RAIL

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Improvements in Data Collection and Linkage for Risk Modeling in Railroad Safety Inspection Programs

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Federal Railroad Administration

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Introduction

Challenges

1. Accurate risk model outputs (i.e., risk scores) depend on many inputs from a variety of sources, such as recent incidents and inspections.

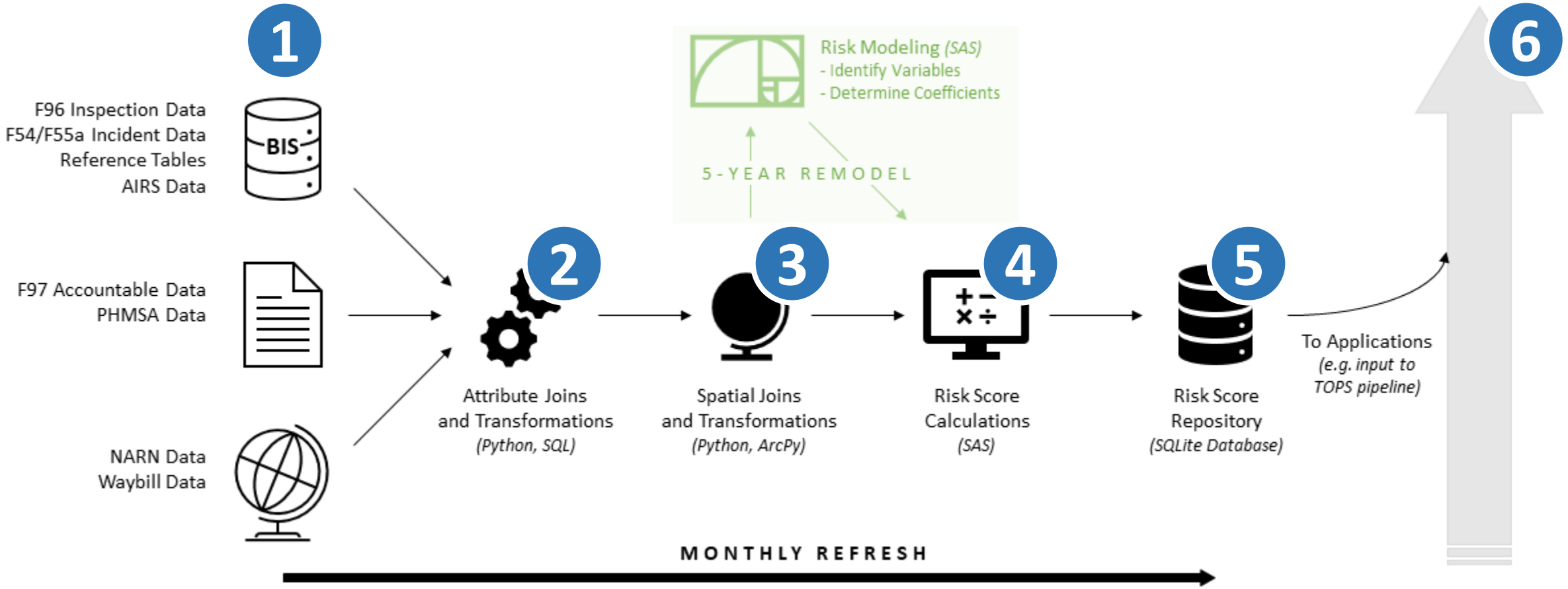
2. Identifying and recording trends in risk requires continuous, regular input of new data.

Solutions

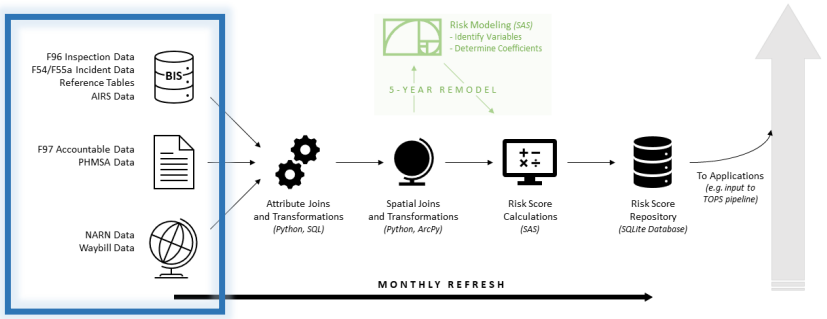
- FRA's data pipeline incorporates geospatial processes to quickly associate all available data per location.

