

## Table captions

**Table S1.** Typical characterizations of the frozen hydrometeor classes.

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	Diameter (mm)	Density (g cm <sup>-3</sup> )	Terminal velocity (m s <sup>-1</sup> )	
Cloud ice	Columnar crystals	0.01—1 <sup>(1)</sup>	0.36—0.7 <sup>(2)</sup>	0.013—0.055 <sup>(2)</sup>
	Plate-like	0.01—1 <sup>(1)</sup>	~0.9 <sup>(1)</sup>	0.02—0.06 <sup>(2)</sup>
	Dendrites	0.1—3 <sup>(1)</sup>	0.3—1.4 <sup>(1)</sup>	0.25—0.7 <sup>(3)</sup>
Snowflakes	2—5 <sup>(1)</sup>	0.05—0.89 <sup>(1)</sup>	0.5—3 <sup>(1)</sup>	
Graupel	0.5—5 <sup>(1)</sup>	~0.4 <sup>(1)</sup>	3—14 <sup>(1)</sup>	
Hail	5—80 <sup>(1)</sup>	0.8—0.9 <sup>(1)</sup>	10—40 <sup>(1)</sup>	

<sup>(1)</sup> Pruppacher H.R. (1978).

<sup>(2)</sup> Jayaweera and Ryan (1972).

<sup>(3)</sup> Mitchell and Heymsfield (2005).

## Figure captions

Fig. S1. The  $110 \times 100$  grid points in the computational domain.

Fig. S2. Profiles of temperature (black line) and relative humidity (red line) from atmospheric radiosonde launched near Edmonton, Alberta on 29 May 2001.

Fig. S3. Probability distribution function of vertical velocities ( $w$ ) at cloud base layer under different fire forcing conditions (a); Relationship between input fire forcing ( $FF$ ) and induced vertical velocity ( $w$ ) at cloud base (b). The aerosol concentration is  $1,000 \text{ cm}^{-3}$ . The shaded area represents the variability of estimation ( $\pm 1/2\sigma$ ).

Fig. S4. Contributions of individual frozen hydrometeor to total frozen water content under four extreme conditions, which are referred to as (1) LULA: low updrafts ( $2,000 \text{ W m}^{-2}$ ) and low aerosols ( $200 \text{ cm}^{-3}$ ); (2) LUHA: low updrafts ( $2,000 \text{ W m}^{-2}$ ) and high aerosols ( $100,000 \text{ cm}^{-3}$ ); (3) HULA: high updrafts ( $300,000 \text{ W m}^{-2}$ ) and low aerosols ( $200 \text{ cm}^{-3}$ ); (4) HUHA: high updrafts ( $300,000 \text{ W m}^{-2}$ ) and high aerosols ( $100,000 \text{ cm}^{-3}$ ).

Fig. S5. Time evolution of surface rain rates for the three aerosol episodes ( $N_{\text{CN}} = 200; 1,000; \text{ and } 100,000 \text{ cm}^{-3}$  respectively) under LU (low updrafts,  $FF=2,000 \text{ W m}^{-2}$ ) and HU (high updrafts,  $FF=50,000 \text{ W m}^{-2}$ ) conditions.

