ECOSYSTEM SERVICES AND BIOLOGICAL DIVERSITY

Dynamic vegetation modelling at ICP IM sites

Progress report

Maria Holmberg
Finnish Environment Institute

22nd ICP Integrated Monitoring
Task Force Meeting and Workshop
Westport, Ireland 7. - 9.5.2014

SYKE

LRTAP
Long-range Transboundary Air Pollution

Dynamic vegetation modelling study at selected ICP IM sites

Contributions from ICP M&M, ICP Forest

Participants (incl. potential participants)

Maria Holmberg (FI, ICP IM), Julian Aherne (IE), Dan Aamlid (NO), Jesper Bak (DE), Luc Bonten (Alterra), Thomas Dirnböck (AT), Alessandra de Marco (IT), Heleen de Wit (NO), Martin Forsius (ICP IM), Martyn Futter (SE), Ulf Grandin (SE), Lars Lundin (ICP IM), Sirpa Kleemola (ICP IM), Pavel Krám (CZ), Janet Mol (Alterra), Enrico Pompei (IT, ICP IM), Maximilian Posch (CCE), Gert Jan Reinds (Alterra), Maija Salemaa (FI), Jésus Miguel Santamaría (ES), Milán Vána (CZ), Jussi Vuorenmaa (FI, ICP IM), Wieger Wamelink (Alterra), Helga Dieffenbach-Fries (DE, ICP IM), Burkhard Beudert (DE, ICP IM), Hubert Schulte-Bisping (DE, ICP IM), Thomas Scheuschner (DE, Oekodata, ICP M&M)

Dynamic vegetation modelling at ICP IM sites

EU No Net Loss of Biodiversity

- Biodiversity threatened by multiple stressors including
  - Nitrogen (N) pollution, climate change, land use
  - Rate of loss of biodiversity not slowing down
  - Pressures increasing

    (Butchart et al. 2010)
- EU Biodiversity strategy 2011
- EU No Net Loss Initiative expected 2015

Dynamic vegetation modelling at ICP IM sites

Role of N deposition in loss of biodiversity

- N emissions stabilized or increased slightly

  Amann et al. 2013

- Long term impacts of N deposition on biodiversity identified and likely to continue under projected deposition levels

  Bobbink et al. 2010

  Dirnböck et al. 2014

Dynamic vegetation modelling at ICP IM sites

Aims of study

- Integrate valuable data into method development process
  - Long term data from wide range of habitats (ICP IM, Forest)
    - N_{tot} input from 1.3 (SE16 1999-2009) to 10.5 (IT12 1997-2011) kg ha^{-1} yr^{-1}
    - *Picea* taiga G3.A, Mediterreanean *Quercus* woodland G2.1
- Dynamic models allow describing
  - Cumulative and delayed effects
- Contribute to testing the effects based approach
  - Models able to reproduce observations?
- Help identify meaningful endpoints
  - Test indicators, reference states and thresholds
    - No net loss of biodiversity

Dynamic vegetation modelling at ICP IM sites

Progress by May 2014

- Overall aim and outline of work identified, sites selected
  - Contacts, discussions, first work plan in 2013
  - 16 sites, and potential for adding 3 sites
- Models identified
  - VSD+ suite of models available at CCE website
  - BERN model version 3.3 by OEKODATA
- Deposition compiled for each site
  - Modelled historic (1880 – 1995) *Schöpp et al. 2003*
  - Modelled scenario (2005, 2010, 2020, 2030) with current legislation and revised Gothenburg protocol emissions

    EMEP model *Simpson et al. 2012*
- Preliminary calibrations for 10 sites

Dynamic vegetation modelling at ICP IM sites

Plans 2014-2015

- Details of workflow to be agreed during this meeting and by email exchange
- Suggested schedule
  - Soil model calibrations by September 2014
    - By modellers representing national sites, or as agreed
  - Vegetation modelling by December 2014
    - By Thomas Dirnböck, Thomas Scheuschner
  - First draft of manuscript by February 2015
    - Compiled by Maria, contributions and comments by all
  - Manuscript submitted to journal by May 2015
    - Ecological Indicators, e.g.

