**Measurement of Endosulfan, Dieldrin and Endrin in Norwegian Air and Sediment Samples**


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# Measurement of Endosulfan, Dieldrin and Endrin in Norwegian Air and Sediment Samples

Rapport 976/2007

Statlig program for forurensningsovervåking

# Preface

Endosulfan, Dieldrin and Endrin are not part of the existing measurement programme of the rural air- and precipitation chemistry monitoring network in Norway. To get an indication on the background concentration levels and long range atmospheric transport potentials of these compounds NILU was requested to measure the concentration of these compounds in air samples from Birkenes and Ny-Ålesund and in marine and fresh water sediment samples from several locations in Norway.

Kjeller, November 2007

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# 1. Summary

Endosulfan-I, endosulfan-II, endosulfan sulfate, dieldrin and endrin are not part of the existing environmental monitoring network in Norway. To get an indication on the background concentration levels and long range atmospheric transport potentials of these compounds, NILU was requested to measure the concentrations of these compounds in air samples from Birkenes and Ny-Ålesund and in marine and fresh water sediment samples from 16 sampling stations distributed all over Norway.

Air samples
For all air samples atmospheric transport trajectories were calculated in order to assess the origin of the air mass and the air contaminants.

The concentrations of endosulfan-I measured in air samples from Birkenes, were in the range of 3,4 to 25 pg/$m^3$, whereas all the other compounds had concentrations below the limit of detection in these samples. The concentrations of endosulfan-I measured in air samples from Ny-Ålesund, were in the range of 5,2 to 13,2 pg/$m^3$ and the concentrations of dieldrin were in the range of <0,2 to 0,99 pg/$m^3$. The concentrations of all the other compounds were below the limit of detection in the air samples from Ny-Ålesund. The concentrations of endosulfan measured at Birkenes and Ny-Ålesund were in the same range as found in samples from other rural or arctic sites which are not influenced by freshly use of endosulfan.

Since we have no historical data from Birkenes or Ny-Ålesund, it is not possible to calculate a temporal trend. However, it seems apparent from the data from the Arctic stations Alert and Tagish the early 1990s, that there is no substantial decrease in the Arctic levels.

The Birkenes samples which are representing the whole summer season of 2006, show a remarkable temporal variability of the concentration with a range varying over nearly one order of magnitude. This alone is already a good indication for the existence of active sources or at least that there are regions which are emitting a significantly higher level of endosulfan-I to air than other regions. In addition, the results show significantly higher values for periods with trajectories from potential source regions (Western and Eastern Europe) compared with periods with trajectories from other areas (British Isles and Arctic). The fact that measurable amounts of endosulfan-I are found at Birkenes and Ny-Ålesund and the correlation of the concentrations with origin of the air masses, are strong indications for airborne long-range transport of endosulfan. This conclusion is in correspondence with the Draft Dossier on endosulfan prepared on behalf of UN-ECE by the German Federal Environment Agency in 2004 and several other reports.

Sediment samples
Endosulfan-I, -II and endosulfan sulfate was not detected in sediment samples from Norway (LoD = 0,01 – 0,2 ng/g d.w.). Dieldrin was detected in one sediment sample from Inner Oslofjord, but the concentration was only slightly above the limit of detection.

# 2. Sammendrag

Endosulfan-I, endosulfan-II, endosulfan sulfat, dieldrin og endrin er ikke del av den eksisterende miljøovervåkningen i Norge. For å få en indikasjon på bakgrunnskonsentrasjonsnivåene og potensialet for atmosfærisk langtransport av disse komponentene, ble NILU bedt om å måle konsentrasjonen av disse komponentene i luftprøver fra Birkenes og Ny-Ålesund, samt i prøver av marine sedimenter og ferskvannssedimenter fra 16 prøvetakningssteder spredd over hele Norge.

Luftprøver
For alle luftprøver ble transportrajektorier beregnet for å kunne bestemme opprinnelsen til luftmassene og luftforurensningene.

De målte konsentrasjoneneav endosulfan-I i luftprøver fra Birkenes var i området fra 3,4 til 25 pg/$m^3$, mens alle de andre komponentene hadde en konsentrasjoner under deteksjonsgrensen. Konsentrasjonene av endosulfan-I målt i luft prøver fra Ny-Ålesund, var i området fra 5,2 til 13,2 pg/$m^3$, og for dieldrin var konsentrasjonene i området fra <0,2 til 0,99 pg/$m^3$.For alle de andre komponentene var konsentrasjonsnivået under deteksjonsgrensen i prøvene fra Ny-Ålesund. Konsentrasjonsnivået av endosulfan-I målt på Birkenes og i Ny-Ålesund er omtrent som for prøver fra andre bakgrunnsområder eller arktiske områder som ikke er påvirket av nylig bruk av endosulfan.

Siden vi ikke har noen historiske data fra Birkenes eller Ny-Ålesund, er det ikke mulig å beregne en trend. Dog virker det åpenbart ved å sammenlikne med data fra de arktiske stasjonene Alert og Tagish fra tidlig 1990-tall, at det ikke er noen betydelig reduksjon i de arktiske nivåene.

Birkenesprøvene som representerer hele sommeren 2006, viser en betydelig tidsvariasjon av konsentrasjone med en spennvidde som varierer med nesten en størrelsesorden. Dette alene er allerede en god indikasjon på tilstedeværelse av aktive kilder, eller i det minste at det er regioner som slipper ut et betydelig høyere nivåer av endosulfan til luft en andre regioner. I tillegg viser konsentrasjonsmønsteret betydelig høyere verdier i perioder med trajektorier fra potensielle kildeområder (Vest- og Øst Europa) sammenlignet med perioder med trajektorier fra andre områder (Britiske øyer og Arktis). Det faktum at målbare mengder av endosulfan blir funnet i luft på Birkens og i Ny-Ålesund og at det er samsvar mellom konsentrasjoner og opprinnelse av luftmasser, gir en sterk indikasjon på luftbåren langtransport av endosulfan. Denne konklusjonen er i samsvar med Draft Dossier på endosulfan framsatt på vegne av UN-ECE av det tyske federale miljøbyrået i 2004, og med flere andre rapporter.

Sediment prøver
Endosulfan-I, -II og endosulfan sulfate ble ikke detektert i norske sedimentprøver (LoD = 0,01 – 0,2 ng/g d.w.). Dieldrin ble målt i en sedimentprøve fra Indre Oslofjord, men konsentrasjonen var bare litt høyere enn deteksjonsgrensen.

# 3. Introduction

Endosulfan-I, endosulfan-II, endosulfan sulfate, dieldrin and endrin are chlorinated organic pesticides which are banned or never have been in use in Norway. Endosulfan-I og –II or α- og β-endosulfan are isomers. Some researchers have observed substantial conversion of endosulfan-II into endosulfan-I. Endosulfan-I is predominant in air samples, whereas endosulfan-II is favored in rain samples (Schmidt, W.F. et al. 2001). All measured compounds are persistent, bioaccumulating and toxic (PBT) and are exposed to long-range atmospheric transport. Endrin and dieldrin are on the Stockholm Convention list of compounds which should be eliminated.

Endosulfan-I, endosulfan-II, endosulfan sulfate, dieldrin and endrin are not part of the existing environmental monitoring network in Norway. To get an indication on the background concentration levels and long range atmospheric transport potentials of these compounds NILU was requested to measure the concentration of these compounds in air samples from Birkenes and Ny-Ålesund and in marine and fresh water sediment samples from 16 sampling stations from whole Norway.

# 4. Sampling Sites and Methodes

## 4.1 Air Sampling

For the standard measurement programme of the rural air- and precipitation chemistry monitoring network in Norway there are high volume air samplers located at Birkenes, Southern Norway (58,38° N, 8,25° E; 190 m a.s.l) and Zeppelin station, Ny-Ålesund, Spitsbergen (78,90° N, 11,88° E; 474 m a.s.l). The routine sampling programme occupy these samplers during 2 days a week. It was decided to take advantage of idle period on these samplers for the additional measurement of endosulfan, dieldrin and endrin.

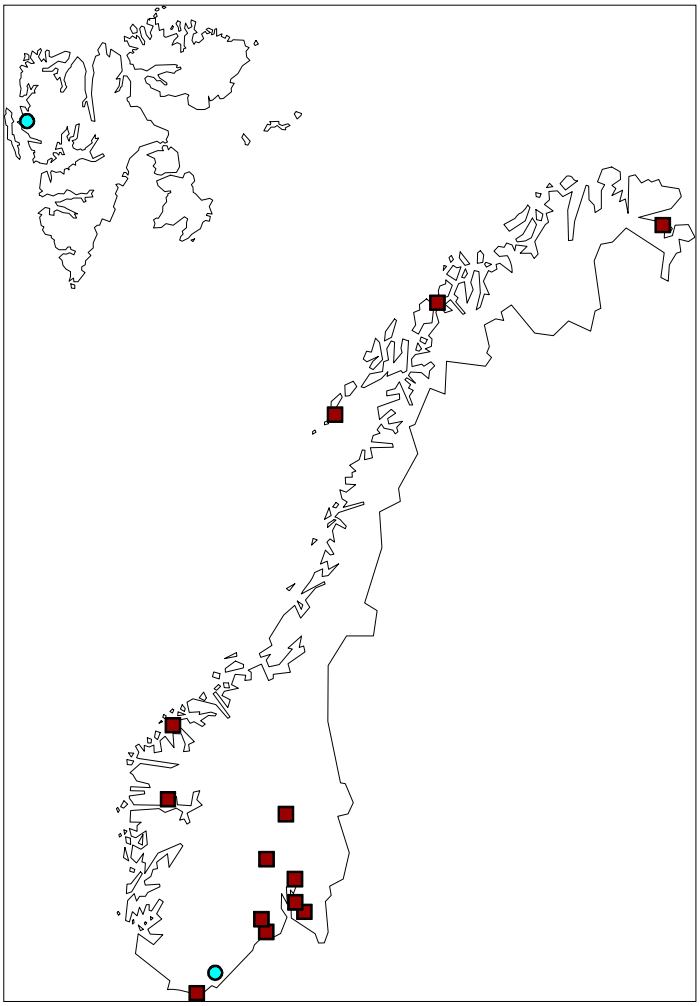


*Figure 1: Brown square : Sediment sampling stations*
*Blue circle: Air sampling stations*

