

Glossary

Glossary Item	Explanation
Acidification (with respect to soil)	Acidification is used to describe the loss of nutrient bases (calcium, magnesium, potassium) in the soil, through leaching, and their replacement by acidic elements (hydrogen and aluminium). Pollutant deposition (e.g. NO _x and Ammonia) enhances the rate of acidification.
Aerosols	Solid or liquid particles suspended in the air. This includes dust, soot and sea-salt crystals, size 1 nm to 100 µm.
Algal blooms	Rapid increase or accumulation of algal biomass in a body of water, due to excessive nutrient loading (see also 'Eutrophication'). Bloom forming algae can be toxic or inedible and their decomposition depletes oxygen in the water body, leading to 'hypoxia' and 'anoxia', with resultant lethal effects on fish and benthos. See Grizzetti <i>et al.</i> 2011, Chapter 17 this volume, and references therein.
Ammonia	A reactive nitrogen form (NH ₃), which is colourless gas with a pungent odour when in high concentration. A product of 'biological nitrogen fixation' (see entry), it can also be synthesized using the 'Haber–Bosch' process (see entry). Most industrially synthesised ammonia is used in the manufacture of synthetic fertilizers, however some other industrial uses exist.
Ammonium	A reactive nitrogen form (NH ₄ ⁺), closely linked to production and destruction of 'ammonia' (see entry). Constituent of many synthetic fertilizers, such as ammonium nitrate.
AN	A reactive nitrogen form, ammonium Nitrate (NH ₄ NO ₃). A common synthetic nitrogen fertilizer in Europe, and present in atmospheric aerosol.
Anamox	'ANAerobic AMmonia OXidation'. An alternative pathway (to denitrification) for the generation of N ₂ from N _r . Bacteria of the group <i>Planctomyces</i> fix CO ₂ and use NH ₄ ⁺ to reduce NO ₂ ⁻ , which results in the production of N ₂ (Voss <i>et al.</i> 2011, Chapter 8 this volume).
Anoxia	The situation where the dissolved oxygen concentration of a water body is zero. See also 'hypoxia'.
Anthropogenic	Effects which relate specifically to human activities, i.e., anthropogenic reactive nitrogen production, through the 'Haber–Bosch' process.
Anthroposphere	All parts of the planetary system which are affected by human activities.
Atmospheric deposition	Removal of suspended material from the atmosphere, this can be classed as either 'wet' or 'dry'. Wet deposition occurs when material is removed from the atmosphere by precipitation. In dry deposition, the material is removed from the atmosphere by contact with a surface. (For more detail see Hertel <i>et al.</i> 2011, Chapter 9 this volume.)
Autotrophy	When discussing agricultural production in regions or watersheds, autotrophy refers to areas where food for humans and feed for livestock is produced locally and any excess products are exported. See also 'heterotrophy' in this setting where the food and livestock feed is imported into the system. (See also Billen <i>et al.</i> 2011, Chapter 13 this volume.)
Benthos	Organisms that live on, in, or near the seabed, also known as the benthic zone.
Biodiversity	Biodiversity is the variability among living organisms, from genes to the biosphere. The value of biodiversity is multifold, from preserving the integrity of the biosphere as a whole, to providing food and medicine, to spiritual and aesthetic well-being (see Dise <i>et al.</i> 2011, Chapter 20 this volume).
Bioenergy	Energy derived from biofuel sources – see 'biofuels'.

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Biofuels	Biofuels are fuels from plant derivatives that gain their carbon from the atmosphere as CO ₂ , and when they are burnt no new CO ₂ is released, with the aim of being 'carbon-neutral' (see also Reay <i>et al.</i> 2011, Chapter 26 this volume).
Biological Nitrogen Fixation	'Fixing' of unreactive di-nitrogen (N ₂) to reactive nitrogen species by microorganisms. Microorganisms which can fix nitrogen are called Diazotrophs. (See Erisman <i>et al.</i> 2011, Chapter 2 this volume.)
