

Impact of Conventional Observations in the analysis and short-range forecast

Carla Cardinali

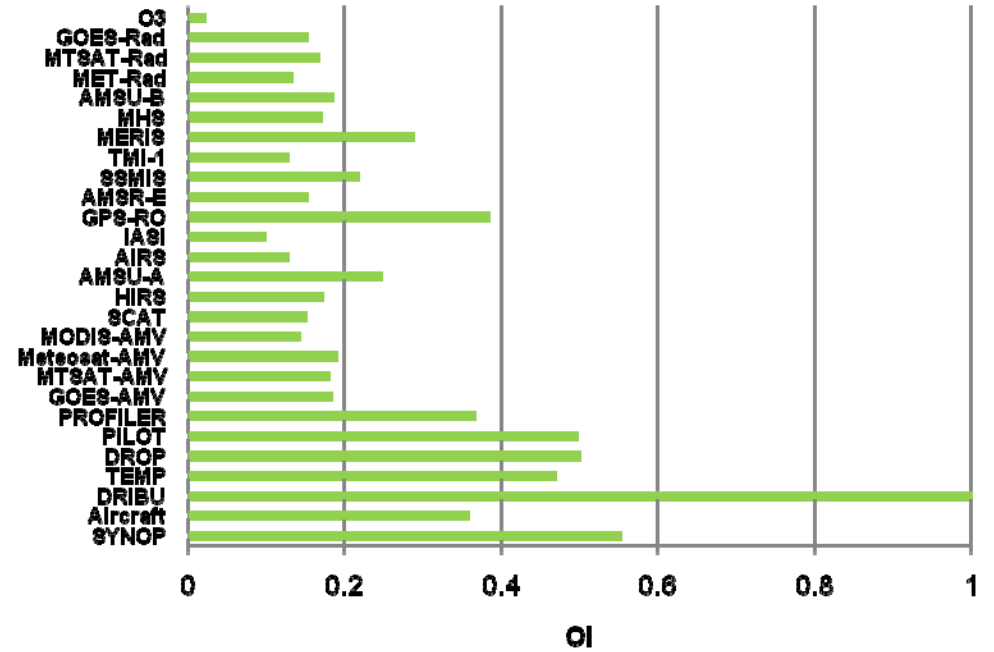
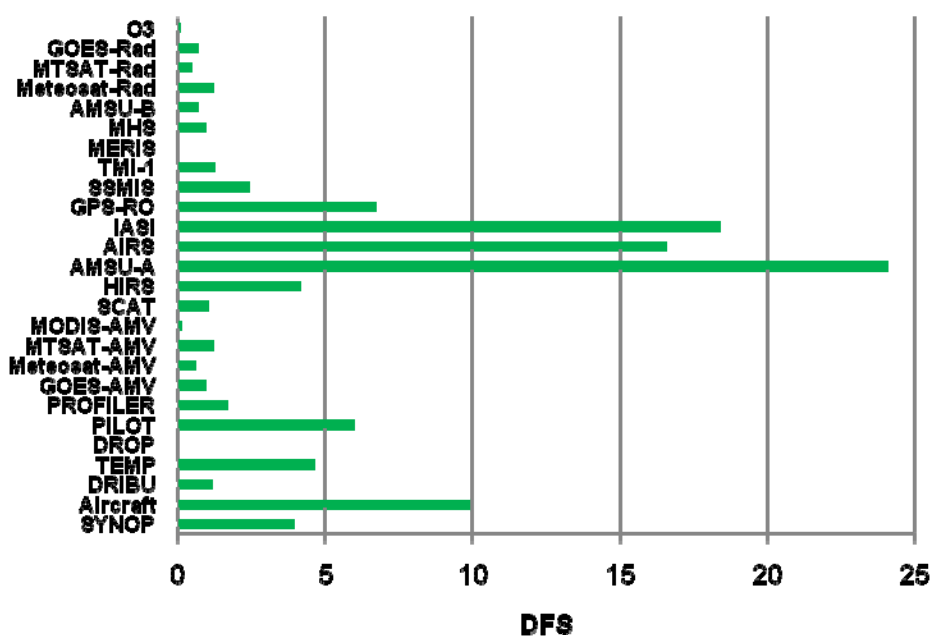
Outline

- **Degree of Freedom for Signal (DFS)** and observation **Forecast Error Contribution (FEC)** comparison to highlight poor short-range forecast performance
- All observing system and in particular conventional observations
- Use of Observation Influence to design the Observation network

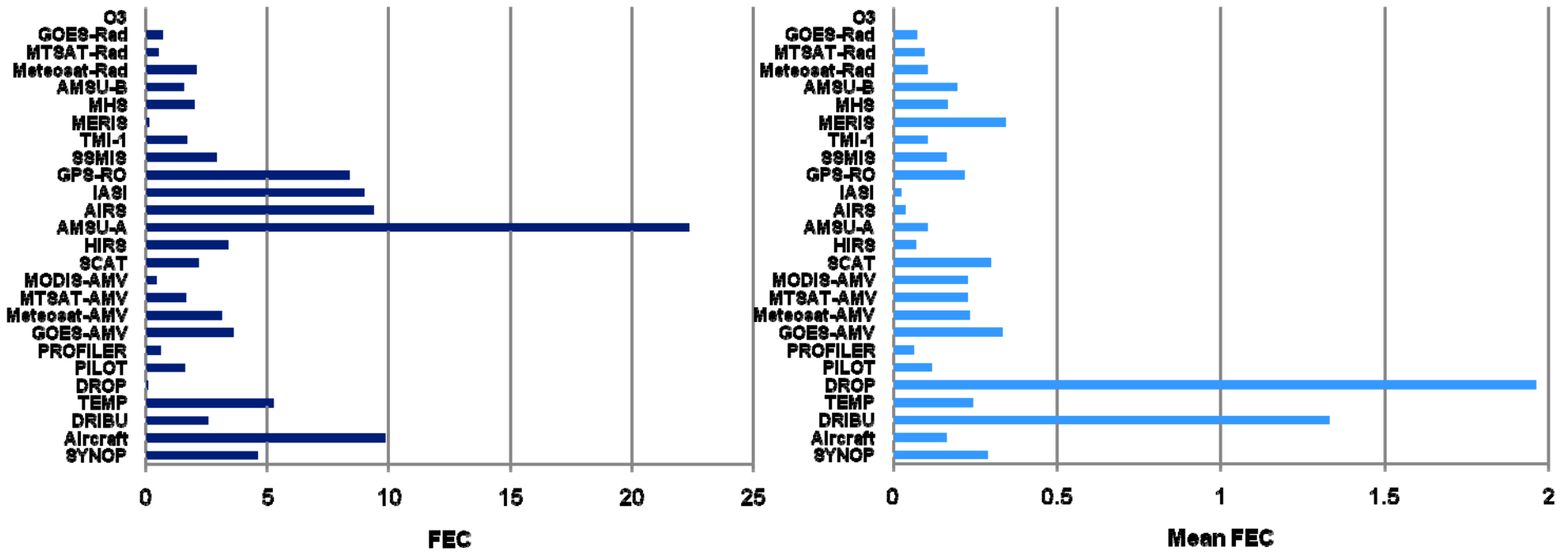
Diagnostic tools principle

- **Degree of Freedom** for **Signal DFS** quantifies the number of statistically independent directions constrained by each observation. The average can be expressed as **Observation Influence OI** $\rightarrow K^T$
- Forecast sensitivity tool computes the *variation of forecast error* due to the assimilated observations: **Forecast Error Contribution FEC** $\rightarrow K^T, FcE, d$
 - **Positive variation** means *forecast error increase*
 - **Negative variation** means *forecast error decrease*
- Forecast error is **Forecast-Analysis** \rightarrow Analysis is a proxy for **Truth**
- **Bias** in the **Verifying Analysis** can *mask* the observation impact
- **Bias** in the **Model** can be *erroneously* interpreted as *negative observation impact*
- **Metric dependent impact**
- **Linearity assumption** must be applied therefore only **24 or 48** hour forecast can be examined
- **Interpretation** of forecast improvement or degradation as depicted by the tool is **Necessary**

