DRIFTSIM

A user-friendly computer program for estimating drift distances of droplets

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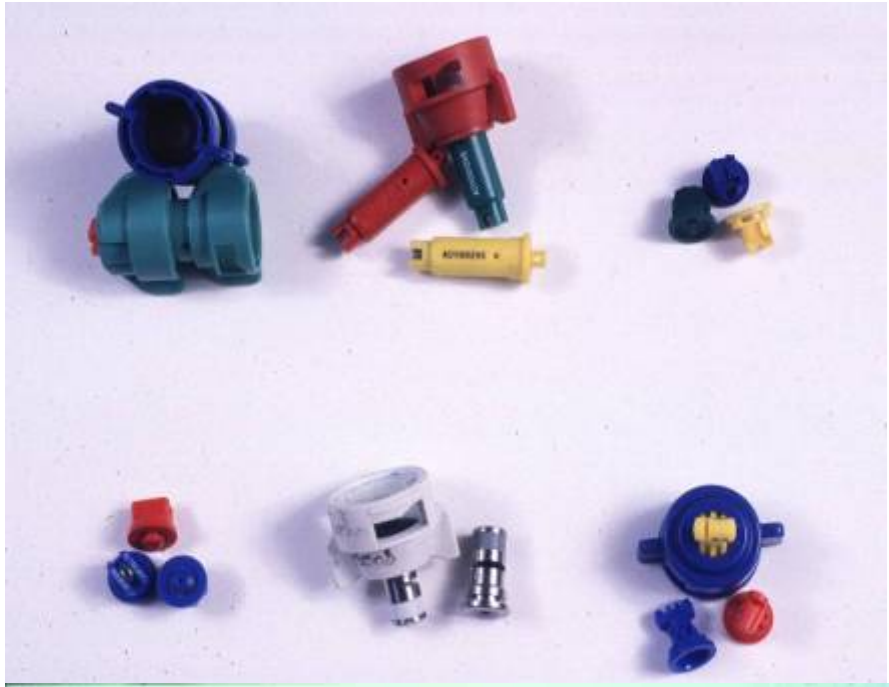
WHY DRIFTSIM ??

What have we done so far?

Delivering strong educational programs




MF


CHEM-TROL
TARGET
GET DOWN

OSU Extension

Bulletin 816

http://ohioline.osu.edu/b816/index/html

OSU Extension Publications:

- **Bulletin 816**

  Reducing Spray Drift

  http://ohioline.osu.edu/b816

- **Factsheet AEX 523**

  New nozzles for spray drift reduction

  http://ohioline.osu.edu/aex-fact/0523

- **Factsheet AEX 524**

  Effectiveness of TurboDrop and TurboTeejet nozzles in drift reduction

  http://ohioline.osu.edu/aex-fact/0524

OSU Extension Publication:

