Developing a Unified Workflow for Convection Allowing Applications of the FV3

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• Research and Operational NWP under the Unified Forecast System
• Why is a unified workflow desirable?
• How?
• Ongoing work and future plans
Current Status of Convection-Allowing Models

- Cover CONUS + OCONUS in a large variety of capacities
  - NAM + Nests
  - HRRR CONUS and Alaska
  - HiRes Windows

- There is a need/desire to consolidate the NCEP production suite
- The Finite Volume Cubed Sphere (FV3) dynamical core was chosen for the Unified Forecast System (UFS)
Limited Area FV3 model

- EMC has developed a limited area modeling capability for the UFS using the FV3 dynamical core
  - Convection-allowing model (CAM) running routinely at 3-km resolution over CONUS, AK, HI, PR, Guam
- Limited area FV3 will form the basis of the Rapid Refresh Forecast System (RRFS)
  - Convection-allowing, ensemble-based data assimilation and prediction system
  - Single-core (FV3-based)
  - Will feature at least an hourly update cadence
Rapid Refresh Forecast System → To replace HREF, SREF, RAP, HRRR, NAM + nests, HiResWs
EMC/GSD/NSSL/AOML/NCAR/DTC/GFDL collaboration

RAPv5/HRRRv4
Freeze all non-FV3 CAM systems

CAM Development Continues
FV3-CAM ensemble DA + forecast system - evaluate against HREF.
Continue physics testing/advancement.

FY20
Development underway
standalone/regional, nesting, DA, physics, etc.

Q3FY20
HREFv3
Replace poorer performing members with FV3-CAM

Q4FY20

FY21

~FY22-FY23
RRFSv1
Implement RRFSv1 pending favorable evaluation
Origin of Regional FV3 Workflows

- Two workflows for running the limited area FV3
  - **Operations-compliant workflow**
    - Developed by EMC
    - Based on current operational systems, adheres to operational implementation standards
  - **Research workflow**
    - Developed by research community (GSD, DTC, NSSL)
    - Flexible/innovative/intuitive
- Operational and research workflows are similar... but also different
- Goal is to merge the two workflows → **unified workflow**
Why merge the workflows?

**Research Workflows**
- Custom script
- Run what you need
- Straightforward
- Everyone has their own

**Operational Workflows**
- Script 1 → Script 2 → Script 3
- Error checking and reporting
- Resilient
- Complex dependencies
- Strict standards

**Innovation!**
- Process involves considerable effort in re-engineering/implementing

**Operations?**
Why merge the workflows?

- NOAA and the research community work on different machines
  - WCOSS, Hera, Jet, Cheyenne, Odin, university clusters

- Development systems don’t have all the utilities/files of the operational system
- But operational environments are often more strict
- R&D is always ongoing, and merging the workflows gives users the option to run in an operational framework
- Merging Ops and R&D workflows leads to more straightforward collaboration across developers and enables transition of innovations to operations
About the Workflows

- The regional_workflow repository is on GitHub:
  - https://github.com/NOAA-EMC/regional_workflow
- Branch names adhere to Gitflow
  - develop branch: operational workflow
  - community_develop branch: research workflow
- Operational and research workflows both utilize the Rocoto workflow manager
- High frequency of commits vs. low frequency of commits
- Some jobs are unique to one workflow, while others are shared between both
  - User can create their own computational domain in the research workflow
Gitflow

- Branch names adhere to Gitflow
  - develop branch: operational workflow
  - community_develop branch: research workflow
- Development occurs in feature branches, changes are then merged back to develop branch
- Release branches are created off the develop branch, and are eventually merged with the master branch (ops)
### Ops Workflow

