

Seasonal variation in ozone deposition to a spruce forest in Norway

Lars R. Hole
 Norwegian Institute for Air Research (NILU)
 P.O. Box 100
 N-2027 Kjeller
lrh@nilu.no

Since 1 July 2000 monitoring of O₃ deposition has been undertaken by the Norwegian Institute for Air Research (NILU) in a Norway spruce forest (*Picea abies*) in Hurdal, East Norway (60° 22' N, 11° 4' E)[\[i\]](#). The forest is relatively homogeneous in tree height and topography and was clear cut about 35 years ago. Average tree height is now around 12 to 14 m. The climate in the area is continental with winter January normal temperature of -7.2 °C and July normal temperature of +15.2 °C. Wind and temperature profiles are measured using a 25 m tower. O₃ concentration at two heights is measured by one UV absorption (API 400 O₃ analyser) switching from intakes at 15 and 25 m above ground in 5 minute cycles. At the same time background measurements are carried out continuously at 15 m. All data are stored as 1 hour averages.

The ozone deposition velocity at 15 m has been calculated by the gradient method, with profile parameterisations from Høglund[\[ii\]](#). Results are corrected for the break down of similarity laws in the surface transition layer above the rough forest[\[iii\]](#). The roughness length is estimated from the wind profiles to be 0.5 m, and the displacement height for the dense forest is set to 12 m.

Diurnal cycles appear in three seasons. In winter (December-February) V_d is almost constant at 1 mm/s. Spring (March-May) nocturnal minimum is equal to the winter average. In this area, the ground is snow covered most of the spring. Another interesting feature is the morning and afternoon daily peaks in the three active seasons. Summer (June-August) diurnal maximum is 9.2 mm/s and summer mean is 5.7 mm/s. Yearly mean is 3 mm/s, while yearly average O₃ concentration at 15 m is 55 µg/m³. In spring, average O₃ concentration at 15 m is 74 µg/m³.

[\[i\]](#) L.R. Hole, A.Semb and K. Tørseth, *Seasonal variation in ozone deposition to a spruce forest in Norway*. In prep.

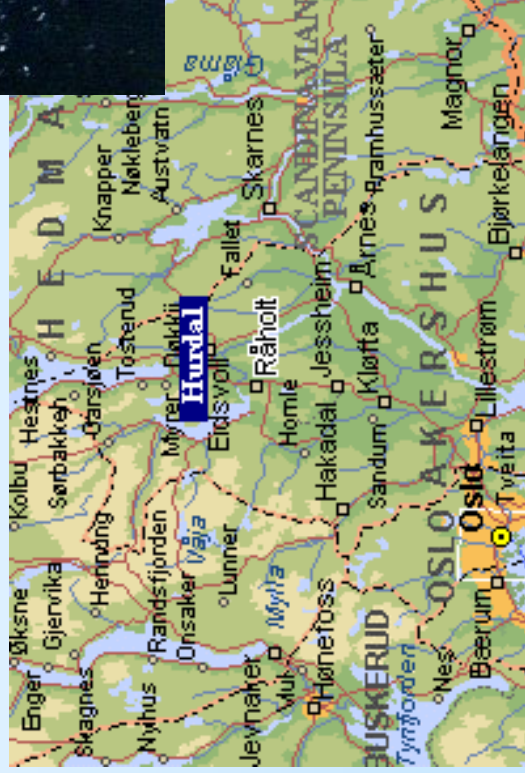
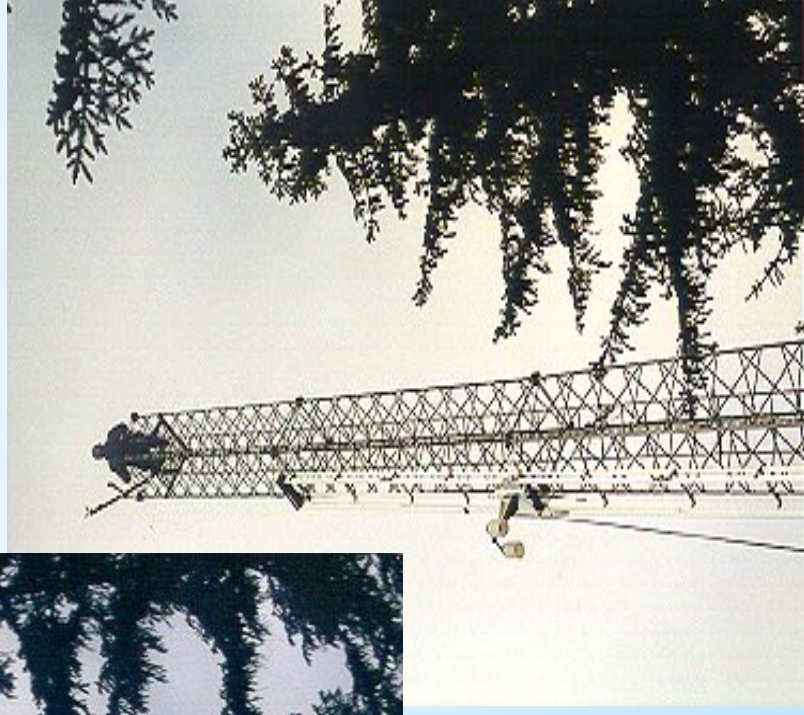
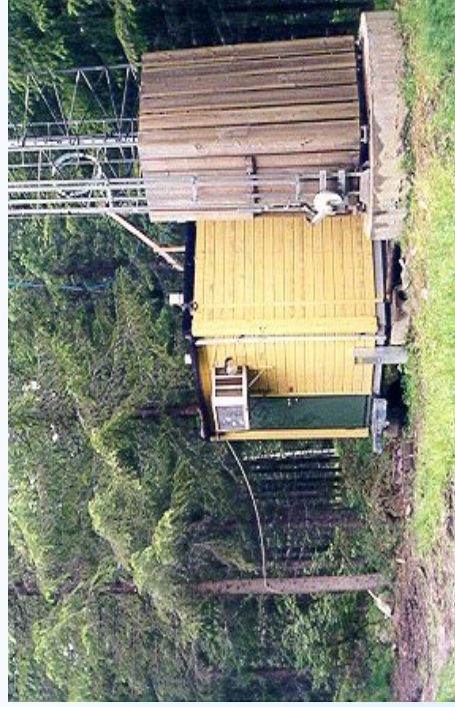
[\[ii\]](#) A.A.M. Høglund, *Estimates of diabatic wind speed profiles form near-surface weather observations*, Boundary layer meteorology **29**, 225-250, 1984.

