Radiosonde descent data – Encouraging preliminary results

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ECMWF = European Centre for
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ECMWF

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- Vaisala: Hannu Jauhiainen and Aki Lilja
- DWD: Alexander Cress, Michael Sommer, Christoph von Rohden
- MétéoFrance: Alexis Doerenbecher
- ECMWF: Ioannis Mallas, Tomas Kral, Peter Lean and Lars Isaksen

Overview

- Background
- ECMWF treatment of radiosonde drift (up/down)
- Results for January and June 2018
- Summary and work required

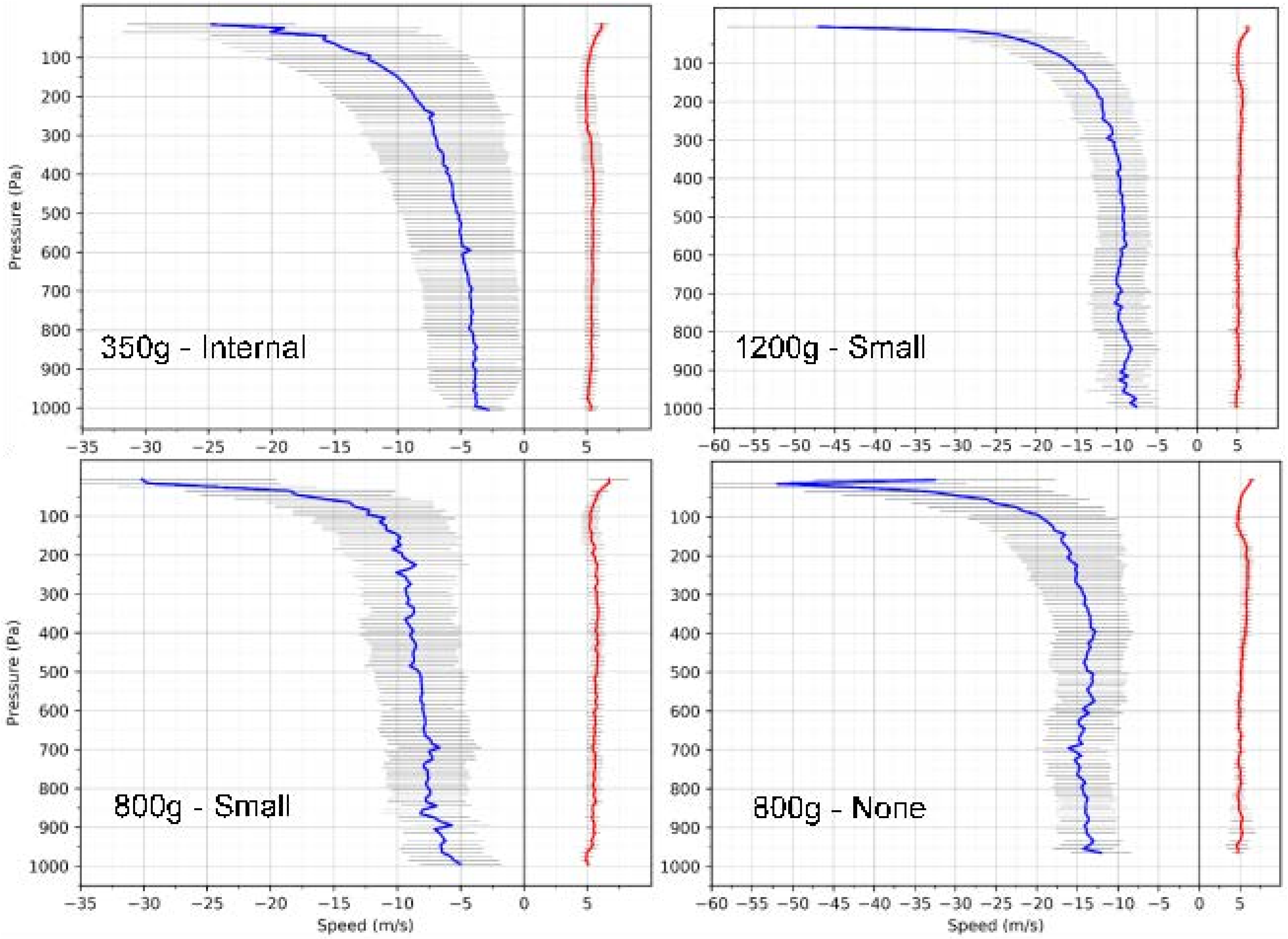
Background

- Currently radiosonde reports stop when balloon bursts
- But radiosonde keeps measuring/transmitting on the way down
  - Receipt of data stops when sonde below horizon
- Little/no extra cost to making descent data available ☺

