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Session 25, January 7, 2021

A Satellite-station Blended Daily Surface Air Temperature Dataset for the Tibetan Plateau

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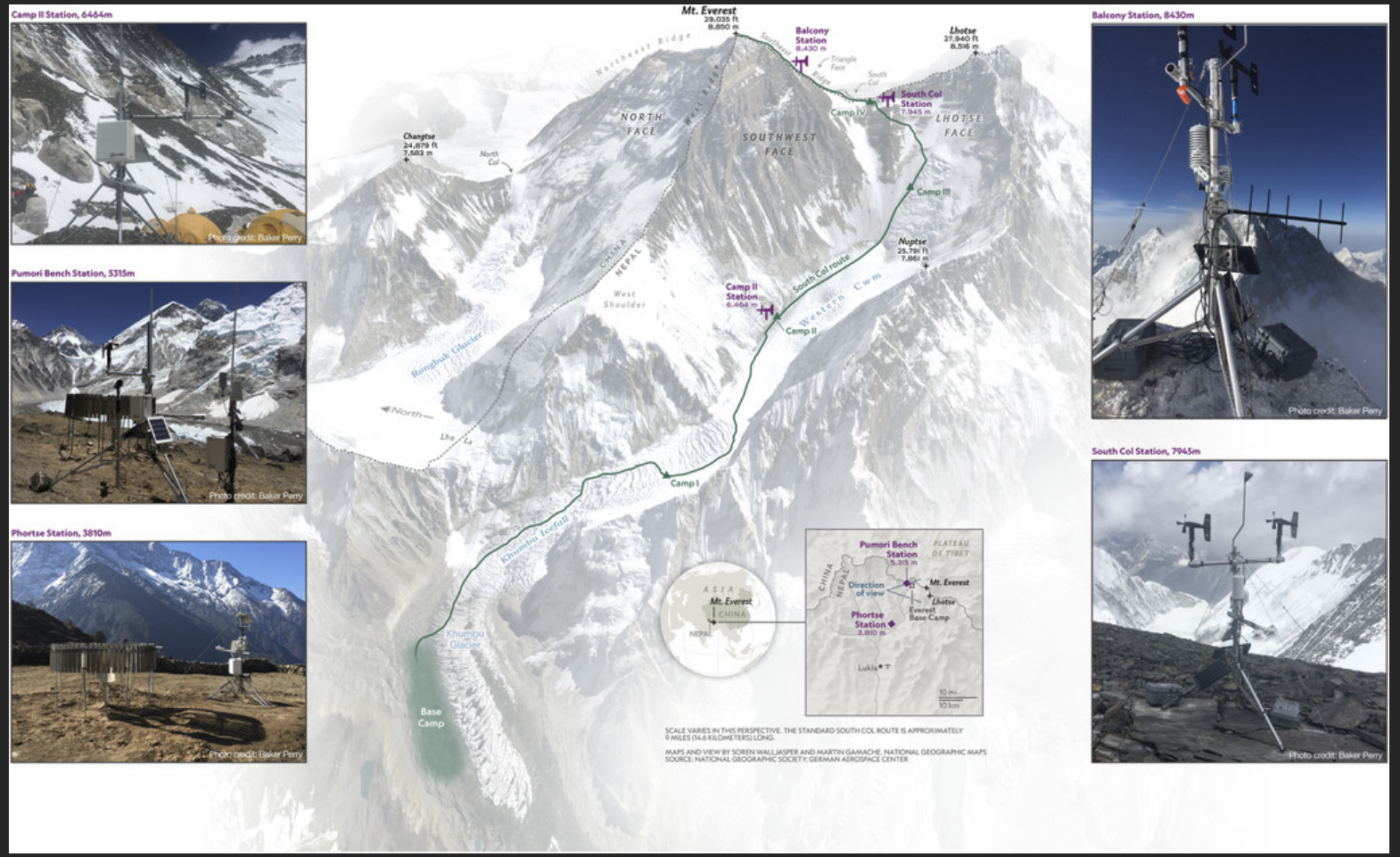
Motivation – Going to Extremes

@ever_weather

An expedition to set up the world's highest weather station



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Matthews, Tom, et al. "Going to extremes: installing the world's highest weather stations on Mount Everest." *Bulletin of the American Meteorological Society* 101.11 (2020): E1870-E1890.

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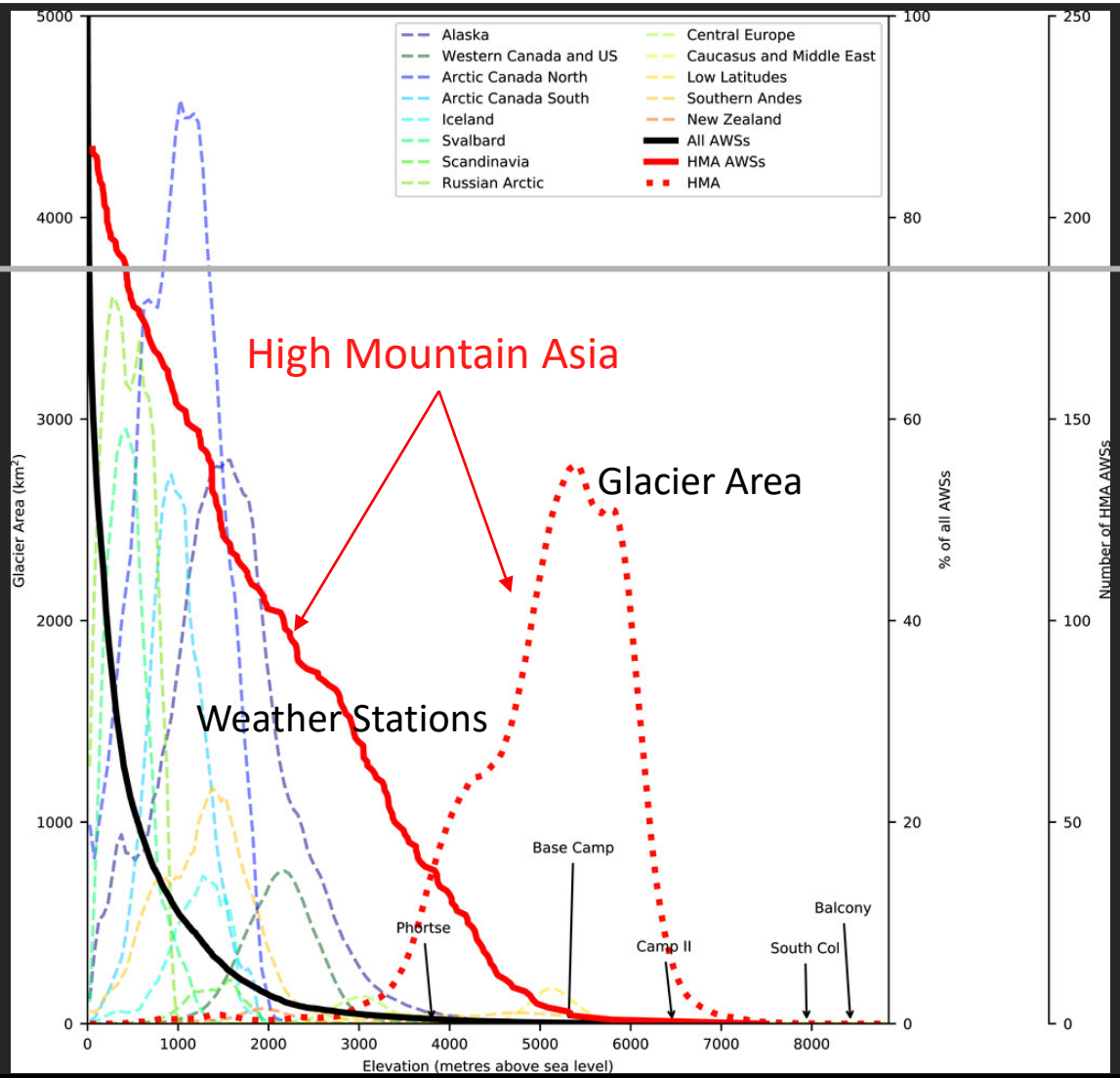
Motivation – Going to Extremes