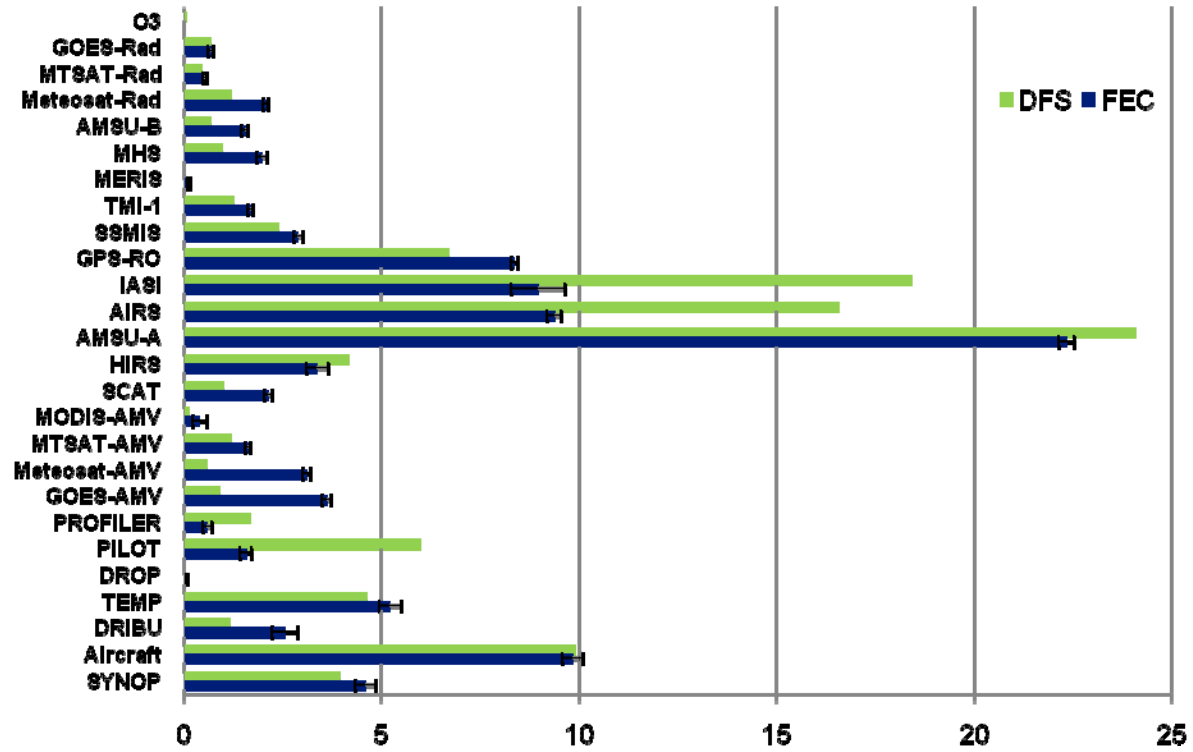
DFS and OI October 2011



Total and Mean FEC October 2011

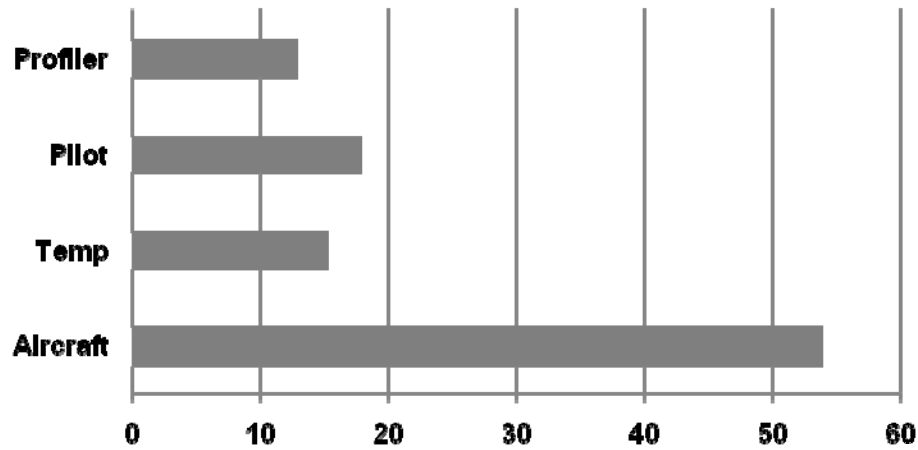


DFS and FEC October 2011

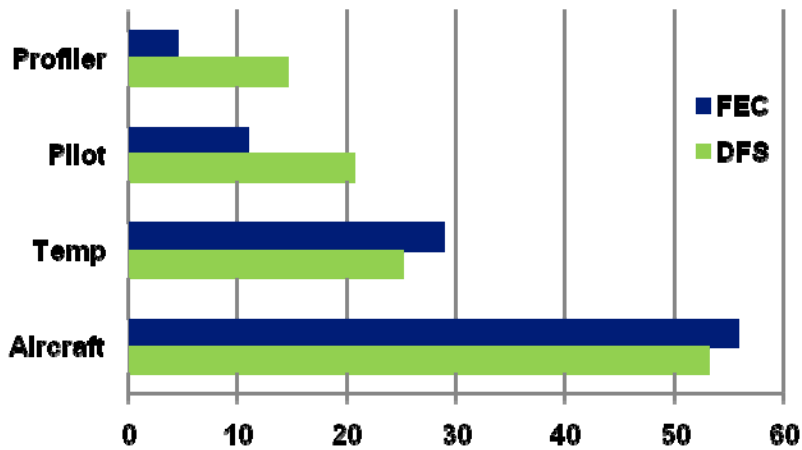


DFS and FEC October 2011: Conventional Observations

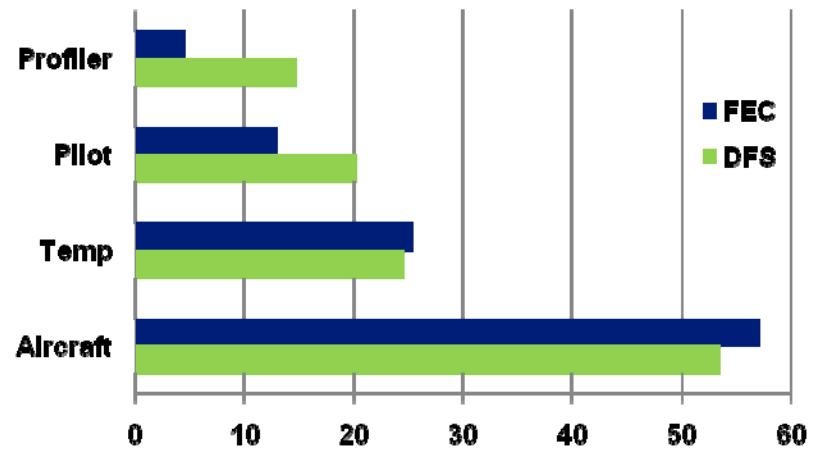
Number



U-Comp

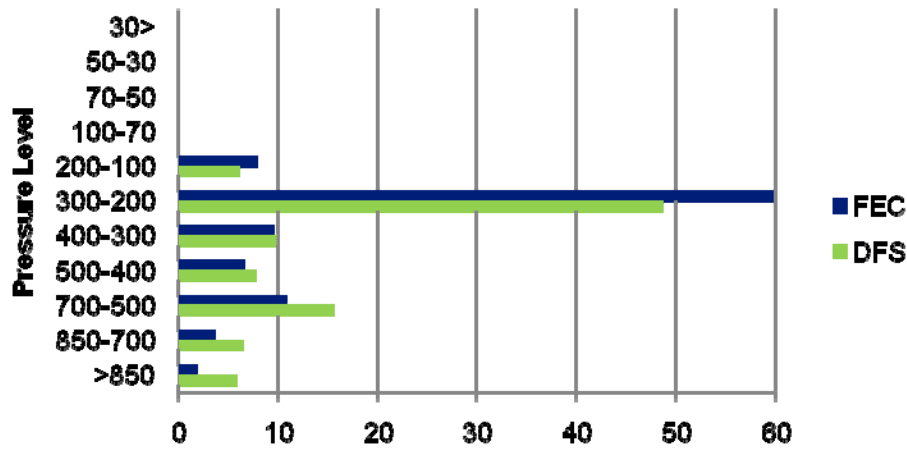


V-Comp

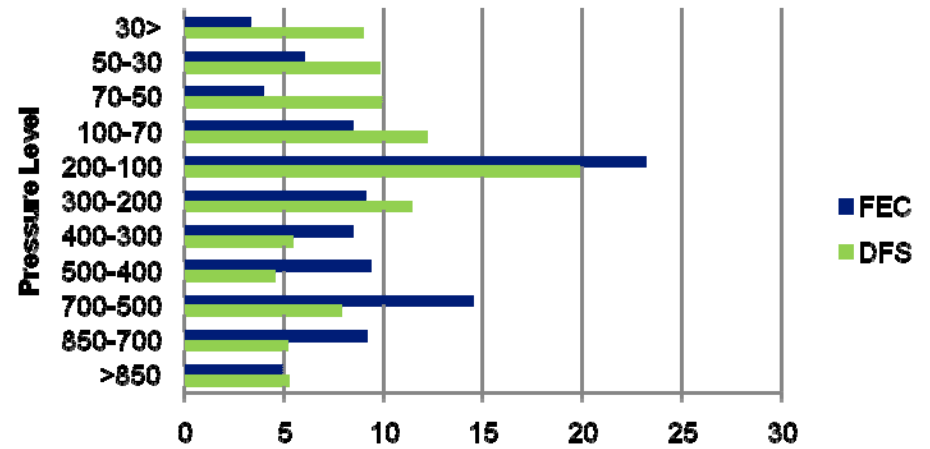


DFS and FEC October 2011: Conventional Observations

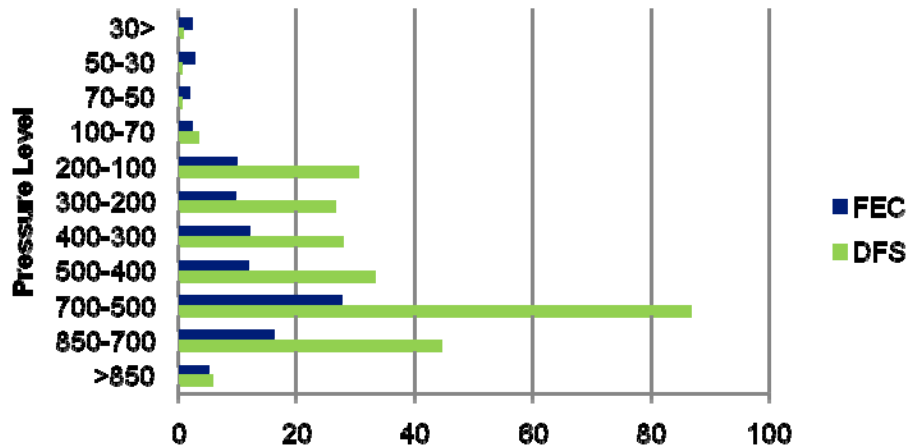
Aircraft U-Comp



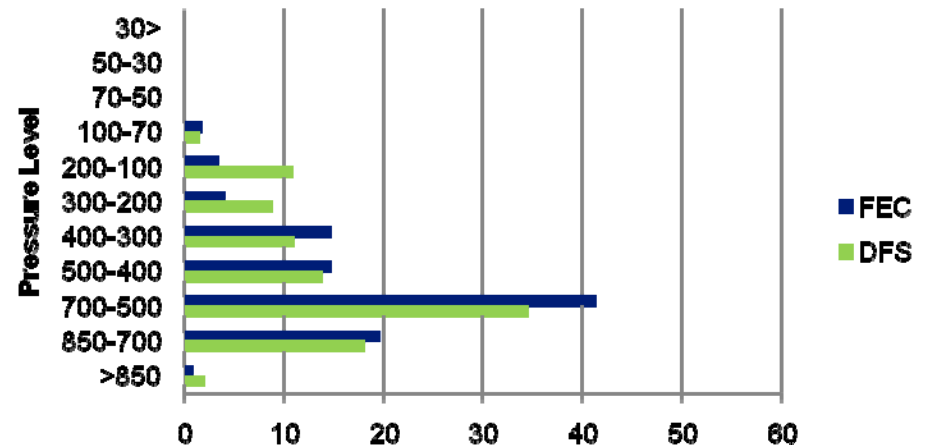
