Virginia Center *for* Transportation
INNOVATION
& RESEARCH

We bring innovation to transportation.

Overview of VDOT Research Toward

Durable and Sustainable Transportation Infrastructure

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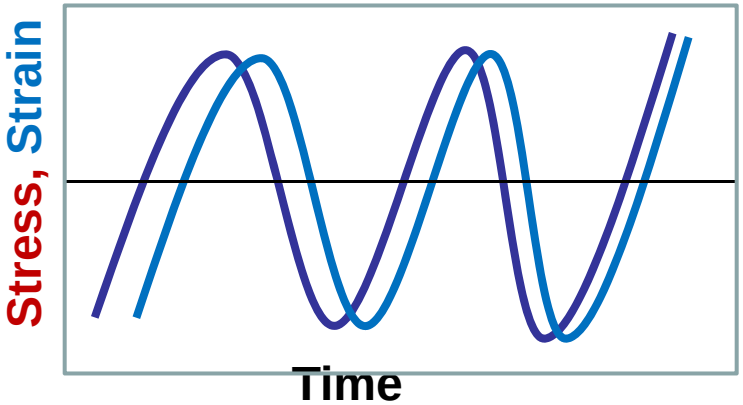
Sustainable Transportation Systems

- Sustainable Transportation means providing exceptional mobility and access in a manner that meets development needs without compromising the quality of life of future generations.
- A sustainable transportation system is safe, healthy, affordable, renewable, operates fairly and limits emissions and the use of new and nonrenewable resources (FHWA)

T. Harman, presentation at Virginia Tech, Blacksburg, 2009

Asphalt Mixture Characterization

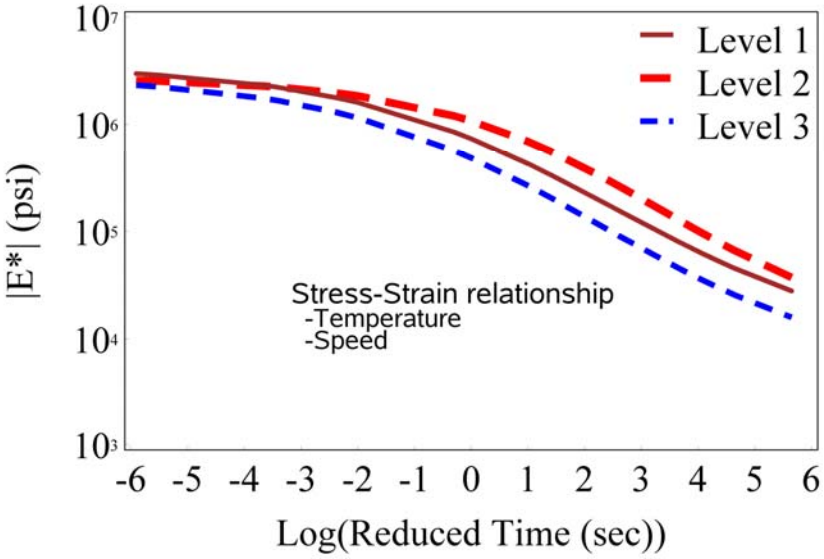
- **Dynamic modulus (E*)**
  - Fatigue & Rutting
- **Flow Number (FN)**
  - Rutting
  - Performance Prediction
- **Binder Stiffness (G*)**
  - Fatigue & Rutting
  - Performance Grade



