

Feature Tracking Process Analysis

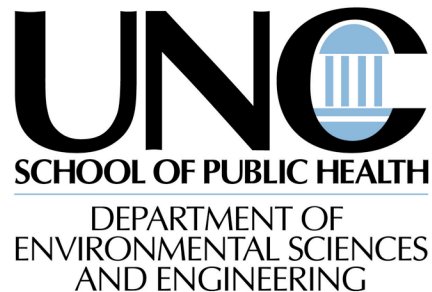
Barron Henderson, William Vizuite, and Harvey Jeffries

5th Annual CMAS Conference

Friday Center

October 16-18, 2006

<http://ftpzone.sph.unc.edu>



Outline

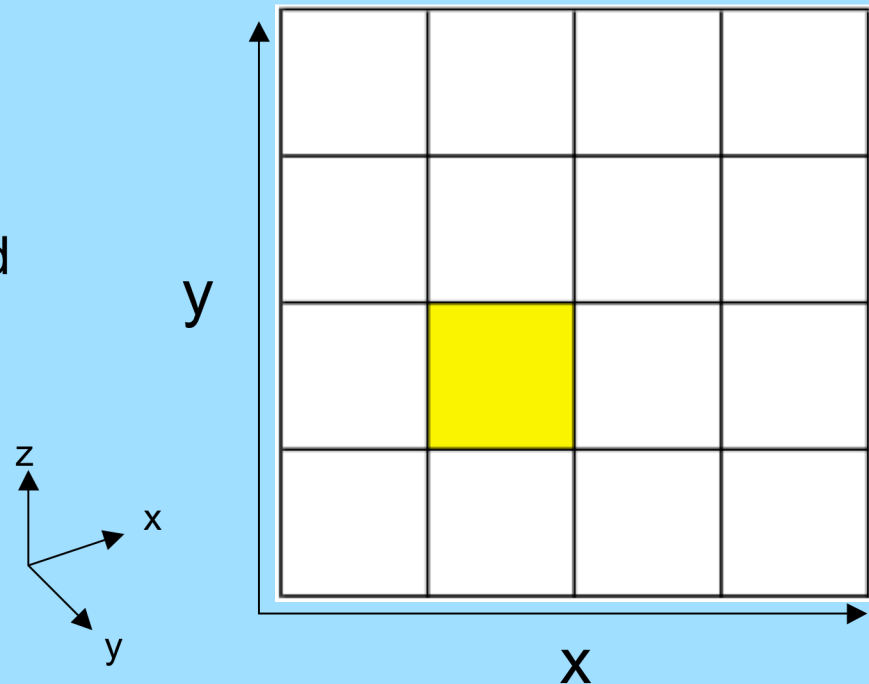
- **History and Functionality**
- Recent Enhancements
- Potential Applications

Photochemical Grid Models: Explaining the Unexplainable

- As Oreskes (1994) and later Beck (2002) have demonstrated, atmospheric models are “open systems” that have “essentially unknowable” inputs
- Can have a wide variety of inputs
 - Generated by different groups
 - Minimum level of detail
 - Come from models with their own uncertainty
- Easily suffer from compensating errors
 - Getting the ‘right answer’ for the ‘wrong reasons’
- Model Performance Evaluations
- Process Analysis

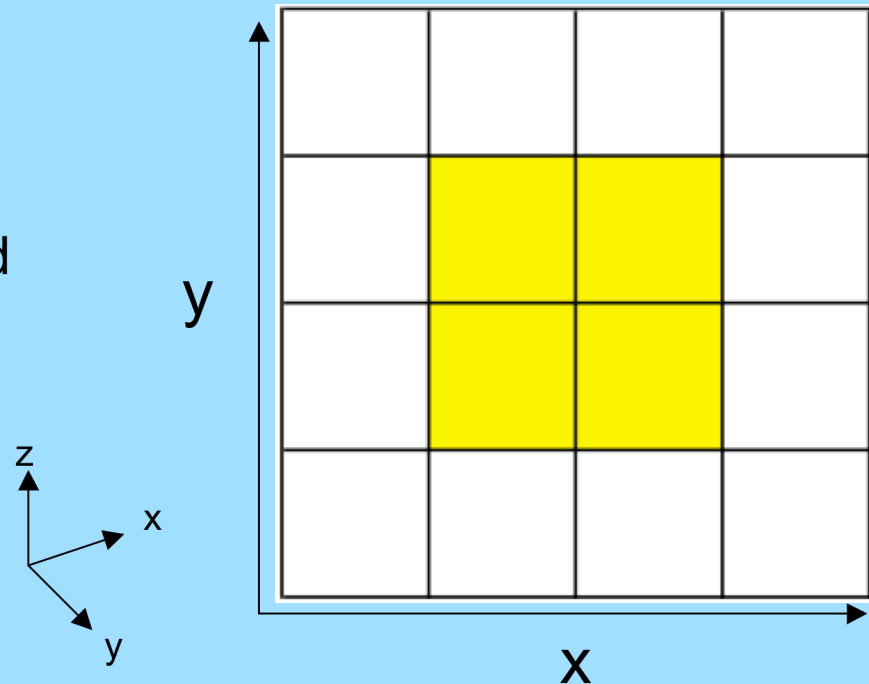
Process Analysis Quantifies Model Processes

- 1994 - Jeffries, H. E., and Shawn Tonnesen. A Comparison of two Photochemical Reaction Mechanisms Using Mass Balance and Process Analysis. *Atmospheric Environment* 28 (18):2991-3003.
- In model algorithm:
 - Process Rates
 - Reaction Rates
 - Time-Step Averaged
- Post Processor
 - Extraction
 - Aggregation



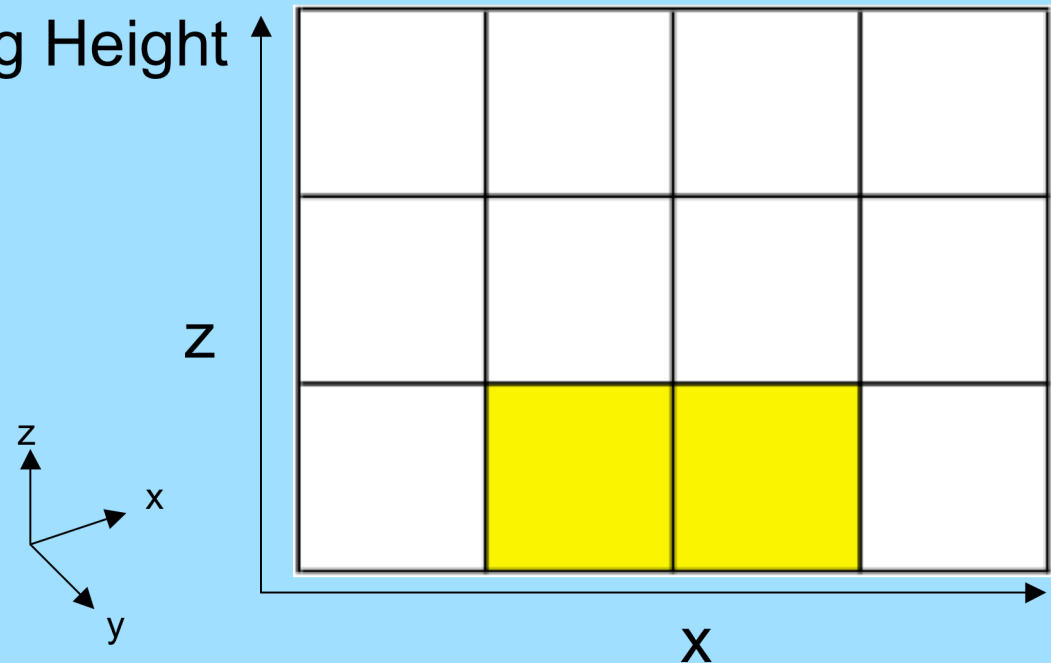
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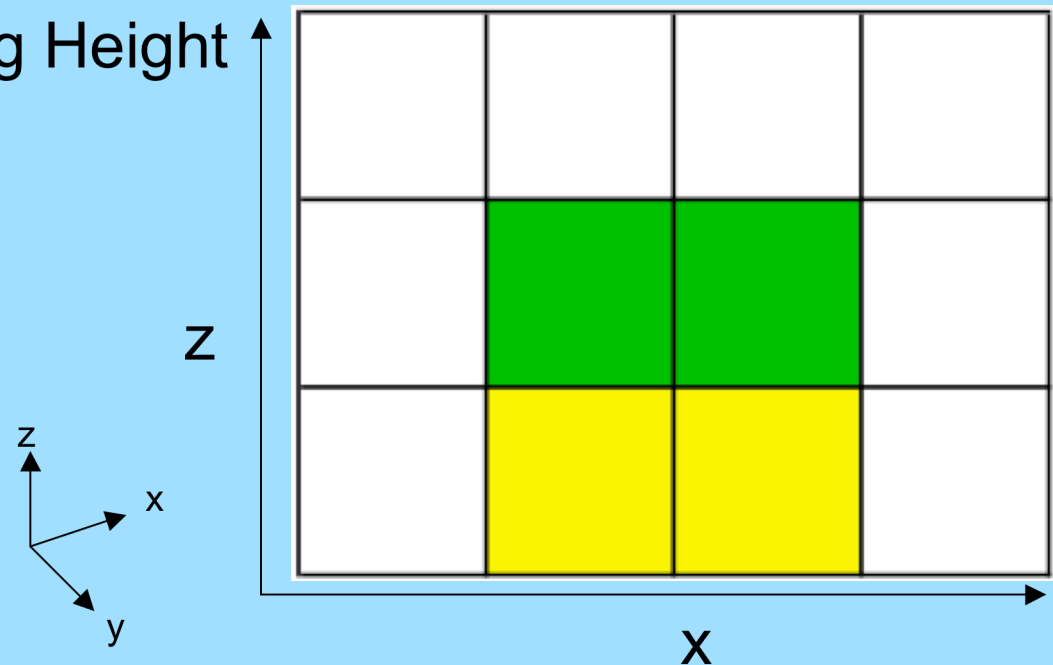
UT/UNC Collaboration Adds Variable Mixing Height

