

# It's Been a Busy Year—Recent Major Updates for the NRC's Accident Consequence Code System (MACCS)

## NEW Postprocessing Capability

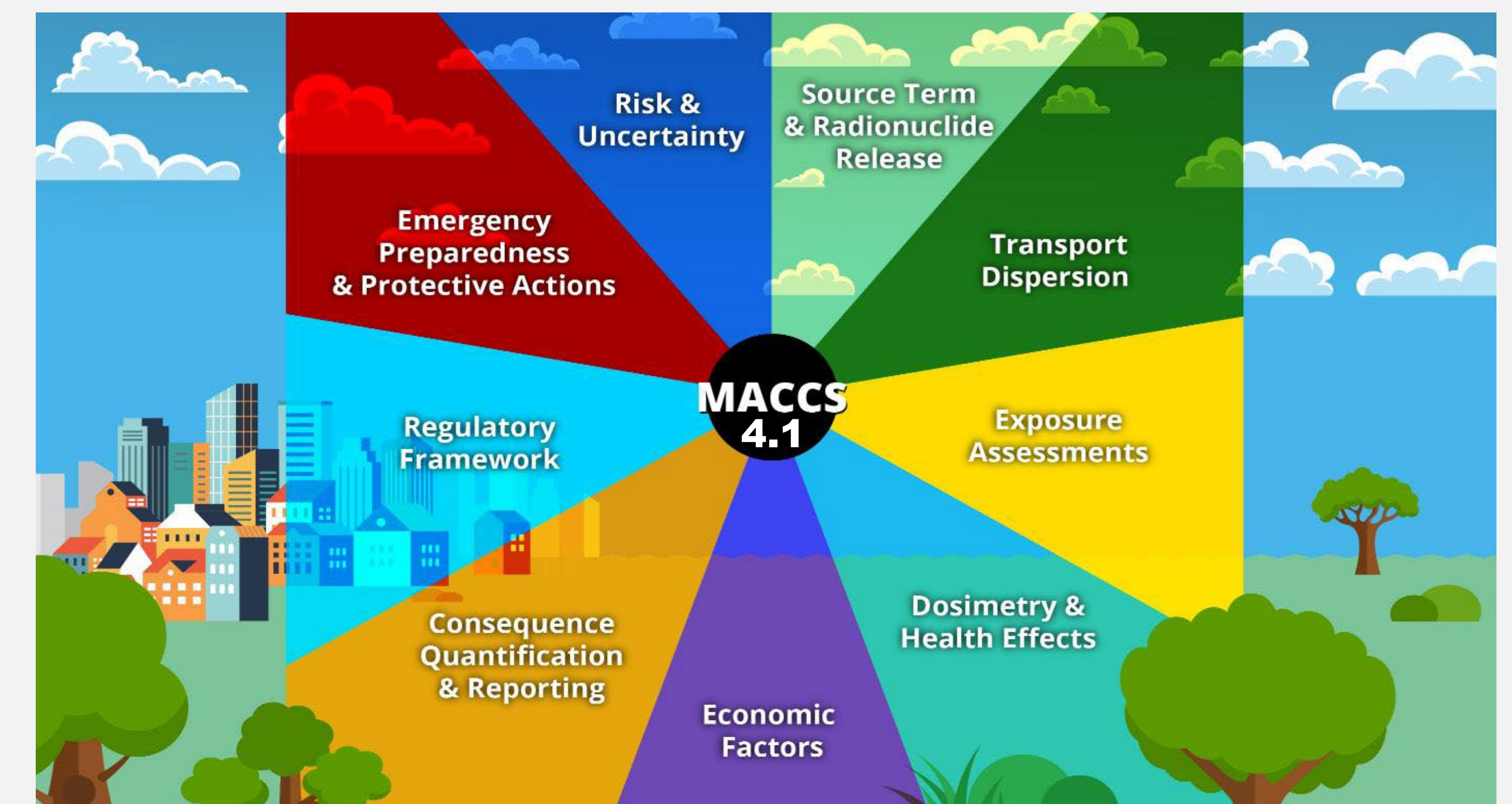
- **AniMACCS**—plume segment animation and mapping utility

## NEW Code Documentation

- **Theory Manual**
- **User Guide**
- Additional MACCS studies and reference documents

## NEW Code Models

- **Near-Field Modeling**—evaluation, guidance, and new models to support modern siting applications
- **HYSPLIT**—high fidelity, state-of-the-art, atmospheric transport and dispersion modeling
- **RDEIM**—alternate offsite cost estimation using gross domestic product (GDP) modeling

