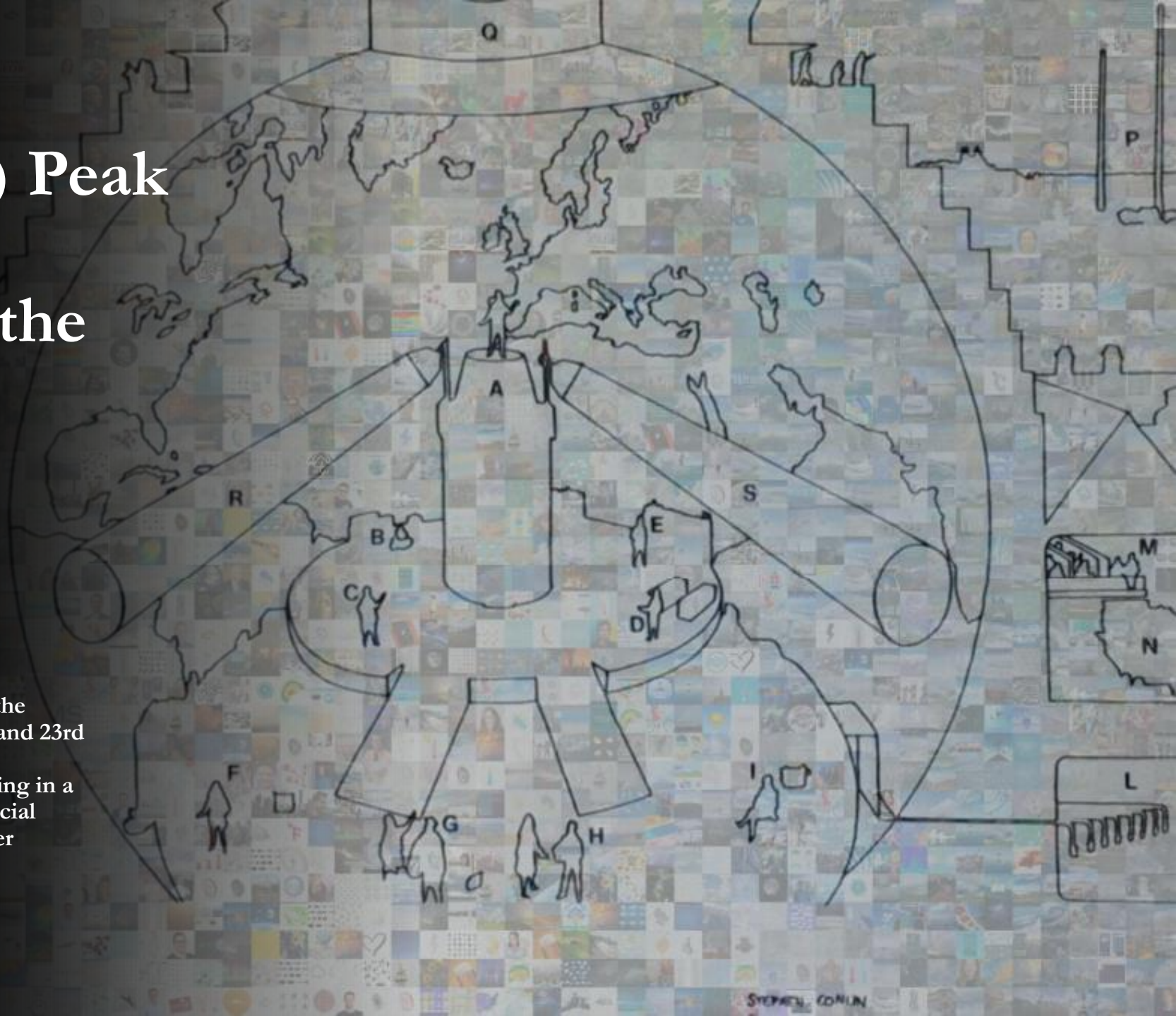


J8.2 - A (Unique) Peak into the Future: Prognosticating the Meteorological Landscape

J. Cory Demko

Joint Session with the Second Symposium on the
Future of Weather, Forecasting, and Practice and 23rd
Conference on Artificial Intelligence for
Environmental Science - Joint Session J8 - Living in a
Changing Environment: Applications of Artificial
Intelligence and Machine Learning for Weather
Forecasting



DISCLAIMER!!!

