

# ***Headquarters U.S. Air Force***

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## **U.S. Air Force Climate Services Update**



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HQ USAF/A3W**

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# *Overview*

- **Current USAF Climate-related Work**
- **Future USAF Climate-related Work**
- **USAF Modeling Modernization Concept**



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# ***Current Climate-related Work***

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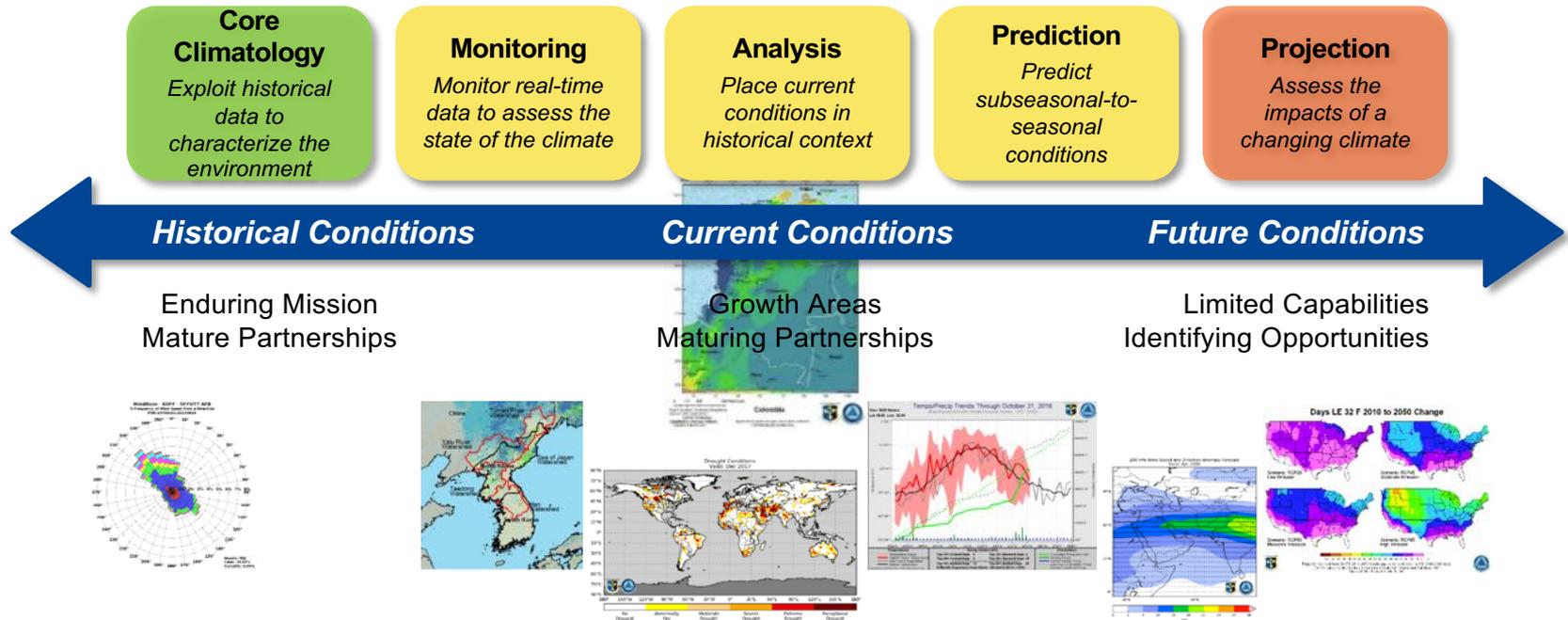
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# Climate Services Continuum

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Climate services span the past, present, and future climate system...

