Main WP4 tasks

- **T4.1 - Quality control, bias adjustment and homogenisation of input observations**
- UNIVIE, ECMWF, UBERN, FFCUL
- Assess and improve the quality of input observations used for reanalysis. This includes quality control, bias adjustment and homogenization of observations.
- **T4.2 - Diagnostics and uncertainty assessments of reanalysis output**
- UNIVIE, ECMWF, RIHMI, DWD, UVSQ
- Quality assessment of reanalysis products. Deliverables consist of Reanalysis Quality Assessment reports.
- Integration and expansion of diagnostic tools for estimating the uncertainty of new assimilation products. Assessment of the **"climate quality"** of the reanalysis products.

Main WP4 tasks

- ECMWF, ocean, carbon communities already have excellent monitoring tools – so where can we contribute?
  - Ensure that essential metadata are right – this is assumed in ECMWF QC
  - Assess and adjust observation biases
  - Check fulfilment of budget constraints
  - Physical relationships as seen in different data sets
  - Help with intercomparisons of (reanalysis) data sets
- Do existing diagnostics meet users' need?

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ERA CLIM 2

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wien

Time varying biases as seen in background departures and budget evaluations

Leopold Haimberger, Marco Milan, Michael Mayer,
Michael Blaschek, Lorenzo Ramella-Pralungo,

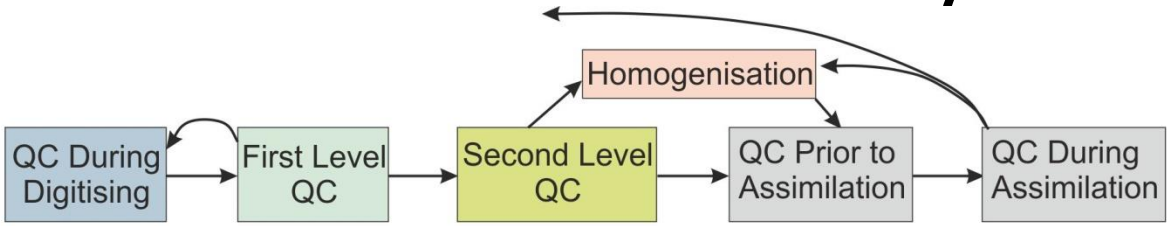
ERA-CLIM2 General Assembly, Nov 20th, 2014

Diagnostic tools

Diagnostic	State X	Observations y	Predicted fluxes Fx	Observed fluxes Fy
Background departures	$y-H(X)$	$y-H(X)$	$F_y-H[F_x(X)]$	$F_y-H[F_x(X)]$
Comparison of (input) obs.		$y_a-H(y_b)$		$F_{yc}-H[F_{yd}]$
State perturb.	$AnInc(X)$		$Spinup(F_x)$	
Tend+Fluxdiv+ Conversion=0?	$X_{fc}, F_x(X_{fc})$ $X_{an}, F_x(X_{an})$	$Tend(y)$, $Fluxdiv(y)$	$F_x(X_{fc})$	F_y
Diagnostic relationships	X_c vs. X_d	y_c vs. y_d	$F_{xa}(X_{fc})$ vs. $F_{xa}(X_{fc})$	F_{yc}vs F_{yd}
Forecast skill	$fs[Y,H(X_{fc})]$, $fs(X_{fc},X_{an})$			$fs(F_y,H[F(X_{fc})])$
OS(S)Es	$X(y)$ vs $X(Y_b)$			$X(F_y)$ vs $X(F_{yb})$

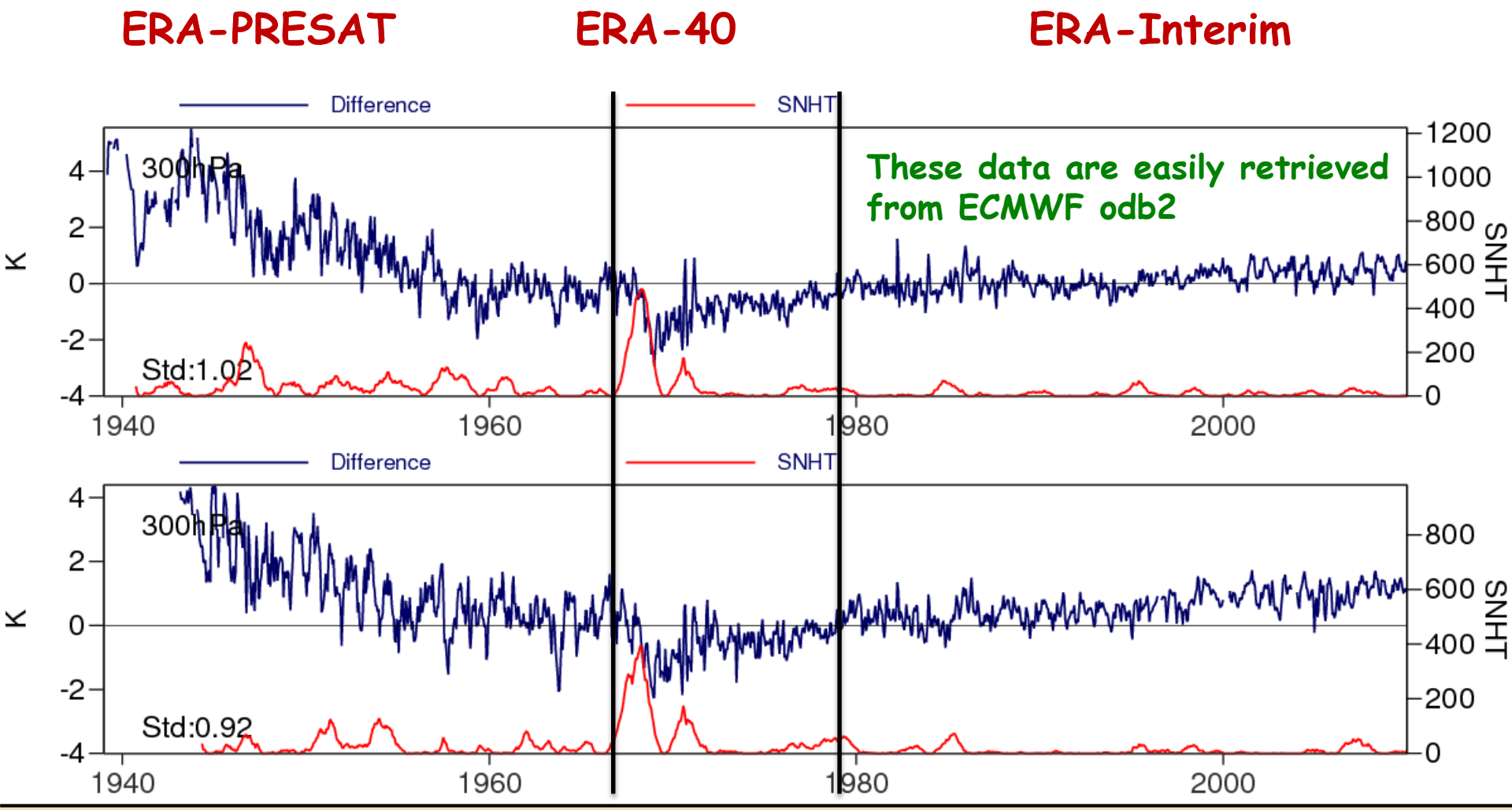
… other, more specialized diagnostics for data assimilation

Departure time series of early radiosonde data



- Background ($\mathbf{y}$-$H\mathbf{x}_b$) and analysis ($\mathbf{y}$-$H\mathbf{x}_b$) departure statistics from pilot assimilations and reanalyses
- These series can be considered third level of QC after basic QC, internal consistency QC
- Credo: Departure statistics have high potential for QC/BC
- ERA-PreSAT **background** departures 1939-1967
- ERA-40/ERA-Interim **background** 1968-1978, 1979-2013
- Use also **analysis** departure statistics from
  - ERA-20C ensemble member 0 (rerun)
  - 20th Century Reanalyses v2 ensemble mean

Moscow obs-ERA-presat



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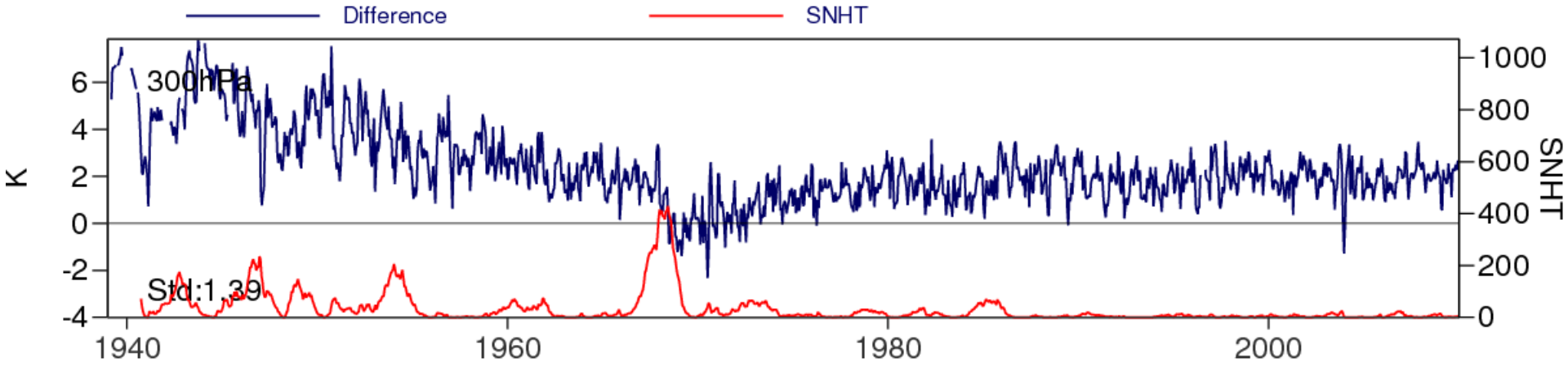
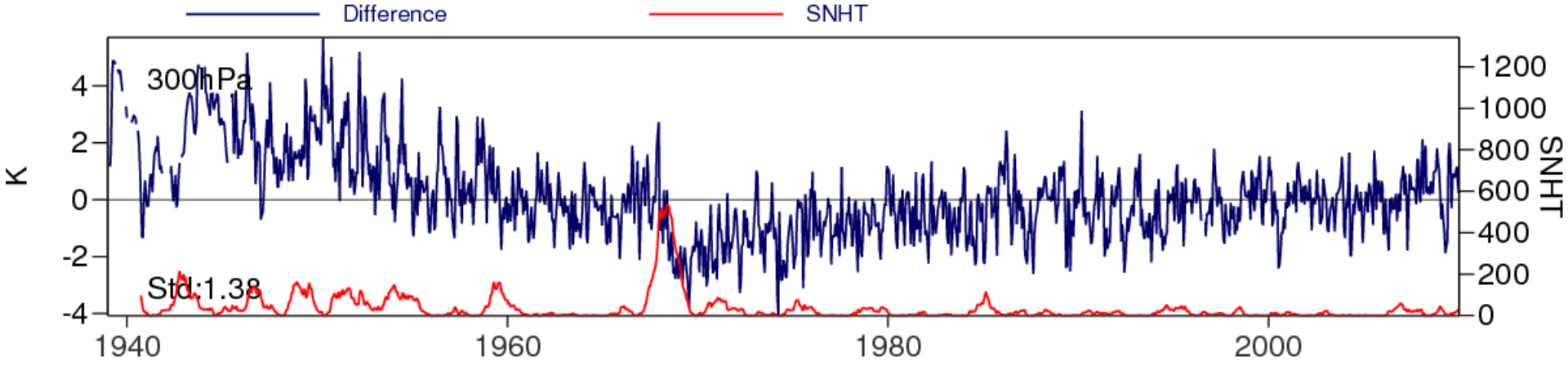
Moscow obs – ERA20C, NOAA-20CR

