

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

NEW Postprocessing Capability

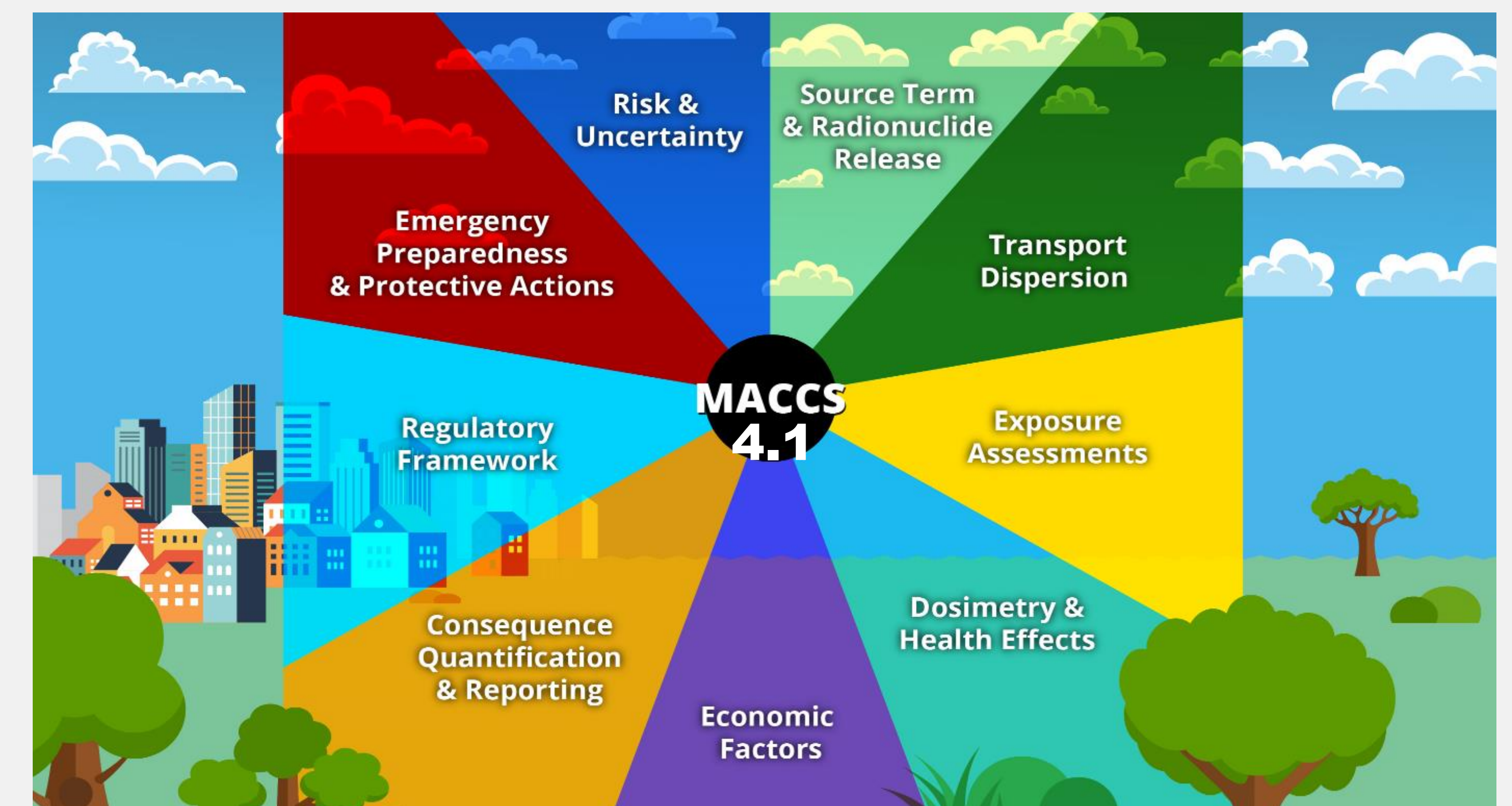
- **AniMACCS**—plume segment animation and mapping utility

