



PHYSICS AND DYNAMICS AROUND THE OVERSHOOTING TOP OF SEVERE THUNDERSTORMS

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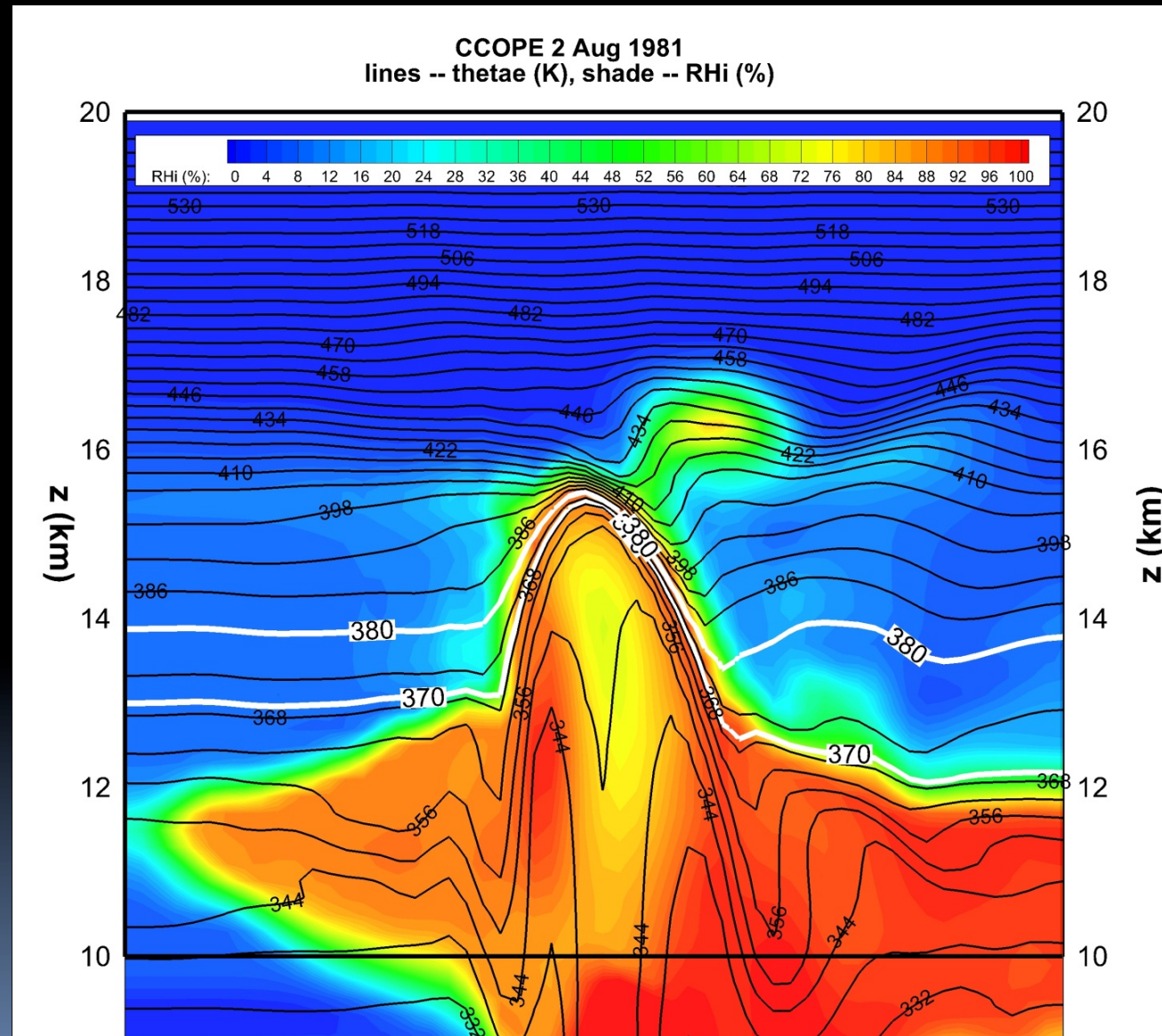
ECSS, 3 October, 2011, Mallorca, Spain

Overshooting top

- ✓ A transitory distortion of the tropopause caused by strong convection
- ✓ The occurrence of an OT **may** or **may not** indicate the material penetration of tropopause
- ✓ This study uses a cloud model to simulate some observed features around an OT



Overshooting \neq tropopause penetration



Features observed around the overshooting top (OT)

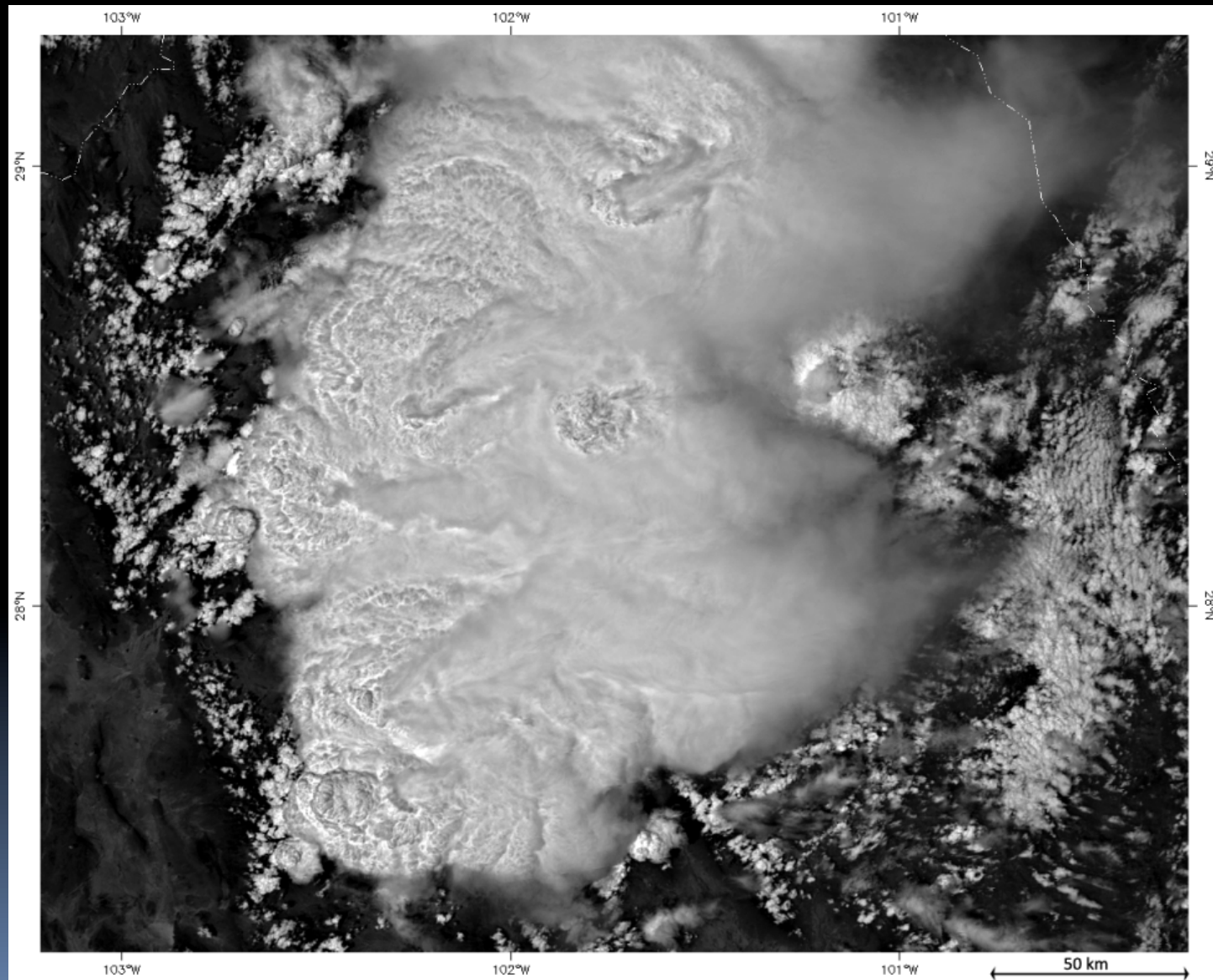
- **Visible features**

- Above-anvil ice plumes (AAIP)
- Jumping cirrus (JC)
- Storm top ship waves (STSW)

