



Finding the Gaps

EO₄OG PROJECT

EARTH OBSERVATION
FOR OIL & GAS: OFFSHORE

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Overview



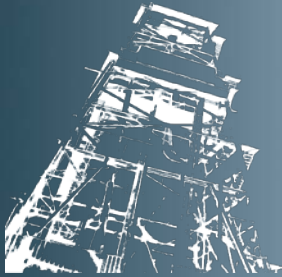
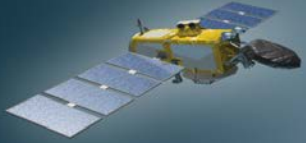
Framework for EO-based services



Capability gaps



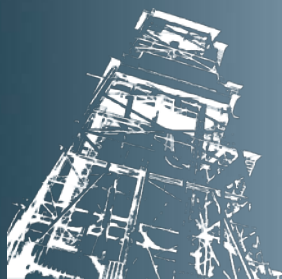
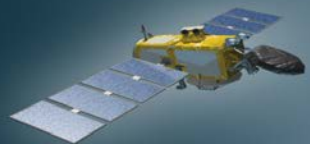
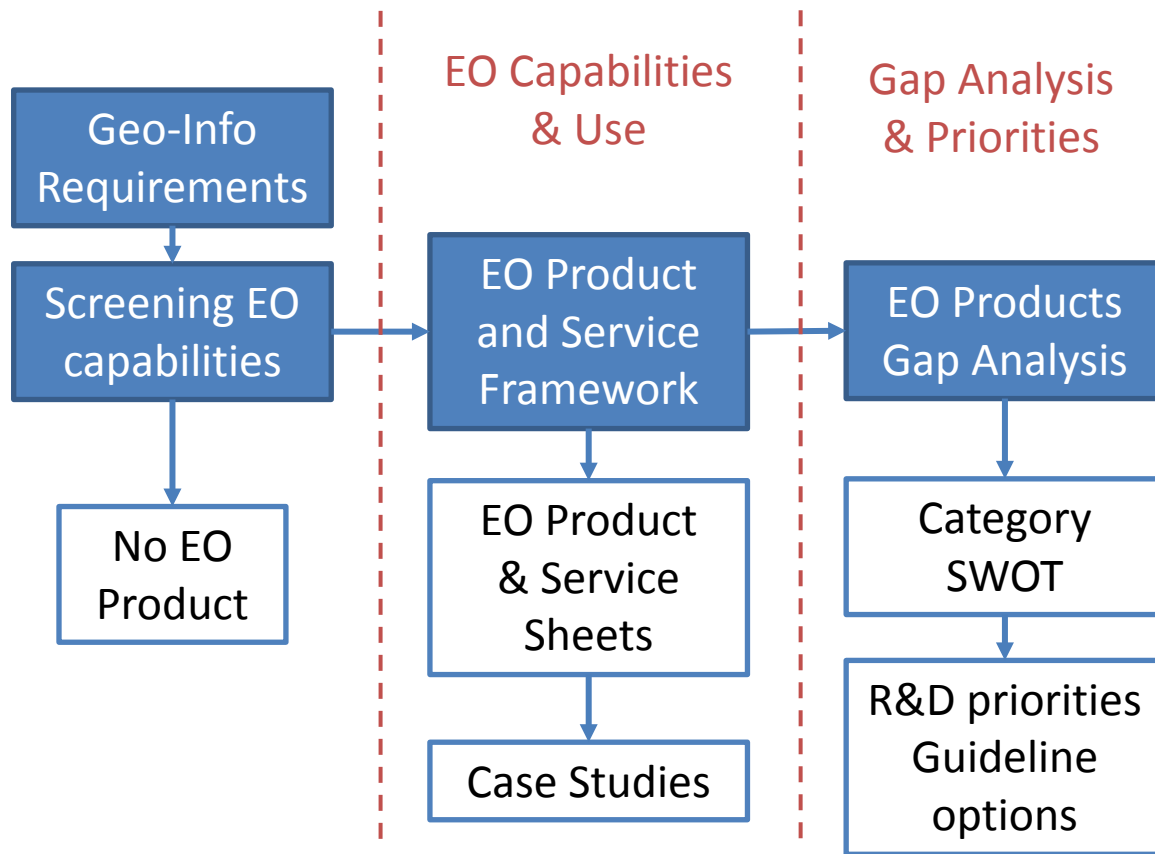
Utilization gaps



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Overall Approach

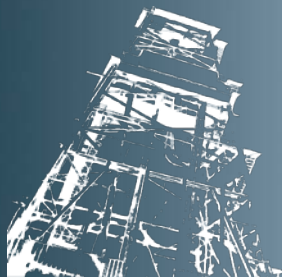
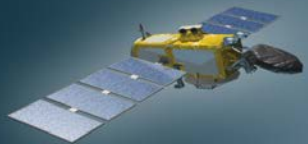


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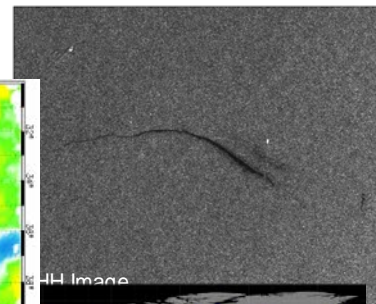
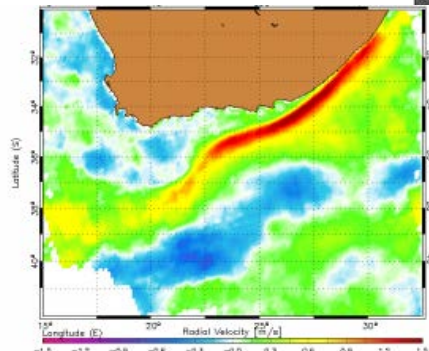


