



Antarctica model Polar WRF

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OUTLINE

❖ Status of Polar WRF

❖ Polar WRF Application

- Over Arctic region
- Over Antarctica region
- Over Third pole region

❖ Summary and Future Work



Status of Polar WRF

- ❖ Polar WRF
- ❖ History of Polar WRF
- ❖ Polar WRF components implemented in WRF
- ❖ Latest versions (Polar WRF 4.1.1)



Polar region

- ❖ It is important because the North and South Poles are the two coldest climatic regions on Earth, and they affect the climate of the entire planet.
- ❖ A second reason consists in that the climate is warming up much more quickly at the poles than elsewhere, that is, especially at the North Pole. We need to understand why this is and what impacts this phenomenon will cause.
- ❖ Antarctica is a unique continent because the average temperature there never rises above zero degrees Celsius. Why is this so special?



Polar WRF

- ❖ **Developed and maintained by Polar Meteorological Group**
- ❖ **Model evaluations of Polar WRF simulations have been performed in the Arctic and Antarctica**
- ❖ **Polar WRF is used by more than 482 users of 43 countries**



History of Polar WRF

- ❖ 4.1.1 (released August 2019)
- ❖ 3.9.1 (released August 2017)
- ❖ 3.8.1 (released August 2016)
- ❖ 3.7.1 (released August 2015)
- ❖ 3.6.1 (released August 2014)
- ❖ 3.5.1 (released September 2013)
- ❖ 3.4.1 (released August 2012)
- ❖ 3.3.1 (released September 2011)
- ❖ 3.2.1 (released August 23, 2010)
- ❖ 3.1.1 (released July 2009)
- ❖ 3.0.1.1 (released November 2008)



Polar WRF components implemented in WRF

- ❖ Implementation of a comprehensive sea ice description
- ❖ Improved treatment of heat transfer for ice sheets and revised surface energy balance calculation
- ❖ Optimal turbulence (boundary layer) parameterization
- ❖ Improved cloud microphysics for polar regions



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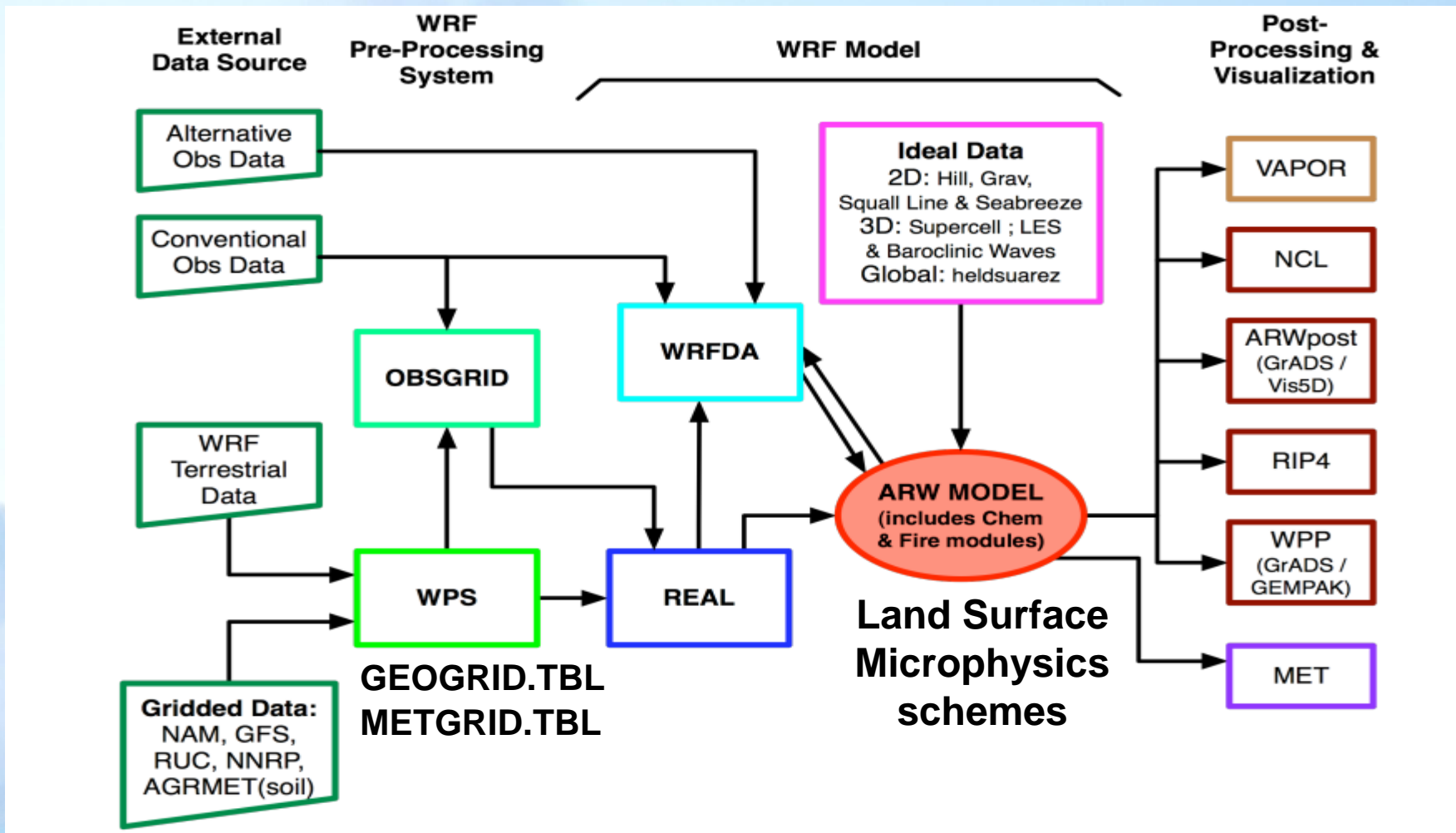


