



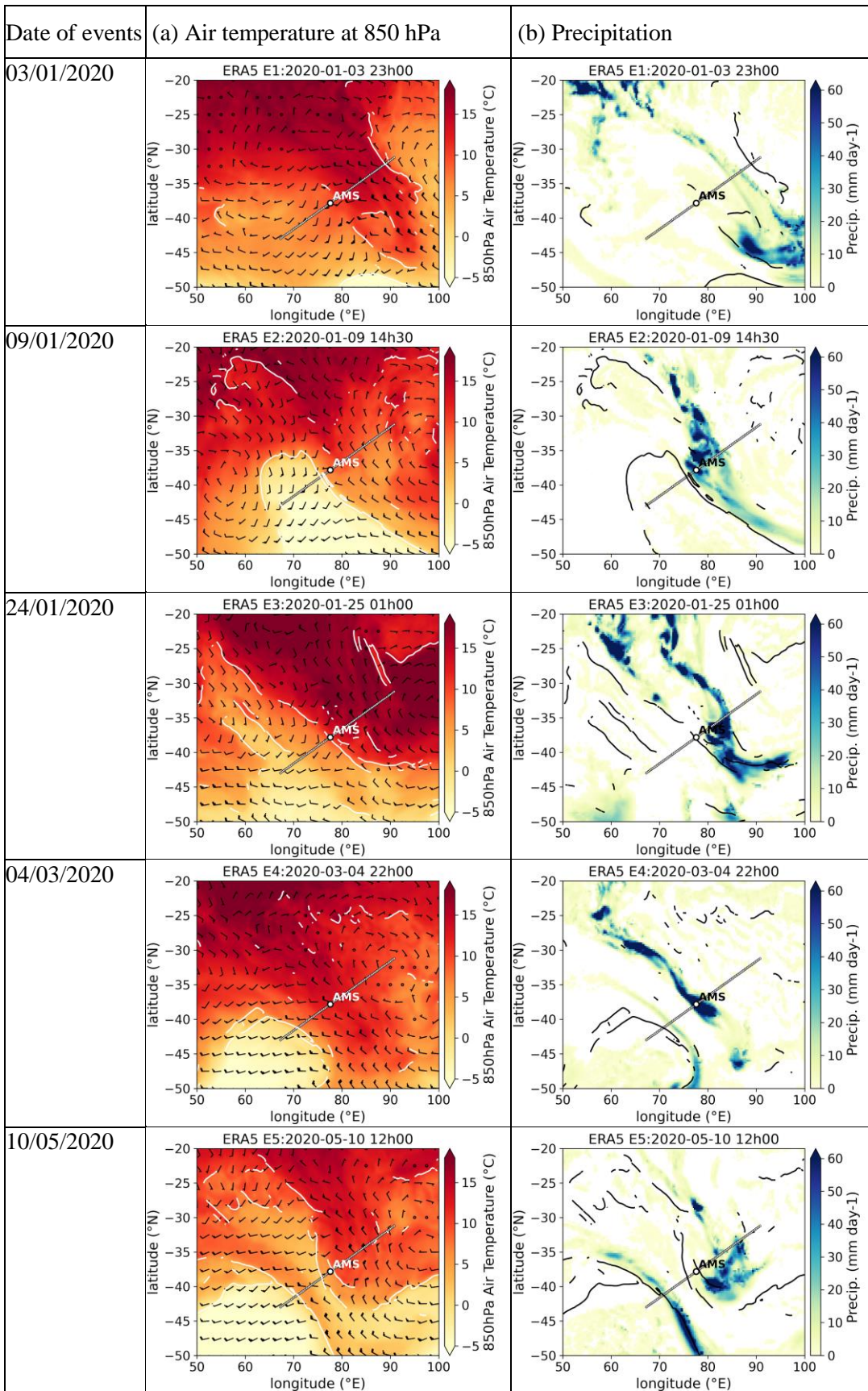
*Supplement of*

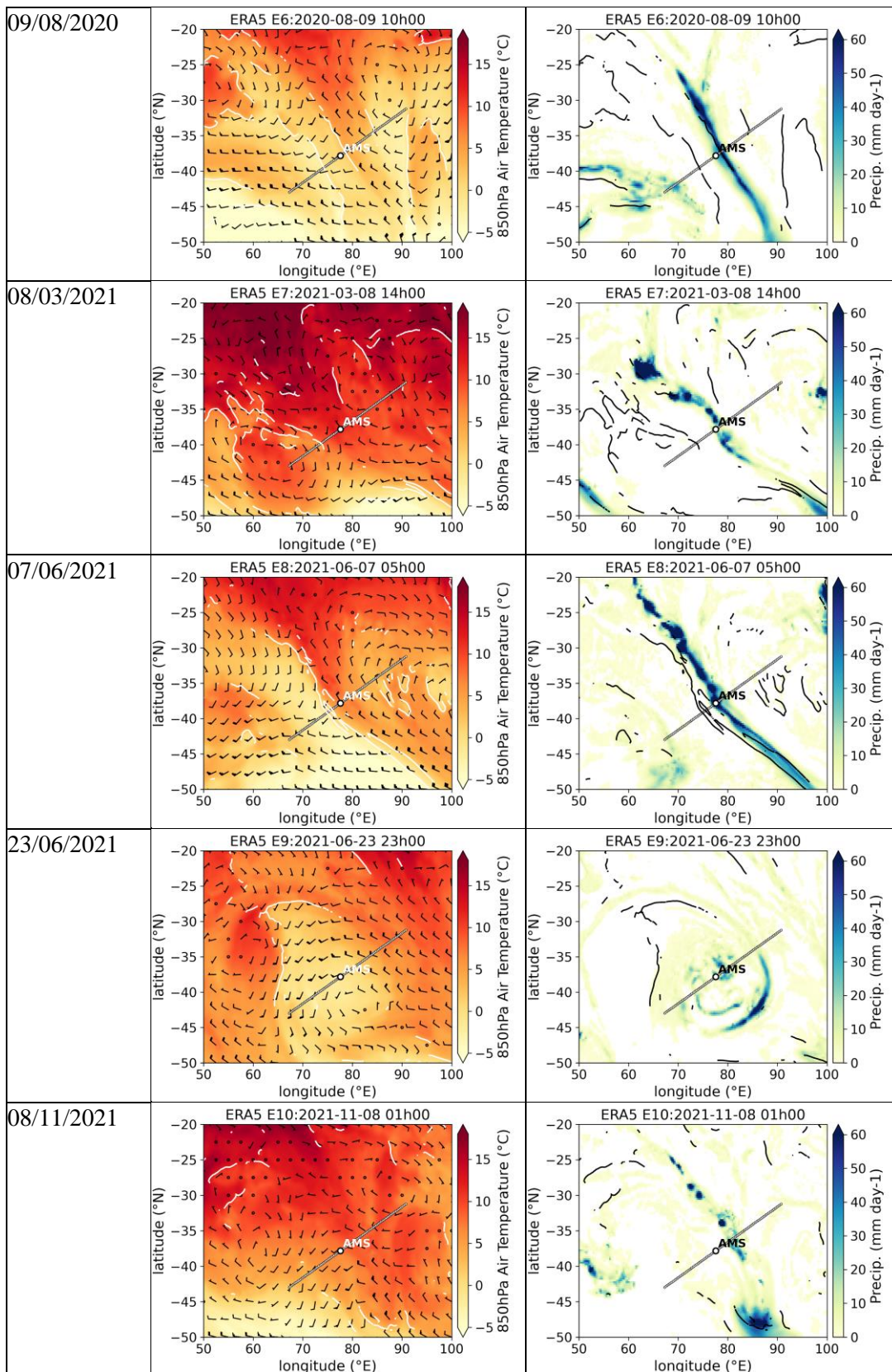
## **Abrupt excursions in water vapor isotopic variability at the Pointe Benedicte observatory on Amsterdam Island**

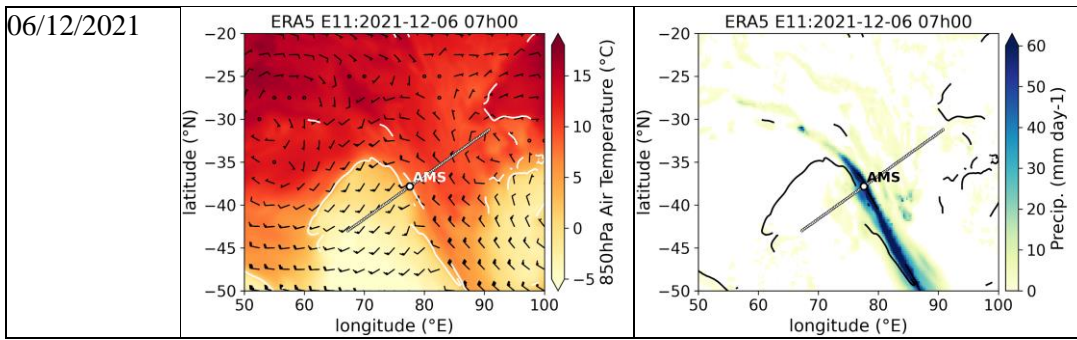
**Amaelle Landais et al.**

*Correspondence to:* Amaelle Landais ([amaelle.landais@lsce.ipsl.fr](mailto:amaelle.landais@lsce.ipsl.fr)) and Cécile Agosta ([cecile.agosta@lsce.ipsl.fr](mailto:cecile.agosta@lsce.ipsl.fr))

