INTRODUCTION

Valid estimates of ammonia (NH₃) emissions from beef cattle feedyards are needed to assess the impact of beef production on the environment, to comply with reporting requirements, and to develop reasonable regulatory policies. Production and volatilization of NH₃ are strongly influenced by environmental and management factors (Fig. 1), which are not captured by constant emission factors. Therefore, process-based models, which track components of interest through biochemical and geochemical reactions as functions of specific conditions (e.g., temperature, pH, precipitation and dietary protein concentration), offer the best approach.

Objectives: Validate two process-based models, the Integrated Farm Systems Model (IFSM) (Rozt et al., 2005, J. Anim. Sci. 83:231) and Manure-DNDC (Li et al., 2012, Nutr. Cycl. Agroecosyst. 93:163), for predicting daily NH₃ emissions from large, open-lot feedyards in the southern High Plains.

Approach: Model predictions were compared to two years of observed NH₃ emissions at two commercial feedyards, Feedyard A and Feedyard E, in Deaf Smith County, Texas: the top cattle feeding region in the U.S. Observed NH₃ fluxes were determined with open-path lasers and an inverse dispersion model (Todd et al., 2011, J. Environ. Qual. 40:1090).

Primary model input:
- Daily weather data: temperature, precipitation, solar radiation, wind speed, etc.
- Average cattle population (one-time capacity):
  - Feedyard A: 12,684 head
  - Feedyard E: 19,620 head
- %Dietary crude protein (CP): calculated monthly from feedbunk samples (Fig. 2).

Fig. 2. %CP fed at the two feedyards. In 2008, %CP was >18% at Feedyard A due to feeding distillers grains. The NRC recommended level is 12.5 to 13.5% CP.

Fig. 1. Processes and factors affecting feedyard ammonia emissions.

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