[\[iii\]](#) J. Garratt, *The atmospheric boundary layer*, p 58. Cambridge Univ Press, ISBN 0-521-46745-4, 1999.

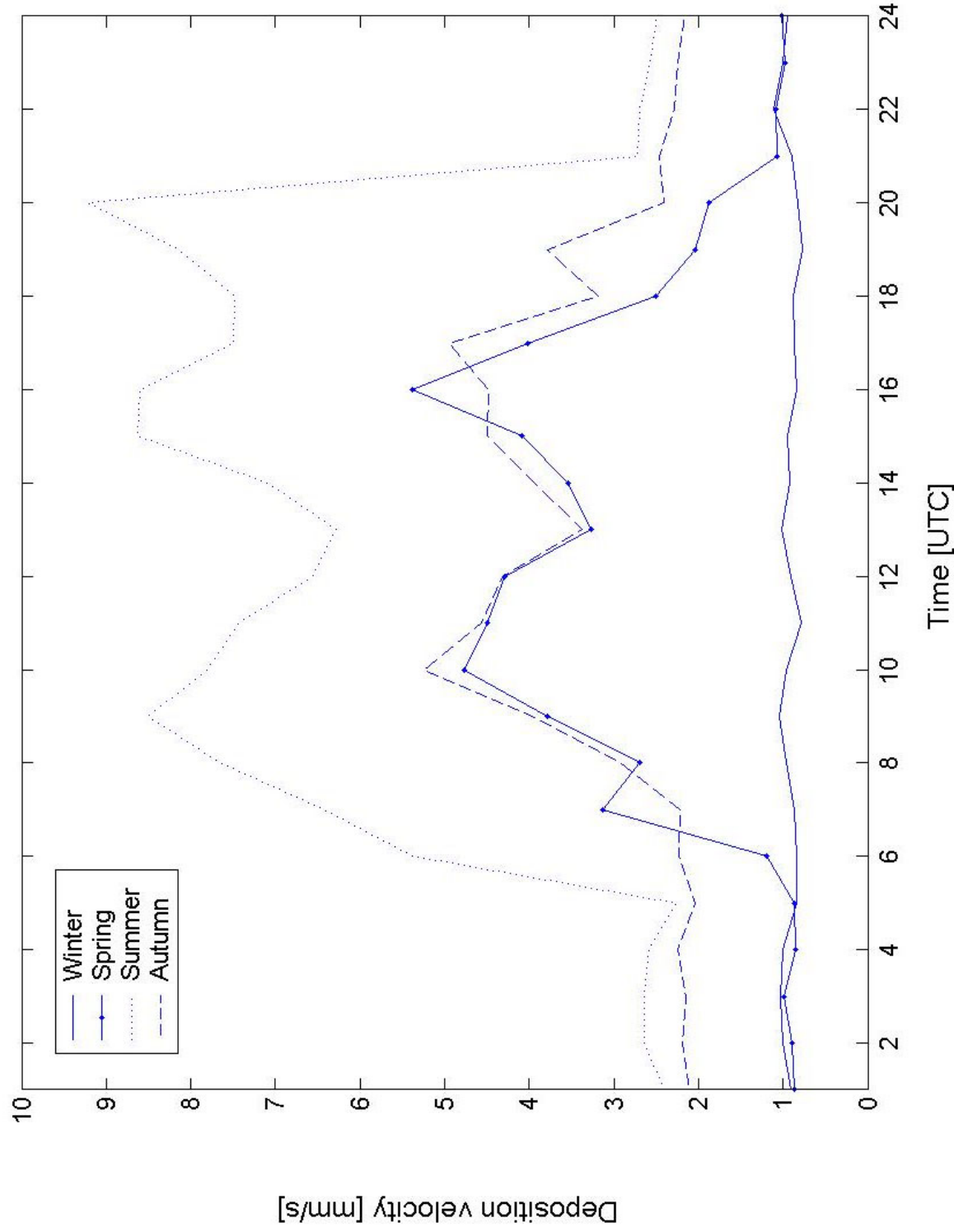
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- UV absorption (API 400) analyser switching from intakes at 15 and 25 m
- V_d estimated by gradient method, $d = 12$ m, $z_0 = 0.5$ m
- Corrected for the break down of similarity laws in the surface transition layer
 $z^* = 100 z_0$