- **IR-features**

- Cold area (CA)
- Cold-V
- Warm-cold couplet (WCC)
- Cold ring, warm trench

above-anvil plumes



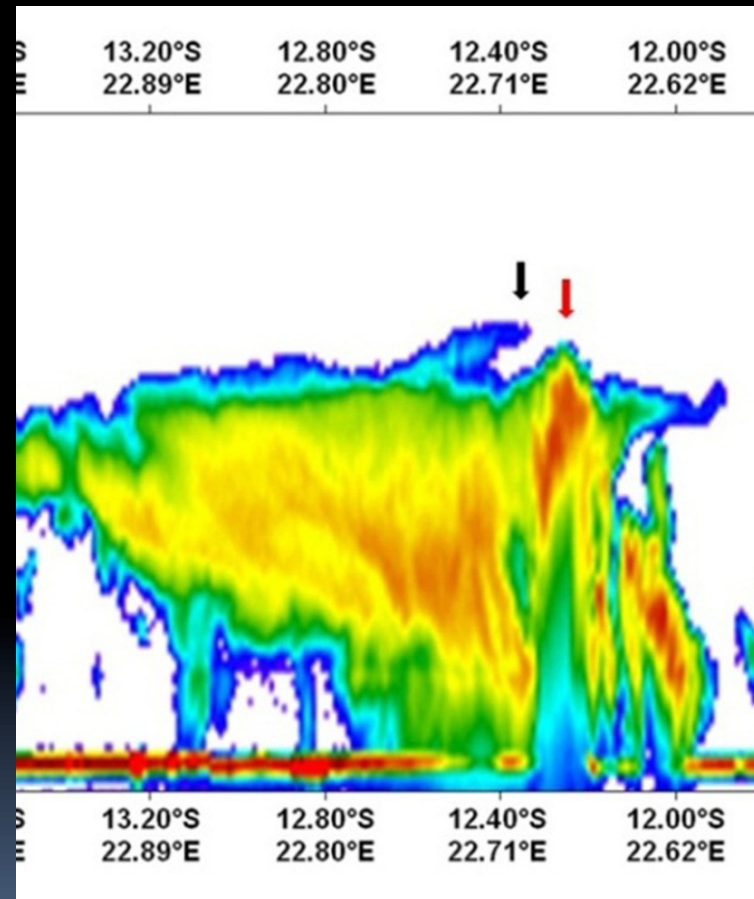
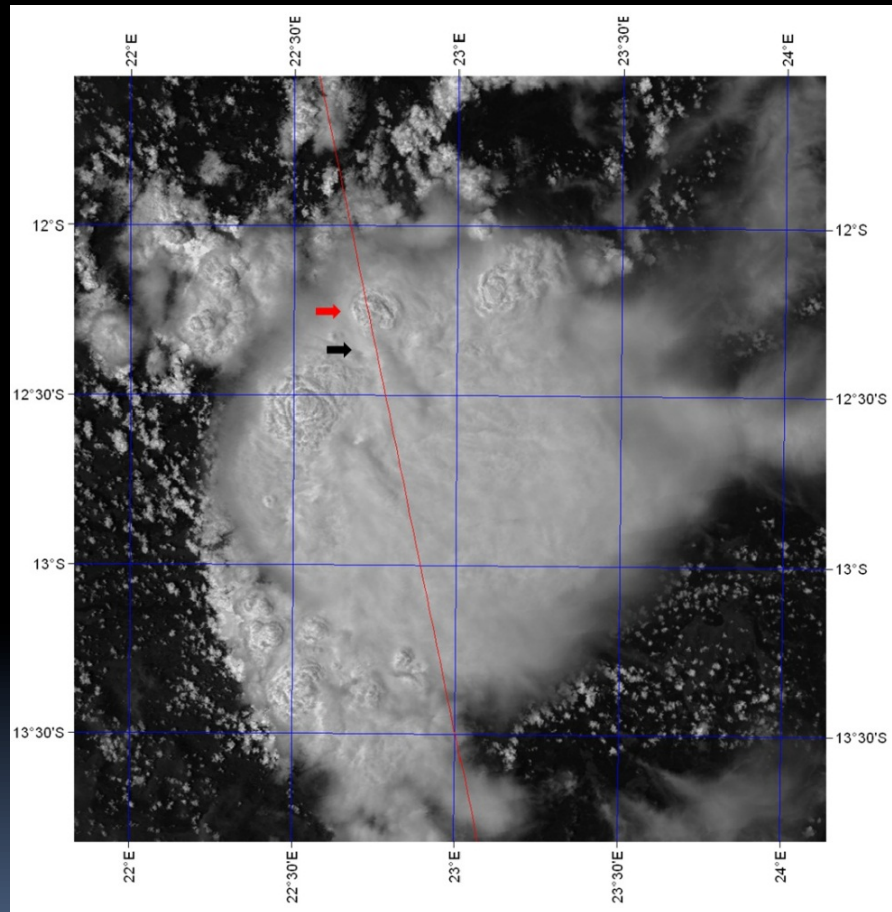
Jumping cirrus

Eau Clair, Wisconsin

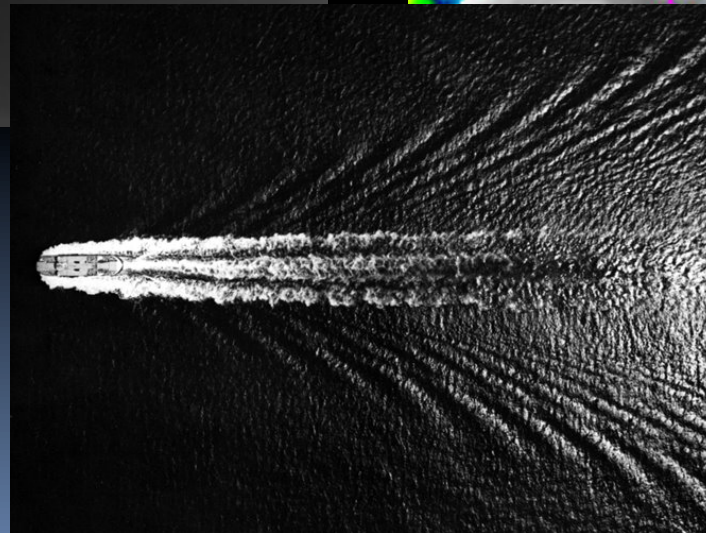
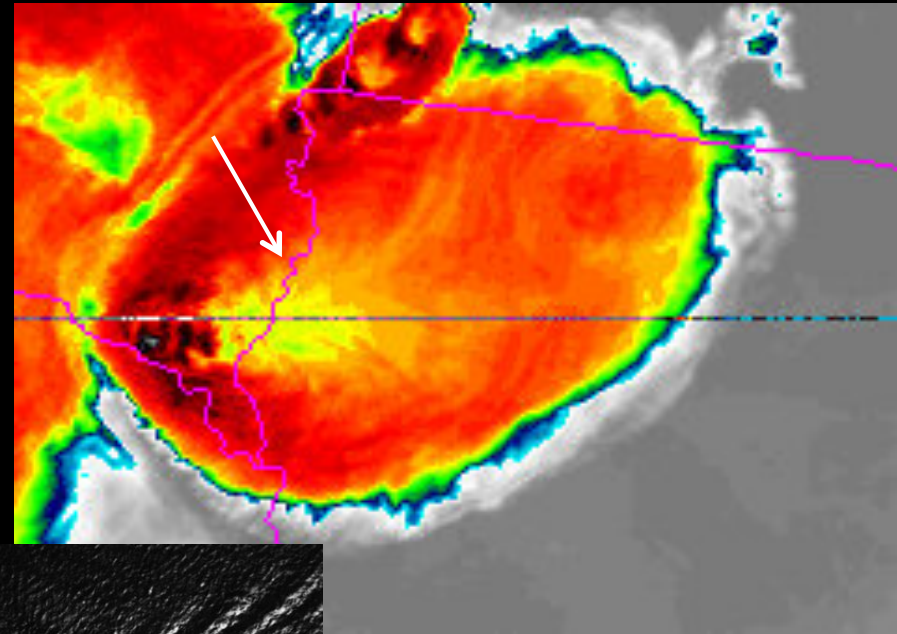
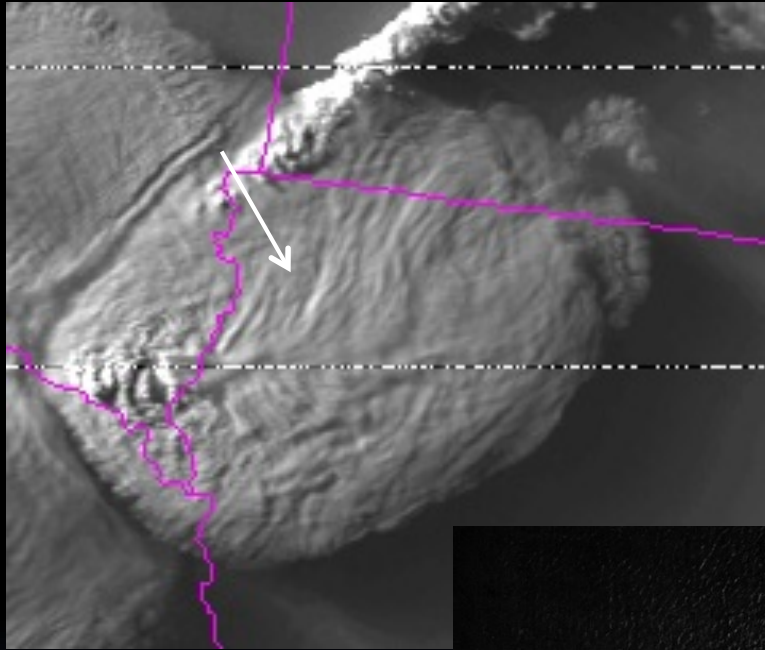


