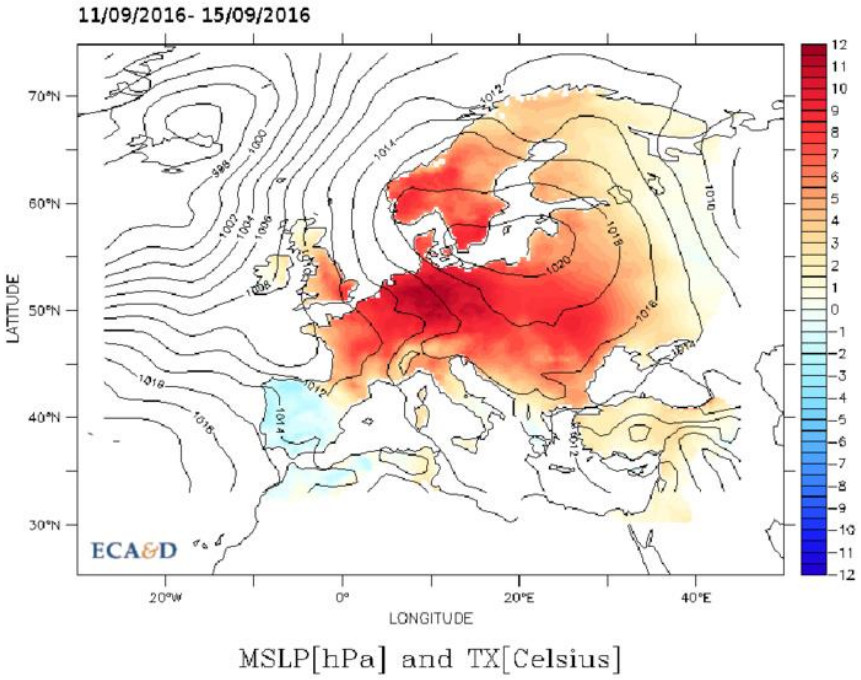
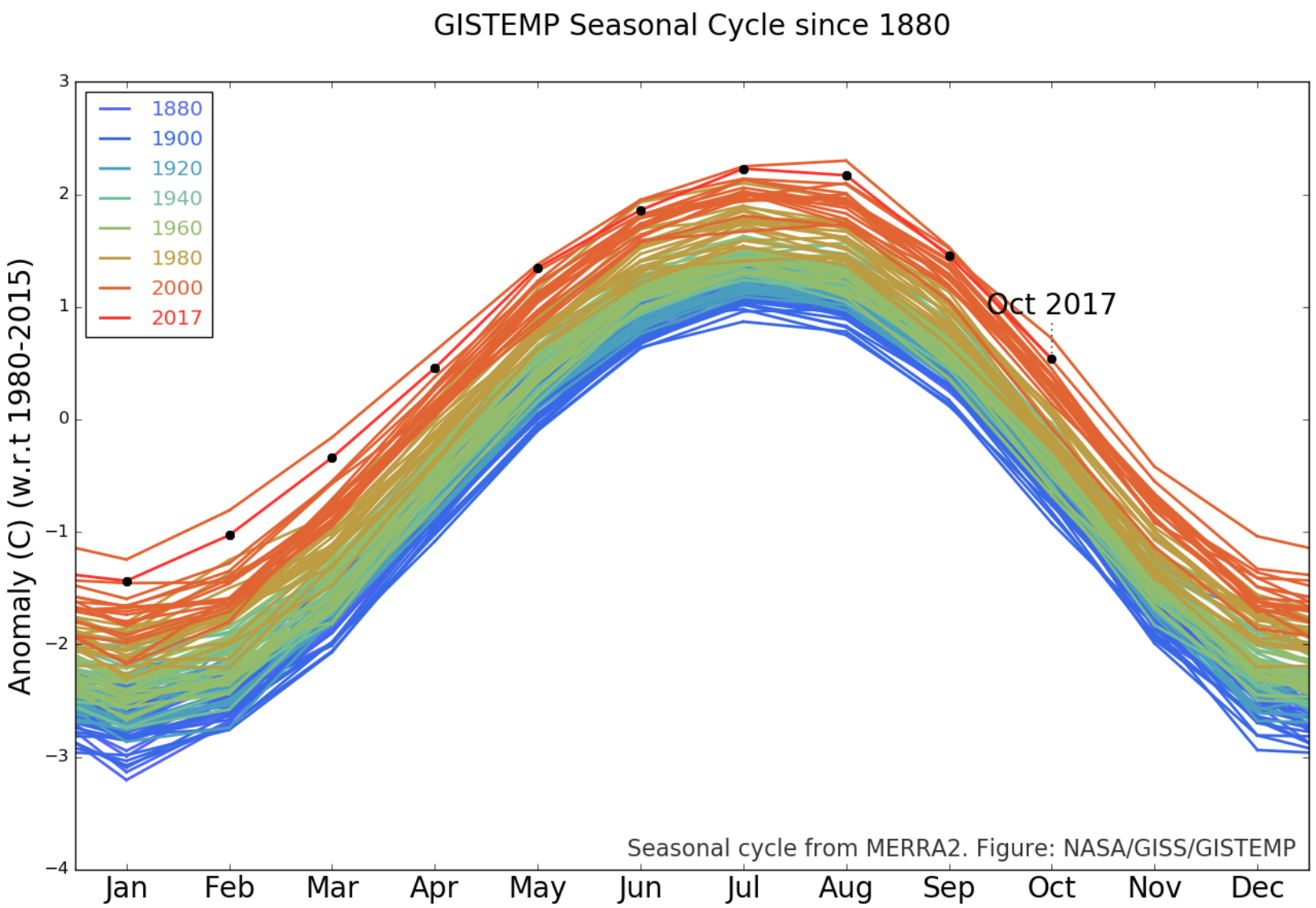
