The ICAN Prototype

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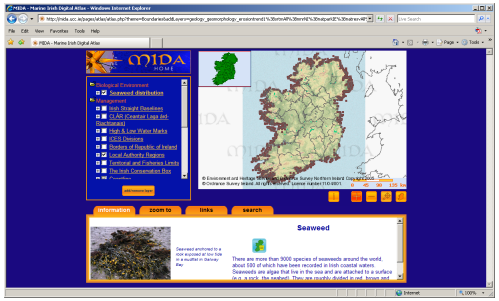
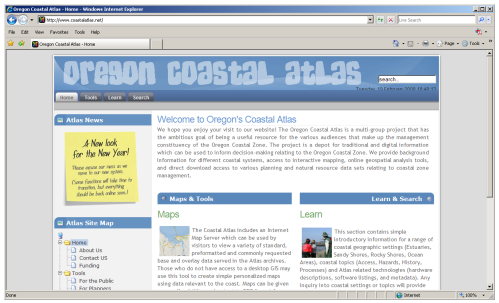
Outline

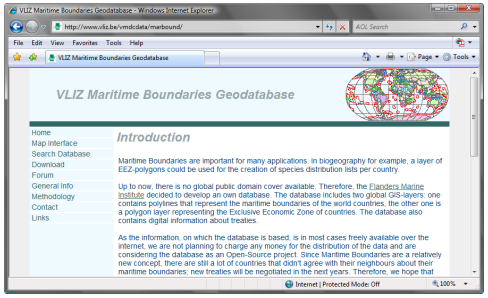
- Problem
- Terminology
- Idea
- Approach
- Architecture
- Ontologies
- Ontologies Mappings
- Query Rewriting
- Demonstration
- Conclusion
- Future Work

Problem





- Interoperability of distributed autonomous and heterogeneous coastal Web atlases (CWA)



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Problem

- Heterogeneity:
  - Syntactic (data formats, query languages)
  - Structural (data schemas)
  - Semantic (meaning of data values)

→ E.g.:

→ Metadata:

- Different metadata standards (ISO vs. FGDC)
- Different terms: 'Seabed' vs. 'Seafloor'
  'Coastline' vs. 'Shoreline'

Terminology

- OGC Web Service:
  - OGC specification
  - Interface allowing requests for geographic "*resources*" across the Web using platform-independent calls
  - Main OGC services:
    - Catalogue Service for the Web (CSW)
    - Web Feature Service (WFS)
    - Web Coverage Service (WCS)
    - Web Map Service (WMS)

Terminology

- OGC Web Service:
  - Catalogue Service for the Web (CSW)
    - Allows requests for metadata across the Web
    - E.g. GeoNetwork is a CSW implementation

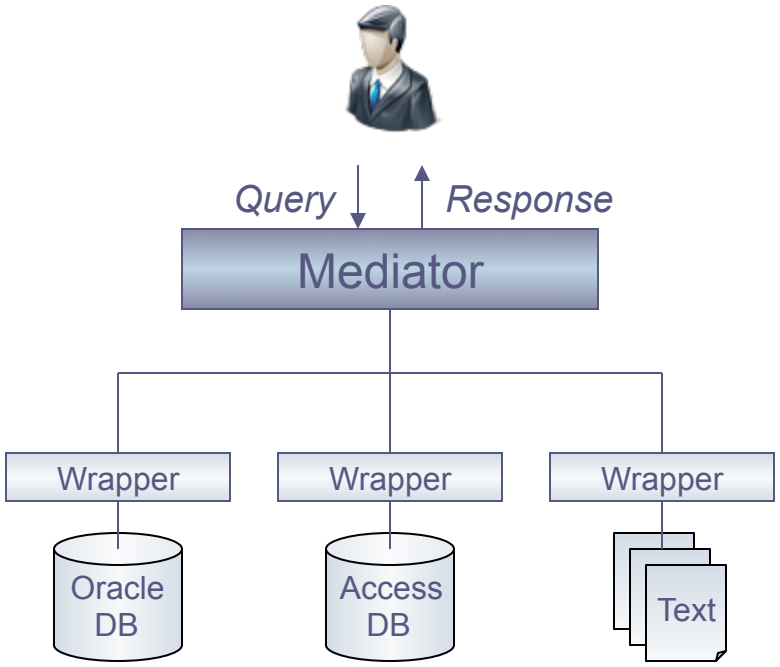
Request	Response
`Get Capabilities`	*Metadata about the types / operations the CSW supports*
`Get Records`	*Metadata records available, with possibility of filtering (bounding box, spatial, temporal, keywords search, etc.)*
`Get Record By ID`	*Record with the specified ID*

Terminology

- Ontologies:
  - A Knowledge Organisation System (KOS)
  - Define concepts (classes and objects)
  - Define relationships between concepts
  - Define inference rules
  - Examples:
    - John *is a* Person
    - Mary *is a* Person
    - Mary *is mother of* John
    - **If** (X *is father* of Y & Y *is father of* Z) **then** X is grand-father of Z

Terminology

- Mediation:
  - A virtual data integration approach
  - Allows transparent access and integration of autonomous distributed heterogeneous data sources



Same data structure
Same semantics

Same query language
Same data model and format

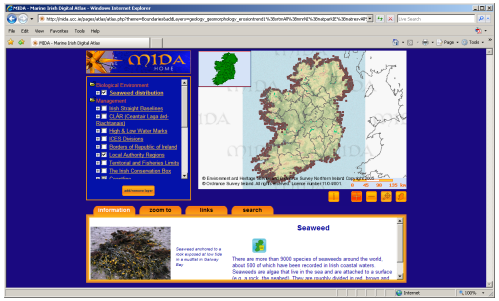
Heterogeneous data sources

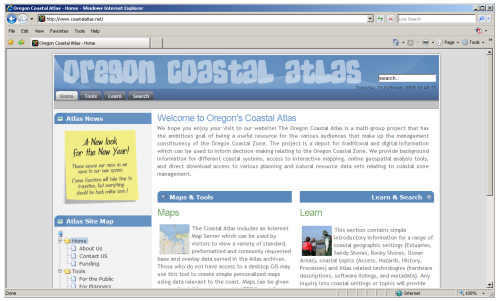
Idea

- Connect individual coastal atlases to an integrated global atlas

Global atlas

Local atlases





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Approach

- Centralised system

  → Resources are accessed through one central system (ICAN global atlas)

- Virtual integration approach

  → Data are not copied into the global Atlas

- Local atlases autonomy

  → Each data atlas is autonomous and organises resources in its own way and uses its own terminology (ontology)

Approach

- To achieve interoperability:
  1. Standardisation:
     - Standardise access interfaces and resource formats
       - Implement OGC Web Services
         - » Catalogue Service for the Web (CSW)
         - » Web Feature Service (WFS)
         - » Web Coverage Service (WCS)
         - » Web Map Service (WMS)
       - Support ISO metadata standards
         - » ISO-19115 & ISO-19139

     → Standardise Web querying and delivery formats

Approach

- To achieve interoperability:
  2. Mediation:
     - Allow local atlases to use their own data structures, semantics and vocabularies (ontologies)
     - Use a common data structure and a common ontology for the global atlas
     - Provide mappings (translations) between local ontologies and the global ontology

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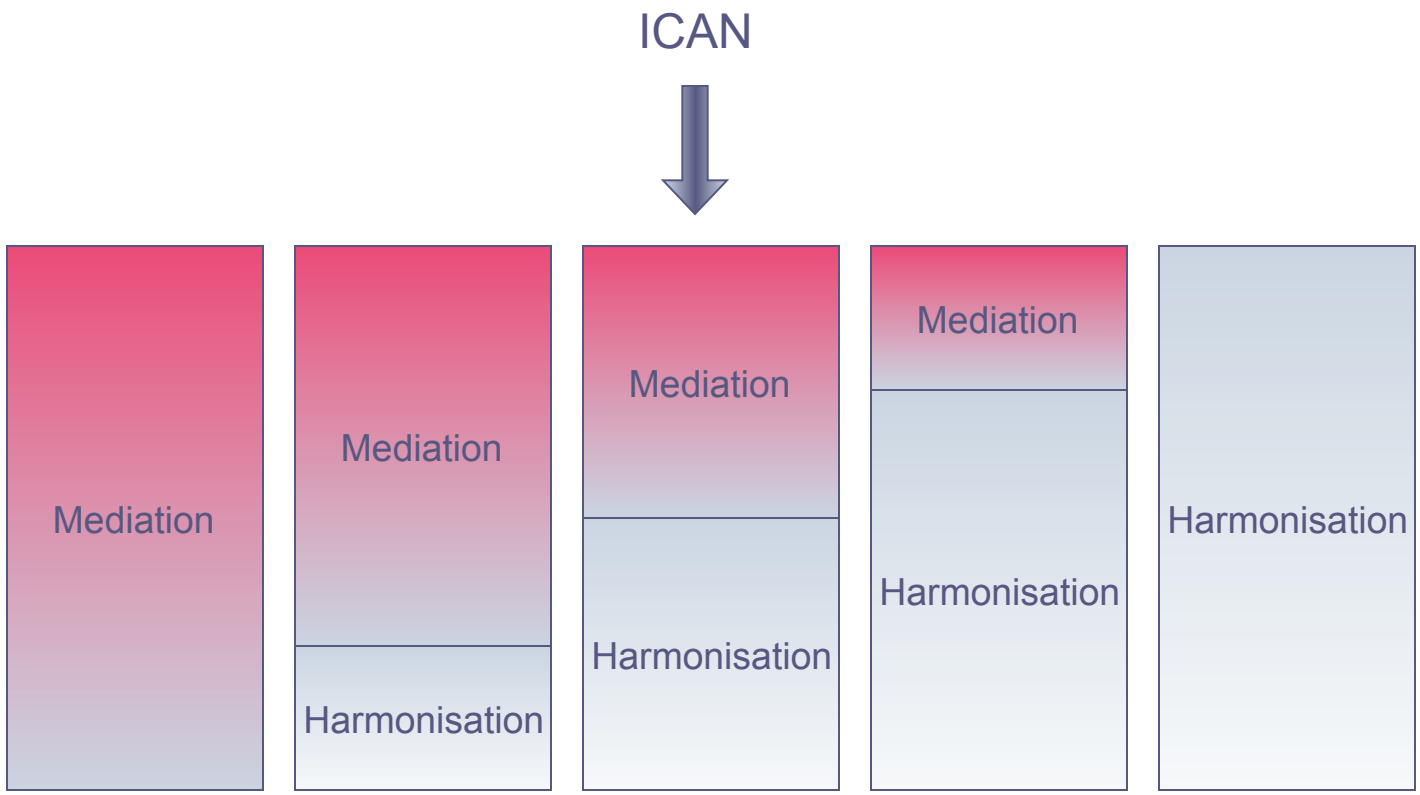
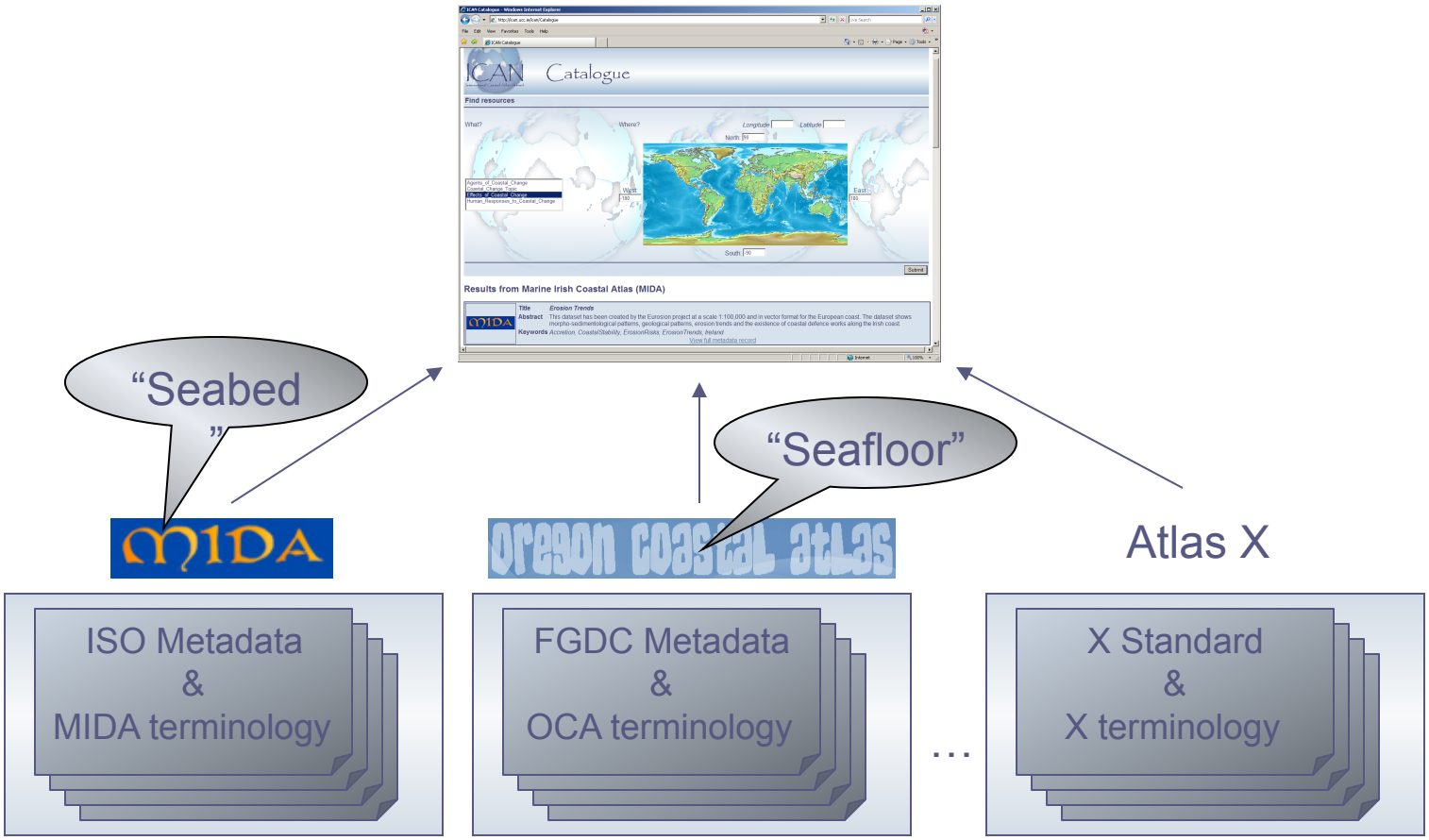
Harmonisation vs. Mediation



