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Future Climates for Pacific Islands Countries and Territories

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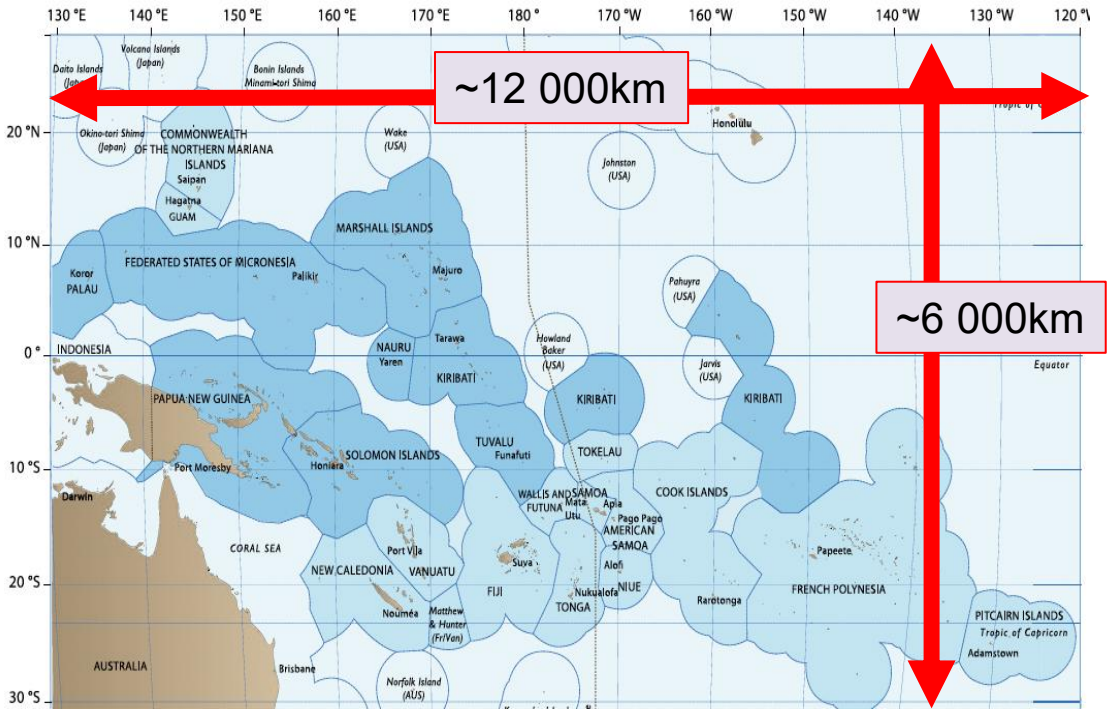
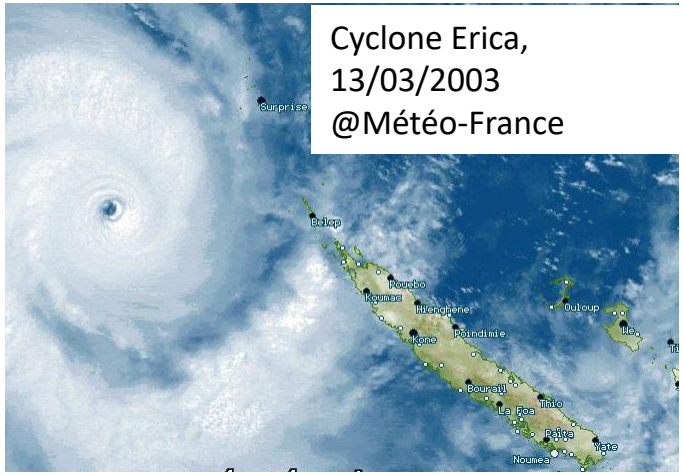
Future Climates for Pacific Islands Countries and TerritorieS (PICTS)

- The Tropical Pacific is composed of myriad of “small” islands which heavily rely on coastal and open-ocean resources (Tokelau: 80% of GDP comes from tuna fisheries)
- They are highly vulnerable to numerous natural hazards:
- Tropical cyclones, sea-level rise adding to extreme waves inducing coastal erosion threaten coastal settlements, especially for low-lying islands and atolls.