I've been oblivious since December 2009.

Paging the Atmospheric Science Community!

Paging the Atmospheric Science Community!
I've been oblivious since December 2009.

Also, think to yourself, are there any problems, really???

No, only science, progress, guided by the 2nd Law of Thermodynamics...

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WELCOME. COME FEEL THE LOVE

What started as a small family business in 1952 has grown to become an East Coast icon of awesome food, crucial convenience, and killer customer service. Sheetz is still family owned, but today we're a bit bigger with over 460 stores across a six-state footprint including Pennsylvania, Ohio, Virginia, West Virginia, Maryland, and North Carolina.

Our loyal fans, known as Sheetz Freakz, visit us for our huge selection of Made-to-Order food and drinks. With a vast assortment of convenience store essentials, clean rest rooms, and low-priced gasoline, we cover all your road trip needs.



BURGERZ & CHICKEN

CHICKEN SANDWICHES

HOMESTYLE CRISPY,
PREMIUM GRILLED
OR SPICY CRISPY
MADE-TO-ORDER
CAROLINA SLAW
THE BOSS BACON
ATOMIC
TWISTED BRUNCH
THE BIG MOZZ

PREMIUM BURGERS

MADE-TO-ORDER
CAROLINA SLAW
THE BOSS BACON
ATOMIC
TWISTED BRUNCH
THE BIG MOZZ



SHNACKZ & SIDEZ

MAC-N-CHEESE

CHILI MAC-N-CHEESE
REGULAR MAC-N-CHEESE
THREE CHEESE MAC-N-CHEESE

GOURMET PRETZELS

CHEESE FILLED
CINNAMON SUGAR
JALAPEÑO CHEESE
PLAIN (NO SALT)
SALTED

SHWINGZ

FULL OR HALF DOZEN
NAKED
BUFFALO
BBQ GLAZE
SPICY ASIAN
OLD FAY
BOOM BOOM
GARLIC PARMESAN

FRYZS & RINGS

CHEESE FRYZ PLATTER
CHILI CHEESE FRYZ PLATTER
GARLIC FRYZ PLATTER
GRANDE FRYZ PLATTER
SHMOKEHOUSE FRYZ PLATTER
CHEESE FRYZ SIDE ORDER
FRYZ BAG/BUCKET/CUP
ONION RINGZ BAG/BUCKET/CUP

SLIDERZ

MEATBALL SLIDERZ
BURGER SLIDERZ
CRISPY CHICKEN SLIDERZ

SHNACK WRAPZ

BURGER SHNACK WRAP
CRISPY CHICKEN SHNACK WRAP



FRIED APPS

FRIED PICKLES
JALAPEÑO POPPERS
MAC-N-CHEESE BITES
MOZZARELLA STICKS
POPCORN CHICKEN
SAMPLER PLATTER
Jalapeño poppers, Mac-n-cheese bites,
Mozzarella sticks

CHICKEN STRIPZ

3PC 5PC

NACHOS

NACHOS & CHEESE
NACHOS GRANDE
SIDE ORDER (CHEESE)

OTHERS

COLESLAW
HARD BOILED EGGS
RICE & BEANS

BURRITOS

BURRITOS

GRILLED CHICKEN
VEGETARIAN
STEAK
PULLED PORK



SUBZ & DOGZ

HOT SUBS

GRILLED CHICKEN
•Made-to-order •Southwest
•Smokehouse •Cordon Bleu
MEATBALL
PEPPERONI
PULLED PORK
STEAK SUB
•Made-to-order •Southwest
•Smokehouse
PRETZEL MELTZ
•Bacon •Country Club
•Ham •Roast Beef •Turkey
FLAT BREAD
•California Turkey •Cuban
•Grilled Cheese

