Spatial Variability in Nutrient and Sediment Loadings due to Climate Change at Chesapeake Bay Watersheds

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Outline

- Objective and Motivation
- Methods
- Supporting Work
- Initial Findings
- Next Steps

Objective

- Explore the spatial variability in phosphorus, nitrogen, and sediment loads through a detailed analysis of global climate model predicted input change of precipitation (PPT), temperature (TMP), and potential evapotranspiration (PET).

Climate Change
Motivation of this study

- Continue to meet water quality standards in a changing world.
- Chesapeake Bay Executive Order (link)
  - "Assess the impacts of a changing climate on the Chesapeake Bay and develop a strategy for adapting natural resource programs and public infrastructure to the impacts of a changing climate on water quality and living resources of the Chesapeake Bay watershed."
- Executive Order – Preparing the United States for the Impacts of Climate Change (link)

Methods

- Watershed fluxes were simulated using the HSPF Watershed Model Phase 5.3.2
- The output of six General Circulation Models (GCMs) was used to create input for the climate change runs
- 10-year hydrological simulations:
  - Baseline scenario: 1990 – 1999
  - Climate change runs: 2086 – 2095

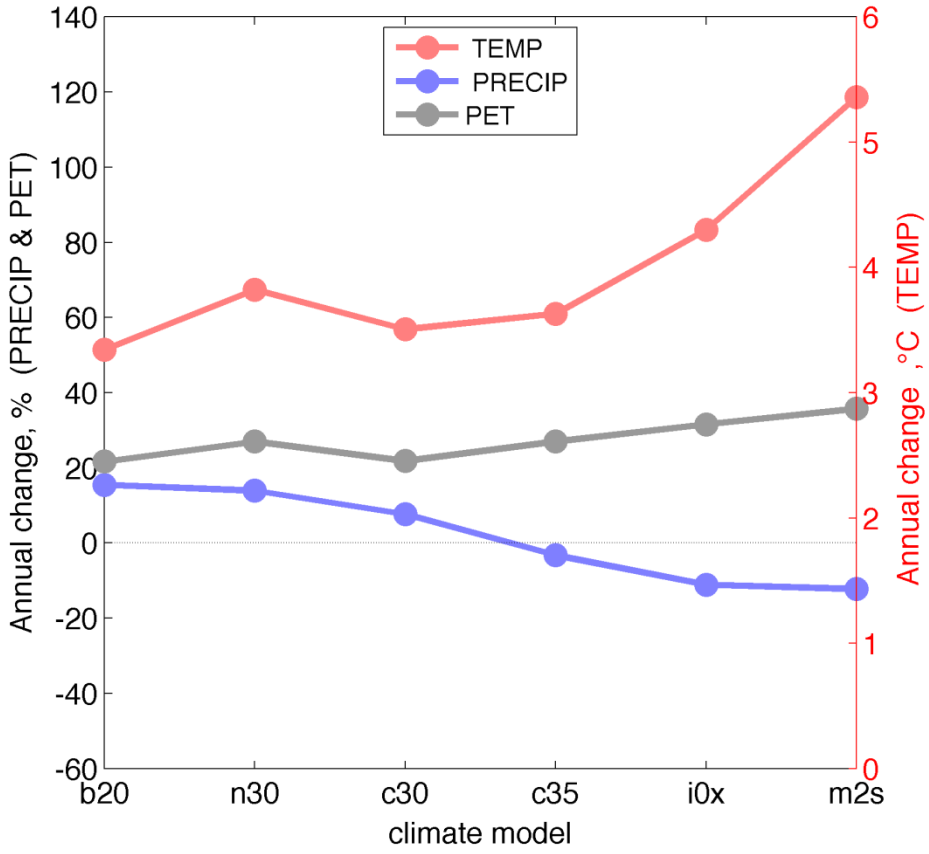
General Circulation Models (GCMs)

id	GCM	Originating group
b20	BCCR-BCM2.0	Bjerknes Centre for Climate Research, Norway
c30	CSIRO-Mk3.0	Commonwealth Scientific and Industrial Research Organization, Australia
c35	CSIRO-Mk3.5	Commonwealth Scientific and Industrial Research Organization, Australia
i0x	INM-CM3.0	Institute for Numerical Mathematics, Russia
m2s	MIROC3.2(medres)	National Institute for Environmental Studies, Japan
n30	NCAR-CCSM3	National Center for Atmospheric Research, USA

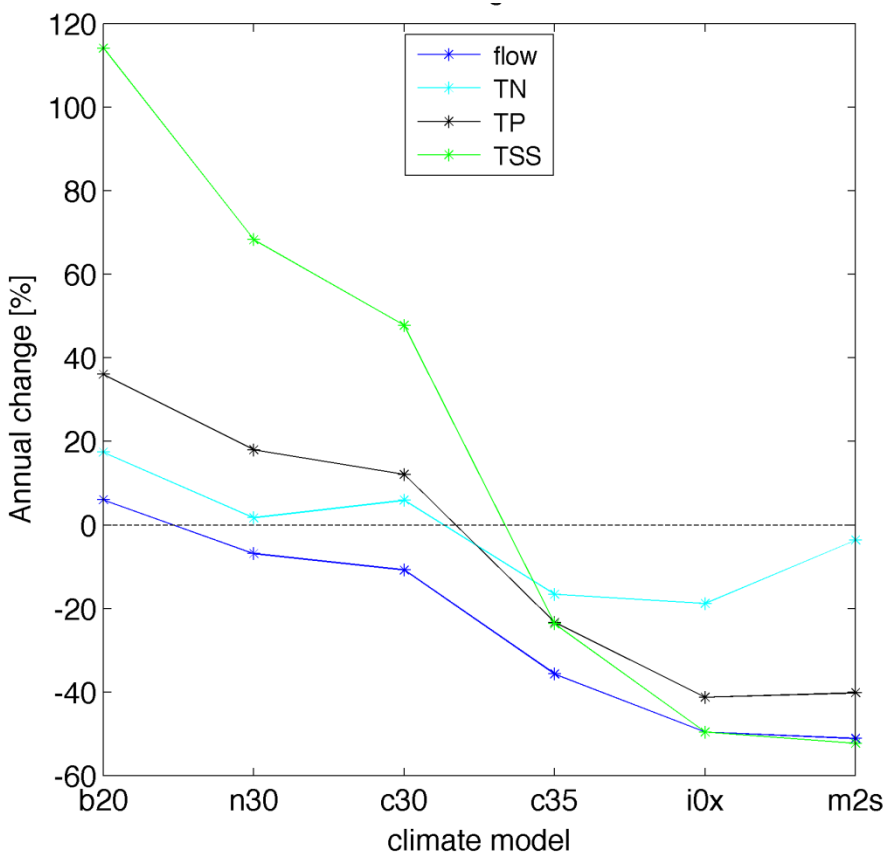
- Monthly mean Temperature and Precipitation from the multi-model dataset archive of the World Climate Research Programme Coupled Model Intercomparison Project, phase 3 (CMIP3)
  http://www-pcmdi.llnl.gov/ipcc/model_documentation/ipcc_model_documentation.php

