



**A YE MASTERCLASS**

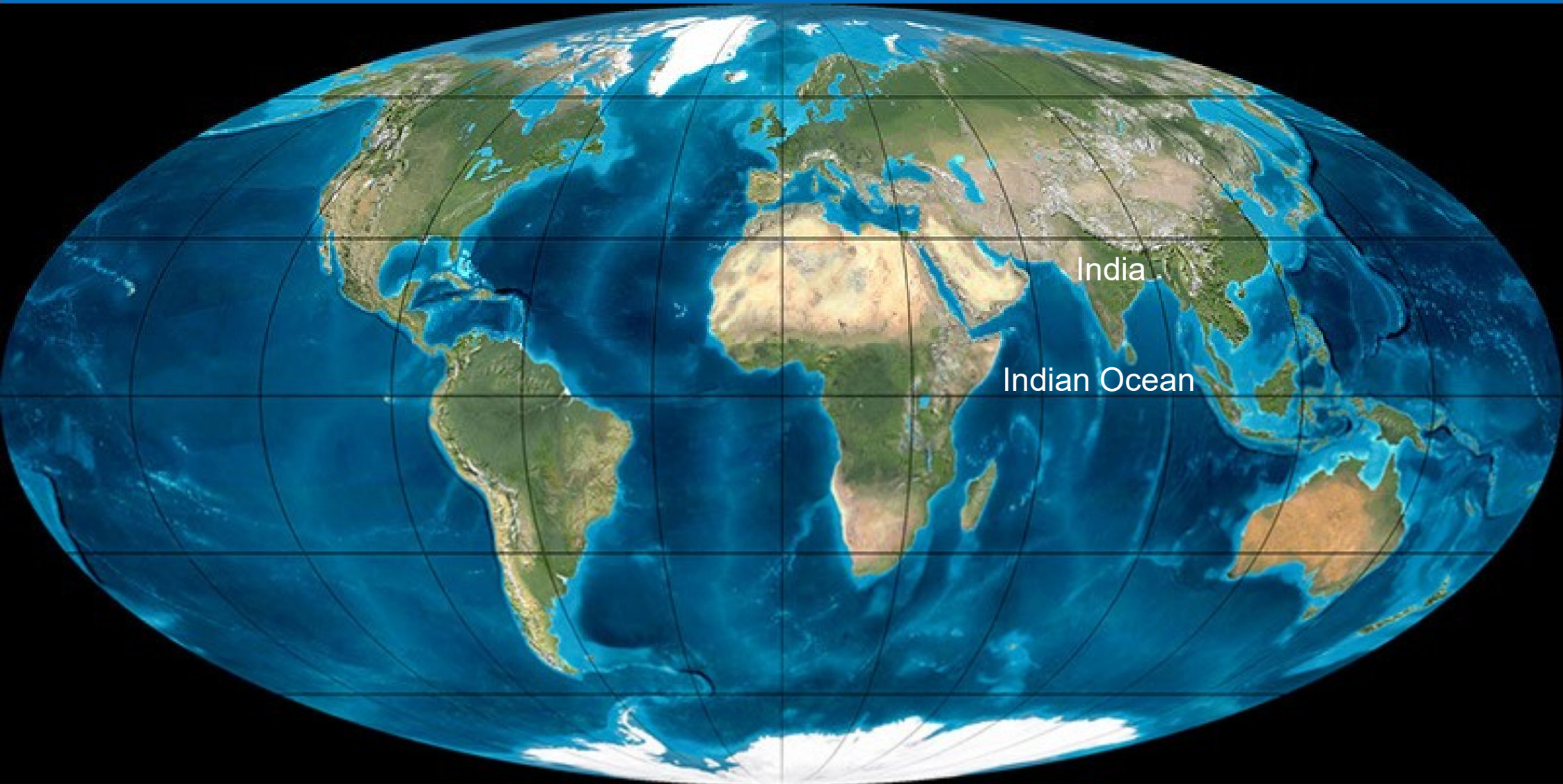
# All about **Monsoons**

**Roxy Mathew Koll**

Indian Institute of Tropical Meteorology



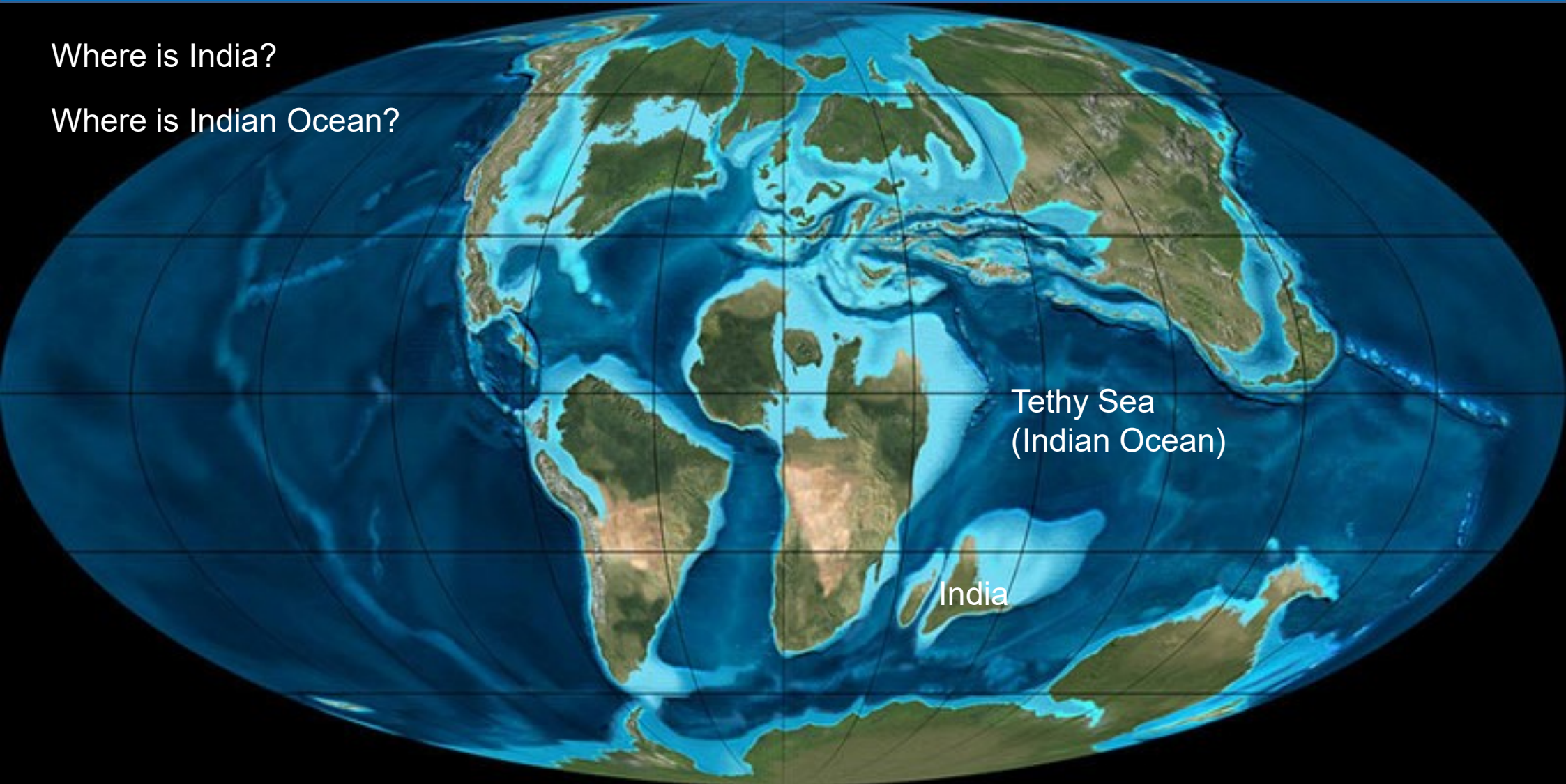
# Earth, now



# Earth, 80 million years ago

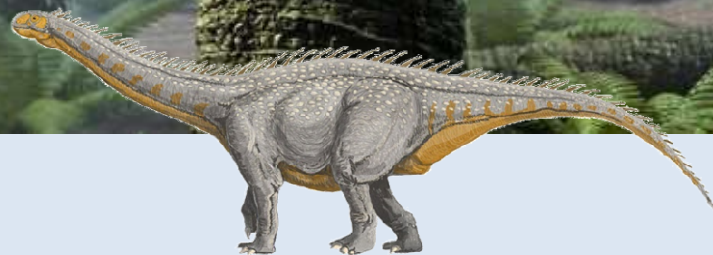
