DEPARTMENT OF
ATMOSPHERIC &
OCEANIC SCIENCE

MDE

SIP Modeling and the role of Boundary Layer Dynamics

Ad-Hoc Mixing Layer Height Working Group

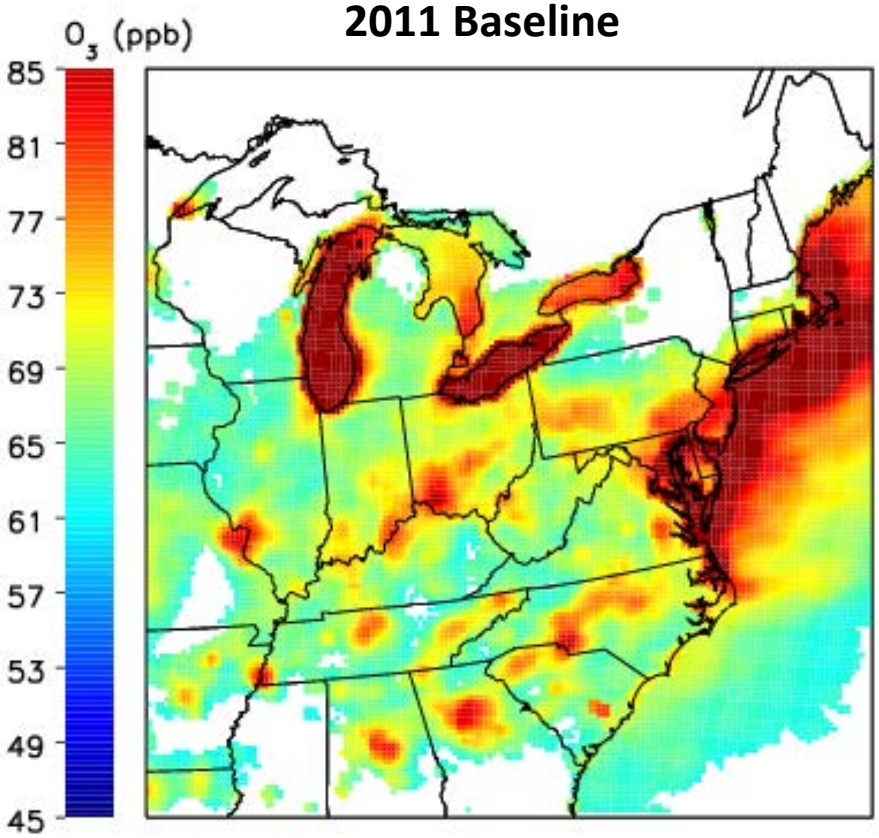
Regulatory air quality models to inform policy decisions

Scenario 4: Impact of Power Plant Emissions

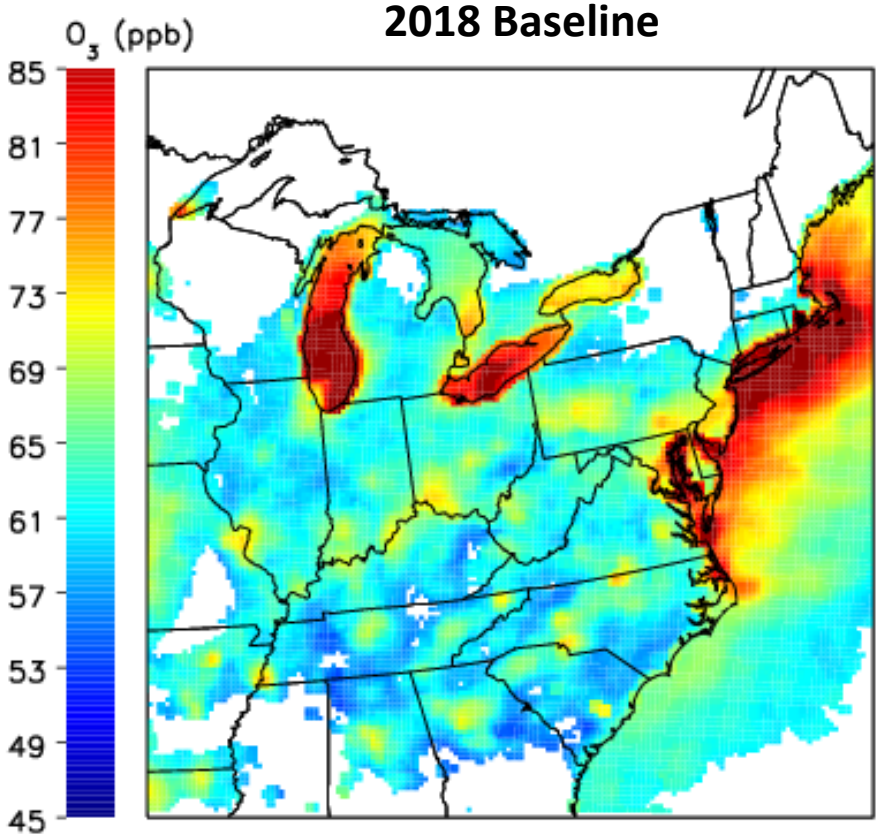
- MDE4A – 2018 w/Tier 3 OTB/OTW, Optimized emissions from Electrical Generating Units (EGU)
- MDE4B – EGUs at worst rates scene in CAMD data
- MDE4C – EGUs at real rates seen in 2011 or 2012
- MDE4D – SCR reductions at remaining post-2017/2018 uncontrolled EGUs

