NCAR | NATIONAL CENTER FOR ATMOSPHERIC RESEARCH

Role of Airborne Sampling

Understanding Cloud/Storm Effects on Atmospheric Composition

Addressing New Science Frontiers with Modeling and Satellites

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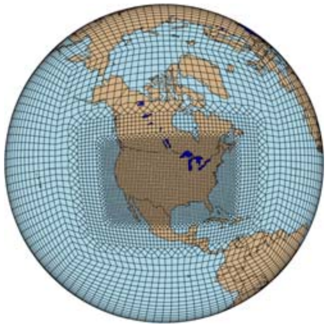
Example Modeling Grid Meshes with Regional Refinement



GOES East Geocolor Image

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Cloud and Chemistry Studies Benefit from Aircraft Measurements

Role of aircraft measurements

1) Sampling in regions where remote sensing and ground measurements cannot
2) Sampling a wide variety of trace gases and aerosols
3) Sampling local to regional to intercontinental scales
4) Complementing and bridging scales for frontier science in atmospheric chemistry

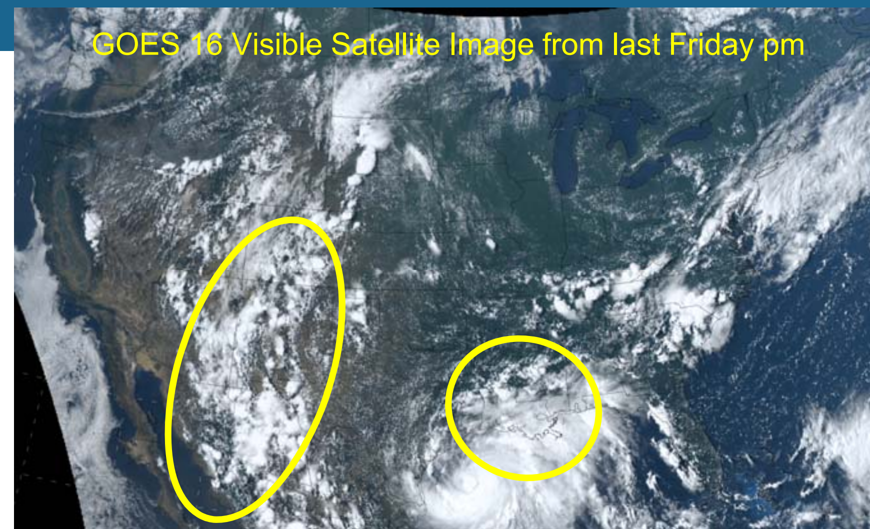
- Aircraft with an extensive payload that can fly from near the surface to the tropopause and long distances downwind of phenomenon

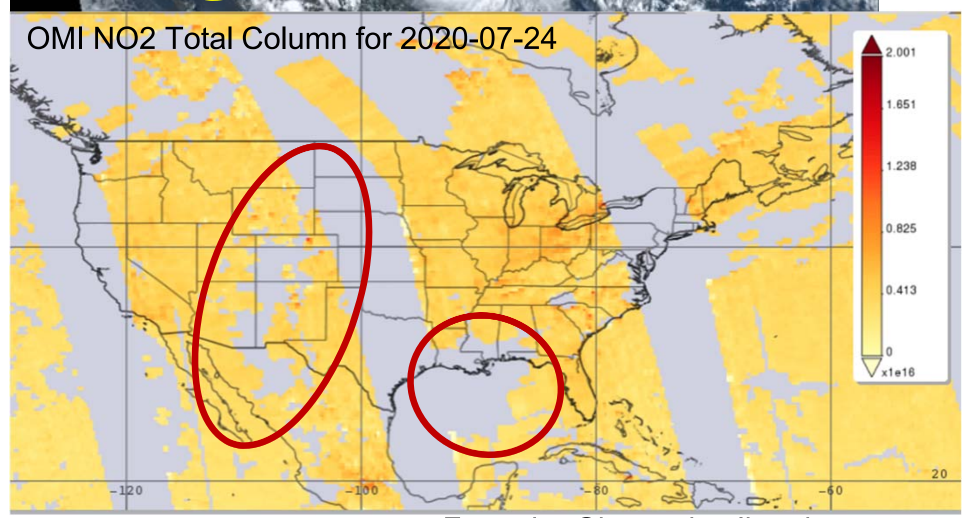
1) Aircraft measurements provide information in regions where remote sensing cannot sample