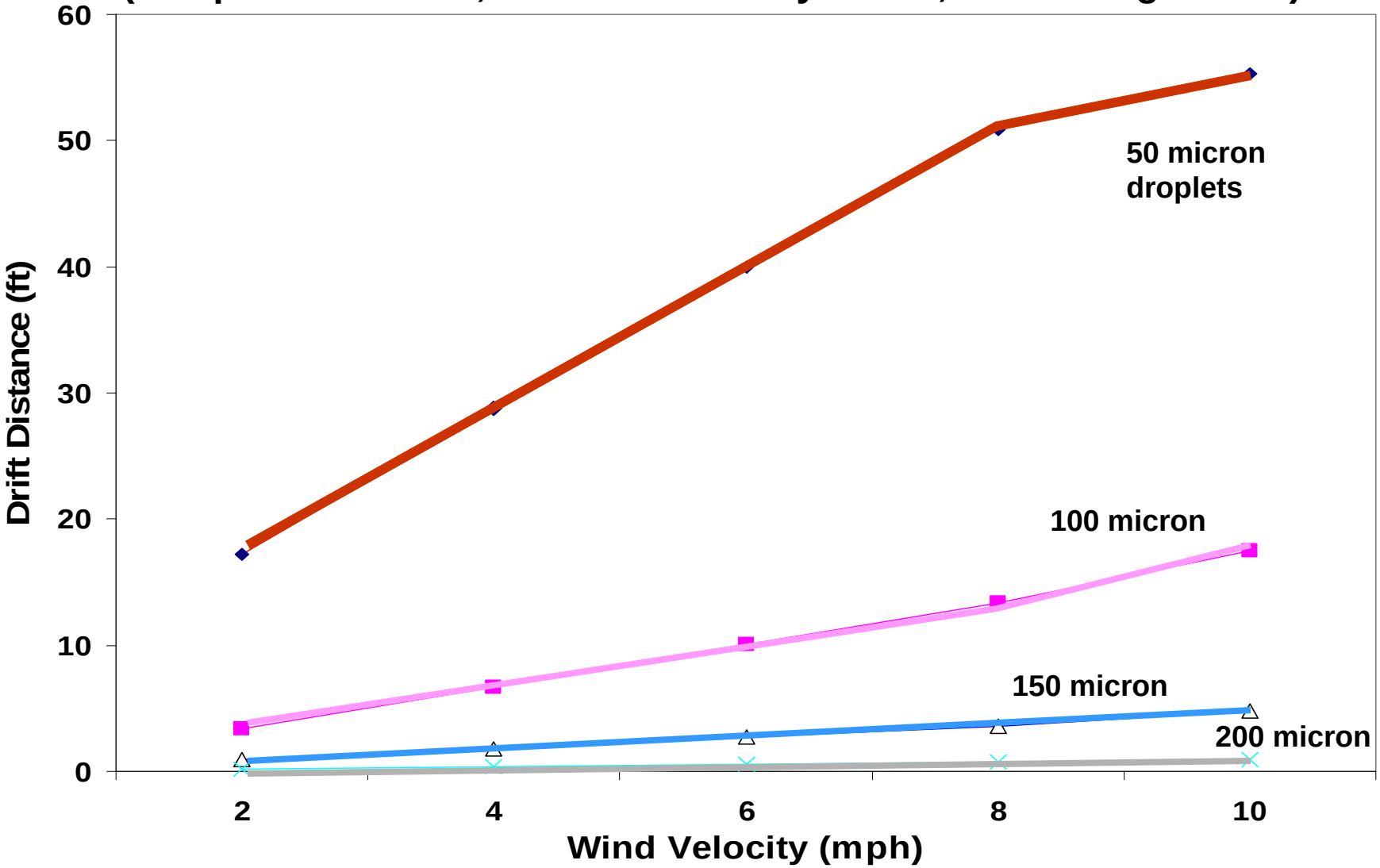
Factsheet AEX 525

Effect of major variables on drift distances of spray droplets

http://ohioline.osu.edu/aex-fact/0525

Effect of Wind Velocity on Drift

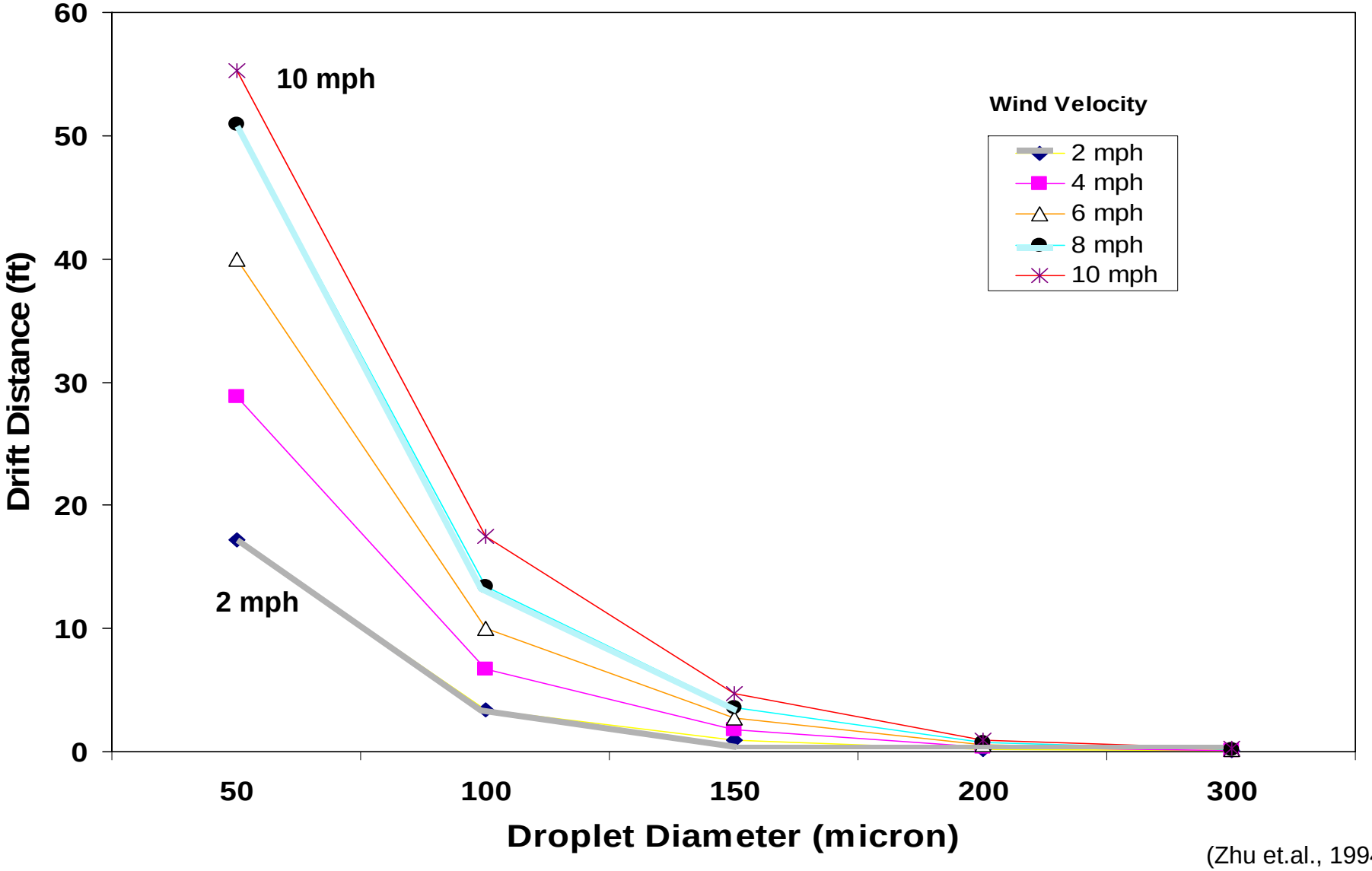
(Temperature= 75 F; Relative Humidity = 60%, Boom Height= 18”).



(Zhu et.al., 1994)

Effect of Droplet Size on Drift

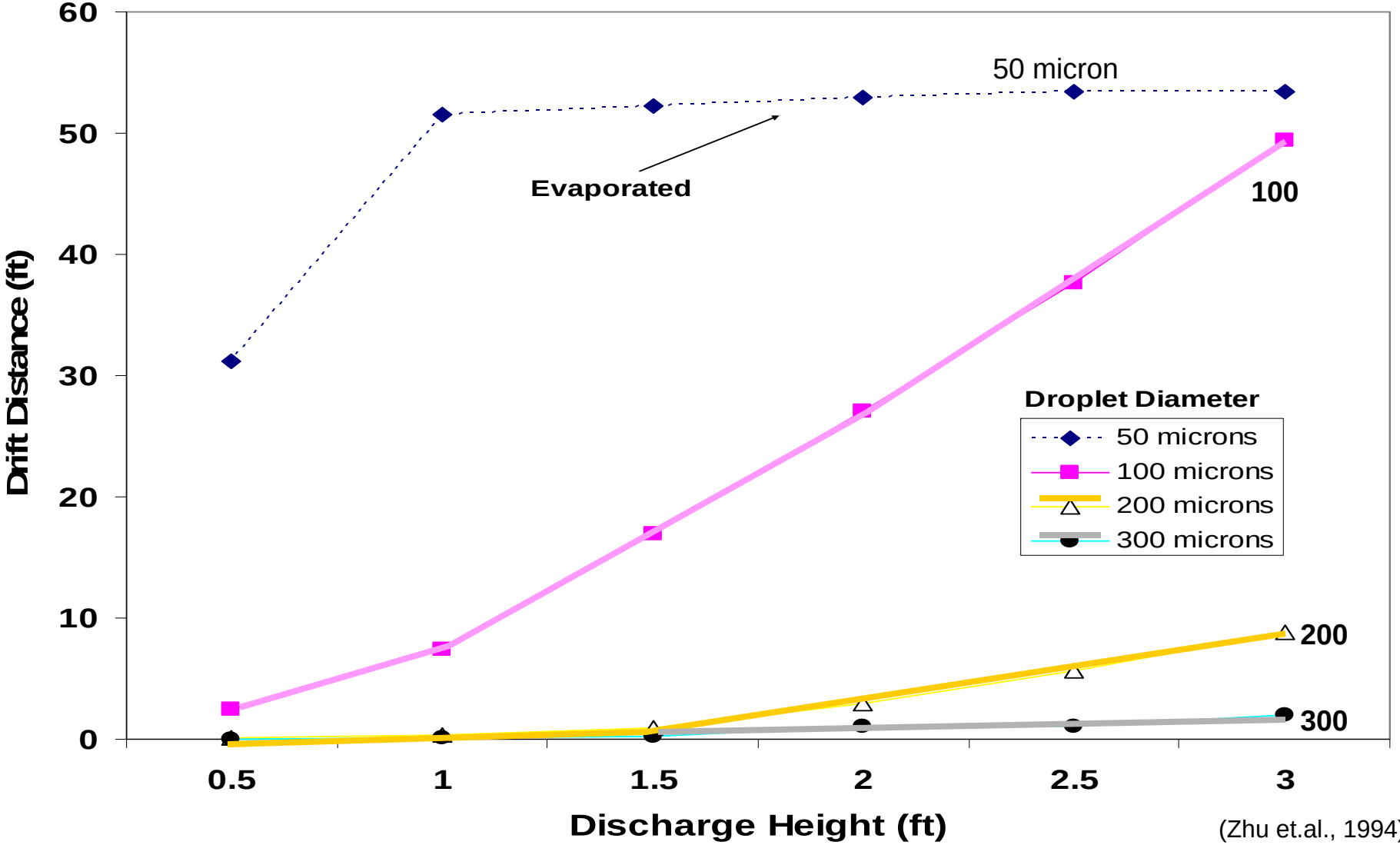
(Temperature= 75 F; Relative Humidity = 60%, Boom Height= 18”)



(Zhu et.al., 1994)

Effect of Boom Height on Drift

(Temperature= 65 F; Relative Humidity = 50%; Wind Speed: 10 mph)



(Zhu et.al., 1994)

What have we done so far?