ERA-20C



NOAA-20CR



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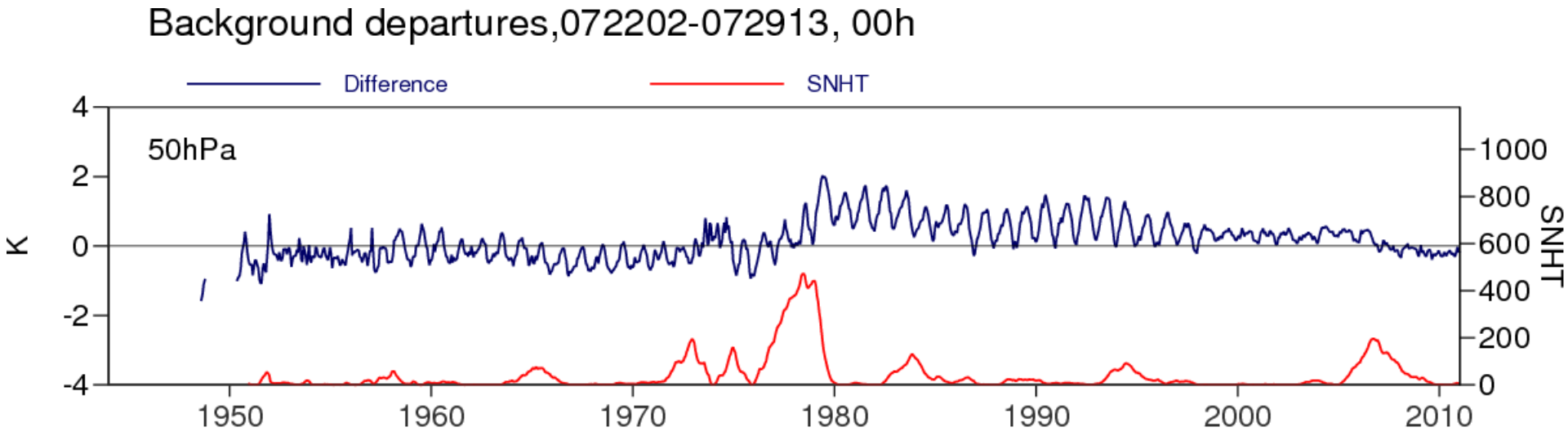
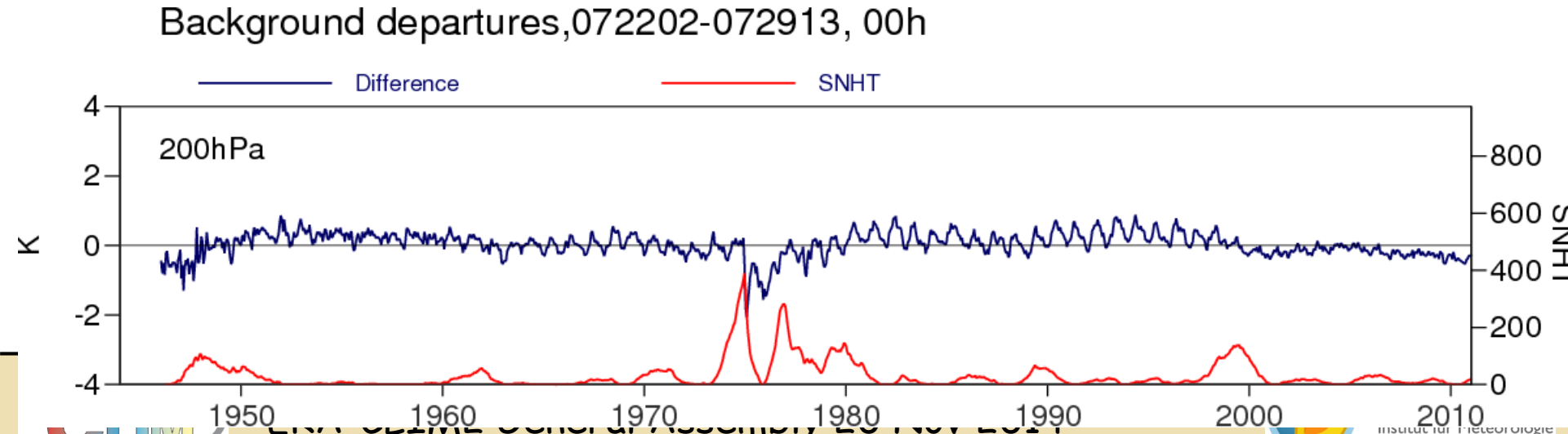
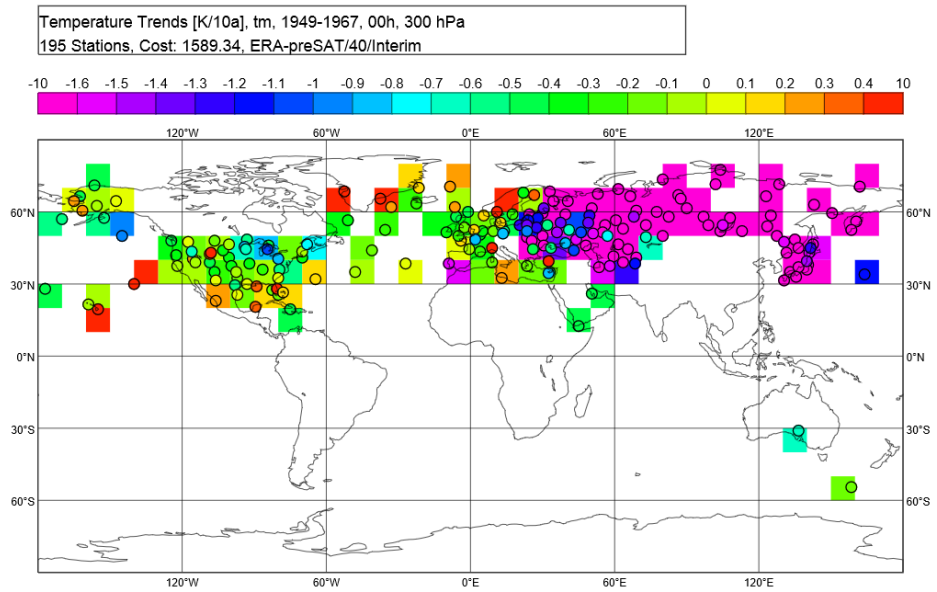
US composite



