CWRF Downscaling to Improve U.S. Seasonal-Interannual Climate Prediction

Xin-Zhong Liang\textsuperscript{1,2}, Ligang Chen\textsuperscript{2}, Shenjian Su\textsuperscript{2}, Julian X.L. Wang\textsuperscript{3}

\textsuperscript{1}Department of Atmosphere & Ocean Science
\textsuperscript{2}Earth System Science Interdisciplinary Center
University of Maryland, College Park
\textsuperscript{3}Air Resources Laboratory
National Oceanic & Atmospheric Administration

Grants: NOAA NA110AR4310-194 & -195 & EPP COM/HU631017
CWRF Physics Options

Diffusion
- Upper
- Eddy
  - Const DIF
  - L2.5 TKE
  - L2 3D DEF

RadExt
- Orbit
- Gases
- Aerosols

SfcExt
- VEG
- SST
- OCN

Cumulus
- BMJ
- NKF
- SAS
- GD
- G3
  - UW
  - ZML
  - CSU
  - GFDL
  - MIT
  - ECP

Cloud CAR
- Aerosol
- Radiation
- LW + SW

Surface
- Urban
  - UCM
  - BEP
  - SLAB
  - RUC
  - PX
  - NOAH
  - CSSP
  - CROP
  - SOM
  - UOM

PBL
- YSU
- ACM
- GFS
- MYJ
- MYNN
- QNSE
- BouLac
- CAM
- UW
- ORO

Microphysics
- Kessler[2]
- Thompson[7]
- Lin[6]
- Hong[3]
- Hong[5]
- Hong[6]
- Zhao[2]
- Tao[5]
- Morrison[10]
- Hong[7]
- Hong[8]

http://cwrf.umd.edu
Min Xu, Xin-Zhong Liang, and Wei Gao: Regional climatic effects of crop growth modeled by the coupled CWRF-CROP system.
B11B-0480—Mon, 12/05, 8:00AM

Feng Zhang, Xin-Zhong Liang, and Shenjian Su: Evaluation of the cloud-aerosol-radiation ensemble modeling system.
A21H-05—Tue, 12/06, 8:00AM

Fengxue Qiao and Xin-Zhong Liang: Effects of cumulus parameterization on the U.S. summer precipitation prediction by the CWRF.
A31H—Wed, 12/07, 9:45AM

Shuyan Liu and Xin-Zhong Liang: Effects of planetary boundary layer parameterizations on CWRF regional climate simulation.
A41A-0041—Thu, 12/08, 8:00AM
Choi 2006; Choi et al. 2007, 2011; Choi and Liang 2010; Yuan and Liang 2010; Liang et al. 2010d
Illinois Soil Moisture Simulations Driven by NARR

Yuan and Liang 2011 (J. Hydrometeorology)
Illinois Soil Moisture by CWRF/CSSP vs WRF/NOAH

Liang et al. 2011 (Bull. Amer. Met. Soc.)
a) Spatial frequency distributions of root mean square errors (RMSE, mm/day) predicted by the CFS and downscaled by the CWRF and b) CWRF minus CFS differences in the equitable threat score (ETS) for seasonal mean precipitation interannual variations. The statistics are based on all land grids over the entire inner domain for DJF, JFM, FMA, and DJFMA from the 5 realizations during 1982-2008. From Yuan and Liang 2011 (GRL).
Observed (OBS), CFS-predicted, and CWRF-downscaled: a) number of rainy days, b) maximum dry spell length (day), c) daily rainfall 95th percentile (mm/day), and d) difference in number of rainy days averaged between the El Niño (warm) and La Niña (cold) events for JFM during 1983-2008. From Yuan and Liang 2011 (GRL).
CWRF
Seasonal-Interannual Climate Prediction

Nested with NOAA/IRI Operational ECHAM

In collaboration with Dave DeWitt of IRI
CWRF Downscaling Improves ECHAM Extreme Events

SON

a) Number of Rainy Days  

b) Maximum Dry Spell Length  
c) Daily Rainfall 95th Percentile  

In collaboration with Dave DeWitt of IRI
U.S. Land Seasonal Precipitation Spatial Pattern Correlation

CWRF downscaling is much more realistic than ECHAM

In collaboration with Dave DeWitt of IRI
CWRF improves predictions at regional-local scales

- CWRF includes advanced physics schemes crucial to climate
- CWRF couples essential components directly linking to impacts
- CWRF builds upon a super ensemble of alternative physics schemes for skill optimization and uncertainty quantification
- CWRF has greater capability & better skill than CMM5, WRF...
- CWRF downscaling improves CFS precipitation predictions

Ready for Climate Service
http://cwrfl.umd.edu