MEPDG Implementation

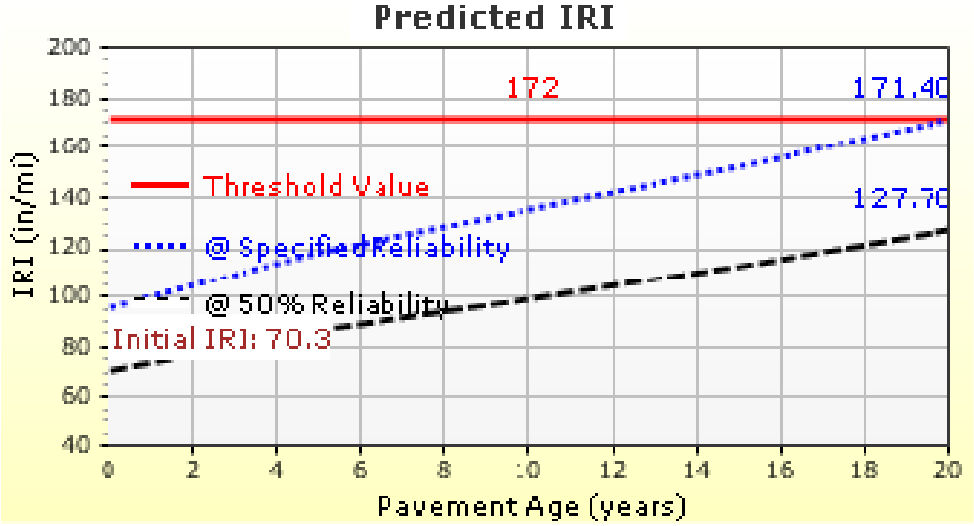
Mechanistic Design Inputs

Dynamic Modulus Master Curves



Performance Prediction

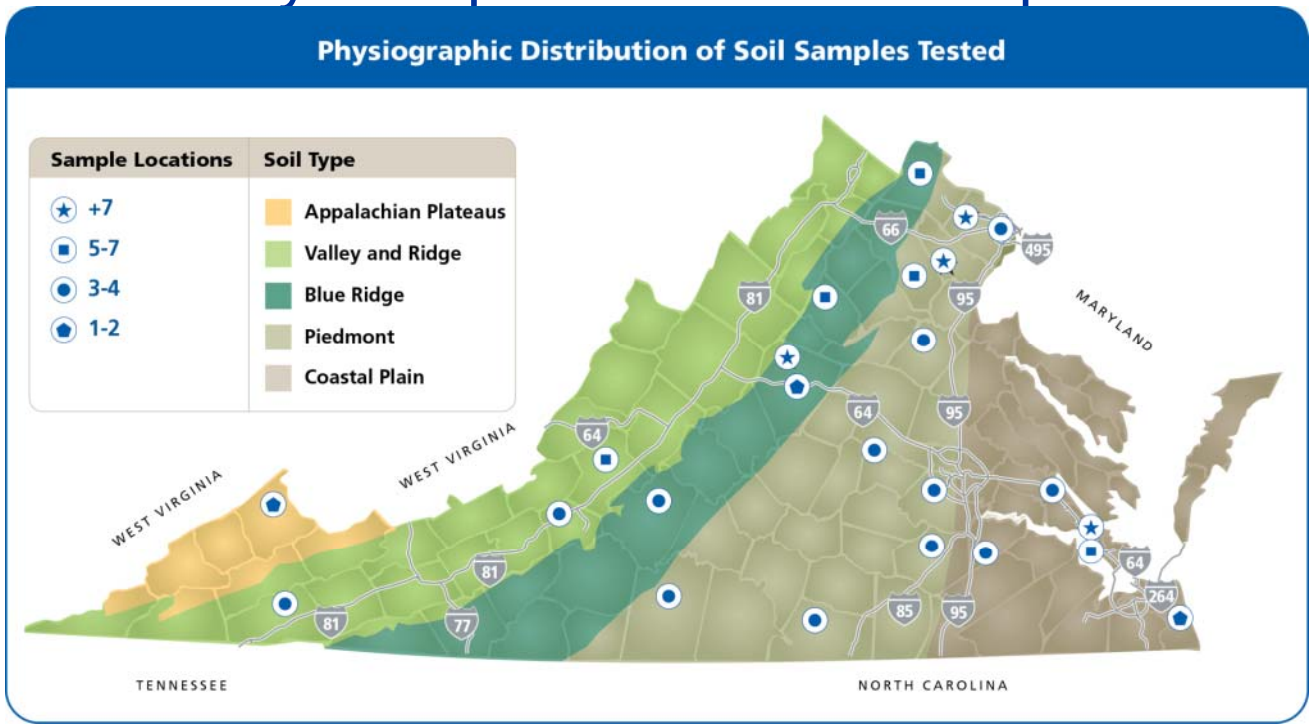
- Rutting
- Fatigue Cracking
- Thermal Cracking