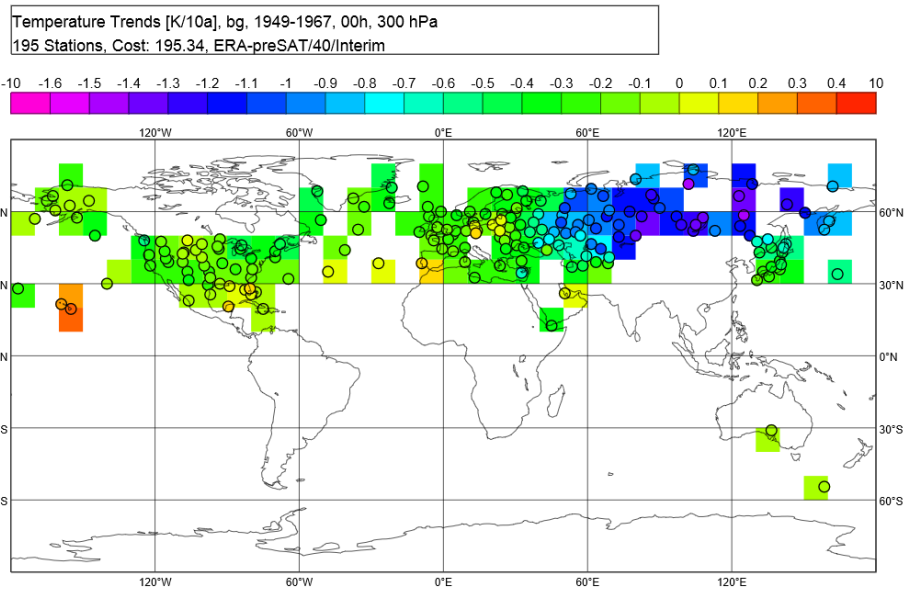


T-Trends, 300hPa, 1949-1967

Unadjusted temperature



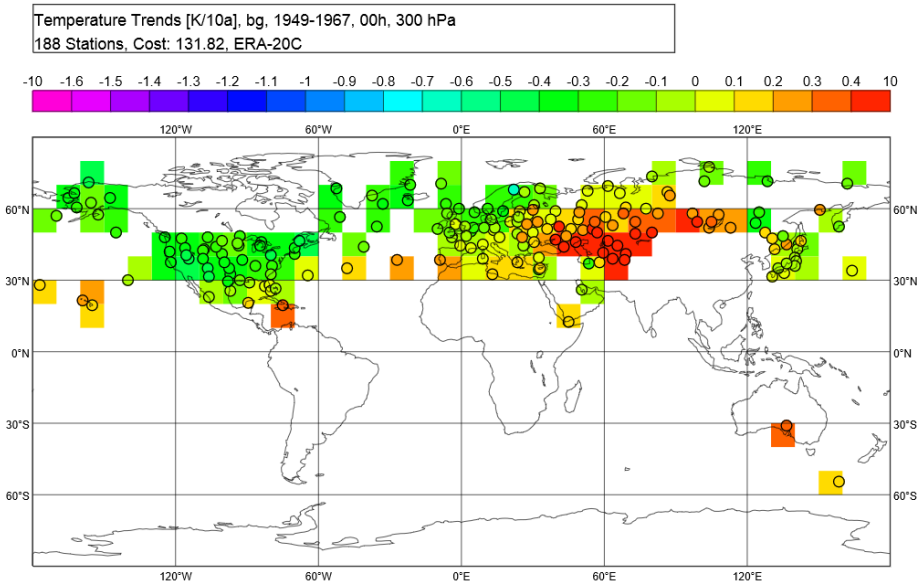
ERA-PreSAT bg



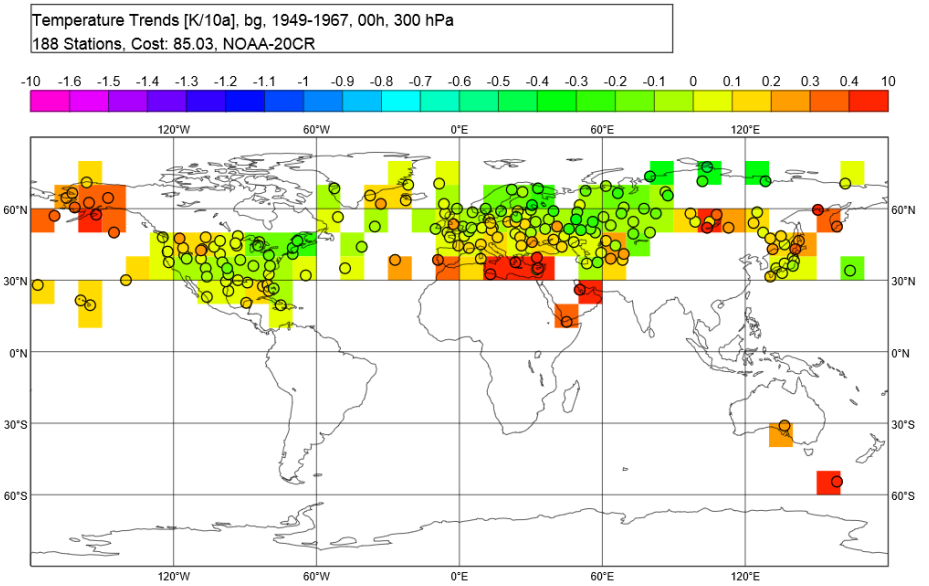
These data are easily retrieved from ECMWF odb2
Very strong cooling in obs over most of FSU, less so in bg
Good agreement over Europe, US

T-Trends, 300hPa, 1949-1967

ERA-20C analysis



NOAA-20CR analysis



No sign of cooling over FSU at all in surface data only reanalyses!

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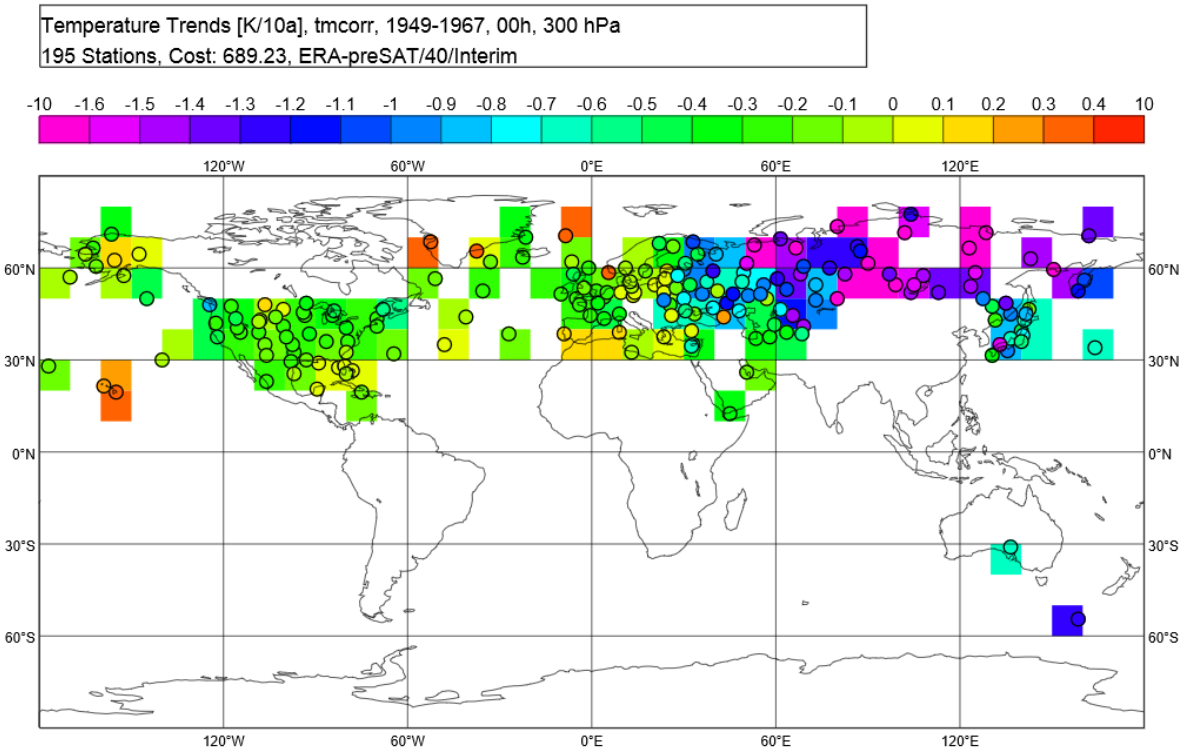
RAOBCORE adjusted tempatures

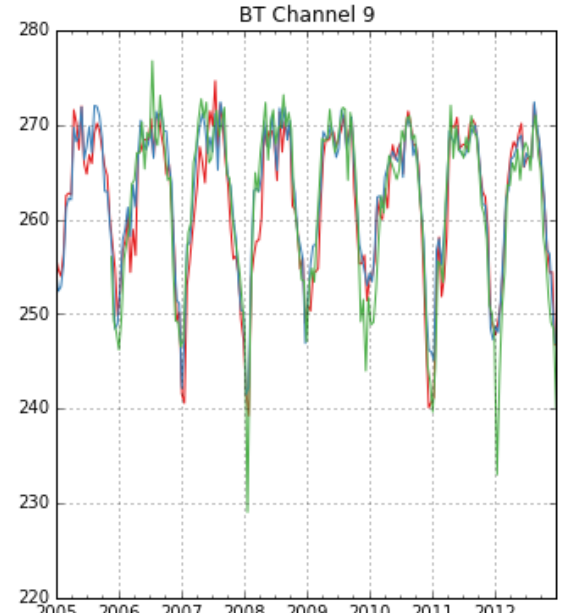


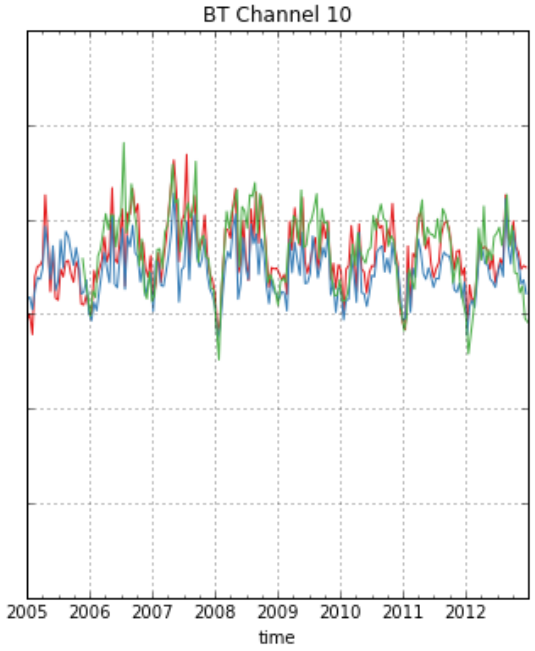
Method does not detect trend-like bias changes
ERA-presat bg also has cooling;
Departures from surface data only reanalyses have large variance

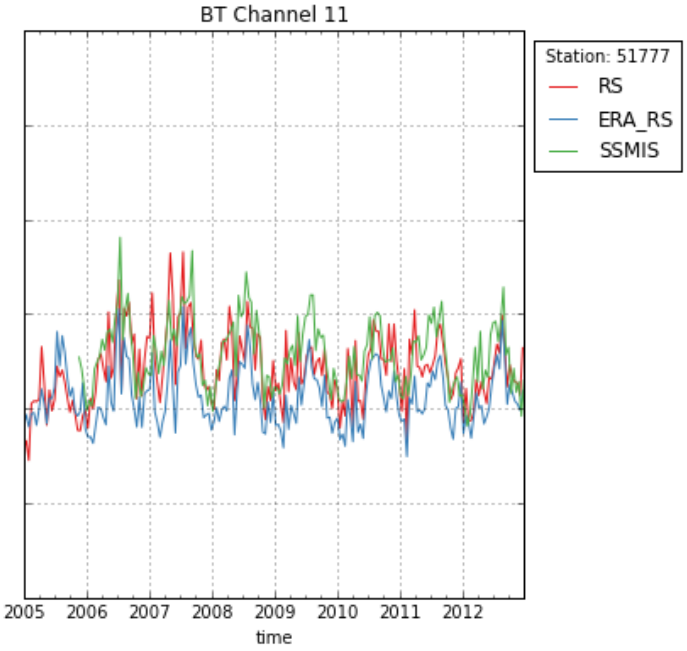
Status of offline homogenization

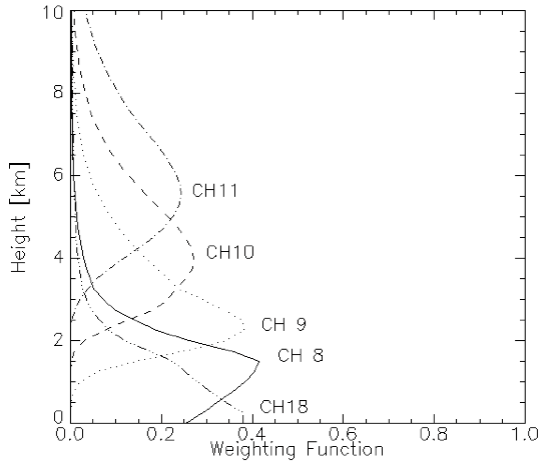
- RAOBCORE/RICH adjustments available back to 1958
- RAOBCORE/RICH adjustments back to 1939
  - RAOBCORE results there depend on reference used, much better break detection with ERA-presat
  - RICH needs to avoid neighbours from same country more strictly
- Wind data adjustments: available back to 1920s, Ramella-Pralungo et al. 2014a,b,c
- Humidity: just started
  - Calculate SSM radiances from RS profiles (using RTTOVs)
  - Analyse Humidity background departures

