

*Comparison of T254 EnKF Single Resolution NOSAT System
with SAT NCEP Hybrid 3D-VAR/EnKF, ERA40/ERAINT, and
JRA55, for one year study periods in 1970,1981,1998*

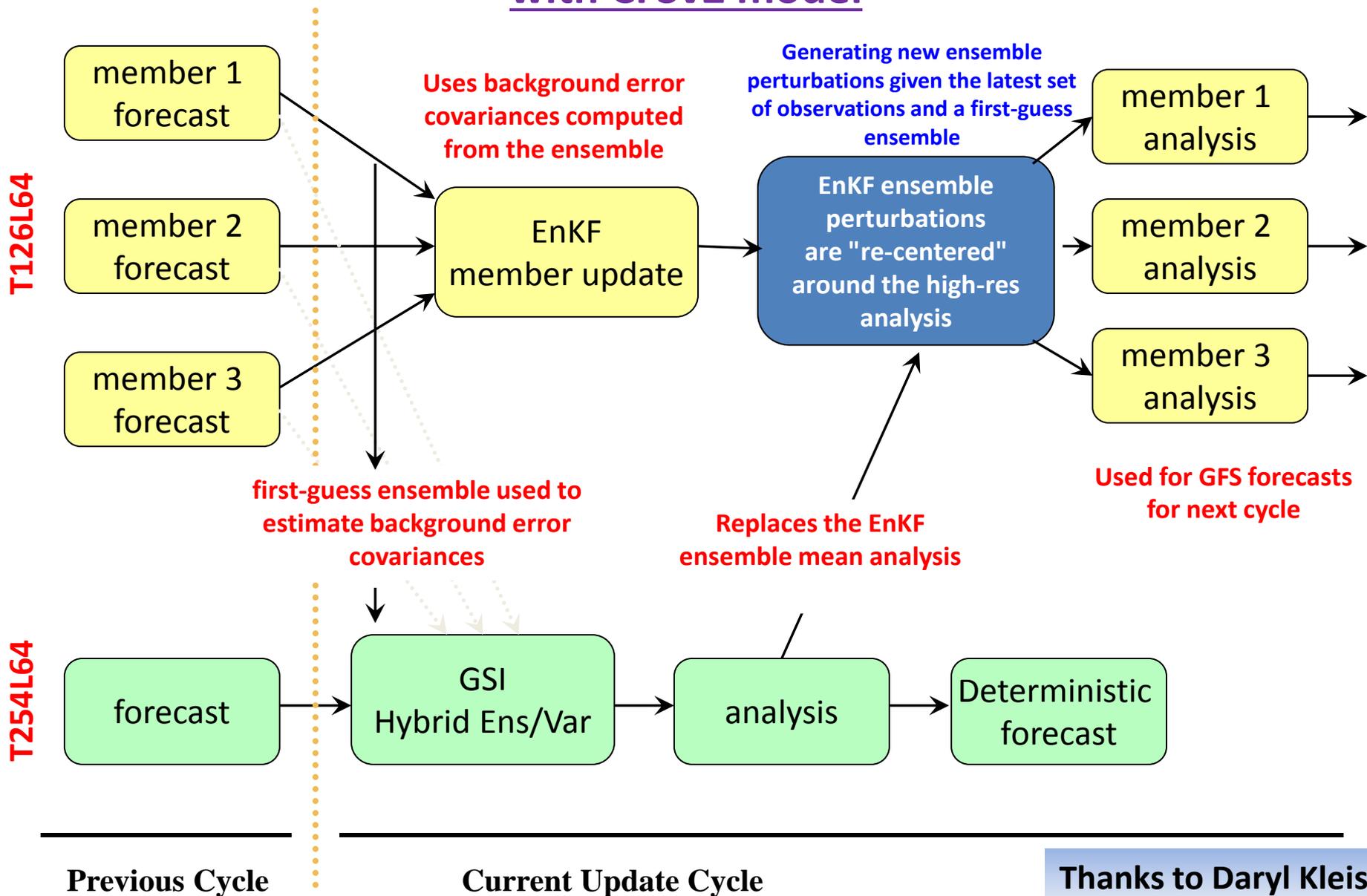
Jack Woollen IMSG/NCEP/EMC

Many Thanks to CRTF, MAPP, PI's, and Fellow Co-Workers

CRTF Reanalysis Research Report Contents:

- *Two ensemble based reanalysis systems are tested*
- *Three 1 year study periods, in 1970, 1981-82, 1998*
- *Two systems compared against each other*
- *Also compared against ERA40/ERA-INT and GR1*
- *Five day 500 mb height forecast anomaly correlations*
- *10 mb Tropical Zonal Winds compared with raobs*

NCEP Dual-Res (254/126) Hybrid 3D-VAR/EnKF with CFSv2 model



Thanks to Daryl Kleist

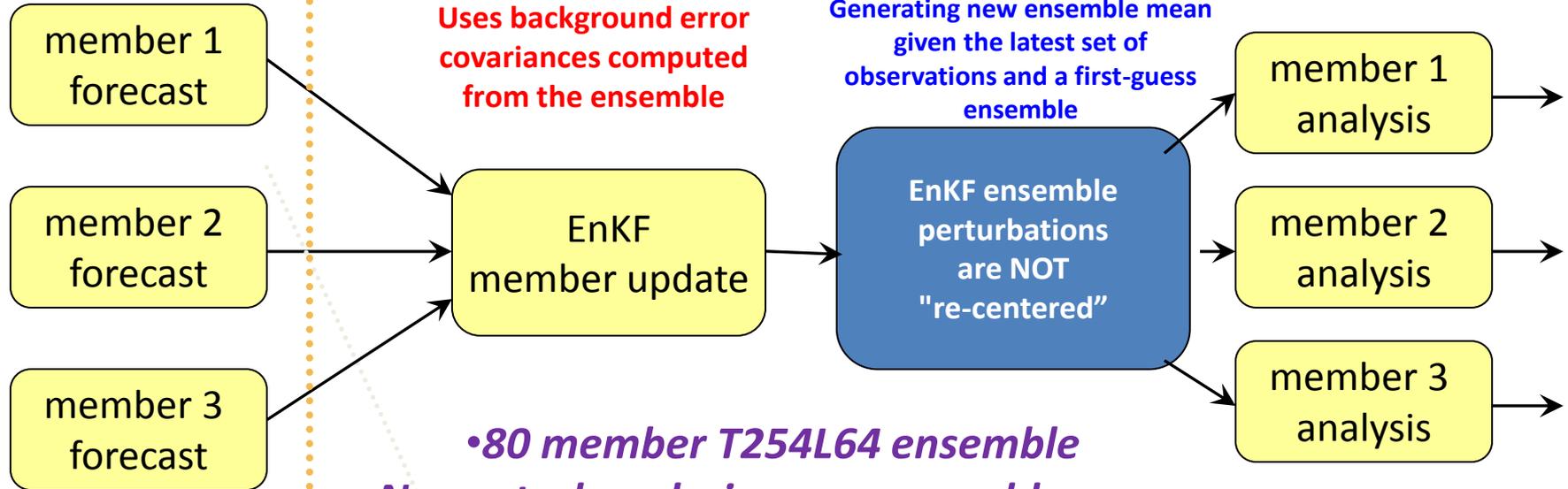
ESRL Single-Resolution (NOSAT) "Pure" ENKF

Conventional obs only in this configuration

Need to update BC to use radiances

Used for forecast IC for next cycle

T254L64



- 80 member T254L64 ensemble
- No control analysis – use ensemble mean
- SL 2015 model uses IAU with stochastic physics