Polar WRF components implemented in WRF

- ❖ Improved heat transfer for ice and snow
- ❖ Sea ice fraction specification
- ❖ Specified variable sea ice thickness
- ❖ Specified variable snow depth on sea ice
- ❖ Sea ice albedo seasonal specifications
- ❖ Surface boundary layer works with fractional sea ice



Components of Polar WRF

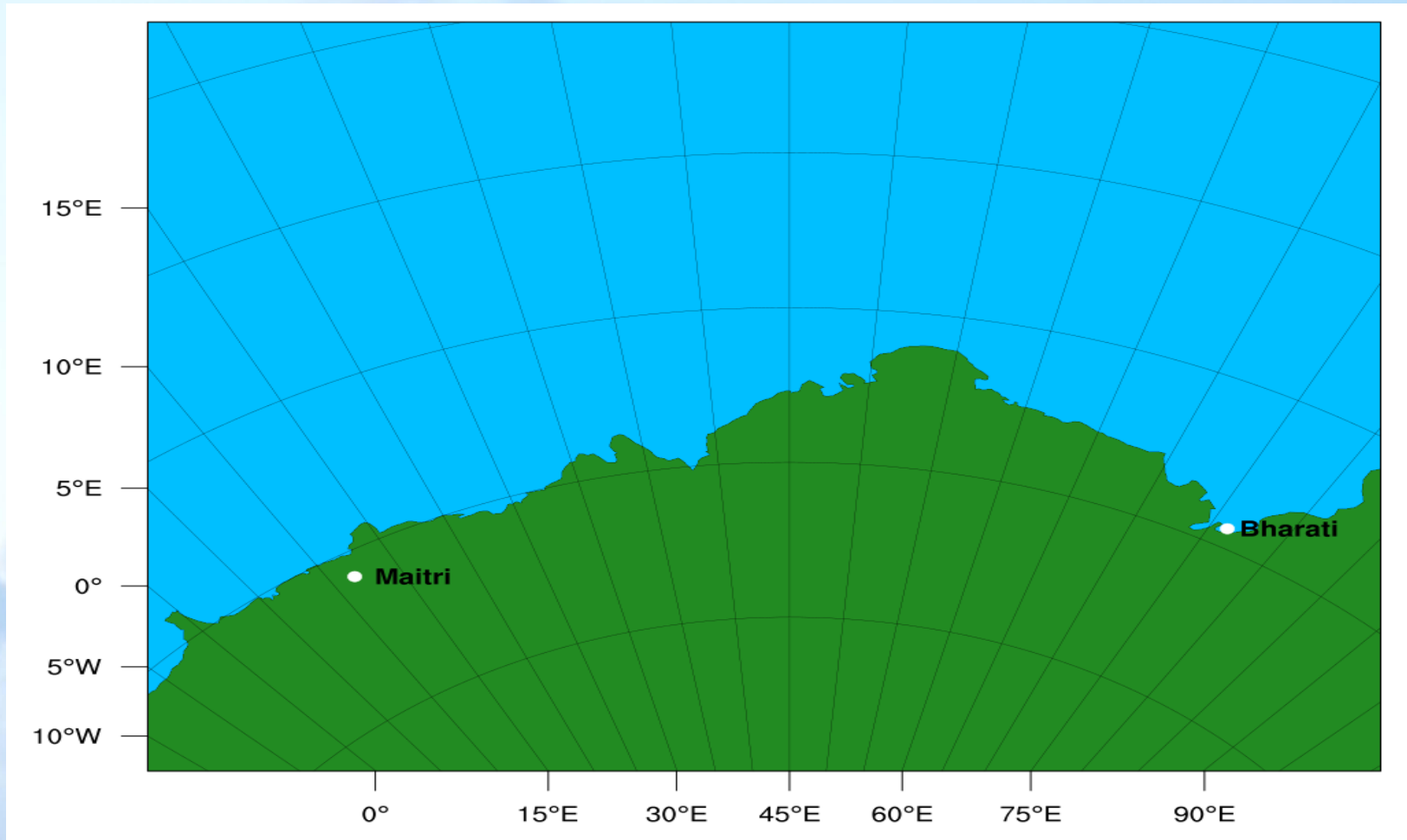


Polar WRF Application

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Polar WRF Application for Antarctica at IMD



IMD WRF Polar WRF domain set up

भारत मौसम विज्ञान विभाग
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IMD's Programme at Maitri & Bharati

Meteorological Services

- Study of Antarctic weather & climate
- Weather Forecast
- Solar Radiation Budget
- Study of Antarctic Ozone hole Phenomenon and surface ozone variations at Bharati



