

# Using AQPlot to Compare MM5 Wind Fields to Observed Data

Prepared by  
Sharon Mc Donald  
Fernando Mercado

# Objective

1. Create 'plume plots' with both observed and modeled data
2. Compare modeled wind data to observed data through AQPlot
  1. Qualify: Compare air mass movement similarities and differences
  2. Quantify: If Possible, provide numeric summary of the comparison
3. Report observations
4. Seek Comments
  1. What is a good statistic to compare these results
  2. Should further work be done

# What is AQPlot

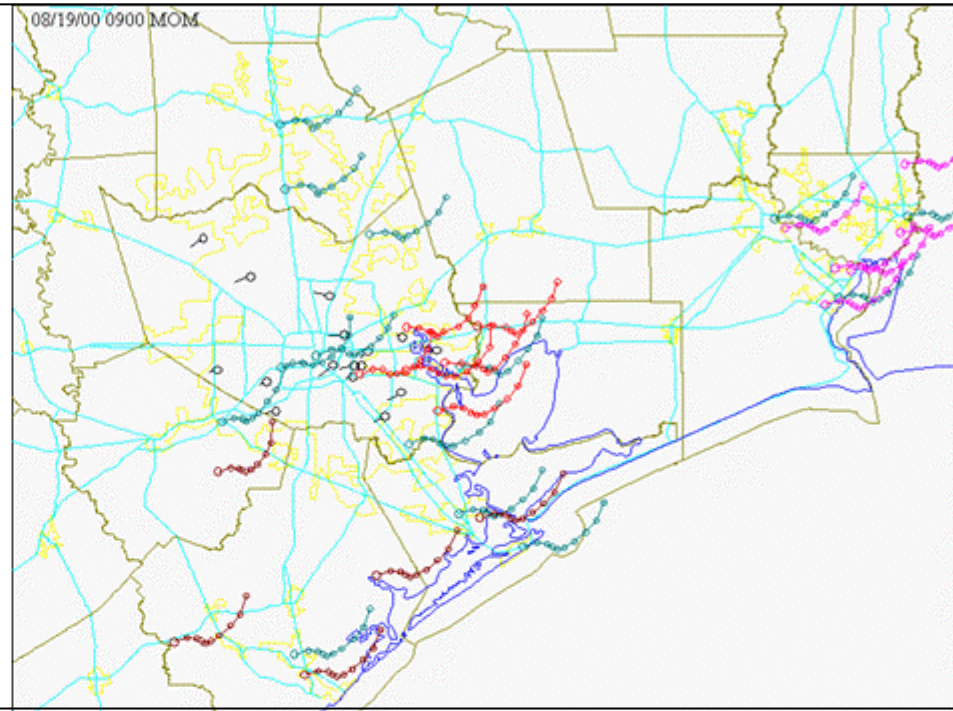
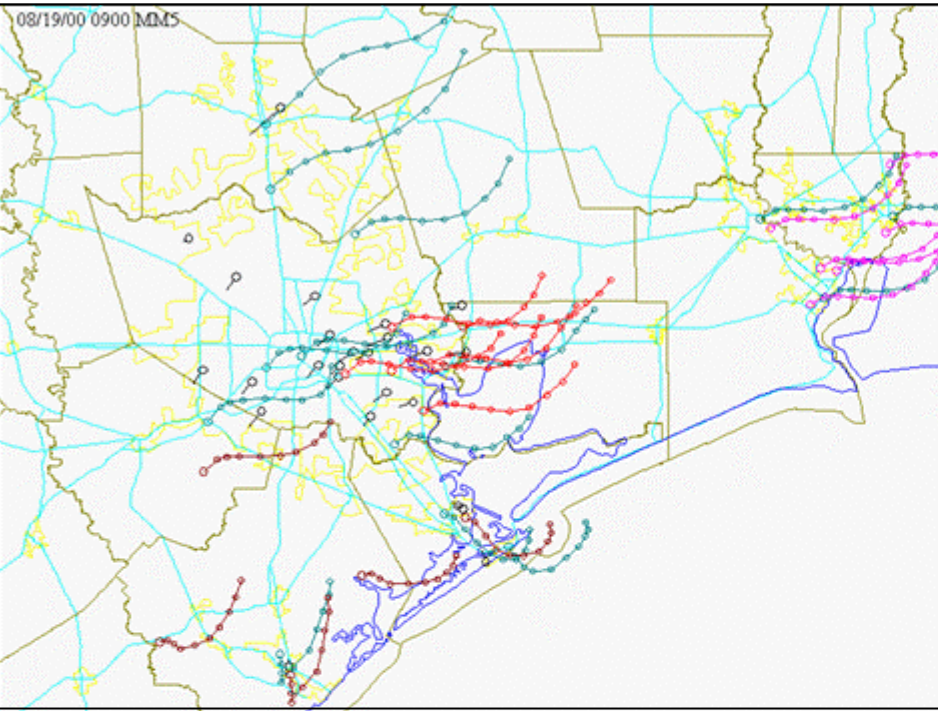
- AQPlot is an interpolating model which predicts the location, in space (2-d) and time, of a particle released into an air-mass driven by observed winds.
- AQPlot uses a simple interpolating scheme and does not include many meteorological concepts.
- AQPlot does not include a mechanism for dispersion.
- AQPlot work well for small modeling domains.
- AQPlot is a forward trajectory tool.

# Methods

- Take data from MM5 and observed data and create 'plume plots' with AQPlot.
- Review plots side by side for similarities.
- Calculate statistics.
- Since both data are being interpreted by the same model and compared to each other, the results will not be greatly affected by the model's algorithm.

