GAW's Measurement-Model Fusion for Global Total Atmospheric Deposition (MMF-GTAD) Initiative

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

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MMF-GTAD Initiative Steering Committee

Task Force on Measurements and Modelling Meeting
11-13 May 2020

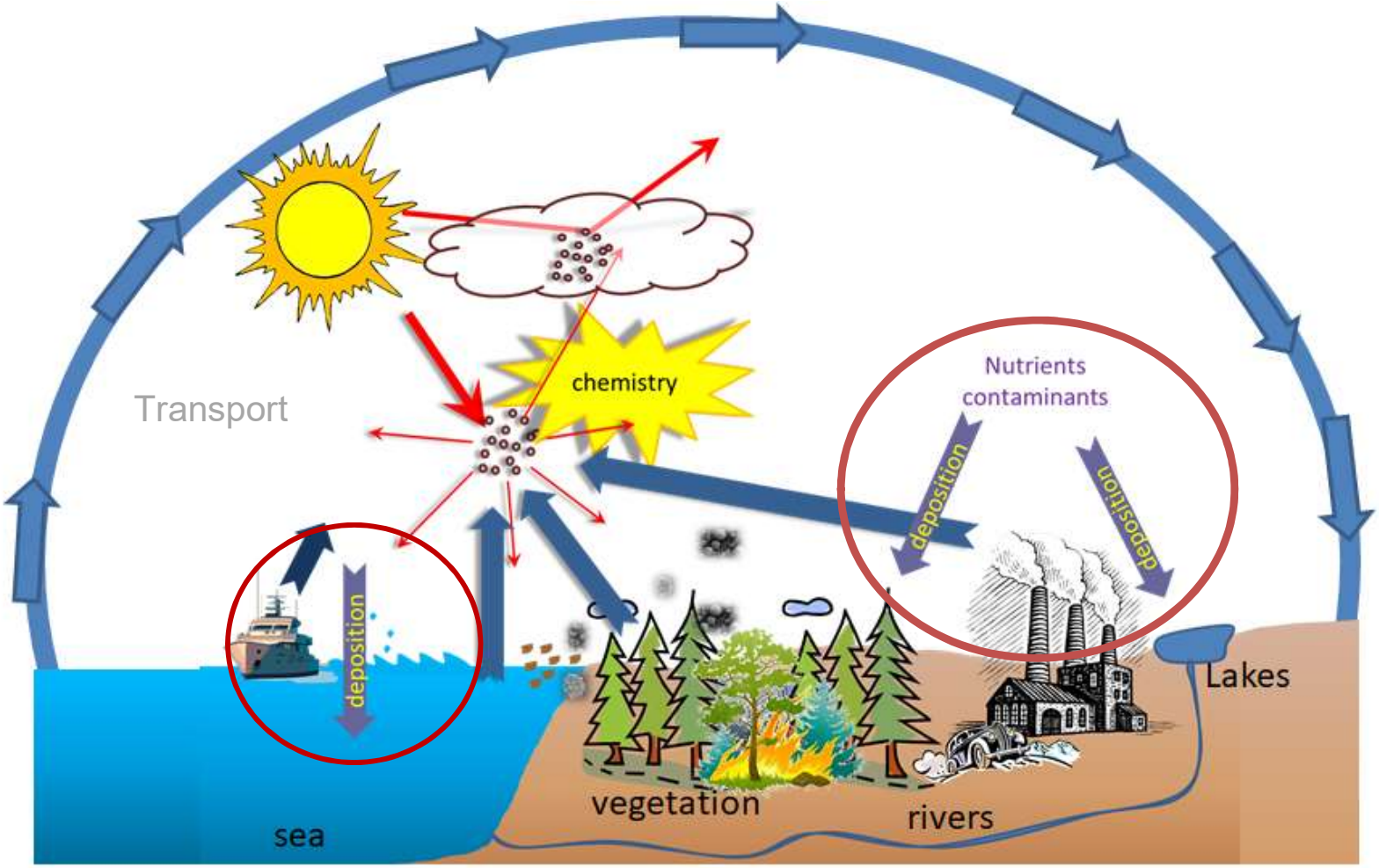
MMF-GTAD Steering Committee

- Amanda Cole, Environment and Climate Change Canada, Canada
- Joshua Fu, University of Tennessee, USA
- Lorenzo Labrador, GAW Secretariat
- Wenche Aas, NILU – Norwegian Institute for Air Research, Norway
- Camilla Andersson, Swedish Meteorological and Hydrological Institute, Sweden
- Leonard Barrie, Stockholm University & The Cyprus Institute
- Frank Dentener, European Commission
- Corinne Galy-Lacaux, CNRS, France
- Jeffrey Geddes, Boston University, USA
- Maria Kanakidou, University of Crete, Greece
- Donna Schwede, US Environmental Protection Agency, USA
- Fabien Paulot, NOAA, USA
- Robert Vet, Retired from ECCC, Canada

Outline

- **Motivation and background**
- **Stakeholder/user communities**
- **Long- and short-term plans**

Atmospheric deposition is a key component of the Earth System



Important loss process for airborne pollutants, therefore critical term for concentrations