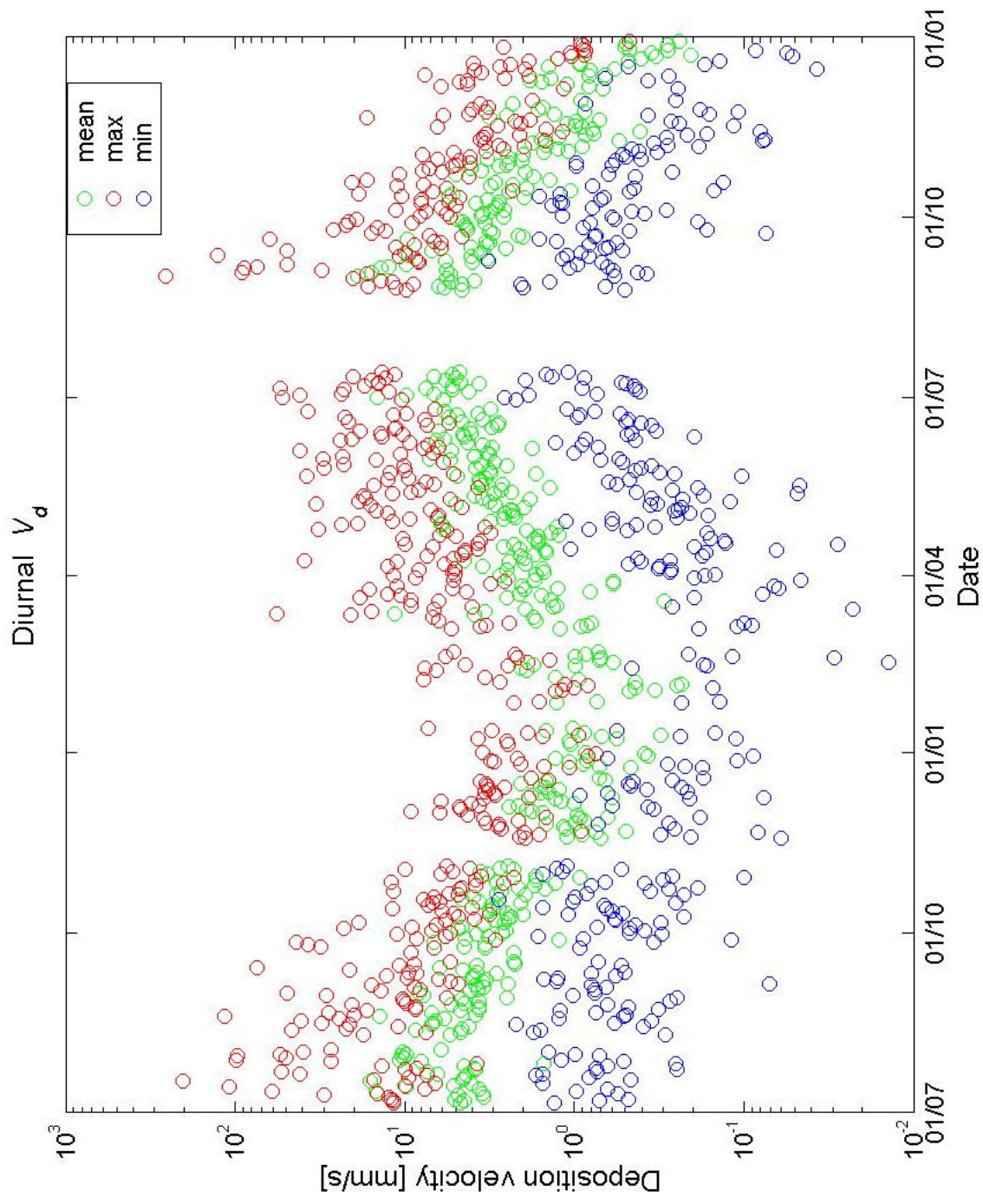
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