Single FOV AIRS only retrievals in clear and cloudy scenes

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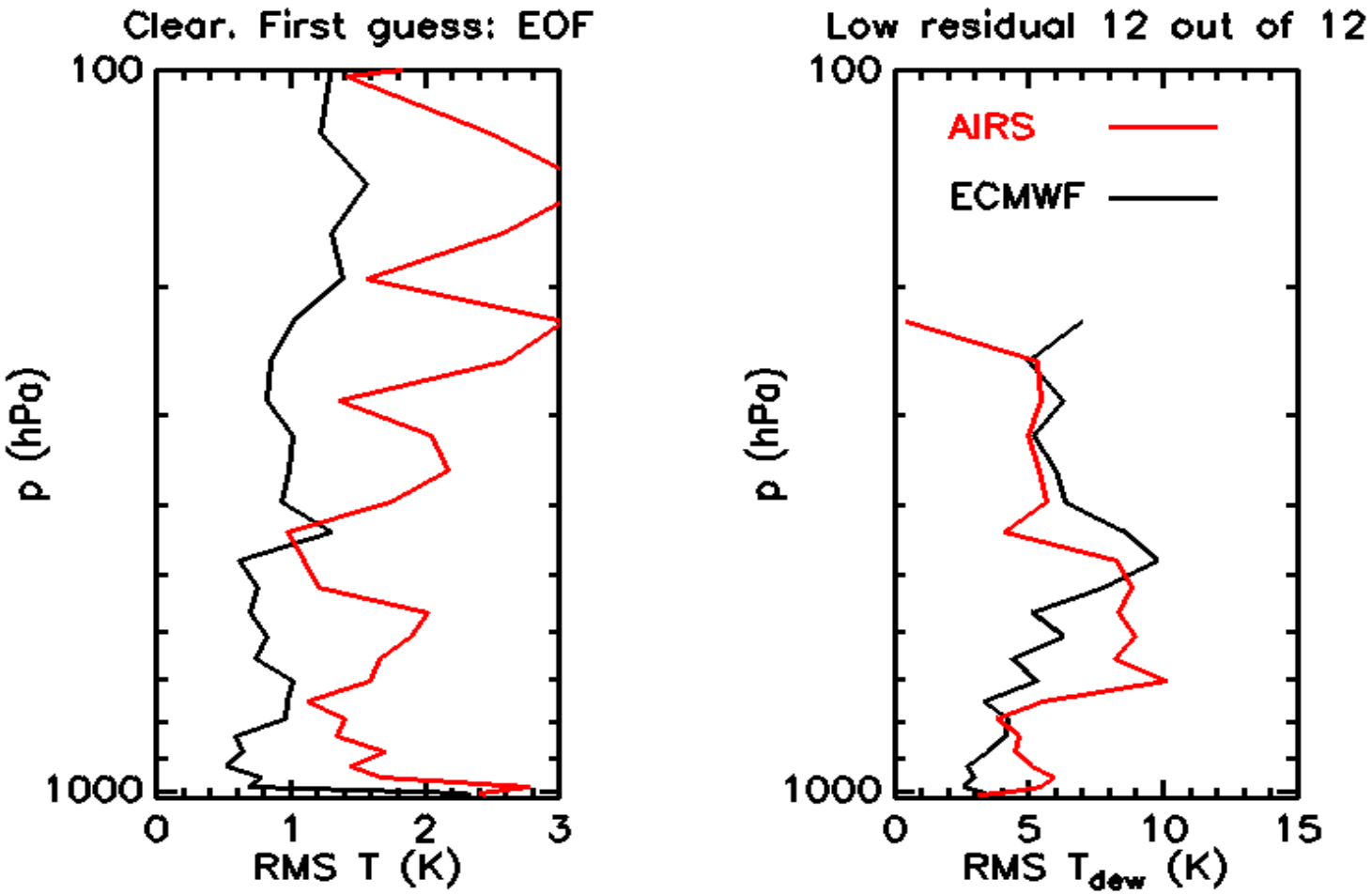
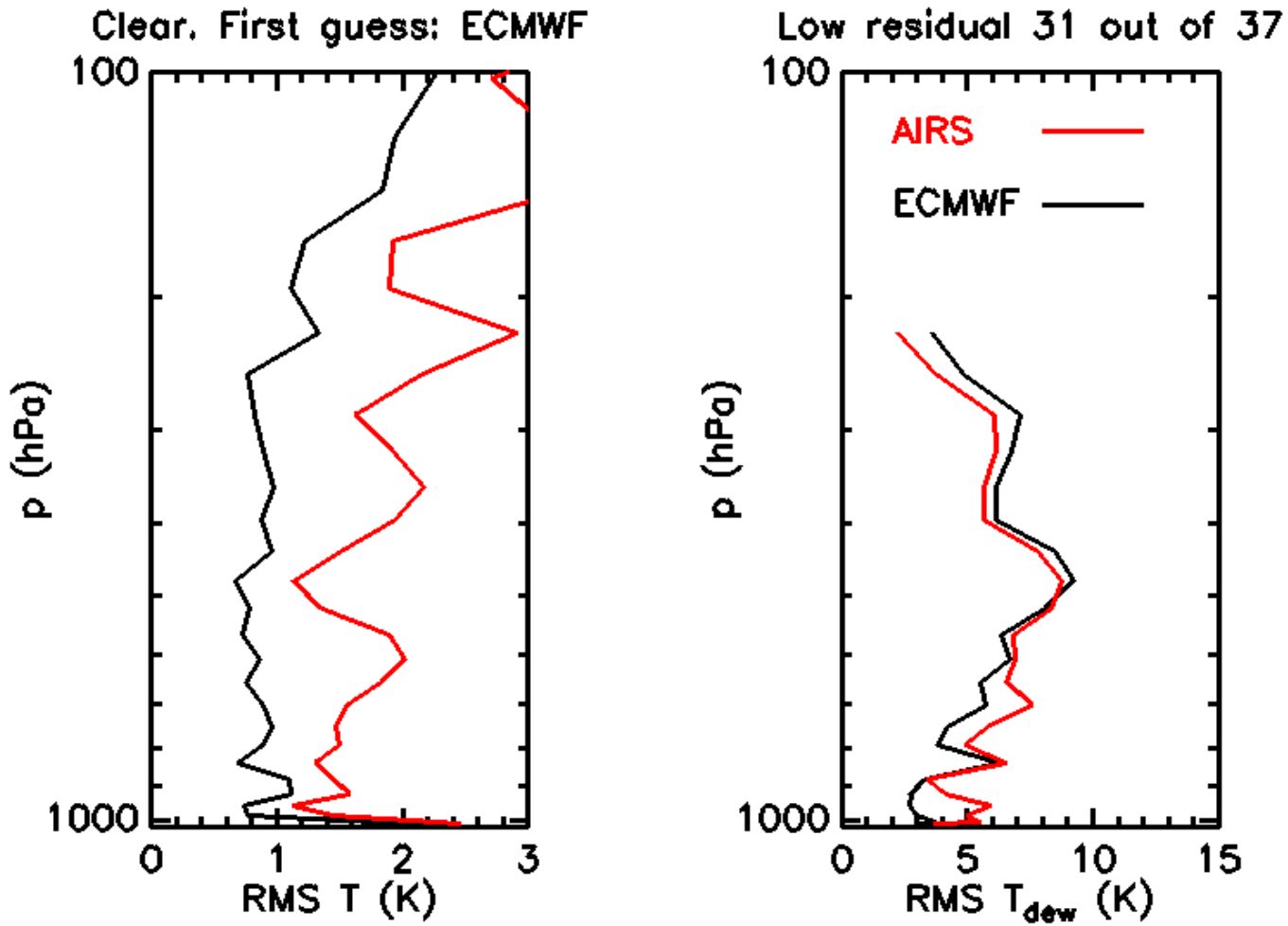
8 retrieval **EXPERIMENTS** compared with radiosondes

- **CLEAR SCENES** retrieved as **CLEAR** using first guesses =
  - **EOF**: EOF linear regression retrieval
  - **ECMWF**: ECMWF analyses
  - **Line**: straight line with constant slope, surface T = SST and Tdew= T – 10 K below 250 hPa. High levels using ECMWF
- **CLEAR SCENES** retrieved as **CLOUDY** using first guesses =
  - **EOF**
  - **ECMWF**
  - **Line**
- **CLOUDY SCENES** retrieved as **CLOUDY** using first guesses =
  - **ECMWF**
  - **Line**

