Preliminary experiment with next implementation of GEFS

Current Operational GEFS:

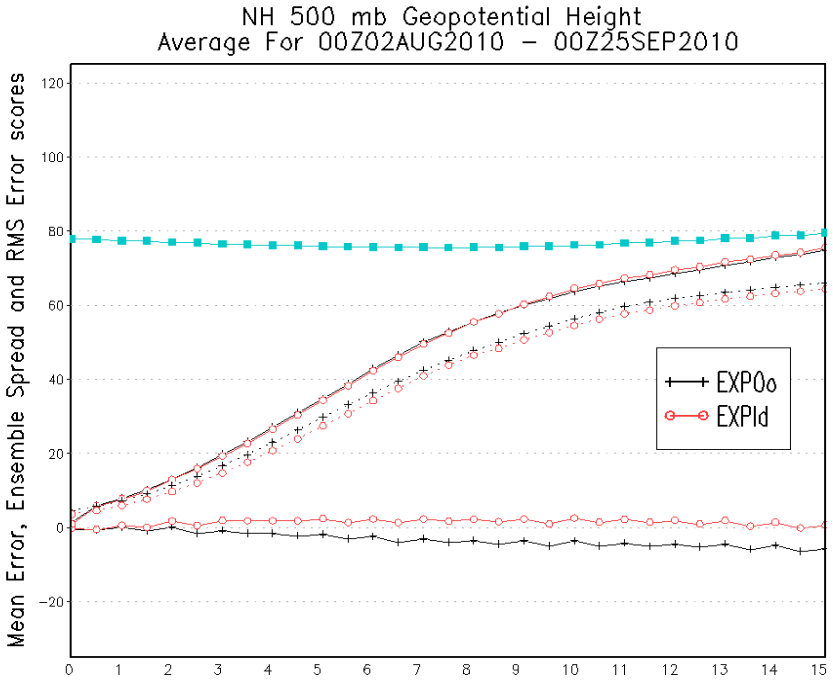
- T190L28 up to 384hr, ETR, STTP
- Previous version of GFS model

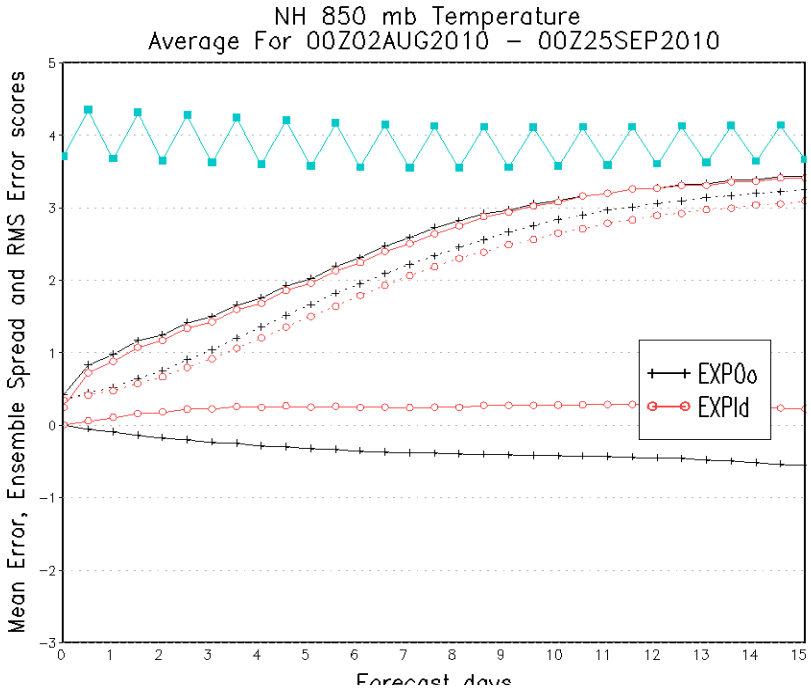
Updated GFS model:

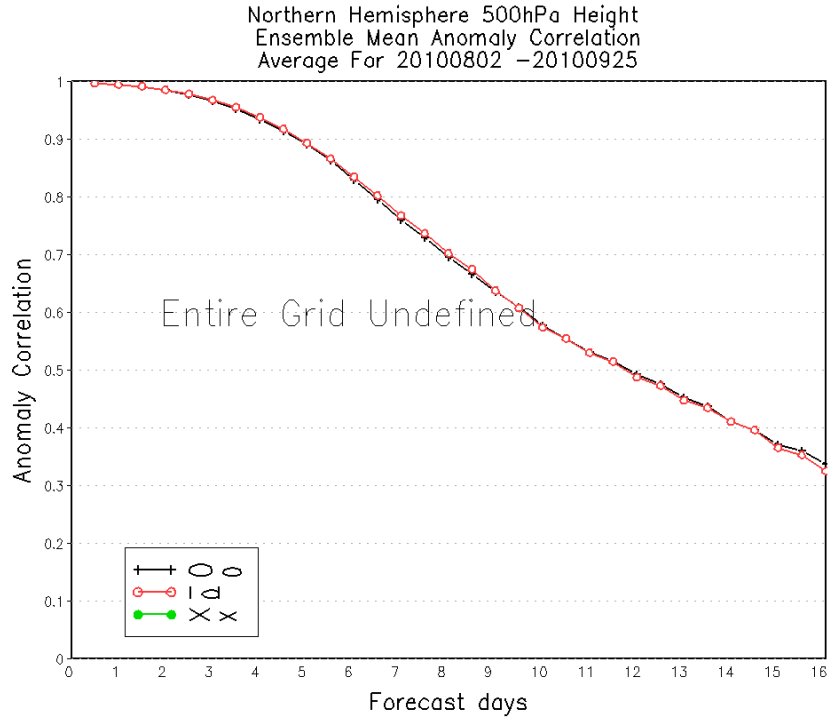
- Improved physics
- Significant improvements in fcst
- Implemented July 28, 2010
- Not used in operational GEFS

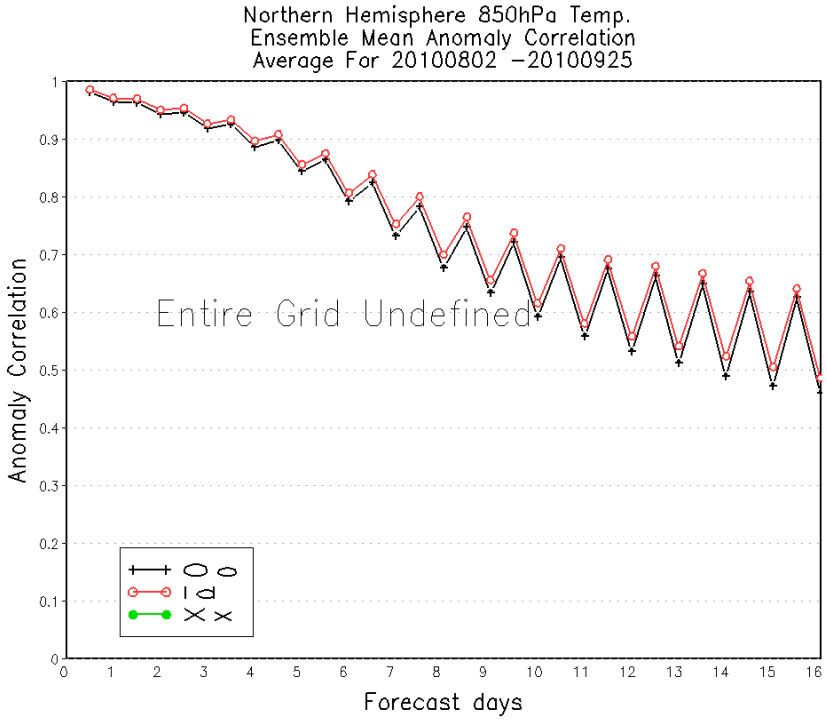
NEXT Implementation of GEFS

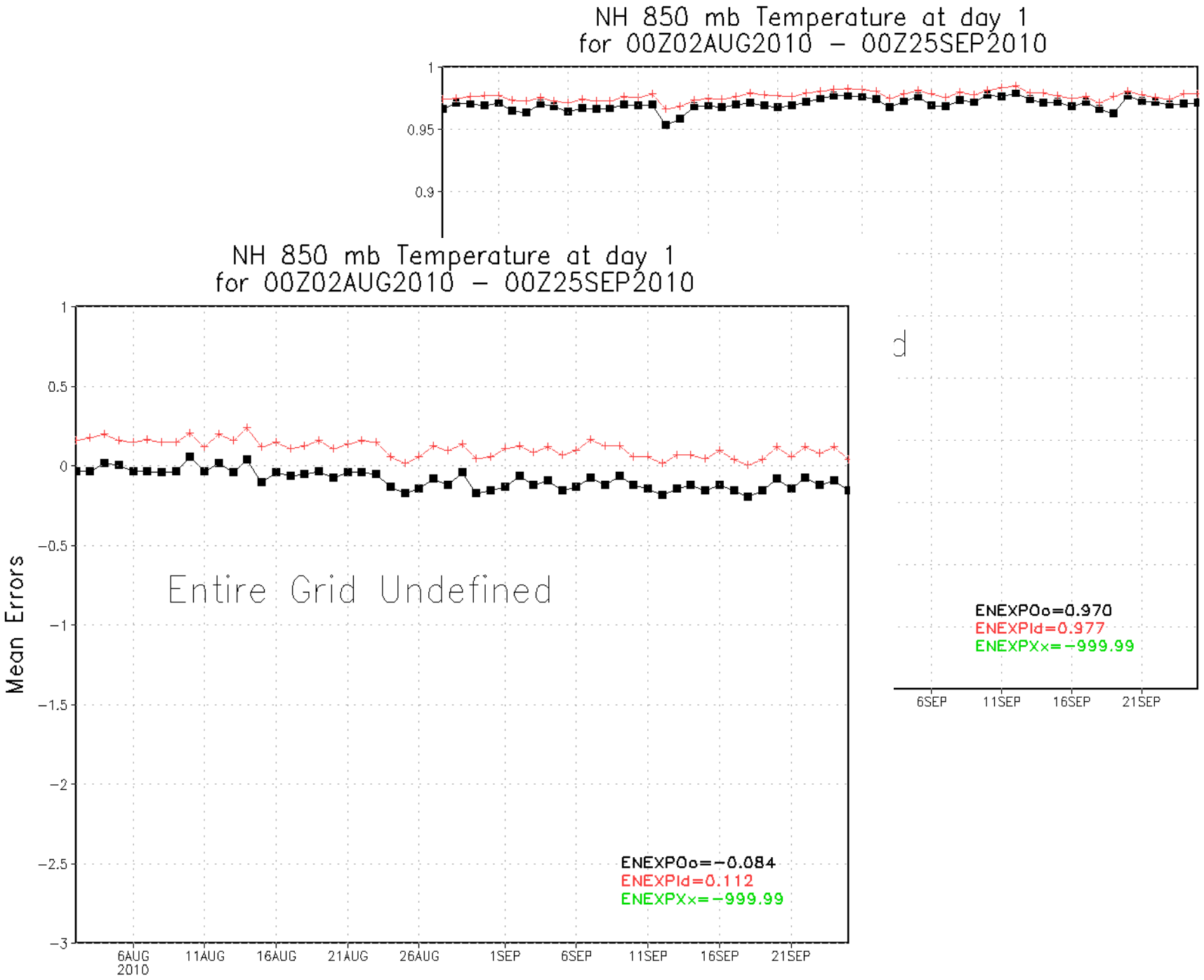
- Planned for Q4 2011
- Increase Resolution:
  - T254L42 for 0-192hr, and the T190L42
- Improved ETR
  - Changing value of rescaling parameter
  - Allowing vertical variation of scaling parameter
- Improved STTP (formerly SPS)
  - STTP parameters added to GFS script/code to allow for tunning
  - STTP parameters reset for model truncation at T192hr
- Other changes?


NH 500 mb Geopotential Height
Average For 00Z02AUG2010 - 00Z25SEP2010
Mean Error, Ensemble Spread and RMS Error scores
EXP0o
EXPId


NH 850 mb Temperature
Average For 00Z02AUG2010 - 00Z25SEP2010
Mean Error, Ensemble Spread and RMS Error scores
EXP0o
EXPId


Northern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20100802 -20100925
Entire Grid Undefined
Anomaly Correlation
Forecast days


Northern Hemisphere 850hPa Temp.
Ensemble Mean Anomaly Correlation
Average For 20100802 -20100925
Entire Grid Undefined
Anomaly Correlation
Forecast days