Climate Change Forcing Functions
Herrmann and Najjar – Summary of results

INPUT

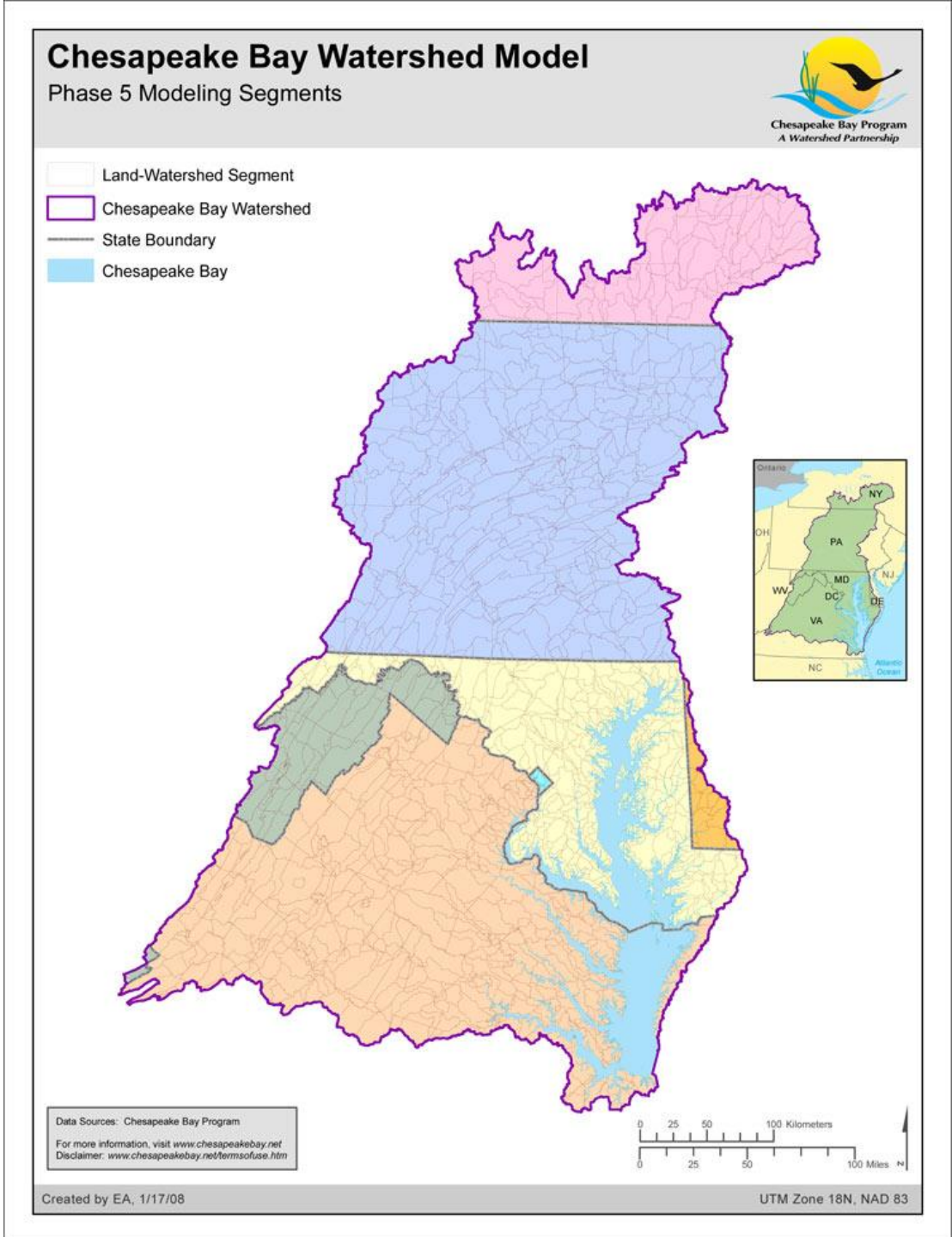


OUTPUT



CBP Watershed Model Segmentation

- 7 jurisdictions
- 368 land segments
- >2000 river segments
- 30 land-uses



Initial Findings

