Progress and Status of Task 1c: Forward Offsite Consequence Analysis

PRESENTED BY

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Contents

- Objectives
- Sources of uncertainty
- Current status after BSAF Phase II
- Planned activities for ARC-F
- Summary

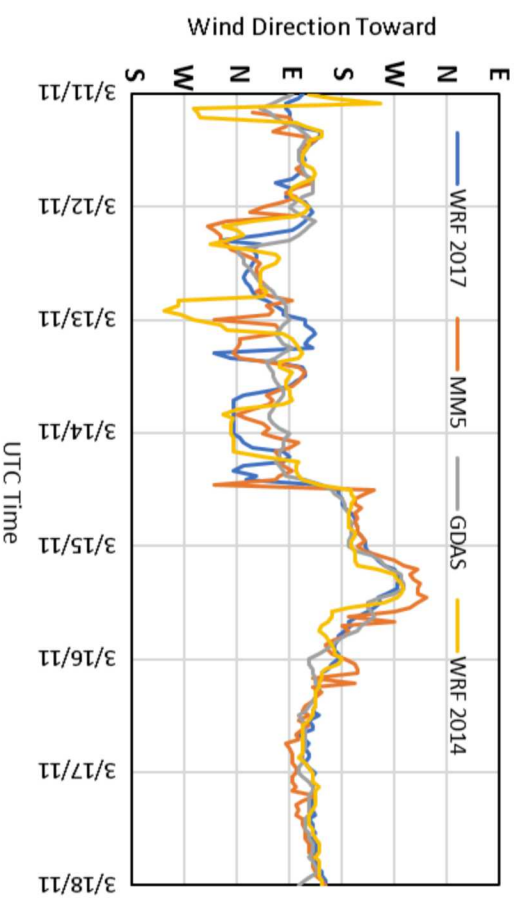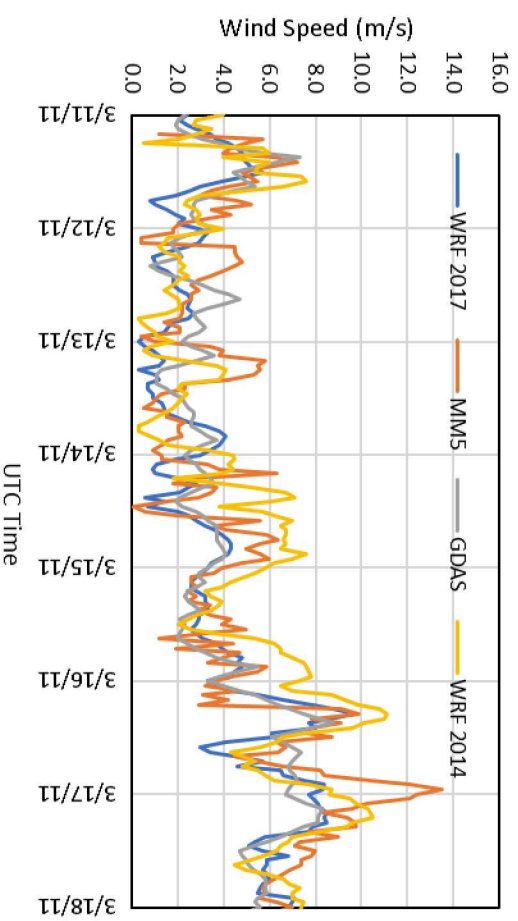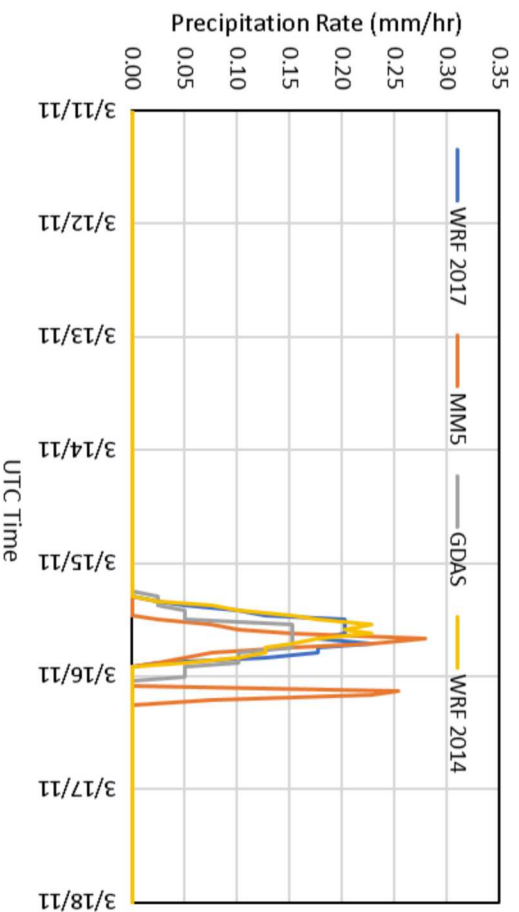# Objectives of Forward Atmospheric Transport Analysis at Fukushima