SSM-T2 brightness temperatures at single station









- RTTOVS 10 used for calculating BTs
- Potential for intercomparison back to early 1990s
- Comparison with GPS-RO?
- Background departures will be examined and interpreted with healthy scepticism

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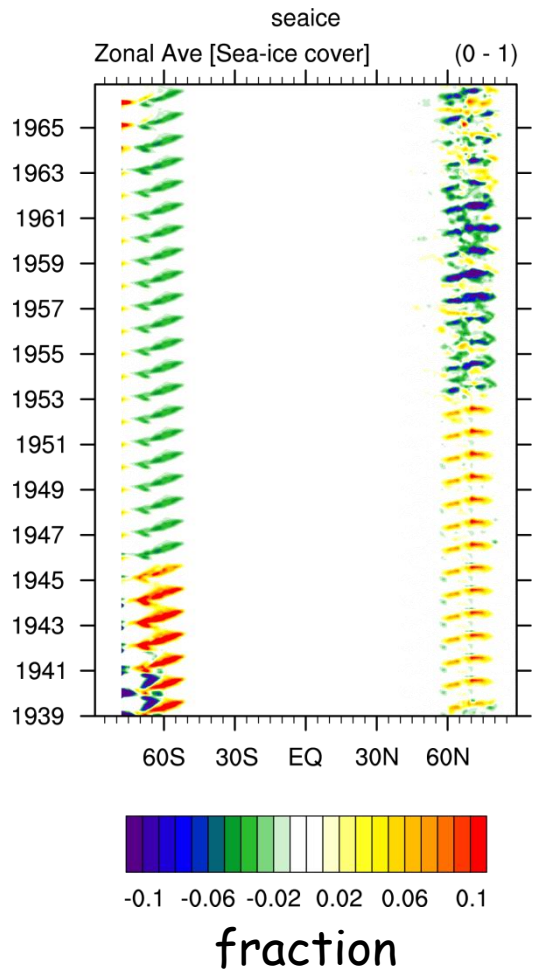
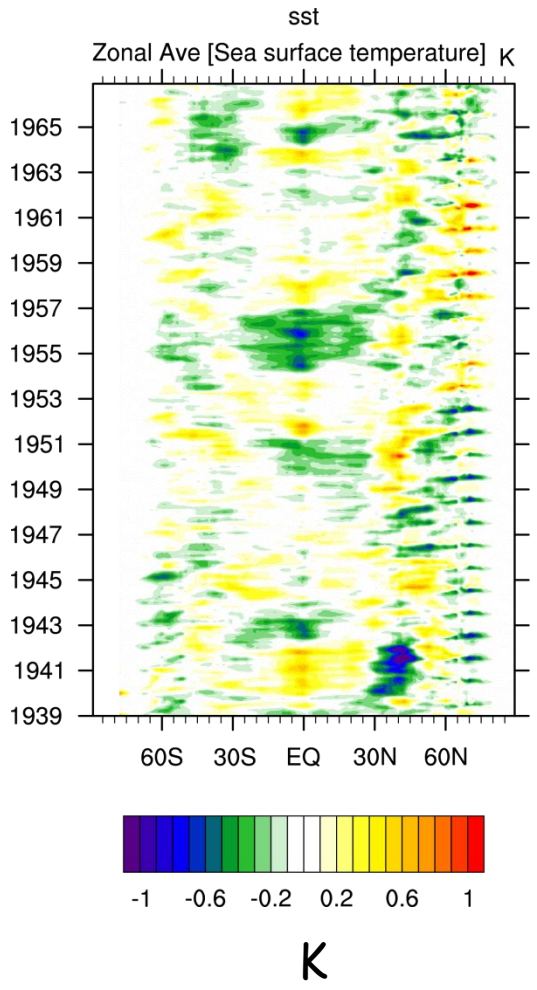
Flux diagnostics

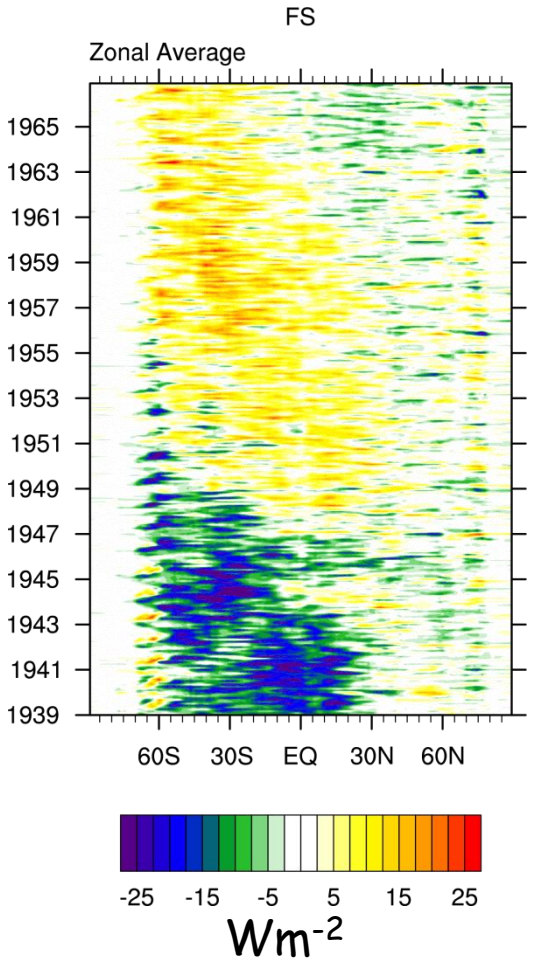
- Relationships between fluxes, state variables
- Mean Analysis increments indicate flux imbalances in early forecast steps
- Variability of fluxes as interesting as variability of state
- Fluxes should fulfil budget constraints, e.g. for vertically integrated total energy

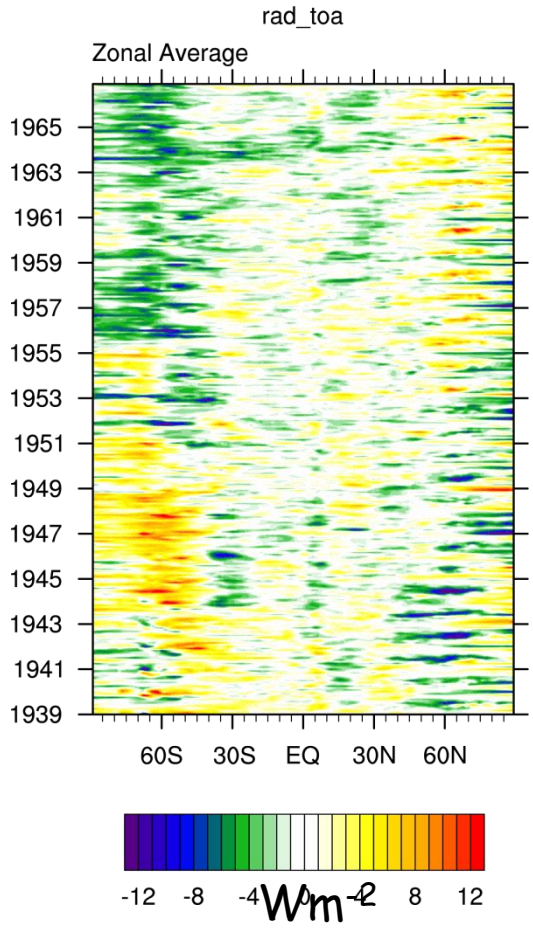
ERA-Presat Sea Ice and SST





Surface Flux and RadTOA, ERA-PreSAT





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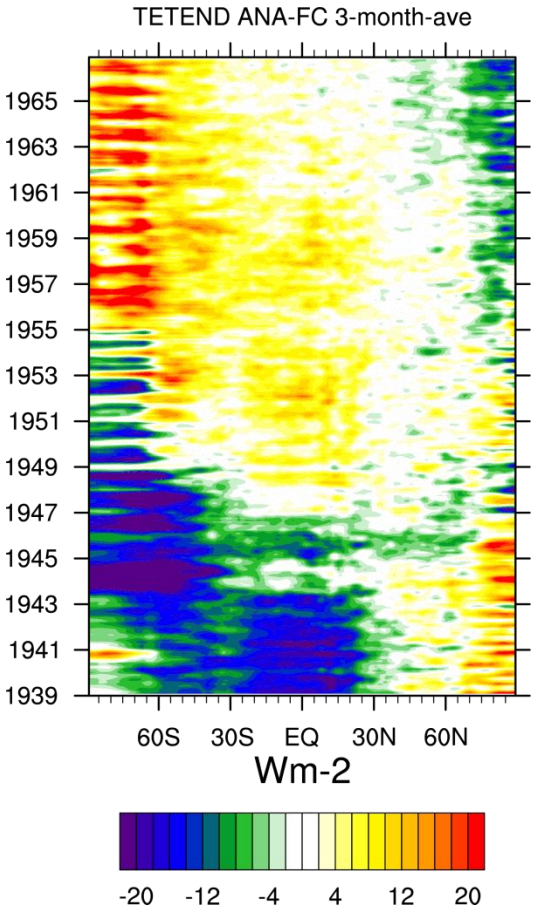
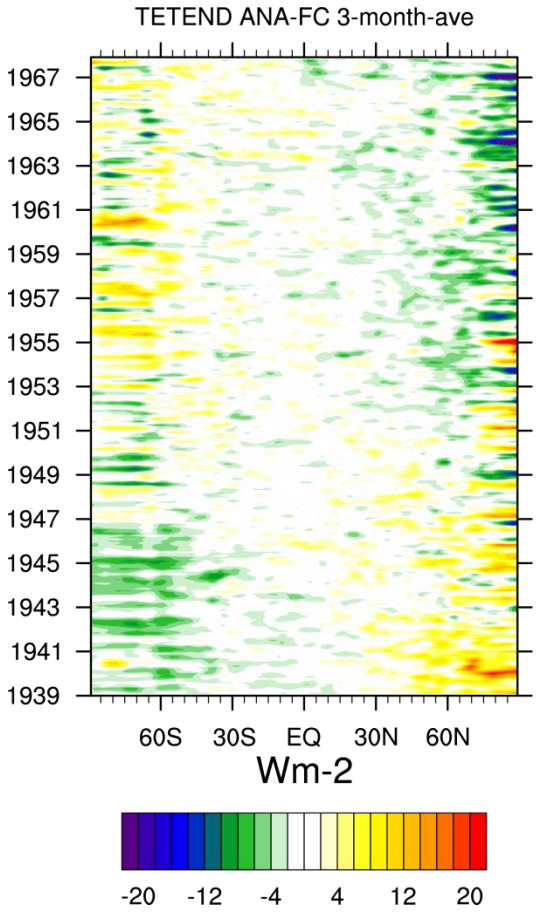
Analysis increment anomalies

