tomorrow.io

How Industry Innovation is Accelerating Advances in Weather Forecasting

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January 2021

The Global Leader in Weather Technology

Partnering With The Brands People Trust Most

AeroMexico · Azul · DELTA · DRIZLY · evergy · facebook · Ford

FOX Sports · nationalgrid · IndiGrid · INMOBI · [intact] · ITS ConGlobal · jetBlue

KAJIMA · PATRIOTS · PORSCHE · Rappi · SB Energy · Denny's · Shipt

SWIGGY · Uber · UNITED · U.S. AIR FORCE · USTA - US OPEN · VIA · NASA · zomato

Fastest Growing Company in the history of the Weather Technology Industry

Offices

Boston | Bourne | Boulder | Denver
Tel-Aviv | Singapore | Mumbai | Tokyo | Australia

Funding

$200M+

First capital $5M | A $15M
B $60M | C $23M | D $77M

Investors

Canaan · Square Peg · pitango · FONTINALIS PARTNERS

CLEARVISION VENTURES · evergy ventures · jetBlue · SB Energy

nationalgrid · Highline Capital · Ford · STONECOURT CAPITAL

Our Work With the Federal Government

$20M contract from U.S. Air Force to fund development of Tomorrow.io's first four weather radar satellites, with first launches planned for late 2022

Conducting feasibility study for developing an **Urban Air Mobility (UAM) weather testbed** to capture fine-scale phenomena
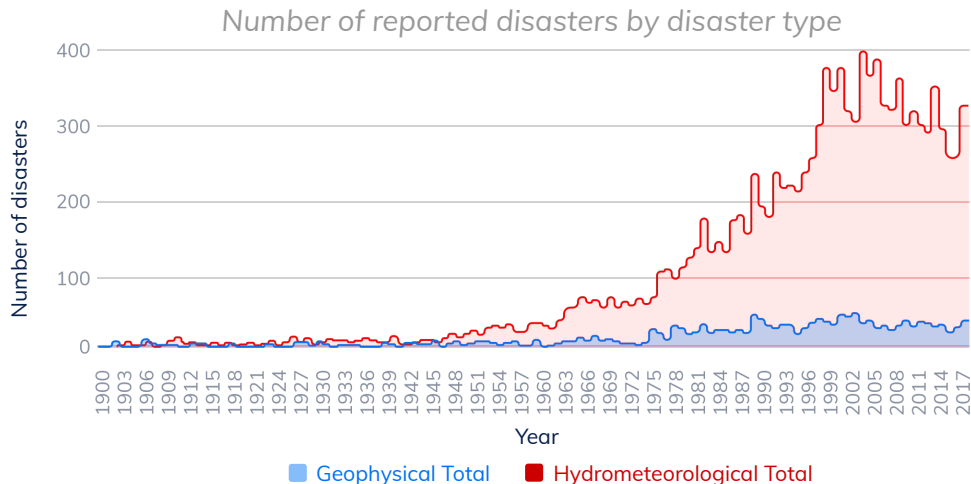
Core teaming partner of Raytheon Technologies, prime contractor for the development of **NOAA's Earth Prediction Innovation Center (EPIC)**
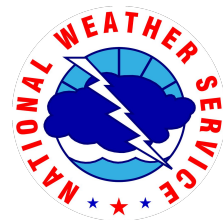
Recognized as **National Weather Service Weather-Ready Nation Ambassador** and trusted partner in delivering life-saving NWS warnings

Climate Security - Our generation's greatest challenge

Number of reported disasters by disaster type

Number of disasters (Y-axis), Year (X-axis)

■ Geophysical Total   ■ Hydrometeorological Total

- **$210 Billion** in weather disaster losses worldwide in 2020, a **record year for hurricanes and wildfires** in U.S.

- 2021 **extreme U.S. weather:** Crippling winter storm, catastrophic flooding & fires, deadliest December tornado outbreak

- U.S. businesses could lose **3.1 million days** of operation and over **$13.5 Billion** from floods in 2022 (source: First Street Foundation)

- **$4 Trillion** worth of assets at risk of climate change by 2030 (source: CDP)

Recognition Growing

Climate change is "the single biggest risk that exists to the economy today."

