The HardSPEC model
HardSPEC is....

- A first-tier model for estimating surface water and groundwater exposure resulting from herbicides applied to hard surfaces
  - Any man-made impermeable surface, such as concrete or asphalt and including railway ballast, that is not intended to bear vegetation
- Used by UK regulators to support environmental risk assessments for change of use, or new herbicides
  - CRD - Chemicals Regulation Directorate
  - PSD - Pesticide Safety Directorate
- UK specific
History of HardSPEC

- Disproportionate contamination of water by herbicides applied to hard surfaces
- Atrazine/diuron highly mobile
- Need for new products on ‘hard surfaces’ market

- Old risk assessment assumed all product was removed after 25mm of rainfall
- Need for more realistic scenario to represent herbicide usage on hard surfaces
- Hard Surfaces Steering Committee created comprising government, industry, researchers
Collaborative project
Key issues

- The primary purpose of the model is to predict herbicide concentrations in water in order to assist Regulators in assessing environmental risk of herbicides applied to hard surfaces
- CRD has a UK-wide remit
  - When developing representative scenarios, some broad assumptions would be necessary = Tier 1 model
- Four hard surface scenarios that differ by:
  - Proportion of different hard surface type
  - Application method or pattern of application
  - Dimensions of water body
- Underlying processes describing the fate of the chemical after application are the same
Groundwater (Railway) exposure scenario

- Ballast/substrate: Depth; Water retention; Bulk density; Organic carbon
- Depends on herbicide properties - half-life
- Standard properties of: Hydrogeology & physico-chemistry
- Chalk
  Jurassic Limestone
  Triassic sandstone
- Ballast sub-model
- Attenuation factor
- 1D slug injection
- Aquifer
- Unsaturated zone
- 75th percentile wettest spring (1959-1981)
- 10% interception
- Daily herbicide mass washed out of ballast
- Daily herbicide mass leaching to groundwater
- Daily herbicide concentration at well head
- 75th percentile wettest value for average daily recharge

- 5 m
Data were generated for:

- Ballast and substrate characteristics
- Herbicide attenuation
Groundwater characteristics

- Based on Environment Agency Groundwater Source Protection Zones
  - Outer Source Protection Zone (SPZ) = 400 day groundwater travel time
  - Inner Source Protection Zone (SPZ) = 50 day groundwater travel time
- Statistical analysis of EA data to give other parameters
- Data simplified to give average flow velocities and distance from contaminant source to well.
Surface water exposure

• Herbicides can enter surface water:
  • Directly via spray drift
  • Via ‘runoff’

• Via leaching
General

- HardSPEC represents reasonable worst-case conditions for UK
- Avoided use of e.g. 90%ile worse case for all parameters
- But for railway/groundwater scenario, it is 99.8\textsuperscript{th} percentile worst-case for aquifer vulnerability
- Validation shows the prediction are reasonable - but railway validation data are limited
Options for model refinement

- Attenuation of herbicide in ballast substrate
  - This would require a robust data set and is likely to be expensive (data generation + implementation in model)
- Attenuation of herbicide in runoff
  - Practical studies feasible
  - Area targeted by spray

Future developments

- Sensitivity analysis
  - Identify parameters that have largest impact on the output
  - This will assist with focussing areas of refinement
- Amend drift calculations
- ??????? Ideas and feedback welcome!