



Convergence of Deterministic NAM & RUC into hourly NARRE & HRRRE Ensembles

Geoff DiMego

Mesoscale Modeling Branch

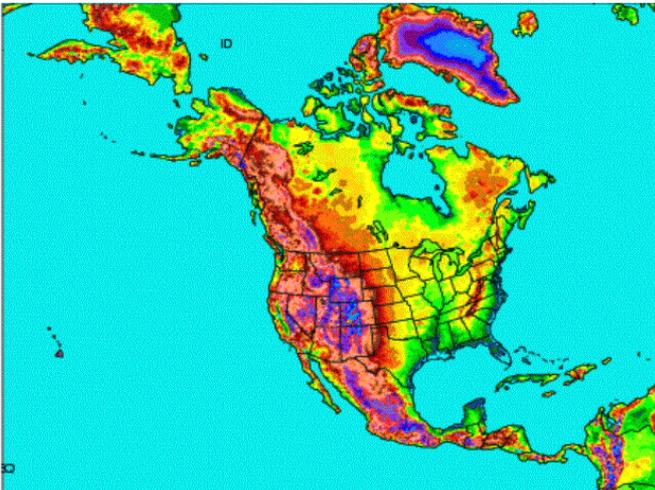
EMC / NCEP

March 24, 2010

“Where America’s Climate, Weather and Ocean Services Begin”

NAM

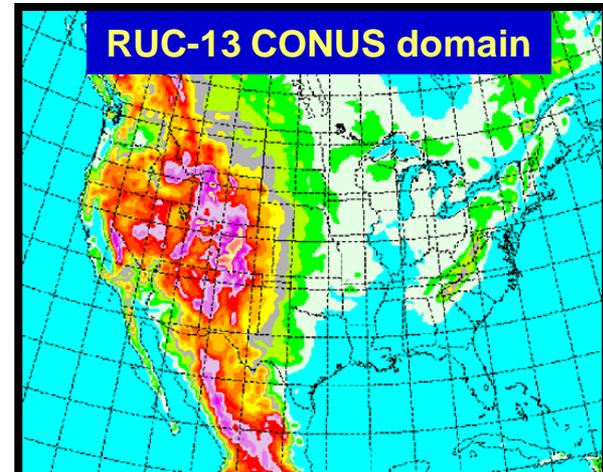
- WRF-NMM (Egrid)
- GSI analysis
- 4/Day = 6 hr update
- Forecasts to 84 hours
- 12 km horizontal
- 60 layers with 2 mb top
- 12 hr pre-forecast assimilation period with 3hr updates (catch-up)



2009

RUC

- Non-WRF RUC model
- RUC 3DVAR analysis
- 24/Day = hourly update
- Forecasts to 18 hours
- 13 km horizontal
- 50 layers with 50 mb top
- Continuous forward cycle with no pre-forecast assimilation period