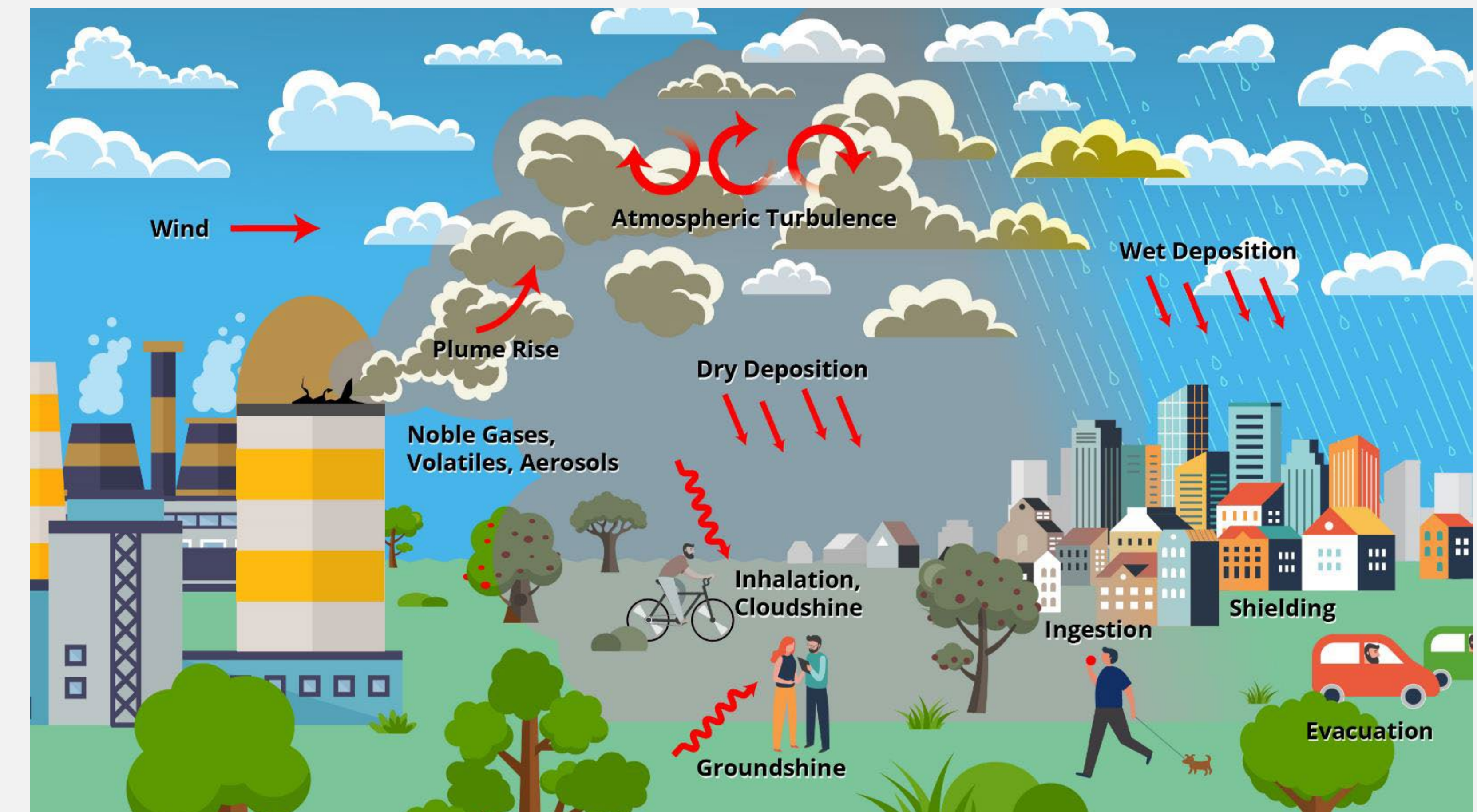




## What Is MACCS and How Is It Used?

The MACCS code was developed and is used to evaluate the offsite consequences of radioactive releases to the environment

- MACCS models atmospheric transport, emergency and long-term protective actions, radioactive exposure pathways, dosimetry, health effects, and economic consequences
- MACCS outputs capture a variety of metrics, including dose, health effects, fatality risk, economic losses, and land contamination
- MACCS uses include regulatory and cost-benefit analyses, environmental reports and impact statements, plant-specific evaluations of severe accident mitigation alternatives, U.S. Department of Energy documented safety analyses, probabilistic risk assessments, and numerous research studies such as the [State-of-the-Art Reactor Consequence Analysis \(SOARCA\) Project](#)



