Modélisation de Nawdex à méso-échelle: comparaison des effets diabatiques entre microphysique paramétrée et microphysique détaillée

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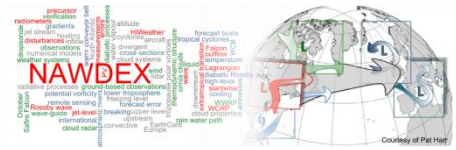


Objectif:

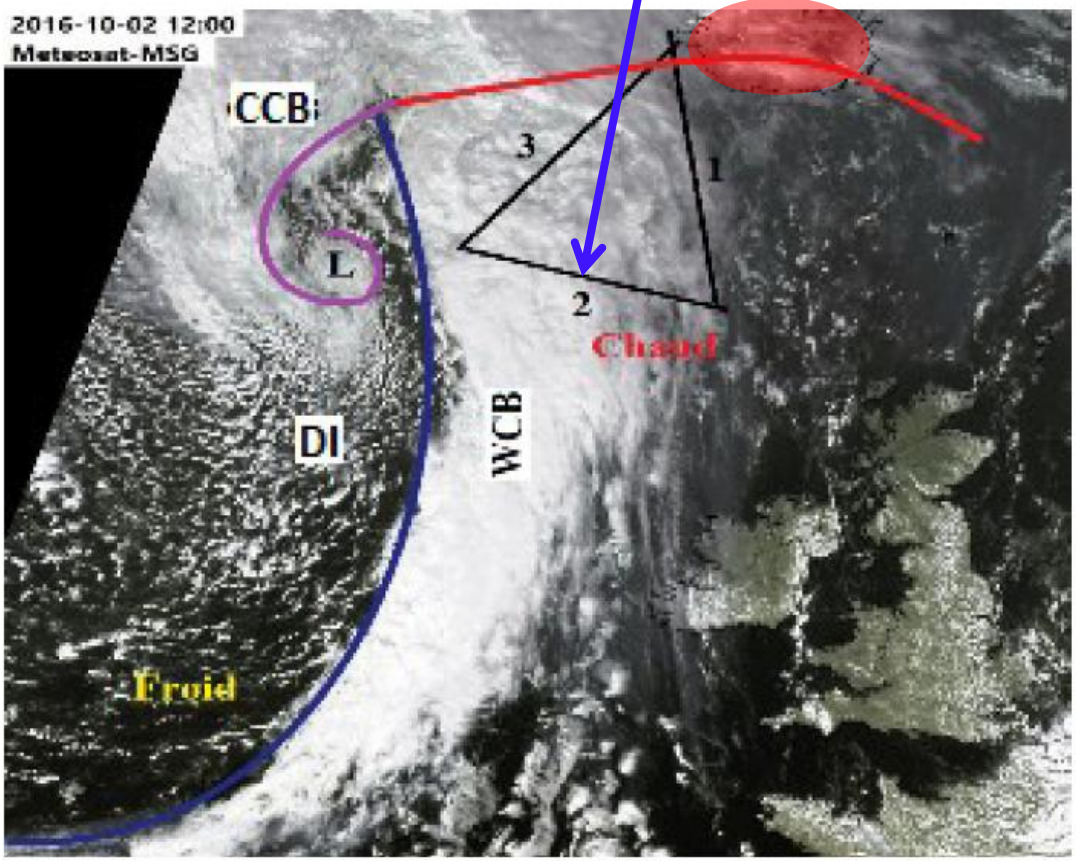
comparer les effets diabatiques résultant des différentes approches microphysiques (et radiatives)

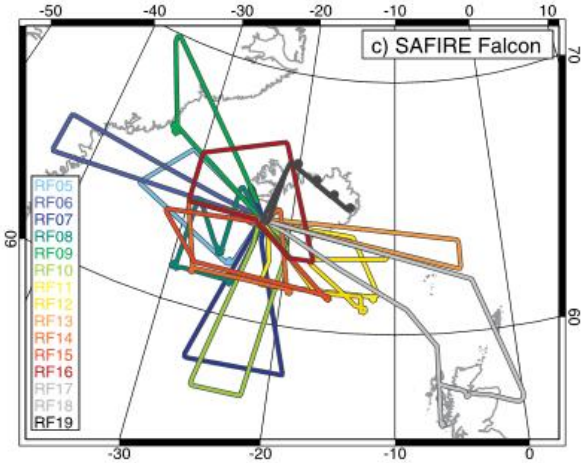
- avec microphysique explicite paramétrée
  (WRF + Thompson ou Morrison + RRTM)
- avec microphysique détaillée
  (modèle de Clark + DESCAM + RRTM)

Méthodologie:

- poursuivre l'évolution individuelle des parcelles d'air à l'aide des trajectoires (backward ou forward) et
- analyser le taux de réchauffement/refroidissement dû à la condensation/évaporation, déposition/ sublimation, givrage et fonte des hydrométéores

Case study: 2nd October 2016





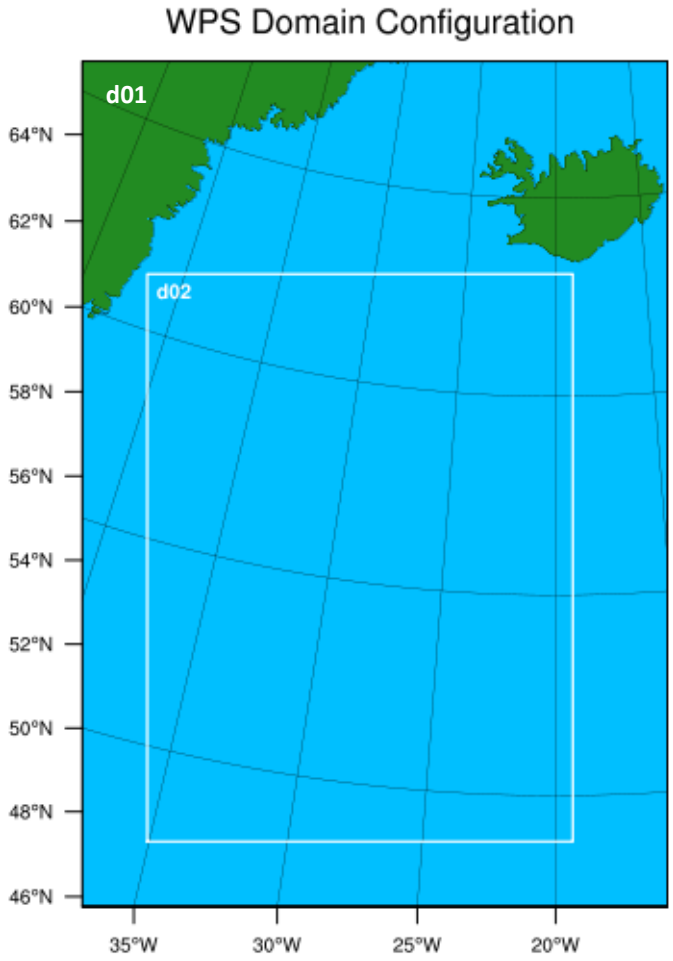
From A. Schäfler et al. (2018, BAMS)

Fig. 6. Image issue du satellite MSG le 02/10/2016 à 1200 UTC.

Le trajet de l'avion est représenté par le tracé en noir avec le segment 1 de 1300 à 1430 UTC, le segment 2 de 1430 à 1515 UTC et le segment 3 de 1515 à 1600 UTC. Le front froid est tracé en bleu, le front chaud en rouge, le front occlus en violet. Le symbole L montre le centre de la tempête.

From Nicolas Blanchard's master thesis

Model set-up (WRF)



- Case study: 2nd October 2016
- 2 nested domains with increasing horizontal resolution (d01 = 16 km, d02 = 4 km)
- Number of grid points:

  100 x 144 for d01

  289 x 355 for d02
- Non-equidistant vertical grid with 72 levels
- Initial time: 02/10/16 at 00:00 UTC
- Forcing data: ECMWF ERA-Interim reanalysis
- Simulation duration: 18 hours

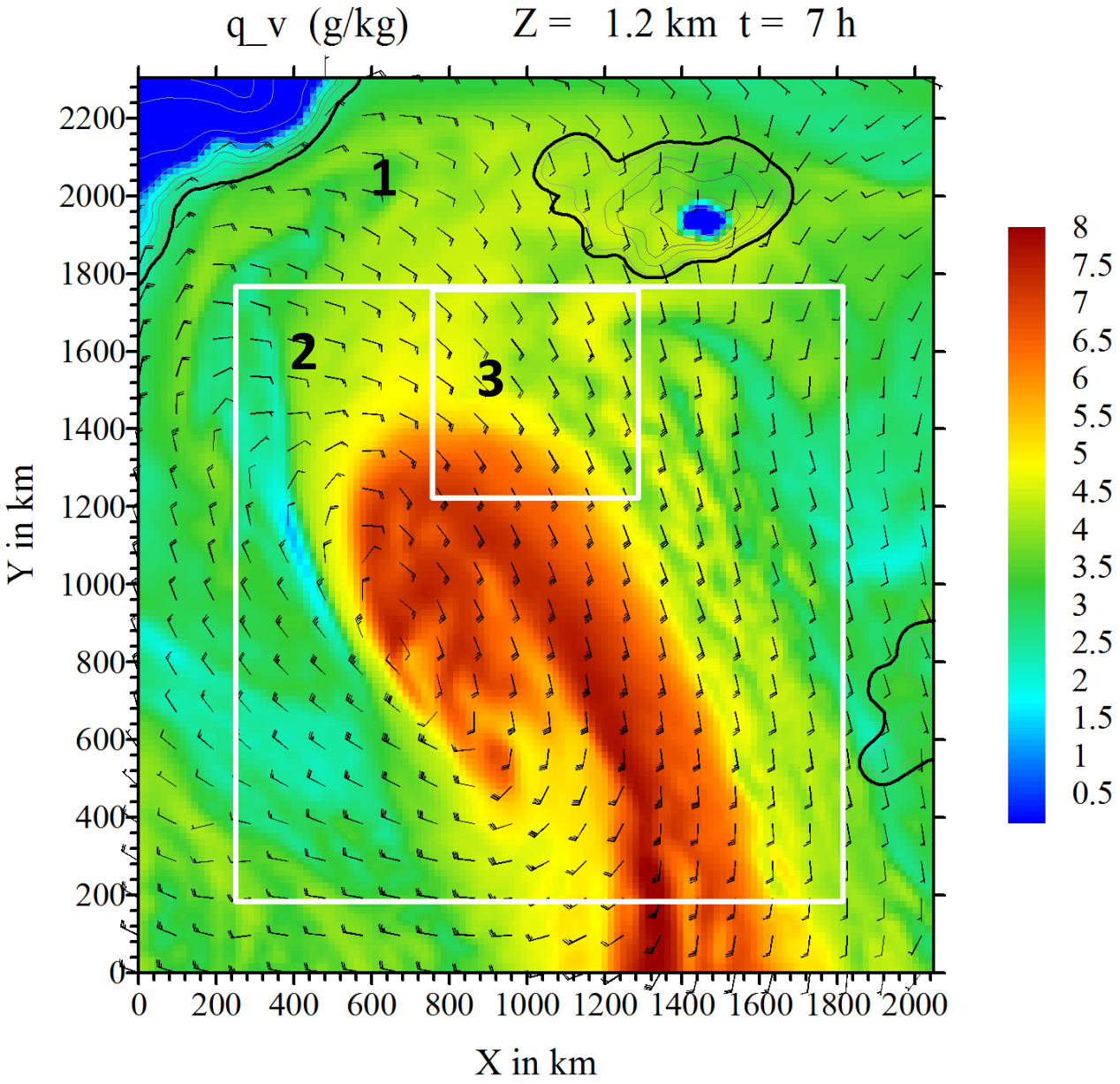
Model set-up (DESCAM)

Outmost domain:
16 km, 128 x 144 points

2nd domain:
4 km, 384 x 384 points

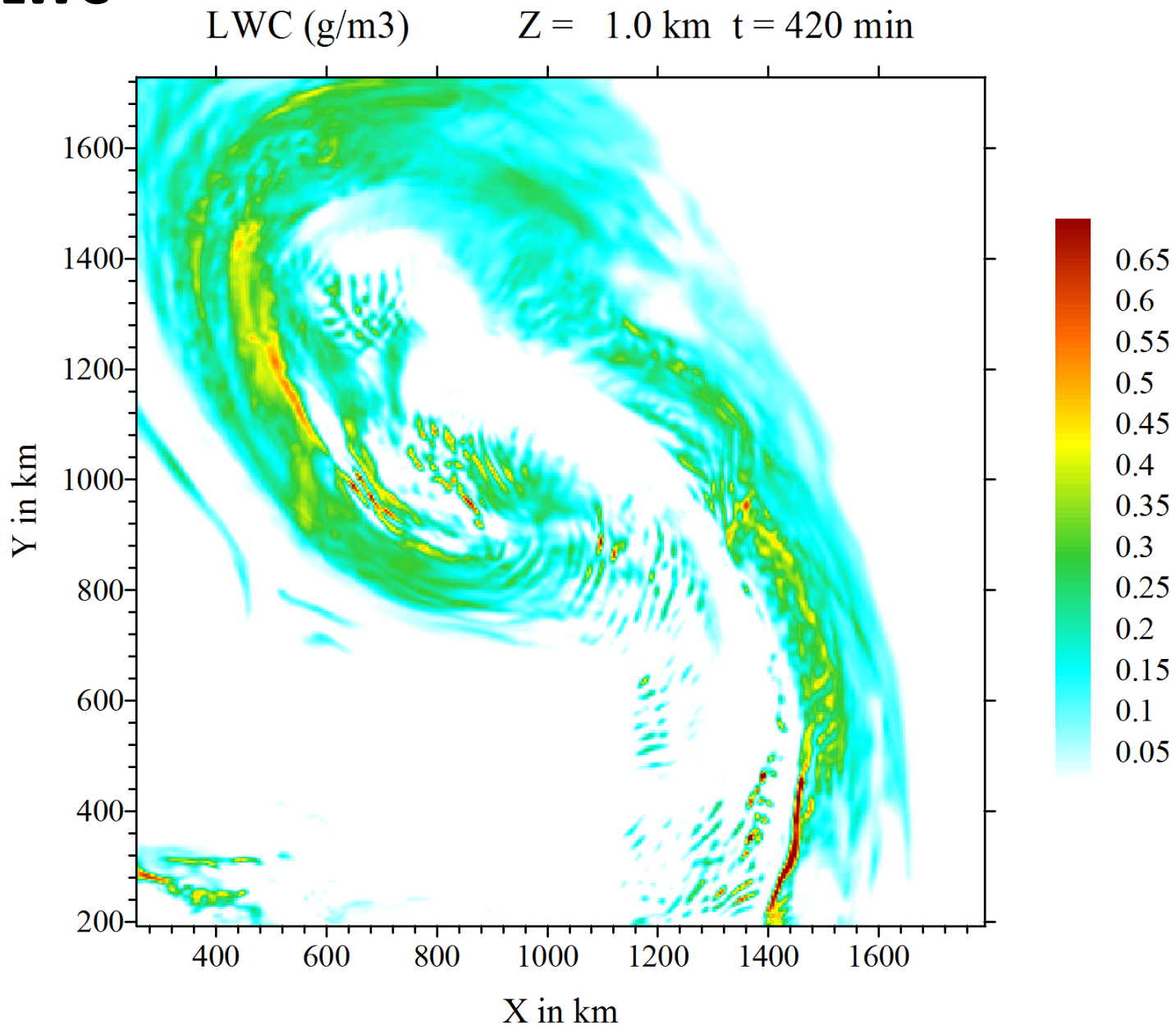
innermost domain:
1 km, 384 x 384 points

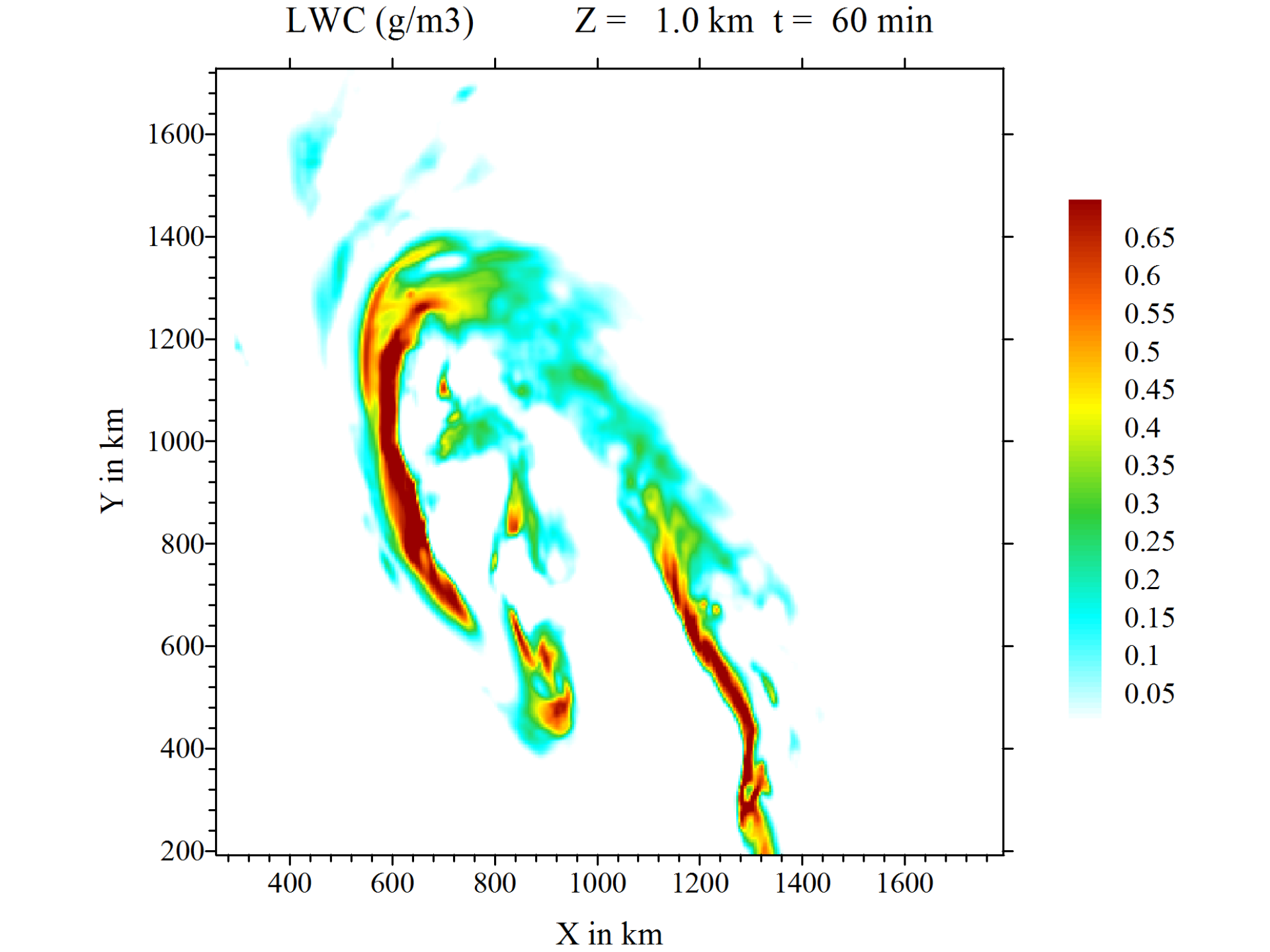
First tests with IFS and ERA:
IFS: start 0h 2 oct 2016
ERA: start 6h



Simulation of LWC in domain 2 from 6 – 14 h

DESCAM




LWC (g/m3)
Z = 1.0 km t = 60 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
400
600
800
1000
1200
1400
1600
0.65
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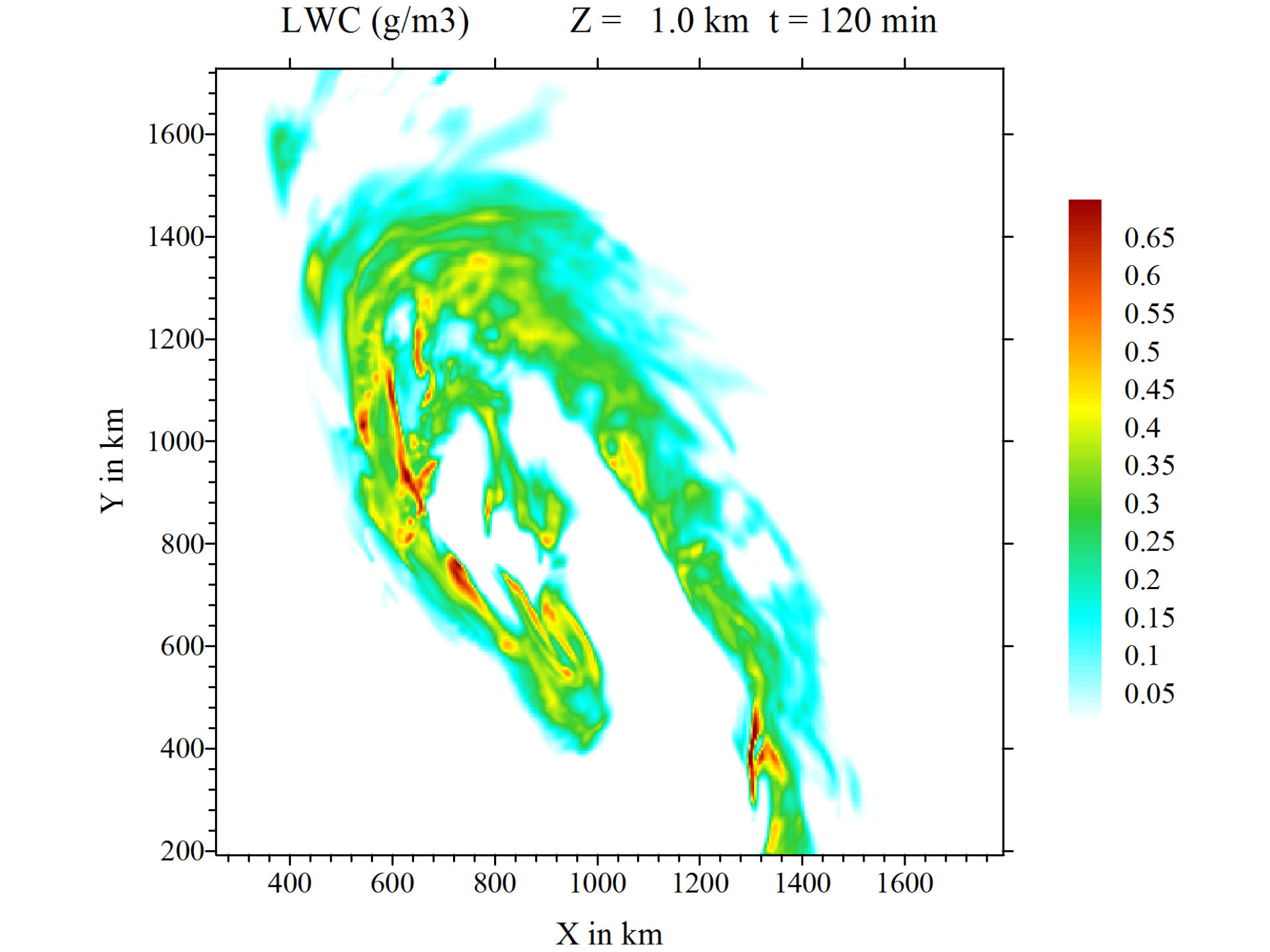
0.05