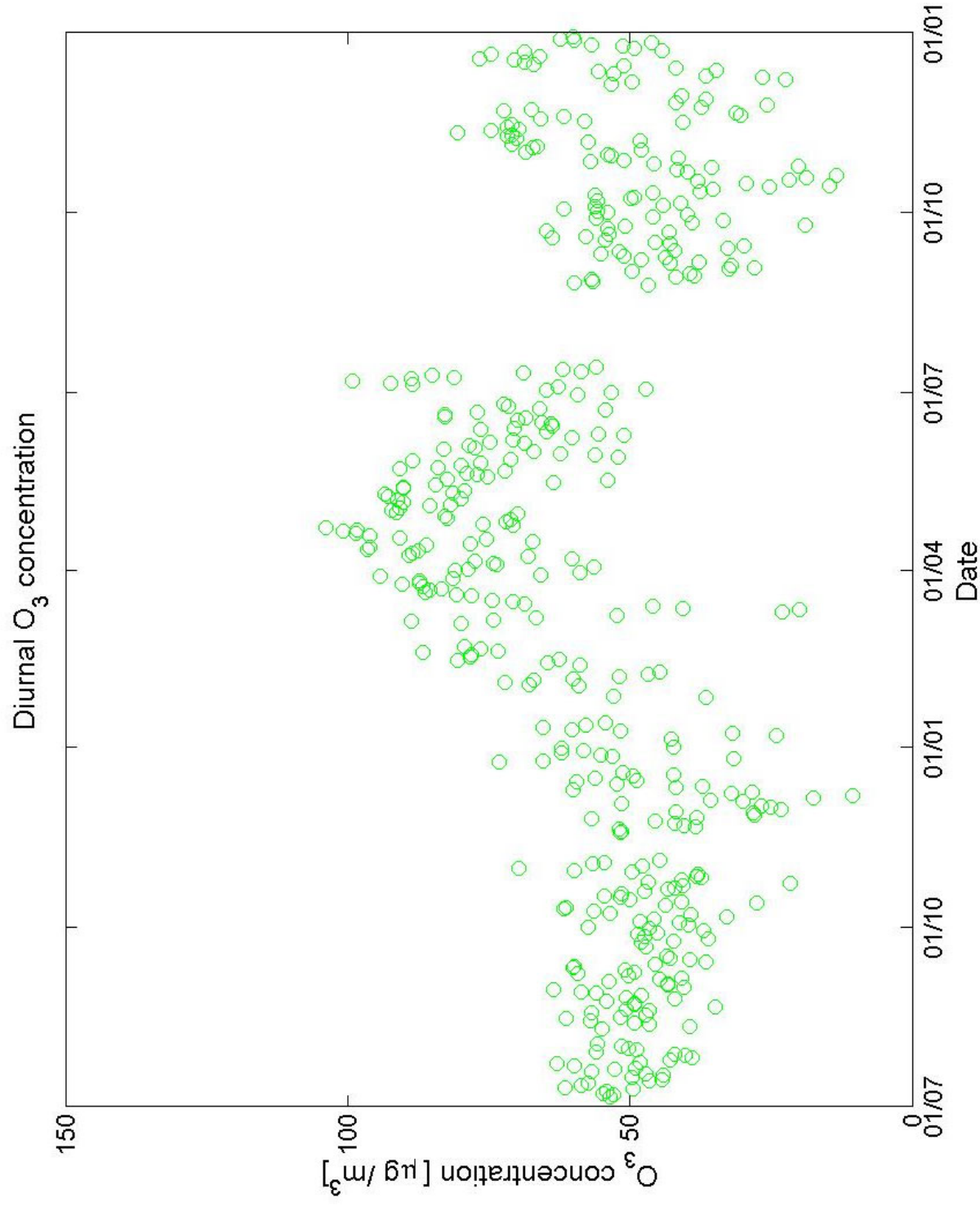
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