THE URGENCY FOR THE VORTEX ENGINE TO SOLVE THE MIDDLE EAST, ASIAN AND NORTH AFRICAN ENERGY AND WATER CRISES

TEHERAN

Problems with natural tropospheric convection

"Study: Warmer World Will Produce Fewer Clouds" January 03, 2014

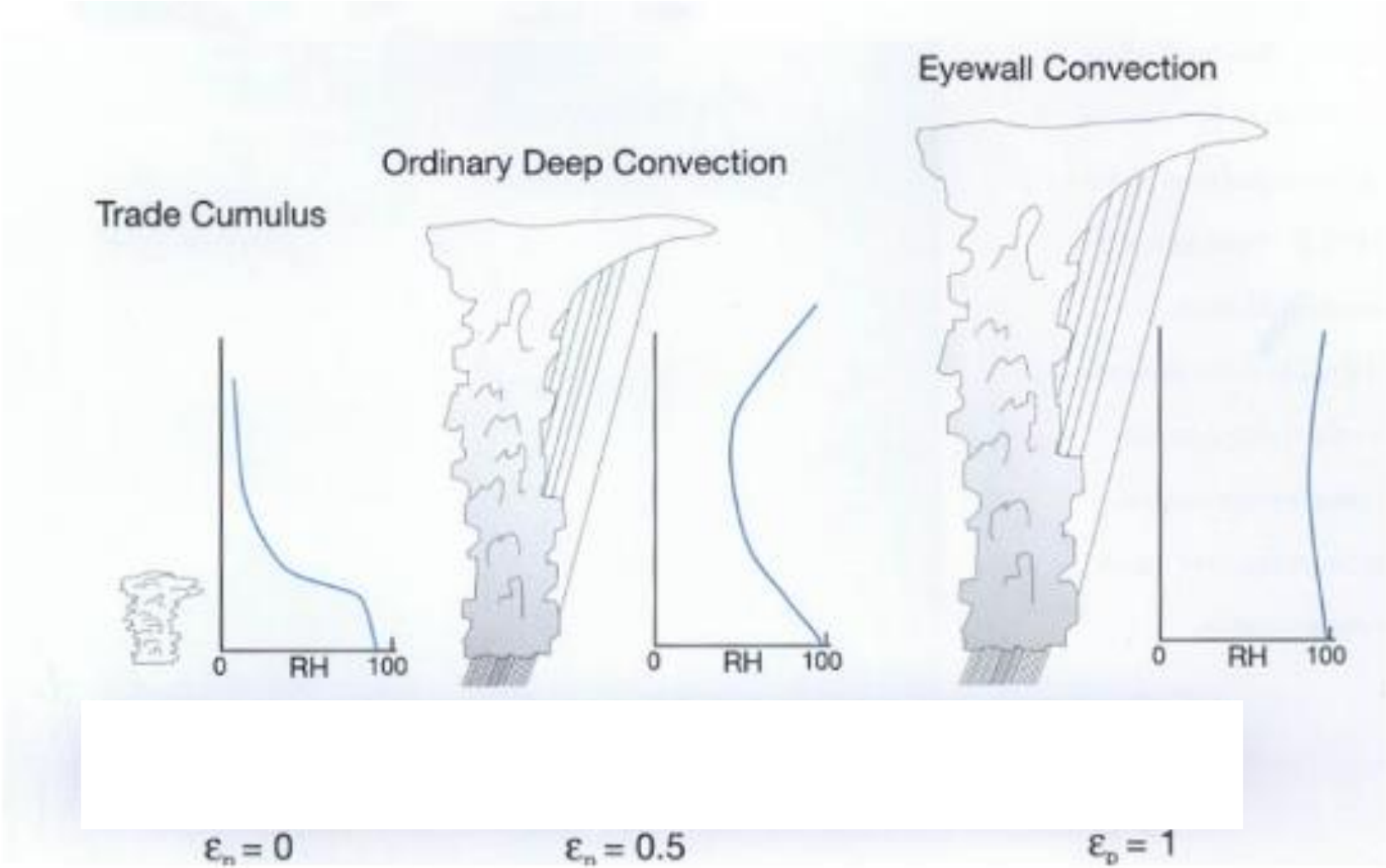
http://www.voanews.com/content/study-warmer-world-will-produce-fewer-louds/1822952.html

Steven Sherwood, a climate scientist at Australia's Centre of Excellence for Climate System Science and lead author of the report, says the prediction of a 4° Celsius global warming is based on the role of water vapour in cloud formation:

> *"What we see in the observations is that when air picks up water vapour from the ocean surface and rises up, it often only rises a few kilometres before it begins its descent back to the surface," Sherwood said. "Otherwise it might go up 10 or 15 kilometres.* ***And those shorter trajectories turn out to be crucial to giving us a higher climate sensitivity because of what they do to pull water vapour away from the surface and cause clouds to dissipate as the climate warms up."***
>
> *(Emphasis added)*

The Atmospheric Brown Cloud is acting to significantly inhibit convection, particularly in the tropics where it is reduced by up to 15%.

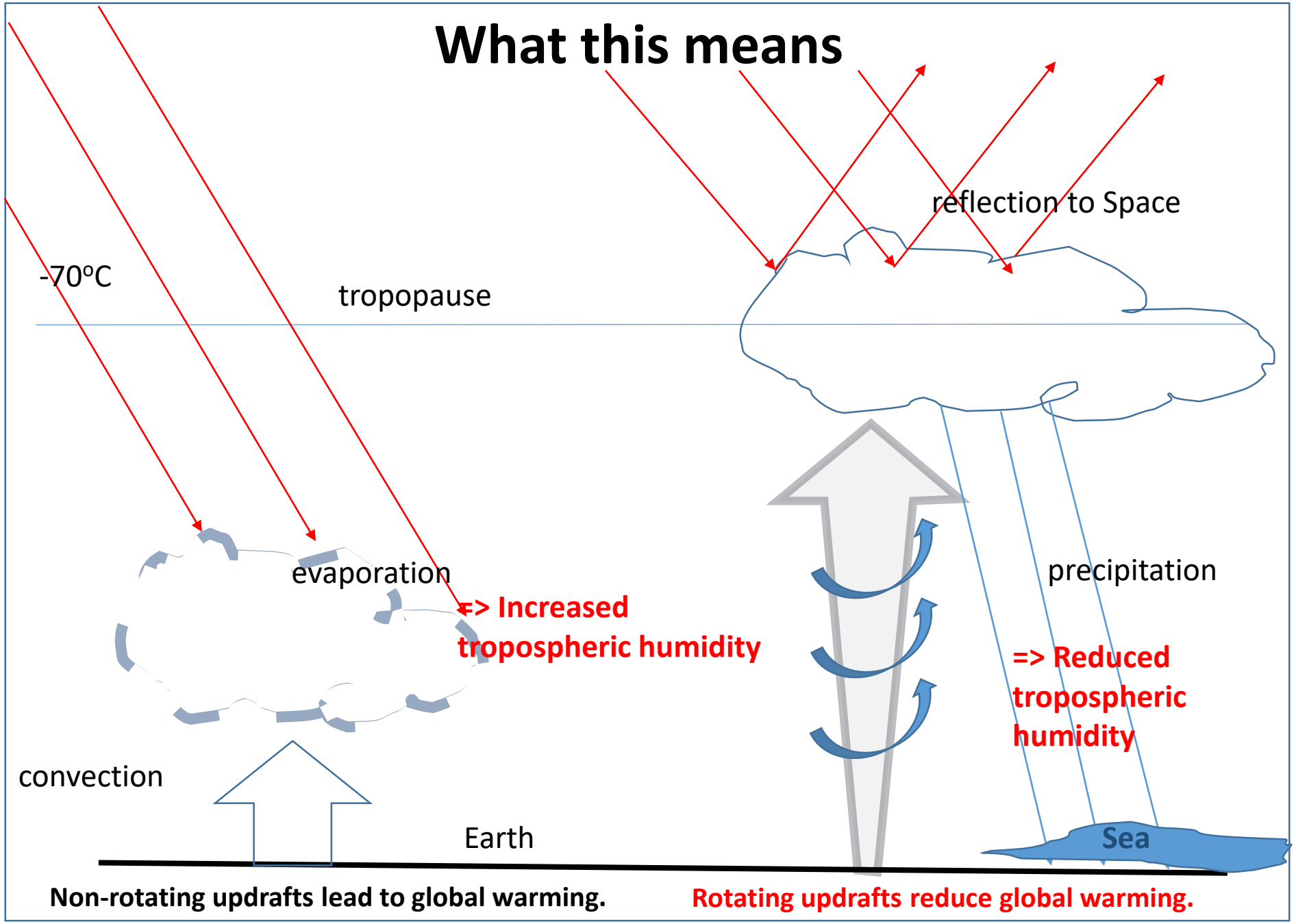
Figure 24.5: The precipitation efficiency of three types of atmospheric convection. "Trade" cumulus clouds (left) are shallow and ascend into dry air; all the water droplets eventually evaporate and so the precipitation efficiency is zero. In ordinary thunderstorms (center), roughly half the water vapor that rises through cloud base eventually reaches the surface as rain.