LWC (g/m3)
Z = 1.0 km t = 120 min
Y in km
X in km
200
400
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0.65
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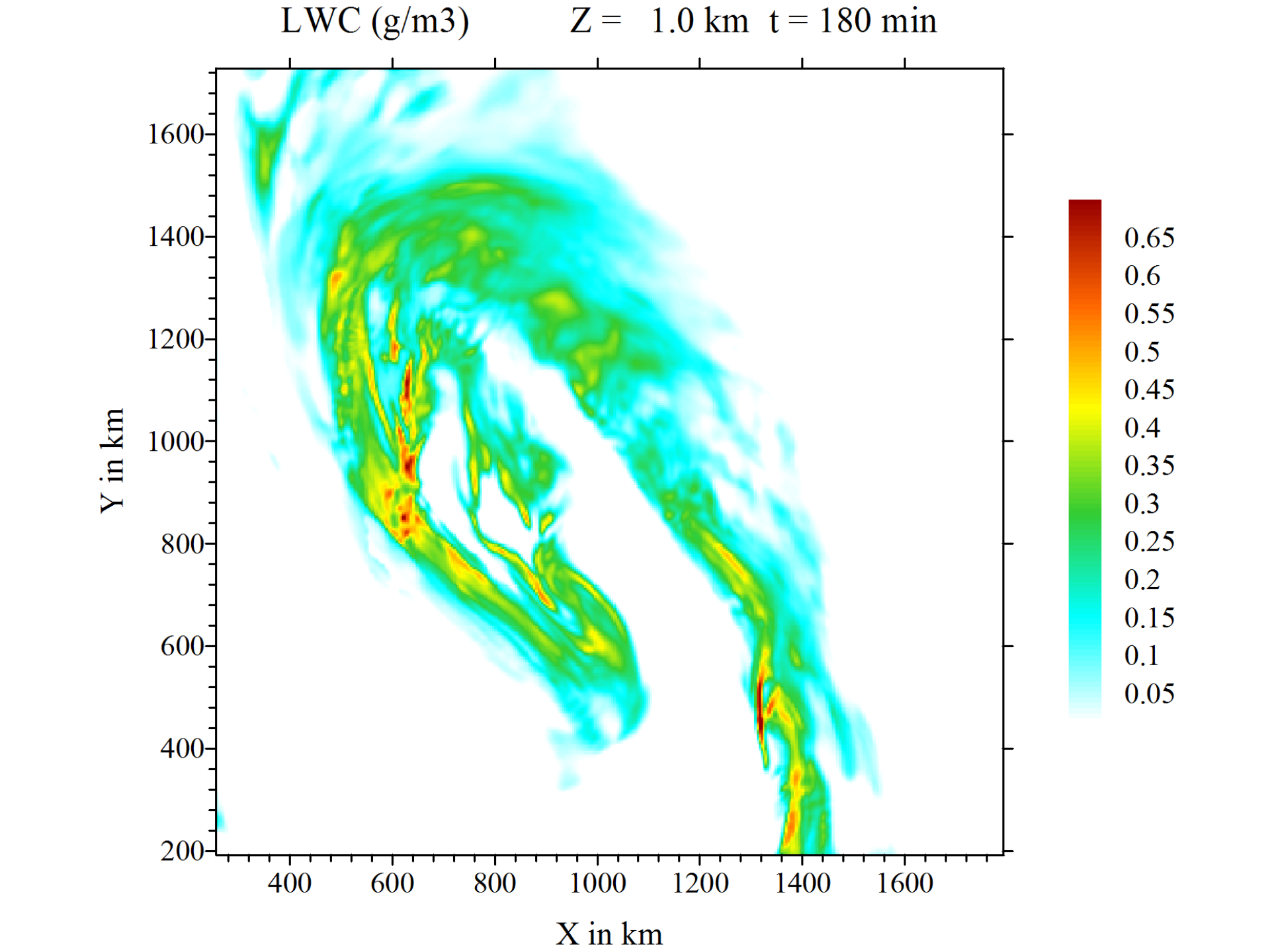
LWC (g/m3)
Z = 1.0 km t = 180 min
Y in km
X in km
200
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0.65
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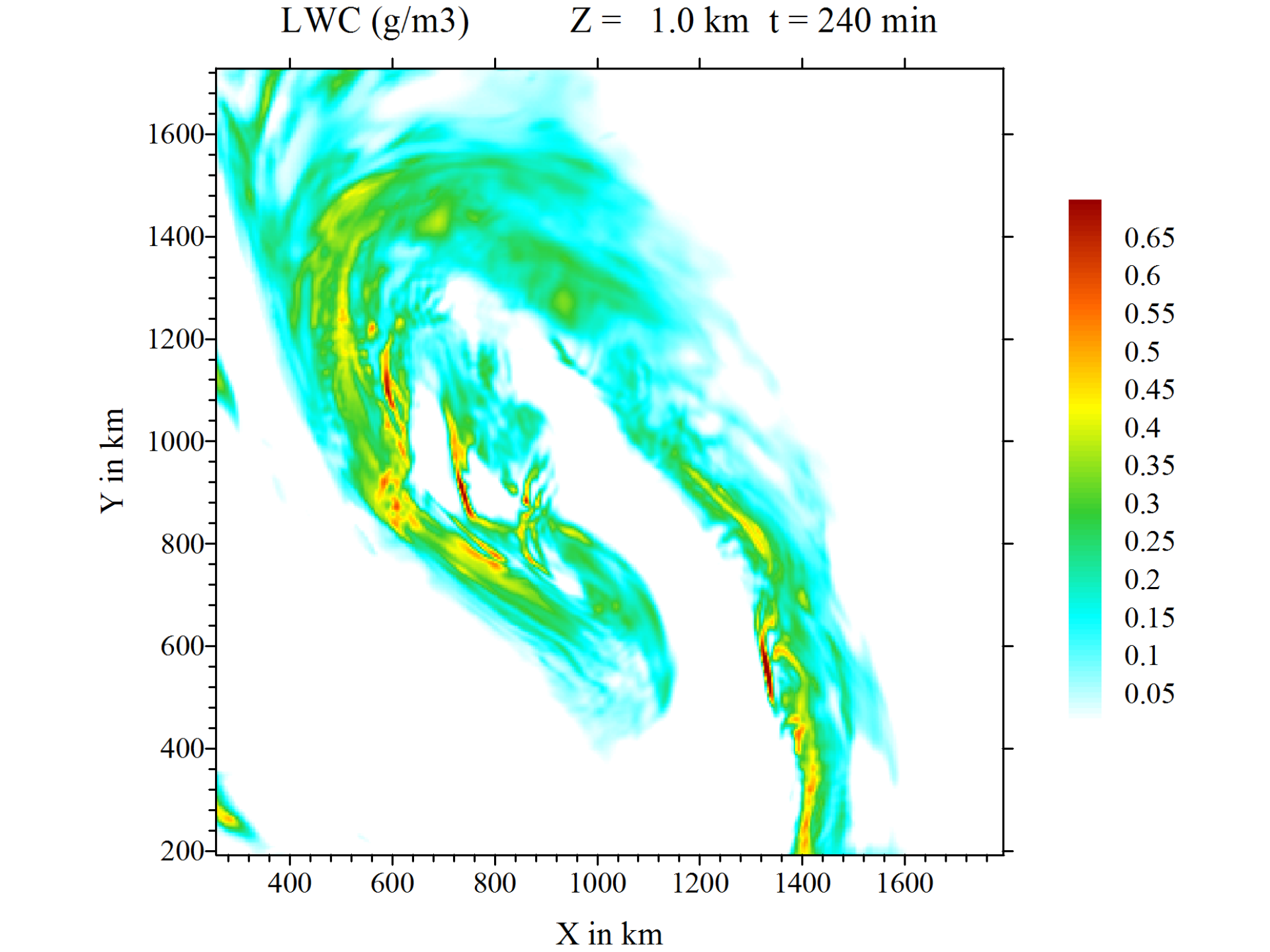
LWC (g/m3)
Z = 1.0 km t = 240 min
Y in km
X in km
200
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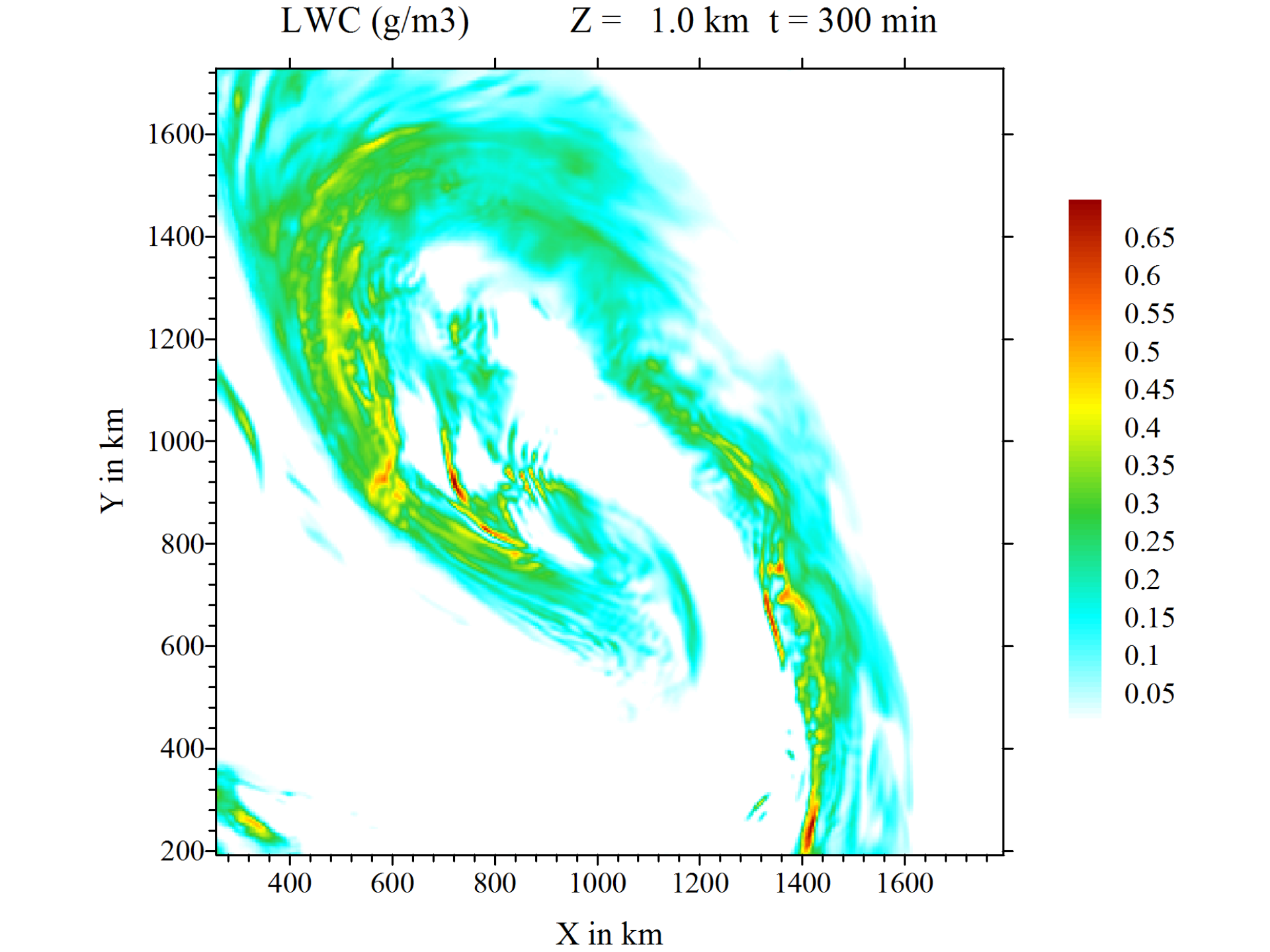
LWC (g/m3)
Z = 1.0 km t = 300 min
Y in km
X in km
200
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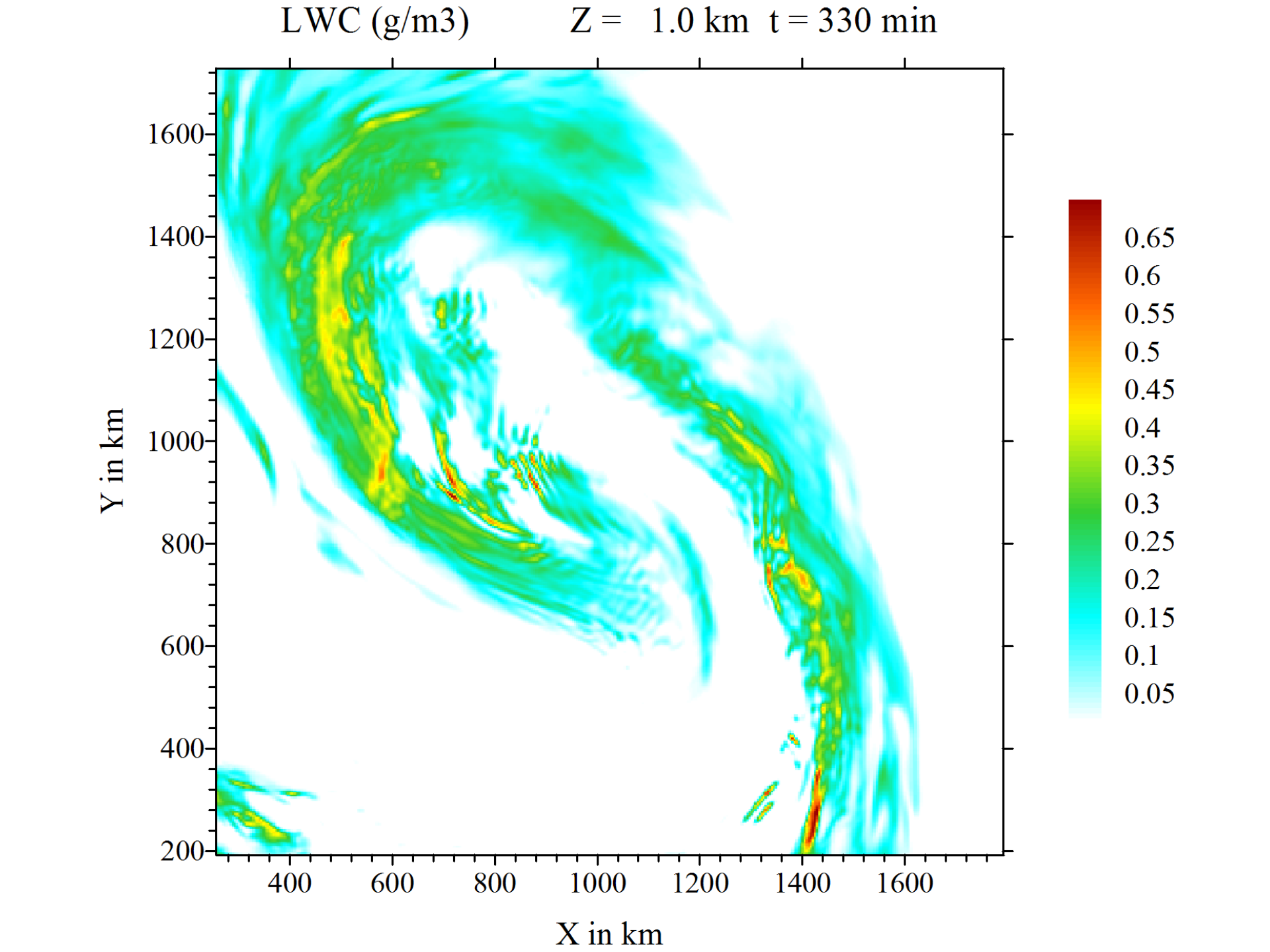
LWC (g/m3)
Z = 1.0 km t = 330 min
Y in km
X in km
200
400
600
800
1000
1200
1400
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1200
1400
1600
0.65
0.6
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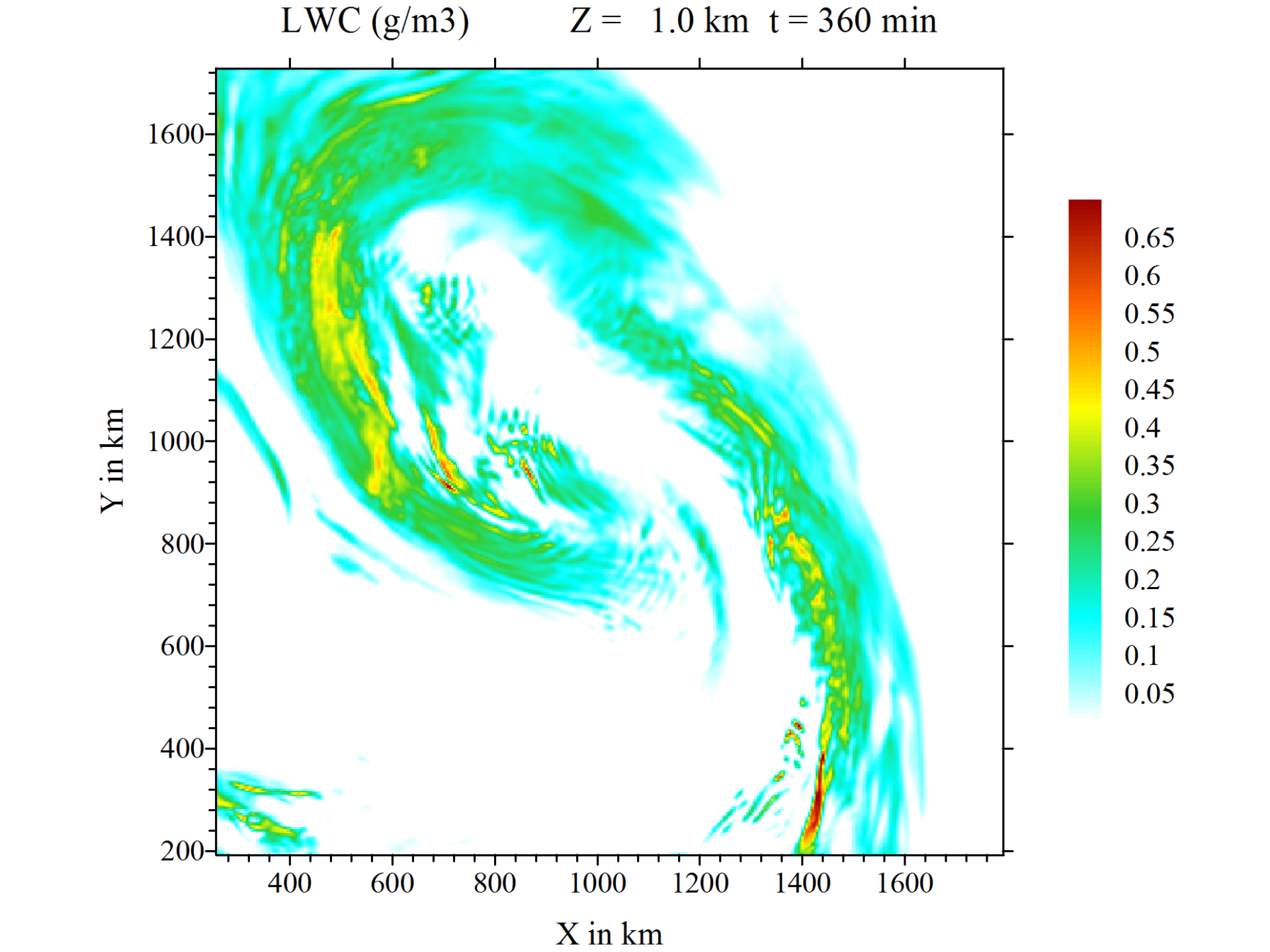
LWC (g/m3)
Z = 1.0 km t = 360 min
Y in km
X in km
200
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0.65
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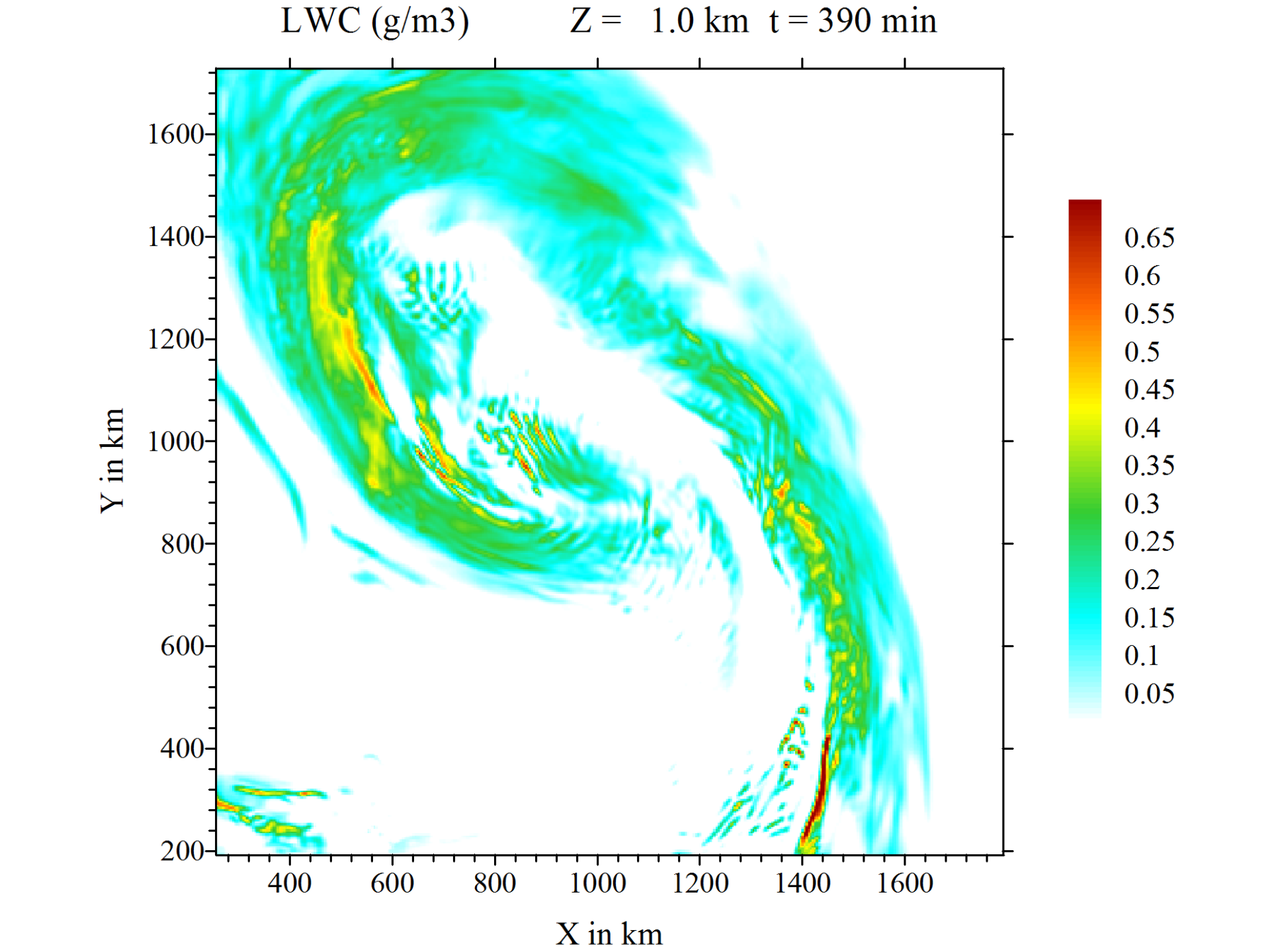
LWC (g/m3)
Z = 1.0 km t = 390 min
Y in km
X in km
200
400
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1200
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1600
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1000
1200
1400
1600
0.65
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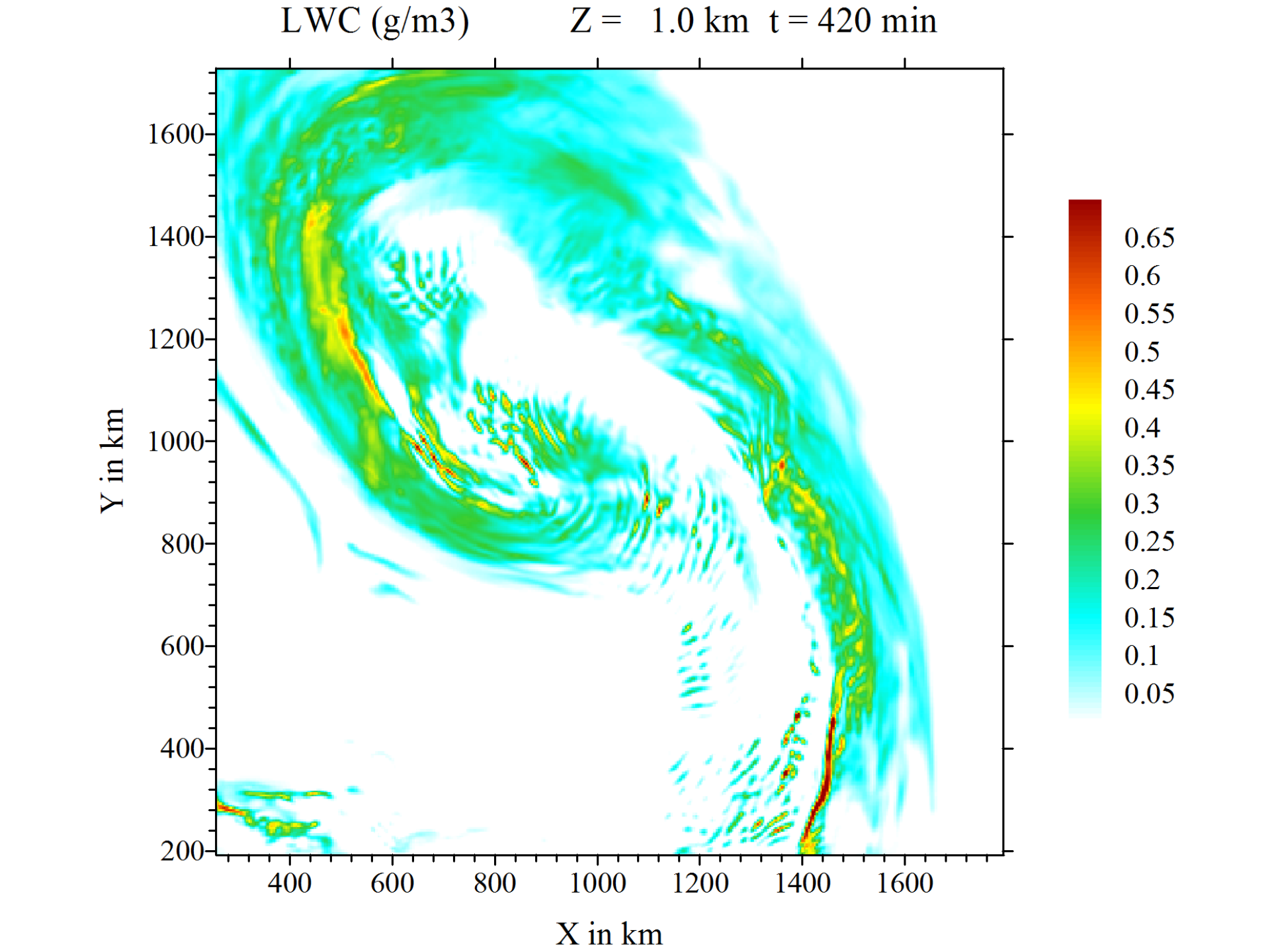
0.15
0.1
0.05


LWC (g/m3)
Z = 1.0 km t = 420 min
Y in km
X in km
200
400
600
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1000
1200
1400
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400
600
800
1000
1200
1400
1600
0.65
0.6
0.55
0.5
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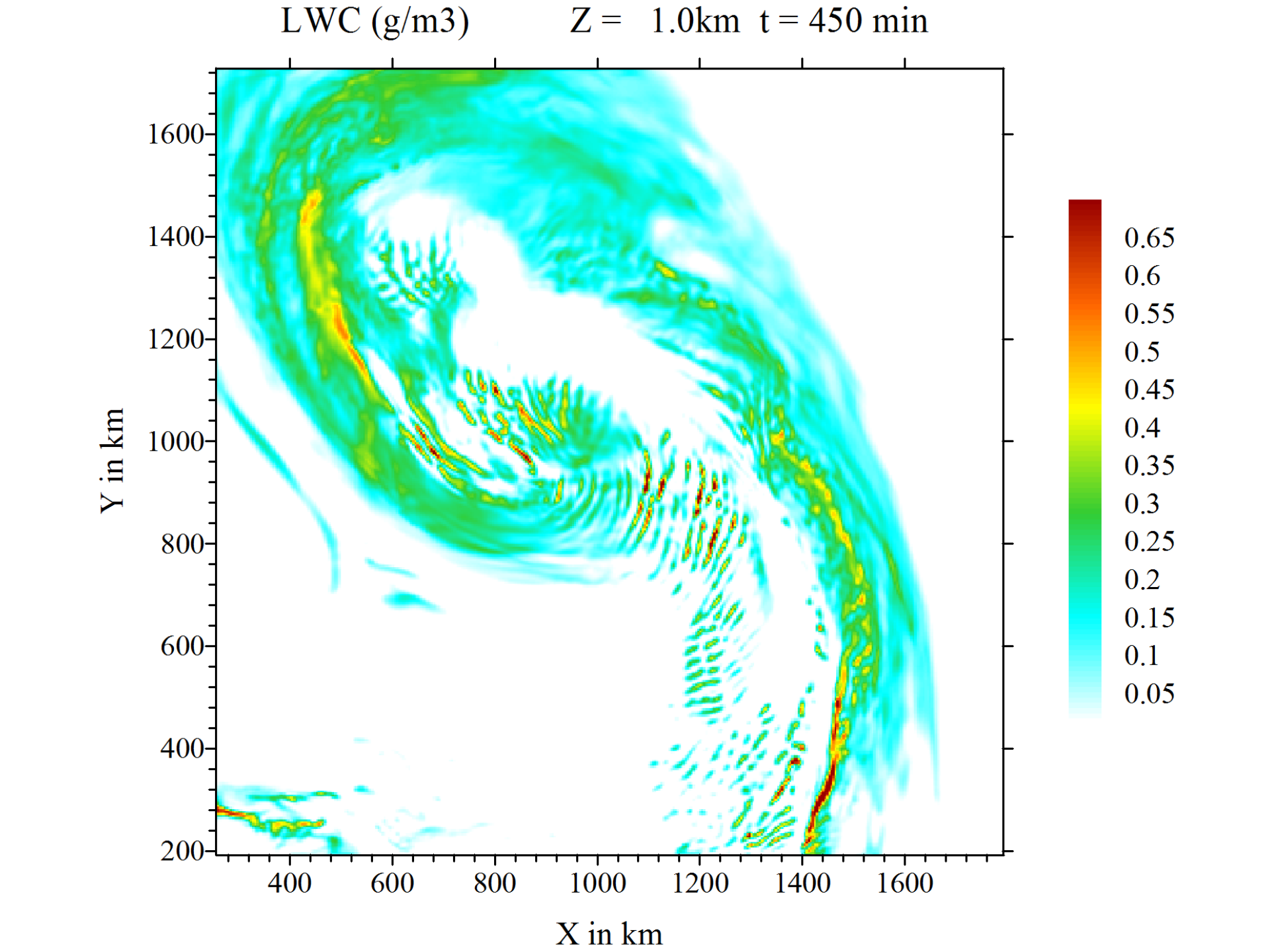
0.25
0.2
0.15
0.1
0.05


LWC (g/m3)
Z = 1.0km t = 450 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
400
600
800
1000
1200
1400
1600
0.65
0.6
0.55
0.5
0.45
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0.2
0.15
0.1
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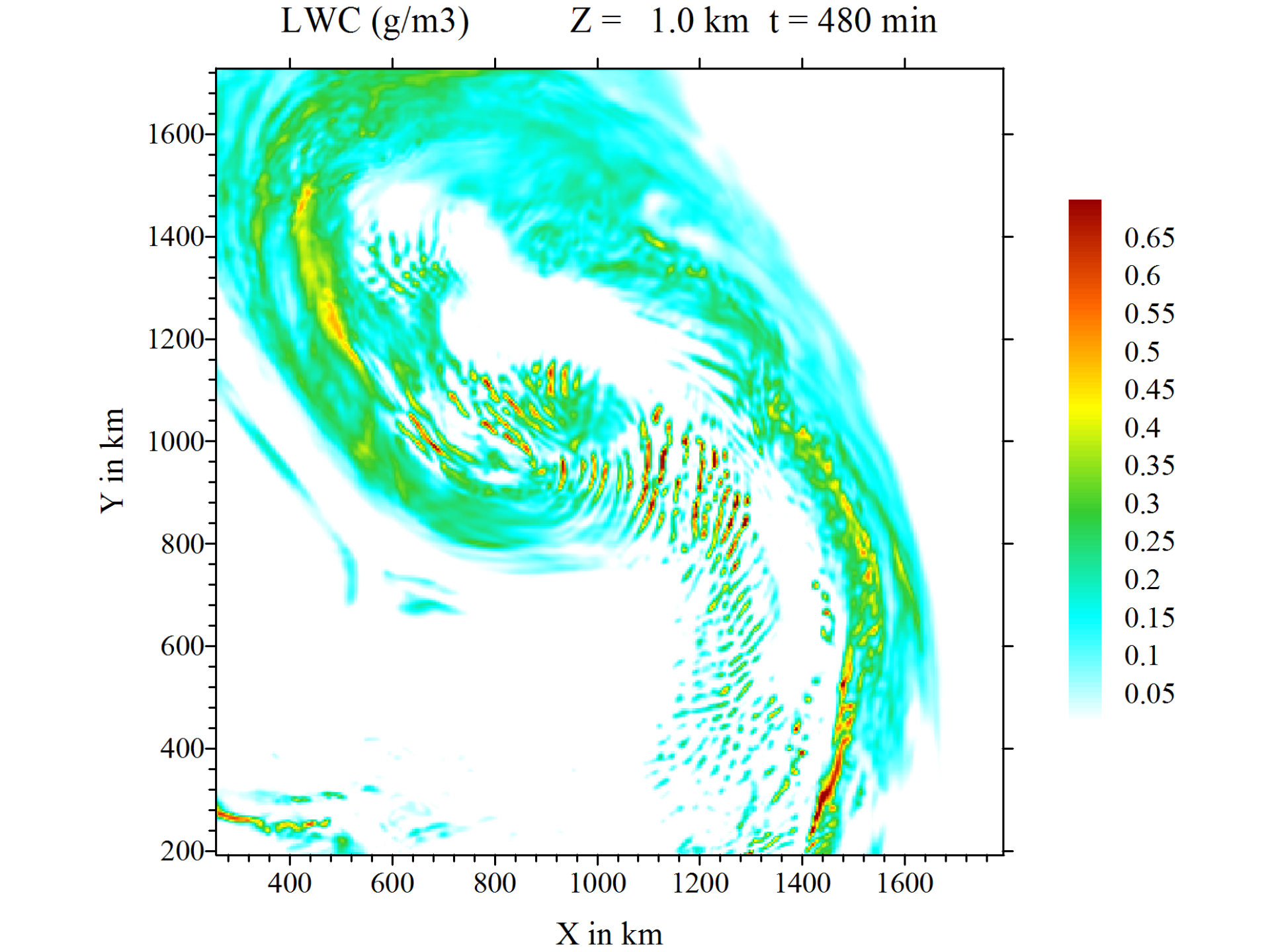
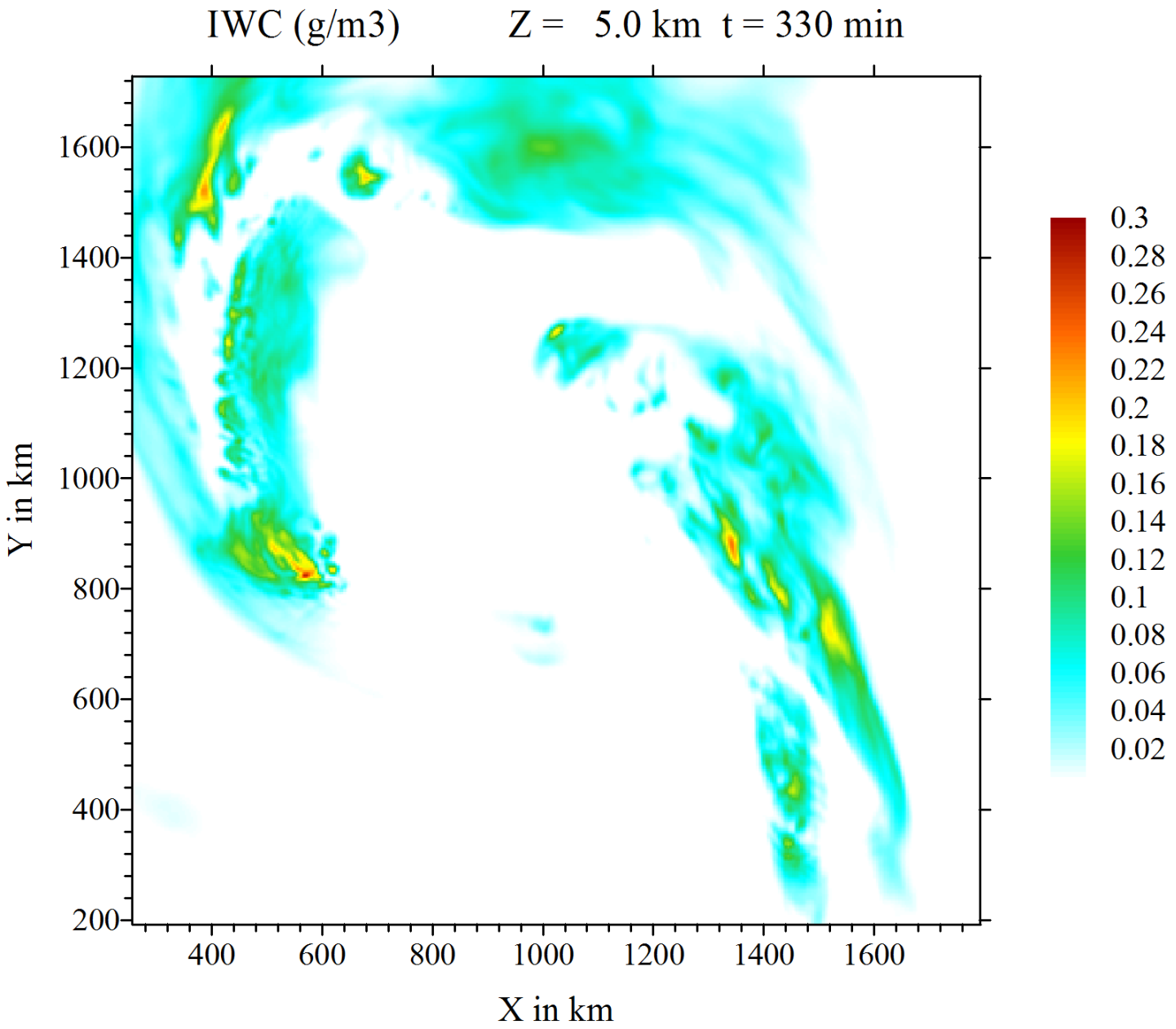
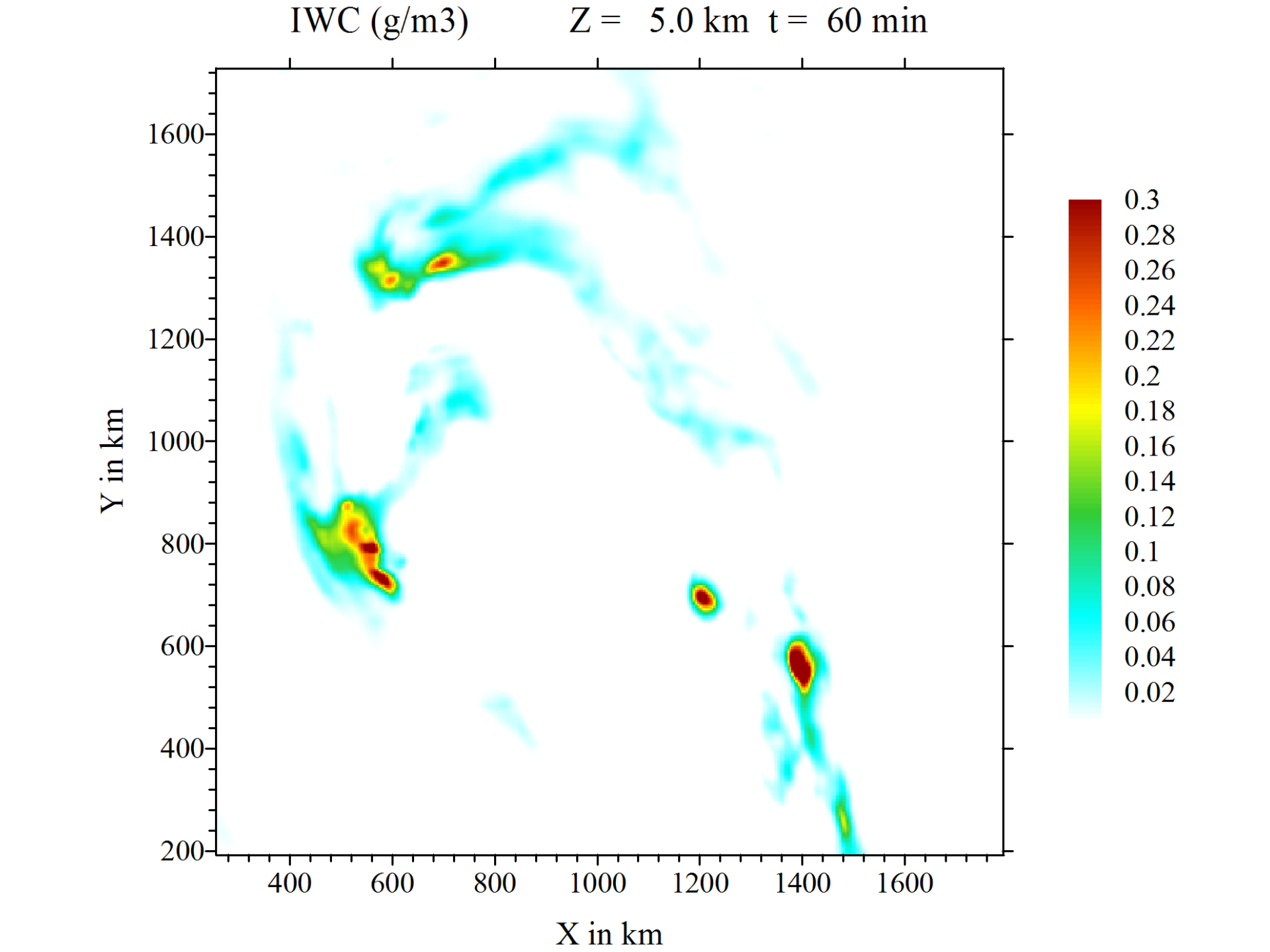
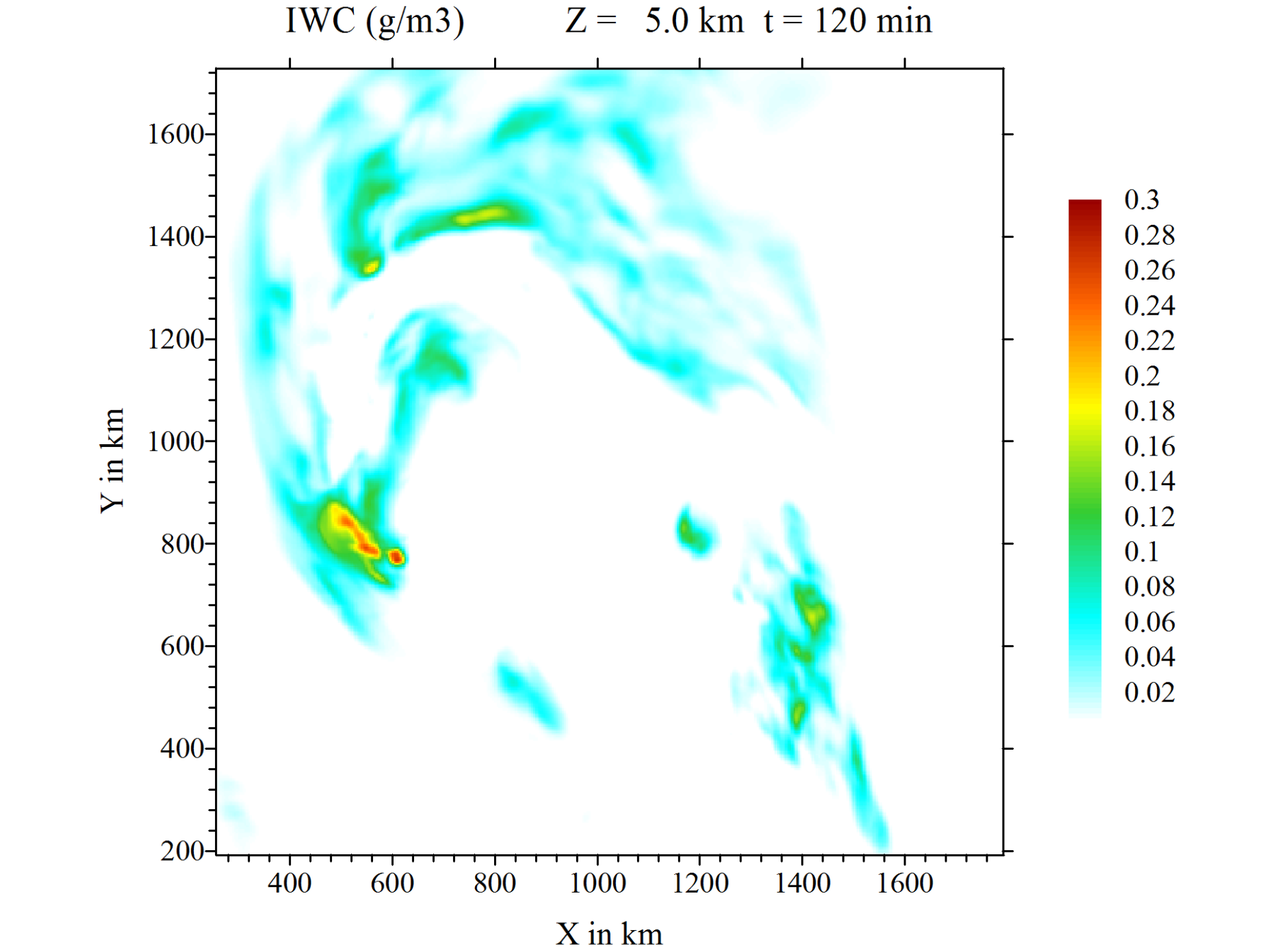