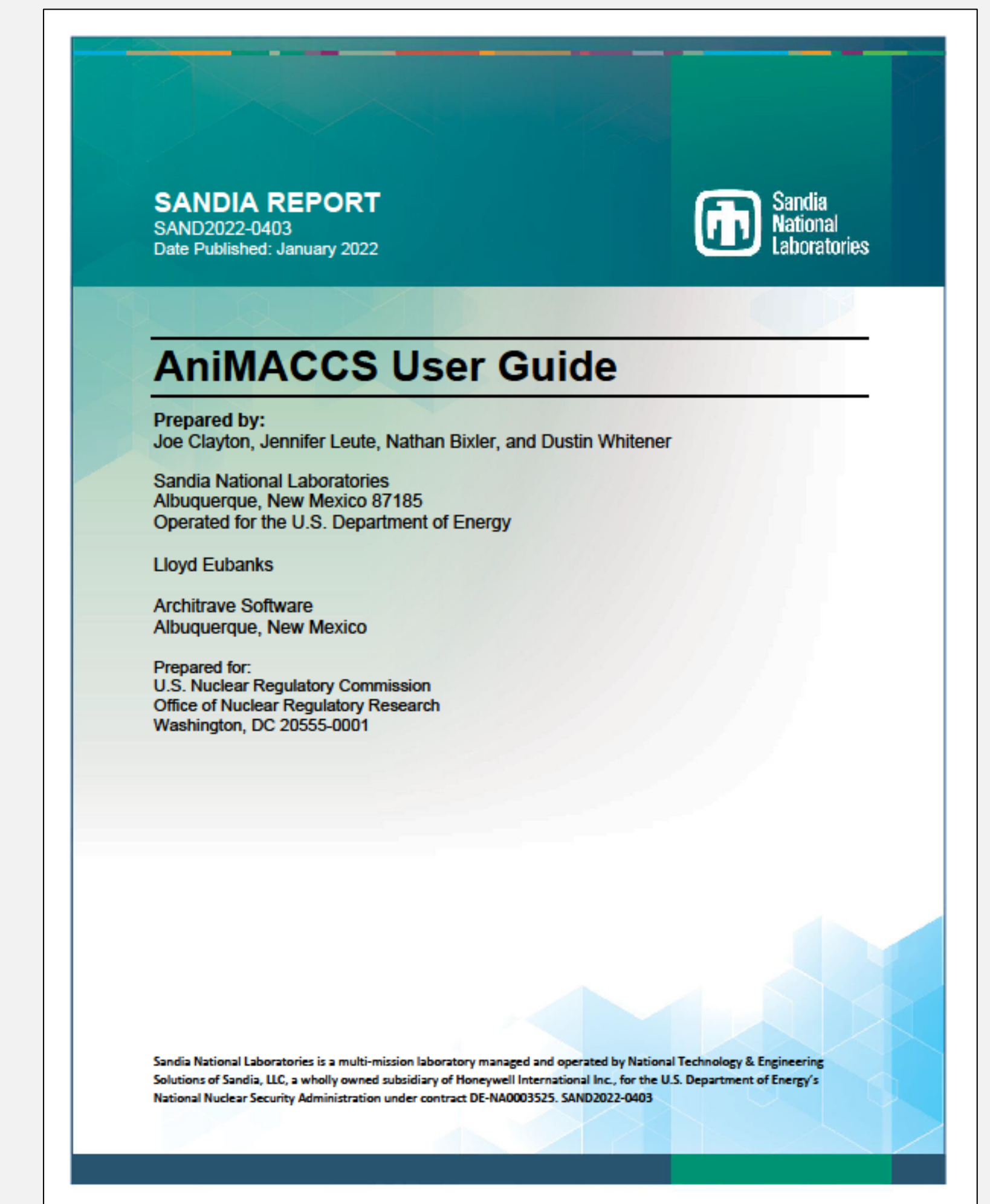