Since 2004, the atmospheric concentration of HCHs, HCBs and PCBs are monitored at Birkenes. Birkenes is located in southern Norway, to the south-east of the Scandinavian mountain chain. Due to the location of the site away from local pollution sources, long-range transport exerts a large influence on the pollution climatology of the site. The site is well-suited for e.g. trend analysis. The site provides data on deposition in support of effect oriented studies (surface water acidification, forest damage, material deterioration etc.). Data for the site are applied for the following monitoring programmes; EMEP, ICP Waters, ICP Forest, ICP Integrated Monitoring, ICP Materials, The Norwegian Air and Precipitation Monitoring Programme, the Norwegian Monitoring Programme on Forest Damage, OSPAR CAMP, and others.

Since 1993, the atmospheric concentration of PCBs, PAHs, HCHs, DDTs,HCB and chlordanes are monitored at the Zeppelin station close to Ny-Ålesund, Spitsbergen. The site is located in an undisturbed Arctic environment. Zeppelin Mountain is an excellent site for atmospheric monitoring, with minimal contamination from the local settlement due to its location above the inversion layer. It is located near Ny-Ålesund, Svalbard (78,90° N, 11,88° E) around 474 m above sea level.

At Birkenes the sampling for this study was started in mid May 2006 and ended in mid November 2006. In total 26 air samples were taken from Wednesday 05:30 h to Thursday 05:30 h each week. Each sample corresponds to about 500 $m^3$ of ambient air.

At Zeppelin station at Ny-Ålesund, Spitsbergen the sampling for this study was started in September finished end of November. In total 8 samples were sent to NILU in Kjeller and all samples were analyzed. The weekly sampling period was Wednesday 07:40 h to Friday 07:40 h resulting in a total air volume of about 1000 $m^3$ of ambient air.

For sampling a standard NILU high volume air sampler as described in the EMEP Manual (http://www.nilu.no/projects/ccc/manual/index.html) was used. The air samples were collected with a glass fibre particle filter followed by two PUF plugs.

## 4.2 Sediment sampling

Fresh water sediment samples were taken with a modified Kajak.Brinkhurst sampler (0 – 1 cm) and marine sediments with a grab or corer sampler (0 – 2 cm). This sediment samples were taken as part of an other SFT project: SFT screening study 2006 and sampling parameters are described in further detail there (SFT 2007).

*Table 1: Sediment sampling stations*

| Sample ID | Station | Latitude | Longitude |
|---|---|---|---|
| 1 | Randsfjorden | 676800 | 6695680 |
| 2 | Mjøsa | 6771700 | 577800 |
| 3 | Vansjø, Storfjorden | 6582675 | 606979 |
| 4 | Indre Oslofjord, Bekkelagsbassenget | 59.88273N | 10.75875E |
| 5 | Indre Oslofjord, Bekkelagsbassenget | 59.88287N | 10.75466E |
| 6 | Indre Oslofjord, Steilene | N 59 49.10 | E 10 33.80 |
| 7 | Indre Oslofjord, Steilene | N 59 49.10 | E 10 33.80 |
| 8 | Ytre Langesundsfjorden | N59.07848 | E9.70780 |
| 9 | Frierfjorden | N59.10537 | E9.61682 |
| 10 | Eidangerfjorden | N59.01485 | E9.78088 |
| 11 | Kristiansandfjorden | N 60 05.80 | E 6 31.98 |
| 12 | Sognefjorden | 61º08994 N, | 7º18,014 Ø |
| 13 | Ålesund | 62,47983 | 6,21067 |
| 14 | Lofoten | N 68 07.00 | E 14 41.00 |
| 15 | Malangen | N 69 30.443 | E 18 07.088 |
| 16 | Varangerfjorden | N 69 56.156 | E 30 06.665 |

## 4.3 Chemical analysis

Filter and PUF plugs form the air samples are extracted separately with a hexane/diethylether 9:1 mixture in a soxhlet extractor. The sediment samples were dried at 40° C and extracted with aceton and cyclohexane.

The extracts are concentrated and then cleaned by using adsorption chromatography (silica). After the concentration to the appropriate volume and addition of the recovery standard the

components are separated and quantified by using gas chromatography combined with mass spectrometry (MS) in the negative ion chemical ionization mode GC/MS-NICI.

For both sample types a QA/QC programme was performed including the determination of several method blanks. All measurement results were at least a factor of 10 lower than blank levels. The limit of detection (LoD) is given in the result tables (Table 2, Table 3, and Table 4). The limit of detection is determined for each sample separately and is varying from sample to sample. This can be due to day-to-day variation of the instrument sensitivity and/or due to unremovable organic sample matrix which may reduce the instrument response.

# 5. Calculated trajectories

Atmospheric trajectory models yield information about the origin of air masses. They are calculated using the FLEXTRA model (Stohl et. al., 1995; Stohl & Seibert, 1998) and relies on meteorological data from European Centre for Medium Range Weather Forecasts (ECMWF). The meteorological data that has been used in the model has a spatial resolution of 1.25 degrees and a 6-hours time resolution. This means that for a one-day sampling period 4 trajectories and for a two-day sampling period, 8 trajectories were calculated for each air sample to assess the origin of the air masses. Processes like degradation of contaminants in the atmosphere and different atmospheric deposition processes that affect the potential for long-range transport have not been taken into consideration. This entails that the relative importance in relation to assessing source contributions has increasing uncertainty as one goes back in time, due to different loss processes (dispersion, dilution, degradation and deposition) that take place during atmospheric transport.

## 5.1 Birkenes

For all 26 samples trajectories were calculated. 8 samples were selected for chemical analysis and classified according to their source regions: 1. Arctic region, 2. British Isles, 3 Western Europe, and 4 Eastern Europe. In the following figures typical trajectories for each of the selected sampling period are shown.