BNF	Biological Nitrogen Fixation.
Bryophytes	The earliest land plants on earth, consisting of mosses, liverworts and hornworts. They are non-vascular land plants which are pioneer colonists of bare or disturbed ground.
CAN	A reactive nitrogen form, Calcium Ammonium Nitrate. A common synthetic nitrogen fertilizer in Europe.
CBD	Convention on Biological Diversity, under the United Nations Environment Programme (UNEP).
Carbon sequestration	The capture and removal of carbon dioxide from the atmosphere and storing it in an alternative carbon related reservoir, e.g. soil organic matter, charcoal, tree growth.
Catch crops	Crops grown after the main crop has been harvested to retain nutrients (especially nitrogen) in order to prevent environmental losses and to promote recycling of nutrients.
Cloud condensation nuclei	Very small particles in the atmosphere, which are required to physically mediate water vapour to coalesce to form clouds of liquid water.
CLRTAP	Convention on Long-range Transboundary Air Pollution, under the United Nations Economic Commission for Europe (UNECE).
Common Agricultural Policy (CAP)	System of European Union agricultural subsidies and programmes, combining a direct subsidy payment for crops and land which may be cultivated with price support mechanisms, including guaranteed minimum prices, import tariffs and quotas on certain goods from outside the EU.
Cost–benefit analysis	Economic tool to explicitly or implicitly, weigh the total expected costs against the total expected benefits of one or more actions in order to choose the best or most profitable option.
Critical level	Concentration or cumulative exposure of atmospheric pollutants above which direct adverse effects on sensitive vegetation may occur according to present knowledge.
Critical loads	A quantitative estimate of an exposure to one or more pollutants below which significant harmful effects on specified sensitive elements of the environment do not occur according to present knowledge.
Cross-compliance	Instrument of Common Agricultural Policy (CAP) where single payments to farmers are linked to meeting environmental, public, animal and plant health and animal welfare standards and the need to keep land in good agricultural and environmental condition.
DALY	Disability Adjusted Life Years: a measure of overall disease burden, expressed as the number of years lost due to ill-health, disability or early death.
Denitrification	The microbial regeneration of di-nitrogen (N ₂) or nitrous oxide (N ₂ O) from nitrate (NO ₃ ⁻). N ₂ O represents an intermediary on the overall pathway of denitrification to form N ₂ .
DIN	Dissolved Inorganic Nitrogen
Di-nitrogen	N ₂ , a colourless, odourless, and unreactive gas which makes up around 78% of the atmosphere. Di-nitrogen is the thermodynamically stable state ('unreactive nitrogen') to be contrasted with many different reactive nitrogen forms.
DON	Dissolved Organic Nitrogen.
DPSIR framework	Framework of causality and policy response: Driver – Pressure – State – Impact – Response (see Oenema <i>et al.</i> 2011, Chapter 4 this volume, for further information).
Endogenous nitrosation	Process in the body of converting organic compounds into nitroso derivatives, e.g. N-nitrosamines, including the carcinogenic variety. N-nitrosamines arise from the reaction of nitrite sources with amino compounds (see also nitrate and nitrite).
Epidemiological studies	Studies into health and disease within the population. Studies aim to relate the disease pattern to factors such as pollution or infectious agents.
Eutrophication	The enrichment of the nutrient load in ecosystems (terrestrial and aquatic), especially compounds of nitrogen and/or phosphorus. This leads to an undesirable disturbance to the balance of organisms in the ecosystem, affecting terrestrial and aquatic biodiversity and water quality. (See also Durand <i>et al.</i> 2011, Grizzetti <i>et al.</i> 2011 and Dise <i>et al.</i> 2011, Chapters 7, 17 and 20, this volume.)

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Exceedance	The amount of pollution above a 'critical level' or 'critical load', expressed in different ways, such as accumulated area of exceedance.
