Application and challenges of using soil moisture information for managing Network Rail’s earthworks

Áine Doggett-Brookes, Network Rail
Oliver Pritchard, Arup

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Network Rail’s Earthworks

Embankments
102,128

Soil Cuttings
72,596

Rock Cuttings
16,218

~190,000 Assets
Impacts of slope instability on the railway
Soil moisture information within Network Rail

Soil Moisture Deficit (SMD) – used historically

- Based on Met Office Rainfall and Evapo-transpiration Calculation System (MORECS).
- 40 x 40km resolution.
- Provided weekly (historically).
- Widely recognised metric of soil moisture in Network Rail.

Risk of desiccation associated with high SMD
Risk of slope instability associated with low SMD
Soil moisture information within Network Rail

- Soil Moisture Index (SMI) – moving forward
  - Based on European forecast model.
  - ~8 x 14km resolution (interpolated from coarser model).
  - Provided through Network Rail’s Weather Service (NRWS).
  - Hourly Resolution (historically: twice daily).
  - Forecastable metric (>7 days).
Soil moisture data as leading indicator of earthworks failure

- Soil moisture used to understand relationship with safety-related earthwork failures.
- Aim to establish a ‘weather normalised’ failures indicator.
- Assessment at different levels:
  - Regional effects
  - Earthwork type (i.e. embankment/cutting)
  - Different geologies (Rock/Soil)
- SMD – higher risk of failure when soil is saturated.
- SMI – provides more detailed indication of when failures might occur.
Soil moisture as leading indicator of earthworks failure

- Network Rail have high number of earthworks assets to manage: **190,000**.
- However, only ~ 100 failures per year….
  ..... **which aren’t always catastrophic**!
- Known that failures more likely in times of more adverse/extreme weather.
- Procedures in place for managing risk (e.g. watchmen, speed restrictions, slope stability alarms, line closure).
- Weather thresholds set based on analysis undertaken alongside rainfall data to advise on when to implement operational procedures.
Soil moisture challenges and requirements for earthworks asset management

Network Rail Earthworks Challenge Statement

“Soil Moisture Challenges

Data management and processing
Spatial and temporal granularity
Forecastable
Confidence in failure prediction
Multiple data platforms
Avoiding black-box methods

Detect of asset failure by means other than train drivers”
Thanks for listening, any questions?