What more can we do?

What more can we do?

Need another educational tool to:

- More effectively demonstrate influence of various factors on reducing drift
- Be able to quickly give answers to "what if…" type questions on factors affecting drift.

Simulation of Drift from Ground Sprayers

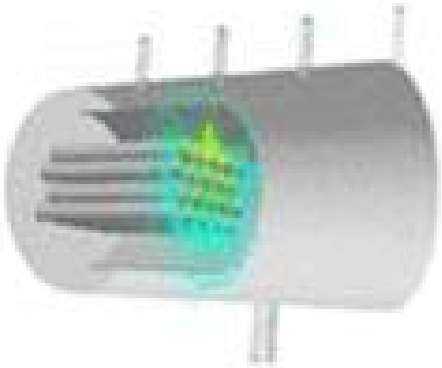
Zhu, H., D.L. Reichard, R.D. Fox, R.D. Brazee and H.E. Ozkan. 1994. Simulation of drift of discrete sizes of water droplets from field sprayers. Transactions of the ASAE 37(5):1401-1407.

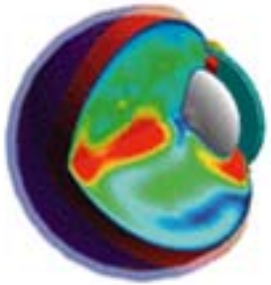
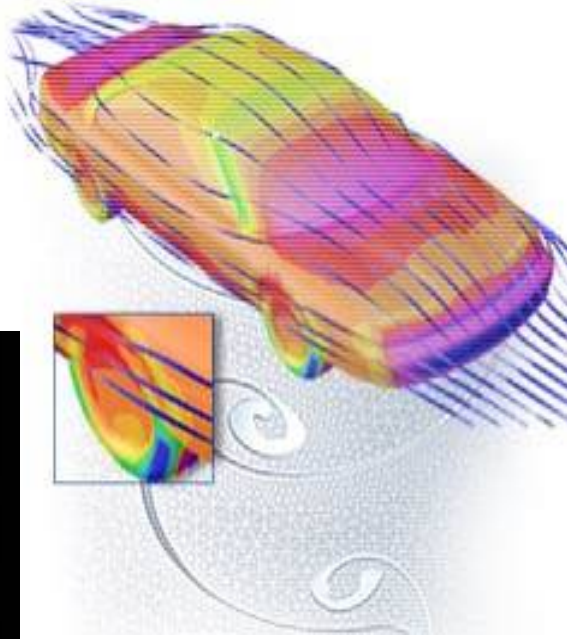
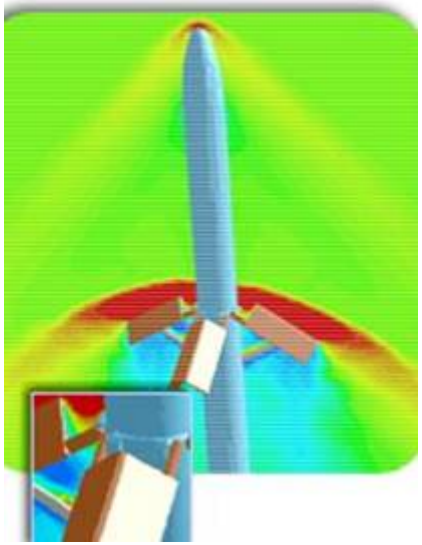
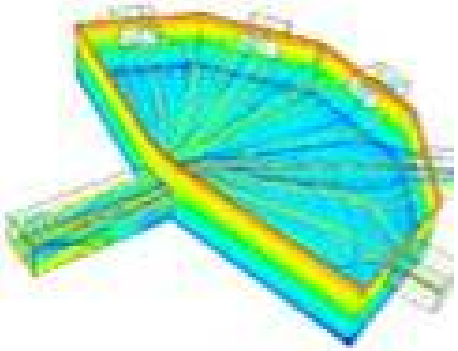
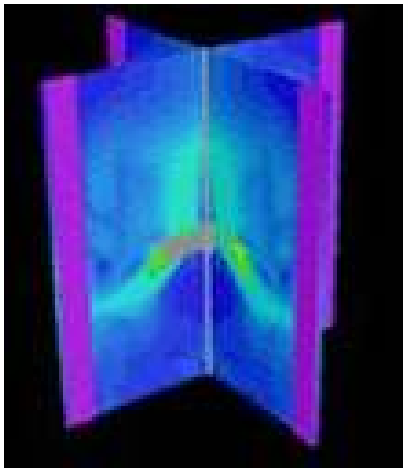
Model

- **Data base from simulations using *FLUENT*, a Computational Fluid Dynamics model (CFD)**

FLUENT – CFD Model

Flow and heat transfer modeling software suited to a wide range of applications.

