University of Genova - Italy
Dept. of Civil, Chemical and Environmental Engineering

WMO/CIMO Lead Centre "B. Castelli"
on Precipitation Intensity
www.precipitation-intensity.it

On the accuracy of precipitation measurements in the Arctic

Luca G. Lanza – PhD, Professor of Hydrology and Water Resources Management
Scientific Resp., WMO Lead Centre on Precipitation Intensity
Matteo Colli – PhD, Research Fellow

ARCTIC CIRCLE 2015 REYKJAVÍK • ICELAND OCTOBER 16 - 18

Breakout Session on:
Metrology for Environment in the Arctic. Traceability and Data Quality for Measurements in Extreme Environments
Reykjavik, 18 October 2015

METEOMET Metrology for Meteorology
REG 3

The EMRP is jointly funded by the EMRP participating countries within EURAMET and the European Union

Types of gauge (solid/liquid precipitation)

Catching type gauges

Geonor 600 mm – vibrating wires gauge

Non-catching type gauges

Vaisala PWD22 – optical disdrometer

Types of gauge (solid/liquid precipitation)

Catching type gauges

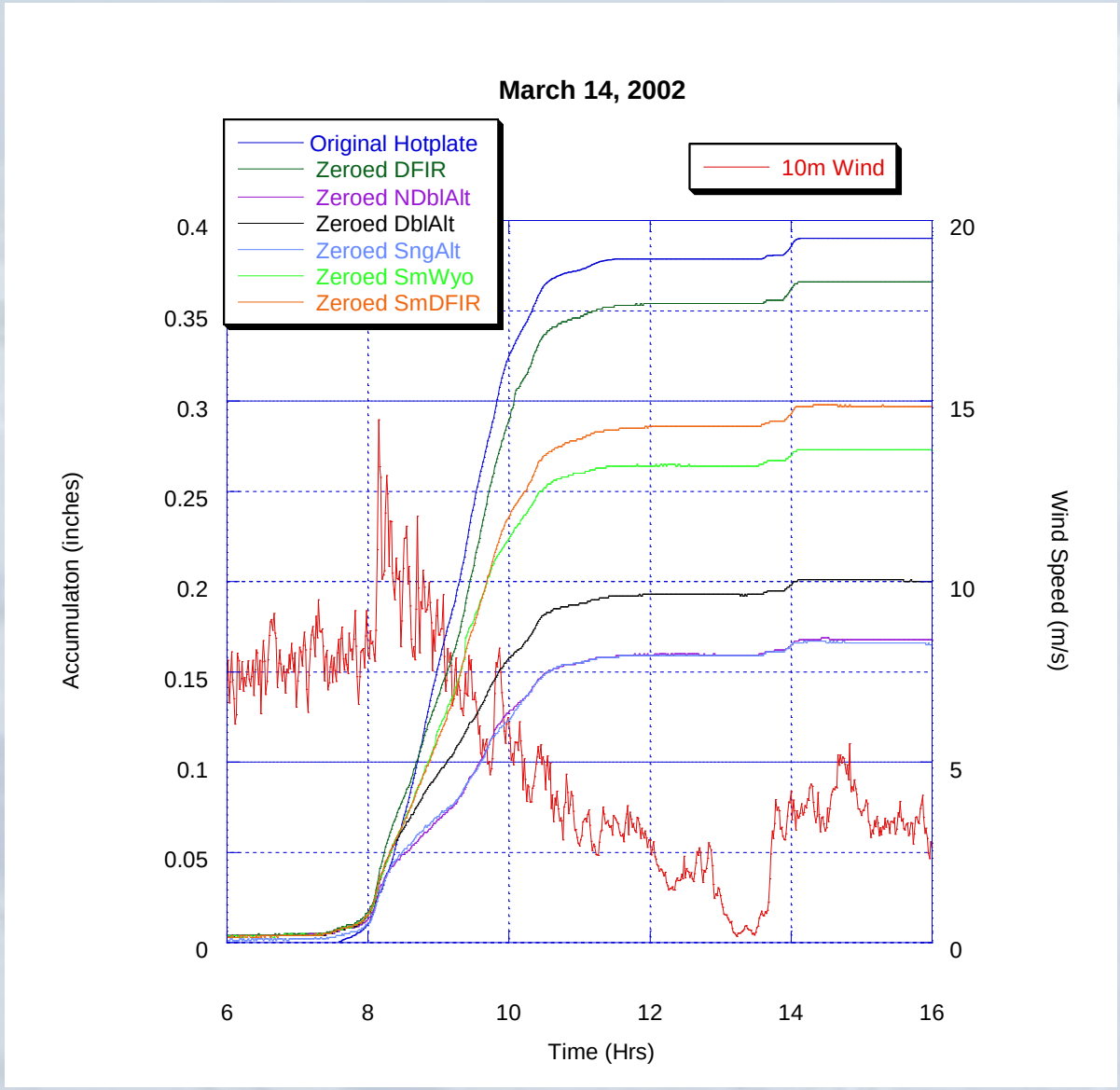
- ✓ Calibration procedures available in laboratory and field conditions
- ✓ Methods described in national standards:
  UNI 11452:2012
  BSI 7843-3:2011
- ✓ **European standard under development:**
  CEN/TR 16469:2012
- ✓ International recommendations available:
  WMO Guide n. 8 to Meteorological instruments and methods of observation
- ✓ Correction algorithms available for some types
- ✓ **Traceability and uncertainty budget under investigation within MeteoMet 2 – REG3**
- ✓ Widely investigated in laboratory and field conditions during the WMO/CIMO Intercomparison of Rainfall Intensity Gauges in 2005 and 2009 and in SPICE (since 2012).