Temp U-Comp



Pilot U-Comp

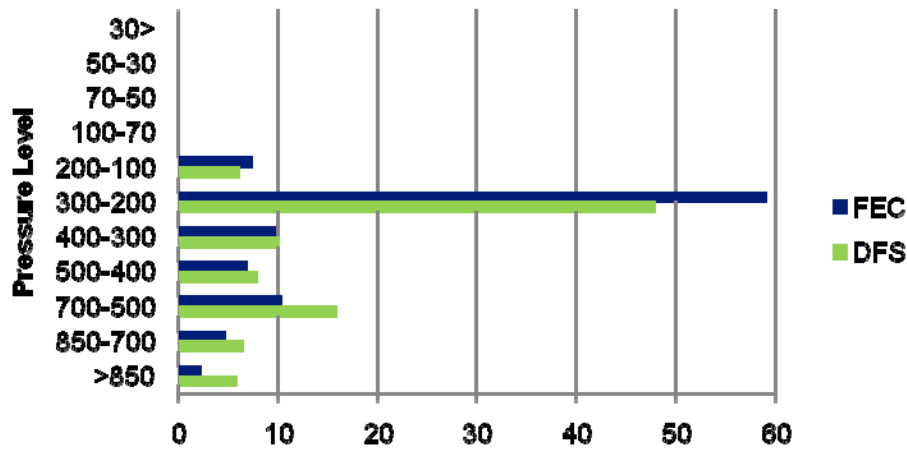


Profiler U-Comp

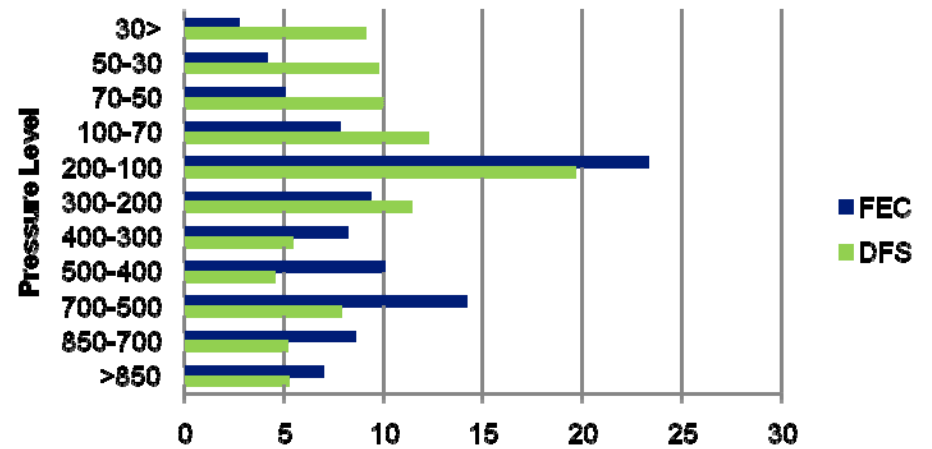


DFS and FEC October 2011: Conventional Observations

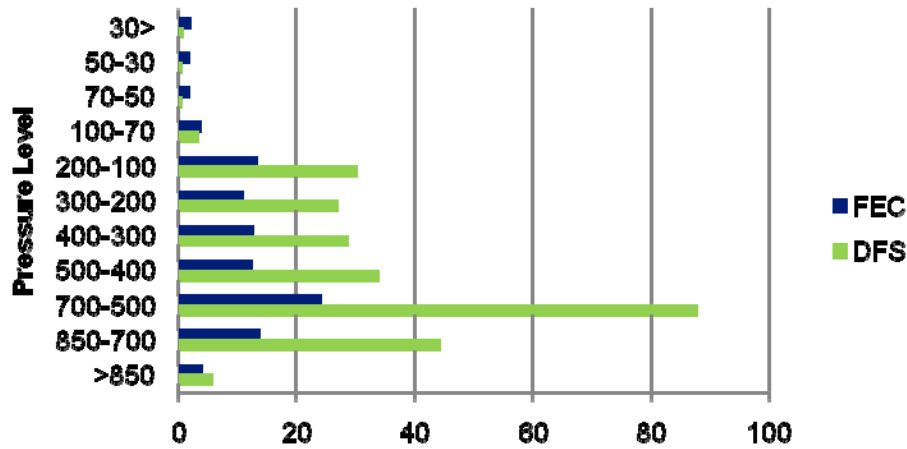
Aircraft V-Comp



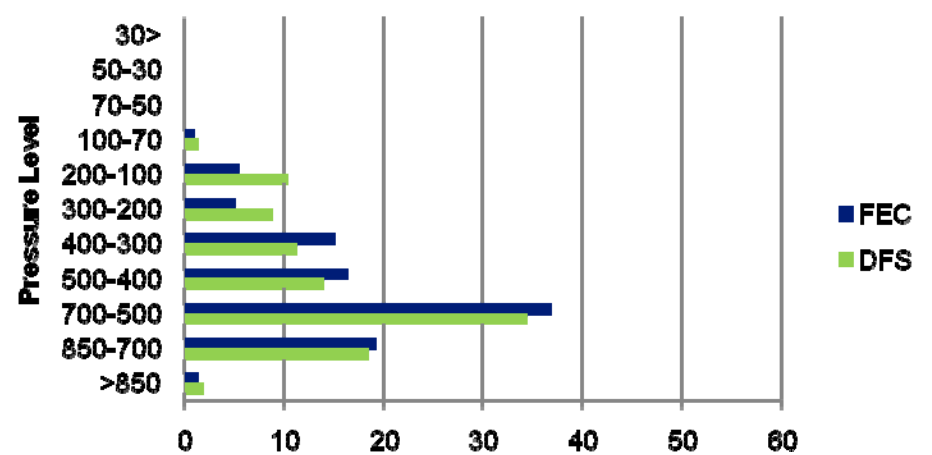
Temp V-Comp



Pilot V-Comp

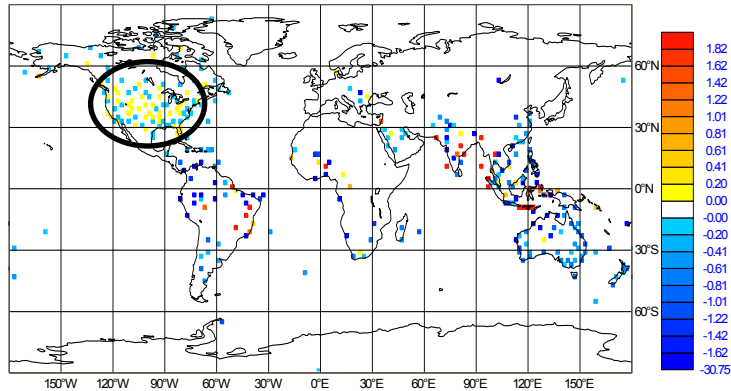
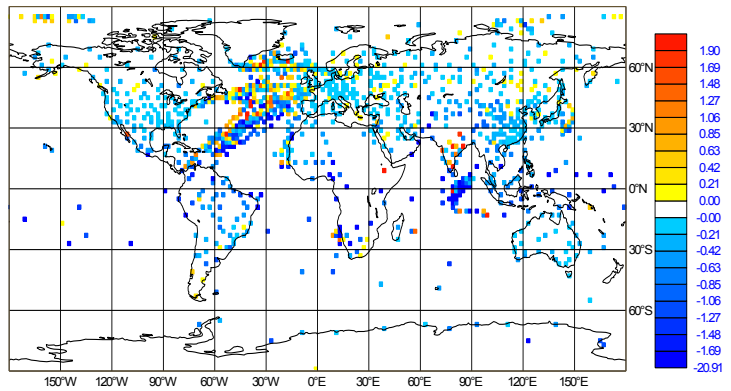
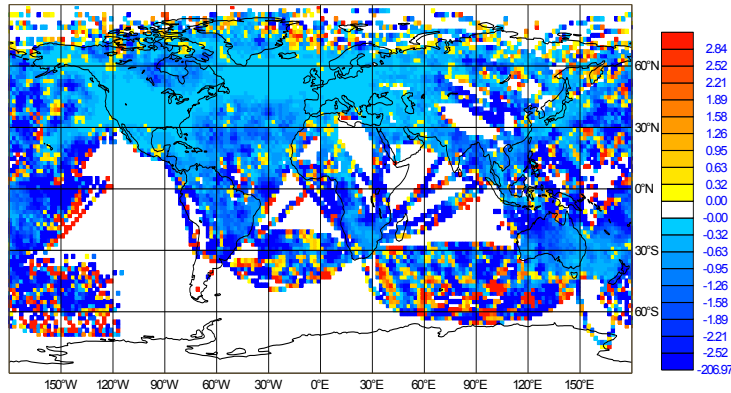


Profiler V-Comp

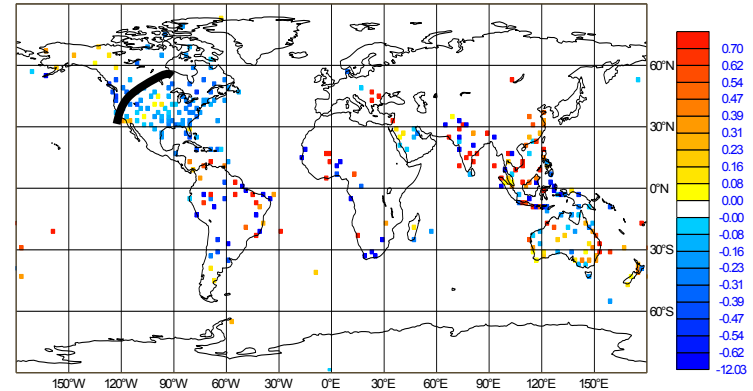
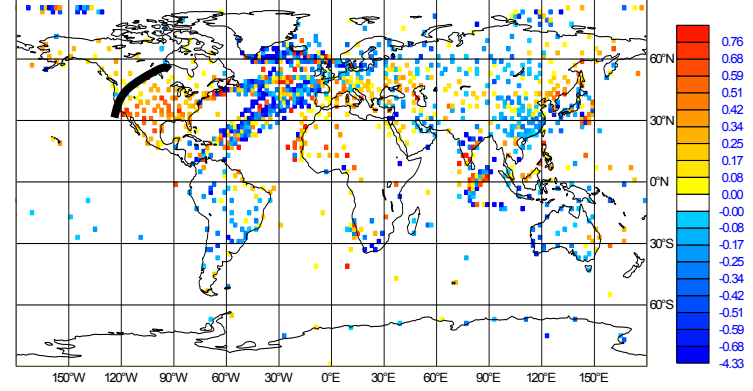
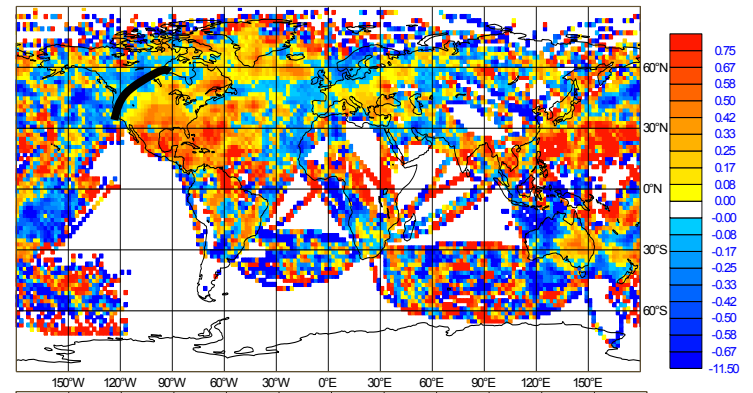