Where is India?

Where is Indian Ocean?





# Earth, 80 million years ago



Captain WH Sleeman discovered the first Barapasaurus from India during 1820s.





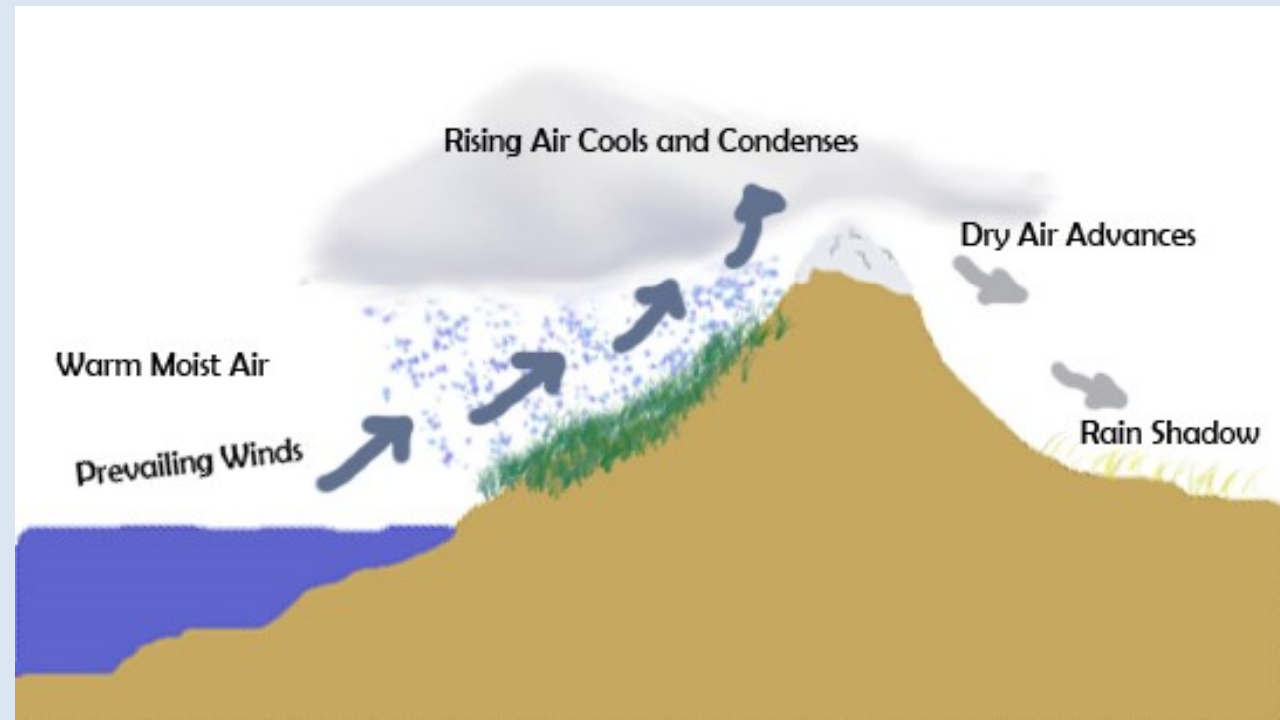
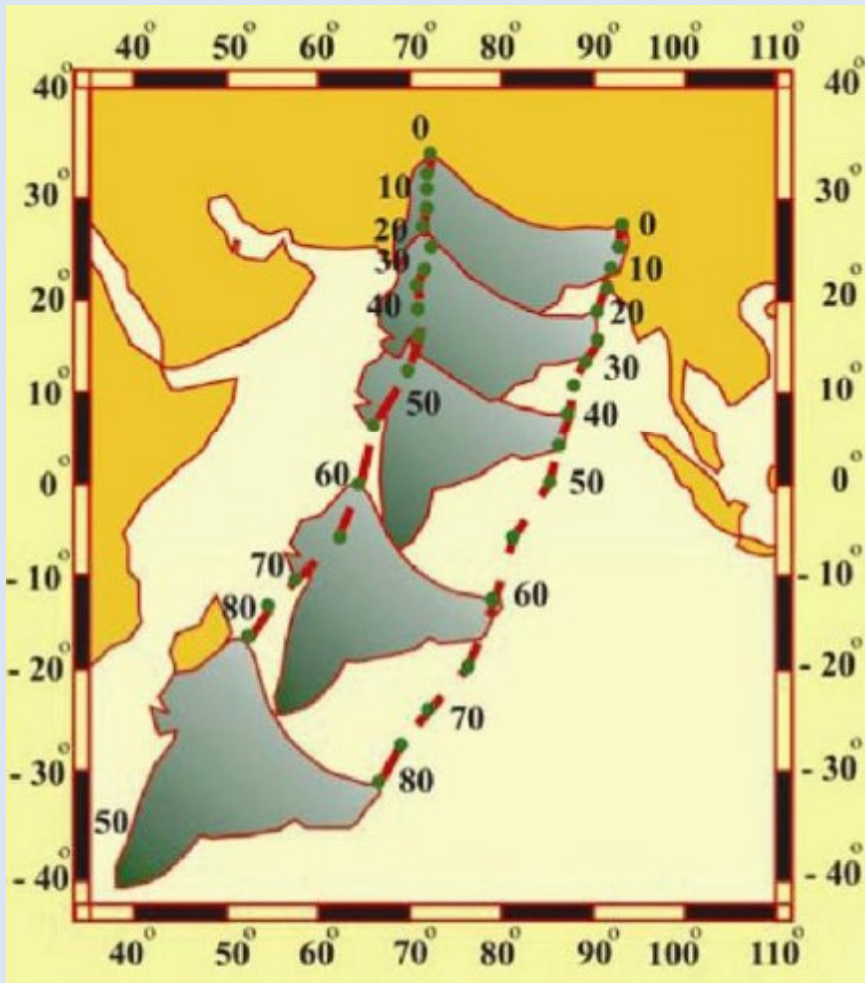
# Asteroids and Deccan Volcanism