- Vaisala MW41 software (used with RS41) has option to generate separate descent reports using BUFR dropsonde template
  - Identifier set to missing unfortunately
  - New BUFR template approved – available next year?
- Descent reports being produced by Germany, Finland and UK

Radiosonde ascent and descent rates

- Radiosondes ascend ~30 km taking ~2 hours and drifting 40-200 km downwind
- Ascent rate ~5 m/s
- Descent rate depends on
  - Parachute or not? Balloon remains.
  - Density – much faster in stratosphere
- Figure from Chris Wyburn-Powell for Met Office radiosondes:
  - 4 autosondes 350 g balloon + parachute
  - 2 manual sondes 800/1200 g balloon + parachute
  - St Helena, Rothera (remote stations) 800 g balloon, no parachute (limited data)
- DWD use parachutes, FMI don’t

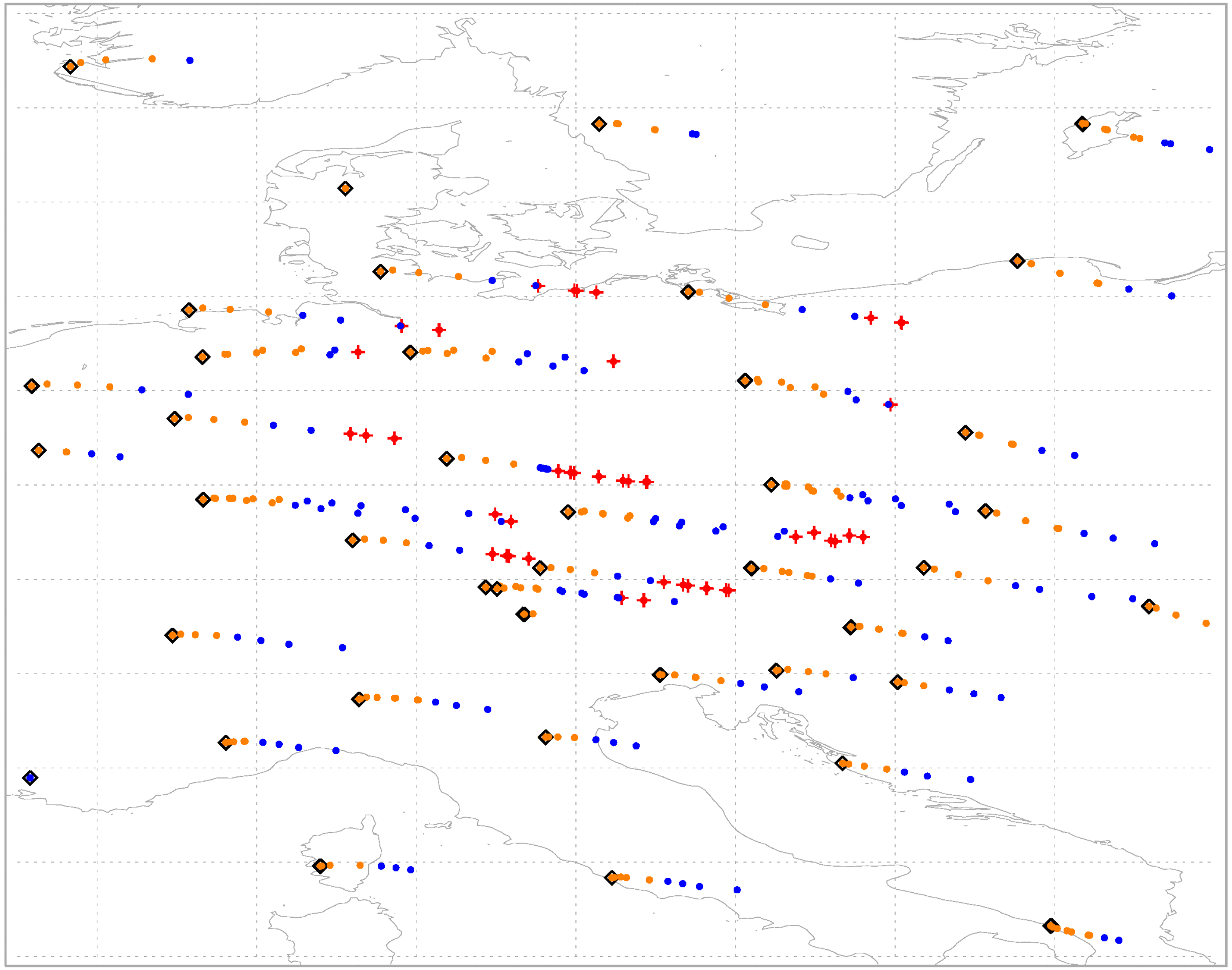


Ascent/descent data (Germany) example

- Black diamonds – launch
- Levels to 100 hPa
- Levels above 100 hPa
- + Descent
- ~13 stations with descent data