Input to land and aquatic ecosystems

Short-term and cumulative effects

Indirect effects, e.g. links to carbon sequestration

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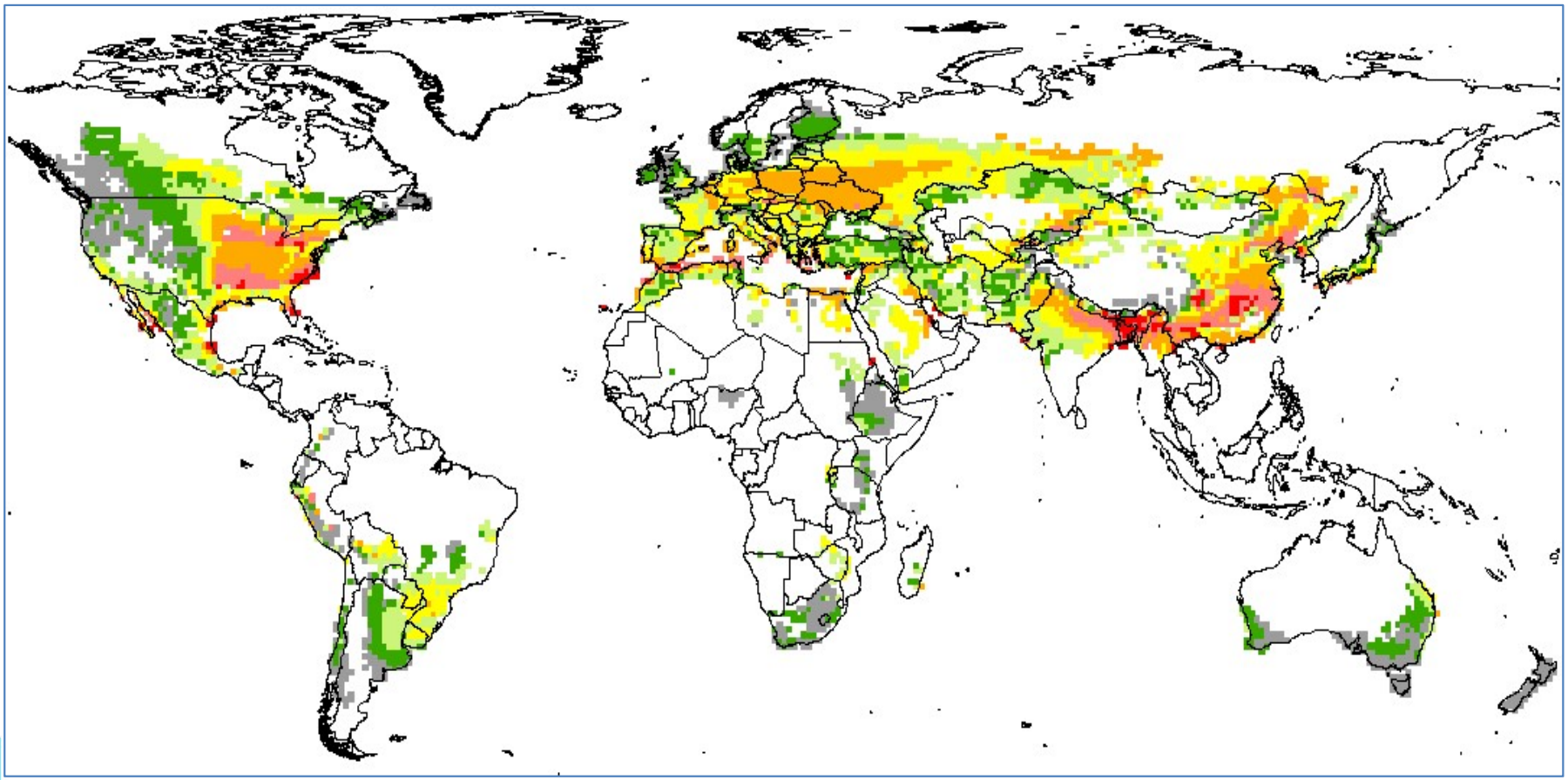
Impact of ozone deposition on agriculture



Wheat yield loss due to ozone deposition onto plant stomata (from Mills et al., 2018)

Estimated financial losses: 14-26 billion US$ yr^{-1} (van Dingenen et al., 2009)

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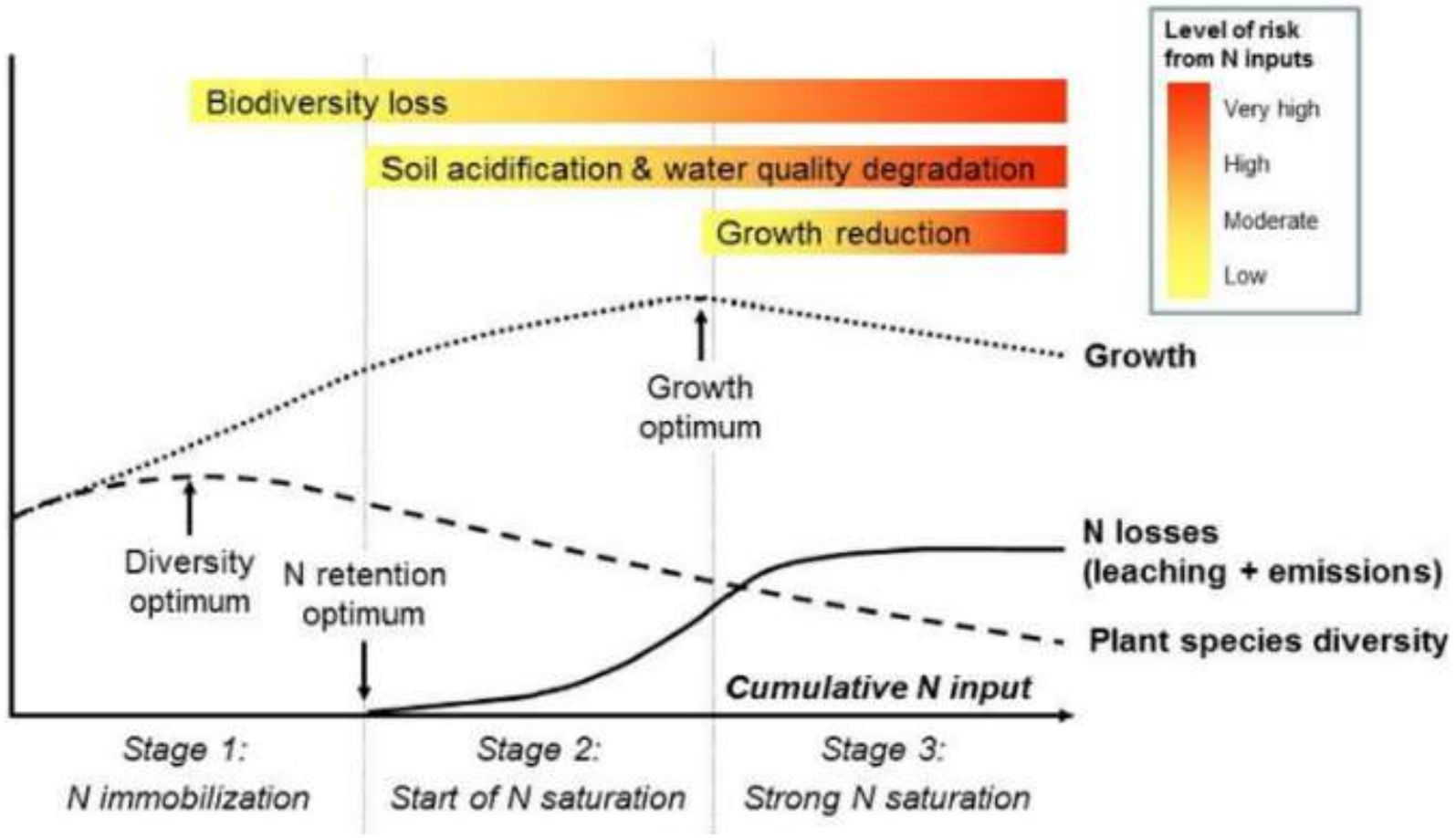
Nitrogen saturation effects on ecosystems

