Strategic Implementation Plan (SIP) for a Community-based Unified Forecast System

Ensemble Working Group

Presented by

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SIP Coordination Meeting

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Ensemble WG
Membership

- *Tom Hamill (ESRL/PSD) ***
- *Yuejian Zhu (NCEP/EMC) ***
- *Ryan Torn (U. Albany) ***
- Phil Pegion (ESRL/PSD)
- Isidora Jankov (ESRL/GSD)
- Carolyn Reynolds (NRL Monterey)
- Walter Kolczynski (NCEP/EMC)
- Dingchen Hou (NCEP/EMC)
- Vijay Tallapragada (NCEP/EMC)
- Jon Gottschalck (NCEP/CPC)
- Xuguang Wang (U. Oklahoma)
- Fanyou Kong (U. Oklahoma)

- *Co-Chair **

Review of SIP (Annex 11, ensembles) main thrusts

- 11.1: FV3 GEFS implementation (see Vijay's report)
- 11.2: High-resolution (HRGEFS), i.e. shorter-range GFS ensemble
- 11.3: Ensuring consistency between global and regional ensemble systems.
- 11.4: Improve uncertainty treatments to make them suitable for S2S and full spectrum of environmental needs.
  - Subproject 1: dry dynamical core uncertainty.
  - Subproject 2: more physically based stochastic parameterization.
  - Subproject 3: methodologies to make GEFS suitable for S2S
    - Ensemble initialization and stochastic physics at atmosphere interface with land, ocean, sea ice
  - Subproject 4: extended ensemble prediction system (2-way wave, space weather coupling).

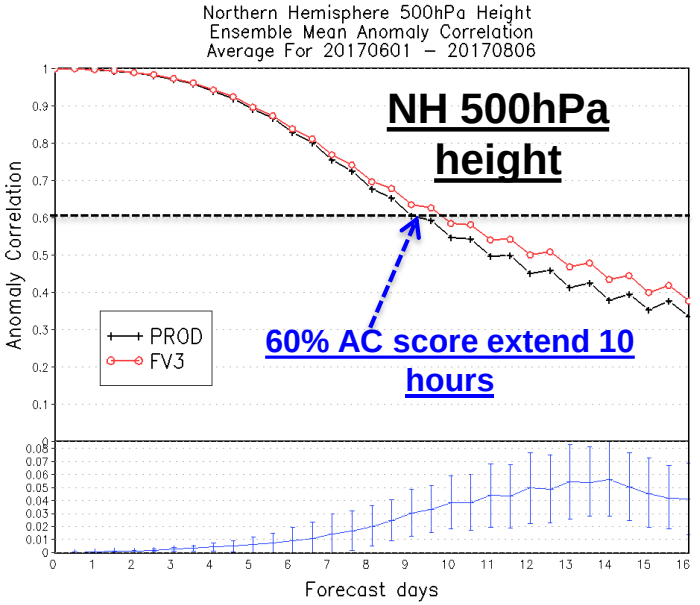
Items in **blue** are currently resourced. Items in **red** should receive additional emphasis.

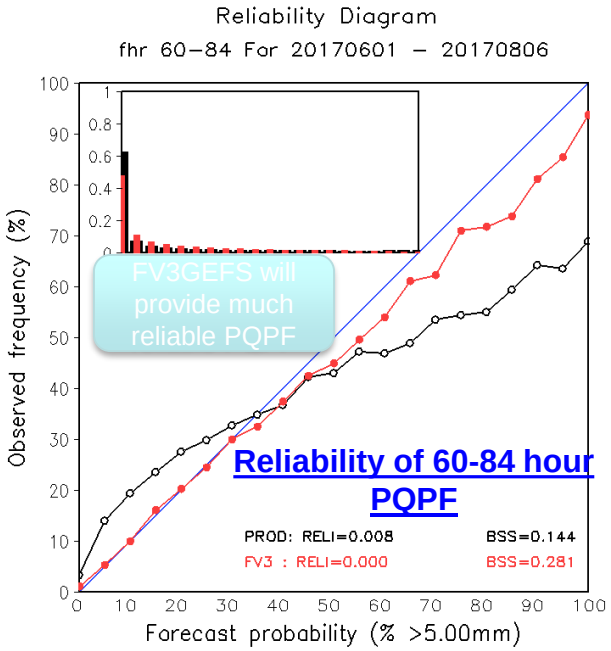
Ensemble WG Accomplishments & Challenges