Jumping cirrus

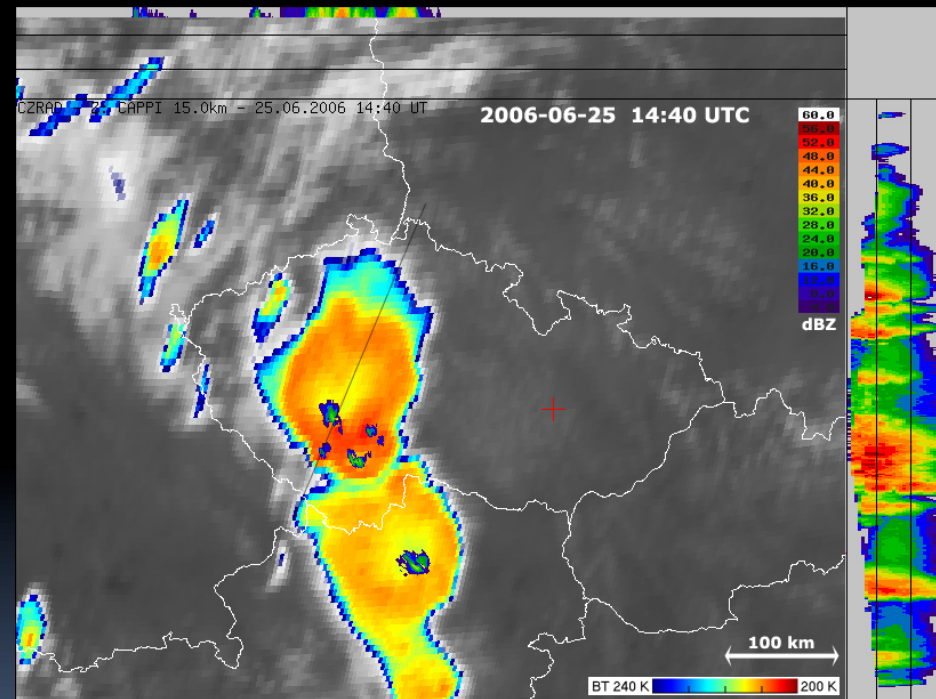
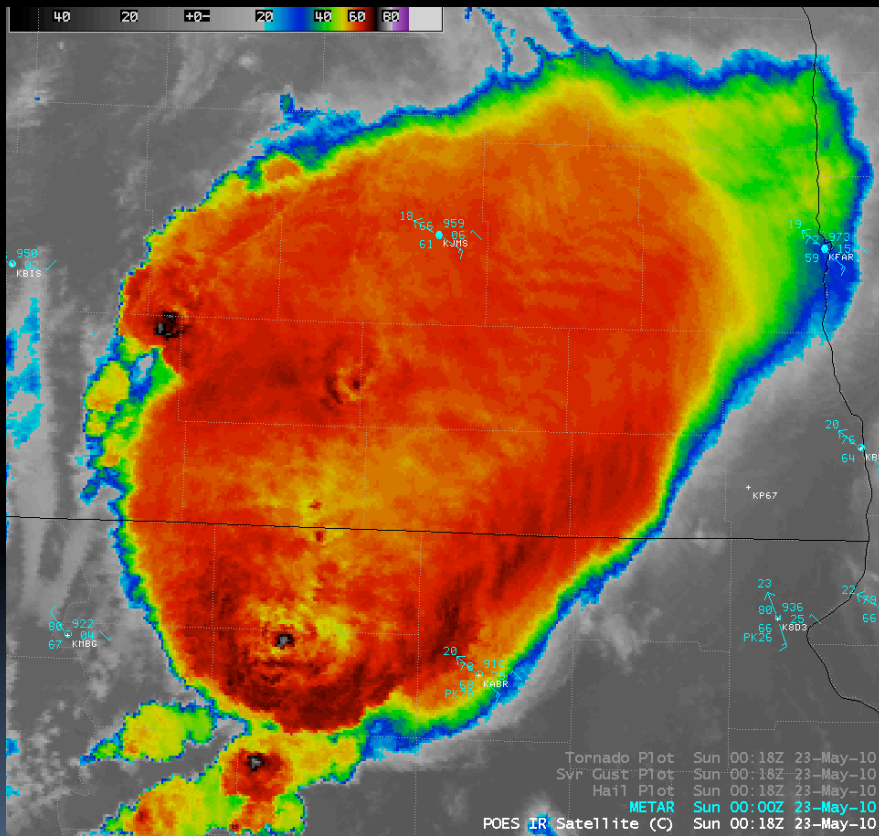
satellite observations



Storm top ship waves

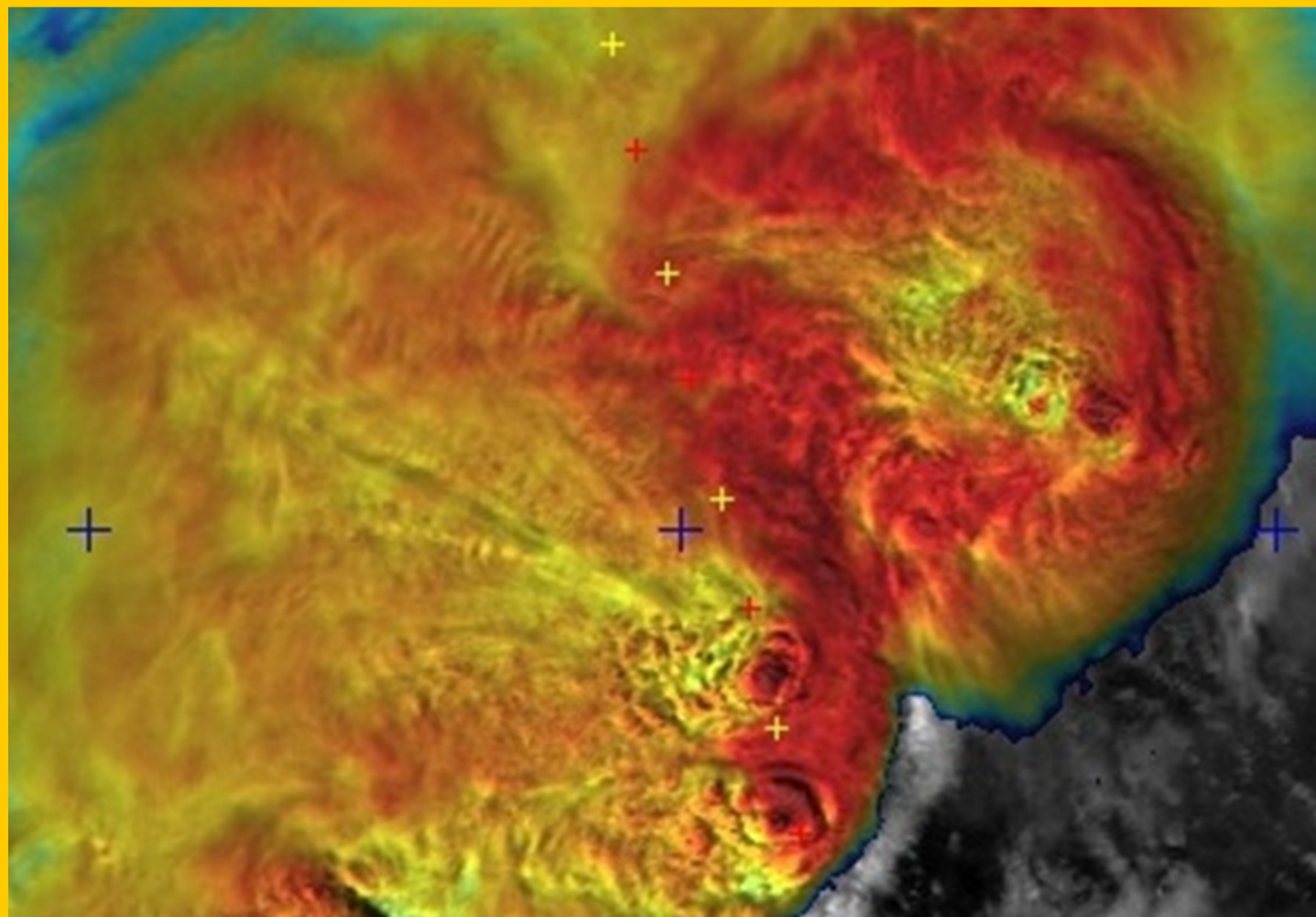


Cold-V, WCC, Cold ring, warm trench



MARTIN'S
sandwiches

@martins
Hand Crafted



f a century!