NH 850 mb Temperature at day 1
for 00Z02AUG2010 – 00Z25SEP2010
Mean Errors
Entire Grid Undefined
ENEXPOo=-0.084
ENEXPId=0.112
ENEXPXx=-999.99
6AUG
2010
11AUG
16AUG
21AUG
26AUG
1SEP
6SEP
11SEP
16SEP
21SEP
NH 850 mb Temperature at day 1
for 00Z02AUG2010 – 00Z25SEP2010
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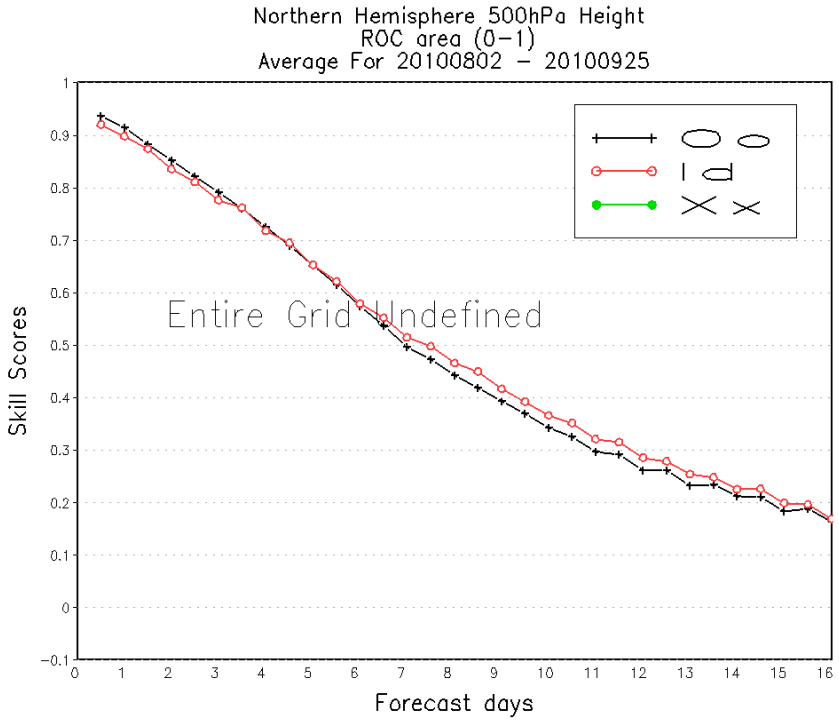
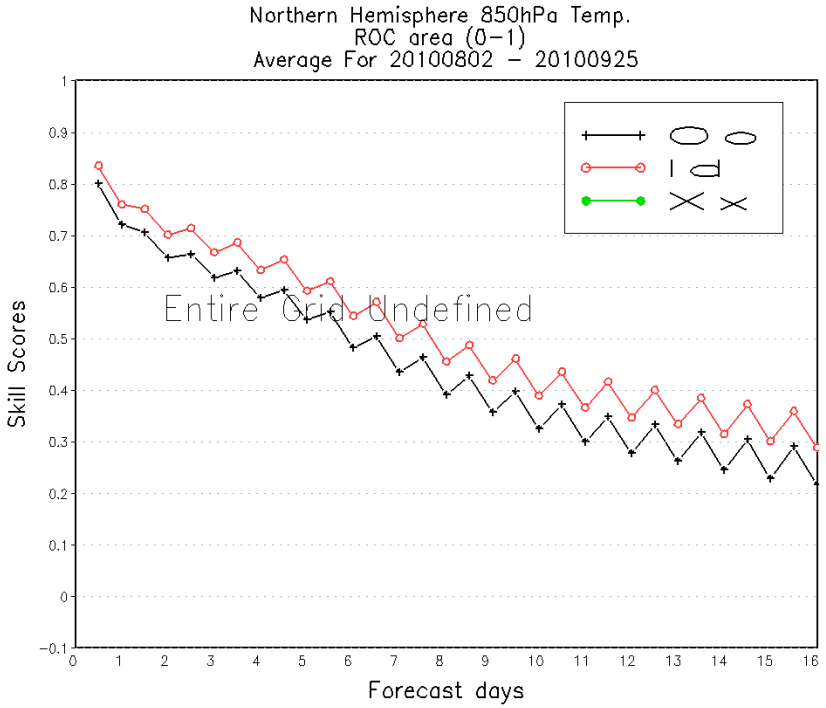
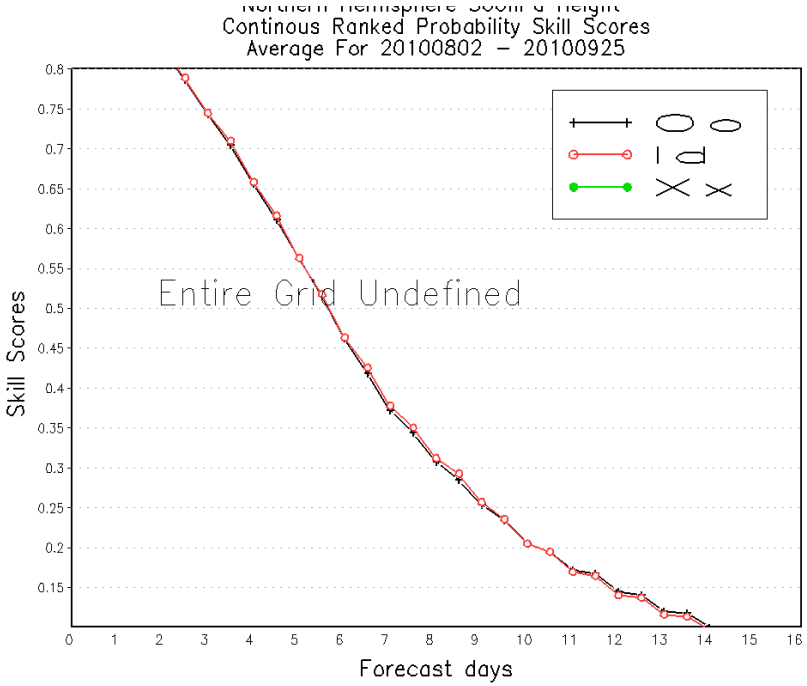
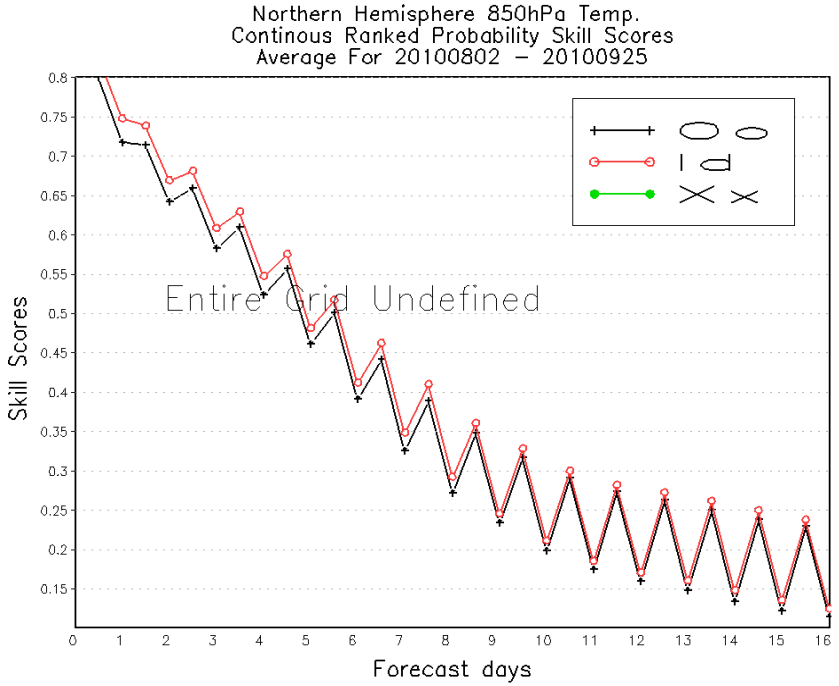
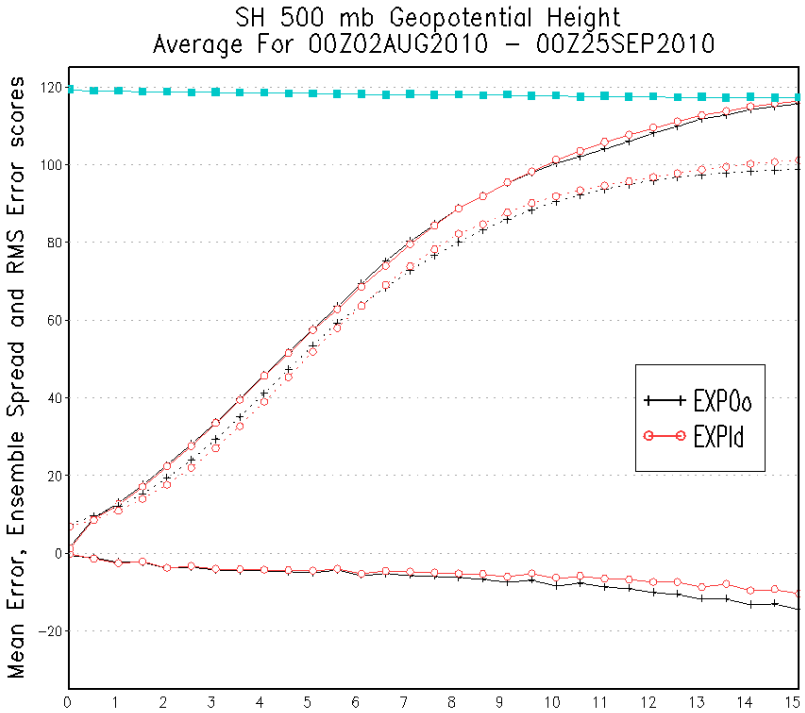
ENEXPId=0.977
ENEXPXx=-999.99
6SEP
11SEP
16SEP
21SEP

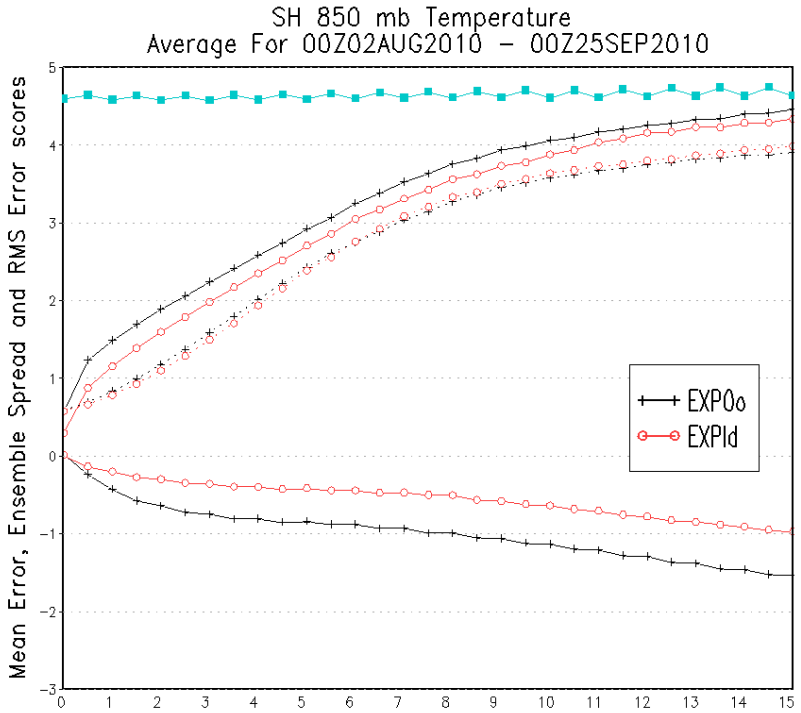

Northern Hemisphere 500hPa Height
ROC area (0-1)
Average For 20100802 - 20100925
Entire Grid Undefined
Skill Scores
Forecast days

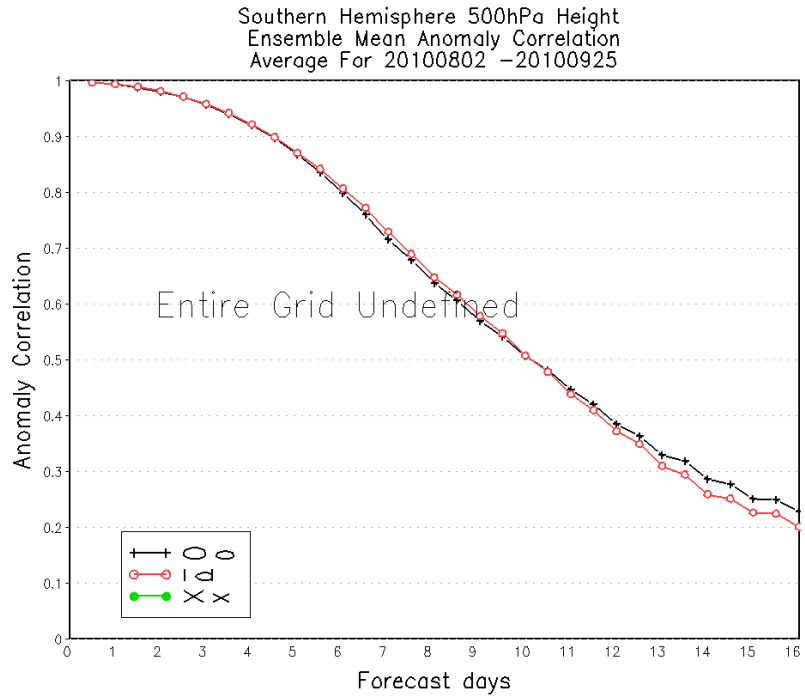

Northern Hemisphere 850hPa Temp.
ROC area (0-1)
Average For 20100802 - 20100925
Entire Grid Undefined
Skill Scores
Forecast days

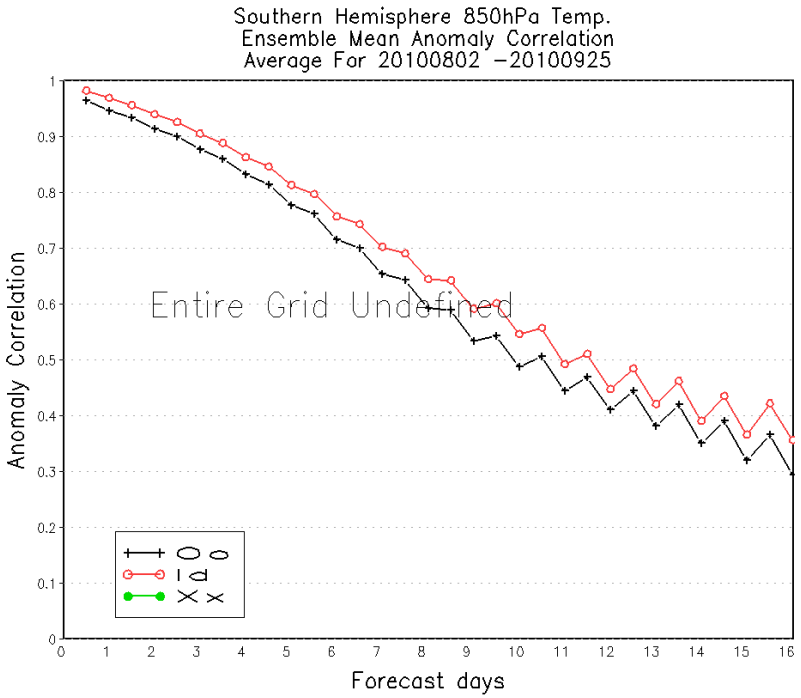

Continous Ranked Probability Skill Scores
Average For 20100802 - 20100925
Entire Grid Undefined
Skill Scores
Forecast days

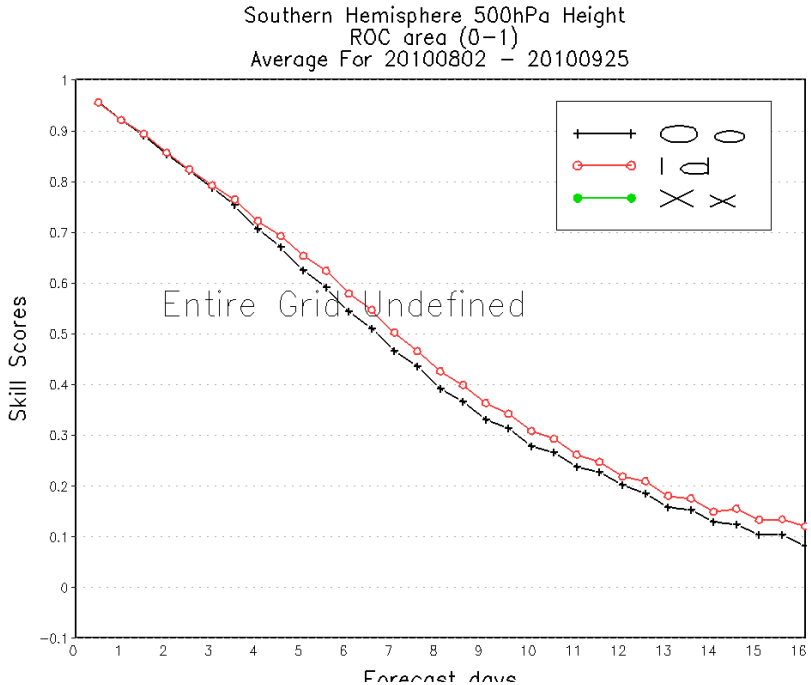

Northern Hemisphere 850hPa Temp.
Continous Ranked Probability Skill Scores
Average For 20100802 - 20100925
Entire Grid Undefined
Skill Scores
Forecast days

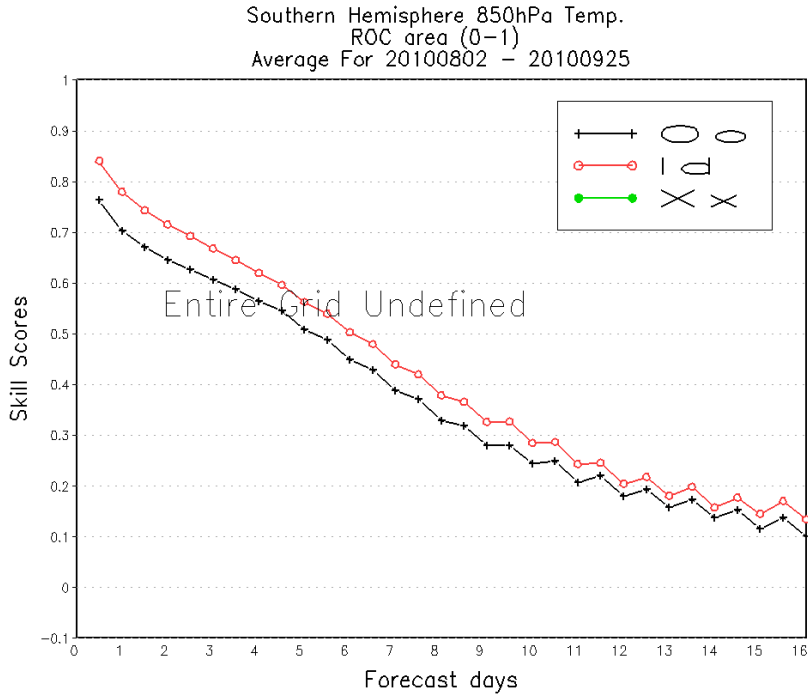

SH 500 mb Geopotential Height
Average For 00Z02AUG2010 - 00Z25SEP2010
Mean Error, Ensemble Spread and RMS Error scores
EXP0o
EXPId

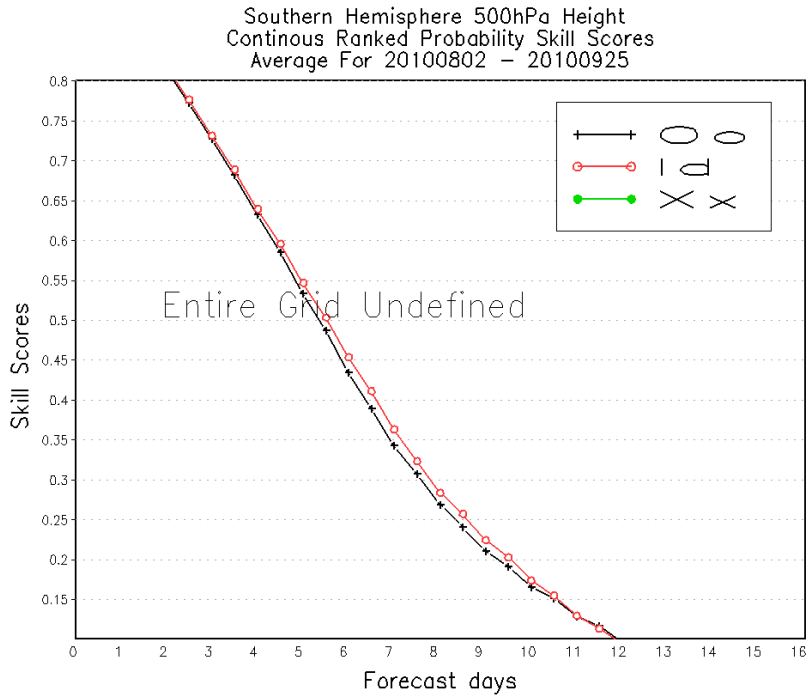

SH 850 mb Temperature
Average For 00Z02AUG2010 - 00Z25SEP2010
Mean Error, Ensemble Spread and RMS Error scores
EXP0o
EXPId

