Pacific International Training Desk

Program Objectives

The initial Pacific Desk program is intended to prepare experienced observers to understand the forecast process, learn fundamental variables and skills required for forecasting, and provide an opportunity for basic hands-on work with meteorological analysis and prediction. The Pacific Desk will prepare trainees to return to their NMS for further operational forecasting experience.

The Pacific Desk curriculum is largely designed to satisfy WMO BIP-MT General Meteorology requirements (excepting instrumentation), and make initial steps toward mastery of BIP-M requirements, with applications to forecasting in tropical Pacific. *Inherent in all learning objectives, whether explicitly stated or not, is a fundamental or introductory-level mastery.* Some candidates may already be familiar with some introductory meteorology and will have satisfied some listed objectives through the course of their employment prior to the Pacific Desk prerequisite program.

The Pacific Desk program is intended as an early step in initial forecast training, preparing trainees for lengthier and more advanced training programs (e.g. AUS Bureau of Meteorology programs, Regional Training Centers in Japan or the Philippines, NZ Met Service professional development hosted in home countries). Future iterations of Pacific Desk training will include more in-depth material for experienced forecasters (2+ years forecast experience), both in Honolulu and across the Pacific.

Program Structure

Prerequisites: Approximately 15 hours of facilitated prerequisites, to be completed prior to application for on-site course. Prerequisite material is to be available online and distributed on USB drives as a low-bandwidth option. Assessments and discussion forums to be conducted online.

On-Site Program: Four-week course in Hawaii, at the NWS Honolulu Forecast Office on the University of Hawaii-Manoa campus. Trainees to come as cohort of two to four, ideally from one or two NMSes, and the practical instruction will take the characteristics and phenomena of their area of responsibility (AOR) into consideration. Instruction methods will include interactive lectures, hands-on activities, frequent assessments and checks for understanding, participation in forecast office activities, and external site visits.

Pacific International Training Desk Learning Objectives

1. **Ensure candidates are adequately prepared for study of basic meteorology and have a fundamental understanding of complementary subjects as outlined in the BIP-MT requirements**

    1.1. Demonstrate command of basic algebra, geometry, trigonometry, and statistics, equivalent to those skills required for secondary-school diploma

    1.2. Demonstrate command of introductory physics, including kinematics (2-dimensional, 3-dimensional, and rotational), thermodynamics, behaviors of gases, waves, electromagnetic radiation, and electricity equivalent to those skills required for a secondary-school physics and/or chemistry course)

    1.3. Demonstrate fundamental understanding of basic oceanography, including general ocean circulation, thermal structure, and waves

    1.4. Demonstrate fundamental understanding of the hydrologic cycle

    1.5. Outline some scientific and technological advances that have contributed to the development of meteorology and its applications

    1.6. Demonstrate ability to prepare written communications and convey information in oral presentation

    1.7. Demonstrate basic computational thinking skills and digital literacy

        1.7.1. Demonstrate competency in accessing meteorological information online

        1.7.2. Perform statistical analysis using spreadsheets

        1.7.3. Create, publish, and update a basic webpage

    1.8. Identify island groups in the tropical Pacific Ocean, including characteristics of significant geographical features of AOR

2. **Demonstrate a fundamental understanding of general atmospheric variables, physics, and dynamics relevant to tropical meteorological operations**

    2.1. Demonstrate an understanding of atmospheric energy, moisture, and convection

        2.1.1. Describe the radiation balance in terms of energy incoming, outgoing, and absorbed by the earth and atmosphere

        2.1.2. List the mechanisms that allow for exchange of energy between the surface and the atmosphere, including latent heat and tropical deep convection

        2.1.3. Describe the role of water vapor in tropical weather and climate

        2.1.4. Describe the process by which clouds form as a result of convection

        2.1.5. Describe how factors such as insolation, moisture, winds, stability, and local geography influence convection

        2.1.6. Describe the general pattern of cloud and precipitation distribution in the tropics, its variability, and factors that influence it

