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| **WMO Marine Weather Forecaster Competence Framework** |
| The following is provided as minimum competence requirements to effectively perform the duties of a marine weather forecaster (MWF). The competence framework identifies the knowledge, skills and behaviours that should be demonstrated. Implicit in the background knowledge and skills for MWF, is the recommendation that they should have successfully completed the Basic Instruction Package for Meteorologists (BIP-M) or relevant parts thereof. It should, however, be recognised that national personnel qualification requirements for MWF, may be set at a higher level, e.g., to also be degree qualified. |
| The marine environment includes the open and coastal seas (including the surf zone), estuaries, large lakes, rivers and their interfaces with the land and the atmosphere. It is recognized that there will be considerable variation in the legitimate functions of Marine Meteorological Services worldwide. Consequently, it is not possible to write a document that exactly matches every office’s function. Once this generic competence framework is adopted, the Marine Meteorological Service will need to define how the competencies relate to their own national operations. That is, the Marine Meteorological Service will have to adapt the competencies, associated underpinning knowledge and performance criteria that are specific to their functions and region. Therefore, the performance criteria should be applied within the context of the following conditions:   1. For the area of responsibility – refer WMO No: 558, Manual on Marine Meteorological Services, Volume 1 – Global Aspects and Volume II, Regional Aspects. 2. In consideration of the impact of meteorological phenomena, variables and parameters on marine operations; and 3. In compliance with marine user requirements, international regulations, local procedures and priorities.   The competence requirements are as follows:   1. Analyse and monitor continually the marine weather situation 2. Forecast marine weather phenomena, variables and parameters 3. Warn of hazardous marine meteorological phenomena 4. Ensure the quality of marine meteorological information and services 5. Communicate meteorological information to internal and external users   **Note:** As this competence framework is recommended and generic to all providers of marine weather forecast and warning services, no priority is stated to either the phenomena or parameters. Any priorities should be established by the Marine Meteorological Service. |

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| **Format of the Framework** |
| The framework is provided under the following headings:   * The recommended element of competence * Competence description * Performance criteria * Background knowledge and skills   The details within each of the headings describe the aspects of competence recommended for an effective service. The specific performance criteria for a given meteorological service’s marine program should reflect the roles and responsibilities of the office’s service.  The role of marine weather forecasters will continue to change in response to evolving technology and user requirements. As such, any change will require high standards of competency and underlying knowledge and skills with a focus on continuous improvement. This framework is presented in an attempt to anticipate as far as possible those changes in the future. The adoption of a quality management approach is strongly recommended. |

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| **1. ANALYSE AND MONITOR CONTINUALLY THE MARINE WEATHER SITUATION** |
| **Competence Description:**  Continuously monitor the latest observations, advisories, forecasts and warnings of marine weather parameters and variables; and significant weather phenomena. Determine the need for issuance, cancellation or amendment/update of advisories, forecasts and warnings according to documented thresholds and regulations. |
| **Performance Criteria** |
| 1. Maintain a weather watch over the marine weather situation, evolving significant weather phenomena and, where available, advisories issued by other meteorological services, and model guidance. |
| 2. Compare current forecasts and warnings against observed conditions. |
| 3. Based on the weather watch, appraise the need for amendments to forecasts and updates of warnings against established and documented criteria. |
| **Background knowledge, skills and abilities** |
| • Knowledge of the marine meteorological products (routine and non-routine), their issue times and the priorities applied in the region. |
| • Knowledge of non-routine weather conditions that trigger gale warnings, special marine warnings, storm warnings, wave warnings, surf warnings and advisories. |
| • Knowledge of meteorological analysis techniques (subjective and objective). |
| • The ability to interpret:  - radar and satellite imagery to identify fog, rapid cyclogenesis, frontogenesis, severe convective system, tropical cyclone, thunderstorms, squalls, sea ice and other potentially dangerous phenomena  - numerical weather prediction guidance (including Ensemble Prediction Systems (EPS)),marine meteorological products and other types of objective guidance, and their assimilation into forecast/warning preparation      - observed variables and parameters when there are differences between automatic sensor  technologies and manual observing techniques and the impact on forecast and warning products    - coded real time raw data including buoy and ship reports. |
| • Knowledge of relevant observing systems, platforms, and sensors that may include remote  sensing (satellite altimeters, scatterometers, microwave sensors; radar, lightning detection  systems); in-situ sensors (anemometers, tide gauges, moored wave buoys, drifting buoys, bottom  pressure sensors); human observing procedures (ship, shore) and how their advantages and  limitations vary with respect to prevailing seasonal and meteorological conditions. |
| • Knowledge of bathymetry, local topography, coastal geomorphology, marine climatology and local  weather systems and their potential impacts on winds, waves and other phenomena, such as  abnormal water level or currents, in the forecast area of responsibility. |
| • The ability to perform manual/subjective analyses (including techniques for analysis in data sparse  areas). |
| • The ability to perform analysis on weather related images. |
| • The ability to perform statistical data analyses. |
| • The ability to apply statistical analysis and other informational techniques to data which has a  geographical or geospatial aspect. |