COLD SUBS

BLT
CHEESE
CHICKEN SALAD
CLUB COMBO
DELI
HAM
ITALIAN
TUNA SALAD

ROAST BEEF
TURKEY SUB
VEGGIE

HOTDOGZ

HOTDOG MADE TO ORDER
JALAPEÑO CHEDDAR DOG



PIZZA

PIZZA BY THE SLICE

SIGNATURE PIZZAS

BUFFALO CHICKEN
MEAT OVERLOAD
PHILLY CHEESESTEAK
VEGGIE
MADE-TO-ORDER



CHEESE OR PEPPERONI

PEPPEROLIS

SALADZ & WRAPZ

SALADZ

CHICKEN CAESAR
TACO
CHIEF (HAM & TURKEY)
CRISPY CHICKEN
GARDEN
GRILLED CHICKEN
STEAK

WRAPZ

GRILLED CHICKEN (HOT)
STEAK (HOT)
BLT
CHICKEN SALAD
CLUB COMBO
DELI
ITALIAN
HAM
TUNA SALAD
TURKEY
VEGGIE
ROAST BEEF
CHICKEN CAESAR

YOU'RE HUNGRY?

Never fear! At Sheetz, we utilize cutting edge Central Pennsylvanian technology to allow you to order your food ELECTRONICALLY through a touchscreen. Browse our extensive menu and check off your custom options with the touch of a finger. Quick. Easy. Nonverbal. Nothing wrong with that.

You like pickles or hate em? You want ketchup on everything? No problem. Need a hotdog STAT with sauerkraut, jalapenos, ketchup, mayonnaise and onions? You got it. This amazing system has a name, and that name is **MADE-TO-ORDER!** or **M•T•O** as we call it for short. Get exactly what you want, when you want it- 24/7. That's pretty convenient.

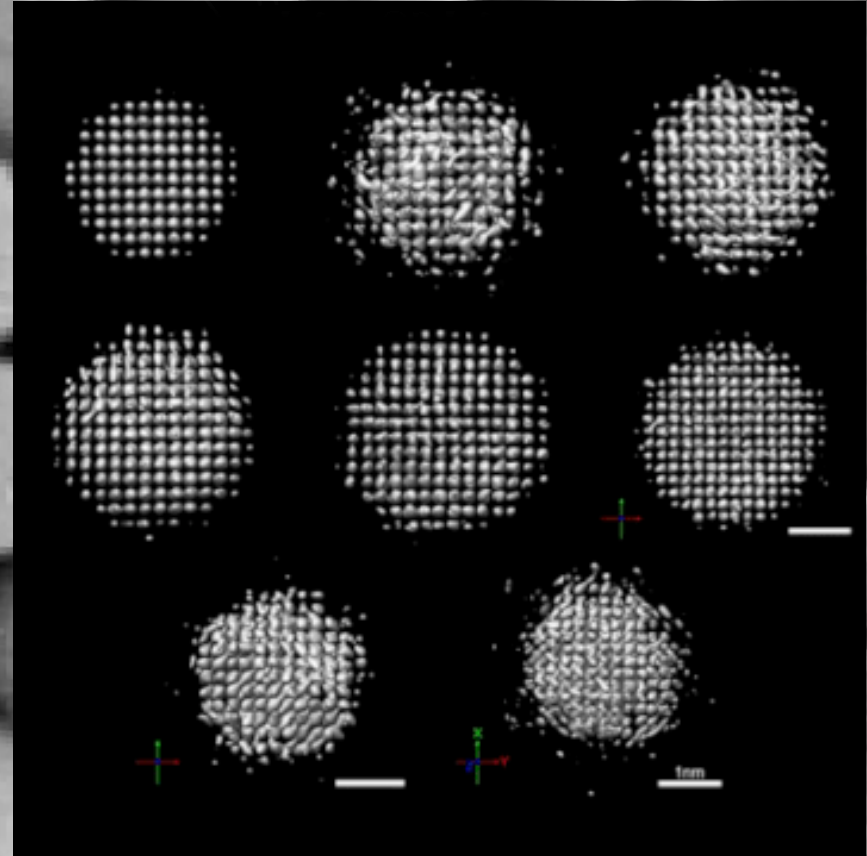
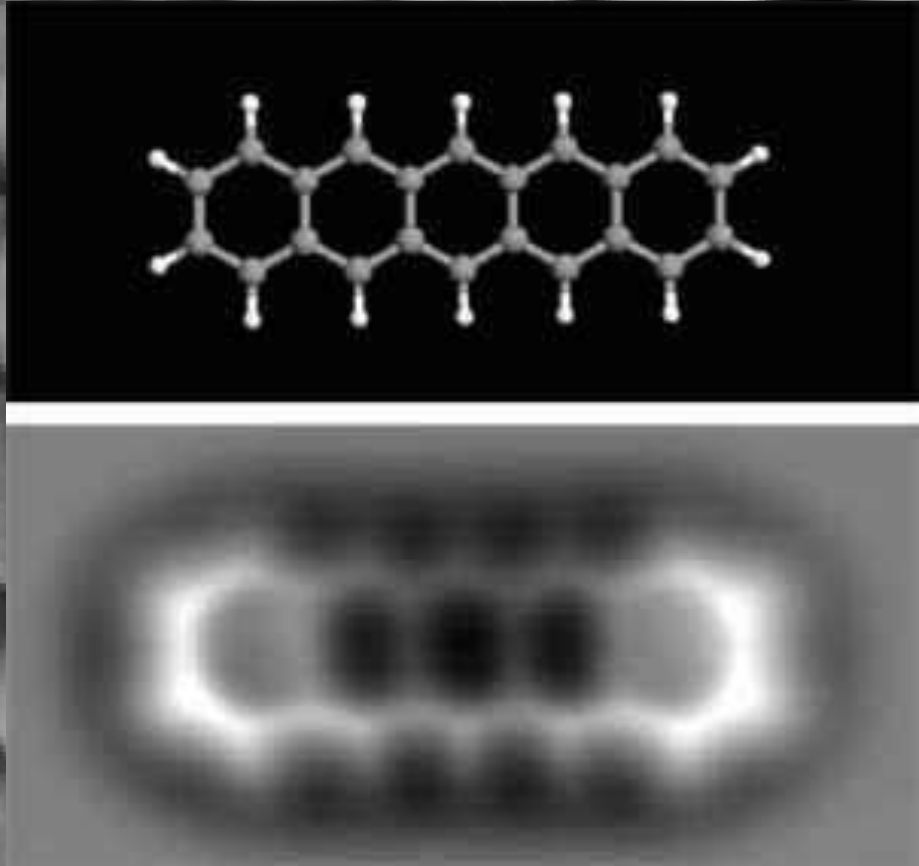


