The importance of reanalysis monitoring: the example of ERA5

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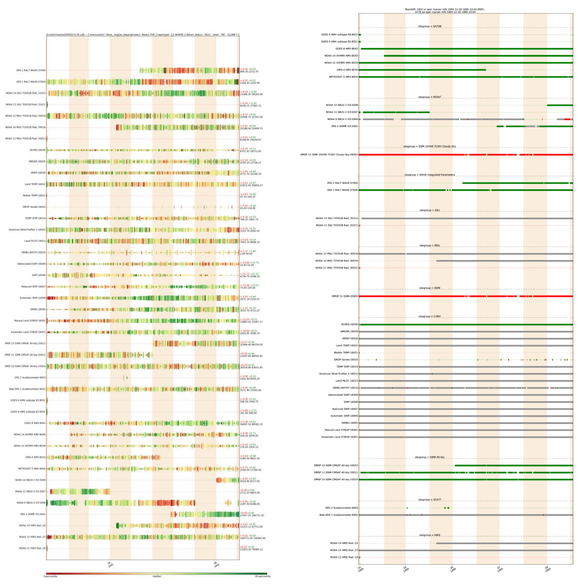
How ERA5 reanalysis production is monitored at ECMWF?

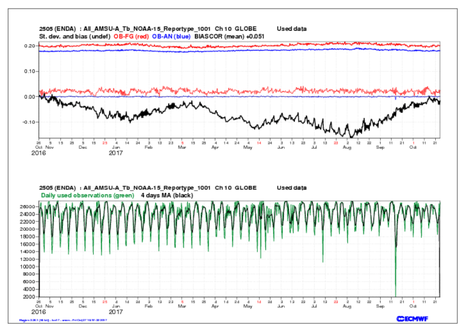
- The monitoring is done on a weekly basis (every Wednesday for a duration of 1-1,5 hours)
- Each production suite is monitored (the production rate is around 6-10 days per day, so in a week we cover around 1,5-2 months)
- The ERA5 team is doing the monitoring in rotations (we are 11 persons at the moment doing the monitoring)
- Sometimes we are inviting colleagues from the ECMWF's Research Department, who are experts on some observation types
- We are documenting our findings in the internal confluence pages of ECMWF
- Problems found and judged to need special attention are discussed and tackled in specific data assimilation meeting (also held on Wednesdays after the monitoring briefing).

What are the diagnostics looked at during monitoring?

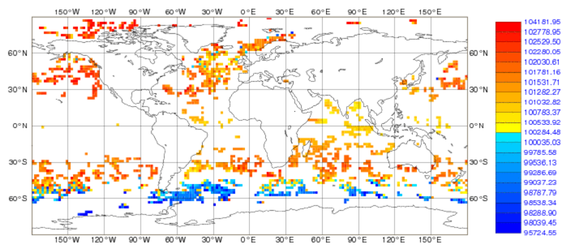
- Observation availability timelines showing the availability of monitored and assimilated observations including comparisons to reference datasets (like ERA-Interim or ECMWF operations).
- Observation minus analysis and observation minus first guess bias and standard deviation departure timeseries for all assimilated observations (stratified along levels, channels).
- Analysis increments and differences showing 6h and 12h analysis increments and reanalysis differences with respect to a reference (typically ERA-Interim) reanalyses
- Two-dimensional observation statistics plots including departure timeseries, geographic maps and Hovmoeller diagrams for observation amounts, analysis and first guess departures.



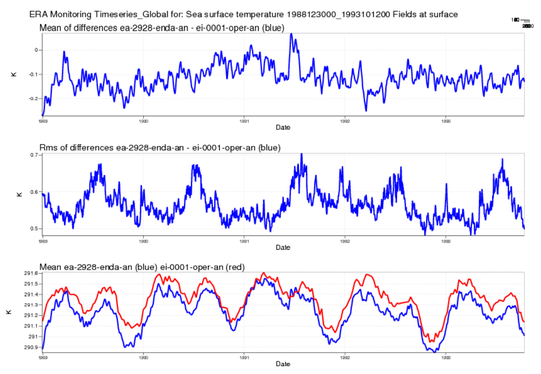
Observation timelines for the 1995 suite: assimilated observations (left); available observations as compared to ERA-Interim (right).



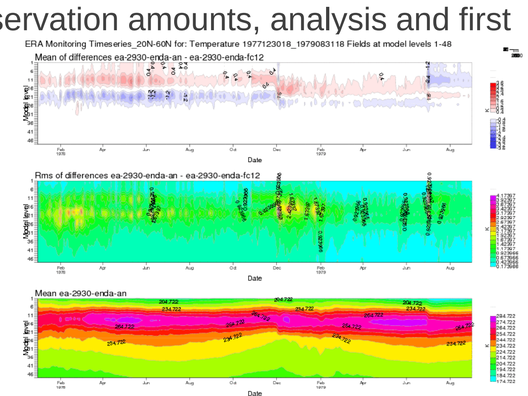
Analysis and first guess departures (and data amounts) for the Near Real-Time (NRT) suite for NOAA-15 AMSU-A channel 15 observations.