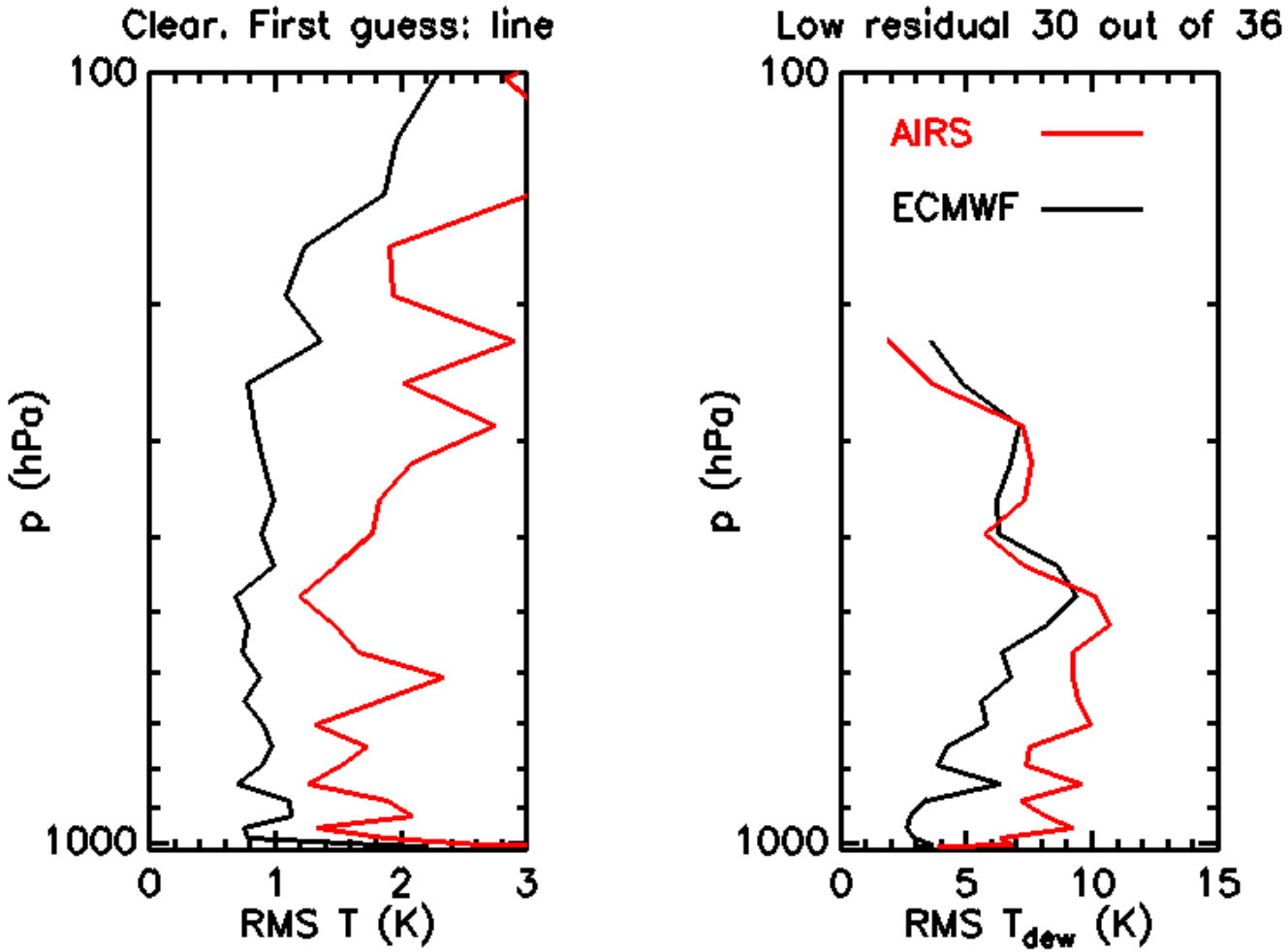
Statistics of **CLEAR** scenes retrieved as **CLEAR**. First guess: **EOF** (comparison with radiosondes)



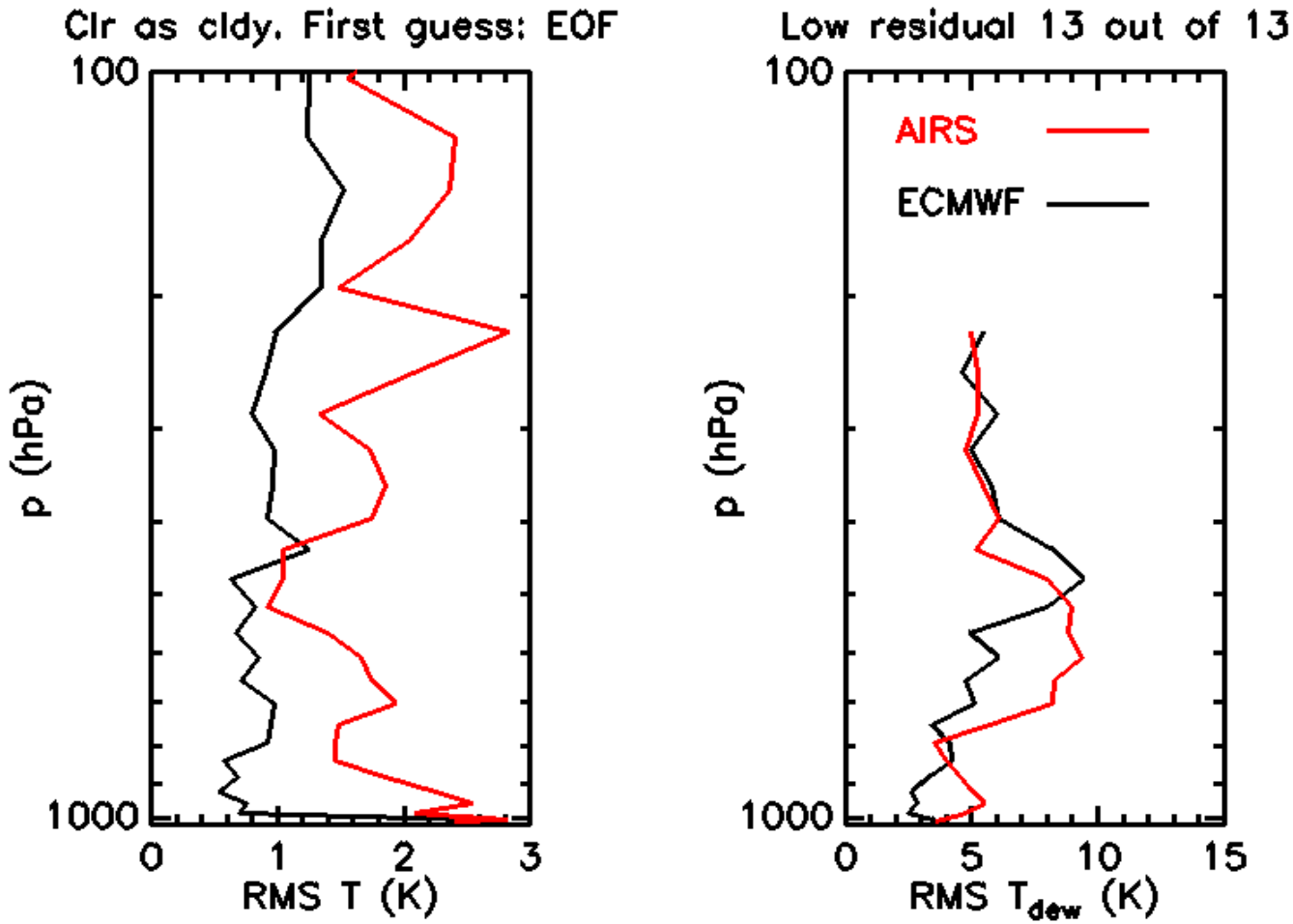
Statistics of **CLEAR** scenes retrieved as **CLEAR**. First guess: **ECMWF** (comparison with radiosondes)



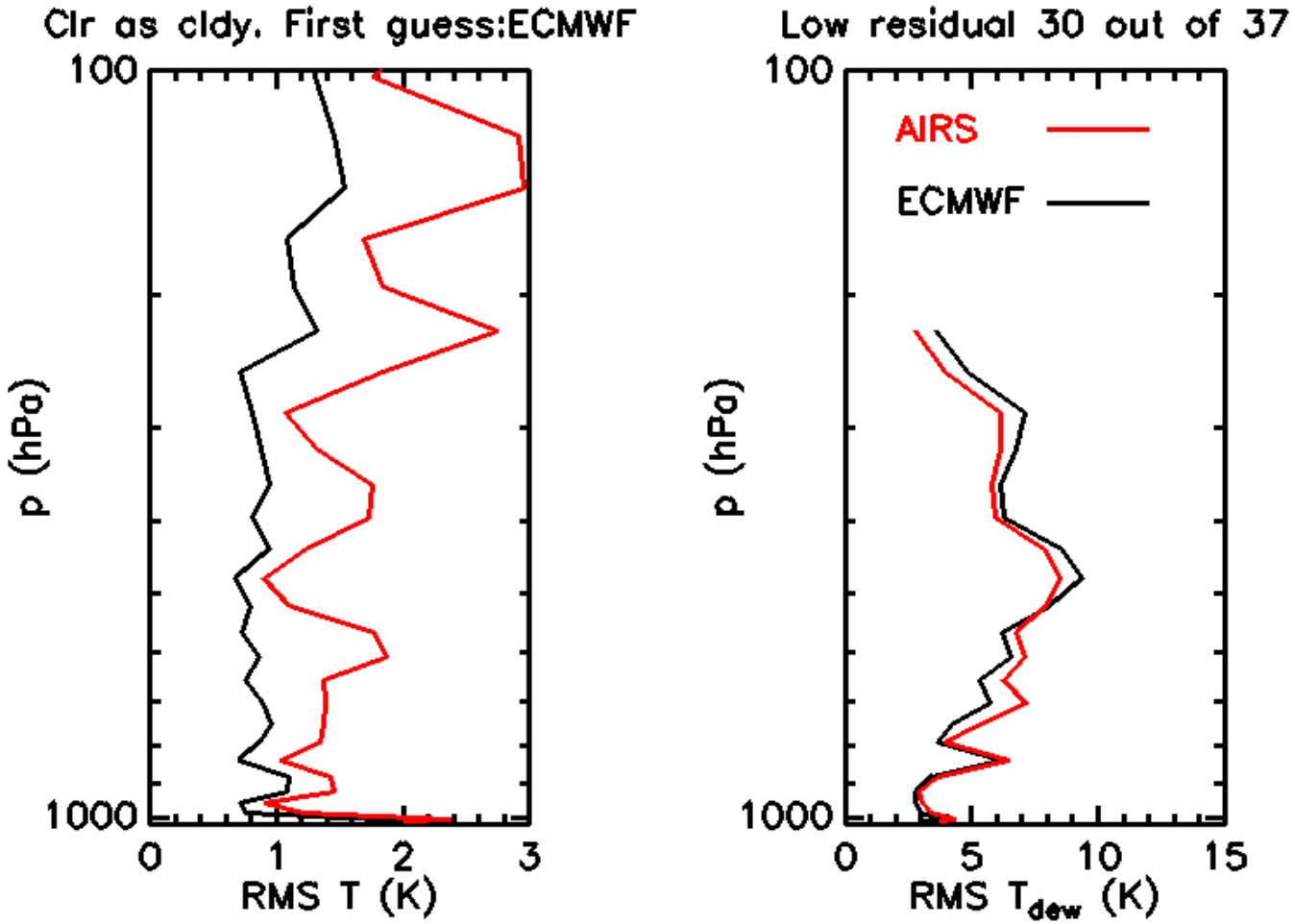
Statistics of **CLEAR** scenes retrieved as **CLEAR**. First guess: **Line** (comparison with radiosondes)



