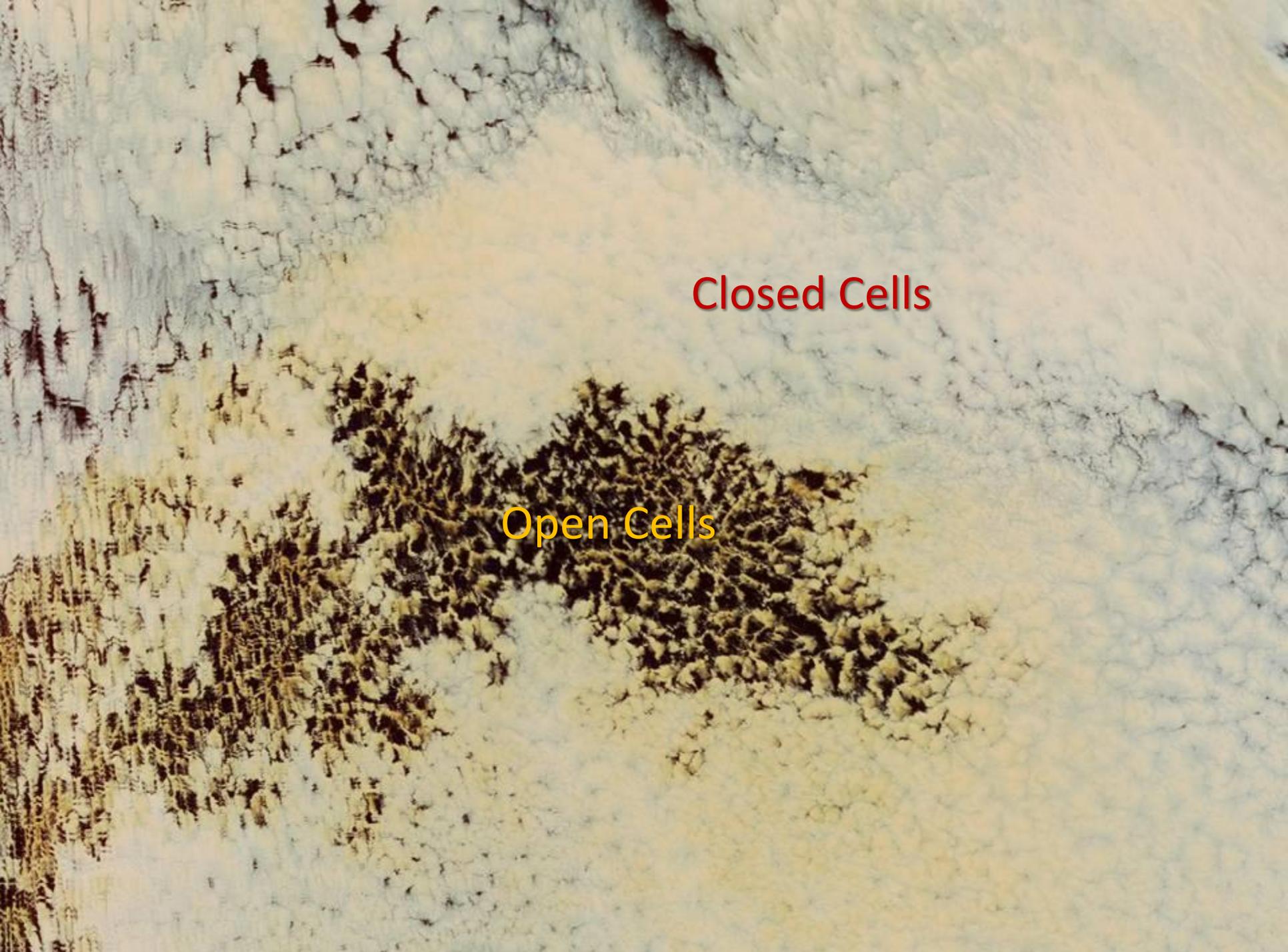


Remote sensing of aerosol interactions with marine stratocumulus:

Cloud radiative effects or forcing?

Daniel Rosenfeld and Tom Goren
The Hebrew University of Jerusalem

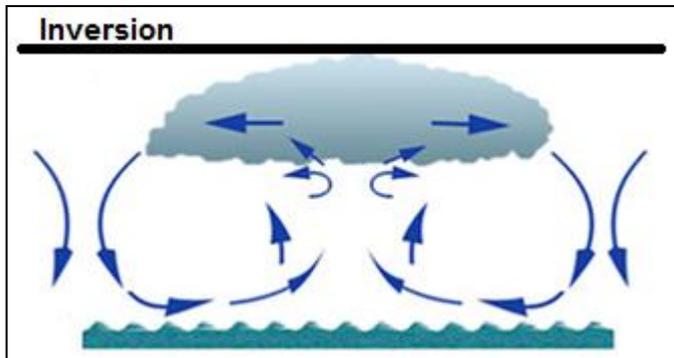


A microscopic image of wood tissue showing two types of cells. The upper portion of the image shows a dense layer of cells with thick, dark walls and small, rounded lumens, labeled as 'Closed Cells'. The lower portion shows a more porous structure with larger, irregular lumens and thinner walls, labeled as 'Open Cells'. The overall color is a mix of light tan and dark brown.

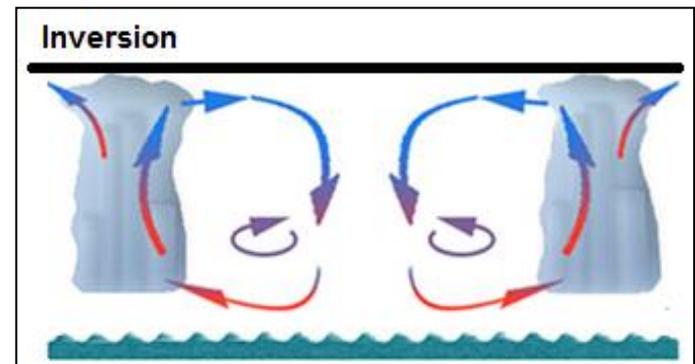
Closed Cells

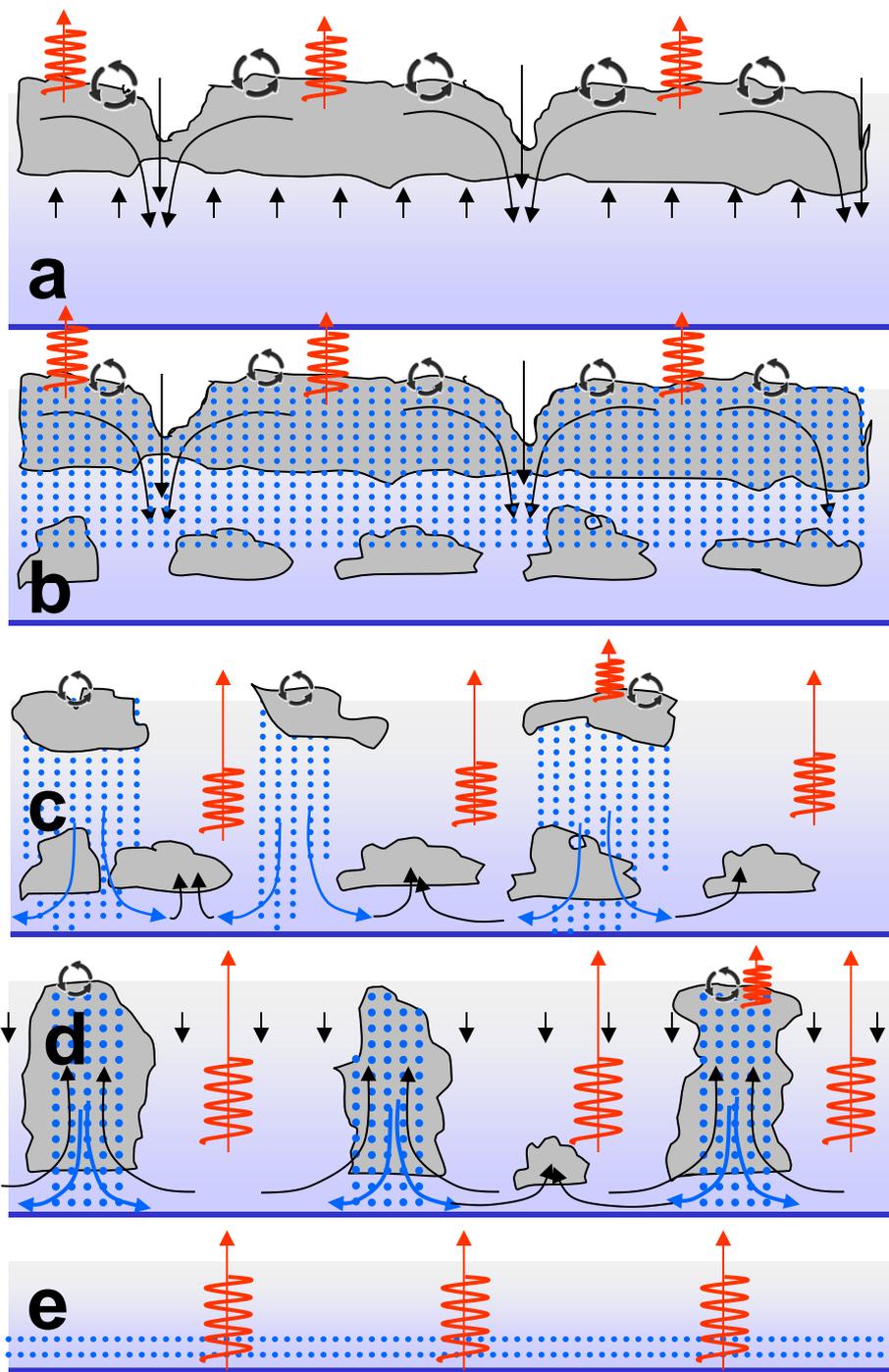
Open Cells

Closed cells



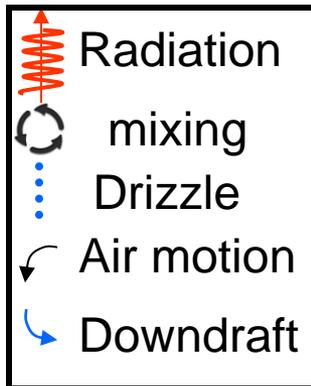
Open cells





Closed
Benard
Cells

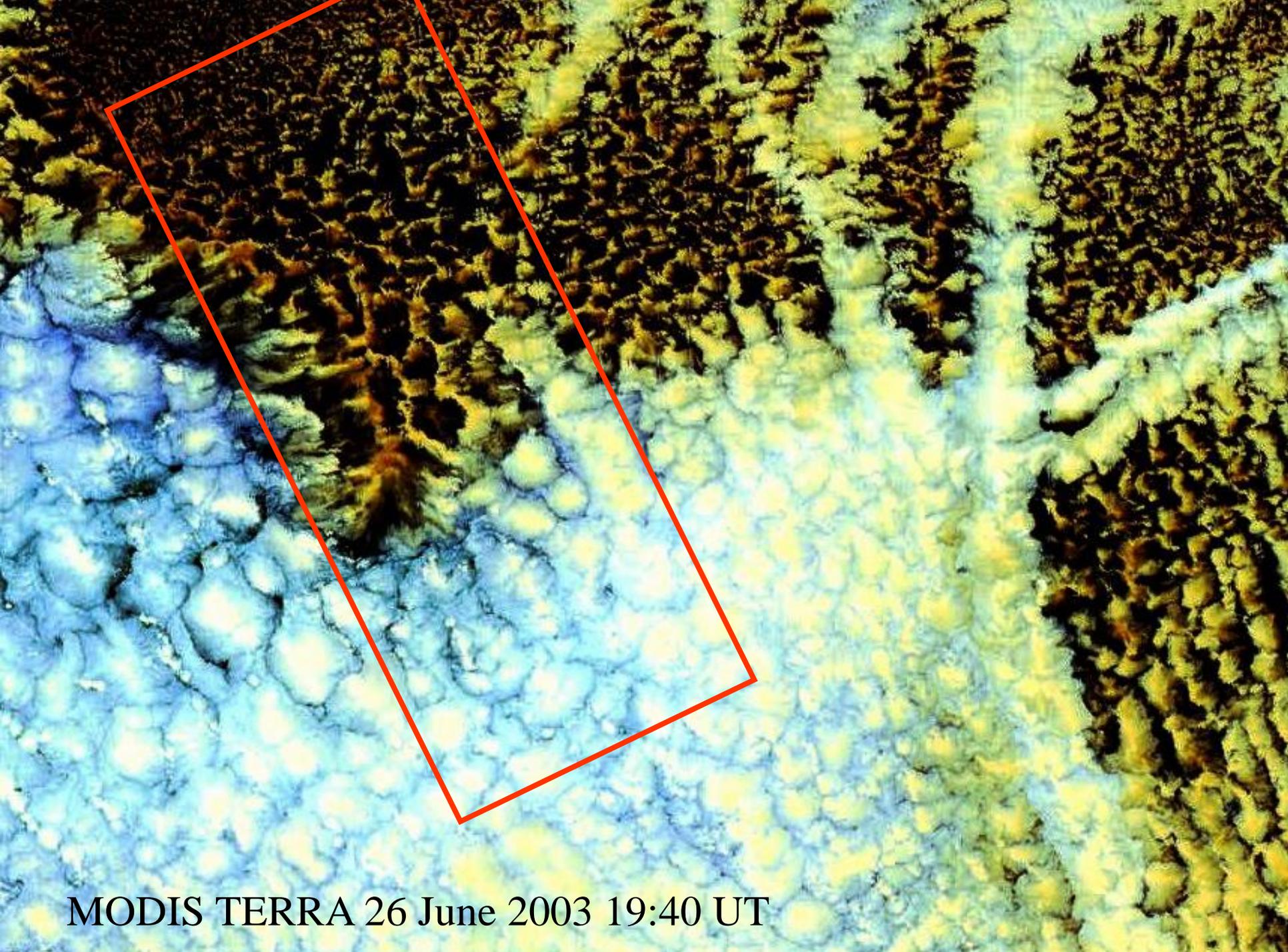
Transition



Open
Benard
Cells

Collapsed
Boundary
Layer





MODIS TERRA 26 June 2003 19:40 UT

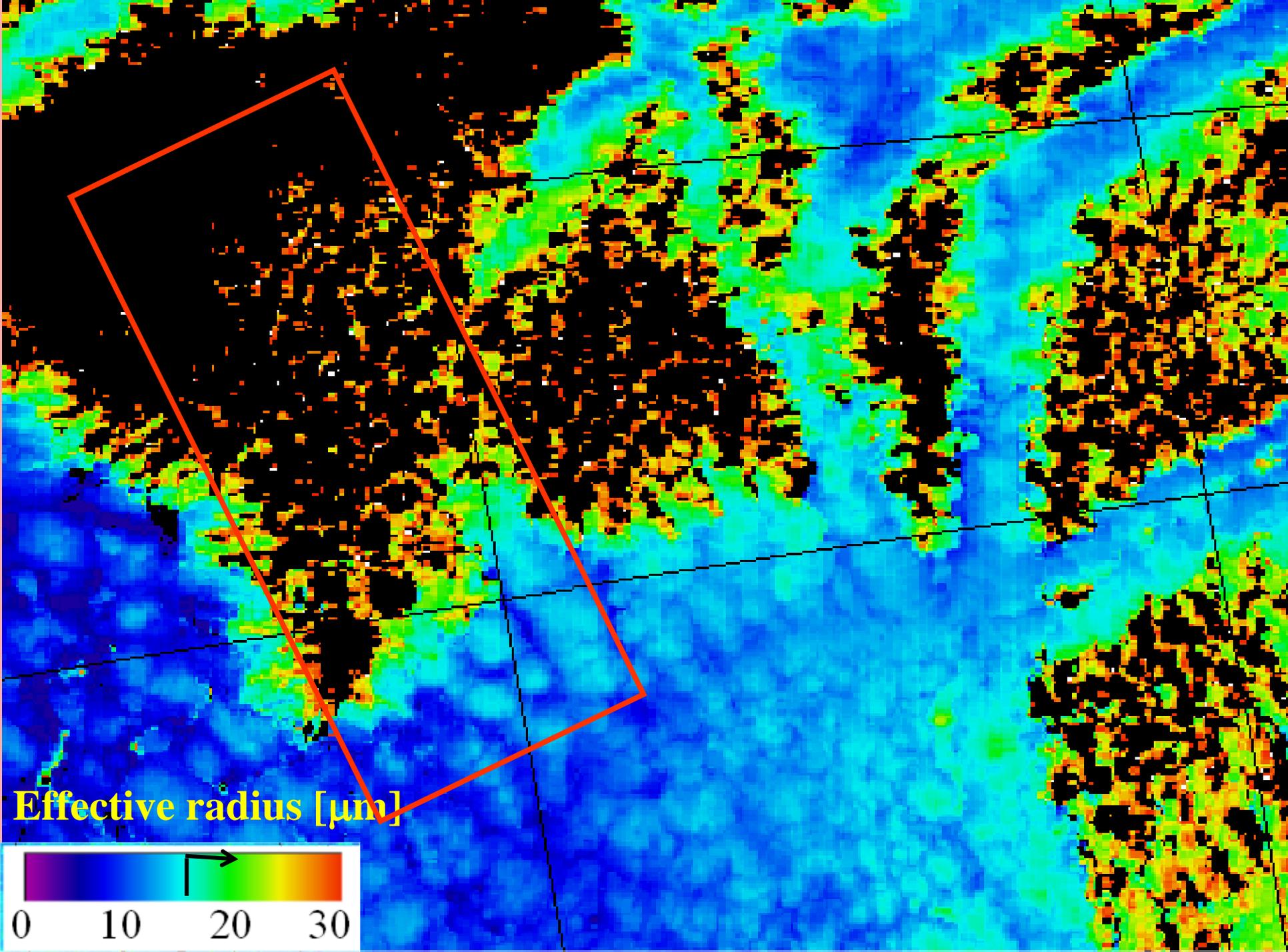




Photo: Joseph Prospero



Photo: Joseph Prospero



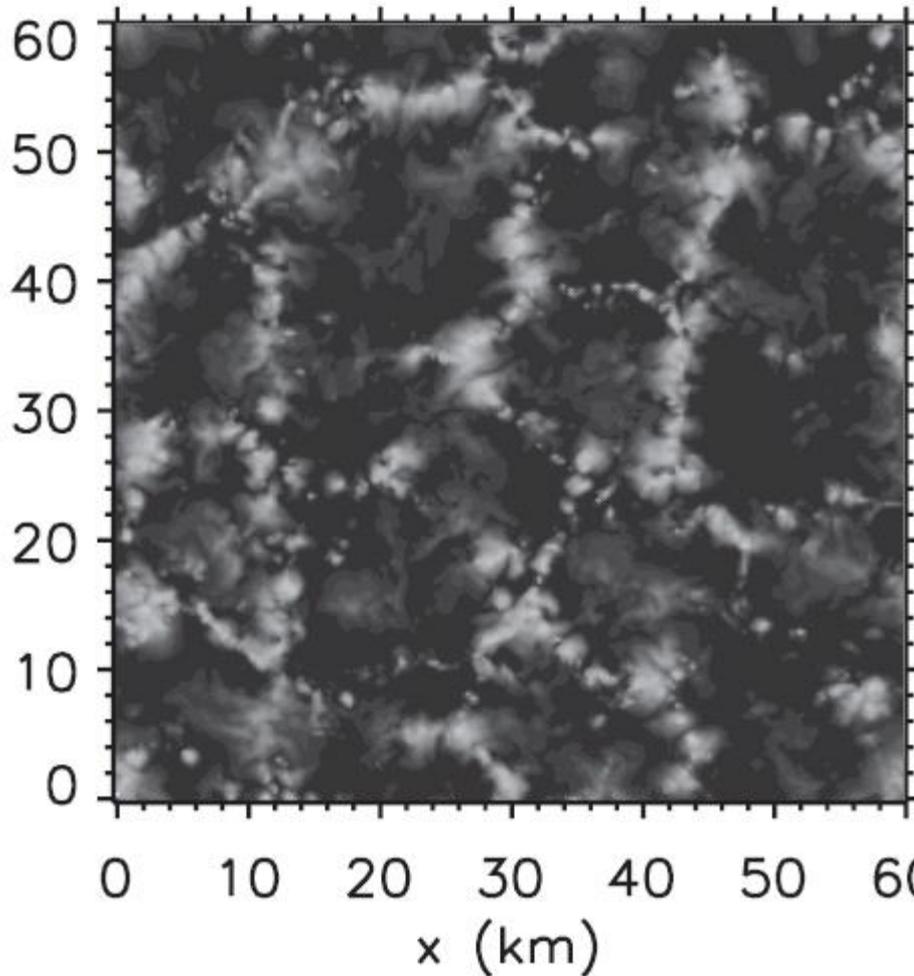
Photo: Joseph Prospero



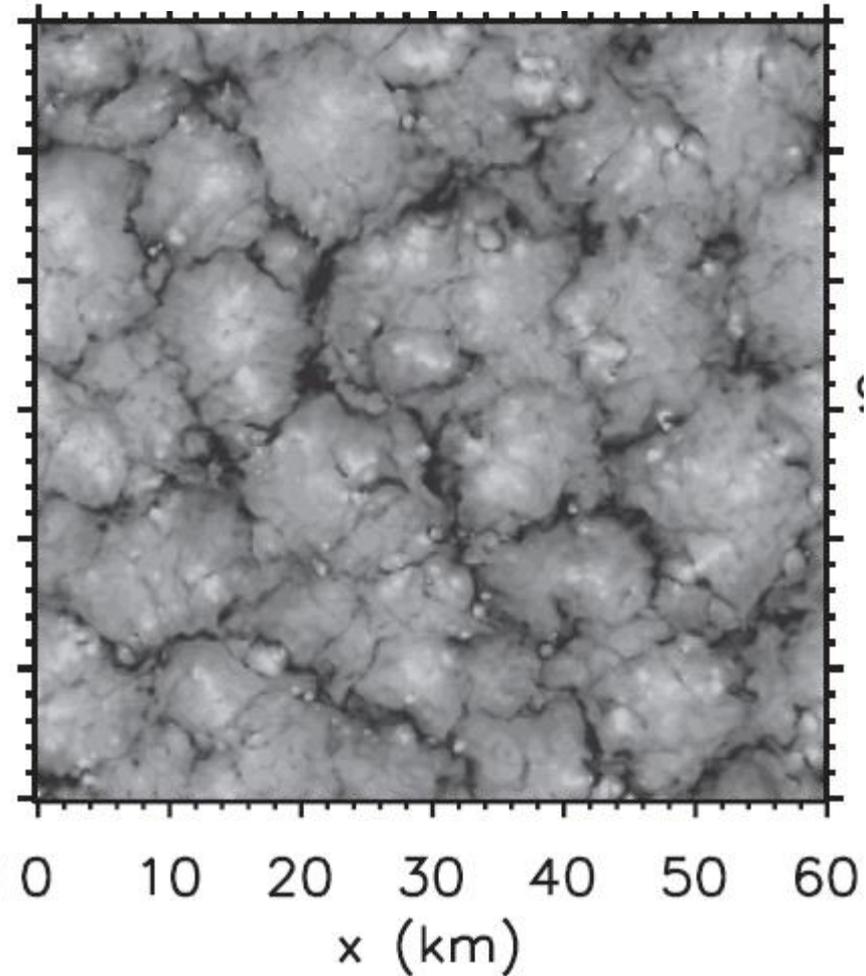
Photo: Joseph Prospero

Simulations of CCN controlling cloud regimes

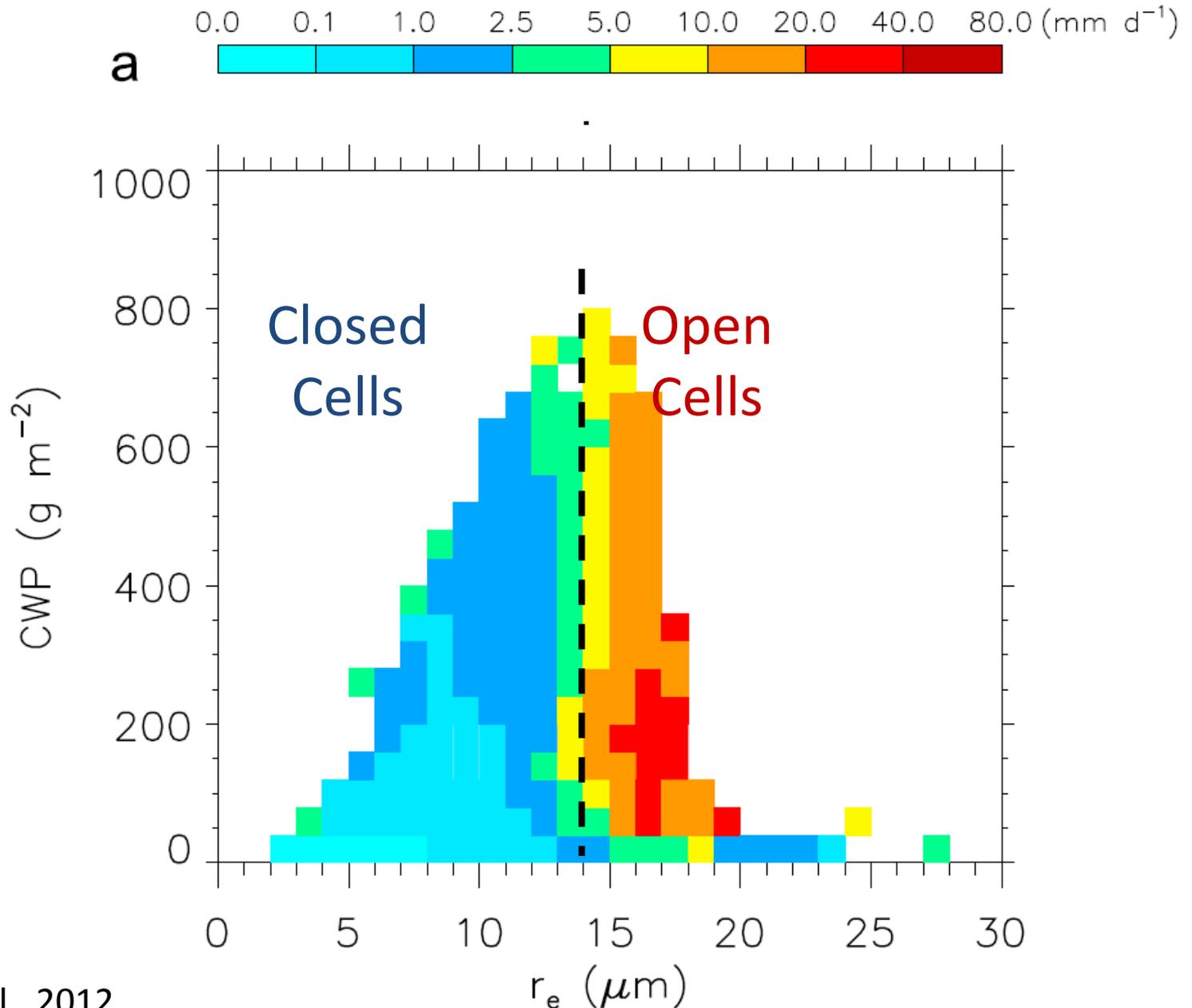
CCN=65 (cm^{-3})



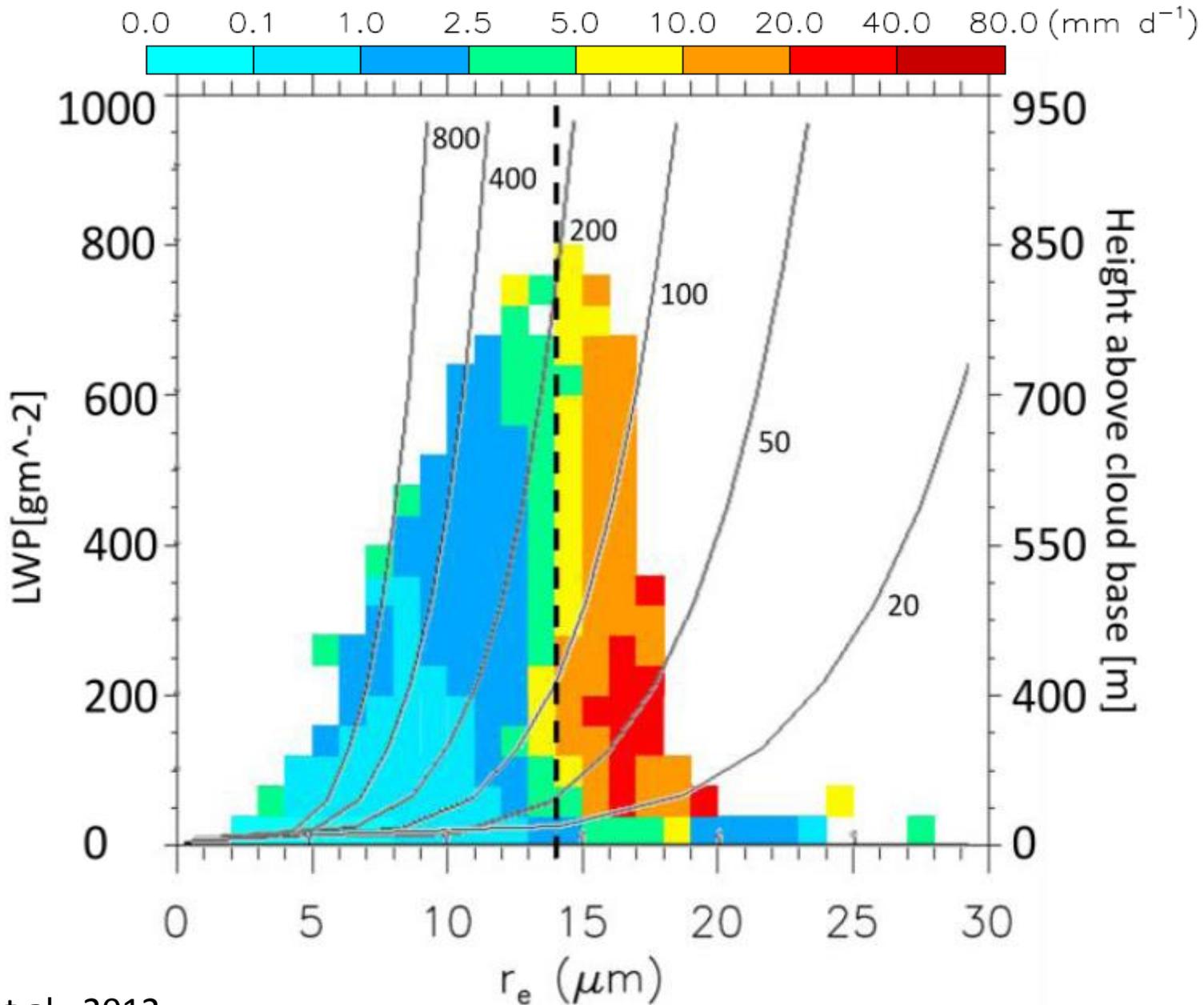
CCN=500 (cm^{-3})

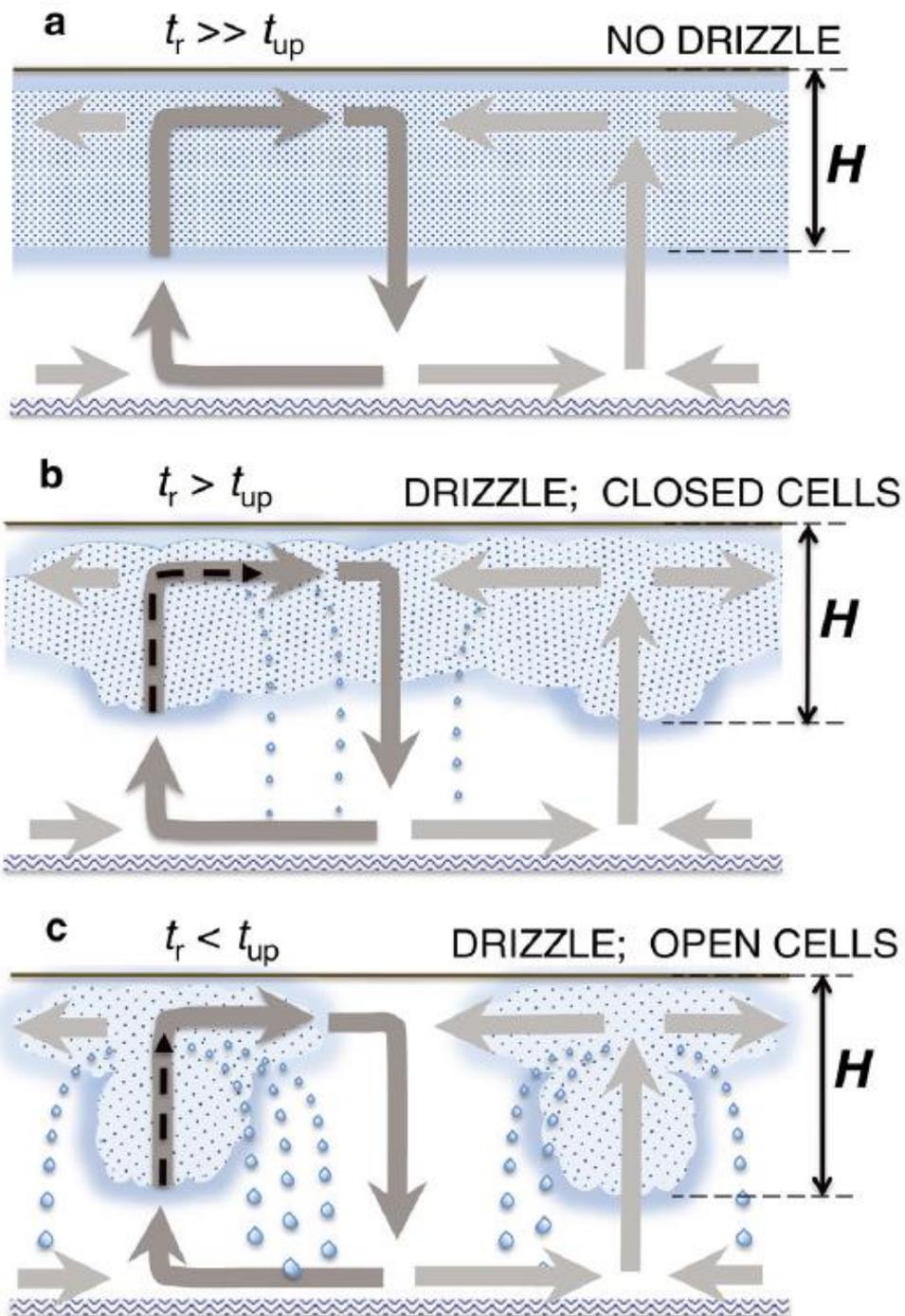


Threshold Re for rain initiation

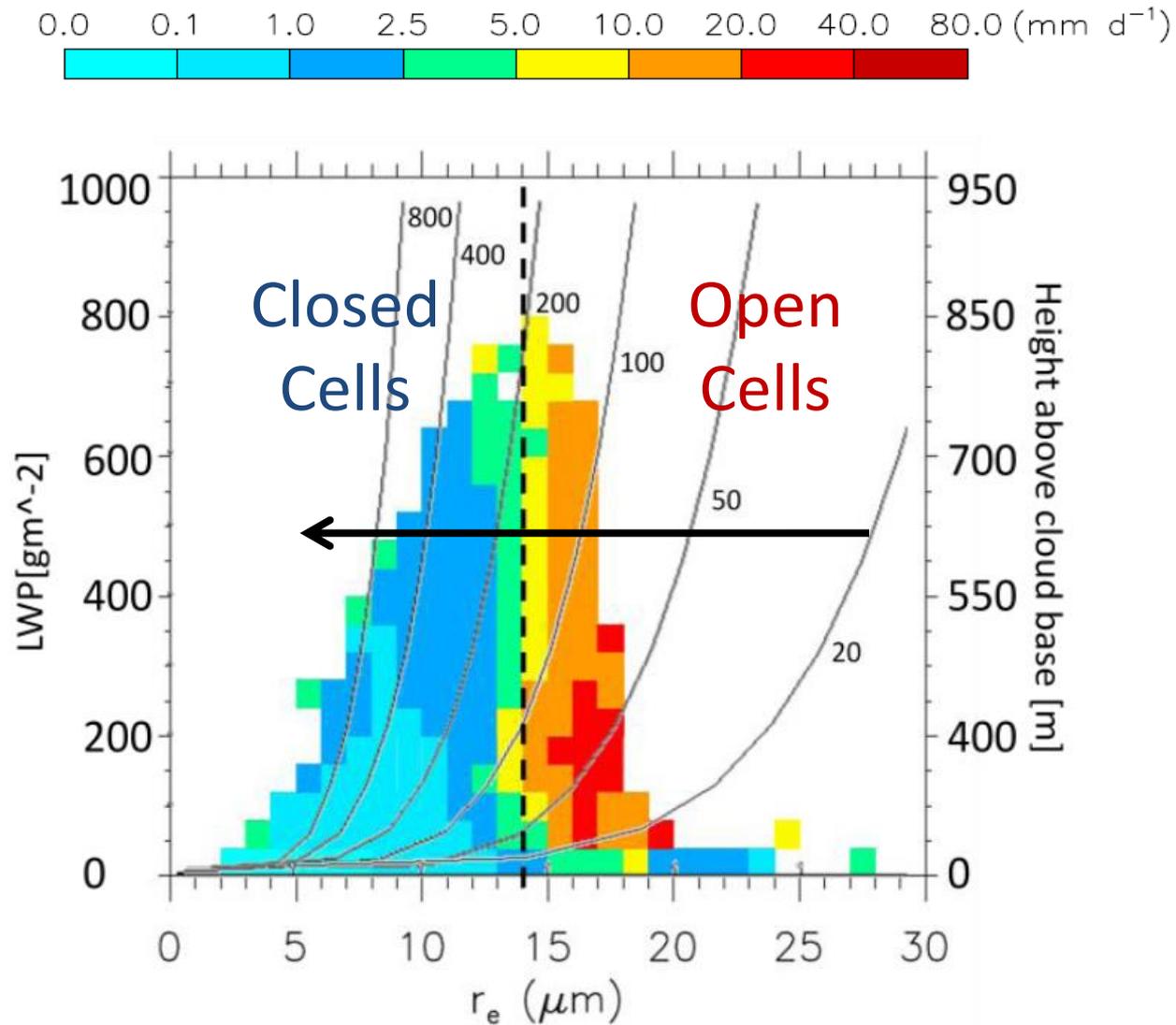


Aerosols control rain initiation

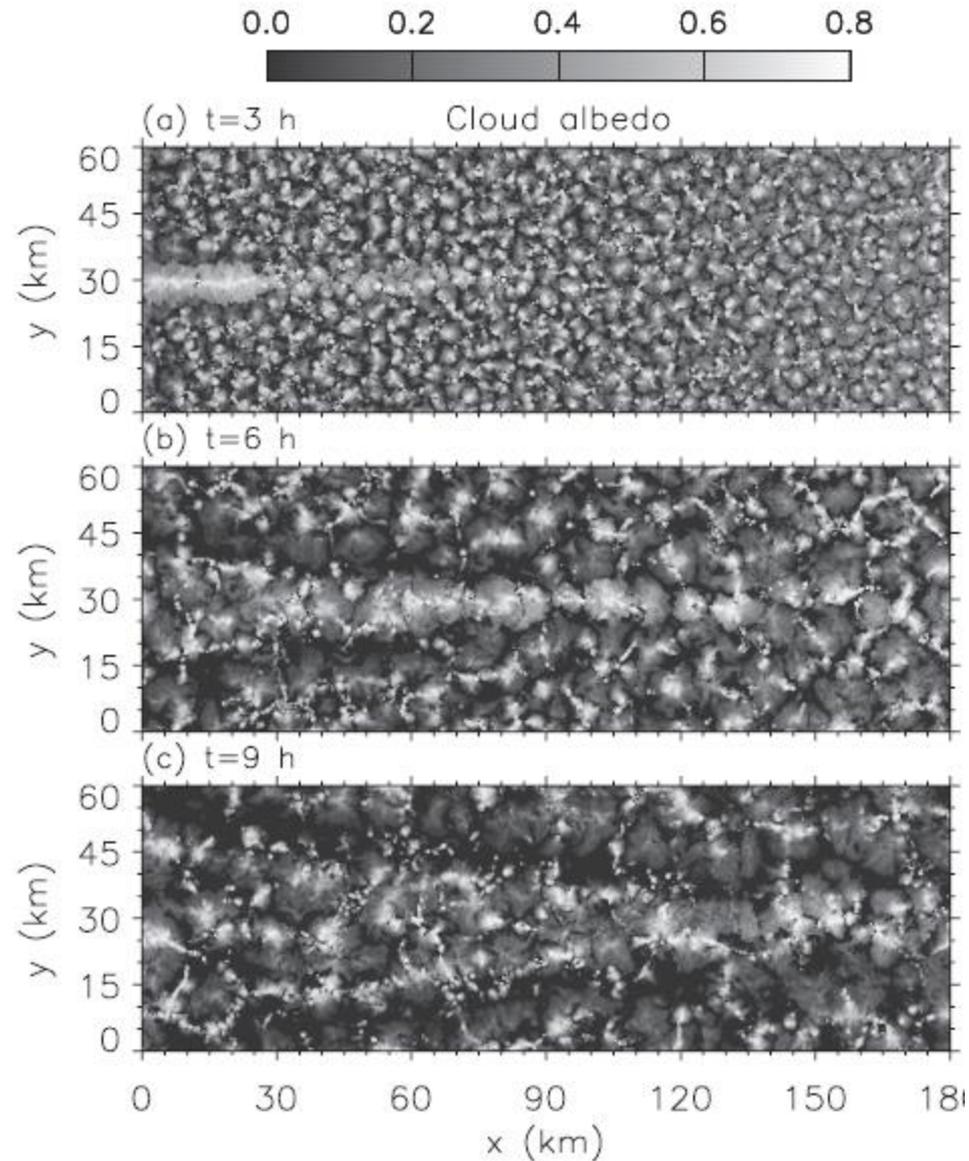




Can aerosols close open cells?

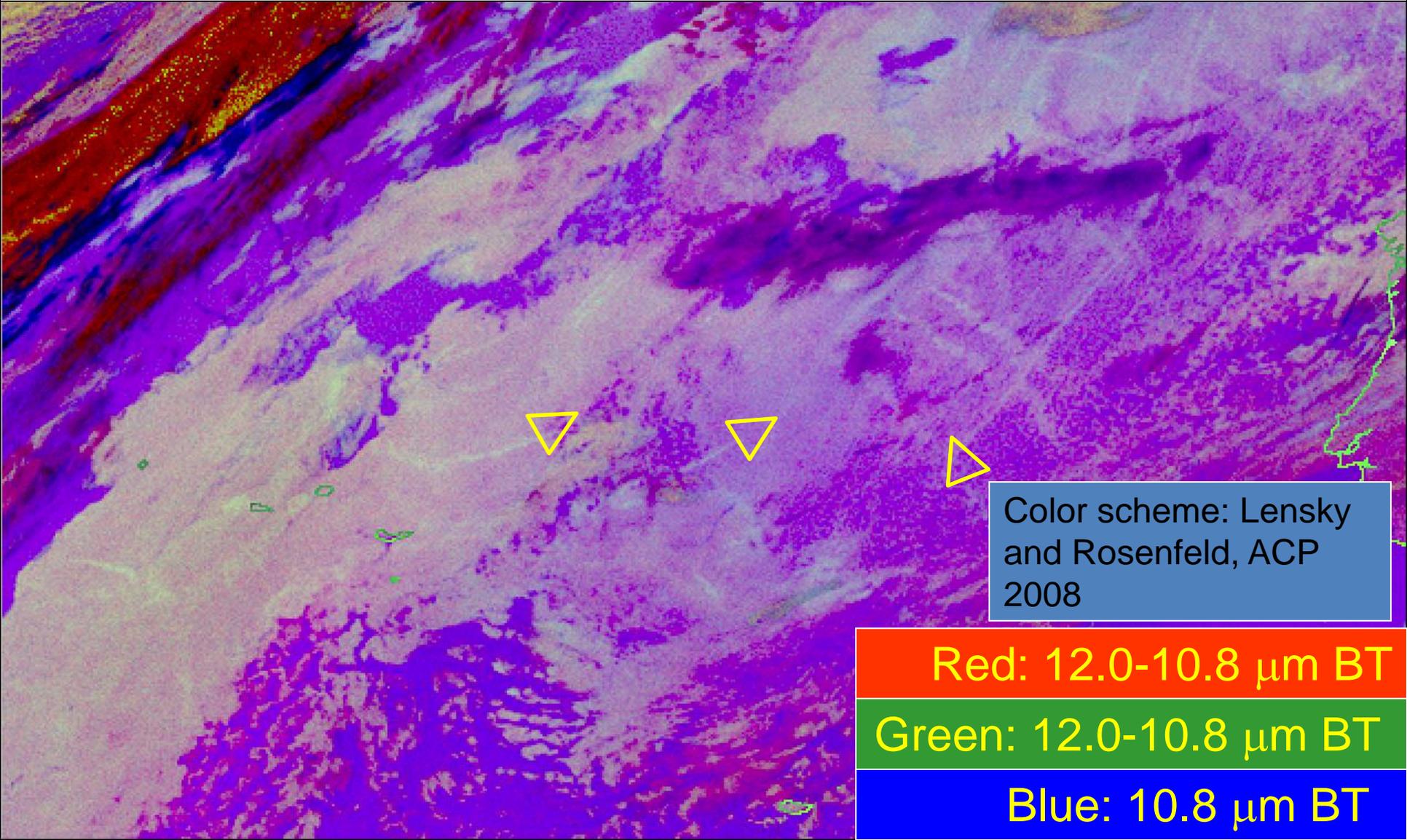


Simulation of ship tracks



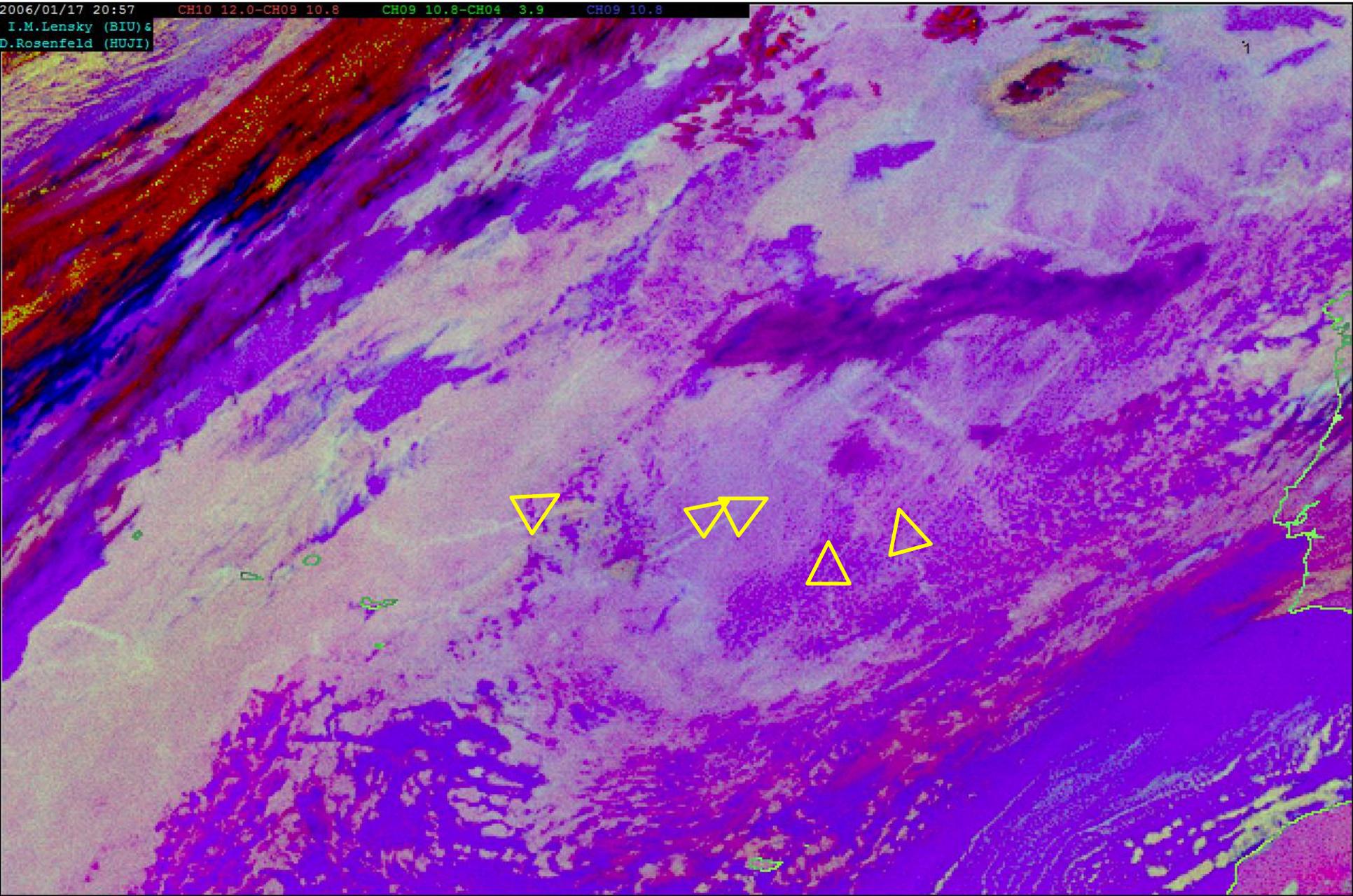
Temporal evolution and longevity of ship tracks

17/1/2006
19:57 MSG



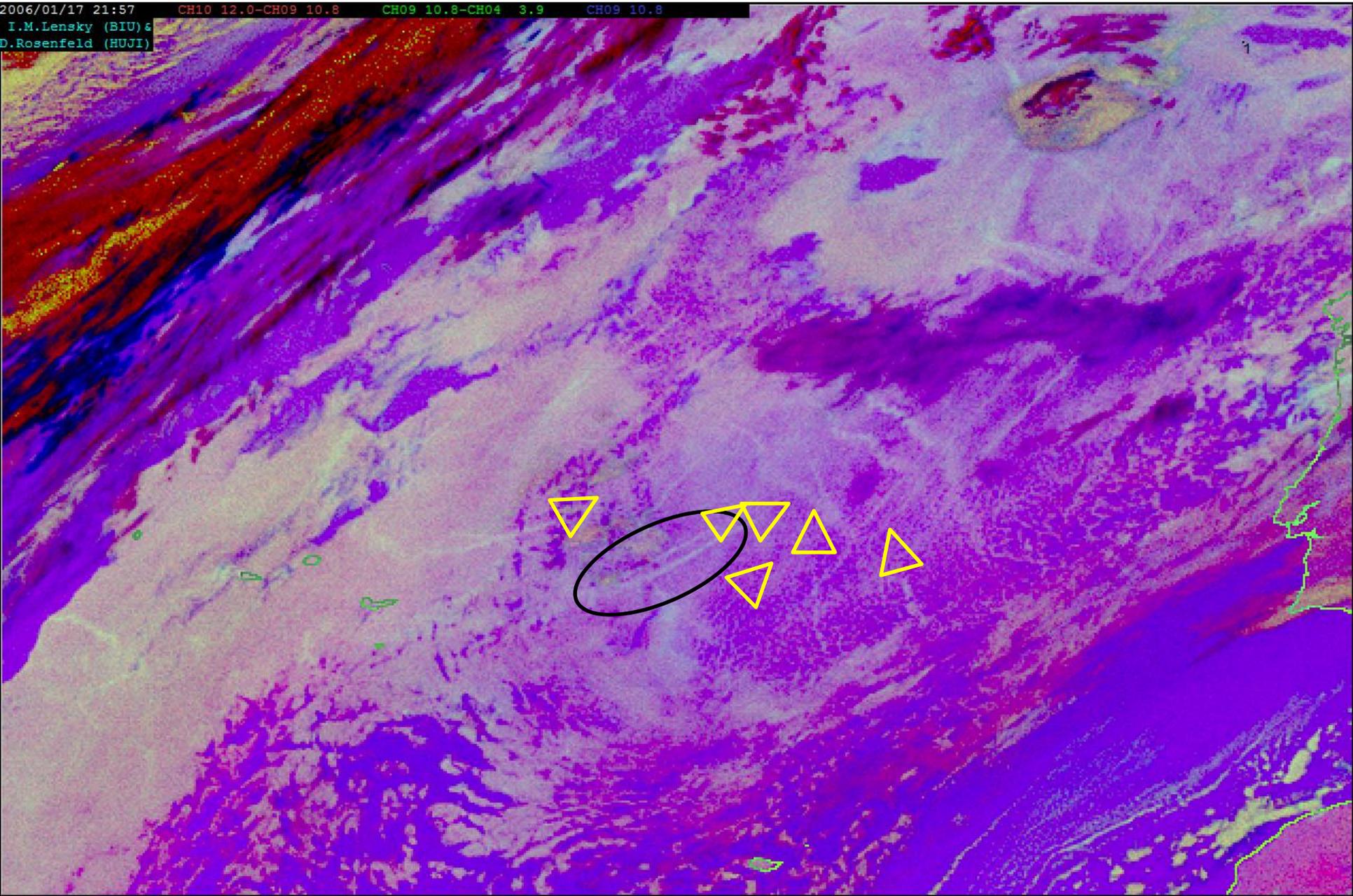
17/1/2006
20:57 MSG

2006/01/17 20:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



17/1/2006
21:57 MSG

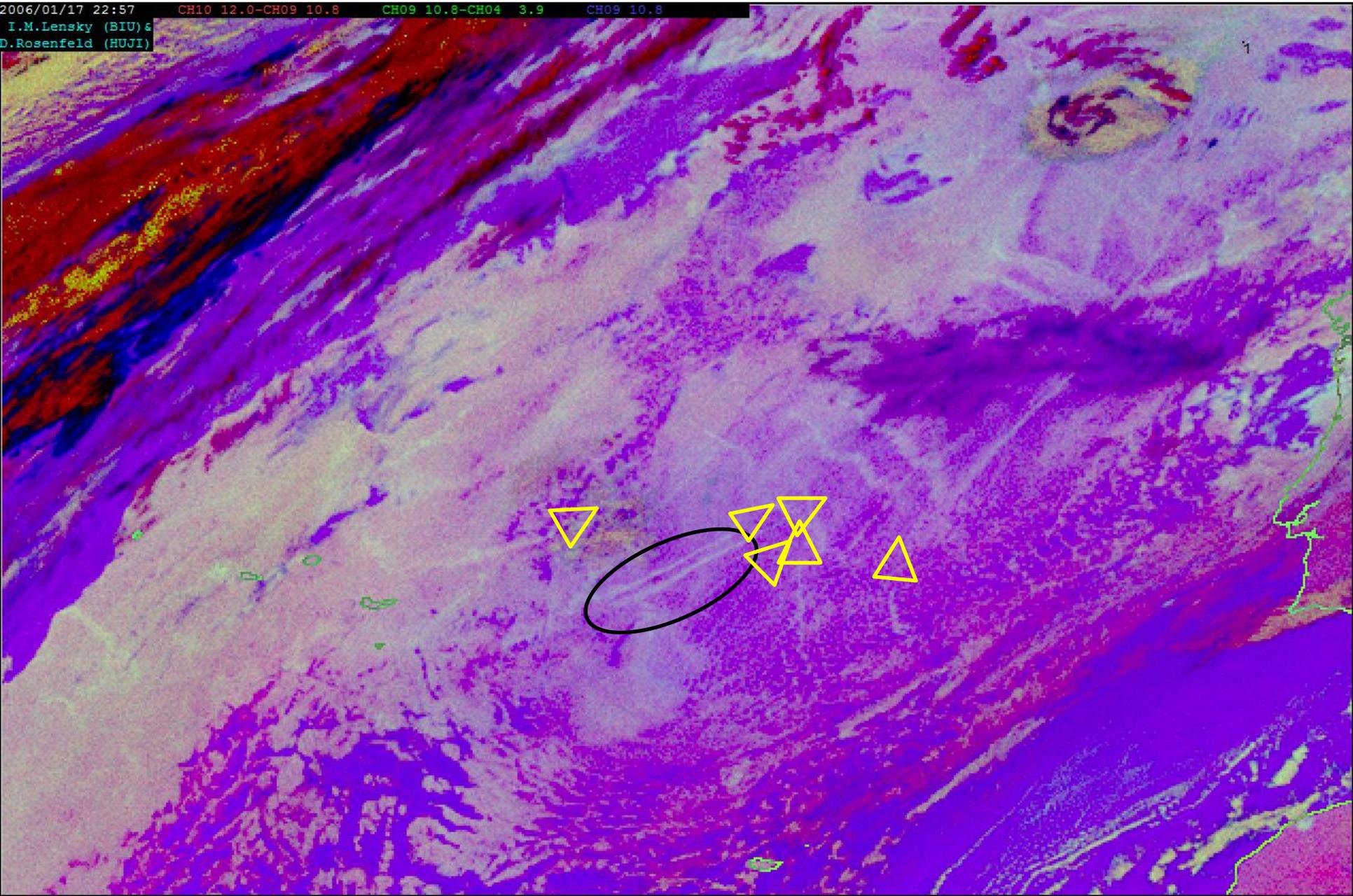
2006/01/17 21:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



