How Does Climate Change Induced Electricity Market Volatility Impact You?

Thomas Schmitz, Energy Advisor, AbsoluteClimo LLC

Battery Asset Management Summit Australia August 26th 2025

What is Climate?
A Box of Statistics?
Weather?

Thomas Schmitz, Energy Advisor, AbsoluteClimo LLC

AbsoluteClimo Climate Model Primer

- Climate and weather: often confused and conflated.
- Climate is not just statistical, it is also a **non-linear dynamic** system.
- Climate is also the accumulation of weather over periods of **1 month** or longer.
- Climate: the tails are getting fatter (tail risk / tail “opportunity”).
- Climate system drives weather (volatility).
- Weather records spanning 30 years are compiled into a climate base period (climatology). The 30-year base period serves as a foundation to calculate averages (normal), anomalies (above or below normal) and provides a useable frame of reference of what to normally expect.
- To capture the **dynamical effects** of Earth's climate, the 30-year base period is updated and shifted forward incrementally once a decade — standard practice.

Climate change scenarios are not forecasts.

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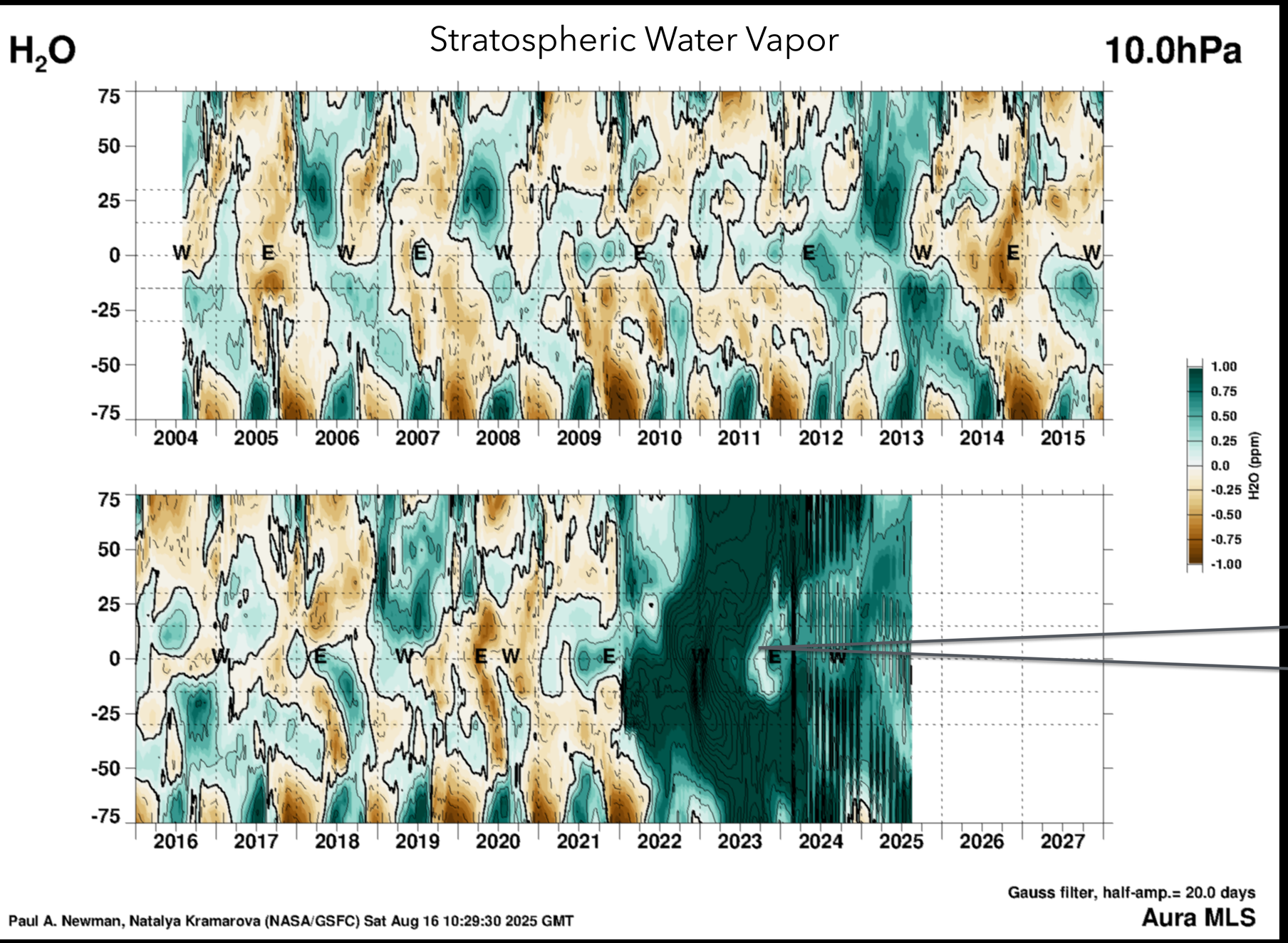
Climate (Change)
&
Tail Risks



