# Ensemble team review

Yuejian Zhu
Ensemble and post process team
September 17th 2010

# Ensemble team members

- Yuejian Zhu (lead)
- Jun Du (SREF)
- Dingchen Hou
- Richard Wobus
- Mozheng Wei
- Yucheng Song
- Bo Cui
- Malaguias Pena
- Jiayi Peng
- Yan Luo
- Jissie Ma
- Vacancy (Civil servant)
- Vacancy (contractor)
- Julia Zhu (RFCs)
- Zhan Zhang
- Weiyu Yang
- George Vandenberghe (HFIP)
- Mary Hart (web)
- Shrinivas Moorthi (model consultant )

# Past Implementations

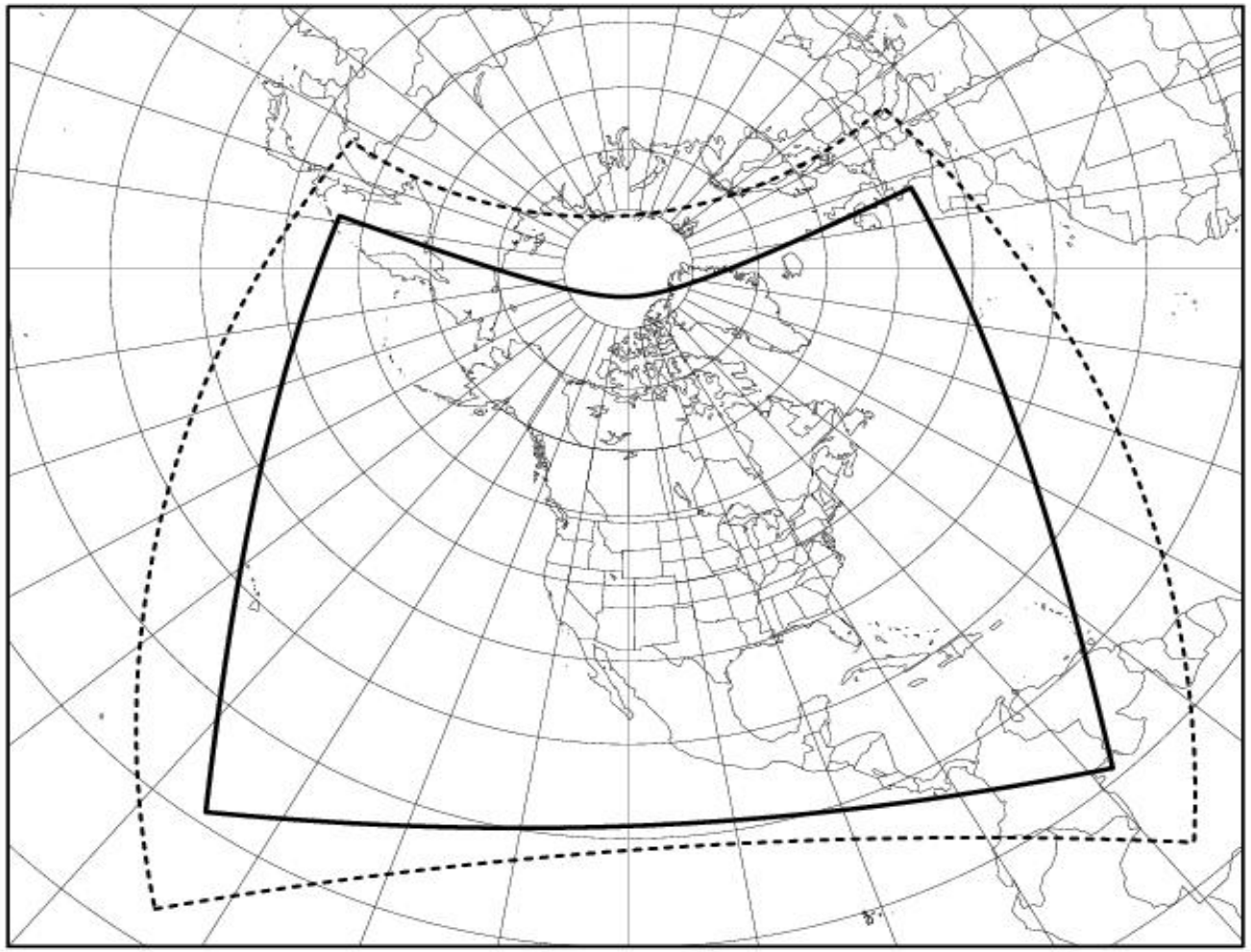
- SREF implementation - Jun
  - Individual model upgrade
  - Increasing resolution
  - Additional products
- GEFS implementation - Yuejian
  - Increasing resolution
  - $8^{th}$ order horizontal diffusion
  - Stochastic total tendency perturbation (STTP)