Low elevation

More populated
Easy to access
More developed

Less vulnerable



High elevation

Less populated
Hard to access
Less developed

More vulnerable

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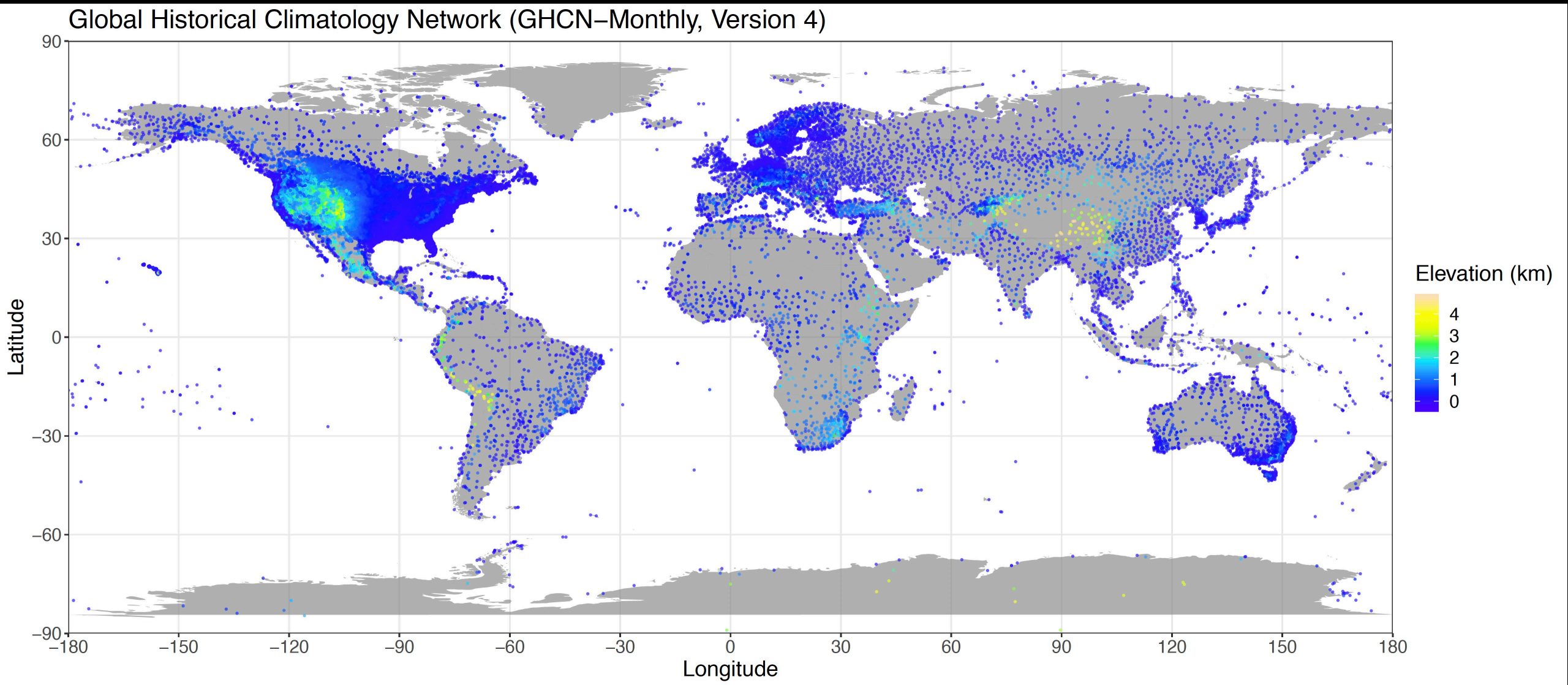
Motivations – A Global Picture



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Data source: NOAA National Centers for Environmental Information

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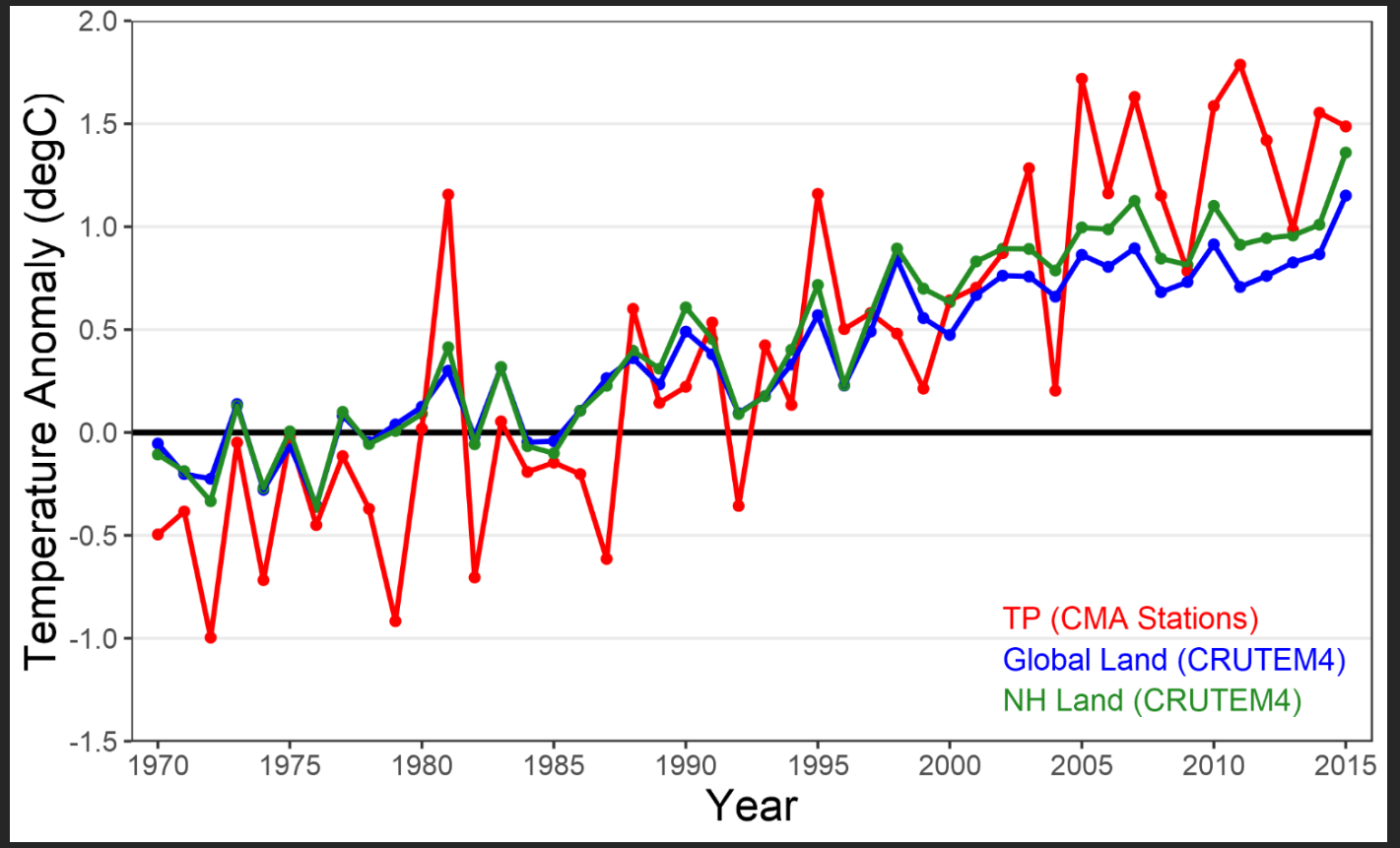
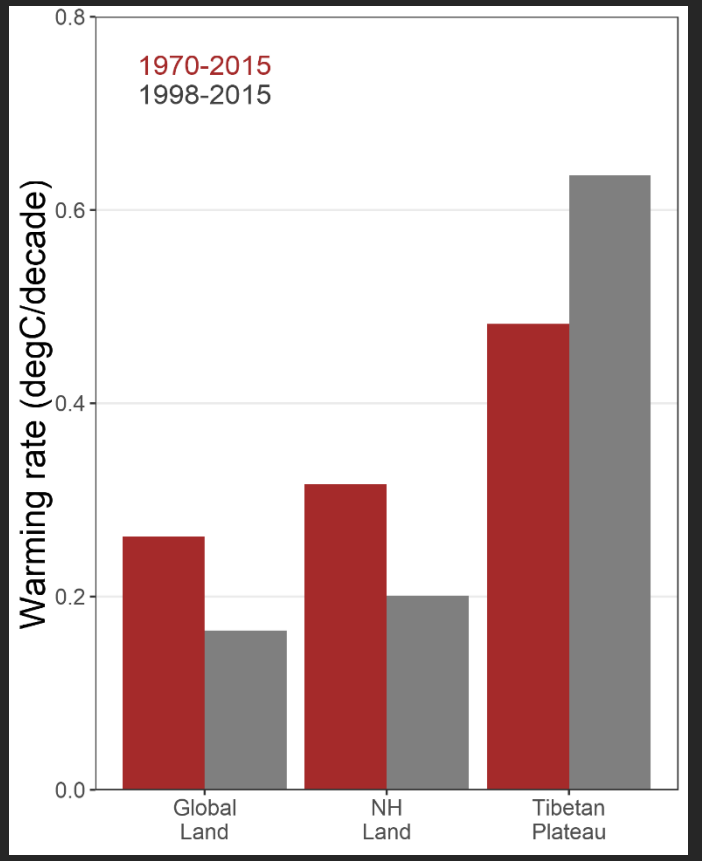
Motivation – A Closer Look at the "Third Pole"





Based on station data, the Tibetan Plateau (TP) has warmed at a notably faster rate than global and northern hemisphere land surface.

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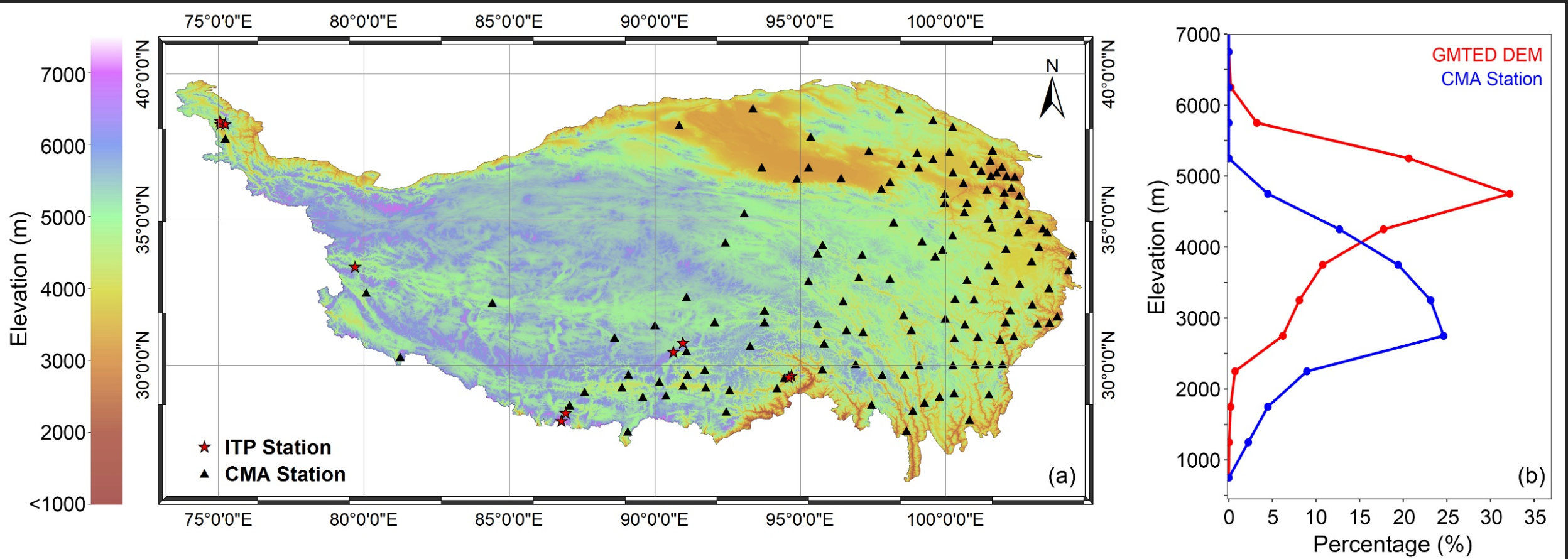

Rao, Yuhan, et al. "Estimating daily average surface air temperature using satellite land surface temperature and top-of-atmosphere radiation products over the Tibetan Plateau." *Remote Sensing of Environment* 234 (2019): 111462.