Framework for EO-Based Services: Product Categories

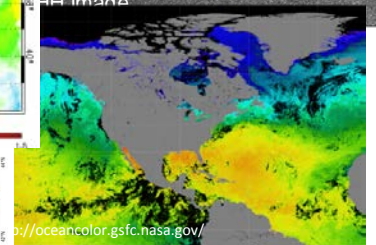
- Coastal
- Subtidal
- Water quality
- Slicks
- Targets
- Ocean surface
- Meteorology
- Wildlife



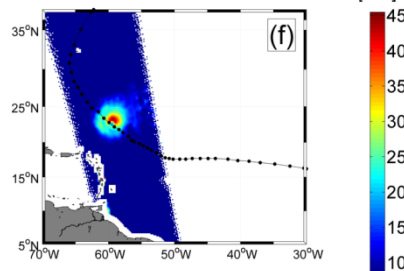
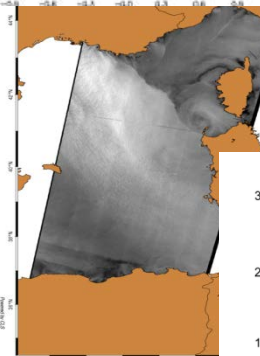
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SAR Image



Sea Surface Temperature (°C)



(f)

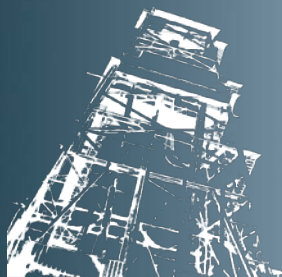
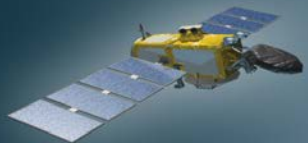
Offshore EO-Based Products

Compliance/Regulatory

Upland/intertidal land cover/habitat
Upland/intertidal land cover/habitat change
Shoreline
Shoreline change
Subtidal habitat/bottom type
Shallow water bathymetry
Turbidity
Plumes
Suspended concentration
Chlorophyll-a concentration
Dissolved organic matter
Other water constituents
Potential oil slick location and distribution
Vessel location, size and type
Iceberg location and size
Gas flares
Sea bird colonies
Marine mammals

Design/Operation

Surface wind statistics
Surface wind (coastal areas)
Surface wind (open ocean)
Wave statistics
Waves (coastal areas)
Waves (open ocean)
Swell forecast
Surface current
Upwelling
Oceanographic front
Interaction between current and bathymetry
Sea ice
Rain cells
Atmospheric fronts
Local weather phenomena
Hurricane tracks
Salinity
SSH
SST



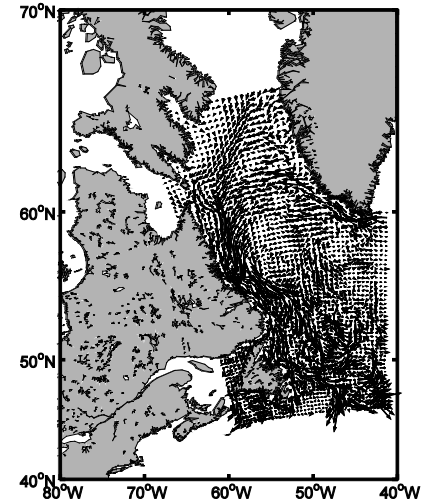
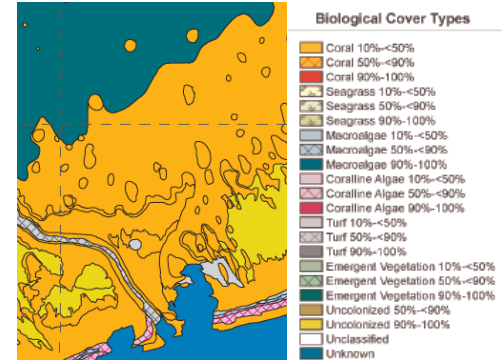
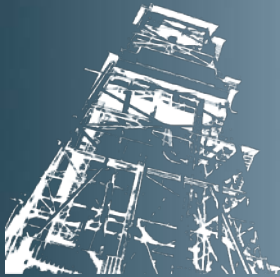
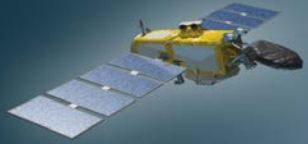
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Use of EO-Based Products

- Direct use
 - Use of product alone or in conjunction with other information
- Indirect use
 - Product is used in model parameterization, calibration or validation
 - Model output is used by users