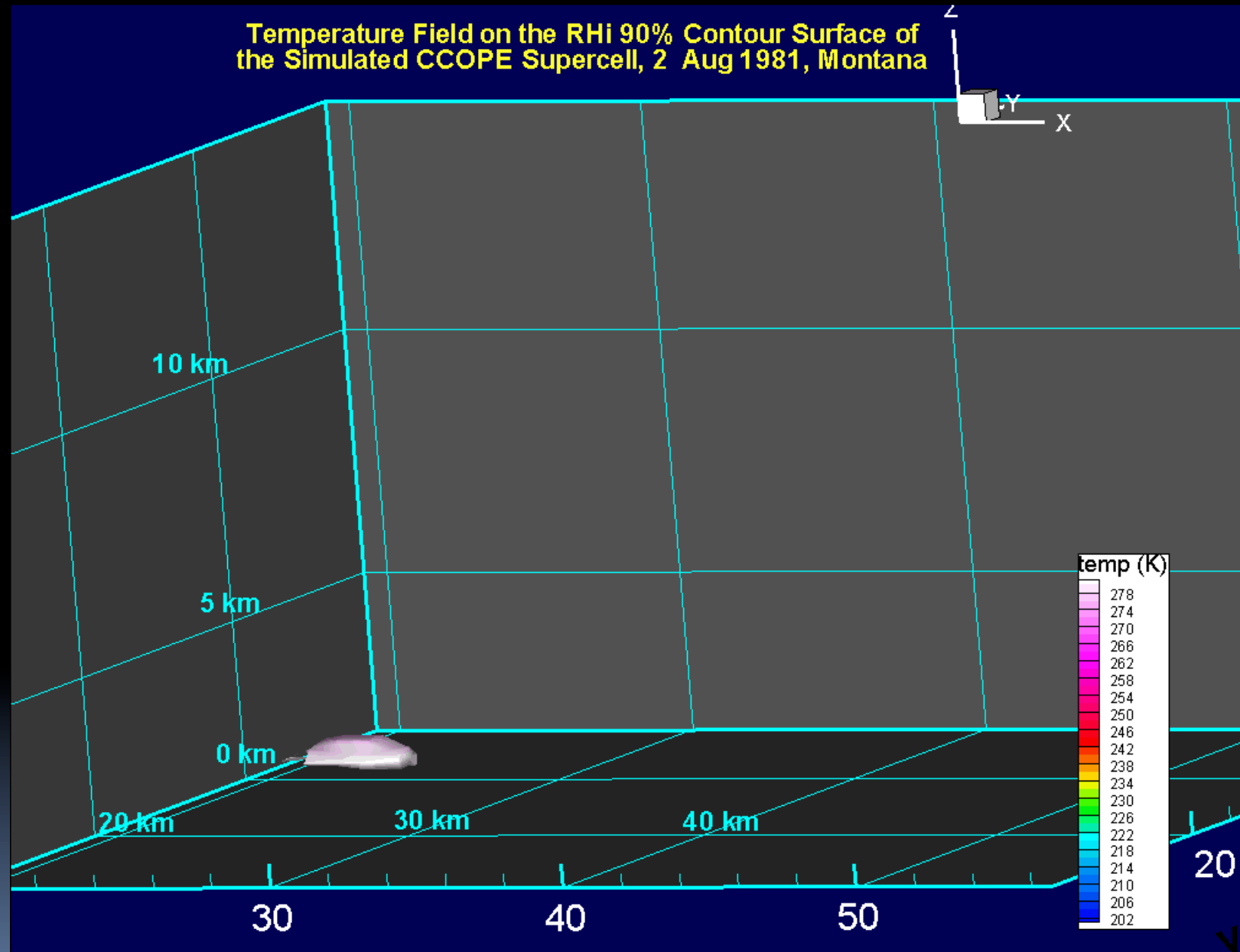
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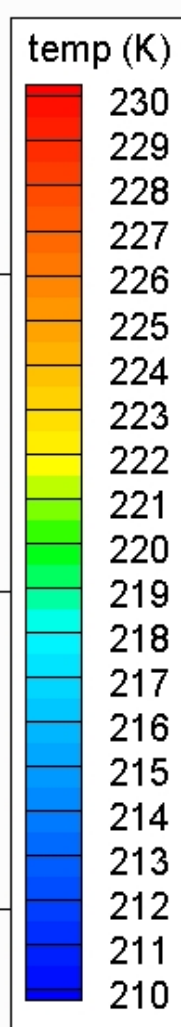
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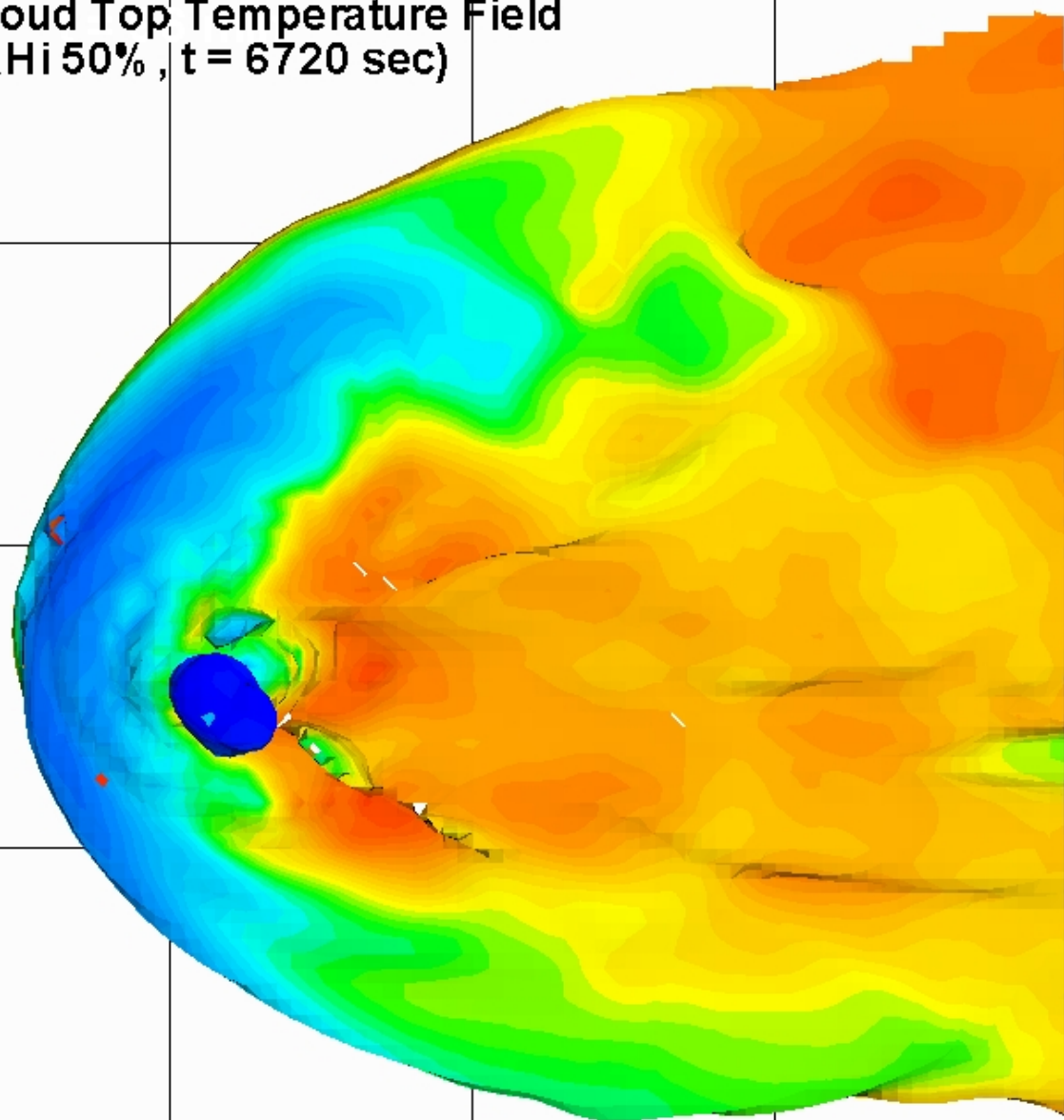
Chick
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Temperature Field on the RHi 90% Contour Surface of
the Simulated CCOPE Supercell, 2 Aug 1981, Montana