LWC (g/m3)
Z = 1.0 km t = 480 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
400
600
800
1000
1200
1400
1600
0.65
0.6
0.55
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05

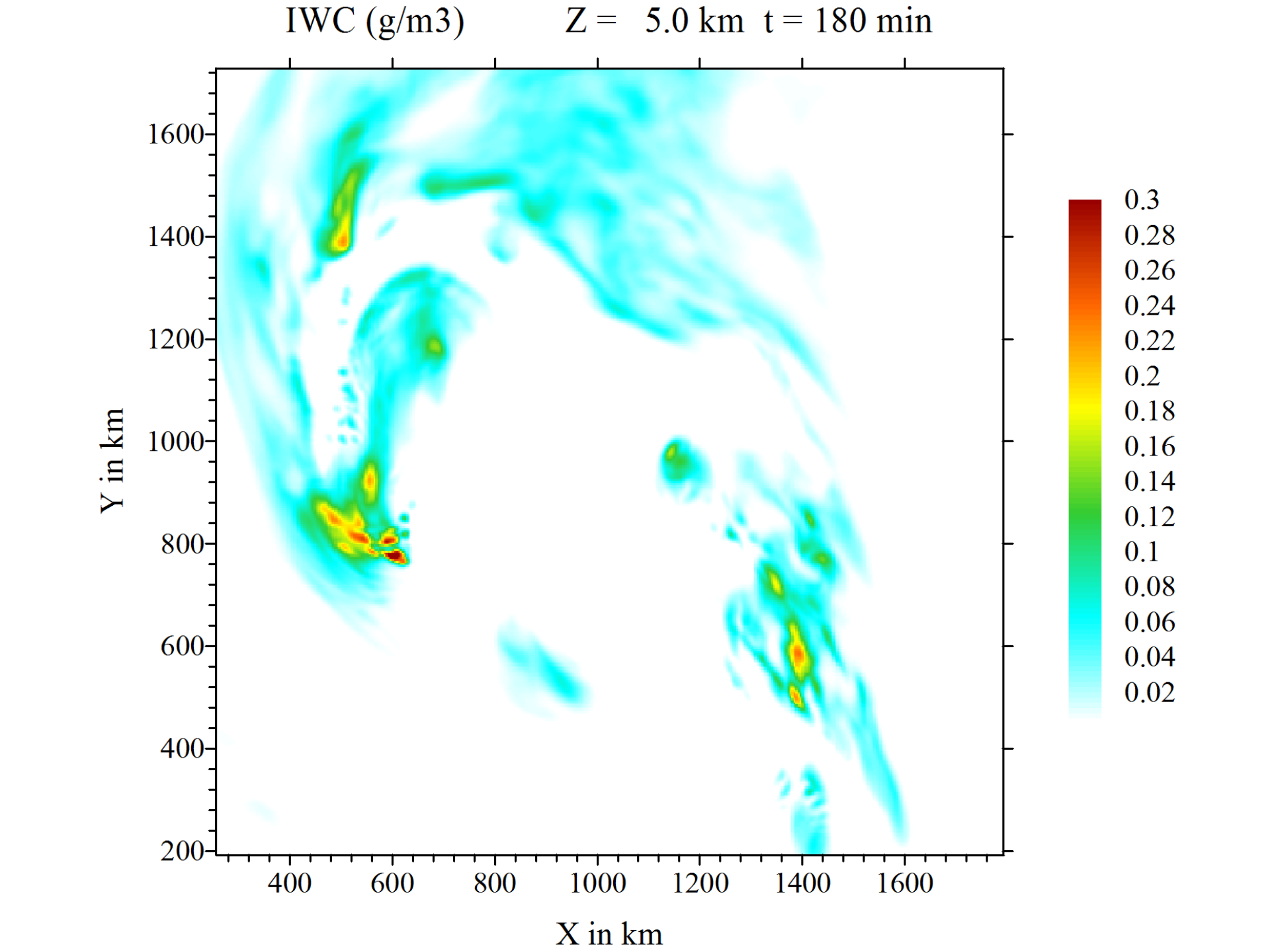
Simulation of IWC in domain 2 from 6 – 14 h

DESCAM




IWC (g/m3)
Z = 5.0 km t = 60 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02


IWC (g/m3)
Z = 5.0 km t = 120 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
0.3
0.28
0.26
0.24
0.22
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02


IWC (g/m3)
Z = 5.0 km t = 180 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
0.3
0.28
0.26
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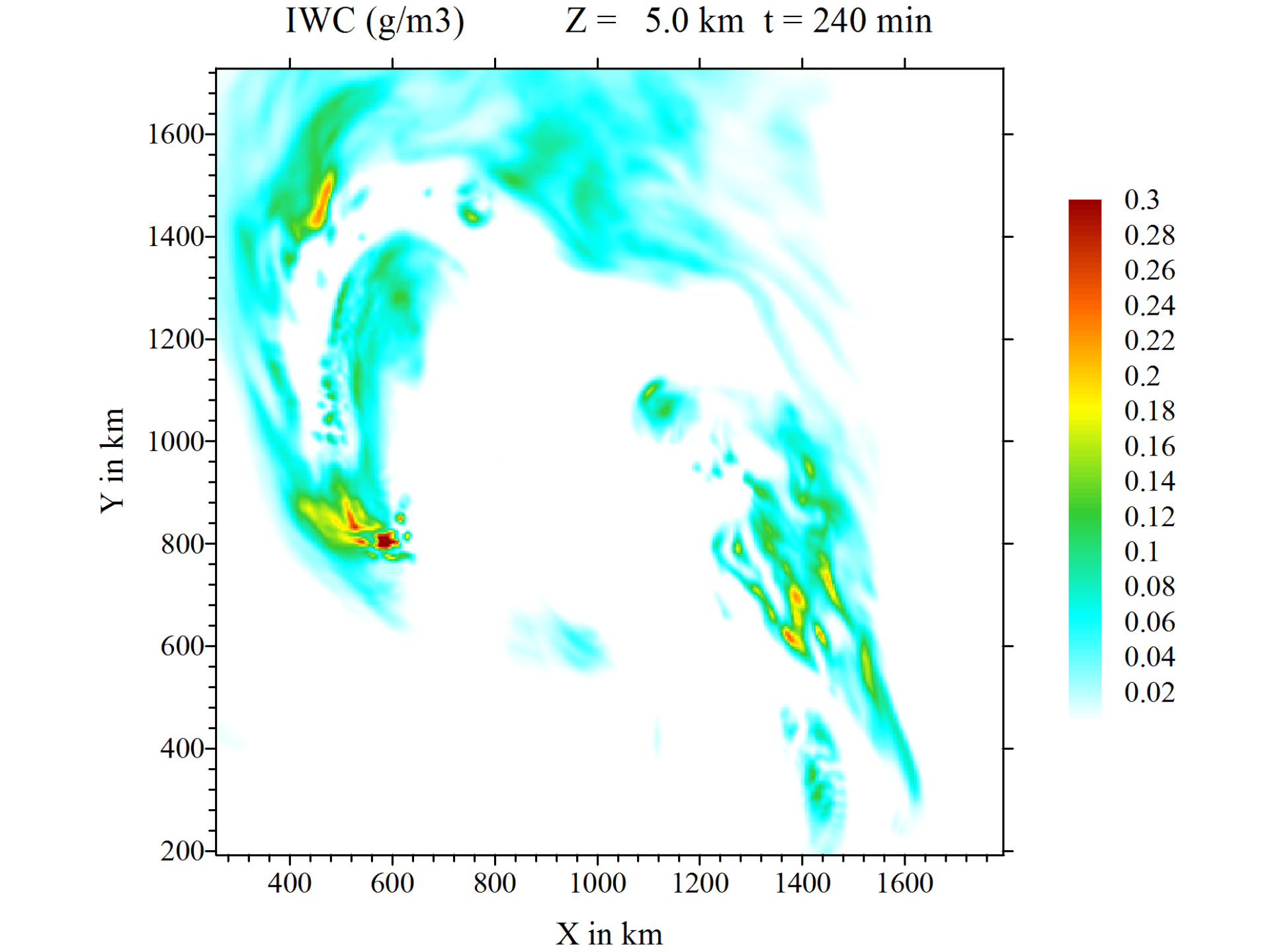
IWC (g/m3)
Z = 5.0 km t = 240 min
Y in km
X in km
200
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800
1000
1200
1400
1600
0.3
0.28
0.26
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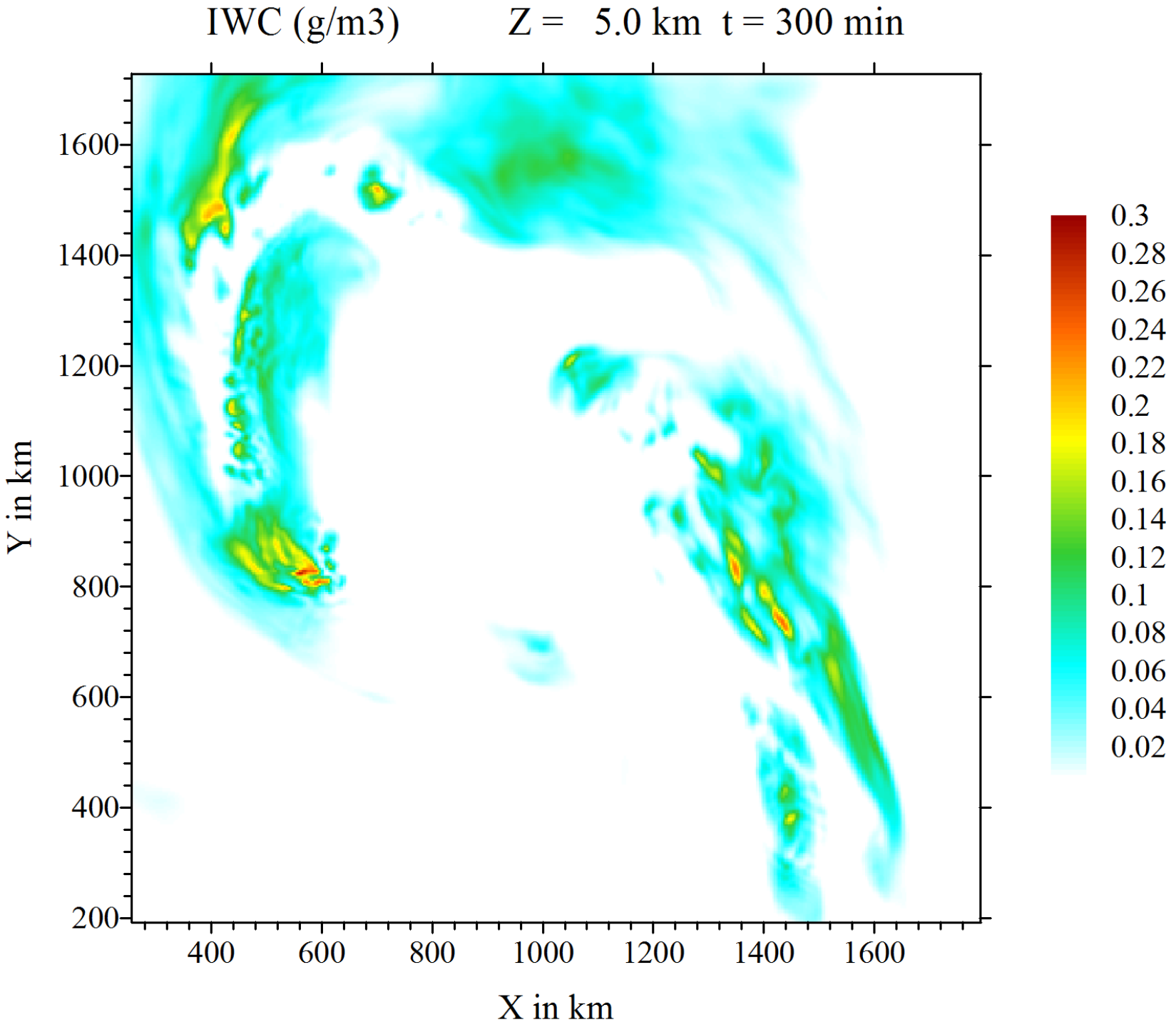
IWC (g/m3)
Z = 5.0 km t = 300 min
Y in km
X in km
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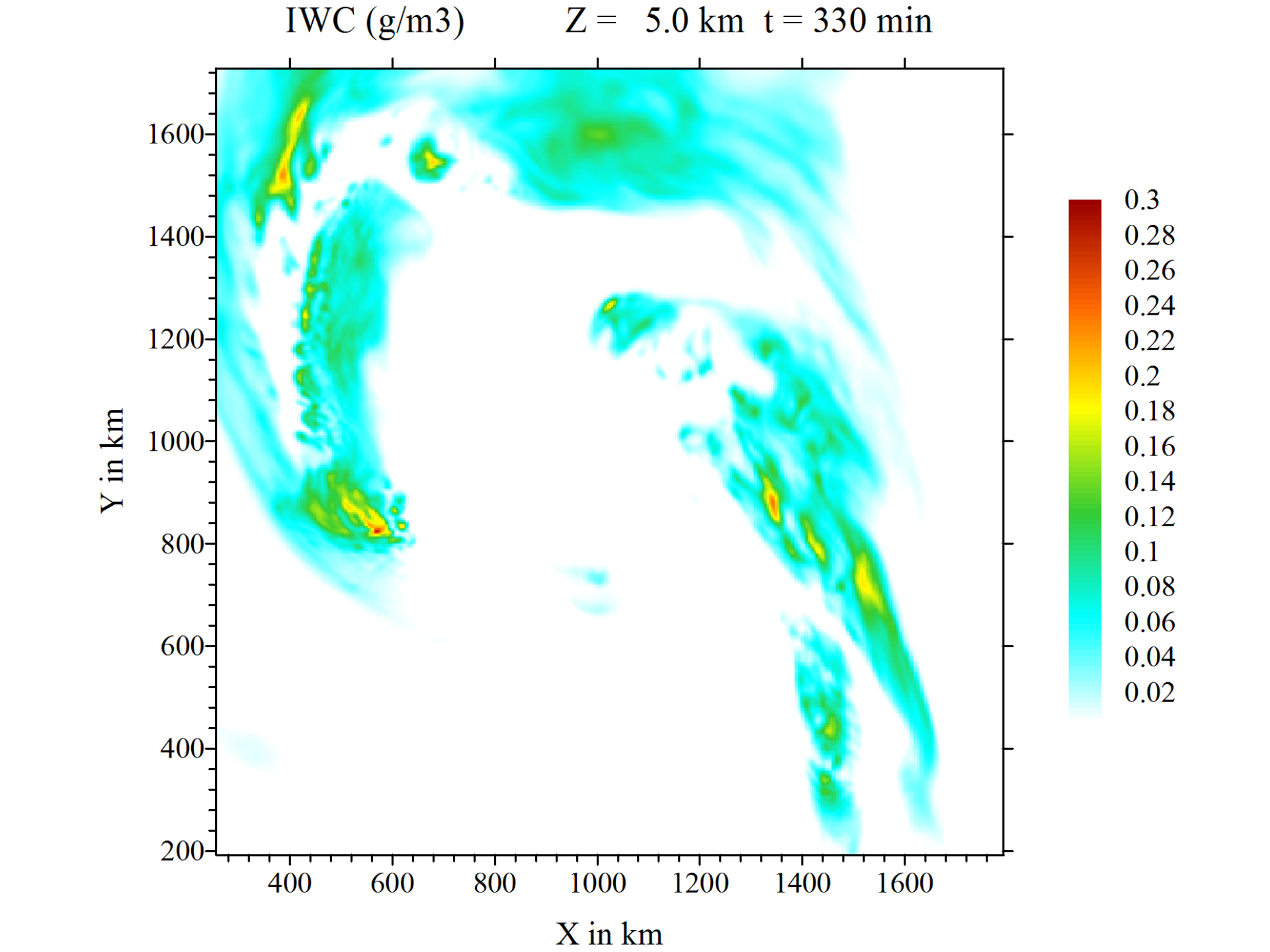
IWC (g/m3)
Z = 5.0 km t = 330 min
Y in km
X in km
200
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0.08
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0.04
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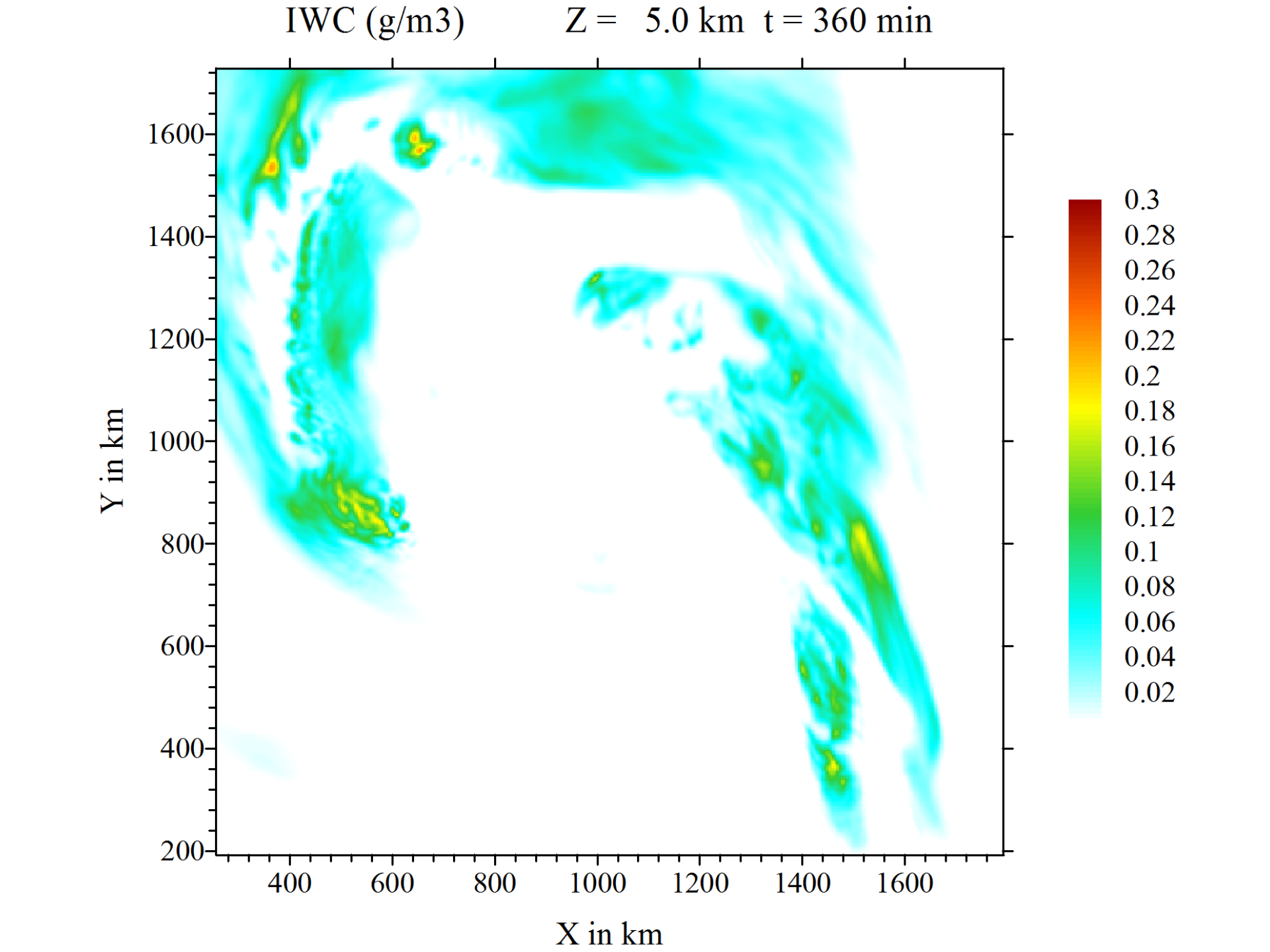
IWC (g/m3)
Z = 5.0 km t = 360 min
Y in km
X in km
200
400
600
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1200
1400
1600
0.3
0.28
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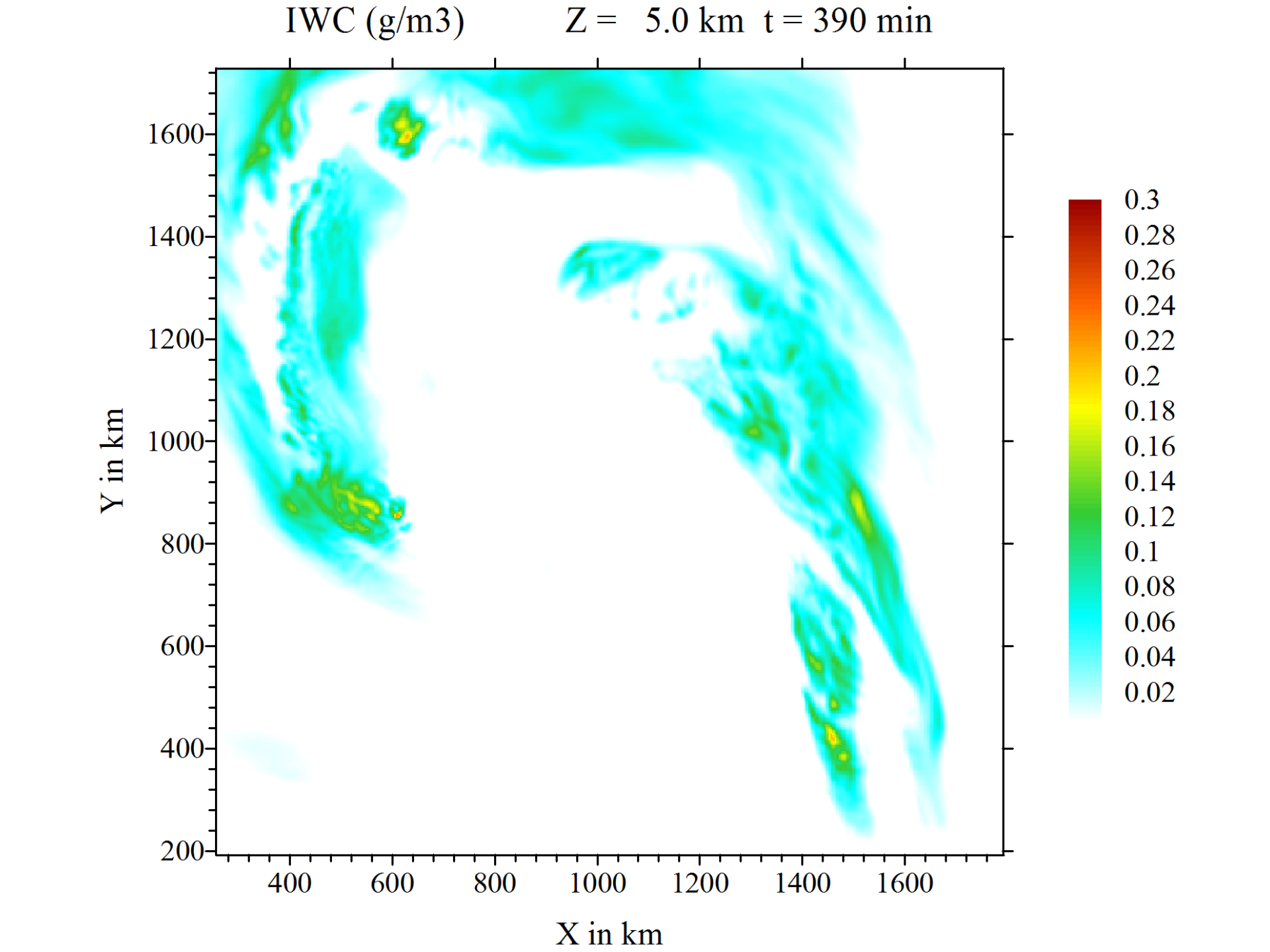
IWC (g/m3)
Z = 5.0 km t = 390 min
Y in km
X in km
200
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0.3
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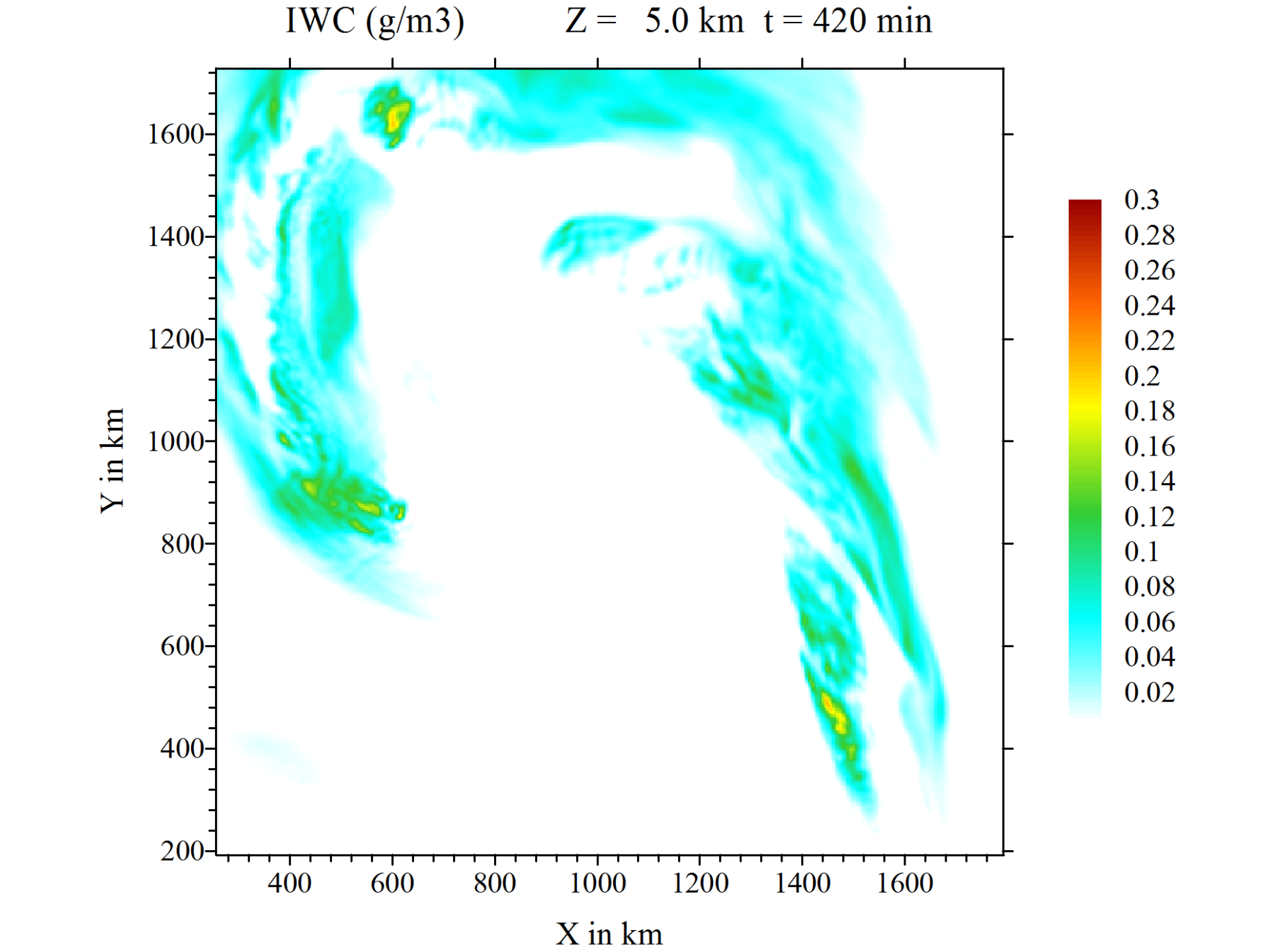
IWC (g/m3)
Z = 5.0 km t = 420 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
0.3
0.28
0.26
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0.1
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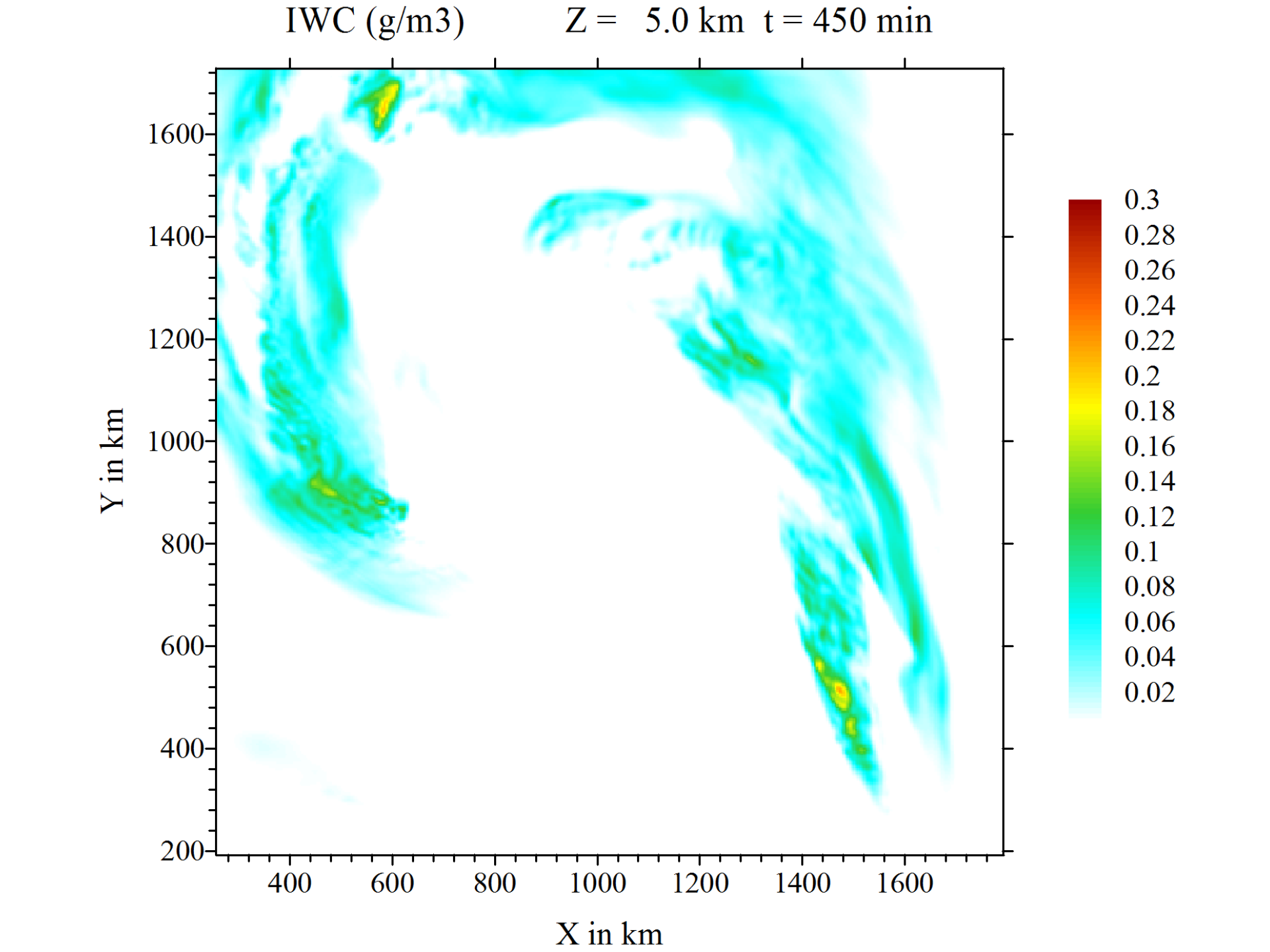
IWC (g/m3)
Z = 5.0 km t = 450 min
Y in km
X in km
200
400
600
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1200
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1600
0.3
0.28
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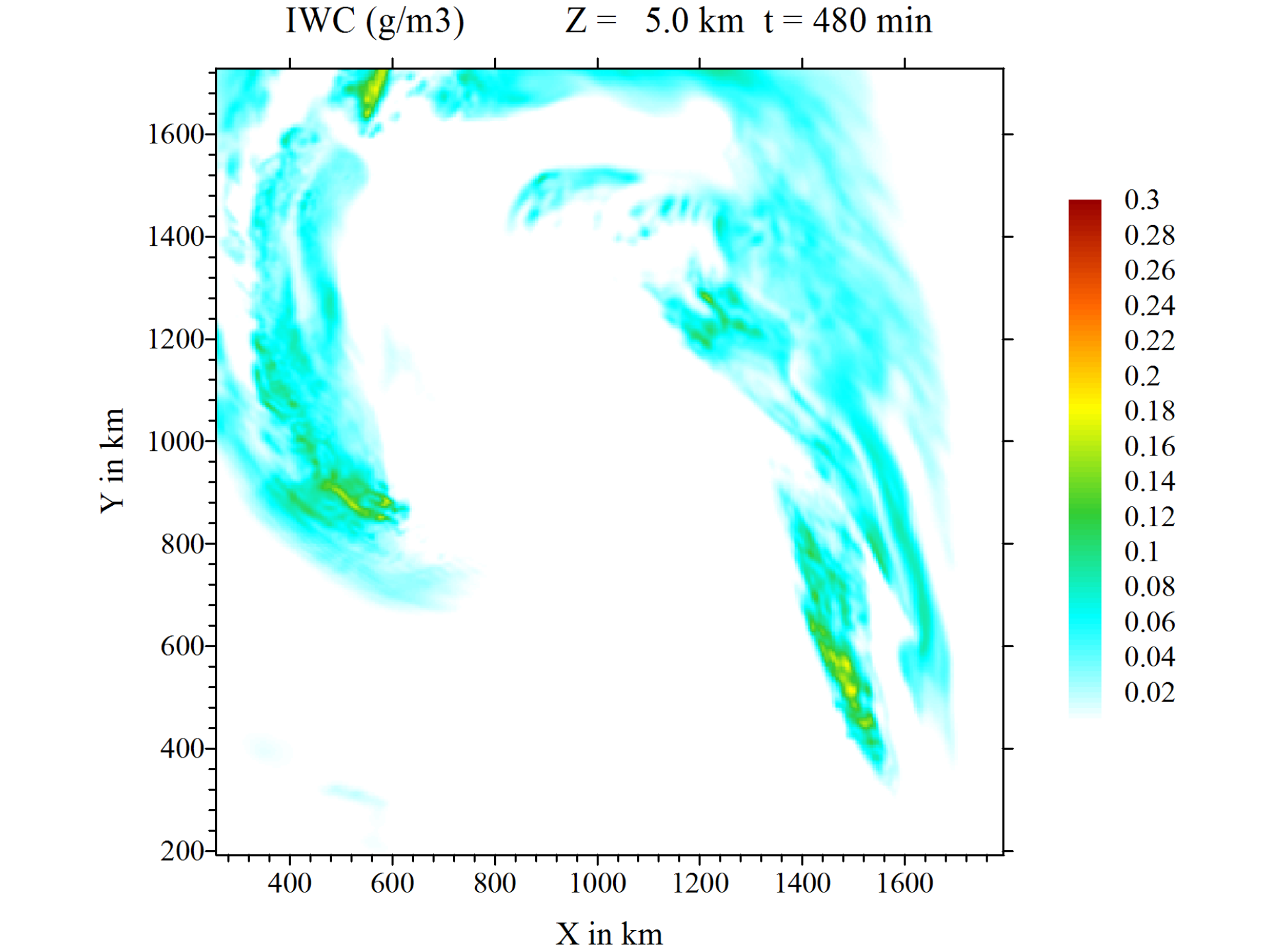
IWC (g/m3)
Z = 5.0 km t = 480 min
Y in km
X in km
200
400
600
800
1000
1200
1400
1600
0.3
0.28
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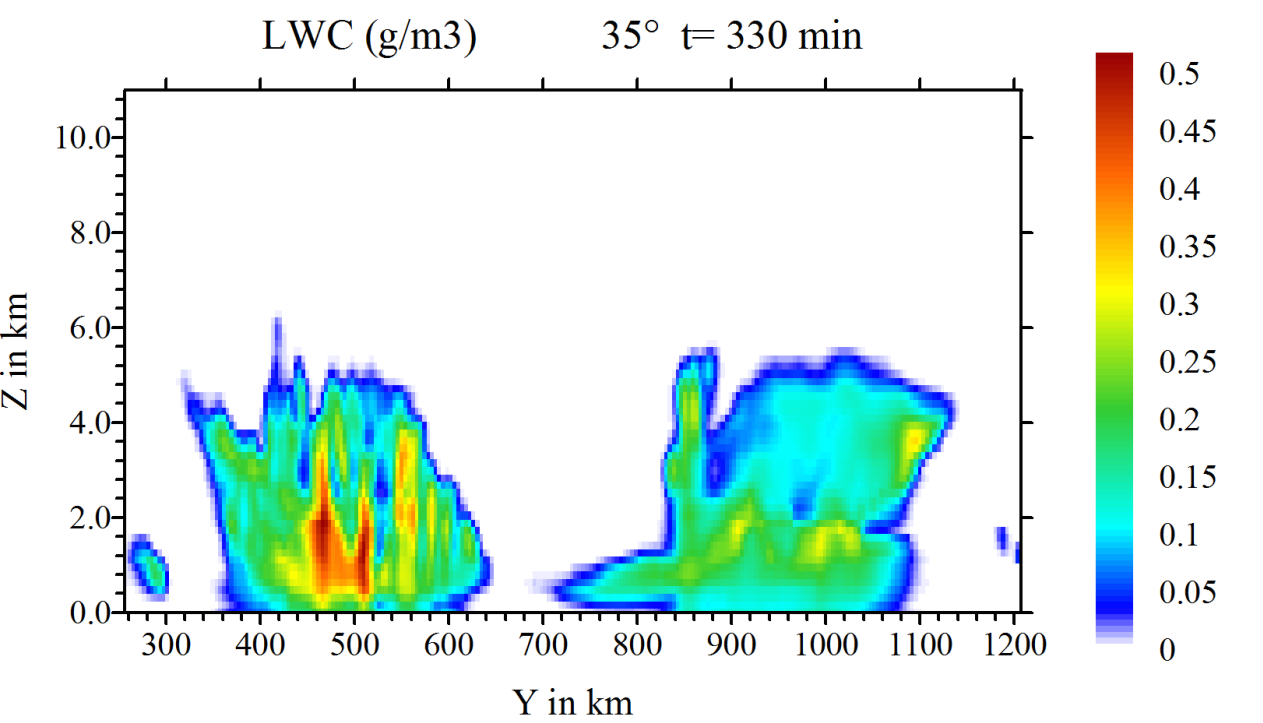
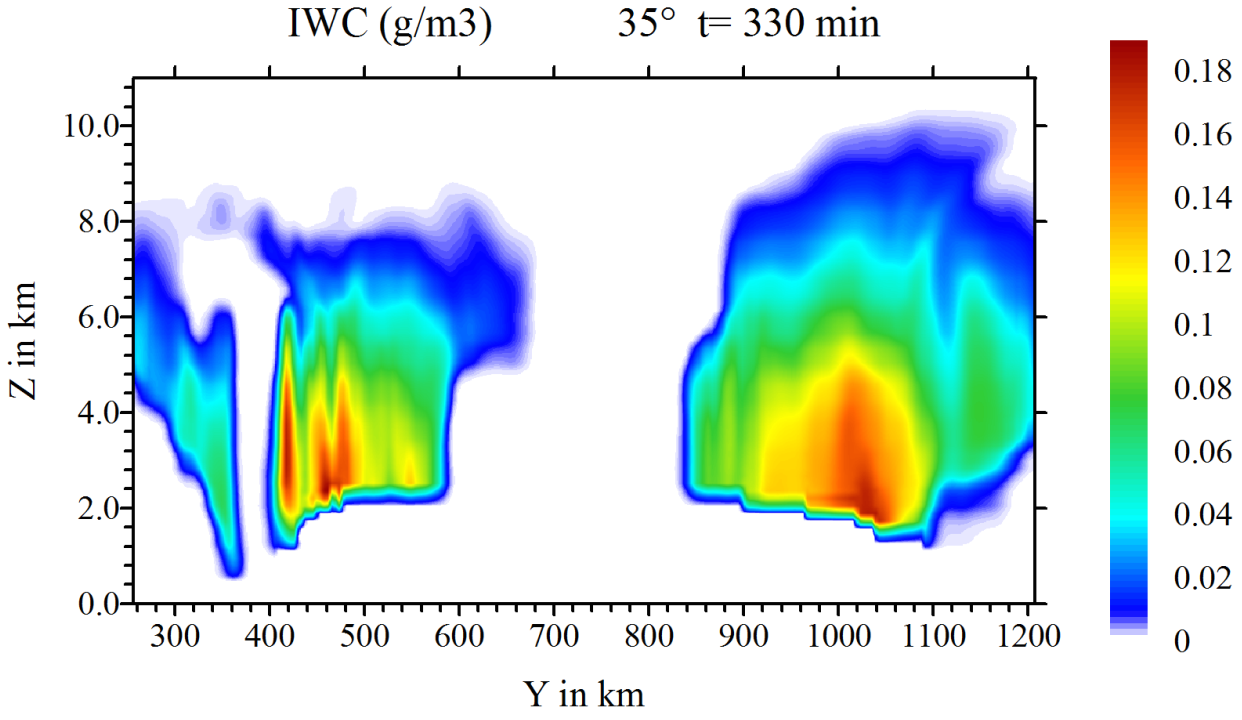