Previous Cycle

Current Update Cycle

Thanks to Jeff Whitaker

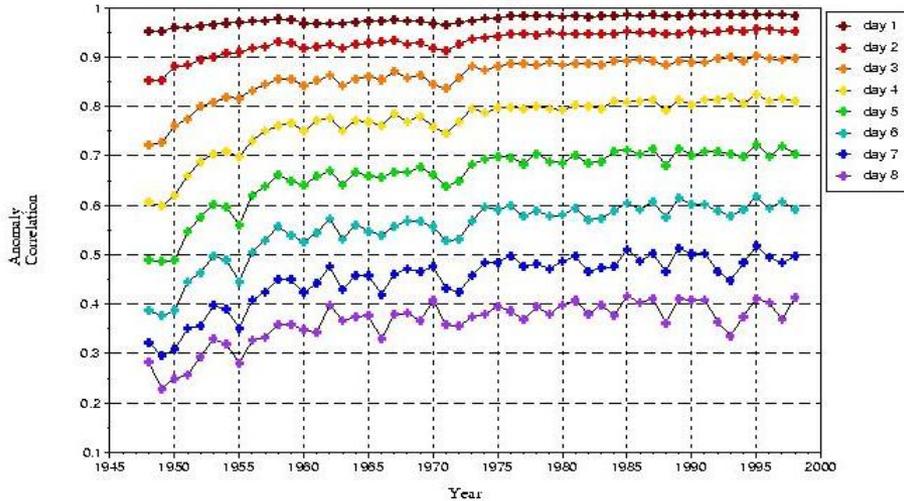
The GAEA implementation analyzes all members in the same batch job to reduce queue waiting

Forecast anomaly correlation comparison results Between NCEP Hybrid and ESRL ENKF NOSAT

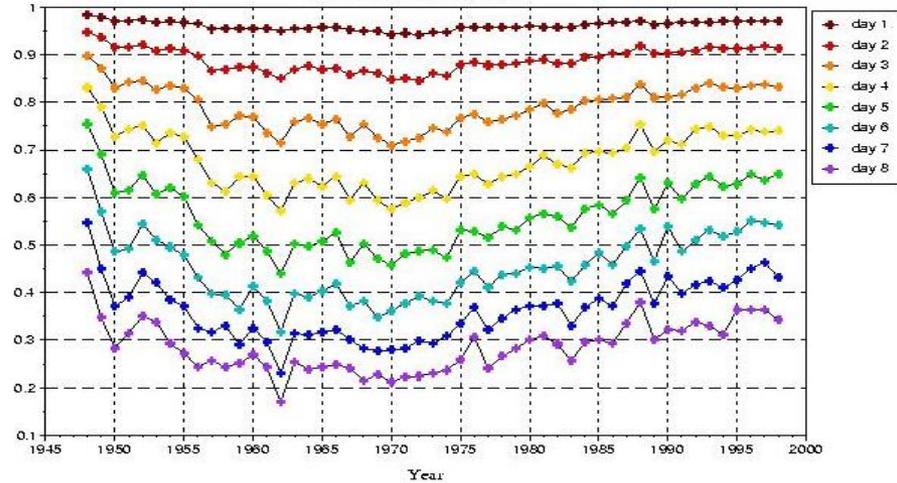
- *Charts used to look up ERA40, ERAINT, and GR1
500mb Z Anomaly Correlation Scores*
- *Comparison of forecast skill from the two systems
in three study periods*

NCEP/NCAR Global Reanalysis Anomaly Correlations by Hemisphere and Year

**Reanalysis Forecast 500 mb Anomaly Correlation
Northern Hemisphere**

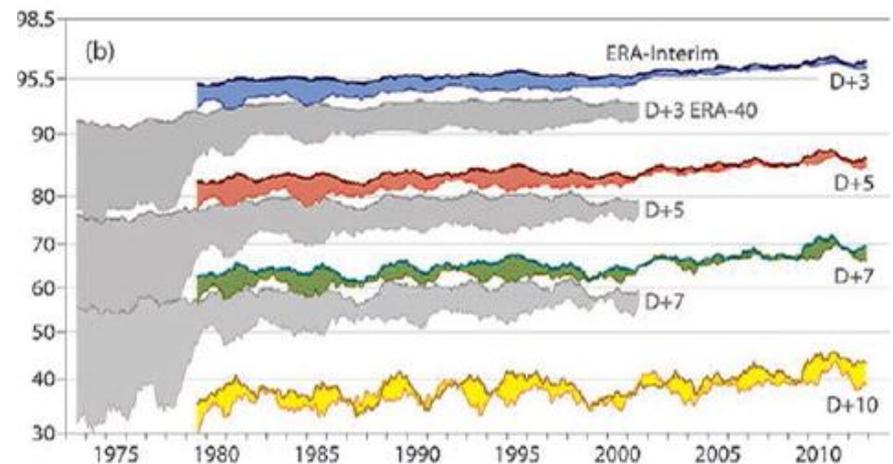
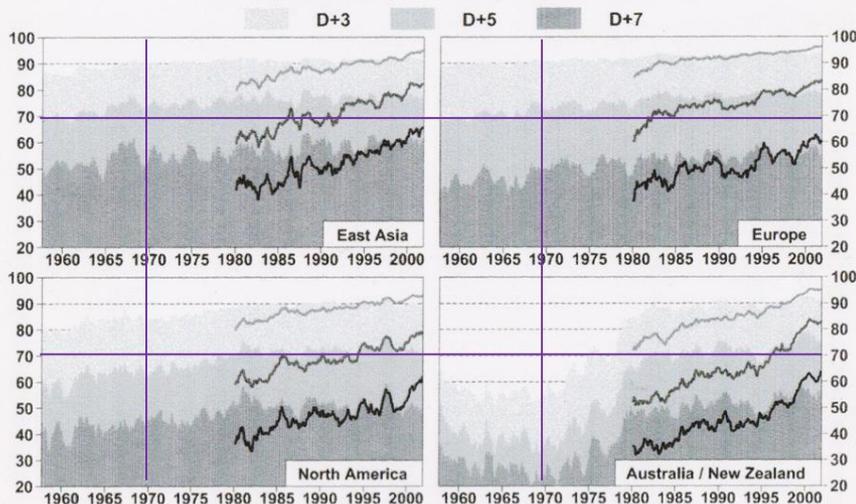