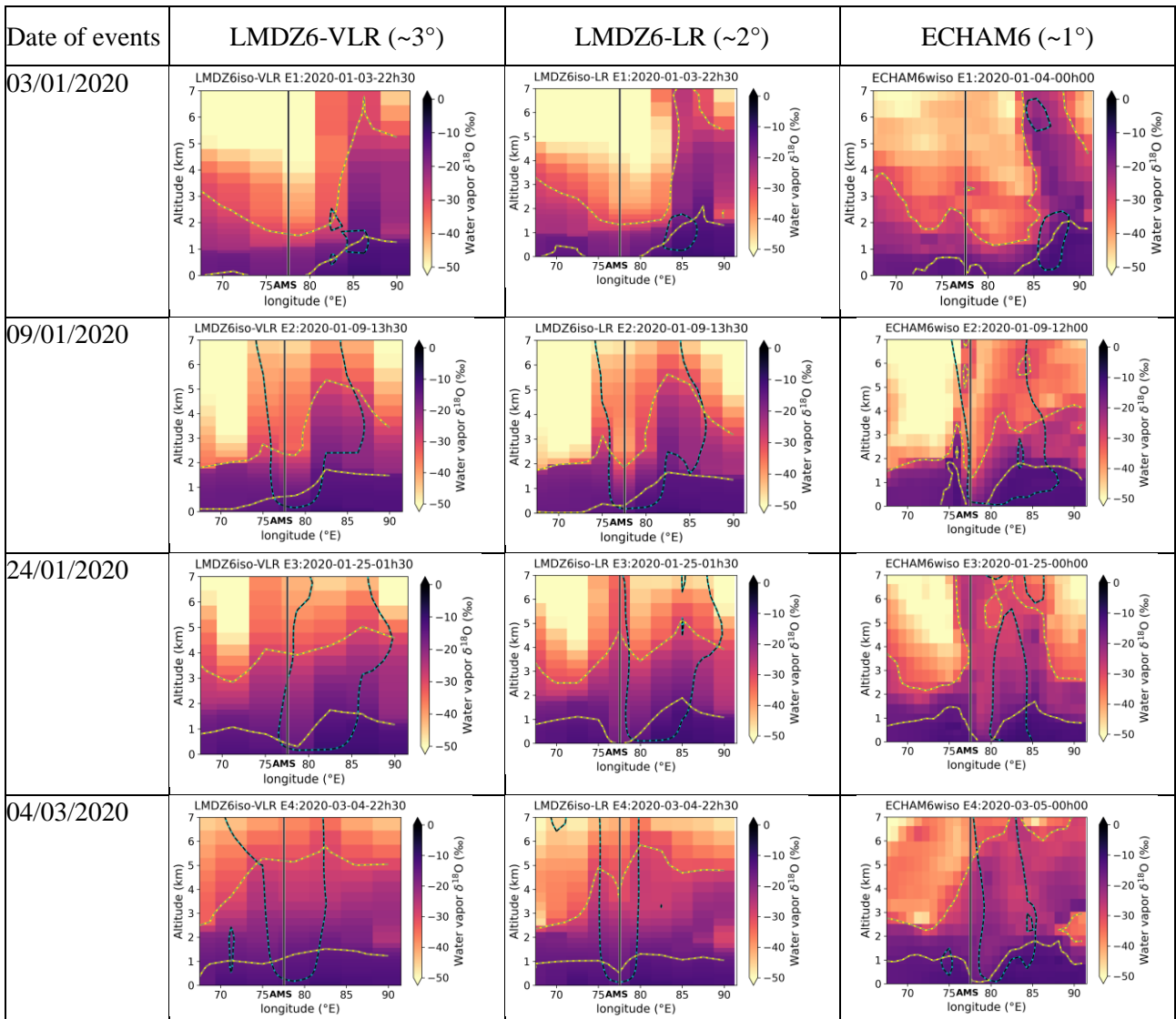
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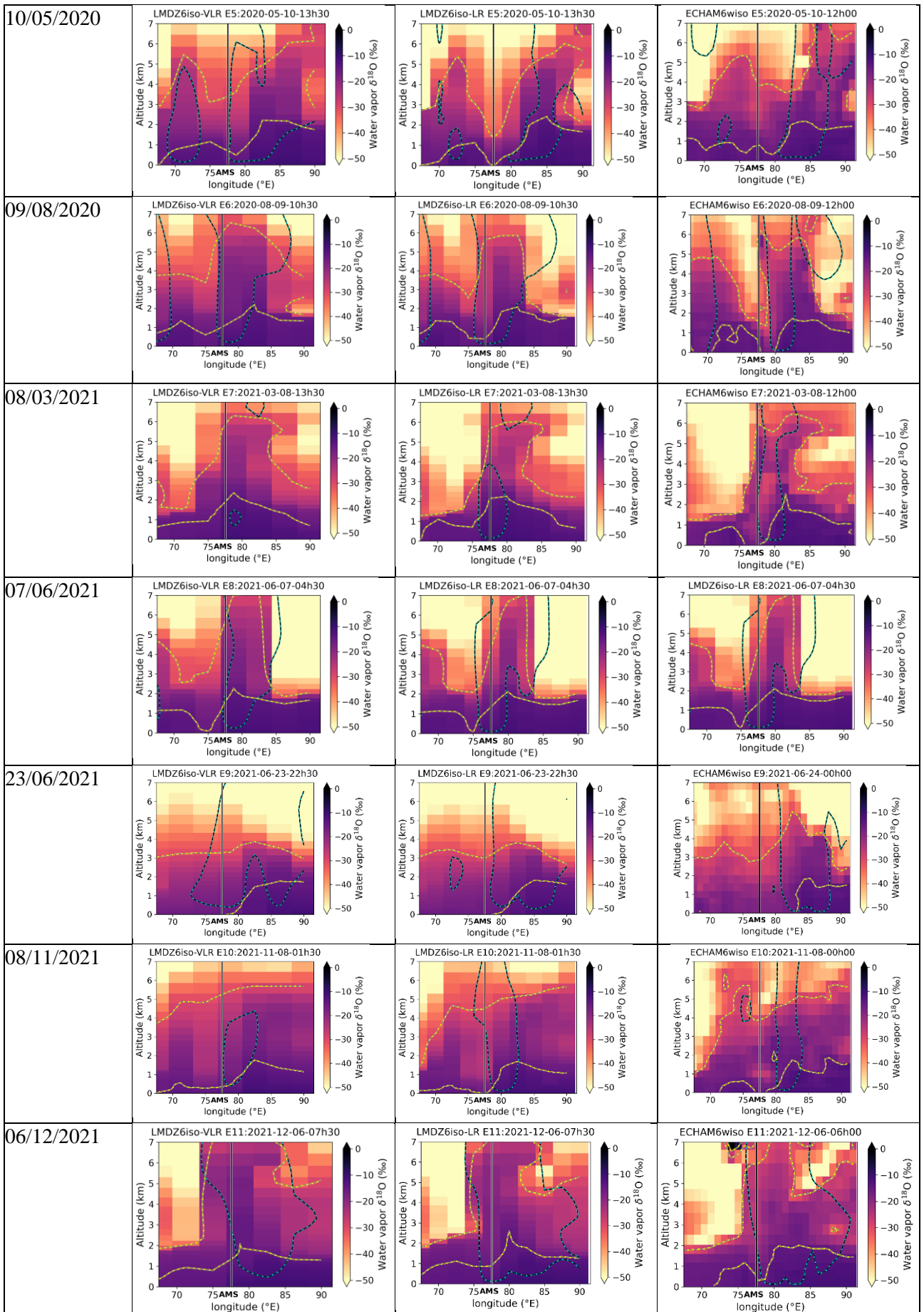