- 2005 - Vizuite, William. Implementation of Process Analysis in a Three-Dimensional Air Quality Model, Chemical Engineering, University of Texas - Austin, Austin.
 - Time Variable Mixing Height
 - Convex Shapes



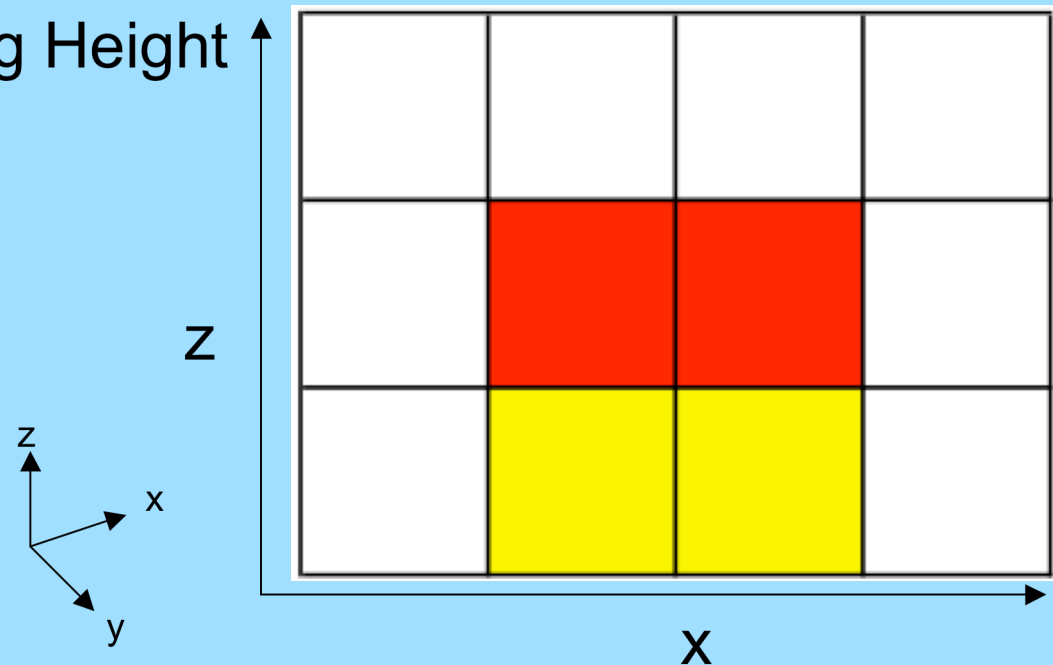
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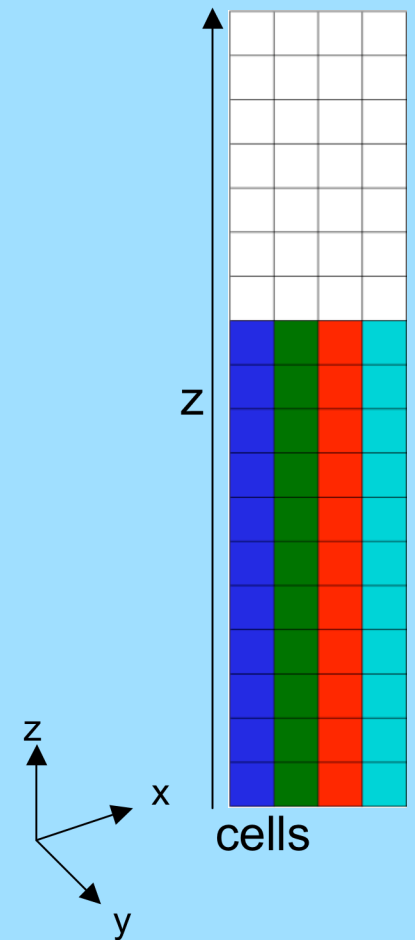
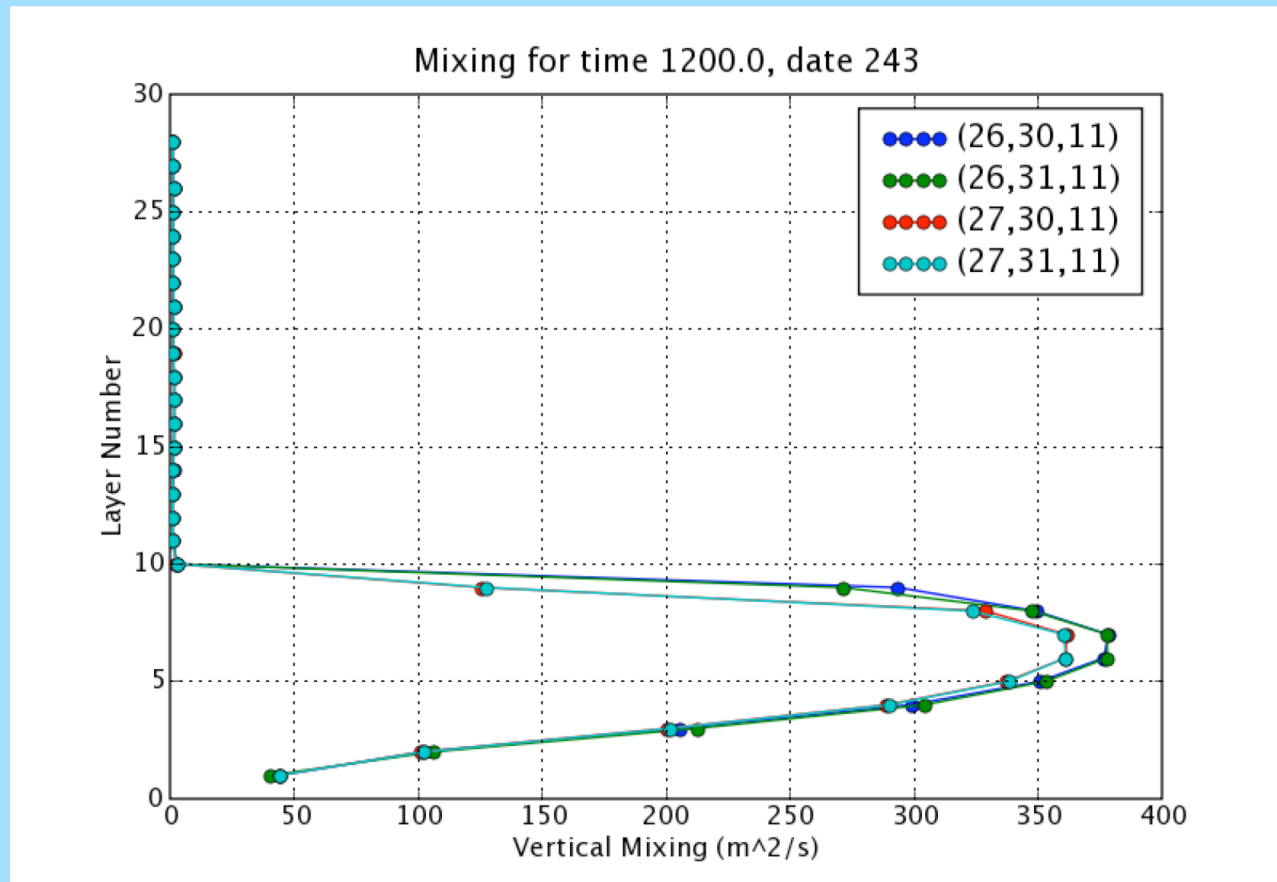
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- History and Functionality
- **Recent Enhancements**
- Potential Applications