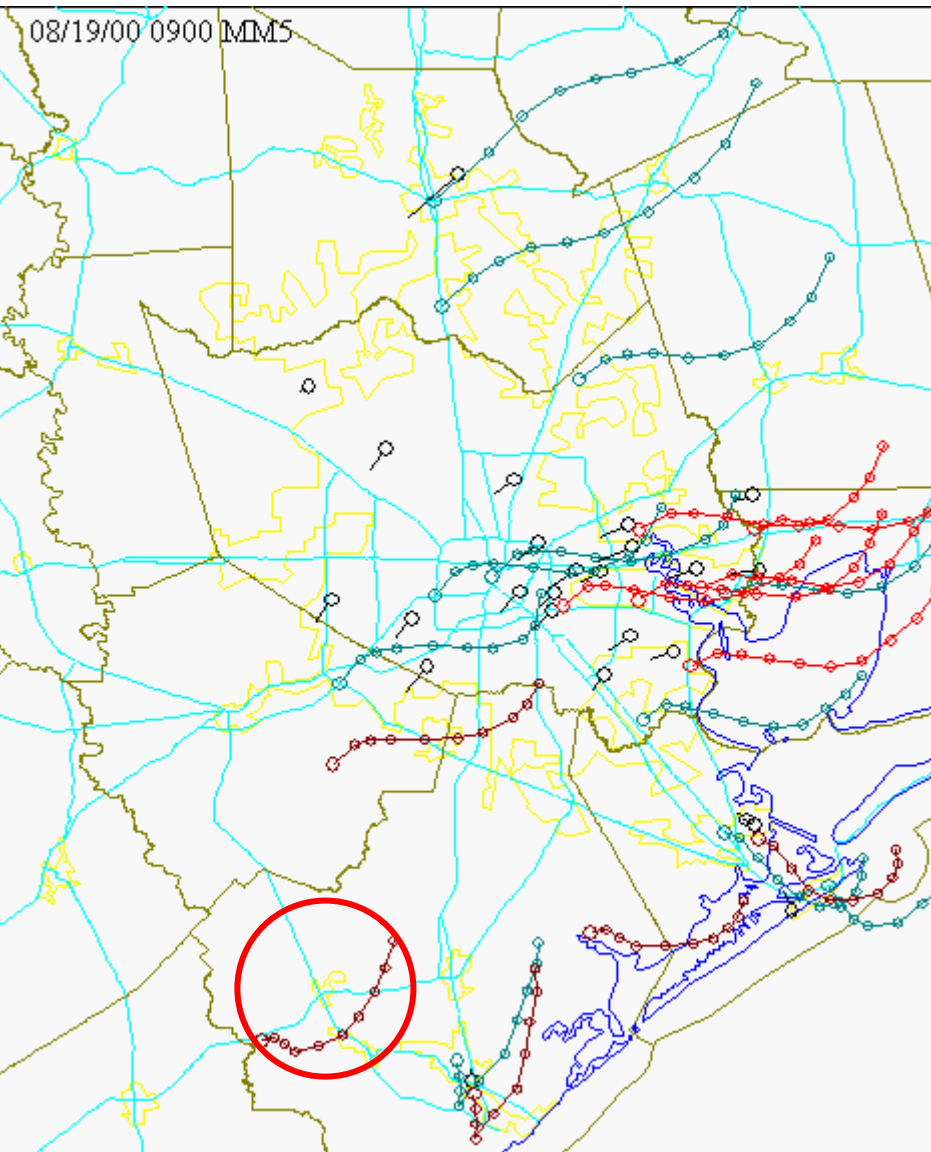
Modeled

Observed

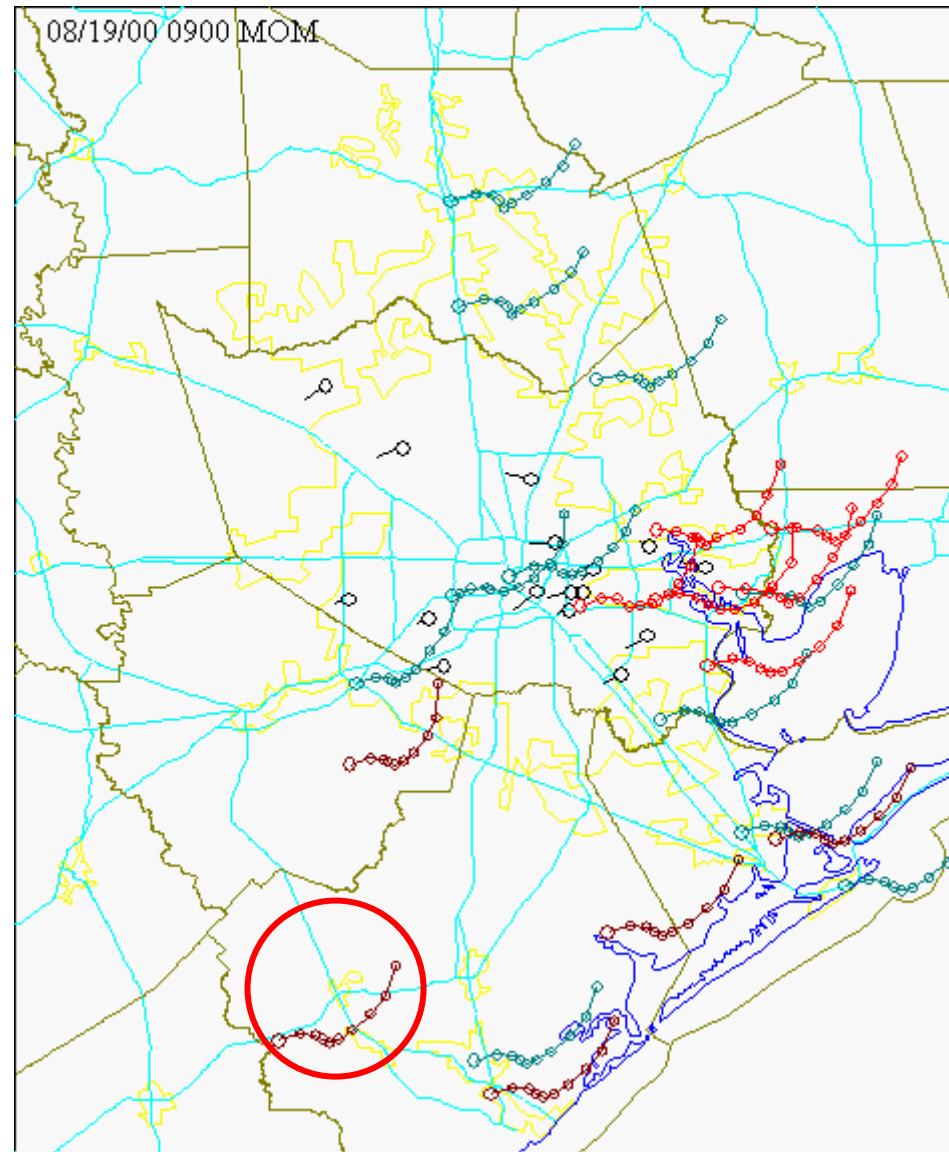


August 19, 2000

# Modeled

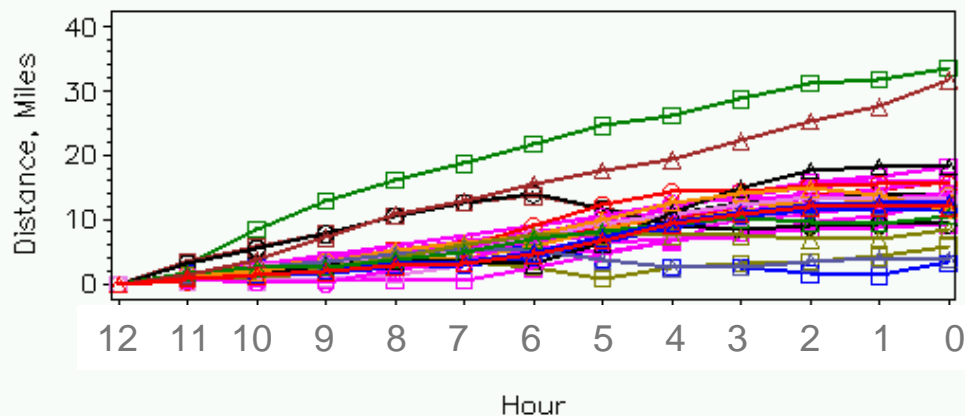


# Observed



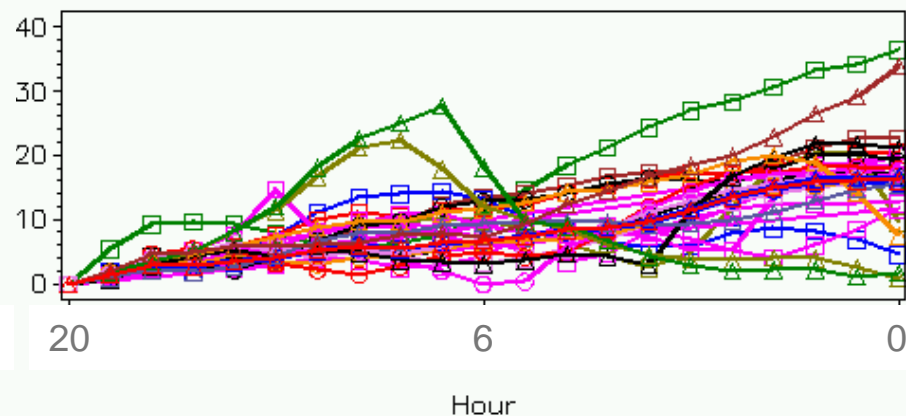
Relative Distance (Obs-MM5) For 08/19/2000

Start Time=12



Relative Distance (Obs-MM5) For 08/19/2000

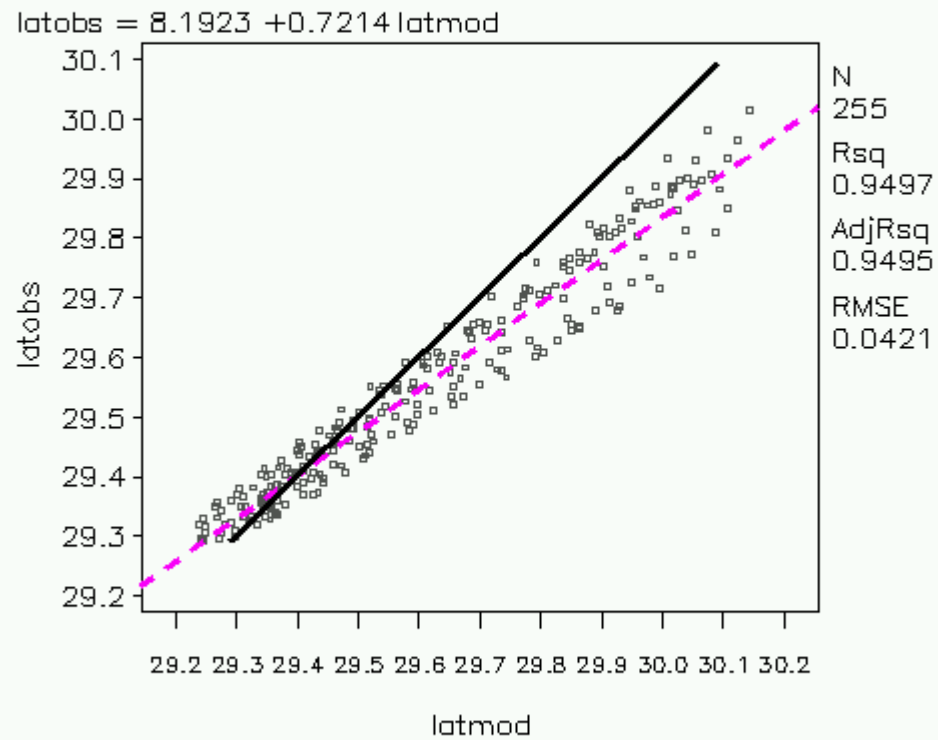
Start Time=20



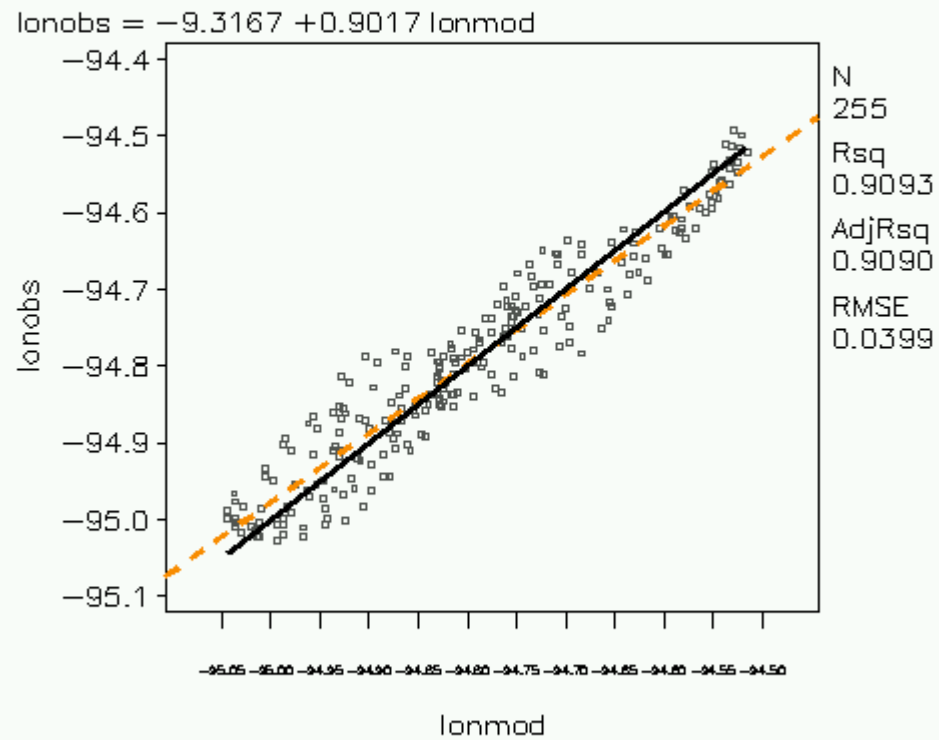
- Site
- |                       |                |
|-----------------------|----------------|
| Baytown               | Beaumont       |
| BeaumontSE            | ChocolateBayou |
| Conroe                | Freeport       |
| Galveston             | Houlnd         |
| Houston               | LaPorte        |
| LakeJackson-Freepport | MontBelvieu    |
| Orange                | PortArthur     |
| PortArthurN           | PortArthurNE   |
| PortArthurSW          | Sheldon        |
| ShipChannelC          | ShipChannelE   |
| ShipChannelW          | Sugarland      |
| Sweeny                | TexasCity      |
| TexasCity-LaMarque    | TheWoodlands   |
| WOrangeN              | WOrangeS       |