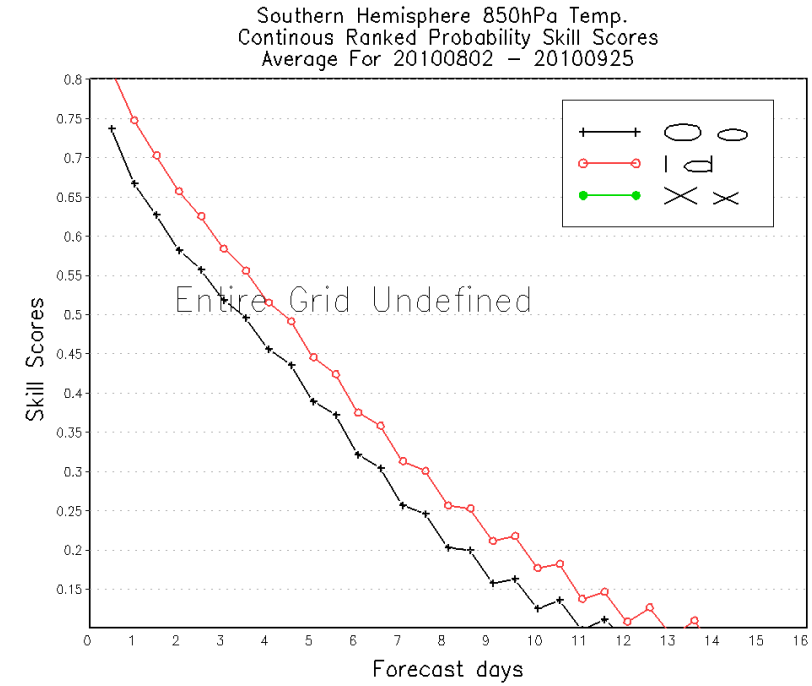

Southern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20100802 -20100925
Entire Grid Undefined
Anomaly Correlation
Forecast days

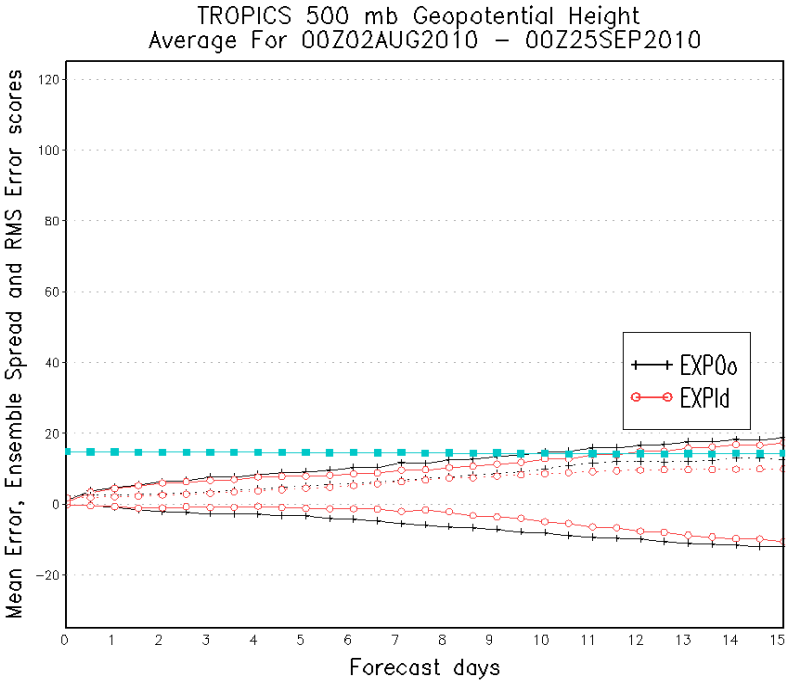

Southern Hemisphere 850hPa Temp.
Ensemble Mean Anomaly Correlation
Average For 20100802 -20100925
Entire Grid Undefined
Anomaly Correlation
Forecast days

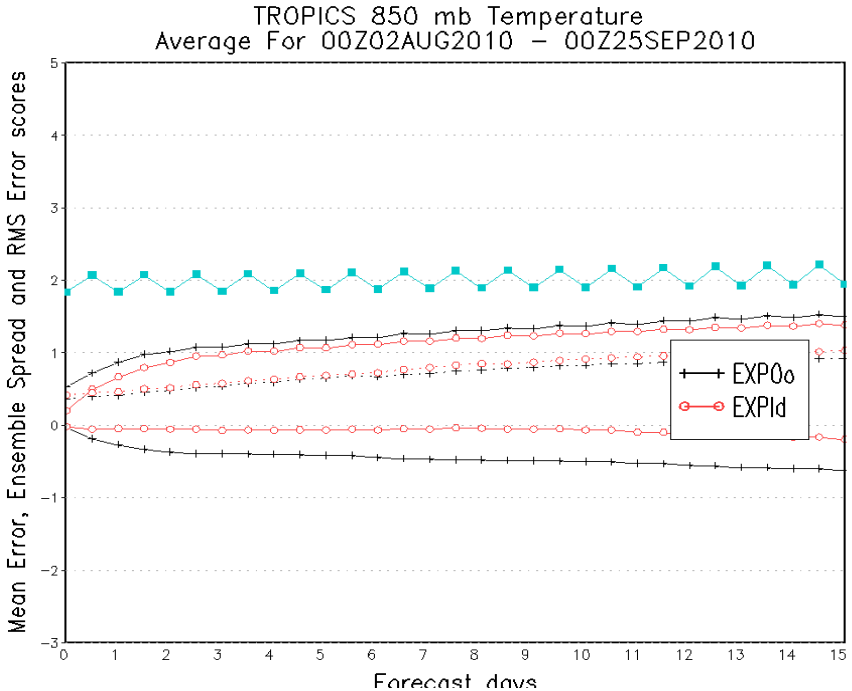

Southern Hemisphere 500hPa Height
ROC area (0-1)
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

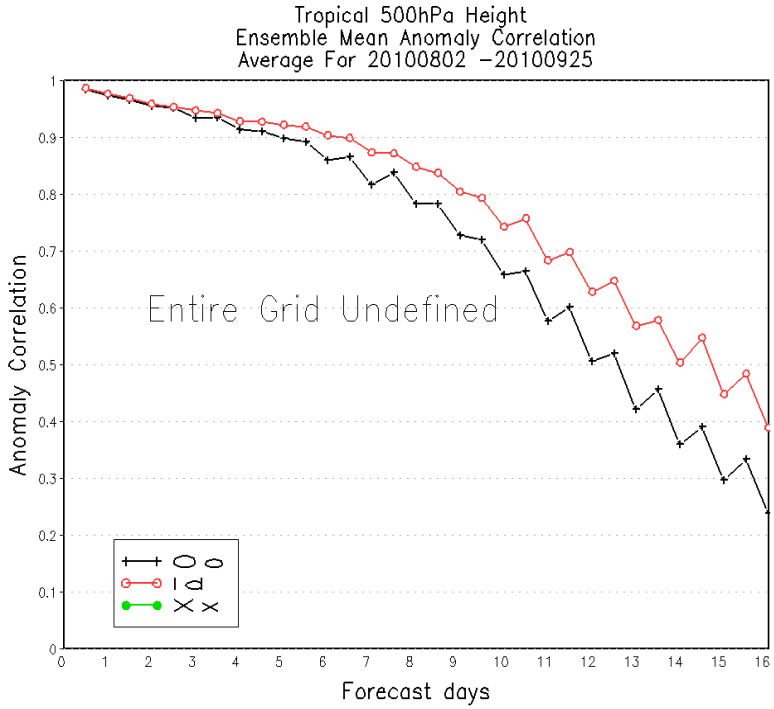

Southern Hemisphere 850hPa Temp.
ROC area (0-1)
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

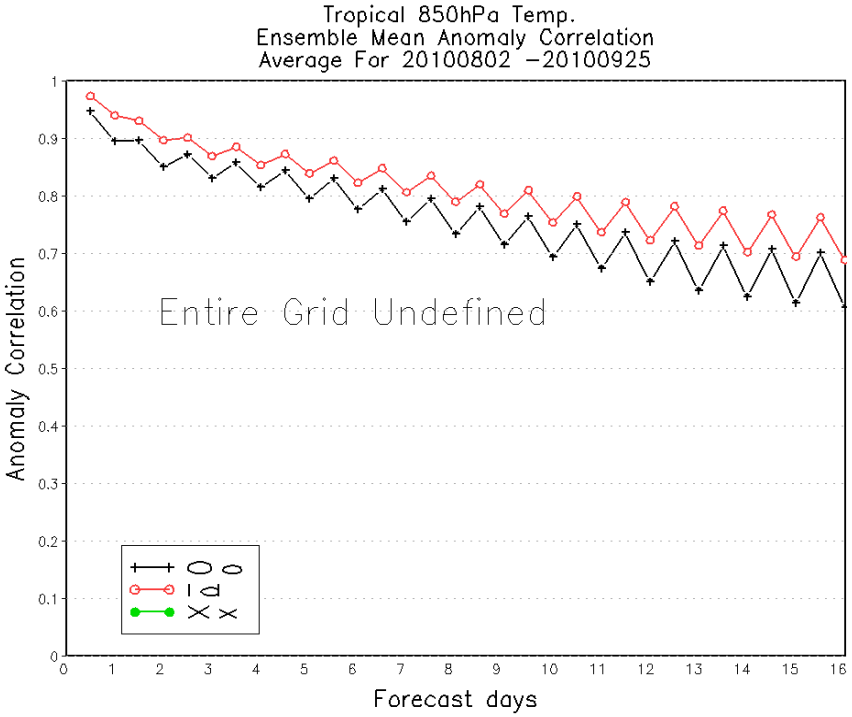

Southern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

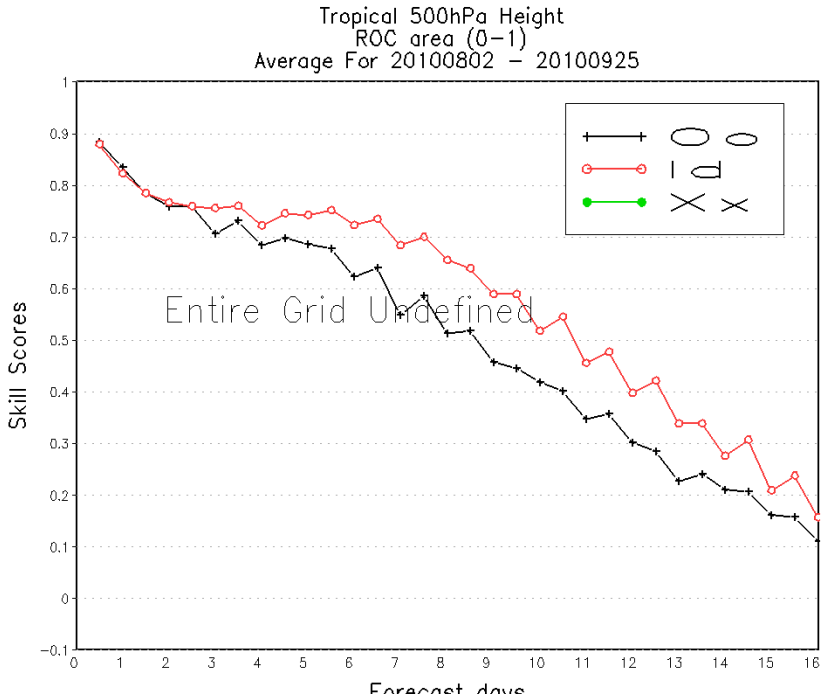

Southern Hemisphere 850hPa Temp.
Continous Ranked Probability Skill Scores
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

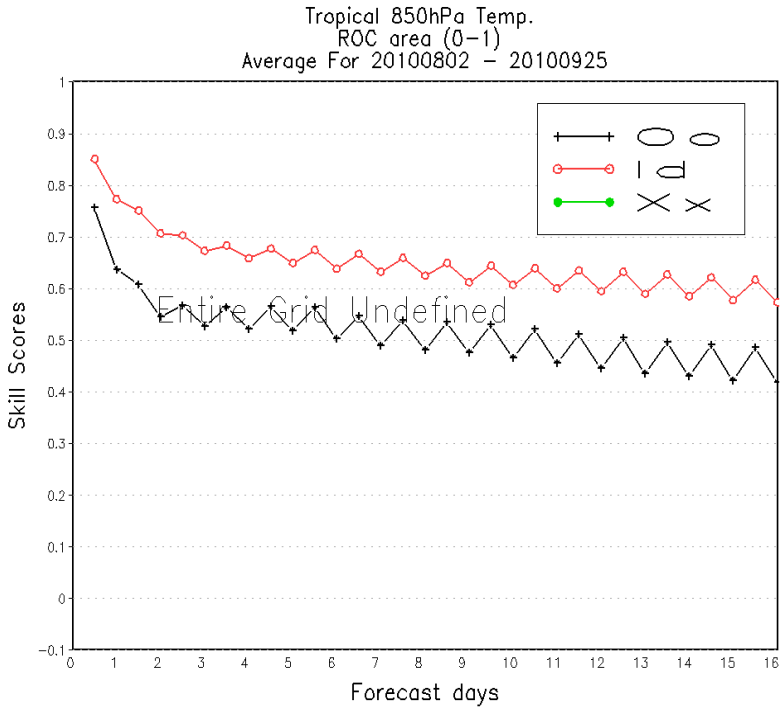

TROPICS 500 mb Geopotential Height
Average For 00Z02AUG2010 - 00Z25SEP2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXP0o
EXPId

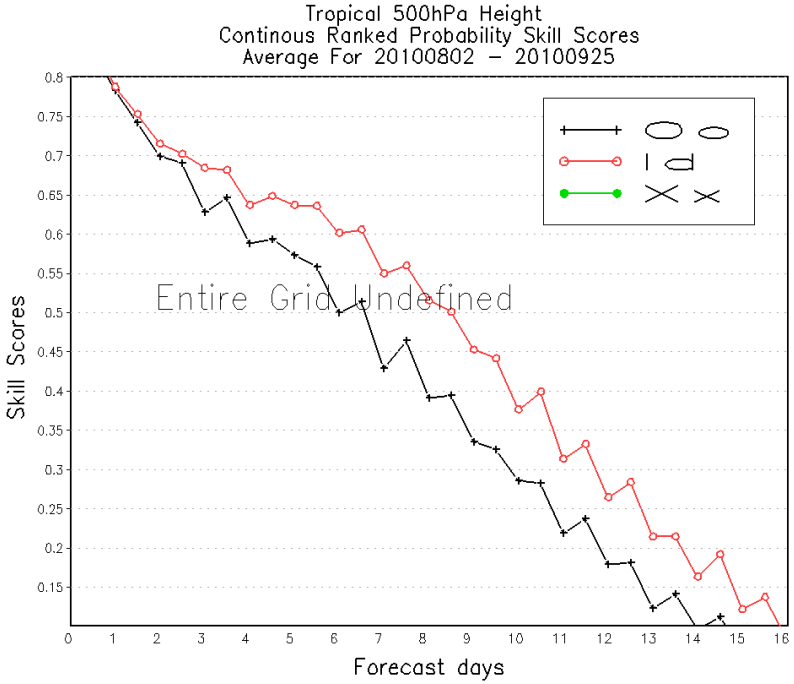

TROPICS 850 mb Temperature
Average For 00Z02AUG2010 - 00Z25SEP2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXP0o
EXPId

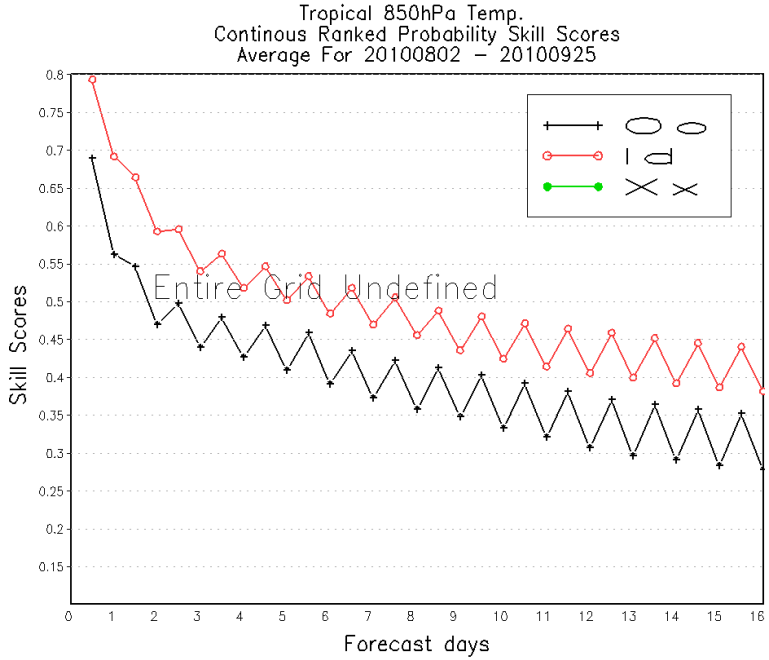

Tropical 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20100802 -20100925
Anomaly Correlation
Forecast days
Entire Grid Undefined


Tropical 850hPa Temp.
Ensemble Mean Anomaly Correlation
Average For 20100802 -20100925
Anomaly Correlation
Forecast days
Entire Grid Undefined


Tropical 500hPa Height
ROC area (0-1)
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

