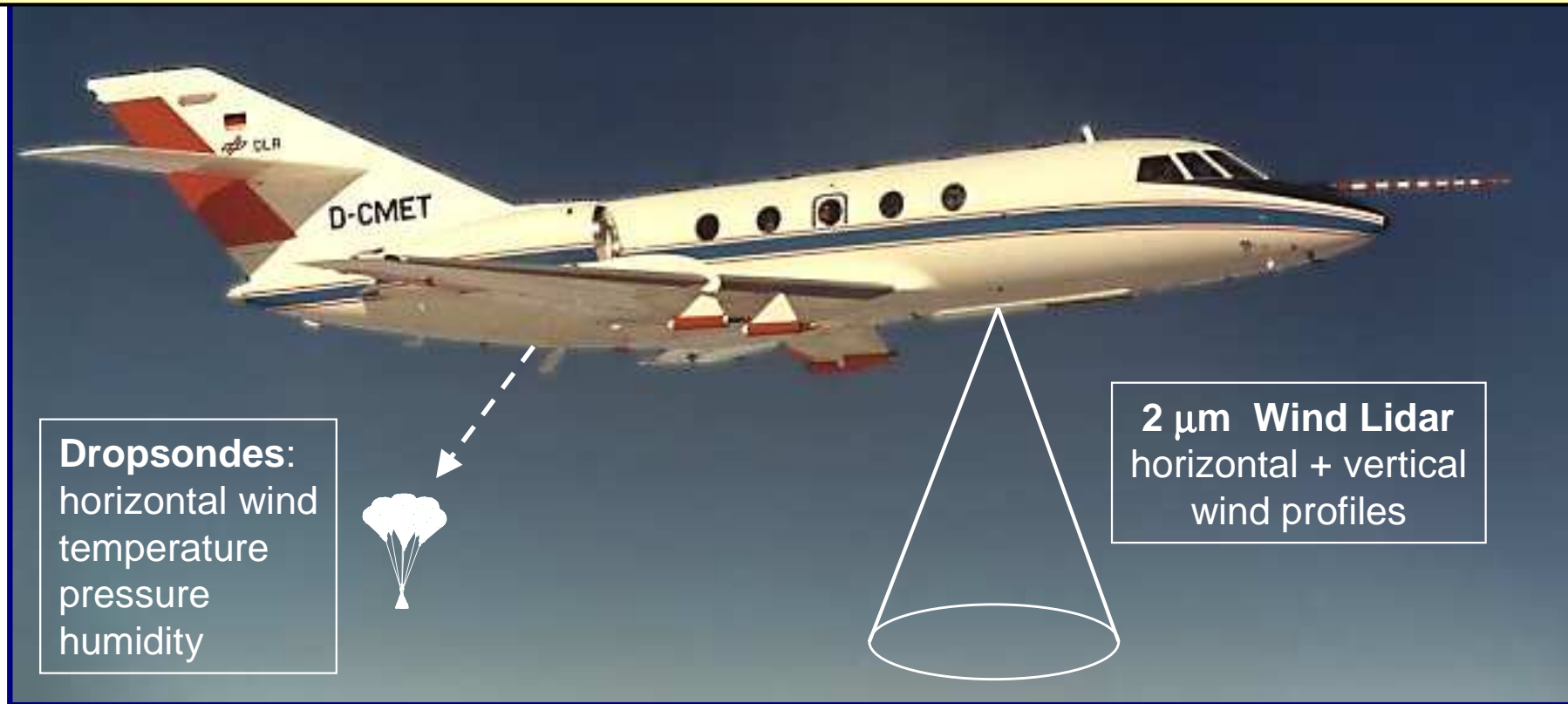


# Airborne Wind Measurements in ATReC

Andreas Dörnbrack, Stephan Rahm, Rudolf Simmet,  
Martin Weissmann, Oliver Reitebuch, Reinhold Busen, and Ulrich Schumann  
DLR Oberpfaffenhofen



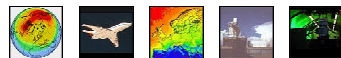
# Remarks related to COPS

Improve QPF ~ THORPEX goal to improve NWP by getting better initial data fields, e.g. through targeting observations

- do they really get better predictions? (predictability issue; targeting vs. denser remote-sensing data network)
- significant difference to case studies in the organisation and planning of this component during the field campaign!!

Contribution to get „real-time“ assimilation of remote sensing data as (wind, water vapor) LIDAR profiles

- challenging technical issue
- in line with ADM and other satellite missions





# Atlantic THORPEX Regional Campaign ( ATReC )

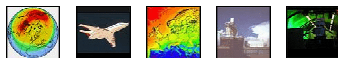
Research/Operational field demonstration of THORPEX components designed to test

- Process of consultation/case selection
- Ability to adaptively control observations
- Assessment of benefits of targeted observations
- Focussed on short range 24-72 h
- Period: October - December 2003

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# Atlantic THORPEX Regional Campaign ( ATReC )

**DLR Beitrag**

***Targeted wind observations during the North Atlantic TOST 2003***

**“The objective is to demonstrate the utility of targeted wind observations in predicted sensitive areas using an airborne wind lidar and dropsondes.”**

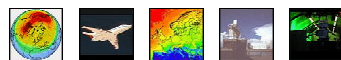
EUCOS: 100 000 €

Total: ~150 000 €

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# Vorhersage der sensitiven Gebiete

Centre	Prediction Technique	Primary Contact
ECMWF	Singular vector (Continuously operated: 24,48 and 72 hour forecast ranges. Up to 3 fixed verification regions)	Martin Leutbecher
MeteoFrance	Singular vectors (18 hours forecast range)	Jean Pailleux
Met Office	ETKF based on ECMWF ensemble (24-72 hour forecast range)	Dave Richardson
NCEP	ETKF based on NCEP ensemble	Zoltan Toth
NRL	Singular vectors (for tropical cyclone)	Pat Harr
University of Miami	ETKF: operated primarily in support of tropical cyclone activities	Sim Aberson

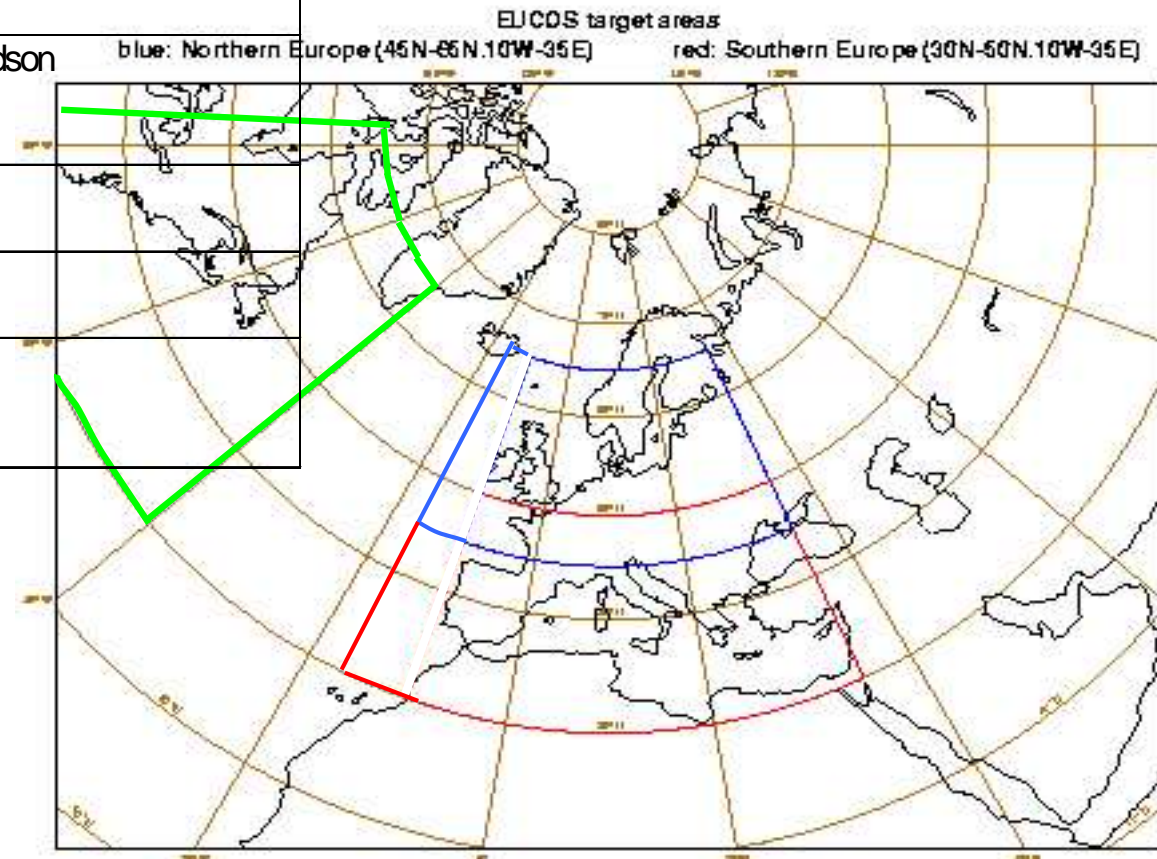


Figure 2: Previous verification regions adopted by EUCOS.

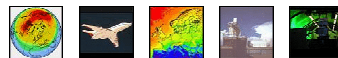
# Beteiligte Flugzeuge USA/Kanada/Europa

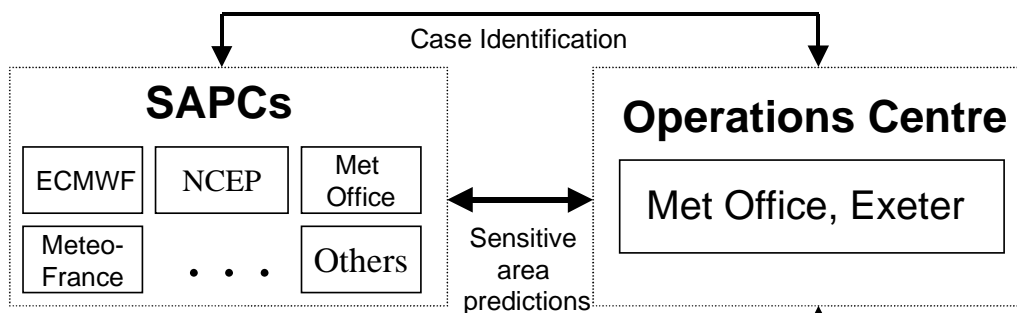
Aircraft	Operator	Targeted Dropsonde capability?	Operating Base	Available Flying Time (directly in support of the NA-TOST)	Availability		
					Duration	Start Date	End Date
DLR Falcon	DLR	Yes	Iceland (Keflavik)	30 hours (5 flights: 50 dropsondes in total)	2 weeks	27 <sup>th</sup> Oct	21 Nov
NOAA G-4	NOAA	Yes	MacDill until early Dec (possible temporary deployment to other locations there after)	To be defined	Full 2½ months (shared)	1 <sup>st</sup> Oct	Mid Dec
Citation	UND	Yes	Bangor, Maine	30-40 hours	1 month	18 Nov	18 Dec
ER-2	NASA	No	Bangor, Maine	30-40 hours	1 month	18 Nov	18 Dec
Convair 580	Canada	Yes	Halifax / St Johns	4 flights – 150 dropsondes	TBD	Early Oct	Late Oct
C-130 (J and H models)	US Air-force	To be confirmed #	To be confirmed	To be confirmed	To be confirmed		

# Some preliminary discussions have also begun with the US Air Force to investigate whether they could alter their training schedule to include some dropsonde missions in support of the Atlantic-TOST.

