A scripting environment for basic WRF ensemble research

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Why bother?

- **Short-term working group (WG13) goals:**
  1) Organize ensemble-related scientific workshops and special sessions in the annual WRF workshop specifically targeted at ensemble studies and applications. Specifically, organize a WRF ensemble forecasting tutorial as part of the regular WRF tutorials beginning in 2007.
  2) Promote the development of needed tools and their sharing through the WRF ensemble forecasting web page (David Stensrud, lead). Encourage ensemble forecasting working group members to collaborate on proposal submissions.
My interpretation

• Chance to get feedback from users (you) before developing further for WRF tutorials
• Could serve as a starting point for a community research system
• More people viewing it means (hopefully) fewer errors
Starting point

- AFWA’s Joint Mesoscale Ensemble (JME) System

**Pros:**
- Flexible
- Capable
- WRF v2.2 and WPS ready
- Lots of error-checking

**Con:**
- Design philosophy already chosen
- Maximum user control means a lot of control files to maintain
Design philosophy

• Maximum user control
  – Namelists for each member maintained individually

• Keyword pairs for control of each member individually and ensemble as a whole
  – Keyword pairs can be arbitrarily located to control either the whole ensemble or a single member
“Rules” for current version

• NCO and NCL must be installed and in your path
• You must have WRF and WPS installed and know where the executables and other necessary files reside
• You must design the domain and run geogrid.exe in advance

No support; you must know something about how to run WPS and WRF!
EnsembleDriver: launches an ensemble forecast

EnsembleStart: writes scripts to run each component, then runs the scripts

WPS launcher
- run_wps: set-up and execute

WRF launcher
- run_wrf: set-up and execute

Post-process launcher
- post-process: NCO and NCL

LoadLeveler, LSF, or none
Current ensemble methods

• Downscaling from NCEP global ensemble
  – Assign a global member to a particular WRF ensemble member or members for initial and lateral boundary conditions

• Random additive noise $\sim N(0,\sigma)$
  – Variable list and $\sigma$ assigned ensemble-wide or for individual members
  – Implemented in an NCL script

• Individual model configuration for each member (multi-model ensemble)
Current ensemble post-processing (L1)

- Ensemble mean (subset of variables)
- Ensemble spread (variance; subset of variables)
- Uses netCDF operators to produce additional netCDF files
Ex: ensemble keyword pairs

ENS_CONFIG_NumMembers :: 3
ENS_CONFIG_RunMembers :: ALL
ENS_CONFIG_EmailNotify :: yes
ENS_CONFIG_NumDomains :: 1
ENS_CONFIG_JGEDataPath :: /d2/ENS_User/JEFS/RETROSPECTIVE_DATA/JGE
ENS_CONFIG_ExecPath :: /d2/ENS_User/wrf/WRFV2/main
ENS_CONFIG_RealExecPath :: /d2/ENS_User/wrf/WRFV2/main
ENS_CONFIG_WPSRoot :: /d2/ENS_User/wrf/WPS
ENS_CONFIG_NamelistPath :: /d1/ENS_User/ENS/WRF_ENS/ENS/ENS_namelist.DEMO
ENS_CONFIG_WPSGeoPath :: /d2/hacker/AFWA_ENS/data/geogrid_out_test
ENS_CONFIG_WPSVtableGFS ::
   /d2/hacker/wrf/WPS/ungrib/Variable_Tables/Vtable.AVN0P5WRF
ENS_CONFIG_ModelDataPath :: /d2/ENS_User/wrf/WRFV2/run
ENS_CONFIG_RealDataPath :: /d2/ENS_User/wrf/WRFV2/run
ENS_CONFIG_FGIIntervalHrs :: 6
ENS_CONFIG_FGNumLevels :: 27
ENS_CONFIG_FcstLengthHrs :: 1
ENS_CONFIG_HistoryInterval :: 1
ENS_CONFIG_PostLevel :: 1
ENS_CONFIG_MeanSprVars :: U10, V10, T2, Q2, U, V, T, QVAPOR
ENS_CONFIG_RandomVariance :: 1.0, 1.0, 0.5, 0.00000001
ENS_CONFIG_RandomVars :: U, V, T, QVAPOR
ENS_CONFIG_PertScript ::
   /d1/ENS_User/ENS/WRF_ENS/ENS/ENS_scripts/ENS_RandomPerturbations.ncl
Ex: member keyword pairs

ENS_CONFIG_RunPath :: Member10_rundir
ENS_CONFIG_MemberName :: Member10
ENS_CONFIG_Namelist :: namelist.input.ENS_10
ENS_CONFIG_JGEMember :: 10
ENS_CONFIG_LANDUSEFile :: LANDUSE9.TBL
Where to find the scripts

- Scripts: ENS_scripts.tgz (includes namelists for example)
- Test/example
  - Input data: gribfiles_2007022800.tgz
  - WPS files: wpsfiles.tgz
A quick demo and test case

- Small domain (60x60x27)
- Short forecast (1 h)
- Perturbations to LBCs and ICs
- 3 ensemble members
- Tested on linux desktop, run serially
Easy extensions

- Some kind of post-processing on individual ensemble members
- More sophisticated ensemble post-processing
- More sophisticated perturbation strategies (except filters)
More difficult extensions (volunteers?)

- Addition of filter and/or WRF-Var
  - Obs stream
  - Background ensemble
- A verification post-processing steps
  - Obs stream
  - Access to many forecasts
Suggestions from you

- A protocol for user contributions?
- Priorities?

Will this effort be useful?