Hans-Ertel-Centre for Weather Research
DATA ASSIMILATION BRANCH

Hans-Ertel-Zentrum für Wetterforschung
Deutscher Wetterdienst

HEIGHT CORRECTION FOR THE ASSIMILATION OF ATMOSPHERIC MOTION VECTORS BASED ON SATELLITE LIDAR OBSERVATIONS FROM CALIPSO

Martin Weissmann[1], Kathrin Folger[1], Harald Anlauf[2] and Alexander Cress[2]

1) Hans-Ertel Centre for Weather Research, Data Assimilation Branch, LMU München, Germany
2) Deutscher Wetterdienst, Offenbach, Germany

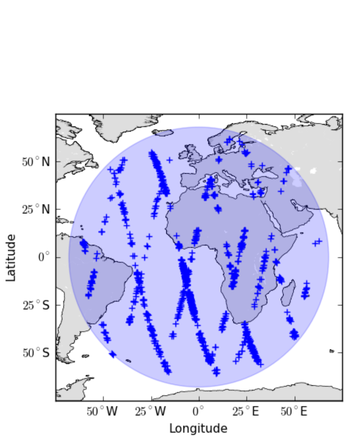
BACKGROUND

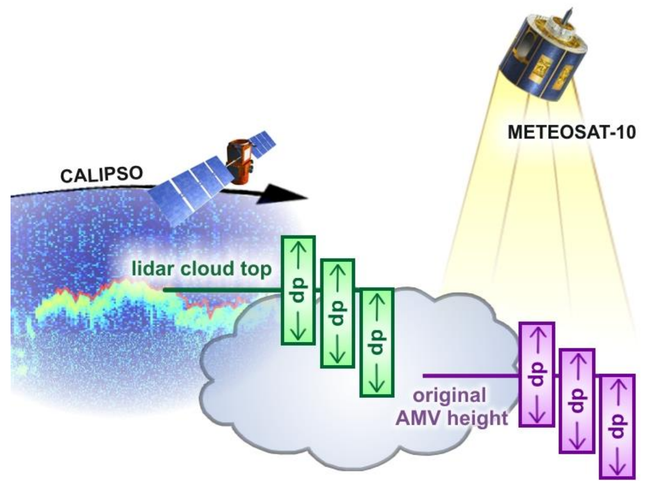
- Atmospheric Motion Vectors (AMVs) are derived by tracking clouds or water vapor structures in consecutive satellite images
- AMVs are the only wind information in many regions of the globe and are thus an essential ingredient for NWP
- Vertical height assignment issues are responsible for up to 70% of the total AMV error
- Lidars can provide accurate information on cloud top heights

APPROACH

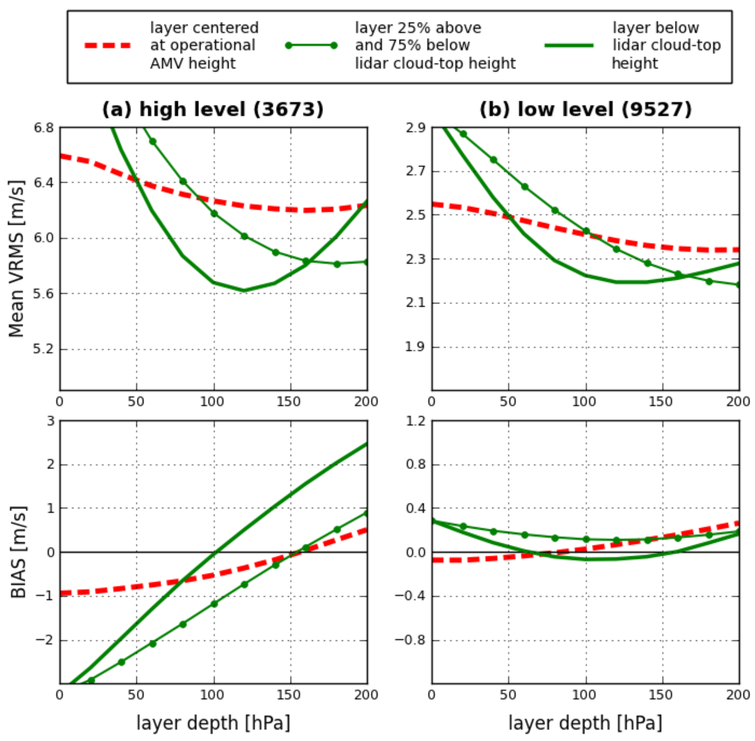
- Correct the pressure heights of Meteosat-AMVs with collocated space-borne CALIPSO lidar observations (height reassignment)
- Derive height bias correction functions based on mean differences between AMV heights and lidar cloud tops (height bias correction)
- Treat AMVs winds as winds in vertical layers
- Evaluate benefit of applying height bias correction and layer-treatment in ICON experiments

