Regional Haze
& BART
The Kansas Perspective

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About Kansas

- No in-state Class I areas
- 19 BART Eligible Sources
- 3 and ½ (I'll explain the 1/2) BART sources required to control
- Participated in CENRAP RPO
- BART handled with agreements or if necessary a rule

Subject-to-BART Units with signed agreements

- KCP&L
  - La Cygne (Units 1 & 2)
- Westar Energy
  - Gordon Evans (Unit 2)
- Westar Energy
  - Jeffrey (Units 1 & 2)
- Projected Emissions Reductions (table to right)
  - From 2002 levels
  - After BART Controls

Subject-to-BART Emission Units	**Projected Emissions Reductions (tons/yr)**	
	NOx	**SO_2**
La Cygne - Unit 1	27,481	2,700
La Cygne - Unit 2	2,133	15,362
Gordon Evans - Unit 2	1,885	3,210
Jeffrey - Unit 1	5,333	16,927
Jeffrey - Unit 2	6,852	20,250
Total	**43,686**	**58,450**

BPU Nearman (the ½)

- Nearman Creek Power Station – Unit 1
- 230MW, Sub-critical, wall fired EGU boiler
- Low Sulfur Powder River Basin (PRB) coal
- 80's vintage LNBs and ESP
- Emissions (2002 reported)
  - NO_x – 3,860 tons
  - SO_2 – 7,625 tons
- Located in KC metro area

BPU History

- KDHE makes requests for 24 hr max emissions
  - NO_x – 3,579 lb/hr (CEM)
  - SO_2 – 3,997 lb/hr (CEM)
- KDHE performs CALPUFF screening using no-obs mode
  - Determines BPU must perform a refined BART modeling analysis.

BPU History (cont.)

- BPU performs refined CALPUFF modeling run
  - 98% delta deciview impact 0.572 dv @HERC
- KDHE determines that BPU is a BART source.
- BPU proposes to control only NOx (new LNB), no SO_2 controls.
- KDHE determines SO_2 controls are also justified.

BPU History (cont.)

- BPU-KDHE continue negotiating SO_2 control requirements
- KDHE discovers error
  - 24 hr SO_2 rate is based on malfunctioning CEM replacement data
  - Allows BPU to redo the BART analysis
- BPU re-analysis
  - Shows they are no longer a BART source
  - BPU requests BART exemption

BPU History (cont.)

- KDHE agrees BPU is not a BART source and starts “Reasonable Progress Analysis”
- KDHE RP analysis
  - Based on cost and visibility impact.
  - Analysis uses CALPUFF in no-obs mode
  - Analysis indicates controls are necessary for meeting reasonable progress
    - Both NO_x and SO_2

BPU History (cont.)

- BPU questions KDHE RP threshold
  - Requests KDHE investigate refined modeling
  - Refined CALPUFF runs show
    - Higher cost benefit
    - Above KDHE threshold for RP
- KDHE – choices
  - Now have two CALPUFF runs
    - Results indicate various impacts
    - Source is on the BART “bubble” for impacts

BPU Domain with observations

		Max. 98th percentile (dv)				
Facility	Class I area	Base run	SO2 control	NOx control	Diff. of base run and SO2 control	Diff. of base run and NOx control
Nearman	Hercules-Glades	0.165	0.09	0.128	0.075	0.037
	Caney Creek	0.109	0.055	0.093	0.054	0.016
	Mingo	0.088	0.044	0.075	0.044	0.013
	Upper Buffalo	0.152	0.084	0.122	0.068	0.03
	Wichita Mnts.	0.076	0.034	0.063	0.042	0.013

KDHE Domain without observations

		Max. 98th percentile (dv)				
Facility	Class I area	Base run	SO2 control	NOx control	Diff. of base run and SO2 control	Diff. of base run and NOx control
Nearman	Hercules-Glades	0.378	0.198	0.318	0.18	0.06
	Caney Creek	0.349	0.136	0.311	0.213	0.038
	Mingo	0.255	0.108	0.233	0.147	0.022
	Upper Buffalo	0.306	0.151	0.269	0.155	0.037
	Wichita Mnts.	0.263	0.116	0.232	0.147	0.031

