

Tethys -- Knowledge Management to Support Environmental Risk Modeling and Mitigation in MHK Power Systems

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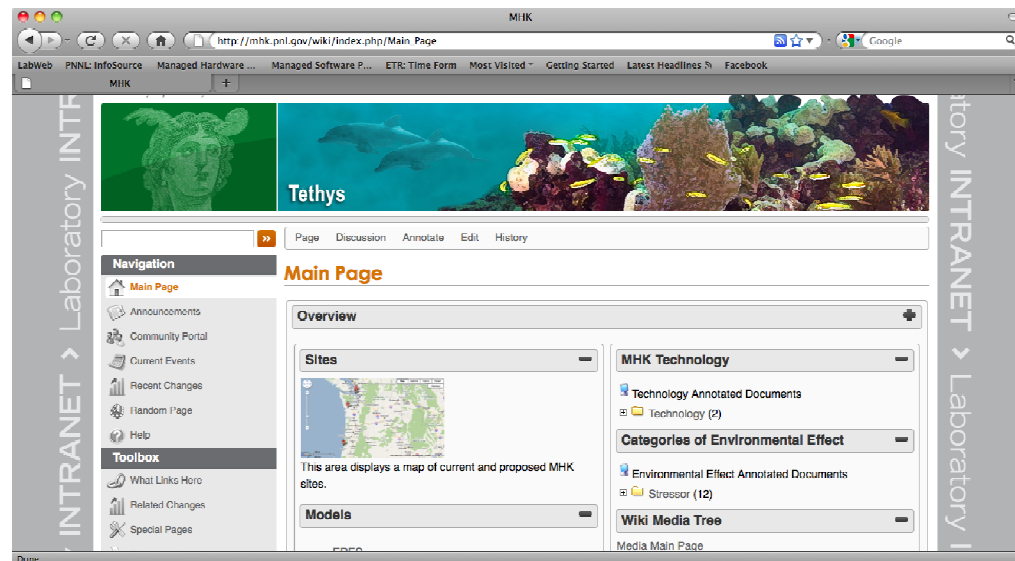
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Outline

- ▶ Project Overview
- ▶ Environmental Risk Evaluation System (ERES)
- ▶ Knowledge Management requirements
 - Tethys, a knowledge management system for MHK
- ▶ Tethys Demo