        2.1.7. Demonstrate and understanding of basic thermodynamics, with respect to atmospheric stability in the tropics.

- 2.2. Demonstrate an understanding of general circulation and global-scale phenomena
  - 2.2.1. Describe the composition and vertical structure of the atmosphere
  - 2.2.2. Describe selected models of global circulation and mechanisms that create their pattern
  - 2.2.3. Discuss and explain the planetary scale circulation controls operating in the atmosphere, showing how these processes determine the preferred location of cyclones and anticyclones
  - 2.2.4. Describe jet streams as they pertain to global circulation

- 2.3. Demonstrate an understanding of synoptic and mesoscale phenomena
  - 2.3.1. Describe mesoscale atmospheric phenomena associated with topography
  - 2.3.2. Describe thermally-induced circulation patterns, with special attention to sea/land-breeze forcing, evolution, and effects on surface weather
  - 2.3.3. Describe common trends of convergence and convection with local circulations
  - 2.3.4. Describe the life cycle of an ordinary thunderstorm, including necessary conditions for formation
  - 2.3.5. Describe severe weather phenomena resulting from convective storms which cause hazardous weather, including heavy rain events, waterspouts, and lightning

- 2.4. Demonstrate an understanding of atmospheric data collection and remote sensing
  - 2.4.1. Describe types and methods of accessing weather observations in the tropics including: point (surface & upper air), radar (where appropriate), and geostationary and low earth orbiting satellites
  - 2.4.2. Briefly describe how satellites work, the atmospheric features they can detect, and their strengths and limitations
    - 2.4.2.1. Differentiate between polar-orbiting and geostationary satellites
    - 2.4.2.2. Differentiate between visible, infrared, microwave satellite sensors and imagery
  - 2.4.3. Describe the differences in texture, brightness, and temperature as seen in satellite imagery for different types of cloud
  - 2.4.4. Locate, on satellite imagery, cloud patterns that indicate convective processes in the atmosphere and indicators of convection intensity

- 2.5. Demonstrate a basic understanding of marine phenomena
  - 2.5.1. Describe large-scale ocean currents and their role in maintaining the global energy budget
  - 2.5.2. Describe factors affecting swell and wave heights
  - 2.5.3. Demonstrate an understanding of coastal geography in AOR
  - 2.5.4. Briefly describe the generation and evolution of a tsunami, including coastal observations and impacts

2.6. Demonstrate a basic understanding of aviation weather
   2.6.1. Explain weather factors affecting aviation operations
   2.6.2. Describe ICAO flight rules and minimum thresholds

2.7. Demonstrate a basic understanding of climatology
   2.7.1. Describe common climatological statistics and methods of determining them (e.g. means, normals, records)
   2.7.2. Articulate seasonal norms of temperature, precipitation, wind for representative stations in AOR

3. Demonstrate fundamental understanding of tropical weather/climate features and their global role

3.1. Describe what makes tropical weather and climate unique
   3.1.1. Define the tropics in several common ways
   3.1.2. Compare and contrast the tropics and mid-latitudes in terms of atmospheric motions, tropopause height, range of surface humidity, coriolis force

3.2. Demonstrate knowledge of meteorological data-collection in the tropical Pacific, primarily remotely-sensed data and products.
   3.2.1. Describe why remote sensing is important in the tropics.
   3.2.2. Describe several tropical meteorology applications of satellite radar and microwave remote sensing, their benefits and limitations

3.3. Demonstrate knowledge of tropical components of the general circulation and global-scale tropical phenomena
   3.3.1. Understand the theoretical basis for the Hadley cell and Walker Circulation as responses to differential heating in the tropics
   3.3.2. Recall the seasonal migration of the tropical circulation systems and hemispheric differences
   3.3.3. Describe the role of the Inter-Tropical Convergence Zone (Near-Equatorial Trade-Wind Convergence) in the general circulation and mechanisms that influence its location
   3.3.4. Locate ITCZ/NETWC on satellite imagery