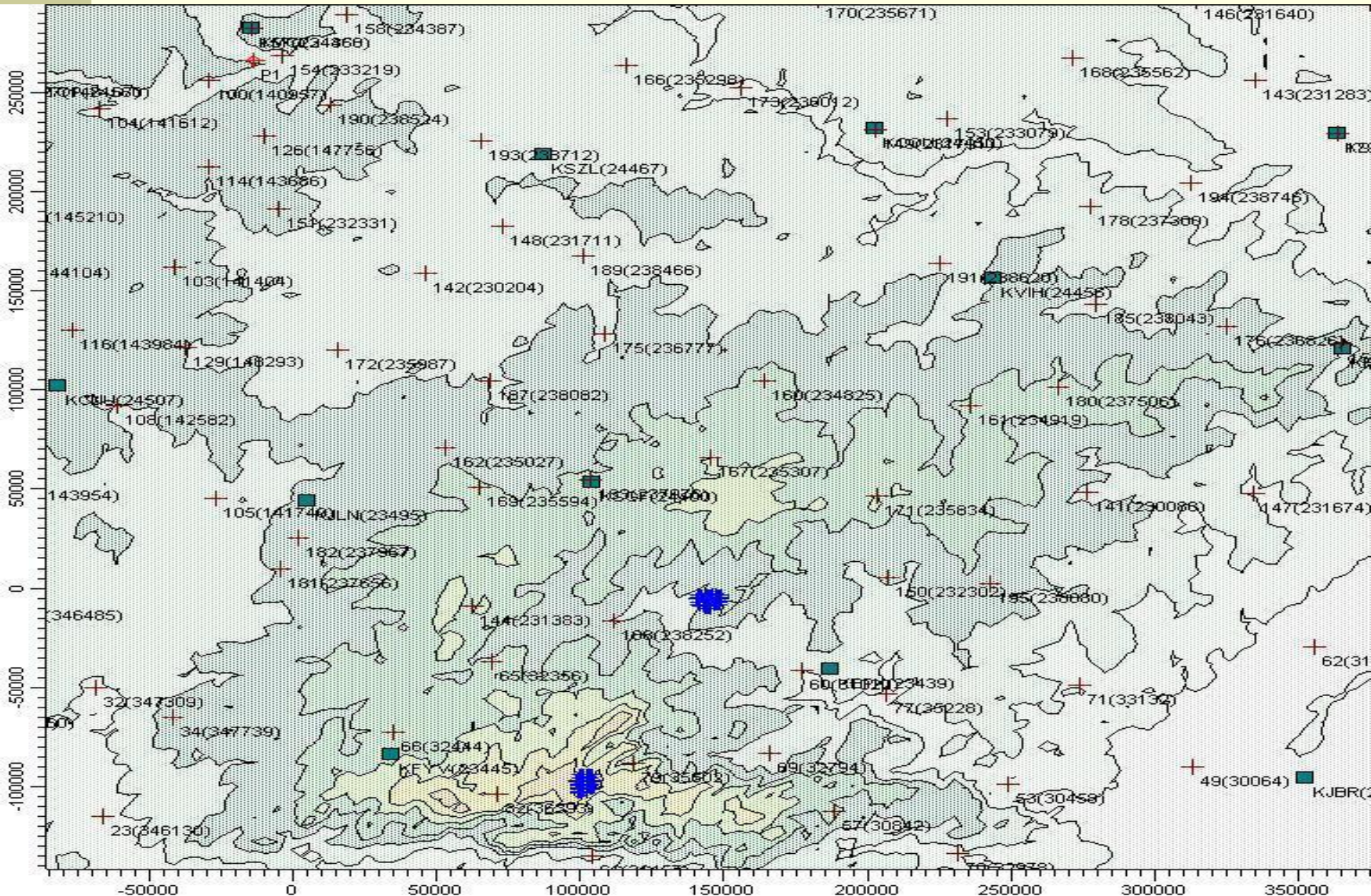
CALPUFF – Why the Difference?

- Model versions
  - KDHE used v5.753 Level 051130
  - BPU used v6.112 level 060412
- Meteorology
  - Observations vs. No-observations
- Domain differences
  - 6 km vs. 4 km spacing