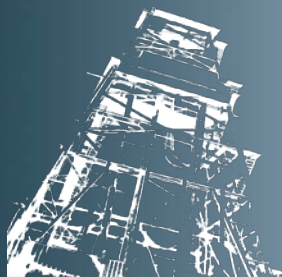
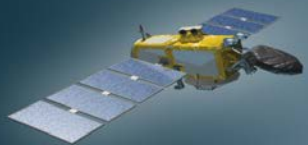
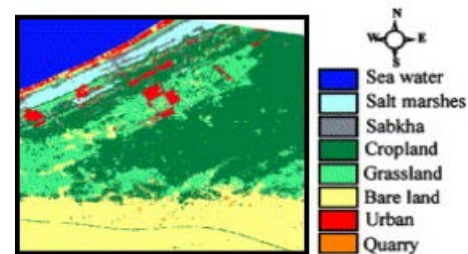
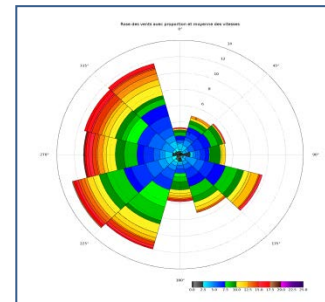


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Framework for EO-Based Services: Service Scenarios

- Study
 - Analysis of archival data
 - EO-derived information typically reported as summary statistics
 - Product is typically report
- Inventory
 - One-time product
 - May accompany report
 - Baseline for later comparison
 - Typically digital map/GIS layer

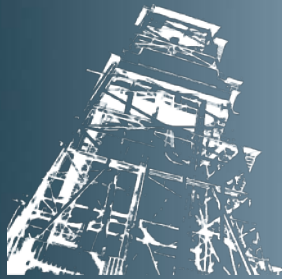
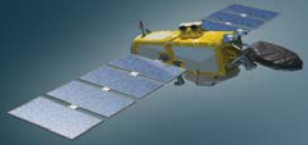
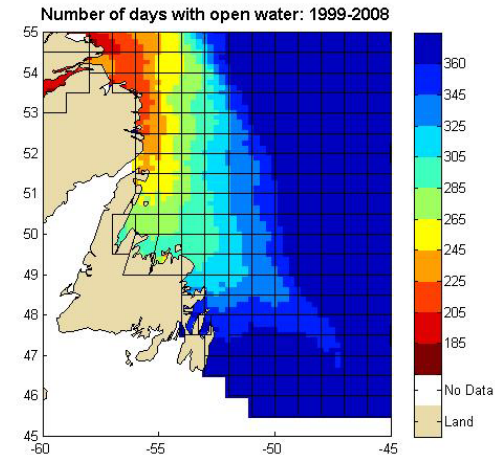
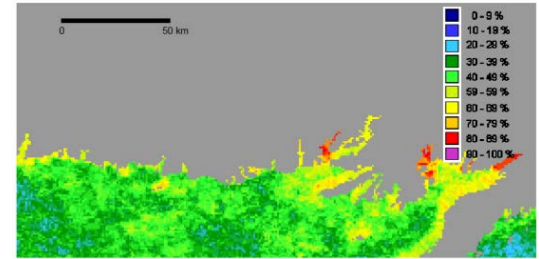


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Framework for EO-Based Services: Service Scenarios

- Change and Trends
 - Repeated information extraction at relatively low frequency (i.e. monthly, seasonally, yearly, multiple years)
 - Comparison against baseline
 - Products may be digital map layers of reports

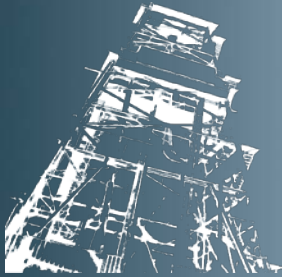
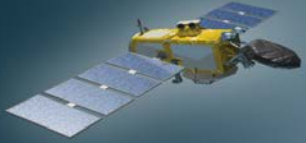
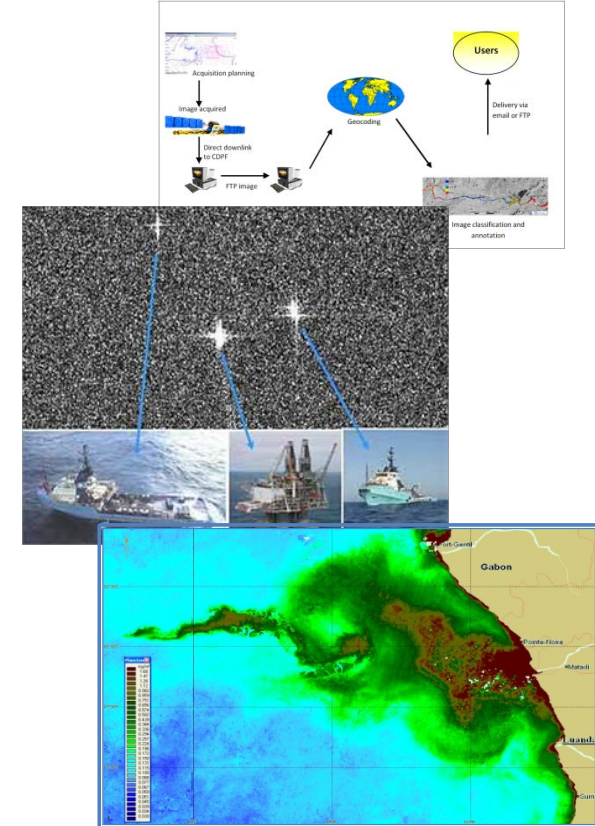


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Framework for EO-Based Services: Service Scenarios

- Surveillance
 - On-going monitoring
 - Product delivery in near real-time (NRT)
 - Period of surveillance typically seasonal or year-round
 - Products feed into tactical decision processes