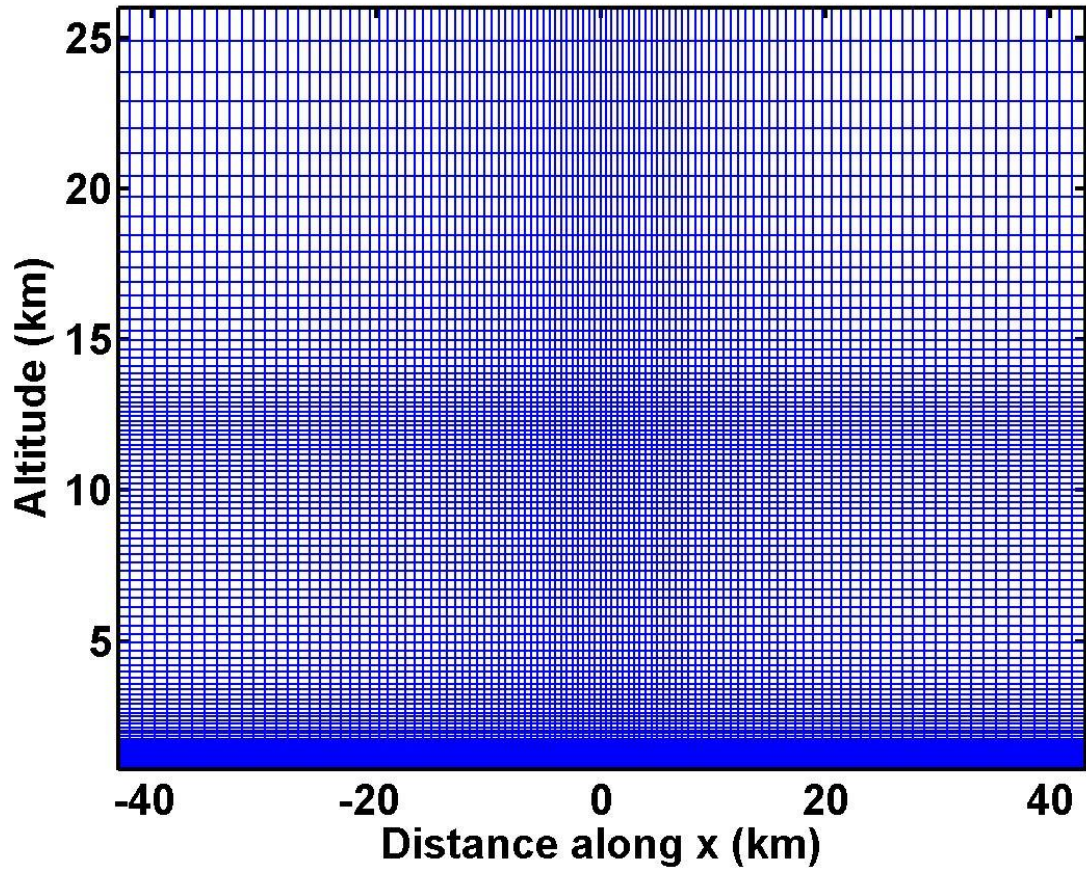
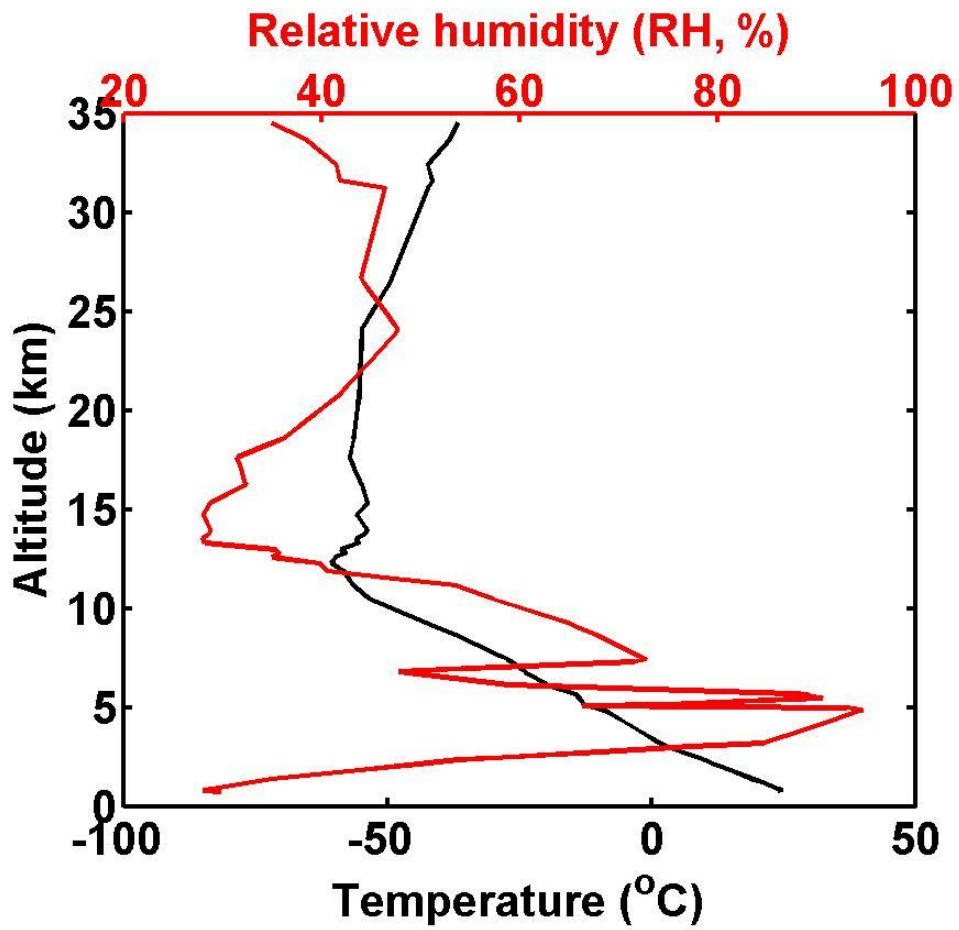