U-Comp FEC Conventional above 400 hPa

Mean FEC



Mean FG-dep



Aircraft

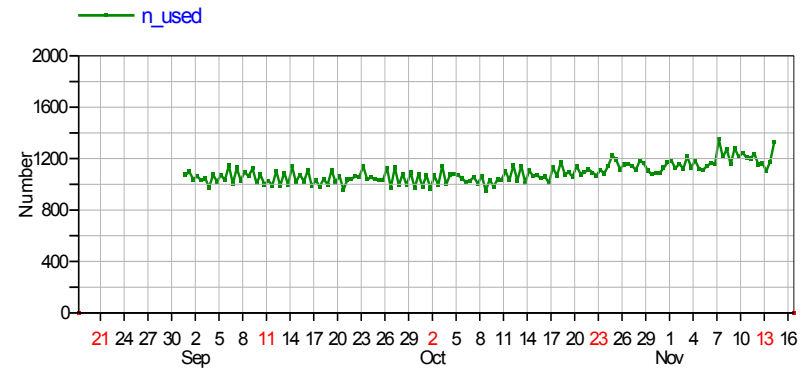
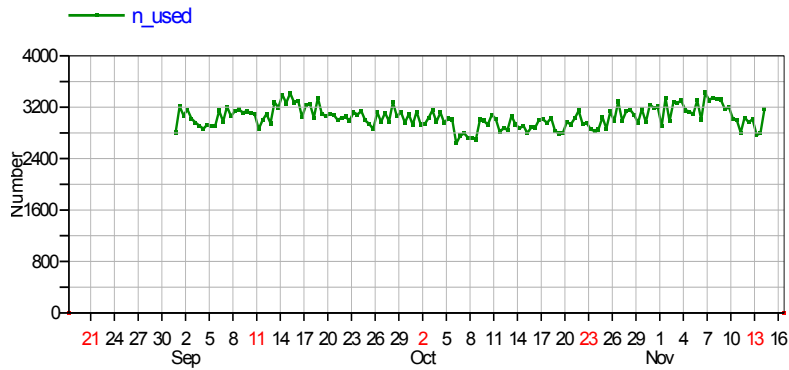
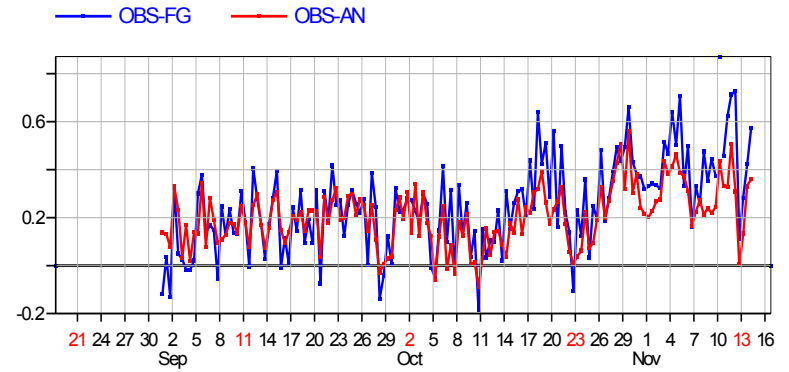
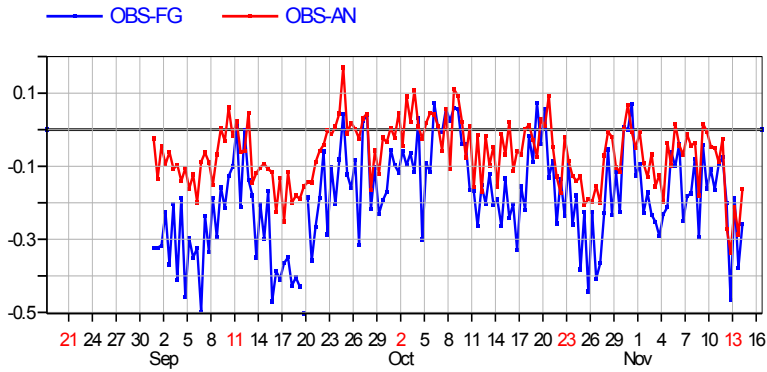
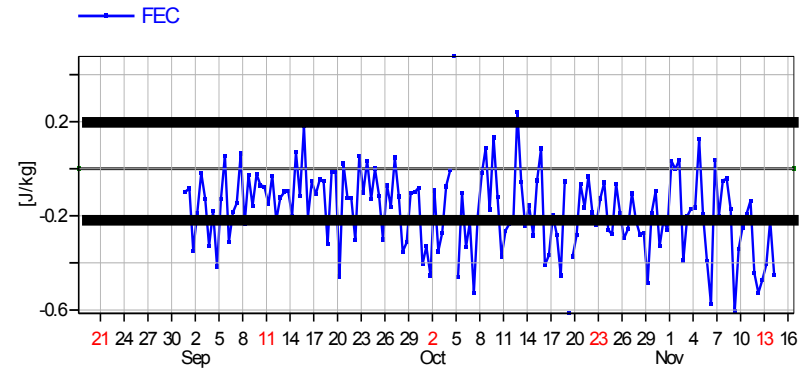
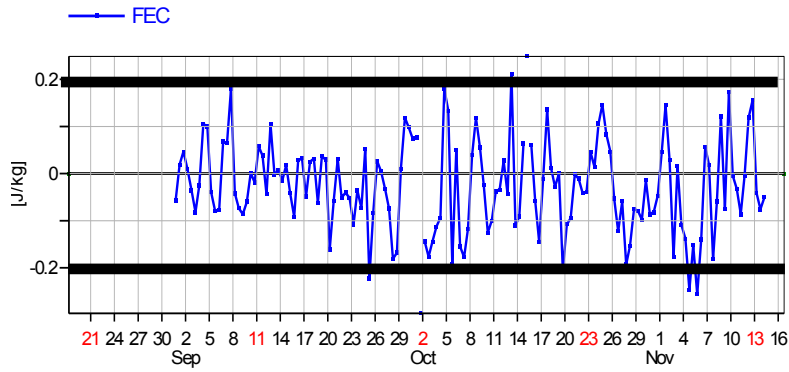
Temp

Pilot

Pilot

U-Comp North America above 400 hPa

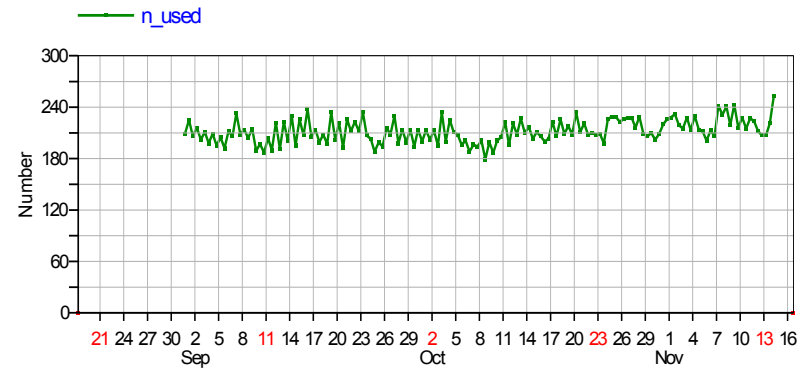
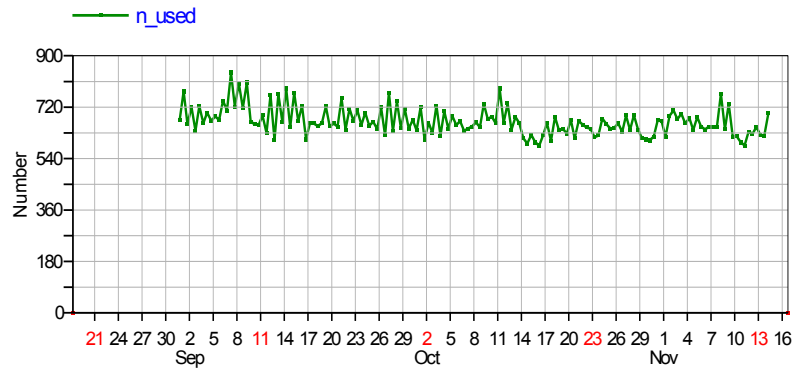
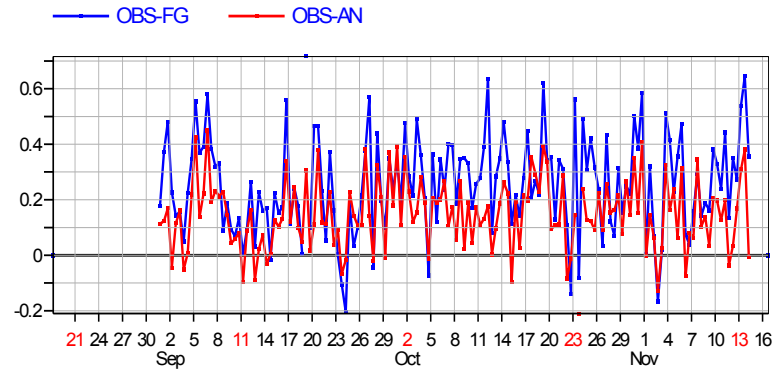
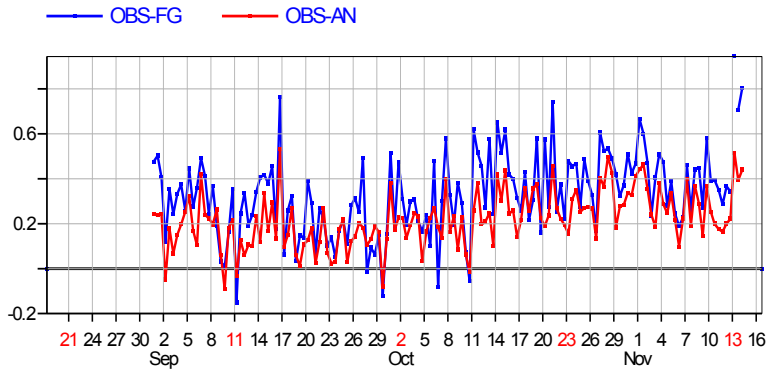
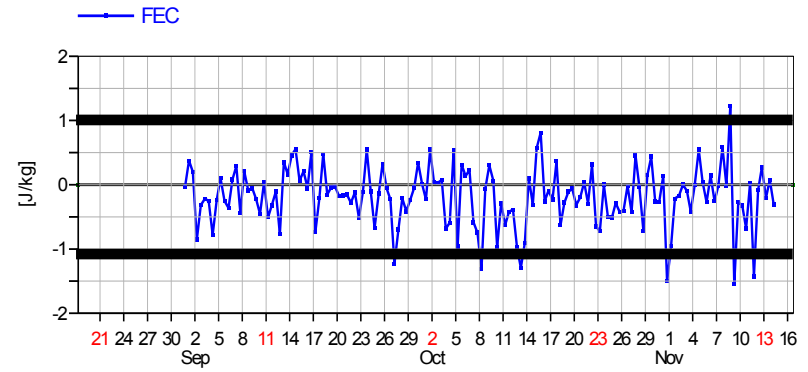
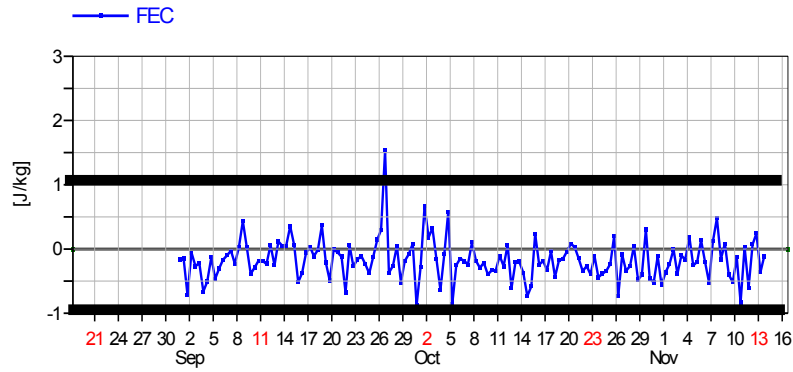
Temp