1. ORDER YOUR FOOD ON THE TOUCHSCREEN.
2. GRAB YOUR RECEIPT.
3. TAKE YOUR RECEIPT TO THE CASH REGISTER & PAY FOR YOUR MEAL.
4. PICK UP YOUR ORDER WHEN IT'S READY.

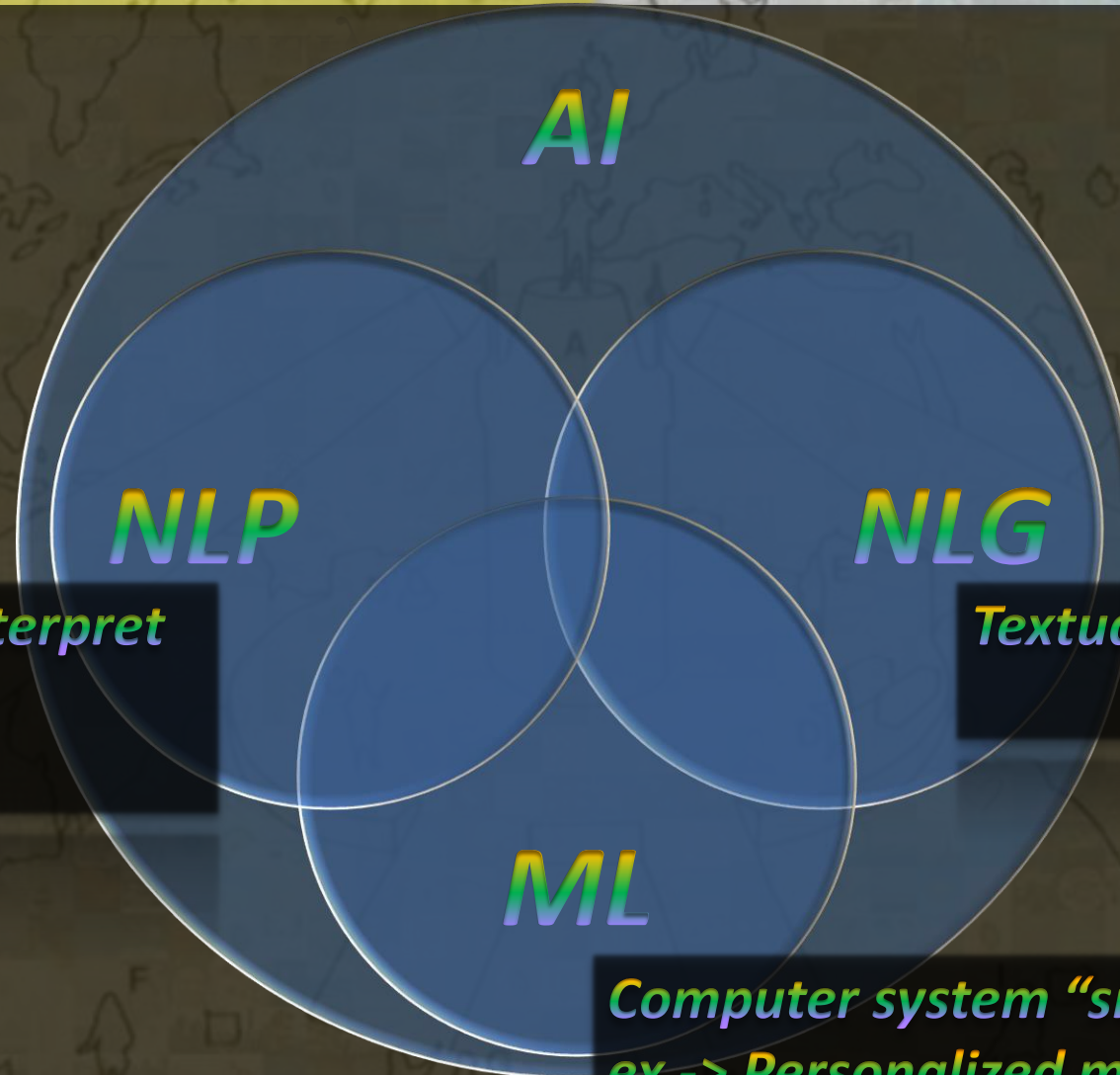


$$S = -k_B \sum_i p_i \ln p_i$$