CMAQ Output July 2011

2011 Baseline

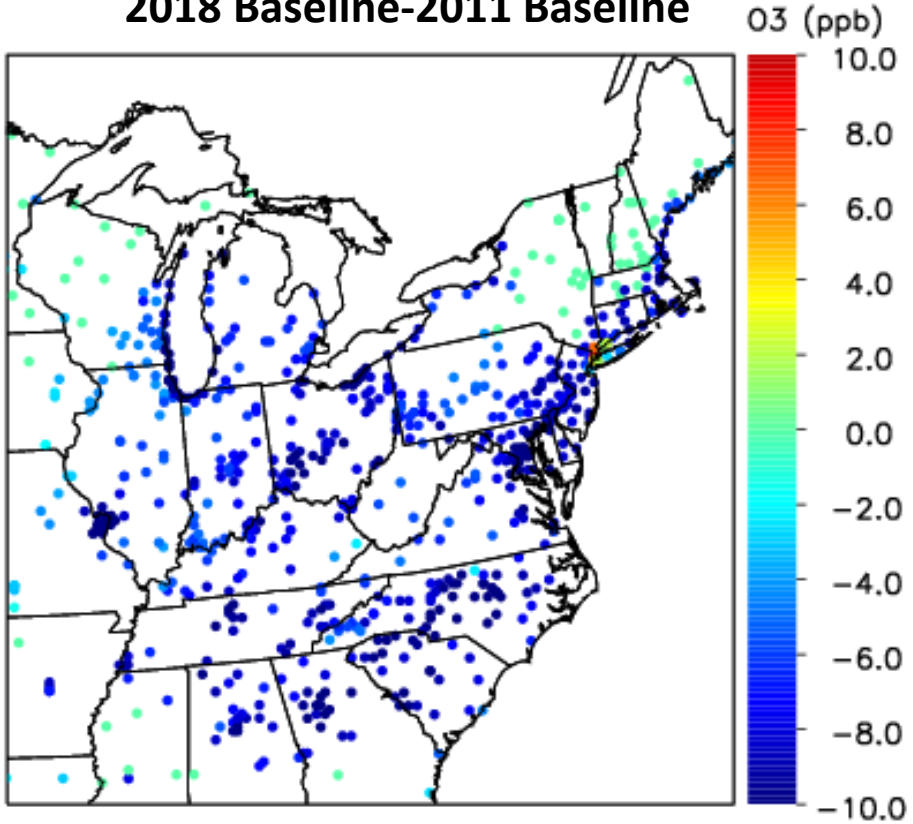


2018 Baseline

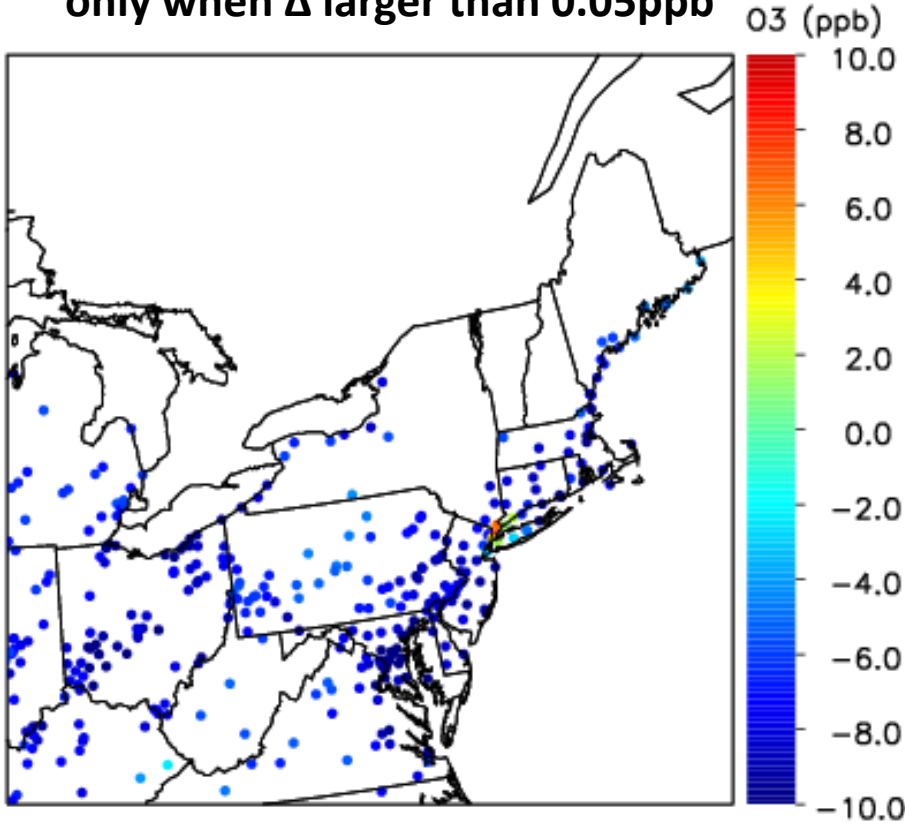


Reduction in CMAQ surface O_3 from 2011 to 2018 at surface AQS sites

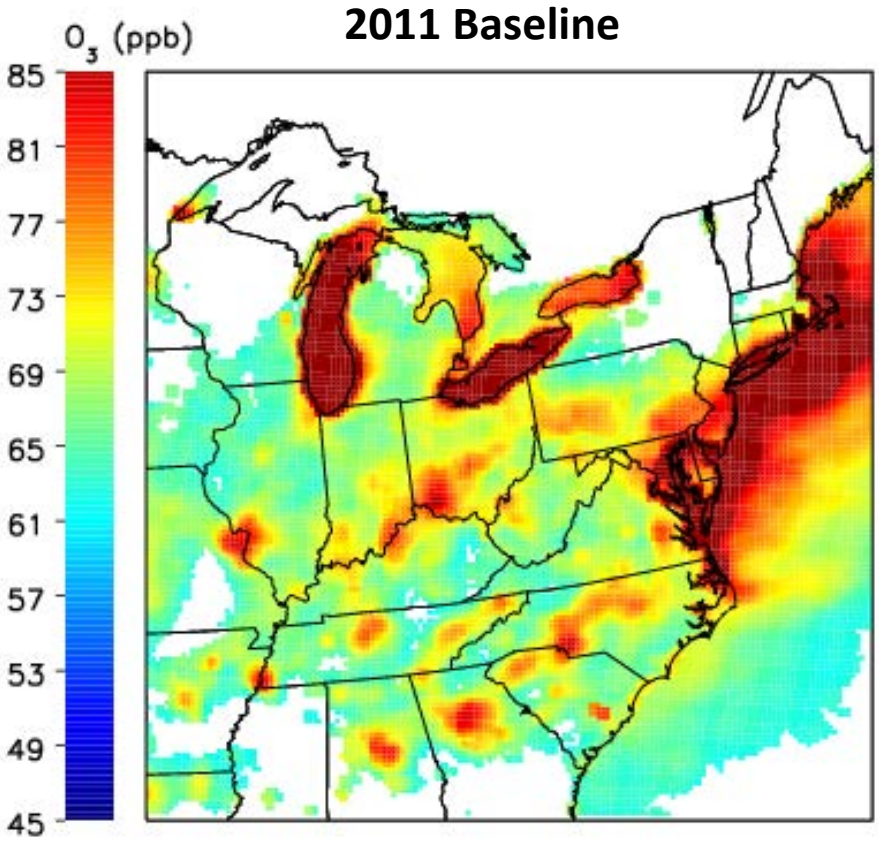
2018 Baseline-2011 Baseline

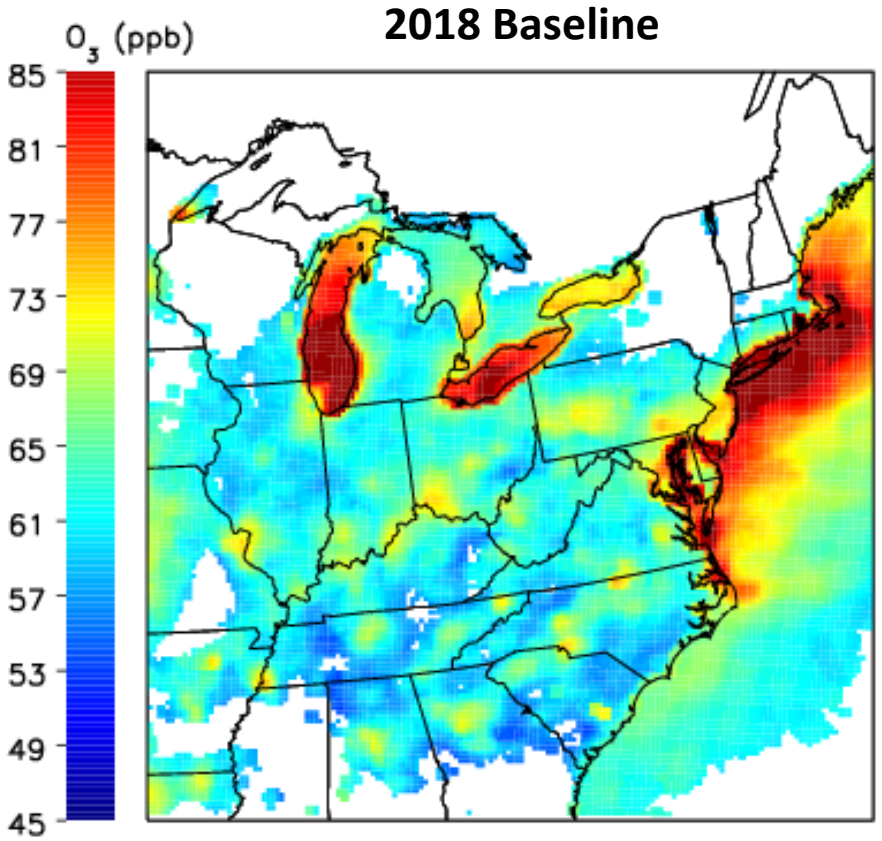


2018 Baseline-2011 Baseline only when Δ larger than 0.05ppb



CMAQ Output July 2011

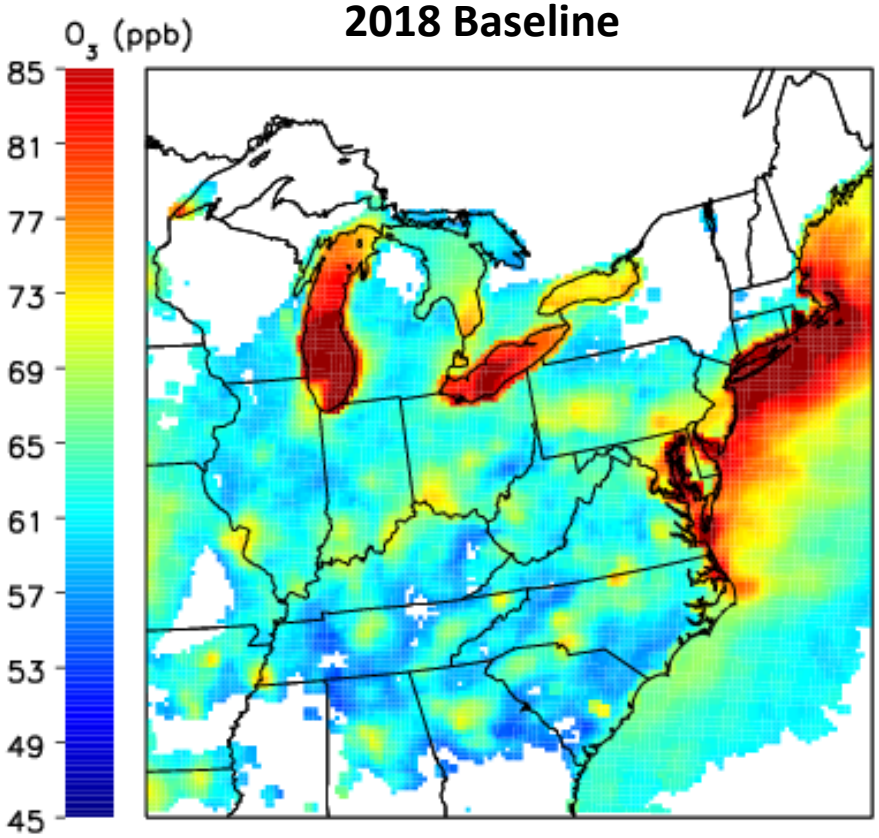




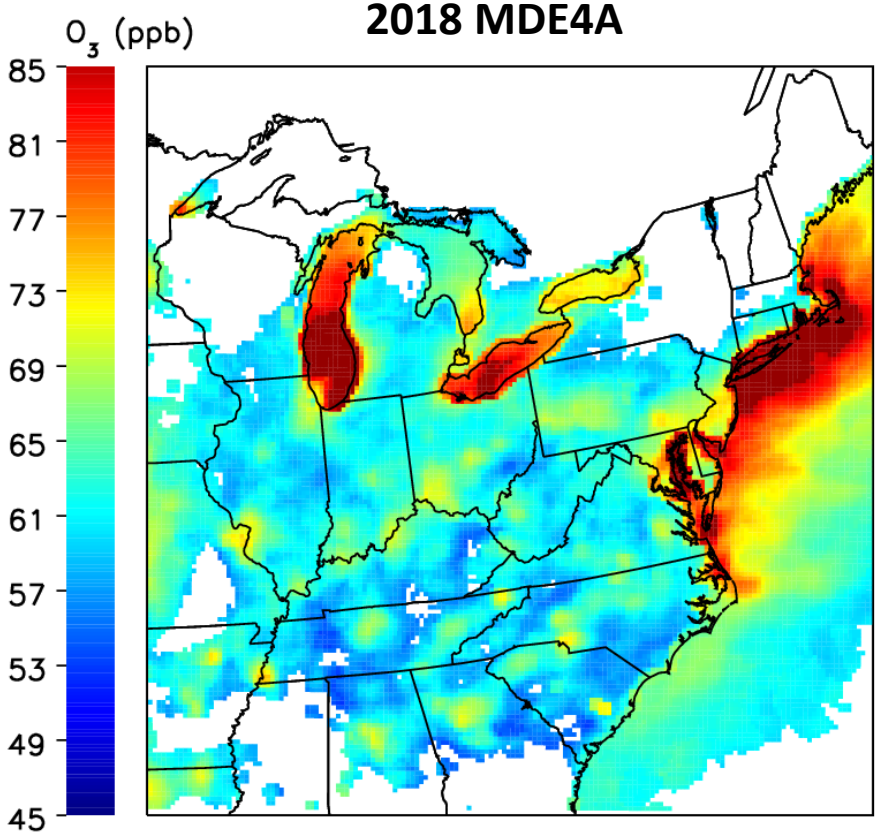
CMAQ Output July 2011

2018 w/Tier 3 OTB/OTW, Opt. EGU

2018 Baseline



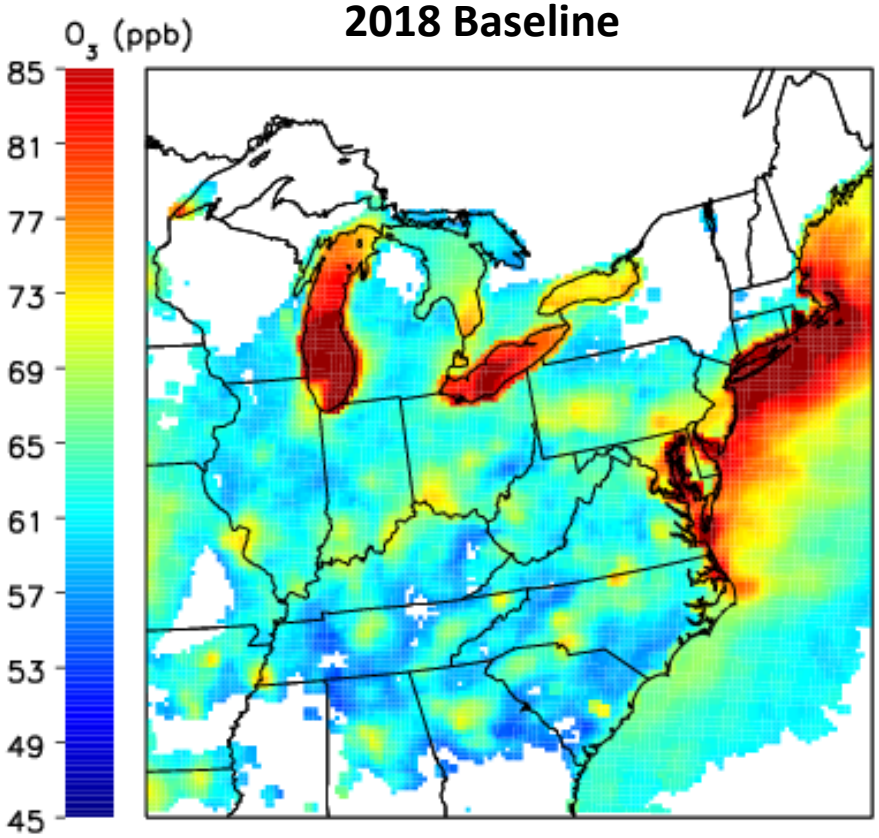
2018 MDE4A



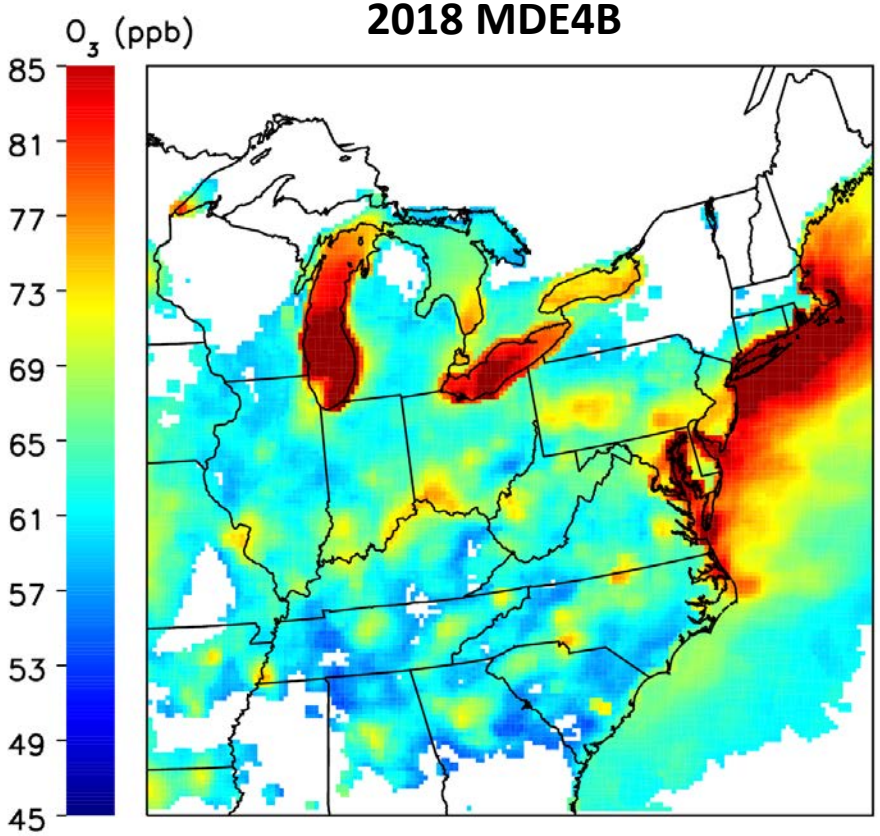
CMAQ Output July 2011

EGUs at worst rates

2018 Baseline



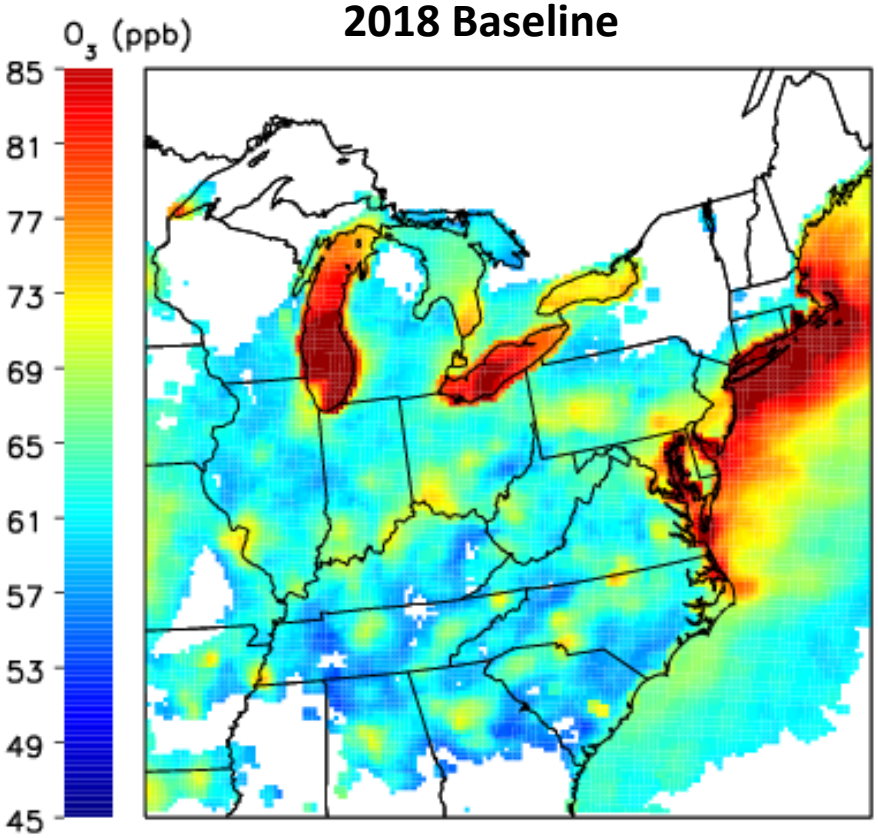
2018 MDE4B



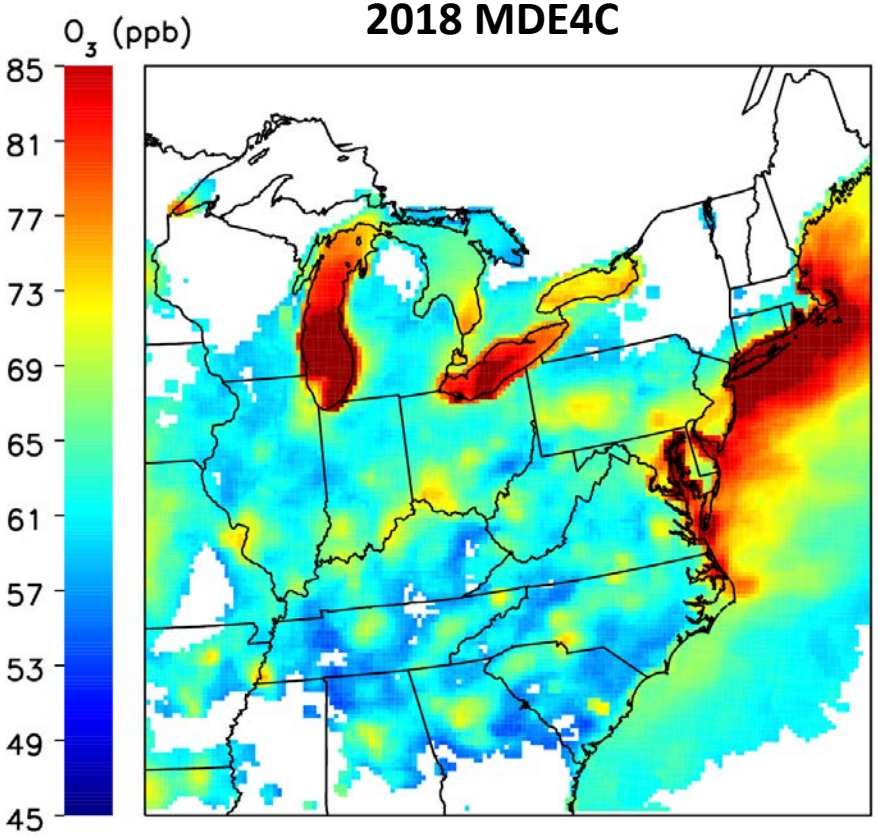
CMAQ Output July 2011

EGUs at real rates seen in 2011 or 2012

2018 Baseline



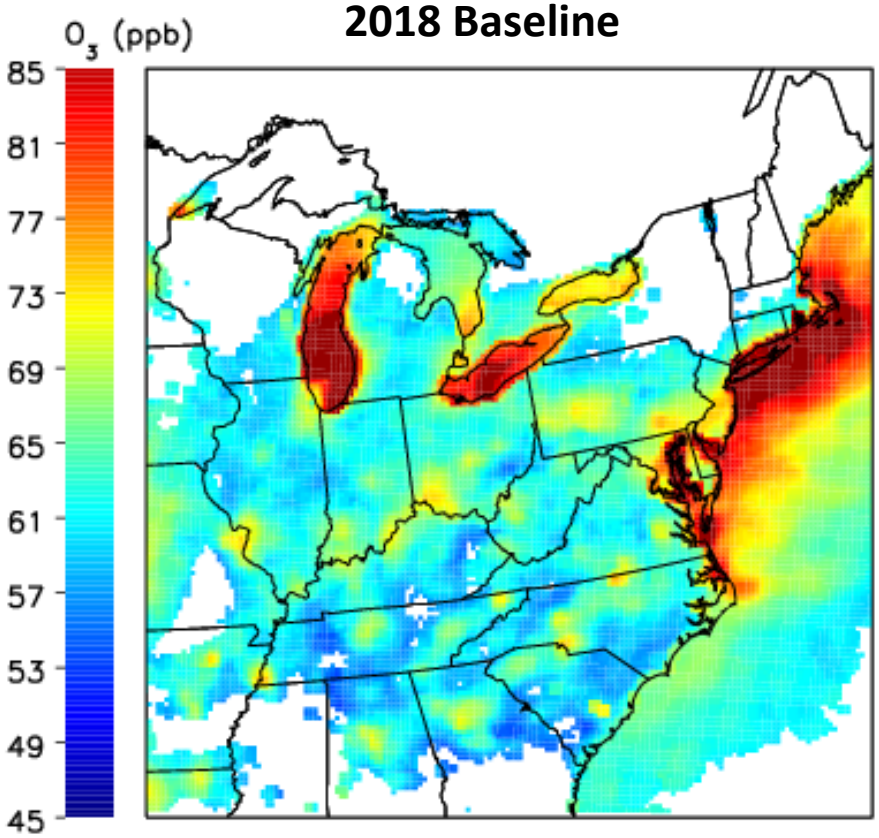
2018 MDE4C



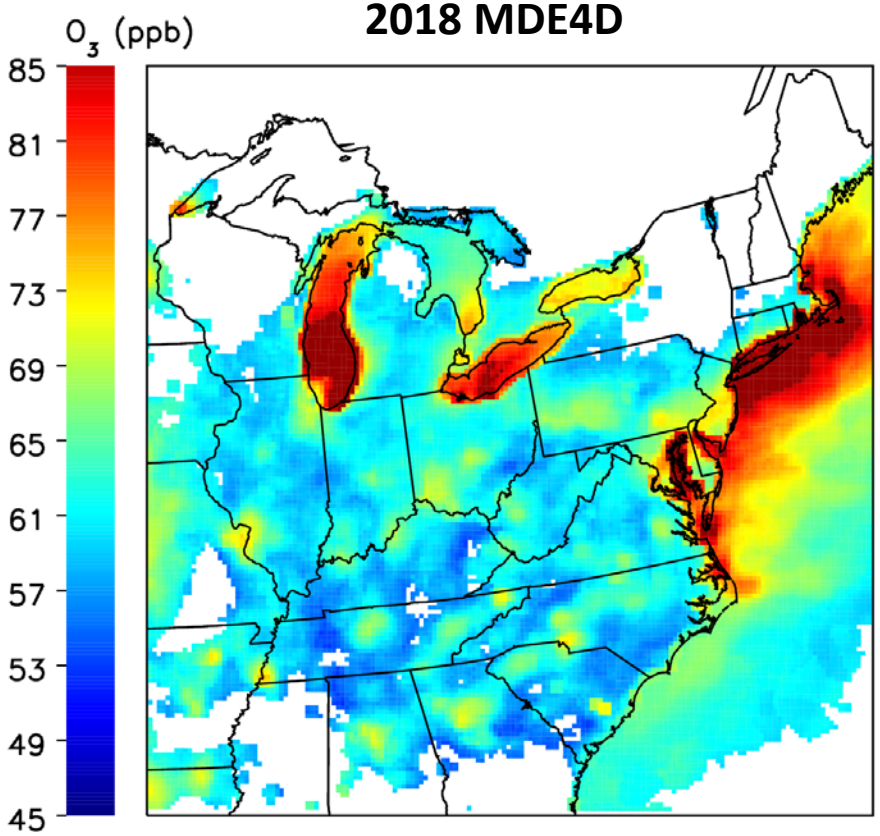
CMAQ Output July 2011

SCR reductions at remaining uncontrolled EGUs

2018 Baseline

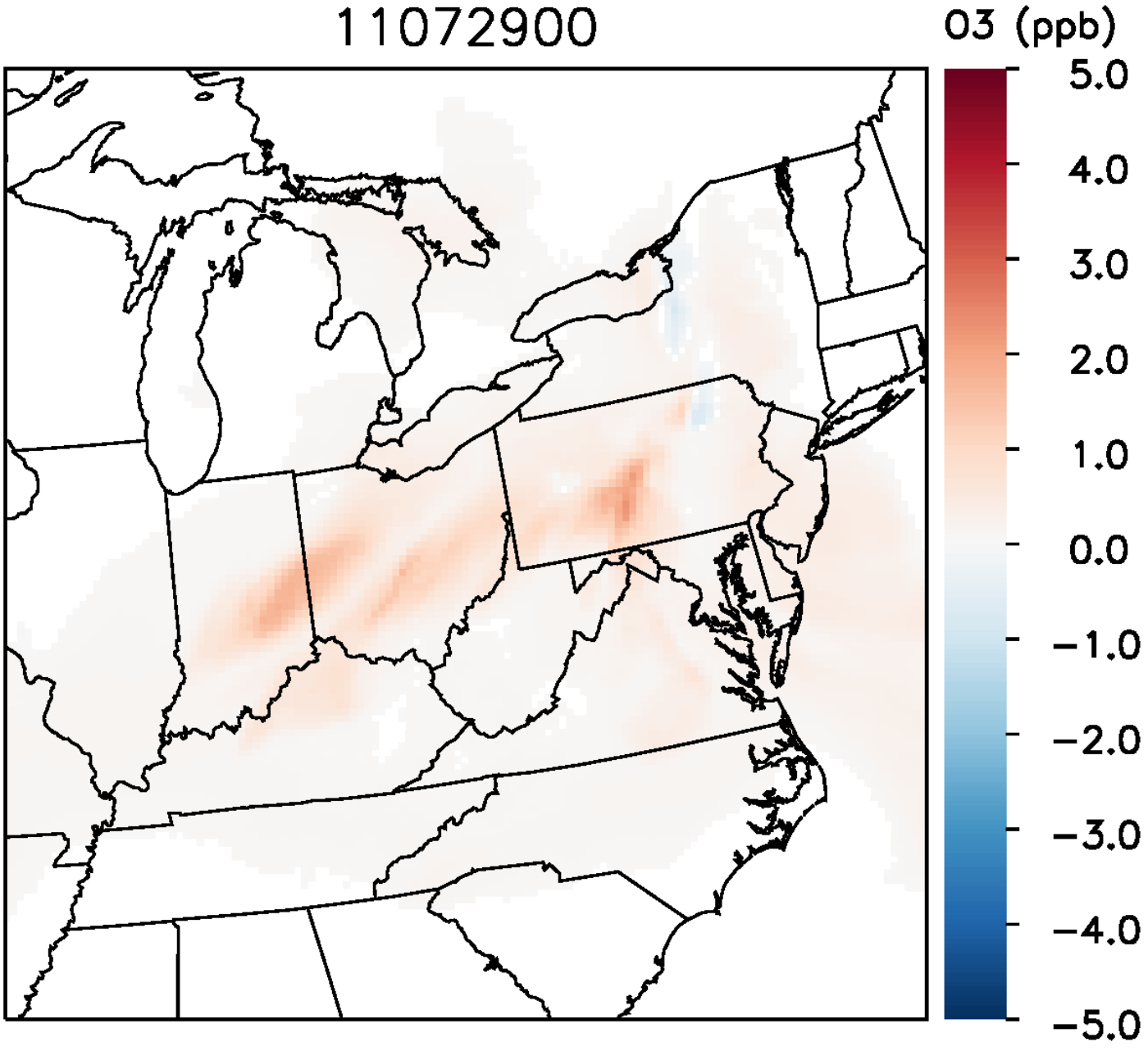


2018 MDE4D



The following series of slides shows changes in hourly 8hr average surface O_3 when reductions are made to emissions from large power plants near the Ohio River Valley.

