Supplementary Material

A Numerical Weather Prediction Model-Based Approach to Assess Fire Weather Conditions over the Northwest Himalayan Forests

Anandu Prabhakaran[1], Piyush Srivastava[1*]

[1]Centre of Excellence in Disaster Mitigation and Management, Indian Institute of Technology Roorkee, Roorkee, Uttarakhand, 247667, India

*Correspondence to: Piyush Srivastava (piyush.srivastava@dm.iitr.ac.in)

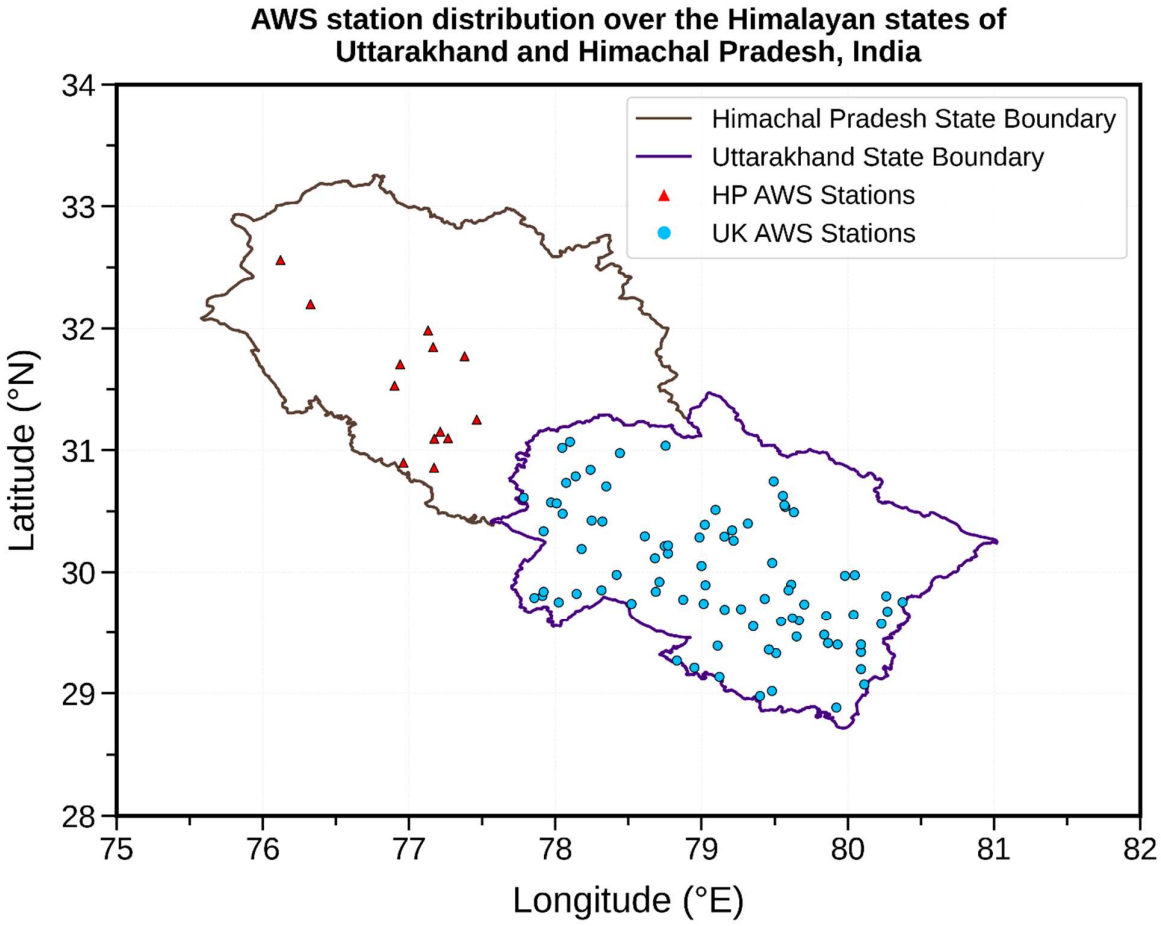


Figure S1 This figure represents the spatial distribution of 98 Automated Weather Stations across the Indian Himalayan States of Uttarakhand and Himachal Pradesh, India.

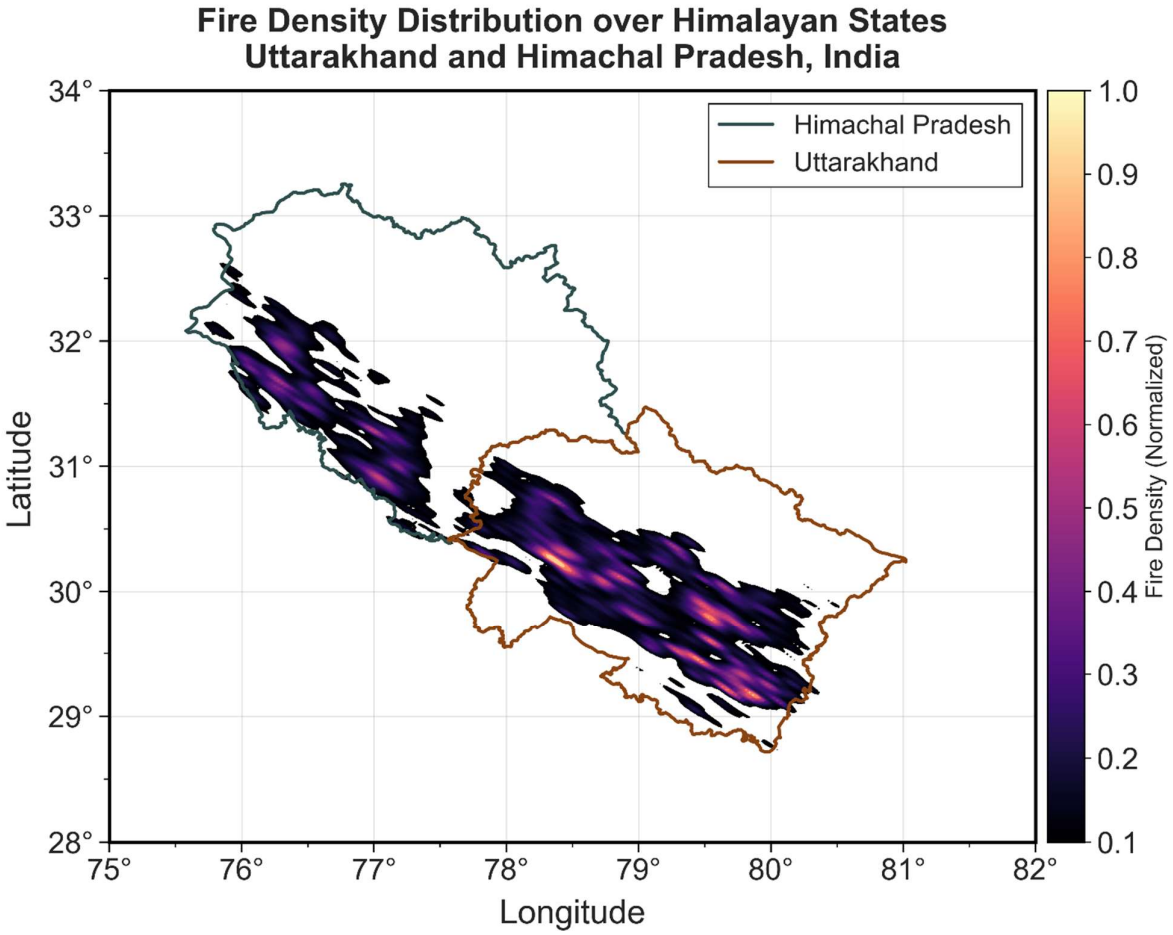


Figure S2 The figure shows the variation of fire density across the Himalayan states of Uttarakhand (red) and Himachal Pradesh (dark blue), India during 2000 to 2024. The fire alerts from the MODIS and SNPP sensors are normalised from 0 to 1.0 with 1 representing the most fire prone region and 0 representing non fire prone region.

Point	Latitude (°N)	Longitude (°E)	Fire Date	Slope Alignment
P01	29.0528	79.4208	21 May 2024	Southwest
P02	30.1447	78.8339	06 May 2024	North
P03	29.5100	79.3008	04 May 2024	West
P04	29.0489	79.4158	09 May 2024	South
P05	30.4108	78.3750	28 May 2024	North
P06	29.7639	79.5658	05 May 2024	North
P07	30.3678	78.4269	28 May 2024	Northeast
P08	29.5028	79.3608	21 May 2024	West
P09	30.1389	78.8147	06 May 2024	Southwest
P10	29.6819	79.7658	06 May 2024	North
P11	29.7728	79.6947	05 May 2024	Southeast
P12	30.7328	78.3597	05 May 2024	Southwest
P13	30.2008	78.0797	19 May 2024	Southeast
P14	30.0769	78.7219	14 May 2024	Southwest
P15	30.0339	78.9639	20 May 2024	North
P16	29.9100	79.4669	06 May 2024	Southwest
P17	31.4442	76.5480	28 May 2024	Southeast
P18	31.2317	76.7503	14 May 2024	North
P19	31.4706	76.4810	14 May 2024	South
P20	31.8617	76.0097	16 May 2024	Southwest
P21	31.8623	76.0350	16 May 2024	Southwest
P22	32.0359	76.6627	19 May 2024	West
P23	32.0364	76.6680	19 May 2024	Northeast
P24	30.9750	77.0639	20 May 2024	Northeast

Table S1 This table shows the identified fire clusters along with their location, fire date obtained from MODIS and SNPP sensors and the alignment of slopes obtained from SRTM Digital Elevation Model.

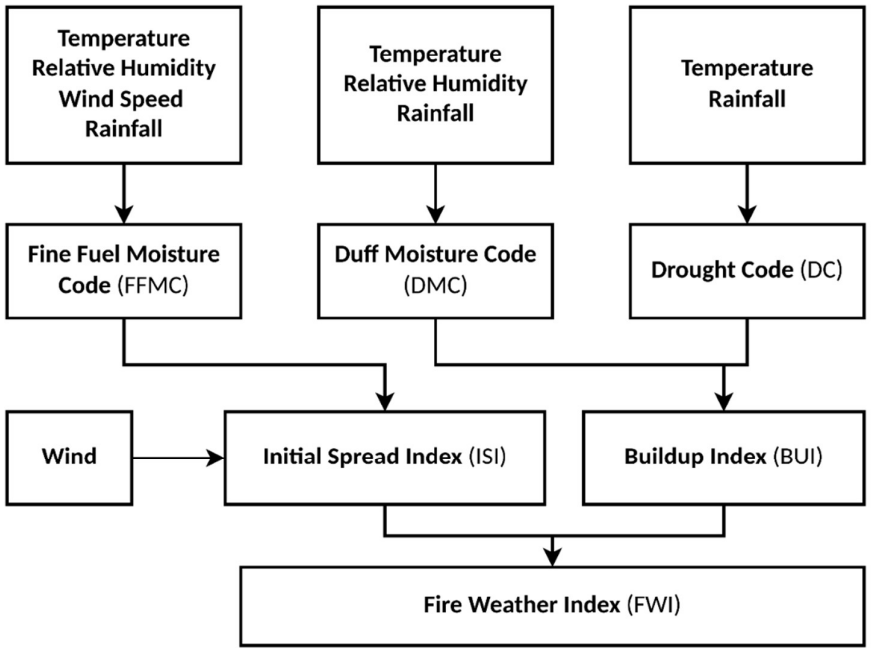


Figure S3 The schematic represents the Canadian Fire Weather Index system for probable forest fire danger rating (Lawson & Armitage, 2008).