With eyewall convection within a cyclone, the precipitation efficiency is typically 100%

Divine Wind: The History and Science of Hurricanes
By Kerry Emanuel

What this means



Waterspout

https://www.youtube.com/watch?v=KUaOOaTE2Fg

Ramifications

With modest convection updraft velocities, temperature loss from the updraft plume via radiation and mixing may be excessive, leading to:

a. **Ineffective or incomplete convective heat transfer through the troposphere.**
b. **Mid-level clouds. The subsequent evaporation of the clouds boosts the build-up of atmospheric water vapour.**

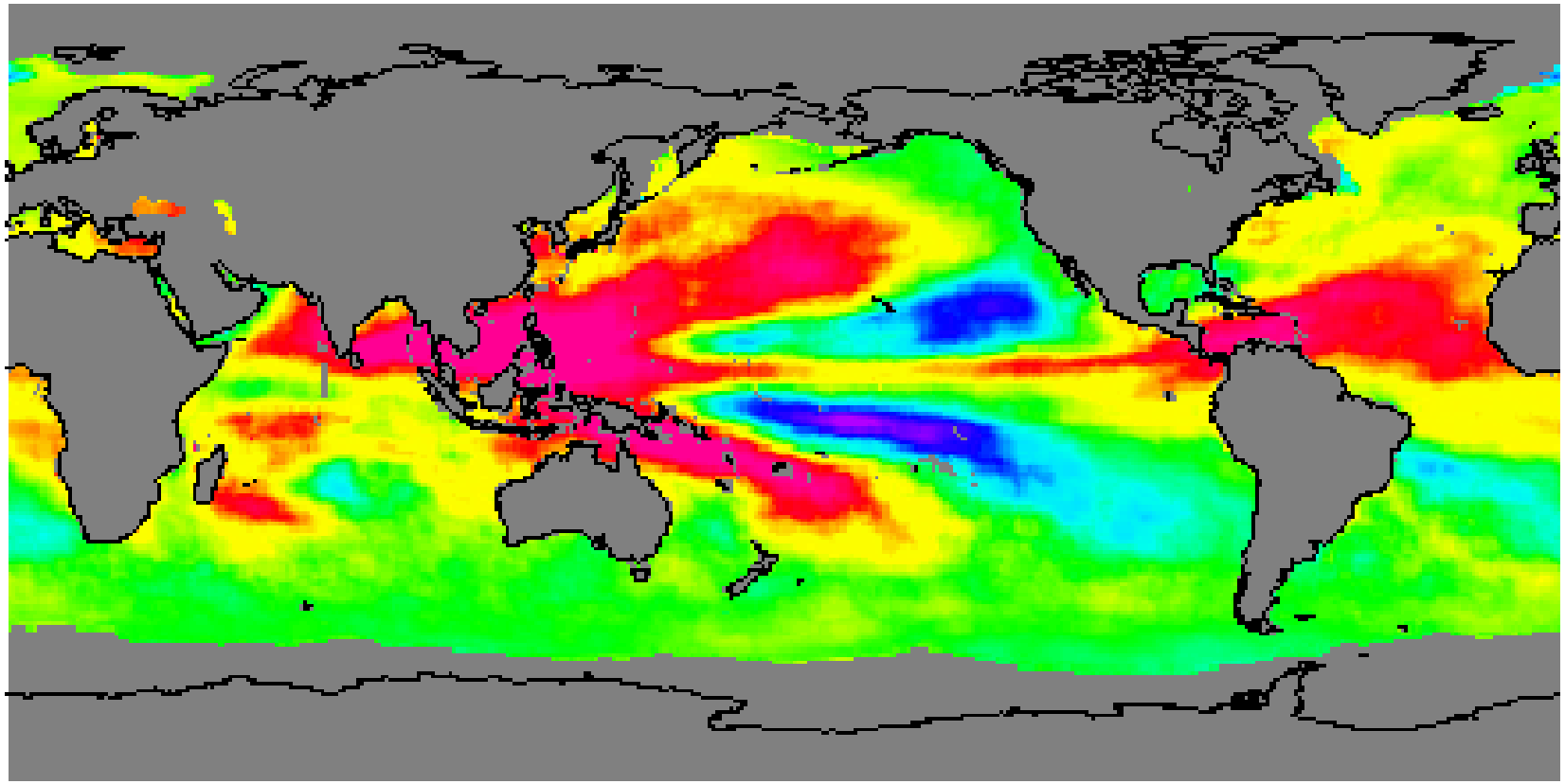
Note that water vapour is the planet's most important greenhouse gas

The high updraft efficiency typical of vortex flow leads to:

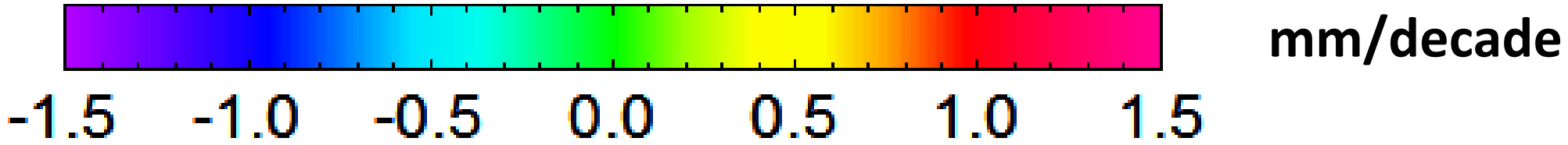
a. **High level reflective clouds**
b. **High precipitation efficiency, hence removal of water vapour from the atmosphere**

The **vortex engine** is designed to initiate and maintain this vortex updraft mechanism

Trends in Water Vapour 1988-2012



http://www.remss.com/research/climate



mm/decade

Tropical Water Vapor Content

- Water vapor content has been increasing (tropics only shown here)
  - Big peaks are El Niño events
  - Climate models can simulate water vapor content well given sea surface temperatures