- Site
- |                       |                |
|-----------------------|----------------|
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| Houston               | LaPorte        |
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| Orange                | PortArthur     |
| PortArthurN           | PortArthurNE   |
| PortArthurSW          | Sheldon        |
| ShipChannelC          | ShipChannelE   |
| ShipChannelW          | Sugarland      |
| Sweeny                | TexasCity      |
| TexasCity-LaMarque    | TheWoodlands   |
| WOrangeN              | WOrangeS       |

Galveston Site, Modeling vs. Observed Latitudes  
Date: 2000/08/19 Hour: All



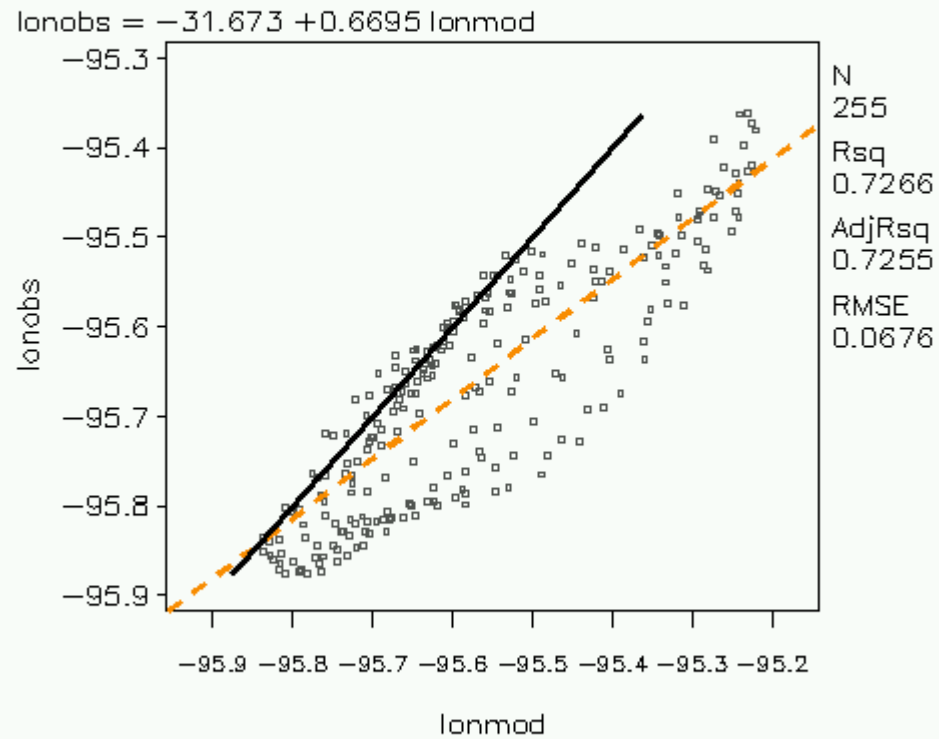
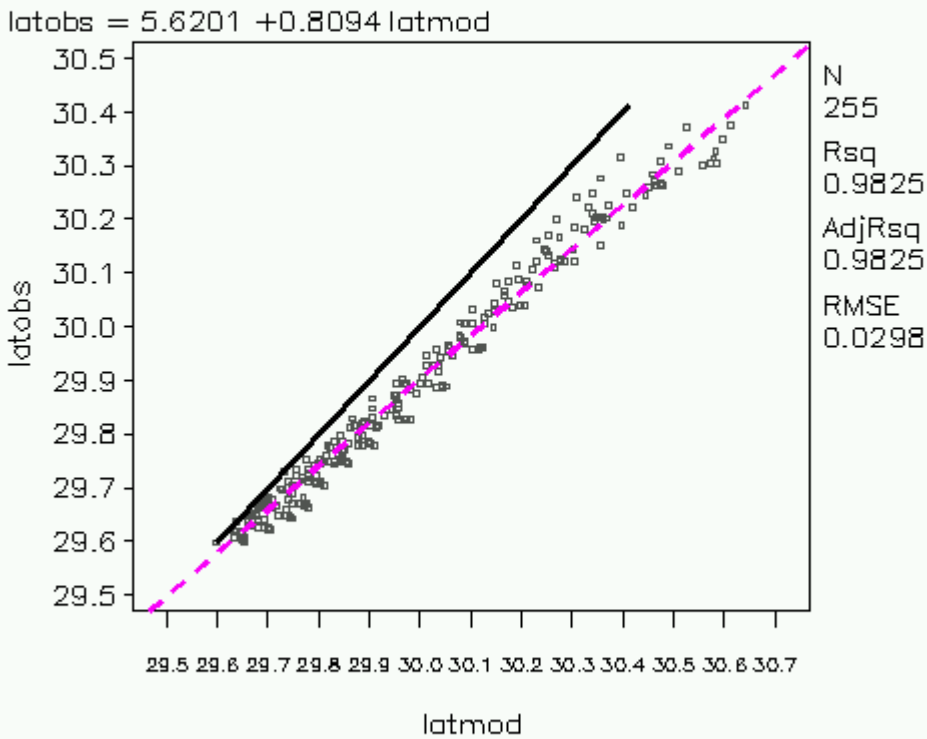
Galveston Site, Modeling vs. Observed Longitudes  
Date: 2000/08/19 Hour: All