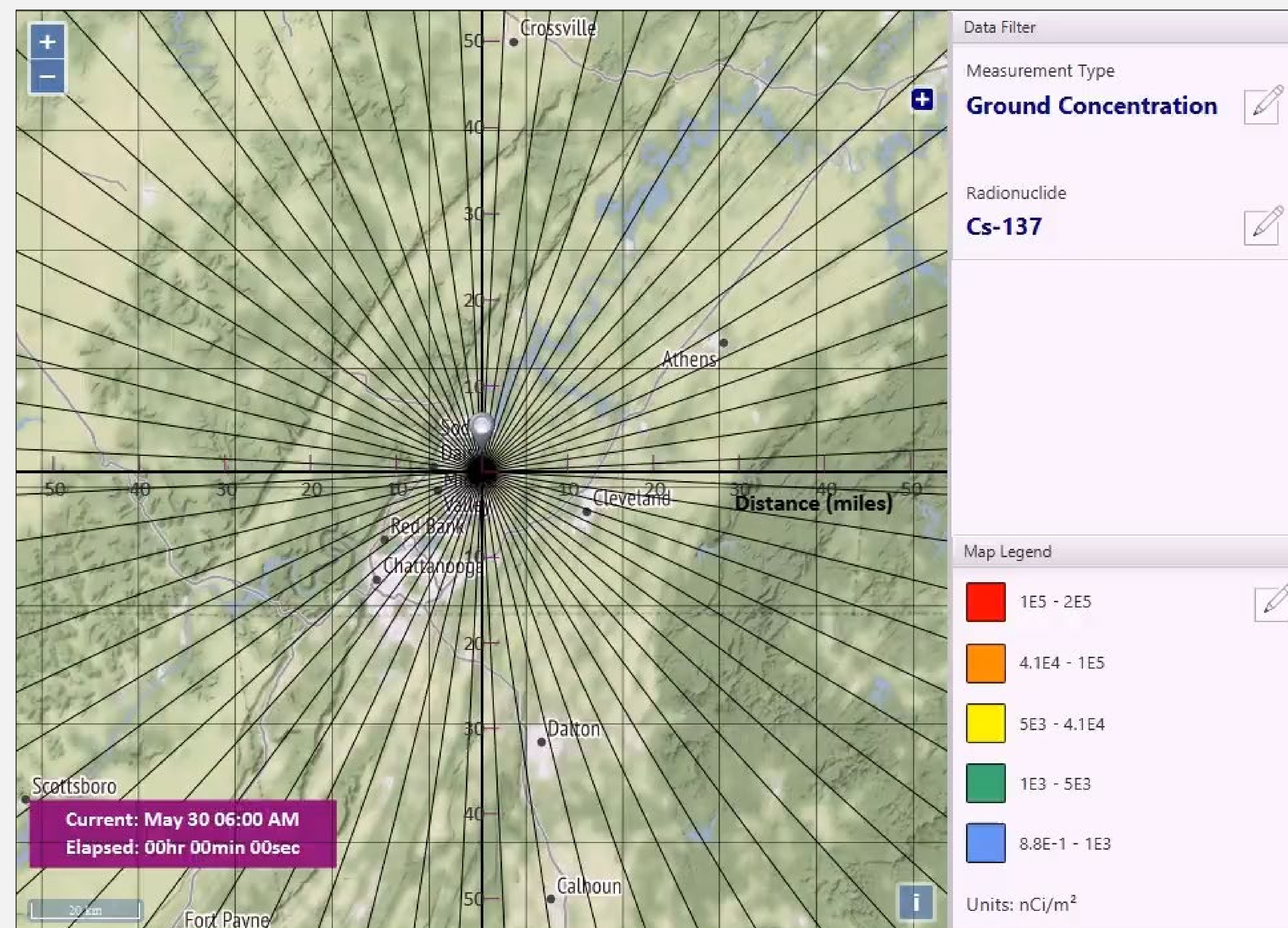
### MACCS Code Suite

