

CRUDE OIL ON RAIL SHIPMENT WAYPOINT

A Crowdsourcing Exercise

Shih-Miao Chin, PhD

Ho-Ling Hwang, PhD

Oak Ridge National Laboratory



Outline

- Motivation of big data application - crude-on-rail
- Crude-on-rail traffic and impacts
- Crowdsourcing approach
- What we've learned

Immersed Technologies

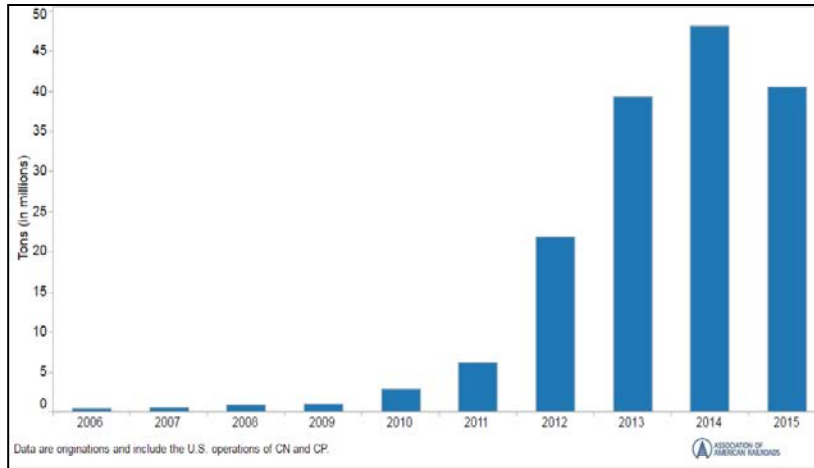
- Big data is everywhere
- Mostly due to the widespread uses of Internet technologies, including Wi-Fi, Bluetooth, etc.
- GPS & Camera on personal mobile communication devices
- Geotagging enable devices – gathering information such as: lat.-long., altitude/bearing, distance, time stamp, etc.
- Web-based or cloud-based photo sharing - users can publish/upload, host, manage, & share digital photos

Big data analytics is the key to discover unexplored/hidden information that can be utilized to generate meaningful insights

Motivation: Examining Crude-on-rail As A Big Data Application

- Technological advances in horizontal drilling and hydraulic fracturing contributed to the shale oil and gas exploration boom
- Since 2010, crude-on-rail traffic has been emerged and increased drastically with the growing production of shale oil
- Information on crude oil production, consumption, and mode of transportation is needed to formulate remedial measures to counter negative impacts induced by shale oil exploration and subsequent transportation logistics

