Drift and Nozzle Classification Issues with ASAE Standard S572 Aug99 Boundaries

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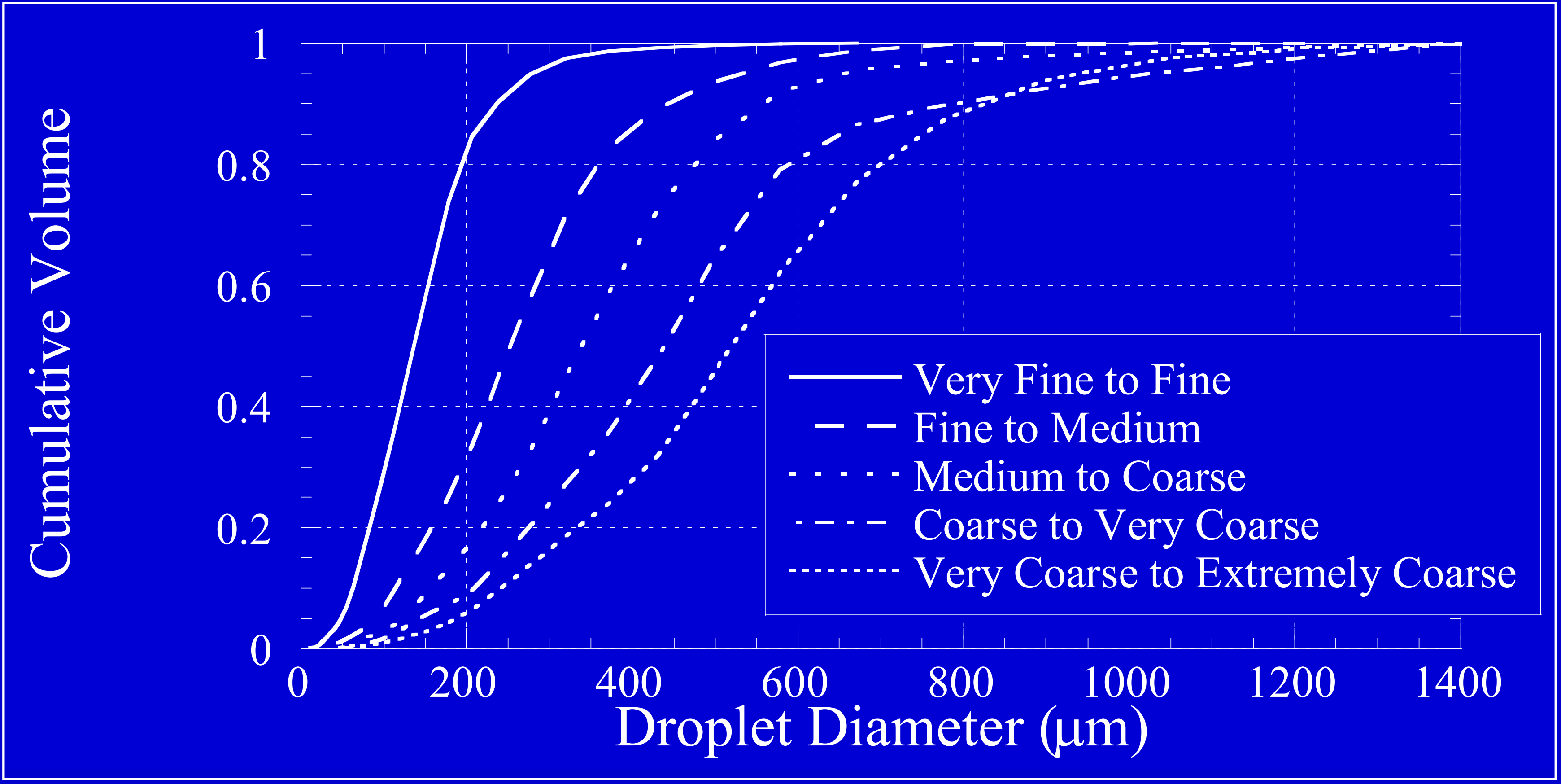
Overview

- ASAE Standard S572 Aug99 helped the industry and applicators respond to drift issues raised by the EPA and concerned environmental groups -- by establishing a method whereby drop size distributions can be classified to reflect their drift potential.
- Based on a BCPC scheme for ground-based applications with flat-fan nozzles, the ASAE Standard identified the classification categories of Very Fine, Fine, Medium, Coarse, Very Coarse, and Extremely Coarse.
- Reference nozzles were selected to delineate the boundaries of these categories.

