ATMOSPHERIC-BOUNDARY-LAYER HEIGHT RETRIEVAL USING MICROWAVE RADIOMETER AND LIDAR SENSORS: ALGORITHMS AND ERROR ESTIMATION

Umar Saeed[1], Francesc Rocadenbosch[1] and Susanne Crewell[2]
[1]Dept. of Signal Theory and Communications, Remote Sensing Lab. (RSLAB), Universitat Politècnica de Catalunya, Barcelona, Spain.
[2]Institute for Geophysics and Meteorology (IGMK), Integrated Remote Sensing, University of Cologne Cologne, Germany.

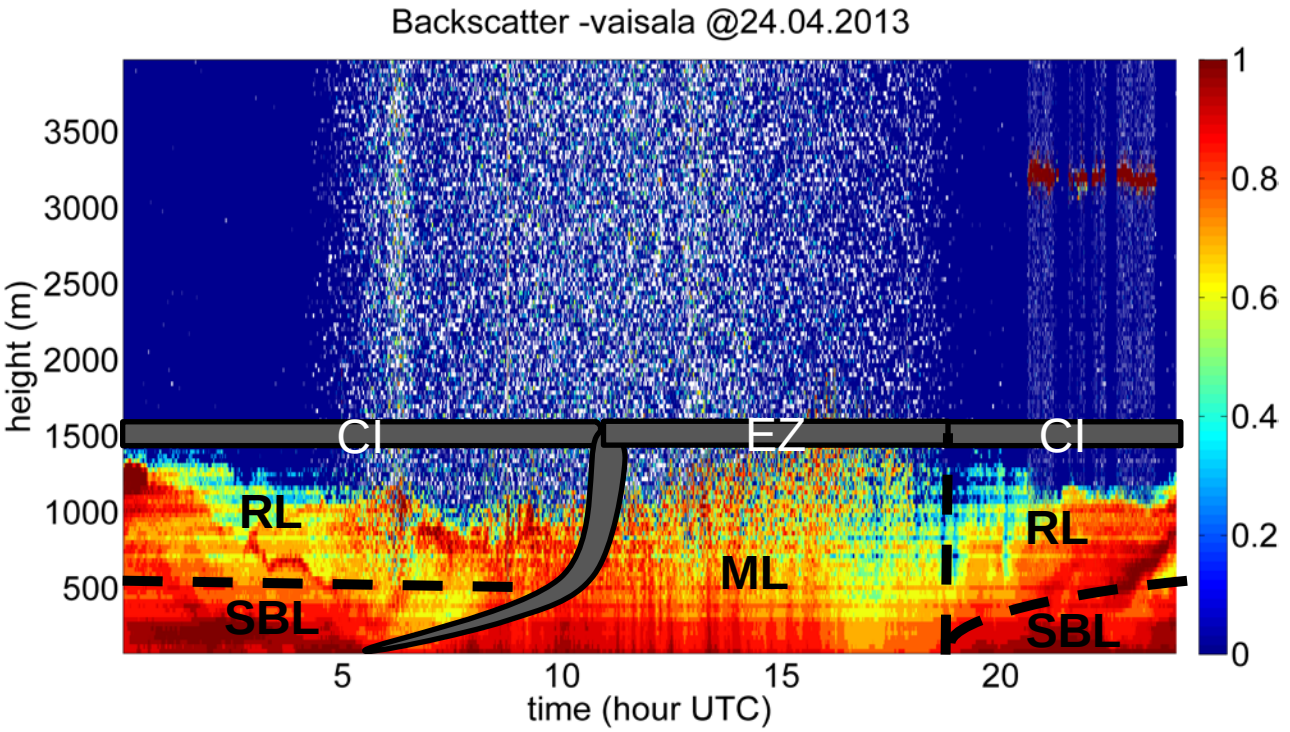
ITaRS Initial Training for atmospheric Remote Sensing

SEVENTH FRAMEWORK PROGRAMME

MARIE CURIE ACTIONS

ABLH USING LIDAR-CEILOMETER

What information can a lidar-ceilometer provide?