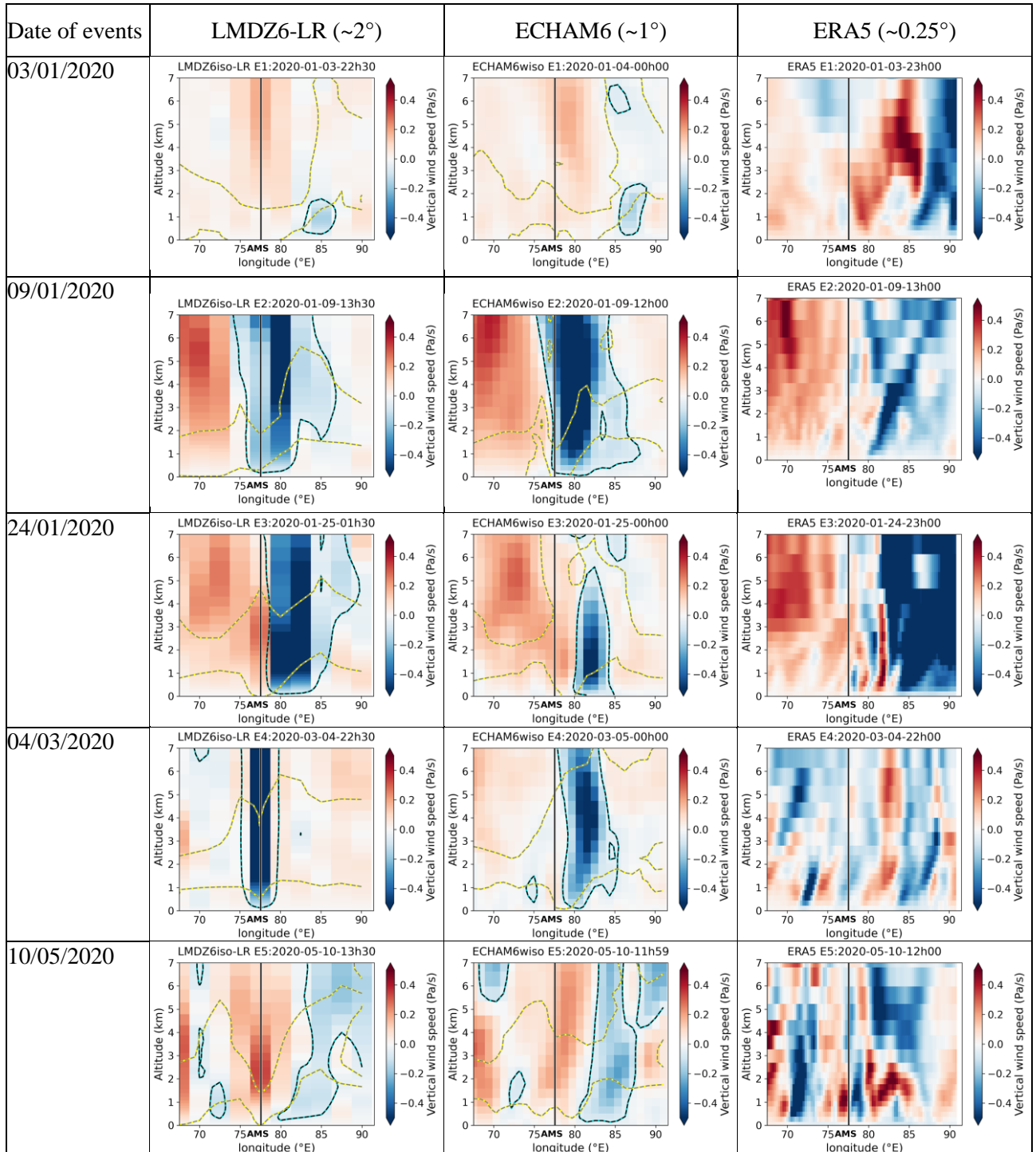


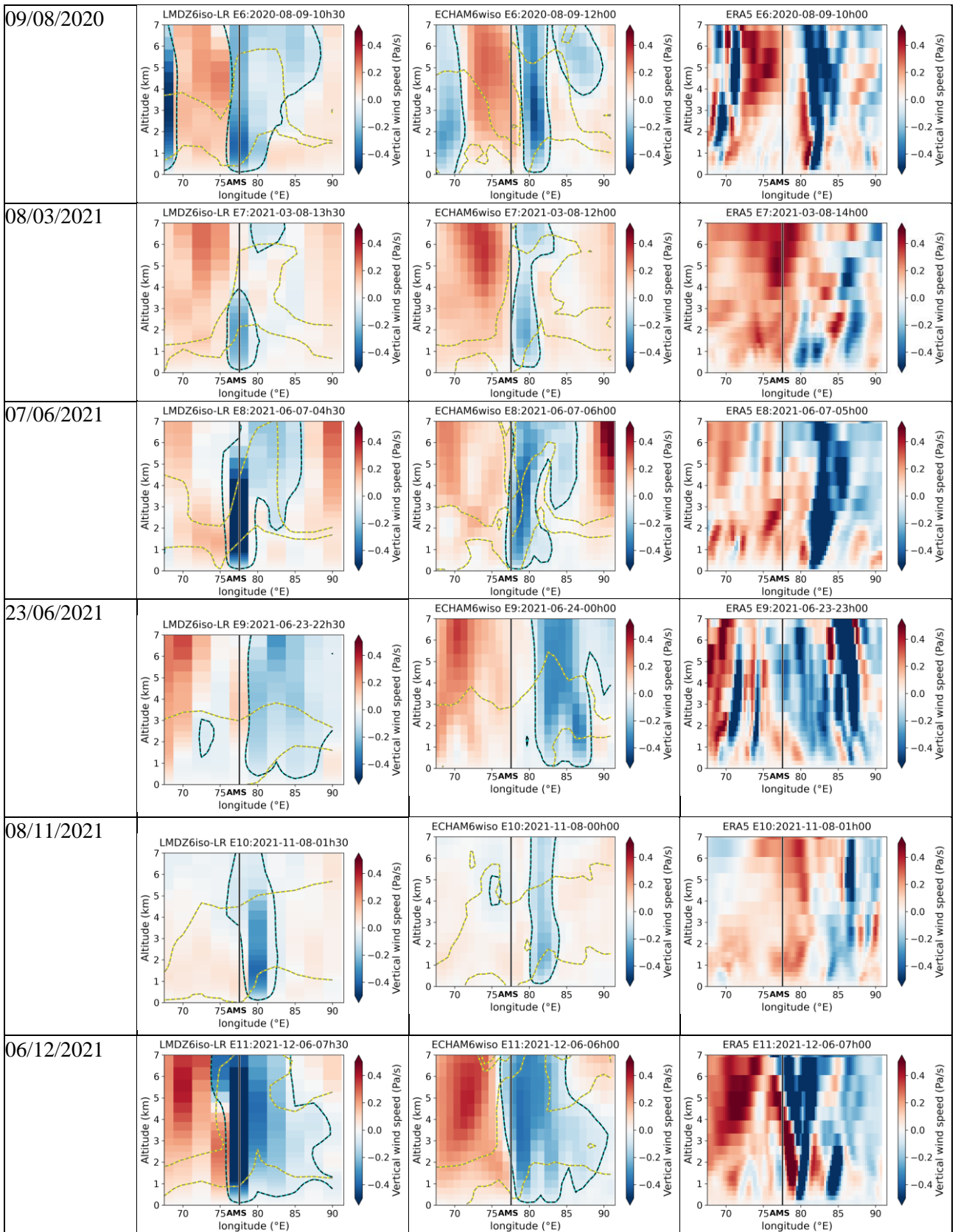
**Figure S1:** Synoptic analysis using hourly ERA5 fields at the time of observed minimum  $\delta^{18}\text{O}$ , corresponding to the 11 events identified in the manuscript: (a) air temperature at 850 hPa, (b) precipitation, and (c) vertical velocity at 850 hPa. White and black lines represent frontal passage, located at the maximum gradient of 850 hPa potential temperature. Front is computed as the zero-line of the gradient of the magnitude of the gradient of 850 hPa air temperature, when the gradient of 850 hPa air temperature is greater than 2 K/100 km, following Schemm et al. (2015). The black dotted line shows the transect location used for the vertical cross-section in Figure S3.