MEPDG Implementation

- Unbound soil and aggregate (21A & 21B)
- Cement-treated aggregate
- Recycled concrete as aggregate
- Soil cements

Analyze to produce MEPDG inputs



High RAP Mixtures in Virginia

- Currently VDOT allows up to 30% RAP in HMA
- VDOT is interested in increasing RAP usage.
- Lack of understanding of how the binder in the RAP affects the virgin binder is a limiting factor on RAP use.
- Will compare no RAP, 25%, 40%, and 100% RAP
- Lab Performance - modulus, fatigue, rut potential, and permeability

Warm Mix Asphalt (WMA)

- WMA: Allows the production of asphalt mixtures at temperatures significantly below those of Hot Mix Asphalt
- WMA technologies
  - Foaming
  - Chemical modifiers
  - Wax modifiers

Warm Mix Asphalt (WMA)

- VDOT benefits
  - Improved compaction and density
  - Longer material life
  - Reduced emissions
  - Longer paving season
  - Lower material costs
  - Increased competition
- Contractor benefits
  - Fuel savings
  - Increased workability
  - Longer paving season
  - Larger market area

HMA

WMA

Pavement Recycling Methods

Reuse existing materials

- Do not re-heat materials from roadway
- Uses a stabilizing additive
  - Cement, lime, fly ash, foamed asphalt, asphalt emulsion

Processes:

- Hot in-place recycling (HIR)
- Cold in-place recycling (CIR)
  - Cold central plant (CCPR)
- Full-depth reclamation (FDR)

increasing depth and level of deterioration

NCHRP 09-51 CIR/FDR

Material Properties of Cold In-Place and Full-Depth Reclamation Asphalt Concrete for Pavement Design

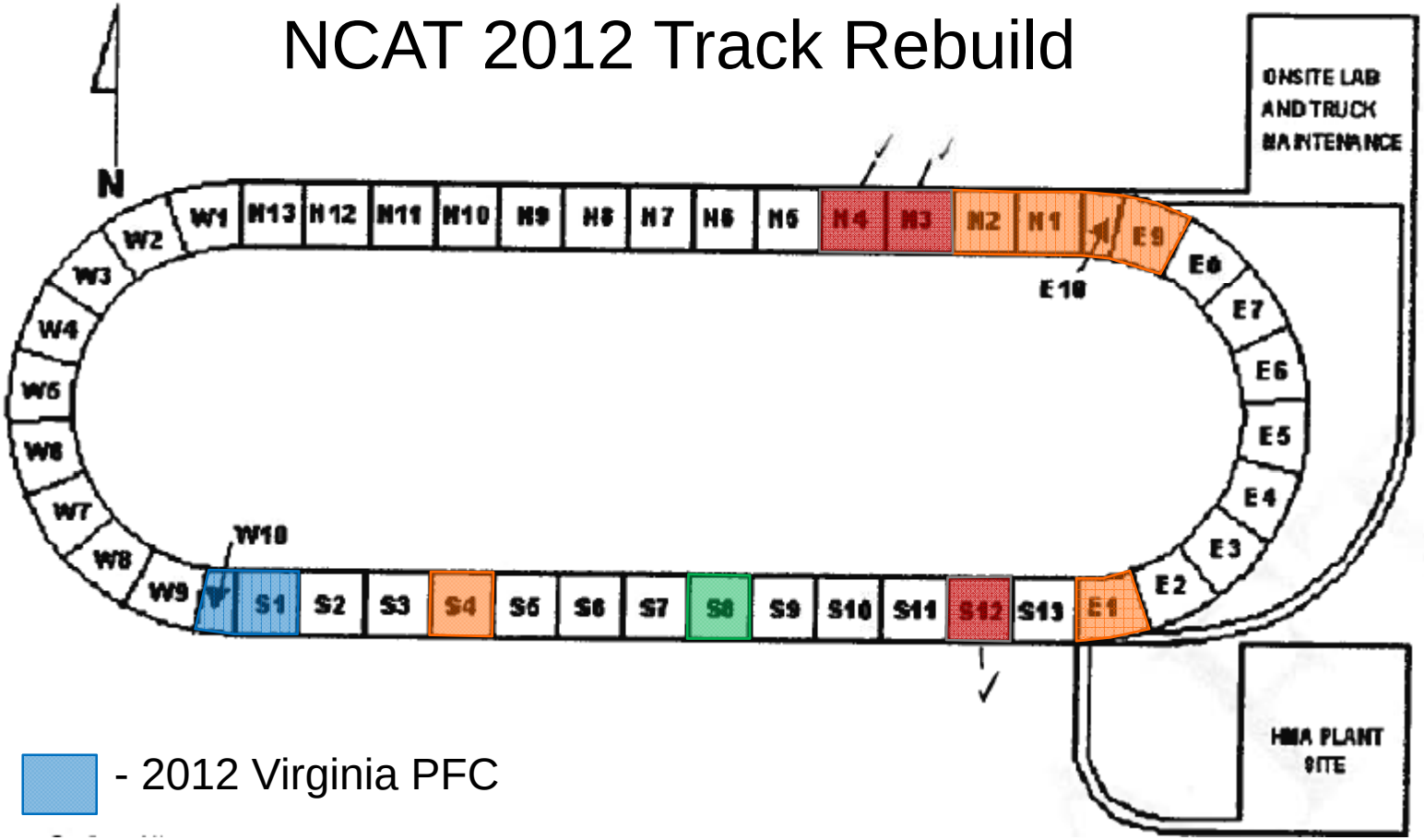
- Investigators
  - PI, Charles Schwartz, University of Maryland
  - Co-PI, Brian Diefenderfer, VCTIR
- Objective
  - Propose material property inputs, test methods, and distress models for predicting the performance of CIR and FDR using asphalt-based materials