**Reanalysis Forecast 500 mb Height AC
Southern Hemisphere**



ERA40 and ERA-Interim Anomaly Correlations by Hemisphere and Year

Anomaly correlation (%) of 500hPa height forecasts



EN1970 .777

ERA40 .710

GR1 .670

01JAN1970

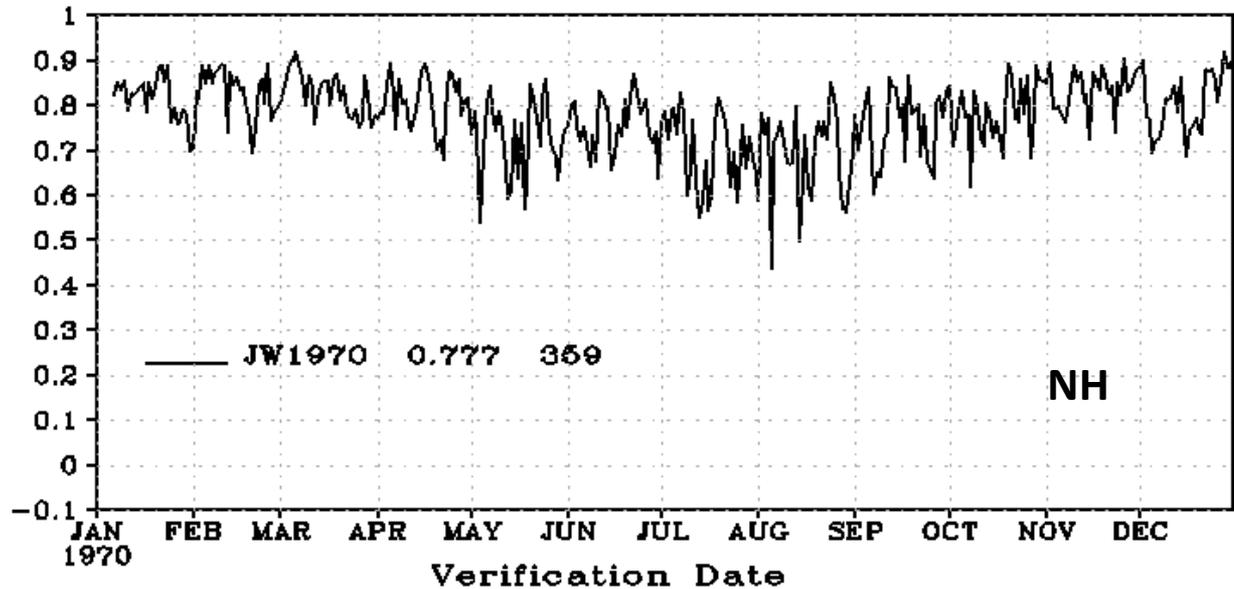
31DEC1970

EN1970 .545

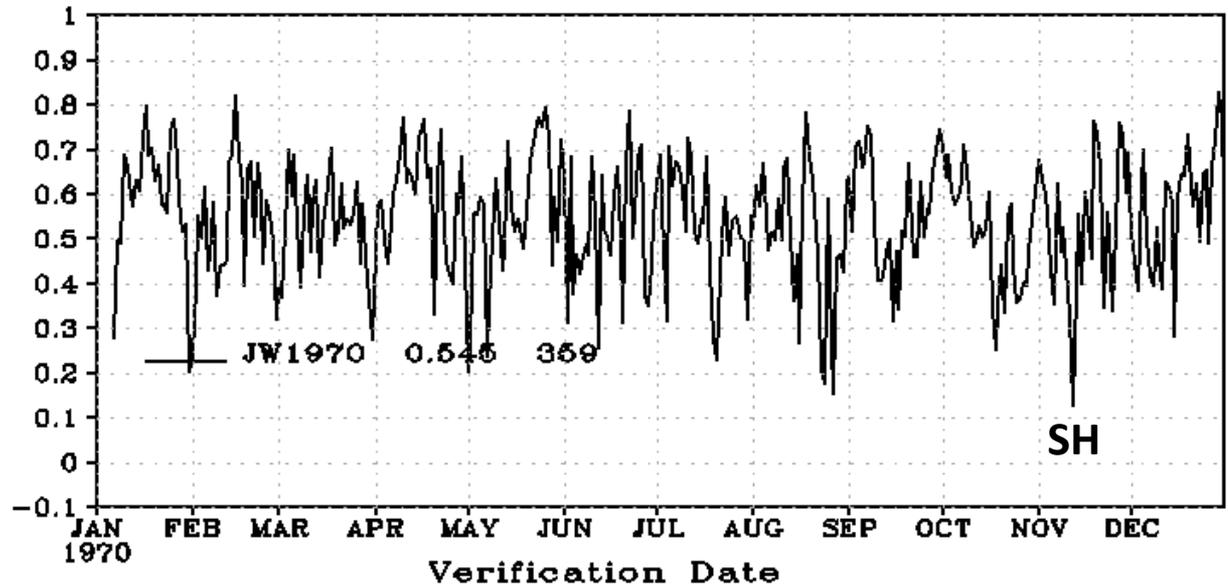
ERA40 .555

GR1 .470

Anomaly Correl: HGT P500 G2/NHX 00Z, fh120



Anomaly Correl: HGT P500 G2/SHX 00Z, fh120



HY1981 .838

EN1981 .801

ERAINT .830

GR1 .700

01JUL1981

30JUN1982

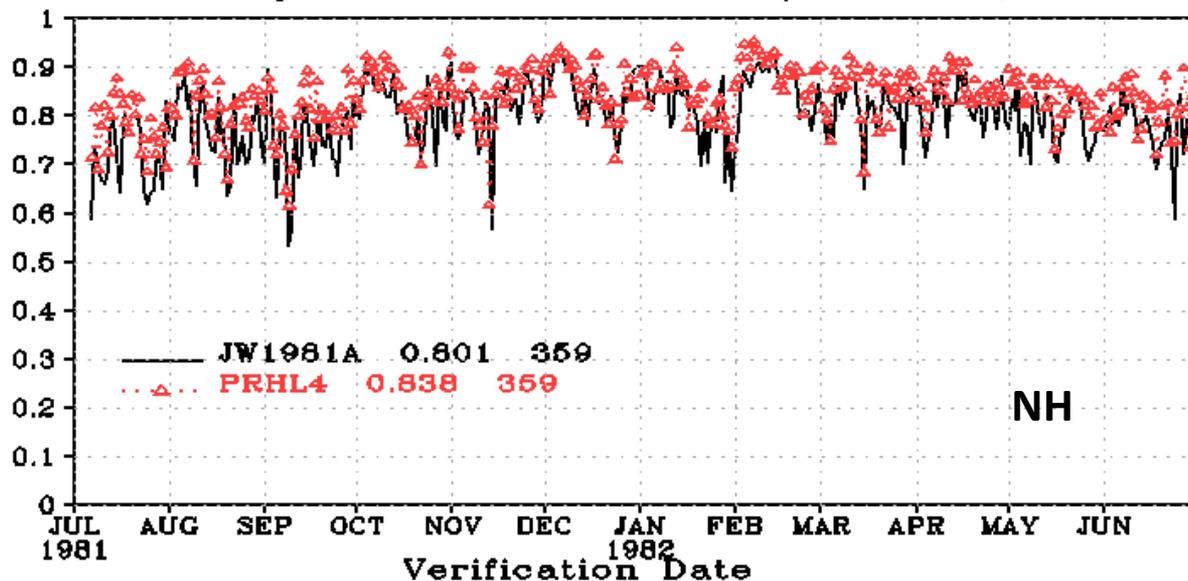
HY1981 .764

EN1981 .633