Weiterhin:

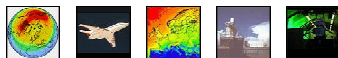
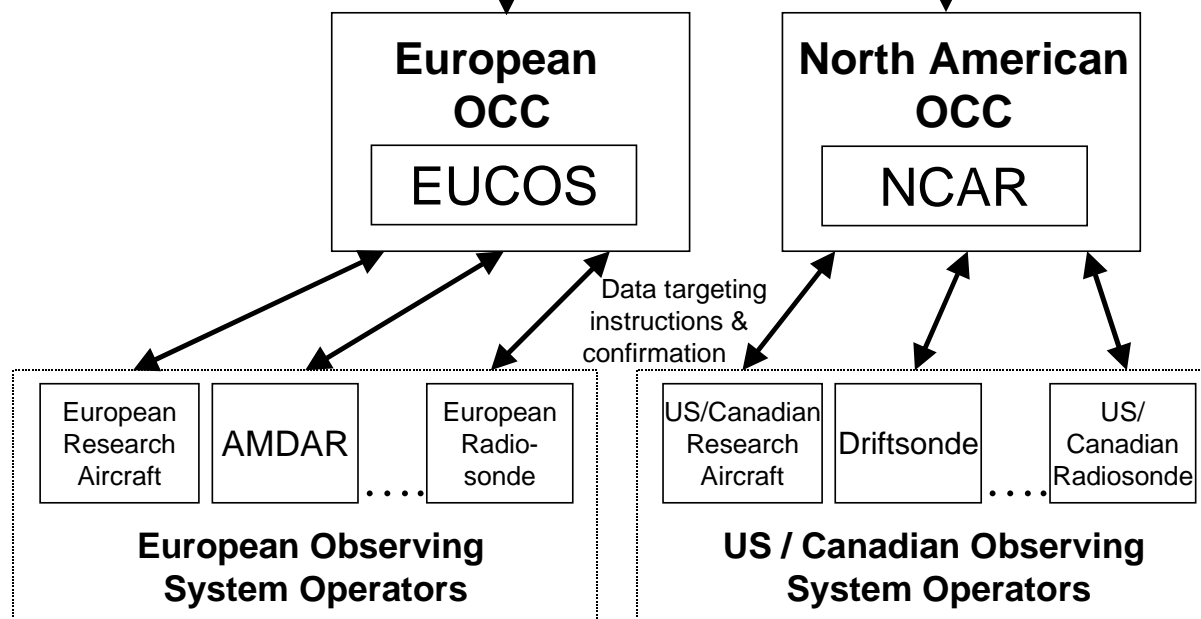
AMDAR, ASAP, additional radiosondes, drifting buoys, satellite rapid scan winds





**SAPCs - sensitive area prediction centers**

Target Area Selection and Observation targeting confirmation





# Review of Ops

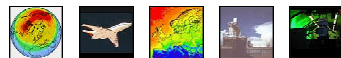
SOP generated:

- 32 separate numbered cases
- 23,000 additional AMDAR obs
- 65 extra ascents from ASAP ships
- 214 additional radiosonde ascents
- 277 aircraft dropsonde profiles
- daily GOES winds

6



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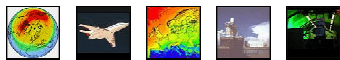


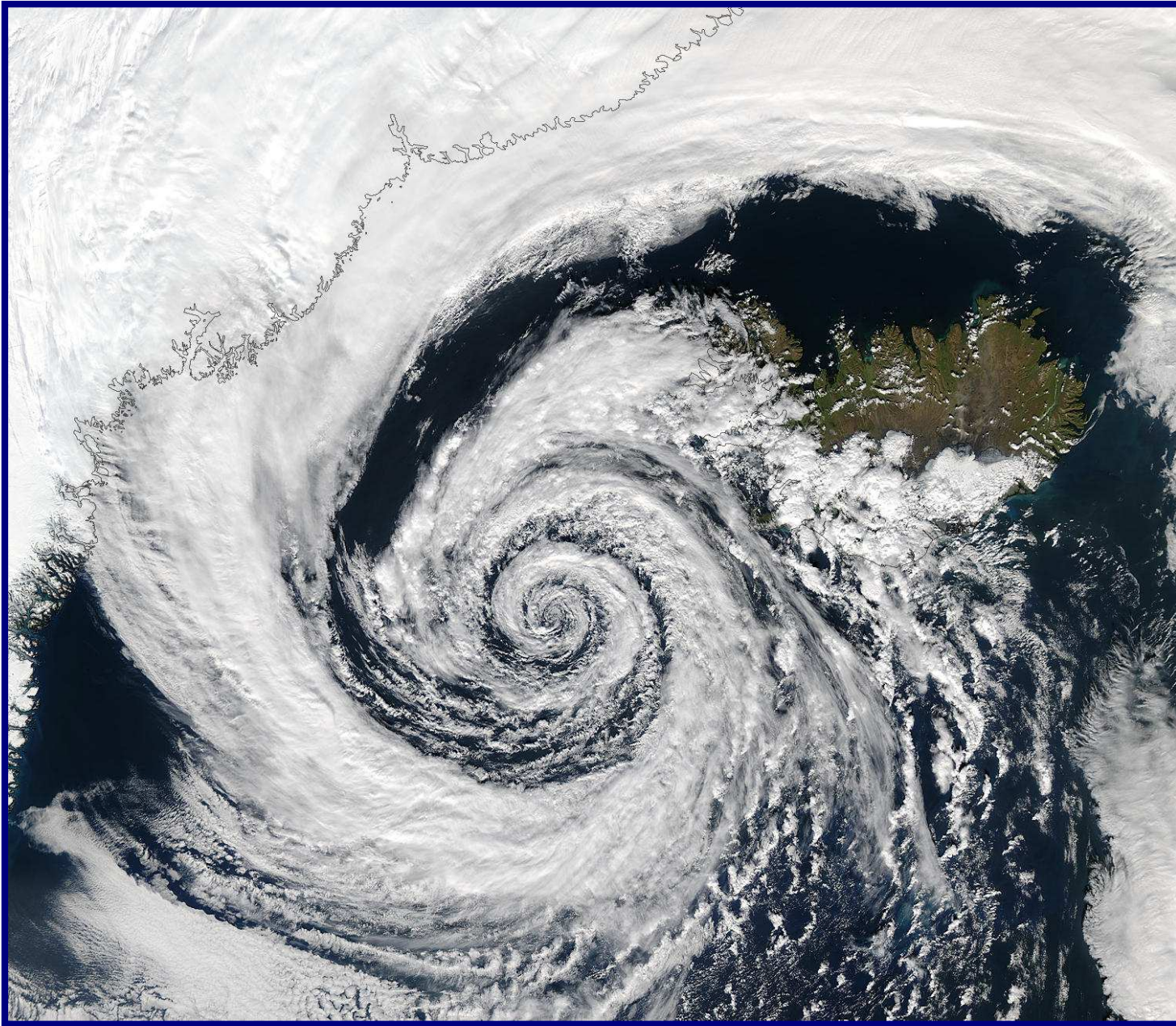


28 January 2004 1355 UTC (MODIS Aqua)



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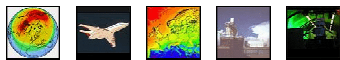




4 September 2003 1410 UTC (MODIS Aqua)



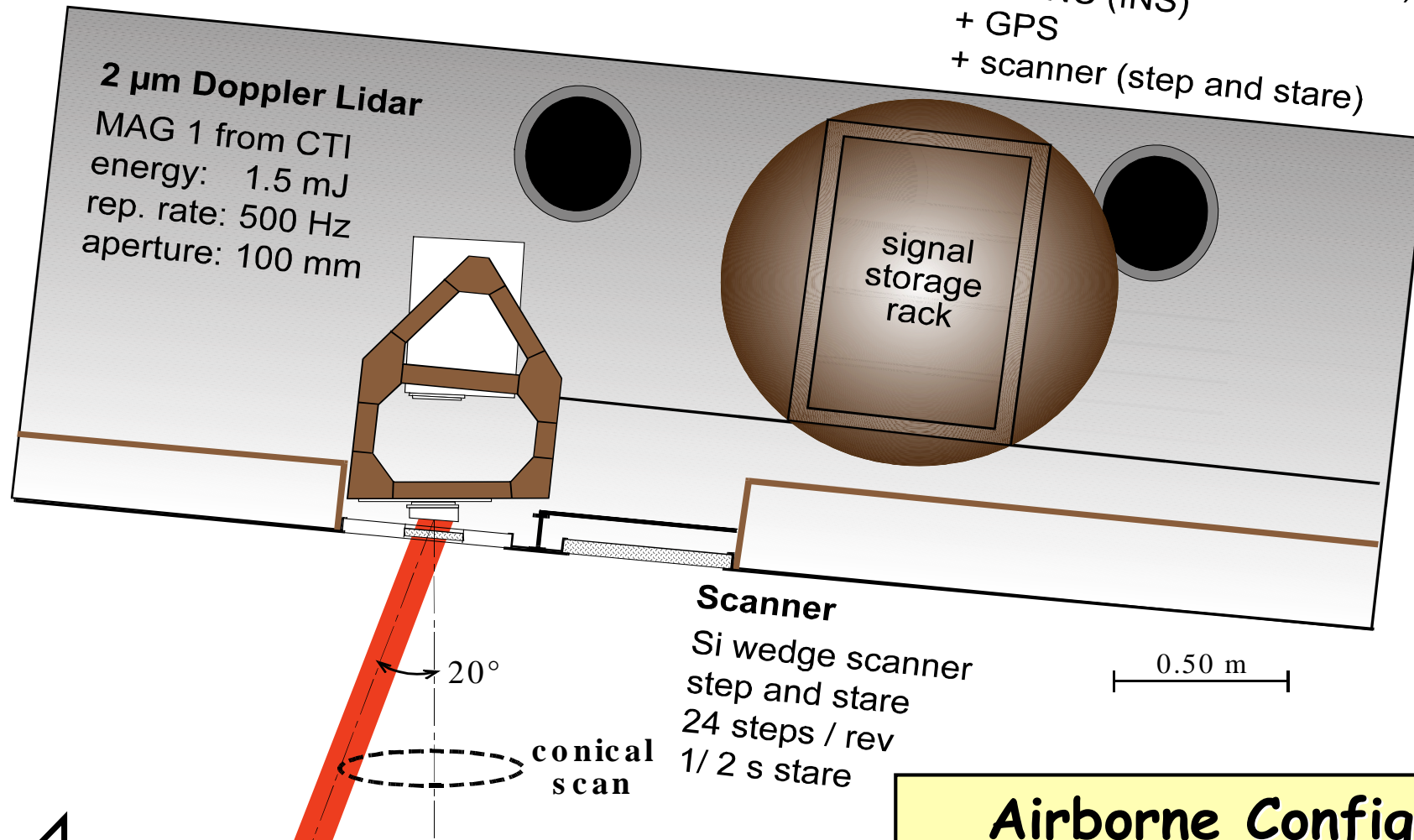
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Horizontal resolution  $\Delta x \sim 6 \text{ km} \dots 40 \text{ km}$