$$H = - \sum_i p_i \log_b p_i$$



So, What the Heck is AI Anyway?



*Understand and Interpret
Human Language
NLP -> "Reads"*

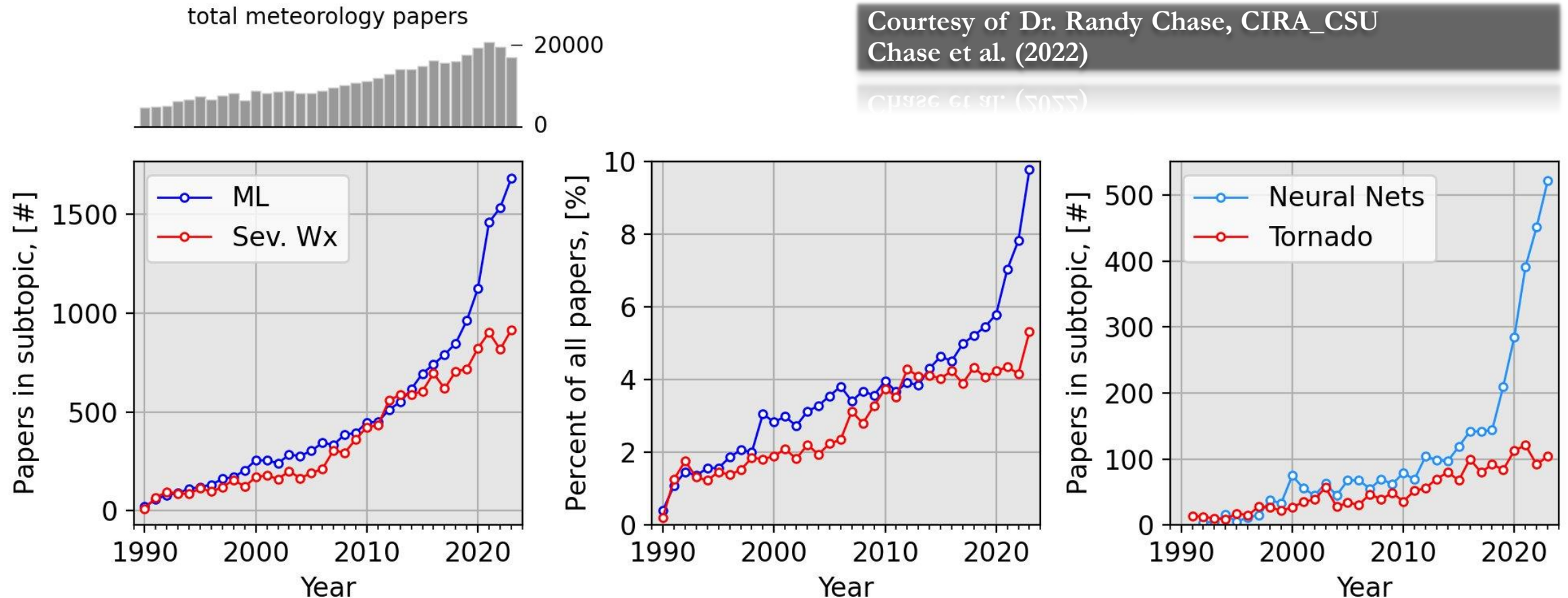
*Textual content production
NLG -> "Writes"*