Coupes verticales

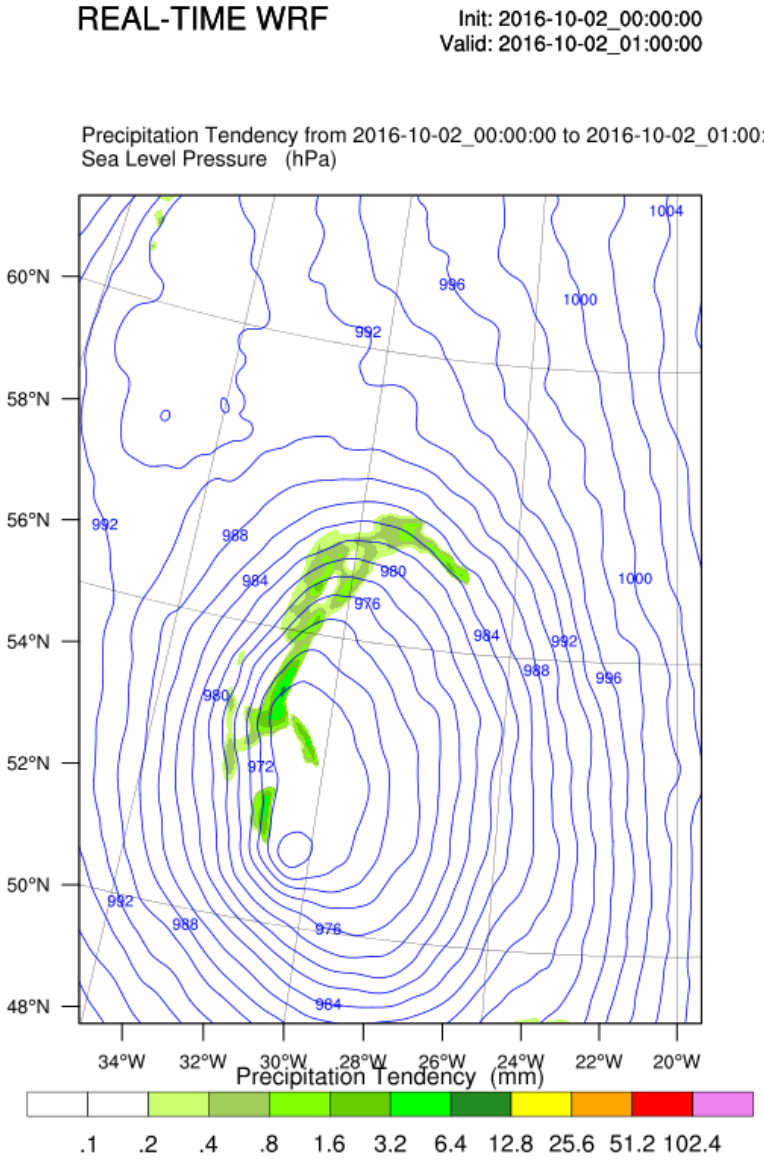
LWC

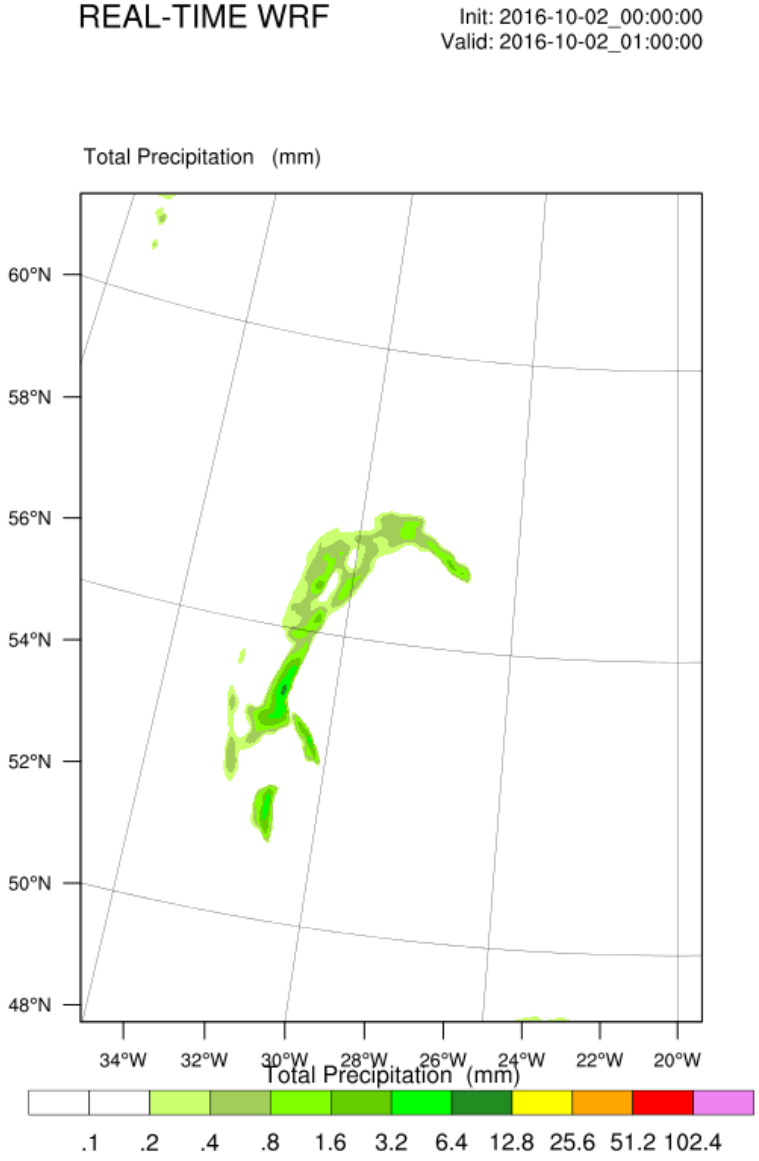
IWC

Simulation of LWC
in domain 2
from 00 – 15 h

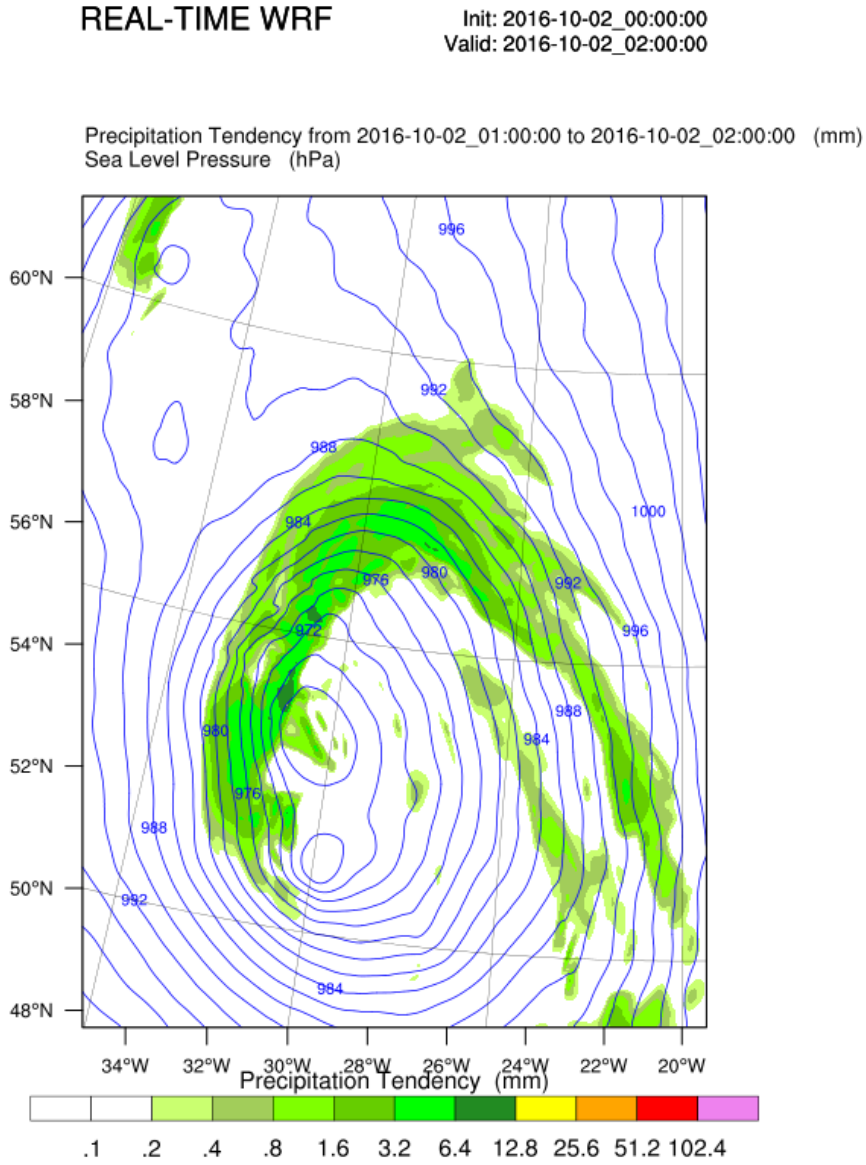
WRF
–Thompson

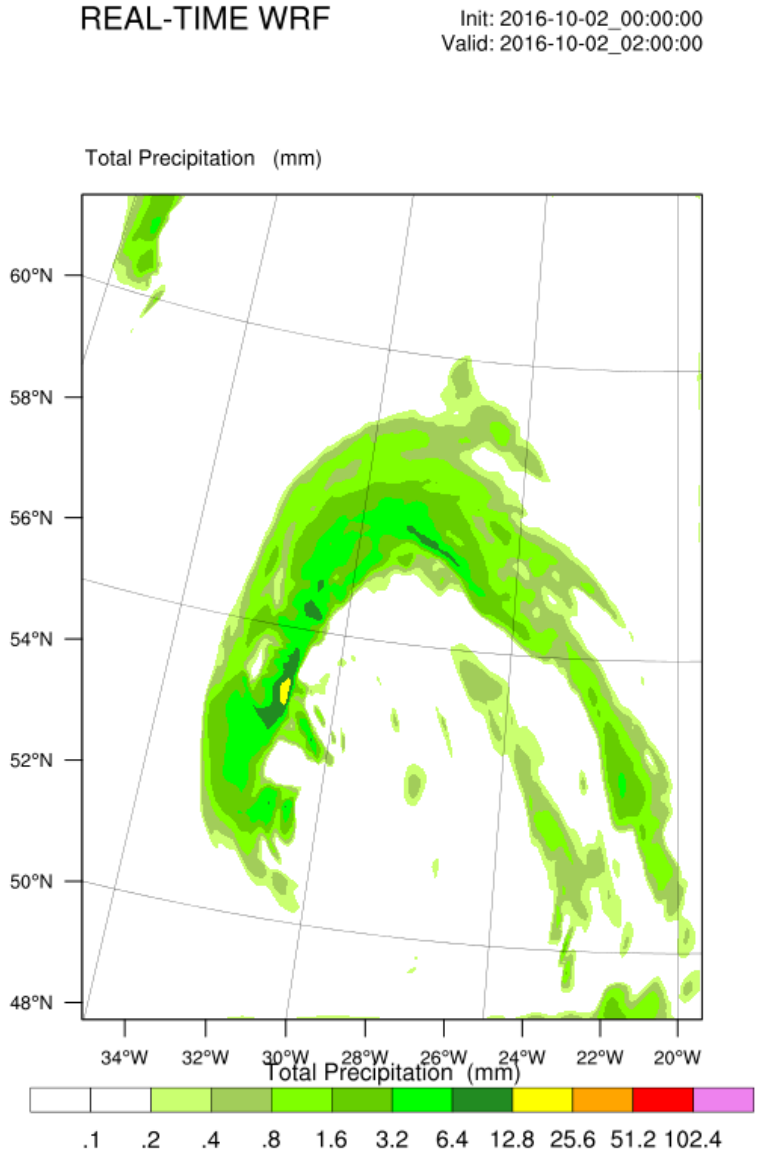
using the Thompson scheme





using the Thompson scheme





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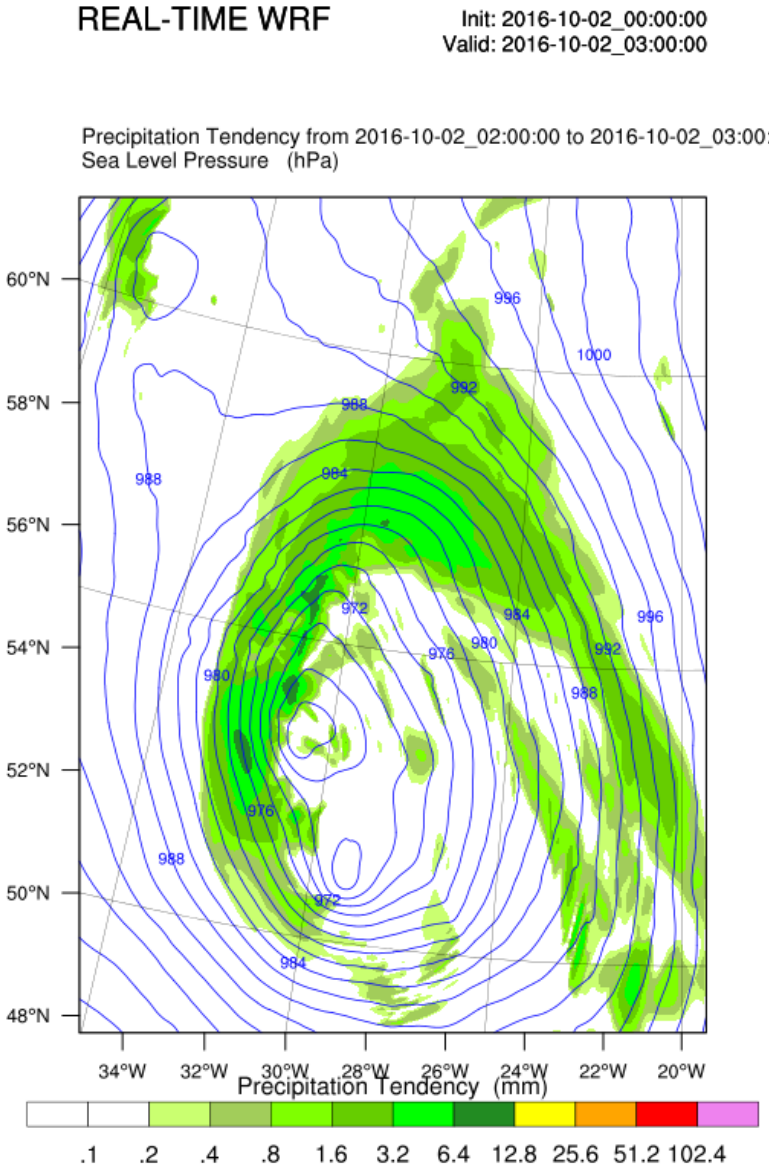

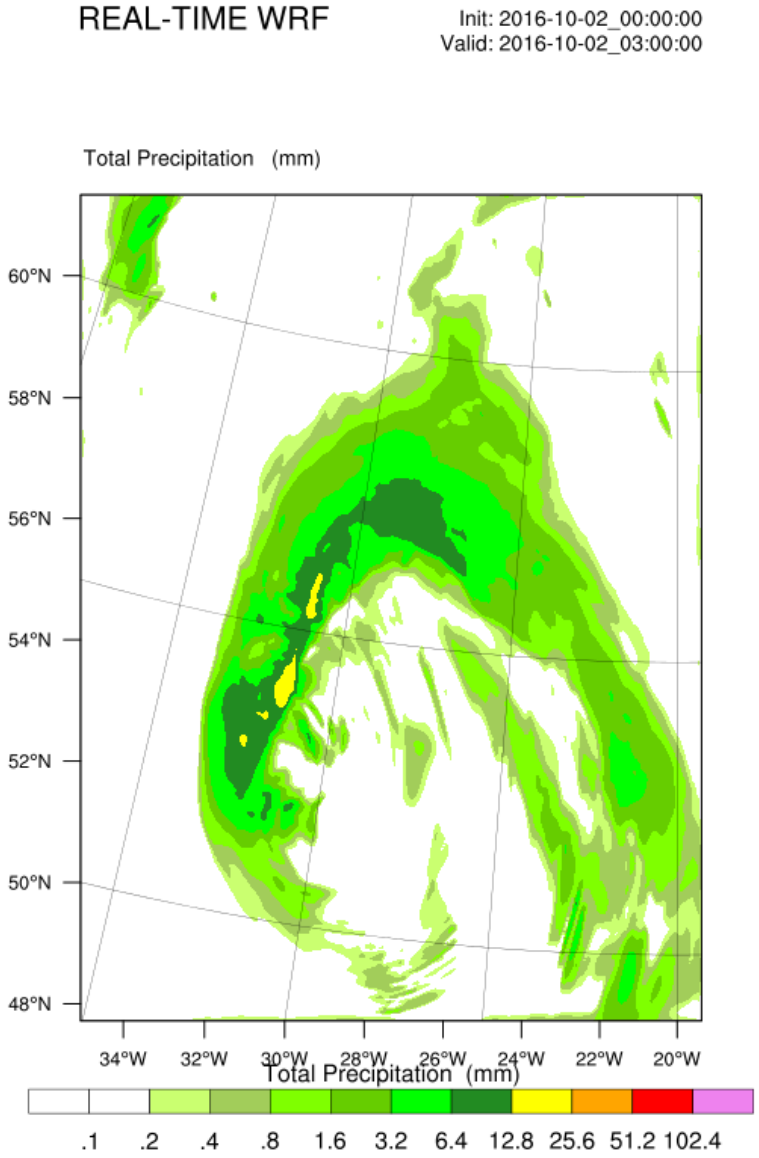

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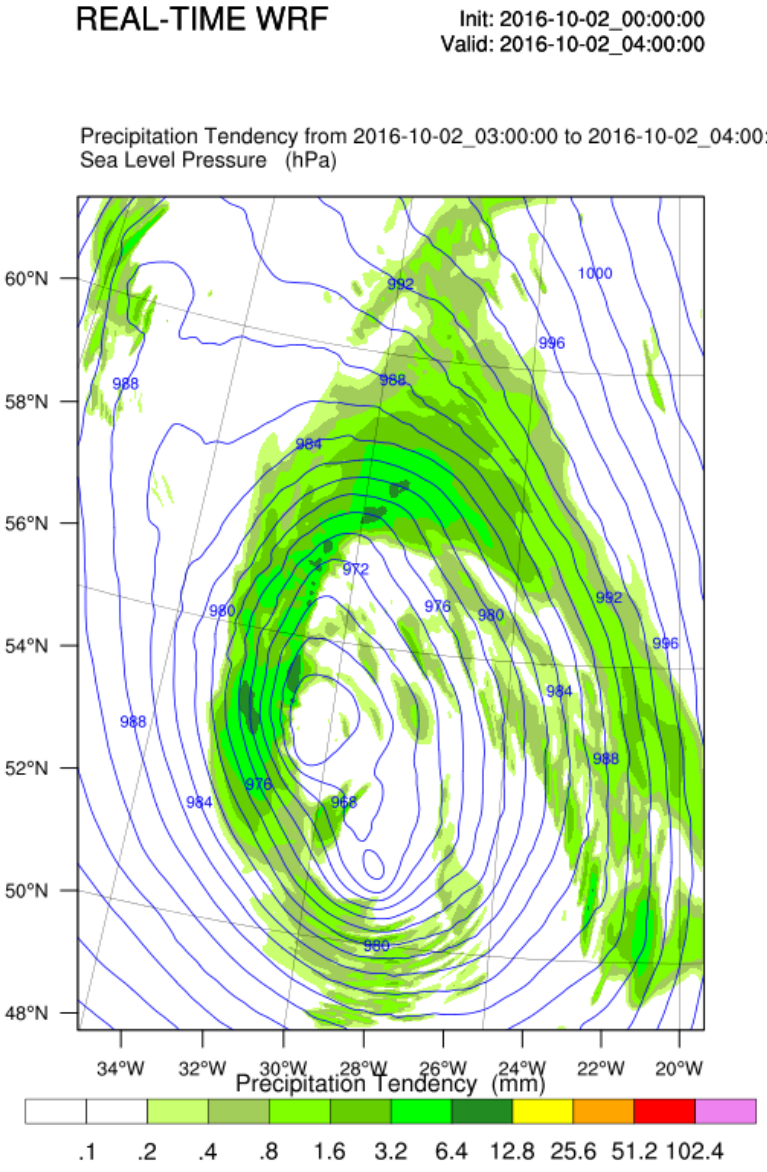

