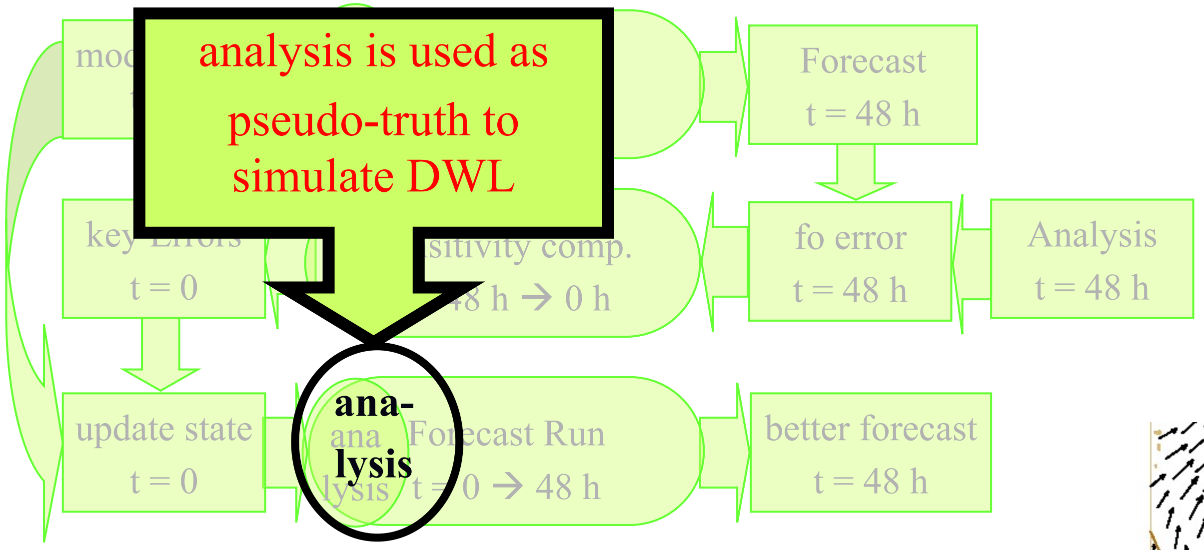
Aeolus follow-on Configurations

Gert-Jan Marseille and Ad Stoffelen
KNMI

PIEW study

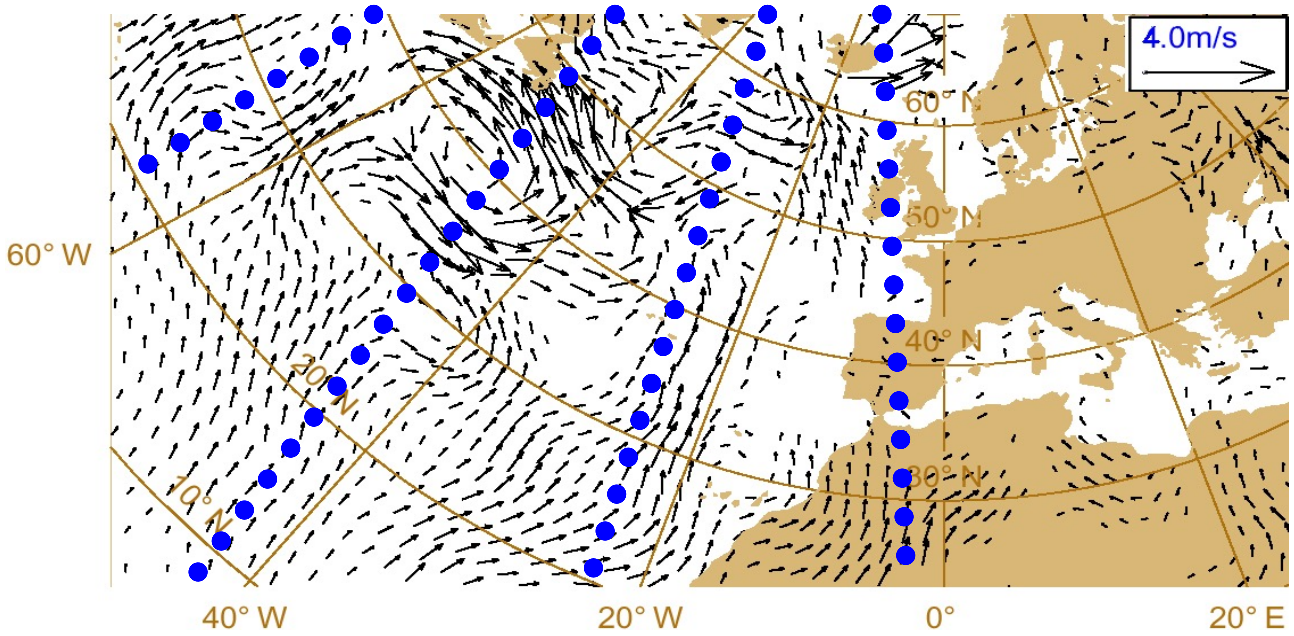
- PIEW – Prediction Improvement in Extreme Weather
- ESA study **2005** (we were optimistic on a soon-to-come Aeolus launch)
- Objectives
  - Assess the potential impact of Aeolus in extreme weather events
  - Assess potential future Aeolus follow-on configurations