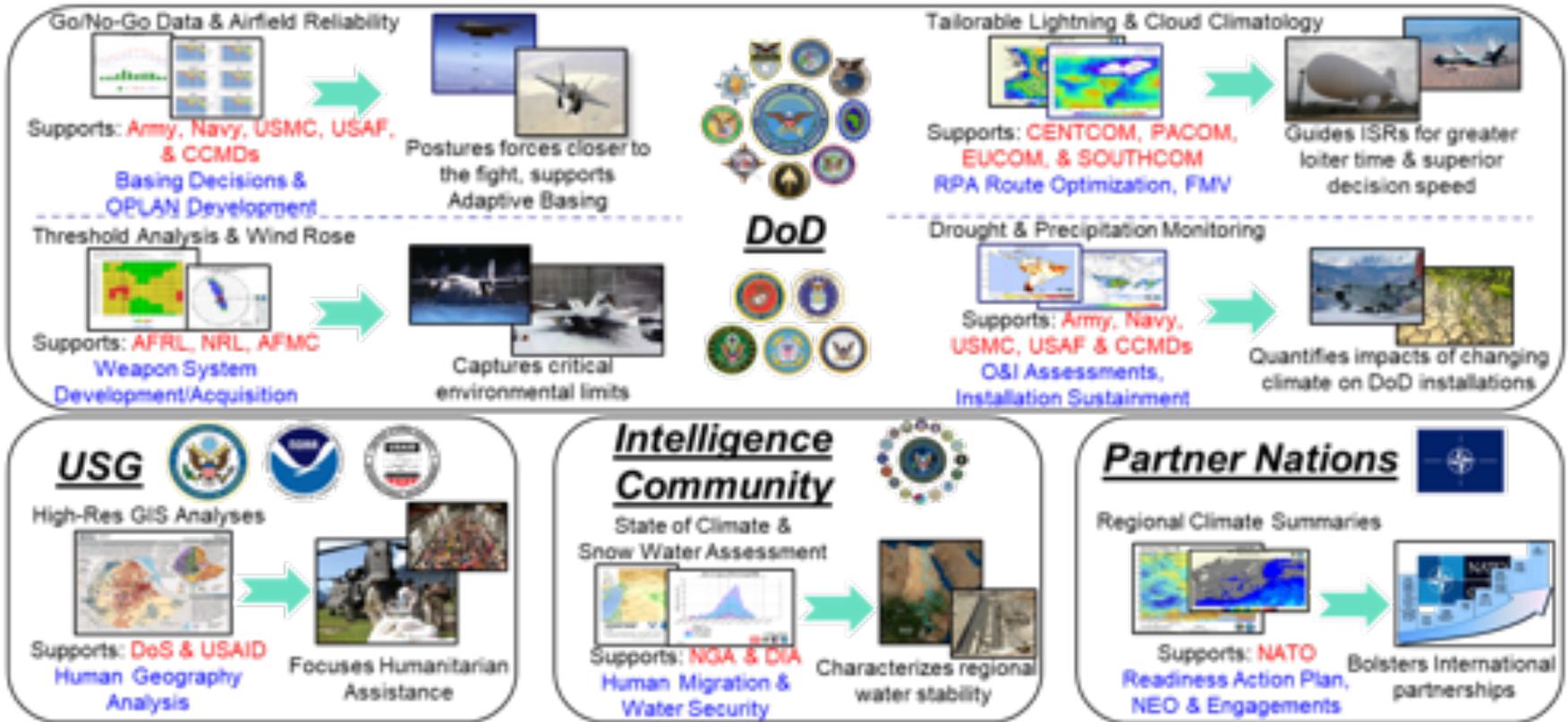




# Climate Operations

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Leverages myriad datasets to provide actionable environmental intelligence to support decisions and increase stakeholders' Resiliency, Readiness & Lethality





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# ***Future Current Climate-related Work***

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# *Demand for Environmental Intelligence (S2S to Decadal)*

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*What is the flood outlook for this spring?*

**How can I establish a monthly M2M pull of drought conditions?**

Can I get that plot, but for the entire watershed and for the last water year?

***Will the likelihood of tropical cyclone landfall increase as a result of this El Niño?***

How will the permafrost change?

**When will coastal ACC bases become untenable?**

***Are these uncharacteristically warm summers in Germany expected to persist?***

Can you provide projected temperature increases for 2035?

**Can you integrate climate projection data into the Engineering Weather Data product?**



# *Climate-Related Impact Examples to DoD Infrastructure*

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- 2019 Midwest Flooding: Local levees failed to keep flooding at bay at Offutt AFB –39 buildings flooded with up to 8 ‘of water with more structures damaged. About 3,000 feet of the 11,700-foot runway was submerged.
- 2018 Hurricane Michael: Tyndall AFB hit with 150+ mph winds; every structure damaged to some degree; evacuated most of aircraft
- 2013 Flooding: Caused landslide to block an entrance to Cheyenne Mountain AFS, significant damage to other base facilities and infrastructure, and \$15M of damage when storm water removal pumps were overcome by water infiltration
- 2011 Extreme Heat: Tinker AFB experienced 63 consecutive days >100oF –base had difficulty keeping Information Transfer Nodes (ITNS) cooled. Approximately 20 cooling-related incidents that year resulted in 800 lost training hours as cooling units could not keep AWACS simulators cool enough

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# ***DoD Climate Adaptation & Resiliency (CAR)***

