SAB/ BOSC
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Nitrogen & Co-pollutant Research Roadmap

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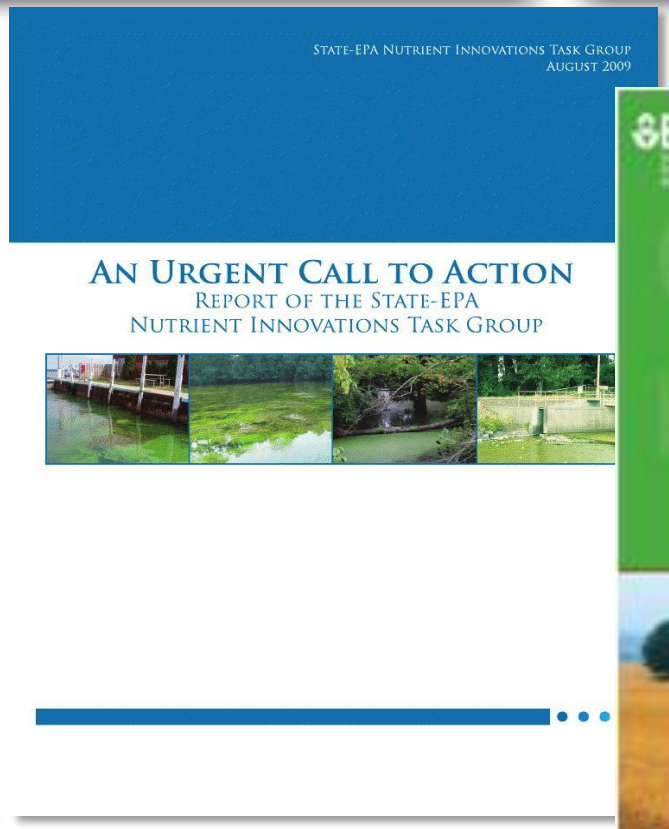
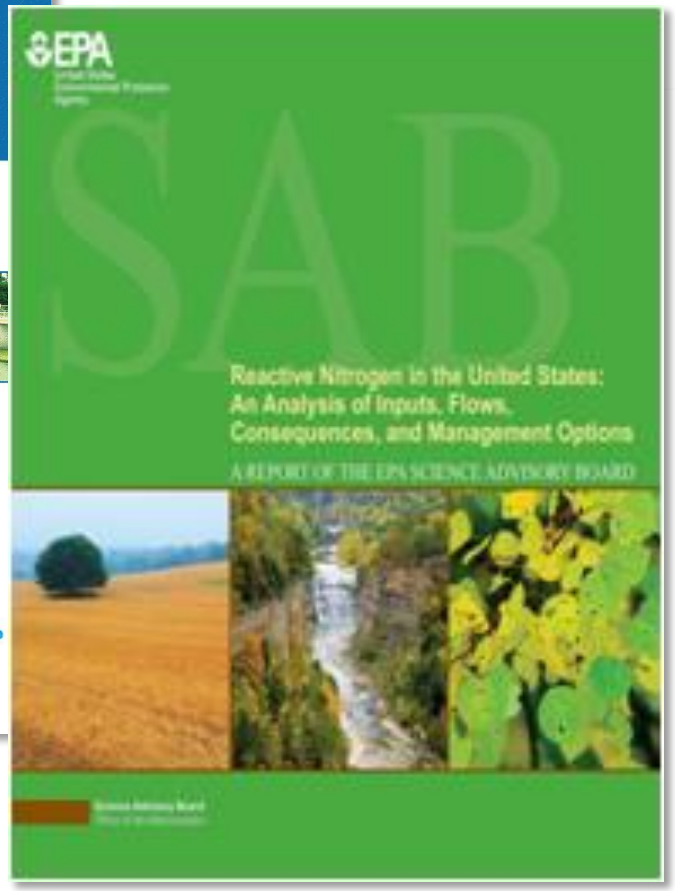
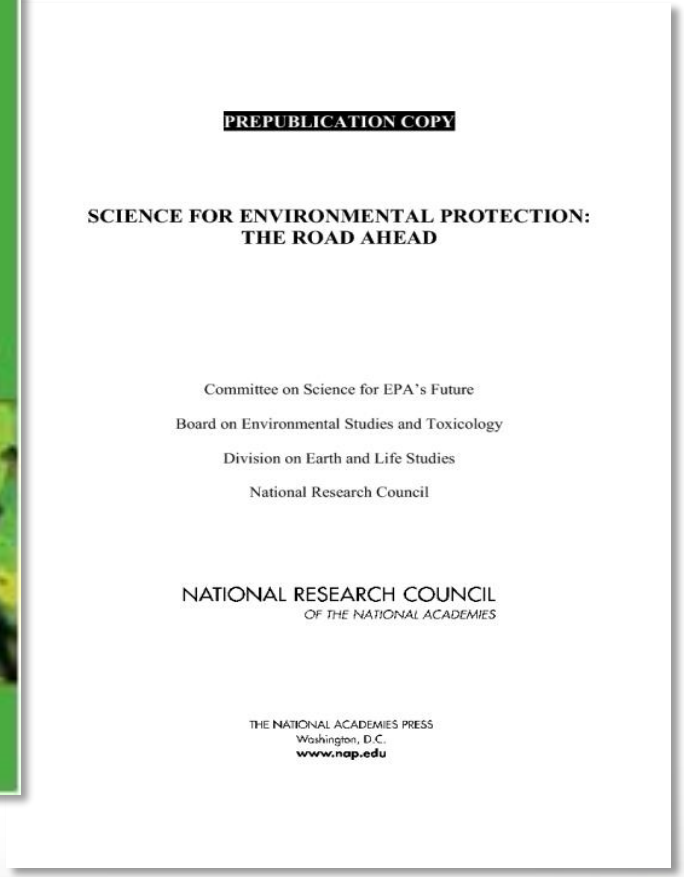
Calls for Integrated Action





