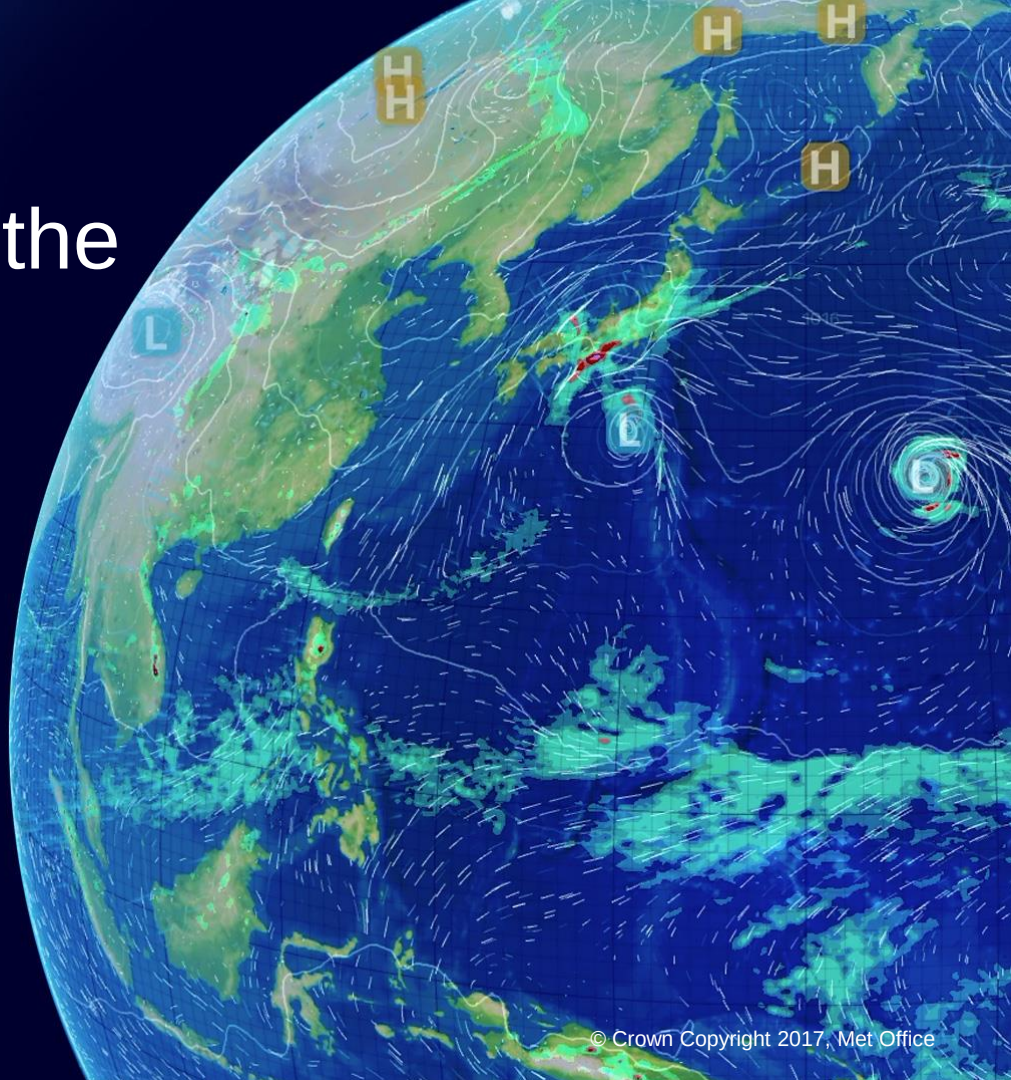
Assimilation Status at the Met Office

Owen Lewis

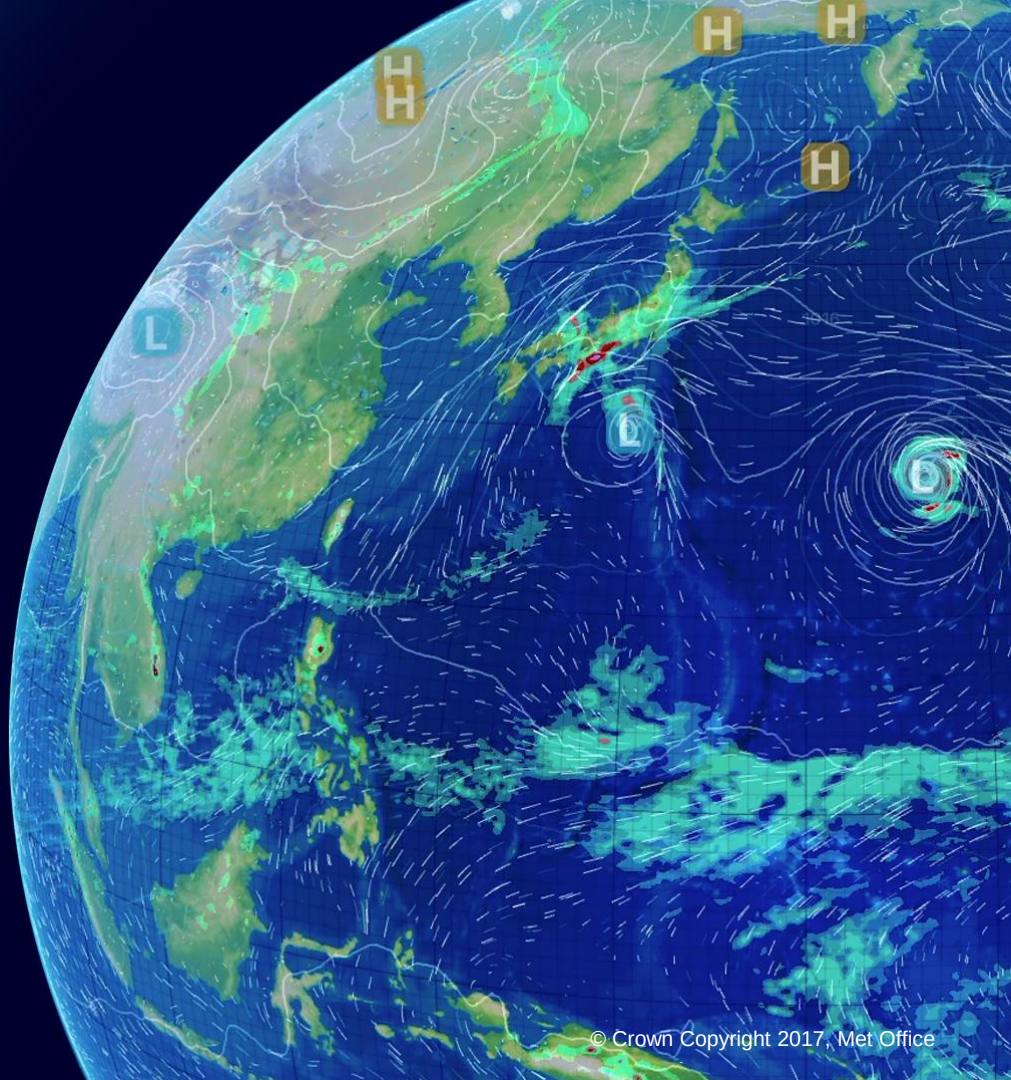
E-GVAP Experts meeting, 28th-29th November 2019, Offenbach



Contents

- Current Global Model
- Ground based GNSS Setup
- Data impacts
- Trials
- UKV data denials
- Plans

Current NWP



PS43

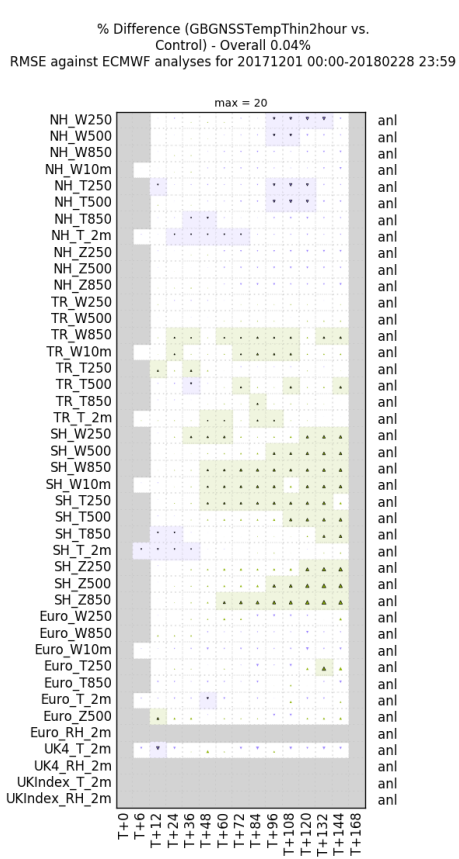
- PS43 should be going into operations next week.

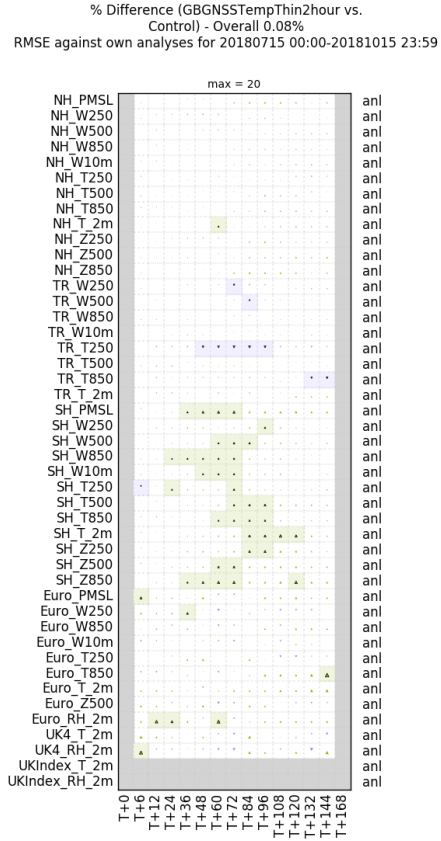
- Major change to ensemble forecast with En-4DEnVar ‘Ensemble of 4D-ensemble-vars. Creates an ensemble of initial conditions generated through their own data assimilation. Better spread and reduced forecast errors.

- Upgrade to model physics with Global Atmosphere 7.2 configuration, improves deep convection, representation of cloud, radiation, warm rain microphysics and boundary layer processes

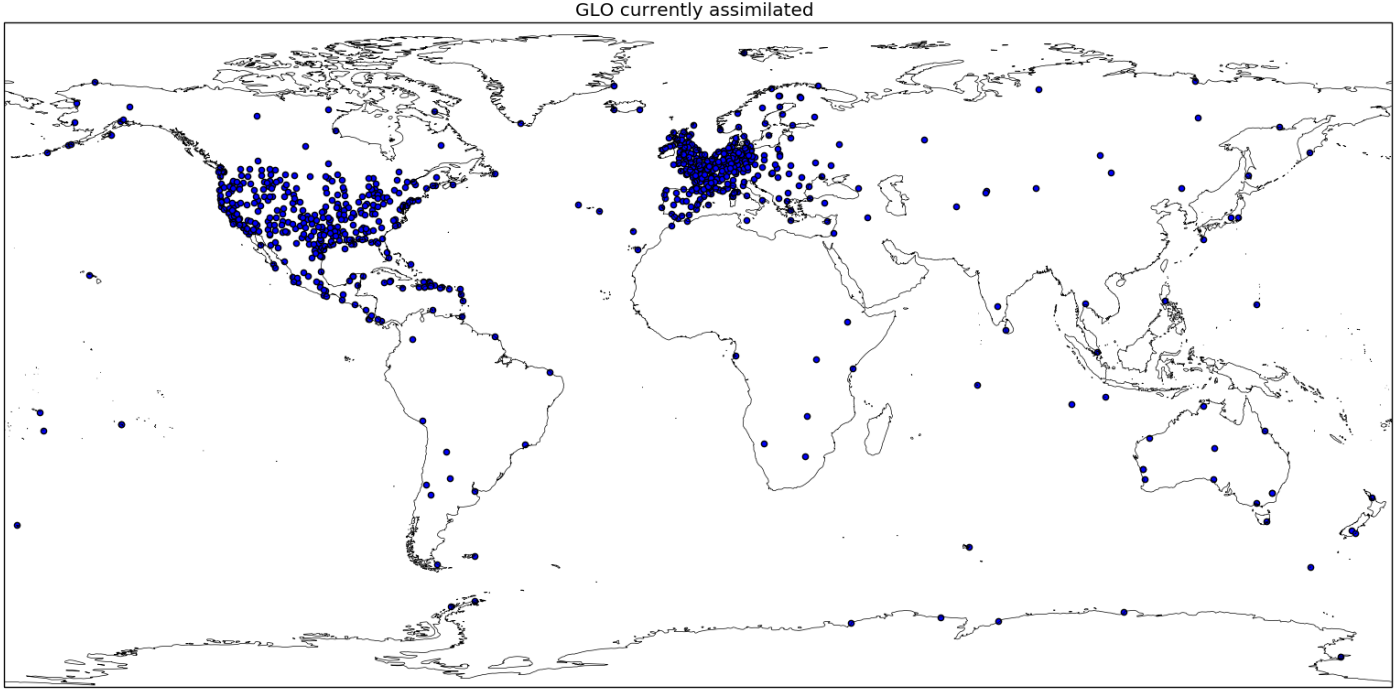
PS43

- Changes to Ground based GNSS temporal thinning in Global.
- Changed from one observation in a 6h assimilation window to 2 hourly thinning. This has increased the number of observations by about 250 %.
- Improvement in SH