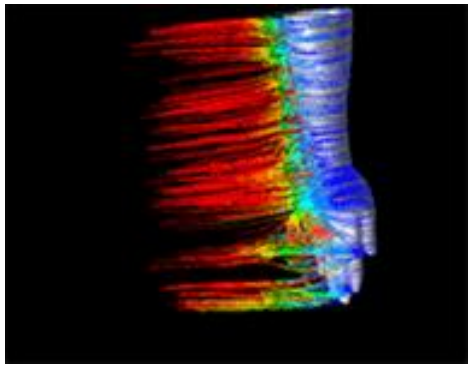


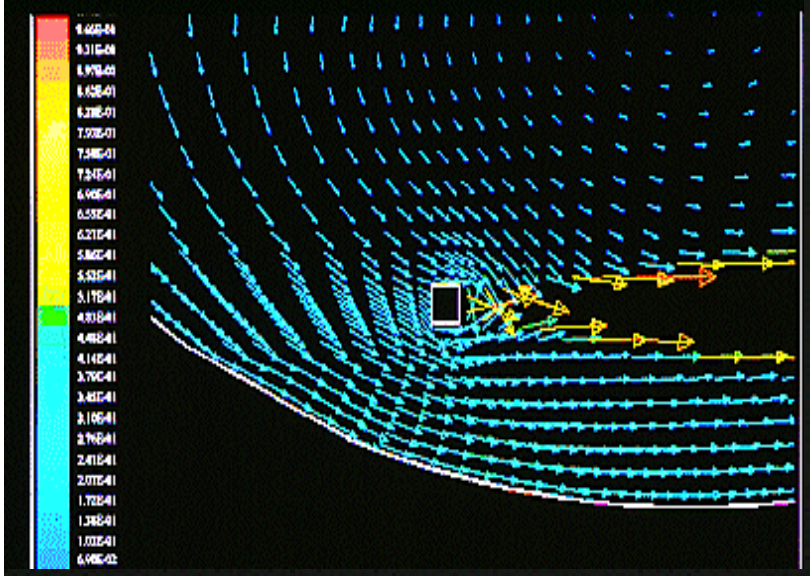
"Designing" the Optimum Stroke

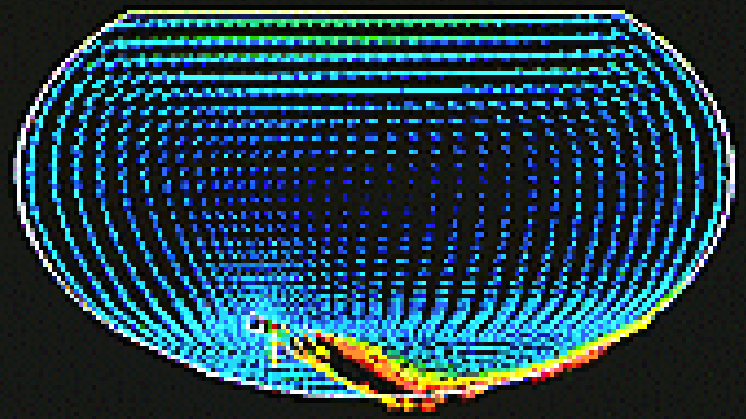
USA SWIMMING

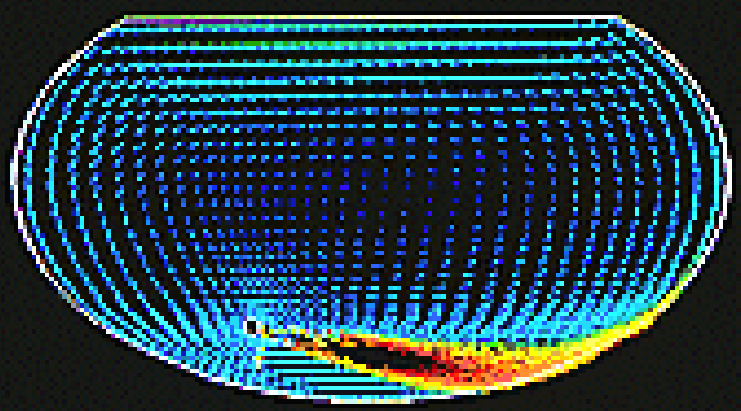
Fluent Inc.