- Perform a complete analysis of the accident and its consequences

- Provide guidance to source-term modelers by estimating ground deposition patterns
  - Deposition pattern depends critically on chronological alignment of release with weather pattern

- Benchmark source term and atmospheric transport models against real data

Three Major Sources of Uncertainty

- Uncertainty in weather. Evaluated using multiple sources
  - WRF (Weather Research and Forecasting) model, generated in 2014
    - 4-km spatial, 20 min temporal discretization
    - No nudging
  - GDAS (Global Data Assimilation System)
    - 0.5 degrees spatial, 3 hour temporal discretization
    - No nudging
  - WRF model, generated in 2017
    - 4-km spatial, 5 min temporal discretization
    - Nudged with observations
- Uncertainty in source term. Evaluated using multiple source terms.
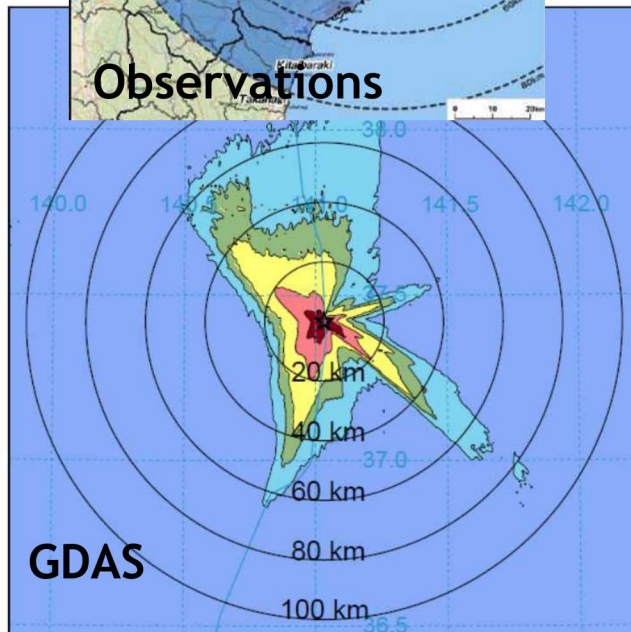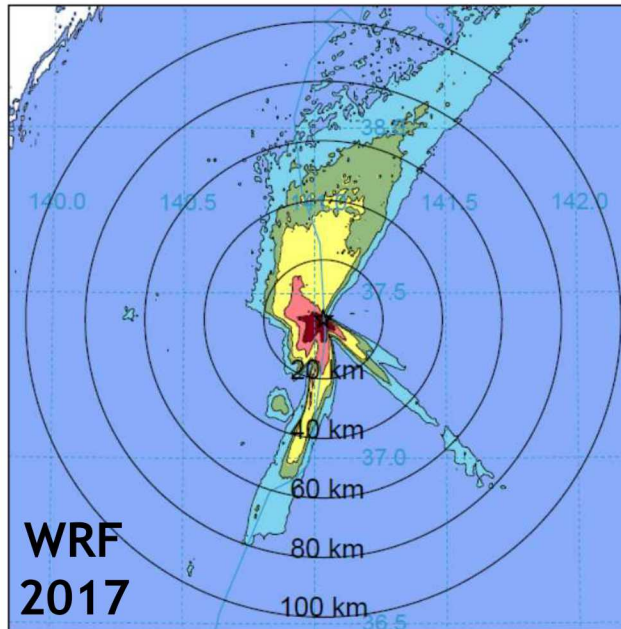- Deposition, especially wet deposition