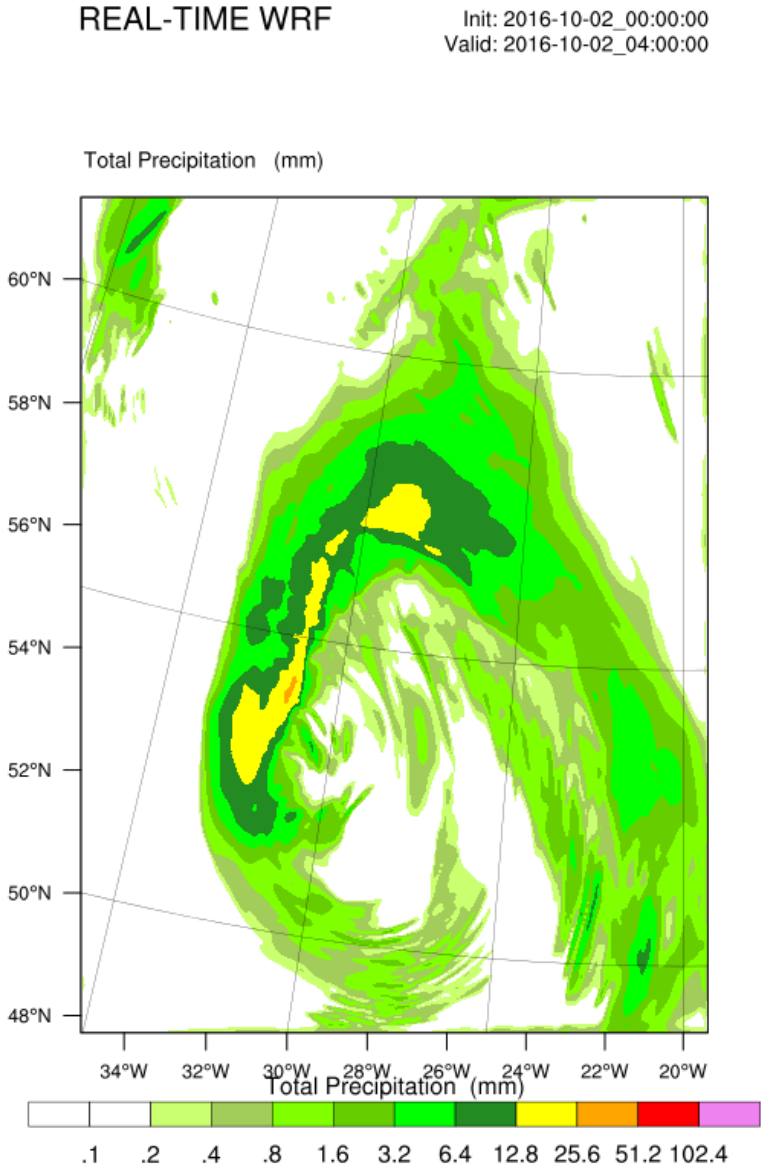

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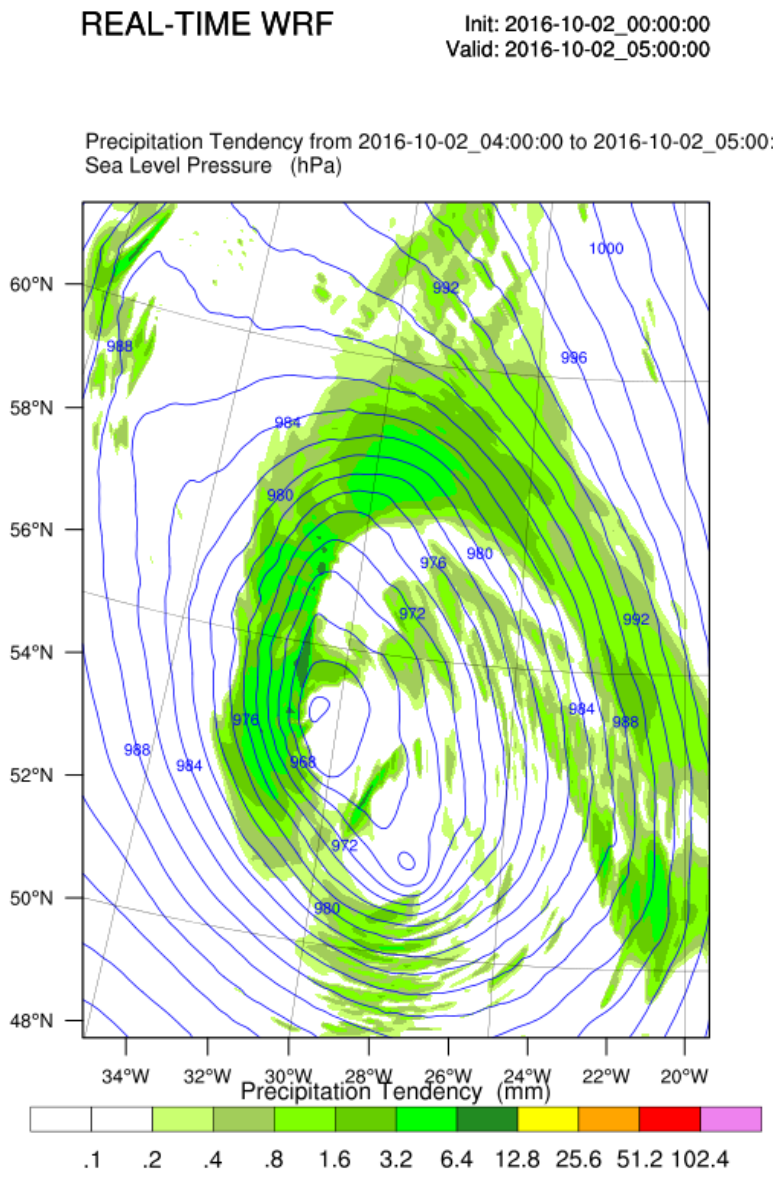

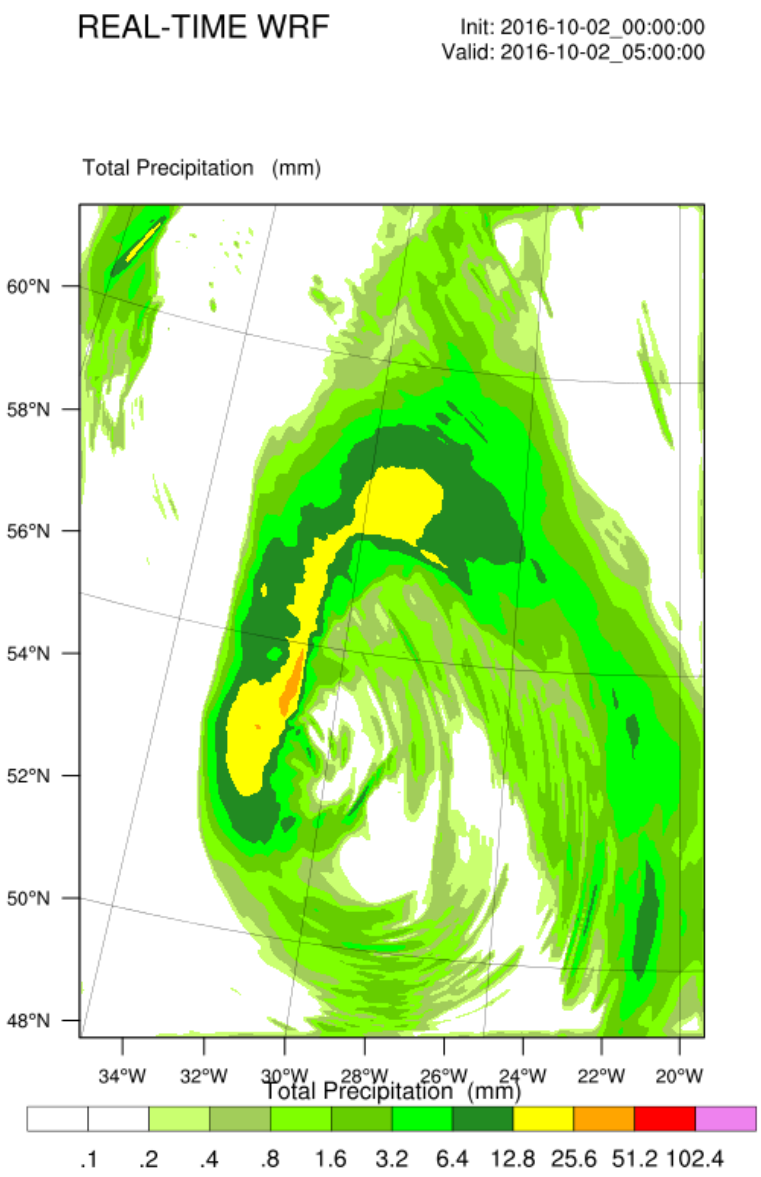

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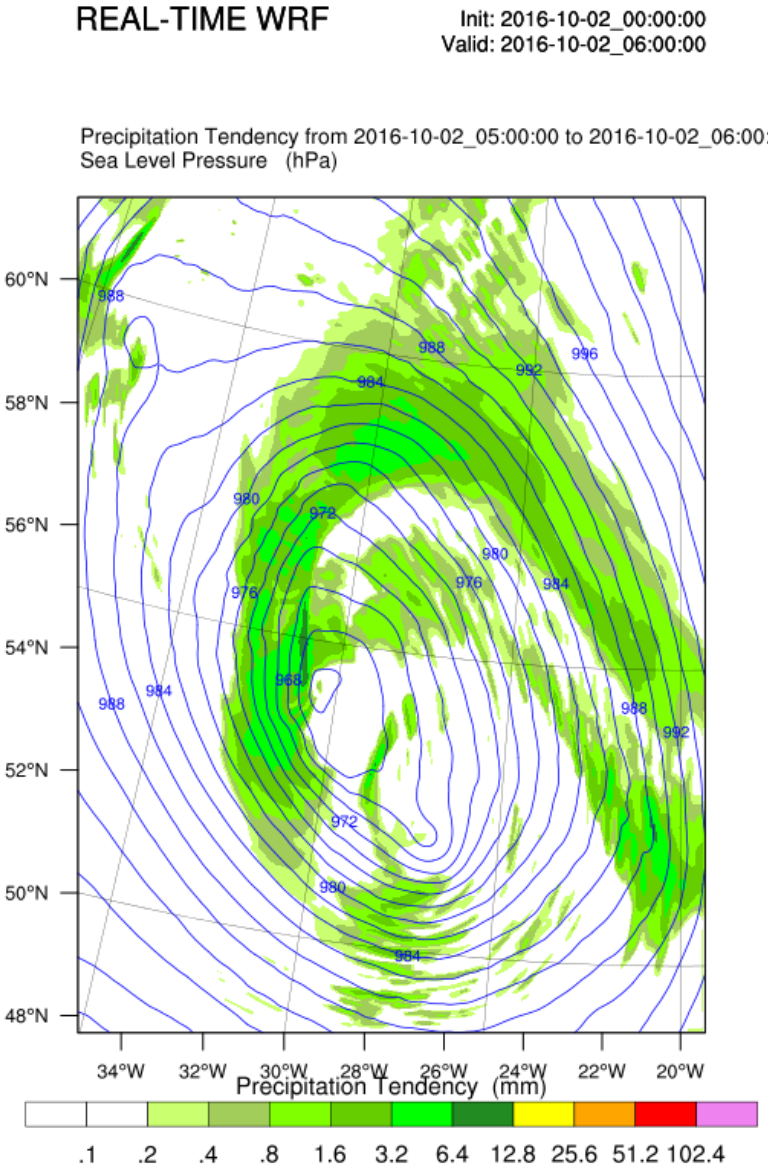

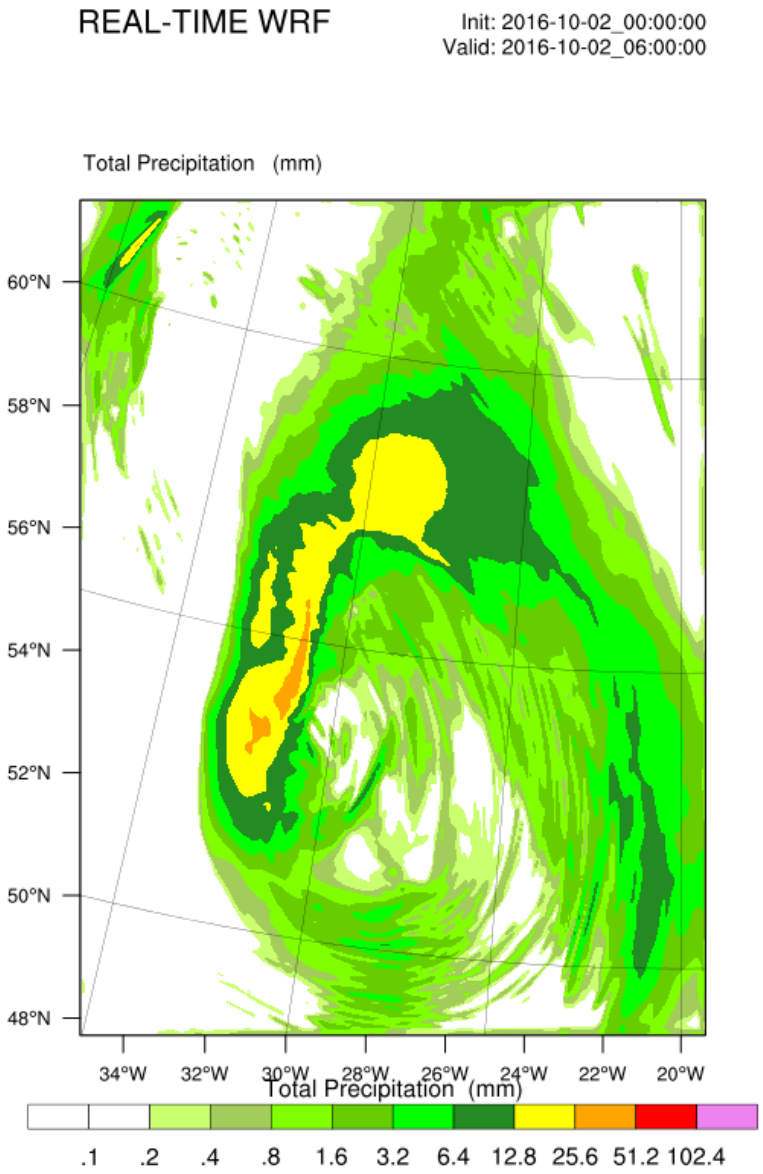

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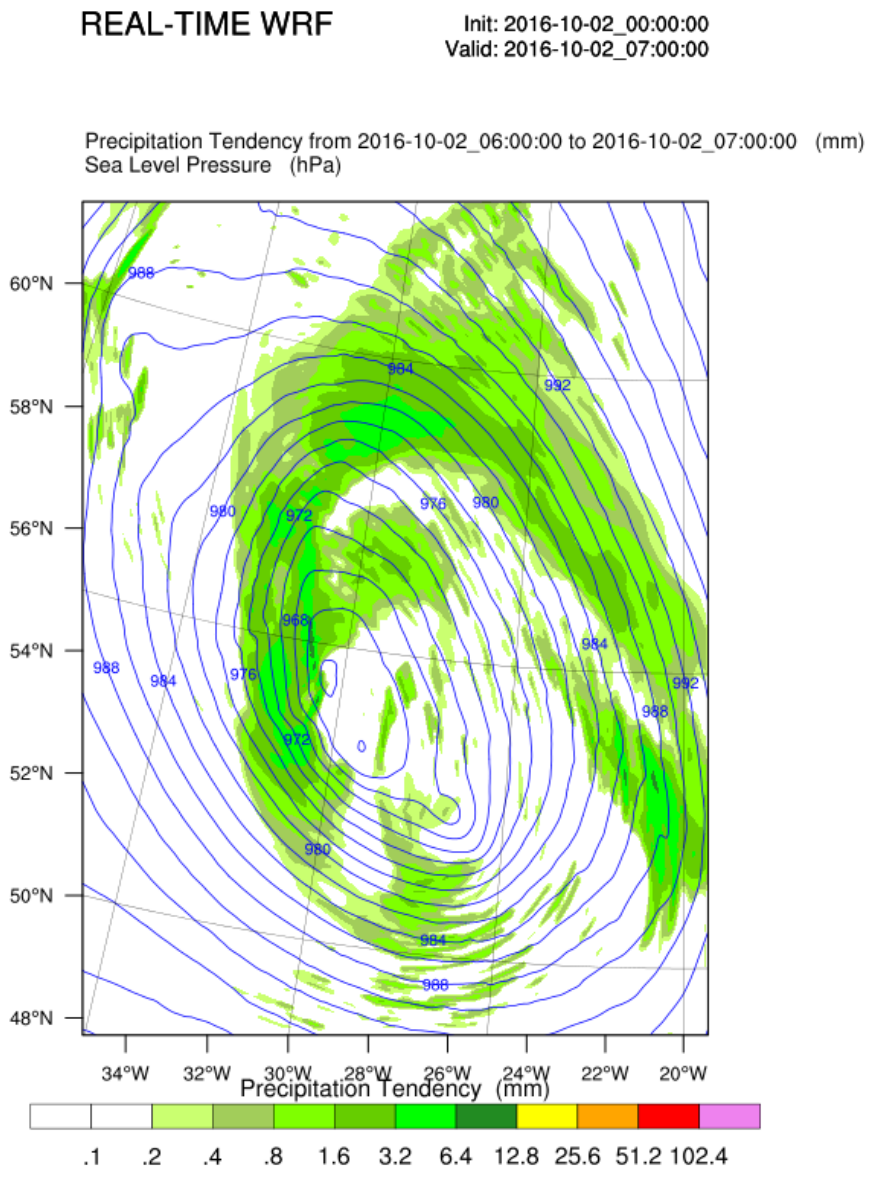

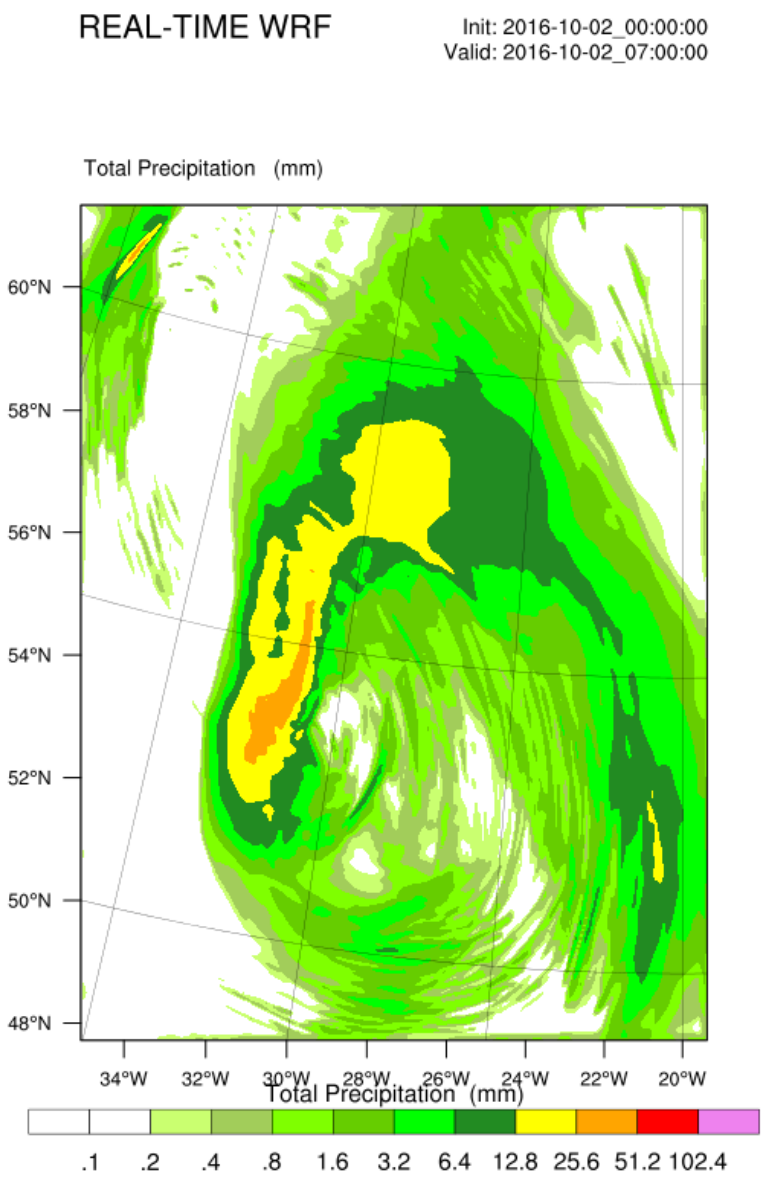

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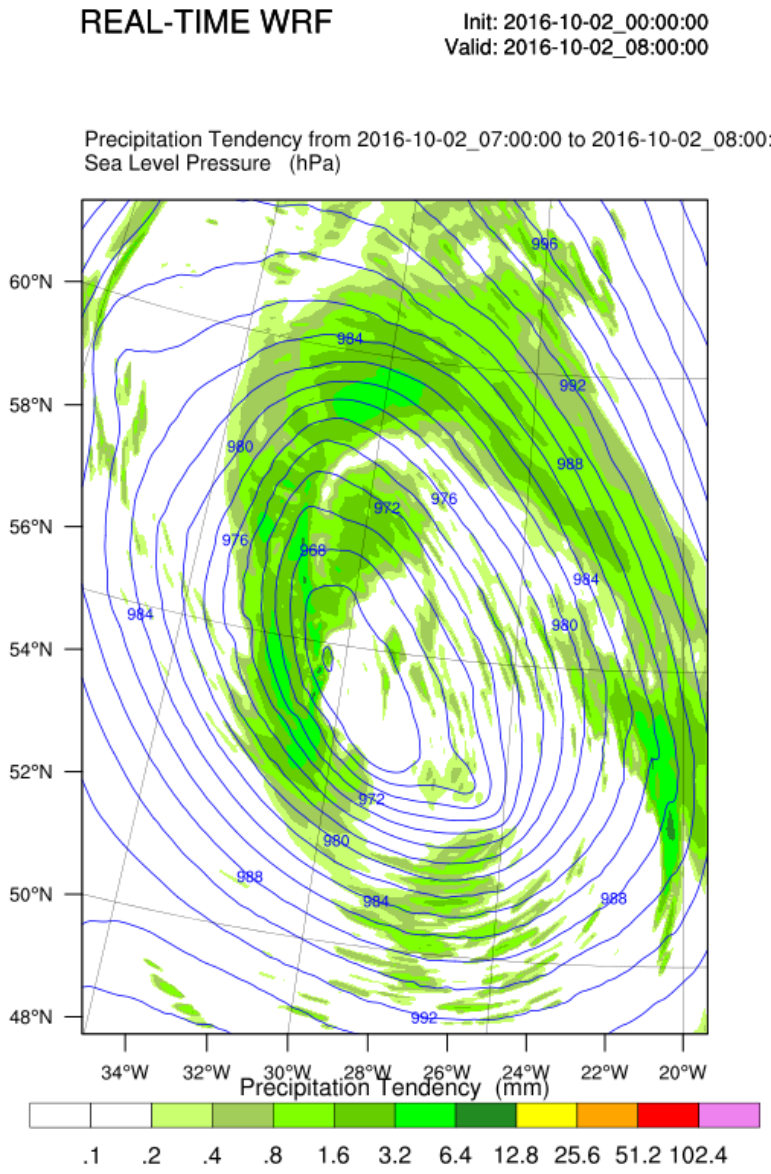

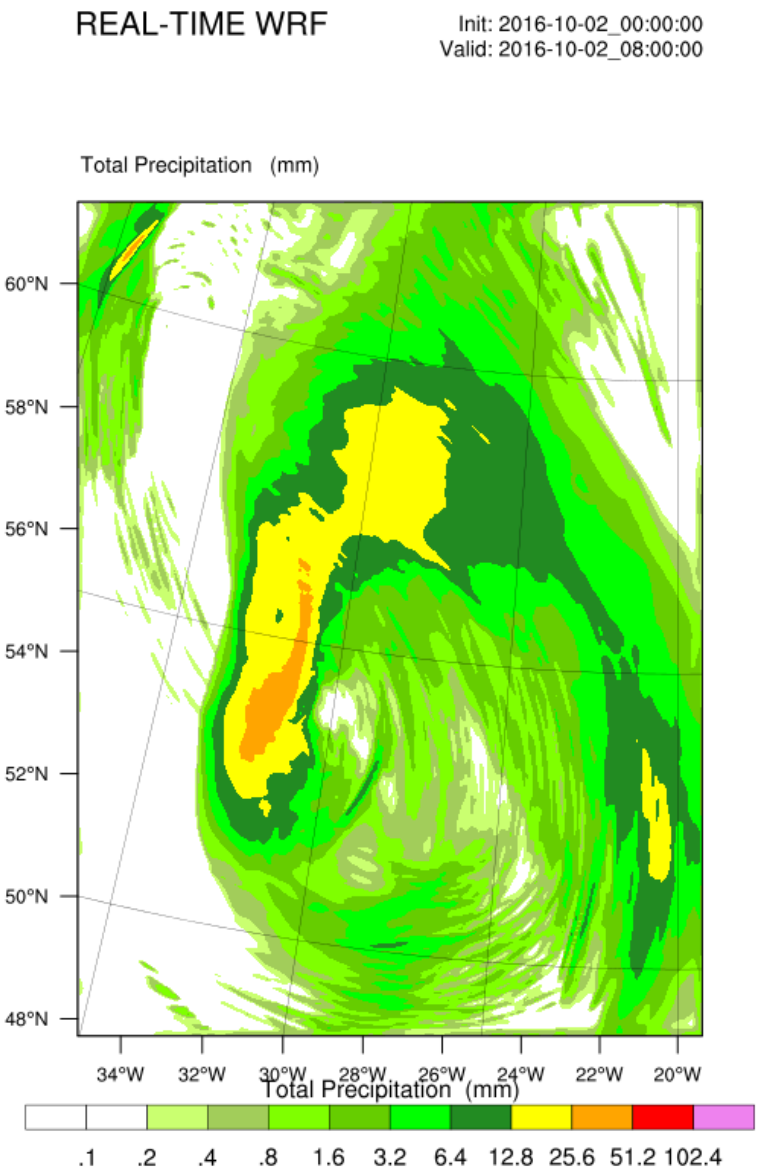

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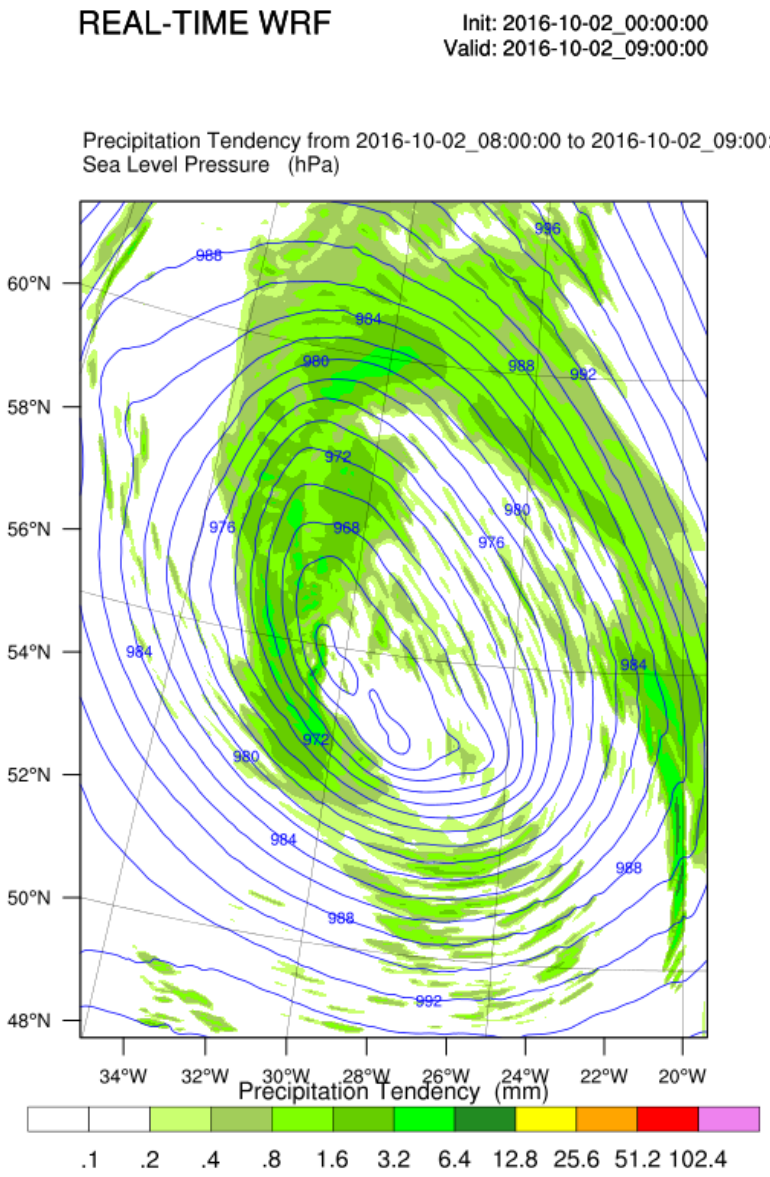