- FRA's data pipeline repeatedly and regularly brings current safety data into the risk models.

Refined Process and Agenda



1 Centralized Data Sources

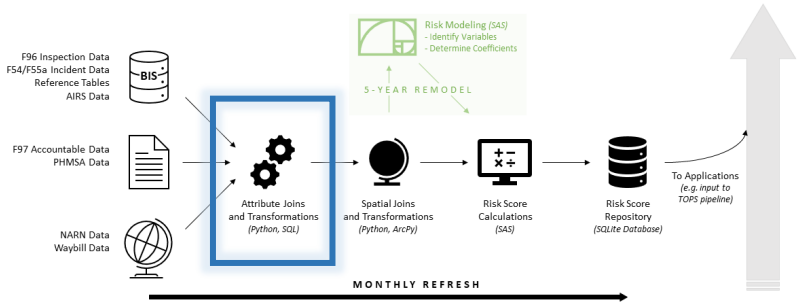


- FRA's current data lake ingests nightly backups from each system of record.
- Risk models benefit from these feeds to regularly update the resulting scores (monthly).

Inputs

- Filed **inspection** reports
- Reported **incident** data (equipment and illness/injury)
- Asset Inventory of Railroad Shippers (**AIRS**) – inspection location base data
- **Accountable** incidents (do not meet regulatory reporting threshold)
- **Hazardous material** release incidents (PHMSA NAR)
- North American Rail Network (**NARN**) base data
- **Waybill** sample, flowed on the NARN

2 Query, Import, and Transform (Build) Current Data



- Python-scripted queries and transformations extract the data relevant to **each discipline**.
- **Close engagement** with specialists and inspectors in each discipline eliminates irrelevant or erroneous input data.

Example: Operating Practices (OP)

- Equipment Incidents (Form 54)
  - Focused on reducing **human factor-caused** reportable equipment incidents.
  - Risk considers the rate of **cause-code 'H'** incidents.

Cause-Code H

- Exceptions (if any)

- Accountables (Form 97)
  - Incidents of a certain cause code *may* be later determined to be human-factor and are **added** from F97.

+ Accountables (subset)

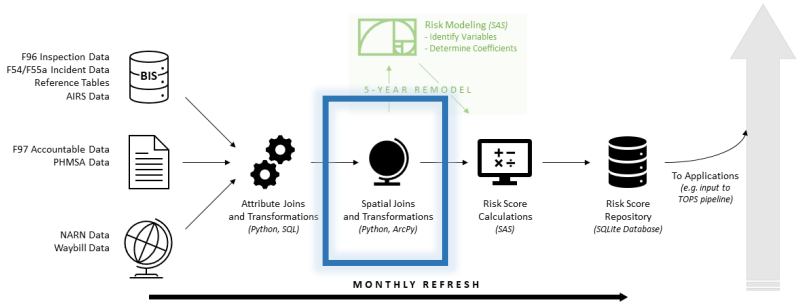
- Inspections (Form 96)
  - Operating Practices inspectors are **type 'O'.**
  - But **activities** of certain types are *not* relevant to risk (excluded).
  - A subset of **critical defects** (inspection results) are elevated in weight.

