

Modern Development in Geospatial Management in the Field of Marine Cadastre

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Marine cadastre

Definition used for Australia (Binns, A., A. Rajabifard, P. Collier, And I. Williamson (2004))

“In essence, the marine cadastre would aim to provide a means for delineating, managing and administering legally definable offshore boundaries and associated rights, restrictions and responsibilities”.



Geospatial desktop software and marine cadastre: advantages

- Delimitation of rights and responsibilities in marine space is needed for a marine cadastre and the use of geospatial software gives the user a speed advantage over manual systems
- Clearer spatial perspective: geo-referenced visual representation of the maritime limits and boundaries (MLB) on a geographic display with relevant geographic reference information as backdrop or overlay.
- GIS geodetic tools enhance the efficiency of maritime limits calculation and boundary delimitation allowing an easy and quick case by case analysis.



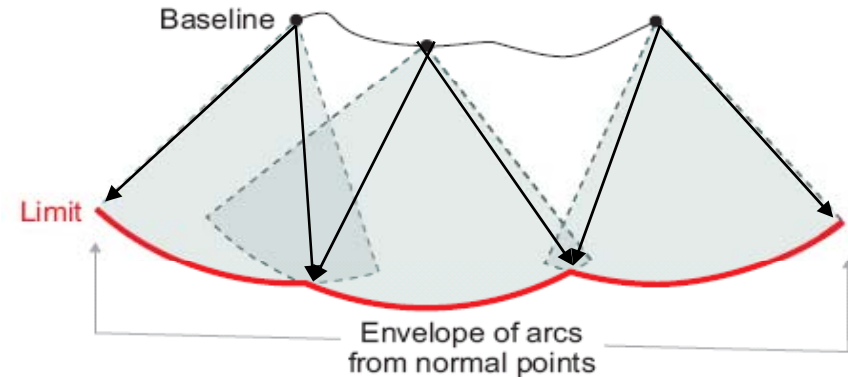
Geospatial desktop software for maritime limits and boundary delineation: requirements

- Geospatial desktop software must be specially designed for UNCLOS – to calculate complying maritime limits and boundaries and Article 76 claims
- It must contain tools to maintain the territorial sea baseline model
- It must also provide geodetic tools for maritime limits and boundary calculations. e.g.:
 - Envelope of Arcs: normal baseline and straight baseline
 - Equidistant/median line
 - Accurate representation as an aid to decision-makers