METHOD AND DATA



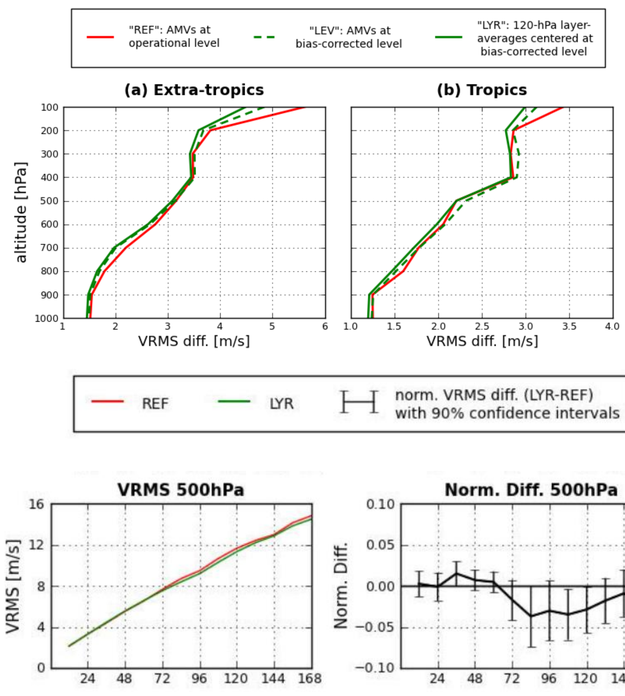


HEIGHT REASSIGNMENT



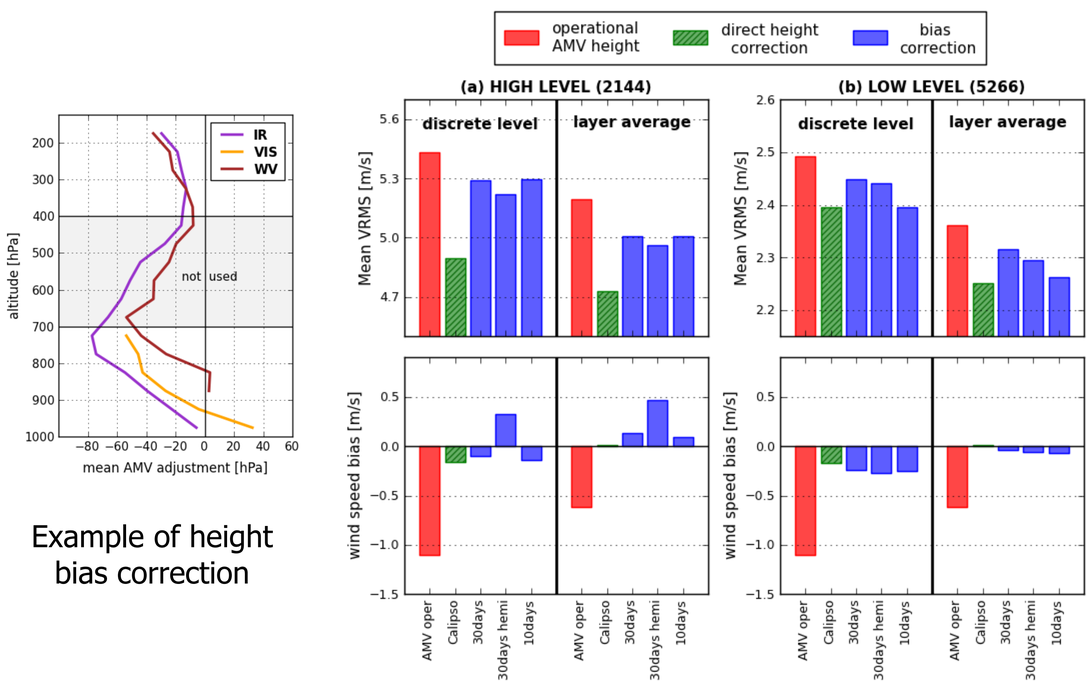
- Differences of AMV winds and layer-averaged operational 3h GME forecasts
- Lowest differences for ~120 hPa layers beneath CALIPSO cloud tops
- The CALIPSO-based height reassignment reduces wind differences by about 10-15%
- Layer-treatment reduces current slow-bias of AMVs