Approach

- We focus on Metadata interoperability



Architecture

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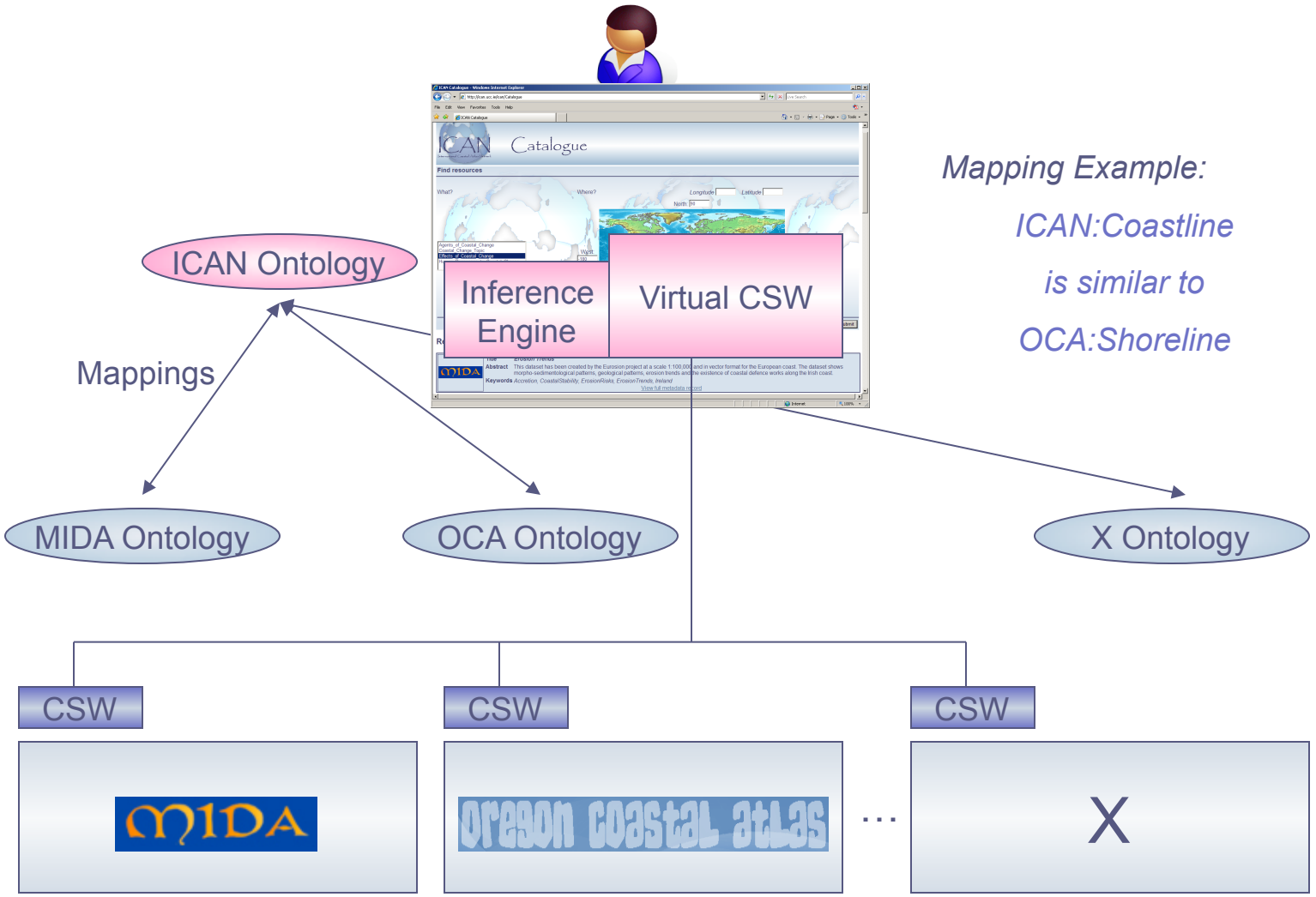

Mapping Example:

ICAN:Coastline

is similar to

OCA:Shoreline

Local and Global Ontologies

- A global ontology represents the keywords used in the virtual ICAN catalogue service
- For each atlas X, a local ontology represents the keywords used by the X catalogue service
- Five types of keywords (ISO-19115): Theme, Discipline, Place, Temporal, Stratum

Local and Global Ontologies

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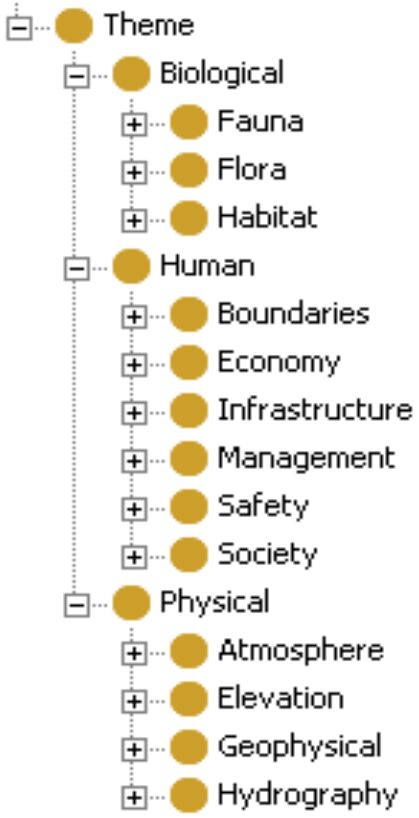
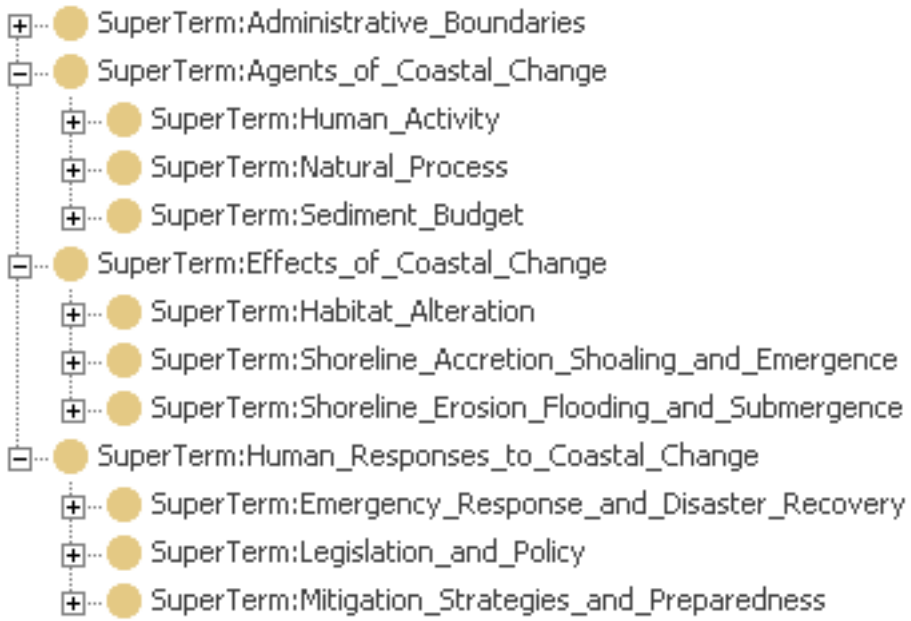
Local Ontology (OCA)