NEW Code Documentation

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

NEW Code Models

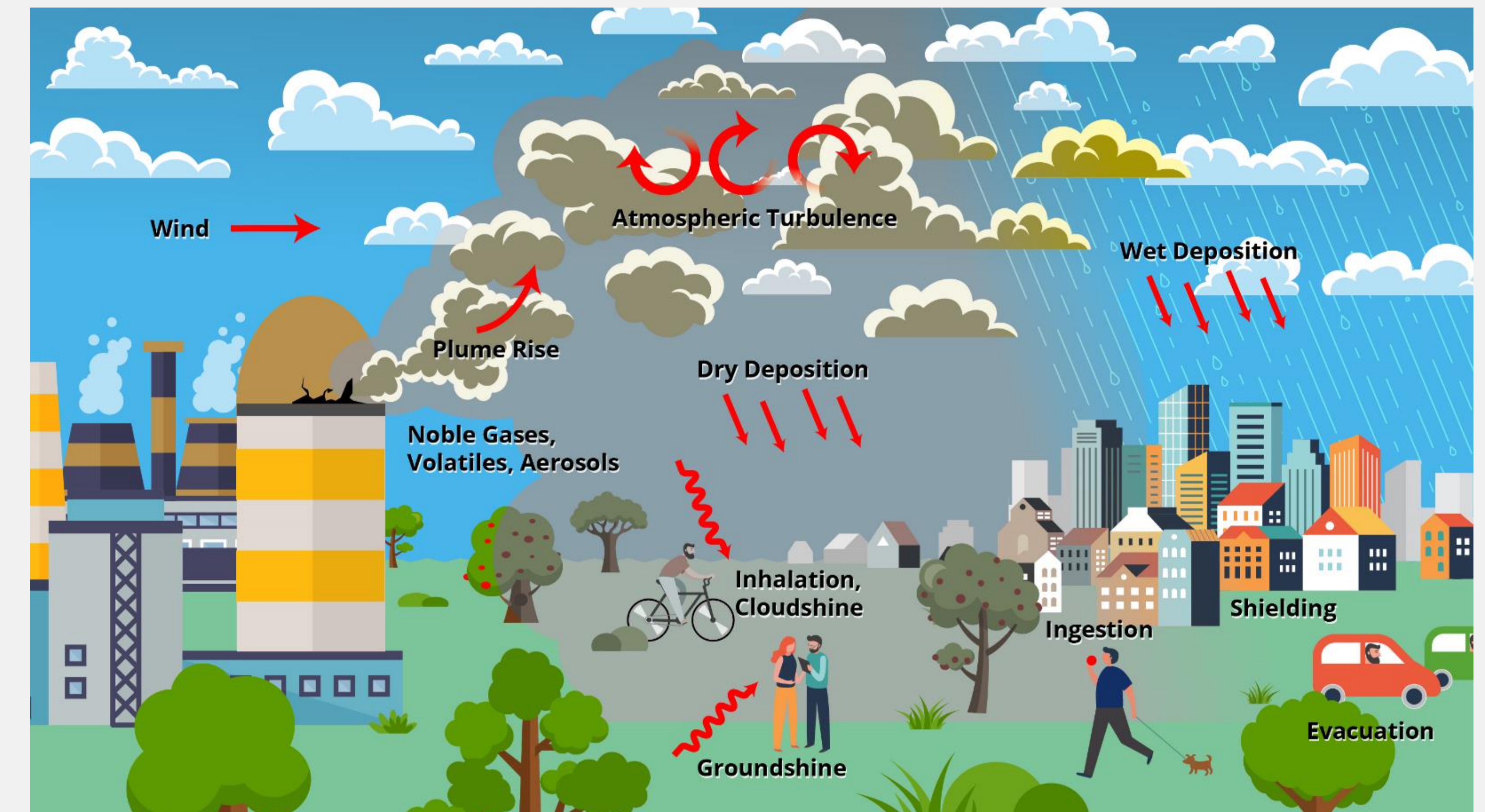
- **Near-Field Modeling**—evaluation, guidance, and new models to support modern siting applications
- **HYSPLIT**—high fidelity, state-of-the-art, atmospheric transport and dispersion modeling
- **RDEIM**—alternate offsite cost estimation using gross domestic product (GDP) modeling