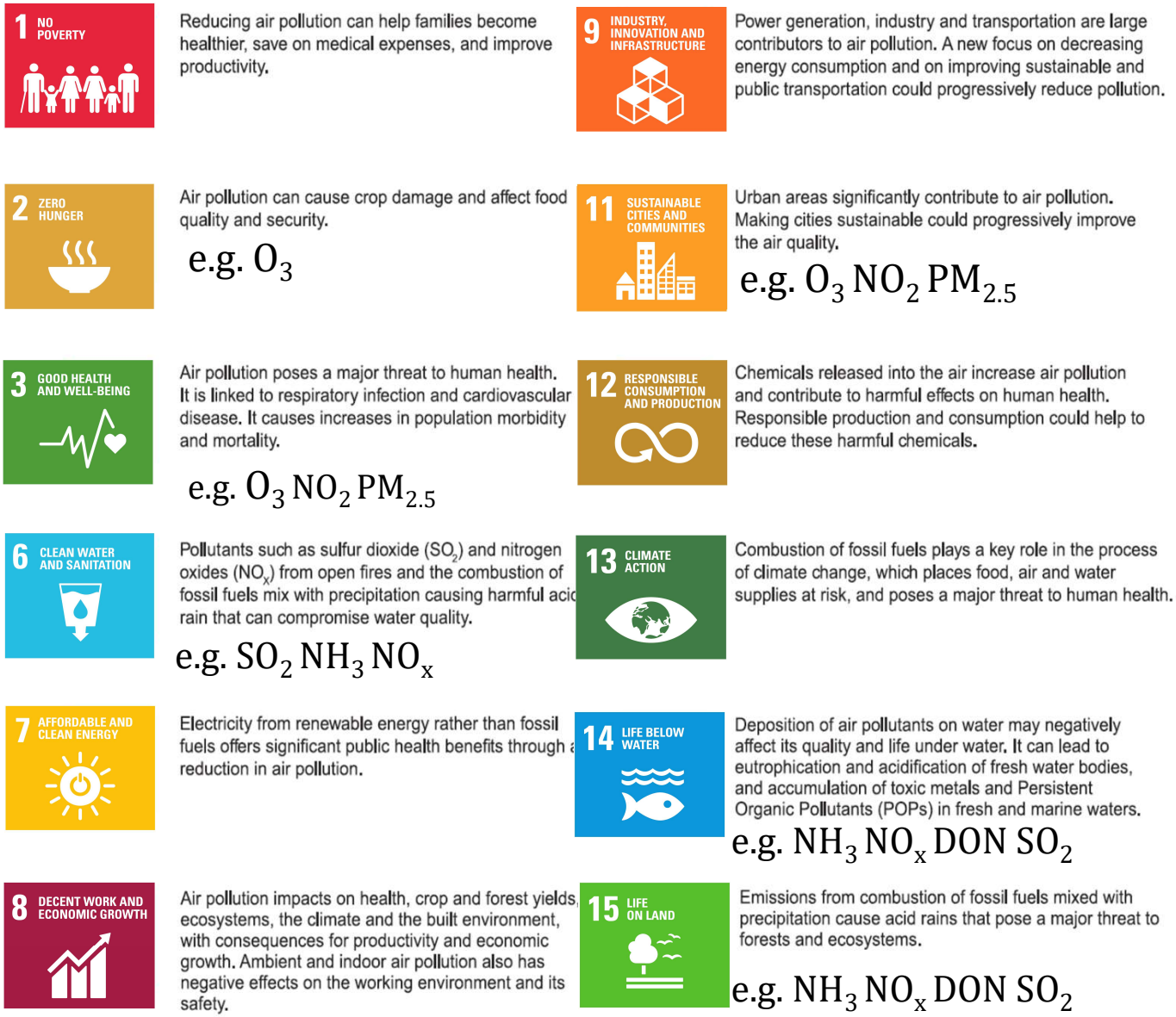


Increasing N deposition →

Adapted from Schmitz et al. (2019)

MMF-GTAD and SDGs

Figure 1.1 How air pollution relates to the UN Sustainable Development Goals



SDG Graphic: EEA, 2017 after UNICEF 2016

MMF-GTAD: rationale

In order to assess the impacts of deposition on the environment and the UN Sustainable Development Goals, there is a need for 'best possible' atmospheric deposition maps produced operationally on a global scale.

For this we propose using "Measurement-Model Fusion"