Global Ontology

Ontology Mappings

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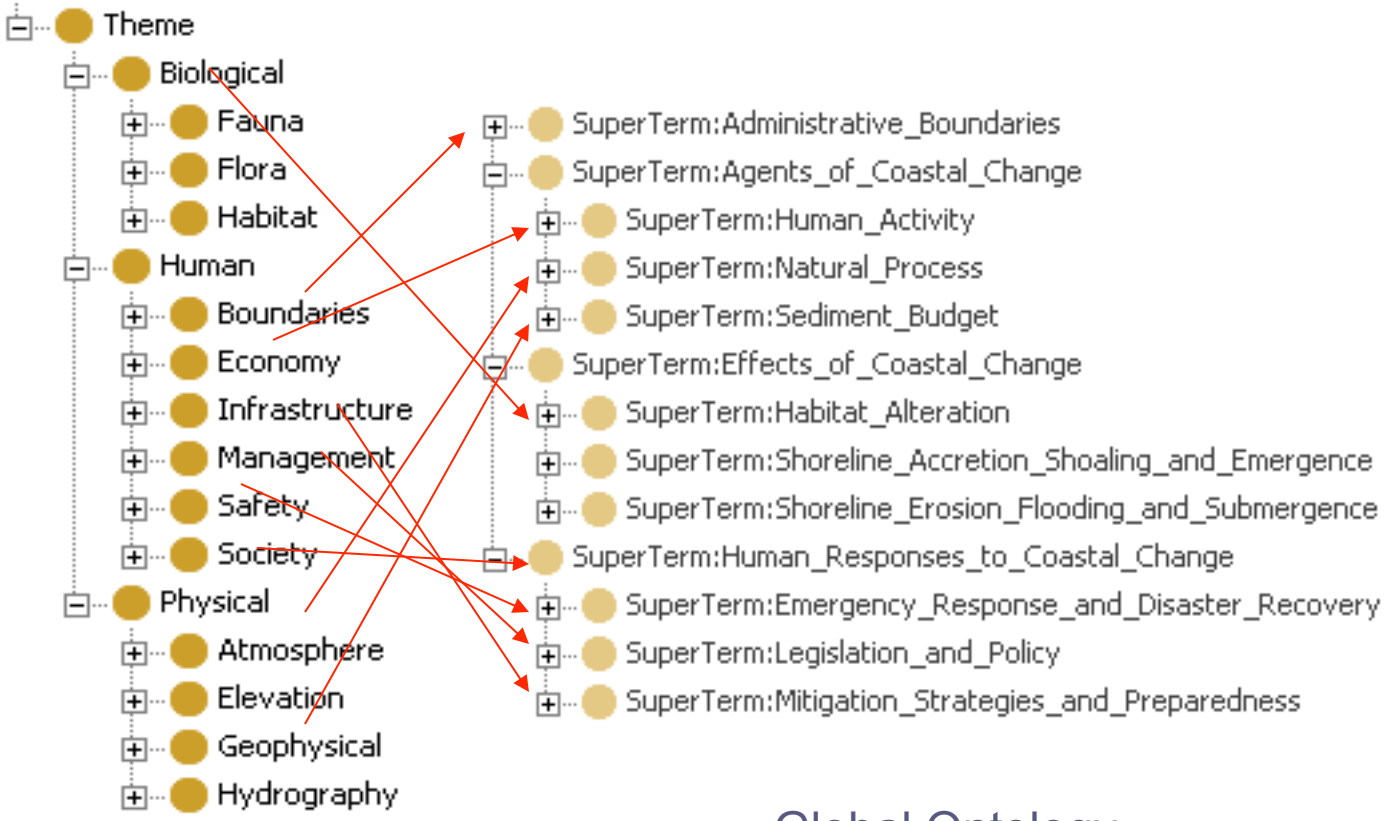
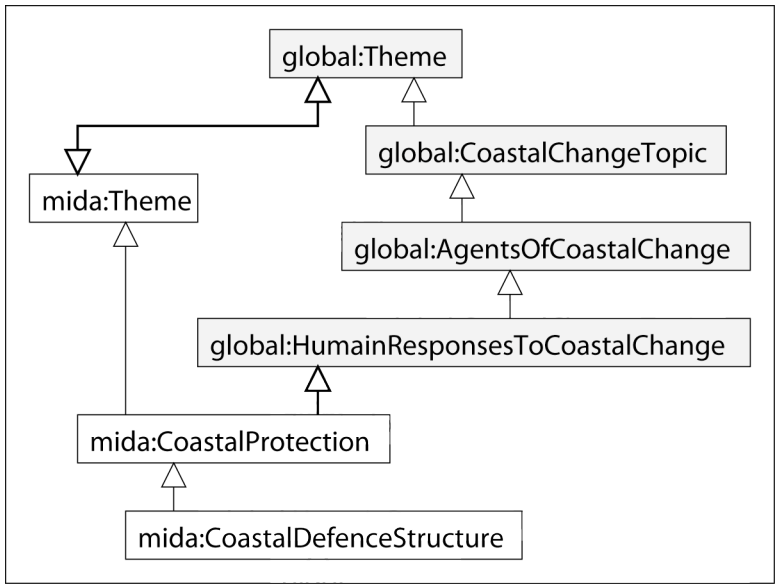


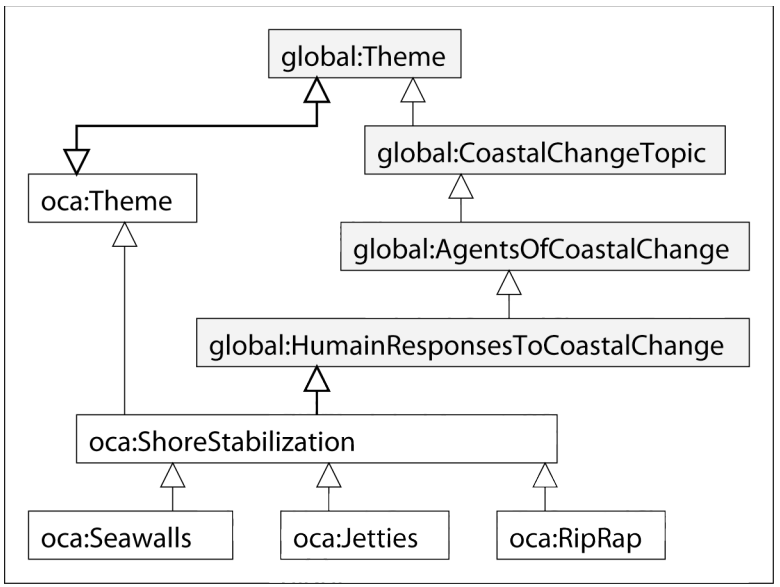
Global Ontology

Ontology Mappings

MIDA Mappings



OCA Mappings



Each mappings file is an OWL ontology

Atlas Connection

5 Steps to connect your atlas to ICAN:

- CSW
- Local ontology
- Ontology mappings
- Metadata using ontology terms as keywords

Atlas

- Registration

ICAN

Atlas Connection

- Atlases

	CSW (2.0.1)	Local Ontology	Ontology Mappings	Metadata Using Ontology	Registration
MIDA	√	√	√	√	√
OCA	√	√	√	√	√
MarBound	(√)	√	√	√	(√)
WashCA		√		√	
WisCA	√	√	√	√	

Query Rewriting

- Rewrite user's request into requests supported by local CSWs

Query Rewriting


```
http://ican.ucc.ie/srv/en/csw?request=GetRecords&service=CSW&version=2.0.1
&resultType=results&namespace=csw:http://www.opengis.net/cat/csw&maxRecords=1000
&elementSetName=summary
&constraint=
<?xml version="1.0" encoding="UTF-8"?>
<Filter xmlns=http://www.opengis.net/ogc xmlns:gml=http://www.opengis.net/gml
    xmlns:csw="http://www.opengis.net/cat/csw/2.0.2">
      <And>
            <PropertyIsLike wildCard="%“ singleChar="_" escape="\">
                  <PropertyName>keyword</PropertyName>
                  <Literal>HumanResponsesToCoastalChange%</Literal>
            </PropertyIsLike>
            <BBOX>
                  <PropertyName>/csw:Record/ows:BoundingBox</PropertyName>
                  <gml:Envelope srsName="http://www.opengis.net/gml/srs/epsg.xml#4326">
                        <gml:lowerCorner>-180 -90</gml:lowerCorner>
                        <gml:upperCorner>180 90</gml:upperCorner>
                  </gml:Envelope>
            </BBOX>
      </And>
</Filter>
&constraintLanguage=FILTER
&constraint_language_version=1.1.0
```

Query Rewriting

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```
http://ican.ucc.ie/srv/en/csw?request=GetRecords&service=CSW&version=2.0.1
&resultType=results&namespace=csw:http://www.opengis.net/cat/csw&maxRecords=1000
&elementSetName=summary
&constraint=
<?xml version="1.0" encoding="UTF-8"?>
<Filter xmlns=http://www.opengis.net/ogc xmlns:gml=http://www.opengis.net/gml
    xmlns:csw="http://www.opengis.net/cat/csw/2.0.2">
      <And>
          <PropertyIsLike wildCard="%“ singleChar="_" escape="\">
              <PropertyName>keyword</PropertyName>
              <Literal>HumanResponsesToCoastalChange%</Literal>
          </PropertyIsLike>
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              </gml:Envelope>
          </BBOX>
      </And>
</Filter>
&constraintLanguage=FILTER
&constraint_language_version=1.1.0
```
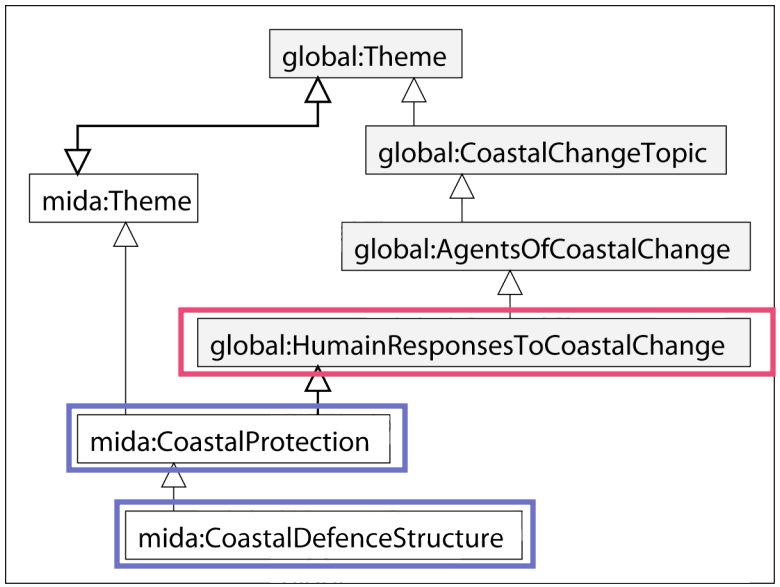
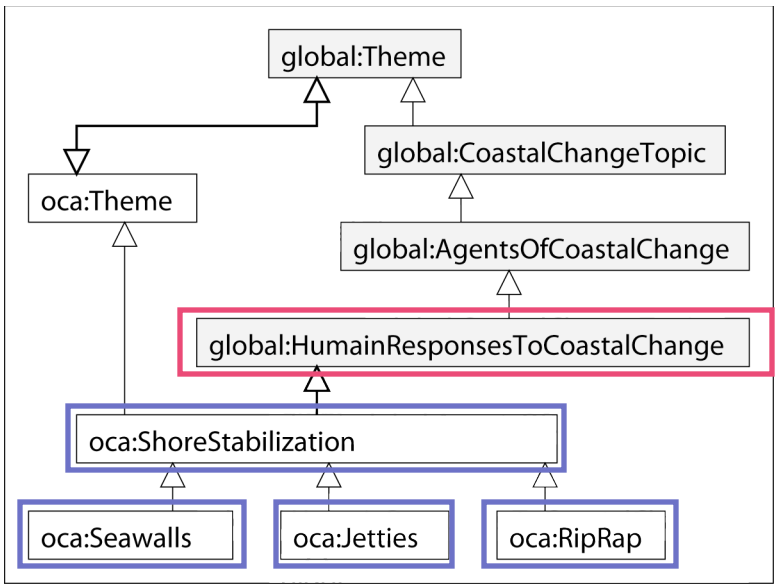

Query Rewriting

Mediator uses inference engine to translate global terms into local terms

MIDA Mappings



OCA Mappings



Query Rewriting

Global