Cyclone PAM 2015 in Vanuatu (REUTERS/UNICEF)

- Knowledge on how these hazards will evolve with ongoing and future climate changes is crucial for public policies and national adaptation plans against climate change.

Future Climates for Pacific Islands Countries and Territories (PICTS)

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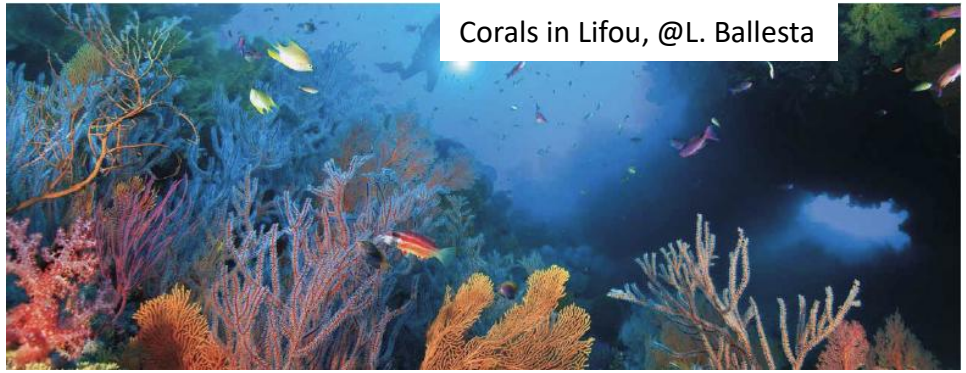
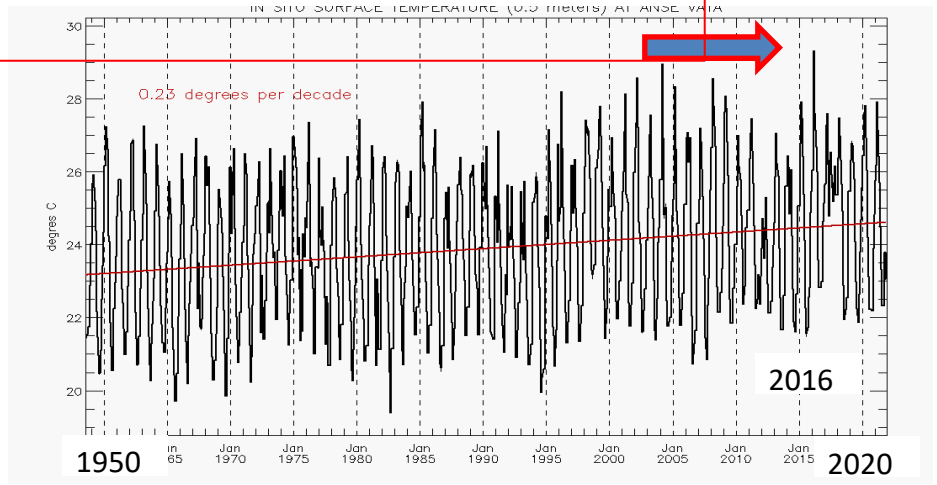
- **Coral reefs** are an exceptional reserve of **marine biodiversity** **Protective barrier** against the ocean's waves, key **economic** resource. Precious **cultural heritage** for many island and coastal populations.