# SREF Implementation (October 27th 2009)

-Geoff Dimego, Jun Du and etc…

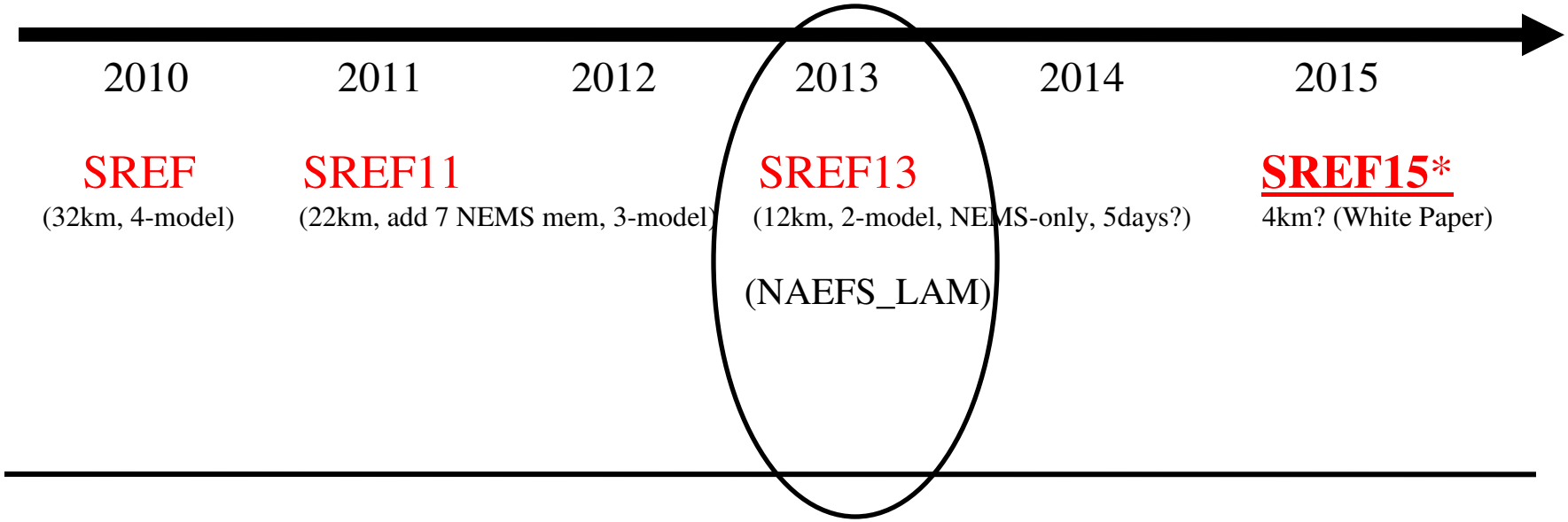
- Upgrade model versions
  - WRF-NMM from v2.0+ to v2.2+
  - WRF-ARW from v2.0+ to v2.2+
  - RSM from v2007 to v2009
- Increase horizontal resolution
  - NMM from 40km to 32km
  - ARW from 45km to 35km
  - RSM from 45km to 32km
- Adjust membership
  - Replace 2 Eta (BMJ-sat) members with 2 WRF-NMM members
  - Replace 2 Eta (KF-det) members with 2 WRF-ARW members
- Enhancement physics diversity of RSM: replace Zhao cloud scheme with Ferrier cloud scheme for 3 SAS members
- Enhance initial perturbation diversity: Replace regional bred perturbations with global ET perturbations for 10 WRF members
- A set of products for aviation forecast