The Salient features of Meteorological observations at Maitri and Bharati

- Synoptic data collected every three hours e.g. visibility, sky condition, wind speed and direction, pressure, temperature, overall weather conditions and snowfall if any.
- The Global, UV-A, UV-B Radiation was continuously recorded.
- Synoptic charts and Satellite pictures were also collected regularly which is essential for outlook for next few days.
- Local weather Forecast were provided for Ship, Helicopter, and any other outdoor Scientific & Logistic activity.



Meteorological Observations at Bharati

Measurements:

- DCWIS (T, P, RH, WS, WD), UV and Global Radiation
- Vertical Ozone Profiles
- Snow fall, Blizzards
- Weather Phenomenon

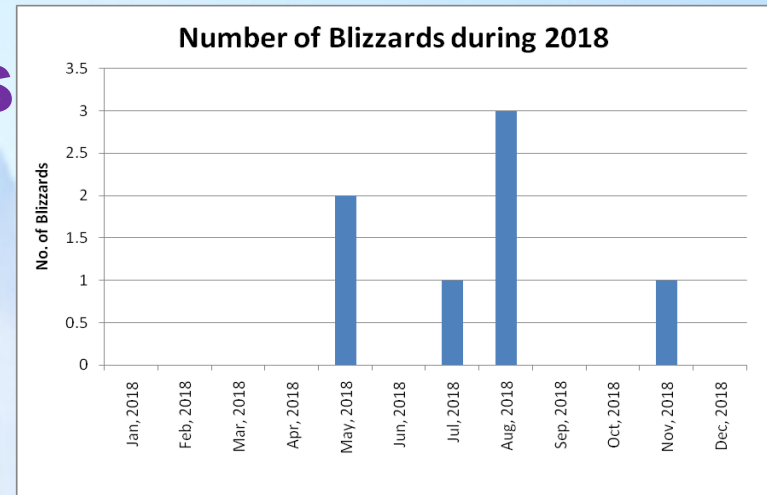
Summary of Observations

Number of Blizzards: 7 (for 2018)

