Application Research and Development Goals, Priorities, and Working Group Breakout Session

Group A

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UFS Applications

UFS applications include the following (**BOLD** are subject of this exercise):

- **Medium-Range Weather (Weather) - Atmospheric behavior out to about two weeks**

- **Subseasonal-to-Seasonal (S2S) - Atmospheric and ocean behavior from about two weeks to about one year**

- Hurricane - Hurricane track, intensity, and related effects out to about one week

- **Short-Range Weather/Convection Allowing - Atmospheric behavior from less than an hour to several days**

- Space Weather - Upper atmosphere geophysical activity and solar behavior out to about one month

- Marine and Cryosphere - Ocean and ice behavior out to about ten days

- Coastal - Storm surge and other coastal phenomena out to about one week

- Air Quality - Aerosol and atmospheric composition out to several days

Breakout Objectives

- Identify top 5-10 high-level forecast or model improvement goals for three core UFS applications: Medium-Range Weather, Subseasonal-to-Seasonal (S2S), and Short-Range Weather/ Convection Allowing

- Propose recommended research and development solutions: Science priorities to address forecast goals

- Propose any changes that may be needed for Working Groups to best support these applications

- Remember that the forecast goals and the science priorities form the basis of activities described in the next SIP (2020-2022).

Groups should consider the Science Priorities Worksheet initiated by the UFS Steering Committee to develop science and prediction priorities of the UFS

Forecast or model improvement Goals

Medium-Range Weather

- Improve lower atmosphere cold bias, PBL, inversions, progressive synoptic patterns, dry precip bias etc.
- General reduction of systematic errors in the global model
- Improve representation of land surface processes (DA as well as model)
- Improve tropical cyclone tracks especially beyond day-5 and for TCs with hurricane strength (NHC priority)
- Better representation of sea-ice and SST analysis, and improved exchange of fluxes at the air-sea-land-ice interfaces

Forecast or model improvement Goals

Subseasonal-to-Seasonal (S2S)

Improve upon sources of predictability at S2S scales:

- Indices: MJO, ENSO-related
- Others: sea-Ice extent, ocean EKE, soil moisture etc.

Improve upon sub-grid scale parameterization for all ESM components (e.g. is ¼ degree ocean resolution adequate?)

Better skill at forecasting extreme or high-impact events

Short-Range Weather/Convection Allowing

- Improve representation of sub-grid-scale clouds
- Improve representation of boundary-layer/land-surface (assimilate surface obs for global mesoscale)
- Improve representation of atmospheric inversions (timing/onset of convective initiation)
- Reduce high bias for very high QPF thresholds inherent at CAM scale
- Reduce high bias in storm-scale motions
- Advance CAM physics suite for both mid-latitude continental and oceanic/tropical applications
- Develop/improve assimilation strategy and algorithms for high-density/frequency observations such as dual-polarization radar data and GOES-16/17 ABIs/products
- Improve spread-skill of CAM ensemble system using single model/physics suite to match operational baseline of HREF

Research/Development Actions/Solutions

Medium-Range Weather

- Develop process level diagnostics that will lead to identifying source of errors documented for GFS v15.1
- Develop/use process oriented evaluation of model forecasts (focus on extreme events, trace the forecast issues to relevant sources of errors)
- Develop capabilities for asynchronous coupling to have increased flexibility for component coupling
- Address known issues collectively (beware of compensating errors)

Subseasonal-to-Seasonal (S2S)

- Hierarchical Model Development; leverage developments from other coupled modeling centers (NCAR, GFDL, NASA etc.)
- Coupled configurations based on science: time steps, fractional grids etc.
- Reforecast/Renalaysis strategy for calibration, bias reduction
- Coupled Data Assimilation

Short-Range Weather/Convection Allowing

- Begin testing of CAM-scale physics suite(s) across CAM applications
- Transition from GSI to JEDI software for frequent-cycling DA testing with FV3
- Start collaboration with global team(s) on global rapid-refresh (SIP project 6.5)

Proposed UFS WG Changes
(did not discuss)

Medium-Range Weather
- Create a Physics tiger team to address known issues with GFS v15.1 (some work happening at EMC to address the cold bias issues)

Subseasonal-to-Seasonal (S2S)
- Create a task-team/tiger-team to address strategy for coupled reanalysis/reforecasts

Short-Range Weather/Convection Allowing
- Need CAM/DA/Physics (minimum) cross-WG representation in a CAM application team