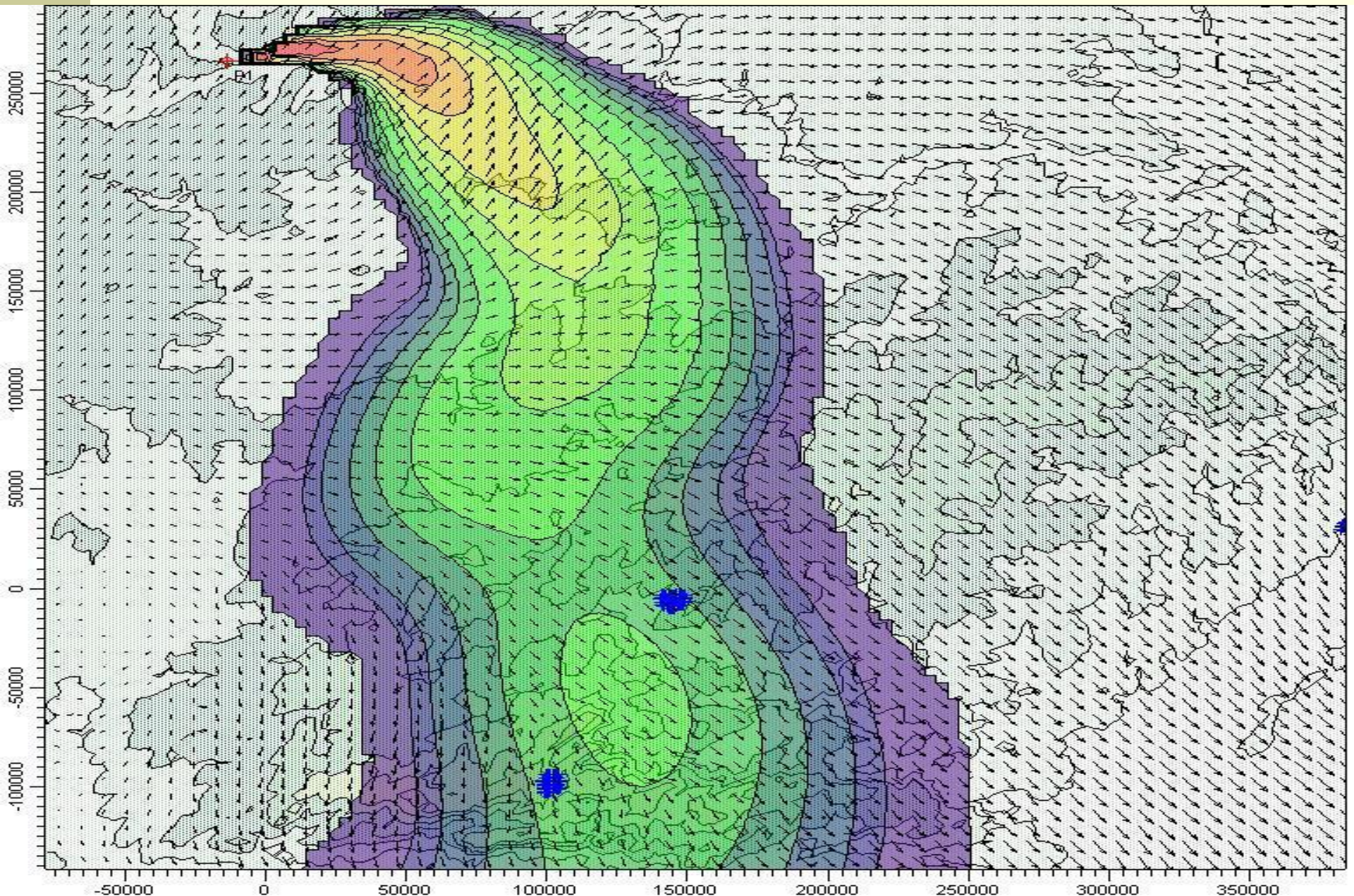
Answer to Why?

- Main difference in results seems to be related to introduction of observations
- Examples follow
  - Only difference in these runs is the introduction of observations
- Which answer is correct?

