Operational NWP-system: ICON, changes effective from Nov. 27, 2019

On **Wednesday, 27 Nov. 2019**, the following modifications in the global data assimilation system and the ICON model will become effective with the **09 UTC** assimilation run.

1) **Use of additional coastal surface observation in the U.S.**
2) **Use of radiosonde descent data from the German research vessel "Polarstern"**
3) **Use of radiosonde humidity measurements from the Vaisala sondes RS41 and RS92 up to 200 hPa**
4) **Changes in climatology-based specification of stratospheric humidity**
5) **Retuning of the non-orographic gravity-wave drag scheme**

1) Use of additional coastal surface observation in the U.S.

An additional surface-based observation data set, consisting of a network of over 300 stations along the coastal areas of the U.S., is operationally available since more than a year. Since the meta data of the observations in Bufr format are not complete enough for an operational use, substantial preparatory work was needed to revise and complete the data set for operational use. Fig. 1 shows an overview of the geographical distribution of the stations along the U.S. coastlines. Based on an extensive data quality monitoring and a couple of assimilation and forecast experiments, a small but positive impact on the global analyses and forecast quality could be determined.

2) First use of radiosonde descent data

Beginning in Sept. 2019, the German research vessel „Polarstern" started a one year experiment journey in the Arctic region (MOSAIC) in order to provide continuous, high quality, unique earth system observations in the Arctic area. Radiosonde measurements are conducted operationally four times a day using the RS 41 sounding system from Vaisala. It enables the potential measurement of meteorological parameters during the descent phase of the radiosonde. The observations from the descent phase are collected and delivered over the GTS into the observation data base system of DWD, from where it can be used by the data assimilation system. The quality of the descent radiosonde observations are comparable to the observations from ascent radiosondes (Fig. 2). For wind speed, the measurement error for decent observations is even smaller than for ascent observations and only the temperature bias in the stratosphere is larger for descent data. Consequently, the temperature observations from descent radiosondes above 70 hPa have been rejected.

3) Use of radiosonde humidity observations up to 200 hPa

As the humidity sensors of radiosondes tend to become inaccurate at very low temperatures, the data assimilation so far uses radiosonde humidity data only up to 275 hPa. Recent monitoring results indicated that the quality of the humidity measurements from Vaisala radiosonde types RS 41 and RS 92 are good enough to use the data at least up to 200 hPa. This was confirmed in analysis and forecasting experiments, and a small positive impact could be detected.

4) Changes in climatology-based specification of stratospheric humidity

Due to the lack of reliable moisture measurements in the stratosphere, the ICON data assimilation system uses a relaxation towards climatological background values above the tropopause. Recent investigations suggested modifying this climatology relaxation in two aspects. First, the relaxation is now deactivated at pressures above 275 hPa, i.e. in the region where radiosonde humidities are generally assimilated, even if the tropopause pressure is even higher. This has a predominantly positive impact on the humidity analyses and forecasts at high latitudes, particularly in summer. Second, the climatology relaxation is turned off over Antarctica between 20 and 150 hPa because it tended to induce a moist bias in winter and spring when the air inside the polar vortex is freeze-dried by the formation of polar stratospheric clouds. In addition, the more realistic humidity slightly reduces the cold bias in this region during Antarctic spring (see Fig. 3).

5) Retuning of the non-orographic gravity-wave drag scheme

In the context of the experiments investigating the biases in the Antarctic polar vortex, it became apparent that the tuning of the non-orographic gravity-wave drag scheme, which has been taken over from ECMWF's IFS, should be revised. So far, the wave-flux source strength assumed in this scheme is reduced by one third compared to the IFS default because early tests during the development phase of ICON exhibited biases that are no longer representative for the current system. The tuning parameter will now be reset to the IFS default value because tests in various seasons indicated a predominantly positive impact on the model biases in the middle and upper stratosphere. The impact on the model biases in the Antarctic polar vortex is illustrated in Figs. 3 and 4.