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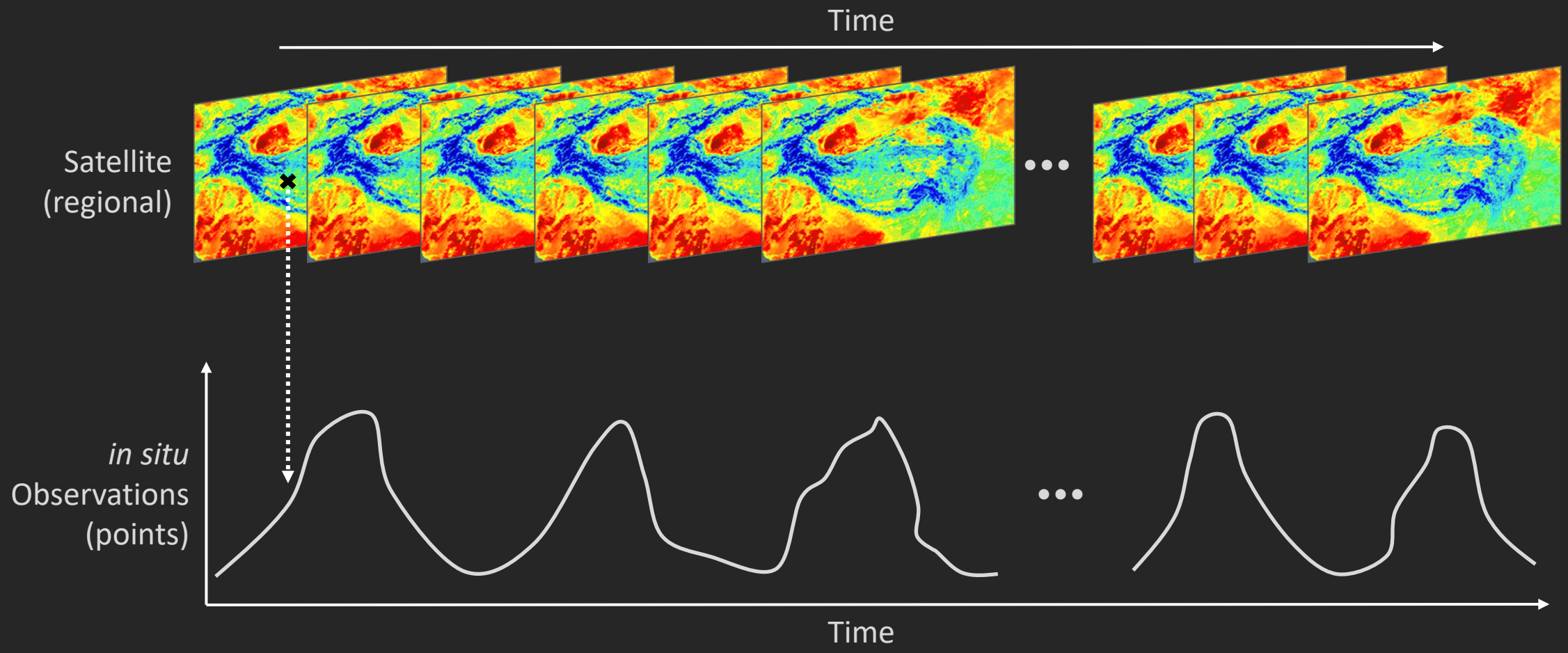
Developing the temperature data for Tibetan Plateau



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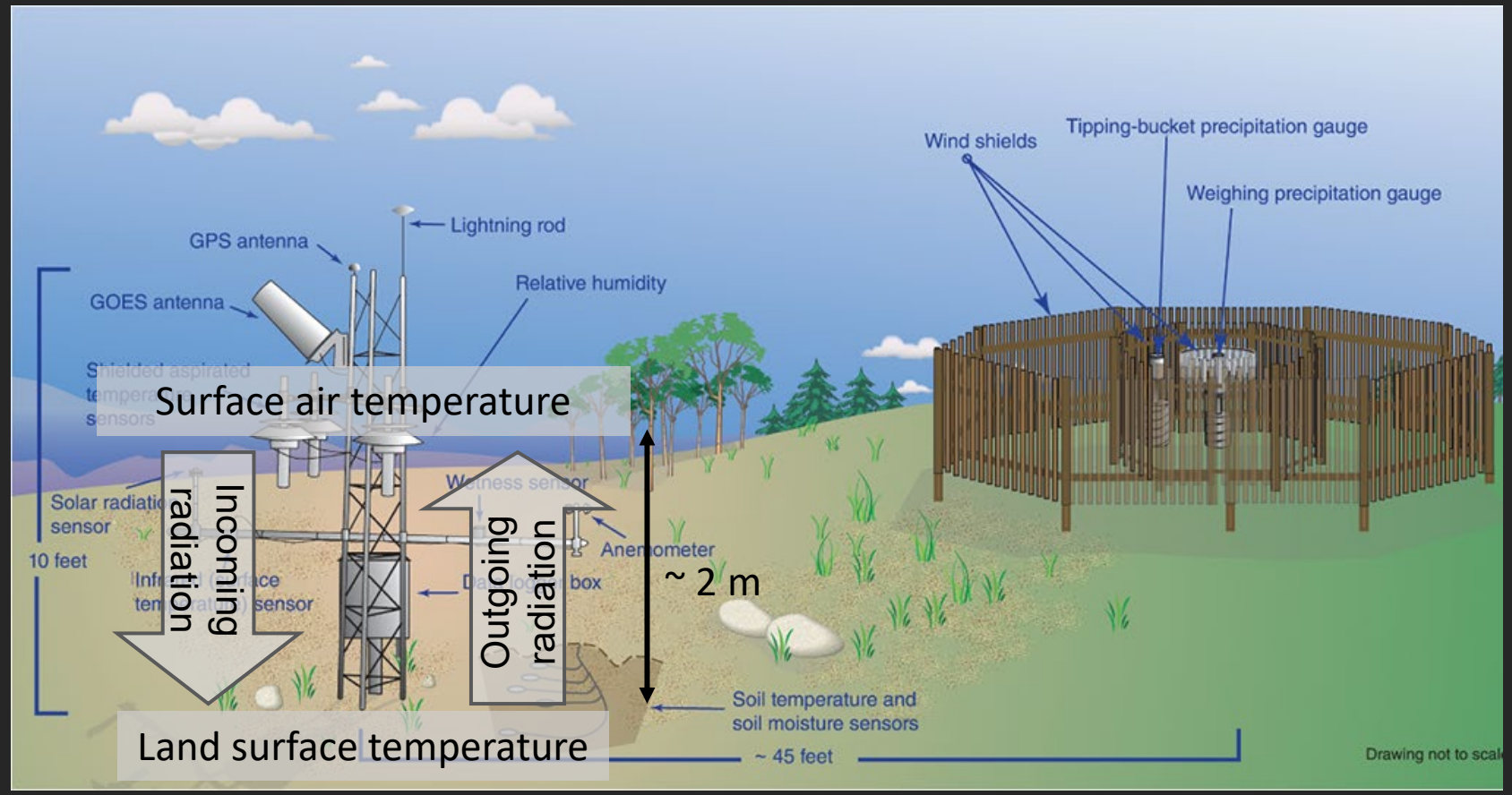
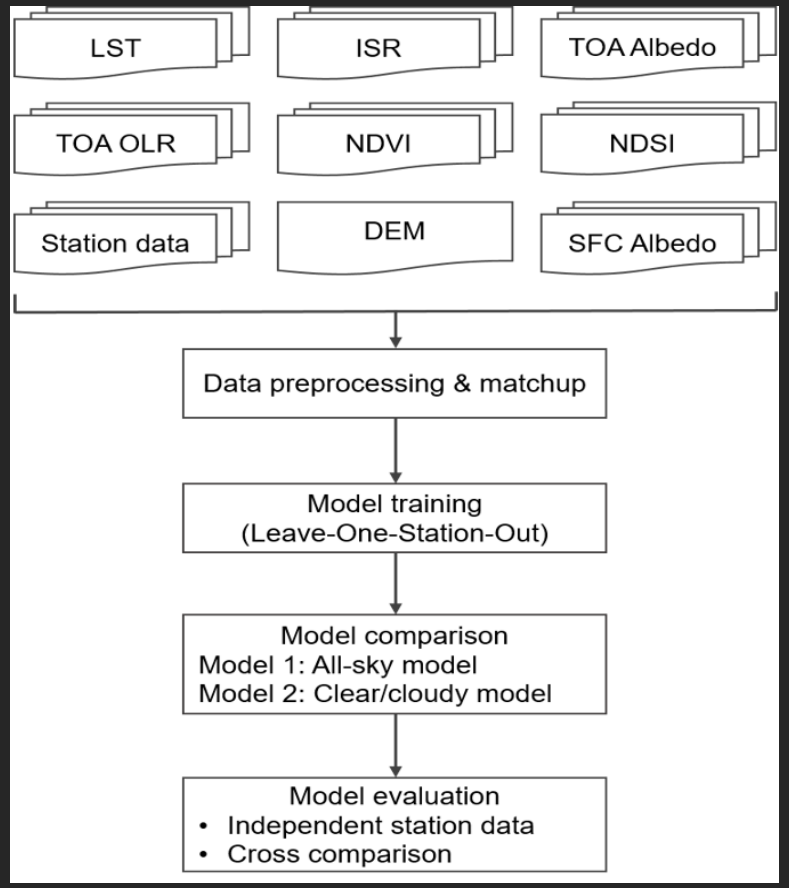
Model Development