Figures show baseline CMAQ output – CMAQ w/reduced emissions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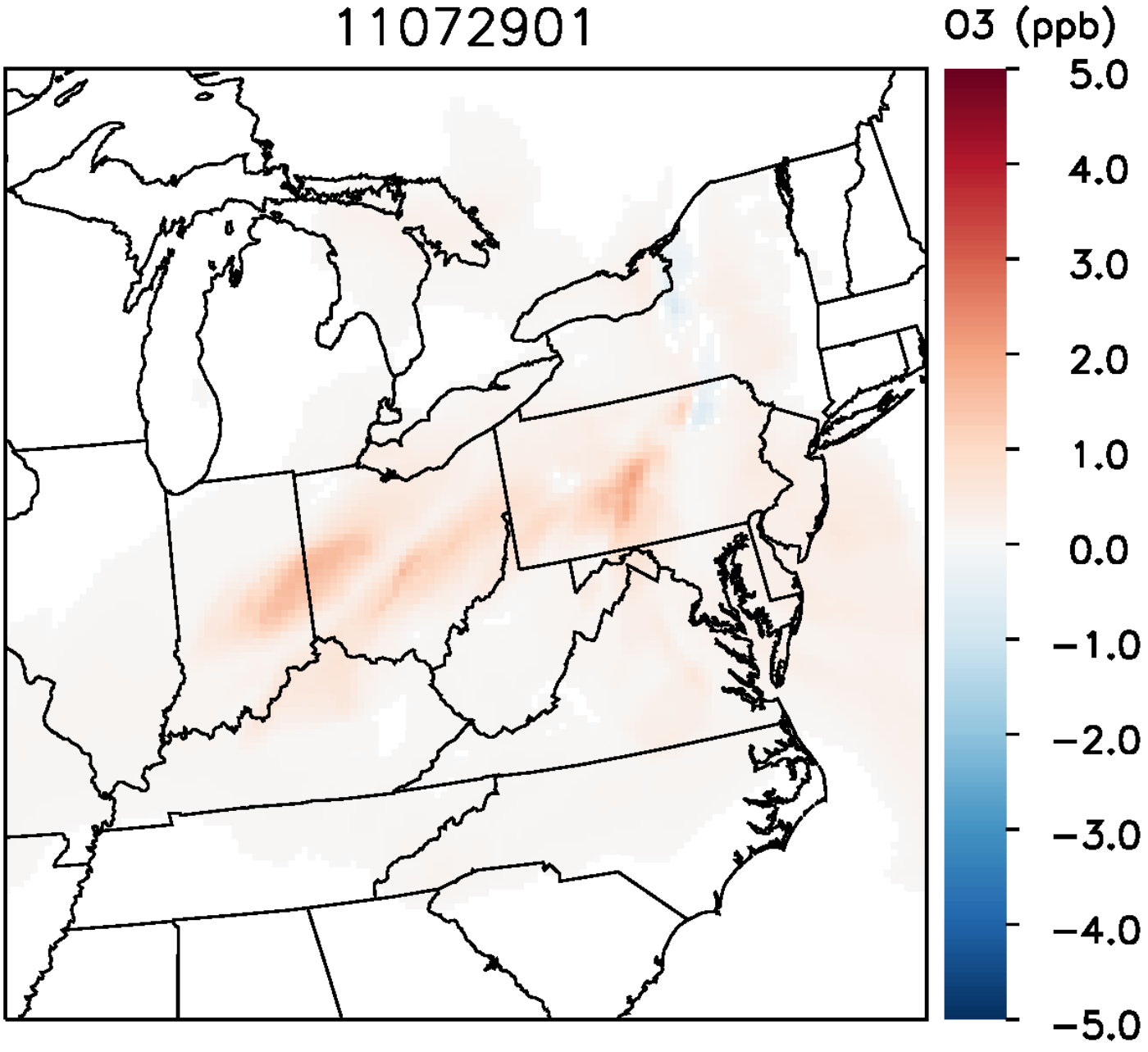
O3 (ppb)
5.0
4.0
3.0
2.0
1.0
0.0
−1.0
−2.0
−3.0
−4.0
−5.0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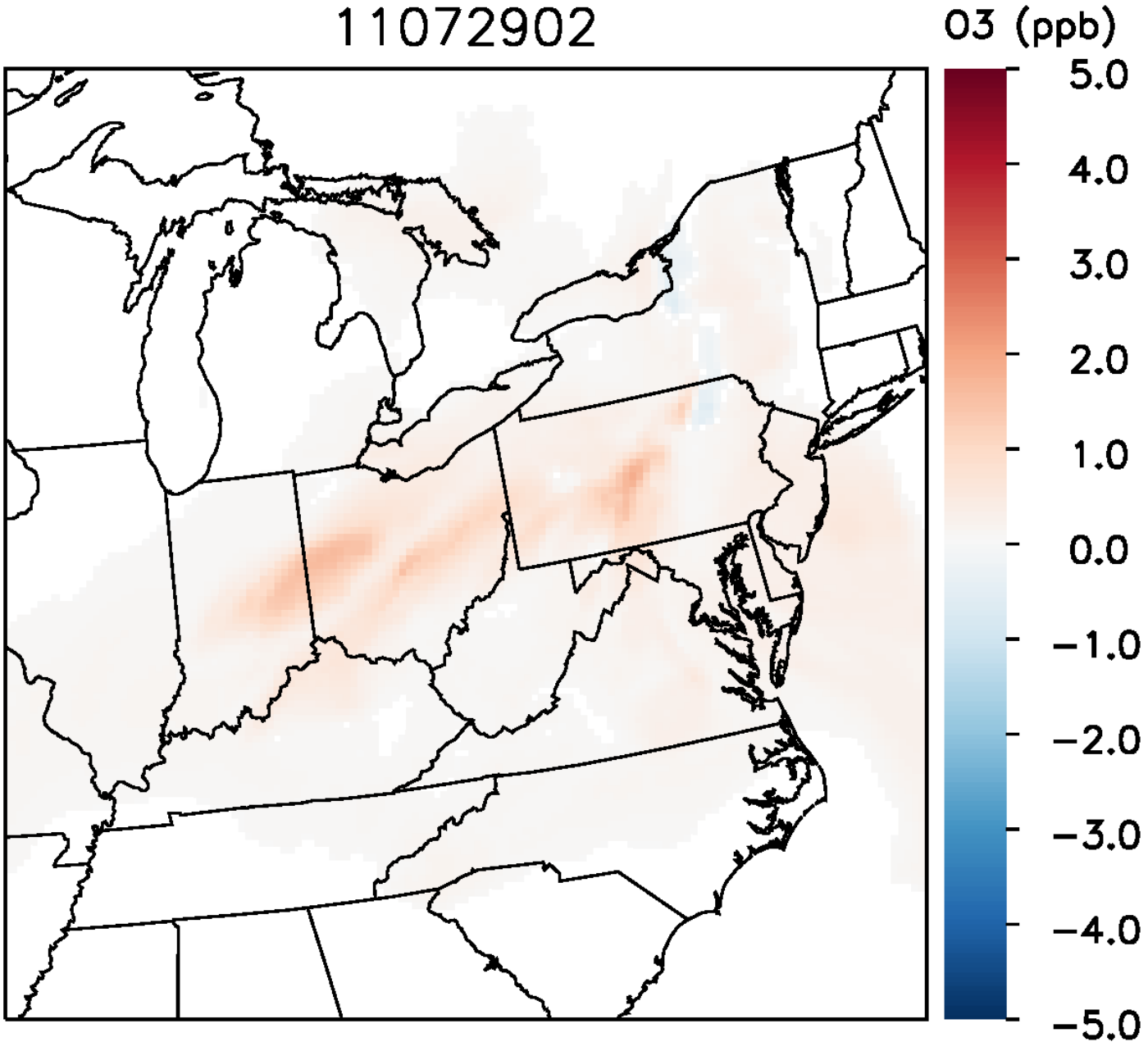
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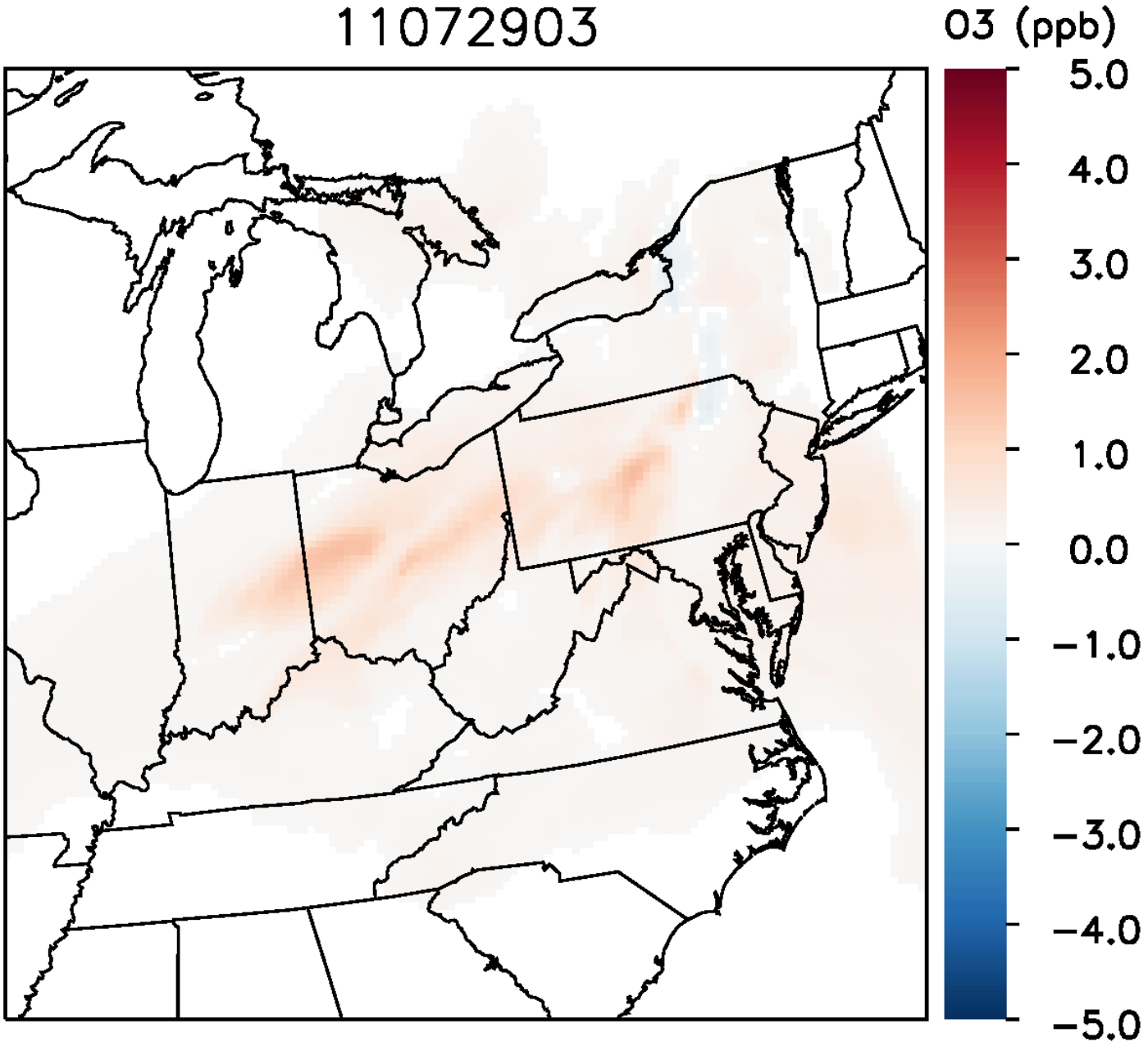
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O3 (ppb)
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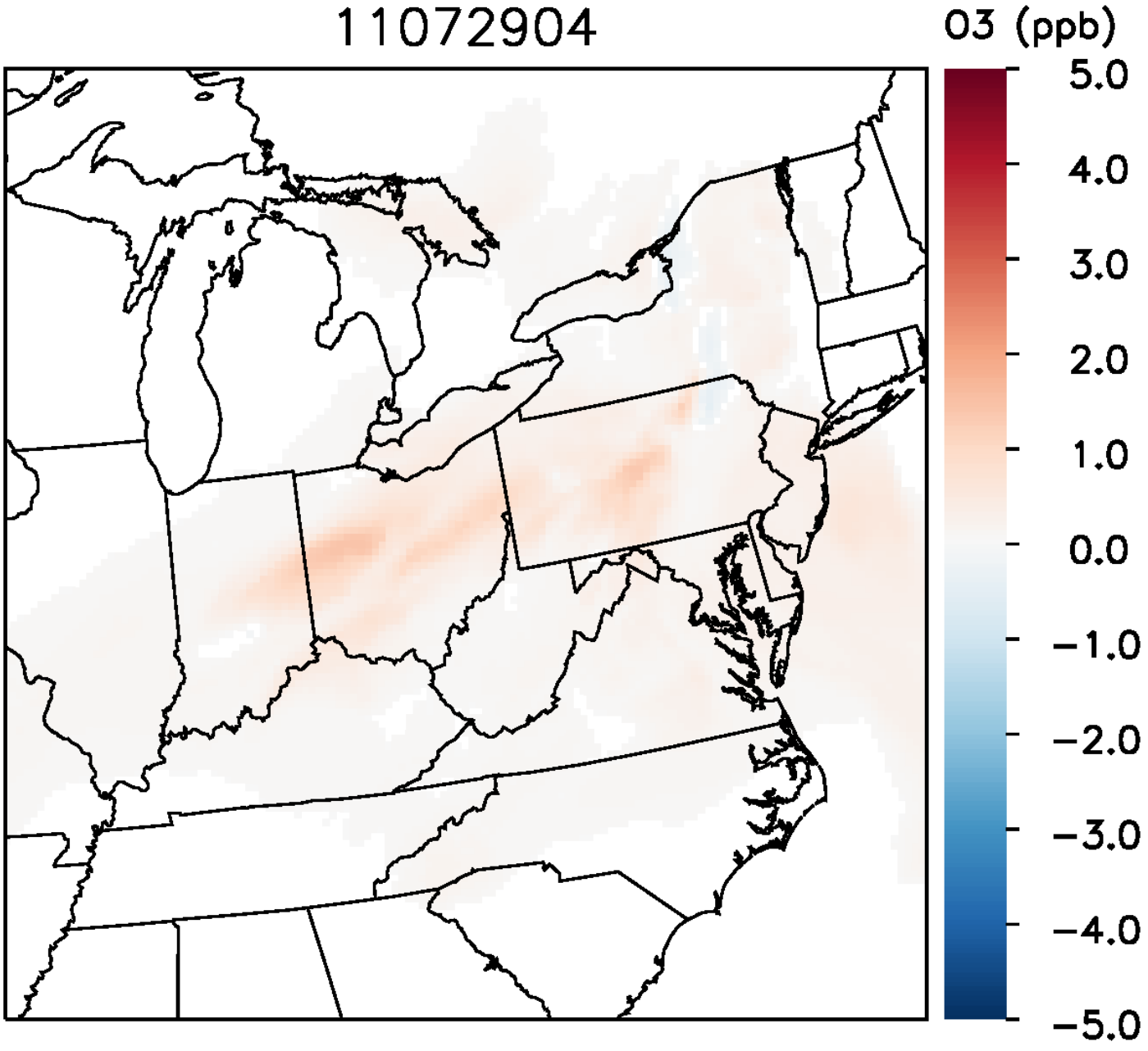
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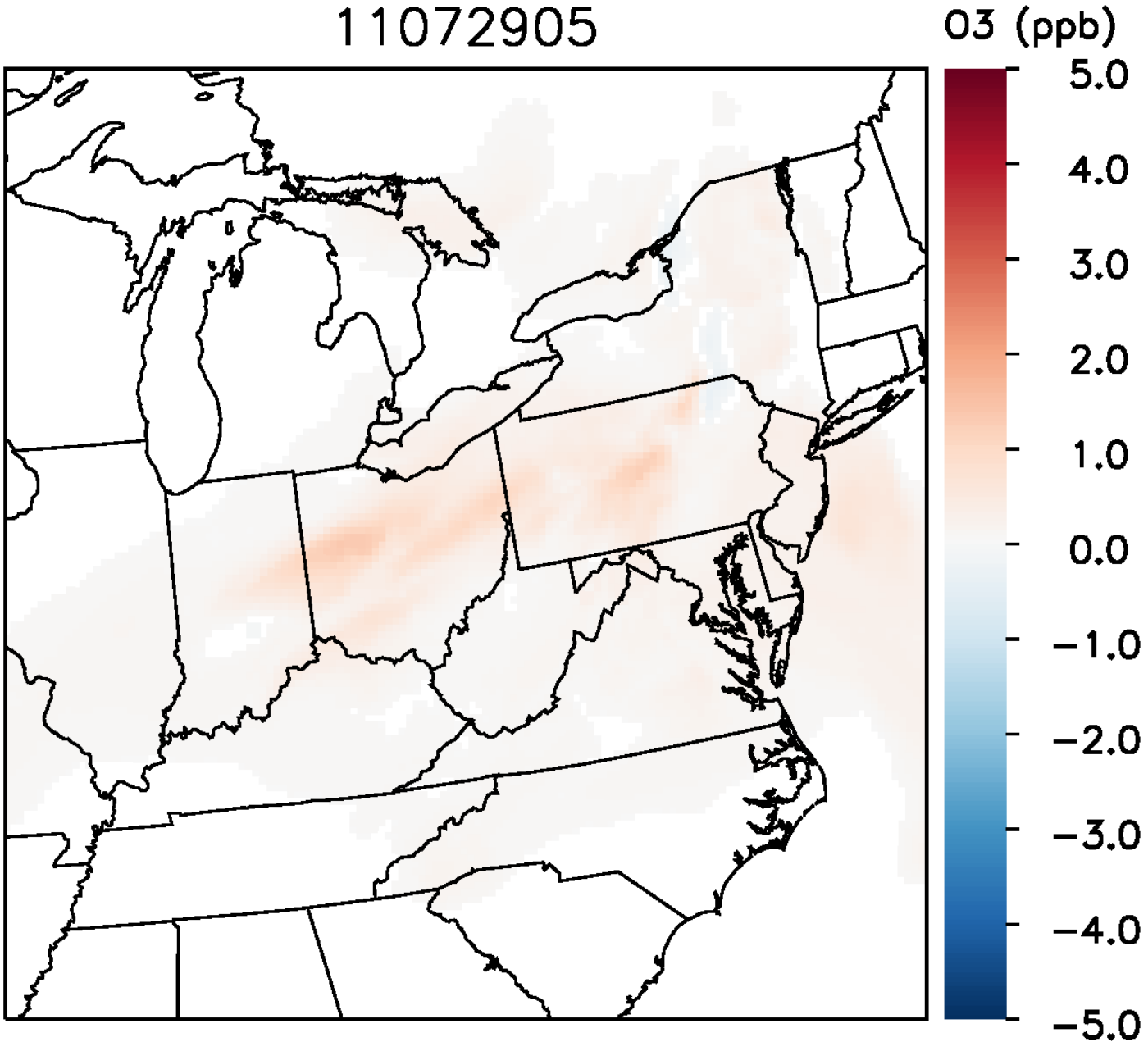
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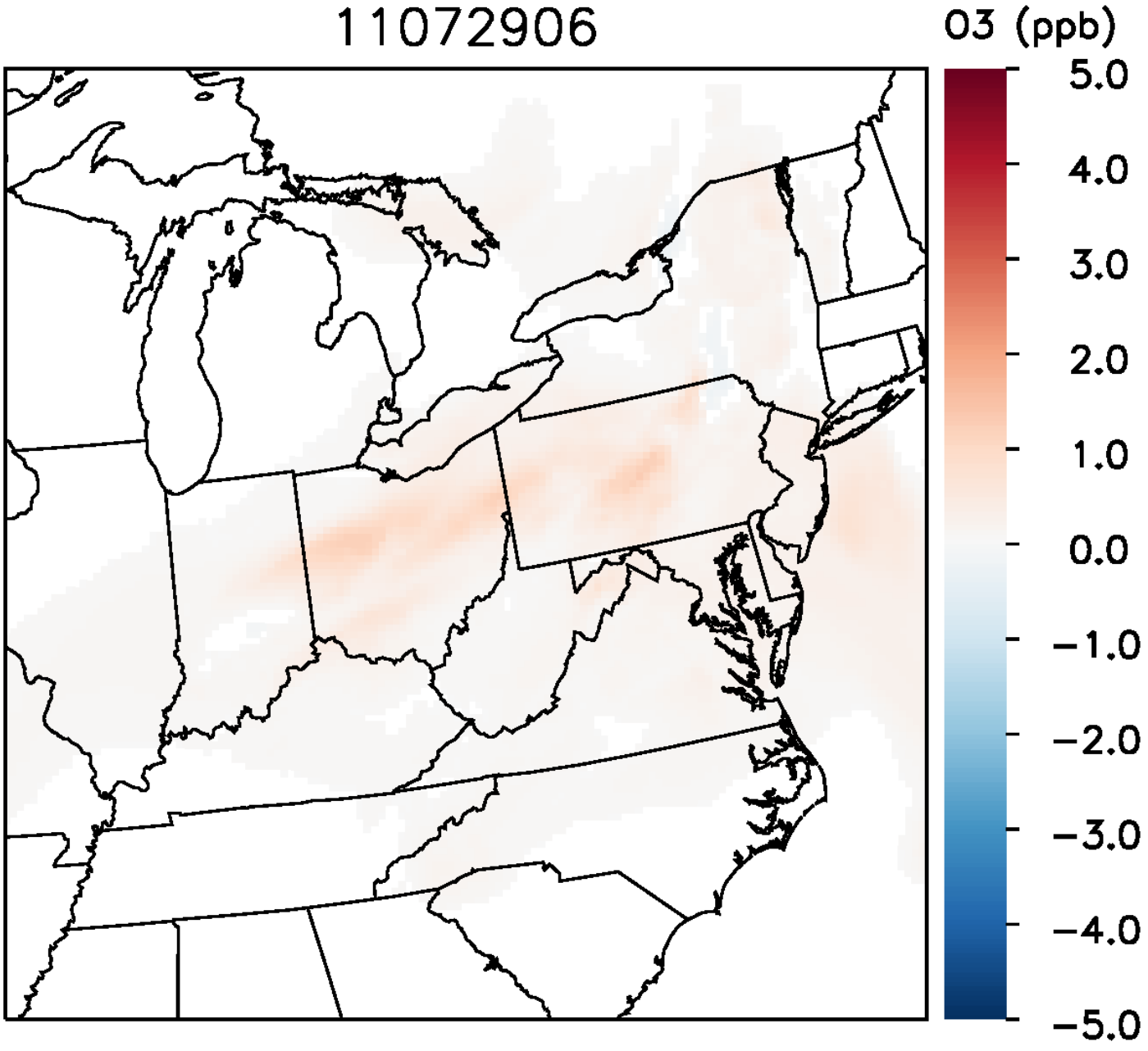
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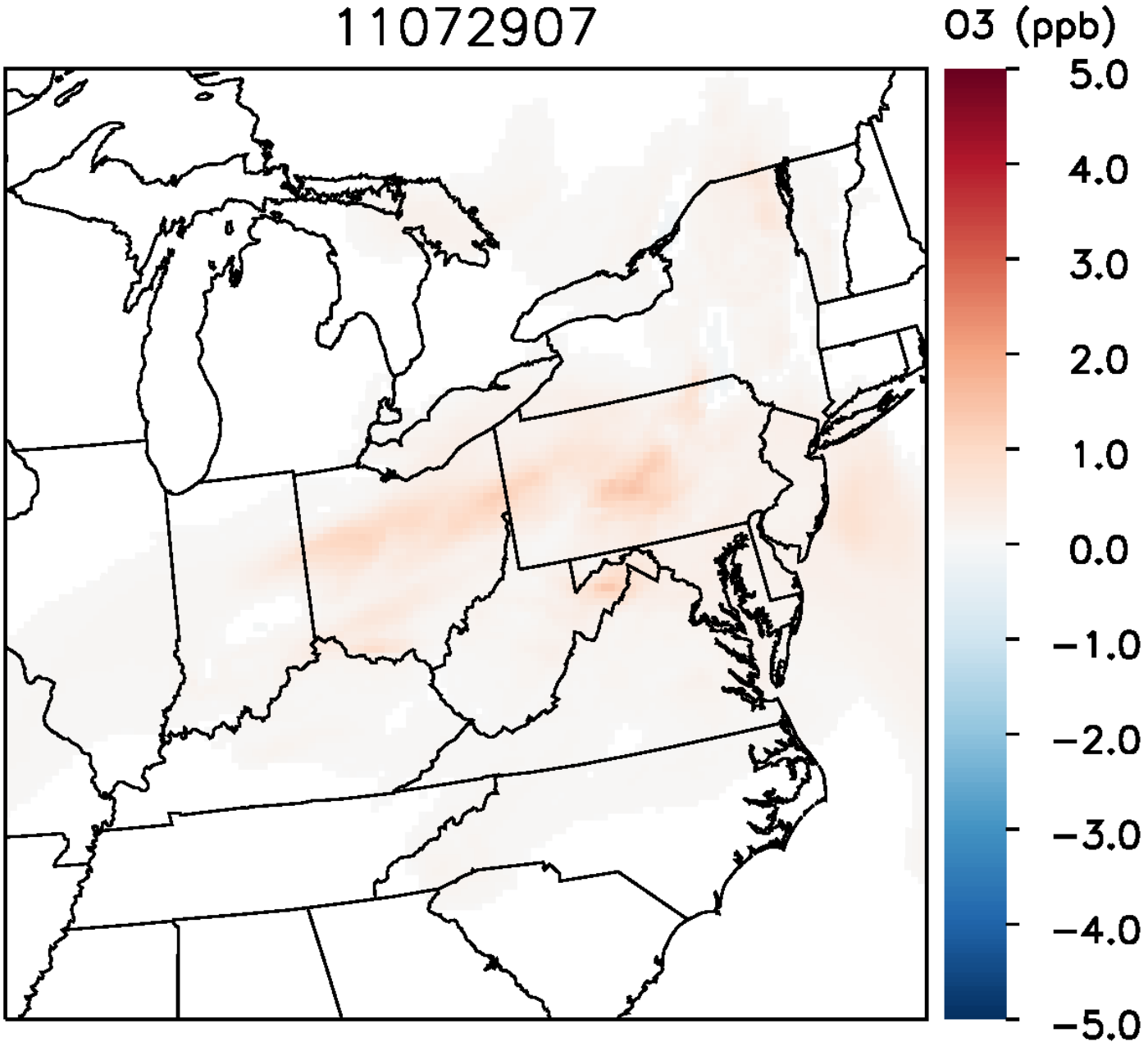
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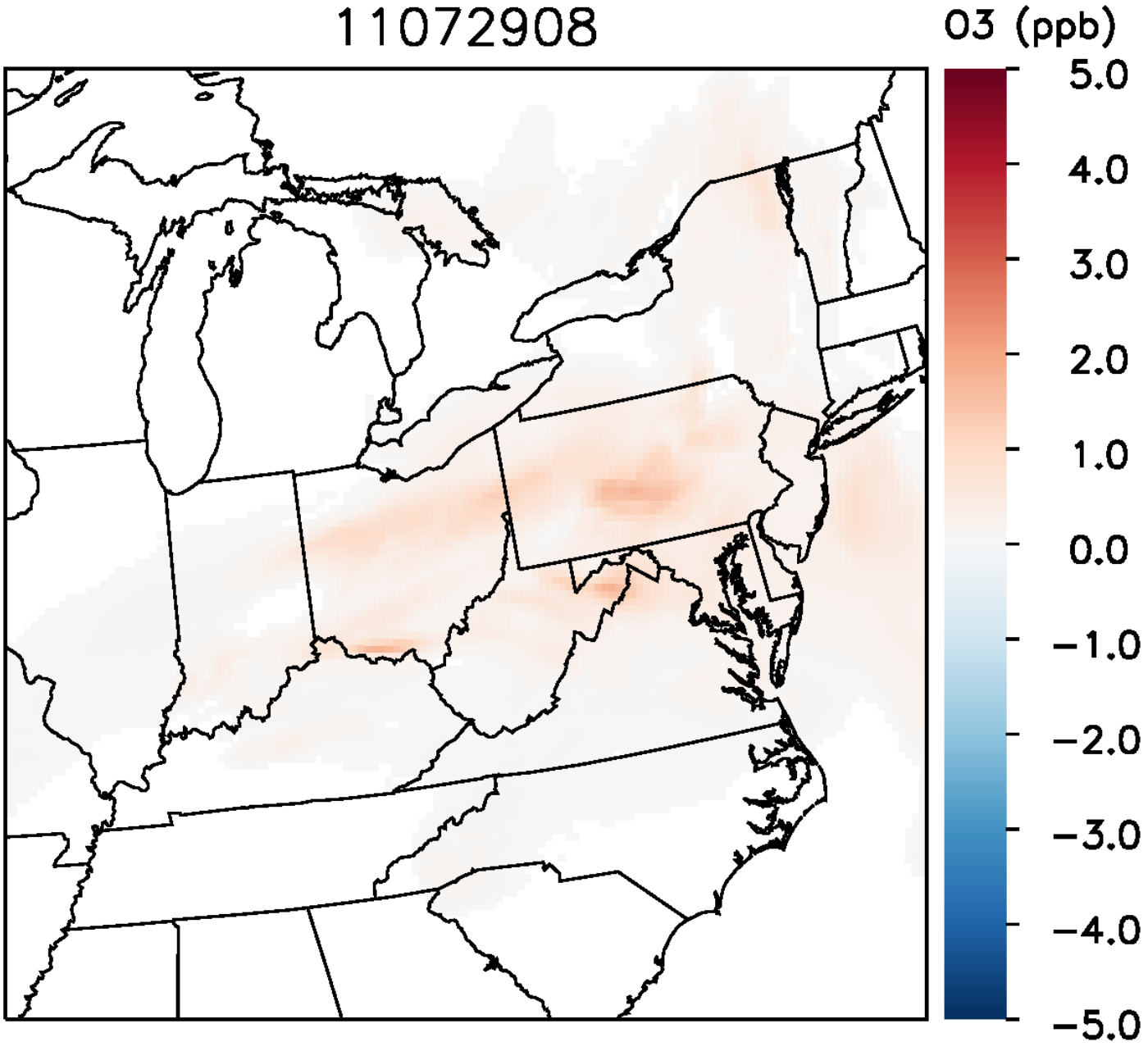
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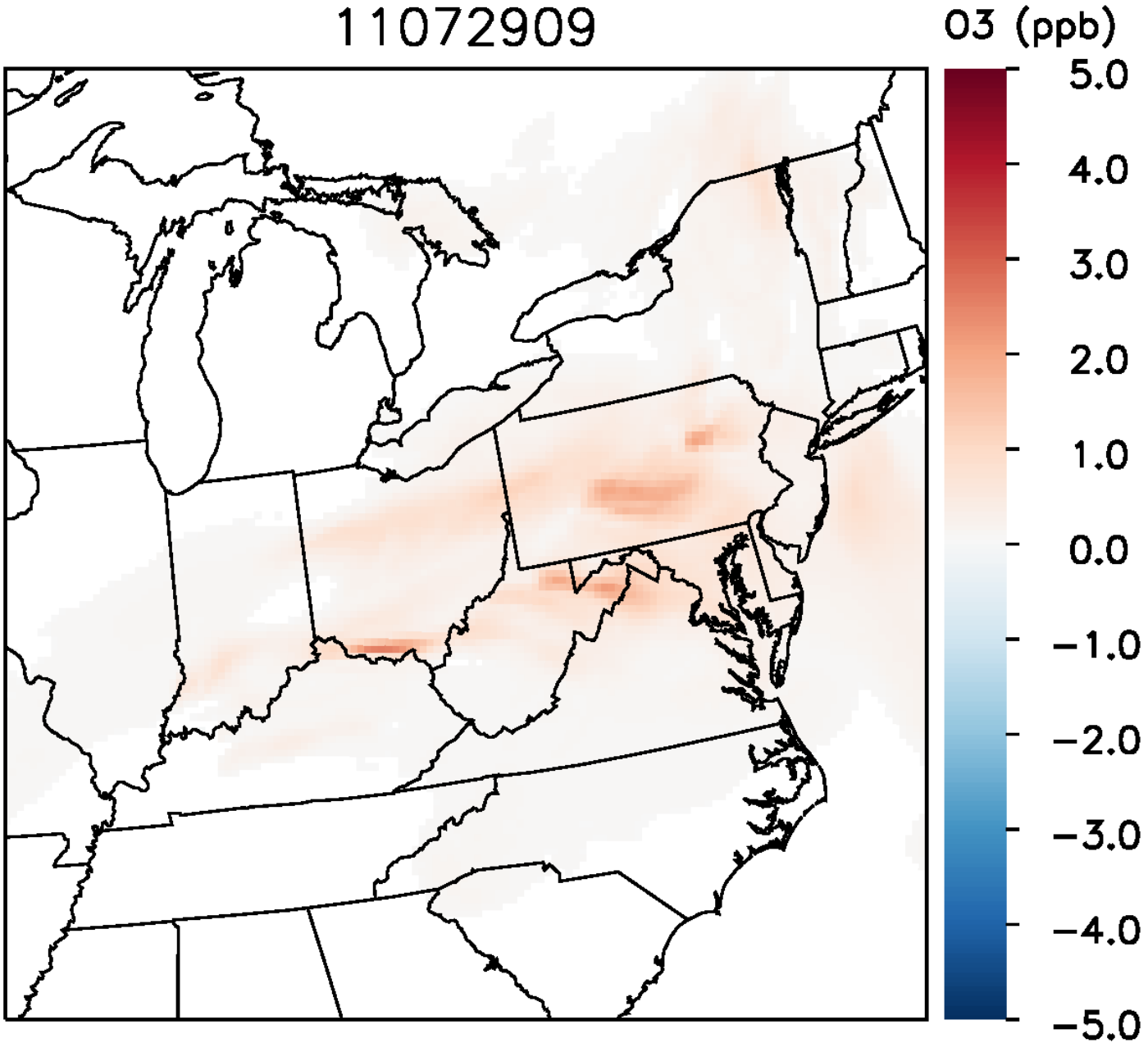
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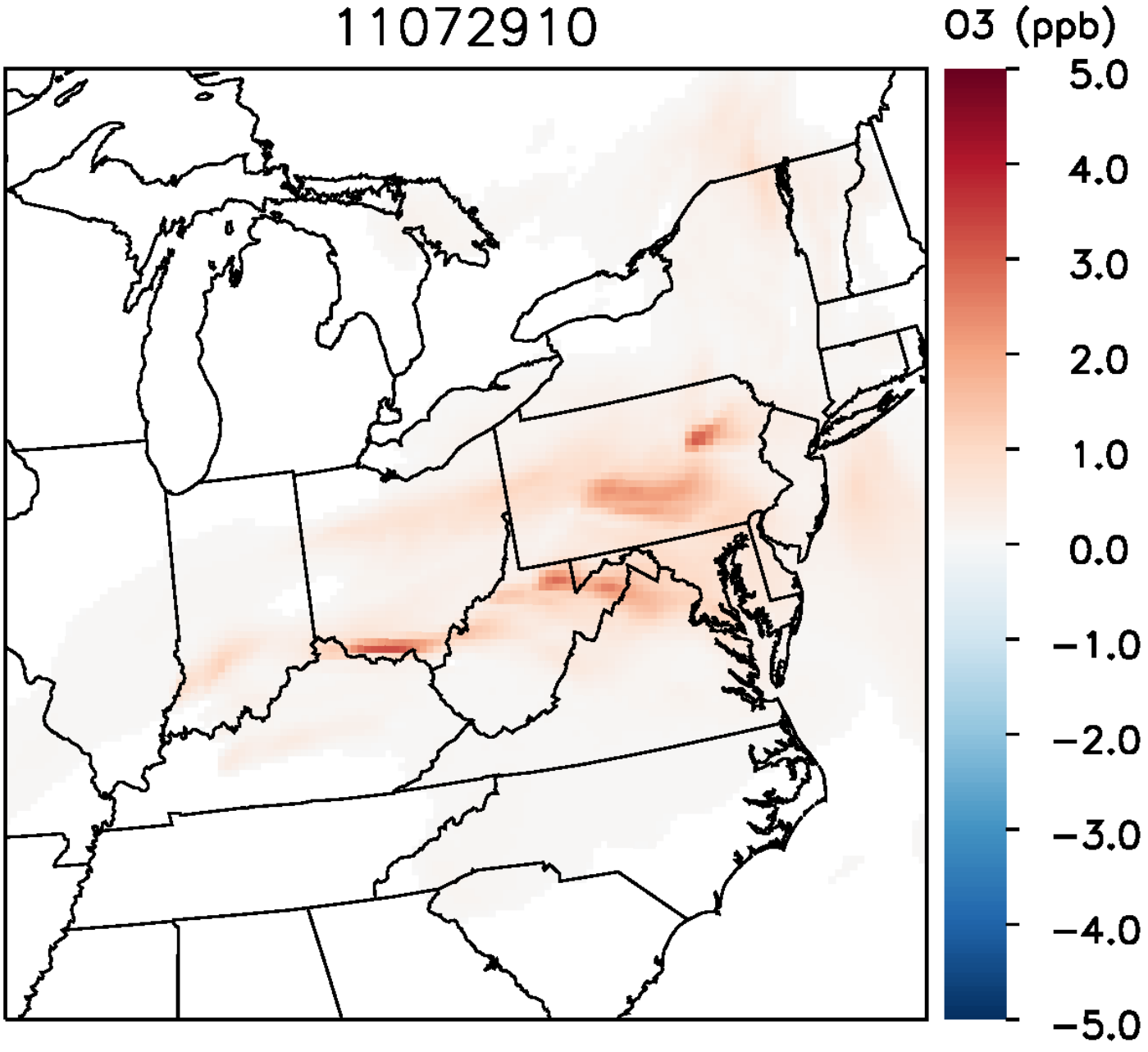
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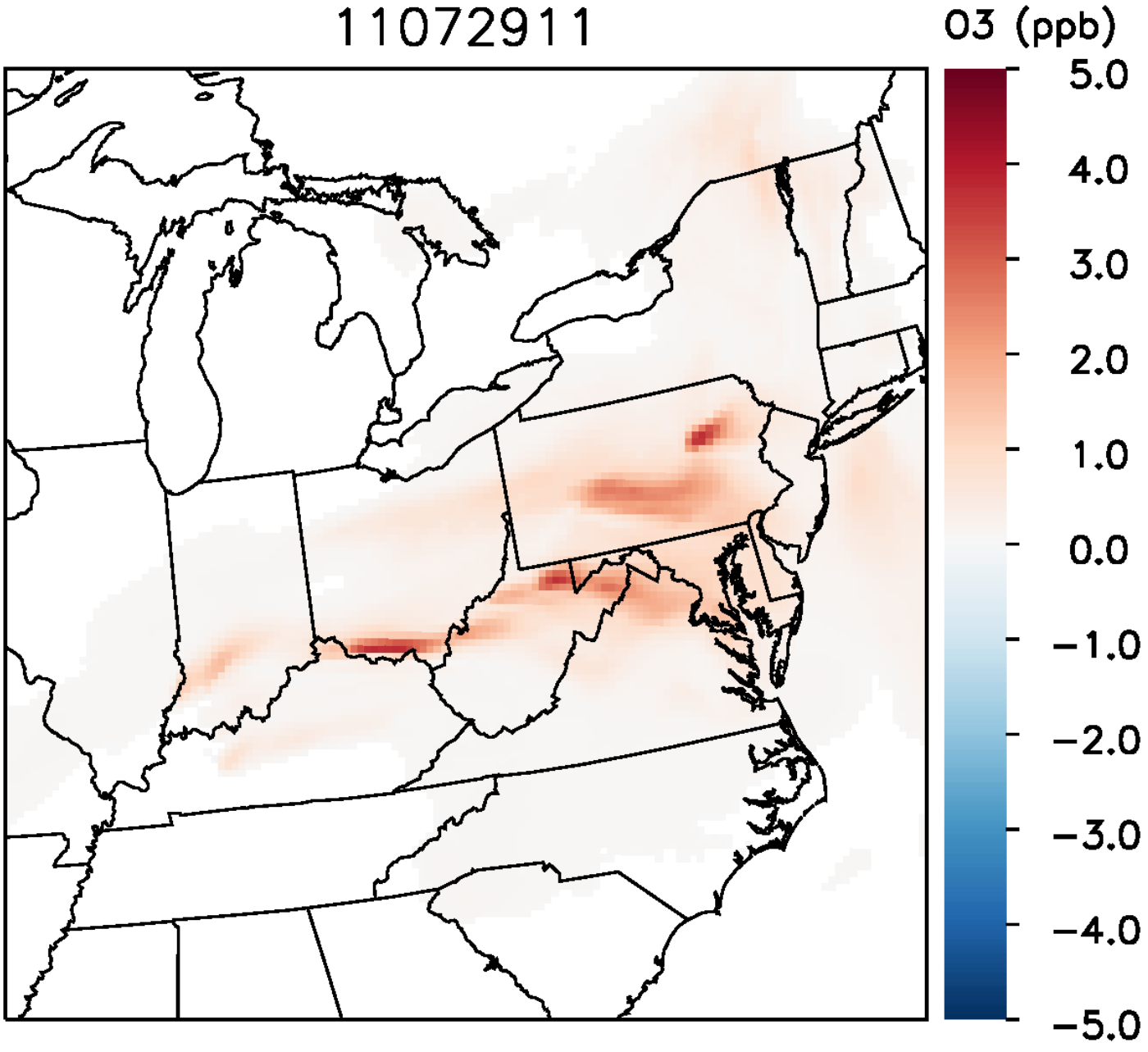