January 2022 Hunga Tonga-Hunga Ha'apai eruption

Water vapor is a greenhouse gas!

A large amount of water vapor was placed into the stratosphere by the massive Tonga eruption in 2022 (a shallow submarine volcano), with impacts to the climate system and therefore also weather in 2023-2024. The stratospheric water vapor (positive) anomaly lingered into 2024 before starting to dissipate, as depicted on the chart to the left in very dark shades of green starting in 2022 and expanding latitudinally across both hemispheres. The chart shows time on the x-axes and latitude on the y-axes..

Consequences: Enhanced Warming e.g., Australia 2023 Winter Warmest On Record, 2024 Second Warmest Winter.

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Human influence has warmed the climate at a rate that is unprecedented in at least the last 2000 years

ipcc

INTERGOVERNMENTAL PANEL ON climate change

Climate Change 2021

Working Group I contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change

Climate change model instability:

- Coupled Model Intercomparison Project (CMIP):
- Version 6 semi-worse off than version 5!

SCIENCE

Climate Scientists Encounter Limits of Computer Models, Bedeviling Policy

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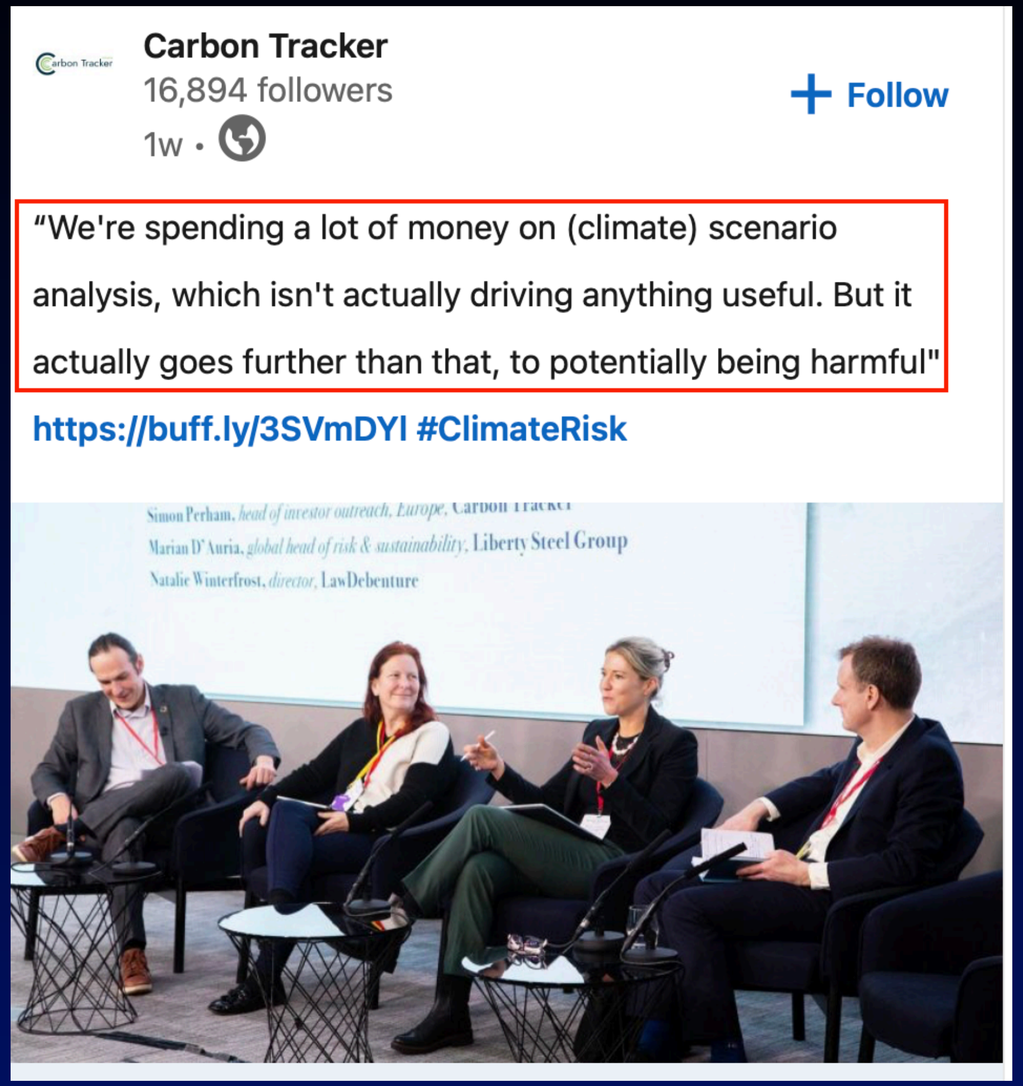
By Robert Lee Hotz | Photographs by Theo Stroomer for The Wall Street Journal
Feb. 6, 2022 10:10 am ET