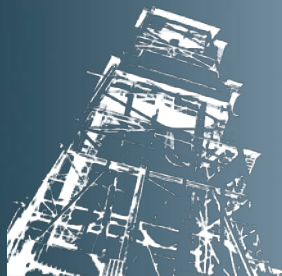
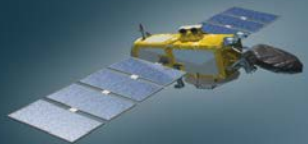


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Framework for EO-Based Services

Product Category	EO-Based Products	Service Scenarios			
		Study	Inventory	Change and Trends	Surveillance
Coastal	Upland/intertidal land cover/habitat	x	x	x	
	Upland/intertidal land cover/habitat change			x	
	Shoreline		x		
	Shoreline change			x	
Subtidal	Subtidal habitat/bottom type	x	x	x	
	Shallow water bathymetry	x	x		
Water quality	Turbidity	x		x	x
	Plumes	x		x	x
	Suspended concentration	x		x	x
	Chlorophyll-a concentration	x		x	x
	Dissolved organic matter	x		x	x
	Salinity	x		x	x
	Other water constituents	x		x	x
Slicks	Potential oil slick location and distribution	x	x	x	x
Targets	Vessel location, size and type	x			x
	Iceberg location and size	x			x

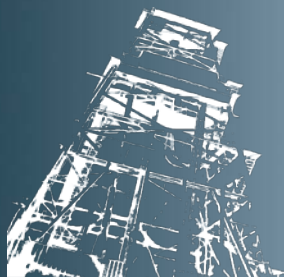
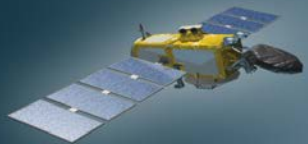


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Utilization and Readiness

- Capabilities and utilization
 - Technology readiness level scheme adapted for EO-based products and services
 - Estimated utilization of EO-derived information by O&G sector
 - Estimated demand from importance of information requirement associated with each life cycle stage

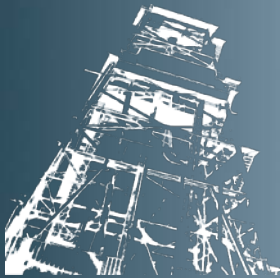
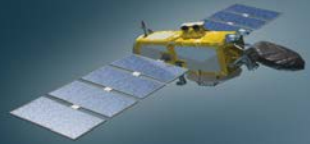


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Technology Readiness for EO-Based Products and Services

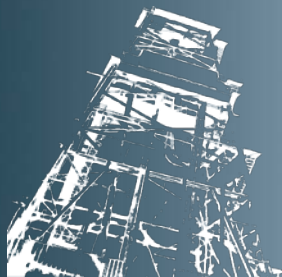
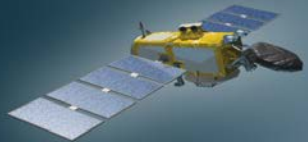


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Technology Readiness Level (TRL)		Development Stage Completed
Concept	0	Hypothetical Concept (Basic R&D, paper concept)
	1	Proven Concept (Based on applied research)
Proof-of-Concept	2	Validated Concept (Experimental proof of concept and limited validation against reference data)
	3	Prototype Tested (Function, performance and reliability of critical service components tested)
Prototype	4	Service Tested (Pre-operational service demonstration)
	5	Service Demonstrated (Operational service demonstration)
	6	Service Implemented (Service is fully implemented and validated; partially meets user requirements)
Field Qualified	7	Field Proven (Service is accepted as proven technology; operated > 3 years; fully meets user requirements)

