NWP Lecture Day 2

Observational data and Statistical downscaling methods

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Outcomes of Day 2

- ✓ Introduction to available observational data.
- ✓ Verification or Evaluation of NWP forecasts.
- ✓ Discuss process to be followed to determine quality of NWP forecast.
- ✓ Statistical downscaling methods.
- ✓ Discuss procedure to be followed to work with model strength and or weakness

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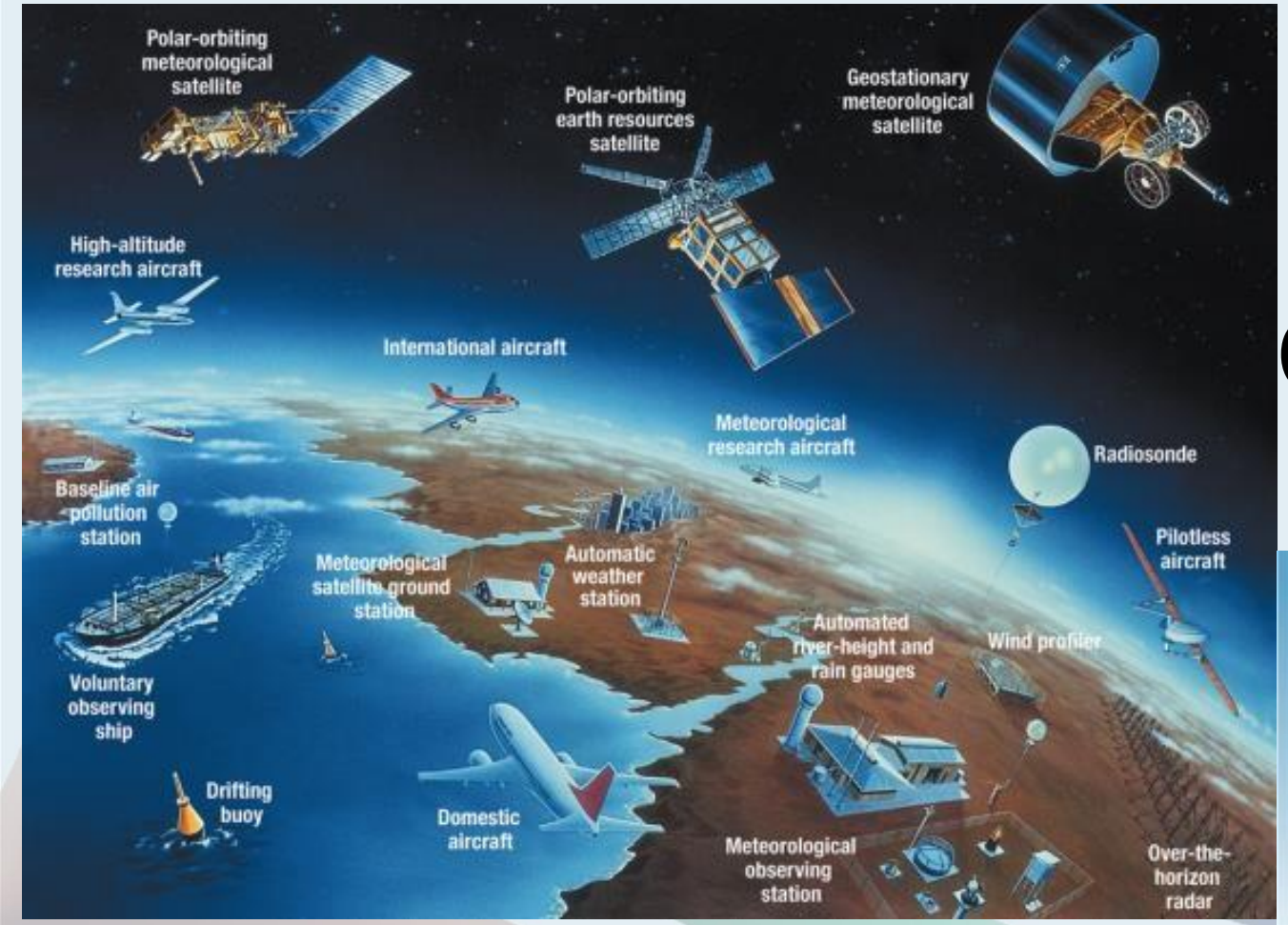
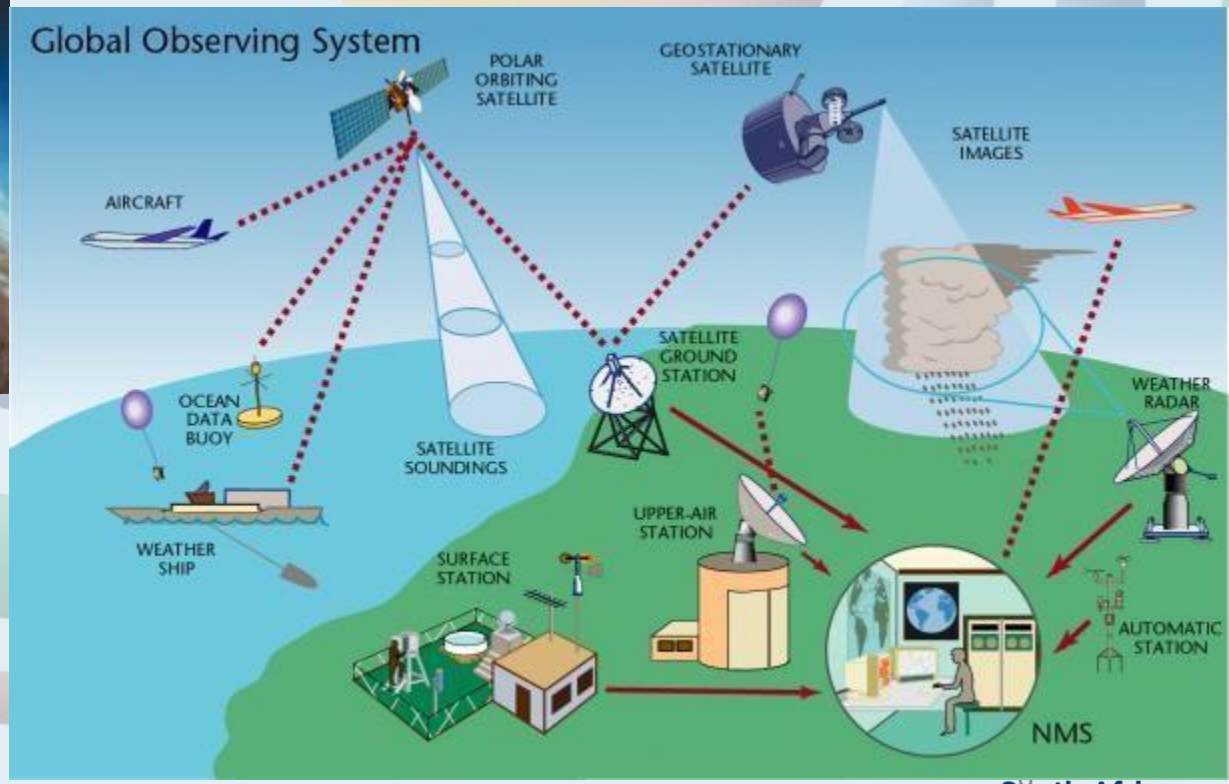
Global observation network
Global Basic Observing Network (GBON)