+Resolution:
+temporal
+spatial
+**Well mixed atmosphere**

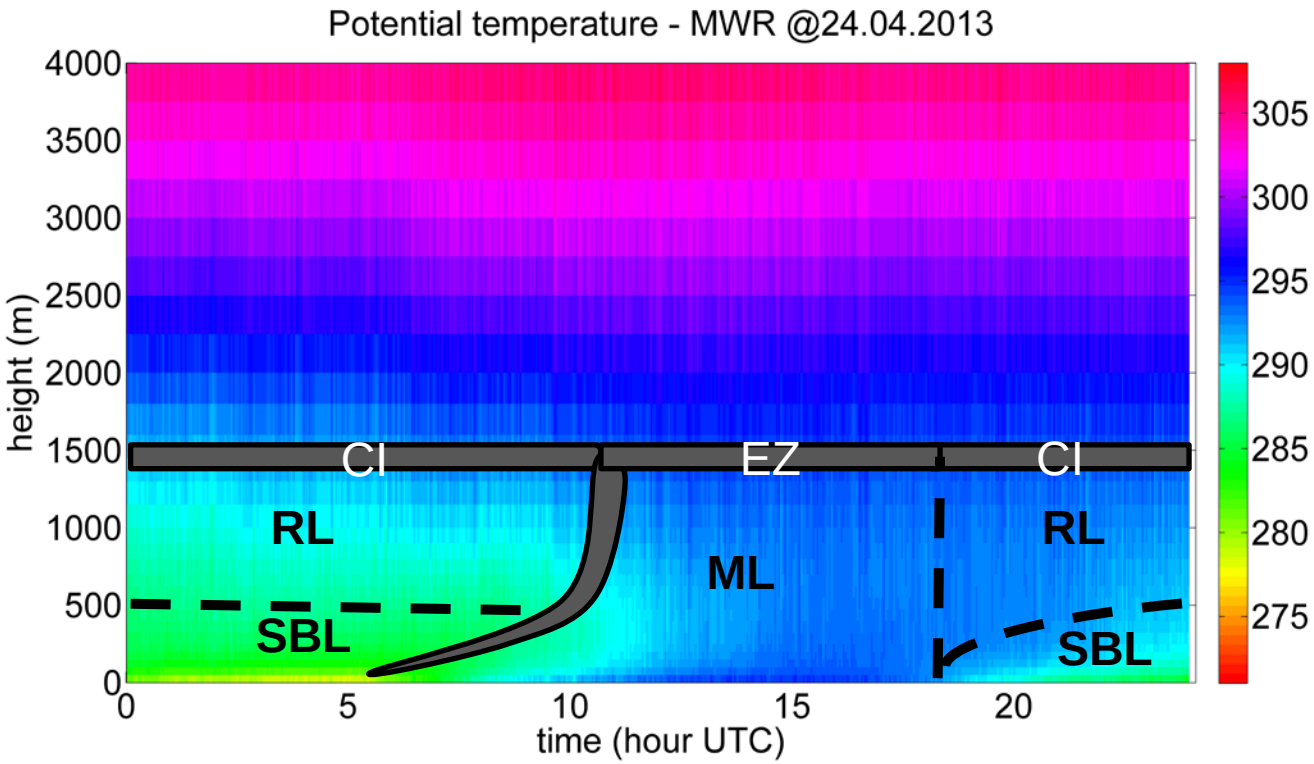
-Incomplete overlap
-Cloud/Rain
-**Prone to physical inconsistencies**

$$P(z) = \frac{K}{z^2}\beta(z)T^2(z) + n(z)$$

K =system constant $[W.m^3]$, z=height [m], $T = e^{-2\int_0^R \alpha(r)dr}$: two-way transmittance, α $[m^{-1}]$: extinction coeff., $\beta[m^{-1}sr^{-1}]$: volume backscatter coeff., n(z): instrumental noise.

ABLH USING MICROWAVE RADIOMETER

What information can a MWR provide?