GHG	Greenhouse Gas – includes carbon dioxide (CO ₂), nitrous oxide (N ₂ O), methane (CH ₄), ozone (O ₃), water vapour and various other gases.
Gothenburg Protocol	A multilateral environmental agreement signed under the UNECE Convention on Long-range Transboundary Air Pollution (CLRTAP), which sets maximum emissions to the atmosphere of SO ₂ , NO _x , NH ₃ and VOCs for national parties to the protocol to be achieved by 2010 (see Oenema <i>et al.</i> 2011, Chapter 4 this volume).
Greenhouse gas balance	The balance of greenhouse gases ('GHG') in the atmosphere. In addition to the contribution of greenhouse gases, the overall 'radiative forcing', is also affected by the contribution of aerosol components.
GPNM	Global Partnership on Nutrient Management (see Bull <i>et al.</i> 2011, Chapter 25 this volume).
Haber–Bosch process	The high pressure chemical process which synthesizes reactive nitrogen as ammonia (NH ₃) from the reaction of N ₂ and H ₂ . Fritz Haber was responsible for the discovery of the process (1908) and Carl Bosch later developed the technique on an industrial scale.
Heterotrophy (wrt nitrogen budgets and watersheds)	When discussing agricultural production in regions or watersheds, heterotrophy refers to areas where either food for the human population is imported from elsewhere or feed for livestock production is imported from elsewhere. See also 'autotrophy' in this setting, where locally produced food and feed is used and any excess products are exported (Billen <i>et al.</i> 2011, Chapter 13 this volume).
Hyporheic zone	A region beneath and lateral to a stream bed, where there is mixing of shallow groundwater and surface water.
Hypoxia	The situation where the dissolved oxygen concentration of a water body is very low, e.g. <10 µmol of oxygen per litre of water (see Voss <i>et al.</i> 2011, Chapter 8 this volume).
Immobilization (in soil)	The incorporation of compounds (such as reactive nitrogen) into soil microbial biomass.
Leaching	The washing out of soluble ions and compounds by water draining through soil.
Legumes	Plants which are able to fix nitrogen from the atmosphere (see 'Biological Nitrogen Fixation'), due to root nodules which contain rhizobia bacteria, which act with the plant in a symbiotic relationship. Legumes can be used by farmers to replenish the reactive nitrogen levels in the soil, in a crop rotation sequence.
Lentic	Ecosystem of standing or still water, e.g., a lake, pond or swamp.
Lichen	Lichen is a partnership between a fungus and an alga. The algae can photosynthesize, providing organic nutrients (in some cases it can also fix nitrogen) and the fungus provides water, nutrients and gases from the environment. The fungus also prevents the drying out of the algae and damage by excessive sunlight.
Methane	A greenhouse gas (CH ₄), which is 21 times more effective at trapping heat in the atmosphere than carbon dioxide (CO ₂) over a 100 year period. Methane is the major constituent of natural gas, it is formed biogenically in anaerobic environments (those without oxygen). It is also a major product of enteric fermentation (the digestive process of cows, sheep, etc.).
Methemoglobinemia	A disorder characterized by the presence of a higher than normal level of methemoglobin (metHb) in the blood. Methemoglobin is an oxidized form of hemoglobin that has almost no affinity for oxygen, resulting in almost no oxygen delivery to the tissues. Formation of metHb is promoted, e.g., by high levels of nitrite, often precursed by nitrate.
Morbidity	Diseased state, disability, or poor health due to any cause. Often used in conjunction with mortality.
N fixing bacteria	A bacteria which is able to fix nitrogen from the N ₂ in the atmosphere (also known as a diazotroph, see also 'biological nitrogen fixation' and 'legumes'). They can be free-living or symbiotic with other organisms.
N ₂	See 'Di-nitrogen'.
N ₂ O	See 'Nitrous oxide'.
Natura 2000	Ecological network of protected areas in the territory of the European Union, brought about by the implementation of the EU Habitats Directive (1992).