Location of ICP IM sites.
Triangles indicate (potential) participation in joint dynamic modelling study.

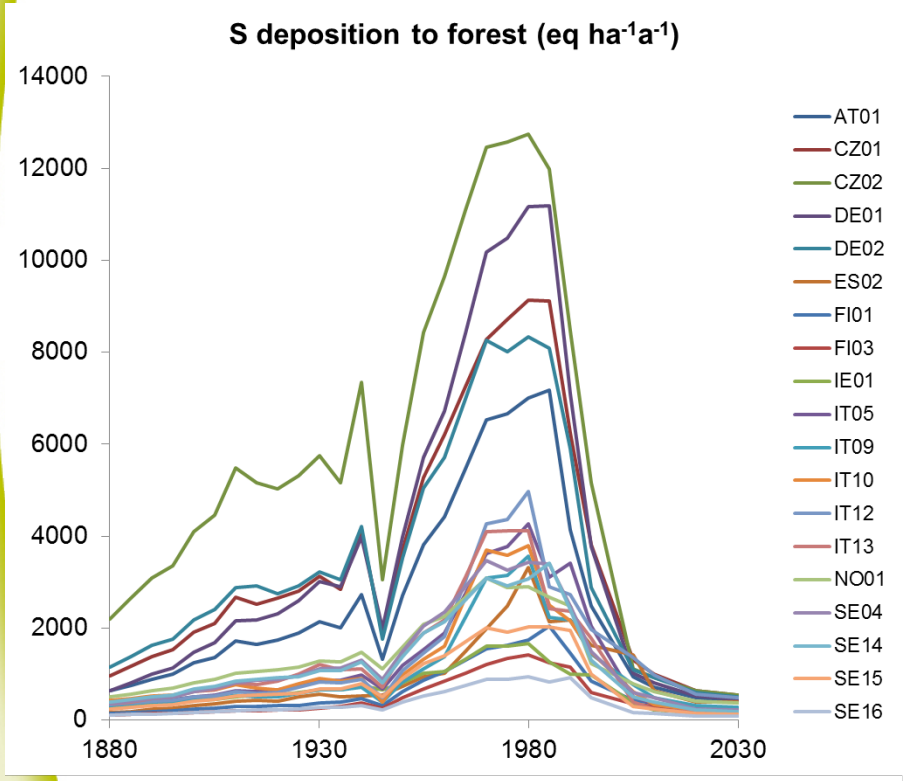
January 2014

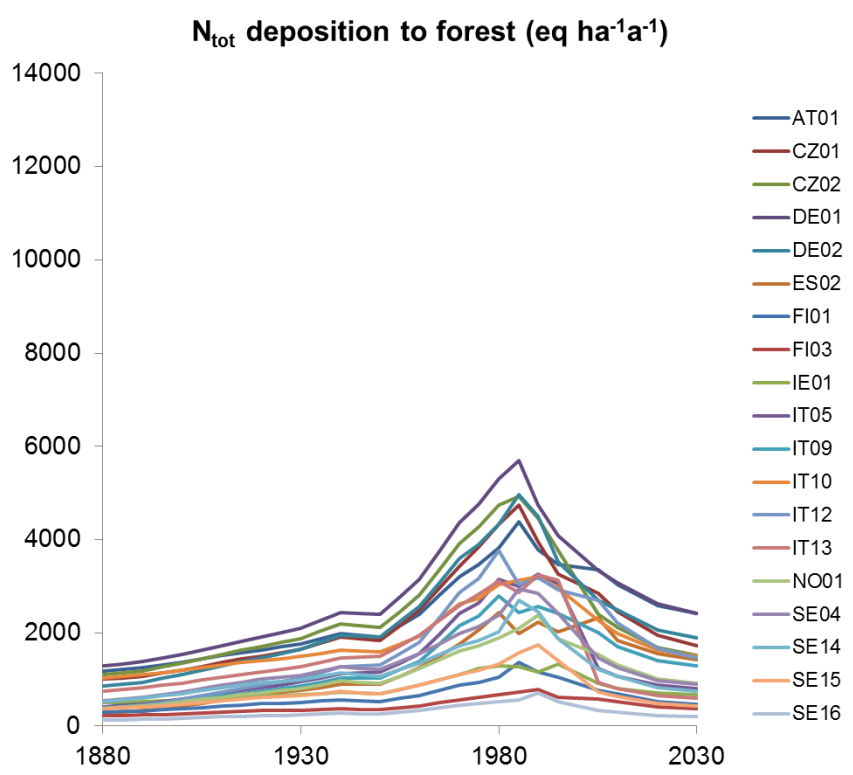
SYKE

ICP IM sites included in dynamic modelling study: 16 sites plus 3 with potential participation indicated by italics

Code	Site	Latitude	Longitude	EUNIS	Predominant vegetation
AT01	Zöbelboden	N47°50'	E14°26'	G3.1, G4	Spruce (Picea abies), Beech (Fagus sylvatica)
CZ01	*Anenske Povodi*	*N49° 35'*	*E15°05'*	*G1, G3.1*	*Alder (Alnus), Spruce (Picea abies)*
CZ02	*Lysina*	*N50° 03'*	*E12° 40'*	*G3.1*	*Spruce (Picea abies)*
DE01	Forellenbach	N48°56'	E13°25'	G1, G3.1	Beech (Fagus sylvatica), Spruce (Picea abies)
DE02	Neuglobsow	N53° 08'	E13° 02'	G4	Beech (Fagus sylvatica) and pine (Pinus sylvestris)
ES02	Bertiz	N43°09'	W01°37'		
FI01	Valkea-Kotinen	N61°14'	E25°03'	G3.A, G4.2	Spruce (Picea abies), Pine (Pinus sylvestris) , Birch (Betula spp.)