Cloud Top Temperature Field
(RHi 50%, $t = 6720$ sec)



40

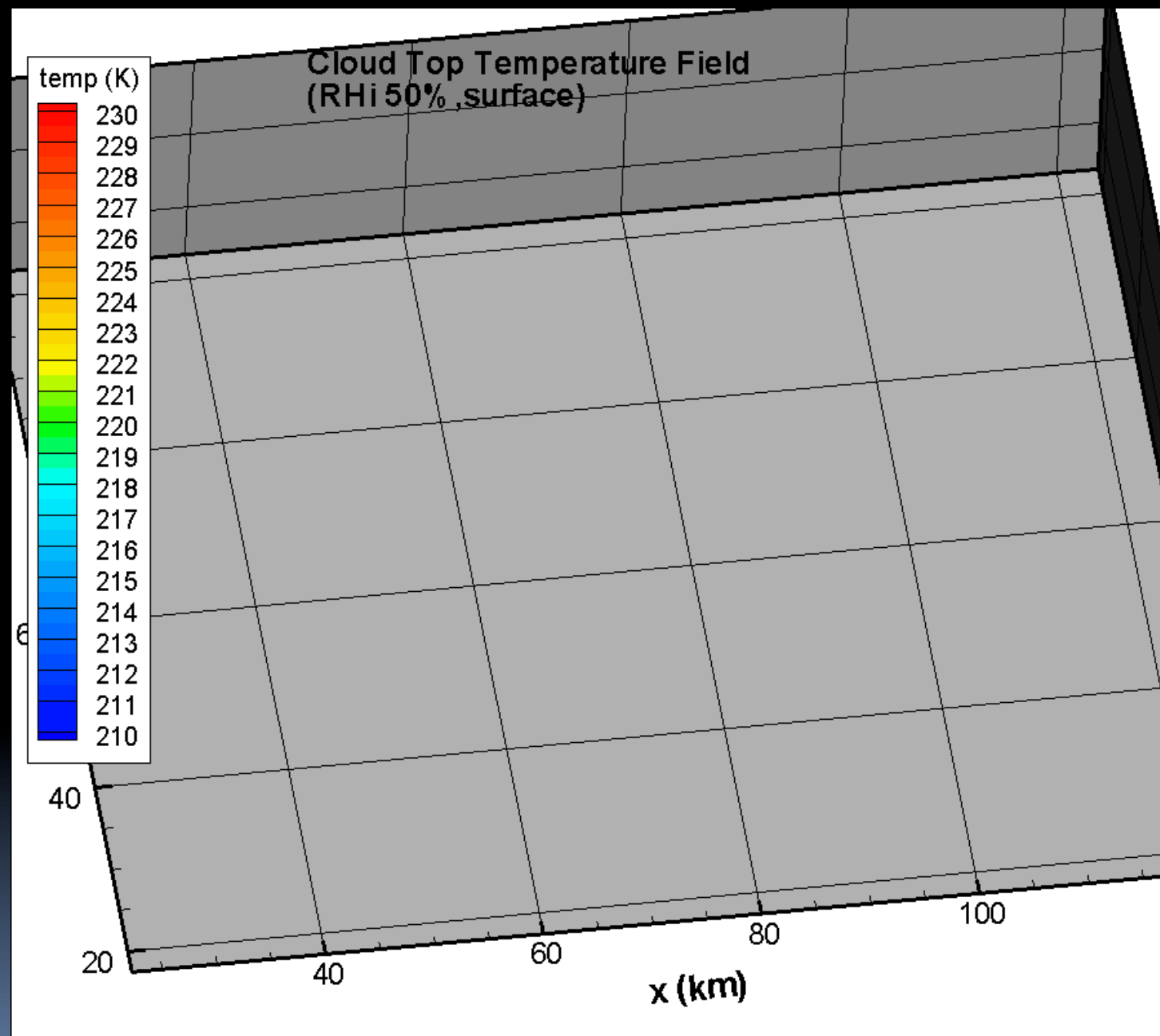
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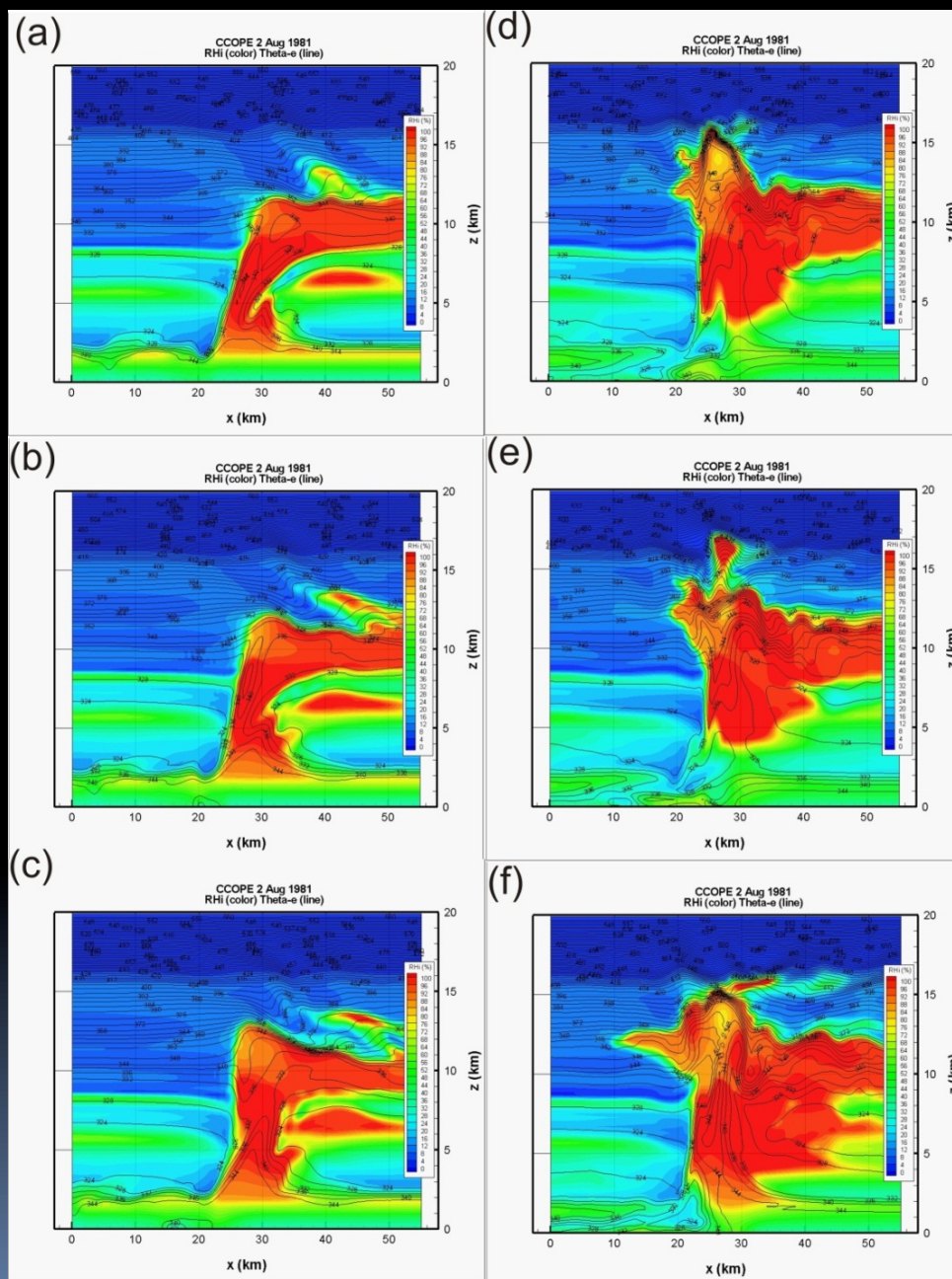
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100