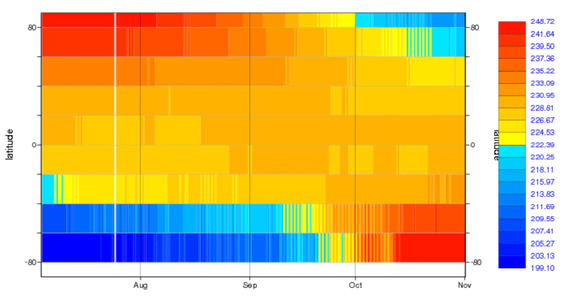
Assimilated buoy surface pressure observation amounts for April, 2008.



Surface analysis differences between ERA5 and ERA-Interim between 1989 and 1993.



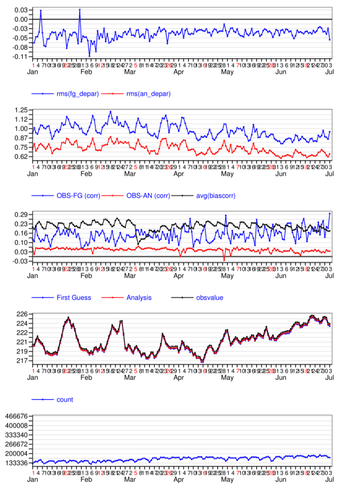
6h temperature increments for the 1979 ERA5 suite for the stratosphere at the Northern Hemisphere mid-latitudes



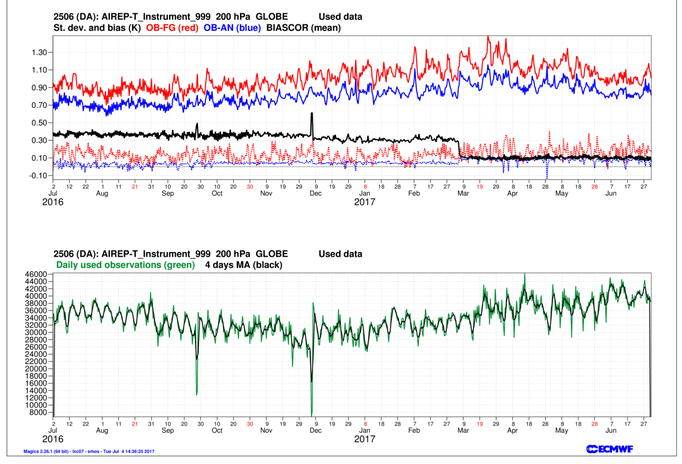
Hovmoeller diagram for July-October, 1979. TIROS-N SSU, channel 1 data amounts.

Example: aircraft bias correction

We have noticed a bias correction jump and consecutive bias increase in aircraft 200 hPa temperature departure maps (right panel). At the same time the model started to drift from the GPS-RO and the radiosonde observations. The problem was related to the grouping of aircraft data and the bias correction of newly appearing aircraft data. This was correctly handled by the operational model (left figure), but initially not by ERA5 (right). This has now been resolved.



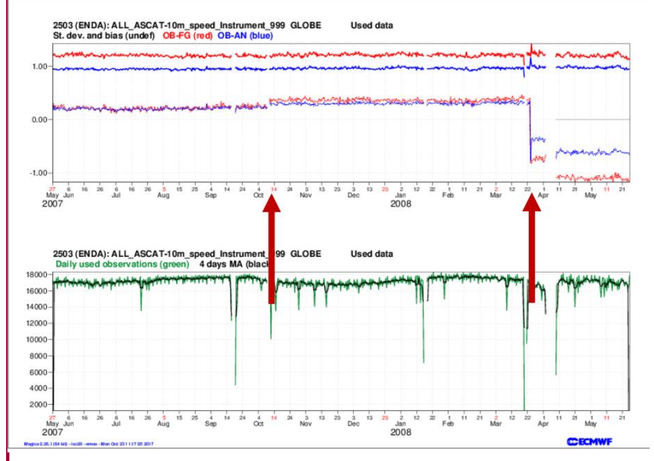
Operational aircraft temperature departure timeseries.



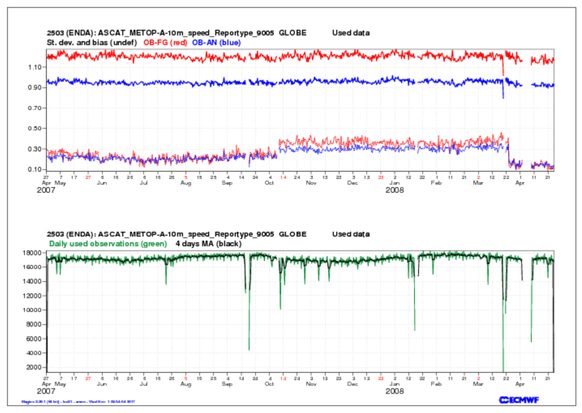
Jump in bias in March, 2017 and increased aircraft bias values in ERA5.

Example: scatterometer problem

We have noticed jumps in scatterometer departure (bias) timeseries in 2007 and 2008. After investigations it was revealed that the changes in scatterometer calibration was used as in operations at that period, which is incorrect for reanalysis, since the re-processed datasets have the same error characteristics throughout the entire reanalysis period (see the improved figure at the right).



Scatterometer departure timeseries plot. Two jumps in bias are clearly visible especially the one in March, 2008.



Scatterometer departure timeseries after correction.

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