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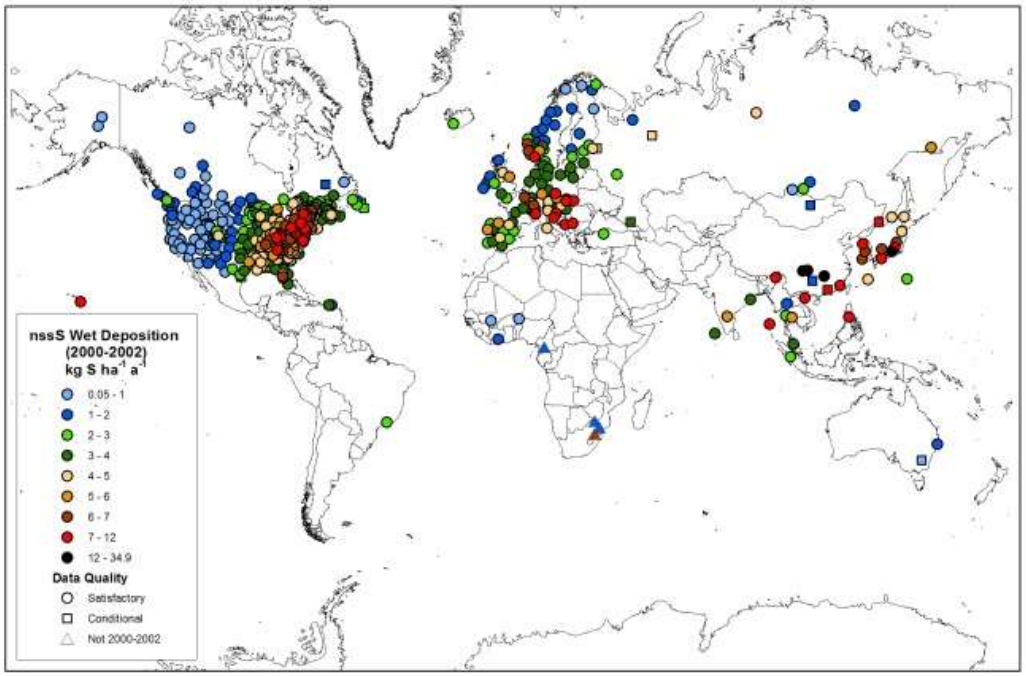
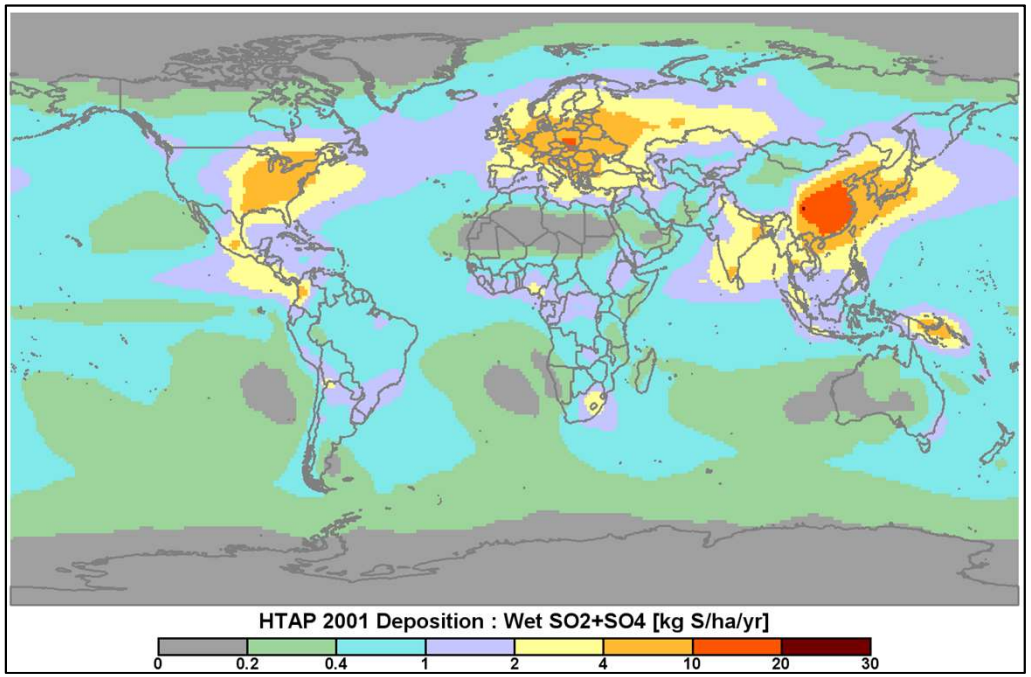
Global measurement-model comparison of atmospheric deposition

Measurement (2000-2002)



Model (2001 Ensemble Mean)



Vet et al. 2014. A global assessment of precipitation chemistry and deposition of sulfur, nitrogen, sea salt, base cations, organic acids, acidity and pH, and phosphorous, *Atmospheric Environment,* 93: 3-100.

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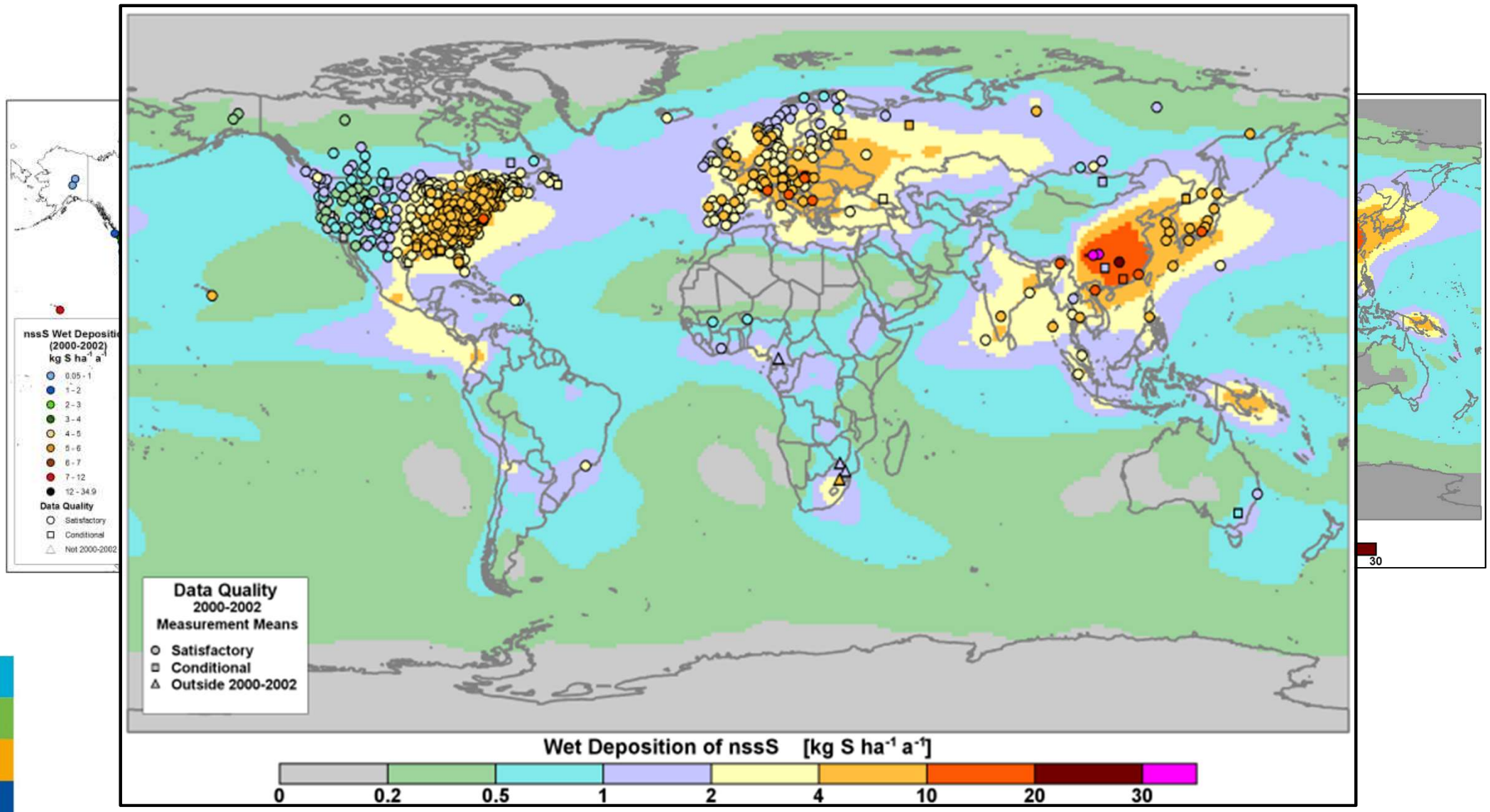
Global measurement-model comparison of atmospheric deposition