Type 'O' Inspections

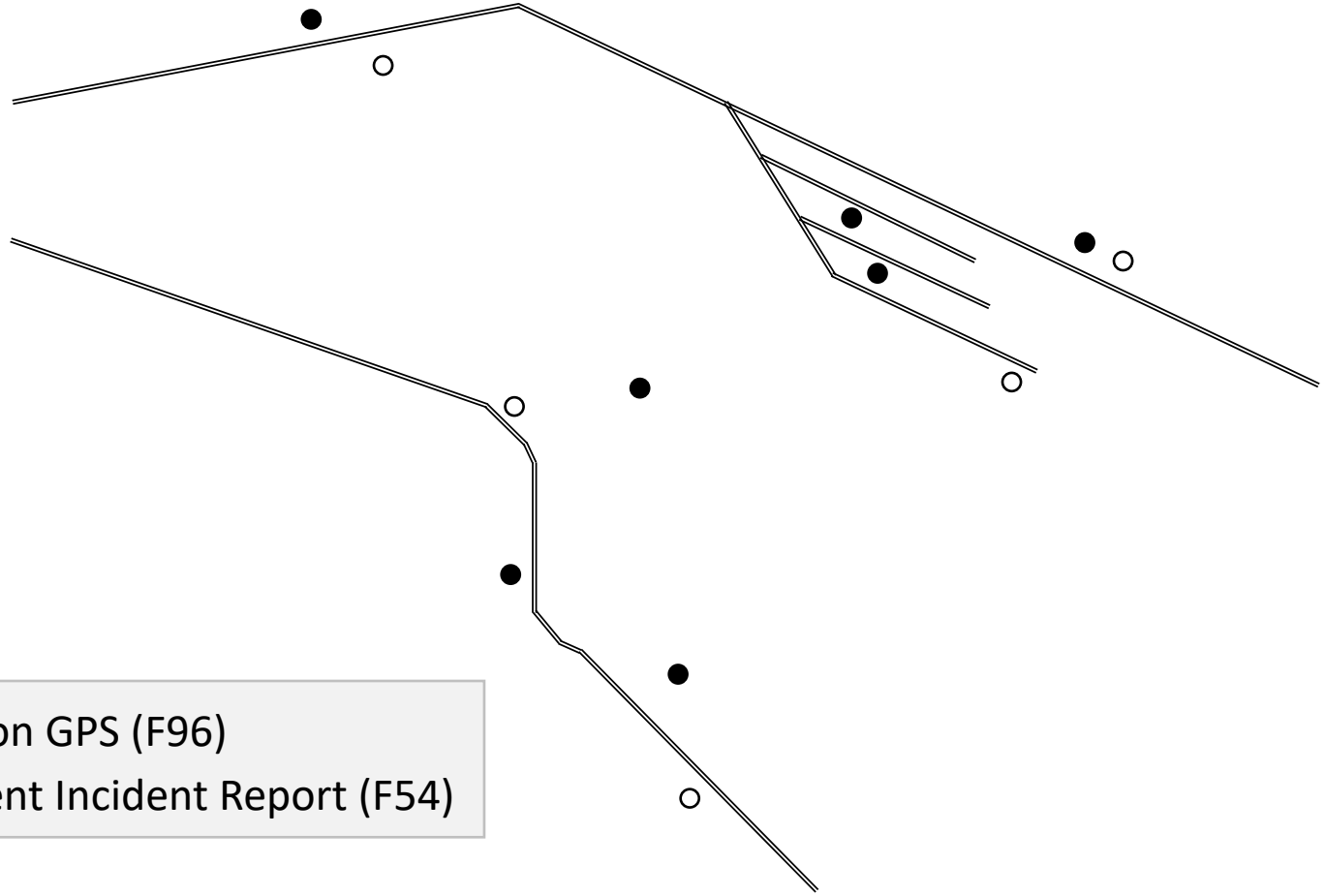
- Excl. Activities

Flag Critical Defects

3 Per-Discipline Spatial Analyses and Summaries



- Geospatial processes summarize **disassociated data**, maximizing the breadth of inputs.
- GIS **quickly and accurately** links multiple events (which do not reference any inventory) to a single geospatial asset.



- ● Inspection GPS (F96)
- ○ Equipment Incident Report (F54)

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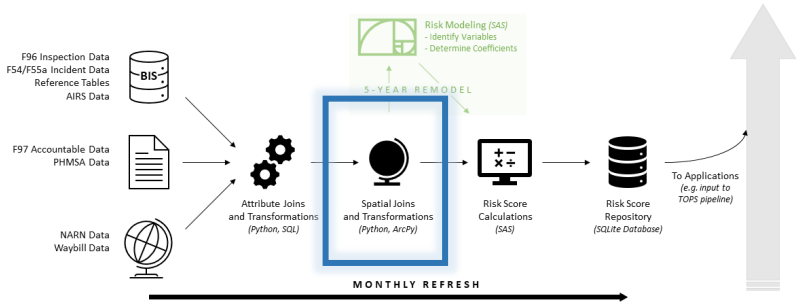