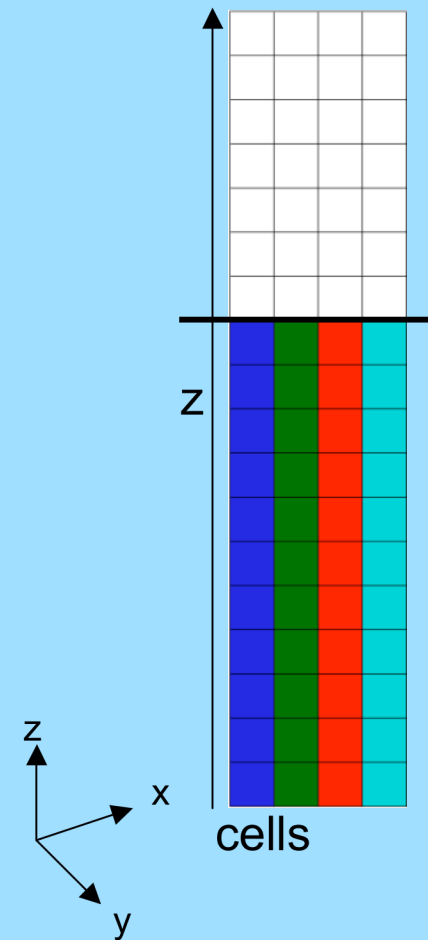
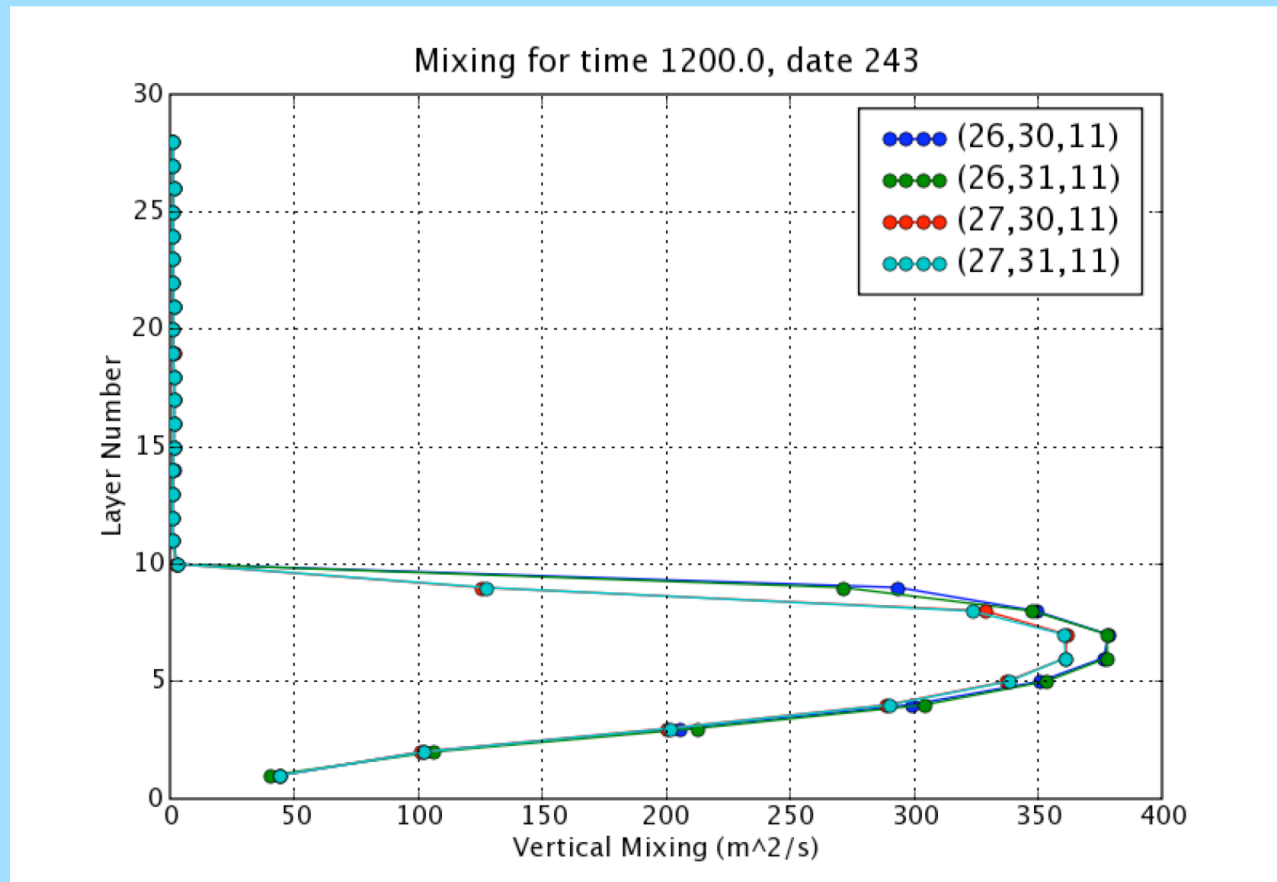
Enhancement 1: Converted Process Analysis to Python

- Python Based Process Analysis
 - Urban Airshed Model (UAM) File Interfaces
 - Spatial Aggregation
 - Entrain and Detrainment
- Increased Volume Shape Flexibility
- Automated Mixing Height Identification