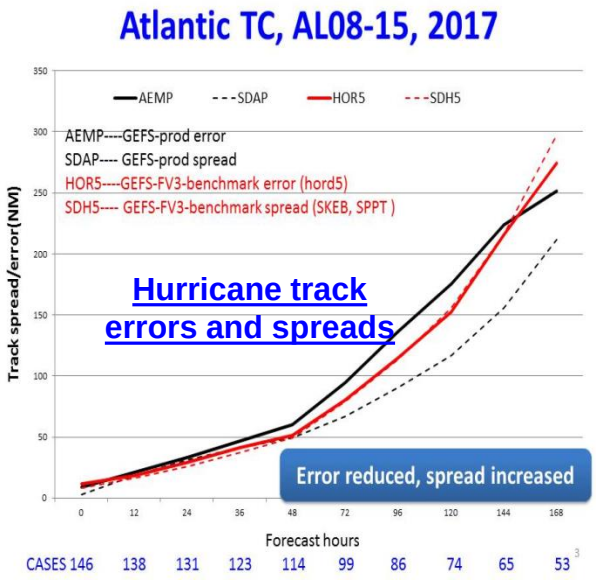
- **SIP project milestones completed/progress to date:**
  - GEFS v12 implementation next year, with new suite of stochastic physics (see Vijay Tallapragada report on global systems).
  - Accompanying reanalysis and reforecast are in production. Data saved internally for NWS, select (>100) variables will be served to external community from disk.
  - Ongoing work on process-based stochastic deep convective parameterization (Jian-Wen Bao, Lisa Bengtsson, ESRL/PSD).
- **SIP ensemble project issues** (will save for last slide**):**
- **Dependencies**: usual (funding, HPC).
- **Document changes**: include mention of sea-ice initial and stochastic perturbations in 11.4, subproject 3 (per Carolyn Reynolds and NRL experience).

Next GEFS operational implementation (~ summer 2020)

	OPS-GEFS (v11)	FV3-GEFS (v12)
Dynamics	**GSM**	**FV3**
Physics	**GFS physics** (ZHAO-CARR MP)	**GFS physics** (GFDL MP)
Resolutions	**T_L574L64 (d1-8) T_L382L64 (d9-16)**	**C384L64 (d1-35)**
Members	**20+1; 4x / day**	**30+1; 4 4x / day**
Initial perts	**EnKF 06 fcst**	**EnKF 06 fcst**
Model uncertainties	**STTP**	**SPPT+SKEB**
Boundary SST	**Relax to Climatology**	**NSST+2-tiered SST**