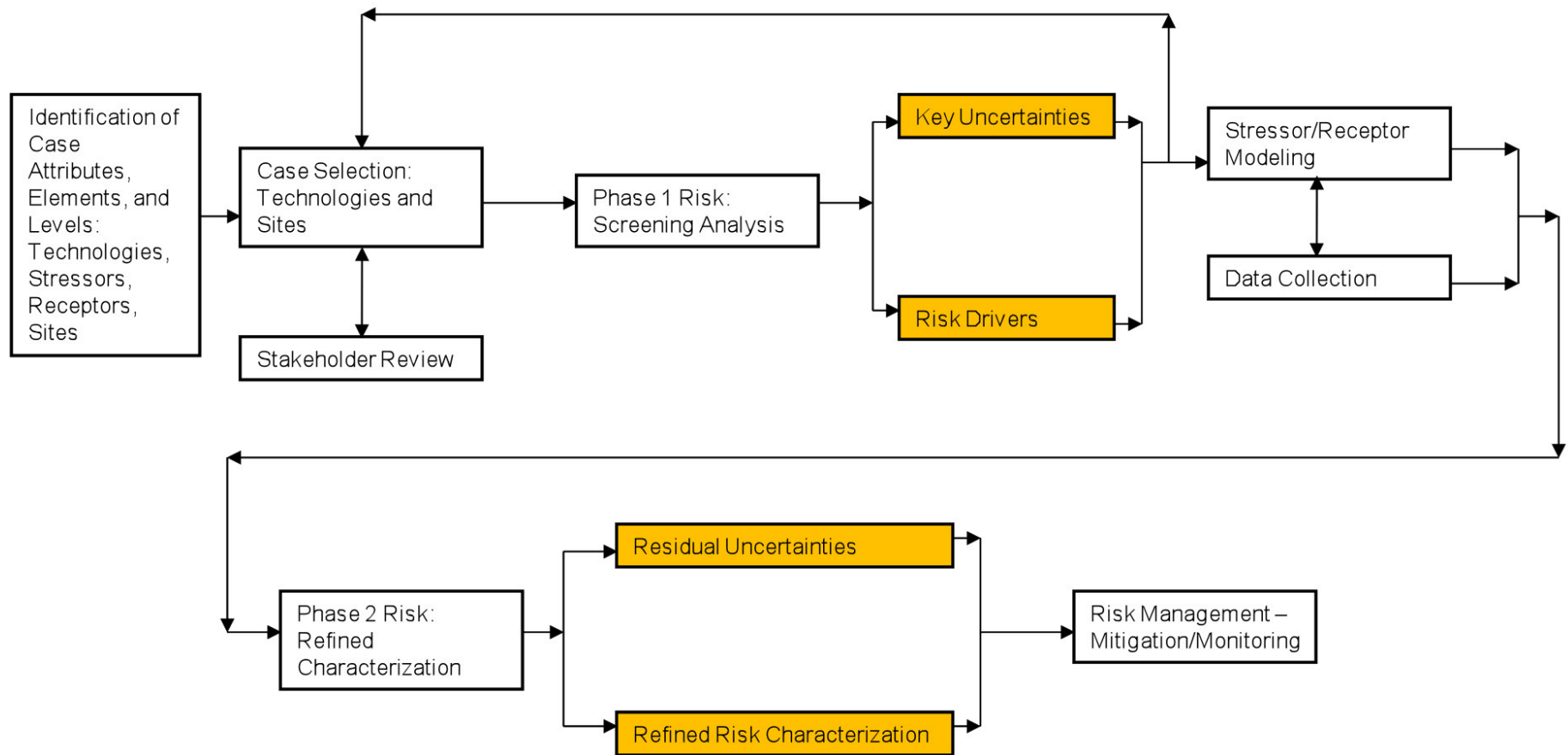
Project Overview

- ▶ Marine Hydrokinetic (MHK) power presents a potential opportunity for bringing new renewable energy sources online
 - EPRI projects US potential of 13,000 MW potential by 2025
 - FERC data indicates ~130 projects under various stages of consideration/development
- ▶ Identification, characterization, and mitigation of environmental risks from Marine Hydrokinetic (MHK) projects is seen as a key obstacle to successful commercialization of this technology
- ▶ PNNL, along with other DOE laboratories, industry and academic partners tasked with creating a risk informed decision framework (ERES) in response to this need.

Environmental Risk Evaluation System (ERES)

- ▶ The Environmental Risk Evaluation System (ERES) is a tool under development to allow scientifically-grounded identification, characterization and prioritization of risks associated with specific MHK scenarios
 - Being developed as a supplement to judgment-based assessment, not a replacement for it
 - Results will be used to inform
 - Site selection and screening
 - Public/stakeholder discourse
 - R&D agendas