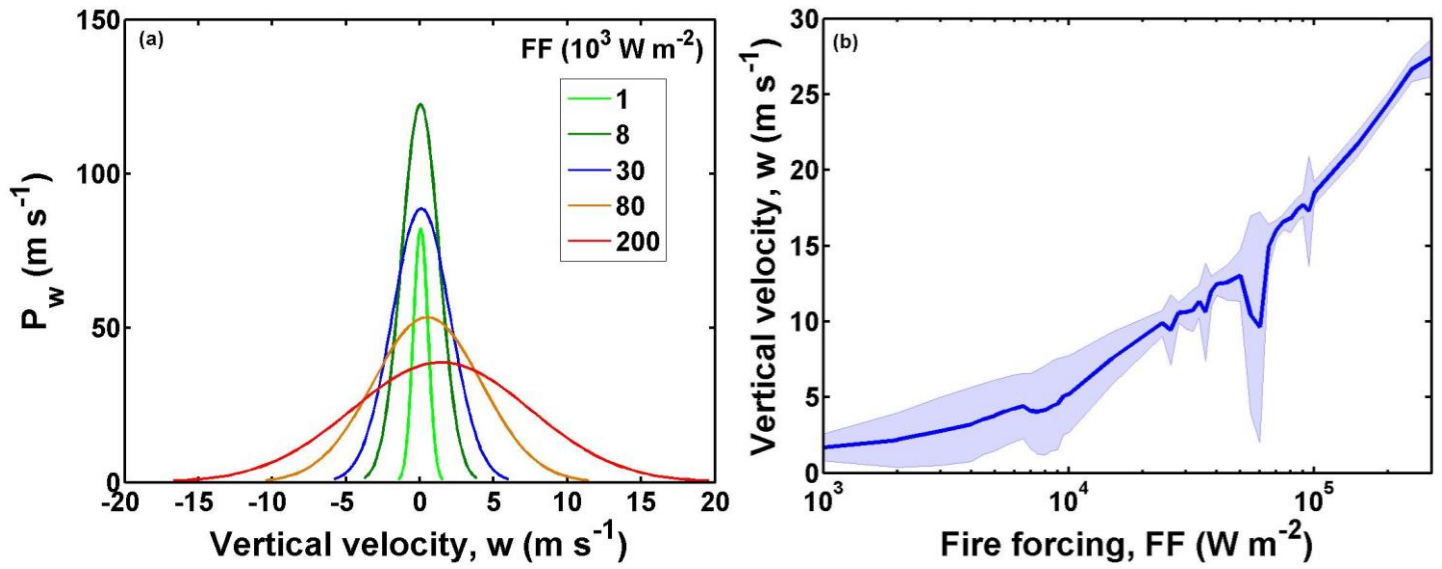