Reforecasts

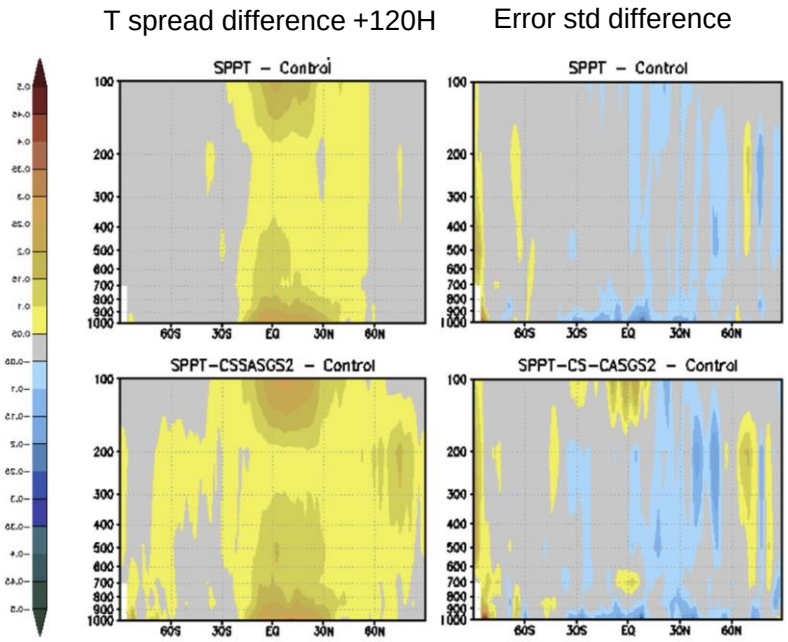
30 years
Every day at 00 UTC
5 members out to 16 days
Except for every Wednesday, when
11 members out 35 days

Select (~120) fields served to public from disk array

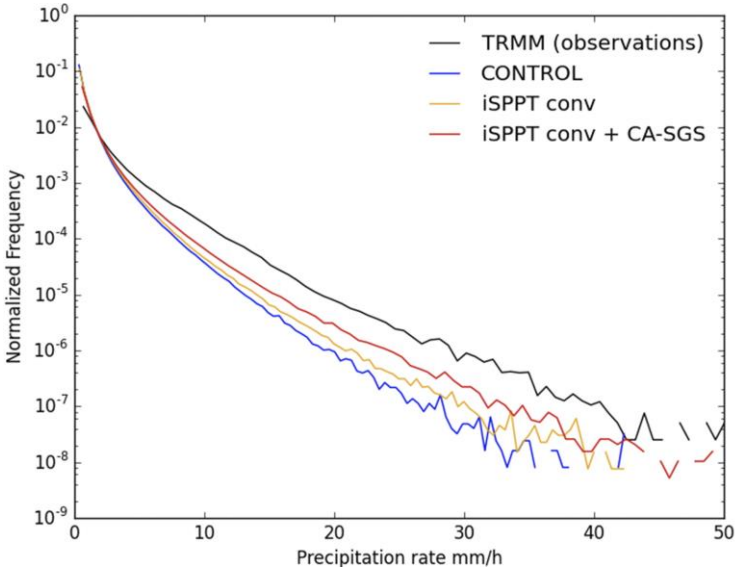
Stochastic deep convective parameterization development

We seek a more physically based way of introducing uncertainty contributed by sub-grid scale processes into the deep convective parameterization. Ideally, this will replace the more ad-hoc SPPT stochastic parameterization for deep convection. Cellular automata (CA) are used to trigger a different number of convective plumes in each grid cell. Stochastic plume numbers depends on details like CAPE and upward VV and have correlations in space and time. c/o Lisa Bengtsson, Jian-Wen Bao, CIRES and ESRL/PSD.

Example : SPPT + CA perturbations compared with SSPT alone.