Pilot

U-Comp North America 400-700 hPa

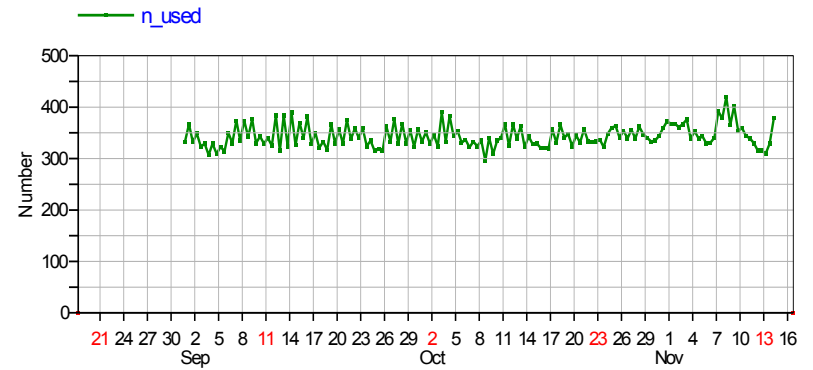
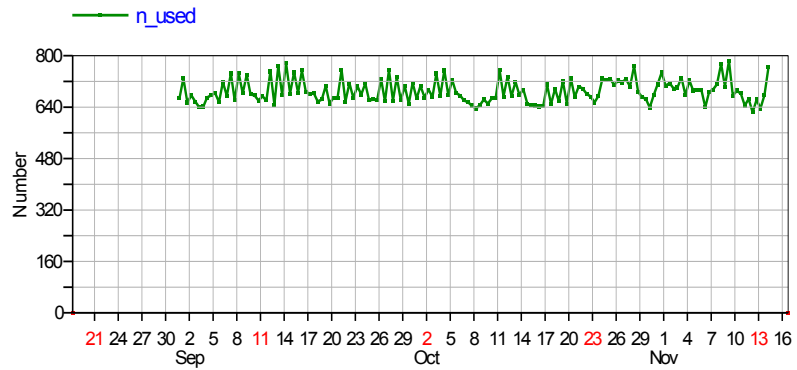
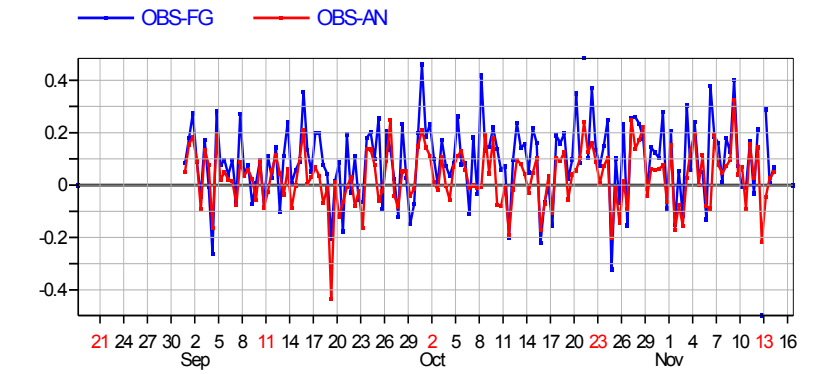
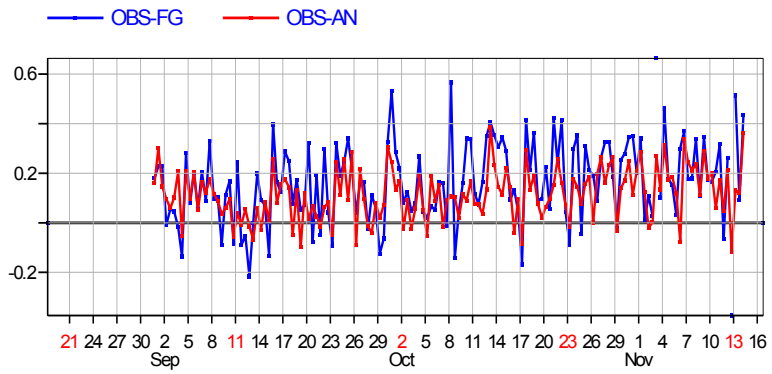
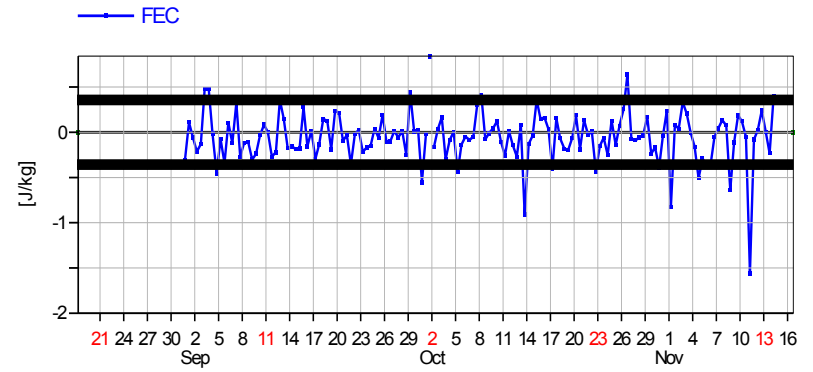
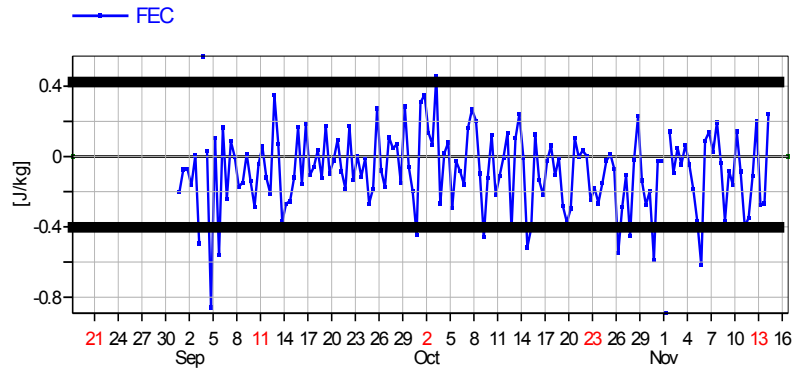
Temp



Pilot

U-Comp North America below 700 hPa

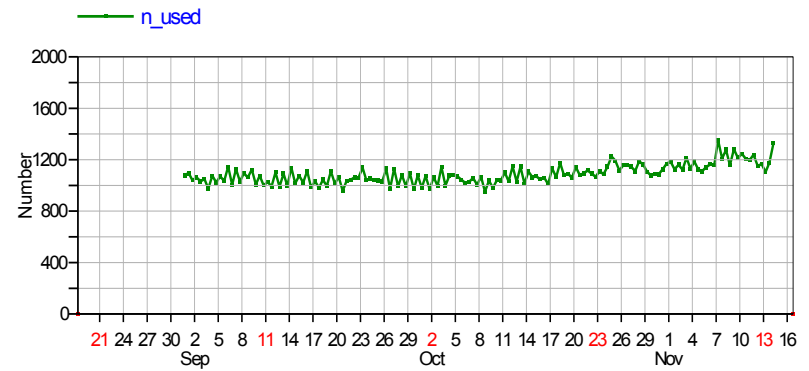
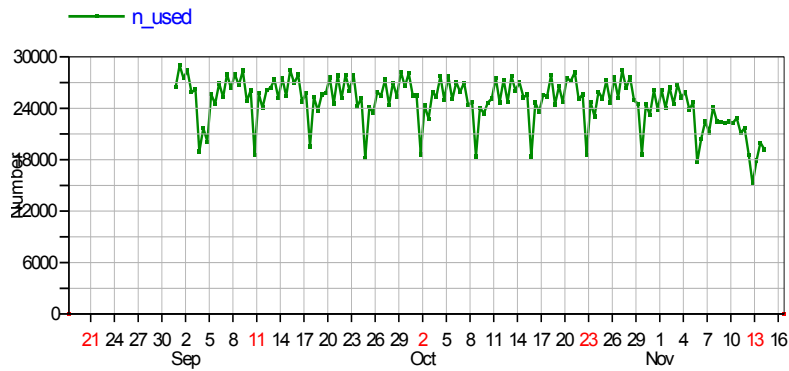
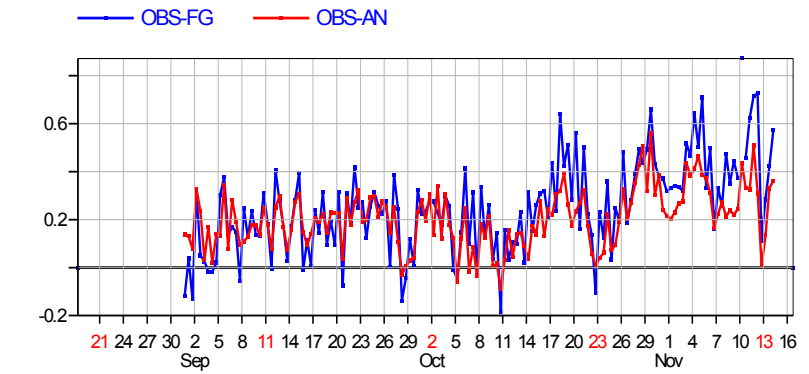
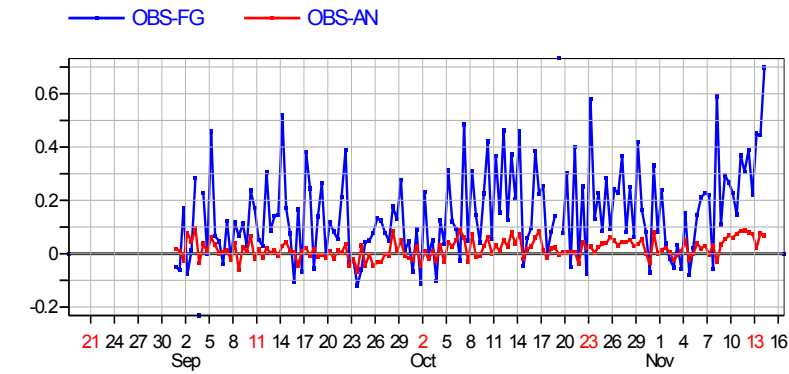
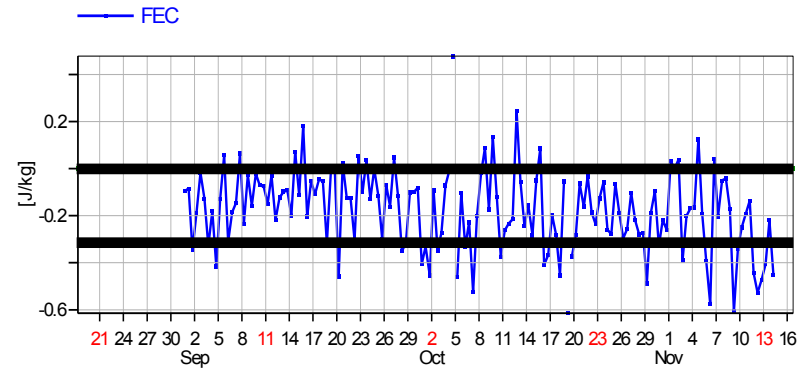
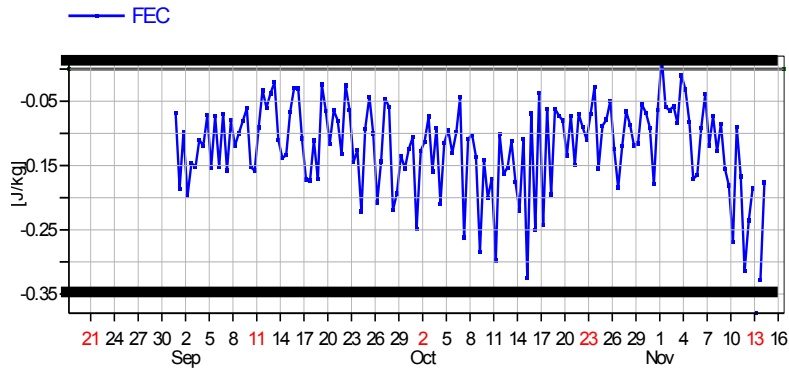
Temp