Former US Treasury Secretary
Henry Paulson

"Climate change is almost invariably the top issue that clients around the world raise with BlackRock. The evidence on climate risk is compelling investors to reassess core assumptions about modern finance."

CEO of BlackRock
Larry Fink

"215 of world's largest public companies identified $970bn in potential losses over 5 years from climate risk."

2018 CDP report

"Investment from venture capital and private equity is pouring into climate tech, reaching US$87.5bn over H2 2020 and H1 2021."

PWC

The Problem

⚠ Most climate mitigation is focused on future, but **weather impacts are happening now**

🚫👁 Much of the world is **blind to weather data**, which hurts forecasts everywhere

❓ Weather data and forecasts are often **confusing and not actionable**


Large gaps in weather observations: Over 5 billion people worldwide live outside of terrestrial radar coverage. (WMO)

The Result

$ The **costs of weather are growing** as the number of extreme events increases

🚫 Businesses and organizations are reactive to weather and **can't link forecasts to expected impact**

🚫 Existing providers typically provide tailored services, **not systems that scale**
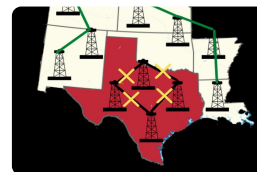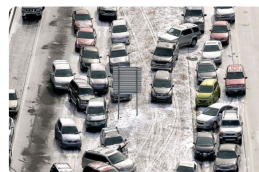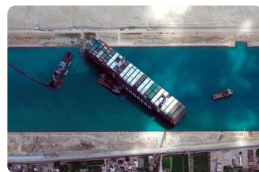
THE JOHNS HOPKINS NEWS-LETTER
(LAKSHAY SOOD)
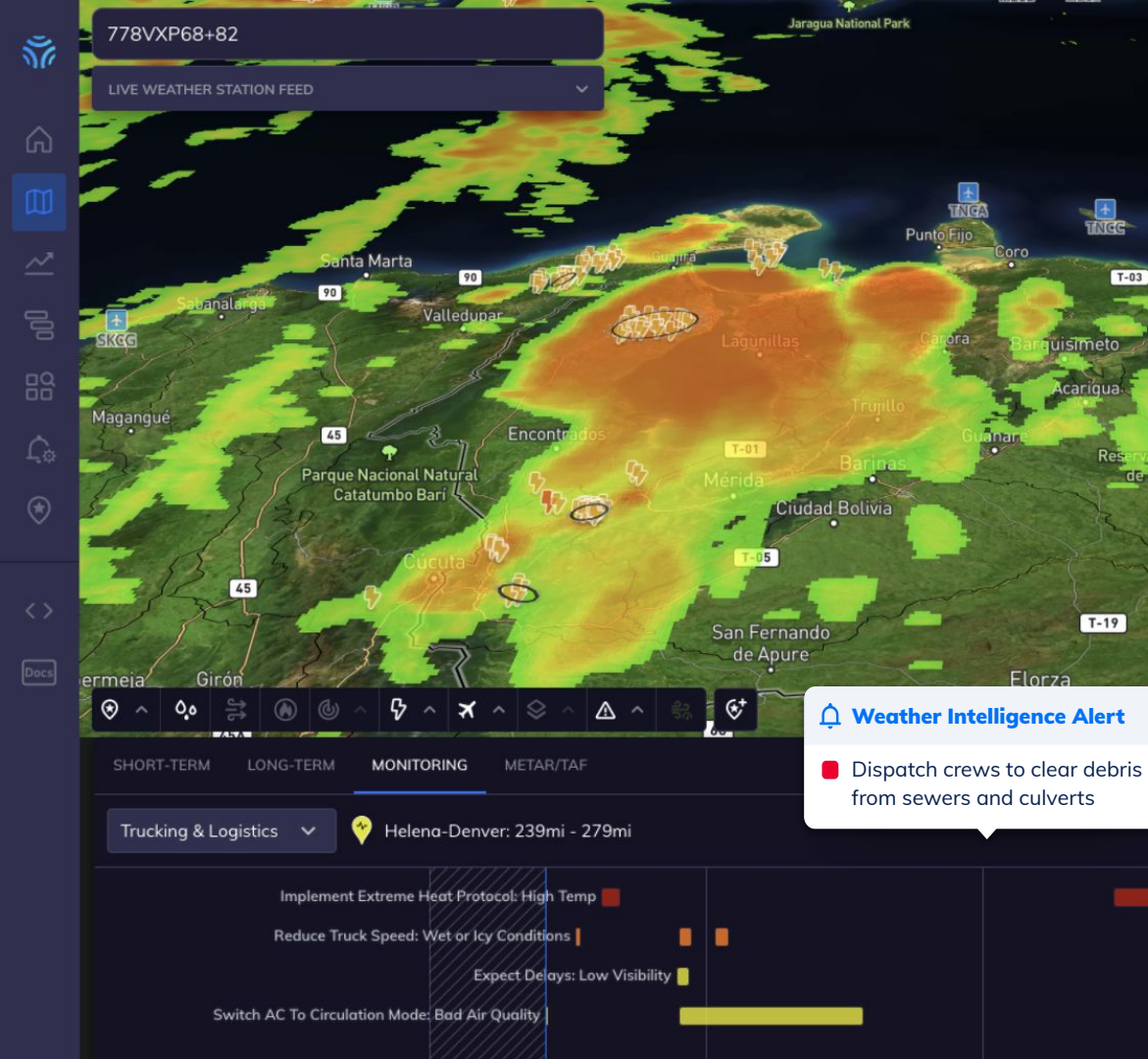
Automate customized action plans with Tomorrow.io's Weather and Climate Security Platform

