atmosphere

MDPI

Supplementary Materials:

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Table S1. Sensor's details at Atmospheric River Observatory (ORA).

Instrument → ↓ Feature	Vertical Micro rain	Disdrometer	Ceilometer	Weather Station
Model / Company	MMR2 / Metek	Parsivel-2/ OTT	CL31 / Vaisala	Campbell Scientific
Sensor Type	Vertical Rain Radar @ 24 GHz	horizontal Laser@ 650 nm	LIDAR vertical @ 400 nm	Several (***)
Measurements	Vertical profile of radio signal back- scattering	Hydrometeors diameter and fall velocity	Vertical profile of laser back-scattering	Air temperature, relative humidity, wind, pressure
Derived variables	Vertical profile radar reflectivity, hydrometeors vertical velocity water liquid content.	Rain/Snow rate, Joint size-velocity distribution	Cloud base (up to 3 layers)	Dew point temperature, rain rate
Sampling rate	2 seg	60 seg	60 seg	15 min
Vertical resolution	100 m & 250 m	NA (local)	30 m	NA (local)
Vertical range	3000 m & 7500 m	NA (local)	7.6 km	NA (local)



Figure S1. A picture of the Atmospheric River Observatory (ORA) on the roof of the Geophysics Department, University of Concepción. The sensors are detailed in Table S1.

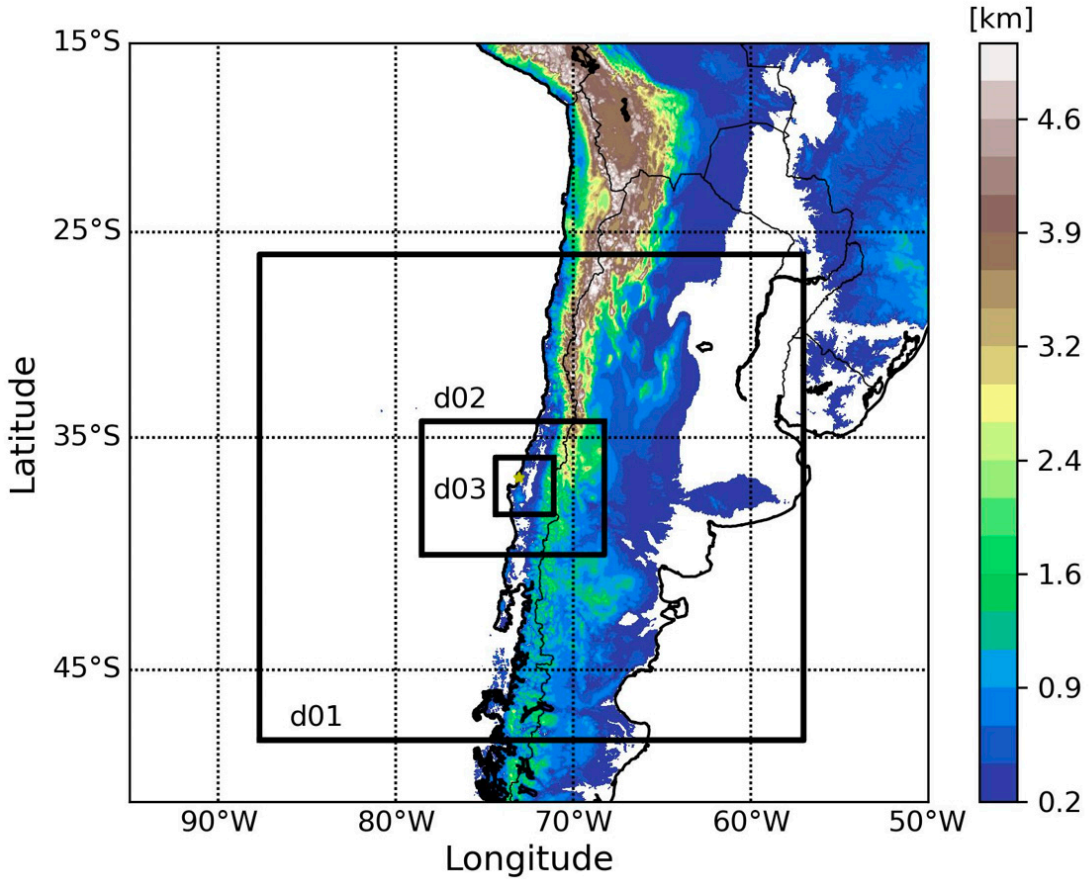


Figure S2. WRF domains configuration. Domain 01: 9 km grid spacing; Domain 02: 3 km grid spacing; Domain 3: 1 km grid spacing. Yellow start indicates location of Concepción.