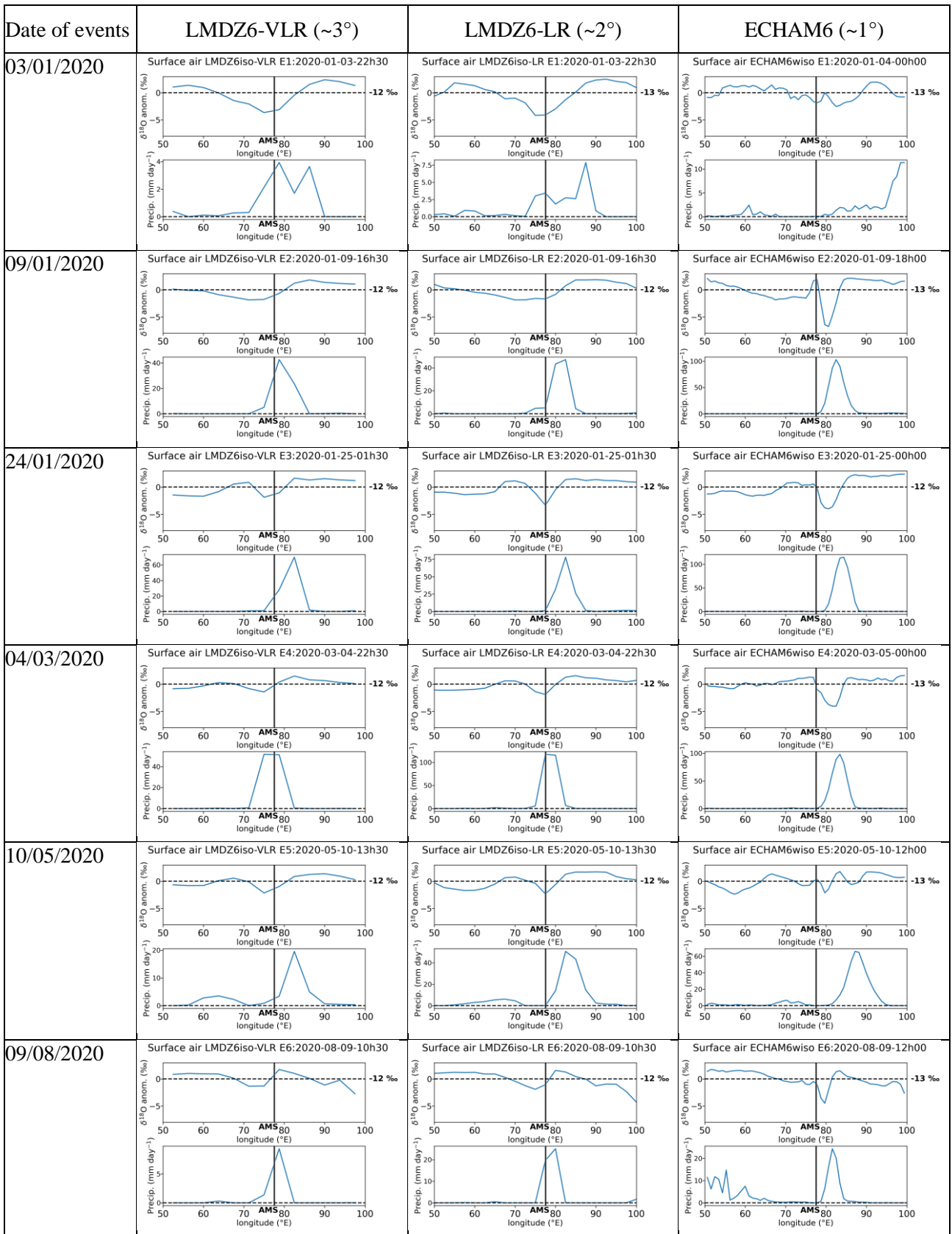


**Figure S2:**  $\delta^{18}\text{O}_v$  plotted on a vertical cross-section (altitude vs. longitude) as modeled by LMDZ6 at very low resolution (left), low resolution (middle) and ECHAM6-wiso (right). Location of the extracted transects are indicated by the white line in Fig. 8g for LMDZ6iso-VLR, 8d for LMDZ6iso-LR and 8a for ECHAM6wiso. Yellow contours indicate  $-30\text{‰}$  (upper) and  $-15\text{‰}$  (lower) contours of surface  $\delta^{18}\text{O}_v$ . Black contours indicate contours of  $-0.05 \text{ Pa s}^{-1}$  vertical velocity (ascendance). The vertical black line denotes Amsterdam Island latitude.