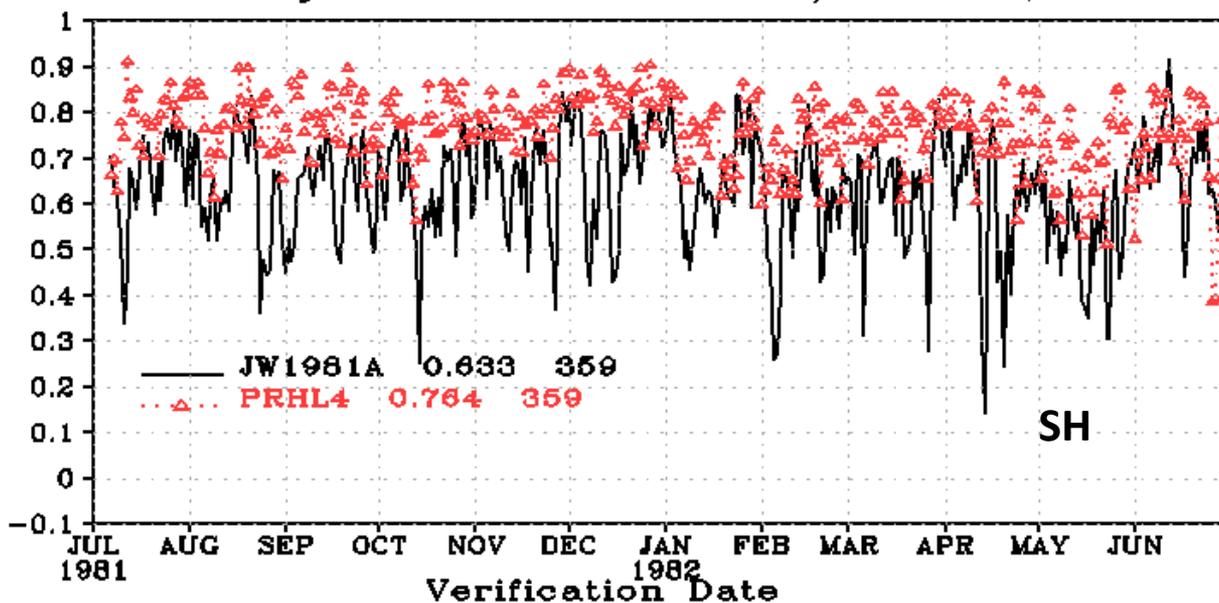
ERAINT .800

GR1 .570

Anomaly Correl: HGT P500 G2/NHX 00Z, fh120



Anomaly Correl: HGT P500 G2/SHX 00Z, fh120



HY1998 .828

EN1998 .814

ERAINT .825

GR1 .700

01JAN1998

31DEC1998

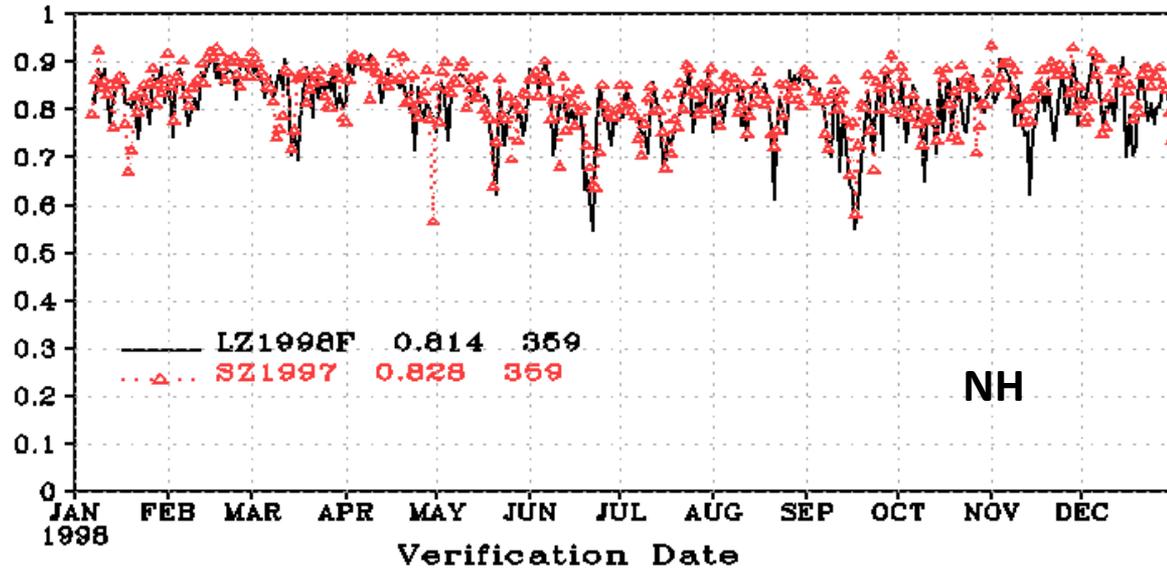
HY1998 .715

EN1998 .656

ERAINT .810

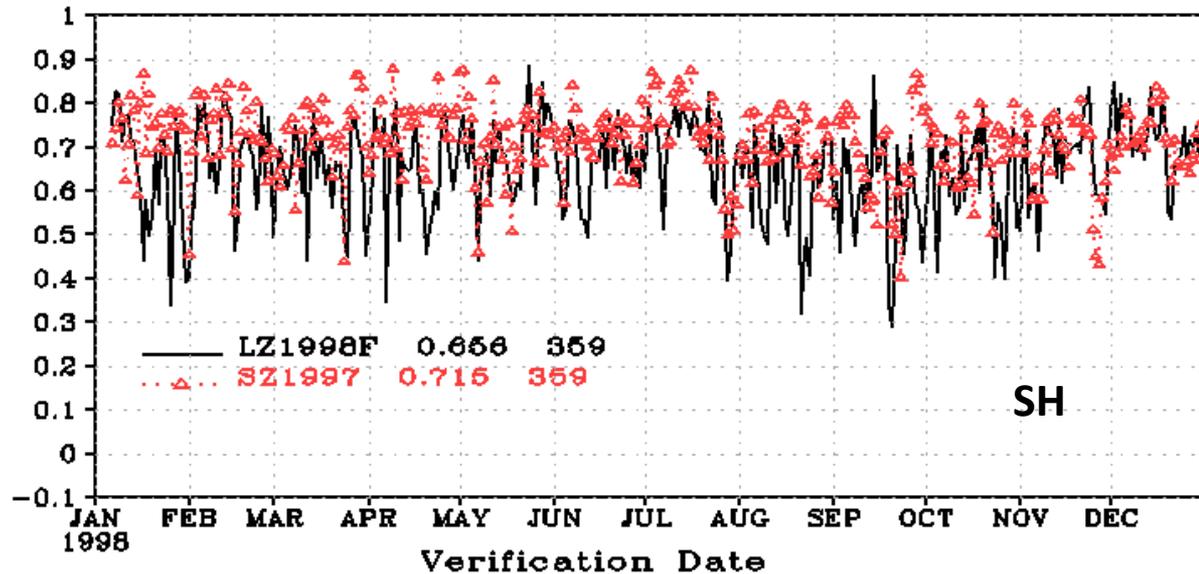
GR1 .650

Anomaly Correl: HGT P500 G2/NHX 00Z, fh120



Thanks to Leigh Zhang and Shuntai Zhou

Anomaly Correl: HGT P500 G2/SHX 00Z, fh120



Reanalysis QBO Tropical 10mb Zonal Wind Response

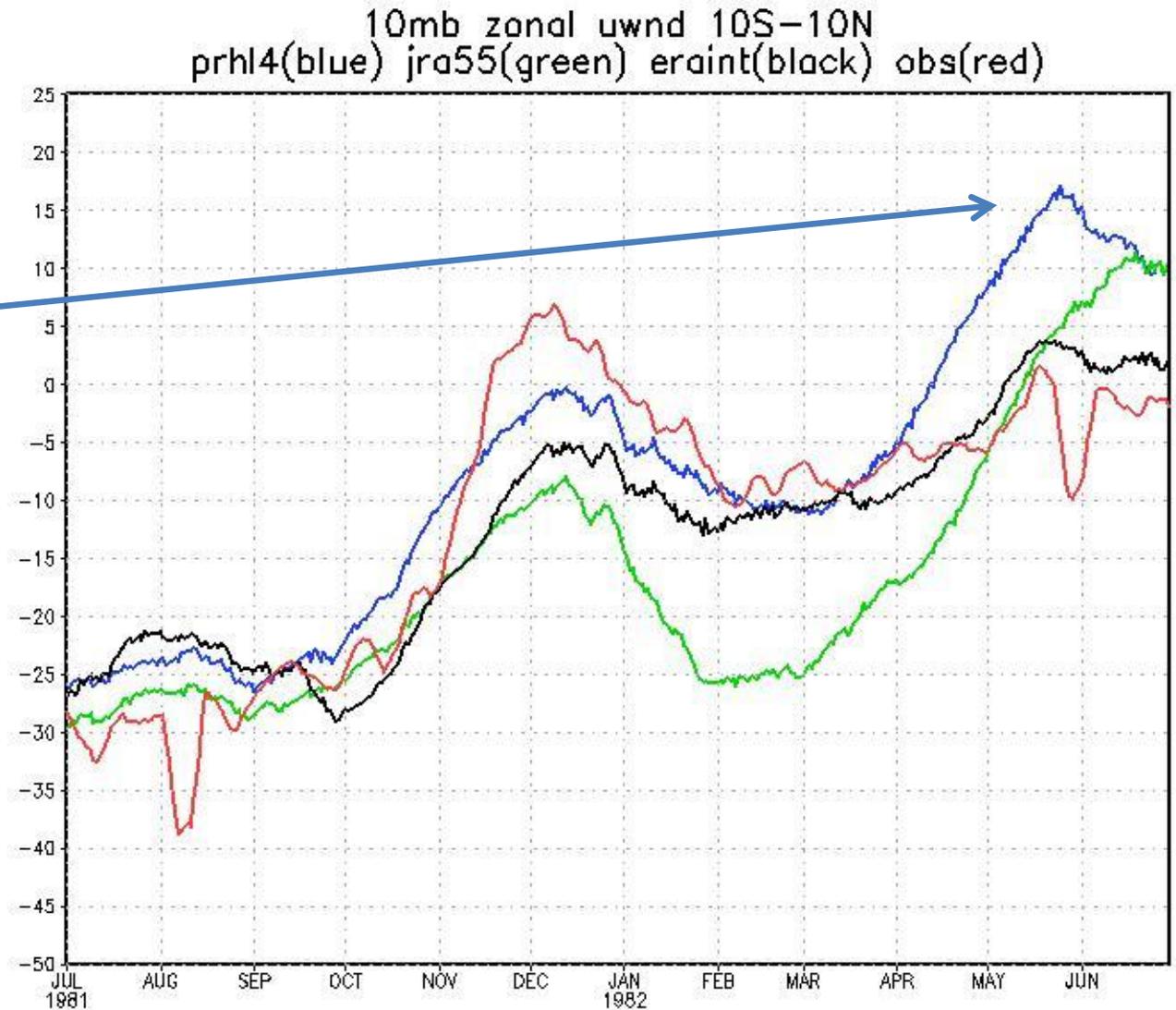
- *Rocketsonde QC and Impact on 10mb QBO Response in 1981*