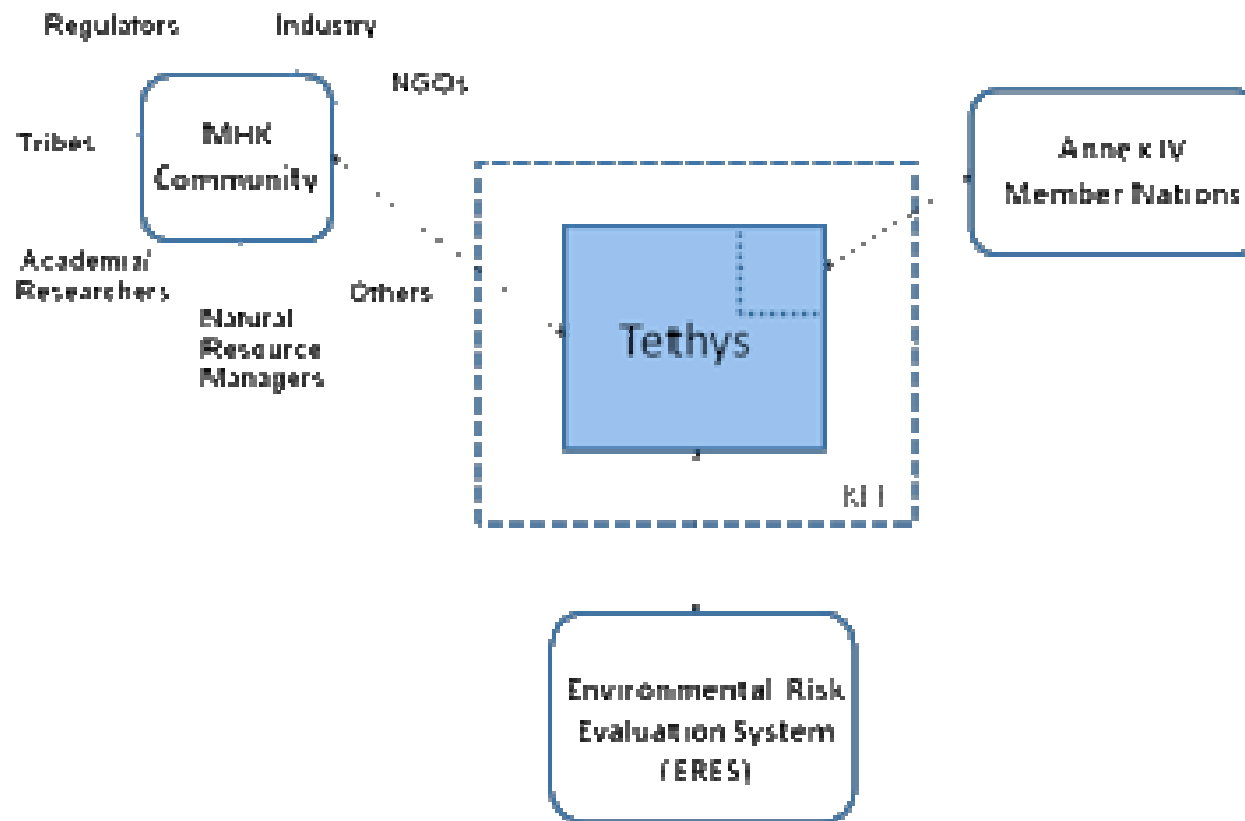
Environmental Risk Evaluation System (ERES)



MHK Knowledge Management System, aka “Tethys”

- ▶ Named for Greek Titan goddess (daughter of Gaia, wife of Oceanus) who was seen as the embodiment of the oceans on earth
- ▶ Primary function of the system is as a knowledge base to support ERES
 - Evidence collection and marshalling
 - Data navigation and management of risk model results
- ▶ Other functions expected to be important
 - Knowledge portal for various stakeholders
 - Portal to other knowledge sources (e.g., Annex IV database under construction)
 - Collaborative environment for MHK research community

Tethys in the MHK “Knowledge Ecosystem”



Tethys and the Annex IV Effort

▶ *Tethys* in a nutshell:

- Wiki-based knowledge management system to facilitate knowledge creation, retrieval, annotation, and aggregation
- Built as extension to Semantic Media Wiki, developed at Karlsruhe University
- Supports a variety of rich semantic annotation features

▶ Annex IV data will be incorporated into *Tethys* via real-time search

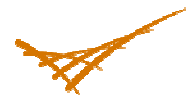
- Likely using web-service oriented interface such as Open Search
- *Tethys* provides annotation layer distinct from the Annex IV DB, while preserving integrity of the Annex IV data
- Capability exists to provide access control for both read and write operations

Key requirements of Tethys

- ▶ Provide access to disparate datasets and documents, including qualitative models and findings, quantitative datasets, geographic, tabular data, as well as papers/PDF files
- ▶ Be sufficiently flexible to accommodate [TBD] future uses or data types
- ▶ Have the ability to sample and aggregate datasets into “data packages”
- ▶ Support ERES through effective software interfaces, as well as consistent identification of data types and relationships
- ▶ Support the performance and documentation of quality assurance on all data, and require the documentation and tagging of QA results
- ▶ Provide access to IEA Annex IV data set currently under development

Our platform for building Tethys: Knowledge Encapsulation Framework (KEF)

- ▶ KEF is a tool intended to capture and manage knowledge related to technosocial models
 - Developed in support of PNNL's Technosocial Predictive Analytics Initiative (TPAI)
 - Intended to manage data from scientific literature, model and simulation documentation, and social media
 - Provides a rich framework for semantic annotation of scientific and technical documents
 - Leverages a large ($\$ > 600K$) investment in knowledge management by PNNL and other agencies
- ▶ Tool is based on wiki technology, but does not conform to the “classic” view of what a wiki does
 - Not *necessarily* open-access
 - Allows rich annotation and collaboration, but with trust