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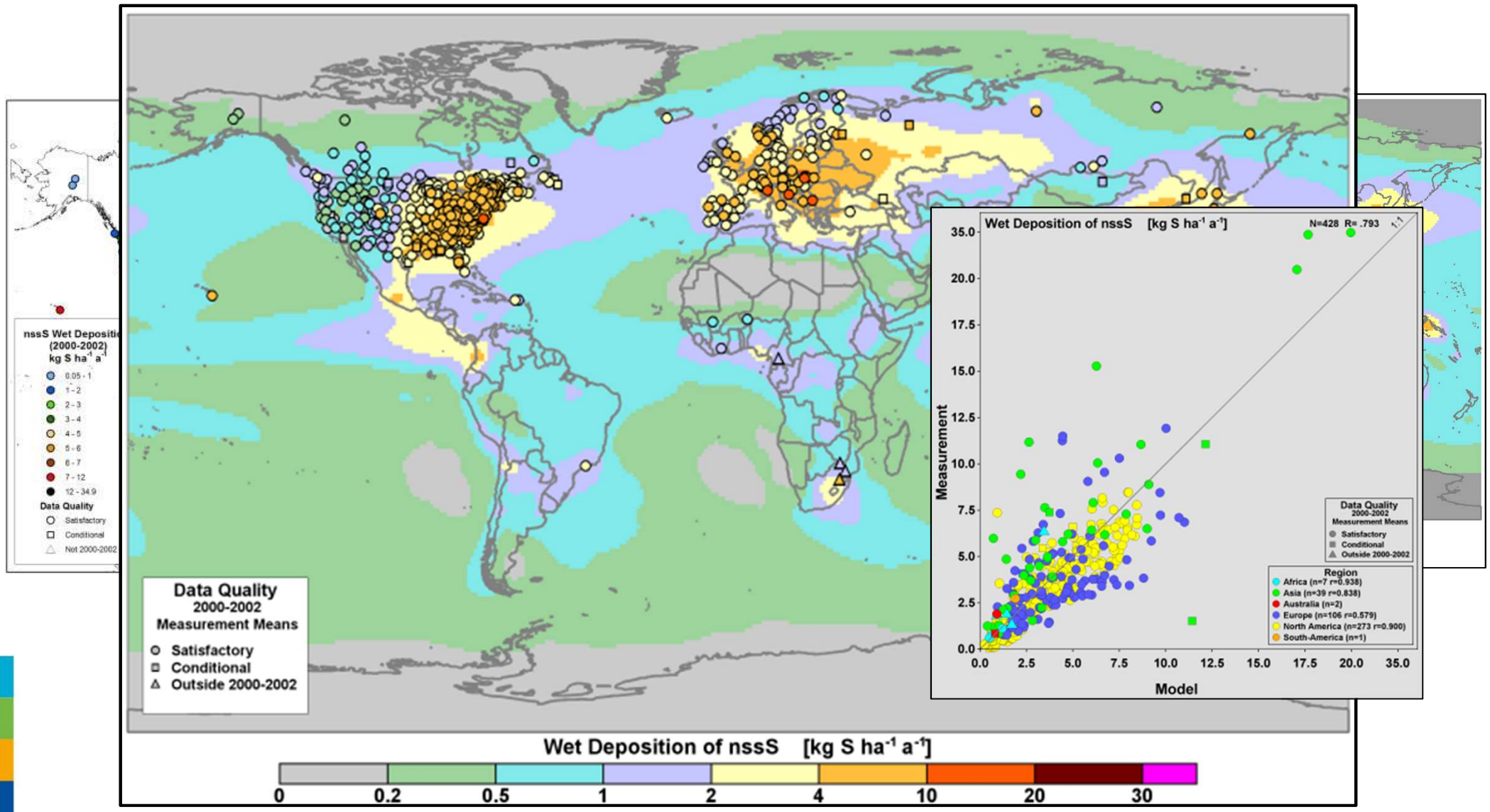
Global measurement-model comparison of atmospheric deposition