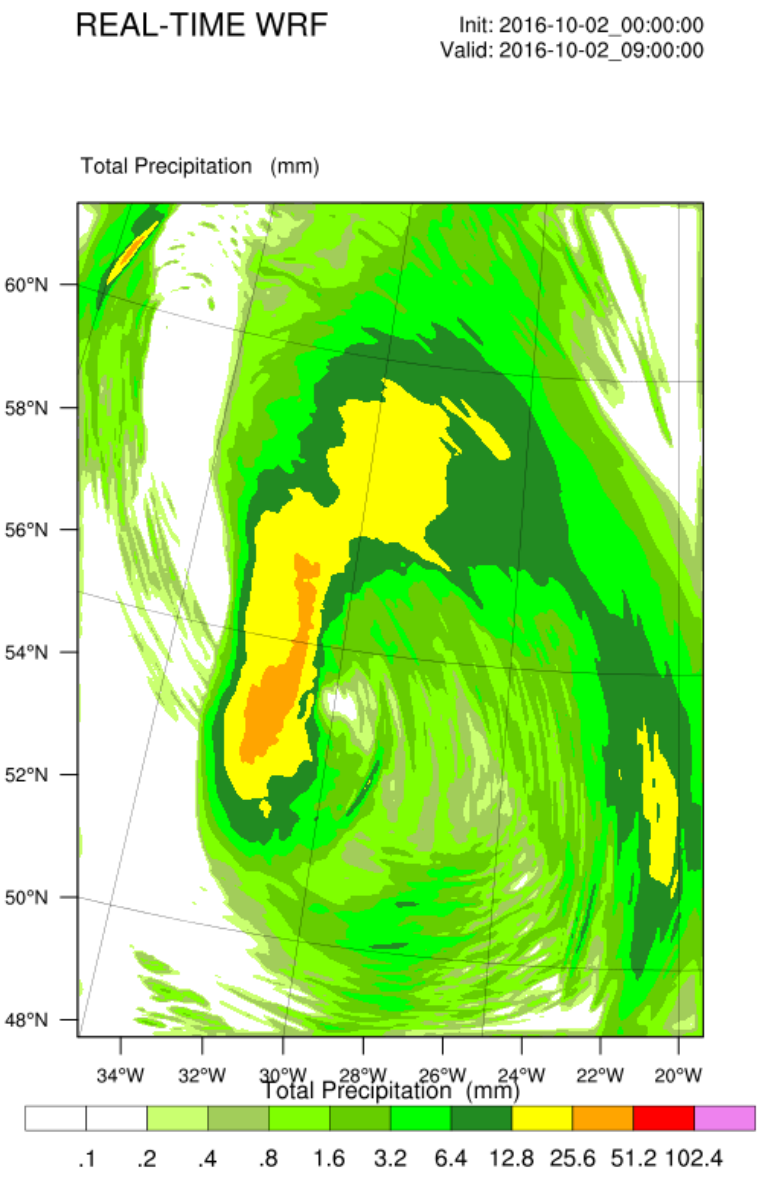

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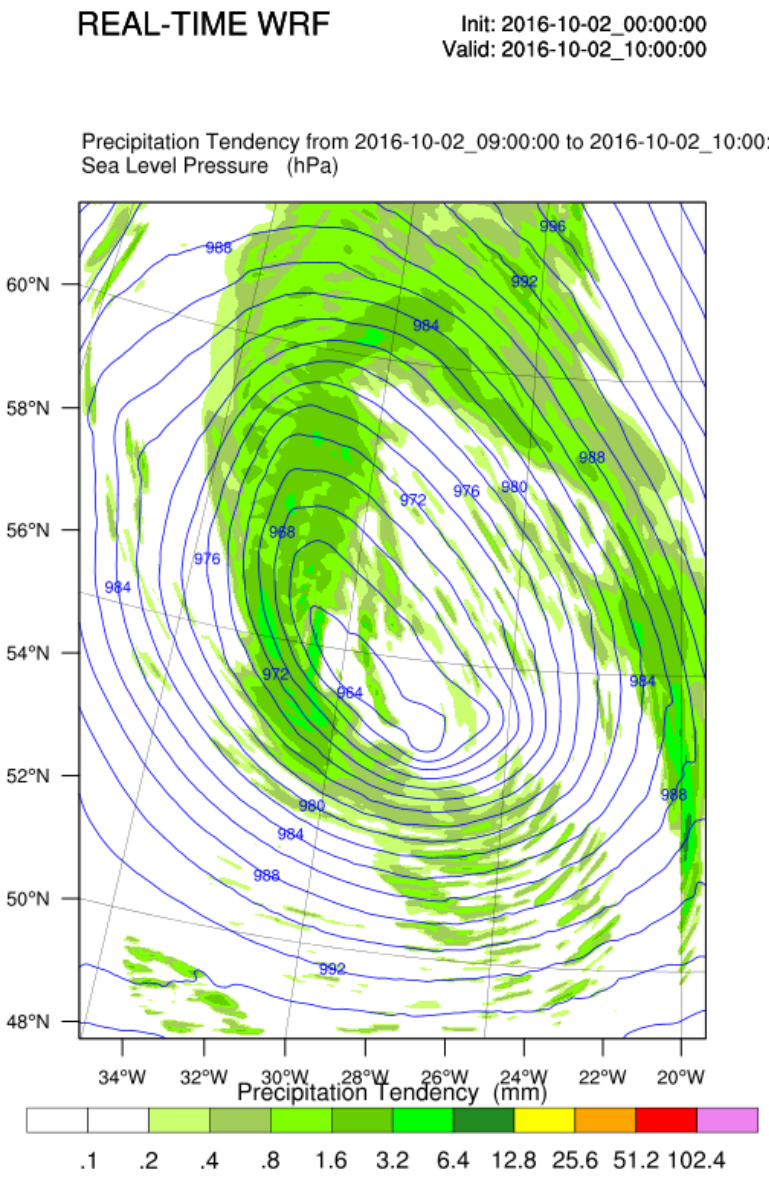
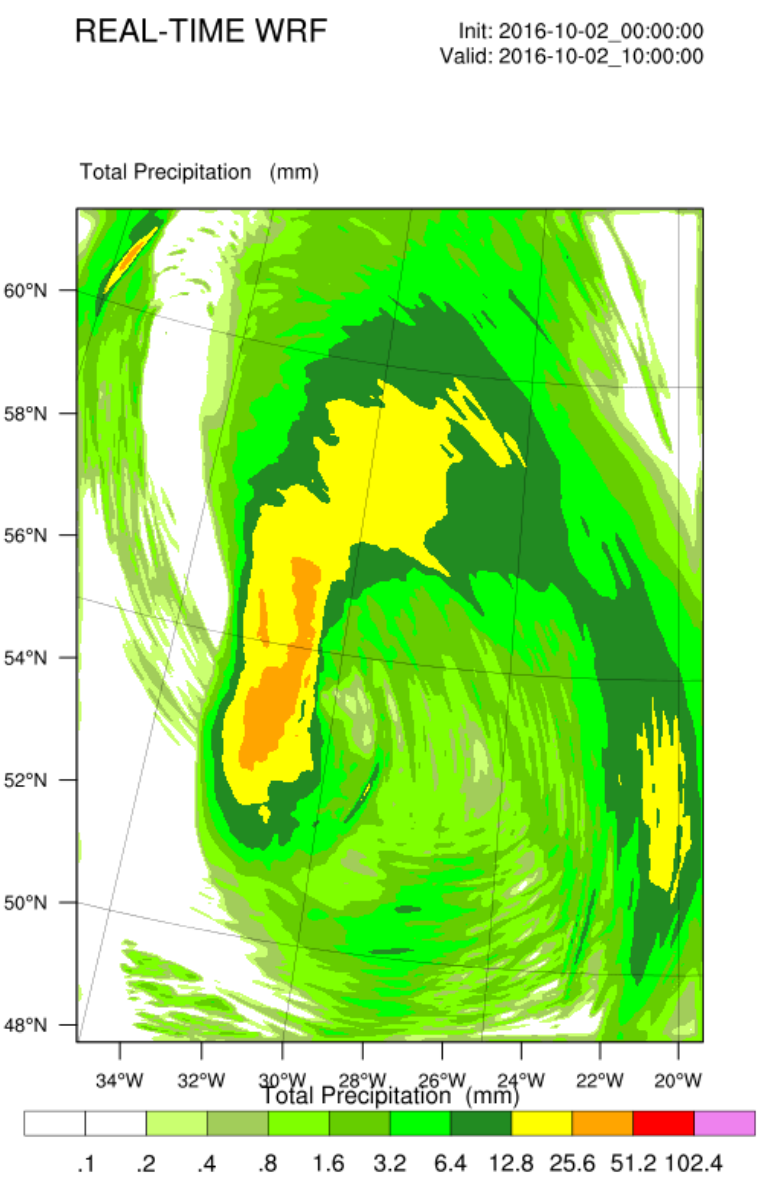
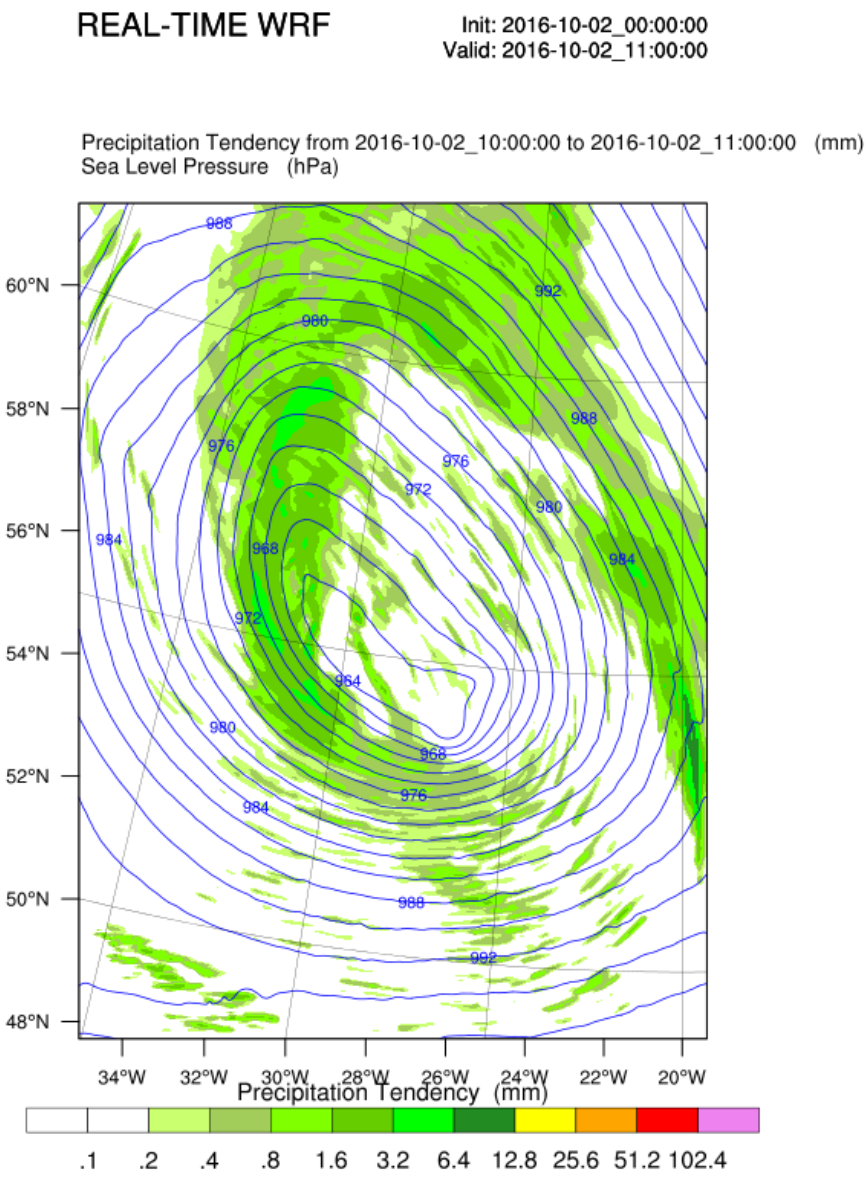
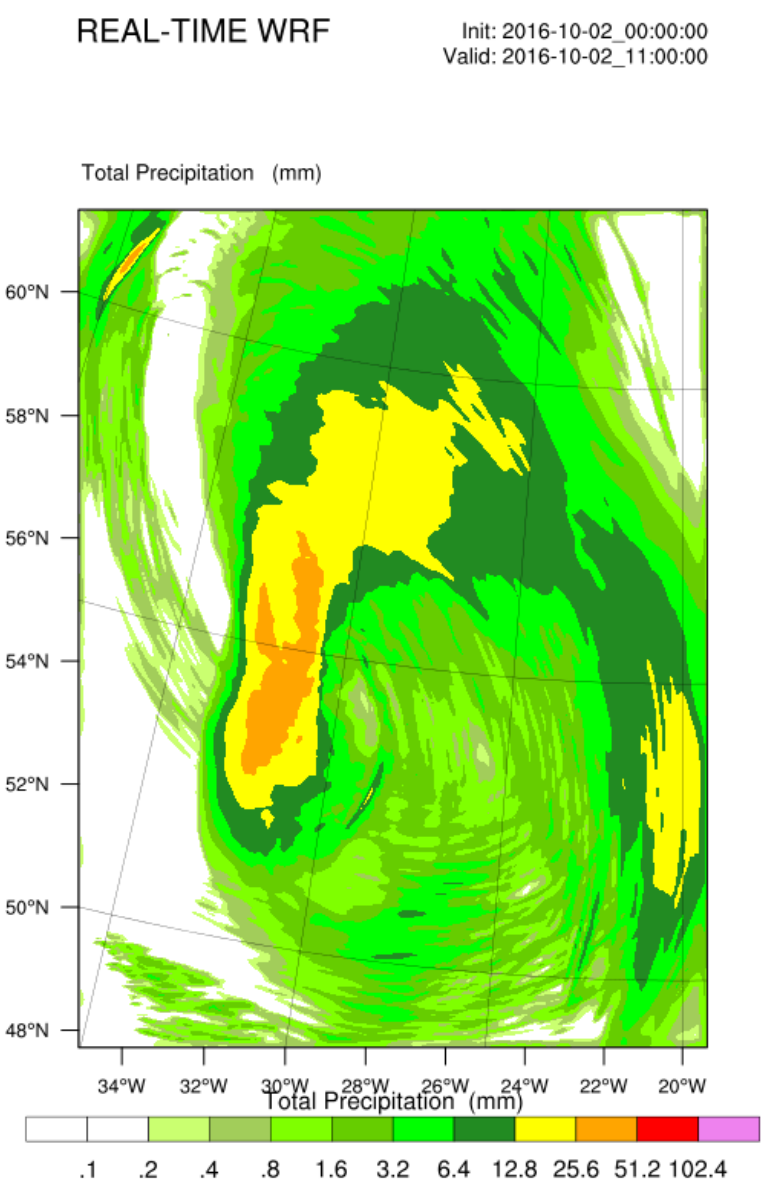




using the Thompson scheme





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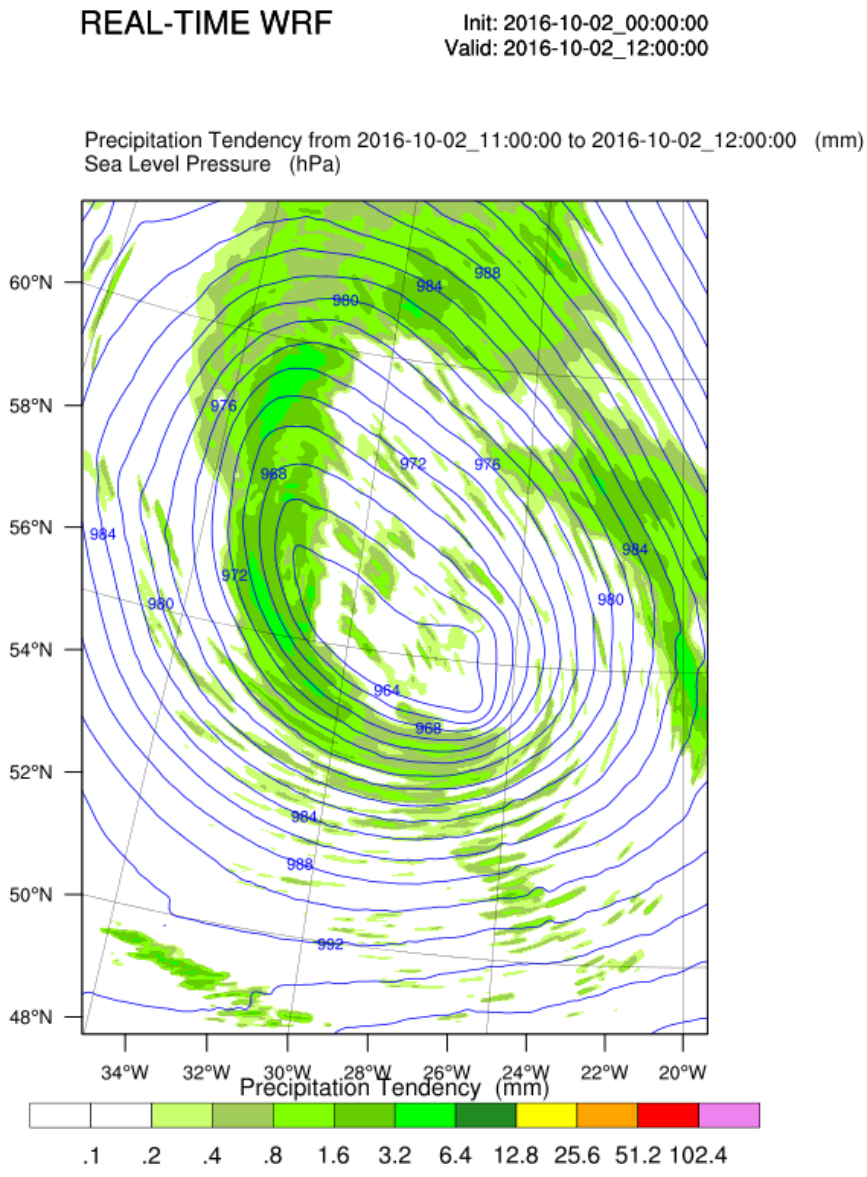

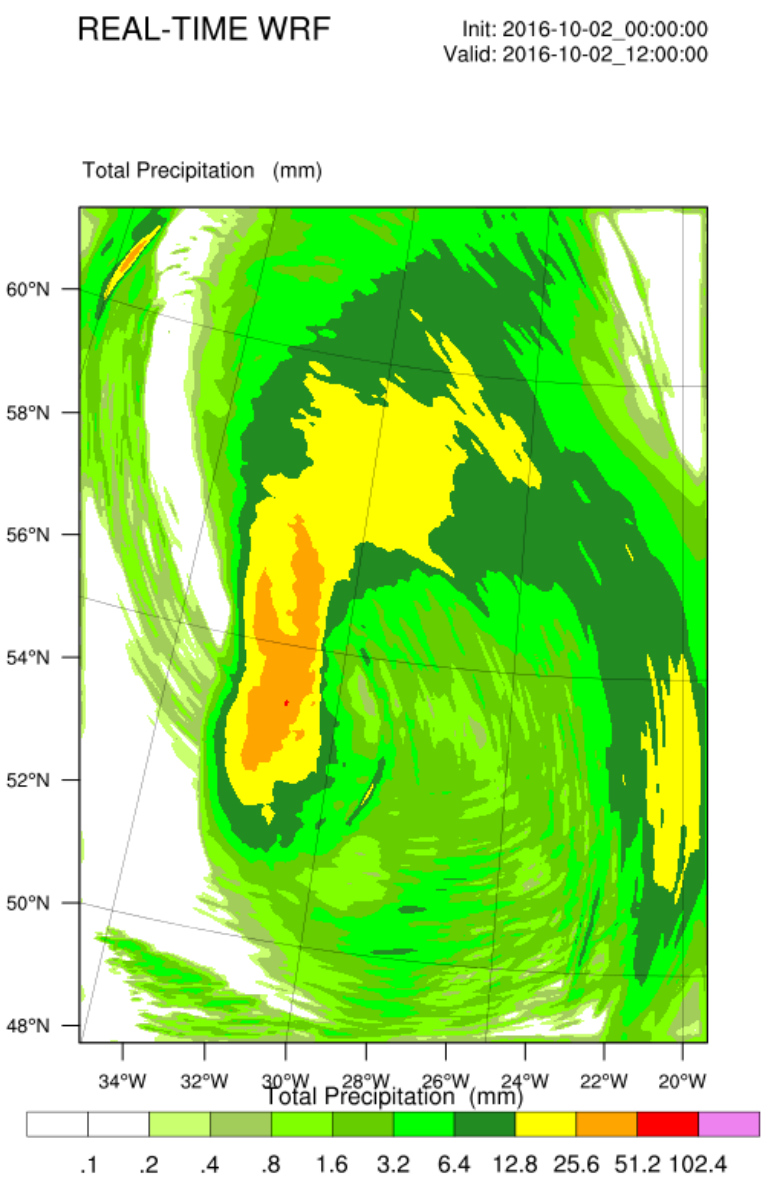

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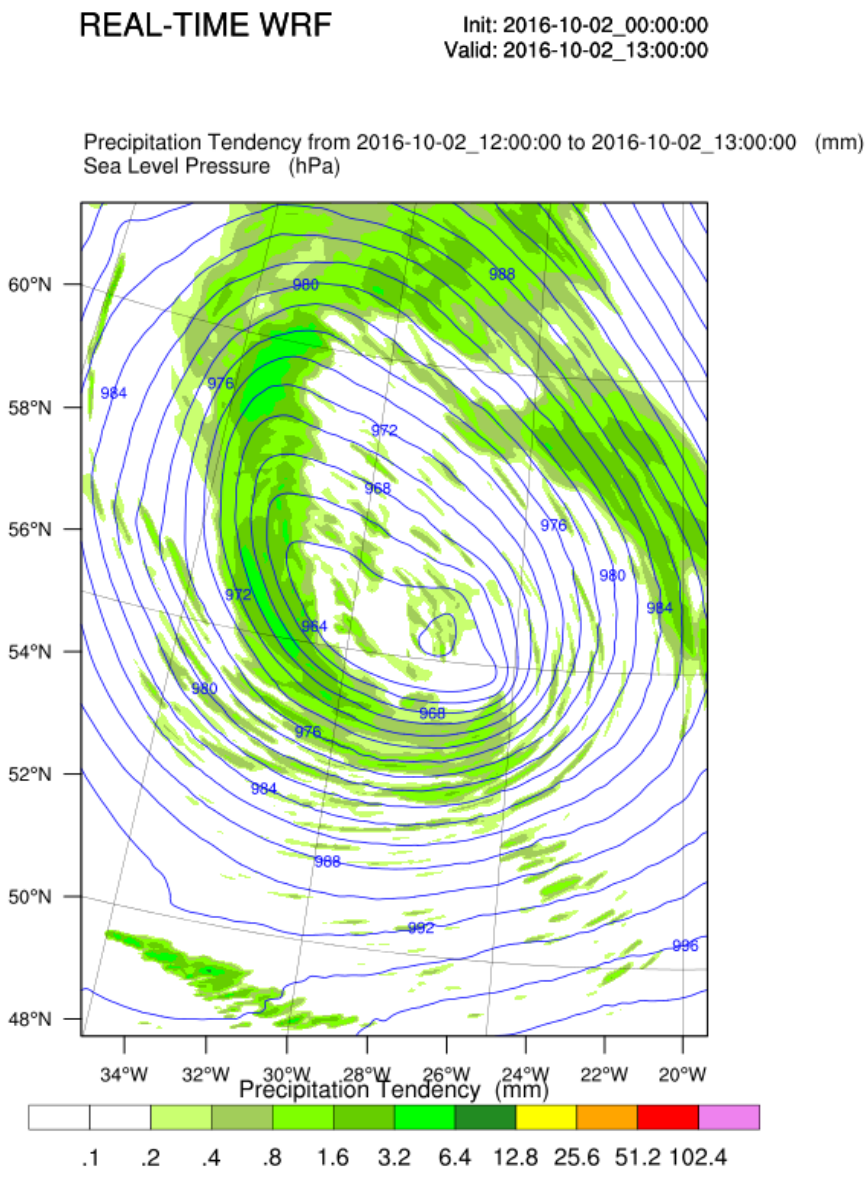

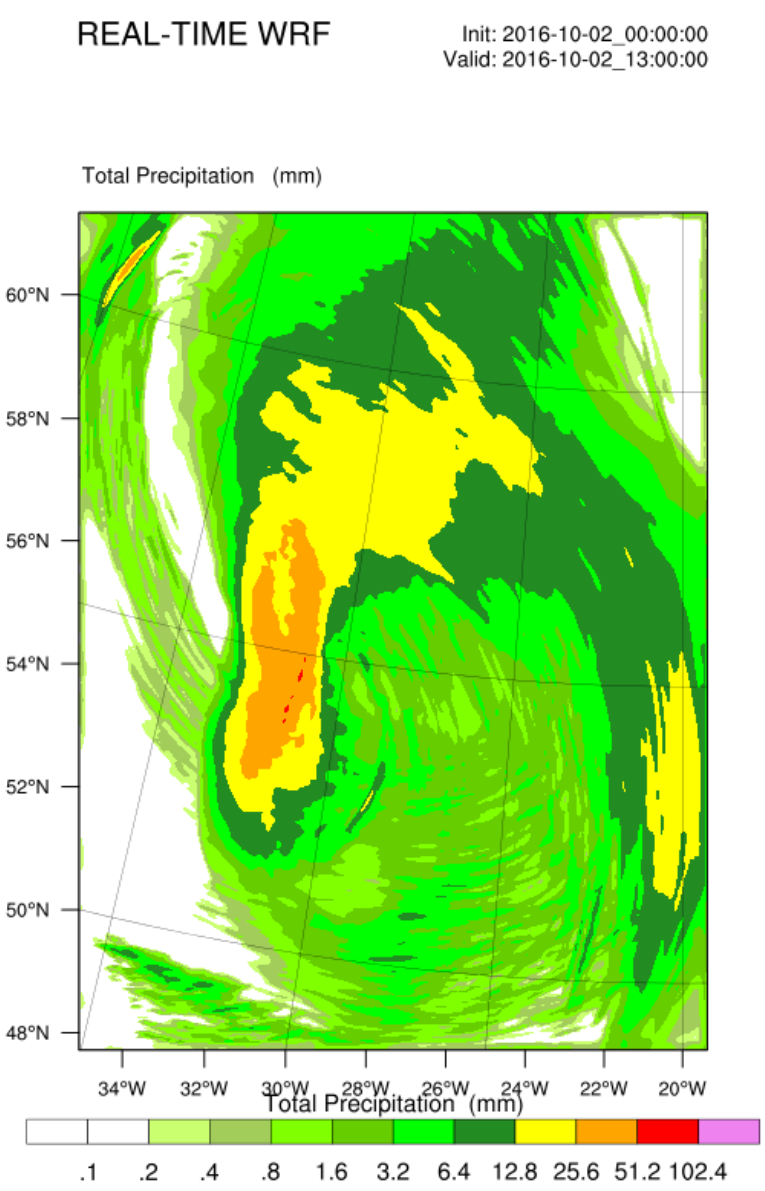

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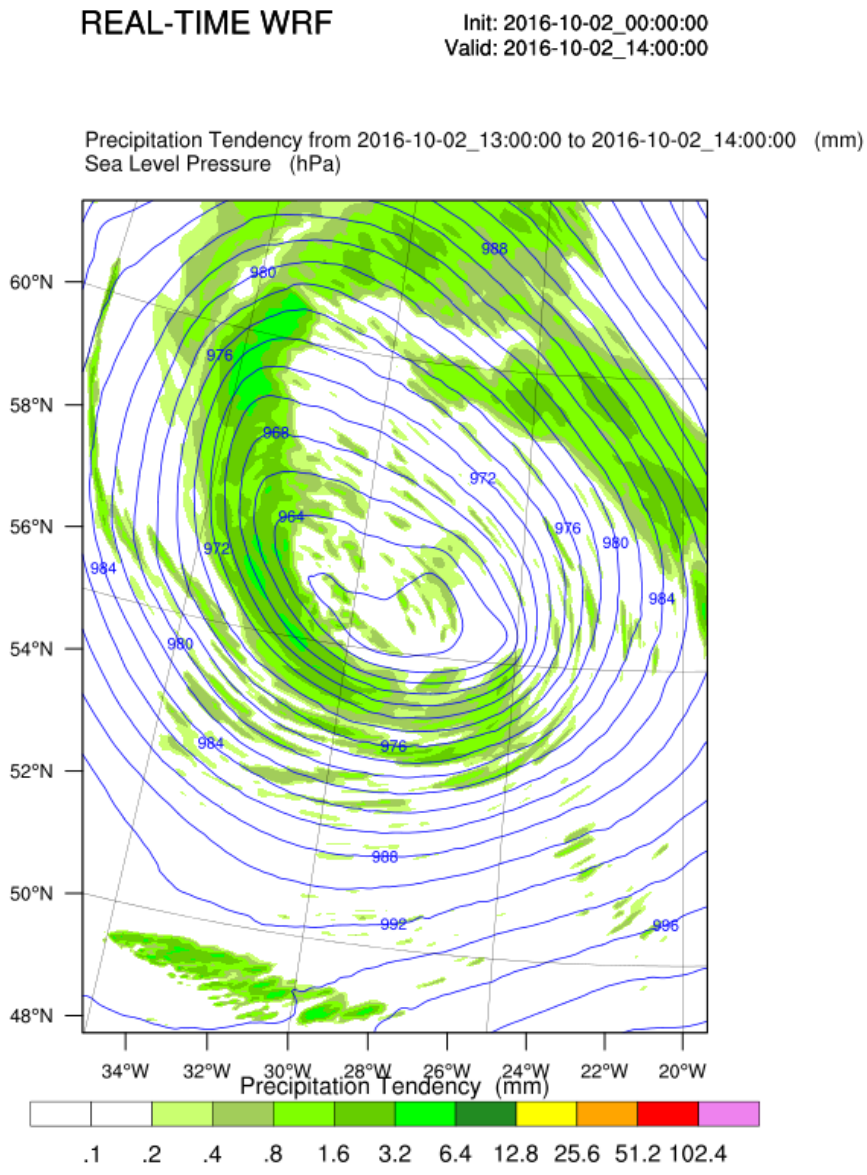

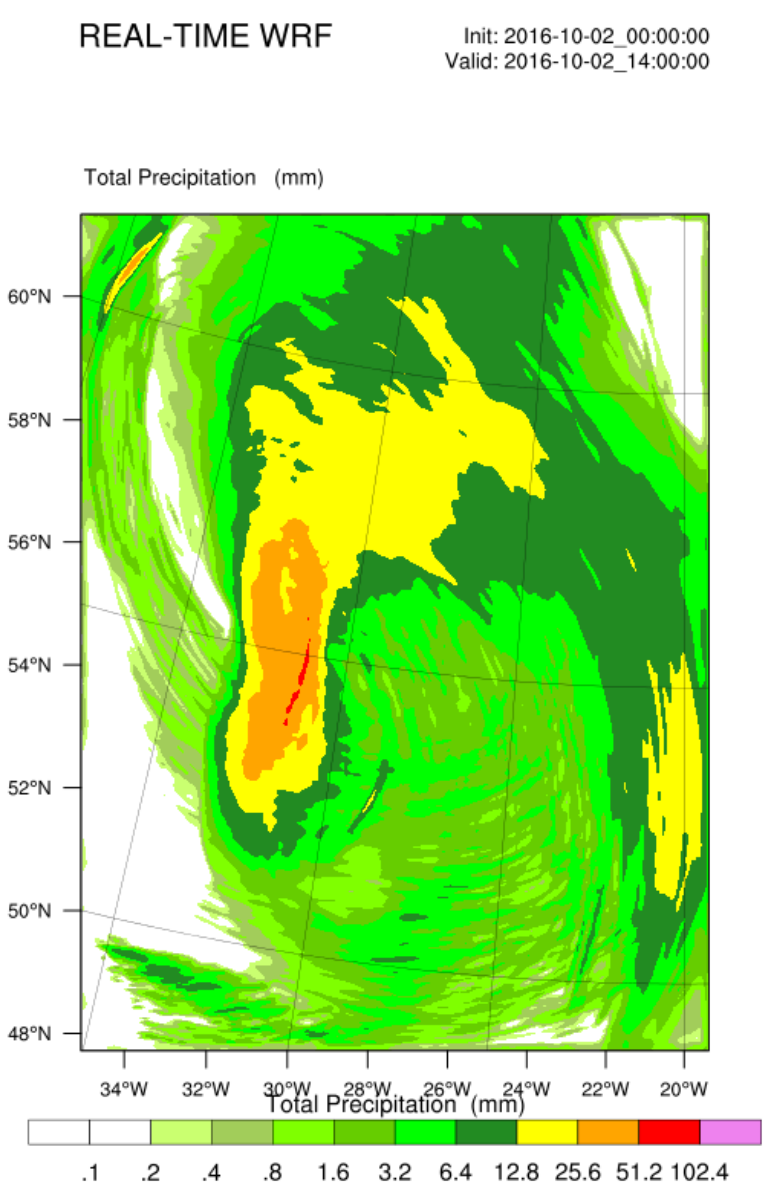

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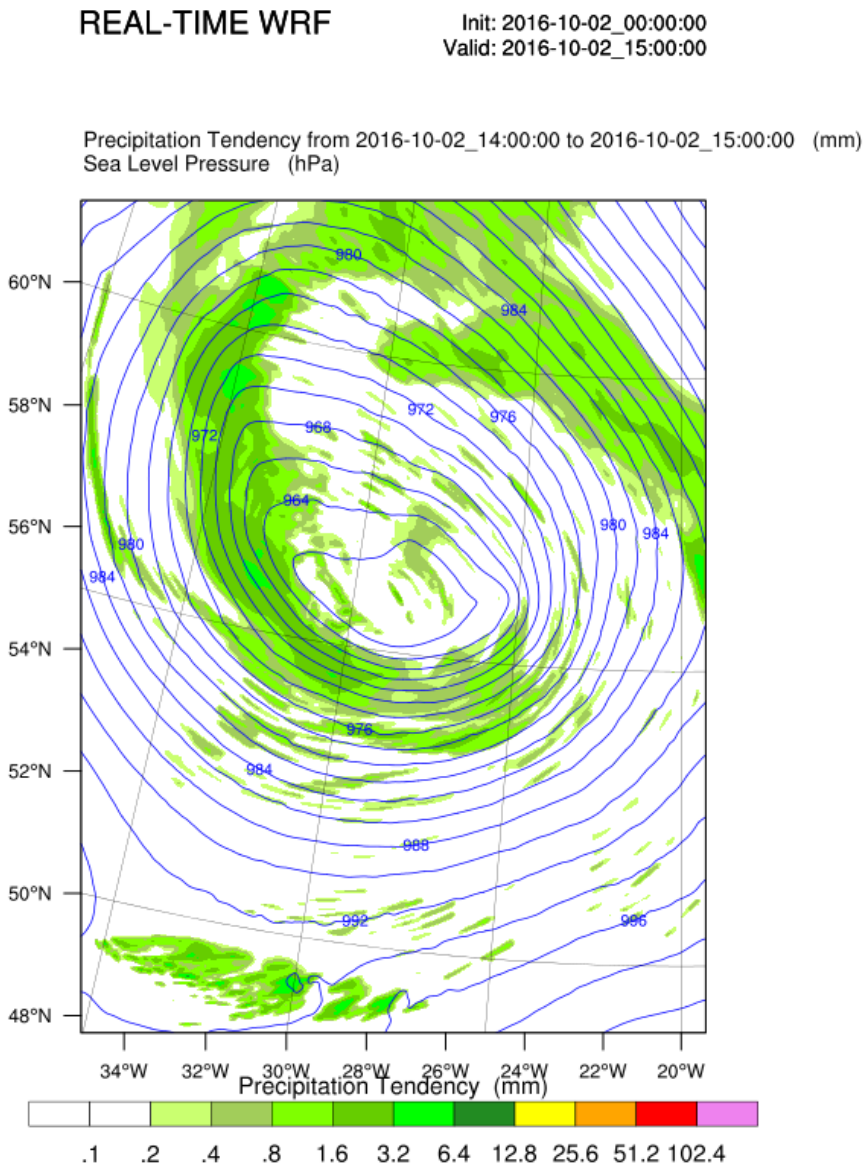