- *Comparison of 10mb QBO Response vs Observations in the 3 study periods*
 - *1970 EN1970-JRA55-ERA40*
 - *1981 HY1981-EN1981-ERAINT*
 - *1998 HY1998-EN1998-ERAINT*

Note: all of the cases examined fit the observations well enough below 10mb.

1981 study period

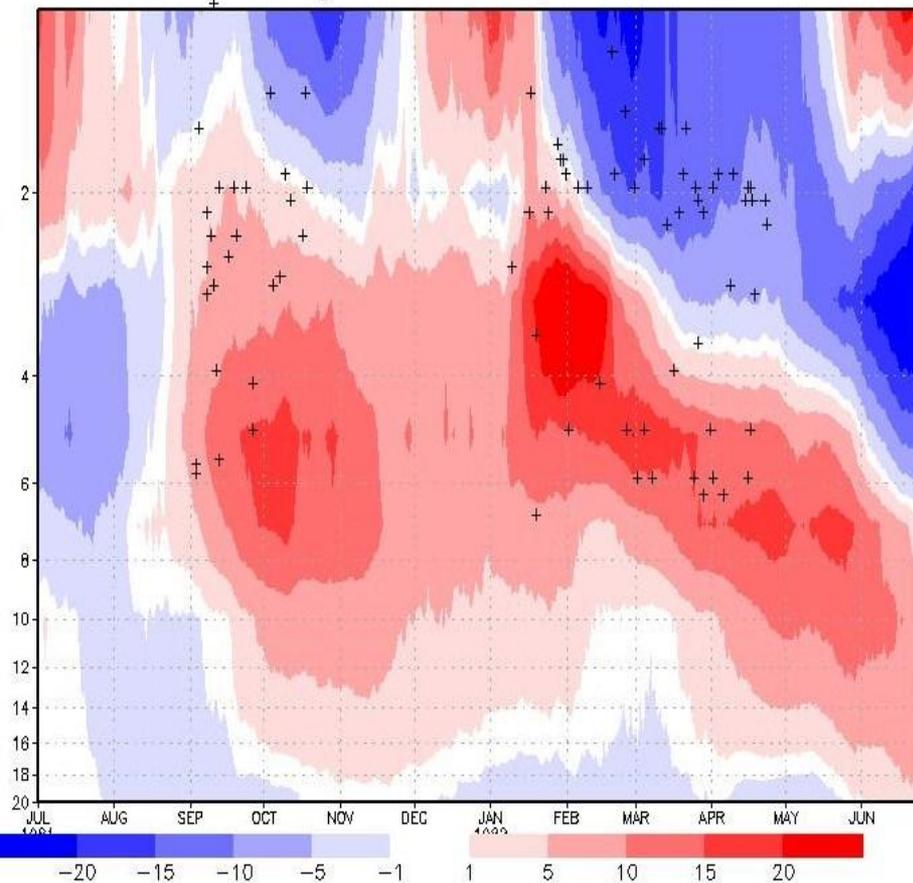
Comparison of PRHL4, JRA55, and ERAINT reveals a large westerly maximum during Apr-June in HY1981 compared to raobs and compared with the other reanalyses.

So we looked at QC in the region and noticed that rejected rocketsonde data up as high as 2mb may play some role in this disparity.