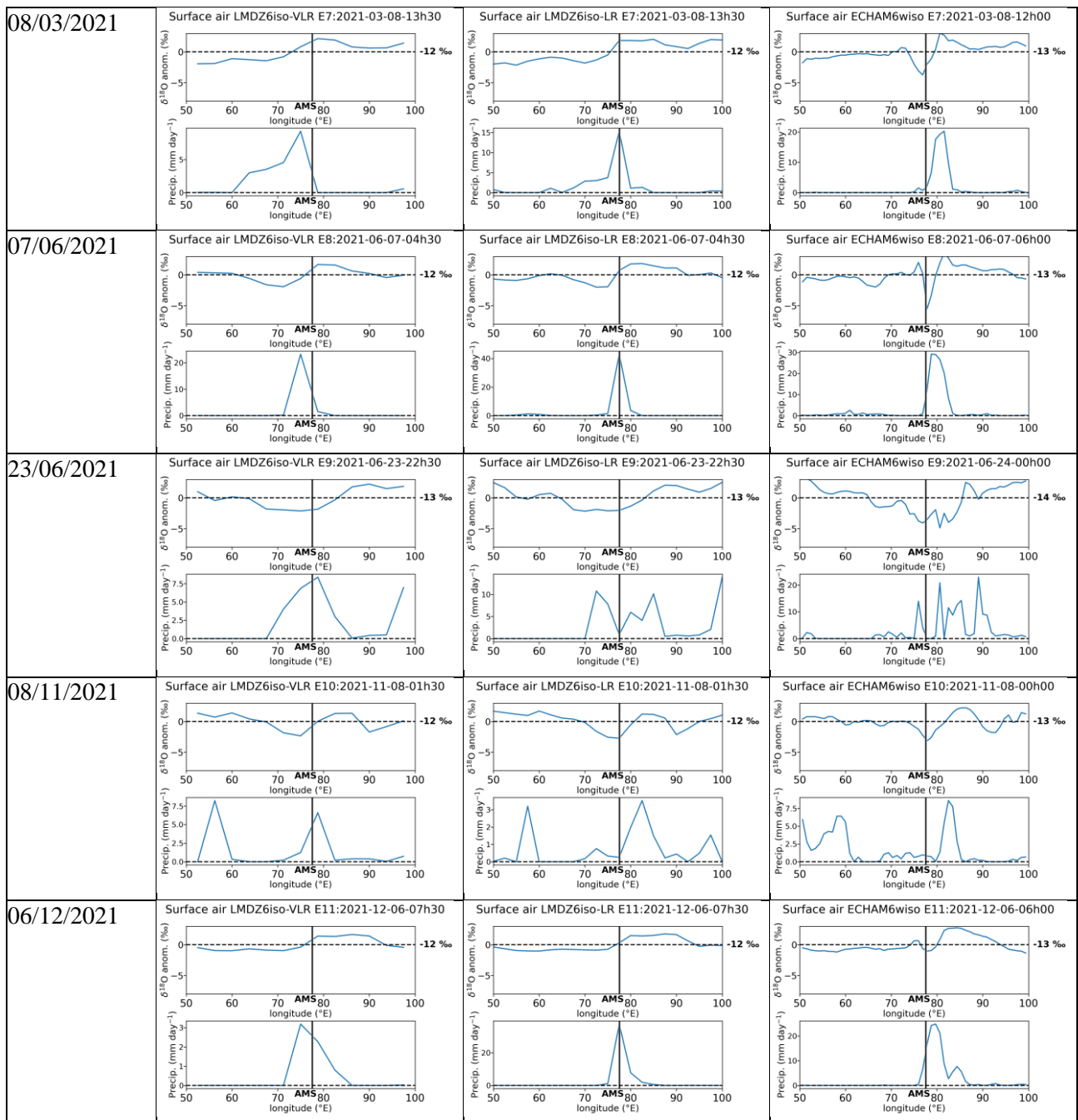




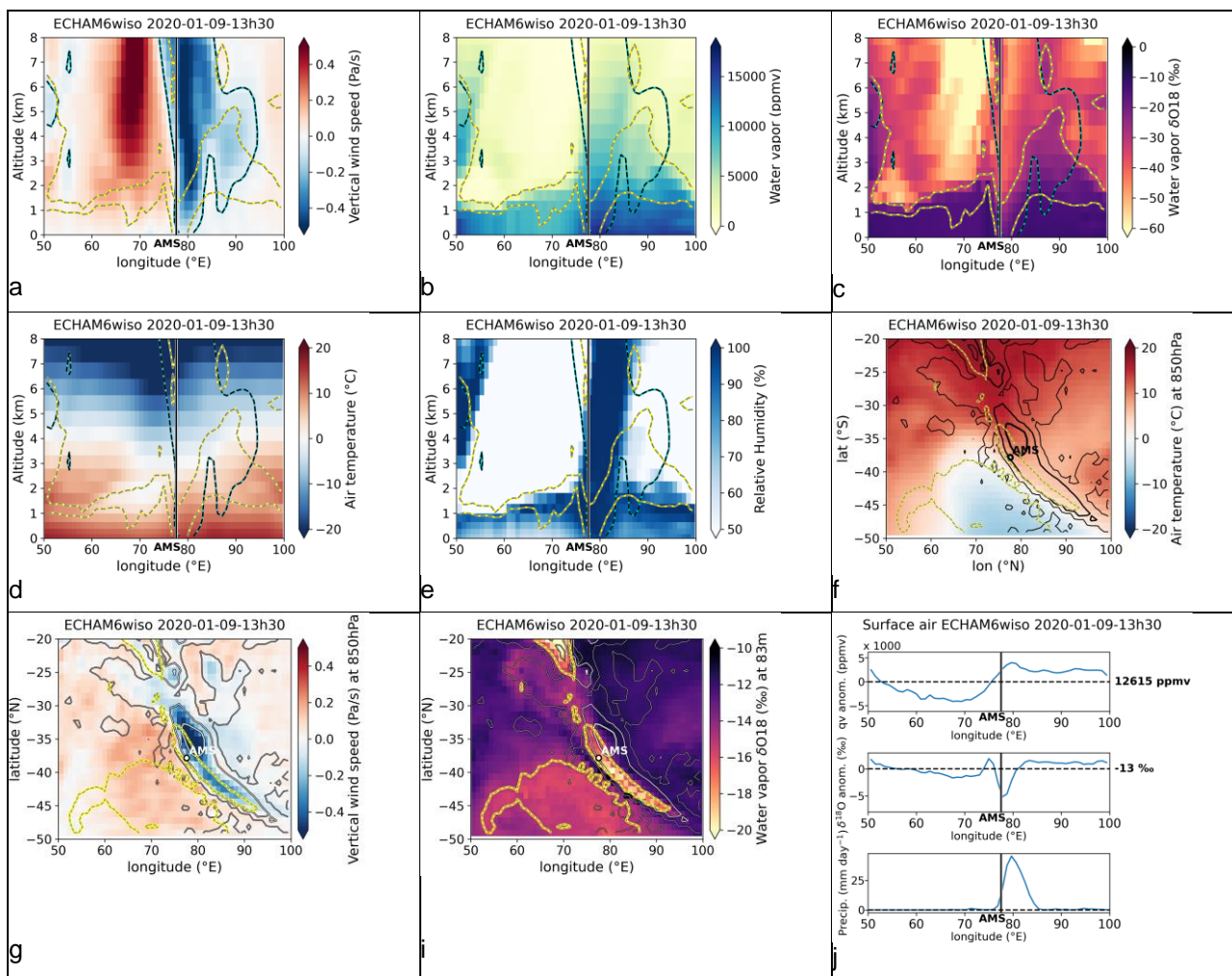
**Figure S3:** Vertical velocity plotted on a cross section of longitude (x) versus altitude (y) at the Amsterdam latitude as modeled by LMDZ-iso at low resolution (1<sup>st</sup> column), ECHAM6-wiso (2<sup>nd</sup> column) and ERA5 (3<sup>rd</sup> column). Location of the extracted transects are indicated by the white line in Fig. 8d for LMDZ6iso-LR, 8a for ECHAM6wiso and 8j or S1 for ERA5. Yellow contours indicate  $-30\text{‰}$  (upper) and  $-15\text{‰}$  (lower) contours of surface  $\delta^{18}\text{O}_v$ . Black contours indicate contours of  $-0.05 \text{ Pa s}^{-1}$  vertical velocity (ascendance). The vertical black line denotes Amsterdam Island latitude.







**Figure S4:** Surface signal ( $\delta^{18}\text{O}_v$  on the top and precipitation on the bottom) as modeled by LMDZ-iso with very low resolution (left), low resolution (middle) and ECHAM6-wiso (right).