Pavement Recycling

<u>Activities:</u>
Characterize materials properties
Develop pavement-design input values
Implement specifications and guidelines

Goal is pavement recycling as a <u>standard</u> pavement rehabilitation option

NCAT 2012 Track Rebuild



- 2012 Virginia PFC
- 2012 Other PFC
- 2009 Other PFC
- 2012 Virginia Recycle

- Five sections (3 recycling, 2 quiet pvmt)
- Construction completed in August
- Test sections include instrumentation
- 2 years of traffic = 10 million ESALs

Roller Compacted Concrete Pavement

Benefits

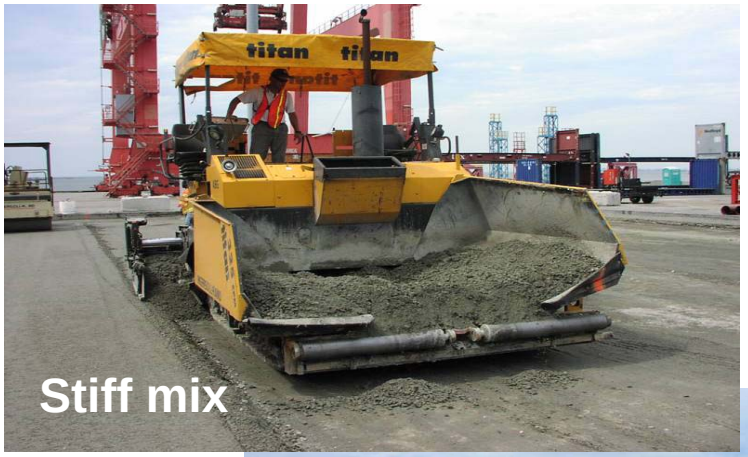
- Carry heavy/slow moving trucks
- Durable
- Open to traffic quicker than conventional concrete