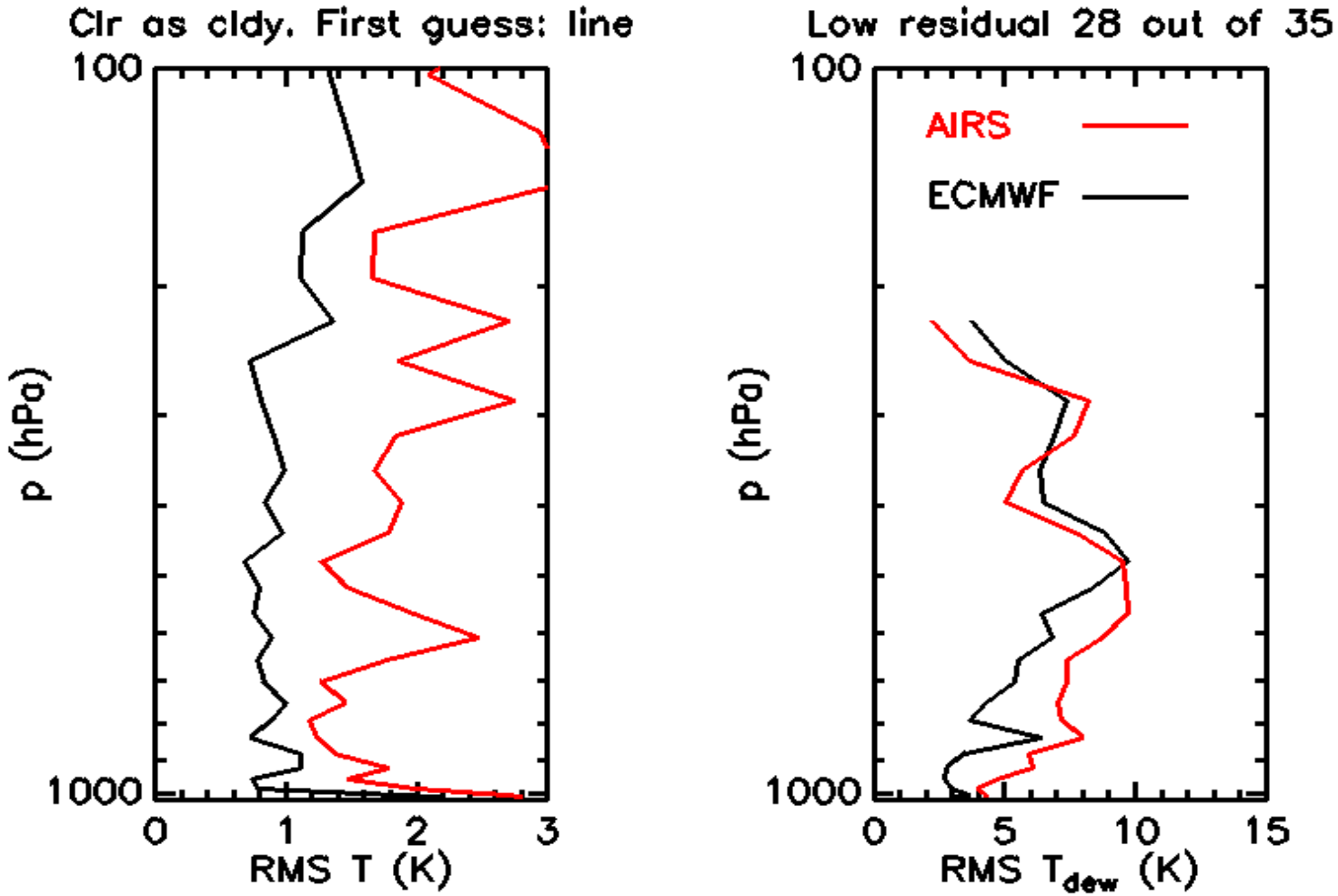
Statistics of **CLEAR** scenes retrieved as **CLOUDY**. First guess: **EOF** (comparison with radiosondes)



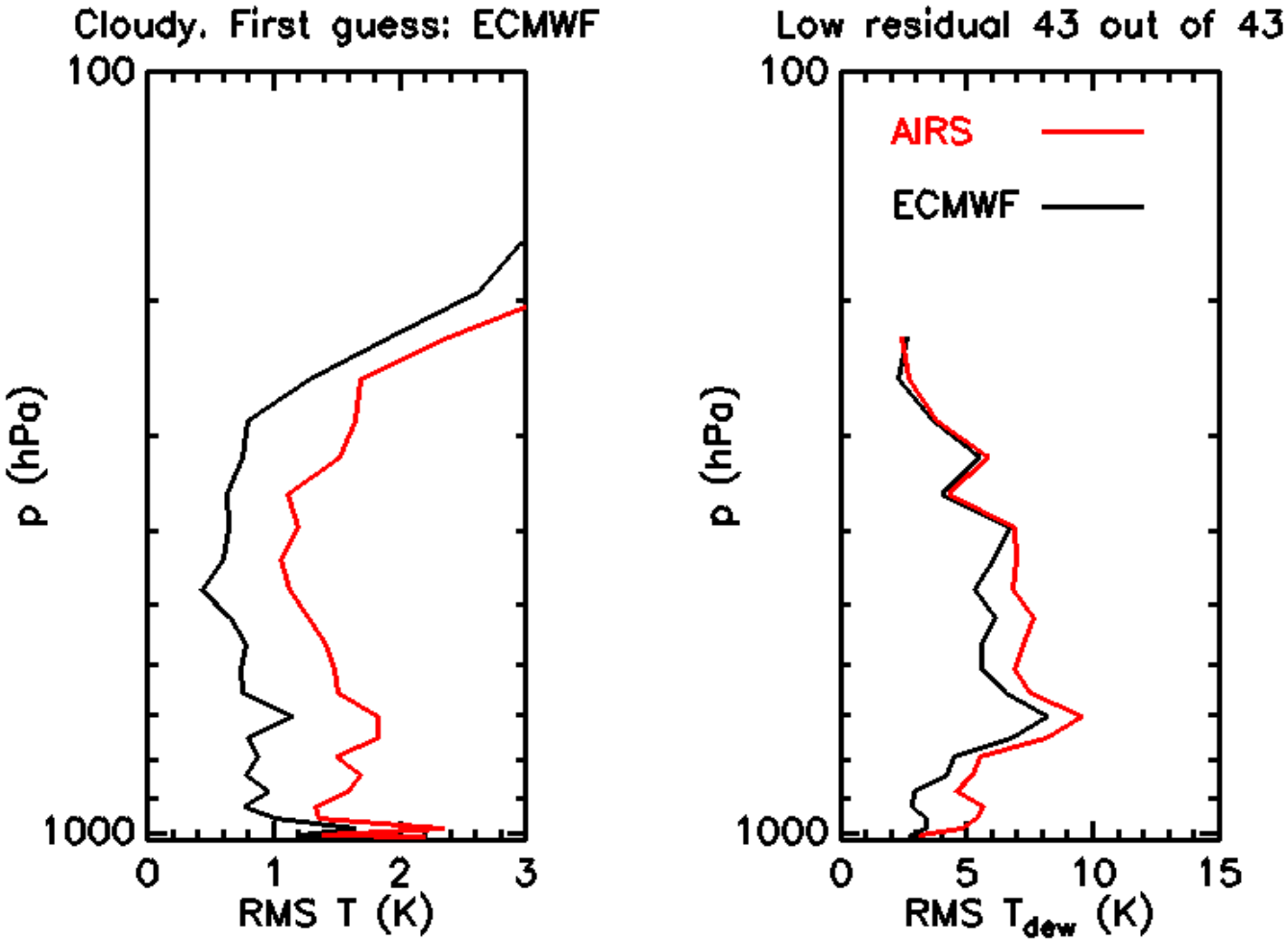
Statistics of **CLEAR** scenes retrieved as **CLOUDY**. First guess: **ECMWF** (comparison with radiosondes)