# Deccan Volcanism



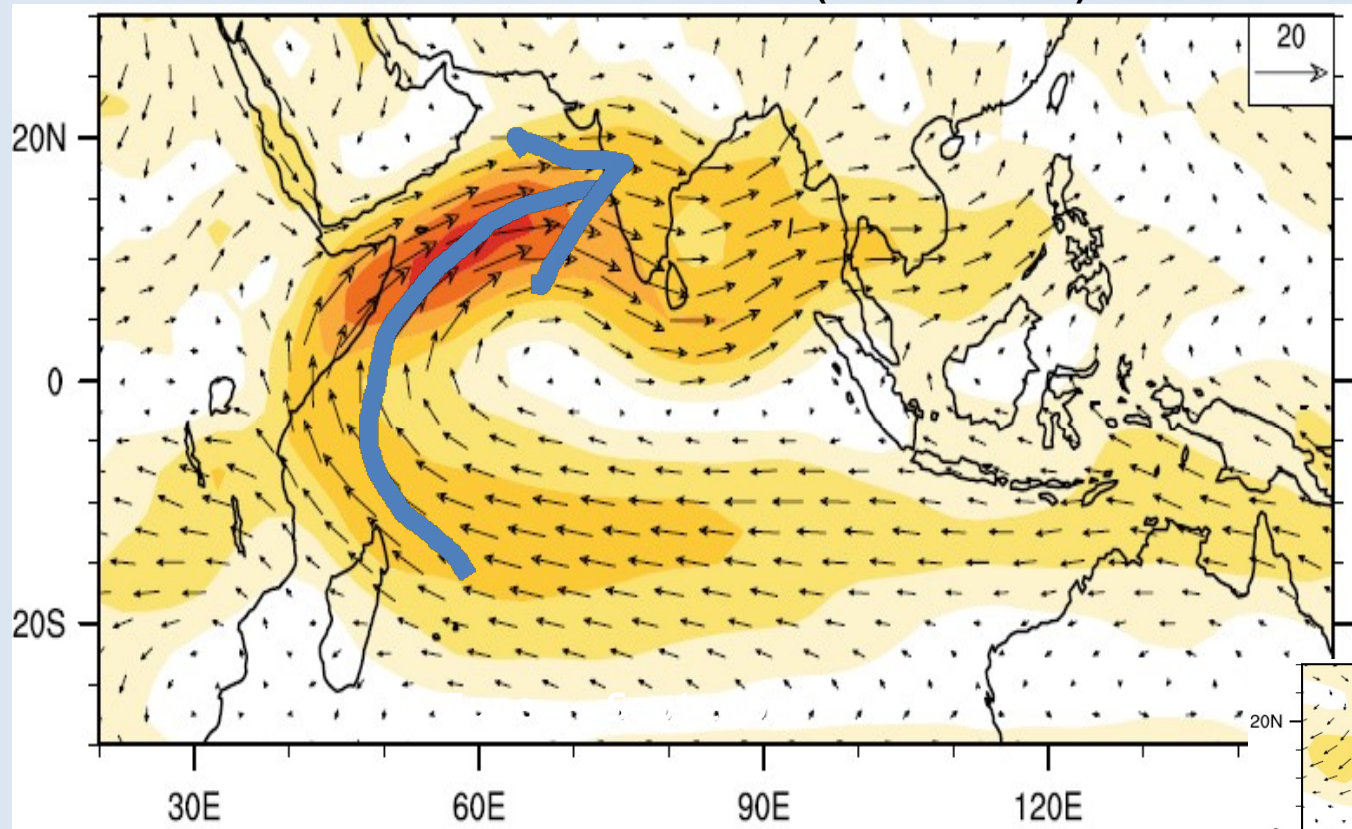


# Rise of the Himalayas

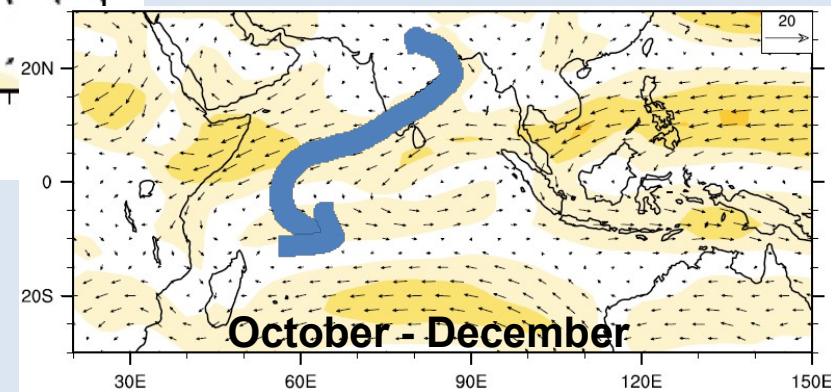


# Monsoon Winds

**Southwest Monsoon (80% of rains)**



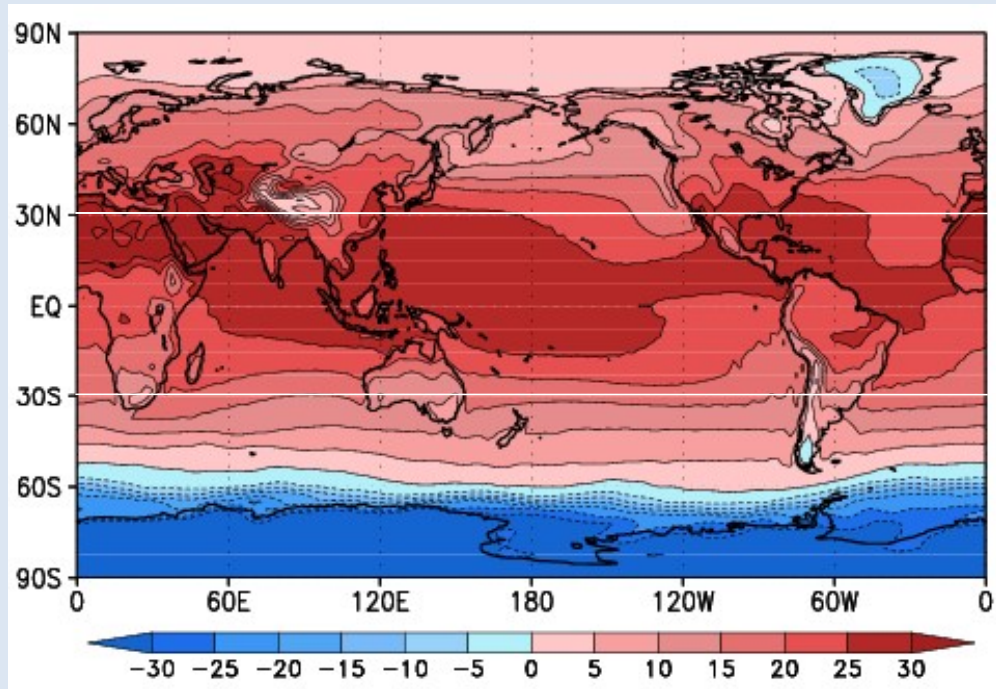
**Northeast Monsoon**



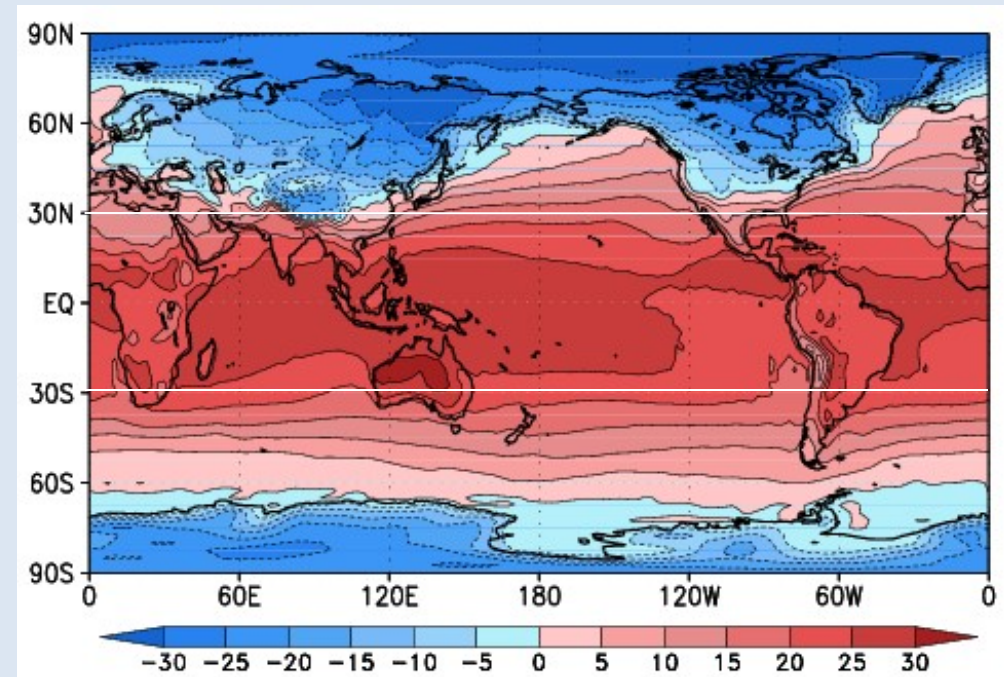


# Monsoon Winds

Summer – land is warmer