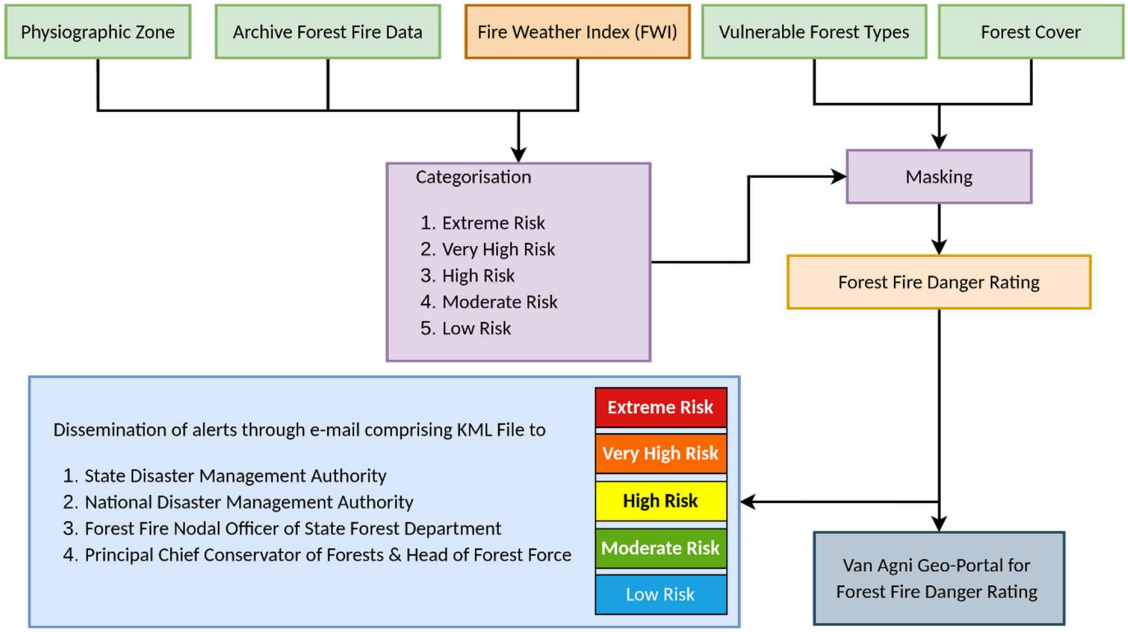


Figure S4 Forest Fire Danger Rating System (FFDRS) and Pre-Fire Alert Dissemination System by Forest Survey of India (Source: Forest Survey of India).

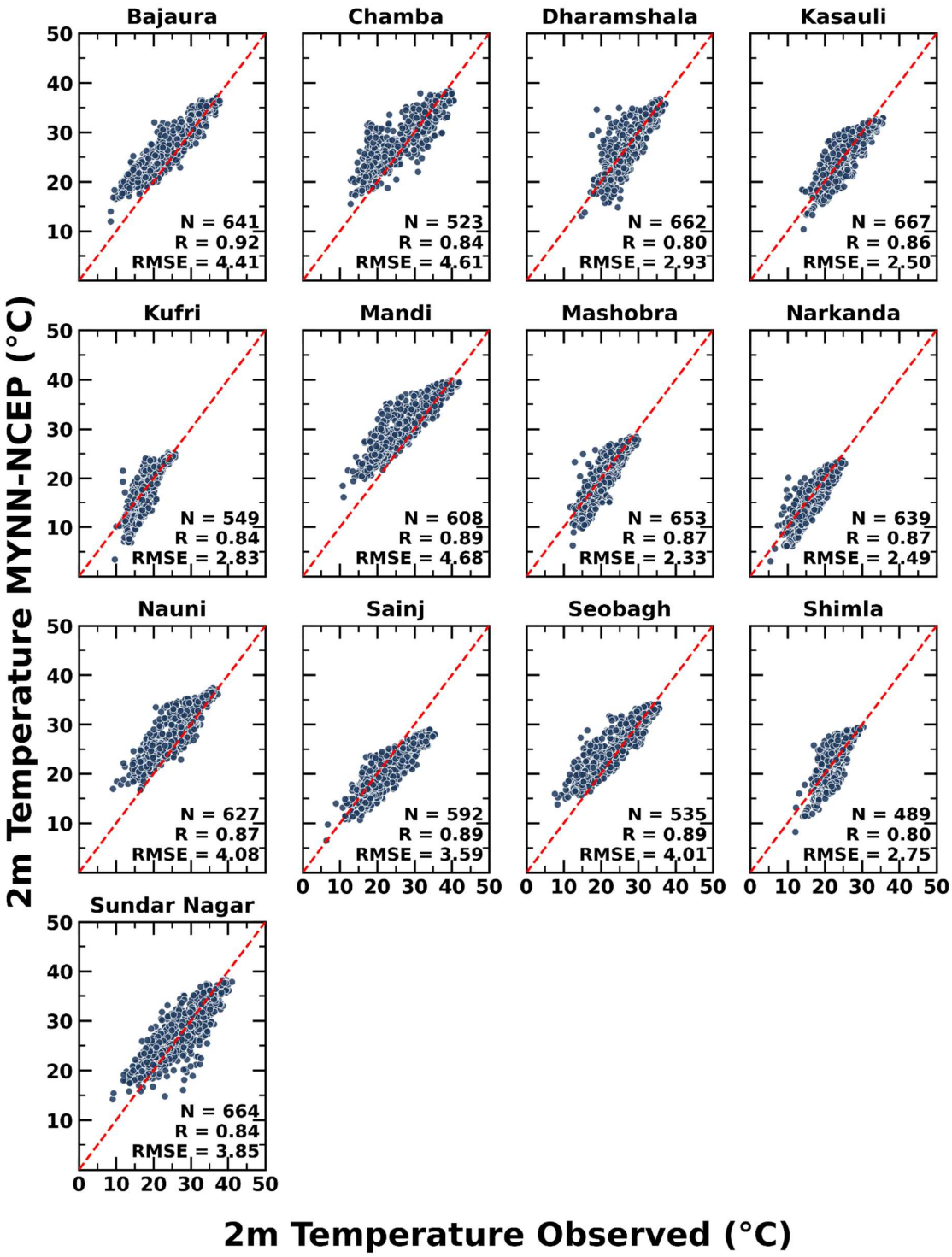


Figure S5 This figure shows the validation of 2m temperature of $MYNN_{NCEP}$ simulation against the India Meteorological Department Automated Weather Station data across Himachal Pradesh, India.

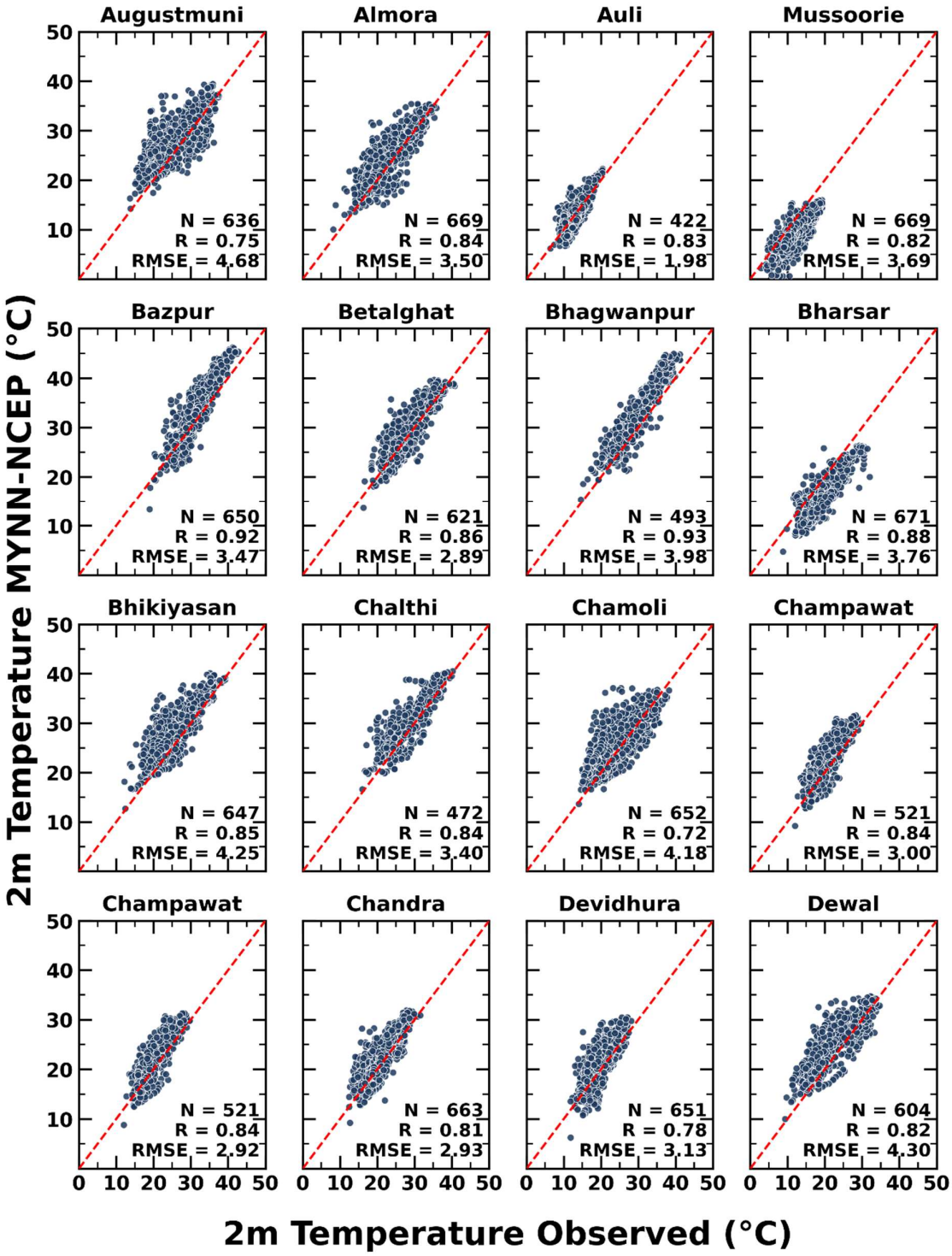


Figure S6 This figure shows the validation of 2m temperature of $MYNN_{NCEP}$ simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