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(Image credit: US Climate Reference Network, NOAA)

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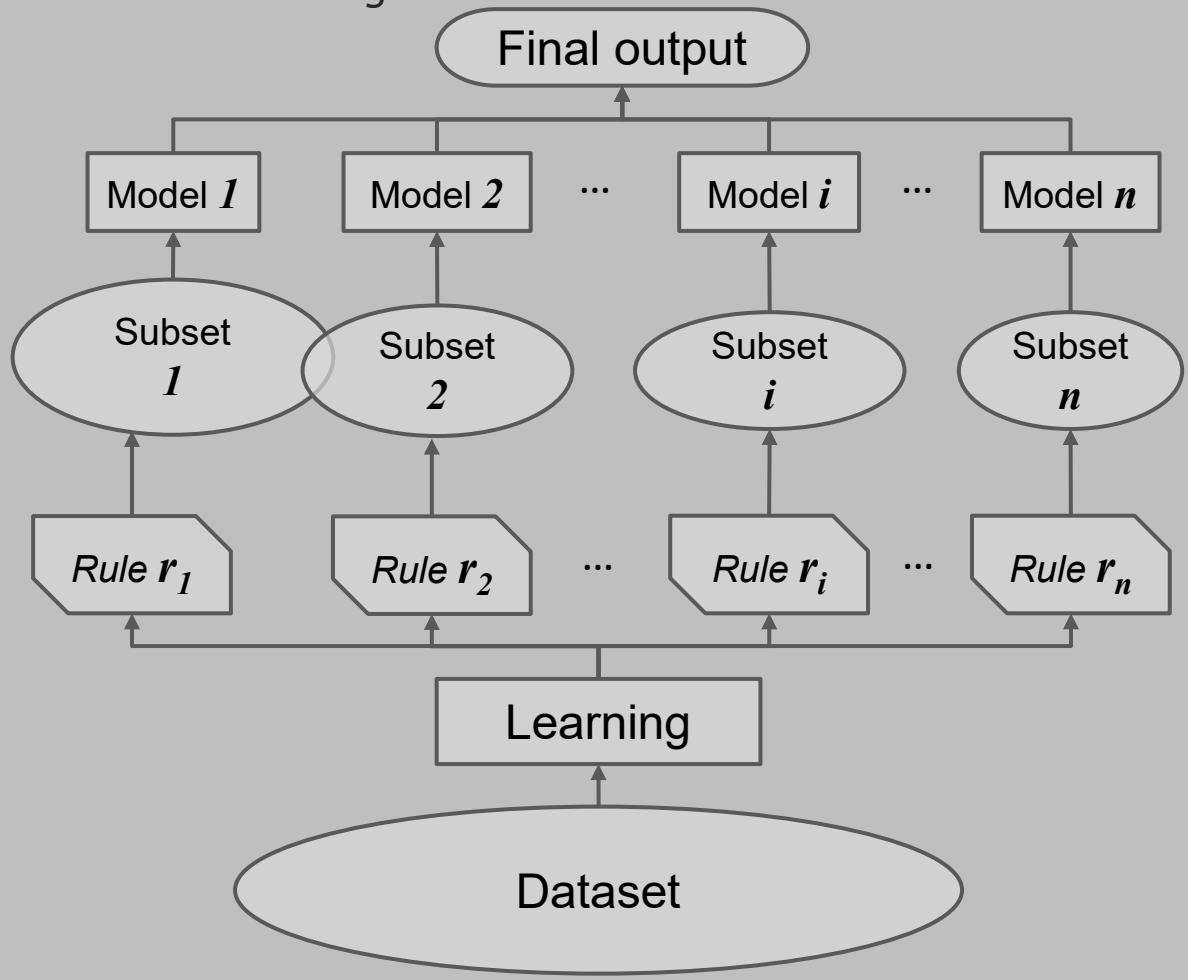
Model Development

Rule-based Cubist regression

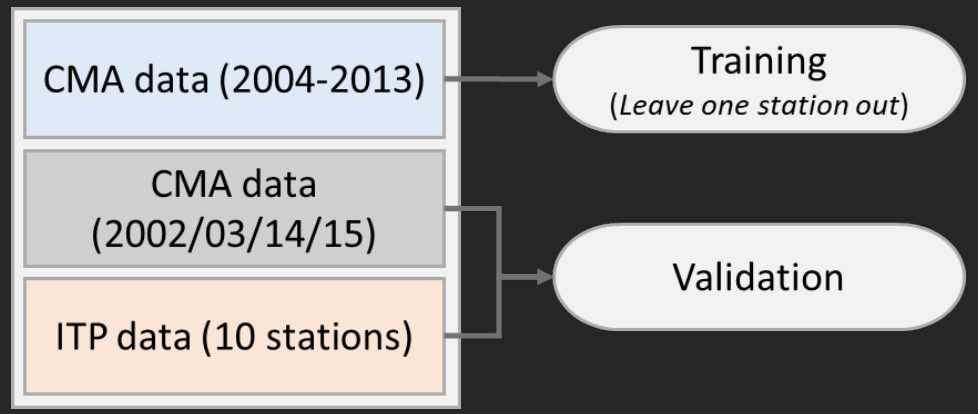


Example rule

Elevation < 4,500 m, *and*

Day of year < 180, *and*

Land surface temperature > 273 K



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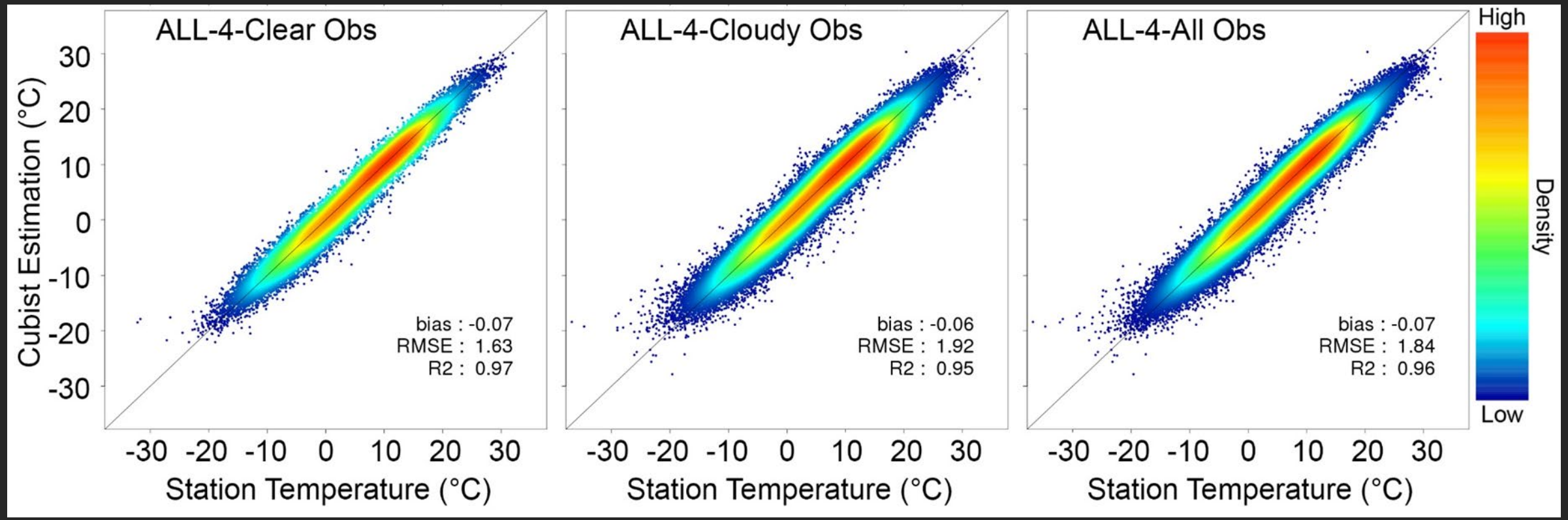
Daily Average Temperature