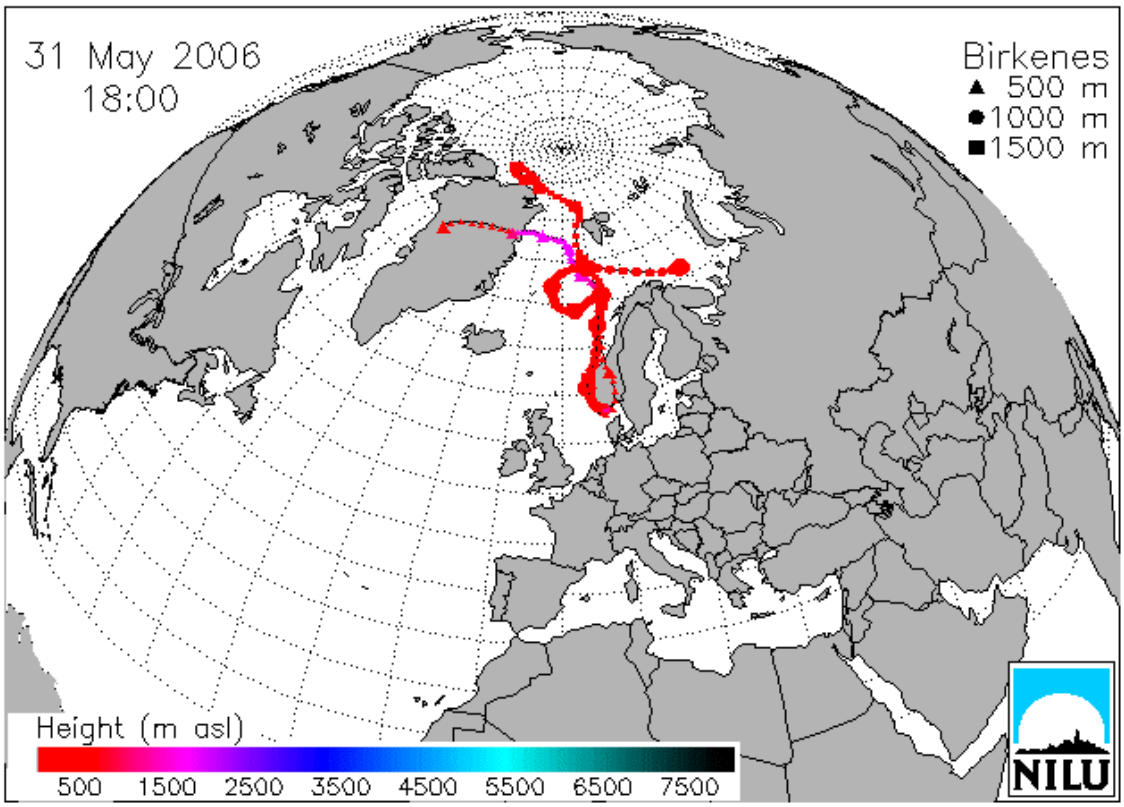



*Figure 2: Sample 1 Arctic region 31.05.-01.06.2006*

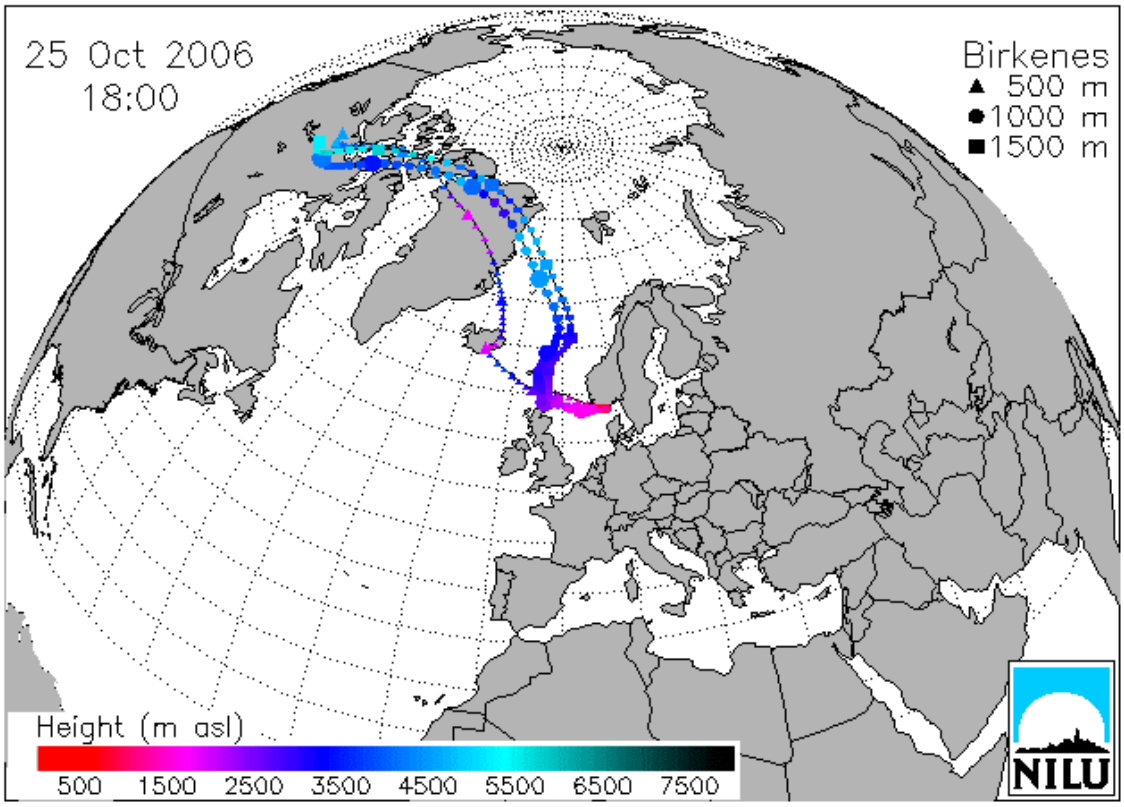



*Figure 3: Sample 2 Arctic region 25.10.-26.10.2006*

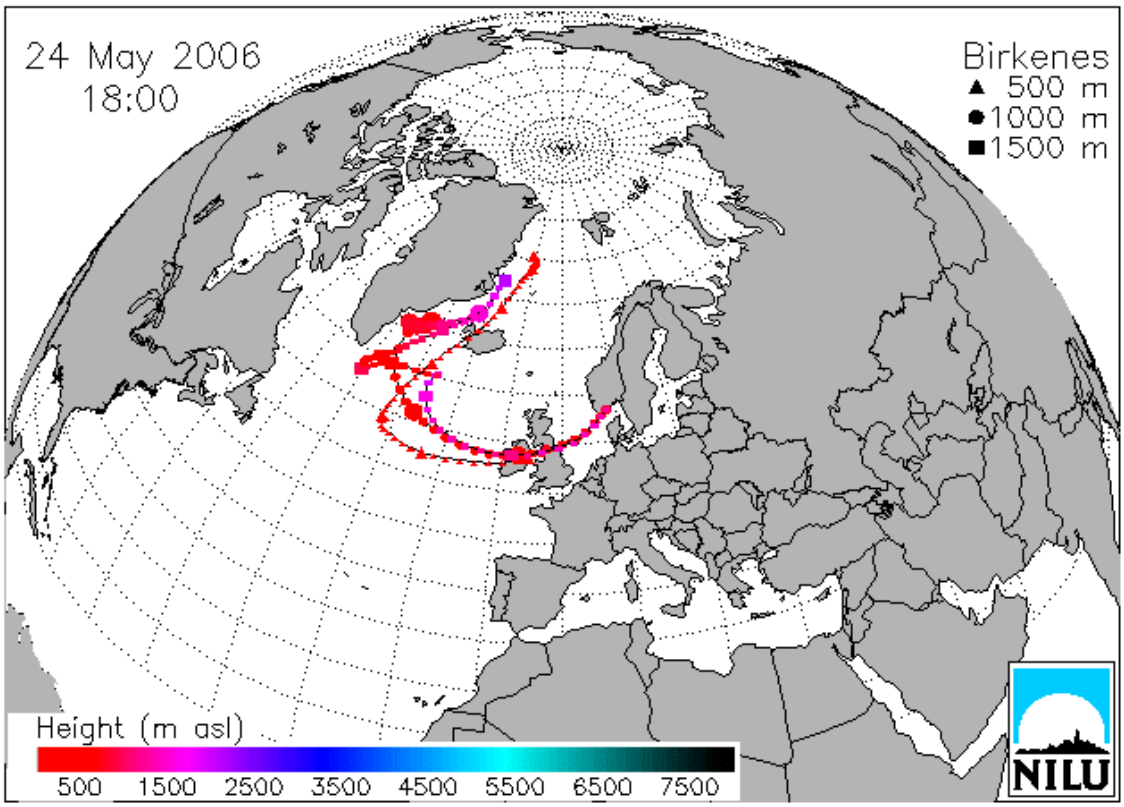



*Figure 4: Sample 3 British Isles 24.05.-25.05.2006*

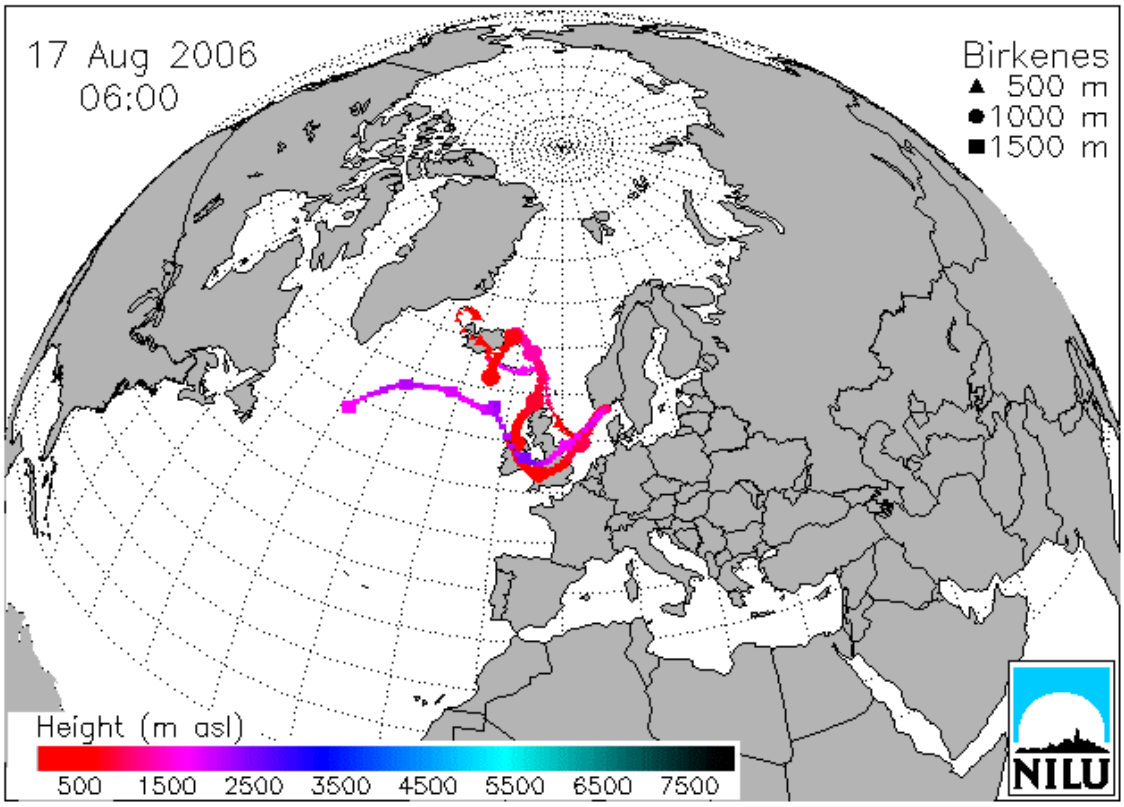



*Figure 5: Sample 4 British Isles 16.08-17.08.2006*

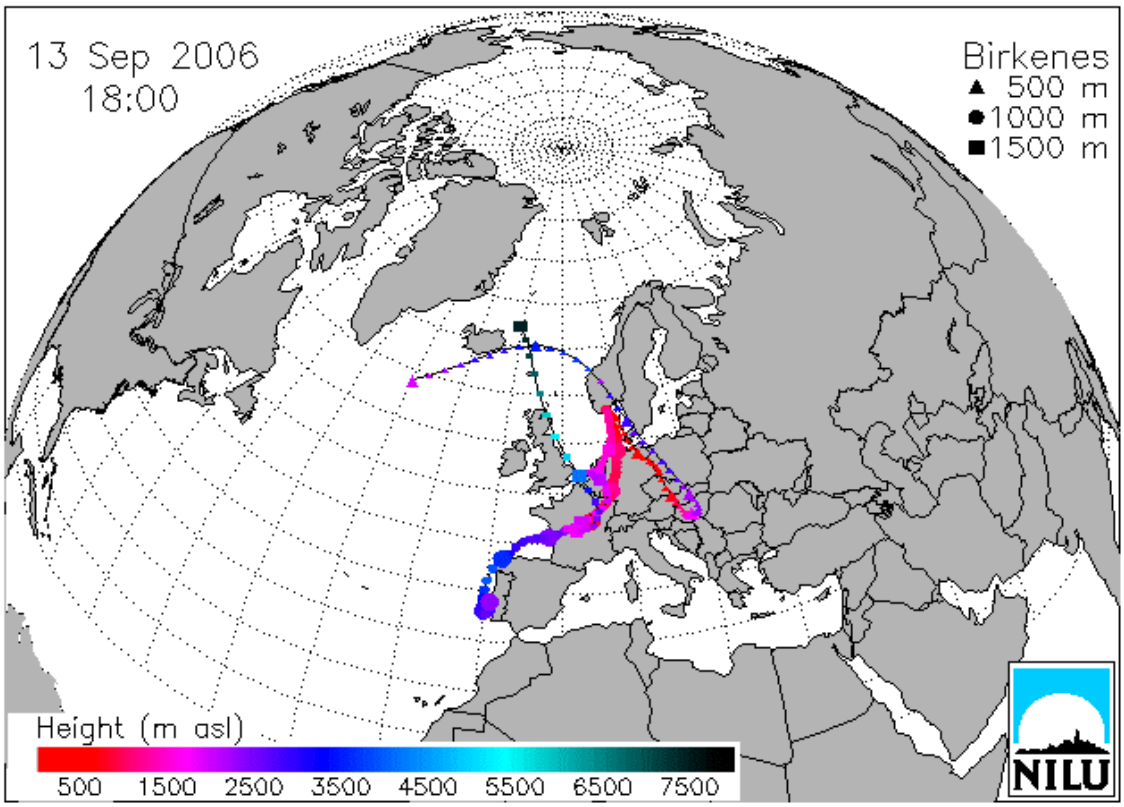



*Figure 6: Sample 5 Western Europe 13.09.-14.09.2006*

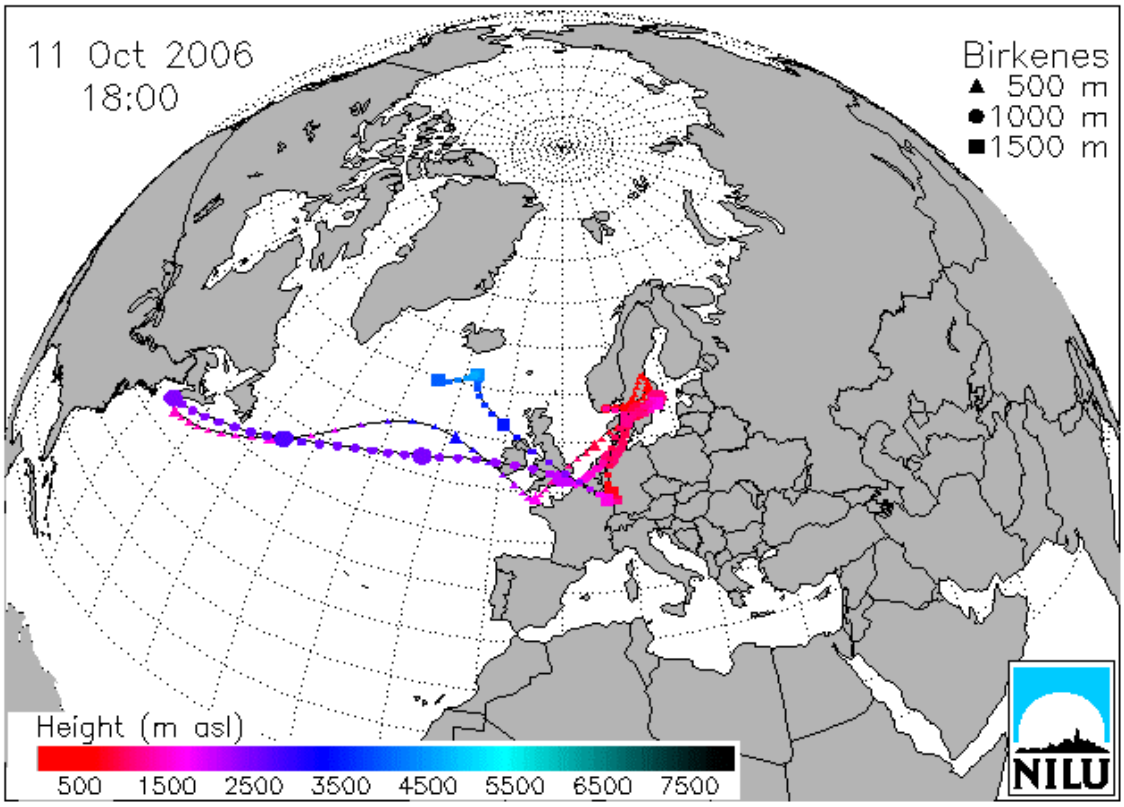



*Figure 7: Sample 6 Western Europe 11.10.-12.10..2006*

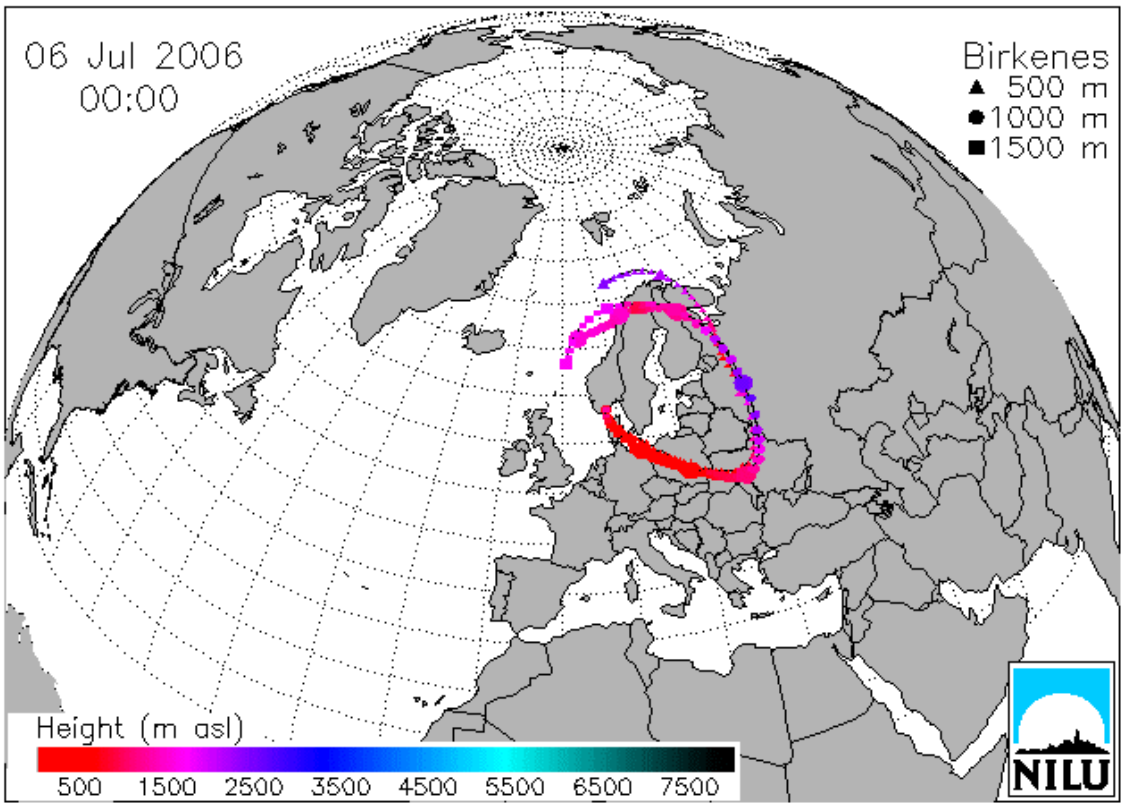



*Figure 8: Sample 7 Eastern Europe 05.07.-06.07.2006*

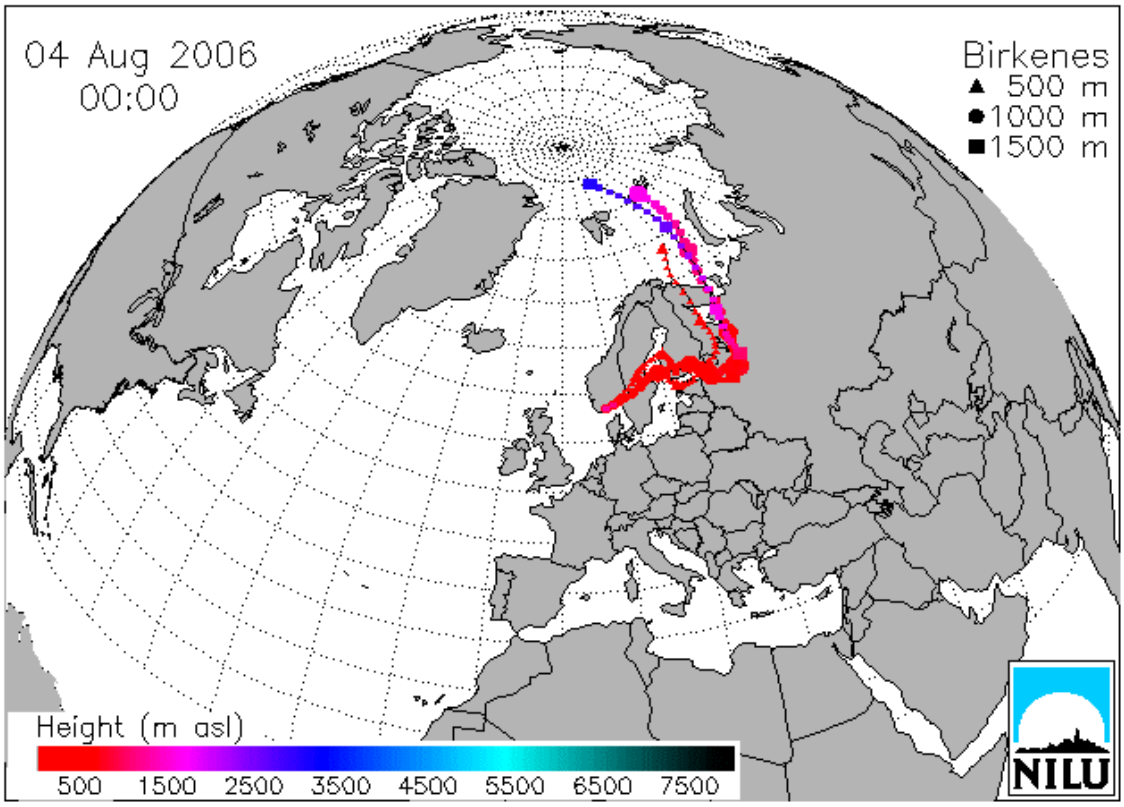



*Figure 9: Sample 8 Eastern Europe 03.08.-04.08.2006*

## 5.2 Ny-Ålesund

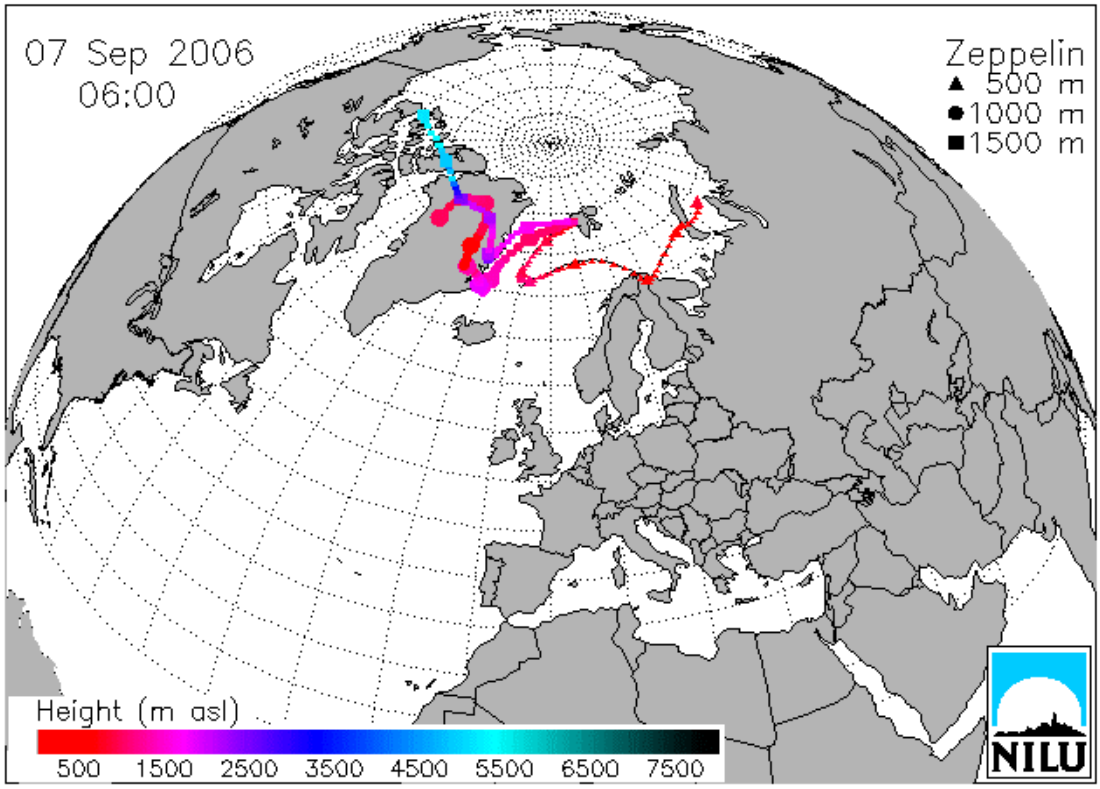



*Figure 10: Sample 1, Arctic region, 06.09.-08.09.2006*

