Shoreline oiling data management for the Deepwater Horizon oil spill, Gulf of Mexico, USA: Proposed core SCAT data standards for future spills of significance

Zachary Nixon, William Holton, Mark White, Chris Locke - Research Planning, Inc. – 1121 Park St, Columbia, SC 29201 USA

Abstract The Shoreline Cleanup Assessment Technique (SCAT) data management program for the Deepwater Horizon oil spill is, to our knowledge, the largest shoreline spill data management effort in history, still currently providing continuous data management of over 35,000 separate surveys covering over 22,000 survey-miles of shoreline and tens of millions of individual pieces of data. While we hope many of the tools and products developed will be of value in near-term future spill responses, we are less clear on the specific recommendations we can make to data managers during the next nationally significant spill in 10 or 20 years. The differing needs of each spill, varying levels of agency and industry personnel participation, and the inevitable and increasingly rapid change in software and information technology environments, all point to the need for a different way forward. We feel the most important contribution we can make is the recommendation of an ***open data standard*** for shoreline oiling and related data management, allowing interested parties in future responses to be assured of data interoperability, transparency, and data quality, while permitting required flexibility. We propose such a standard here.

Introduction

The Shoreline Cleanup Assessment Technique (SCAT) data management program for the Deepwater Horizon oil spill is, to our knowledge, the largest shoreline spill data management effort in history, still currently providing continuous data management of:

- Over 35,000 separate surveys
- Over 22,000 survey-miles of shoreline and
- Tens of millions of individual pieces of data.

The program, similar to many previous efforts by dedicated SCAT programs and data managers, flexibly expanded the scope of coverage to support the changing requirements of survey and cleanup over the response, from surface and subsurface oiling survey data to treatment and administrative status, while maintaining backward compatibility and constant availability for planning and analysis.

Methods

While we hope many of the tools and products developed will be of value in near-term future spill responses, when contemplating specific recommendations to data managers during the next nationally significant spill in 10 or 20 years, there are ***none***. This is due to:

- The invariably differing needs of each spill
- Varying levels of agency and industry personnel participation
- The inevitable and increasingly rapid change in software and information technology

We feel the most important contribution we can make is the recommendation of an ***open data standard*** for shoreline oiling and related data management, allowing interested parties in future responses to be assured of data interoperability, transparency, and data quality, while permitting required flexibility.

Data Standards are documented agreements on representation, format, definition, structuring, tagging, transmission, manipulation, use, and management of data. We adopt the following guidelines in laying out a conceptual standard.

- Standard is not a perfect or complete solution – it can change as needed
- Standard does not tell users how to define their needs
- Standard is not a replacement for data Quality Assurance/ Quality Control
- Standards only standardize existing reporting requirements and do not impose new

The proposed data standard does not compete with or supplant any existing vendor or solution, and is completely agnostic about physical spill environment, data collection methods, algorithms, software and computing environment. In fact, most well executed SCAT data management software packages or bespoke data management procedures used in past spills ***already conform to the standard.***

Results: The Proposed Standard

Table 1 describes the key conceptual entities, spatial references and core structured data elements of the proposed standard. Conceptual entities have implied temporal relationships (Figure 1) and spatial relationships (Figure 2). Temporal relationships are enforced by storing of structured data elements. Spatial relationships are enforced by requiring linear features to be coincident to the resolution of the software employed. While the standard requires the core conceptual elements and key temporal and spatial references and relationships, specific structured data elements are free to change from user to user and event to event as long as contents, codesets, and categorical definitions are ***explicitly defined in accompanying data dictionaries or metadata*** for other users.

Table 1. Conceptual entities, spatial reference geometries, and structured data elements of the proposed core standard

