Climate Change Impact on Plant Pests and Diseases and on Weeds

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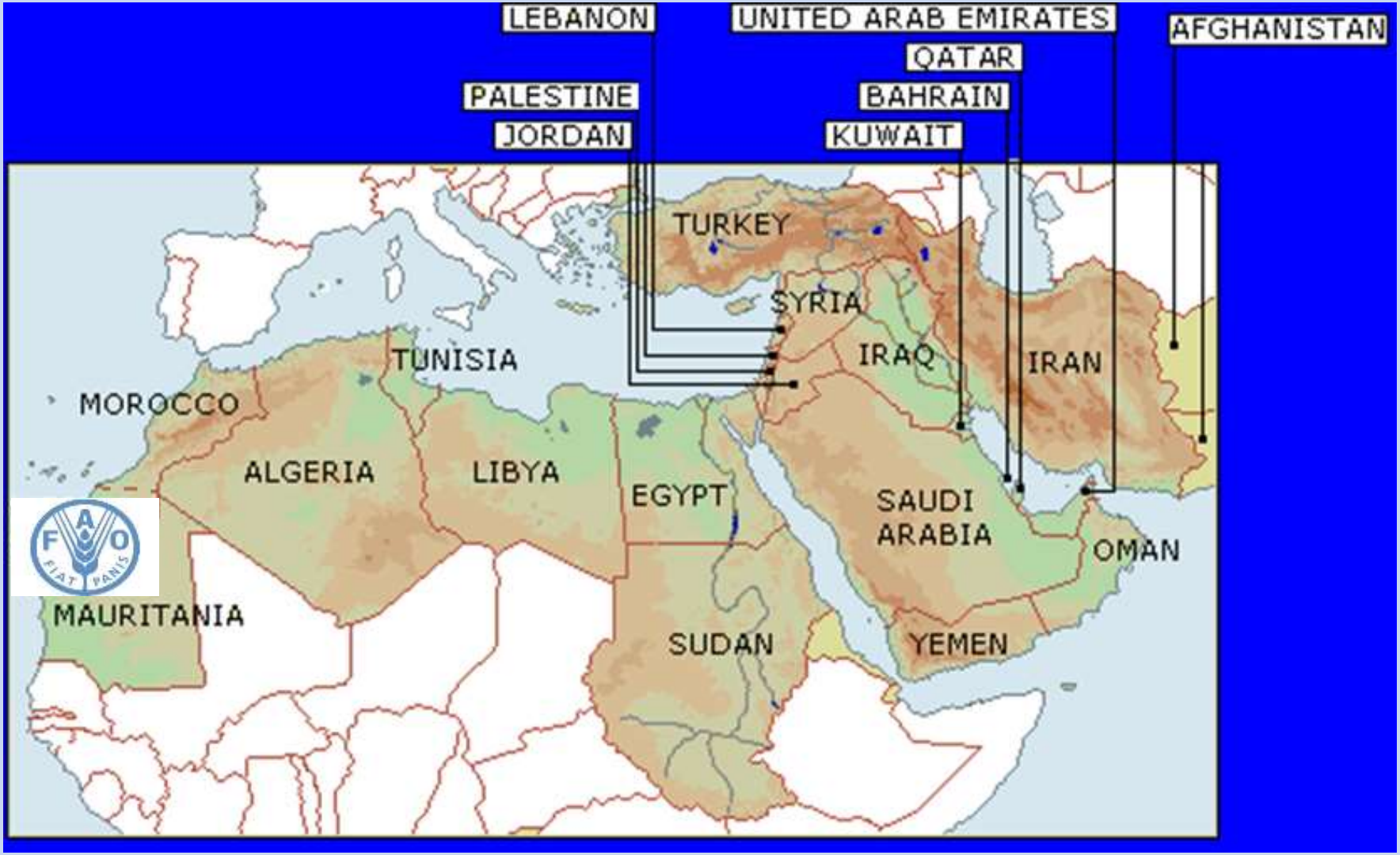
- Consultation Workshop on the NERC 34th Document -
(Rabat, Morocco, 5-6 February 2018)