- Main tests use 15 minute sub-profiles for ascent and 5 minutes for descent (plot: 15 minutes for both)
- *ECMWF started operational treatment of radiosonde drift (ascent only) in June 2018 for BUFR reports*

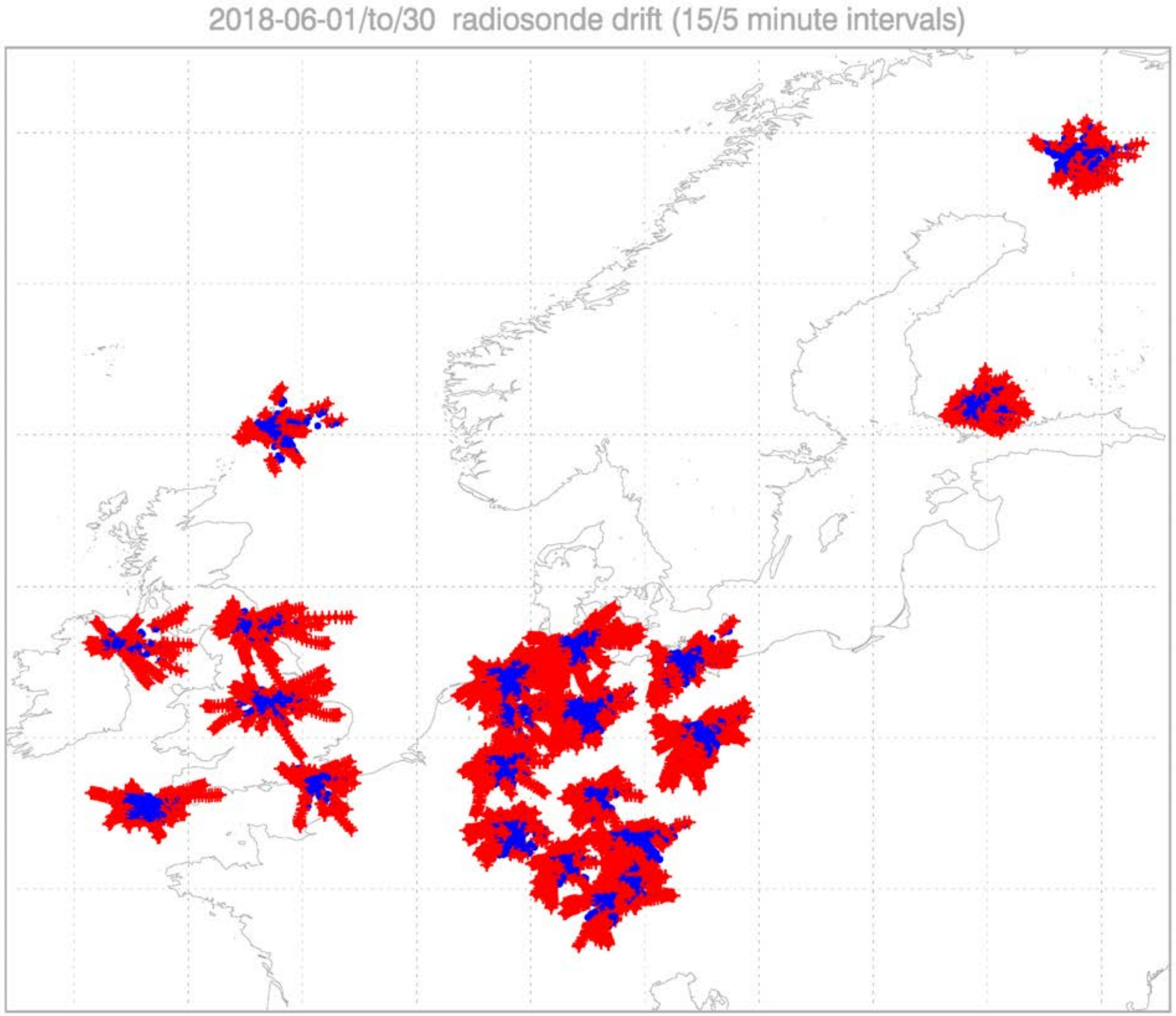
2018-01-31 00 radiosonde drift (15 minute intervals)