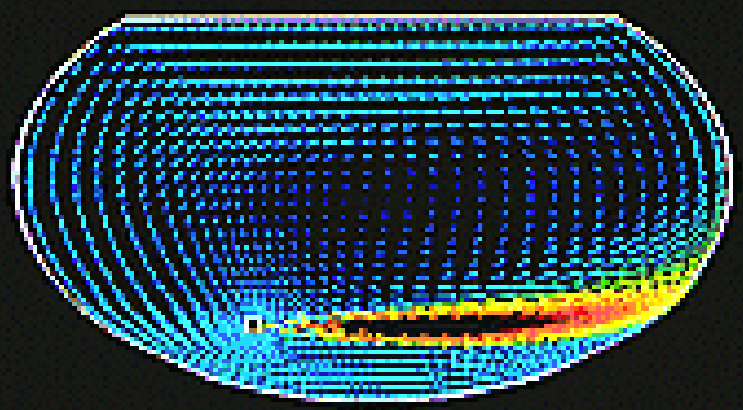


FLUENT – Sprayer agitator design



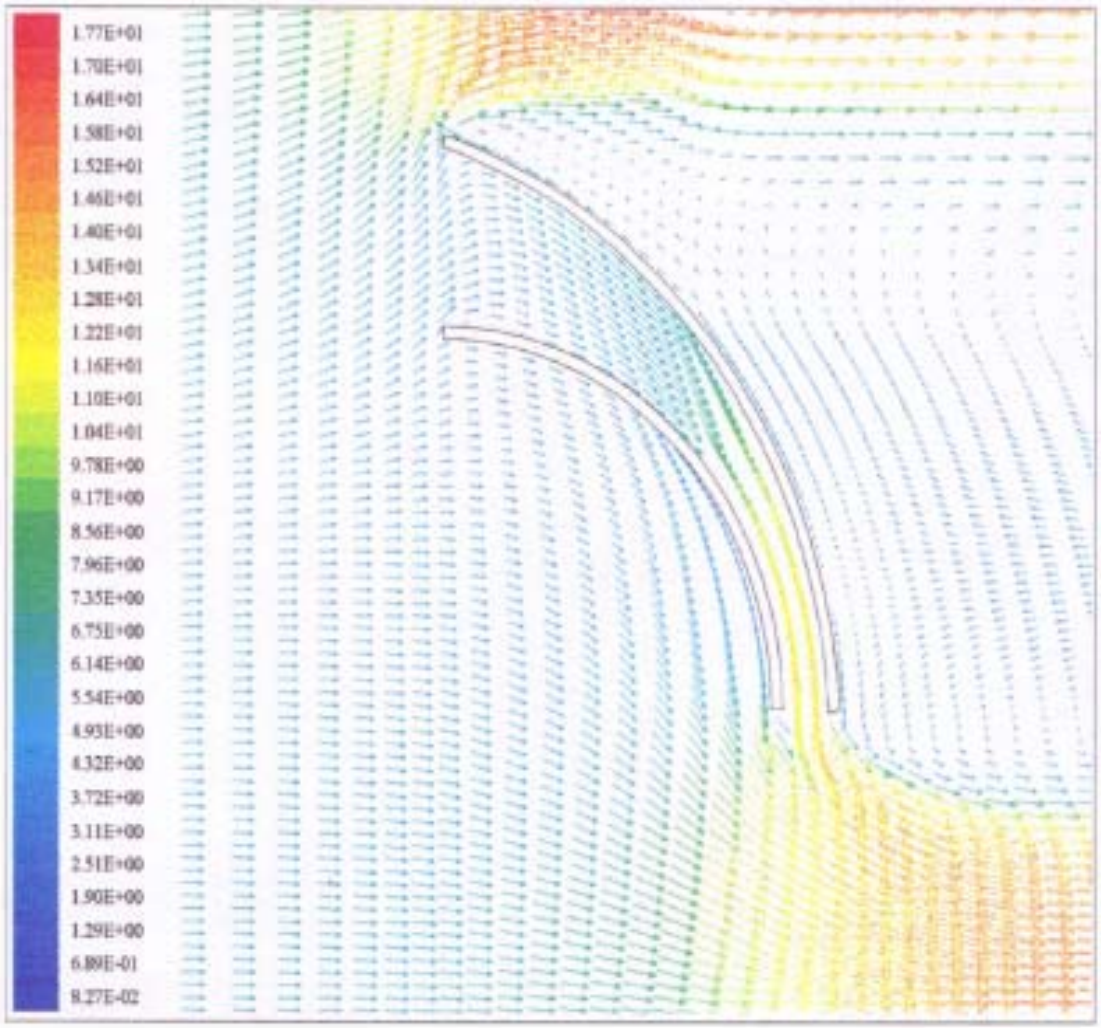






FLUENT – Sprayer shield design

Air velocity, m/s



Variables

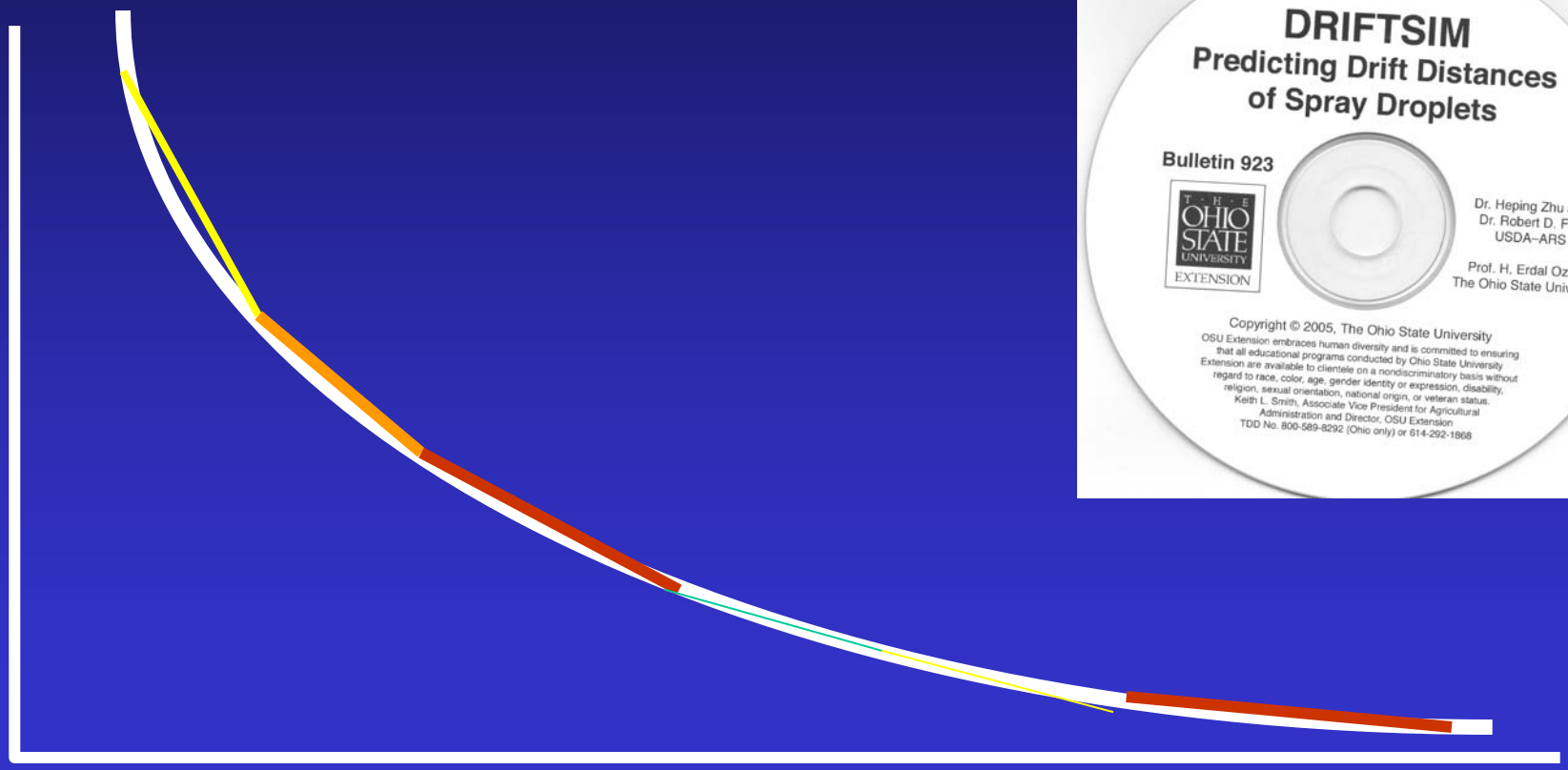
- Temperature
- Droplet discharge height (nozzle height)
- Droplet velocity
- Relative humidity
- Wind velocity
- Droplet size