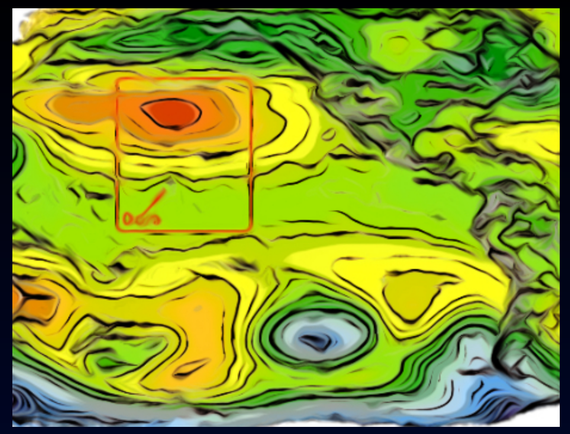


Investors: Scenarios not fit for purpose.

"We're spending a lot of money on (climate) scenario analysis, which isn't actually driving anything useful. But it actually goes further than that, to potentially being harmful."

Carbon Tracker February 2024

Hawaiian Electric
Tales of the tails



Climate change (anthropogenic global warming) limitations of “what if” scenarios, scores

Hawaiian Electric Recently Caught By Surprise Twice!

1. December 2021 Emergency Flooding -> Honolulu business district power outage (Iwilei substation)
2. August 2023 Lahaina, Maui Catastrophic Wildfires -> Liability -> $ Asset Divestiture

- Climate change scenarios / scores do not well resolve to Maui scale winds, humidity, fire
- There are numerous climate elements besides just emissions, temperatures
- Global, national policy change guesswork is … just guesswork (50+ years from now)
- *“Should we relocate a road? When, where, how much $?”*
- IPCC/NGFS/gov climate models do not resolve / forecast streams, rivers, Great Lakes

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Hawai‘i Early August 2023 Wildfires
FEROCIOUS DOWNSLOPE WIND STORM
NEVER SEEN BEFORE IN HAWAII
A BLACK SWAN & RED HERRING

In November, HEI lifted a warning about its ability to remain in business, stating that a recent capital raise helped mitigate the concerns.