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- The Air Force continues to incorporate climate as a consideration in its guidance and policies: Integrated Installation Planning, Mission Sustainment
- DoD response to FY18 NDAA, Sec 335: Services provided top 10 vulnerable installations to climate impacts (Desertification, Drought, Flooding, Thawing Permafrost, Wildfires)
- DoD response to FY19 NDAA, Sec 2805: Assessing minimum flood mitigation requirements to update Unified Facilities Code (UFC) for civil engineers
- AF working with Tyndall AFB PMO with Design Flood Elevation (DFE) determination for more adaptive and resilient reconstruction of the airfield



# *Climate as a GEOINT Layer*

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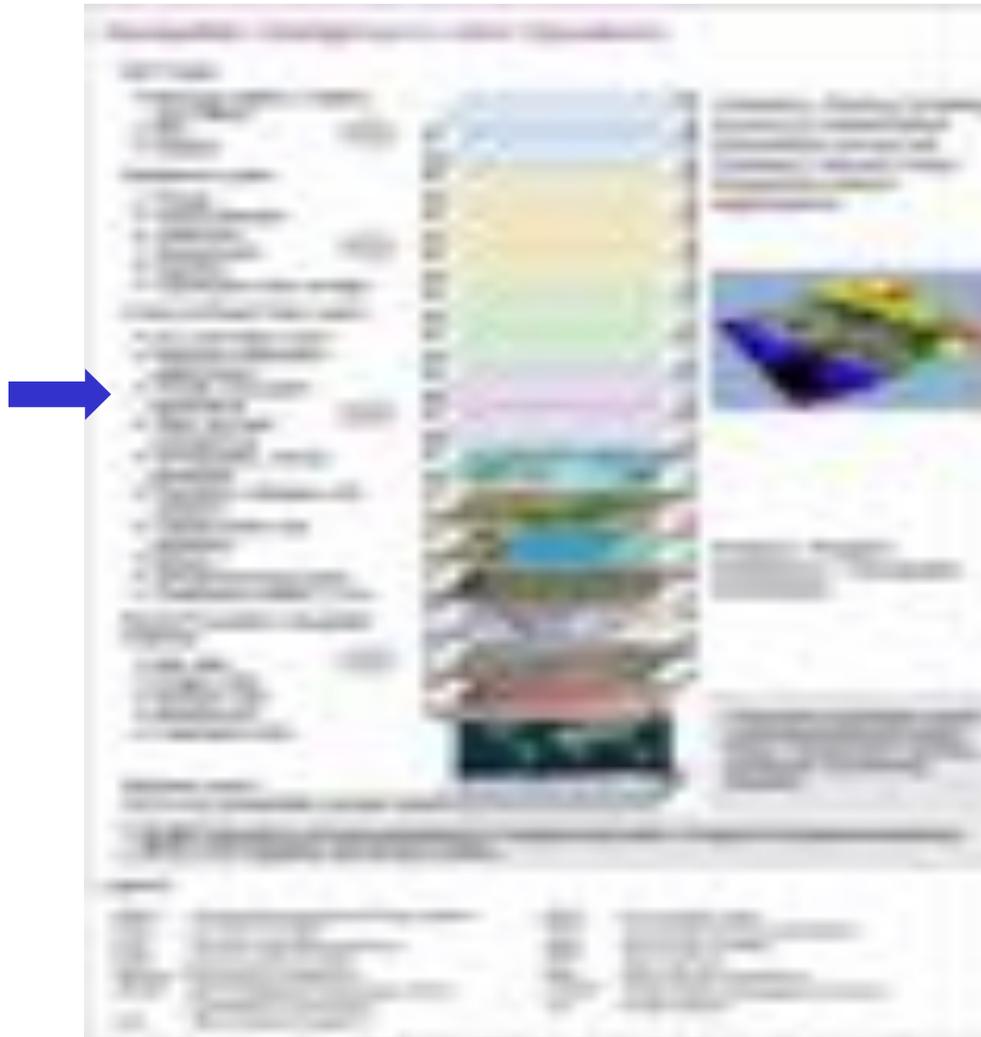
- Support to Intelligence Community (IC) on classified networks provides a unique capability only the DoD can provide
  - Authoritative climate data is used for forensic analysis to understand how and why events happen
  - Delivering S2S forecasting products will be helpful to support the IC's shift to the Anticipatory Intelligence (AI) paradigm
  - AI is about delivering models and modeling capabilities in order to provide strategic warning, mission forecasting, and global humanitarian relief preparations
    - Using M2M processes and machine learning will accelerate AI

**Fusing authoritative climate information as a layer into geospatial intelligence (GEOINT) improves the IC's ability to understand the world and anticipate future events; increasing the decision advantage ahead of our adversaries**