Vertical resolution  $\Delta z \sim 100 \text{ m}$

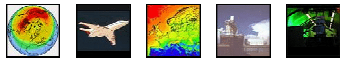
**Signal Storage (DLR)**  
single shots,  
early digitizing (1 GByte/min)  
+ ARINC (INS)  
+ GPS  
+ scanner (step and stare)



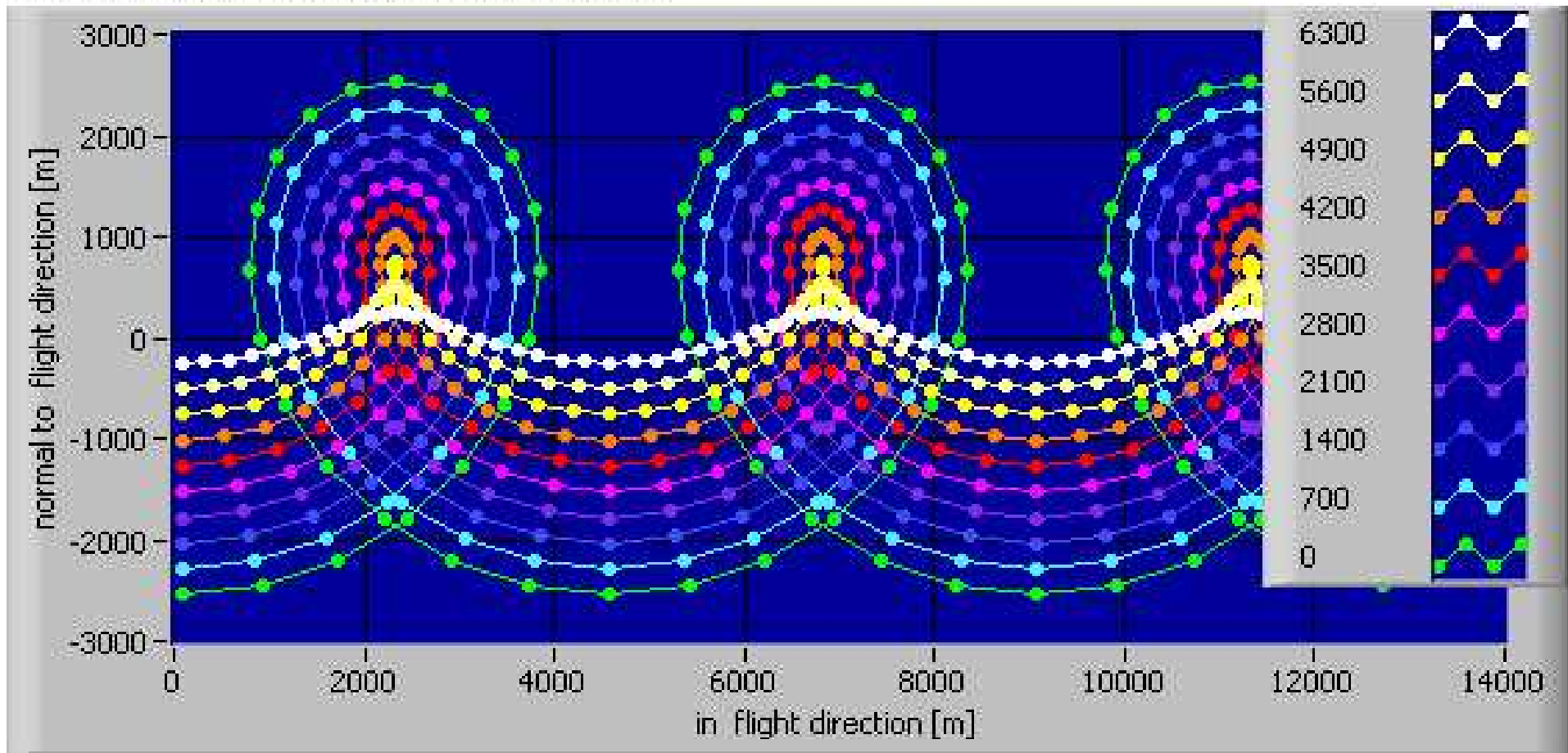
**Airborne Configuration**



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Scan Pattern; Altitude 7000 m, Velocity 150 m/s

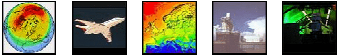




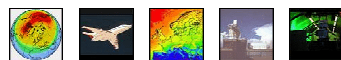
# Väisälä RD93 Dropwindsonde

Vertical resolution  $\Delta z \sim 10 \text{ m}$

Accuracy of wind measurements  $\pm 0,5 \text{ m/s}$



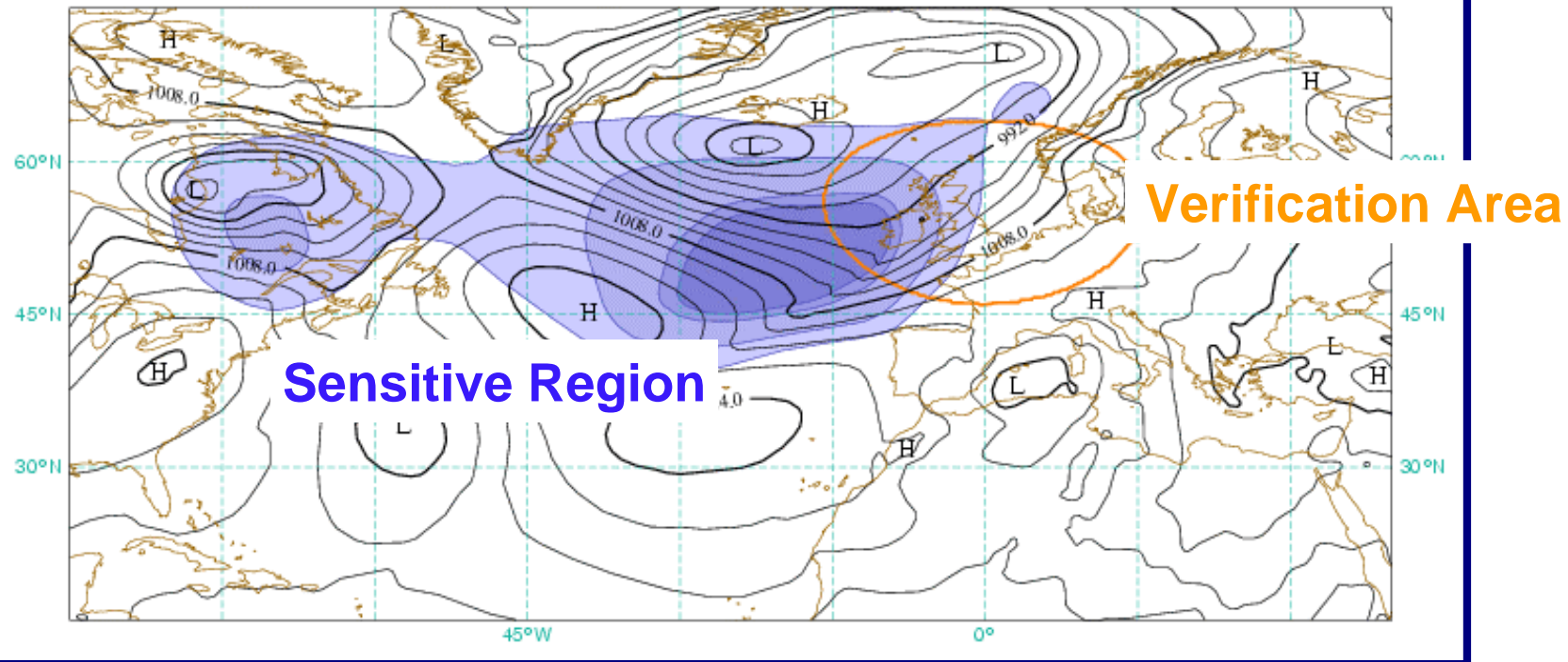
Missions:		Windlidar	Drops	No
14 Nov.: Transfer OP - Keflavik	4.0 h	236 profiles		
15 Nov.: 1st ATReC flight	3.5 h	189 profiles	11	# 12
18 Nov.: ENVISAT-SAR	2.5 h	145 profiles		
20 Nov.: 2nd/3rd ATReC flights	6.5 h	206 profiles	10	# 16
22 Nov.: 4th ATReC flight	3.5 h	203 profiles	12	# 18
24 Nov.: Greenland Tip Jet	3.0 h	281 profiles	4	# 19
25 Nov.: 5th ATReC flight	3.5 h	203 profiles	12	# 18_3
28 Nov.: Transfer Shannon-OP	2.0 h	131 profiles		
	$\Sigma$ 28.5 h	1587 profiles	49	
		160000 data points		