FI03	Hietajärvi	N63°09'	E30°40'	G3.A, G4.2	Spruce (Picea abies), Pine (Pinus sylvestris) , Birch (Betula spp.)
IE01	Brackloon Wood	N53° 46'	W09° 33'		
IT05	Selva Piana	N41°50'	E13°35'	G1.6	Beech (Fagus sylvatica)
IT09	Monte Rufeno	N42°49'	E11°54'	G1.8	Oak (Quercus cerris)
IT10	Val Masino	N46°14'	E09°33'	G3.1	Spruce (Picea abies)
IT12	Colognole	N43°30'	E10°26'	G2.1	Oak (Quercus ilex)
IT13	La Thuile	N45°43'	E06°55'	G3.1	Spruce (Picea abies)
NO01	*Birkenes*	*N58° 23'*	*E08°15'*	*G1,G3.A,G3.B*	*Aspen (Populus tremula), Spruce (Picea abies), Pine (Pinus sylvestris)*
SE04	Gårdsjön	N58° 03'	E12° 01'	G1, G3.1	Birch (Betula), Spruce (Picea abies)
SE14	Aneboda	N57° 07'	E14° 32'	G3.1	Mixed norway spruce (Picea abies) and -scots pine (Pinus sylvestris)
SE15	Kindla	N59° 45'	E14° 54'	G3.A	Norway spruce (Picea abies)
SE16	Gammtratten	N63°51'	E18°06'	G3.A	Norway spruce (Picea abies) and pine (Pinus sylvestris)