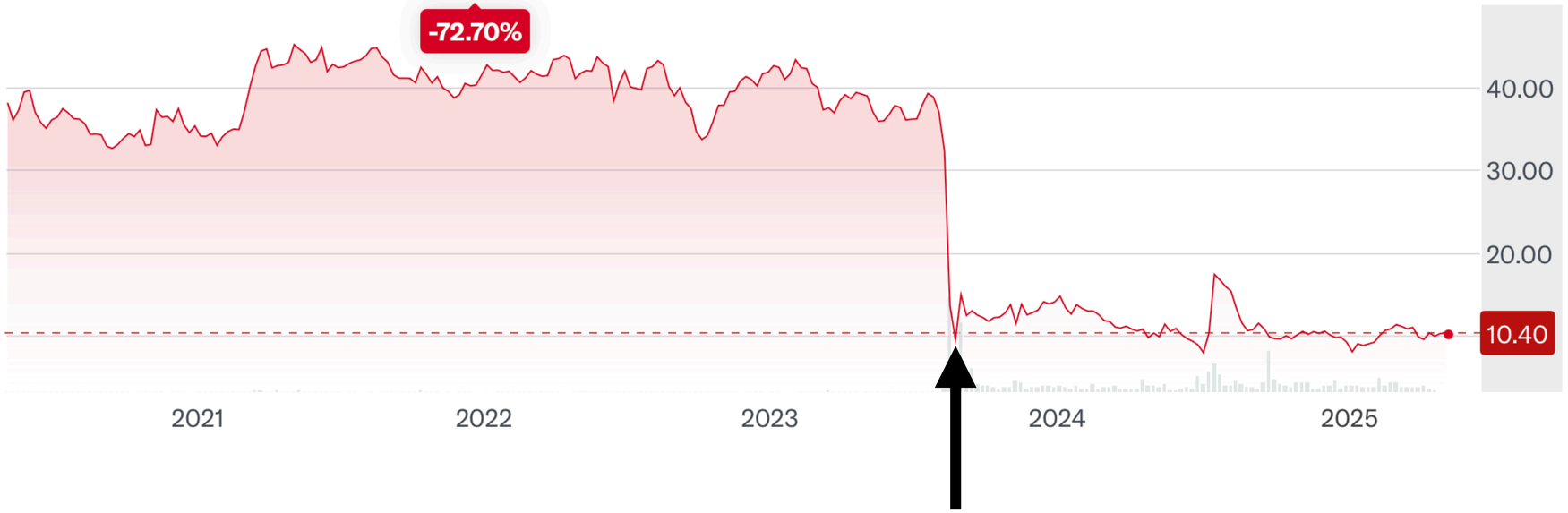
NYSE - Nasdaq Real Time Price • USD

Hawaiian Electric Industries, Inc. (HE) ☆ Follow + Add holdings

10.40 -0.10 (-0.90%)

As of 12:13:13 PM EDT. Market Open.