- 2,816,000 simulated mean drift distances

- Calculated with FLUENT and stored in 3200 data files

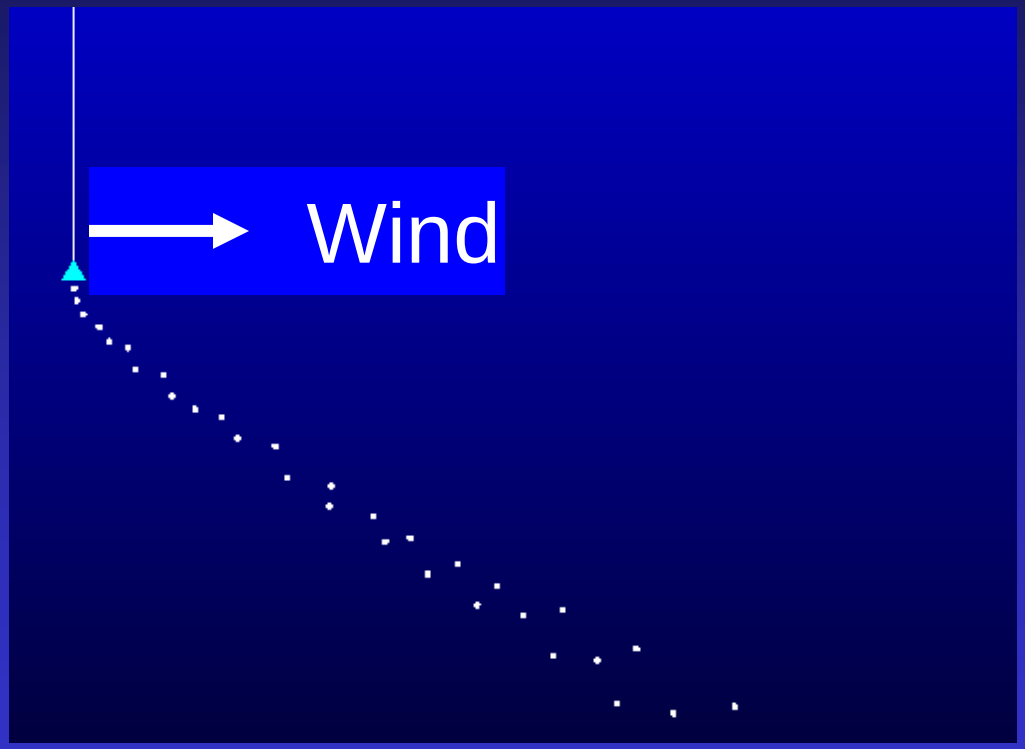
Interpolation

Fluent Data ⟶ DRIFTSIM



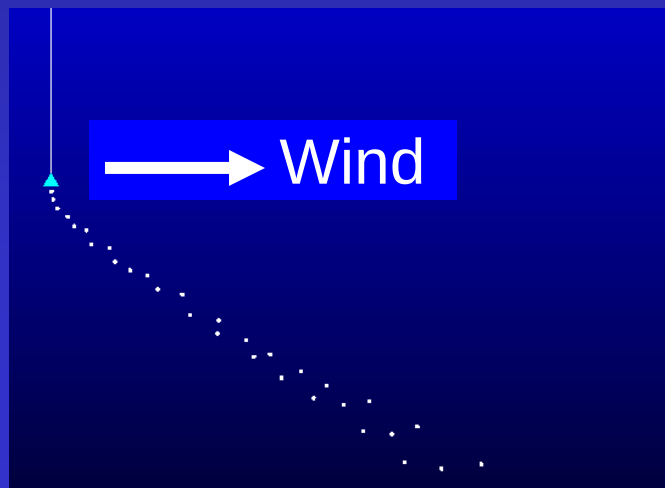
DRIFTSIM

- **Visual BASIC language program**



DRIFTSIM

- Visual BASIC language program
- Data base from simulations using a CFD model
- **Determines drift distances of droplets up to 656 ft** (200m) **from point of discharge**



DRIFTSIM

- Visual BASIC language program (Windows)
- Data base from simulations using a CFD model
- Determines drift distances of droplets up to 200 m from point of discharge
- Can be used to determine effects of individual variables on drift distances of droplets

DRIFTSIM-- Input parameters

- Temperature
- Droplet discharge height (nozzle height)
- Droplet velocity
- Relative humidity
- Wind velocity
- Droplet size

Variables and Values used in Simulations for Database

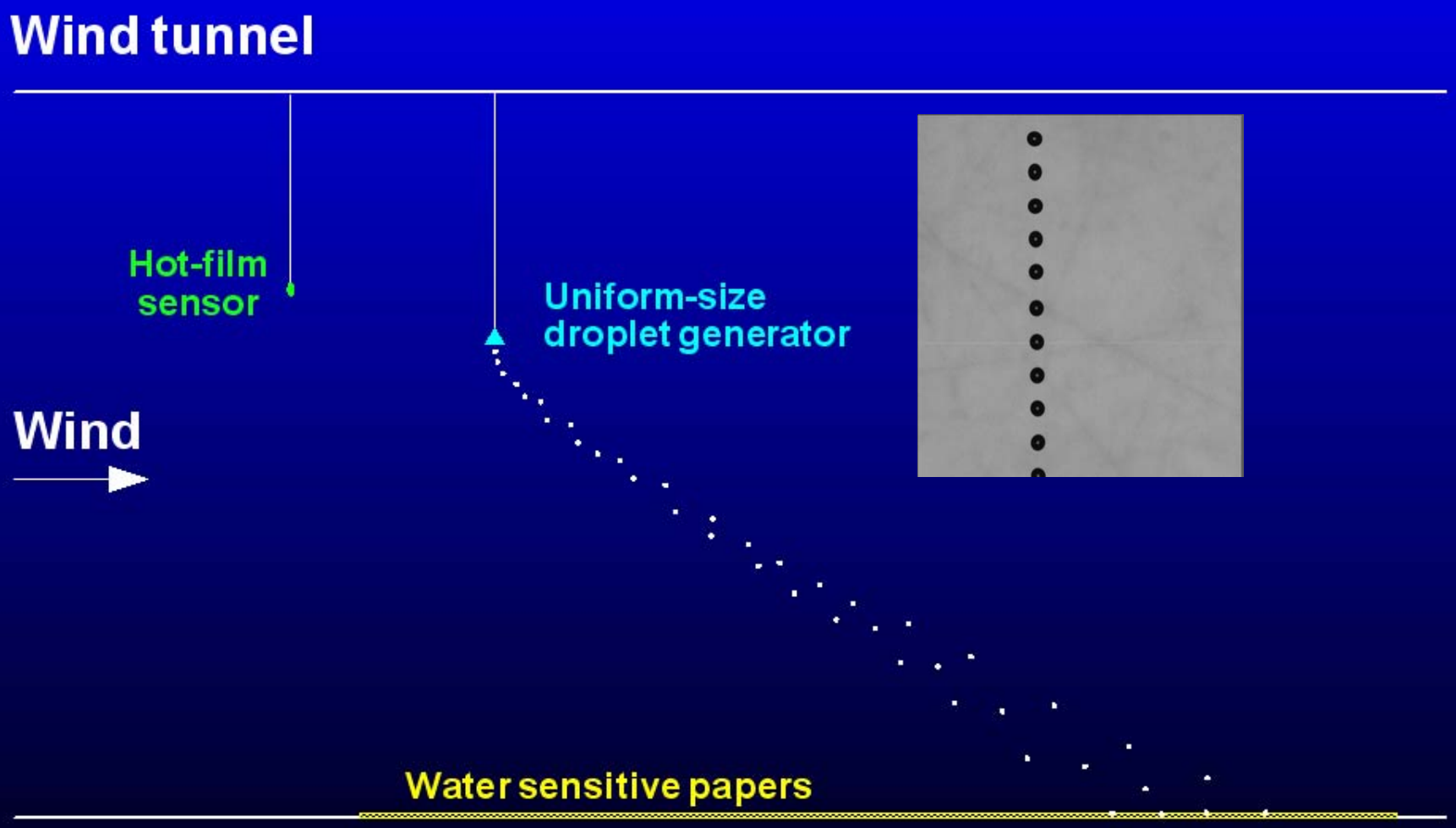
Variable	Units	Range
Temperature	ºF (ºC)	50-86 (10-30)
Nozzle height	ft (m)	0-6.5 (0-2)
Droplet velocity	mph (m/s)	0-110 (0-50)
Relative humidity	%	10-100
Wind velocity	mph (m/s)	0-22 (0-10)
Droplet size	micron	10-2000

OUTPUT

- **One of 2 statement types:**

1. "Droplet would completely evaporate after traveling about (S) distance downwind".
2. "Droplet would drift about (S) distance downwind".

