

Hybrid wind reconstruction algorithm

Unique, patent-pending method enables lowest measurement uncertainty



“Overall, better accuracy classes than evaluated for WindCube v2.1 in the height range above 100m can hardly be expected for any monostatic remote sensing devices implementing probe volume spatially separated by about 50m to 150m for detecting different radial wind speed components.”

Axel Albers

Managing Director, Deutsche WindGuard Consulting GmbH

New breakthrough: Combining scalar and vector averaging

The hybrid wind reconstruction algorithm, or hybrid method, is a scientific breakthrough unique to Vaisala, that combines scalar and vector averaging to achieve the lowest measurement uncertainty.

While both scalar and vector averaging methods have proven high accuracy in meeting wind industry standards, they depend quadratically on the wind direction turbulence, but with opposite sign. After observing these phenomena in the field and deriving the physics behind them, Vaisala developed the hybrid wind reconstruction algorithm — combining both methods to mathematically eliminate the turbulence sensitivity and provide a truly cup-equivalent 10-minute value.

This innovative hybrid method further increases the measurement quality and reduces its uncertainty level. Following an independent review conducted over 44 verification campaigns, DNV confirms that WindCube® v2.1 with hybrid wind reconstruction:

- Meets all verification criteria (just like previous WindCube versions using scalar and vector averaging).
- Improves the sensitivity to turbulences, which may lead to further reduction in the measurement uncertainty in a wind resource assessment or Power Performance Testing campaign.

IEC classification and unrivaled accuracy class

WindCube v2.1 with hybrid wind reconstruction was fully classified by Deutsche WindGuard® in December 2020 according to IEC 61400-12-1, Edition 2, 2017 (report PP20063.A0).

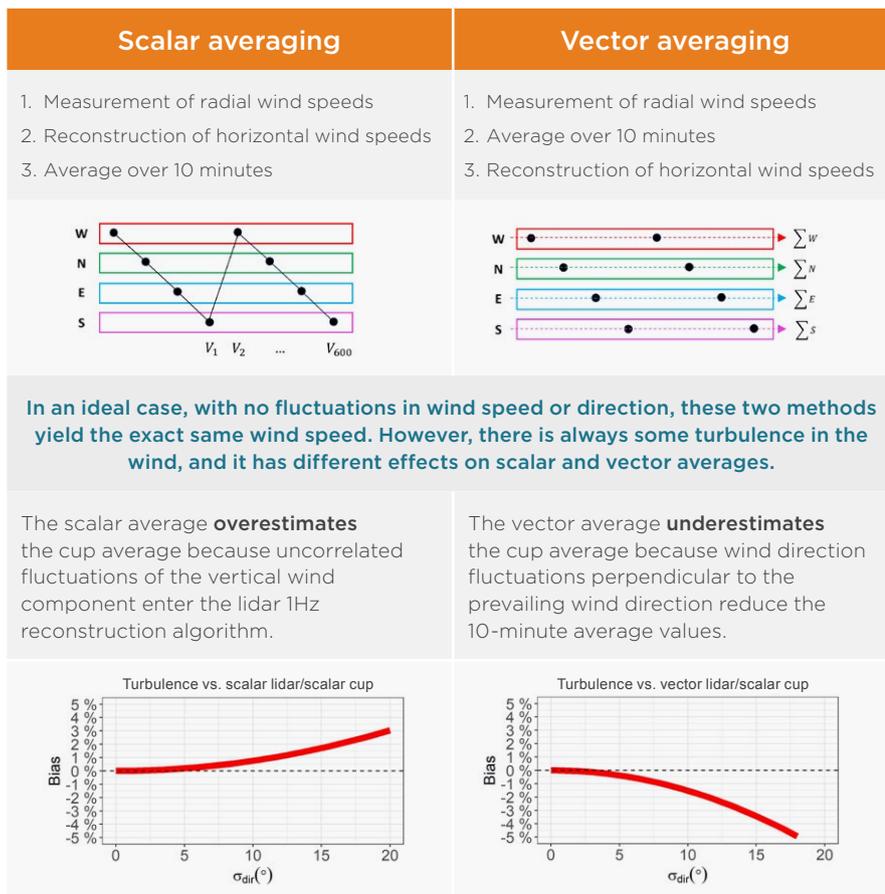
| | Class number at 120m | Standard uncertainty at 120m |
|---------------------------------------|----------------------|------------------------------|
| WindCube (scalar averaging) | 4.4 | 2.5% |
| WindCube (vector averaging) | 2.1 | 1.2% |
| Other lidar technology | 2.6 | 1.5% |
| WindCube (hybrid averaging) | 1.1 | 0.6% |

Wind speed reconstruction: Scalar, vector, and hybrid averaging

According to IEC standards, the cup anemometer is still the industry standard for wind speed measurement. Remote sensing devices are always compared to cups to validate their performance.

However, wind is a three-dimensional vector, and cups measure only the horizontal component — they are not sensitive to the vertical component or the wind direction. In contrast, WindCube measures in 3D, along its oblique laser beams, and is sensitive to both the vertical component and the wind direction — so the horizontal wind speed must be mathematically reconstructed.

There were originally two methods to reconstruct the 10-minute scalar horizontal wind speed from 1Hz samples.



Mixing both scalar and vector averages in a single wind reconstruction method reduces the sensitivity to turbulence.

For a more detailed look at this new breakthrough, view our [on-demand webinar](#).

Why Vaisala for renewable energy?

We are innovators, scientists, and discoverers who are helping fundamentally change how the world is powered. Vaisala elevates wind and solar customers around the globe so they can meet the greatest energy challenges of our time.

Our weather and environmental monitoring solutions for renewable energy are guided by several key priorities:

- Thoughtful evolution in a time of change
- Making renewable energy smarter at every stage
- Extending our legacy of leadership

Vaisala is the only company to offer 360-degree renewable energy solutions — from sensors and systems to digital services and actionable intelligence — nearly anywhere on the planet (and even on Mars). Every Vaisala solution benefits from our 85+ years of experience, pioneering deployments in 170+ countries, and unrivaled thought leadership.

Our innovation story, like the renewable energy story, continues.

VAISALA

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