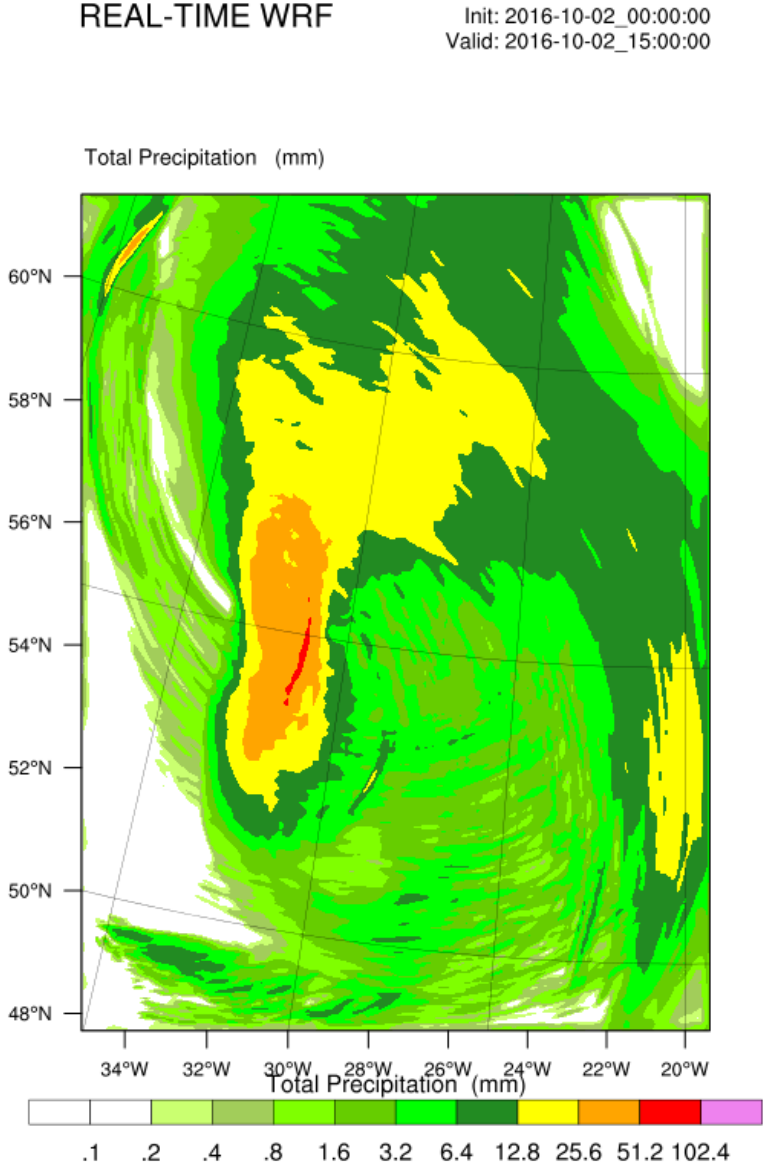

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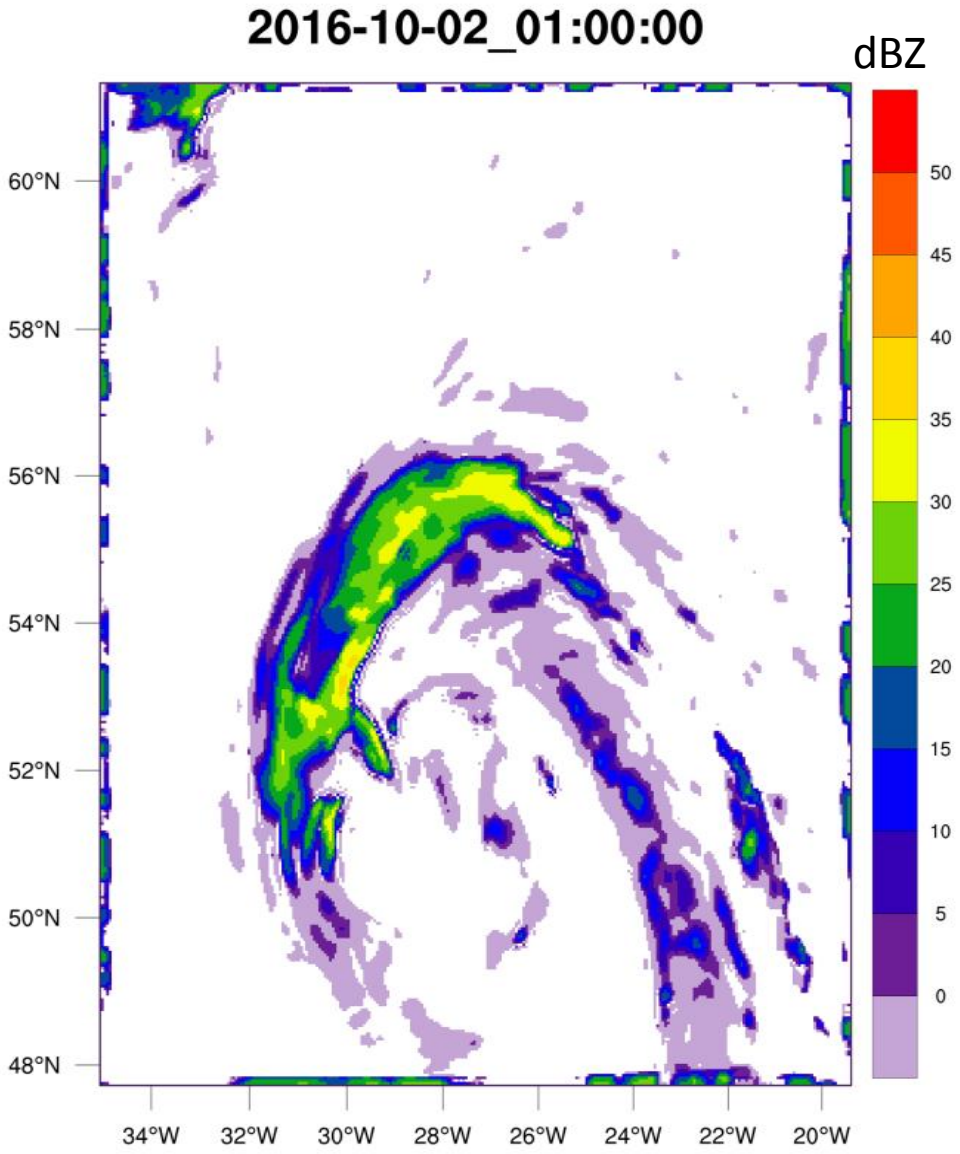

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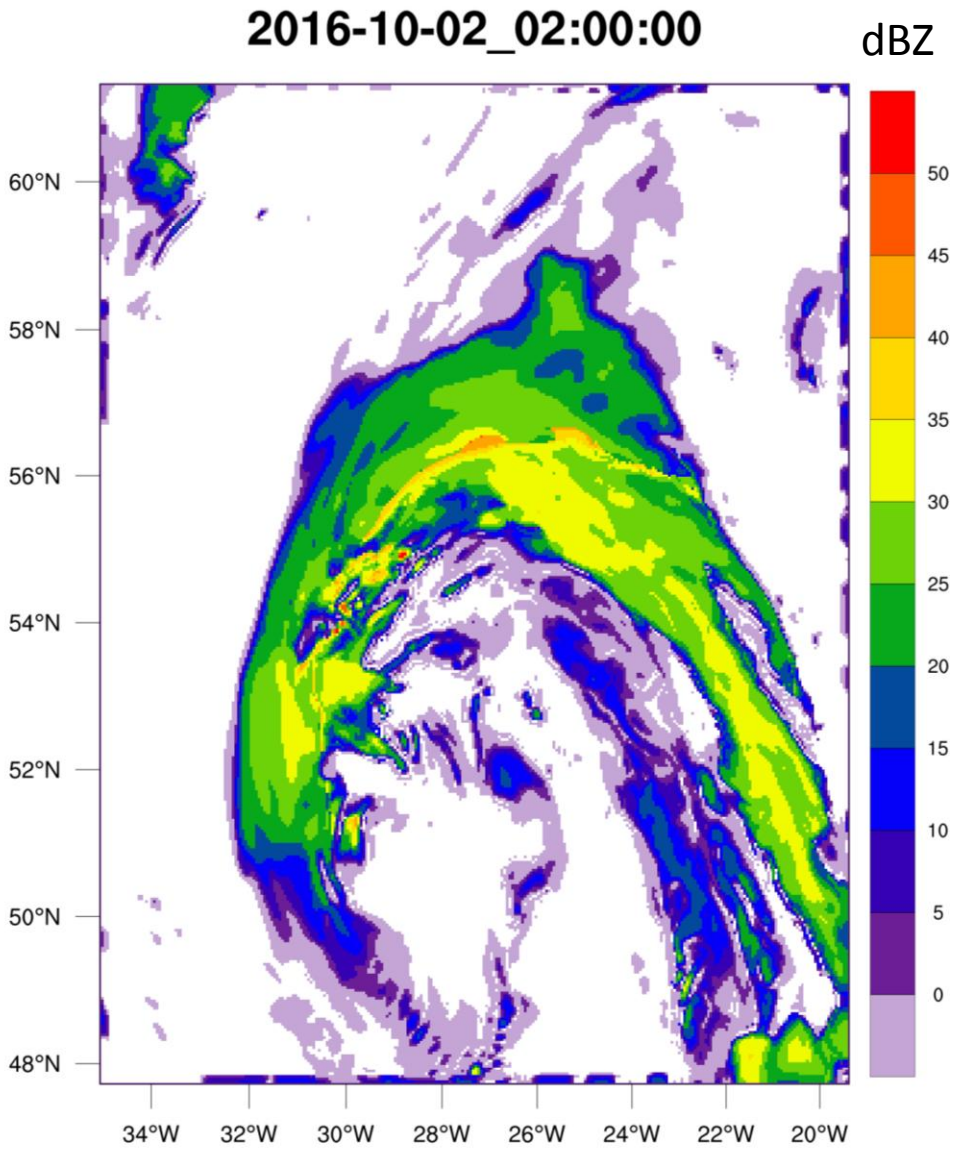

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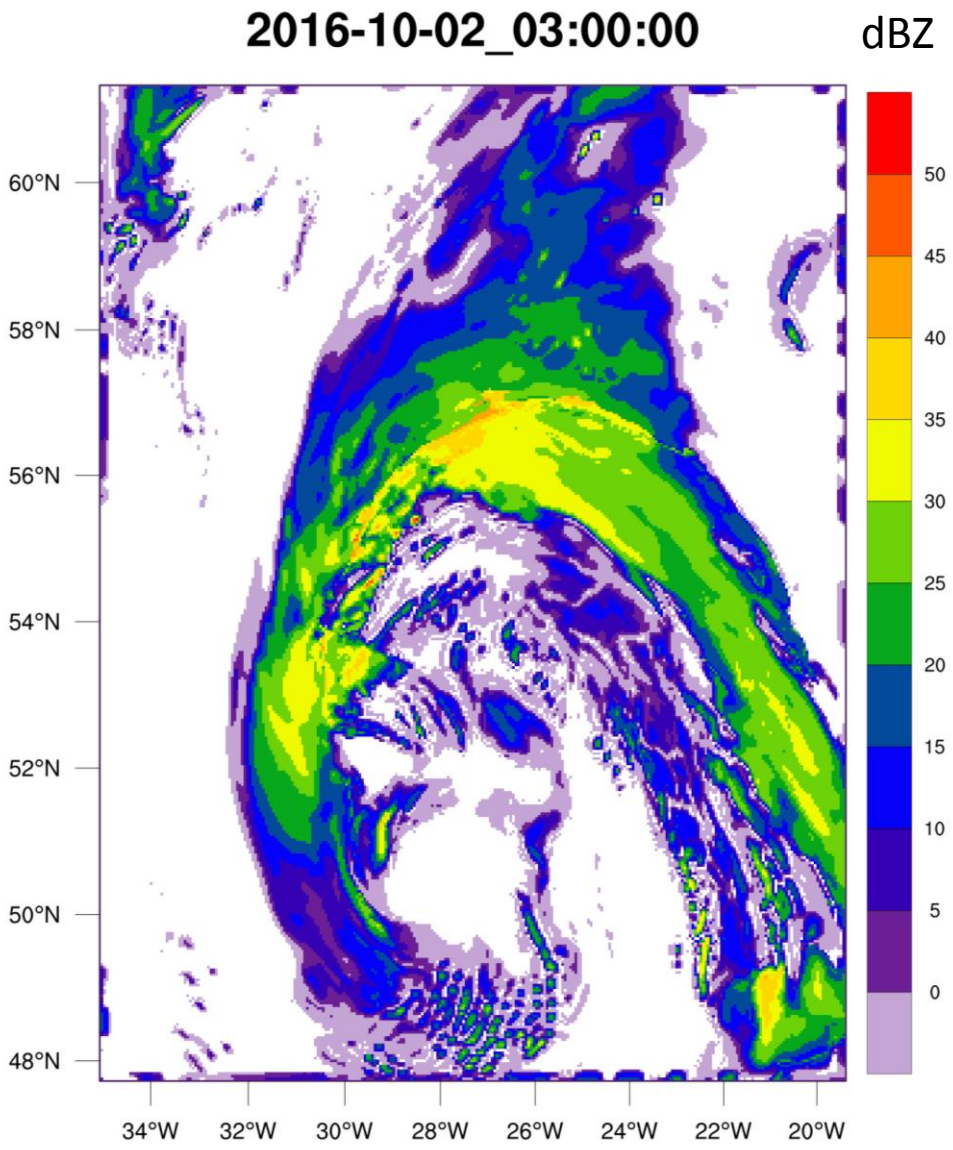

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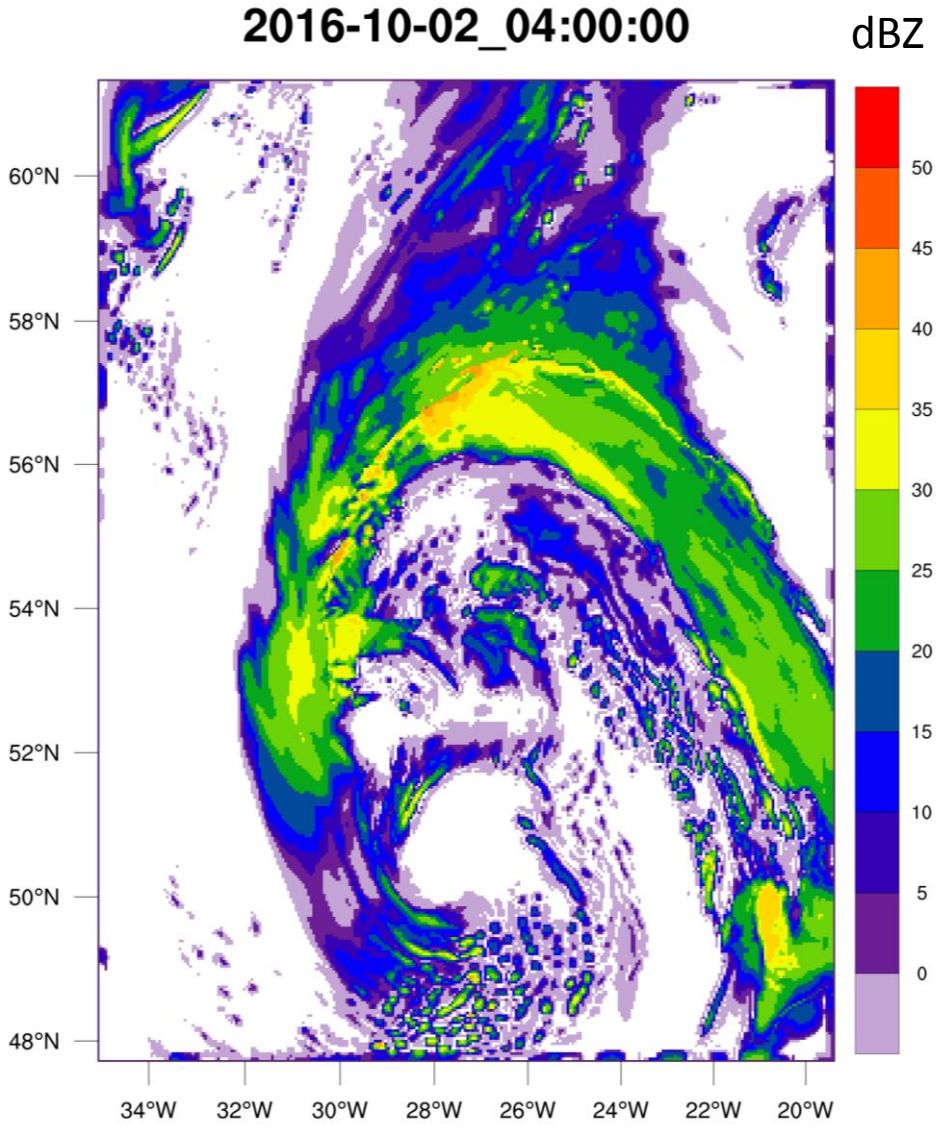

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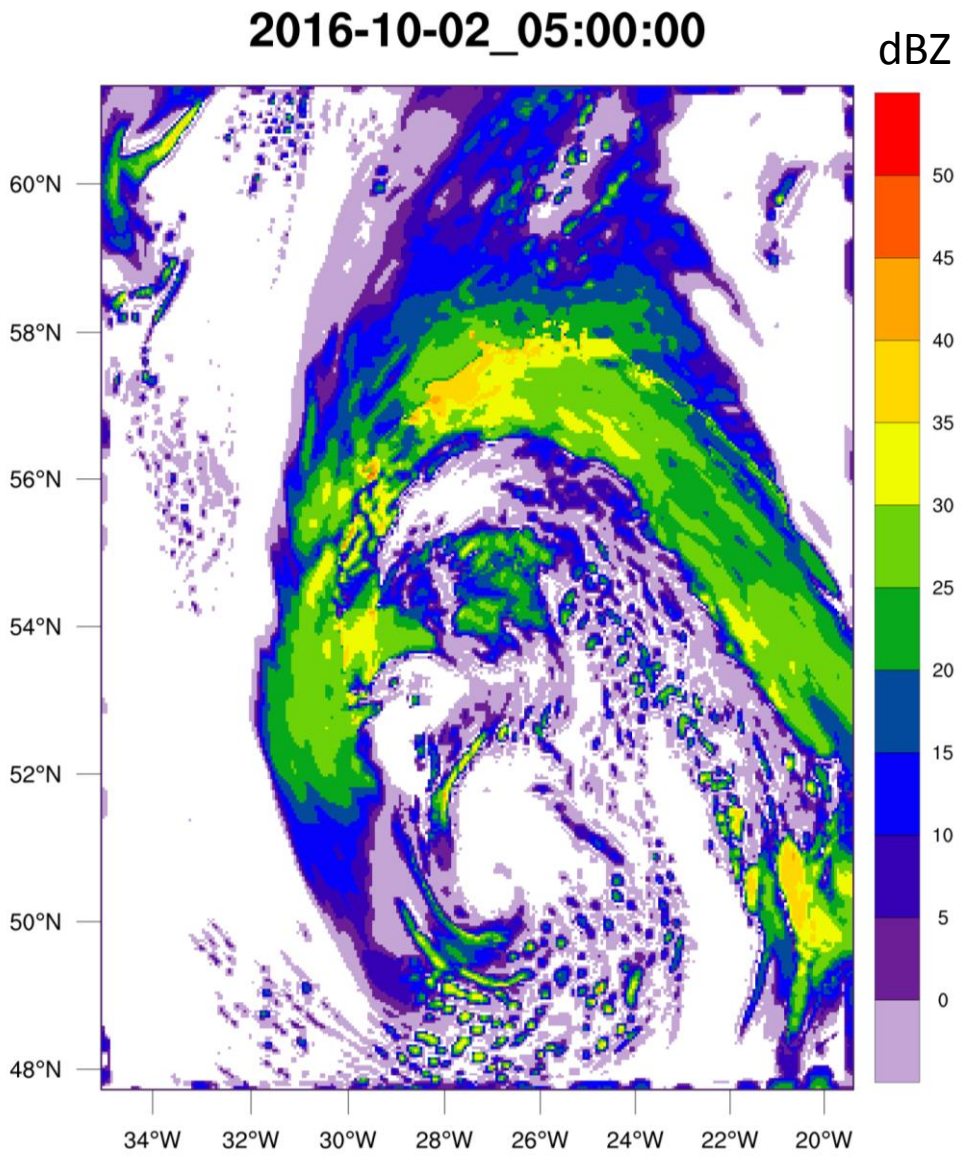

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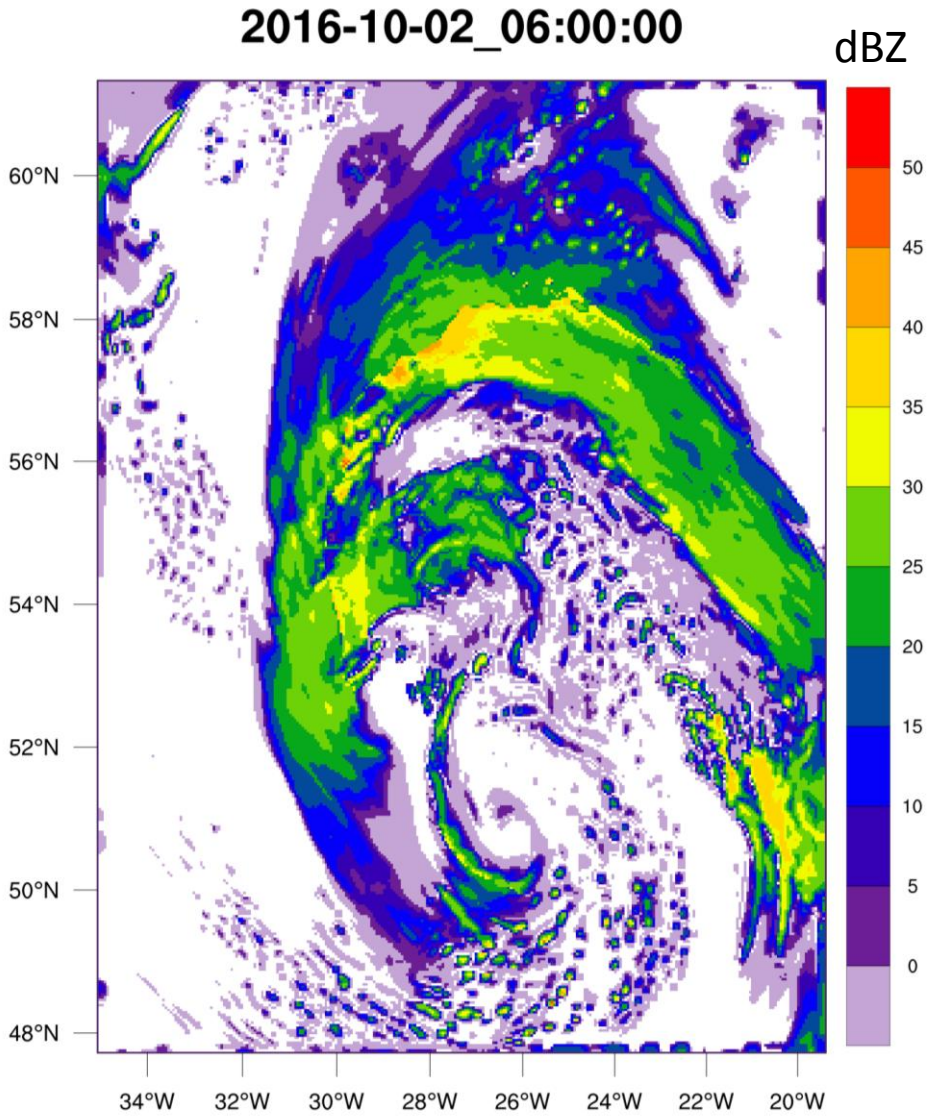

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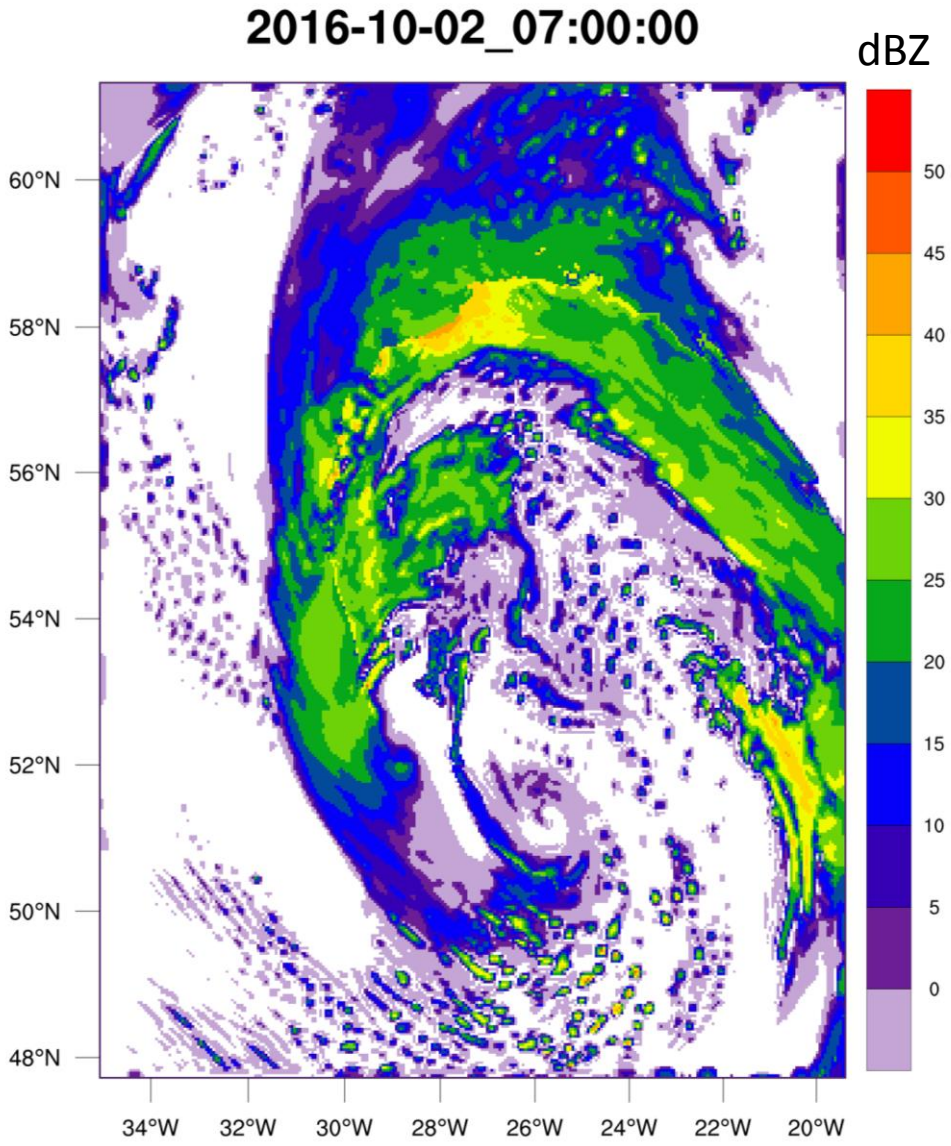

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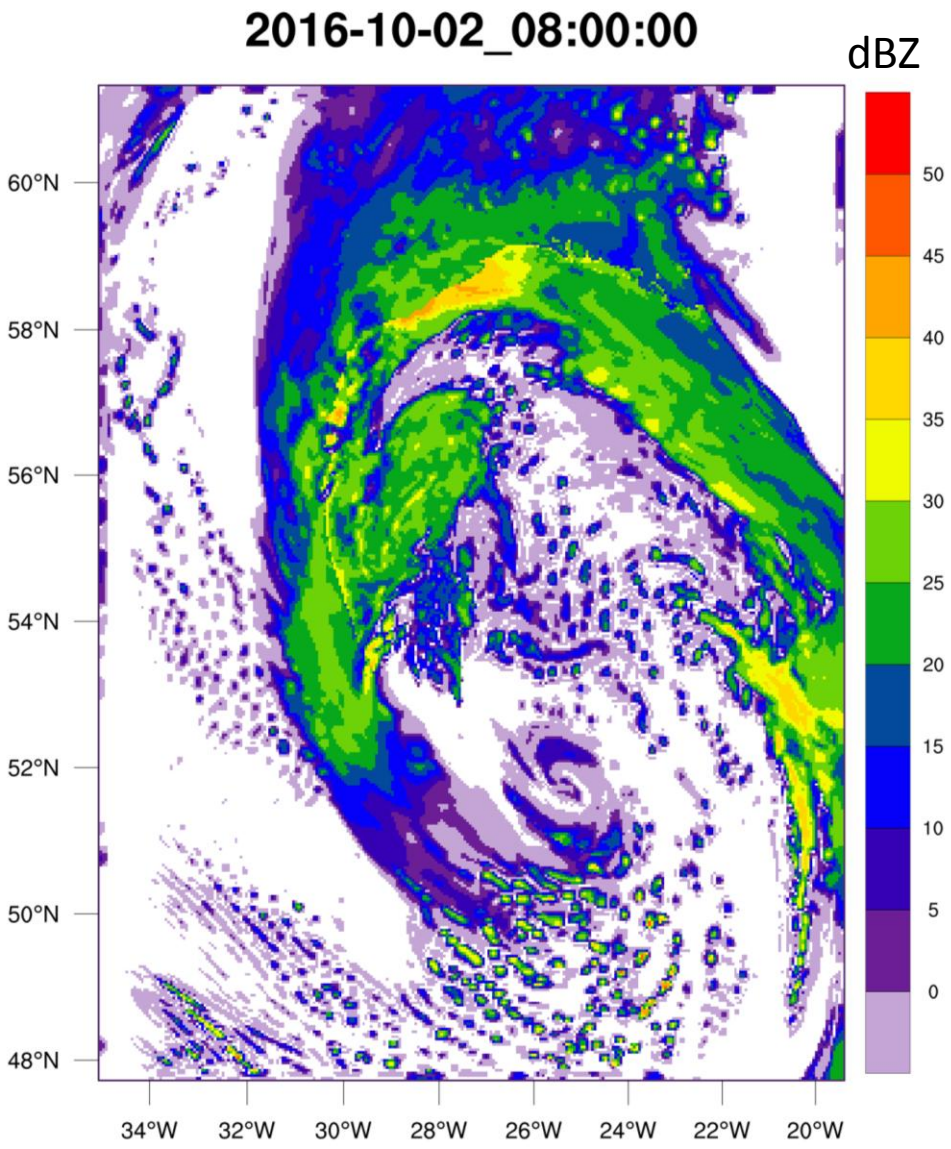

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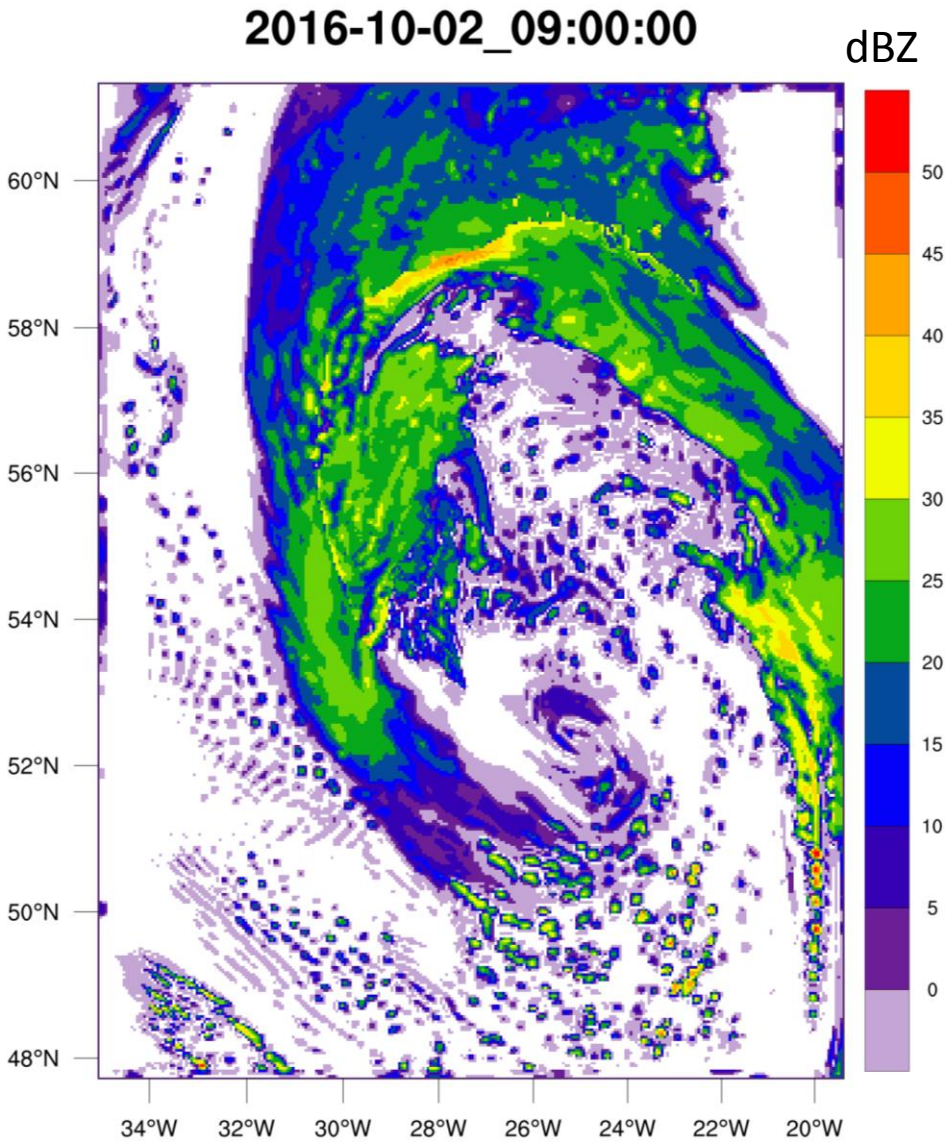

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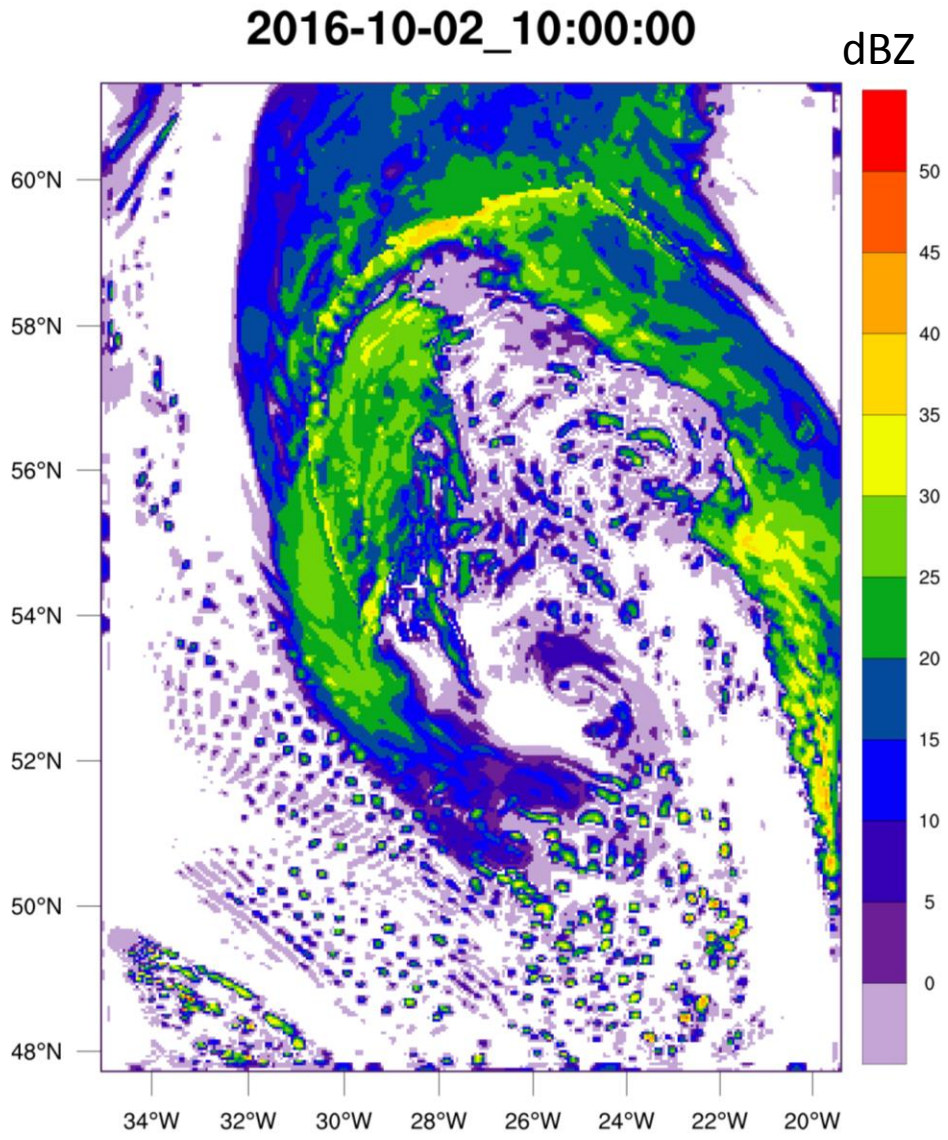

