DTC MU-MIP updates

Xia Sun

On behalf of the DTC group:

Kathryn Newman, Mike Ek, Ligia Bernardet

Subject-Matter Experts: Judith Berner, Lisa Bengtsson

June 22, 2022

Overview

- DTC funded project (planned 3 year) to:
  - Conduct runs using the Common Community Physics Package (CCPP) SCM with physics relevant to NOAA
  - Produce diagnostics from these runs to inform parametrization development
- **Year 1 (Completed):** Produce simulations using an array of CCPP SCMs forced by coarse-grained ICON high-resolution runs
- **Year 2 (Current*):** Develop and apply diagnostic tools to inform deterministic and stochastic physics development
- **Year 3 (planned):** Perform simulations using an array of CCPP SCMs forced by course-grained UFS high-resolution runs; refine and apply diagnostic tools developed in year 2

*May 2022 - May 2023

CCPP SCM Configuration

- Common Community Physics Package Single Column Model
- n_level=127
- dt=600.0
- Physics Suite: GFSv16
- Prescribe surface fluxes
- mom_forcing_type=2: *geostrophic winds and large scale vertical velocity*
- thermal_forcing_type =2: *horizontal advective tendencies of θil and qt, active radiation scheme (with zero prescribed radiative heating), and the large scale vertical pressure velocity*
- Hourly outputs from 44,000 SCM runs for 3 hour forecast are concatenated along lat and lon using Python Xarray, resulting around 89 M for each variable

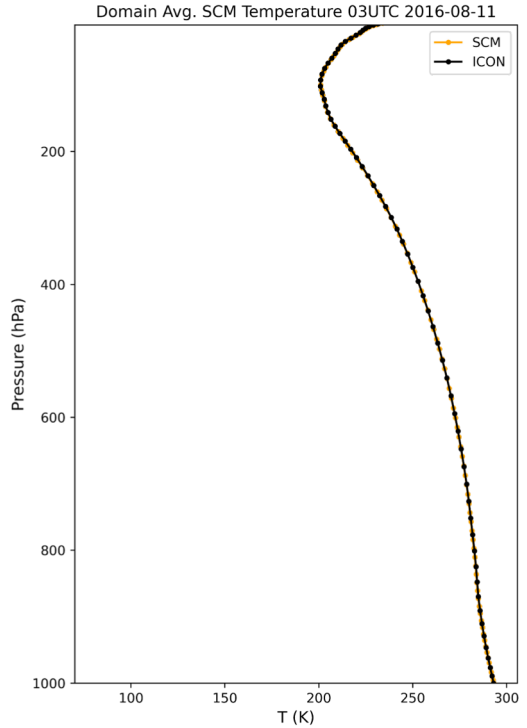
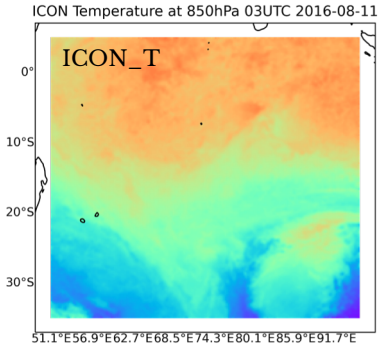
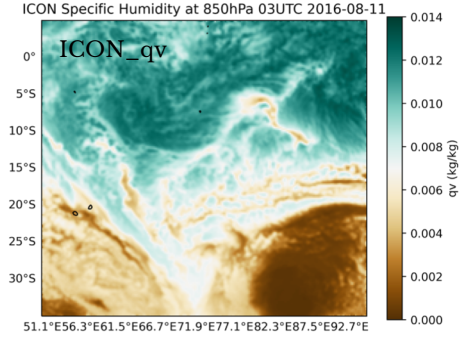
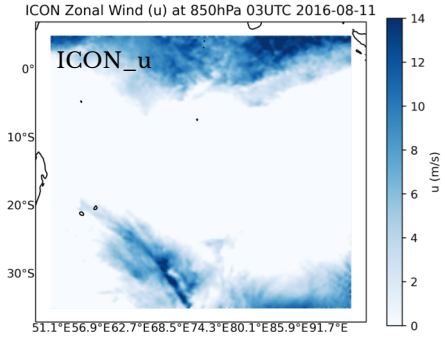