Note: Both Modeling and Observed have been processed by AQPlot

Sugarland Site, Modeling vs. Observed Latitudes  
Date: 2000/08/19 Hour: All

Sugarland Site, Modeling vs. Observed Longitudes  
Date: 2000/08/19 Hour: All



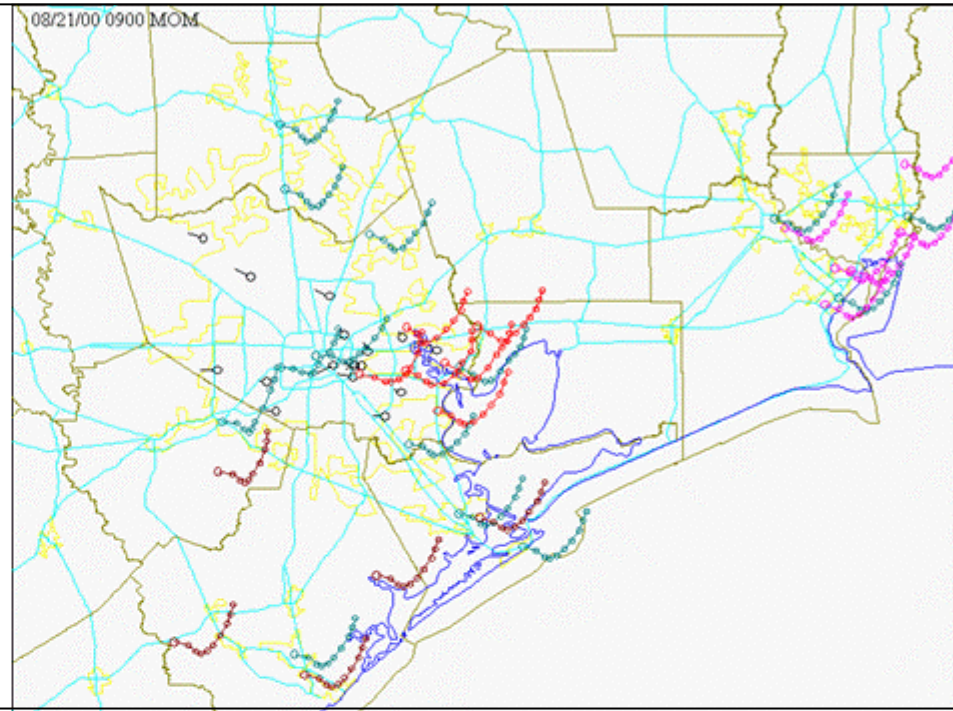
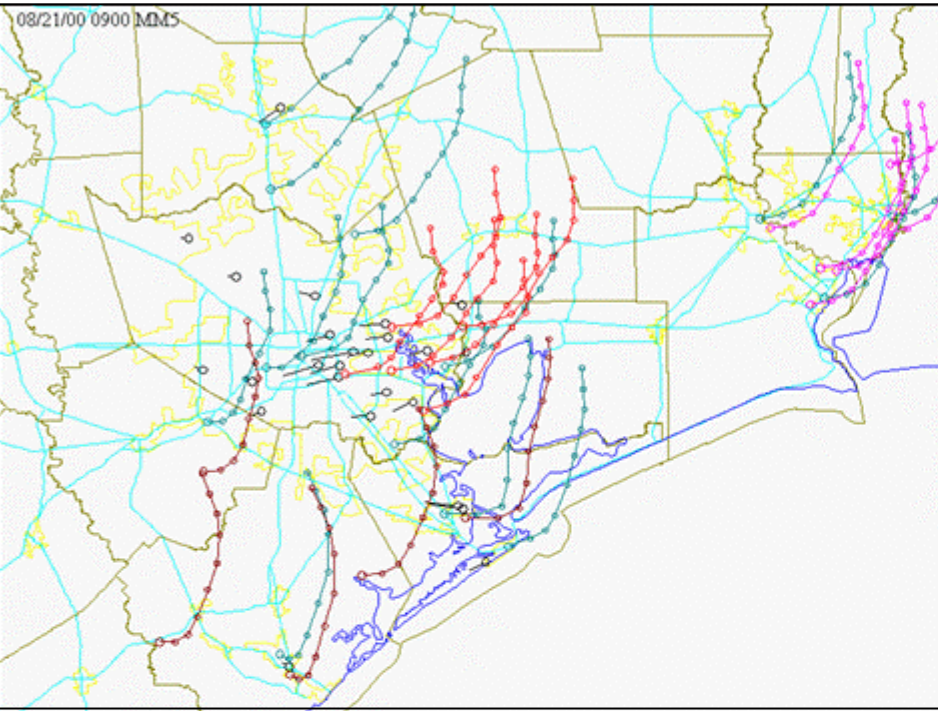
Note: Both Modeling and Observed have been processed by AQPlot

# Observation 8/19/2000

- General air mass movement is replicated
- Wind speeds are 'faster' in MM5
- Scatter-plots show good correlation among the latitudes and longitudes

Modeled

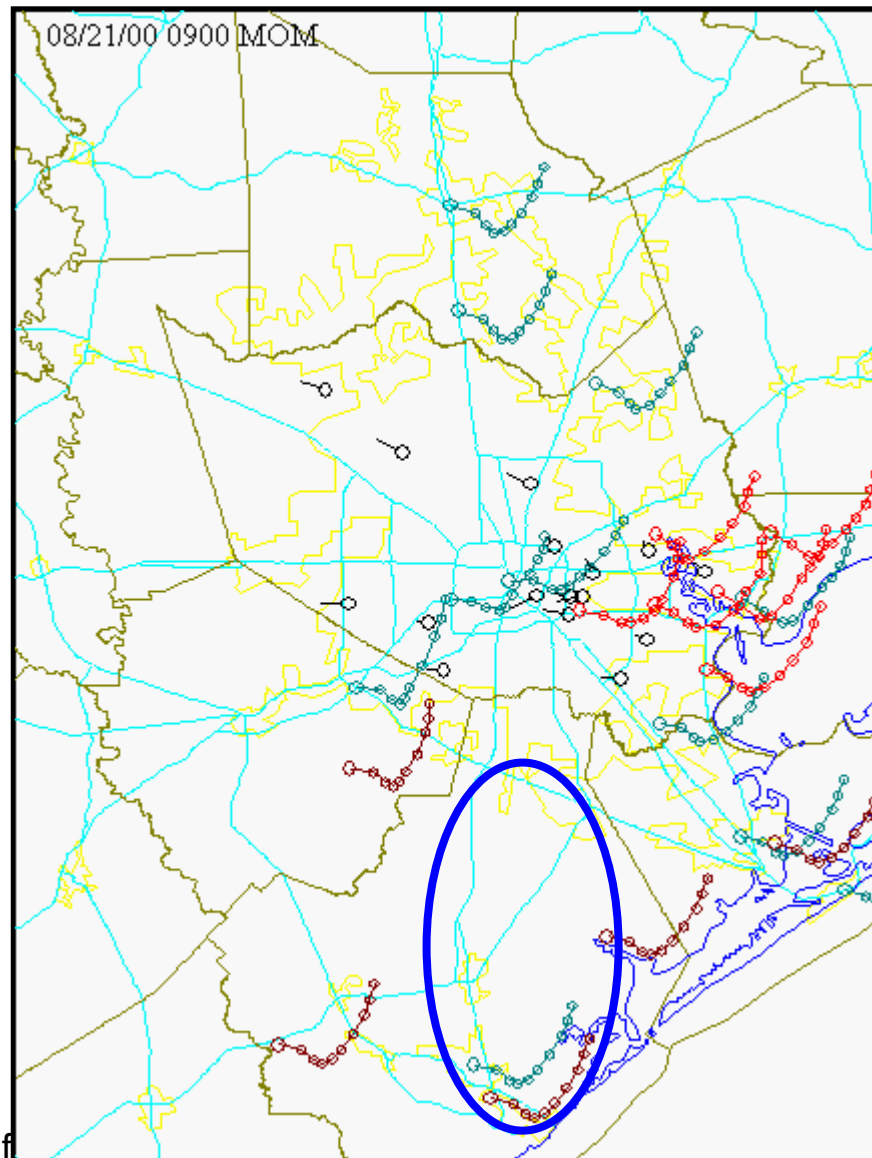
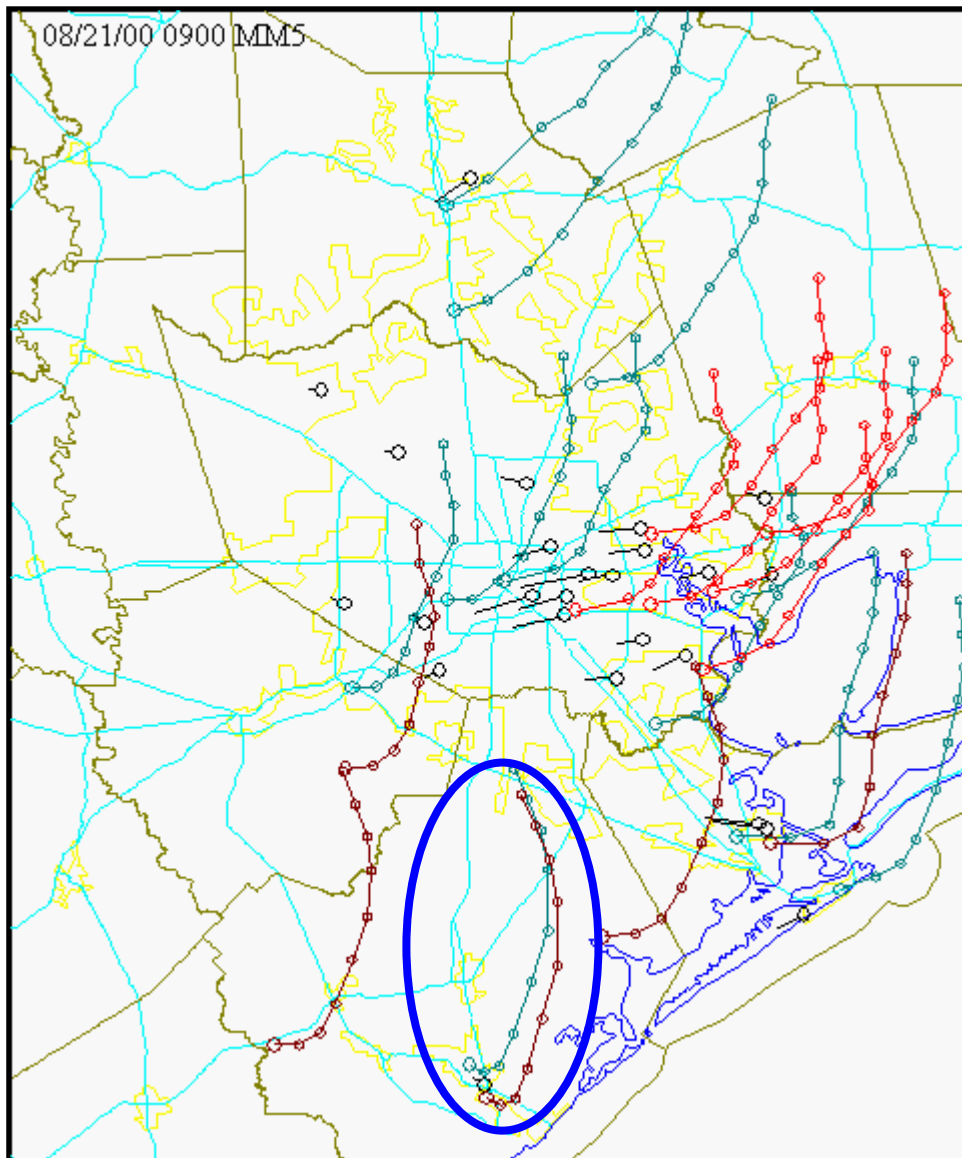
Observed



