



# Update from ICP Vegetation\*: Global impacts of ozone on wheat & mapping Natura 2000 habitats at risk from ozone

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*and the participants of the ICP Vegetation*

\* Supported by Defra (UK), NERC (UK) & UNECE

# Outline

- ❑ First global flux-based map of ozone impacts on wheat yield
- ❑ Impacts of ozone on biodiversity: mapping Natura 2000 areas at risk
- ❑ Other activities:
  - Update field-based evidence ozone impacts on vegetation
  - Preparations ozone CLs workshop, w/c 7 November 2016, Spain
  - Progress European moss survey 2015/16
  - Common workplan items WGE/EMEP
- ❑ Medium-term workplan (2017 – 2019)



# First ozone flux-based global assessment

- Based on ozone-flux calculations, global economic losses due to ozone effects on annual wheat yield (9.4% loss) are estimated at \$24.3 billion.
- Material is currently being prepared for a paper that we hope to publish soon. This paper will provide further details, including maps.



# Ozone impacts on biodiversity: recent reviews



Chapter 4: Impact of ozone on biodiversity, including case studies  
<http://icpvegetation.ceh.ac.uk>

2013

2015

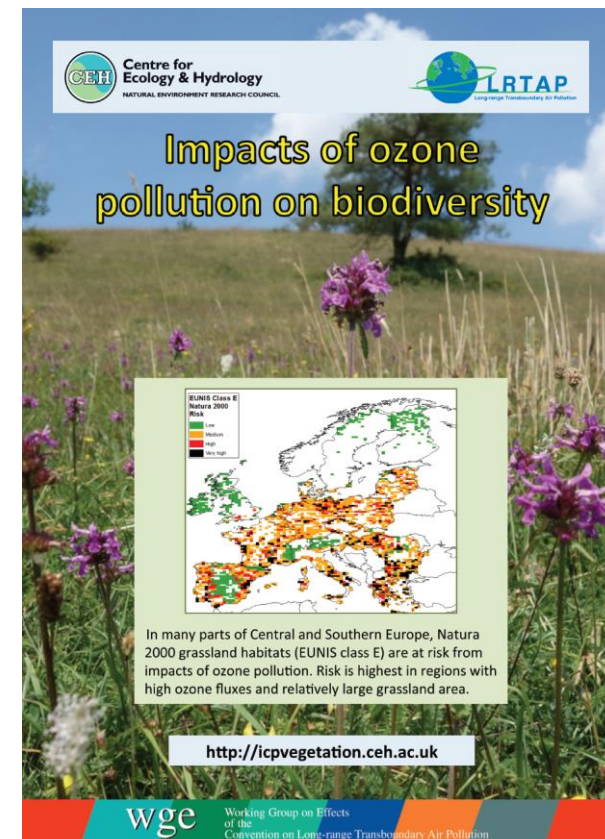


<http://www.umweltbundesamt.de/en/publikationen/>

45<sup>th</sup> TFIAM, 23 – 25 May 2016, Lisbon

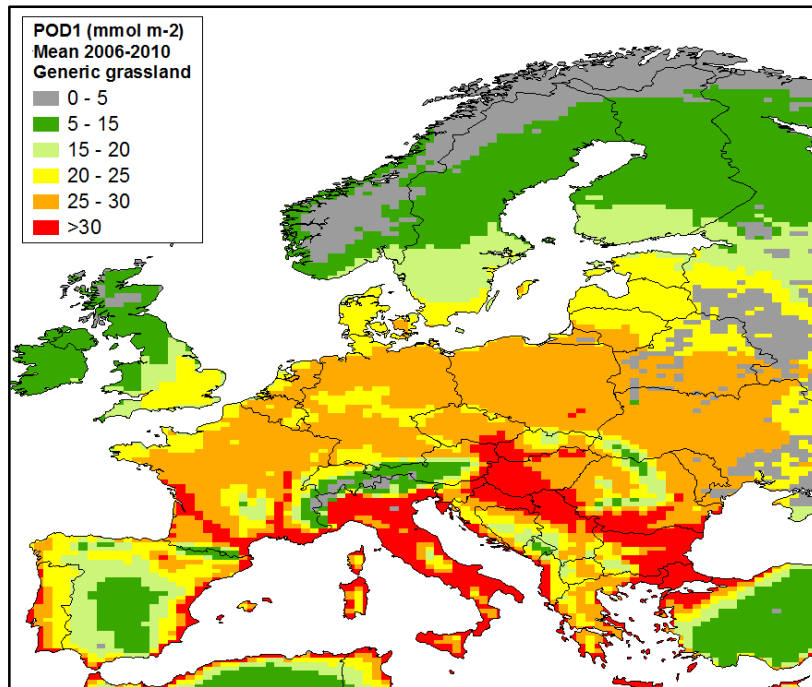
- Field-based evidence scarce – changes in species composition observed