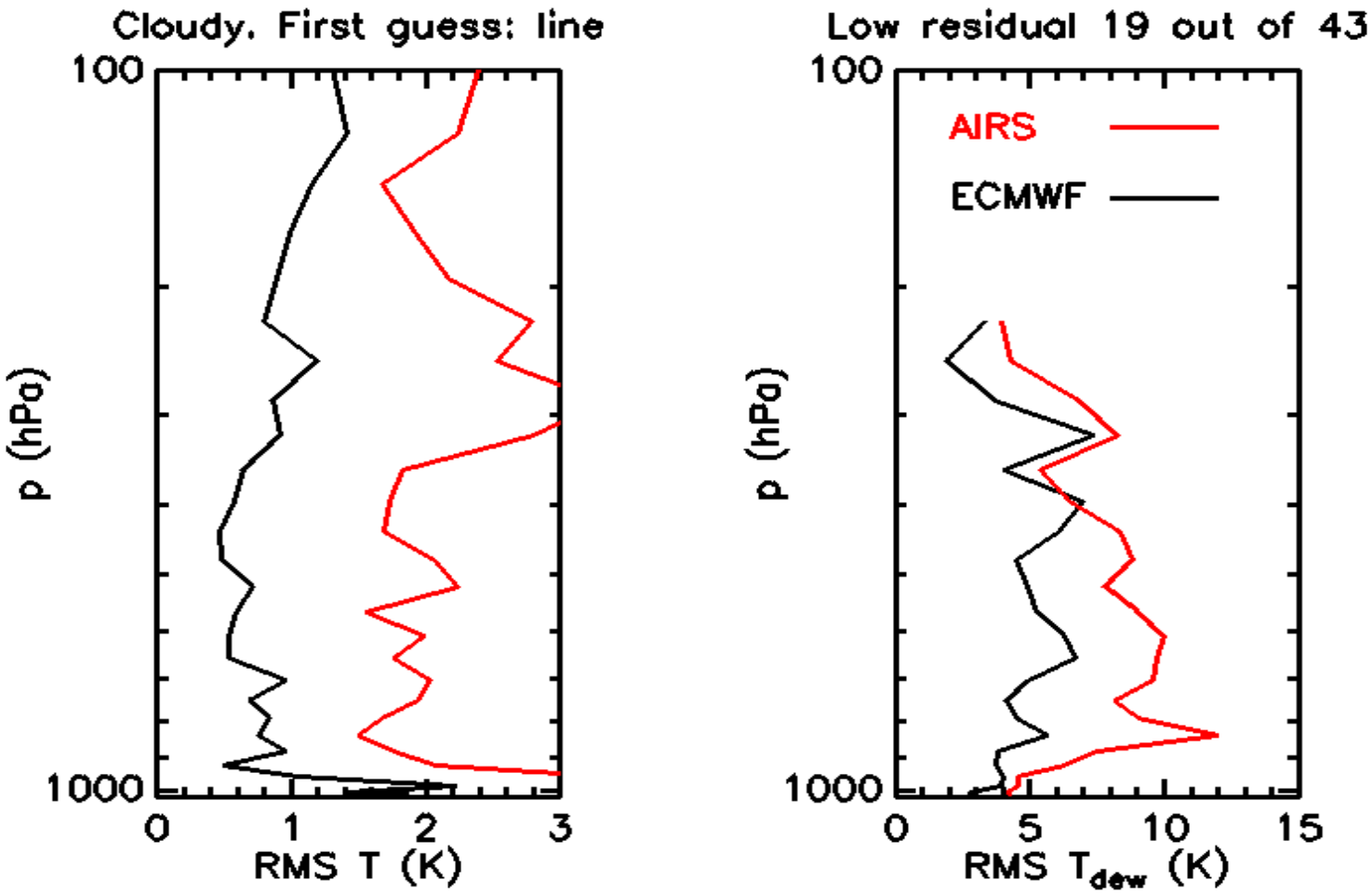
Statistics of **CLEAR** scenes retrieved as **CLOUDY**. First guess: **Line** (comparison with radiosondes)



Statistics of **CLOUDY** scenes retrieved as **CLOUDY**. First guess: **ECMWF** (comparison with radiosondes)



Statistics of **CLOUDY** scenes retrieved as **CLOUDY**. First guess: **Line** (comparison with radiosondes)



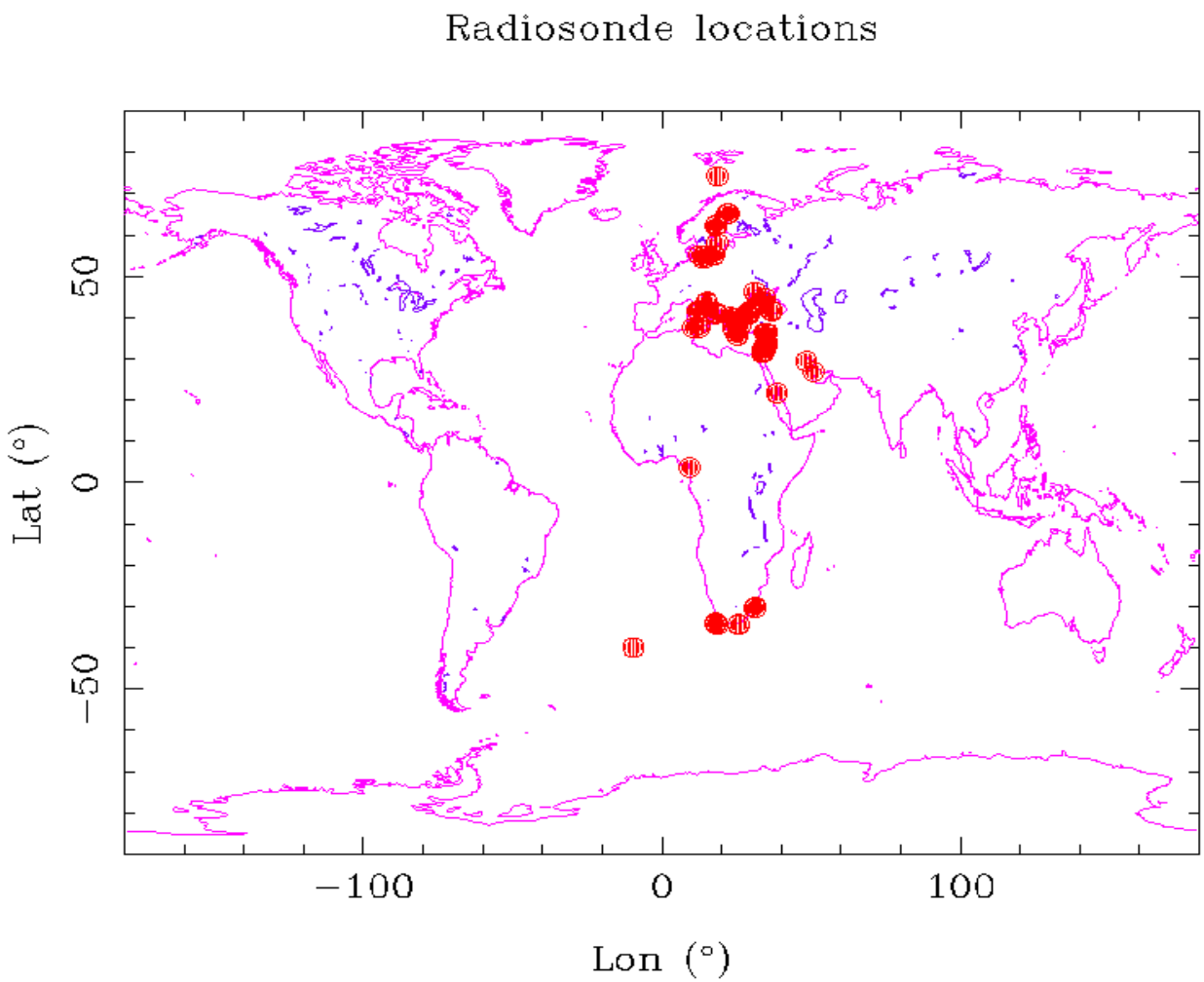
Variational (Physical) **CLEAR** and **CLOUDY** retrievals (1/2)

- Retrievals with physical constraints (NO background): forbid superadiabatic lapse rate and supersaturation.
- First guess: EOF, ECMWF and straight Line. They all work as long as the first guess is similar to the real profile especially at the near-surface levels.
- Iterations performed until convergence with AIRS measured spectra is reached (T step < 0.1 K)
- Comparison with radiosondes is shown in the statistics.

Variational (Physical) **CLEAR** and **CLOUDY** retrievals (2/2)

- Bias and error covariance corrections obtained from a subset of radiosonde and AIRS observations (because of the small sample)
- Optimal error covariance used: OBS – CALC standard deviation
- Two-step retrieval: first WV only with WV band and then WV, T and SST with all “good” channels
- Retrievals over sea around + 1 hour from midnight
- Visually obtained closest AIRS measurement to the radiosonde. Located at most two to three AIRS FOVs from conventional radiosondes