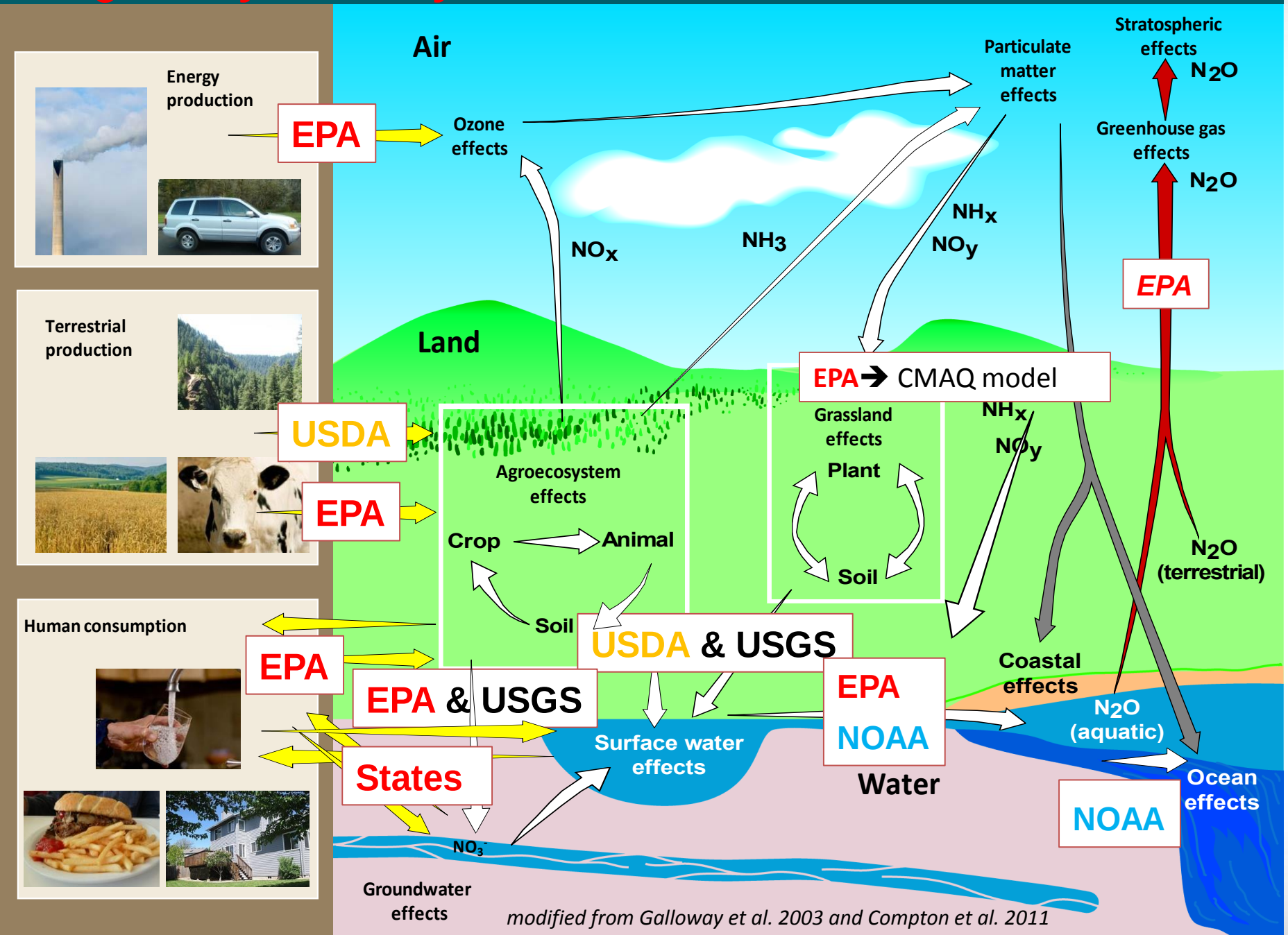


Nutrients are Mission Critical

Nutrient management poses many challenges to traditional pollution regulatory systems since effects cross media-specific regulatory boundaries

(Clean Air Act, Clean Water Act, Safe Drinking Water Act)

Regulatory authority or incentives



modified from Galloway et al. 2003 and Compton et al. 2011

The Nitrogen Cascade

N management involves multiple media, work by multiple Agencies, and management at multiple scales

Nitrogen & Co-Pollutant Research Roadmap

1. Vision for Integration

- ❖ One-EPA perspective
- ❖ Research integration is key
- ❖ Sustainable approach that is economically feasible, socially acceptable, and protects environmental & public health
- ❖ Broad stakeholder engagement

2. Research Integration Plan

- ❖ Underscores innovation & sustainability
- ❖ Synthesis
  - Inform decisions
  - Enables integration
  - Identifies research gaps
  - Adds value to ORD Research Programs, Program Offices & Regions

Research Integration Plan Approach

- Overarching outcome & outputs
  - ❖ Six Science Challenges
    - —Sub-outcome
    - —Sub-outputs
    - —Generalized Research Path
- Science challenges not necessarily sequential
- Gap analysis used to define needs
- Assist National Research Plans with future directions