For potential questions please contact

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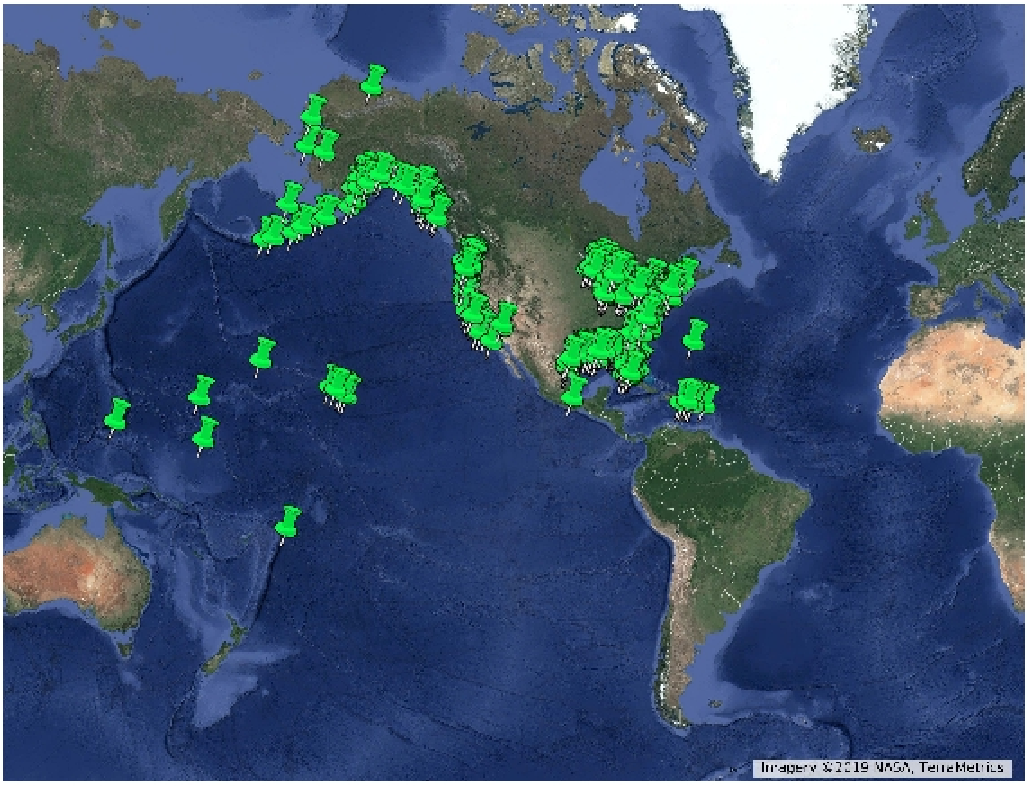

Figure1: Geographical distribution of the U.S. coastal stations (C-MAN).

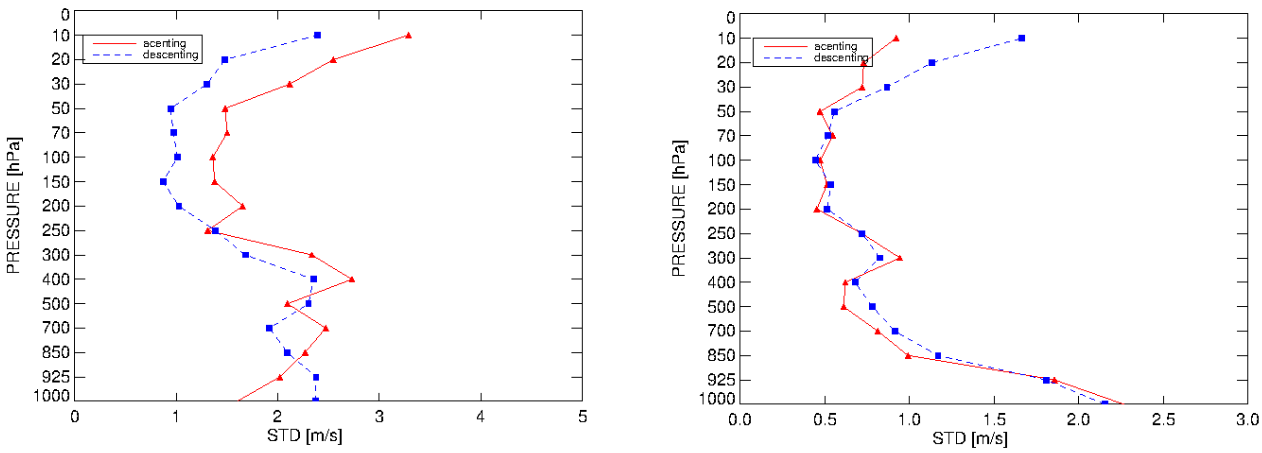

Figure 2: Observation minus First Guess (3-hour forecast) standard deviation averaged over a 10-day period in October 2019 for the wind velocity (left) and the temperature (right) and for the radiosonde ascent data (red) and for the descent data (blue) of the German research vessel Polarstern.