- **Interactive map and timeline** enables users to visualize and track real-time weather and air quality as well as trends over time

- **Predictive insights dashboard** shows how weather will impact your operations or business and recommends specific actions

- **Autonomously monitor many locations** at once and automatically send alerts to your team to take action ahead of incoming weather

The Weather Value Chain – Today

| Data | Models | Products |

Government ←→
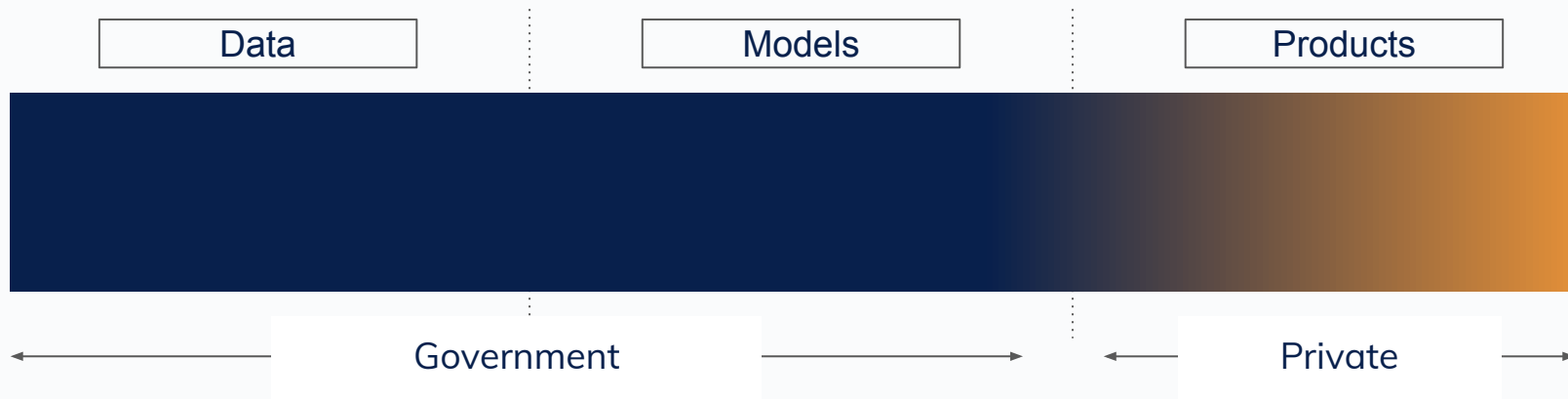
Private ←→

- **Most of the work done by government agencies**

- **Private market focused on repackaging data, few contributions to the backbone**