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Why is GOS important to NWP or National Weather Service

- ✓ Weather predictions beyond the 3-4 day range essentially requires observations from the whole world.
- ✓ Generally, any lack of global observations area in some areas limits the ability to understand and predict weather and climate patterns everywhere else.
- ✓ Global Numerical Weather Prediction depends on availability of global coverage of observation.
- ✓ Global NWP is a foundational capability for all weather prediction and most climate monitoring activities.
- ✓ Most weather prediction products available to users world-wide are based on or depend on global NWP guidance.

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Why is GOS important to NWP or National Weather Service

- ✓ Without local observations, the NWP guidance will be of poor quality, especially in the tropics
- ✓ Global NWP is a pre-requisite for high resolution NWP and related methods used for nowcasting and short-range weather prediction.
- ✓ Global NWP shares many of its requirements with high resolution NWP, except the latter are even more
- ✓ Regional NWP may fail if the global model providing the boundary conditions sees a different set of observations from that used by the inner model.

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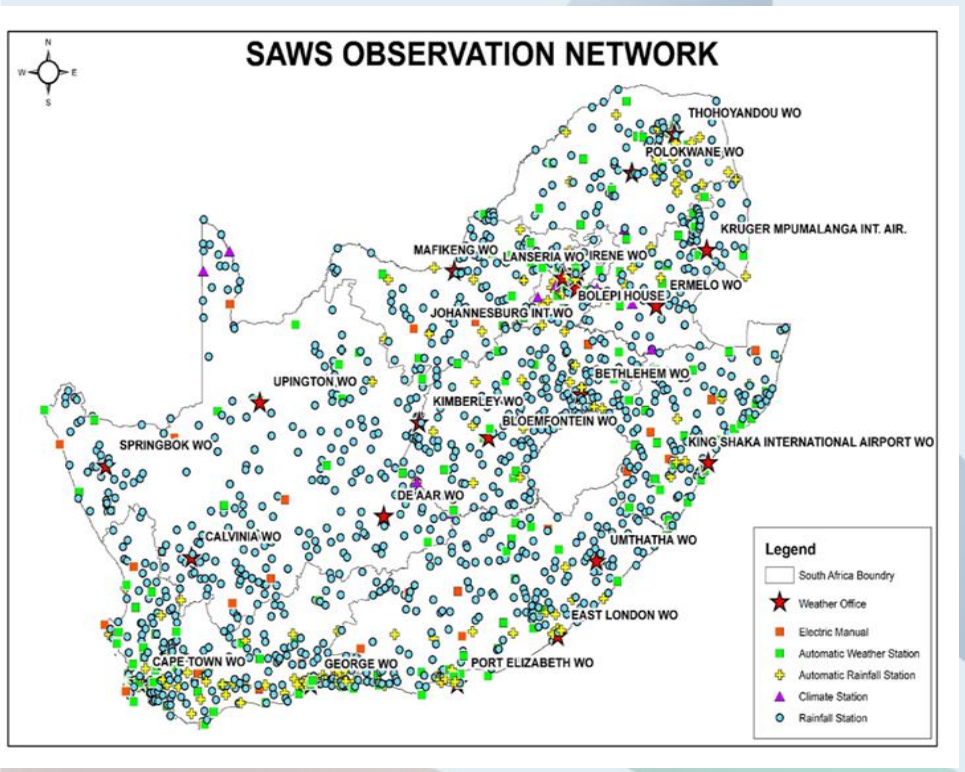
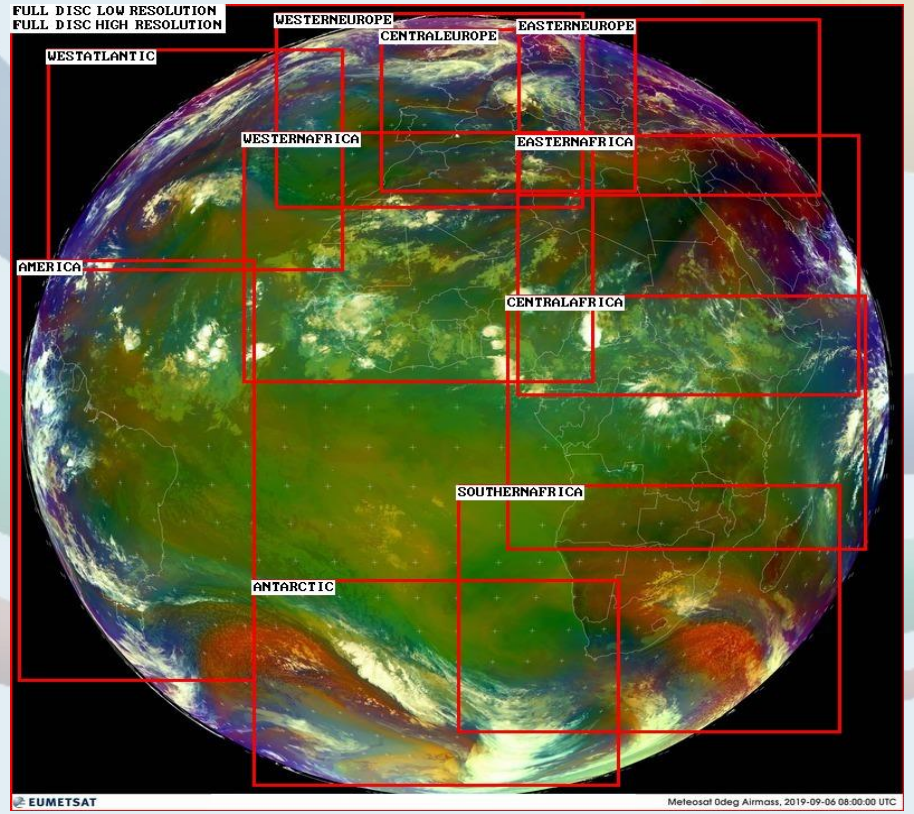
SAWS observational Networks