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](#)

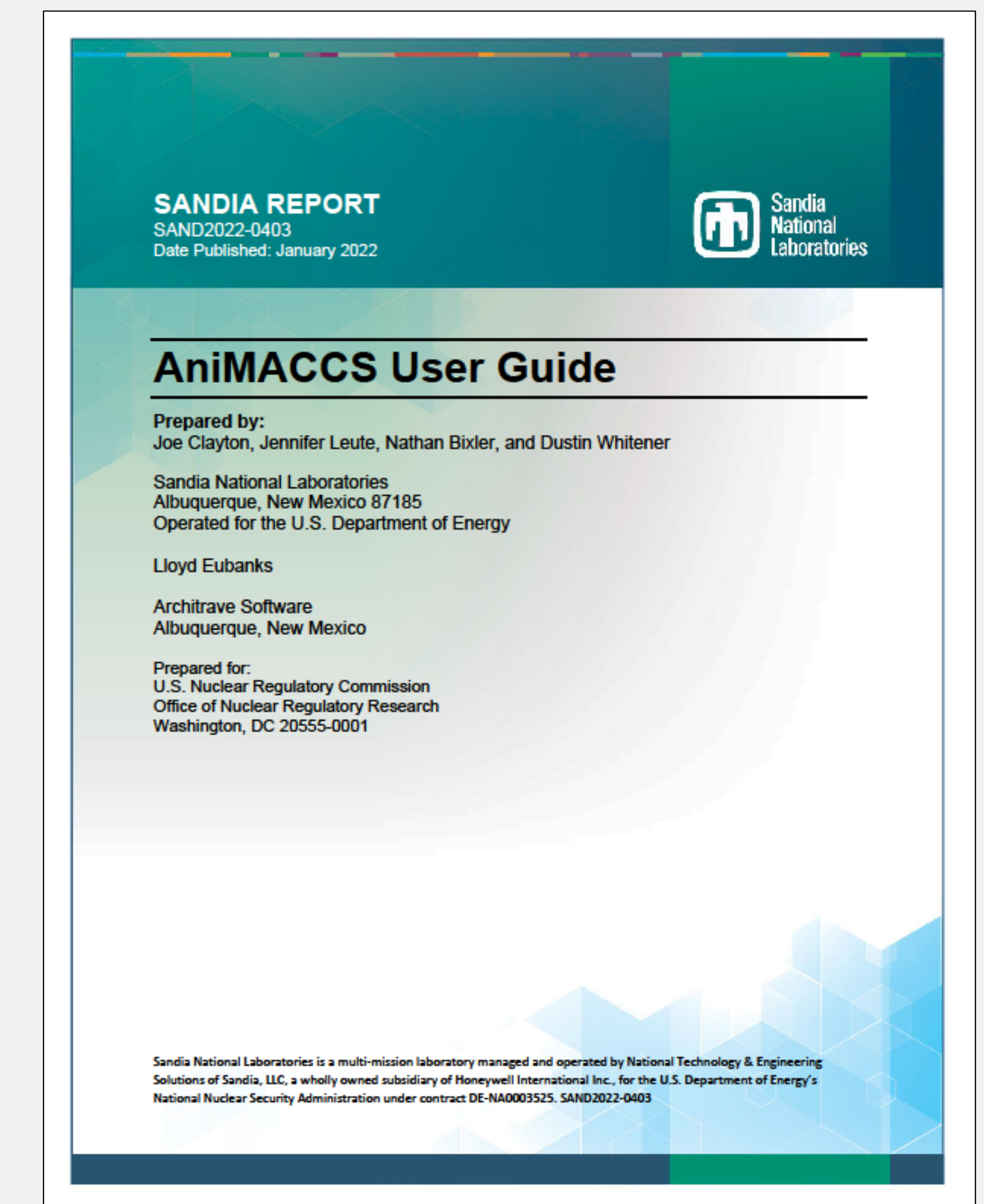
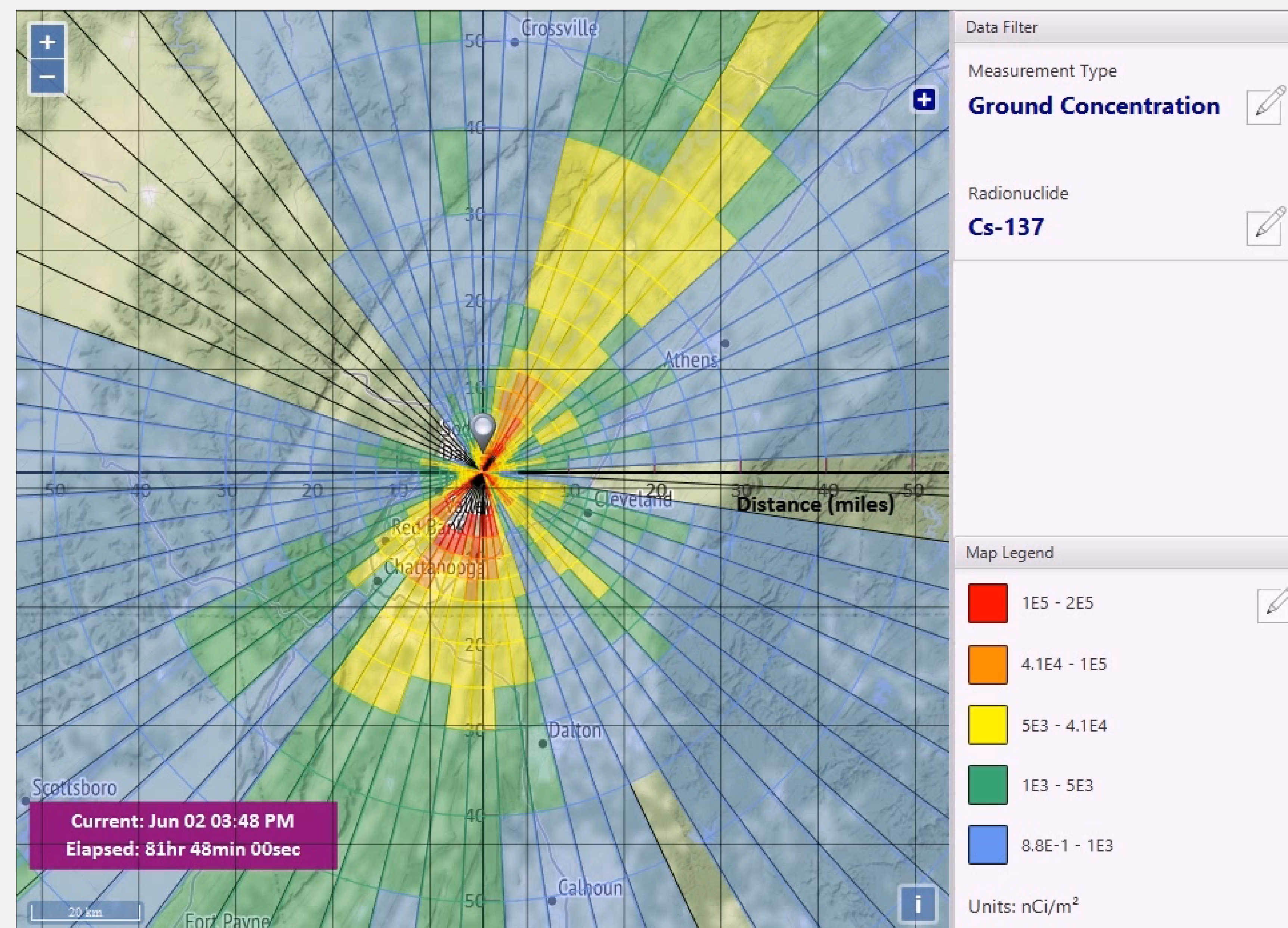