Non-catching type gauges

- ✓ No agreed calibration procedure
- ✓ **No national /international standards**
- ✓ Correction algorithms only provided by manufacturers
- ✓ **Traceability and uncertainty budget under investigation within MeteoMet 2 – REG3**
- ✓ Investigated in field conditions during the WMO/CIMO Intercomparison of Rainfall Intensity Gauges in 2005 and 2009 and in SPICE (since 2012).

-> **Performance not yet fully proven**

Further uncertainty in field measurements: the wind-induced undercatch



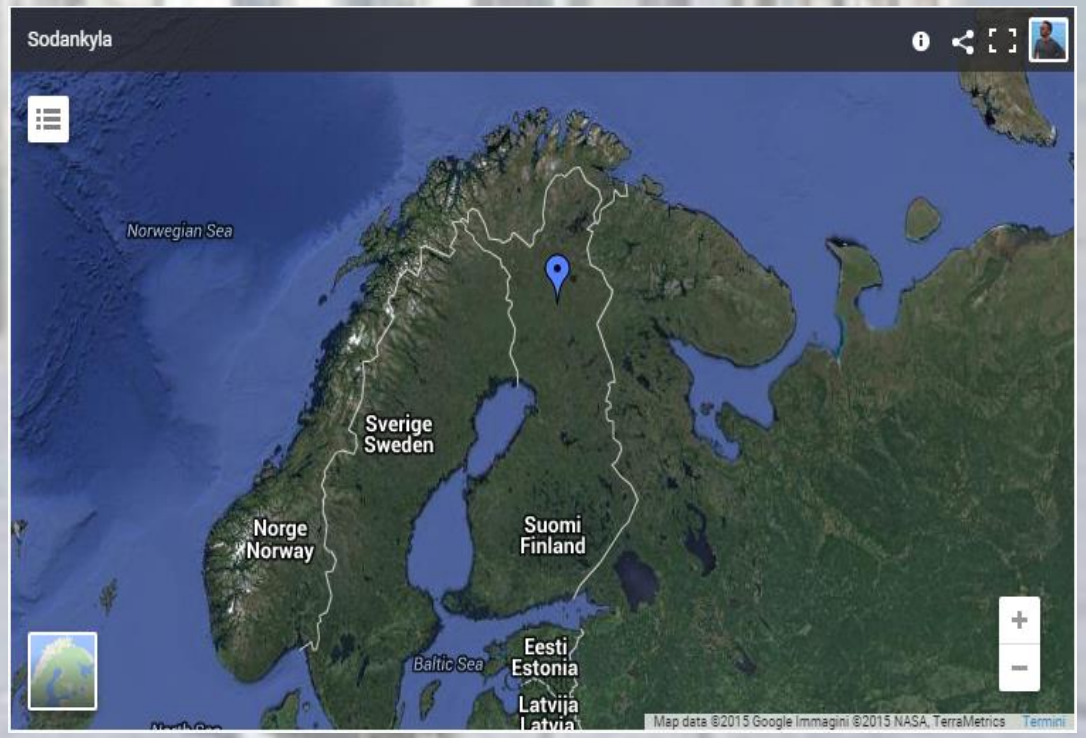
Comparison of different co-located automatic snow gauges at the NOAA/FAA/NCAR Marhsall field site