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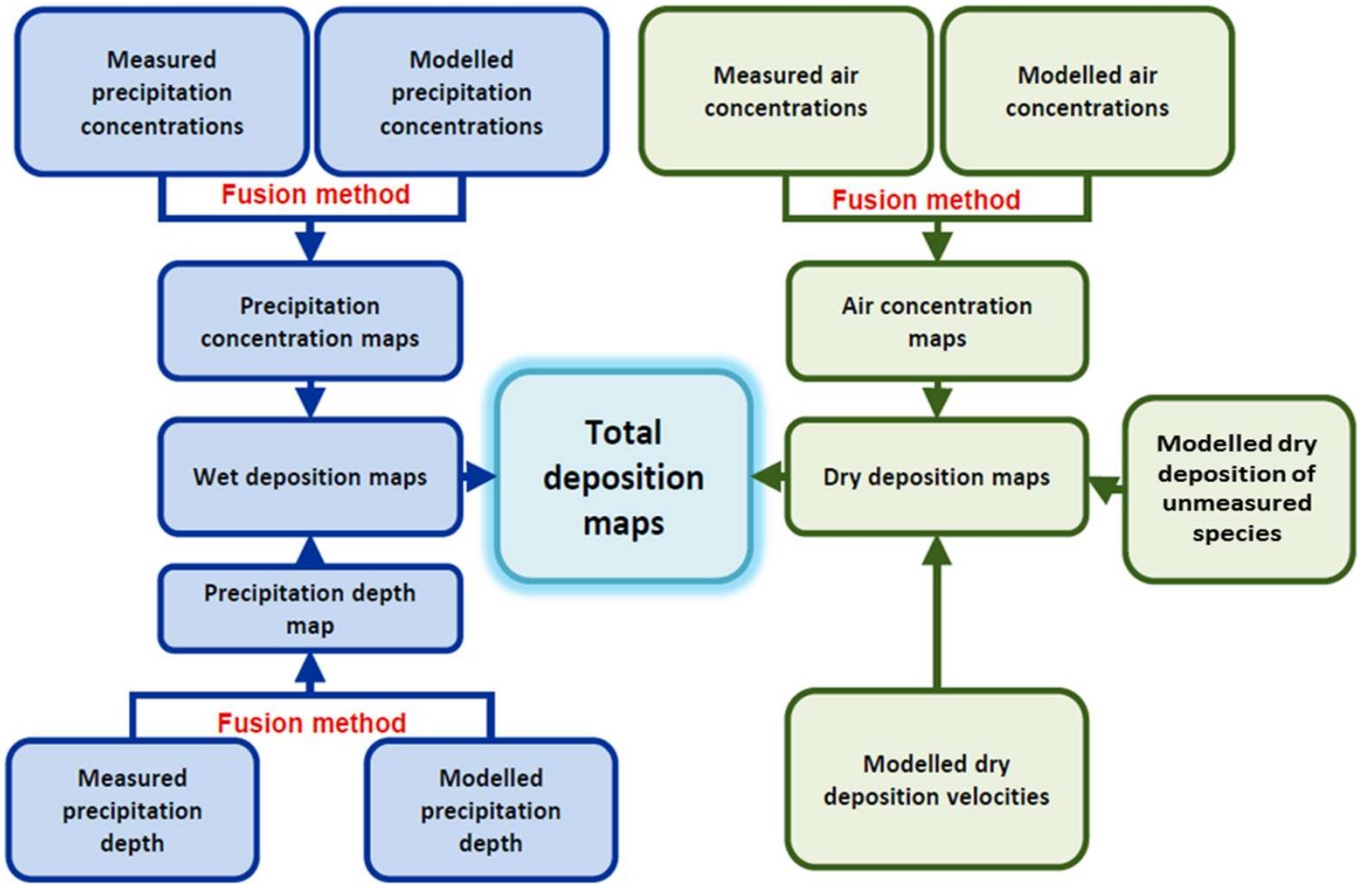
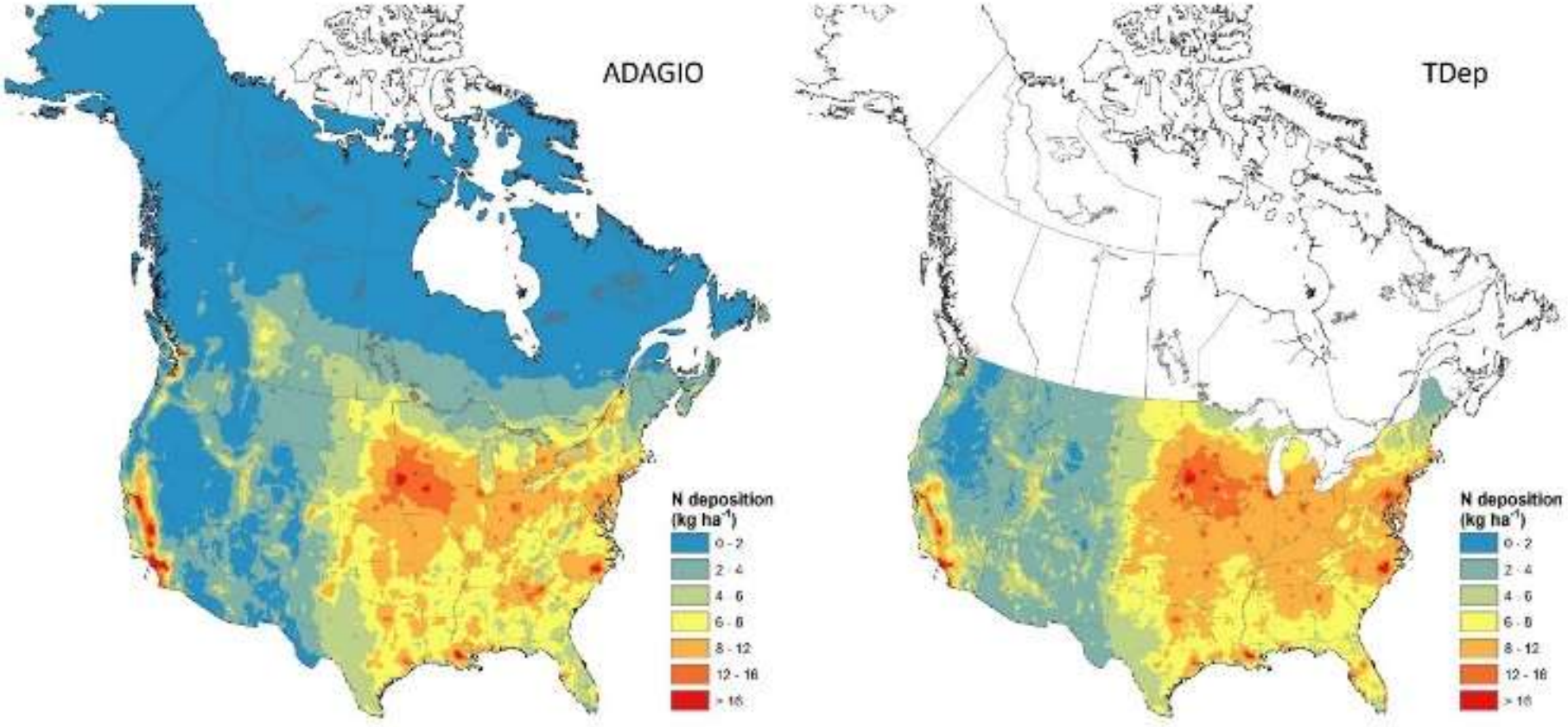
MMF-GTAD: methodology

- **MMF brings together best-available data and modelling results** on precipitation chemistry, precipitation depth, air concentrations and dry deposition velocities to estimate wet, dry and total deposition