- WinMACCS 4.1—MACCS Windows graphical user interface (GUI)
- SECPOP 4.3.0—population and economic data utility
- MelMACCS 2.0.1—[MELCOR](#) radioactive source term input utility
- AniMACCS 1.3—plume segment animation and mapping utility



# AniMACCS

- MACCS added the capability to graphically visualize atmospheric results
- AniMACCS displays plume movement and ground and air concentration over a site map
- AniMACCS allows user flexibility to modify map scale, contour colors, zoom in or out, take screen captures, and export animation to video



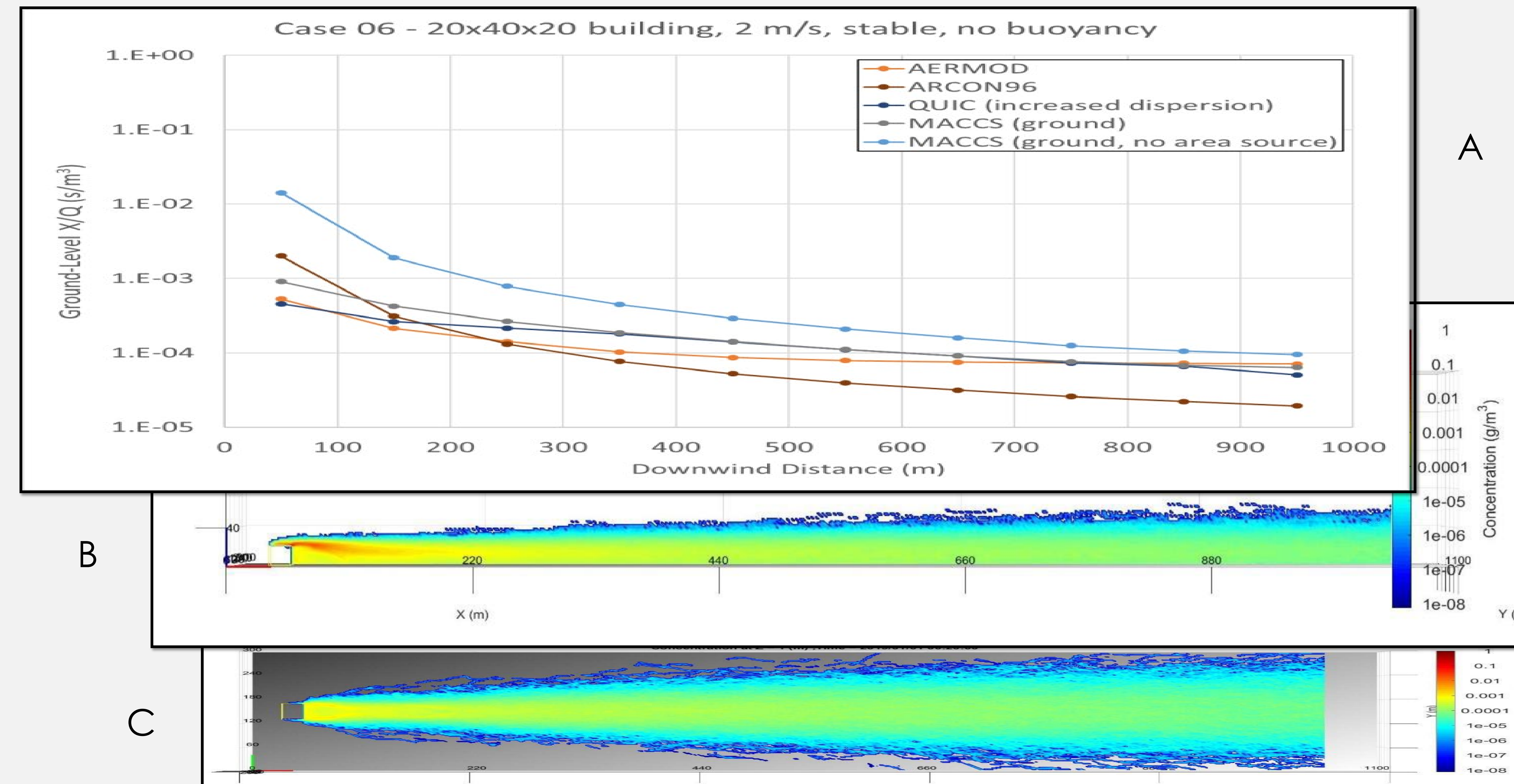
The [AniMACCS User Guide \(SAND2022-0403\)](#) was published in January 2022



# Near-Field Modeling Benchmark and Improvements

## Near-Field Code Comparison

- Recent near-field modeling improvements support computer code readiness to evaluate advanced reactors
- In 2020, MACCS 3.11.6 was compared to other codes, including QUIC, ARCON96, and AERMOD2 ([SAND2020-2609](#))
- Comparison showed MACCS can be used within 500 meters (~0.3 miles) from the release location to model near-field results
- MACCS 4.1 enhancements added plume meander and building wind-effect models to simulate or bound near-field assessments of other codes



A. Ground-level, time-integrated X/Q versus distance for AERMOD2, ARCON96, and QUIC compared with bounding MACCS calculations (Figure 5-8 from SAND2020-2609)