- Satellites generally cannot see chemical composition in or below clouds

Need for aircraft that can

- ➢ Probe regions in and near clouds
- ➢ Map vertical structure iq|lqj#iurp#qhdu# vxuidfh#wr#orzhu#vwudwrvskhuh

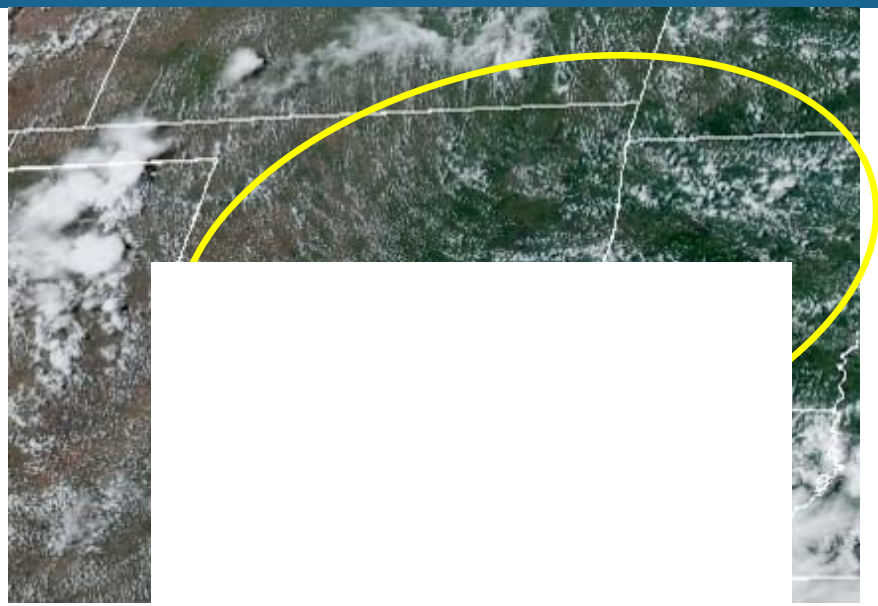


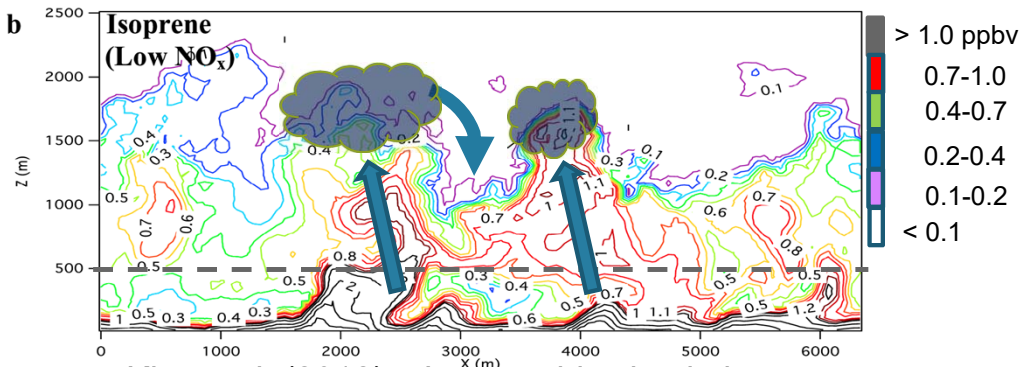


From the Giovanni online data system

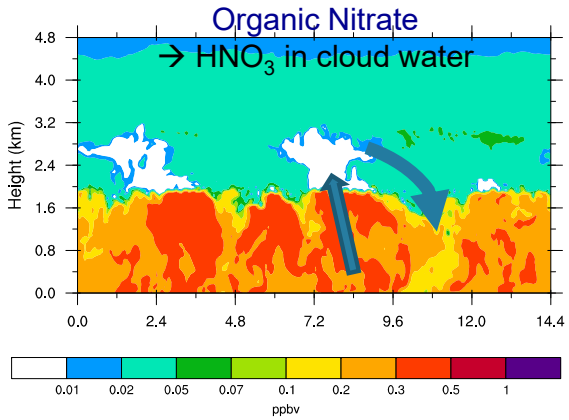
1) Aircraft measurements provide information in regions where ground measurements cannot sample