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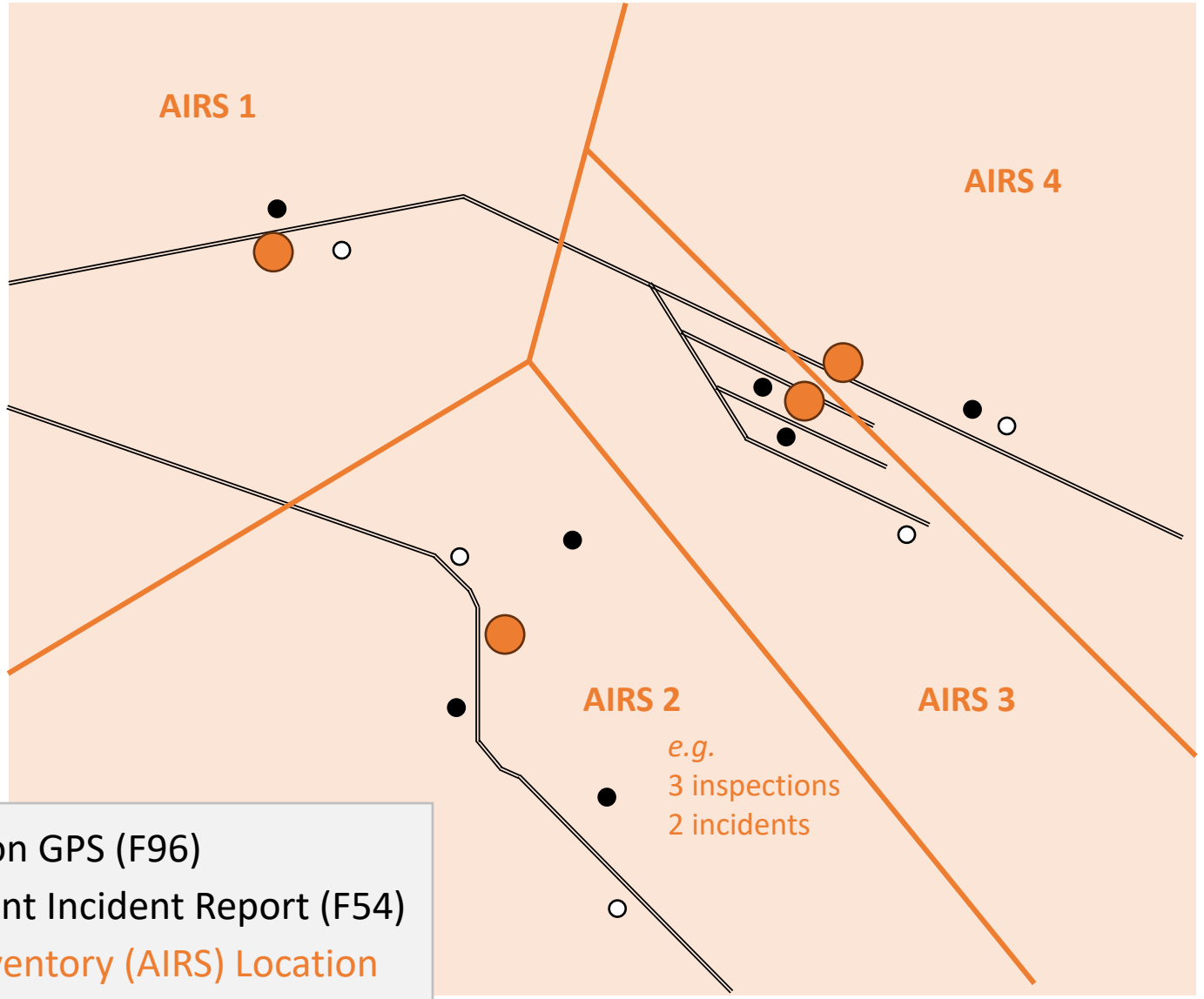
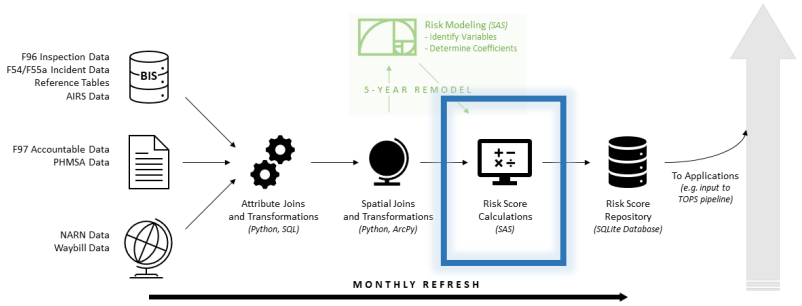
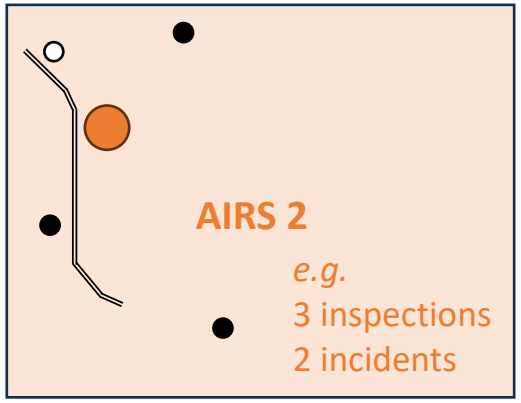