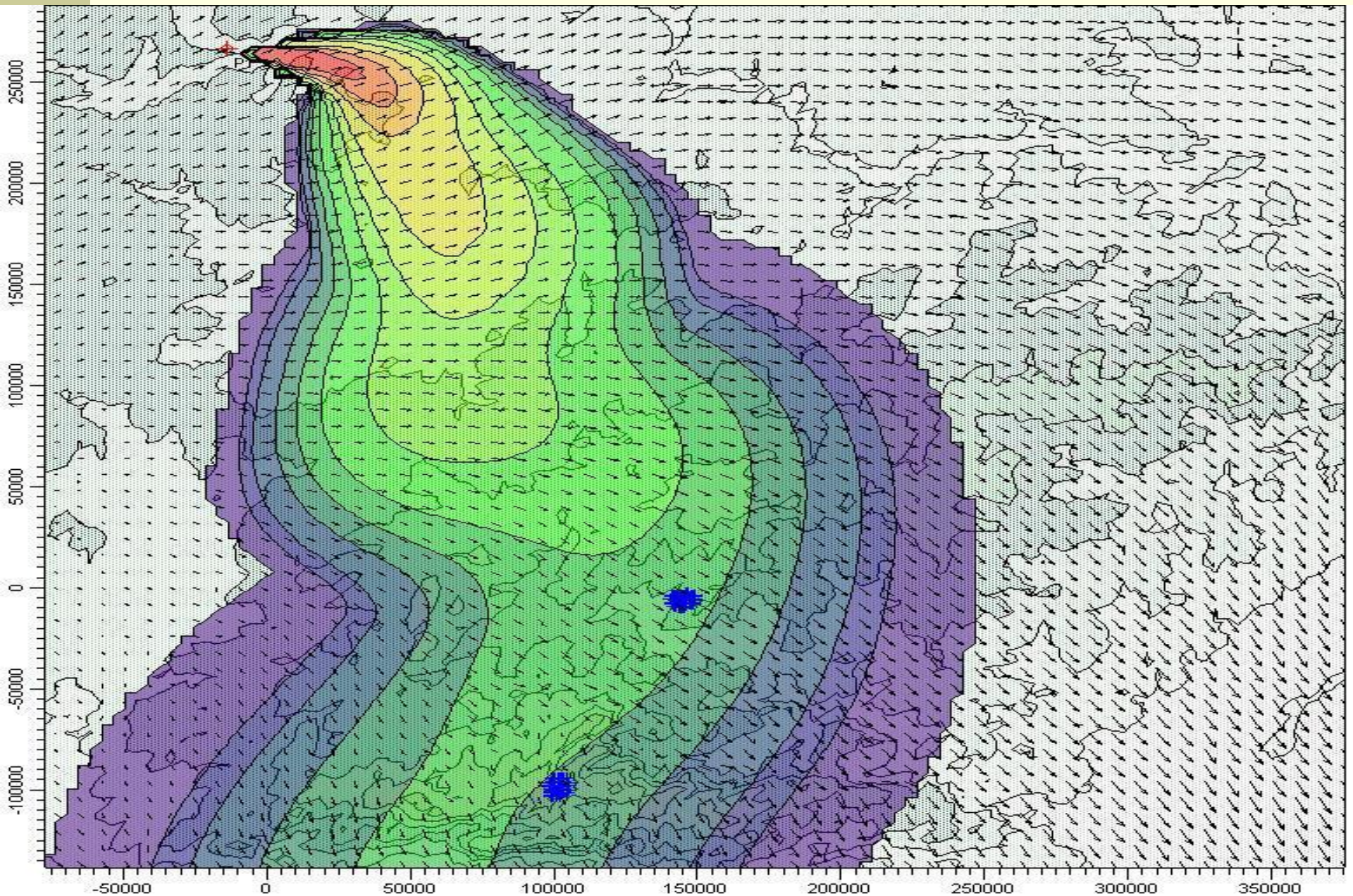
Surface and Precipitation Stations



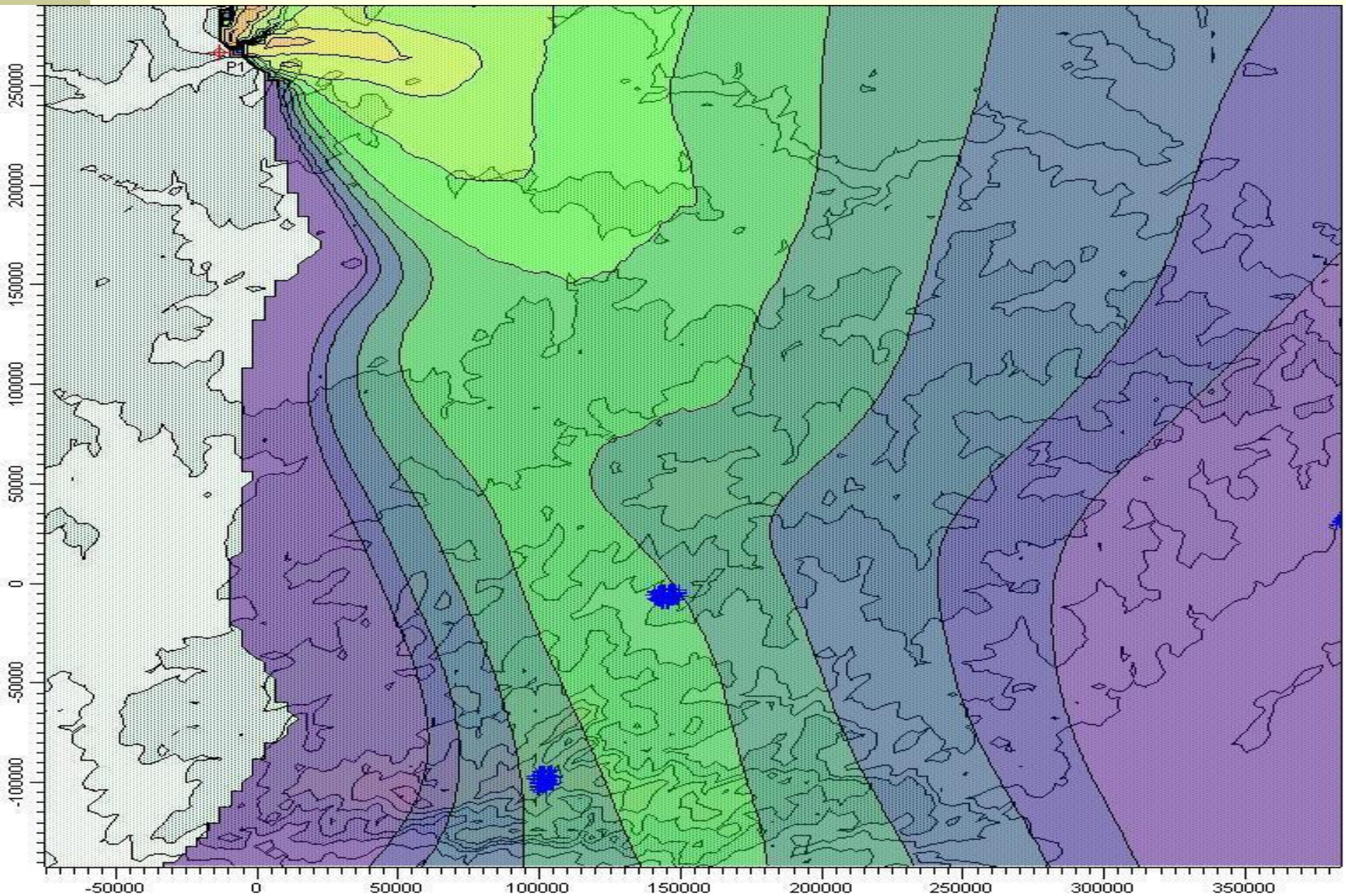
Hourly with Observations



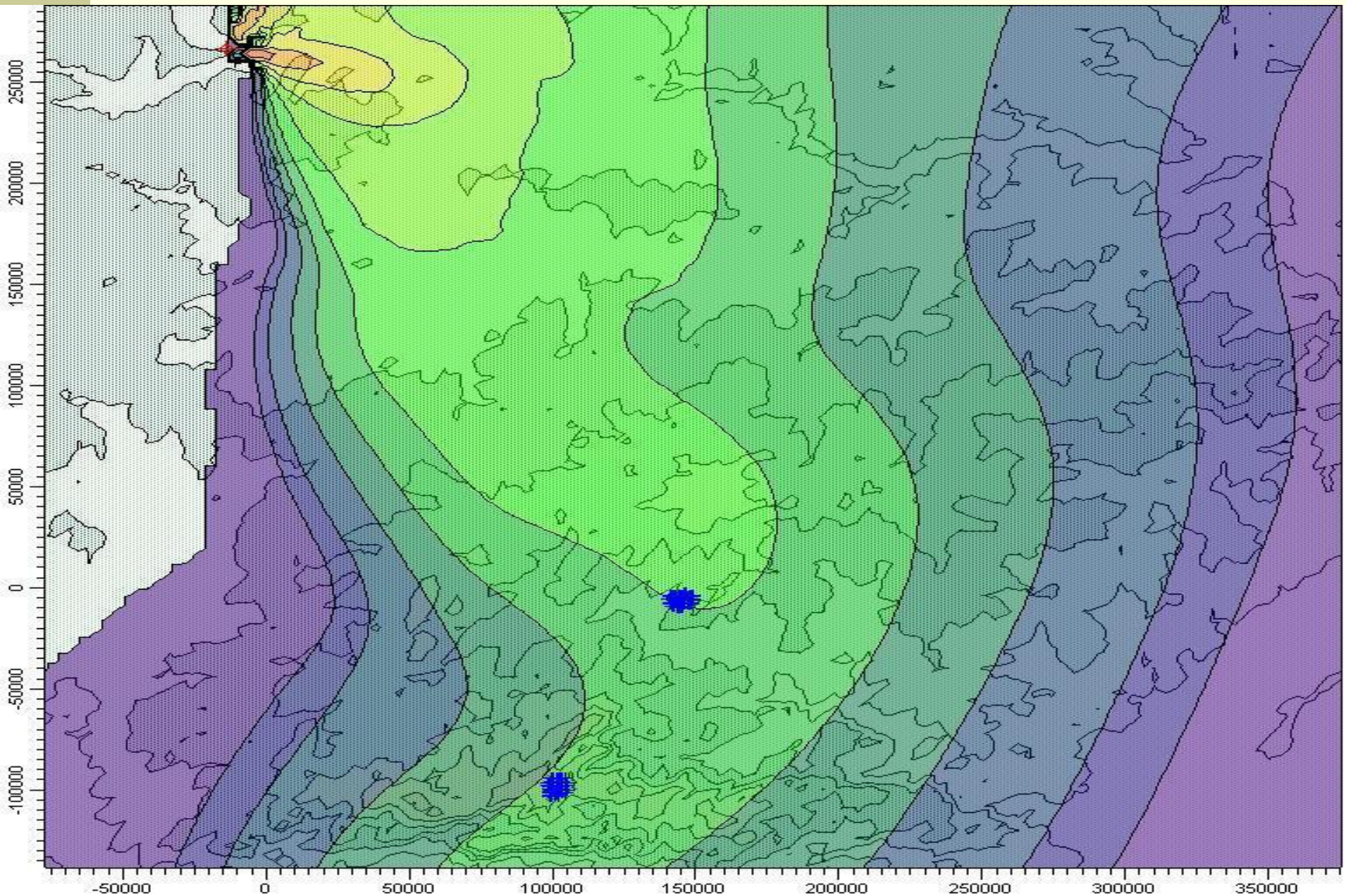