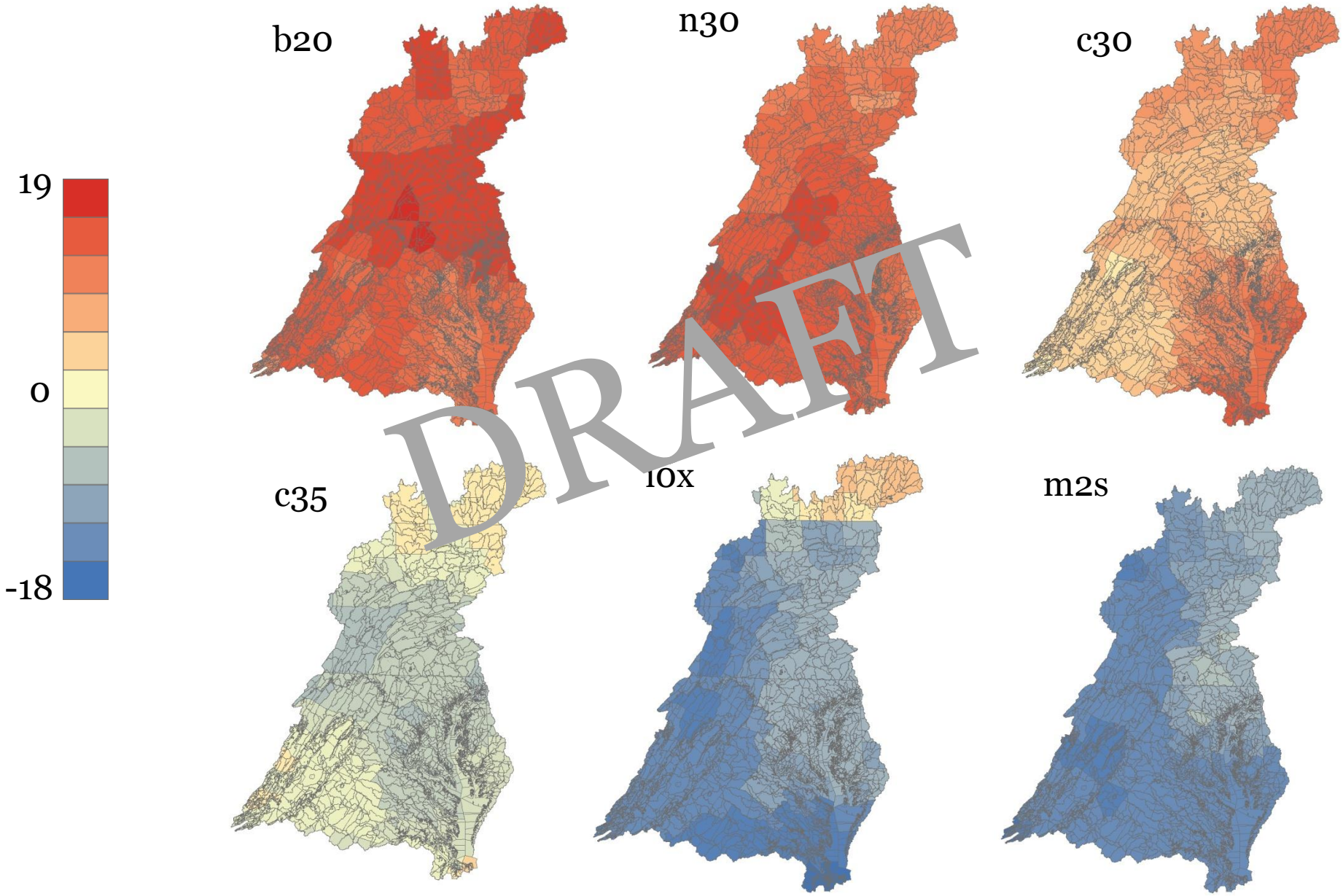
INPUTS

For the six different climate scenarios, the only input changes are precipitation (PPT), temperature (TMP), and potential evapotranspiration (PET).

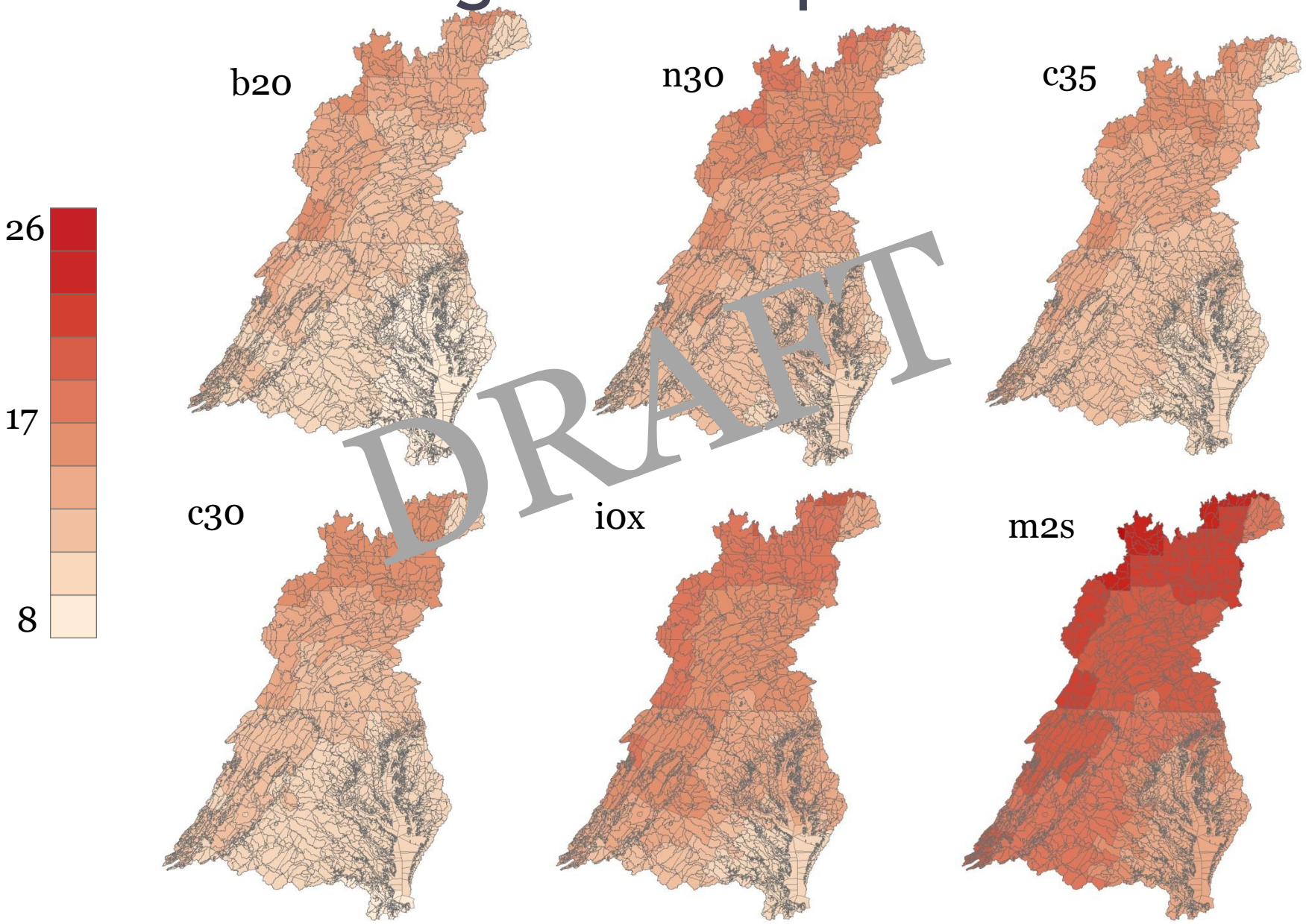
Change (Δ) = GCM scenario – base scenario