Wind-induced undercatch: case study

Sodankylä (Finland) case study

Latitude: 67.36663 **Longitude**: 26.62901 **Altitude**: 179 meters

Overview of the Sodankylä field site (ral.ucar.edu)

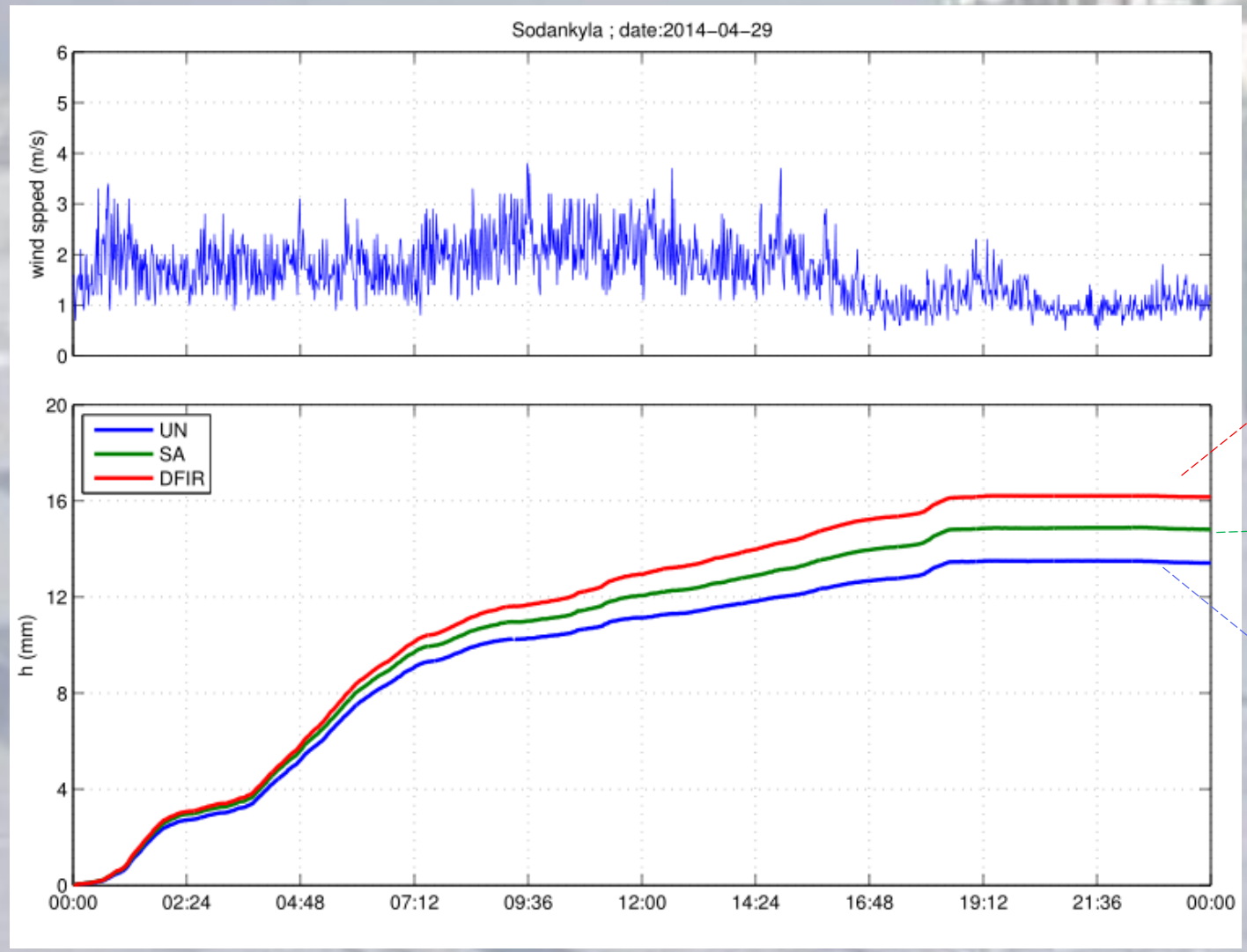


SPICE: WMO SOLID PRECIPITATION INTERCOMPARISON EXPERIMENT (2012-ongoing)