```
<PropertyIsLike wildCard="%“ singleChar="_" escape="\">
        <PropertyName>keyword</PropertyName>
        <Literal>HumanResponsesToCoastalChange%</Literal>
</PropertyIsLike>
```

MIDA

```
<Or>
        <PropertyIsLike wildCard="%“ singleChar="_" escape="\">
                <PropertyName>keyword</PropertyName>
                <Literal>CoastalProtection%</Literal>
        </PropertyIsLike>
        <PropertyIsLike wildCard="%“ singleChar="_" escape="\">
                <PropertyName>keyword</PropertyName>
                <Literal>CoastalDefenceStructure%</Literal>
        </PropertyIsLike>
</Or>
```

Demonstration

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http://ican.ucc.ie

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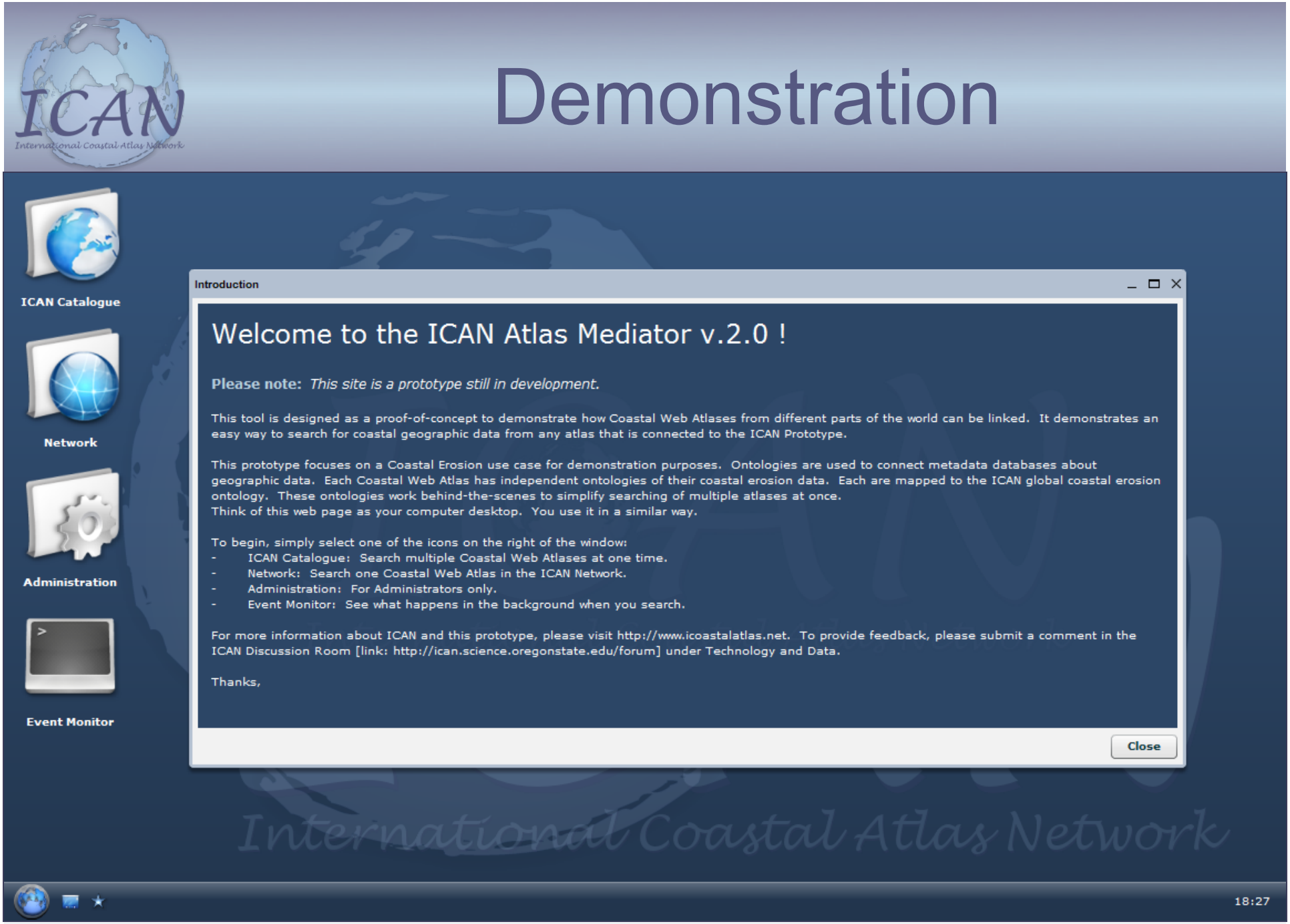

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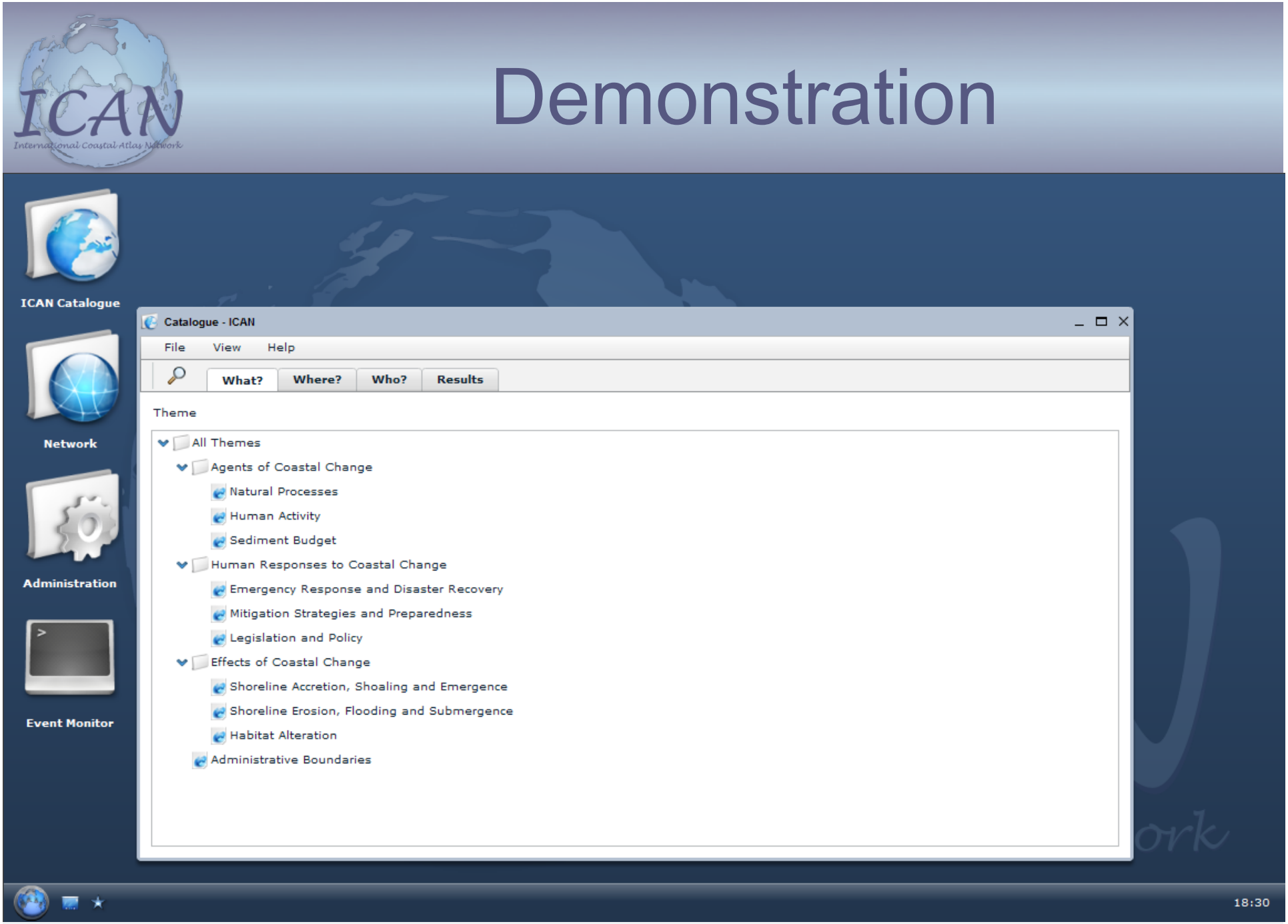

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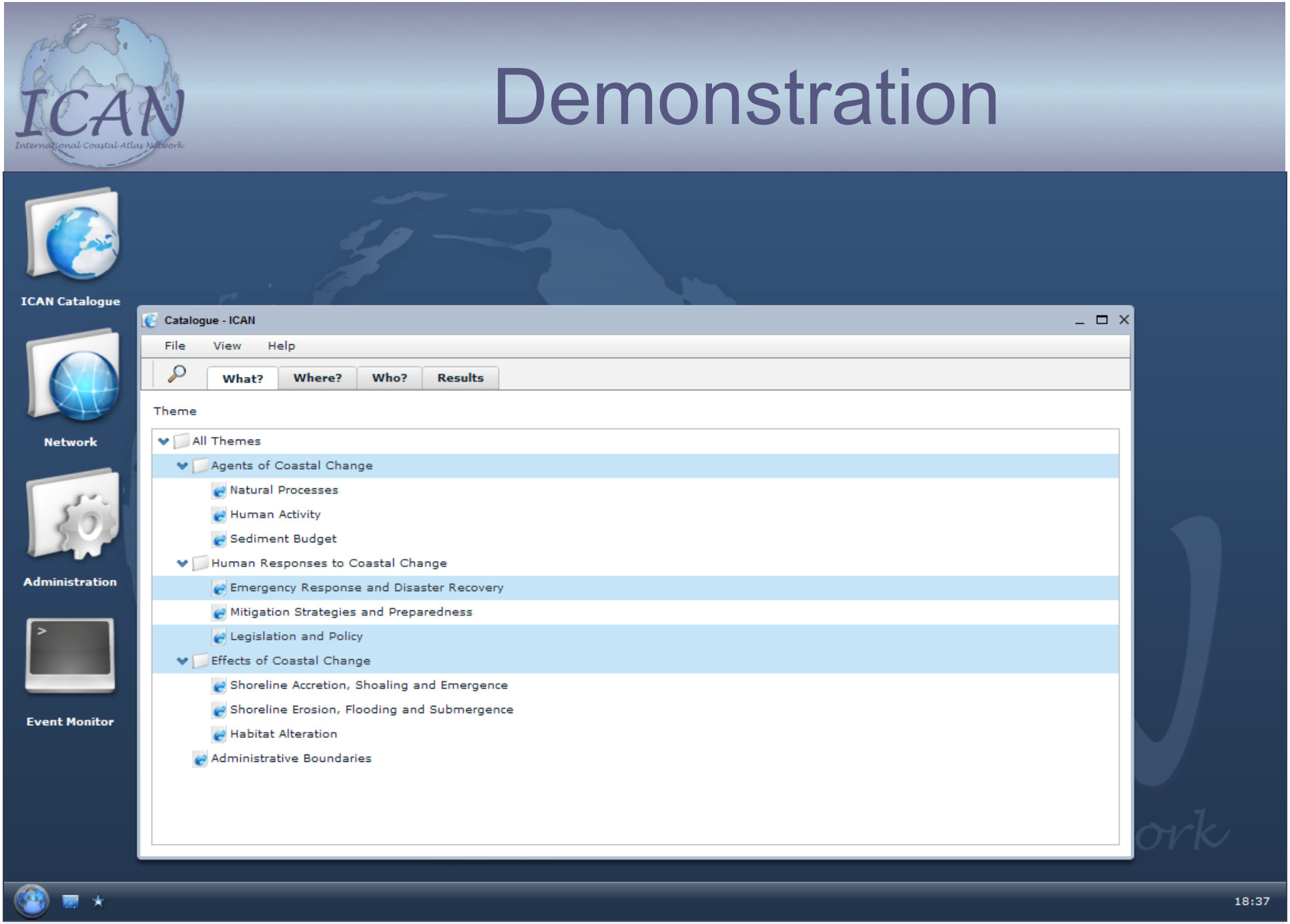

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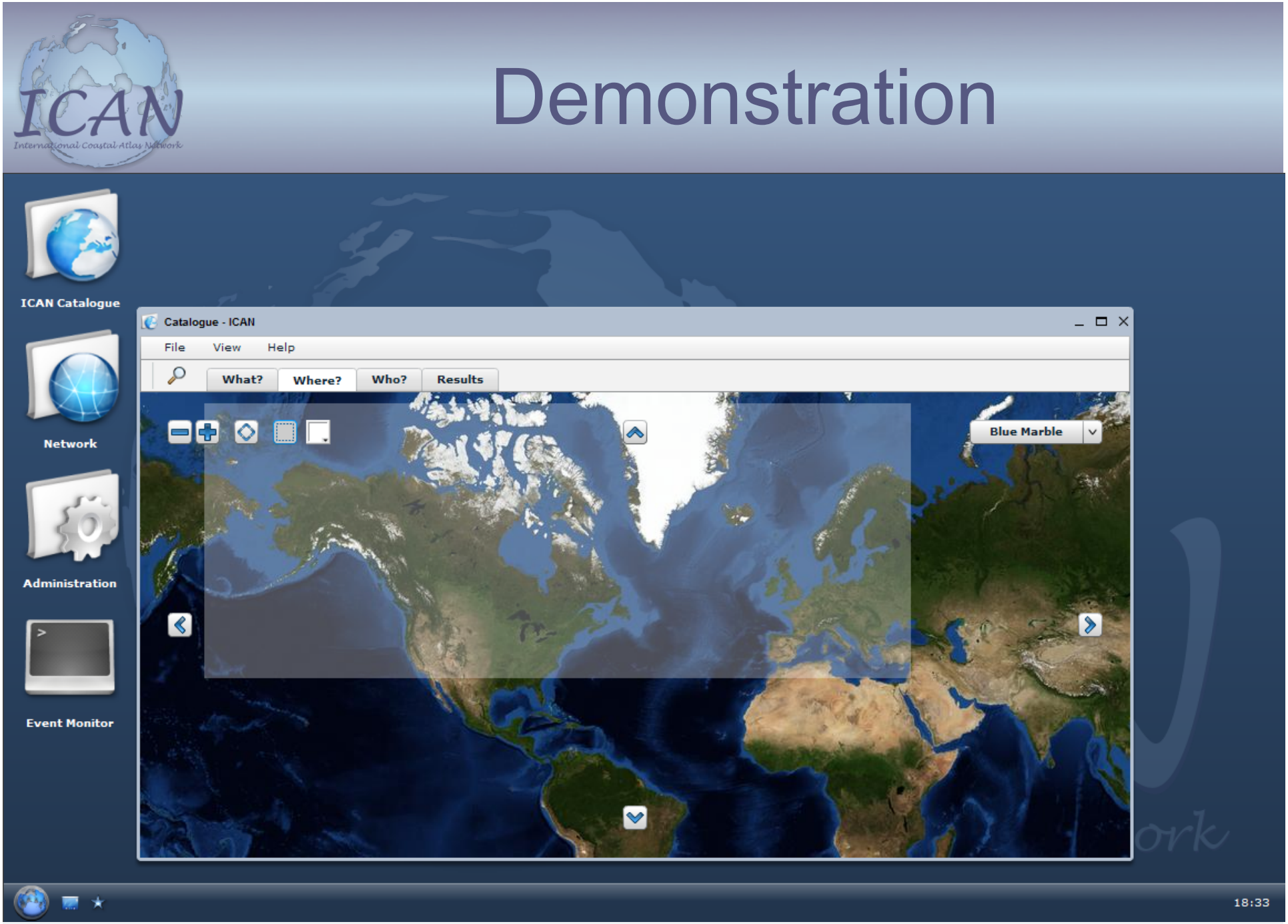

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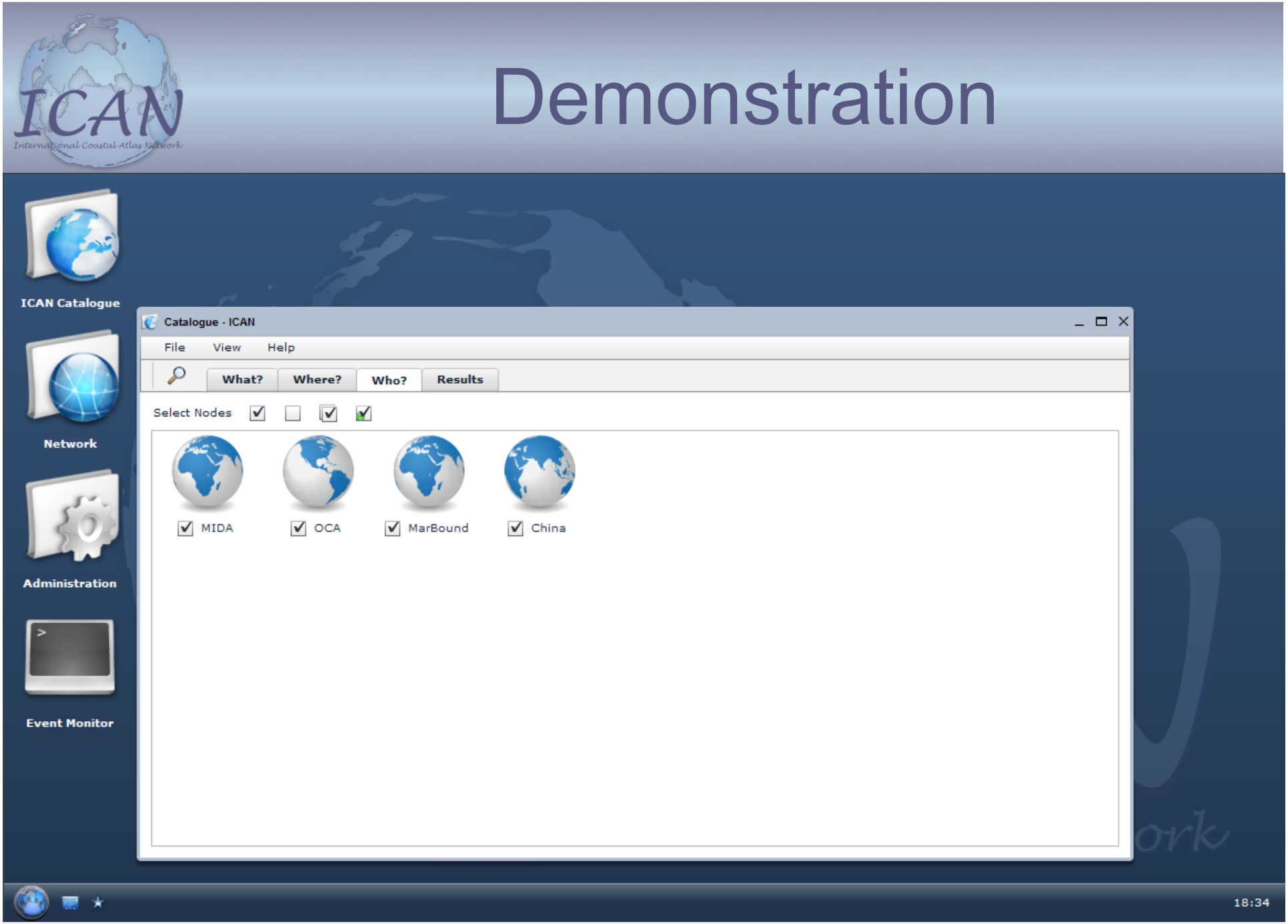

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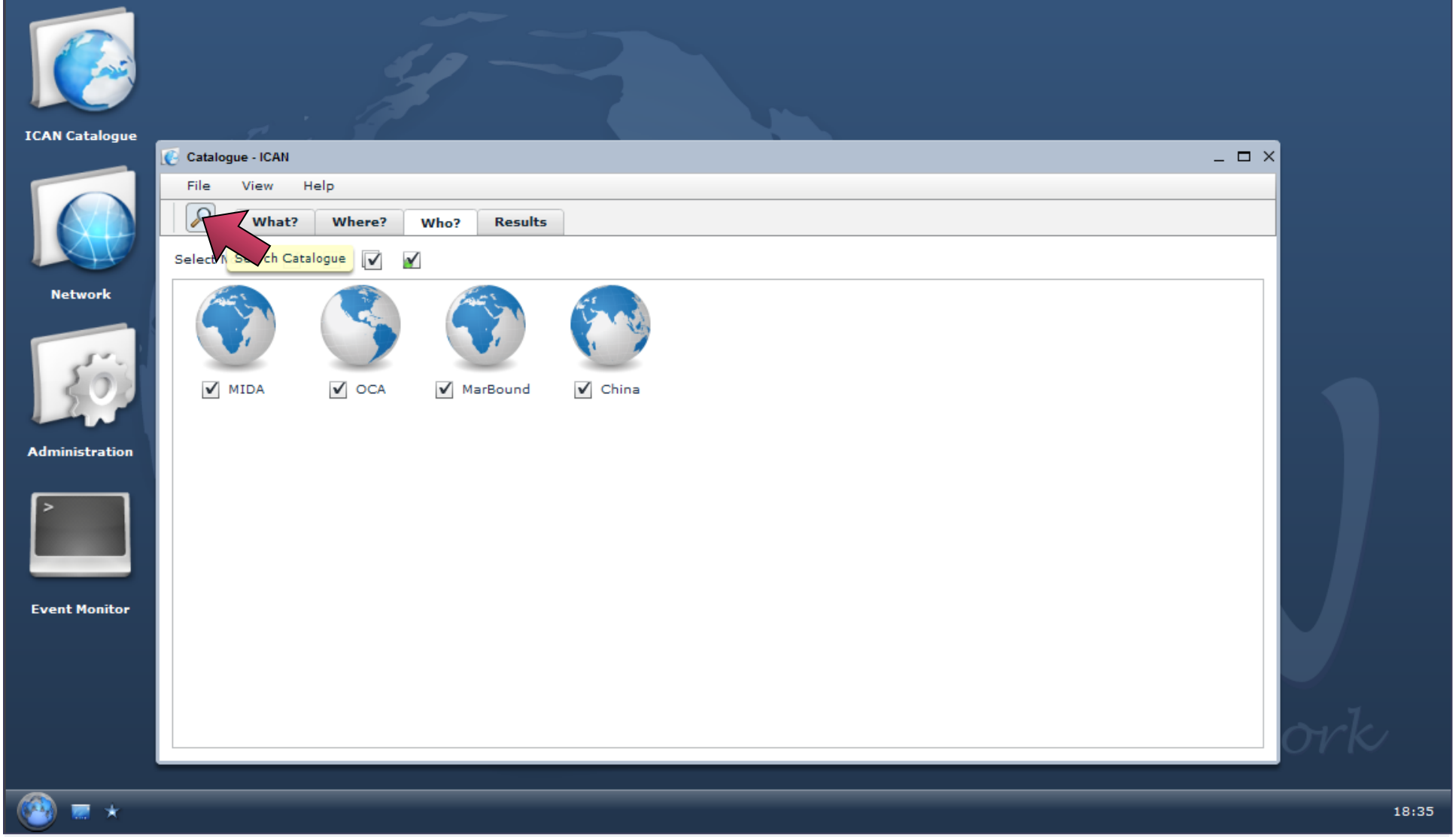

