Department of the Navy SBIR/STTR Transition Program
Pending SYSCOM Review

Topic # N142-121
The Advanced Climate Analysis and Forecasting System - Decision Support System
Clear Science, Inc

ABSTRACT

Decision-makers, intelligence analysts, modelers/simulators and others could gain a tactical or strategic advantage with foreknowledge of the atmosphere from two weeks to 1 year and beyond. The ACAF-DSS uses state-of-the-science historical climate datasets and long-range predictive models to provide the user with heretofore unavailable weather and oceanographic information. ACAF-DSS leverages an innovative approach to asynchronous data recall coupled with clustered computing and an innovative user interface to make petabytes of data exploitable. Mission-planning, tactical decision aids, simulations, and decision-systems will all benefit from the core technology of the ACAF-DSS by offering extended probabilistic determination of the future environment on-demand. CSI seeks to leverage the ACAF-DSS technology to create solutions for organizations that plan, stage resources, or mitigate risk by providing decision-enhancing environmental information early and continuously.

THUMBNAIL

DOD personnel can gain a significant tactical or strategic advantage with foreknowledge of the atmosphere from two weeks to 1 year and beyond. The ACAF-DSS core technology assists decision-makers, intelligence analysts, modelers/simulators with decision-enhancing information early and continuously.

KEYWORDS

decision support, planning cycle, decision science, early warning, environmental hazard, meteorology, oceanography, climate, long-range forecasting

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The Advanced Climate Analysis and Forecasting System - Decision Support System

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WHO

SYSCOM: ONR

Sponsoring Program:

Transition Target: Fleet Numerical Meteorology and Oceanography Center (FNMOC)

TPOC:

Mr. Daniel Eleuterio
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Other transition opportunities: The ACAF-DSS core technology can be expanded and adapted to create customized solutions for decision-makers, intelligence analysts, modelers/simulators by providing foreknowledge of the atmosphere, 2 weeks to 1 year in advance.

Notes: The ACAF-DSS displays information in many forms via the advanced user interface to assist users in making great decisions for resource planning and staging, risk mitigation, energy consumption and many other potential uses. The goal of the ACAF-DSS is to provide information in a form the warfighter can leverage. From a presentation-ready figure, to data suitable for importing into a tactical decision aid, to an API return for use by another application or cloud, the ACAF-DSS lives up to its billing of being the 'Swiss army knife' of climate information.

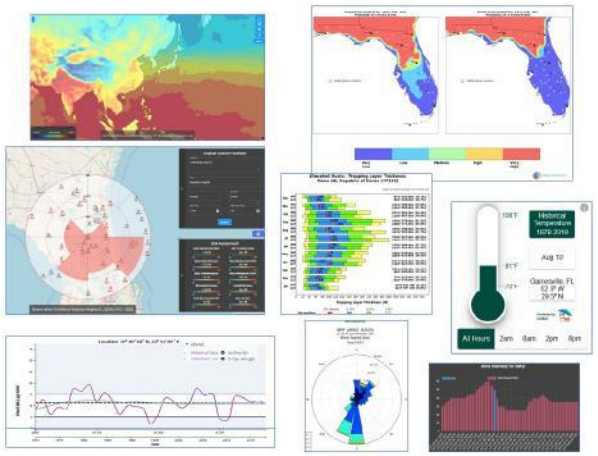

Image courtesy of Clear Science, Inc.

WHAT

Operational Need and Improvement: Decision-makers, intelligence analysts, modelers/simulators and others can gain a significant tactical or strategic advantage with foreknowledge of the atmosphere from two weeks to 1 year and beyond. Commonly available predictive models offer environmental predictions to about two weeks. Longer range models are improving, and when used, they must be understood within the context of the state of the climate and historical limits.

Specifications Required: This technology must leverage modern computing technology in terms of data storage, large dataset schema and rapid, asynchronous recall techniques. In addition, the application will deliver the information in the most value-added method possible be it an advanced user interface packed with analysis tools, or calculated data delivered via an API for use in outside applications or clouds. More importantly, the application will deliver the predictive environmental information in a form the decision-maker, analyst, modeler, planner or researcher can readily consume such as an intuitive chart, a probabilistic summary or even a stoplight diagram.

Technology Developed: The ACAF-DSS is an environmental decision support system. The ACAF-DSS accesses scores of historical datasets and long-range predictive models to provide the decision-maker with heretofore unavailable weather and oceanography information. The system applies an innovative approach to data recall coupled with a clustered computing power and an interactive user interface to make petabytes of data accessible and discernible. Based on the user's request the system recalls the necessary data, computes the requested solutions, and displays or sends it to the user within seconds. Within the user interface the user may layer multiple requests on a global, interactive map, create cross-sections in space and time, correlate regions/times, create vertical profiles within the ocean or atmosphere and more.