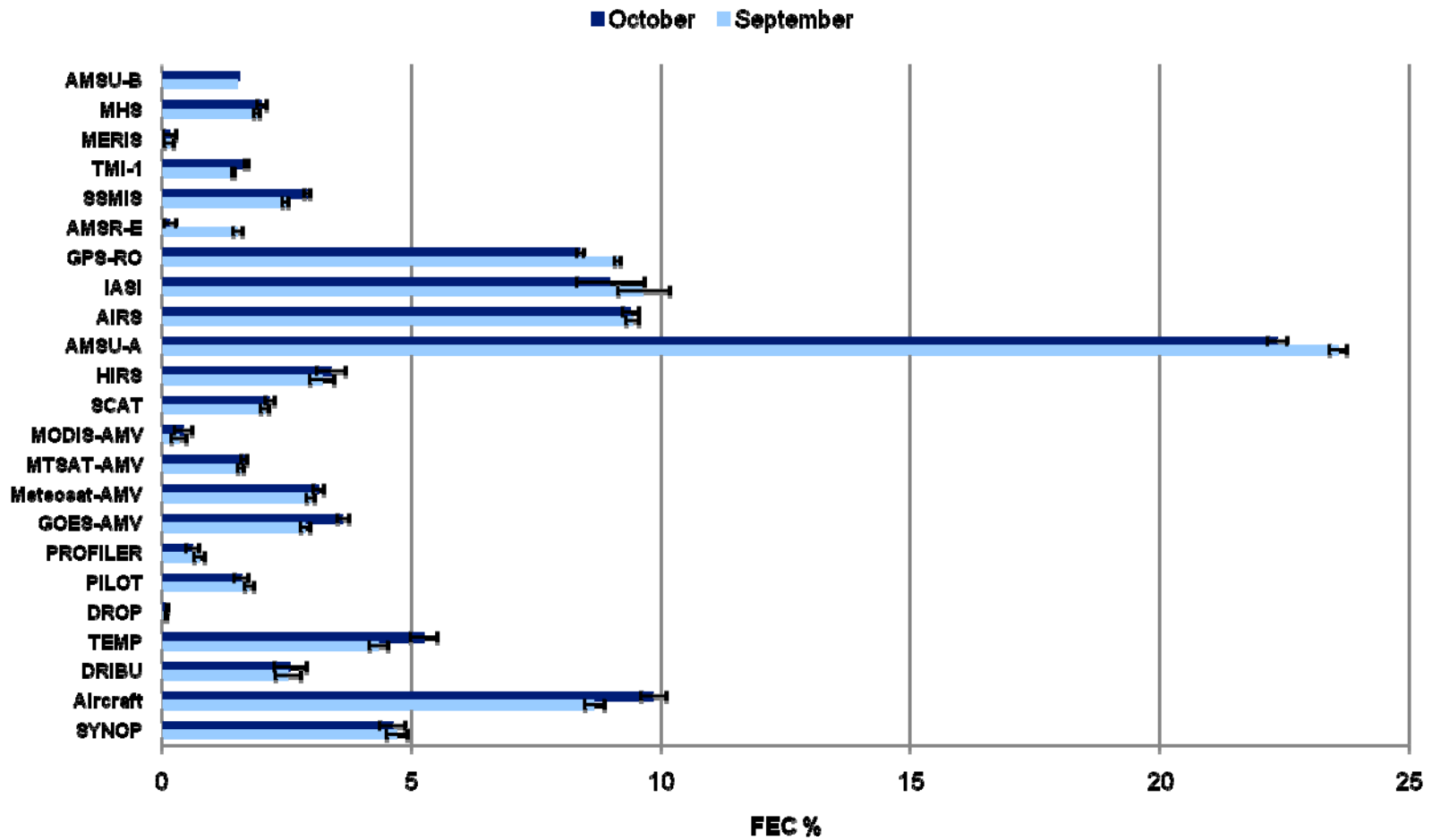
Aircraft

U-Comp North America above 400 hPa

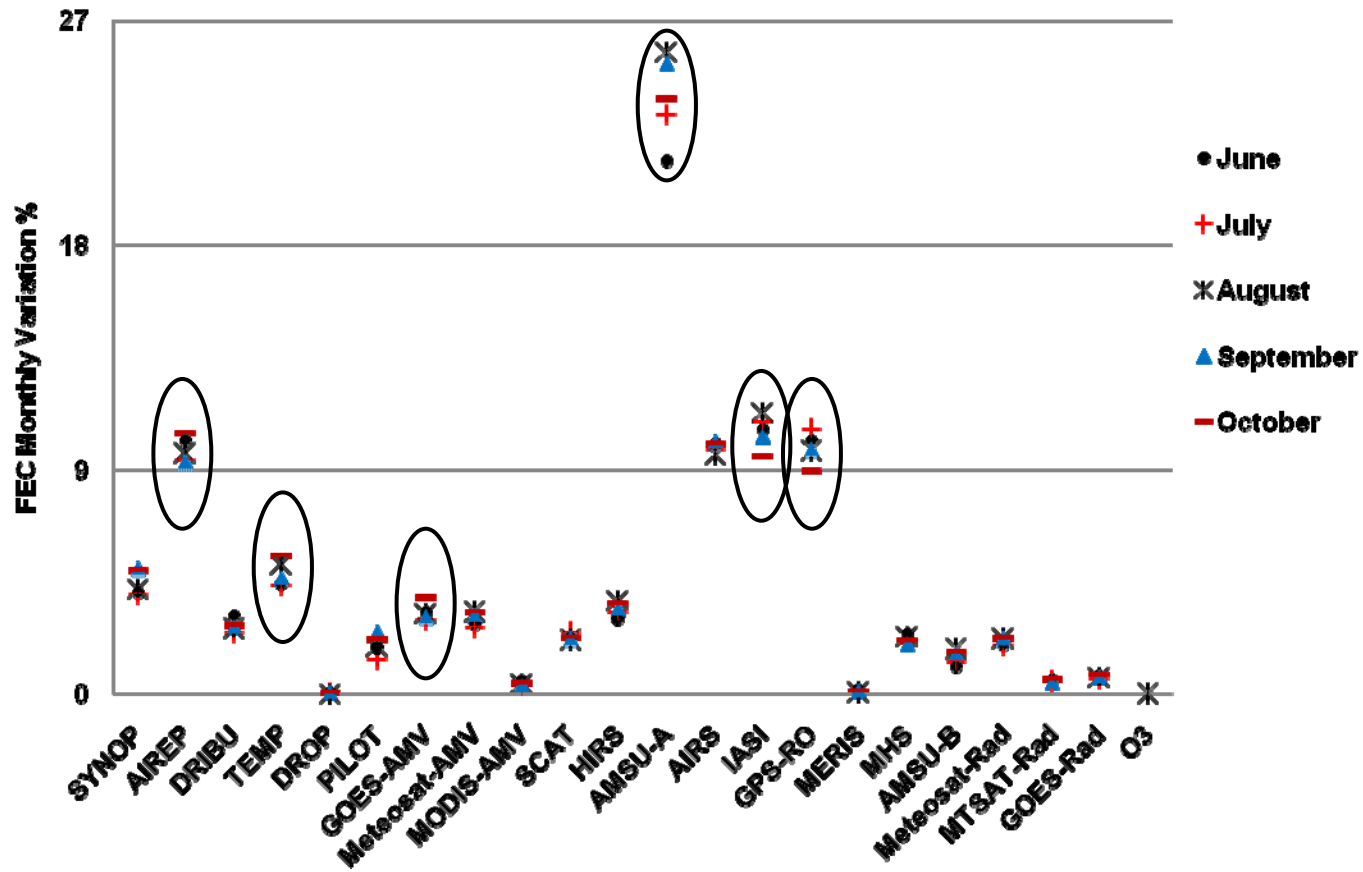
Temp



FEC September & October 2011: Monthly Variation

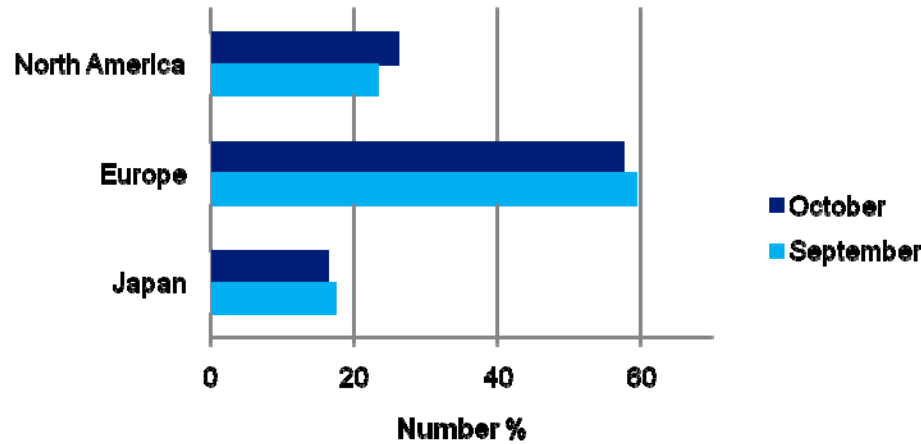


FEC September & October 2011: Monthly Variation

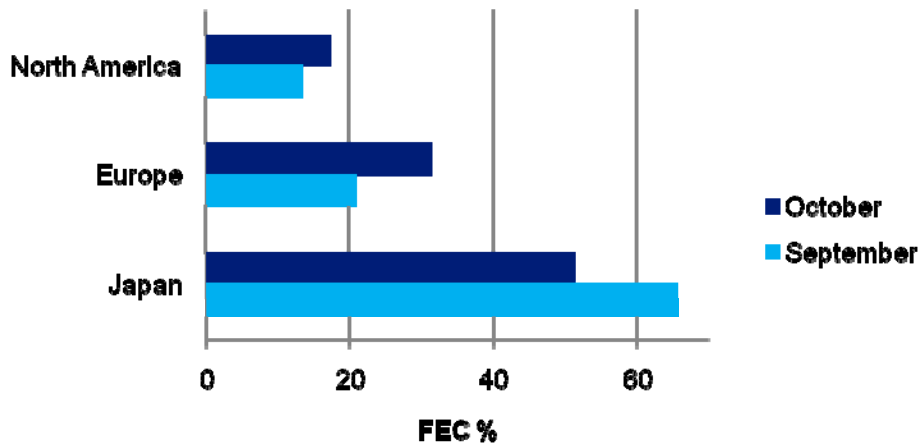


FEC October & September 2011: Profiler

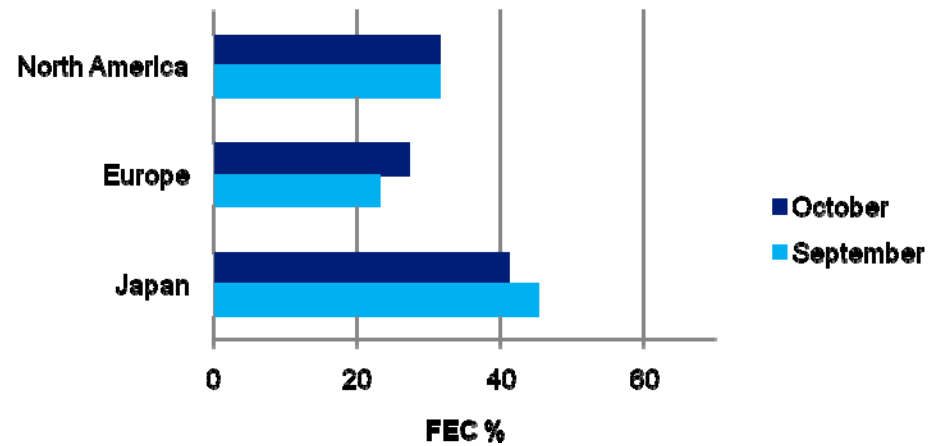
Number



U-Comp

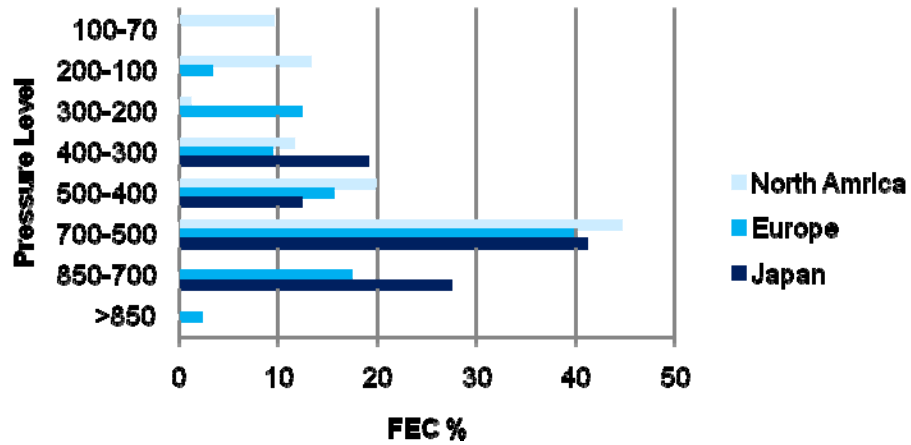


V-Comp

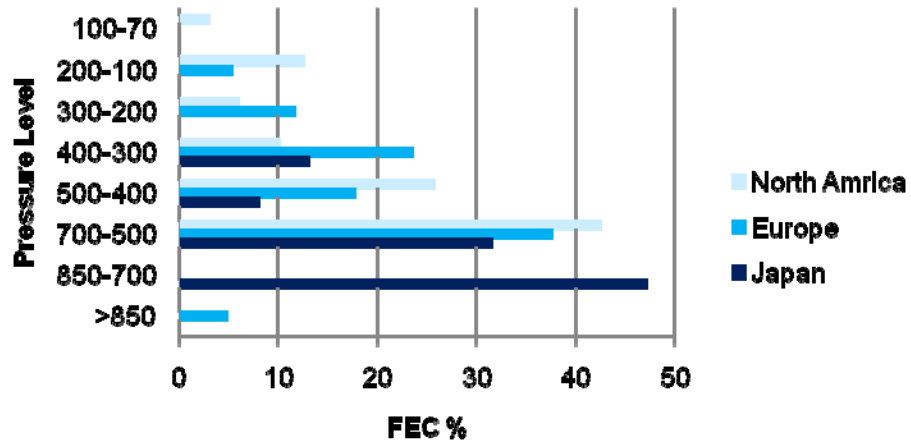