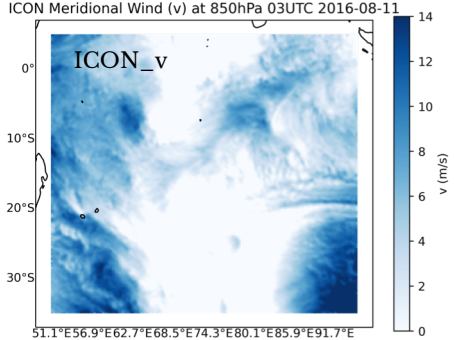
Illustration of interpolation of vertical levels from 77 levs in ICON coarse-grained data to 127 levs in SCM

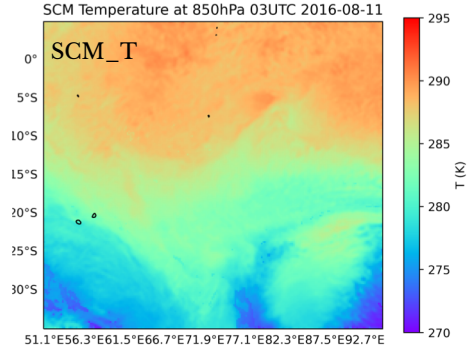
Spatial Distribution of Met Vars at 850 hPa F03