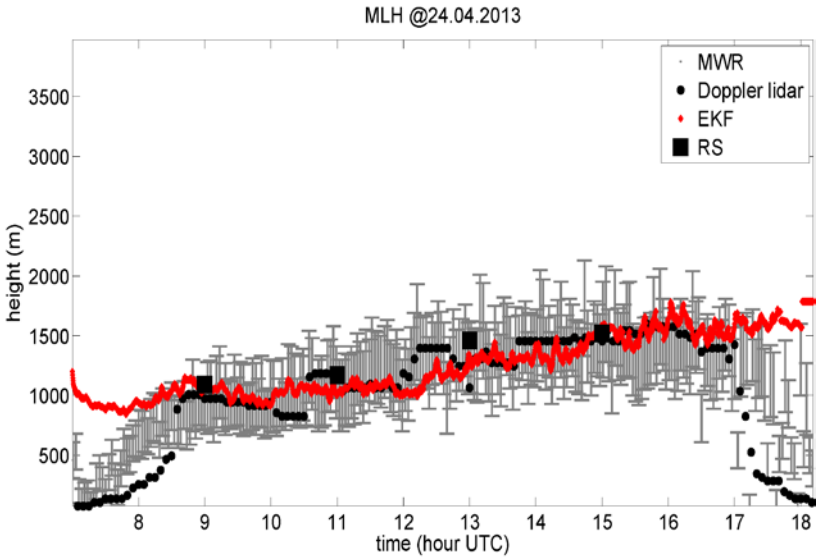
+Temperature:
physically meaningful
+Temporal resolution
+Nocturnal inversions
+ Cloud/Rain

-Retrieved quantity → retrieval errors
-**Vertical resolution**
-Can miss inversions at higher altitudes

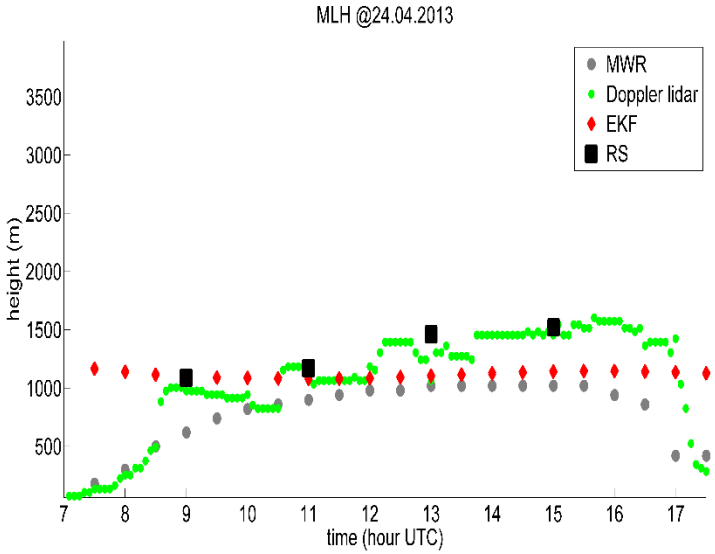
- Measures brightness temperature at multiple freq. and angles.
- 3-4 independent pieces of information (points in the profile) for temperature retrieval in the 50-60 GHz band.

SYNERGETIC MIXING-LAYER HEIGHT

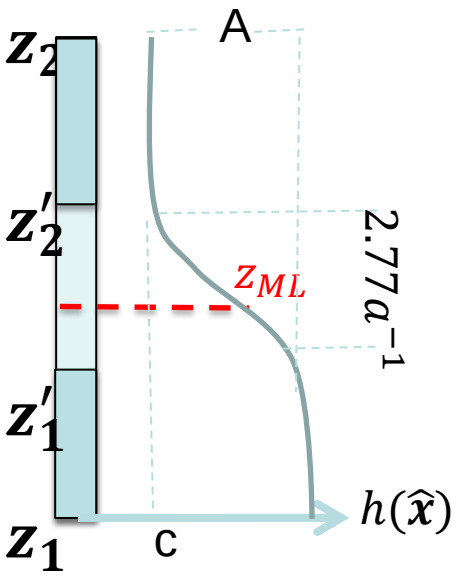
Real measurements



LES-simulated data



$$h(\hat{\boldsymbol{x}}) = \frac{A}{2}\left\{1 - erf\left[\frac{a}{\sqrt{2}}(z - z_{ML})\right]\right\} + c$$