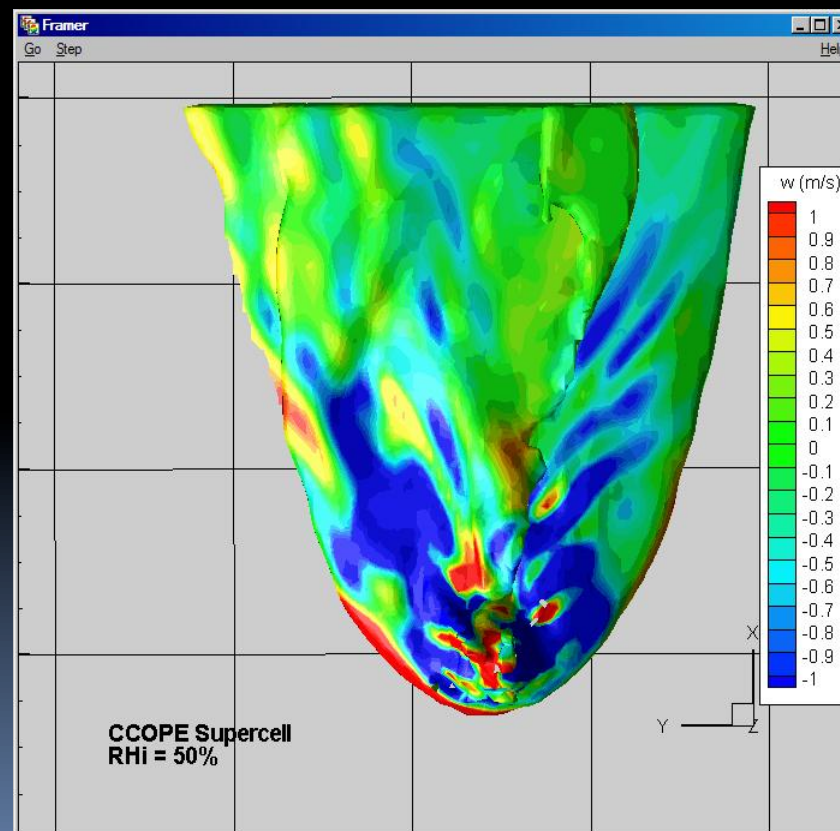
120

x (km)

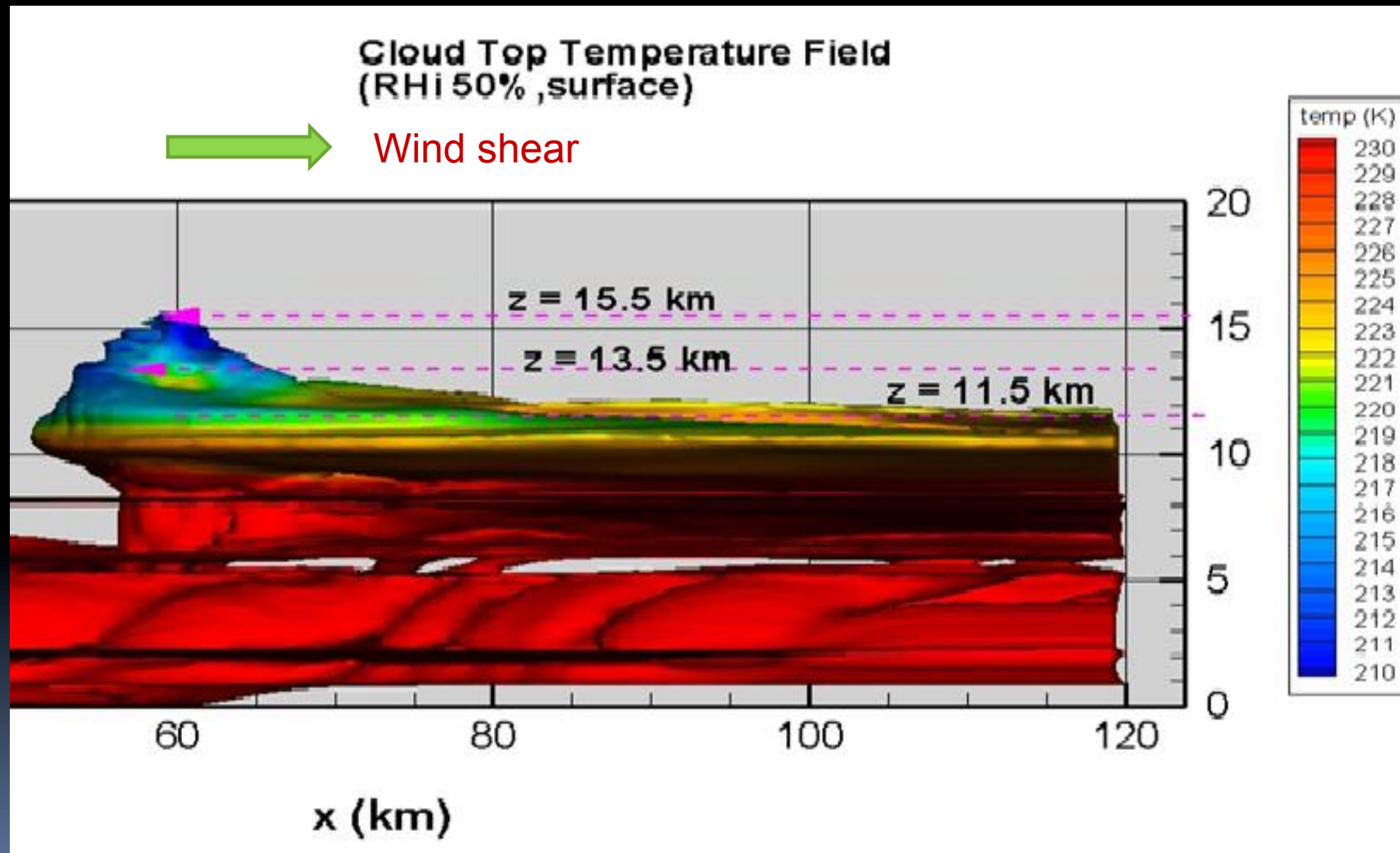




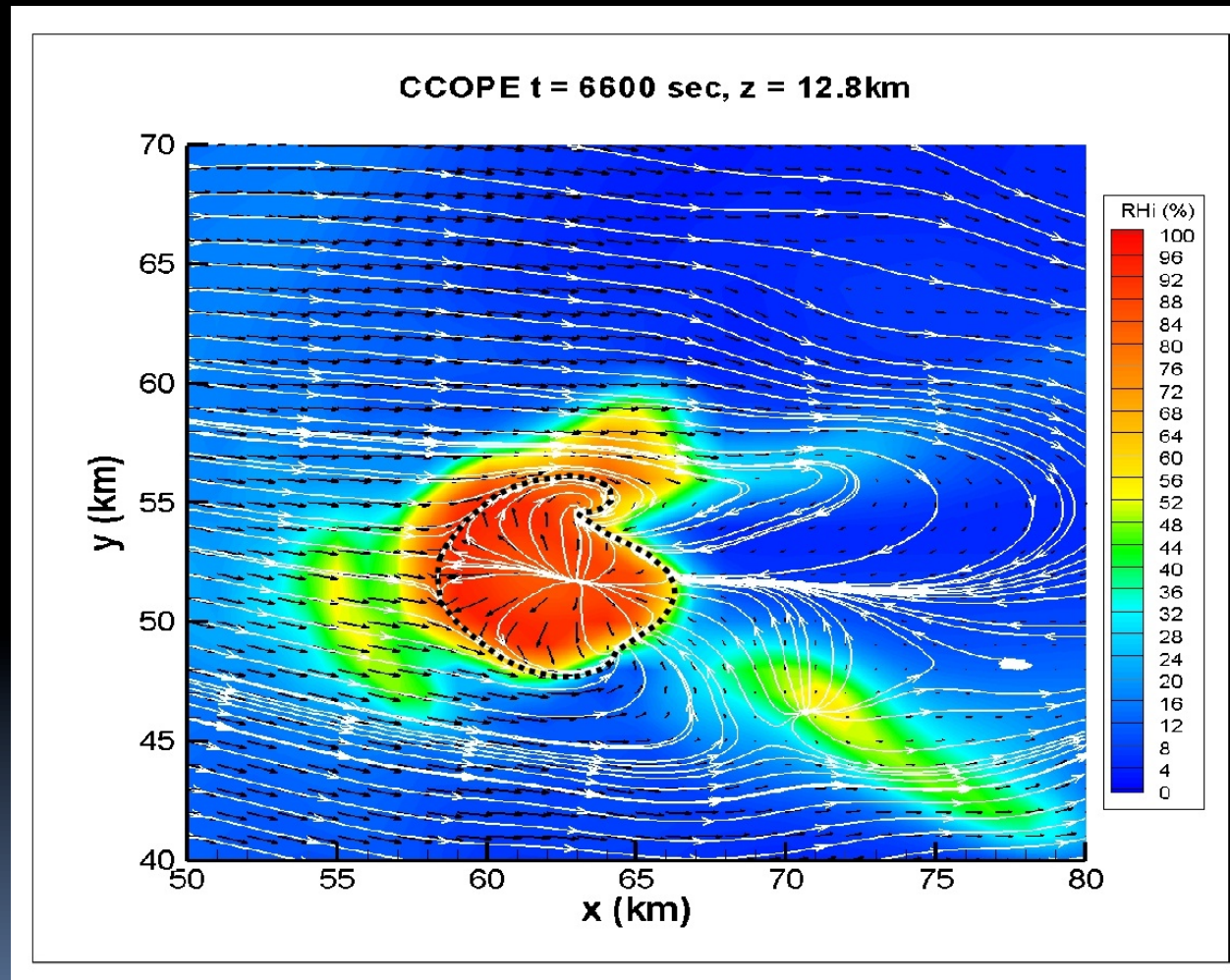
Storm circulation in the overshooting dome creates a quasi-blocking region (QBR), causing quasi-mountain waves, gravity wave breaking (AAIP and JC) and ship wave signatures.