Hourly without Observations



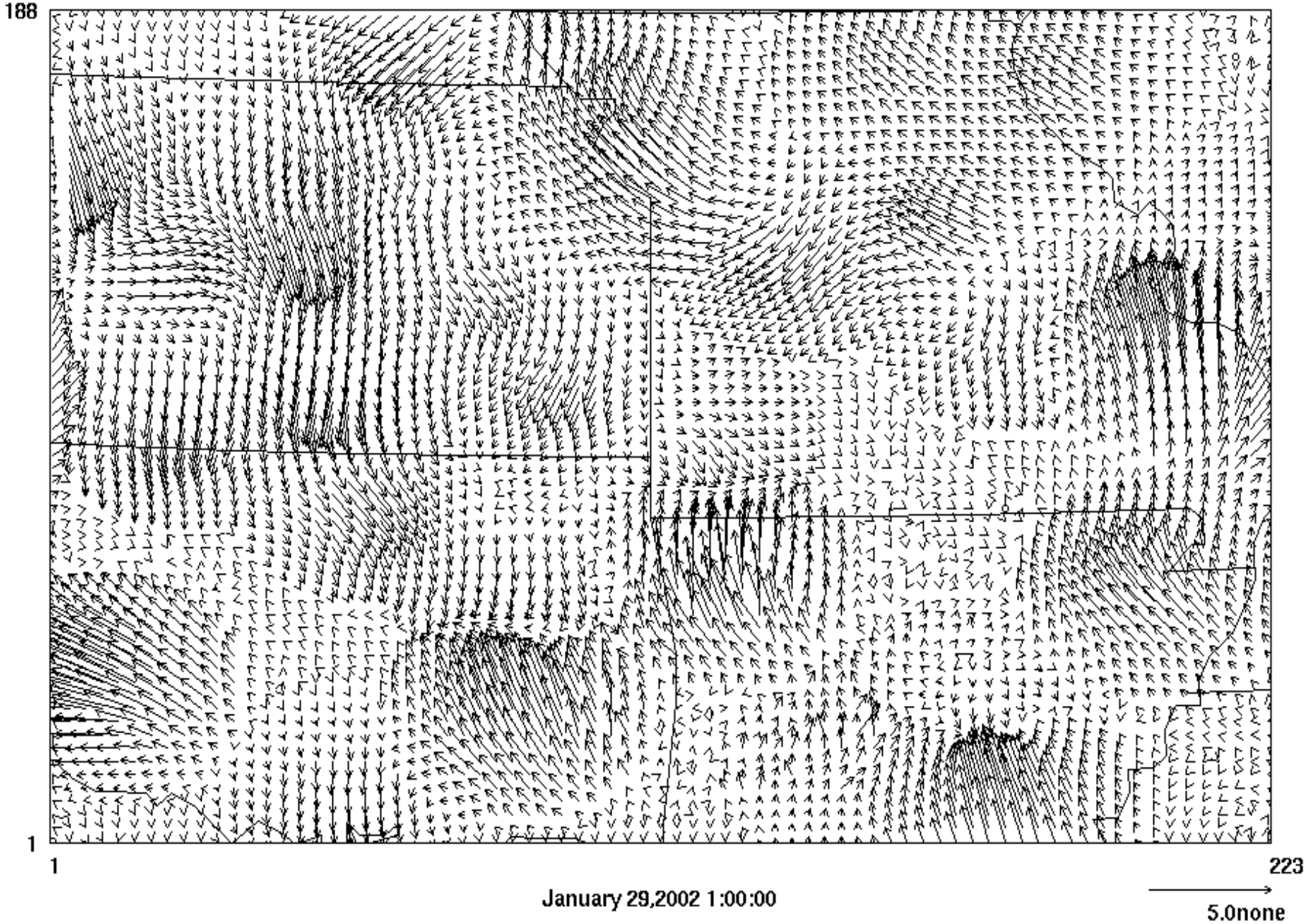
24hr Average - with Observations



24hr Average - No Observations



CALPUFF Wind Field Difference



What's Next?

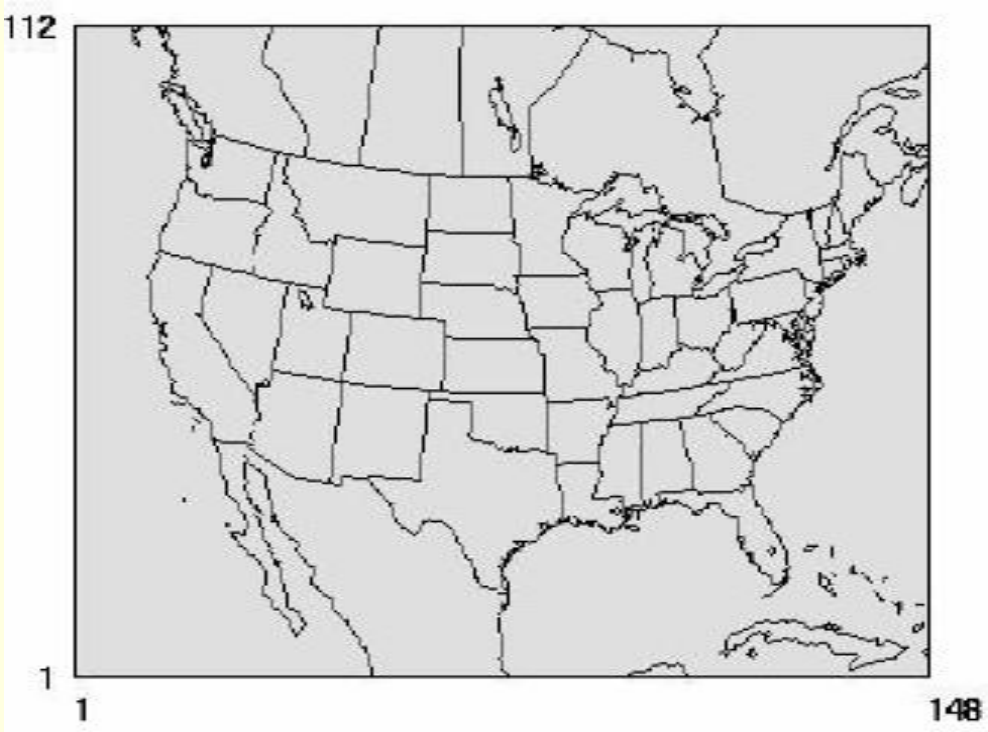
- Uncertainty with CALPUFF
  - BPU BART or not?
  - Benefits of controls?
- Availability of CAMx datasets
- Other states using CAMx for BART
  - TX, AR, NE
- KDHE decides to try CAMx