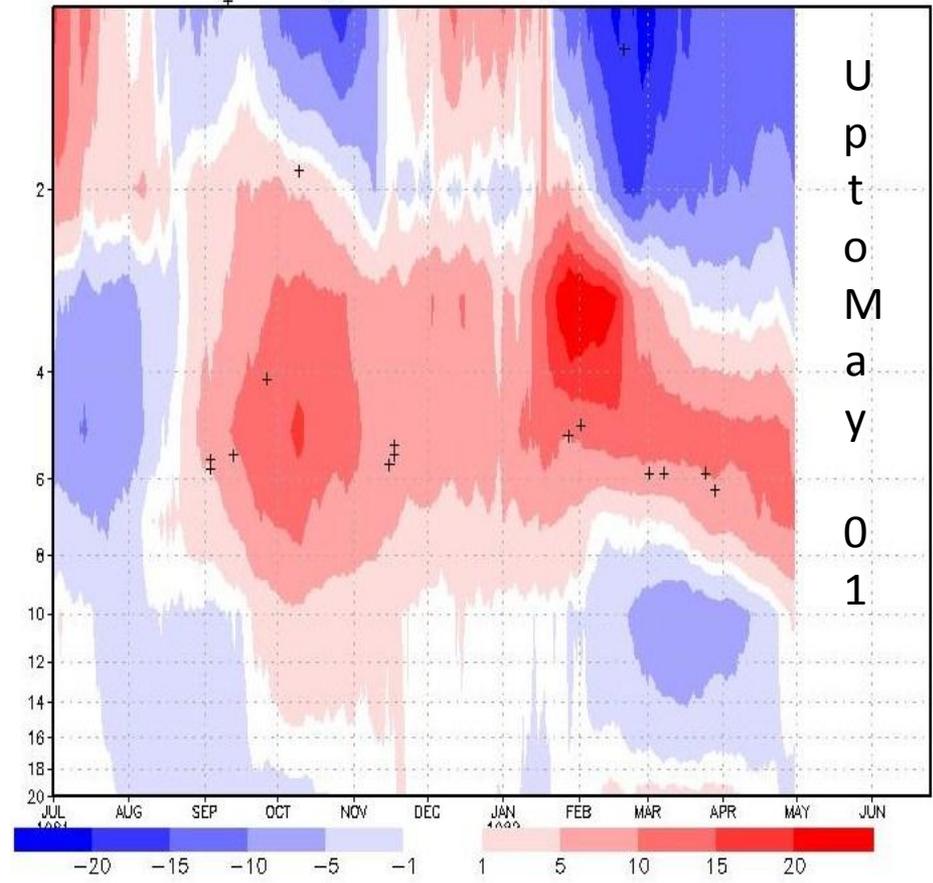


The difference between PRHL4 and ERAINT seemed in part due to many rejected rocketsonde winds in the hybrid. The plot labeled PRHL4-ERAINT below left shows the rejected data by +. The plot below right shows the comparison with PRHN4, like PRHL4, but with all wind data above 5mb retained. When the data is assimilated, the differences from ERAINT diminish. This appears to be one cause of the PRHL4 westerly hump in Apr-June 1982, and emphasizes that a good first guess in the high tropical stratosphere can be very important for getting the most out of the very sparse data up there.

mean ugrd 10s-10n prhl4 - eraint



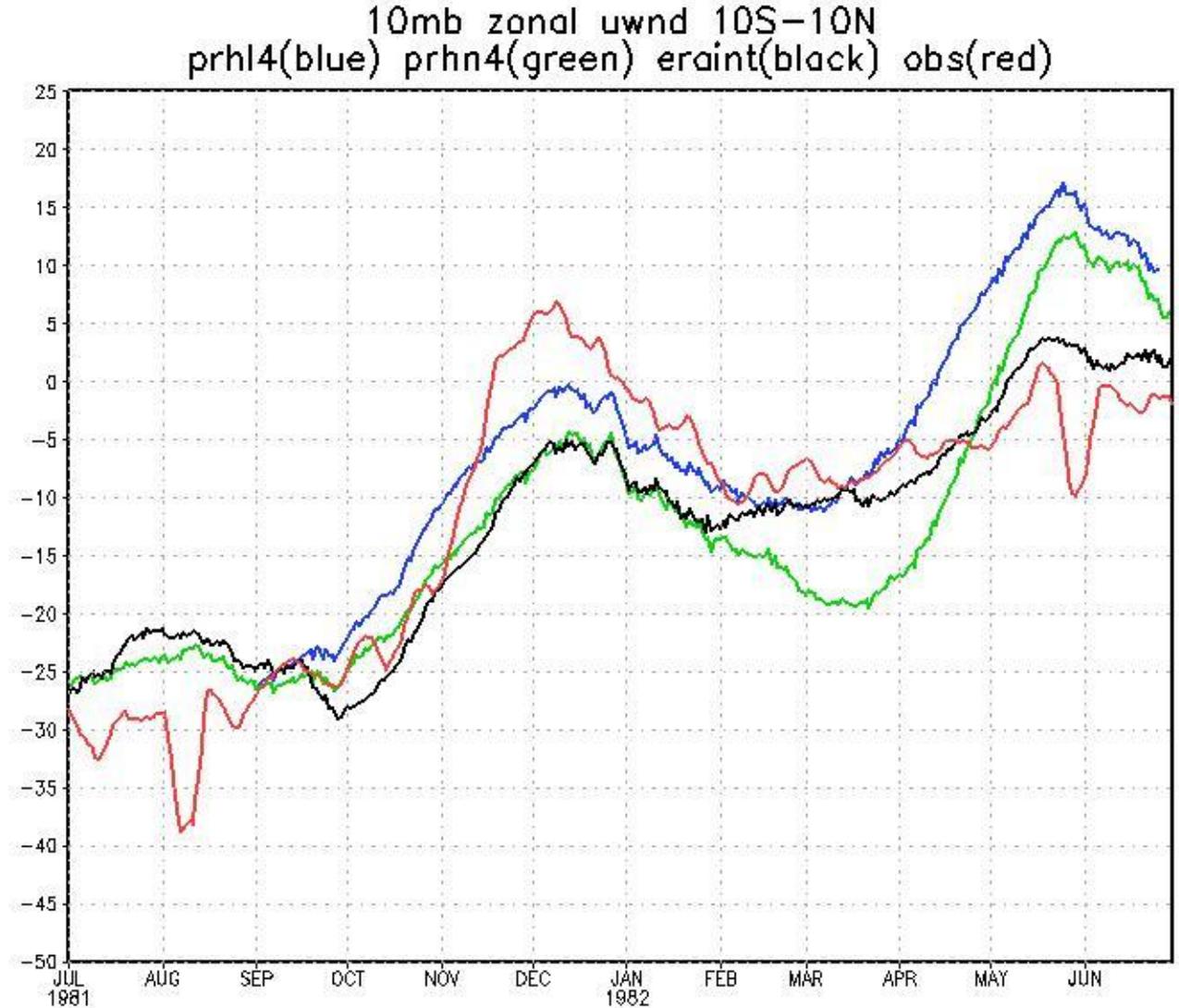
mean ugrd 10s-10n prhn4 - eraint



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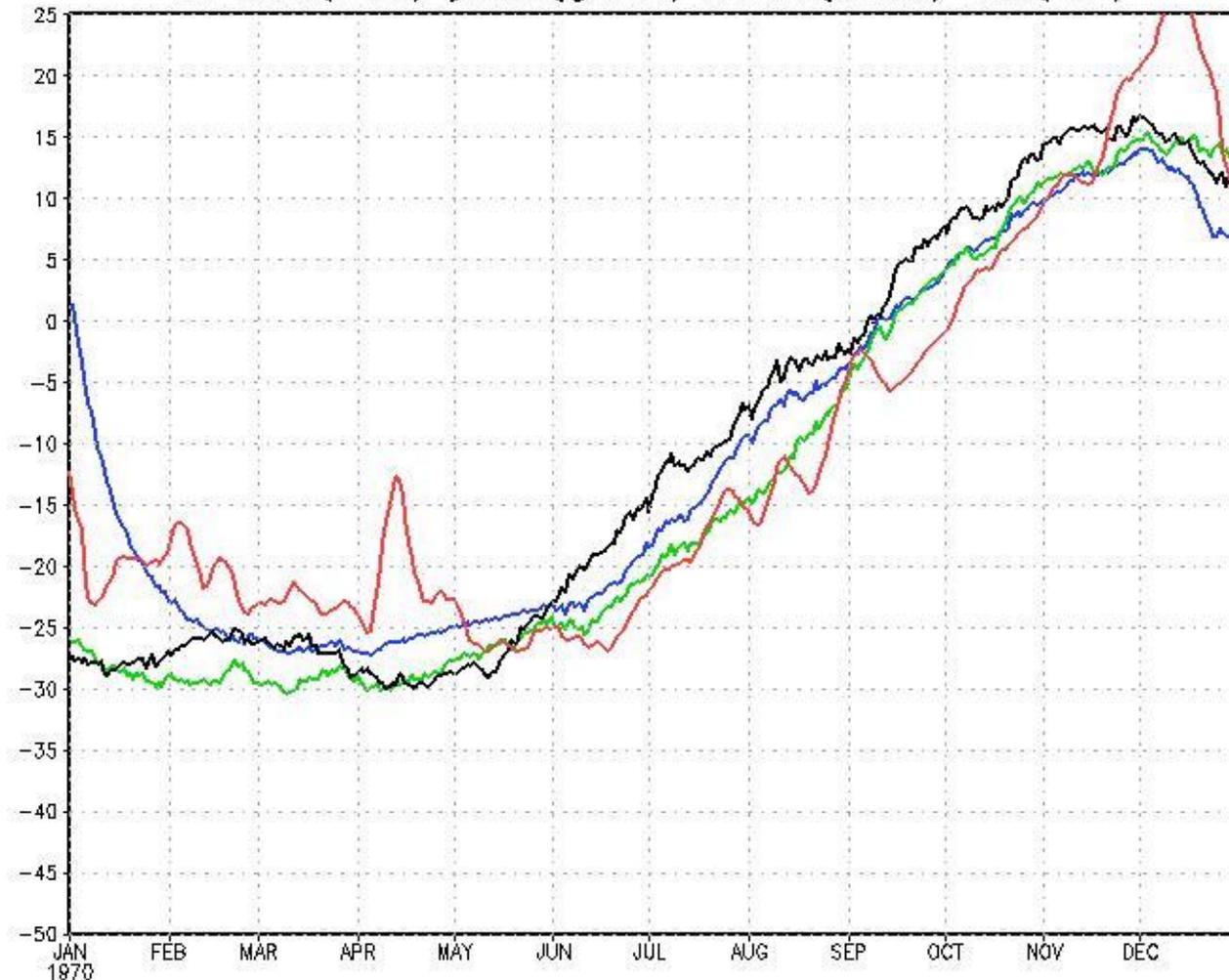
1981 study period with and without rocketsondes