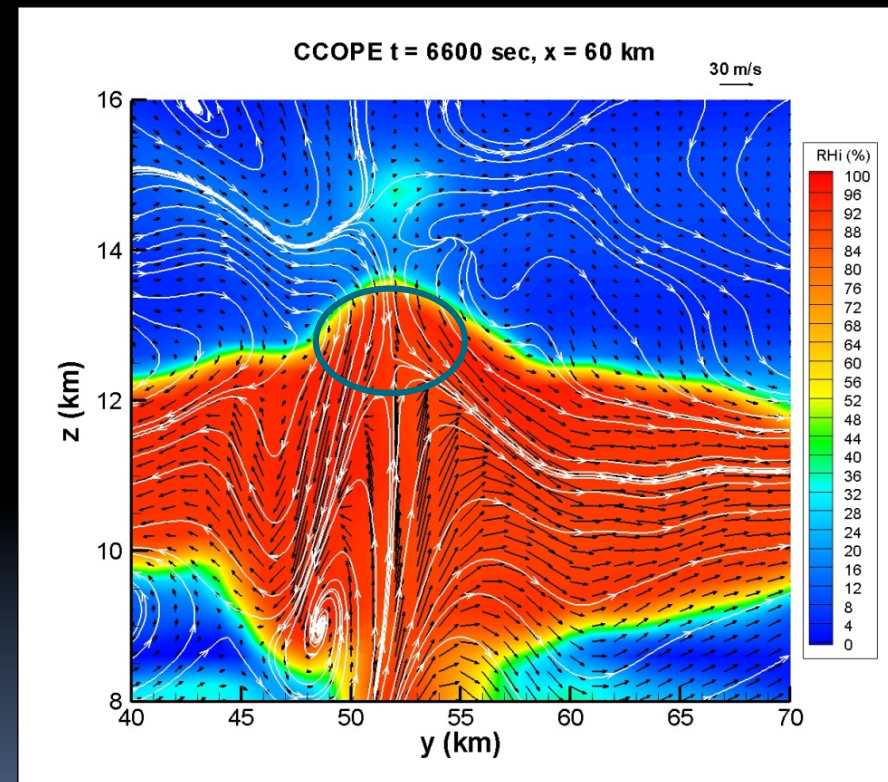
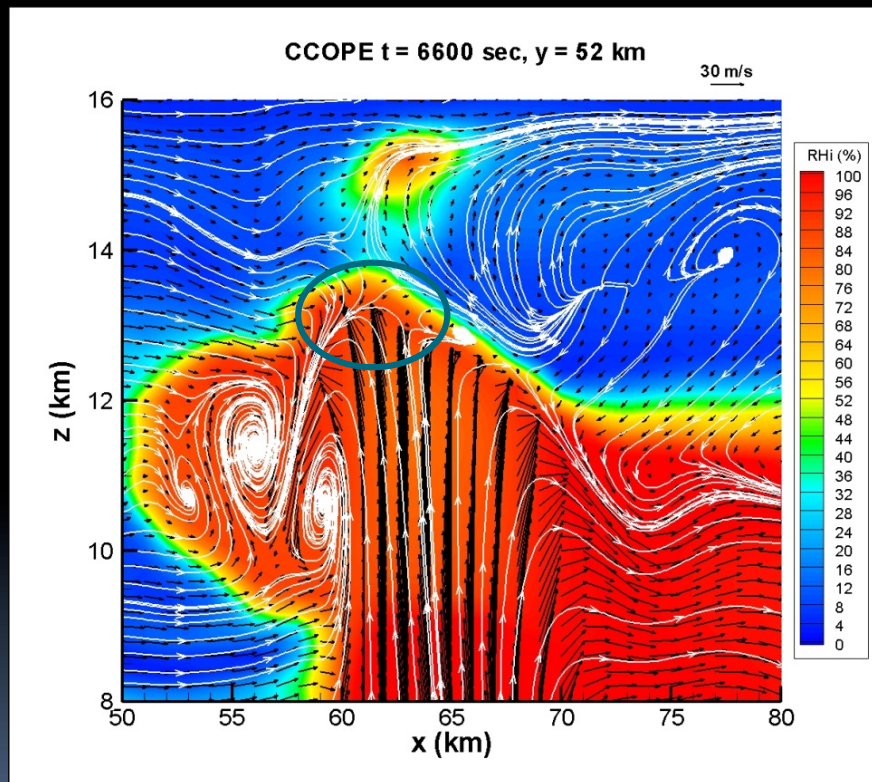
The QBR also forces the back sheared anvil to rise that results in the cold-V. The air descends after passing the QBR and produces the close-in warm area (CWA).