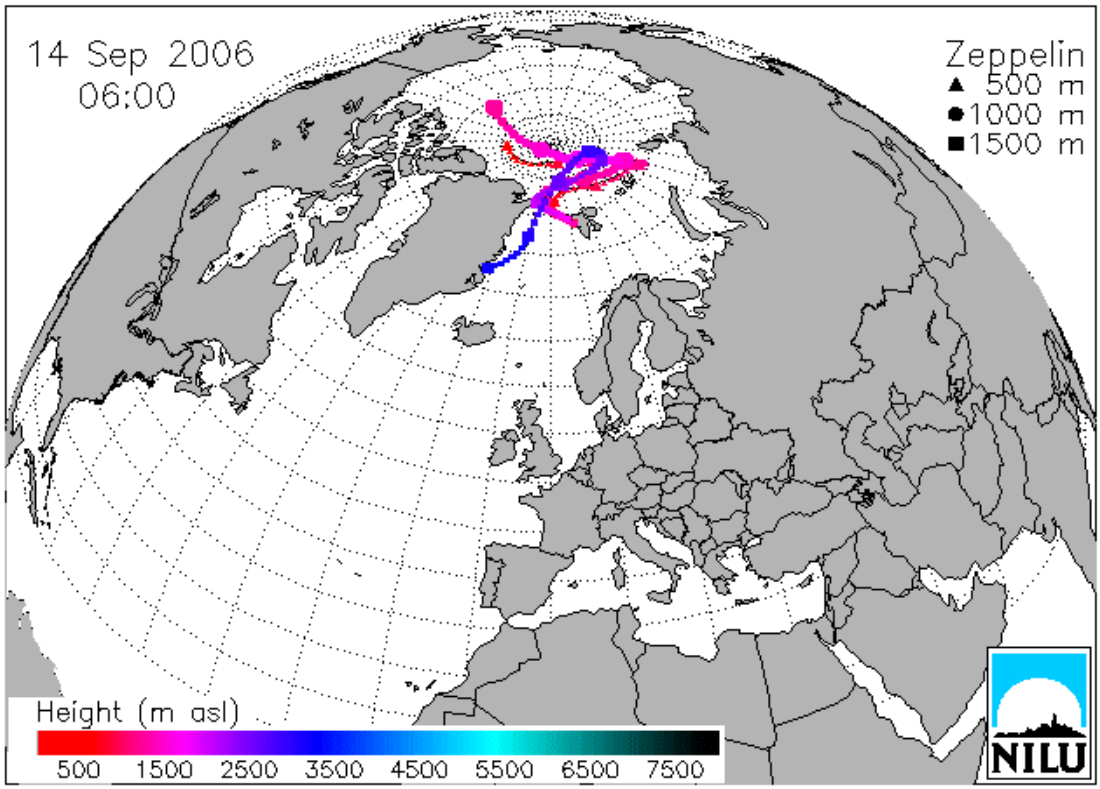



*Figure 11: Sample 2, Arctic region, 13.09.-15.09.2006*

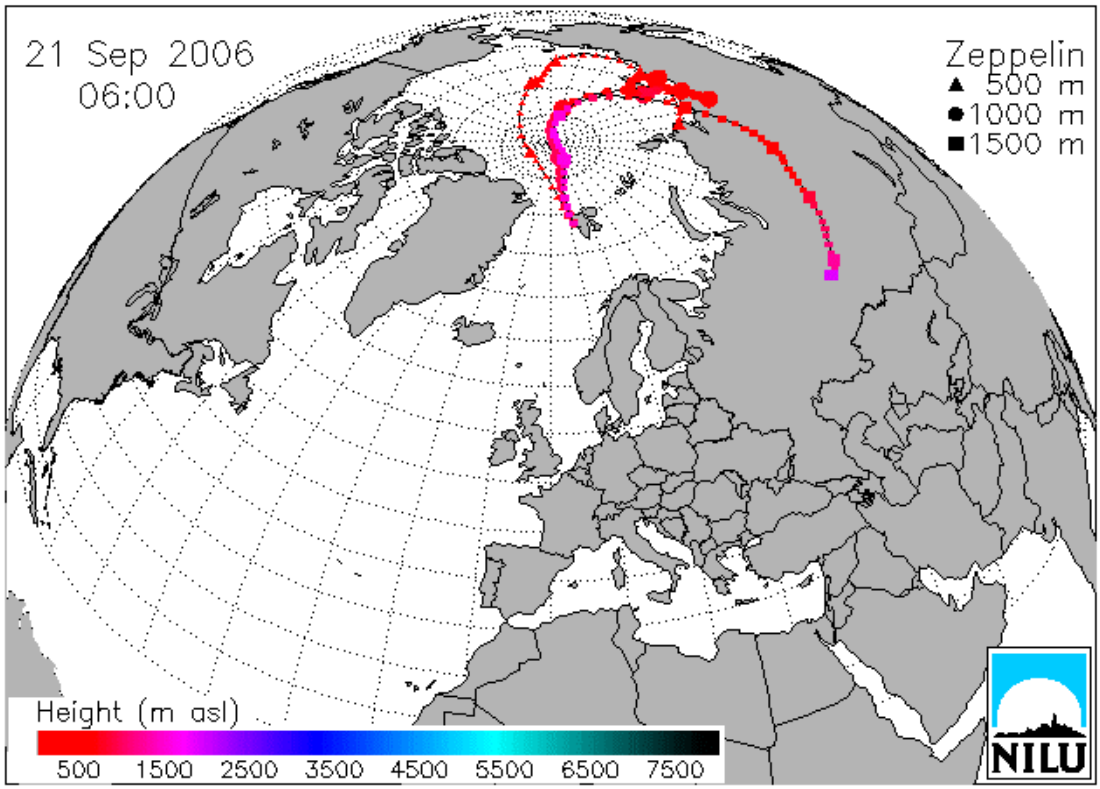



*Figure 12: Sample 3, Arctic region, 20.09.-22.09.2006*

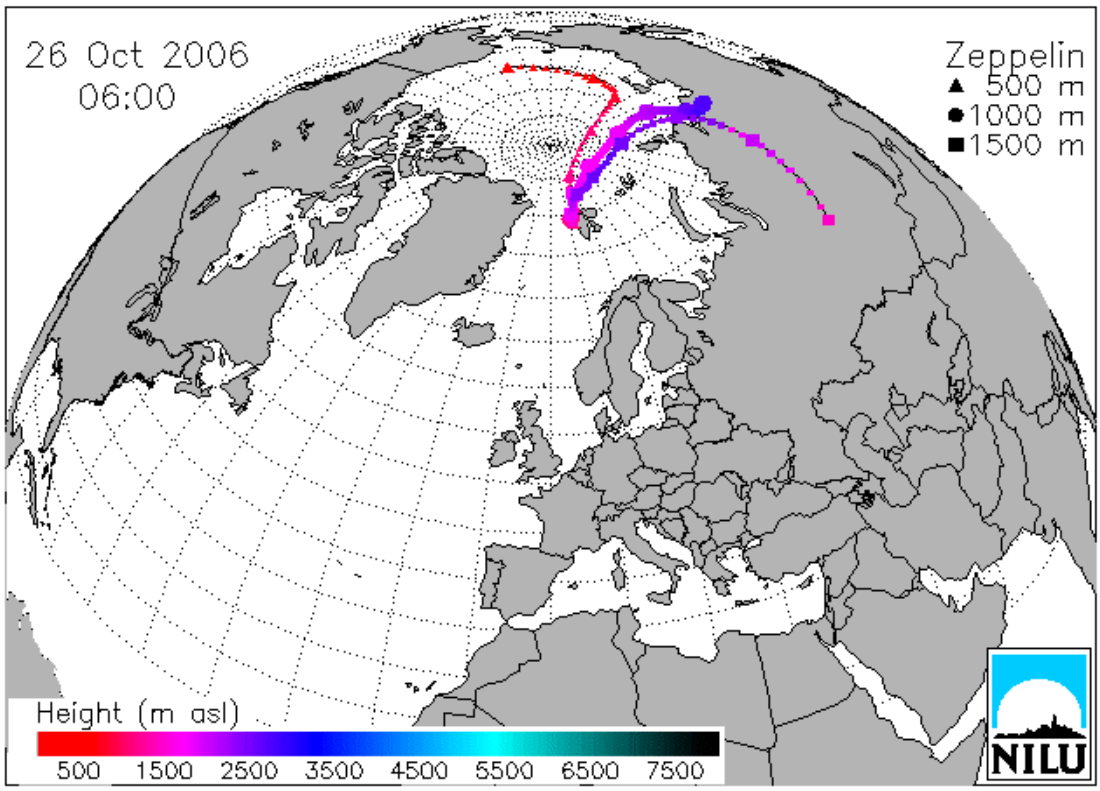



*Figure 13: Sample 4, Arctic region, 25.10.-27.10.2006*

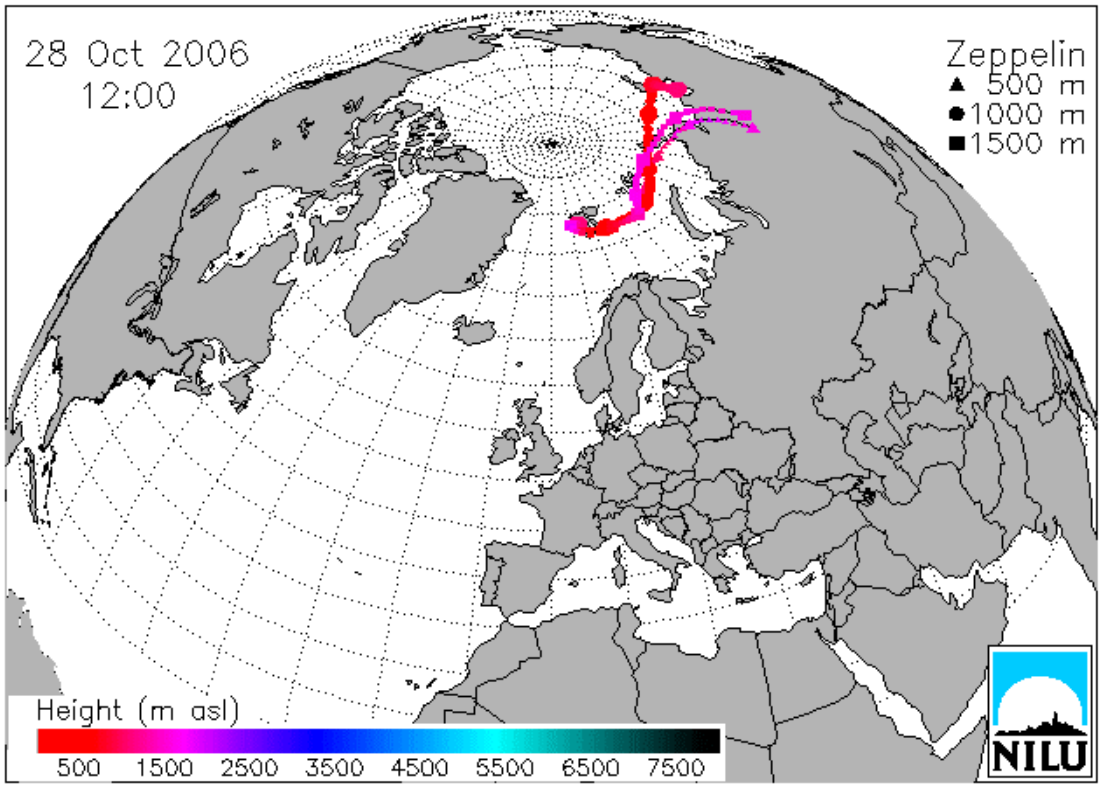



*Figure 14: Sample 5, Arctic region, 27.10.-29.10.2006*

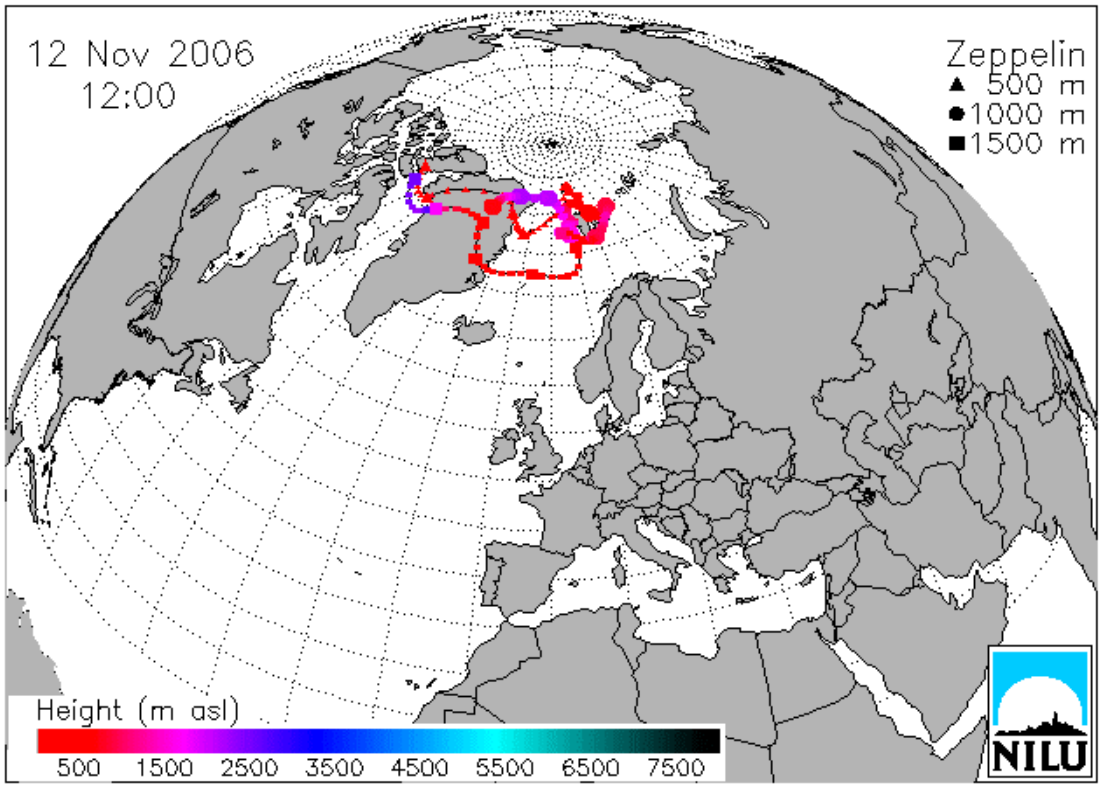



*Figure 15: Sample 6, Arctic region, 10.11.-13.11.2006*

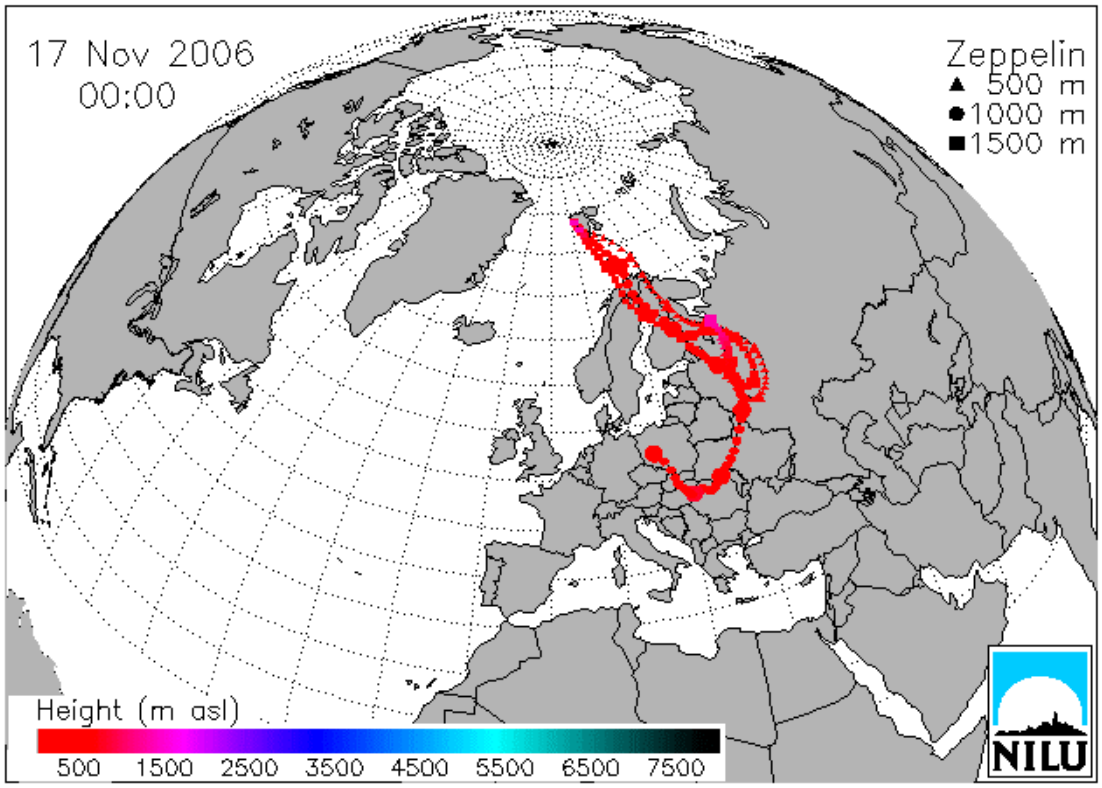



*Figure 16: Sample 7, Central Europe, 15.11.-17.11.2006*

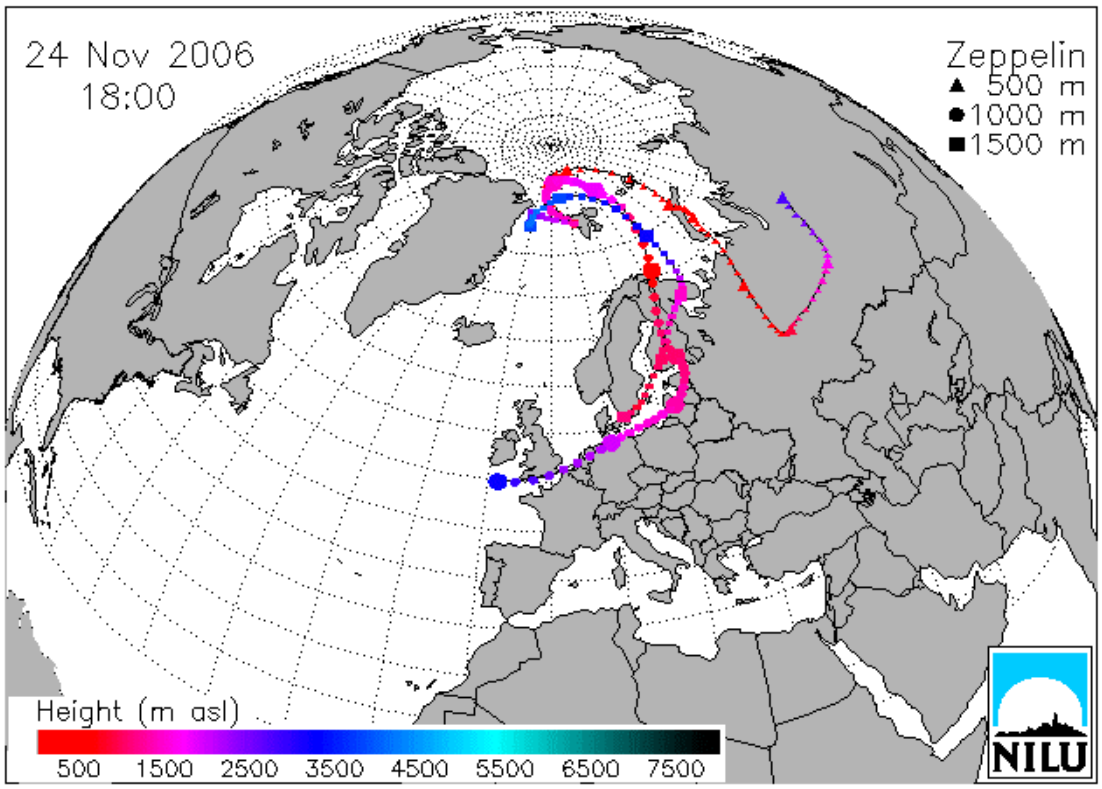



*Figure 17: Sample 8, Northern Europe, 24.11.-26.11.2006*

# 6. Results

## 6.1 Air samples from Birkenes

The concentration of endosulfan-I measured in air samples from Birkenes was in the range of 3,4 to 25 pg/$m^3$, whereas all the other compounds had a concentration below the limit of detection (see Table 2).