Data examined

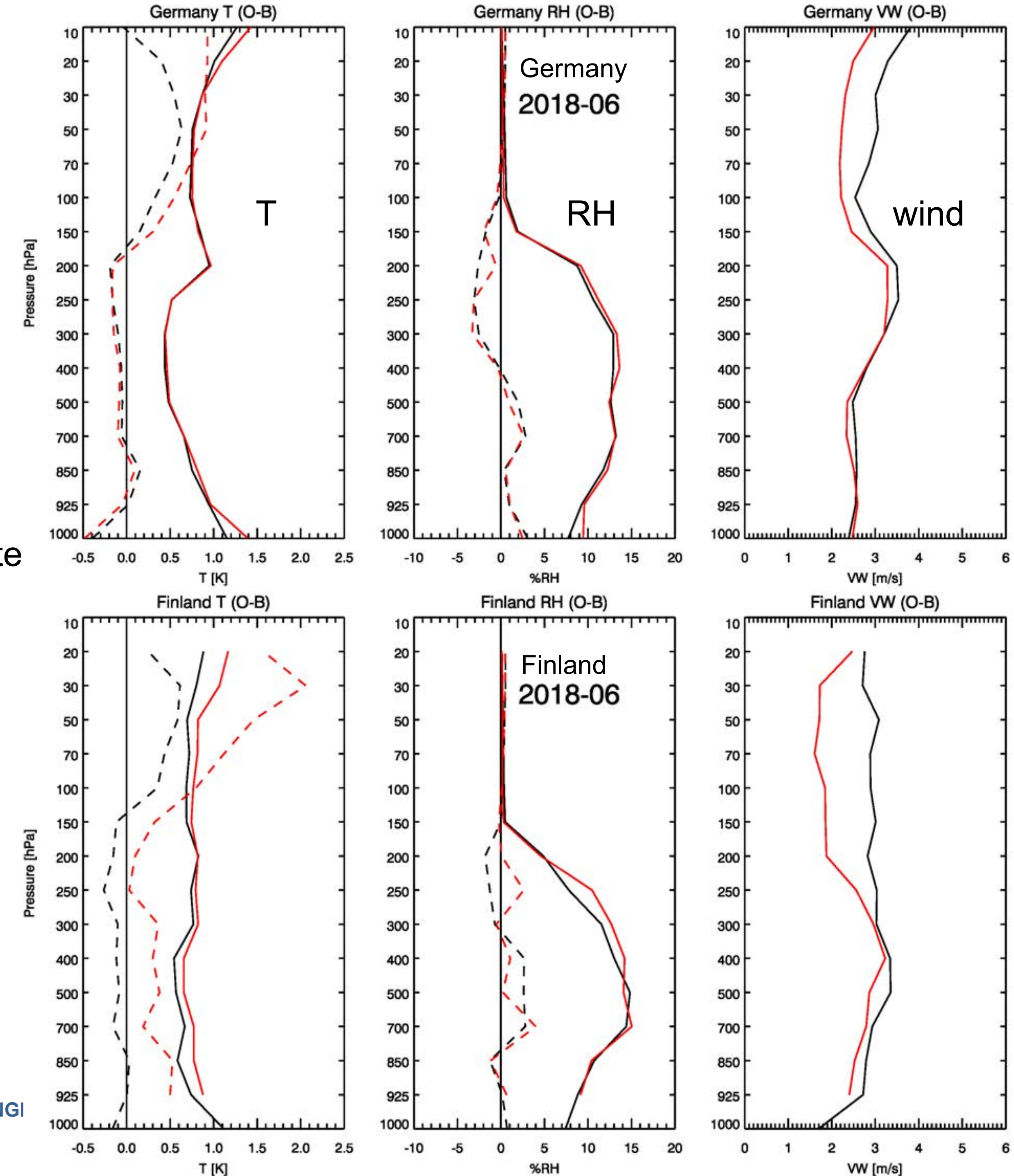
- DWD: 14 stations
- UK: 6 stations (+2 remote)
- FMI: 2 stations