- **Many problems result from that, main one is massive inequality in data and forecasts**

- **Access to reliable and useful weather/climate information - still a dream for most of world**

Global distribution of terrestrial radars
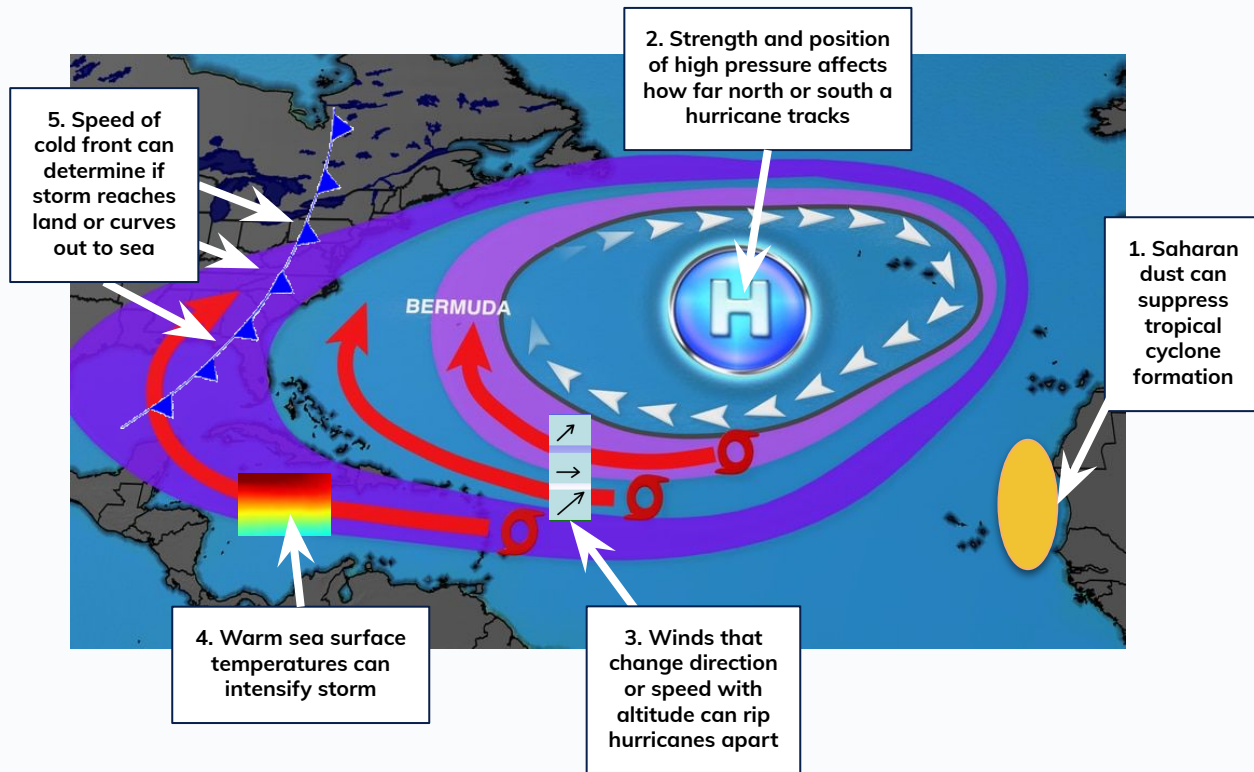Source: WMO

Basic Weather Data Still Not Universal

- More than 5 billion people live outside of radar coverage, with almost no coverage of the oceans

- Precipitation is ranked the top priority out of 152 Earth observations by the Group on Earth Observations

- "One of the greatest forecasting challenges … is the need to improve precipitation forecasts across timescales from weather to climate." -NOAA