- Surface concentrations do not necessarily represent concentrations at top of PBL
- ➢ Aircraft are needed to map out the vertical & horizontal structure of the PBL
- ➢ Need for high-frequency sampling of constituents



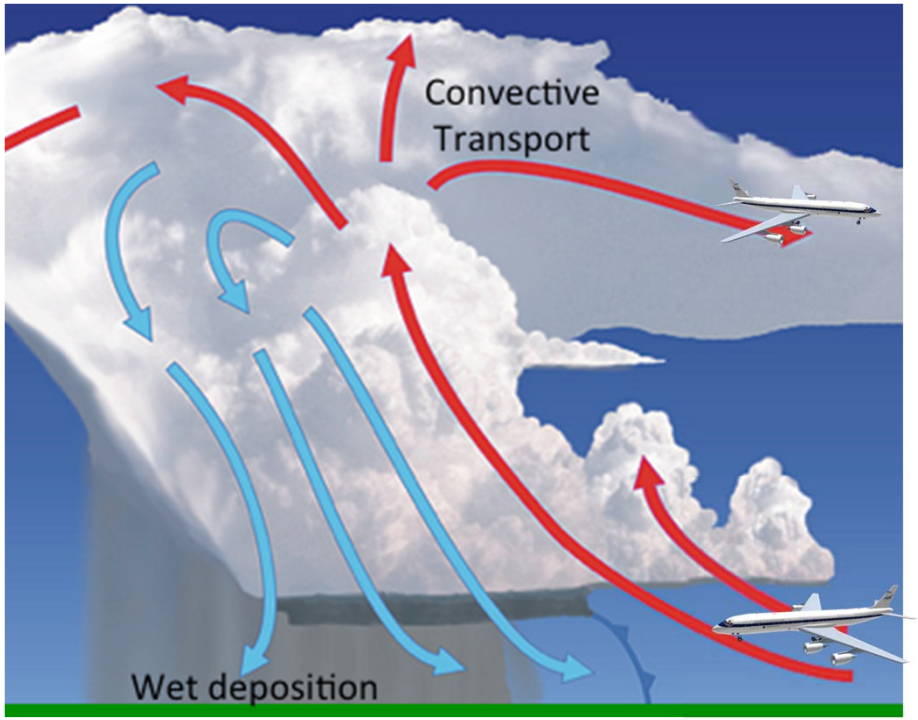


Kim et al. (2012) – Large-eddy simulations



2) Wide variety of trace gases and aerosols need to be measured

Deep Convective Clouds and Chemistry (DC3) Design



Schematic from NWS Jetstream online school
https://www.weather.gov/jetstream/tstrmtypes

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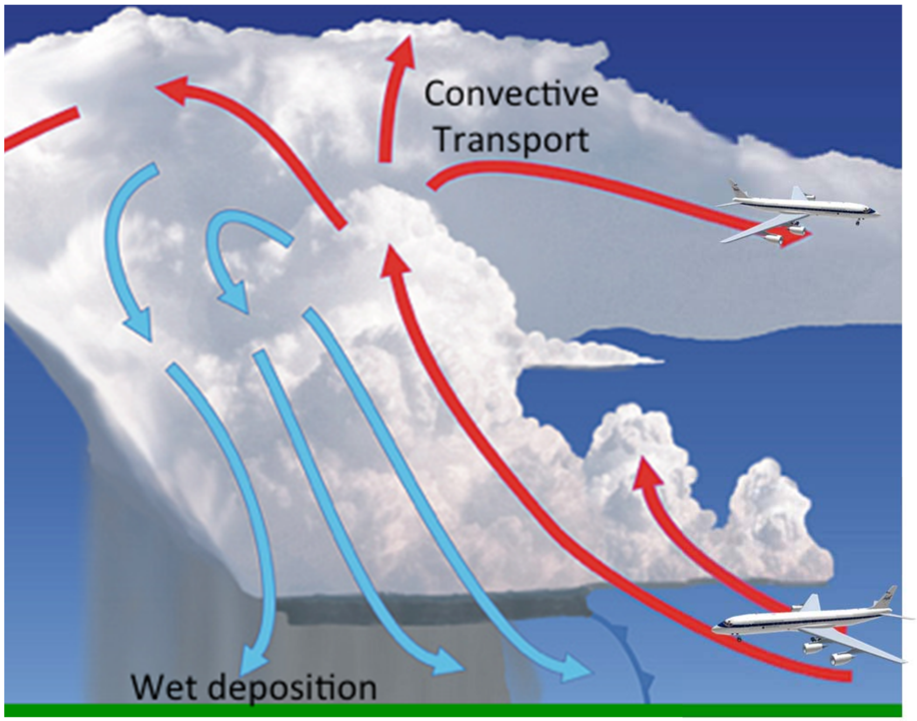
- ➢ Q hhg#iru#klj k#uhtxhqf|#vdp sdqj#wr#vhh# vp doovfddn#skhqrp hqrq