# DLR Falcon ATReC flight      Keflavik, Iceland - Shannon, Ireland

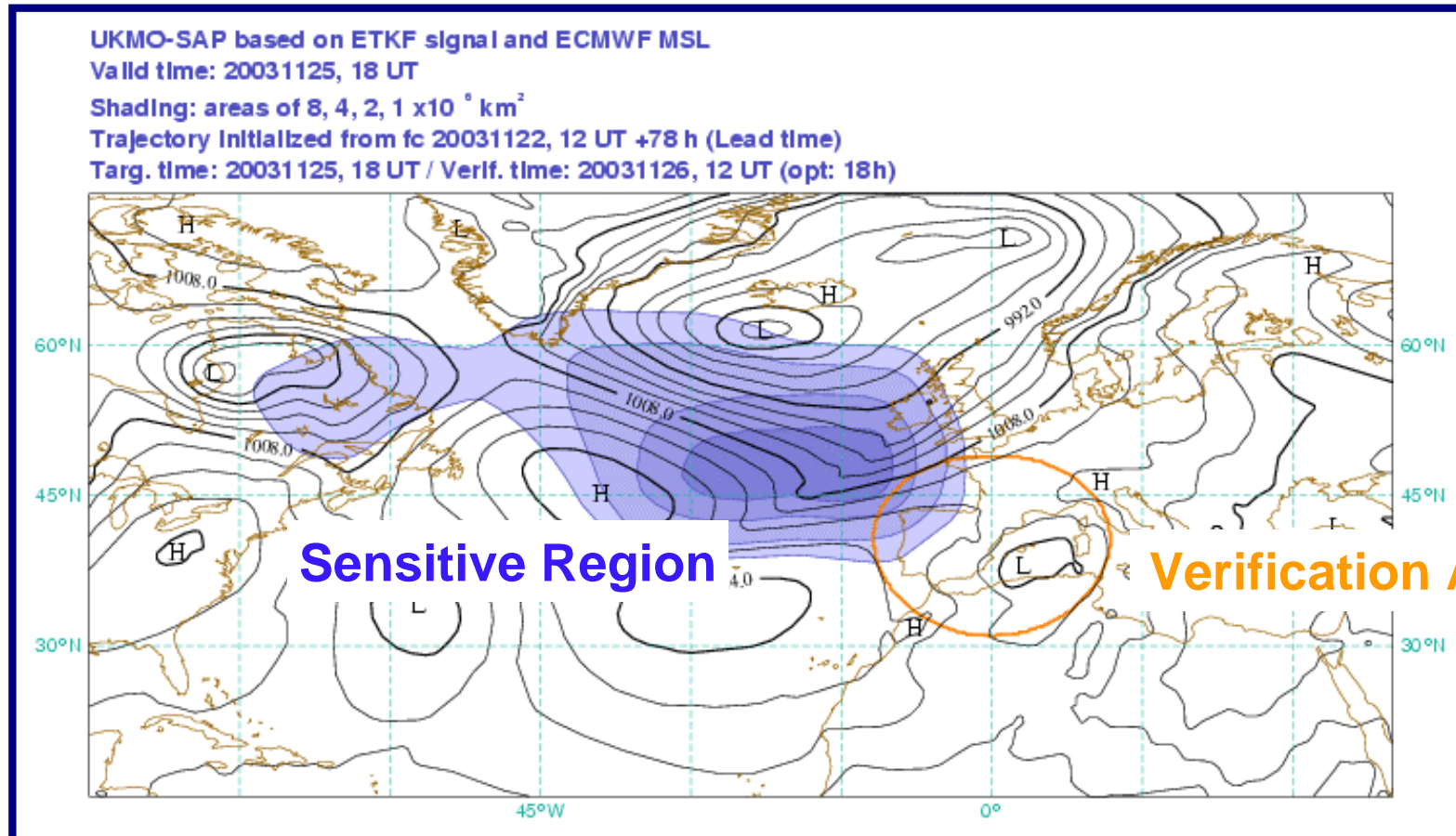
## 25 November 2003 15:30 - 18:45 UTC (TReC #18\_3)

UKMO-SAP based on ETKF signal and ECMWF MSL  
Valid time: 20031125, 18 UT  
Shading: areas of 8, 4, 2, 1 x10<sup>6</sup> km<sup>2</sup>  
Trajectory initialized from fc 20031122, 12 UT +78 h (Lead time)  
Targ. time: 20031125, 18 UT / Verif. time: 20031126, 12 UT (opt: 18h)



# DLR Falcon ATReC flight      Keflavik, Iceland - Shannon, Ireland

25 November 2003 15:30 - 18:45 UTC (TReC #18\_3)





DLR Falcon ATReC flight

Keflavik, Iceland - Shannon, Ireland

25 November 2003 15:30 - 18:45 UTC (TReC #18\_3)



Iceland

Ireland

MODIS 25 Nov 2003 13:55 UTC

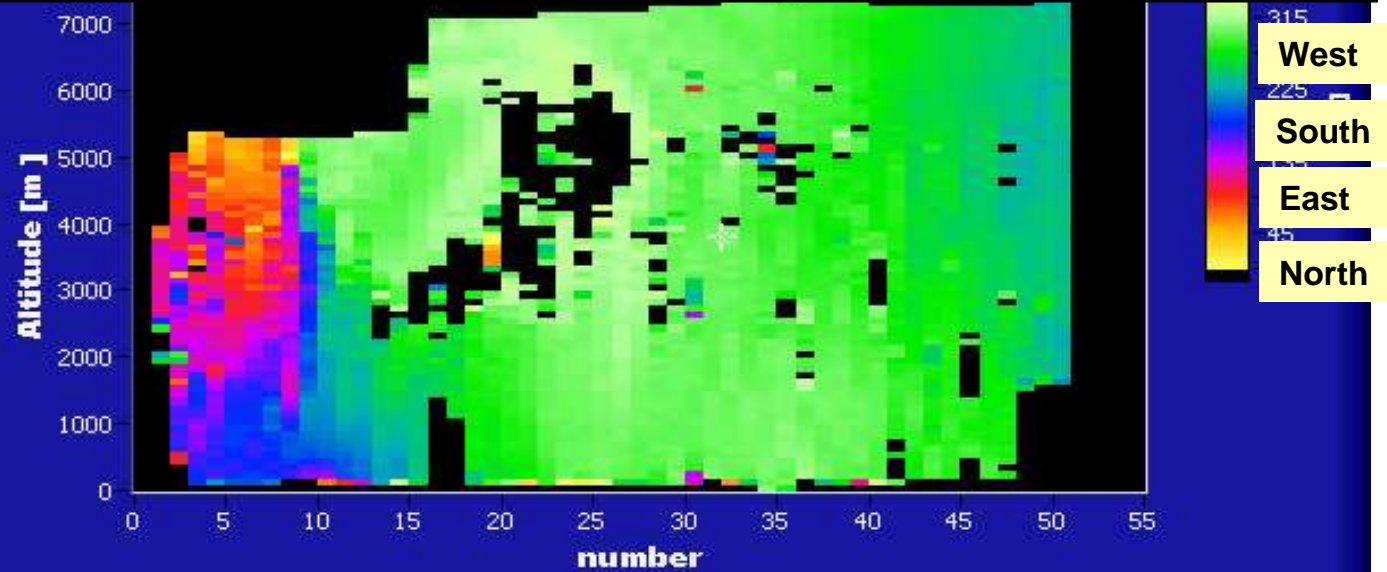


DLR

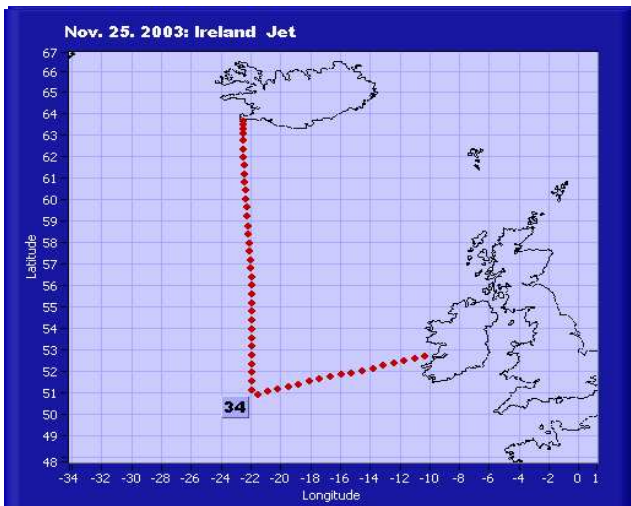
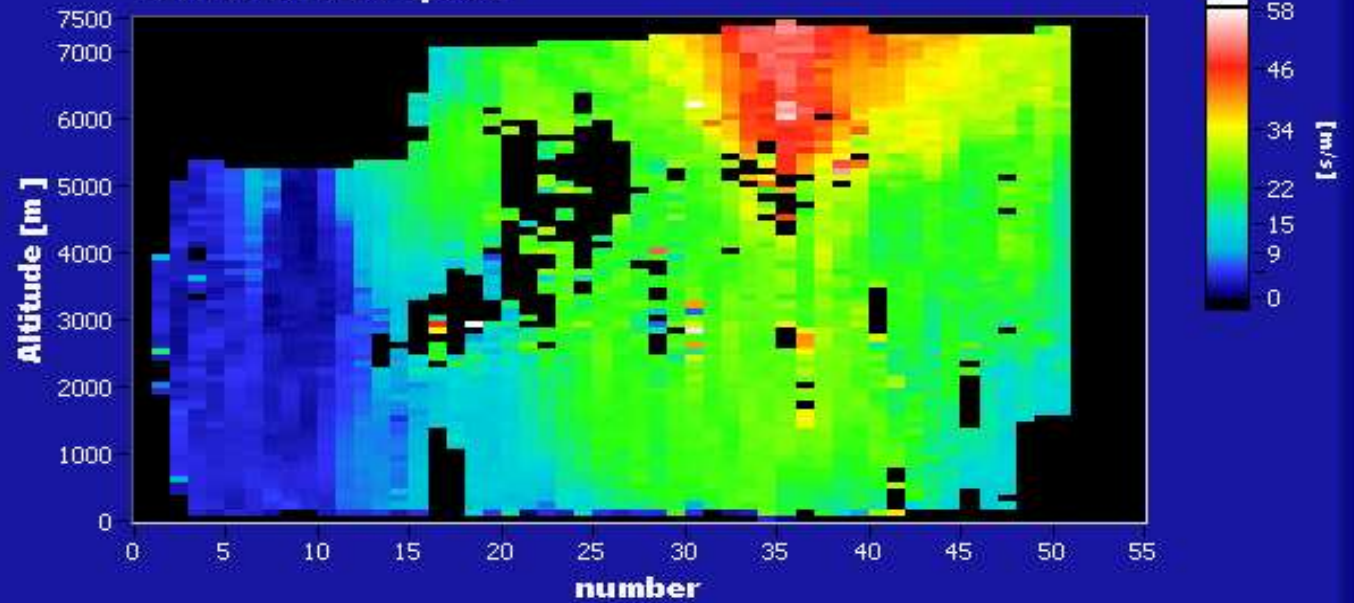
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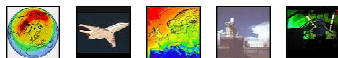
# TReC #18\_3: Lidar wind profiles with **one** and **four** scanner revolutions