RADIOSONDE LOCATIONS



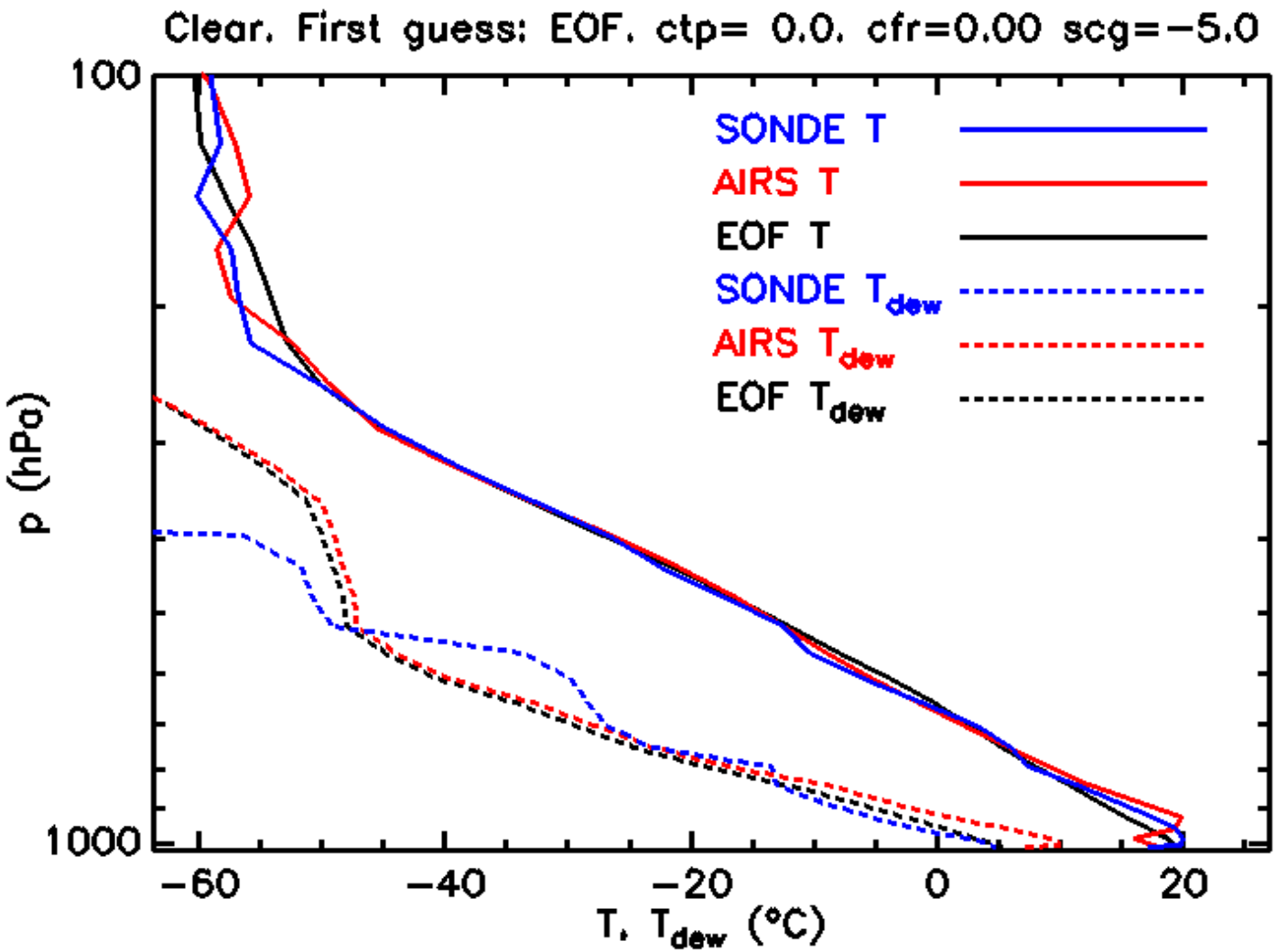
Variational (Physical) **CLEAR** retrievals

- Clear condition estimated visually using co-located MSG infra-red image

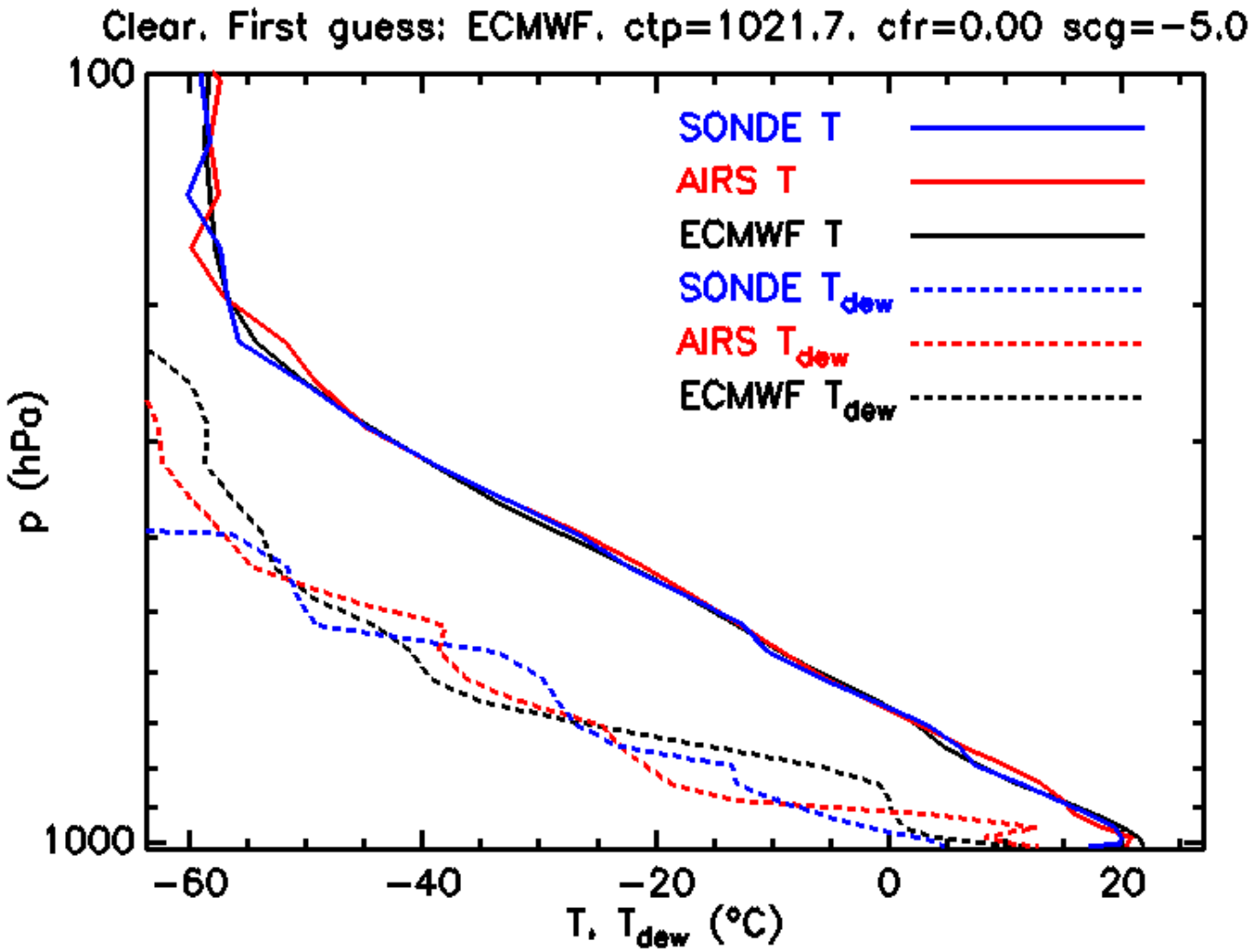
Variational (Physical) **CLOUDY** retrievals

- RTTOV 8.5 used for cloudy radiances modelling: grey clouds with cloud top pressure and cloud fraction only.

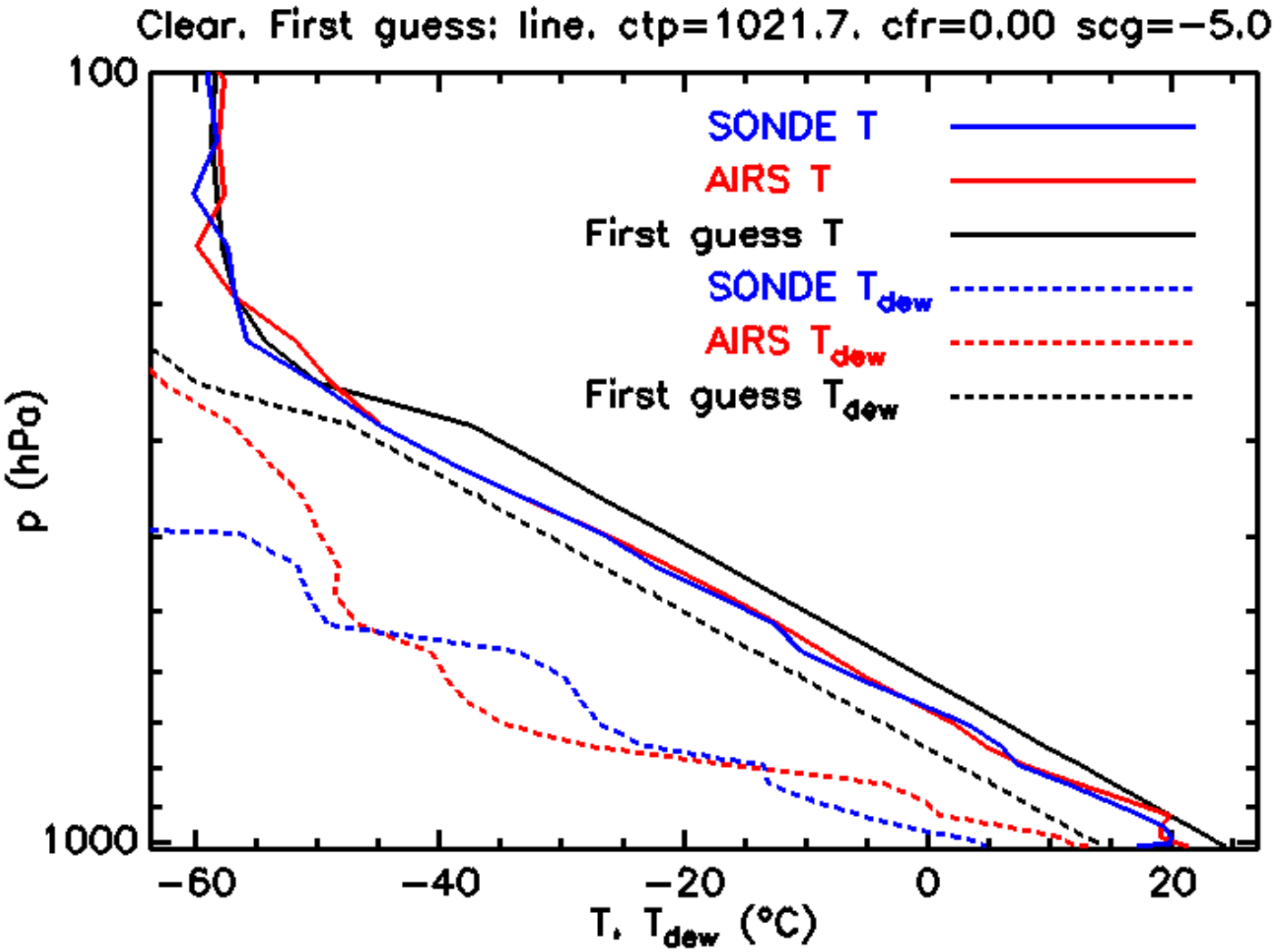
Example of **CLEAR** scene retrieved as **CLEAR**. First guess: **EOF**