4 Apply Risk Model to Refreshed Summary Data



- **SAS-scripted calculations** take spatially summarized data per AIRS location as input…



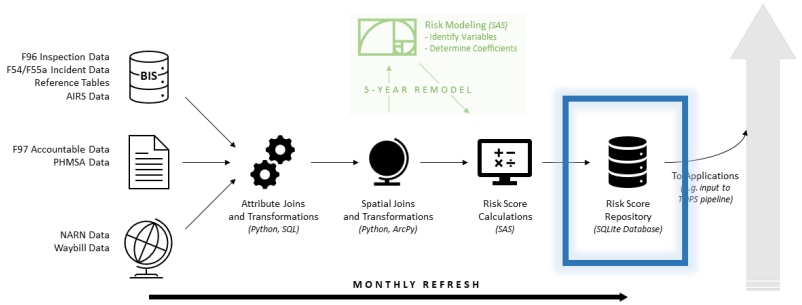
- …and output an **updated risk score** (0-100) reflecting probability and severity of an incident at each AIRS location.

AIRS 2 Risk Score: **78**

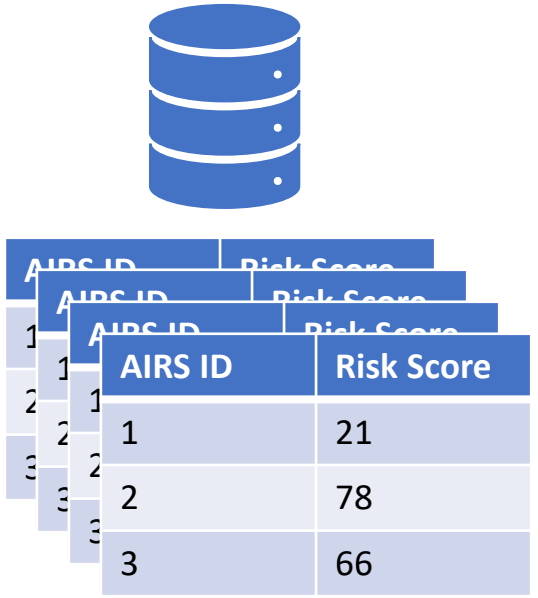
- **Driving inspections**, which ideally result in improvements that reduce incidents and therefore risk.

AIRS 2
5 inspections
1 incident

5 Write Refreshed Risk Scores to Repository



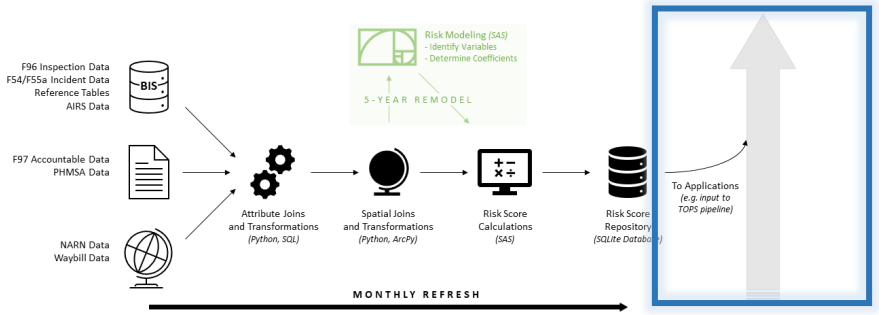
- After calculating refreshed results, risk scores are saved to a **risk repository database**.
- Keeps a **history** of risk scores per AIRS point.
- Makes current scores **available** to other applications.