Upper-air sounding station data

68842 - Port Elizabeth,
68424-Upington
Irene - 68263



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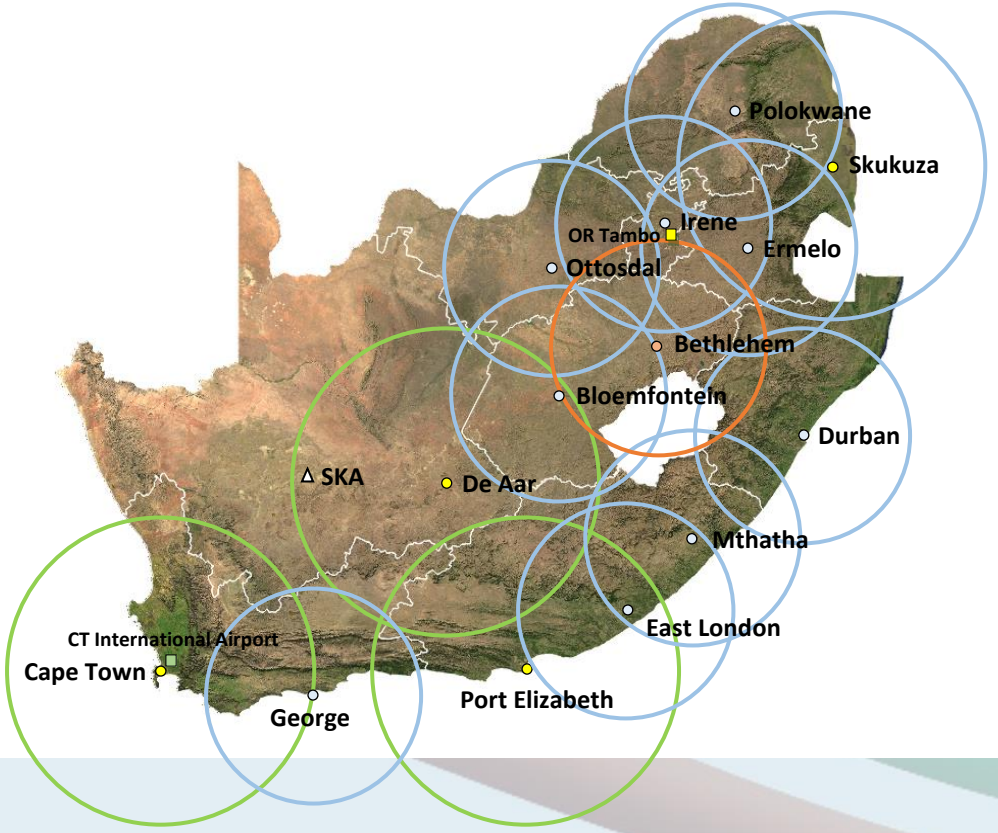
SAWS observational Networks

Radar Network



The SAWS radar network showing a combination of old and new radars. Green circles are C-band radars, Cyan circles are for S-band radars, and the orange circle is an S-band radar with dual-polarization.

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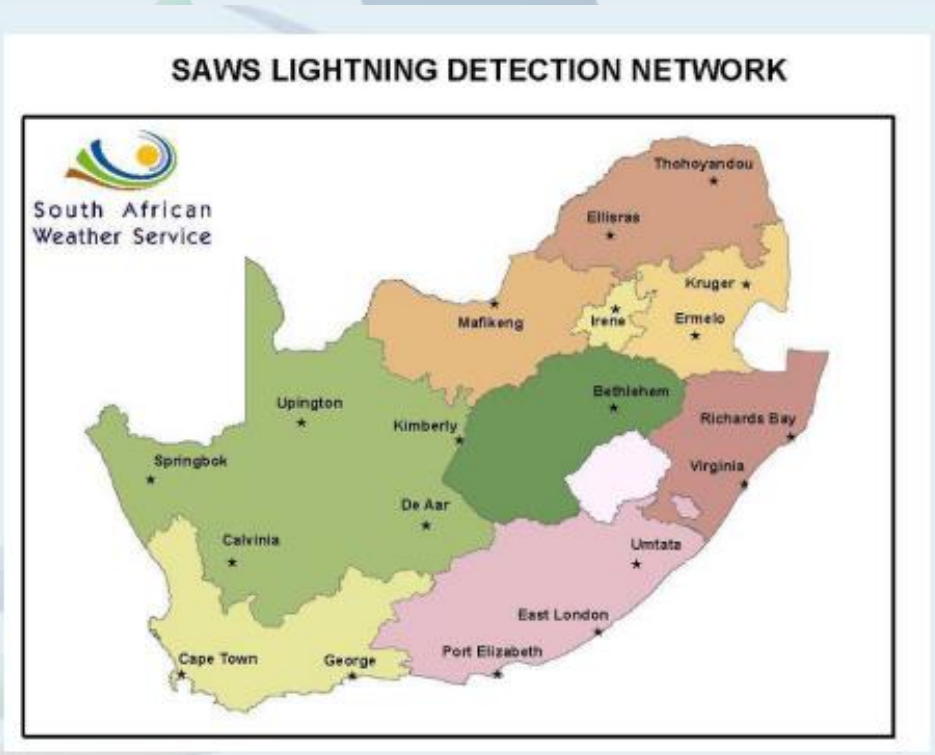
Lightning Detection Network



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Meteorological Observations for Aviation Forecasting

- Direct observations include observations from automated weather stations (METARs), direct reports from pilots (PIREPs), and state variable measurements collected by commercial aircraft instrumentation (AMDAR).
- METARs
- PIREPs
- AMDAR

Aircraft Meteorological Data Relay (AMDAR)

AMDAR - Data is collected from instruments on the plane and sent back to a ground station receiver where it is decoded.