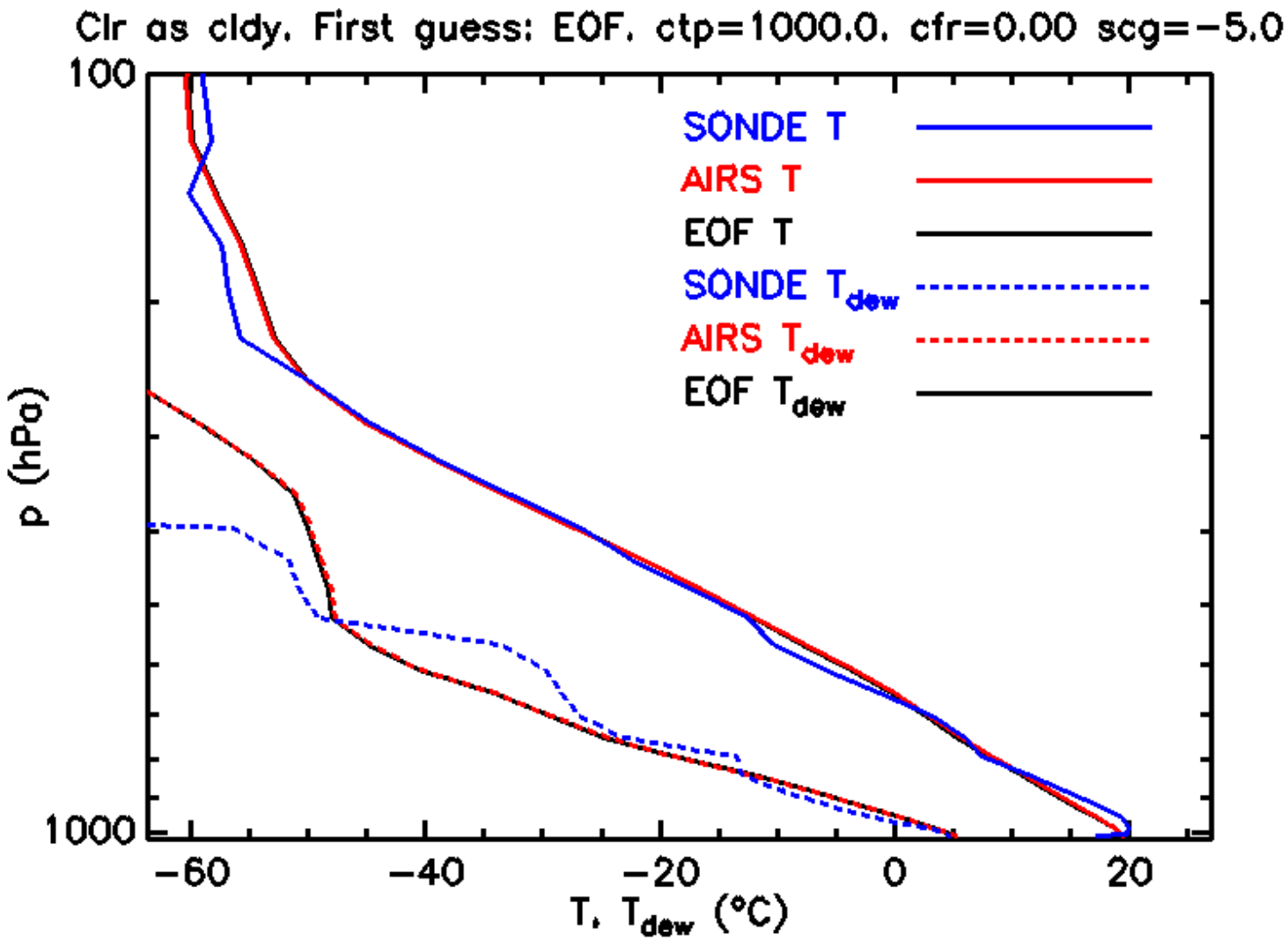
Example of **CLEAR** scene retrieved as **CLEAR**. First guess: **ECMWF**



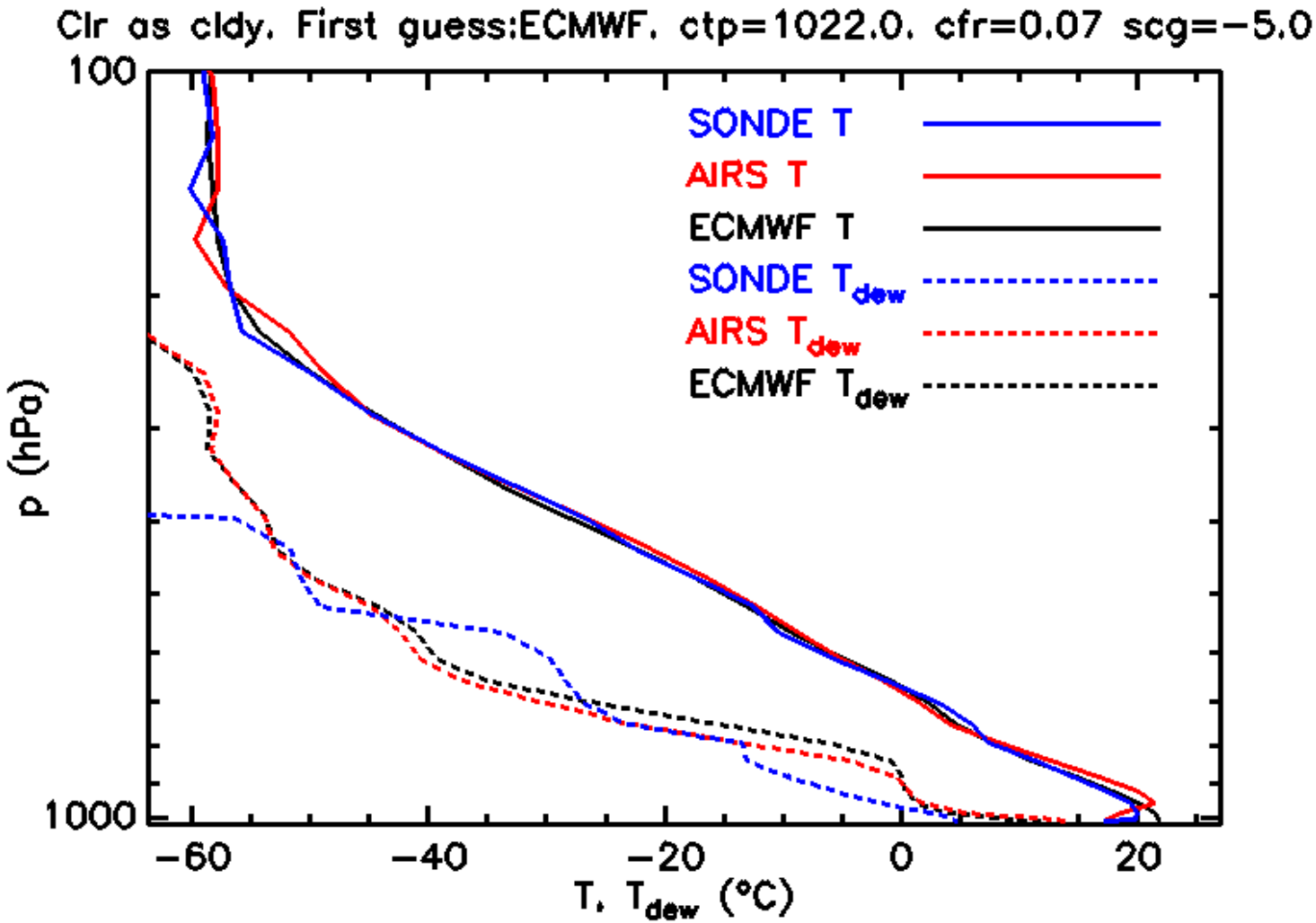
Example of **CLEAR** scene retrieved as **CLEAR**. First guess: **Line**