2016



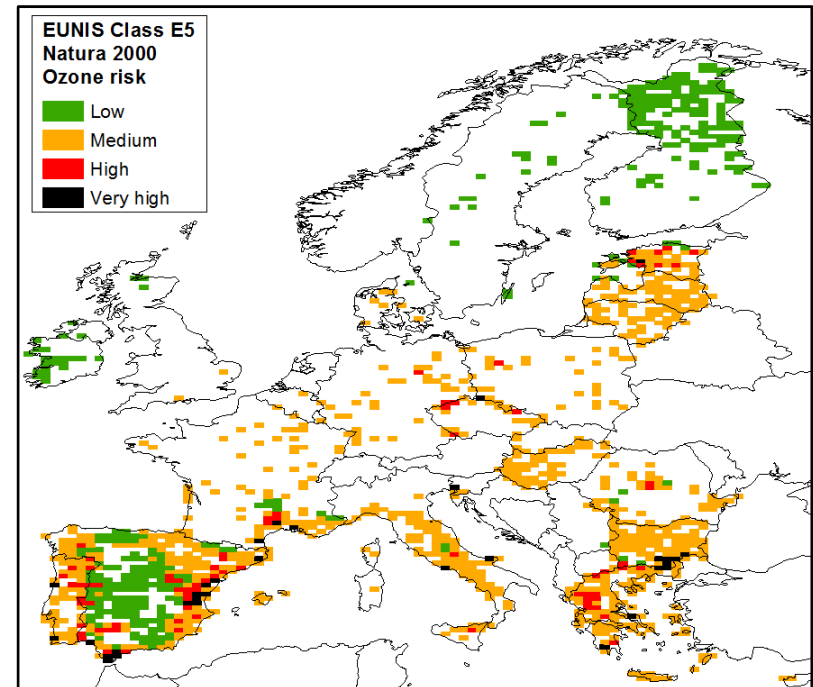
# Natura 2000 grassland habitats at risk (1)

Grassland area in grid cell (%)	POD <sub>1</sub> grass (mmol m <sup>-2</sup> )*	<5	5 - 15	15 - 20	20 - 25	25 - 30	>30
	RISK	1	2	3	4	5	6
0.5 – 5	1	1	2	3	4	5	6
5 - 10	2	2	4	6	8	10	12
>10	3	3	6	9	12	15	18



Ozone flux grassland (POD<sub>1</sub>)