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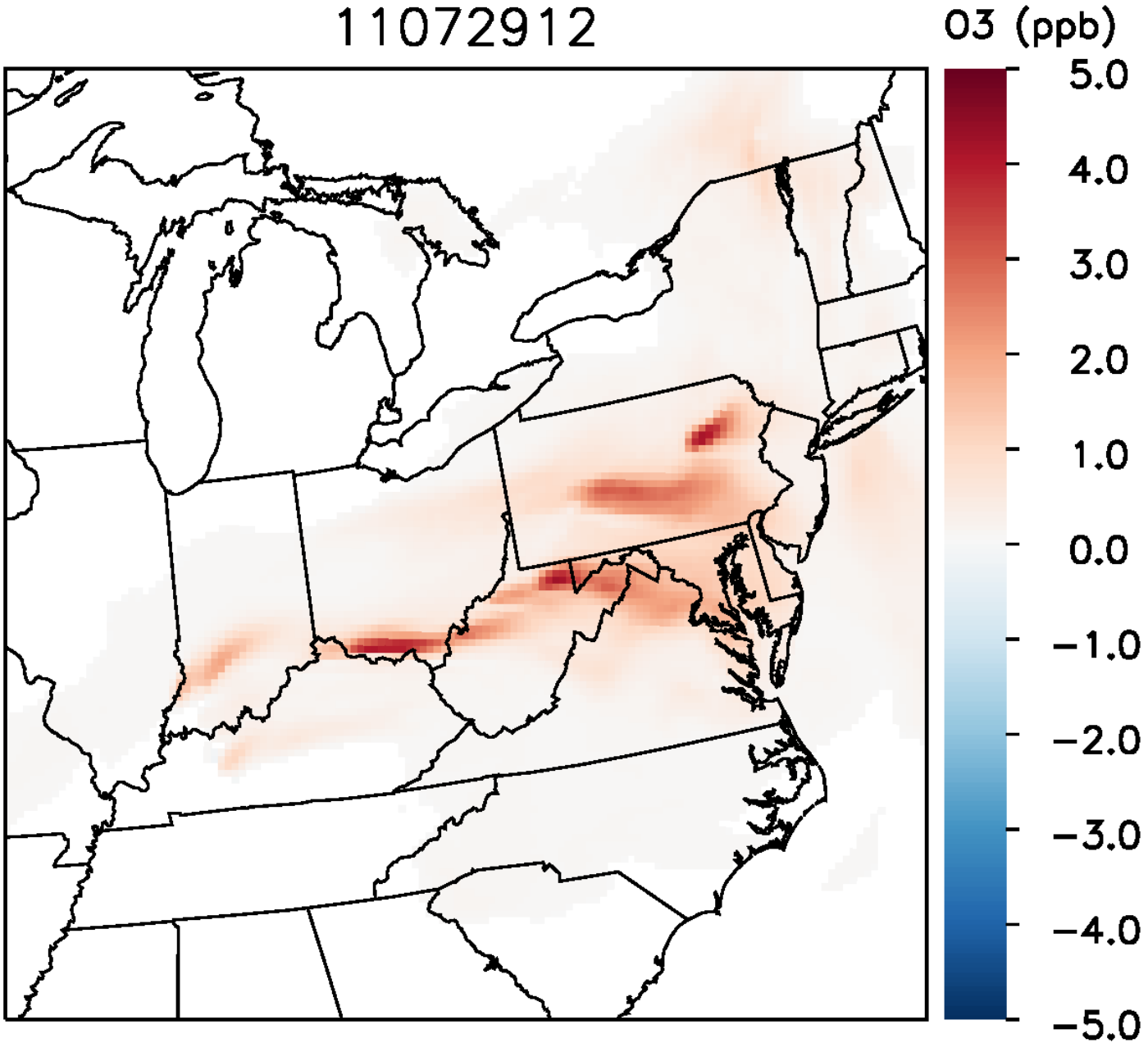
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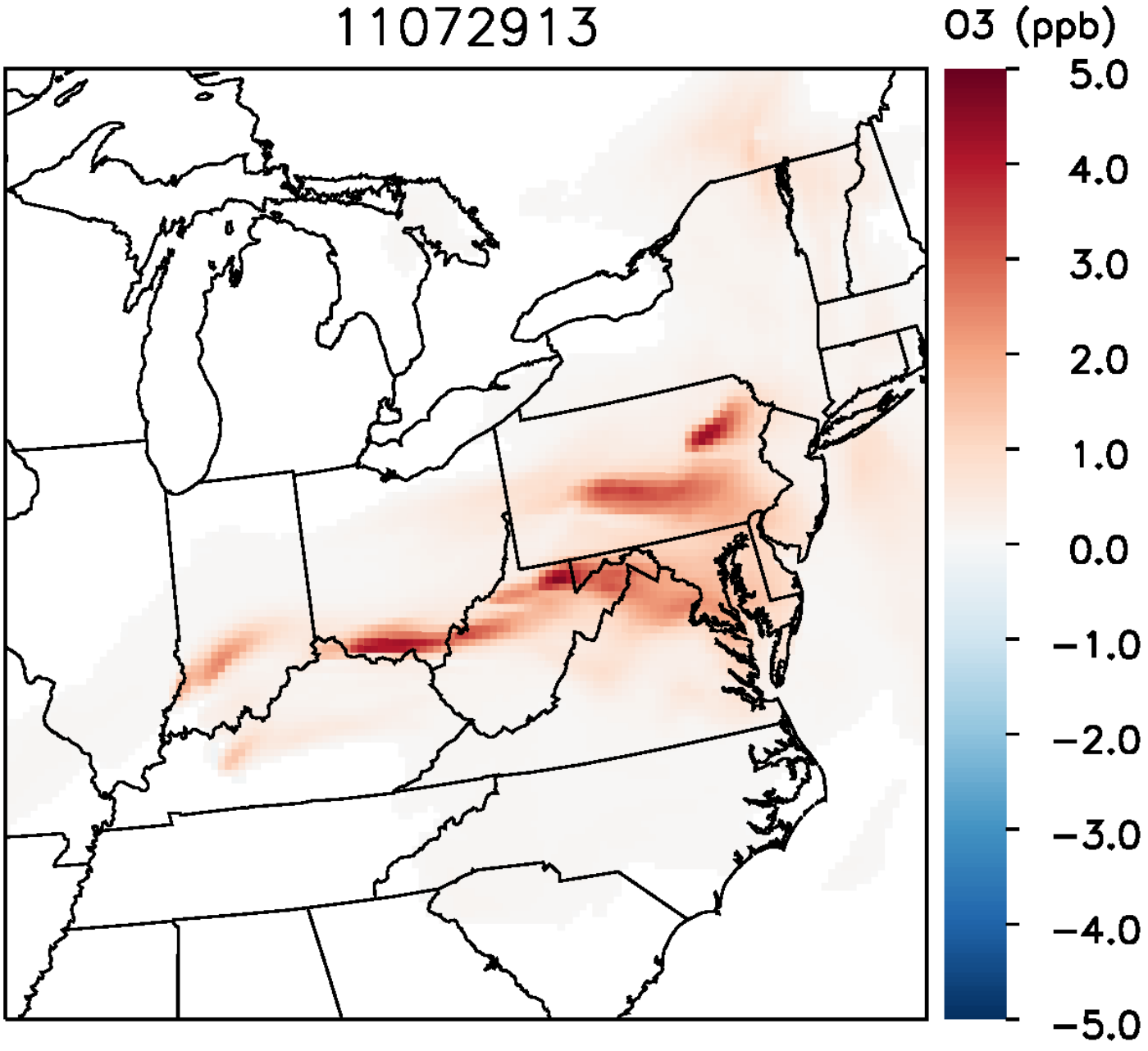
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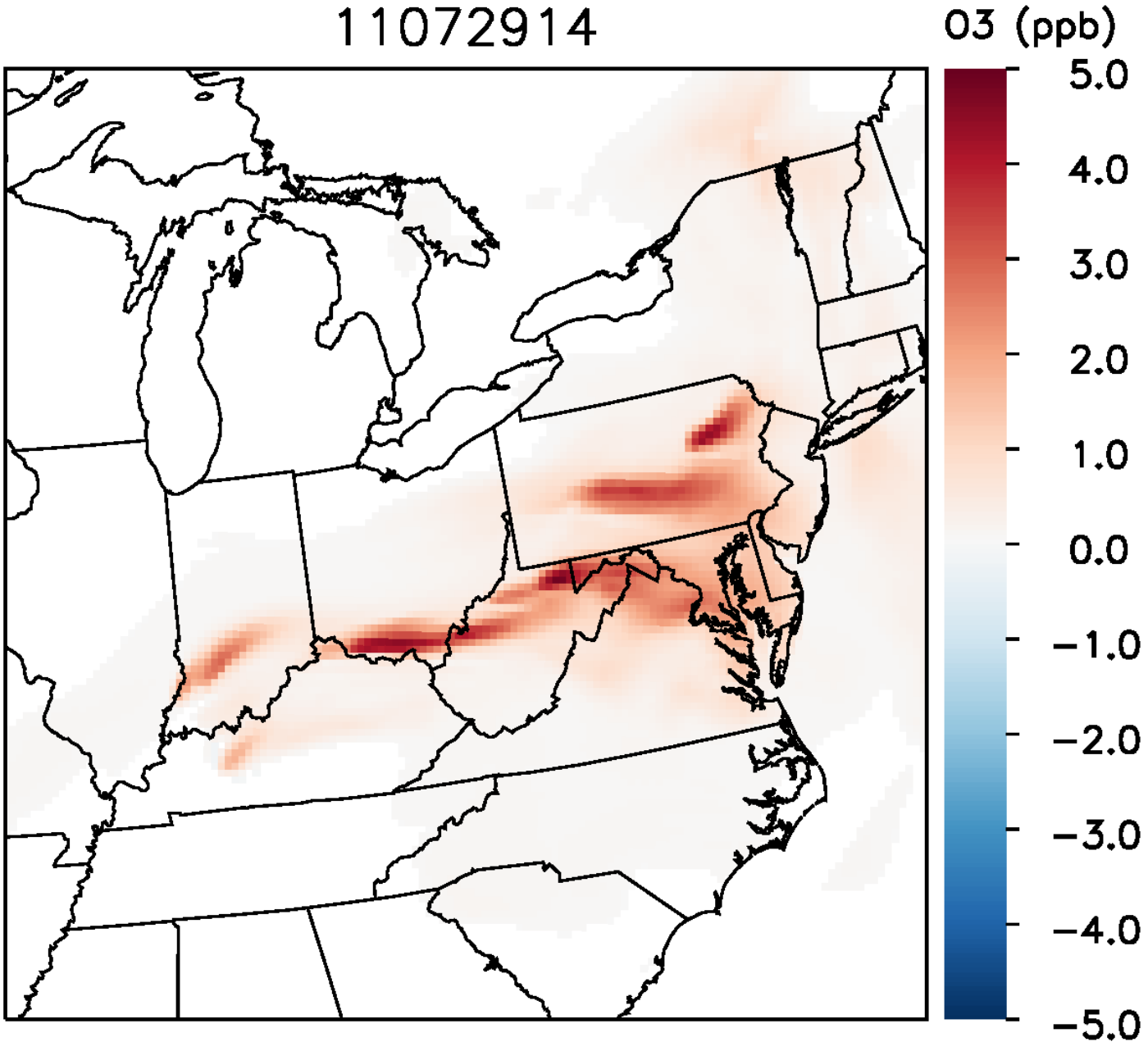
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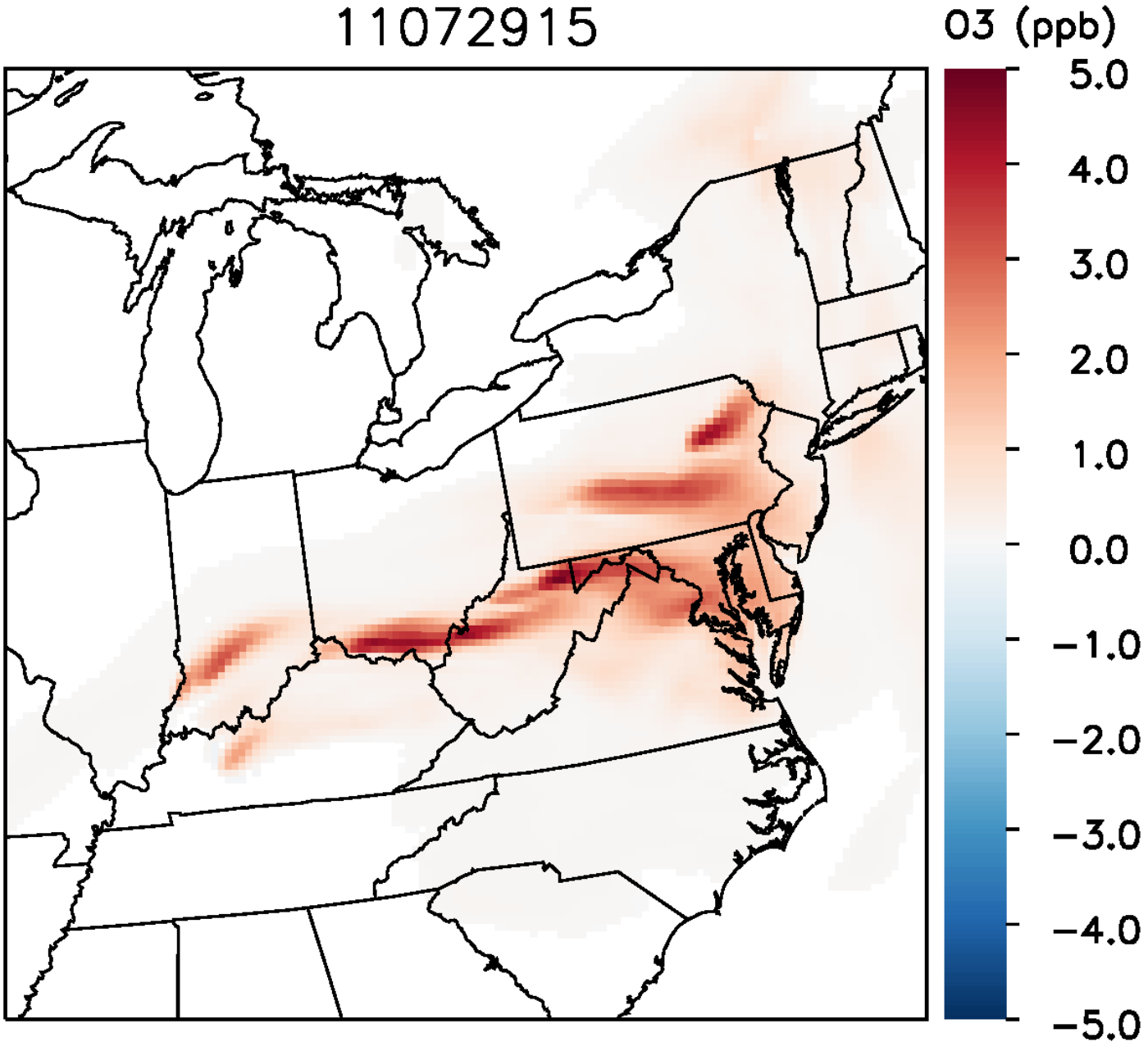
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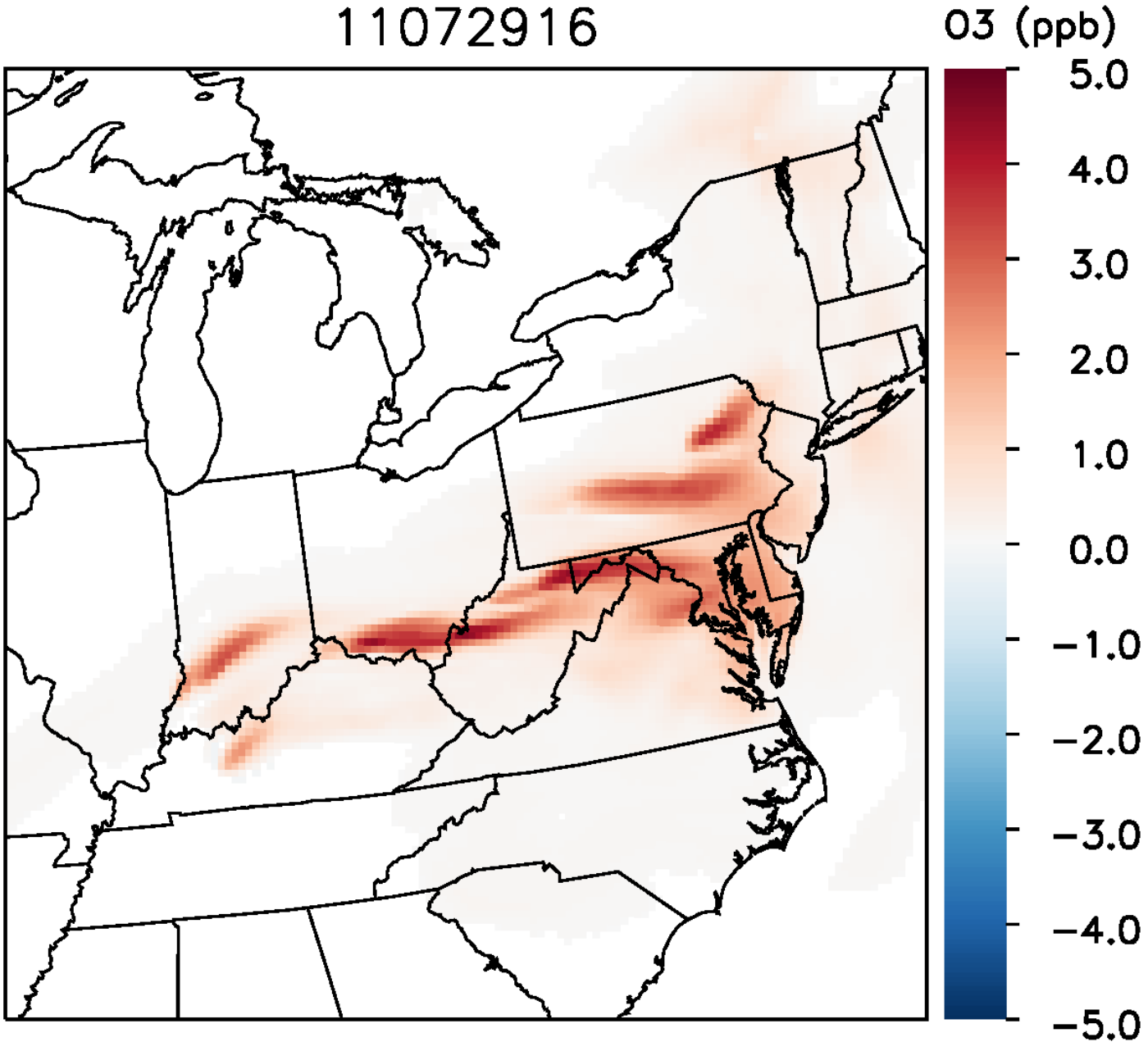
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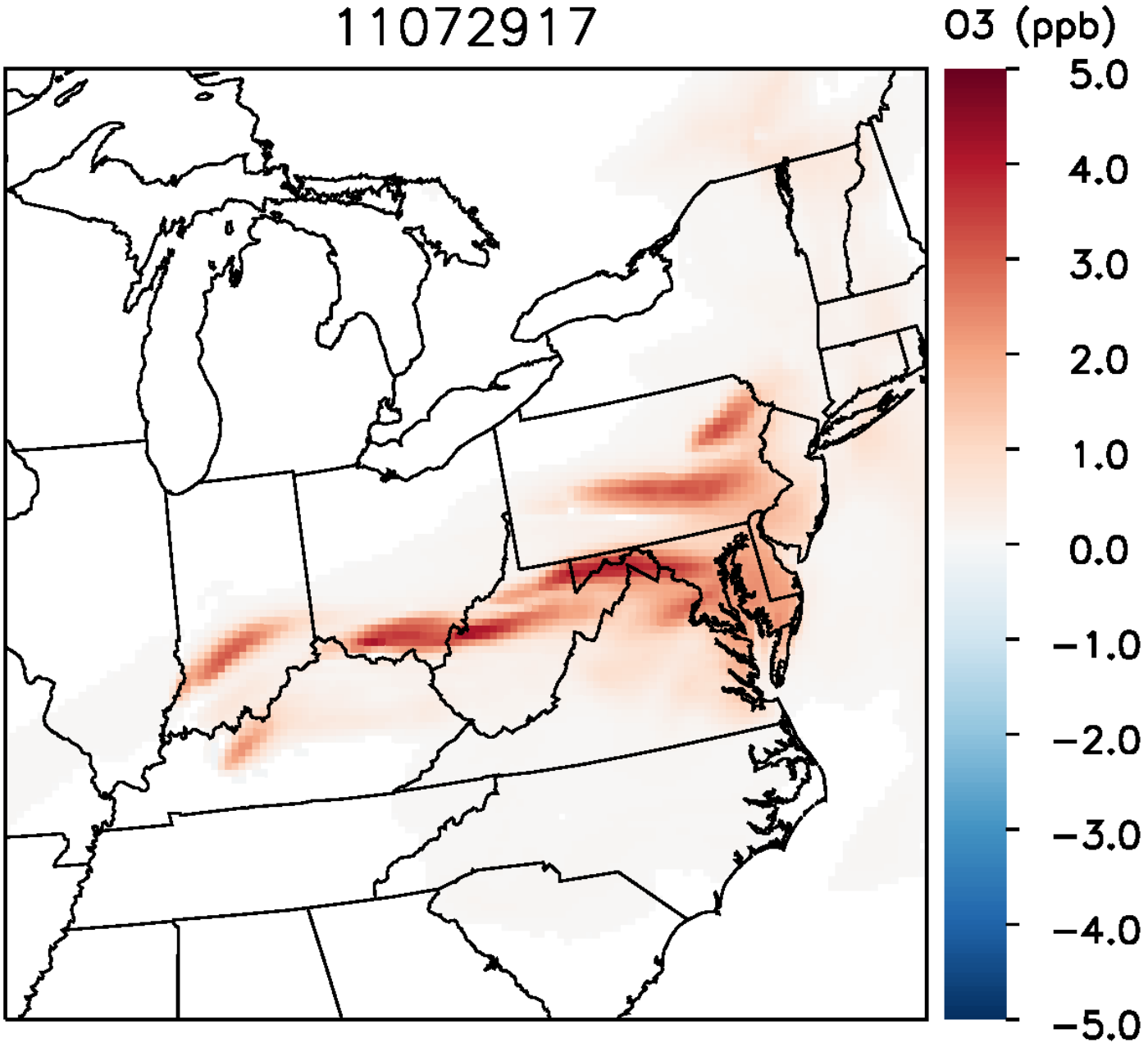
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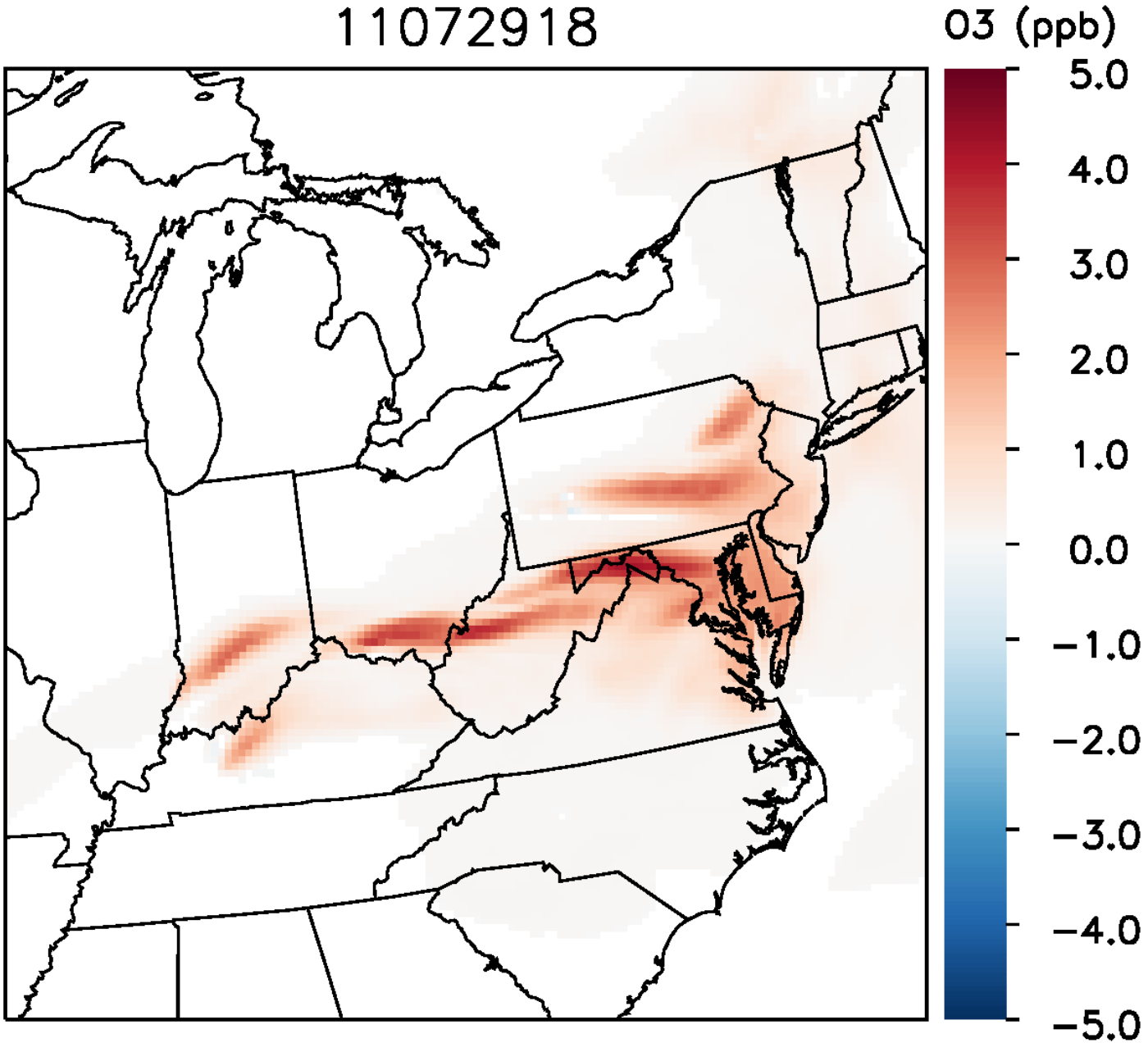
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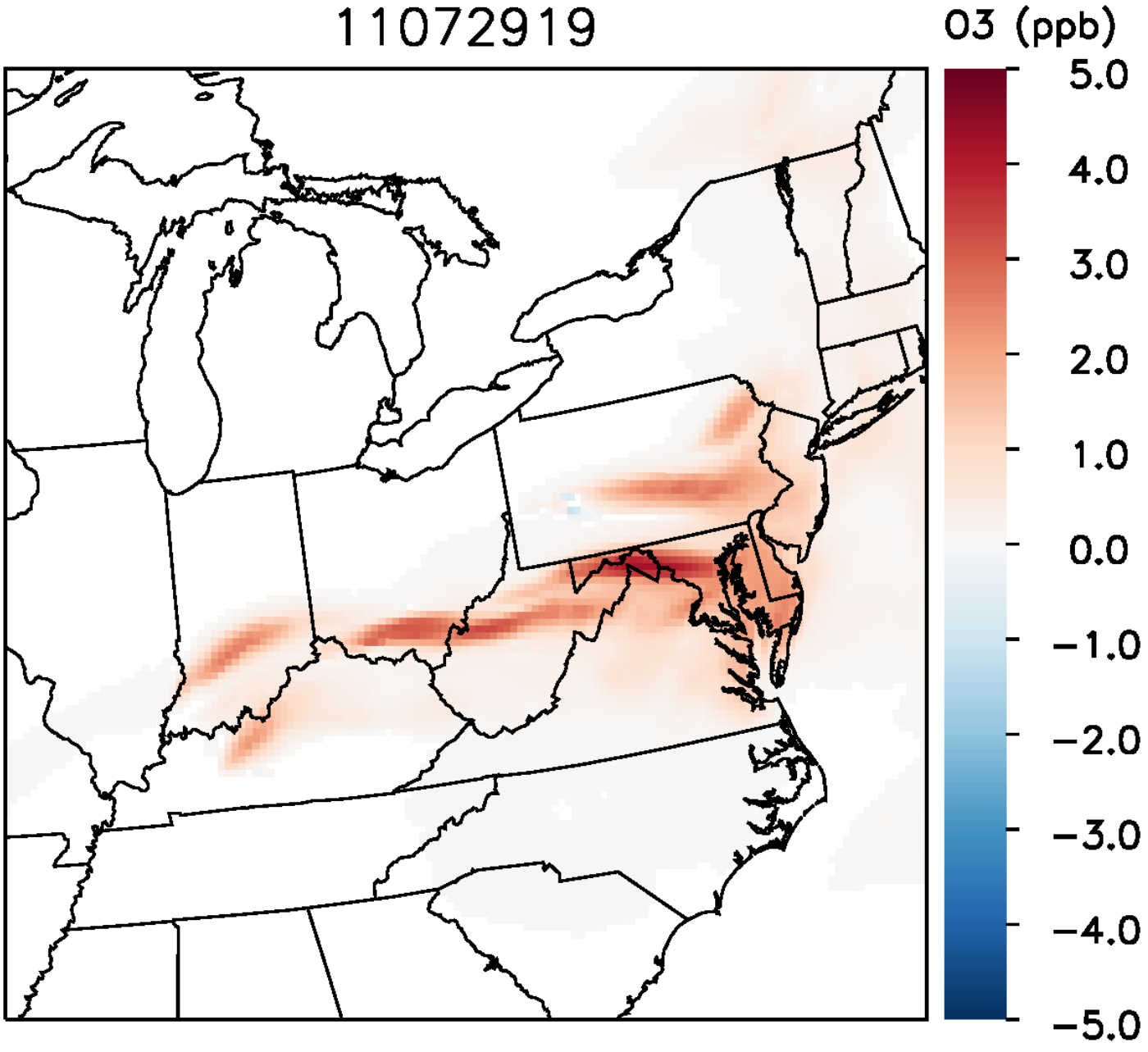
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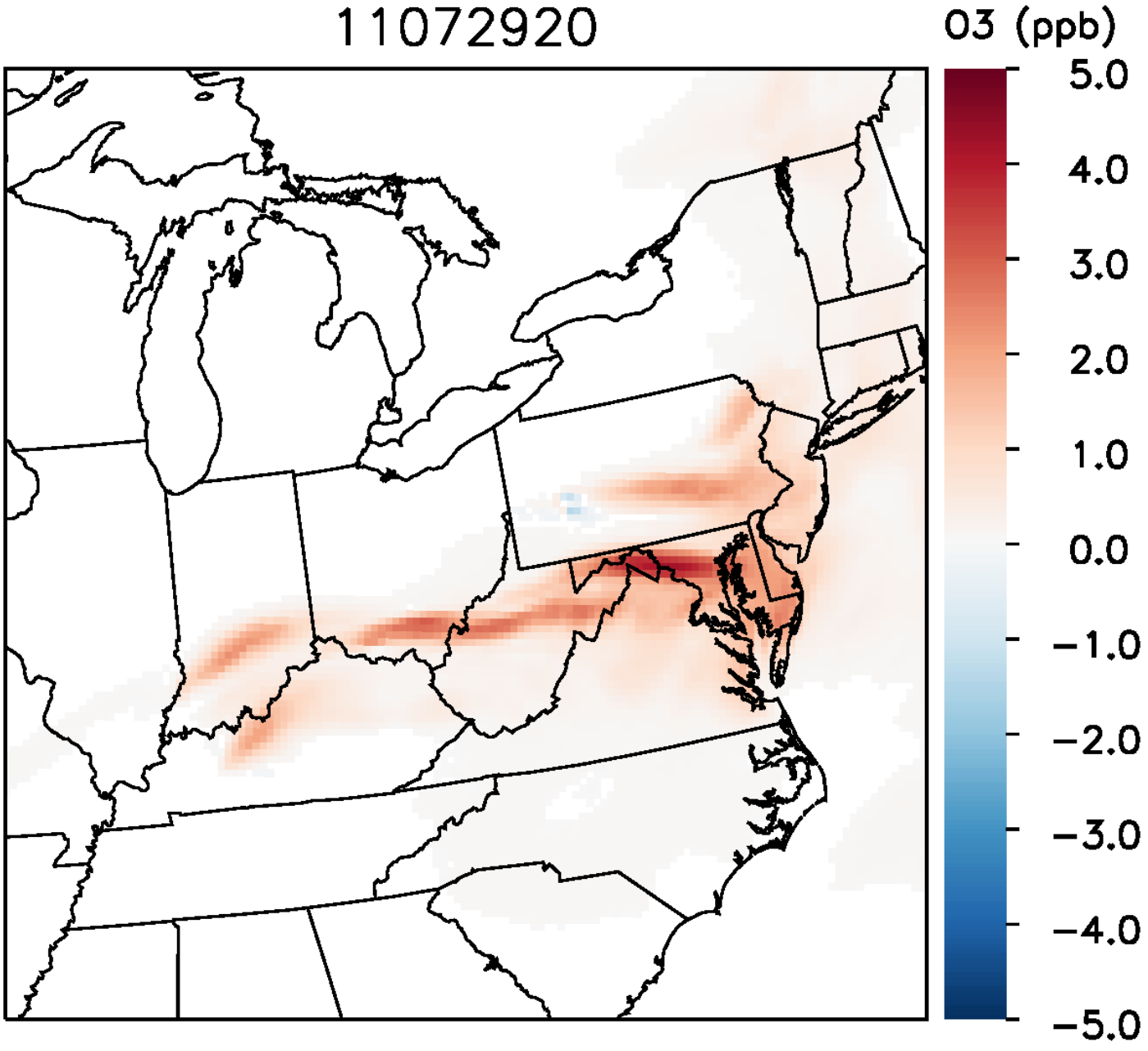
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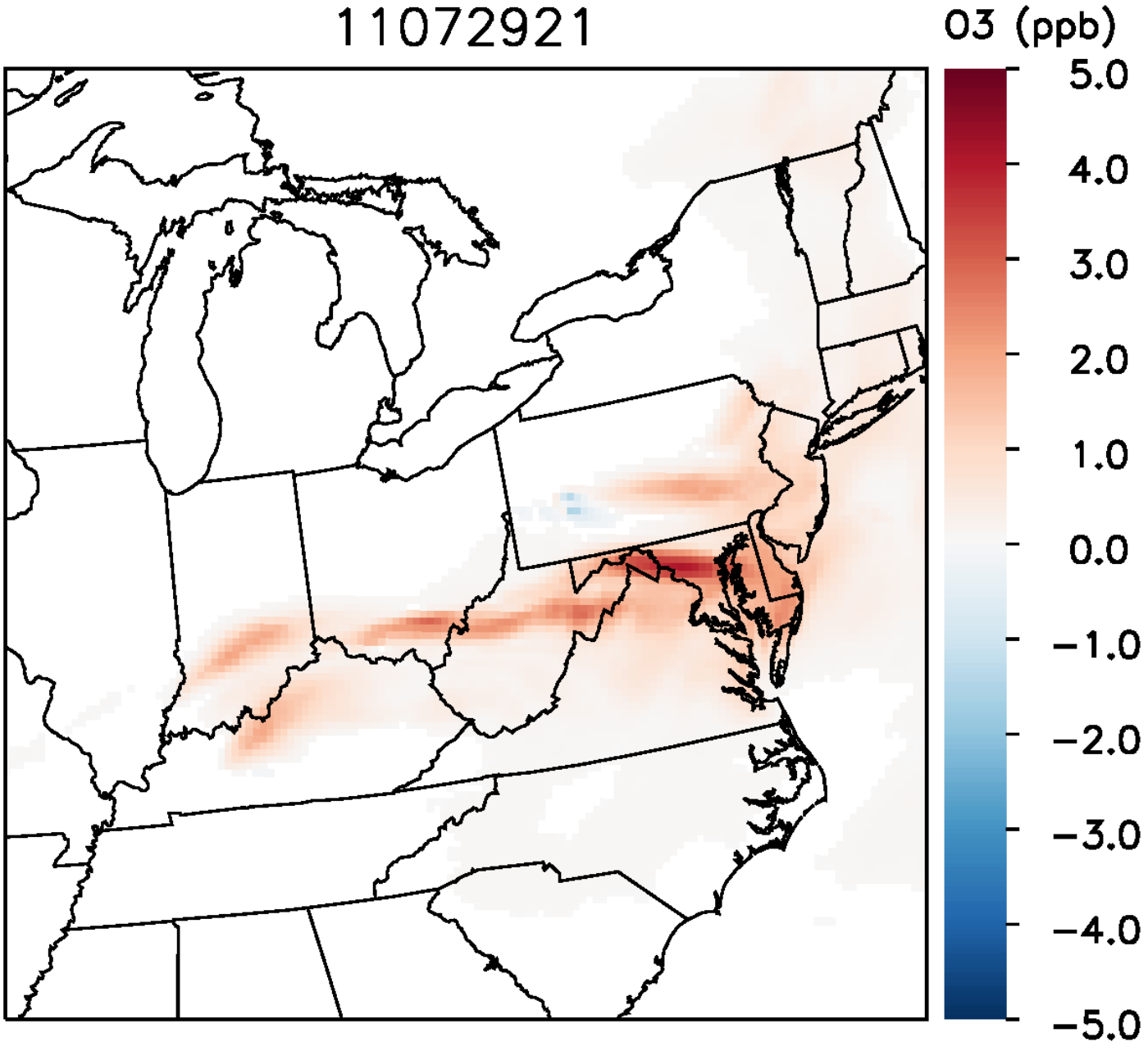
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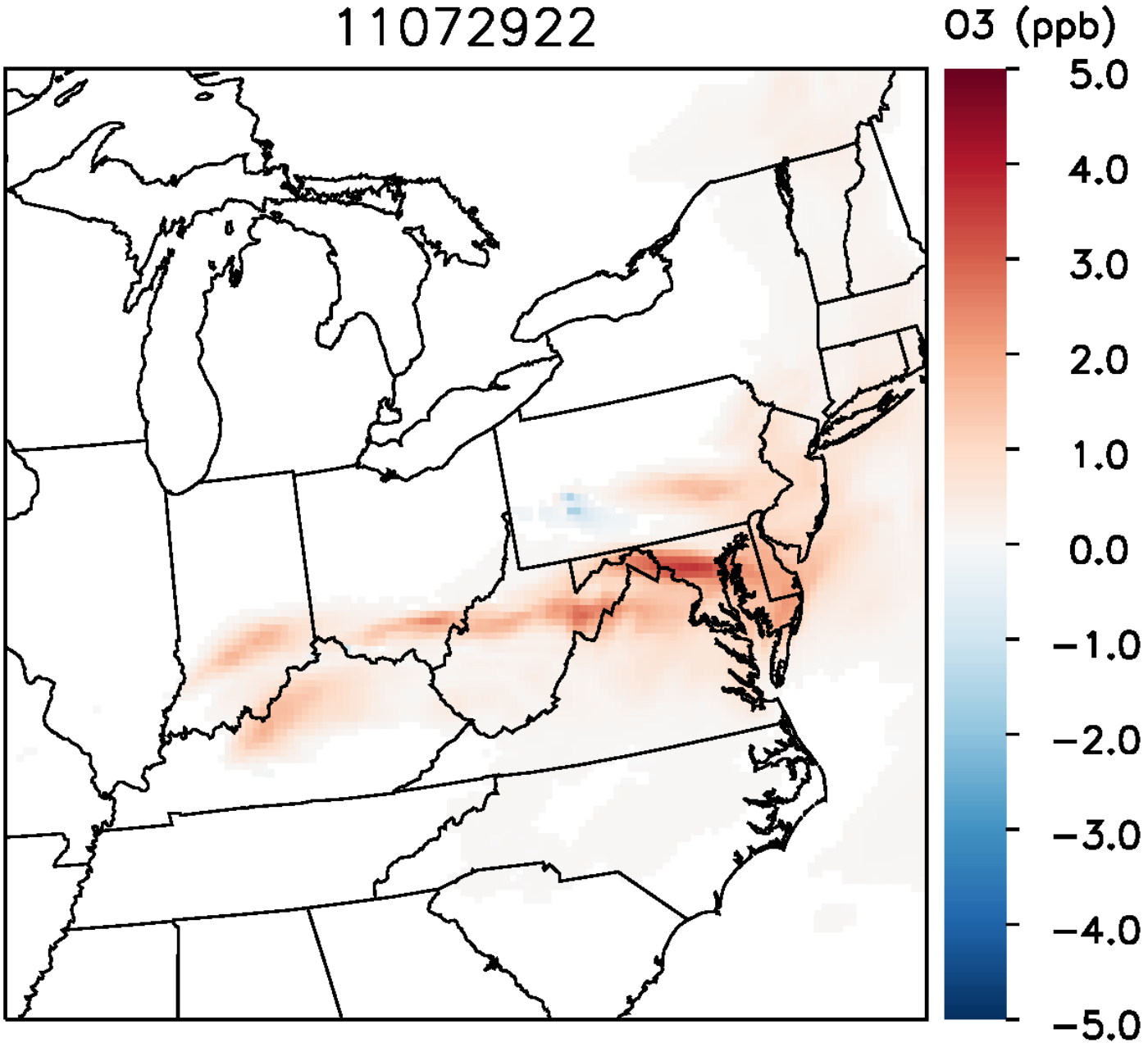
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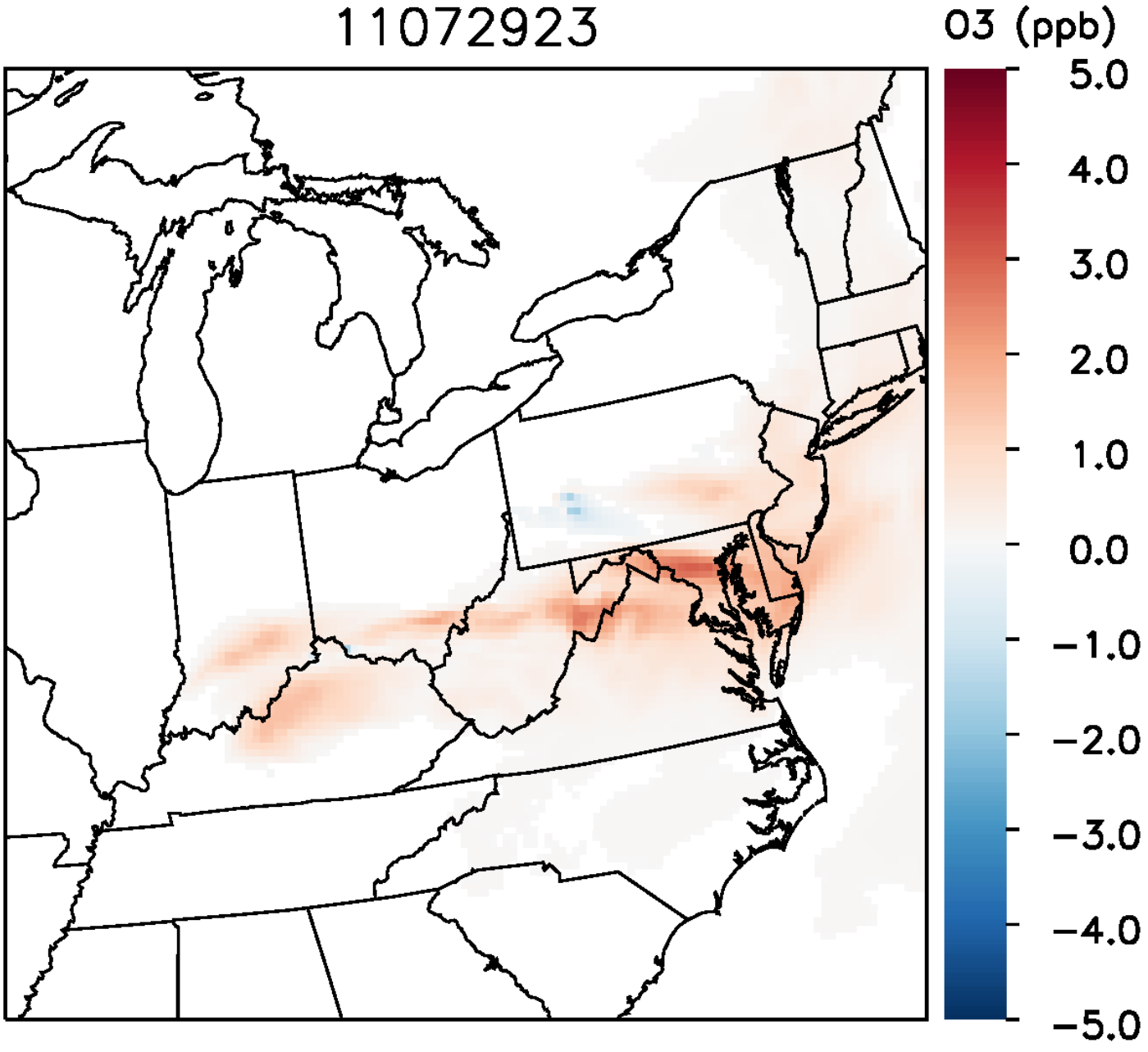
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−2.0