SOSE
Sensitivity Observing System Experiment



SOSE enables to assess the potential impact of future observing systems in real atmospheric scenes using existing model configurations and the current global observing system (GOS)

1. is realistic *pseudo-truth*
2. fits with existing observations
3. improves the 2-day forecast



More details in Tellus special issue on Aeolus (2008)

- Marseille, G.J., Stoffelen, A., Barkmeijer J., *Sensitivity Observing System Experiment (SOSE) - A New Effective NWP-based Tool in Designing the Global Observing System,* Tellus A, **60 (2)**, 2008., pp. 216-233, doi: 10.1111/j.1600-0870.2007.00288.x

- Marseille, G.J., Stoffelen, A., Barkmeijer J., *Impact Assessment of Prospective Space-Borne Doppler Wind Lidar Observation Scenarios,* Tellus A, **60 (2)**, 2008., pp. 234-248, doi: 10.1111/j.1600-0870.2007.00289.x

- Marseille, G.J., Stoffelen, A., Barkmeijer J., *A Cycled Sensitivity Observing System Experiment on Simulated Doppler Wind Lidar Data during the 1999 Christmas Storm "Martin" ,* Tellus A, **60 (2)**, 2008., pp. 249-260, doi: 10.1111/j.1600-0870.2007.00290.x

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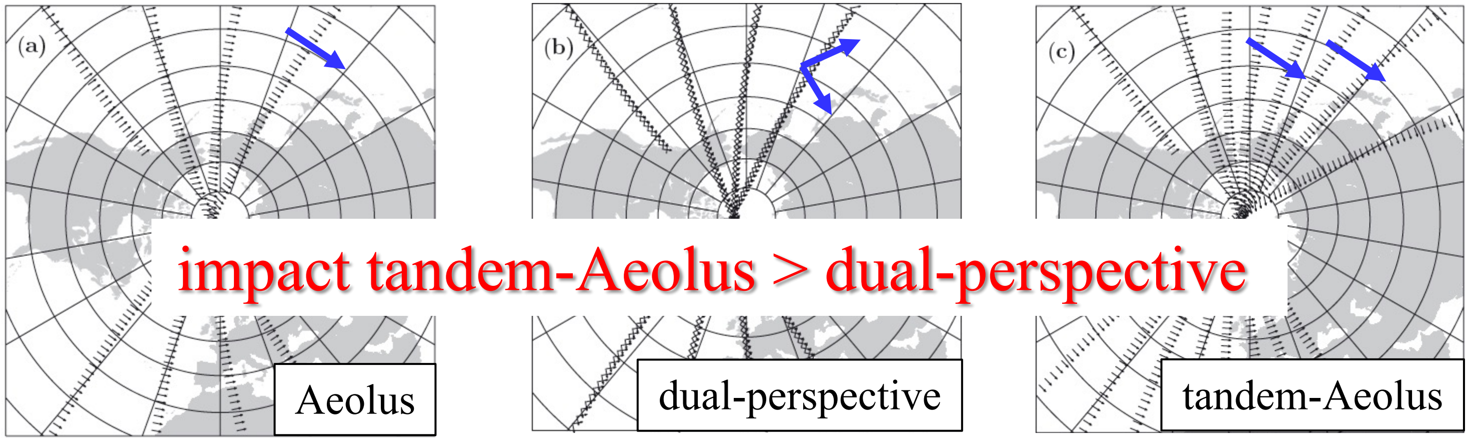
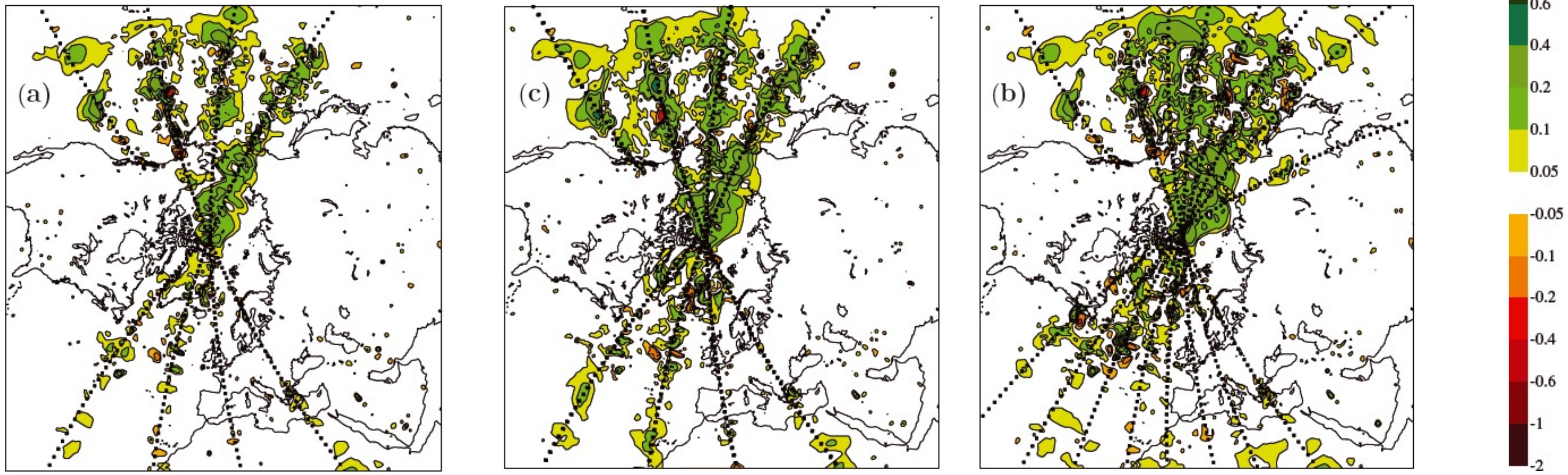
Optional future scenarios