Sea temperatures are rising

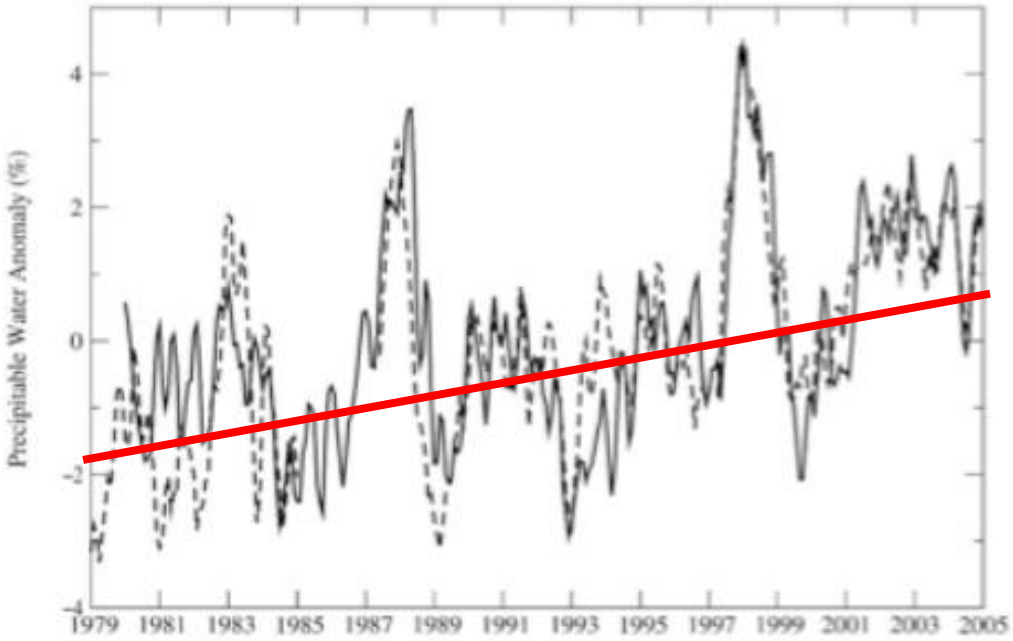


FIG. 1. A time series of the tropical-mean (30°N–30°S), ocean-only column-integrated water vapor from satellite observations (dashed) and GFDL GCM simulations with prescribed SST (solid). The satellite observations for 1979–84 are from the SMMR (Wentz and Francis 1992) and for 1987–2004 are from the SMM/I (Wentz 1997). The mean seasonal cycle is removed from both the observations and model simulations, and the SMMR anomalies are adjusted such that their mean equals that of the model for their overlapping time period (1980–84). All time series are smoothed using a 3-month running mean.

http://www.atmos.washington.edu/~dargan/587/587_3.pdf

Where Would The Vortex Engine Work Best?

Regions

- Tropical regions with good geothermal resources such as **Indonesia, Bangladesh, the Philippines, the Middle East** and high CAPE (Convective Available Potential Energy) – e.g. the **inter tropical convergence zone**
- Arid or semi-arid regions such as Australia, **the Arabian Peninsula**, Turkey, Palestine and southern and northern Africa
- Along arid regions with good geothermal resources such as the **Red Sea**, **Persian Gulf, Afghanistan, Tibet, northern India, Pakistan, Jordan, Ethiopia and Nepal**
- South western USA and northern Mexico
- Offshore north-western Europe - Britain and the Netherlands reportedly have the highest frequency of tornadoes per unit area on Earth, although of relatively low intensity
- Offshore **Japan and China** (geothermal resources and high CAPE)

Ideal Conditions

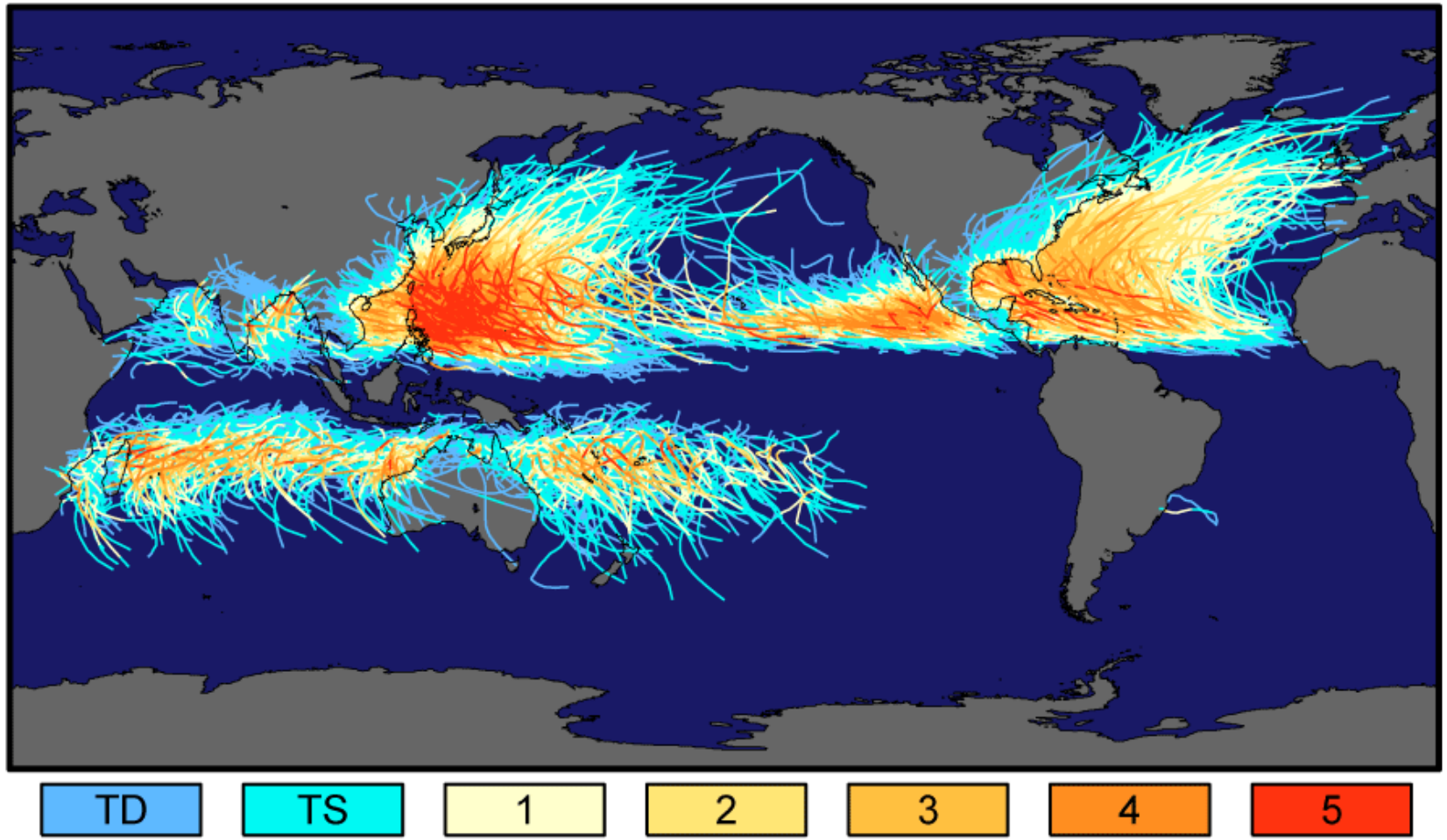
- Low crosswinds
- High CAPE
- Geothermal energy availability
- Currently arid or semi arid (to make use of enhanced precipitation)

“Stuck in the Doldrums” – the Intertropical Convergence Zone (ITCZ)

“The Intertropical Convergence Zone, is the region that circles the Earth, near the equator, where the trade winds of the Northern and Southern Hemispheres come together. ***The water in the equator is warmed by the intense sun which in turn heats the air in the ITCZ, raising its humidity and making it buoyant****.”*

(i.e. High convective available potential energy – CAPE)