Nitrogen Roadmap Framework

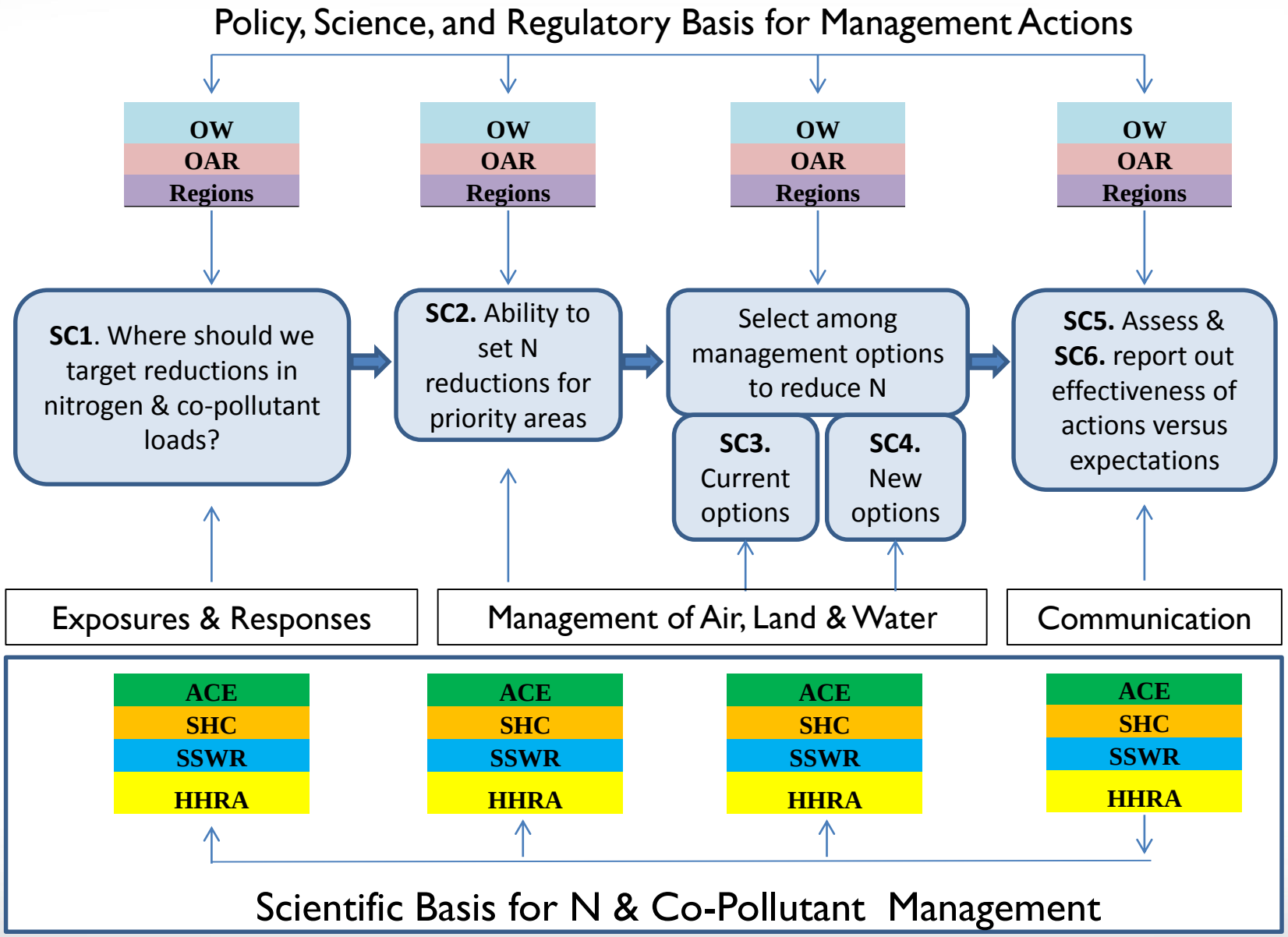
Overarching Outcome

Reduced & avoided ecological & public health impacts from N & co-pollutants to air, water & land

Overarching Outputs

Models, tools & technologies that incorporate scientific, social, economic & cross-media factors to inform regulatory & non-regulatory solutions to excess N & co-pollutants

N & Co-Pollutant Roadmap Conceptual Diagram



Example: SC1. Where Should We Target Reductions in N & Co-Pollutant Loads?

Sub-Outcome

Programs & stakeholders know where N & co-pollutant reductions are needed to prevent harmful ecological & public health impacts

Sub-Output

Tools & technologies to evaluate:

a) N & co-pollutant sources
b) Exposure to N & co-pollutant pollution
c) N & co-pollutant pathways through ecosystems
d) Ecological & human endpoints & thresholds
e) Decision-support tools that incorporate social & economic costs & benefits of N & co-pollutant management

Example: SC1. Where Should We Target Reductions in N & Co-Pollutant Loads?