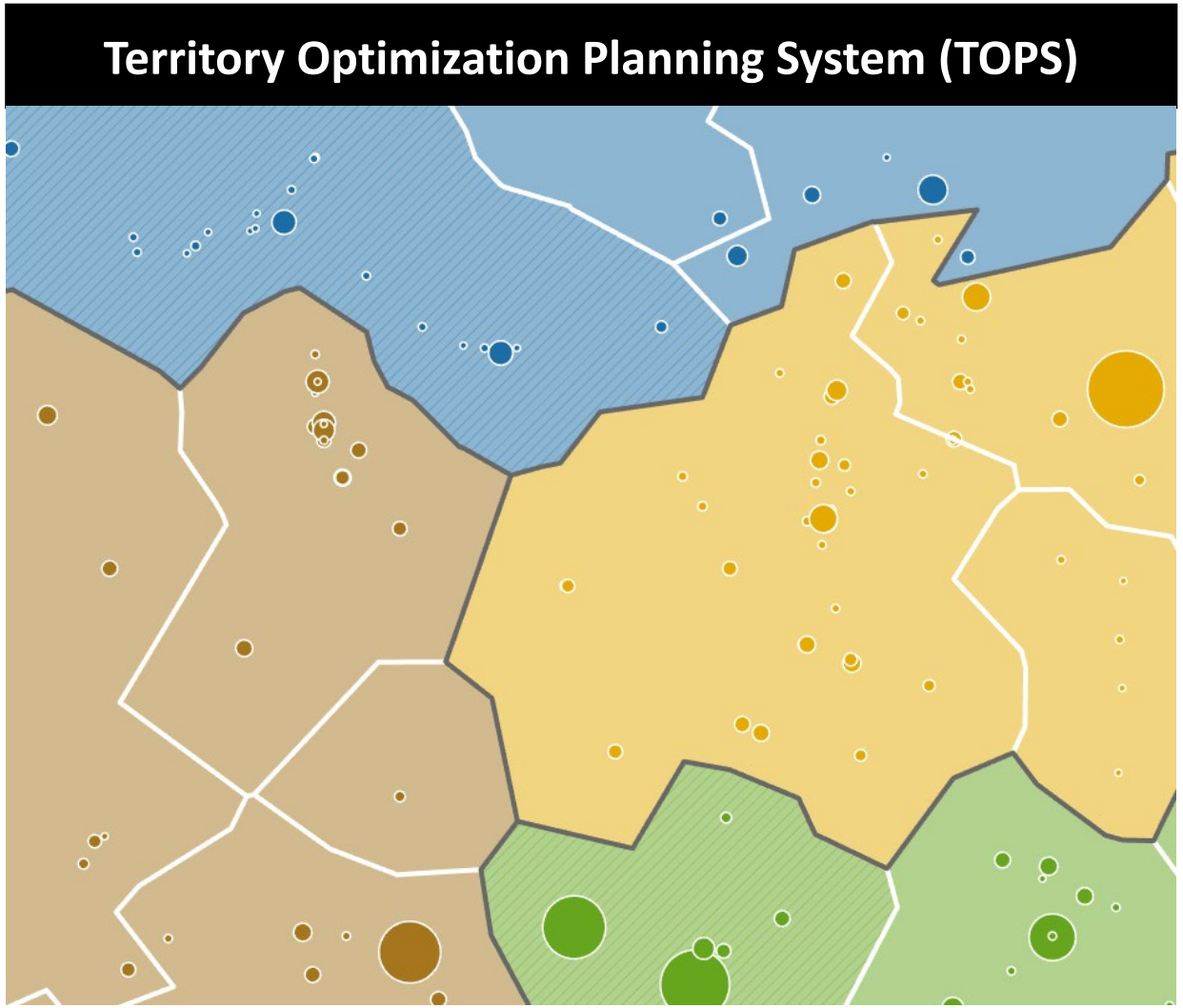
AIRS ID	Risk Score
1	21
2	78
3	66

- **Mapping**
- **Analysis**
- **Other Databases**
- **Reporting**

6 Presentation through Web Map Applications



- In TOPS, AIRS points are updated monthly, sized by relative risk, and provided to the inspectors.
- Larger points have a higher likelihood / greater severity of incidents.