Conceptual Entity	Description	Spatial Reference	Core Structured Data Elements
Segments	Relatively fixed, spatially unchanging lengths of shoreline. Traditionally, these are predefined before surveys take place, or even before a spill occurs. Optimally segments have consistent geomorphic and physical characteristics and are fixed in space. If a spill event persists for long enough, shorelines may move or change in morphology.	Lines	• Segment ID • Segment morphology/habitat (categorical)
Surveys	Time-specific survey of some portion of shoreline by field teams. Survey specific surface and subsurface oiling observations are made by field teams on a specific survey of one or more segments.	Lines	• Survey ID • Date / time (date) • Personnel (unstructured) • Weather/tides (categorical)
Surface Oil (SO) Representations	Survey and time-specific representations of consistent observed surface oiling and other shoreline characteristics. Surface oiling representations are generally explicitly referenced to one or more linear segments of a one-dimensional digital shoreline together with an across-shore width scalar value and a tidal elevation.	Points Lines Polygons	• Representation ID • Areal percent cover or particle density (numeric with units or categorical) • Oil thickness or particle size (numeric with units or categorical) • Oil character or description (categorical) • Across-shore width of oiling (numeric with units if linear or point representations) • Tidal elevation of oiling representation (numeric with units or categorical) • Substrate type (categorical - must differentiate vegetation from sediment) • Vertical extent on vegetation canopy (numeric with units if substrate includes vegetation) • Vertical elevation on vegetation canopy (numeric with units if substrate includes vegetation)
Subsurface Oil (SSO) Representations	Survey and time-specific locations of observed subsurface oiling and other shoreline characteristics. Subsurface oiling representations are generally explicitly referenced with a single zero-dimensional point together with one or more scalar depth values.	Points	• Representation ID • Vertical extent of oiled stratum or strata in subsurface (numeric with units) • Vertical elevation of oiled stratum or strata in subsurface (numeric with units) • Vertical extent of investigation – e.g. pit/core depth (numeric with units) • Areal percent cover or particle density within oiled stratum or strata (numeric with units or categorical) • Oil character or description (categorical)
Treatment Recommendations	Often abbreviated as STR or Shoreline Treatment Recommendation, treatments are time-period specific recommended cleanup actions.. May be referenced to surface or subsurface representations of any geometry from one or multiple segments.	Points Lines Polygons	• Treatment ID • Date / time range (dates) • Relevant segment IDSs (Segment IDs) • Relevant surface or subsurface representation IDs (representation IDs) • Nature of recommended treatment (unstructured)

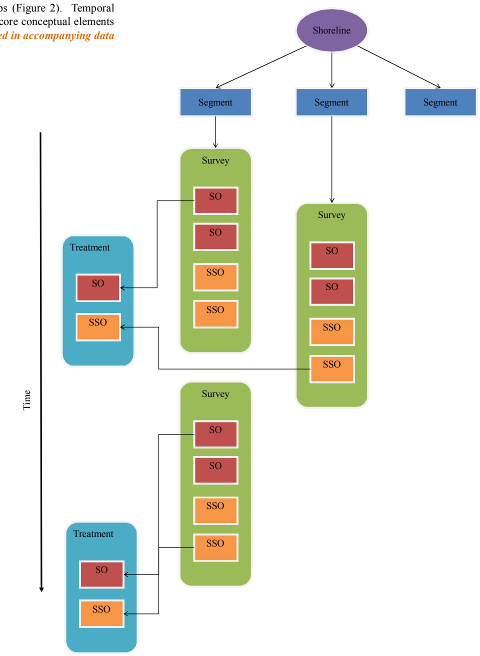

Figure 1. Conceptual relationships over time between conceptual entities in proposed data standard

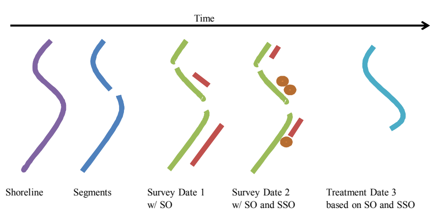

Figure 2. Spatial Relationships between conceptual entities in proposed data standard

Conclusions

The differing needs of each spill, varying levels of agency and industry personnel participation, and the inevitable and increasingly rapid change in software and information technology environments, all point to the need for ***open data standard*** for shoreline oiling and related data management. Such a standard would allow interested parties in future responses to be assured of data interoperability, transparency, and data quality, while permitting required flexibility.

We propose the core elements of such a standard here which we feel captures the most essential set of conceptual elements and relationships while remaining minimally burdensome. We hope, however, that this will serve as a ***starting point for ongoing discussions*** within the response community as to the best path forward.

References and Bibliography

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For more information:

znixon@researchplanning.com
1121 Park St. Columbia, SC 29201
803.256.7322

RPI