*Computer system "smart"
ex -> Personalized marketing, image
recognition, FMV exploitation, etc...*

- Atmospheric science begins researching Data Science applications, mainly ML techniques
- Lagging behind but catching up are CV applications -> mainly from complexity

Courtesy of Dr. Randy Chase, CIRA_CSU
Chase et al. (2022)

Chase et al. (2022)



- What If(s) (and again maybe these have already begun)

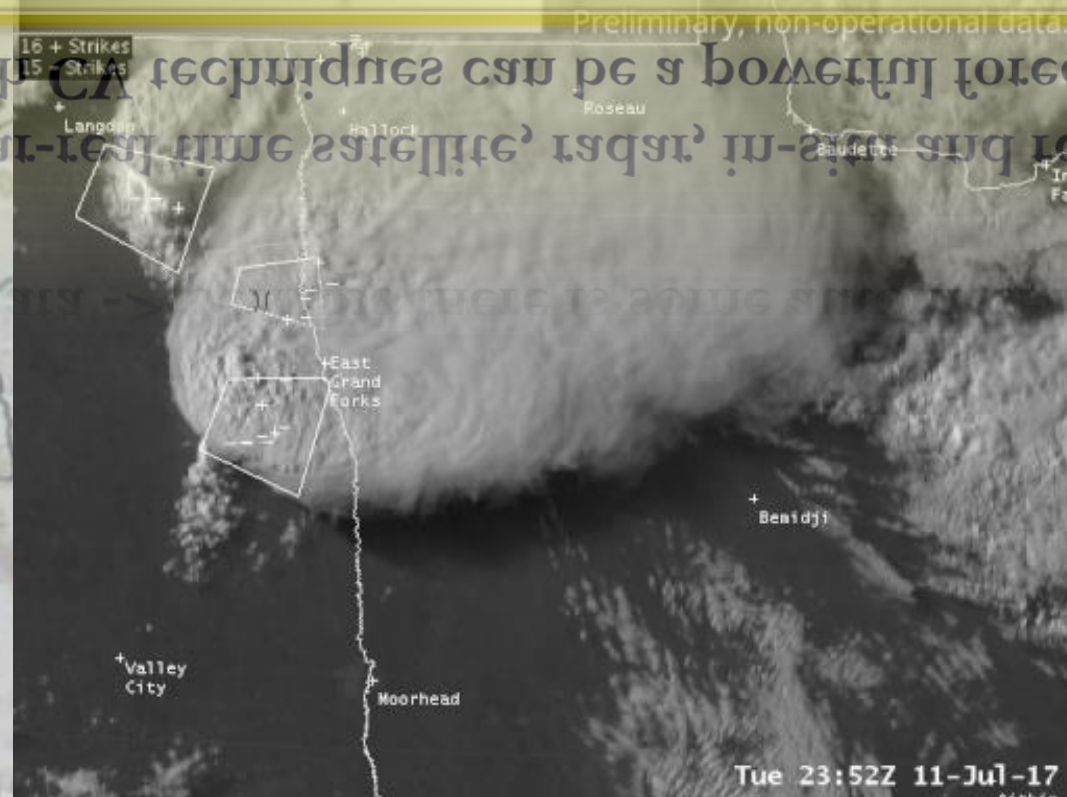
- NWP coupled with other disciplines (i.e., other Earth Science based -> agricultural, marine, biological, chemistry, etc..., to non-science based -> transportation and communication networks, social media, etc..)
 - Those deemed higher priority and/or more appropriately, greater correlated/impact
 - Also, science will dictate what needs assimilated and incorporated into modeling system vice applied on output.

modeling system vice applied on output.