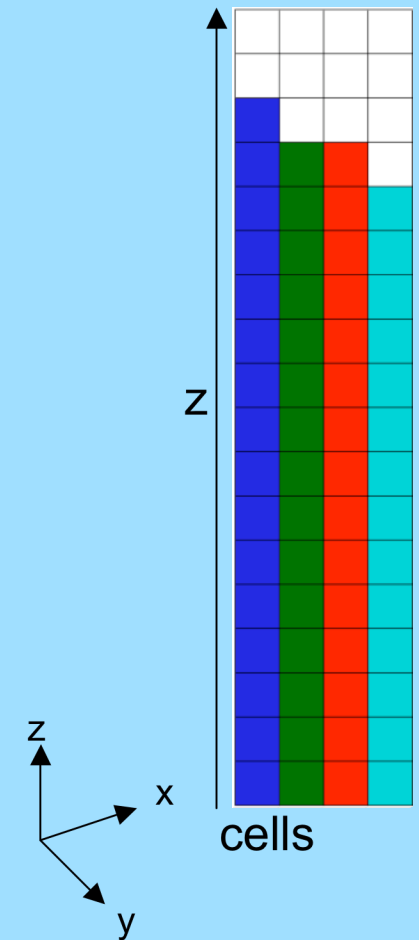
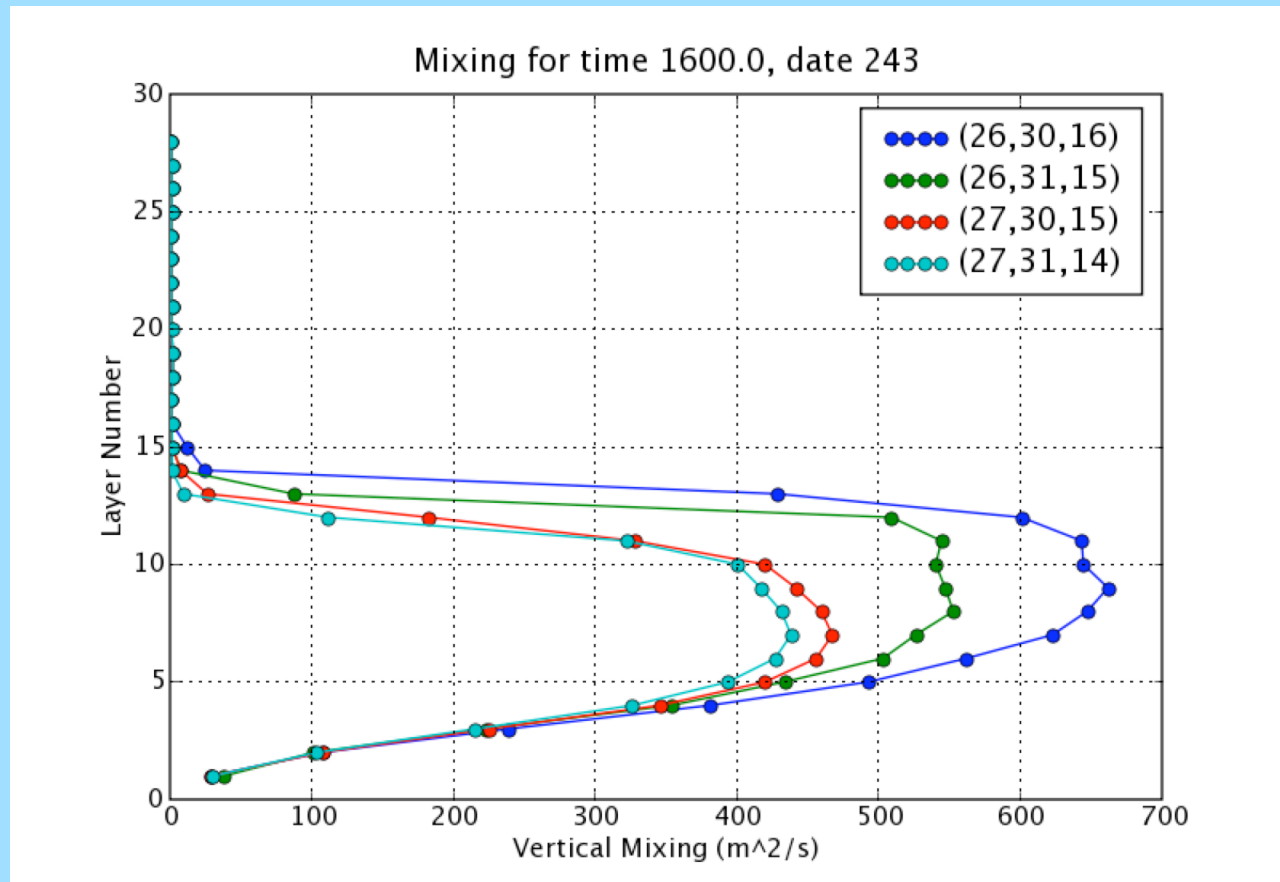
Enhancement 2: Allow for Spatially Variable Mixing Height