17/1/2006

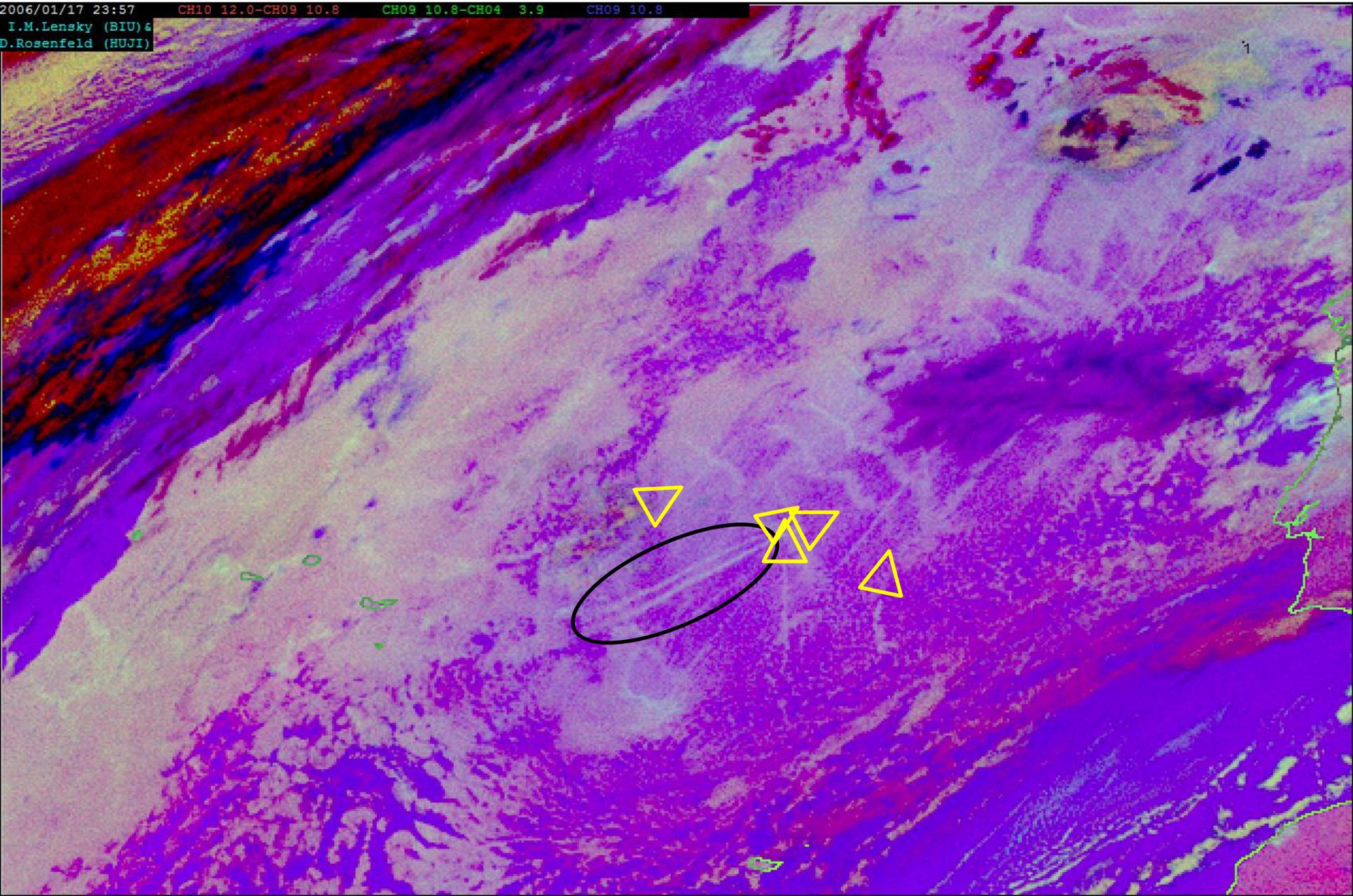
22:57 MSG

2006/01/17 22:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



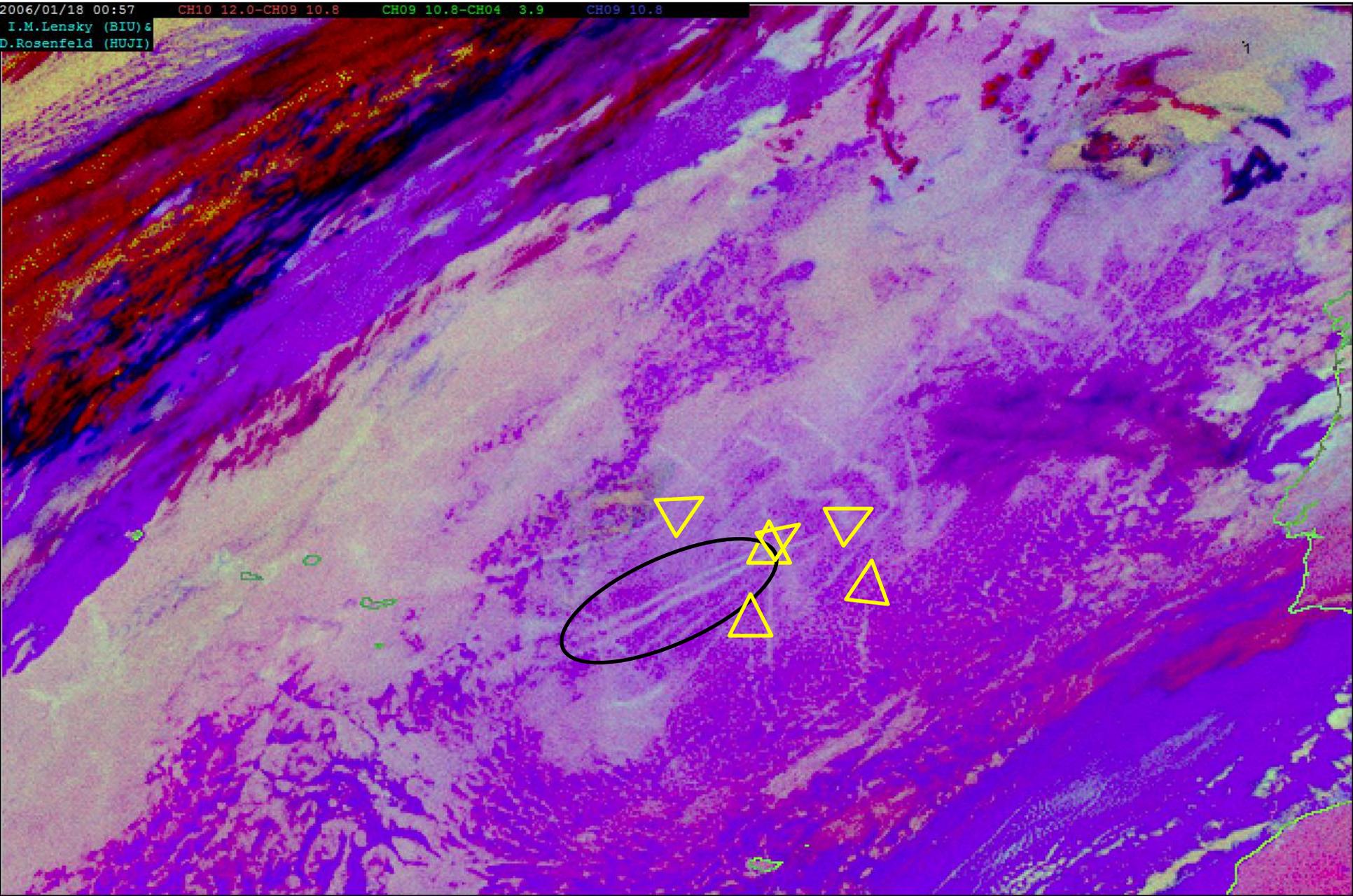
17/1/2006
23:57 MSG

2006/01/17 23:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



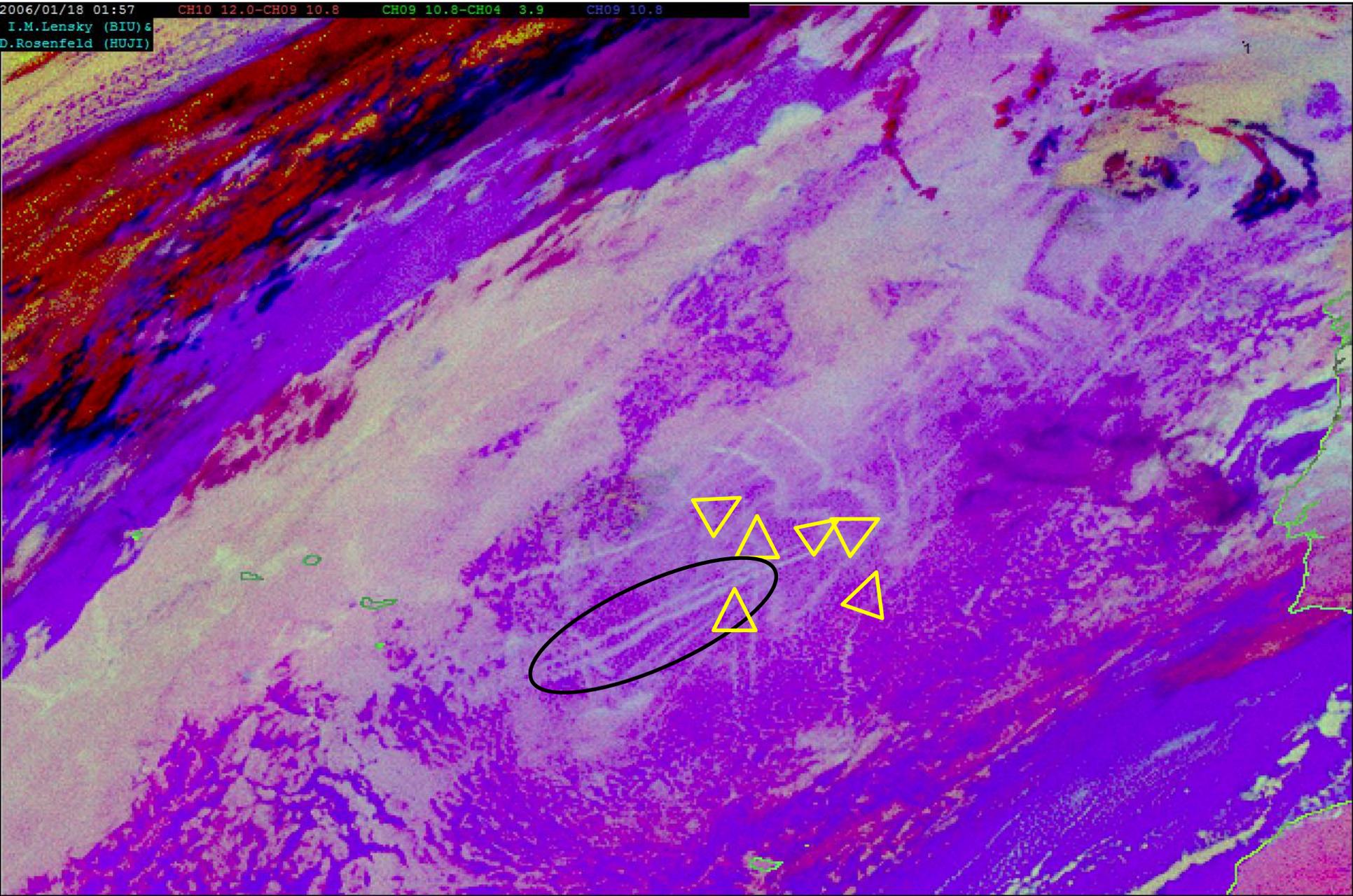
18/1/2006
00:57 MSG

2006/01/18 00:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



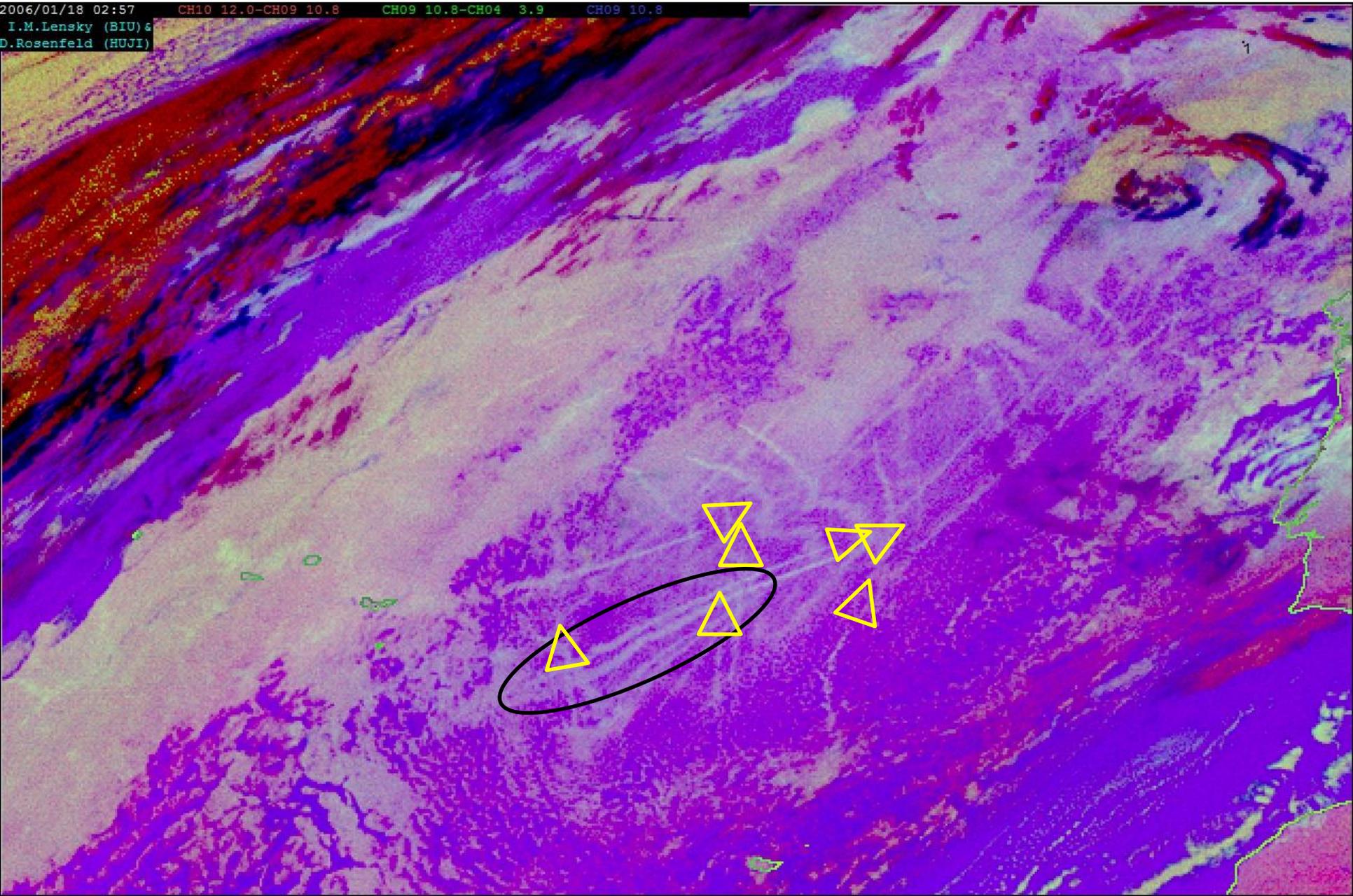
18/1/2006
01:57 MSG

2006/01/18 01:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



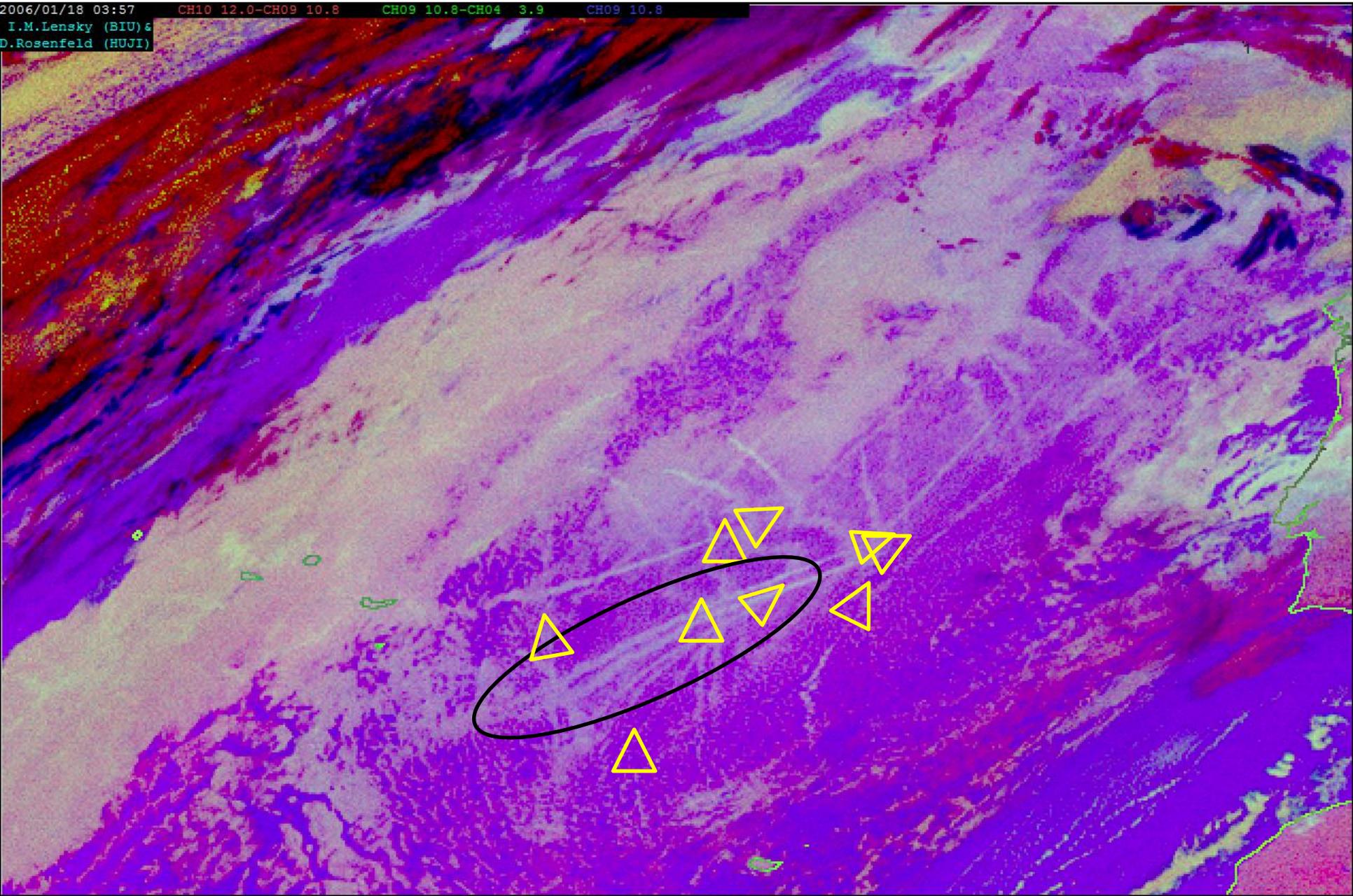
18/1/2006
02:57 MSG

2006/01/18 02:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



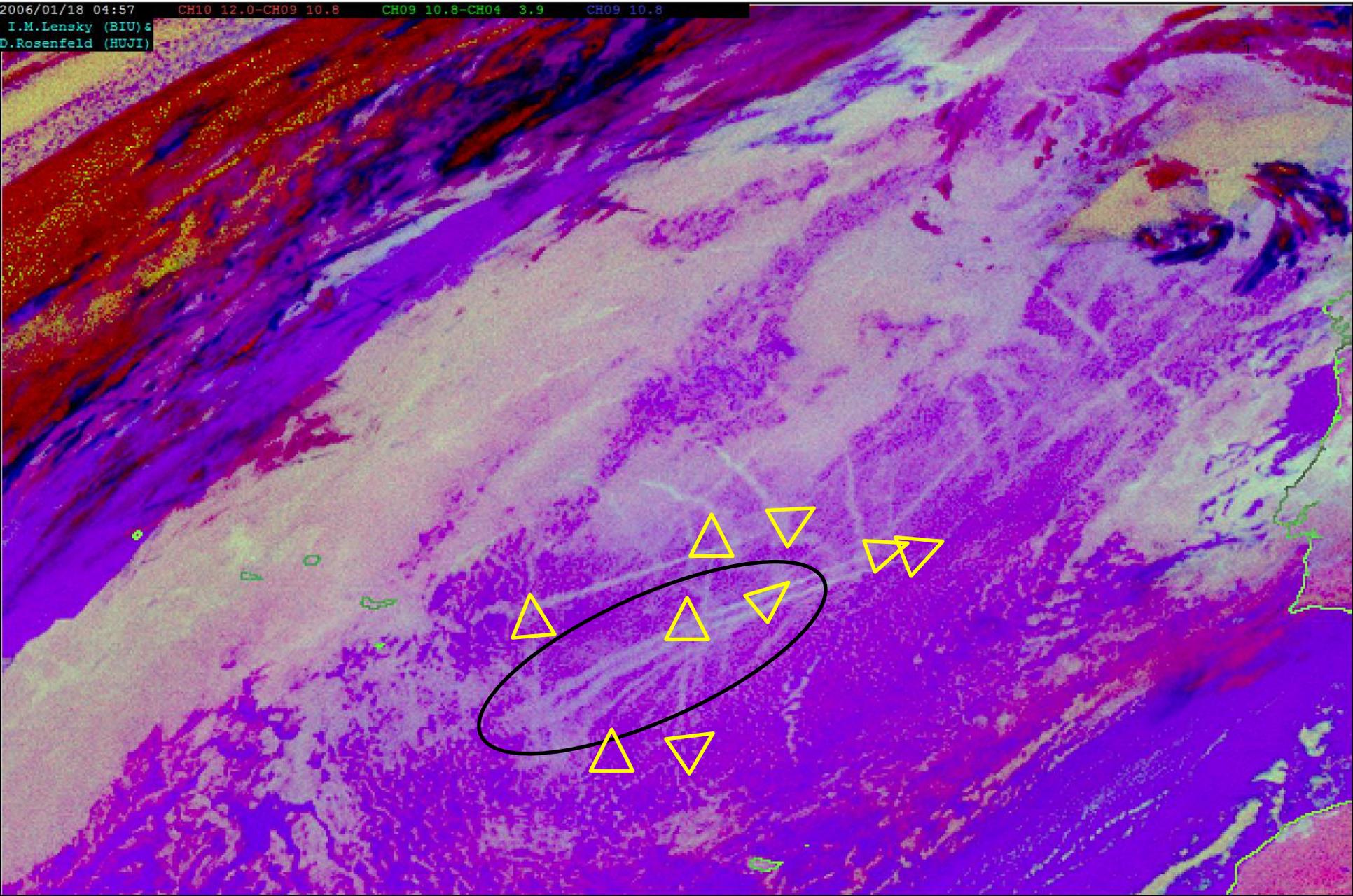
18/1/2006
03:57 MSG

2006/01/18 03:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



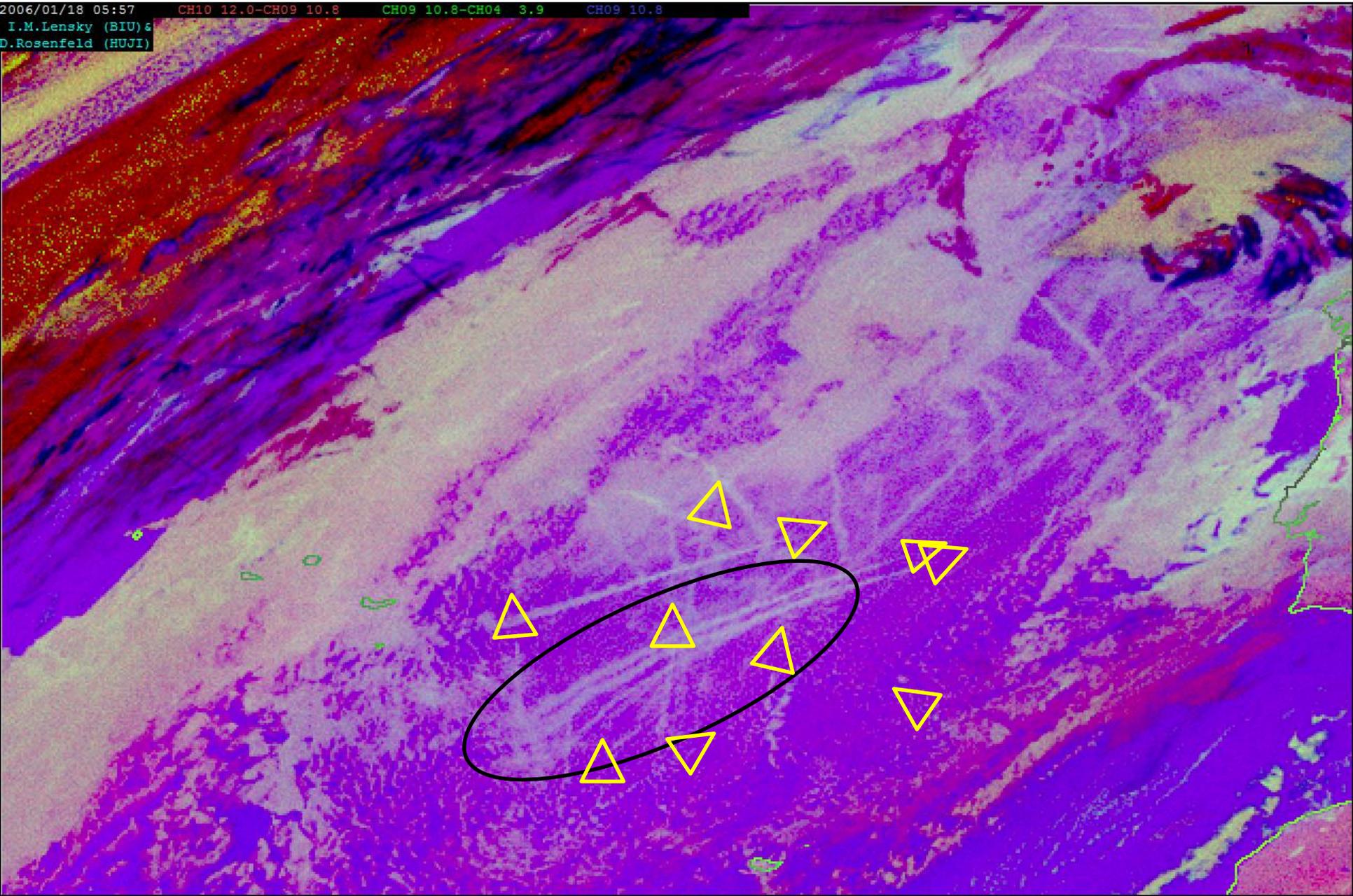
18/1/2006
04:57 MSG

2006/01/18 04:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



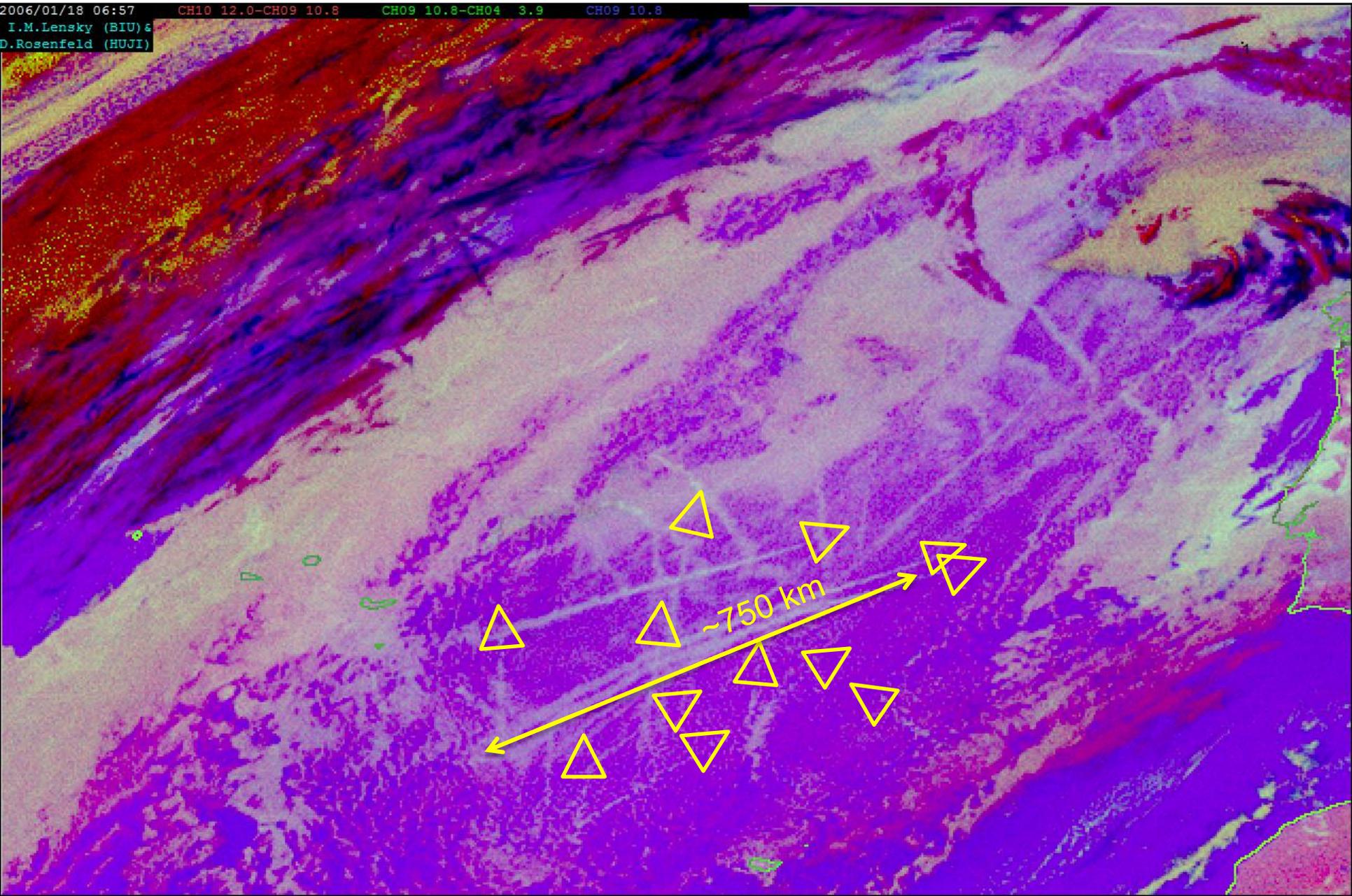
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05:57 MSG

2006/01/18 05:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)

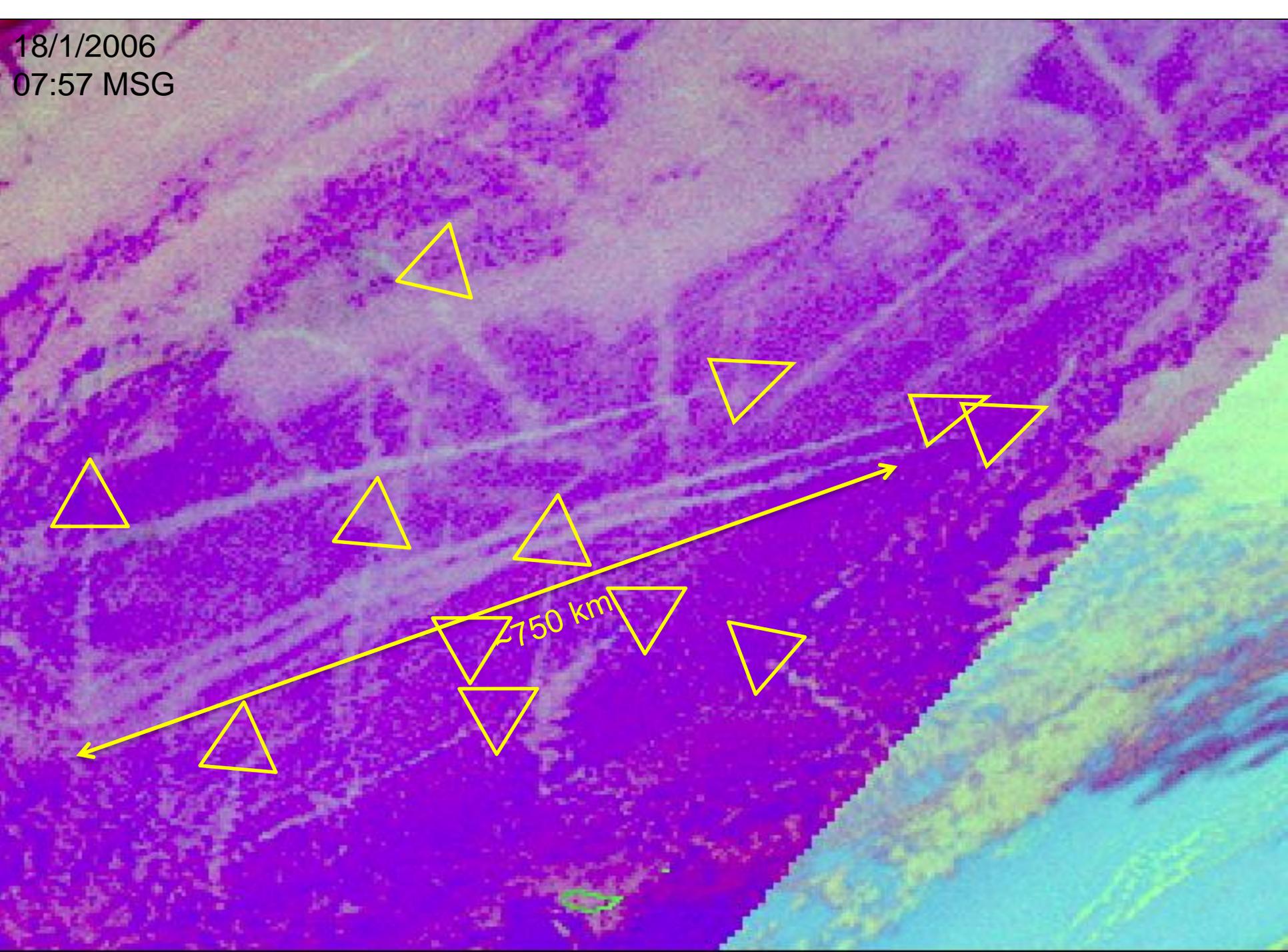


18/1/2006
06:57 MSG

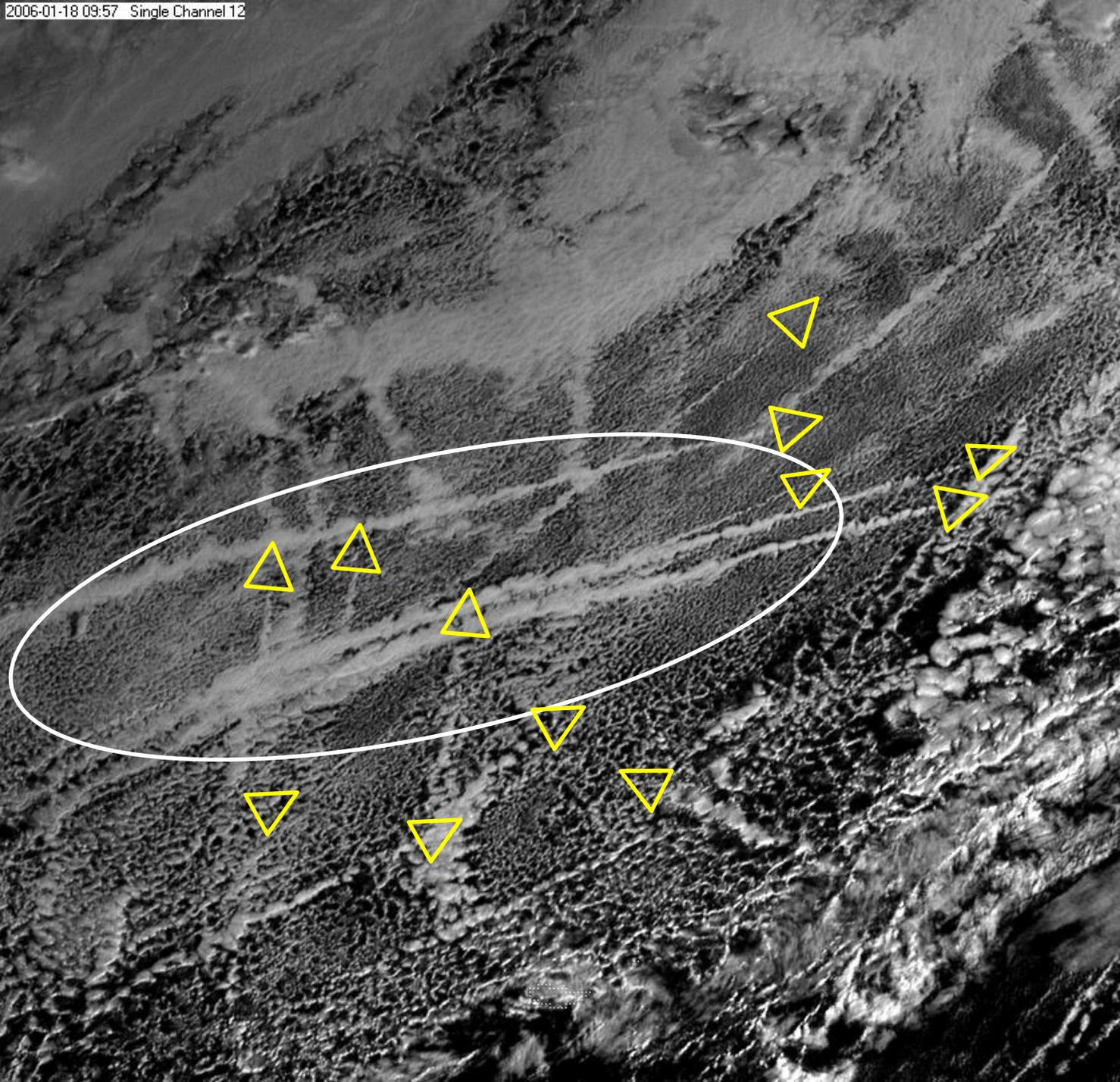
2006/01/18 06:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



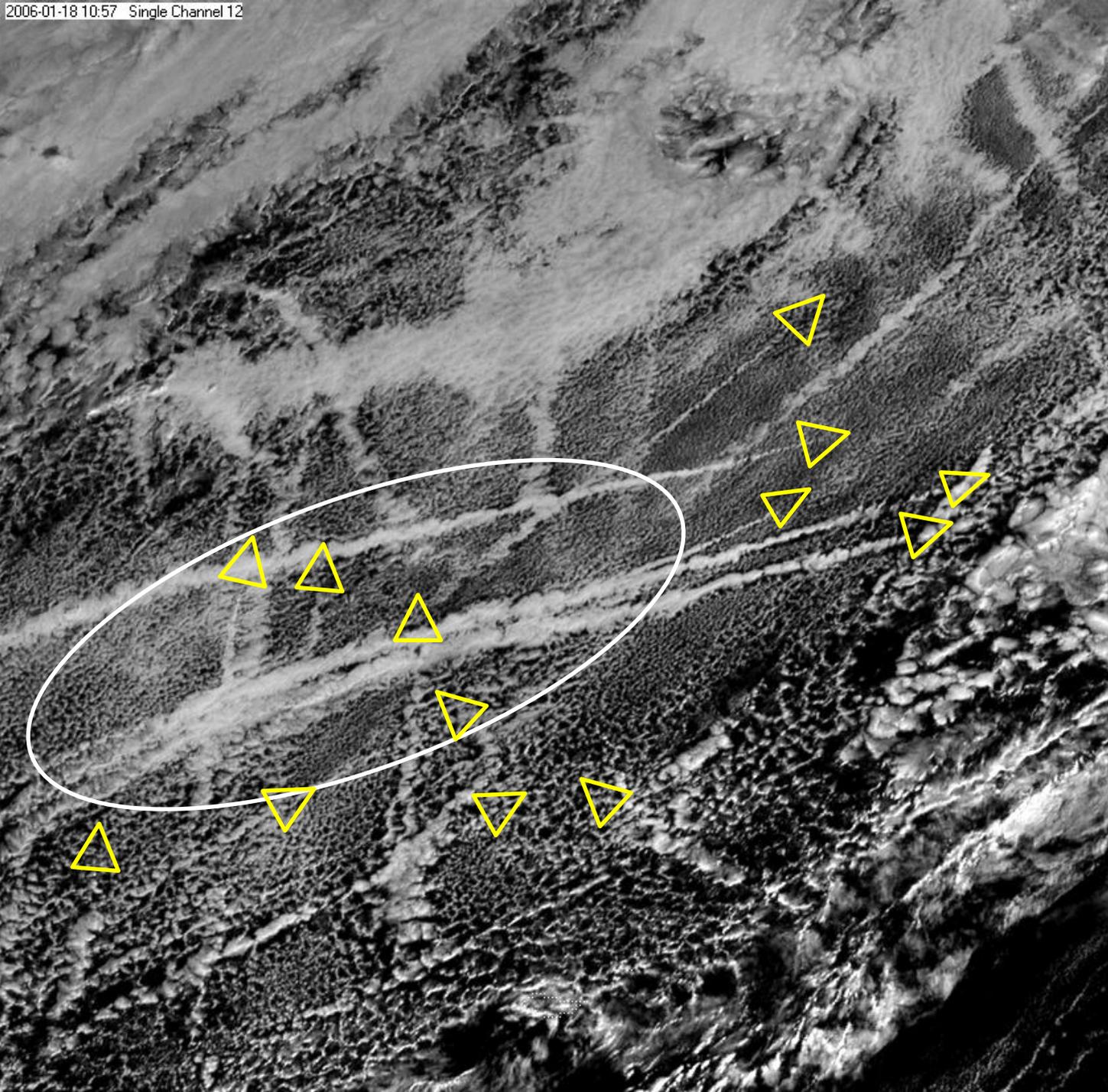
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07:57 MSG



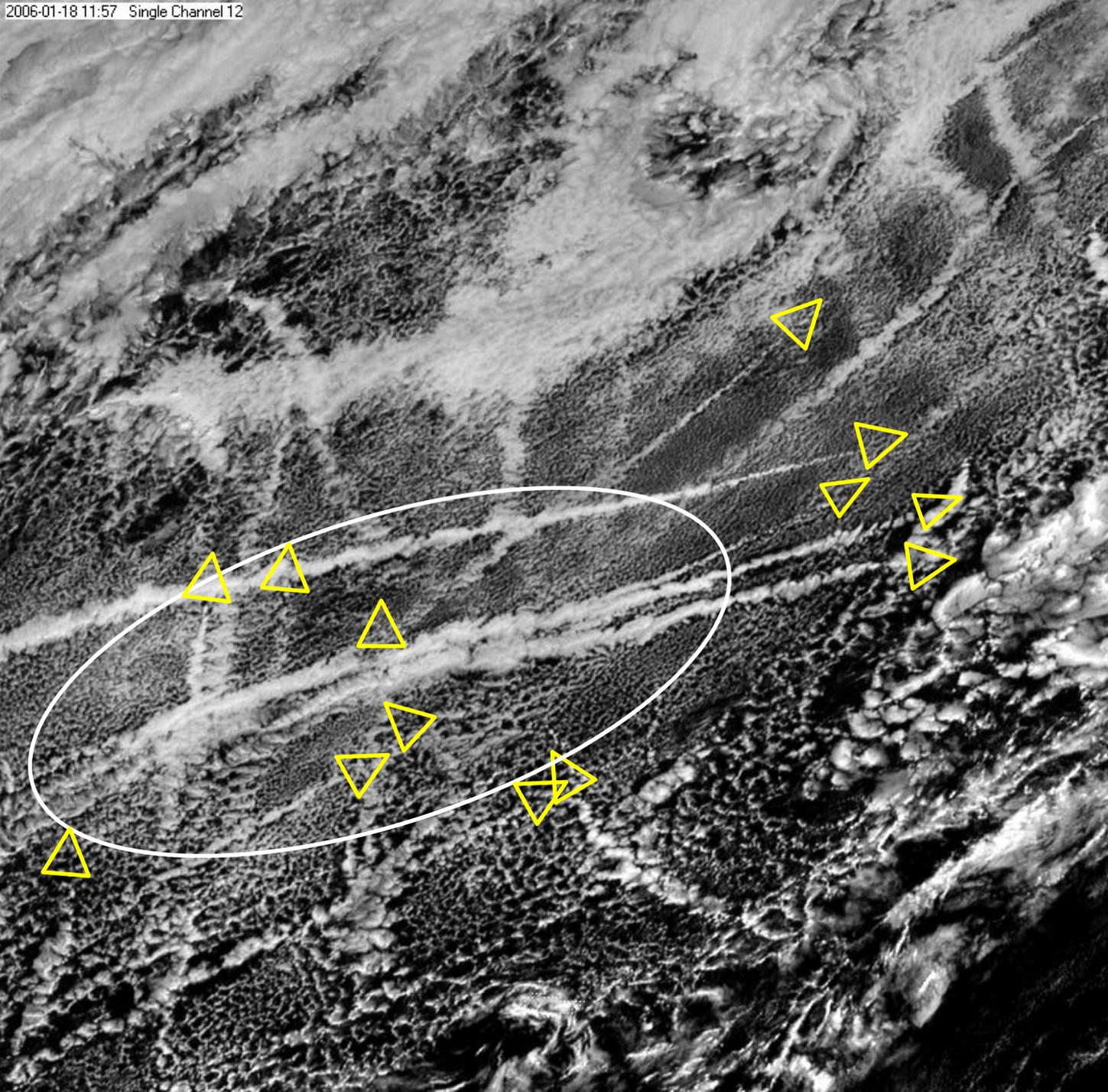
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09:57 MSG



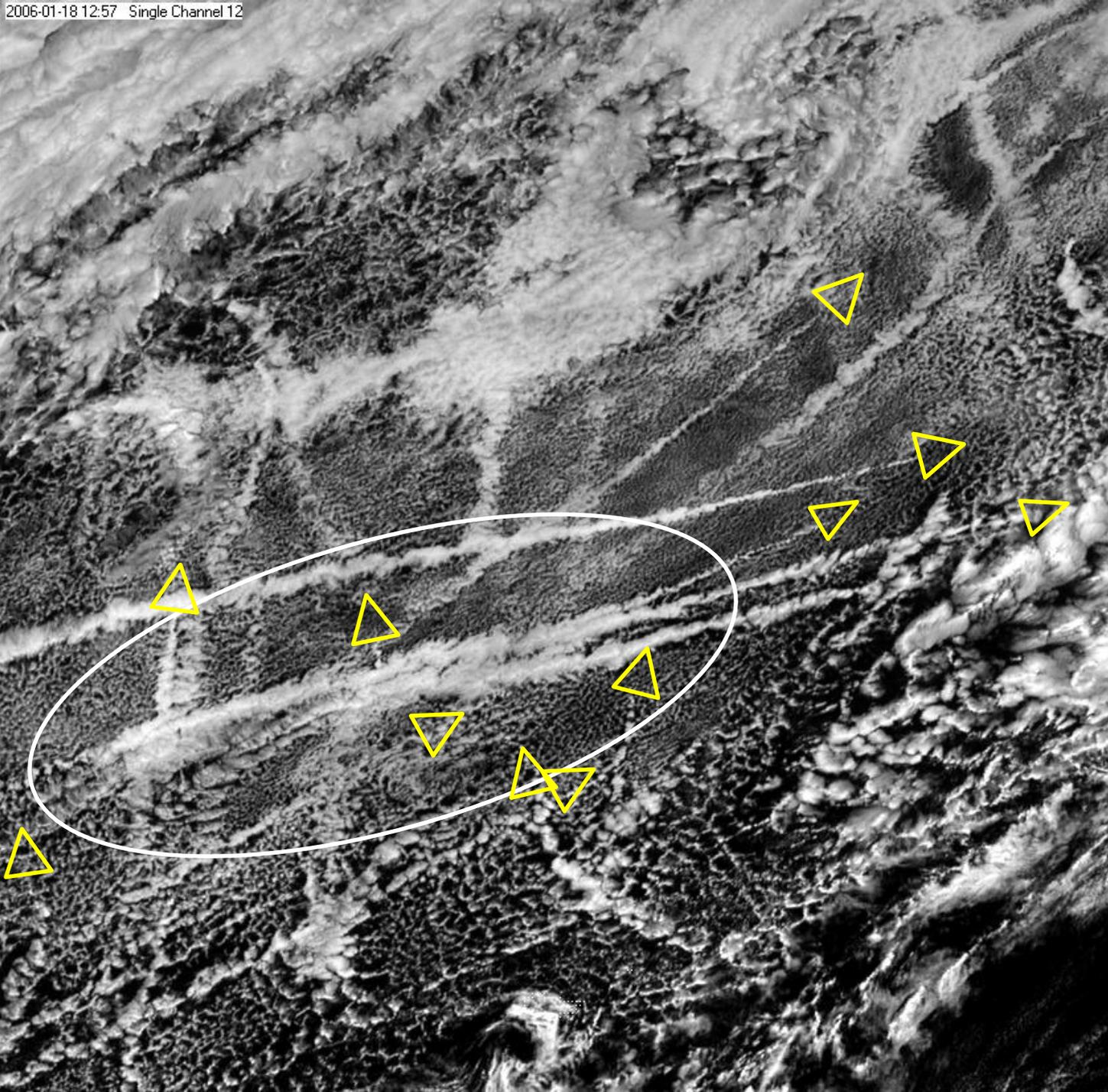
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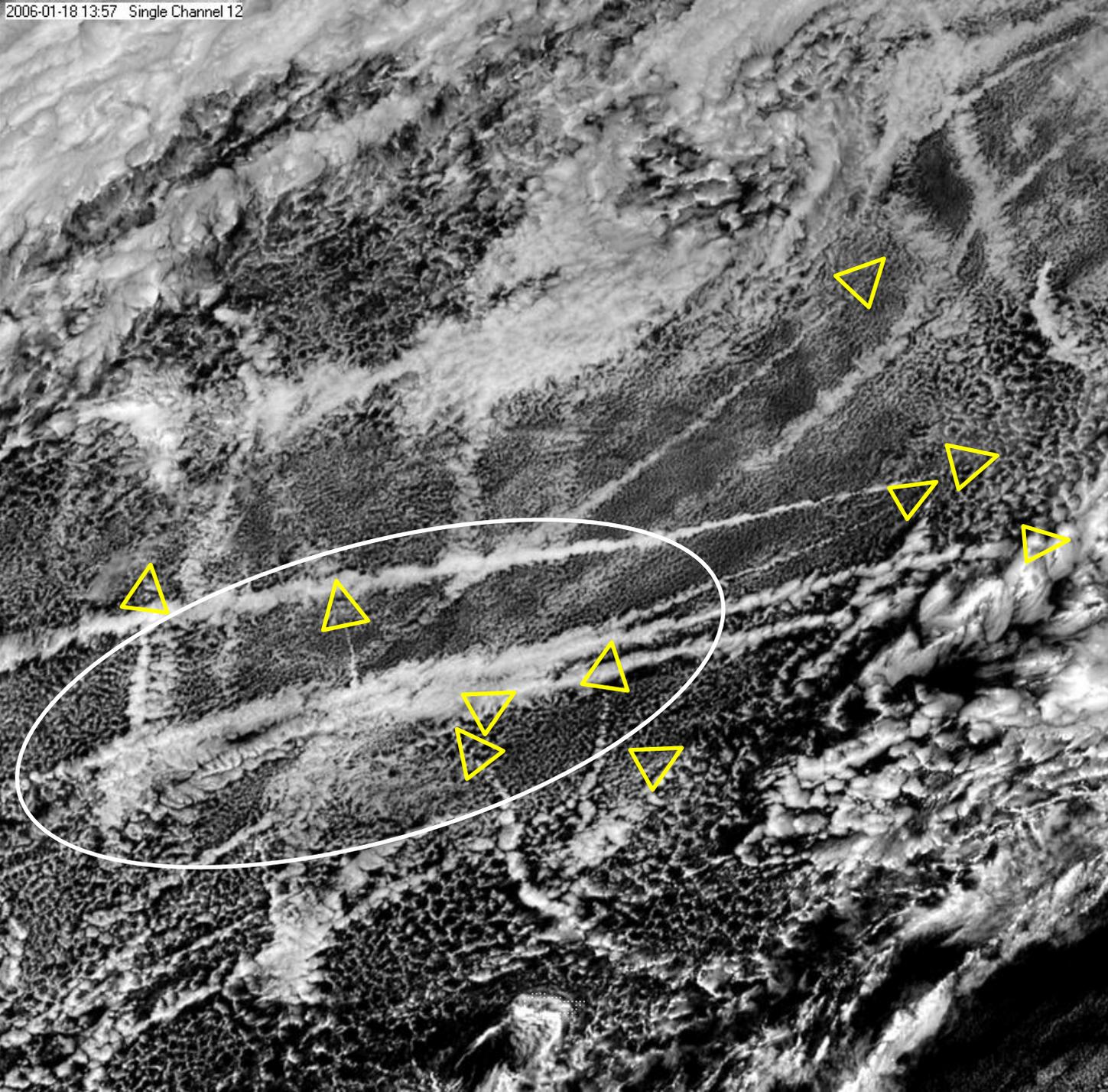
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11:57 MSG



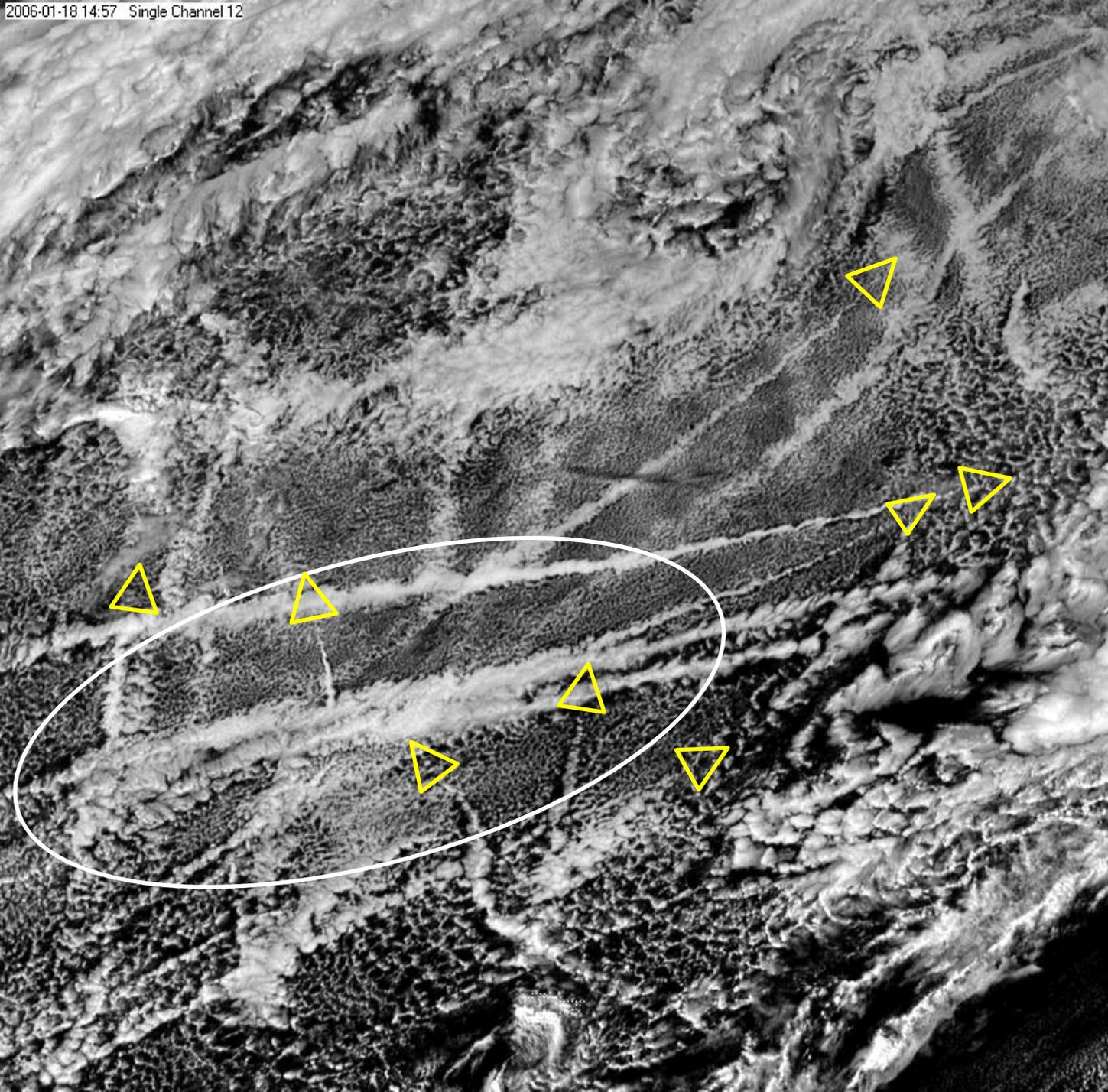
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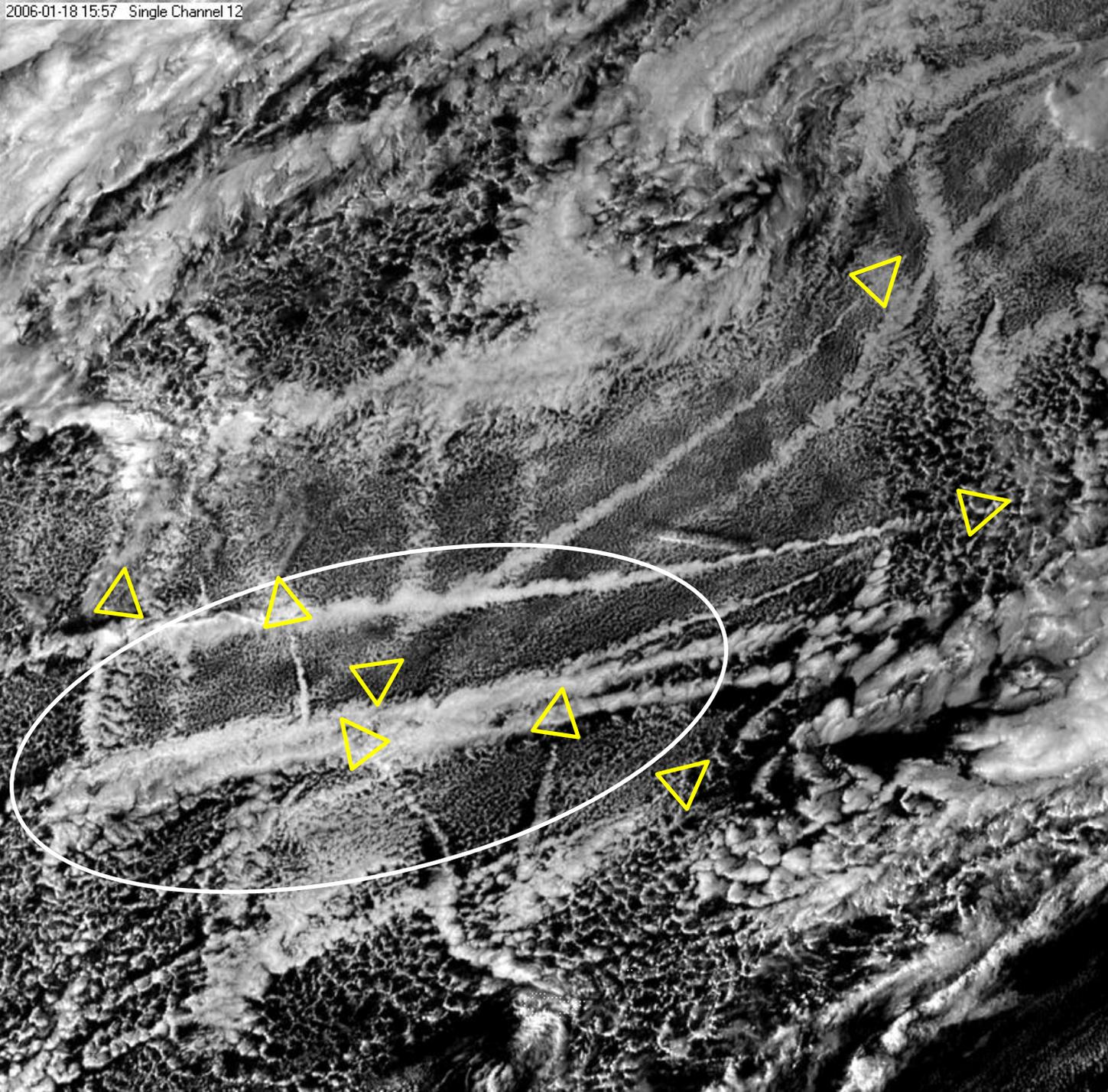
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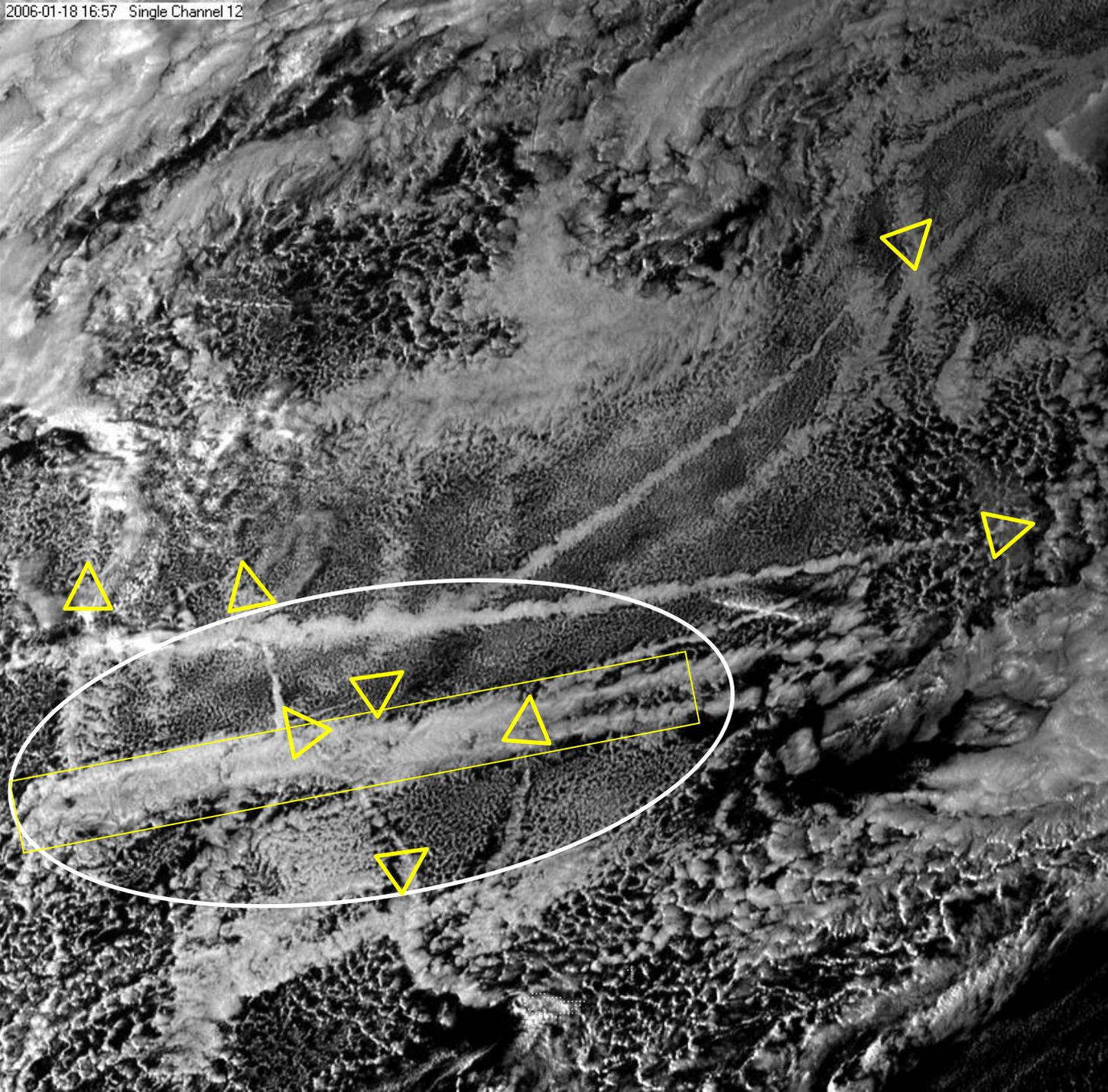
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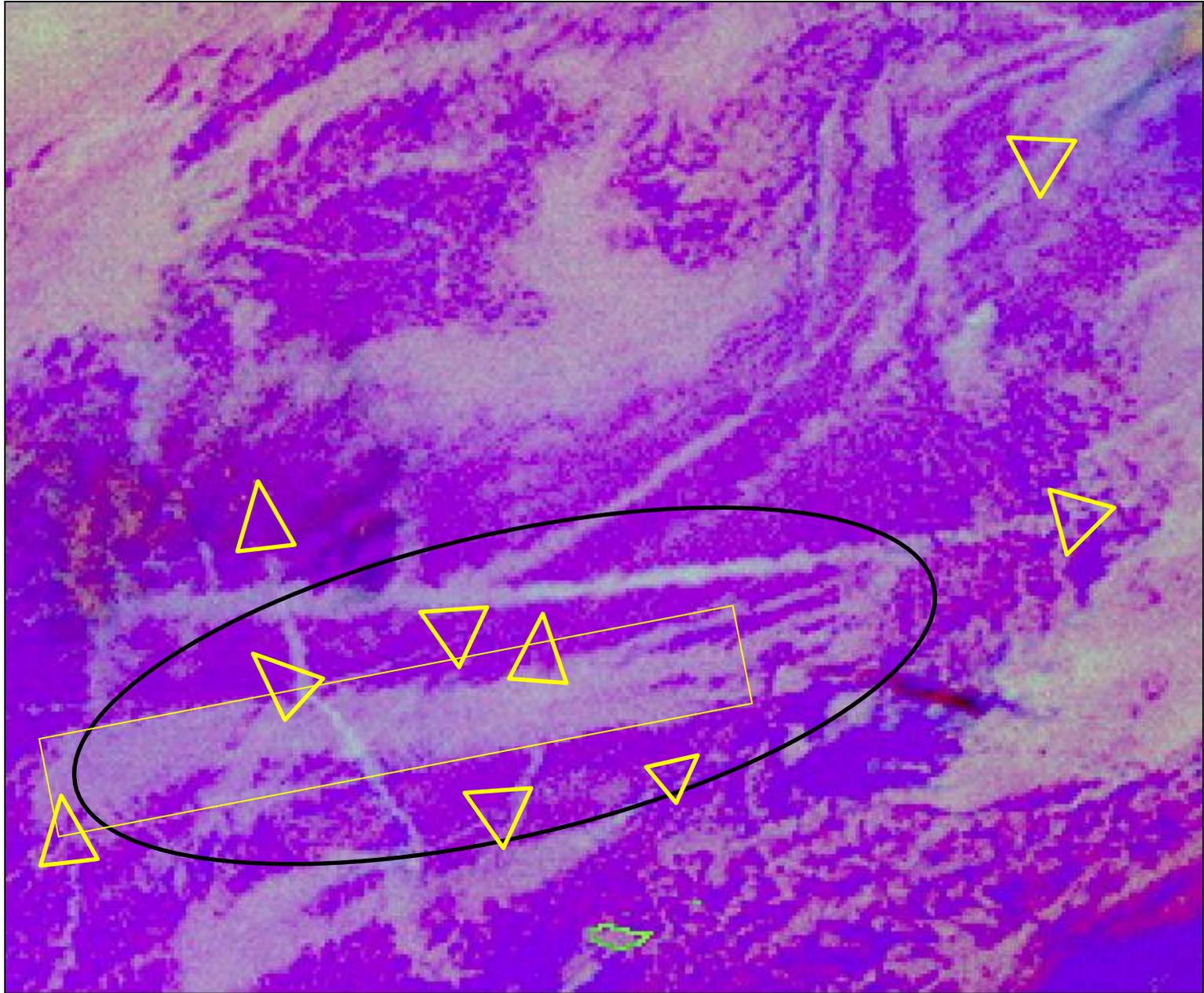
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15:57 MSG