- **AMDAR - is a WMO program in which airplanes collect and record meteorological data during the flight process. AMDAR is set up to help provide data internationally.**
- **AMDAR data is used to fill in data gaps that may exist in areas where radiosonde data is either unavailable or too distant to be useful.**
- **Specific data are always collected via instrumentation embedded on commercial aircraft.**
- **Meteorological Variables collected are Latitude and , speed and , direction, Temperature, Altitude.**

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METeorological Aerodrome Report (METAR)

- A METAR is a routine weather report produced every hour from numerous airfields and observation networks around the world. It is one of the most commonly used weather observations.
- A METAR is an international standard format used by meteorologists, air traffic controllers, air traffic managers, and pilots.
- METAR, you may encounter a special report, or SPECI, which is an unscheduled report.
- A SPECI is issued when conditions deteriorate or improve based on pre-designated criteria.

Remember, METARs always have the following components, in this order

The type of report
Station identifier/ICAO
Issuance time and date
Wind speed and direction
Visibility
Significant weather present (blank if nothing)
Sky coverage amount
Cloud base layers
Temperature and dew-point
Altimeter reading

KMWL 111155Z 13012KT 8SM -TSRA SCT100CB OVC250 08/06 A2998 RMK RAB32 OCNL LTGIC VC SW-OHD TSB34 MOV NE P0012 T00780059 SLP150 10105 20052 60012

PIREP – Pilot Report

- Pilot Report, or PIREP, is a report of the actual weather conditions and/or aircraft impacts as encountered by an aircraft in flight.
- These reports are transmitted by radio or electronically. In contrast to a METAR, which documents weather conditions at a specific surface location at regular time intervals.
- PIREP can be given or solicited as needed at any time or location, and at any altitude.

PIREP

- Example of PIREP
- UA /OV AMA-CDS /TM 2116 /FL050/TP A321 /WX FV03SM /TA 14 /TB LGT CHOP /RM MOD RAIN /
- The **flight level** is 5000 feet. The **type of aircraft** is an Airbus A321. The **flight visibility** is 3 statute miles. The **air temperature** is 14 degrees Celsius. There is light chop occurring and **moderate rain**.

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Verification of NWP forecasts

- Verification systems which allow scientists to measure the quality of forecasts and diagnose model performance.
- Objective Vs. Subjective verification
- Deterministic Vs. Probabilistic Verification.

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Statistical Downscaling

- **Downscaling – Method of mapping coarse resolution data onto a higher resolution grid.**
- **Two types of Downscaling.**
- **Statistical Vs. Dynamical Downscaling.**
- **Statistical downscaling**

is when temperature forecasts from weather models are adjusted with some statistical method to modify weather model output to real-world conditions.

- **Downscaling methods**

- Nearest Point.

- Bi-linear interpolation.

- Intelligent grid-point selection.