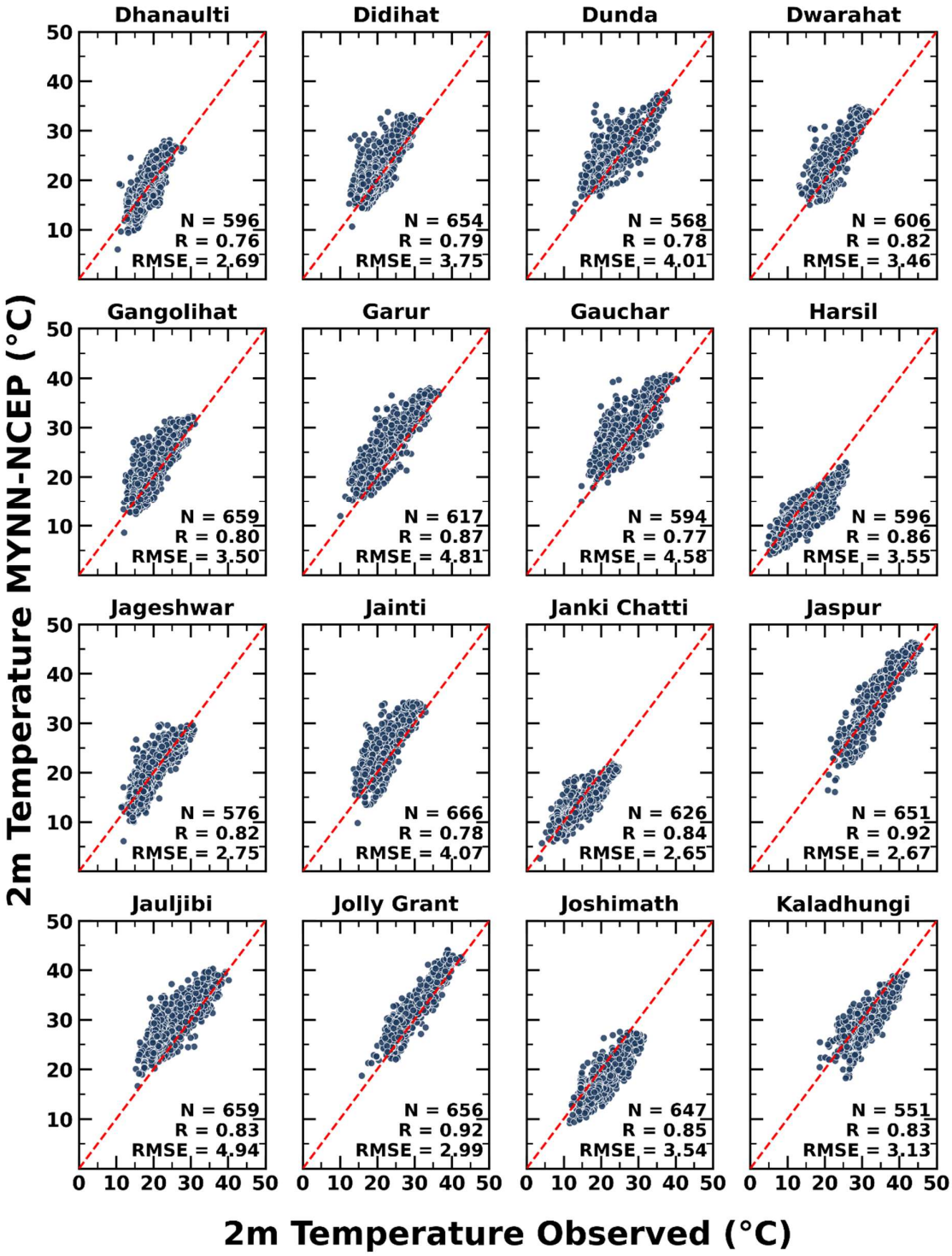


Figure S7 This figure shows the validation of 2m temperature of $MYNN_{NCEP}$ simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

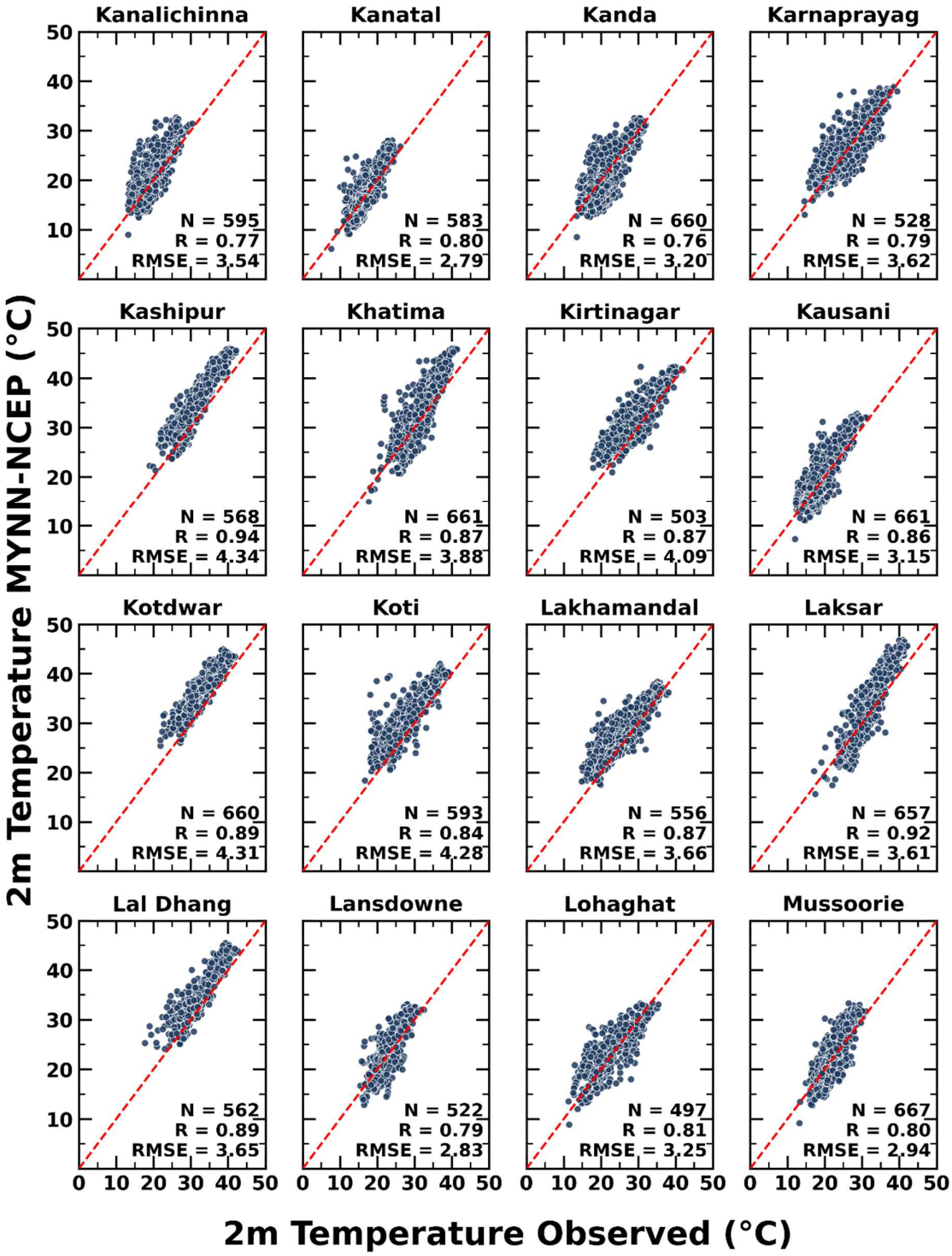


Figure S8 This figure shows the validation of 2m temperature of $MYNN_{NCEP}$ simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

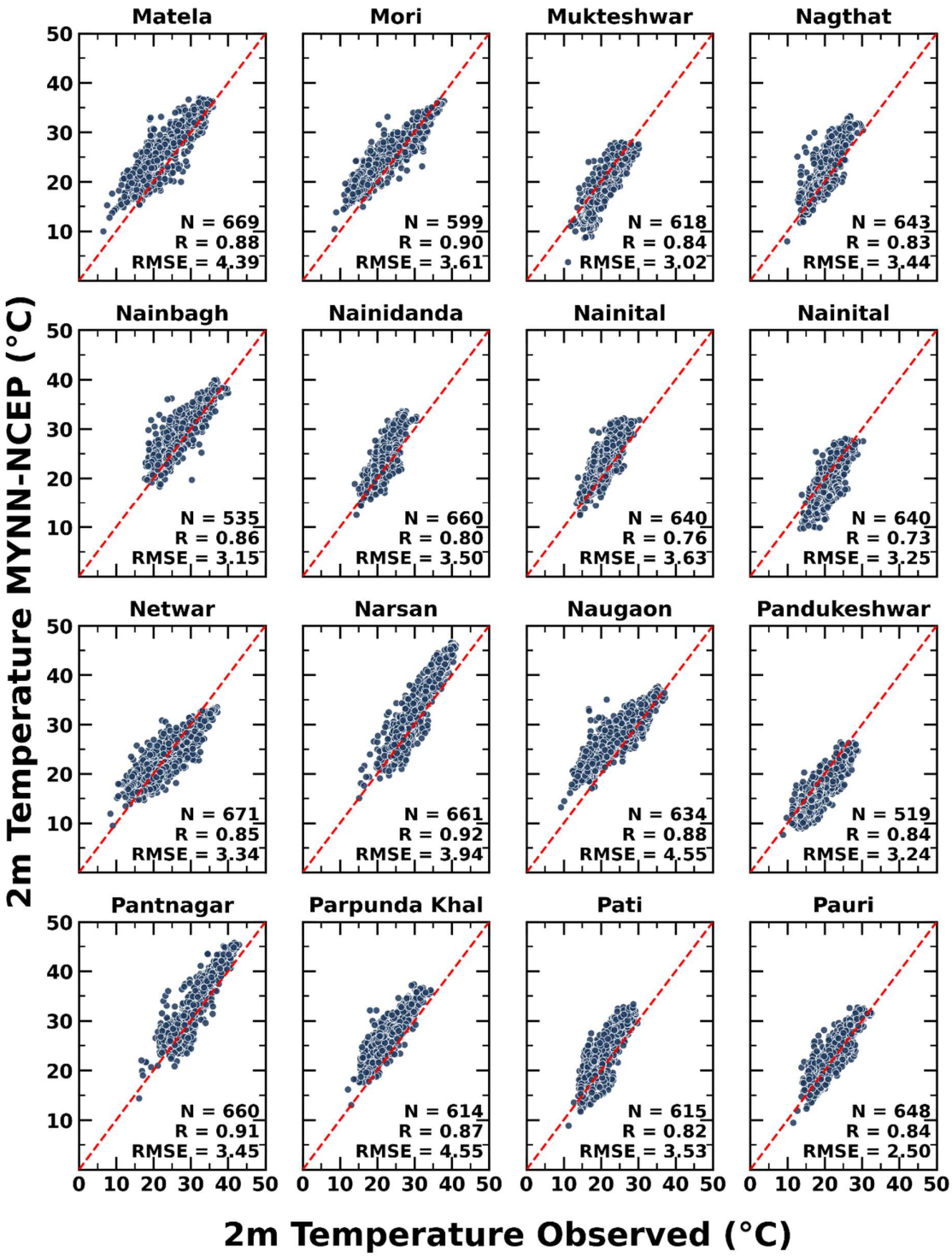


Figure S9 This figure shows the validation of 2m temperature of $MYNN_{NCEP}$ simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India