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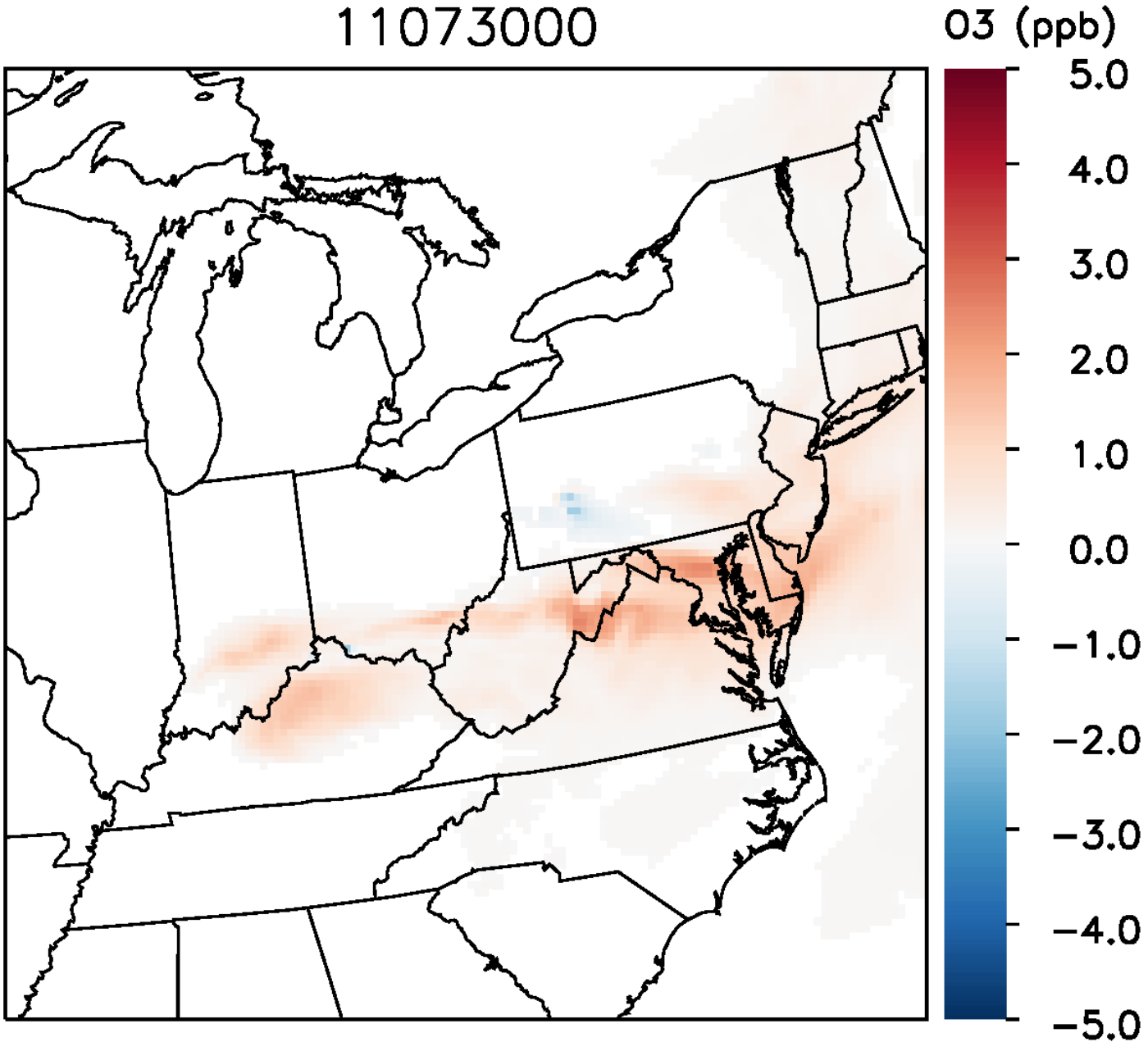
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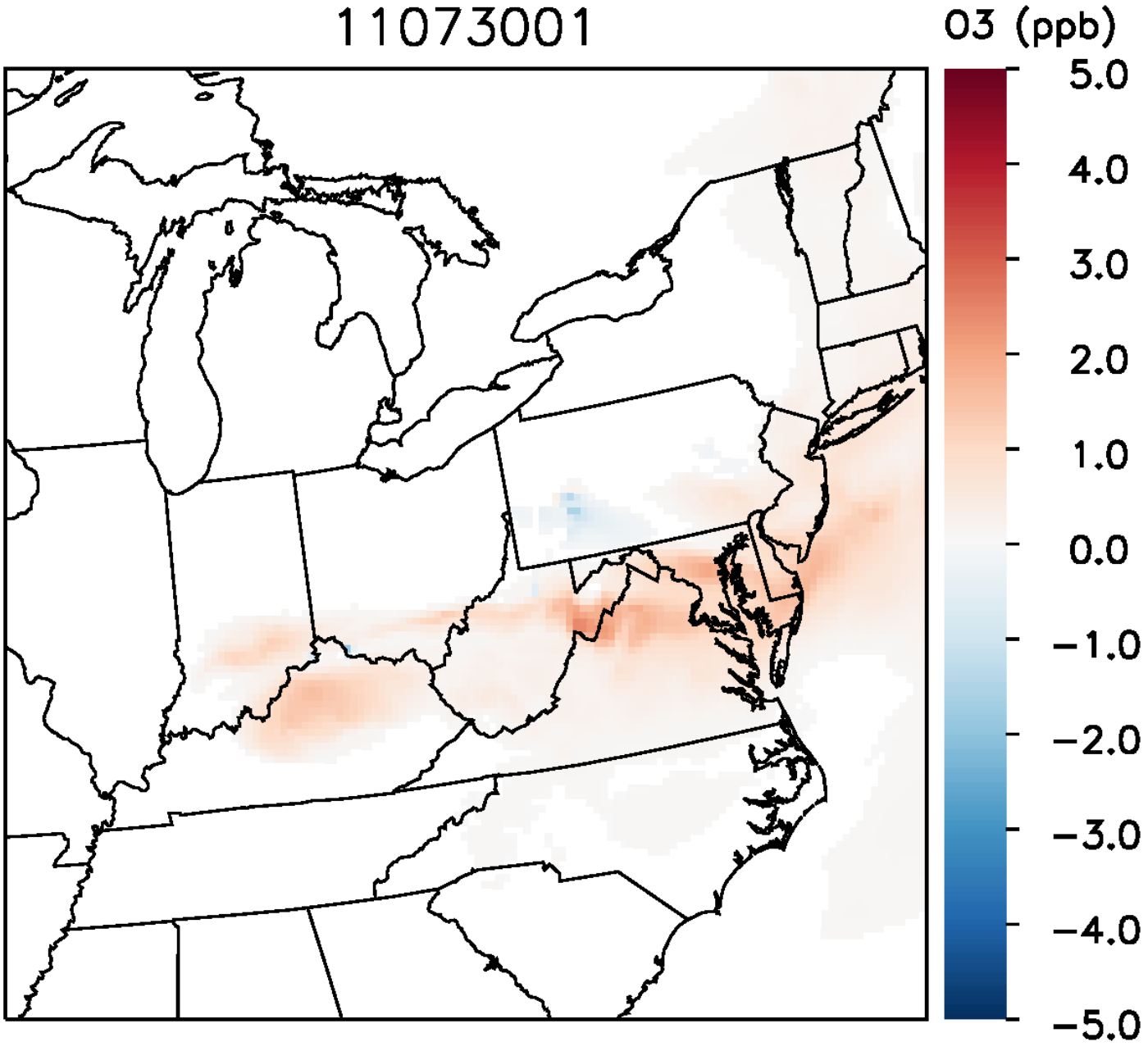
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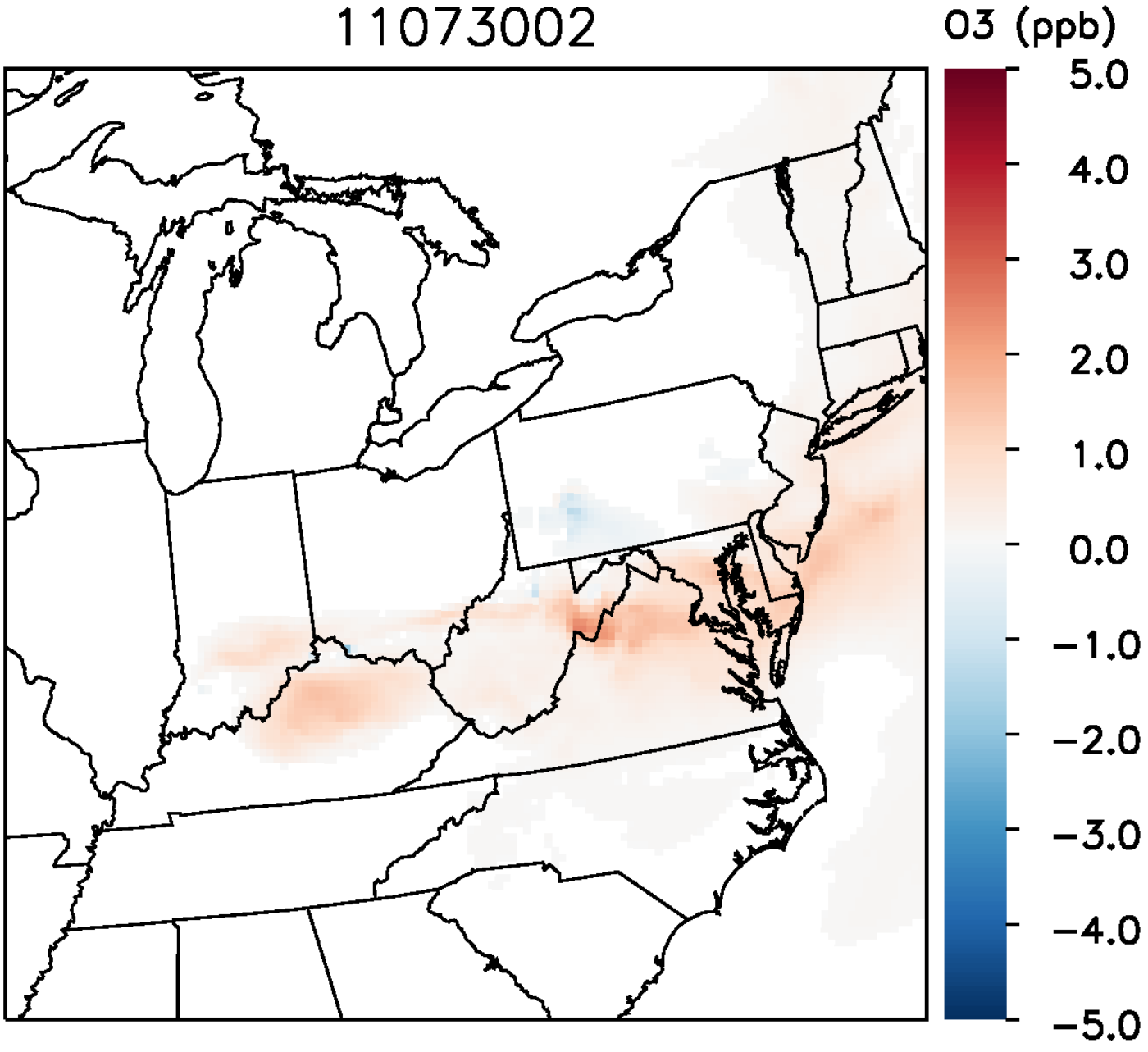
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−2.0
−3.0
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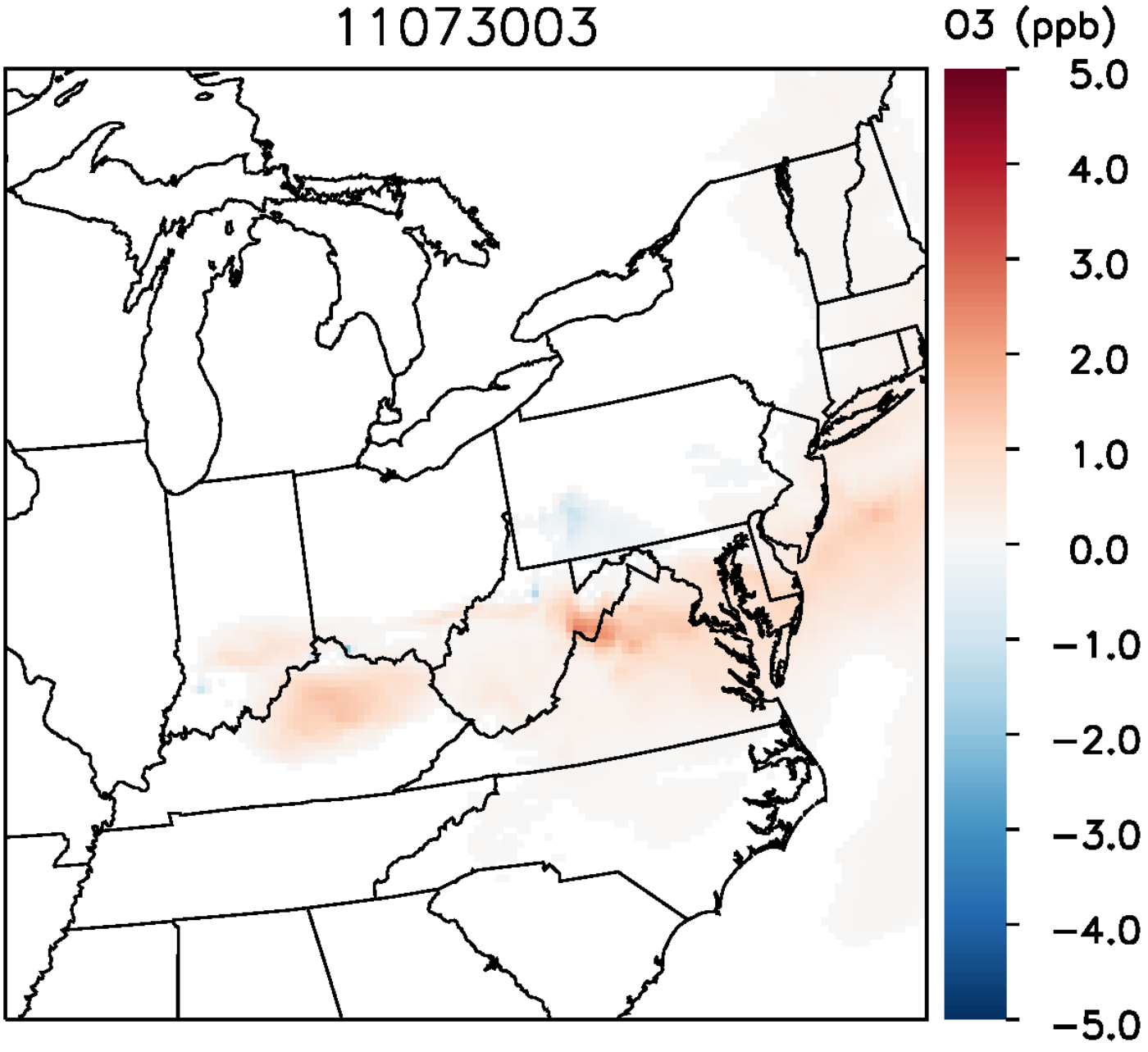
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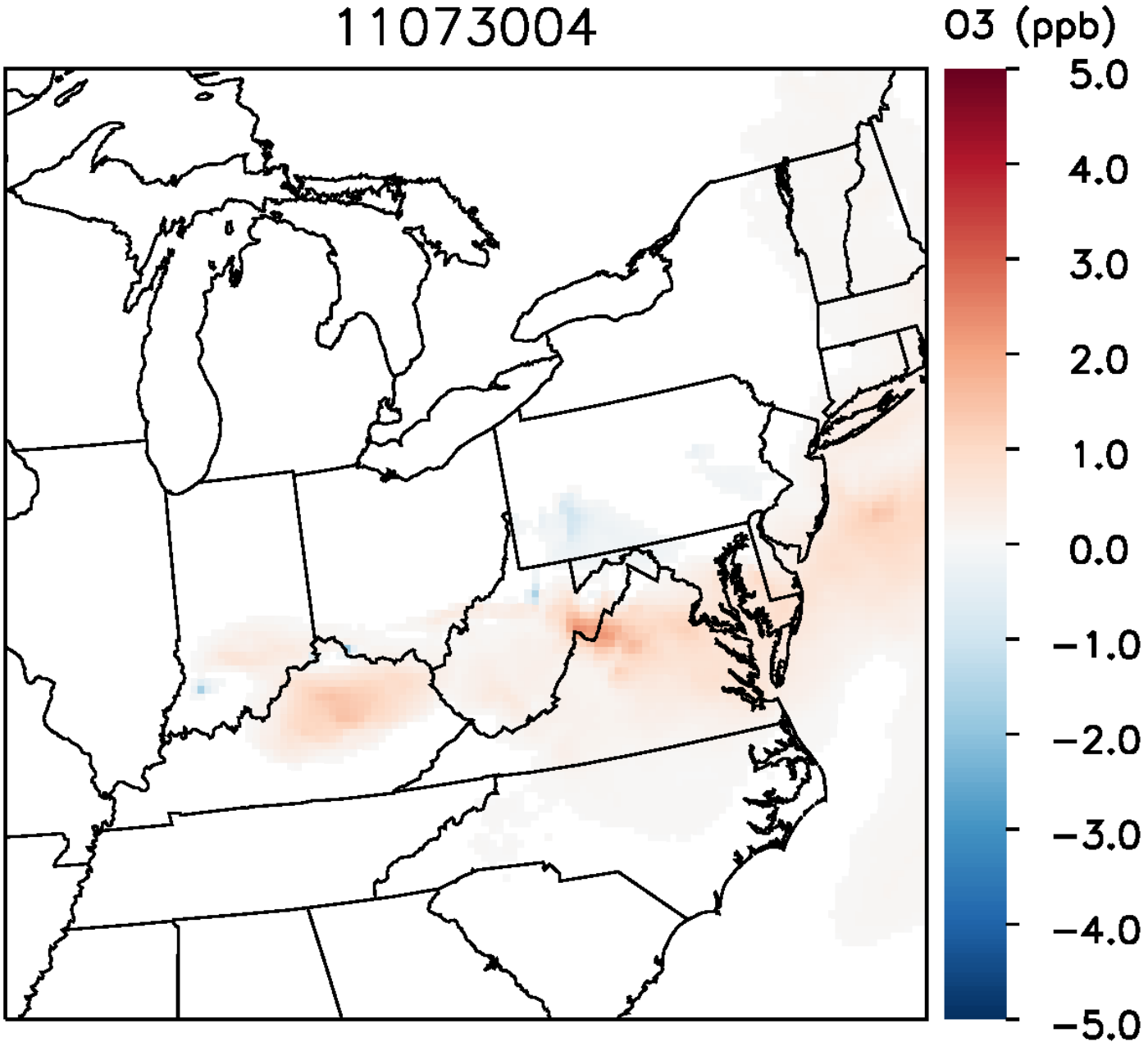
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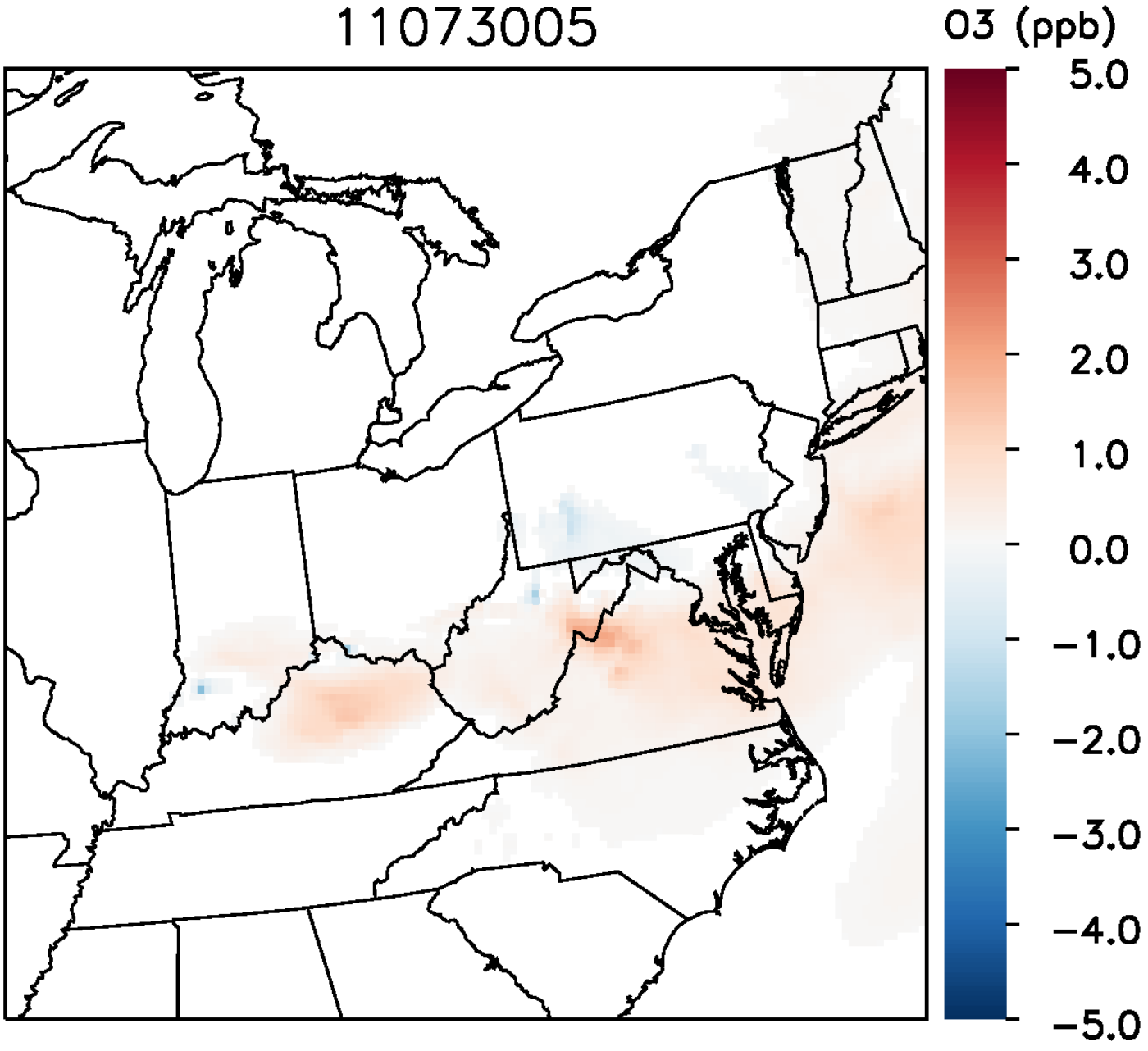
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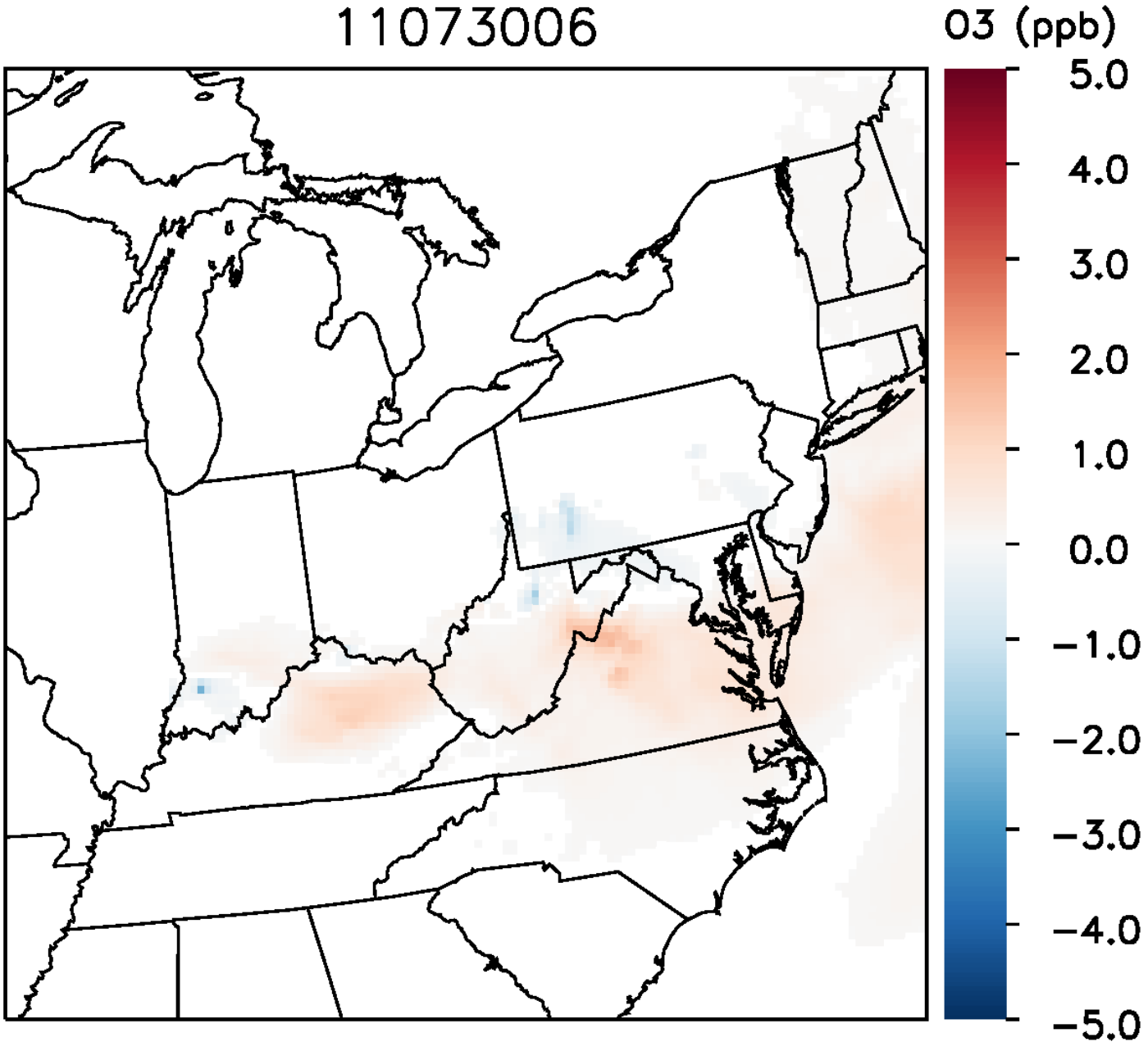
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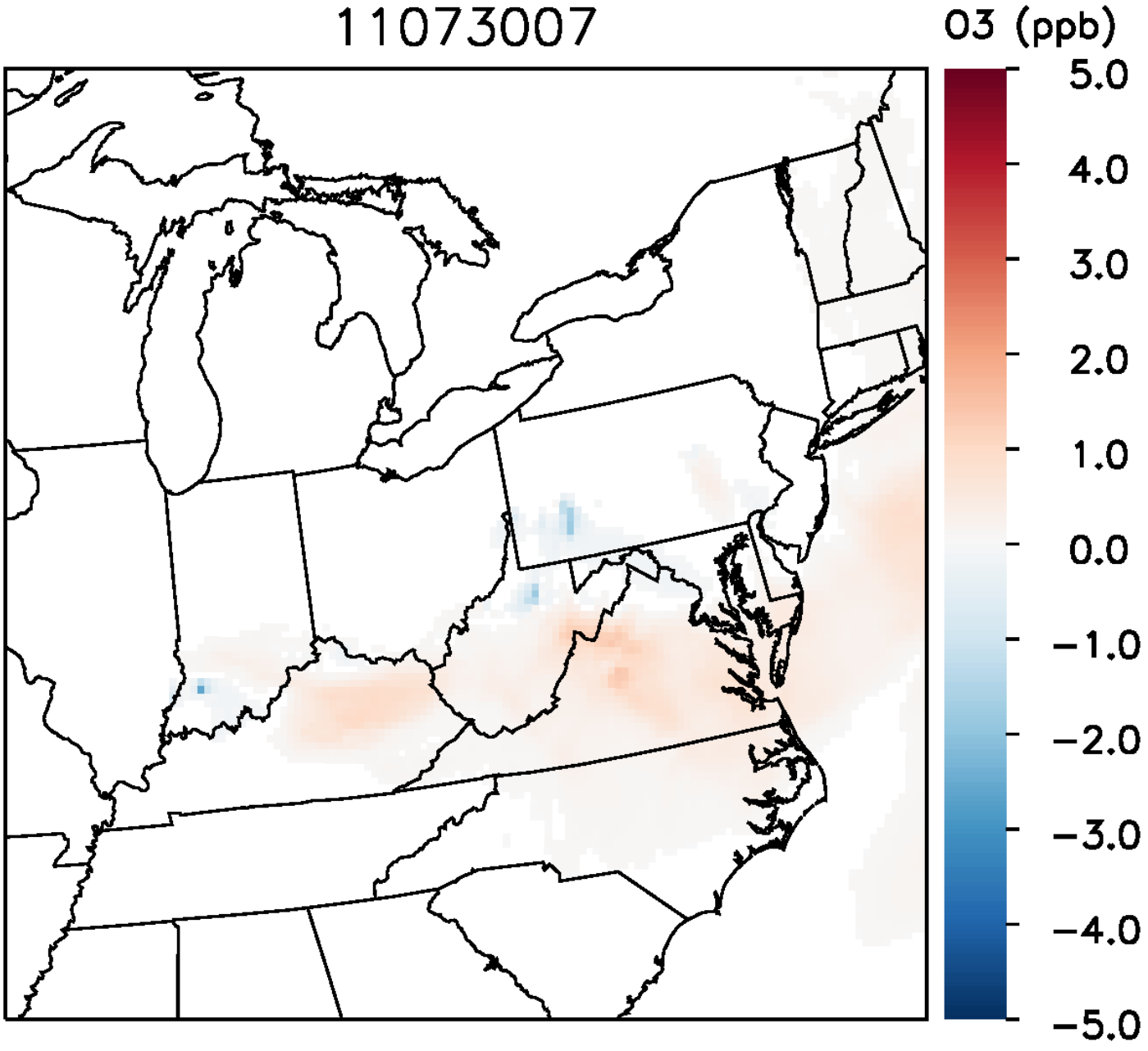
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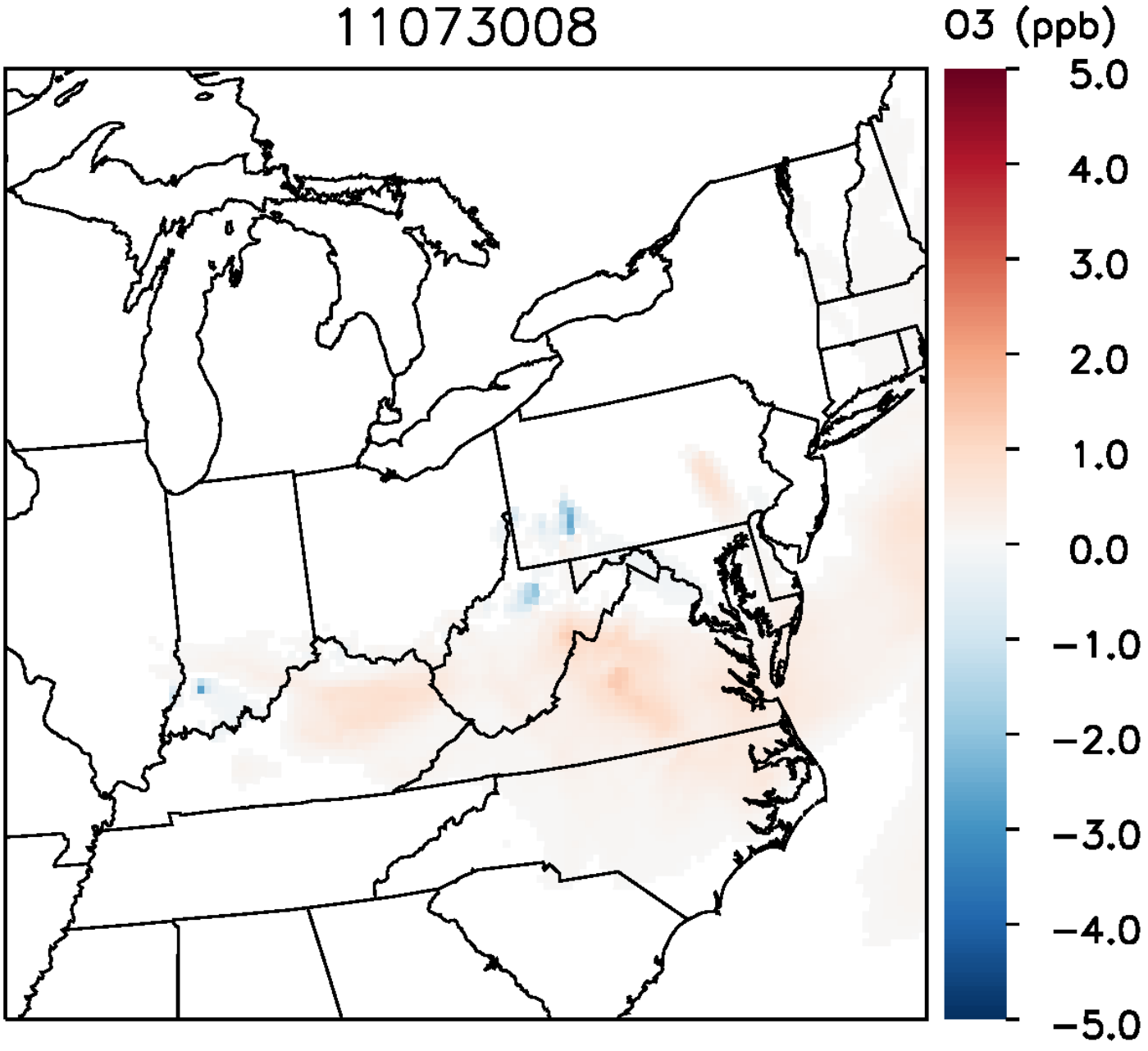
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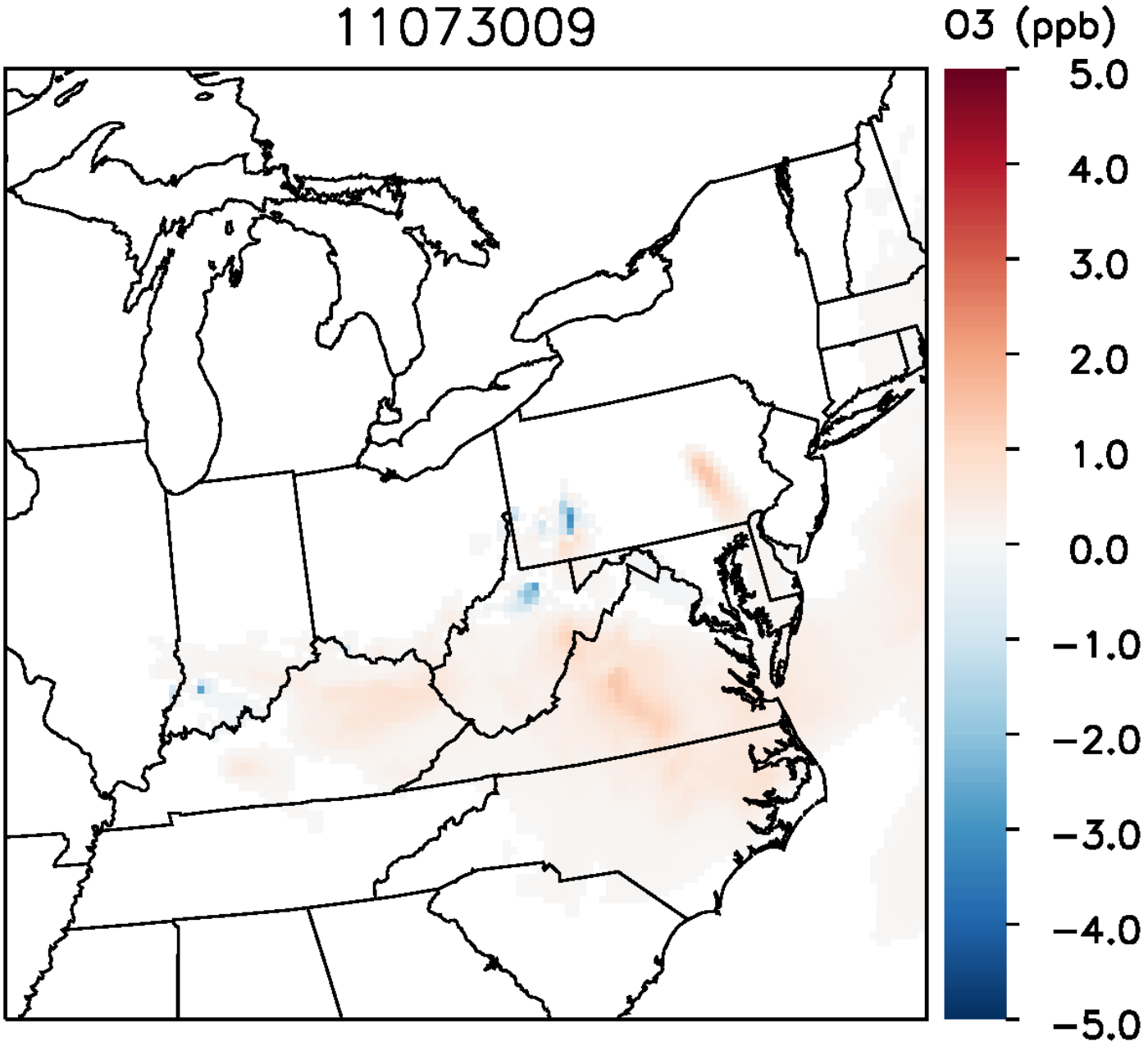
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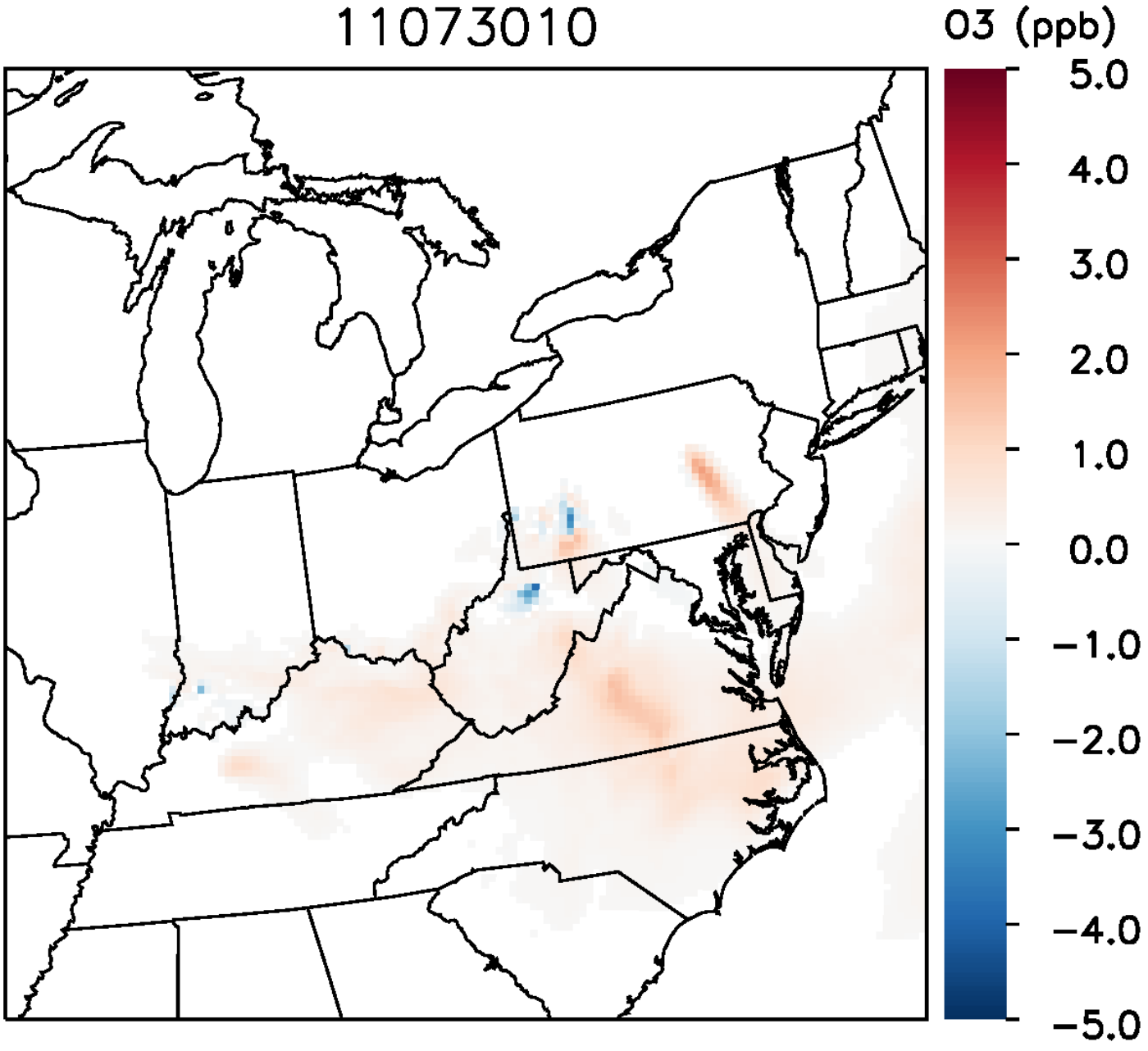
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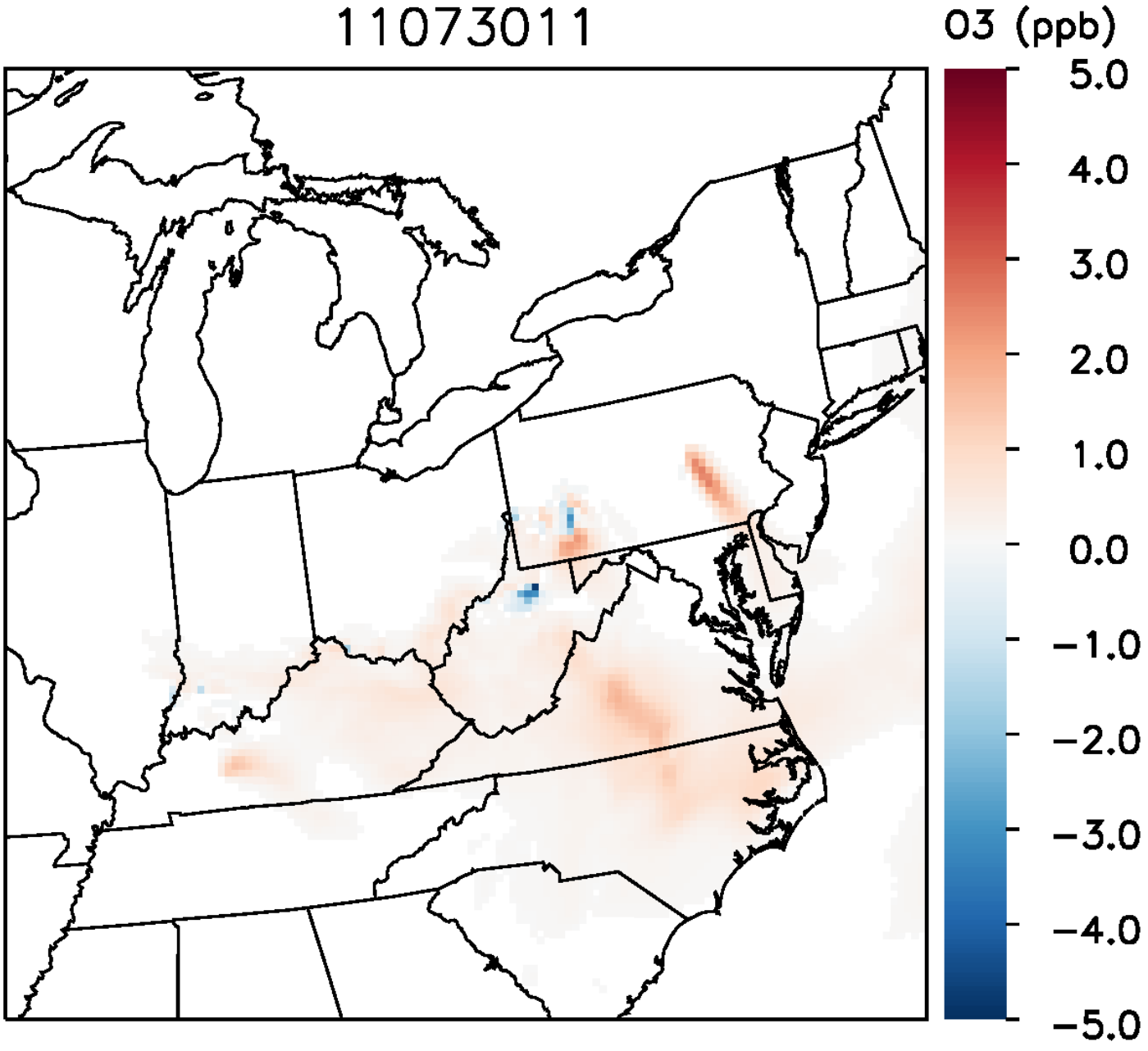