= increase = decrease

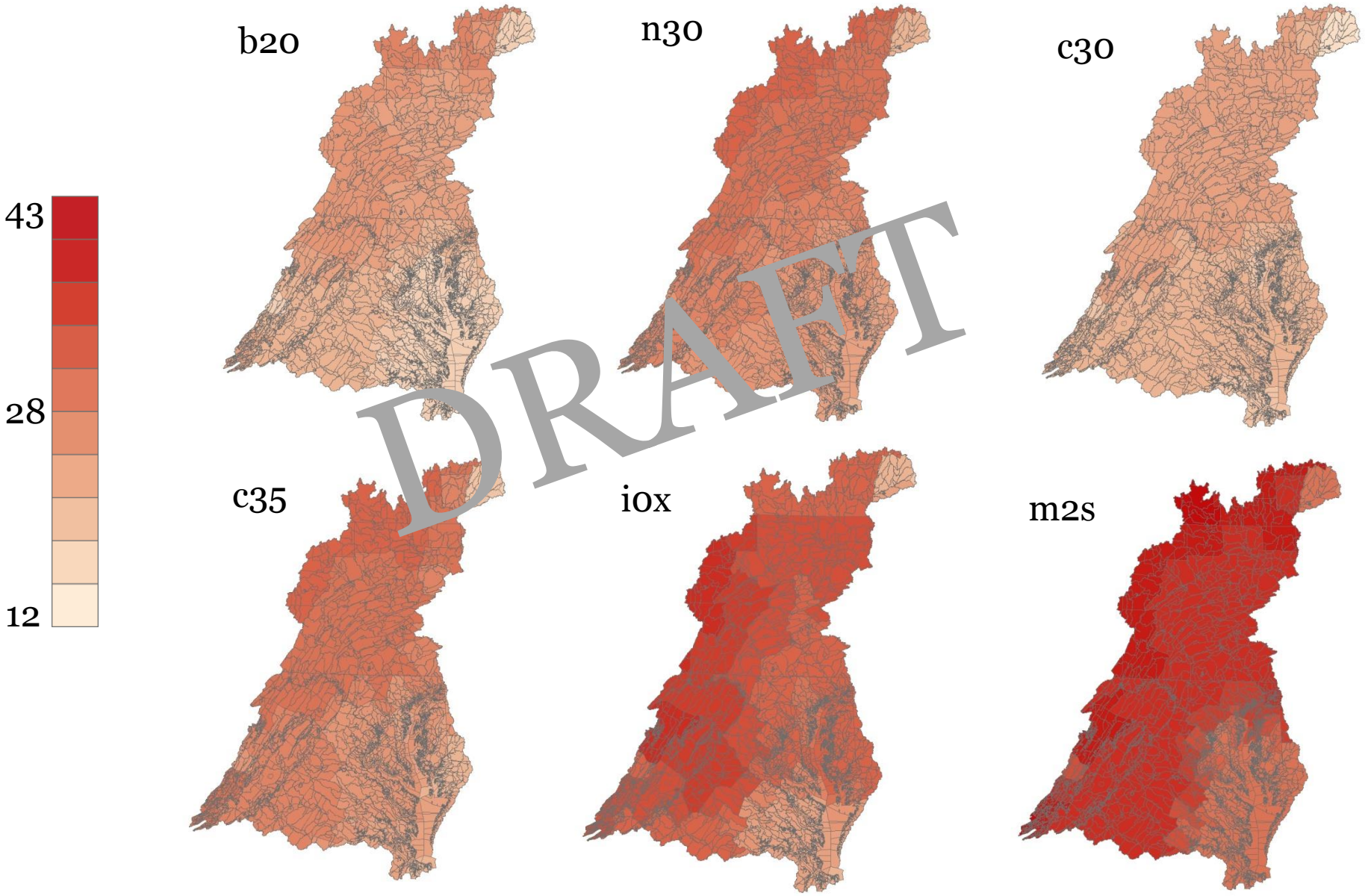
Percent Change in Precipitation



Percent Change in Temperature



Percent Change in Potential Evapotranspiration



Output

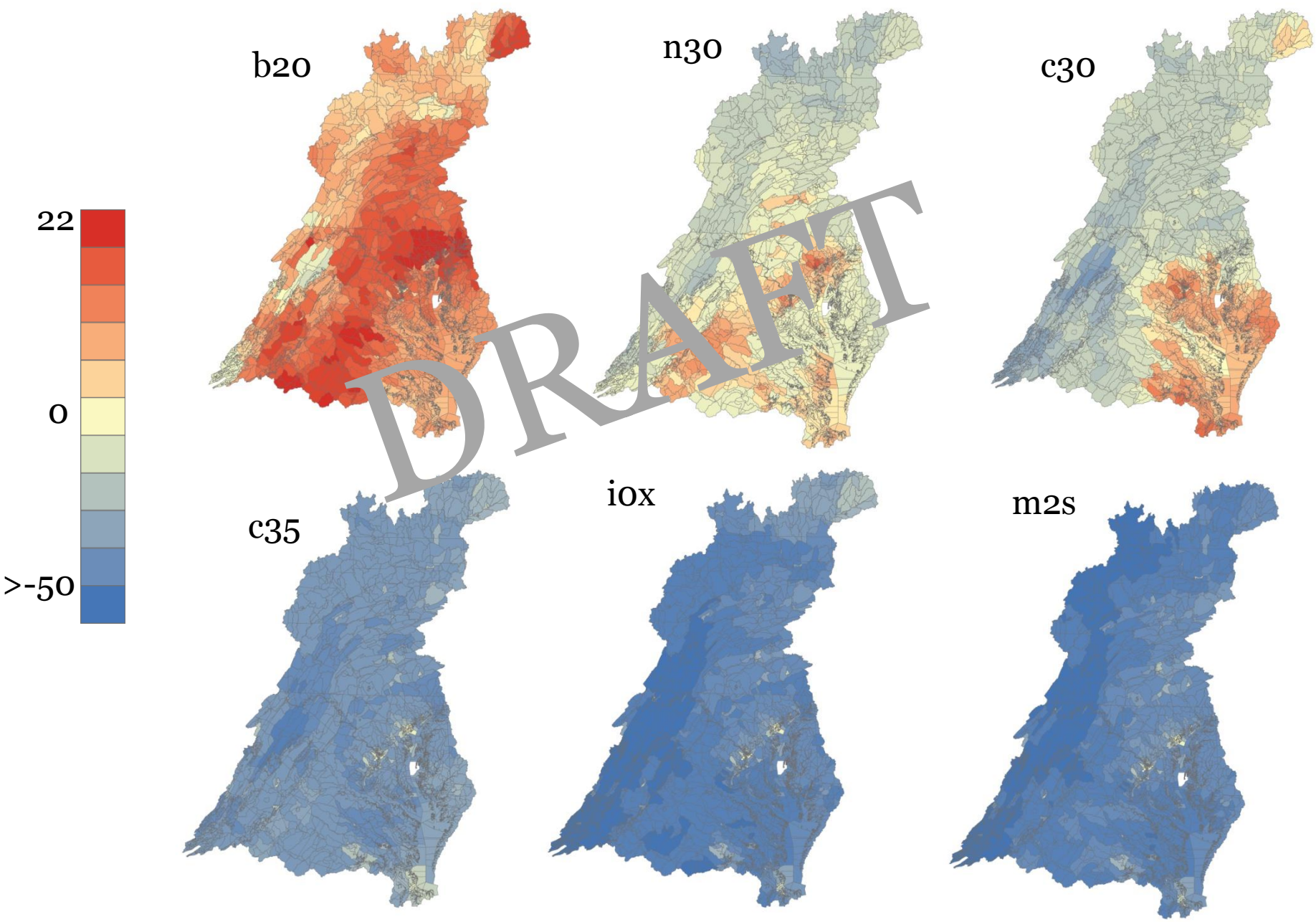