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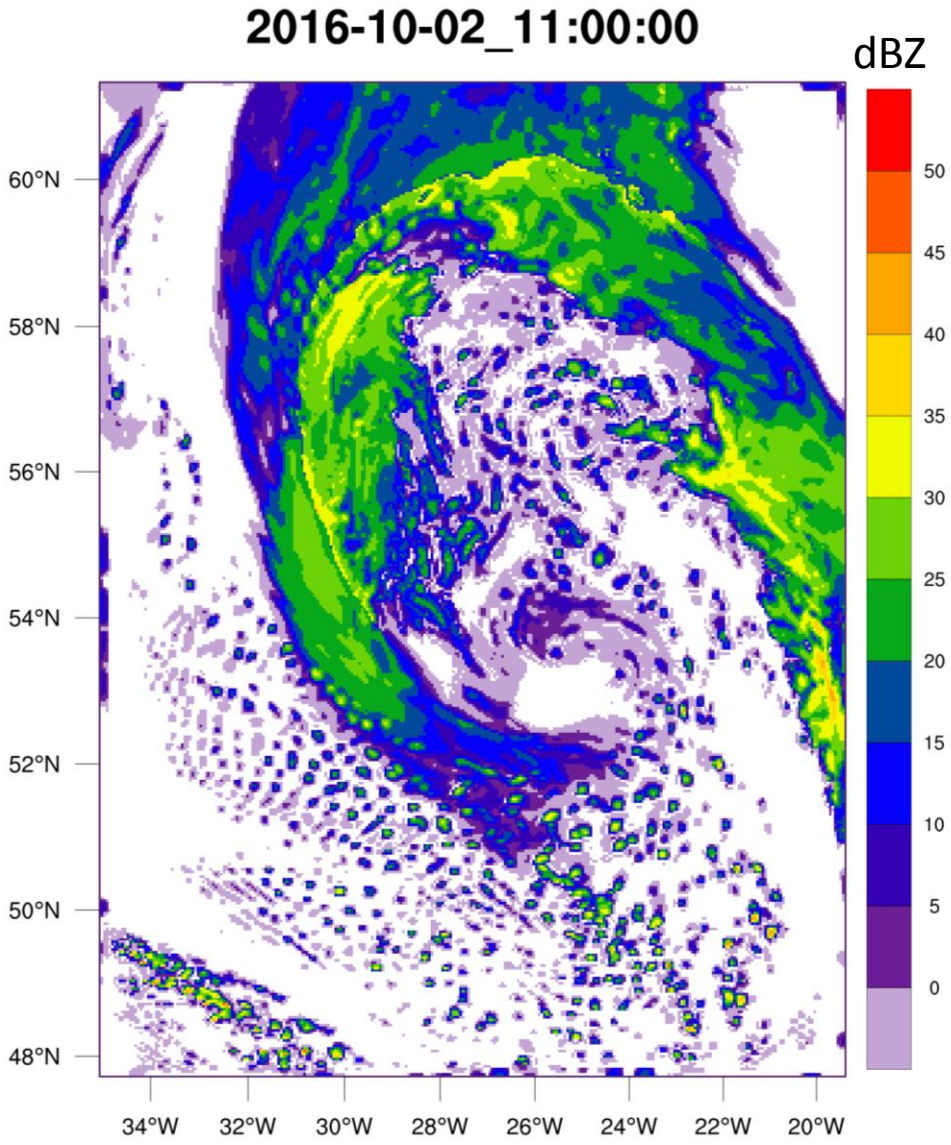

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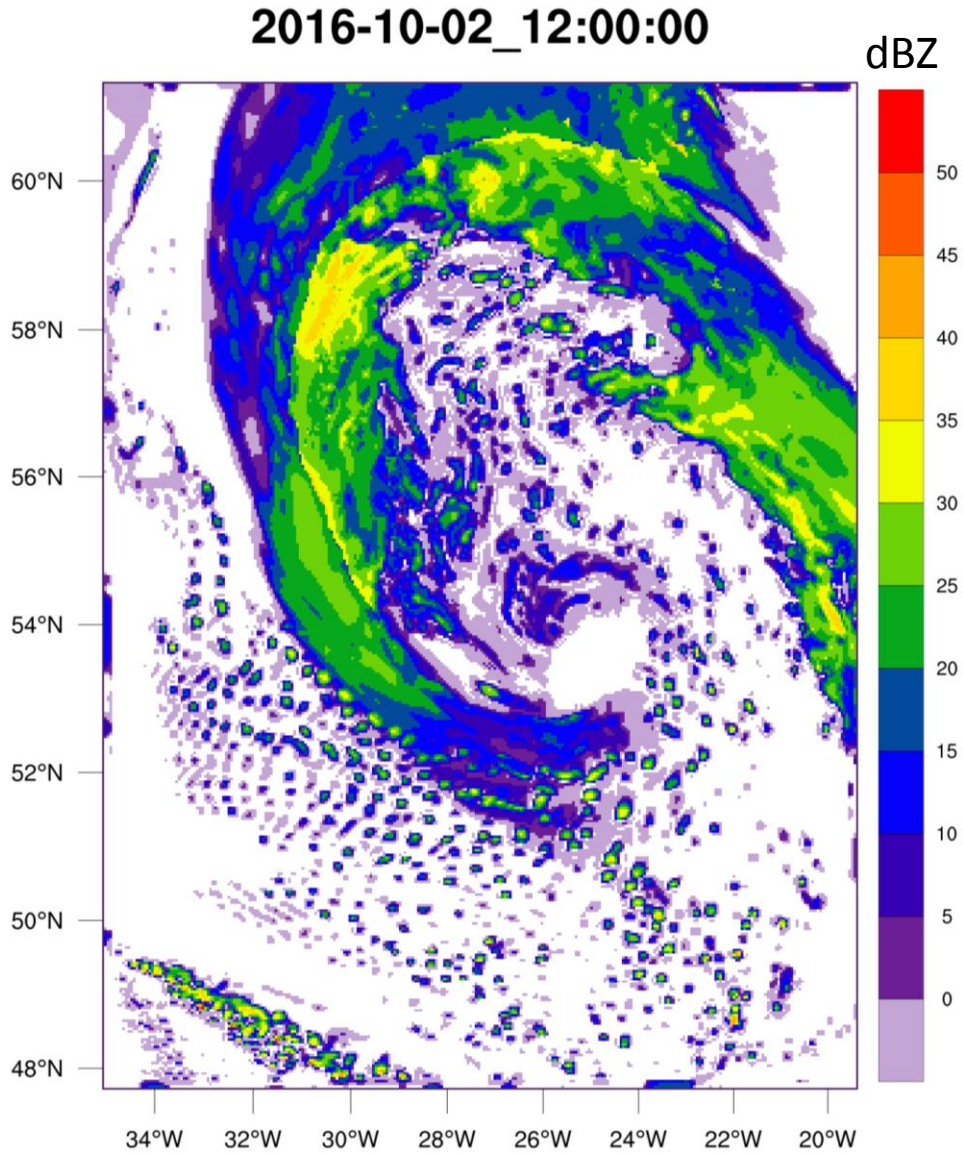

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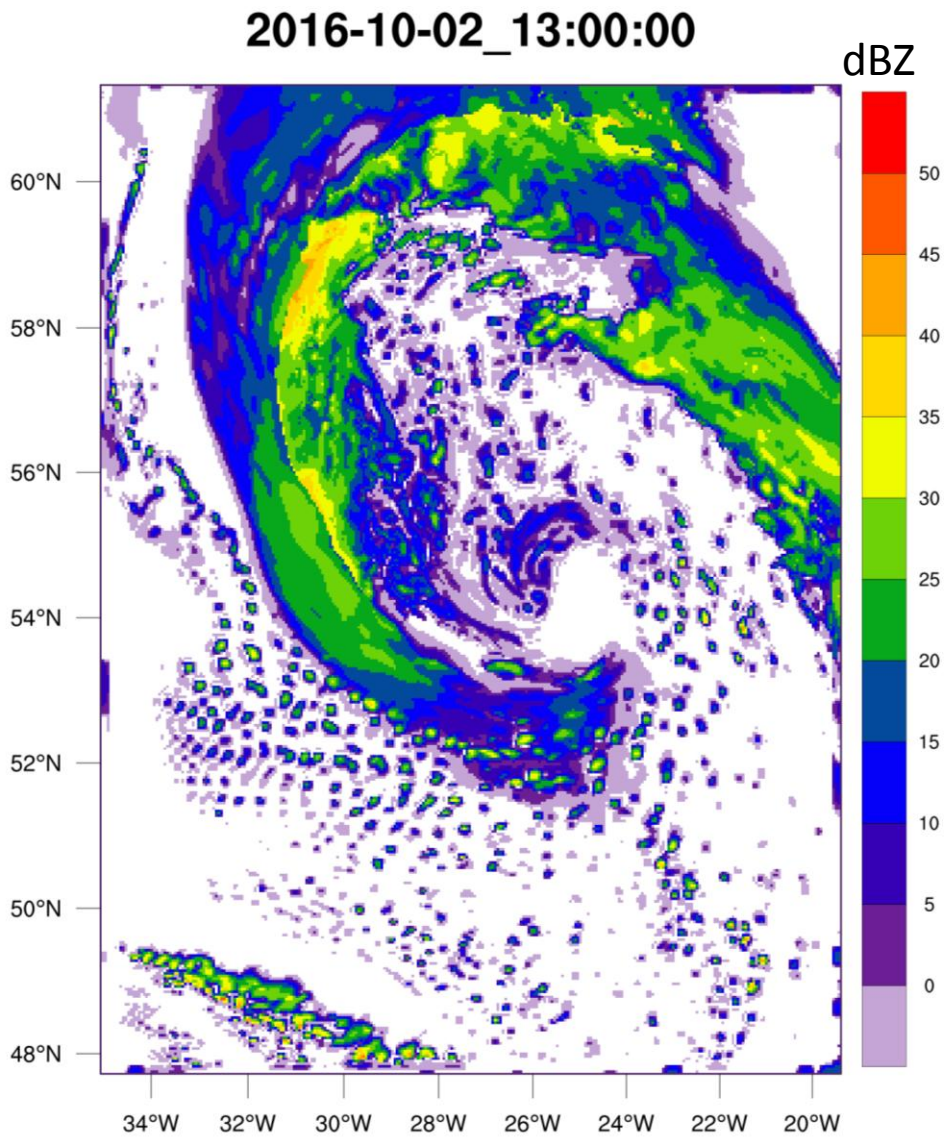

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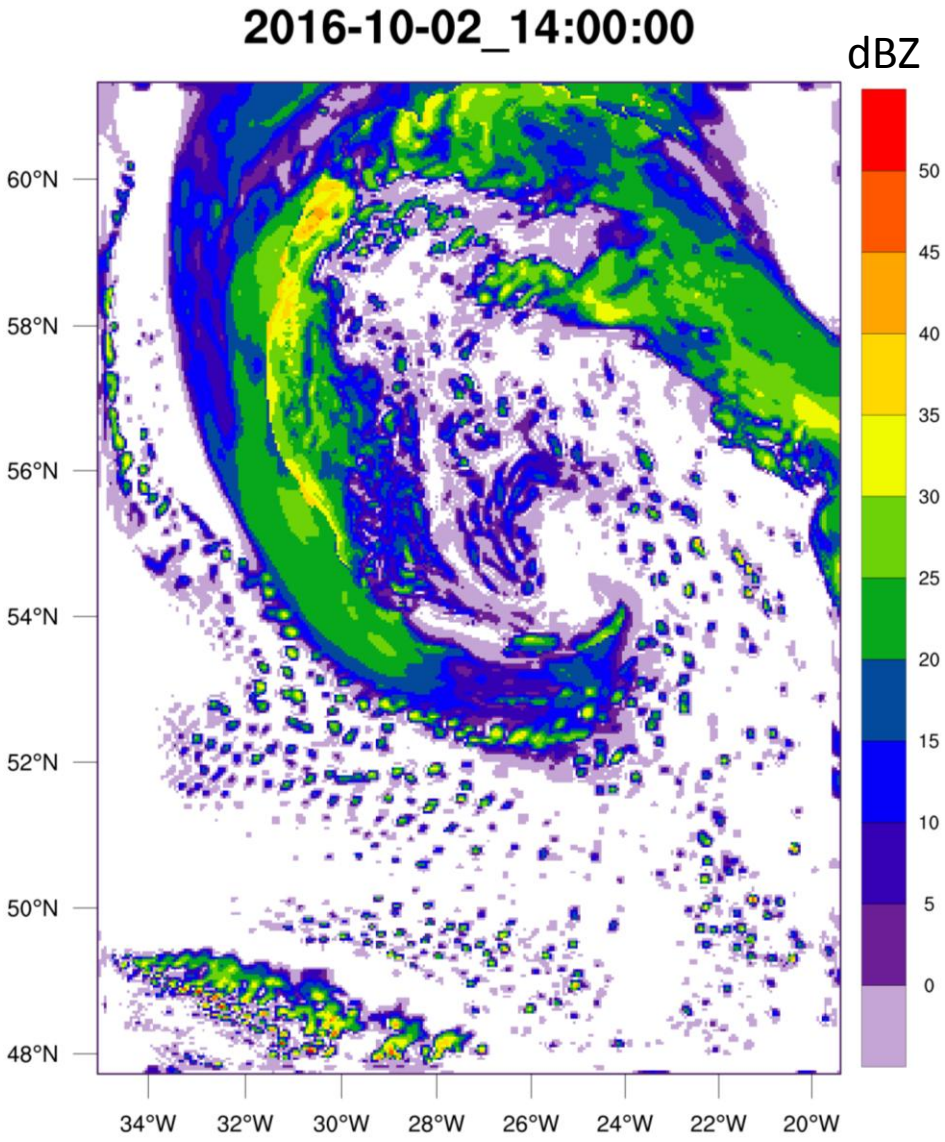

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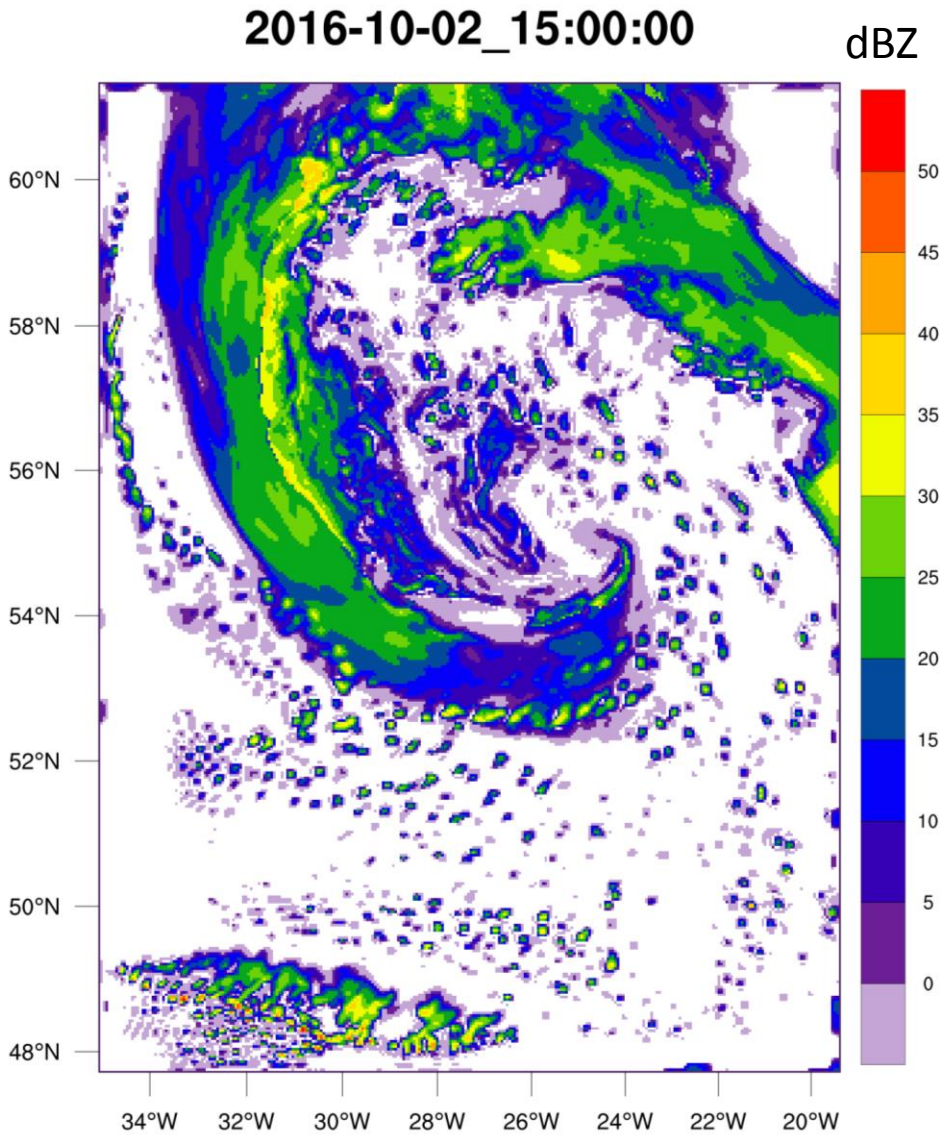
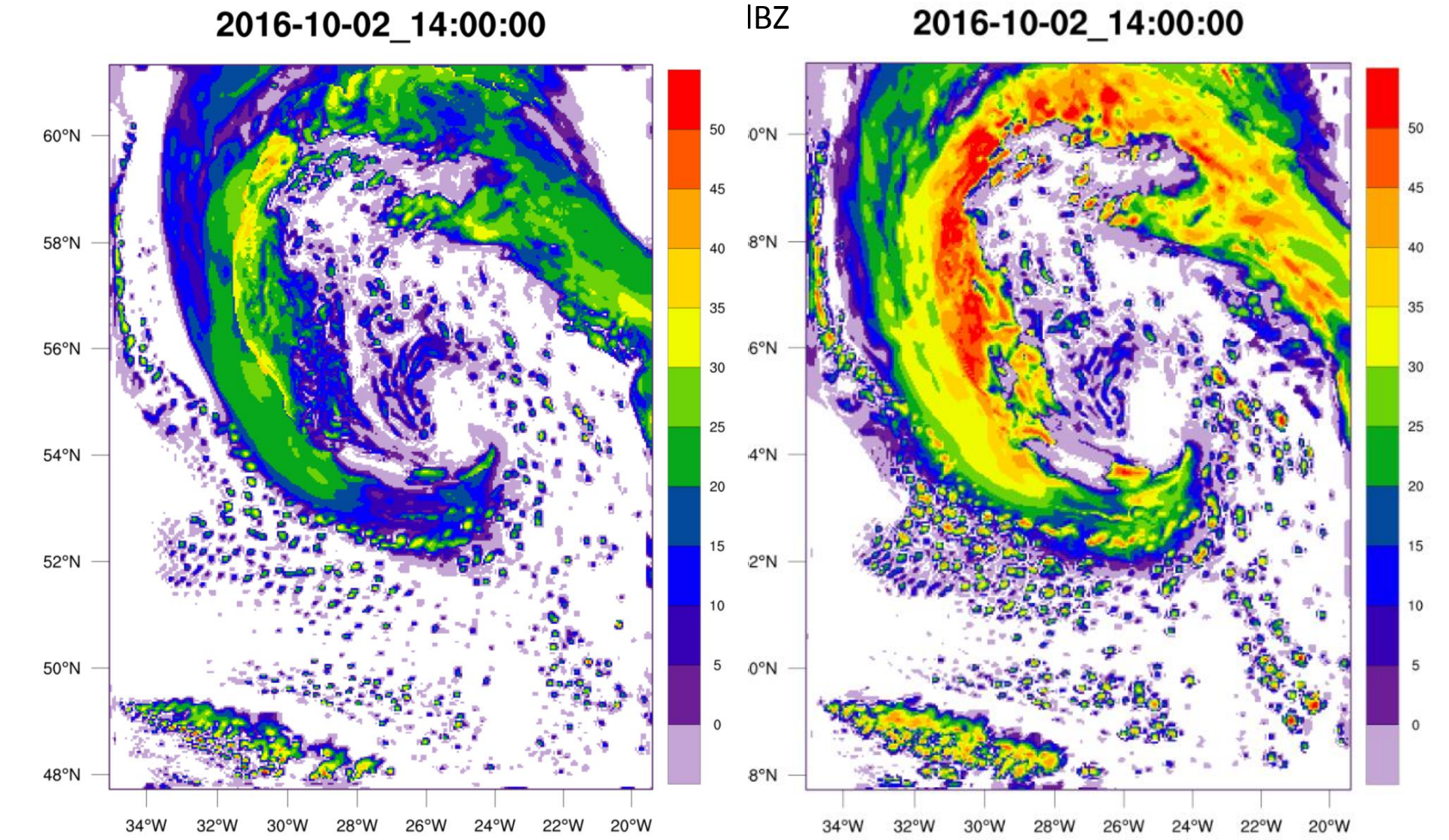


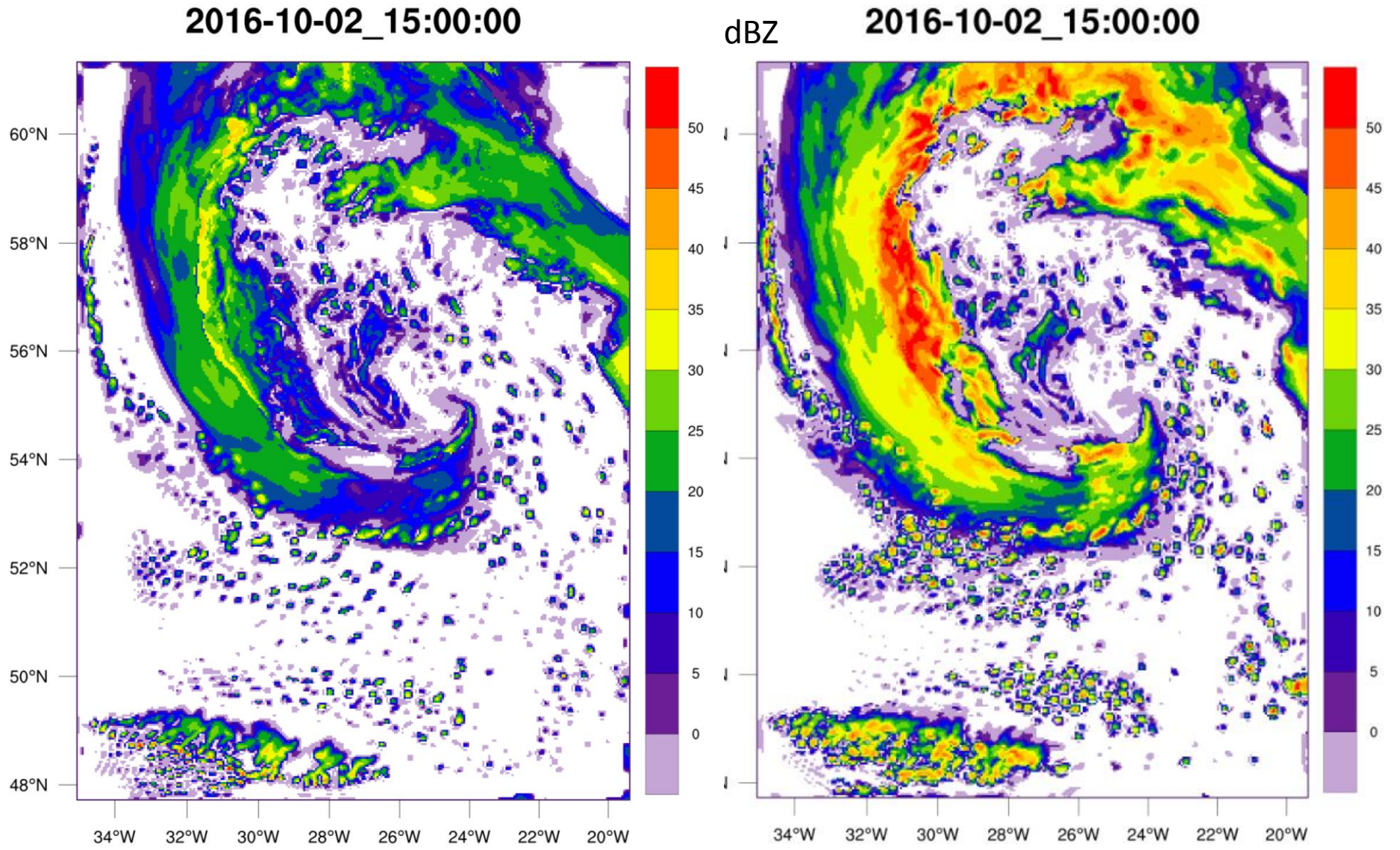
Thompson scheme

Morrison scheme



Thompson scheme

Morrison scheme



Méthodologie:

- poursuivre l'évolution individuelle des parcelles d'air à l'aide des trajectoires (**backward ou forward**) et
- analyser le taux de réchauffement/refroidissement dû à la condensation/évaporation, déposition/ sublimation, givrage et fonte des hydrométéores

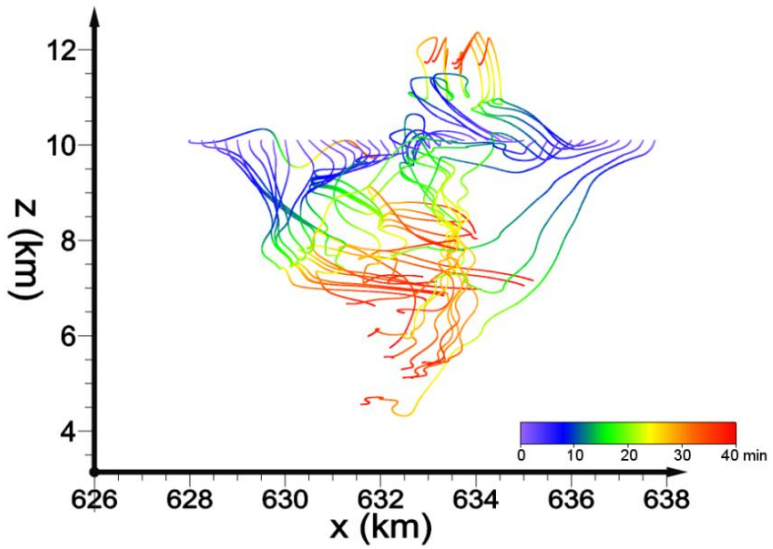
<u>Analyse des trajectoires</u>

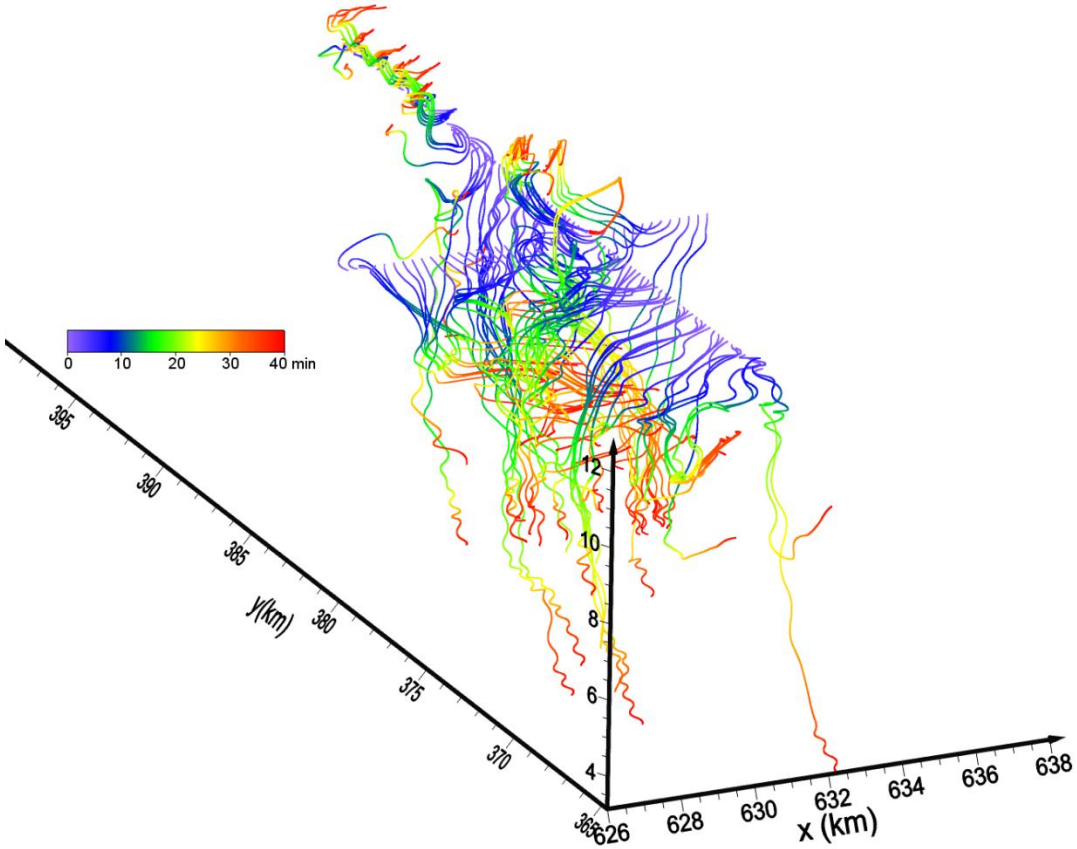
1) méthode lagrangienne: sélection des parcelles individuelles + suivi de T, w, Q_{LWC}, Q_{ice}, taux de condensation, …

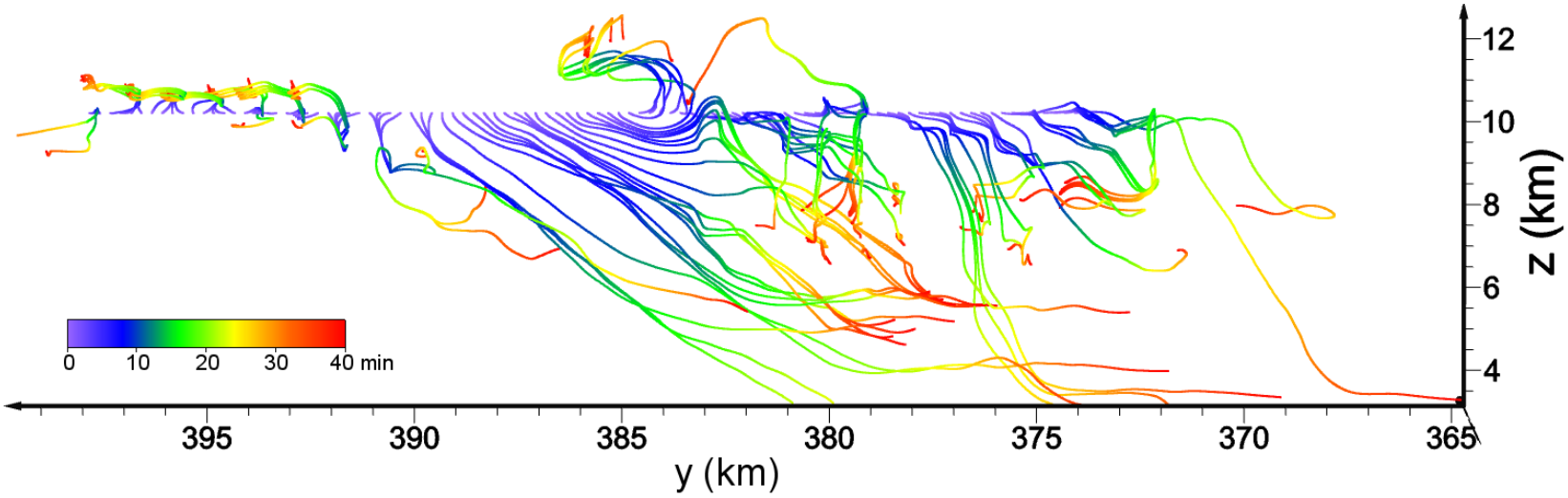
2) sélection d'une scène importante (30-40 min) avec tous les paramètres d'intérêt (u, v, w, T, RH, $Q_{LWC,}$ …) en 3D sur un domaine réduit.

➔ Calcul des trajectoires **backward ou forward** pour chaque points du domaine sélectionné

Darwin 2014 (HAIC)







- Quelques questions techniques
  - Le 2 octobre = IOP6 ou IOP7 car nomination différente sur Wiki page et dans le BAMS
  - Le Falcon FR trajectoire du 2 octobre = RF06 ou RF07 car dénomination différente sur Wiki page et dans le BAMS
  - Base de données – accès ?

- Quelle(s) IOP(s) pour le meilleur cas d'étude possible ? 2 octobre est ok?