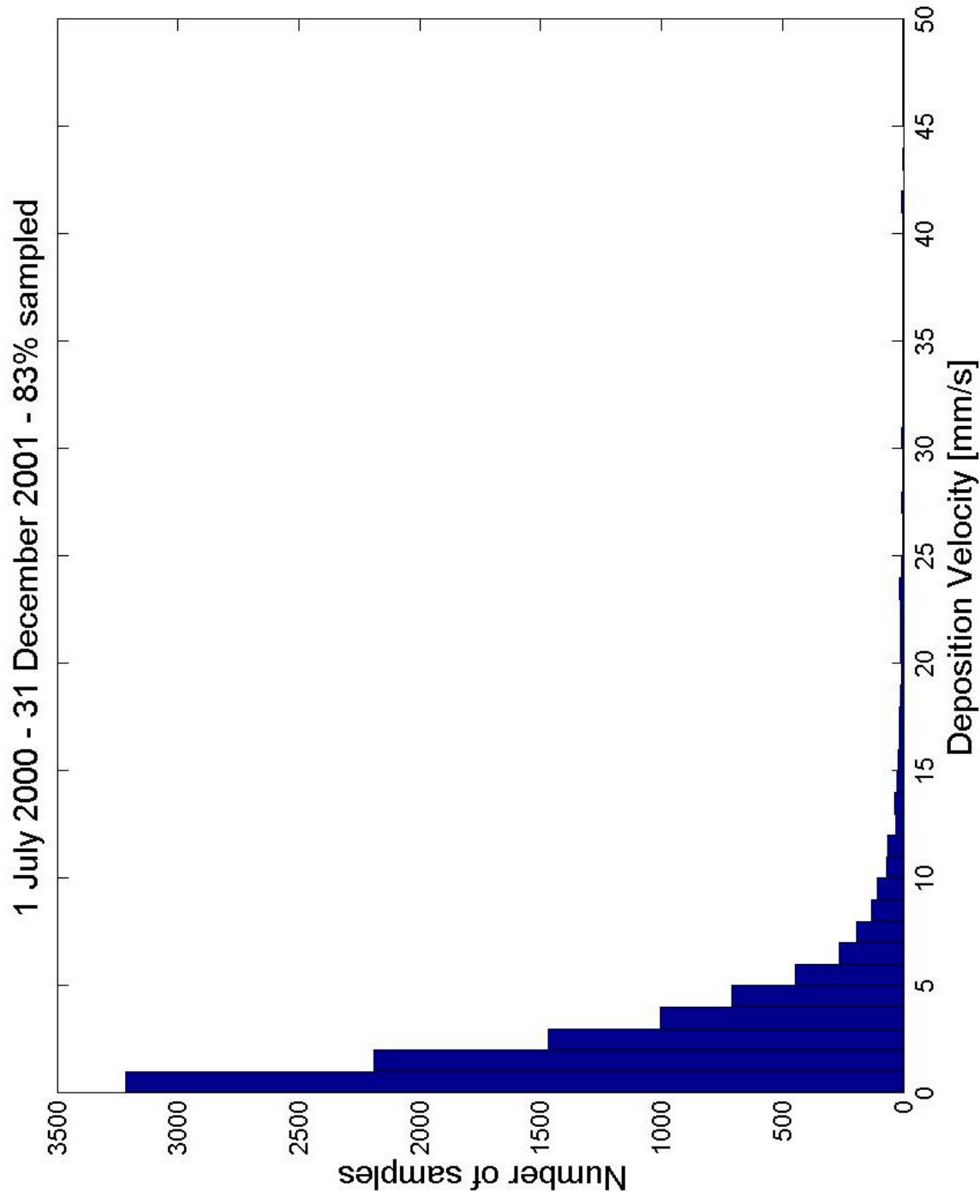
Ozone deposition July 2000 – December 2001