Examples of desktop software uses: Envelope of Arcs (EoA) – geodetic limit tool

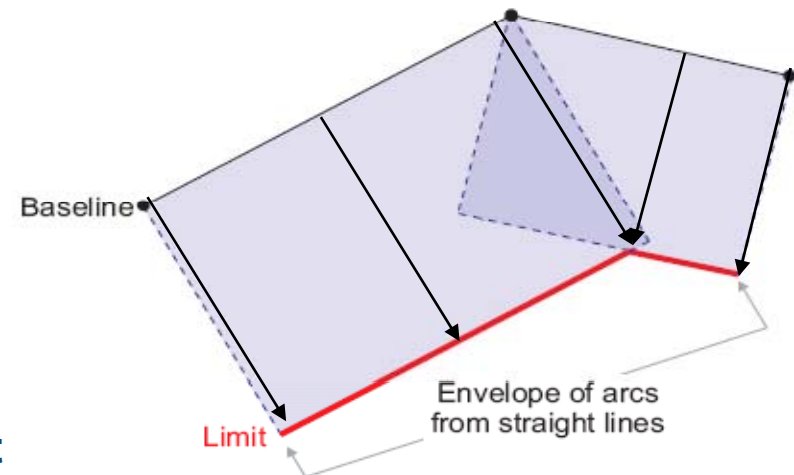
EoA from Normal baseline points

- Each point generates a geodetic arc of constant geodetic radius



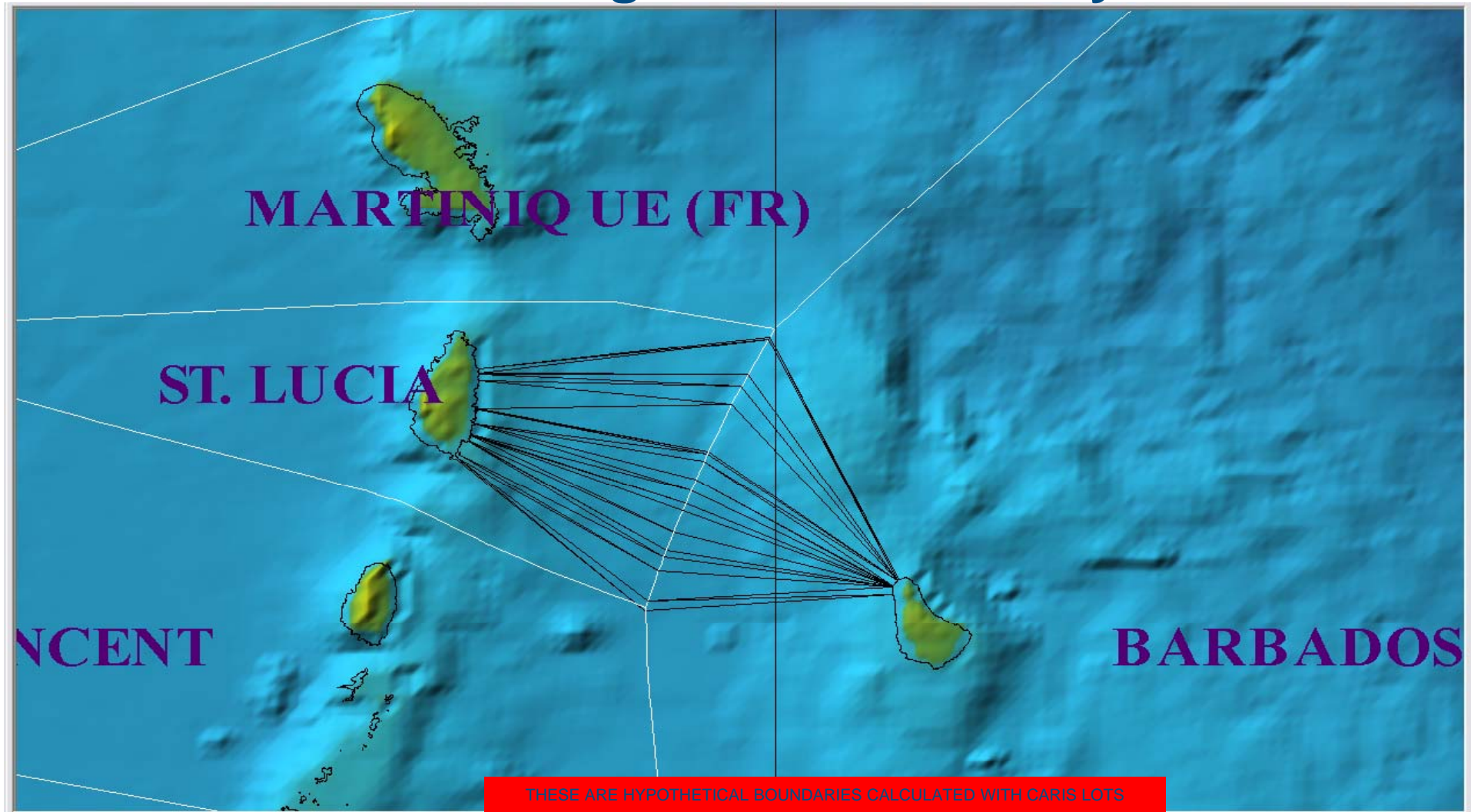
EoA from Straight baselines

- Each segment of line is considered as a continuous series of baseline points



For both types of EoAs, the seaward-most envelope of Arcs is retained. This tool is used for calculating the 3M, 6M, 12 M, 24 M, 200M maritime Limits.