1D 5D 1M 6M YTD 1Y 5Y All Key Events Mountain Advanced Chart



Aug. 25 2023

Reuters My News

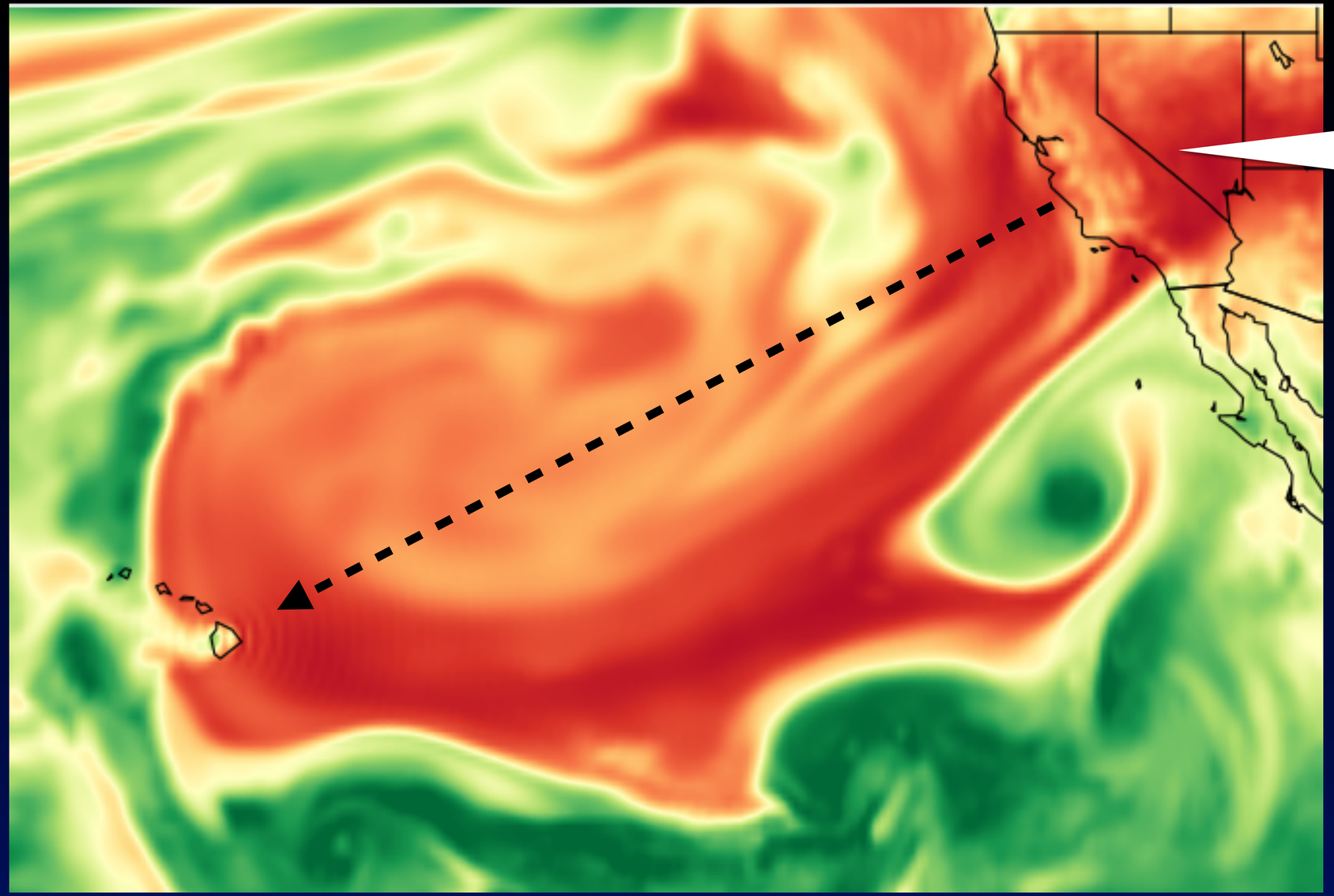
Hawaiian Electric sells 90% interest in American Savings Bank

By **Reuters**

January 1, 2025 2:57 AM GMT+7 · Updated 4 months ago

Dec 31 (Reuters) - Hawaiian Electric Industries (HEI) (HE.N) said on Tuesday it had closed the deal to sell a 90.1% stake in its unit American Savings Bank (ASB), helping the company raise funds for the deadly 2023 Maui wildfire settlement.

The deal values the bank at $450 million, with the investors purchasing 90.1% of ASB common stock for a cash consideration of $405 million.



Key Meteorological Driver

Non-tropical weather consisting of **very dry air** originating in U.S. West **surged** toward Hawaii in a layer ≈ 3,000 to 10,000 feet (≈ 914 to 3048 meters) aloft.

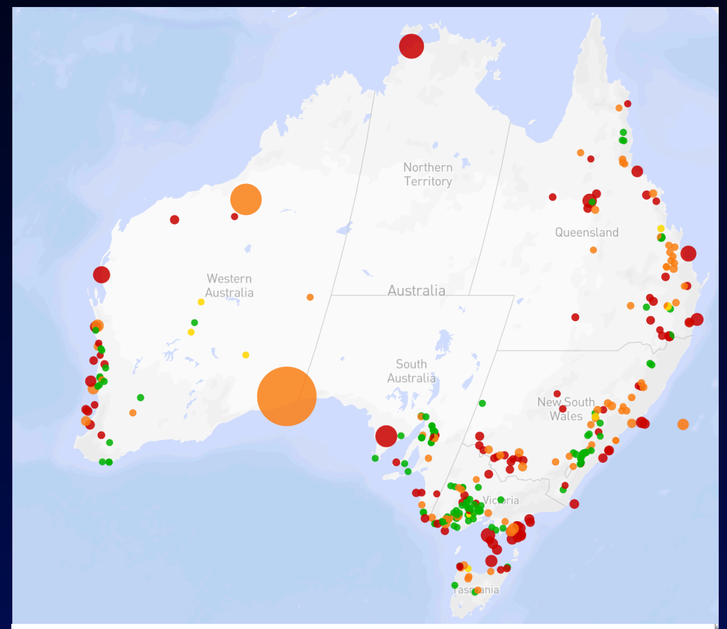
Trouble Really Starts Aug. 7th 2023:
Arrival of **leading punch** of **very dry air**, **mixed & sank** (**dry air is heavier**) **enhancing winds off mountains**

Dry sinking air enhanced by **large**, **anomalously strong** North Pacific High pressure system which had rapidly developed.