ASAE Standard S572 Aug99

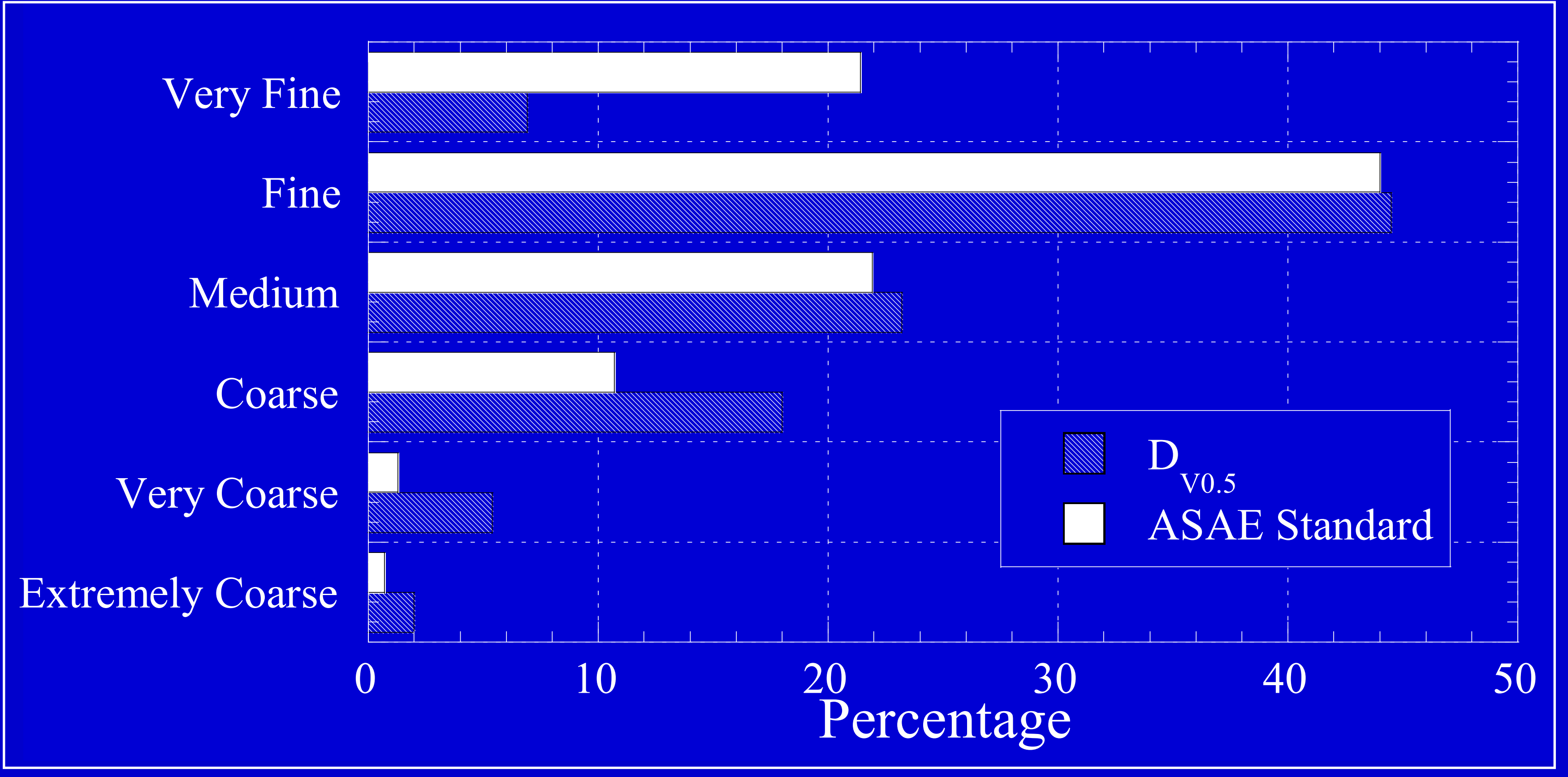


Standard Rules

- The ASAE Standard is built on the requirement that the finest category containing $D_{V0.1}$, $D_{V0.5}$, or $D_{V0.9}$ shall be the classification of the nozzles whose drop size distribution is represented by these parameters. The classification scheme is challenged when $D_{V0.1}$, $D_{V0.5}$, and/or $D_{V0.9}$ fall into different categories, particularly when $D_{V0.9}$ suggests a finer category than suggested by $D_{V0.1}$ or $D_{V0.5}$.

- These crossings were not fully appreciated during the selection of the standard nozzles, but are fairly common for many nozzle types and tank mixes.

SDTF Atomization Database