Corals in Lifou, @L. Ballesta

- **Most threatened ecosystems**. **20% of the world's coral reefs** have already been destroyed (**marine heat waves**, urbanization…)

Nouméa, Anse Vata, New Caledonia

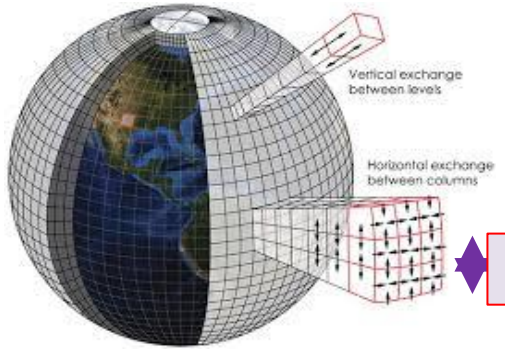


Coral bleaching @Fanny Houlbrèque, 2016

- **Preserving these ecosystems and putting in place sustainable management** methods at the heart of the Sustainable Development Goals (SDGs) adopted for the 2030 horizon by the United Nations and all its member states.

- PICTS, like others, plan to elaborate **marine planning**, **adaptation plans against climate changes** but can **current climate change information be used** to understand **local sectorial impacts** on socio-ecosystems ?

WHAT DO WE LEARN ABOUT THE PACIFIC CLIMATE IN GLOBAL CLIMATE MODELS ?

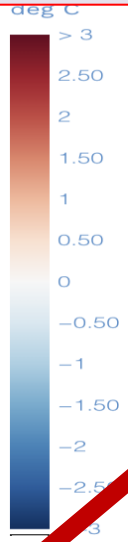


IPCC WGI Interactive Atlas: Regional information (Advanced)

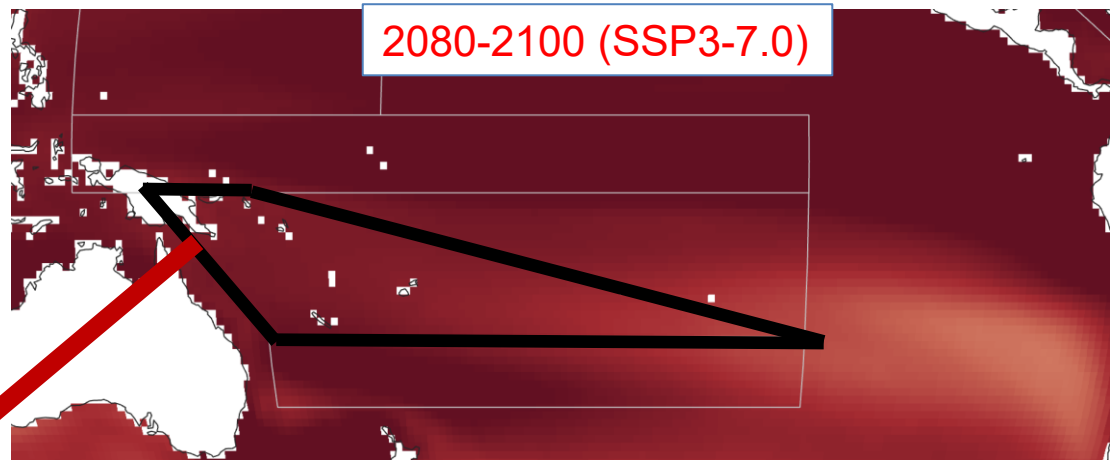
100-200km, meaning we only have 1 value (of Temperature) in a 100x100km square

SURFACE TEMPERATURE EVOLUTION IN 2040-2060 (SSP3-7.0)