3) Aircraft measurements are needed on a wide range of scales

Deep Convective Clouds and Chemistry (DC3) Design



Schematic from NWS Jetstream online school
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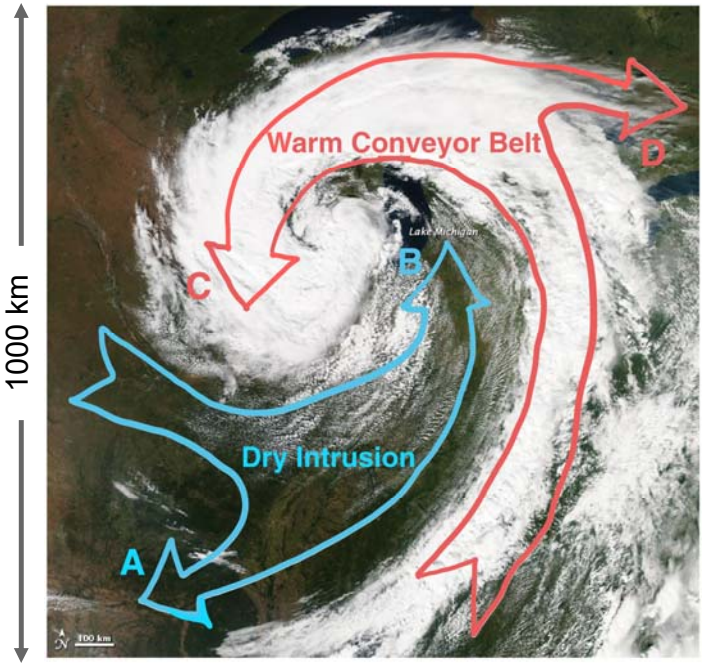
On the local scale:

- Dlufudiw#fdsdeoh#ri#io|lqj#iurp#qhdu# vxuidfh#wr#orzhu#vwudwrvskhuh
- Dlufudiw/#lqohw/#dqg#lqvwuxphqw# fdsdeoh#ri#io|lqj#lq#forxgv
- Ghvluh#wr#froohfw#forxg#sduwlfohv#iru# dqdo|vlv#ri#frpsrvlwlrq#

In deep convection:

- Qhhg#iru#d#uxjjhg#dlufudiw#wr#sureh# lq2qhdu#wkh#vwrup#fruh#

3) Aircraft measurements are needed on a wide range of scales



Jaegle et al. (2017)

On the long-range scale:

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- Dlufudiw#fdsdedn#ri#d|bj#4333v#hp #grz qz bg#ri# skhqrp hqrq
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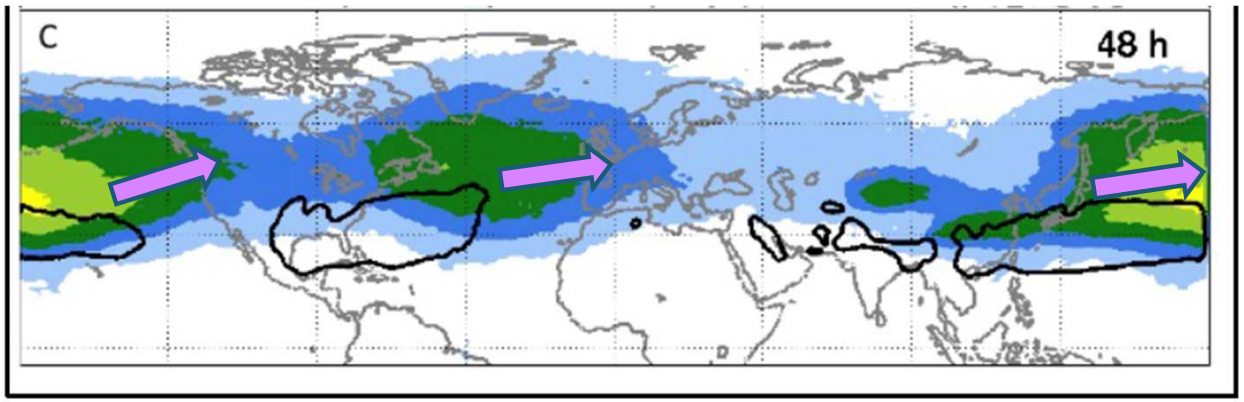
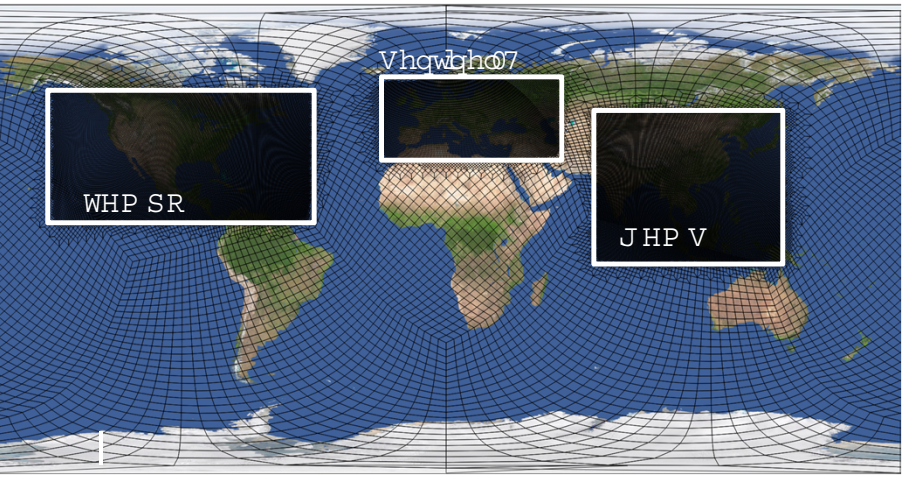
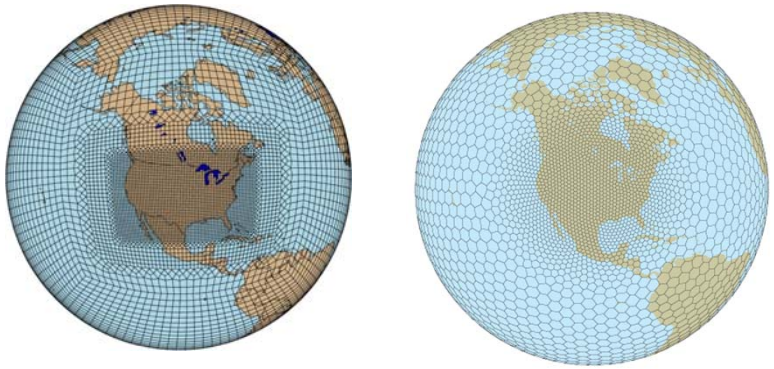


From Madonna (2013) – Location of WCB air parcels pathways 48 hr after uplift

4) Aircraft measurements will provide essential information to bridge multiple scales