- Plot shows June 2018 – descents in red, other radiosondes not shown
- January and June 2018 processed, results similar will show those for June



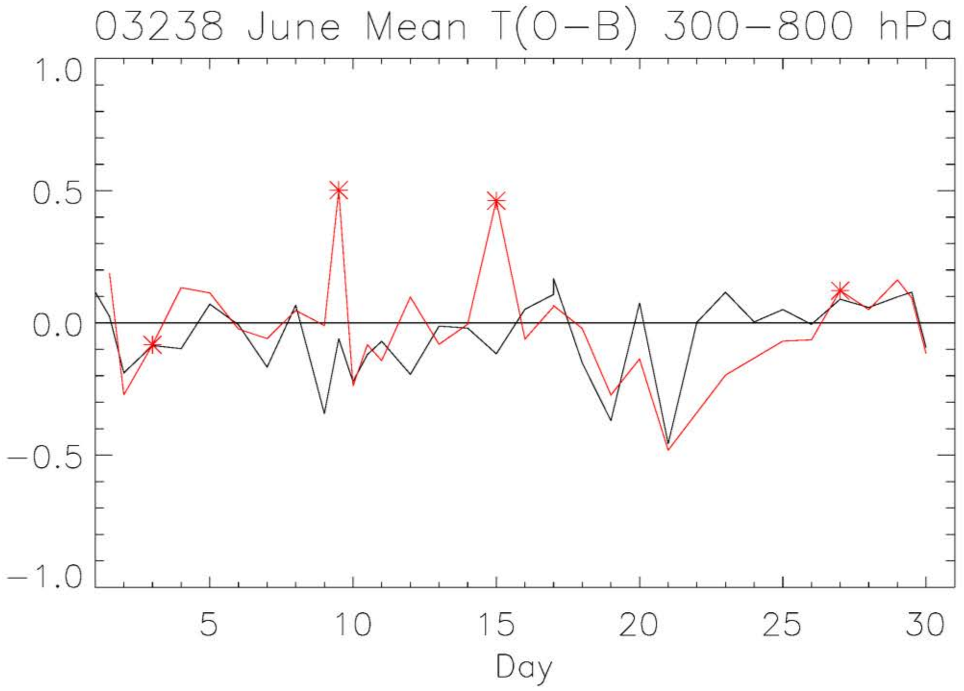
Descent O-B statistics

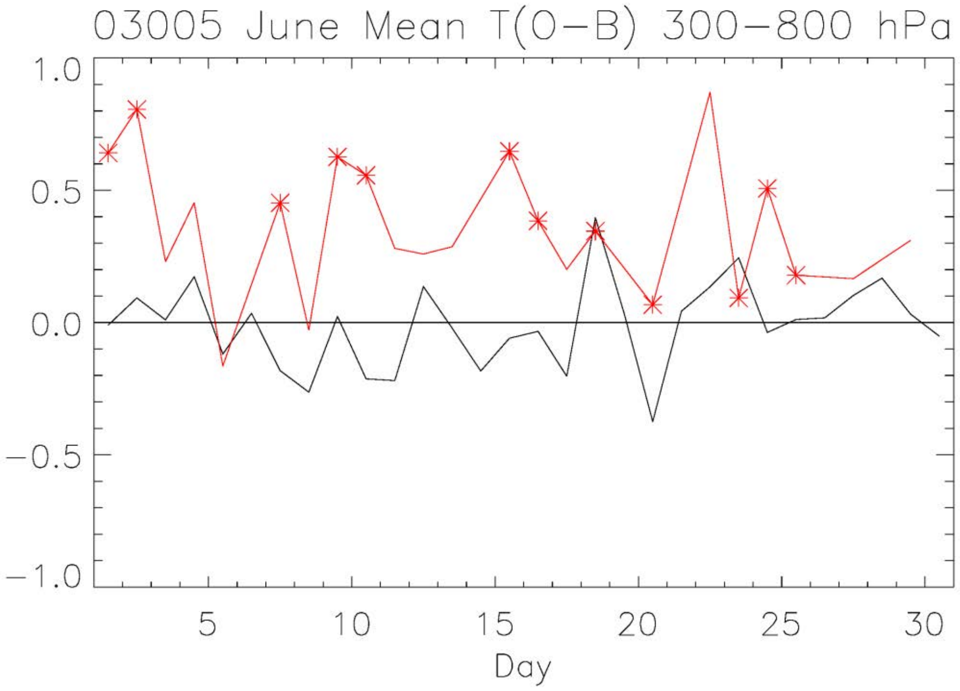
- Encouraging O-B statistics (red – descent)
  - Observation minus Background (Forecast), mean (dashed) and standard deviation
  - Temperature, RH, Vector Wind (rms)
  - Germany (top) has best/smoothest results
  - But warm bias at upper levels
  - Warm bias (and SD) worse without parachute bias extends to troposphere – Finland, (bottom), also seen for St Helena ☹
  - Wind rms(O-B) smaller?? Descent oversmoothed or ascent undersmoothed? (Filtered to remove pendulum motion.)
  - UK statistics intermediate (not shown)
  - Check day-to-day variability (next)