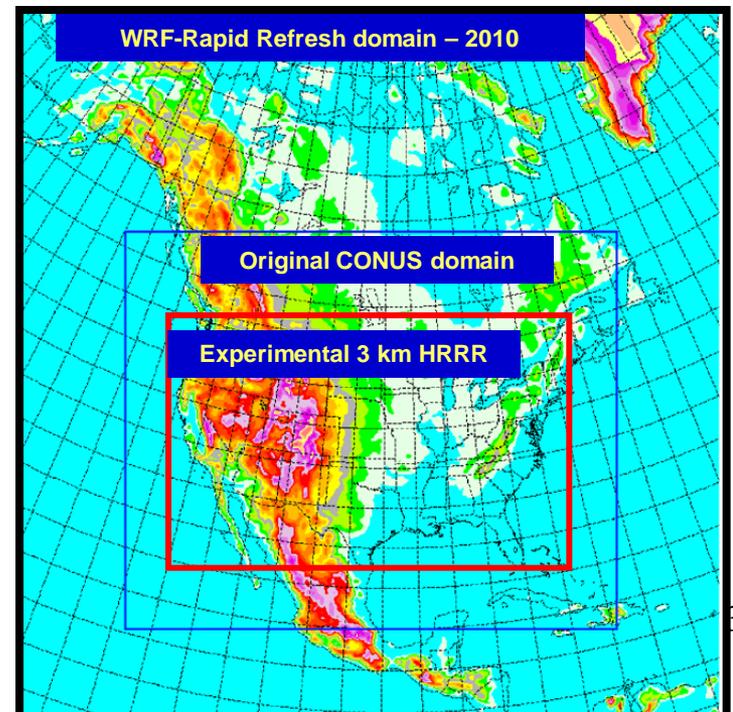
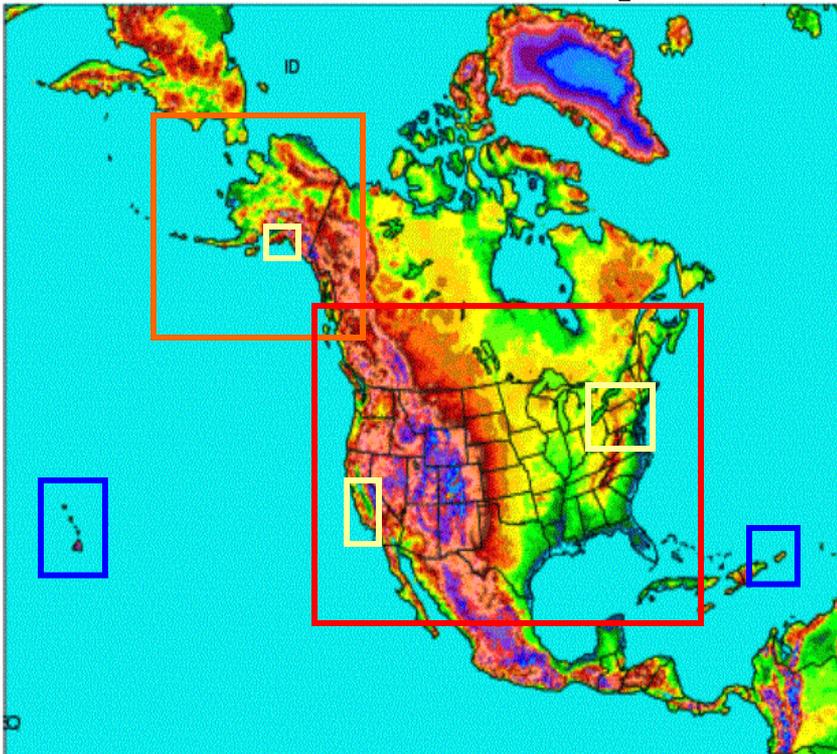
NAM

2010-2011

Rapid Refresh

- NEMS based NMM
- Bgrid replaces Egrid
- Parent at 12 km / 70 levels
- Multiple Nests Run to 60hr
 - ~4 km CONUS nest
 - ~6 km Alaska nest
 - ~3 km HI & PR nests, and/or a ~2 km DHS/FWIS/Terminal possible

- WRF-based ARW
- NCEP's GSI analysis
- Expanded 13 km Domain to include Alaska
- Experimental 3 km HRRR



2012-2013

North American Rapid Refresh ENSEMBLE (NARRE)

- NEMS-based NMMB/ARW models & GSI analysis
- Common NAM parent domain at 10-12 km
- Initially ~6 member ensemble made up of equal numbers of NMMB- & ARW-based configurations
- Hourly updated with forecasts to 24 hours
- NMMB & ARW control assimilation cycles with 3 hour pre-forecast period (catch-up) with hourly updating
- NAM & SREF 84 hr forecasts are extensions of the 00z, 06z, 12z, & 18z runs – for continuity sake.
 - SREF will be at same 10-12 km resolution as NARRE by then
 - SREF will have 21 members plus 6 from NARRE for total of 27
- NARRE requires an increase in current HPCC funding⁴

2012-2013

High Resolution Rapid Refresh ENSEMBLE (HRRRE)

- Each member of NARRE contains
 - 3 km CONUS and 4 km Alaskan nests (plus Hawaii & Puerto Rico)
 - The two control runs initialized with radar data & other hi res obs
- This capability puts NWS/NCEP/ESRL in a position to
 - Provide NextGen Enroute AND Terminal guidance
 - Provide PROBABILITY guidance with full Probability Density Function specified
 - Provide a vehicle to improve assimilation capabilities using hybrid (EnKF+4DVar) technique with current & future radar & satellite
 - Address Warn-on-Forecast as resolutions evolve towards ~1 km
- NAM nests are extensions of the 00z, 06z, 12z & 18Z runs.
- HRRRE requires an increase in current HPCC funding