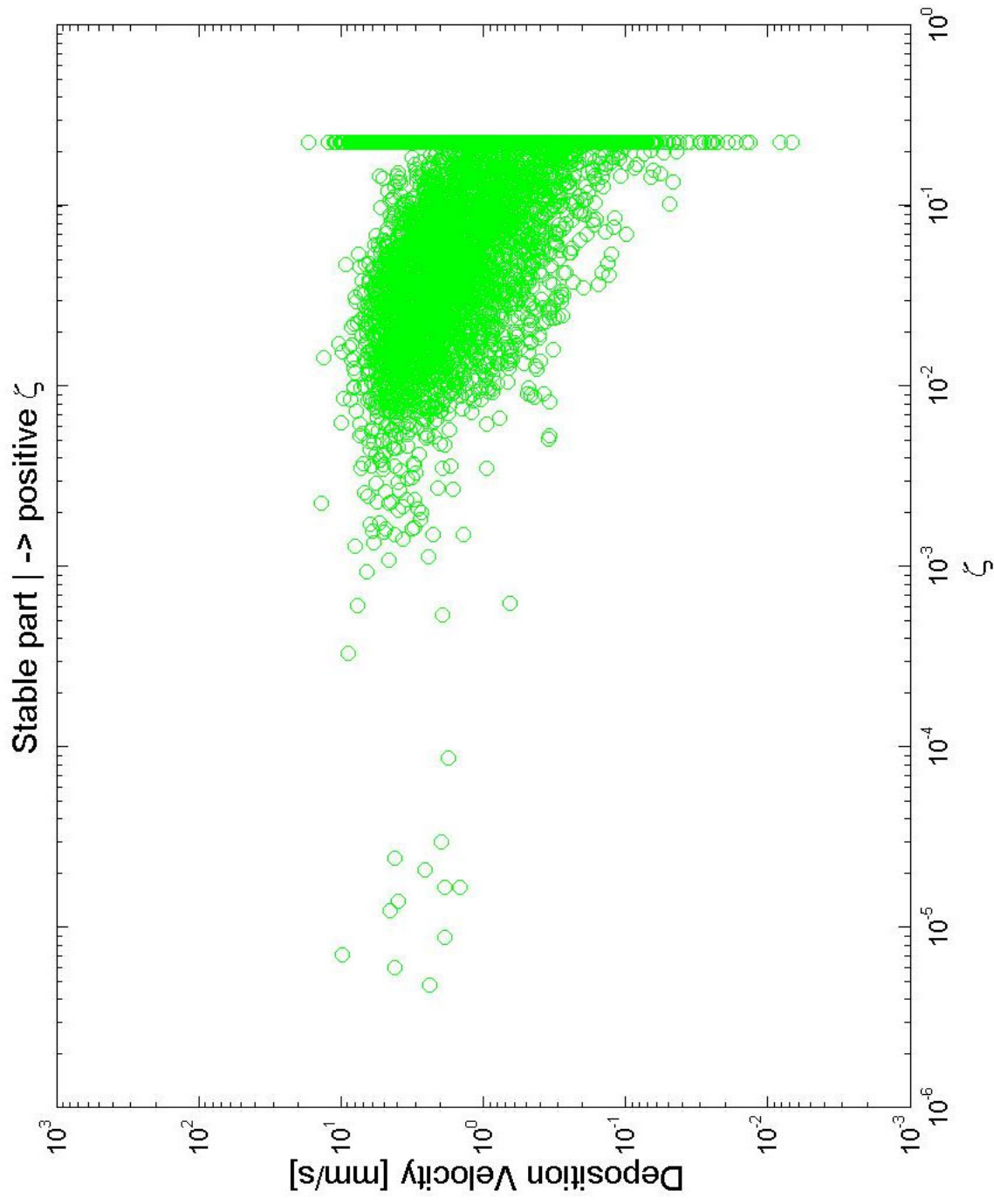
Ozone concentration July 2000 – December 2001