Also, science will dictate what needs assimilated and incorporated into correlated/impact

Those deemed higher priority and/or more appropriately, greater

- What If CV integrates into meteorological/NWP processes?
 - What does the meteorological community have plenty of? -> Images -> Primed for CV
 - Need labeled data -> perhaps there is some automated labeling techniques in development?
 - Combining near-real time satellite, radar, in-situ and remote sensed, and model data with CV techniques can be a powerful forecasting tool???



- **What If NLP integrates with/into NWP**
 - Coupled with assimilation, Navier Stokes, or end user applications
 - NWS has been integrating NLG techniques for years (i.e., 3D grids to text-based forecast)
 - What if NWS, and other weather consumers, interrogate NWP output akin to prompting questions to ChatGPT? -> this would be via post processing...
 - But could we interrogate NWP output via assimilation/Navier Stokes?
 - How

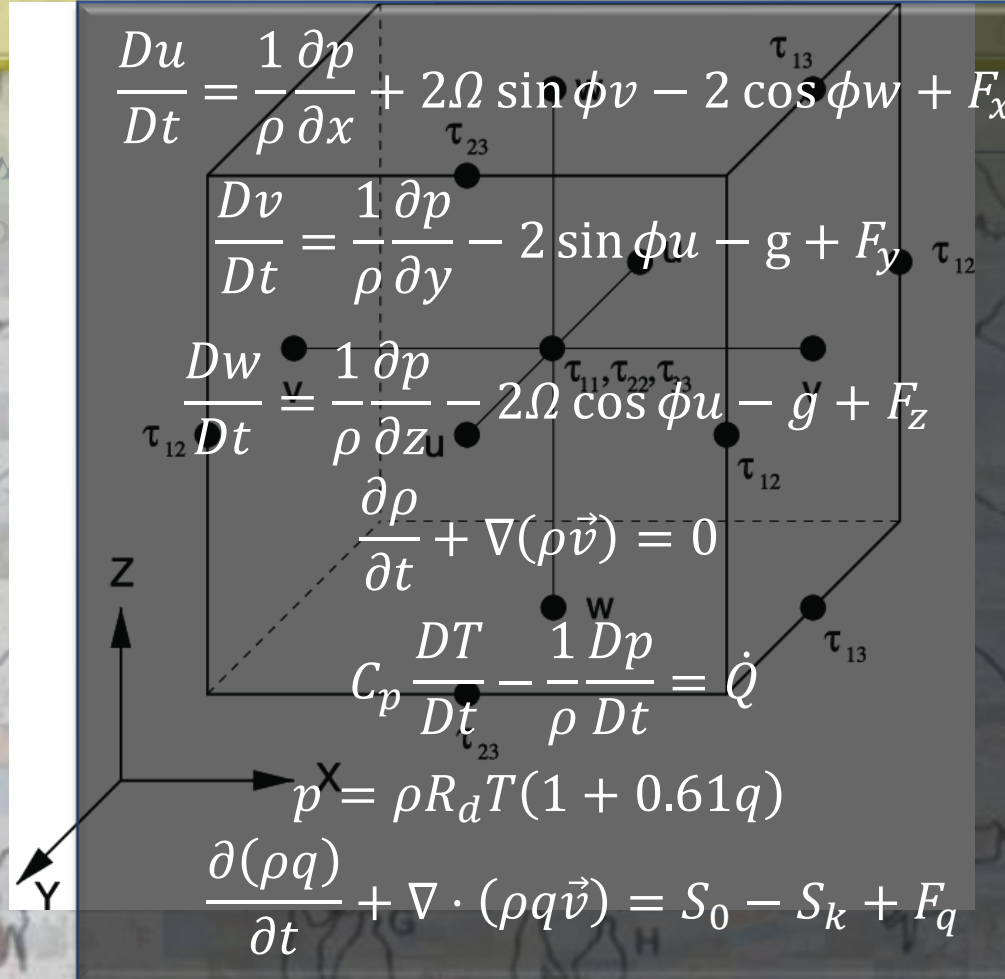


- What If Quantum Computing assists/integrates into NWP processes?
 - Encode the equations of motion, data assimilation, etc... into quantum states
 - This sounds like a fun random Tuesday ☺
 - Map everything onto quantum algorithms and quantum gates
 - Hybrid approach will more than likely be the first iteration