EMEP: Simpson et al., 2012

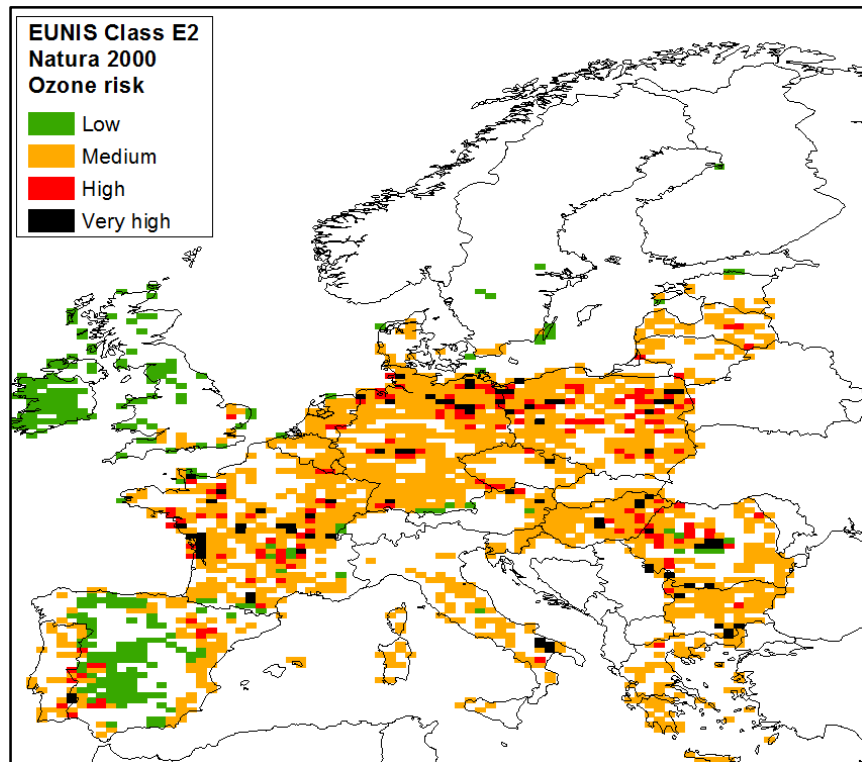


EUNIS class E5 – woodland fringes (CCE)