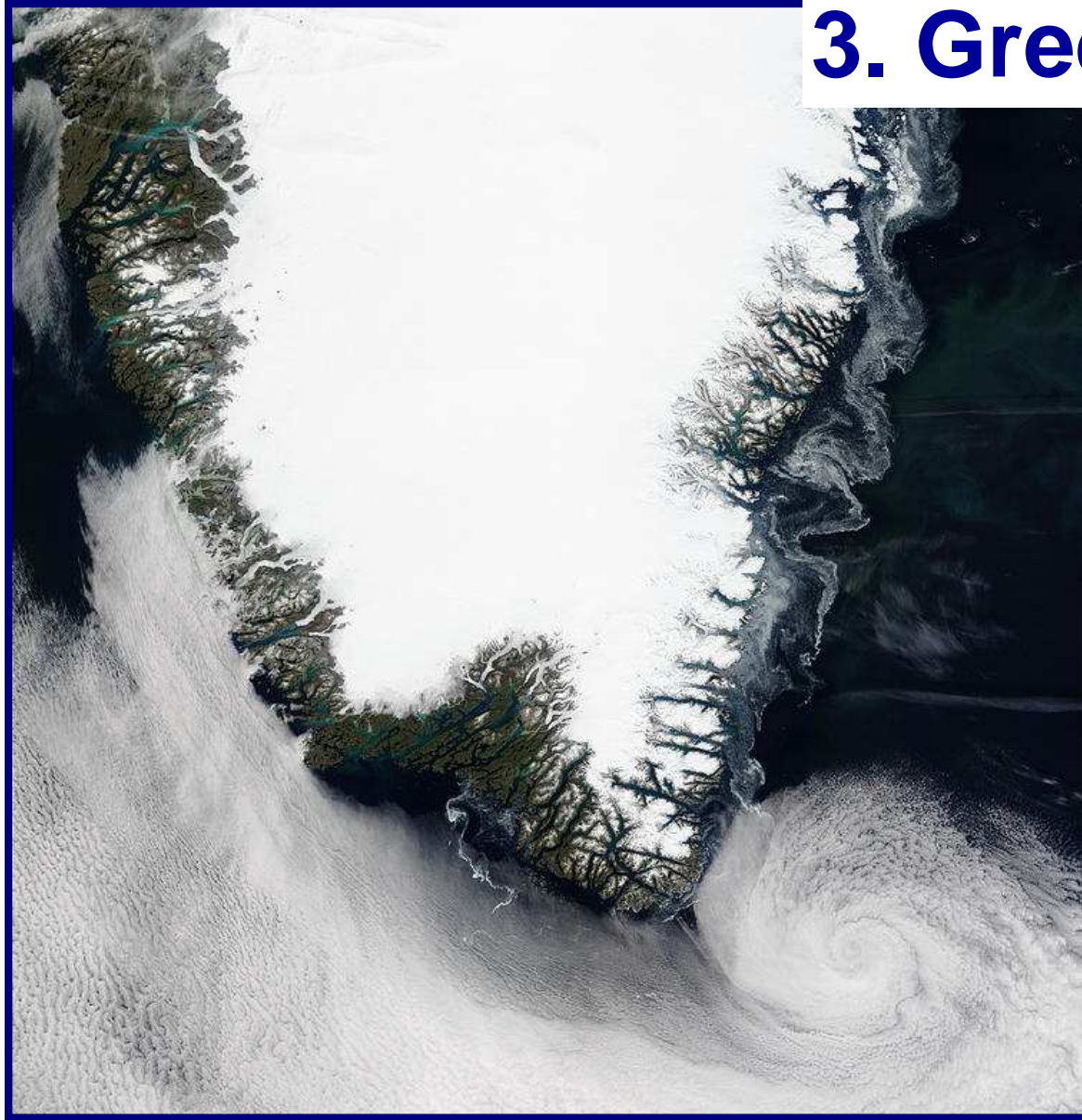
Horizontal Wind Speed



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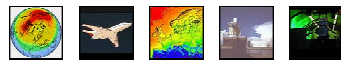
# 3. Greenland Tip Jet



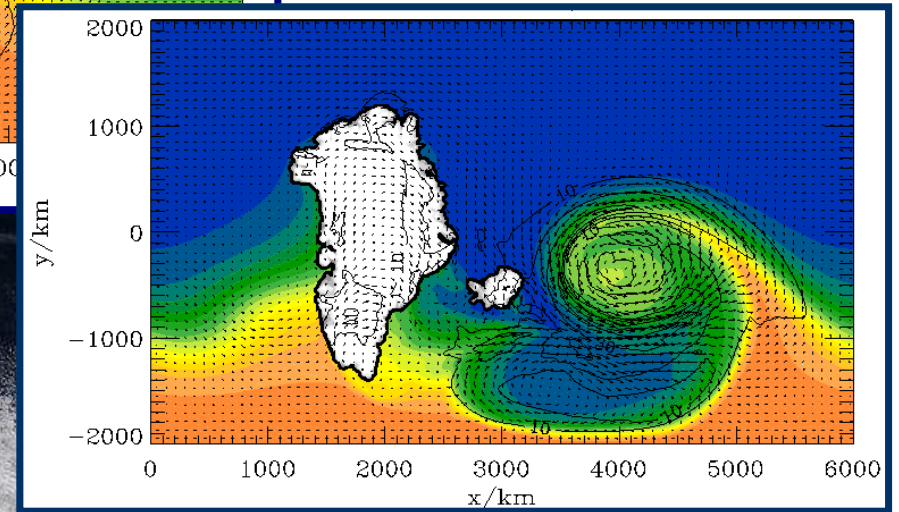
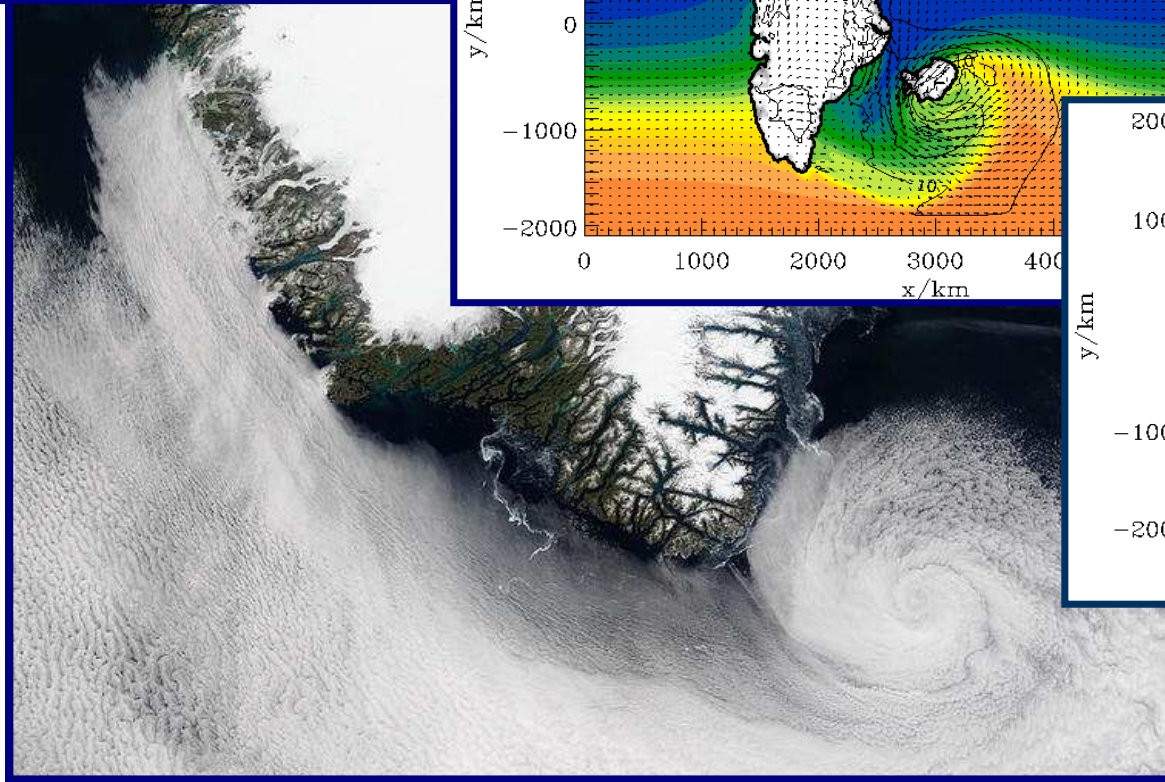
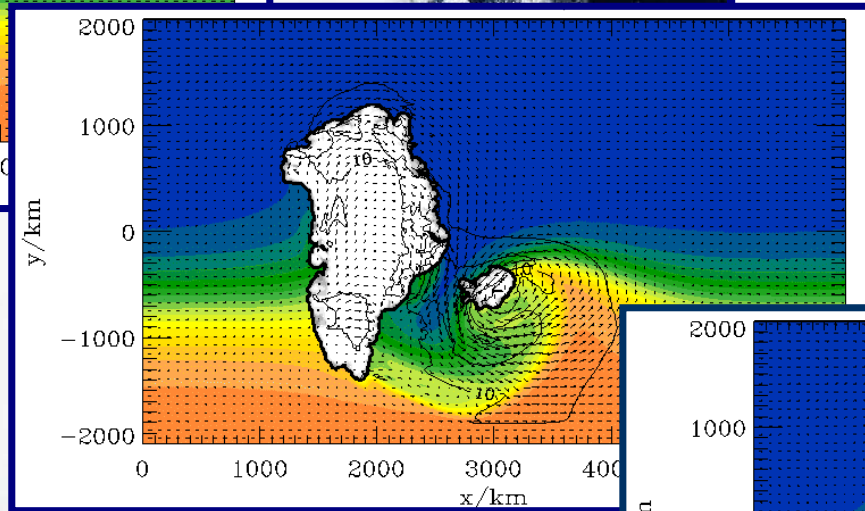
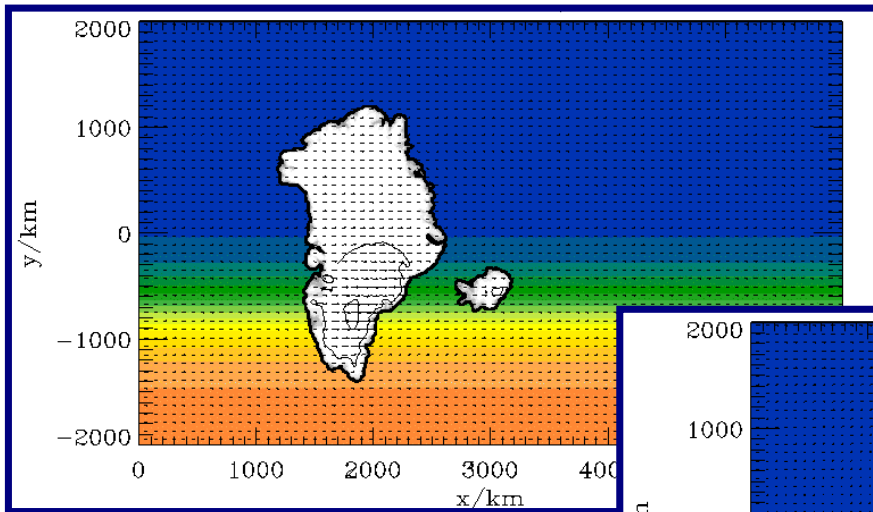
27 July 2002 1425 UTC (MODIS Terra)