3.4. Demonstrate knowledge of intra- and inter-seasonal variability in the tropics
   3.4.1. Describe El Nino - Southern Oscillation in terms of onset, maximum amplitude, and duration
   3.4.2. Identify, compare, and contrast the warm phase (El Nino) and cold phase (La Nina) patterns in terms of atmospheric and oceanic anomalies across the equatorial Pacific
   3.4.3. Describe each ENSO phase’s specific influence on environment in AOR

- 3.4.4. Describe the structure and time scale of the Madden-Julian Oscillation, and its impact on tropical weather
- 3.4.5. Describe the current conceptual model of a monsoon and the evolution of the Asian or Australian monsoon

3.5. Demonstrate knowledge of selected synoptic and mesoscale tropical phenomena

- 3.5.1. Identify the semipermanent cyclones/anticyclones in the tropics and subtropics
- 3.5.2. Describe the general characteristics of equatorial waves including length scale, duration, speed, and their effects on tropical weather
- 3.5.3. Describe the South-Pacific Convergence Zone and identify on satellite imagery
- 3.5.4. Describe the dominant cloud types in the tropics and identify on satellite imagery

3.6. Demonstrate knowledge of tropical cyclones, their evolution, and risks

- 3.6.1. Describe Pacific climatology of tropical cyclogenesis and tracks
- 3.6.2. Identify structural features and energy sources of a tropical cyclone
- 3.6.3. Describe the conditions necessary for formation
- 3.6.4. Describe the life cycle of a tropical cyclone and factors that influence intensity
- 3.6.5. Explain how satellite imagery can be used to determine intensity and locate centers of circulation and other features within tropical cyclones
- 3.6.6. Describe the hazards of tropical cyclones, particularly those at landfall

4. Demonstrate fundamental understanding of the weather-forecasting process, from analysis to verification

4.1. Analyze and interpret basic meteorological and climatological fields on surface and upper-air charts from available data in AOR

- 4.1.1. Describe UTC time and recall relevant times for AOR and NMS
- 4.1.2. Correctly interpret meteorological visualizations such as contour fields, streamlines, vertical profiles, and time series
- 4.1.3. Position standard isopleths or streamlines by interpolating between plotted data, and inferring physical fields from secondary information
- 4.1.4. Identify significant features on fields of meteorological data
- 4.1.5. Locate data and perform surface and upper-air and analyses, satellite products, model products, etc, relevant to home country AOR

4.2. Explain surface weather elements in terms of relevant physical processes

- 4.2.1. Discuss large-scale physical processes significant to smaller-scale weather patterns
- 4.2.2. Relate current surface data fields to synoptic-scale, mesoscale, and local features.
- 4.2.3. Relate convergence/divergence and vorticity to wind field
- 4.2.4. Describe the impact of land and sea breezes on the observed wind (and topography and mountain/valley winds as appropriate to AOR)
- 4.2.5. Brief the current weather situation to peers

- 4.2.6. Explain the reasoning used in preparing the diagnosis, emphasizing the techniques used

- 4.3. Demonstrate the intelligent use of numerical weather prediction
  - 4.3.1. Briefly describe the overall strategy of NWP
    - 4.3.1.1. Describe the components of an NWP model and how the model fits into the forecast process
    - 4.3.1.2. Describe the impact of horizontal and vertical resolution on computer resources and the requirements in resolution necessary to depict certain mesoscale phenomena
  - 4.3.2. Explain the influence of physical parameterizations on NWP forecasts
    - 4.3.2.1. Explain the need to parameterize convection and other sub-gridscale phenomena
    - 4.3.2.2. Describe the operational impact of convective parameterization on forecasts of location and timing of convective precipitation
    - 4.3.2.3. Describe the effect of convective parameterization on interpretation of model products (e.g. synthetic satellite imagery) in the tropics
  - 4.3.3. Identify select forms of operational and research NWP model output available operationally for AOR
    - 4.3.3.1. Discuss the characteristic features of models that can influence the quality of their forecasts; identify their strengths and weaknesses
    - 4.3.3.2. Identify the various fields plotted on operational NWP chart output
    - 4.3.3.3. Demonstrate ability assess the validity of a forecast by evaluating model treatment of currently-observable features and consistency from run to run
    - 4.3.3.4. Discuss the characteristics and quality of longer-range forecasts (3-5-day up to seasonal outlooks)