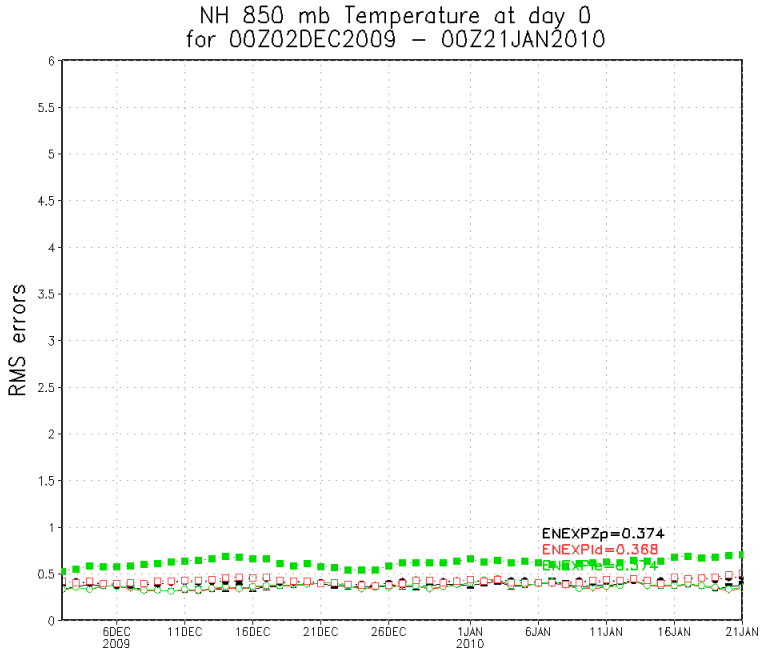

Tropical 850hPa Temp.
ROC area (0-1)
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

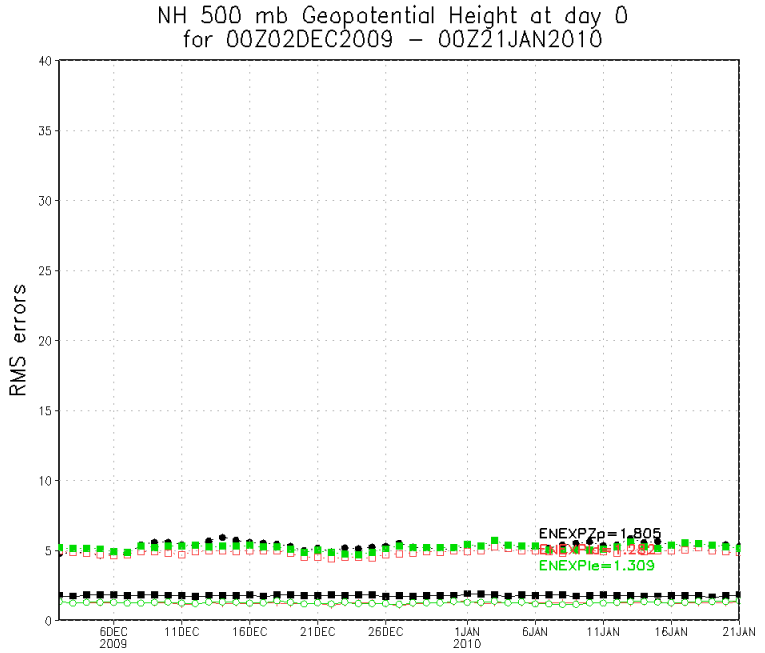

Tropical 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

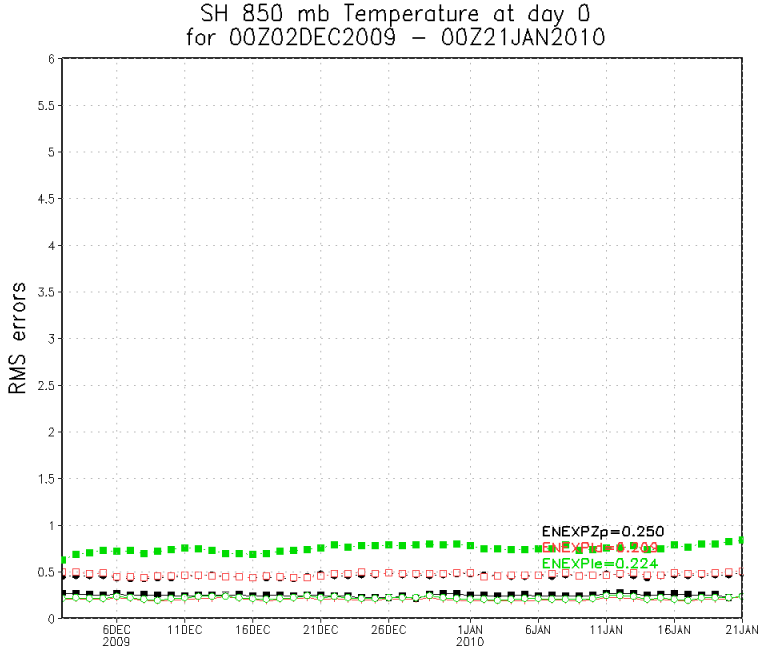

Tropical 850hPa Temp.
Continous Ranked Probability Skill Scores
Average For 20100802 - 20100925
Skill Scores
Entire Grid Undefined
Forecast days

Summary and Discussions
Bench Mark, Summer Season

- Generally, there are significant improvements.
- Less improvements for NH, especially Z500.
- Lack of improvement in NH is mainly due to building up of positive bias in the new GFS, especially in T850.
- NH fcst can be improved with GFS bug-fix?
  - –New test started
- Improvement is primarily due to use of NEW GFS, or its “delayed” implementation in GEFS.
- Reduced negative bias by new GFS.
- The two versions of ET, different in TR t850
  - –Production: new analysis + old GFS model
  - –Bench mark: new analysis + new GFS model


NH 850 mb Temperature at day 0
for 00Z02DEC2009 – 00Z21JAN2010
RMS errors
ENEXPZp=0.374
ENEXPId=0.368
ENEXPIe=0.374
6DEC 2009
11DEC
16DEC
21DEC
26DEC
1JAN 2010
6JAN
11JAN
16JAN
21JAN


NH 500 mb Geopotential Height at day 0
for 00Z02DEC2009 – 00Z21JAN2010
RMS errors
ENEXPZp=1.805
ENEXPIe=1.309
6DEC 2009
11DEC
16DEC
21DEC
26DEC
1JAN 2010
6JAN
11JAN
16JAN
21JAN


SH 850 mb Temperature at day 0
for 00Z02DEC2009 – 00Z21JAN2010
RMS errors
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ENEXPIe=0.224
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11DEC
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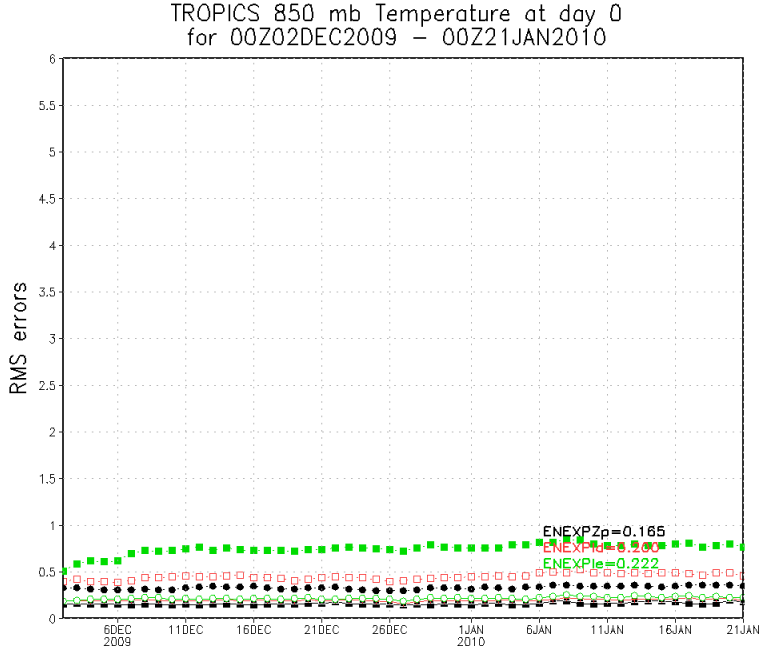
26DEC
1JAN 2010
6JAN
11JAN
16JAN
21JAN


TROPICS 850 mb Temperature at day 0
for 00Z02DEC2009 – 00Z21JAN2010
RMS errors
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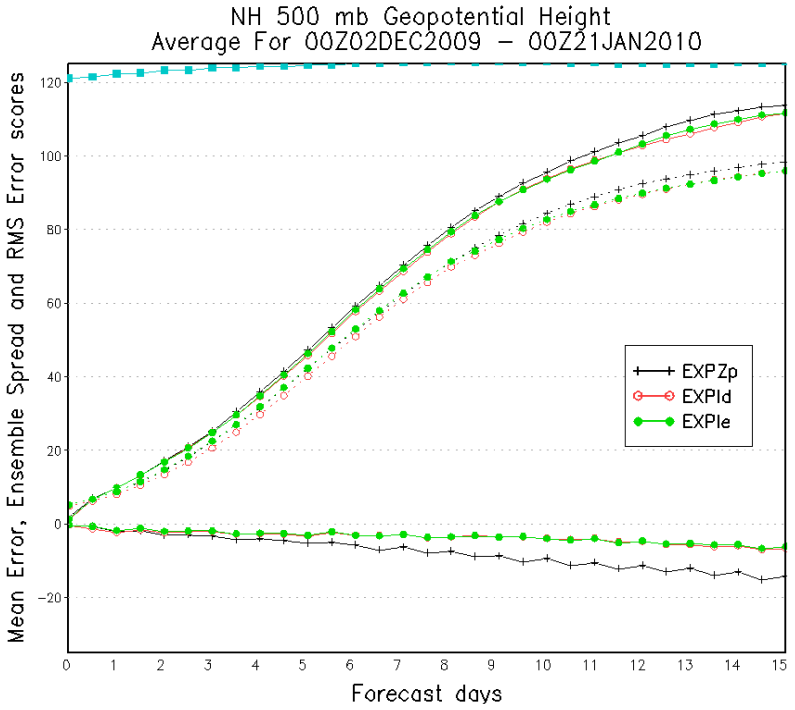
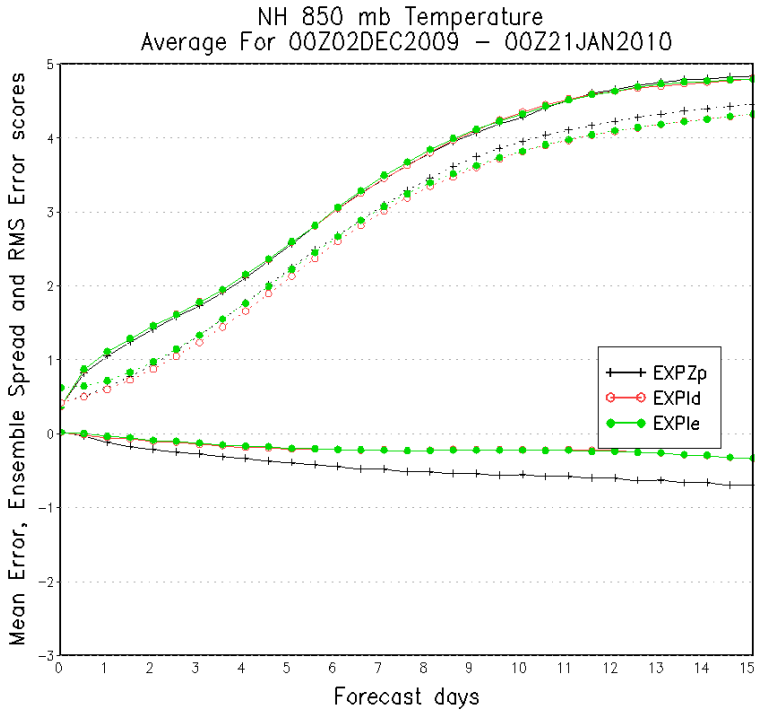
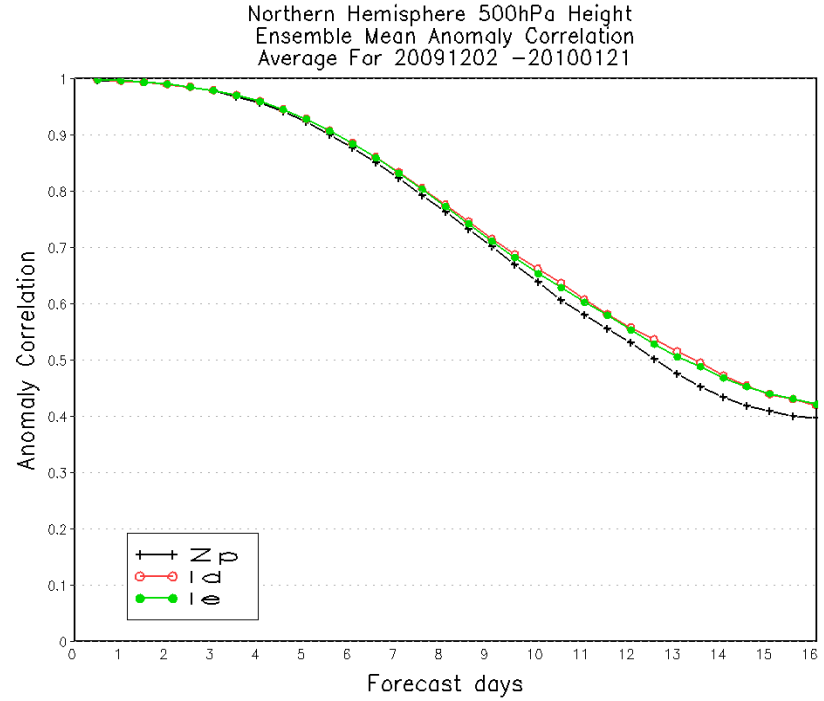
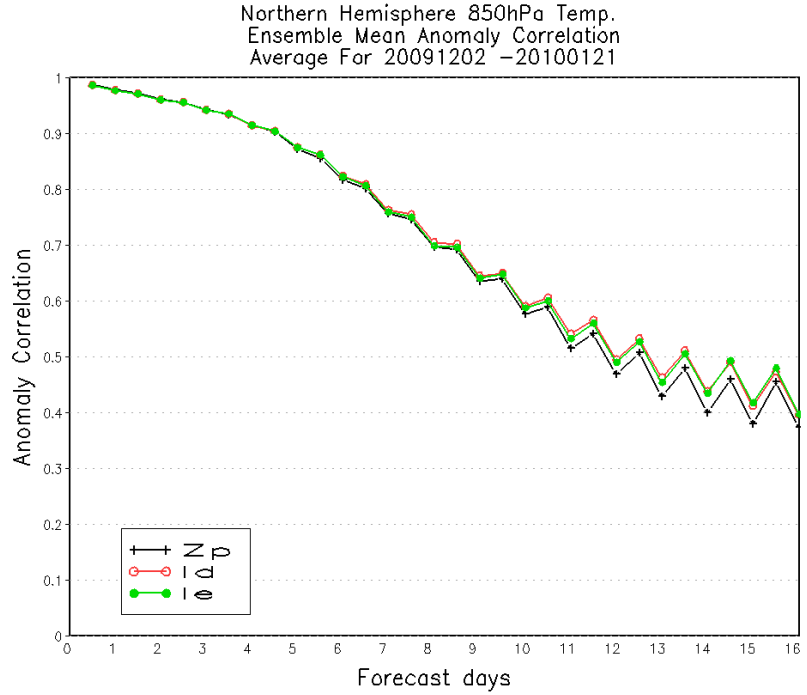
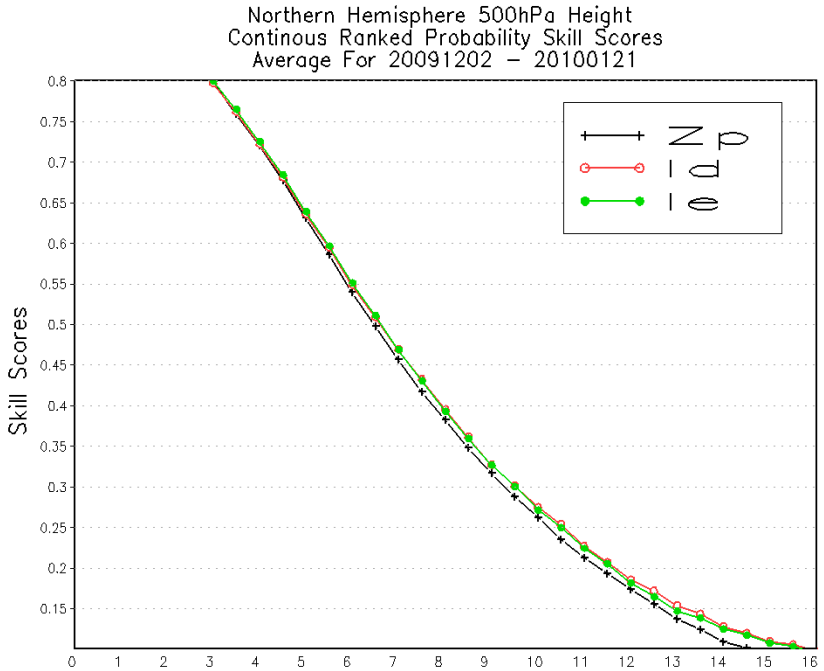
6DEC 2009
11DEC
16DEC
21DEC
26DEC
1JAN 2010
6JAN
11JAN
16JAN
21JAN

