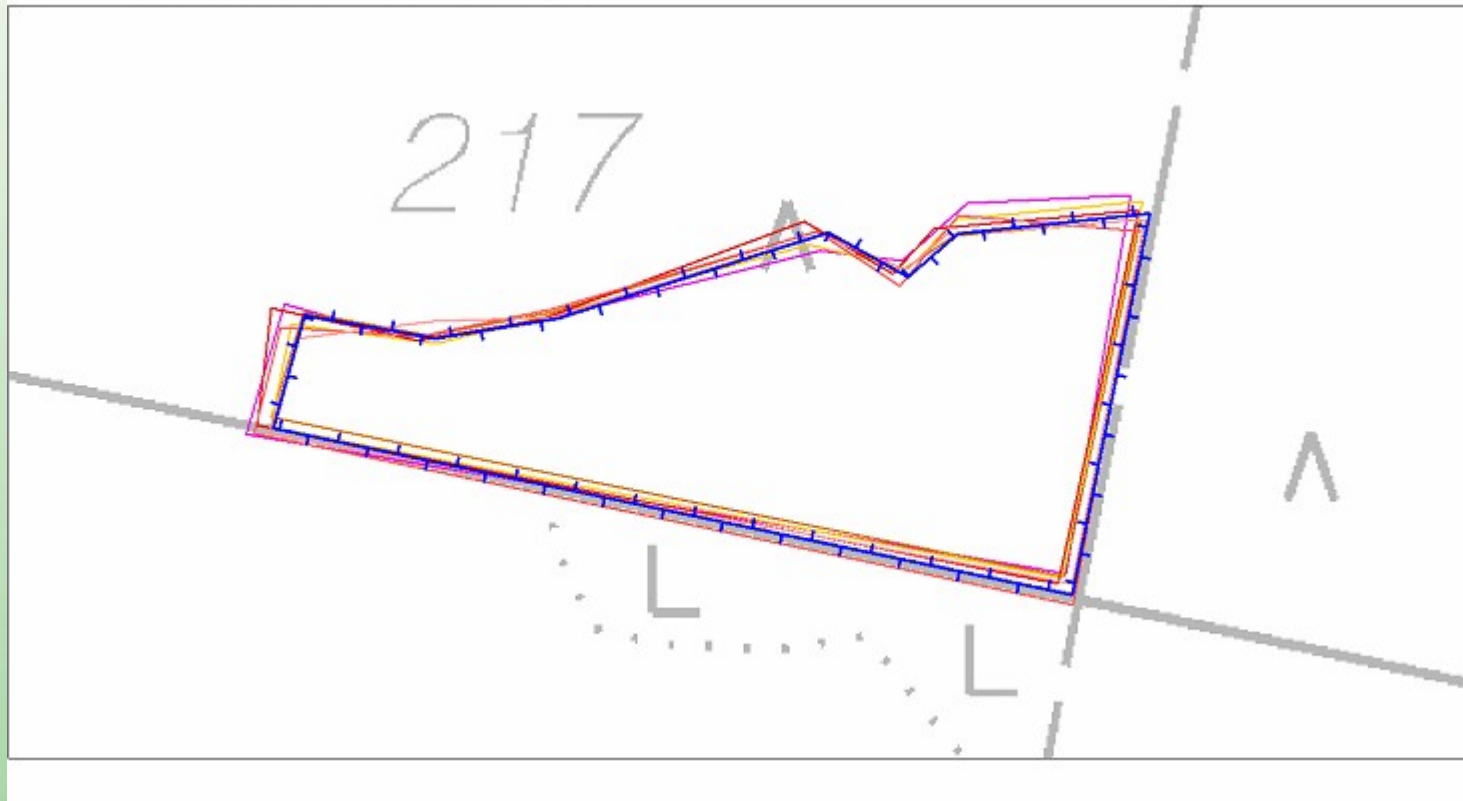
- The purpose of the test measurement was to test the measuring capabilities and accuracy of GPS devices within the conditions of a limited horizon. The plot was covered by a 60-year-old pine-birch-spruce stand.
- Measuring was performed by the method of averaging (It is a software based function that allows us to take the average of measurements made in every point from up to 150 recordings in one point (and the most extreme recordings are been eliminated).
- The following GPS devices were used for measuring: a Tablet PC iX104C3V AllVue computer together with xGPS module.
- Tolerance was calculated by the rule: $\text{Tolerance} = 1.5 \times \text{circumference of the area (m)} \times 0.0001$. In second column (2x tolerance): $\text{Tolerance} = 3.0 \times \text{circumference of the area (m)} \times 0.0001$.