Special Considerations

- Smoothness
- Unreinforced

Projects

- Staffordboro Commuter lot
- Craney Island Expansion

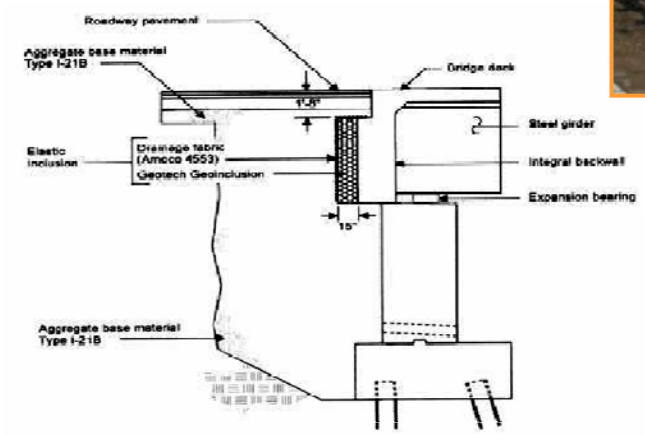


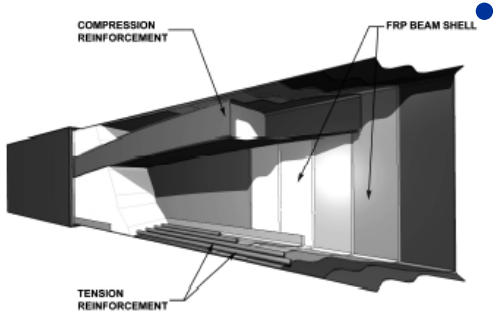
Stiff mix

Asphalt Paver

Asphalt Roller

Innovative Structural Systems





- Integral and Semi-integral Abutments
- HPC and LWC Prestressed beams
- Full-depth precast decks
- Geosynthetic Reinforced Soil Abutments
- FRP Composite Deck/Superstructure systems

Geosynthetic Reinforced Soil Integrated Bridge System

GRS-IBS Abutments feature:

- **Reduced construction cost (25 -60%)**
- **Reduced construction time**
- **Construction less dependent on weather conditions**
- **Flexible design -easily field modified for unforeseen site conditions (e.g. obstructions, utilities, different site conditions)**
- **Easier to maintain (fewer bridge parts)**

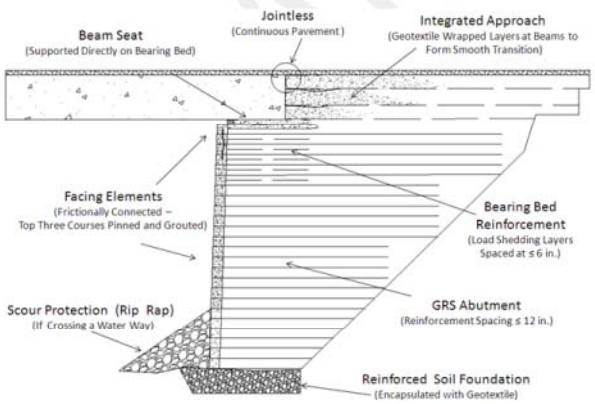


Figure 1.1. Profile of a GRS Abutment.
From Adams et al. (2011a). [Pending permission by authors]

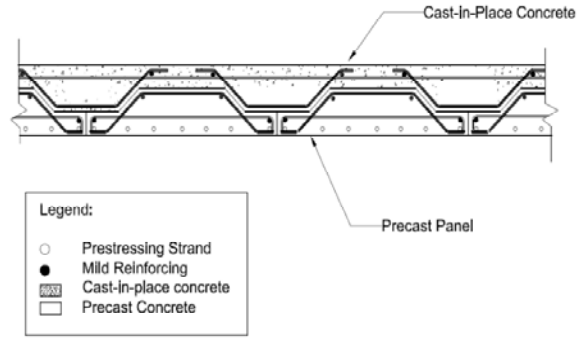
Full-scale testing by Virginia Tech

Designing for use on Towlston Road over Rocky Run in Fairfax County

Inverted-T Beam

- Prestressed inverted T-beams and reinforced, cast-in-place concrete topping
- Creates a composite slab superstructure
- Useful for short to medium span bridge applications
- Design eliminates reflective cracking through topping common to adjacent boxes, hollow-core slabs and similar superstructures.