http://www.wmo.int/pages/prog/www/IMOP/intercomparisons/SPICE/SPICE-News.html

Wind-induced undercatch: types of windshield

Sodankylä (Finland) case study



DFIR

SINGLE ALTER

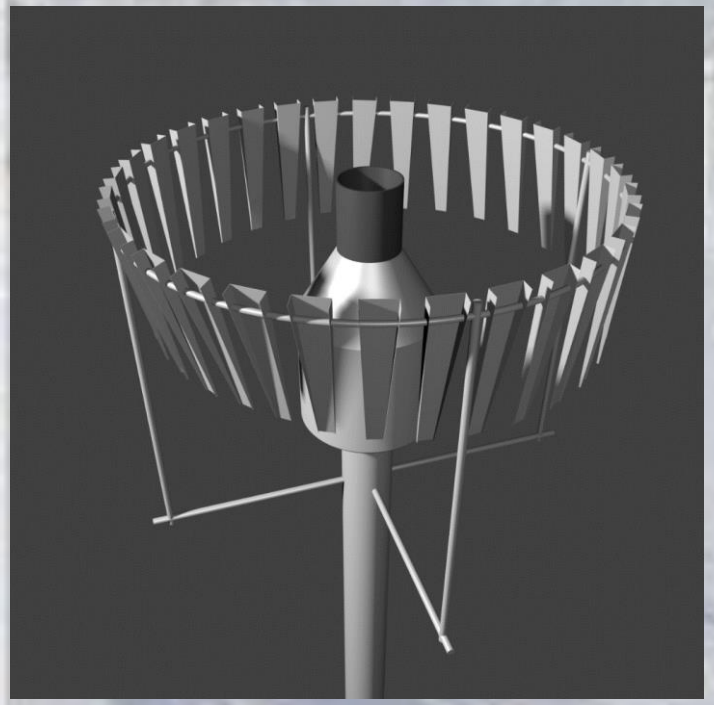
UNSHIELDED

COLLECTION EFFICIENCY

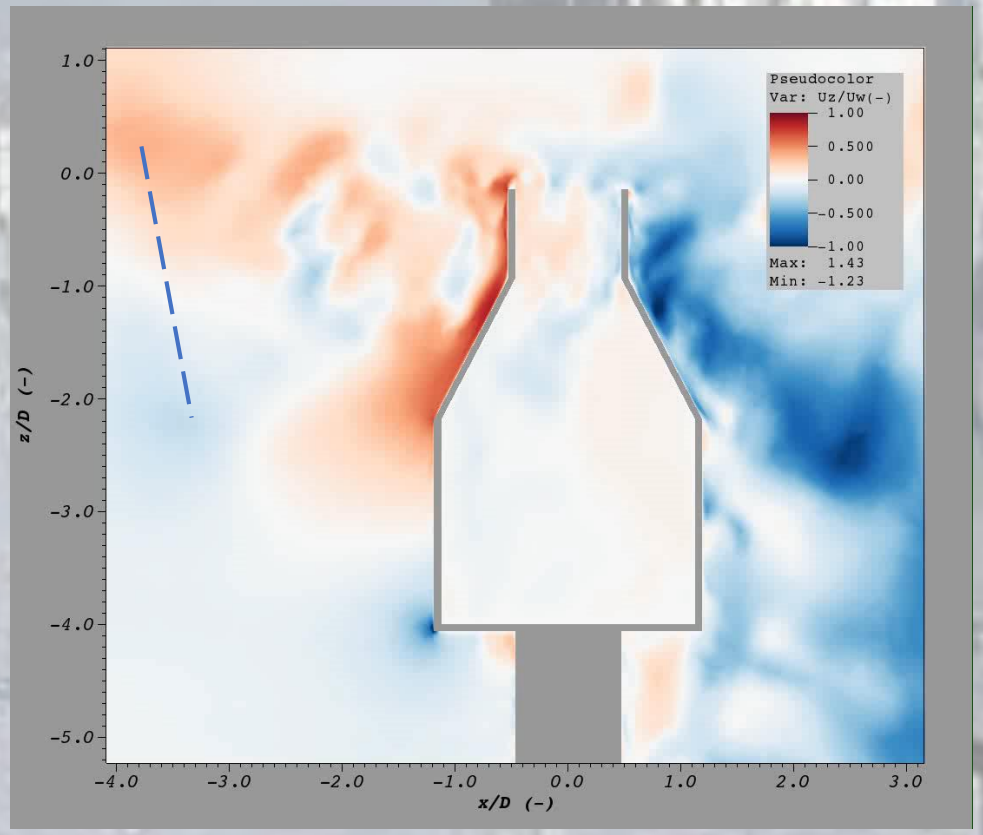
Courtesy of Timo Laine and Osmo Aulamo (Finnish Meteorological Institute)