Generalized Research Path

1.1 Synthesis

1.2 Endpoints & Thresholds

1.3 Exposure

1.4 Services

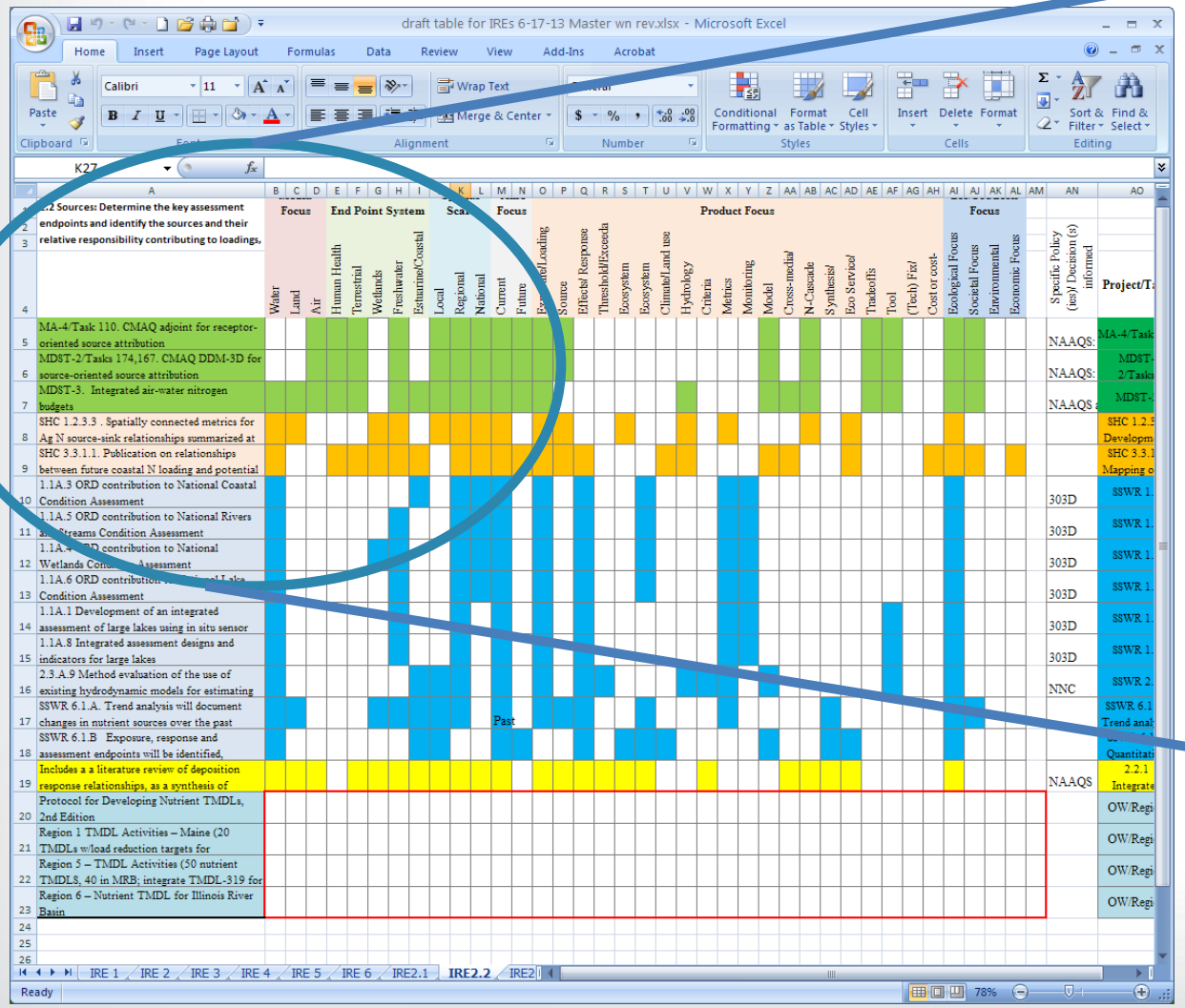
1.5 Climate Change

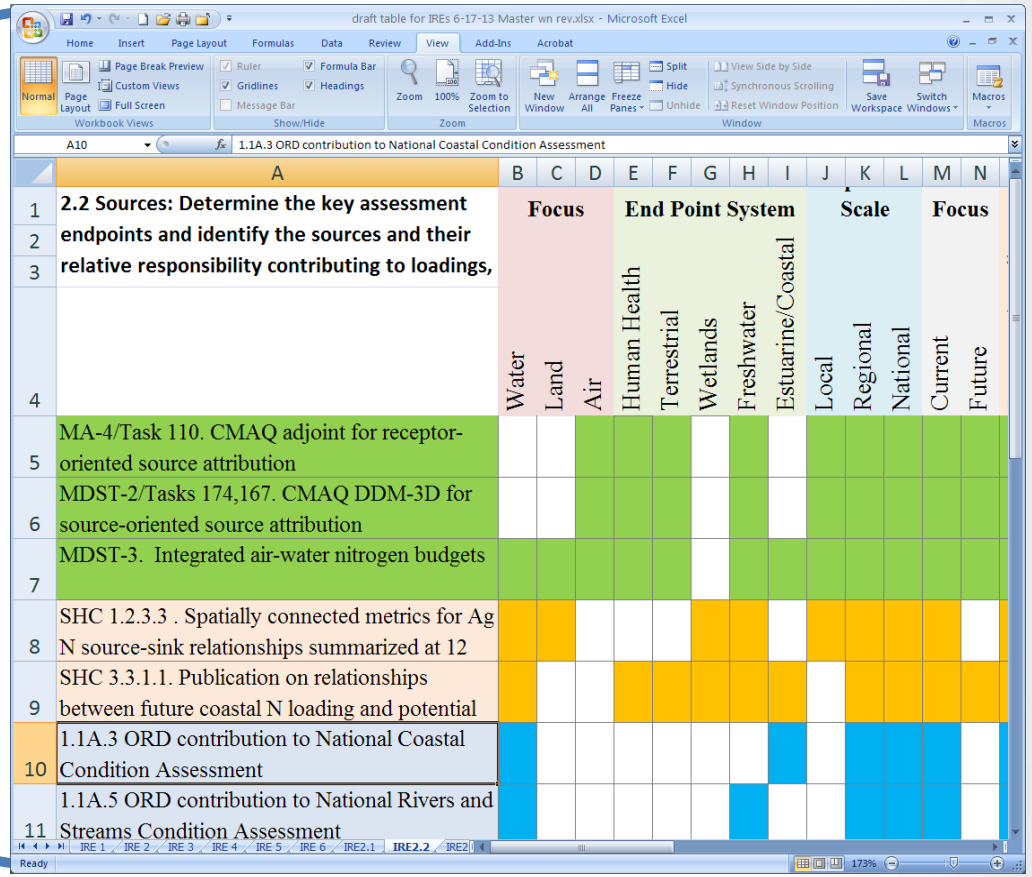
1.6 Exceedance

1.7 Tools

EPA Research Portfolio Mapping

Gap analysis spreadsheet – Science Challenge 2.2





Close-up of Product x Focus Matrix

Research Portfolio Mapping by National Research Program & Office

Generalized Research Pathway	ACE	SSWR	SHC	HHRA	OW	OAR
SC 1 – Identify priority areas						
Step 1.1 Synthesis						
Step 1.2 Endpoints and Thresholds						
Step 1.3 Exposure						
Step 1.4 Services						
Step 1.5 Climate Change						
Step 1.6 Exceedance						
Step 1.7 Tools						
SC 2 – Set reduction goals for priority areas						
Step 2.1 Synthesis						
Step 2.2 Sources						
Step 2.3 Exposure Response						
Step 2.4 Endpoint Response						
Step 2.5 Services						
Step 2.6 Climate Change						
Step 2.7 Tools						
SC 3 – Current management options						
Step 3.1 Synthesis						
Step 3.2 Technologies						
Step 3.3 Data						
Step 3.4 Cost impacts						
SC 4 – New management options						
Step 4.1 Synthesis						
Step 4.2 Innovative Strategies						
Step 4.3 Future factors						
Step 4.4 Analysis of Strategy Effectiveness						
SC 5 – Assess effectiveness						
Step 5.1 Synthesis						
Step 5.2 Models						
Step 5.3 Metrics						
Step 5.4 Verification procedures						
Step 5.5 Monitoring systems						
SC 6 – Report on effectiveness						
6.1 Inter-office Accountability						
6.2 Inter-office Points of Contact						
6.3 Synthesis						
6.4 Communication Strategy						
6.5 Communications Eval. & Meas.						