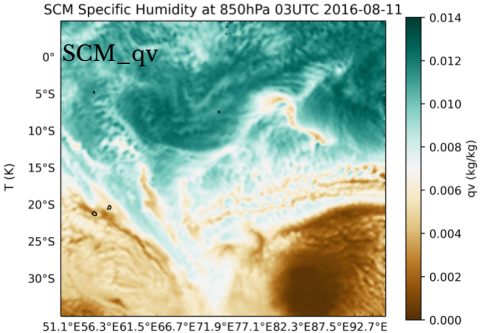


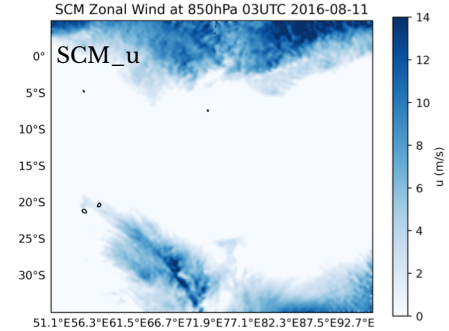


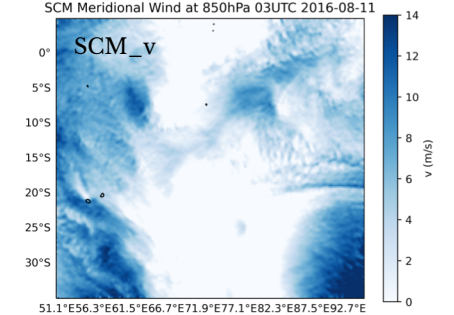






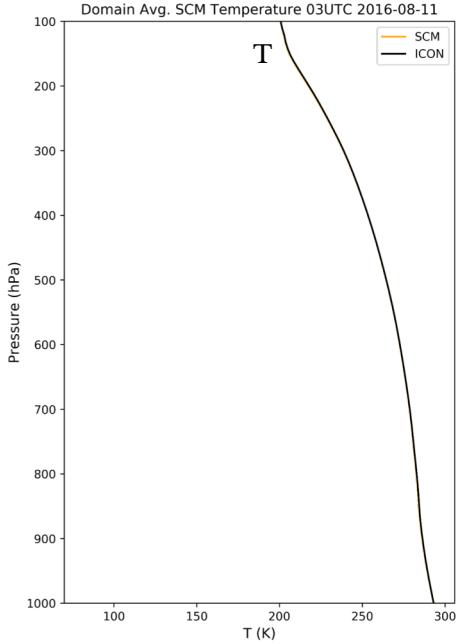


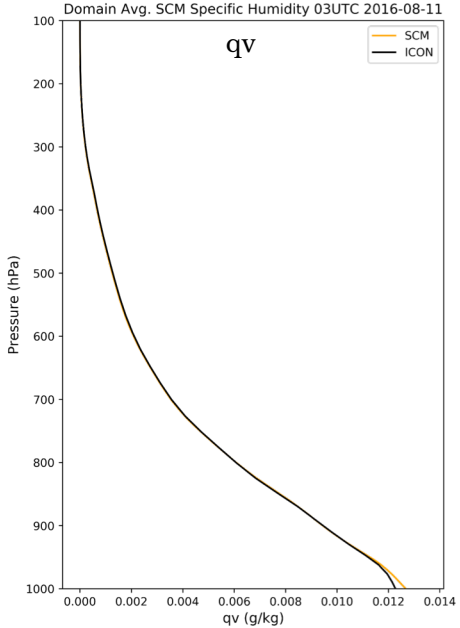


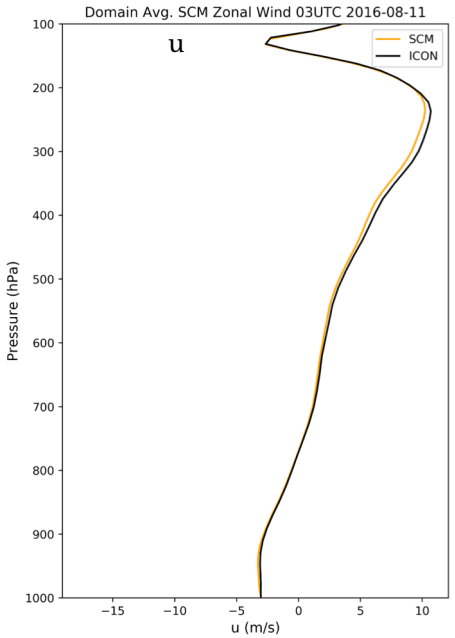


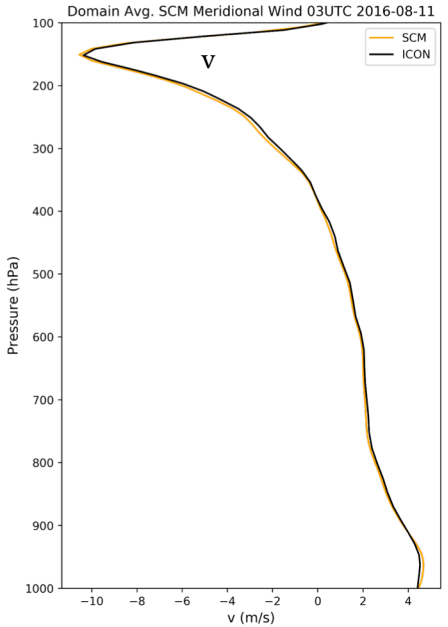
**ICON means coarse-grained forcing data here*

Domain Average of Met Vars F03









**ICON means coarse-grained forcing data here*

Discussion

- SCM vertical levels: Should we use 77 levels (ICON) or 127 levels (GFS). Top level pressure in ICON is 1.34 hPa. 127 lev: 0.01hPa
  - Discard the data near pressure top
  - Boundary layer structure is an important consideration
- Extra input vars desired: TKE, thetal, thetal_adv, rv_adv
  - Are coarse grained TKE applicable to one grid point?
  - Hannah will send scripts of how to calculate these variables
- Output vars: T, qv, u, v, pressure, tendencies for each scheme
  - For maximum flexibility, we output tendencies for each time stamp, and calculate the accumulative tendencies in the post-processing step
  - Are ICON tendencies dataset available?
    - Not available. We can calculate the physics tendencies using advection tendencies and the overall tendencies
- Better ways to concatenate files: Currently using Python Xarray, reads in all files, and write out to NetCDF file
  - Judith is suggesting Zarr format.
  - Or with 3 hourly frequency?
- Next steps:
  - Plot time series over 3 hour run to check spin up properties
    - If not stable at 3 hours, consider longer forecast
    - Xia: won't our profiles for T, qv, u, v suggest the spin up is okay at 3 hour? Or did they mean to check 1st hour and 2nd hour
  - Run without surface fluxes and with LSM to check for bias difference