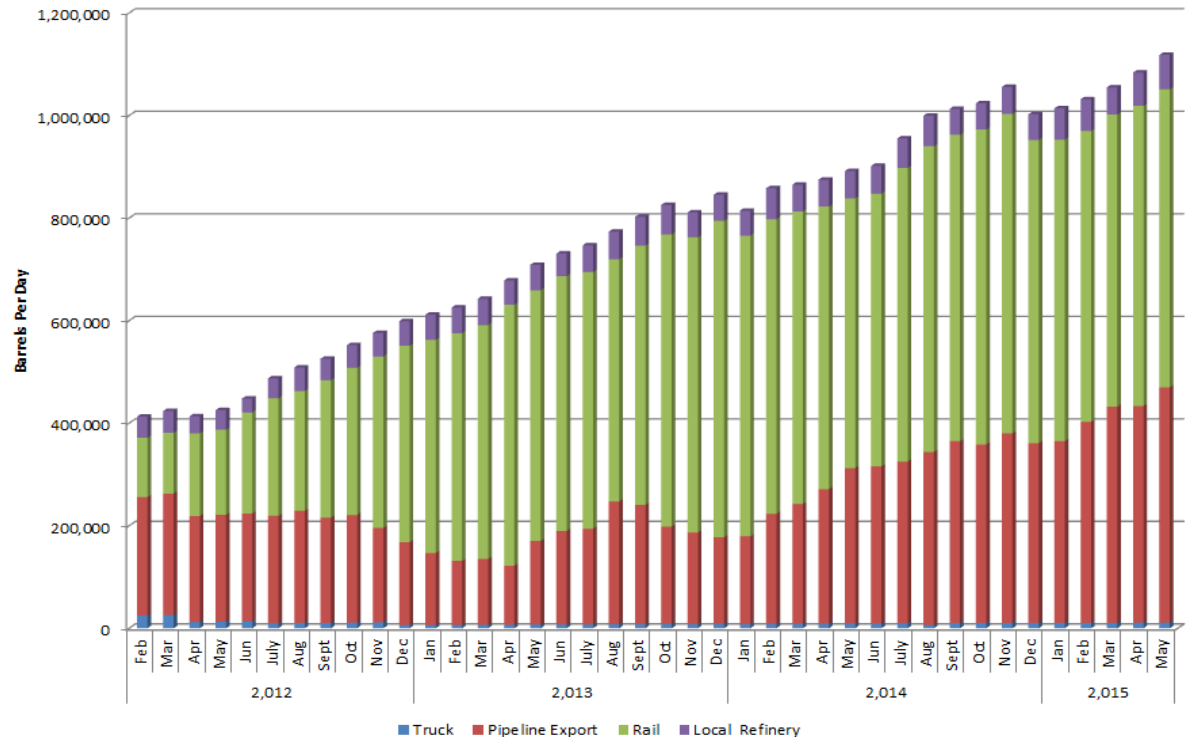
Volumes Of Crude On Rail



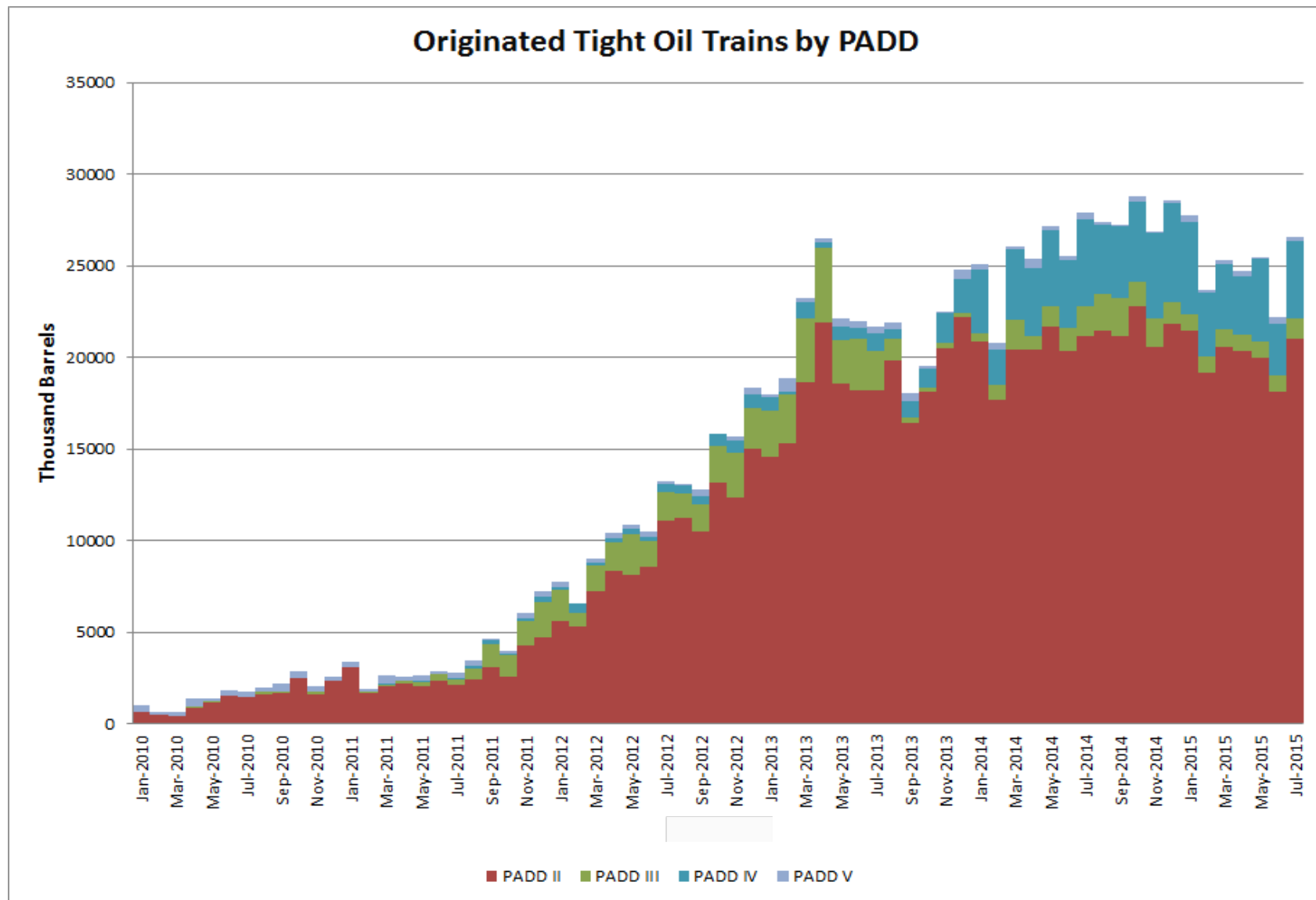
Annual tonnages of crude oil moved by Class I railroad (in millions) indicated crude-on-rail traffic increased dramatically since 2012
 – AAR statistics