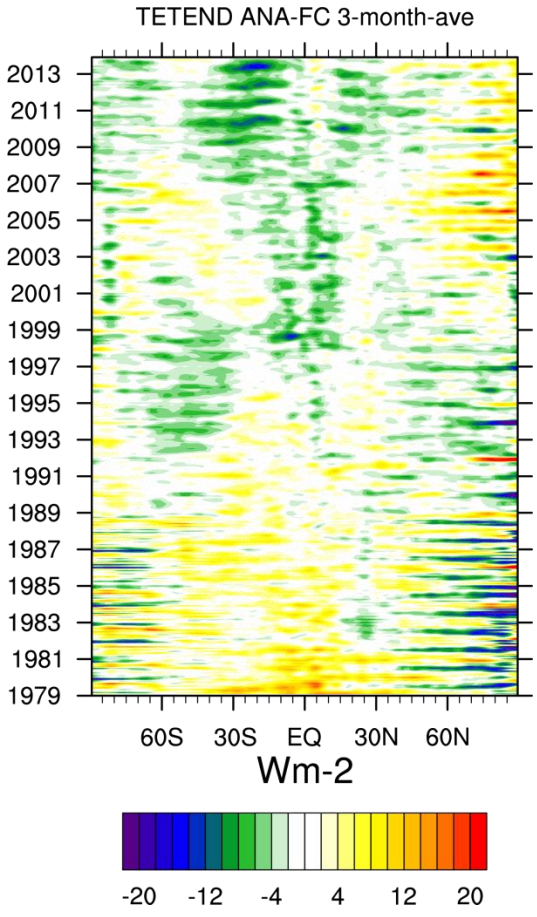
ERA-PRESAT



ERA-20C



ERA-Interim



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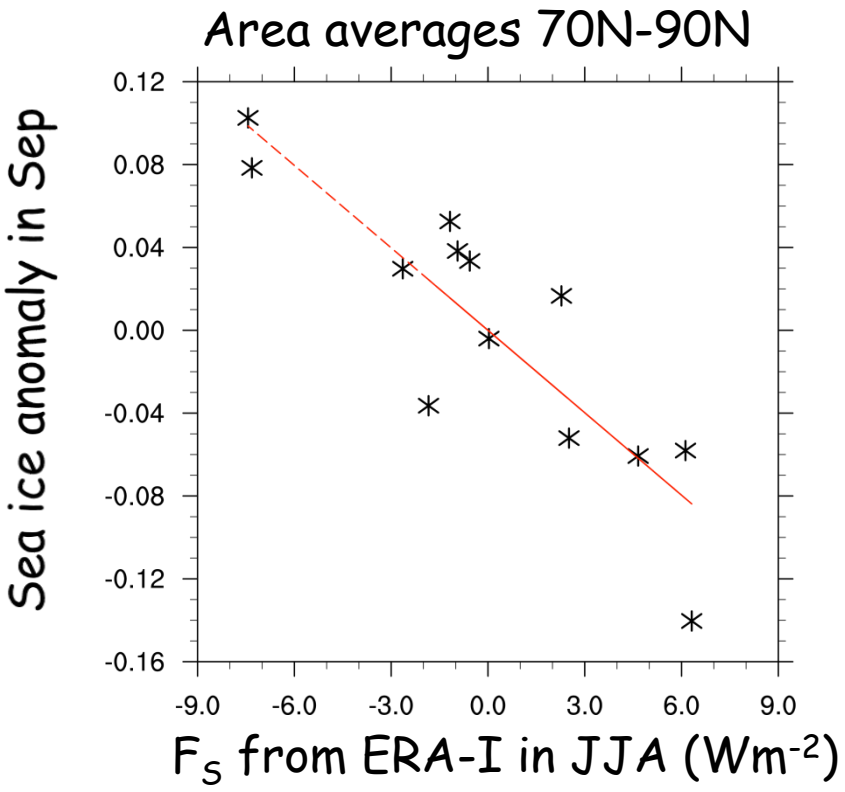
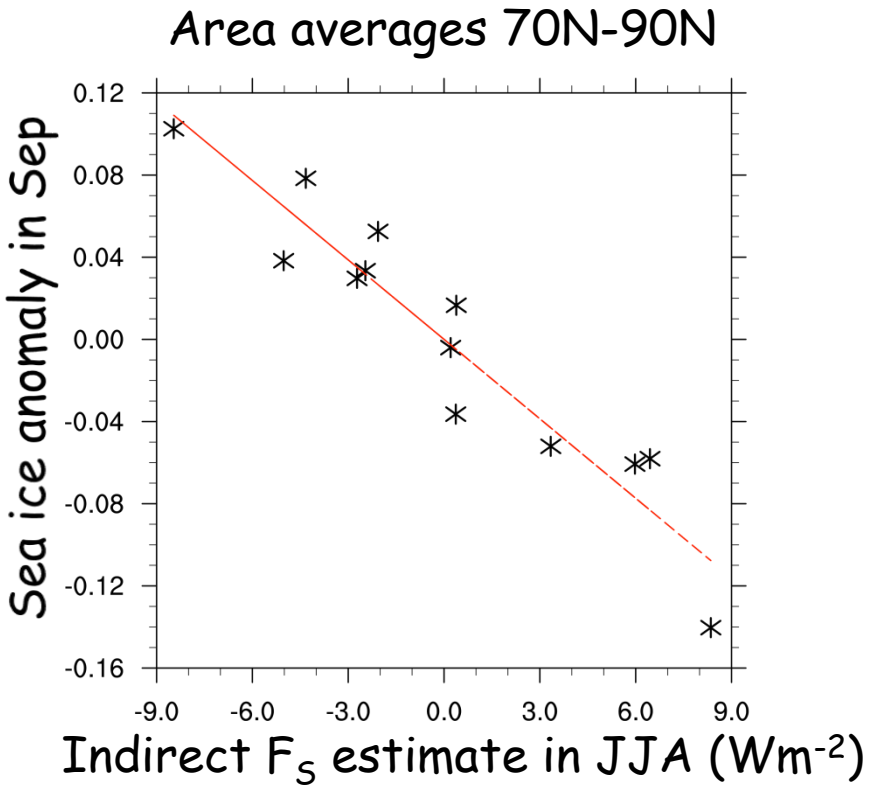
Surface flux and sea ice extent

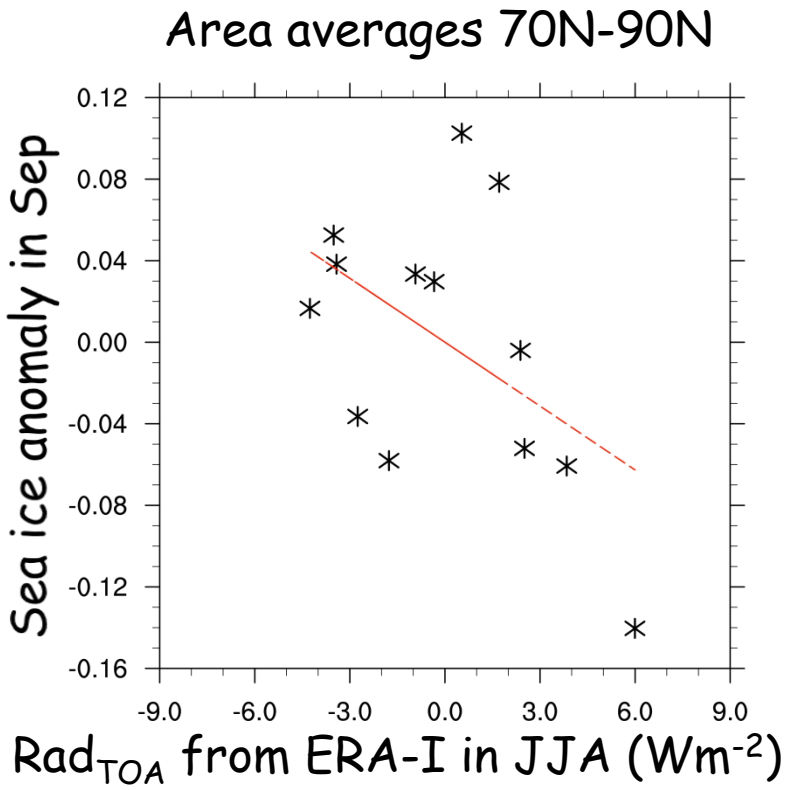
- Robust relationship between summer surface energy flux and September ice extent anomalies
- Indirect F_S estimate from satellite data and atmospheric budgets yields even clearer results