II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk (2-1)

Measurement results of the area no 5-1								
Measurement no	Device no	Measurement date	GPS device	Area (ha)	Circumference (m)	Difference in comparison to the real area (%)	Tolerance (ha)	2xTolerance (ha)
Results of angle meter measurements				1,35	583			
1	1	5.12.2007	Tablet PC	1,33	589	1,73	0,09	0,18
2	1	13.12.2007	Tablet PC	1,30	576	4,08	0,09	0,17
3	1	13.12.2007	Tablet PC	1,27	569	6,54	0,09	0,17
4	1	14.12.2007	Tablet PC	1,35	591	0,22	0,09	0,18
5	1	14.12.2007	Tablet PC	1,44	594	-5,78	0,09	0,18
6	1	14.12.2007	Tablet PC	1,34	572	0,67	0,09	0,17
			Average area	1,34				
			Deviation (max-min)	0,17				
Deviation constitutes 12.3% of the average surface area.								
The difference between the border point and actual point is 0-9 meters, average deviations 4-6 meters								
Time used for evaluation: angle meter and measuring tape 120 minutes (2 people), GPS 40 minutes								

II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk (2-2)

Measurement results of the area no 5-1



II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk (2-3)

Results area no 5-1 (object area 1,35 ha, 9 angle points)

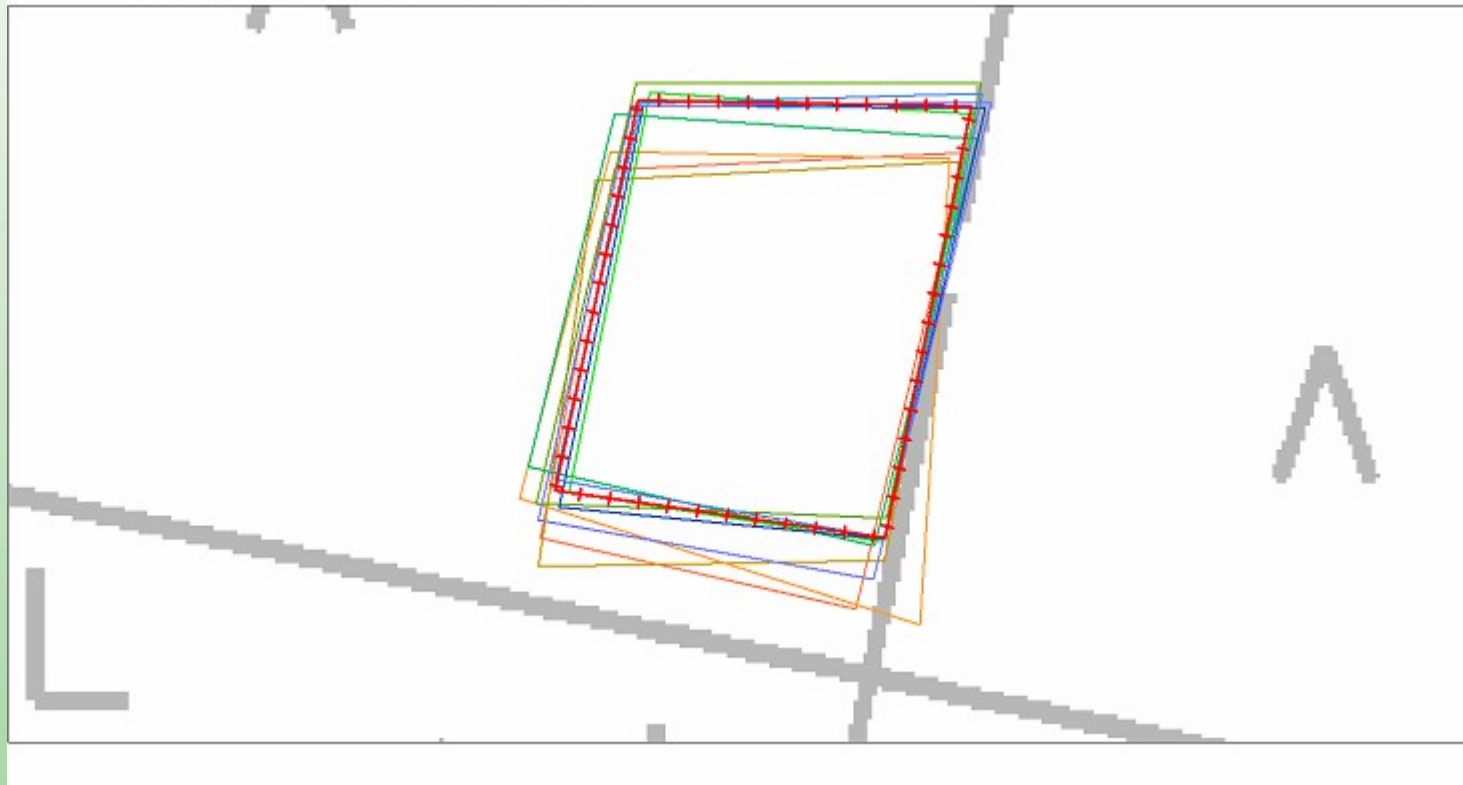
- According to test measurements, surface differences constituted up to $\pm 6.5\%$ of the area; i.e., they were within the allowed double margin of error (10%);
- By calculation, all measurements remained within the double tolerance margin (Tolerance = $3,0 \times \text{area circumference (m)} \times 0,0001$);
- The difference between various GPS measurement lines and the location of the angle points of the actual object was 0 to 9 meters (measurements in precisely the same point);
- The deviation of various measurements constituted 12.3% of the actual area;
- The time spent for test measurements:
 - measuring by angle meter + measuring tape, 2 experts – 120 minutes;
 - measuring by GPS, by the method of averaging, 1 expert – 40 minutes.