ICON EXPERIMENTS (preliminary)



- Reduced differences of AMV winds and 3h ICON forecasts
- Reduction of forecast error through height bias correction, but results only based on 1-week experiment

HEIGHT BIAS CORRECTION

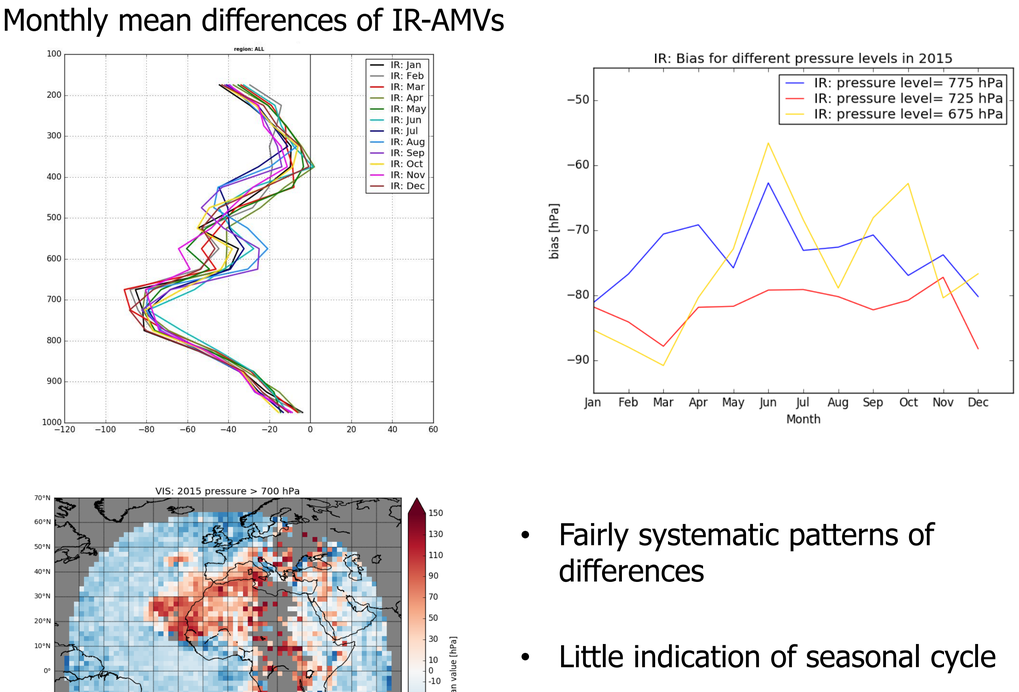


Example of height bias correction

- The height bias correction reaches about half of the reduction of wind differences of the height reassignment
- The height bias correction can be applied to all AMVs, it's simple to implement in NWP systems (no need for real-time CALIPSO data) and therefore it poses a promising approach for operational NWP

LONG-TERM EVALUATION (preliminary)

Monthly mean differences of IR-AMVs



- Fairly systematic patterns of differences
- Little indication of seasonal cycle
- Some indication of systematic geographic differences (less clear for other channels/heights)

OUTLOOK

- Evaluation of differences longer period (2015)
- Comparison to ECMWF level-of-best-fit statistics
- Longer assimilation experiments

REFERENCES

- Folger, K. and M. Weissmann, 2016: Lidar-based height correction for the assimilation of atmospheric motion vectors. J. Appl. Meteor. Climatol., accepted.
- Folger, K. and M. Weissmann, 2014: Height correction of atmospheric motion vectors using satellite lidar observations from CALIPSO. J. Appl. Meteor. Climatol., 53, 1809–1819.