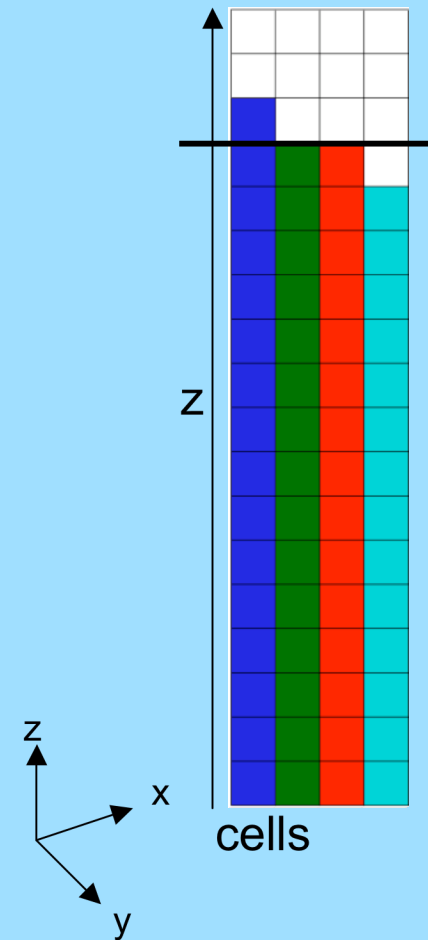
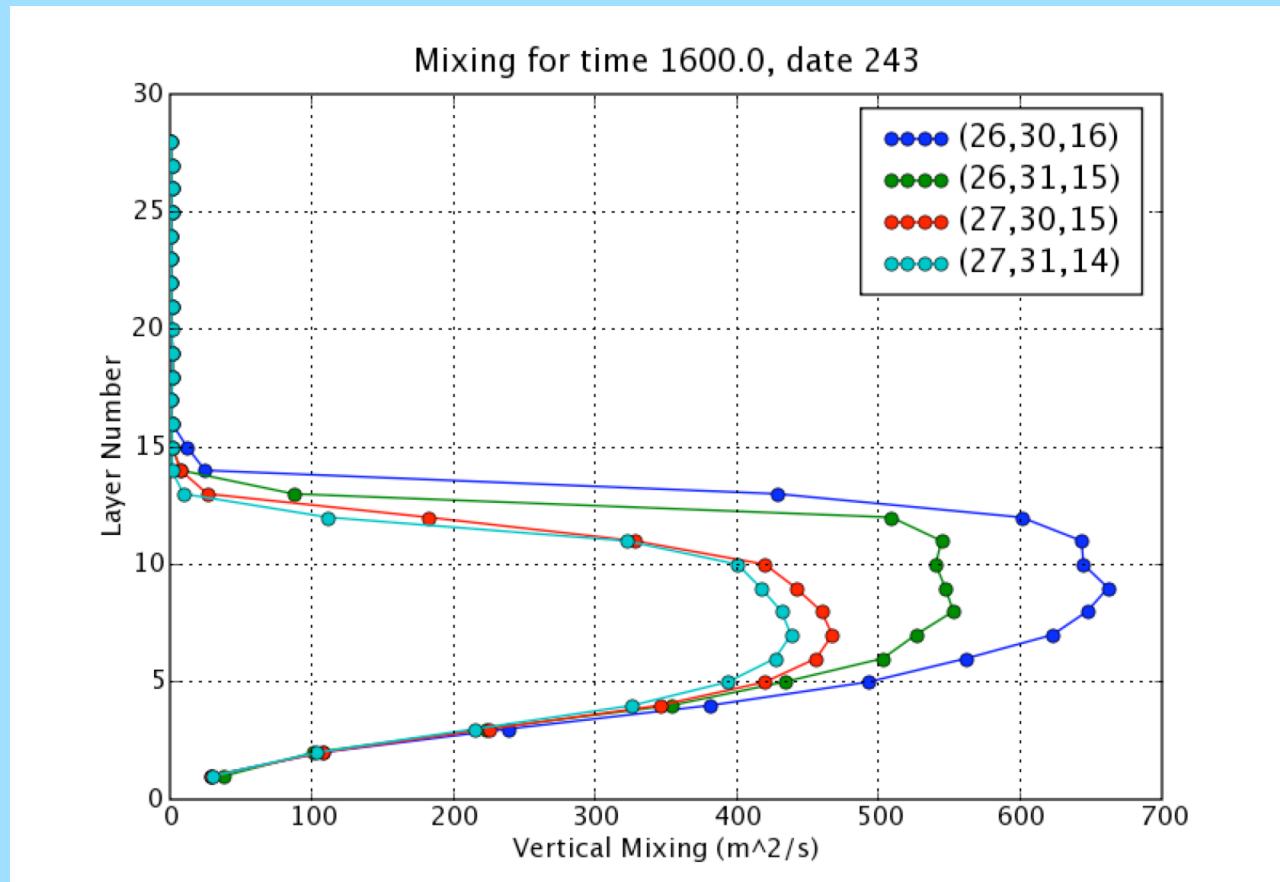
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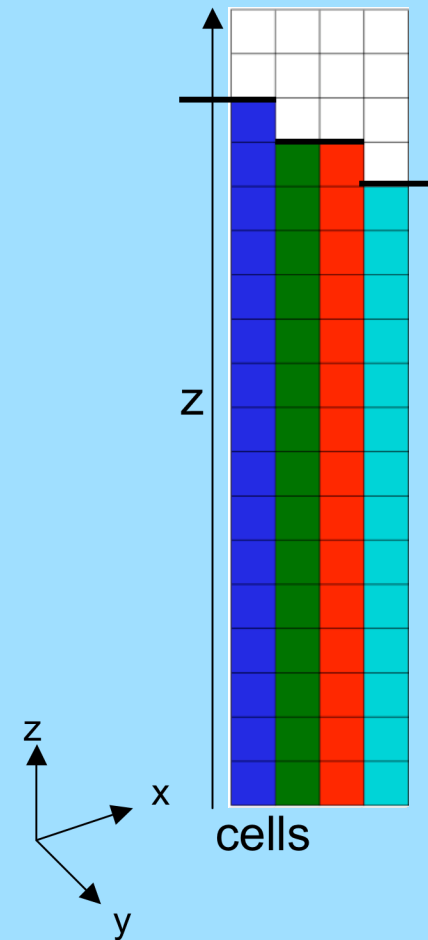
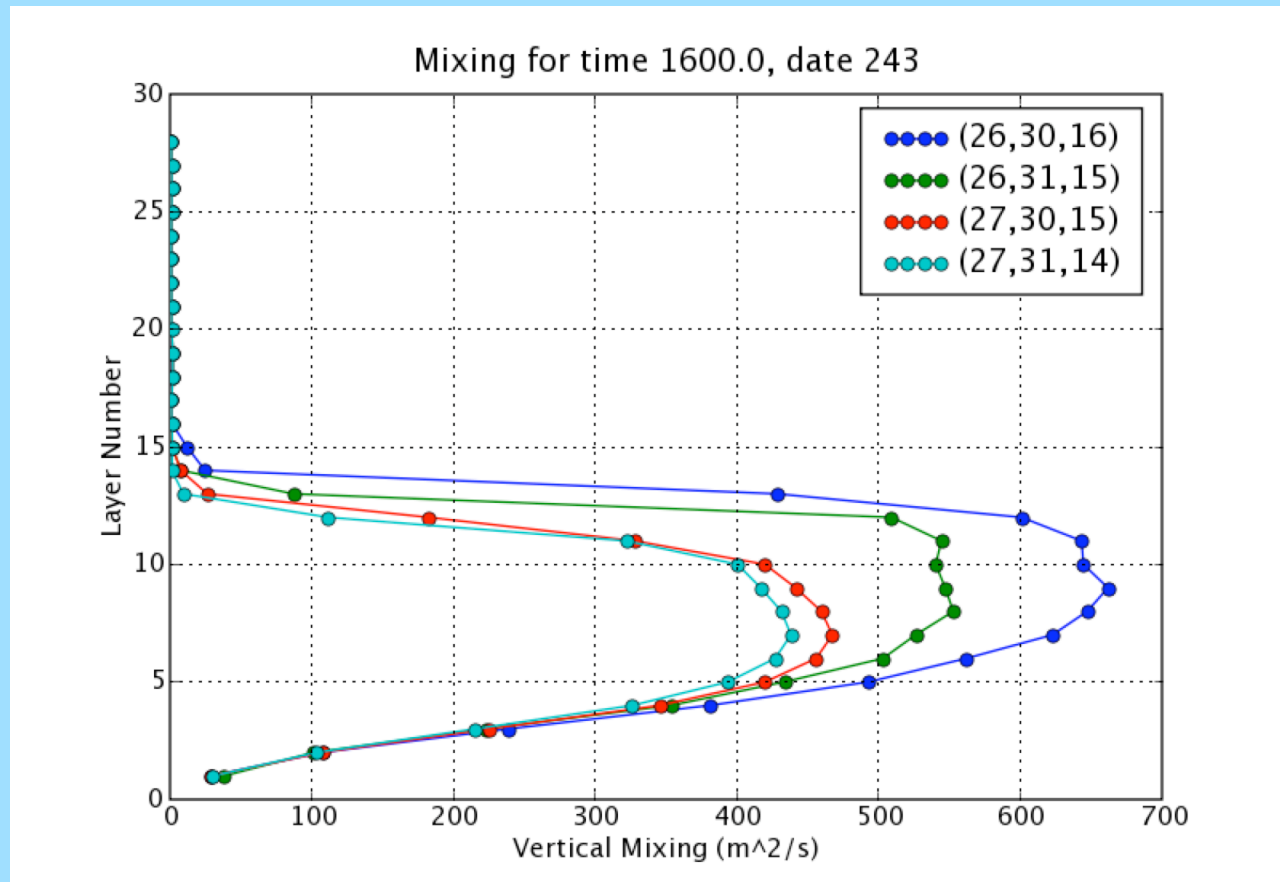
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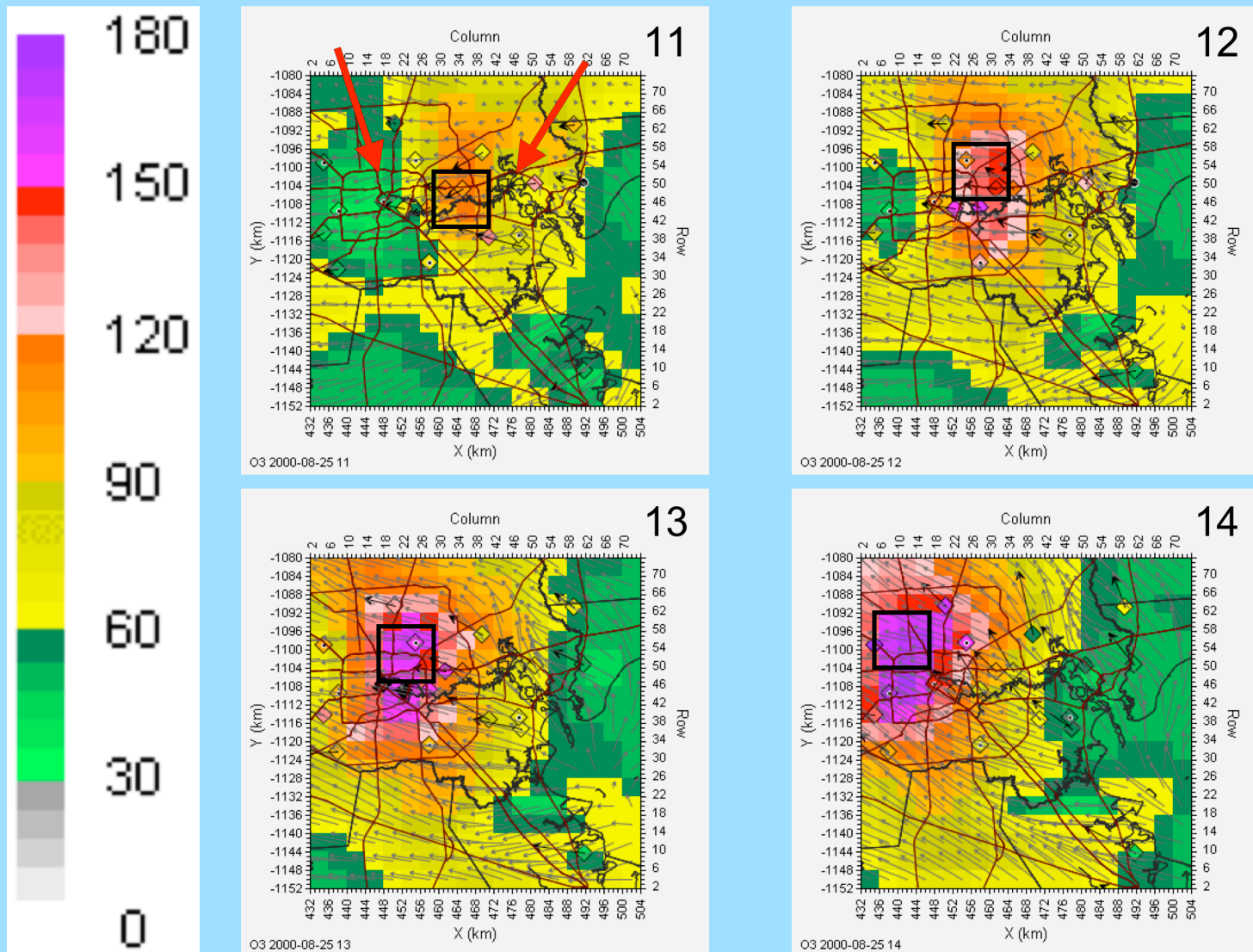
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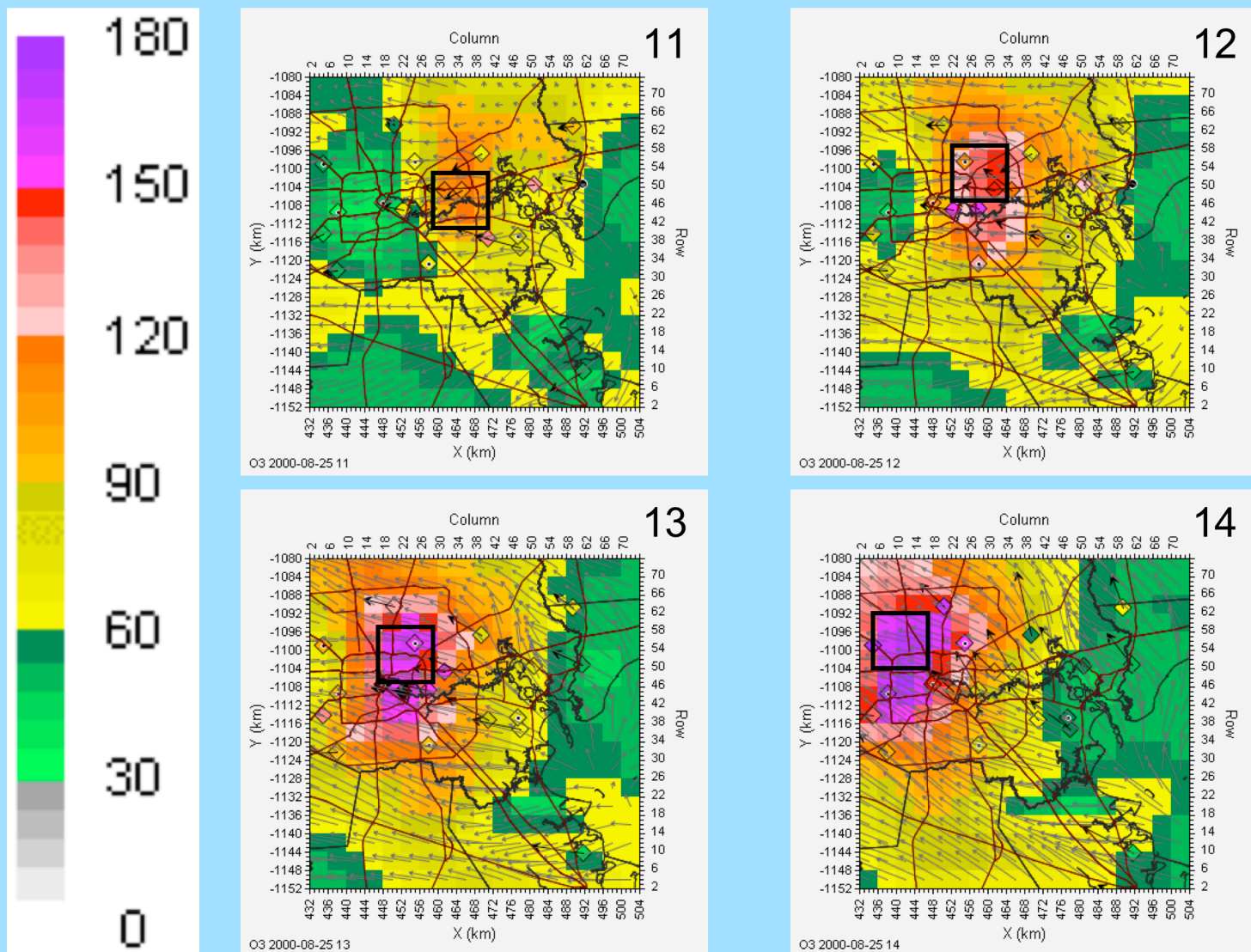
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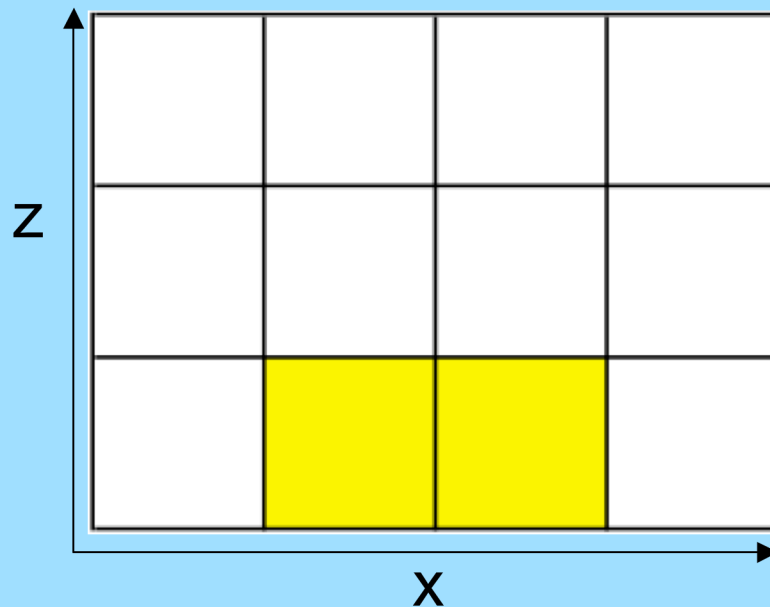
Enhancement 3: Enable Focus Volume to Follow Ozone Peak