Warfighter Value: Planning for intelligence gathering, resource employment, unit movements, location selection, risk mitigation and other governmental activities typically takes place at timescales that are far longer than commonly available weather models predict. The ACAF-DSS offers the warfighter a means to understand the emerging environmental conditions far in advance of operations to make better decisions and plans. Access to this information continuously improves today's and tomorrow's decisions and plans cumulatively impacting strategic and tactical decisions and ultimately improving outcomes.

MORE

Contract Number: N68335-20-C-0827

- Built to assist decision-makers who are tasked with preparations for S2S and longer time frames
- This technology is a platform/tool for analysis and display of long-range (CFS), S2S (NMME, SUBx) forecasts and historical datasets
- Facilitates the use of pre-determined indicators based on data factors (e.g., A-10 mission constraints, drought, flood, famine algorithms)
- Consumes gridded (forecast, reanalysis, analysis) and tabular data (ISD, ICOADS, Best Track)
- Datasets need not be limited to environmental datasets
- Analysis/data is API reachable and can feed other applications, models and/or interfaces

HOW

Projected Business Model: CSI will leverage the core, very broad ACAF-DSS technology to create custom solutions for government (e.g., long-range hurricane formation predictions, fire conditions early warning, freeze probability outlook, etc.). CSI will also license this technology to use as-is for use by institutions for operations or research

Company Objectives: CSI will continue to develop the ACAF-DSS technology and transition it to the DOD. In addition, CSI will continue to seek commercial and government partners that have specified and limited needs for which the technology can be leveraged. CSI's ACAF-DSS technology is unmatched in the marketplace and we intend to maintain our leadership in the area of providing access to a large set of climate/historical and predictive datasets from which instant analysis and computations can be completed. We will continue to invent technology and approaches for the exploitation and display of decision-supporting environmental information.

Potential Commercial Applications: Commercial application of this technology span many economic sectors. Business interests that have interest in predicting weather or ocean phenomena can benefit from this technology. For instance insurance/reinsurance would immediately enhance underwriting with a better understanding of their environmental hazard risk posture many months in advance. The finance and investing sector could time strategy better with an understanding of the future environment. Energy buyers are extremely environmentally sensitive in timing of purchases. Construction, logistics, shipping, etc. Nearly all economic sectors could capitalize and profit from accurate, advance knowledge of environmental conditions that impact them most, and lead times that favor their operations

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Extending the Strategic Advantage Through Foreknowledge of the Atmosphere

The Advance Climate Analysis and Forecast Decision Support System (ACAF-DSS)

Clear Science, Inc.

Topic N142-121

ONR

Presented by:
Bruce W. Ford, President
Clear Science, Inc.

Video Link: https://youtu.be/sJJueXlYbCs

Clear Science, Inc. - Environmental R&D since 2003

- Laser-focused Scientific Domain Expertise: Meteorology, Oceanography, Climate Datasets, Geospatial Information/Open Geospatial Consortium (OGC) Services
- Key Technical Competencies:
  - Transitioning Systems to Gov: ACAF (6 versions), Drift-SAR
  - System Design: service design, performance optimization, application programming interface (API) customization, cloud/clustered computing
  - Data Science: dataset creation, dataset recasting, statistics creation
  - Data Analytics: algorithm development, output dataset optimization, statistical analysis, predictive analytics, decision support parametric analysis
  - Front End Development: user interface design, output visualization
- Sole legacy ACAF developers dating back to 2008

The Navy Challenge

TOPIC OBJECTIVE: **Develop a software suite which would allow DoD mission planners to access, manipulate, display, and save extended range (intra-seasonal to inter-annual) probabilistic environmental prediction graphical products from a distributed Federal data service through a fast, flexible, and IA-compliant web service.**

DESCRIPTION HIGHLIGHTS:

"Almost all mission analysis and planning tools in the DoD rely heavily on short range (0-7 days) explicit deterministic forecasts."

"…forecast and related product datasets are massive and provided in diverse formats that are not well suited for DoD use, especially for use in decision support tools applicable to DoD mission planning"

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Why the ACAF-DSS?