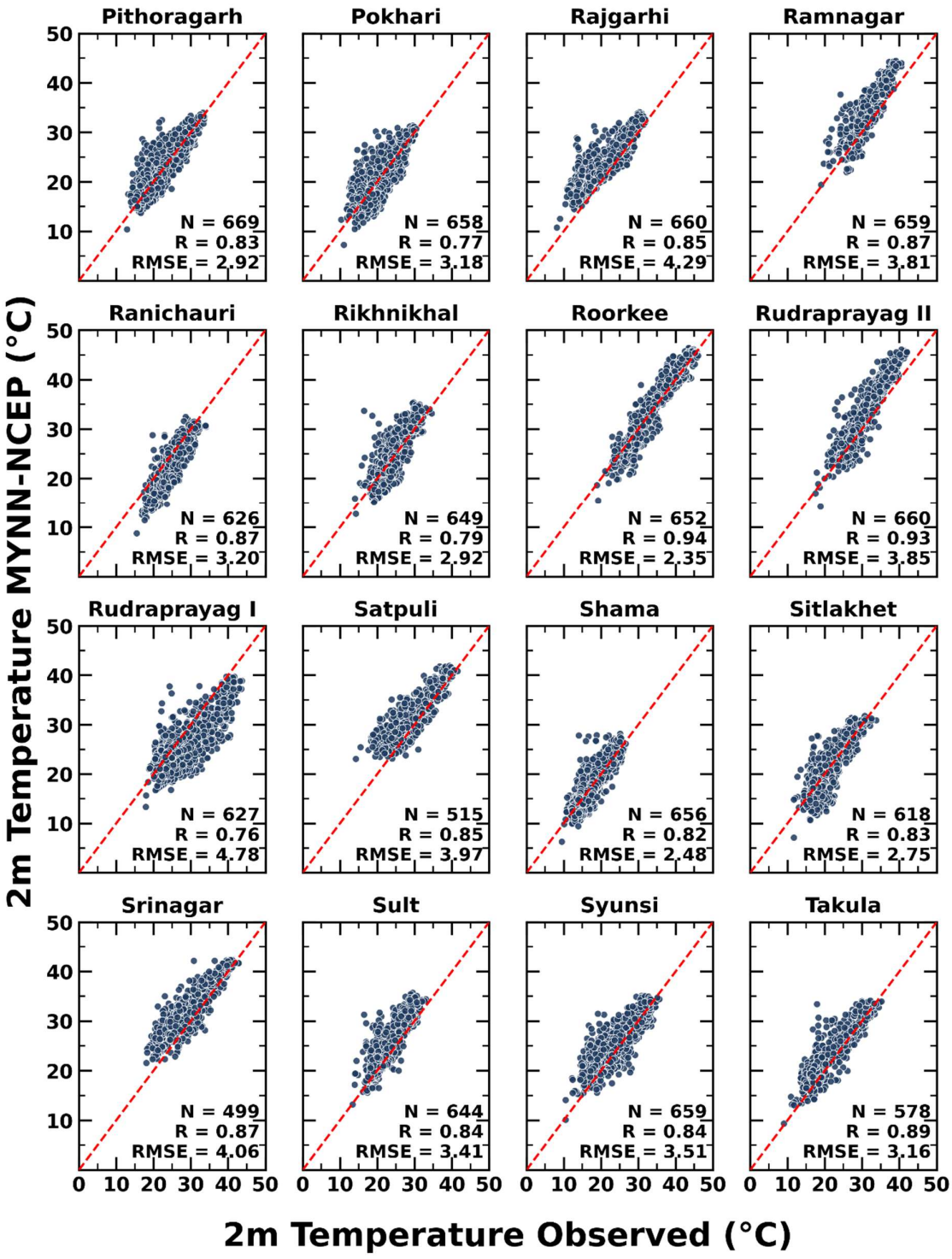


Figure S10 This figure shows the validation of 2m temperature of $MYNN_{NCEP}$ simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

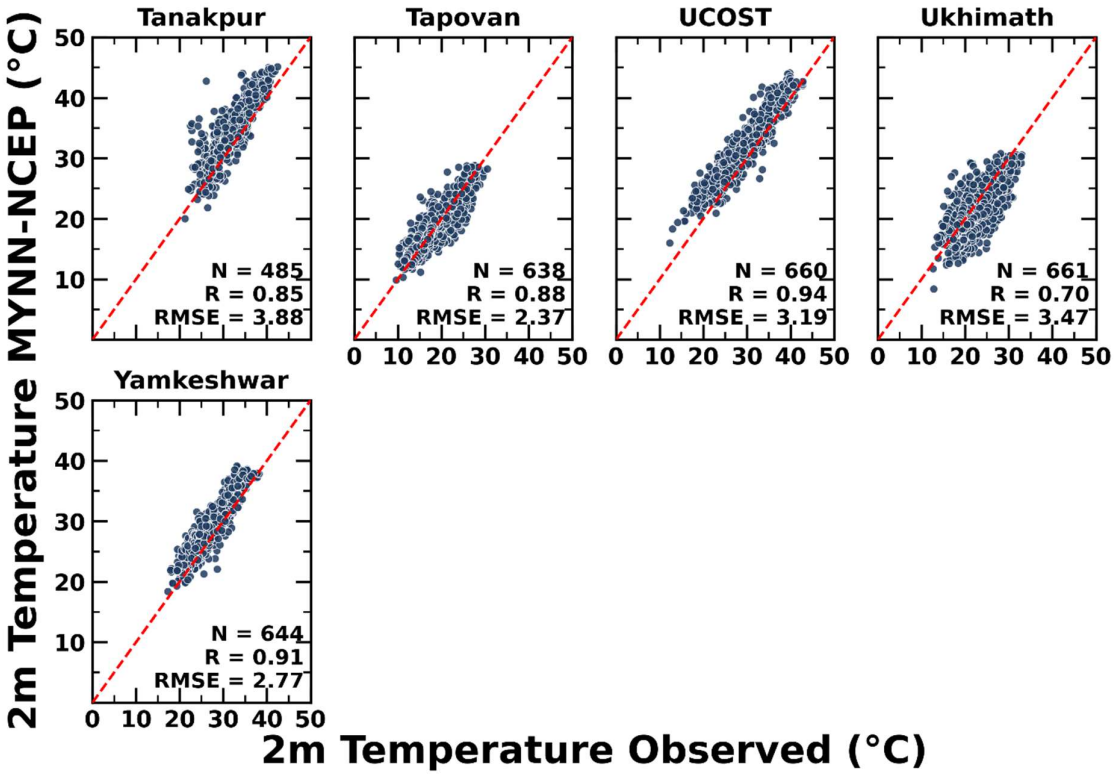


Figure S11 This figure shows the validation of 2m temperature of $MYNN_{NCEP}$ simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

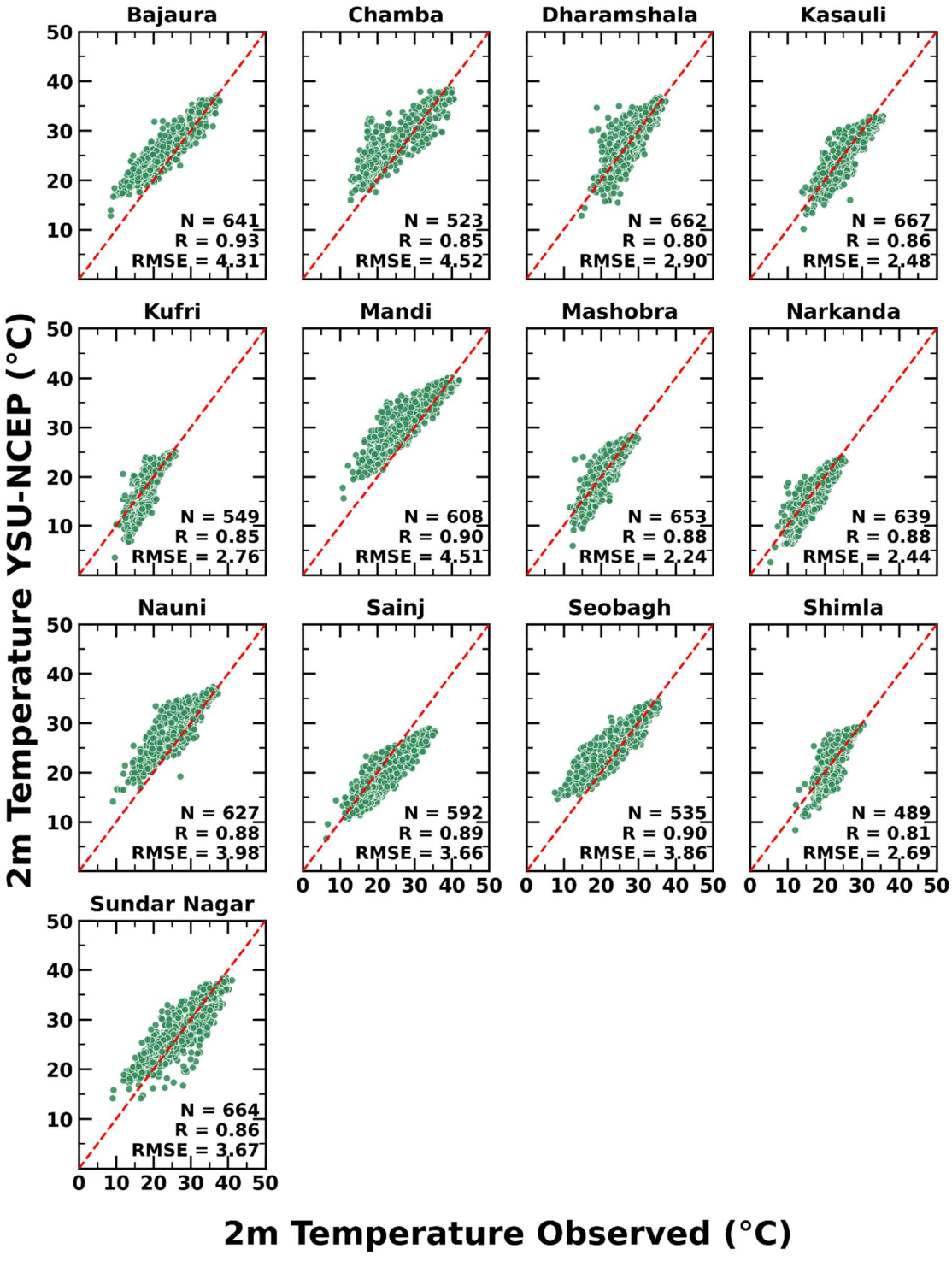


Figure S12 This figure shows the validation of 2m temperature of YSU_{NCEP} simulation against the India Meteorological Department Automated Weather Station data across Himachal Pradesh, India.