Current Stations Assimilated



The map of assimilated stations as of 26/11/2019
745 stations

PS43 updates

- On release of PS43 there will also be a few other Ground based GNSS updates
- In the Global model the METG and METO ACs will be replaced by MTGH and MTRH.
- A new bias correction will also be included.
- METO will also be replaced in the UKV but still needs to be formalised.

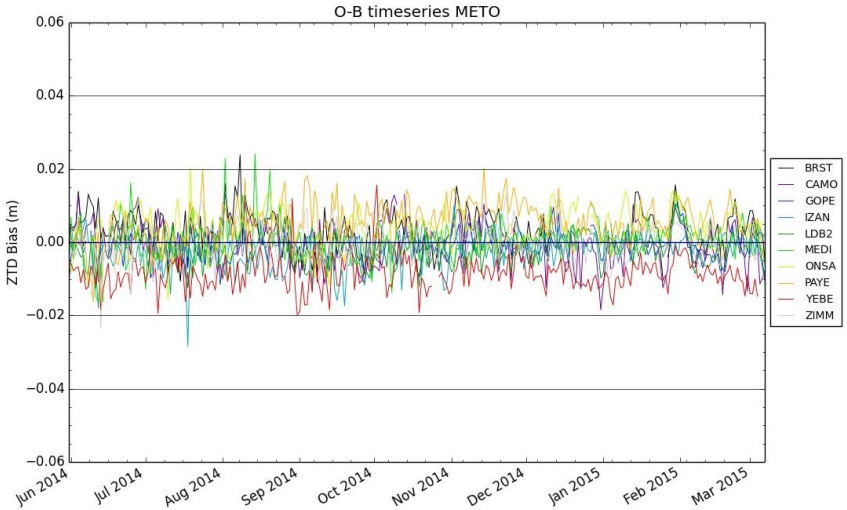
Current Ground Based GNSS Setup

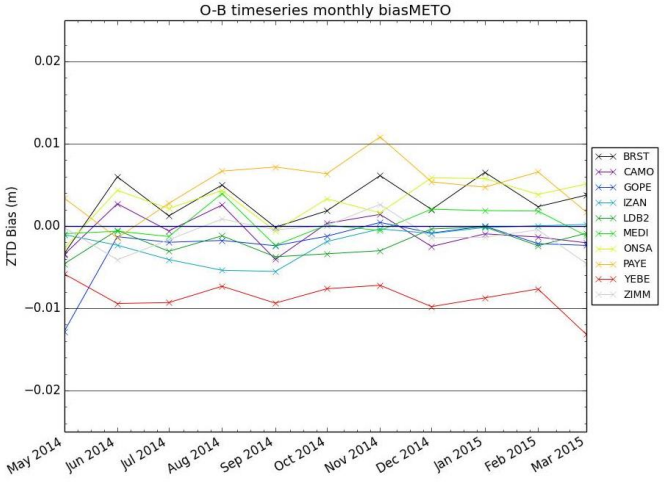
- Ground based GNSS assimilated in both the Global NWP model and the convective scale 1.5 km UKV NWP model.

- Use 4D-VAR assimilation in both Global and UKV but only Global is assimilating more then one ob in the assimilation window.

Bias Correction

- Use a static bias correction with stats accumulated over a longer time period, preferably about a year.





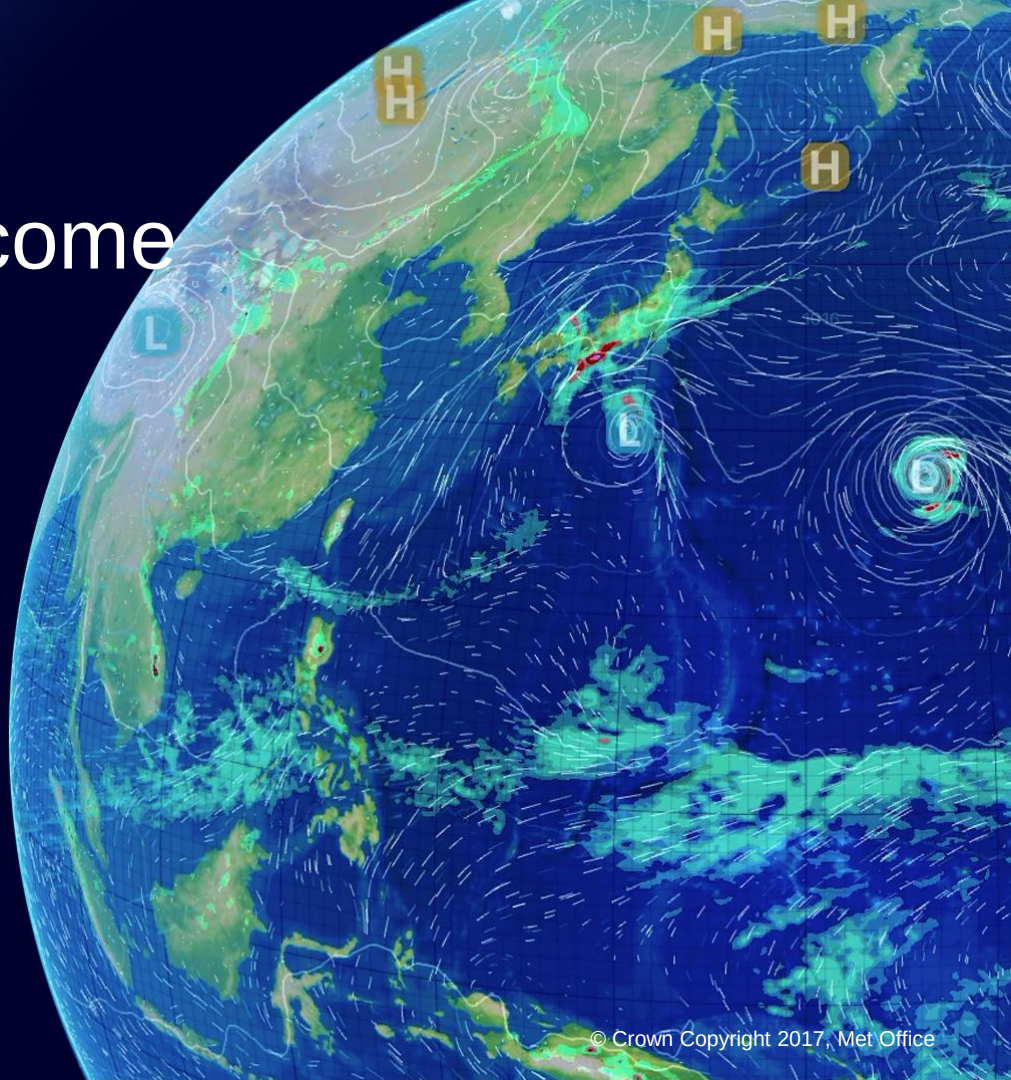
Station list

- We use a white listing method, everything is rejected and then observations brought back in if they pass quality control.

- Observations rejected if
  - height difference between station and model greater then 300m
  - O-B is greater then 0.055 m (This needs to be revised more to come)
  - Do not have a bias correction
  - Not in the list of processing centres

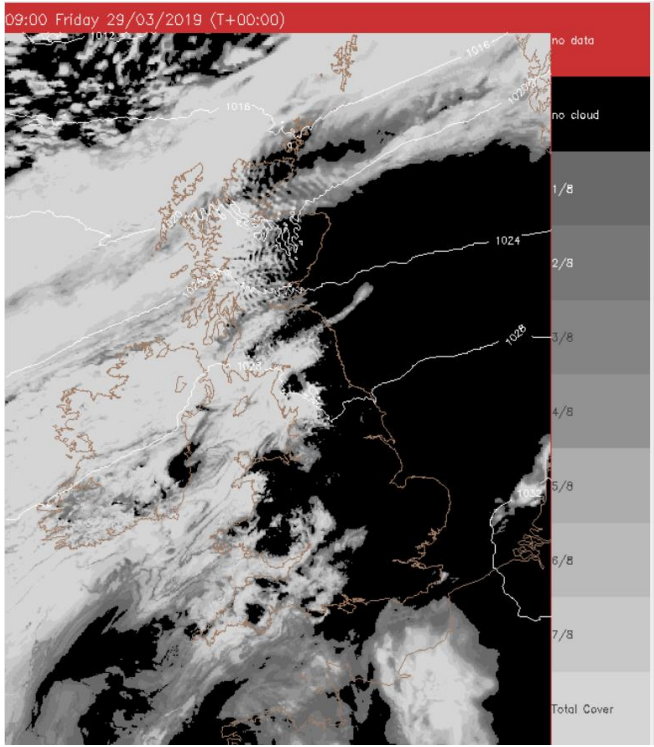
Where did that cloud come from?

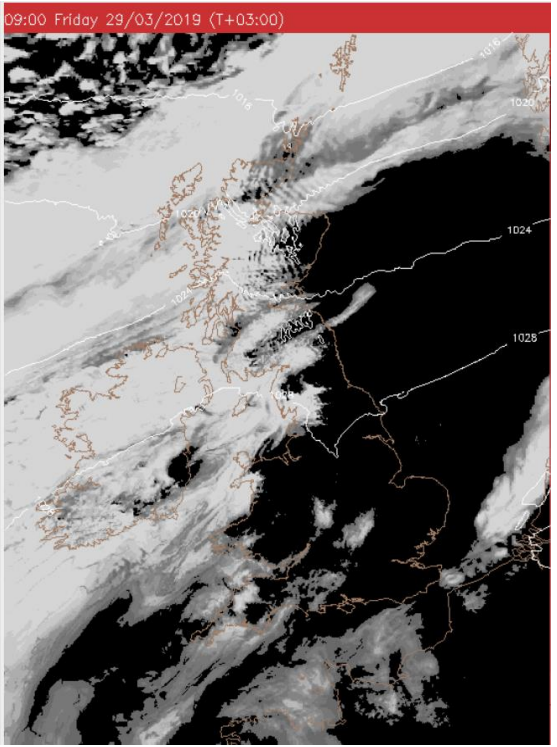
An interesting operational case that demonstrated the need for good quality control.