Examples of desktop software uses: Hypothetical median line – geodetic boundary tool



Boundary & Limits data: Caribbean Sea (data from UKHO LOS)

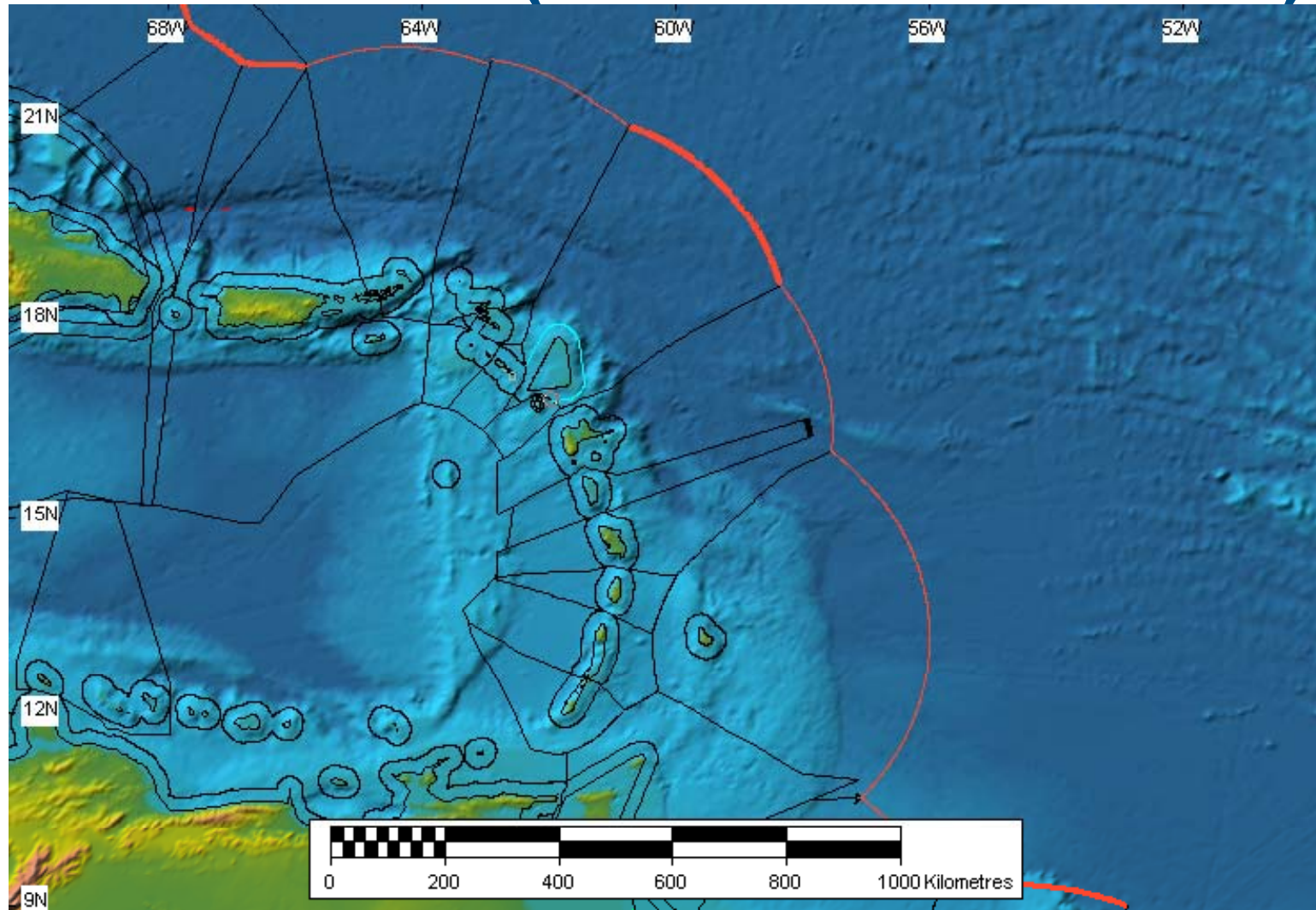
The screenshot displays the CARIS LOTS V4.0 software interface. The main window shows a map of the Caribbean Sea with various boundary and limit data overlaid. The interface includes a menu bar (File, Edit, View, Select, Digitize, Article76, Limits, Geodetic, Draw, Tools, Window, Help), a toolbar with various drawing and editing tools, and a left-hand panel with a 'Logic' section (AND/OR), 'Load From' options (Selection, SuperSelection), and a 'Feature Types' section with checkboxes for Line, Polygon, Name, Spot Height, Sounding, Compound Line, Symbol, and Image. Below the feature types are 'Inclusive' and 'Exclusive' radio buttons, and 'Apply', 'Default', 'Save', and 'Load' buttons. A 'Filters' section is also visible. The main map area shows a bathymetric map of the Caribbean Sea with black and red lines representing boundaries and limits. A small inset map in the bottom right corner shows the location of the main map area. The status bar at the bottom indicates 'Drawing complete.' and provides coordinates: 1:31962841.369157, 32.492013760, -90.042137926.