MACCS Code Suite

- 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

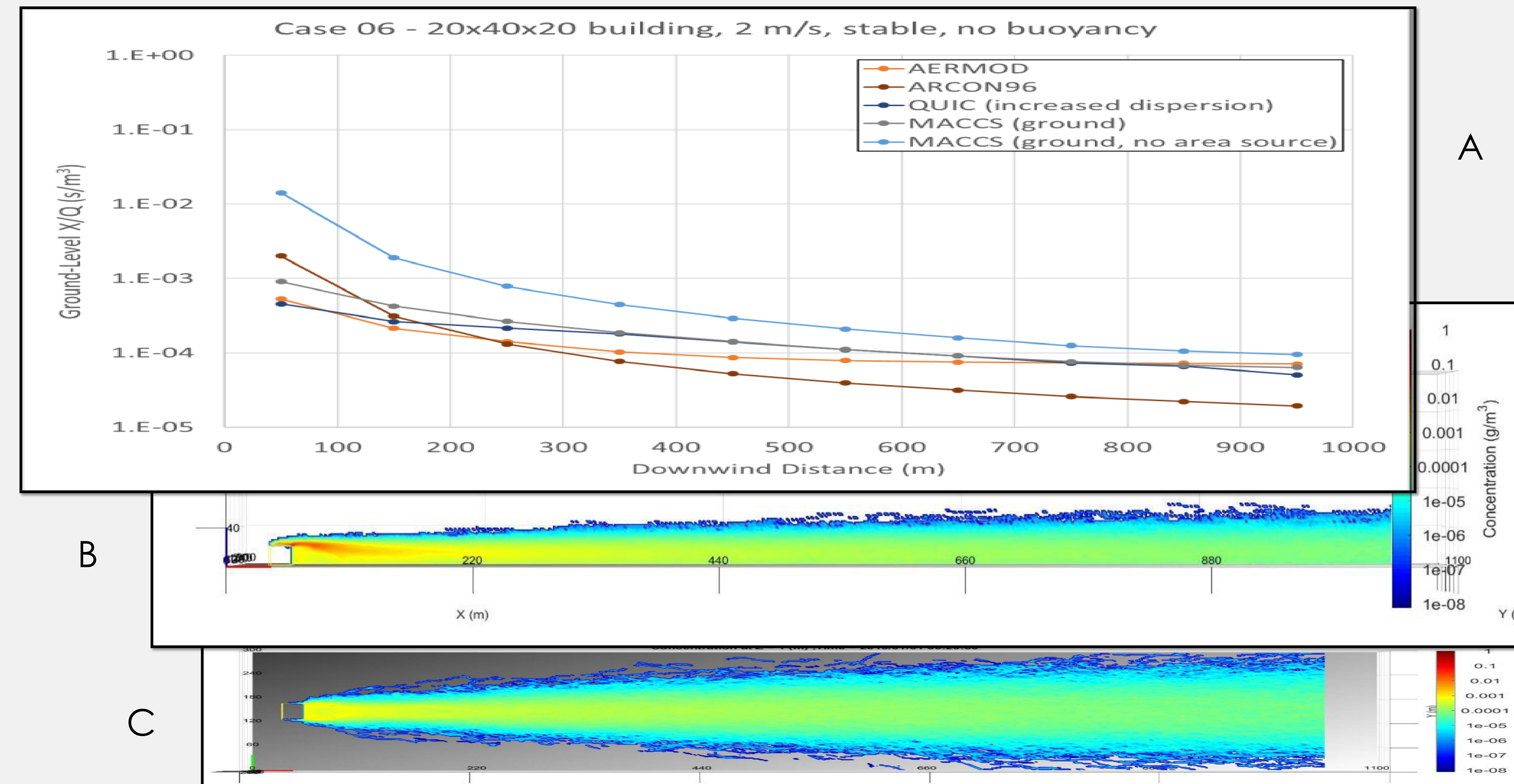


The [AniMACCS User Guide \(SAND2022-0403\)](#) was published in January 2022

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)