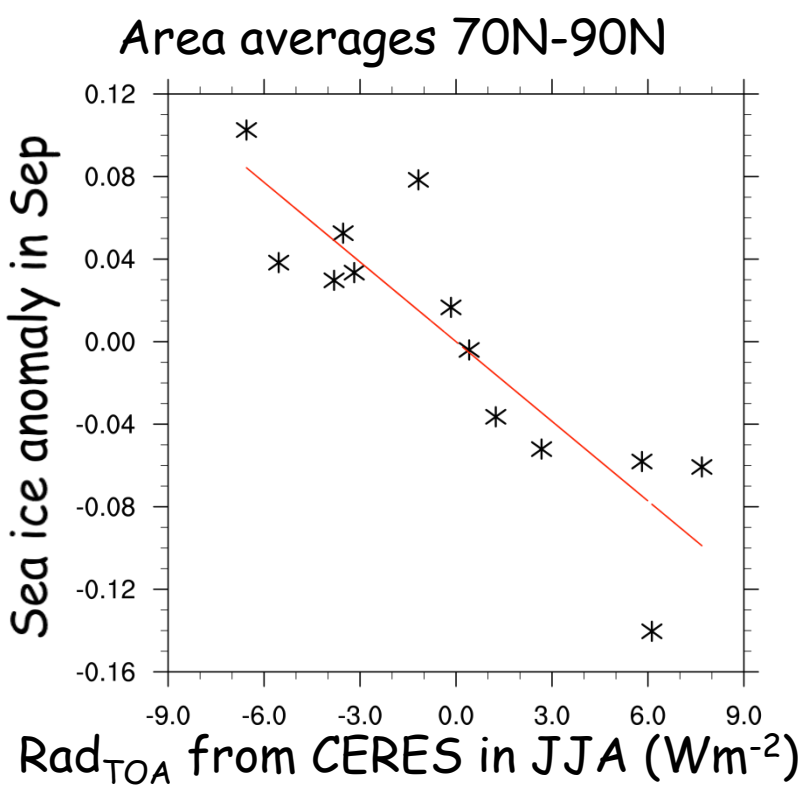




Radiation at TOA and sea ice extent

- Summer (JJA) Rad_{TOA} clearly has strong impact on September sea ice extent
- Reanalysis has difficulties to show this, probably due to cloud biases





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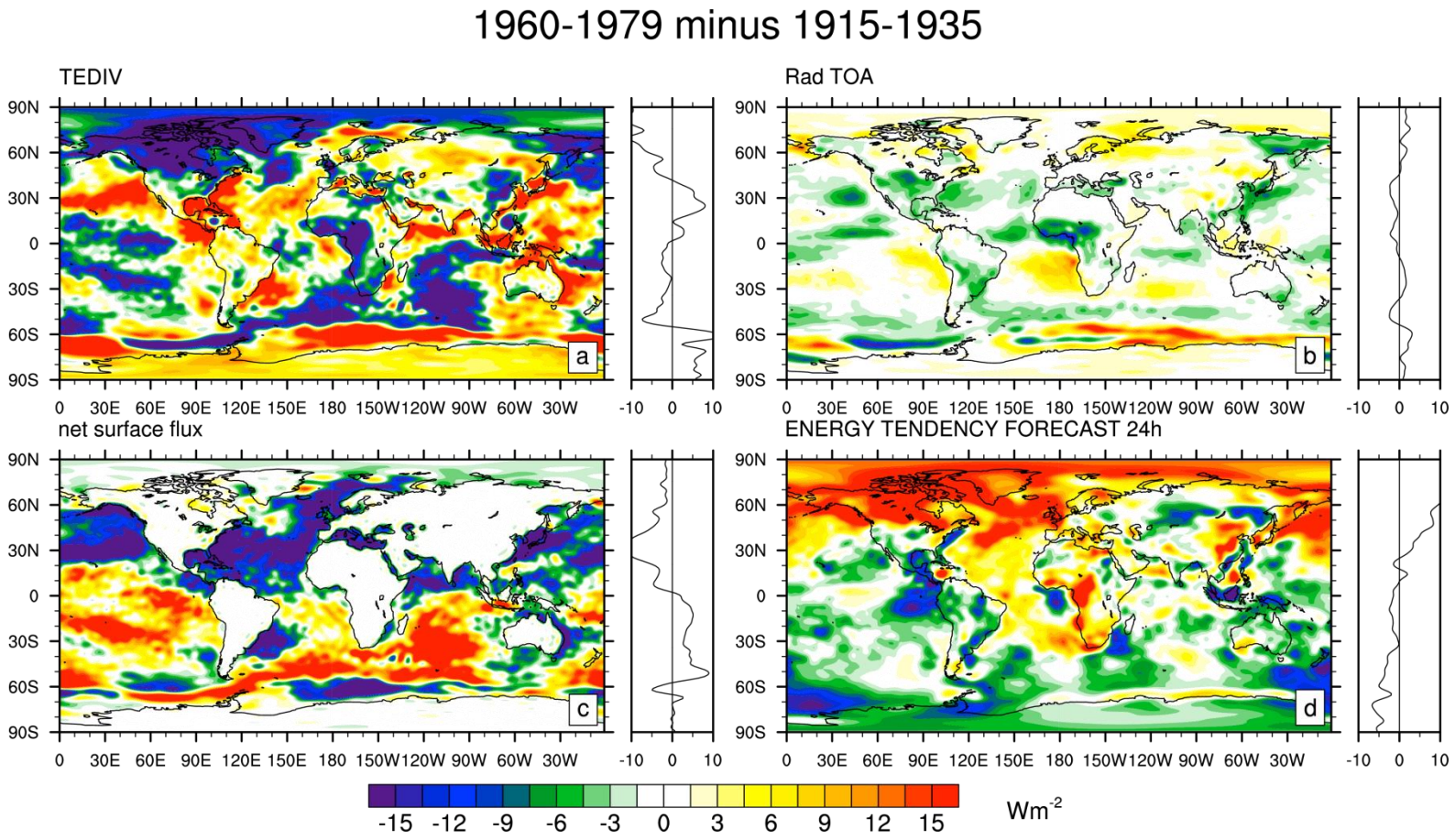
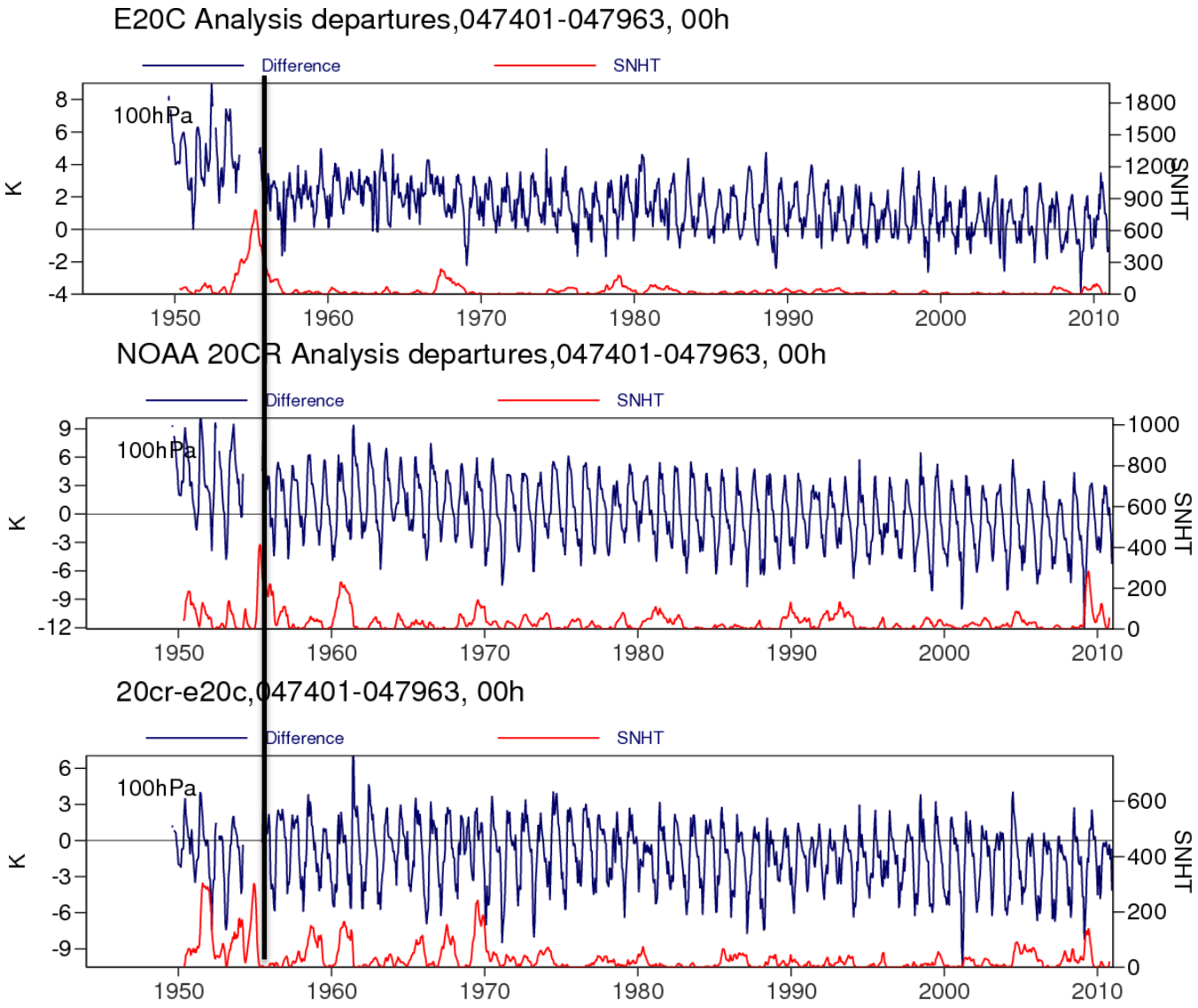
Do these results improve anything ?

- (Radiosonde) observation bias estimation
  - Offline:
    - Ready for wind (Ramella-Pralungo et al. 2014),
    - backward extension for Temperature to pre-1958 ongoing
  - Online: Bias model for VarBC of Radiosonde-T ->Marco Milan
  - Implemented by end of year but not sufficiently tested
- Budget diagnostics:
  - Need to be communicated early to have a chance of improvement within project
  - Valuable tool to discover physical relationships
- Need „canonical" set of diagnostics for comprehensive intercomparison of reanalysis, flux data

Conclusions

- Radiosonde T/wind bias estimation offline/online:
  - Deliverable due at end of year
  - Implemented but testing delayed
- Budget diagnostics:
  - Reveal problems but not necessarily a solution. Communication with „modelers" important
  - Emphasis on polar regions planned
- So far most work in WP4 in parallel, without much interaction except with ECMWF.