Mode shares for transporting shale oil from the Williston Basin (Bakken):

- share of rail increased consistently from 2012 to 2013
- rail continued to hold over 50% of market shares in 2014 & 2015
- pipeline doesn't have enough capacity to transport the Bakken shale oil production



Majority of Crude-on-Rail Shipments Originated from PADD2 (EIA)



Burlington Northern Santa Fe's Oil Train



Unlike Other HAZMAT Transportations...

- Railroad companies are regulated by Surface Transportation Board
- Oil trains are not subject to the same strict routing requirements
- Oil trains are permitted to pass directly through cities (negative impact: undesirable consequence happened)
- In the absence of more protective regulations, people began to take matters in their own hands

Crude oil train incident at Heimdal, North Dakota in May 2015



Crude oil train disasters in the U.S. since 2012.
Last Updated 10/2016



Importance of Risk Communication

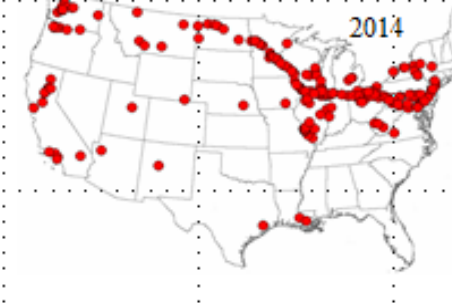
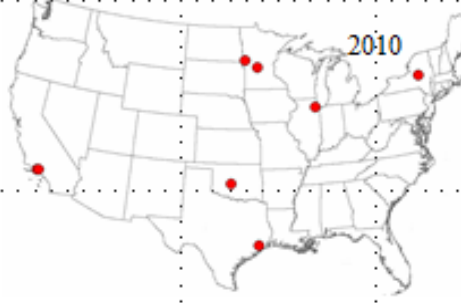
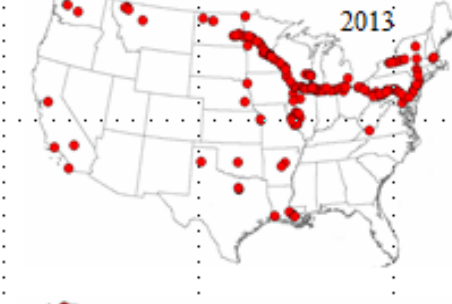
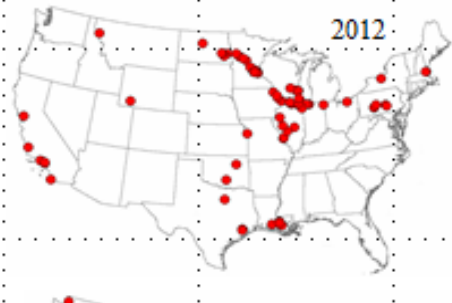
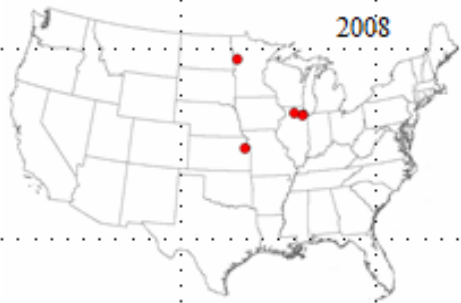
- Crude-on-rail operation information is critical for formulating remedial measures to counter any negative impacts
- Emergency preparedness officials need information to help residents of affected communities to
 - understand the processes of oil train risk assessment and management
 - form scientifically-valid perceptions of the likely crude oil release and subsequent fire
 - participate in making decisions about how risk should be managed
- There is a need to compile a crude oil-train flow database that can be used seamlessly with associated energy commodity origin-destination flows and logistic information provided by the CFS/FAF.