Clear Sky Observations | Cloudy Sky Observations | All Sky Observations



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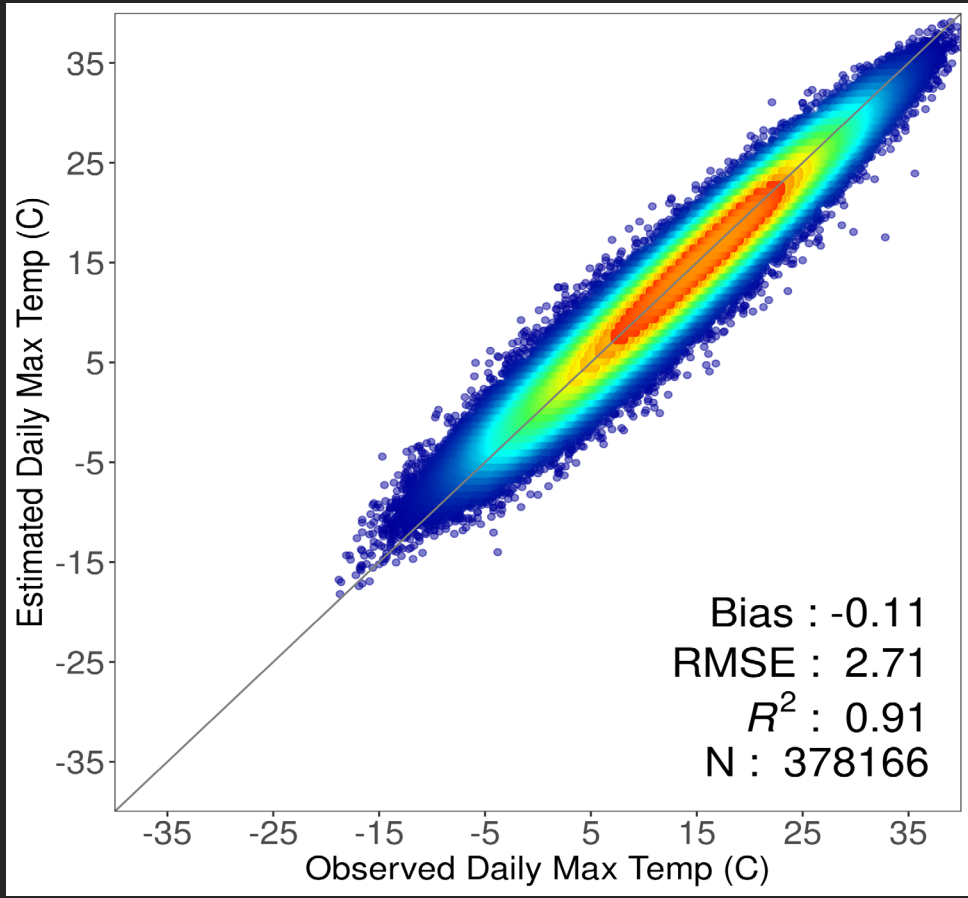
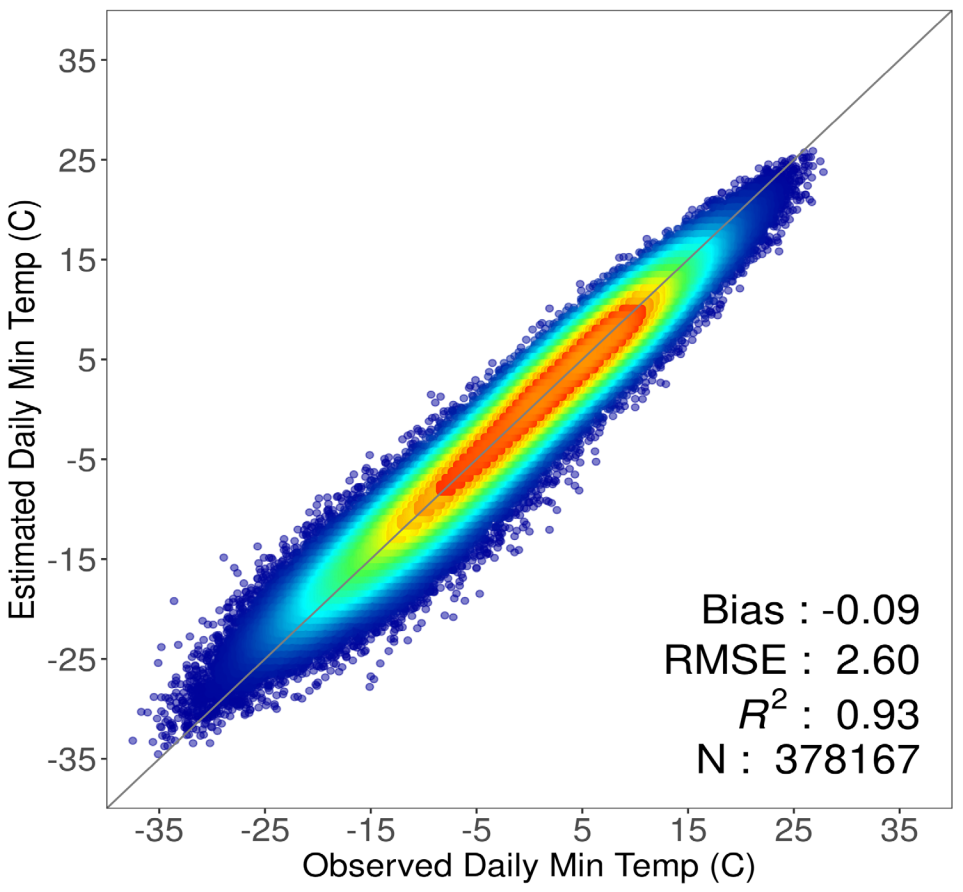
Daily Maximum & Minimum Temperature

Daily Maximum Temperature



Daily Minimum Temperature



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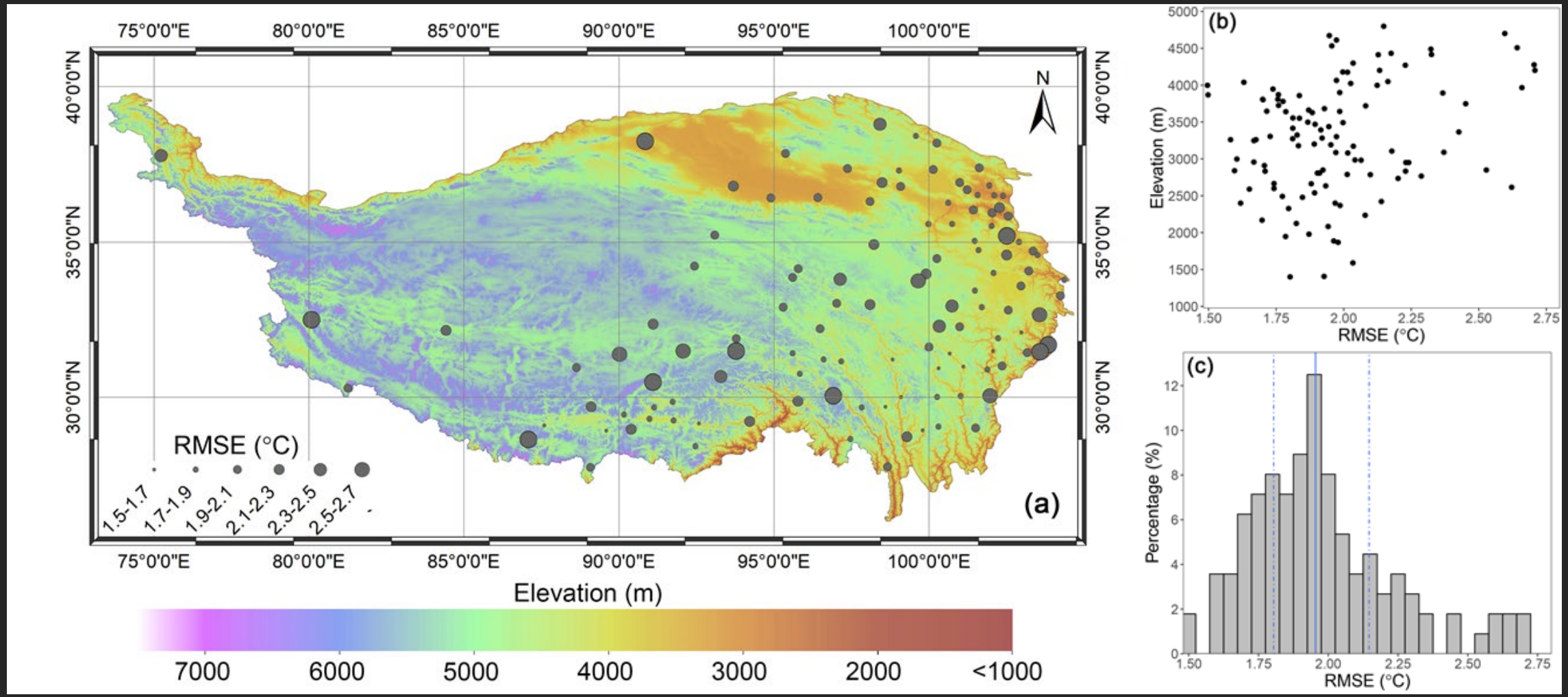
Results of the Leave-One-Station-Out (Daily Average Temperature)