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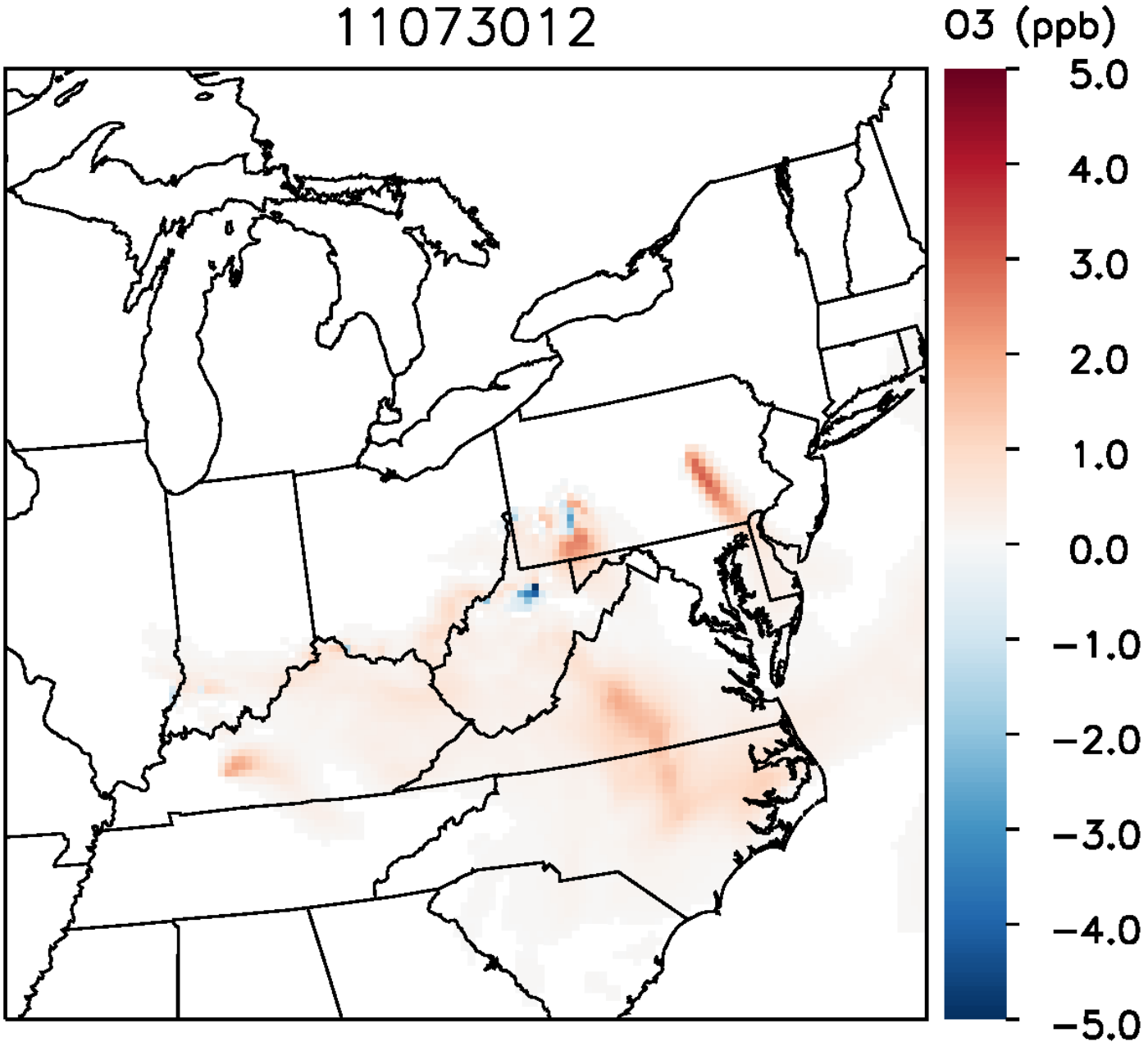
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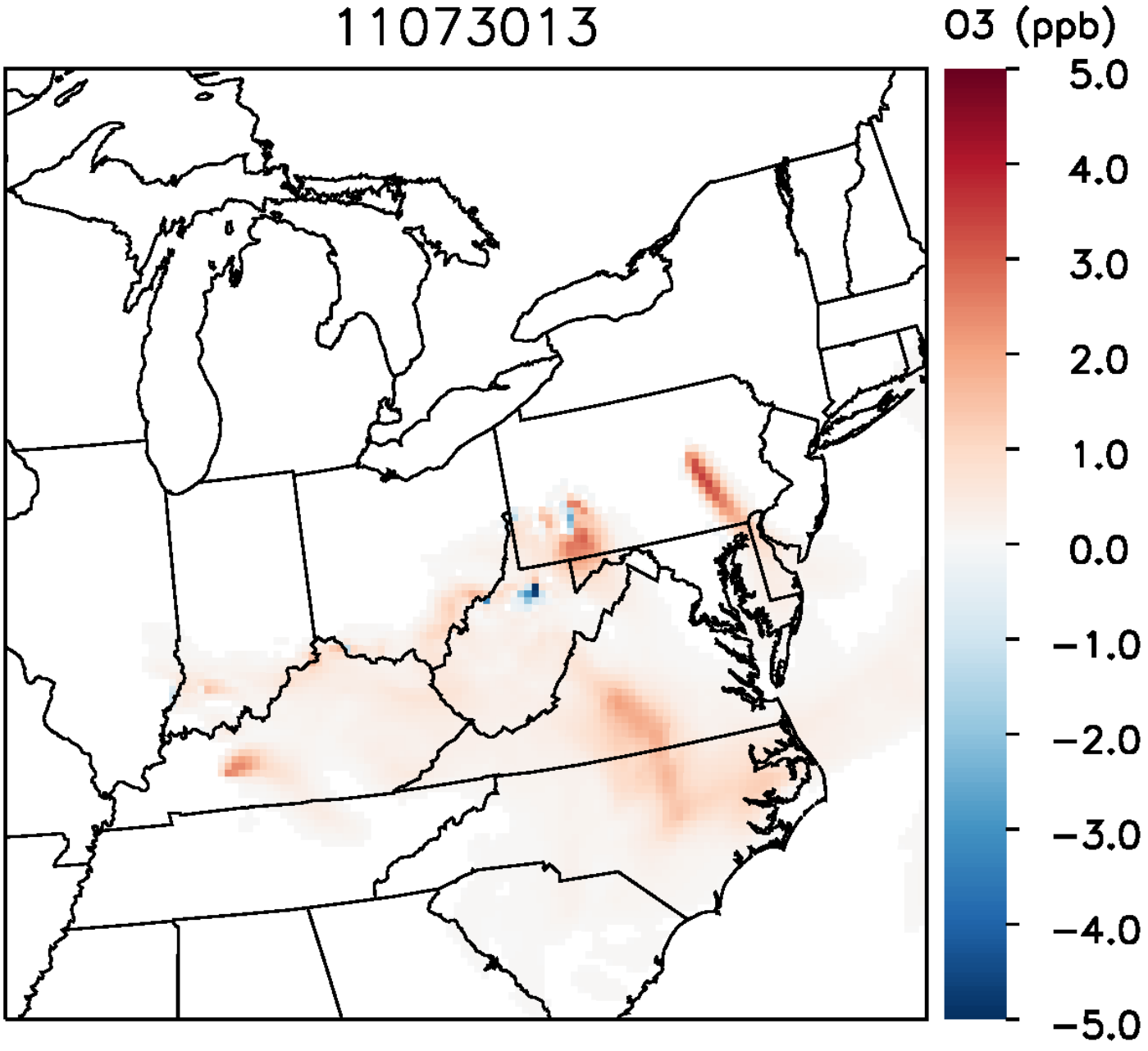
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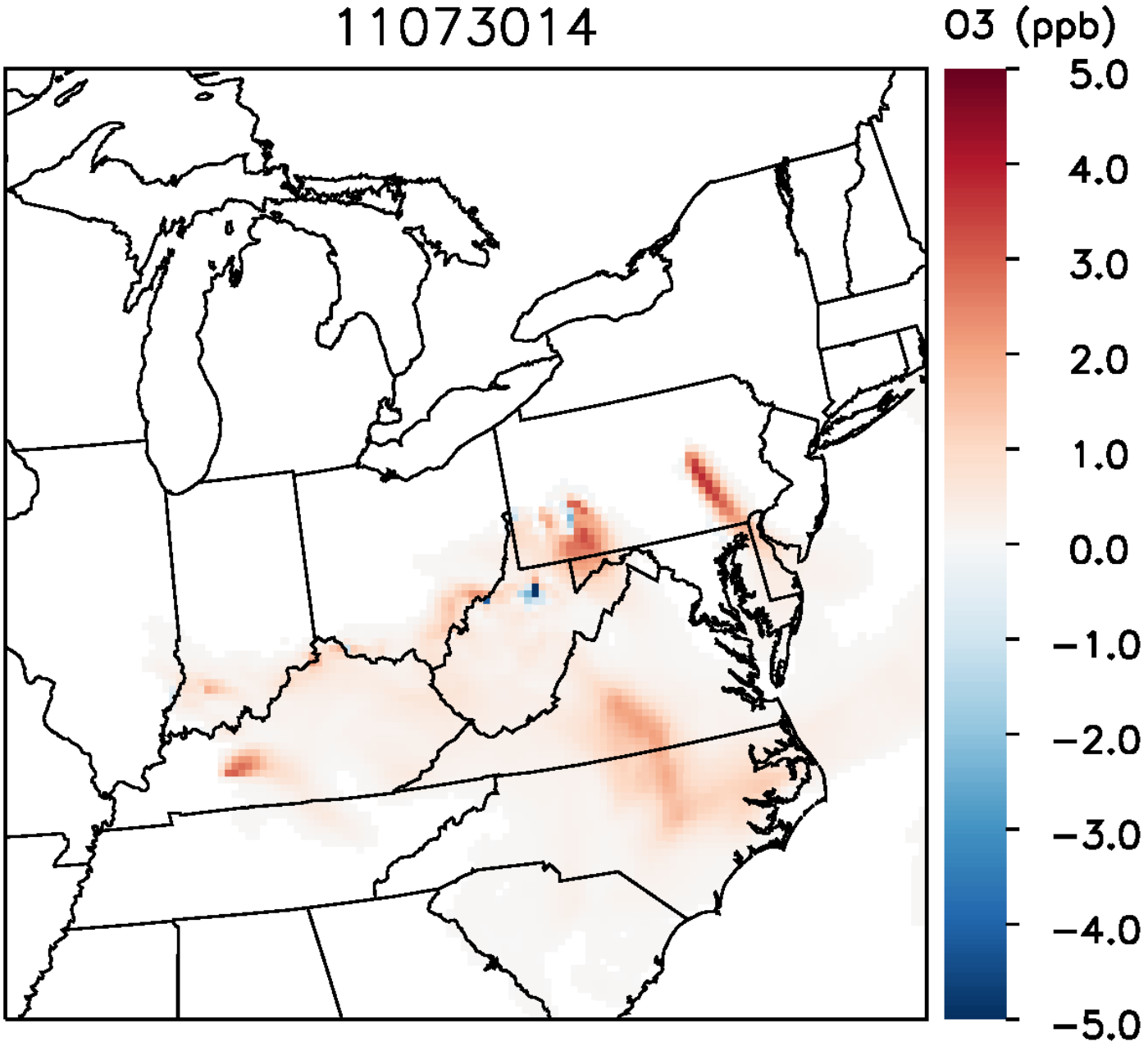
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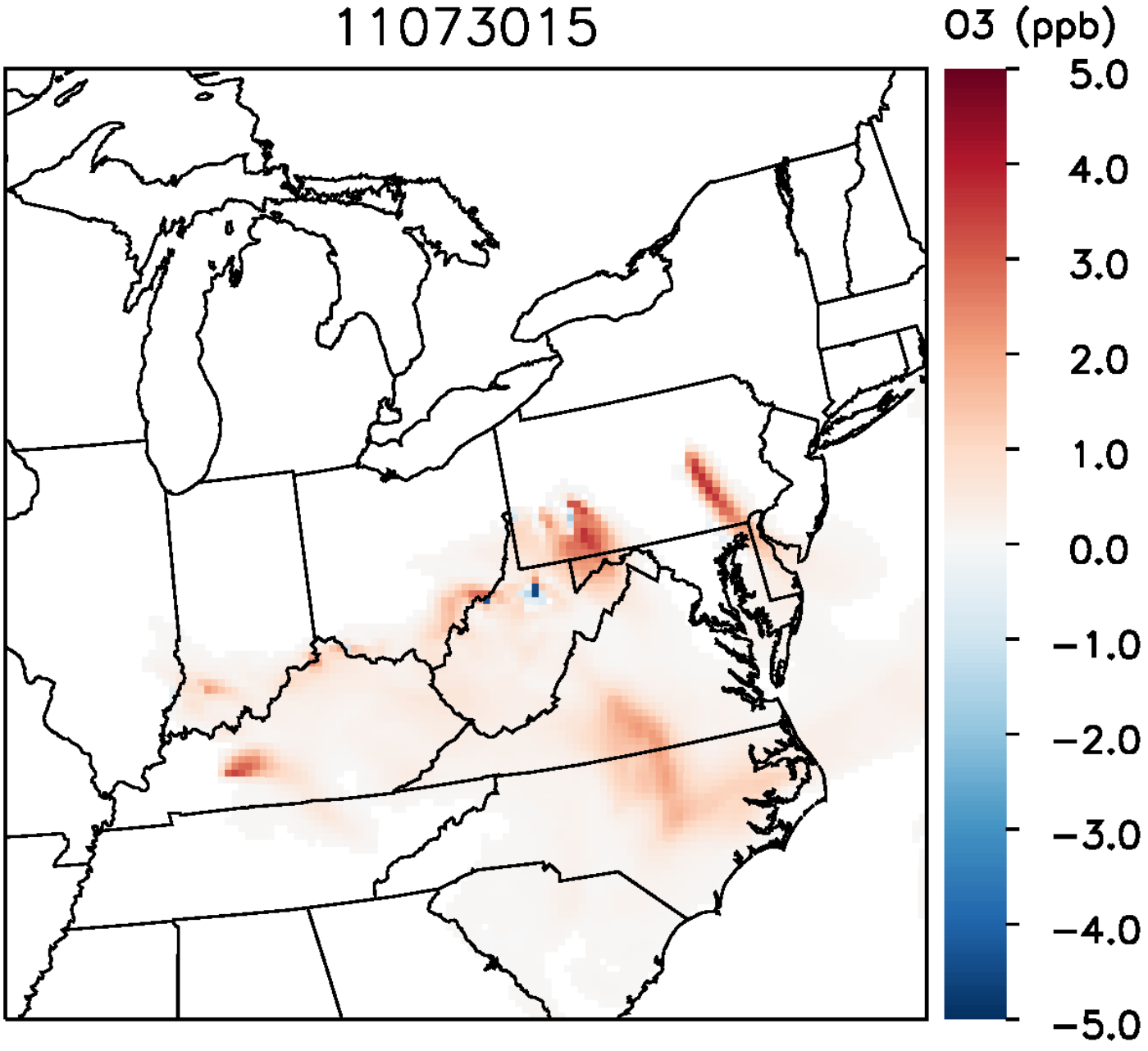
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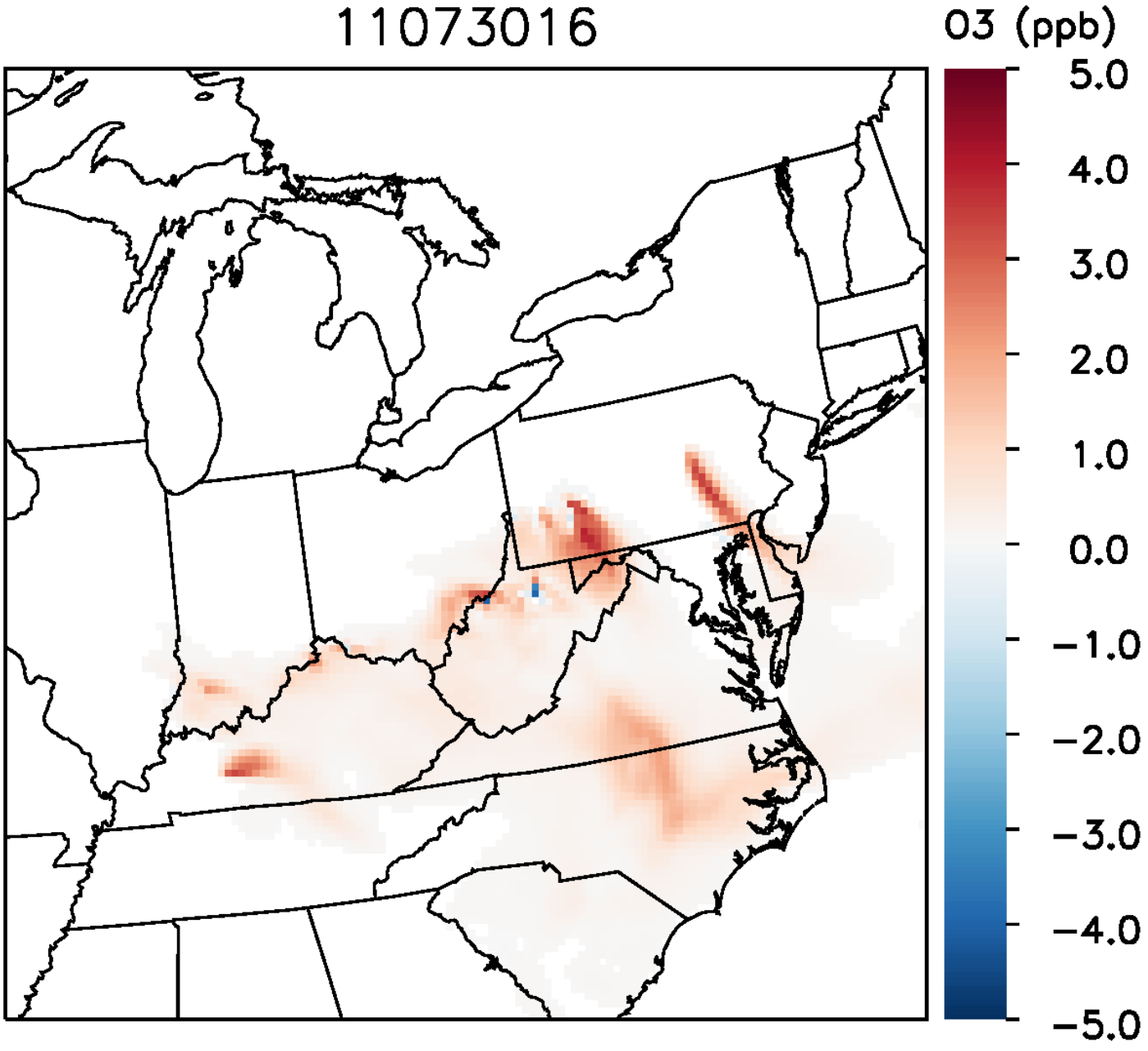
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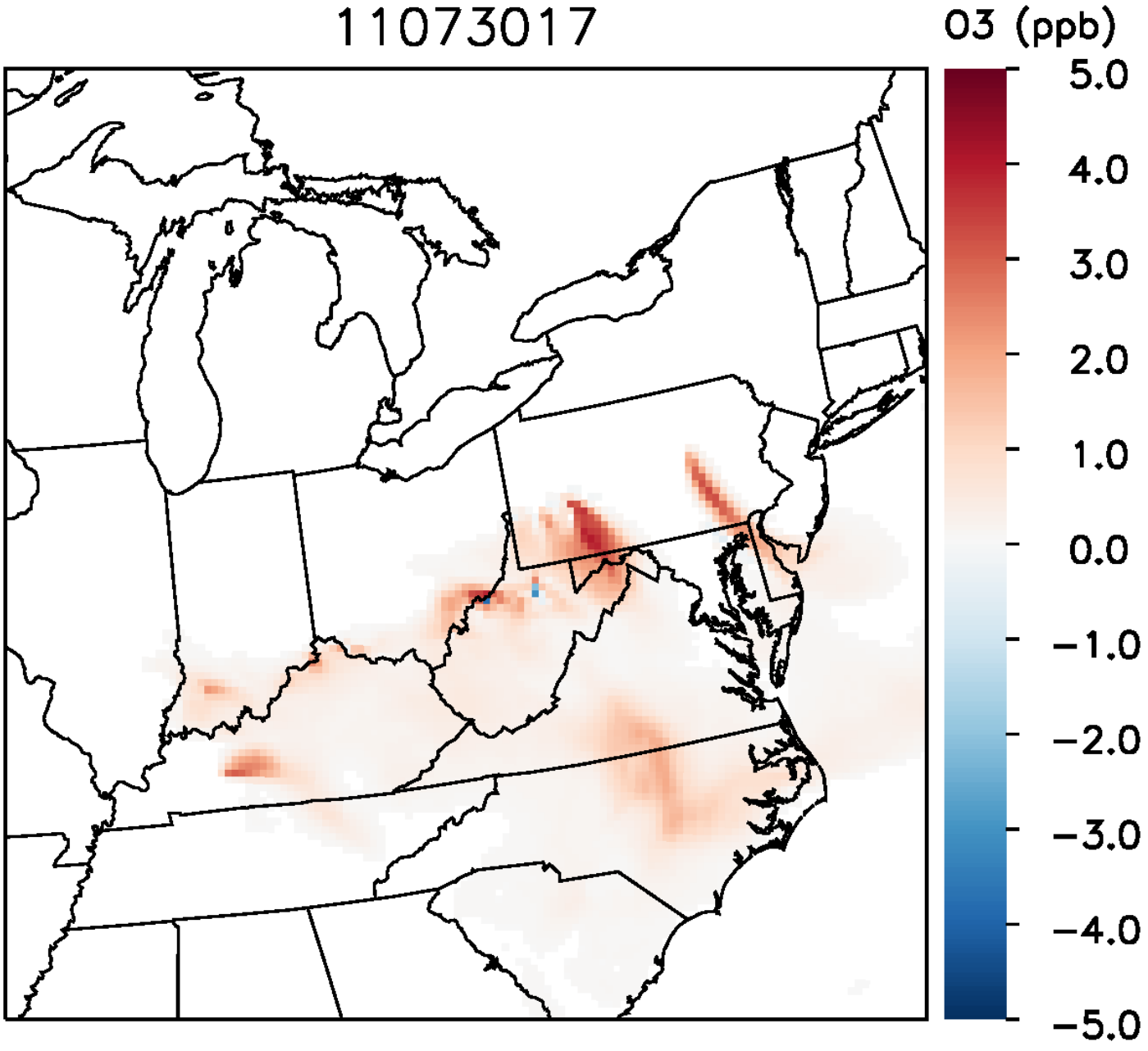
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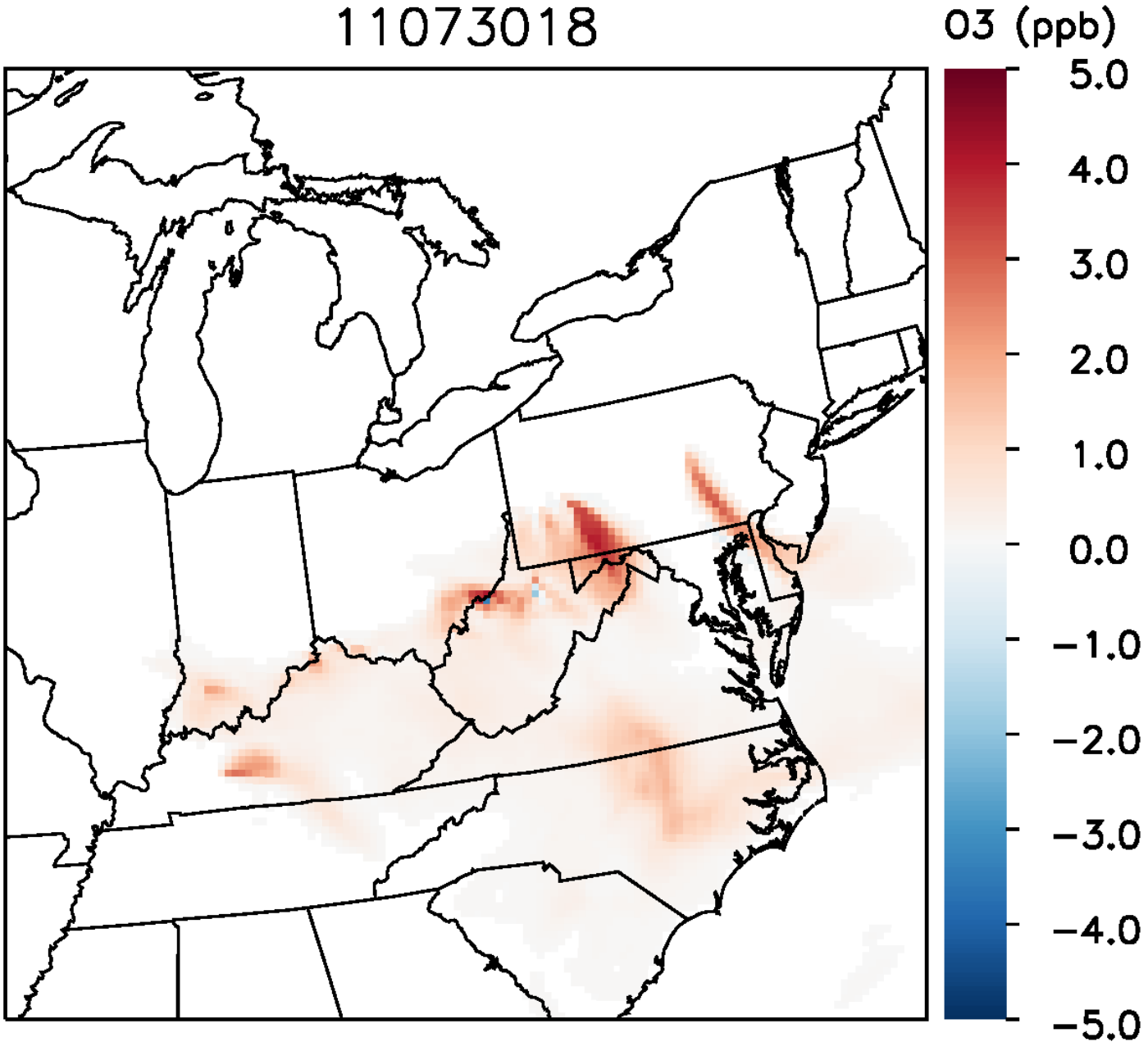
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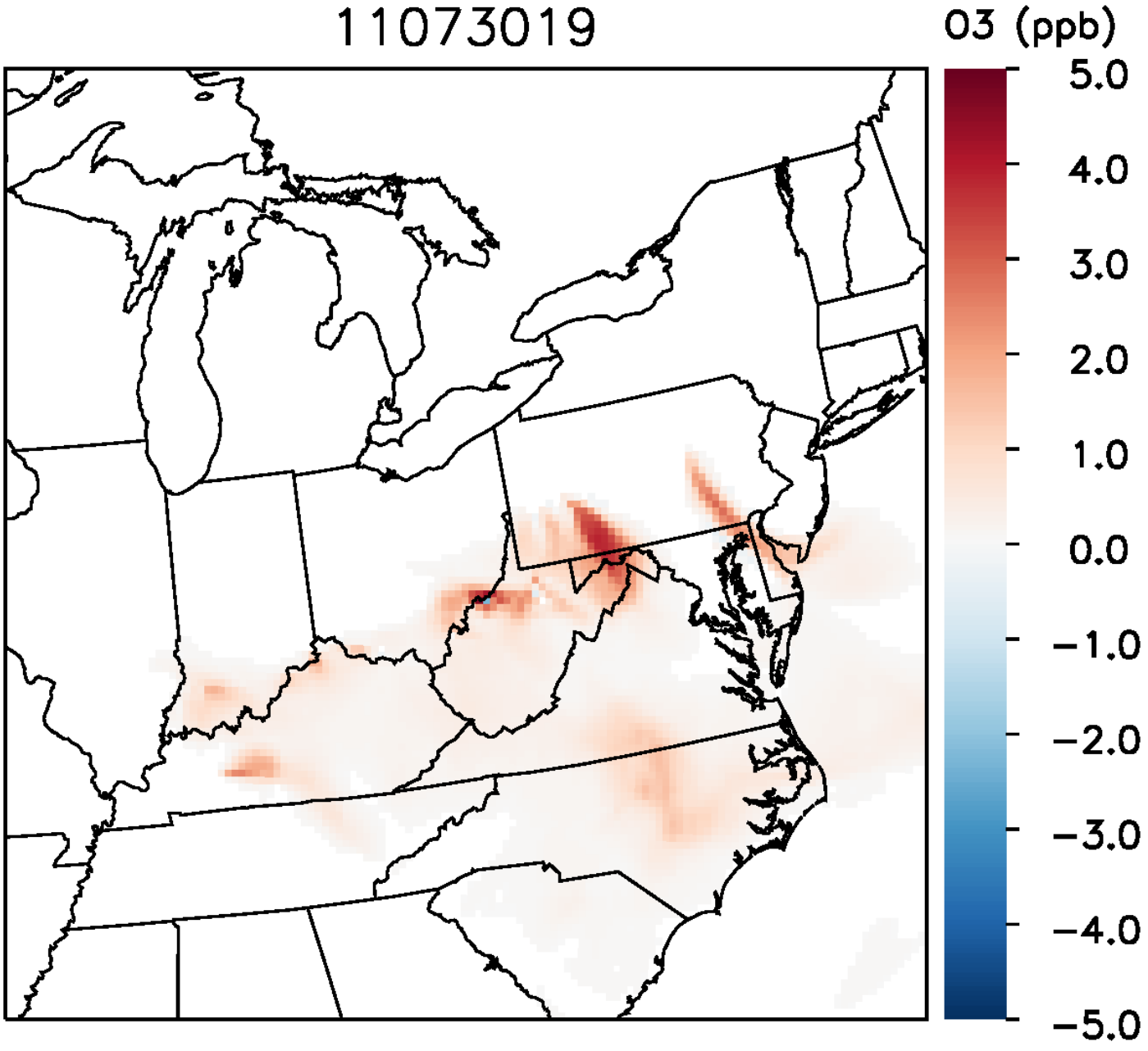
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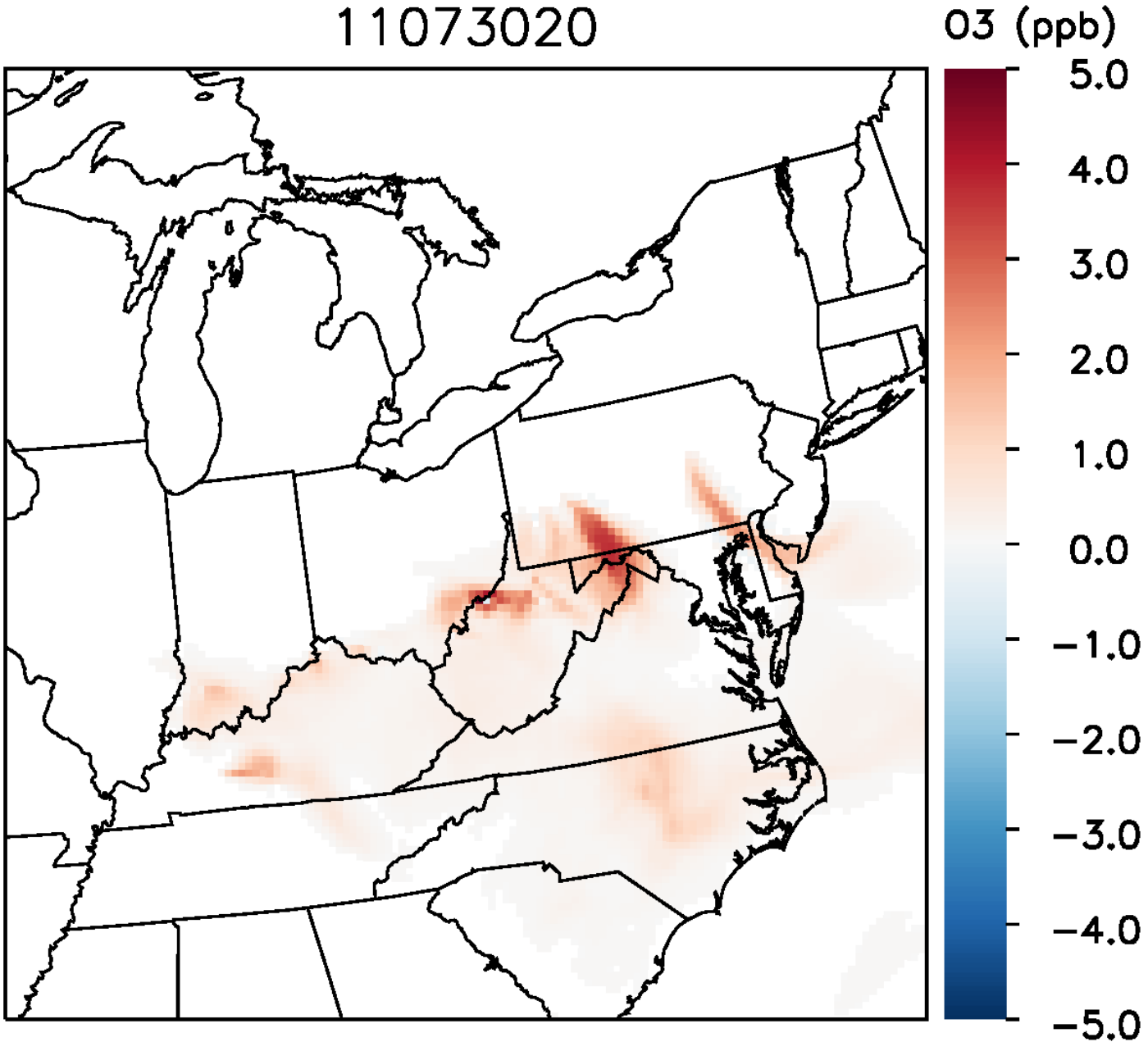
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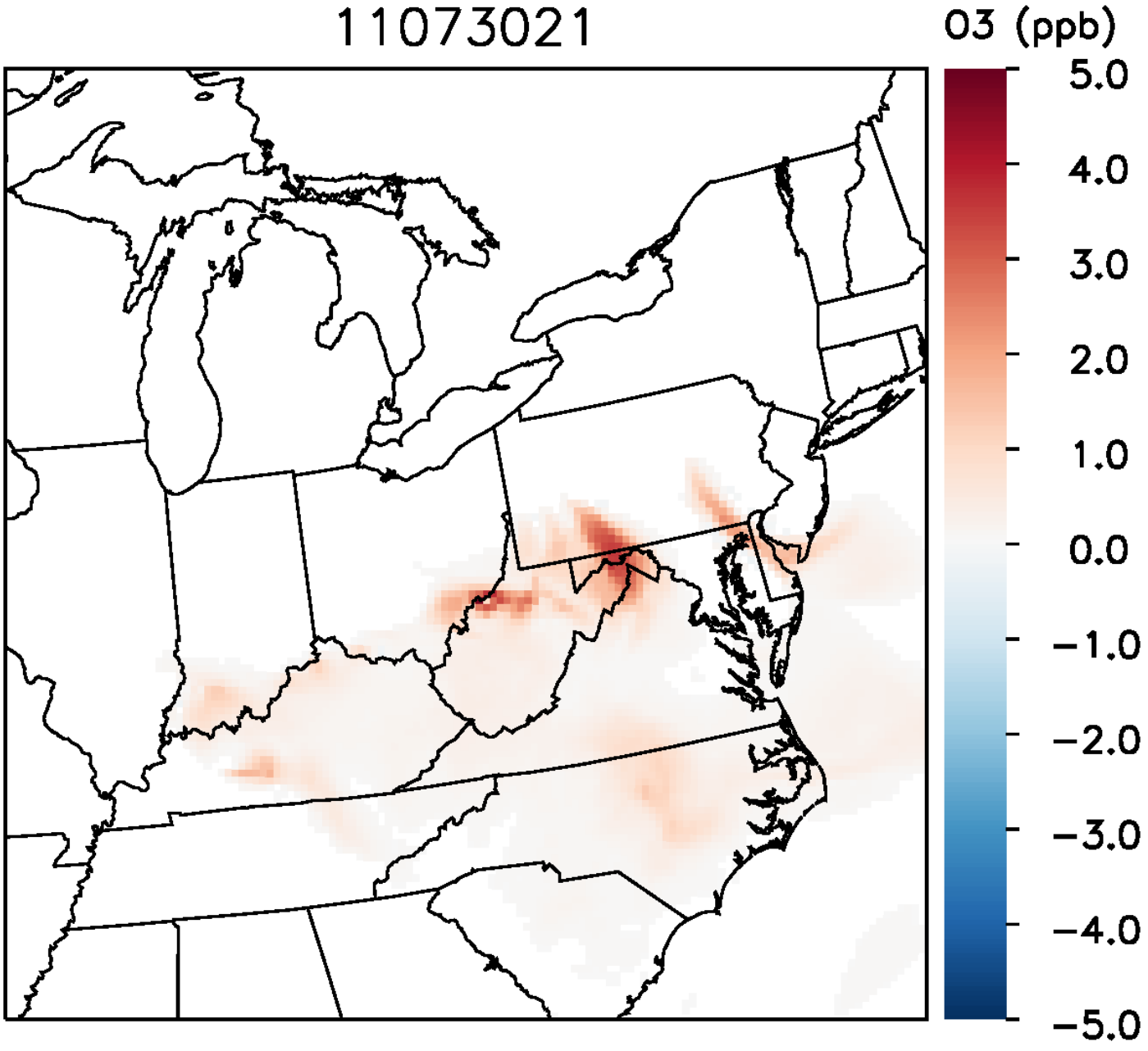
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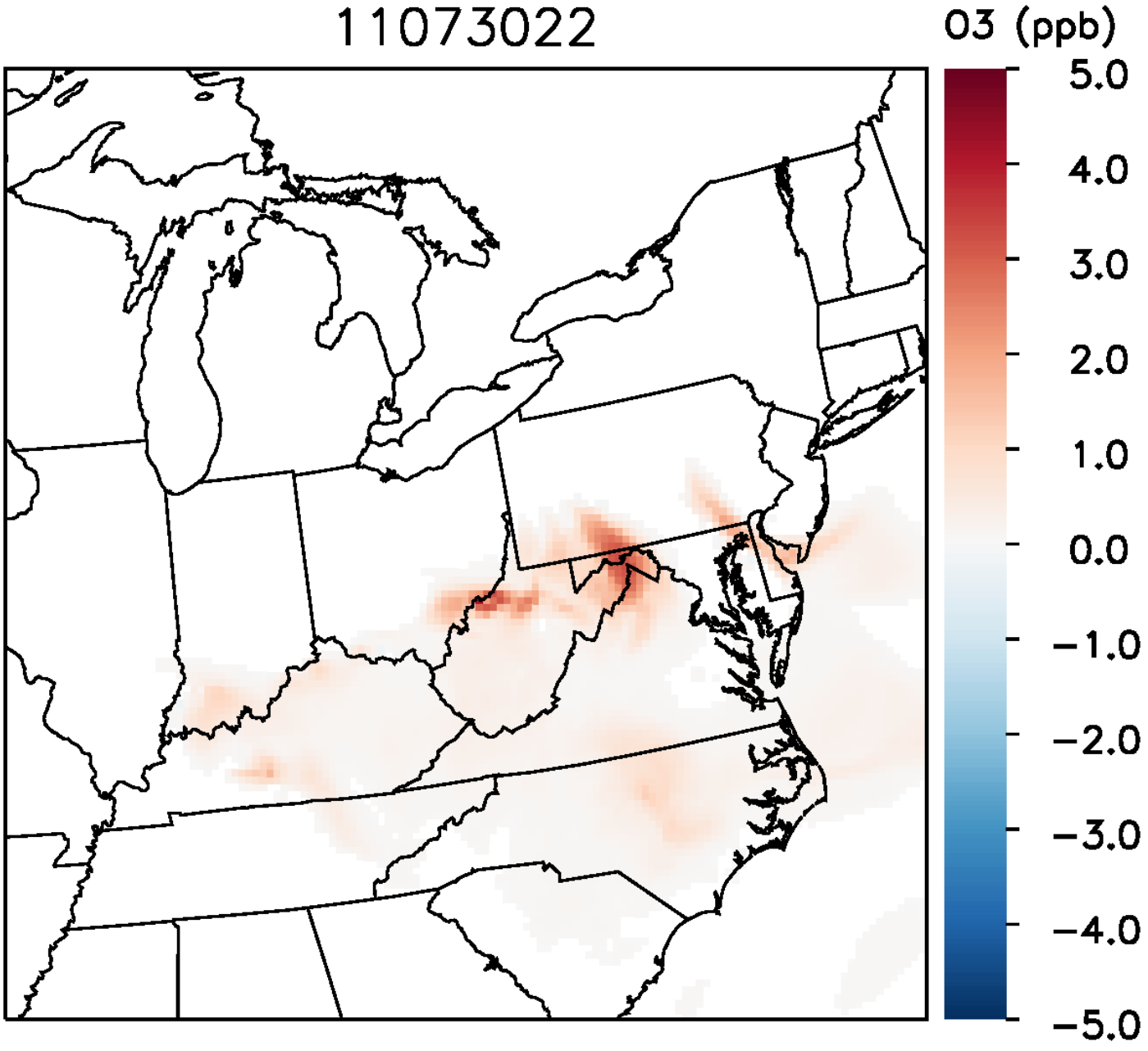
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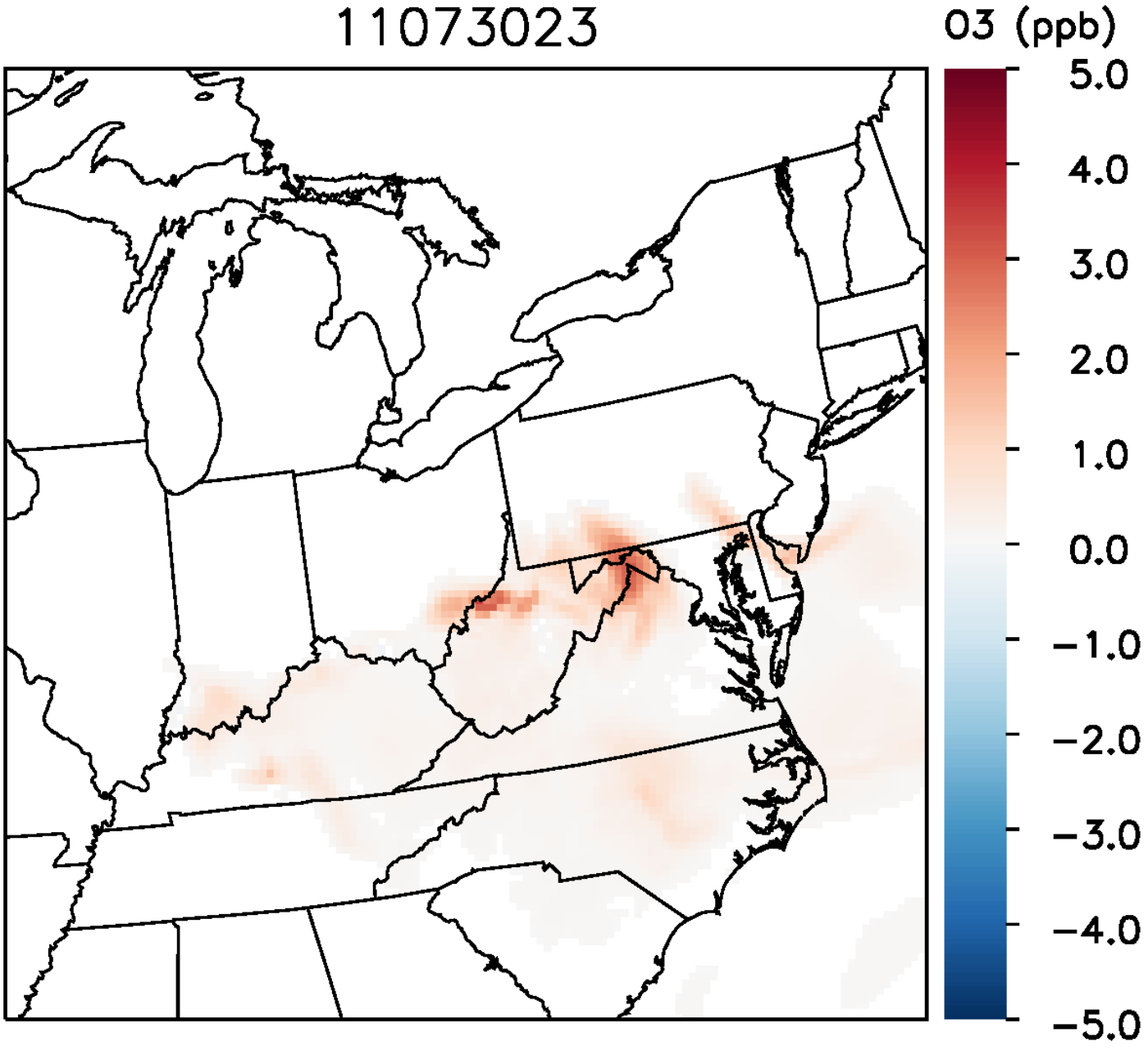
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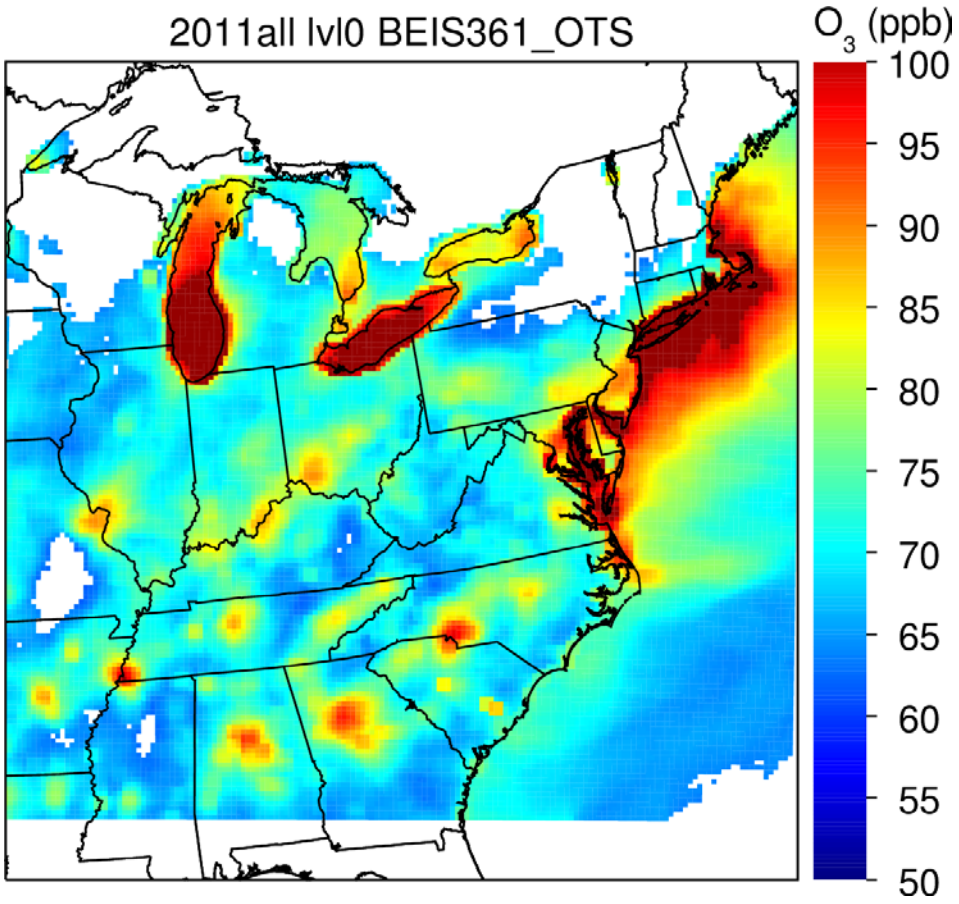
JJA 2011 Baseline CMAQ