- **Total N**
- **Total S**
- **O_3**



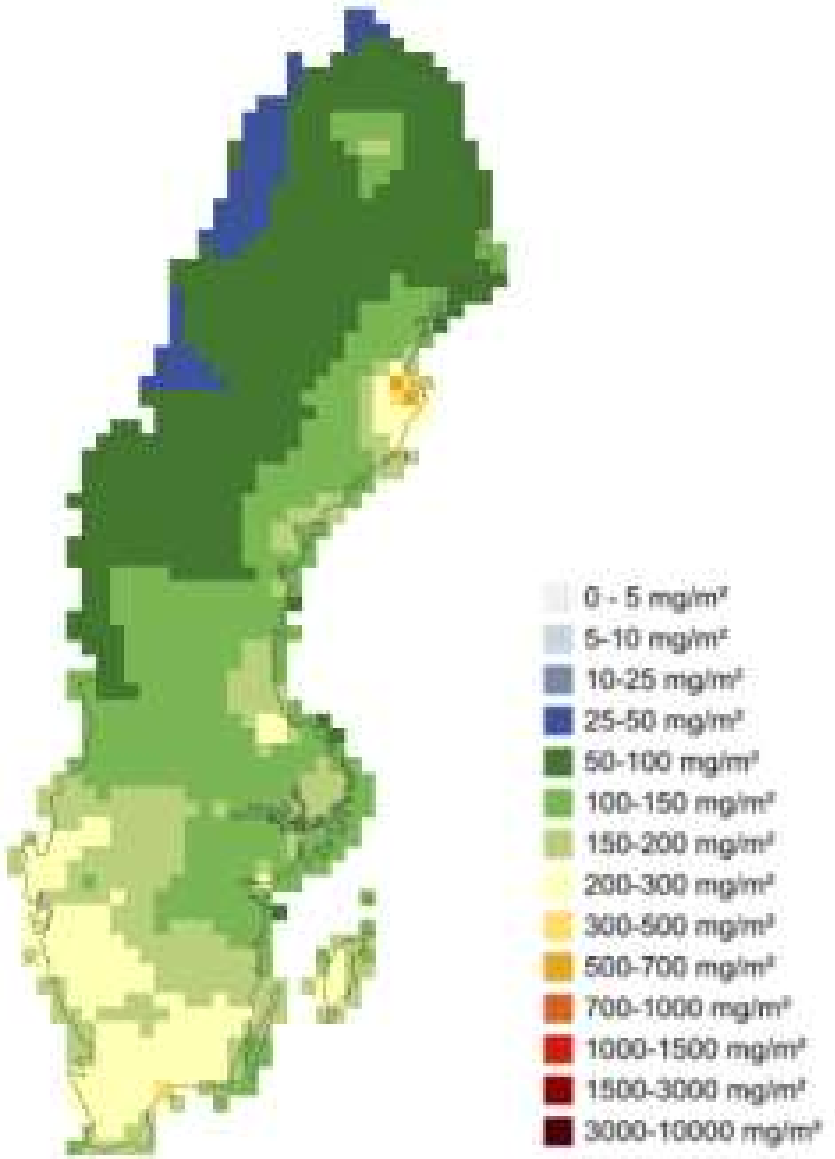
Regional MMF maps: ADAGIO and TDep, N deposition



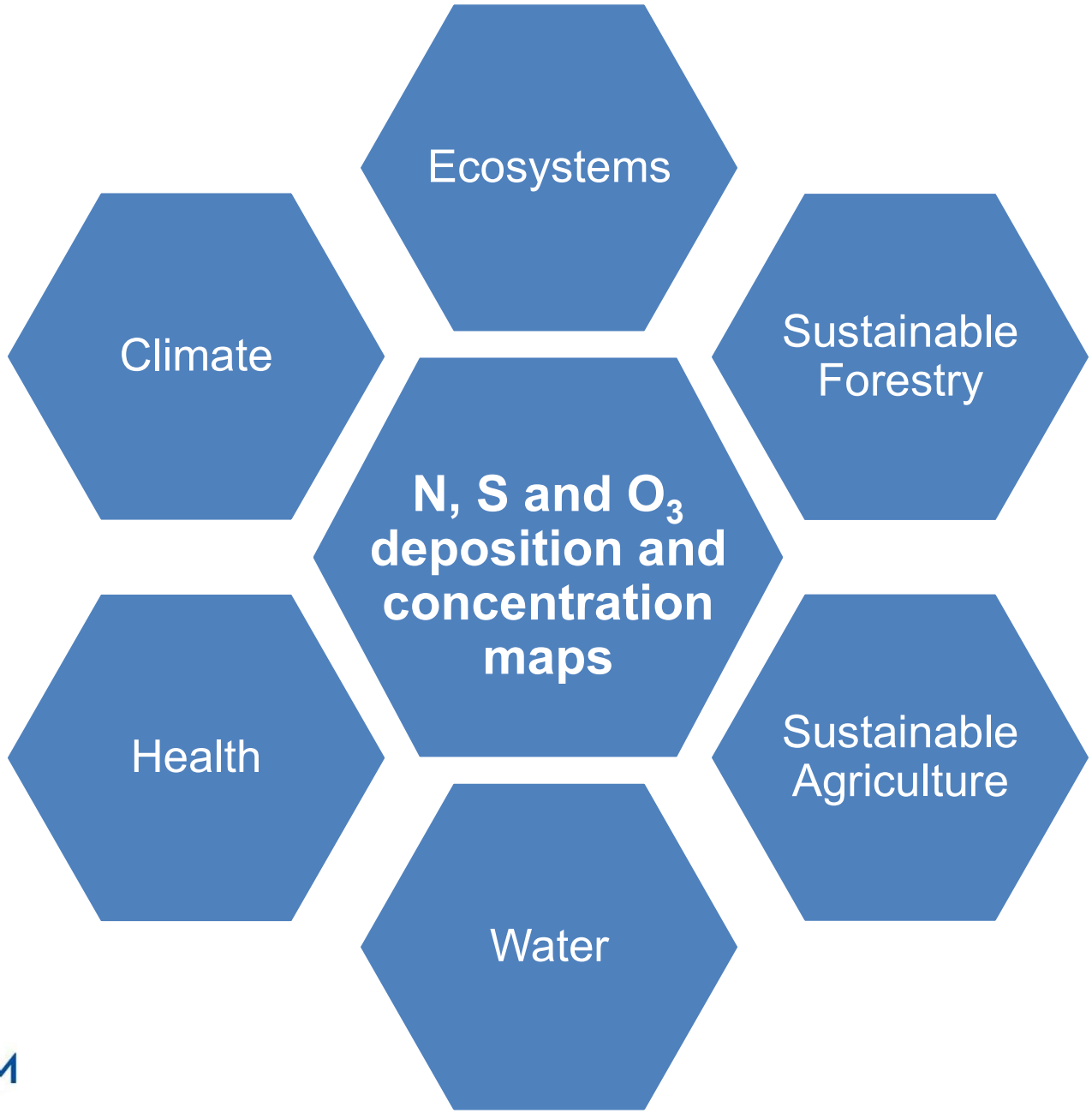
Adapted from Schwede, D., A. S. Cole, R. Vet, G. Lear. Ongoing US-Canada collaborations on nitrogen and sulfur deposition, Environmental Management, June 2019.