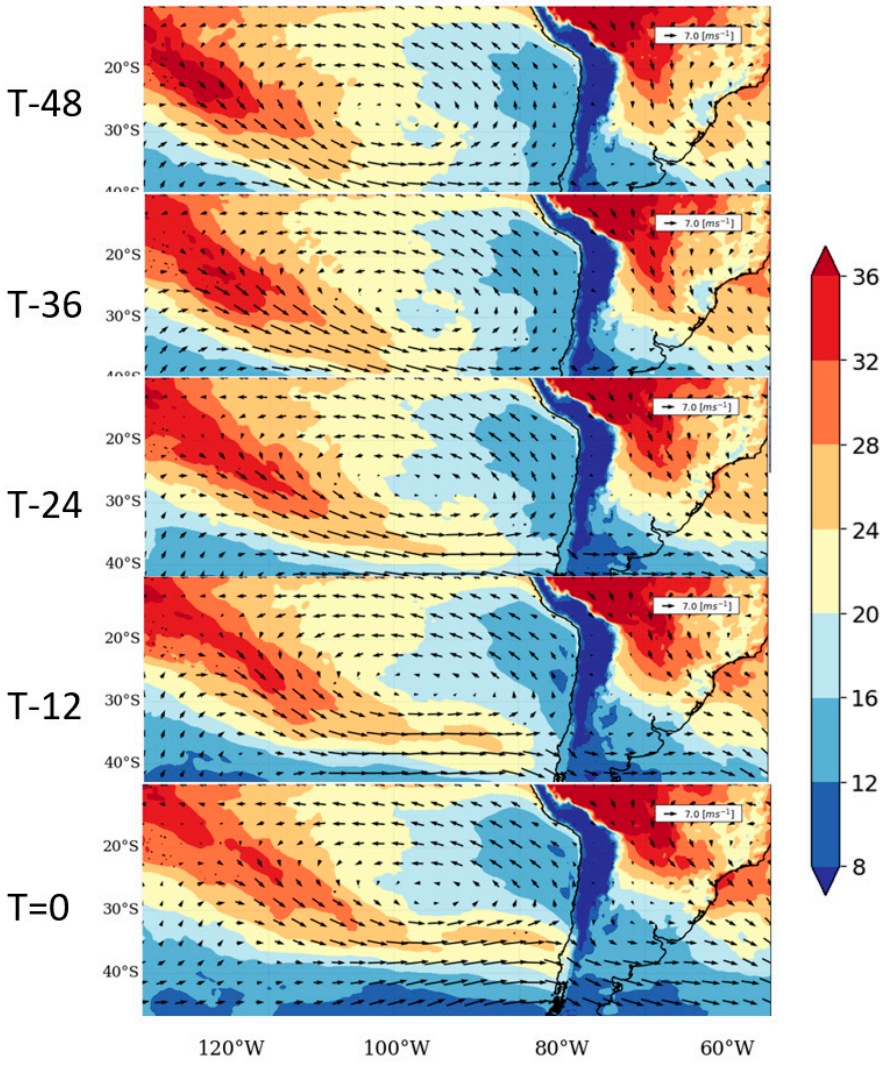


Figure S3. Composite maps of precipitable water (color, mm) and 850 hPa wind vectors (arrows) from 48 hours to landfall time for the ZAR.