MODEL VERIFICATION

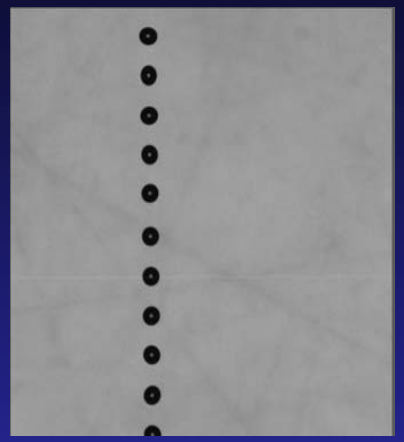


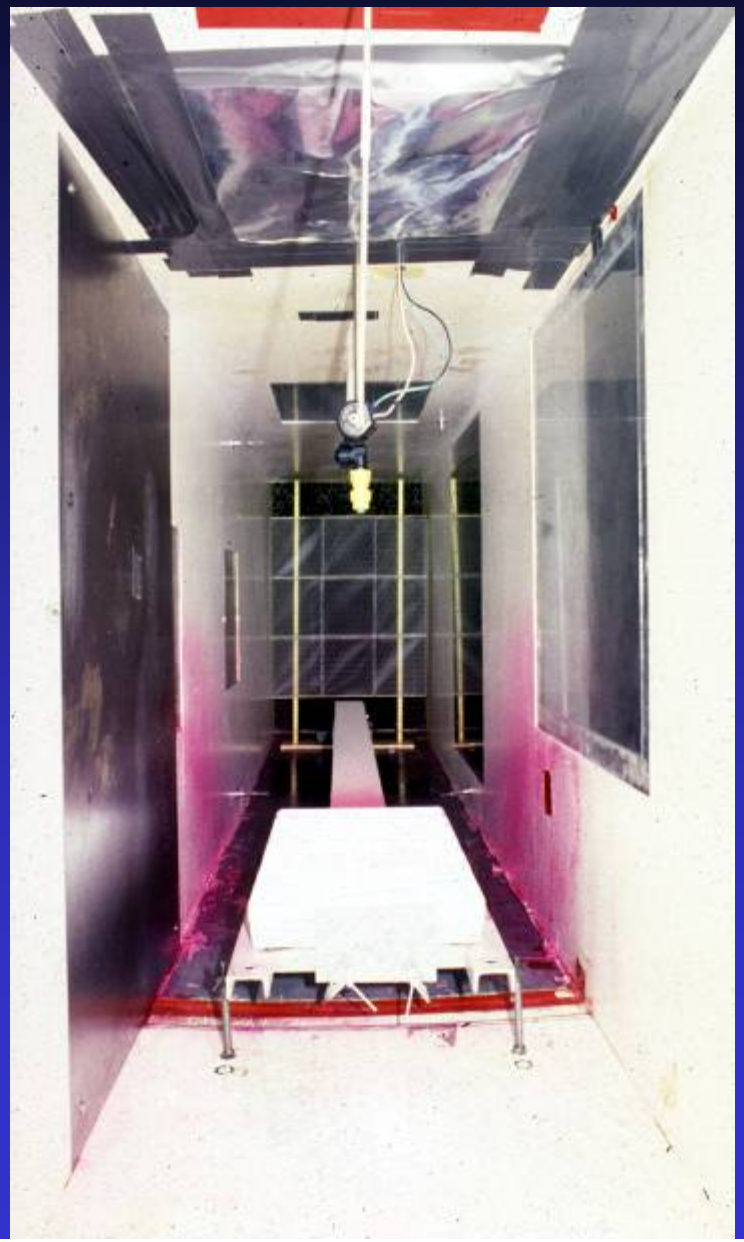
MODEL VERIFICATION

Detailed Information:

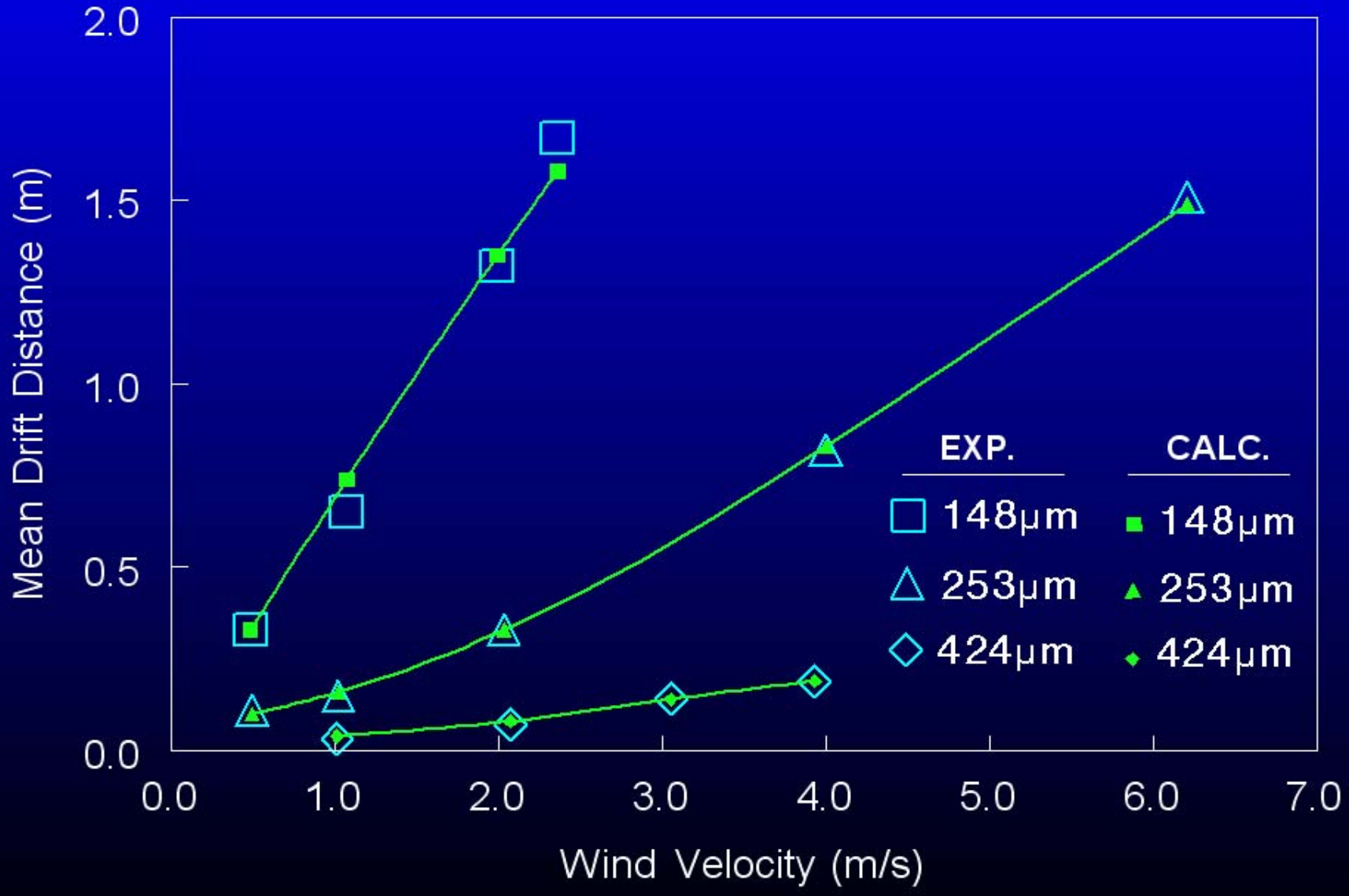
Reichard, D.L., H. Zhu, R.D. Fox, and R.D. Brazee. 1992. Wind tunnel evaluation of a computer program to model spray drift. Transactions of the ASAE 35(3):755-758.