BPU and CAMx

- CAMx – Comprehensive Air Quality Model with Extensions
  - Full chemistry model, with source receptor sensitivity
  - Version 4.2
  - CENRAP modeling domain, emissions and meteorology
  - Particulate source apportionment (PSAT)
  - Plume in Grid (PiG)
  - BPU emissions rates with actual average emissions

CAMx Setup - Modeling Domain

- CENRAP 36 km grid
  - 148 x 112
  - 19 vertical layers
- LCC:
  - CLAT: 40° N Lat
  - CLON: 97° W Lon
  - TLAT1: 33° N Lat
  - TLAT2: 45° N Lat



CAMx Setup (cont.)

- Used CENRAP datasets
  - emissions (unmerged form)
  - meteorology
- For BPU Nearman
  - Needed to modify emission rates
  - Plume-in-Grid treatment (PiG)
  - Source Apportionment (PSAT group)
  - Received code to modify source(s) from EPA Region VII
    - flag the source as PiG
    - modify hourly pollutant emissions
    - place in PSAT source group

CAMx Setup (cont.)

- CAMx Emissions merging
  - Point sources (ascii files)
    - Modify rates, flag for PiG and PSAT
  - Off shore elevated (ascii)
  - Fires (binary)
- Use CAMX utilities
  - mrgpts, pigset to merge files (CAMx ready binary)
- QA final merged emissions files!
  - Mass consistency
  - Individual species hourly rates

CAMx Setup (cont.)

- 8 - Intel(R) Xeon(R) CPU X5355 @ 2.66GHz
  - Fedora Core 7, 2.6.20, 64 bit, PGI compiler
- Inputs (per day)
  - 214MB – pt source file
  - 37MB – area files
  - 357MB – met files
- Outputs (mass + source apportionment)
  - 915MB
- Runtime
  - ~ 16 min/day (for 1 PSAT source group)

BPU and CAMx - Results

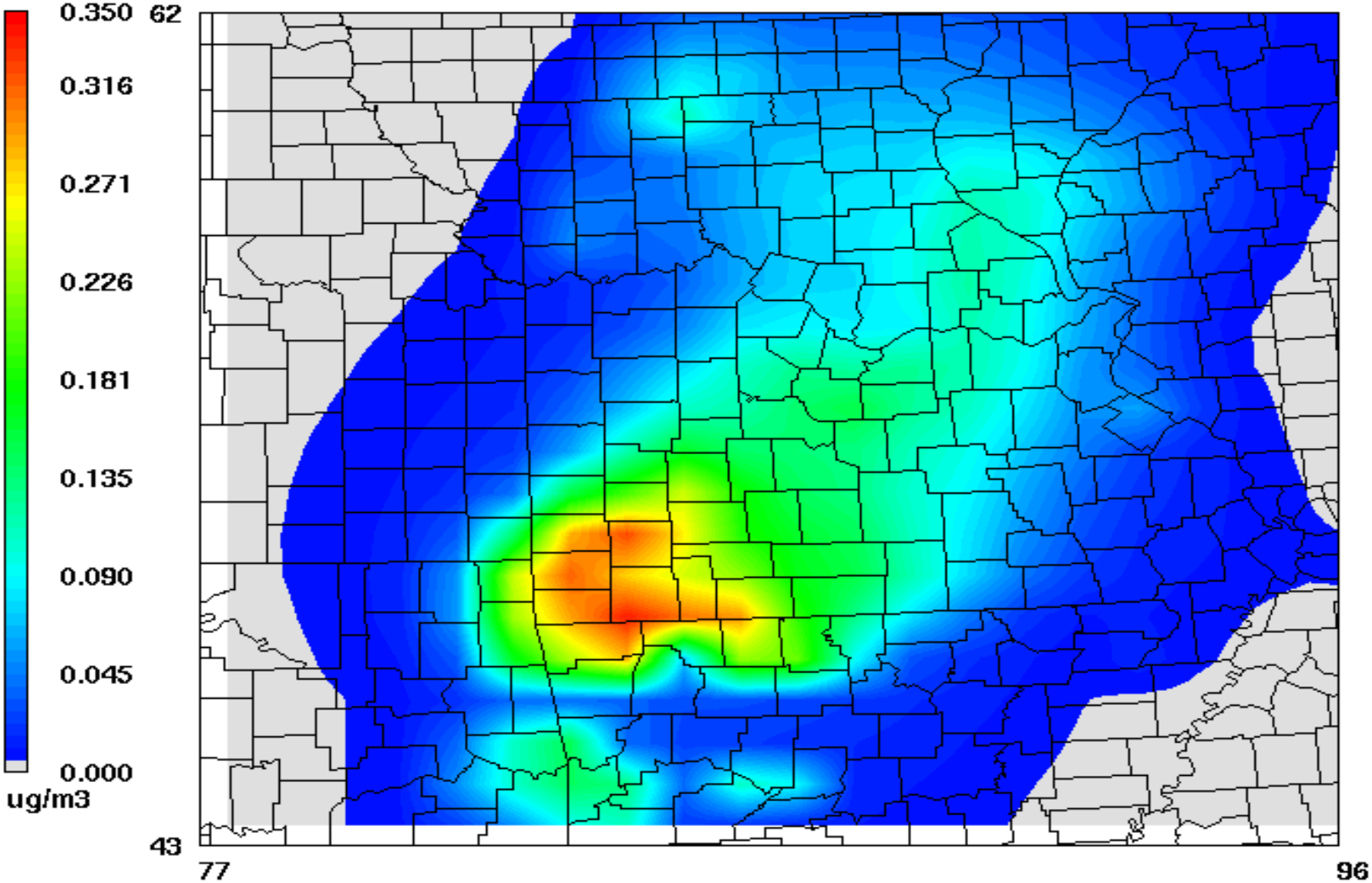
- 4th high impact of 0.51 dv at Hercules-Glades
  - This was using actual average emissions not 24hr max. emissions
- CAMx or CALPUFF?
  - CAMx
    - Has full science
    - Uses representative meteorology
    - No distance limitation
  - KDHE decides to use CAMx results
    - Consultation with EPA Region VII
    - BPU should remain a BART source