# SREF Domains



**model domain (dash)**
**output domain (solid)**

# SREF Evolution




*NEMS = NOAA Environmental Modeling System (a unified modeling framework)

*SREF (32→22→12 →4km)

# GEFS Implementation (February 23rd 2010)

- Use operational GFS (version 6.0???)
- Upgrade horizontal resolution from T126 to T190
  - 4 cycles per day, 20+1 members per cycle
  - Up to 384 hours (16 days)
- Use 8th order horizontal diffusion for all resolutions
  - Improved forecast skills and ensemble spread
- Introduce ESMF (Earth System Modeling Framework) for GEFS
  - Version 3.1.0rp2
  - Allows concurrent generation of all ensemble members
  - Needed for efficiency of stochastic perturbation scheme
- Add stochastic total tendency perturbation (STTP) scheme to account for random model errors
  - Increased ensemble spread and forecast skill (reliability)
- Add new variables (28 more) to pgrba files
  - Based on user request
  - Supports NAEFS ensemble data exchange
  - From current 52 (variables) to future 80 (variables)

# Upcoming Implementations

- NAEFS data on NCEP NOMADS – Dick
  - Already in operation by July 2010
- CCPA – Dingchen/Yan
  - Implemented by July 13 2010
- Alaska downscaling - Bo
  - Julia Zhu is running real time parallel (SMS)
  - Expect Q4 (NCO starting work on – 09/02/2010)
- TIGGE additional variables – Dick
  - Expect Q4 (RFCs – 08/31/2010)
- Global tracking (Guangping Lou)
  - In NCO real time parallel
  - Implemented by July 2010
- CMC's raw ensemble (GRIB2) - Bo
  - Plan for FY2011Q1
- NAEFS inclusion of FNMOC ensemble (EMC milestone) - Bo
  - Plan for FY2011Q1
- NAEFS upgrading (post-process) - Bo
  - Plan for FY2011Q3
- GEFS implementation (EMC milestone) – ensemble team
  - Plan for FY2011Q4
- SREF implementation (EMC milestone) – Jun and SREF team
  - Plan for FY2011Q3