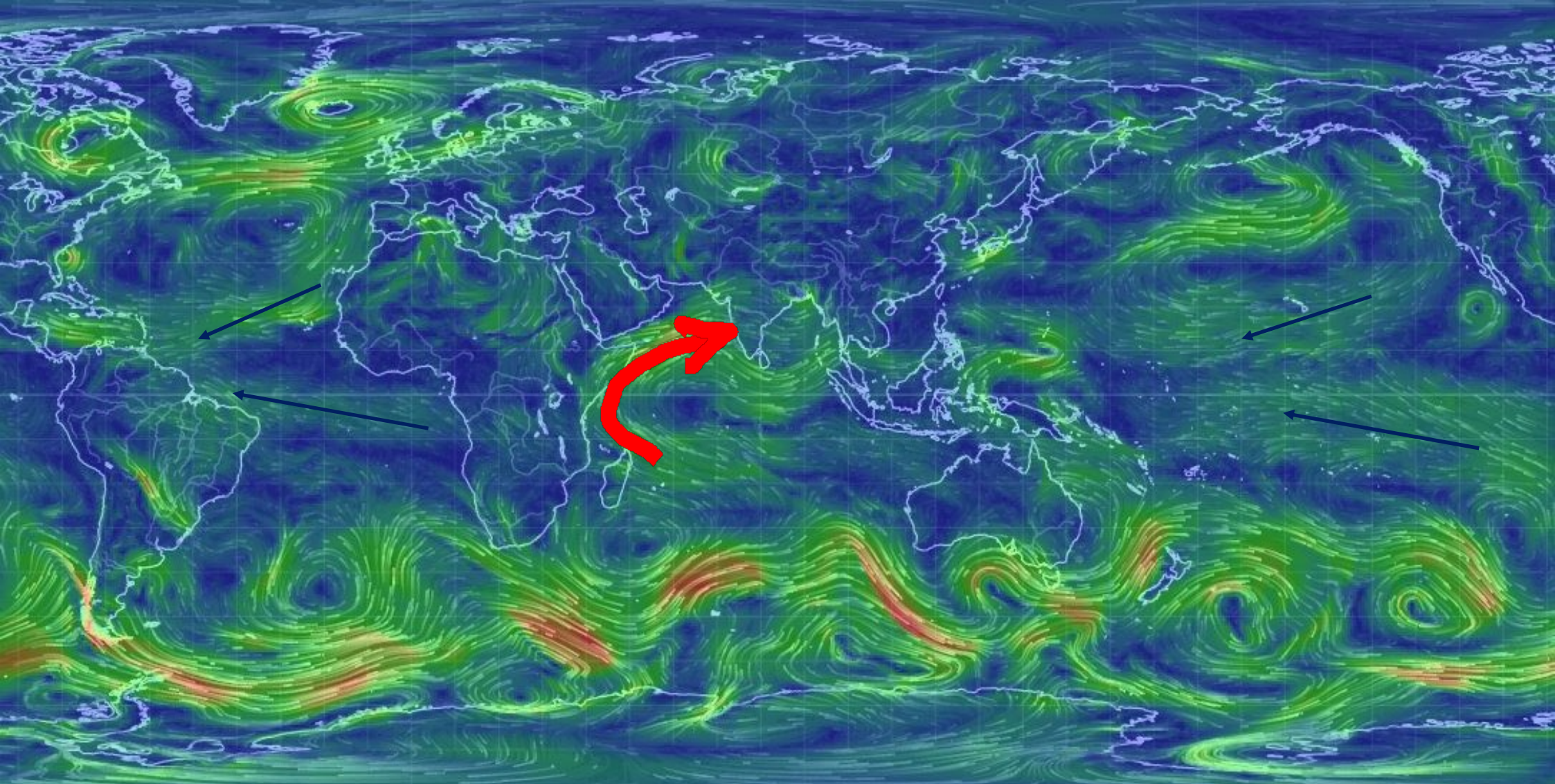


Winter – ocean is warmer





# The way the Winds work





# Onon, the Mongolian Cuckoo on the Winds

## Flight 1. Onon flies Mongolia to Africa

25 September 2019

Onon leaves India, crosses Arabian Sea and reaches Saudi Arabia (2000 km)

Winds at 700 hPa ~ 3 km altitude