1960-1979 minus 1915-1935
TEDIV
Rad TOA
net surface flux
ENERGY TENDENCY FORECAST 24h
90N
60N
30N
0
30S
60S
90S
0 30E 60E 90E 120E 150E 180 150W120W 90W 60W 30W
-10 0 10
a
b
c
d
-15 -12 -9 -6 -3 0 3 6 9 12 15
Wm-2



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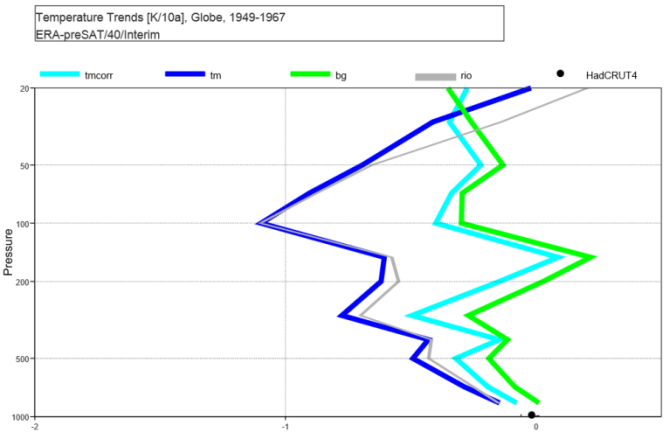
Temperature Trends [K/10a], Globe, 1949-1967
ERA-preSAT/40/Interim
tmcorr
tm
bg
rio
HadCRUT4
Pressure
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1000
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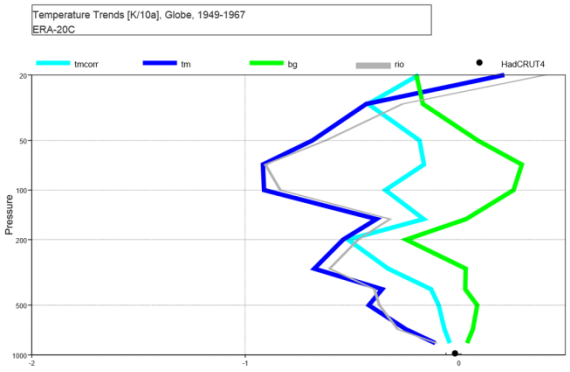
-1
0


Temperature Trends [K/10a], Globe, 1949-1967
ERA-20C
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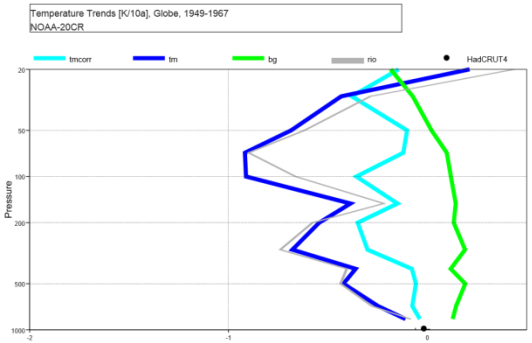
Temperature Trends [K/10a], Globe, 1949-1967
NOAA-20CR
tmcorr
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HadCRUT4
Pressure
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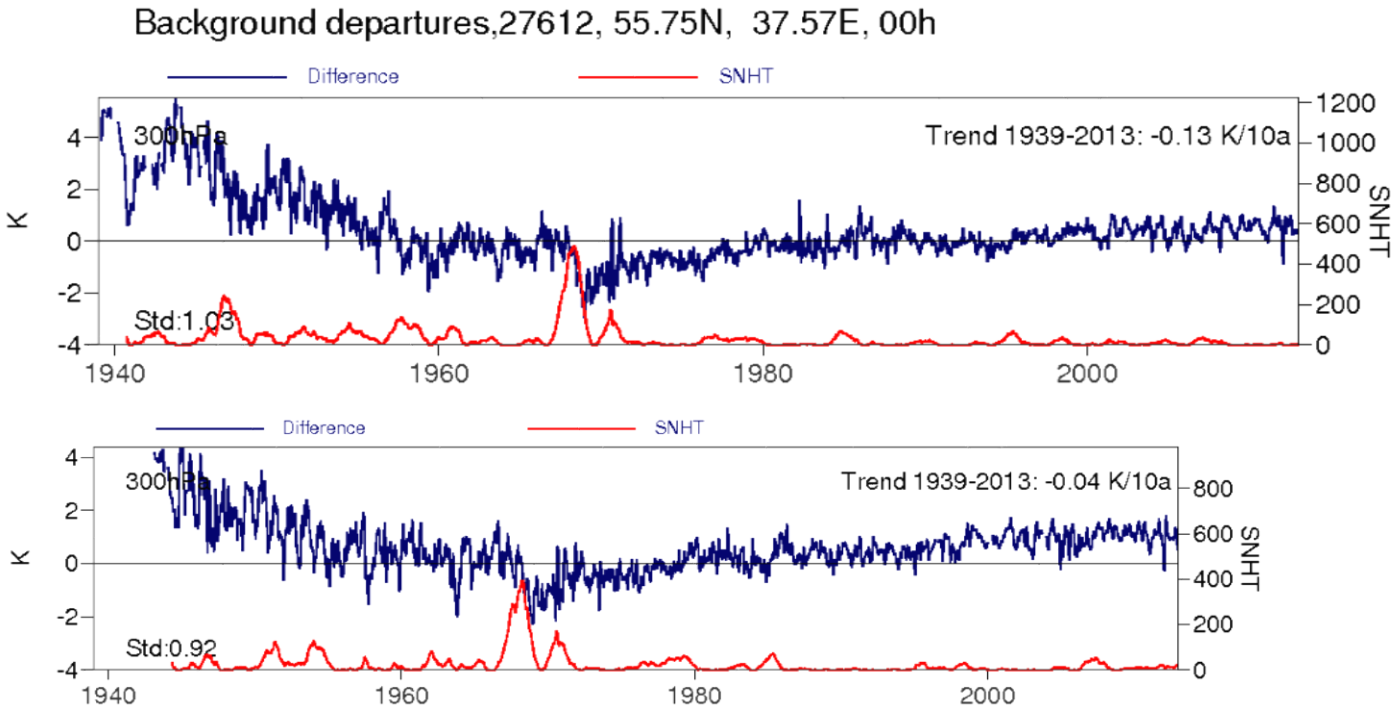
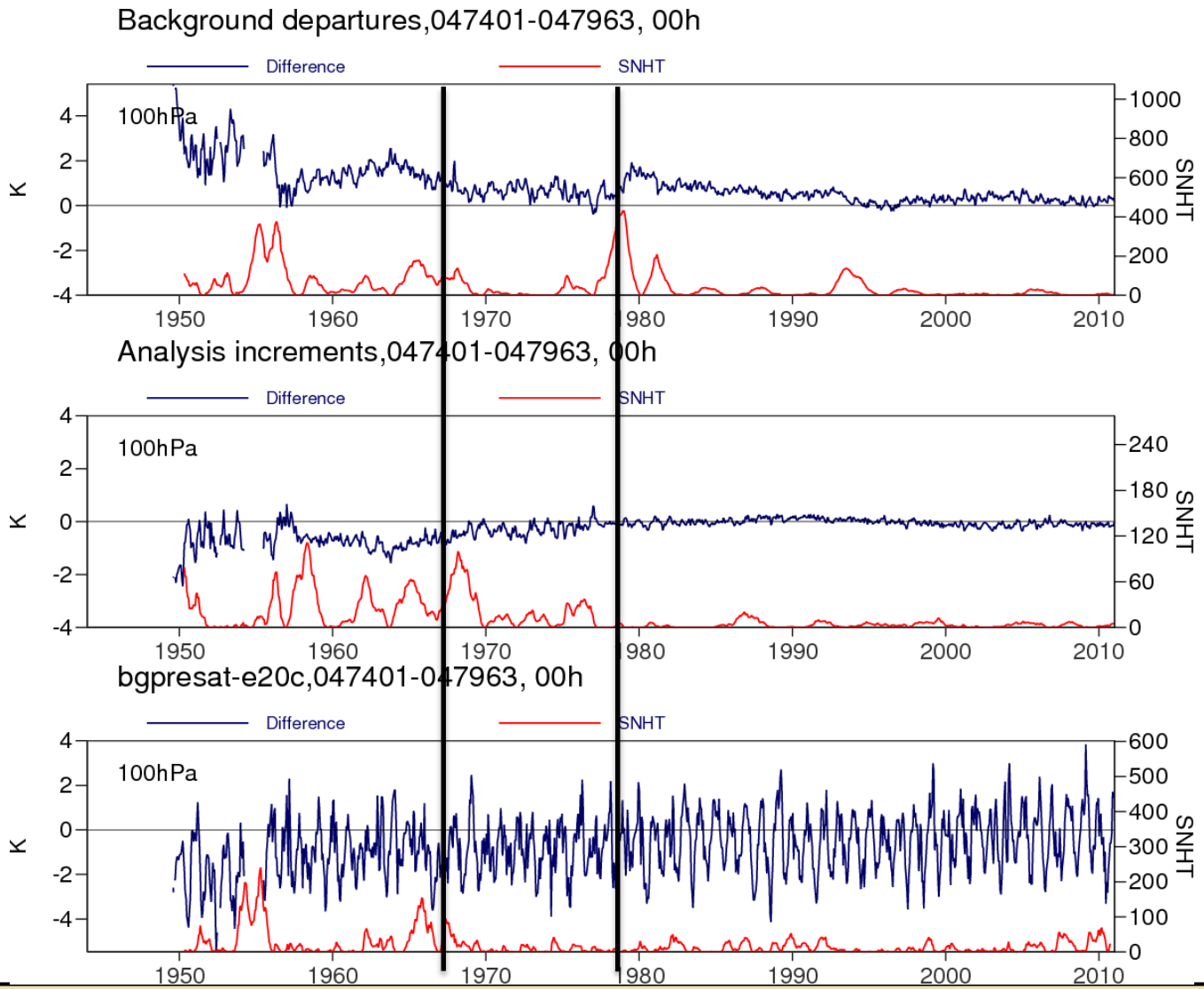
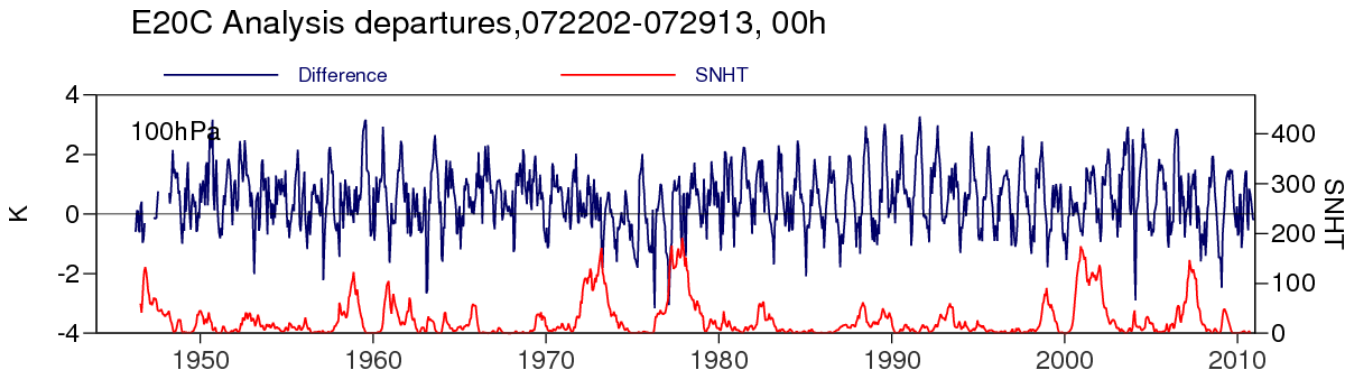
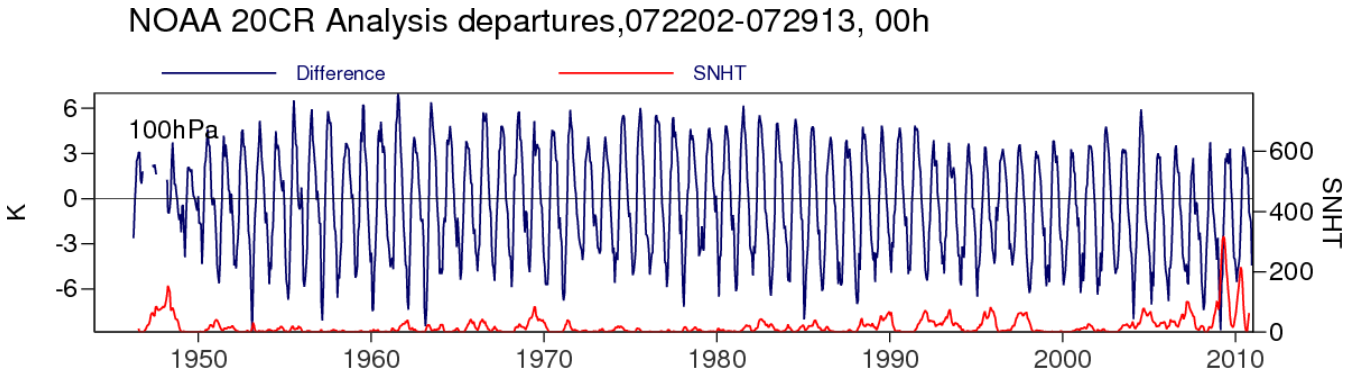
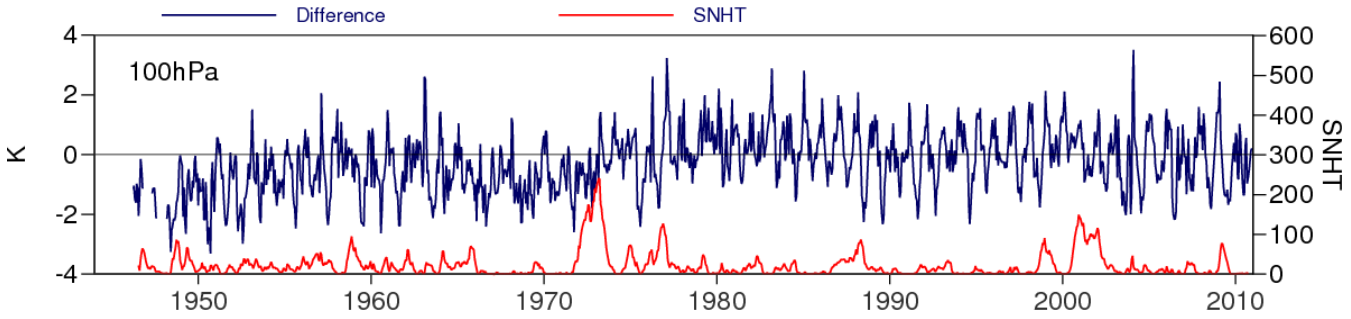