**Longhiest Blizzard: 24 hours
(05/11/2018 to 06/11/2018)**

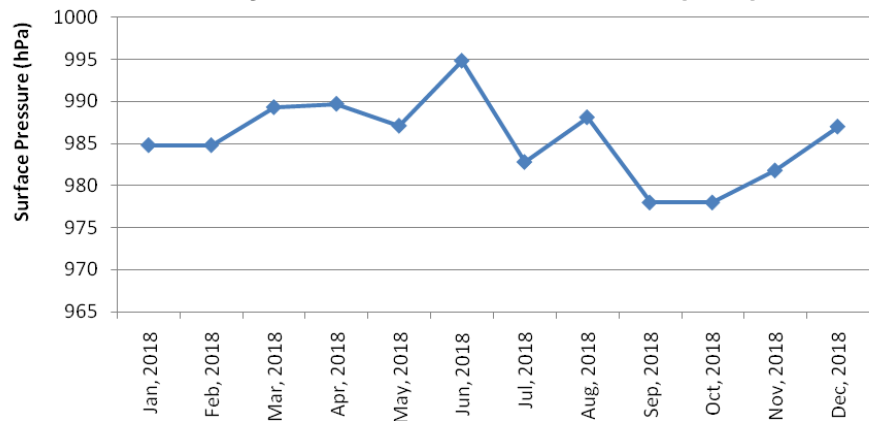
**Total Snowfall: 78.9 mm
(Jan, 2018 to Dec, 2018)**

No of snowfall days: 112

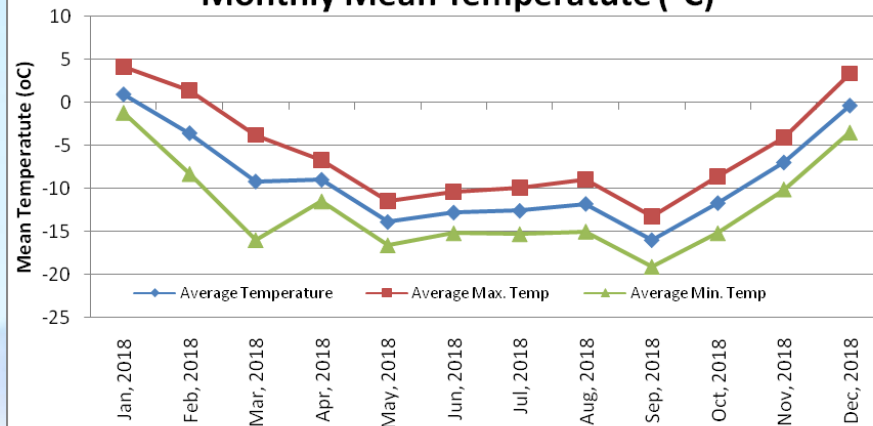


Meteorological Observations (2018) at Bharati

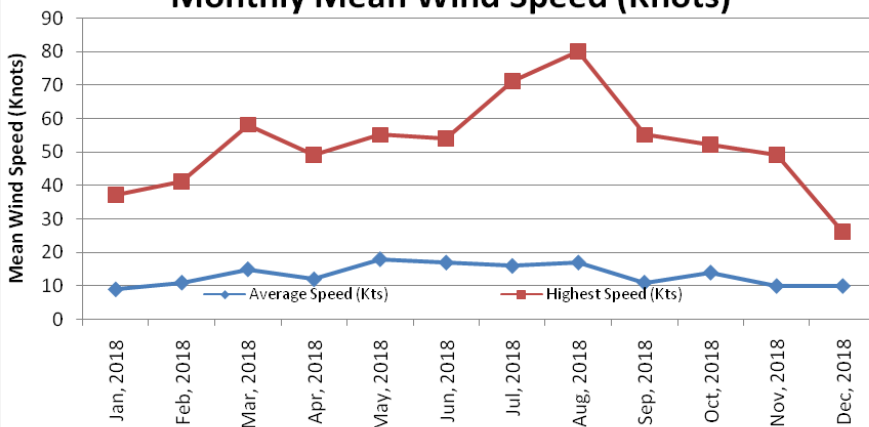
Monthly Mean Sea Level Pressure (hPa)



