

## Acknowledgements

Doing measurements is great. If you liked to play with LEGO-technic when you were a child or when you fancy a bit of computer programming, try this: playing around with state of the art equipment amidst geese and cows on a peatland site on a nice summer's day. It probably takes a mental deficit to enjoy trimming a laser spectrometer to single mode operation and to get excited of a green scattering line appearing on the PC screen. On the other hand, there are addictions with more negative social and economic impacts. This type of work is rewarding because it aims to better understand how mother nature deals with what we humans impose on her. Furthermore we like to get a grip on what we can do to ease that burden and avoid potential negative consequences. Having been able to do this work now for two decades is valuable. Having been able to do this work in a team of nice colleagues who share my 'mental deficits' to a large extend, is priceless.

In chronological order I have to start to thank my mentor at Utrecht University, Jeroen van der Hage, who learned and showed me the fun of doing experimental work both in the lab and on the Atlantic ocean. With him and with my "grandpa Hensen" I share the hamster habit of preserving (and if necessary retrieving from a container) all kind of seemingly useless things that are key tools for an experimentalist.

Sjaak Slanina (†), Pim Kieskamp and Kees van der Klein hired me at ECN and I thank them for giving me the opportunity to work in the dunes. Sjaak once promised me that if he would catch me holding a screwdriver he would chop my hand off. Fortunately that never happened in spite of all the tools I used. With Pim Kieskamp, Pim van der Bulk and Alex Vermeulen we started installation of the monitoring system at the Cabauw tower. In 1992 we made a sketch of a network of tall towers to monitor greenhouse gasses. Now, in 2011, the ICOS NL proposal (co submitted by Alex), asks funding for that same idea. Pim and Alex have both contributed significantly to this booklet and I thank them for all the nice work we did together. Paul Wyers, Jan Willem Erisman and Gerard de Groot were my supervisors in the subsequent years. With Paul I was introduced to ammonia experiments and to some aerosol work. I really liked the MEMORA project in which Gerard Kos and Harry ten Brink provided me with a re-introduction to the aerosol work I did with Jeroen.

With Jan Willem I had lots of nitrogen-fun, ranging from ammonia plume measurements to designing energy-friendly roads, to making the Nitrogenius game. The latter still provides me with an annual highlight: giving a lecture on Nitrogenius and evaluation of the games played at Wageningen University, with Carolien Kroeze. Jan Willem is still leading the integrated Nitrogen work, although (unfortunately) at a somewhat larger distance. In this work Albert Bleeker fortunately works just around the corner and we have spend many hours together designing working on the N-visualization tool and on all kind of other Nitrogen projects. In the substantial carbon and nitrogen related projects like LIFE, GRAMMINA, GREENGRASS and NITROEUROPE I also worked closely with the other team members. Piet Jongejan, Han Möls, Mark Blom, Peter Fontein, Hans van 't Veen and Arnoud Frumau also provided valuable input for this thesis. Lots of experiments were also successful thanks to Theo Schrijver who provided all sorts of the handy tools and adaptations for our instruments. Gerard de Groot supervised us over the last years and I really appreciate him helping me out with project administrative activities.

I have had the pleasure to work together with several trainees and guests both from Dutch and international origin. Yuanhang Zhang worked with me on the REA paper. A Spanish delegation with Antonio Diegues, Luis Amor and Julio Mosquera thought me how to prepare tortilla and they were very nice colleagues to work with. Julio played an

important role for the Braunschweig papers and is still a good friend. So is Chris Flechard, who came after Julio left. These two have taught me to read more literature before doing something yourself. The positive aspects of proper theoretical underpinning of the experimental work I also learned from Petra Kroon, who I supervised during her thesis work at ECN. With her and Aline Kraai we carried out very nice projects in recent years looking at greenhouse gas emissions and for example emissions from ships. Great fun as long as your equipment is not washed away from the cay (life on Radio-1). In many projects we worked together with the teams at KNMI, RIVM, RUG, TNO, WUR, UU, VU and international teams. I especially enjoyed working with Daan Swart, and his Lidar team and with the TNO colleagues Jan Duyzer and Hilbrant Weststrate whom I met in several projects. Marc Zahniser and the US Aerodyne team have meant a lot to me, providing ECN with the beautiful laser spectrometers that are key instruments in this thesis. Albrecht Neftel and his team, Pierre Cellier, Benjamin Loubet and Patricia Laville are part of the Nitrogen research community and also active with these instruments. This also goes for the CEH Edinburgh crew. I am honoured to have David Fowler in the thesis committee. He and his team at CEH with Mark Sutton, Eiko Nemitz, Ute Skiba, Celia Milford and Daniela Famuliari et. al., have done and are doing lots of innovative experiments that were an example for me and may others. From the same scene I know Klaus Butterbach Bahl who is a bit of a modeler but that should by no means be interpreted as a disqualification. Annette Freibauer is the lady on the committee and she was co-coordinating the MIDAIR project that features in chapter 7 and fortunately we've kept in contact after that in the EU carbon projects. The other two committee members Thomas Röckmann and Ko van Huissteden are Dutch university partners in several projects where we cooperate either at the Cabauw tower or at the Horstermeer site.

I thank both Han Dolman and Jan Willem Erisman as my promoter and co promoter. Han and I have quite a long relation in time but intermittent in intensity. Jan Willem is a nearby and stimulating colleague. Both of them helped me to get this work done. For all layout work and corrections needed, Marloes Krijnen and Albert Bleeker provided significant input for the thesis. And there are many other colleagues in and outside ECN that I should thank but I will not do that here to keep within the  $12 \times 1 \times 12 = 144$  pages which seems appropriate given the defence day date.

Last but certainly not least I owe great and many thanks to Marije. She helped me a lot to keep me work on this booklet, providing both time at home and comments to the final version. I thank Emma and Timo to make me realize how important this work really is.....

I hope you, the reader of this, will like what you see in this booklet and if you have any questions left, do not hesitate to contact me.

Arjan