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# *On the Horizon*

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## ■ **Climate Relevancy Focus**

- Impacts garnering senior leader visibility
- Recognition of environmental threats to DoD

## ■ **Subseasonal-to-Seasonal (S2S) Prediction**

- Not only temperature and precipitation, but also military relevant variables
- Improve drought and hydrology related impacts
- Need for increased training/knowledge across AFW
- Leverage IAW Modeling Strategy Concept

## ■ **Decadal Projection**

- 14 WS has limited capability ... develop partnerships
- Leverage IPCC/NCA4 reports and available tools such as SLR projections

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# ***AF Weather Modeling Modernization Concept***

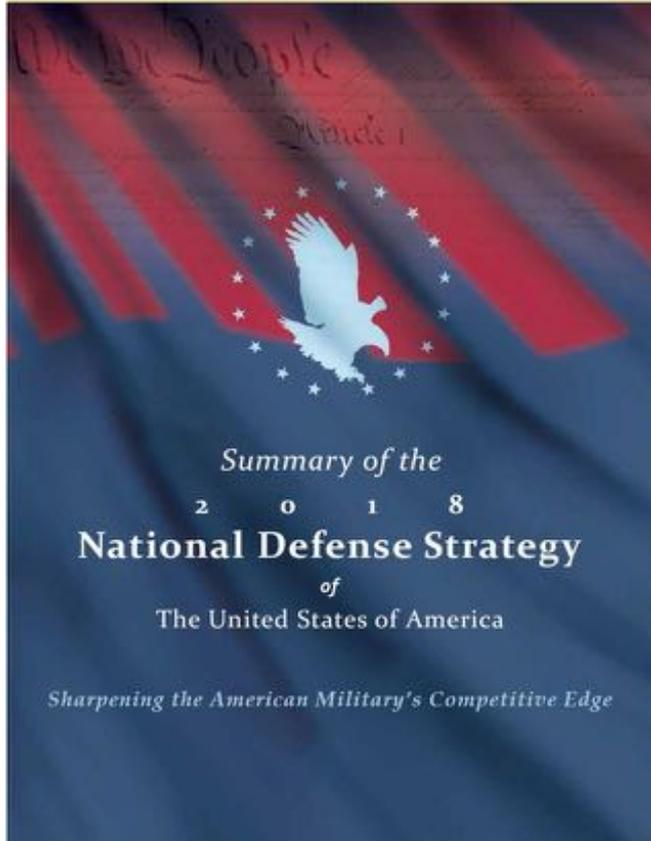
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# *AF Weather Strategic Vision based on the National Defense Strategy*



- **Lethality and Readiness**
  - *Improve Integration*
  - *Enhance Resiliency*
  - *Realign Our Force*
- **Alliances & Partnering**
  - *DoD & Government Agencies*
  - *Allies & Trusted Coalition Partners*
  - *Industry & Academia*
- **Reform for Performance and Affordability**
  - *Rapidly Modernize*
  - *Attack our inefficiencies*
  - *Redesign our Force*



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# *Challenge*

- **The future challenge of near-peer conflict and the needs of future weapons systems to compete in that conflict will not be met by our current modeling approach**



- **Improve/Evolve/Sustain Existing Capability to Fully Meet Current User Needs**
- **Provide Modeling Capability to Meet Gaps**
- **Add Resilience To Our Modeling System**



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# *Major Decisions*

- **Model Operations**
- **Model Configuration**
- **Distributed Computing**
- **Hydrology**
- **Unclassified/Classified processing**
- **Sub-Seasonal to Seasonal Forecasting**
- **Cloud Modeling**



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## *Lines of Effort*

- **Objective: Improve/Evolve/Sustain Existing Capability to Fully Meet Current User Needs**
  - **Global Numerical Weather Prediction (NWP) Model**
  - **Regional NWP Model**
  - **Cloud Model**
    - **Pursue Explicit Cloud Forecast Capabilities**
  - **Land Modeling**
  - **Dust/Volcanic Ash Model**



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## *Lines of Effort*

- **Objective: Improve/Evolve/Sustain Existing Capability to Fully Meet Current User Needs**
  - **Stochastic Modeling Approaches**
  - **Post Processing**
    - **Machine-to-Machine Applications**
    - **Stochastic post-processing**
  - **Verification**



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# *Lines of Effort*

- **Objective: Provide Modeling Capability to Meet Gaps**
  - Polar Regional Model
  - Global/Regional Hydrology Model
  - **Sub-seasonal-to-Seasonal Model**
  - High Altitude NWP Model
  - Surrogate Models Machine Learning/Artificial Intelligence
  - Aerosol/Chemistry Modeling



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## *Lines of Effort*

- **Objective: Add Resilience To Our Modeling System**
  - **Modular Hardware and Software**
  - **Distributed Computing**
  - **Non-Traditional Data Sources**
  - **Modeling Operations with Limited Data Sets**
  - **Operational Back Up**
  - **Multiple Model Ingest for Model Blending**
  - **Multiple data sources**



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# Questions?