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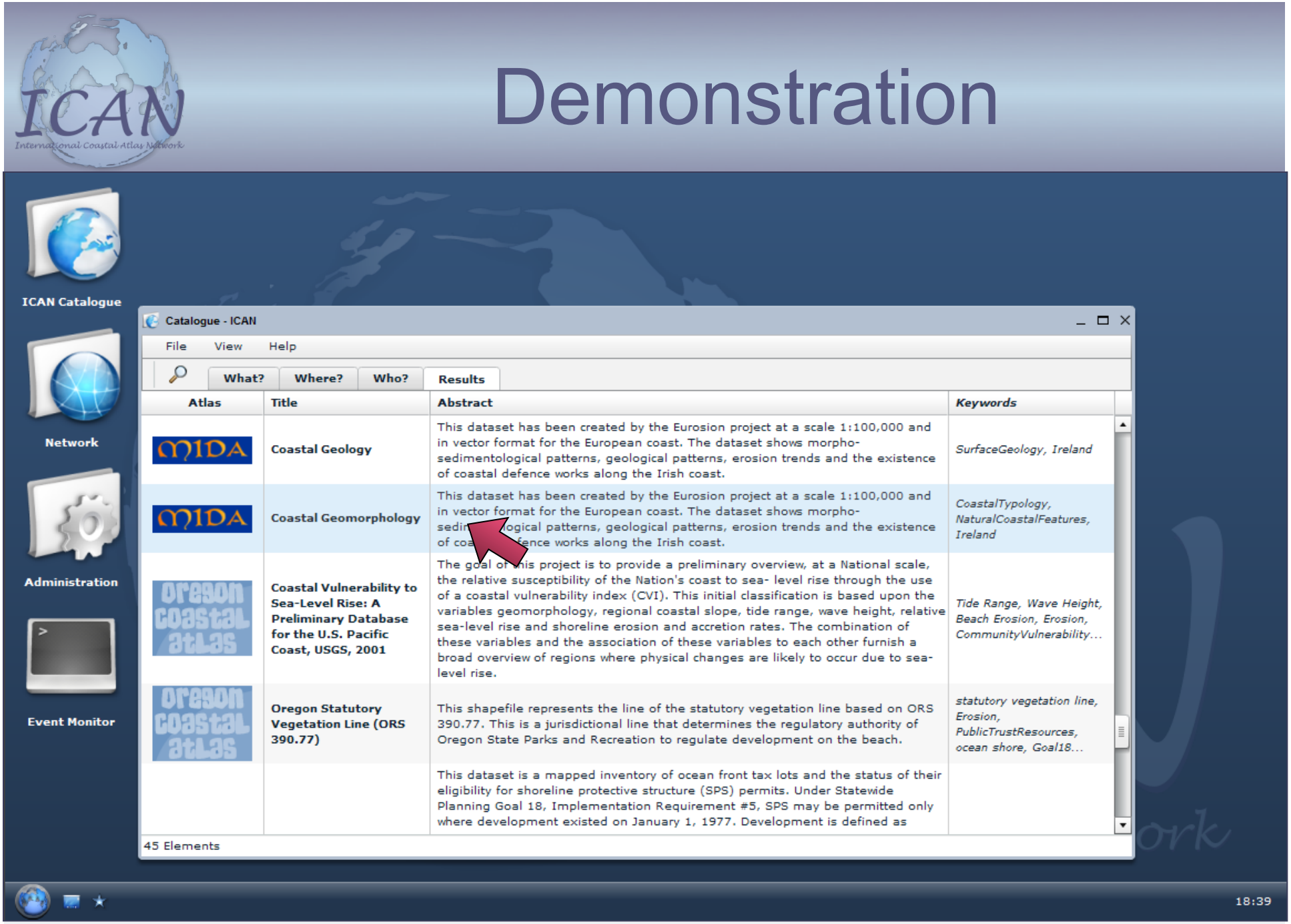

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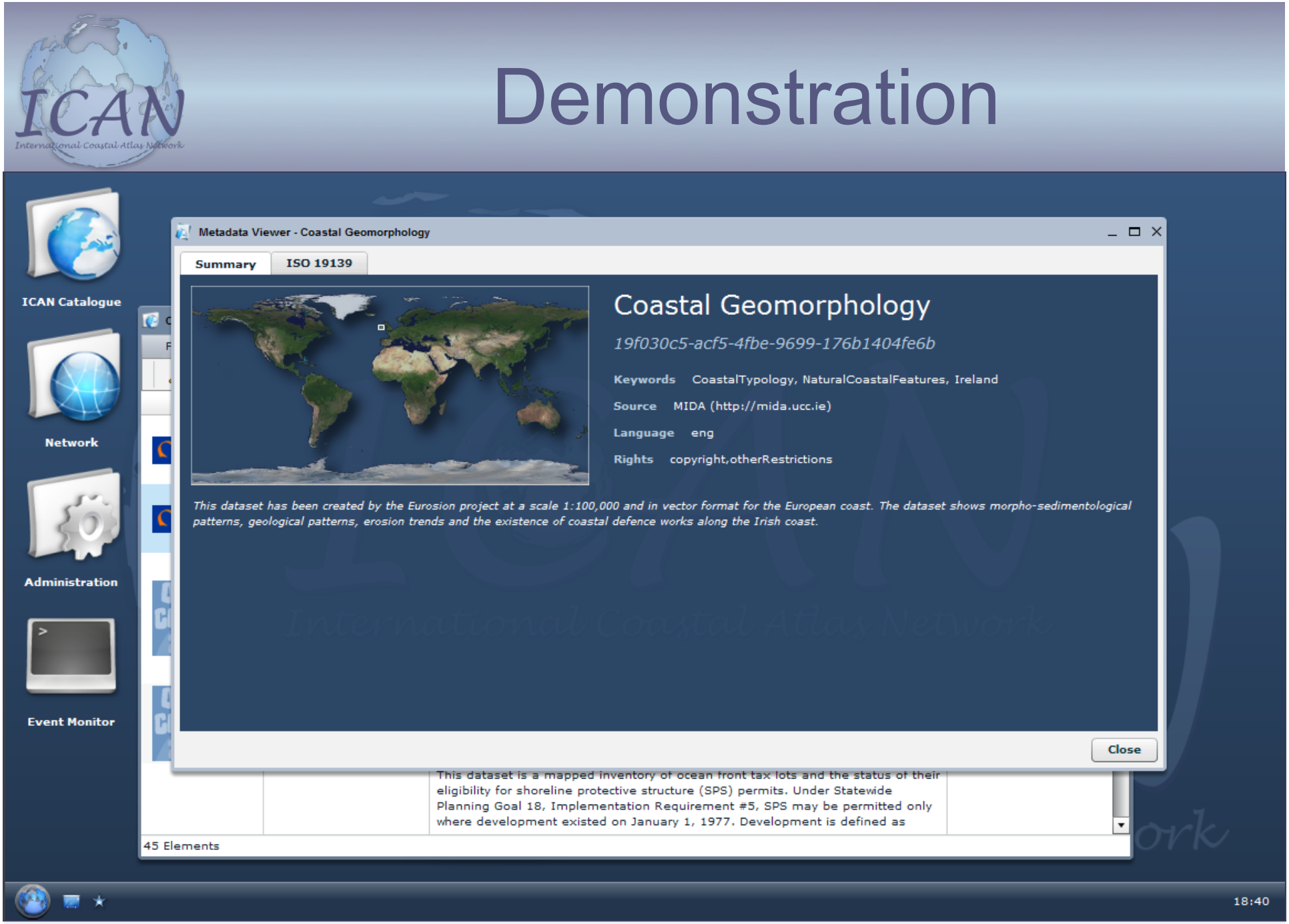

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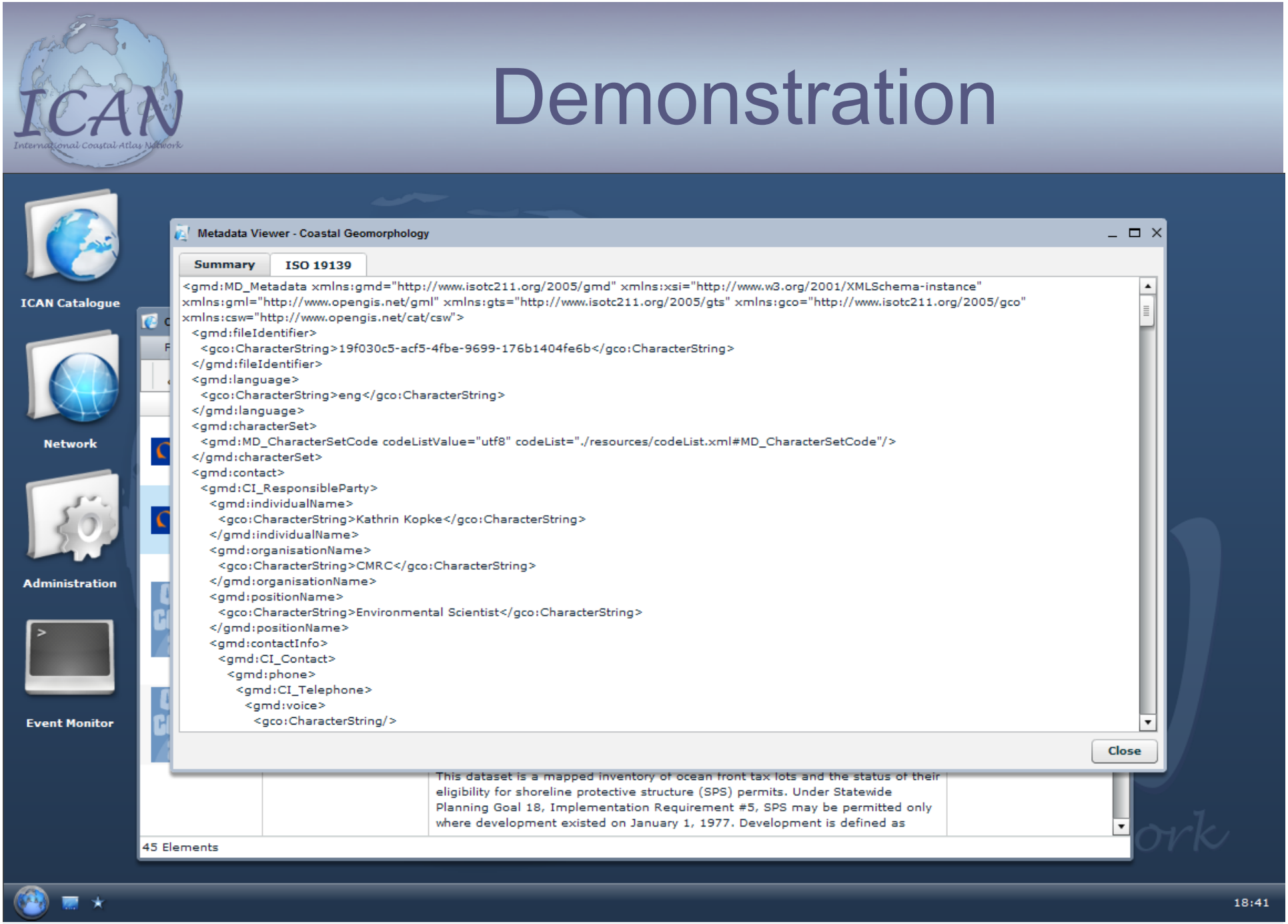

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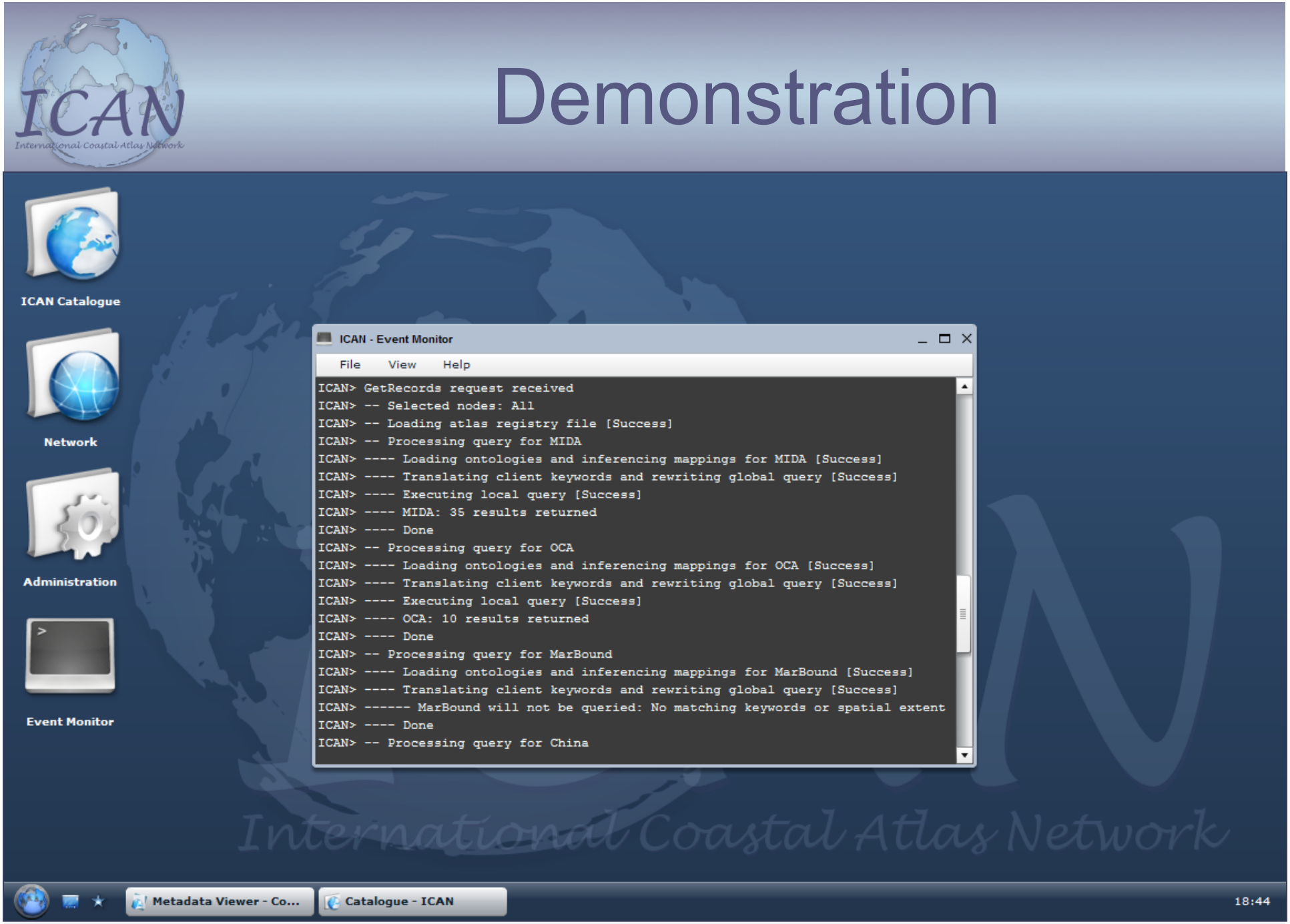

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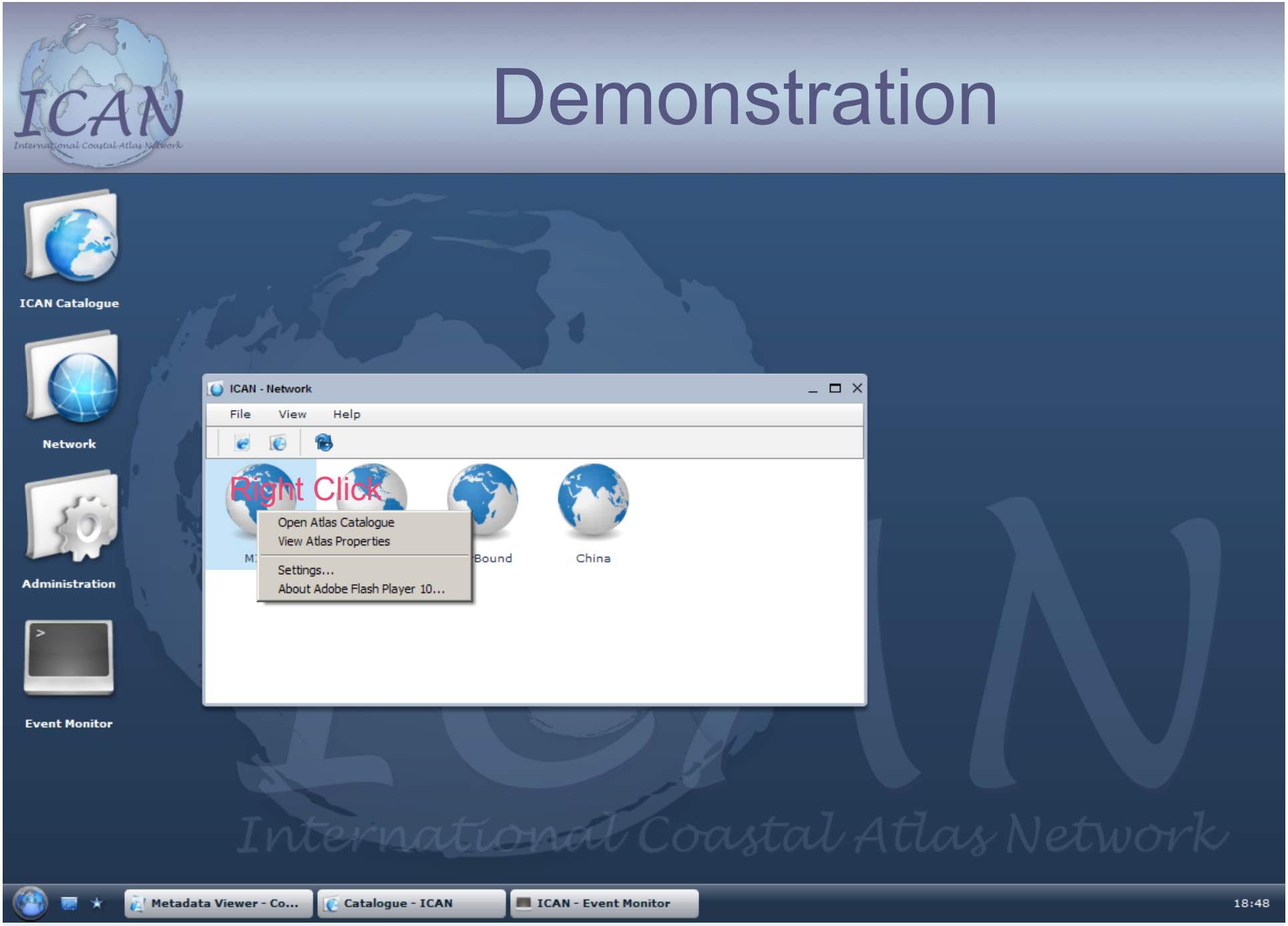

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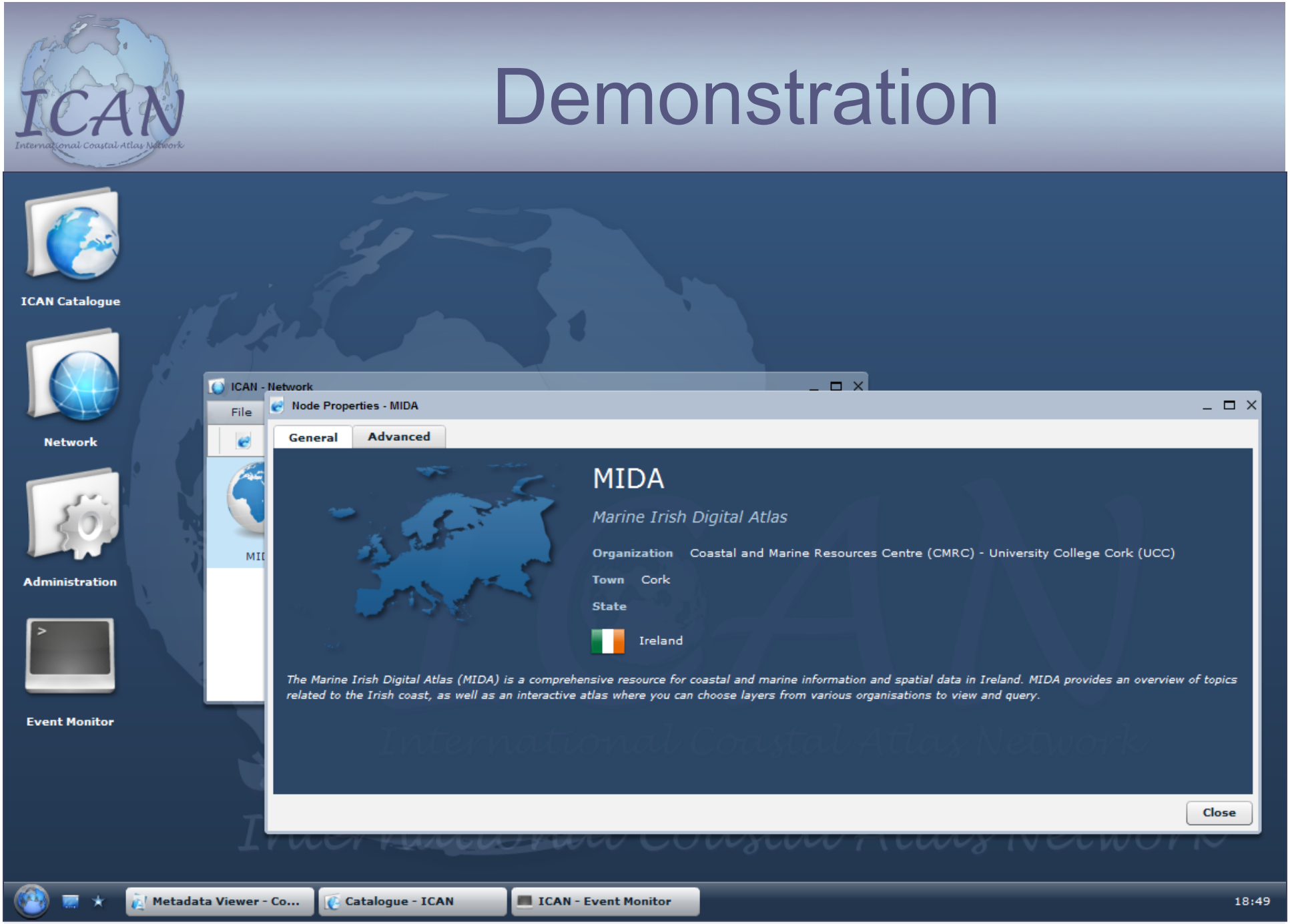

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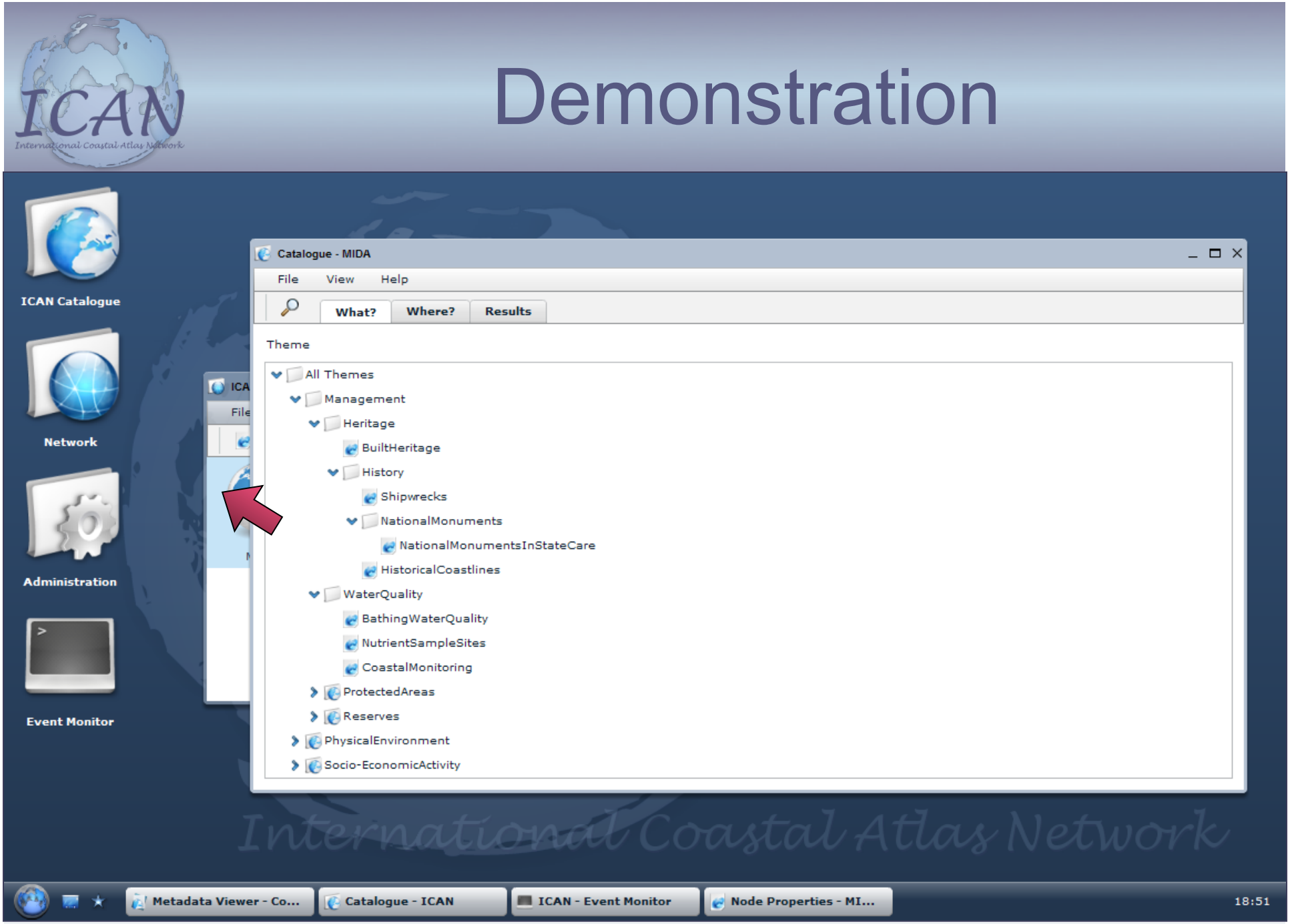