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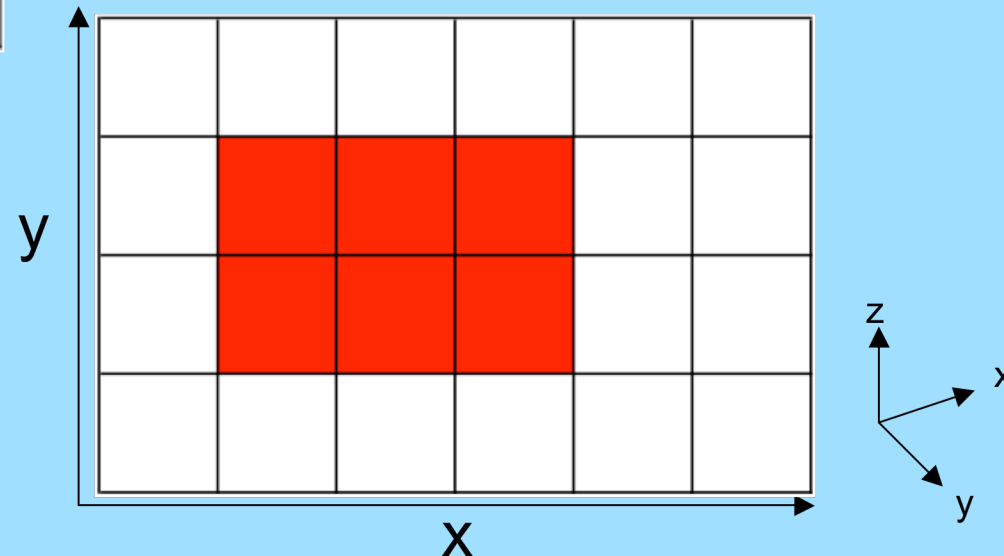