Example of Meteorological Uncertainty: First 7 Days

- Weather data have similar trends
- but
  - Significant variations in detail

Weather Data Comparison

SNL MELCOR 5/2018

Observations

WRF 2017

GDAS

WRF 2014

Legend:
- >1.0E+07 Bq/m2
- >3.0E+06 Bq/m2
- >1.0E+06 Bq/m2
- >6.0E+05 Bq/m2
- >3.0E+05 Bq/m2
- >100 Bq/m2

Maximum: 9.1E+07 Bq/m2
Minimum: 2.0E+01 Bq/m2
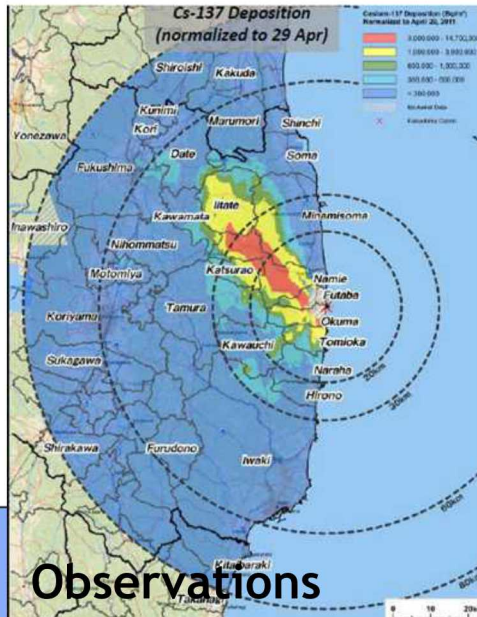
- **Weather data significantly affect deposition pattern**
- **Isopleths significantly match observations**
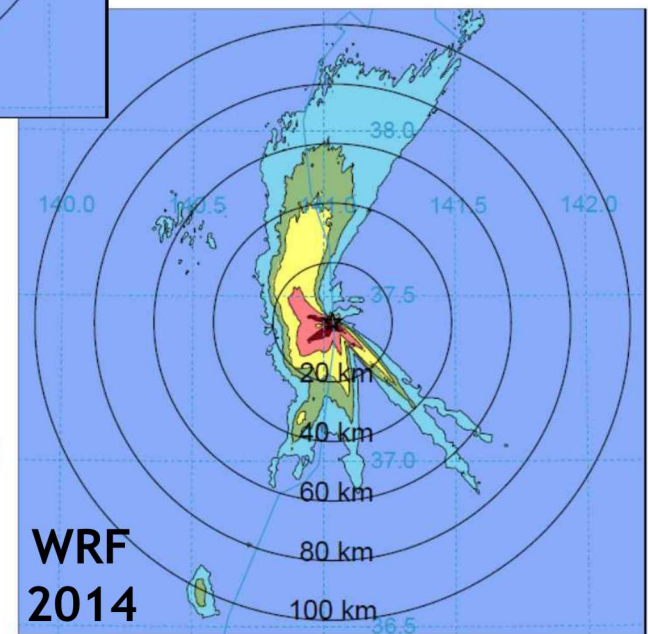
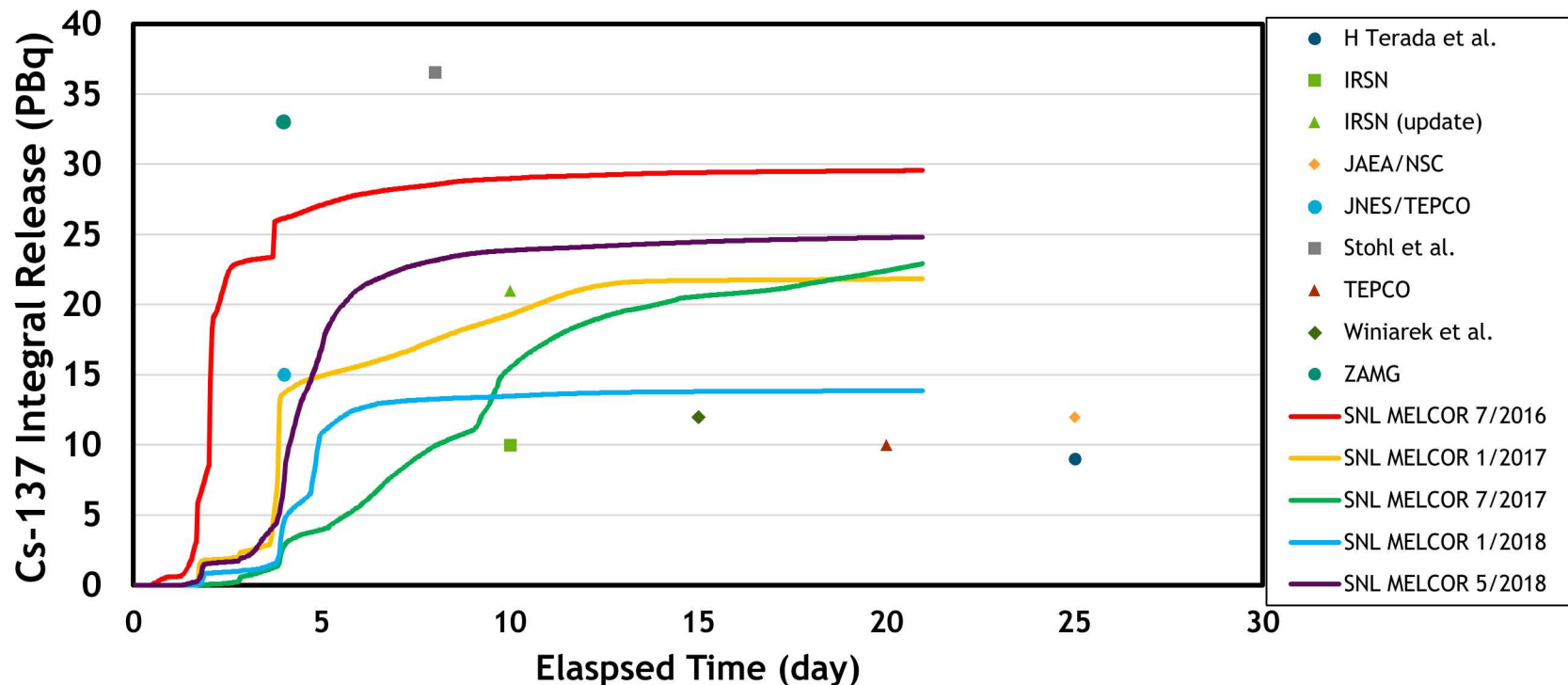# Evolution of 3-Unit Integral Release Estimated by NRC/SNL
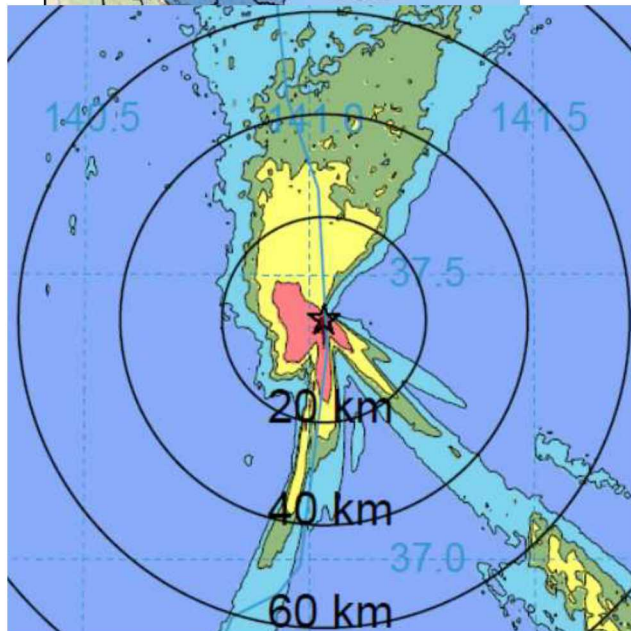