FEC October 2011: Profiler

Profiler U-Comp



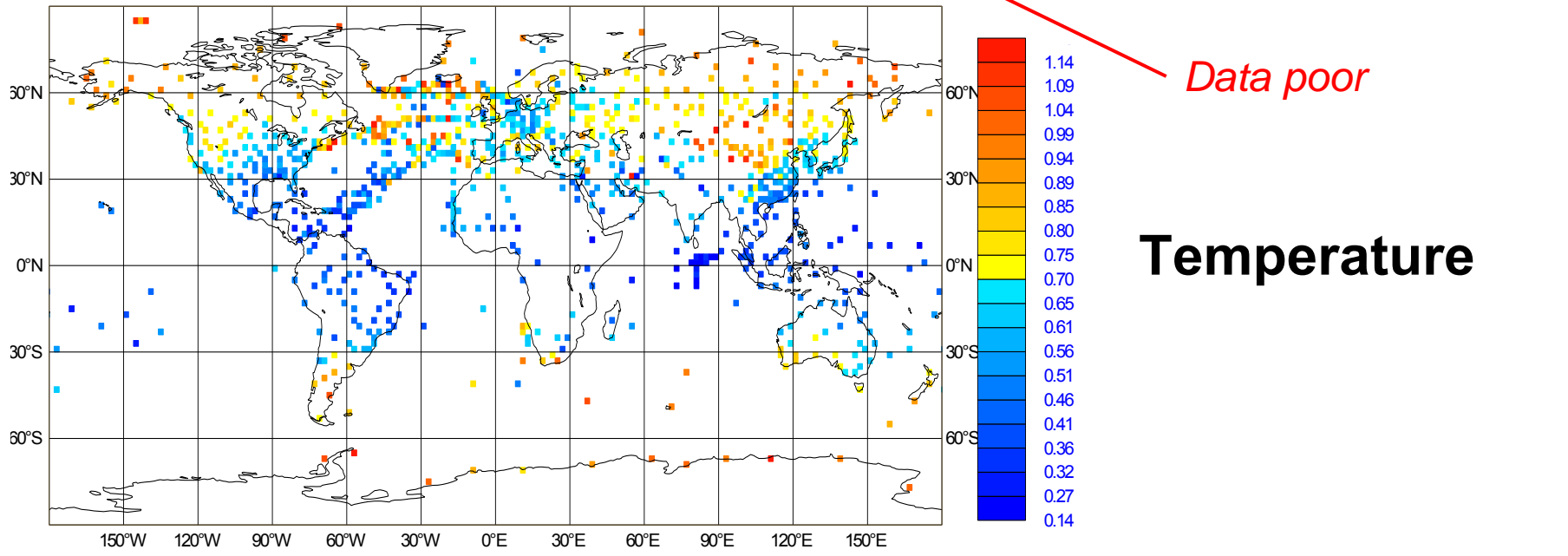
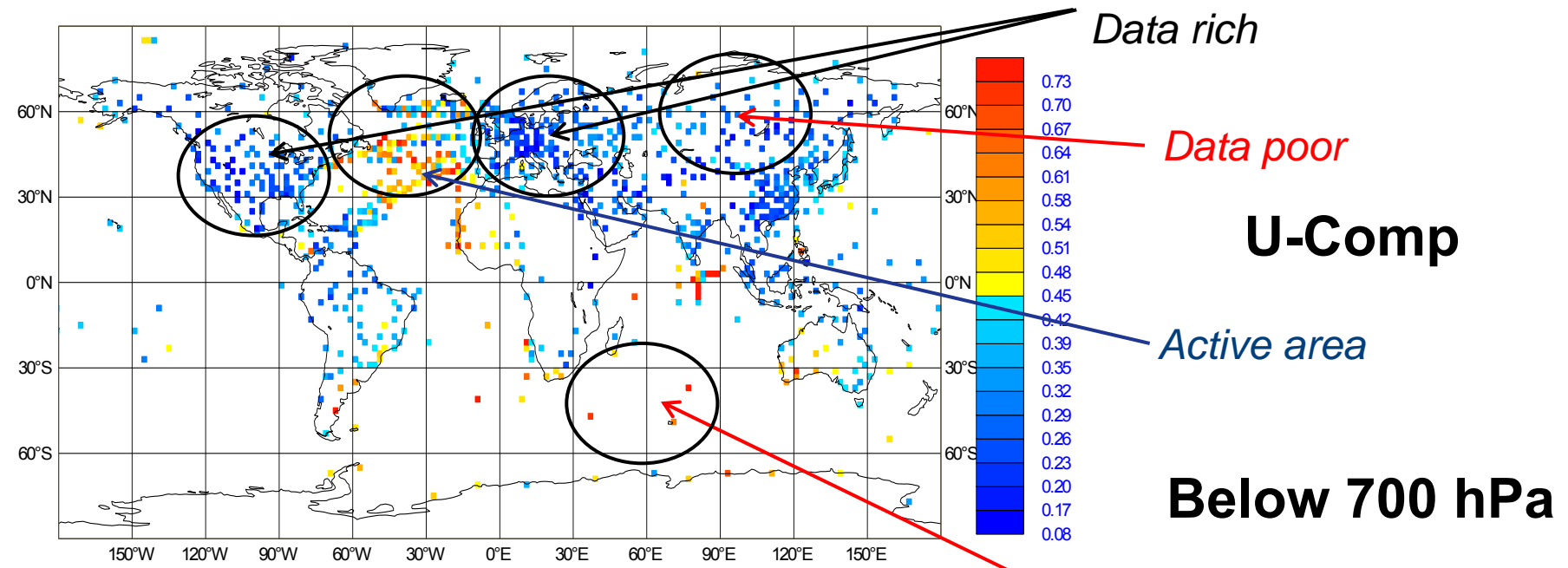
Profiler V-Comp



Observation Network Design

- Some degree of Observation Redundancy must be assured
- Use the most influential observations to design the observation network
 - Observation in **data sparse** versus observation in **data rich**
 - Observation at the **beginning** of the assimilation window versus the **end of the window**
 - Observation in **dynamically active areas**