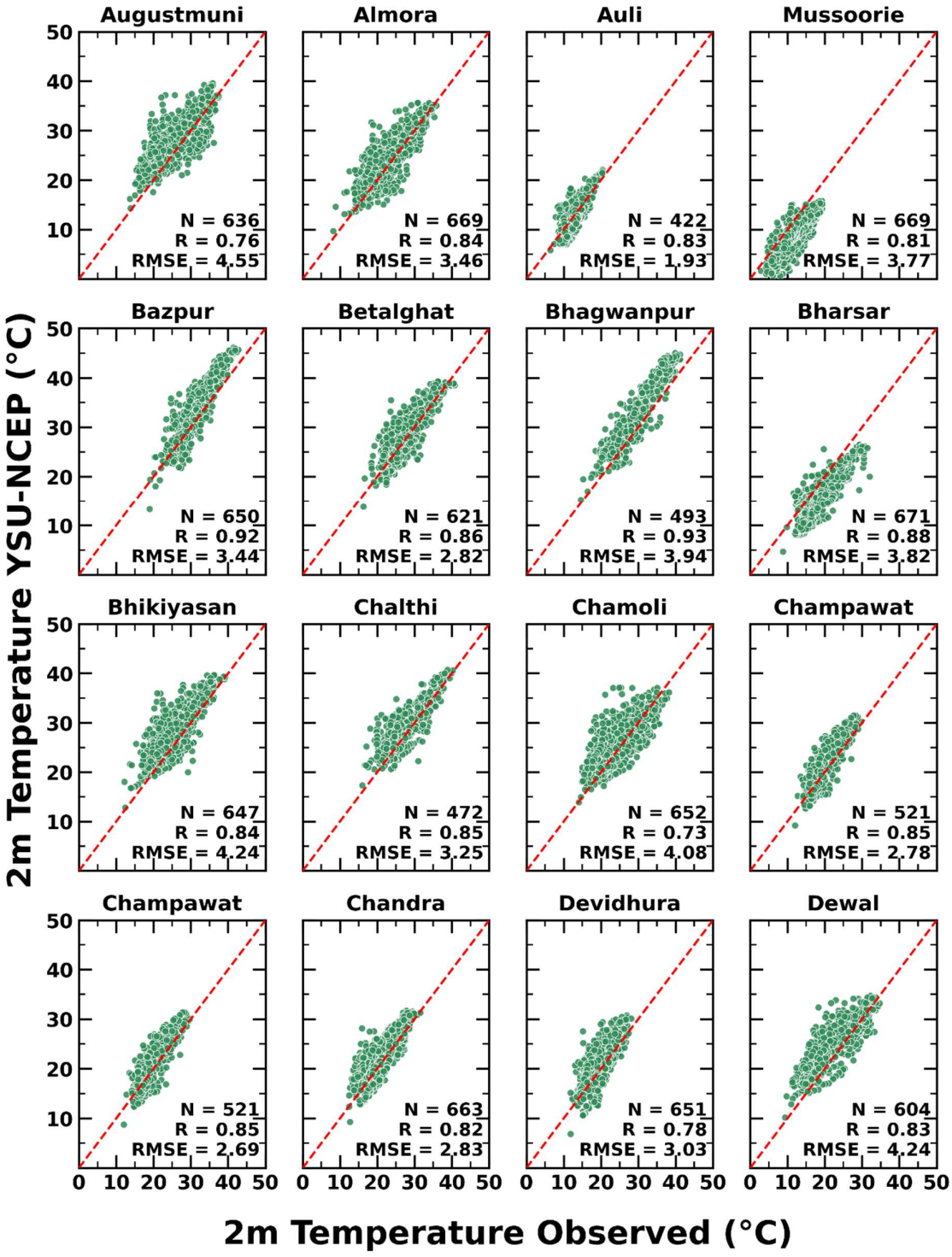


Figure S13 This figure shows the validation of 2m temperature of YSU_{NCEP} simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

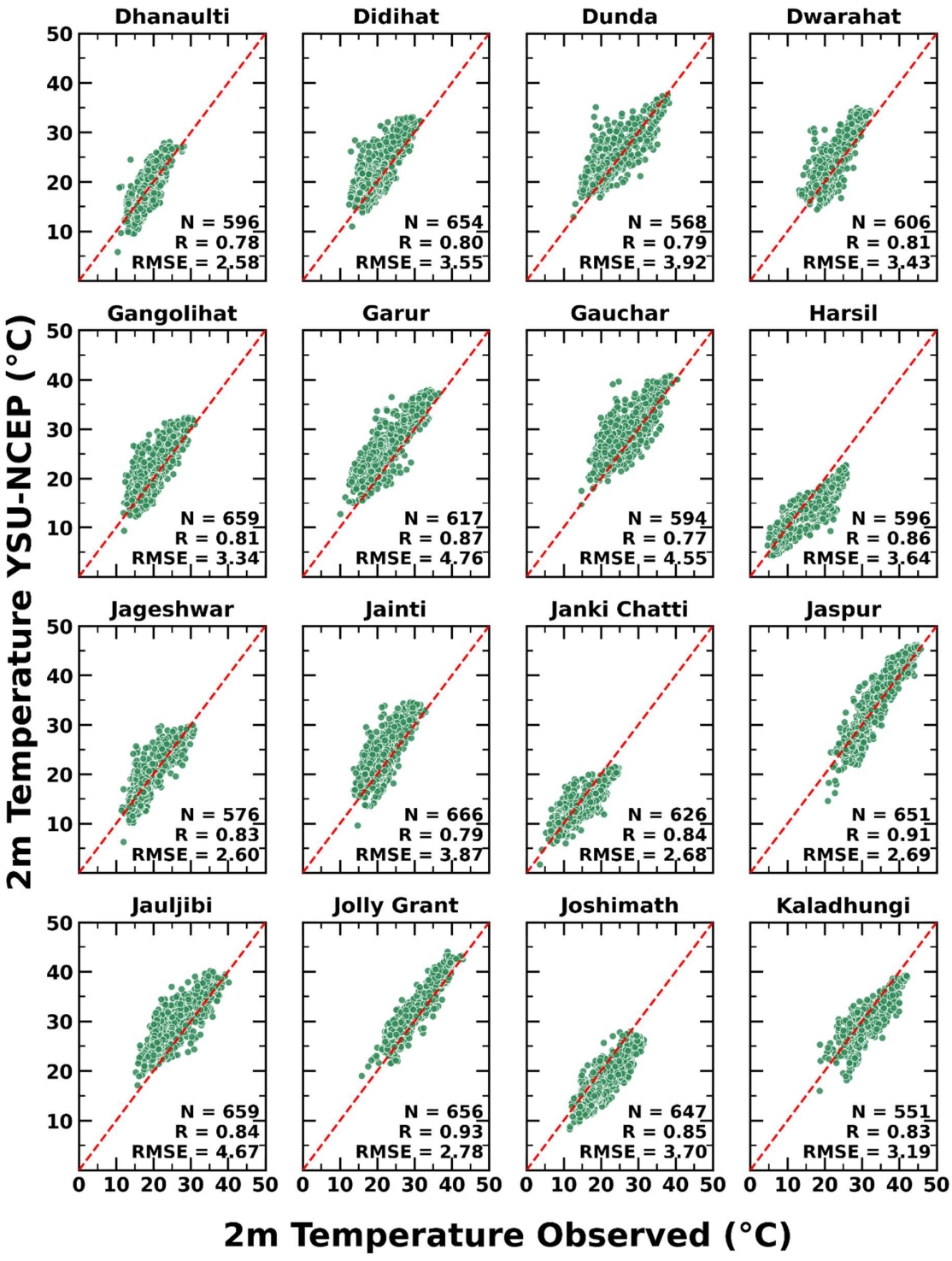


Figure S14 This figure shows the validation of 2m temperature of YSU_{NCEP} simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

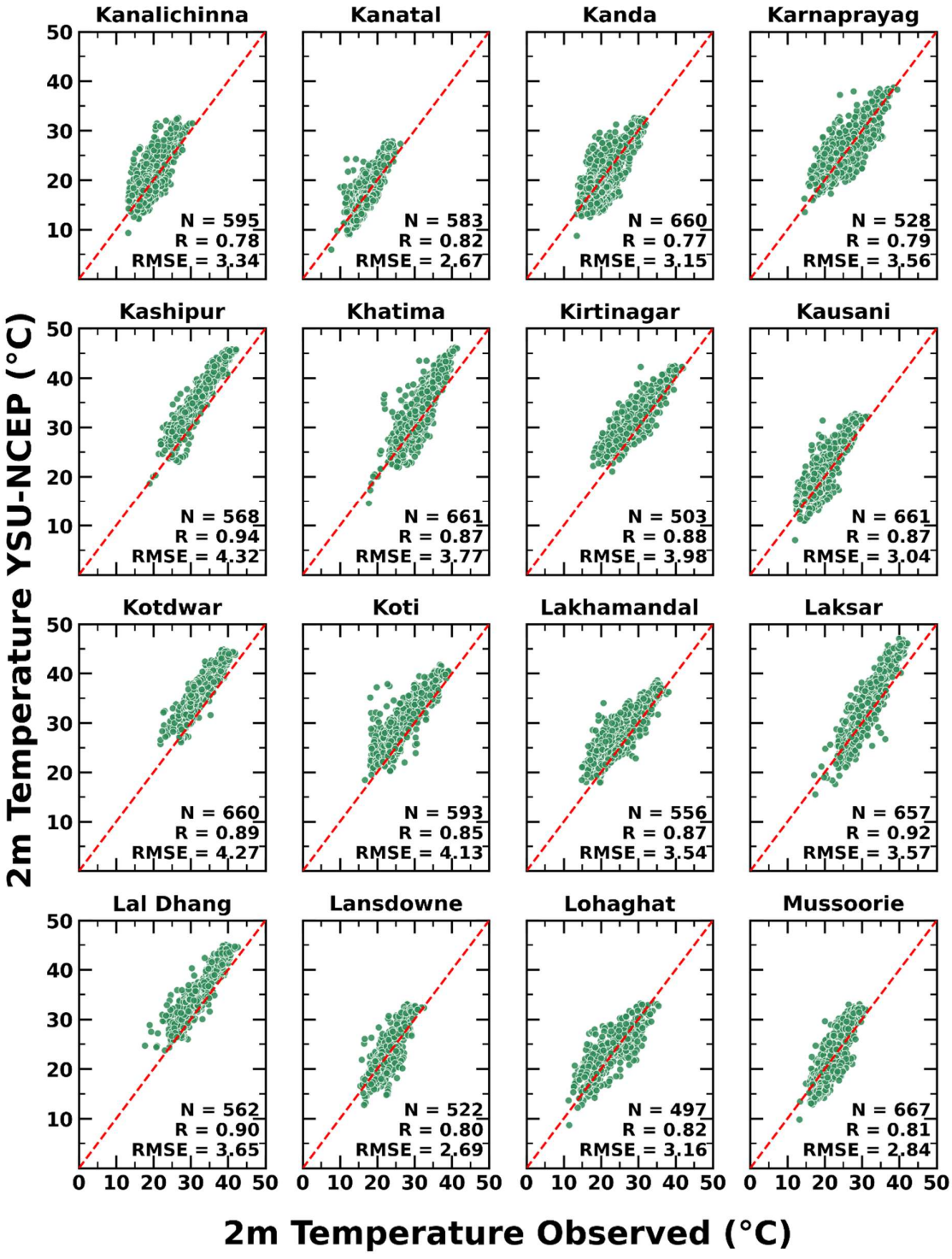


Figure S15 This figure shows the validation of 2m temperature of YSU_{NCEP} simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