For the six different climate scenarios, output of flow (Q), nitrogen (N), phosphorus (P), and sediment (S) were investigated.

Output = edge of field

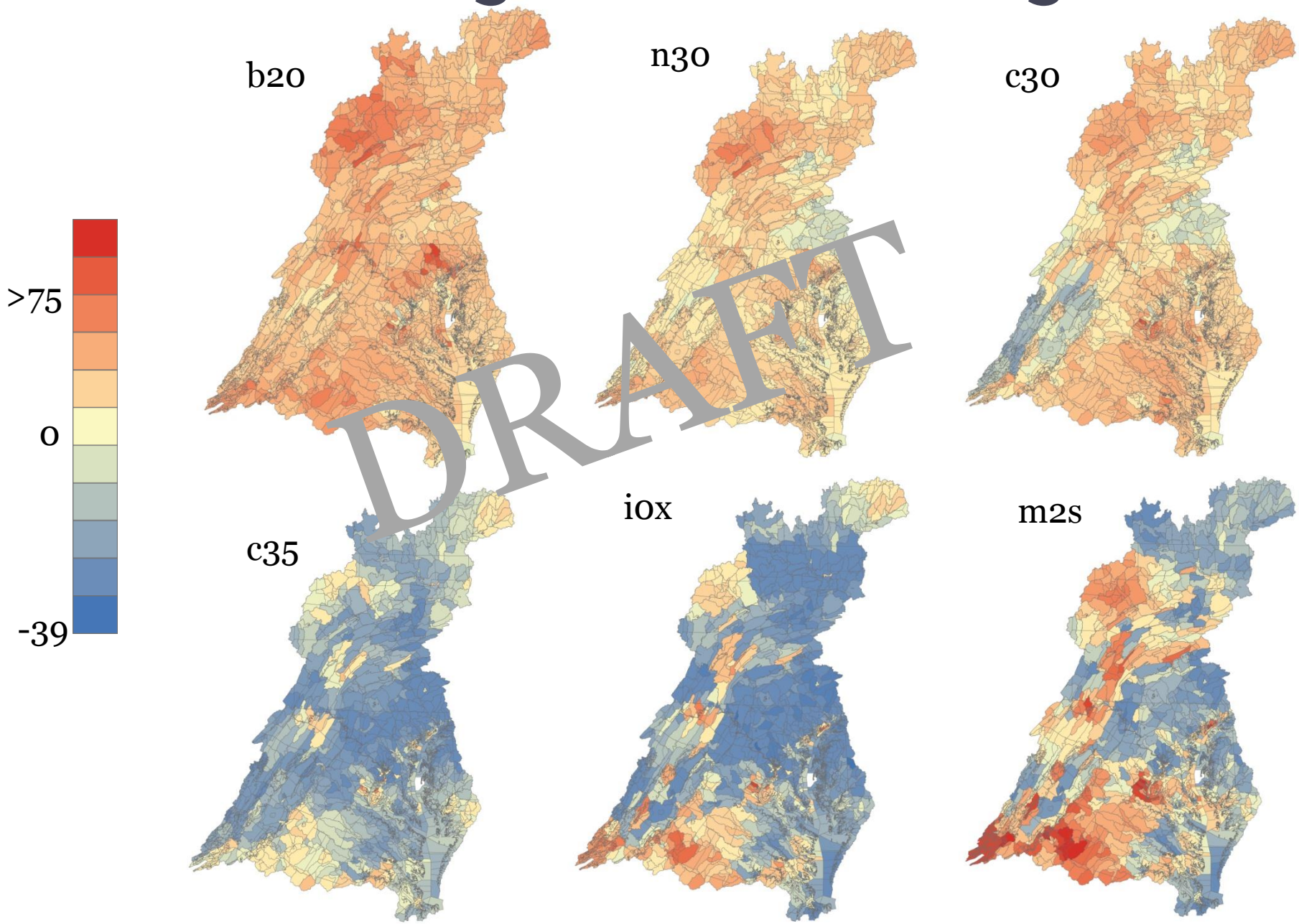
Change (Δ) = GCM scenario – base scenario