Model Verification





Wind Tunnel Varification of Accuracy of FLUENT Simulation



Droplet Size (micron)	Wind Velocity (ft/s)	Drift Distance (ft)		Difference (ft)
		FLUENT	DRIFTSIM	
15	1.6	1.5*	1.9*	0.33
15	16.4	9.8*	11.1*	1.31
15	32.8	15.8*	18.0*	2.20
110	1.6	1.6	1.7	0.10
110	16.4	16.4	17.2	0.79
110	32.8	33.5	34.9	1.48
325	1.6	0.03	0.03	0.00
325	16.4	0.23	0.26	0.03
325	32.8	0.46	0.56	0.01
1050	1.6	0.00	0.00	0.00
1050	16.4	0.03	0.04	0.00
1050	32.8	0.07	0.09	0.03

*Droplets evaporated before deposition

DRIFTSIM

Version 1.12.04

Created by

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Application Technology Research Unit
USDA-ARS

and Dr. H. Erdal Ozkan

Professor and Extension Agricultural Engineer

Food, Agriculture, and Biological Engineering Department
The Ohio State University

Start Driftsim

DRIFTSIM

DRIFTSIM options

- American
- Metric

To change data values, just type in new values. If unknown,drop velocity may be calculated;click on droplet velocity box. Enter spray pressure in the pop-up box

Droplet diameter (µm)	200
Discharge height (ft)	2
Wind velocity (mph)	10
Relative humidity (%)	40
Temperature (°F)	86
Droplet velocity (mph)	44.7

Calculate drift distance

- Single size droplets
- Array of droplets (DVs)
- Array of droplets (nozzle)

1 Orifice Nozzle | 2 Orifice Nozzle

Flat fan nozzles: Enter system pressure to compute drop velocity.

Pressure	Velocity
psi	mph
40	44.74

Continue

DRIFTSIM

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Droplet diameter (µm)	200
Discharge height (ft)	2
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Droplet would drift about 2.92 ft downwind.

Calculate drift distance

Print Results

- Single size droplets
- Array of droplets (DVs)
- Array of droplets (nozzle)

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Continue

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Wind velocity (mph)	10
Relative humidity (%)	40
Temperature (°F)	86
Droplet velocity (mph)	44.7

- ( ) Single size droplets
- (•) Array of droplets (DVs)
- ( ) Array of droplets (nozzle)

Enter Drop Size Distribution

DV.1	DV.5	DV.9
75	172	296

Calculate Drift Distance

Report: Date: May 13, 2005Time: 2:19:40 PM

Discharge Height (ft)	2
Wind Velocity (miles/hr)	10
Relative Humidity (%)	40
Temperature (°F)	86
Droplet Velocity (miles/hr)	44.7

Dv0.1 = 75 Dv0.5 = 172 Dv0.9 = 296

Class No.	width (µm)	Portion of volume	Mean drift distance (ft)
1	19 - 56	0.01	21.65 *
2	56 - 94	0.09	59.45
3	94 - 138	0.16	20.38
4	138 - 170	0.17	8.43
5	170 - 201	0.13	4.1
6	201 - 233	0.12	2.07
7	233 - 264	0.10	1.12
8	264 - 296	0.08	0.69
9	296 - 328	0.13	0.49

* Droplets completely evaporated before deposition

Calculate another drift distance

Print Results

DRIFTSIM

DRIFTSIM options

- (•) American
- ( ) Metric

To change data values, just type in new values. If unknown,drop velocity may be calculated;click on droplet velocity box. Enter spray pressure in the pop-up box

Discharge height (ft)	2
Wind velocity (mph)	10
Relative humidity (%)	40
Temperature (°F)	86
Droplet velocity (mph)	44.7

- ( ) Single size droplets
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Enter Drop Size Distribution

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Calculate Drift Distance

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Discharge height (ft)	2
Wind velocity (mph)	10
Relative humidity (%)	40
Temperature (°F)	86
Droplet velocity (mph)	44.7

Examples:Nozzle type and pressure, click to select

- XR8001_40
- XR8001_60
- XR8002_40
- XR8003_40
- XR8004_40
- XR8006_40
- XR8007_40
- XR8008_40

DRIFTSIM

DRIFTSIM options

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- ( ) Metric

- ( ) Single size droplets
- (•) Array of droplets (DVs)
- ( ) Array of droplets (nozzle)

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Discharge height (ft)	2
Wind velocity (mph)	10
Relative humidity (%)	40
Temperature (°F)	86
Droplet velocity (mph)	44.7

Enter Drop Size Distribution

Nozzle type: XR8002_40

DV.1	DV.5	DV.9
112	237	427

Calculate Drift Distance

Report: Date: Dec 07, 2004Time: 1:38:12 PM

Discharge Height (ft)	2
Wind Velocity (miles/hr)	10
Relative Humidity (%)	40
Temperature (°F)	86
Droplet Velocity (miles/hr)	44.74

Dv0.1 = 112 Dv0.5 = 237 Dv0.9 = 427

Class No.	width (µm)	Portion of volume	Mean drift distance (ft)
1	28 - 84	0.01	41.11 *
2	84 - 140	0.09	49.87
3	140 - 202	0.18	15.81
4	202 - 247	0.18	8.14
5	247 - 292	0.14	4.79
6	292 - 337	0.12	2.95
7	337 - 382	0.09	1.9
8	382 - 427	0.07	1.31
9	427 - 472	0.13	1.02

* Droplets completely evaporated before deposition

Calculate another drift distance

Print Results

Limitations of DRIFTSIM

- **This is a <u>MODEL</u> to estimate the <u>relative</u> effects of variables on drift of uniform size droplets discharged from a nozzle.**

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- Predictions are based on Water droplets

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- In spray cloud, small droplets may not evaporate as fast as the program predicts for individual droplets.

Limitations of DRIFTSIM

- This is a MODEL to estimate the relative effects of variables on drift of uniform size droplets discharged from a nozzle..
- Predictions are based on Water droplets
- In spray cloud, small droplets may not evaporate as fast as the program predicts for individual droplets.
- Should not be used for air-assisted spray droplets.

DRIFTSIM

Advantages

- Excellent teaching tool
- Verified
- User-friendly
- Does not require a high-power computer

DRIFTSIM

Journal Article

Zhu H., D.L. Reichard, R.D. Fox, H.E. Ozkan and R.D. Brazee. DRIFTSIM, a program to estimate drift distances of spray droplets. Applied Engineering in Agriculture 11(3):365-369.

Detailed instructions for running DRIFTSIM are available online

(http://ohioline.osu.edu/b923/pdf/b923.pdf)

The DRIFTSIM software can be purchased at $10

From:

Ohio State University Communications and Technology Office

(http://ohioline.osu.edu/b923/)

Dept. of Food, Agricultural & Biological Engineering

Erdal Ozkan

Professor and Extension Agric. Engineer

THE OHIO STATE UNIVERSITY