August 21, 2000

MM5

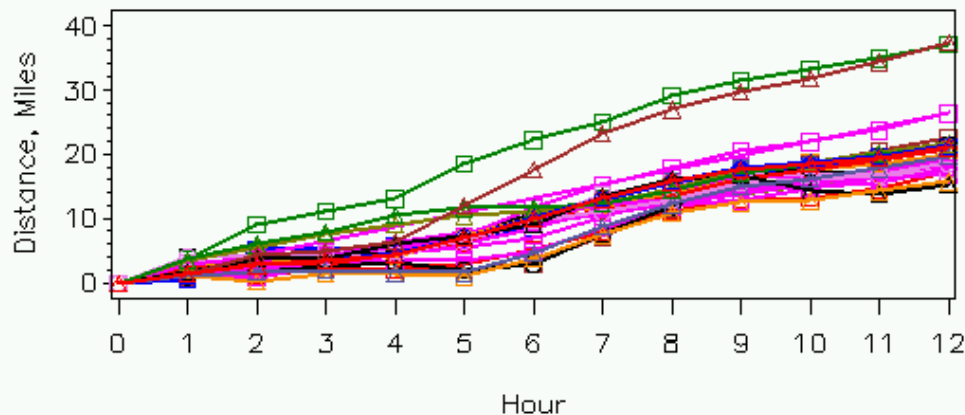
Observed



af

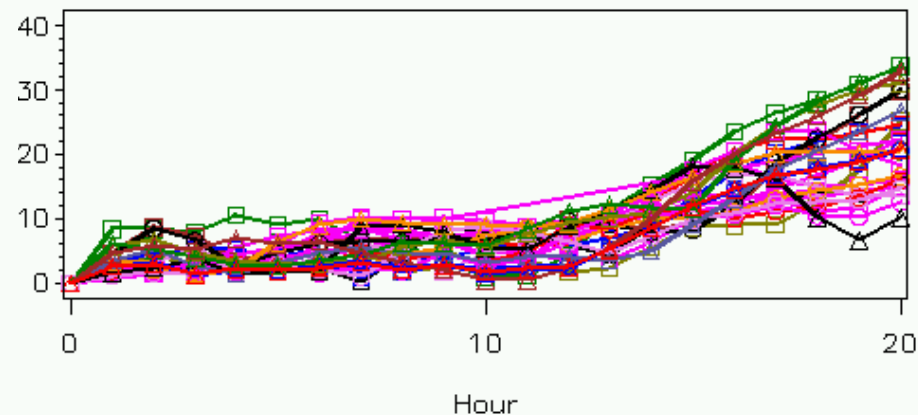
Relative Distance (Obs-MM5) For 08/21/2000