18/1/2006
16:57 MSG

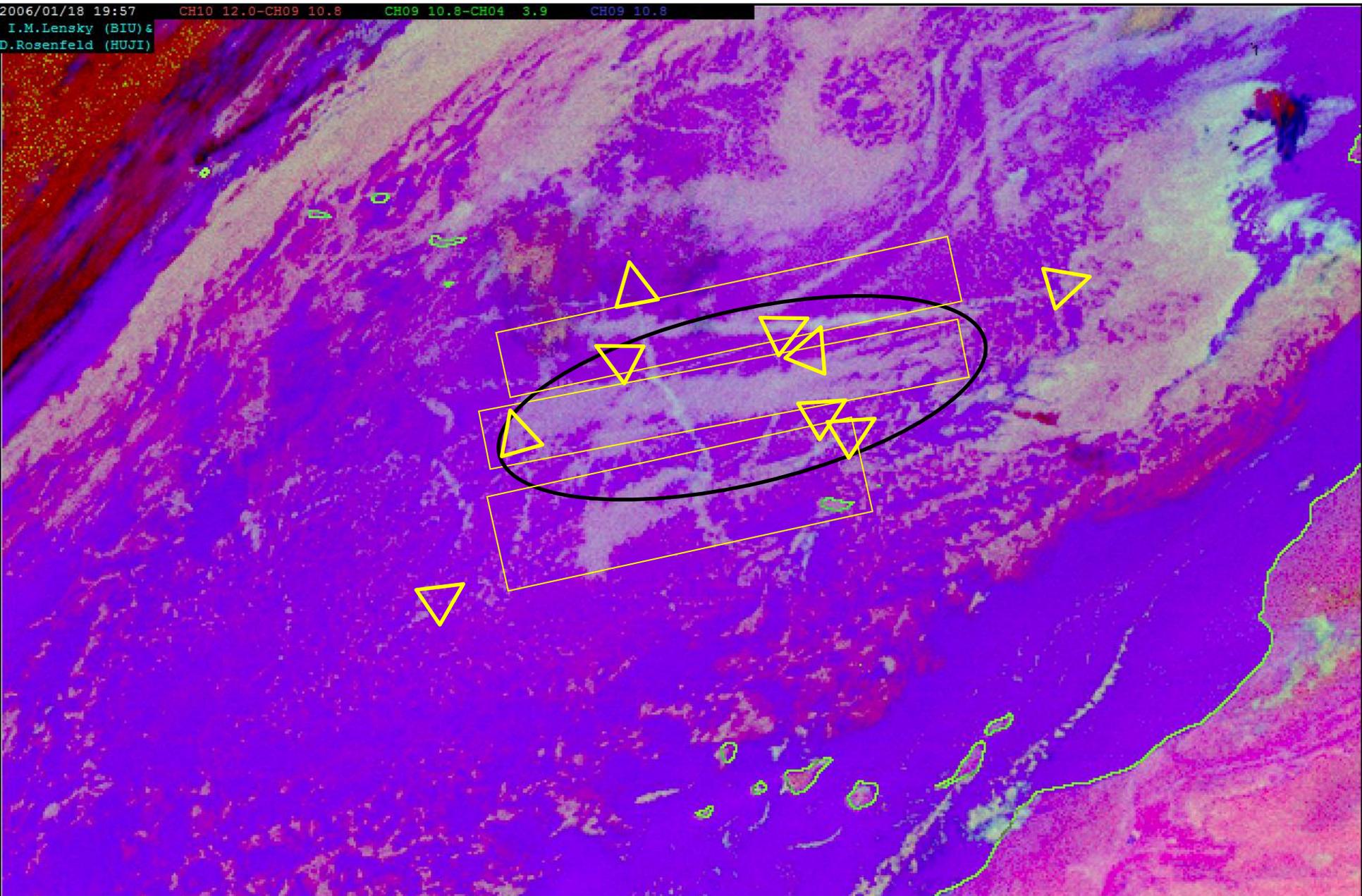


18/1/2006
18:57 MSG



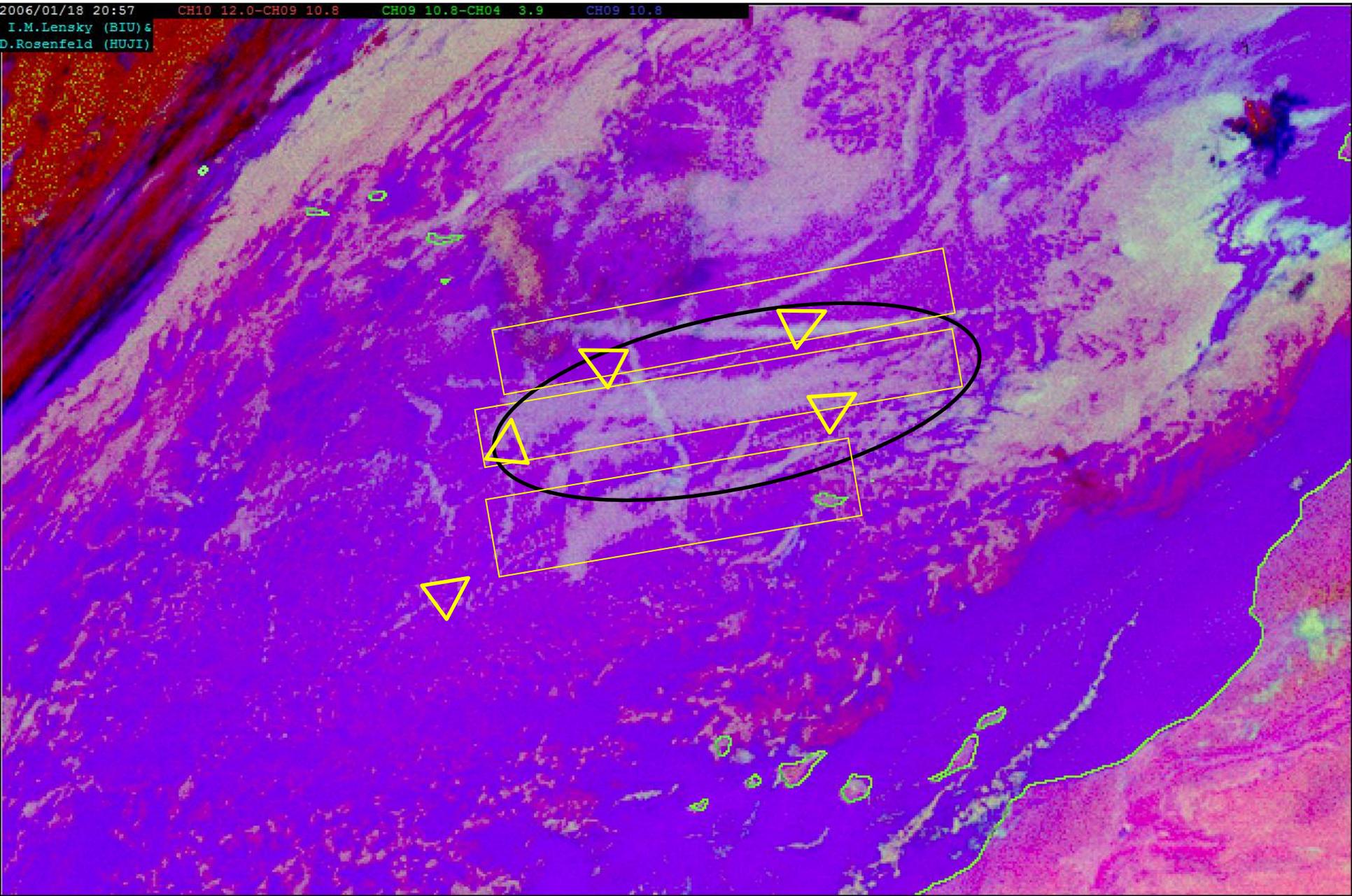
18/1/2006
19:57 MSG

2006/01/18 19:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



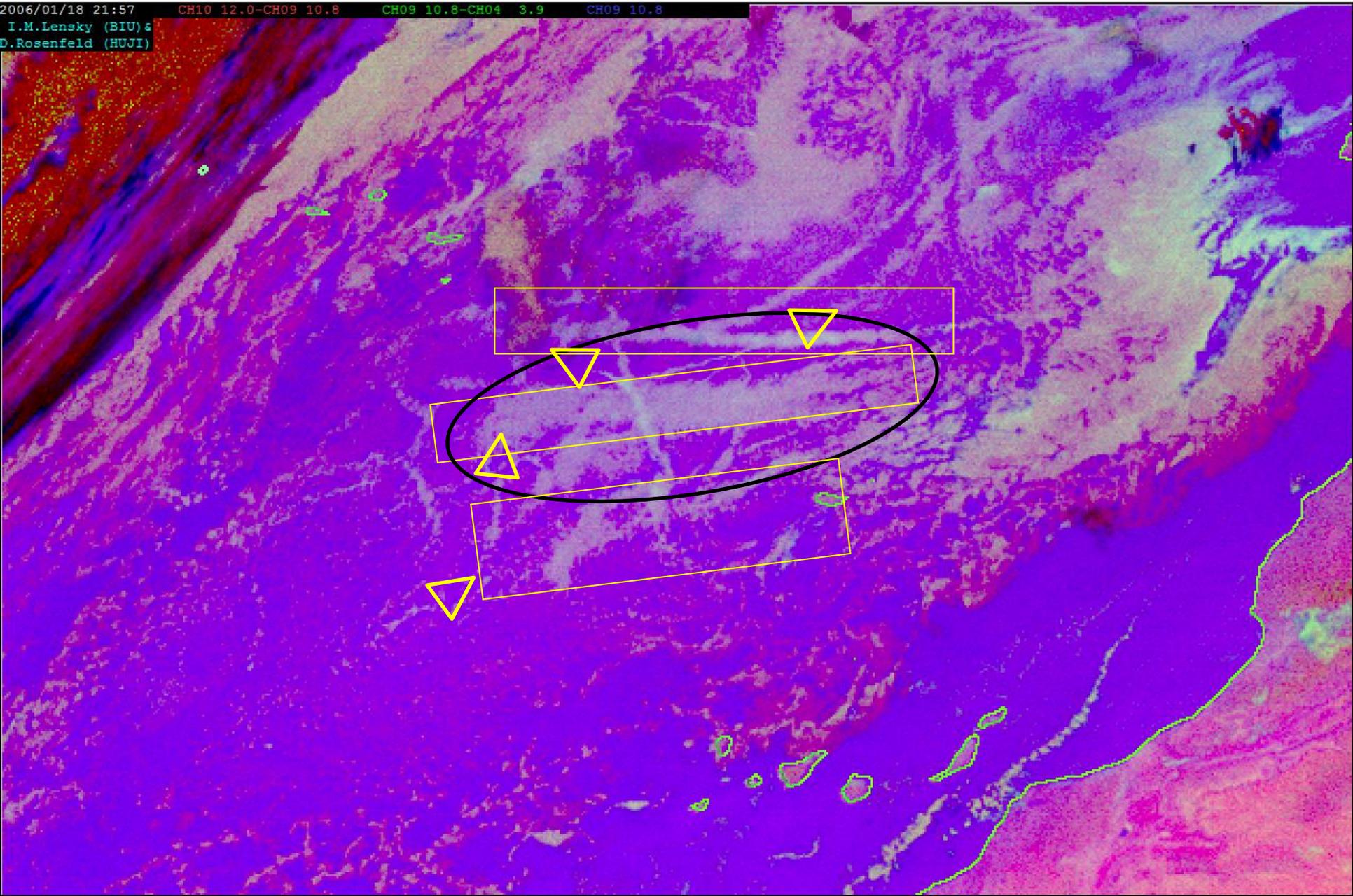
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2006/01/18 20:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
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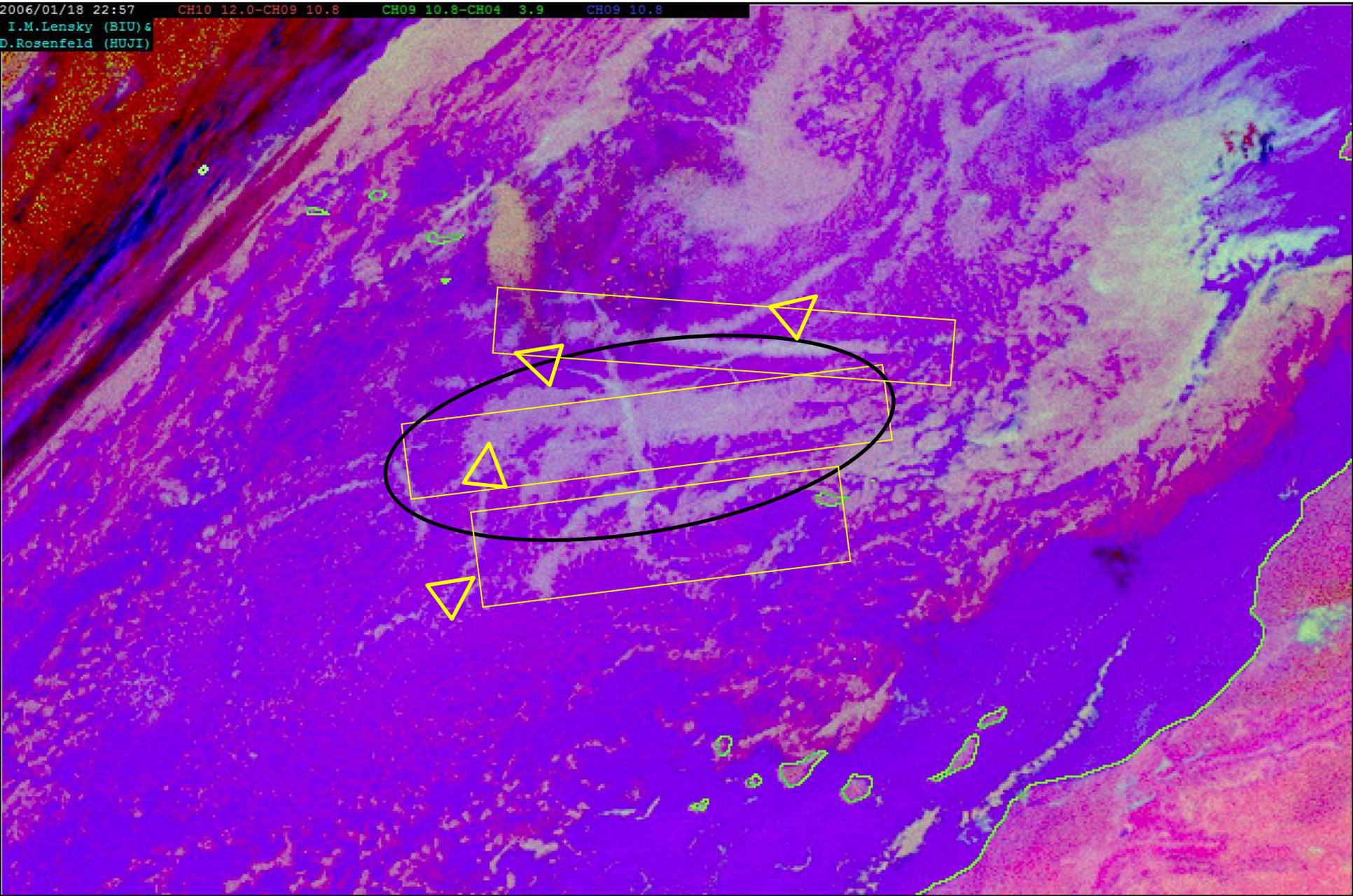
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2006/01/18 21:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
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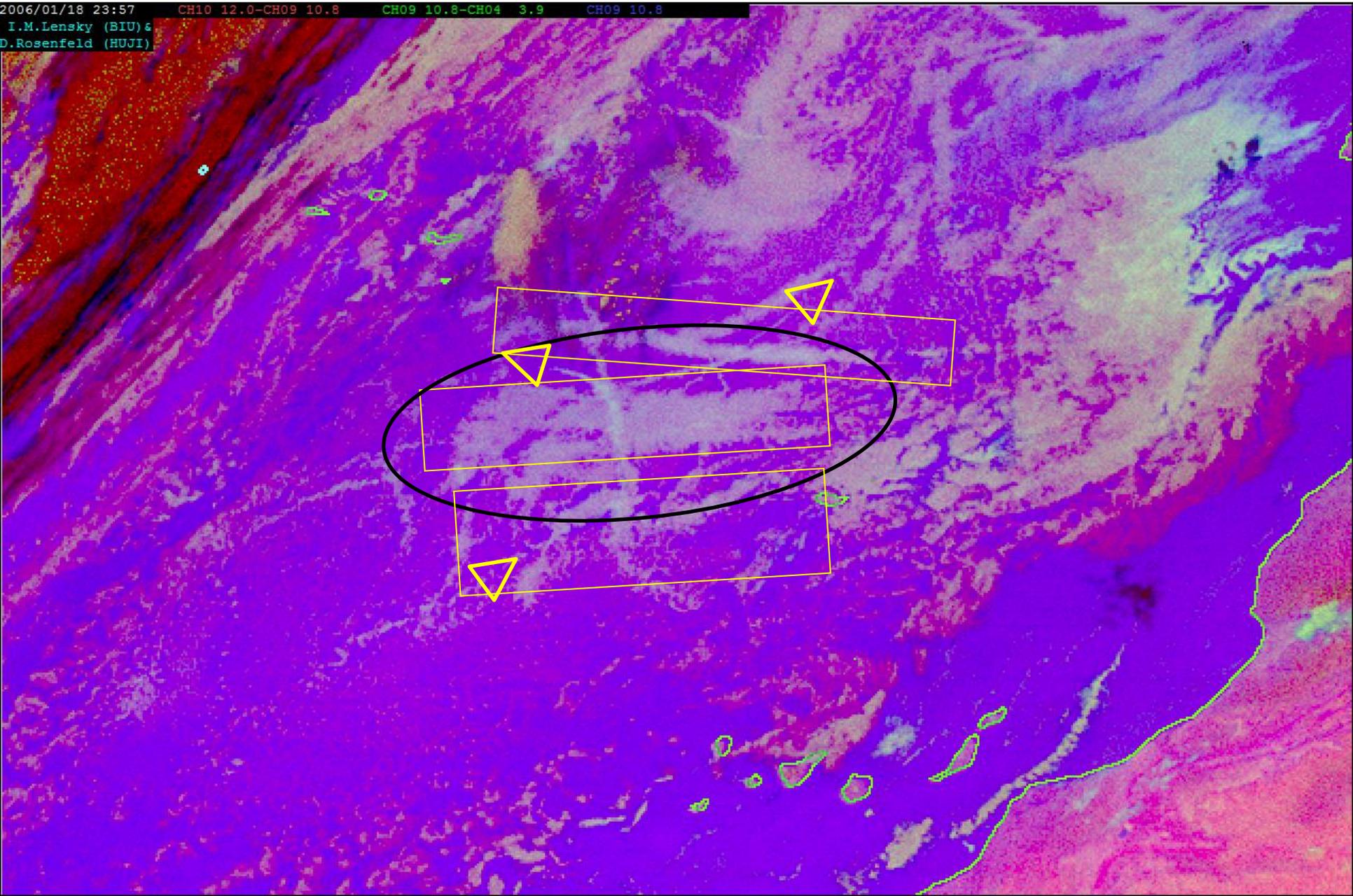
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22:57 MSG

2006/01/18 22:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



18/1/2006
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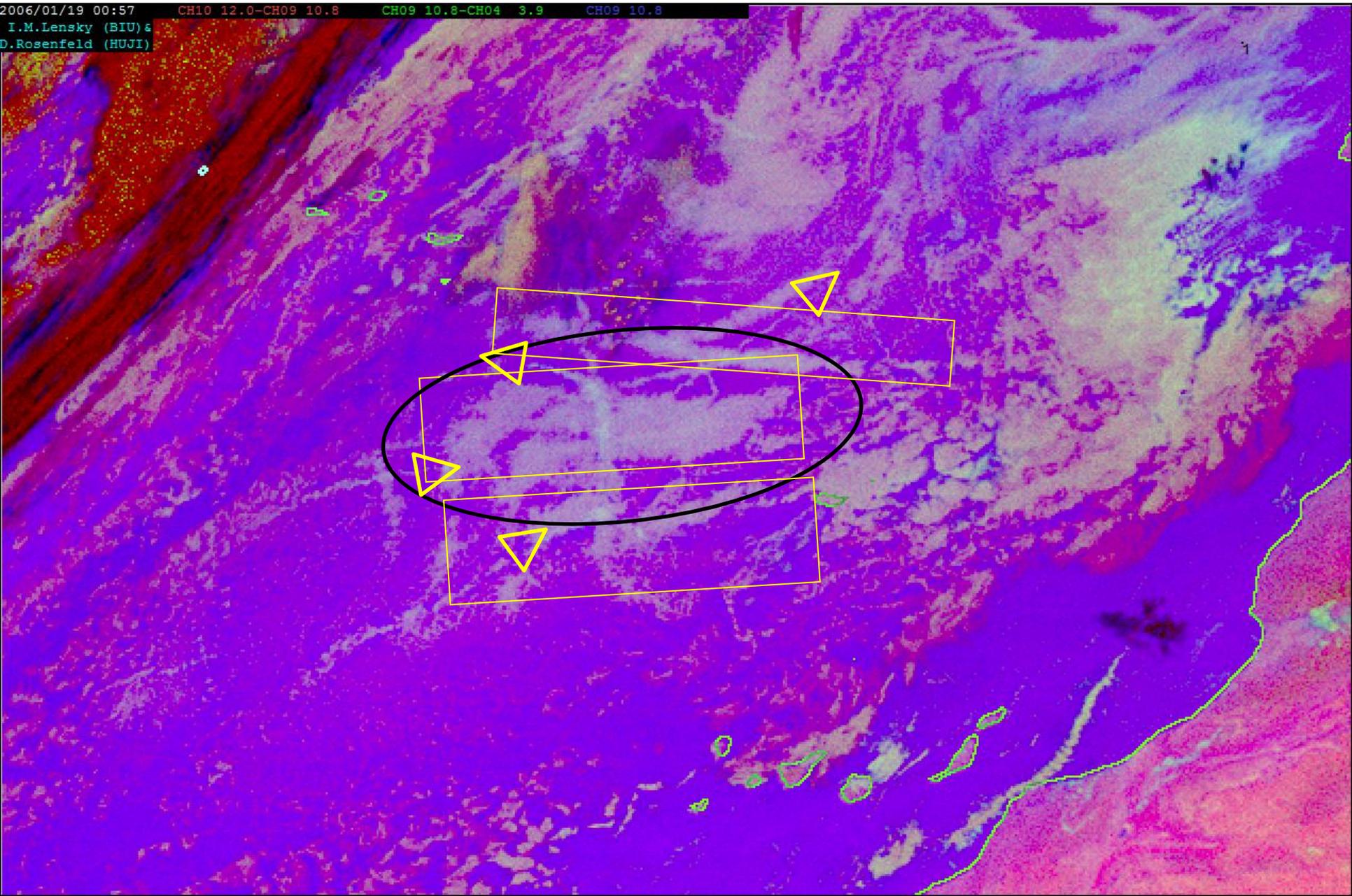
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I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



19/1/2006
00:57 MSG

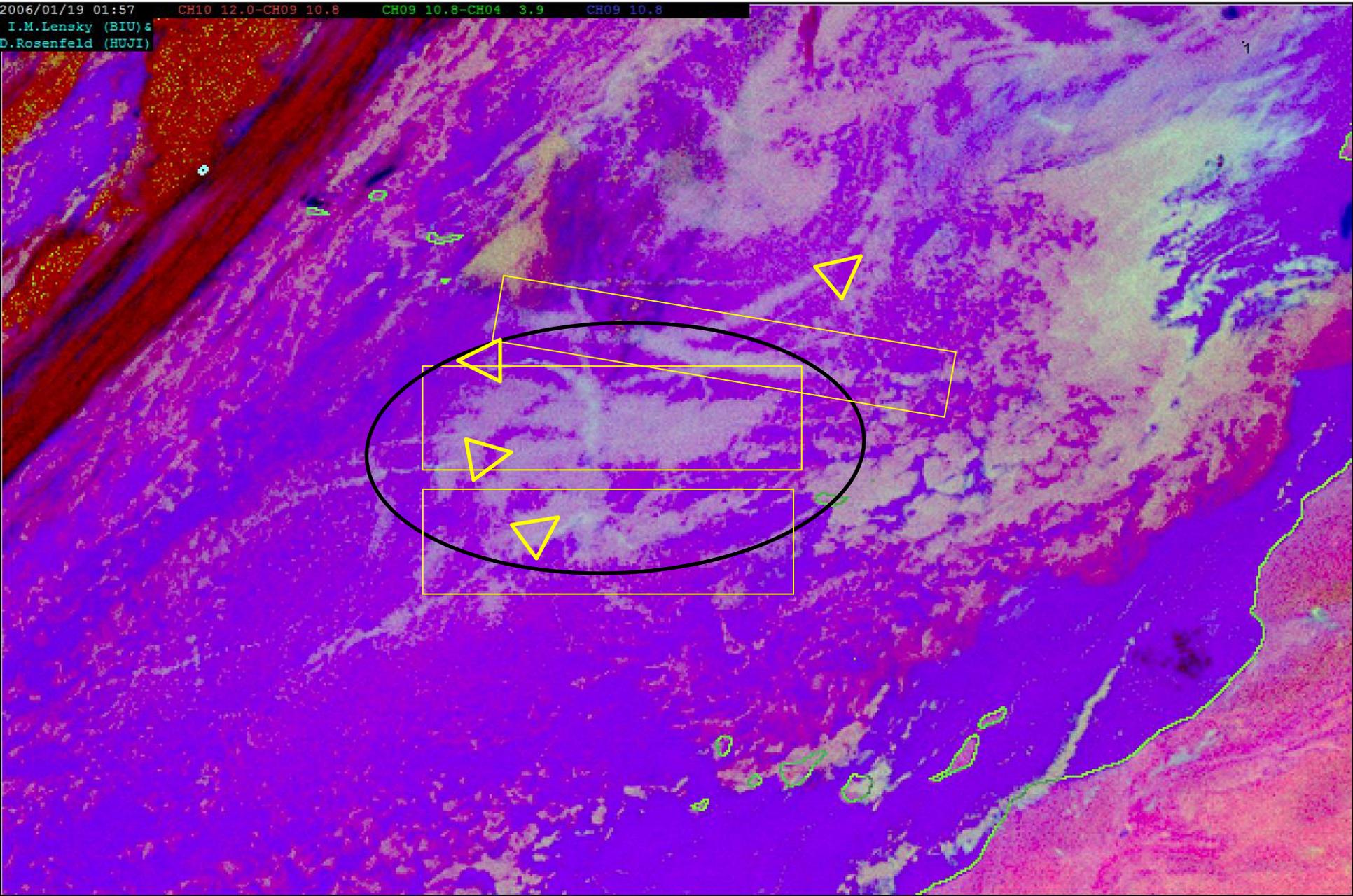
2006/01/19 00:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8

I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



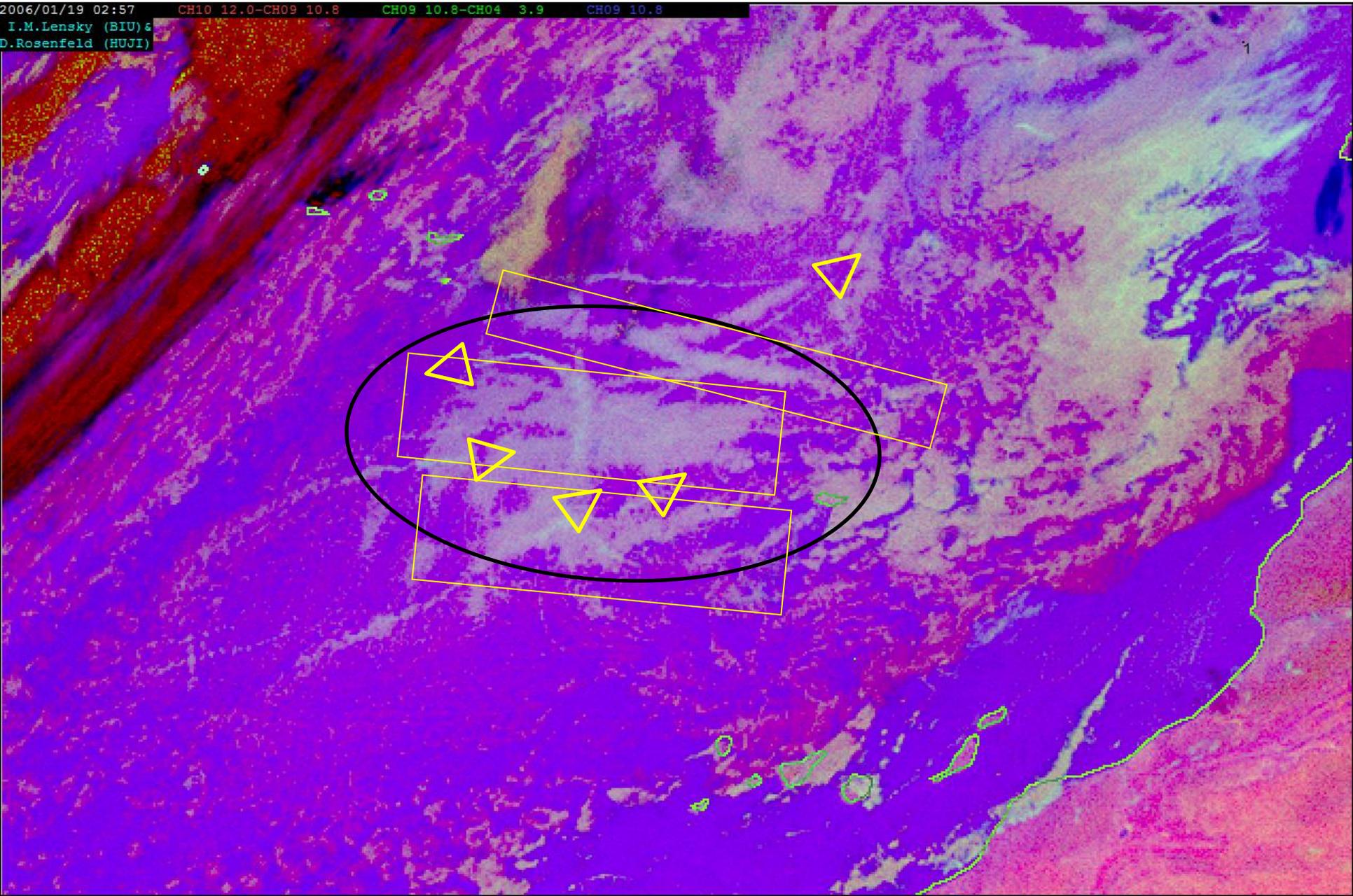
19/1/2006
01:57 MSG

2006/01/19 01:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



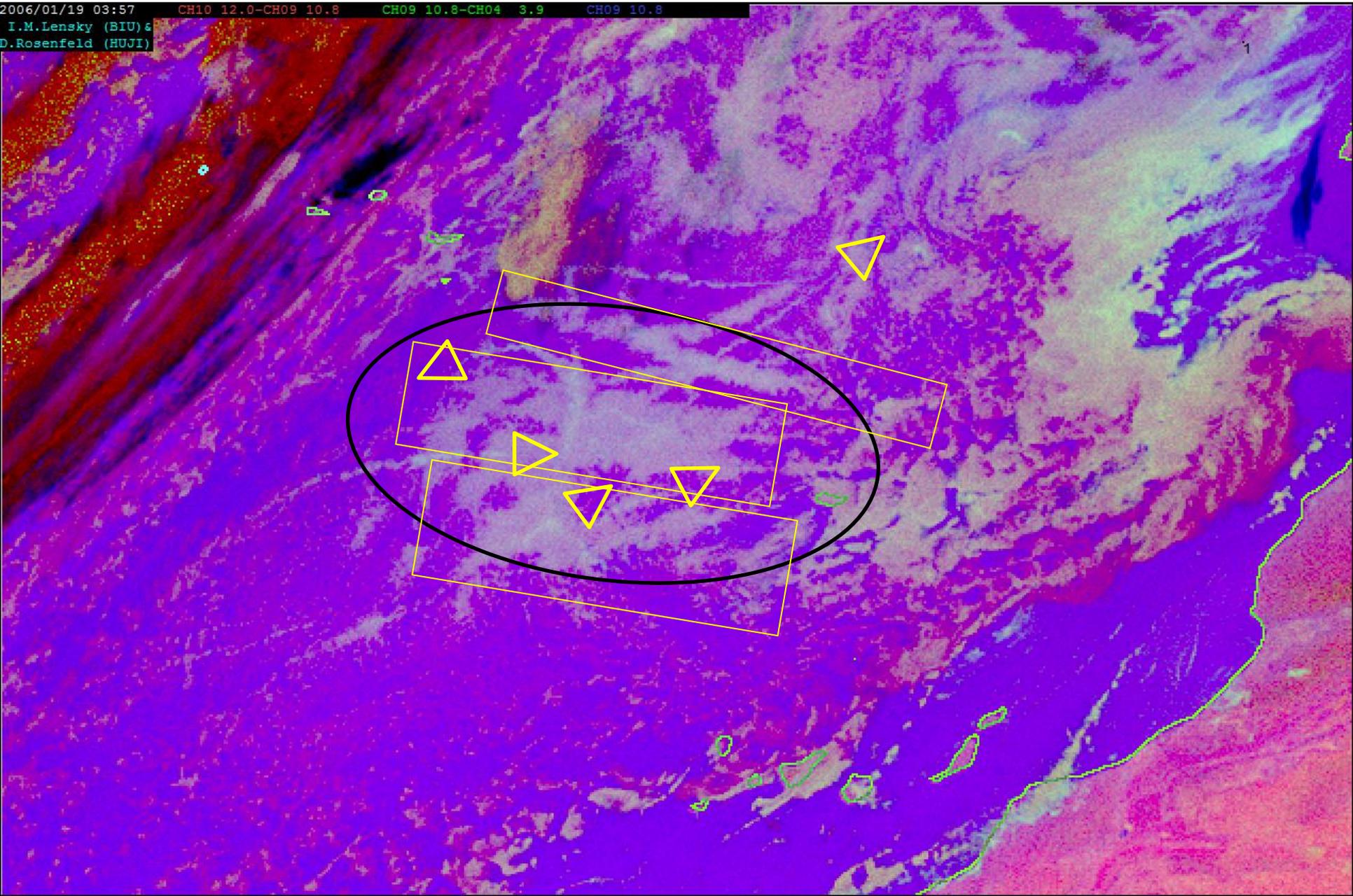
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2006/01/19 02:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



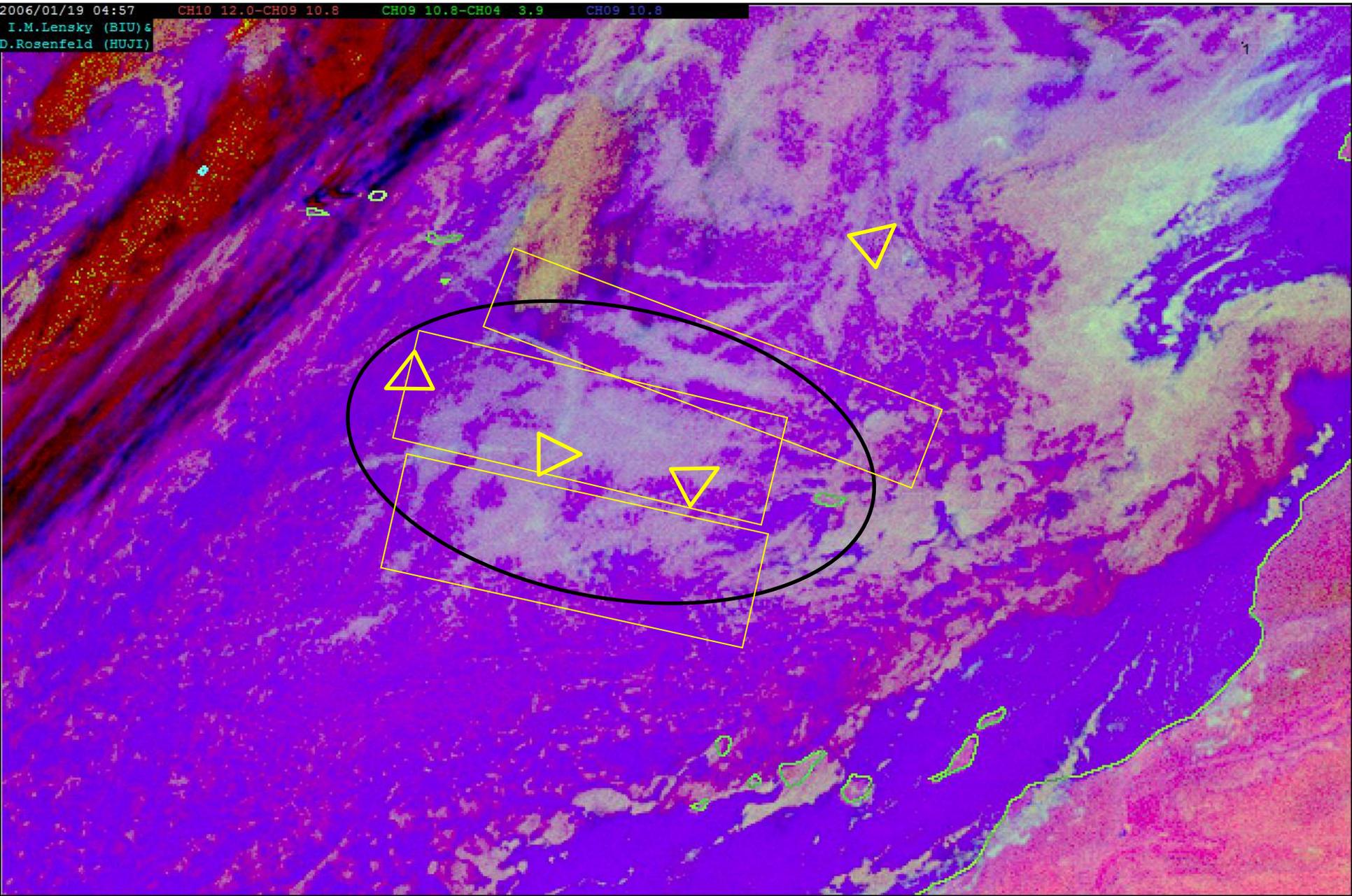
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2006/01/19 03:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
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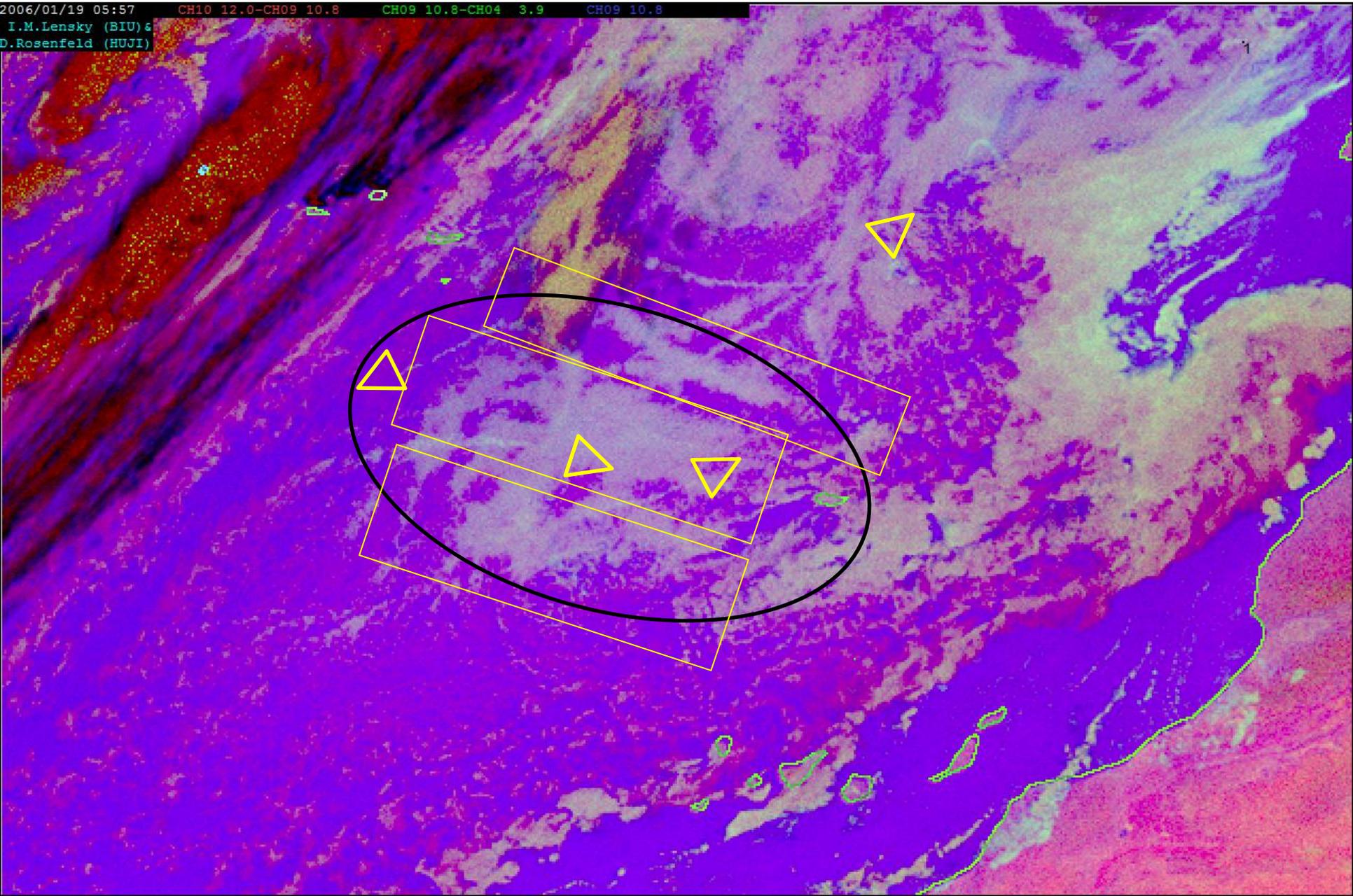
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2006/01/19 04:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
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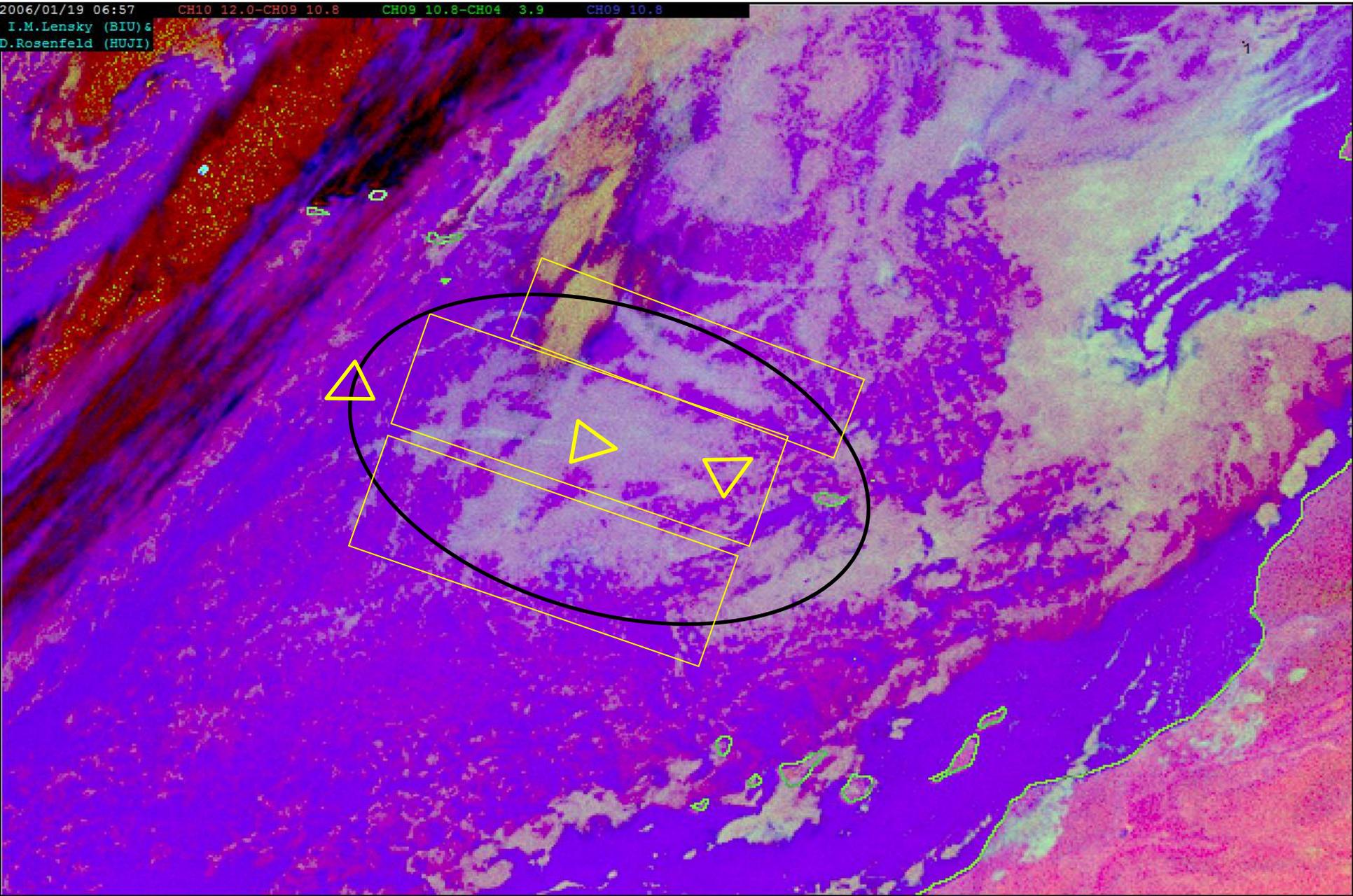
19/1/2006
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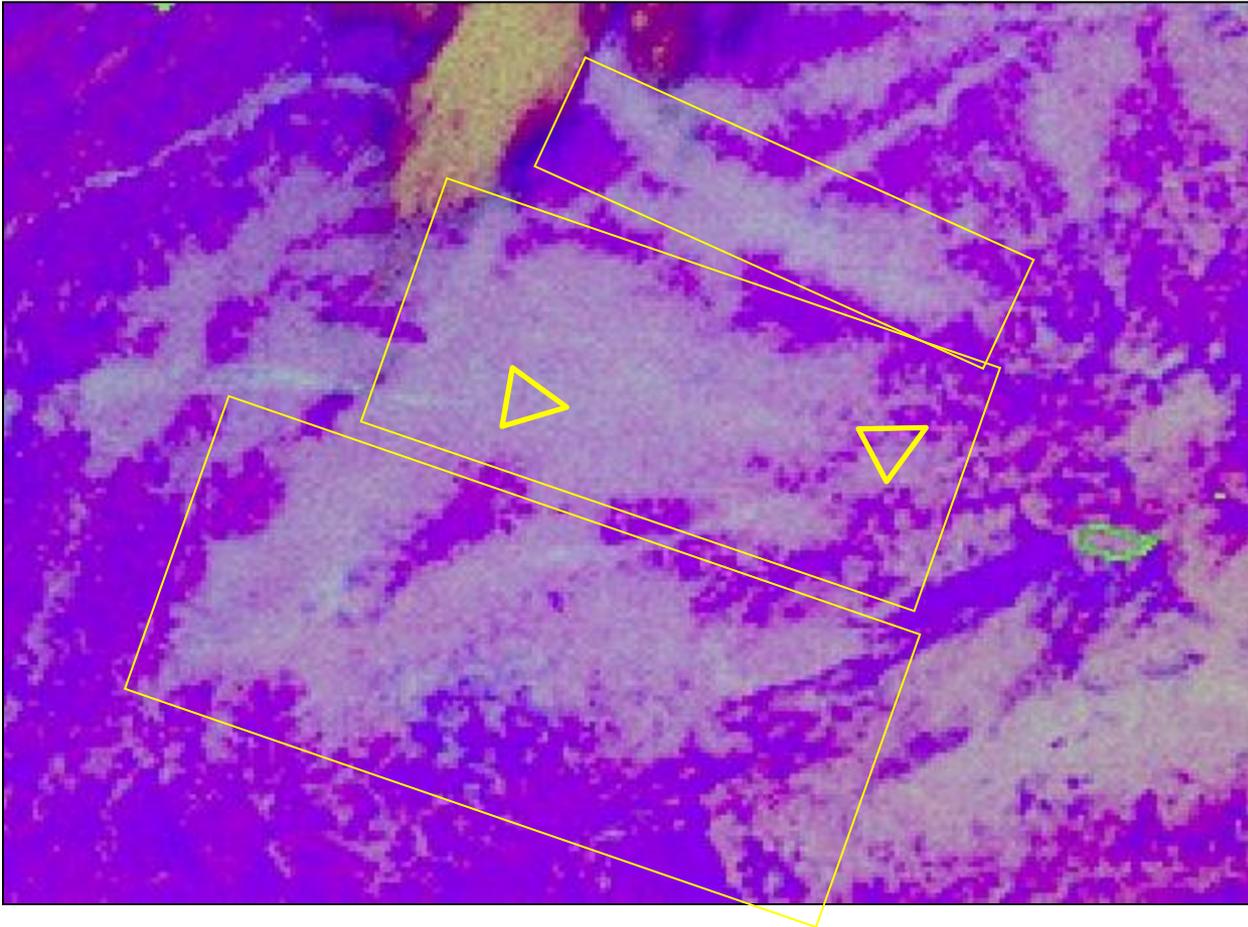
2006/01/19 05:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



19/1/2006
06:57 MSG

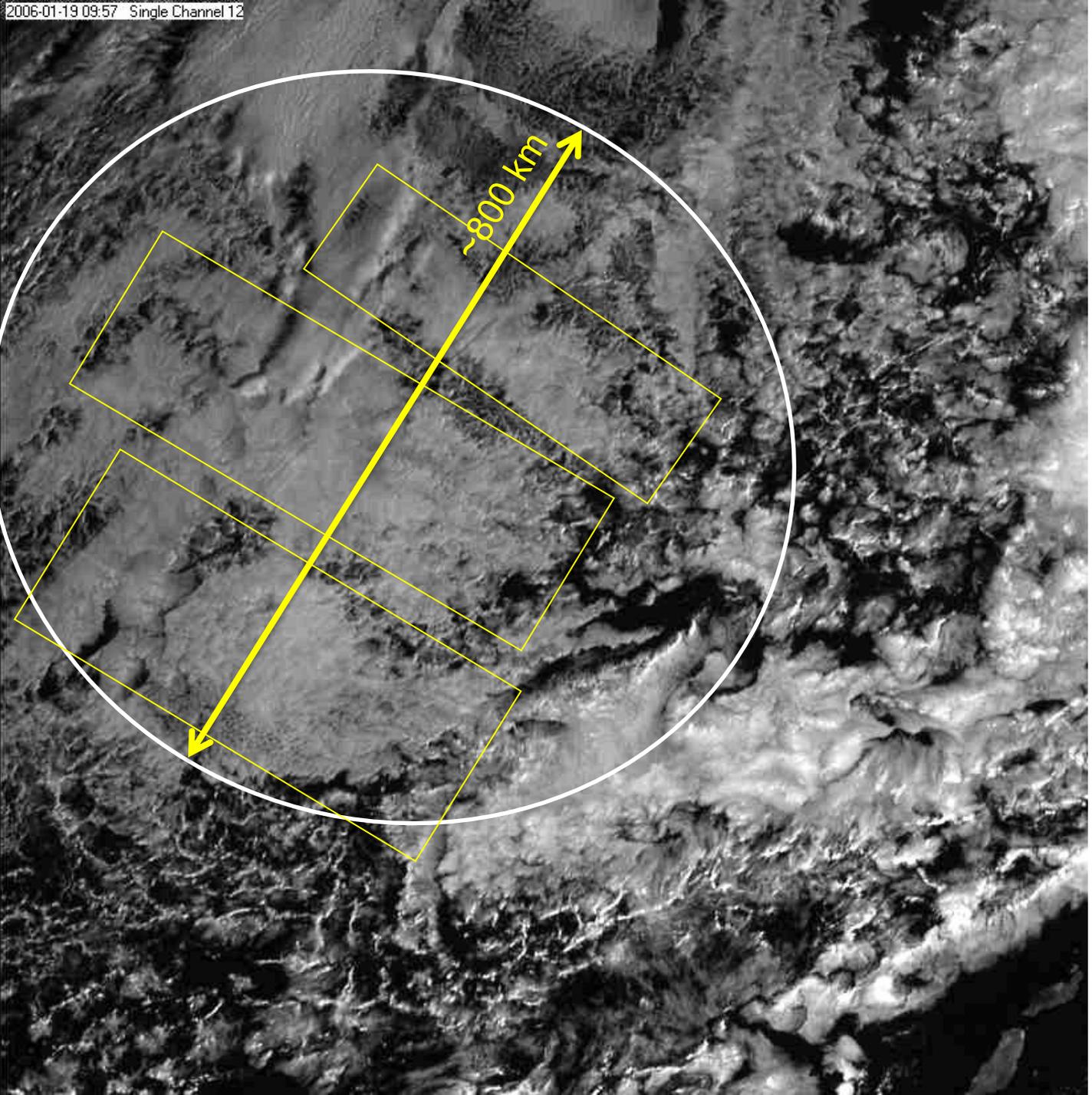
2006/01/19 06:57 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)



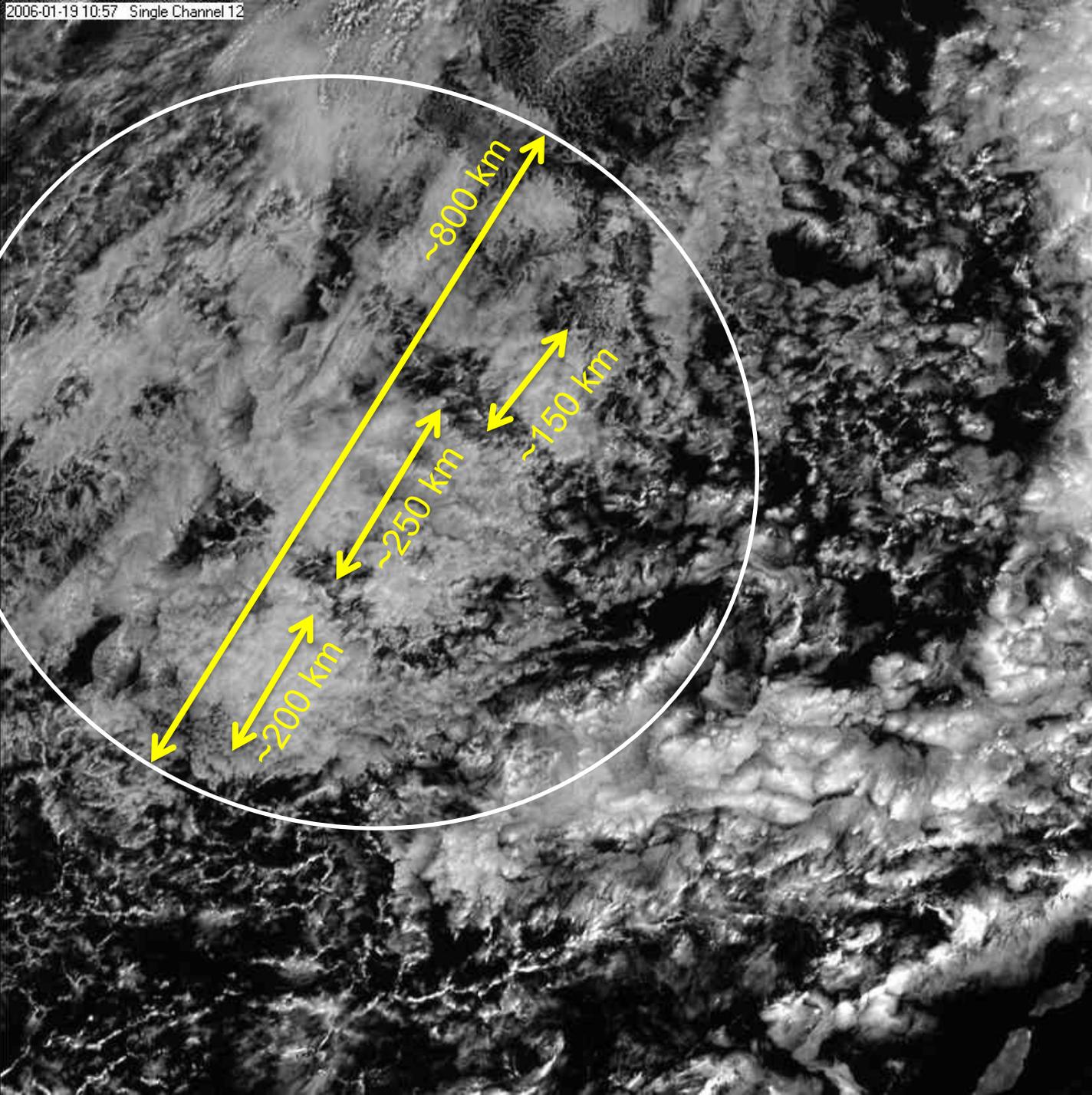


19/1/2006
09:57 MSG

2006-01-19 09:57 Single Channel 12

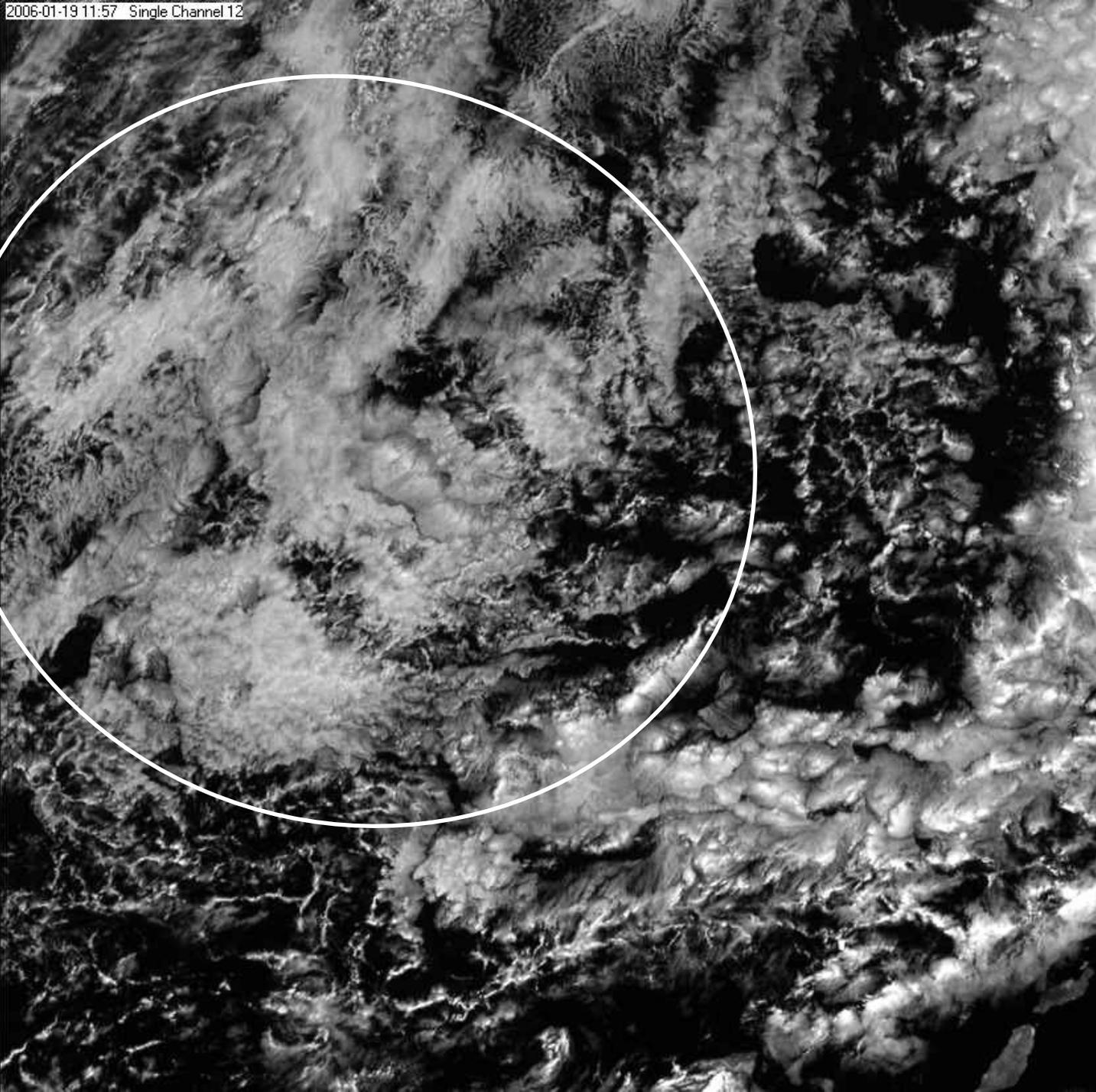


19/1/2006
10:57 MSG

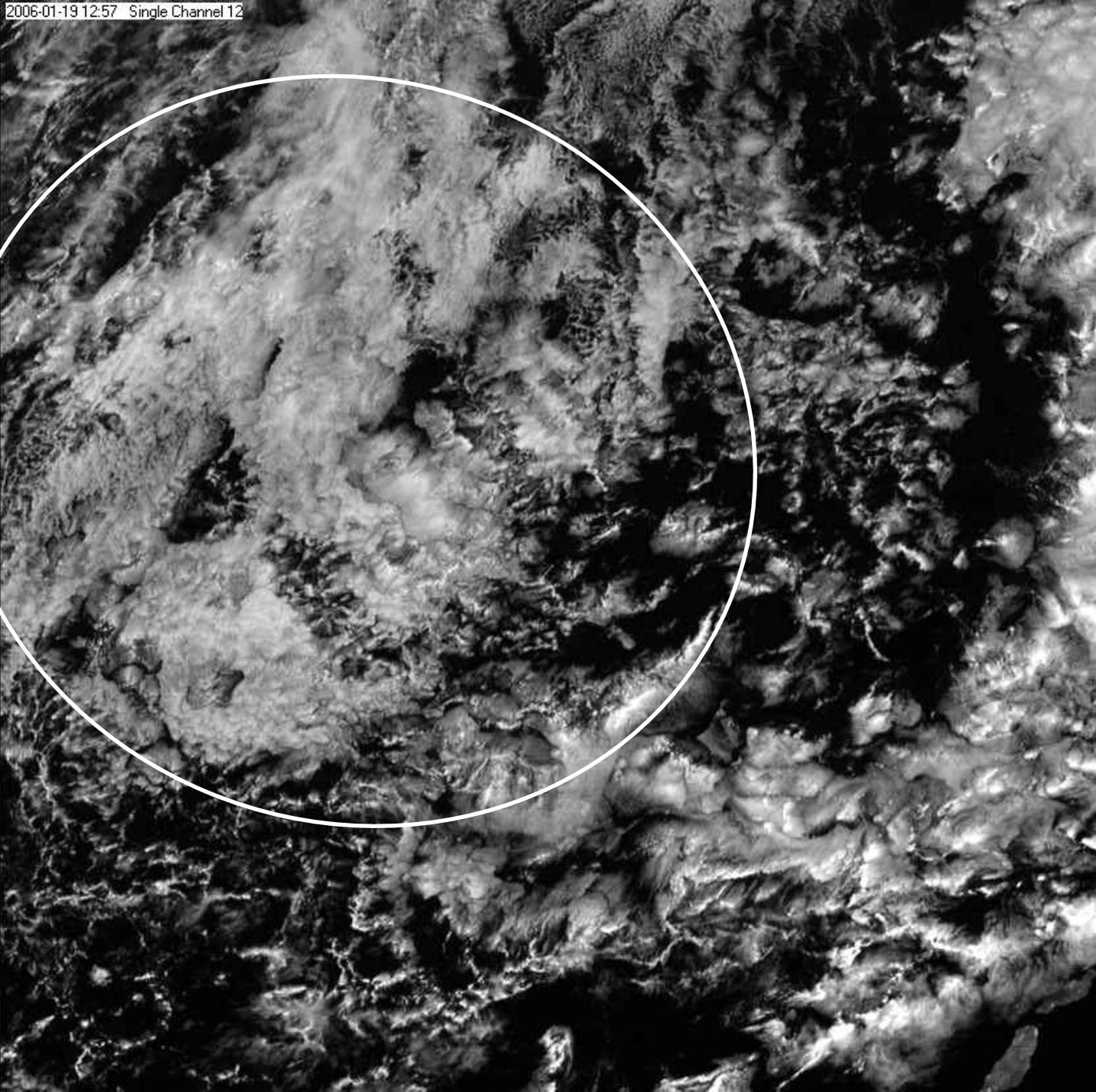


19/1/2006
11:57 MSG

2006-01-19 11:57 Single Channel 12



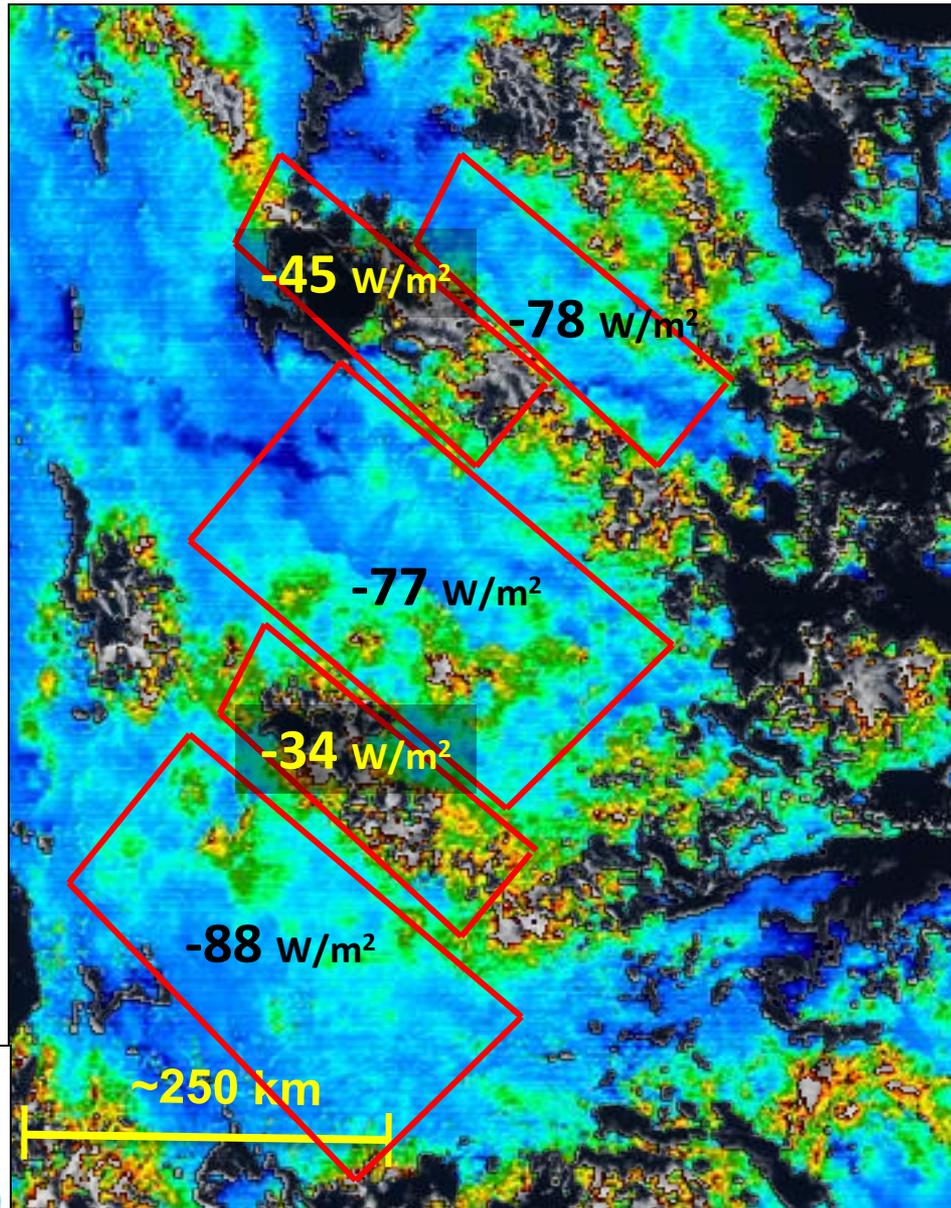
19/1/2006
12:57 MSG



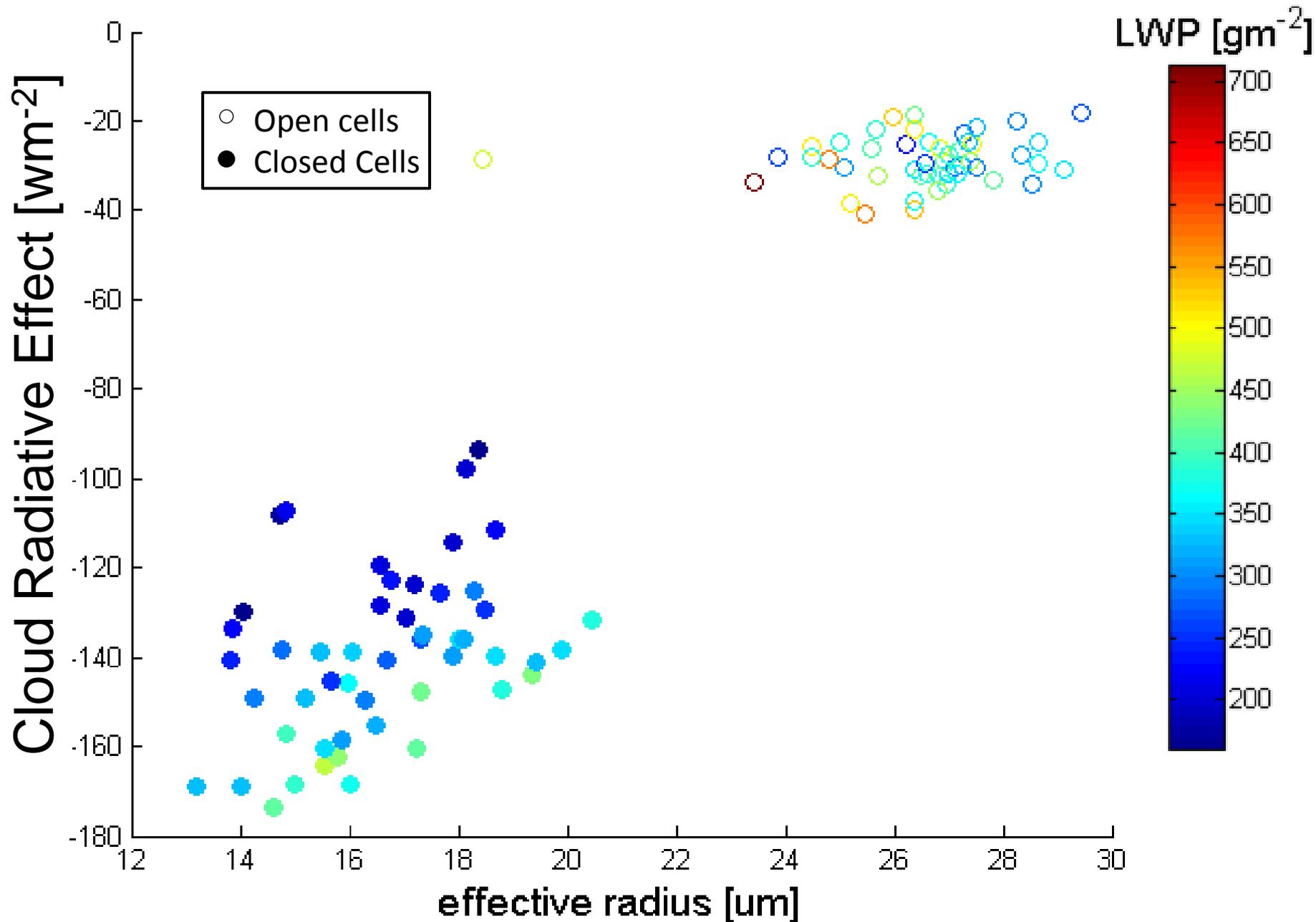
Air pollution from 42 hours old ship tracks