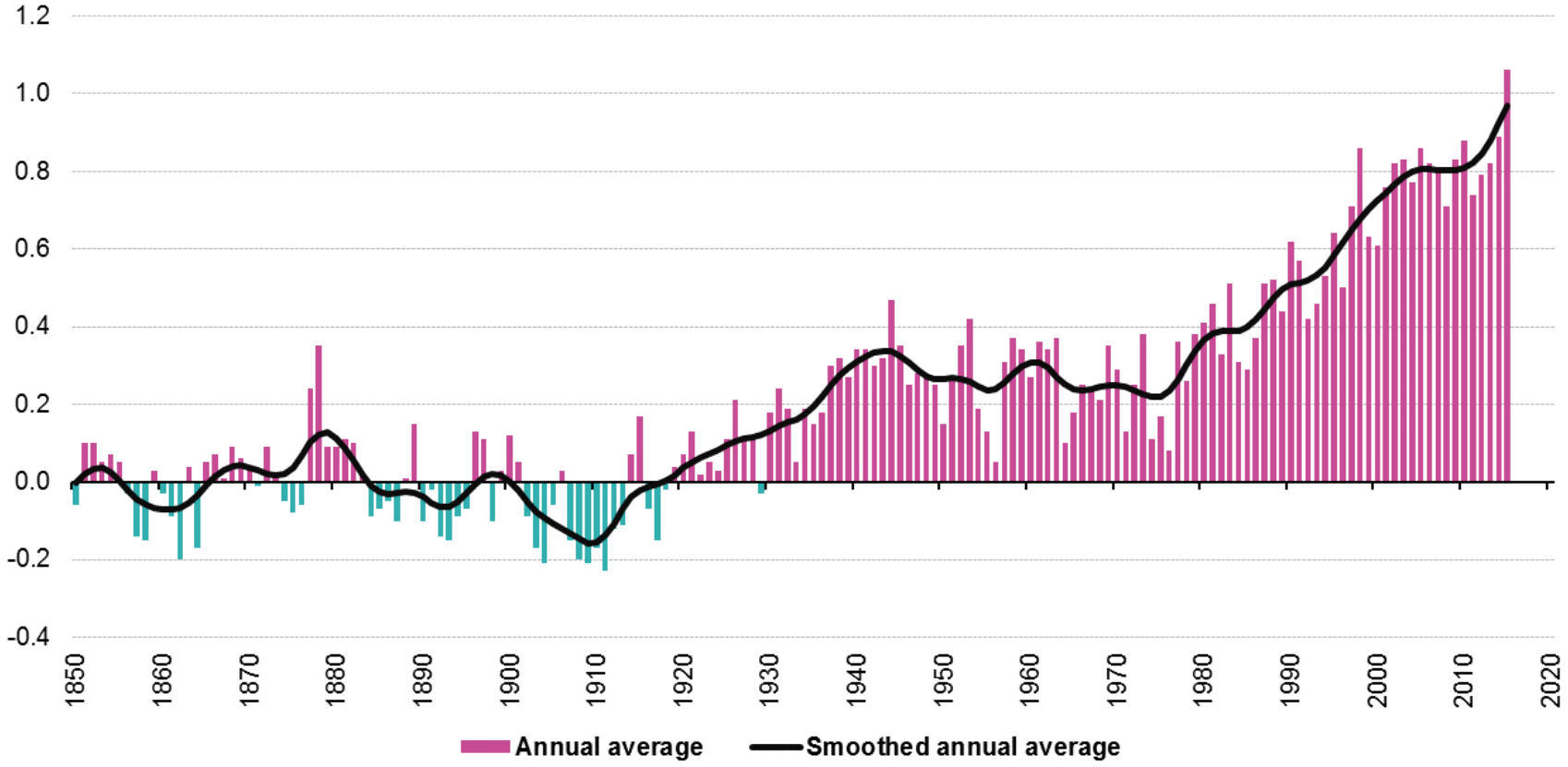