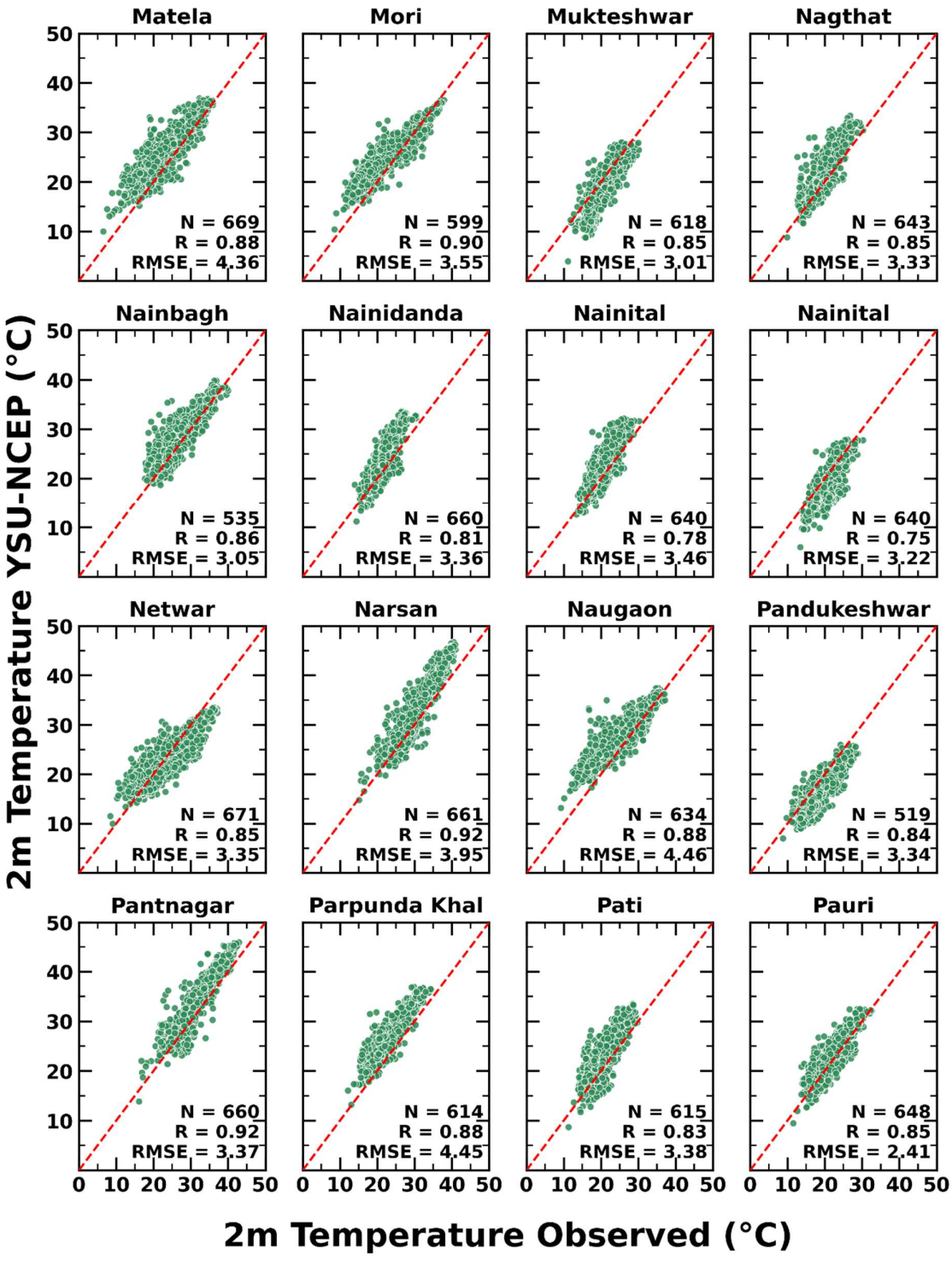


Figure S16 This figure shows the validation of 2m temperature of YSU_{NCEP} simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

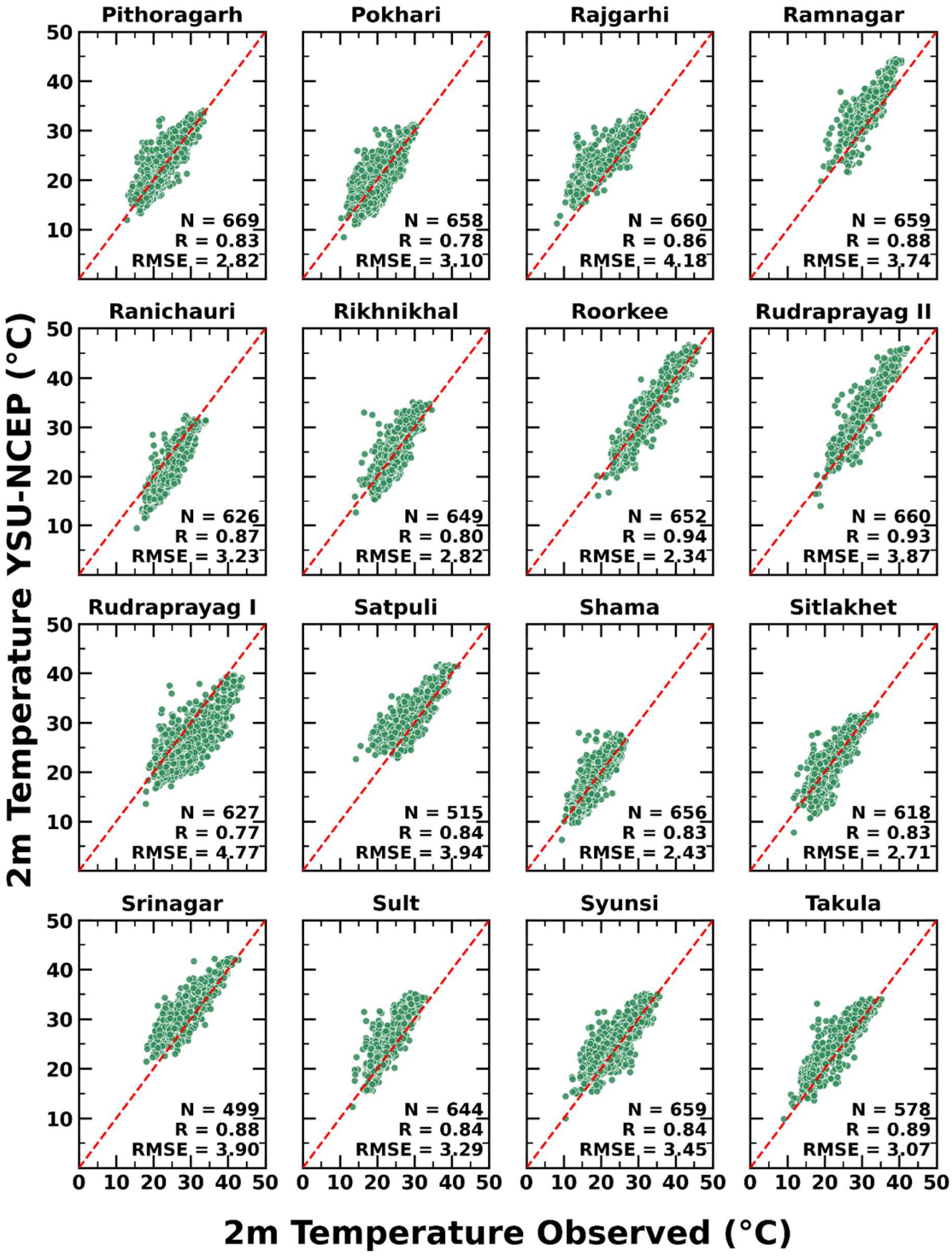


Figure S17 This figure shows the validation of 2m temperature of YSU_{NCEP} simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

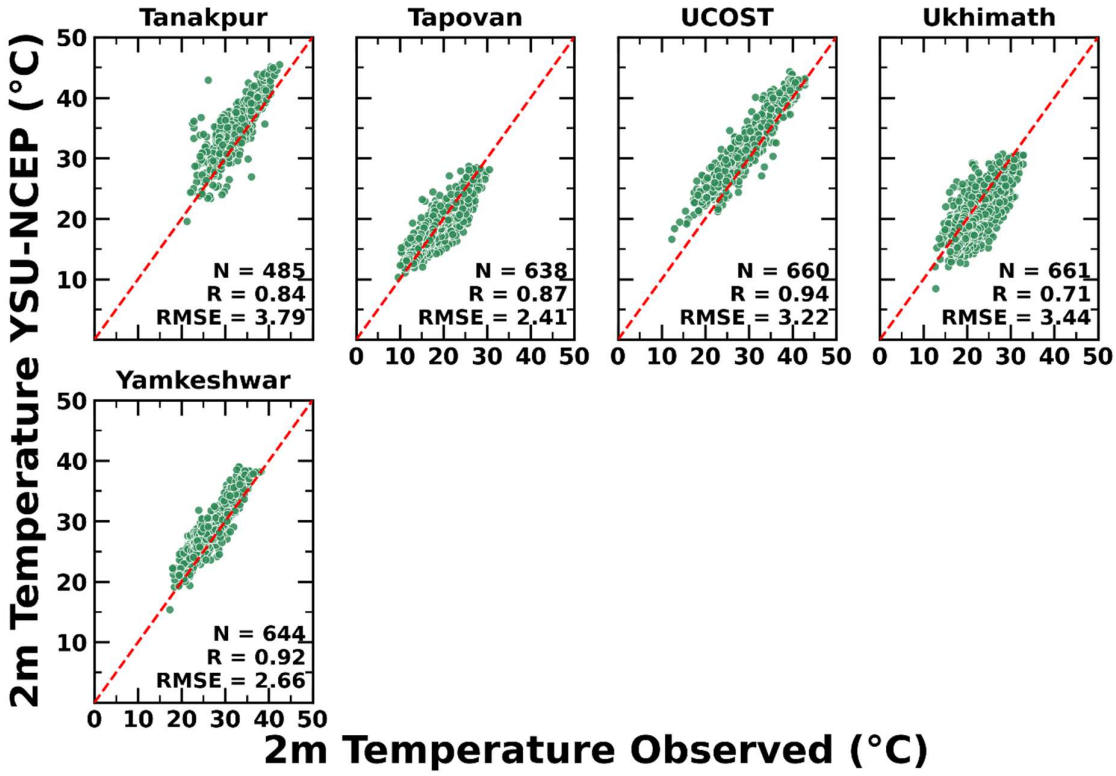


Figure S18 This figure shows the validation of 2m temperature of YSU_{NCEP} simulation against the India Meteorological Department Automated Weather Station data across Uttarakhand, India.