Other Standard Problems

- The reference nozzles are flat-fan nozzles, and there is a concern of possible bias in categorizing other nozzle types with the same standard.
- The reference nozzles are for ground applications, and there is also a concern that aerial nozzle operation -- at airspeeds well above the wind tunnel speeds used to generate the drop size distribution classifications -- may bias the standard as well.

Proposed Approach

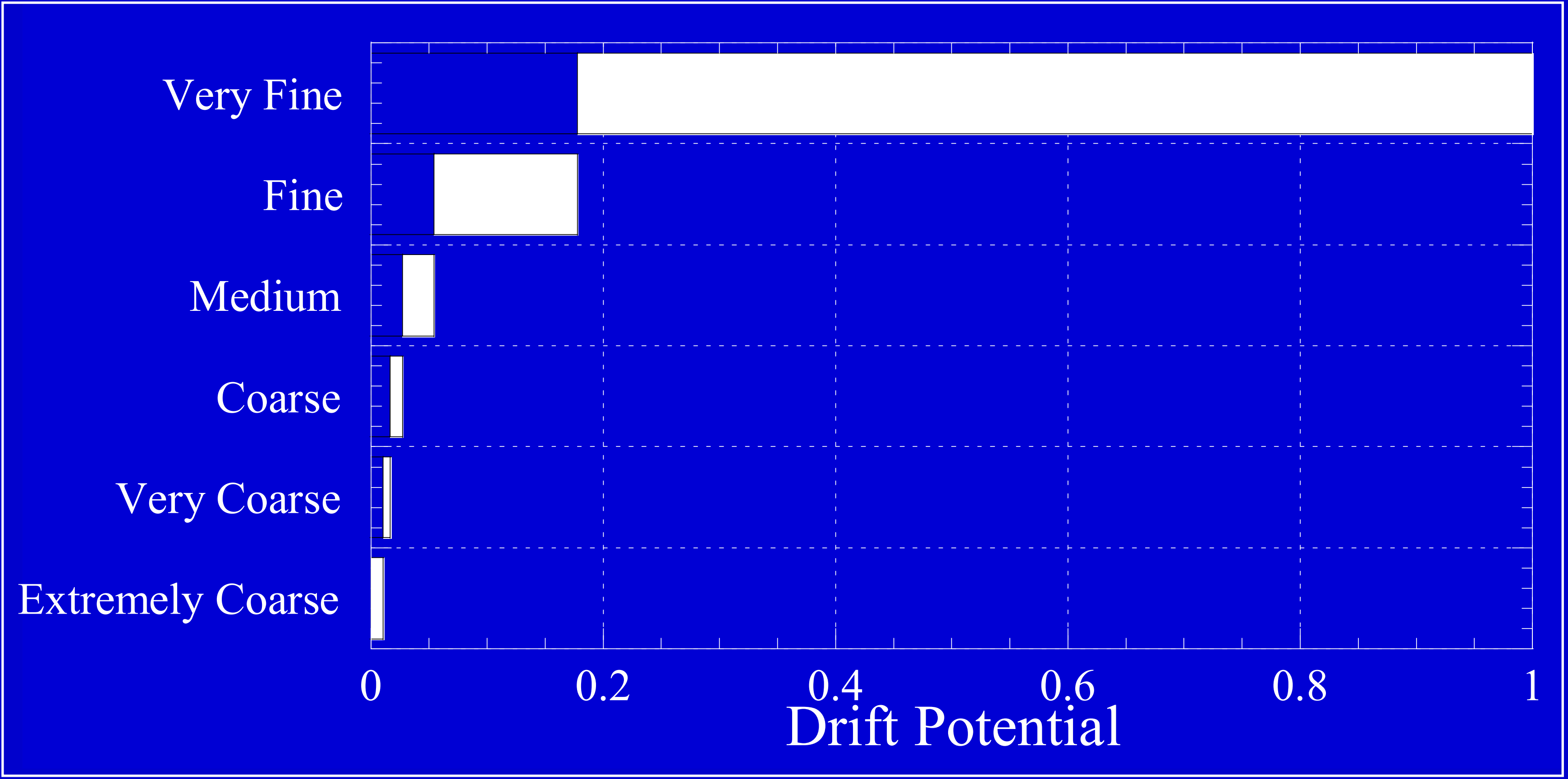
- If the purpose of the ASAE Standard is to examine $D_{V0.1}$, $D_{V0.5}$, and $D_{V0.9}$ with the intent of indicating drift potential, why not eliminate the current headaches with curve crossovers and simply look at drift potential?