Tracks and Intensity of All Tropical Storms



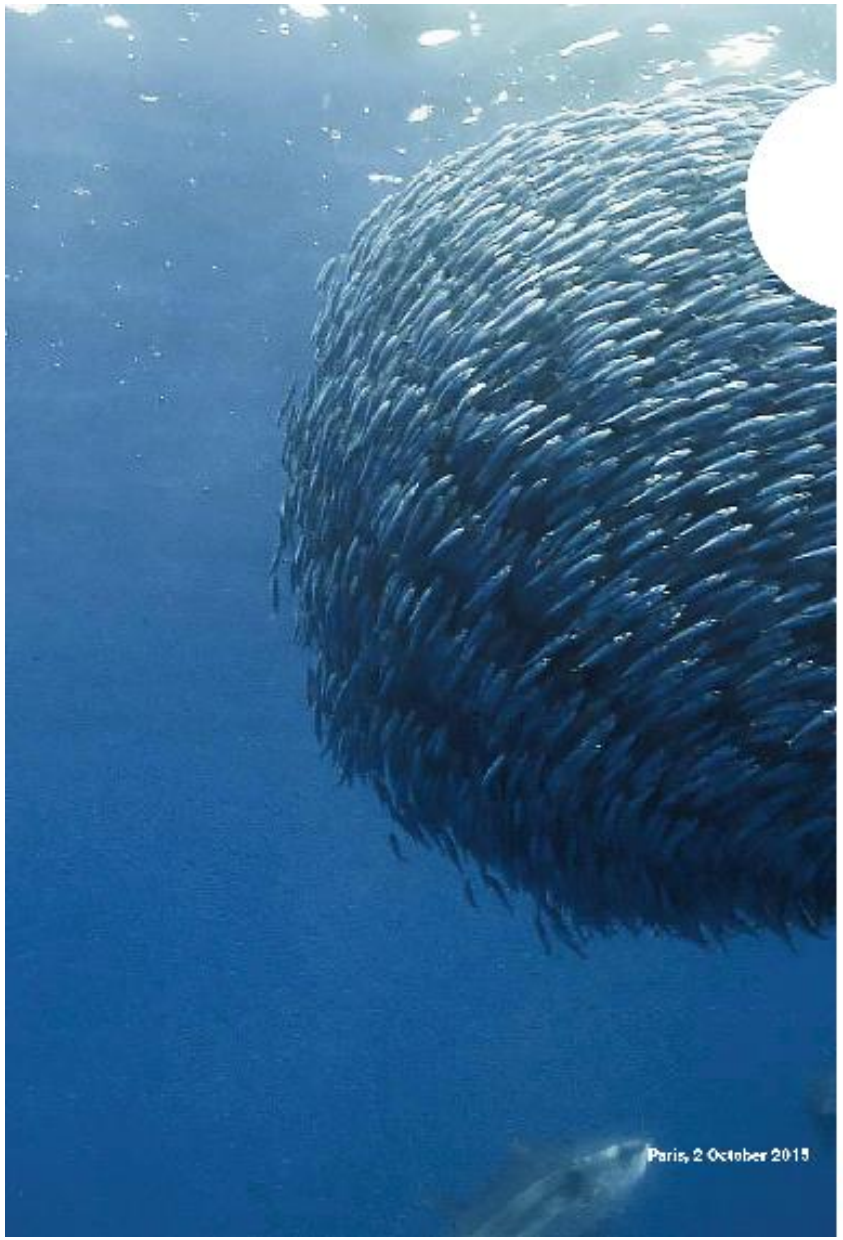
Saffir-Simpson Hurricane Intensity Scale

http://www.goes-r.gov/users/comet/tropical/textbook_2nd_edition/navmenu.php_tab_9_page_1.0.0.htm

Cyclones are not naturally generated at the equator because of the lack of a Coriolis effect.

The vortex engine can easily fix this problem by imparting the required vorticity.

Coral Bleaching



Coral reefs in peril

Ove Hoegh-Guldberg
Professor and Director
Global Change Institute
University of Queensland
Brisbane, Australia

Implementing the Ocean SDG: from knowledge to action

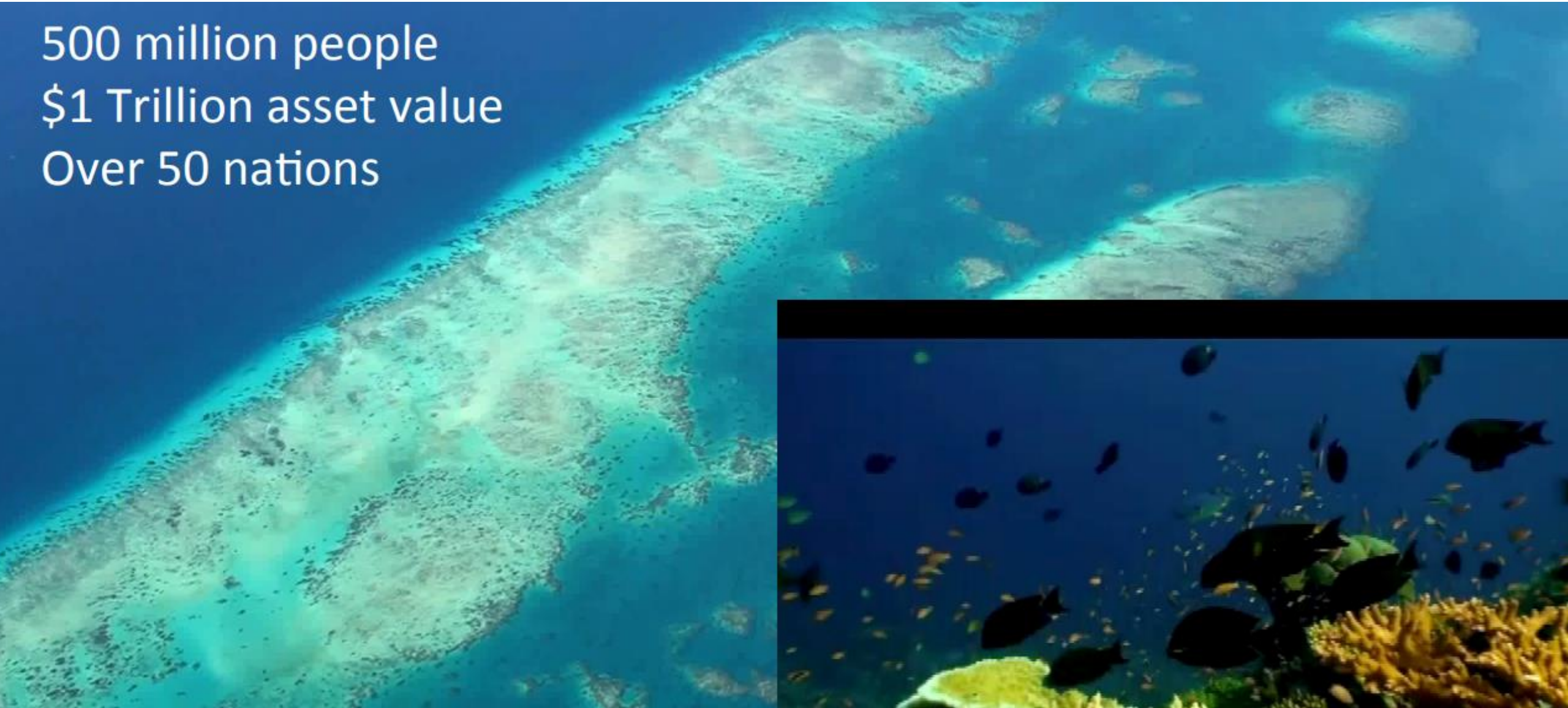
OCEANS 2015 INITIATIVE

gciQ Global Change Institute

IDDRI

Coral Bleaching

http://www.iddri.org/Evenements/Conferences-internationales/15.10.02_conf%20oceans%20sdg%20ppt%20Ove%20Guldberg.pdf



Coral Bleaching

So why will the loss of our Great Reefs cost the world one trillion dollars?

The coral reef's monetary value comes from a 2015 report from the Director of University of Queensland's Global Change Institute; Ove Hoegh-Guldberg.