Being installed on U.S. 360 over Chickahominy River under IBRD grant



Structural Testing at Virginia Tech

Corrosion Resistant Reinforcing Steel

- Support VDOT implementation of CRR specification
- Continue to evaluate alternative materials
- Consider design parameters to optimize use of material properties

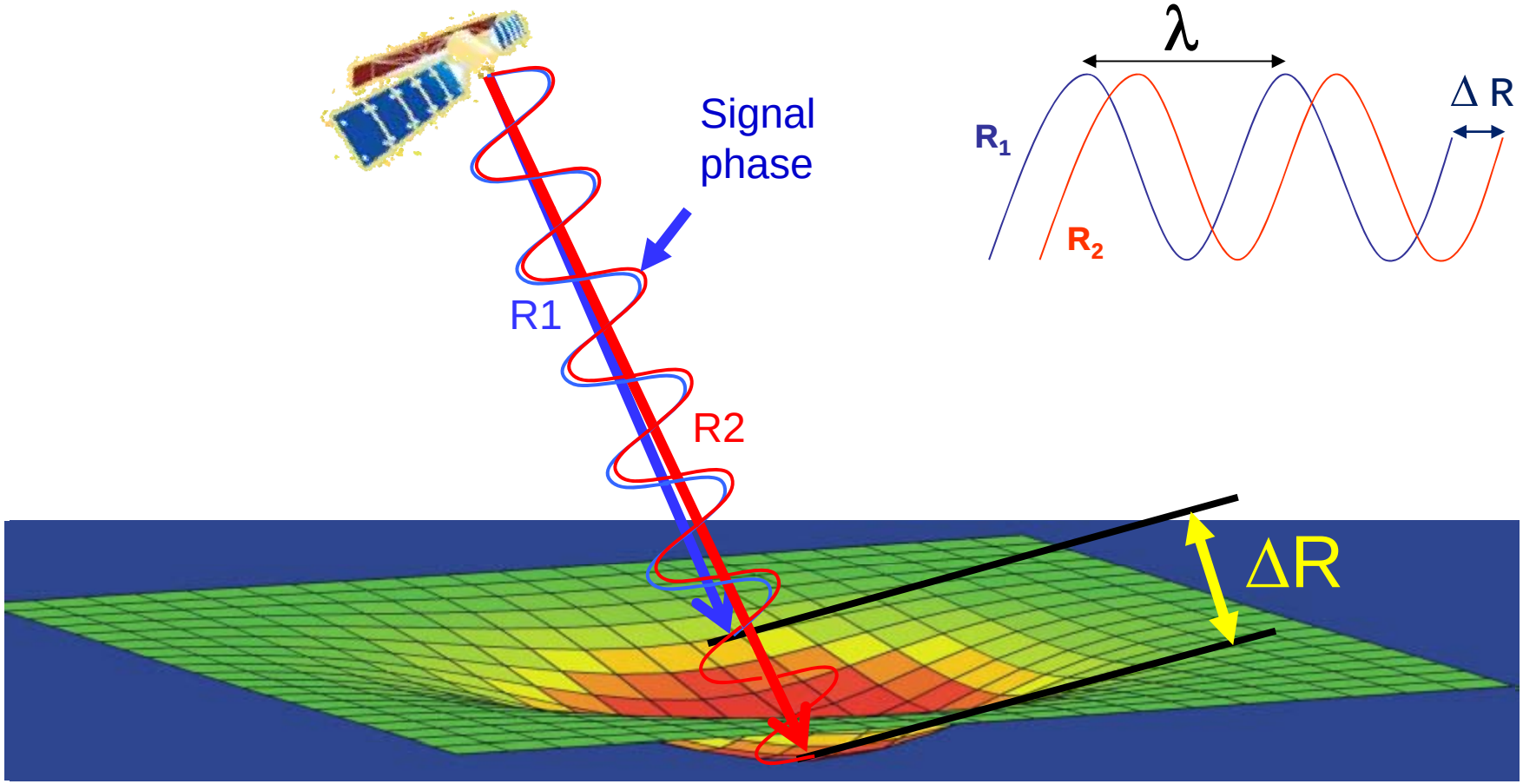
Carbon Fiber Composite Cable

Corrosion on Steel Strand

CFCC

Corrosion Resistant Strand

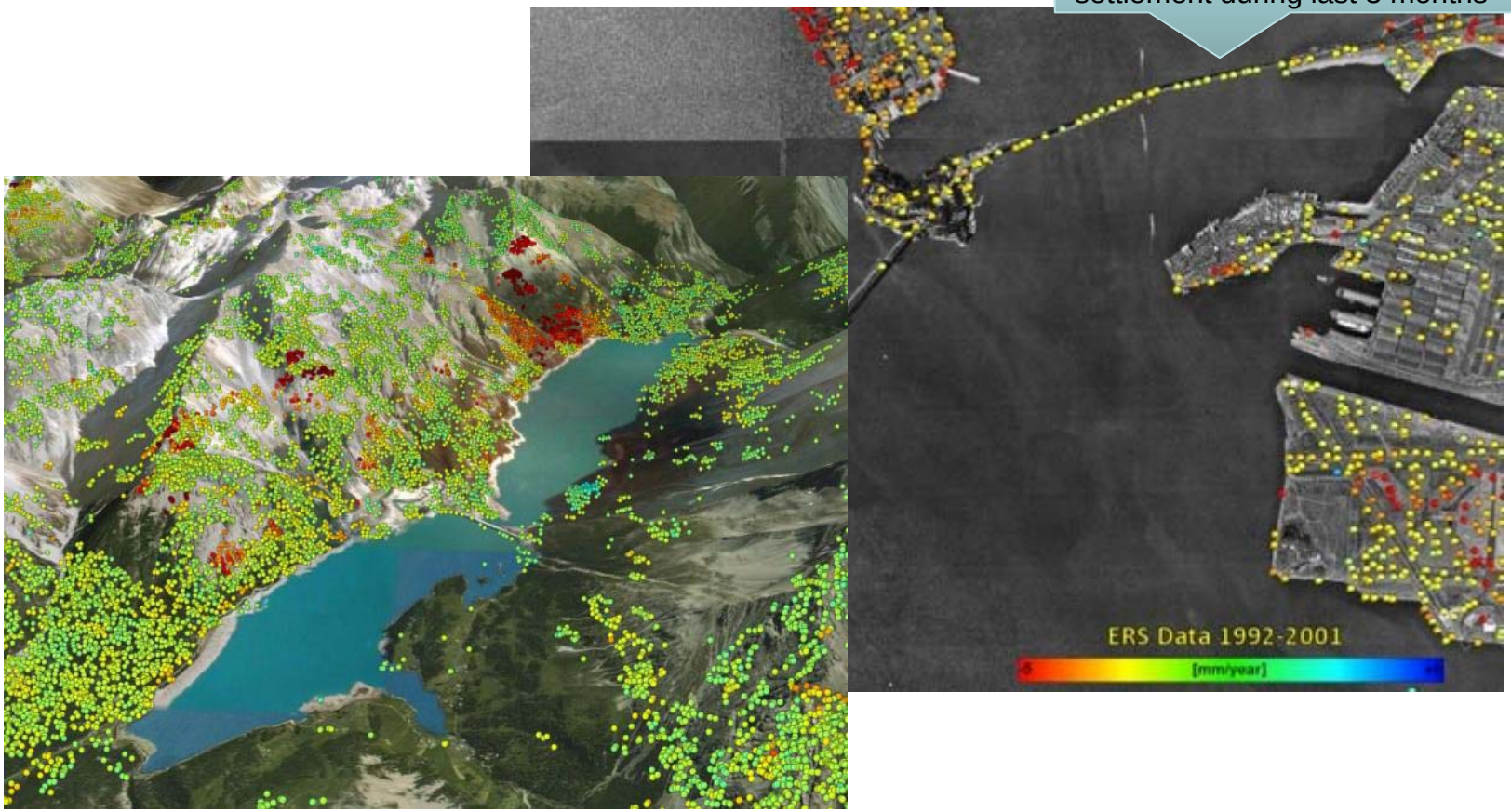
Interferometric Synthetic Aperture Radar (InSAR)



InSAR Applications

- Image analysis methods for detecting significant events (movement of a **rockslide**, subsidence due to a potential **sinkhole**, **settlement** of a structure.)

Irregular bridge settlement detected.
Average yearly settlement = 1.3 cm;
settlement during last 3 months = 3.7cm



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Thank you

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