Type	Feature Code	Key	Layer	Source ID	Elevation

Process Output: Spatial Selection

Drawing complete. 1:31962841.369157 32.492013760 -90.042137926

Boundary & Limits data: Caribbean Sea Lesser Antilles (data from UKHO LOS)





Geospatial desktop software and marine cadastre: challenges and limitations

- The increase in volumes of file-based MLB data produced by marine geospatial users means data management becomes harder over time.
 - Multiple data files, difficult to maintain and manage as a whole
- Ambulatory or time-based boundaries difficult to maintain
 - Hard to track changes over time
 - May be difficult to update all relevant files each time a boundary changes
 - More on this later...



Territorial Sea Baseline (TSB) model maintenance for a marine cadastre

- Challenge: maintaining ambulatory parts of TSB in a file-based storage system
- Environmental factors
 - Global warming:
 - Sea level rise
 - Increase in strong storm strengths: Storm surges, erosion and sediment transport
 - Seismic or tectonic activity:
 - Uplifting or subsidence of continental crust: gain or loss of low tide elevations for baseline model
- Impact on dependant maritime limits and boundaries



Geospatial database software and marine cadastre

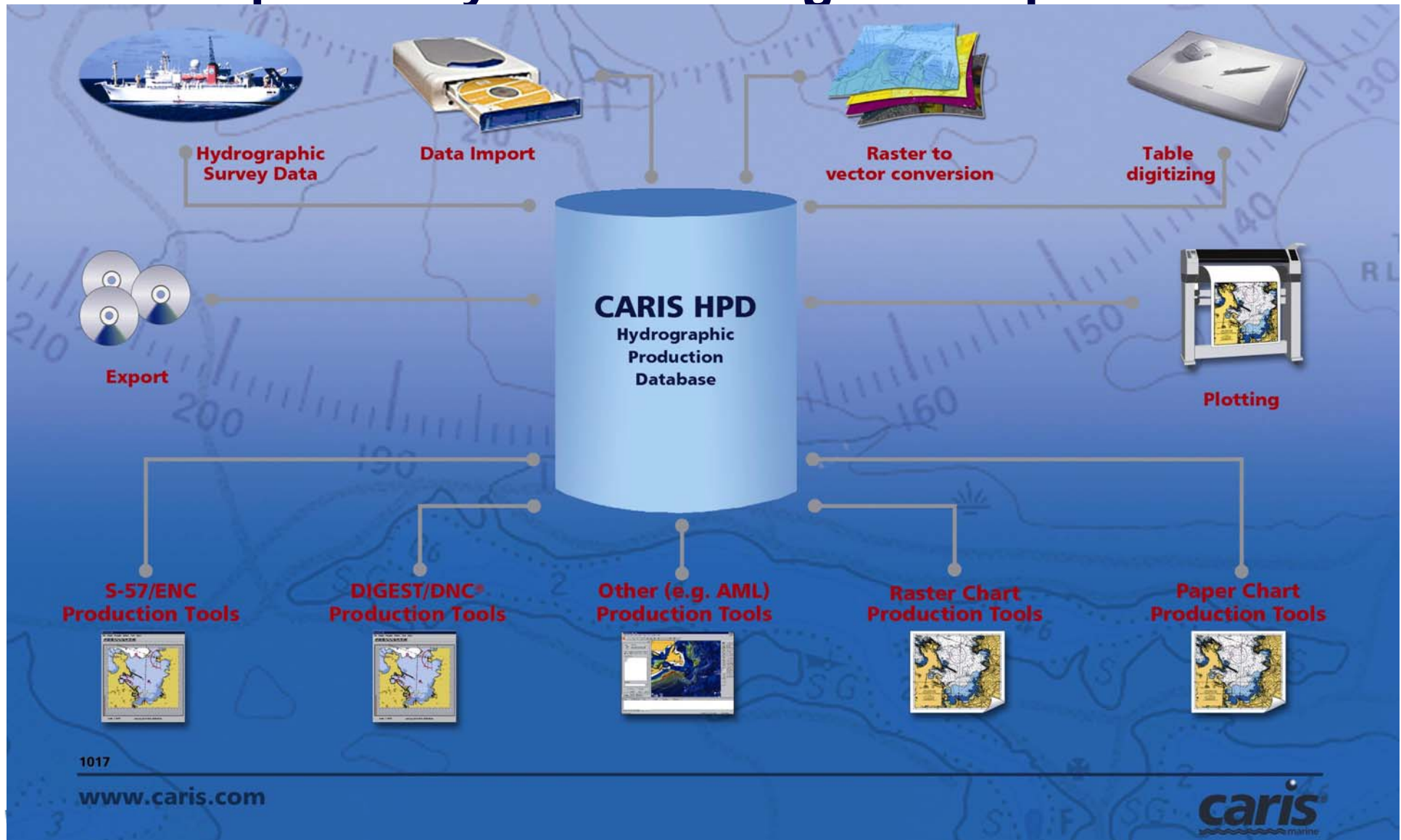
- Improving the TSB Model Maintenance: using a hydrographic production database
 - Allows change tracking, keeping a record of who made each specific change and when and the rapid updating of marine products
 - History tracking by object
 - Reduces the time from survey to chart or to S-57 ENC production by storing the data directly in S-57 ready format and by allowing a single change to the source data stored only once to be reflected in all the nautical products that share this area and feature



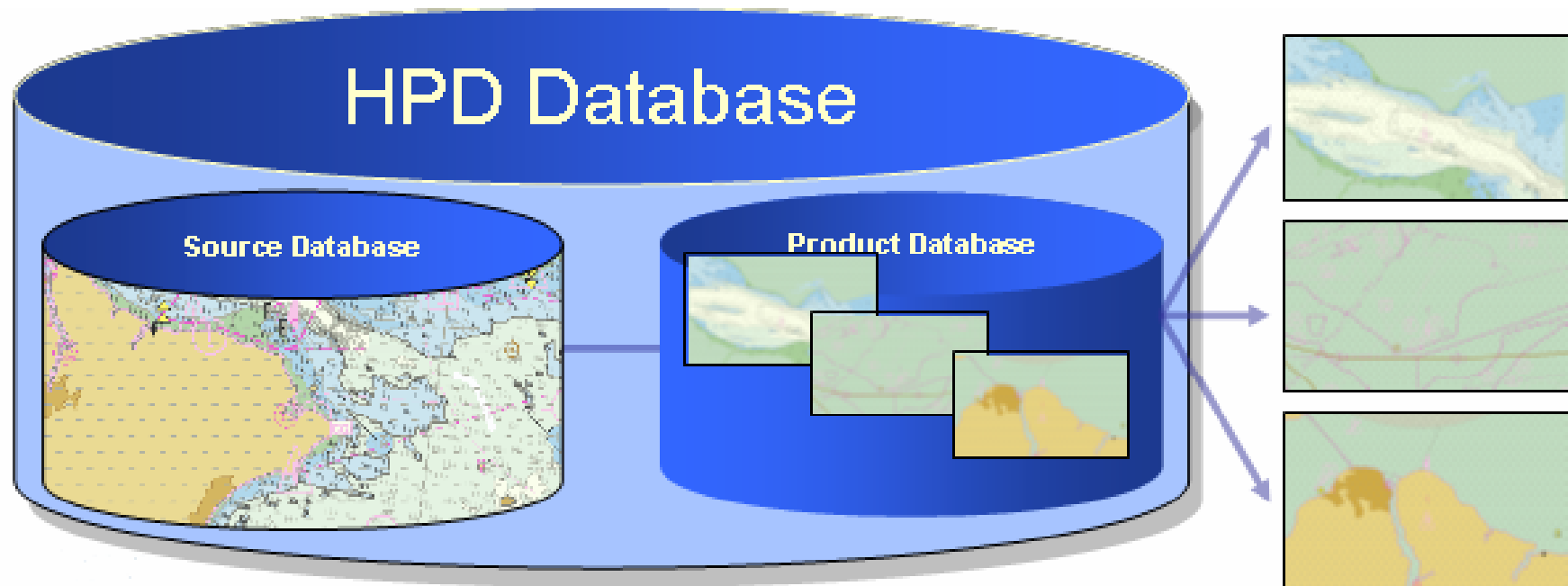
Geospatial database software and marine cadastre