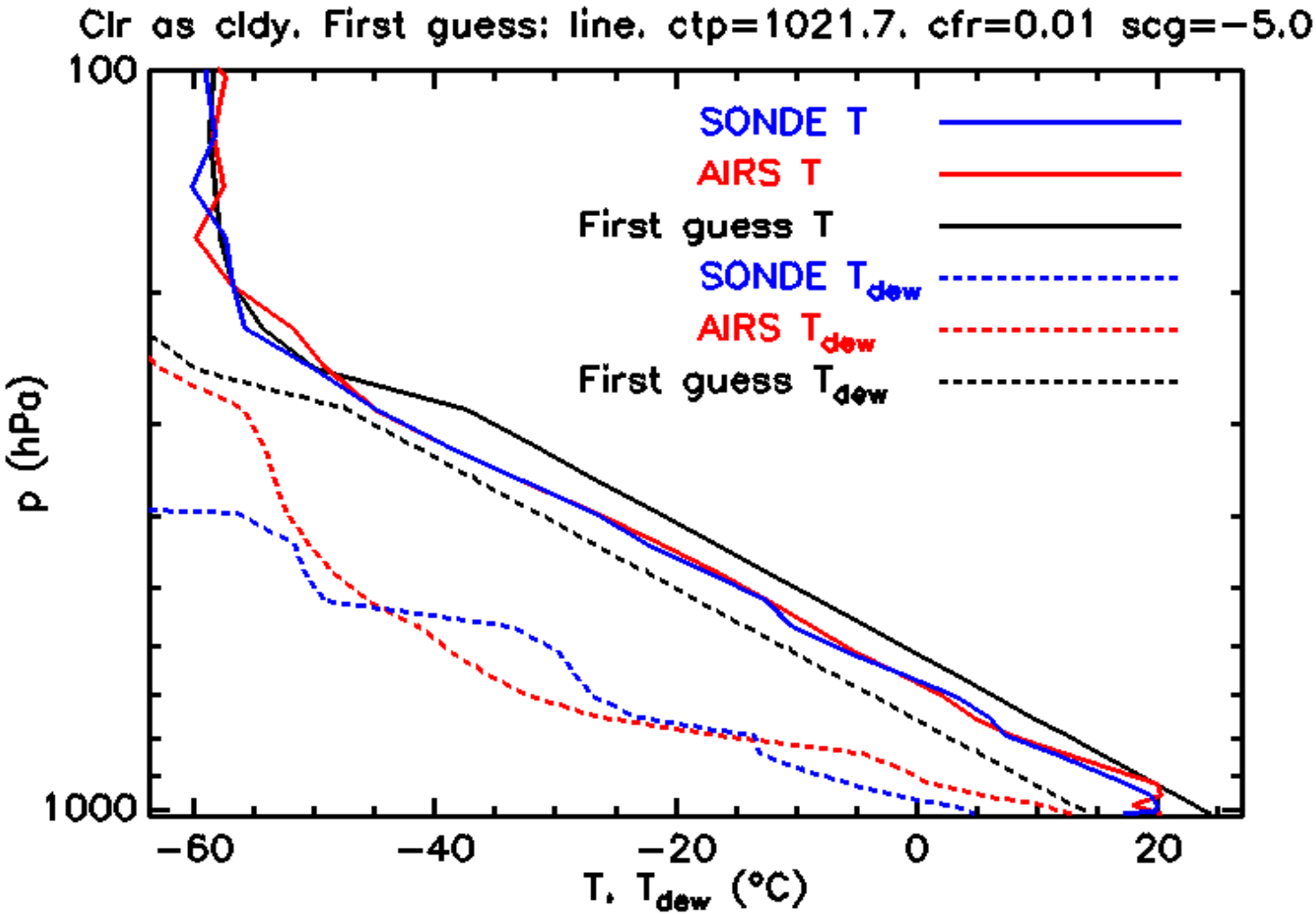
Example of **CLEAR** scene retrieved as **CLOUDY**. First guess: **EOF**



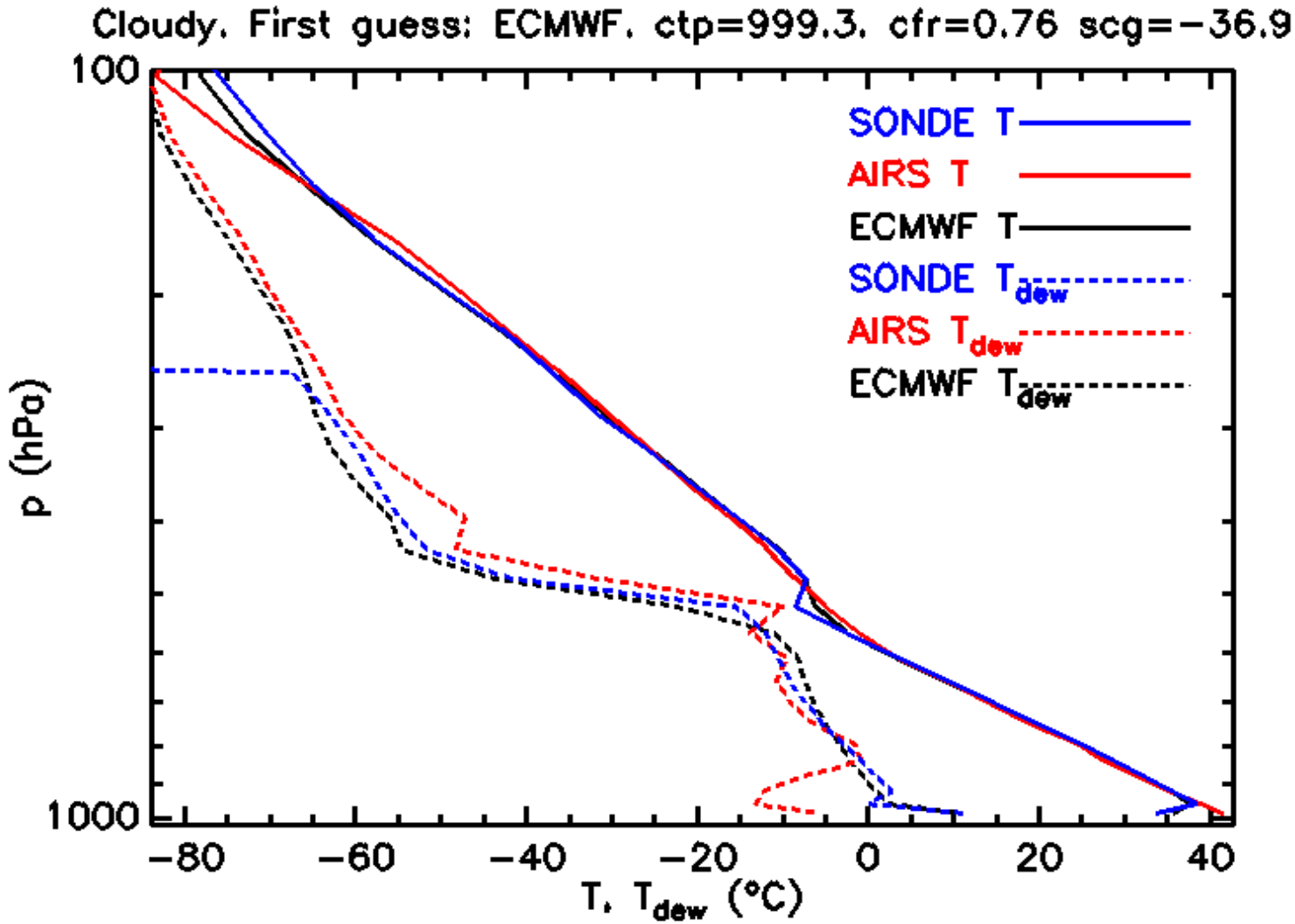
Example of **CLEAR** scene retrieved as **CLOUDY**. First guess: **ECMWF**



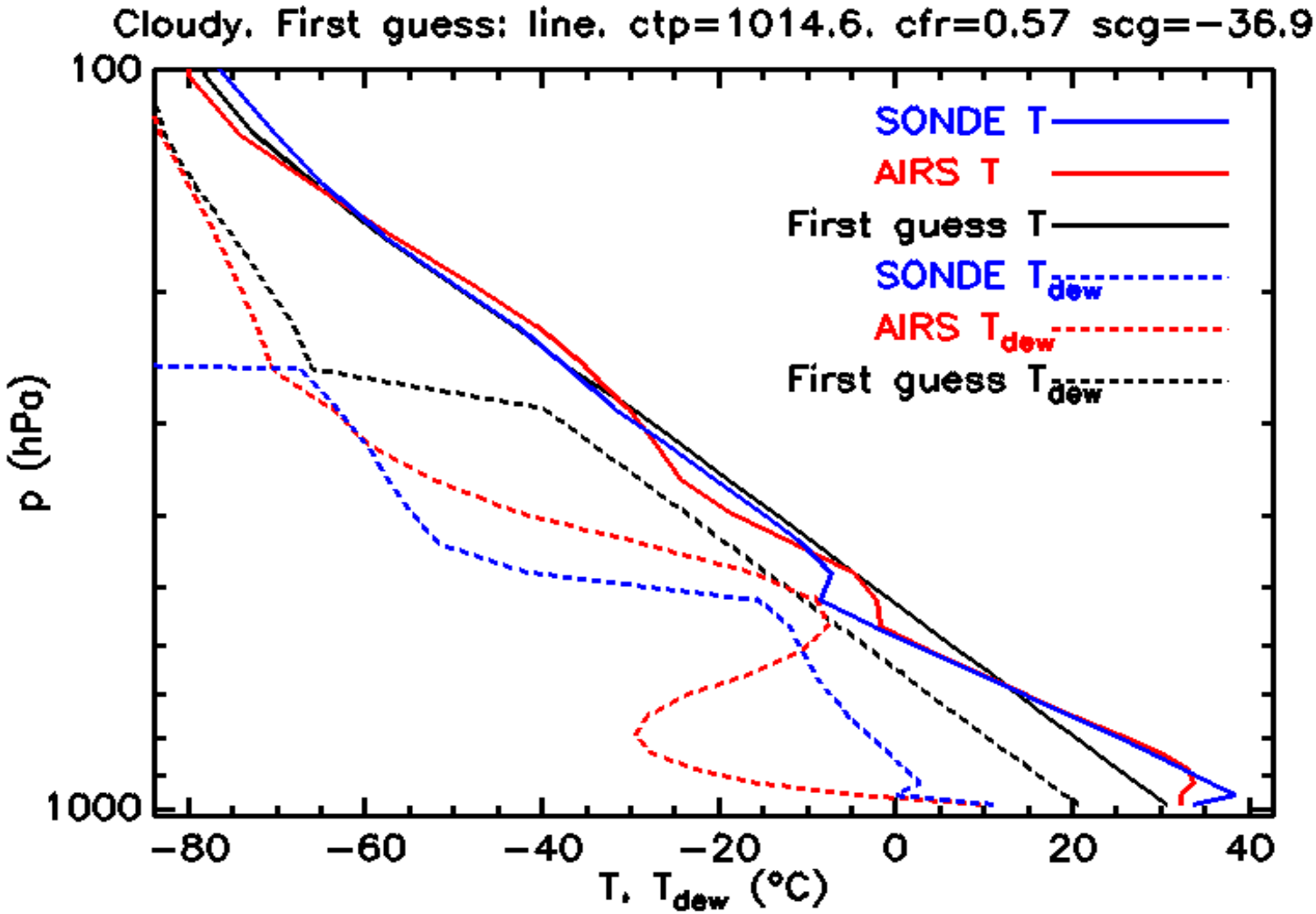
Example of **CLEAR** scene retrieved as **CLOUDY**. First guess: **Line**