"Clouds" the Oceans

19/1/06 12:00 UTC
MODIS Re TERRA

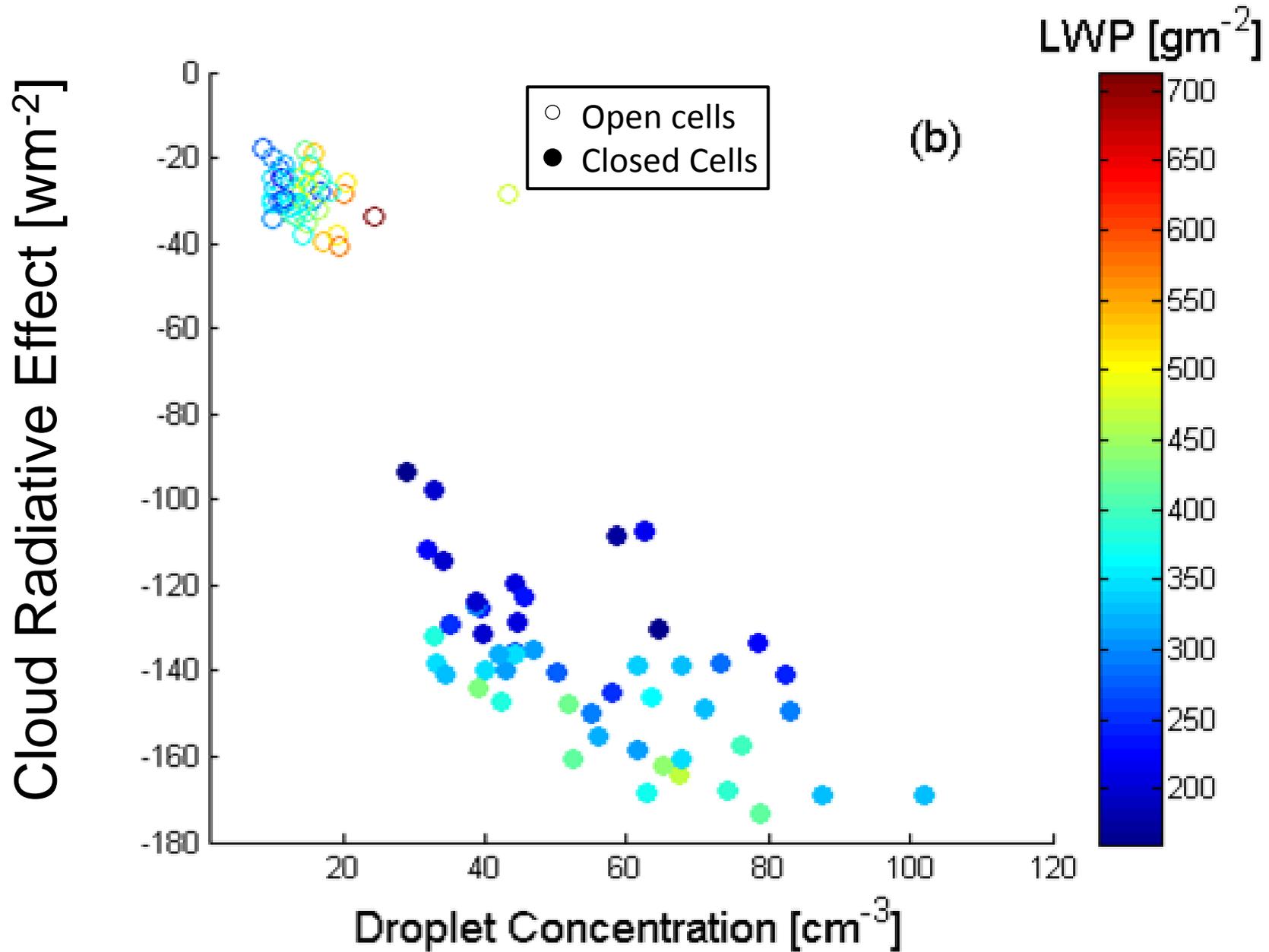


*Goren and Rosenfeld,
in preparation, 2011*



For the 5% most reflective pixels

Goren and Rosenfeld, under review



For the 5% most reflective pixels

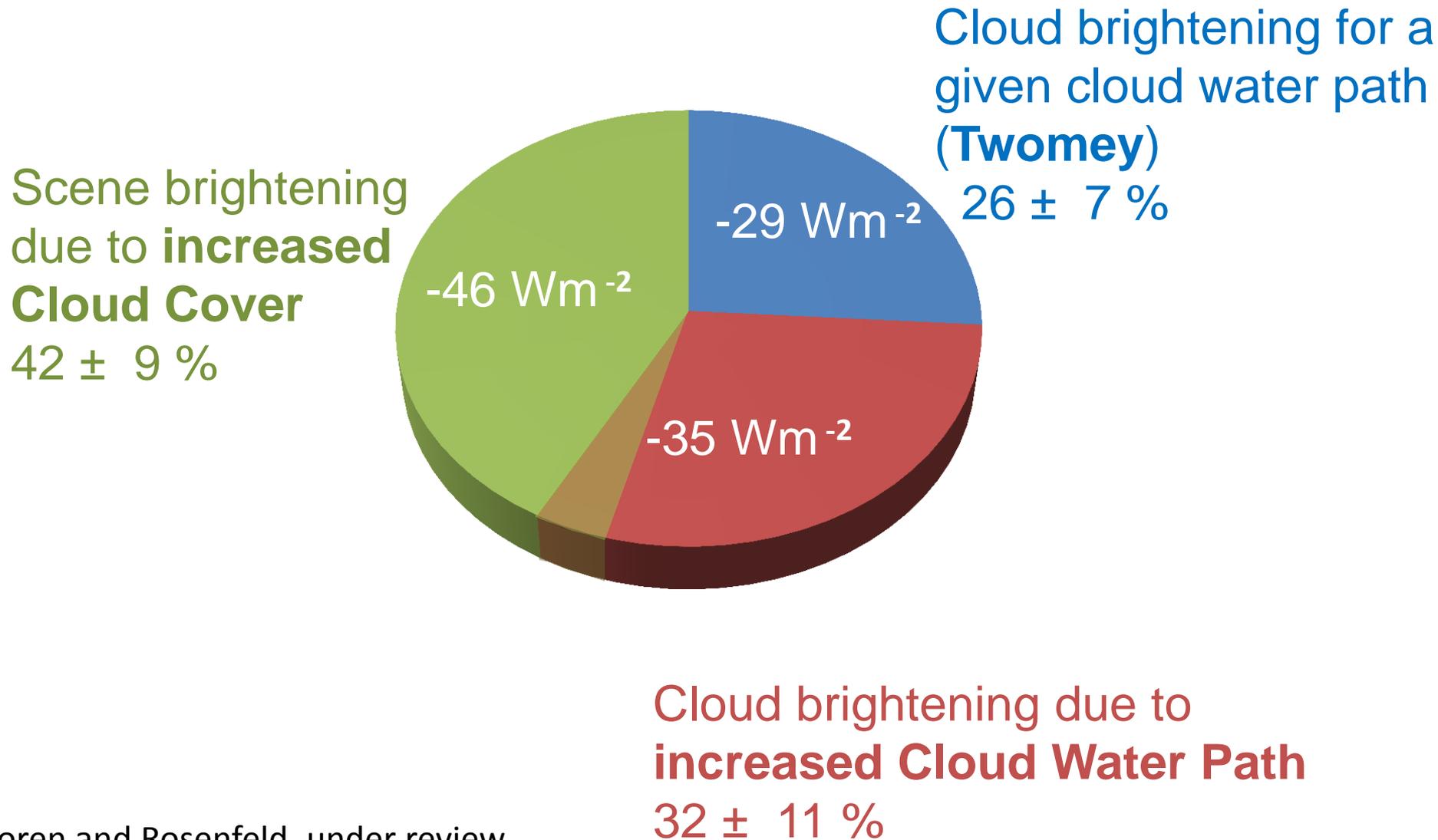
Goren and Rosenfeld, under review

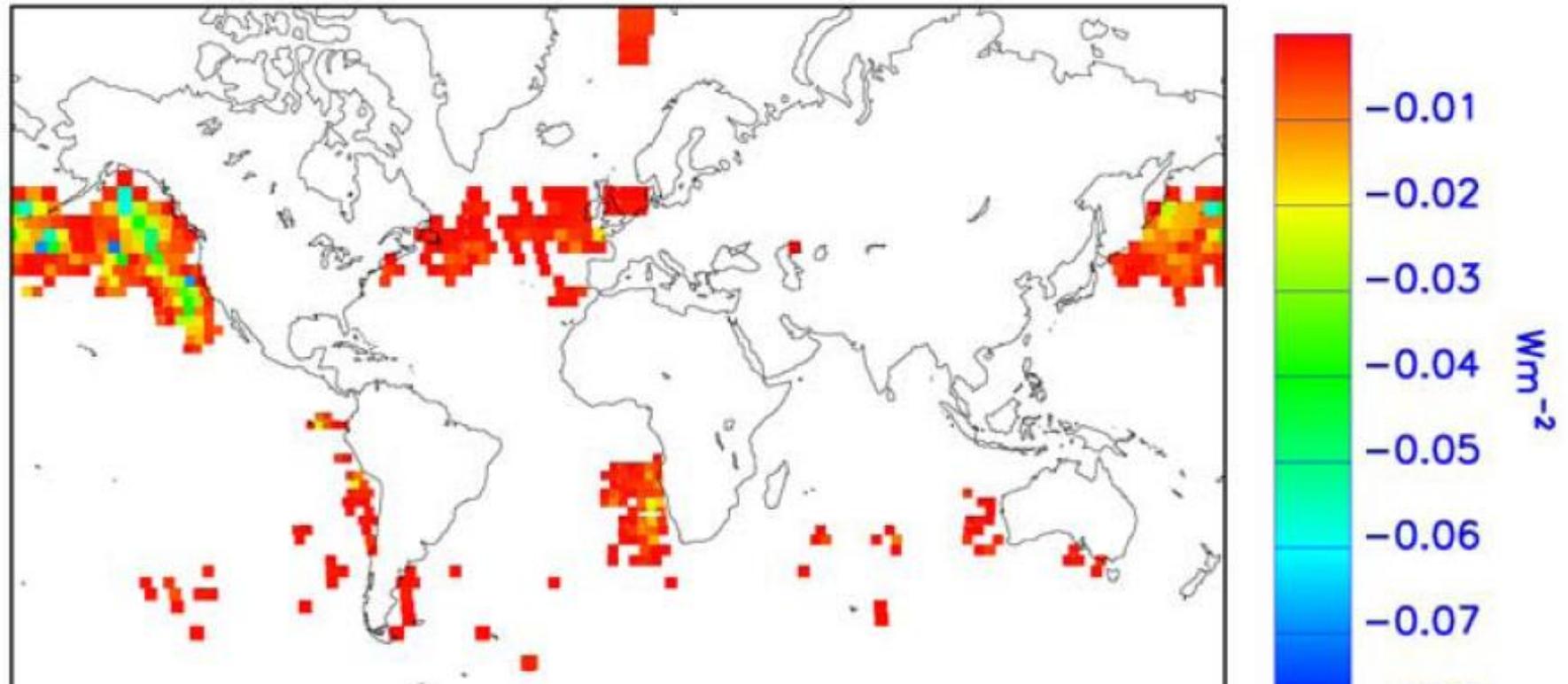
Analysis of 50 pairs of open vs. adjacent closed cells

	Open	Closed	Difference Closed-Open
N of cloud drops [cm³] [Szczodrak et al., 2001]	13 (± 3)*	53 (± 18)*	40*
	6 (± 1)	47 (± 16)	41
Effective radius [mm] [MODIS cloud product]	26 (± 1)*	15 (± 2)*	11*
	26 (± 1)	16 (± 1)	10
Radiative Effect [Wm⁻²]	-28 (± 5)	-138 (± 19)	-109

* For the 5% most reflective pixels

The components of the radiative forcing due to closing open MSC

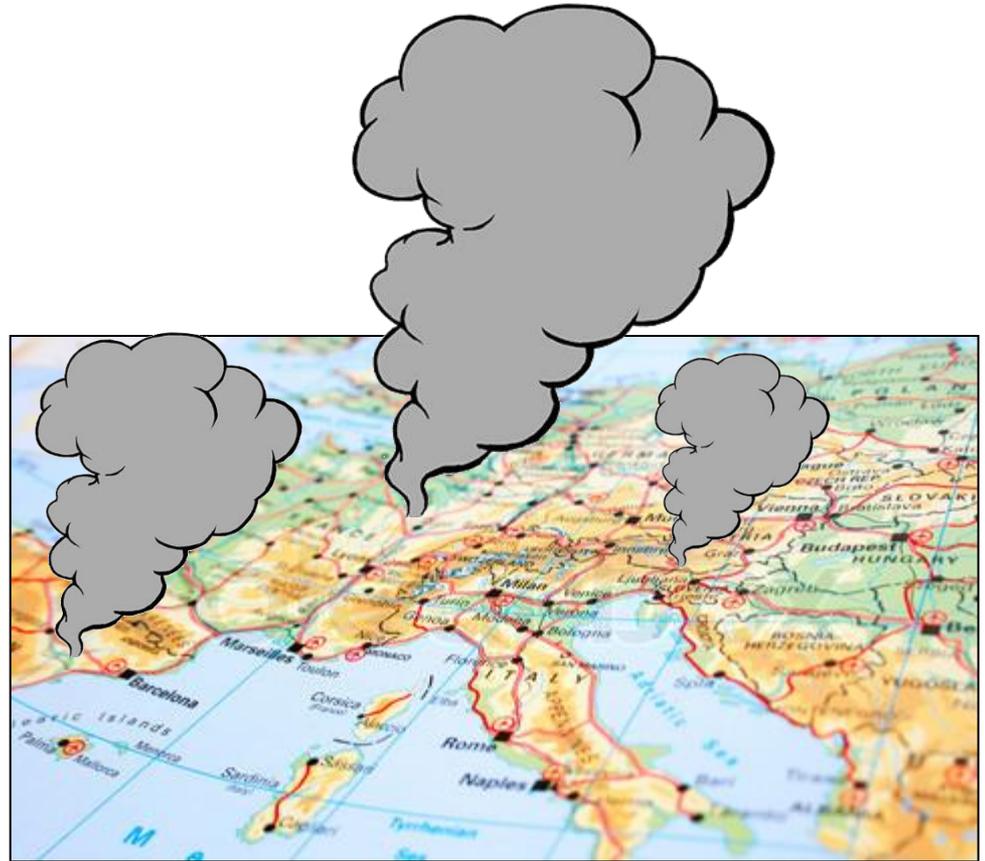




The global radiative forcing due to visible ship tracks is $\sim 0.005 \text{ Wm}^{-2}$. So do ship emissions matter at all?

Annual mean radiative forcing of ship tracks
During 2004. *Schreier et al., GRL 2007.*

Can Europe act as a huge ship?



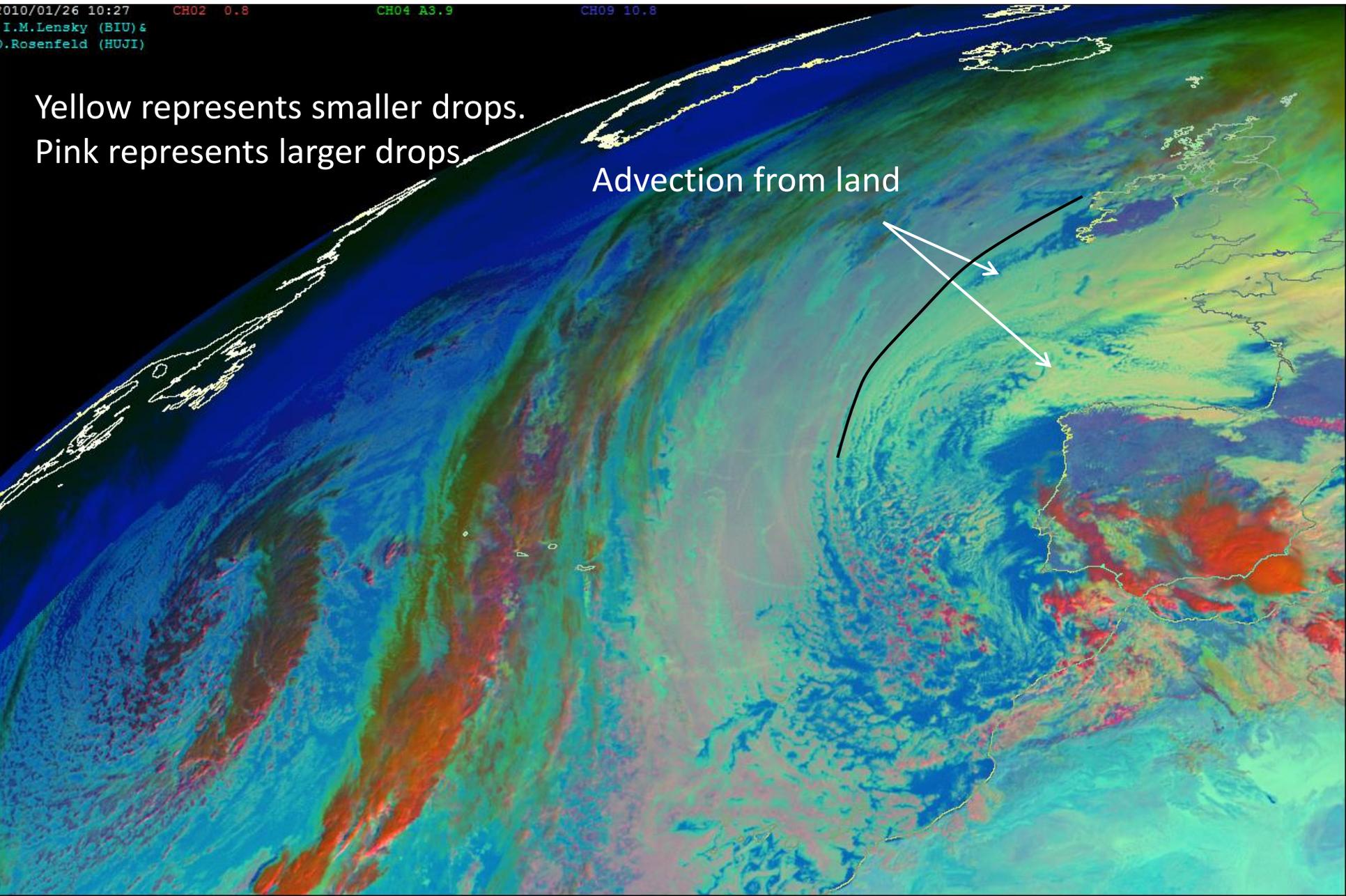
2010 January 26

10:27 UTC

010/01/26 10:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Yellow represents smaller drops.
Pink represents larger drops

Advection from land



2010 January 26

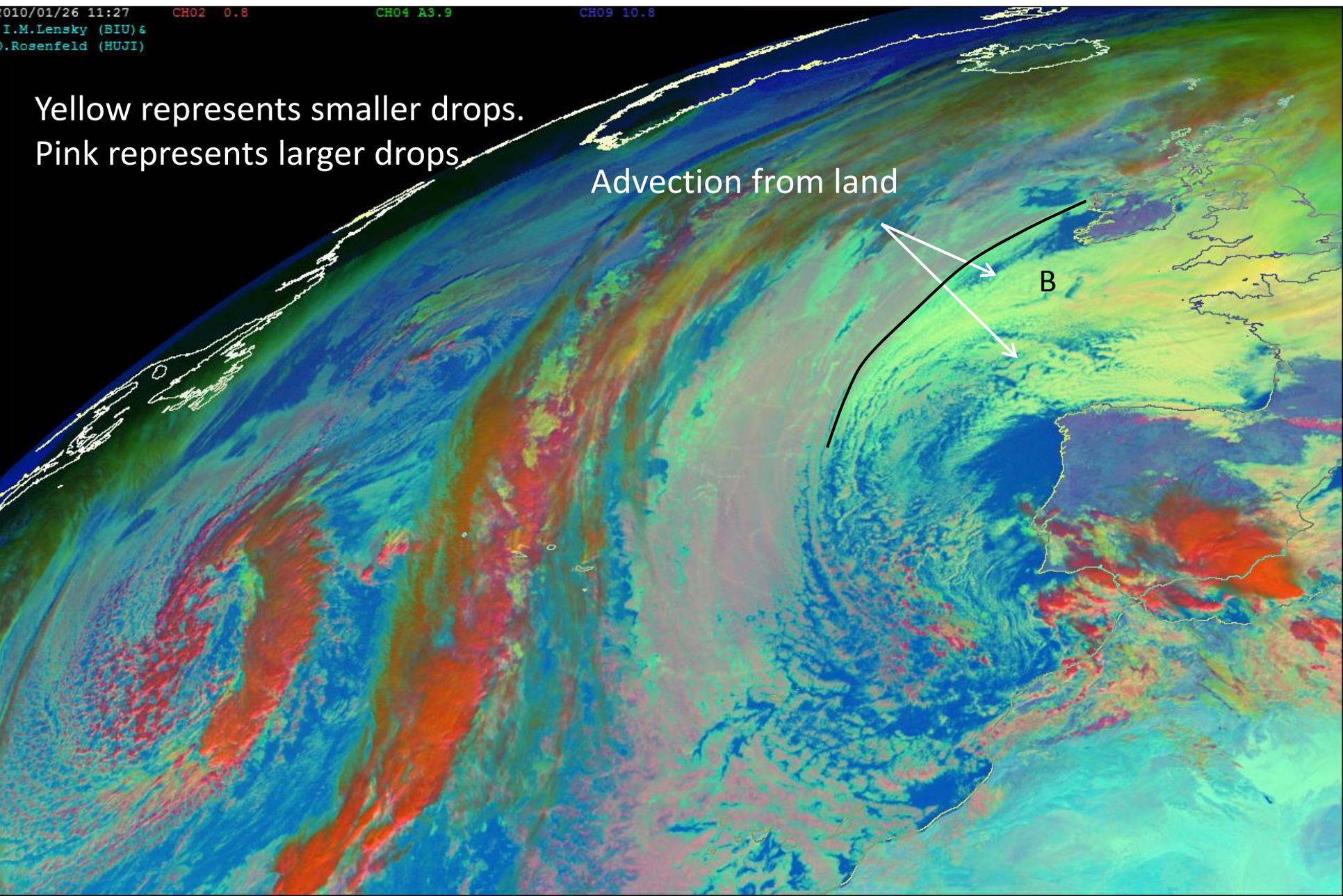
11:27 UTC

010/01/26 11:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Yellow represents smaller drops.
Pink represents larger drops

Advection from land

B



2010 January 26

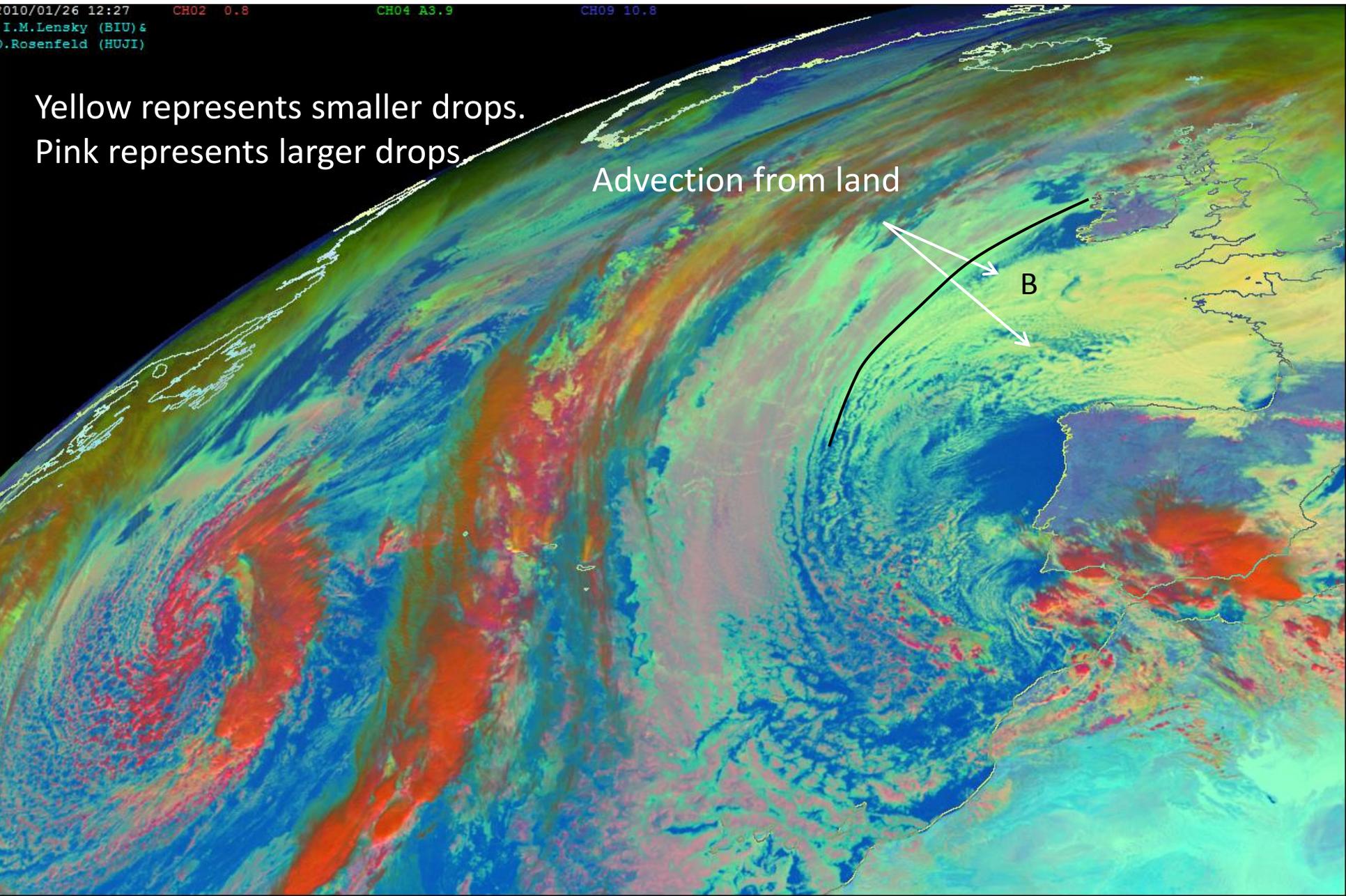
12:27 UTC

010/01/26 12:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)

Yellow represents smaller drops.
Pink represents larger drops

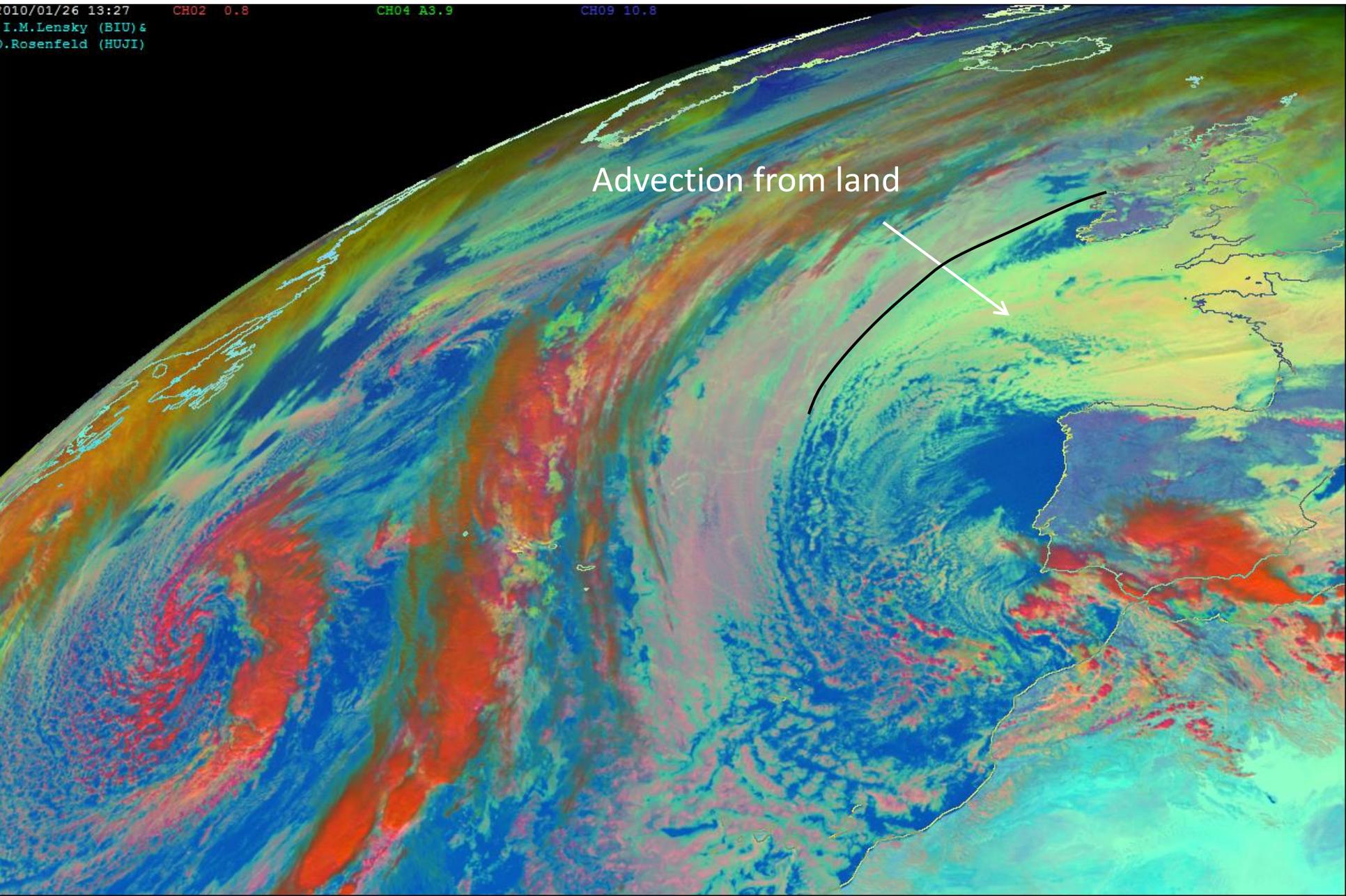
Advection from land

B



2010 January 26
13:27 UTC

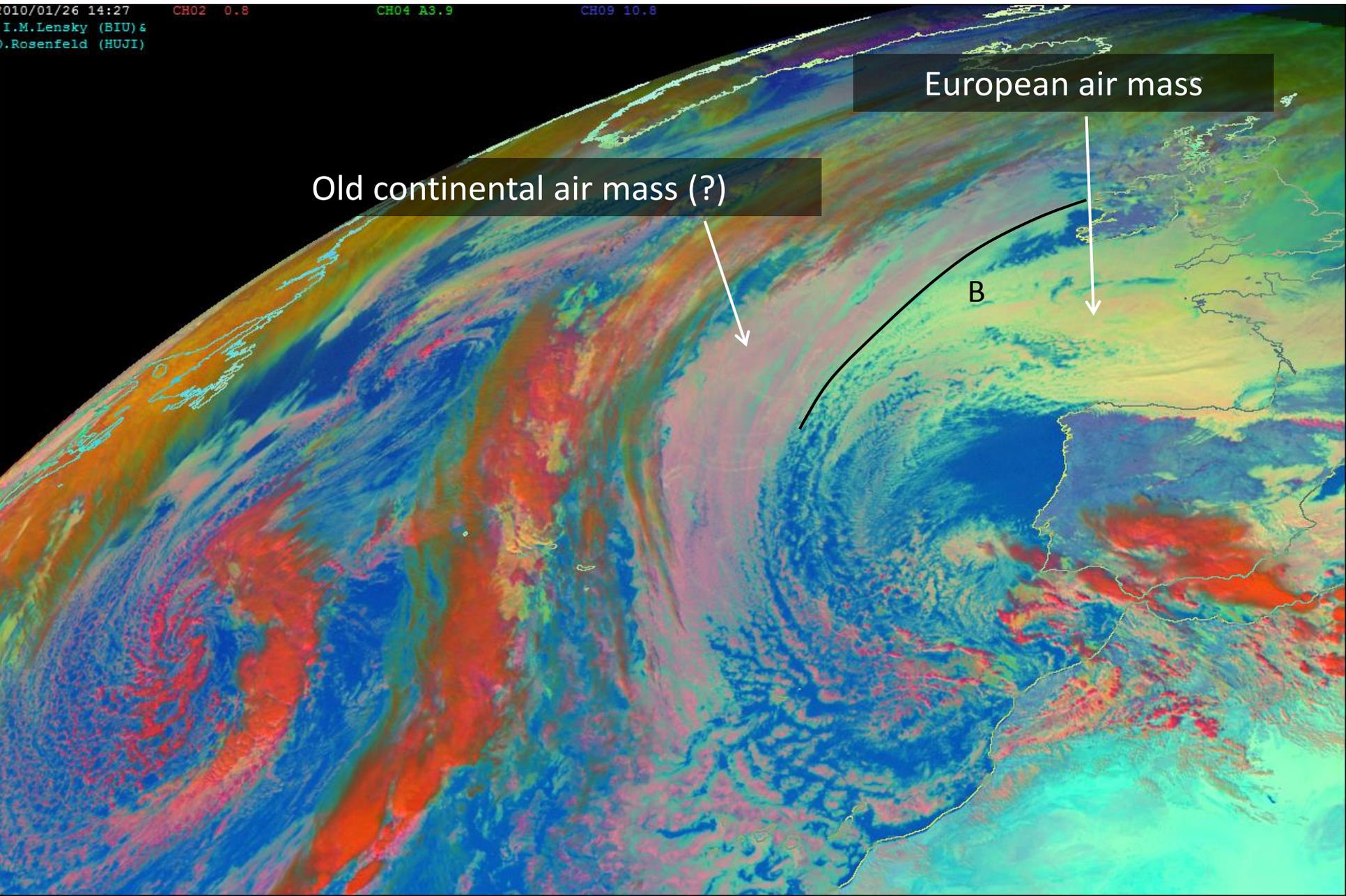
010/01/26 13:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)



Advection from land

2010 January 26
14:27 UTC

010/01/26 14:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)



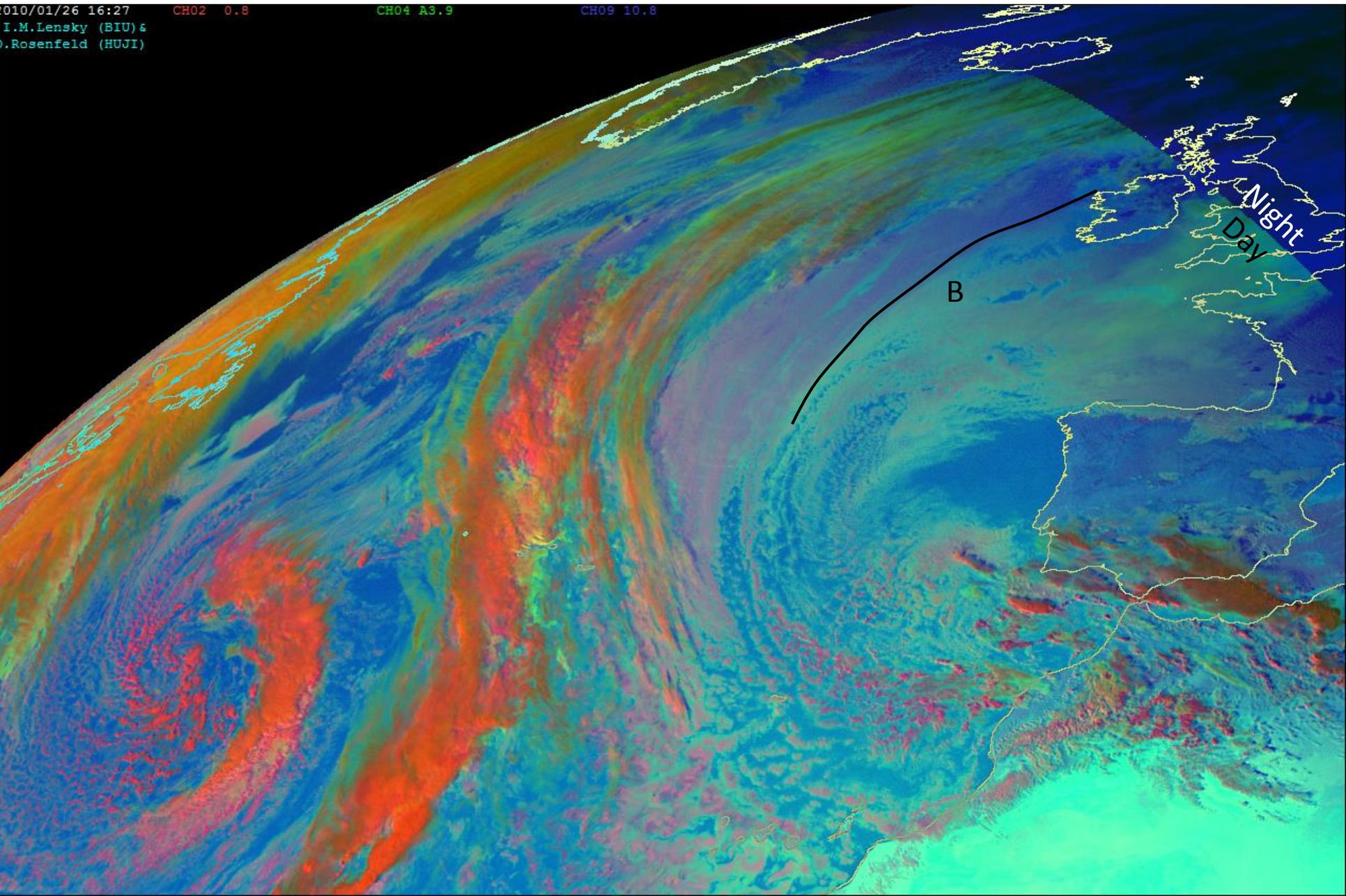
European air mass

Old continental air mass (?)

B

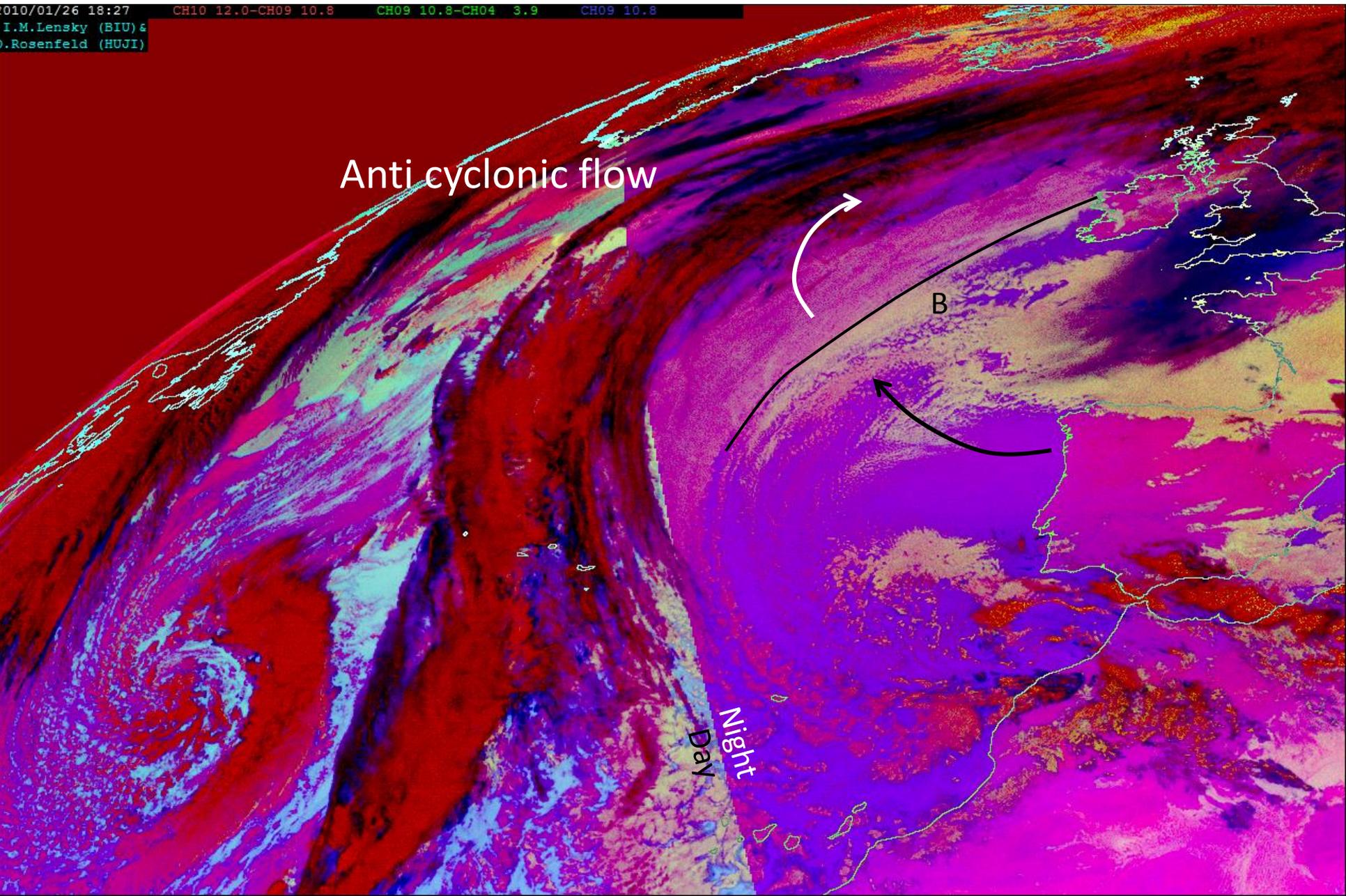
2010 January 26
16:27 UTC

2010/01/26 16:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)



2010 January 26
18:27 UTC

010/01/26 18:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



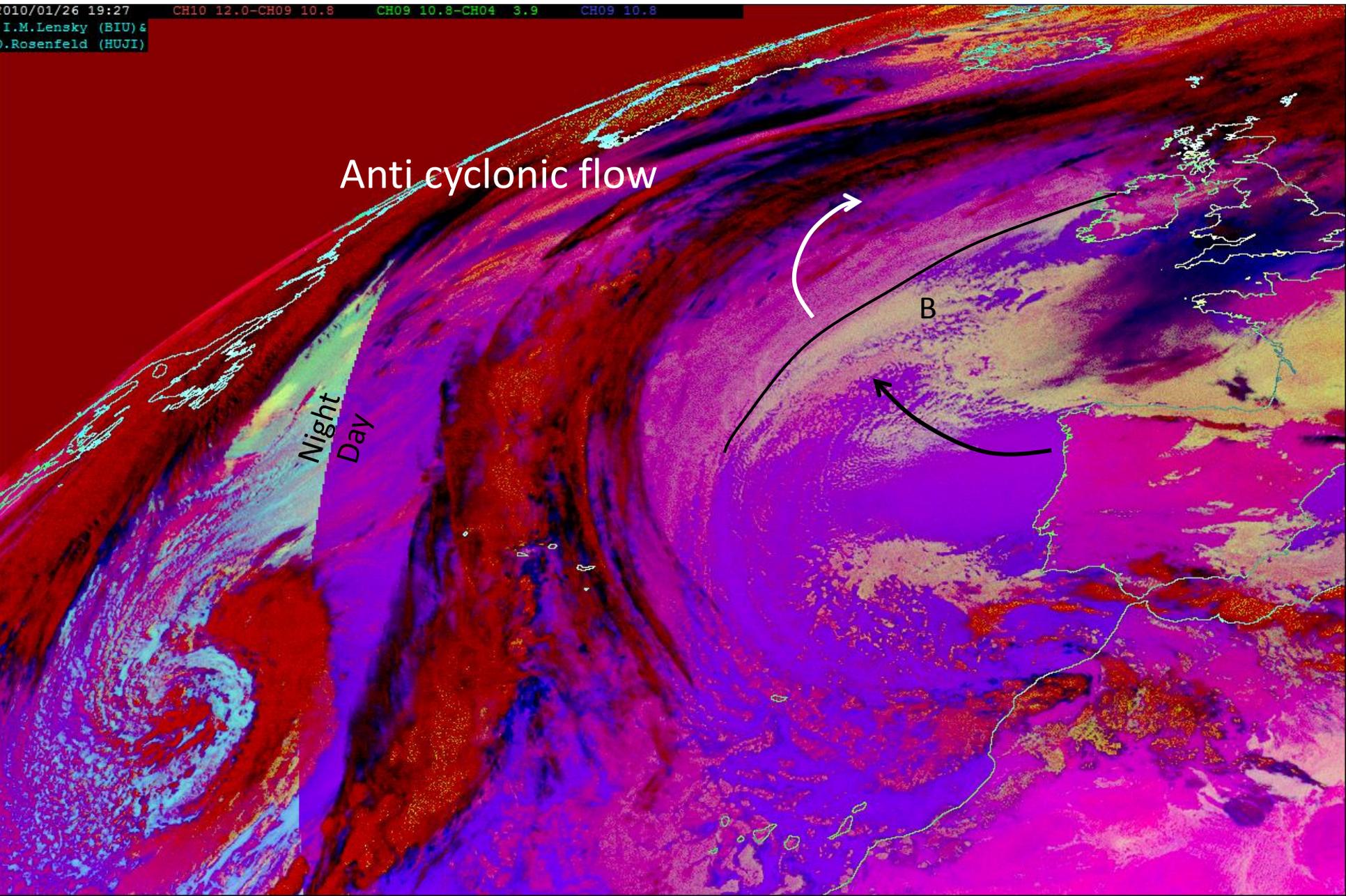
Anti cyclonic flow

B

Night
Day

2010 January 26
19:27 UTC

010/01/26 19:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



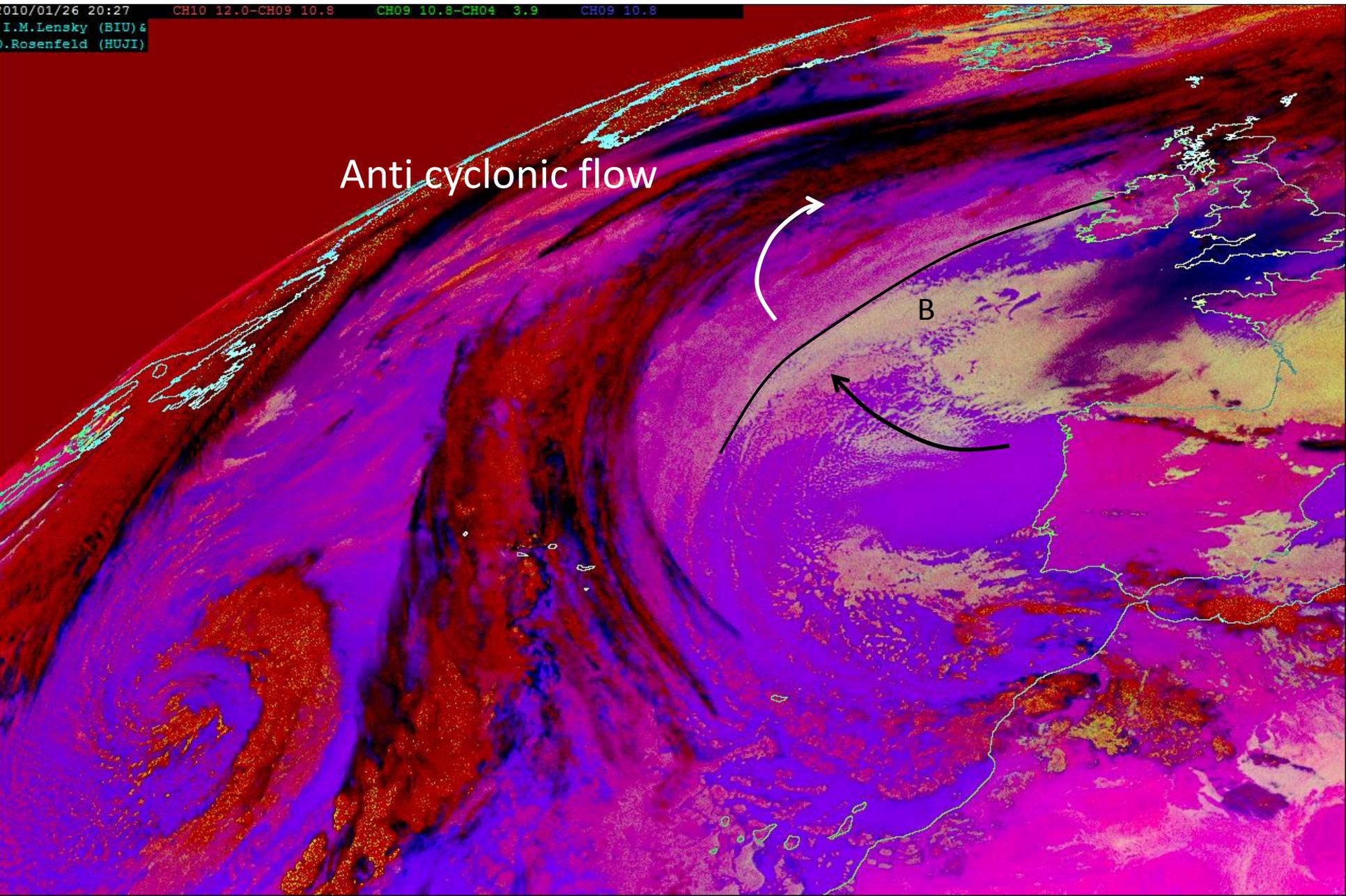
Anti cyclonic flow

Night
Day

B

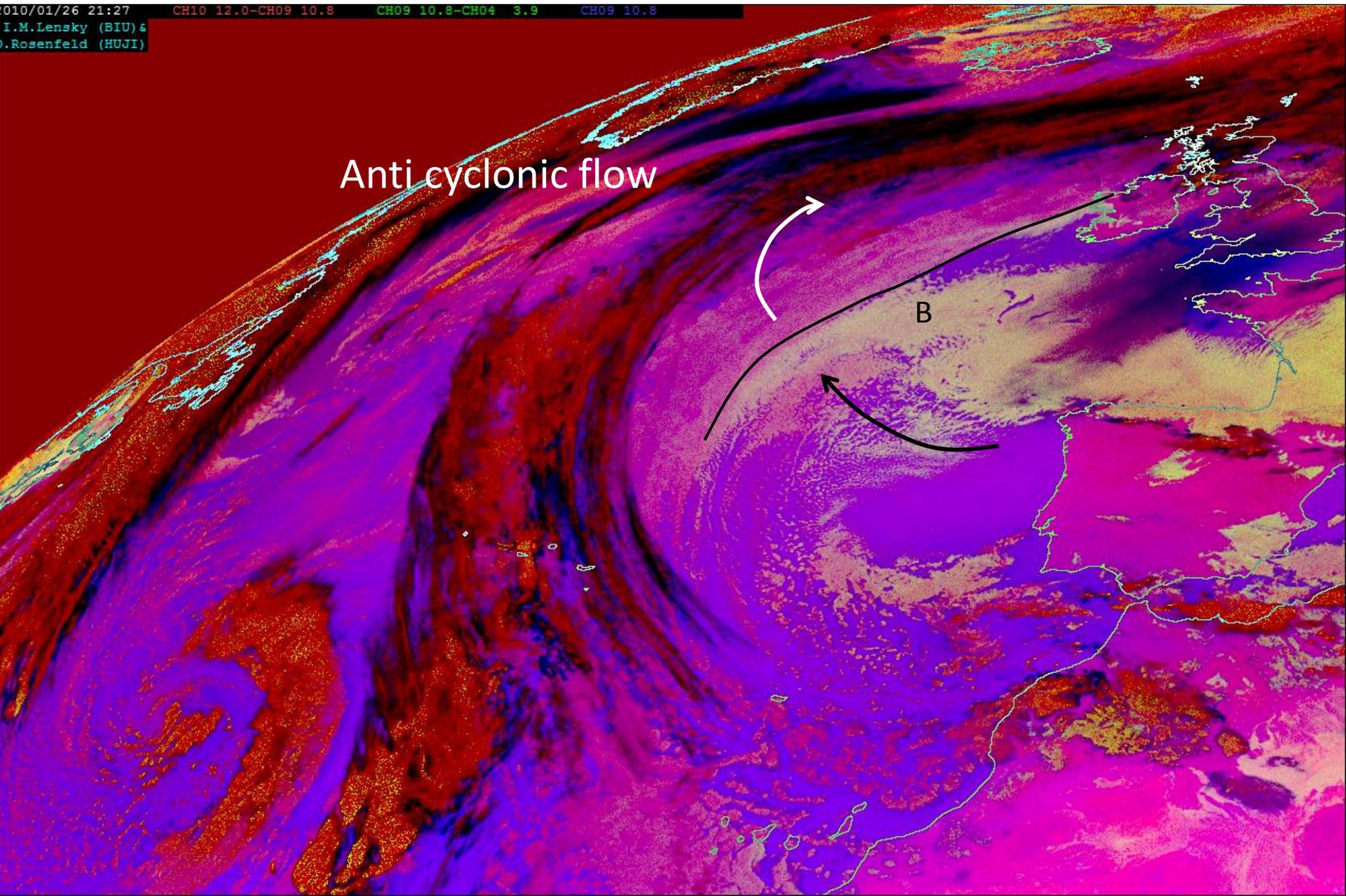
2010 January 26
20:27 UTC

010/01/26 20:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



2010 January 26
21:27 UTC

010/01/26 21:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

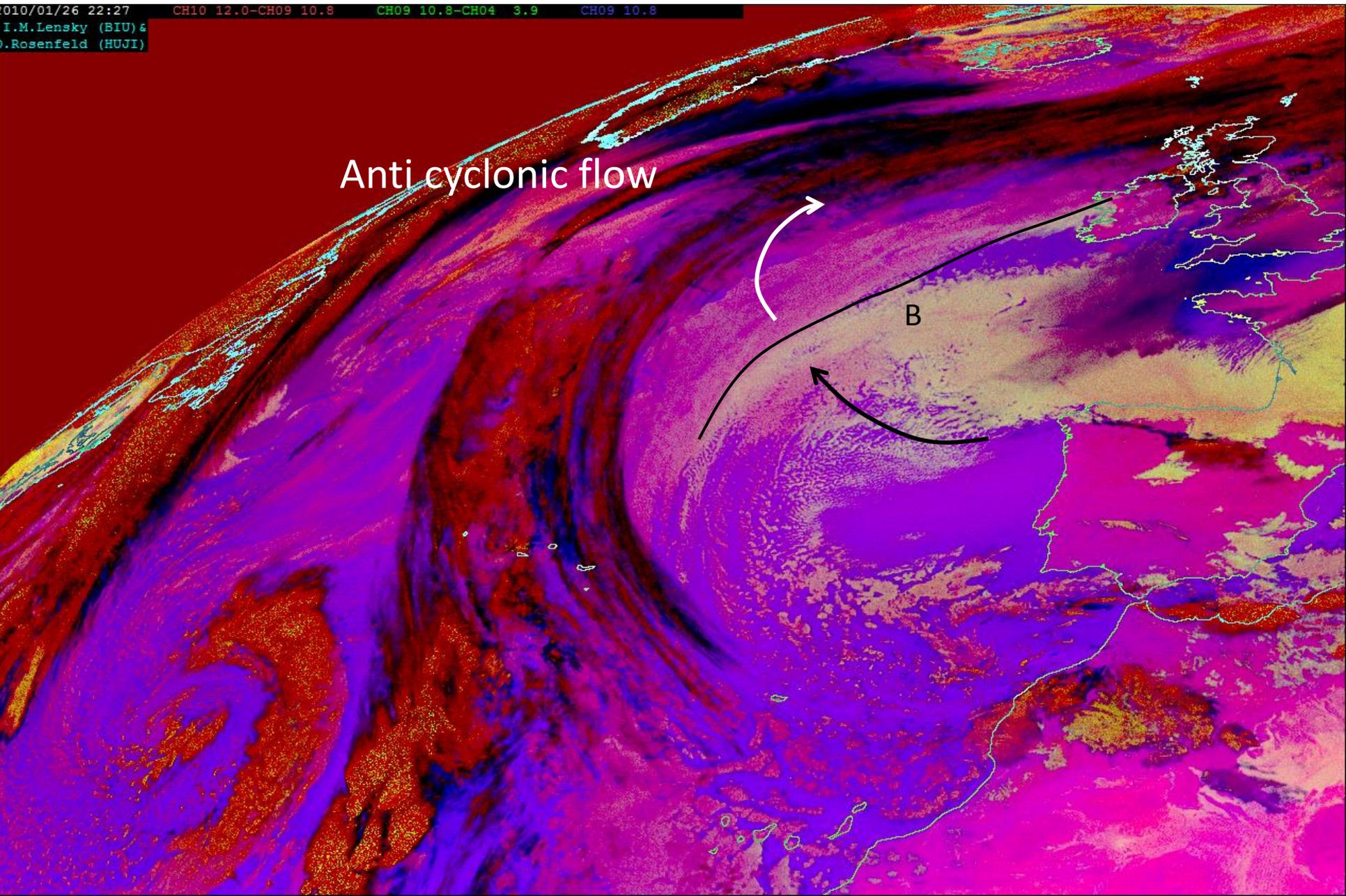


Anti cyclonic flow

B

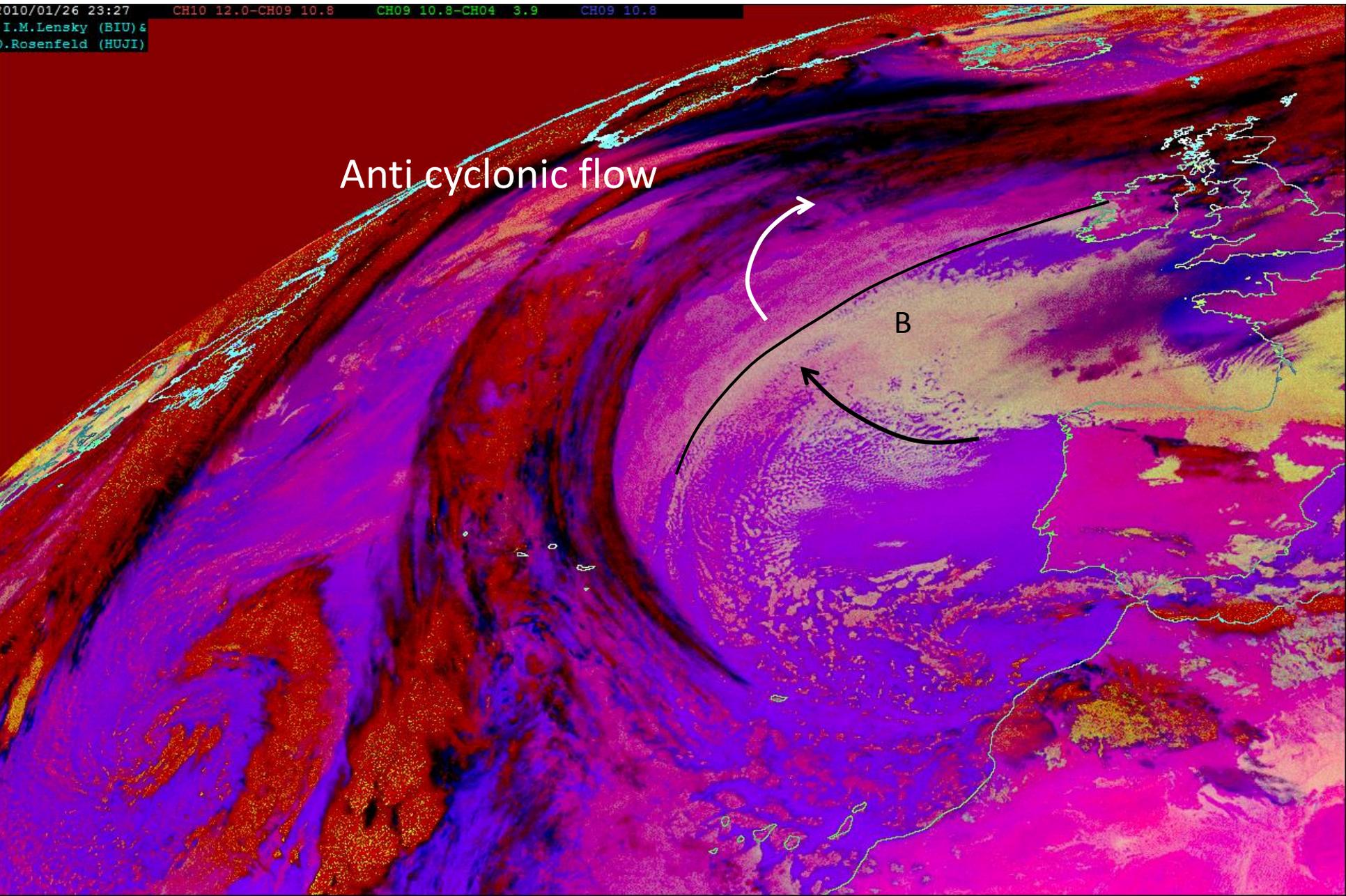
2010 January 26
22:27 UTC

010/01/26 22:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



2010 January 26
23:27 UTC

010/01/26 23:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

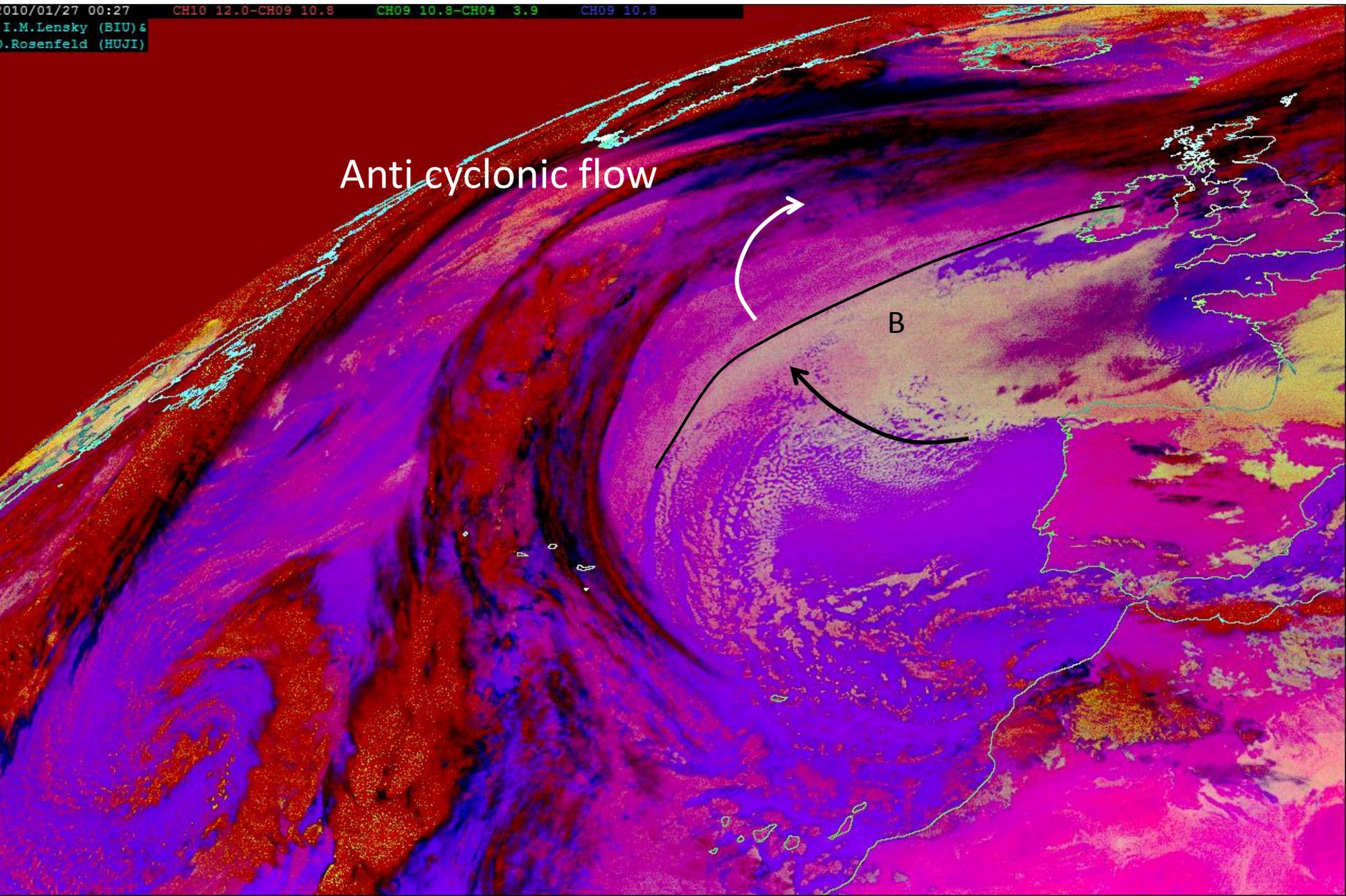


Anti cyclonic flow

B

2010 January 27
00:27 UTC

010/01/27 00:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Anti cyclonic flow