- 4.4. Demonstrate understanding of the craft and philosophy of weather forecasting
  - 4.4.1. Discuss the unique challenges of weather forecasting in the tropics
  - 4.4.2. Describe the role and added value of human weather forecaster in age of digital products, artificial intelligence, and numerical weather prediction
  - 4.4.3. Demonstrate the ability to operate relevant software and online tools for the examination of weather information
  - 4.4.4. Describe typical predicted variables for both points and areas (e.g. cloud cover descriptions, probability of precipitation)
  - 4.4.5. Demonstrate the ability to transform a generic forecast from a different NMS and tailor it to the needs of the local population (when applicable)
  - 4.4.6. Successfully describe a technical weather situation in a manner that a non-scientific public would find value in it (e.g. relate the science to impacts on an individual)

- 4.5. Demonstrate understanding of the forecast process
  - 4.5.1. Describe various methods of making a forecast (e.g. persistence, climatology, extrapolation, NWP). Articulate advantages and disadvantages of each approach.

- 4.5.2. Practice making short-range weather forecasts
  - 4.5.2.1. Determine the most significant processes and factors influencing weather in the AOR and describe expected short-term changes in these forcing mechanisms
  - 4.5.2.2. Access historical data and apply simple extrapolative techniques to predict the short-term movement and trends of identifiable weather features, both at the surface and aloft
  - 4.5.2.3. Assimilate all information into a scientifically sound forecast of short-term evolution of weather systems consistent with current and historical data, over a period of 12 hours
- 4.5.3. Demonstrate ability to communicate forecast and articulate rationale behind it.
  - 4.5.3.1. Construct in chart and text form forecasts of relevant meteorological features in formats appropriate to NMS guidelines
  - 4.5.3.2. Successfully communicate a forecast to peers
  - 4.5.3.3. Explain the reasoning used in preparing the prognosis emphasizing the techniques used

4.6. Demonstrate understanding of specific forecast products appropriate to AOR.

- 4.6.1. Demonstrate basic understanding of daily public forecasts
  - 4.6.1.1. Discuss the components and purpose of a public weather forecast, stating its users' needs and meteorological knowledge
  - 4.6.1.2. Practice making a verifiable short-term forecast of appropriate variables, within simulated data/technology environment and time constraints as home NMS.
- 4.6.2. Demonstrate basic understanding of marine forecasts
  - 4.6.2.1. Discuss the components and purpose of a marine forecast, stating its users' needs and meteorological knowledge
  - 4.6.2.2. Divide the area of responsibility of the marine forecast, combining regions of relatively similar conditions
  - 4.6.2.3. Practice making a short-term forecast of appropriate marine variables for waters in AOR within simulated data/technology environment and time constraints as home NMS
- 4.6.3. Demonstrate basic understanding of forecasts for severe weather events
  - 4.6.3.1. Explain critical thresholds for severe weather with respect to rain, winds, waves, tropical cyclones, and other relevant hazards
  - 4.6.3.2. Identify weather elements that would fall under home NMS criteria for Watch/Warning/Statement
  - 4.6.3.3. Demonstrate ability to communicate pertinent information regarding severe weather to appropriate audiences
    - 4.6.3.3.1. Describe components of a severe weather bulletin for public use
    - 4.6.3.3.2. Understand needs of emergency management personnel and use of weather information by non-scientist decision-makers

4.7. Demonstrate ability to verify a forecast.

- 4.7.1. Collect appropriate data for forecast verification, evaluate, and reject any spurious reports
- 4.7.2. Practice computing statistics for forecasts, including error in quantitative forecasts, successful forecasts, false alarms, missed forecasts, and non-events successfully forecast, total number of forecast and observed events
- 4.7.3. Demonstrate familiarity with verification indices, as appropriate, such as frequency, skill score, false alarm ratio, probability of detection, bias