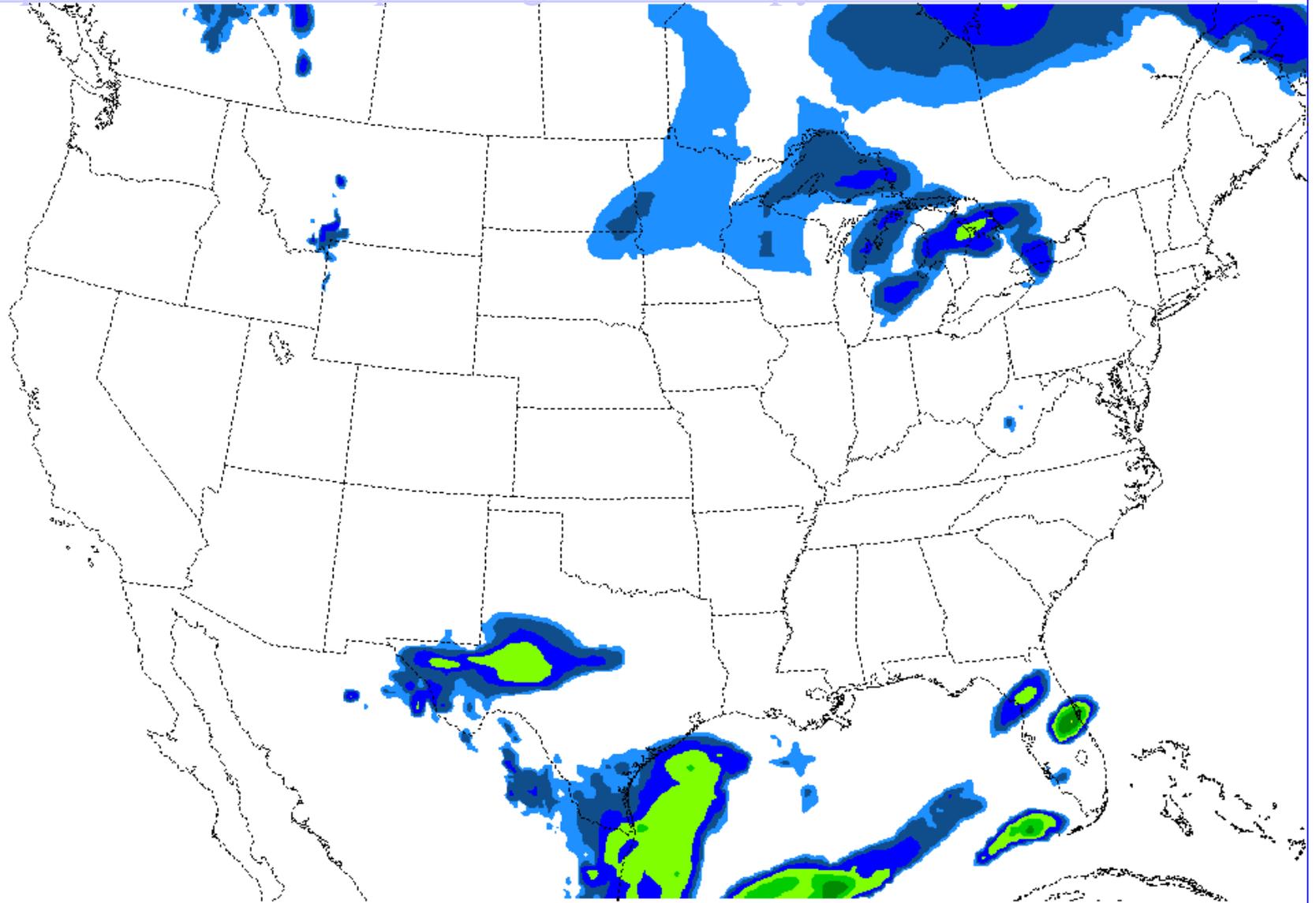
2012-2015

A Catch-Up Cycle for NARRE & HRRRE could constitute the Analysis of Record

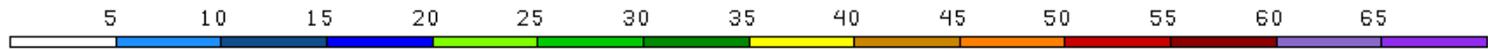
- Catch-up = reach back in time to include late arriving obs
- Assimilate ALL in situ and remote data sources
- Use state-of-the-art 4-dimensional data assimilation technique
 - Likely a hybrid of Ensemble Kalman-Filter and 3D-/4D-Variational
 - Able to take quick advantage of its evolution
- Use state-of-the-art nonhydrostatic numerical models
 - Advanced Research WRF (ARW) core from NCAR & ESRL/GSD
 - Non-hydrostatic Multiscale Model on B-Grid (NMMB) from NCEP
 - Interoperable physics from WRF community & NCEP operations
 - Able to take quick advantage of their evolution
- Extend to include NextGen required parameters
- This AoR requires an increase in current HPCC funding