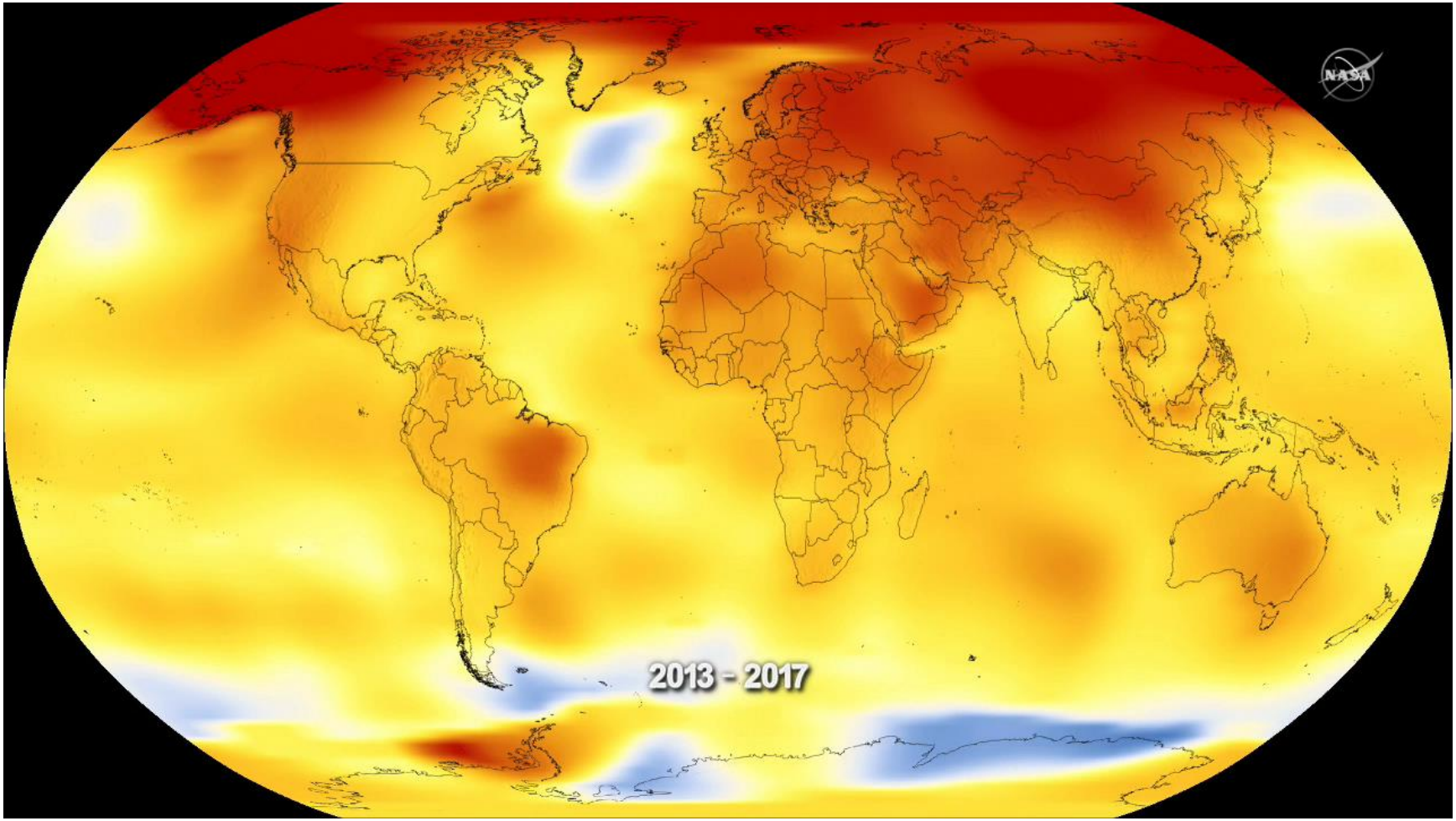
Climate changes and impacts on beekeeping sector