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| **2. FORECAST MARINE WEATHER PHENOMENA, VARIABLES AND PARAMETERS** |
| **Competence Description**  Forecasts of meteorological parameters and phenomena are prepared and issued in accordance with documented requirements, priorities and deadlines. |
| **Performance Criteria** |
| 1. Analyse and diagnose the marine weather situation as required for the preparation and issue of forecasts. |
| 2. Prepare forecasts for the following weather phenomena and parameters and variables, including spatial extent, onset/cessation, duration, intensity and temporal variations, where applicable:  \*For High Seas, Coastal forecast requirements   * wind including directional variability, speed and wind gusts * sea state * damaging large waves or multiple swell systems * precipitation and associated horizontal visibilities * fog or mist, and associated horizontal visibilities * other types of obscuration to visibility, including smoke, dust, haze, sand-storms, dust-storms, blowing snow, volcanic ash/rock and associated horizontal visibilities * sea ice state * synoptic situation for tropical, sub-tropical, temperate and polar climate zones as required * thunderstorms, heavy precipitation with poor horizontal visibility, down-burst/microburst, squalls or gust front, hail, tornadic/water spout activity * freezing spray or precipitation, snowfall * icing on vessels or structures * tropical cyclones/hurricanes/typhoons and their movement * icebergs and their movement   Other international/national forecast requirements as listed under Regional Variations. |
| 3. Ensure that forecasts are prepared and issued in accordance with Volume I and II of WMO - No.558, Manual on Marine Meteorological Services and/or national standard operating procedures (SOPs) including format, codes and technical regulations on content, accuracy and timeliness. |
| 4. Ensure that forecasts of weather parameters and phenomena are consistent (spatially and temporally) across boundaries of the area of responsibility as far as practicable, whilst maintaining meteorological integrity. This will include monitoring forecasts/warnings issued for other regions, and liaison with adjacent regions as required. |
| **Background knowledge, skills and abilities** |
| • Knowledge of methods for predicting meteorological and oceanographic conditions and their  application. (Including those required by the application regional variations.) |
| • Knowledge of forecasting models (deterministic models and EPS) including wave models. |
| • Knowledge of remote sensing applications. |
| • Knowledge of forecast preparation systems (including use of the software). |
| • Knowledge of areas of responsibility (local and regional), and in particular forecast boundaries and  associated observation sites. |
| • Knowledge of forecast issue times and work priorities. |
| • Knowledge of types and characteristics of wave and swell; generation and decay of wave and  swell; and shallow water wave characteristics |
| • Knowledge of tropical cyclones/hurricanes/typhoons and their impact on marine activities. |
| • Knowledge of sea and tidal currents, sea level (including storm surges and tsunami) and drifting of  objects or pollutants. |
| • The ability to forecast sea ice extent, thickness, concentration, stage of development, drift,  deformation, growth and melting. |
| • The ability to forecast icebergs and their movement, as required. |

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| **3. WARN OF HAZARDOUS PHENOMENA** |
| **Competence Description:**  Warnings are issued in a timely manner when hazardous conditions are expected to reach documented threshold values and updated, amended or cancelled, as appropriate, according to documented criteria. |
| **Performance Criteria** |
| 1. Forecast and warn for the following hazardous weather phenomena, variables and parameters, including spatial extent, onset/cessation, duration, an intensity and its temporal variations:  a. Tropical cyclones / hurricanes / typhoons  b. Wind Hazards  c. Thunderstorms, heavy precipitation with poor horizontal visibility, down-burst/microburst, squalls or gust front, severe hail, tornadic/water spout activity  e. Ice accretion   * freezing spray or precipitation and icing on vessels or structures * snowfall   f. Restricted Visibility (less than 1 nautical mile)   * reduced horizontal visibility caused by precipitation, fog, dust, smoke, haze, sand-storms, dust-storms and blowing snow * reduced horizontal visibility caused by volcanic activity   g. Unusual and hazardous sea-ice conditions   * exceptional and rapidly changing sea ice conditions * icebergs   h. Storm-induced abnormal water (sea) levels   * sea level and storm surge * harbour seiches   i. Unusual and hazardous wave/current conditions  **Note:** Forecasts for the occurrence of phenomena that cause obscuration to visibilities may be the responsibility of other jurisdictions and in such cases, the Marine Meteorological Services are not required to provide forecasts. For example volcanic eruptions emitting volcanic ash/rock. |
| 2. Ensure that warning products are prepared and issued in accordance with thresholds for hazardous weather as per Part Volume I and II of WMO- No.558, Manual on Marine Meteorological Services and/or national SOPs including formats, codes and technical regulations on content, accuracy and timeliness. |
| 3. Ensure that warnings of hazardous weather phenomena are consistent (spatially and temporally), across boundaries of the area of responsibility as far as practicable, whilst maintaining meteorological integrity. This will include monitoring forecasts/warnings issued for other regions, and liaison with adjacent regions as required. |
| **Background knowledge, skills and abilities** |
| • Knowledge of SOPs for warning. |
| • Knowledge of marine warning criteria and associated amendment criteria). |
| • Ability to utilize forecasting models (deterministic models and EPS) outputs. |
| • Knowledge of areas of responsibility (local and regional), warning boundaries. |