Technical aspects of Tethys (for the geekish among us)

- ▶ Key requirement....is the extensibility of the tool!
 - Building on widely supported open-source framework
 - PHP/mySQL/AJAX – core technologies of the modern web
 - Large developer base available to extend/modify
- ▶ Examples
 - Incorporation of MIT's Simile Timeline
 - Auto-complete features for insuring data consistency
 - Automated harvesting of dynamic data sources
- ▶ Extensibility reflected in data structure
 - Hybrid between structured data (e.g, relational db) and and unstructured data (e.g., web site)
 - Use of semantic markup allows treating unstructured text as values in a structured data set

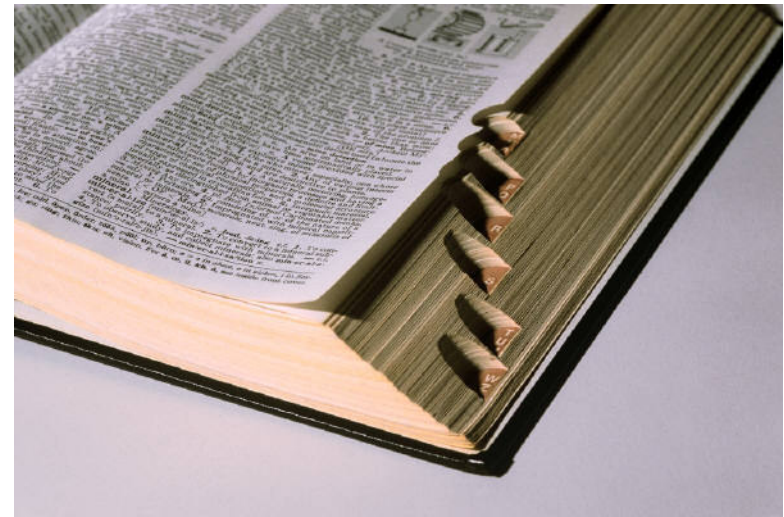
Key features in KEF

- ▶ Automated ingest of documents into a wiki-like environment
 - PDF files, Word documents, web pages, etc
 - Automatic semantic encoding of many meta-data fields
- ▶ Semantic “pipeline” processing to aid in recognizing and tagging key types of entities
 - People
 - Places
 - Specific vocabulary terms
- ▶ Rich annotation features
- ▶ Semantic search

Explicit semantics facilitate the capture of tacit knowledge

Tacit

expressed or carried on without words or speech ; 2) implied or indicated (as by an act or by silence) but not actually expressed



Semantic linkages to provide model transparency

- ▶ A key motivation for the Tethys data modeling approach is to allow the linkage of disparate data and document types to model scenarios
 - Dubbed “evidence marshalling” – allows the rationale for model parameters to be annotated and explored in depth
 - Though not yet operational in Tethys, other instantiations of KEF have used this to directly link model descriptions to model case studies
 - Subsidiary goal is to provide insights into how the model(s) work – shine light into the black box

Tethys Demo

The screenshot shows a web browser window displaying the Tethys Main Page. The browser's address bar shows the URL http://mhk.pnl.gov/wiki/index.php/Main_Page. The page features a header with a green-tinted image of a classical head and a blue-tinted image of dolphins and coral. Below the header is a navigation menu with options: Page, Discussion, Annotate, Edit, and History. The main content area is titled "Main Page" and includes an "Overview" section with a map of sites, a "Models" section, and a "MHK Technology" section with links to annotated documents and stressors. A vertical sidebar on the left contains navigation links such as "Main Page", "Announcements", "Community Portal", "Current Events", "Recent Changes", "Random Page", and "Help". A vertical sidebar on the right contains the text "Laboratory INTRANET".

Issues we're inviting input on

- ▶ Data sources in the MHK domain
 - What are the varieties of data collected, published? Who publishes them? Where?
 - To what extent is social media used within the MHK community
 - What online sources (databases, wikis, etc) exist?
- ▶ What are the limitations of current MHK risk data?
 - Quality? Scope? Accessibility? Other?
- ▶ Who are the likely stakeholders?
 - Who will create the data? Use the data? View it? Care about it?

Acknowledgements

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- ▶ KEF development supported by the PNNL Technosocial Predictive Analytics Initiative (TPAI)