**Support information**

This file includes

Table S1

Fig. S1-S3

**Table S1.** Emissions in California based on EPA NEI in 2010, 2012, and 2014 (unit of 1000 tons).

| Species | 2010 | 2012 | 2014 |
|---------|------|------|------|
| CO | 9601.807 | 3445.952 | 5607.007 |
| $NH_3$ | 1273.116 | 850.5079 | 510.4905 |
| $NO_X$ | 851.5883 | 674.9153 | 585.4978 |
| $PM_{10}$ | 1198.705 | 469.3941 | 714.4845 |
| $PM_{2.5}$ | 712.6443 | 200.5515 | 403.0768 |
| $SO_2$ | 75.54085 | 33.26507 | 47.19099 |
| VOC | 2202.771 | 842.6653 | 1471.331 |
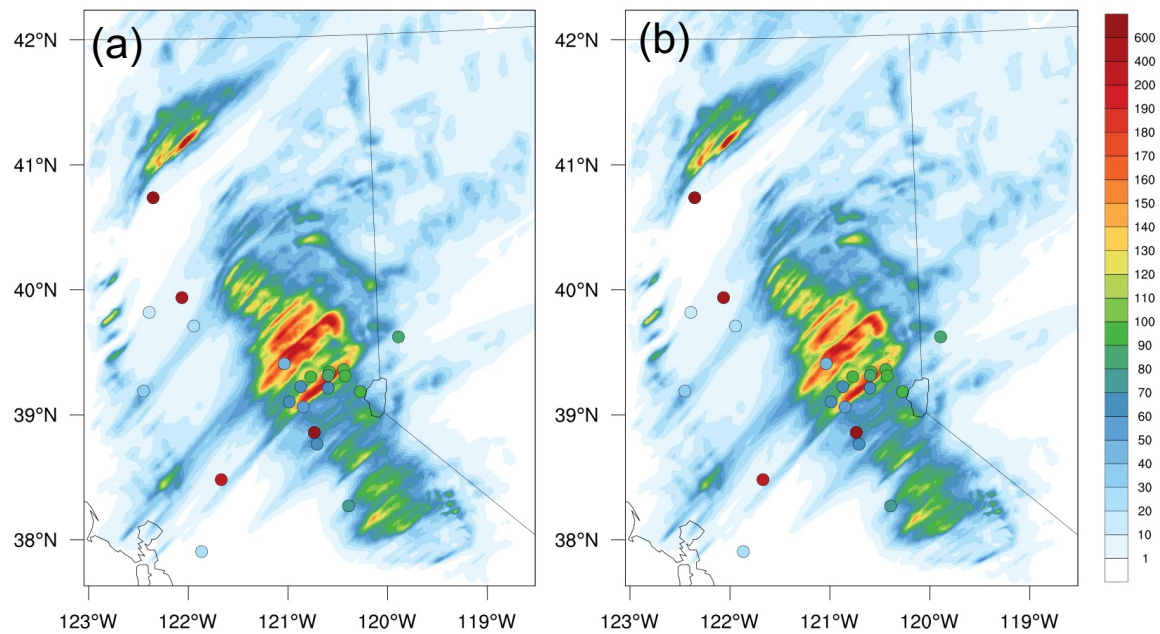