Table 1. Research and management efforts for Nr and co-pollutant Science Challenges (SCs) and steps.
Major efforts are indicated by black, contributing programs in gray, and white indicates minor or no effort.

Broad Priority Research Needs Identified

- Develop empirical data and models that better tie nitrogen and co-pollutant related water quality impairments to quantitative loads, and better predict how impairments vary with changes in load, concentration, and biogeochemical conditions.
- Determine how the magnitude, frequency, and duration of nitrogen and co-pollutant loading affect expression of impairment for aquatic endpoints.
- Develop better tools to determine nitrogen and co-pollutant source apportionment in watersheds at a range of scales.
- Incorporate climate change (temperature, precipitation) into models predicting environmental impacts of future nitrogen and co-pollutant loads.
- Better integrate pollution-response models across air, land, and all water body types.

See Roadmap for full text and list of priorities

Current Research – Informing EPA Decision Making

HHRA – NOxSOx Integrated Science Assessment

Scientific foundation for OAR risk and policy assessments that guide the EPA to determine whether or not to set, revise or retain the NOx and SOx National Ambient Air Quality Standards (NAAQS).

SSWR – Science Support for Water Quality Criteria

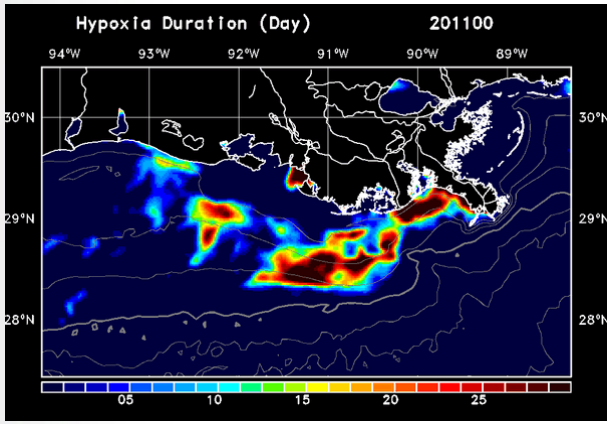
Experimental data and modeling tools to support the development of numeric nutrient criteria and interpretation of narrative standards for inland waters and downstream estuarine and coastal waters.

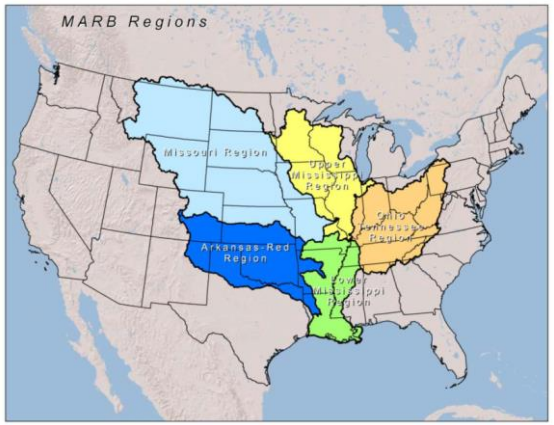
SHC – Informing Sustainable Nitrogen Decisions using an Ecosystem Services Framework

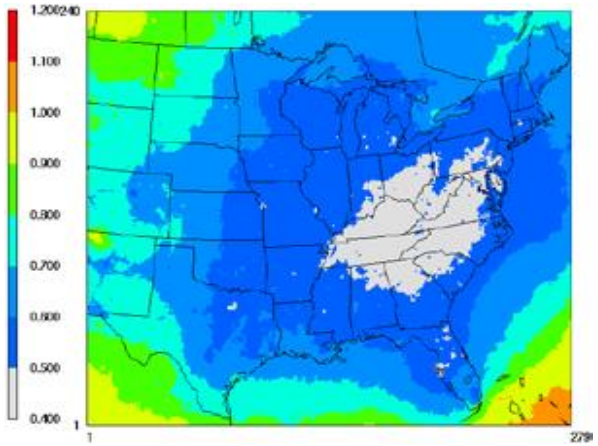
The NEWS (Nutrient Export from Watersheds) was used to predict future nitrogen inputs to the coastal zone based on scenarios of “business as usual” and “ambitious” approaches to nutrient management.