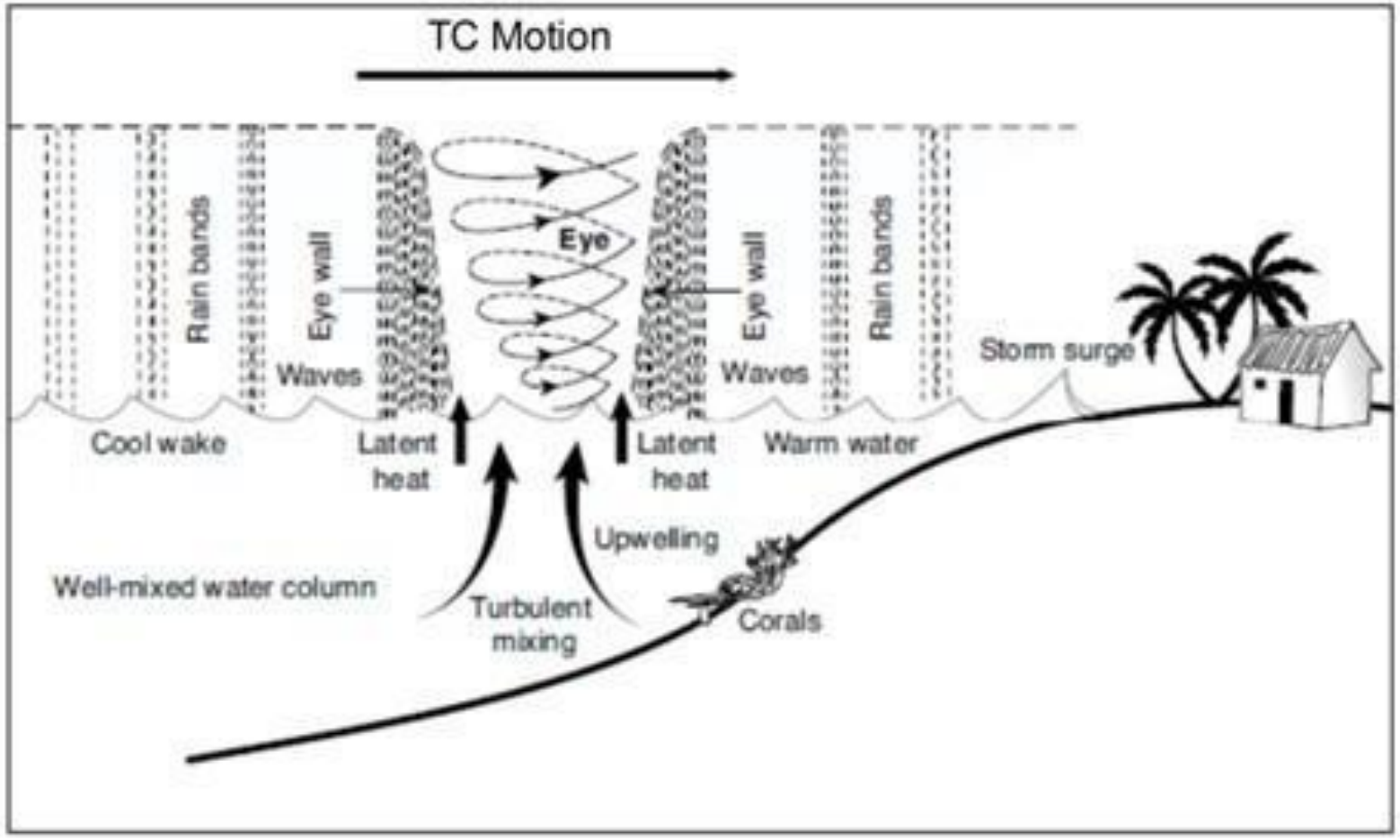
The report highlights that the world's coral reefs support 500 million people across 50 different countries.

The reefs are in great danger of being lost due to coral bleaching caused by increases in Sea SurfaceTemperature (SST).

Sea Cooling

Upwelling and evaporation caused by a cyclone can be very effective in reducing sea surface temperatures to overcome coral bleaching. The vortex engine can achieve the same in a much more controlled way:

https://www.coris.noaa.gov/activities/caribbean_rpt/SCRBH2005_03.pdf



ITCZ - “The Doldrums” – perfect for the vortex engine

“Aided by the convergence of the trade winds, the buoyant air rises. As the air rises it expands and cools, releasing the accumulated moisture in an almost perpetual series of thunderstorms.”

The Dreaded Belt of Calm

“Early sailors named this belt of calm “the Doldrums” because of the inactivity and stagnation they found themselves in after days of no wind. In an era when wind was the only effective way to propel ships across the ocean, finding yourself in the Doldrums could mean death…”

https://blog.mytimezero.com/2014/01/10/stuck-in-the-doldrums-the-intertropical-convergence-zone/

This combination of high Convective Available Potential Energy (CAPE) and low crosswind is ideal for the operation of the vortex engine.

The Atmospheric Brown Cloud

"The Asian brown cloud is created by a range of airborne particles and pollutants from combustion (e.g., woodfires, cars, and factories), biomass burning and industrial processes with incomplete burning. The cloud is associated with the winter monsoon (November/ December to April) during which there is no rain to wash pollutants from the air."

Wikipedia

The Asian Brown Cloud is now referred to as the Atmospheric Brown Cloud, as it occurs around the world and is closely associated with the Inter Tropical Convergence Zone.

The Atmospheric Brown Cloud (ABC)

Atmospheric brown clouds: Impacts on South Asian climate and hydrological cycle
http://www.pnas.org/content/102/15/5326.abstract

(i) ***Increase in aerosols can nucleate copious amounts of small droplets, which can inhibit the formation of larger raindrops and decrease precipitation efficiency*** *(33).* ***This microphysical effect can suppress rainfall in polluted regions*** *(5) and add to the rainfall decreases simulated in the present study.*

(ii) *There has been a steady increase of drought frequency from the 1930s, which peaked in the 1980s (Fig. 7), with decrease in average rainfall after the 1960s. The drought frequency abated during the 1990s (30), but the decadal rainfall was still less than normal. During 2001–2004, two droughts have already occurred, and the average rainfall for this decade so far is 9% below normal. These negative trends lead us to speculate whether the ABC is indeed appearing to show its impact as guided by our modelling results, even though there may be other causes such as El Niño–Southern Oscillation–monsoon (32, 34) interactions or natural variations in other slowly varying boundary conditions such as land-surface moisture, Eurasian snow cover, and others (34).*

(iii) ***ABCs have such a large effect on the monsoon primarily because the forcing simultaneously impacts many components of the monsoon system, including the solar heating of the surface–atmosphere system, the SST gradient, the convective instability of the troposphere, evaporation, and the Hadley circulation, which are factors that have fundamental influences on the monsoon rainfall*** *(25, 30, 31, 34).*

SST = Sea Surface Temperature

The Atmospheric Brown Cloud

"…The increase in atmospheric stability and the reduction in rainfall are important aspects of the air pollution impacts on climate. Both these effects can enhance the lifetime of aerosols because increases in low-level inversion (see Fig. 4) can increase the persistence of brownish haze layers, and reduction in rainfall can decrease the washout of aerosols. Such feedback effects should be included in future studies to understand the full impact of the ABCs on South Asia. Of particular concern is the reduction in monsoon rainfall in India because in South Asia there is a strong positive correlation between food production and precipitation amount (35). In addition, availability of fresh water is a major issue for the future (36). Even with the forcing fixed at 1998 values, the rainfall decrease in India continues to worsen beyond 1998 (Fig. 3B). The impact of the ABC on monsoon rainfall, in conjunction with the health impacts of air pollution (37), provides a strong rationale for reducing air pollution in the developing nations."

"However, a sudden reduction in air pollution without a concomitant reduction in global GHGs also can accelerate the warming in South Asia because, according to the present simulations, ABCs have masked as much as 50% of the surface warming due to GHGs."

http://www.pnas.org/content/102/15/5326.full

"...White sulfur aerosols cool the climate; black carbon soot warms the climate. So when you mix the two kinds of aerosol pollution up in the Asian brown cloud, one would expect climate effects to even out. Unfortunately in our physical world things are never that simple."

COOLING ON GROUND, WARMING IN AIR

"The reason the reflective (light) and absorbing (dark) aerosols in the brownish mix do not compensate each other's effects, is that they both block sunlight - so they both lead to cooling on the surface directly beneath the haze, which is thickest over the north of India, including the Ganges Basin. As darker-coloured soot aerosols are dominant in the mix higher up in the atmosphere, energy absorption outweighs solar reflection - so the brown haze leads to net atmospheric warming."