B

2010 January 27

01:27 UTC

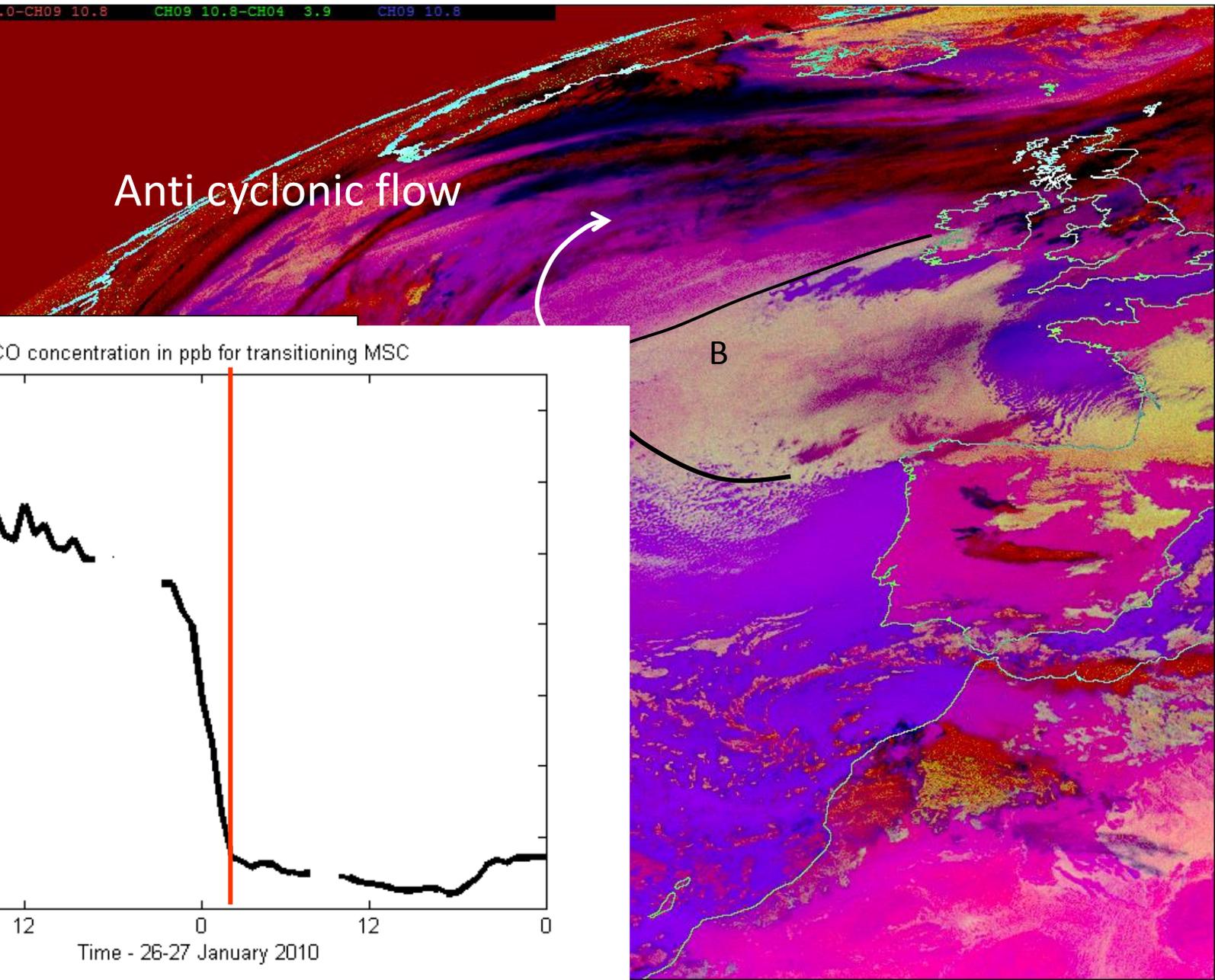
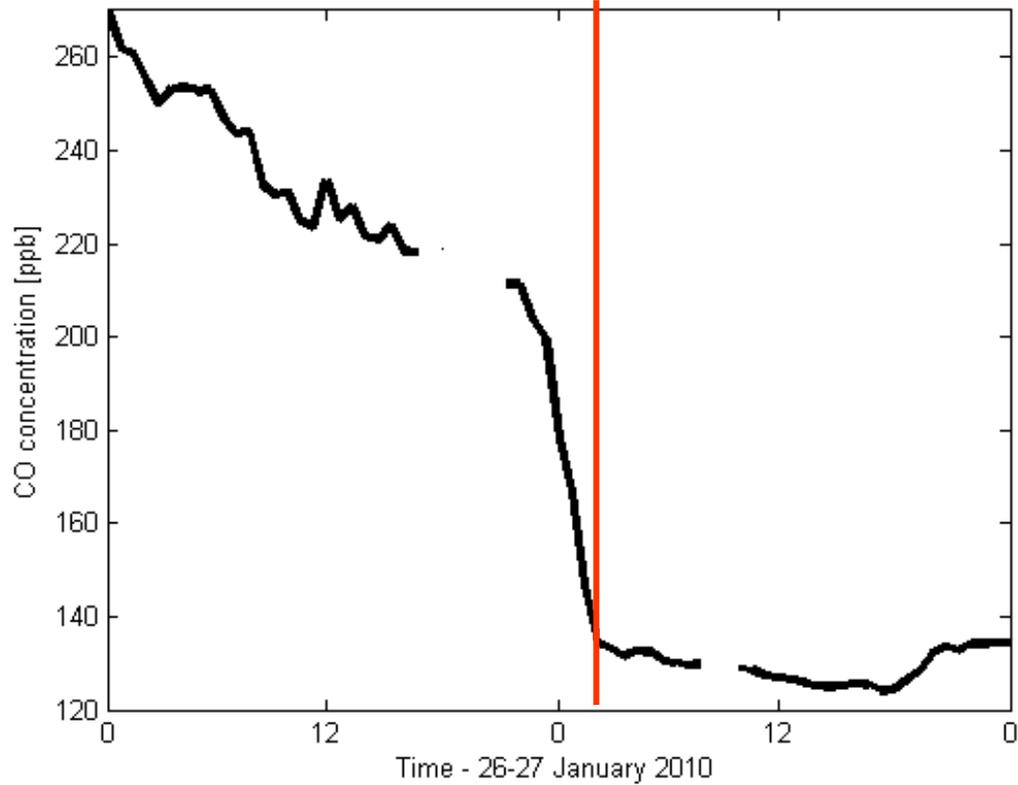
2010/01/27 01:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)

Anti cyclonic flow



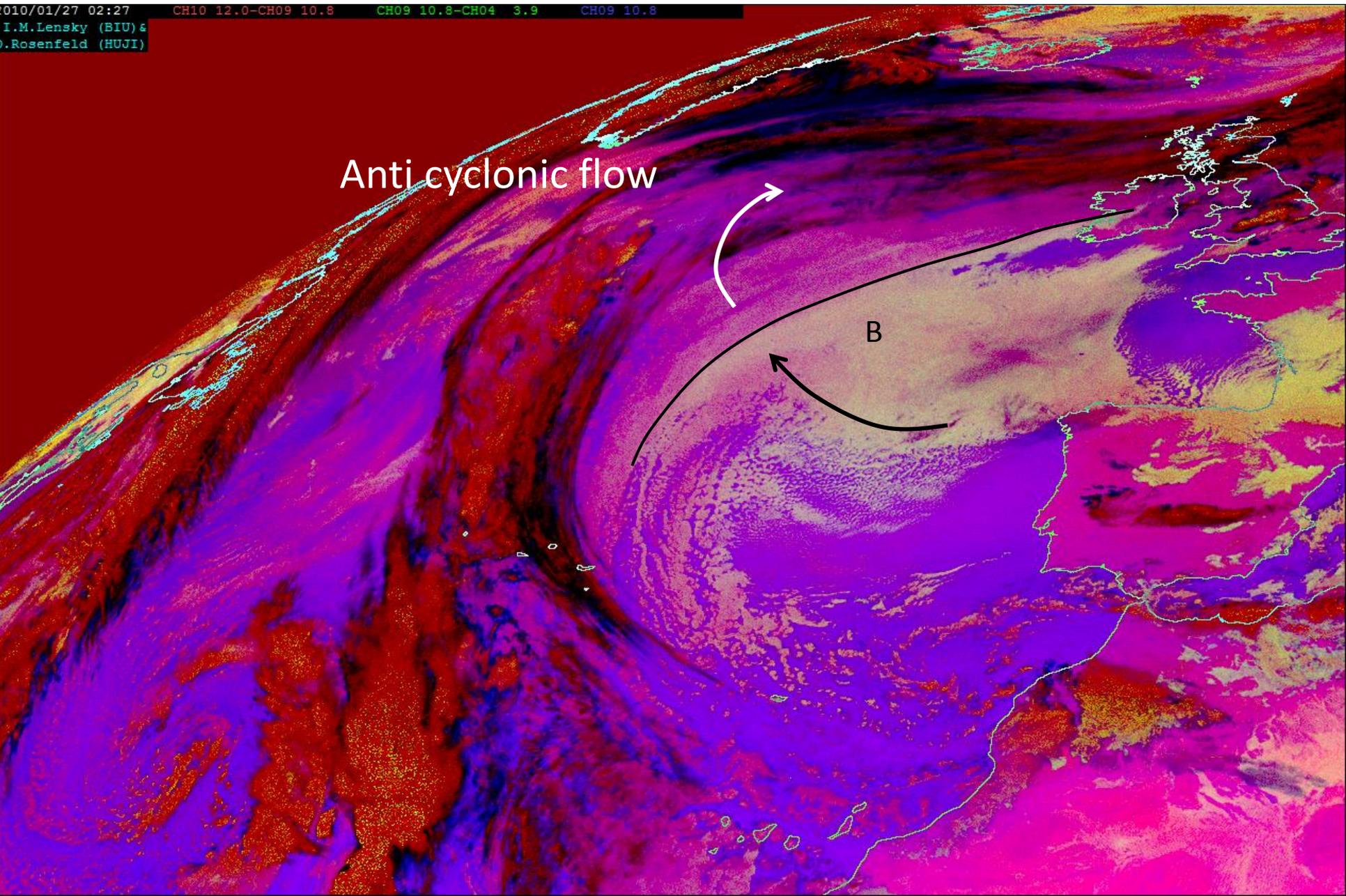
B

CO concentration in ppb for transitioning MSC



2010 January 27
02:27 UTC

010/01/27 02:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

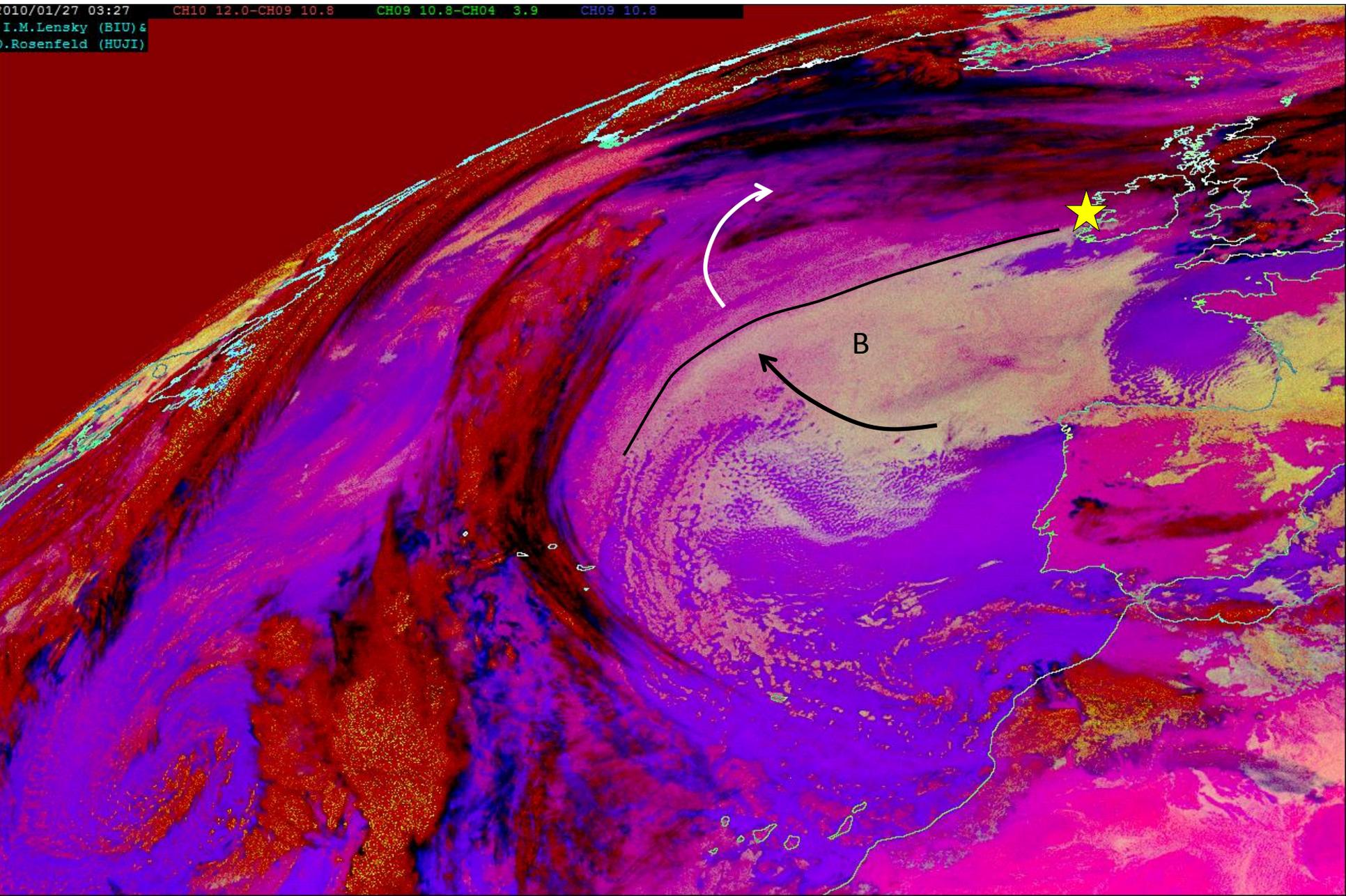


Anti cyclonic flow

B

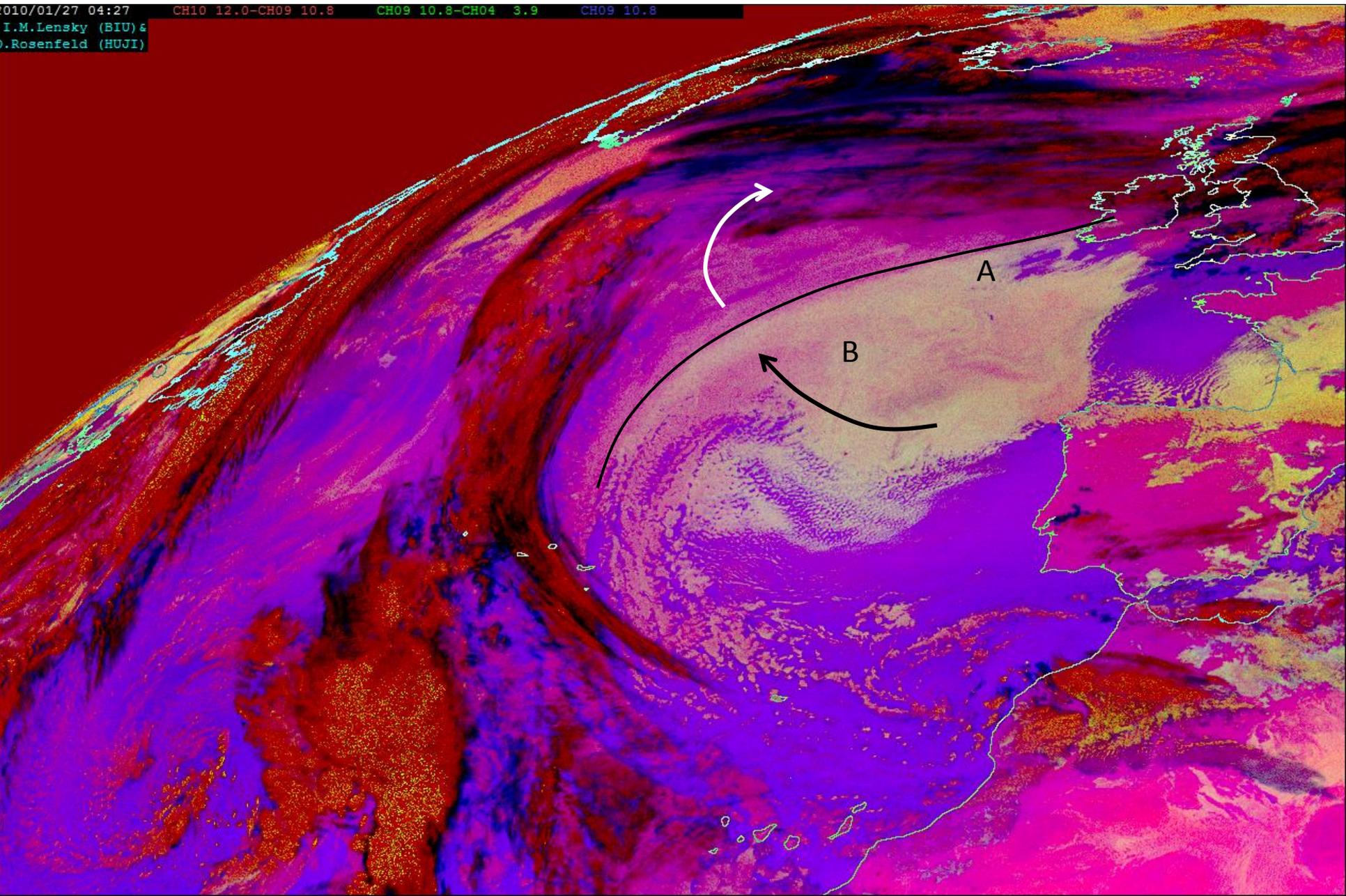
2010 January 27
03:27 UTC

010/01/27 03:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



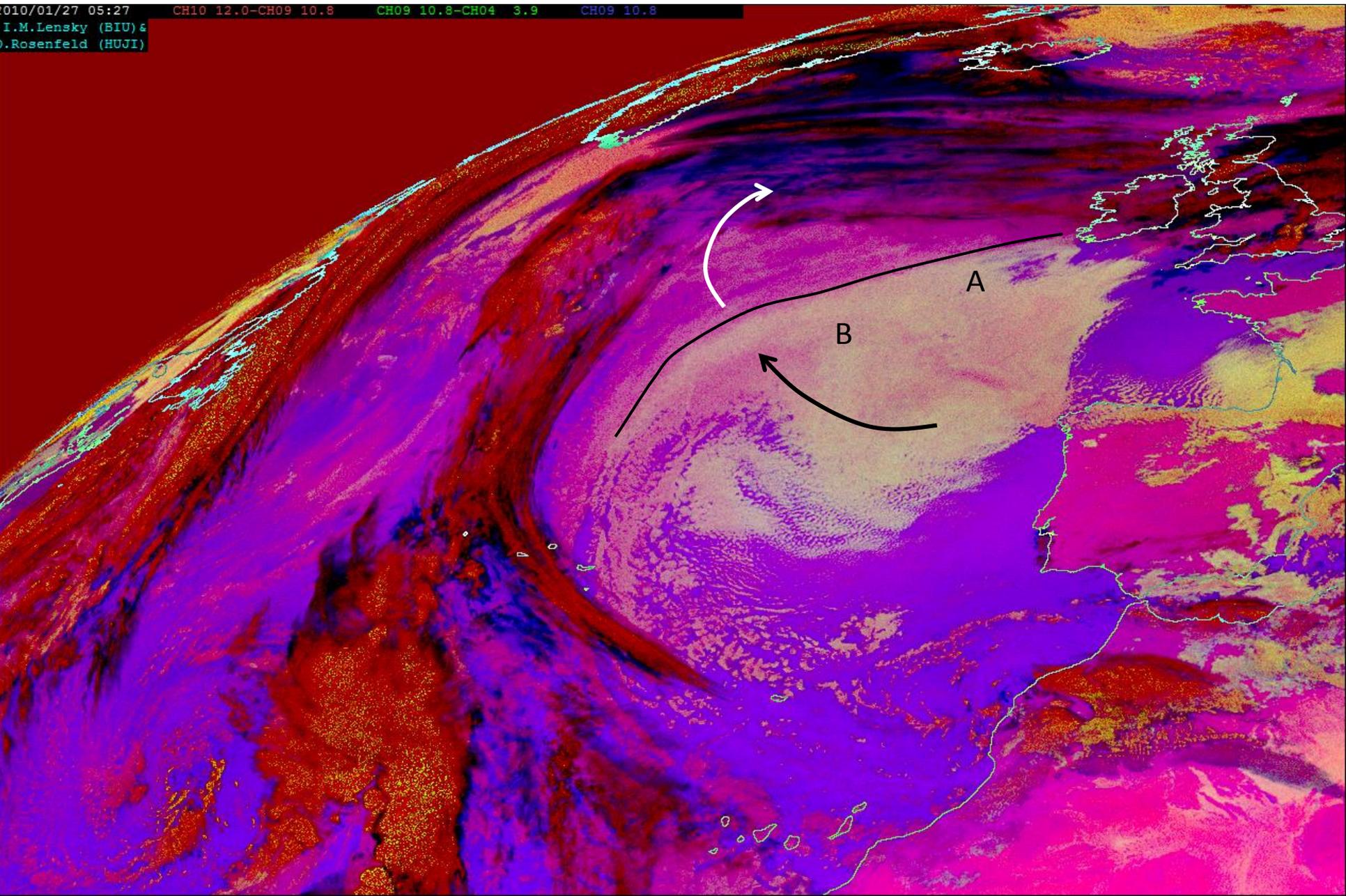
2010 January 27
04:27 UTC

010/01/27 04:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



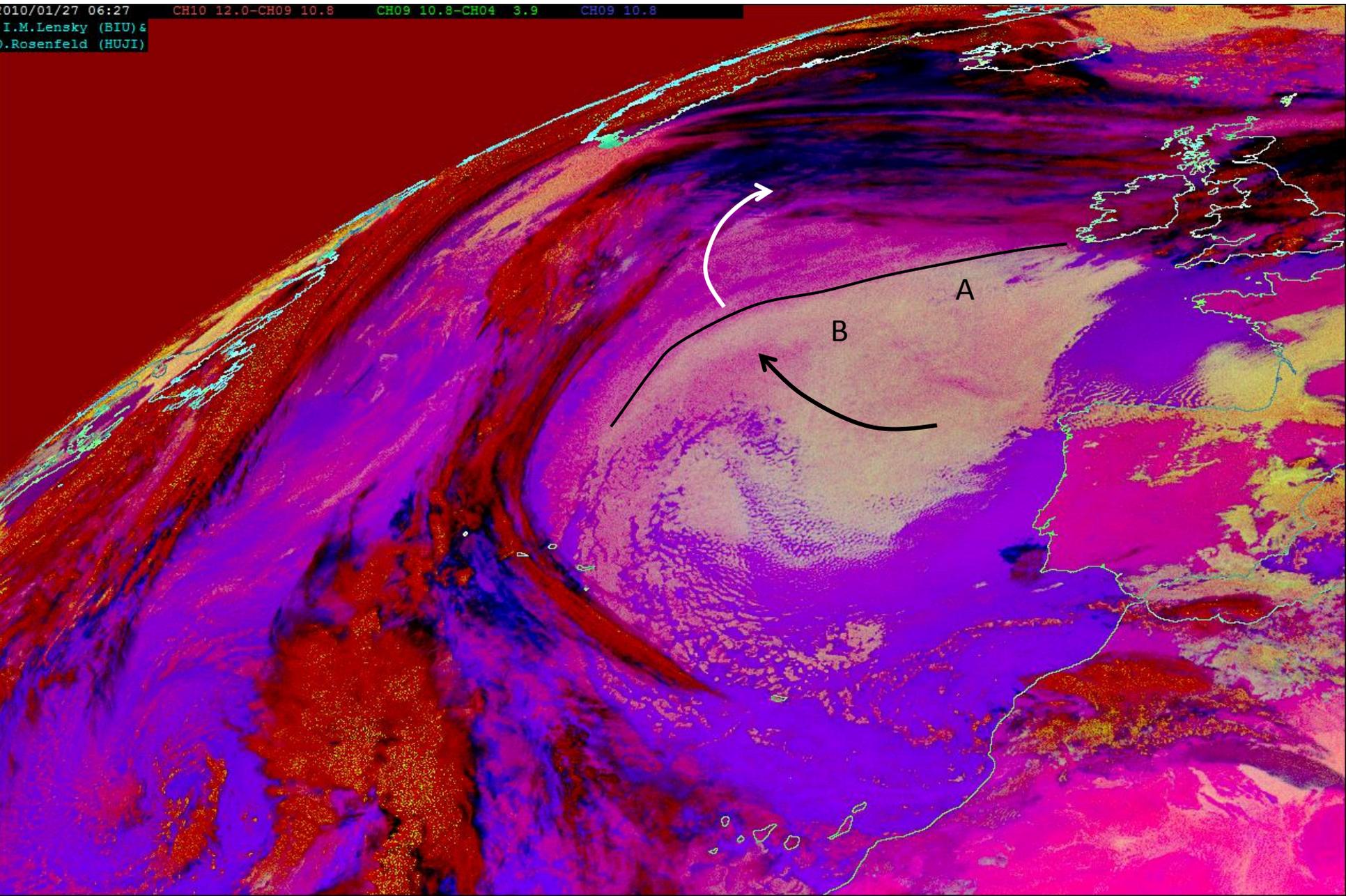
2010 January 27
05:27 UTC

010/01/27 05:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



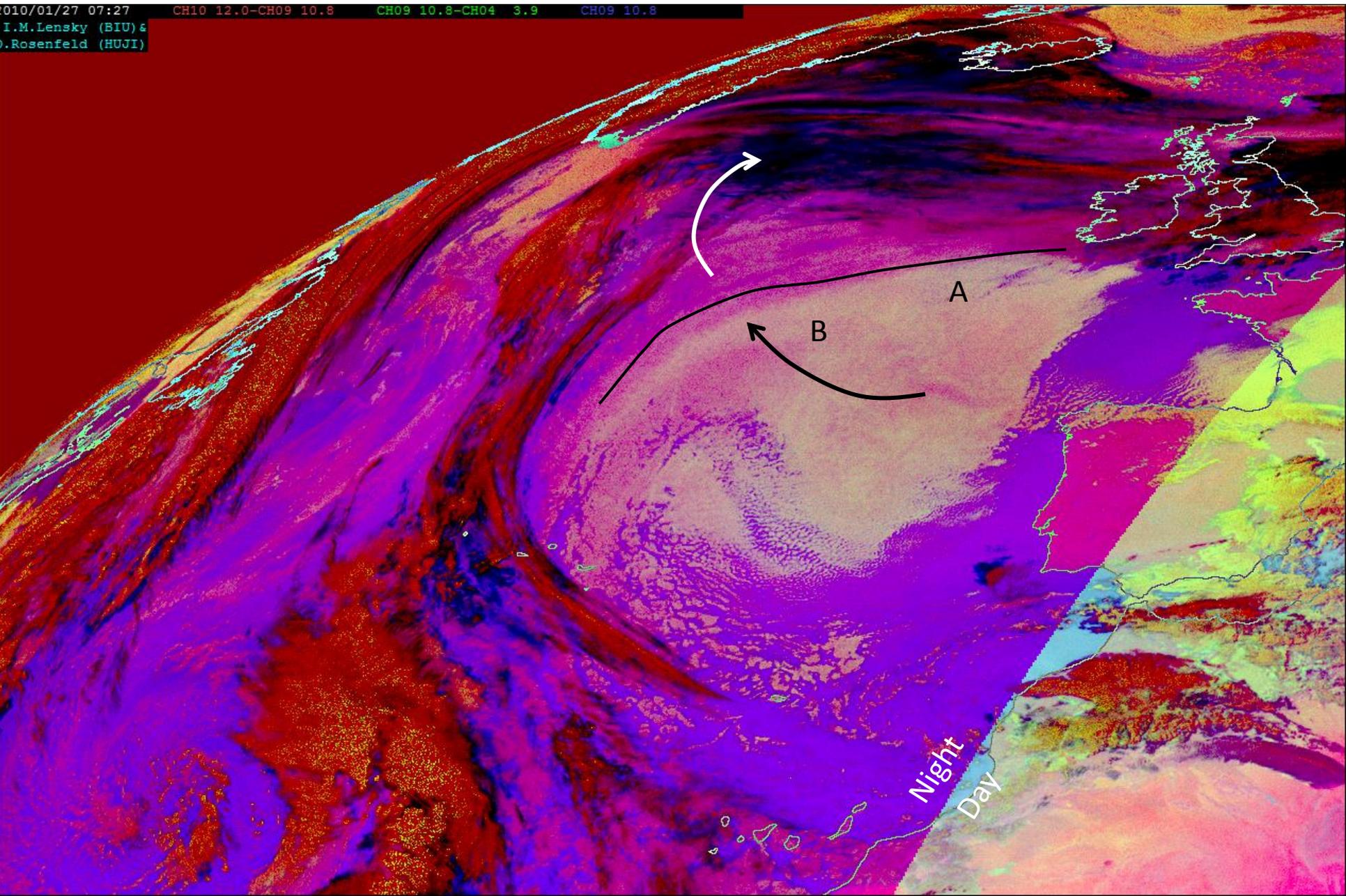
2010 January 27
06:27 UTC

010/01/27 06:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



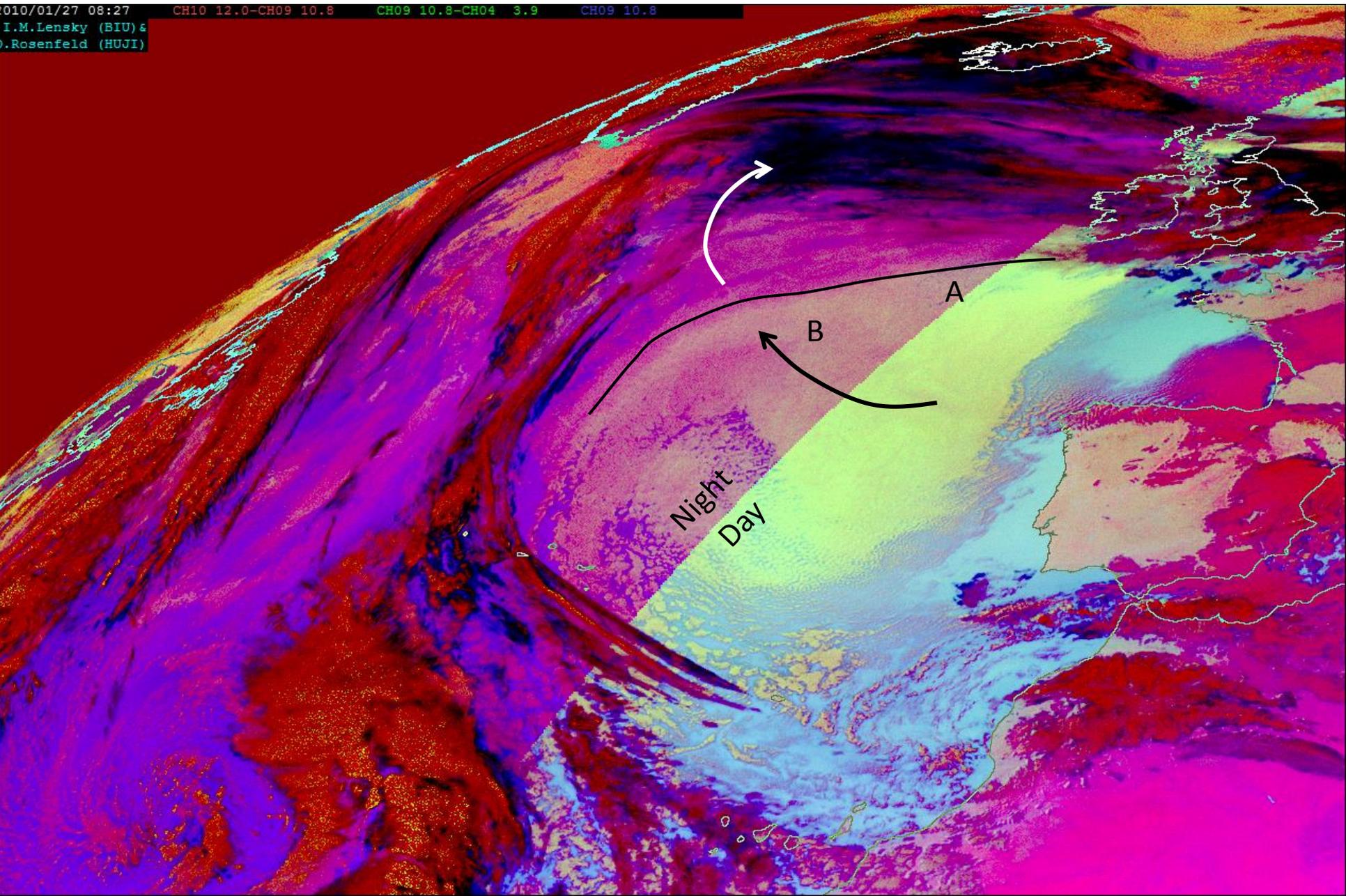
2010 January 27
07:27 UTC

010/01/27 07:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



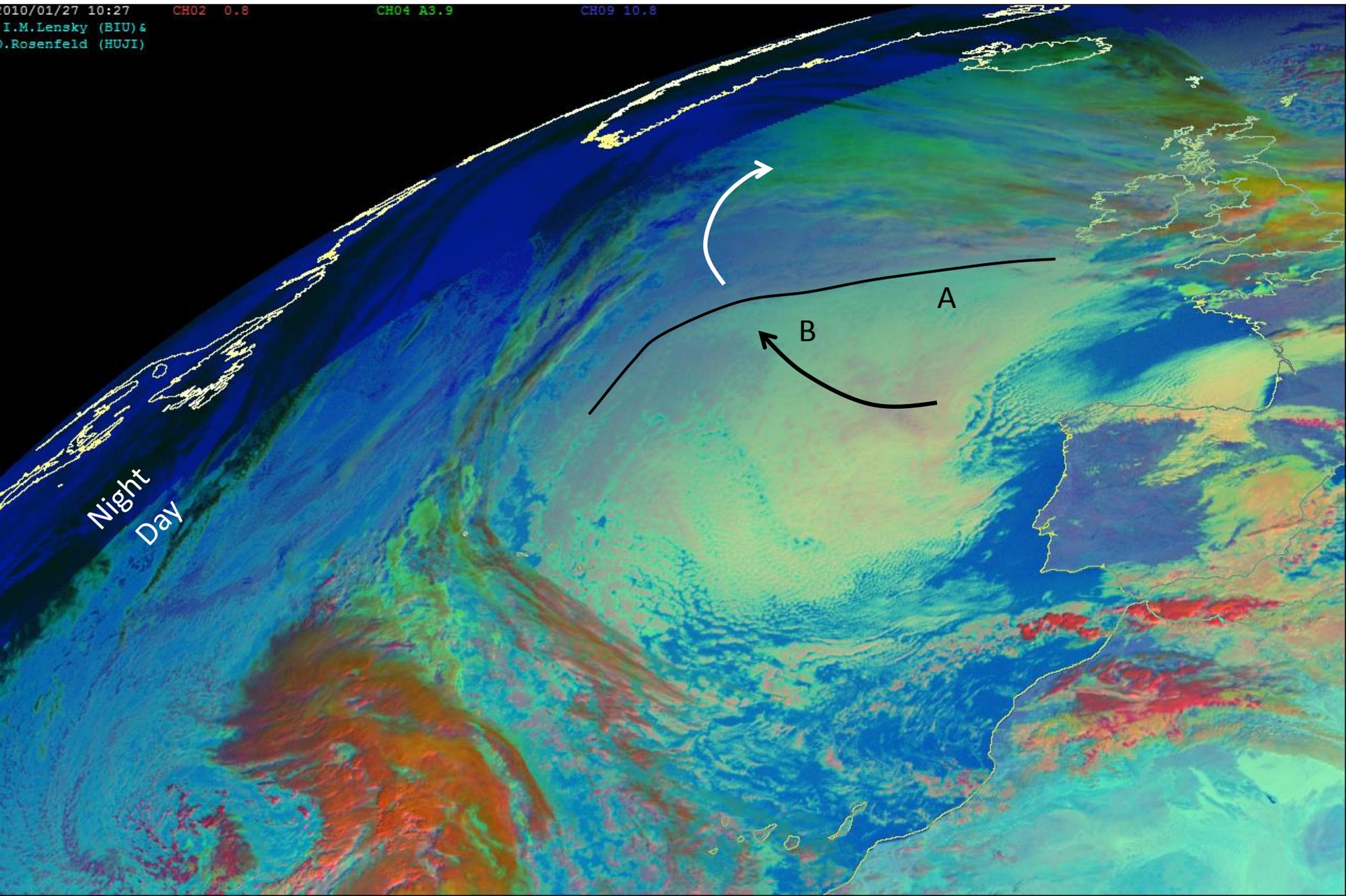
2010 January 27
08:27 UTC

010/01/27 08:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



2010 January 27
10:27 UTC

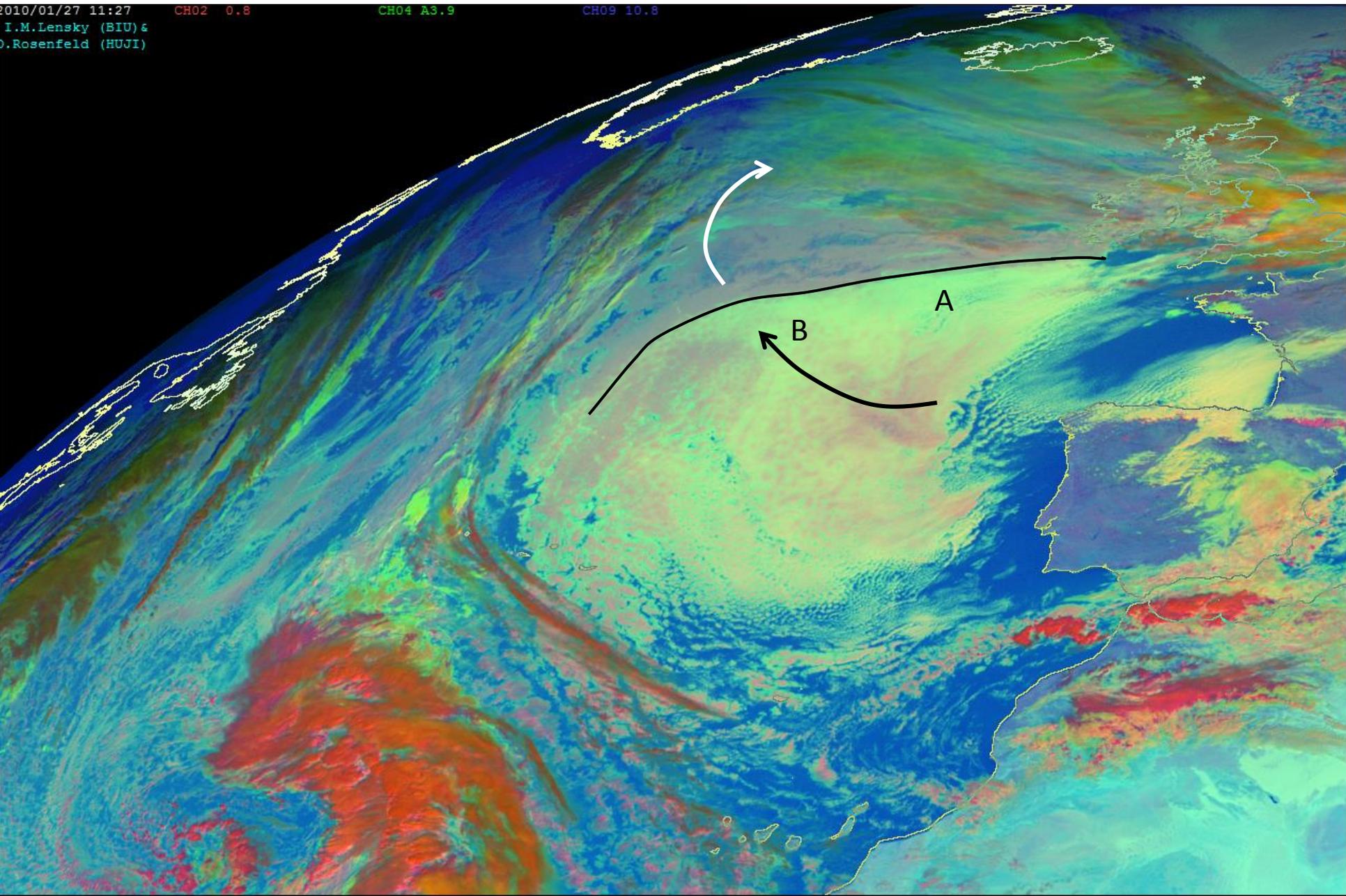
010/01/27 10:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



2010 January 27
11:27 UTC

2010/01/27 11:27
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)

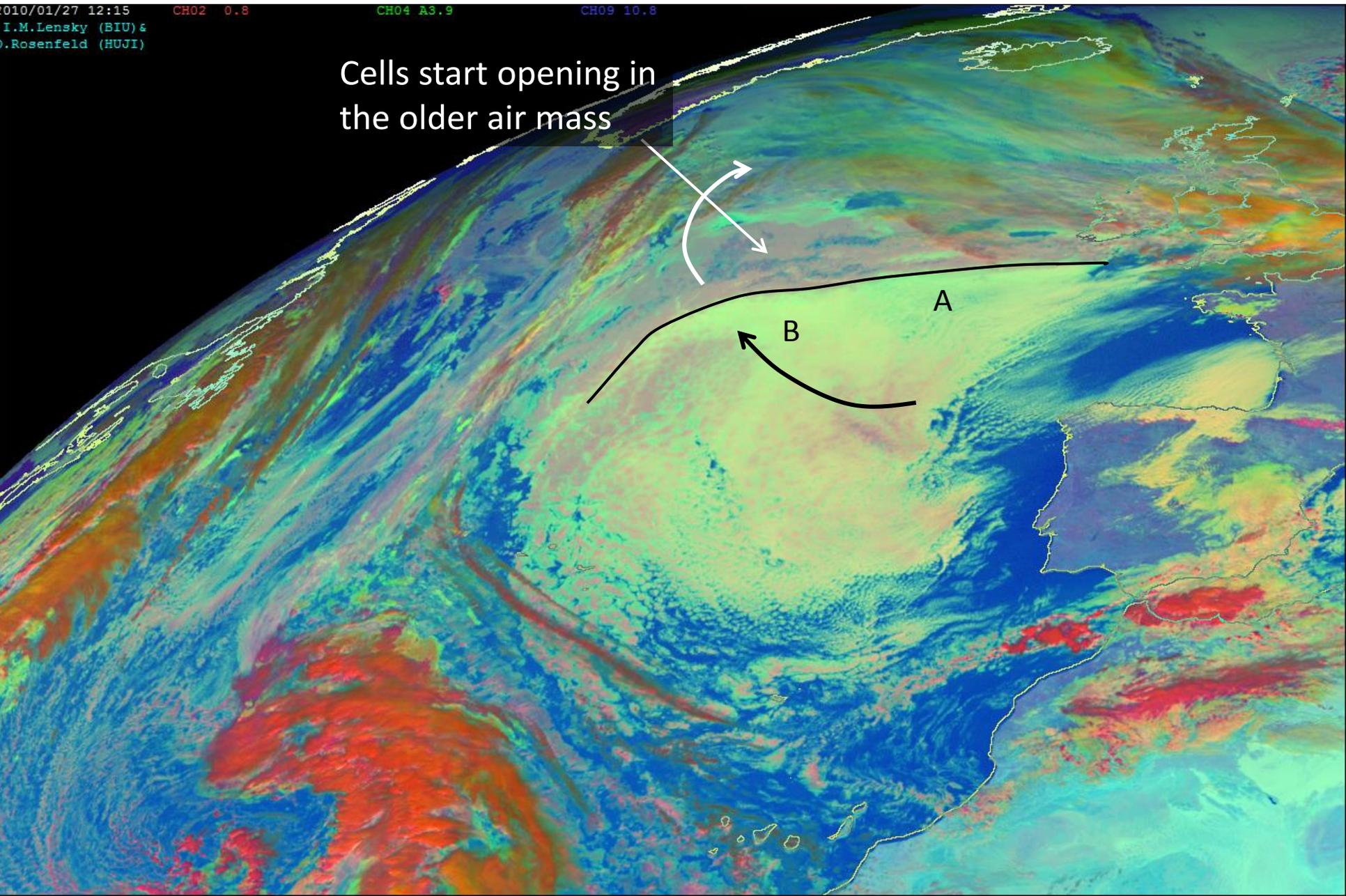
CH02 0.8 CH04 A3.9 CH09 10.8



2010 January 27
12:15 UTC

010/01/27 12:15 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Cells start opening in
the older air mass



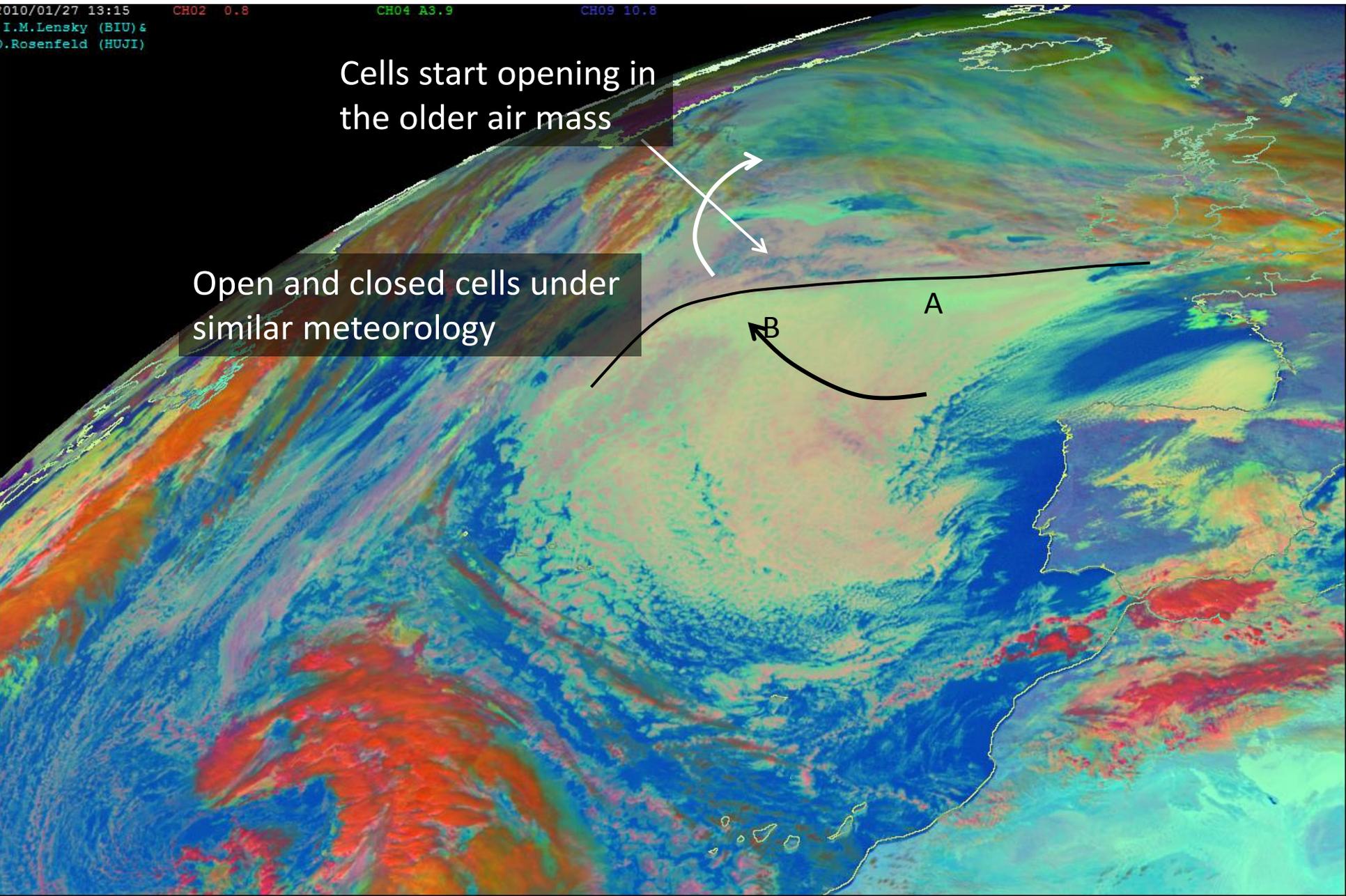
2010 January 27
13:15 UTC

2010/01/27 13:15
I.M.Lensky (BIU) &
D.Rosenfeld (HUJI)

CH02 0.8 CH04 A3.9 CH09 10.8

Cells start opening in
the older air mass

Open and closed cells under
similar meteorology



2010 January 27

14:15 UTC

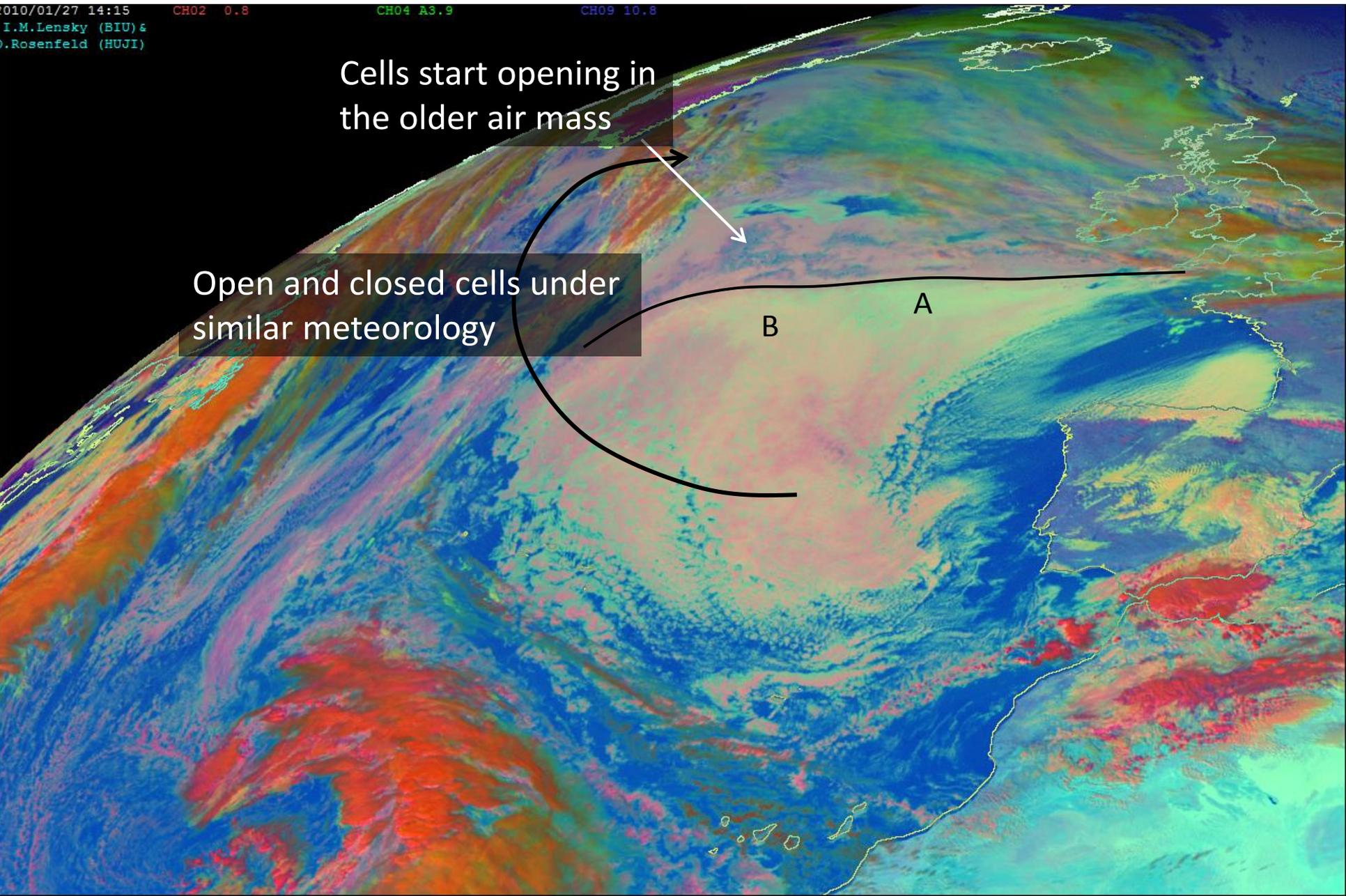
2010/01/27 14:15 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Cells start opening in
the older air mass

Open and closed cells under
similar meteorology

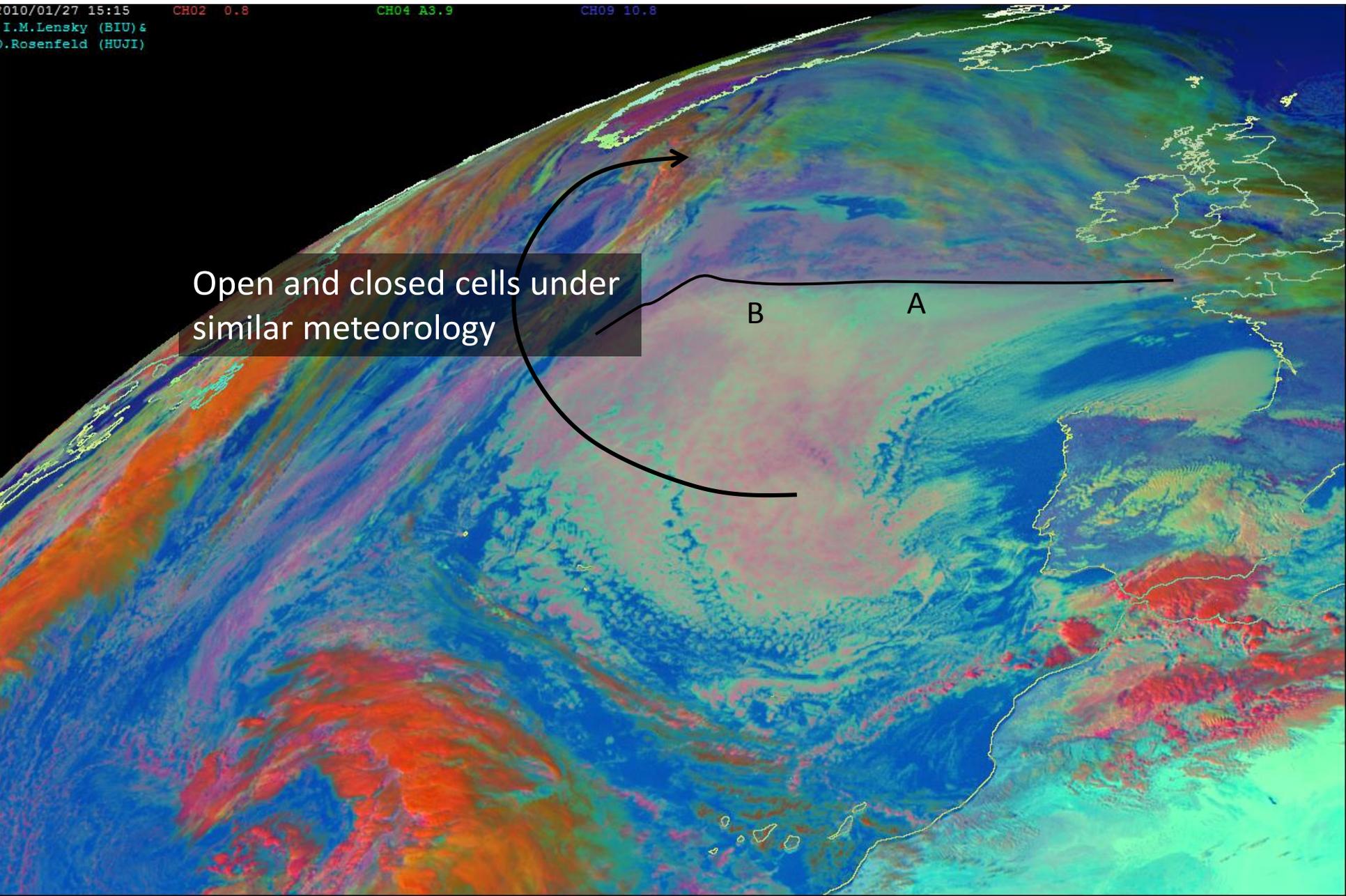
B

A



2010 January 27
15:15 UTC

2010/01/27 15:15 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



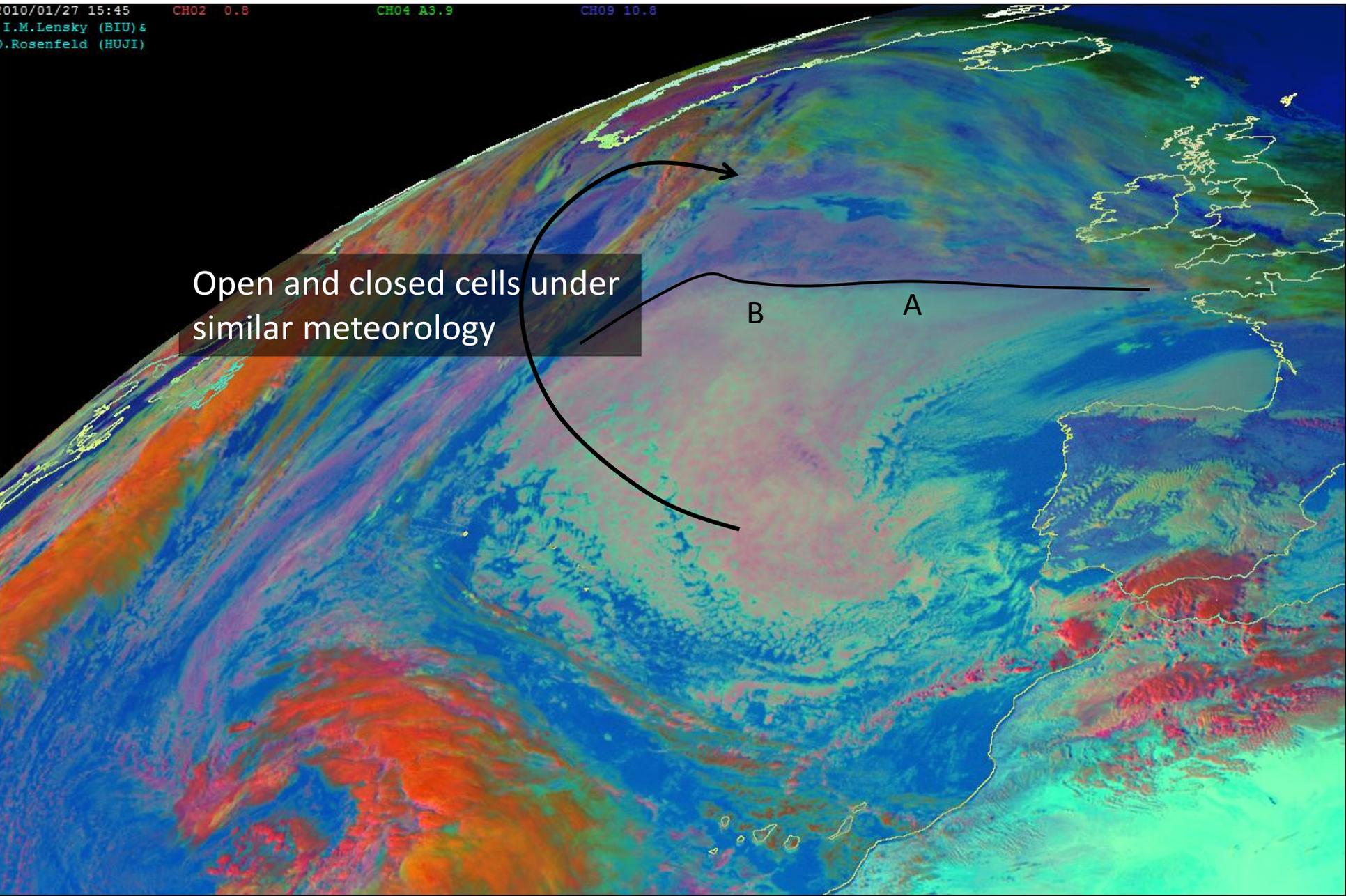
Open and closed cells under similar meteorology

B

A

2010 January 27
15:45 UTC

010/01/27 15:45 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



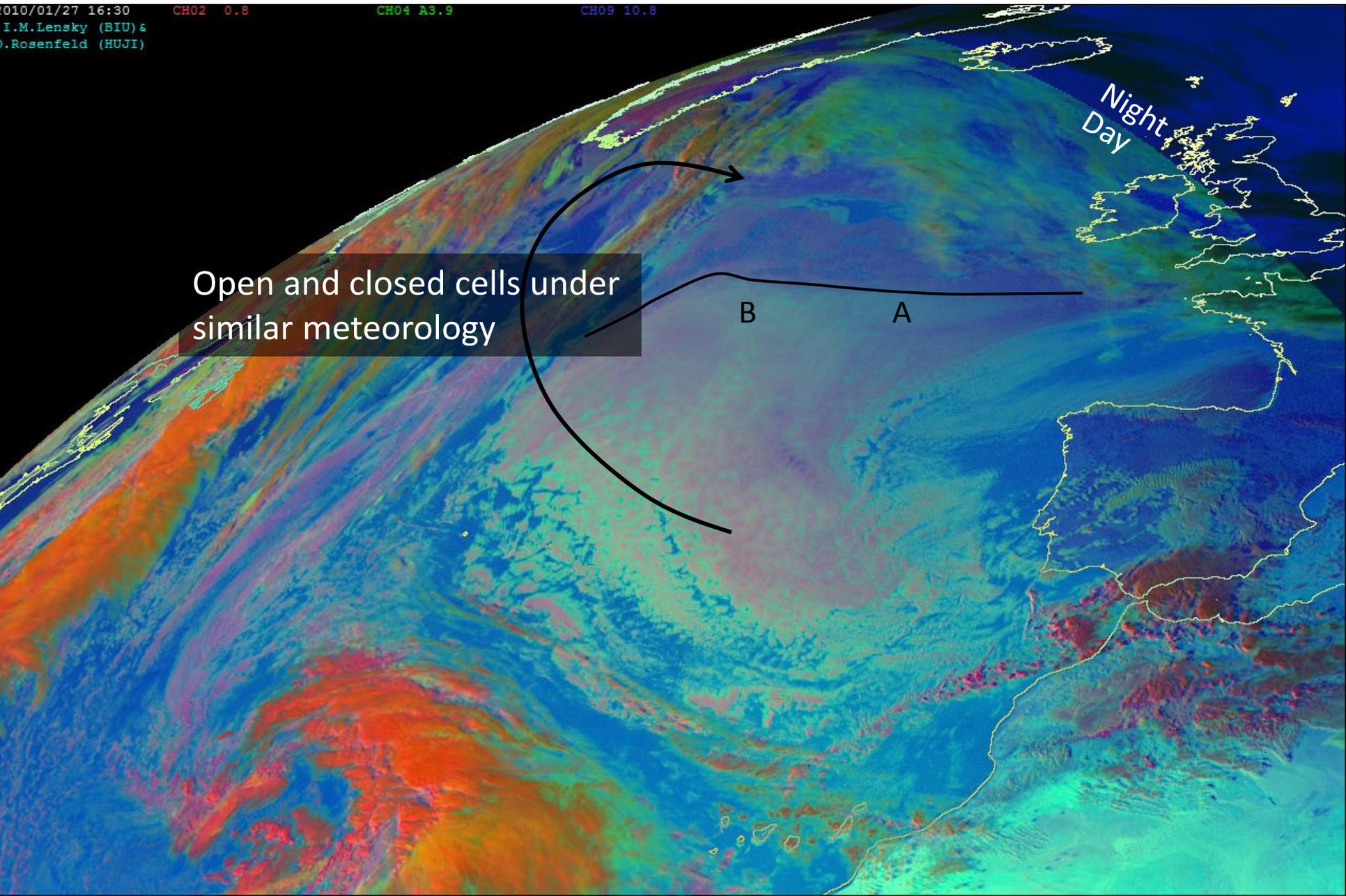
Open and closed cells under similar meteorology

B

A

2010 January 27
16:30 UTC

010/01/27 16:30 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open and closed cells under similar meteorology