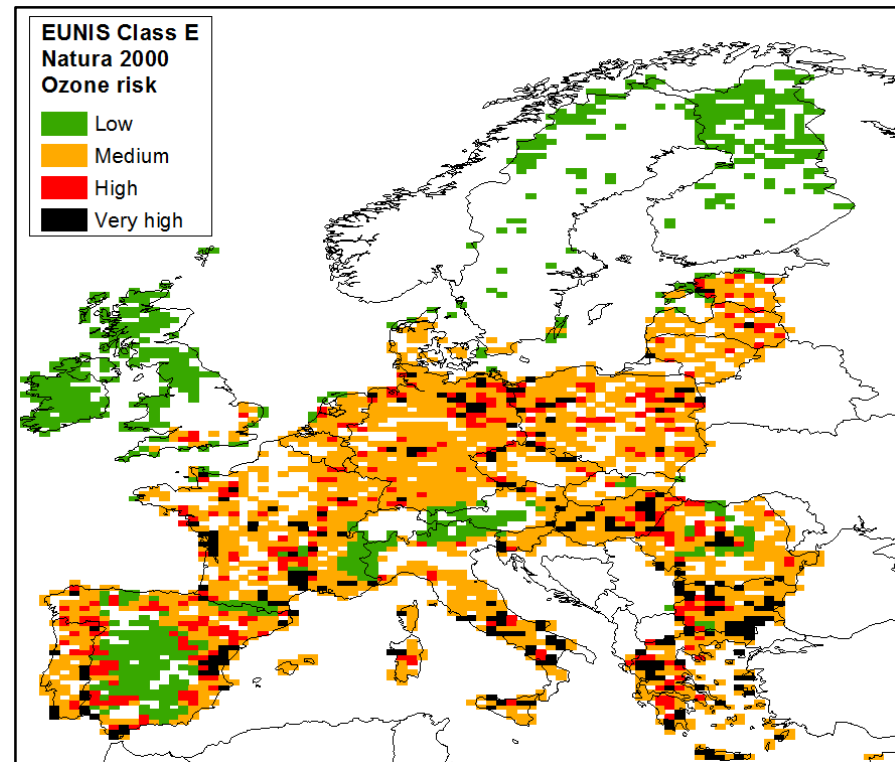
Natura 2000 area per grid (%)  
at risk

# Natura 2000 grassland habitats at risk (2)

## Mesic grassland (E2)

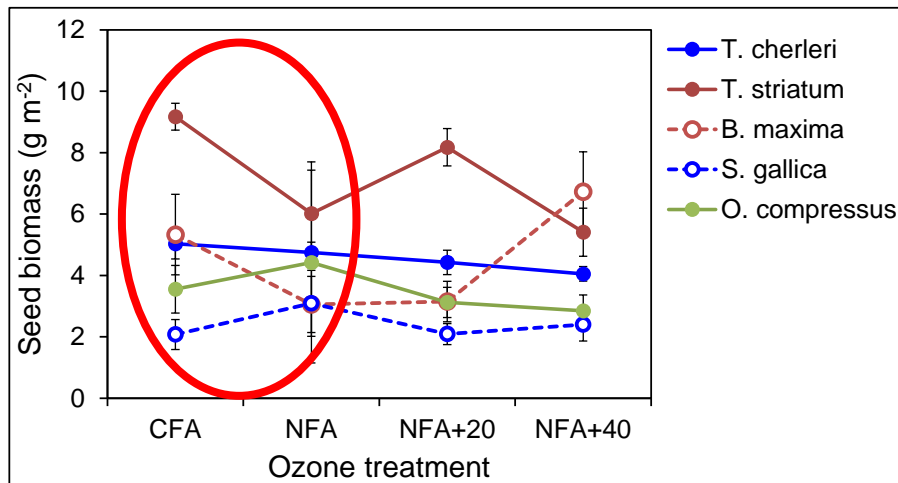
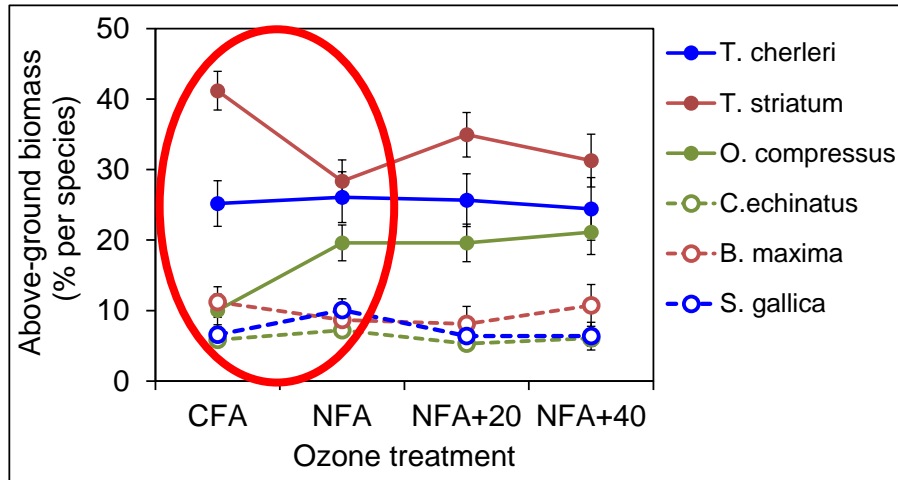


## Grassland (E)



- In many parts of central and southern Europe, Natura 2000 grassland habitats are at risk from impacts of ozone pollution. Risk is highest in regions with high ozone fluxes (Phytotoxic Ozone Dose) and relatively large grassland area.

# Ozone impacts on Dehesa pasture species



Dehesas are high biodiversity  
Mediterranean ecosystems protected  
under the EU Habitats Directive

- ❑ Ozone induced changes in species composition of a mesocosm formed by six annual Dehesa pasture in open-top chambers: decline ozone-sensitive legume *Trifolium striatum*, increase tolerant legume *Ornithopus compressus* (Calvete-Sogo et al., 2016, Oecologia).
- ❑ Ozone also affected seed production per species (Calvete-Sogo et al., in prep.).

# Field-based evidence of ozone impacts

## Field evidence of ozone impacts on vegetation in ambient air (2007-2015)

Widespread impacts of ambient ozone have been demonstrated on a wide variety of crop, tree and (semi)-natural vegetation species.

Large reductions in yield have been attributed to ozone for several crops including wheat, soybean, rice, and other legumes.

Detected impacts on natural vegetation species are diverse and include visible leaf injury and reductions in biomass.

