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StandardGuide for Selection of Airborne Remote Sensing Systems for Detection and Monitoring of Oil on Water[1]

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1. Scope

1.1 This guide provides information and criteria for selection of remote sensing systems for the detection and monitoring of oil on water.

1.2 This guide applies to the remote sensing of oil-on-water involving a variety of sensing devices used alone or in combination. The sensors may be mounted in helicopters, fixed-wing aircraft, or lighter-than-air platforms. Excluded are situations where the aircraft is used solely as a telemetry or visual observation platform and exo-atmosphere or satellite systems.

1.3 The context of sensor use is addressed to the extent it has a bearing on their selection and utility for certain missions or objectives.

1.4 This guide is generally applicable for all types of crude oils and most petroleum products, under a variety of marine or fresh water situations.

1.5 Many sensors exhibit limitations with respect to discriminating the target substances under certain states of weathering, lighting, wind and sea, or in certain settings.

1.6 This guide gives information for evaluating the capability of a remote surveillance technology to locate, determine the areal extent, as well as measure or approximate certain other characteristics of oil spilled upon water.

1.7 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 Remote sensing of oil-on-water involves a number of safety issues associated with the modification of aircraft and their operation, particularly at low altitudes. Also, in some instances, hazardous materials or conditions (for example, certain gases, high voltages, etc.) can be involved. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Significance and Use

2.1 The contributions that an effective remote sensing system can make are:

2.1.1 Provide a strategic picture of the overall spill,

2.1.2 Assist in detection of slicks when they are not visible by persons operating at, or near, the water's surface or at night,

2.1.3 Provide location of slicks containing the most oil,

2.1.4 Provide input for the operational deployment of equipment,

2.1.5 Extend the hours of clean-up operations to include darkness and poor visibility,

2.1.6 Identify oceanographic and geographic features toward which the oil may migrate,

2.1.7 Locate unreported oil-on-water,

2.1.8 Collect evidence linking oil-on-water to its source,

2.1.9 Help reduce the time and effort for long range planning,

2.1.10 A log, or time history, of the spill can be compiled from successive data runs, and

2.1.11 A source of initial input for predictive models and for "truthing" or updating them over time.

3. Remote Sensing Equipment Capabilities and Limitations

3.1 The capability of remote sensing equipment is, in large measure, determined by the physical and chemical properties of the atmosphere, the water, and the target oil. There may be variations in the degree of sophistication, sensitivity, and spatial resolution of sensors using the same portion of the electromagnetic spectrum and detector technology. Sensors within a given class tend to have the same general capabilities and typically suffer from the same limitations.

3.2 Combinations of sensors offer broader spectral coverage which, in turn, permit better probability of detection, better discrimination, and effective operation over a broader range of weather and lighting conditions. Certain combinations, or

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sensor suites, are well documented, and their use is particularly suited to oil spill response missions.

3.3 The performance of virtually all sensors can be enhanced by a variety of real-, near real-time or post processing techniques applied to the acquired data or imagery. Furthermore, image or data fusion can greatly enhance the utility of the remote sensing output or product. Similarly, there exists a variety of technological considerations and organizational ramifications that relate to the delivery of the remote sensing information to the user.

3.4 Certain parameters need to be identified and quantified to provide an oil spill response decision-maker with all of the information needed to best respond to a spill. These are:

3.4.1 Location—of the approximate center and edges of the spill,

3.4.2 Geometry—source or origin, total area, orientation and lengths of major and minor axes, fragmentation, and distribution,

3.4.3 Physical conditions—oil appearance, entrained debris,

3.4.4 Environmental conditions—wave height and direction; water temperature; position of oceanic fronts, convergence and divergence zones,

3.4.5 Proximity of threatened resources, and

3.4.6 Location of response equipment.

3.5 Remote sensing can contribute to all of the above data needs. Depending on the spill situation and the employment of remote sensing, some of this information may already be available, or can be determined more cost effectively by other means. For example, in a response mode, or tactical employment of remote sensing, it is likely that the source, general location and type of oil have been reported well in advance of the launch of the remote sensing platform. In a regulatory or patrol context, this information may not be available. The spill situation influences the priorities among the elements of information and, thereby, influences the selection priorities for sensors.

3.6 A responder may require the data on an oil spill, 24 hours per day, independent of the prevailing weather.

3.7 Information from remote sensing is required in a timely manner. Strategic or enforcement information, such as the overall extent and location of a spill, should be available preferably within two to four hours from information gathering to presentation.

3.8 Tactical information, such as steering information for response vessels, should be available in as little as five minutes from detection to communication. The acceptable data delivery time is a function of the dynamics of the slick, proximity to critical areas, and the availability of clean-up resources.

3.9 No sensor is currently available to give information on oil thickness. An IR camera may provide an indication that a slick is relatively thin or thick.

3.10 Table 1 lists sensors based upon their mode of operation. Summary information on their advantages and disadvantages is presented.

3.11 Table 2 presents a summary of key attributes which generally influence the selection of remote sensing instrumentation.

3.12 Table 3 addresses the mission specific aspects of sensor selection.

4. Summary

4.1 The information presented in this guide should be considered a starting point for sensor selection. In addition to the context of use and the attributes of the various types of sensors, the system planner will have to give due consideration to the capabilities of the aircraft and the information needs of the users before finalizing the system design. Both sensor technology, and image and data analysis capabilities are evolving rapidly. Most equipment is not commercially-available and requires assembly and in some cases requires development. Up to two years lead time may be required for some equipment.