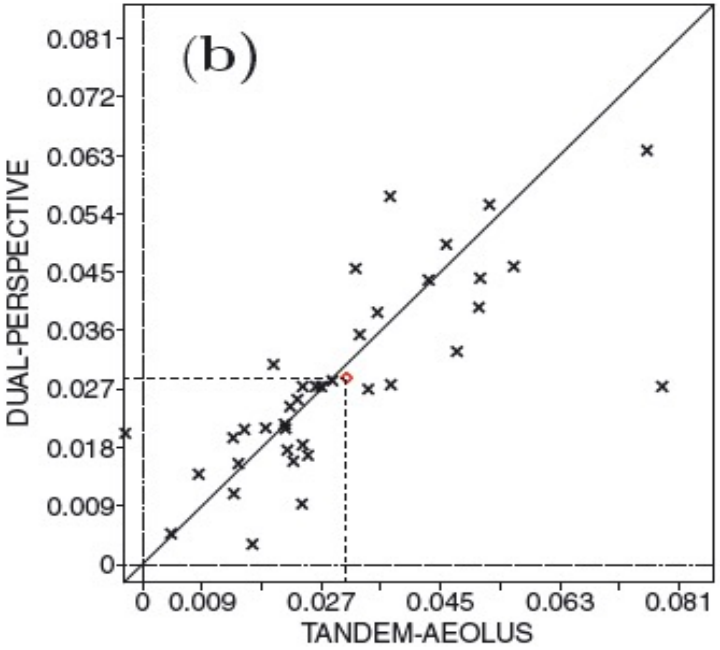


impact tandem-Aeolus > dual-perspective



SOSE applied to 38 cases

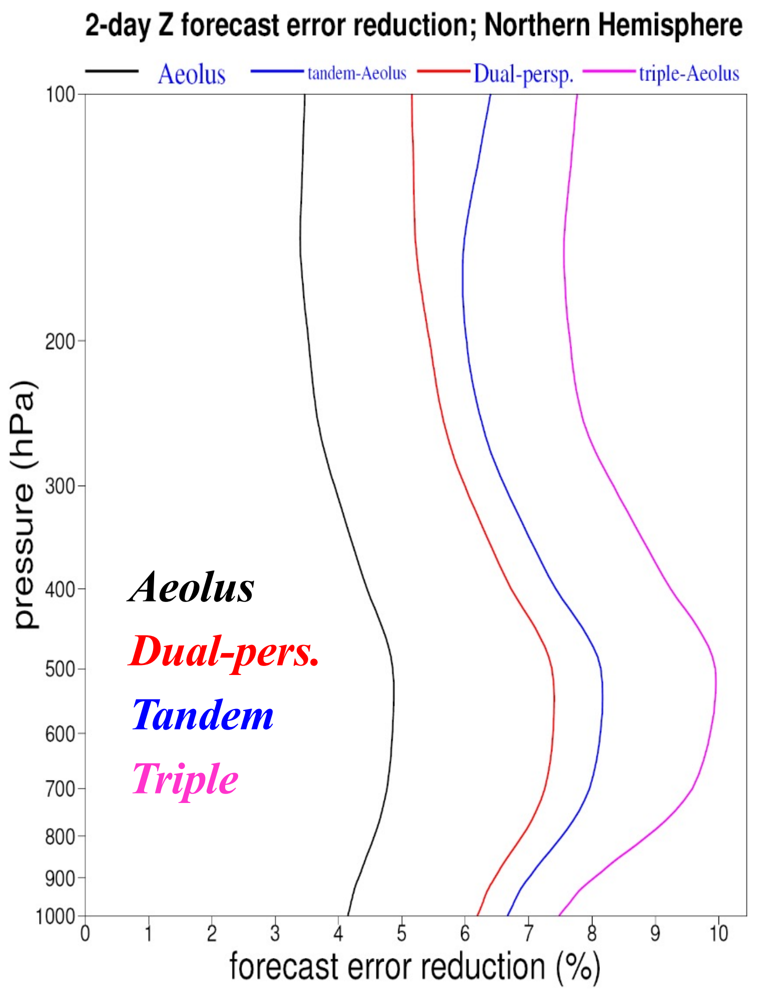
selection of worst ECMWF 2-day forecasts over Europe and North America in period 1998-2004



Improvement on FC+48 geopotential height

500 hPa

(%)	N.Hemis	N.Atlantic	Europe	N.Pacific	N.America	N.Pole
Aeolus	4.9	2.9	2.8	6.6	5.4	9.9
Dual-perspective	7.3	3.9	3.8	9.8	8.5	14.1
Tandem-Aeolus	8.0	5.0	5.3	11.1	7.4	15.8
Dual-inclination	6.6	4.4	4.7	8.5	5.8	10.8
Triple-Aeolus	9.8	6.4	8.0	13.1	8.8	18.3