Extra Cloud over France - 29th March 2019

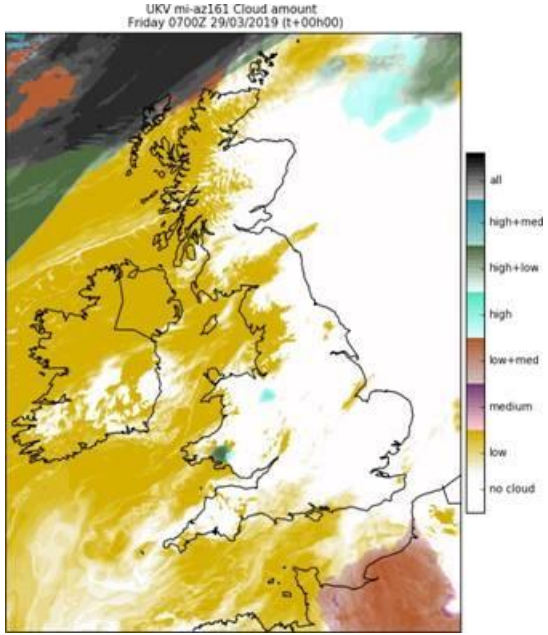
- Substantial difference in the amount of cloud over France between the 6Z T+3 (right) and the 9Z (left).
- This was identified by the Chief Meteorologist and passed on to R2O



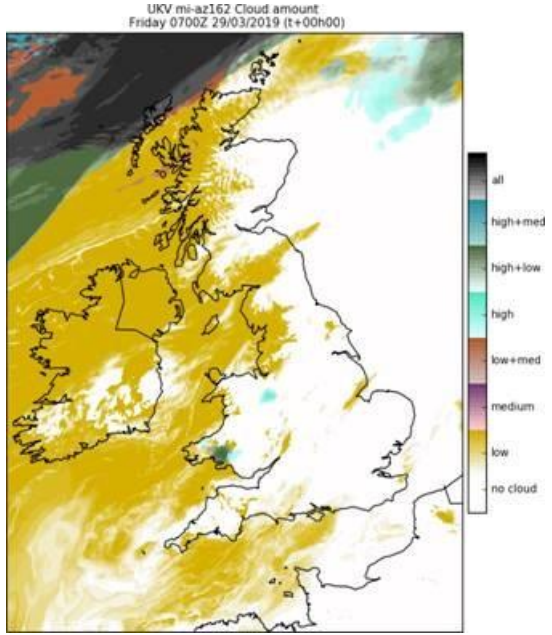


29th March 2019

- R2O did some Ground based GNSS denial reruns at the 7Z cycle.
- The left is with GNSS observations, right without.
- Lots of medium level cloud over France, not much difference over the UK.



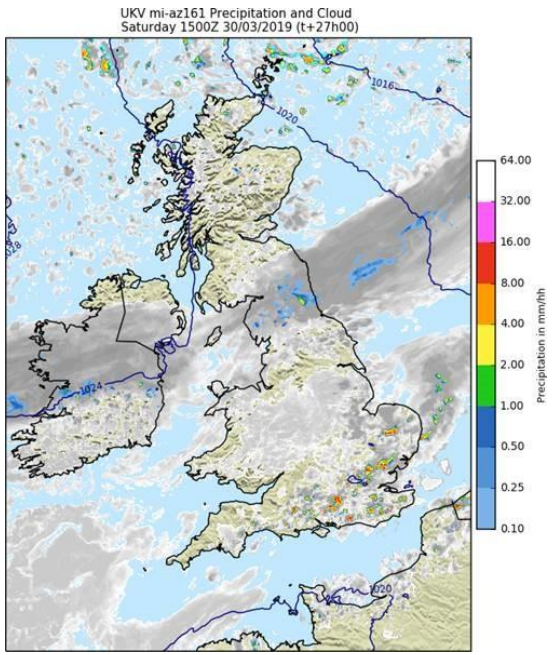
GNSS Observations



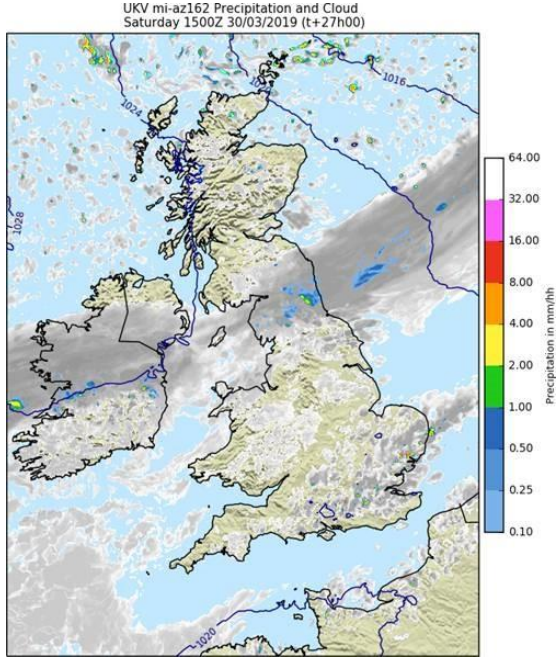
No GNSS Observations

Forecast Precipitation

- 12Z runs at T+27 show the precipitation that was produced in the forecast over the South East UK.



GNSS Observations



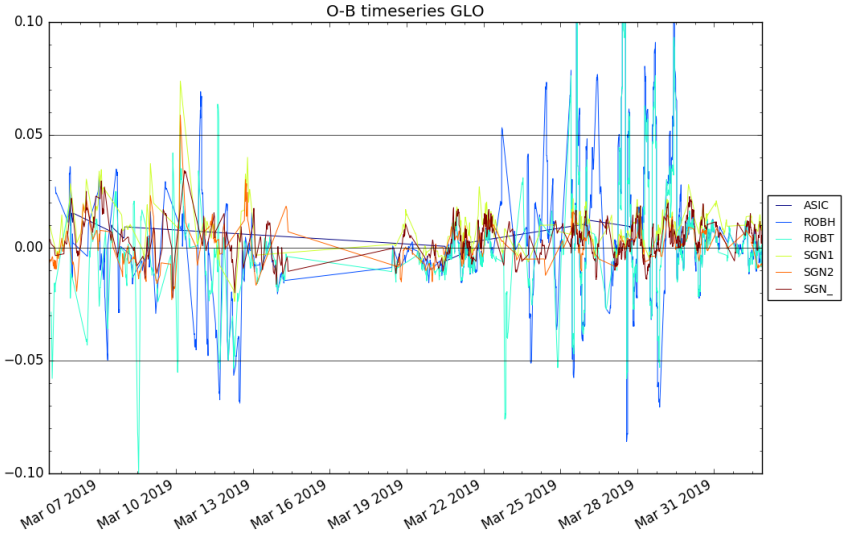
No GNSS Observations

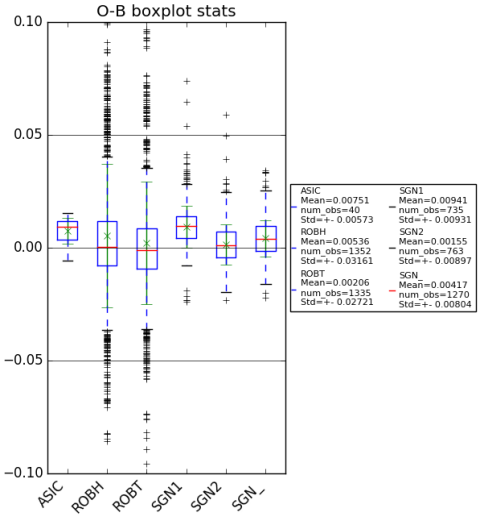
ROBH Data

CHBL Station in Northern France

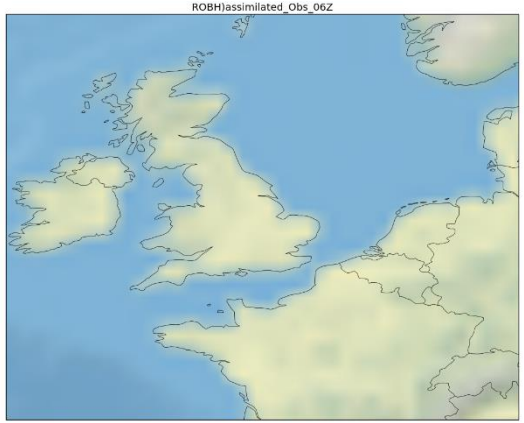
Royal Observatory of Belgium Hourly processing