Comparing the HY1981 with and w/o rocketsondes (PRHN4 and PRHL4) turns out to have a mixed result. PRHN4 fits ERAINT better up to Feb1982, but not so well afterwards. Probably ERAINT assimilated the rocketsonde data in Sep-Oct 1981. PRHN4 however becomes more easterly after Feb1982. The “hump” in May-June is reduced but the fit to data clearly degrades in Feb-Mar-Apr. ERAINT fits the raobs very well in this period. Data selection is obviously a tricky and critical issue in this very data sparse situation.



1970 study period

10mb zonal uwnd 10S-10N
en1970(blue) jra55(green) era40(black) obs(red)

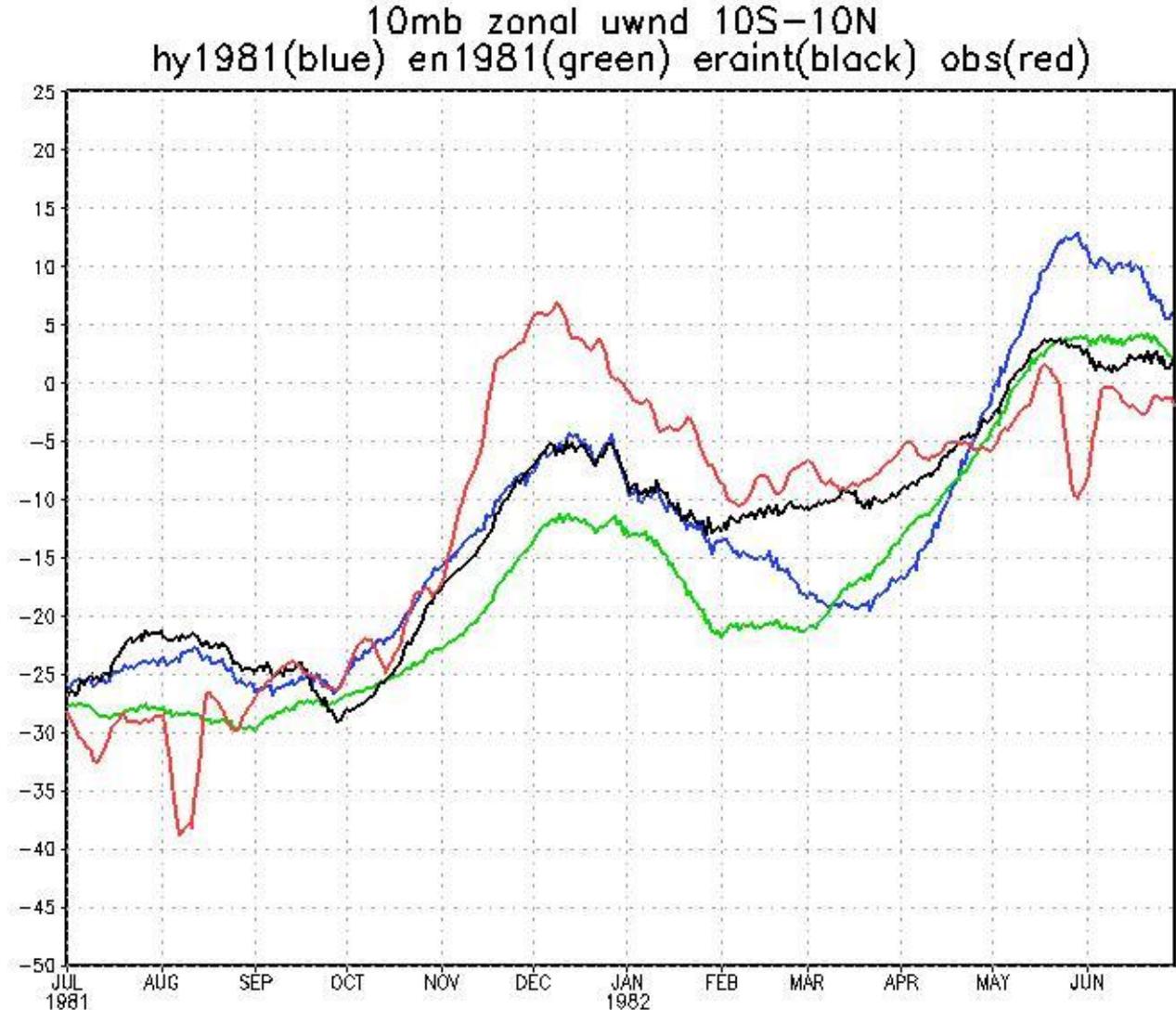


All three re-analyses capture the 10mb wind fairly well as measured by observations in 1970. The EN1970 was started from 20CR Initial conditions on 01jan1970. Since 20CR did not assimilate upper air observations, the EN1970 initial point is quite different from JRA55 or ERA40. However it draws directly to the observations in less than one month.

