Managing Spatial Data at CABGOC
CHEVRON

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SASBU GIS - 2018
IT- Technical Computing
Agenda

- SASBU - GIS Operational Overview and Spatial Data Sources
- CABGOC GIS Data Usage and Data Flow
- Overview of Geodesy and Cartography
- Projects and Implementations Using Spatial Data
- Q & A
GIS Usage

- **Exploration New Ventures** - uses ArcGIS to help find new exploration opportunities around the world.
- **Asset development** - uses ArcGIS to help obtain maximum value while developing Chevron’s fields.
- **Facility Engineering** - is used to plan, design, optimize and keep track of infrastructure, drilling platforms, pipeline networks.
- **HES** uses ArcGIS to monitor the operation of Chevron’s facilities and their impact on the environment.
- **Drilling** – Spatial analysis within GIS for optimized well drilling patterns and efficient configurations.
- **Production** – Allows data integration and visualization of production volumes, injection rates.

Key Responsibilities

- Installation and configuration
- Troubleshooting / Consultation
- Automation and Scripting
- Geospatial Data management
- Mapping Solutions
- Create and maintain replication process between Sites
- Web Mapping Interface support
Using GIS Data Through the Oil Life Cycle

Benefits

- Improve the Cost-Efficiency and delivery timely information
- Geography influences all aspects of the CABGOC’s work from locating and extracting new resources to improving field management and ensuring HES compliance.
- Empowers decision making – plan the optimal pipeline and cable route, emergency response, better management of facilities, integrate results of seismic survey and manage spills.
- Supports future action and ongoing exploration activities – improves exploration efficiency by supporting a consistent, auditable corporate prospect portfolio, for ongoing decisions.
Overview of Geodesy and Cartography

What is Geodesy?

- Geodesy is a branch of mathematics that deals with the size, shape, positioning of points upon, representation of, and the gravitational field of the Earth.

- Information is considered “Geodetic” when it has been derived using measurements and computations that are based in Geodesy.

“Flat Earth” to Map transformation
Overview of Geodesy and Cartography

The earth is not really a perfect sphere, but more of an ellipsoid. And a wrinkly ellipsoid at that.

- We figure out methods to convert our real earth coordinates (latitude, longitude) to equivalent coordinates on a smooth ellipsoid. Then we use some more math to project these ellipsoid coordinates to coordinates on a perfect sphere and then to projected XY coordinates on a flat map.

Real Earth to Ellipsoid to Sphere to Map Transformation
Unfortunately, how we measure real earth coordinates (latitude, longitude) involves taking astronomical sightings from a level platform, and this depends on the direction of gravity. Which depends on the mass distribution of the earth – all those mountains and valleys and oceans. So astronomically derived (latitude, longitude) coordinates are not very good for accurate maps.

Gravity-Dependency of Astronomical Measurements
Overview of Geodesy and Cartography

DEFINING OFFSHORE BLOCKS OWNERSHIP
## Overview of Geodesy and Cartography

Typical survey errors & consequences of geo-reference integrity failures

<table>
<thead>
<tr>
<th>Operation</th>
<th>Scenario</th>
<th>Root Cause</th>
<th>Business Impact</th>
</tr>
</thead>
</table>
| Platform Drilling | Directional drilling contractor drilled 12 new wells from a production platform. The meridian grid convergence was incorrectly applied in the directional software. Bottom hole locations were not hit resulting in 12 dry wells. | Convergence correction was of the wrong magnitude and sign conventions.  
• Latitude setting on the North Seeking  
• Device was also incorrect.                                                                 | Loss of capital expenditure ($2 million).  
• Contractor received a non conformance report.  
• New campaign on drilling had to be recommenced.                                                                                                           |
| Appraisal Well Planning | While merging two separate 3D seismic datasets observed on different CRS(Coordinate Reference System), a cumulative error was made of 250 m due to incorrect coordinate transformations. | Lack of knowledge of the proper transformation method.  
• Use of different geology and geophysics (G&G) software packages that did not handle CRS data properly.  
• Lack of quality control (QC)                                                                                                                                 | Resources spent on investigating error.  
• Expensive reprocessing which took 3 months.  
• Knock on effect on subsequent operations (e.g well planning or drilling sequence)                                                                                                  |
| Data Conversion  | A small E&P operator had recently purchased a mature field from another company containing several development wells. All corporate datasets for this field had been merged into the new companies existing database. Top-hole locations for each of the wells were correctly transformed taking into account the different UTM zones that the previous operators CRS had used. However, the bottom-hole positions were found to be in error by 65 meters. | A 3° difference in grid headings between the two UTM zones and this had not been accounted for in the azimuth references within the downhole deviation logs.  
• The anti-collision software did not alert the well planners to the close proximity of nearby well path when drilling a new sidetrack as the azimuth references were in error by 3°. | The rig inadvertently drilled through a neighboring well bore causing extensive damage to the well and numerous reservoir problems.  
• A relief well had to be drilled as a contingency.  
• Massive cost implications and if the error had not been found earlier, other wells may have been drilled to the wrong subsurface locations. |
Overview of Geodesy and Cartography
Cabgoc Coordinate Systems