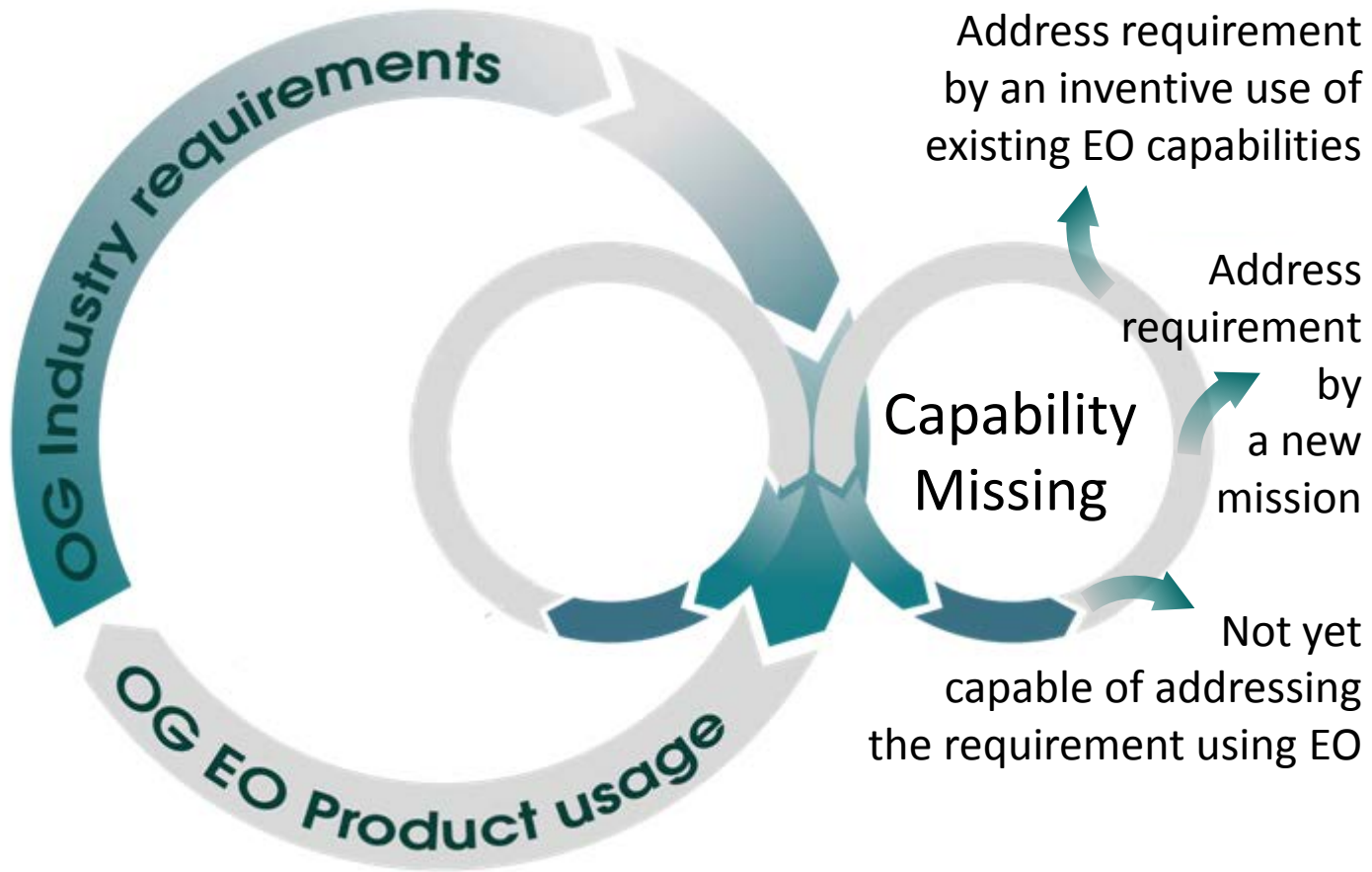
(Adapted from API 17N - Recommended Practise for Subsea Production System Reliability, Technical Risk and Integrity Management)



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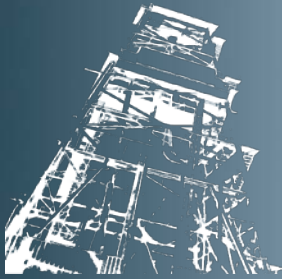
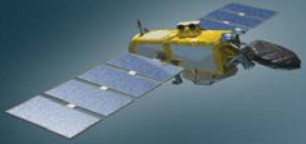


EO Capability Gaps



EO Capability Gaps: EO is not Applicable

- Historic records for currents at depth
- Observations of current at depth
- Submarine landslides and seabed stability
- Shipwrecks and other archaeological value areas at depth
- Information on presence and abundance of deep water fauna



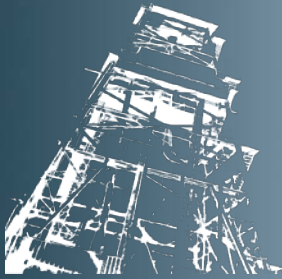
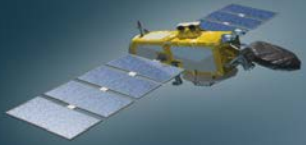
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EO Capability Gaps: R&D Priorities

- General
 - Increasing data volumes from new and emerging missions (e.g. Sentinels, SkyBox, PlanetLabs)
 - Examine use multi-source imagery
 - Interface with other suitable data streams (e.g. in-situ, AIS)
 - Improve EO data archives for enhanced statistical analyses

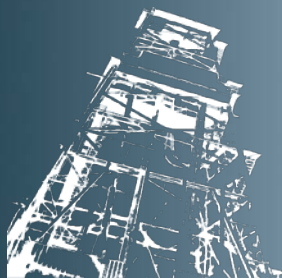
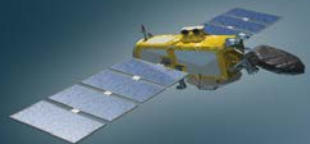


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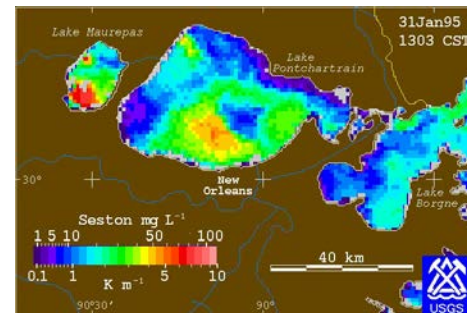
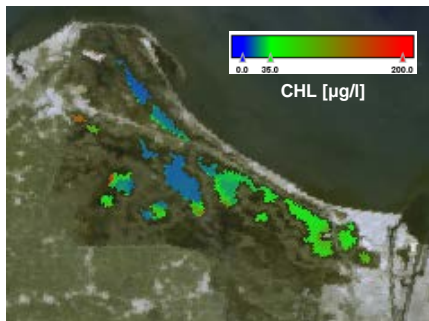