Factors from hurricane Dora were negligible.

Wind at 100m

(not so simple) wind at layers: surface / 10m, 50m,100m



TOTAL WIND FARM PHASES SELECTED 27,135

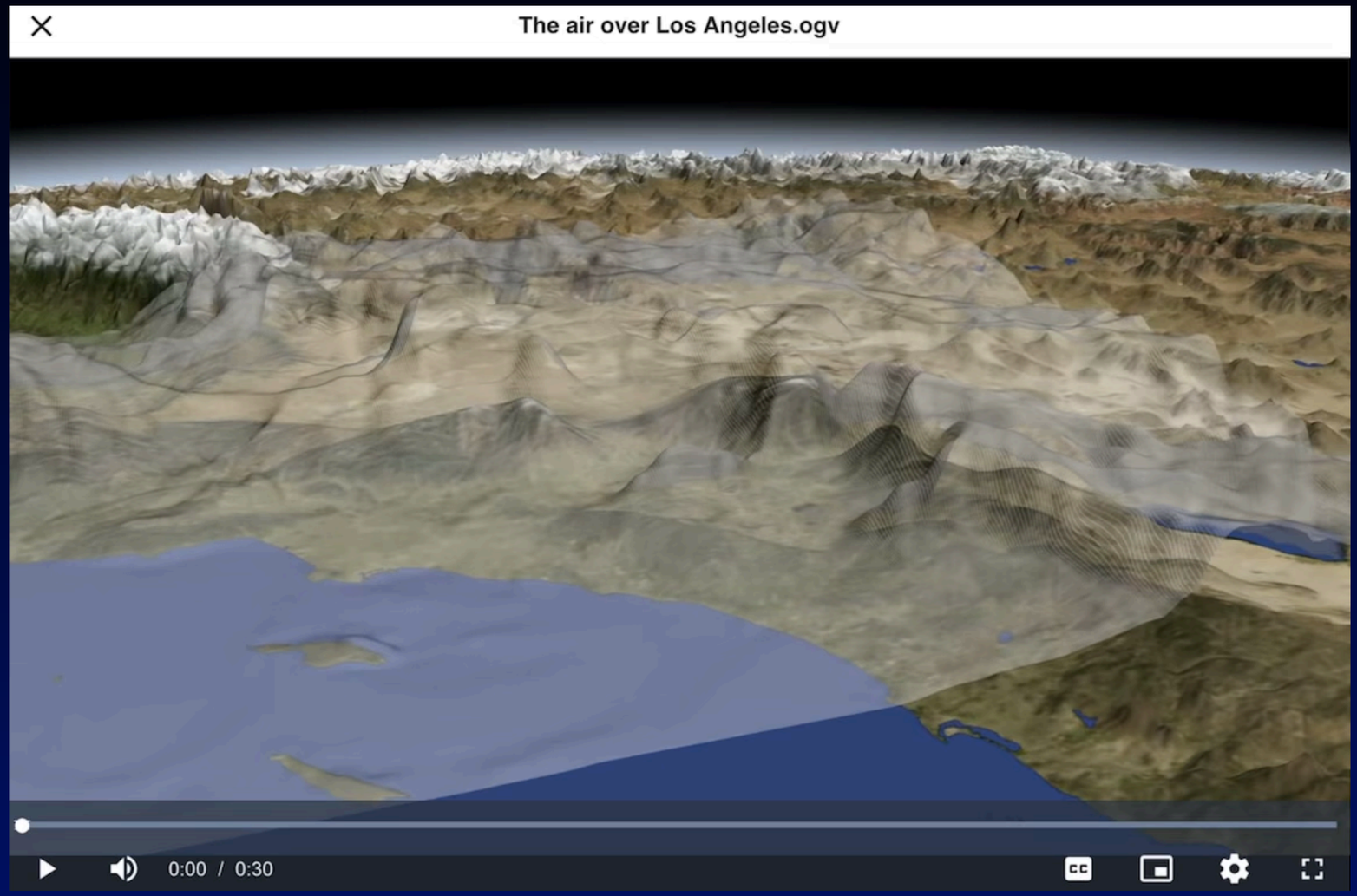
☑ ● Operating	18340
☑ ● Announced	1661
☑ ● Construction	1441
☑ ● Pre-Construction	5693

