Comparison of ERA-20C and ERA-PreSAT with 20CR and reconstructions

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Outline

- 1940-1942 El Niño event
- Extreme events
- Early 20th century Arctic warming
- Winds
Data sets

- ERA-20C, ERA-PreSAT, 20CR
- AMIP-typ models (ERA-20CM, ECHAM5.4)
- Monthly statistical 3D-reconstructions based on SLP, station temperature, and upper-level data

BL2004: northern extratropics, 1939-1947, PCA regression

REC1: global, 1880-1957, PCA regression

REC2: global (incomplete), 1918-1957, only «cone of influence» around locations with upper-air data
The 1940s El Niño

- El Niño late 1939 to early 1942, contrasted with 1939, 1943/44 (La Niña years).
- Among the largest multiannual signal you can get
- Including the stratosphere
- Following: Jan.-Apr. (1940-1942) minus (1939, 1943, 1944)
100 hPa GPH

20CR

ERA-20C

ERA-PreSAT

BL2004

REC1

REC2
100 hPa Temperature

20CR

ERA-20C

ERA-PreSAT

BL2004

REC1

REC2
Sudden Stratospheric Warmings ERA-PreSAT

Downward propagation timing not right
Analyses of Extremes

> 20CR (ensemble mean), ERA-20C (deterministic), ERA-PreSAT

> All work done by students of the «Seminar in Climatology and Climate Risks», FS 2014
Typhoon Cobra 1944

Figure 3. Contours indicate isobars of 6 hourly mean SLP in [hPa] on 15 December 1944 12 UTC (top) and 18 December 1944 06 UTC (bottom) from 20CR (left), ERA-20C (middle) and ERA-PreSAT (right).
20CR has typhoon better than ERA20C and ERA-PreSAT.

Figure 4. Wind vector fields at 10 m in [m/s] on 18 December 1944 12 UTC in 20CR (left), ERA-20C (middle) and ERA-PreSAT (right). The values are 3 (6) hourly means in 20CR (ERA-20C and ERA-PreSAT). The arrows indicate the wind direction; the colour contours indicate the wind speed in [m/s].

Figure 5. Contours show the 2-day-precipitation accumulation in [mm] for 17 and 18 December 1944 in 20CR (left), ERA-20C (middle) and ERA-PreSAT (right).
Typhoon Hongkong 1906

Figure 2: Sea-level pressure of ERA-20C (top) and 20CR (bottom) from 17.09.1906 12:00 UTC to 18.09.1906 00:00 UTC in the area 110°E -130°E / 10°N - 30°N.

ERA20C has typhoon better than 20CR
Hurricane Janet 1955

**Figure 4:** Minimum sea level pressure (SLP) development over time for Hurricane Janet with data from the 20CR and ERA-20C reanalysis datasets.

**Figure 8:** Difference map of SLP with data from ERA-20C and 20CR on 28 September 1955 at 00 UTC. (Negative values (violet) mean that 20CR represents a lower SLP than ERA-20C.)

ERA20C misses the hurricane

Christoph Bertschi, Jan Stohler, Selina Studer
Typhoon Bart 1999

Underestimated in both, Slightly better in ERA20C

Figure 3: The minimum SLP time series of Typhoon Bart from the 18 September 00UTC to the 24 September

Figure 2: Sea Level Pressure (SLP) fields in hectopascal (hPa) on the 23 September 00UTC in a) 20CR and b) ERA-20C. Low SLP values in blue close to the southern coast of Japan represent Typhoon Bart.
1930s Arctic warming comparisons

Data compared:
Observation-based data:
> ERA-20C (one member)
> 20CR (ensemble mean)
> EREC = REC1: Monthly statistical reconstructions based on surface and upper-air data using hemispheric principal components across all variables and levels (Griesser et al. 2010)

Model simulations:
> ERA-20CM (ensemble mean)
> CCC400 (ensemble mean): ECHAM5.4, T63, AMIP-type, 30 members
700 hPa GPH DJF
Differences w/r to 1900-19

Differences over N Atlantic
20CR and ERA20C
signature over N Pacific
is model driven

Martin Wegmann
Same for 700 hPa temperature

ERA20C has different shape of warming

Martin Wegmann
Same but w/r to 1971-2000 (GPH)

Martin Wegmann
Same but w/r to 1971-2000 (Temp)

REC1

Model (ERA20CM)

20CR

Model (E5.4)

ERA-20C

Martin Wegmann
Arctic temperature

Temperature field average 60–90°N 700 hPa DJF

- 20CR
- REC1+ERA40
- ERA20C
- ERA20PS
- ECHAM5.4 GCM
- ERA20CM
ERA-20C 10 m wind speed, area averages
Wind speed, 10 m or 0.995 sigma, 20-yr moving averages
Cold Spell Argentina 1918

Both have signs of a cold spell although only 3 station in ISPD.

Carla Laub, Andrea Omlin, Sébastien Rapaz
Australian Heatwave 1939

SLP (Pa) and 500 hPa geopotential (left) or geopotential height (right)

Clear differences – not sure which is better

Alden Ackerman, Jacqueline Fenwick, Mridula George
Flood event Japan 1938

Precipitation (mm/6hrs) on 2 (left), 3 (middle) and 4 (right July 1939

20CR better shows an extratropical cyclone and an approaching tropical cyclone undergoing extratropical transition.

Jessica Russell, Marlon Fochler, Oliver Kumar
Figure 1: Spatial distribution of 2 m air temperature on January 5th (A, B) and February 20th (C, D). The reanalysis dataset ERA-20C (A, C) and 20CR (B, D) are shown over North America. Temperature values are in Kelvin.

ERA20C has cold spell better than 20CR