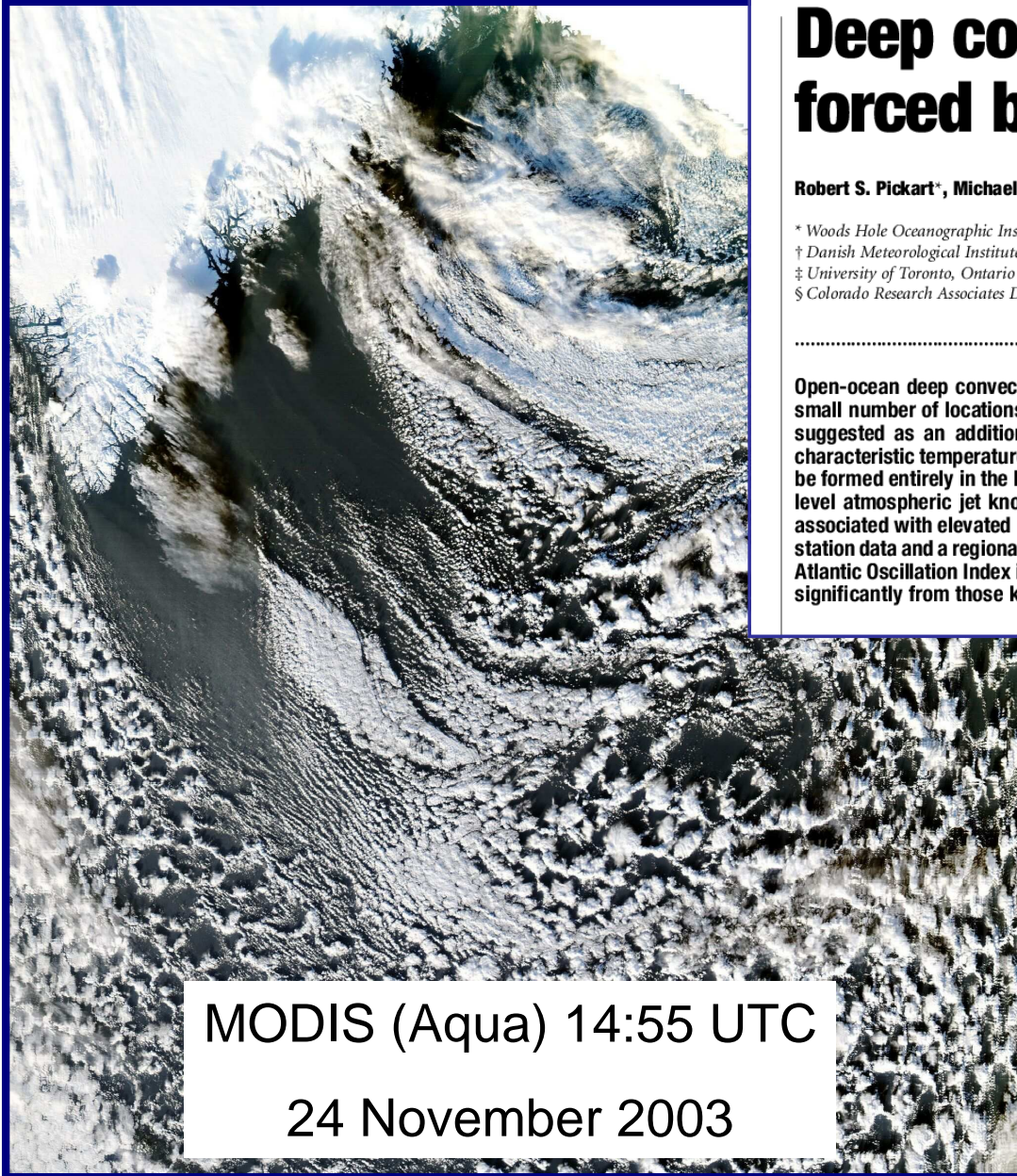


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# 3. Greenland Tip Jet





## articles

# Deep convection in the Irminger Sea forced by the Greenland tip jet

Robert S. Pickart\*, Michael A. Spall\*, Mads Hvid Ribergaard†, G. W. K. Moore‡ & Ralph F. Milliff§

\* Woods Hole Oceanographic Institution, Woods Hole, Massachusetts 02543, USA

† Danish Meteorological Institute, Copenhagen DK-2100, Denmark

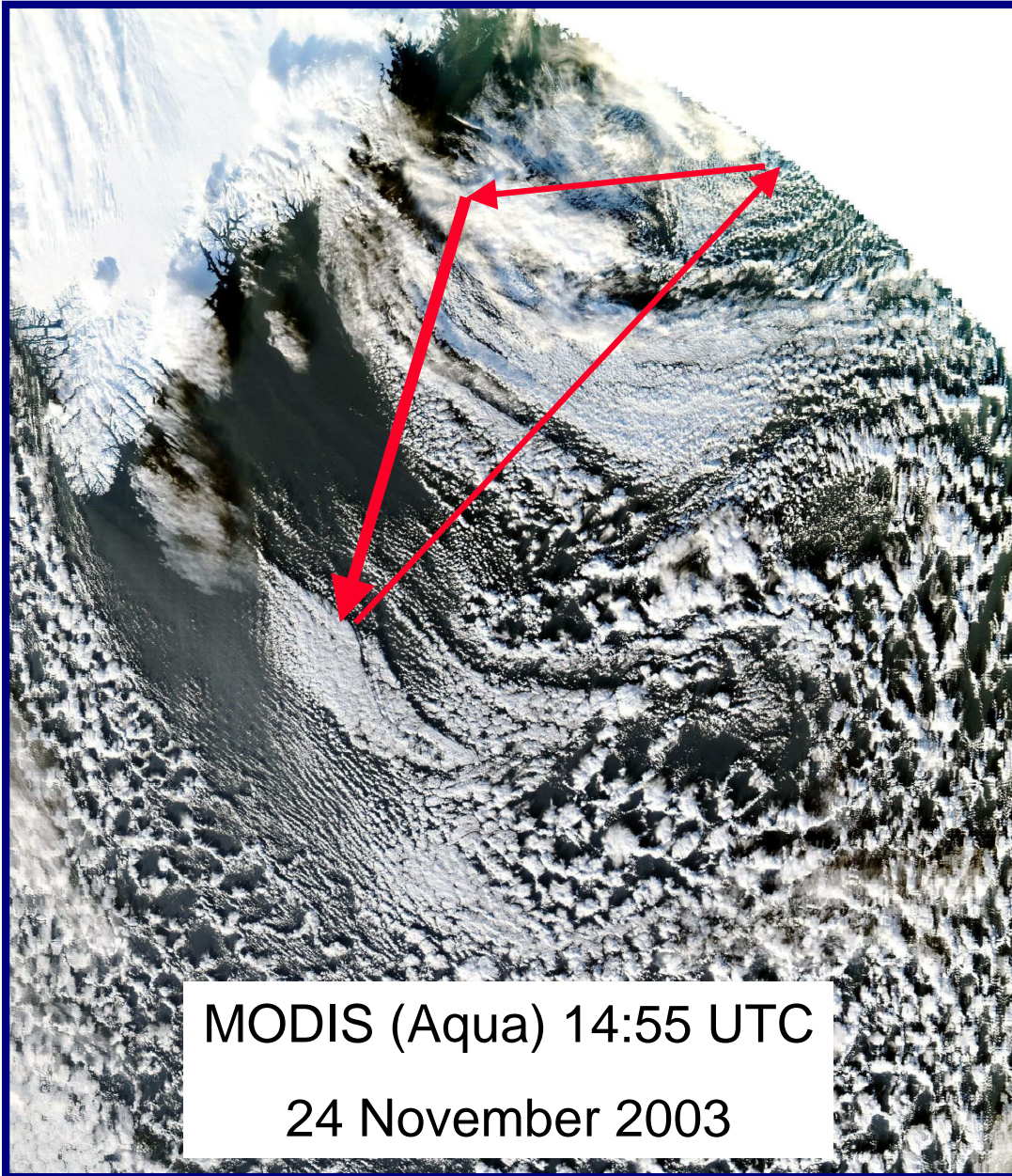
‡ University of Toronto, Ontario M5s 1A1, Canada

§ Colorado Research Associates Division, NWRA, Boulder, Colorado 80301, USA

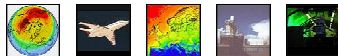
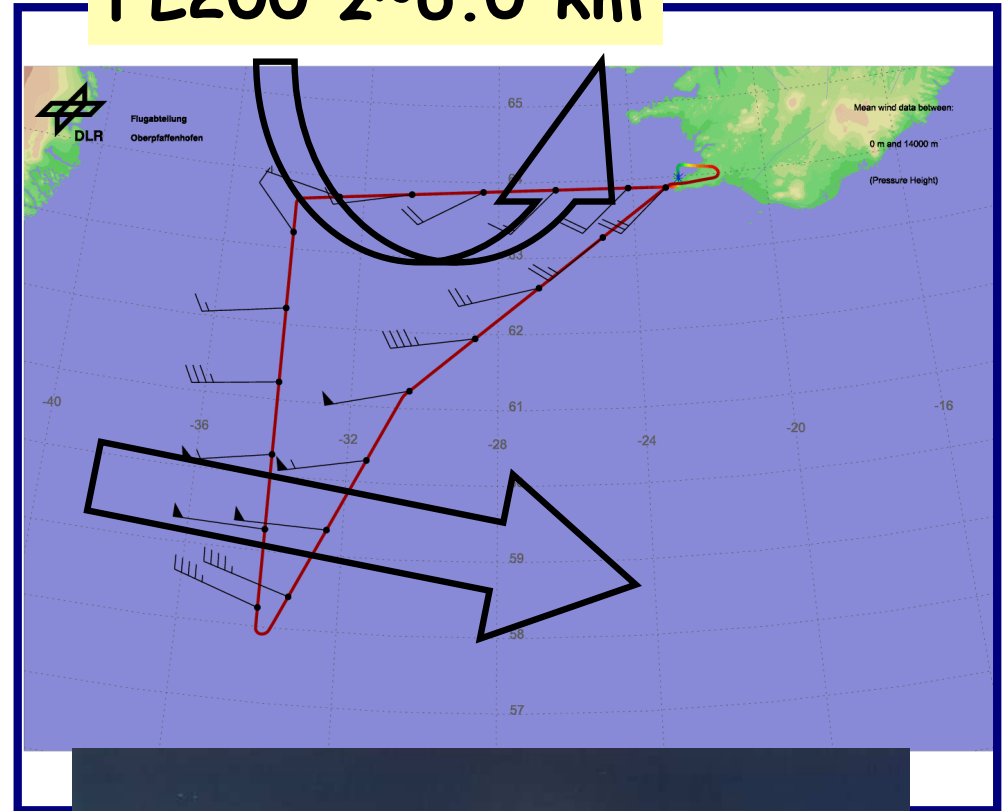
Open-ocean deep convection, one of the processes by which deep waters of the world's oceans are formed, is restricted to a small number of locations (for example, the Mediterranean and Labrador seas). Recently, the southwest Irminger Sea has been suggested as an additional location for open-ocean deep convection. The deep water formed in the Irminger Sea has the characteristic temperature and salinity of the water mass that fills the mid-depth North Atlantic Ocean, which had been believed to be formed entirely in the Labrador basin. Here we show that the most likely cause of the convection in the Irminger Sea is a low-level atmospheric jet known as the Greenland tip jet, which forms periodically in the lee of Cape Farewell, Greenland, and is associated with elevated heat flux and strong wind stress curl. Using a history of tip-jet events derived from meteorological land station data and a regional oceanic numerical model, we demonstrate that deep convection can occur in this region when the North Atlantic Oscillation Index is high, which is consistent with observations. This mechanism of convection in the Irminger Sea differs significantly from those known to operate in the Labrador and Mediterranean seas.