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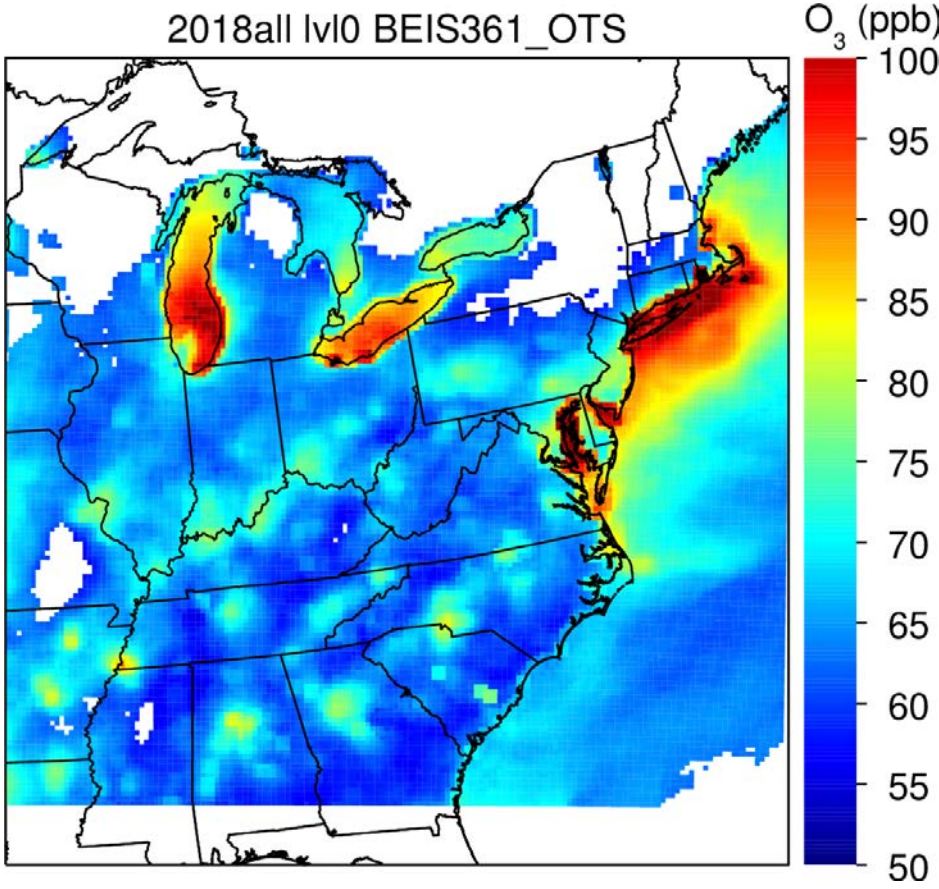
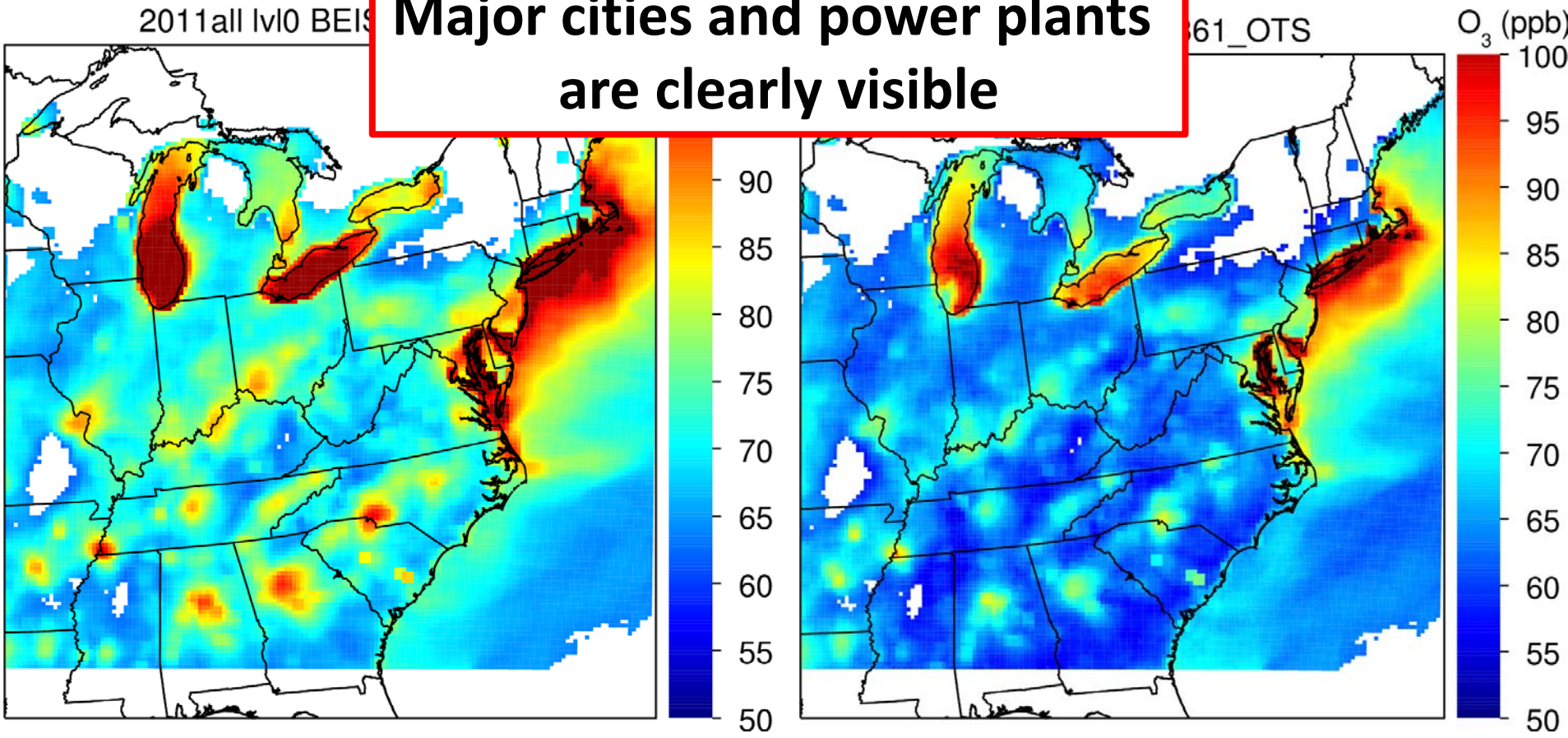