- Many of the initial and boundary conditions needed to estimate accident progression were poorly understood
  - Initial damage state was unknown
  - Water injection may have failed, succeeded, or partially succeeded
- Curves indicate evolution of integral release for three units as estimated by NRC/SNL over the course of BSAF Phase II

Source Term Comparisons Based on WRF 2017 Met Data

Cs-137 Deposition (normalized to 29 Apr)
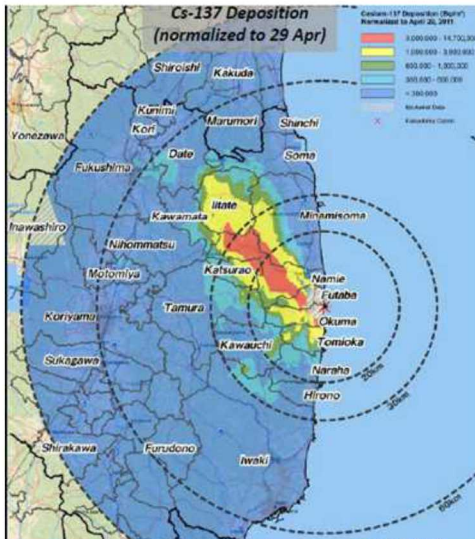
- **Only predictions include dark red isopleth contour**
- **Shape and intensity differ for most recent SNL predictions**
- **Both contain features that are not observed**
- **Neither predicted orange isopleths extend as far as observations**
- **Actual releases appear more punctuated in time than predictions**

(dark red)	>1.0E+07 Bq/m2
(pink)	>3.0E+06 Bq/m2
(yellow)	>1.0E+06 Bq/m2
(green)	>6.0E+05 Bq/m2
(light blue)	>3.0E+05 Bq/m2
(blue)	>100 Bq/m2

Maximum: 9.1E+07 Bq/m2
Minimum: 2.0E+01 Bq/m2
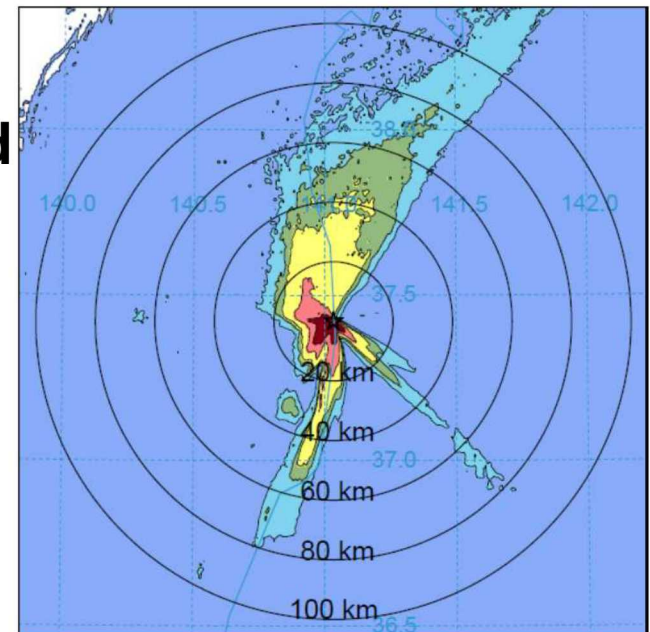
SNL MELCOR 1/2018

SNL MELCOR 5/2018

ARC-F: Responses from Survey

Participant			Source Terms		Codes		Expected	
Org.	Country	POC	Own	Others	ST	ATD	Presentations	Comments
NAS	Ukraine	V. Krasnov		X		LEDI		Evaluate a variety of weather datasets
IRSN	France	M. Barrachin	X		ASTEC	C3X	Winter 2021	
SNL	USA	N. Bixler	X	X	MELCOR	HYSPLIT/MACCS	Each Meeting	Evaluate a variety of weather datasets

- Forward analyses currently awaiting updated STs
- Two participants, NAS, Ukraine, and SNL, USA, are willing to evaluate STs from other participants
  - Most value added when process begins early enough to create feedback loop
- Plan to coordinate sharing of weather datasets
- SNL has created synthetic single weather tower data to share with ARC-F participants for reverse analyses or other purposes
  - Based on location of Fukushima Unit 1
  - Data extracted from GDAS, WRF 2014, and WRF 2017 files
  - Time is UTC
  - Wind direction is based on 64 compass sectors, with 1 centered on north and numbered clockwise
  - Other data or formats can be requested

Summary

- BSAF Phase II was instrumental for validating source-term and atmospheric transport tools.
- ARC-F provides an opportunity for continued improvement of understanding and refinement of tools
- Path forward is parallel development of backward and forward analysis approaches
- Sharing of weather data and other information should provide perspective on best practices and uncertainties