Wind-induced undercatch: numerical simulation

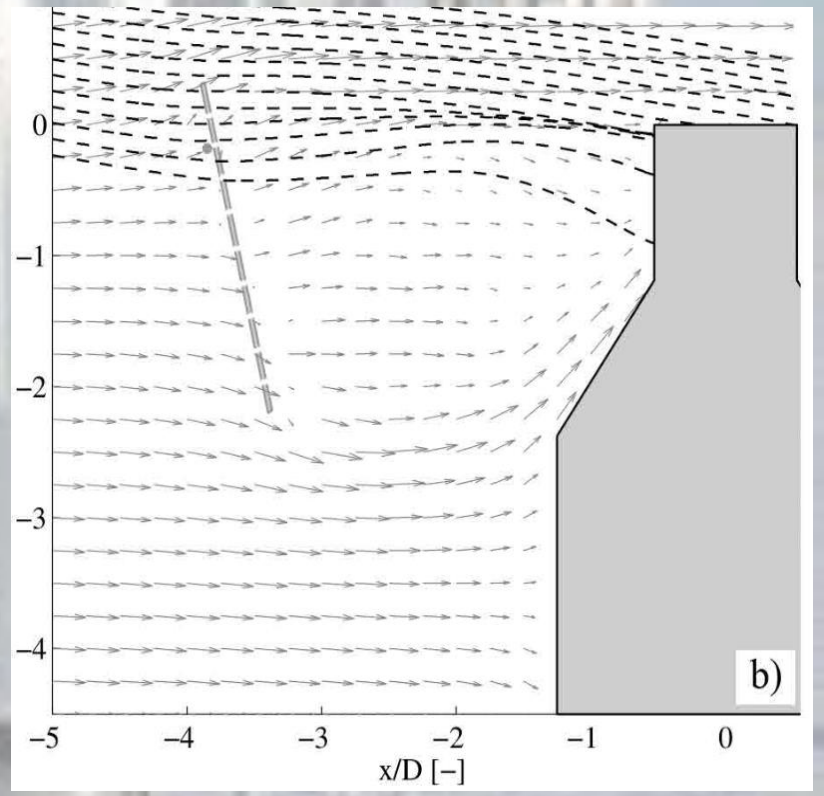
COMPUTATIONAL FLUID DYNAMICS STUDY



3D model of the gauge/windshield assembly



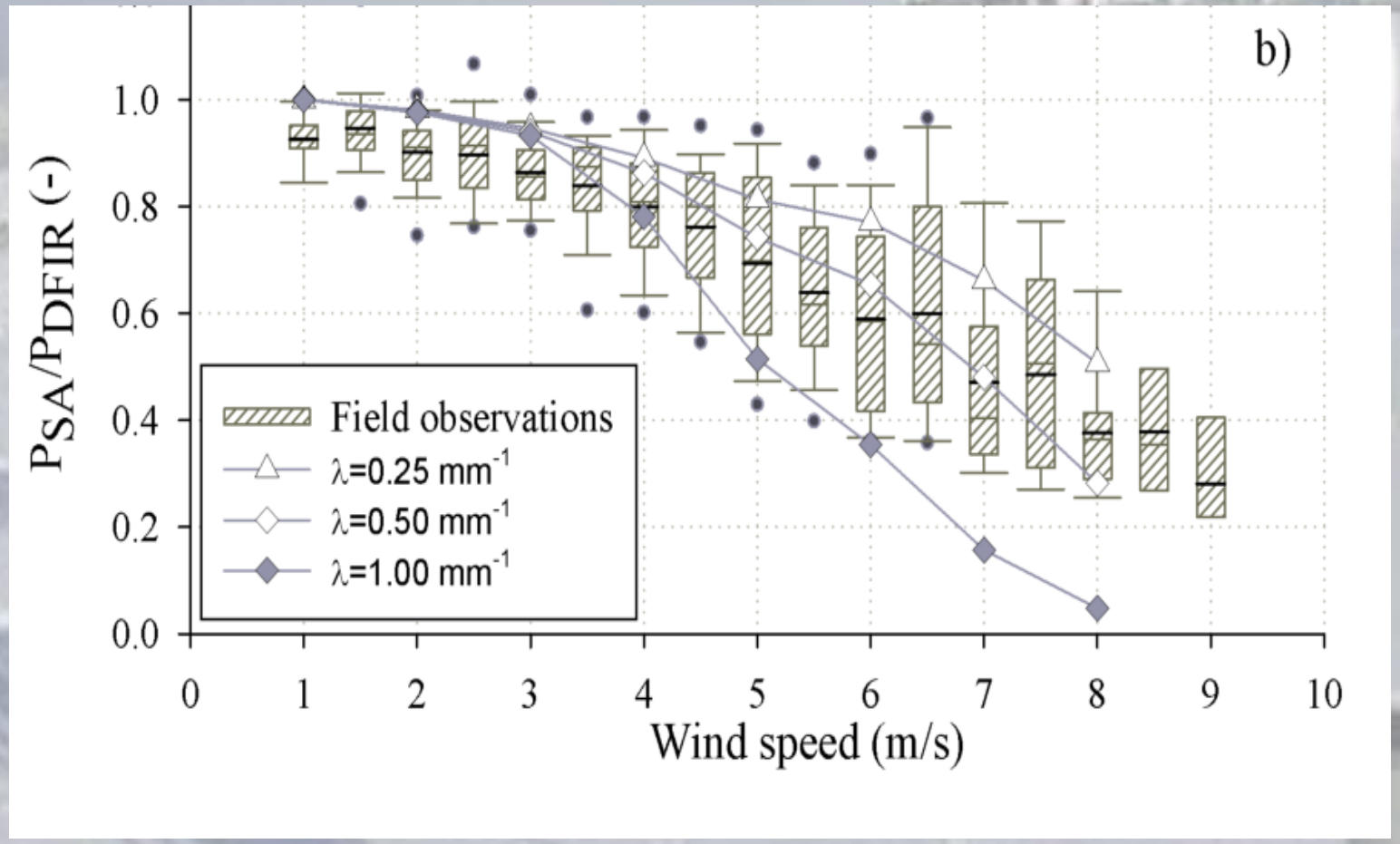
Air vertical velocity time-dependent analysis (LES model)



Lagrangian snow trajectories model

Wind-induced undercatch: transfer functions

COMPUTATIONAL FLUID DYNAMICS STUDY



Field observations from the NOAA/FAA/NCAR Marhsall (CO, USA) field site

SINGLE ALTER

CONCLUSIONS

- ✓ Accurate precipitation measurements in the Arctic are relevant for climate studies
- ✓ **The accuracy of precipitation measurements is presently unknown in many operational weather stations**
- ✓ Calibration uncertainty should be dealt with using existing knowledge (catching type gauges)
- ✓ **Wind is among the most relevant environmental factors affecting the measurement uncertainty in field**
- ✓ Errors in measurements due to the wind are easily in the range 10-80 %
- ✓ Correction for wind effects can be obtained from numerical simulation studies
- ✓ **Non-catching gauges should be used with caution until proper calibration procedures are made available**

Further reading

- Colli, M. , Rasmussen, R., Thériault, J. M., Lanza, L., Baker, B., Kochendorfer, J., 2015. An improved trajectory model to evaluate the collection performance of snow gauges. Journal of Applied Meteorology and Climatology, *J. Appl. Metorol. Climatol.*, **54**(8), 1826–1836.
- Colli, M. , Lanza, L., Rasmussen, R., Thériault, J. M., 2015. The collection efficiency of shielded and unshielded precipitation gauges, part I: CFD airflow modelling. *Journal of Hydrometeorology,* in press.
- Colli, M. , Lanza, L., Rasmussen, R., Thériault, J. M., 2015. The collection efficiency of shielded and unshielded precipitation gauges, part II: modelling particles trajectories. *Journal of Hydrometeorology*, in press.

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