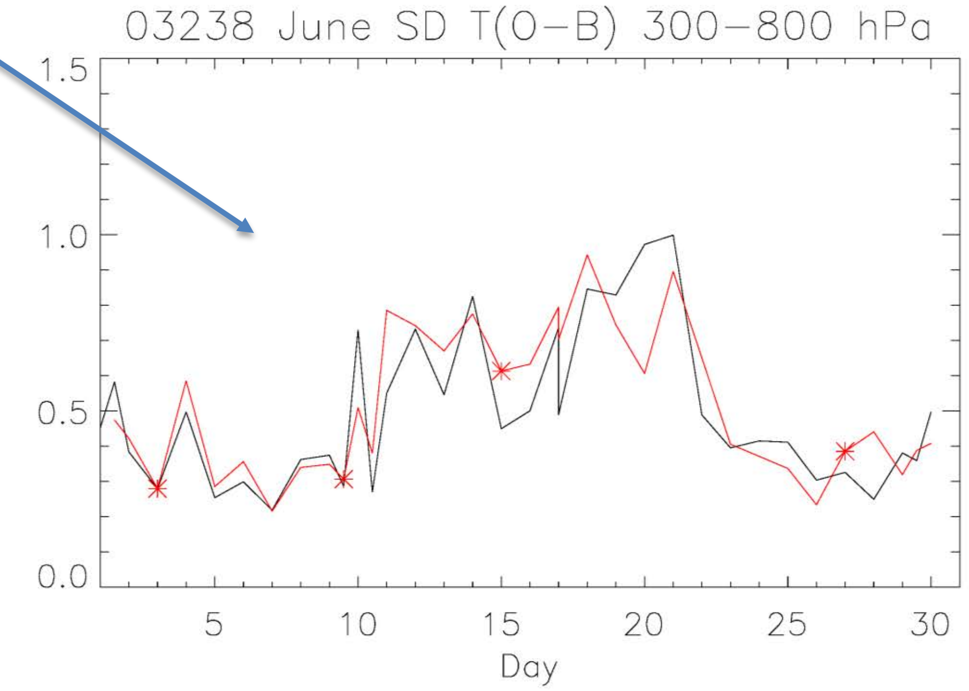


Day to day variation

- Lerwick (1200 g balloon) below, Albemarle (350 g balloon, autosonde) right
- Ascent and descent O-B for 300-800 hPa
- Some association between fastest descent (*) and larger biases. *Needs more work.*
- SD(O-B): no link to descent rate? Background error varies with the weather?