= increase = decrease

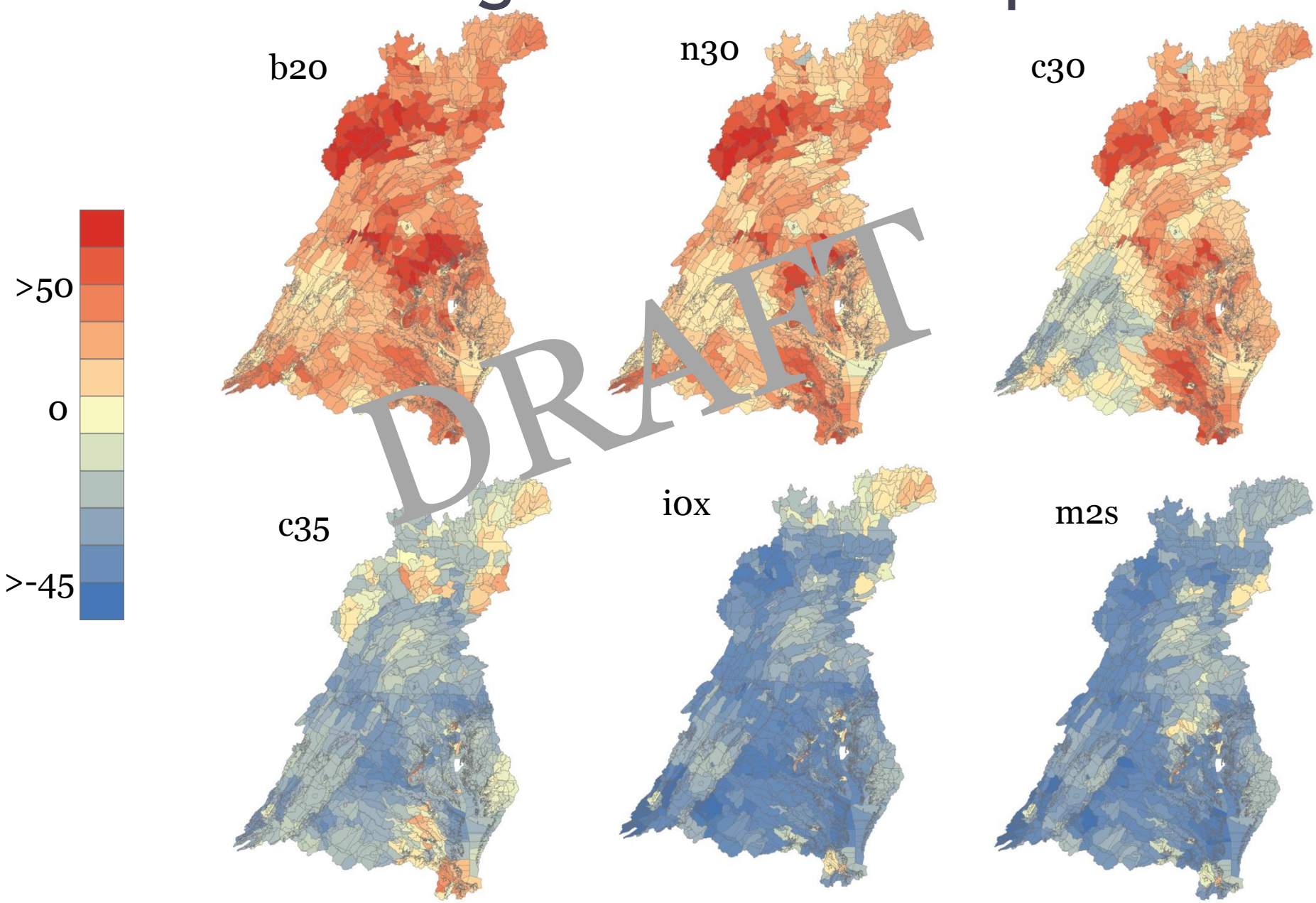
Percent Change in Flow



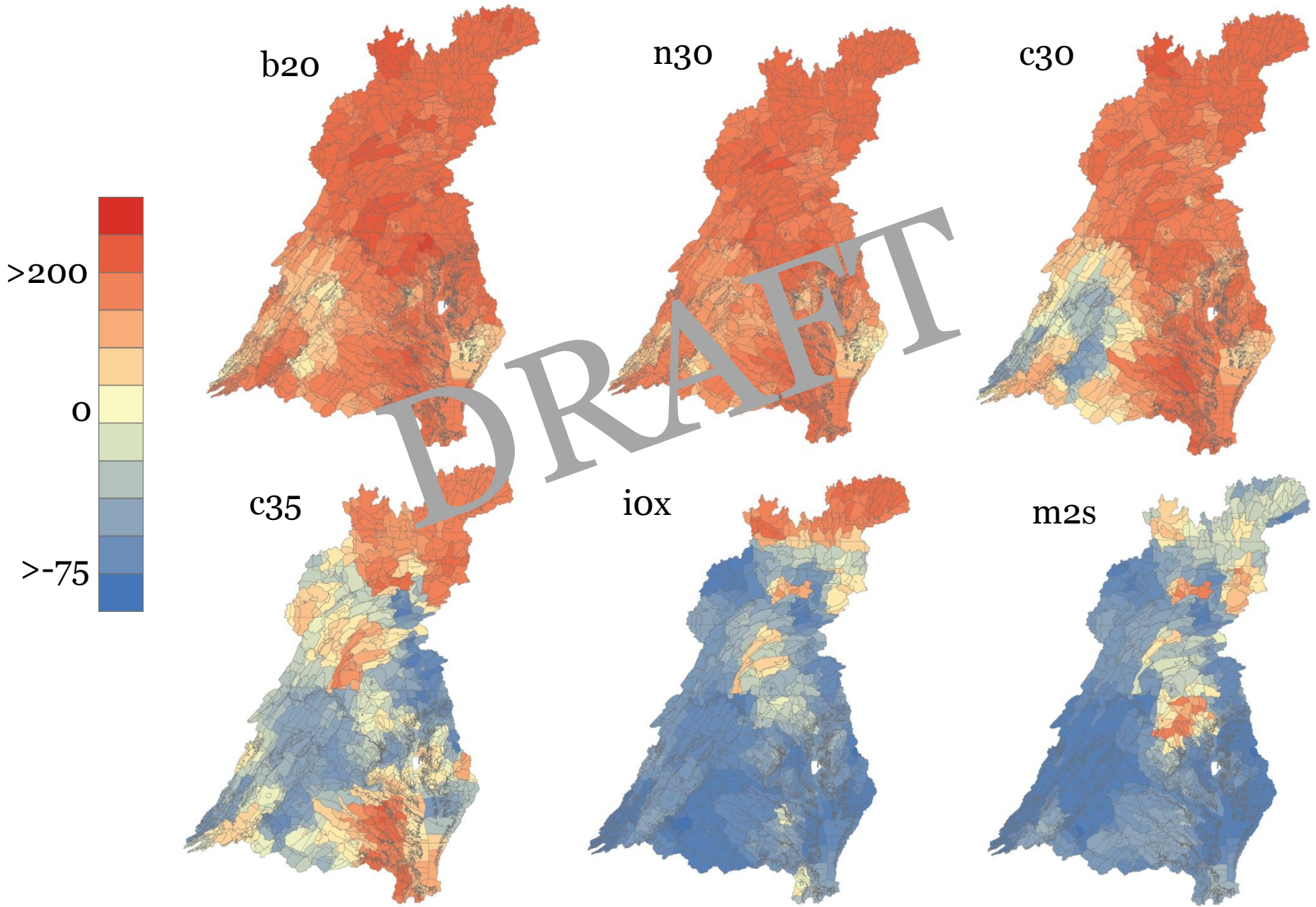
Percent Change in Total Nitrogen



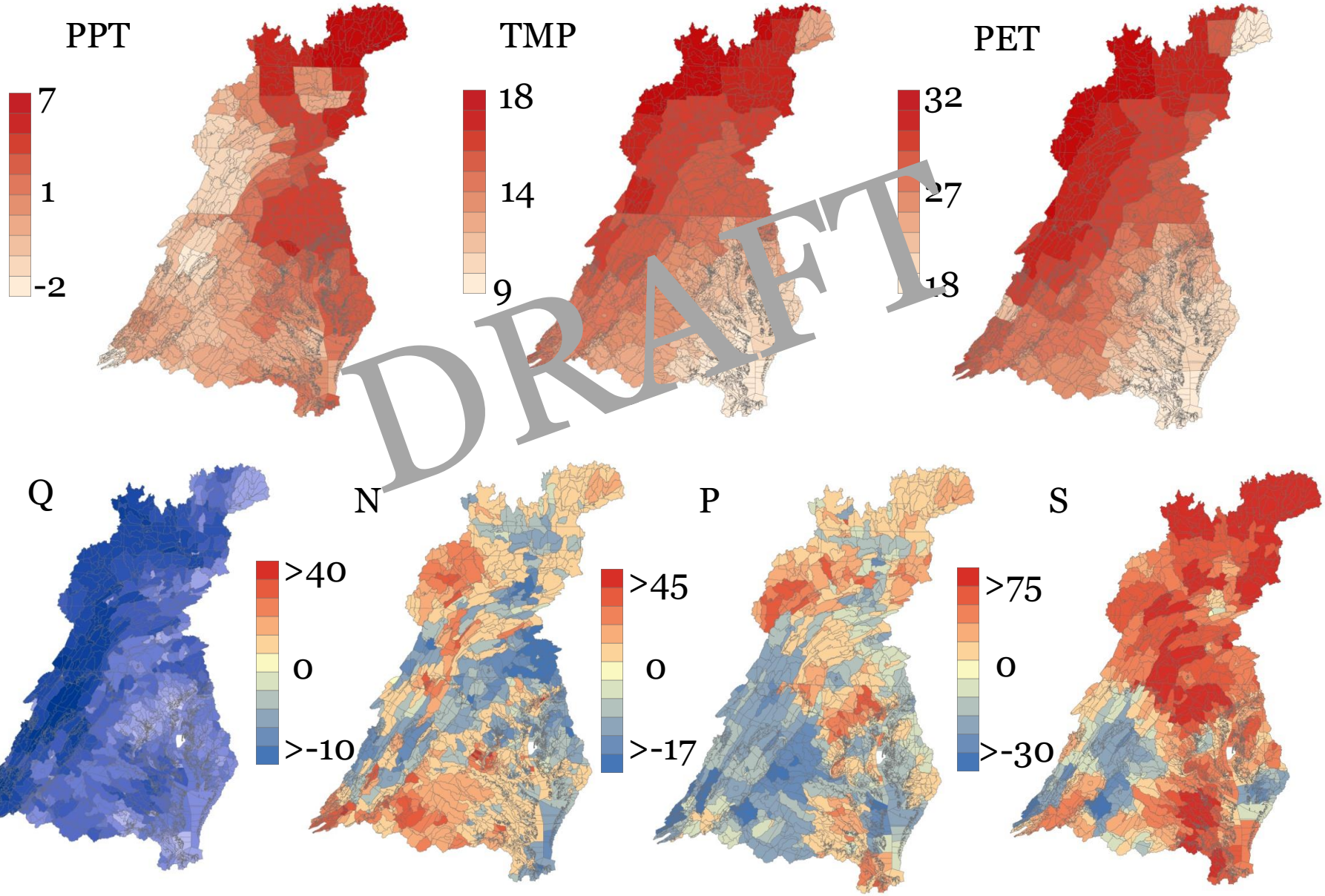
Percent Change in Total Phosphorus



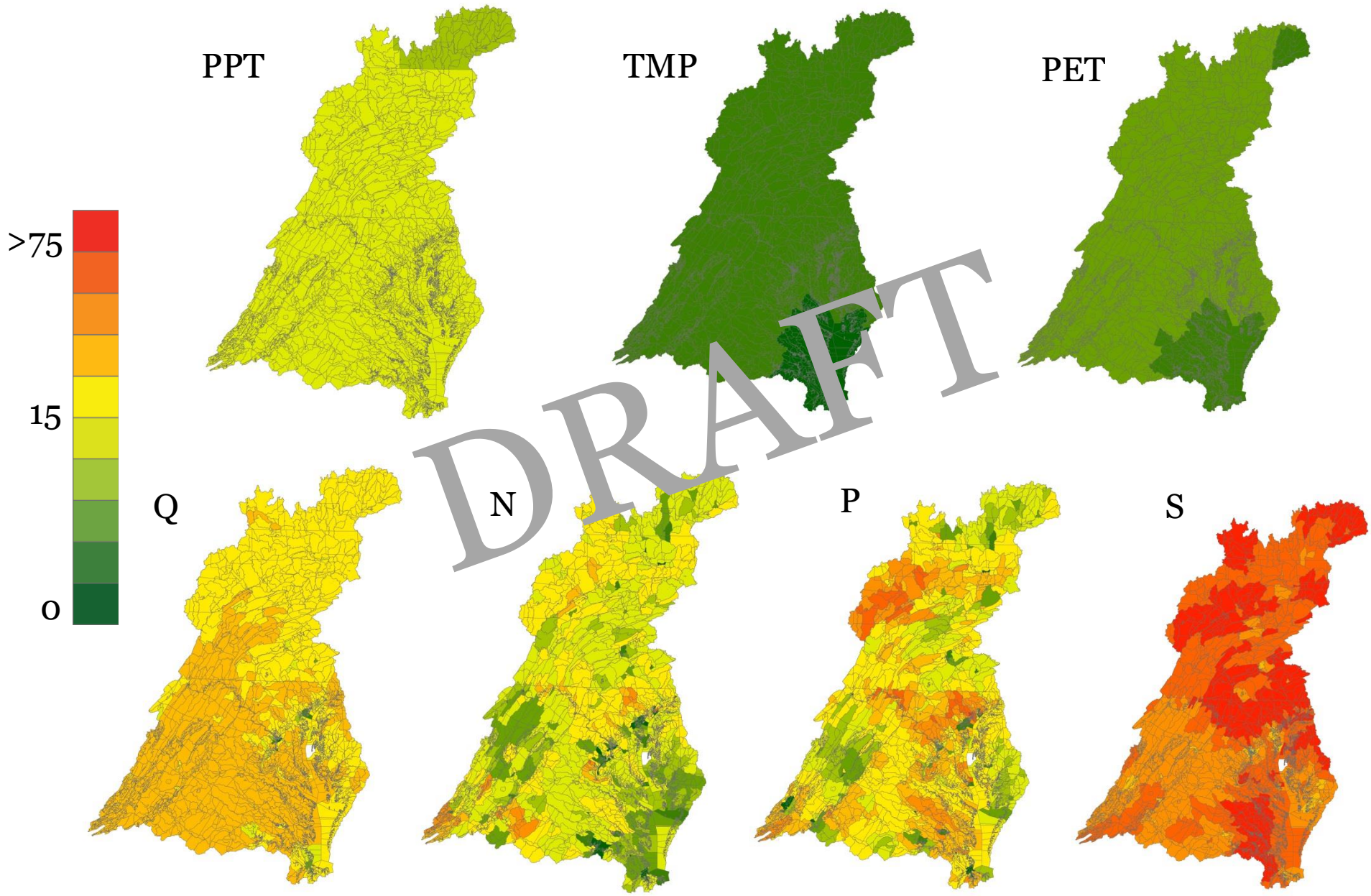
Percent Change in Total Sediment



Model Averages – Percent Change



Model Standard Deviations



Next Steps

- Further investigate spatial data – The why!
  - Major basins, regional differences, etc.
- Evaluate the effectiveness of ongoing implementation of best management practices in light of climate change – Management implications!
- Include seasonality
- Include land-use change protections
- Include the effect of elevated levels of CO_2 on plant water consumption in photosynthesis

Thank you for listening!

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