CAMx Results (Cont.)

ClassIArea	Date	bSO4	bNO3	bOC	bEC	bSOIL	bCM	**Del-dv**
HEGL1	20	1.72%	0.71%	0.00%	0.00%	0.01%	0.00%	**1.065**
HEGL1	348	0.71%	0.30%	0.00%	0.00%	0.01%	0.00%	**0.588**
HEGL1	299	0.62%	0.73%	0.00%	0.00%	0.02%	0.01%	**0.550**
HEGL1	6	1.52%	0.36%	0.00%	0.00%	0.01%	0.00%	**0.506**
HEGL1	258	1.14%	0.33%	0.00%	0.00%	0.01%	0.00%	**0.491**
HEGL1	259	1.02%	0.10%	0.00%	0.00%	0.01%	0.00%	**0.437**
HEGL1	146	1.53%	0.49%	0.00%	0.00%	0.01%	0.00%	**0.357**
HEGL1	309	0.44%	0.27%	0.00%	0.00%	0.01%	0.00%	**0.321**
HEGL1	308	0.42%	0.23%	0.00%	0.00%	0.01%	0.00%	**0.318**
HEGL1	340	0.43%	0.14%	0.00%	0.00%	0.00%	0.00%	**0.299**
HEGL1	310	0.51%	0.35%	0.00%	0.00%	0.01%	0.00%	**0.280**
HEGL1	165	1.55%	0.48%	0.00%	0.00%	0.01%	0.00%	**0.273**
HEGL1	260	0.59%	0.06%	0.00%	0.00%	0.01%	0.00%	**0.256**
HEGL1	236	0.67%	0.09%	0.00%	0.00%	0.00%	0.00%	**0.208**
HEGL1	306	0.58%	0.38%	0.00%	0.00%	0.01%	0.00%	**0.201**

Layer 1 PS4001001j

CAMx 4.42 v4.42.bpu
j=camx.v4.42.bpu.bpu_psat.2002020.sa.grd01



January 20,2002 7:00:00
Min= 0.000 at (77,62), Max= 0.338 at (84,48)

Where are we now?

- KDHE continues to pursue both NO_x and SO_2 controls
- BPU continues to question the determination
  - Would like to follow the original protocol
  - ~$100 million cost of SO_2 controls
  - Limited ability to review CAMx modeling results
  - Consistency between states and EPA regions

Summary

- CAMx was used for a single source BART determination in Kansas.
- CAMx believed to be more accurate than CALPUFF in this case
  - Full science model
  - Large source receptor distance
- Difficult model to run
  - Model setup (hardware and software)
  - Inputs – meteorology and emissions
  - Computing resources

Final Thoughts

- CAMx Possible for States
  - PSD visibility analysis
  - Regional Haze analysis
- Need resources
  - Trained Staff
  - Specialized computing equipment
  - Processed Emissions (entire country)
  - Processed Meteorology (entire country)
- OAQPS, FLMs and EPA Regional Offices
  - Provide data inputs
  - Guidance for use
  - Support and training

Questions

Show CAMx mpeg here…