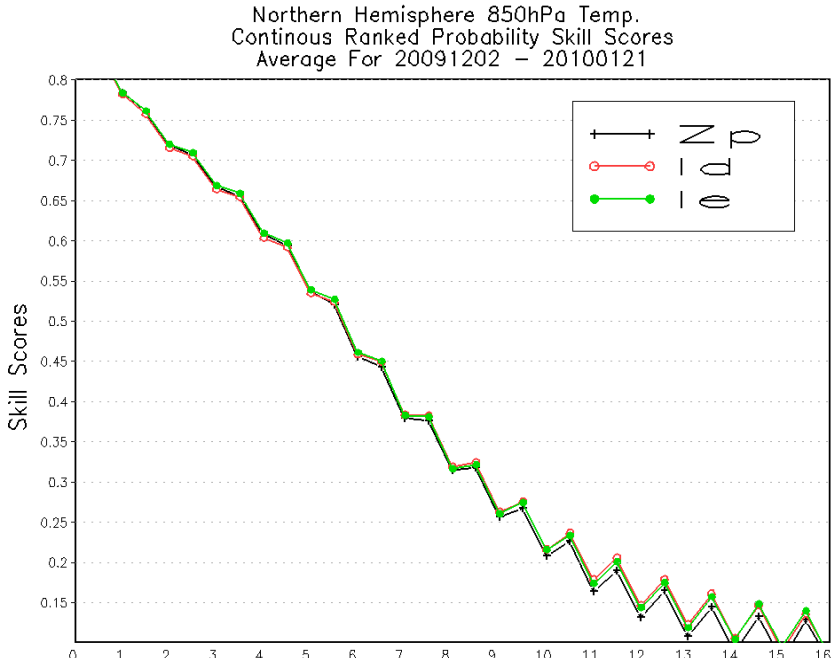

NH 500 mb Geopotential Height
Average For 00Z02DEC2009 – 00Z21JAN2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXPZp
EXPId
EXPIe

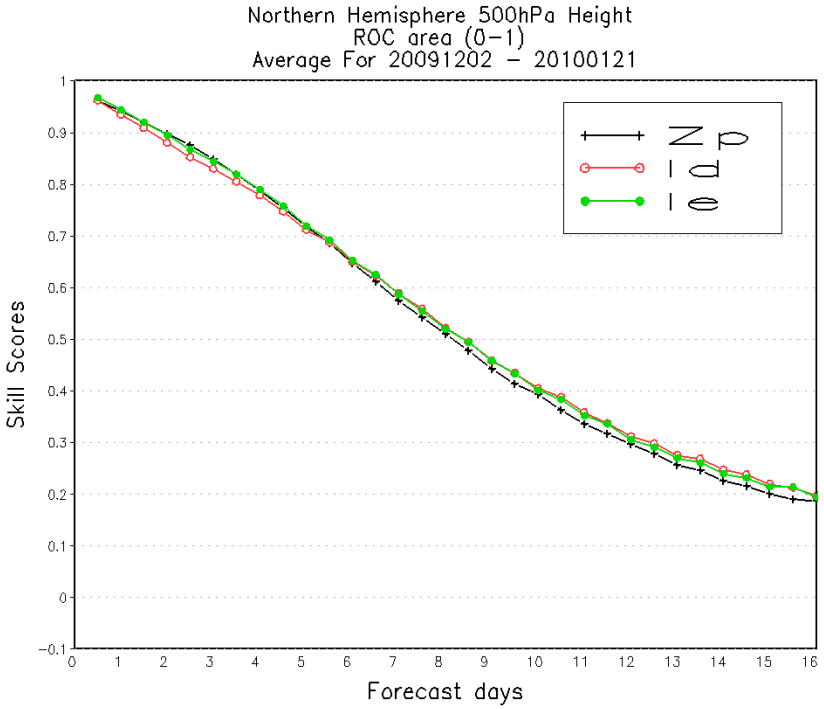

NH 850 mb Temperature
Average For 00Z02DEC2009 – 00Z21JAN2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXPZp
EXPId
EXPIe

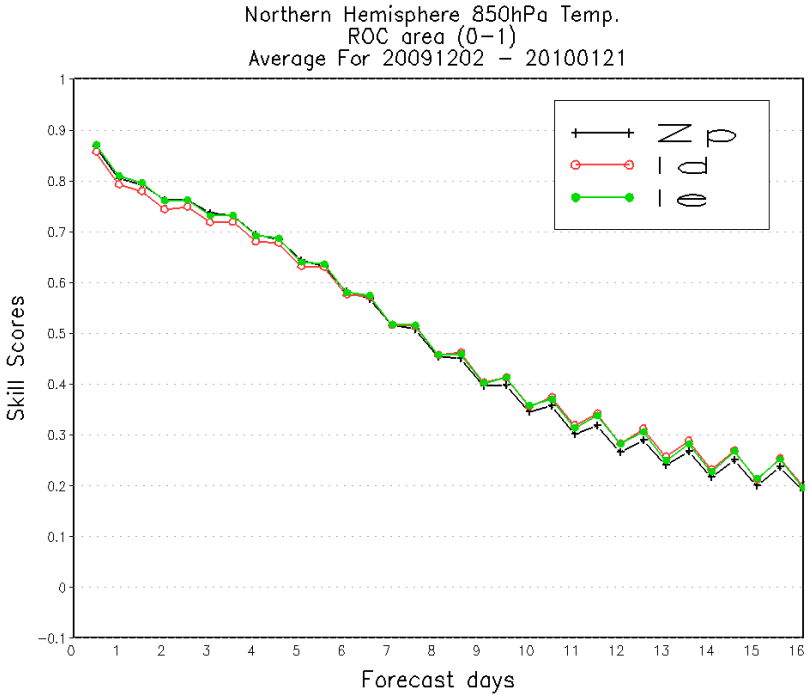

Northern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20091202 –20100121
Anomaly Correlation
Forecast days

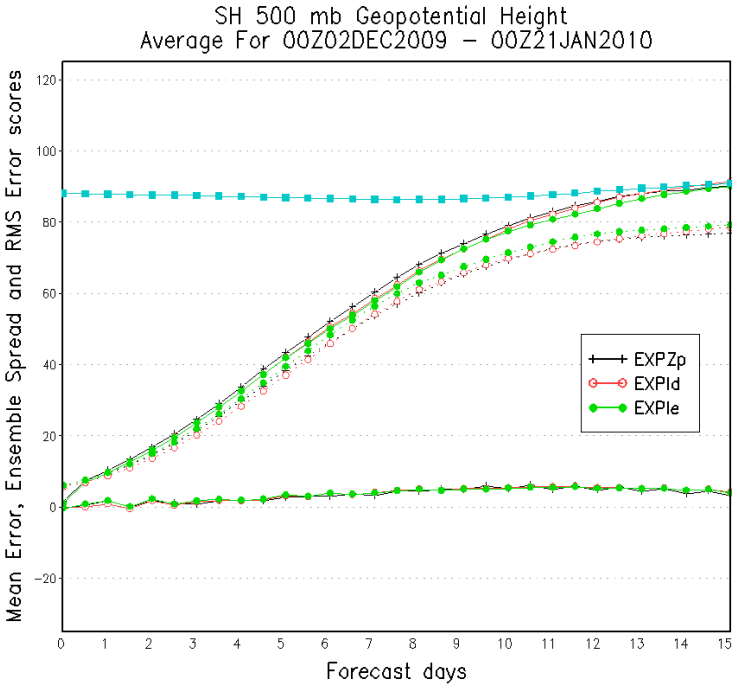

Northern Hemisphere 850hPa Temp.
Ensemble Mean Anomaly Correlation
Average For 20091202 –20100121
Anomaly Correlation
Forecast days

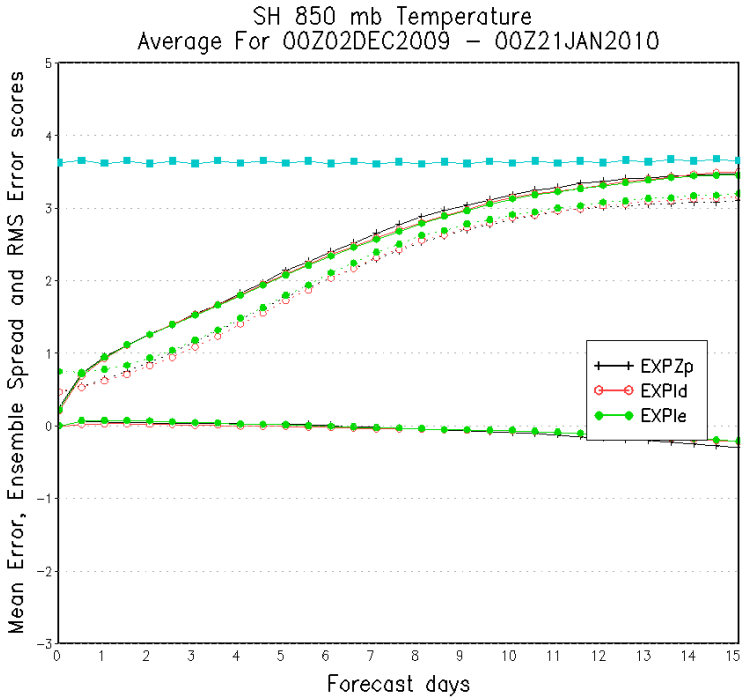

Northern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20091202 – 20100121
Skill Scores
Np
Id
Ie

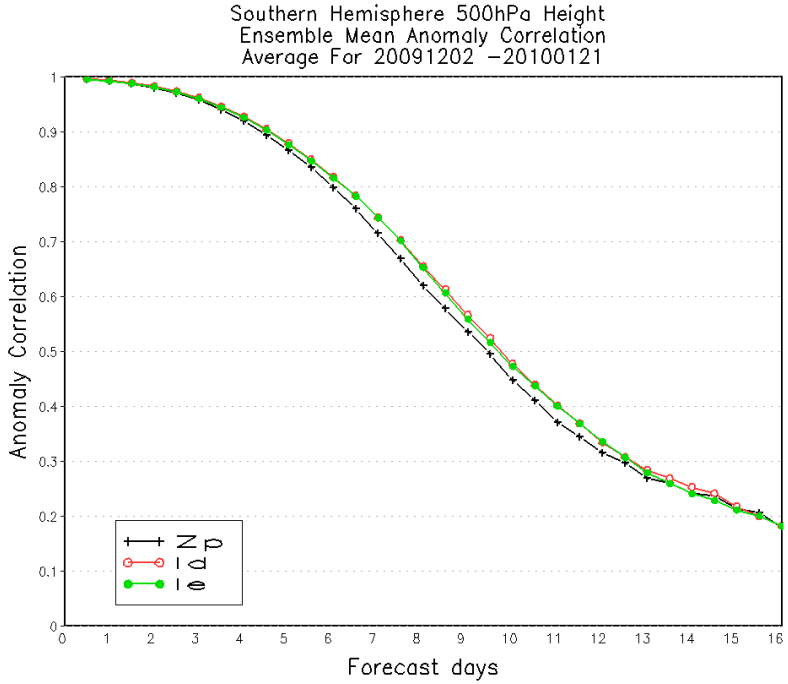

Northern Hemisphere 850hPa Temp.
Continous Ranked Probability Skill Scores
Average For 20091202 – 20100121
Skill Scores
Np
Id
Ie

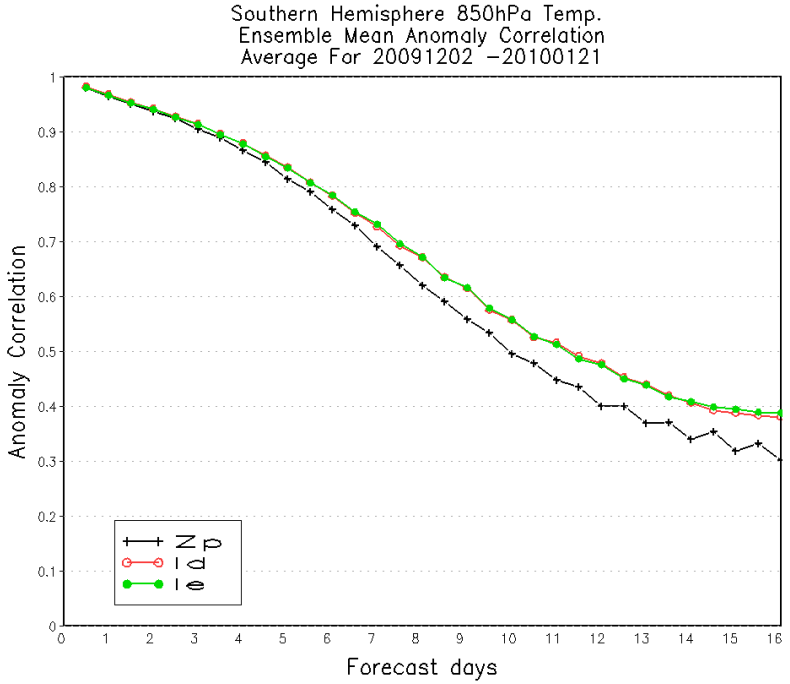

Northern Hemisphere 500hPa Height
ROC area (0–1)
Average For 20091202 – 20100121
Skill Scores
Np
Id
Ie
Forecast days

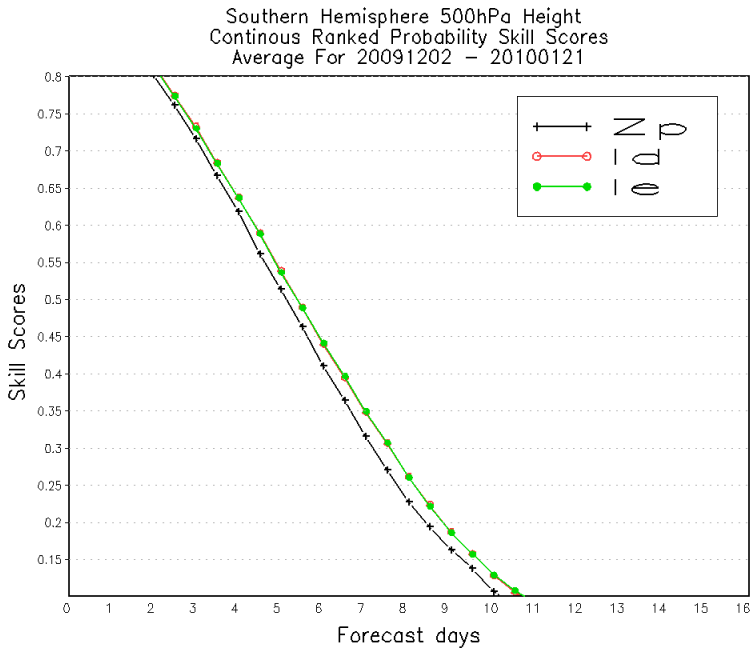

Northern Hemisphere 850hPa Temp.
ROC area (0–1)
Average For 20091202 – 20100121
Skill Scores
Np
Id
Ie
Forecast days

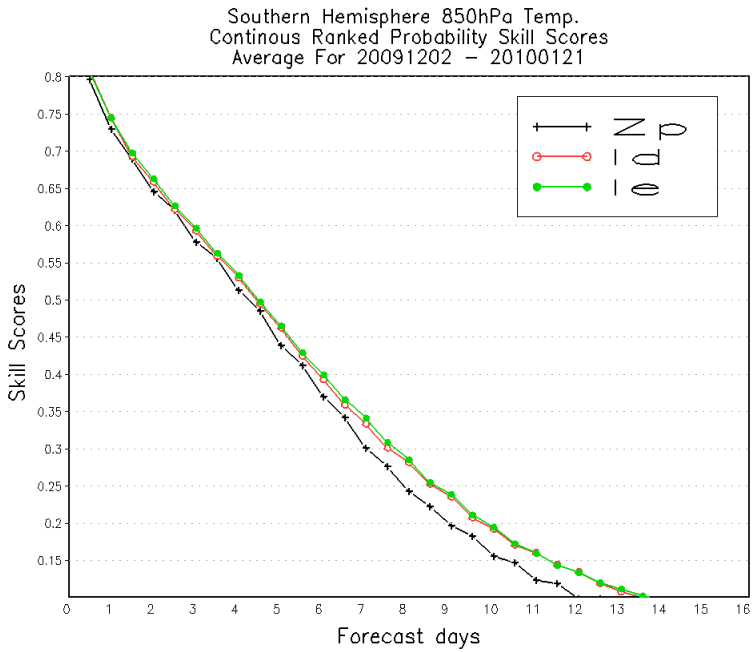

SH 500 mb Geopotential Height
Average For 00Z02DEC2009 – 00Z21JAN2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXPZp
EXPId
EXPIe

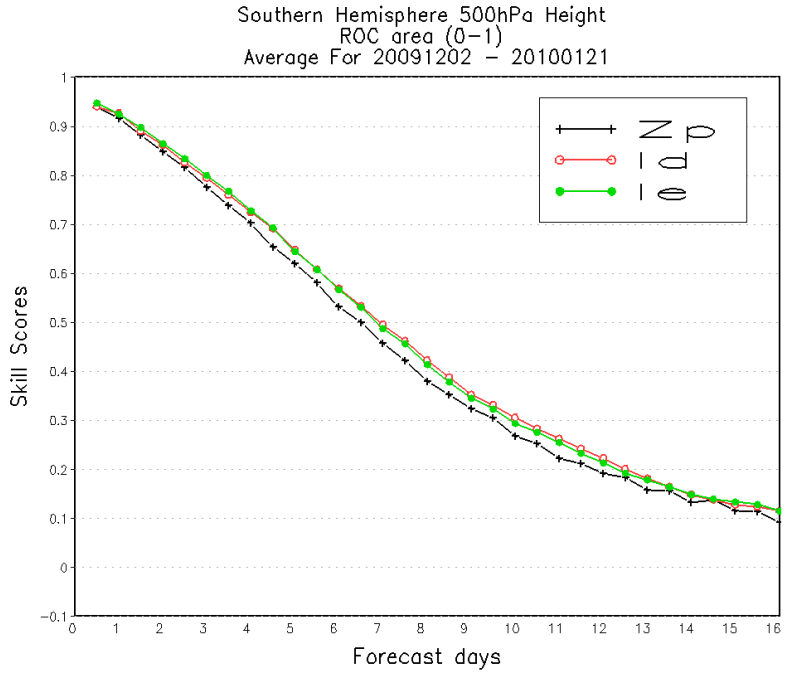

SH 850 mb Temperature
Average For 00Z02DEC2009 – 00Z21JAN2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXPZp
EXPId
EXPIe