Current Research – Cross ORD National Program Collaboration on Nutrients Research

MARB – Northern Gulf of Mexico Modeling Case Study







SSWR

1) Mechanistic research to understand the processes driving continental shelf hypoxia
2) Development of coastal hydrodynamic (Navy) and eutrophication models (GEM; GOMDOM)

SSWR-ACE

1) Development of a Mississippi River Basin modeling framework to marry atmospheric, hydrologic, and biogeochemical models
2) Model forecasts based on nutrient management and climate scenarios

ACE

1. Improve air quality models (CMAQ) for air-surface exchange to reduce uncertainty
2. Couple meteorology (WRF) and hydrology (VIC) for internally consistent drivers of the ecosystem models
3. Expand the atmospheric modeling system to better link to the ecosystem models

Cross-Agency Collaboration

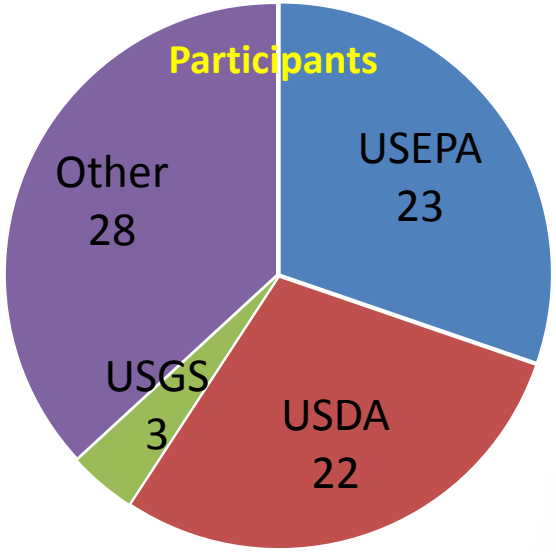
Purpose:

Develop a partnership between EPA, USDA, and USGS to promote sustainable management of N and co-pollutants

Expected Products:

- Report (Oct 2014)
- Joint Science & Management Action Plan to support EPA-USDA-USGS N and co-pollutant management
- Workgroups (Dec 2014):
  - Inventory of N sources and impacts
  - Policy solutions
  - Technical solutions
  - Cross-walk of Agency research

Working Meeting: Management Strategies for Reactive N and Co-Pollutants
June 24 – 26, 2014



Consideration of State Research Needs

Briefing Scheduled for 8/12/14

ECOS/ERIS 2013

Nutrients in Water

- Develop models for nutrient discharges from wastewater facilities similar to air models that are already in use to replace or augment monitoring
- Identify approaches for treating phosphorus in municipal or industrial wastewater, in nonpoint discharges, or sediments
- Develop new technologies to assist in addressing phosphorus loadings to lakes, especially as related to algal blooms in Lake Erie
- Study the transport of nutrients to better understand if and how they move from the upper Midwest to the Gulf of Mexico
- Develop and share Best Management Practices related to nutrient losses

N and Co-pollutant Roadmap: Framework for Nutrient Research in SSWR 2016-19 Research Plan

N Roadmap
Six Science Challenges

1. Where should we target reductions in nitrogen & co-pollutant loads?

2. Ability to set N reductions for priority areas

3. Current options

4. New options

5. Assess &
6. report out effectiveness of actions versus expectations

SSWR – Nutrients Research Topic
Three Research Objectives

1: Improve Thresholds and Targeting Actions

2: Improve Nutrient Management Practices

3: Improve Metrics of Benefits, Accountability and Communication

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Discussion

Many thanks to…

- Robin Dennis (ACE/NERL)
- Jana Compton (SHC/NHEERL)
- Hal Walker (SSWR/NHEERL)
- Tara Greaver (HHRA/NCEA)

Plus many other contributors from across ORD, OW, OAR & Regions