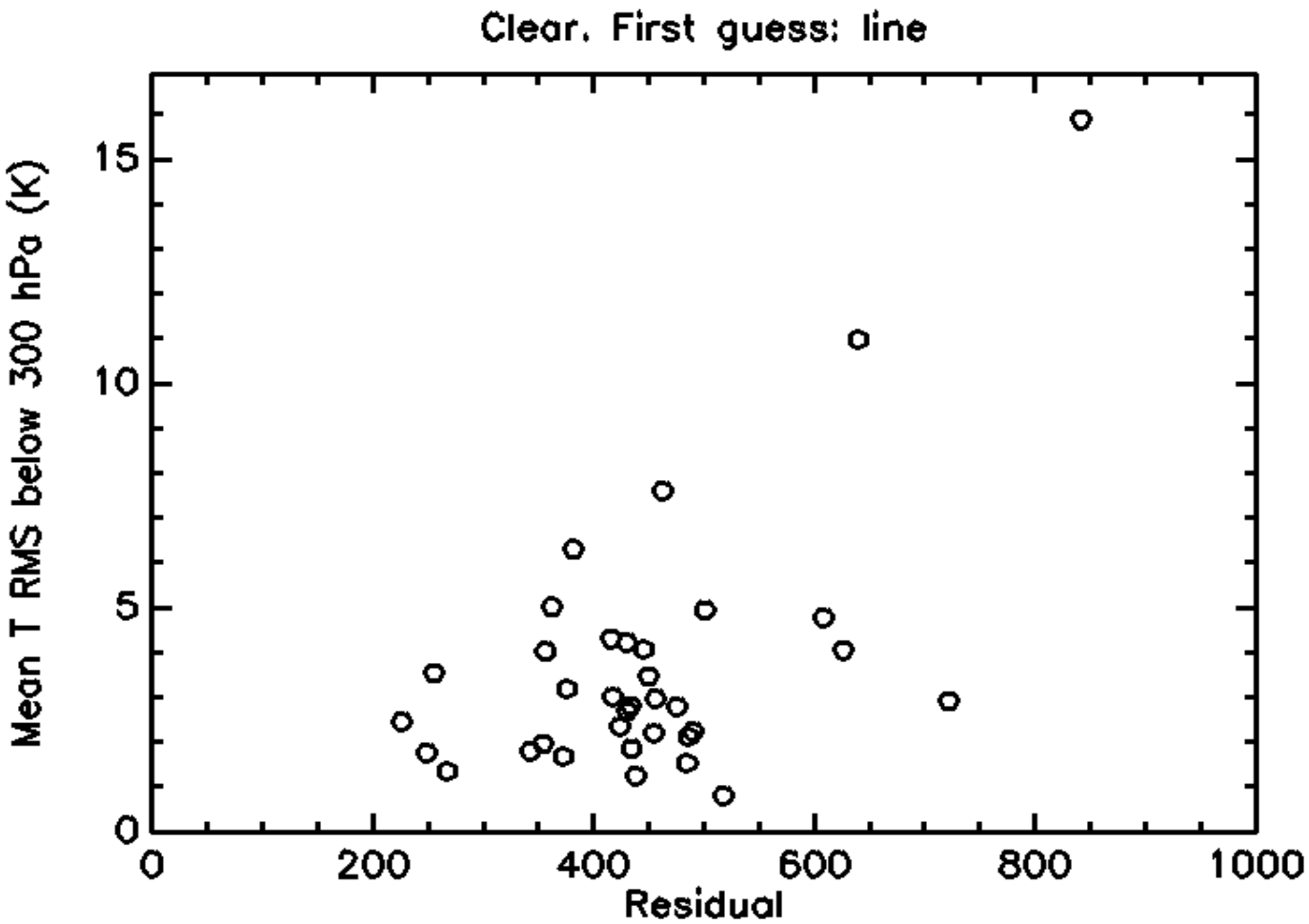
Example of **CLOUDY** scene retrieved as **CLOUDY**. First guess: **ECMWF**



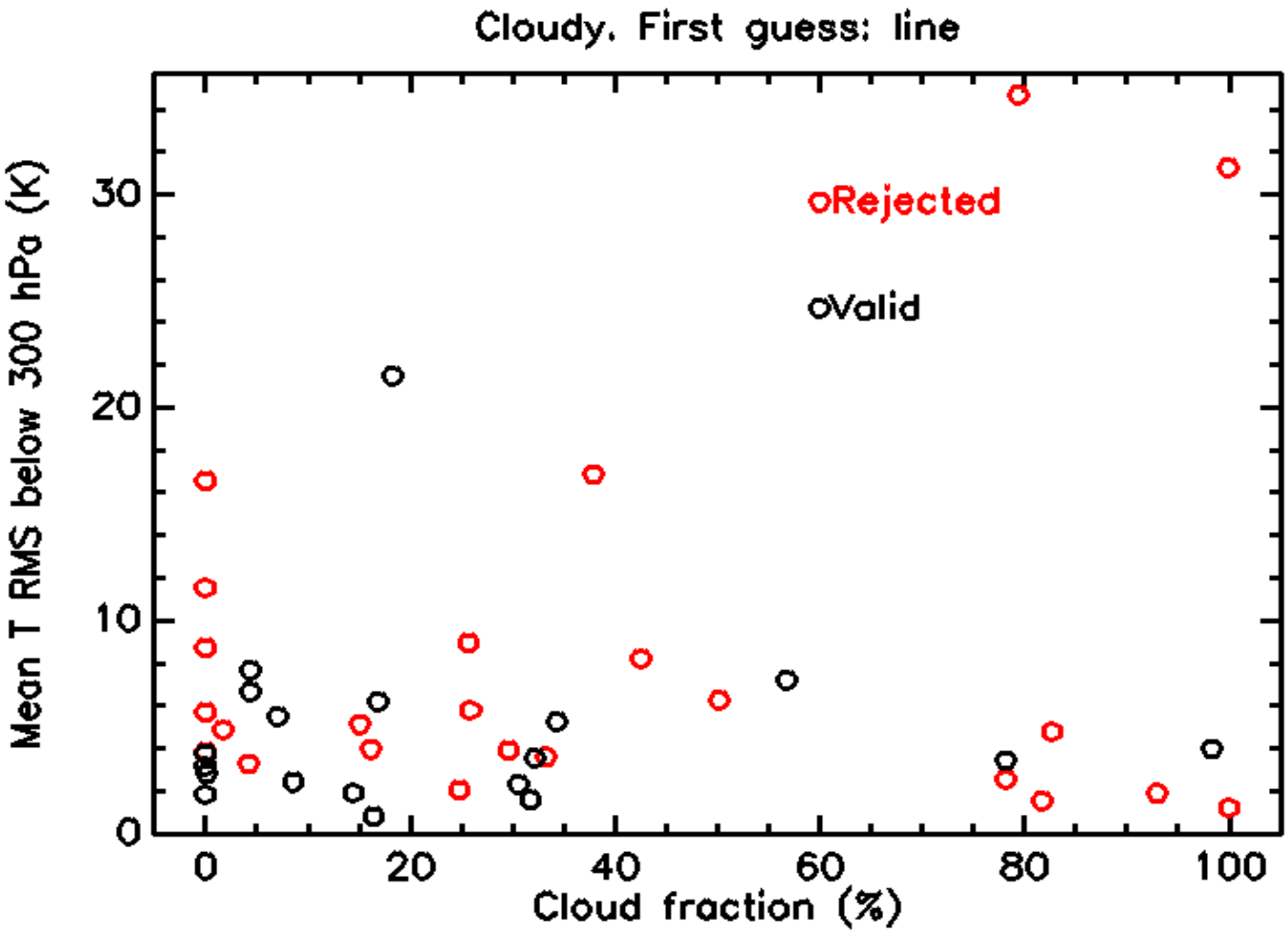
Example of **CLOUDY** scene retrieved as **CLOUDY**. First guess: **Line**



Selection of **RESIDUAL THRESHHOLD**



RMS as a function of **CLOUD FRACTION**



CONCLUSIONS

- Physically constrained retrievals provides good profiles for clear and cloudy cases
- Retrieval statistics, in general, does not depend much on first guess, but individual retrieved profiles do.
- Cloudy retrievals of T and WV profiles work with simple cloud model (grey body) as long as the initial guess is close to reality especially at lower levels and cloud fraction <0.7
- Cloud top pressure still not very accurate because it is "compensated" by cloud fraction. Use of AVHRR cloud information for IASI