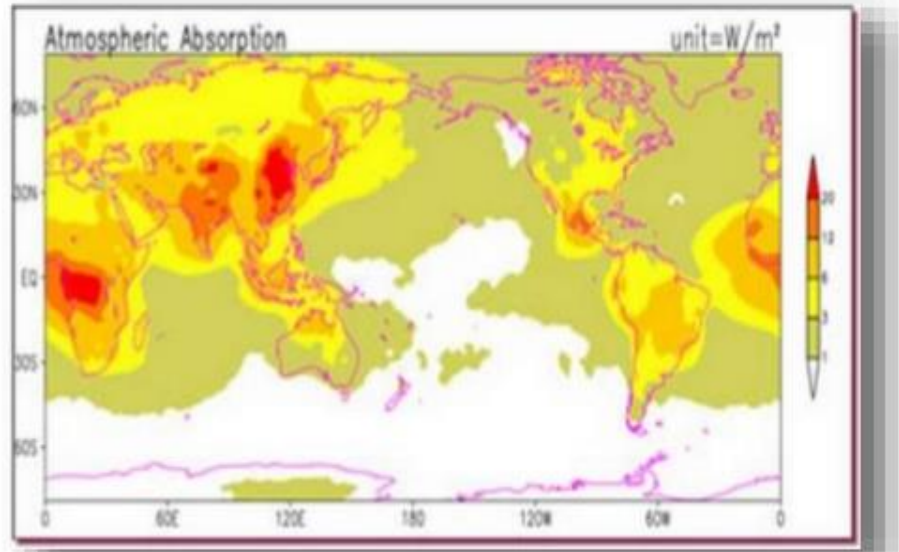
"When you have warm air up high and cooler temperatures on the ground, you create what meteorologists call a stable atmosphere, with suppressed convection, and little precipitation. Higher air pressure at the surface makes the brown haze block the monsoon …"

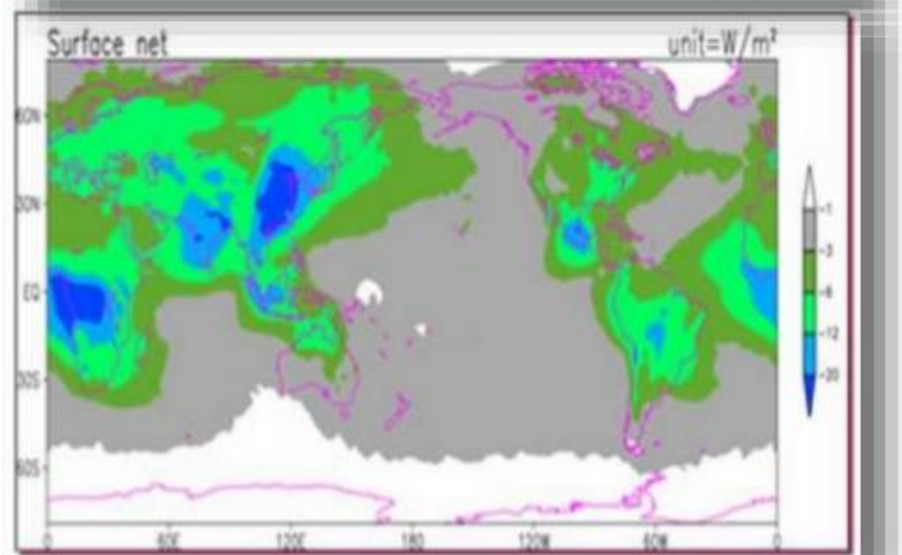
http://www.bitsofscience.org/indian-monsoon-climate-change-3470/

So this is a further significant barrier to atmospheric convection.

Atmospheric Brown Cloud

- Widespread layers of brownish haze
- Regions
  - Indo Gangetic Plain in South Asia
  - East Asia
  - Indonesian Region
  - Southern Africa extending southwards
  - The Amazon basin in South America