Start Time=12



Relative Distance (Obs-MM5) For 08/21/2000

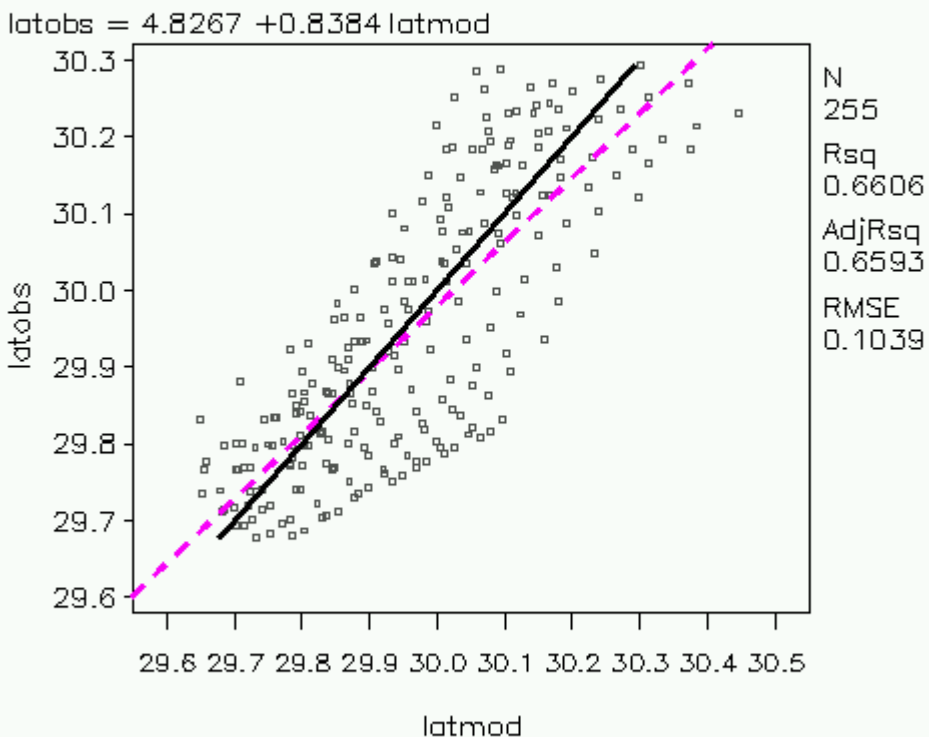
Start Time=20



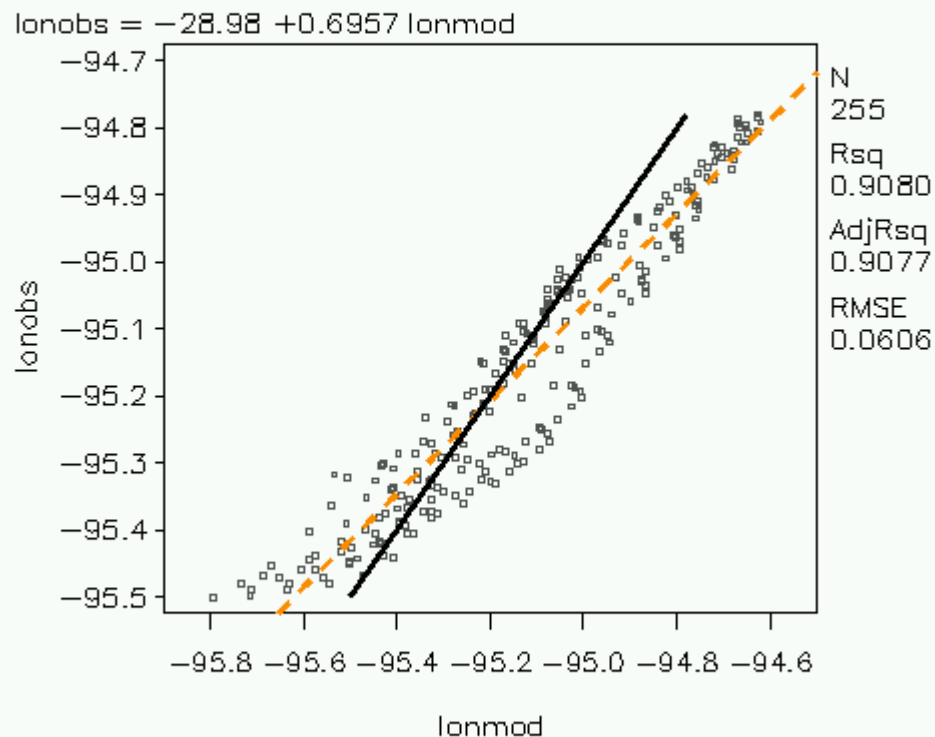
- Site
- |                      |                |
|----------------------|----------------|
| Baytown              | Beaumont       |
| BeaumontSE           | ChocolateBayou |
| Conroe               | Freeport       |
| Galveston            | Houln          |
| Houston              | LaPorte        |
| LakeJackson-Freepart | MontBelvieu    |
| Orange               | PortArthur     |
| PortArthurN          | PortArthurNE   |
| PortArthurSW         | Sheldon        |
| ShipChannelC         | ShipChannelE   |
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| Sweeny               | TexasCity      |
| TexasCity-LaMarque   | TheWoodlands   |
| WOrangeN             | WOrangeS       |

- |                      |                |
|----------------------|----------------|
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| BeaumontSE           | ChocolateBayou |
| Conroe               | Freeport       |
| Galveston            | Houln          |
| Houston              | LaPorte        |
| LakeJackson-Freepart | MontBelvieu    |
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| PortArthurN          | PortArthurNE   |
| PortArthurSW         | Sheldon        |
| ShipChannelC         | ShipChannelE   |
| ShipChannelW         | Sugarland      |
| Sweeny               | TexasCity      |
| TexasCity-LaMarque   | TheWoodlands   |
| WOrangeN             | WOrangeS       |

ShipChannelE Site, Modeling vs. Observed Latitudes  
Date: 2000/08/21 Hour: All



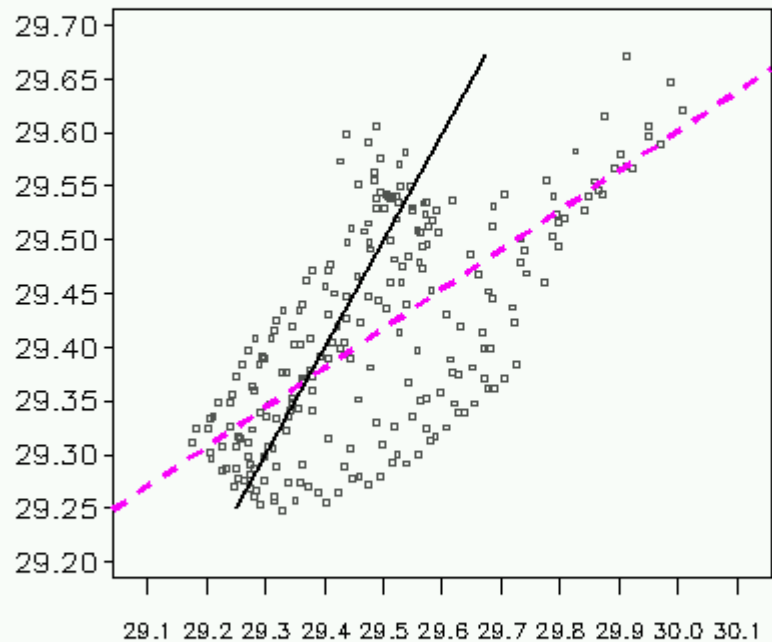
ShipChannelE Site, Modeling vs. Observed Longitudes  
Date: 2000/08/21 Hour: All