B. QUIC time-averaged air concentration for a vertical plane at building centerline (Figure 4-24b from SAND2020-2609)

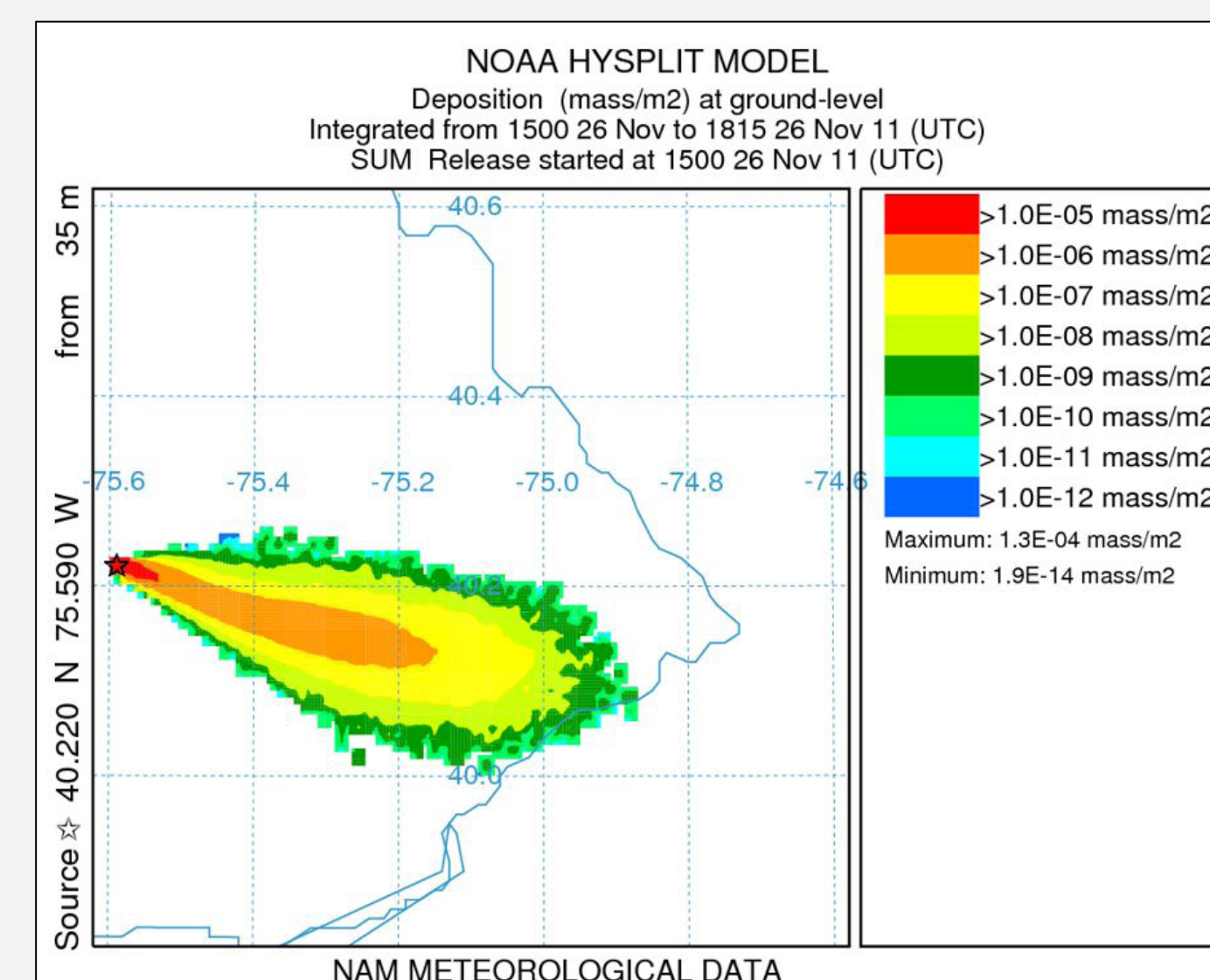
C. QUIC time-averaged air concentration for a horizontal plane at 1 meter elevation (Figure 4-24a from SAND2020-2609)



