Table 2. Research Needs in Atmospheric and Ocean Science

Research Topics	Type of Research B = Basic; A =Applied
A. General Research	
1. Intensity and Structure Changes. a. Environmental scale processes (e.g., dry air, midlevel easterly jet, and suspended mineral dust from Saharan Air Layer; vertical shear of horizontal wind; easterly wave disturbance; TUTT and monsoon trough influences). b. Vortex scale processes (e.g., eyewall replacement and rainband development, vortex mixing and resilience). c. Convective scale processes (e.g., convective bursts, vortical hot towers). d. Turbulent and microphysical scales (e.g., momentum and enthalpy fluxes; cloud microphysics; radiation; e. Upper ocean processes and structure (e.g., oceanic heat content; currents; waves; SST; mesoscale features). f. Landfall effects (e.g., surface flux changes; topographic and land surface effects). g. Extratropical transition. h. Predictability limits.	B,A
2. Track. a. Convective and vortex structure (e.g., asymmetries) b. Land interaction. c. Multi-vortex interactions. d. Predictability limits.	B,A
3. Tropical cyclone formation. a. Convective processes. b. Mesoscale processes (e.g., stratiform precipitation, vorticity structure). c. Environmental processes. d. Tropical transition.	B,A
4. Precipitation. a. Environmental interaction. b. Microphysical processes (hydrometeor production and conversion, fallout, aerosol impacts). c. Topographic effects.	B,A
5. Coastal and inland inundation (i.e., surge, waves, flooding). a. Surge wave and ocean bottom interaction. b. Wave breaking and set up.	B,A
6. Predictability of seasonal tropical cyclone activity.	B,A

Table 2 (continued). Research Needs in Atmospheric and Ocean Science

Research Topics	Type of Research B = Basic; A =Applied
B. Model Development Topics	
1. Data assimilation (e.g., technical approach, high resolution data, new data sources/instrument, vortex initialization, atmosphere and ocean initialization; techniques to evaluate the uncertainty and representativeness of observations and use of observations for initializing NWP models).	A
2. Global and regional model development/improvements (e.g., resolution, nesting, coupling to ocean; coupling with hydrology/inundation models).	A
3. Relative importance of physical processes in global and regional models on track, intensity and structure, and precipitation. a. Atmosphere-ocean boundary layer for coupled air-sea-wave problem; momentum (wave-induced drag) and enthalpy fluxes (sea spray complexity). b. Upper ocean processes and structure (e.g., oceanic heat content; currents; waves; SST; mesoscale features). c. Land surface coupling: sensitivity of Land Surface Model, radiation. d. Microphysical processes (e.g., hydrometeor production and conversion, fallout, aerosol impacts, radiation). e. Convective processes (e.g., latent heating, momentum transfer, mixing).	B, A
4. Verification for three dimensional, high-resolution regional models for all phases of the tropical cyclone life cycle; varying atmosphere/ocean environment.	A
5. Diagnostic techniques to further increase the utility of global and regional models in forecasting tropical cyclone track, intensity structure, precipitation, and genesis.	A
6. Development of advanced, probabilistic guidance (e.g., ensembles); optimal ensemble construction and configuration; value of high-resolution deterministic forecasts vs. ensembles.	A
7. Studies to optimize resolution and scale dependent parameterization.	B, A
8. Development of statistical models or forecast techniques	A
C. Observations and Observing Strategies	
1. Observing strategies/capabilities to improve analyses and forecasts of tropical cyclones (e.g., formation, track, intensity, structure, inundation). a. Where to take observations for initialization of tropical cyclone vortex and environment. b. Alternatives and tradeoffs for observing tropical cyclone and their environment (OSE, OSSE, cost/benefit). c. Information systems (e.g., data fusion, visualization).	A
2. Required observations to support model diagnostics and verification (e.g., IFEX, TCS-08, CAMEX III/IV. TCSP, RAINEX, NAMMA).	A
3. New and/or improved observational technologies.	B,A

Blue highlighted portion above indicates changes from previous version of Table 2 used in FY08 snapshot.