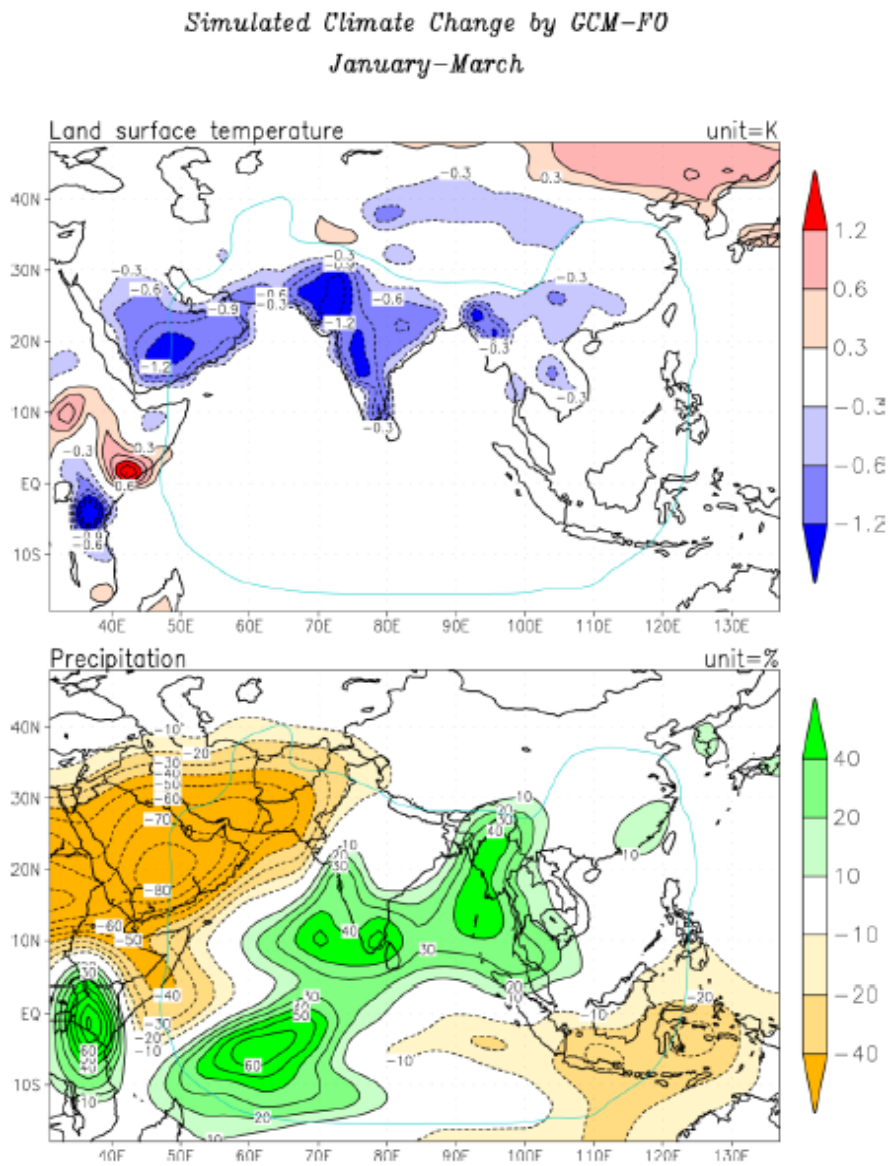




http://www.slideshare.net/srujanirulzzworld/asian-brown-cloud

Effect of South Asian Haze on Dry Season Surface Temperature and Rainfall

http://www.rrcap.ait.asia/abc/Documents/ABC_Report_2002_Full.pdf



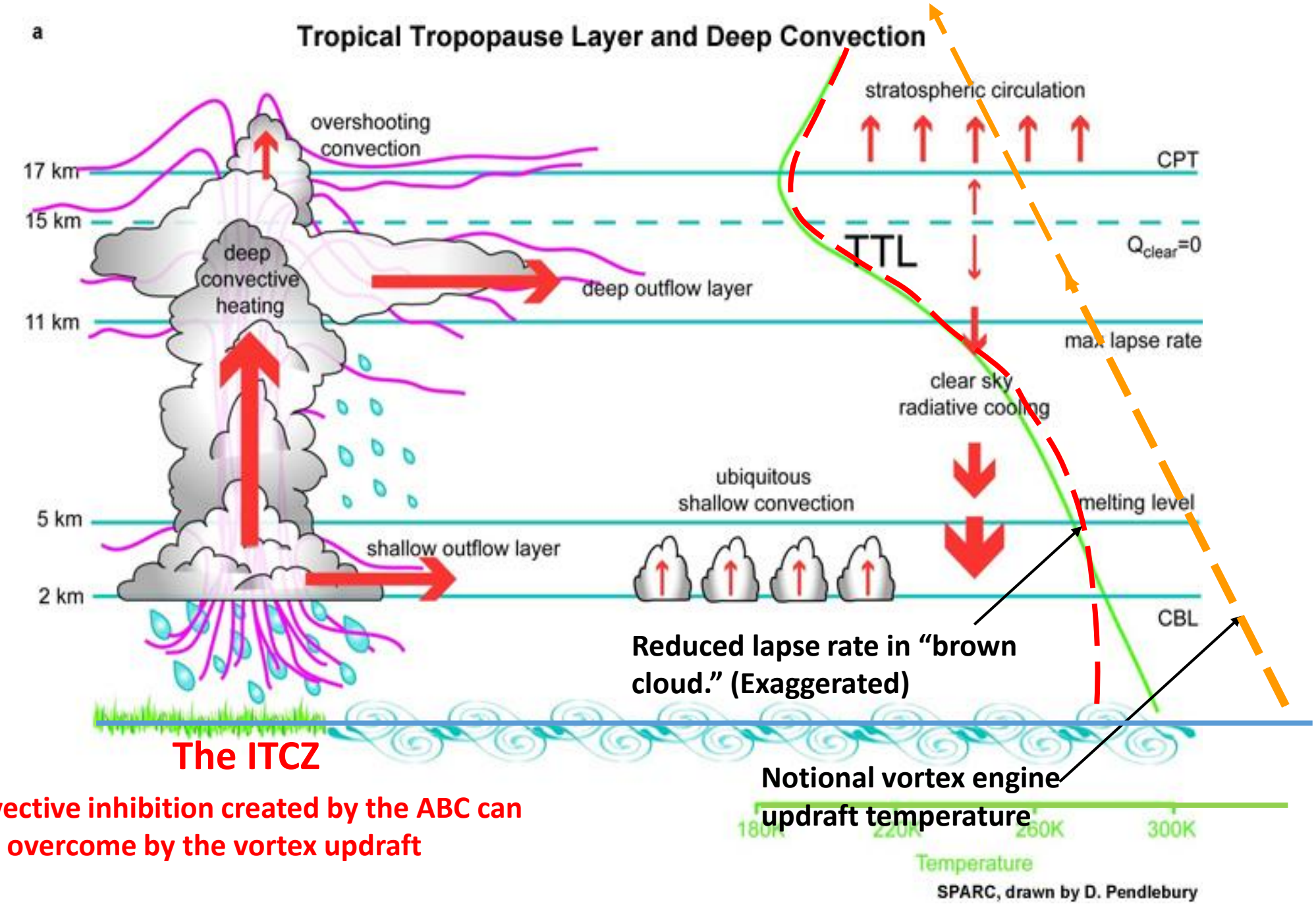
Simulated climate change (January-March) simulated with NCAR/CCM3 and with observed sea surface temperature (SST). Land surface temperature change (upper panel) in units of K. Precipitation change (lower panel) is displayed in units of percentage (Chung et al., 2002).

And you think Beijing is polluted?

The Chinese capital doesn't make the top 10 list for world's most polluted cities – and neither does Delhi. But nine cities in Asia do:

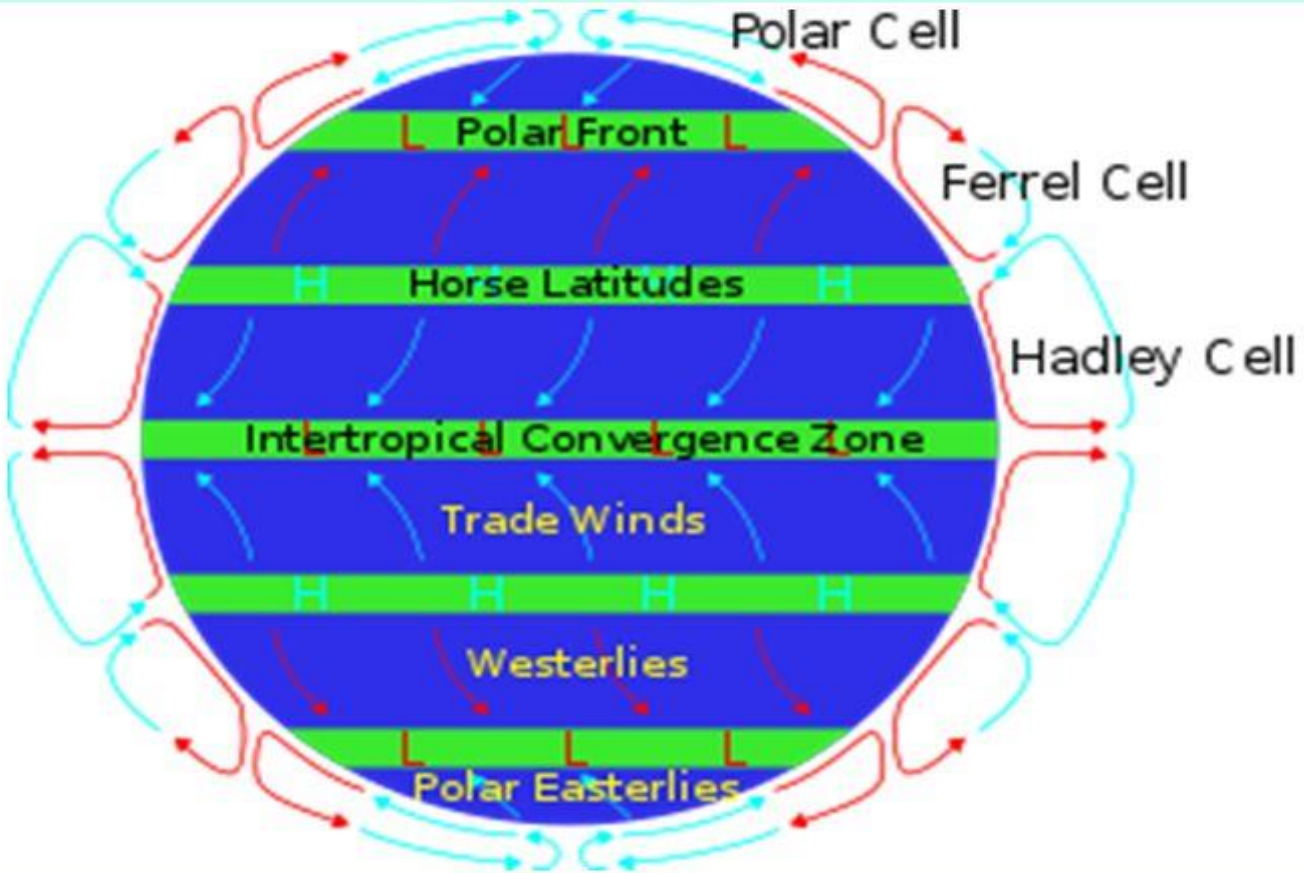
Subhra Priyadarshini
http://www.natureasia.com/en/nindia/article/10.1038/nindia.2016.165

The Middle East includes particulates from dust storms



The convective inhibition created by the ABC can easily be overcome by the vortex updraft