Source: Global Energy Monitor

Planetary Boundary Layer

Can Impact Wind at Hub Height

- Planetary Boundary Layer Meteorology
  - Lowest part of Earth's atmosphere;
  - Height above Earth's surface expands and contracts, variable (typical max ≈2000 m);
  - Day / Night changes;
  - **Wind Impacts / Wind volatility:**
    - At night above layer wind remains mixed and flowing;
    - At night below layer with temperature inversions wind less mixed / less flowing (air cools and calms near the surface);
    - Low pressure: tends to be windier, mixed layer even at night can be at the surface;
    - High pressure: tends to bring cooler weather, calming winds especially night;
    - Boundary Layer can be deeper (higher above the surface) with big cool high pressure systems and light winds can impact **wind turbine generation**.
    - Boundary layer meteorology played a key role in **ferocious** downslope wind: Maui catastrophic wildfires August 2023;

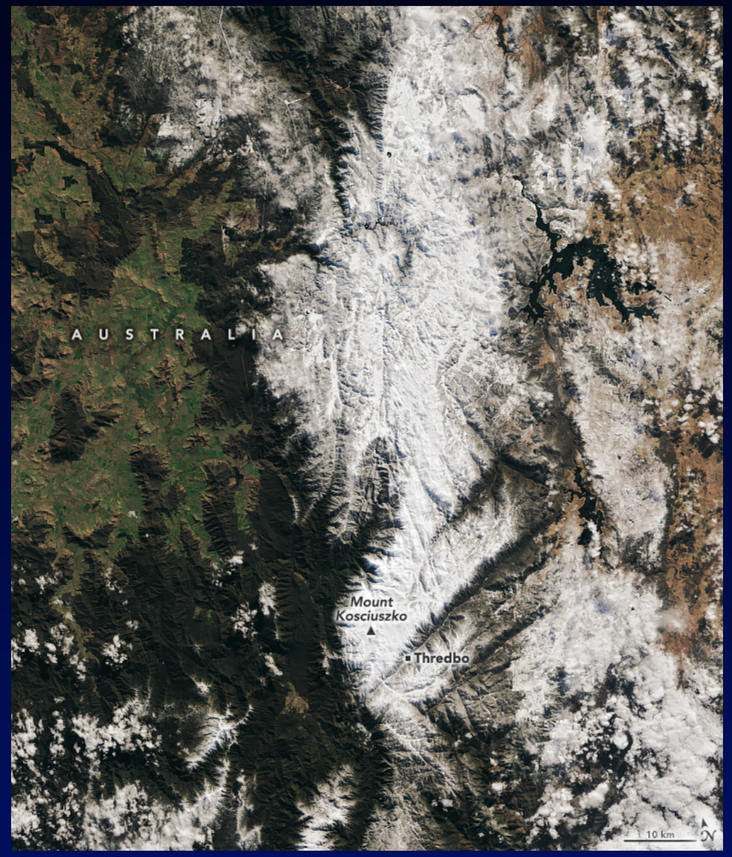


Animated video source: NASA

Hydro

not so simple

Australia's Snowy Mountains 28 July 2024



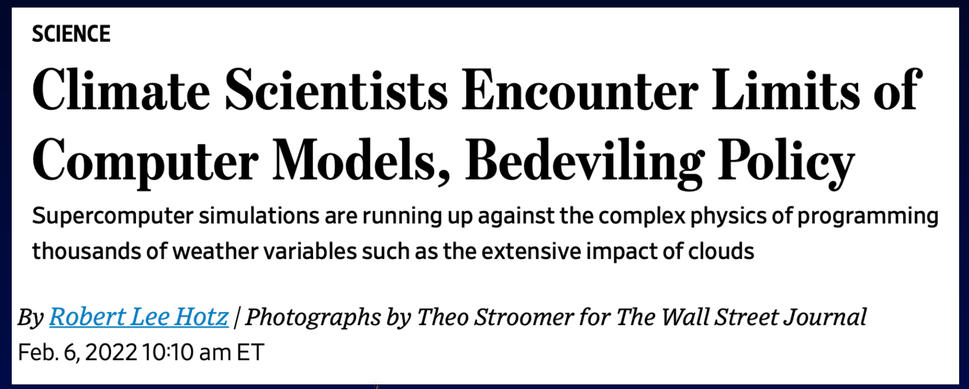
Source: NASA

- Precipitation Accumulation (over time: months, seasons, years)
- Snowfall Accumulation
- Snow Water Content
- Snow Melt (rate)
- Potential Evaporation
- Surface Runoff
- Sub-surface (Baseflow / Interflow)
- Stream / River Flows
- Soil Conditions (Moisture, Temperature)
- Droughts (including flash droughts)
- Influenced by seas, oceanic conditions
- Inflow tail risks / opportunities -> $ assessment and hedging