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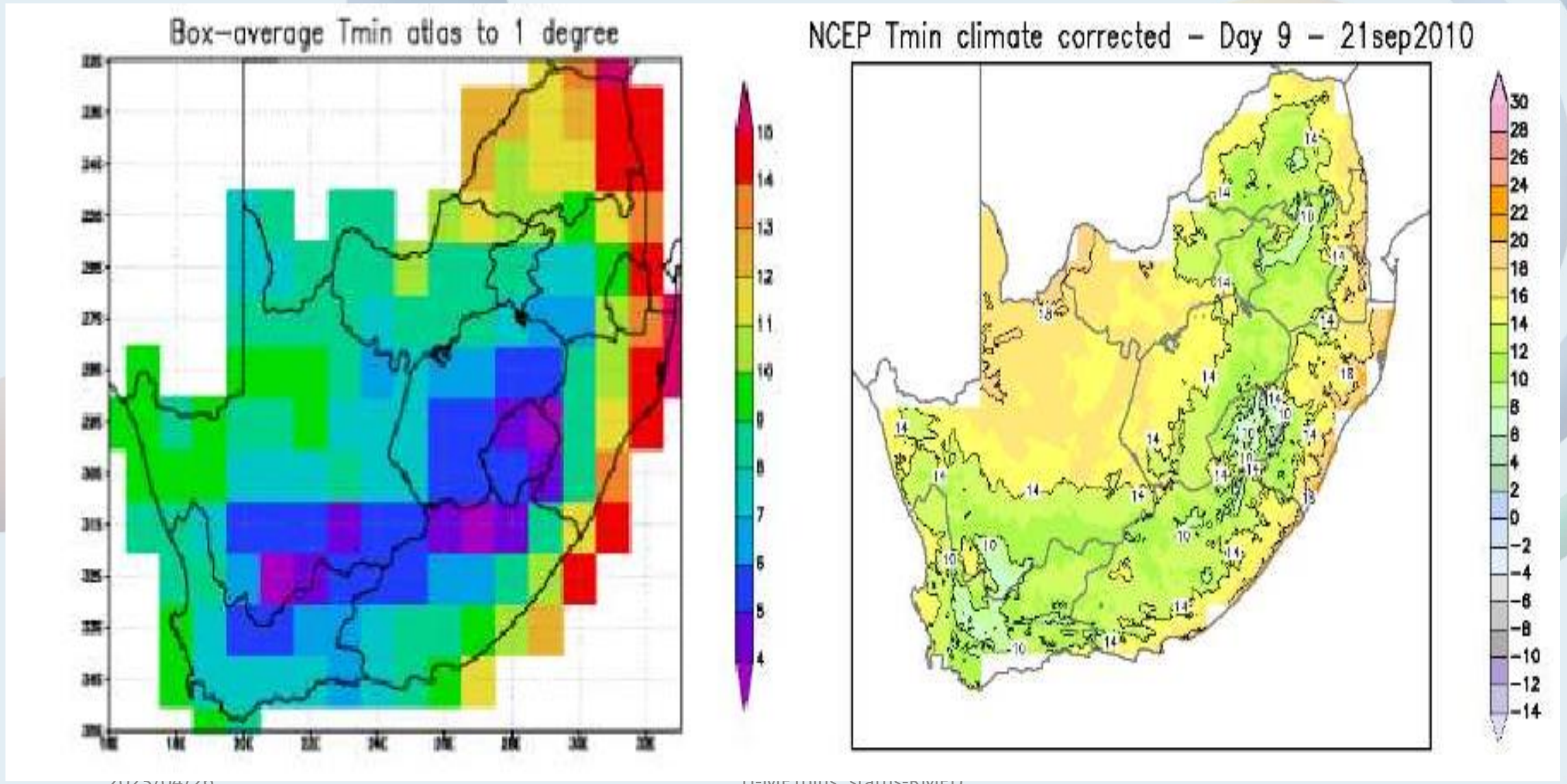
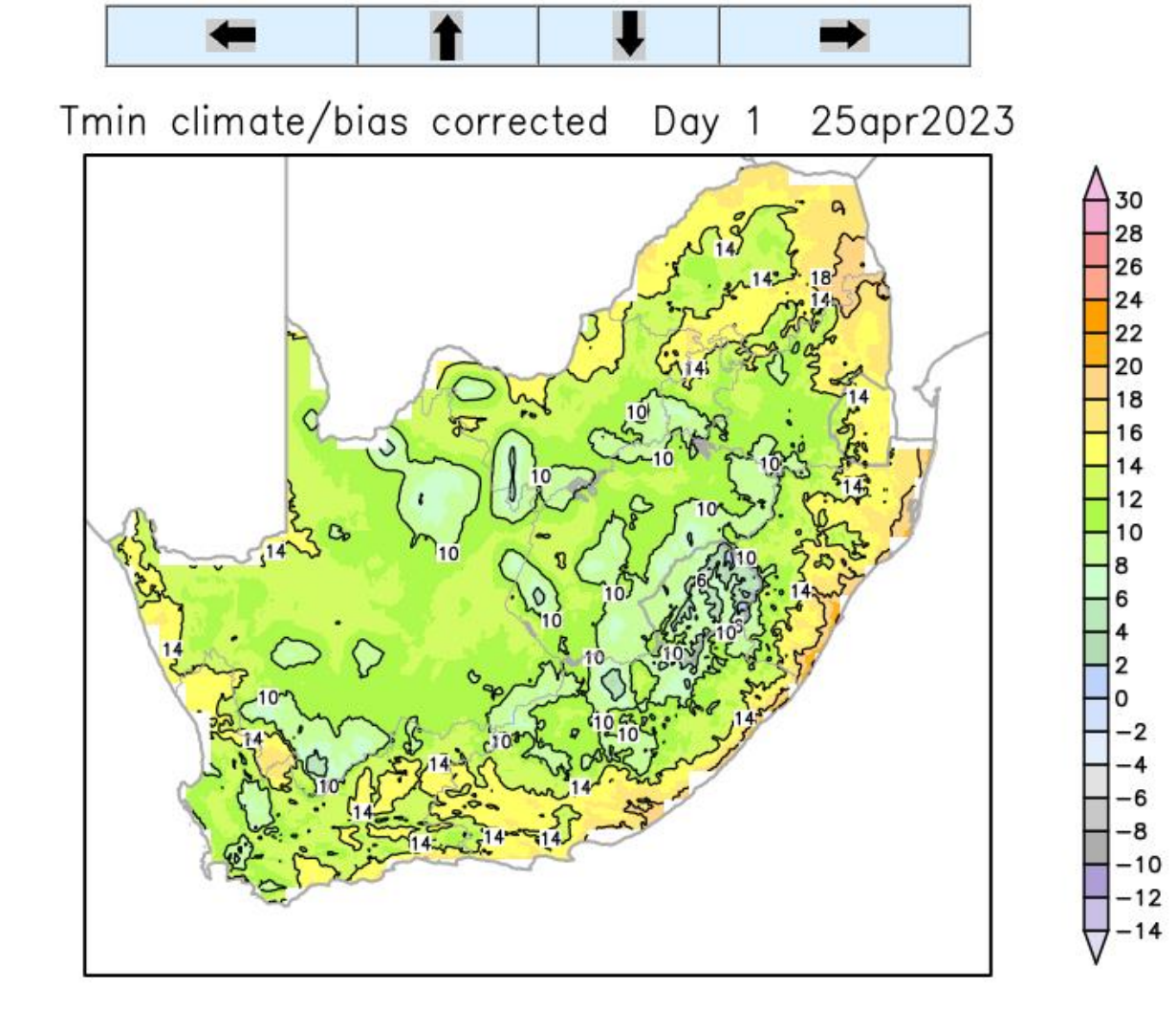
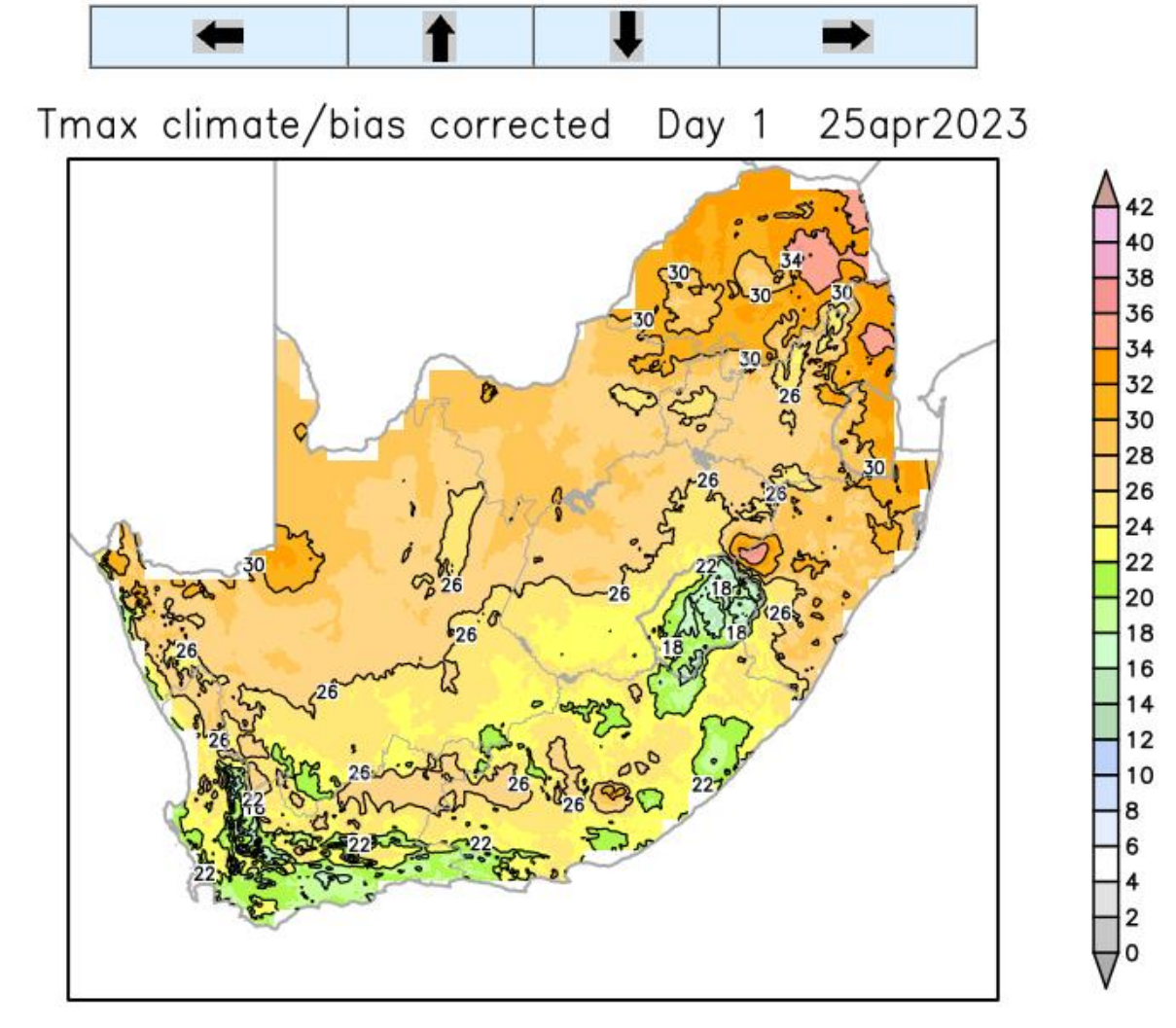
Climate corrected temperatures