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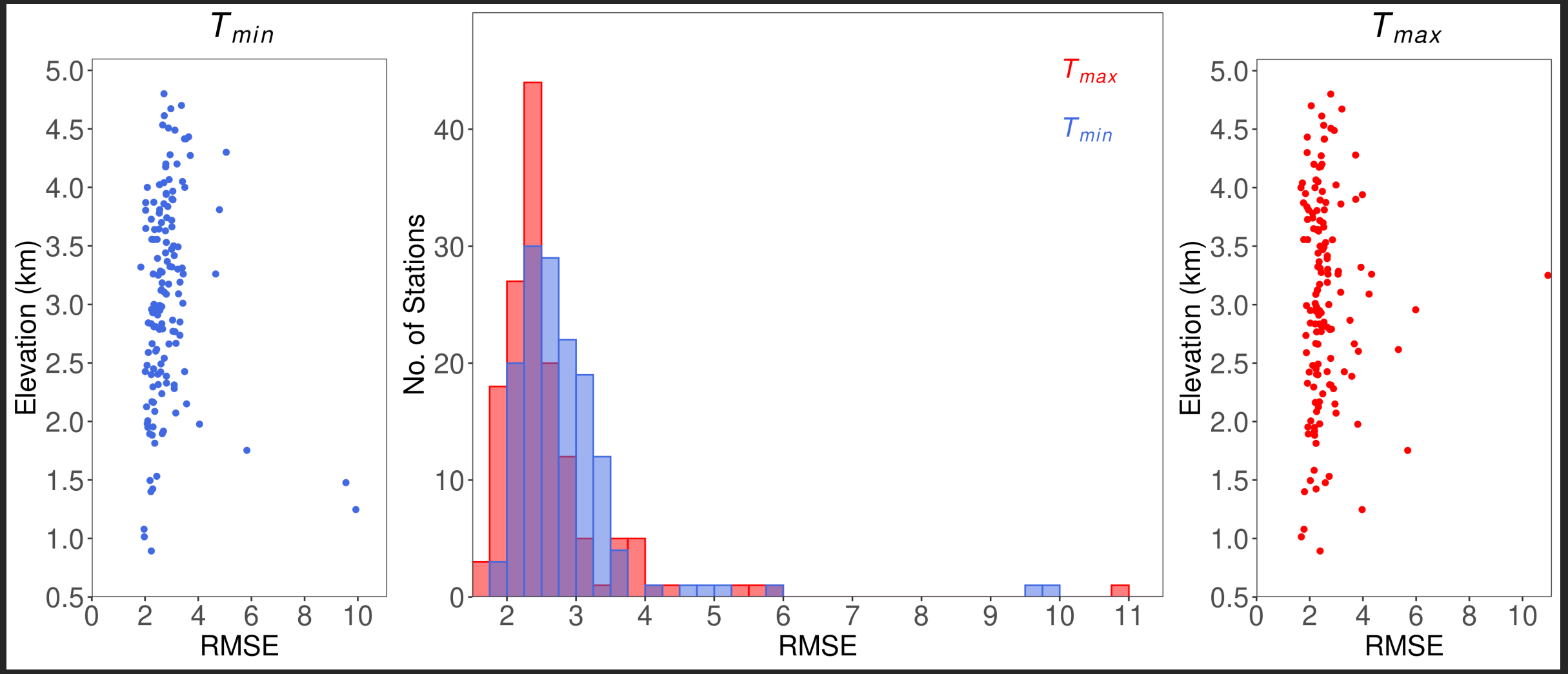
Results of the Leave-One-Station-Out (Daily Maximum & Minimum Temperature)



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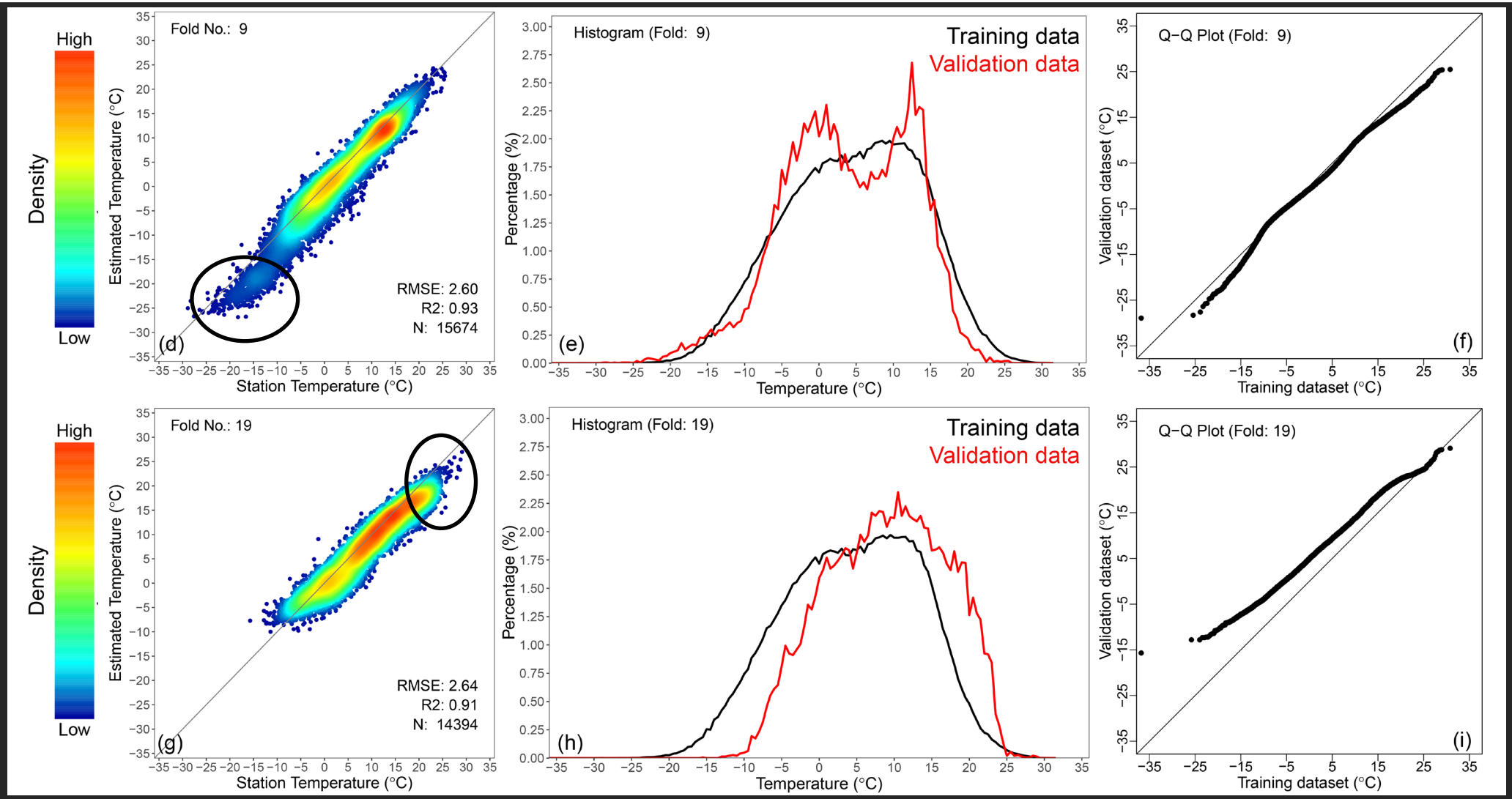
Training Data *v.s.* Testing Data



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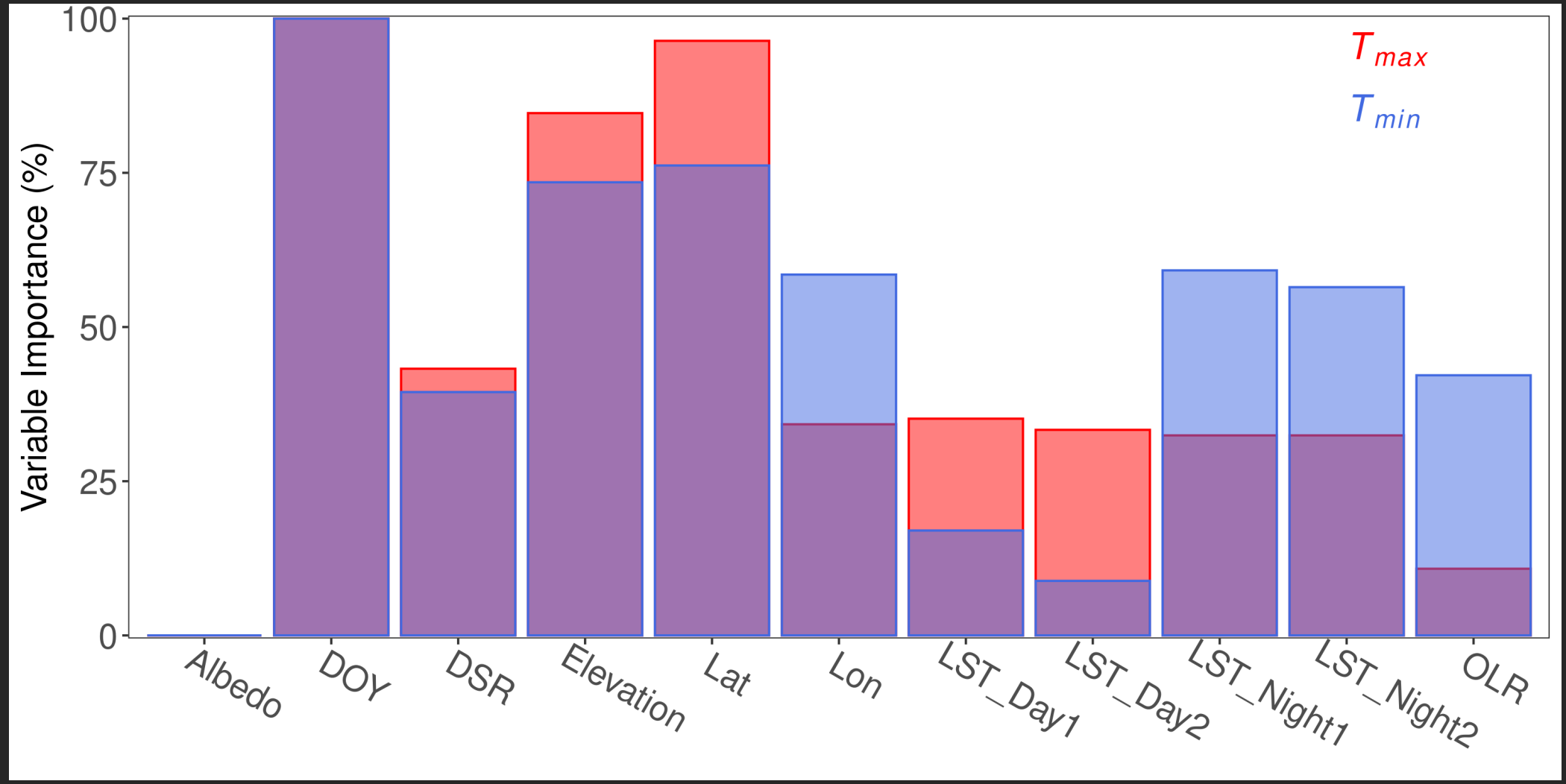
Variable Importance within Models