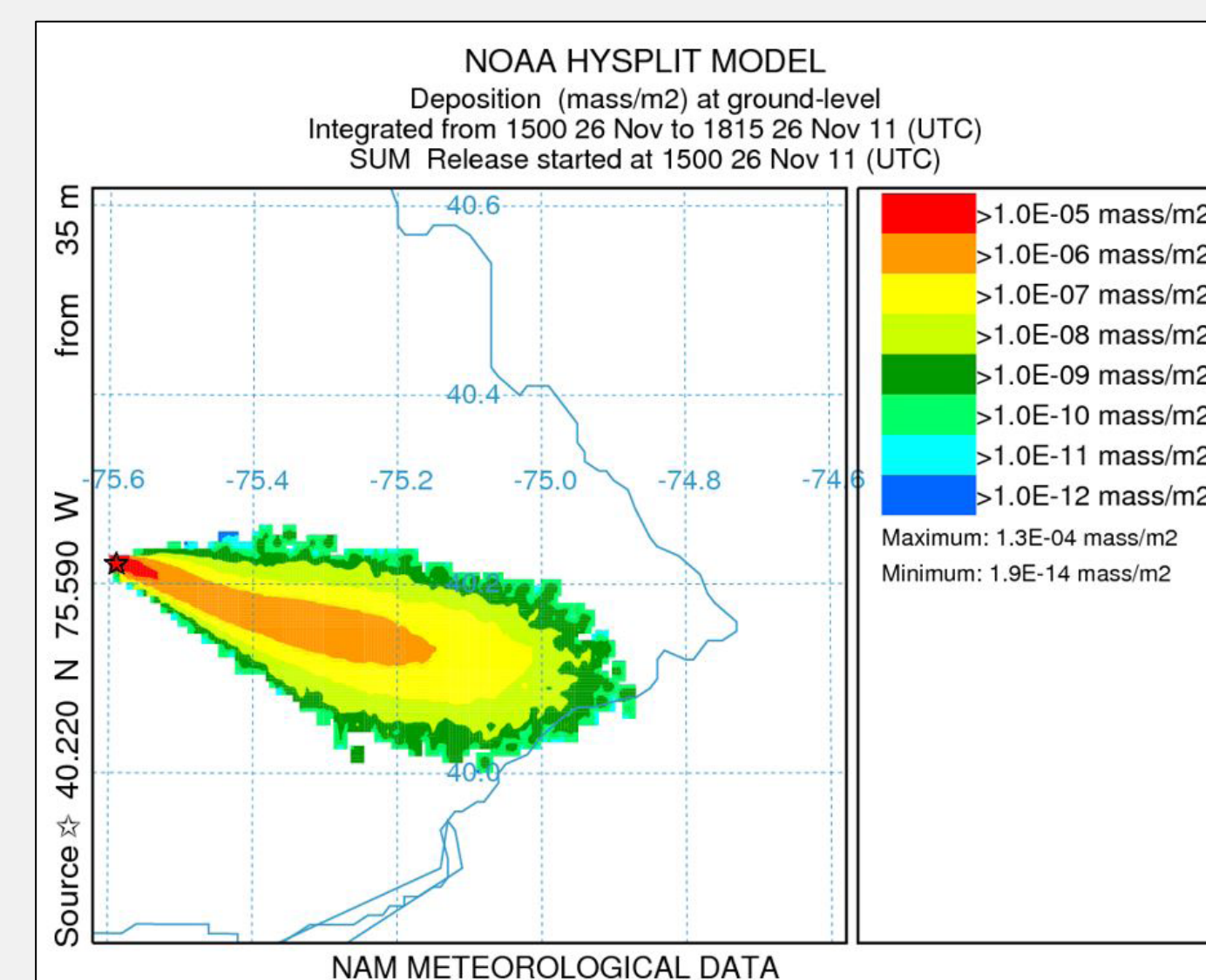
B. QUIC time-averaged air concentration for a vertical plane at building centerline (Figure 4-24b from SAND2020-2609)