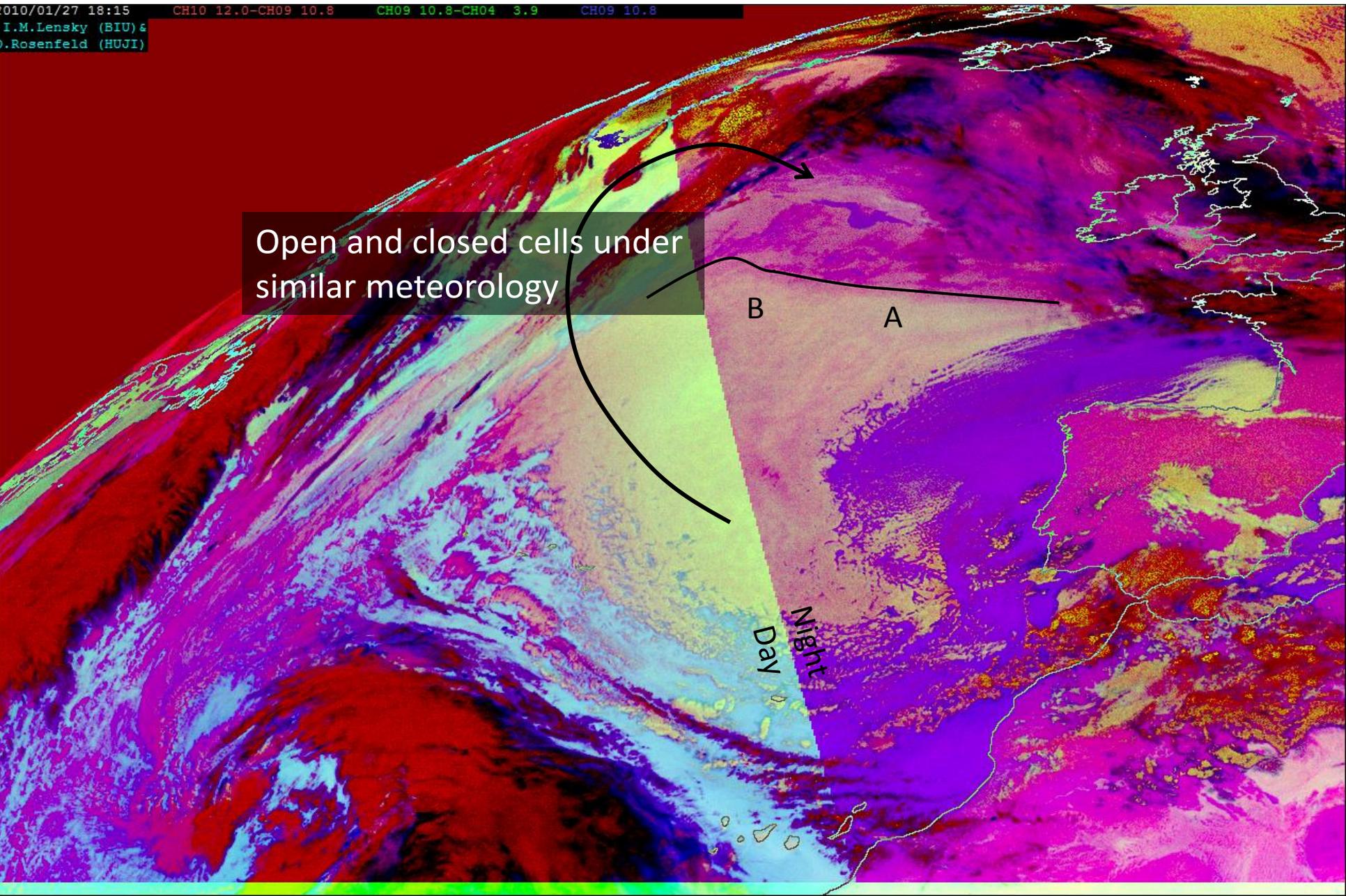
B

A

Night Day

2010 January 27
18:15 UTC

010/01/27 18:15 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open and closed cells under similar meteorology

B

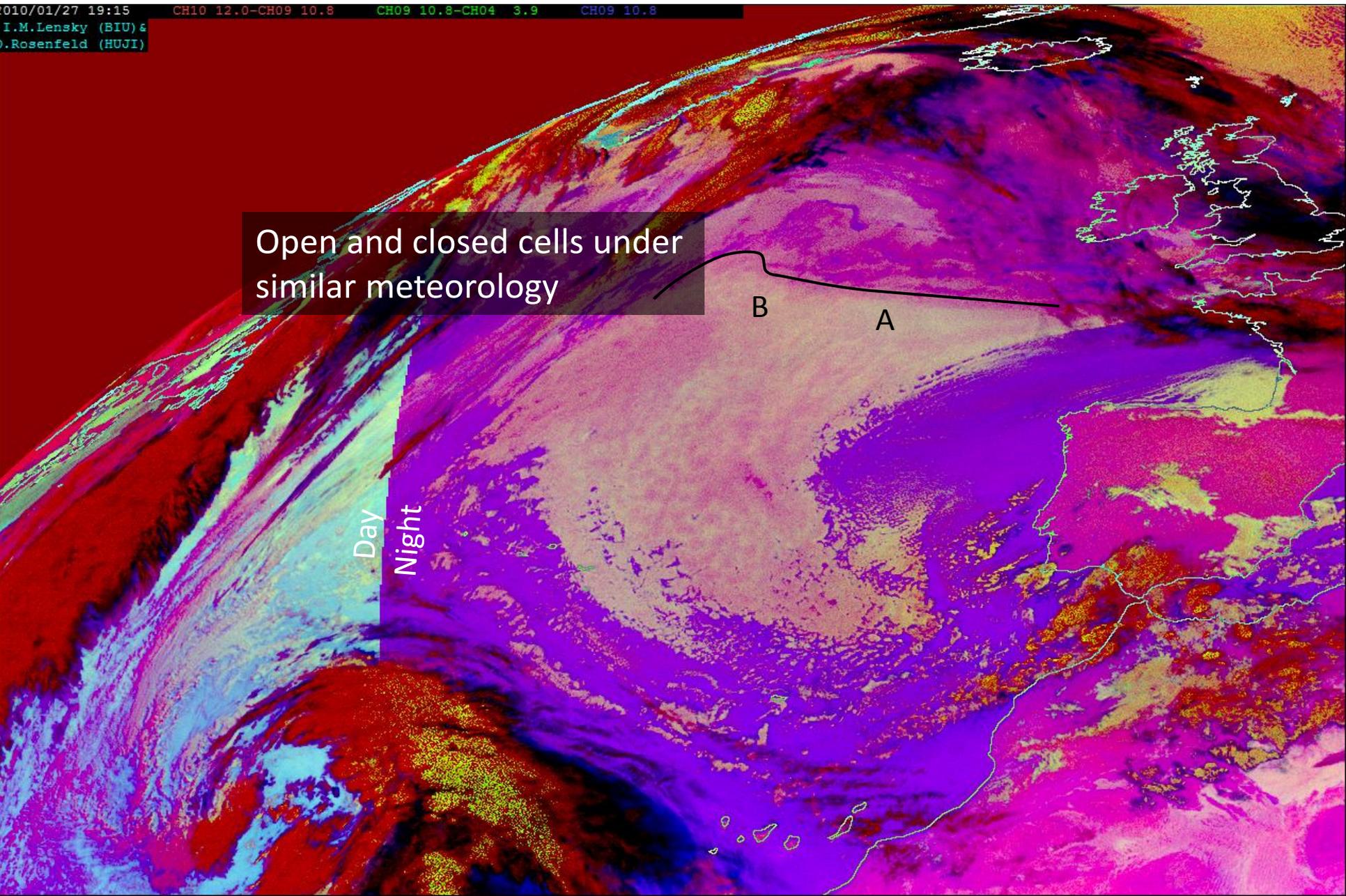
A

Day
Night

2010 January 27
19:15 UTC

010/01/27 19:15 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

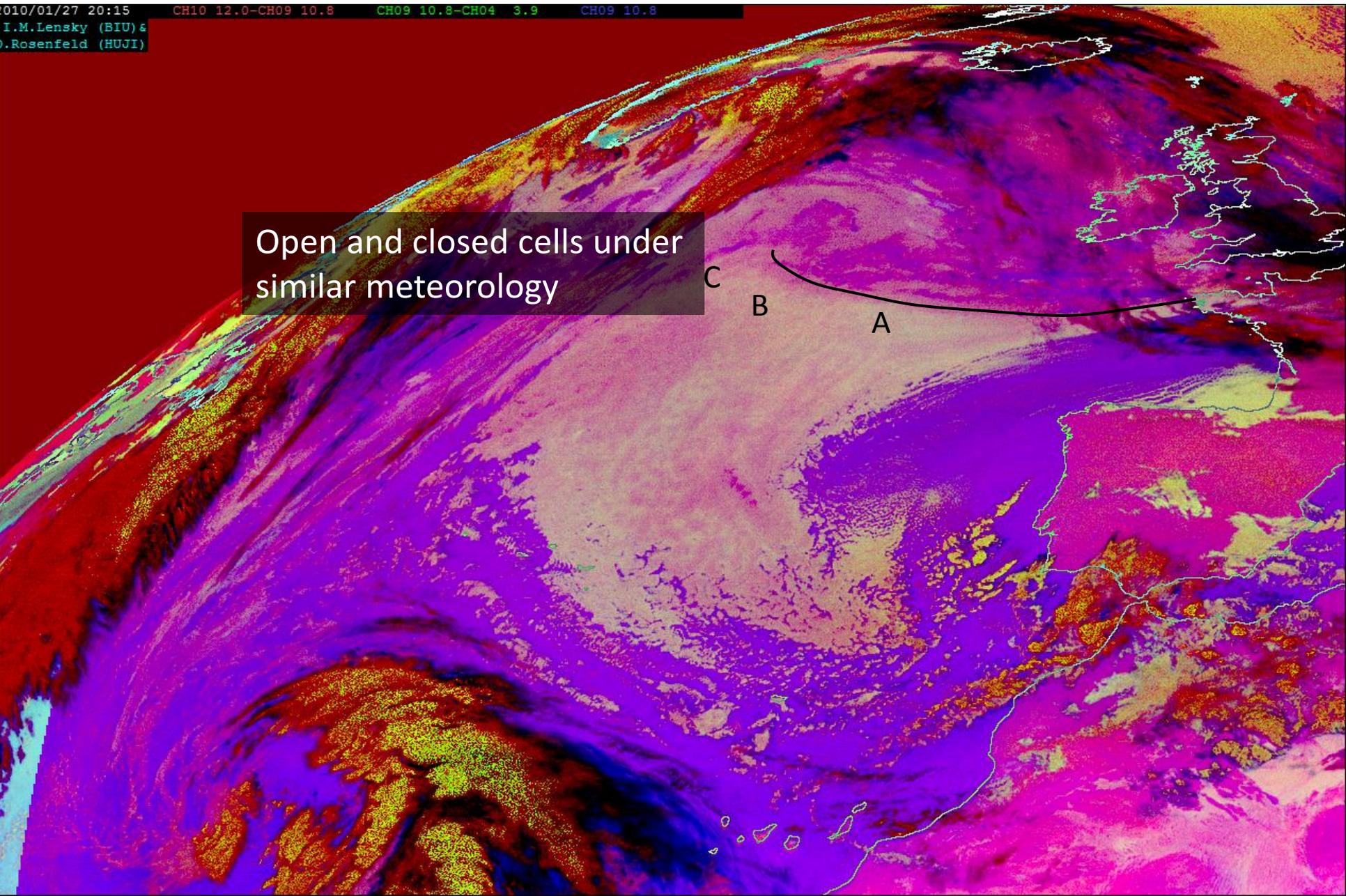
Open and closed cells under similar meteorology



2010 January 27
20:15 UTC

010/01/27 20:15 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

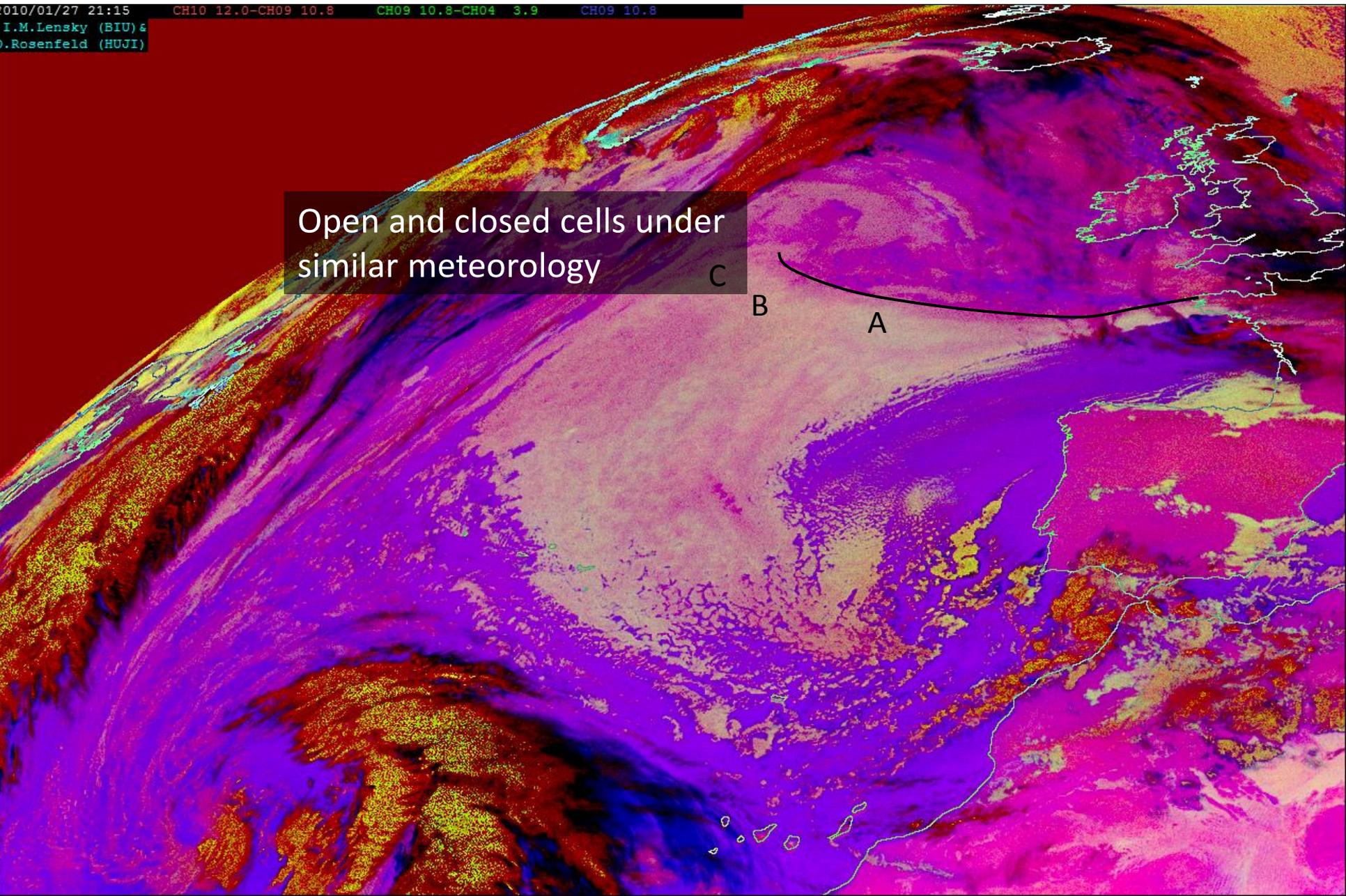
Open and closed cells under similar meteorology



2010 January 27
21:15 UTC

010/01/27 21:15 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

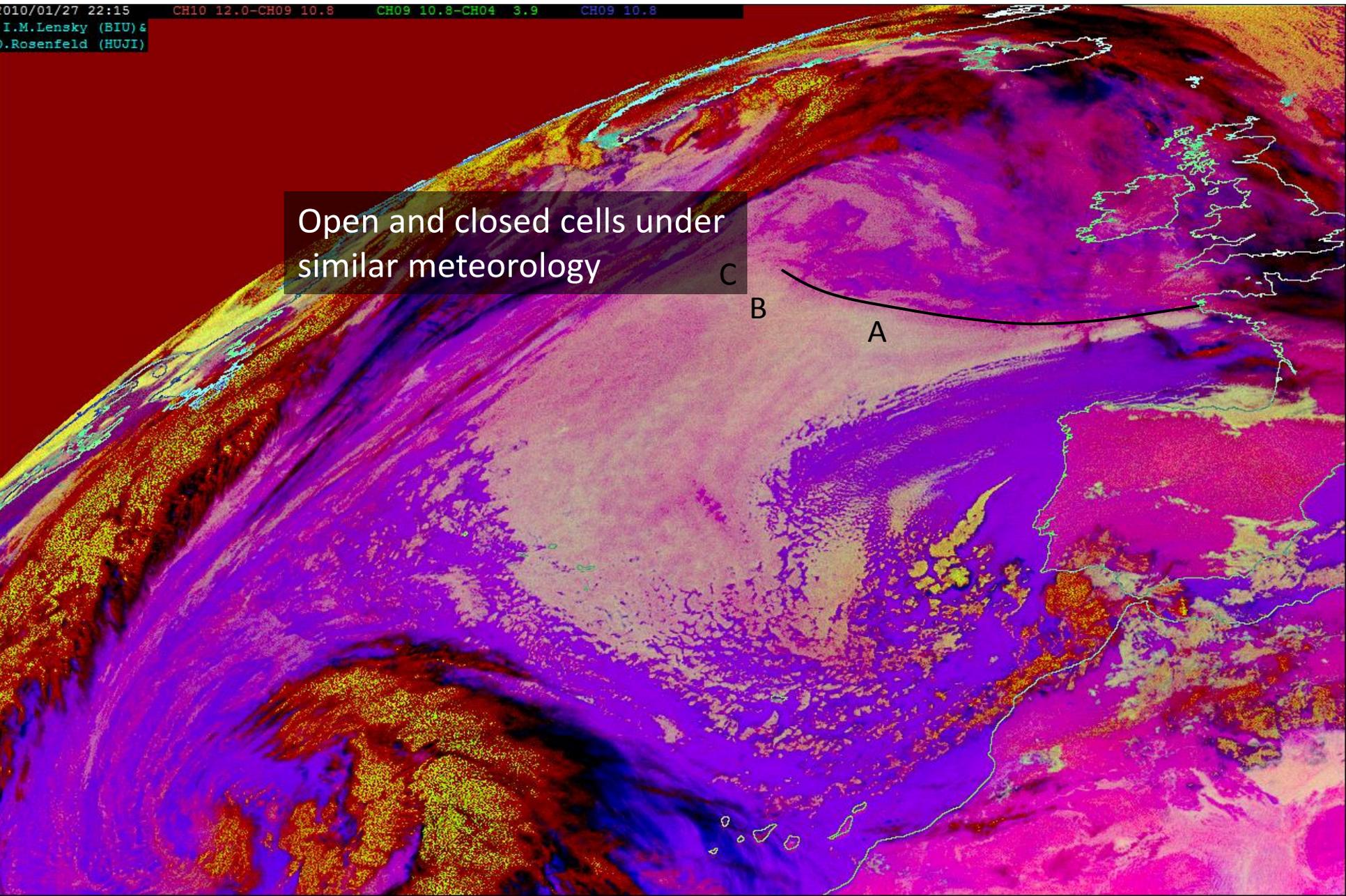
Open and closed cells under
similar meteorology



2010 January 27
22:15 UTC

010/01/27 22:15 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

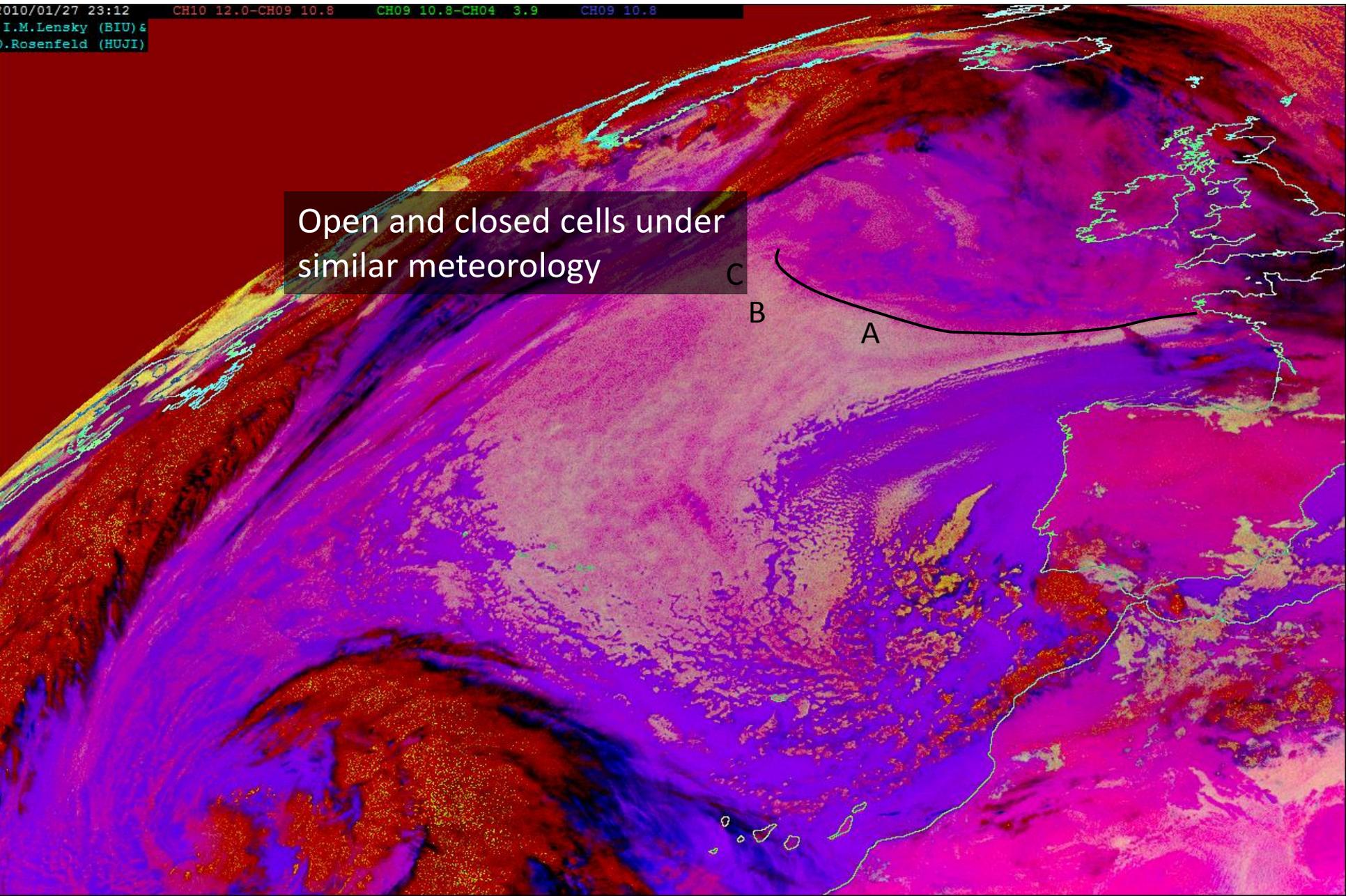
Open and closed cells under
similar meteorology



2010 January 27
23:12 UTC

010/01/27 23:12 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Open and closed cells under
similar meteorology

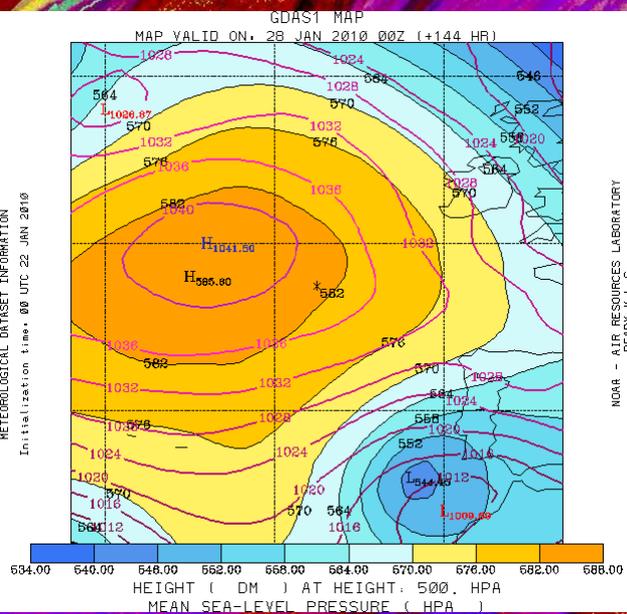
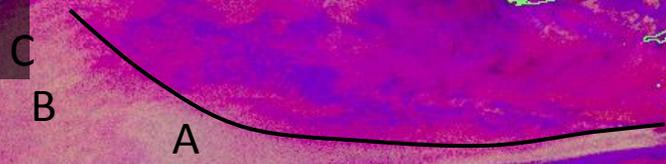


2010 January 28

00:27 UTC

010/01/28 00:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Open and closed cells under similar meteorology

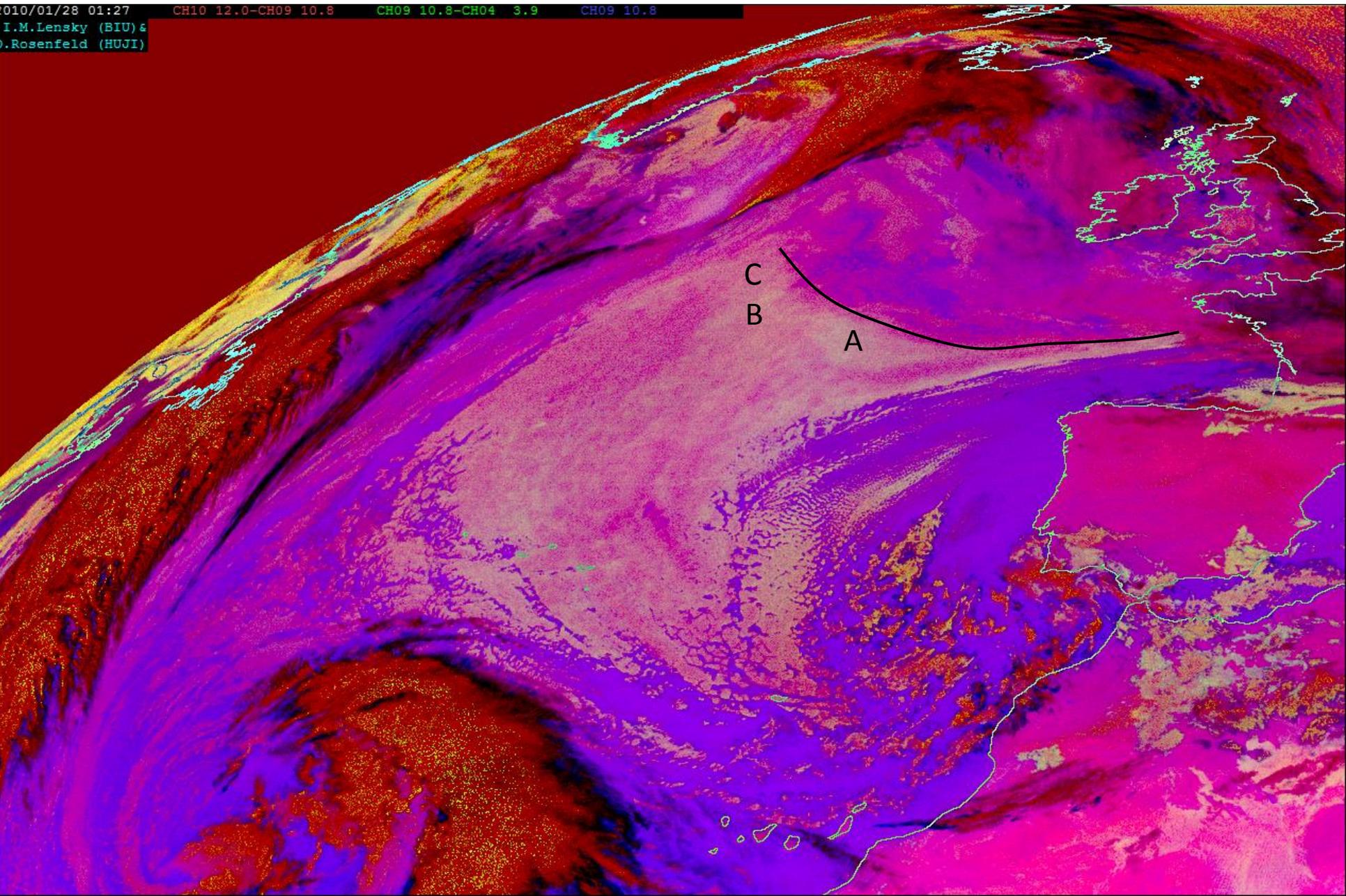


METEOROLOGICAL DATASET INFORMATION
Initialization time: 00 UTC 22 JAN 2010

NOAA - AIR RESOURCES LABORATORY
READY FOR SERVICE

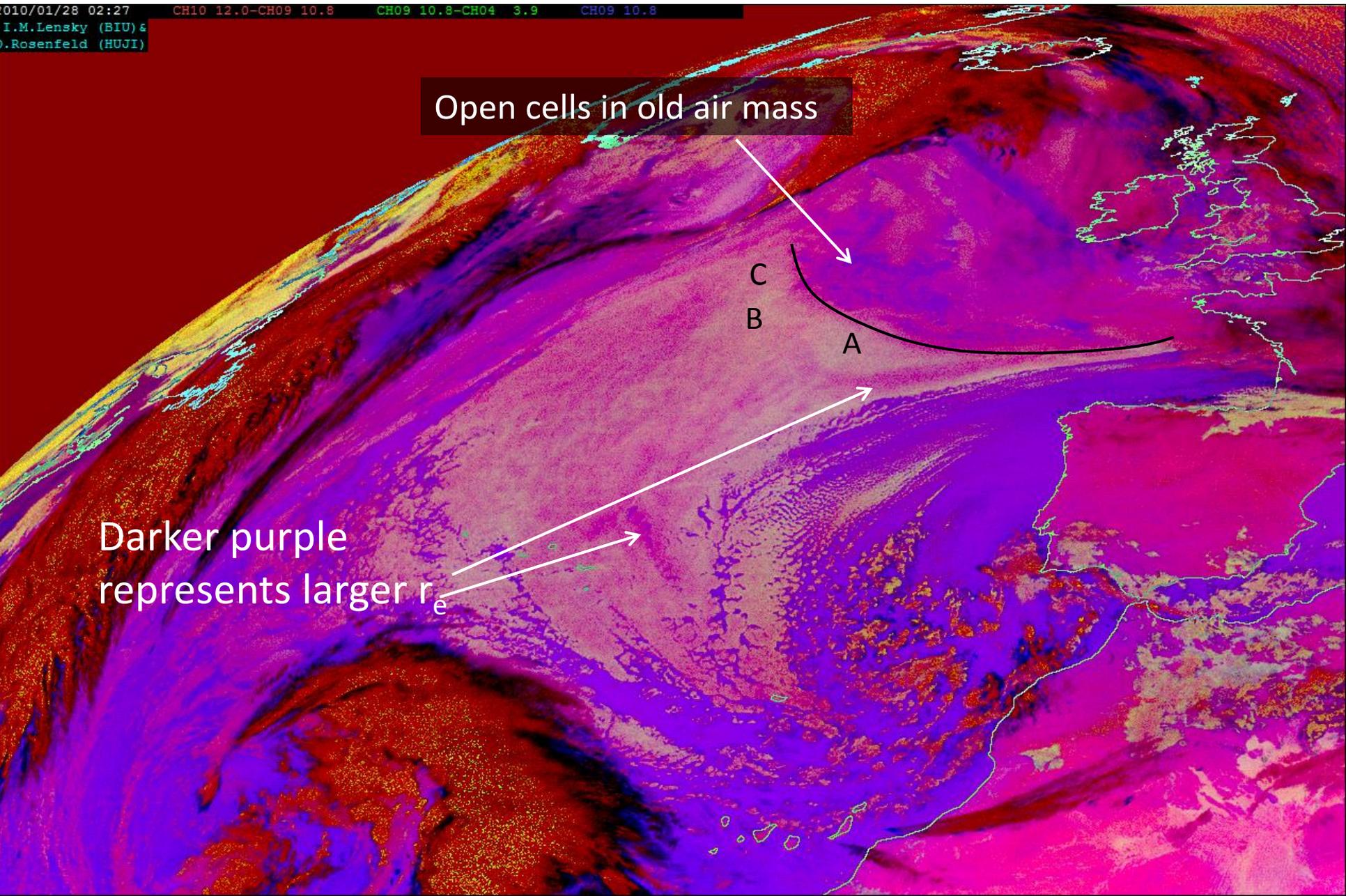
2010 January 28
01:27 UTC

010/01/28 01:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



2010 January 28
02:27 UTC

010/01/28 02:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



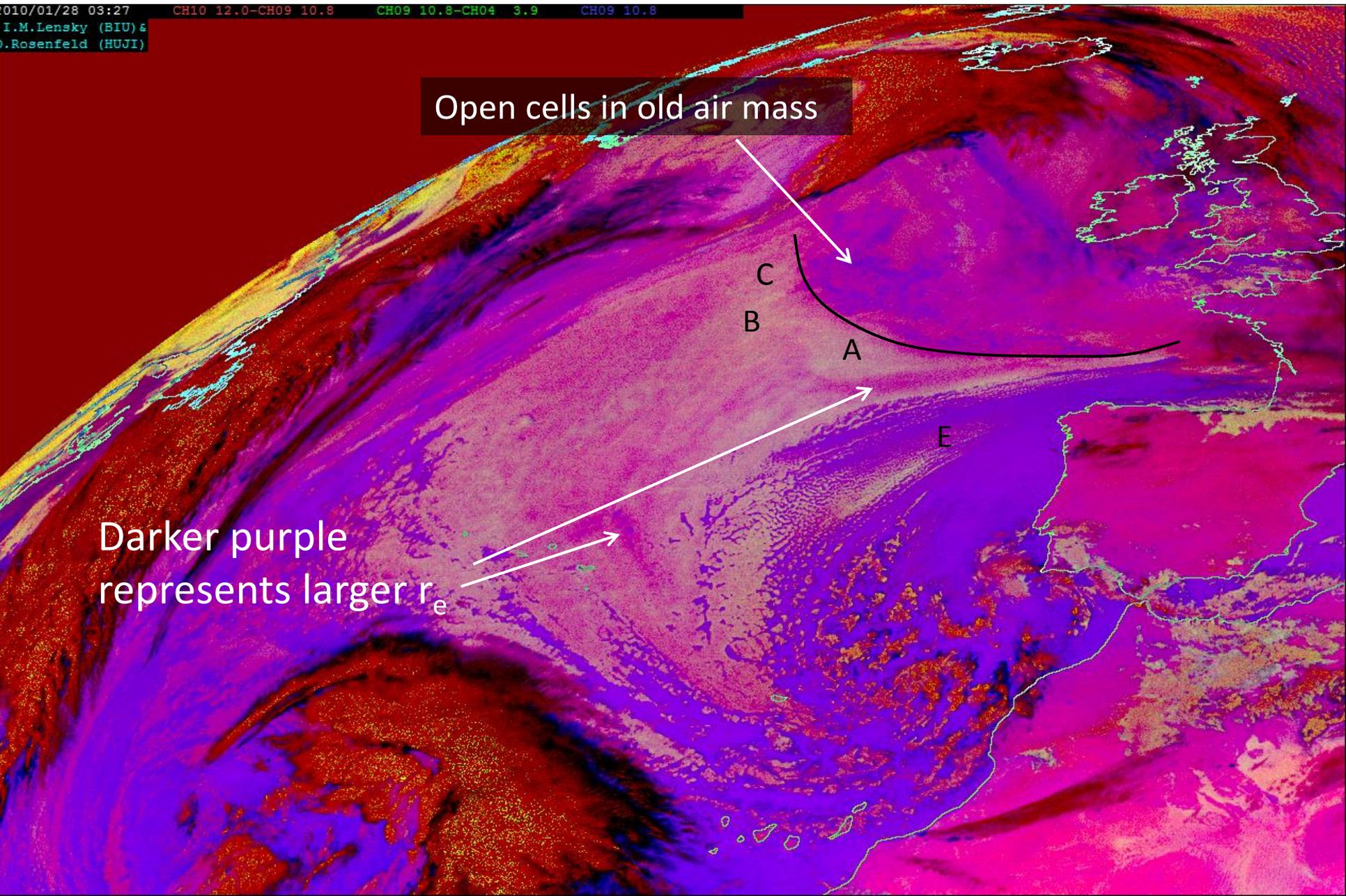
Open cells in old air mass

C
B
A

Darker purple
represents larger r_e

2010 January 28
03:27 UTC

010/01/28 03:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open cells in old air mass

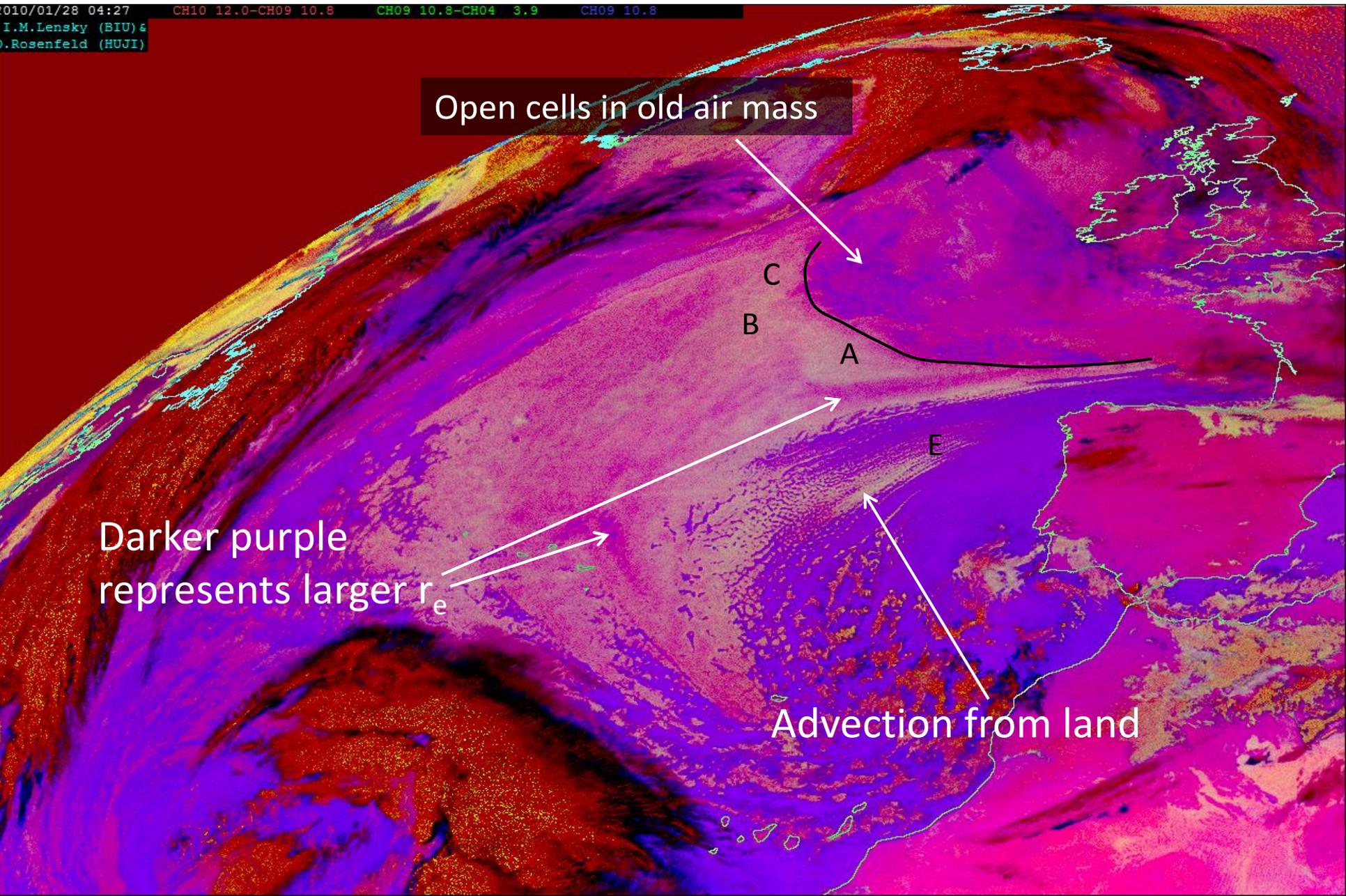
C
B
A

E

Darker purple
represents larger r_e

2010 January 28
04:27 UTC

010/01/28 04:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open cells in old air mass

C
B
A

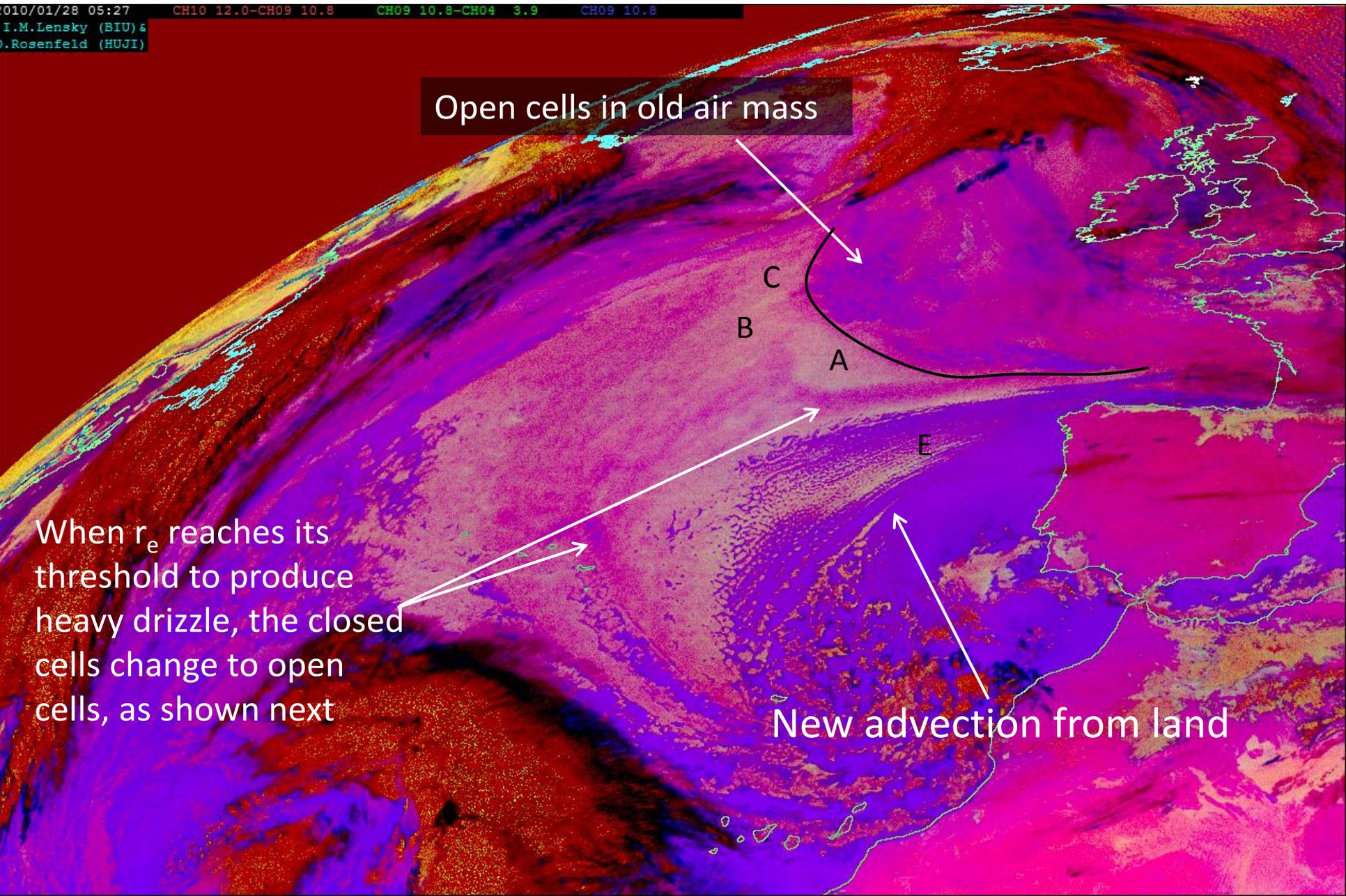
Darker purple
represents larger r_e

Advection from land

2010 January 28

05:27 UTC

010/01/28 05:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open cells in old air mass

C
B
A

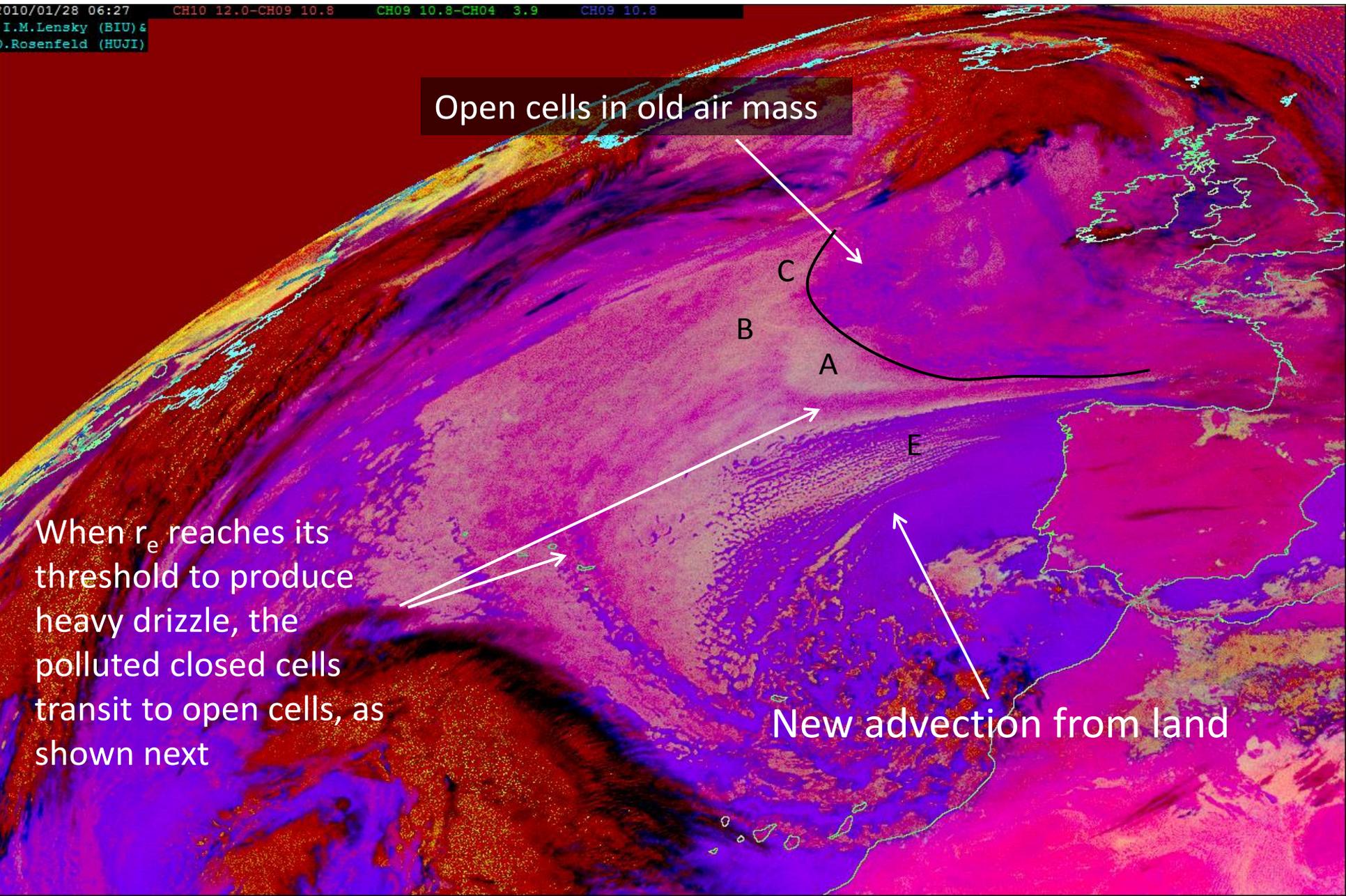
When r_e reaches its threshold to produce heavy drizzle, the closed cells change to open cells, as shown next

New advection from land

2010 January 28

06:27 UTC

010/01/28 06:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open cells in old air mass

C

B

A

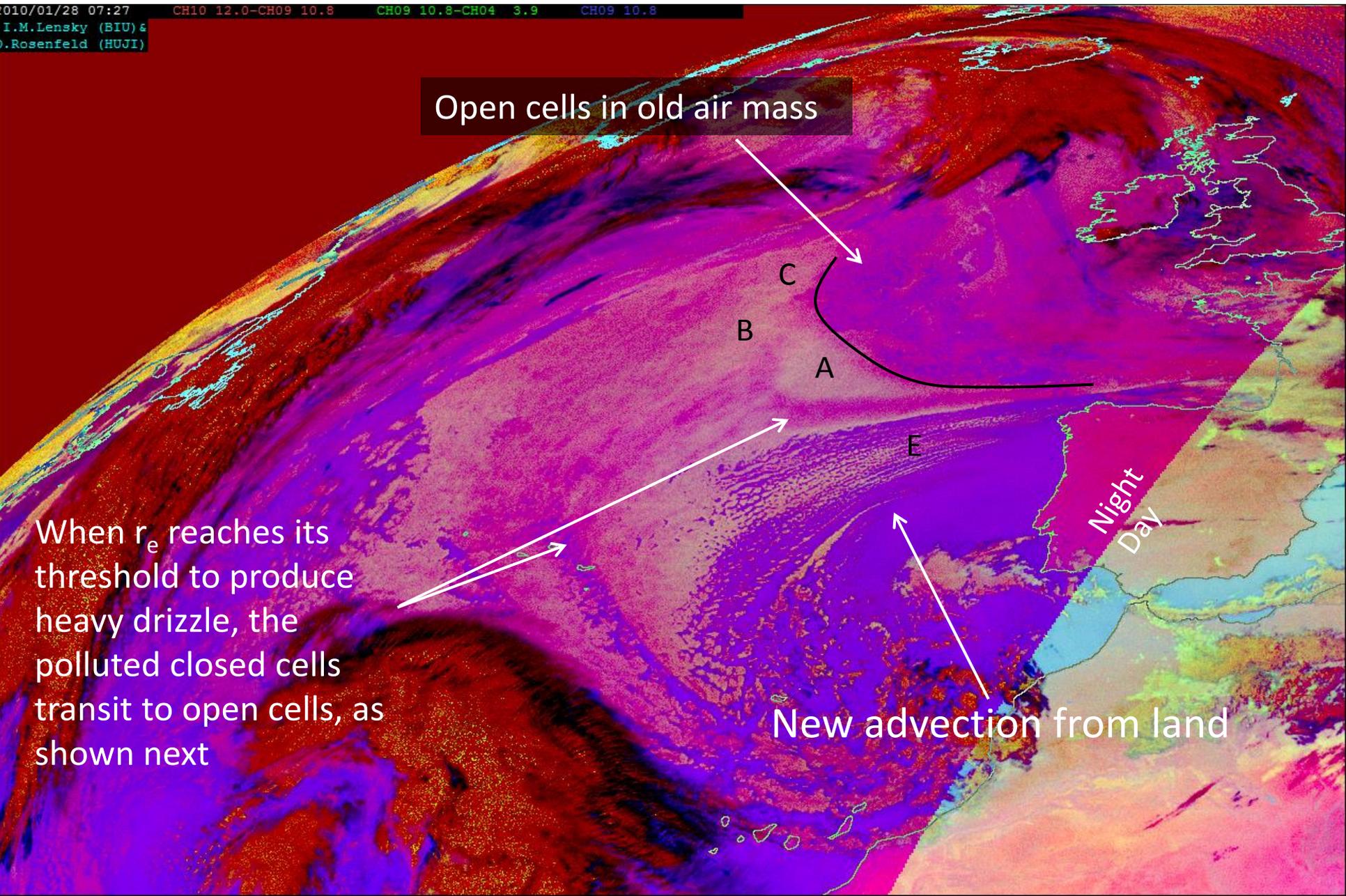
E

When r_e reaches its threshold to produce heavy drizzle, the polluted closed cells transit to open cells, as shown next

New advection from land

2010 January 28
07:27 UTC

010/01/28 07:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open cells in old air mass

C

B

A

E

Night
Day

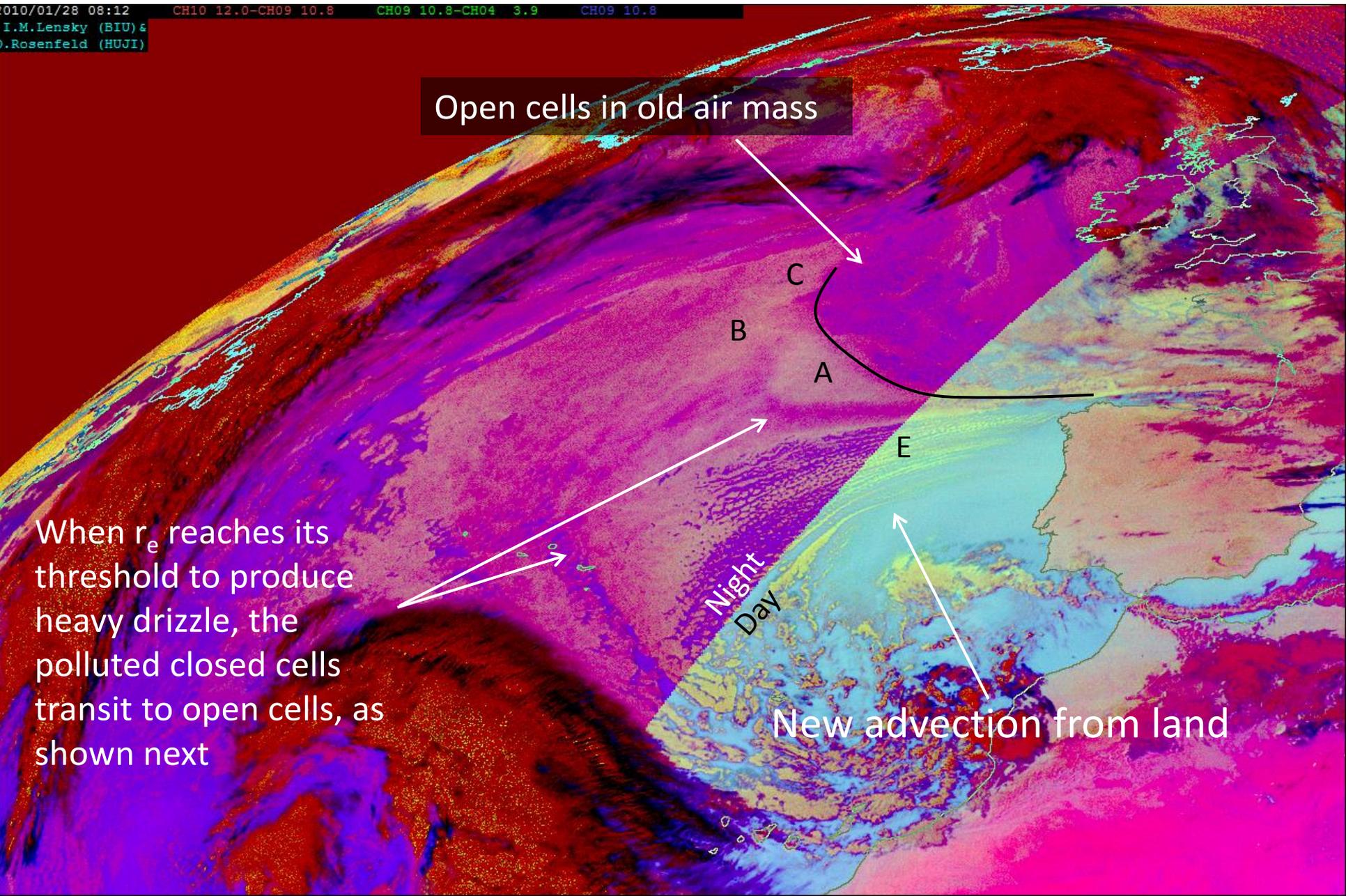
When r_e reaches its threshold to produce heavy drizzle, the polluted closed cells transit to open cells, as shown next

New advection from land

2010 January 28

08:12 UTC

010/01/28 08:12 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



Open cells in old air mass

C

B

A

E

Night
Day

New advection from land

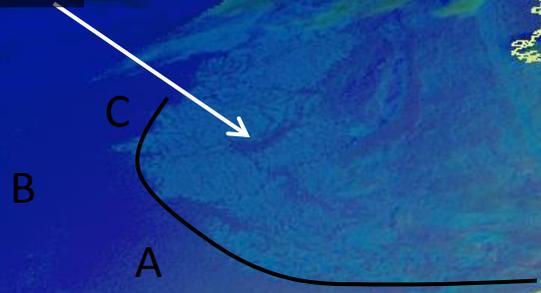
When r_e reaches its threshold to produce heavy drizzle, the polluted closed cells transit to open cells, as shown next

2010 January 28
09:12 UTC

010/01/28 09:12
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

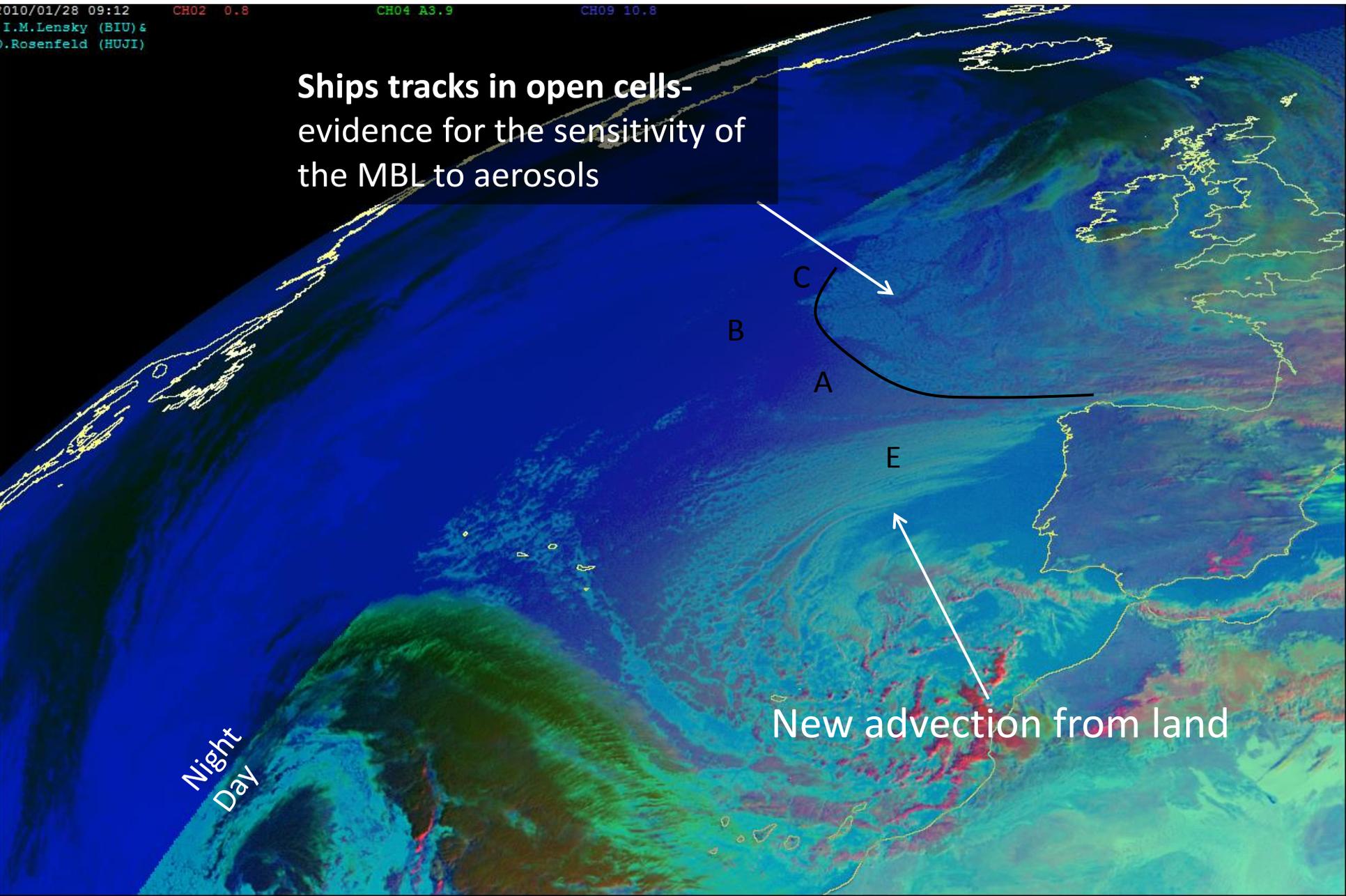
CH02 0.8 CH04 A3.9 CH09 10.8

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols



New advection from land

Night
Day



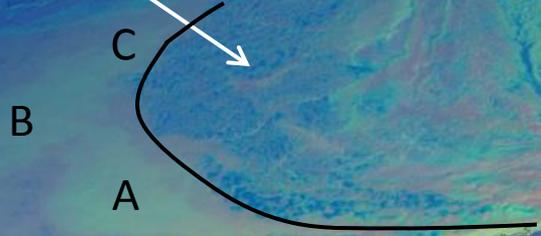
2010 January 28
10:12 UTC

010/01/28 10:12
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

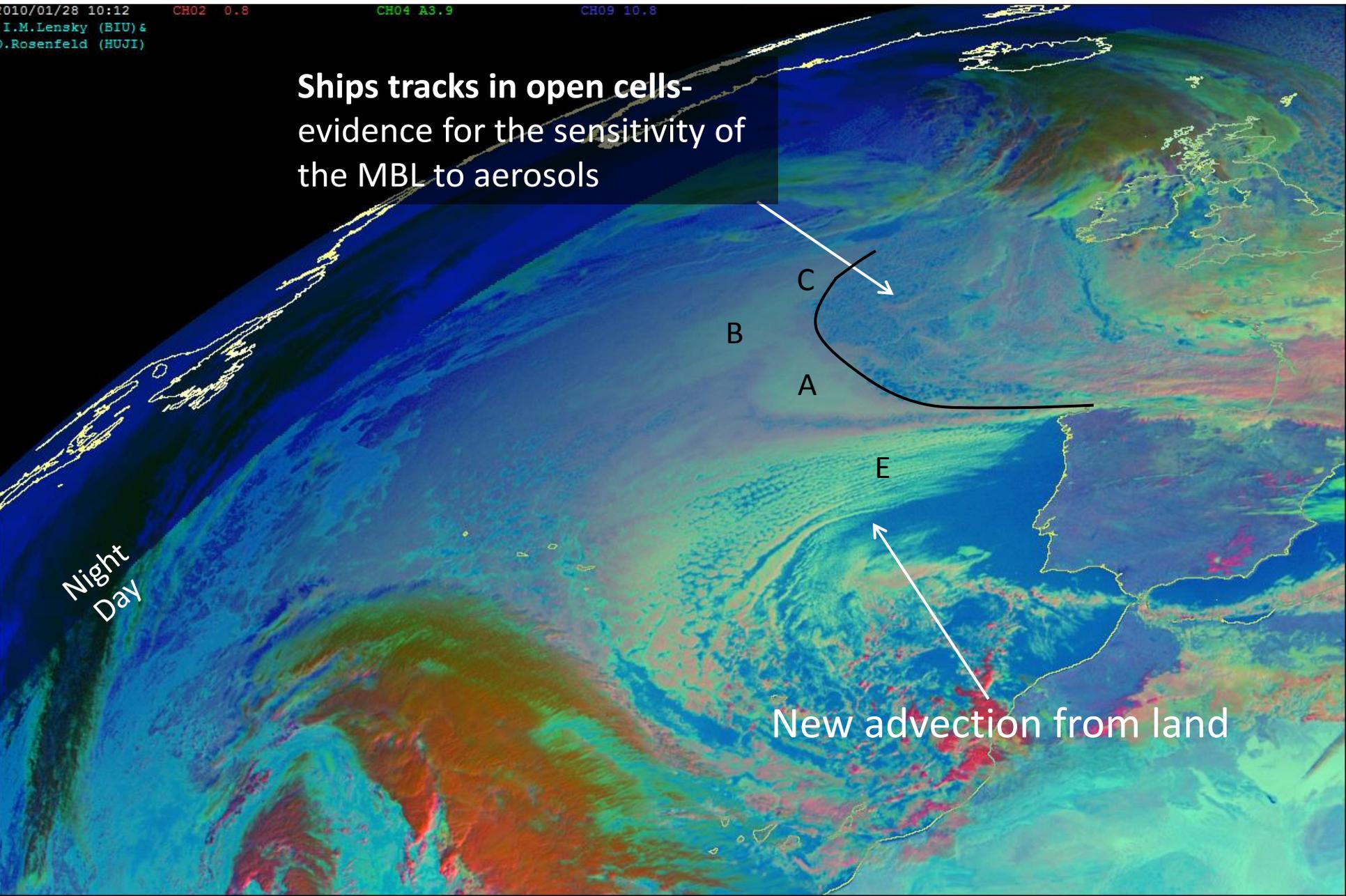
CH02 0.8 CH04 A3.9 CH09 10.8

**Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols**

Night
Day



New advection from land



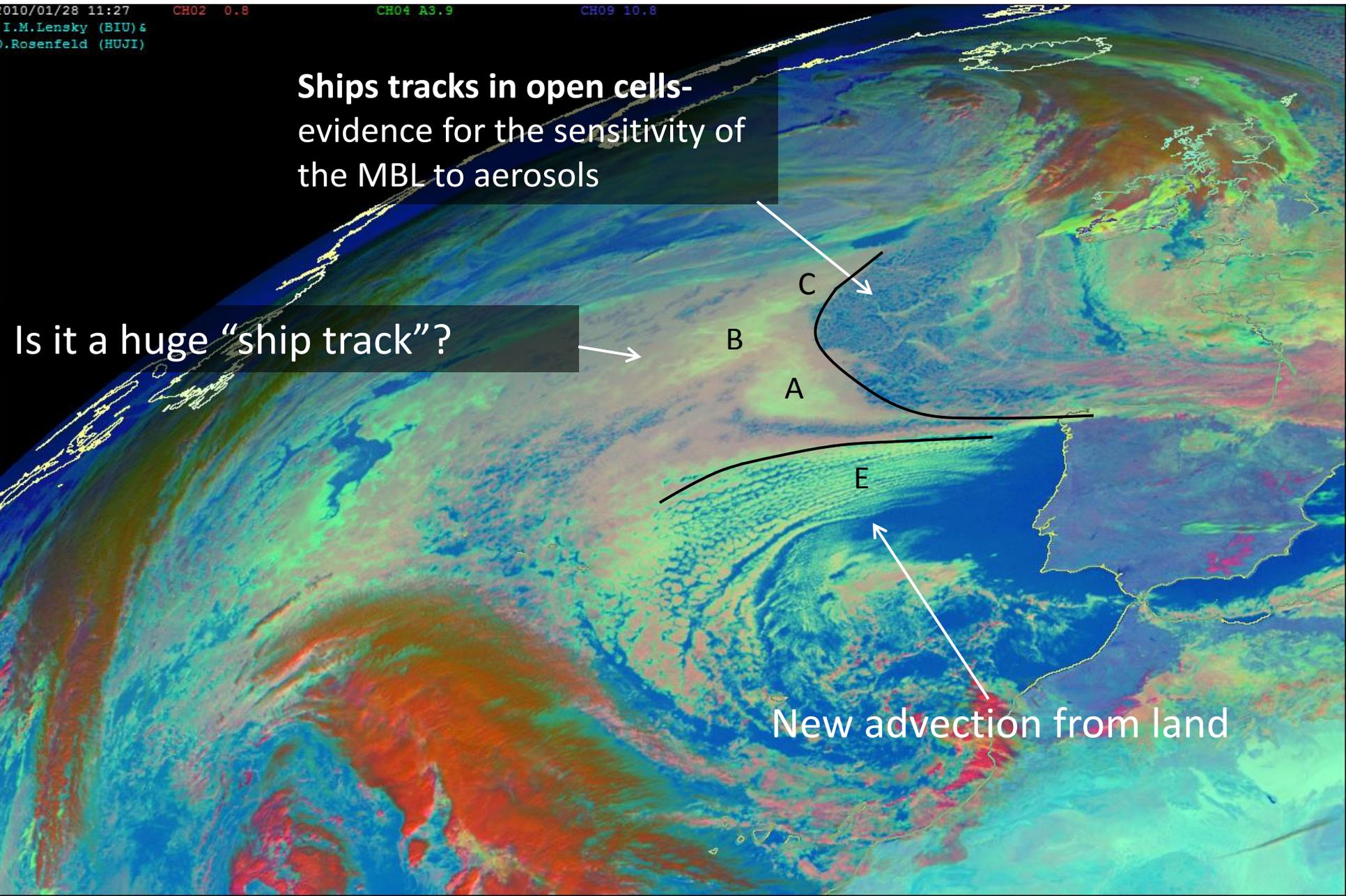
2010 January 28
11:27 UTC

010/01/28 11:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Is it a huge "ship track"?