This an example of where the minimum and maximum temperature fields of a low-resolution model are corrected with topography and bias corrected with observations





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Kalman Filtering min and max Temperatures

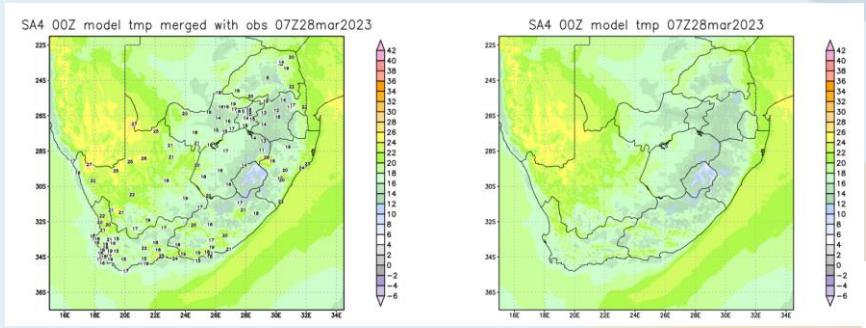
* Update 3: Updates approximately 9:30 SAST
* NOTE: Day1 MIN : (06Z Day0 - 06Z Day1), Day1 MAX : (06Z Day1 - 06Z Day2)
* NOTE: Day2 MIN : (06Z Day1 - 06Z Day2), Day2 MAX : (06Z Day2 - 06Z Day3)
Unified Model Temperature Forecasts from SA4 for 20230425
* Forecasts corrected using a Kalman Filter estimate (experimental - use with caution)
* SA4 6z used for Day1 TMin, SA4 00z used for Day1 TMax, Day2 TMin and TMax

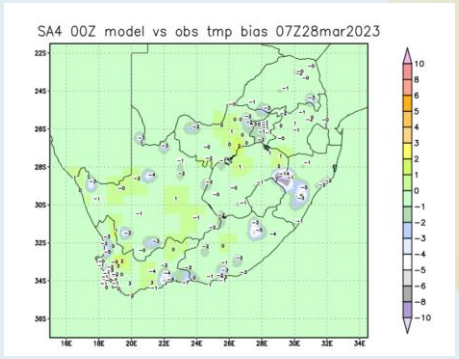
					Corrected Day 1		Corrected Day 2	
	Station Name	Day 1 Min	Day 1 Max	Day 2 Min	Day 2 Max	Day 1 Min	Day 1 Max	Day 2 Min	Day 2 Max
Gauteng									
	BRONKHORSTSPRUIT	9	26	10	25	9	26	10	25
	CARLETONVILLE	11	24	11	24	*	*	*	*
	HAMMANSKRAAL	13	27	13	28	12	*	13	*
	IRENE	12	24	12	24	12	28	13	28
	JOHANNESBURG_BOT_GARDENS	15	24	15	23	11	28	11	27
	OR_TAMBO	13	23	14	23	14	26	15	25
	PRETORIA	14	25	15	25	13	30	14	30
	ROODEPOORT	14	23	14	23	*	*	*	*
	SOWETO_ZUURBEKOM	10	23	10	23	7	28	8	28
	SPRINGS	12	25	13	24	*	*	*	*
	VEREENIGING	11	25	11	25	8	29	9	28
	WONDERBOOM	15	26	15	27	10	*	11	*
Mpumalanga									
	BADPLAAS	13	28	13	25	*	*	*	*
	BELFAST	10	23	11	20	7	26	10	23
	BLYDE_RIVER_CANYON	12	27	14	21	12	30	13	25
	CAROLINA	8	25	9	23	8	28	10	26
	ERMELO	9	25	11	23	*	*	*	*
	GRASKOP	16	25	16	20	14	27	16	23
	GROBLERSDAL	15	29	14	27	12	33	12	31
	KOMATIDRAAI	17	32	18	26	16	34	18	29
	LYDENBURG	11	27	11	22	10	31	11	26
	NELSPRUIT	15	27	15	24	14	29	16	27
	PIET_RETIEF	14	26	13	24	*	*	*	*
	SECUNDA	9	25	10	24	9	28	10	27
	SKUKUZA	15	33	16	27	13	36	15	31
	STANDERTON	9	25	9	24	*	*	*	*
	WITBANK	9	27	10	24	11	28	14	26