- **The only way to close this gap is with a constellation of radar satellites**
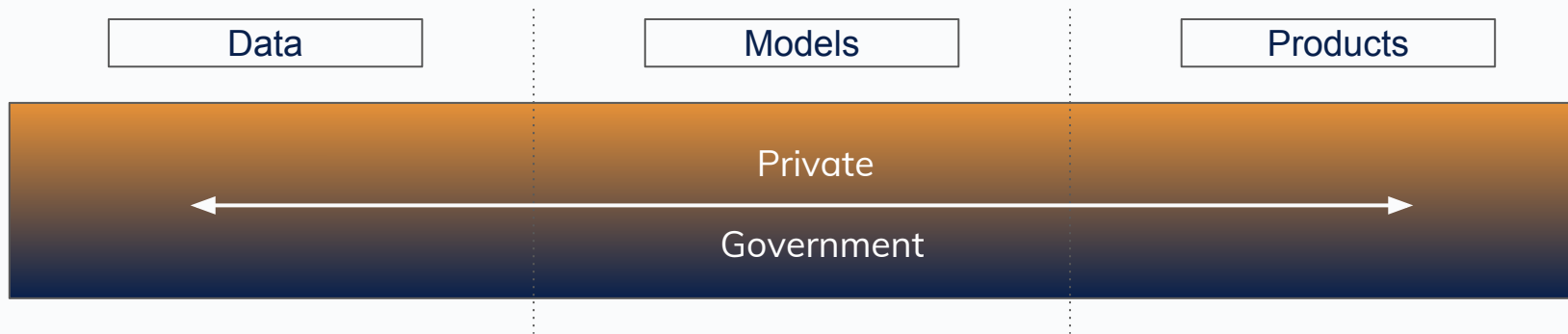
Why do data gaps elsewhere matter to the United States?
Because all local weather forecasts depend on global data

Hurricanes are a perfect example of how conditions spanning thousands of miles can determine if, when and where a storm makes U.S. landfall, and how strong it is.

2. Strength and position of high pressure affects how far north or south a hurricane tracks

5. Speed of cold front can determine if storm reaches land or curves out to sea

1. Saharan dust can suppress tropical cyclone formation

BERMUDA

4. Warm sea surface temperatures can intensify storm

3. Winds that change direction or speed with altitude can rip hurricanes apart

Weather Value Chain 2.0

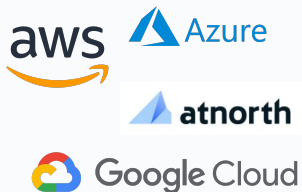| Data | Models | Products |

Private

Government

- **Urgent need for improvement requires "whole-of-nation" approach**

- **Private Market can and should take a much more significant role**

- **Tech enablers (next slide) make it feasible**

- **Industry is innovating across the value chain**

Technology Enablers

"Space 2.0"

Remote sensing costs down by 10^2

Cloud Computing

Mature enough to host large-scale NWP

IOT
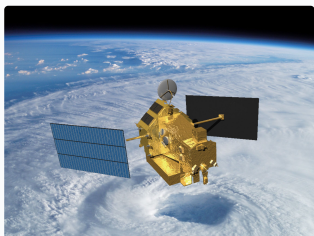
Massive distributed sensing networks

Open Source

Best models no longer hidden behind walls

Building on 25 Years of USG Investment in Spaceborne Radars

Industry innovation enables transition from research to operations

NASA TRMM
1997-2015

NASA GPM
2014- ~2025

NASA RainCube
2018-2021

Tomorrow Space
2022 and beyond

Large Satellites
$1B/unit

Cubesat, Narrow Swath
<$5M/unit

Small Satellites, Wide Swath
<$5M/unit

Single Satellites, Primarily for Research
Low Revisit Rate (2-3 days)

Operational Constellation
**~32 satellites, Hourly Revisit**

To date, no space-based radar mission has achieved revisit rates suitable for operational applications, with no other solution on the horizon

Weather Radar From Space:
# A New Paradigm in Weather and Climate Prediction
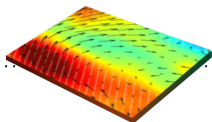
Ocean Surface Winds