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# Back Up Slides



# Climate Prediction



- Predict changes to analyzed climate conditions within the subseasonal-to-seasonal (S2S) timescale

- **Status:** Growth area and energizing partnerships

- **Example Products / Services:**

Temperature, Precipitation, and Drought Predictions

Long-range Outlook

Analyst-in-the-loop Discussions

**EUCOM**  
Valid: January - June

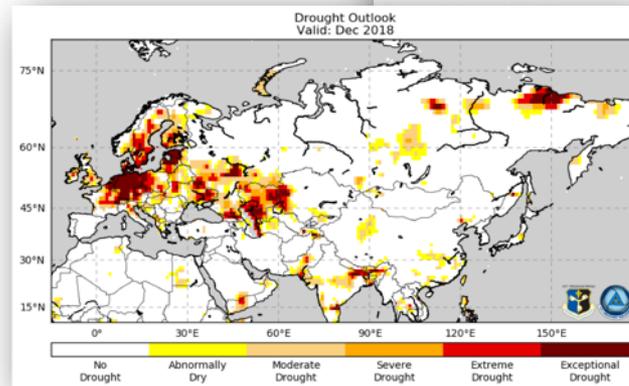
ENSO Update: El Niño is expected to form and continue through the Northern Hemisphere winter 2018-19 (90 percent chance) and into spring (50 percent chance). Check out our El Niño impacts guide at [https://climate.af.mil/data/datasets/enso\\_definition\\_impacts\\_14ws.pdf](https://climate.af.mil/data/datasets/enso_definition_impacts_14ws.pdf)

DERIVED IMPACTS	FORECAST	LOCATIONS
Drought Risk	Above Normal	Albania, Austria, Belarus, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Montenegro, Netherlands, Norway, Poland, Russia, Slovakia, Sweden, Switzerland, Turkey, Ukraine, and the UK

Remain above normal across much of the region through the upcoming winter. In Russia have recently experienced well below normal temperatures due to El Niño. Projections show this pattern continuing through January across much of Scandinavia during January as well. On average, Scandinavia and February during El Niño winters.

Remain near normal across most of the region during this period. However, above normal temperatures are expected from January through March, which is supported by generally El Niño winters.

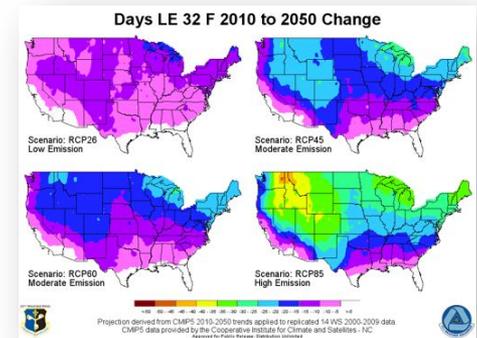
Intense drought conditions are expected to continue throughout the winter and into spring, with the most intense drought conditions will continue to reside across portions of the region significantly impacted in some areas.





# Climate Projection

- Assess the decadal and longer impacts of a changing climate
- **Status:** Limited capabilities and identifying resources
- **Example Products / Services:**
  - Temp, Dew Point, Precip Change Depictions
  - Station Parameter Change Projections
  - Projected Engineering Weather Data (*contract*)



**RCP45 Low Moderate Emissions Scenario Climate Change Report for SOTO CANO AB, (ICAO\_MHSC)**

Year	Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
2010	TEMPMEANMAX	81	86	89	91	90	86	86	87	86	83	80	81	86
2030	TEMPMEANMAX	82	87	91	93	91	88	87	88	87	84	81	82	87
2050	TEMPMEANMAX	83	88	92	94	92	89	89	89	88	85	82	83	88
2010	TEMPMEAN	72	74	77	79	78	76	76	76	75	75	72	71	75
2030	TEMPMEAN	72	76	78	80	79	77	77	77	76	76	73	72	76



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# By the Numbers

## In Calendar Year 2018:

- 1.1 billion observations collected
- 8.7 million data quality database audits applied
- 99.9% website/system up-time achieved
- 885 support requests addressed
- 399 distinct organizations supported
- 228 thousand NIPR web hits sustained
- 33 thousand SIPR web hits sustained