Background departures,27612, 55.75N, 37.57E, 00h
Difference
SNHT
300hPa
Trend 1939-2013: -0.13 K/10a
Std:1.03
K
SNHT
Difference
SNHT
300hPa
Trend 1939-2013: -0.04 K/10a
Std:0.92
K
SNHT

Japanese Radiosonde Composite







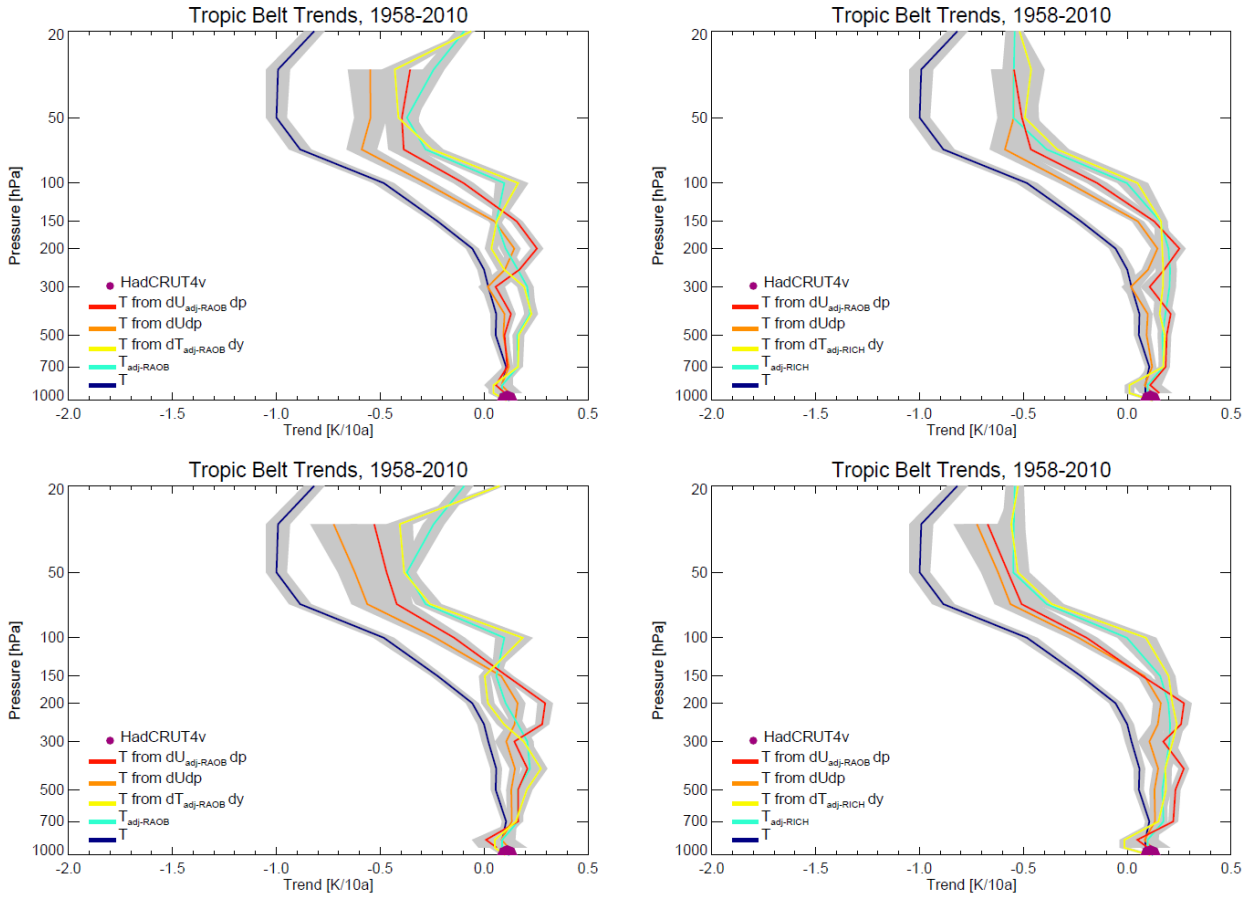


US

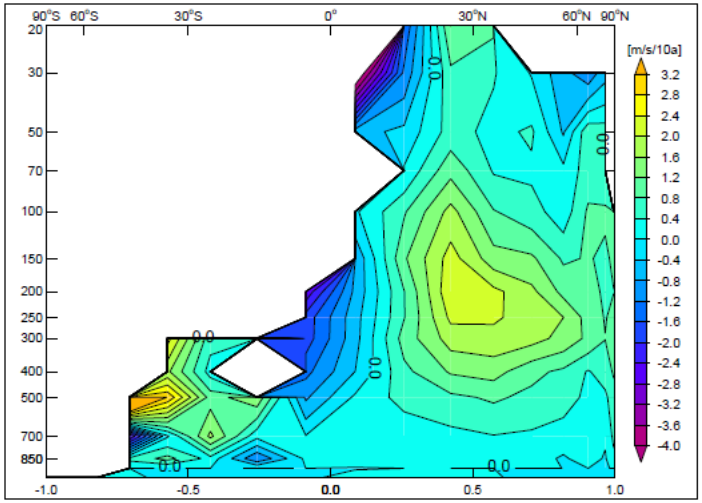
1972, 1977, 2002,2007???

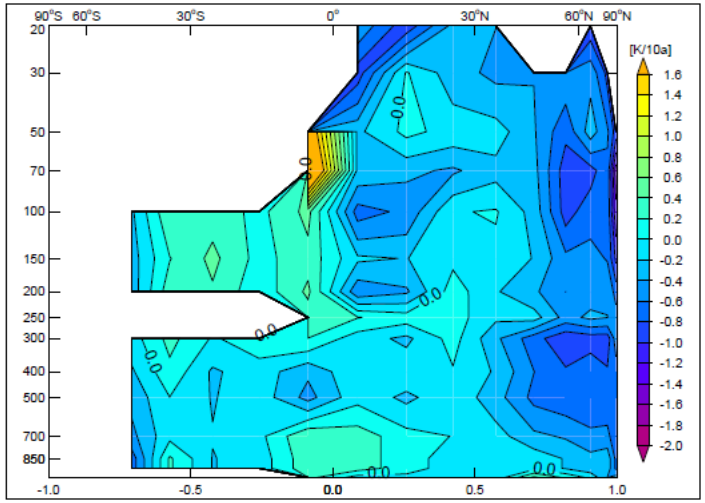
NOAA-20CR No obvious sign of break

Tropical trends 1958-2010



Temperature and wind 1950-1970





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