Etienne BRUNEAU - Graz, 24 février 2018


GISTEMP Seasonal Cycle since 1880
1880
1900
1920
1940
1960
1980
2000
2017
Oct 2017
Anomaly (C) (w.r.t 1980-2015)
3
2
1
0
−1
−2
−3
−4
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Seasonal cycle from MERRA2. Figure: NASA/GISS/GISTEMP

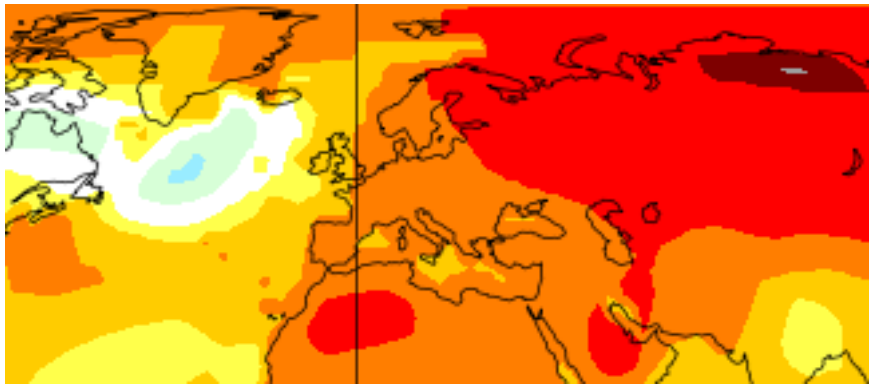
Temperature deviation in EU in °C in comparison with1850 1899



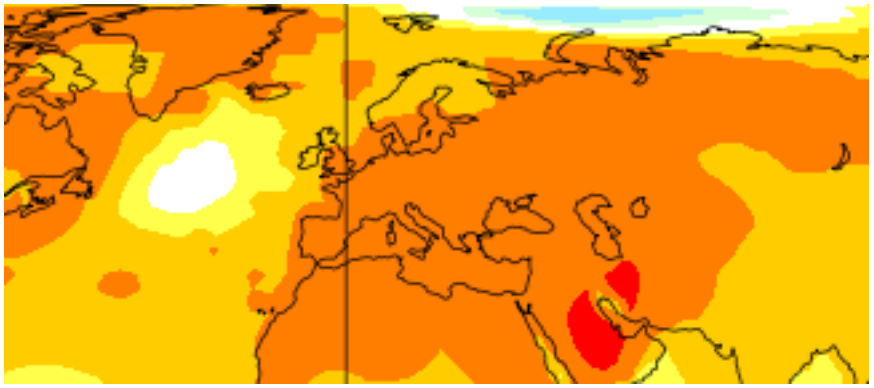

NASA
2013 - 2017

Climate Change (5 years)