New advection from land



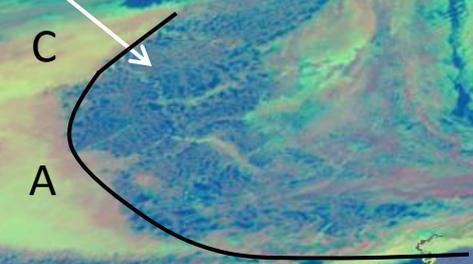
2010 January 28

12:27 UTC

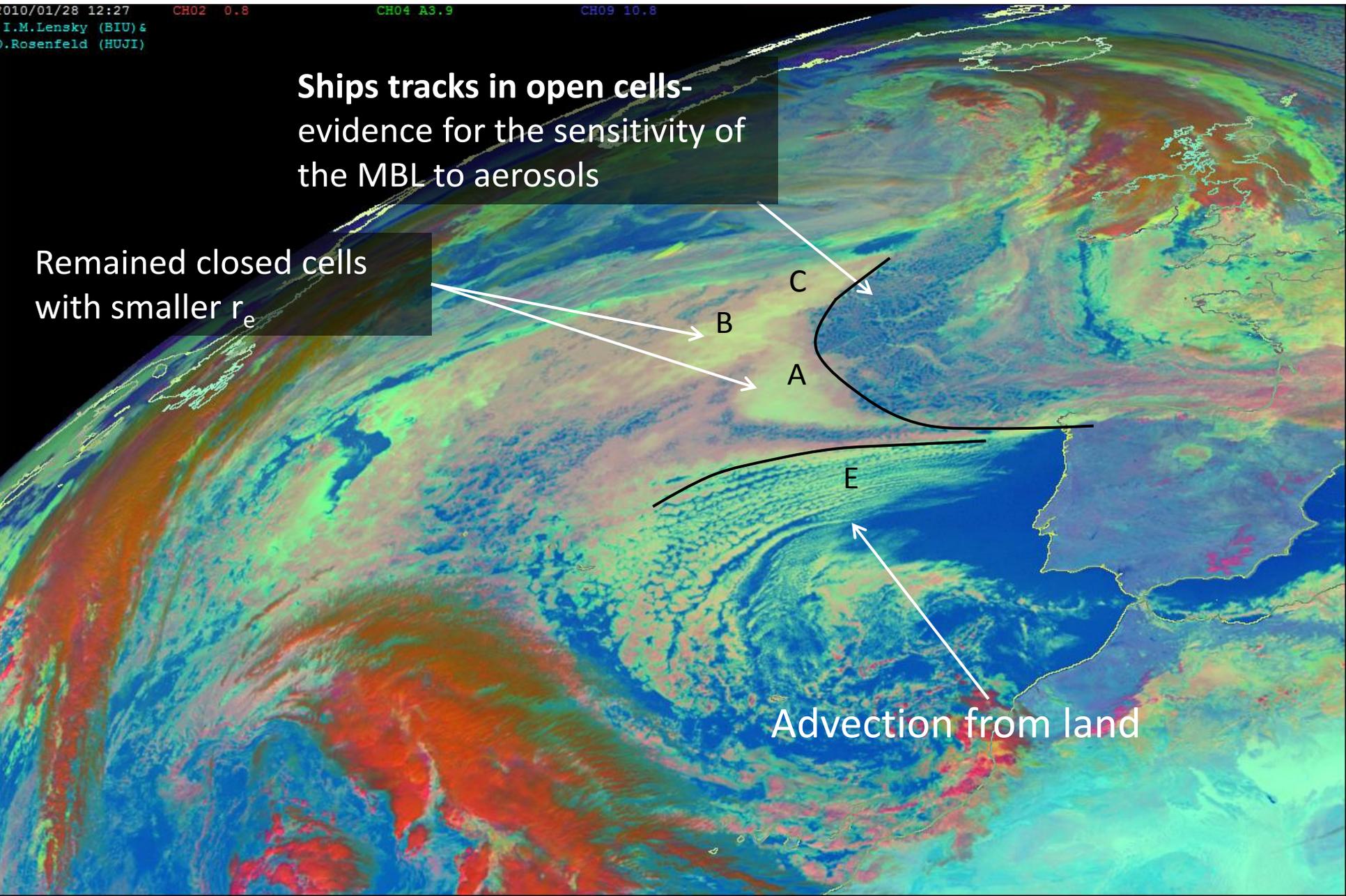
010/01/28 12:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



Advection from land



2010 January 28

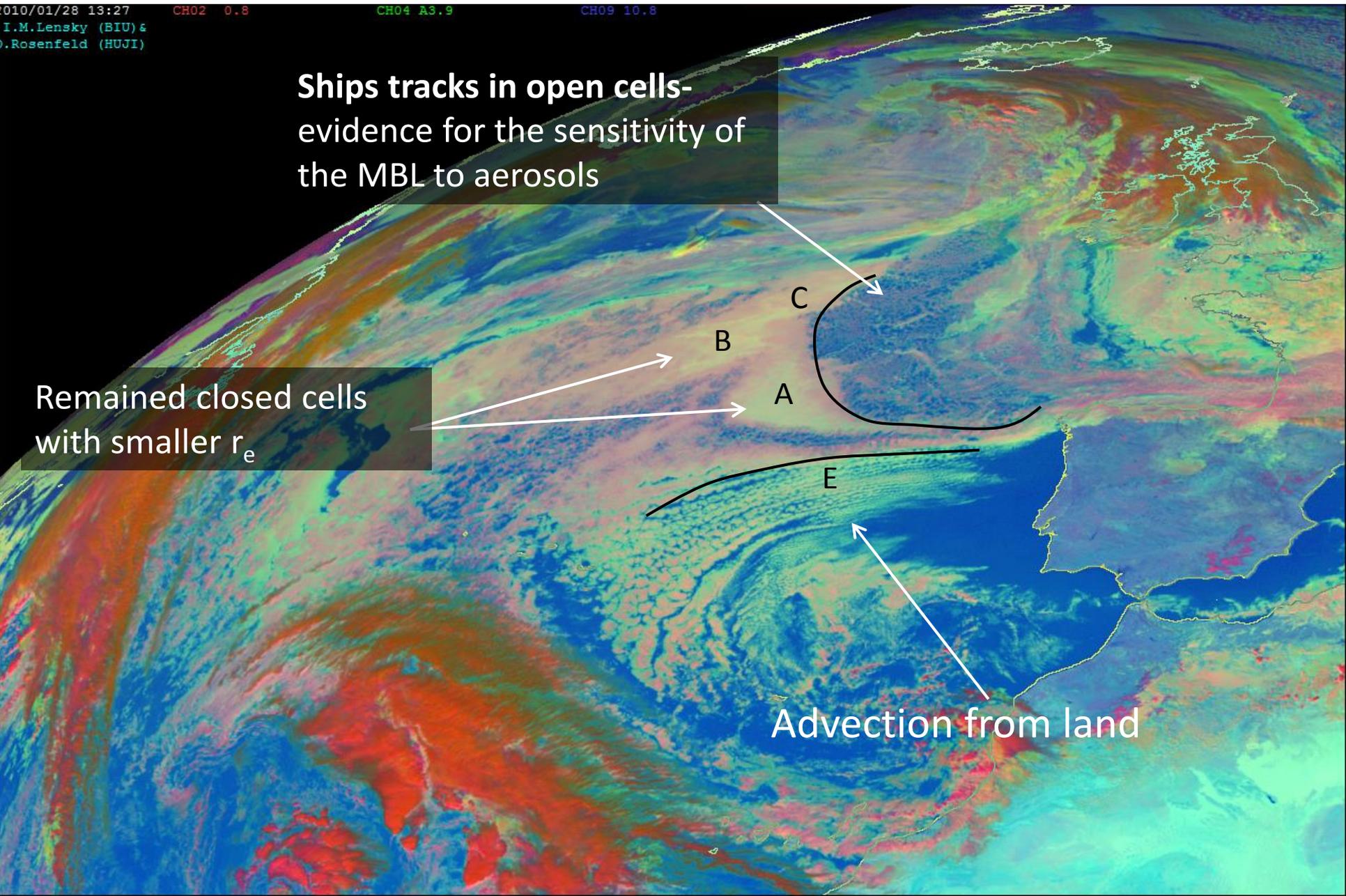
13:27 UTC

010/01/28 13:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e

Advection from land



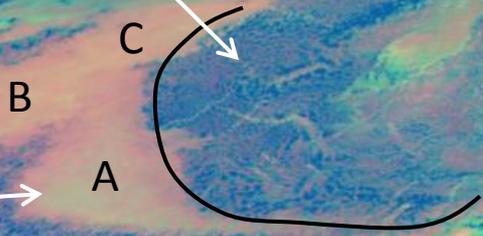
2010 January 28

14:27 UTC

010/01/28 14:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



Advection from land

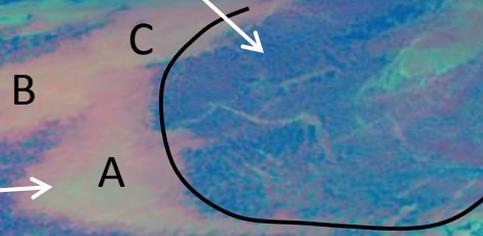
2010 January 28

15:27 UTC

2010/01/28 15:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



Advection from land

2010 January 28

16:27 UTC

010/01/28 16:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e

B

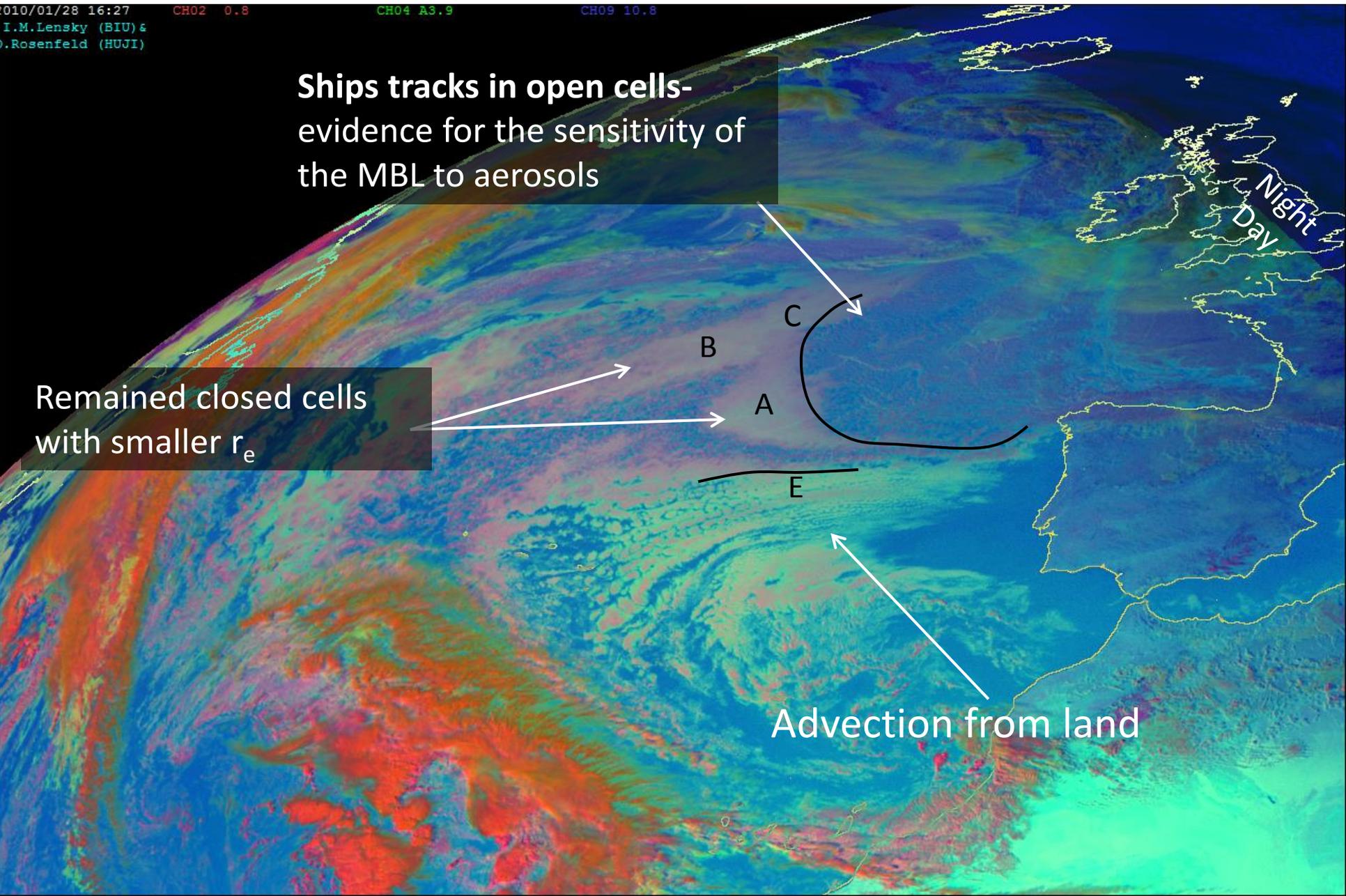
A

C

E

Advection from land

Night
Day

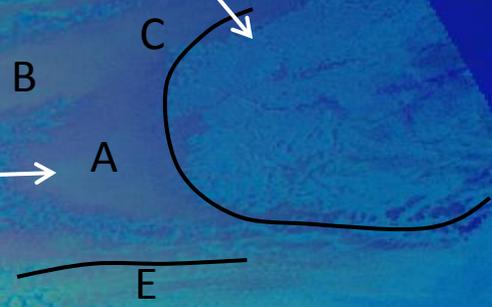


2010 January 28
17:27 UTC

010/01/28 17:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)

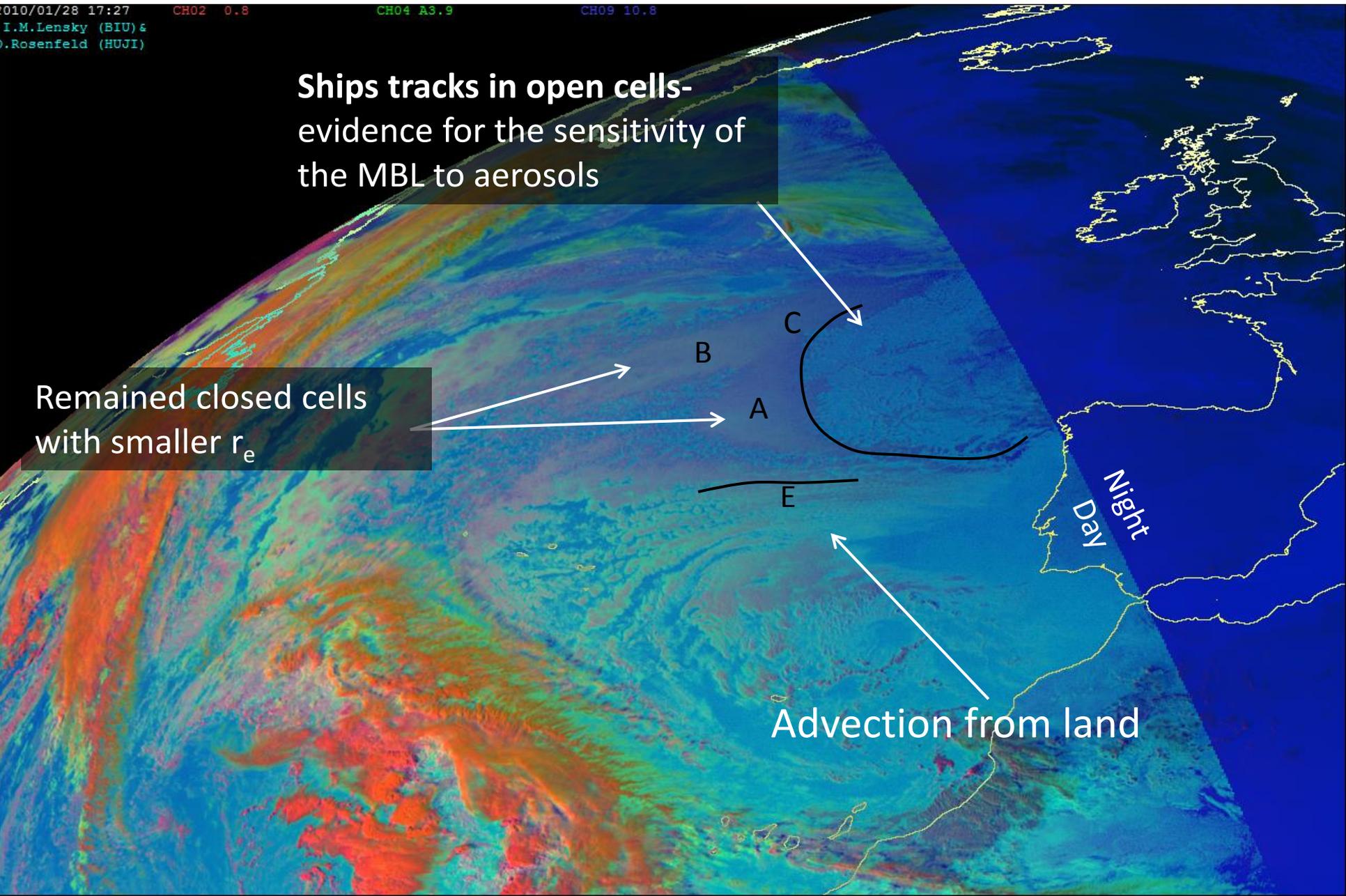
Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



Night
Day

Advection from land

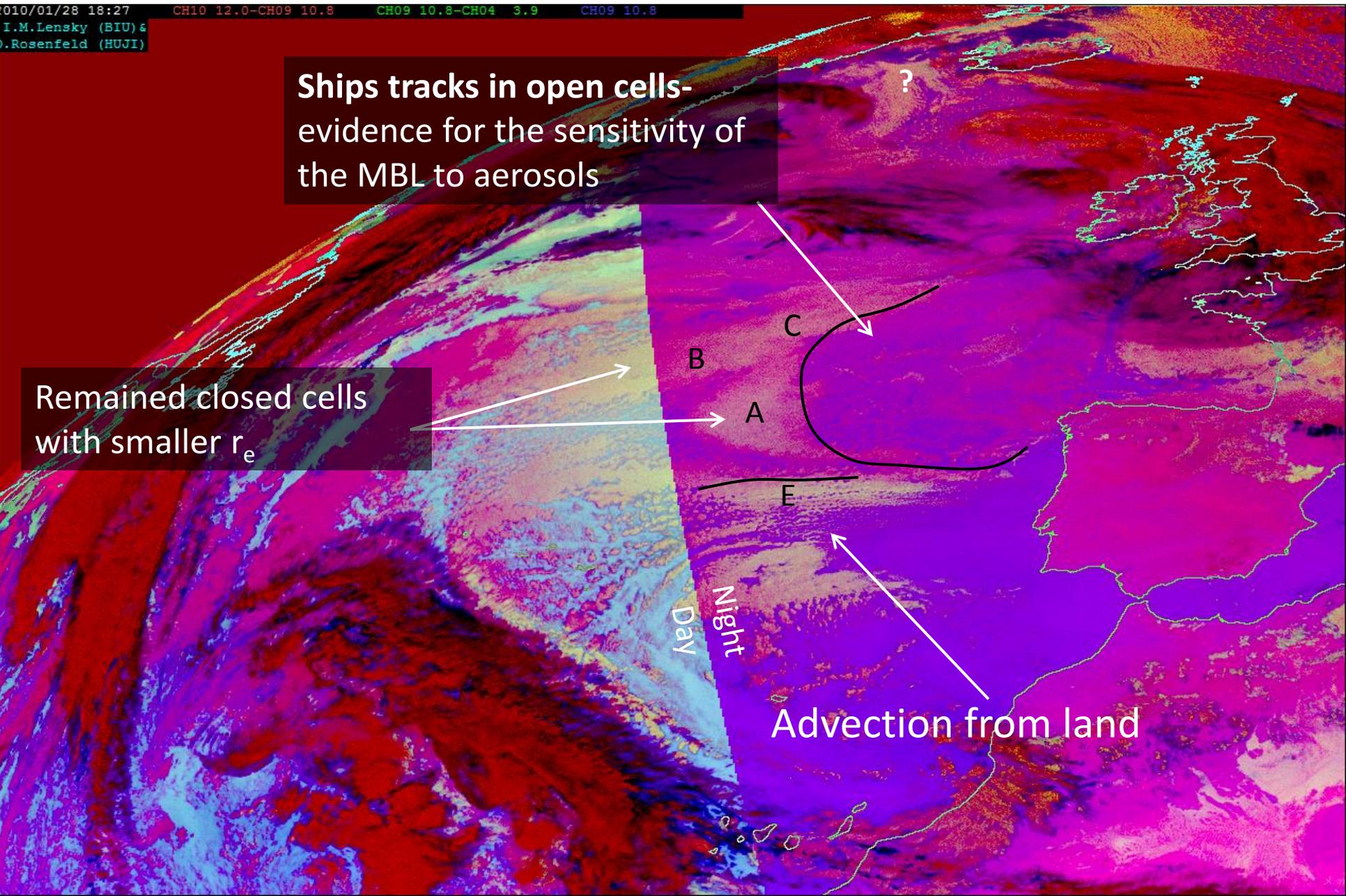


2010 January 28
18:27 UTC

2010/01/28 18:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M. Lensky (BIU) &
D. Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



Day
Night

Advection from land

?

B

A

C

E

2010 January 28

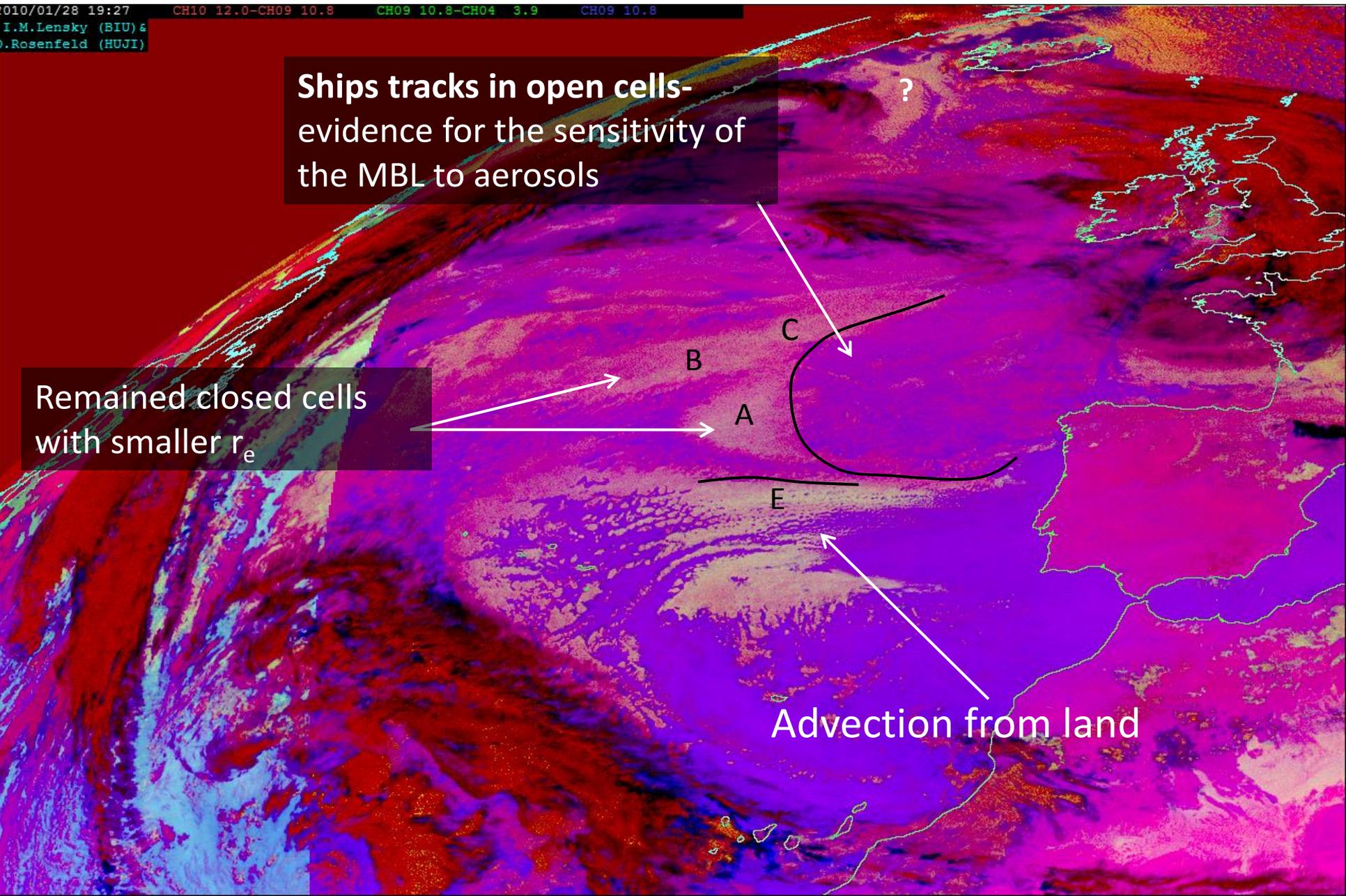
19:27 UTC

010/01/28 19:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e

Advection from land



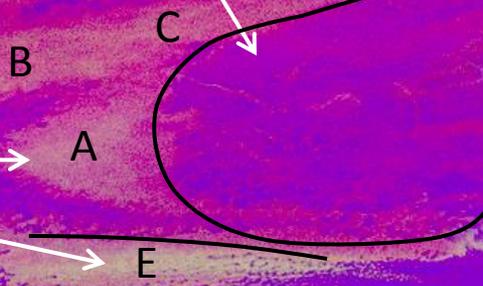
2010 January 28

20:27 UTC

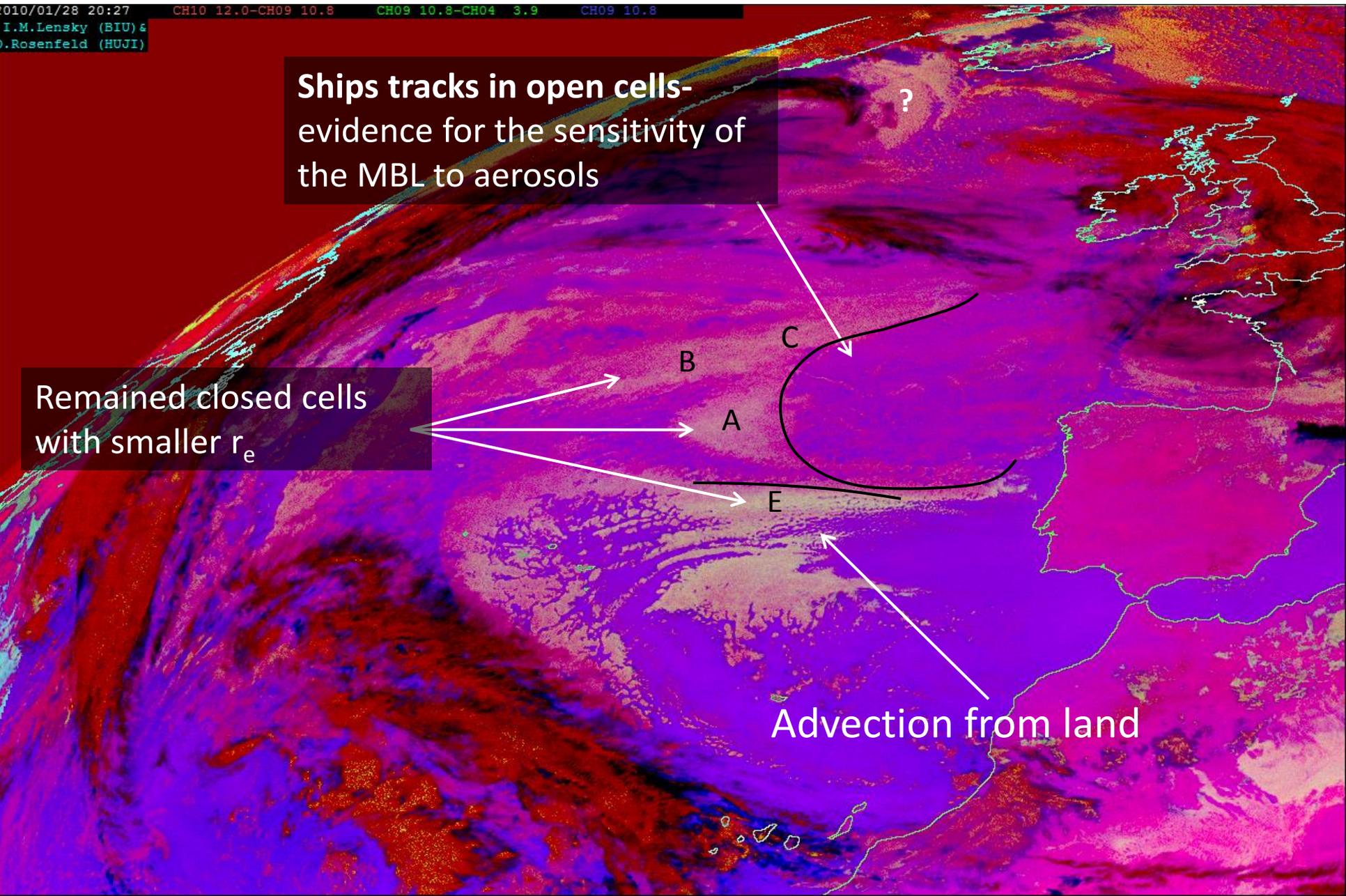
010/01/28 20:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
)Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



Advection from land



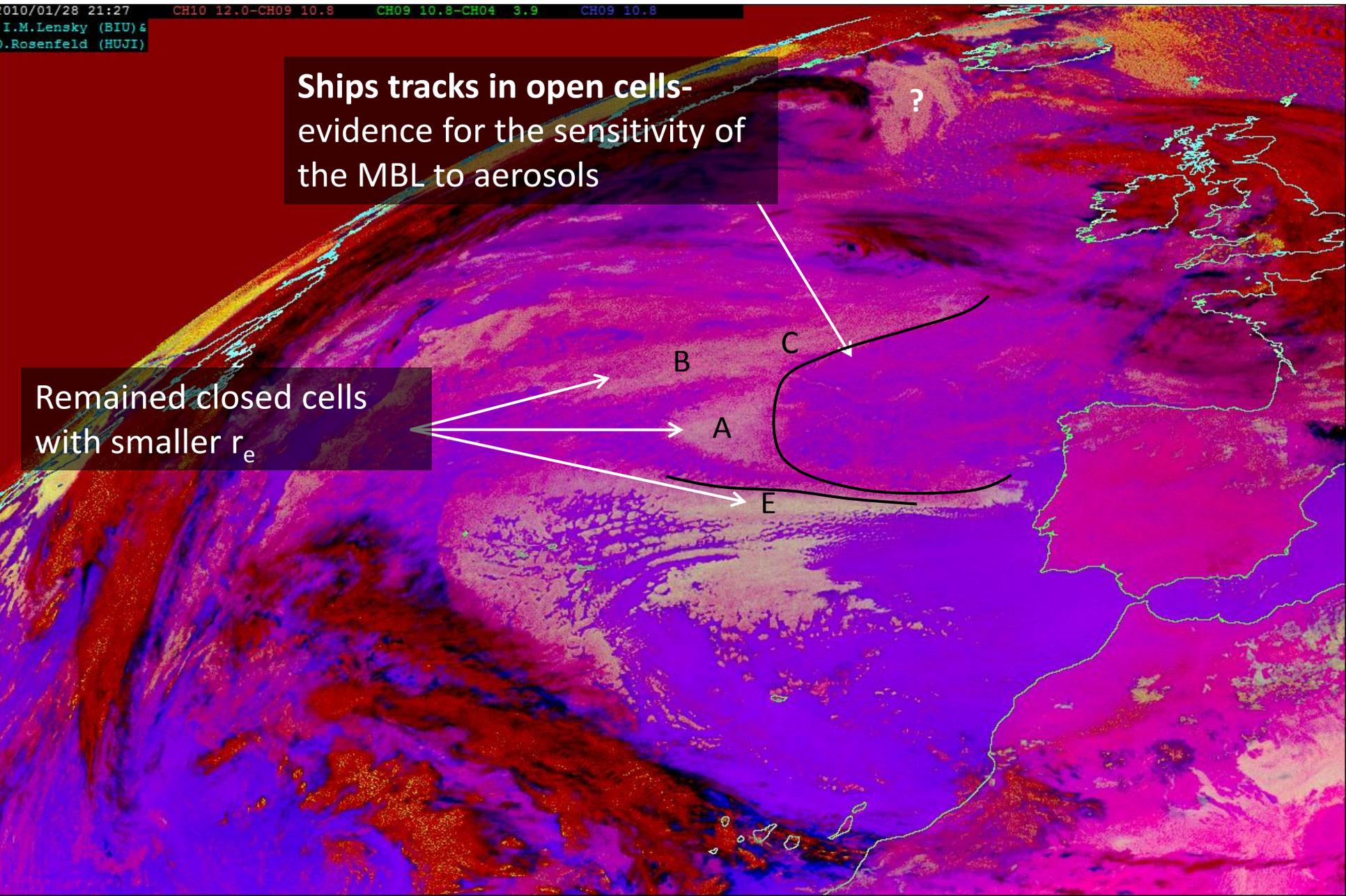
2010 January 28

21:27 UTC

010/01/28 21:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



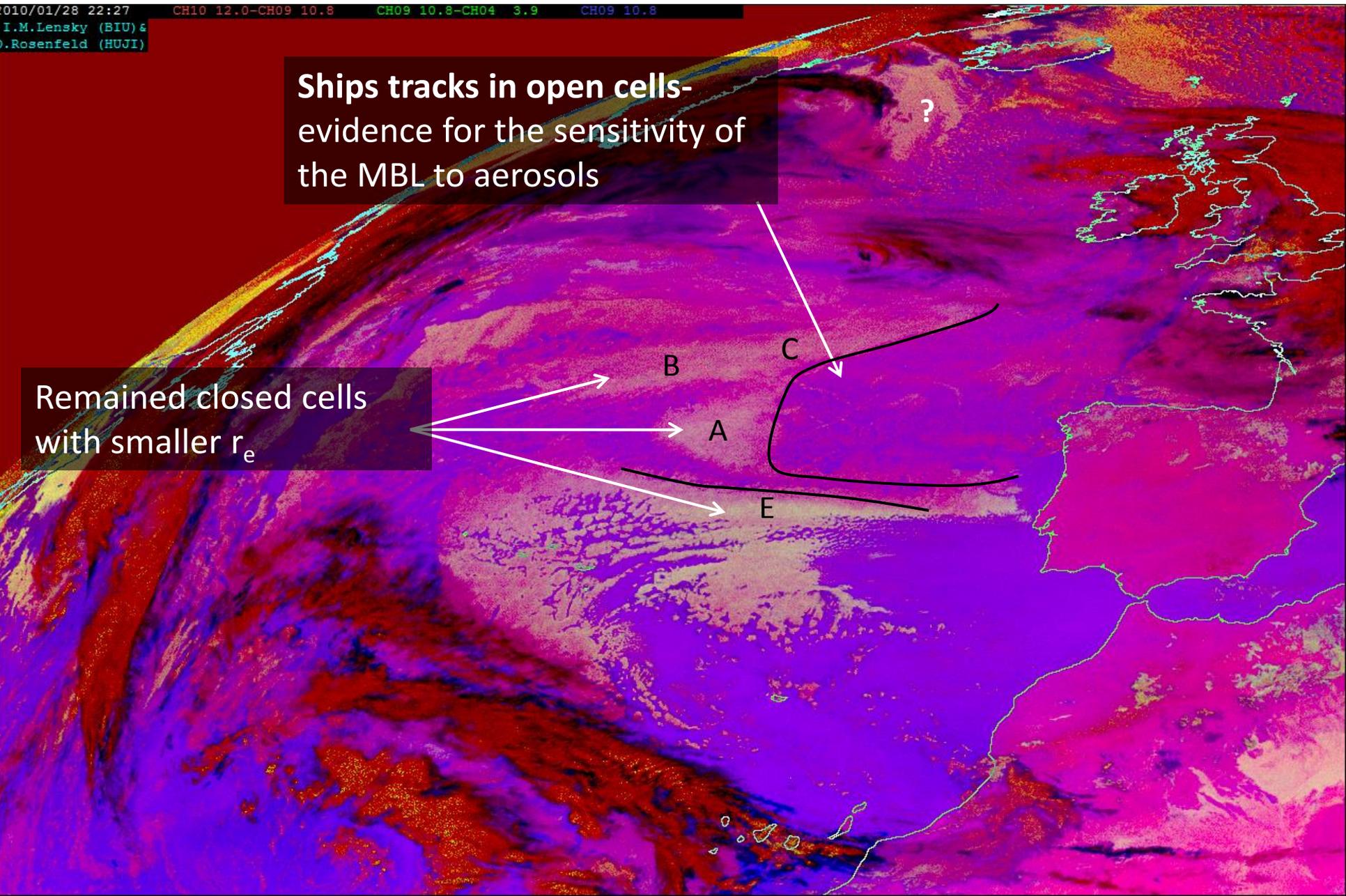
2010 January 28

22:27 UTC

010/01/28 22:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)

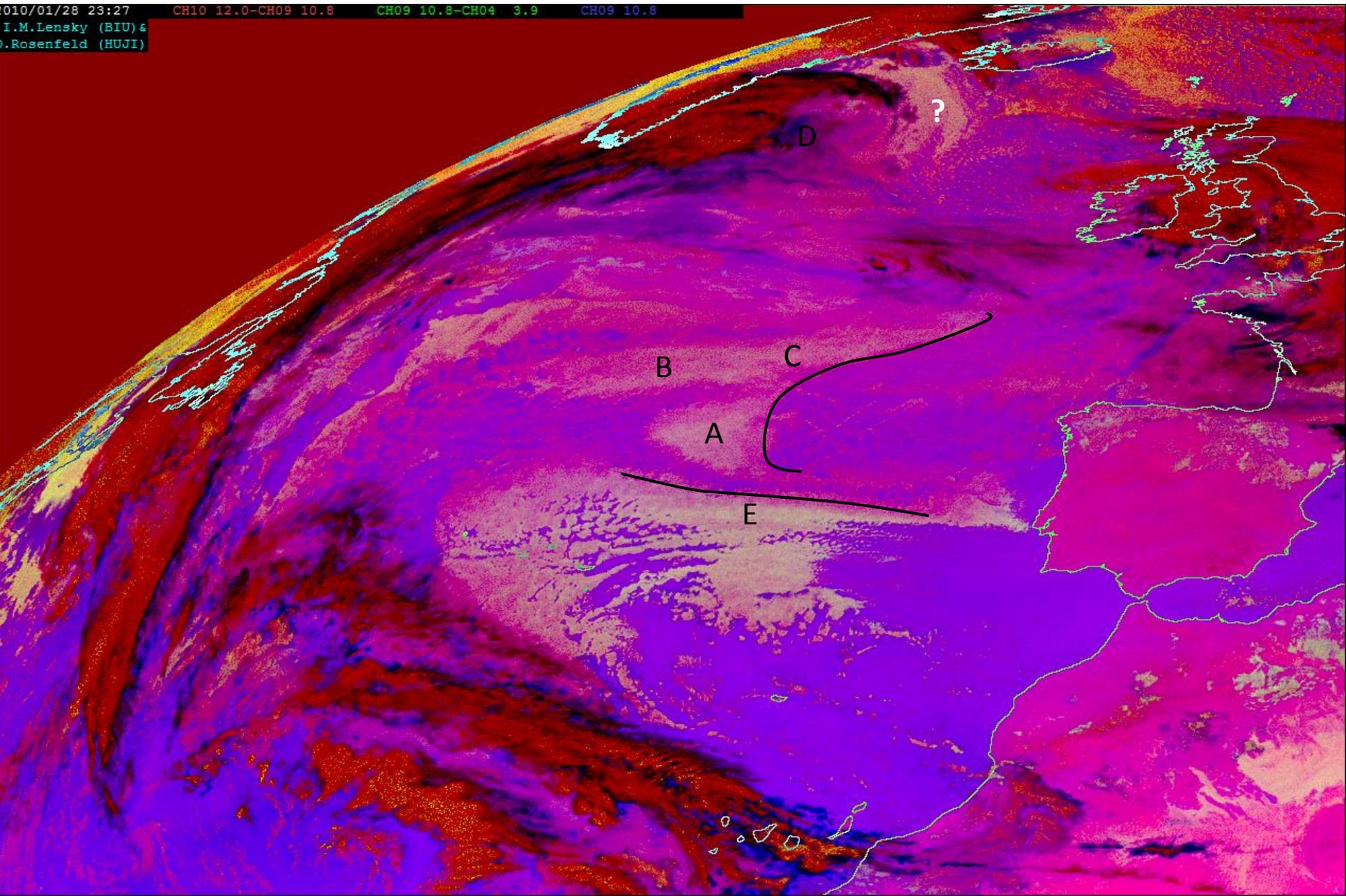
Ships tracks in open cells-
evidence for the sensitivity of
the MBL to aerosols

Remained closed cells
with smaller r_e



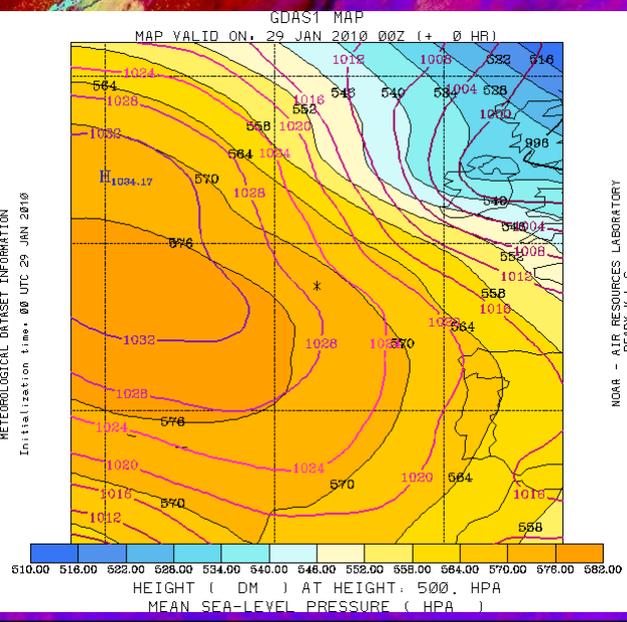
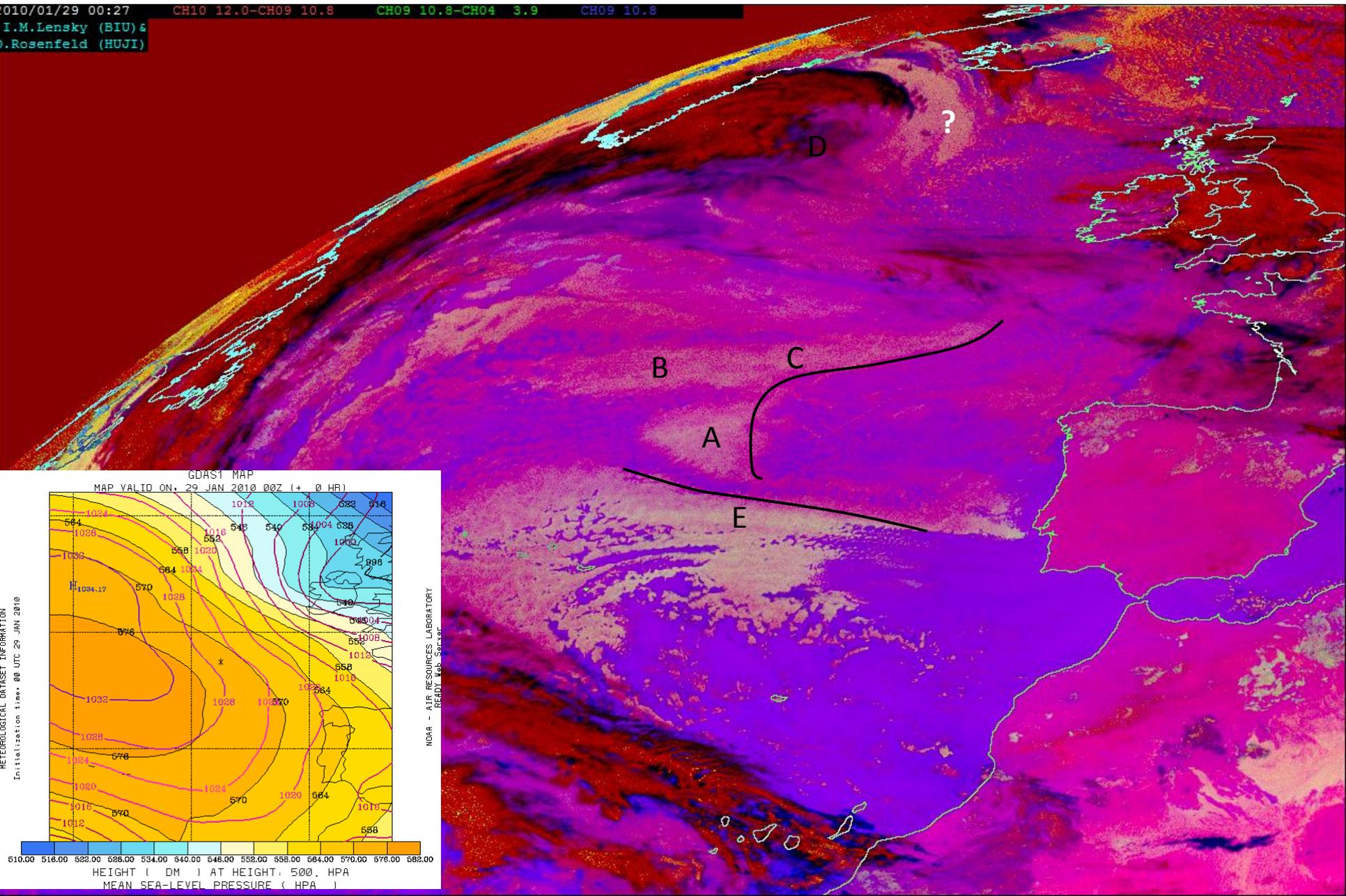
2010 January 28
23:27 UTC