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National Emissions Ceilings Directive	A European Commission Directive (1999), often referred to as the NEC Directive, which sets maximum emissions to the atmosphere of SO ₂ , NO _x , NH ₃ and VOCs for the European Union to be achieved by 2010. The NEC Directive is part of the EU transposition of the UNECE Gothenburg Protocol (see Oenema <i>et al.</i> 2011, Chapter 4 this volume).
NH ₃	See 'Ammonia'.
NH ₄ ⁺	See 'Ammonium'.
NH _x	Sum of ammonia and ammonium.
Nitrate Vulnerable Zones	Designated areas of land which drain into areas of water which are polluted by nitrates from agriculture – as defined by the 'Nitrates Directive'. In these areas, mandatory rules exist for agricultural practices which can lead to nitrate loss into the environment.
Nitrate(s)	A reactive nitrogen form, (NO ₃ ⁻) a nitrate ion. Nitrate salts are soluble in water and very mobile. Nitrates are an important nutrient for crop plants, but in high concentrations can cause eutrophication, especially in semi-natural ecosystems and cause adverse health effects when present in excess in drinking water.
Nitrates Directive	A European Commission Directive (1991), which regulates agricultural practices which can lead to losses of nitrate to the environment. It is part of the Water Framework Directive.
Nitric oxide	A reactive nitrogen form (NO), formed mainly in combustion processes and also emitted during nitrification and denitrification processes in soils.
Nitrification	The microbial conversion of ammonium ions (NH ₄ ⁺) to nitrate (NO ₃ ⁻).
Nitrite	A reactive nitrogen form (NO ₂ ⁻) a nitrite ion. It has a high oxidative potential and is therefore used in cured meats. Nitrite is typically present in much less abundance than nitrate (NO ₃ ⁻) and in high concentration is toxic to humans.
Nitrogen cascade	A term used to describe the passage of reactive nitrogen through the environment (see Sutton <i>et al.</i> 2011, Chapter 1 this volume).
Nitrogen dioxide	A reactive nitrogen form (NO ₂), is an oxide of nitrogen formed mainly by combustion processes where fuel N is oxidized or atmospheric N ₂ is oxidized at high temperatures.
Nitrogen oxides	A reactive nitrogen form, refers specifically to the sum of NO (nitric oxide) and nitrogen dioxide (NO ₂), also known as NO _x . As with other oxides of nitrogen these oxides are formed mainly by combustion processes where fuel N is oxidized or atmospheric N ₂ is oxidized at high temperatures.
Nitrogen use efficiency	The ratio of nitrogen input and output of a system (e.g., soil, plant, farm animal, farm). Various techniques can be employed to increase nitrogen use efficiency in crop and livestock systems (see Jarvis <i>et al.</i> 2011 and Oenema <i>et al.</i> 2011, Chapters 10 and 23 this volume).
Nitrophilic	Literally translates to 'nitrogen-loving', i.e., a species which may be nitrogen limited and therefore benefits from an increase in reactive nitrogen availability in the environment.
Nitrous oxide	A reactive nitrogen form (N ₂ O), also known as laughing gas. This is an oxide of nitrogen formed mainly by microbial denitrification processes in soils and waters. It is also emitted by combustion and other industrial processes. N ₂ O is also a greenhouse gas which is 310 times more effective at trapping heat in the atmosphere than carbon dioxide over a 100 year period.
NO ₂	See 'Nitrogen dioxide'.
NO ₂ ⁻	See 'Nitrite'.
NO ₃ ⁻	See 'Nitrate(s)'.
NO _x	Sum of NO and NO ₂ .
NO _y	Various forms of oxidized nitrogen including, NO _x and nitrates.
N _r	Reactive nitrogen.
O ₃	See 'Ozone'.
Oligotrophic	'Poor in nutrient'. The opposite of eutrophic (see Eutrophication).
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic established in Oslo – Paris (OSPAR) 1992.
Oxidative stress	Imbalance between the production of reactive oxygen species and a biological system's ability to readily detoxify the reactive intermediates or to repair the resulting damage.