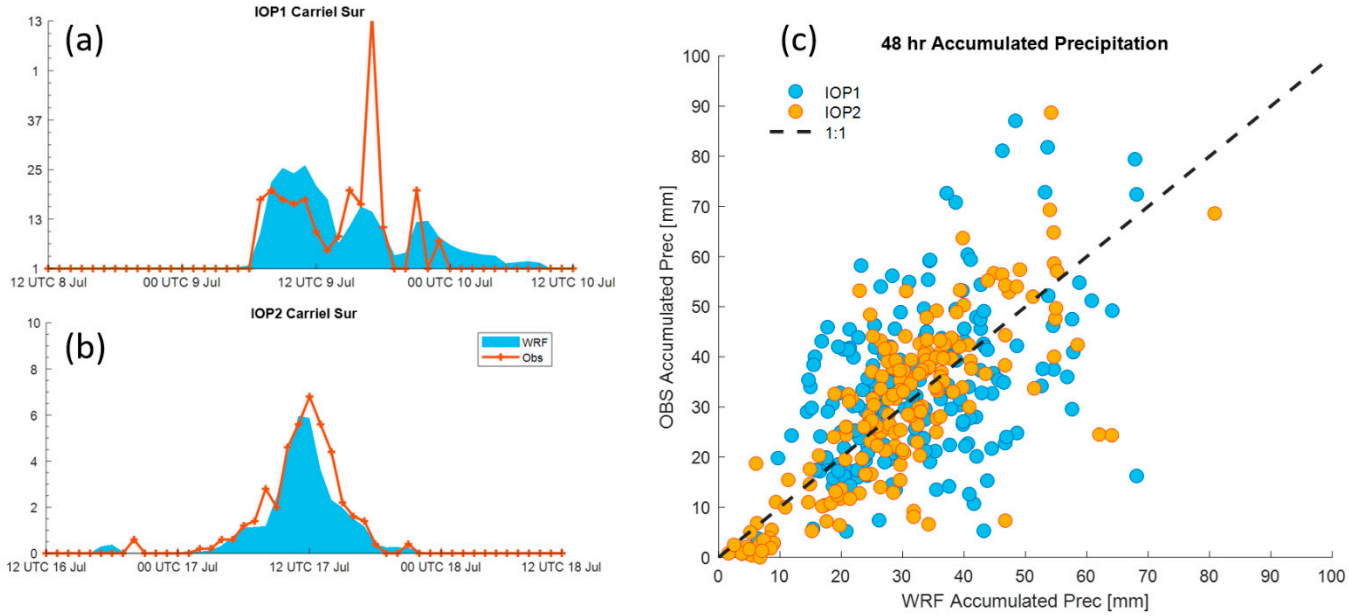


Figure S4. WRF Validation. (a) and (b): Hourly WRF precipitation (domain 2, 9 km) interpolated to Concepción for IOP1 and IOP2, respectively. (c) Scatter plot between WRF accumulated precipitation interpolated to stations within domain 2 against observed accumulations for IOP1 and IOP2.