JJA 2011 Baseline CMAQ

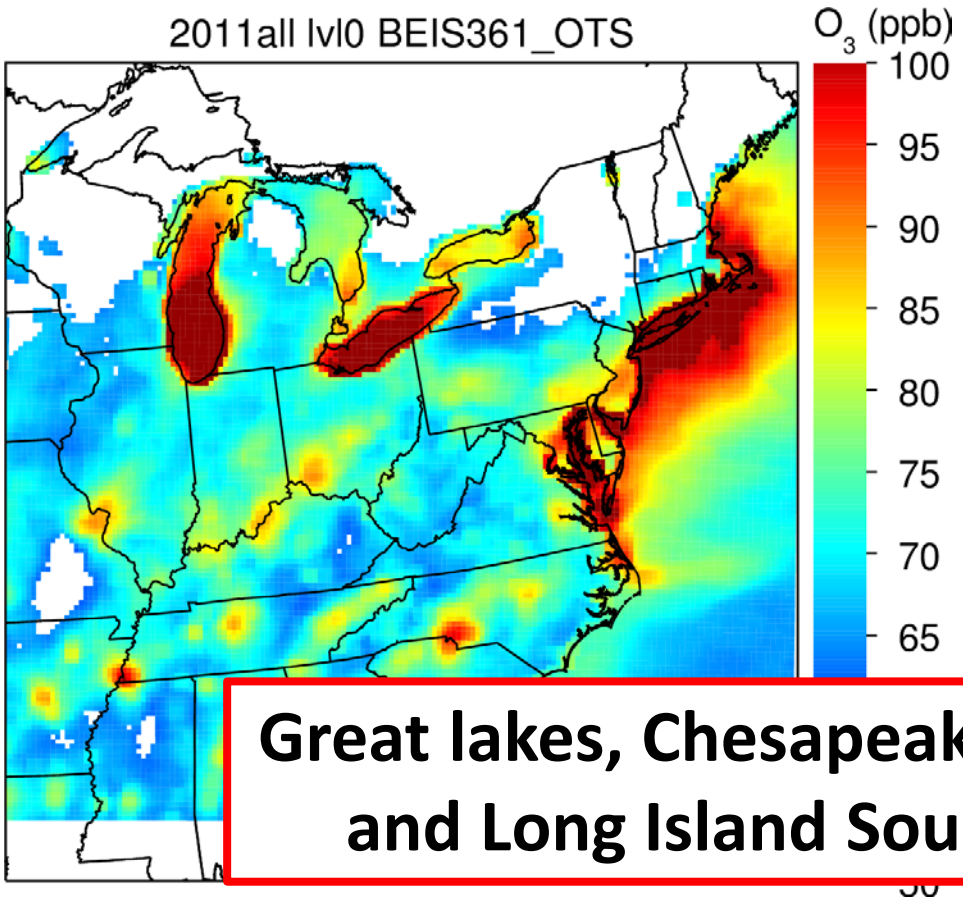
JJA 2018 Baseline CMAQ

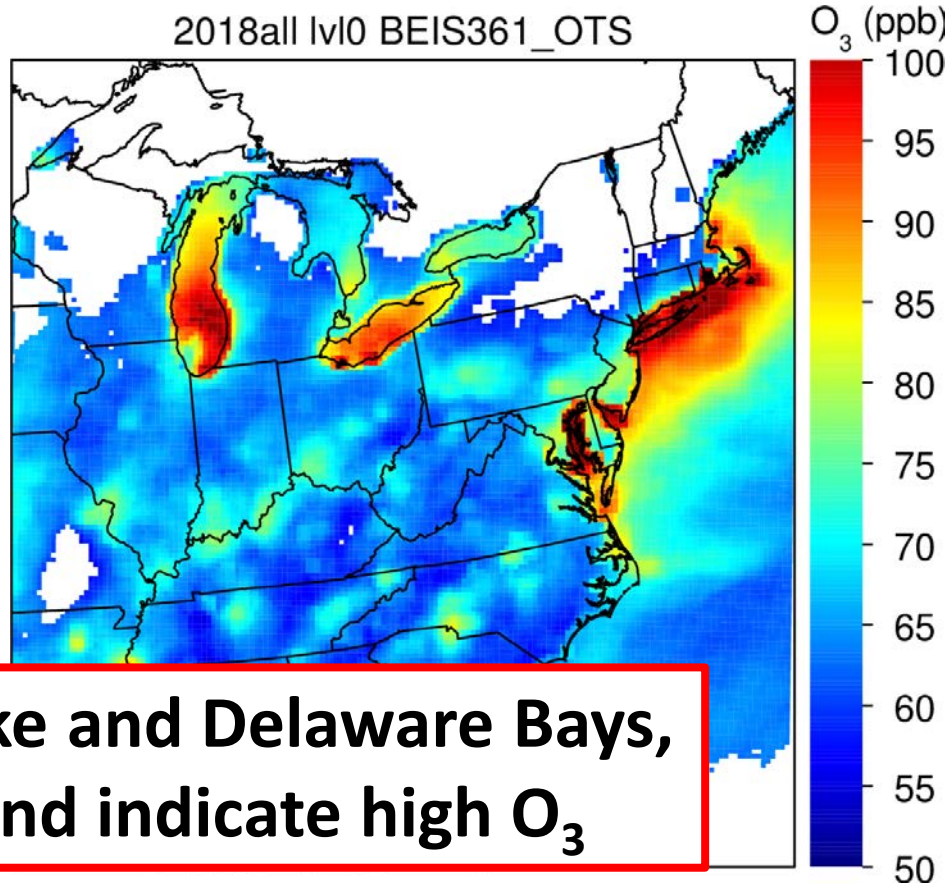
Major cities and power plants are clearly visible



JJA 2011 Baseline CMAQ

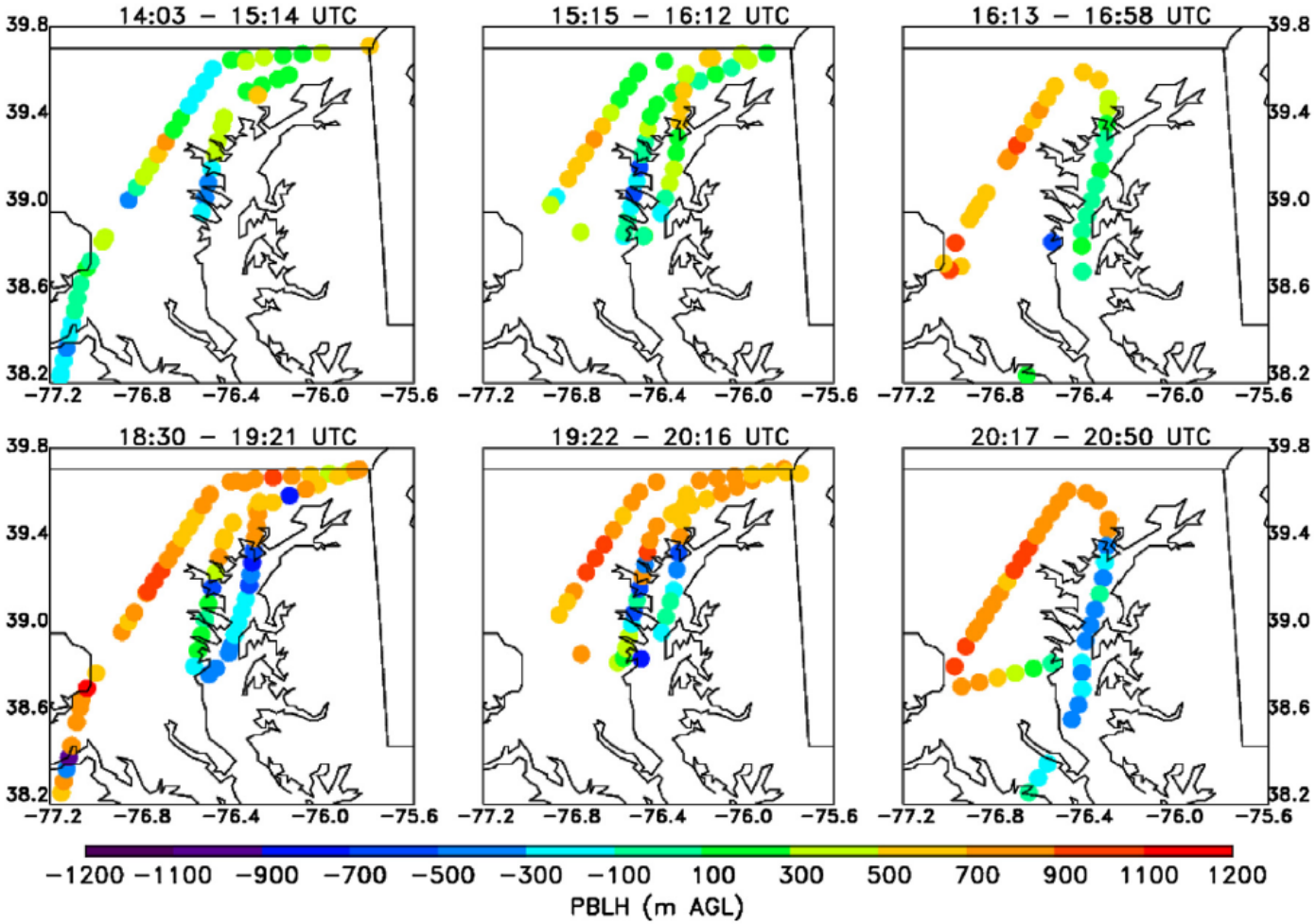
JJA 2018 Baseline CMAQ





Great lakes, Chesapeake and Delaware Bays, and Long Island Sound indicate high O_3

PBL Height over the Chesapeake Bay



Difference in PBL height (WRF minus aircraft obs.) for July 20, 2011

In morning, model PBL within 100m of observed

Afternoon PBL ~300-400 lower than observed over the Chesapeake Bay

Goldberg et al., *Atmospheric Environment*, 2014

Observations wishlist?

- Diurnal variations in boundary layer height under different meteorological conditions near different source types such as
  1. power plants
  2. roadways
  3. near shore
  4. regions of with large biological sources (“isoprene volcano” region of the Ozarks)
- Or at times of satellite overpass: OMI ~1:30pm
- Over well travelled waterways (Chesapeake, LIS)