Better decision = better outcomes

- Reason #1
  - Predict variability
- Reason #2
  - Extended lead times to support planning decisions
- Reason #3
  - A realized tactical/strategic advantage

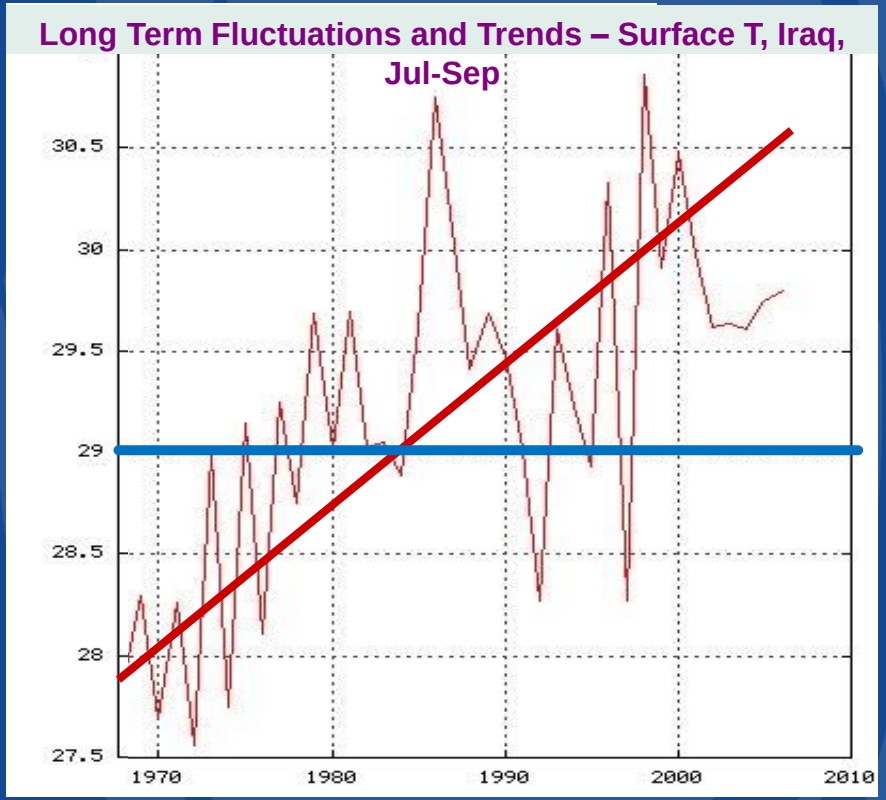

Image courtesy of Naval Postgraduate School

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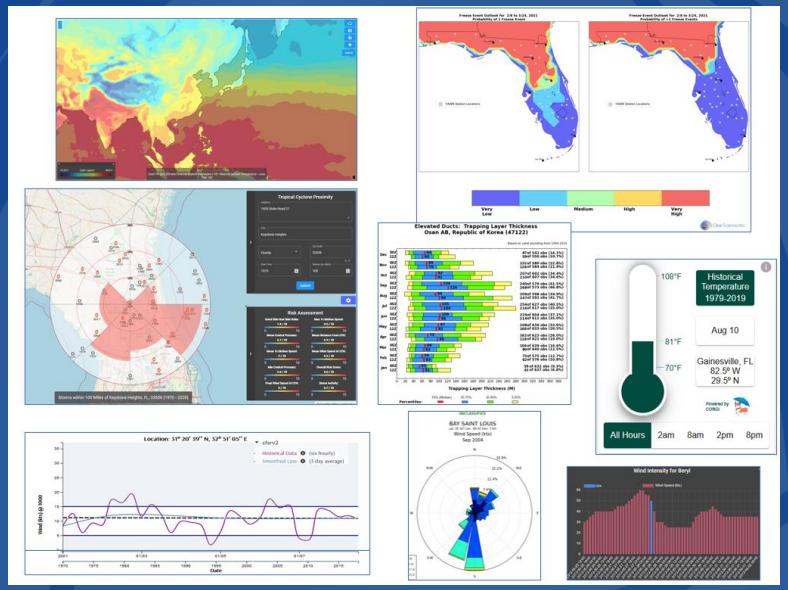
What is the ACAF-DSS

- Full-featured Decision Support System (DSS) accessible via web, API call or OGC service
- Access to 20+ historical datasets (1970-present)
- Long-range forecasts
- State-of-the-global-environment tools
- Extensive visualization and analysis suite



- Target users: Mission analysts/planners, decision-makers, intelligence analysts, modelers/simulators, support-providers, etc.
- Target systems: Tactical decision aids, mission-planning software, simulation suites, intel package systems, etc.

- What is the likelihood of freezing conditions over my operating area?
- What is the probability of a hurricane impacting my exercise in October this year?
- How frequently can I expect high sea states in the northwest Pacific this March?
- How likely are favorable are extended range conditions three months in the north Atlantic?