Note: Both Modeling and Observed have been processed by AQPlot

Galveston Site, Modeling vs. Observed Latitudes  
Date: 2000/08/21 Hour: All

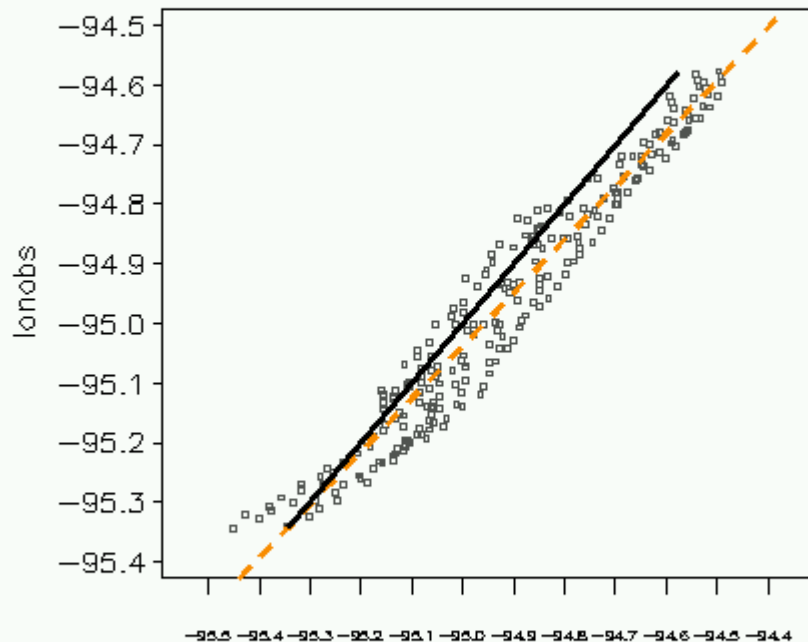
$$\text{latobs} = 18.58 + 0.3674 \text{latmod}$$



N  
255  
Rsq  
0.4502  
AdjRsqr  
0.4480  
RMSE  
0.0764

Galveston Site, Modeling vs. Observed Longitudes  
Date: 2000/08/21 Hour: All

$$\text{lonobs} = -10.735 + 0.8874 \text{lonmod}$$

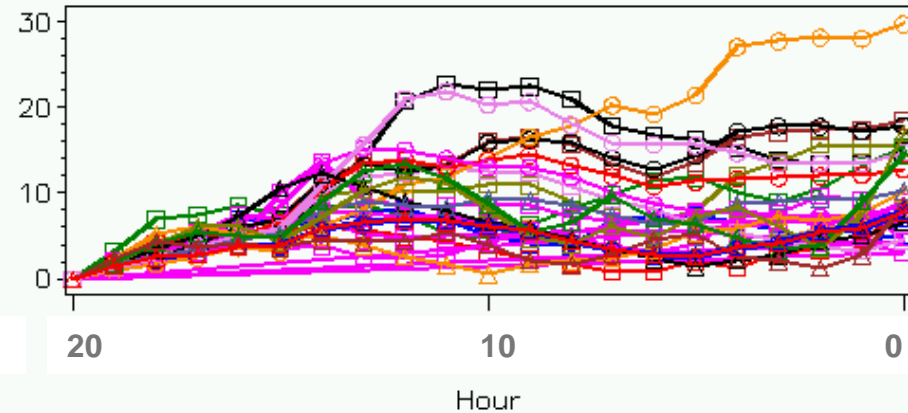
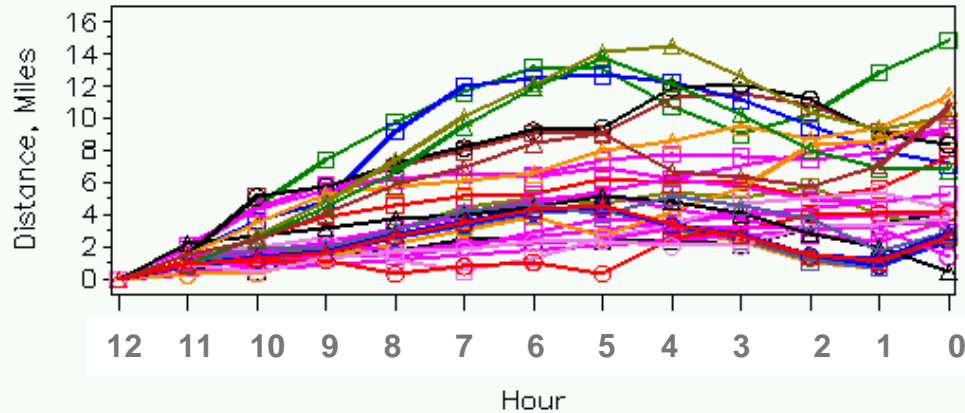


N  
255  
Rsq  
0.9406  
AdjRsqr  
0.9404  
RMSE  
0.0503

Note: Both Modeling and Observed have been processed by AQPlot

Relative Distance (Obs-MM5) For 08/25/2000  
Start Time=12

Relative Distance (Obs-MM5) For 08/25/2000  
Start Time=20



- Site
- |                     |                |
|---------------------|----------------|
| Baytown             | Beaumont       |
| BeaumontSE          | ChocolateBayou |
| Conroe              | Freeport       |
| Galveston           | Houln          |
| Houston             | LaPorte        |
| LakeJackson-Freepor | MontBelvieu    |
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| WOrangeN            | WOrangeS       |

- Site
- |                     |                |
|---------------------|----------------|
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| BeaumontSE          | ChocolateBayou |
| Conroe              | Freeport       |
| Galveston           | Houln          |
| Houston             | LaPorte        |
| LakeJackson-Freepor | MontBelvieu    |
| Orange              | PortArthur     |
| PortArthurN         | PortArthurNE   |
| PortArthurSW        | Sheldon        |
| ShipChannelC        | ShipChannelE   |
| ShipChannelW        | Sugarland      |
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| WOrangeN            | WOrangeS       |

# Observations 8/21/2000

- Early morning winds are not replicated well probably due to low wind speeds.
- MM5 is replicating wind speeds faster.
- Fast winds can have the effect of diluting precursors of ozone thus lowering modeled ozone.
- Fit parameters vary from site to site and tend to vary.
- Overall replication is not 'so great', worse in the morning. Some problems in the evening too.
- Errors are probably being propagated.

# Daily Parameter Summary Comparison

Date	General Air Mass Replication Movement *	Average			
		RSME, deg		R <sup>2</sup>	
		Latitude	Longitude	Latitude	Longitude
August 19, 2000	Good	0.036	0.054	0.965	0.820
August 21, 2000	O.K., problems both in early and late hours. Low wind speed problems	0.096	0.064	0.598	0.909
August 25, 2000	Good	0.057	0.052	0.867	0.905
August 30, 2000	O.K., problems with low wind speeds	0.104	0.035	0.323	0.977
Sept 5, 2000	O.K., problems with low wind speeds	0.086	0.065	0.662	0.388

# In General,

- MM5 does replicate the general air mass movement but,
- MM5 has difficulty replicating stagnant wind or low wind speeds.
- Error is incurred and carried throughout the day, because early morning winds tend to be low.
- MM5 seems to have 'faster' wind speeds.

# Future Work

- Residence time of plumes over source regions.
- Comparing individual 'plumes' over source regions.
- Create better descriptive statistics.
- Incorporate mixing heights.

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## Acknowledgements:

Sharon McDonald for creating all the plume plots.