# Projects review

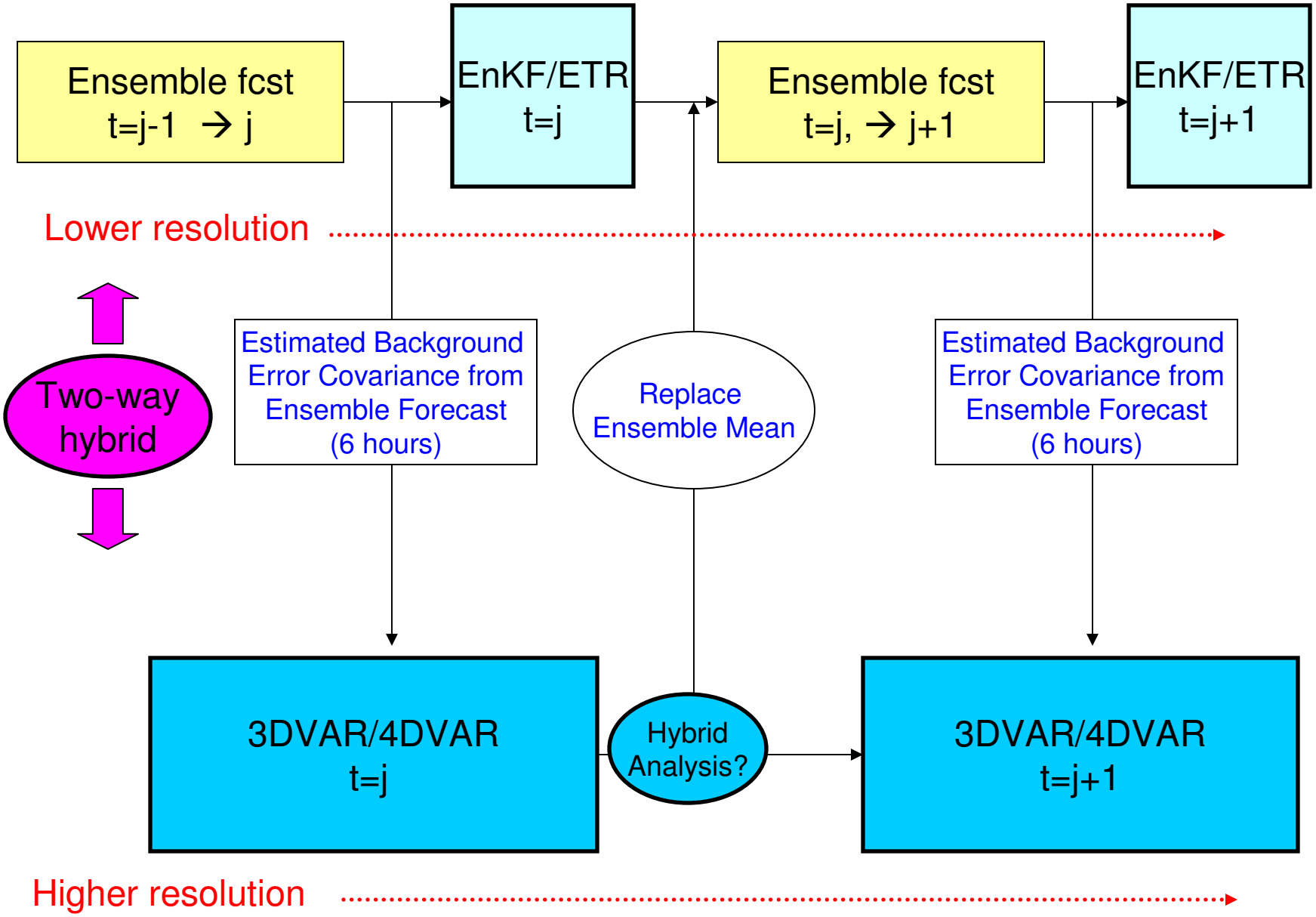
- THORPEX proposals
  - Hydrid data assimilation - Mozheng
  - NAEFS post process - Bo
  - GEFS stochastic physics - Dingchen
  - Target observation - Yucheng
- HFIP ensemble
  - Hi-resolution demonstration project – George/Mozheng/Jiayi/Jessie
  - Hi resolution HWRF ensemble – Zhan/Jun
  - Post process study for TC forecast – Jiayi/Zhan
- OHD collaboration
  - Precipitation analysis - Dingchen/Yan
  - Precipitation calibration and downscaling – Dingchen/Bo/Yan
- CTB proposal – Malaquias
  - Distribution fitter
  - Collaborated with NASA for coupling
  - Collaborated with IRI for multi-model seasonal post process

# NCEP next GEFS Configurations (Q3/4 FY11)

- Yuejian Zhu (07/14/2010)

- According to total resource distribution for each model (Jigsaw puzzle)
  - GEFS has 40% of total CPUs (52 of 130) during +4:35 and +6:00 for main integration and main post-process
- Current: GEFS and GEFS/NAEFS post processing
  - T190L28 for all 384 hours lead-time
  - 20+1 members per cycle, 4 cycles per day
  - Computation usage: average 20 nodes (22 high mark) for 50 minutes
- Next GEFS and GEFS/NAEFS post processing (Q3/Q4FY2011):
  - T254L42 (0-192hr) – increasing both horizontal and vertical resolutions
    - Factor of 3.6 by comparing T190L28
  - T190L42 (192-384hr) – increasing vertical resolution
    - Factor of 1.5 by comparing T190L28
  - 20+1 members per cycle, 4 cycles per day
  - Total cost for integration and post processing
    - Factor of 3.6 for 0-192hrs, factor of 1.5 for 192-384
    - Average factor for processing (0-384hrs) is 2.55
    - 51 nodes for 50 minutes (start: +4:35 end: +5:25)
- Why do we make this configurations?
  - Considering the limited resources
  - Increasing horizontal resolution is more important than vertical resolution