*Table 2: Concentration of the analyzed pesticides in air samples from Birkenes, Southern Norway given in pg/$m^3$.*

| Sample ID | Source region | Date | Endo-sulfan-I | Endo-sulfan-II | Endosulfan sulfate | Dieldrin | Endrin |
|---|---|---|---|---|---|---|---|
| | | | in pg/$m^3$ | | | | |
| 1 | Arctic region | 31.05.-01.06.2006 | 3,83 | <0,02 | <0,01 | <0,3 | <1,0 |
| 2 | Arctic region | 25.10.-26.10.2006 | 5,08 | <0,02 | <0,01 | <0,3 | <1,0 |
| 3 | British Isles | 24.05.-25.05.2006 | 3,35 | <0,02 | <0,01 | <0,3 | <1,0 |
| 4 | British Isles | 16.08.-17.08.2006 | 10,7 | <0,02 | <0,01 | <0,3 | <1,0 |
| 5 | Western Europe | 13.09.-14.09.2006 | 22,0 | <0,02 | <0,01 | <0,3 | <1,0 |
| 6 | Western Europe | 11.10.-12.10.2006 | 7,80 | <0,02 | <0,01 | <0,3 | <1,0 |
| 7 | Eastern Europe | 05.07.-06.07.2006 | 25,1 | <0,02 | <0,01 | <0,3 | <1,0 |