Crowdsourcing: Crude-oil-train Photo Sources & Sharing

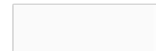
- Railway enthusiast, or railway buff, is a person interested in a recreational capacity in rail transport
- Railway buff of many ages can be found worldwide - often combine their interests with other hobbies, especially photography & videography;
- Image or photo sharing is the publishing or transfer of a user's digital photos online; these websites offer services such as uploading, hosting, managing and sharing of photos (publicly or privately)
- List of image-sharing websites
(https://en.wikipedia.org/wiki/List_of_image-sharing_websites)

- Wikipedia

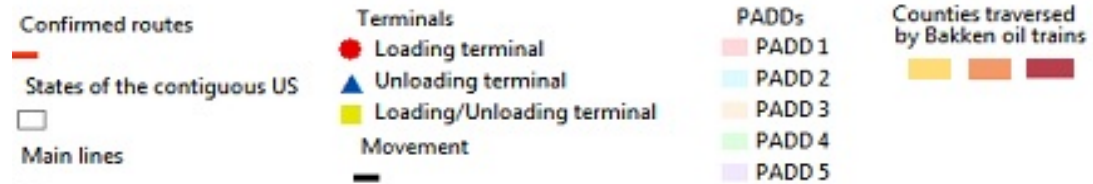
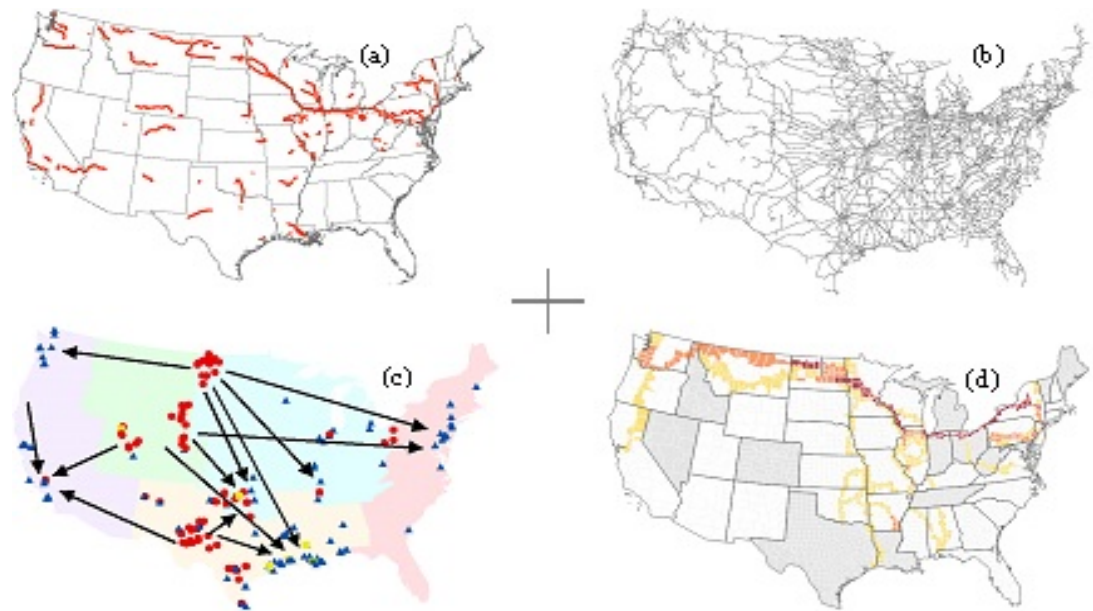
Crude-on-Rail Maps – Based on Photo Locations



Combined 2008-2015 data



Inference - Integrating photo locations with rail network & other information



Crude Oil Train Routes



Confirmed routes



Inferred routes



Benefit of Crude-on-Rail Maps

- Analyze crude-on-rail travel pattern
- Show proximity of crude-on-rail track to my neighborhood
- Formulate family emergency/evacuation/communication plan
- Locate emergency shelters
- Plan evacuation routes

What We've Learned

- Ideally, crowdsourcing campaign should be directed and conducted by authoritarian organizations
- Symbiotic relationship
 - Passive: web-based geocode oil train photo collection
 - Active: communities fight to stop oil trains (e.g., activist groups against oil train)
- Other geocoded crude-on-rail related databases
 - PHMSA's incident report database
 - FRA railroad reportable accidents and incidents
 - ...