Enhancements Require New Algorithms for En(De)trainment

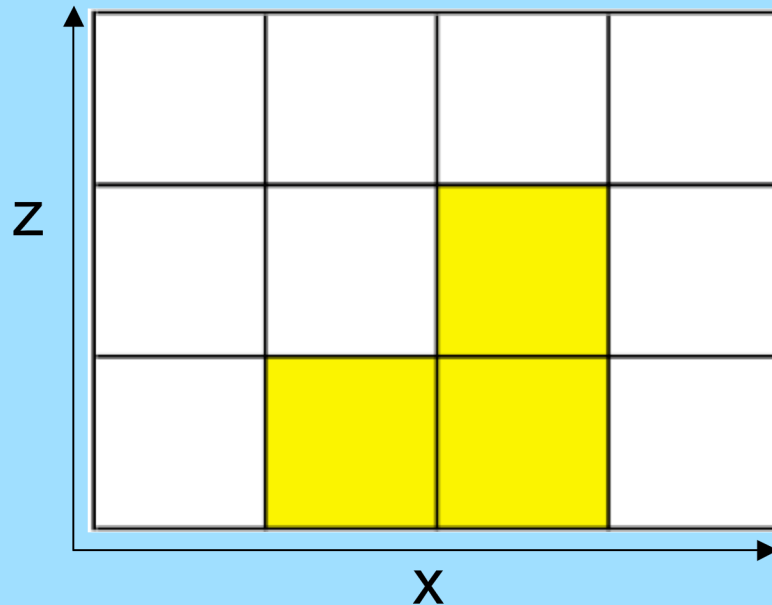


- Vertical
 - Simultaneous Entrainment and Detrainment

- Horizontal
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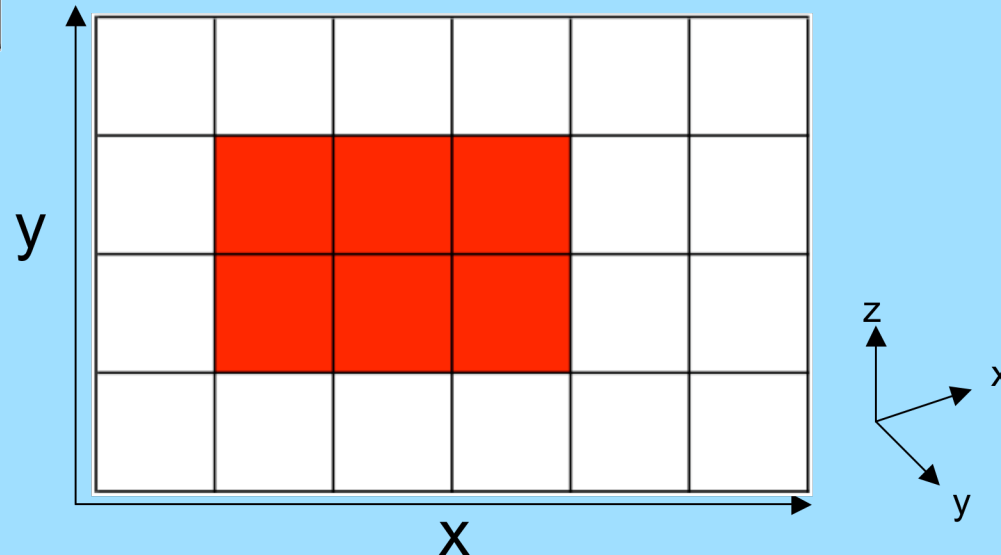


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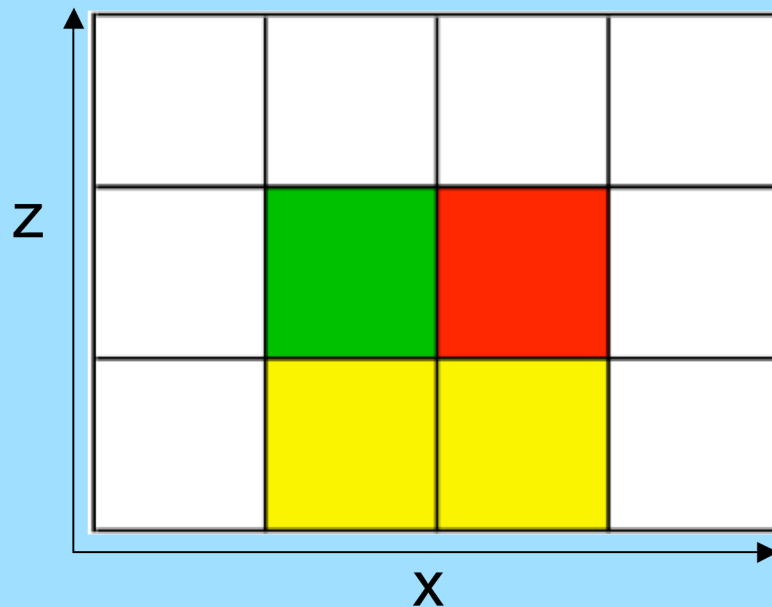


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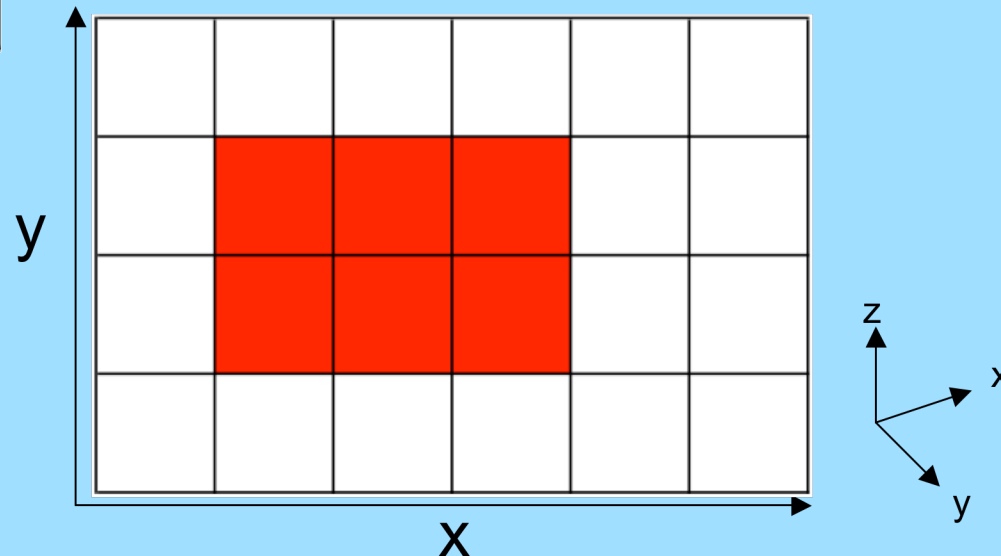


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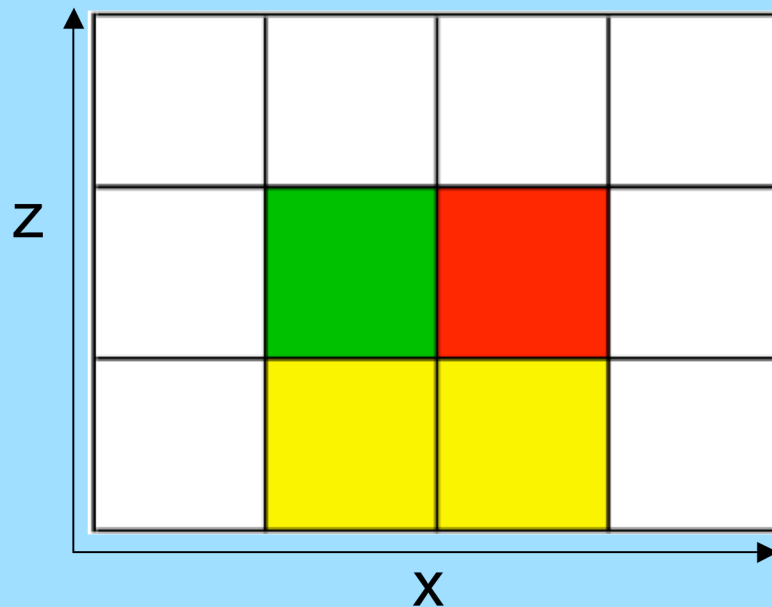


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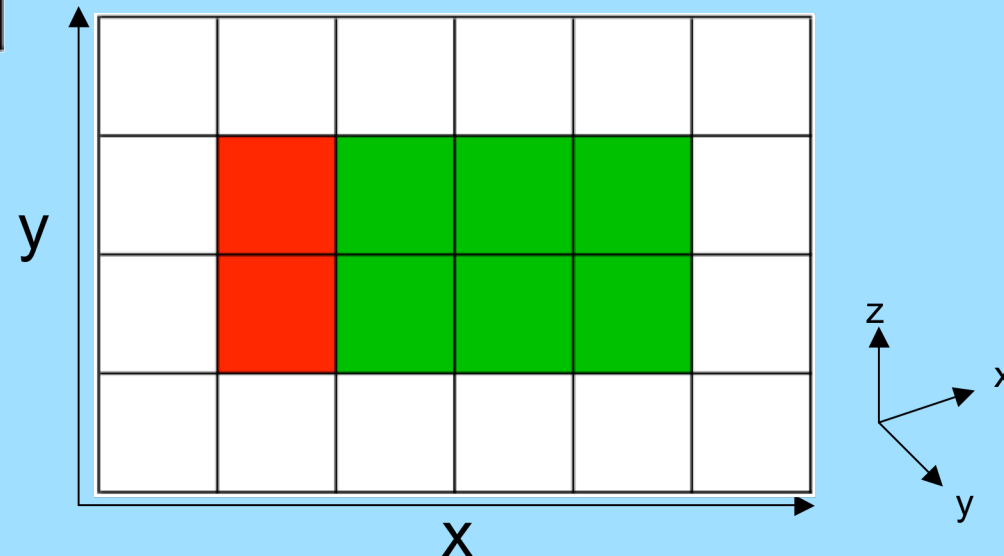