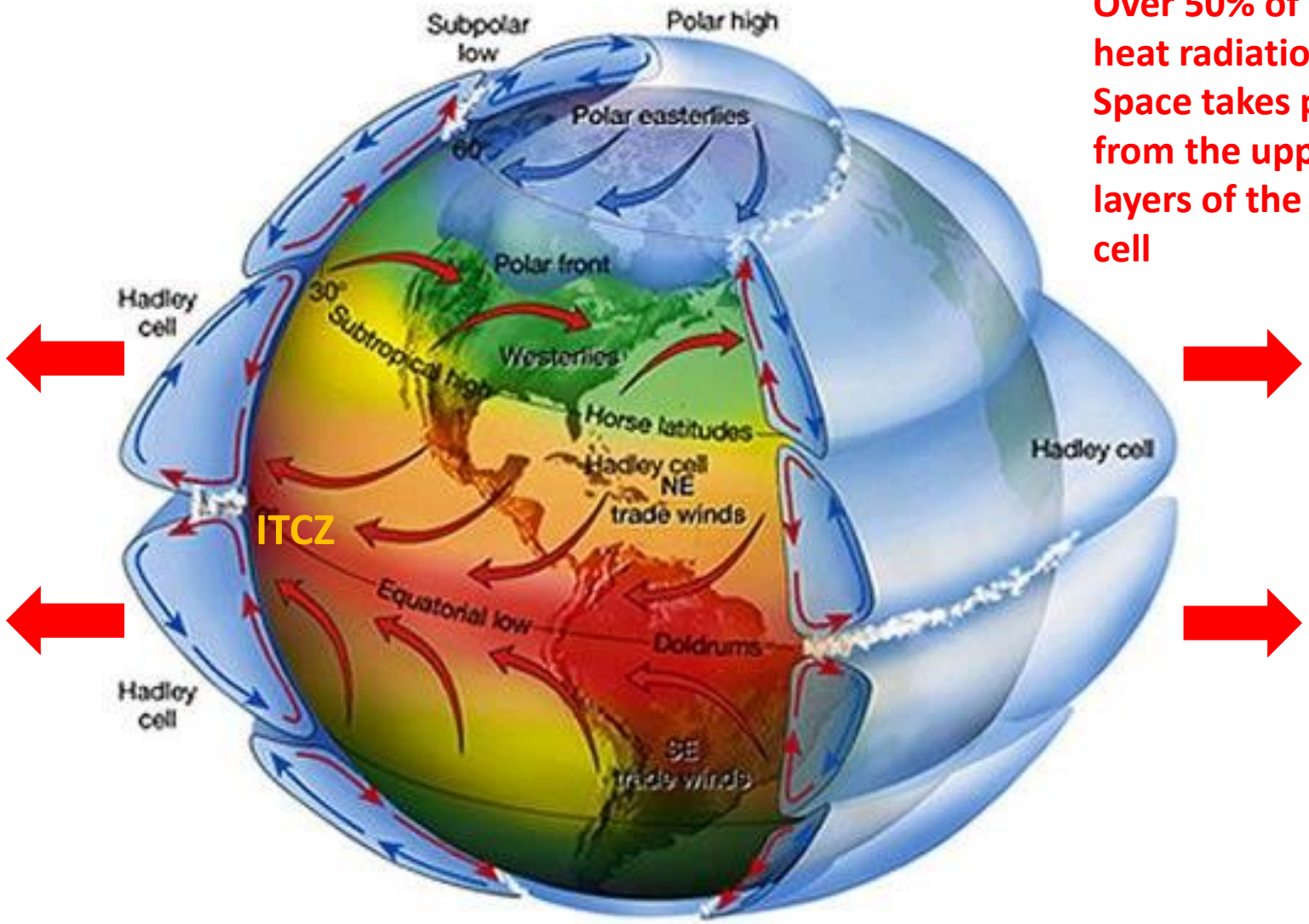
Idealized Tropospheric Circulation



ITCZ & Polar Front Storm Belts – Hi Precipitation

Horse Latitude & Polar Deserts

Over 50% of Earth's heat radiation to Space takes place from the upper layers of the Hadley cell



Efficient operation of the Hadley cell is crucial for Earth's heat balance!

Where would the vortex engine systems best be located?

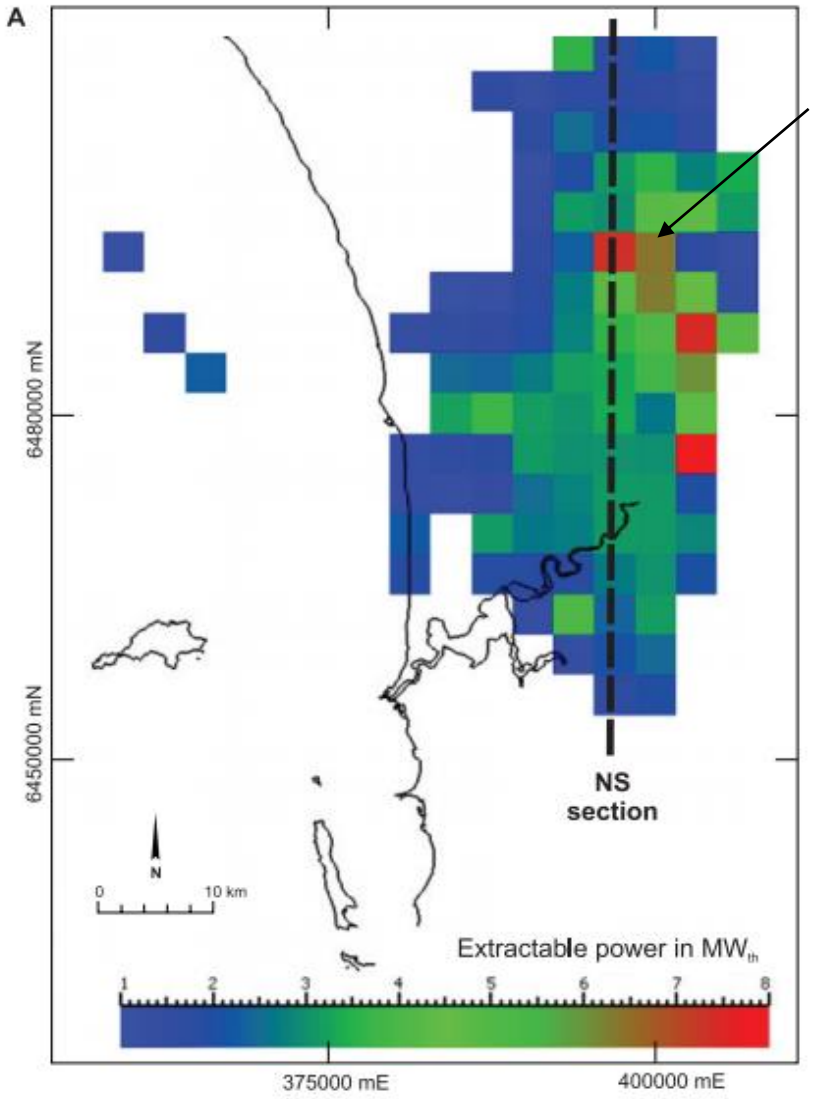
Sedimentary aquifer geothermal resources

Sedimentary basins of the world

Source: modified from www.glossary.oilfield.slb.com/DisplayImage.cfm?ID=15

http://www.curtin.edu.au/research/cusp/local/docs/geothermal-oldmeadow-marinova.pdf

Hot sedimentary aquifer example



Gnangara mound north of Perth, Western Australia

Figure 3.7: (a) Map view of summed reservoirs above 1 MW_{th} potentially fulfilling the parameters we defined for absorption chiller applications. Areas with reservoirs producing less than 1 MW_{th} are left white. The colour map shows the extractable thermal power. (b) Section view of target

Total sustainable yield approximately 200 MW_{th}

The Arabian peninsular (including the Persian Gulf and Red Sea) and that part of Asia within the ITCZ have excellent conditions for application of the vortex engine. These include:

- High convective available potential energy (CAPE)
- Good medium temperature geothermal resources
- Low crosswinds compared to temperate regions
- High sea surface temperatures

Will vortices work?

*'…**Nilton Renno**, a professor at the department of atmospheric, ocean and space sciences at the University of Michigan, has spent his career studying tornadoes and water spouts. He says there is no reason why [the] vortex engine wouldn't work.'*

Still, Renno isn't without reservations. He's particularly concerned about the ability to control such a powerful monster.

"The amount of energy involved is huge. Once it gets going, it may be too hard to stop," he says.

The Toronto Star, July 21 2007

"…'The science is solid,'… 'Once you induce circulation nearby, the vortex can be self-sustaining.'"

Discovery, Feb 28 2013

*"…What's necessary at this point is to do proofs of concept," says professor **Kerry Emanuel**, the hurricane expert at MIT. "[The] idea is pretty simple and elegant. My own feeling is that we ought to be pouring money into all kinds of alternative energy research. There's almost nothing to lose in trying this..."*

ODE Magazine, March 2008

Conclusions

- Convection within the troposphere is critical in order to prevent global warming
- Convection is currently significantly inhibited by several atmospheric mechanisms including:
  - Inversion layers
  - Atmospheric brown clouds
- The atmospheric vortex engine can arguably help to overcome these inhibitory factors and in doing so yield:
  - significant energy
  - additional local precipitation
  - a cooler global atmosphere
  - reduced atmospheric pollution

Thank you