EO Capability Gaps: R&D Priorities

- Water quality
 - Improve portability across water bodies
 - Integrate EO and in-situ data streams (e.g. RTWQ) to enable extraction of WQ parameters that are not optically active (e.g. salinity, phosphates)

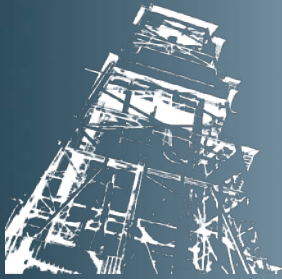
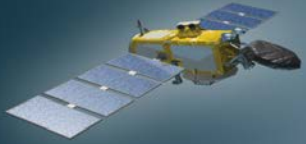


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EO Capability Gaps: R&D Priorities

- Slicks
 - Improve discrimination between slicks and look-alikes (e.g. wind shadow)
 - Improve characterization of slick thickness
 - Take into account slick heterogeneity to improve estimation of drift and diffusion
- Targets
 - Improve target identification
 - Improve detection of small targets

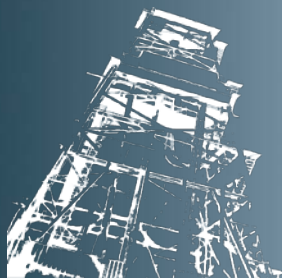
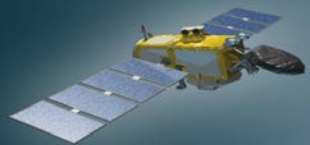


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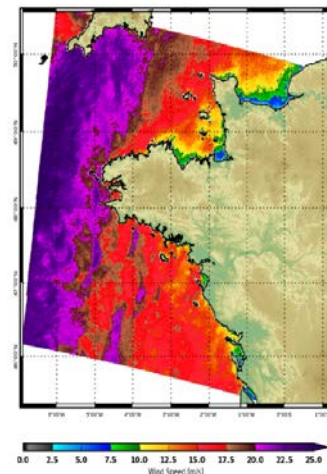
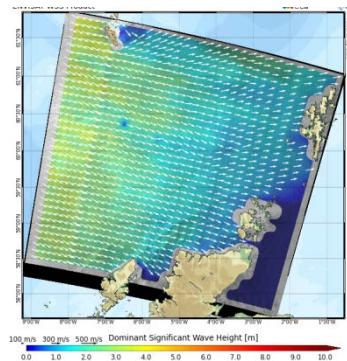


EO Capability Gaps: R&D Priorities

- Ocean surface
 - Improve parameter extraction in coastal areas (e.g. coastal winds)
 - Establish frequency of coverage appropriate for dynamic systems

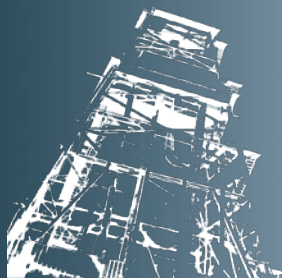
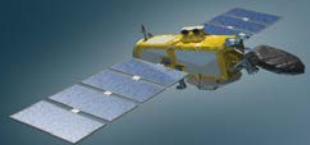


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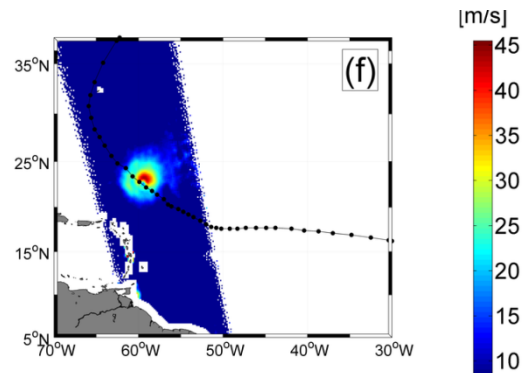


EO Capability Gaps: R&D Priorities

- Meteorology
 - Improve characterization of convective cells
 - Improve characterization of cloud and fog (spatial and temporal resolution, discrimination)

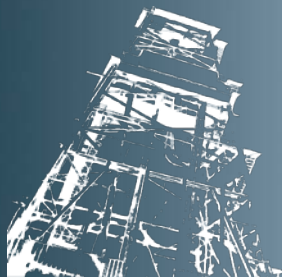
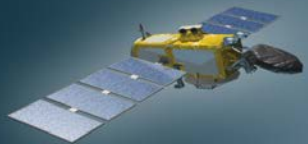


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EO Capability Gaps: R&D Priorities