Demonstration

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Demonstration

Progress to Date

- Version 1.0 → Version 1.1
- Bugs fixed
  - Bounding boxes, idle nodes, etc.
- Idle nodes
- New GUI using Adobe Flex
- Separation between server side and client side code
- New functionalities
  - Direct interaction with nodes, node selection, event monitor,

Conclusion

- Efficient solution for facilitating syntactic, structural and semantic interoperability
- Ontologies and standards facilitate interoperability
- This is a first step in atlases interoperability focusing only on metadata and catalogue services

Future Work

- Include Web Map Service (WMS) for data visualisation
- Include Web Feature Service (WFS) & Web Coverage Service (WCS) for actual data delivery
- Share resources (thematic information about layer)

  → Structure thematic information using ontologies (instruments, platforms, parameters, themes, disciplines, etc.)

Future Work

- Advanced semantic framework

Driven by NETMAR

http://esaotewiki.epistematica.com/OTE/navigateInfoDomain

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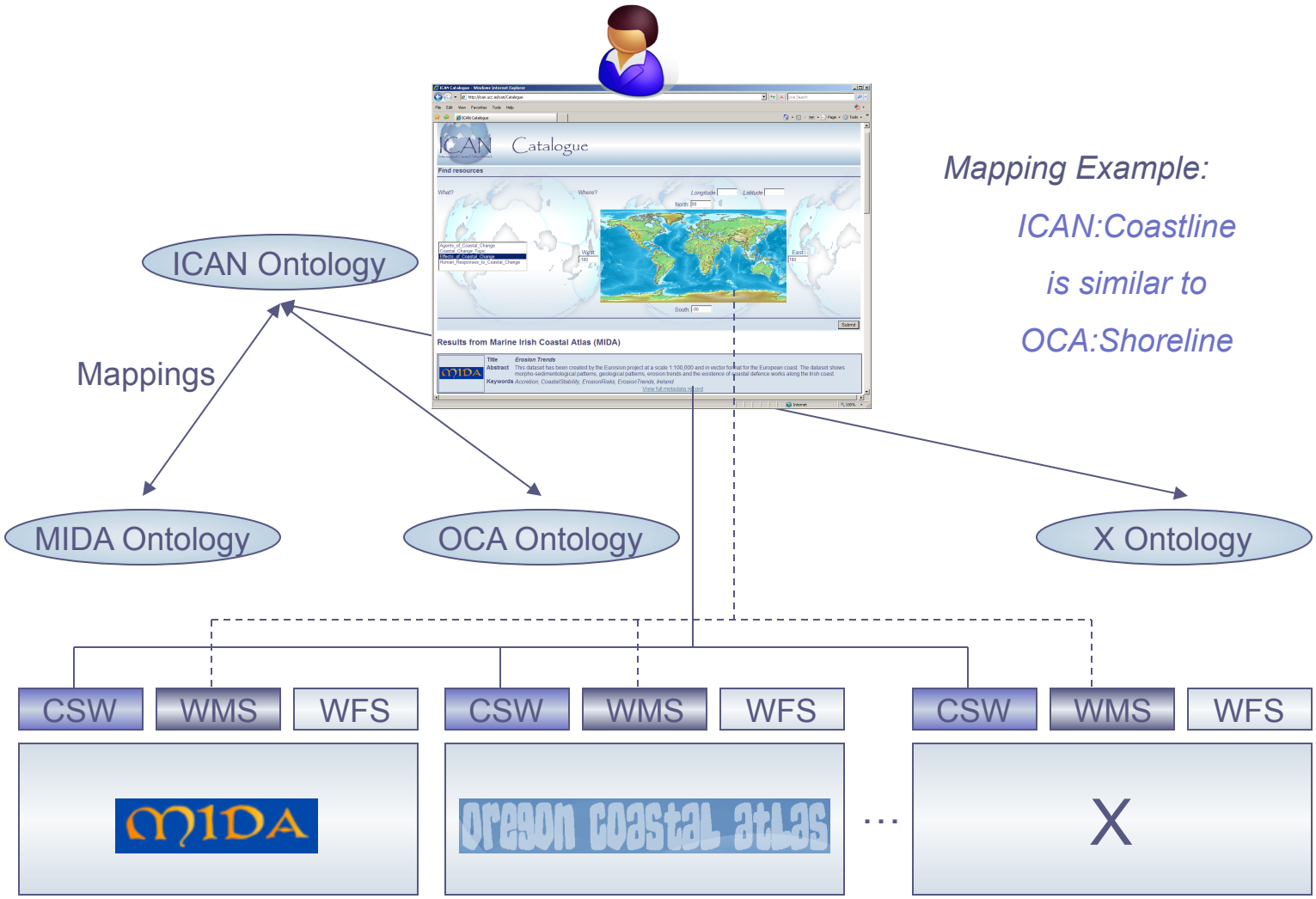

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Thank You