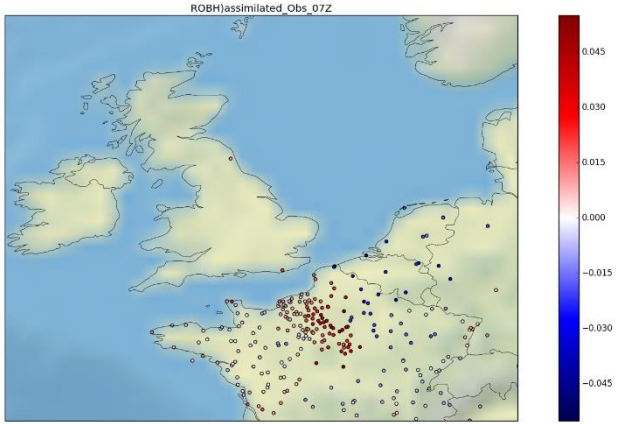
O-B > 55 mm are rejected

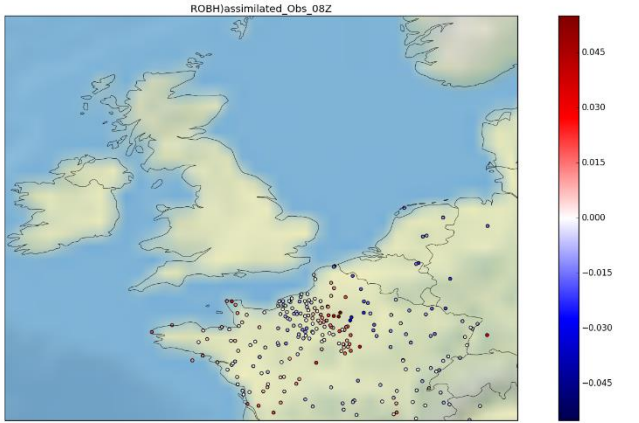


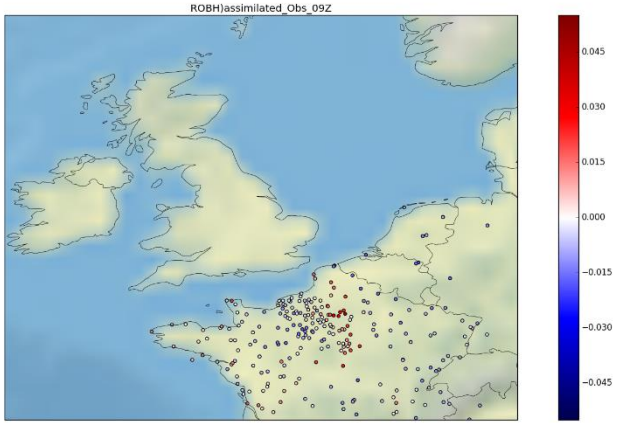


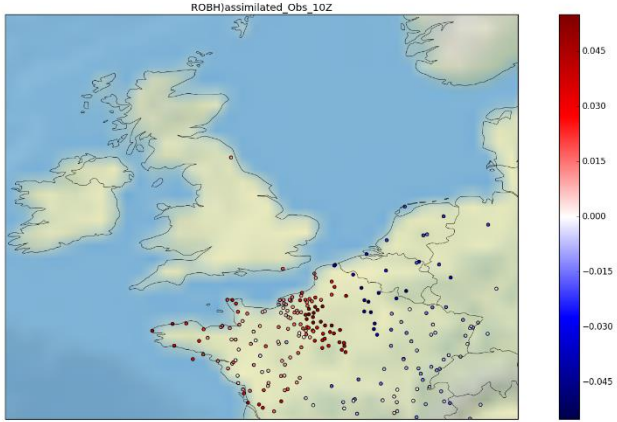
ROBH Assimilated O-B values

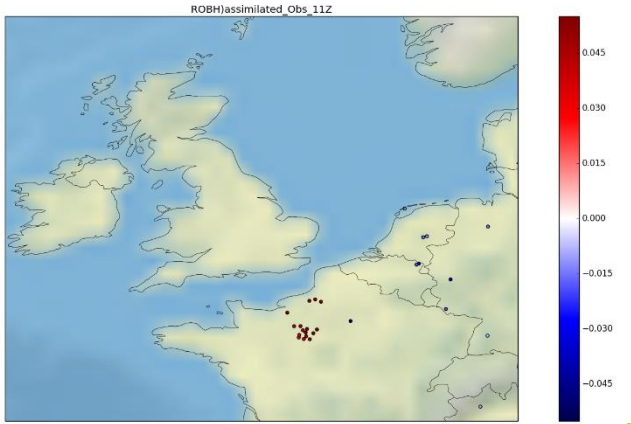












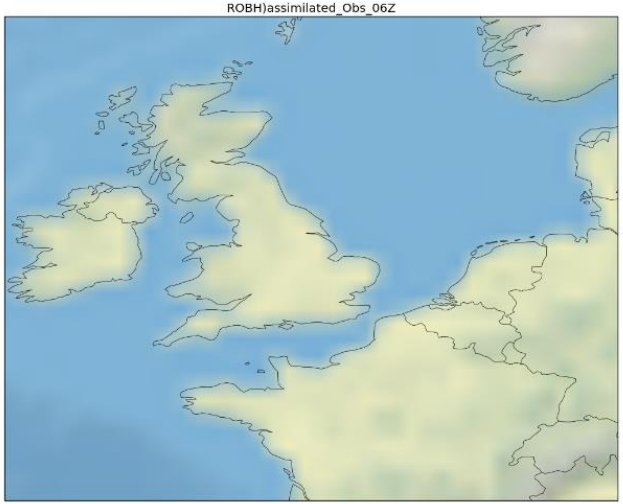
ROBH Removed

- The processing from ROBH was producing bad data particularly in Northern France.
- The QC threshold was not suitable in this case to remove these observations.
- ROBH has been temporarily removed from the Station list
- Will need to change the O-B QC threshold. Quick fix will be to reduce the value.

- I thought it would be interesting to look further into what happened

- Looked at the model fields of the medium level cloud to see what was being produced in the model.