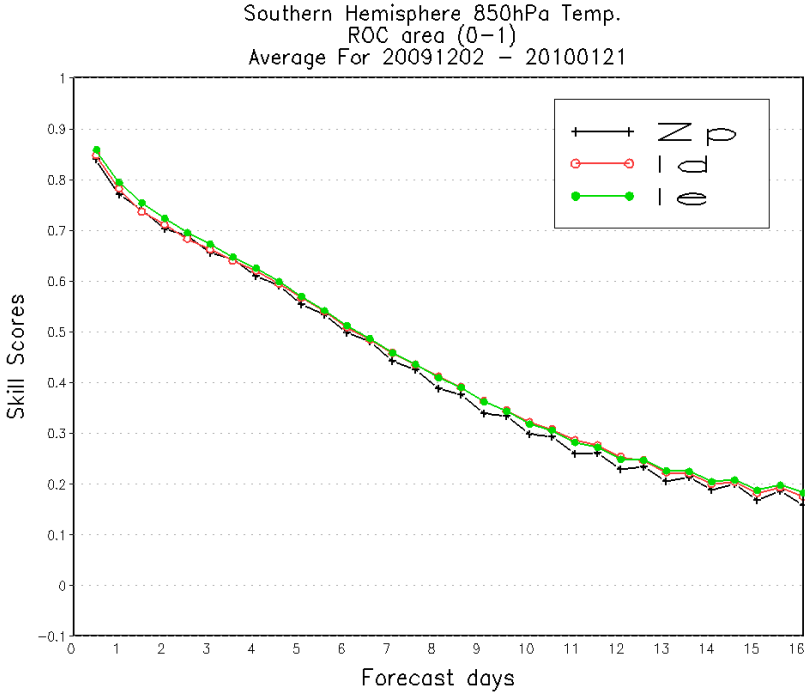

Southern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20091202 –20100121
Anomaly Correlation
Forecast days

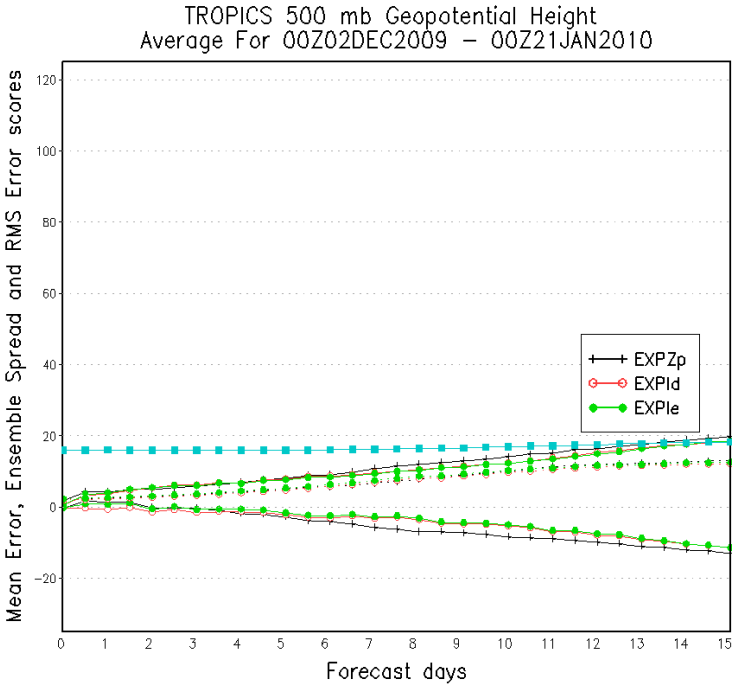

Southern Hemisphere 850hPa Temp.
Ensemble Mean Anomaly Correlation
Average For 20091202 –20100121
Anomaly Correlation
Forecast days

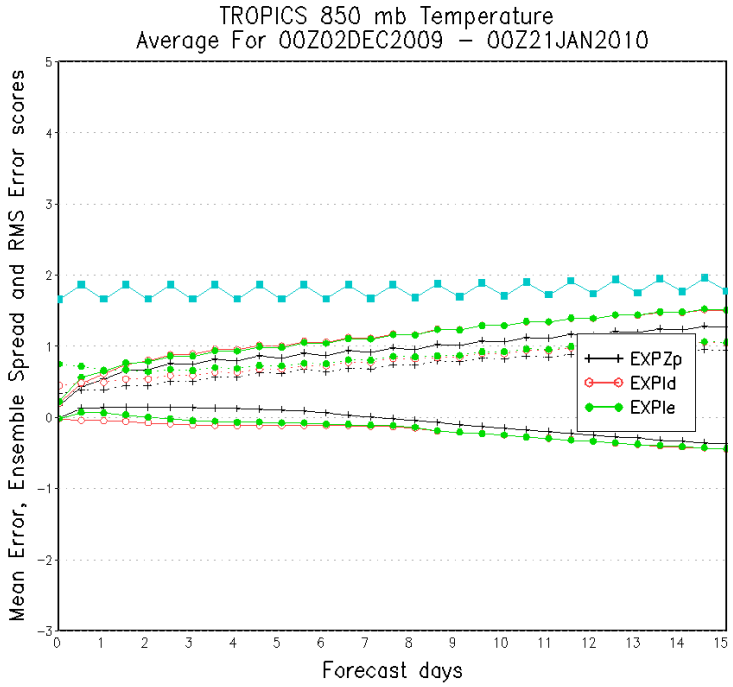

Southern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20091202 – 20100121
Skill Scores
Forecast days
Np
Id
Ie

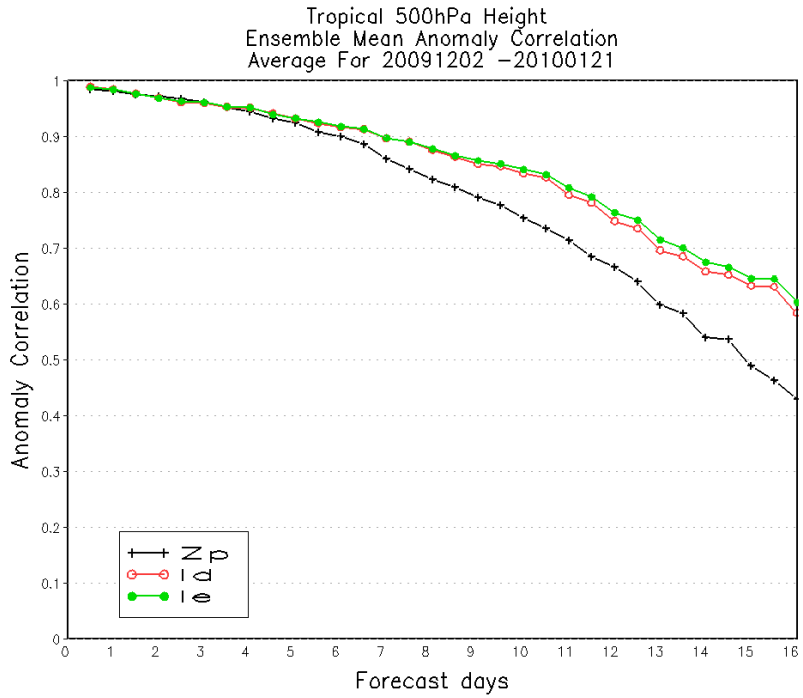

Southern Hemisphere 850hPa Temp.
Continous Ranked Probability Skill Scores
Average For 20091202 – 20100121
Skill Scores
Forecast days
Np
Id
Ie

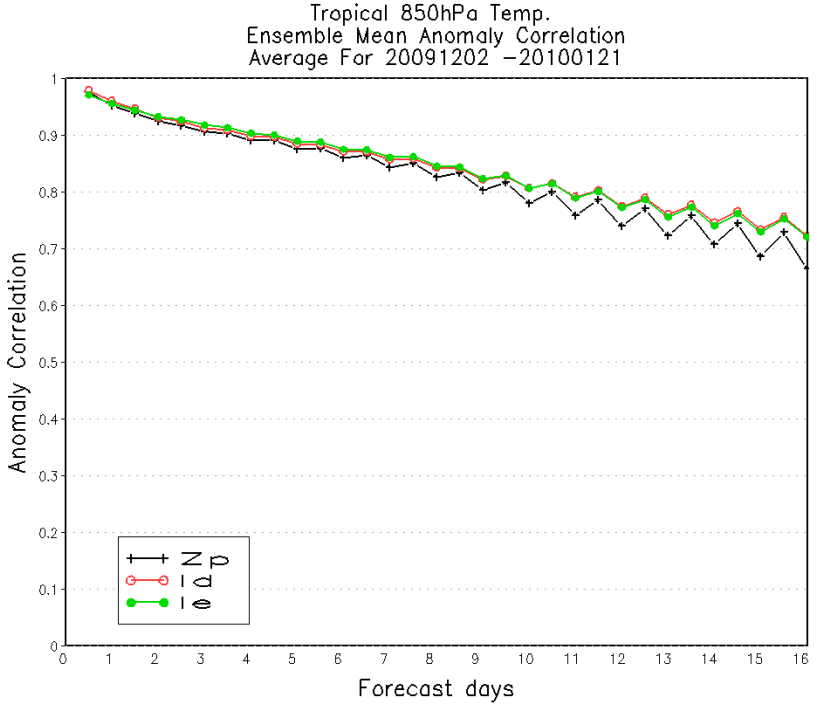

Southern Hemisphere 500hPa Height
ROC area (0–1)
Average For 20091202 – 20100121
Skill Scores
Forecast days
Np
Id
Ie

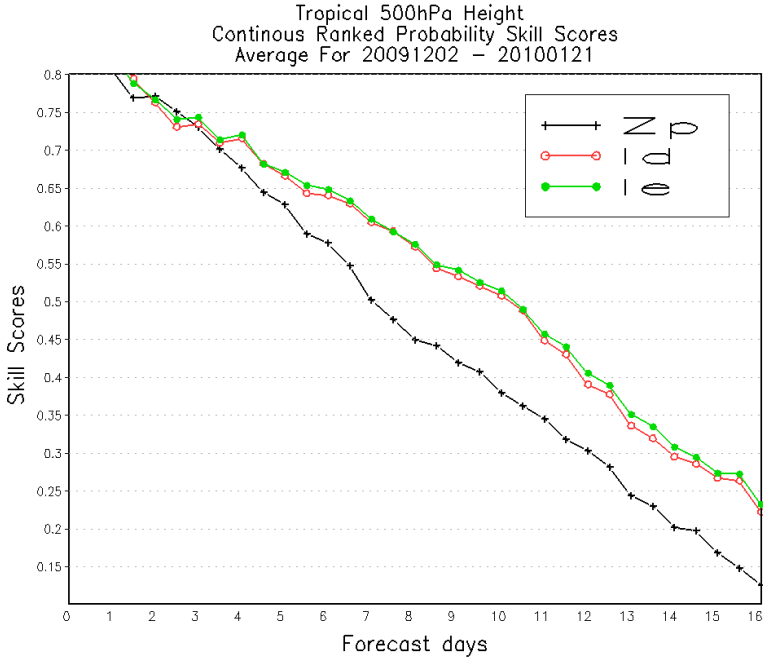

Southern Hemisphere 850hPa Temp.
ROC area (0–1)
Average For 20091202 – 20100121
Skill Scores
Forecast days
Np
Id
Ie

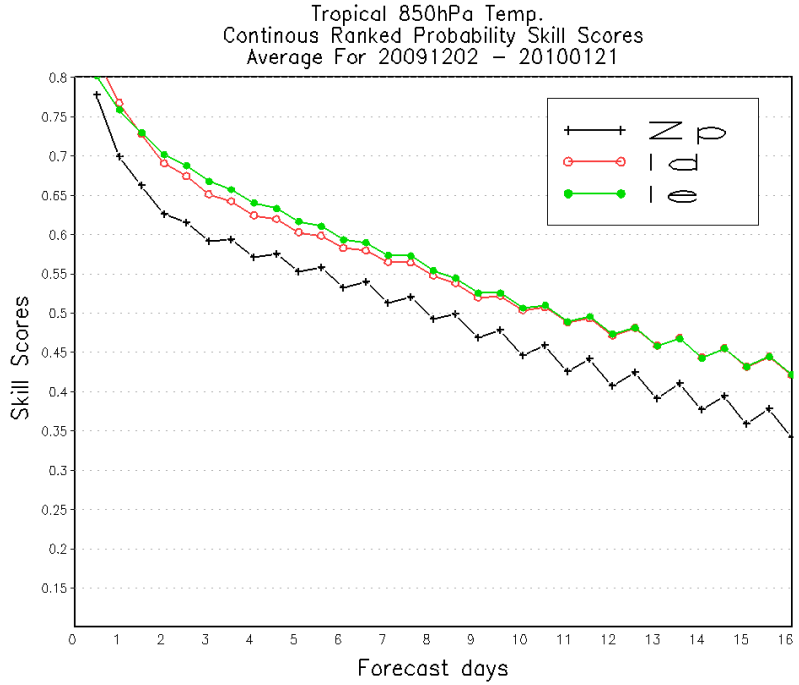

TROPICS 500 mb Geopotential Height
Average For 00Z02DEC2009 – 00Z21JAN2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXPZp
EXPId
EXPIe

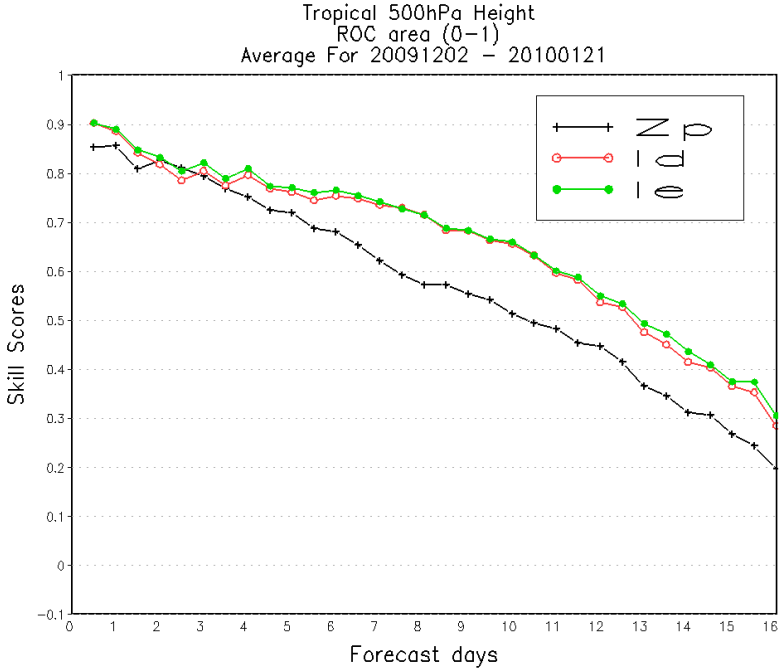

TROPICS 850 mb Temperature
Average For 00Z02DEC2009 – 00Z21JAN2010
Mean Error, Ensemble Spread and RMS Error scores
Forecast days
EXPZp
EXPId
EXPIe

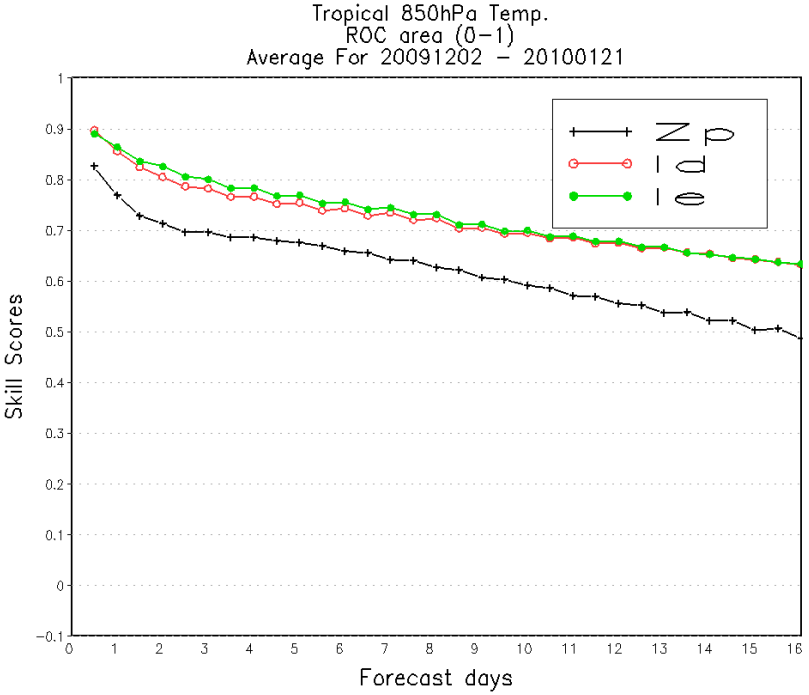

Tropical 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20091202 –20100121
Anomaly Correlation
Forecast days


Tropical 850hPa Temp.
Ensemble Mean Anomaly Correlation
Average For 20091202 –20100121
Anomaly Correlation
Forecast days


Tropical 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20091202 – 20100121
Skill Scores
Forecast days
N p
l d p
l e


Tropical 850hPa Temp.
Continous Ranked Probability Skill Scores
Average For 20091202 – 20100121
Skill Scores
Forecast days
N p
l d p
l e


Tropical 500hPa Height
ROC area (0–1)
Average For 20091202 – 20100121
Skill Scores
Forecast days
N p
l d p
l e


Tropical 850hPa Temp.
ROC area (0–1)
Average For 20091202 – 20100121
Skill Scores
Forecast days
N p
l d p
l e

Summary and Discussions
Bench Mark + Modified ETR, Winter Season

- Generally, there are improvements.
- Less uniform improvements. Note the verification is against different analysis. All cases are model-verification consistent.
- Noticeable improvement even for NH Z500.
- No building up of positive bias in the new GFS, even in T850.
- Some probabilistic fcst skill scores are hurt but modified ETR can repair this.

