Table 1-1. NAAMES science traceability matrix, *linking mission science goals and objectives to measurement, instrument, and investigation requirement.*

Science Objectives & Questions	Scientific Measurement Requirements	Instrument Functional Requirements	Investigation Functional Requirements
Science Objectives: • Characterize plankton ecosystem properties during primary phases of the annual cycle in the North Atlantic and their dependence on environmental forcings • Determine how primary phases of the North Atlantic annual plankton cycle interact to recreate each year conditions for an annual bloom *Question #1: How do environmentally-driven changes in phytoplankton growth rate and seasonal changes in ecosystem interactions create the spring bloom, and what does the relative importance of these two processes imply about future change?* *Question #2: How are seasonal changes in community composition linked to bloom formation?*	1. Continuous, mission-long plankton ecosystem properties from satellite ocean color data (e.g., VIIRS, MODIS, HICO, OCM-2, OCLI, SGLI) 2. Continuous, in situ mission-long plankton ecosystem properties through the water column at distributed locations in N. Atlantic 3. In situ measurements of mixed layer plankton concentrations, species composition, POC, cDOM, and phytoplankton growth, accumulation, total loss, and grazing loss rates 4. UV-to-NIR airborne radiometric measurements linking local-scale analytical data (item 3 above) to satellite remote sensing resolution 5. Field measurements in items 3 and 4 above conducted over a wide dynamic range in ecosystem properties and encompassing differences in seasonal timing of ecosystem annual cycle events 6. Field measurements in items 3 and 4 above conducted during contrasting stages of the annual plankton cycle	1. Autonomous measurements of water column optical and physical properties at 5 m vertical resolution and sustained over annual cycle 2. Ship-based ecosystem and optical measurements with the spatial-temporal resolutions and uncertainties specified in Table 2-2 3. Ship- and aircraft-based in situ aerosol, aerosol-precursor, trace-gas, and cloud measurements with the size range, temporal resolutions, and uncertainties specified in Table 2-3 4. Passive airborne remote sensing of mixed layer plankton and cDOM properties at spatial resolutions and uncertainties specified in Table 2-1 5. Active airborne remote sensing of subsurface particles at spatial resolutions and uncertainties specified in Table 2-1 6. Passive airborne remote sensing of column-averaged aerosol properties from surface to aircraft level at spatial resolutions and uncertainties specified in Table 2-1 7. Active airborne remote sensing of aerosols between surface and aircraft levels at spatial resolutions and uncertainties specified in Table 2-1 8. Active and passive airborne remote sensing of clouds at spatial resolutions and uncertainties specified in Table 2-1 9. Passive airborne remote sensing of spectral aerosol optical depth above the aircraft at spatial resolutions and uncertainties specified in Table 2-1	1. Four field campaigns targeting biomass increasing/decreasing phases and transition periods of the annual plankton cycle 2. Co-located ship and airborne measurements and long-range, transport-scale airborne measurements. 3. Field measurements of the subtropical to subarctic gradient in ecosystem and aerosol properties 4. Autonomous sensor deployment along latitudinal gradient to sustain in situ observations of annual cycle 5. Airborne transects including (1) long-range low-altitude (below-to-above cloud) sampling (Azores to ship), (2) match-up with ship samples, (3) 200 km along forecasted ship transect, (4) vertical profile sampling of lower troposphere and (5) long-range measurements at high-altitude (ship to Azores) 6. Basin-scale retrievals of aerosol and ecosystem properties from existing/upcoming satellites 7. Central data archive 8. Climate-ecosystem modeling to (1) optimize field campaign design, (2) understand mechanisms of observed ecosystem variability, (3) forecast change in ecosystem properties, with relevance to aerosols
Science Objective: • Resolve how remote marine aerosols and boundary layer clouds are influenced by plankton ecosystems in the North Atlantic *Question #3: How do ocean-ecosystem emissions alter remote marine aerosol burden, spatial distribution, and properties?* *Question #4: How do these biogenic aerosols affect cloud condensation nuclei abundance and, in turn, cloud microphysical properties?*	*Ecosystem and optical properties as in 1-4 above plus the following with spatial-temporal coverage as in 5-6:* 1. Measurements of surface air concentrations of aerosols (e.g., sea salt, POA, SOA) and trace gases (e.g., VOCs, DMS) 2. Measurements of aerosol concentration, size distribution, composition, optical properties and CCN activity below, above, and between clouds 3. In situ and remote sensing measurements of cloud droplet number density, size, and liquid water content 4. In situ measurements of seawater volatile organics and their production and consumption rates 5. Continuous, mission-long record of passive-sensor, satellite-derived aerosol and cloud properties		