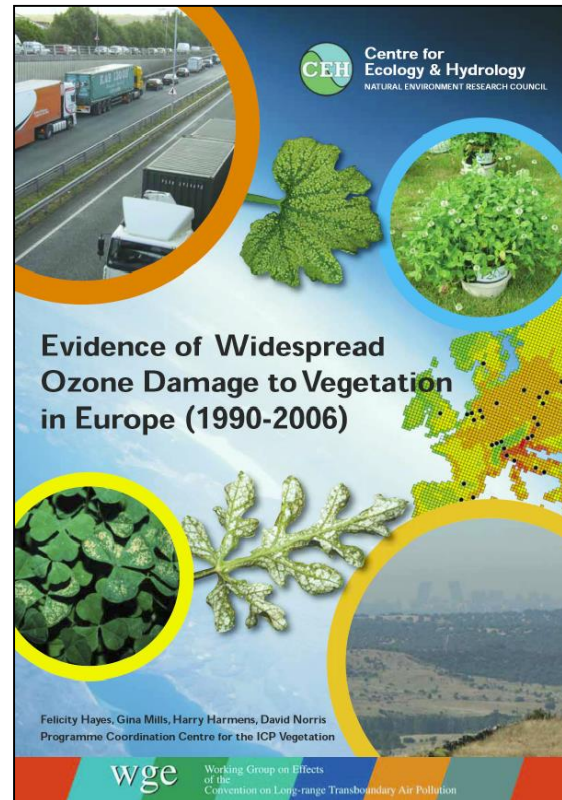
<http://icpvegetation.ceh.ac.uk>

wge

Working Group on Effects of the Convention on Long-range Transboundary Air Pollution

2016: Update evidence report

- Biomonitoring experiments
- Records of visible leaf injury
- Charcoal-filtered vs non-filtered air
- Epidemiology studies



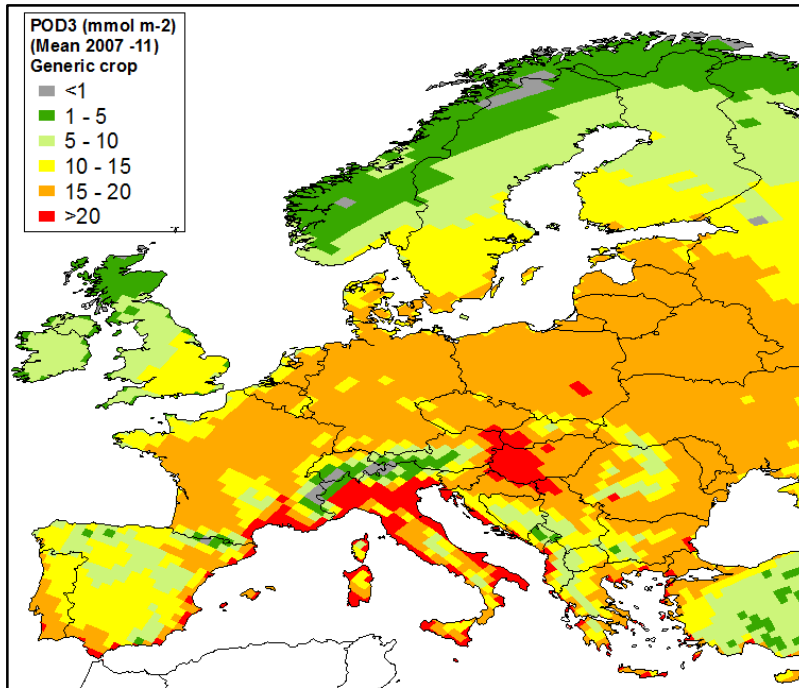
2007: 'Evidence report on ozone impacts'