010/01/28 23:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



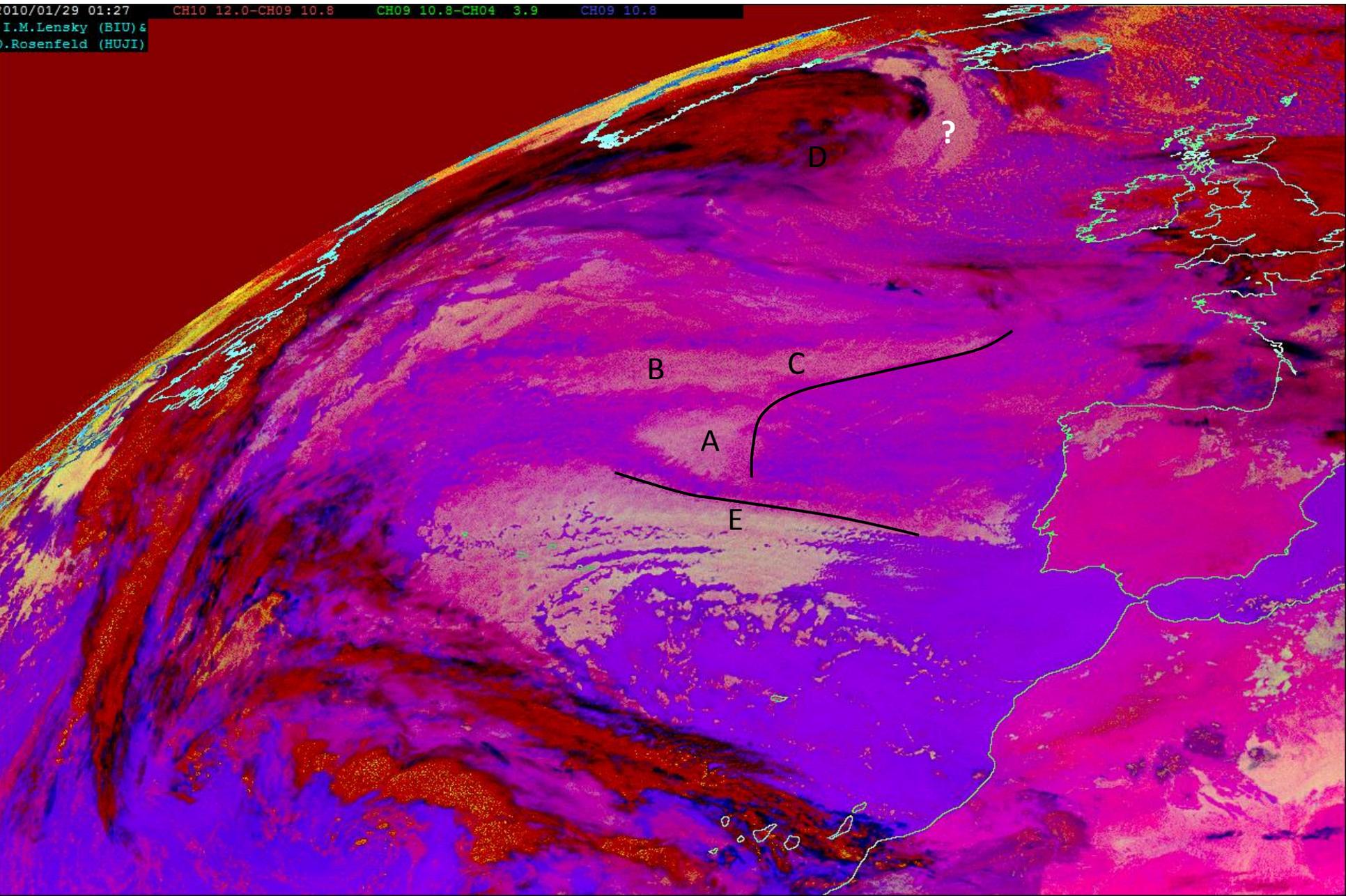
2010 January 29
00:27 UTC

010/01/29 00:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



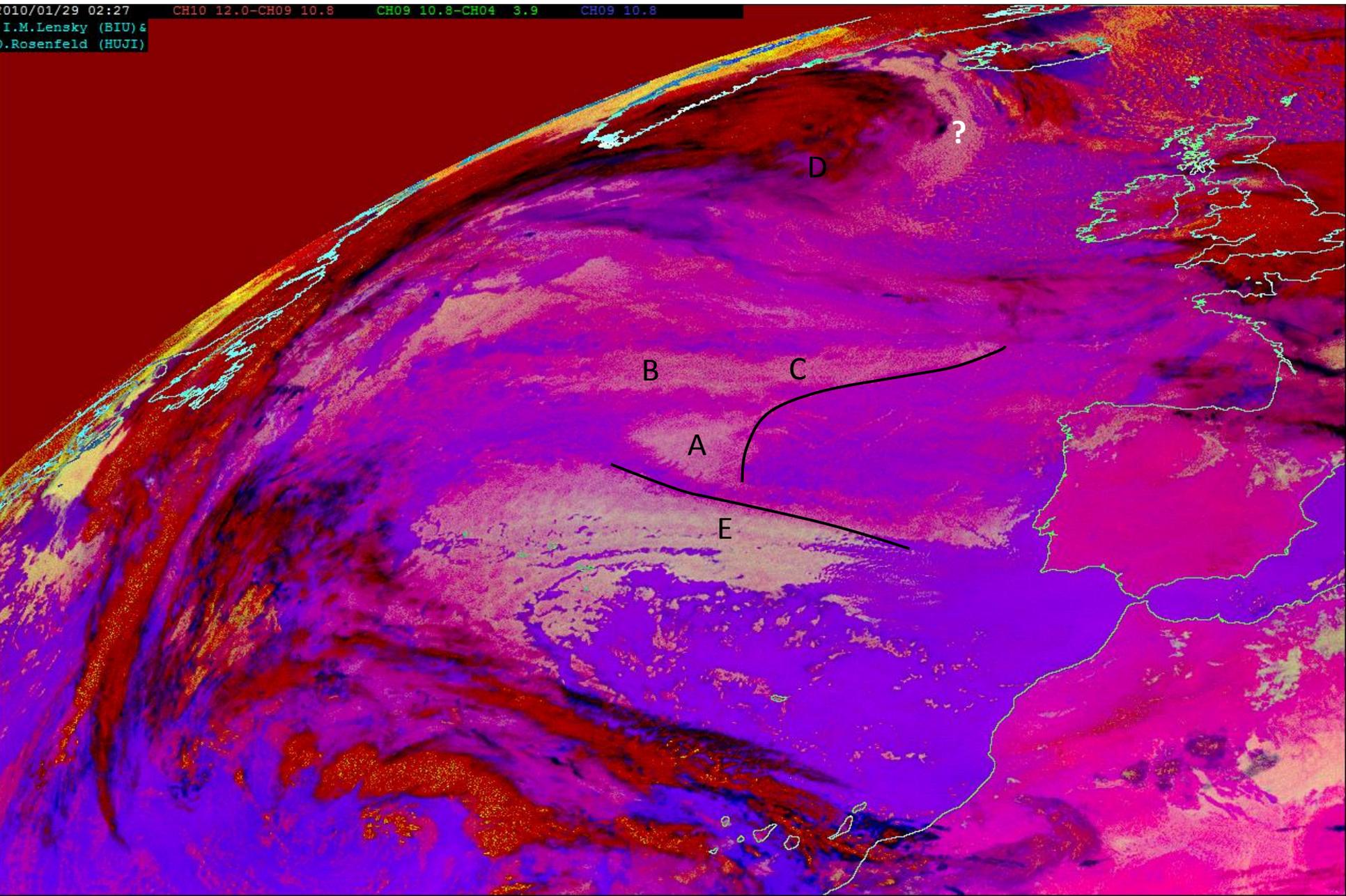
2010 January 29
01:27 UTC

010/01/29 01:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



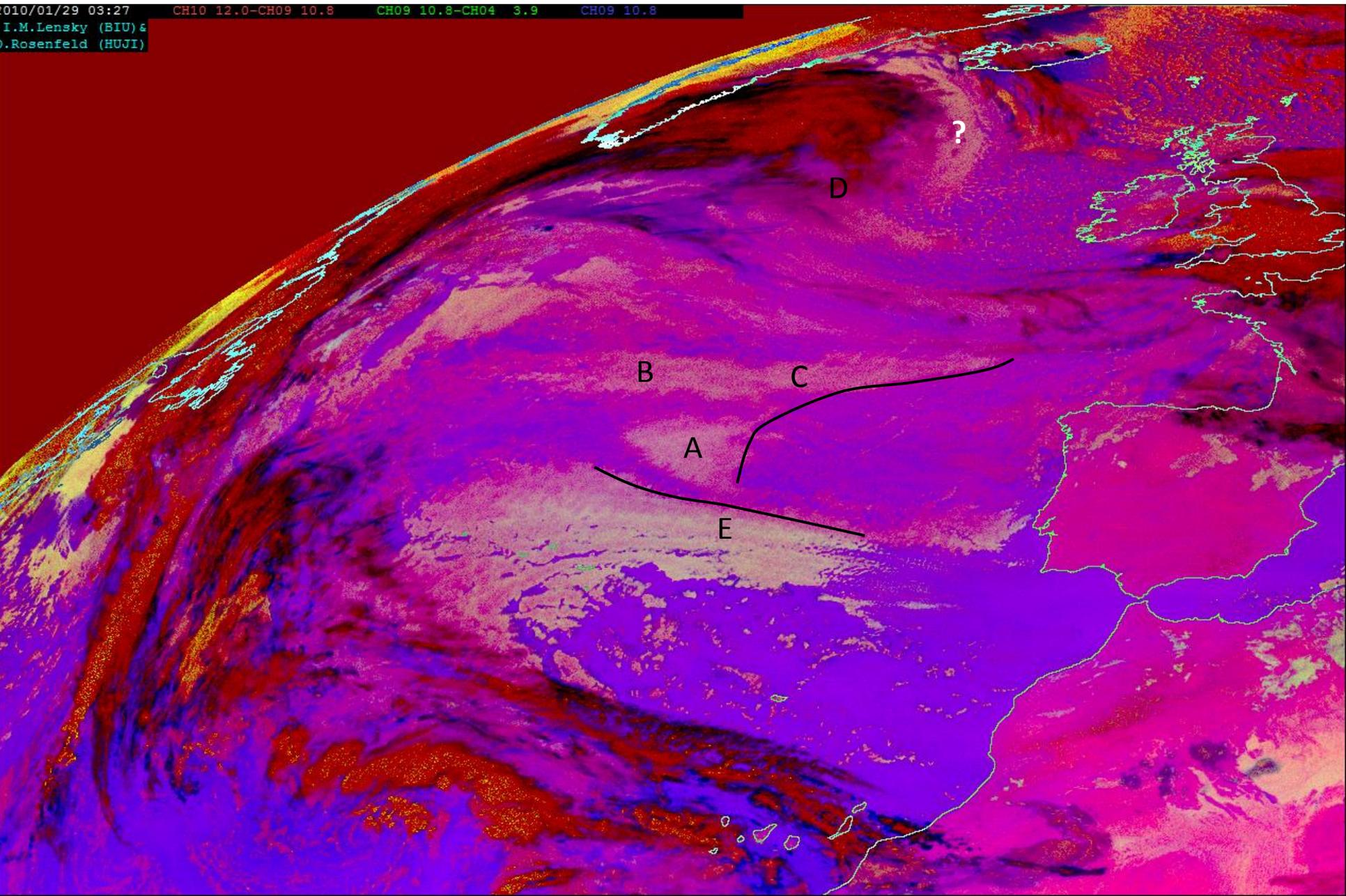
2010 January 29
02:27 UTC

010/01/29 02:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



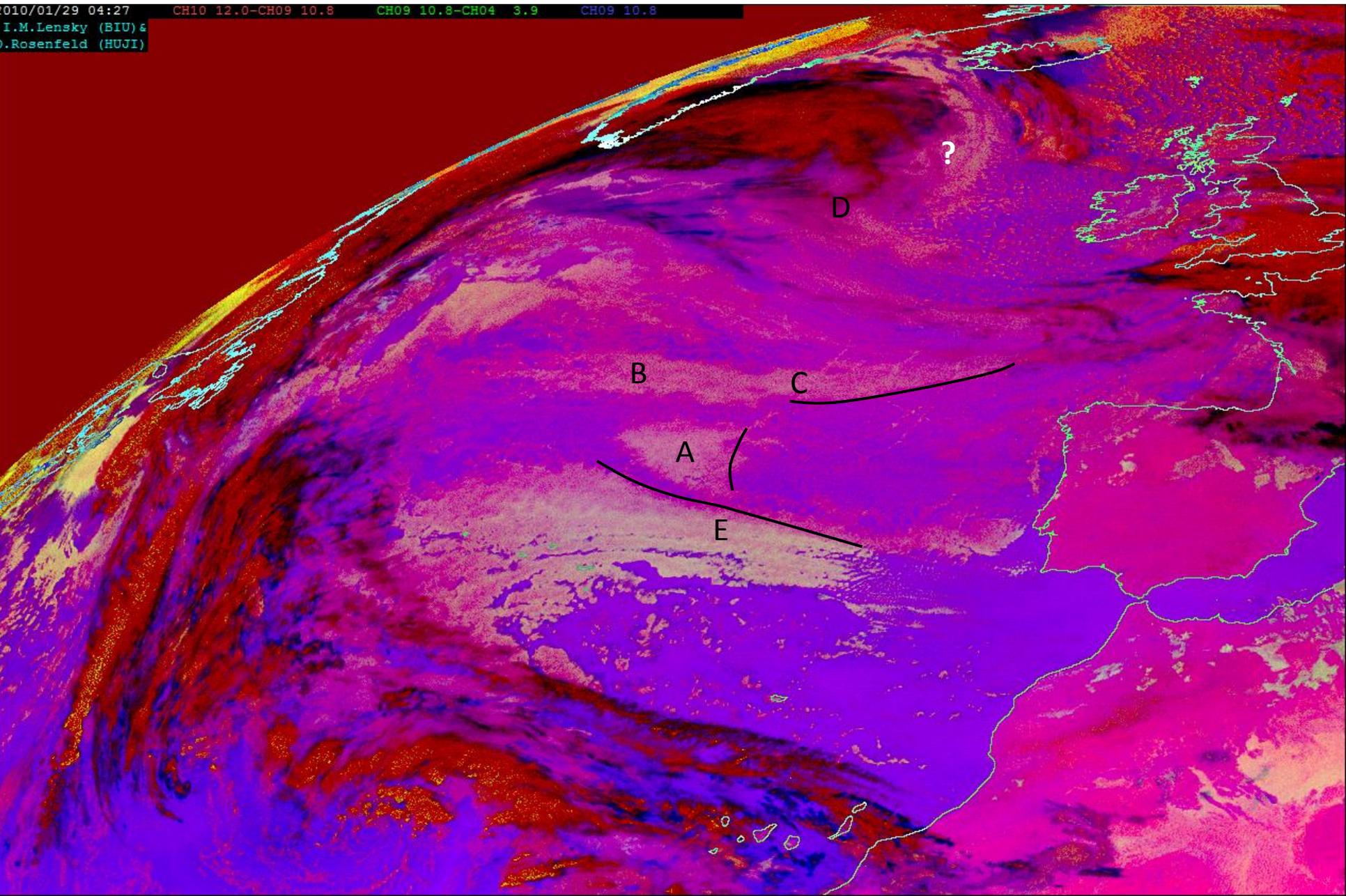
2010 January 29
03:27 UTC

010/01/29 03:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



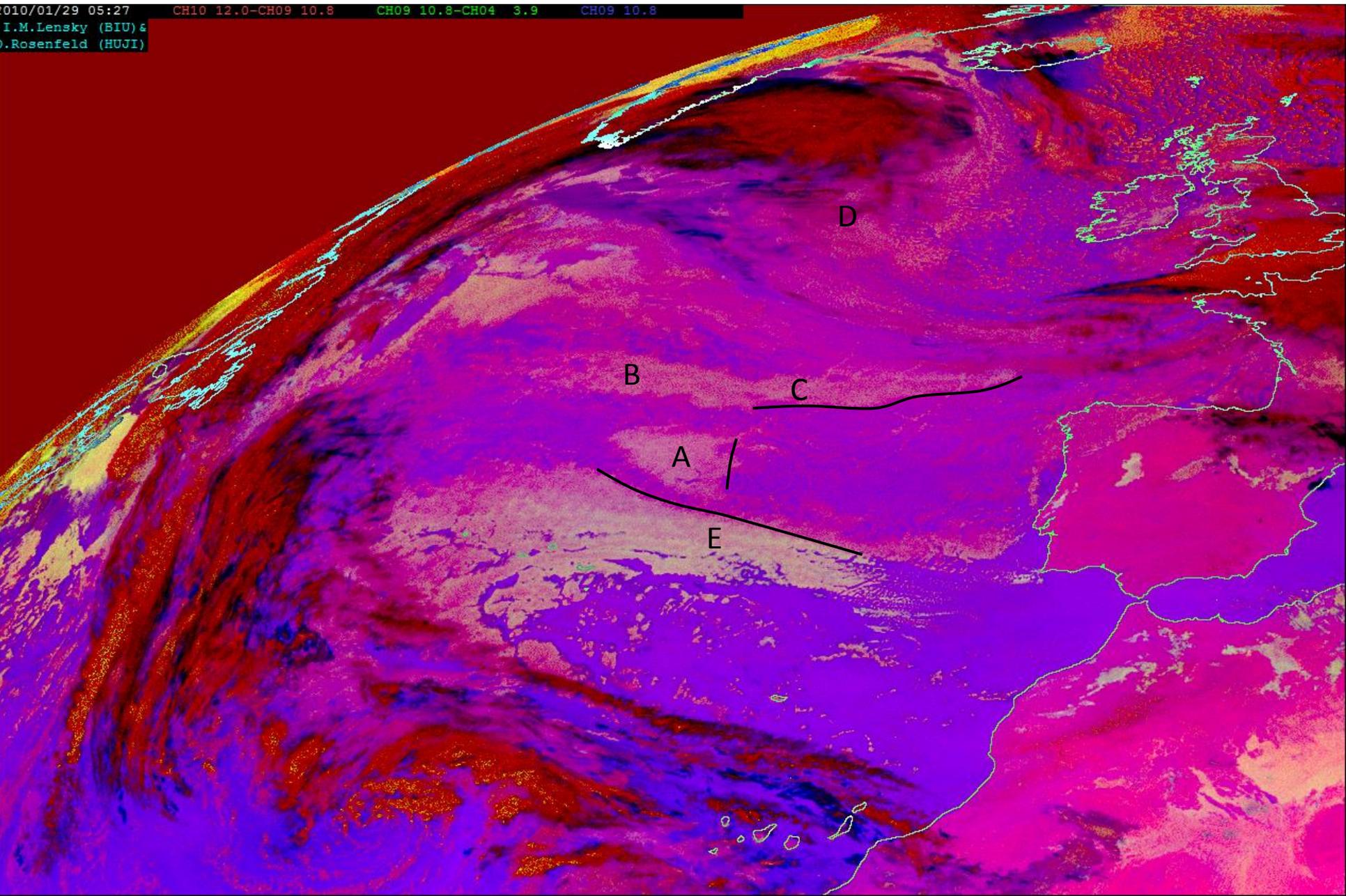
2010 January 29
04:27 UTC

010/01/29 04:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



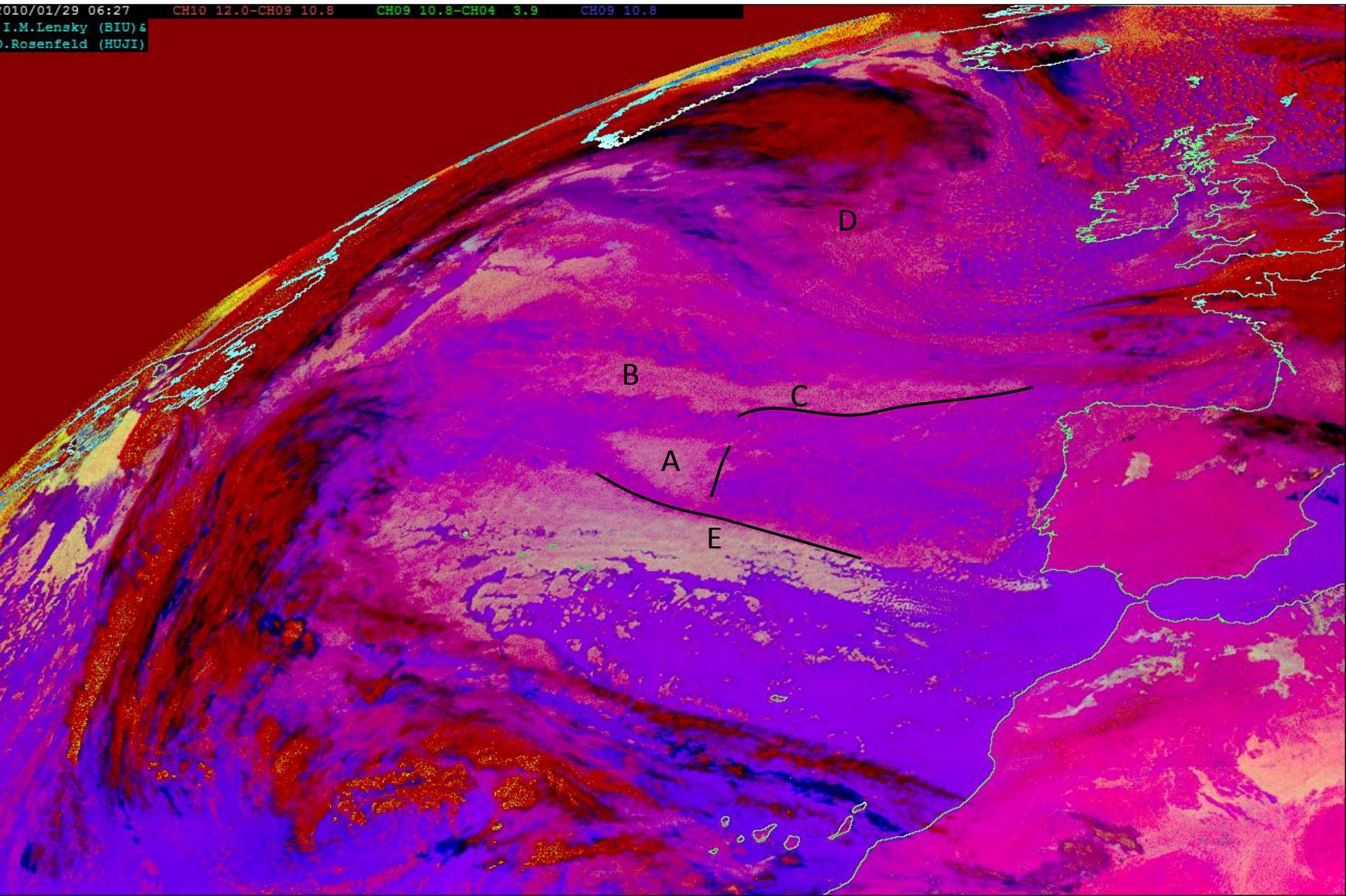
2010 January 29
05:27 UTC

010/01/29 05:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



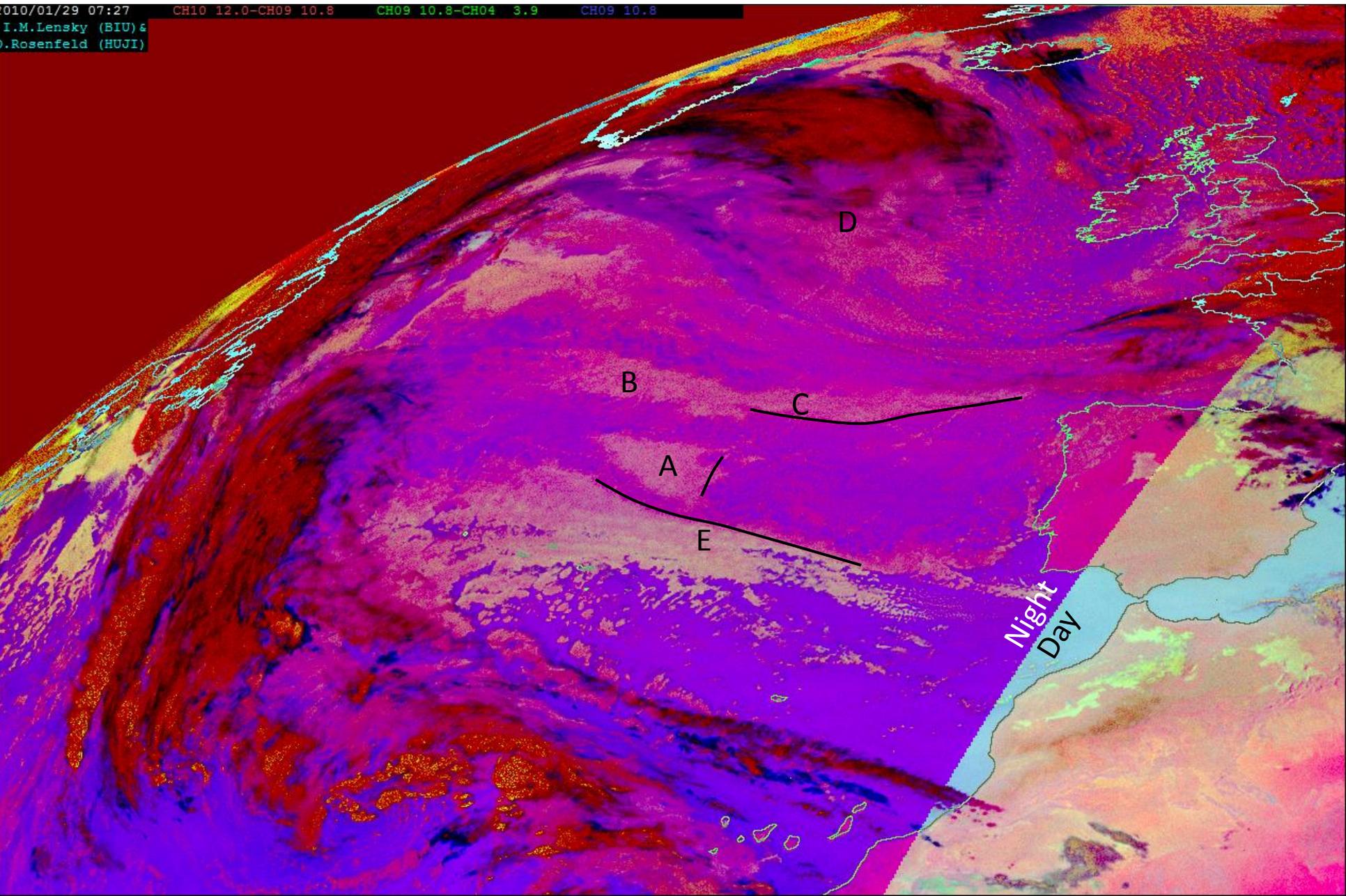
2010 January 29
06:27 UTC

010/01/29 06:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



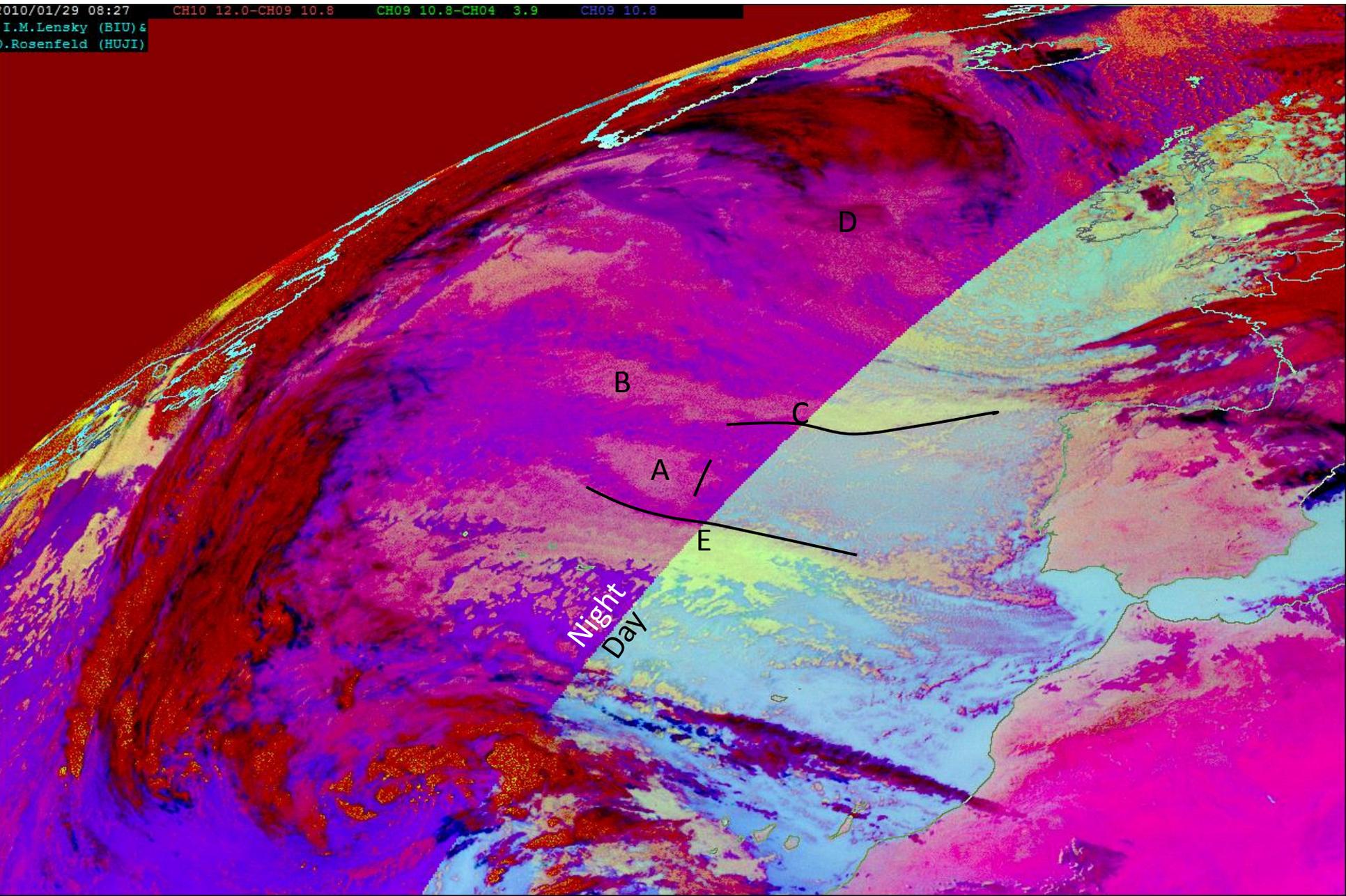
2010 January 29
07:27 UTC

010/01/29 07:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



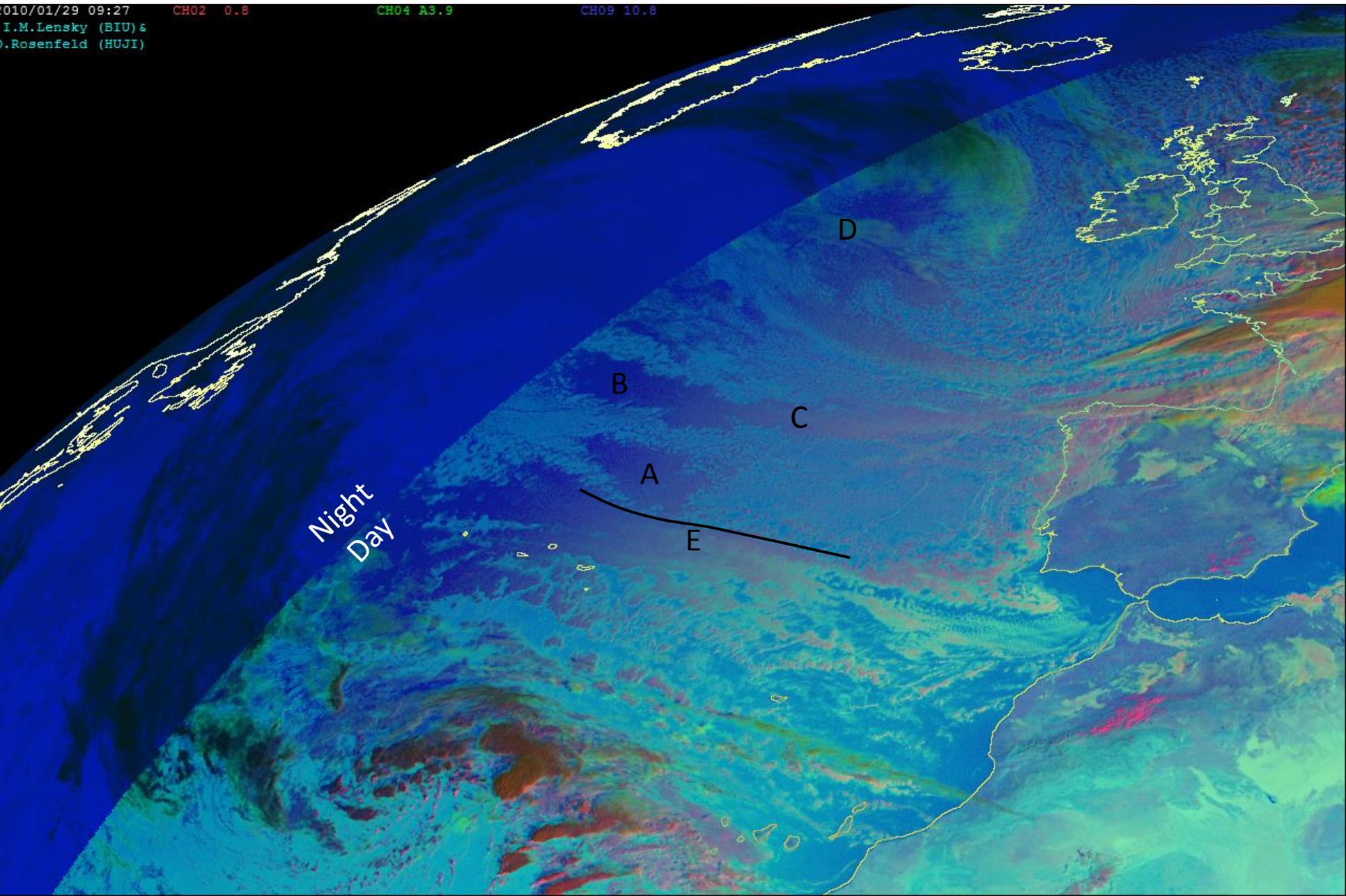
2010 January 29
08:27 UTC

010/01/29 08:27 CH10 12.0-CH09 10.8 CH09 10.8-CH04 3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



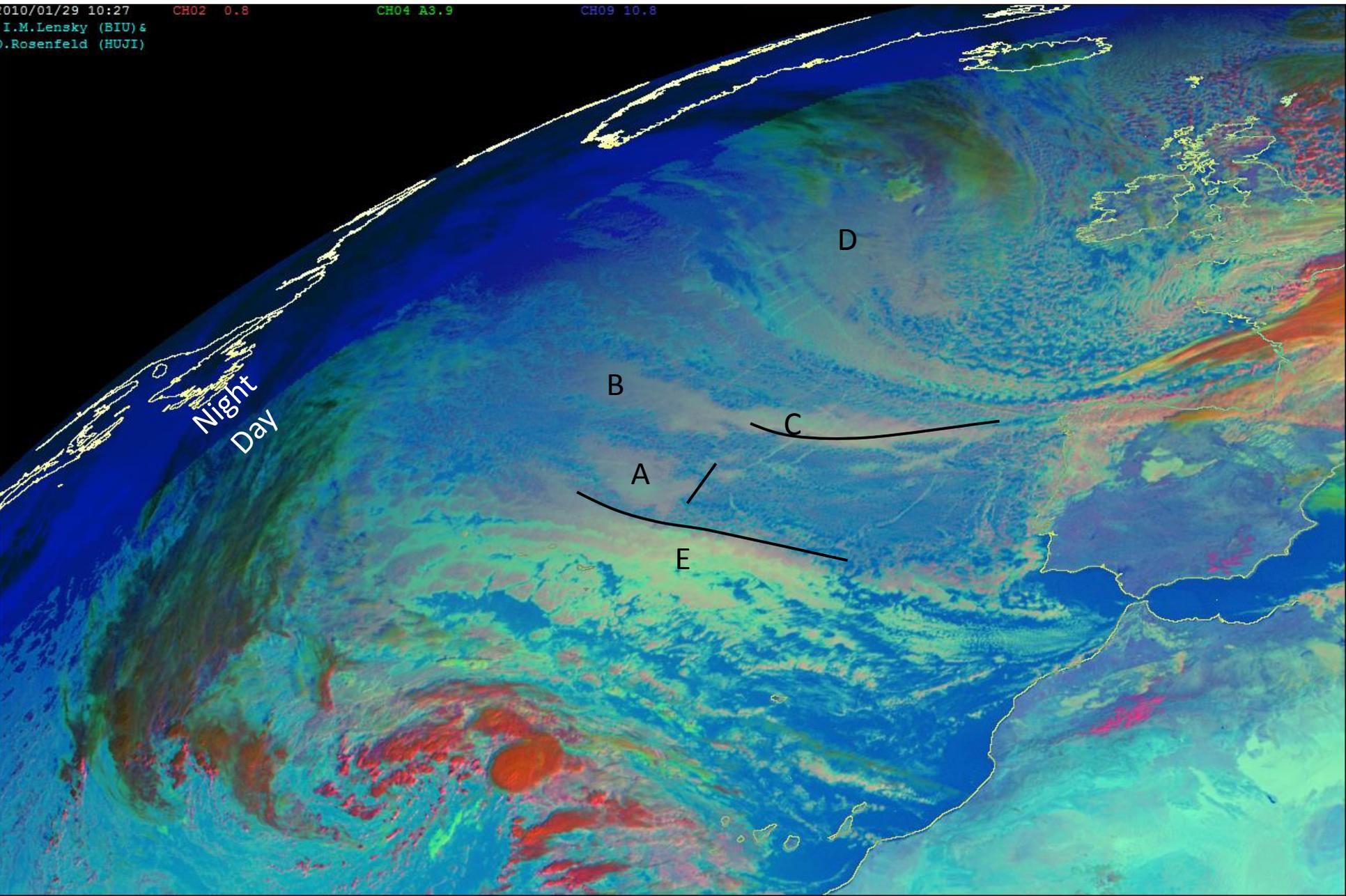
2010 January 29
09:27 UTC

010/01/29 09:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



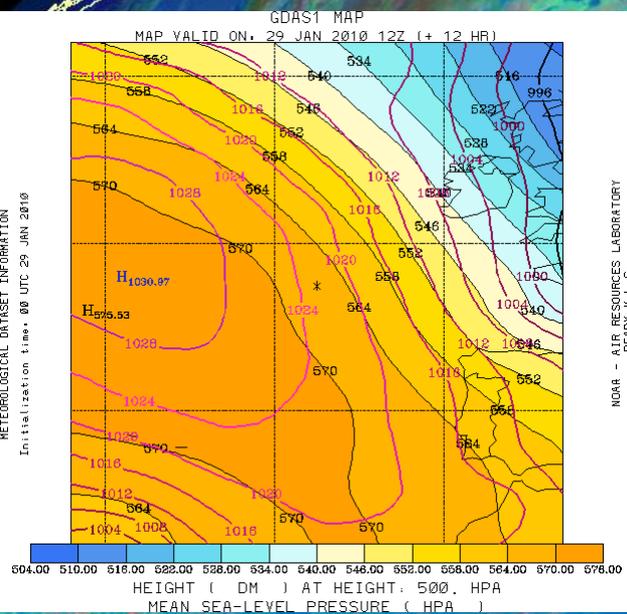
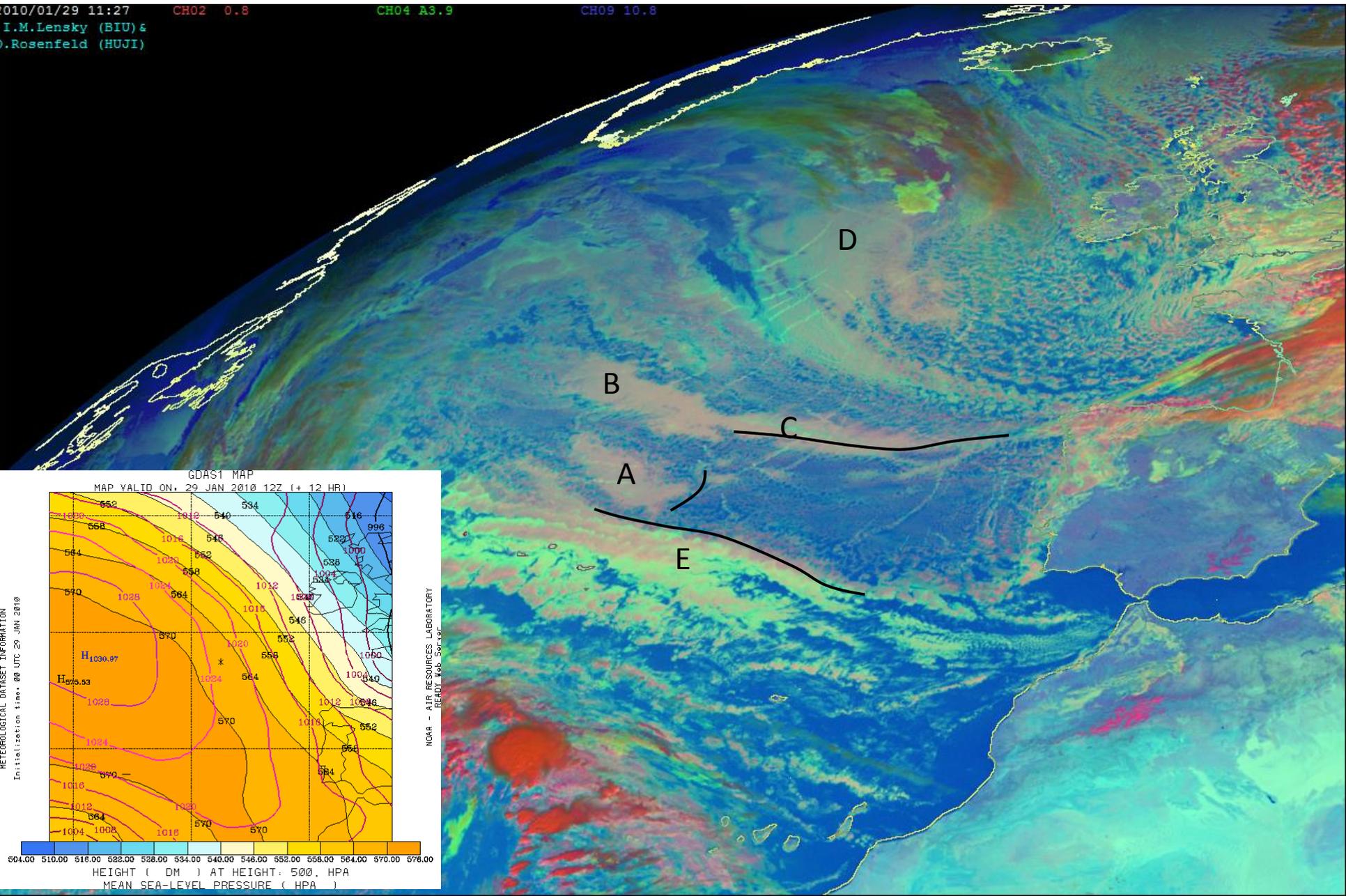
2010 January 29
10:27 UTC

010/01/29 10:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



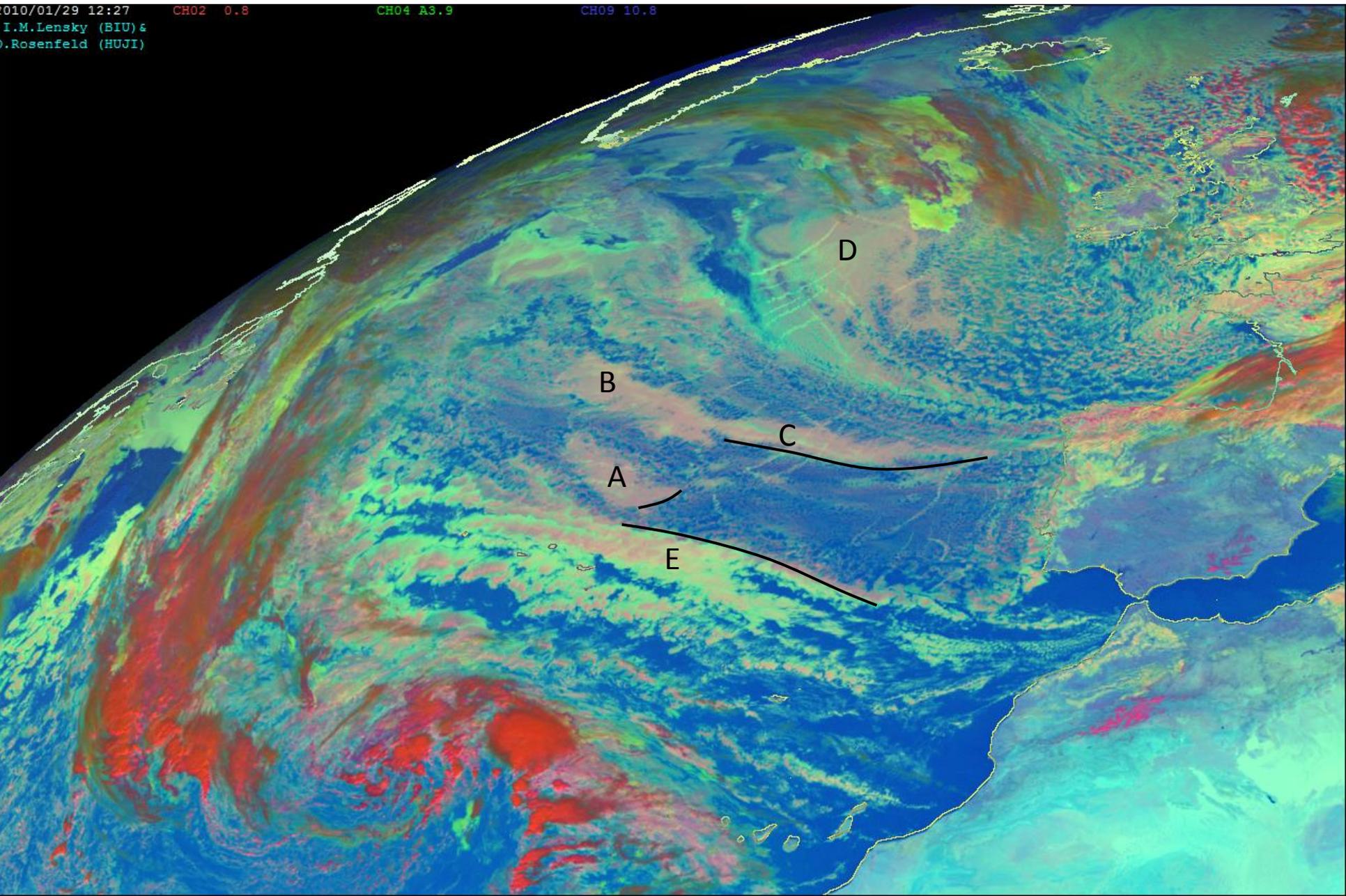
2010 January 29
11:27 UTC

010/01/29 11:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



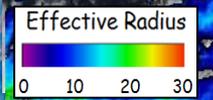
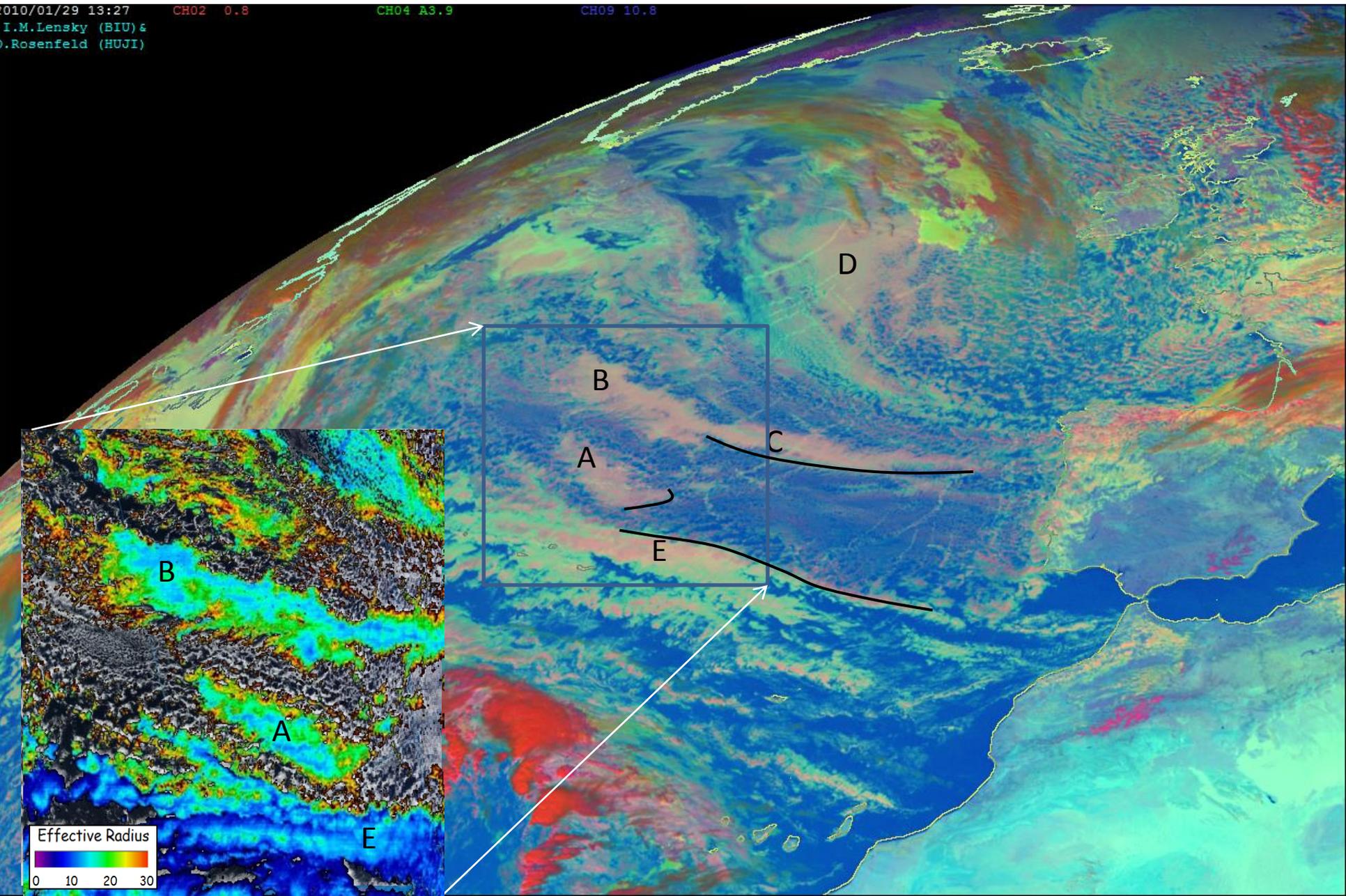
2010 January 29
12:27 UTC

2010/01/29 12:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



2010 January 29
13:27 UTC

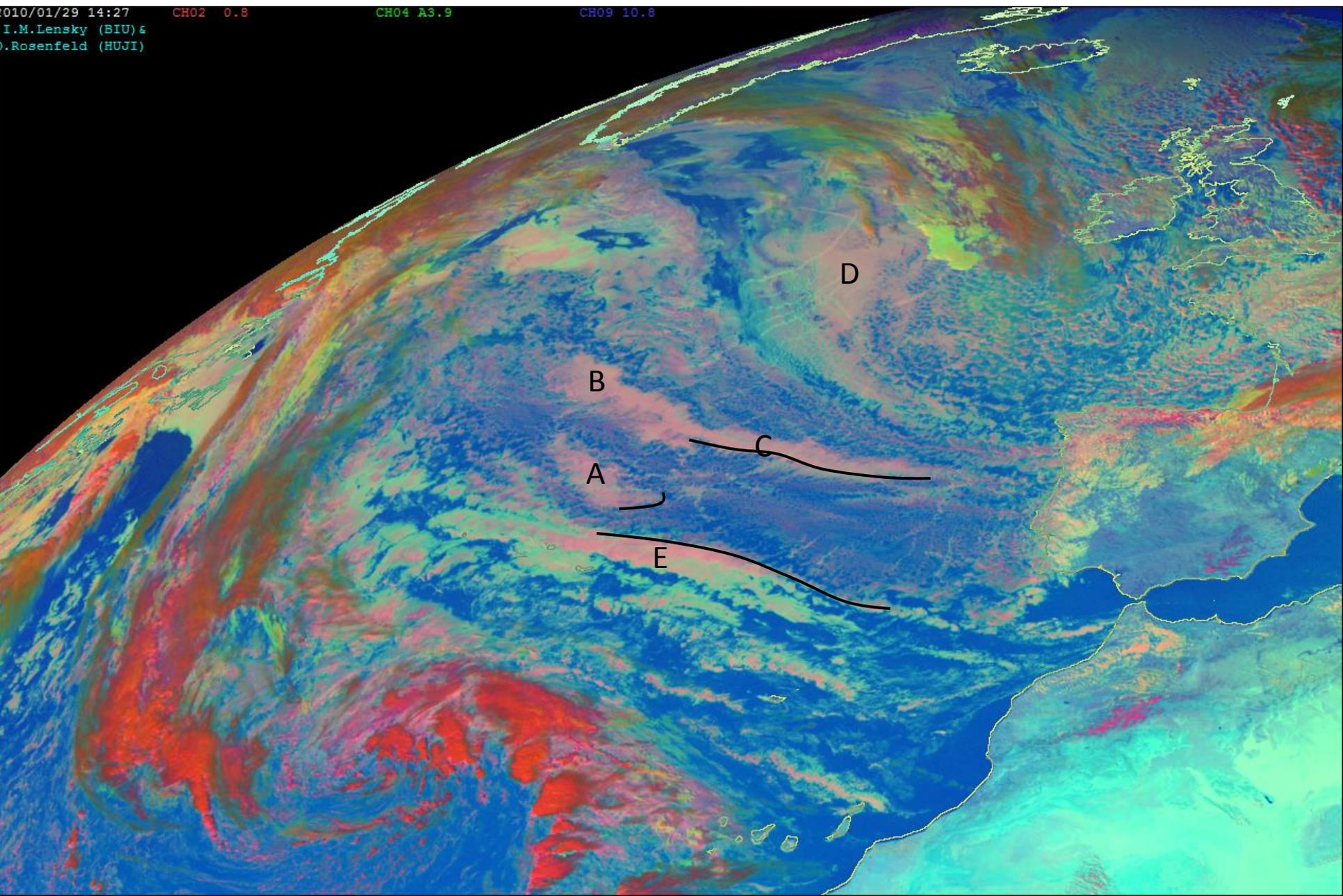
2010/01/29 13:27 CH02 0.8 CH04 A3.9 CH09 10.8
I.M.Lensky (BIU) &
.Rosenfeld (HUJI)



2010 January 29

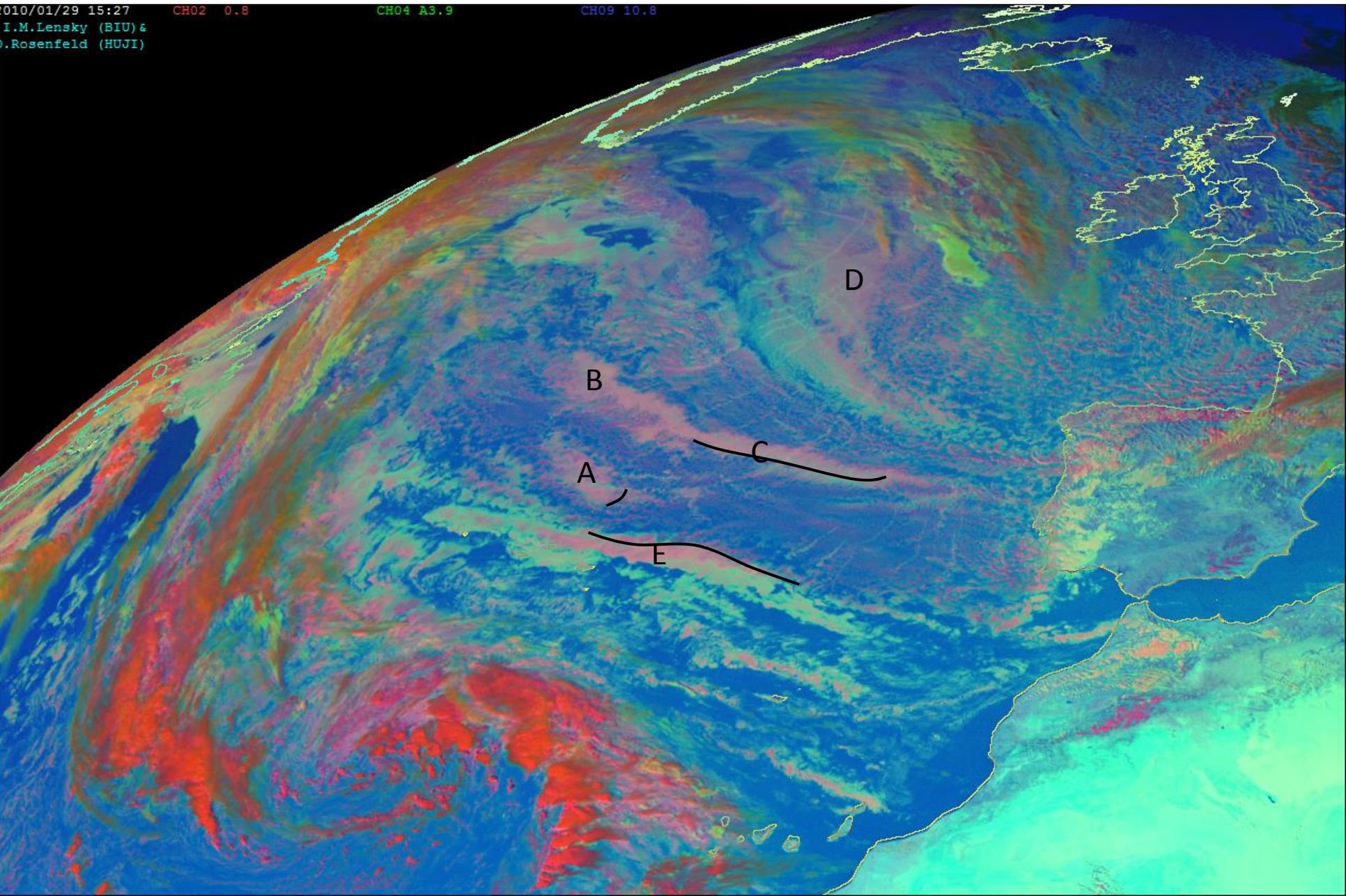
14:27 UTC

Maritimization



2010 January 29
15:27 UTC

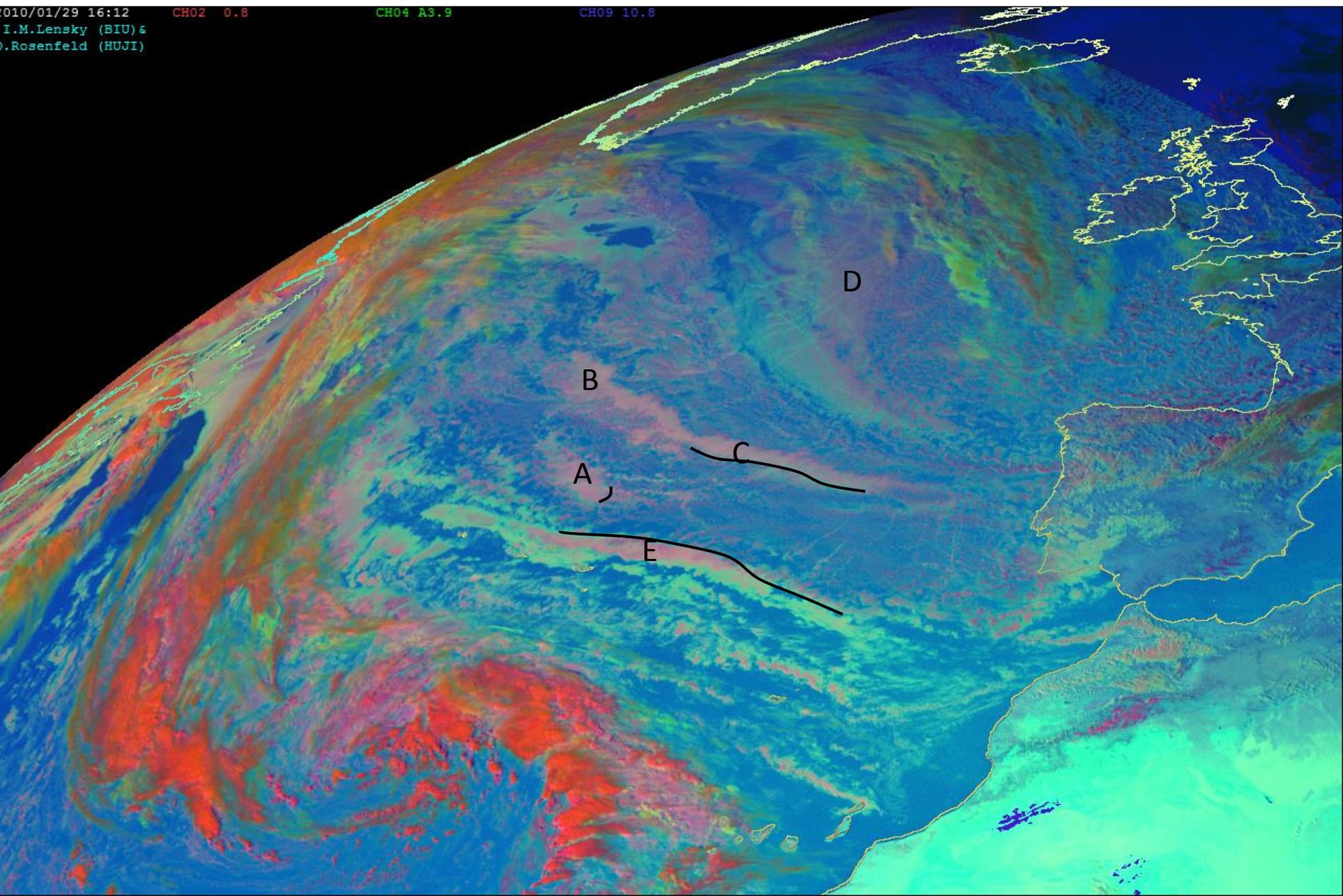
Maritimization



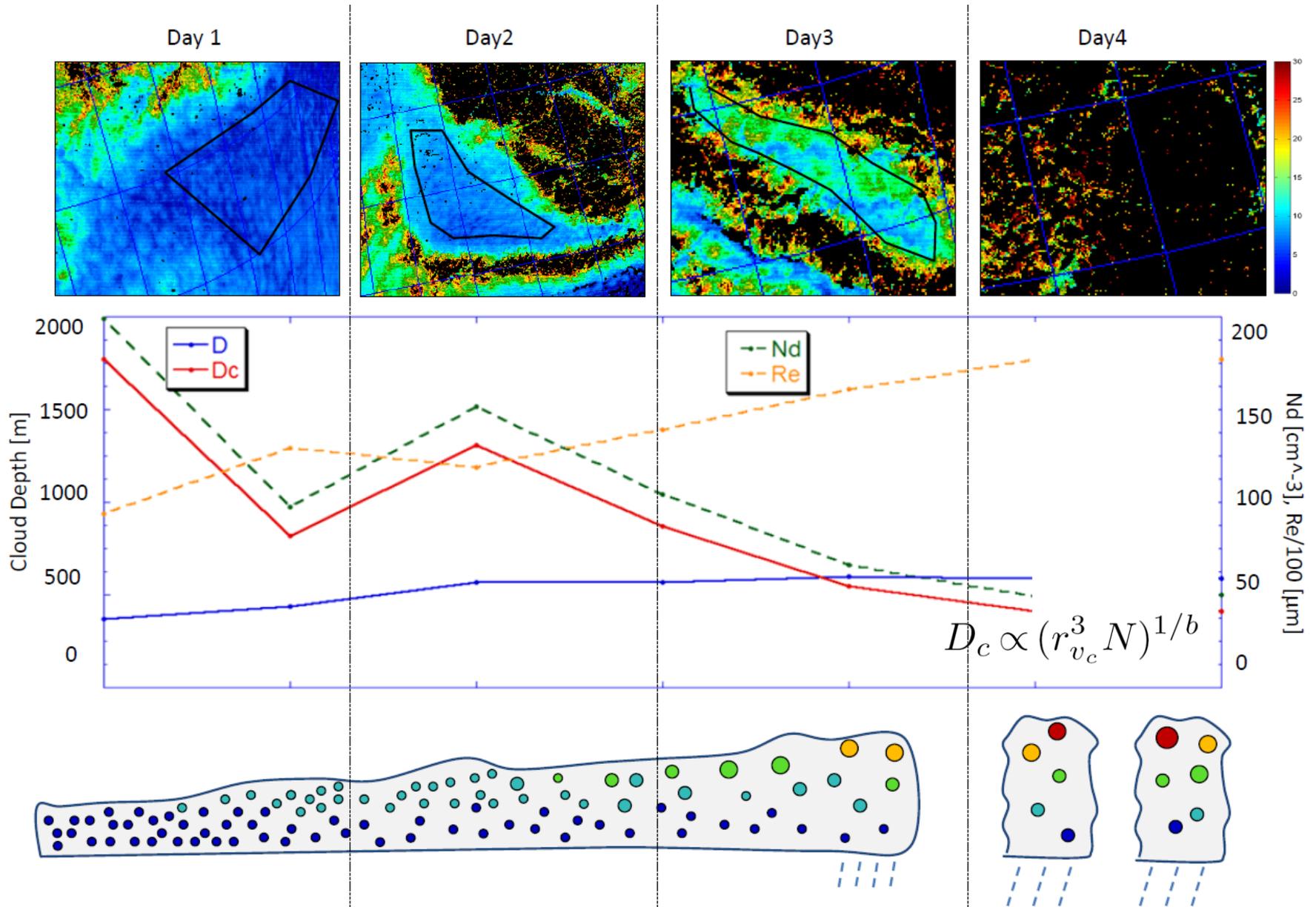
2010 January 29

16:12 UTC

Maritimization

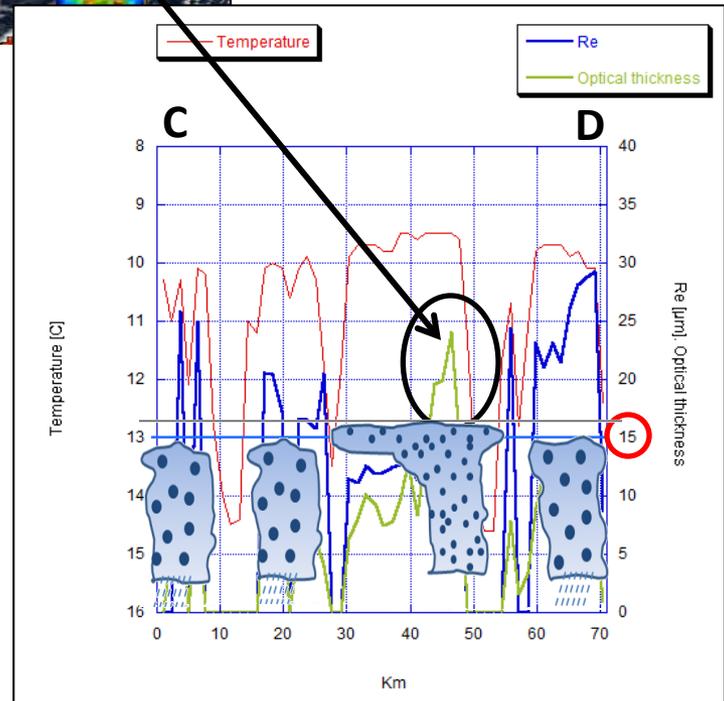
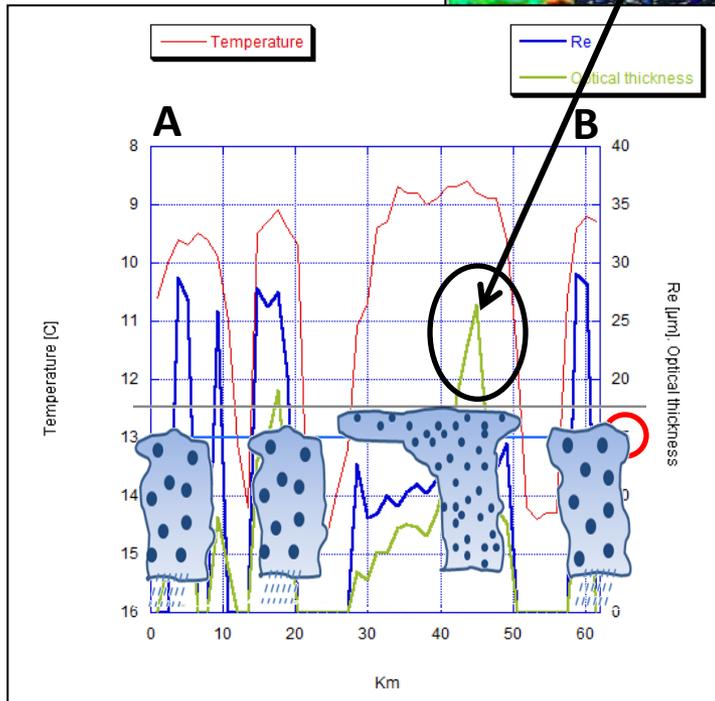
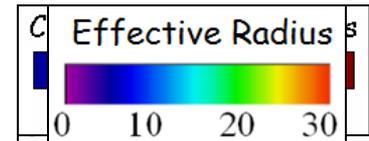
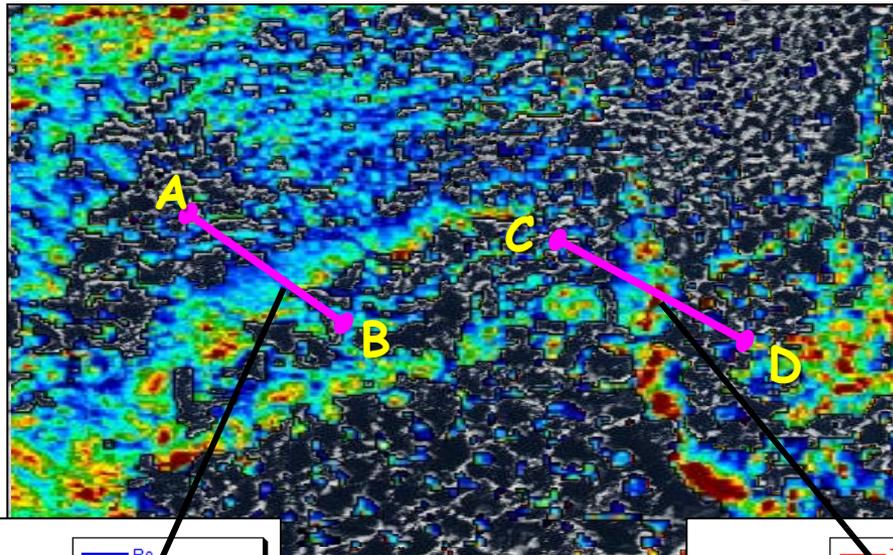


Maritimization



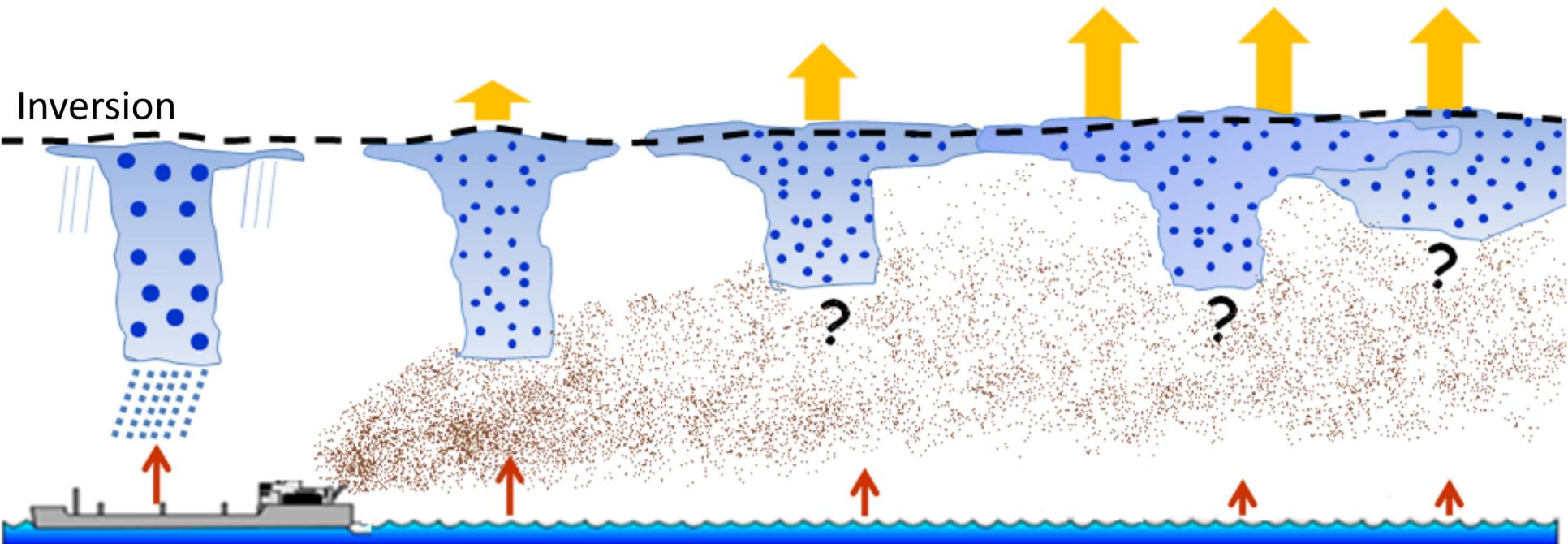
Can aerosols close open cells?

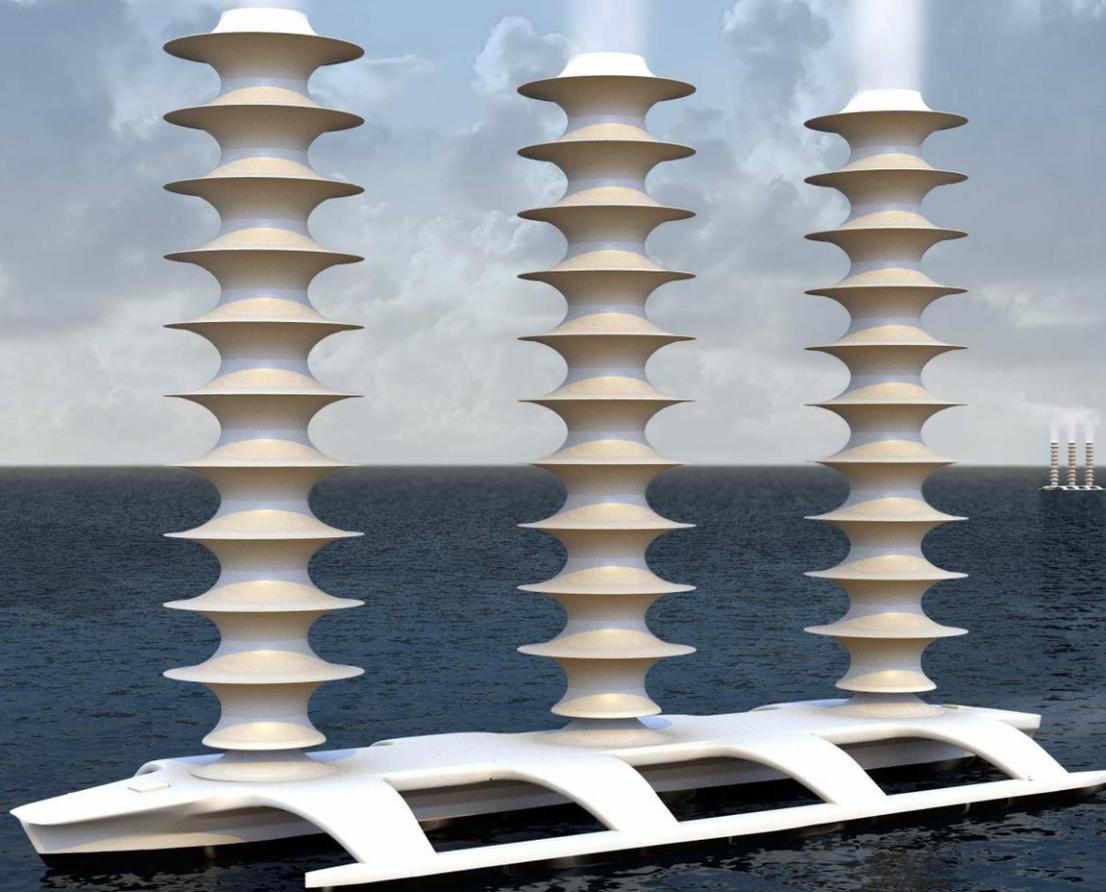
18/1/06 14:30 UTC
MODIS AQUA



Can aerosols close open cells?

18/1/06 14:30 UTC
MODIS AQUA



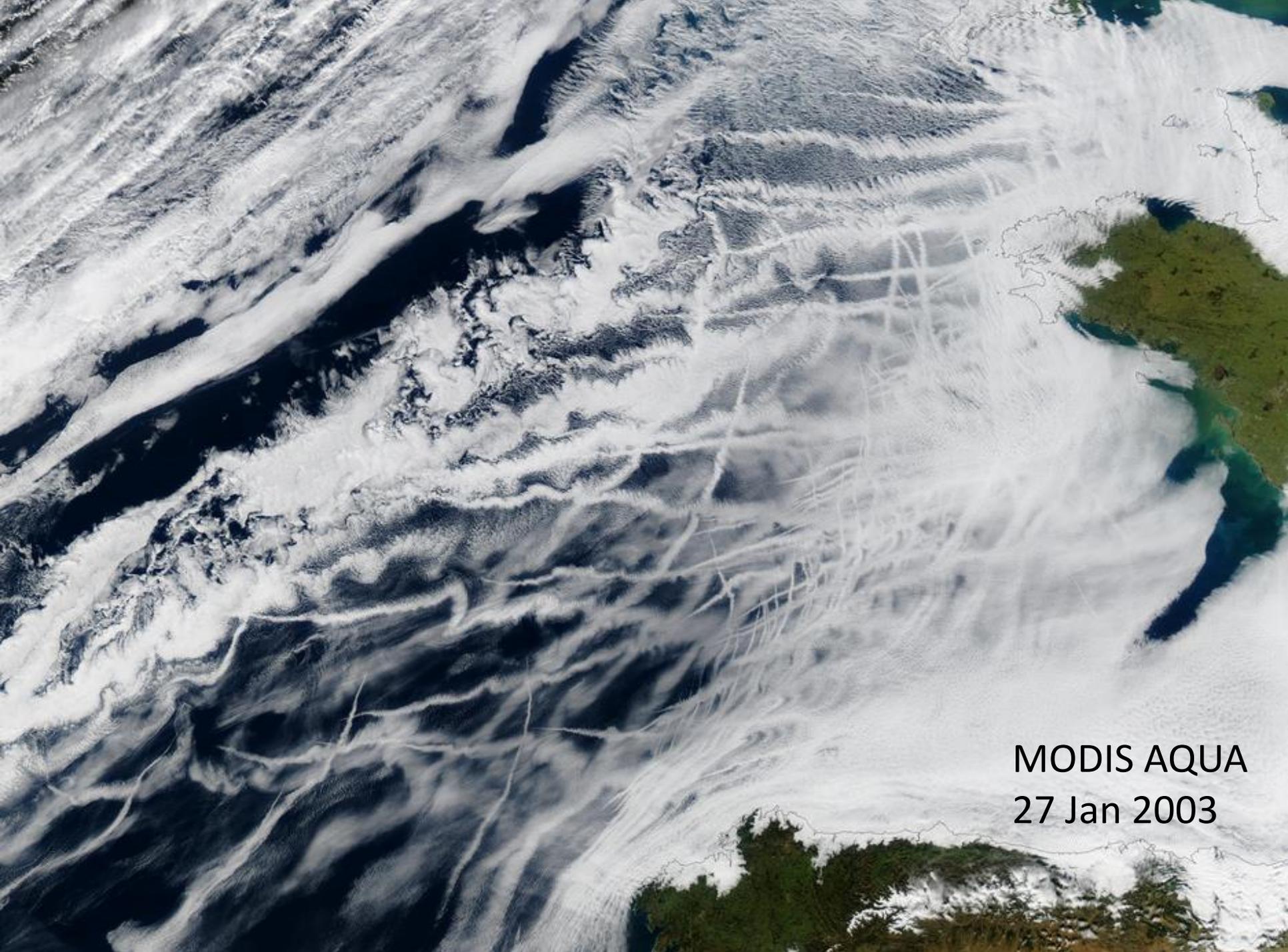


A seeding device of sub-micron sea salt particles, as illustrated and proposed by Salter and Latham in

http://www.mmm.ucar.edu/people/latham/files/cloud_albedo_spray_quantity_paper.pdf

Summary

1. On the transitions between open and closed cells a large change in cloud drop number concentrations and respective CCN are observed, incurring a differential RCE $> 100 \text{ w m}^{-2}$.
2. Only 26% s albedo effect, 32% LWP effect, and 43% cloud cover effect.
3. The ship tracks can close open cells over large areas. Then the CRE becomes CRF.
4. Continents in fact behave like huge ships in the ocean. Aerosols from land delay the opening of closed cells over large ocean areas.
5. This can potentially create vast closed cells areas which are presently not recognized as originated from aerosol perturbations.



MODIS AQUA
27 Jan 2003