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Ozone	Powerful oxidizing gas formed by the reaction of sunlight on air which contains hydrocarbons and nitrogen oxides. These can react to form ozone directly at the source of the pollution or many kilometers down wind.
PAN	A reactive nitrogen form, peroxyacetyl nitrate (C ₂ H ₃ O ₅ N), is one constituent of photochemical (formed with the input of sunlight) smog air pollution, both VOCs and nitrogen dioxide (NO ₂) contribute towards its generation.
Pedosphere	The planetary sphere which contains soil.
Pelagic fish	Fish that live in the water column of coastal, ocean and lake waters.
PM _{2.5} /PM ₁₀	PM _{2.5} /PM ₁₀ : Aerosol mass contained in particles with an aerodynamic diameter below 2.5 (10) micrometre, measured with a reference technique. Used as a metric to assess the human health impact of particle air pollution (see Moldanová <i>et al.</i> 2011, Chapter 18 this volume).
Pollution swapping	Applying an environmental measure which results in one form of pollution being reduced, but which then results in the introduction or increase in another form of pollution.
Radiative balance	Balance of ingoing and outgoing thermal radiation of the planet.
Reactive nitrogen	Collectively any chemical form of nitrogen other than di-nitrogen (N ₂). Reactive nitrogen (N _r) compounds include NH ₃ , NO _x , N ₂ O, NO ₃ ⁻ and many other chemical forms, and are involved in a wide range of chemical, biological and physical processes.
Redfield ratio	Redfield ratio or Redfield stoichiometry is the molecular ratio of carbon, nitrogen and phosphorus in phytoplankton.
Riparian	Interface between land and a river or stream.
Ruminants	Mammals with a four-chambered complex stomach, that digests plant-based food by initially softening it within the animal's first stomach, then regurgitating the semi-digested mass, now known as cud, and chewing it again. The process of rechewing the cud to further break down plant matter and stimulate digestion is called 'ruminating'.
Runoff	Waterflow over land – which occurs when the soil is saturated with water.
Saprotrophic decomposers	Organisms which can generate energy from dead or decaying matter from plants or animals.
Sewage sludge	Residual, semi-solid material left from industrial wastewater, or sewage treatment processes.
Stratospheric ozone depletion	Depletion of ozone in the stratosphere (the second layer of the atmosphere, situated above the 'troposphere'). This depletion allows increased levels of UVB (a harmful form of ultraviolet radiation) to reach Earth's surface. When the depletion is strong in a specific area, this is commonly referred to as an 'ozone hole'.
Sulphur dioxide	SO ₂ , atmospheric pollutant mainly emitted from fossil fuel combustion. It is also a precursor (aids in the creation of) particulate matter in the atmosphere (see PM ₁₀ and PM _{2.5}) which can be harmful to health.
Synthetic fertilizer	Industrially produced fertilizer, using the 'Haber-Bosch' process.
TAN	Total Ammoniacal Nitrogen.
TFRN	Task Force on Reactive Nitrogen. A task force under the Working Group on Strategies and Review of the CLRTAP (see Bull <i>et al.</i> 2011, Chapter 25 this volume).
Throughfall	Rainwater (precipitation) falling through the canopy (foliage) of a forest or crop.
Tillage practices	The agricultural preparation of the soil by ploughing, ripping, or turning it.
Troposphere	The lowest portion of the Earth's atmosphere, the depth of which varies geographically, being deepest at the tropics and shallowest at the poles.
Urea	A reactive nitrogen form, urea (or carbamide) is an organic compound with the chemical formula (NH ₂) ₂ CO. Urea is widely used in fertilizers as a convenient source of nitrogen. Urea is also an important raw material for the chemical industry.
Volatile Organic Compounds (VOCs)	Organic compounds that easily vaporize at room temperature, e.g., benzene.
Willingness to pay (WTP)	Maximum amount a person would be willing to pay, sacrifice or exchange for goods or services.