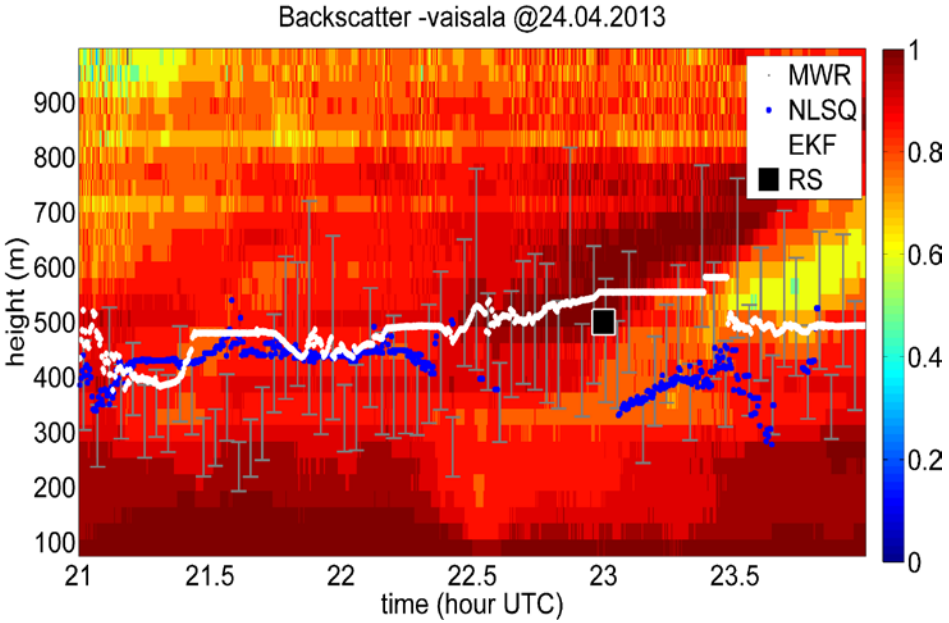


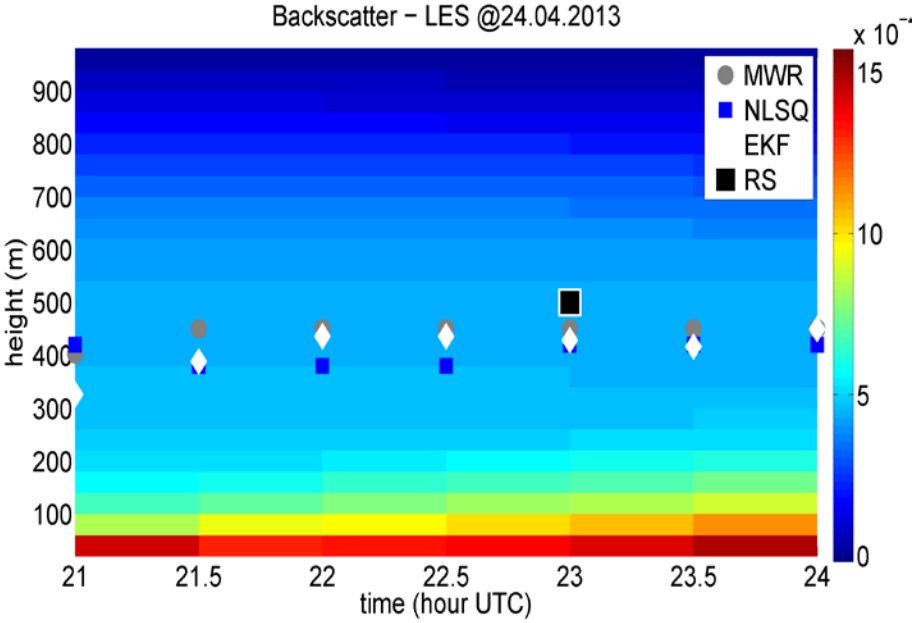
- State vector: $\hat{x} = (z_{ML}, a, A, c)$

where $\hat{\boldsymbol{z}}_{ML}$: MLH., $\boldsymbol{a}$: scaling factor related to EZ., $\boldsymbol{A}$: total backscatter coeff., $\boldsymbol{c}$: molecular background.

- z_1, z_1', z_2', z_2 are the EKF fitting ranges.

SYNERGETIC STABLE BOUNDARY-LAYER HEIGHT





$$h(\hat{\boldsymbol{x}}) = Bexp\left\{-\frac{1}{2}[a(z - z_{SBL})]^2\right\} + d$$

State vector: $\hat{x} = (z_{SBL}, a, B, d)$

where $\hat{\boldsymbol{z}}_{SBL}$**:** SBLH, ***a***: ±1σ Gaussian-model width, ***B***: Gaussian-model amplitude, and ***d***: background variance level.

- z_1, z_1', z_2', z_2 are the EKF fitting ranges, where z_1, z_2, are defined by error-bars from potential temperature-based estimates.