Ensembles

- Sample uncertainty within membership
 - Initial conditions
 - Lateral boundary conditions
 - Dynamics
 - Physics
- Provide full description of uncertainty
- Can adapt to rapidly evolving science of underlying data assimilation and modeling



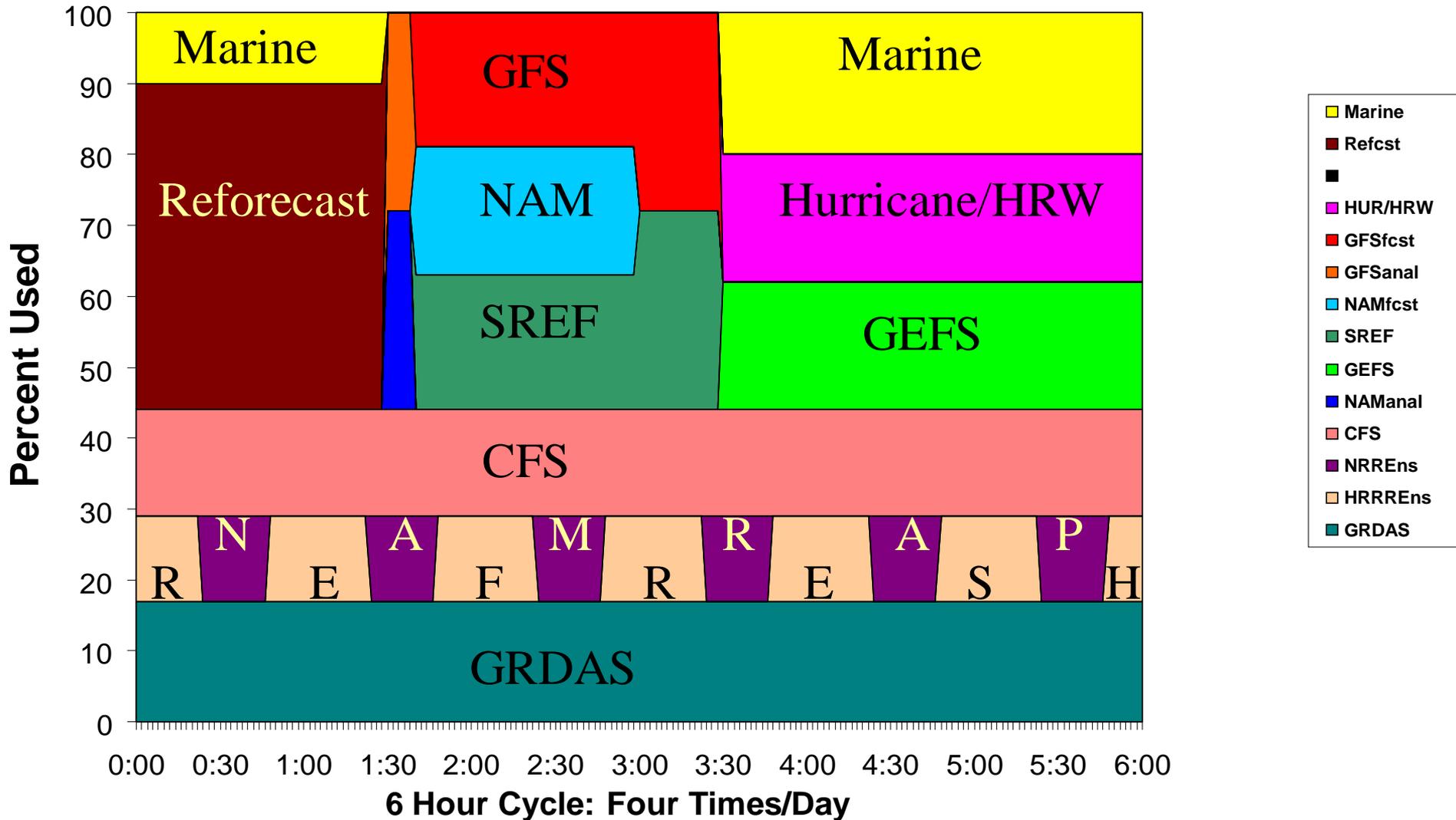
091204/1200V000 1000 M REFD



1000 m AGL simulated radar reflectivity

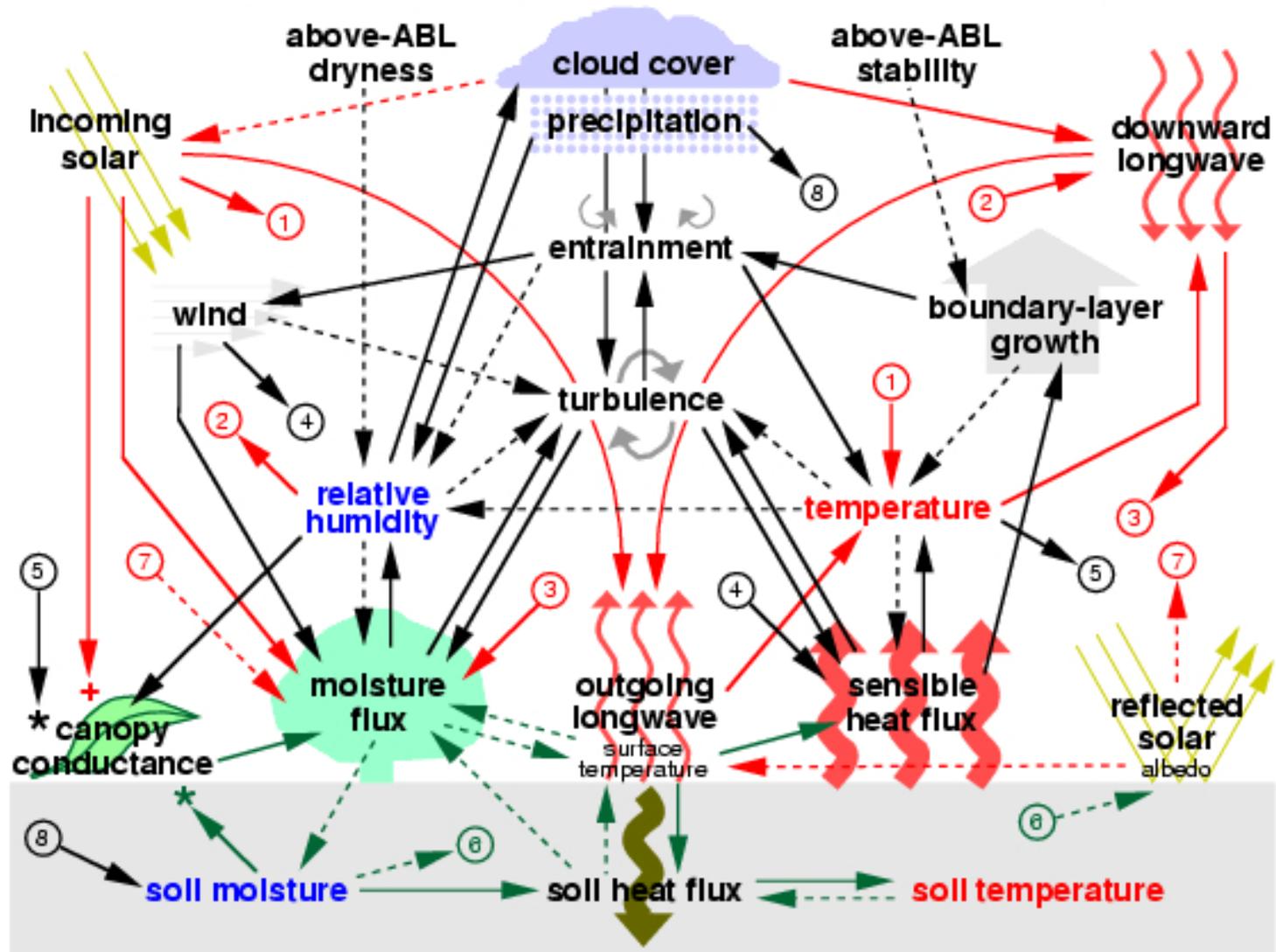
Default Production Suite ~2017.5

NCEP Production Suite
 Weather, Ocean & Climate Forecast Systems
 Default Version 2017.5



PHYSICS “WHEEL OF PAIN”

land-surface - ABL - radiation interactions



+ positive feedback for C3, C4 plants, negative feedback for CAM plants

* negative feedback above optimal values

→ surface layer/ABL processes
 → land-surface
 → radiation
 —→ positive feedback
 - - -→ negative feedback