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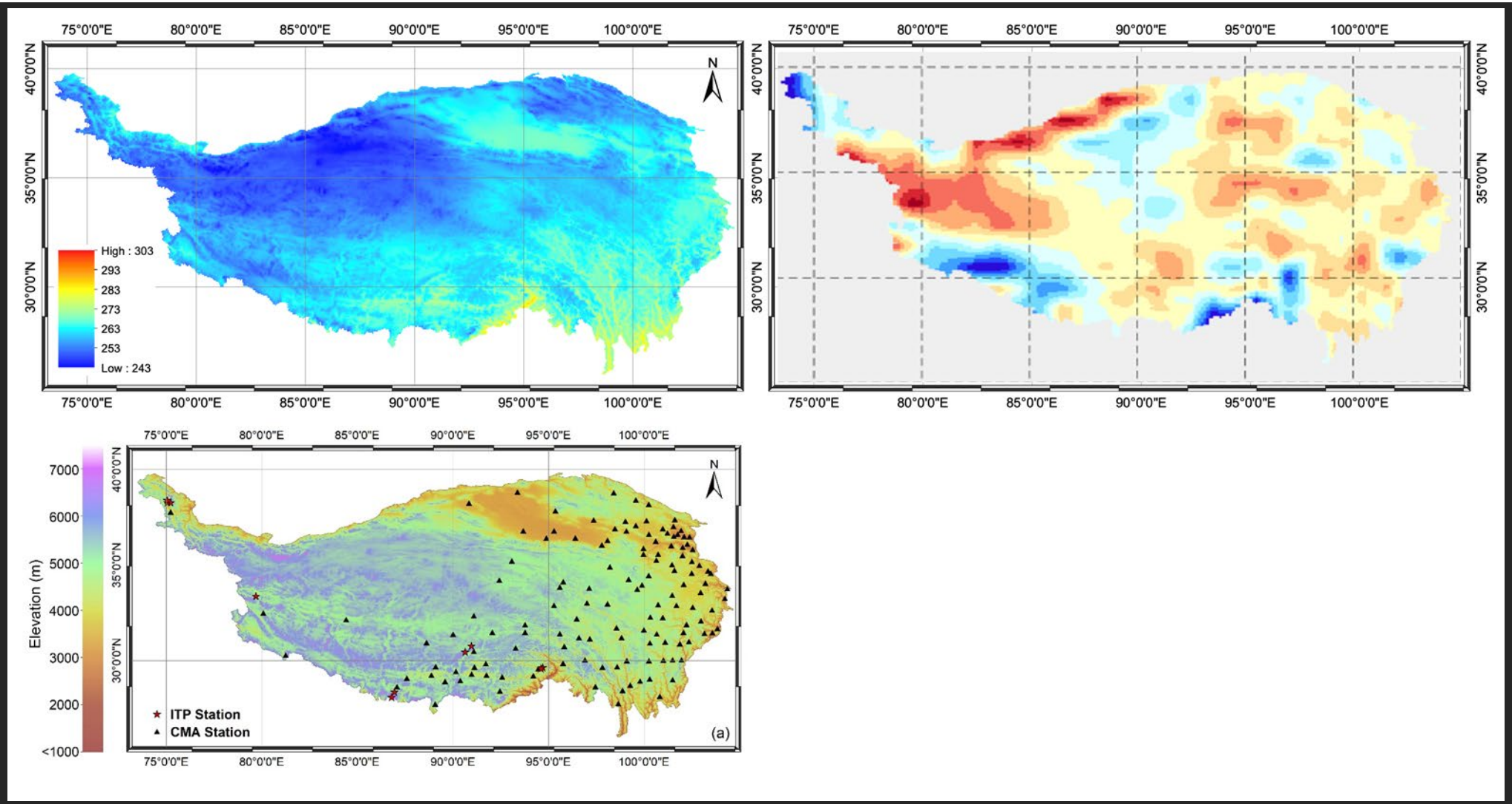
Surface Warming Analysis



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“Only if we understand,
can we care.

Only if we care,
we will help.

Only if we help,
we shall be saved.”
Dr. Jane Goodall

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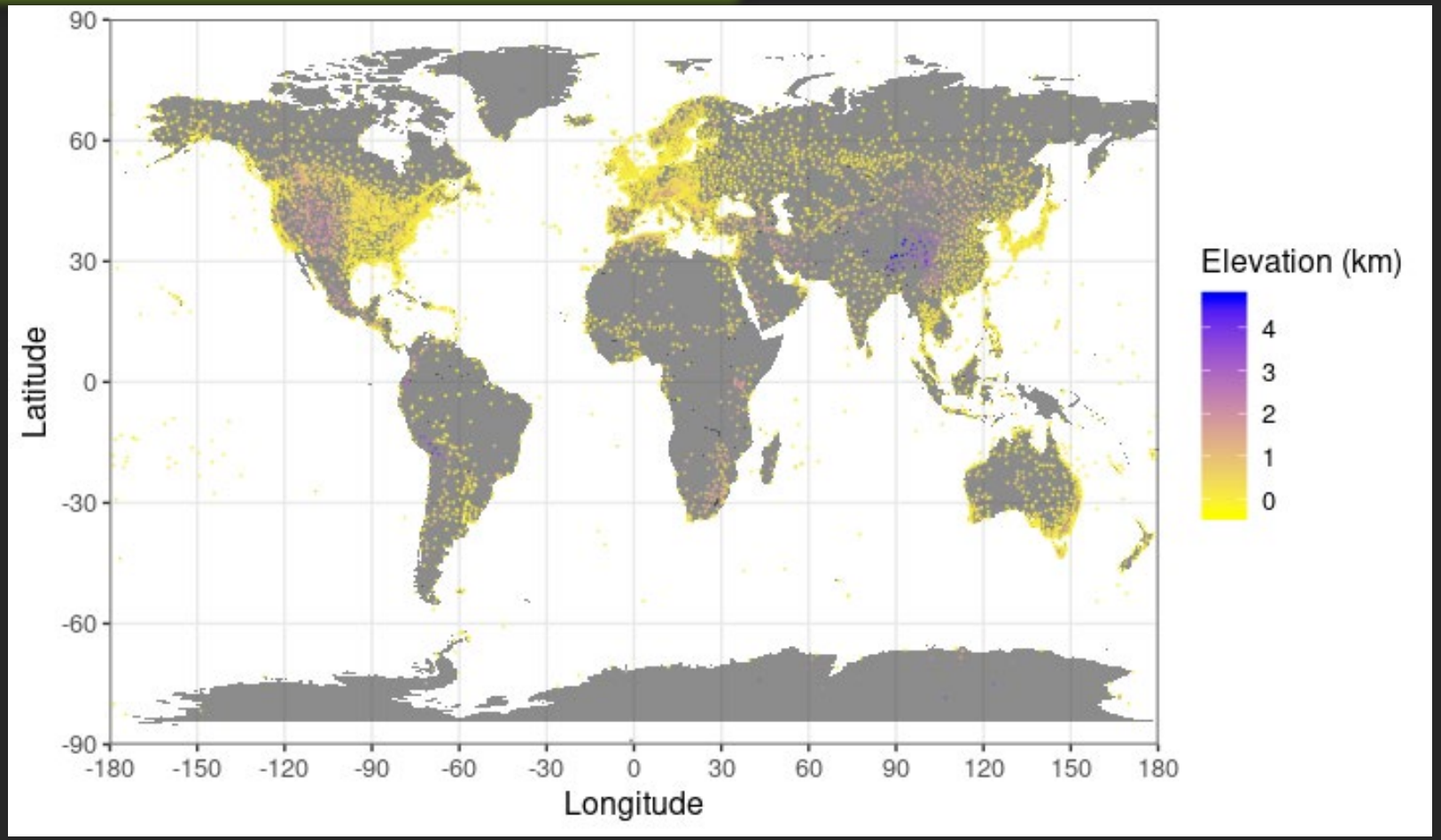
Moving forward – A plan for global

Land: Global Summary of the Day

Ocean: International Comprehensive Ocean-Atmosphere Dataset (ICOADS)

Satellite: High-resolution Infrared Radiation Sounder (HIRS)



- Globally consistent daily observations;
- Observed at same UTC time;
- Provide reference information over global land;
- ***Source: NOAA NCEI***