Modelled deposition to ICP IM sites from 1880 to 2030



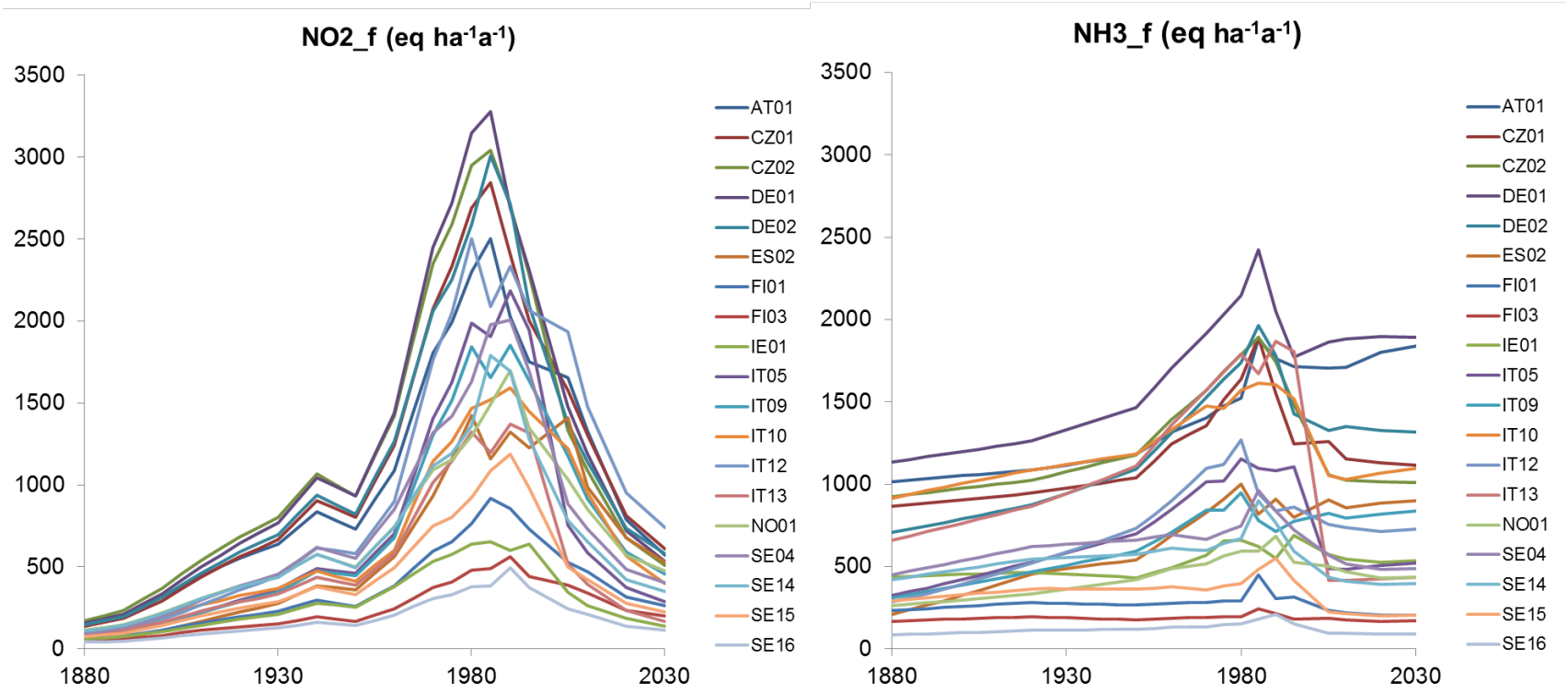


SYKE

LRTAP Long-range Transboundary Air Pollution

ECOSYSTEM SERVICES AND BIOLOGICAL DIVERSITY

Modelled N deposition to ICP IM sites



SYKE

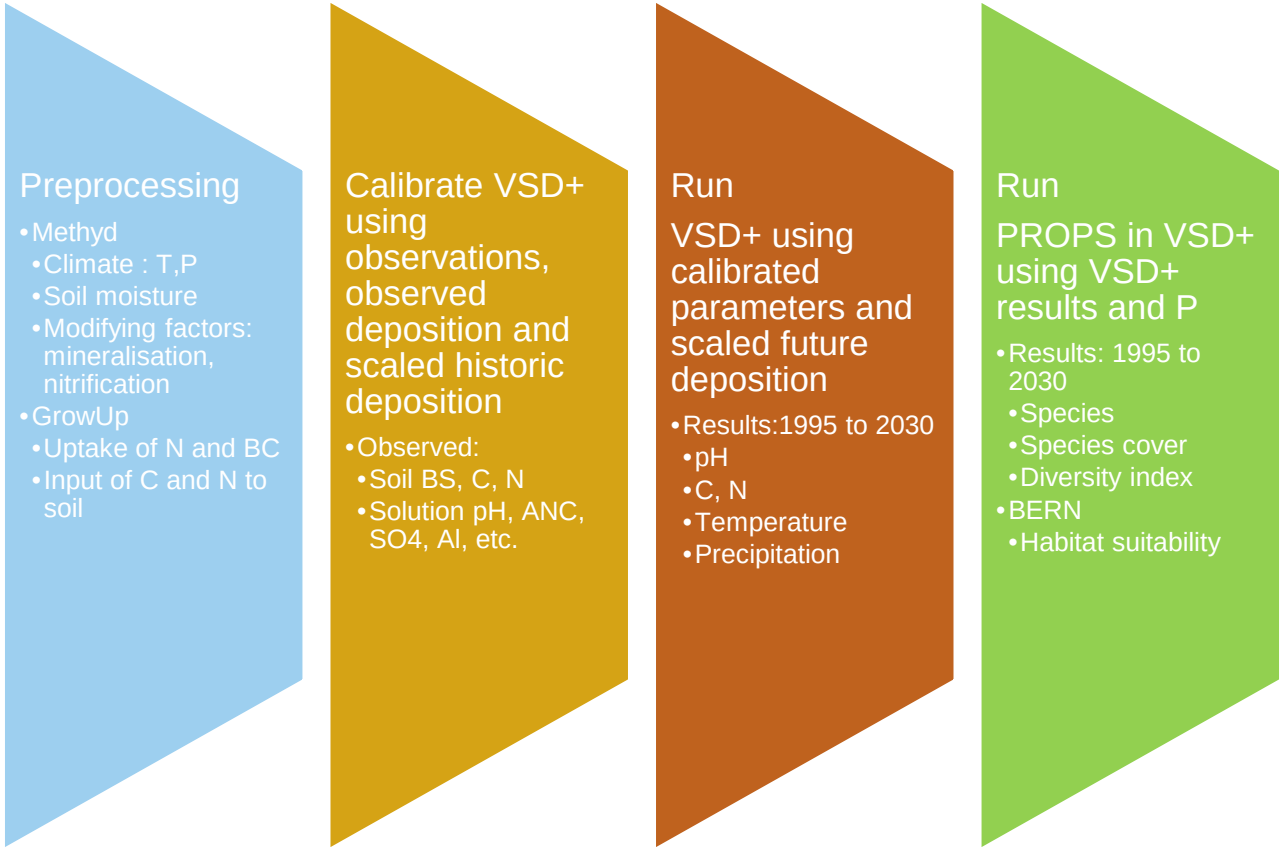
LRTAP Long-range Transboundary Air Pollution

Dynamic vegetation modelling at ICP IM sites

Models

- VSD suite of models (most recent updates)
  - http://wge-cce.org/Methods_Data/The_VSD_suite_of_models
  - VSD+ version 24.2.2014
    - *Posch and Reinds 2009; Reinds et al. 2009; ; Bonten et al. 2012*
  - MetHyd version 21.11.2013
  - GrowUp version 1.11.2013
  - PROPS new version will be available May 2014
- BERN model version 3.3. by OEKODATA
    - *Schlütow et al. 2010*

Dynamic vegetation modelling at ICP IM sites



Dynamic vegetation modelling at ICP IM sites

Scenarios

- First phase: Focus on air pollutant effects
  - S, N deposition
    - Historical 1880 – 1995 (CCE, EMEP)
    - Observed present deposition used to scale historical and future
    - Future:Gothenburg_CLE 2020, 2030 (CCE, EMEP)
- *To consider in future potential continuation of the study:*
  - Climate change
    - Warming
      - ETS
    - Drought
      - Nr of consecutive dry days

Dynamic vegetation modelling at ICP IM sites

Indicators, references, thresholds

- Test if possible to replicate observed vegetation changes

  Dirnböck et al. 2014

  - 28 sites
  - Oligotrophic species declined
  - Majority of newly established species eutrophic

- Test selection of
  - Indicators
  - References
  - Thresholds

Dynamic vegetation modelling at ICP IM sites

Reporting and publication plans

- ICP M&M meeting in Rome 7-10.4.2014
  - *First communication*
- ICP IM meeting in Westport 7-10.5.2014
  - *Progress report in ICP IM Annual Report 2014*
- Results and material for scientific manuscript compiled in 2014
- Draft manuscript submitted for review in 2015

Thank you for your attention!