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

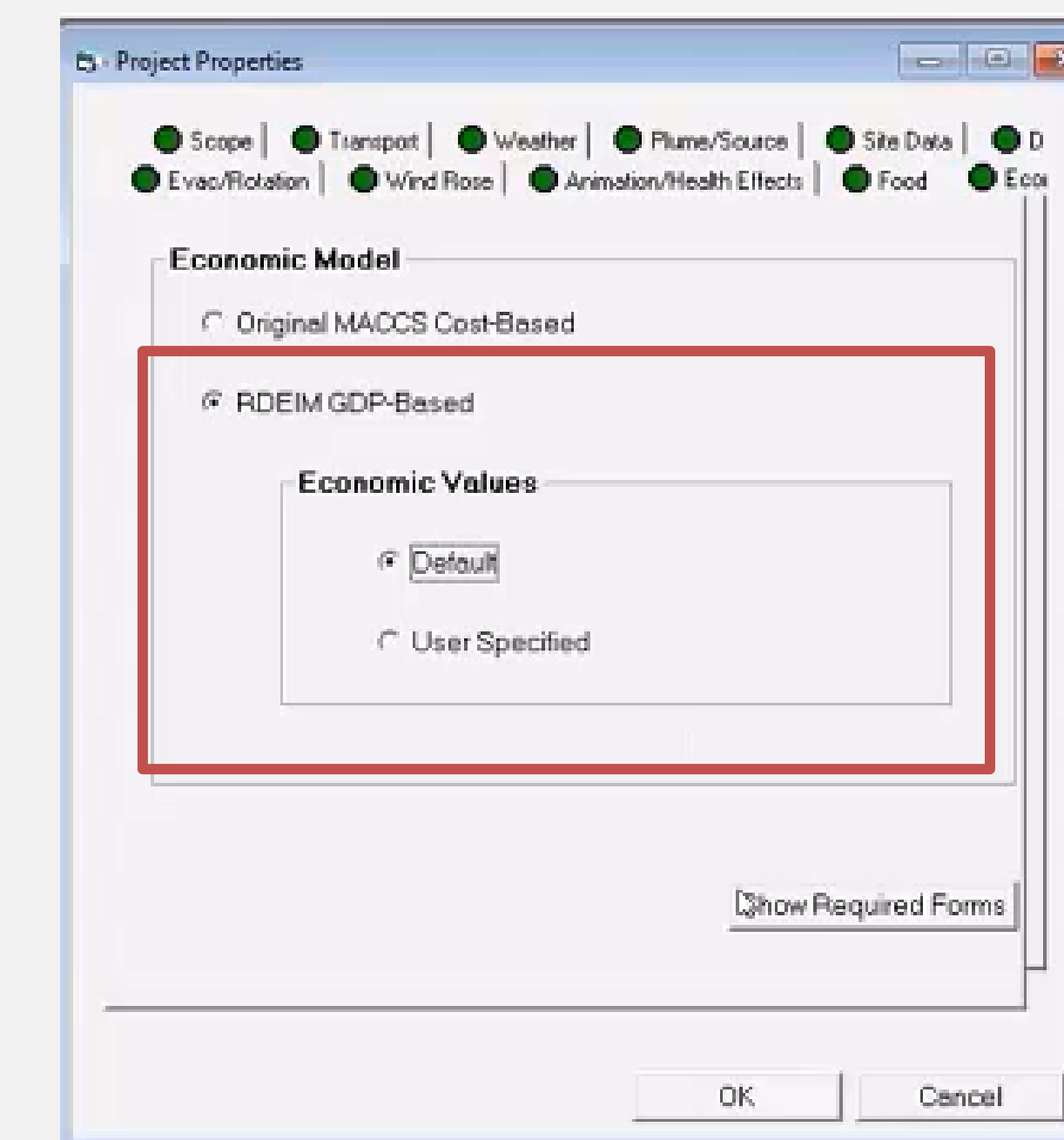
- MACCS added NOAA'S [HYSPLIT](#) as an optional atmospheric transport and diffusion model
- HYSPLIT is a complete system for simulating complex atmospheric transport with both puff and particle tracking dispersion models
- Users can choose between the traditional MACCS Gaussian plume segment model or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