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| **4. ENSURE THE QUALITY OF METEOROLOGICAL INFORMATION AND SERVICES** |
| **Competence Description:**  Forecasts, warnings and related products are provided within a quality management framework. |
| **Performance Criteria** |
| 1. Apply the organisation’s quality management system and procedures as required. |
| 2. Assess the impact of known observational error characteristics (e.g. bias, achievable accuracy and limitations of observations and sensing methods) on forecasts and warnings. |
| 3. Verify and validate marine meteorological data, products, forecasts and warnings (timeliness, completeness, and accuracy), using real-time verification tools. |
| 4. Monitor the functioning of operational systems, gather and assess customer comments, suggestions and complaints, and take remedial actions when necessary. |
| 5. Identify and evaluate weather forecasting and warning problems and determine appropriate corrective and preventive actions for continuous improvement. |
| **Background knowledge, skills and abilities** |
| • Knowledge of quality management principles, practices and procedures. |
| • Knowledge of SOPs for forecast and warning. |
| • The ability to utilize verification techniques and statistics. |
| • Knowledge of contingency plans. |
| • Knowledge of stakeholder needs. |
| • Knowledge of relevant stakeholder operations and needs for and applications of forecasts, including:  - Stakeholder operations (e.g., procedures, tactics, planning processes and cycles)  - Stakeholder limitations, including operating limits, legal constraints, geopolitical limits)  - Stakeholder desired outcomes from operation |
| • General knowledge of stakeholder terminology (e.g., nautical terms, acronyms, abbreviations, technical  terms related to forecast variables (e.g., state of the sea, currents, waves, swell, tides), customer preferred  measurement units) |
| • Knowledge of stakeholder communication and security systems, if required. |
| • Knowledge of the Impact of weather variables, parameters and phenomena on stakeholder operations/activities. |

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| **5. COMMUNICATE METEOROLOGICAL INFORMATION TO INTERNAL AND EXTERNAL USERS** |
| **Competence Description:**  Marine weather forecasts and warnings are communicated in a timely and clear manner to meet user community needs. |
| **Performance Criteria** |
| 1. Ensure that all forecasts and warnings are disseminated via the authorised communication channels to user groups. |
| 2. Provide marine weather briefings as necessary, and provide consultation to meet specific user needs. |
| 3. Make use of forecasts and warnings of meteorological parameters, variables and phenomena to describe their impact on marine operations, safety of life and property, including the coastal environment and population. |
| **Background knowledge, skills and abilities** |
| • Knowledge of primary users and operations and weather sensitivities. |
| • Knowledge of available communication systems, techniques and methodologies. |
| • Ability to ask users the appropriate questions so as to better understand their needs. |
| • Ability to utilize cross-boundary consistency techniques – national and international, as well as inter-disciplinary / inter-agency checks as needed. |
| • Ability to communicate effectively, orally, graphically and in writing (level of details to meet the  identified needs of specific users). |
| • Ability to communicate at an acceptable level of language proficiency. |

**REGIONAL VARIATIONS**

Regional variations referred to within the document may include but are not limited to the following:,

* Agreed and documented criteria and thresholds
* The range of weather and sea phenomena including but not restricted to:
* tsunami
* tides, sea level and storm surge
* sea currents and drifting of objects/pollutants
* sea surface temperature and salinity where required
* volcanic ash cloud dispersion
* volcanic ash deposition
* significant debris post tropical cyclones and tsunami
* surf zone hazards
* Appreciation of the types and use of forecast guidance
* Designated offices responsible for advice on volcanic ash, tropical cyclones/hurricanes/typhoons, sea ice, ice bergs and tsunami
* Regional regulations
* Boundaries of forecast and warning areas
* Communication language(s)
* Communications technology for forecast and warning transmission, and for weather briefing
* Forecast database(s) utilized – gridded/text/graphical/digital, etc.

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