<table>
<thead>
<tr>
<th>Coordinate System</th>
<th>Datum</th>
<th>EPSG</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angola Malongo 87 UTM 33S CM (Africa – Angola (Cabinda) and DR Congo (Zaire) Offshore)</td>
<td>Malongo 87</td>
<td>7992</td>
<td>Transverse Mercator</td>
</tr>
<tr>
<td>Angola Malongo 87 UTM 32S CM (Africa – Angola (Cabinda) and DR Congo (Zaire) Offshore)</td>
<td>Malongo 87</td>
<td>4259</td>
<td>Transverse Mercator</td>
</tr>
</tbody>
</table>

**Geodetic Datum used in Africa - Angola (Cabinda) and DR Congo (Zaire) - offshore**

Malongo 1987 is a geodetic datum first defined in 1987 and is suitable for use in Angola (Cabinda) - offshore and The Democratic Republic of the Congo (Zaire) - offshore. Malongo 1987 references the International 1924 ellipsoid and the Greenwich prime meridian. Malongo 1987 origin is Fundamental point: Station Y at Malongo base camp. Latitude: 5°23′30.910″S, longitude: 12°12′01.590″E (of Greenwich). Malongo 1987 is a geodetic datum for Oil industry offshore exploration and production from 1967. It was defined by information from Chevron Petroleum Technology. Replaced Mhast (offshore) (code 6705) in 1987. Origin coordinates constrained to those of Mhast (offshore) but other station coordinates differ. References to "Mhast" since 1987 often should have stated "Malongo 1987".

<table>
<thead>
<tr>
<th>Datum Details</th>
</tr>
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<tbody>
<tr>
<td><strong>DATUM NAME:</strong> Malongo 1987</td>
</tr>
<tr>
<td><strong>CODE:</strong> 6259</td>
</tr>
<tr>
<td><strong>AREA OF USE:</strong> Africa - Angola (Cabinda) and DR Congo (Zaire) - offshore</td>
</tr>
<tr>
<td><strong>SCOPE:</strong> Oil industry offshore exploration and production from 1987.</td>
</tr>
<tr>
<td><strong>TYPE:</strong> geodetic</td>
</tr>
<tr>
<td><strong>REALIZATION EPOCH:</strong> 1987</td>
</tr>
<tr>
<td><strong>ORIGIN:</strong> Fundamental point: Station Y at Malongo base camp. Latitude: 5°23′30.910″S, longitude: 12°12′01.590″E (of Greenwich).</td>
</tr>
<tr>
<td><strong>EPILOPDID:</strong> International 1924</td>
</tr>
<tr>
<td><strong>PRIME MERIDIAN:</strong> Greenwich</td>
</tr>
<tr>
<td><strong>APPLICABLE CRS:</strong> The following CRSs are based on this datum: Malongo 1987</td>
</tr>
</tbody>
</table>

**META DATA**

- Replaced Mhast (offshore) (code 6705) in 1987. Origin coordinates constrained to those of Mhast (offshore) but other station coordinates differ. References to "Mhast" since 1987 often should have stated "Malongo 1987".

**INFORMATION SOURCE:** Chevron Petroleum Technology.
**DATA SOURCE:** OGP
**REVISION DATE:** 06/24/2008
**CHANGE ID:** 2005.751 (2008.045)

<table>
<thead>
<tr>
<th>Alias</th>
<th>Name</th>
<th>System</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mhast</td>
<td>EPSG alias</td>
<td>This same alias is ambiguous as is also used for Mhast (onshore) and Mhast (offshore).</td>
<td></td>
</tr>
</tbody>
</table>
Projects and Implementations Using spatial Data

Example

Production Information from Data Foundation
Turtle hatching density (HES)

Hatchling activity between October and April

LCB – Activity Map
Projects and Implementations Using Spatial Data
Lead Analysis - Reachability

Iabe lead 10,000 ft deep
Projects and Implementations Using Spatial Data

Examples

Seafloor rendering showing anchor Locations for the Lucapa-6 well

- Oil companies use seismic surveys to discover and map oil and gas.

- CABGOC lately performed two large seismic surveys in Block 0 and 14.

- Aside from reservoir mapping, we were also able to capture water depth information over large areas for entry into GIS.

- Through GIS we produced daily or weekly maps to inform local fishing communities where the seismic vessels would be working, thereby minimizing our impact on their fishing activity.
Projects and Implementations Using Spatial Data

Map created using SASBU GIS
Projects and Implementations Using Spatial Data

SASBU GIS Usage Temporal Change Detection

2005-2006 QuickBird (0.6 M)  
2008 Ikonos (1.0 M)
Obrigado
Thank you

Perguntas
Questions