| 8 | Eastern Europe | 03.08.-04.08.2006 | 12,3 | <0,02 | <0,01 | <0,3 | <1,0 |

## 6.2 Air samples from Ny-Ålesund

The concentration of endosulfan-I measured in air samples from Ny-Ålesund was in the range of 5,2 to 13,2 pg/m$^3$ and of dieldrin in the range of <0,2 to 0,99 pg/m$^3$, whereas all the other compounds had a concentration below the limit of detection (see Table 3).

*Table 3: Concentration of the analyzed pesticides in air samples from Ny-Ålesund, Spitsbergen given in pg/m$^3$.*

| Sample ID | Source region | Date | Endo-sulfan-I | Endo-sulfan-II | Endosulfan sulfate | Dieldrin | Endrin |
|---|---|---|---|---|---|---|---|
| | | | in pg/m$^3$ | | | | |
| 1 | Arctic region | 06.09.-08.09.2006 | 9,98 | <0,01 | <0,01 | <0,2 | <0,5 |
| 2 | Arctic region | 13.09.-15.09.2006 | 8,04 | <0,01 | <0,01 | 0,99 | <0,5 |
| 3 | Arctic region | 20.09.-22.09.2006 | 5,16 | <0,01 | <0,01 | <0,2 | <0,5 |
| 4 | Arctic region | 25.10.-27.10.2006 | 13,2 | <0,01 | <0,01 | 0,21 | <0,5 |
| 5 | Arctic region | 27.10.-29.10.2006 | 8,61 | <0,01 | <0,01 | <0,2 | <0,5 |
| 6 | Arctic region | 10.11.-13.11.2006 | 6,36 | <0,01 | <0,01 | <0,2 | <0,5 |
| 7 | Central Europe | 15.11.-17.11.2006 | 10,3 | <0,01 | <0,01 | 1,48 | <0,5 |
| 8 | Northern Europe | 24.11.-26.11.2006 | 5,57 | <0,01 | <0,01 | 1,42 | <0,5 |

## 6.3 Sediment samples from Norwegian coastal stations

With the exception of Dieldrin in one sediment sample from Inner Oslofjord all analytes in all samples are below the limit of detection (see Table 4). The limit of detection is determined for each sample separately and is varying from sample to sample. This can be due to day-to-day variation of the instrument sensitivity and/or due to unremovable organic sample matrix which may reduce the instrument response.