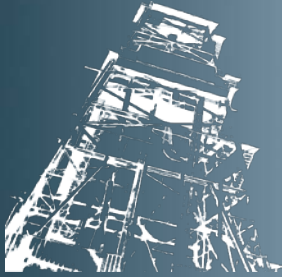
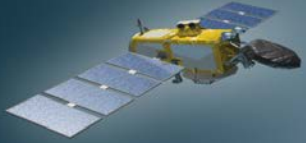
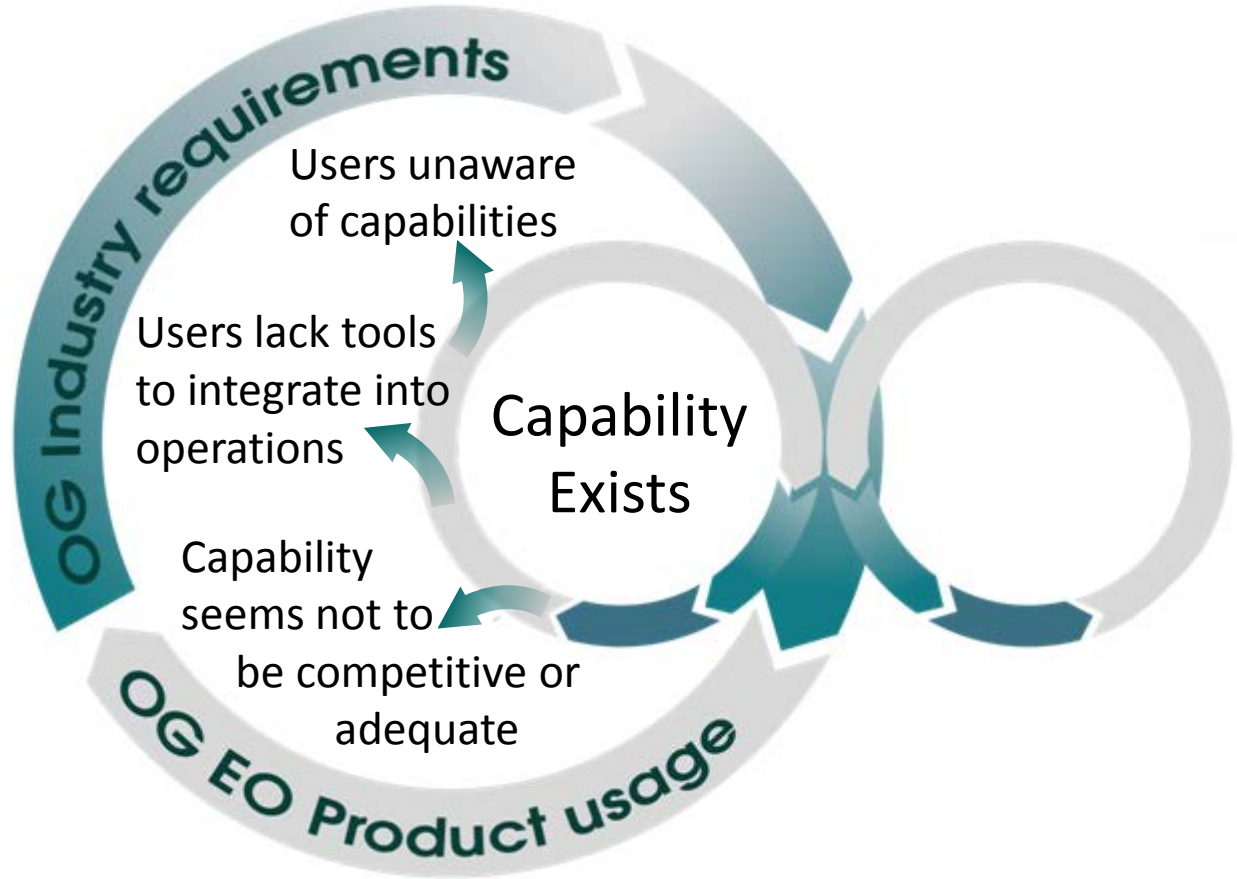
- Wildlife
 - Examine EO-derived information about gas flares (e.g. Intensity, frequency) as indicator of risk to seabirds
 - Examine footprint of seabird colonies (detection, areal extent, changes in extent)
 - Detection and identification of marine mammals



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EO Utilization Gaps



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EO Utilization Gaps

Product Category	EO-Based Products
Coastal	Upland/intertidal land cover/habitat
	Upland/intertidal land cover/habitat change
	Shoreline
	Shoreline change
Subtidal	Subtidal habitat/bottom type
	Shallow water bathymetry

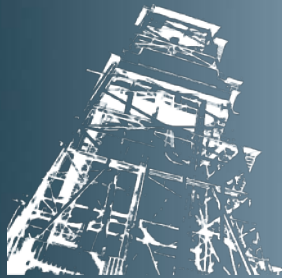
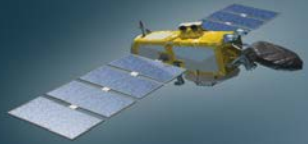
Well Used
Used
Rarely Used
Experimental

Industry Usage

Field Qualified
 Prototype
 Concept

TRL 6-7
TRL 3-5
TRL 0-2

Technical Readiness



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EO Utilization Gaps

Product Category	Offshore EO-Based Products
Water quality	Turbidity
	Plumes
	Suspended concentration
	Chlorophyll-a concentration
	Dissolved organic matter
	Salinity
	Other water constituents

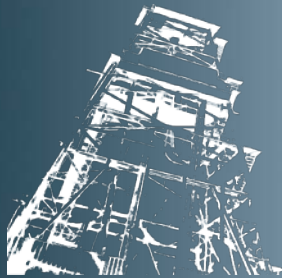
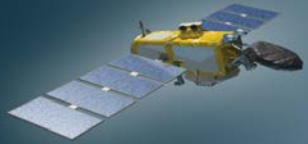
Well Used
Used
Rarely Used
Experimental

Industry Usage

Field Qualified
 Prototype
 Concept

TRL 6-7
TRL 3-5
TRL 0-2

Technical Readiness



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EO Utilization Gaps

Product Category	Offshore EO-Based Products
Slicks	Potential oil slick location and distribution
Targets	Vessel location, size and type
	Iceberg location and size

