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

Group C

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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

1. Cold bias increasing with time
2. Hurricane track skill
3. Preconvective environment and general PBL issues
4. Too progressive synoptic features
5. Kelvin wave and MJO errors (systematic errors)
6. Improve periods of low forecast skill

Forecast or model improvement Goals

Subseasonal-to-Seasonal (S2S)

1. Tropical Pacific SST
2. Kelvin wave and MJO errors (systematic errors)
3. Diabatic heating errors
4. Systematic errors in land state
5. Improving teleconnections

Forecast or model improvement Goals

Short-Range Weather/Convection Allowing

1. Convective initiation
2. Improved cloud forecast
3. Improved vertical profiles of temperature, winds, and humidity
4. Improve prediction of convective mode
5. Improve misplacement of features in initial conditions
6. Improve boundary conditions
7. Improve initialization of convective features

Research/Development Actions/Solutions

Medium-Range Weather

- Improve accuracy of downward shortwave radiation at surface within 20 W/m2 (sub grid scale clouds)
- Identify and reduce key systematic errors (i.e. MJO, PBL)
- Predictability (mid-atm)
- Interaction of clouds and radiation
- Estimate of uncertainty (ensembles)
- Better use of surface observations
- Better process diagnostics (tools) across scales
- Physics tendencies balanced with DA

Research/Development Actions/Solutions

Subseasonal-to-Seasonal (S2S)

- Reduce systematic errors of Landstate, polar stratosphere, QBO, MJO and Tropical SST
- Aerosols, clouds, and radiation interaction
- Seamless validation across scales
- Testing CAM resolution systematic errors at S2S scales

Research/Development Actions/Solutions

Short-Range Weather/Convection Allowing

- Improve radiative balances (cloud, pbl, radiation)
- Improve initial condition and model uncertainty representation using single core ensemble system (aka stochastic forcings)
- Improved DA strategies for convective scale (need non-Gaussian, feature based DA, etc.)
- Improved use of observations: satellite, radar (dual-pol), new observations.
- Determine level of needed complexity for physics & microphysics for the wide range of forecast needs (micro: 2 moments? 3 moments?)
- Cost analysis for benefit of high resolution (1 km or less) runs versus lower resolution.

Proposed UFS WG Changes

Overall changes:

- Develop tiger teams that would go for OWAQ/OSTI larger grants
- Redesign for exascale (software engineering issue)
- Reorganize around DA, Dynamics, Physics, Ensemble/Postprocessing

Medium-Range Weather

Subseasonal-to-Seasonal (S2S)

Short-Range Weather/Convection Allowing