NENA Countries



Climate Change Components

3 Components:

Temperature: Globally increasing

Moisture: Changing, depending on the area

CO_2: Increasing in the atmosphere

Climate change not uniform in the world

Some areas → **Hotter and dryer**

Other areas → **Wetter**

Climate Change Components

Extreme climatic phenomena:

Very high temperatures,

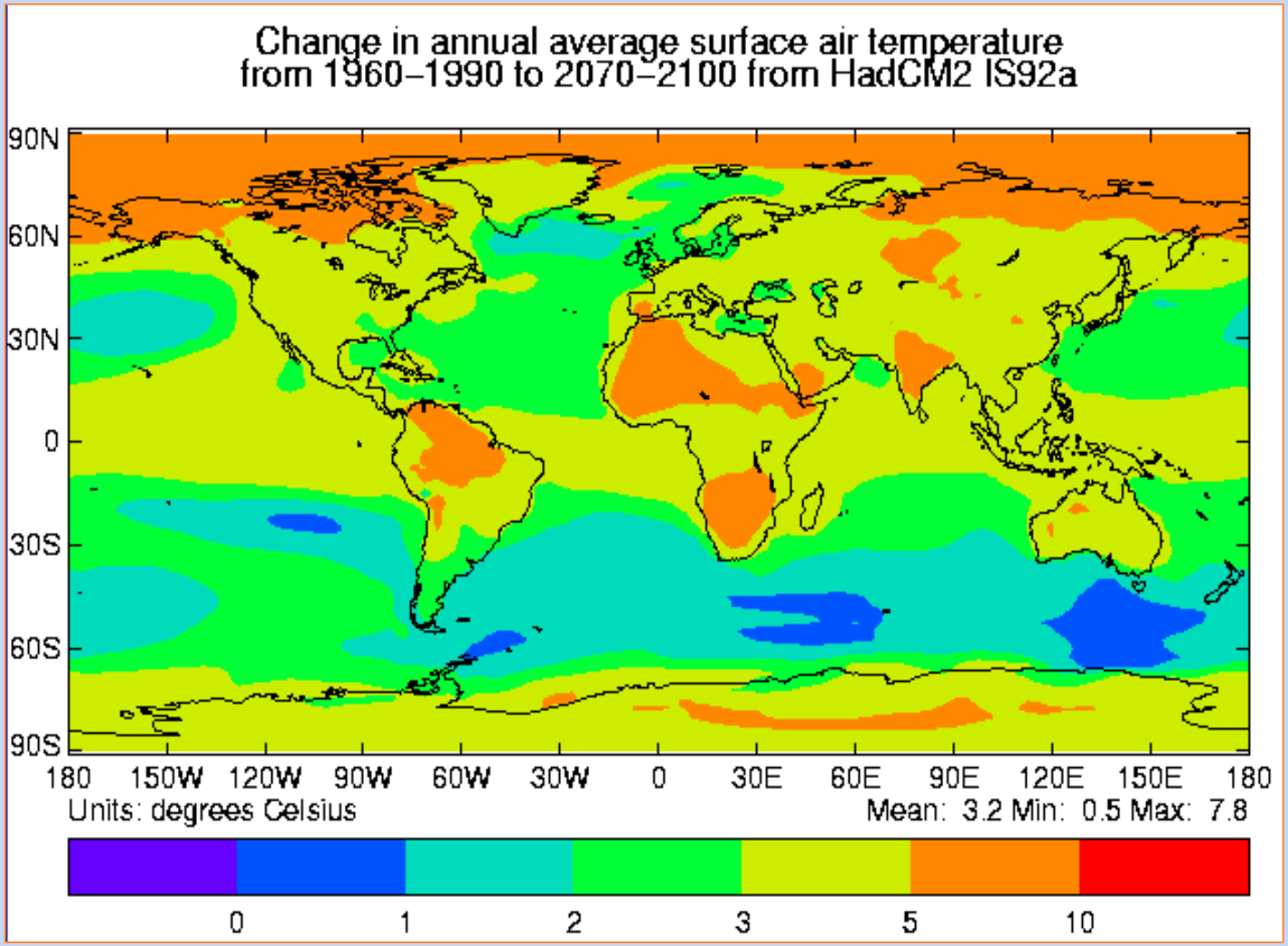
Unusual flooding, …..,

Would be more and more frequent

Climate change: Crucial impacts on plant pathogens and pests and on weeds

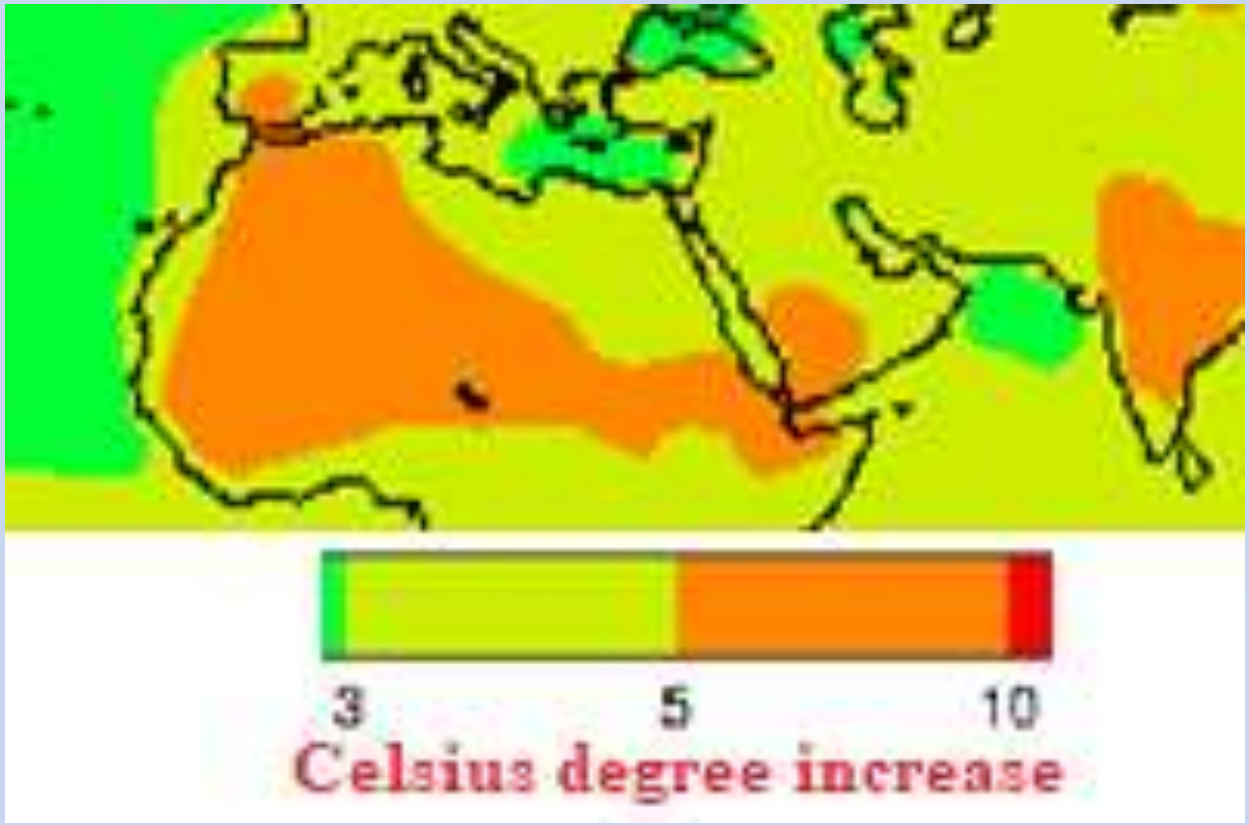
Temperature change in the world:

From 1960/1990 to 2070/2100



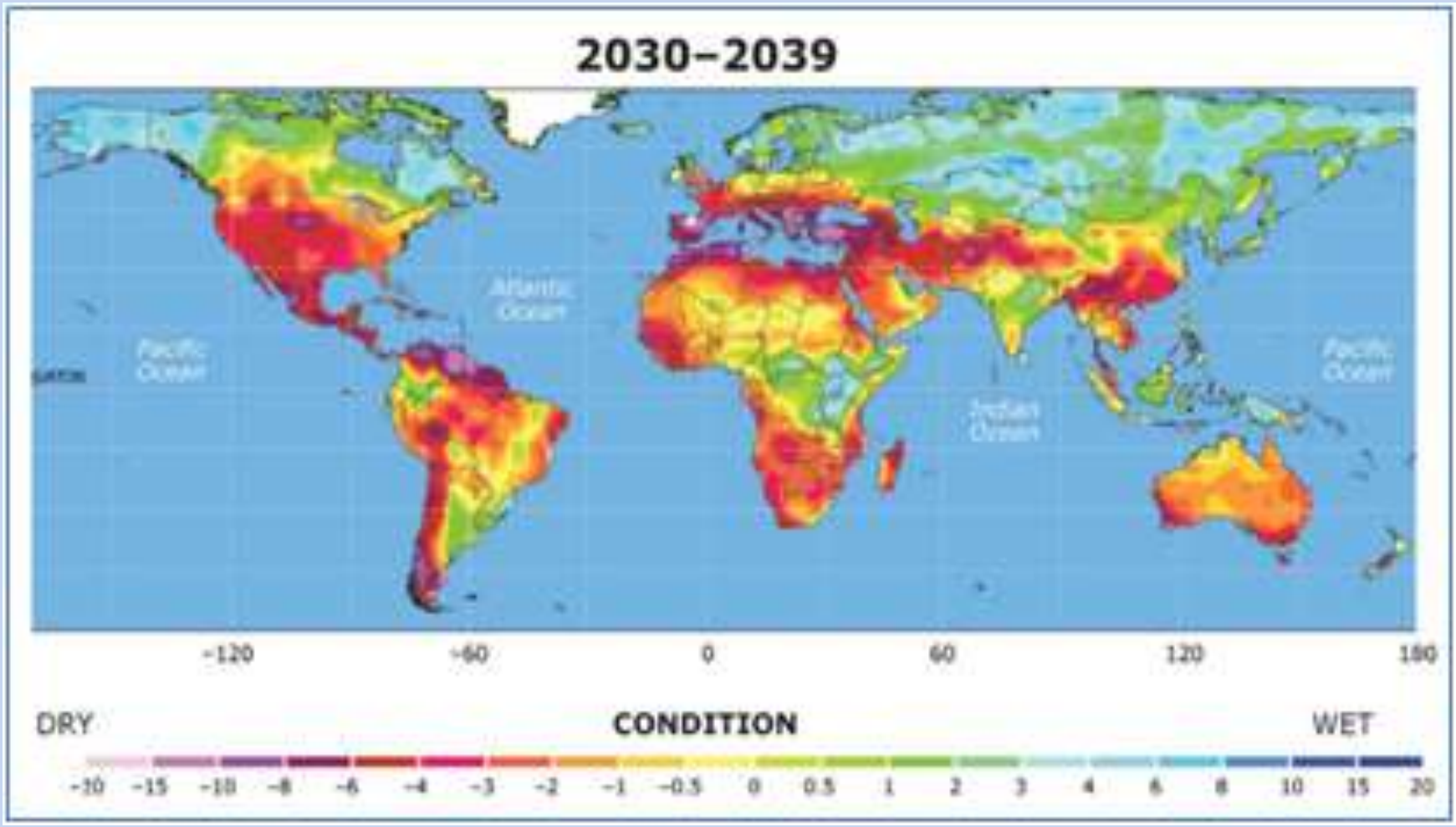
Temperature increase in NENA Region:

From 1960/1990 to 2070/2100



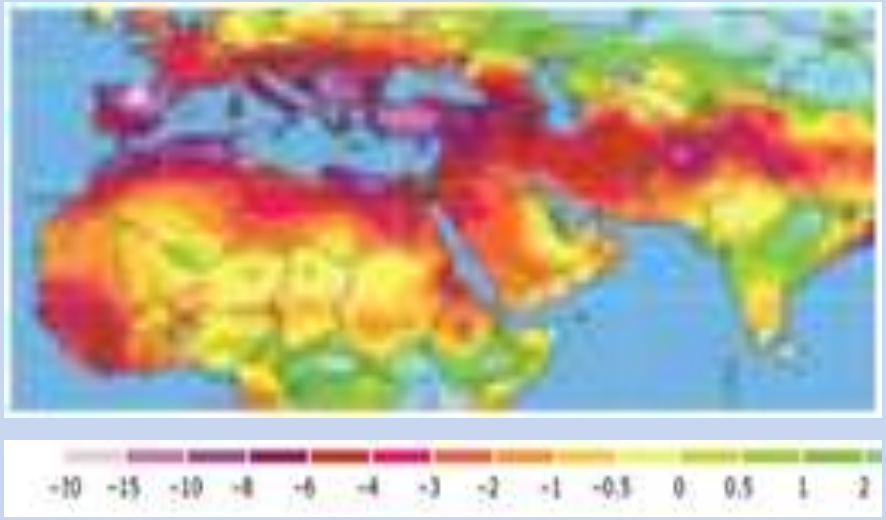
Moisture change in the world:

Precipitation change during the 2030's



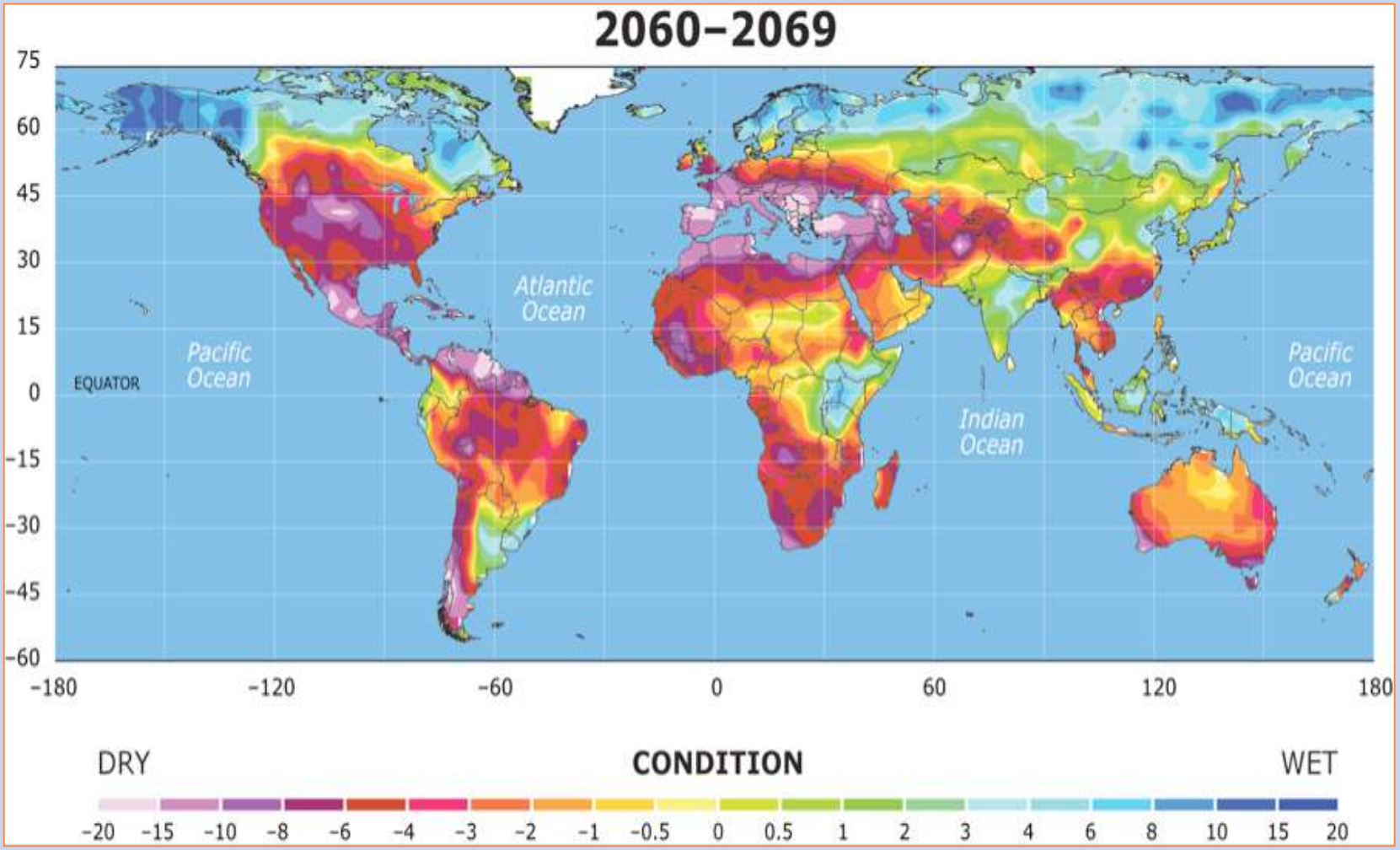
Moisture change in NENA Region:

Precipitation change during the 2030's



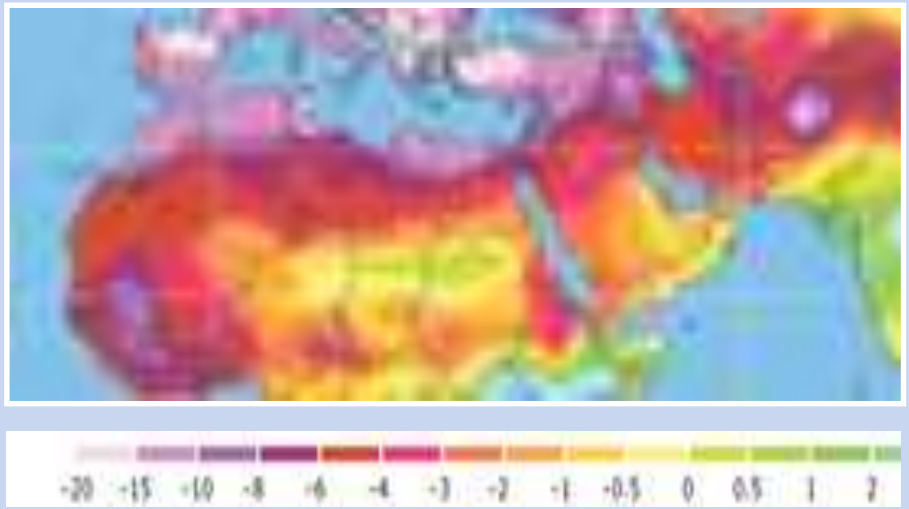
Moisture change in the world:

Precipitation change during the 2060's



Moisture change in NENA Region:

Precipitation change during the 2060's



Climate Change Impact

Plant Pathogens

Climate Change Impact

Three factors needed for a disease development:
(1) Pathogen in contact with (2) host Plant, and (3) Environment favorable.

Environmental change, affects disease severity in:

- Plant: resistance, growth, development,…

- Pathogen: multiplication, virulence, dispersal,…

Climate change: affects occurrence and epidemic evolution of plant diseases

Climate Change Impact:
Rising Temperature / Pathogens

Usually, pathogens develop best on plants in moderate temperatures (often 10-30 °C)

Global warming: low temperature areas → temperatures increase → areas harbor more pathogens under suitable temperatures, and plants might be less resistant

Climate Change Impact: Rising Temperature / Pathogens

Examples:

- **Potato late blight (*Phytophthora infestans*): develops well between 7 and 27 °C → earlier seasonal temperature increase (global warming) → earlier pathogen attacks → more severe epidemics → more fungicide treatments.**

- **Cereal Fusarium diseases (*Fusarium* spp.): Favored in drought stressed plants → with temperature increase → more severe attacks**

Climate Change Impact:
Rising Temperature / Pathogens

Examples:

- Cereal stem rust (*Puccinia graminis*): adapted to relatively high temperatures → develops in new areas where temperatures would turn from medium to slightly higher.

- Cereal leaf rust (*Puccinia recondita*): epidemic late season → develop earlier due to earlier increase of temperatures during the season.

Climate Change Impact: Rising Temperature / Pathogens

Examples:

- Cereal yellow rust (*Puccinia striiformis*): already heat-tolerant races exist → disease spreading more as epidemics (already adapted to global warming).

- *Barley yellow dwarf virus*: More drought → increase the spread aphids (virus vectors) → more epidemic disease.