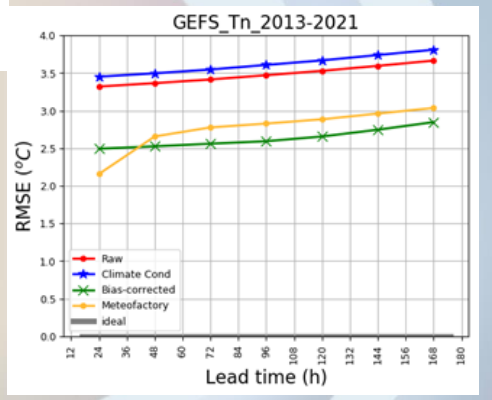
In this file, the Unified Model temperatures are corrected for specific stations with synop observations. The table indicate the raw model forecast as well as the corrected value.

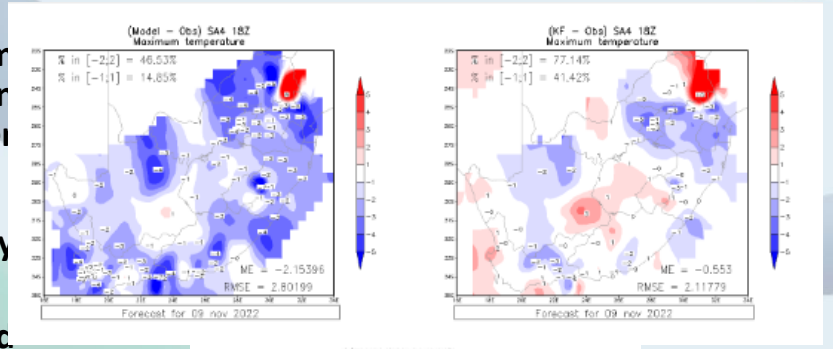
3 Main temperature correction processes

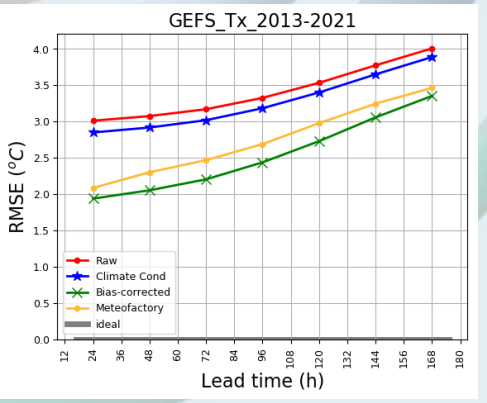
- **NCEP GEFS model min/max temperature bias-correction**
  - **The past 14-day running mean biases are calculated between the forecast and synoptic observations for each synop station point. These biases are interpolated to a bias grid and subtracted from the grid of the most recent model forecast to remove the model bias.**
  - **Bias-corrected temperatures outperform raw model temperature forecasts**
- **UM SA 4km model min/max temperature bias-correction**
  - **The min/max temperature forecasts from the UM SA 4km model are bias-corrected according to synoptic station observations using a 1-dimensional Kalman Filter correction technique.**
- **UM SA 4km model hourly temperature merged with hourly synoptic observations**
  - **The system merge the specific hour's model forecasts and observations into a hybrid 4km grid, from which any lon/lat point value can be extracted as the hour's observational value.**