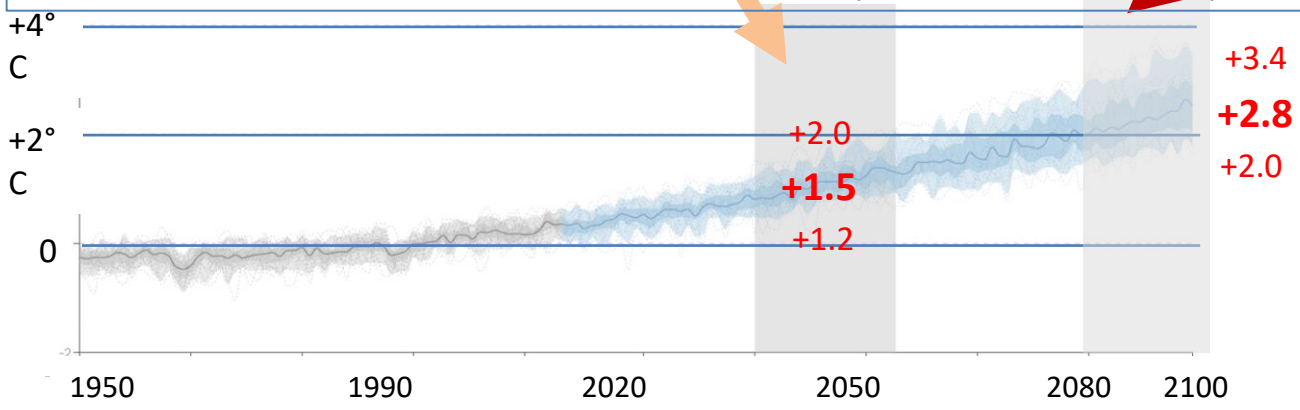
« SMALL ISLAND » REGION



2080-2100 (SSP3-7.0)



EVOLUTION OF OCEAN TEMPERATURE (SINCE 1850-1900) IN SOUTH PACIFIC BOX



- "Every fraction of a degree matters to the people already on the frontlines of the climate emergency. (Chikondi Chabvuta)
- **One value for 100-200km² is an enormous surface not adapted for PICTS and coastal planning**

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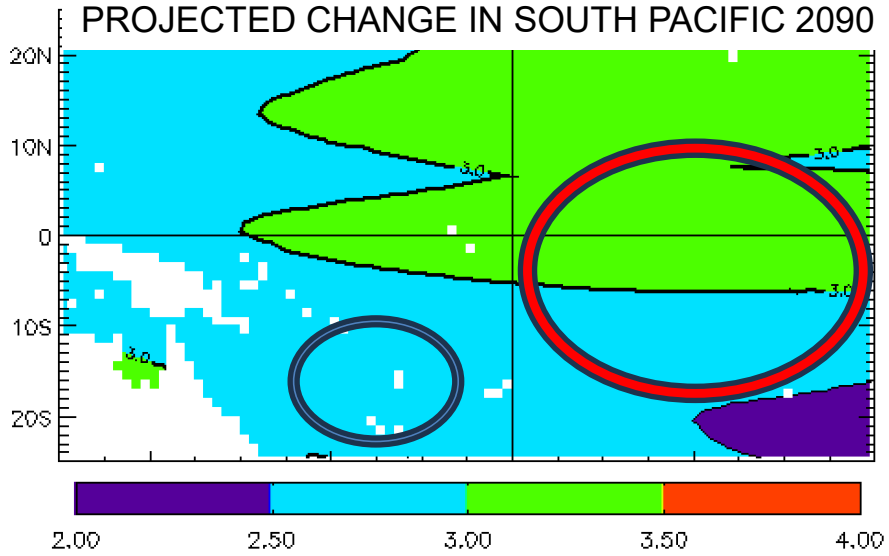
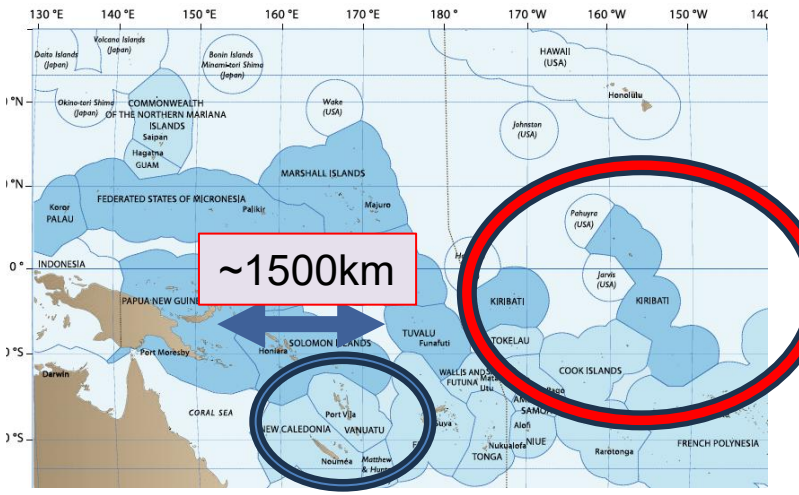
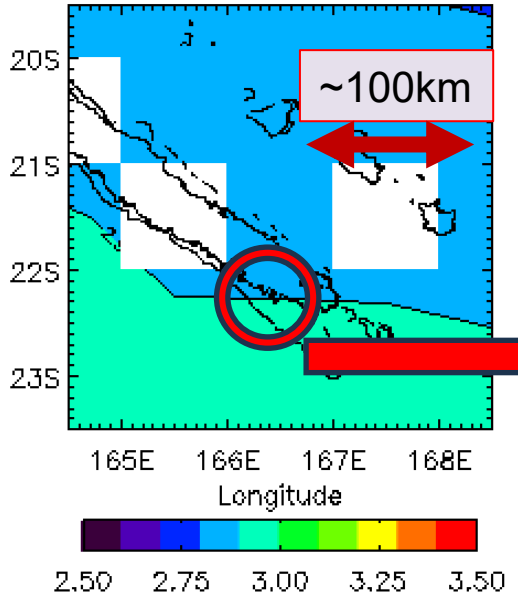
NOT THE RIGHT SCALES FOR PACIFIC ISLANDS