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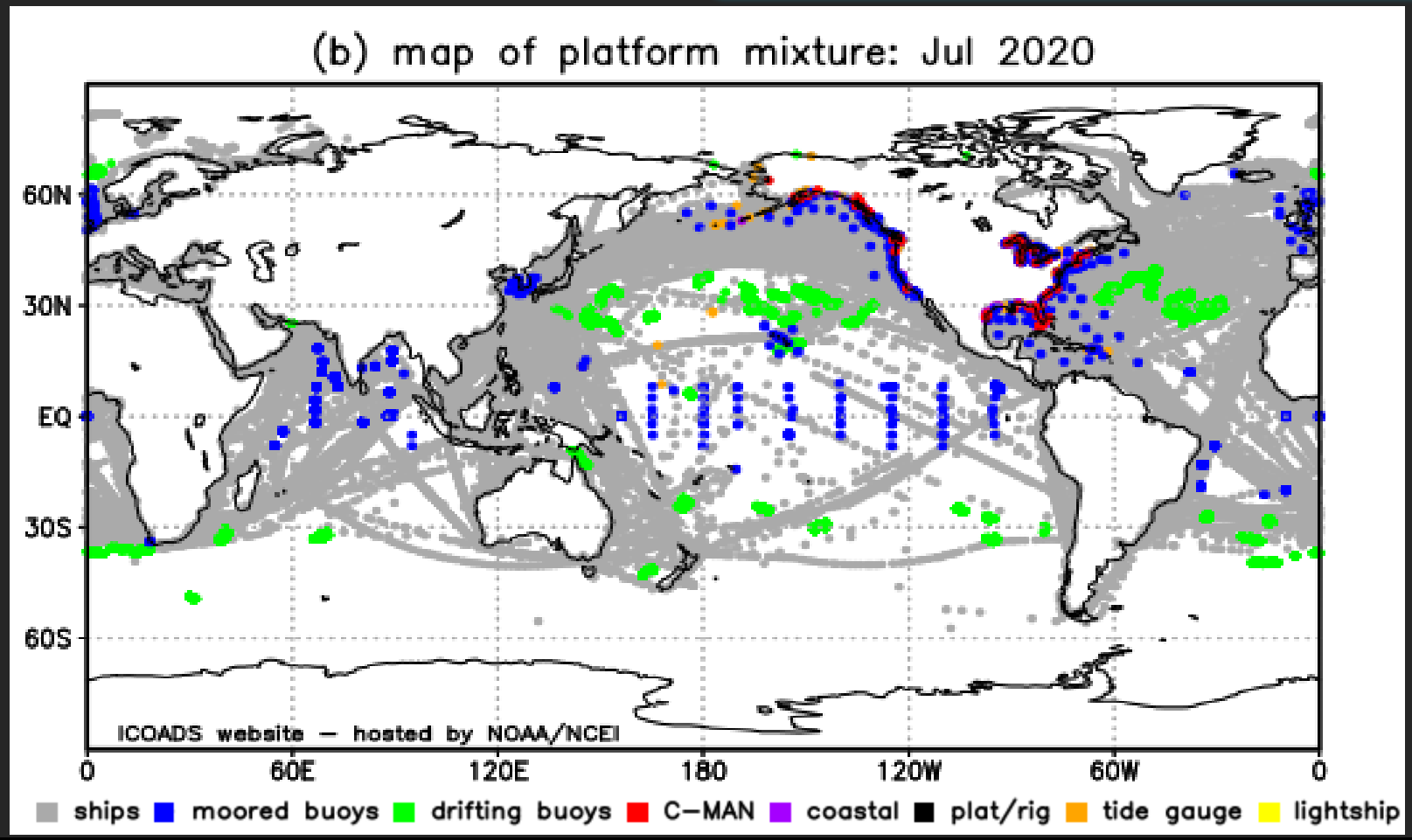

- Most complete archive of surface marine observations;
- Consistent quality control and data format;
- Provide reference information over global ocean;
- ***Source: NOAA / UCAR***

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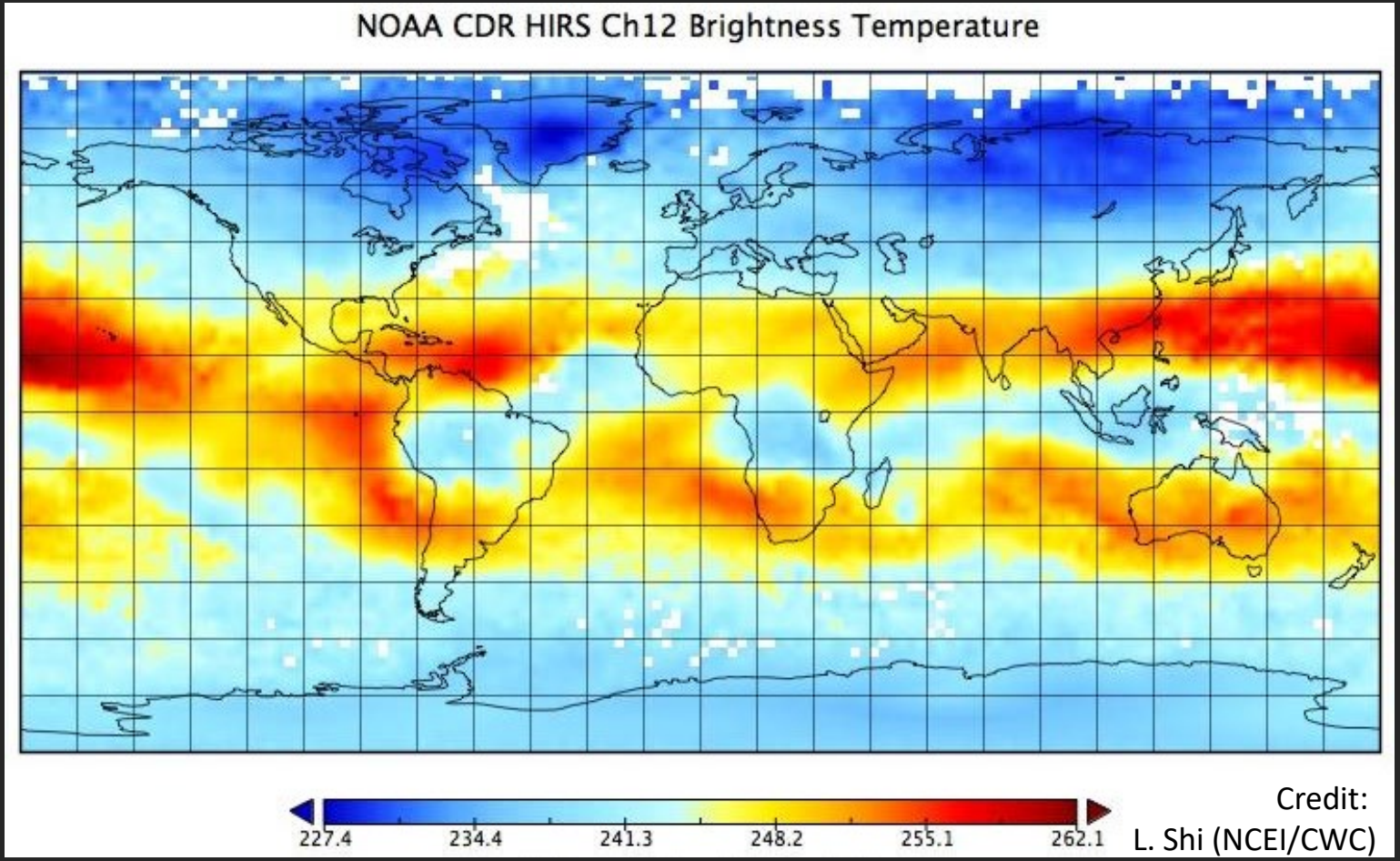

Credit: L. Shi (NCEI/CWC)

- Over ***40 years*** of climate data records (CDR) of temperature profiles;
- Consistent quality across satellite platforms (NOAA POES, EUMETSAT Metop);
- Sub-daily information of temperature over all surface;
- ***Source: NOAA NCEI / STAR***

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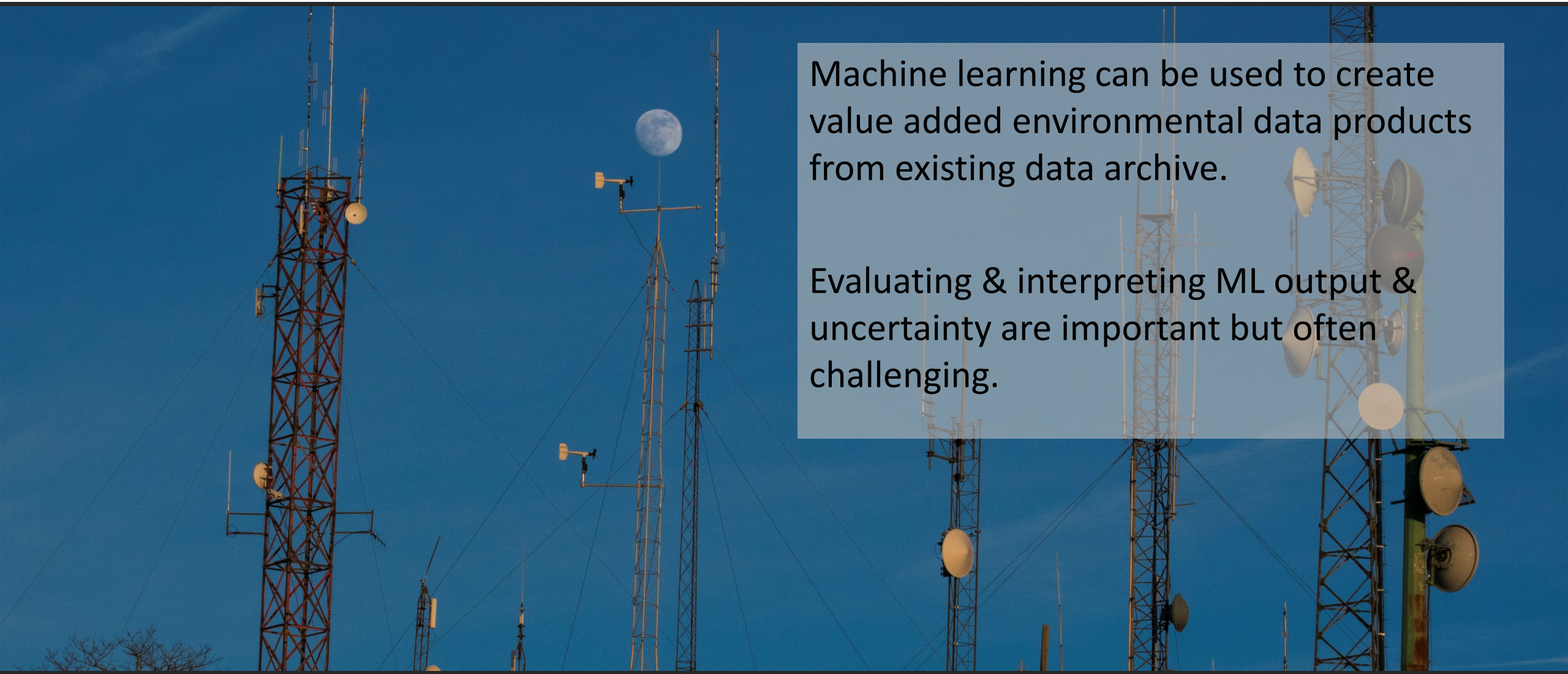
Summary



Machine learning can be used to create value added environmental data products from existing data archive.

Evaluating & interpreting ML output & uncertainty are important but often challenging.

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