- To do this we either start a major test program or we use an existing, validated computer model (AGDISP/AgDRIFT) to predict drift potential within a set of well-defined and mutually agreed upon model assumptions.

Model Application

- To show how this works, we make the following assumptions:
  - Select the parameters $D_{V0.1}$, $D_{V0.5}$, $D_{V0.9}$, F_{141}
  - Select the model default conditions accepted by the EPA (10 ft release height, 10 mph crosswind, AT-401, 20 swaths)
  - Define drift potential as the fraction of spray material aloft over the edge of the application area
  - Correlate the results with statistical software
  - Classify all nozzles unambiguously

Reference Nozzles



Drift Potential Correlation

- Linear regression recovers an exact solution for drift potential:

$$\text{Drift Potential} = + 0.00126534 + 0.000074433\, D_{V0.1} - 0.00000337\, D_{V0.5} - 0.0000186\, D_{V0.9} + 0.3397122\, F_{141}$$

- It might be argued that a drop size distribution can be analyzed to recover $D_{V0.1}$, $D_{V0.5}$, $D_{V0.9}$, and F_{141}, and drift potential determined by this equation.

Questions

- Are $D_{V0.1}$, $D_{V0.5}$, $D_{V0.9}$, and F_{141} the best parameters to represent a drop size distribution?
- Is fraction of spray material aloft over the edge of the application area the best representation of drift potential?
- Is reasonable worst case application, meteorology, and environmental conditions the best assumption?
- What about spray efficacy, aircraft spraying speeds, drift mitigation, and tank mix properties?