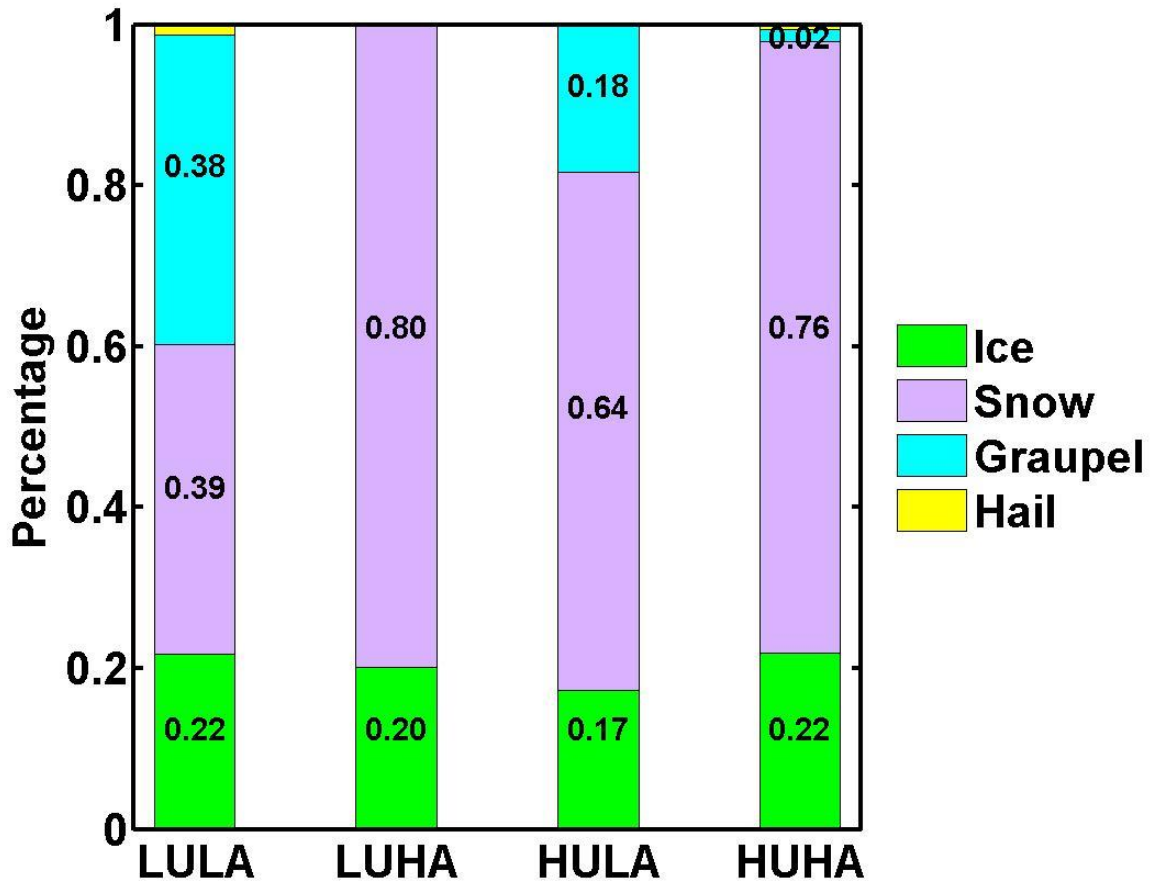
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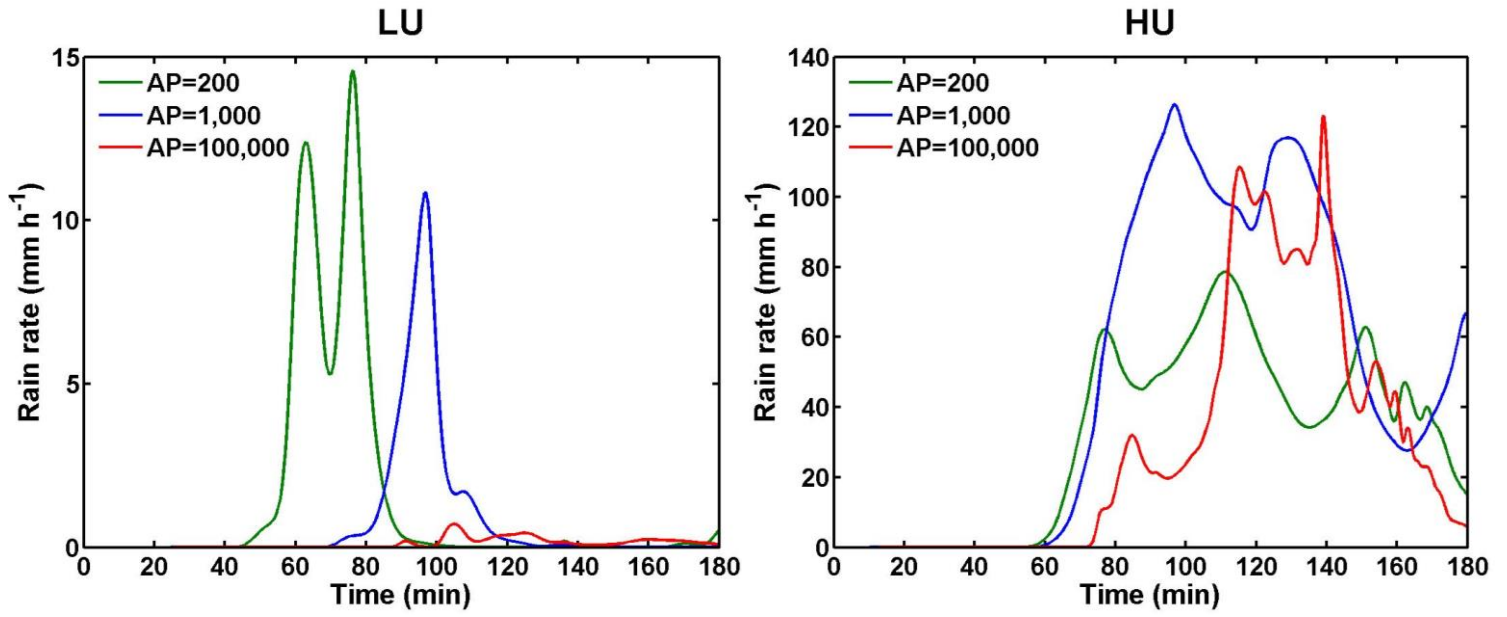


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## References

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Pruppacher H.R., K. J. D.: *Microphysics of Clouds and Precipitation*, D. Reidel, 1978.