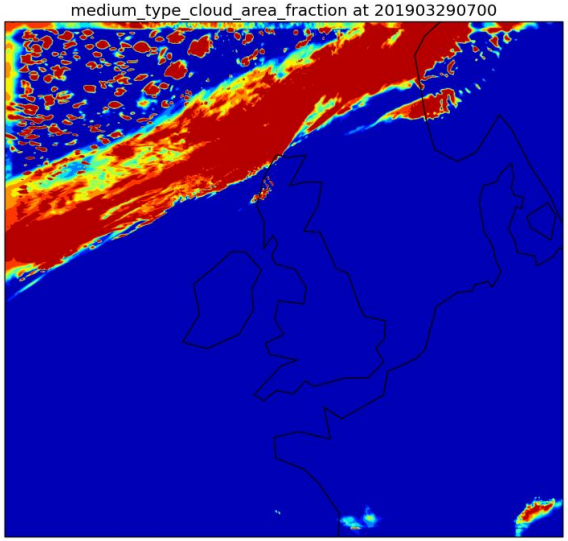
Medium Level Cloud 06Z



ROBH Obs that went in 6Z cycle

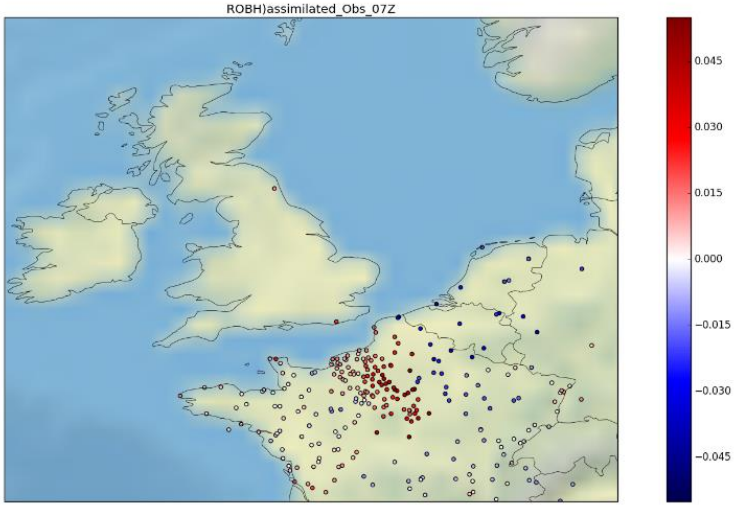
Obs

produced



Background used for 7Z cycle

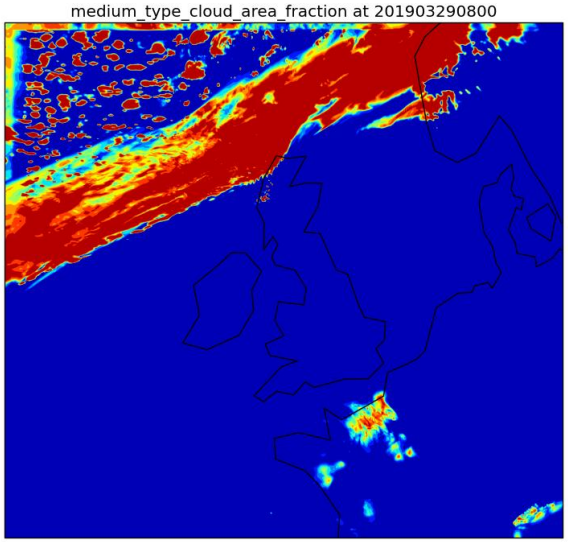
Medium Level Cloud 07Z



ROBH Obs that went in 7Z cycle

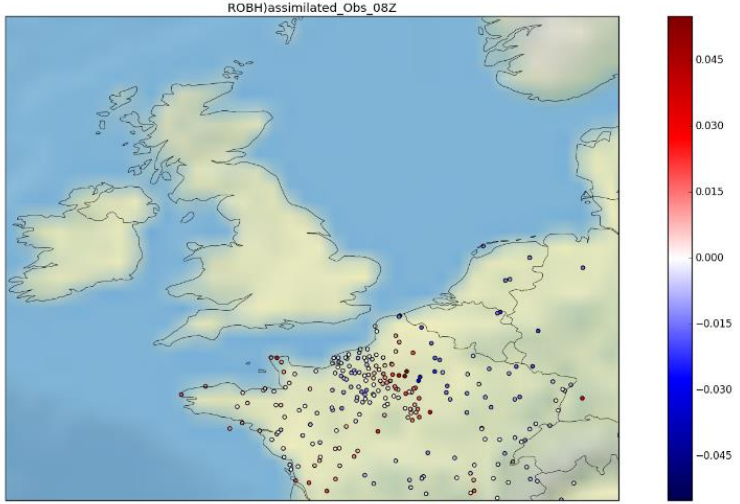
Obs

produced



Background used for 8Z cycle

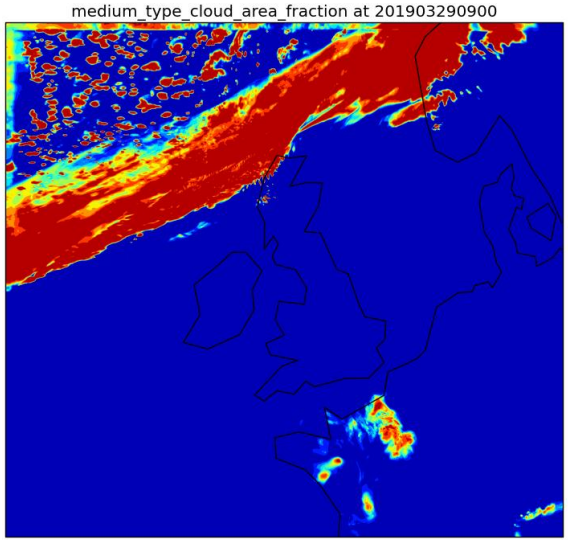
Medium Level Cloud 08Z



ROBH Obs that went in 8Z cycle

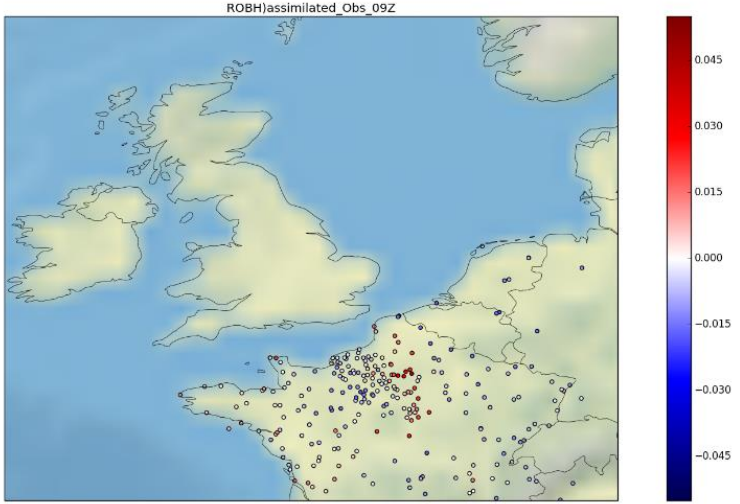
Obs

produced



Background used for 9Z cycle

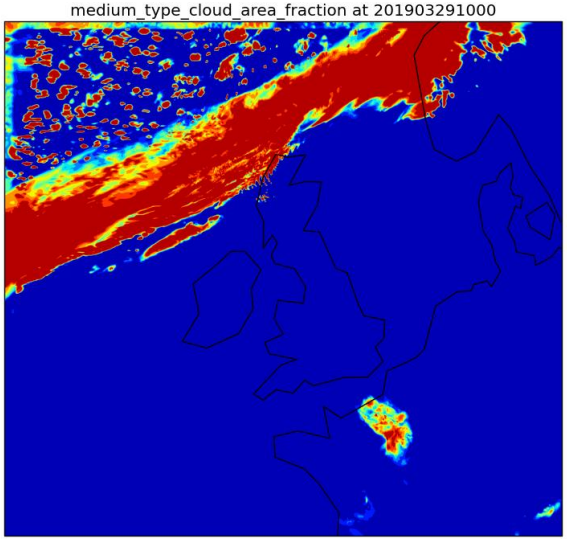
Medium Level Cloud 09Z



ROBH Obs that went in 9Z cycle

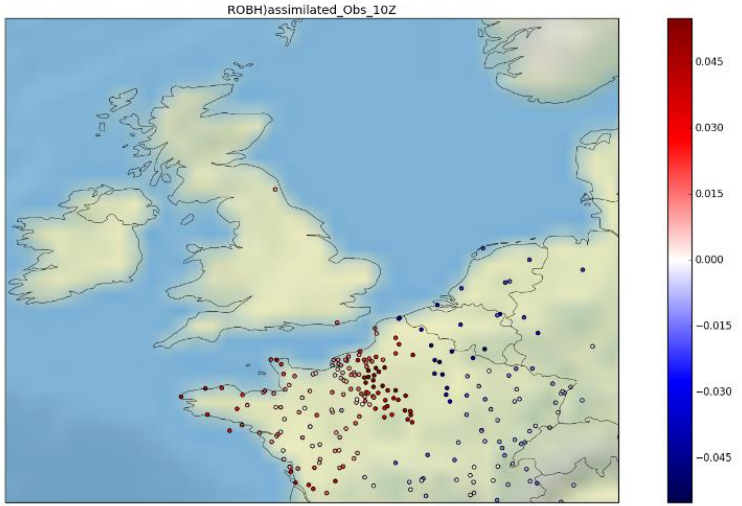
Obs

produced



Background used for 10Z cycle

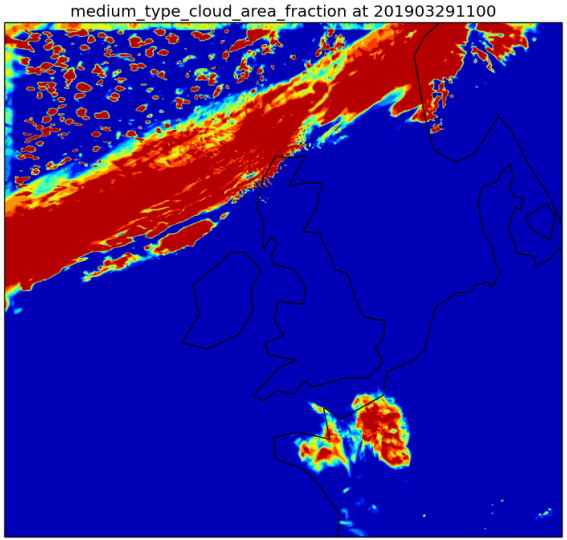
Medium Level Cloud 10Z



ROBH Obs that went in 10Z cycle

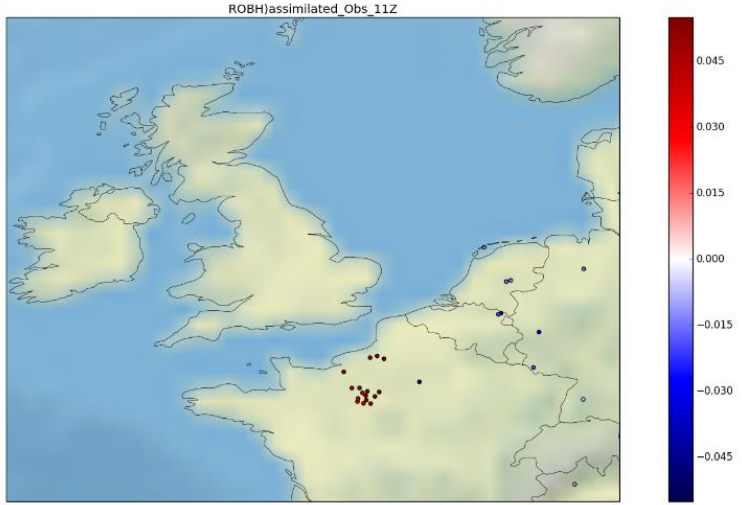
Obs

produced



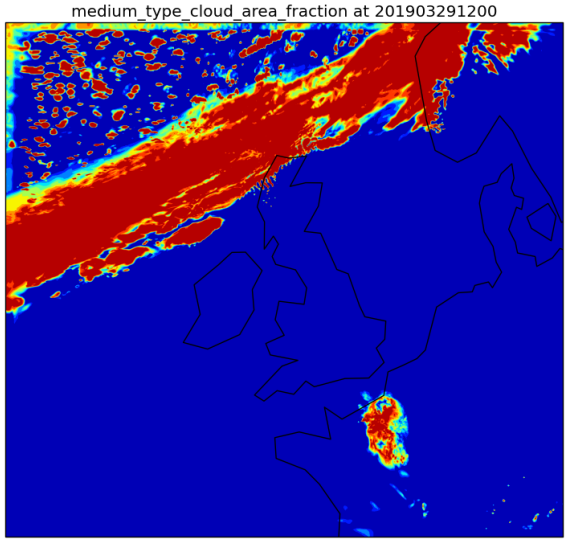
Background used for 11Z cycle

Medium Level Cloud 11Z



Obs

produced



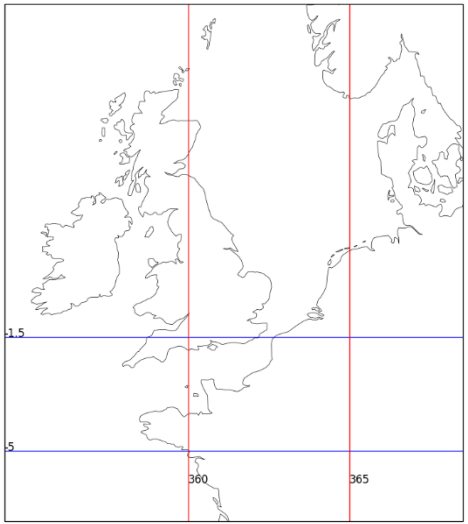
ROBH Obs that went in 11Z cycle

Background used for 12Z cycle

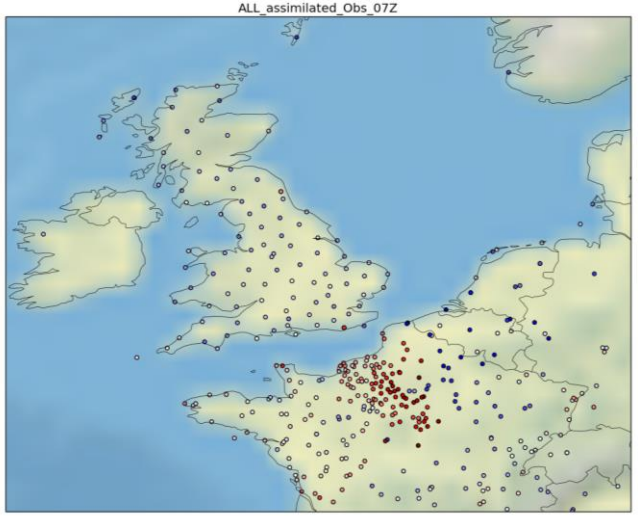
Analysis Increments

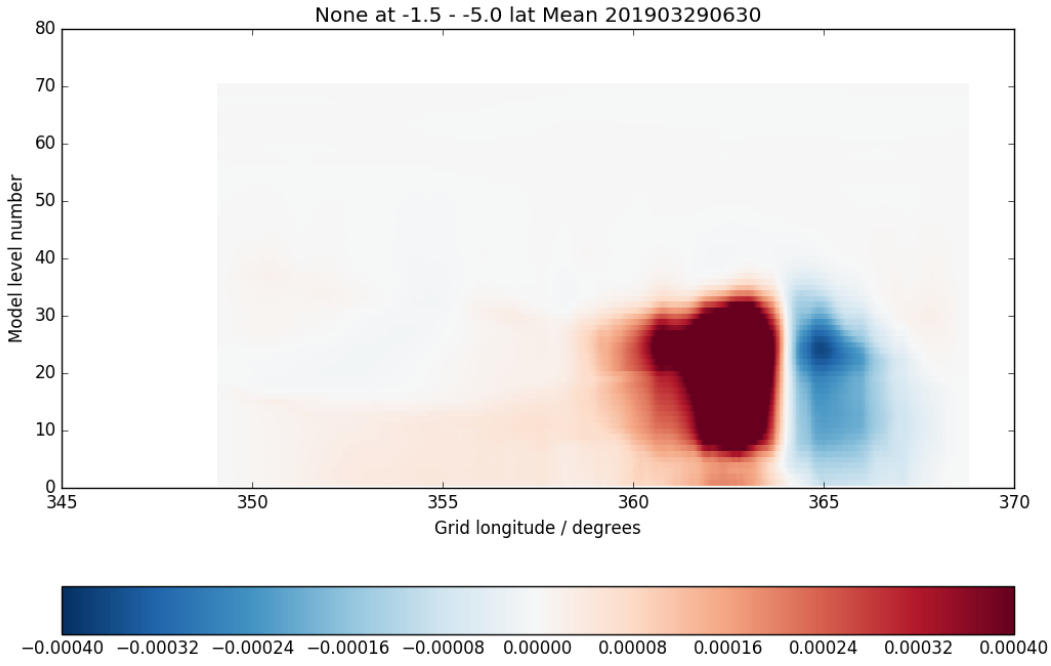
- Look to see where the moisture was being added

- Took a mean cross section of the total specific humidity increments between -1.5 and -5 (Rotated Polar coordinates)