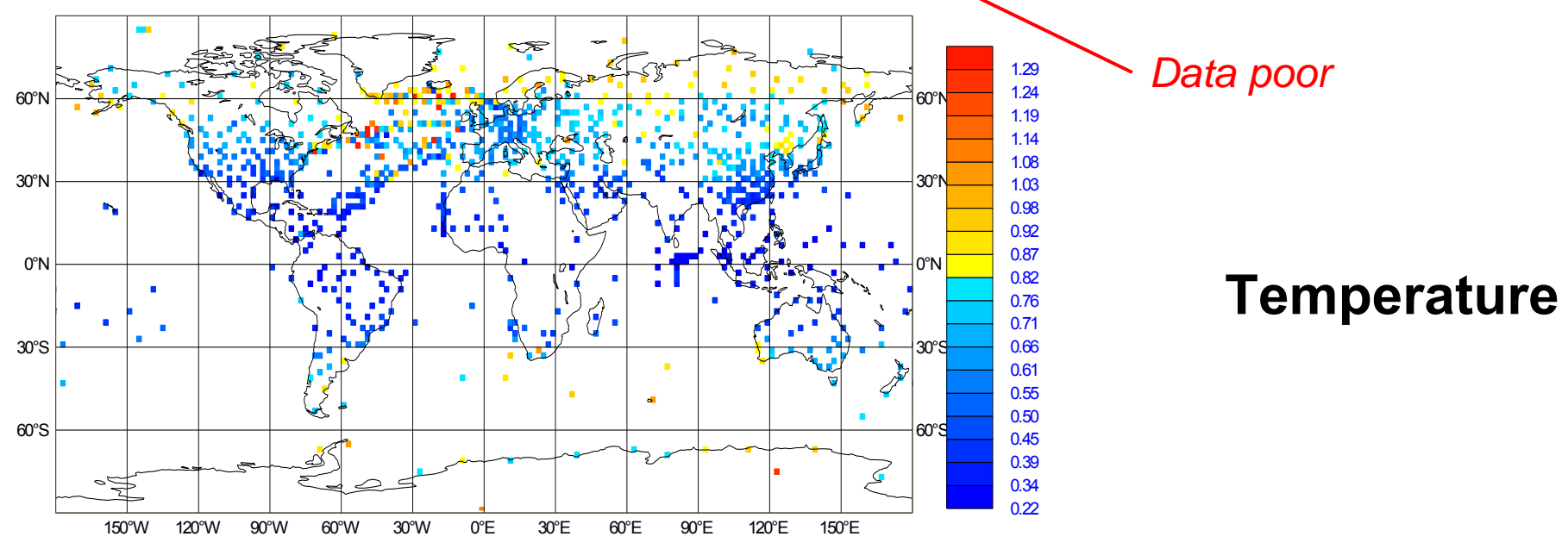
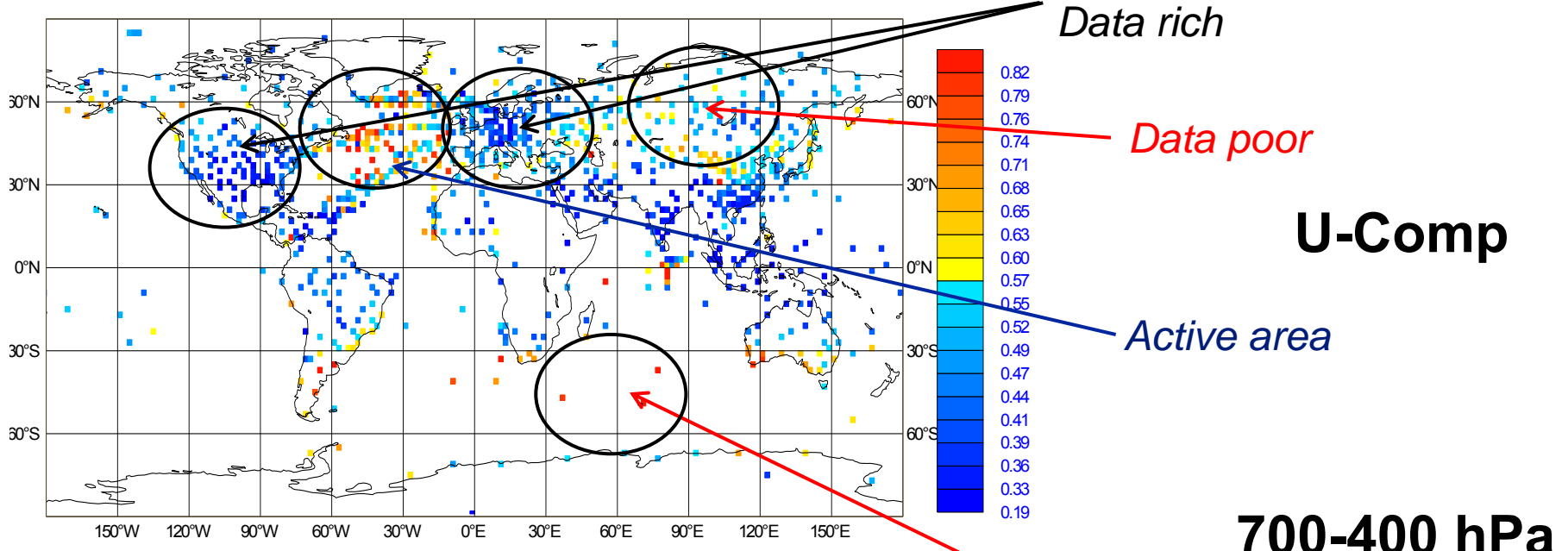
October 2011 Radiosonde Observation Influence $0 < OI < 1$



October 2011

Radiosonde Observation Influence

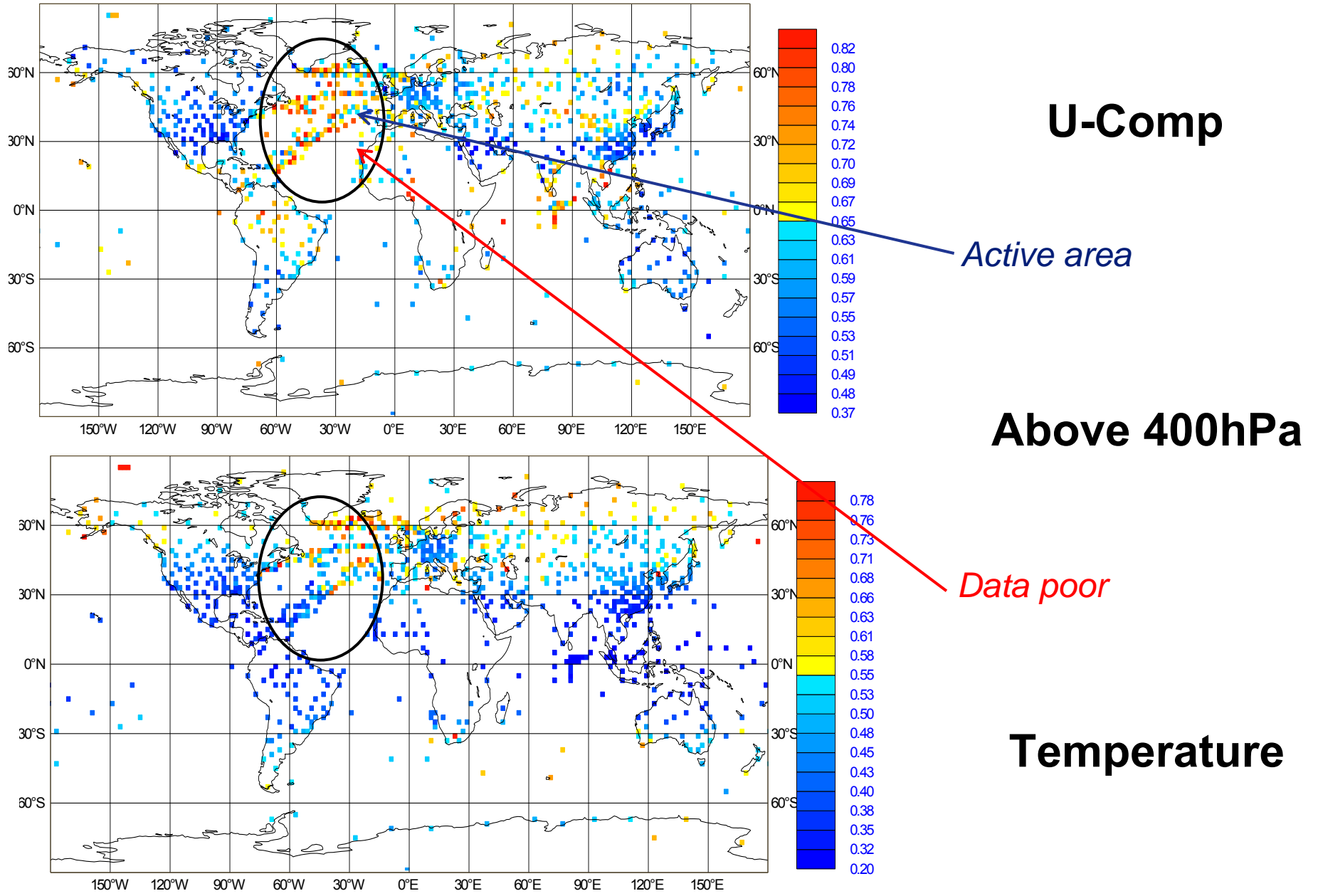
$0 < OI < 1$



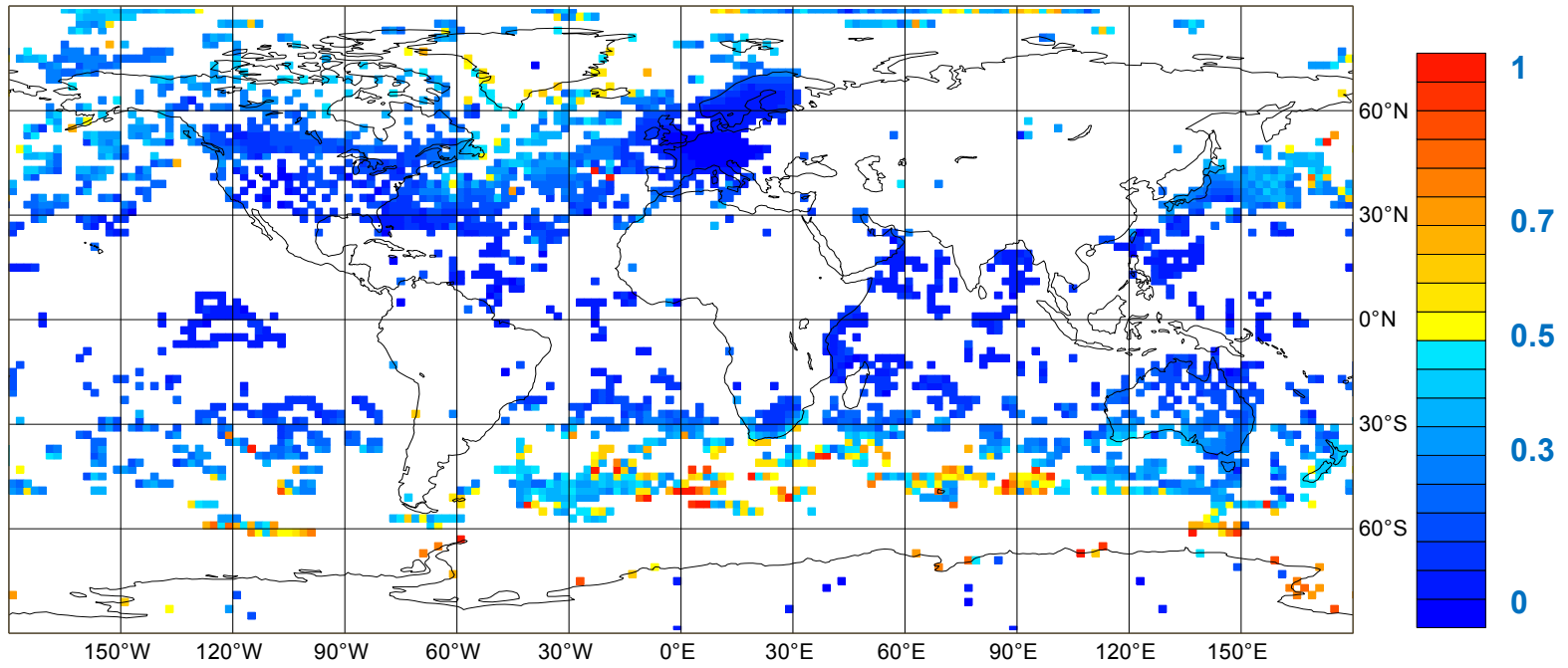
October 2011

Radiosonde Observation Influence

$0 < OI < 1$



BUOYS-SHIP Observation Influence



Summary

- DFS and FEC can be used together to highlight cases of poor forecast performance. The cause of deterioration should be investigated
- Poor performance of Pilot – Radiosonde at significant levels- has been spotted likely due to the way the wind information, rapidly varying with the altitude, is assimilated
- Smaller Temp performance above 200hPa is likely due to model bias
- If the observation network needs to be reduced, Observation Influence can be used to design the alternative network. OSEs can be used to complement the study