- Better Overall Data Management: using a hydrographic production database
 - Hydrographic standards-based data structure (for example S-57 compatible)
 - Again, data stored only once in a source database
 - Addition of objects and attributes in catalogue (open)
 - New Law of the Sea Objects
 - New Law of the Sea Attributes
 - Flagging of changes required in related marine products
 - Integration of the MLB data in the production of marine products: paper charts, S-57 ENCs, AMLs, MIOs, ...

Example of geospatial database software and interoperability with existing desktop software



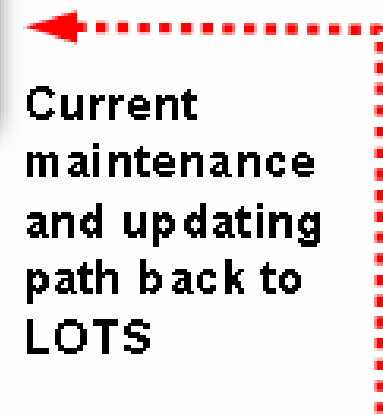
Hydrographic Production Database: CARIS HPD



Law of the Sea (LOS) Information – CARIS Workflow

LOS custom catalog extension added to HPD catalog

Rules file: map LOTS objects to S-57 custom LOS objects at import



Current maintenance and updating path back to LOTS

Future maintenance will be done in HPD



Future Limits and Boundaries Tools plug-in



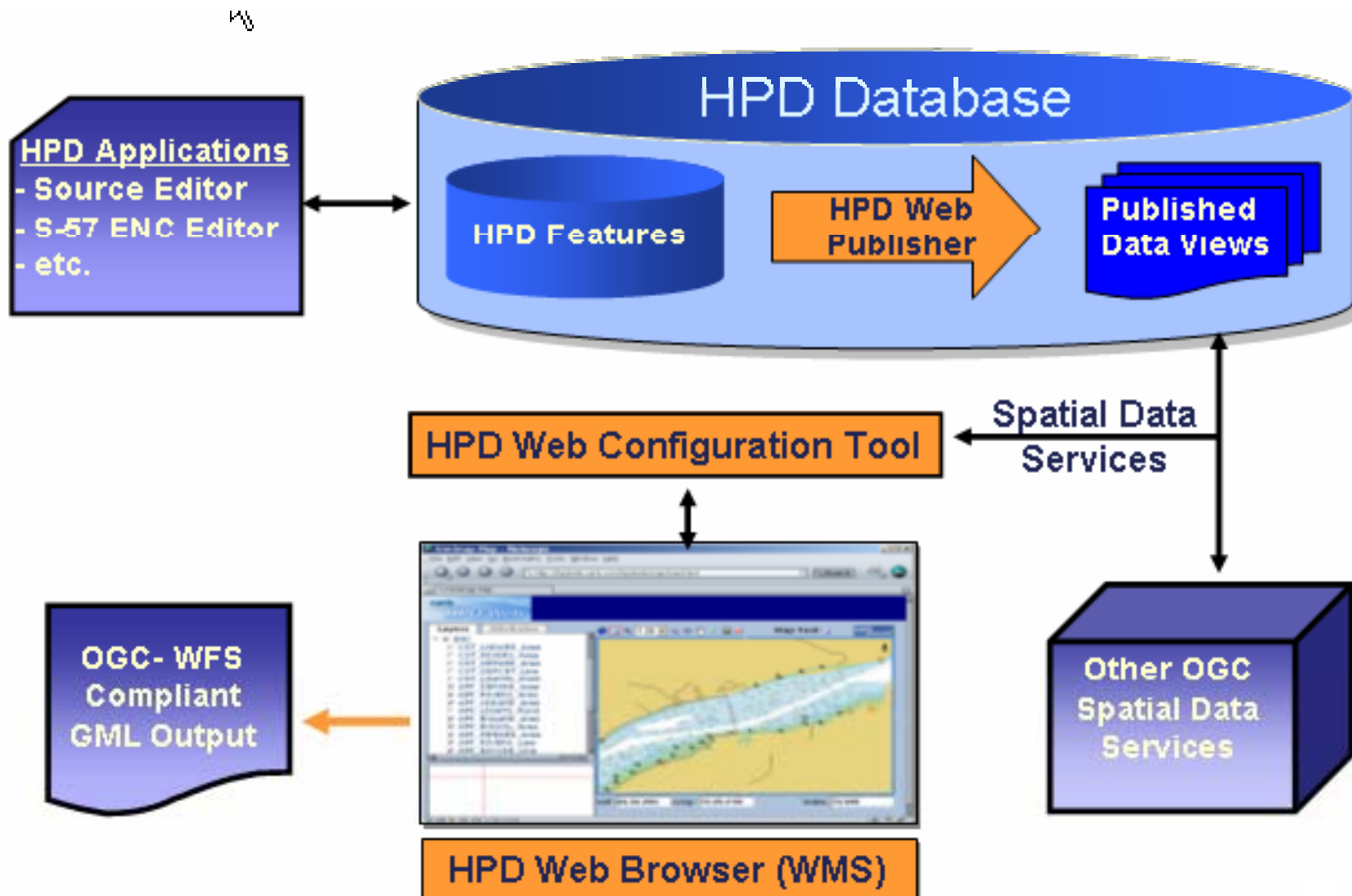
LOTS objects imported in the HPD Database