Mills et al., 2011.  
Global Change Biology

45<sup>th</sup> TFIAM, 23 – 25 May 2016, Lisbon

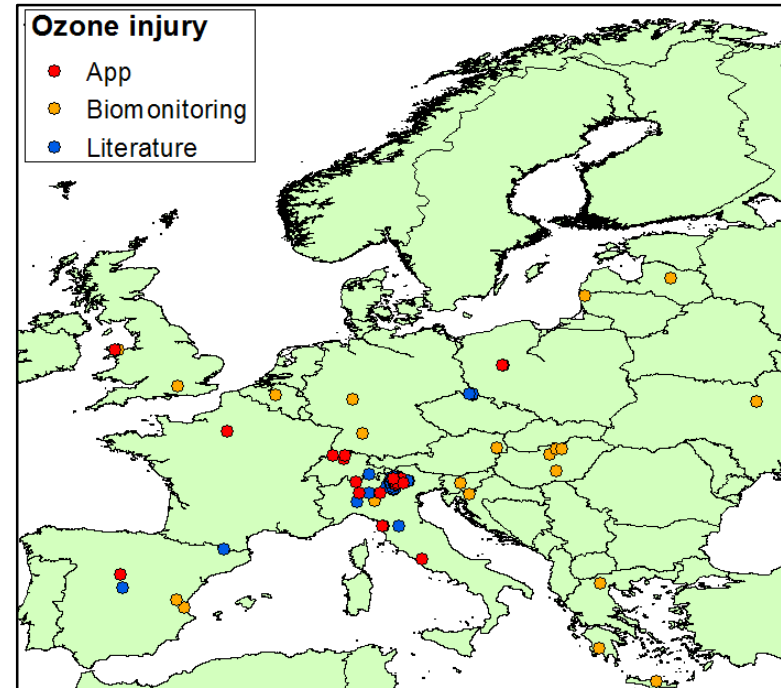
# Visible leaf injury in ambient air

## EMEP/MSC-West



Flux-based risk of ozone damage  
in crops (mean 2007 – 2011)

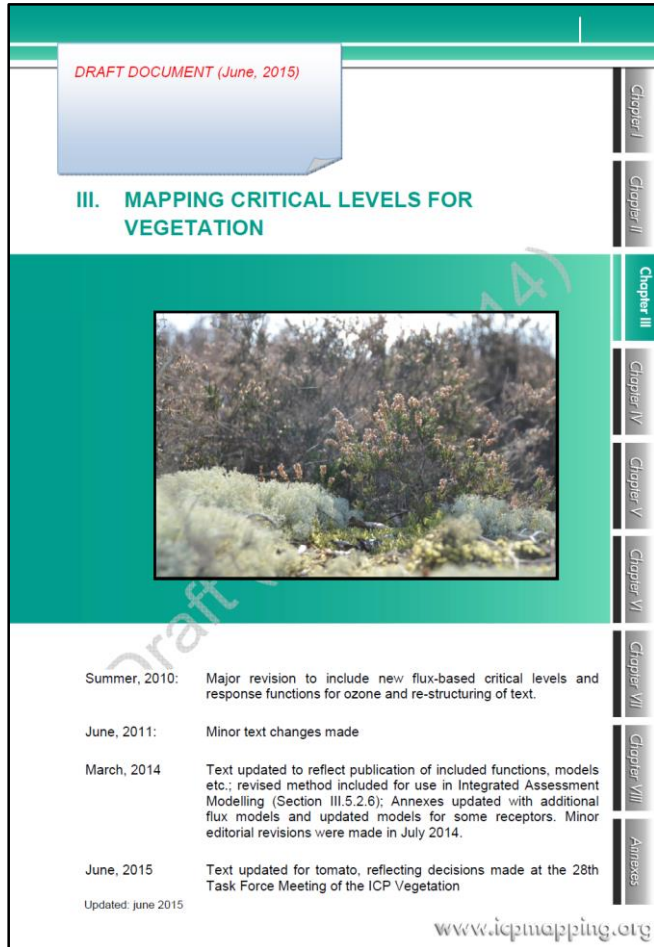
## ICP Vegetation



Evidence of ozone damage on crops  
and wild flowers (2007 – 2015)

- Field-based evidence of ozone damage on vegetation in Europe coherent with risk of damage as estimated from ozone flux, with damage being widespread

# Ozone critical levels - Chapter 3 Mapping Manual



- ❑ 23 – 25 November, 2015: Epidemiology and Critical Levels Methodology Workshops, Hindås (nr. Gothenburg), Sweden, 30 experts
- ❑ 7 – 9 June 2016: Preparatory Critical Levels Dose-response Workshop, Bangor, UK (invited experts). [Financial support from Switzerland.](#)
- ❑ w/c 7<sup>th</sup> November 2016: UNECE Ozone Critical Levels Workshop, Madrid, Spain (CIEMAT)
- ❑ 2017: Report on revised ozone risk assessment methods for vegetation
- ❑ 2017: Revision of Chapter 3 Mapping Manual