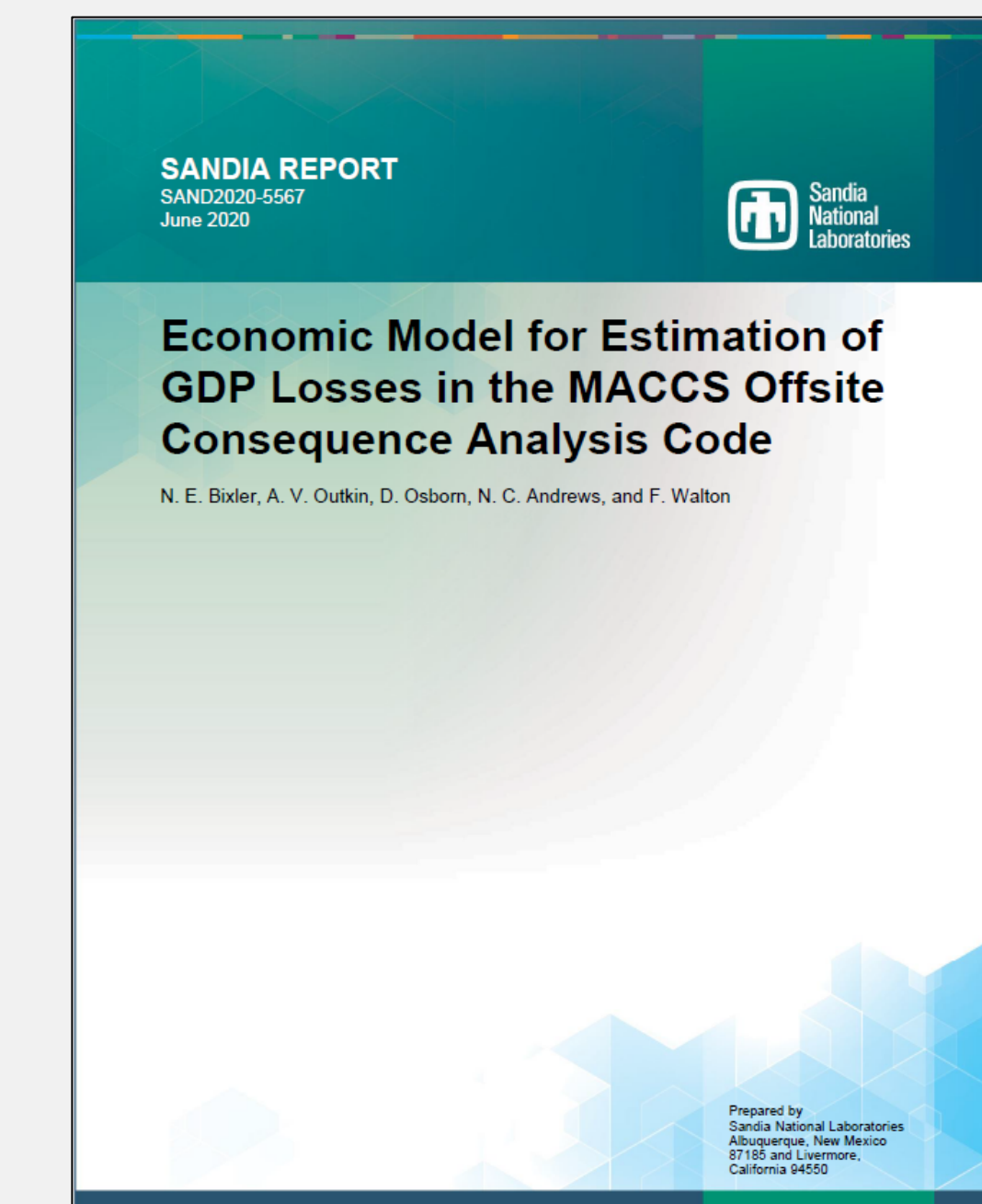
HYSPLIT Model Deposition Map

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

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

Contact: MACCSCodes@nrc.gov

MACCS Code Support

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

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