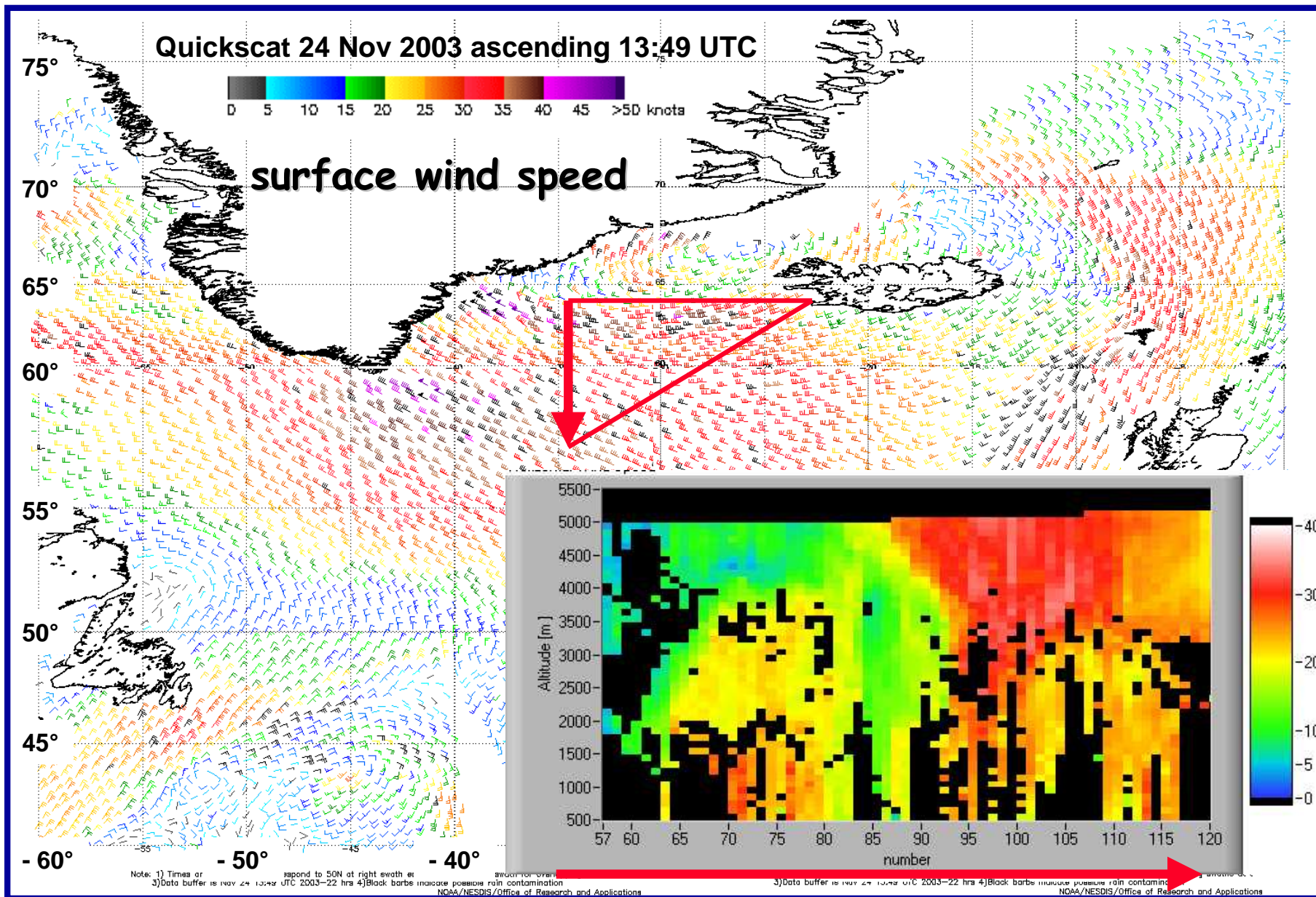
nature 424 (2003) 152-156

# Greenland Tip Jet - DLR Wind Lidar observation



FL200 z~6.0 km

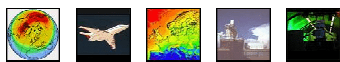


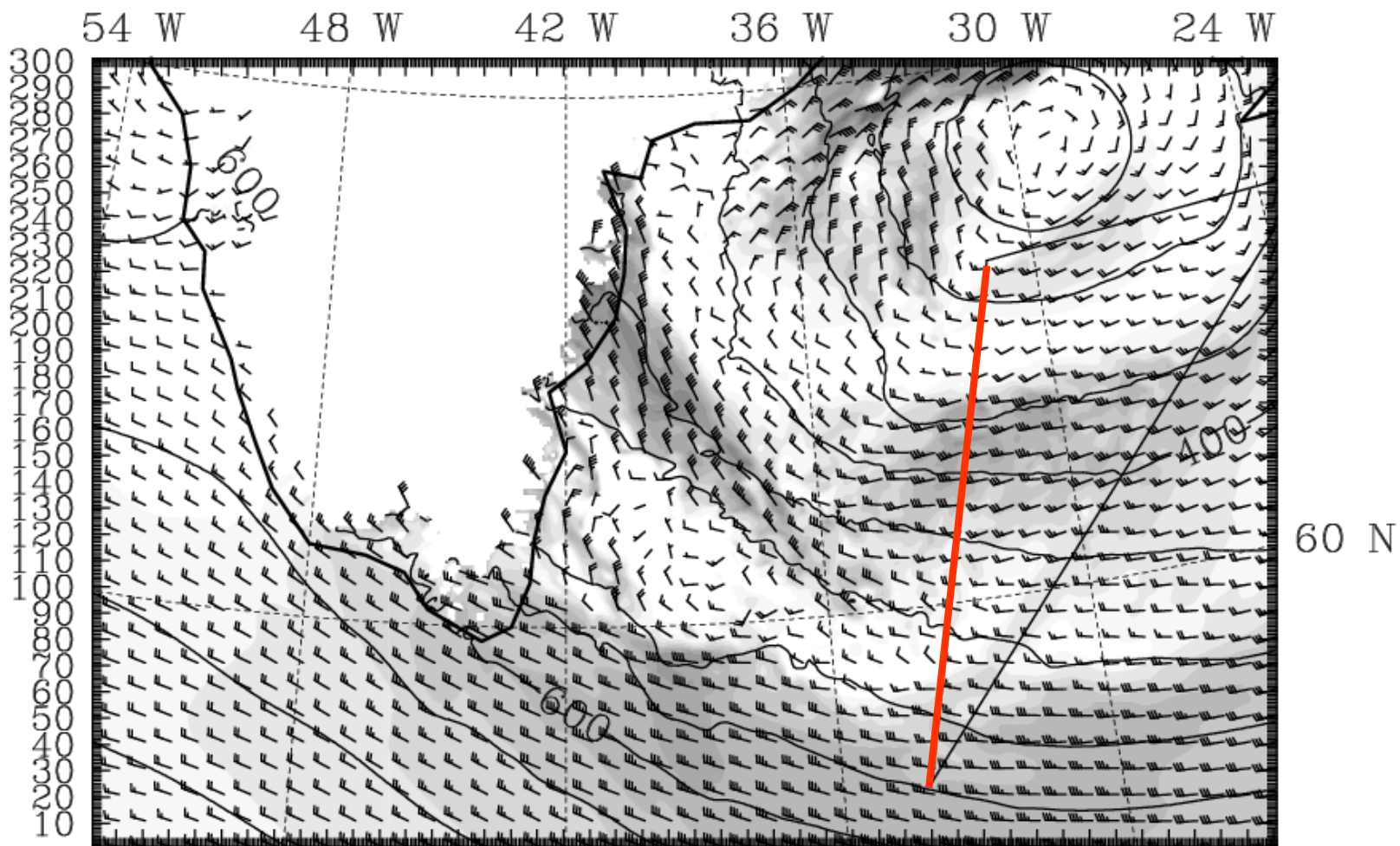


Wind speed (m/s) by DLR Doppler Wind Lidar  
between 1230 and 1330 UTC



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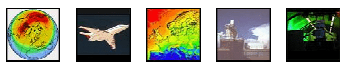




**24 November 2003 12 UTC Wind and Geopotential at 925 hPa**



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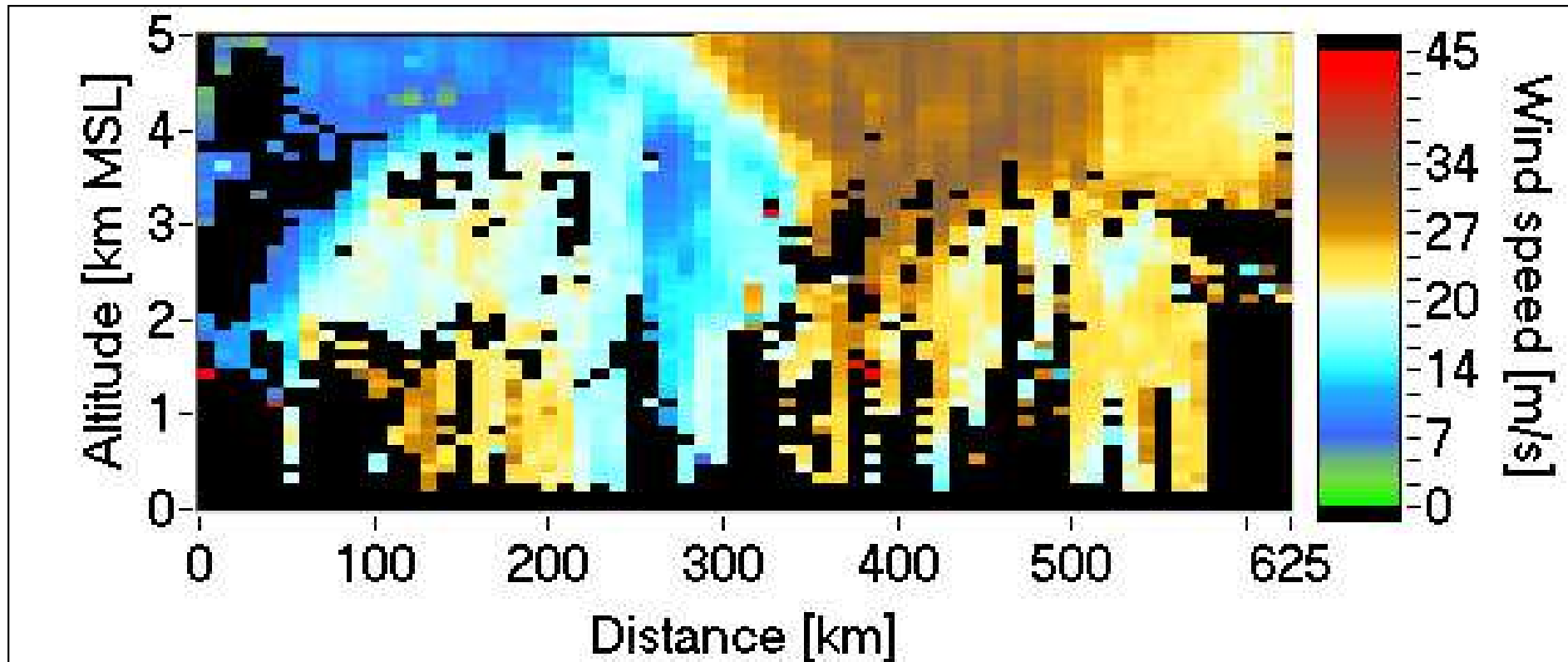