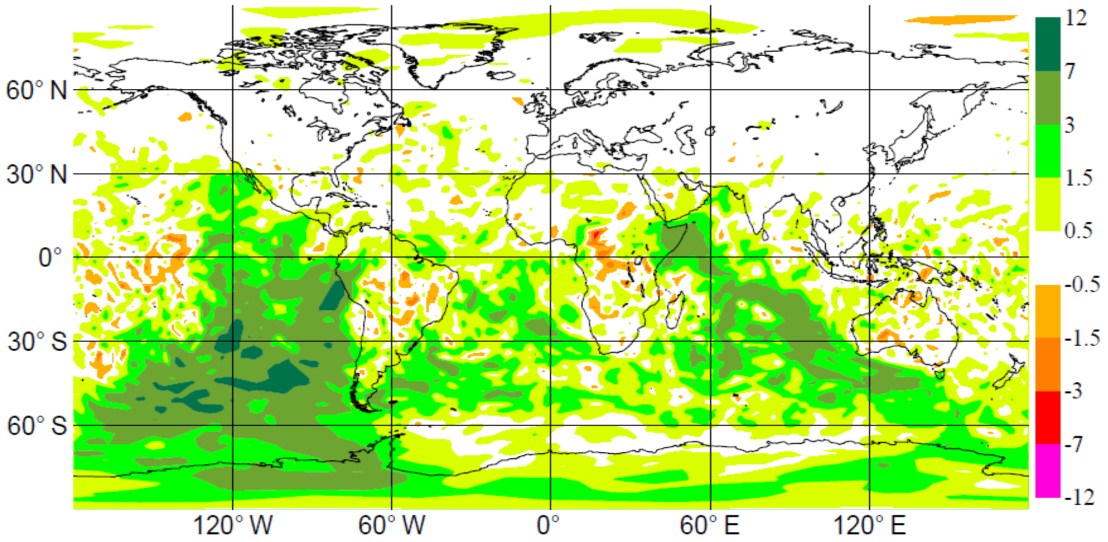


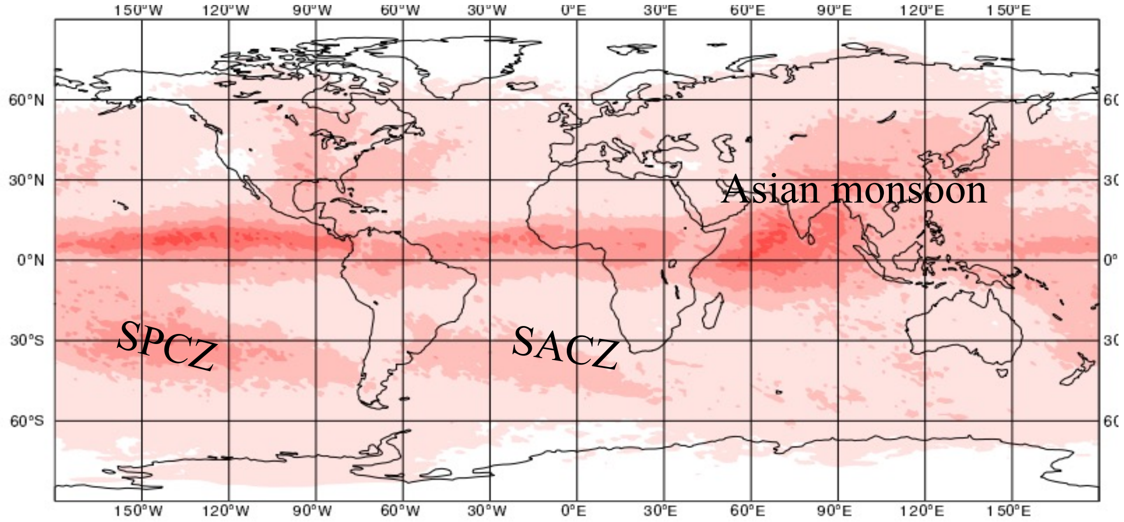
- ☞ Tandem-Aeolus shows overall largest 2-day forecast improvement
- ☞ Added value of Triple-Aeolus largest for Europe
- ☞ Europe: Forecast improvement linear with # Aeolus’

Study recommendations

- Adopt SOSE approach, e.g. to test ADM vertical sampling modes
- SOSE cycling for series of pseudo-truth / long-loop 4D-Var?
- Besides sampling of 12UTC window, also test sampling in the other 6-hour windows, in particular for dual-inclination impact assessment
- Test Aeolus follow-on mission in tropical region
  - Measuring the meridional wind component is of about equal importance as zonal wind component (Nedjeljka Žagar) – different inclination angle?
- Just fly more Aeolus-type instruments!

Shelf life of previous impact studies





courtesy: Michael Rennie - ECMWF

- 1999 Aeolus **OSSE** – 200 hPa wind vector analysis impact
- Stoffelen, A., Marseille, G.J., Bouttier, F., Vasiljevic, D., de Haan, S. and Cardinali, C. *ADM-Aeolus Doppler Wind Lidar Observing System Simulation Experiment,* Q.J.R. Meteorol. Soc., **132**, pp. 1927-1947, 2006, doi: 10.1256/gj.05.83

- Mid-2020 **OSE**: Period 4 April to 19 August 2020
- Standard deviation of 250 hPa zonal wind analysis change

- Despite all the differences (seasonal effects, model upgrades, GOS, …), the main conclusions hold
- ➢ Largest impact in the tropical upper troposphere, SH extra-tropics and NH oceans

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WMO OSCAR database

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https://www.wmo-sat.info/oscar/

The "threshold" is the minimum requirement to be met to ensure that data are useful

The "goal" is an ideal requirement above which further improvements are not necessary

The "breakthrough" is an intermediate level between "threshold" and "goal" which, if achieved, would result in a significant improvement for the targeted application. The breakthrough level may be considered as an optimum, from a cost-benefit point of view, when planning or designing observing systems.

Wind; global NWP (PBL/FT/UTLS)	**Goal**	**Breakthrough**	**Threshold**
Uncertainty	1 (m/s)	3 (m/s)	5 (m/s)
Horizontal resolution	15 (km)	100 (km)	500 (km)
Vertical resolution	0.5 (km)	1 (km)	3 (km)
Observing cycle	60 (min)	6 (hr)	12 (hr)
Timeliness	6 (min)	30 (min)	6 (hr)

Aeolus

(along track only!)