# HYSPLIT and RDEIM Economic Model

## HYSPLIT

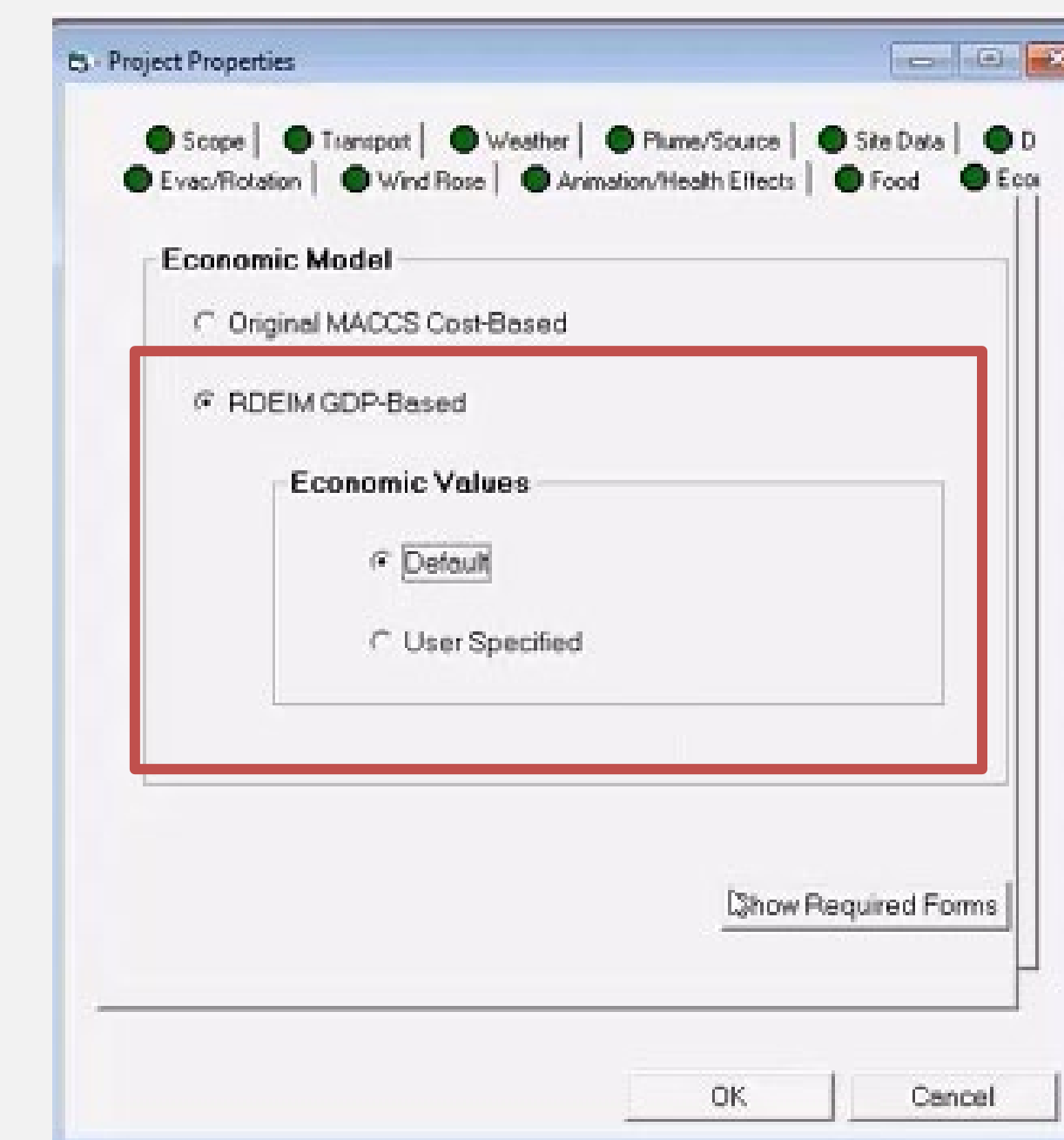
- MACCS added NOAA'S [HYSPLIT](#) as an optional atmospheric transport and diffusion model
- HYSPLIT is a complete system for simulating complex atmospheric transport with both puff and particle tracking dispersion models
- Users can choose between the traditional MACCS Gaussian plume segment model or the higher fidelity HYSPLIT model