- Most PICTS are not at all represented in global climate models, which estimate local climates in ~100kmx100km boxes
- Very crude representation of "larger" countries.
- From global climate models there are very small variations in projected changes at EEZ scales (~1000km… true ?)
- Global models are not relevant for coastal and lagoon futures, which are a major target of public policies
- Precludes appropriate adaptation plans for Pacific Islands

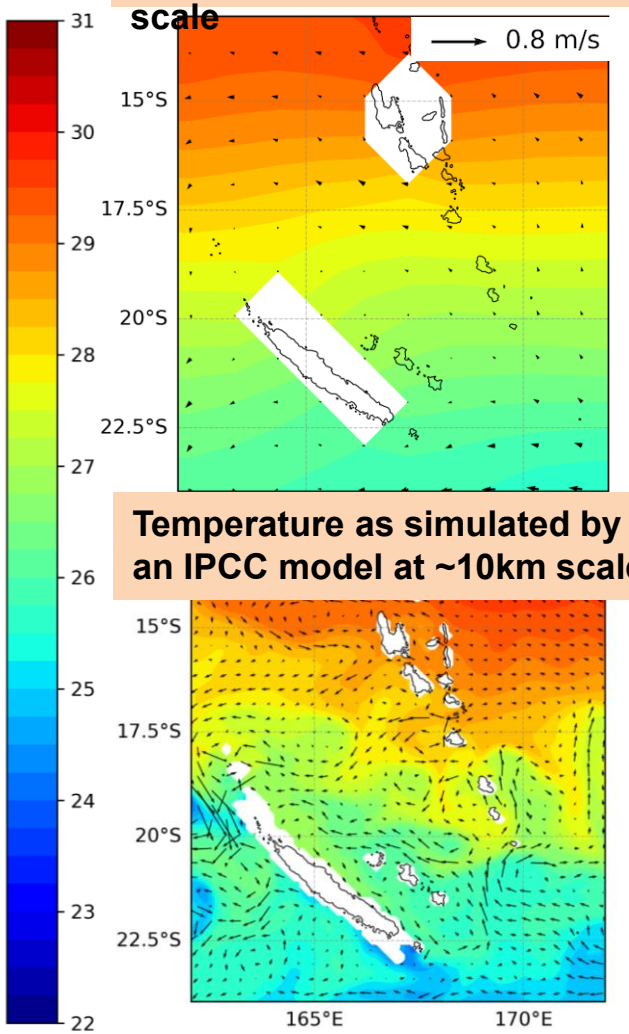




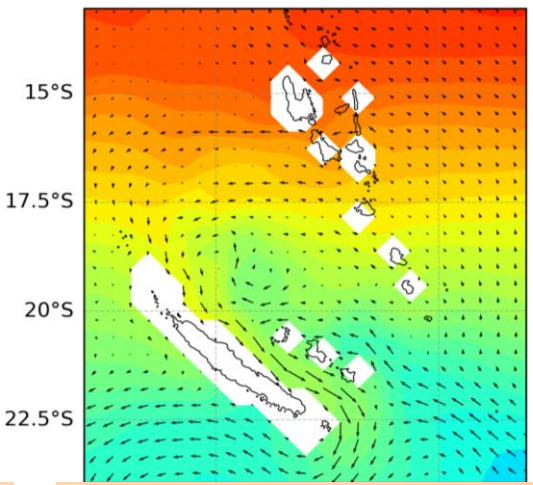


- An example of what is gained when going at a kilometer scales in the ocean
- At ~100km (IPCC models), the temperature is very uniform from east-west. Ocean currents are weak
- As spatial resolution is increased, currents and as temperature structures are developing. Much colder temperature are developing punctually in the 10km and 2km simulations in response to local processes.
- That is crucial because it shows that during marine heat waves, not all coastal regions will respond similarly.
- It is likely that the climate change warming signal will also be inhomogeneous unlike the homogenous response seen in IPCC model simulations.

Temperature as simulated by an IPCC model at ~100km scale

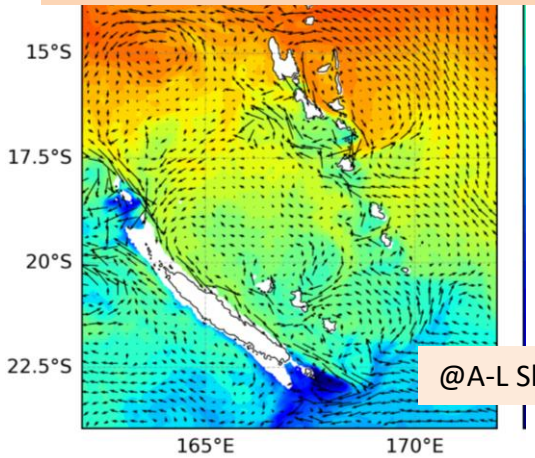


Temperature as simulated by an IPCC model at ~30km scale



Temperature as simulated by an IPCC model at ~10km scale