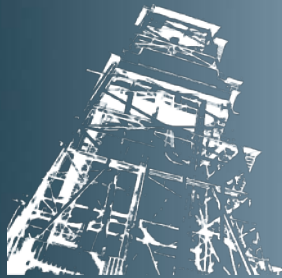
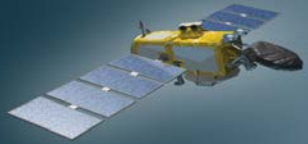


Industry Usage

Field Qualified
Prototype
Concept



Technical Readiness



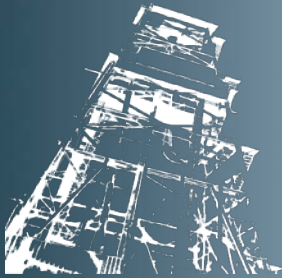
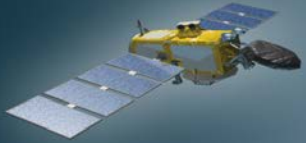
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EO Utilization Gaps

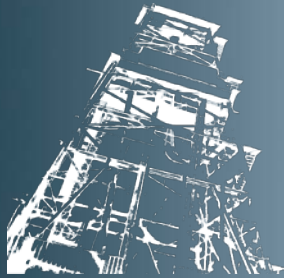
Product Category	EO-Based Products
Ocean surface	Sea surface height (SSH)
	Sea surface temperature (SST)
	Surface wind statistics
	Surface wind (coastal areas)
	Surface wind (open ocean)
	Wave statistics
	Waves (coastal areas)
	Waves (open ocean)
	Swell forecast
	Surface current
	Upwelling
	Oceanographic front
	Interaction between current and bathymetry
	Sea ice



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EO Utilization Gaps



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Product Category	EO-Based Products
Meteorology	Rain cells
	Atmospheric fronts
	Local weather phenomena
	Hurricane tracks
Wildlife	Gas flares
	Seabird colonies
	Marine mammals

Well Used
Used
Rarely Used
Experimental

Industry Usage

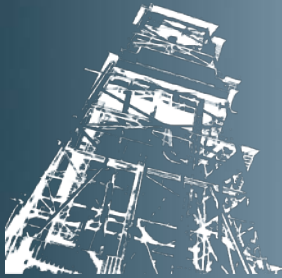
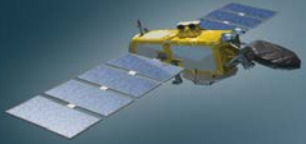
Field Qualified
Prototype
Concept

TRL 6-7
TRL 3-5
TRL 0-2

Technical Readiness

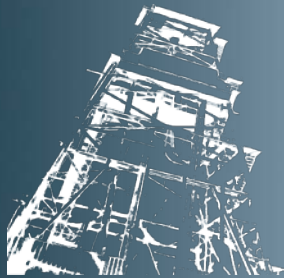
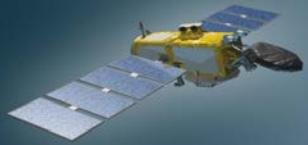
EO Utilization Gaps: Major Factors

- Varied EO expertise in user organizations
- EO capabilities are not effectively communicated
- Limited information on how EO is best used within a particular context



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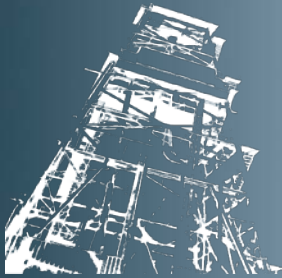


EO Utilization Gaps: Major Factors

- Other technologies (e.g. in-situ, UAV) are considered more appropriate than EO for a particular application
- Cost (relative to context) and availability of EO data
- Concerns over continuity of relevant EO data

EO Utilization Gaps: Opportunities

- Continue and build on dialogue between O&G and EO communities
 - Effective communication mechanisms (e.g. via OGEO portal)
 - Comprehensive documentation on EO capabilities
 - Consistent EO products and services

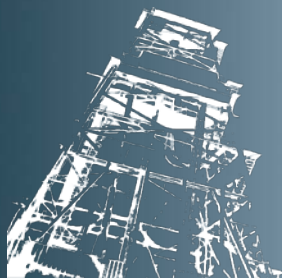
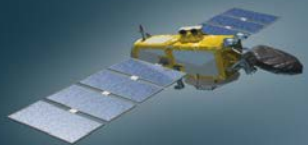


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EO Utilization Gaps: Opportunities

- Paradigm shift towards free and open access to global EO data
 - Public access to comprehensive, global EO data
 - Long-term commitment
 - Free data “explosion” with Sentinel missions



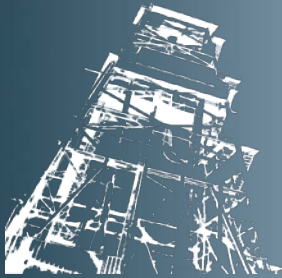
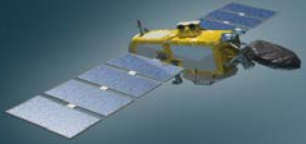
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Priorities for Guideline Development

- EO-based products and services well used within the O&G sector
 - Slicks
 - Targets
 - Ocean surface
 - Meteorology
- Under-used EO capabilities
 - Water quality
 - Subtidal (e.g. coral reefs)
 - Coastal



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