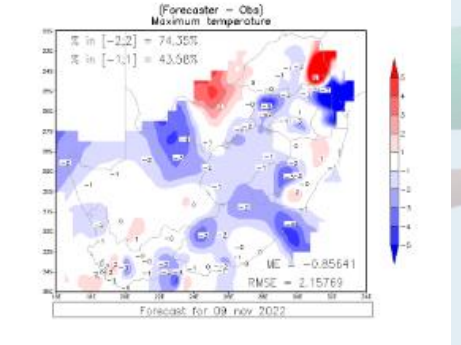












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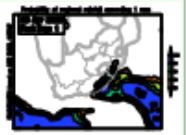
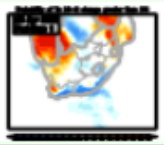
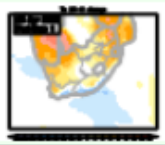
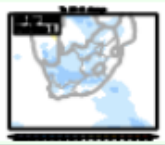
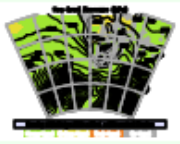
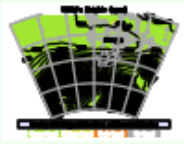
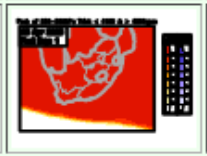
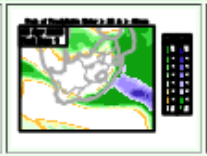
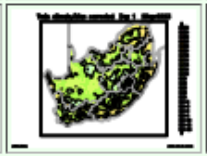
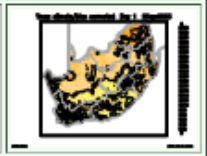
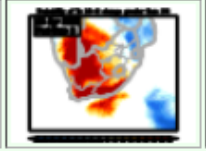
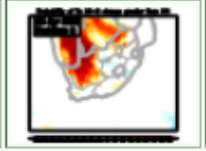
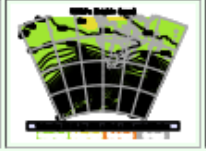
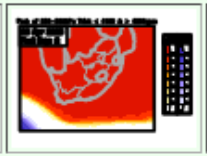
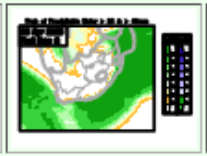
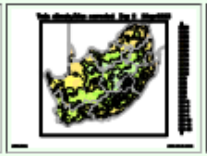
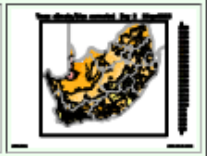
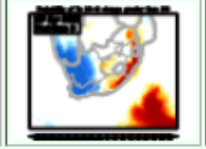
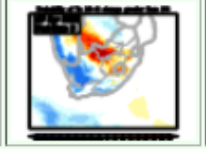
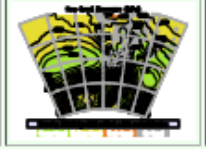
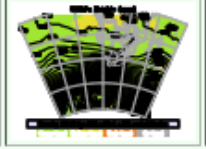
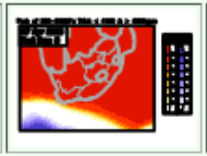
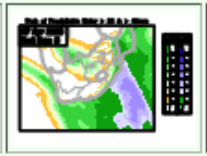
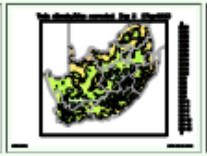
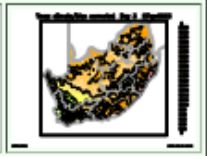
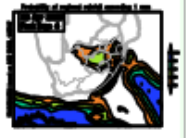
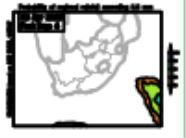
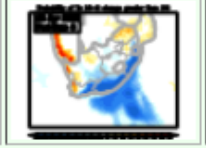
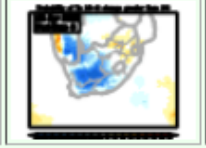
Bias corrected products at SAWS

http://cyclone-web.saws.co.za/nwp_products_p5xp5.html

14-Day Ensemble Forecast Products :: 0.5x0.5 degree Resolution : 21 Members

Date of forecast	Probability of Rainfall > 1mm	Probability of Rainfall > 8.5mm	Probability of 24H Tx change > 2 deg	Probability of 24H Tn change > 2 deg	Mean 24H Tx change	Mean 24H Tn change	Sea-level Pressure	500hPa Heights	Thickness Probabilities	CAPE & Precip Water	Tmin climate corrected	Tmax climate corrected
Tuesday 25 Apr 2023 Day: 1												
Wednesday 26 Apr 2023 Day: 2												
Thursday 27 Apr 2023 Day: 3												
Friday 28 Apr 2023 Day: 4												
Saturday 29 Apr 2023 Day: 5												
Sunday 30 Apr 2023 Day: 6												

Outcomes of Day 2

- ✓ Introduction to available observational data.
- ✓ Discuss process to be followed to determine quality of NWP forecast.
- ✓ Verification or Evaluation of NWP forecasts.
- ✓ Statistical downscaling methods.
- ✓ Discuss procedure to be followed to work with model strength and or weakness

South African Weather Service

Assignment

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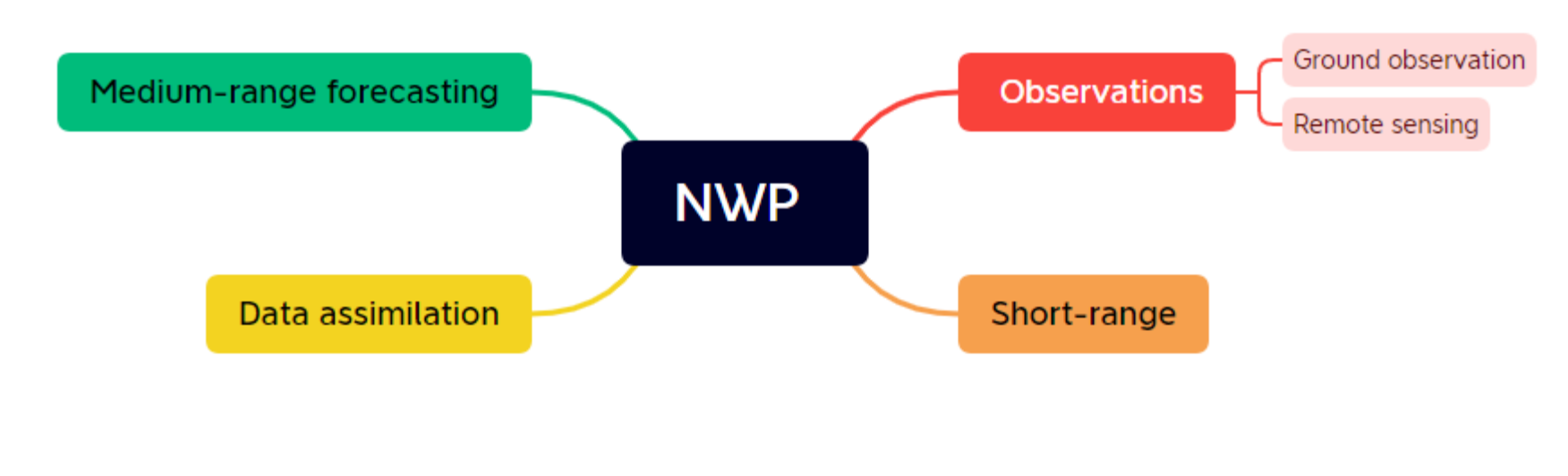

- **Observational Networks used at SAWS.**
- **NWP forecasting models (i.e., UM, CCAM, ECMWF,WRF)**
- **What are the observations used for ? i.e., Data assimilation, Agriculture, Research**

Assignment Due Date : 25 May 2023