Temperature as simulated by an IPCC model at ~2km scale



@A-L Shaefer

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- From Global Models, the challenge is to provide regional climate information for the ocean and the atmosphere to understand climate change impacts on socio-ecosystems in PICTS
- Downscaling information from global models is called regional climate downscaling
- There are ongoing research programs to provide « regional climate » downscaling from multiple research groups : the « CORDEX » (https://cordex.org) experiments but for the atmosphere and not for small islands

CORDEX
Coordinated Regional Climate Downscaling Experiment

- That is just starting for Small Pacific Island Countries for the atmosphere (Evans and Menkes, 2025) IC-Pac, building on research programs such as CLIPSSA (https://clipssa.org/en/home/) aiming at providing island scale atmospheric simulations to feed 3 Pacific French territories and Vanuatu adaptation plans on agriculture.

Island Climate – Pacific (IC-Pac)

2 January 2025

CORDEX
Flagship Pilot Studies

CLIPSSA
CLIMAT DU PACIFIQUE, SAVOIRS LOCAUX ET STRATÉGIES D'ADAPTATION

METEO FRANCE

IRD
Déployer la recherche
Partager la science
Transformer l'avenir

AFD
AGENCE FRANÇAISE DE DÉVELOPPEMENT

- The ocean cannot be studied without the atmospheric input, but there is no internationally coordinated effort to provide regional simulations for the oceans at the island/EEZ scales at present.