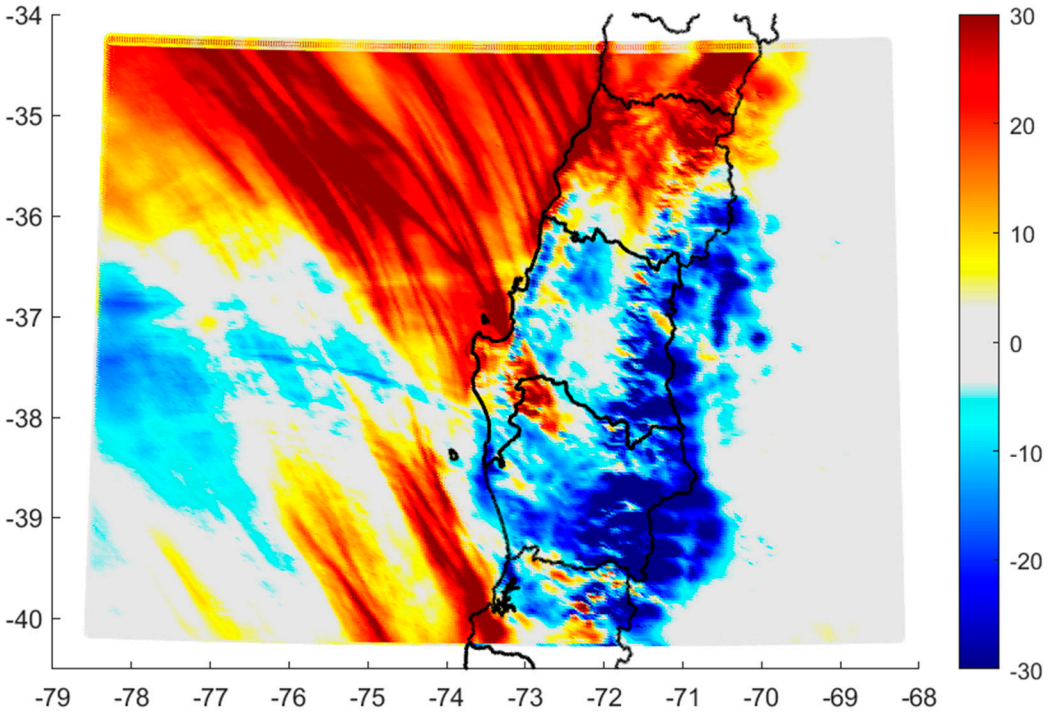


Figure S5. The difference in WRF (domain 2) accumulated precipitation (colors, mm) for IOP1 minus IOP2.

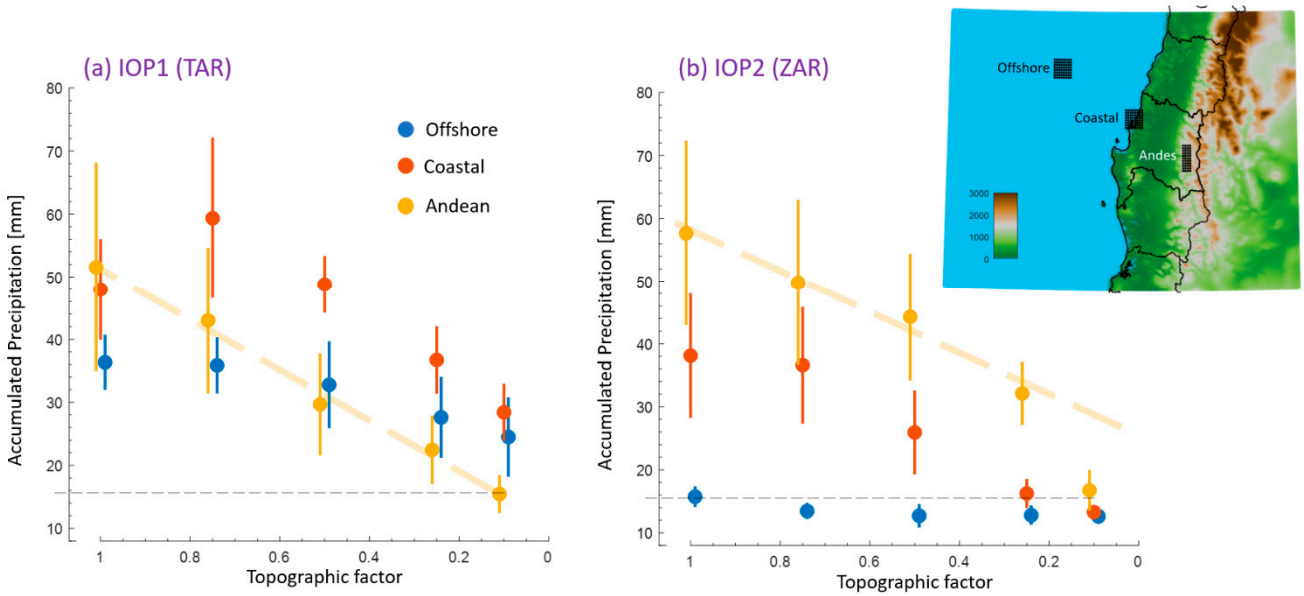


Figure S6. Sensitivity analysis using WRF (Domain 2) for (a) IOP1 and (b) IOP2. The horizontal axis is the topographic factor (τ) applied to the terrain elevation. The vertical axis is the accumulated precipitation in the offshore (blue), coastal (red), and Andean (yellow) boxes defined in the inset map. The circle corresponds to the mean accumulation and the vertical line is the range of values within the box. There is a linear accumulation decrease in the Andean box across the full range of τ for IOP1 (MAR) but only up to 0.25 in IOP2 (ZAR).