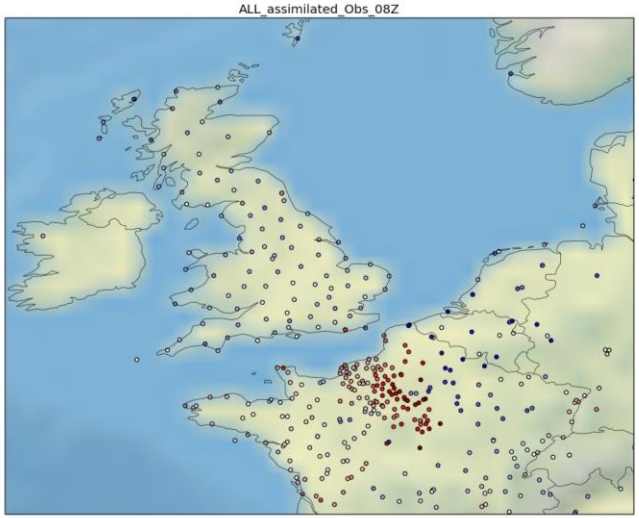
Vertical Cross Section 7Z

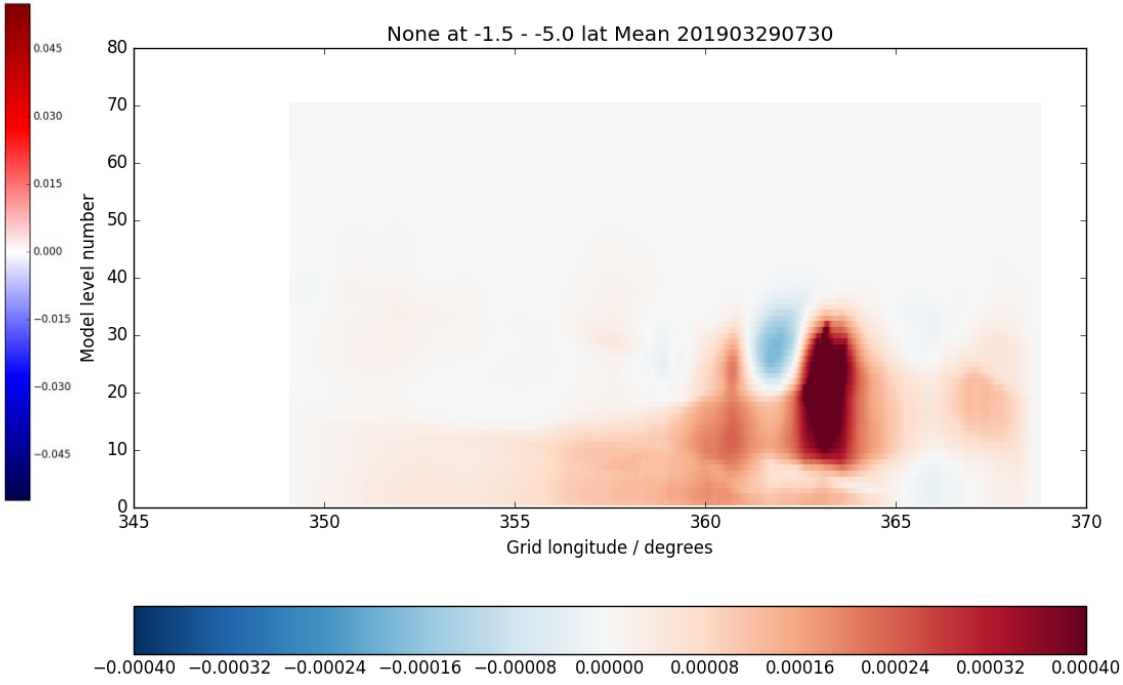




O-B all assimilated GNSS stations

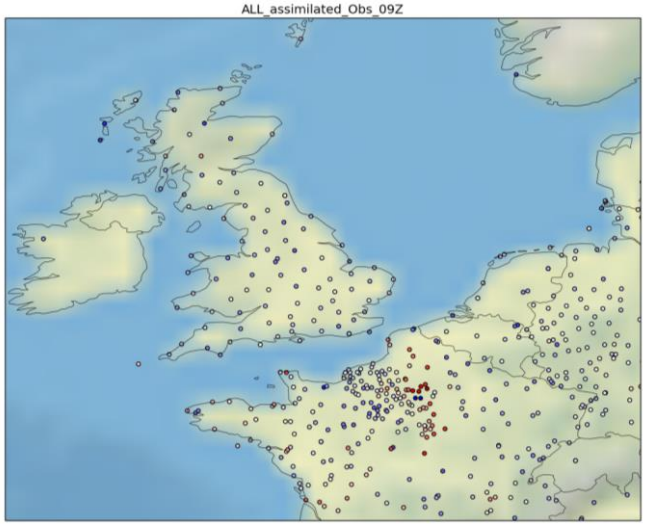
Vertical Cross Section 8Z

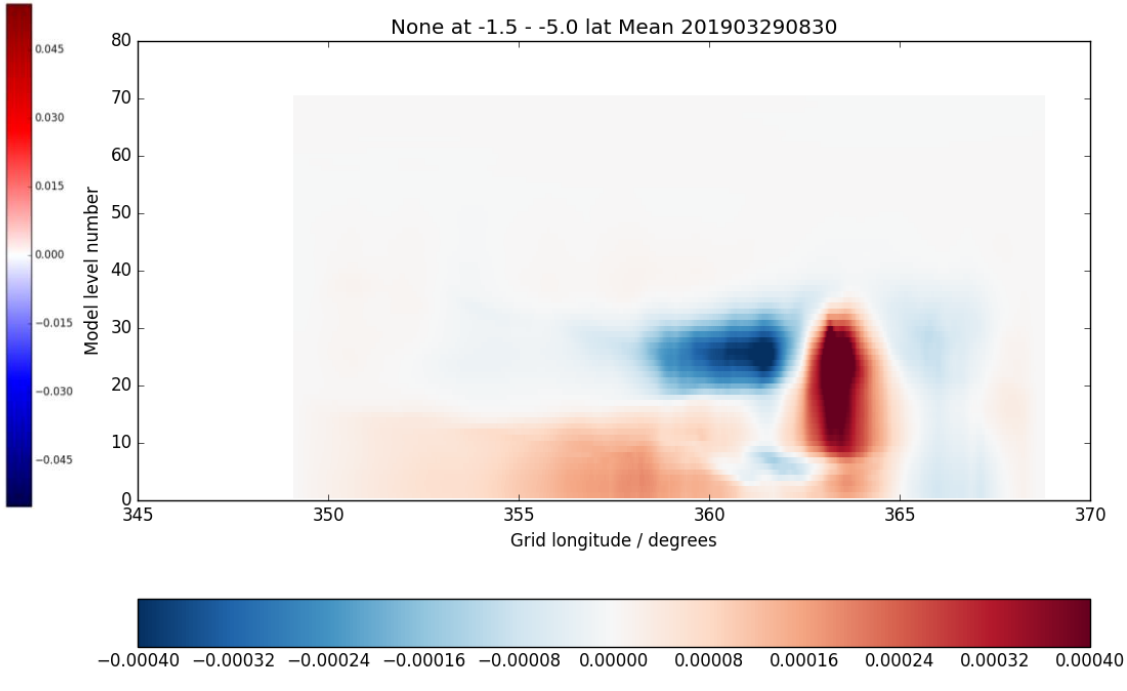




O-B all assimilated GNSS stations

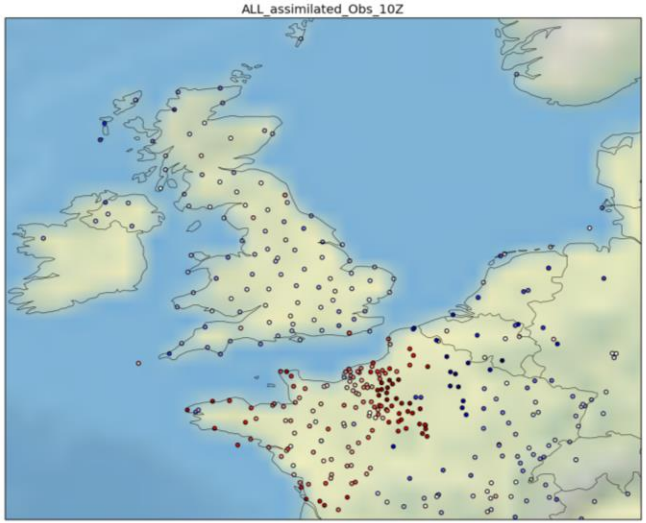
Vertical Cross Section 9Z

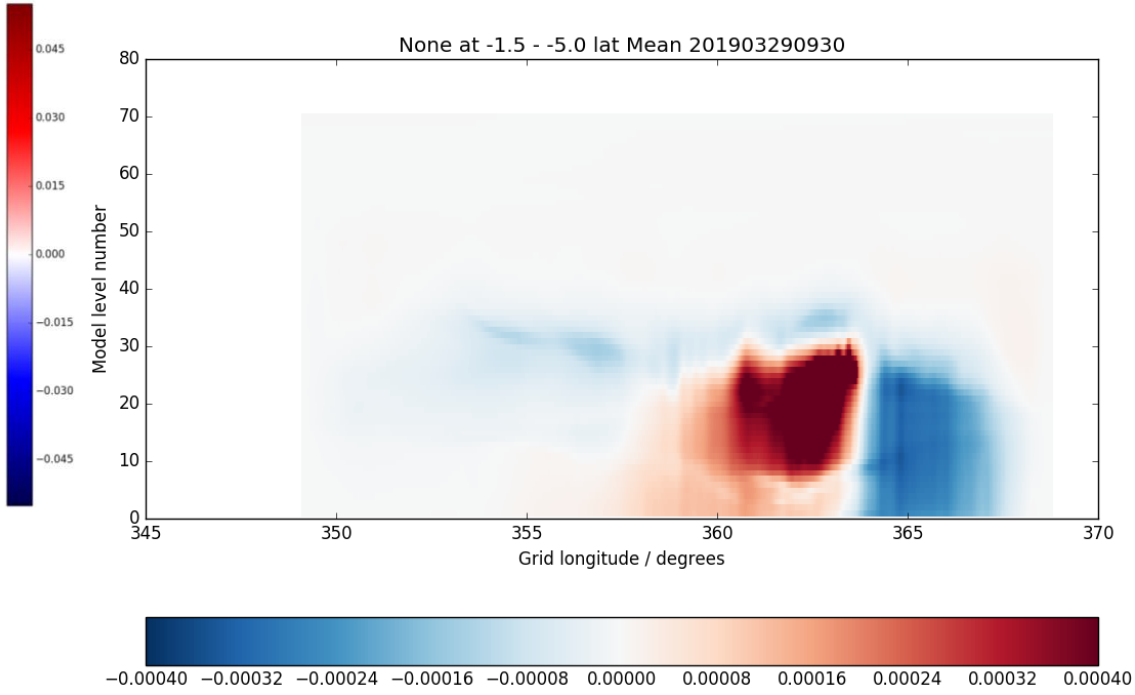




O-B all assimilated GNSS stations

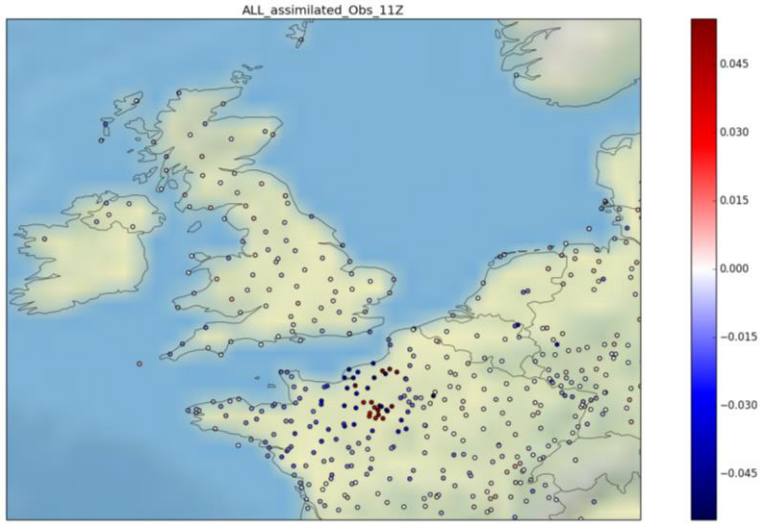
Vertical Cross Section 10Z



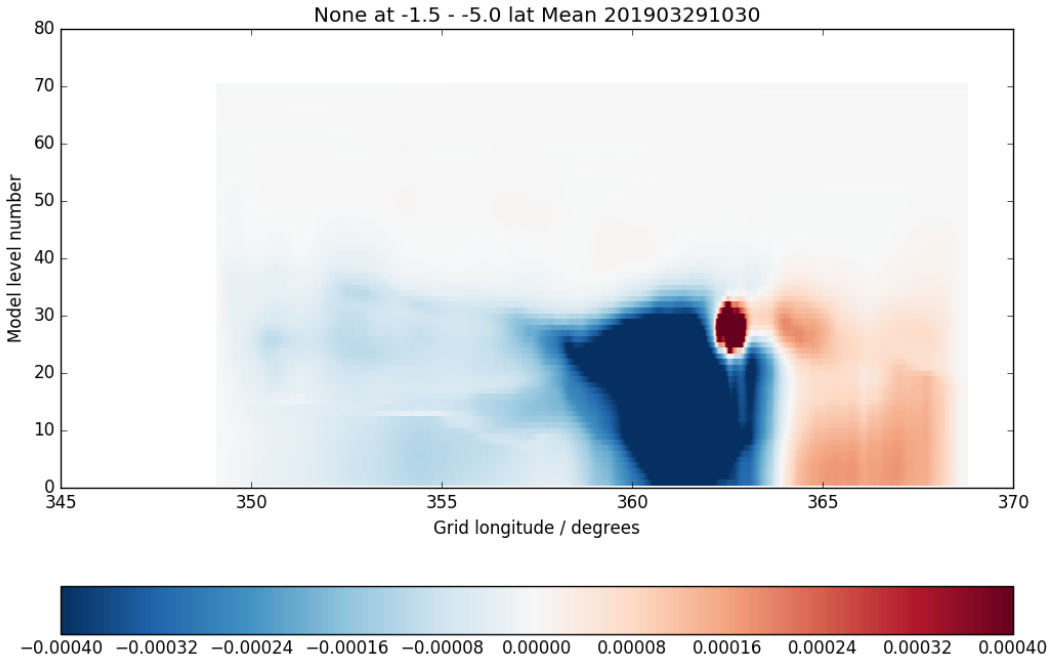


O-B all assimilated GNSS stations

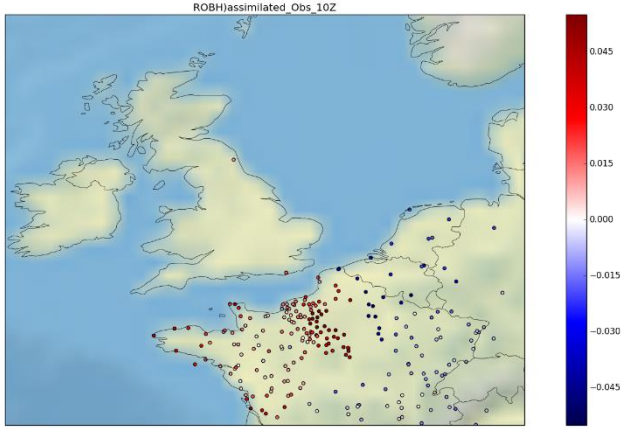
Vertical Cross Section 11Z

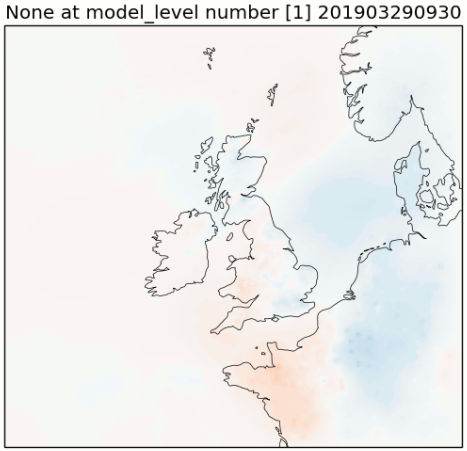


O-B all assimilated GNSS stations



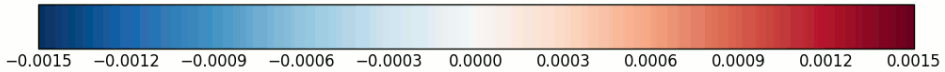
Level by Level Maps 10Z



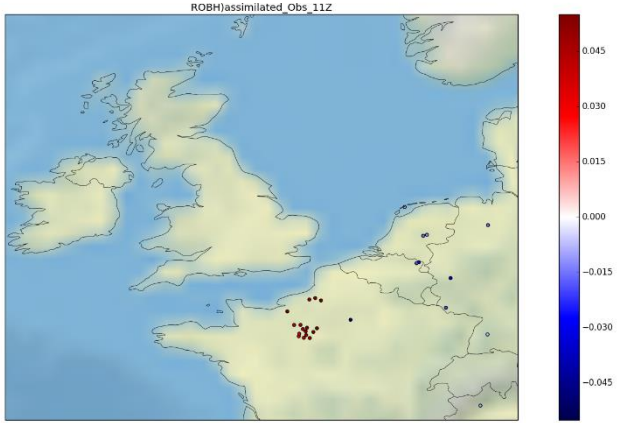


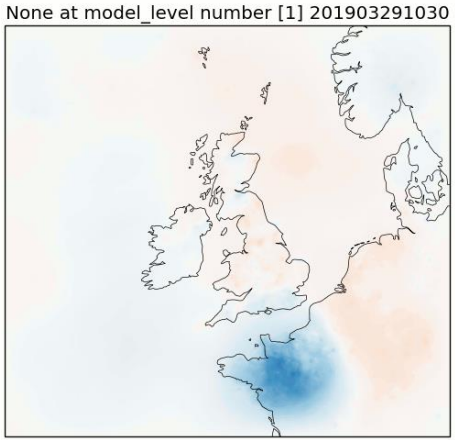
Level 40 ~ 5.6 km

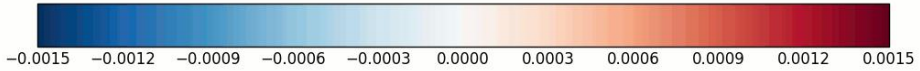
Can see the impact of individual stations.