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PROGRAMME PRIORITAIRE DE RECHERCHE OCÉAN & CLIMAT

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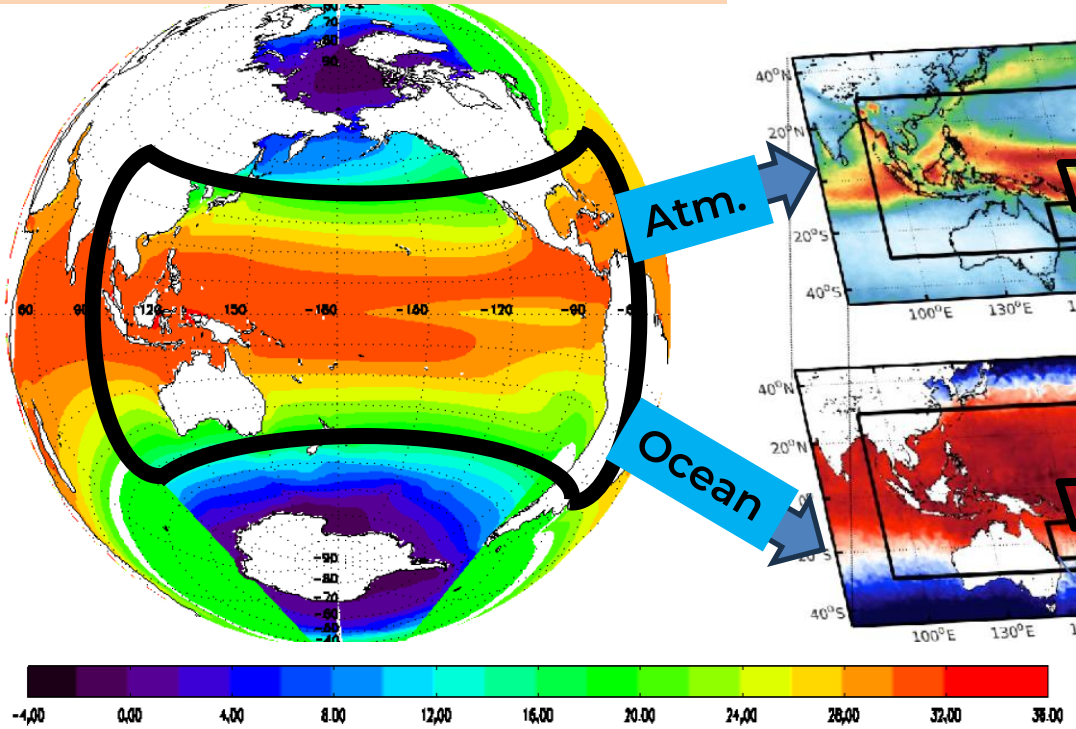
MaHeWa 2024-2028