**Figure S1.** Modeled daily accumulated precipitation from (a) the simulation using WRF-Chem-SBM fully-coupled model and (b) the simulation using WRF-SBM with the aerosols hourly interpreted from a coarse resolution WRF-Chem simulation for 07 February during 00:00-23:00 UTC. The overlaid circles are the rain gauge measurements.
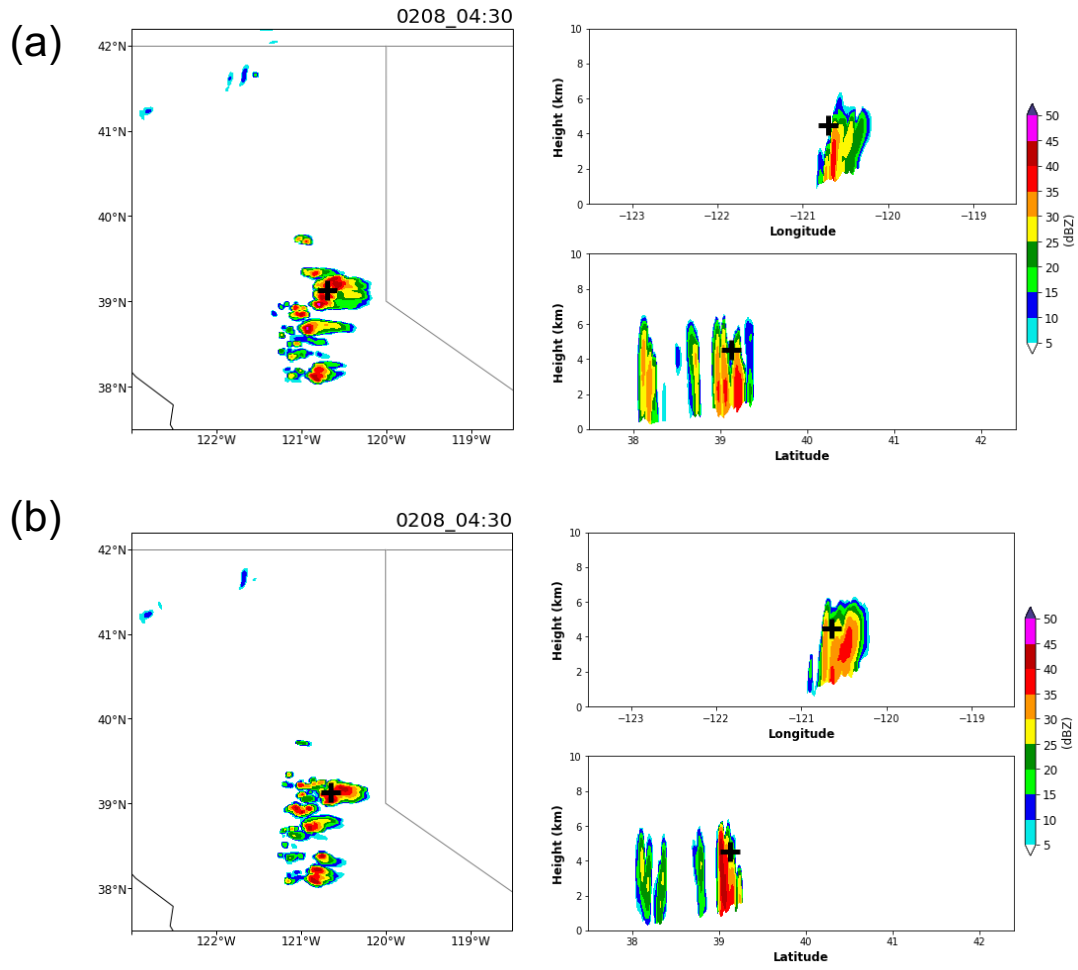
**Figure S2.** Same as Figure 4b, except for the simulations of (a) Bigg and (b) DM15.
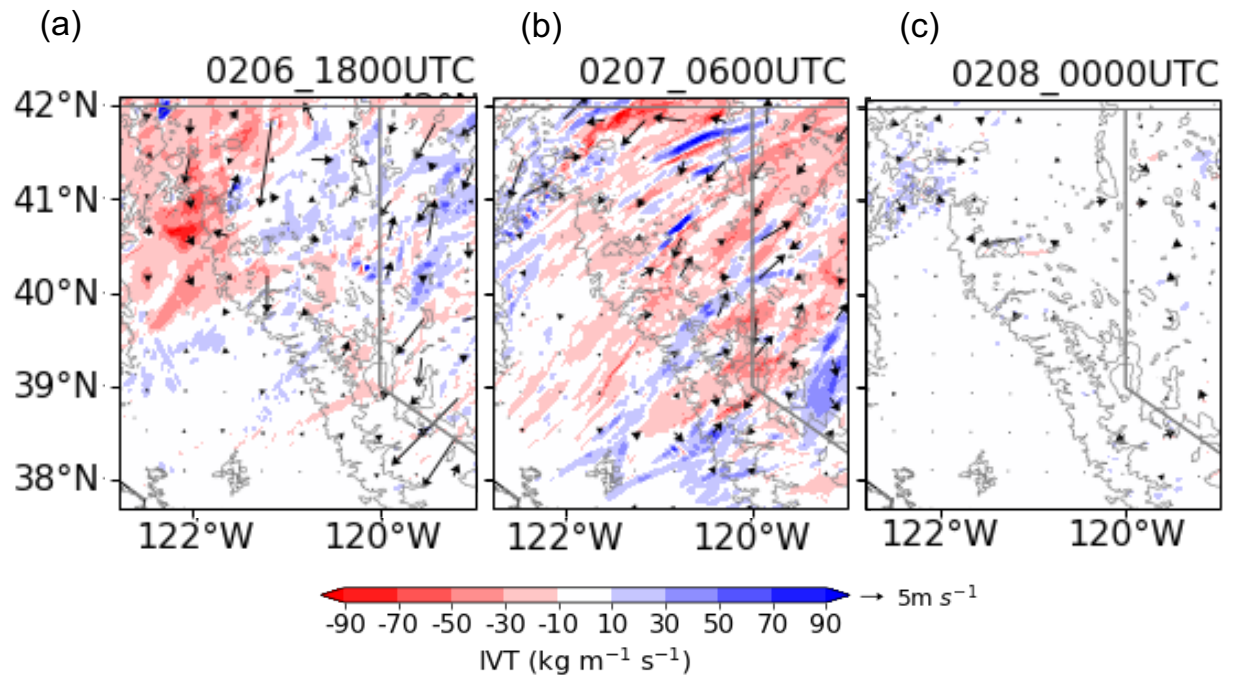
**Figure S3.** Differences of IVT (color) and wind (vector) between DM15+MC18 and DM15 at a time from the stages (a) before landfall, (b) after landfall, and (c) post-AR.