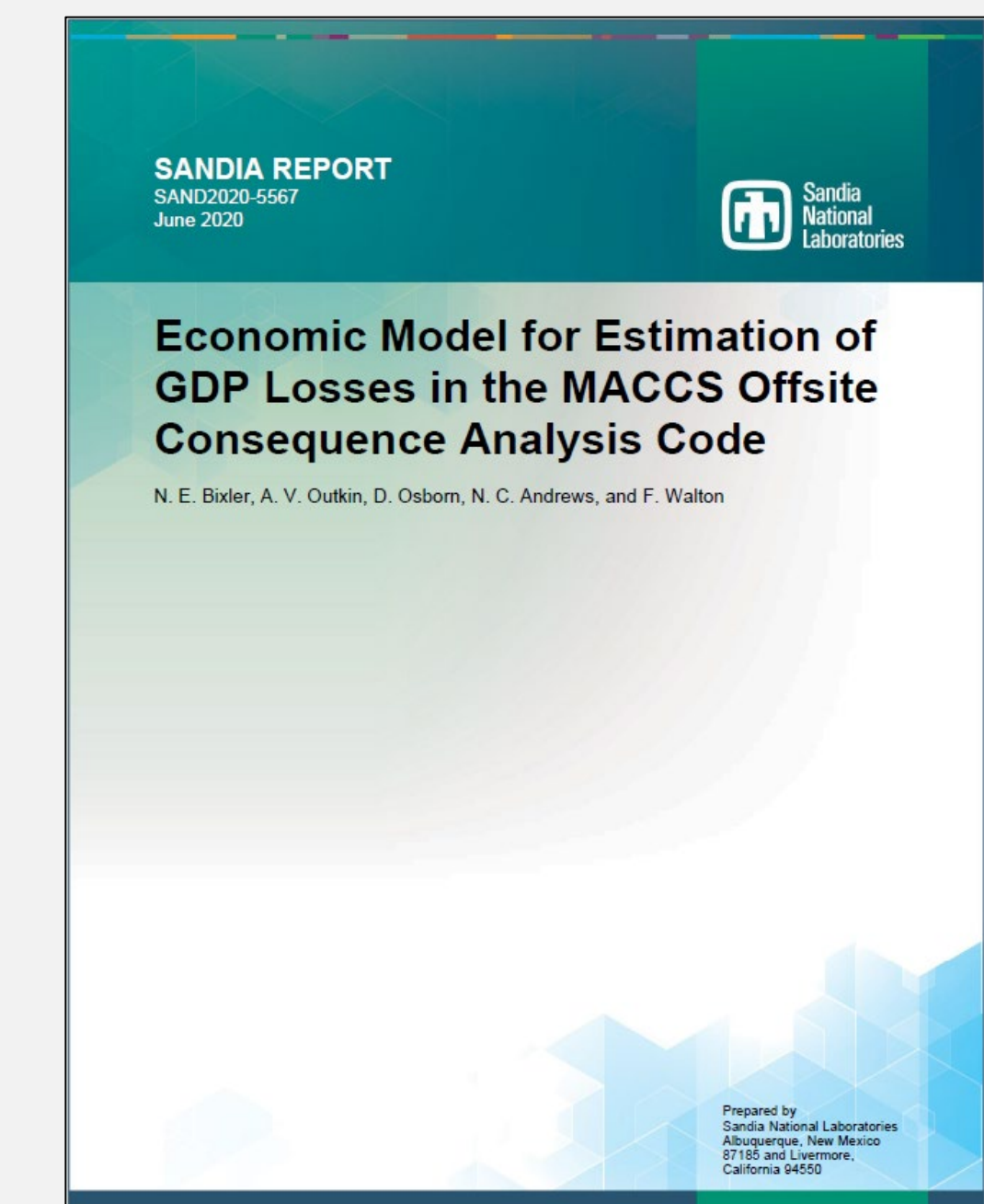
HYSPLIT Model Deposition Map

## Regional Disruption Economic Impact Model (RDEIM)

- MACCS added RDEIM to estimate offsite economic costs using current state-of-practice economics
- RDEIM includes income losses due to land restrictions in the directly affected area, national supply chain disruptions, and economic gains due to national recovery
- Users can select the new RDEIM model, which replaces the MACCS loss-of-use cost output with the GDP-based capability



MACCS GUI RDEIM Model Selection



RDEIM Model Document ([SAND2020-5567](#))



# Updated MACCS User Guides, Theory Manual, and Verification Report

## MACCS 3.10 and 4.0 User Guides ([SAND2021-1588](#), [SAND2021-8998](#))

- User guides published corresponding to new code releases
- User guide is intended to assist analysts in understanding both the WinMACCS GUI and MACCS inputs and outputs
- Provides guidance on getting started, parameter screens, tutorials, and required auxiliary input such as the site, meteorological, and dose conversion factor files

## MACCS Theory Manual ([SAND2021-11535](#))

- Updates the previous theory manual from 1990 (NUREG/CR-4691, Vol. 2)
- Captures software improvements since MACCS 1.5
- Consolidates model descriptions contained in various historical documents
- Presents the current mathematical modeling and assumptions for MACCS modules and output results

## MACCS Verification Report (ADAMS Accession No. [ML22026A461](#))

- Documents the systematic testing and verification of MACCS equations and algorithms
- Verification began with MACCS 4.0 and resulted in minor upgrades to MACCS 4.1, ensuring simulation consistency with analytic results





# MACCS Documentation

## Numerous documents published 2019–2022

- AniMACCS User Guide (SAND2022-0403)
- MACCS Theory Manual (SAND2021-11535)
- MACCS 4.0 User Guide (SAND2021-8998)
- Nearfield Consequence Analysis Implementation (SAND2021-6924)
- MACCS 3.10 User Guide (SAND 2021-1588)
- MACCS Verification Report (ADAMS Accession No. ML22026A461)
- Nearfield Model Evaluation (SAND2020-2609)
- RDEIM Economic Model Description and Benchmark (SAND2020-5567)
- SOARCA Project, Sequoyah (NUREG/CR-7245)





# Contact Information

## **MACCS Code Distribution**

AJ Nosek—Code Distribution Manager  
U.S. NRC, Office of Nuclear Regulatory Research,  
Accident Analysis Branch

<https://maccs.sandia.gov/getcode.aspx>

Contact: [MACCSCodes@nrc.gov](mailto:MACCSCodes@nrc.gov)

## **MACCS Code Support**

<https://maccs.sandia.gov/default.aspx>

Contact: [wg-maccs-entity@sandia.gov](mailto:wg-maccs-entity@sandia.gov)