II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk (3-1)

Measurement results of the area no 5-2								
Measurement no	Device no	Measurement date	GPS device	Area (ha)	Circumference (m)	Difference in comparison to the real area (%)	Tolerance (ha)	2xTolerance (ha)
Results of angle meter measurements				0,25	203			
1	1	5.12.2007	Tablet PC	0,29	217	-12,00	0,03	0,07
2	1	5.12.2007	Tablet PC	0,25	204	-0,95	0,03	0,06
3	1	5.12.2007	Tablet PC	0,25	205	-1,30	0,03	0,06
4	2	5.12.2007	Tablet PC	0,24	200	2,49	0,03	0,06
5	2	5.12.2007	Tablet PC	0,27	212	-7,14	0,03	0,06
6	2	5.12.2007	Tablet PC	0,25	202	-0,71	0,03	0,06
7	1	13.12.2007	Tablet PC	0,28	213	-10,14	0,03	0,06
8	1	13.12.2007	Tablet PC	0,25	203	-0,32	0,03	0,06
9	1	14.12.2007	Tablet PC	0,25	204	-0,87	0,03	0,06
			Average area	0,26				
			Deviation (max-min)	0,04				
				Deviation constitutes 16.1% of the average surface area.				
The difference between the border point and actual point is 0-13 meters (4 in this case of measurement), 0-5 meters (5 in this case of measurement)								
Time used for evaluation: angle meter and measuring tape 40 minutes (2 people), GPS 20 minutes.								

II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk (3-2)

Measurement results of the area no 5-2



II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk (3-3)

Results area no 5-2 (object area 0,25 ha, 4 angle points)

- According to test measurements, surface differences constituted up to $\pm 12.0\%$ of the area; i.e., they were within the allowed double margin of error (10%);
- By calculation, all measurements remained within the double tolerance margin (Tolerance = $3,0 \times \text{area circumference (m)} \times 0,0001$);
- The difference between various GPS measurement lines and the location of the angle points of the actual object was 0 to 9 meters for 4 measurements and 0-5 meters for 5 measurement (measurements in precisely the same point);
- The deviation of various measurements constituted 16.1 % of the actual area;
- The time spent for test measurements:
 - measuring by angle meter + measuring tape, 2 experts – 40 minutes;
 - measuring by GPS, by the method of averaging, 1 expert – 20 minutes.