Regional MMF maps - S

2017 sulfur deposition in Sweden produced by the Swedish Meteorological and Hydrological Institute (adapted from Leung et al., 2019).



MMF-GTAD products - potential users



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MMF-GTAD
a Science for Services Initiative

Vision: stakeholders will be able to access high-resolution, high-quality, global-scale maps of total atmospheric deposition to meet societal needs as they relate to the environment and global sustainable development.

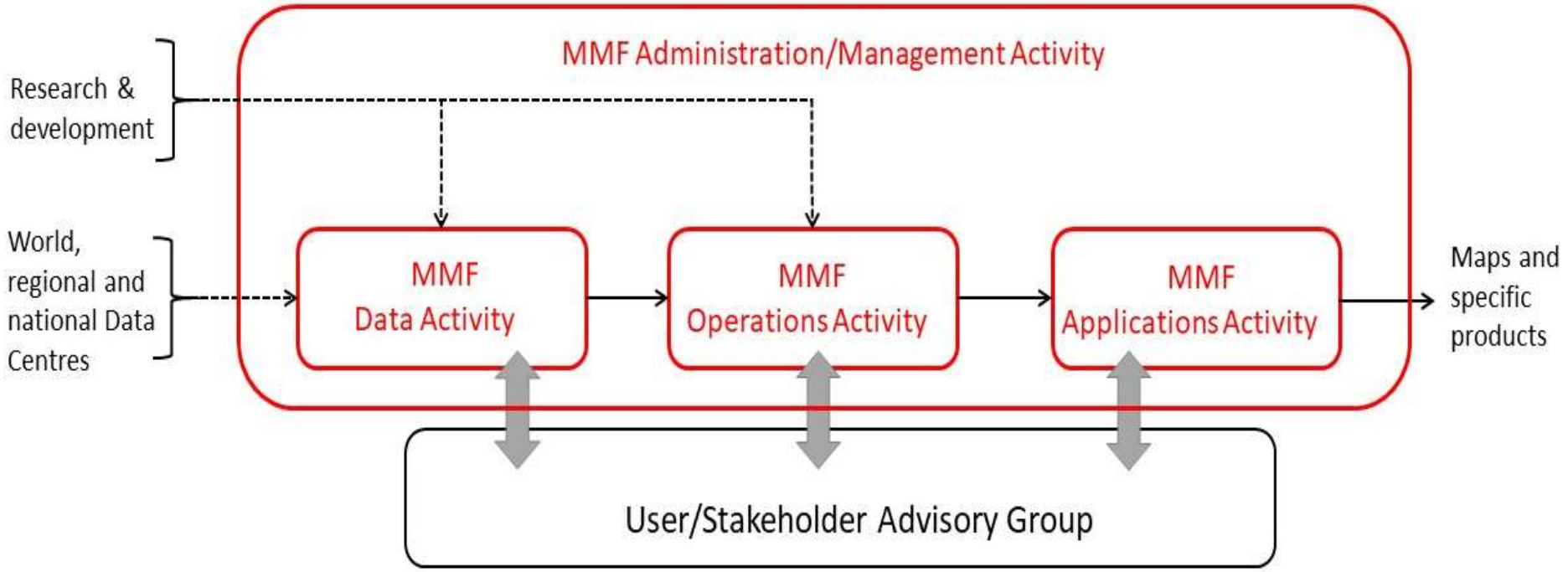
MMF-GTAD near- and mid-term activities

- Drafting of the project's Implementation Plan
- Publication of overview/motivation paper
- Single year global maps – method development and proof of concept
- European map – for regional detail
- Data harmonization strategy
- Establishment of the operational MMF-GTAD mapping system in 3 years, *provided sufficient resources become available*.

MMF-GTAD Project - further steps

- Establish a **Resource Mobilisation Strategy** for finding funds to support the near-term and mid-term Implementation Plan activities
- Establish a **method for engaging** stakeholders, end-users, and partners in the Project, e.g., a Stakeholder Advisory Group
- Use evolving scientific research and development to **upgrade and improve** the MMF-GTAD system, methods and products.

MMF-GTAD project - Working arrangements



Conceptual diagram of the MMF-GTAD Project mapping system.

Many thanks for your attention!

https://public.wmo.int/en/resources/bulletin/measurement-model-fusion-global-total-atmospheric-deposition-wmo-initiative

Back up slides

Identified potential users of MMF-GTAD products

Ecosystems

- UN Convention for Biological Diversity (Strategic Plan for Biodiversity and Aichi Target 8, Biodiversity Indicators Partnership)
- United Nations Environment Programme (UNEP)
- International Nitrogen Management System (INMS)
- Intergovernmental Science-Policy on Biodiversity and Ecosystem Services (IPBES)
- National and regional regulatory bodies responsible for ecosystem conservation

Sustainable Agriculture and Forestry

- United Nations Food and Agriculture Organization (FAO)
- United Nations World Food Programme
- Global Partnership on Nutrient Management
- International Nitrogen Initiative (INI)
- A plethora of institutional and NGO stakeholders working on sustainable agriculture, but lacking data and knowledge on the role of deposition

Climate, Health, Water …..

Identified potential users of MMF-GTAD products

Ecosystems, Sustainable Agriculture and Forestry……

Climate

- United Nations Framework Convention on Climate Change (UNFCCC) and Paris Agreement
- Intergovernmental Panel on Climate Change (IPCC)
- UN Environment Programme (UNEP)
- Climate and Clean Air Coalition
- A range of institutional and NGO's working on climate change, but lacking data and knowledge on the role of deposition

Health

- World Health Organization (WHO): Air Quality Guidelines, Global Burden of Disease Assessment, Global Platform on Air Quality and Health
- National and regional regulatory bodies responsible for human health and air quality

Water

- Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP) *International Maritime Organisation .

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