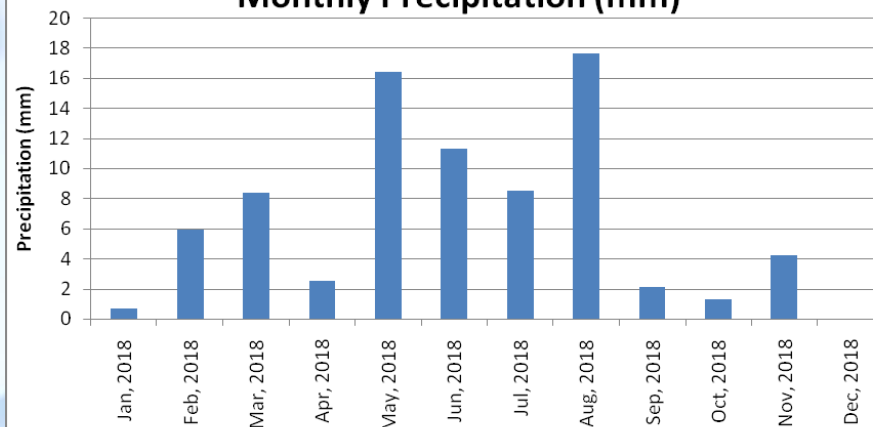
Monthly Mean Temperature (°C)



Monthly Mean Wind Speed (Knots)



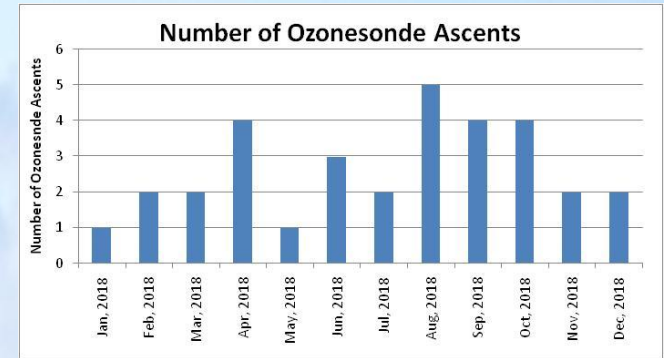
Monthly Precipitation (mm)



Ozone Sonde Observations

GPS based Ozone sonde installed on 06th Feb, 2016 at IMD observatory, Bharati and first balloon launched on 13th Feb, 2016.

Total Ascents during 2018: 32



Polar WRF Application for Antarctica at IMD

IMD Setup

Running:

- Hourly Polar WRF at 3KM spatial resolution

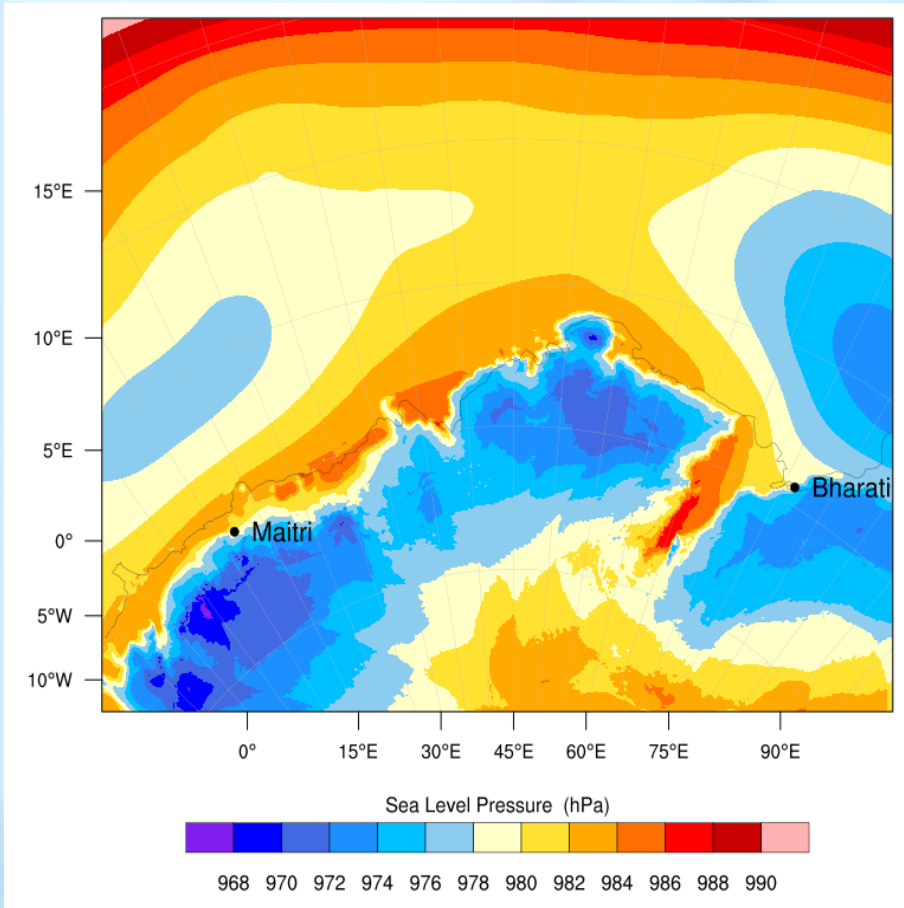
Forecast

Boundary conditions:

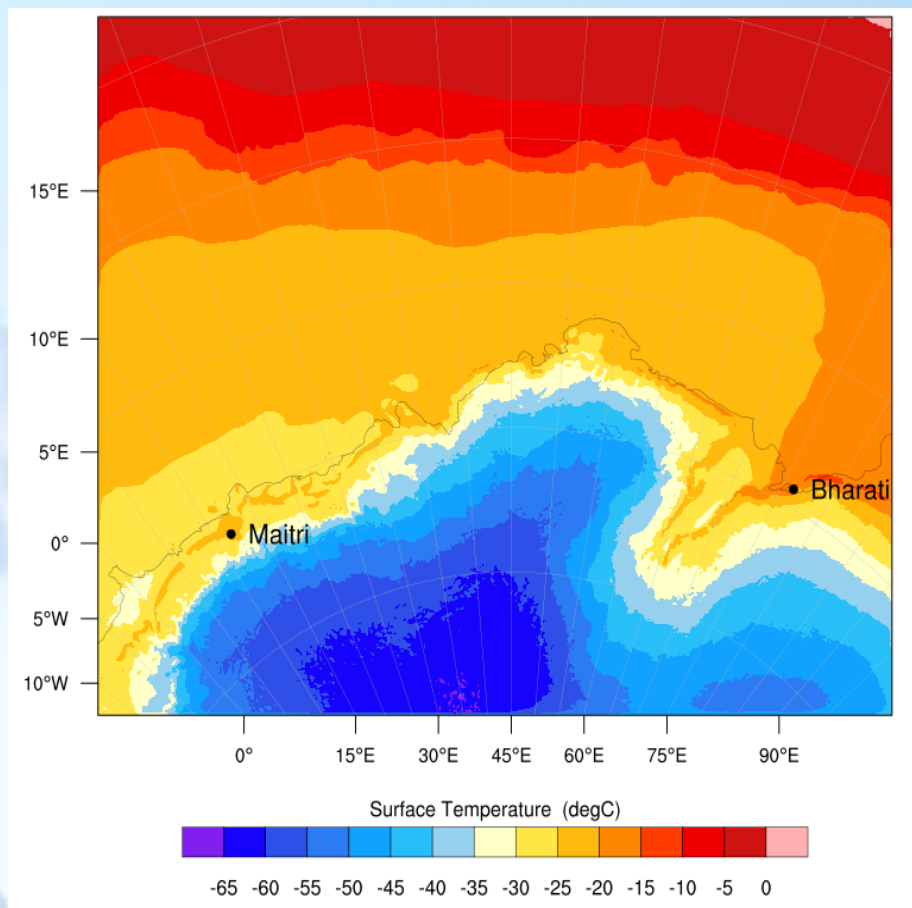
- IMD GFS Forecast at 12.5 KM spatial resolution with 03 hourly temporal resolution