## Flight 2. Onon flies Africa to Mongolia

04 May 2020

Onon leaves Africa crosses Arabian Sea and reaches India (5000 km)

Winds at 1000 hPa ~ near surface

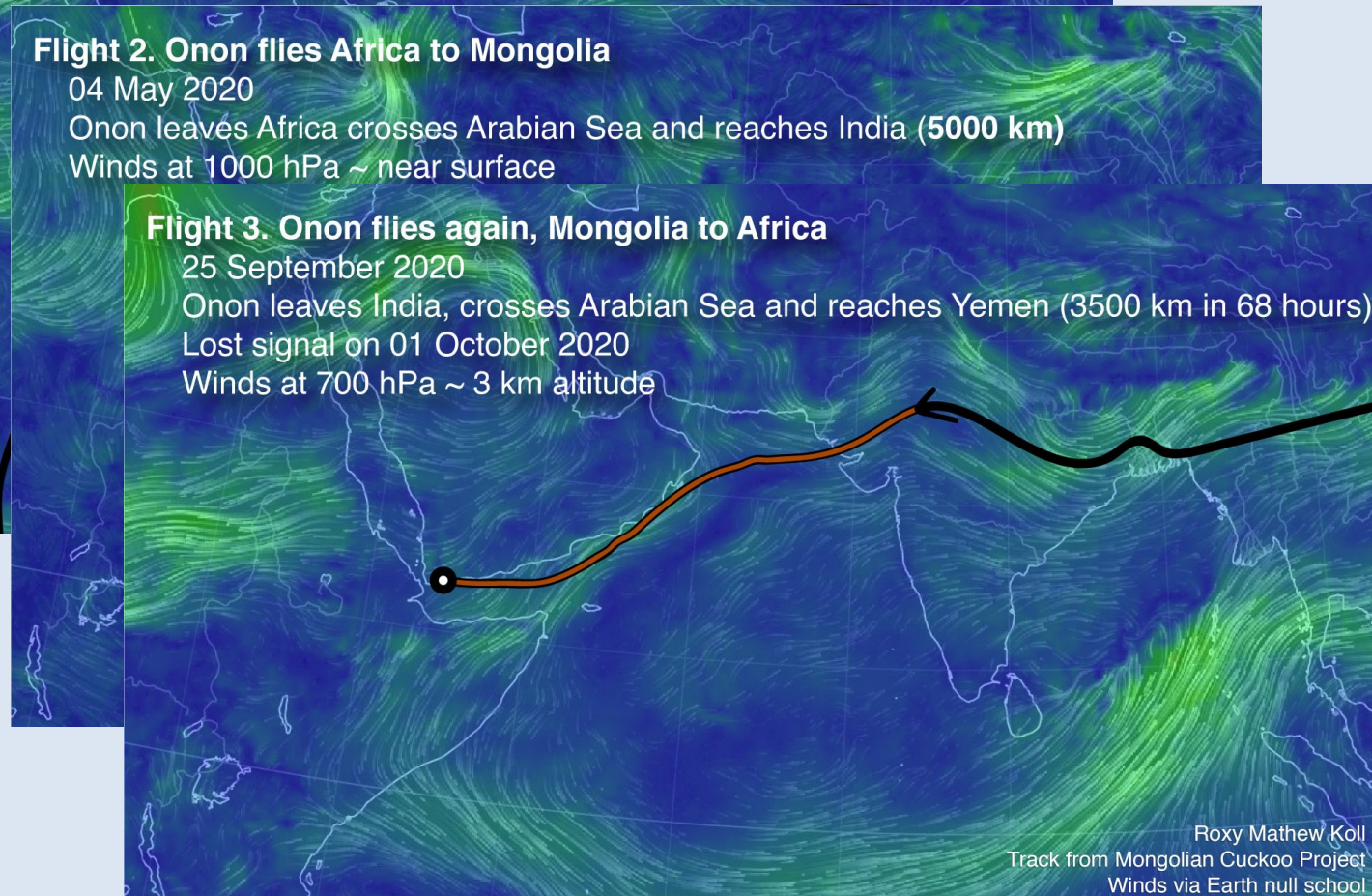
## Flight 3. Onon flies again, Mongolia to Africa

25 September 2020

Onon leaves India, crosses Arabian Sea and reaches Yemen (3500 km in 68 hours)