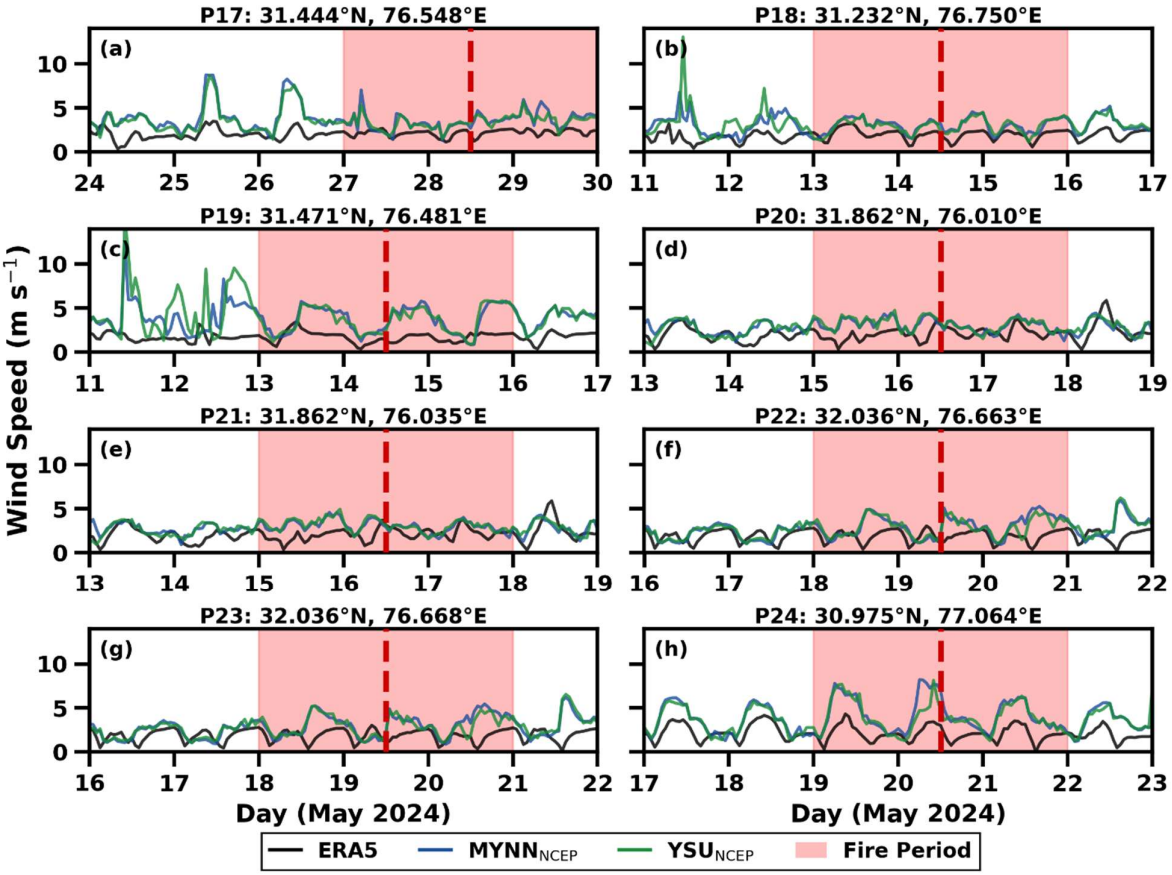


Figure S19 This figure shows the variation in wind speed (in m/s) across the 08 major fire clusters identified across Himachal Pradesh, India. The red shaded region represents the fire period window, with the dotted line representing fire detection by the satellite sensors. ERA5 - Land reference, MYNN, and YSU simulations are represented in the respective plots.

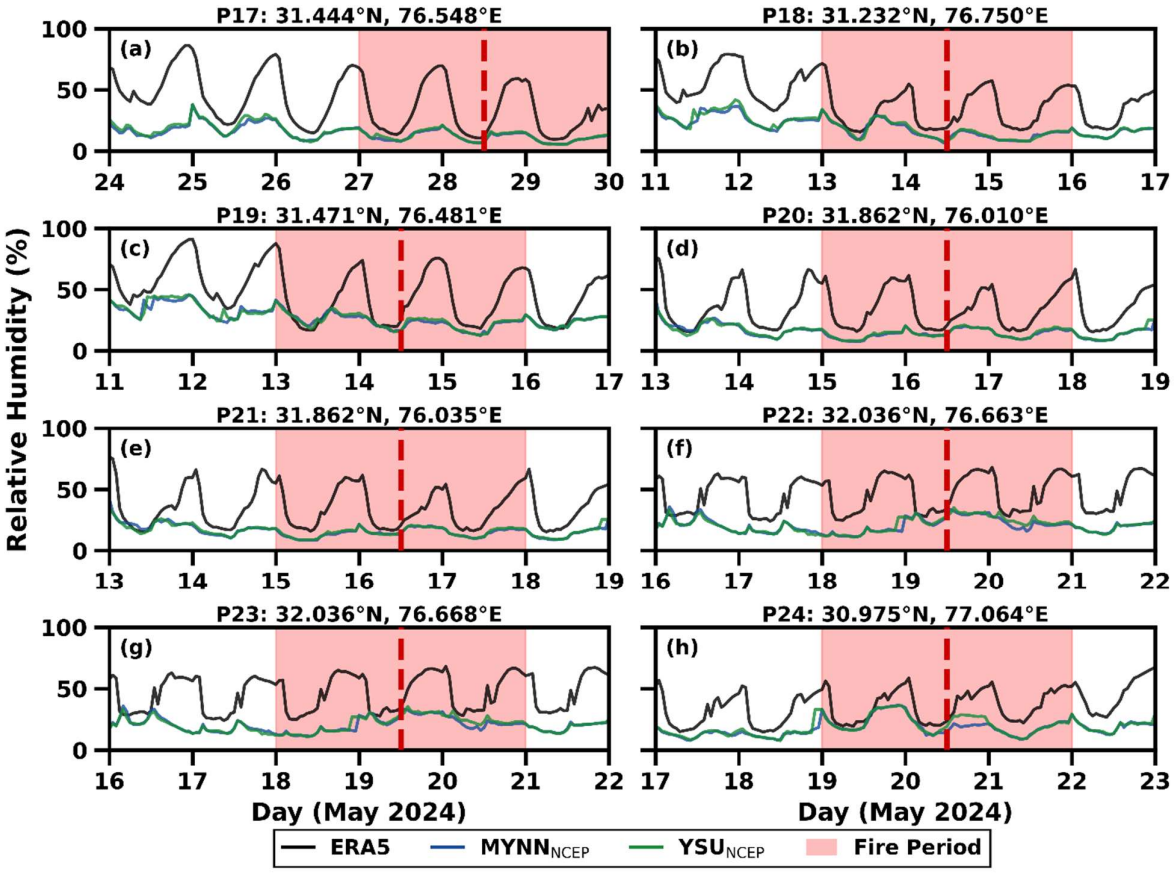


Figure S20 This figure shows the variation in relative humidity (in %) across the 08 major fire clusters identified across Himachal Pradesh, India. The red shaded region represents the fire period window, with the dotted line representing fire detection by the satellite sensors. ERA5 – Land reference, MYNN, and YSU simulations are represented in the respective plots.

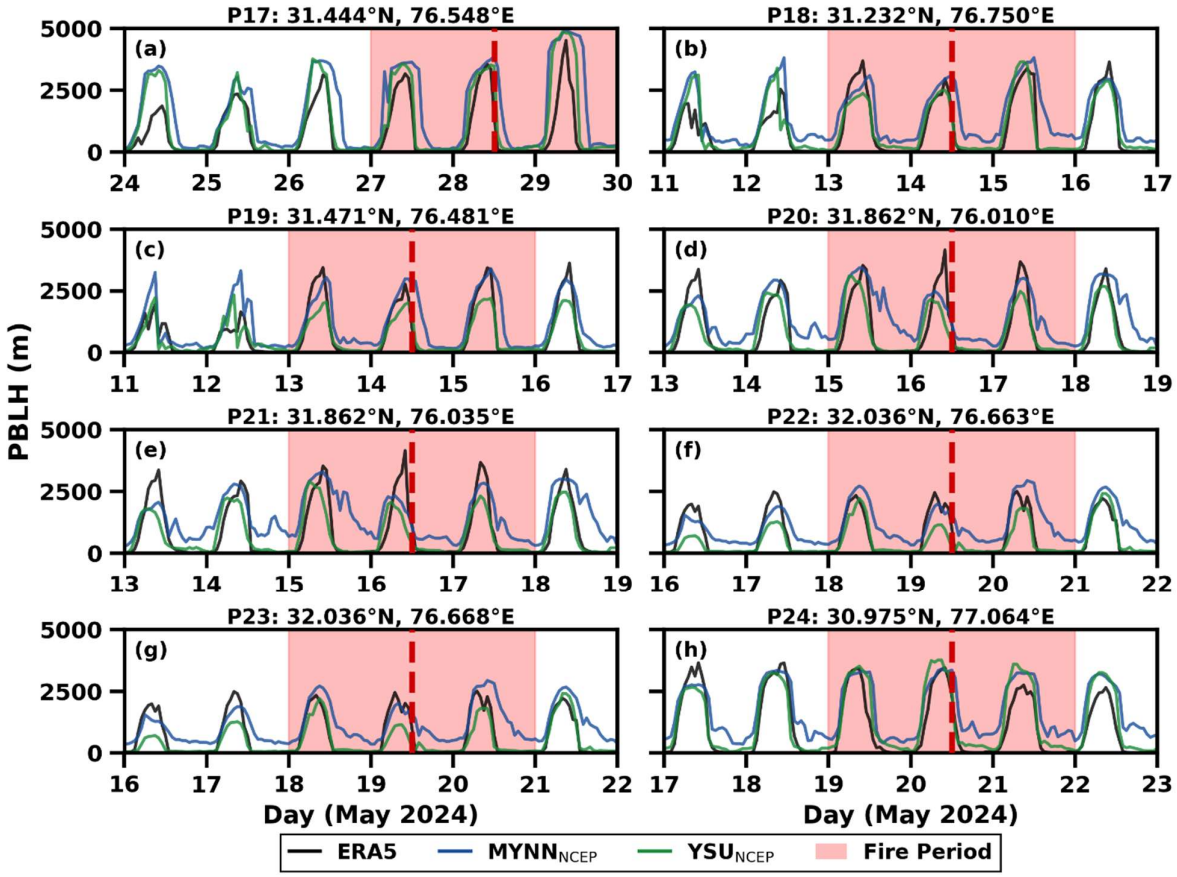


Figure S21 This figure shows the variation in planetary boundary layer height (in m) across the 08 major fire clusters identified across Himachal Pradesh, India. The red shaded region represents the fire period window, with the dotted line representing fire detection by the satellite sensors. ERA5 - Land reference, MYNN, and YSU simulations are represented in the respective plots.