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ACAF-DSS Status

- 'Adding capability to a full-functioning version' – TRL 7 - Phase 2.5
- Portions of technology already transitioned to DOD
  - Transition partner: Fleet Numerical Meteorology and Oceanography Center (FNMOC) Monterey, CA
  - Two most challenging technical hurdles scaled:
    - Asynchronous data access/data schema
    - Separation of data recall and computational function to distributed computing environment
- Targeted outgrowths
  - Targeted Environmental Risk Analysis System – Tropical Cyclone (TERAS-TC)
    - Atlantic hurricane historical risk assessment tool based on a specific location
  - Florida Freeze Probability Outlook
    - Implemented to assist Florida specialty crop growers (Winter/Spring 20/21)

ACAF-DSS Innovations/Benefits

Innovation/Feature	Benefit to Warfighter
Probabilistic environmental predictions within seconds (weeks to months lead time)	Enhanced planning, extend TDAs, better resource selection, risk reduction
System is available 24/7/365	All planning cycle decisions can be enhanced with high-quality environmental information
> 20 historic and predictive datasets available and counting	Global/regional coverage to address any use case
Flexible output methods (UI, API, common formats, custom output)	Ensures decision-enhancing information is available across platforms
User interface (UI) with built-in data analysis tools (trends, bracketing, vertical/time/space cross sections, correlation/regression, time series)	Planners can customize information for specific purposes such as an operational constraint or timeframe
Extendibility – system built to facilitate custom-use out-growths	Reoccurring needs for information can be addressed in actionable, improved ways

ACAF-DSS Transition and Beyond

- Expect to continue transition path to FNMOC
  - Data store, APIs, UI – core components
  - Exact timeline unknown
  - Phase II.5 contains ambitious capability enhancements
  - Currently in Phase II.5 base period
  - Once transitioned, will be available DOD-wide
  - Phase III likely to add datasets/capabilities
- Outgrowth Opportunity – DOD, other departments
  - Special purpose interfaces that answer specific needs/time scales
  - Examples:
    - Hurricane probabilities (already built)
    - Flood early warning system
    - Fire risk early warning system
    - Sensor selection tool
    - TDA extension (weeks to months)

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ACAF-DSS Potential Commercial Markets

- Insurance/Reinsurance (property, crop, health, liability)
- Finance/investment (world-wide commodities, capital allotment, investment timing)
- Agriculture (growth, infestation, timing, nutrient leeching)
- Energy (planning, timing energy purchases)
- Logistics (routing, staging, energy purchasing, expense forecasting)
  - Shipping (port selection, fuel conservation)
- Retail (pattern-of-life, shopper sentiment, shipping, sales space optimization)
- Healthcare (catastrophic event planning, staging)
- Tourism (early/late season onset, project planning)

ACAF-DSS is a Force Multiplier!

- Add the benefit of improved environmental awareness to ALL of your organization's planning (e.g., the cumulative improvement effect of incrementally better information throughout the cycle).
- Let CSI apply this technology for your organization's benefit delivered exactly how your decision-makers need it, delivered constantly.
- Prime contractors – could your Government partners benefit by an extended weather/oceanography horizon? Mission-planning, TDAs, simulation creators, we can integrate with our platform.
- Industry – ACAF-DSS technology adaptable and expandable to a plethora of commercial applications. Advanced information about the emerging atmosphere can increase profits.

ACAF-DSS What's next

➢ Contact us!

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Contact us to get an account and try our technologies out for yourself

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Reference Sheet

Reference Sheet for Clear Science, Inc. Topic Number N142-121					
Slide #	**Slide Title**	**Content Citation**	**Graphic Citation**	**Notes**	**Checked by BC**
1	Title Slide	N/A			
2	Clear Science, Inc. - Environmental R&D since 2003	Clear Science, Inc. Business Development			
3	The Navy Challenge	Navy SBIR Topic Number N142-121 solicitation/description			
4	Why the ACAF-DSS?	TPOC update meeting	Image courtesy of Naval Postgraduate School (Dr. Tom Murphree [murphree@nps.edu])		
5	What is the ACAF-DSS	Clear Science, Inc. quad chart, TPOC review meetings	Copyright 2021 Clear Science, Inc.		
6	ACAF-DSS Status	TPOC reviews, Clear Science, Inc. quad chart			
7	ACAF-DSS Innovations/Benefits	Clear Science, Inc. derived R&D, quad chart			
8	ACAF-DSS Transition and Beyond	Clear Science, Inc. business development			
9	ACAF-DSS Potential Commercial Markets	Clear Science, Inc. business development			
10	ACAF-DSS is a Force Multiplier!	Clear Science, Inc. derived R&D, quad chart			
11	ACAF-DSS What's next	Clear Science, Inc. business development			