Lost signal on 01 October 2020

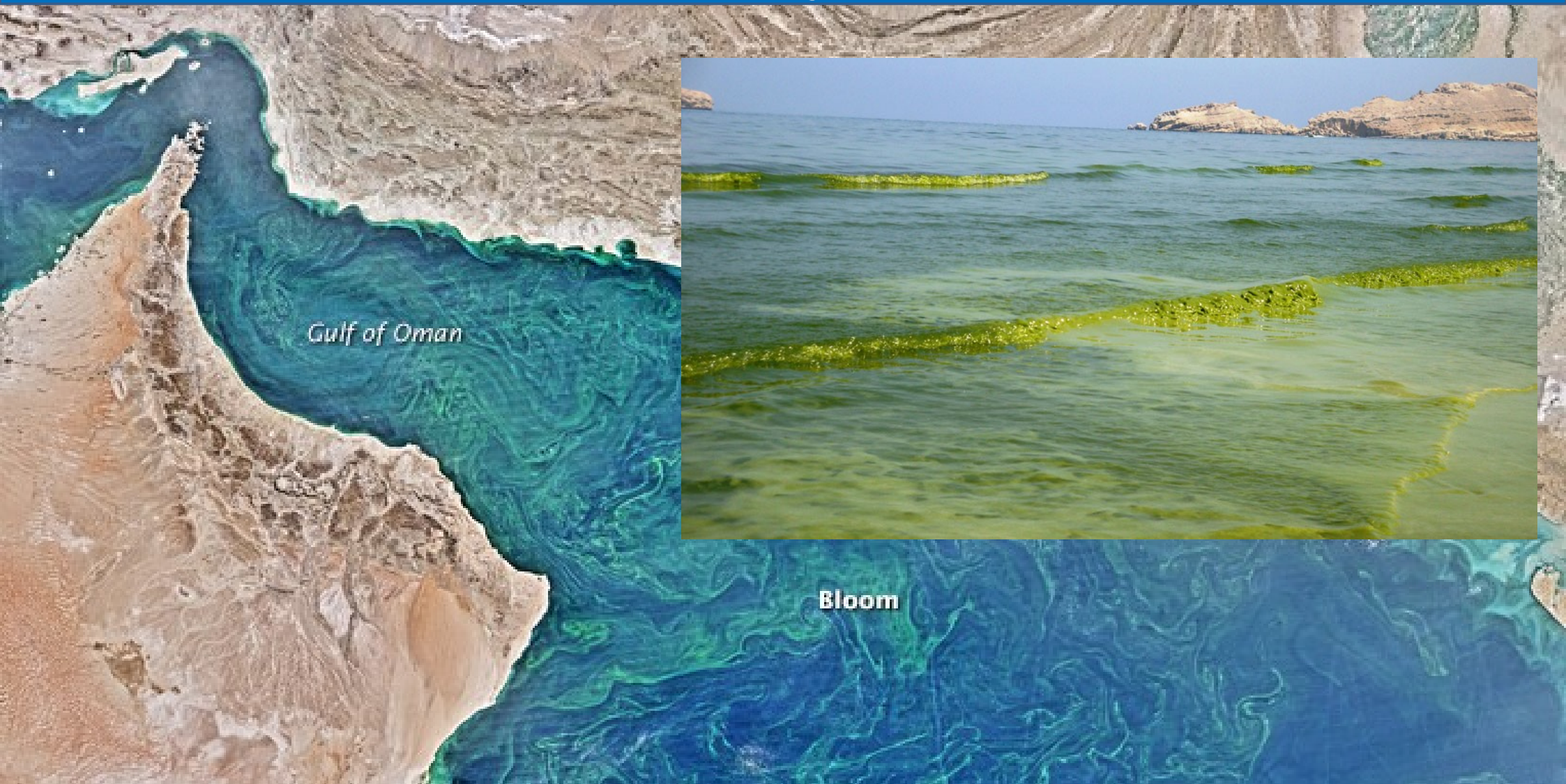
Winds at 700 hPa ~ 3 km altitude



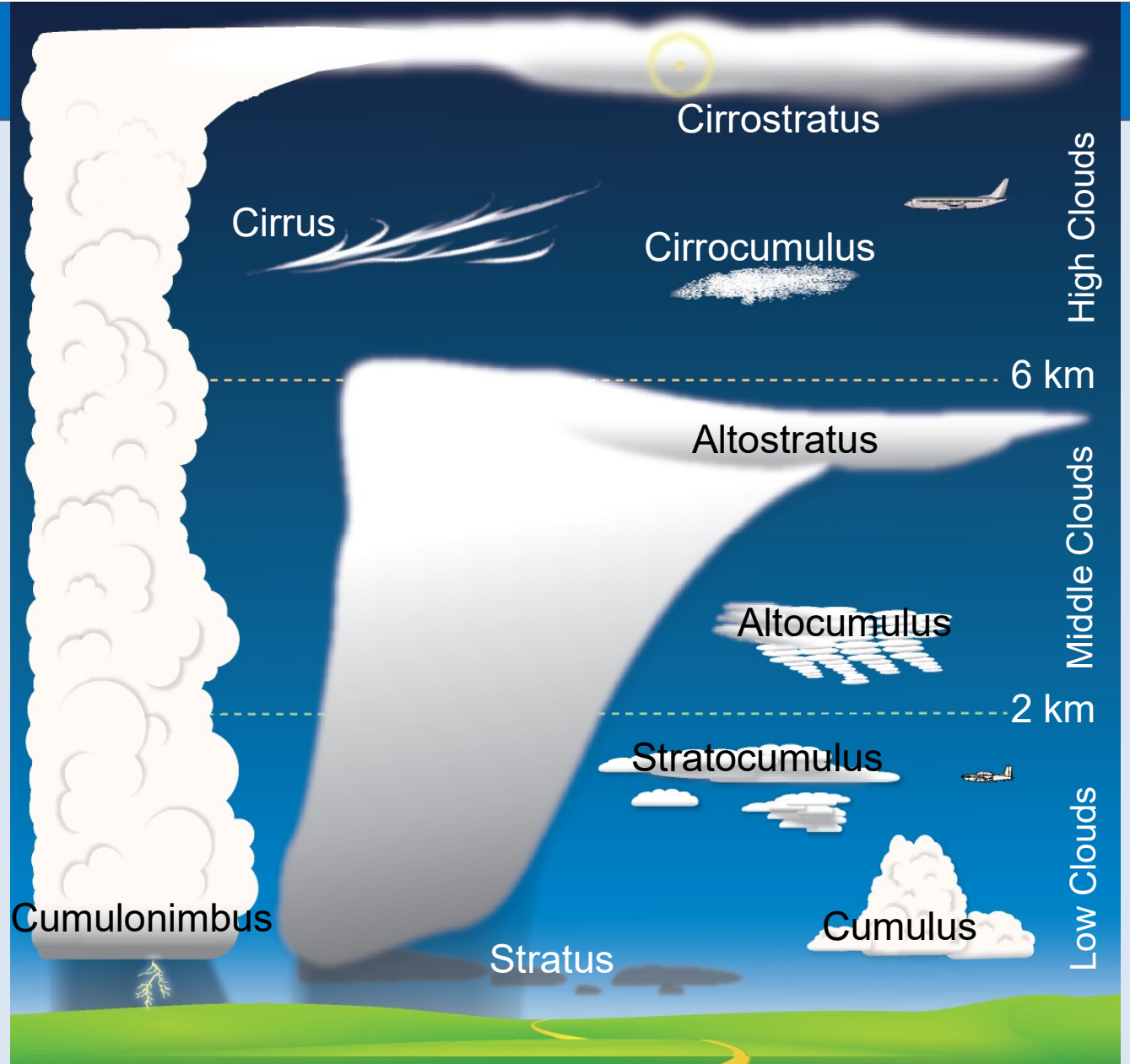
Roxy Mathew Koll  
Track from Mongolian Cuckoo Project  
Winds via Earth null school