The screenshot displays the CARIS HPD Source Editor interface. The main window shows a map with various layers and a red boundary. The Layers panel on the left lists several layers, including Overview, General, Deleted Objects, Coastal, Approach, Harbour, Berthing, Markers, and Project Boundaries. The Properties panel shows the General properties for the selected layer, including Override Colour (Black) and Override Transparen (0). The Output panel shows a table of data for the selected layer.

Key	Feature Code	Geometry	Layer	Text	Source ID	Depth	Angle	Size	Area	Length
~8221	BDY	Line	4444		DR-VENEZ				N/A	40935.22
~8222	MEDIAN	Line	2244		DR-NETH				N/A	81747.31
~8275	BDY	Line	4444		DR_VENEZ				N/A	229984.18
~8285	2047	Line	0		MAY 06				N/A	34417.70
~8340	RA3007	Line	8888		FEB_05				N/A	1142750.01



Data distribution





Conclusions

- Definite advantages to using a hydrographic production database to manage law of the sea-related cadastral maritime limits and boundaries (MLB).
- Flexibility and customizability are achieved by expanding the object and attribute catalogue for special Law of the Sea objects.
- Easier updates and publishing of MLB data in related marine products is now possible.
- CARIS HPD's IHO standards-based data model is ideally suited for a marine cadastre application and can be combined with CARIS LOTS tools for geodetic calculations.

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