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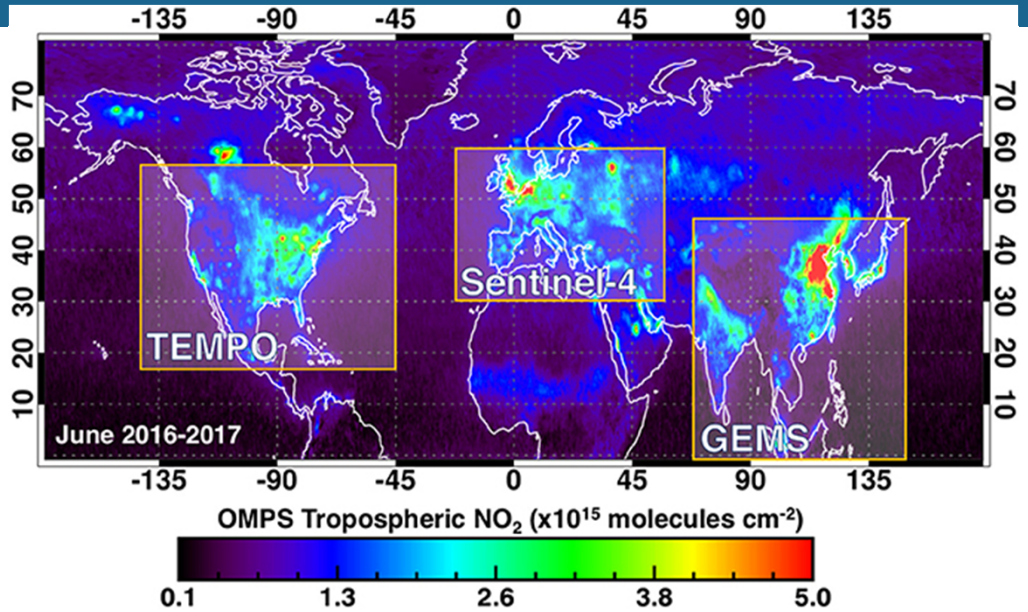

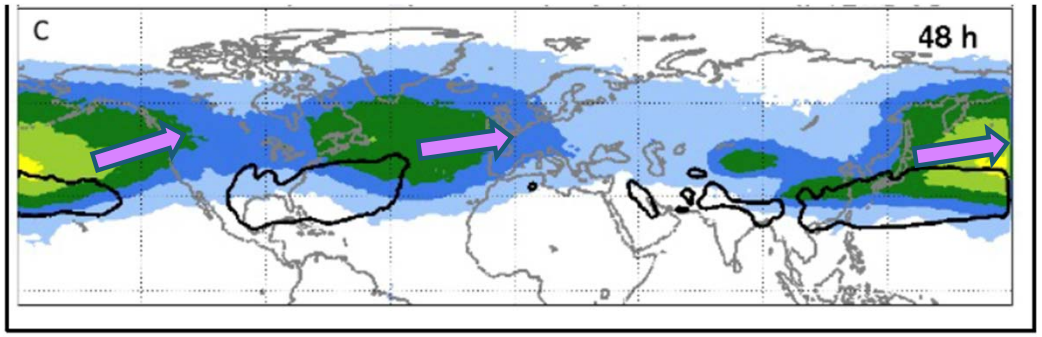

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Some frontier science combining refined grid mesh modeling, airborne research, and satellites

- Vxe0vhdvrqdo#wr#vhdvrqdo#lu#txdolw|#suhglfwlrq
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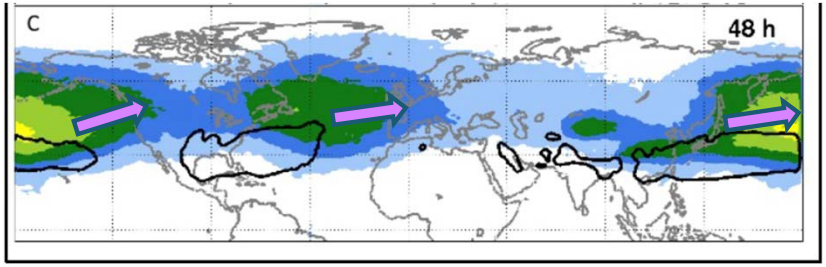

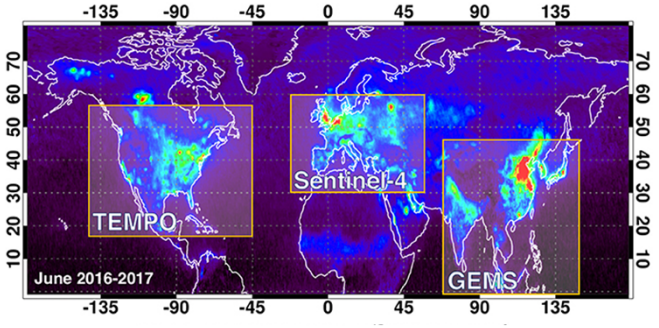

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