1981 study period

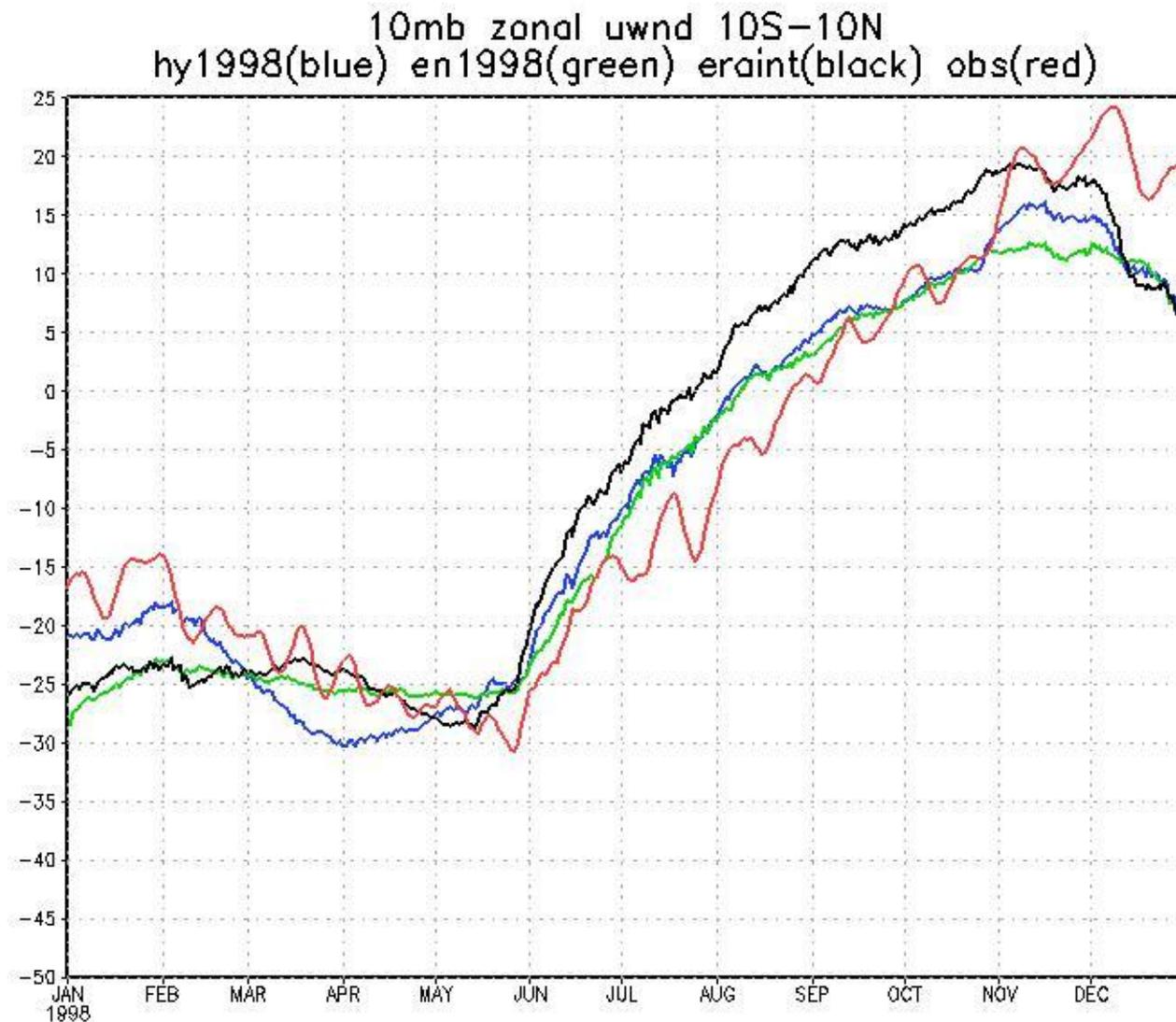
The EN1981 fits the raobs very well in May and June But is worse than HY1981 or ERAINT from Nov-Feb. Note that EN1981 did its own (non-GSI) QC and was not guided to accept or reject the rocketsonde observations.

Also note that none of the systems examined fit the obs at all well from Nov-Feb. The EN1981 fits obs better from Jul-Oct. All in all this is a satisfactory result.



1998 study period

The three systems displayed show fairly good attention to the obs and agreement with one another. By 1998 the QBO is well defined by the radiosonde data.



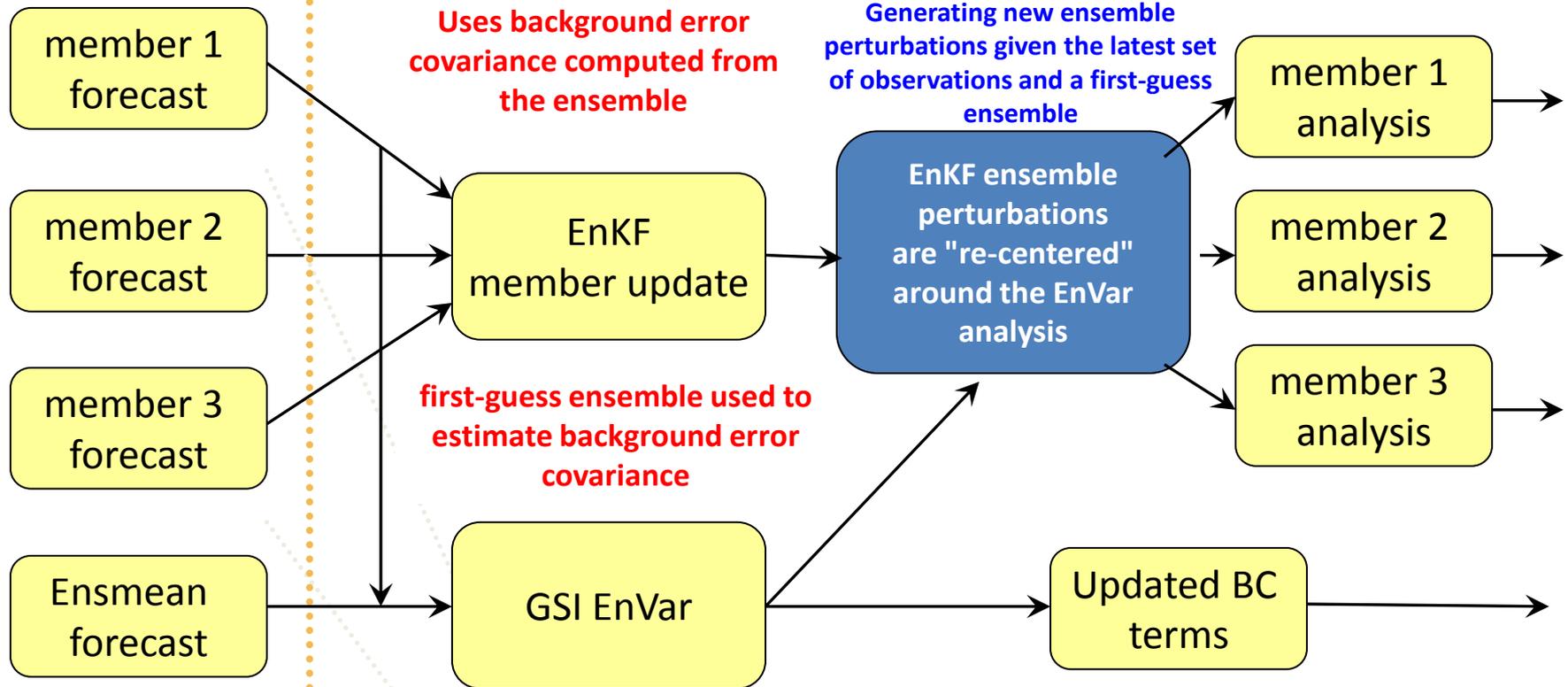
Proposed ESRL Single-Resolution SAT Hybrid

Direct radiance assimilation configuration

BC updated in GSI step

Used for forecast IC for next cycle

T254L64



Previous Cycle

Current Update Cycle

Thanks to Jeff Whitaker

Could be a very good system for SAT reanalysis

Conclusions, thoughts, and comments

- ❖ *The EN system shows good potential to rerun GR1 very efficiently*
- ❖ *Even without satellites the EN results are very good in the NH*
- ❖ *Direct radiance assimilation is necessary for a full GR1 replacement*
- ❖ *Need to bring up and evaluate the single-res SAT HYBRID ENKF*
- ❖ *The faster NOSAT system could be used for reanalyzing 1948-1975*
- ❖ *A 65 year NOSAT reanalysis is also on the agenda*

Thank You Very Much