- Detect tropical cyclone formation and measure radius of tropical storm winds

- Resolve hurricane inner-core wind structure and detect hurricane winds over ocean

- Improve marine wind/wave warnings, ship routing, and wind energy forecasts
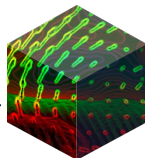
3D Wind Profiles
(inside clouds and rain)

- One of the highest ranked observation priorities to improve weather models

- Better forecasts of daily weather, hurricane track and intensity, and extreme winds

- Improve prediction of El Niño/La Niña and transport of pollutants and trace gases
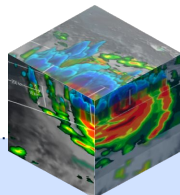
3D Precipitation

- Ranked the highest priority out of 152 parameters by Group on Earth Observations

- New level of understanding and prediction of hurricanes

- Improve flood, landslide, wildfire and drought monitoring and prediction

- Enable equal access to radar and reliable weather forecasts worldwide
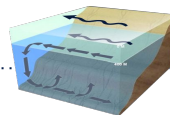
Ocean Surface Currents

- Inform planning for military anti-submarine and amphibious operations

- Reduce ship fuel consumption and enable safe and efficient marine navigation

- Improve search and rescue, hazmat cleanup, and marine ecosystem management
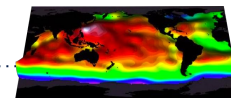
Sea Surface and Wave Height

- Enhanced monitoring and prediction of tides, sea level rise and coastal erosion

- Track ocean heat storage and improve seasonal and individual hurricane forecasts

- Improve ship routing, fisheries management, and coupled ocean-atmosphere models

All data available globally, at high horizontal and vertical resolution, with hourly (avg) revisit

Our Constellation Will Address Numerous Applications

Numerical Weather Prediction
Drive significant improvement in forecast skills for global and regional NWP models

Flood & Landslide Risk
Accurate early warnings of flooding and landslide risk for developed and developing world

Aviation
Global en-route storm detection tracking. Weather radar and nowcast for every airport on earth.

Hurricanes & Typhoons
Improve intensity and trajectory forecast for every hurricane, typhoon and cyclone on earth

Agriculture
Power farming decisions for every farm on earth using the world's most accurate and comprehensive rainfall data.

Wildfire & Drought Risk
Worldwide precipitation data to inform fire danger indices and drought forecasts

Renewables
Storm prediction for assets outside of terrestrial radar coverage; accurate and timely streamflow forecasts.
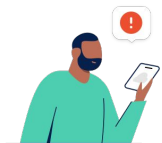
Shipping & Supply Chain
Global en-route storm detection. Ocean wave height and surface winds mapping

TomorrowNow.org

We are invested in a future where everyone has access to the innovations needed to act and adapt to a changing climate.

We work with NGOs, Governments and multinational organizations to build capacity and **solve the hardest challenges of Climate Adaptation.**

TOMORROWNOW LEADS $2M "OSIRIS" GRANT
This project will build the foundations for life changing weather intelligence in Africa.

Billions still without access to early warnings

Delivering Hope with Innovation and Partnerships

> *Although desert locusts have been here since biblical times, recent intense outbreaks can be linked to anthropogenic climate change and the increased frequency of extreme weather events*

Nature Magazine

Partners

WMO

THE WORLD BANK
IBRD • IDA

NCAR
UCAR

Republic of Kenya
Ministry of Agriculture,
Livestock and Fisheries

CGIAR
Platform for
Big Data
in Agriculture

BILL & MELINDA
GATES foundation

MERCY
CORPS

Kenya
Red Cross

Digital Green

WFP

Inspire
Challenge

How USG Can Tap Into Industry Innovation
To Augment (Not Replace) Government Capabilities

- Traditional contracting (government-owned and operated systems)

- Commercial Data Pilots → Programs of Record

- Other Transaction Authority

- Joint Venture Public-Private Partnerships

- Grand challenges (less prescriptive solicitations, let industry innovate path to solution)

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So you can take control