Comparison of Ceilometer Derived Multi-Layer Cloud Base Height in a Coastal Environment at Mace Head

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Overview:

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The site

Latitude: 53.20 N Longitude: 9.54 W Clean Sect: 180°-300° from North





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Instruments

Vaisala CL31:

Measuring principle: Measurement range: Resolution: selectable Time to measure: Light source: Optical (LIDAR) 0...25,000 ft (7.5 km) 5m / 10 ft, units

Time to measure:2...120 sLight source:InGaAs diode, 910 nmEve safety Class 1M IEC/EN 60825-1

Electrical

<u>Power</u> : 100 / 115 / 230VAC ±10%, 50...60 Hz, max. 310 W including heating <u>Interfaces Data</u>: RS232 / RS485 / Modem <u>Bits per second RS232 / RS485</u>: 300...57,600 <u>Modem V.21, V.22, V.22bis</u>: 300...2400

Data messages

Cloud hits (up to 3 layers) and status information Cloud hits, status and backscatter profile Cloud hits and internal monitoring data **Mechanical**

Dimensions: <u>Total:</u> 1190 x 335 x 325 mm <u>Measurement unit:</u> 620 x 235 x 200

mm

Weight: <u>Total:</u> 31 kg <u>Measurement unit:</u> 12 kg <u>Tilt positions:</u> Vertical or 12° tilted Automatic window blower / heater Radiation shield and pedestal Optical filters for protection against direct sunlight **Environmental** Temperature range: -40...+60 °C (-40...+140 °F)

Humidity: 0...100 % RH



Jenoptik CHM15K: Measuring principle: Measuring range: Resolution:

Time to measure:

Targets: Measured quantities:

depth, vertical heigth of PBL Light source: Optical (LIDAR) 30 m - 15 km 15 m 15 s...30 s (for cloud heights < 5 km) 60 s (for cloud heights > 5 km) 600 s (for PBL and visibilities) Aerosols, clouds Cloud heights (standard: three layers),penetration visibility,

Wind: 55 m/s C-CAPS

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Nd:YAG solid-state laser, λ 1064 nm

Selection of Case studies

Air masses characterization:

Table 1. Air masses origin. 7-days back-trajectories (NOAA HYSPLIT MODEL, GDAS data)										
Incoming direction	2008/09/07	2008/09/18	<mark>2008/10/22</mark>	2008/11/04	2008/11/05	<mark>2008/11/14</mark>	<mark>2008/11/15</mark>			
	North-East	West	<mark>West</mark>	West	North-West	<mark>West</mark>	South-West			
Incoming direction	2008/11/17	2008/11/19	2008/12/23	2008/12/24	<mark>2008/12/25</mark>	2008/12/26				
	South-West	West	SW-stagnant	SW-stagnant	<mark>SW-stagnant</mark>	SW-stagnant				

Cloud pattern classification:

Table 2. Cloud classification										
2008/09/07	2008/09/18	<mark>2008/10/22</mark>	2008/11/04	2008/11/05	<mark>2008/11/14</mark>	<mark>2008/11/15</mark>				
Single layer: Stratus (St)	Single layer: Altostratus (As) => Nimbostratus (Ns)	Three layers: 1) Altostratus 2) open cells 3) Cumulus (Cu)	Single layer: Stratus	Two layers: 1) Stratocumulus (Sc) 2) Stratus	Two layers: 1) Altostratus => Nimbostratus 2) Stratus	Two layers: 1) Altocumulus 2) Altostratus => Nimbostratus				
2008/11/17	2008/11/19	2008/12/23	2008/12/24	<mark>2008/12/25</mark>	2008/12/26					
Single layer: Altostratus	Single layer: Altostratus	Single layer:	Single layer:	Single layer:	Single layer:					
=> Nimbostratus	=> Nimbostratus	Stratus	Stratus	Stratus	Stratus					



Selection of case studies

satellite 🦉 AVHRR images from thermal 🏧 channel, 10.3-IR 11.3µm: each case has a different cloud pattern with different cloud number of layers. "2008/10/22" 🏧 has a lower level made by Cu (~ 800 m, 📷 ppn), an no intermediate level 🏴 made by open cells of MC precipitating Cu and an upper level of thickening As with progressive lowering of the cloud base to become Ns in the Ac-As evening with heavy ppn.





81115 5:36 UTC

The c-caps Algorithm

Lidar equation:

Attenuated atm. Vol. backscatter coeff.:

Gradient of the β -signal:







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σ_{CBH} = stdv(rejected maxima)



CL31_{C-CAPS} vs CHM15K_{C-CAPS}





$\text{CL31}_{\textit{VAIS}} \text{vs CHM15K}_{\textit{JEN}}$





CL31_{C-CAPS} vs CHM15K_{C-CAPS}





$CL31_{C-CAPS}$ vs $CHM15K_{C-CAPS}$







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CL31_{C-CAPS} vs CHM15K_{C-CAPS}







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Conclusions

- C-CAPS algorithm provides close cloud base height values for the two ceilometers
- C-CAPS algorithm assures a better agreement between the two instruments than the Jenoptik and Vaisala in-built algorithms.
- C-CAPS algorithm can be made real-time with little changes.
- Jenoptik CHM15K has higher sensitivity and wider range. It allows good measurements of Ci-Cc-Cs too.



perspectives

- Jenoptik CHM15K ceilometer outputs have been implemented into CloudNet software
- Mace Head research station hosts now a group of three remote sensing instruments: K-Band MIRA36 cloud radar, 1064-nm CHM15K ceilometer, RPG-HATPRO microwave radiometer.
- The three instruments provide input to the CloudNet software.
- In April 2009 to be expected the first products of cloud microphysics.



K-band mira36 and chm15k