<http://icpvegetation.ceh.ac.uk>

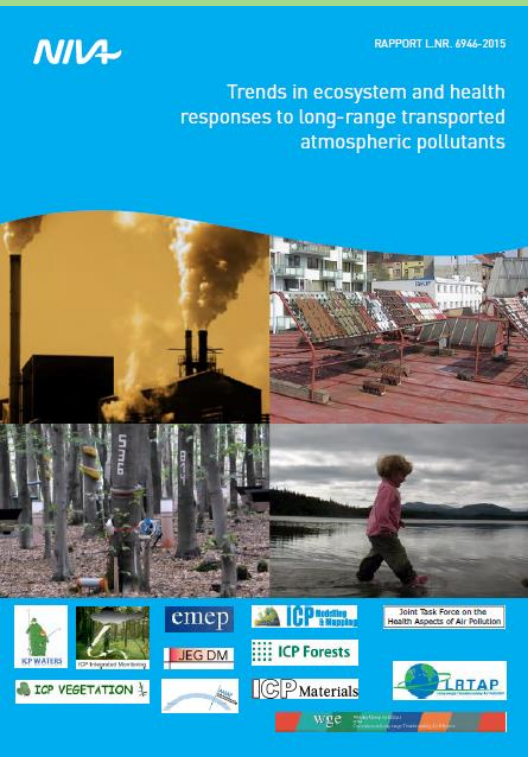
# Participation moss survey 2015/16

- Since 2014, new Moss Survey Coordination Centre at the Joint Institute for Nuclear Research, Dubna, Russian Federation

Rest Europe (17)	Rest Europe	SEE Europe (9)	EECCA (7)	Asia + Africa (6)
Austria	Italy	Albania	Azerbaijan	India
Czech Republic	Latvia	Bulgaria	Belarus	Mongolia
Denmark (Faroer Isl.)	Norway	Croatia	Georgia	South Africa
Estonia	Poland	Greece	Kazakhstan	South Korea
France	Slovakia	Macedonia	Moldova	Thailand
Germany	Spain	Romania	Russian Federation	Vietnam
Hungary	Sweden	Serbia	Ukraine	
Ireland	Switzerland	Slovenia		
Iceland		Turkey		

**2018: Report moss survey 2015/16**

# WGE Trends Report, Assessment Report



Convention on Long-Range Transboundary Air Pollution

## Towards Cleaner Air

Scientific Assessment Report 2016

Draft 4 March 2016

### A4. Ozone trends and impacts on health and ecosystems B3. Air pollution at a wider scale

#### Key messages:

- ❑ Large areas in Europe remain at risk of adverse impacts of ozone on vegetation (biomass reduction, crop yield reduction, leaf damage)
- ❑ Global cooperation is required to reduce the risk of ozone impacts on vegetation in Europe (with a focus on methane emission abatement)

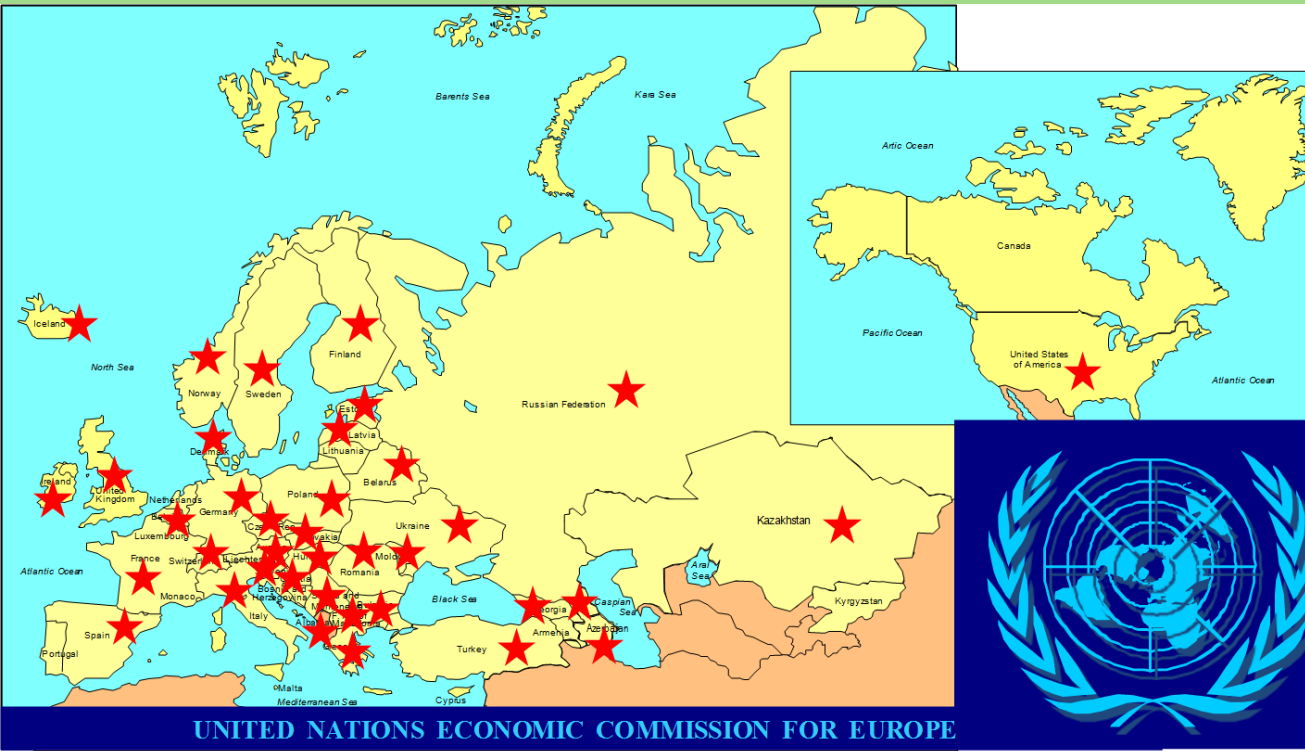
De Wit, Hettelingh,  
Harmens (Eds.)