Polar WRF Application for Antarctica at IMD



Polar WRF model simulated average SLP for Aug 2021



Polar WRF model simulated average surface temperature for Aug 2021



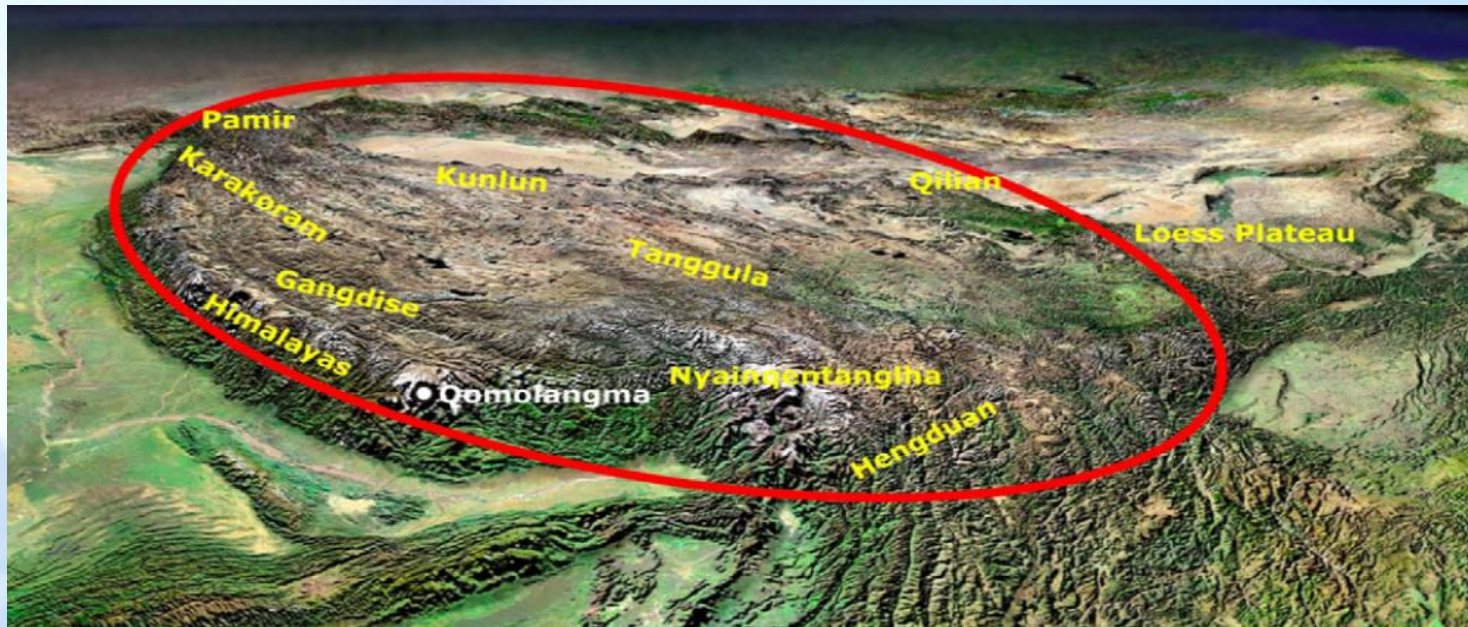
Summary and Future Work

- ❖ **IMD is planning to implement Polar WRF over Arctic region in the near future**
 - North Pole is warming up much more quickly.
 - Himadari station ($78^{\circ} 55' N$ and $11^{\circ} 56' E$)

- ❖ **IMD is also planning to implement Polar WRF over Third Pole (Hindu Kush) region in near future**



Third Pole Region



The geographical location of the Third Pole region



Third Pole Region

The Hindu Kush-Himalayan (HKH) region, also known as the Third Pole region, spans **Afghanistan, Bangladesh, Bhutan, China, India, Kyrgyzstan, Laos, Myanmar, Nepal, Pakistan, Tajikistan, Uzbekistan and Vietnam.**

Third Pole region area: Approx 5 million square kilometers

More than 2 billion people

World's largest store of snow and ice outside the polar region

Source of ten major rivers, and particularly sensitive to climate change



THANKS

Questions please?