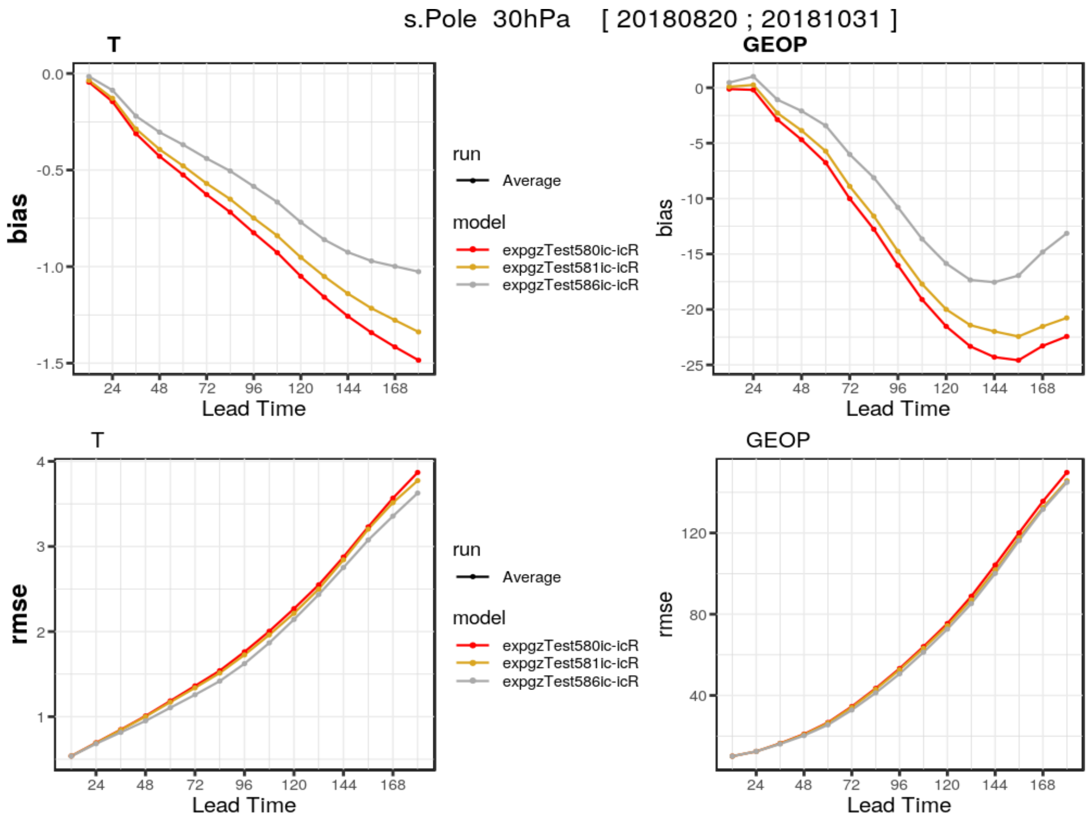

Figure 3: Analysis verification results for temperature and geopotential over Antarctica at 30 hPa from a set of experiments for the time period of Aug. 20 - Oct. 31, 2018. Colours indicate the reference (red), the experiment with modified climatology relaxation (orange) and the experiment with revised tuning of the gravity-wave drag scheme (gray).

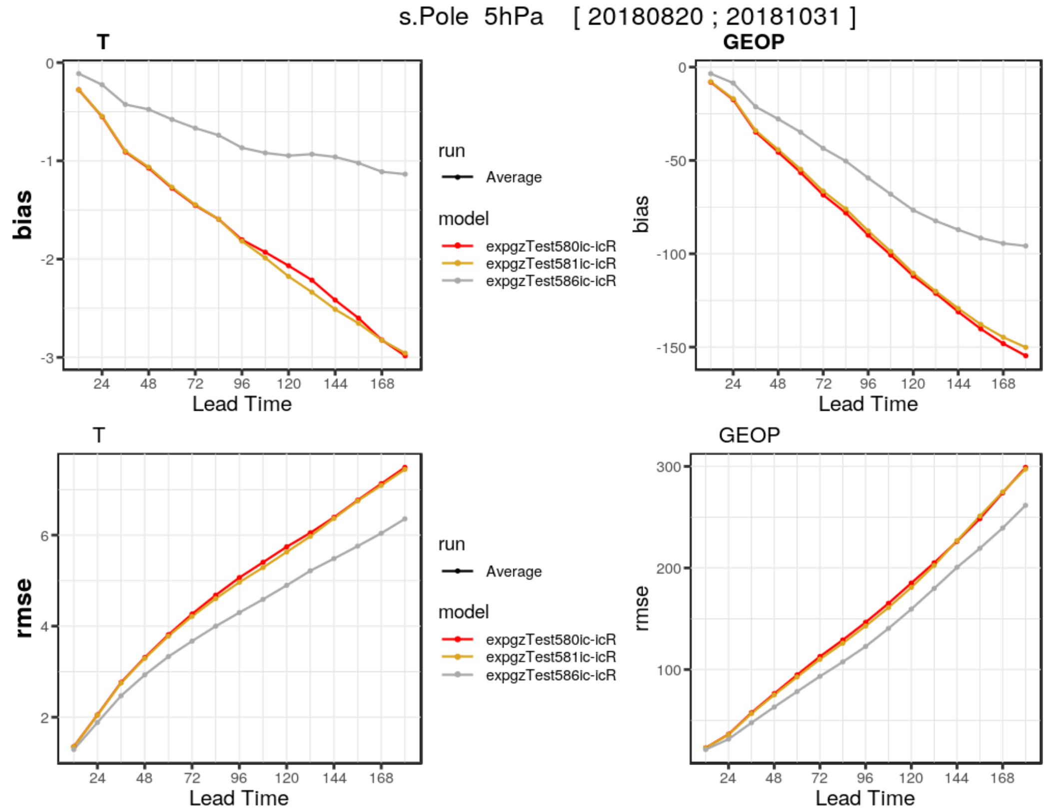

Figure 4: Same as Fig. 3, but for 5 hPa