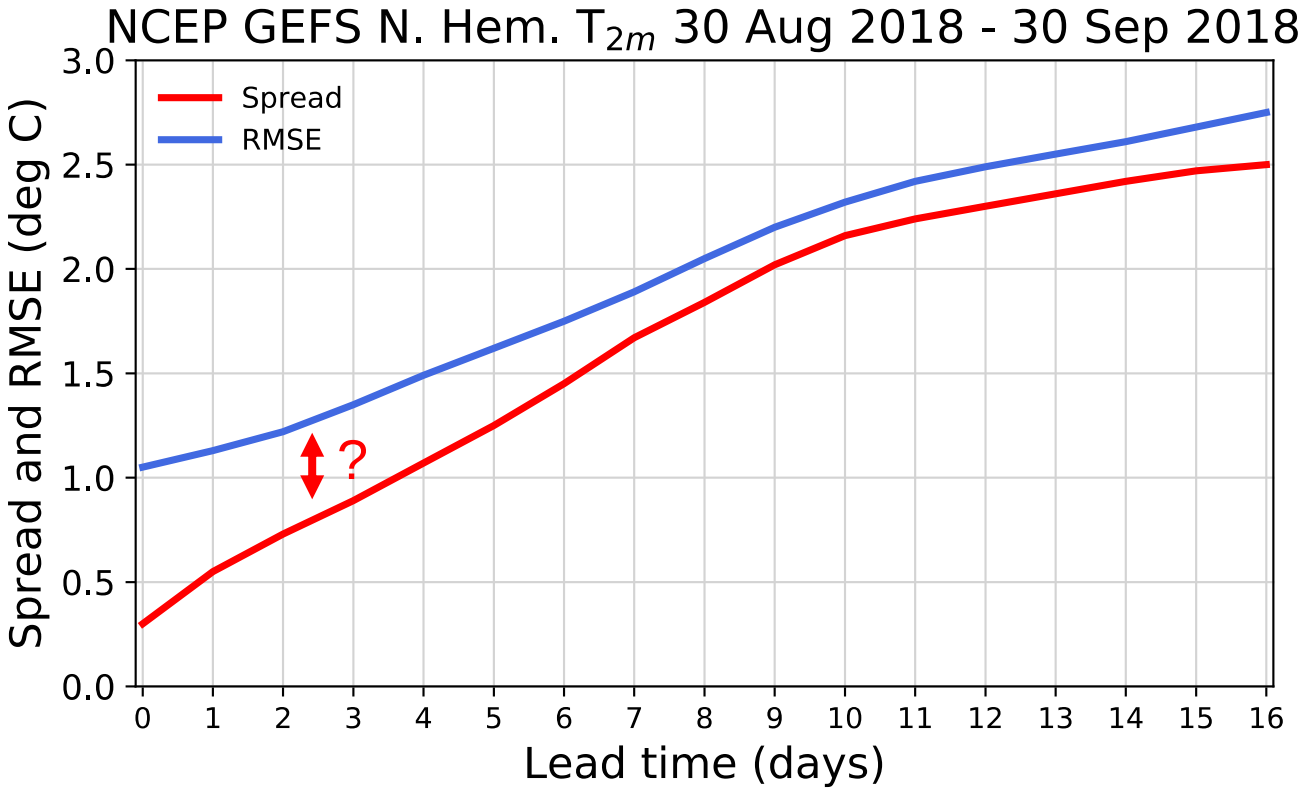


Example: frequency distribution of 6h precipitation showing that there are fewer drizzle events and more strong precipitation events with CA, which is more like observations.



This change of model climatology with stochastics may be important for S2S, e.g MJO variability

Improving probabilistic 2-meter temperatures



- 2-m temperatures are one of the most under-spread and important forecast variables. Affects short-range out to S2S forecasts.
- Appropriate initialization (coupled ensemble DA) and stochastic parameterization needed.