# Monsoon Winds and Phytoplankton Blooms



# Clouds





# Monsoon Clouds and Rains



## MONSOON MELODIES BY INDIAN FROGS

KREEA-KRODAA-KREEA-KRODAA



INDIAN BULL FROG

tikitikitikitik!



COMMON SKITTERING FROG

BRRUMP! BRRUMP!



PAINTED KALOULA

titik-titik-titik



KOTTIGEHARA DANCING FROG

PAINP! PAINP! PAINP!



VARIEGATED RAMANELLA

♪ KROUWA ♪



JOG NIGHT FROG

TRREE-tink-tink-tink



YELLOW BUSH FROG

PIHEEUWW-pip-pip-pip!



KEMPHOLEY NIGHT FROG

MODERN BOLLYWOOD MUSIC 'CROAKS!' NOT FROGS.



JOHAN



Green Humour for a Greying Planet  
An Amazon Bestseller!





# Monsoon Melodies

Credits: RoundGlass Sustain

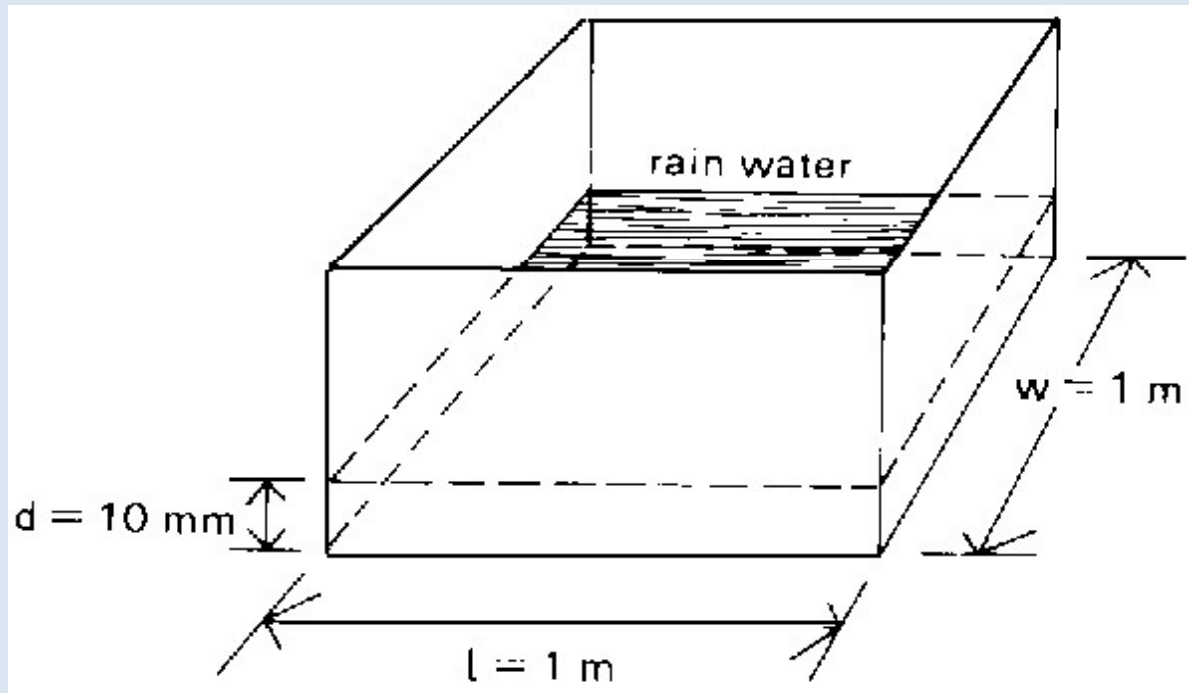


Specially the  
**frogs** and **toads**

# Rain in Numbers

## 10 mm rain means

10 liters of rain water in 1 square meter



Volume =  $1\text{m} \times 1\text{m} \times 0.01\text{m} = 0.01 \text{ m}^3$  or 10 liters

Annual Rainfall received by India = 850 mm

**That's about 2 million (20 lakh) liters of water per person**

The math:

Area = 3 trillion  $\text{m}^2$

Rain = 850 mm

Volume = 2700 trillion liters

Population = 1.3 billion

Per capita water = 2,000,000 liters

= **2 million liters of water**

**per person**



# Measure the Rain on your own!





# How do we measure and forecast the monsoon?

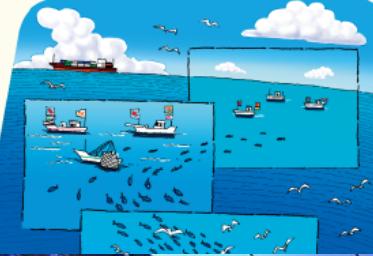
Agriculture/Farming



Water Resource Management



Fisheries/Marine Transportation



We code the physics of the ocean, atmosphere, land processes in these super computers.



## PRATYUSH

India's Fastest & First Multi-Petaflops Supercomputer to Improve Weather & Climate Forecasts

It takes the data and tell us how the weather and climate changes



# Climate Change



SURE, *YOU'LL* BE GONE WHEN IT HAPPENS, BUT *I* WON'T! NICE PLANET YOU'RE LEAVING ME!