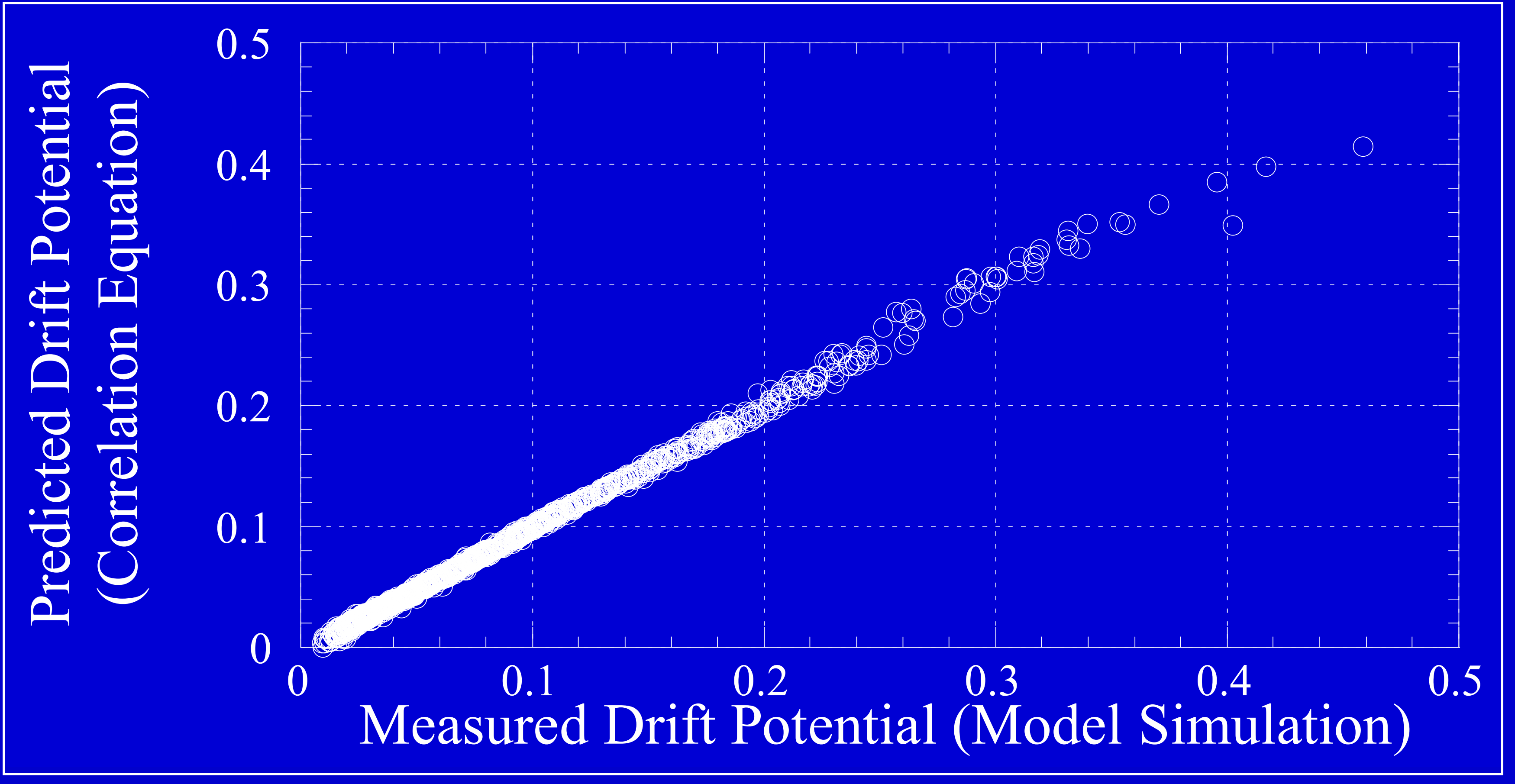
Extension with SDTF Data

- The SDTF measured 1195 aerial tank mixes and nozzle combinations. If the proposed approach is used on all of these entries, extracting $D_{V0.1}$, $D_{V0.5}$, $D_{V0.9}$, and F_{141}, then correlating the results by linear regression, we obtain a refined expression for drift potential with an $R^2 = 0.9972$.

- With Very Fine = 1, Fine = 2, Medium = 3, Coarse = 4, Very Coarse = 5, and Extremely Coarse = 6, the existing ASAE Standard recovers an average classification value of 2.28.

- Drift potential for the SDTF data recovers 2.43.

SDTF Data Correlation



Observations

- Is the ASAE Standard biased toward flat fan nozzles? Using the 1-6 number assignments, we find 2.06 (flat fan nozzles), 2.35 (disc-core swirl nozzles), and 2.90 (straight stream nozzles), with 2.43 (the entire SDTF database).
- The linear regression shows the importance of $D_{V0.9}$.
- Because drift potential must be determined for the reference nozzles, so that all other drop size distributions may be classified, it really doesn't matter how the reference nozzles were selected. Or even what our default set of model conditions are.

Conclusions

- Clearly, by implementing the use of drift potential, we eliminate many of the problems apparent with the ASAE Standard.
- Of course, we also generate several new areas of concern, that will require examination by the industry through a select committee dedicated to resolving drift problems with the development of a revised standard.
- That standard should include an additional category less than Very Fine (for mosquito control), at least one additional category subdividing Fine and Medium, and a category beyond Extremely Coarse (for forestry applications).