*Table 4: Concentration of the analyzed pesticides in air samples from Ny-Ålesund, Southern Norway given in pg/m$^3$.*

| Sample ID | Station | Endo-sulfan-I | Endo-sulfan-II | Endosulfan sulfate | Dieldrin | Endrin |
|---|---|---|---|---|---|---|
| | | in pg/m3 | | | | |
| 1 | Randsfjorden | < 0,01 | < 0,01 | < 0,01 | < 0,06 | < 0,06 |
| 2 | Mjøsa | < 0,02 | < 0,01 | < 0,01 | < 0,10 | < 0,10 |
| 3 | Vansjø, Storfjorden | < 0,01 | < 0,01 | < 0,01 | < 0,03 | < 0,04 |
| 4 | Indre Oslofjord, BB | < 0,03 | < 0,05 | < 0,01 | < 0,75 | < 0,90 |
| 5 | Indre Oslofjord, BB | < 0,06 | < 0,07 | < 0,01 | 1,39 | < 0,99 |
| 6 | Indre Oslofjord, Steilene | < 0,08 | < 0,08 | < 0,01 | < 1,49 | < 1,80 |
| 7 | Indre Oslofjord, Steilene | < 0,04 | < 0,06 | < 0,01 | < 0,84 | < 1,01 |
| 8 | Ytre Langesundsfjorden | < 0,04 | < 0,06 | < 0,01 | < 0,78 | < 0,94 |
| 9 | Frierfjorden | < 0,06 | < 0,07 | < 0,02 | < 1,06 | < 1,28 |
| 10 | Eidangerfjorden | < 0,07 | < 0,19 | < 0,01 | < 1,36 | < 1,64 |
| 11 | Kristiansandfjorden | < 0,04 | < 0,06 | < 0,01 | < 1,03 | < 1,24 |
| 12 | Sognefjorden | < 0,01 | < 0,01 | < 0,01 | < 0,05 | < 0,06 |
| 13 | Ålesund | < 0,06 | < 0,06 | < 0,02 | < 0,87 | < 1,06 |
| 14 | Lofoten | < 0,01 | < 0,01 | < 0,01 | < 0,03 | < 0,03 |
| 15 | Malangen | < 0,04 | < 0,07 | < 0,01 | < 0,87 | < 1,06 |
| 16 | Varangerfjorden | < 0,03 | < 0,05 | < 0,01 | < 0,67 | < 0,81 |

# 7. Discussion and Conclusions

## 7.1 Air samples

To the best of our knowledge these are the first measurements of endosulfan in air samples in Norway. However, both endosulfan, dieldrin and endrin have been measured frequently in other countries.

*Table 5: Concentration of endosulfan, dieldrin, and endrin in air samples from other countries. Mean concentration/Concentration range*

| Area/ Year | Site type | Endo-sulfan-I | Endo-sulfan-II | Endosulfan sulfate | Dieldrin | Endrin | Reference |
|---|---|---|---|---|---|---|---|
| | | in pg/m3 | | | | | |
| Great Lakes, Chicago, USA 1996-2003 | Urban | 72/ 0,2-1200 | 6/ 0,048-65 | n.a. | 110 | 9,4 | Sun, 2006 |
| Great Lakes, Sleeping Bear Dunes,USA 1995-2003 | Rural | 84/ 0,12-1600 | 8,9/ 0,013-120 | n.a. | 24 | 3,6 | Sun, 2006 |
| Great Lakes Burnt Island, Canada 1993-2003 | Rural | 21/ 0,50-580 | 2,6/ 0,018-77 | n.a. | 9,2 | 0,78 | Sun, 2006 |
| Central Pyrenees | Rural | 1,0 – 6,6 | 0,5 – 1,6 | | | | van Drooge et al., 2004 |
| High Tratras | Rural | 1,4 – 42,8 | 0,7 – 7,5 | | | | van Drooge et al., 2004 |
| Råö, Sweden | Rural | 10,2 1,9 – 17 | 1,0/ 0,2 – 2,4 | 0,28/ 0,1 – 0,5 | n.a. | n.a. | IVL, 2004 |
| Pallas, Finland | Rural | 4,9/ 2,5 – 8,6 | < 0,4 | 0,25/ <0,2 – 0,3 | n.a. | n.a. | IVL, 2004 |
| Alert, Canada 1993-1997 | Arctic | 4,2 0,02-16 | n.a. | n.a. | 1,1 0,01-3,8 | n.a. | Hung, 2002 |
| Tagish, Canada 1993-1994 | Arctic | 7,05 0,08-89 | | | 1,11 0,04-20,6 | 0,26 0,07-4,52 | Halsall, 1998 |
| Birkenes | Rural | 11 3,35-25,1 | | | | | This study |
| Ny-Ålesund | Arctic | 8,4 5,16-13,2 | | | | 1,03 <0,2-1,48 | This study |

The concentration range of endosulfan measured at Birkenes, 3,4 to 25 pg/m$^3$, and Ny-Ålesund, 5,2 to 13,2 pg/m$^3$, are in the same range as samples from other rural or arctic sites which are not influenced by freshly use of endosulfan.

Since we have no historical data from Birkenes or Ny-Ålesund it is not possible to calculate a temporal trend. However, it seems apparent from the data from Arctic stations Alert and Tagish which are from the early 1990s that there is no substantial decrease of the Arctic levels.

The Birkenes samples which are representing the whole summer season of 2006 show a remarkable temporal variability of the concentration with a range varying over nearly one order of magnitude. This alone is already a good indication for the existence of active source

or at least that there are regions which are evaporating a significant higher level of endosulfan to air than other regions. In addition the concentration pattern shows significant higher values for periods with trajectories from potential source regions (Western and Eastern Europe) compared with periods with trajectories from other areas (British Isles and Arctic).

The fact that measurable amounts of endosulfan-I are found at Birkenes and Ny-Ålesund and the correlation of the concentration with origin of the air masses, are giving strong indications for airborne long-range transport of endosulfan. This conclusion is in correspondence with the Draft Dossier on endosulfan prepared on behalf of UN-ECE by the German Federal Environment Agency in 2004 and several other reports.

## 7.2 Sediment samples

Endosulfan-I, -II and endosulfan sulfate was not detected in sediment samples from Norway (LoD = 0,01 – 0,2 ng/g d.w.). Dieldrin was detected in one sediment sample from Inner Oslofjord but only slightly above the limit of detection.

In a recent Swedish screening study endosulfan-I, endosulfan-II, and endosulfan sulfate were analyzed. However, only endosulfan sulfate was detected in concentrations slightly above detection limit (0,09 – 0,15 ng/g d.w.) (LoD for endosulfan-I and –II: 0,5 - -1 ng/g d.w.).

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| Measurement of Endosulfan, Dieldrin and Endrin in Norwegian Air and Sediment Samples | Martin Schlabach |
| | NILU PROJECT NO.<br>O-106117 |
| AUTHOR (S)<br>Martin Schlabach, Stein Manø, and Sabine Eckhardt | CLASSIFICATION *<br>A |
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| KEYWORDS | | |
|---|---|---|
| Endosulfan | Ny-Ålesund | Birkenes |

ABSTRACT
Endosulfan-I, endosulfan-II, endosulfan sulfate, dieldrin and endrin are not part of the existing environmental monitoring network in Norway. To get an indication on the background concentration levels and long range atmospheric transport potentials of these compounds, NILU was requested to measure the concentrations of these compounds in air samples from Birkenes and Ny-Ålesund and in marine and fresh water sediment samples distributed all over Norway. Measurable amounts of endosulfan-I are found at Birkenes and Ny-Ålesund and the correlation of the concentrations with origin of the air masses, are strong indications for airborne long-range transport of endosulfan. Endosulfan-I, -II and endosulfan sulfate was not detected in sediment samples from Norway.

TITLE

Measurement of Endosulfan, Dieldrin and Endrin in Norwegian Air and Sediment Samples

ABSTRACT (in Norwegian)
Endosulfan-I, endosulfan-II, endosulfan sulfat, dieldrin og endrin er ikke del av den eksisterende miljøovervåkningen i Norge. For å få en indikasjon på bakgrunnskonsentrasjonsnivåene og potensialet for atmosfærisk langtransport av disse komponentene, ble NILU bedt om å måle konsentrasjonen av disse komponentene i luftprøver fra Birkenes og Ny-Ålesund, samt i prøver av marine sedimenter og ferskvannssedimenter spredd over hele Norge. Målbare mengder av endosulfan blir funnet i luft på Birkens og i Ny-Ålesund og at det er samsvar mellom konsentrasjoner og opprinnelse av luftmasser, gir en sterk indikasjon på luftbåren langtransport av endosulfan. Endosulfan-I, -II og endosulfan sulfate ble ikke detektert i norske sedimentprøver.

| | | |
|---|---|---|
| ** Classification:* | *A* | *Unclassified (can be ordered from NILU)* |
| | *B* | *Restricted distribution* |
| | *C* | *Classified (not to be distributed)* |

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