Preliminary Tests

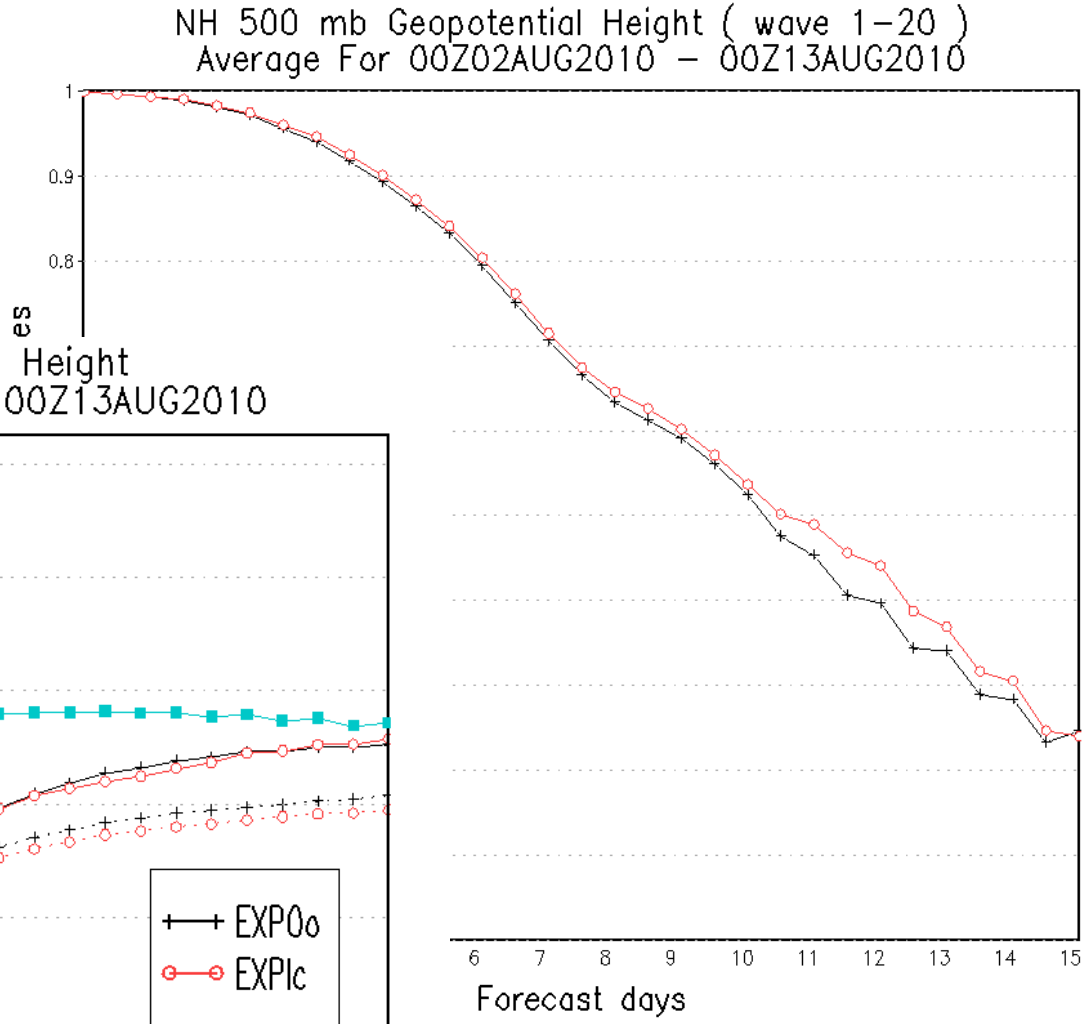
Control = T190L42, operational, old GFS

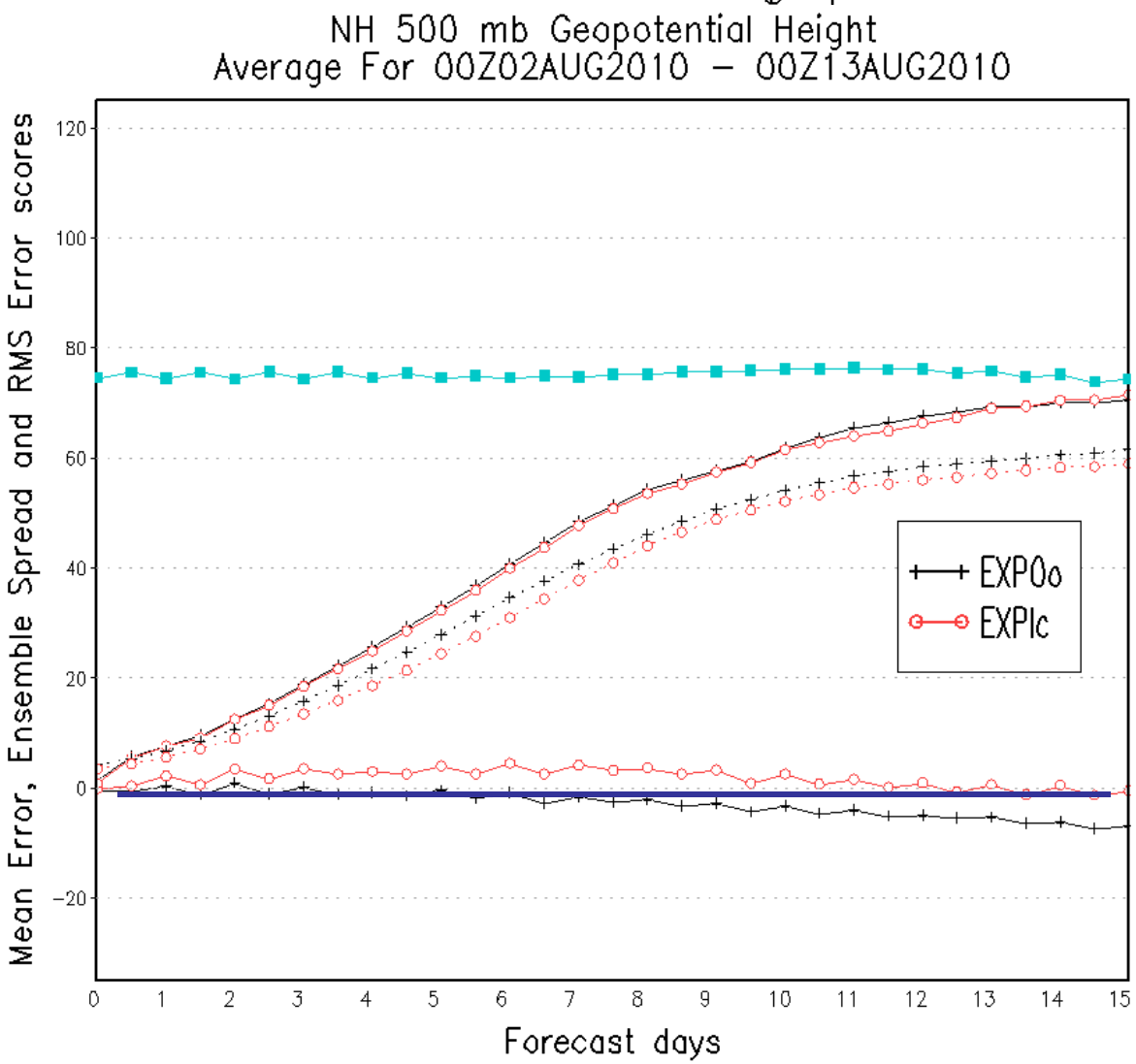
EXP = T254L42 up to 384hr, New GFS

ETR rescaling parameter

reduced so that initial spread is similar to the control.

NH 500Z



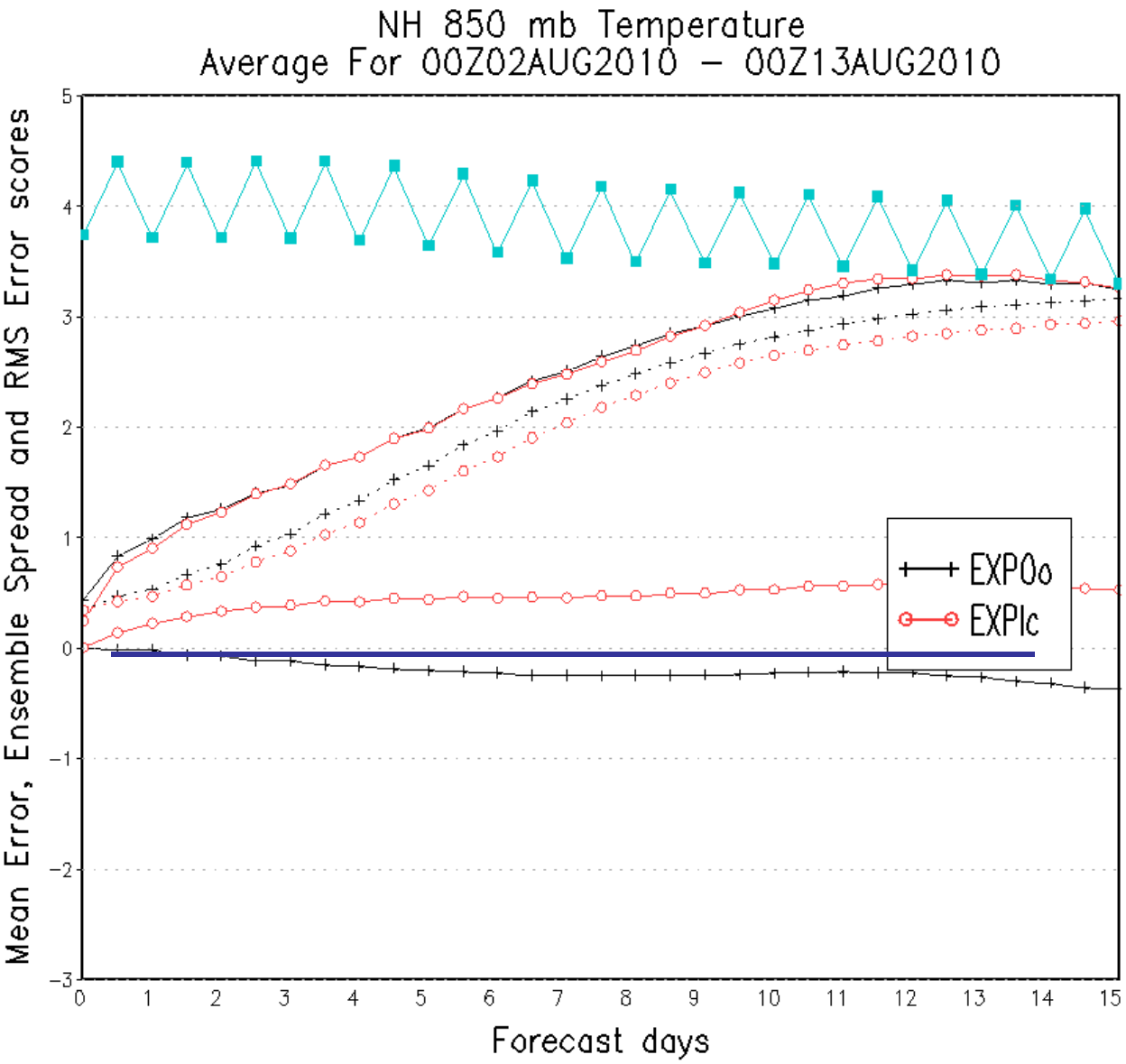


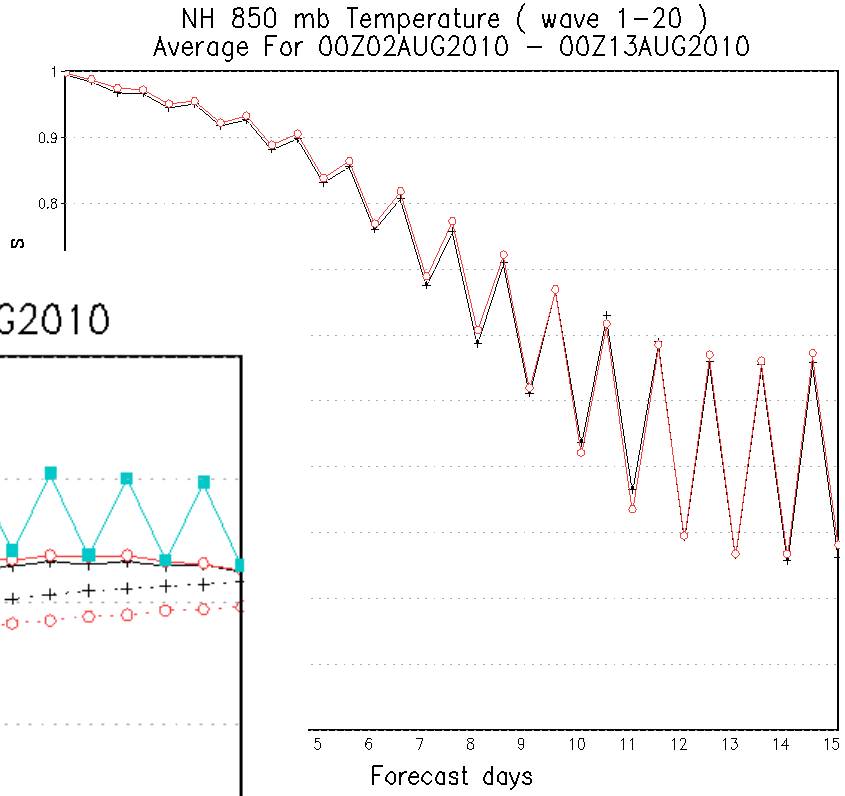
Improved AC

But

Positive Bias (day 1-8)