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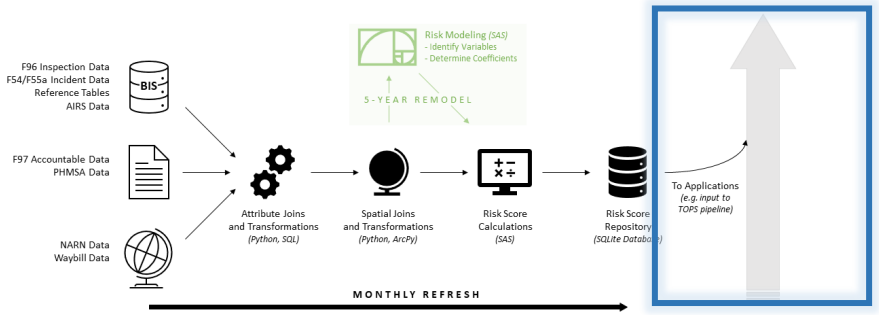
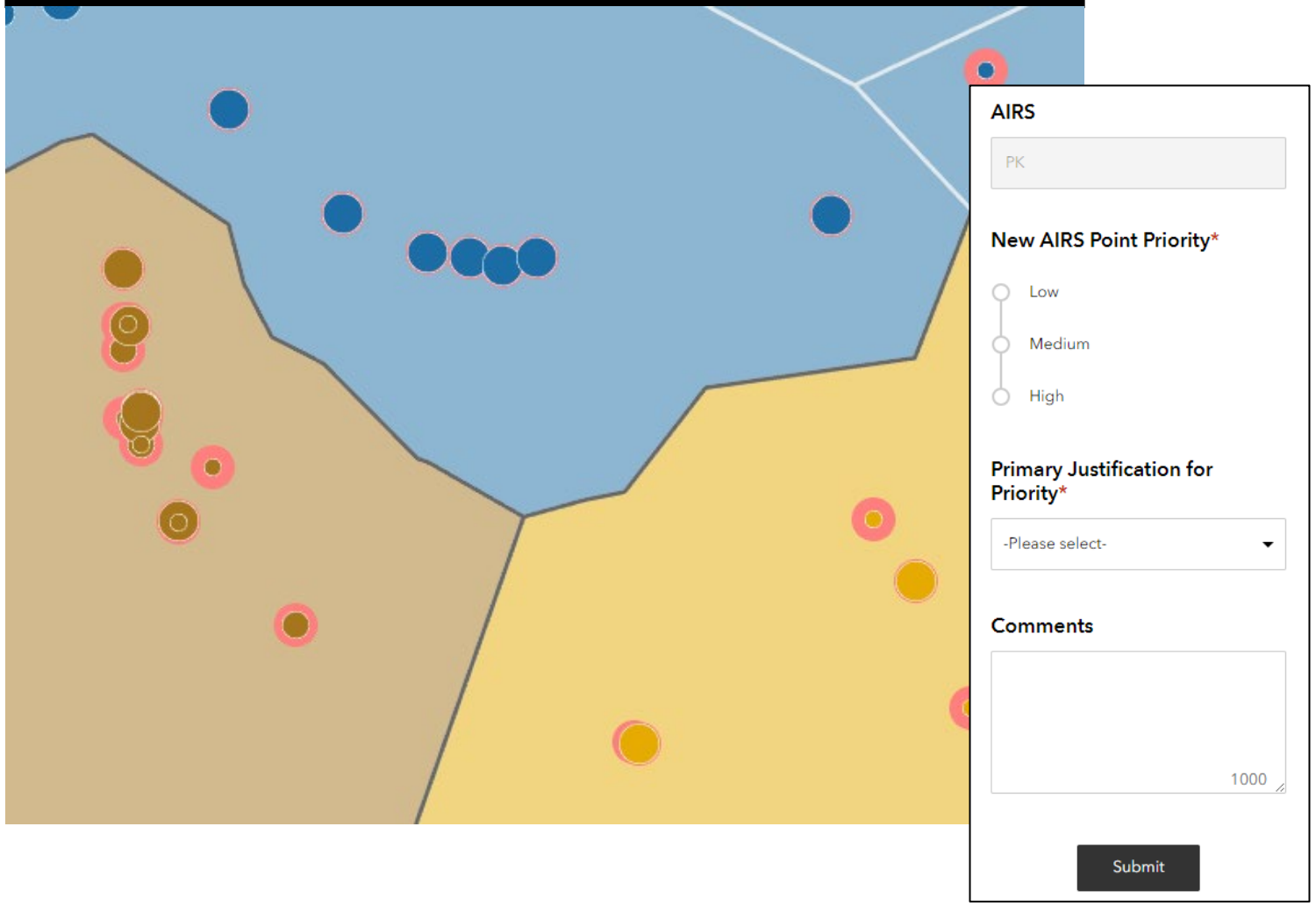
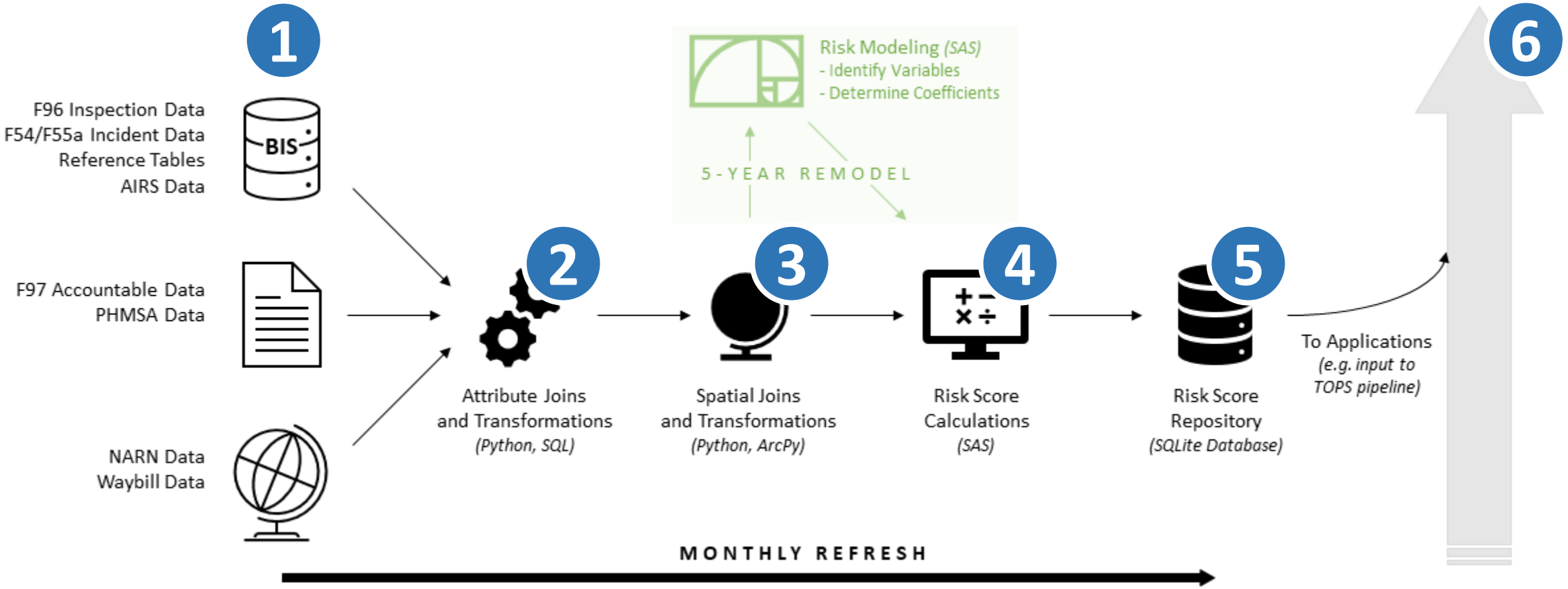


- Also through TOPS, inspectors can designate priorities, further modifying the risk score.
- AIRS points with red halos have a priority score: high, medium, or low – a data source for risk model validation and improvements.

Territory Optimization Planning System (TOPS)



Summary


1
F96 Inspection Data
F54/F55a Incident Data
Reference Tables
AIRS Data
BIS
F97 Accountable Data
PHMSA Data
NARN Data
Waybill Data
Risk Modeling (SAS)
- Identify Variables
- Determine Coefficients
5-YEAR REMODEL
2
Attribute Joins
and Transformations
(Python, SQL)
3
Spatial Joins
and Transformations
(Python, ArcPy)
4
Risk Score
Calculations
(SAS)
5
Risk Score
Repository
(SQLite Database)
To Applications
(e.g. input to
TOPS pipeline)
6
MONTHLY REFRESH

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