Enclosed diverging region

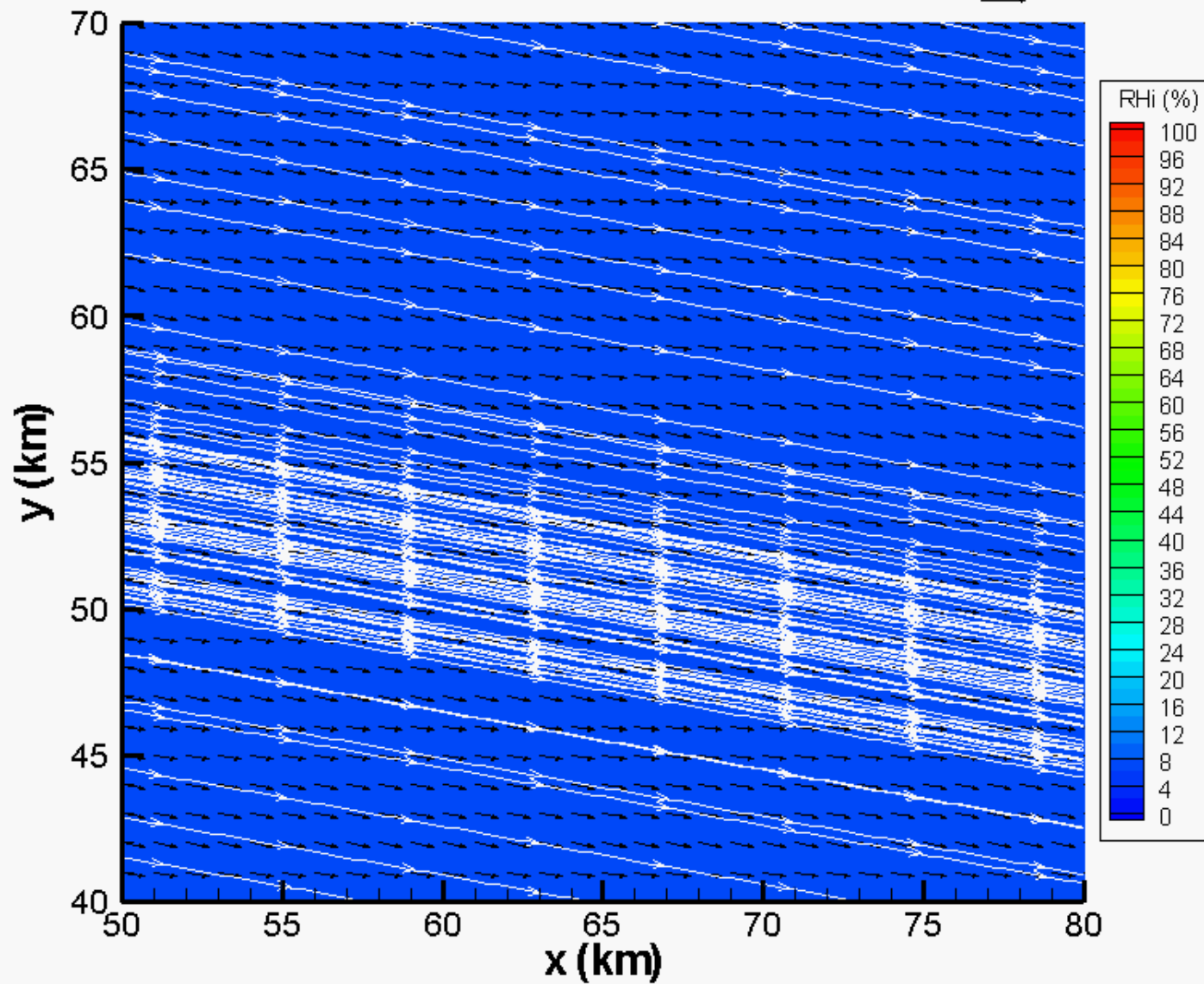


Blocking effect near the tropopause



CCOPE t = 0000-7200sec, z = 12.8 km

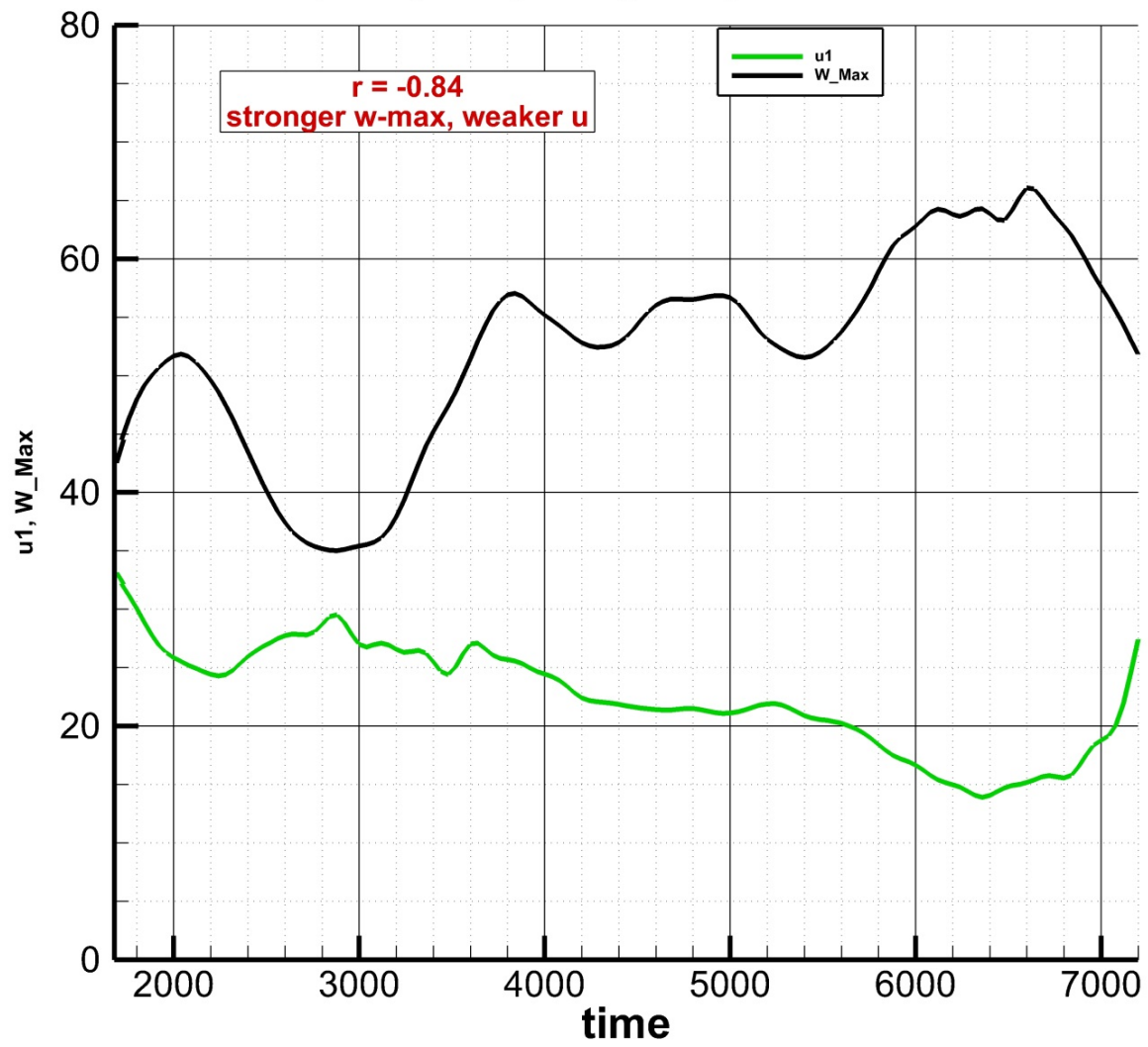
30 m/s
→

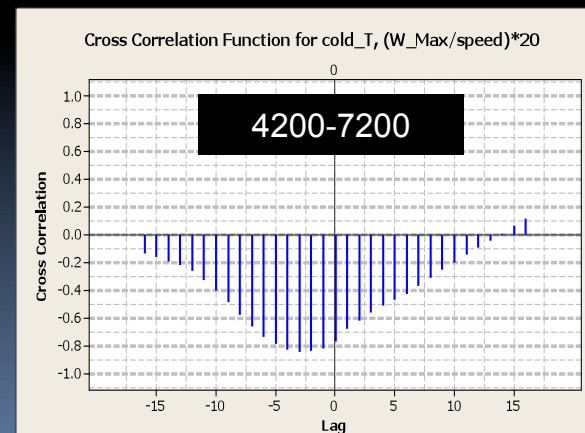
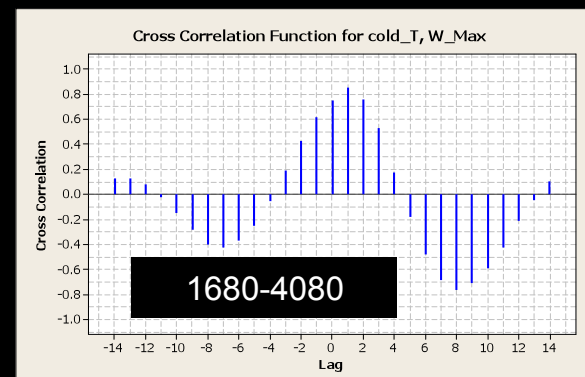
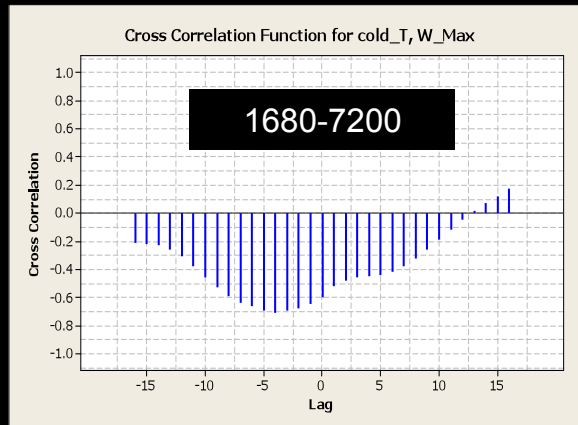
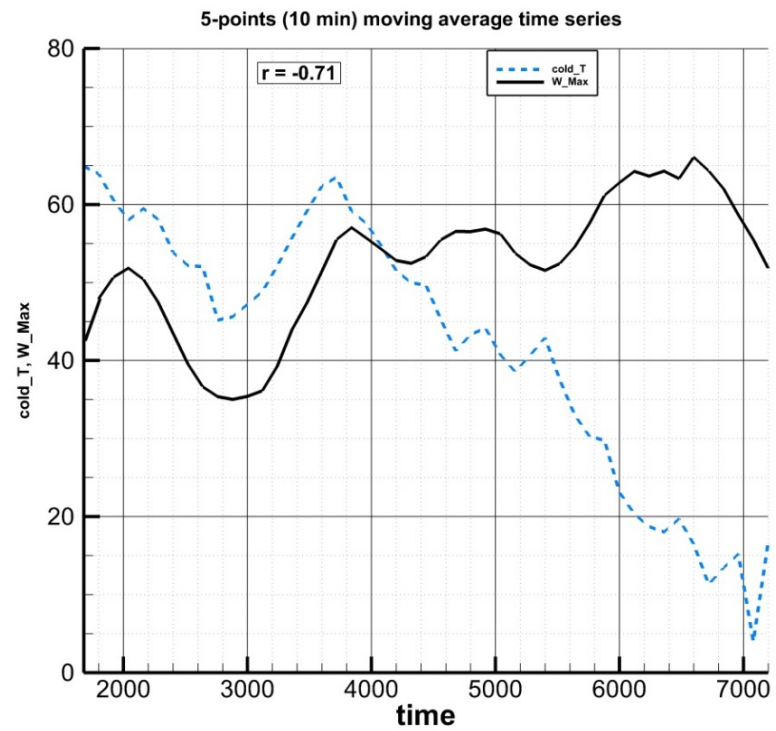


conclusions

- The development of the QBR in the overshooting dome is responsible for many physical features observed around the OT.
- How and when the QBR develops are still unclear at present.
- The understanding of this mechanism is not only important to basic storm physics but may have useful applications in nowcasting and data assimilation using satellite retrieval

5-points (10 min) moving average time series







The end
Thank you