NH 850T



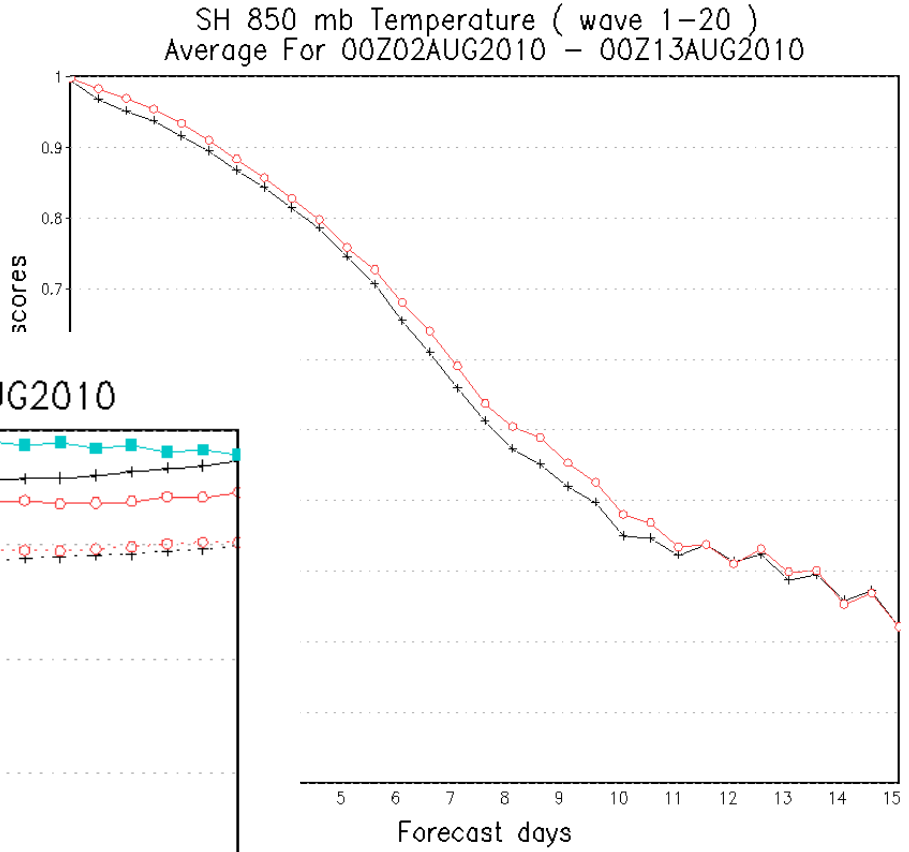


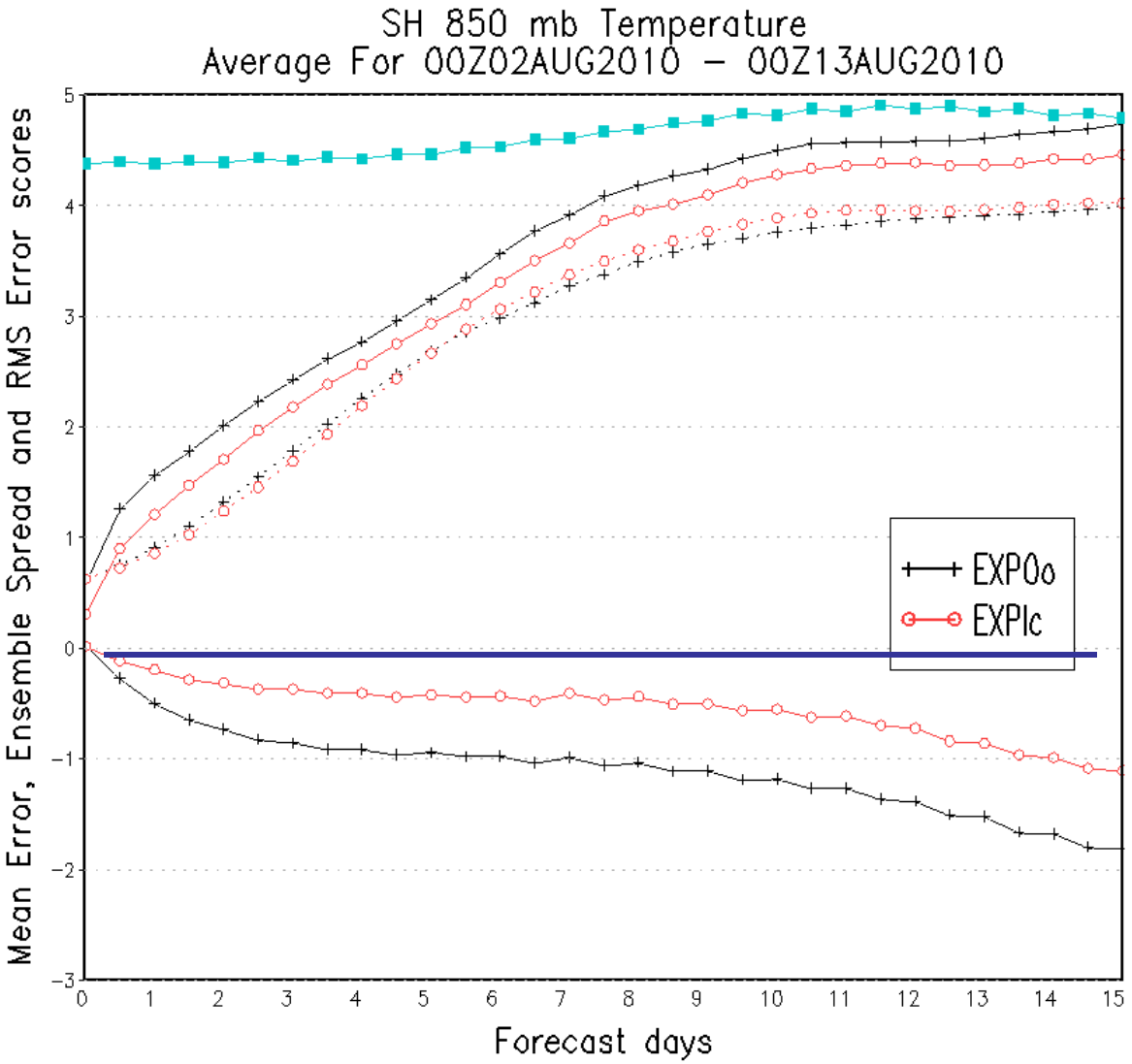
Slightly Improved AC

But

Large, warm bias build up rapidly

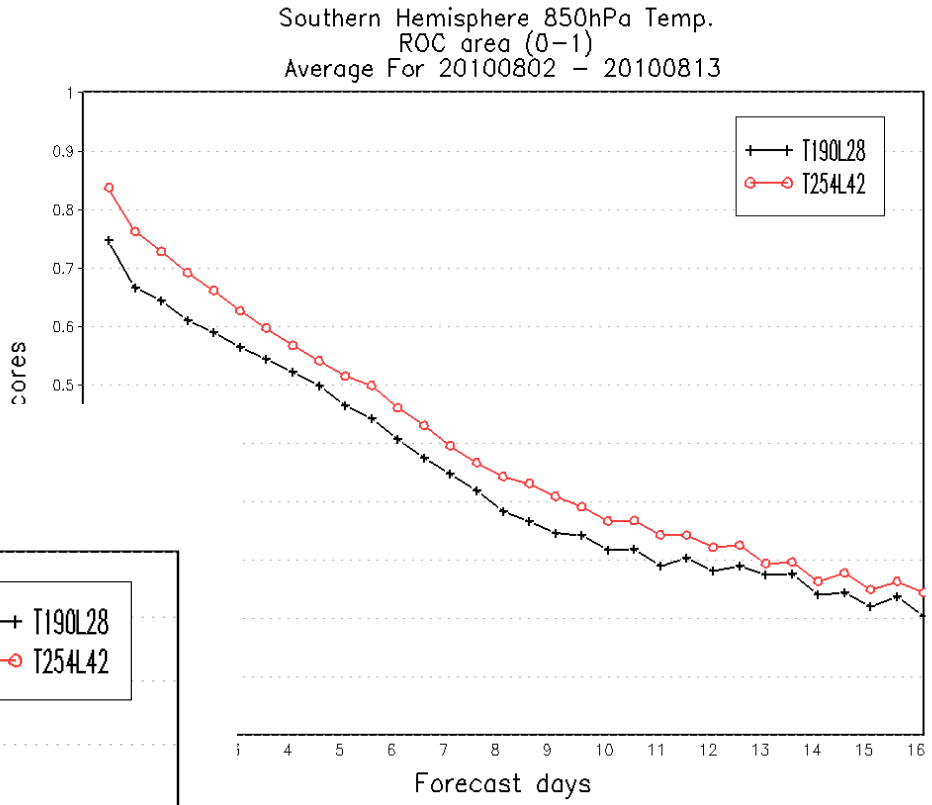
SH 850T

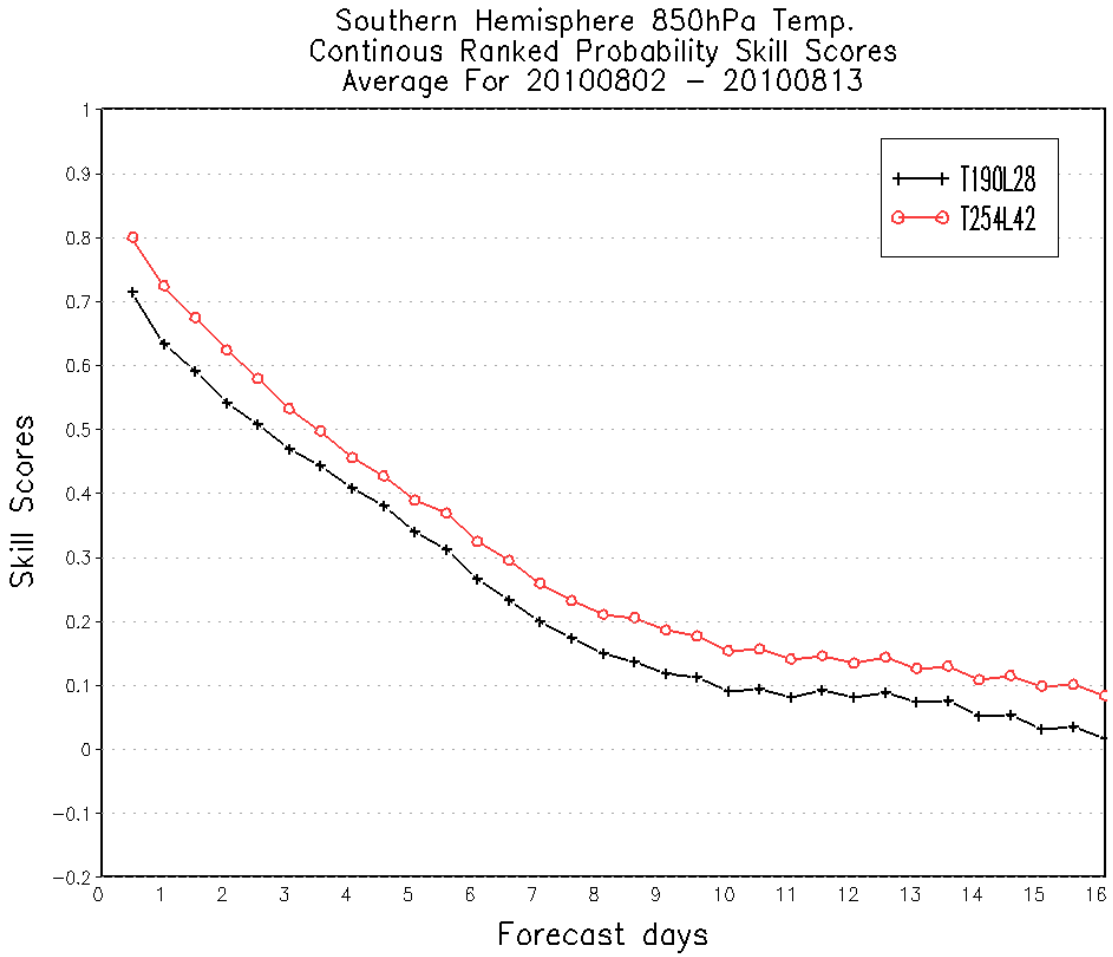




Improved AC
And
Reduced cold bias

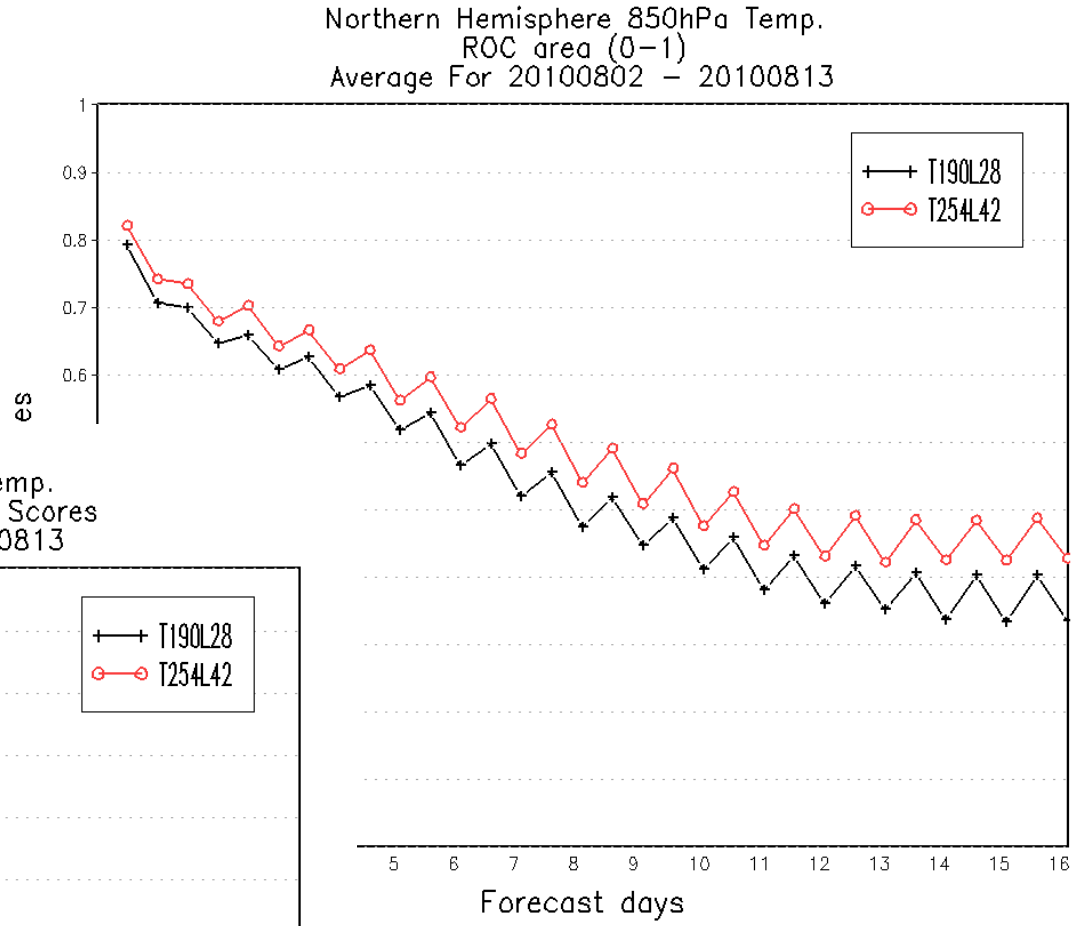
SH 850T

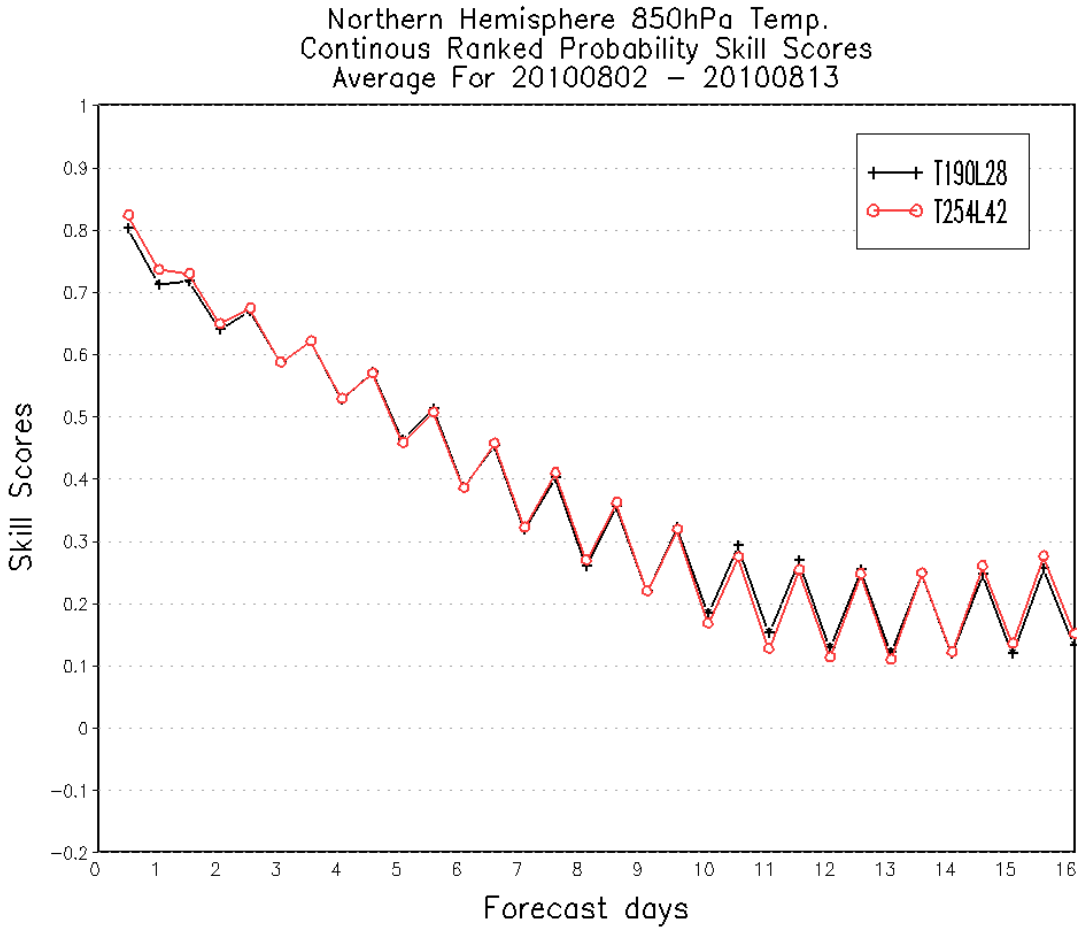




Probabilistic Fcst Scores
Improvement in both
ROC and CRPSS
(and others as well)

NH 850T





However, in NH
Improved ROC
But
Not clear in CRPSS

Summary of results

- Significant improvement in general but …
- Less improvement or negative impact in NH, especially in CRPSS and BSS reliability.
- Improvement is due to the increased AC and reduced negative bias.
- Negative impact is mainly due to building up of positive bias over NH, especially in T850.
- Positive bias is introduced by the new GFS model.

Challenges in the implementation

- Adopt the new GFS: The positive Bias
  - The winter month test showed more alarming results: positive bias even for SH and TR.
  - Need to do a concrete test for winter cases: requires gfs analysis (using new gfs model) in historical parallel runs.
  - Support the plan for gfs minor implementation to reduce the positive bias.
- ETR
  - Global tuning is straightforward and effective
  - Vary the rescaling parameter in vertical?
- STTP
  - Current parameters works fine but tuning may be beneficial.
  - modify the gfs code to input the parameters from outside for easy tuning. (include this into the gfs minor implementation, if any)