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- Map everything onto quantum algorithms and quantum gates

- What If Treating Non-Traditional Information as Fluids...i.e., Integrating Information Theory into Fluid Dynamics

- Everything is probabilistic related with everything and given an adequate scientific and mathematical framework...



$$\frac{Du}{Dt} = \frac{1}{\rho} \frac{\partial p}{\partial x} + 2\Omega \sin \phi v - 2 \cos \phi w + F_x$$

$$\frac{Dv}{Dt} = \frac{1}{\rho} \frac{\partial p}{\partial y} - 2 \sin \phi u - g + F_y$$

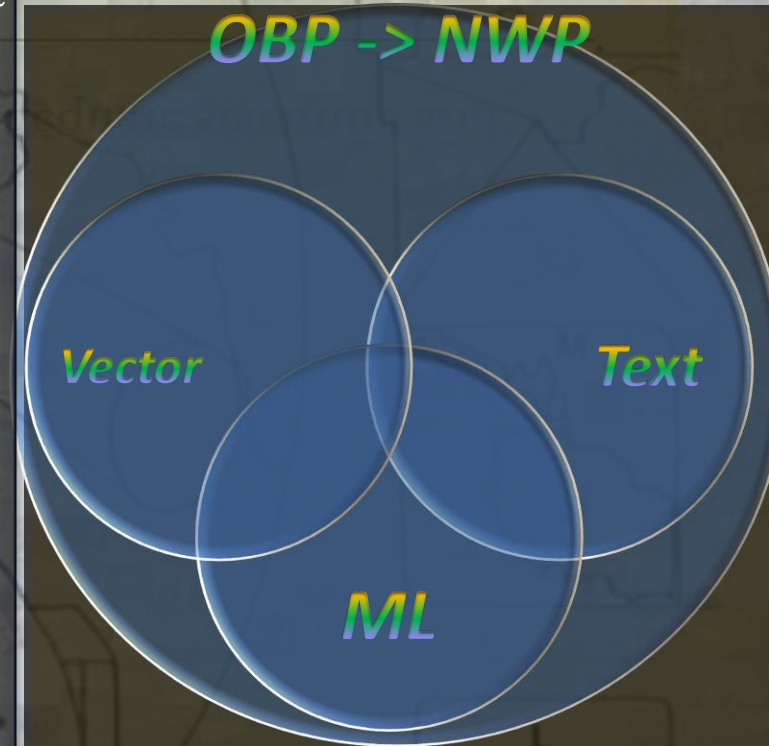
$$\frac{Dw}{Dt} = \frac{1}{\rho} \frac{\partial p}{\partial z} - 2\Omega \cos \phi u - g + F_z$$

$$\frac{\partial \rho}{\partial t} + \nabla(\rho \vec{v}) = 0$$

$$C_p \frac{DT}{Dt} - \frac{1}{\rho} \frac{Dp}{Dt} = \dot{Q}$$

$$p^x = \rho R_d T (1 + 0.61 q)$$

$$\frac{\partial(\rho q)}{\partial t} + \nabla \cdot (\rho q \vec{v}) = S_0 - S_k + F_q$$



- So where are we all headed...
 - Earth Science Community needs to/continues being the exemplar community on numerical modeling/forecasting processes
 - Integration of responsible AI (which will include ML/CV/NLP)
 - Integration of non-traditional data sources into NWP
 - Integration of Information Theory into NWP (or NWP into Information Theory)
 - Direct communication with NWP with smart devices/other networks (i.e., NWP with transportation networks, personal homes, businesses, etc..., making weather forecasting ubiquitous)
 - NWP will morph into NHSM (Numerical Human and Societal Modeling)
 - Greater need for creating/developing/sustaining other planetary climatologies, NWP

climatologies, NWP

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