<table>
<thead>
<tr>
<th>Branch</th>
<th>Commit Message</th>
<th>Latest Commit</th>
</tr>
</thead>
<tbody>
<tr>
<td>develop</td>
<td>BenjaminBlake-NOAA: Changes to run with latest NEMFs3gfs master code (#122)</td>
<td>3 days ago</td>
</tr>
<tr>
<td></td>
<td>doc/user_guide: Initial commit of the basic files necessary to build a Users Guide (#32)</td>
<td>3 months ago</td>
</tr>
<tr>
<td></td>
<td>exec: Feature/buildport (#24)</td>
<td>3 days ago</td>
</tr>
<tr>
<td></td>
<td>jobs: Changes to run with latest NEMFs3gfs master code (#122)</td>
<td>3 days ago</td>
</tr>
<tr>
<td></td>
<td>manageExternals: Add manage externals (#28)</td>
<td>3 months ago</td>
</tr>
<tr>
<td></td>
<td>modulefiles: Final set of changes for port to Hera (#112)</td>
<td>12 days ago</td>
</tr>
<tr>
<td></td>
<td>parm: Changes to run with latest NEMFs3gfs master code (#122)</td>
<td>3 days ago</td>
</tr>
<tr>
<td></td>
<td>rocoto: Changes to support OCONUS domains and chgres cube on WCOS</td>
<td>9 days ago</td>
</tr>
<tr>
<td></td>
<td>scripts: Changes to support OCONUS domains and chgres cube on WCOS</td>
<td>9 days ago</td>
</tr>
<tr>
<td></td>
<td>src: Changes to support OCONUS domains and chgres cube on WCOS</td>
<td>9 days ago</td>
</tr>
<tr>
<td></td>
<td>ush: Changes to support OCONUS domains and chgres cube on WCOS</td>
<td>9 days ago</td>
</tr>
<tr>
<td></td>
<td>util/ush: Commit VLab repository</td>
<td>4 months ago</td>
</tr>
<tr>
<td></td>
<td>External.cfg: Changes to support OCONUS domains and chgres cube on WCOS</td>
<td>9 days ago</td>
</tr>
<tr>
<td></td>
<td>README.md: Merge feature/merge_comm_to_emc into develop (#71)</td>
<td>2 months ago</td>
</tr>
<tr>
<td></td>
<td>update_fork.pl: fix commit</td>
<td>3 months ago</td>
</tr>
</tbody>
</table>
R&D Workflow
## Job Sequence

<table>
<thead>
<tr>
<th>Research Workflow only</th>
<th>Both workflows</th>
<th>Operational workflow only</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 <strong>make_grid_orog</strong></td>
<td>4/1 <strong>make_ic</strong></td>
<td>5 <strong>archive</strong></td>
</tr>
<tr>
<td>Create grid and orography files for user-specified domain</td>
<td>Generate initial conditions</td>
<td>Archive post processed output</td>
</tr>
<tr>
<td>2 <strong>make_sfc_climo</strong></td>
<td>5/2 <strong>make_bc</strong></td>
<td>6 <strong>cleanup</strong></td>
</tr>
<tr>
<td>Regrid climatology fields onto the model grid</td>
<td>Generate boundary conditions</td>
<td>Scrub working directories and all unneeded files</td>
</tr>
<tr>
<td>3 <strong>get_input</strong></td>
<td>6/3 <strong>forecast</strong></td>
<td></td>
</tr>
<tr>
<td>Retrieve external model data needed to run downstream jobs</td>
<td>Run the full model forecast</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7/4 <strong>post</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post process the forecast model output</td>
<td></td>
</tr>
</tbody>
</table>
FV3 code sprint took place the week of 15-19 July in Boulder, CO
  • Initiated the process of merging the ops and R&D workflows
The develop branch of the regional_workflow repository was frozen on 10 October
Community_develop branch now has capability to run in an operations-compliant framework
Capability will be tested on operational HPC in the coming weeks
Progress is continuing on merging the ops and R&D workflows after the July code sprint
Unified workflow will be used for running the Rapid Refresh Forecast System
Scientific + technical challenges remain
  • Must ensure capabilities in one workflow are retained in the unified workflow
  • How to get effective ‘good’ spread from a single core CAM ensemble?
Strong collaborative effort between NOAA and non-NOAA agencies
Longer term plan to run the workflow on the cloud for R&D (not operations) has been approved

Thanks! Questions?
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