Clearly see where the medium level cloud is



Level by Level Maps 11Z





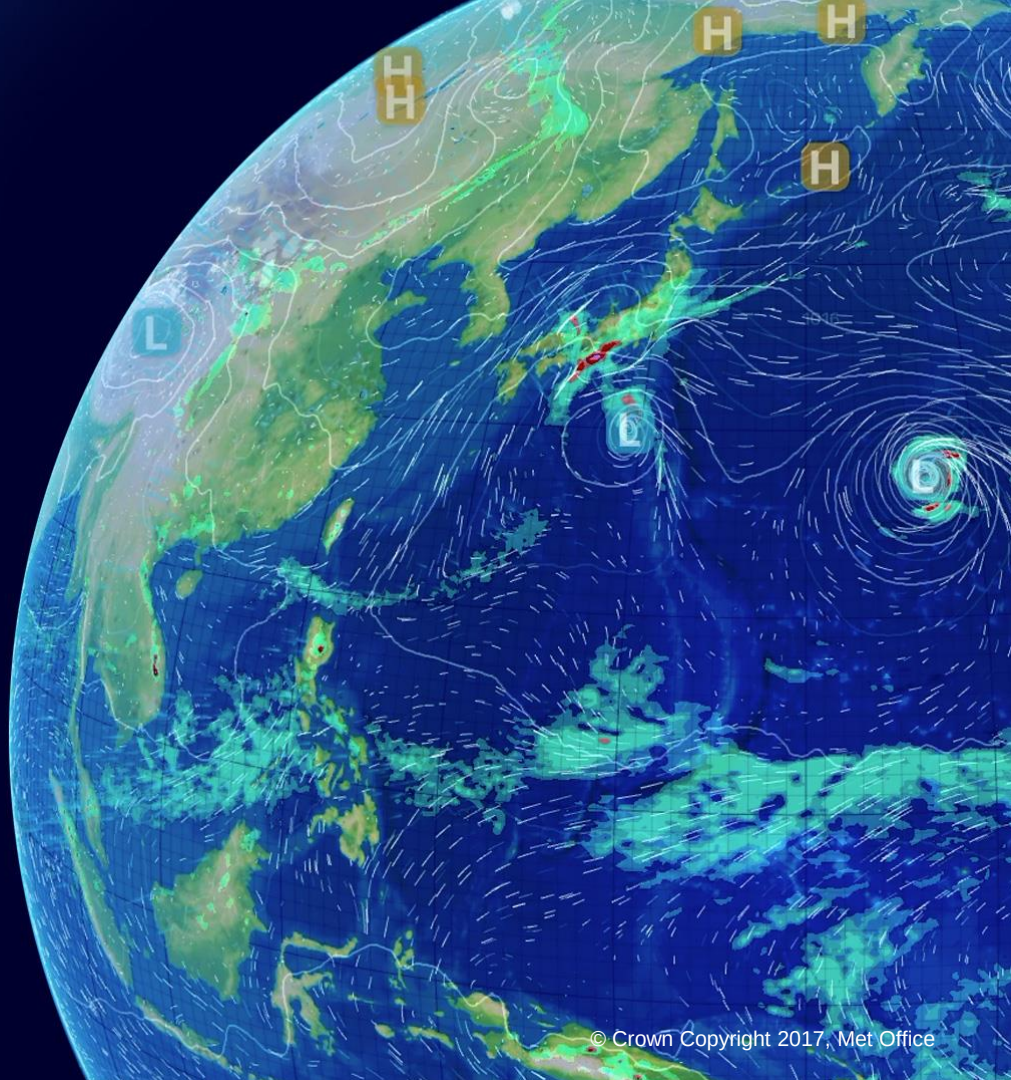


11Z cycle only a few ROBH observations.
Trying to dry out but these obs continue to indicate moisture

- At the 11Z cycle the other Ground based GNSS observations are working to remove moisture from this region but the few observations from ROBH are still indicating higher humidity is required.

- The low observation error of 6 mm for Ground based GNSS means that the data assimilation will pull strongly to these observations.

Trials

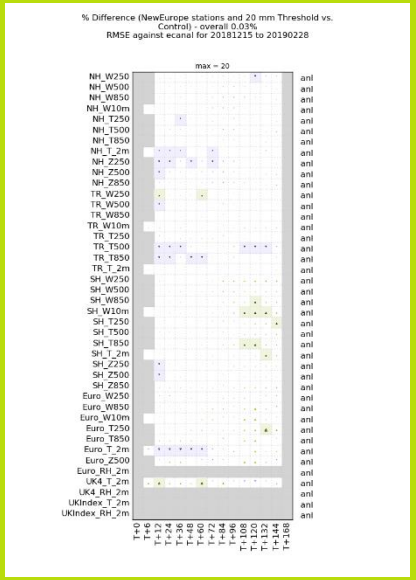


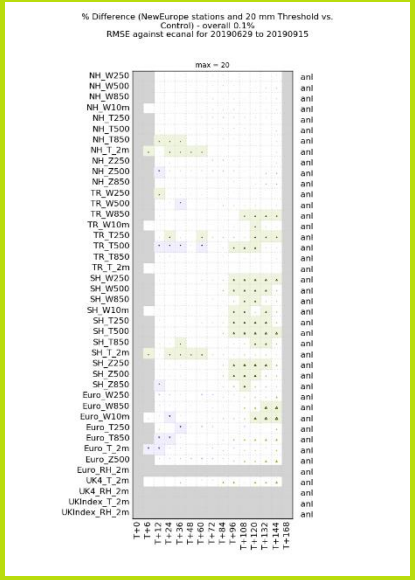
Trials

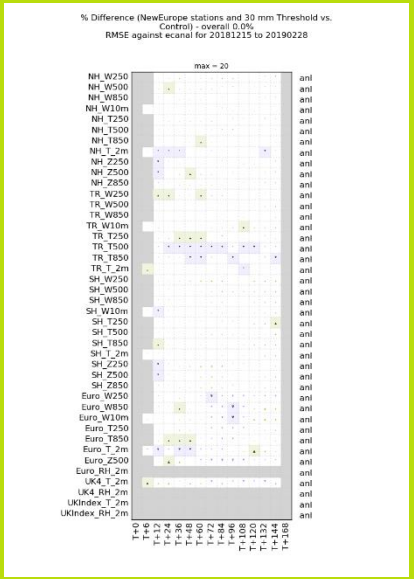
- Have ran trials trying reduced the O-B quality control threshold from 55mm to 30 mm and 20 mm.

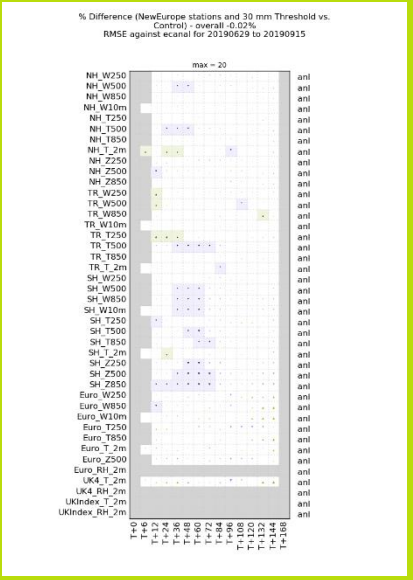
- Have also tried including several new processing centres including GA01, NGA1, WUEL, MTGH, METRH and WUHN.

- No clear picture from these combinations.