See full presentation here

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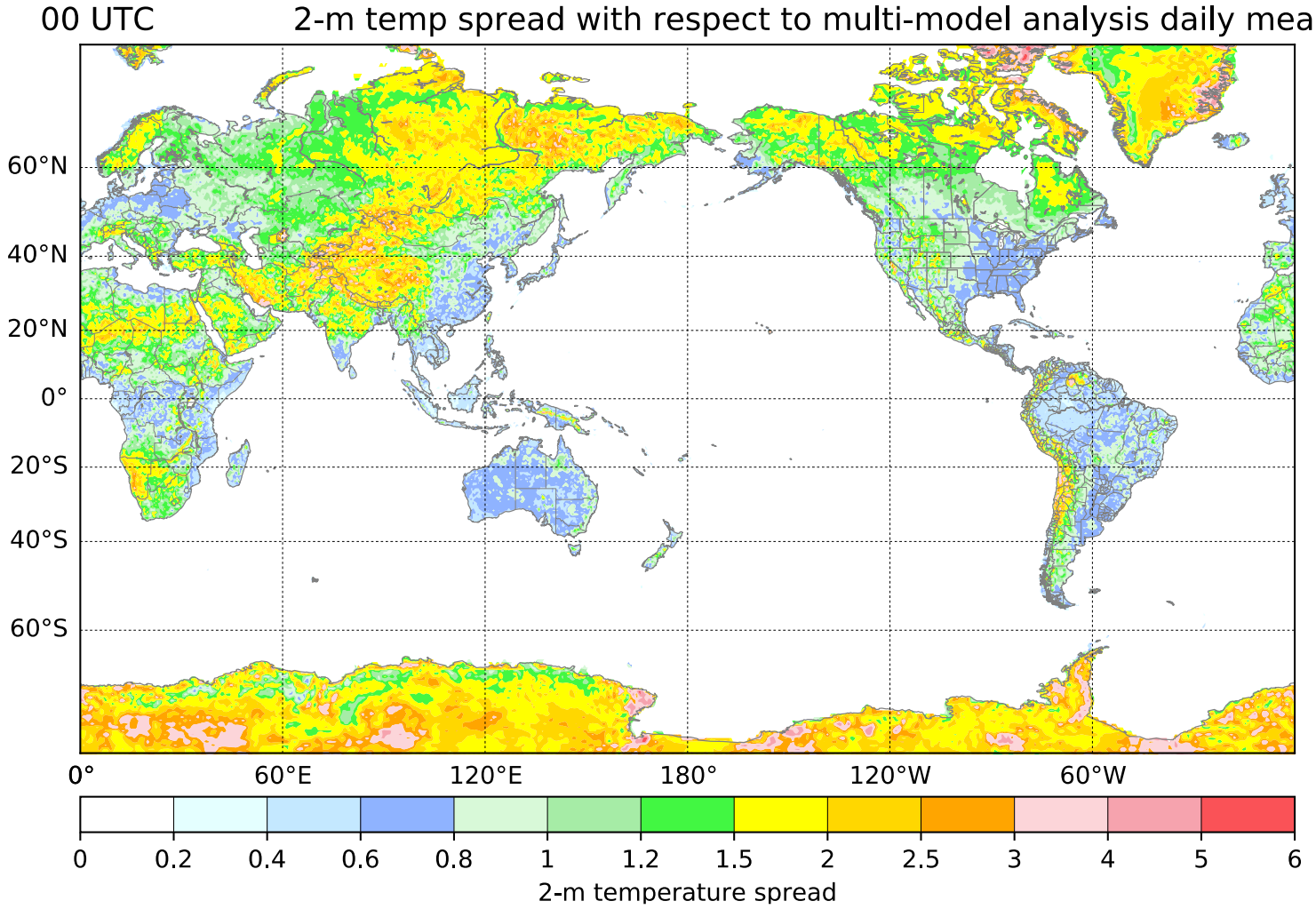
2-meter temperature spread among global analyses



The GEFS initial spread is much smaller than the spread between analyses, which we take as a surrogate for analysis uncertainty.

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Perspective on management issues

- Streamlining the steering committee sounds appealing.
- Ensemble team members have related meetings (Model Uncertainty Group, Reanalysis/Reforecast tag-up) but otherwise the team is not formally very active. Is that really bad?
- Are MMEs envisioned, inside or outside the UFS? At OAR S2S planning meeting, this was a topic of lively discussion [UCACN, UMAC and subsequent review committees strongly endorse one system]. Clarity in strategic/implementation plans appreciated.
- Funding and coordination.
  - NGGPS, EPIC, JTTI, S2S, EPIC, etc.. Constant proposal writing, money chasing → less science.
  - Year-to-year funding → extra work and uncertainty that affects hiring.
  - Low TRL SIP activities currently take a back seat to high TRL; slower rate of system improvement down the road.
  - Continuity: low TRL projects (OWAQ, CPO) to high TRL projects (STI).