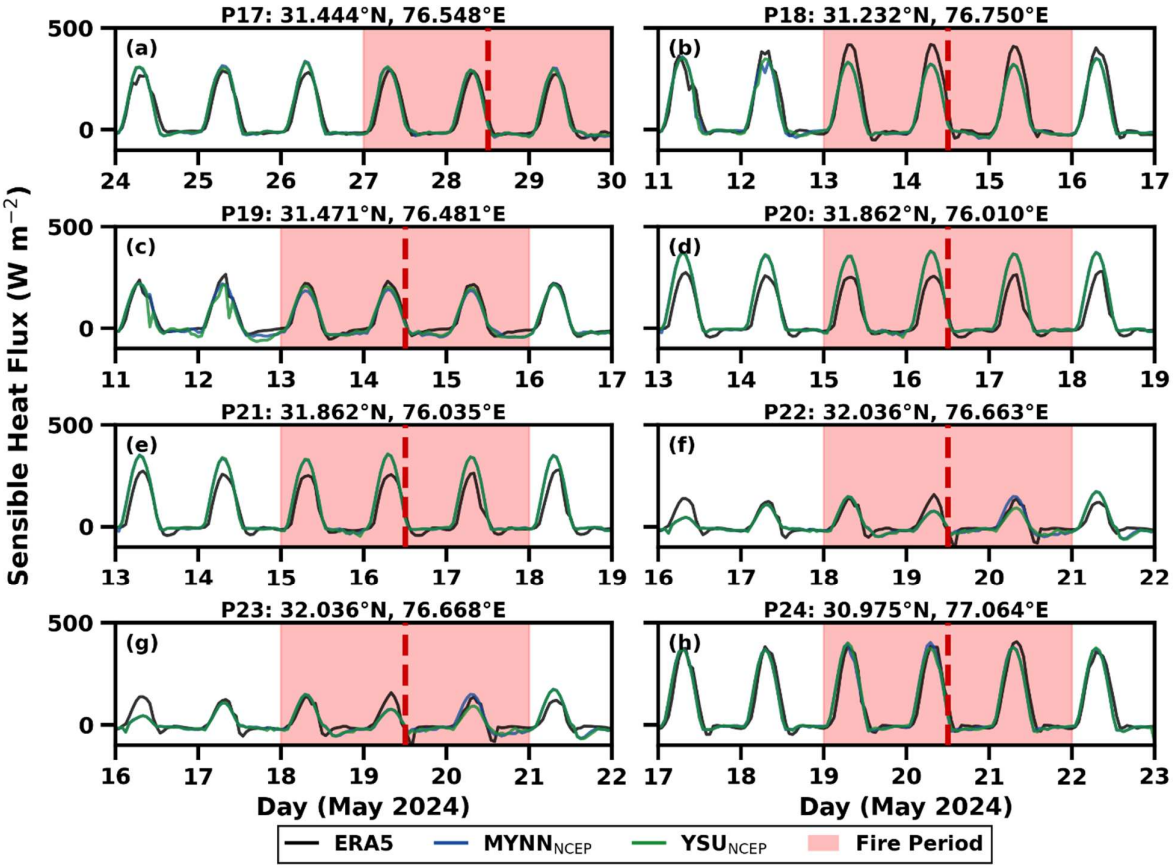


Figure S22 This figure shows the variation in sensible heat flux (in W/m^2) across the 08 major fire clusters identified across Himachal Pradesh, India. The red shaded region represents the fire period window, with the dotted line representing fire detection by the satellite sensors. ERA5 - Land reference, MYNN, and YSU simulations are represented in the respective plots.

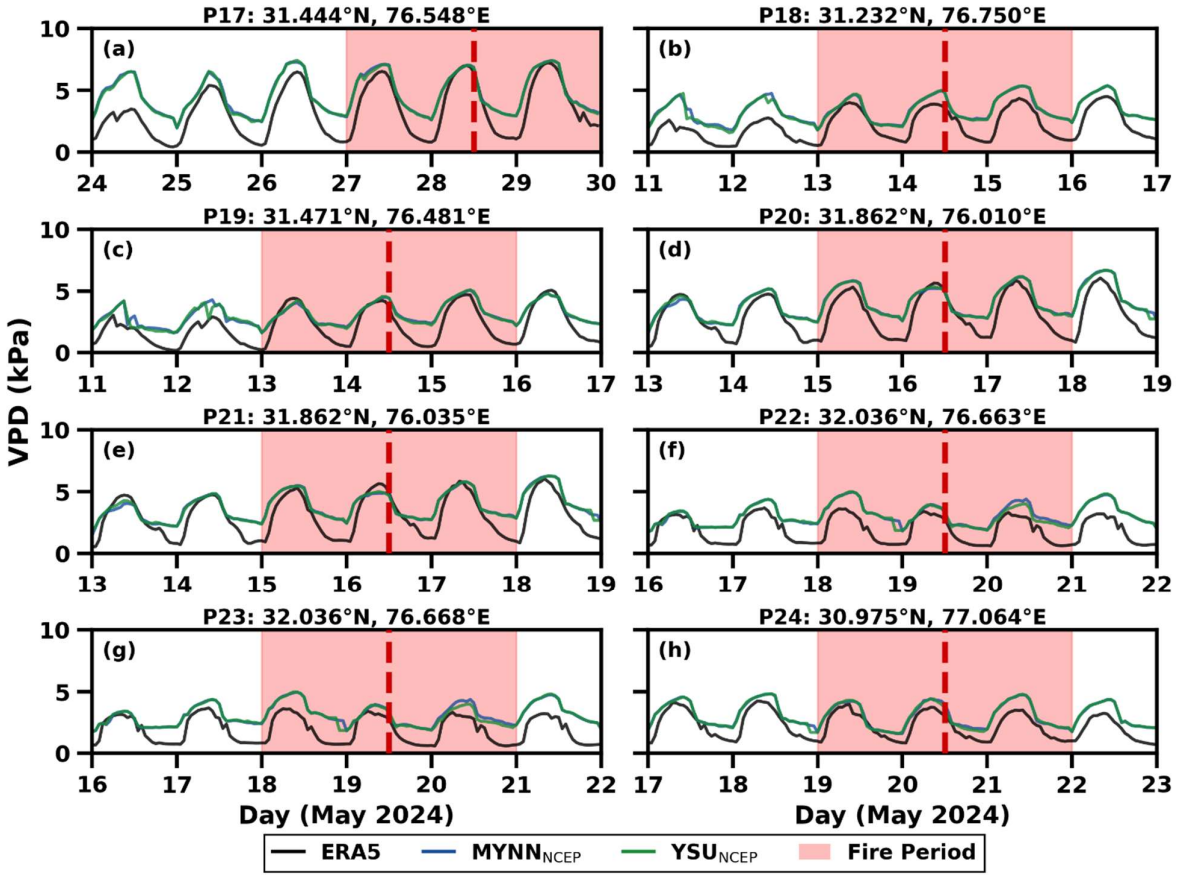
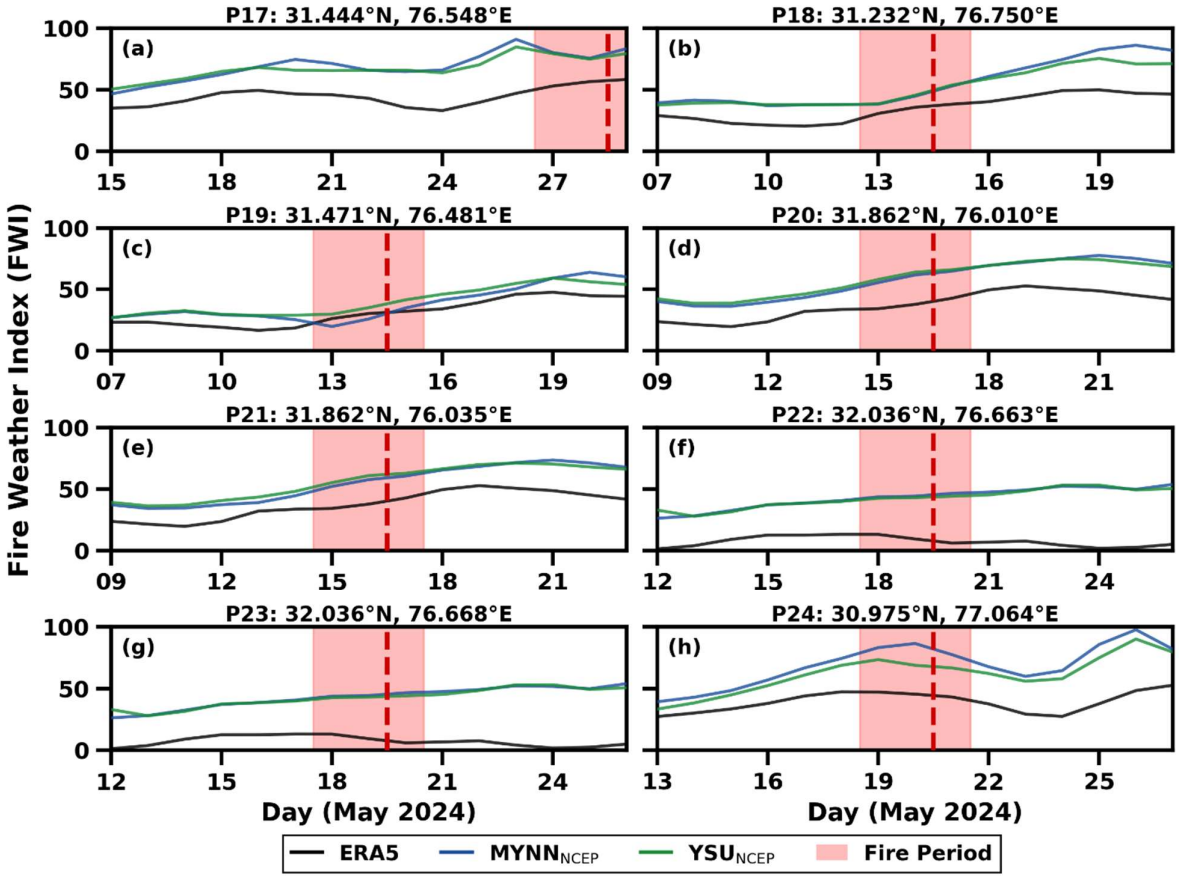


Figure S23 This plot shows the variation in vapour pressure deficit (in kPa) across 08 major fire clusters identified across Himachal Pradesh, India. The red shaded region represents the fire period window, with the dotted line representing fire detection by the satellite sensors. ERA5 – Land VPD, MYNN, and YSU simulated VPD are represented in the respective plots.



93

94 **Figure S24** This figure shows the variation in the Fire Weather Index across 08 major fire clusters
95 identified across Himachal Pradesh, India. The red shaded region represents the fire period window,
96 with the dotted line representing fire detection by the satellite sensors. ERA5 – Land FWI, MYNN,
97 and YSU simulated FWI are represented in the respective plots.