**MM5 Simulation ( $\Delta x=27,9,3$  km,  $\Delta z=150$ m)**



North

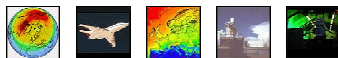
South



## Horizontal Wind Speed - Wind Lidar (One Scanner Revolution)

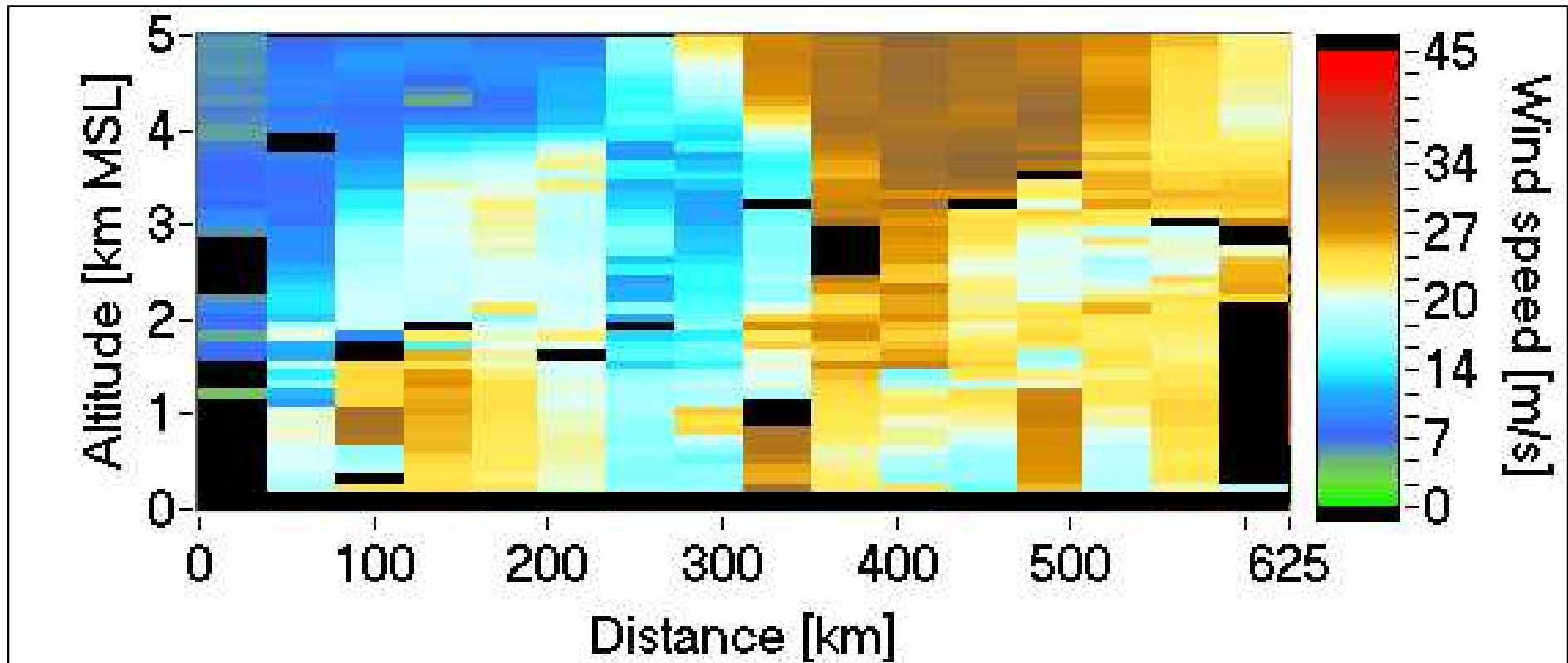


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North

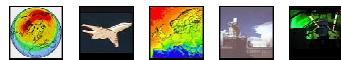
South



## Horizontal Wind Speed - Wind Lidar (Four Scanner Revolution)

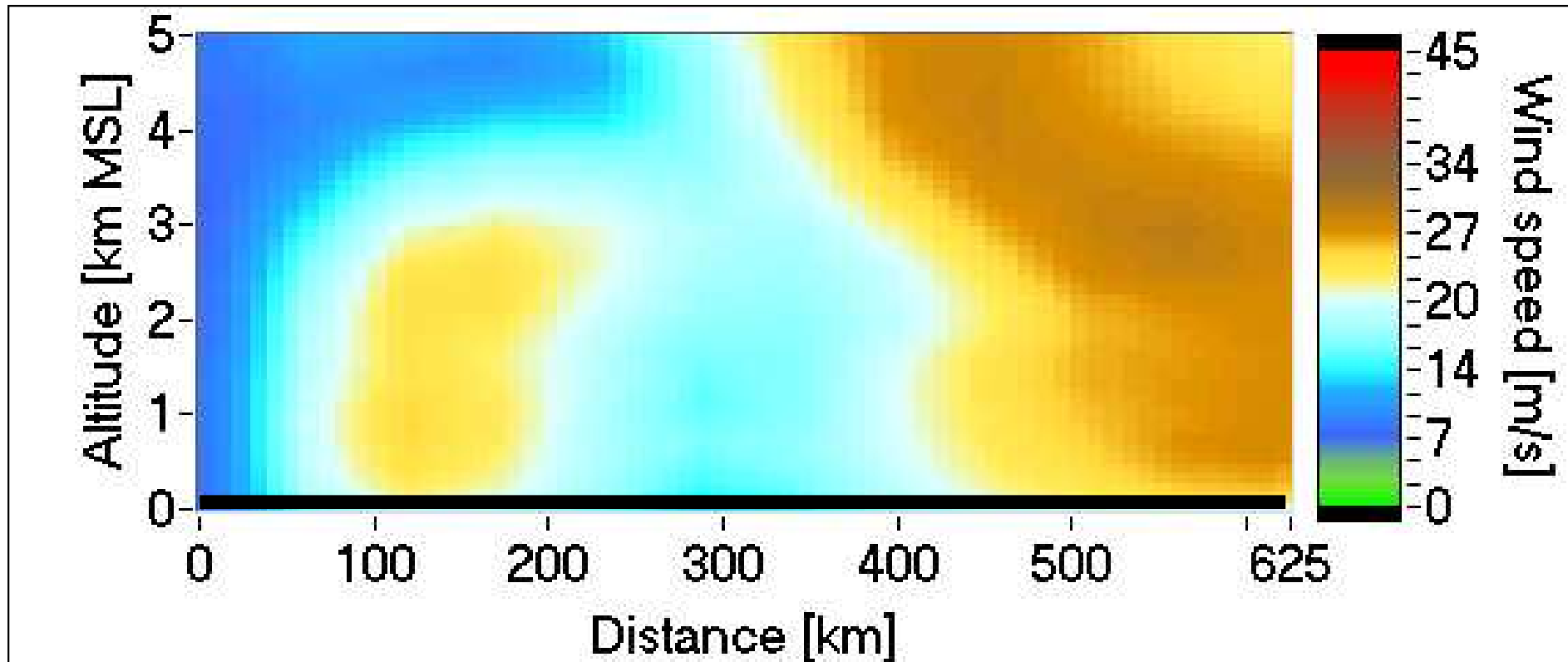


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North

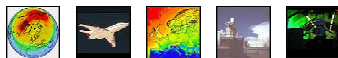
South



## Horizontal Wind Speed - ECMWF T511/L60 Operational Analysis

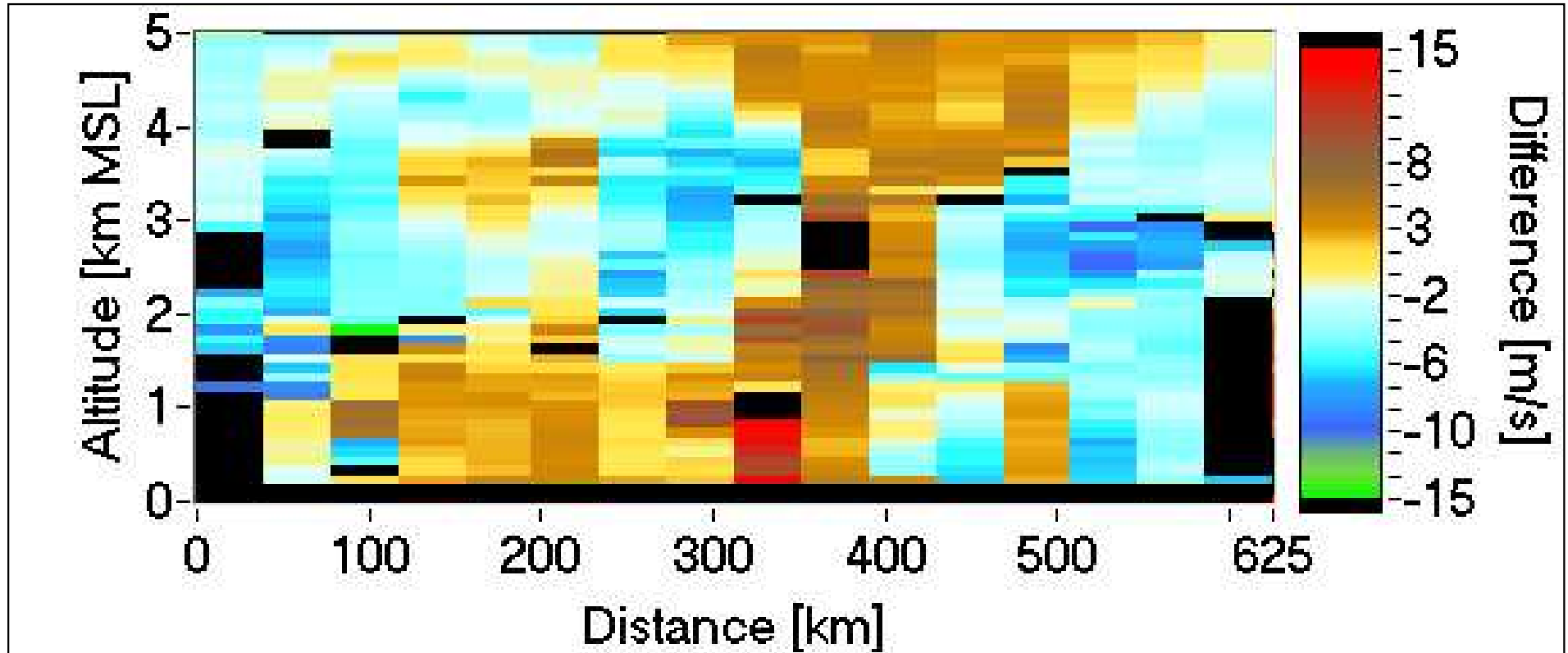


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North

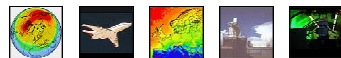
South



Horizontal Wind Speed -  $\Delta$  LIDAR-ECMWF



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# RESULTS

First DLR Falcon targeting mission

Dropsonde data transmitted in near real time into GTS

- data were transferred via DLR/ECMWF/UK MetOffice
- for future missions setup of direct transfer via DWD

Comprehensive data set of wind lidar and dropsonde data

- data assimilation studies (ECMWF, ADM)
- ENVISAT SAR validation
- case studies (tip jet)

Looking forward to  
further targeting missions with

Dropsondes + in-situ data

2 $\mu$ m Doppler wind lidar +  
Water vapor DIAL

During COPS