Solar Irradiance

also not so simple

"You solve one problem and create another."



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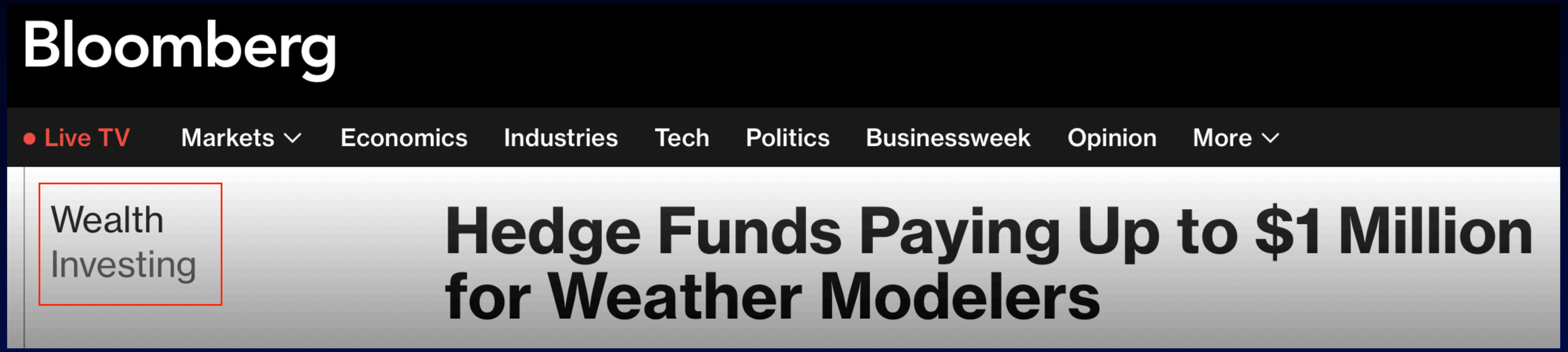
"If you don't get clouds right, everything is out of whack."

- Clouds: at different layers (low, middle, high)
- Clouds: influenced by the Planetary Boundary Layer
- Clouds are very difficult to model, resolve, predict
- Clouds: can be highly local, small scale
- Clouds: impact surface temperatures
- Solar irradiance: obviously limited (unavailable at night)
- Other factors: haze
- Other factors: aerosols, pollution, dust, bushfire smoke
- Other factors: snowfall accumulating on solar panels
- Climate Change Scenario Models (IPCC): forget about it

Temperature

battery cycles anyone?

- Increased variance or mostly just warming (GHG warming)?
- Even or uneven distribution / heating (by latitude)?
- Seasonal climate anomalies drive -> weather volatility
- Influenced by oceanic conditions
- Oceans are the largest carbon sinks!
- Temperature extremes: what's your tolerance?
- Temperature daily maximum?
- Temperature daily minimum?
- Temperature daily mean?
- Clouds
- Hydro / precipitation
- Planetary Boundary Layer
- Battery cycling anyone?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Hedge Funds Paying Up to $1 Million for Weather Modelers

AbsoluteClimo LLC

Est. 2016

Our mission is bettering life on Earth (◉) by helping people impacted by climate variability and change.

Contact: thomas@absoluteclimo.com