Climate Change Impact:
Changing Moisture / Pathogens

Examples:

- With frequent and extreme precipitations → moisture increases greatly → more favorable to many diseases: Beet tumor (*Urophlyctis leproides*), Apple scab (*Venturia inaequalis*), Potato late blight (*Phytophthora infestans*),…

Climate Change Impact: Changing Moisture / Pathogens

Examples:

- **With lower precipitations → moisture decreases → more favorable to other diseases: Powdery mildew (*Erysiphe* spp.).**

- **More precipitations → plant sizes bigger → more shade, less sunrays → higher moisture: favorable to many diseases.**

Climate Change Impact: Increasing CO_2 / Pathogens

- Industrial activities → releasing more and more CO_2 in the atmosphere → higher CO_2 level intensifies plant growth → bigger canopies → higher moisture favorable to the majority of pathogens.

- Higher CO_2 levels induce intense sporulation of many fungal pathogens → higher spore dissemination and survival → more diseases.

Climate Change Impact: Increasing CO_2 / Pathogens

- Higher CO_2 level → slow down crop residue decomposition → better conditions to overwintering pathogens → diseases start with higher levels of inoculum → earlier and faster disease epidemics.

Climate Change Impact

Plant Insect Pests

Climate Change Impact

Climate Change influences insects: survival, development, geographic habitat, population size,…

Since insects are cold-blooded organisms

Temperature has the major effect on these pests, (compared to Moisture and CO_2)

Climate Change Impact: Rising Temperature / Insects

- Rising temperature → accelerate insect development → more generations/year.

- Warmer winter temperature → lower winter insect mortality → increase their populations.

- Insects colonize cold areas + high altitudes more than before

Climate Change Impact:
Rising Temperature / Insects

Insect natural enemies/rising temperature → insect develops/passes rapidly through the vulnerable life stages before parasitoid emergence → parasitism reduced

Window of parasitism opportunity:

closed or very reduced

Climate Change Impact: Rising Temperature / Insects

Examples:

- Potato beetle (*Leptinotarsa decemlineata*), would extend with rising temperature.

- Pea leaf miner (*Liriomyza huidobrensis*), would extend in warmer winter areas.

- Corn moth (*Ostrinia nubilalis*), would be able to produce additional generations.

Climate Change Impact: Rising Temperature / Insects

Examples:

- Cabbage worm (*Pieris brassicae*), would increase in diversity, range and abundance with rising temperature.

- Gypsy moth (*Lymantria dispar*), would increase in outbreaks in future warmer areas.

- Pine processionary (*Thaumetopoea pityocampa*), would enhance its overwintering in warmer climate.

Climate Change Impact: Rising Temperature / Insects

- **Rising temperature → not allow farmers to grow anymore some crop species → closely specific insects decrease in populations.**

- **Insect populations reduced → become insufficient for their natural enemies (pathogens, parasitoids, predators) → that endangers useful living organisms.**

Climate Change Impact: Changing Moisture / Insects

- Some insects largely extend in areas becoming very rainy, others are sensitive to heavy rain removing or killing them.

- Populations of rain-preferred insects would be reduced in areas becoming dryer, leaving space to new insect populations more adapted to drought.

Climate Change Impact: Increasing CO_2 / Insects

Experiment:

Soybean grown under higher CO_2 atmospheric concentration → more damaged by a range of its insects: probably more simple sugars in leaves stimulates more pest feeding.

Climate Change Impact

Invasive Weeds

Climate Change Impact: Invasive Weeds

- **Rising temperature → enhances invasive weed expansion into higher altitude and latitude.**

- **More rainfall and moisture → fevores invasive weed development.**

Climate Change Impact: Invasive Weeds

- Higher CO_2 level → stimulates invasive weed photosynthesis.

- Any factor that increases the environmental stress on crops → makes them less competitive against weeds.

Climate Change Impact: Bioaggressor Management

- More crop bioaggressors → need more pesticide treatments → more resistance risk + more environment pollution.

- Slower decomposition of crop residues → increase pathogen inoculums and pest populations → harder management.

(Bioaggressors: Pathogens + Insect pests + Weeds)

Climate Change Impact: Bioaggressor Management

Exclusion and quarantine regulation of bioaggressors → become more difficult for authorities because they appear and evolve more frequently on more crops.

(Bioaggressors: Pathogens + Insect pests + Weeds)

Thank You