II. The results of test measurement by the method of averaging and their comparison to the results of polygonometric walk (2)

- According to calculations, all GPS measurements with averaging remained within the double tolerance margin (Tolerance = $3,0 \times \text{circumference of the area (m)} \times 0,0001$), but the difference between various GPS measurement lines and the location of the angle points of the actual object was 0 to 13 meters for 4 measurements (in area no 5-2). I.e., the area of objects measured by GPS was within allowed margins, but in some cases the objects are not located in the real location of the object (measured object is in deviation – area no 5-2, brown lines);
- The time spent on measuring – as a result of the evaluation of two objects, the polygonometric walk took 2-3 times more time than evaluation by GPS by the method of averaging;
- Evaluation takes a lot of time, and therefore the cost of inspection could become inefficiently high compared to the amount of provided support.

III. Surface area estimation options during inspection of forest areas

- Precision measured cadastral unit boundaries are used for determining the areas.
- Using visual survey as a method for estimating the surface area can definitely be considered in case of cadastral units that lie entirely within a Natura area, in a single zone, are entirely covered by forest, have clearly distinguishable boundaries and the boundaries of the cadastral unit have been measured using precision measurement.
- Using the method of visual survey, the specialist ensures that the area and shape of the object correspond to plans and maps.

III. Surface area estimation options during inspection of forest areas (2)

- The specialist can ensure the correspondence of the boundaries of the surveyed object (object of application) to:
 - the “National Register of Forest Resources” database or a digital forest map reflecting the location of the forest parcel
 - Natura 2000 area (special conservation area, limited or special management zone) layer;
 - Cadastral unit boundary layer;
 - EELIS (Estonian Nature Information System) layers;
 - Semi-natural community layer (State Nature Conservation Centre)
 - Agricultural parcel layer (ARIB);
 - The base layer (the “background”) can be:
 - Base Map;

IV. Surface area estimation options during inspection of forest areas

- The subsidised area can be considered correct upon visual evaluation if the shape and boundaries of the tract of forested land correspond to the boundaries of the cadastral unit and the shape of the forest area on the “National Register of Forest Resources” map. The area in the application must be smaller than or as great as the surface area of the tract of forested land marked on the “National Register of Forest Resources” map and forest land area of the cadastral unit.

V. Polygon surveying (1)

- . An alternative to GPS measurement would be polygon surveying. To make a polygon, the boundary of the evaluated object has to be divided into straight lines.
- . The coordinates of corner points required for calculating the area of the object are found by measuring the polygon, which means measuring the lengths and azimuths of the sides of the object.
- . *Polygon surveying activities:*
 - *determining the first corner point of the object,*
 - *dividing the object's boundary into straight lines,*
 - *measuring the lengths of all lines (sides),*
 - *measuring the azimuths of all lines (sides),*
 - *making a tie.*

V. Polygon surveying (2)

- . The tying error can not be greater than 3%; otherwise, the object has to be measured again.
- . A big disadvantage of polygon measurement is that it is time-consuming.

VI. GPS measurement using averaging

- In the “fieldwork” module of the Register of Forests software, the following rule set for static measurement is used: 150 readings are taken in corner points, with only these readings taken into account that include data from at least 4 (5) satellites and have a PDOP value of < 5 .
- An arithmetical average of points falling within a double standard deviation will be calculated from the resulting “point cloud”. In this way, extreme values that could have resulted from a momentary bad satellite signal are excluded from the averaging.

VII. Estonian University of Life Science research about using GPS- technology in the forest (1)

- Private Forest Centre ordered research from Estonian University of Life Science compiler in march 2008
- The purpose of the research was find out optimal possibilities with GIS GPS point coordinates and surface areas in the forest.

VIII. Estonian University of Life Science research about using GPS- technology in the forest (2)

- Recommendation to use DGPS correction from GPS datasheet, which transmit format are internationally RTCM (*Real Time Correction Method*).
- Connection with GPS base station is possible:
- GSM data calls, where GIS GPS are connected with mobile phone
- with GPRS connection, GPS access to the base station IP address. Data moving by Internet.