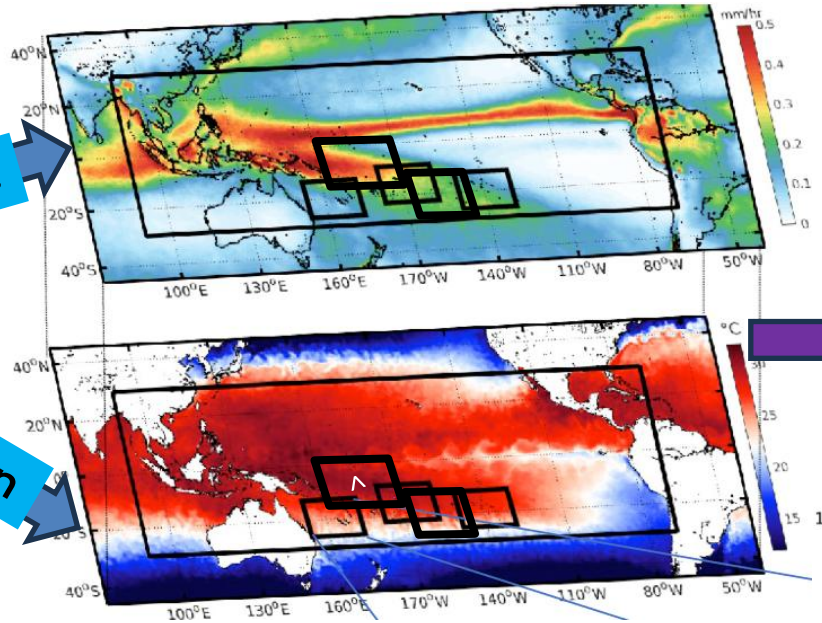
CLIPSSA CLIMAT DU PACIFIQUE, SAVOIRS LOCAUX ET STRATÉGIES D'ADAPTATION

- Ongoing ocean Island Scale climate downscaling for the Pacific Islands, the CLIPSSA, SPC-IRD climate Flagship and MAHEWA (marine heat waves, https://mahewa.fr/) research programs:
- Building on climate simulations from IPCC, the purpose is to provide, ocean (and atmosphere) regional simulation at Pacific Island EEZ scales for the future to feed country adaptation plans (e.g marine heat wave impacts)

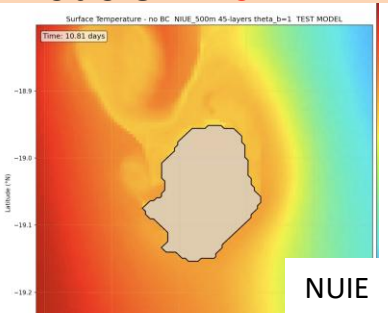
1- IPCC Global Model Simulations ~100-200 km: (1950-2100)



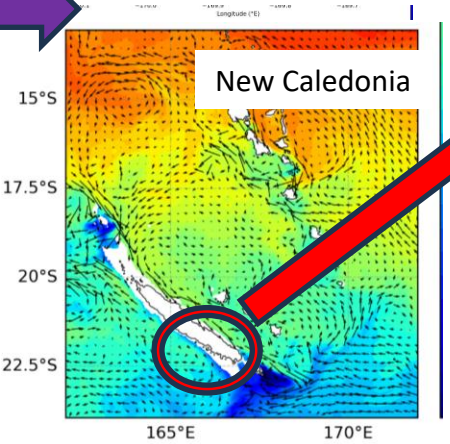
2- Regional Climate Models ~10-20 km (1950-2100)



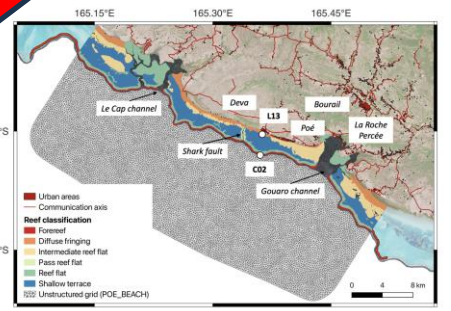
3- EEZ/Island Climate models ~1-3km



@Gabriela Mayorga-Adame



4- Coastal climate models for public policies: biggest challenge ~10m



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CONCLUSIONS

- The future climates of Pacific Island Countries and Territories cannot be assessed by IPCC global climate models due to their coarse resolution.
- Because global climate model information is not adapted, obtaining pertinent climate information at Island and EEZ scales is not available at present but is a prerequisite to build sectorial policies and future adaptation plans
- Our goal is, like CORDEX in other regions, to provide to countries open access, internationally coordinated climate simulation (next 100 years) for the Pacific Island EEZs at ~2km scales, in the atmosphere (IC-PAC cordex, starting, no funding at present) and in the ocean (coordinated experiments need funding too !).
- For Pacific Countries, there key challenges on data access, data storage, data managements, computer capacities, climate science education and capacity building !!
- For islands, another major challenge of climate research in the coming years will be to also provide climate change information at the scales pertinent to coastal socio-ecosystems such as lagoons <50m.

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