# Flow Chart for Hybrid Variation and Ensemble Data Assimilation System (HVEDAS) - concept

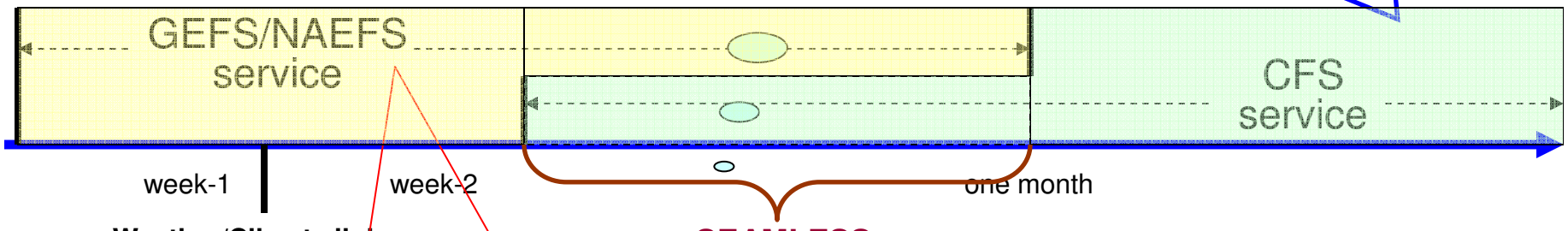


# Future seamless forecast system

NCEP/GEFS will plan for T254L42/64 (2010 GFS version) resolution with newly EnKF + ETR Initial perturbations (possible around new hybrid analysis) 21 ensemble members, forecast out to 16 days and 4 cycles per day. **Extended to 45 days at T126L28/64 resolution, 00UTC only (coupling is still a issue?)**
NAEFS will include FNMOC ensemble in 2011, with improving post process which include bias correction, dual resolution and down scaling

Main products:

Main event
MJO




Main products:

1. Probabilistic forecasts for every 6-hr out to 16 days, 4 times per day: 10%, 50%, 90%, ensemble mean, mode and spread.
2. D6-10, week-2 temperature and precipitation probabilistic mean forecasts for above, below normal and normal forecast
3. **MJO forecast (week 3 & 4 … )**

Next Operational CFS will plan to be implemented by Q1FY2011 with T126L64 atmospheric model resolution (CFSv2, 20??version) which is fully coupled with land, ocean and atmosphere (GFS+MOM4+NOAH), 4 members per day (using CFS reanalysis as initial conditions, one day older?), integrate out to 9 months. (check with Sura)

Future: initial perturbed CFS

# Upcoming important experiments

- T254L42(0-192hrs) experiments for new GFS – Dingchen/Mozheng/Jessie
  - On vapor machine
  - Tuning rescaling parameters (2D)
  - Possible test semi-Lagrangian method
- EnKF data assimilation set up – Mozheng/Dick
  - 6-hr cycling at T254L64
  - Hybrid with GSI analysis
  - Testing combined EnKF with ETR for ensemble initialization
  - Testing period: June 15 – September 15 2010
- Intraseasonal study – Malaquias
  - Continue week 3 & 4 and MJO study through GEFS retrospective runs
  - CFS couple system (new version – MOM4)
  - Future CFS/GEFS coupling system (building up now)
  - Post-process
- Post-process (NAEFS/NUOPC) – Bo
  - Adding new variables
  - Adding additional regions
  - Testing BEP (if it is available)