IX. Estonian University of Life Science research about using GPS- technology in the forest (3)

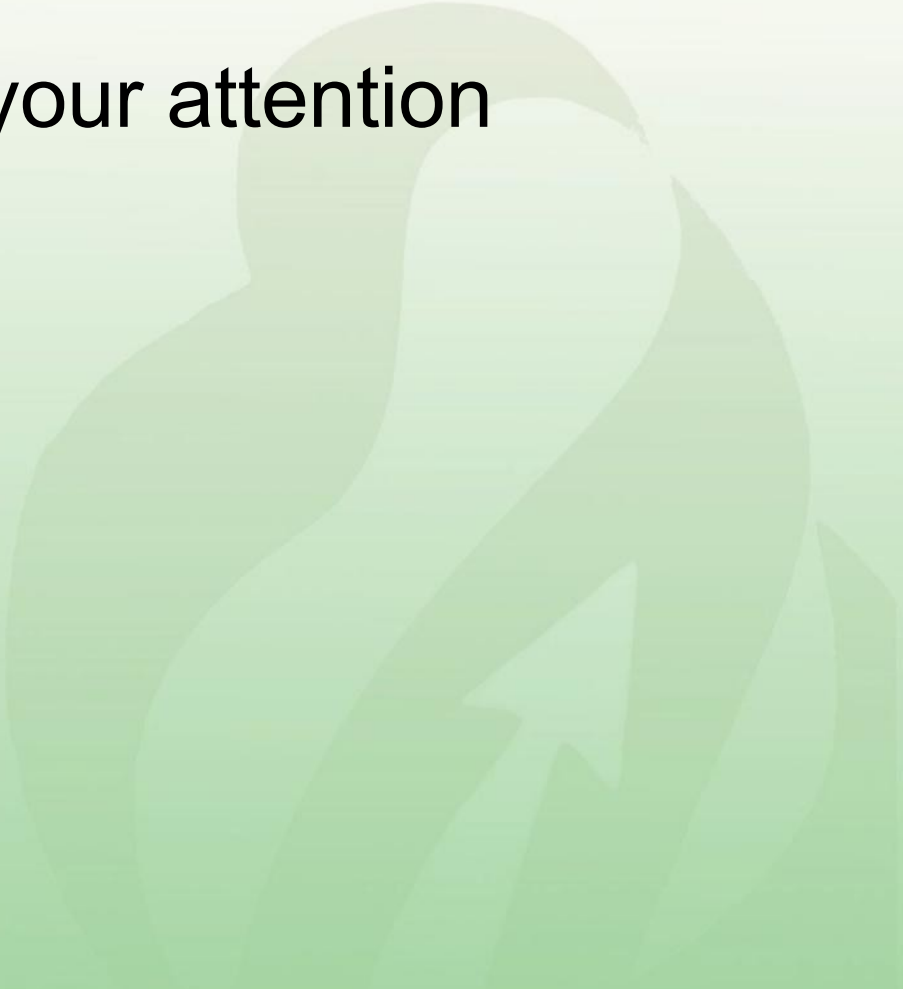
DGPS-stations in Estonia (2)

- Estonian University of Life Science Tartu stationary tugijaamas töötab Trimble kahesageduslik NetRS vastuvõtja ning Trimble Zephyr Geodetic antenn.
- OÜ Geosoftil Tallinnas viie sageduslik Trimble NetR5 koos Trimble Zephyr Geodetic II antenniga
- Basically suffice to Estonia one DGPS-station

X. Estonian University of Life Science research about using GPS- technology in the forest (4)

Results and suggestions

- 1) In the forest is possible accomplish land-surveyings and attain point coordinate allocation accuracy 1 m in case that:
 - At the same time of the measuring GPS need at least 5 satellites
 - At the same time of the measuring is PSOP>6
 - Using DGPS correction from GPS base station (transmit format is internationally RTCM)
 - In the specification brought GPS-receiver accuracy is 1 m
 - On a every point must be made at least three remeasurements
- 2) Using outer GPS-aerial (Chocke Ring type) or put GPS-receiver higher that GPS dont cover up satellite signals
- 3) Measuring DGPS-corrections must invigilate constantly ,that connection with GPS base station is available or accidentally interrupted.



Thank you for your attention