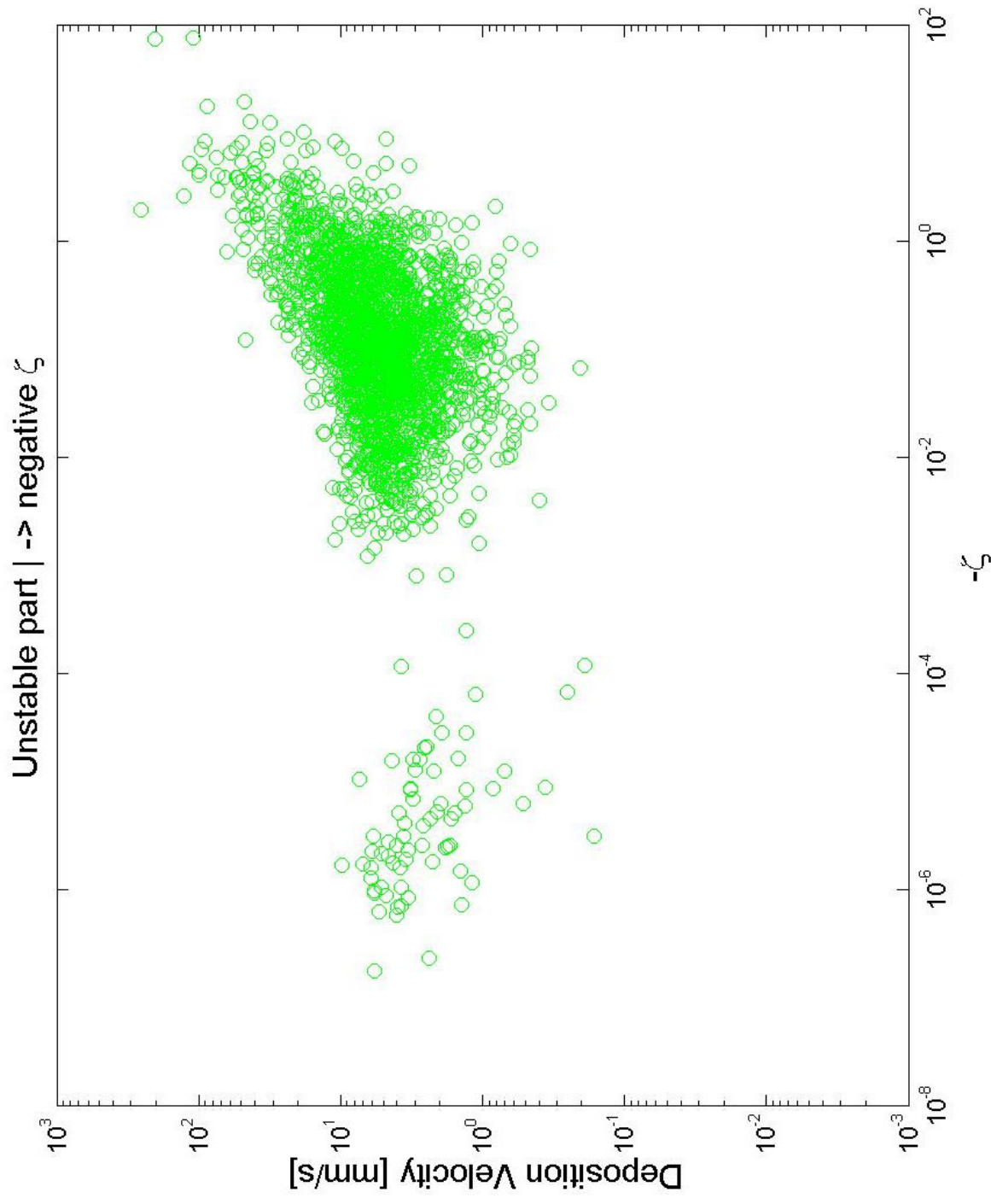
Frequency distribution



Stability analysis



Stability analysis



Future

- Install sonic anemometer (July 2002) for better analysis and measurements of u^* and θ^*
- Modelling (EMEP, NILU CTM ...)