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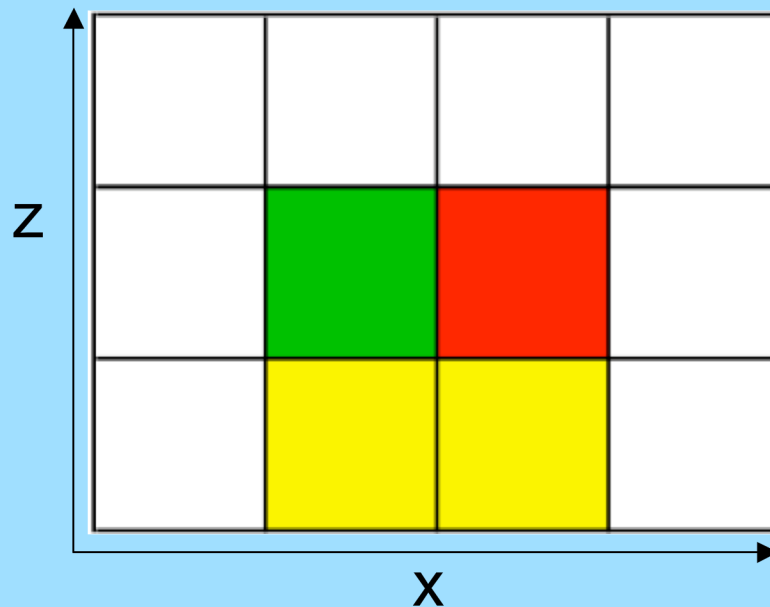


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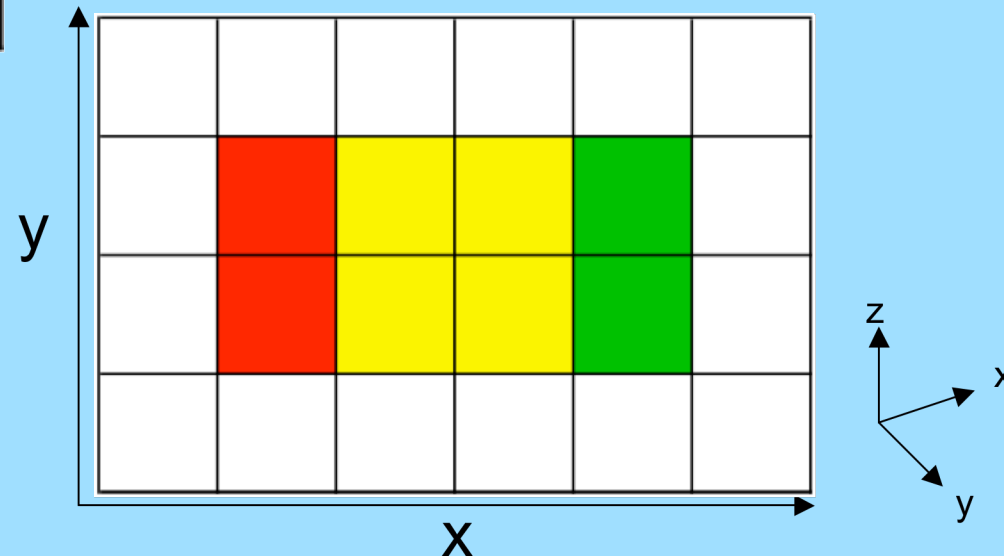


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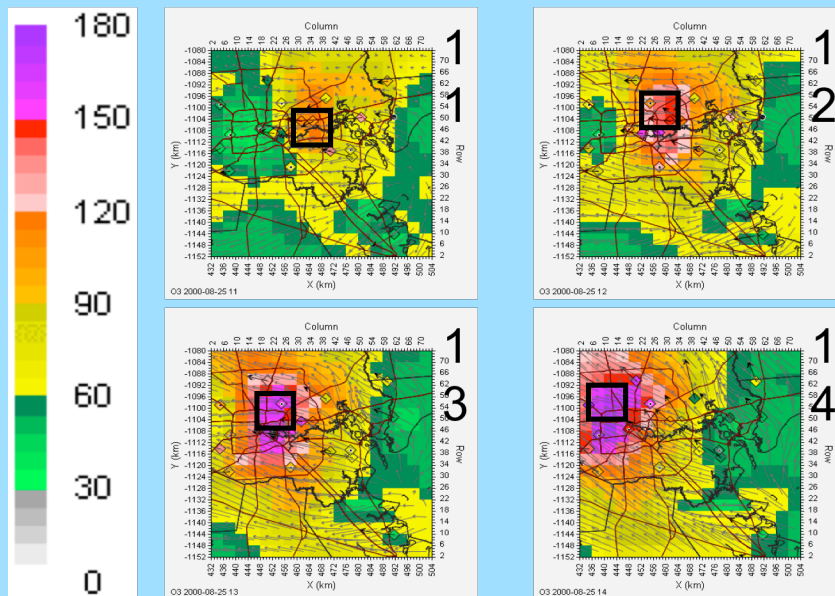
Potential Applications

- Features of Interest
 - Concentration Peaks
 - Chemical Plumes
 - Impacts of Mega-cities on surroundings
 - Transcontinental Chemical Transport
 - Wildfires
 - Airplane Observations
 - Any Moving Feature!
- Moving Process Analysis allows us to quantify transported and local processes and their interactions

Acknowledgments

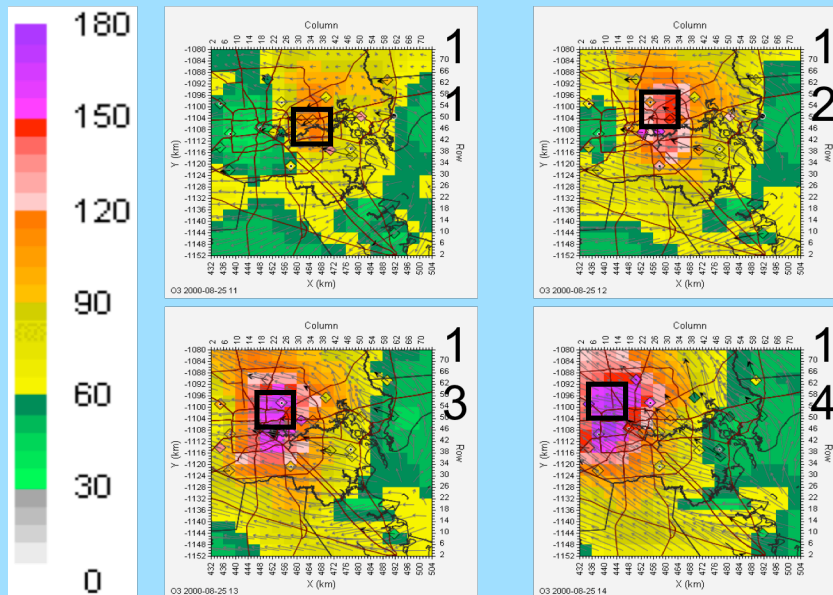
- Funding From:
 - 8 Hour Ozone Coalition
 - HARC H60 “Regional Transport Modeling for East Texas” - Jay Olaguer, Project Officer
- Thanks to:
 - Jim Smith and TCEQ for providing CAMx ready files
 - Dr. Kimura at UT for his work on the previous versions of Process Analysis
 - Dr. Byeong-Uk Kim at Georgia Dept. of Natural Resources
 - The rest of the UNC MAQ Lab Group

Questions?



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