# Tentative workplan (2018/19)

- Report European moss survey 2015/16 + brochure
- Update moss monitoring manual for 2020 survey
- Report on ozone risk assessment based on new flux models and critical levels (in collaboration with EMEP)
- Protocol for data access and usage
- **Brochures:**
  - Ozone impacts on food production (raising awareness for growers and breeders)
  - Ozone impacts on forests (in collaboration with ICP Forests)
  - Ozone impacts on Natura 2000 areas – case studies
  - Outreach activities (e.g. Latin America, India, China)



# ICP Vegetation participation



- Outside UNECE:**
- ❖ China
  - ❖ Cuba
  - ❖ Egypt
  - ❖ Guatemala
  - ❖ India
  - ❖ Japan
  - ❖ Mongolia
  - ❖ Pakistan
  - ❖ South Africa
  - ❖ South Korea
  - ❖ Thailand
  - ❖ Vietnam



**Ca. 90 experts from 33 countries  
at 29<sup>th</sup> ICP Vegetation TFM, Dubna, Russia**

International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops



## ICP Vegetation

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### Welcome to ICP Vegetation

#### The International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops

The ICP Vegetation was established in 1987 under the United Nation Economic Commission for Europe (UNECE) [Convention on Long-Range Transboundary Air Pollution \(LRTAP\)](#). The ICP Vegetation is an international research programme investigating the impacts of air pollutants on crops and (semi-)natural vegetation and reports to the [Working Group on Effects \(WGE\)](#). The programme focuses on the following air pollution problems: impacts of ozone pollution on vegetation and the atmospheric deposition of heavy metals and nitrogen to vegetation. In addition, the ICP Vegetation is taking into consideration impacts of pollutant mixtures (e.g. ozone and nitrogen), consequences for biodiversity and the modifying influence of climate change on the impacts of air pollutants on vegetation. The results of studies conducted by the ICP Vegetation are used in assessments of the current, and predictions of the future, state of the environment. Thirty five Parties to the LRTAP Convention participate in the programme.

The programme is led by the UK, has its Programme Coordination Centre at the [Centre for Ecology and Hydrology - Bangor](#), and is funded by the [Department for Environment Food and Rural Affairs](#) (Defra).

### News

New reports/brochures:

- [Annual report 2012/13 now available](#)
- [Ozone pollution: Impacts on ecosystem services and biodiversity](#)
- [Heavy metals and nitrogen in mosses: European survey 2010/11](#)
- [Benefits of air pollution control for biodiversity and ecosystem services \(WGE full report and brochure\)](#)

[27th ICP Vegetation Task Force Meeting, 28-30 Jan 2014, Paris, France](#)

- 30<sup>th</sup> ICP Vegetation Task Force meeting, 14 – 17 February 2017, Poznan, Poland



Thank you!