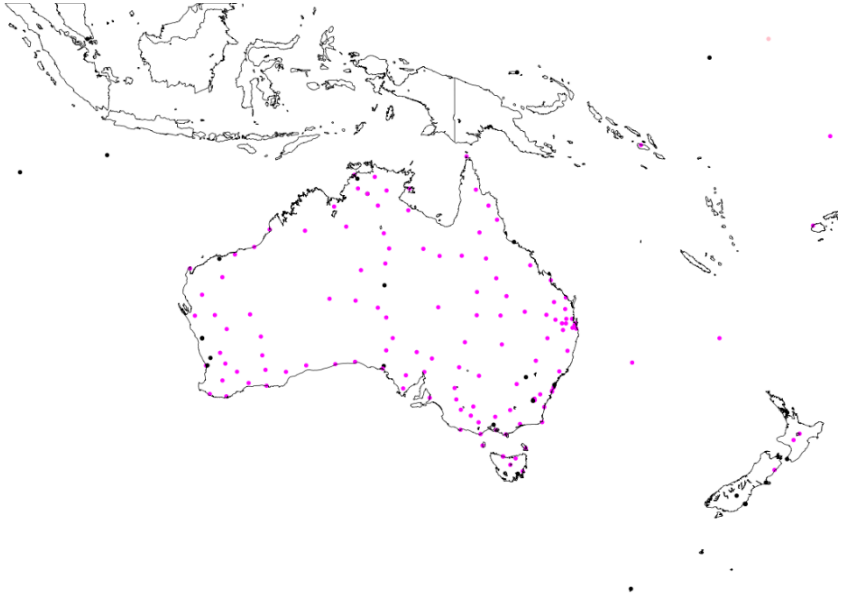




Extra European data

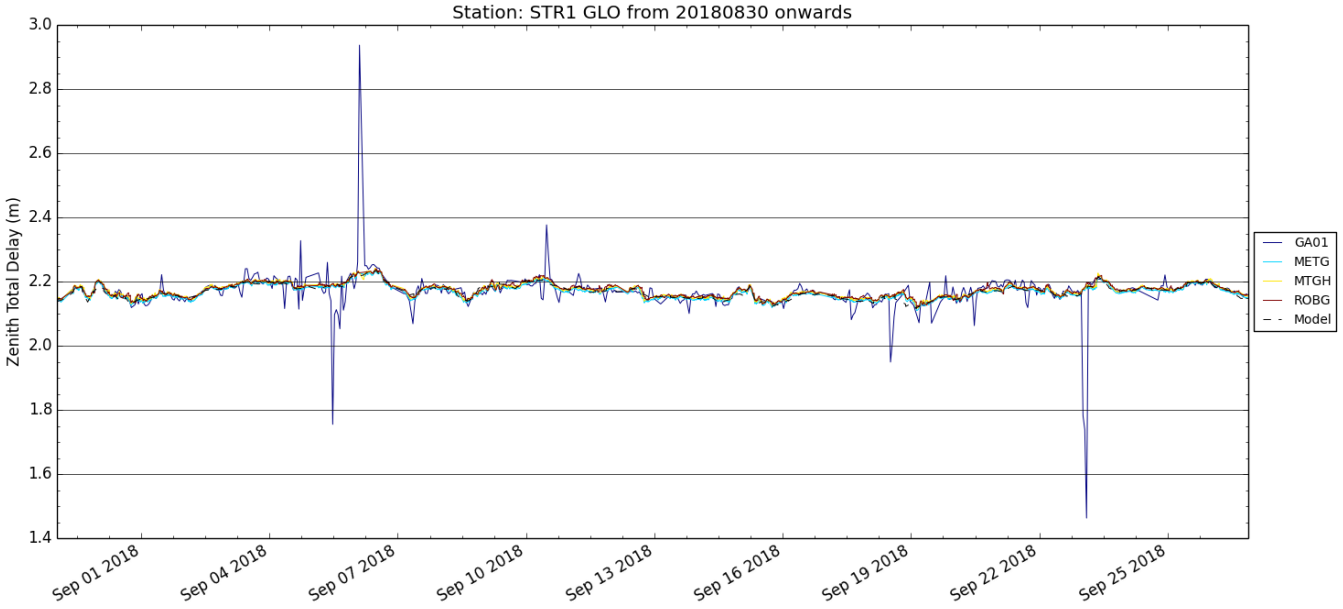
- Including MTGH, MTRH, NGA1 and WUEL with 20mm and 30 mm QC thresholds
- Very unclear results.
- We think it is all just in the noise of the trials.

Geoscience Australia GA01



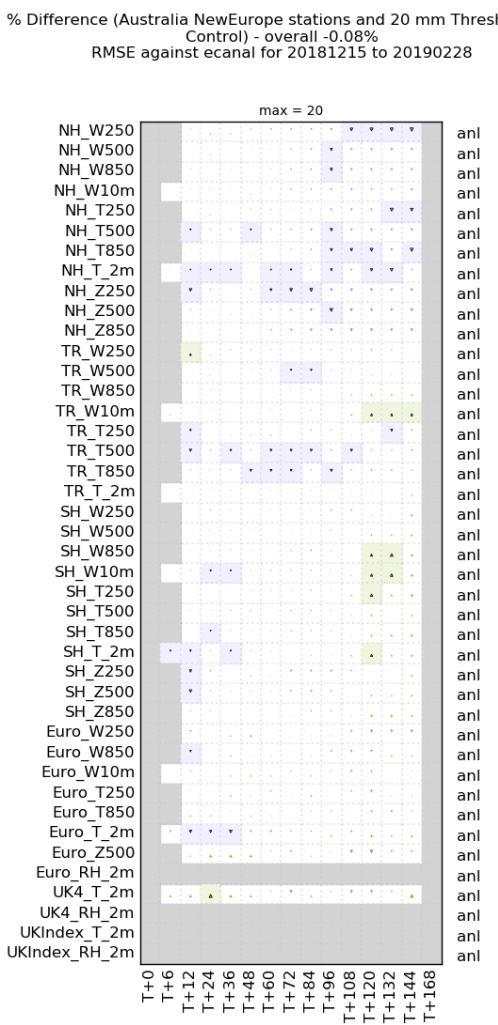
- Good coverage over Australia
- A couple of stations in New Zealand also
- The data looks good apart from issue with sporadic spikes.

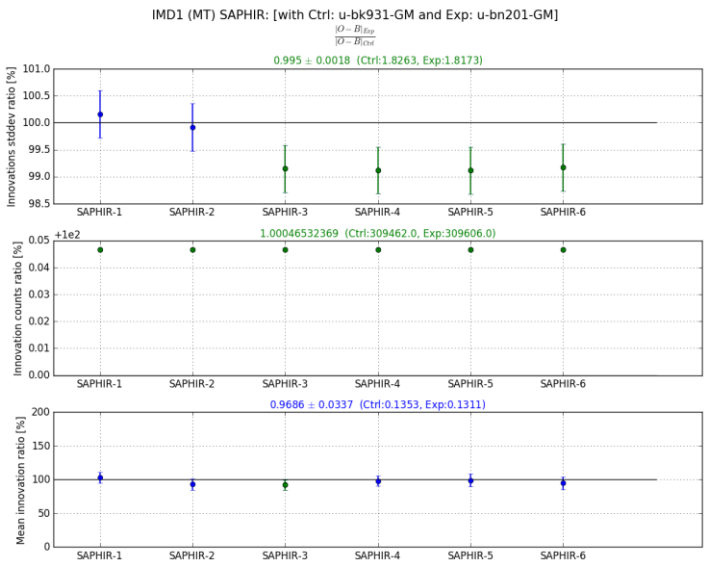
Geoscience Australia GA01 STR1

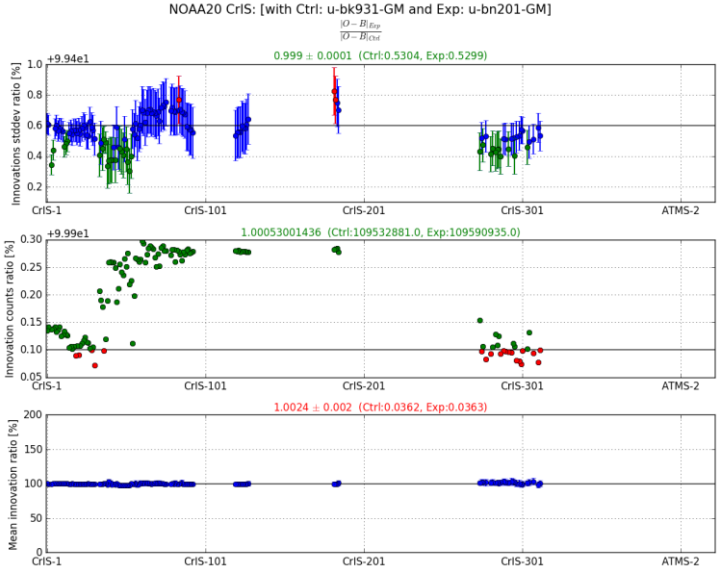


GA01 and European

- Adding the GA01 onto the other new European ACs appears to show a negative signal against the ECMWF analysis.
- When looking at the effect on other obs find that most others show improvement.







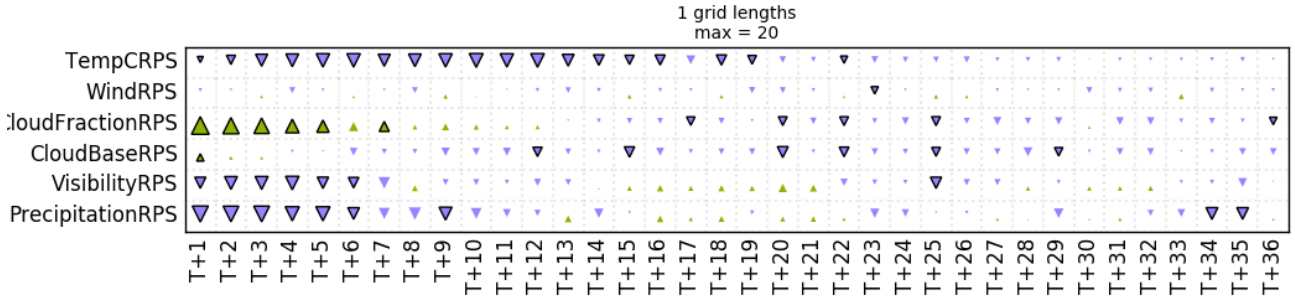
Saphir and Cris both showing positive fits in humidity channels.

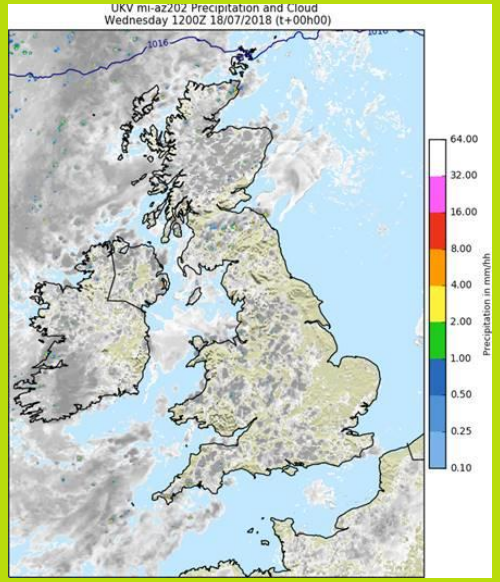
- Need to look a bit more into these trials to understand them a little more.

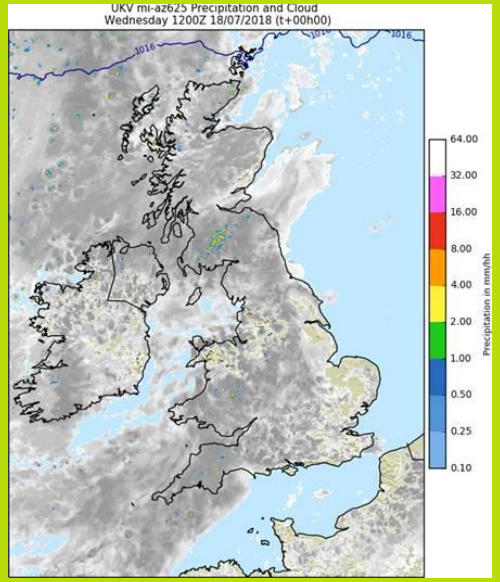
- Don’t seem to get a positive impact from adding the extra data in the Southern Hemisphere but given the lack of data there would expect to improve.

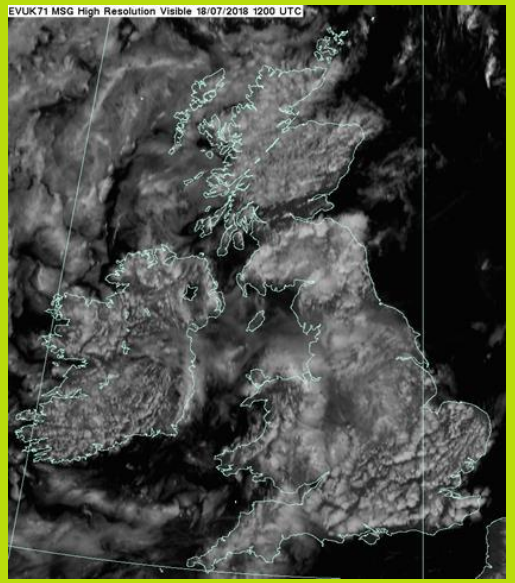
UKV Data Denials

- We have ran some data denial trials with the UKV model.
- Removed various observation types including Ground based GNSS
- Removing Ground based GNSS showed detriment in the forecast particularly during the summer trial period.









GBGNSS

No GBGNSS

Satellite

Good example of GBGNSS helping to get the cloud cover.

Although the stats suggest that cloud was better without, may an be issue with verification method for cloud

Plans

- Move to monitoring the FSOI of the individual stations
- Make a decision on the best approach for QC, might opt to use the generic background check built into the Operational Processing System (OPS).
- May be starting a project to prepare for the next generation of computer architecture. This will be a significant change to the code for processing observation and assimilating them.