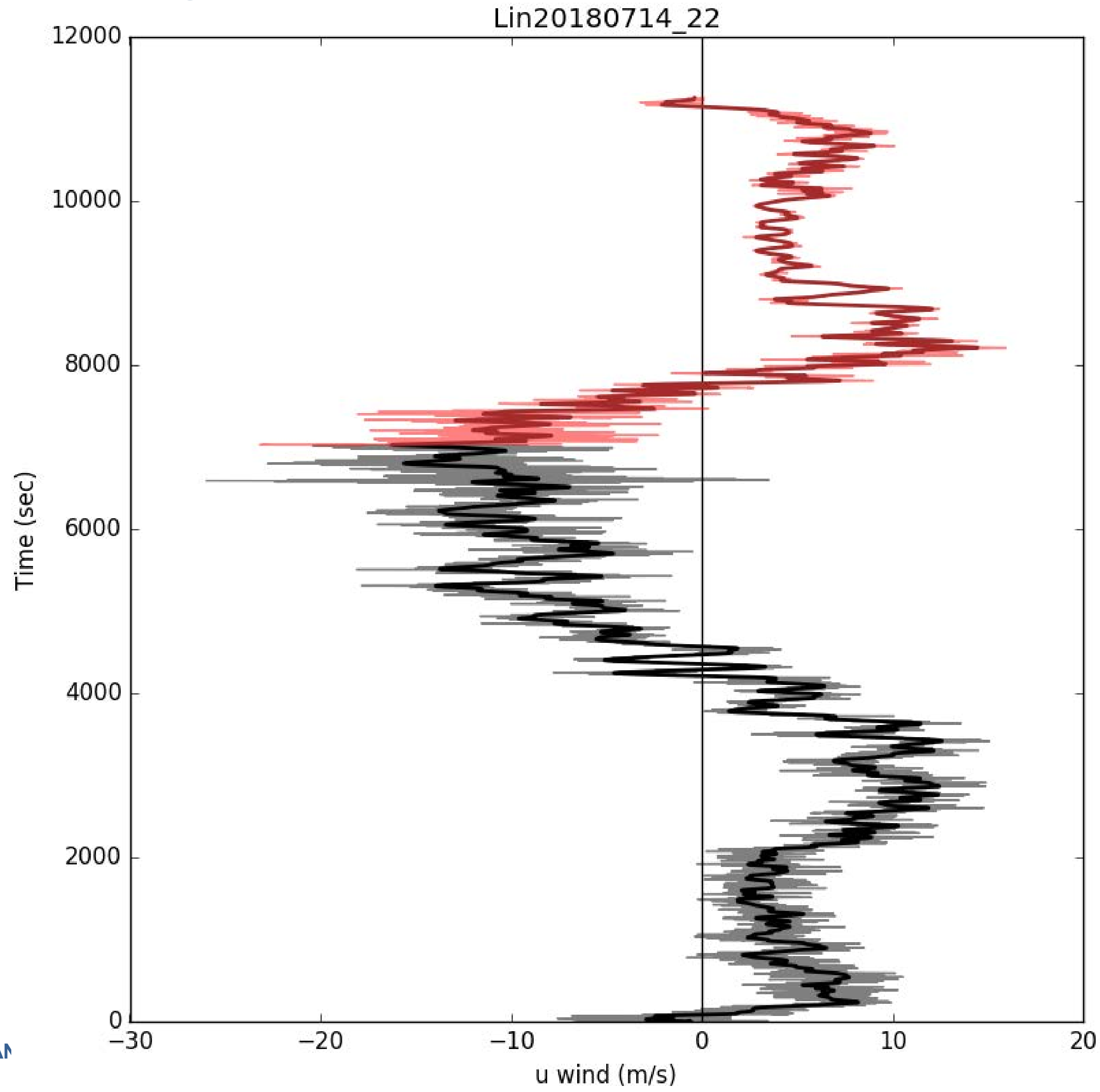




Pendulum motion and wind filtering

- Radiosonde swings under the balloon
- This adds high frequency noise to the GPS-derived winds – removed by filtering (eg Dirksen et al, 2014) – thin line raw data, **bold curves show filtered u wind** (data from Lindenberg, Michael Sommer)
- The noise varies …
- How much is signal?
- Some operational radiosondes seem to over-smooth.

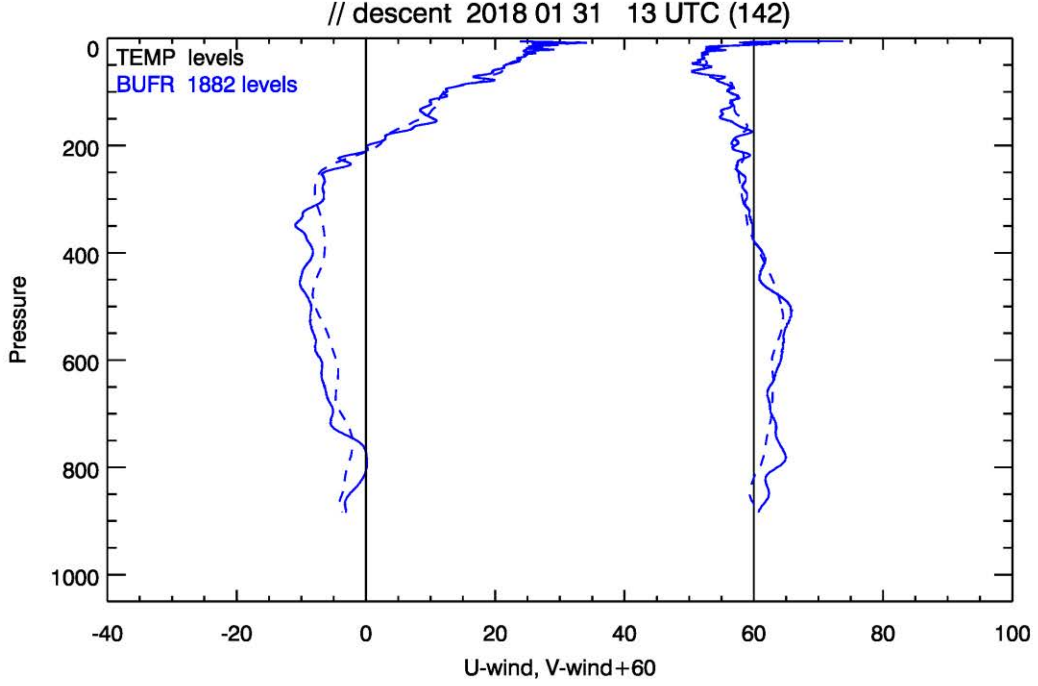
- Less noise in troposphere for descents?