References

- Bonten, L., Posch, M., Reinds, G.J. 2012. The VSD+ Soil Acidification Model. Model Description and User Manual. Version 1.01. Alterra, Wageningen, Coordination Centre for Effects, RIVM, Bilthoven. 25 p**.**
- Amann, M., Klimont, Z., Wagner, F., 2013. Regional and Global Emissions of Air Pollutants: Recent Trends and Future Scenarios, in: Gadgil, A., Liverman, D.M. (Eds.), Annual Review of Environment and Resources, Vol 38. Annual Reviews, Palo Alto, pp. 31-55.
- Bobbink, R. et al. 2010. Global assessment of nitrogen deposition effects on terrestrial plant diversity: a synthesis. Ecological Applications 20, 30-59.
- Dirnböck, T. et al. 2014. Forest floor vegetation response to nitrogen deposition in Europe. Global Change Biology 20, 429-440.
- Posch, M., Reinds, G.J., 2009. A very simple dynamic soil acidification model for scenario analyses and target load calculations. Environmental Modelling & Software 24, 329-340.
- Reinds, G.J., Posch, M., Leemans, R., 2009. Modelling recovery from soil acidification in European forests under climate change. Science of the Total Environment 407, 5663-5673.
- Simpson, D. et al. 2012. The EMEP MSC-W chemical transport model – technical description. Atmos. Chem. Phys. 12, 7825-7865.
- Schlütow, A., Kraft, P, Nagel, H.-D., Scheuschner, T., Weigelt-Kirchner, R. 2010. Modelling and mapping of spatial differentiated impacts of nitrogen input to ecosystems within the framework of the UNECE – Convention of Air Pollution Prevention. The Model BERN – Assessment of Vegetation Change and Biodiversity (in German). Umweltbundesamt UBA-EB 001341. Dessau-Rosslau 123 p.
- Schöpp, W., Posch, M., Mylona, S., Johansson, M., 2003. Long-term development of acid deposition (1880-2030) in sensitive freshwater regions in Europe. Hydrology and Earth System Sciences 7, 436-446.
- Wamelink, G.W.W. et al. 2011. Ecological ranges for the pH and NO3 of syntaxa: a new basis for the estimation of critical loads for acid and nitrogen deposition. Journal of Vegetation Science 22, 741-749.

SYKE

LRTAP Long-range Transboundary Air Pollution

ECOSYSTEM SERVICES AND BIOLOGICAL DIVERSITY

Dynamic vegetation modelling at ICP IM sites

Tasks and schedule 2014 – 2015

adjusted to reflect discussion in meeting 7.5.2014

1. **June 1st** : DropBox (or similar account) created and address and instructions shared (Maria).
2. **September 30th**: Draft texts of model descriptions (Bonten, Reinds, Posch, Wamelink). Draft outline of manuscript (Maria)
3. **October 30th** : Site descriptions, VSD+ calibration results, parameters, observations, net uptake values, comments and conclusions concerning calibrations, everything shared in DropBox (All modellers)
4. **December 15th**: Shared files checked for consistency (Maria)
5. **January 31st** : Vegetation response simulated (Thomas D.)
6. **March 31st** : Manuscript first draft shared (Maria)
7. **April 30th** Comments and corrections to draft (All participants)
8. **May 31th**: Progress report to IM annual report AR 2015
9. **Later in 2015**: Manuscript submitted to Ecological Indicators (or other journal)

SYKE