THIS FROM THE KID WHO WANTS TO BE CHAUFFEURED ANY PLACE MORE THAN A BLOCK AWAY.



# It doesn't rain when you want it to rain...

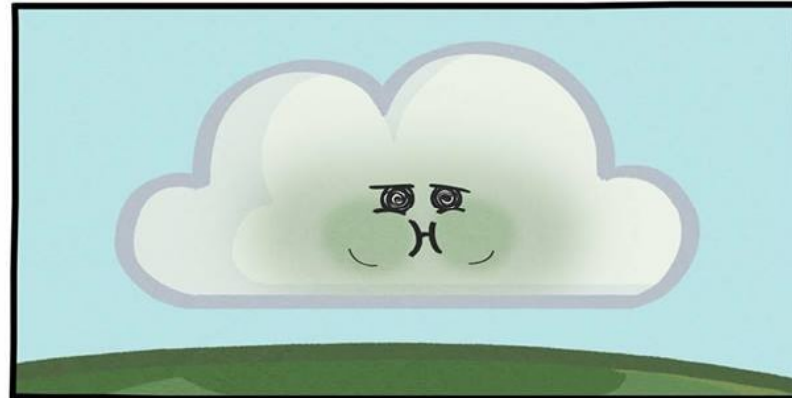




# Climate Change and Floods



**As oceans warm,  
they provide more  
moisture to the clouds**



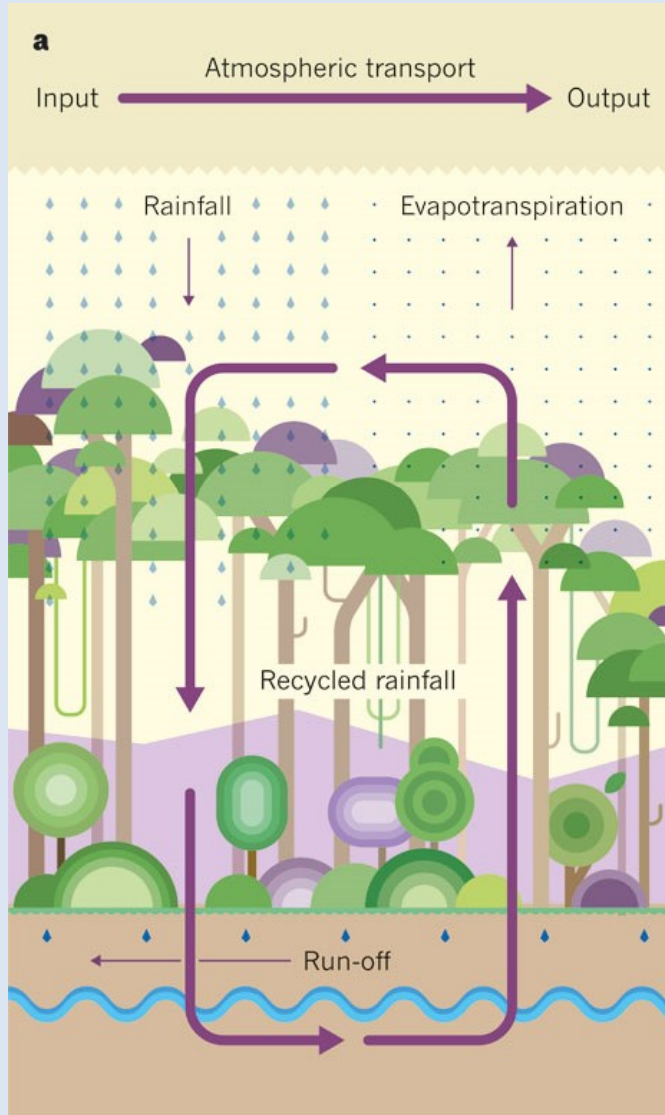
**Warmer air holds  
more moisture for  
longer time**



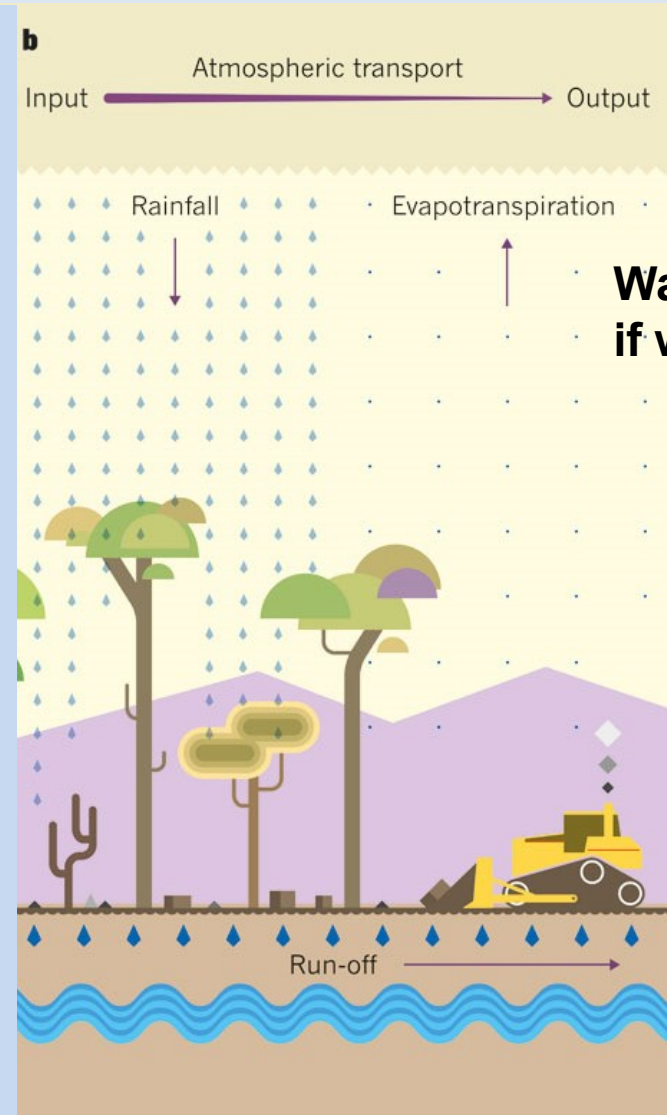
**When it rains, it  
dumps all the water,  
causing floods**

# Why trees are important for the rains

**Water is recycled if we have trees**



**Water is lost if we don't have trees**





# Why cities are vulnerable to floods





# Enjoy the Monsoon!



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