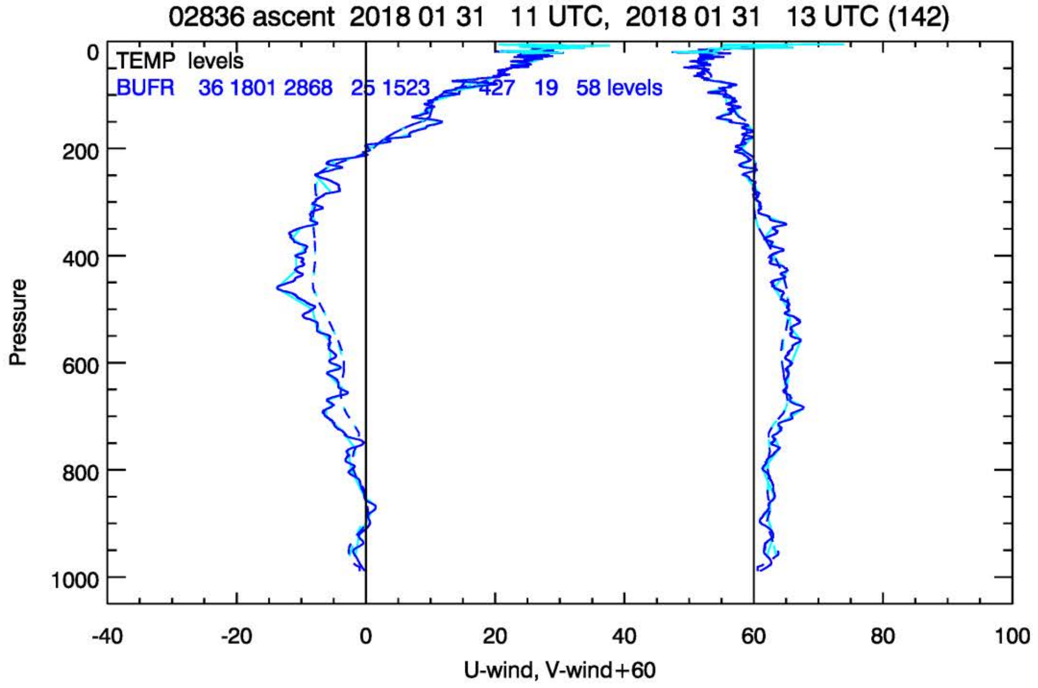


Example wind profile

- Reported – solid, background – dashed
- Descent (top) is clearly smoother than ascent (bottom), is this due to:
- Less pendulum motion? ☺
- Too much smoothing? ☹
- Balloon “catches” small-scale wind more?
- Other?

- Vaisala: “filtering the same for ascent and descent” (function of time)
- Vertical scale larger when radiosonde falling faster





Summary

- Preliminary O-B statistics for January and June 2018
  - German/UK T and RH look OK (similar to ascent) ☺ except for T bias at top ☹
  - Finnish T looks worse than ascent – faster fall rate? ☹
  - Both sets of wind look good ☺ – descent smoother than ascent ☺/☹?
    - Is this real or are descent winds oversmoothed? Talking to Vaisala re filtering
  - Results encourage further work, move towards operational monitoring
- To do (ECMWF)
  - Operational processing in 2019 (use new Descent template when available)
  - Look at extra QC checks (reject T when falling fast?), estimated errors
  - Re-evaluate new, lighter RS41
  - Assimilation tests
- Should operators use parachutes where they don't already?
- Future: more use of raw radiosonde data in NWP?