**Figure S5:** ECHAM6-wiso profiles during event of January 9<sup>th</sup> 2020, at its minimum modeled surface  $\delta^{18}\text{O}_v$  (09/01/2020 13h30), used to design Figure 9. Cross sections of longitude (x-axis) versus altitude (y-axis) at the Amsterdam latitude for (a) vertical velocity ( $\text{Pa s}^{-1}$ ), (b) water vapor (ppmv), (c)  $\delta^{18}\text{O}_v$  (‰), (d) temperature ( $^{\circ}\text{C}$ ) and (e) relative humidity (%). Map of (f) air temperature at 850 hPa ( $^{\circ}\text{C}$ ), (g) vertical velocity at 850 hPa ( $\text{Pa s}^{-1}$ ). (i) Surface level at the Amsterdam latitude as a function of longitude, for (top) water vapor (ppmv), (middle)  $\delta^{18}\text{O}_v$  (‰), and (bottom) precipitation at the ground ( $\text{mm day}^{-1}$ ).

### Reference:

Schemm, Sebastian, Irina Rudeva, et Ian Simmonds. « Extratropical Fronts in the Lower Troposphere—Global Perspectives Obtained from Two Automated Methods ». *Quarterly Journal of the Royal Meteorological Society* 141, no 690 (2015): 1686-98. <https://doi.org/10.1002/qj.2471>.