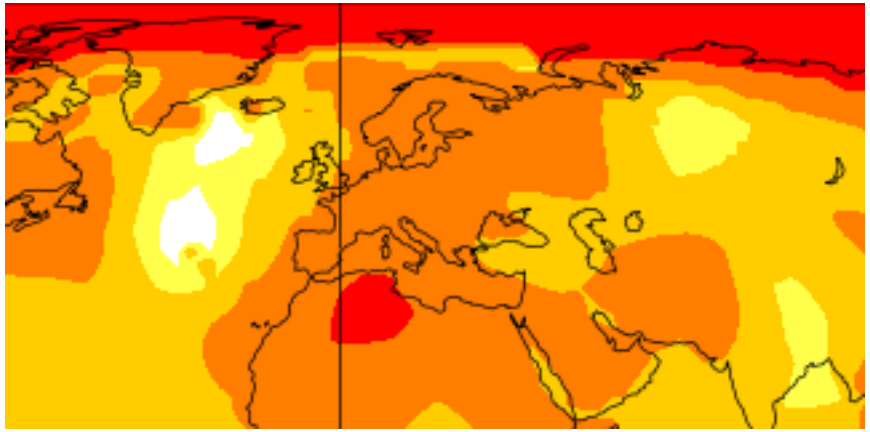
- Spring



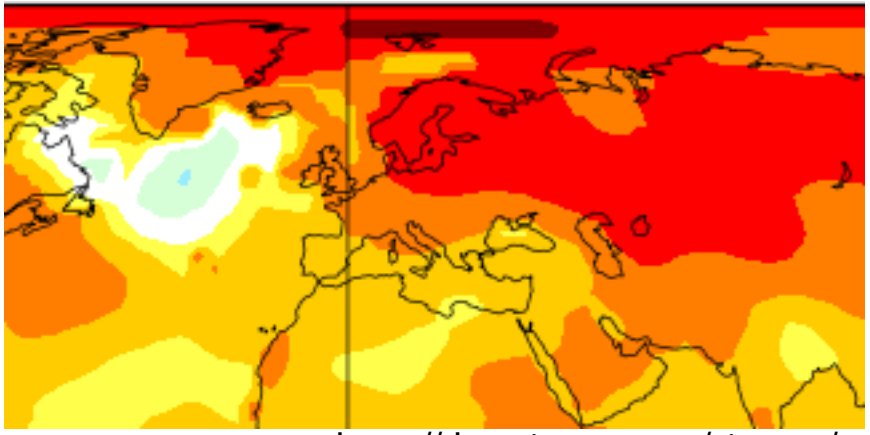
Summer



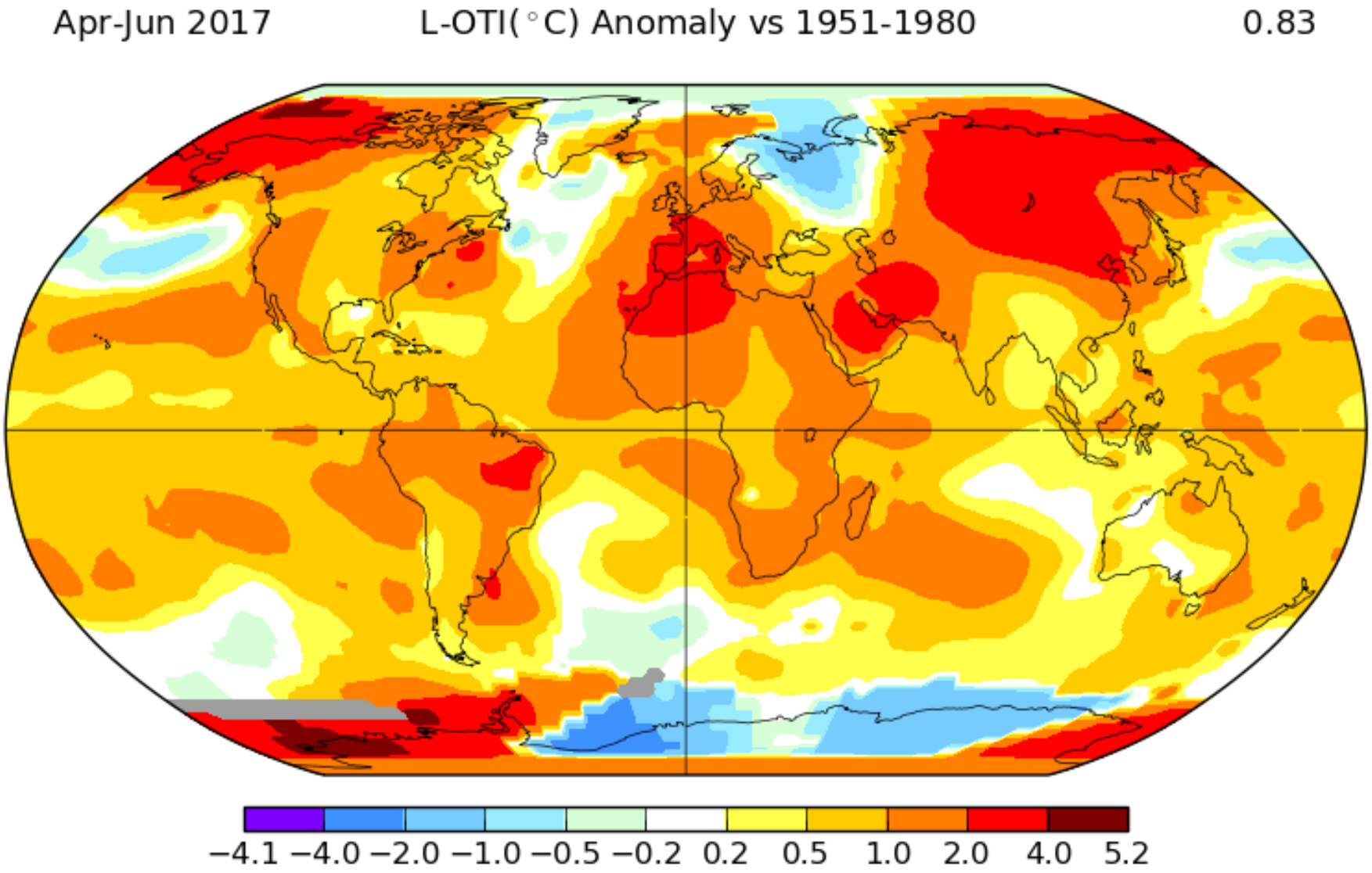
- Automn



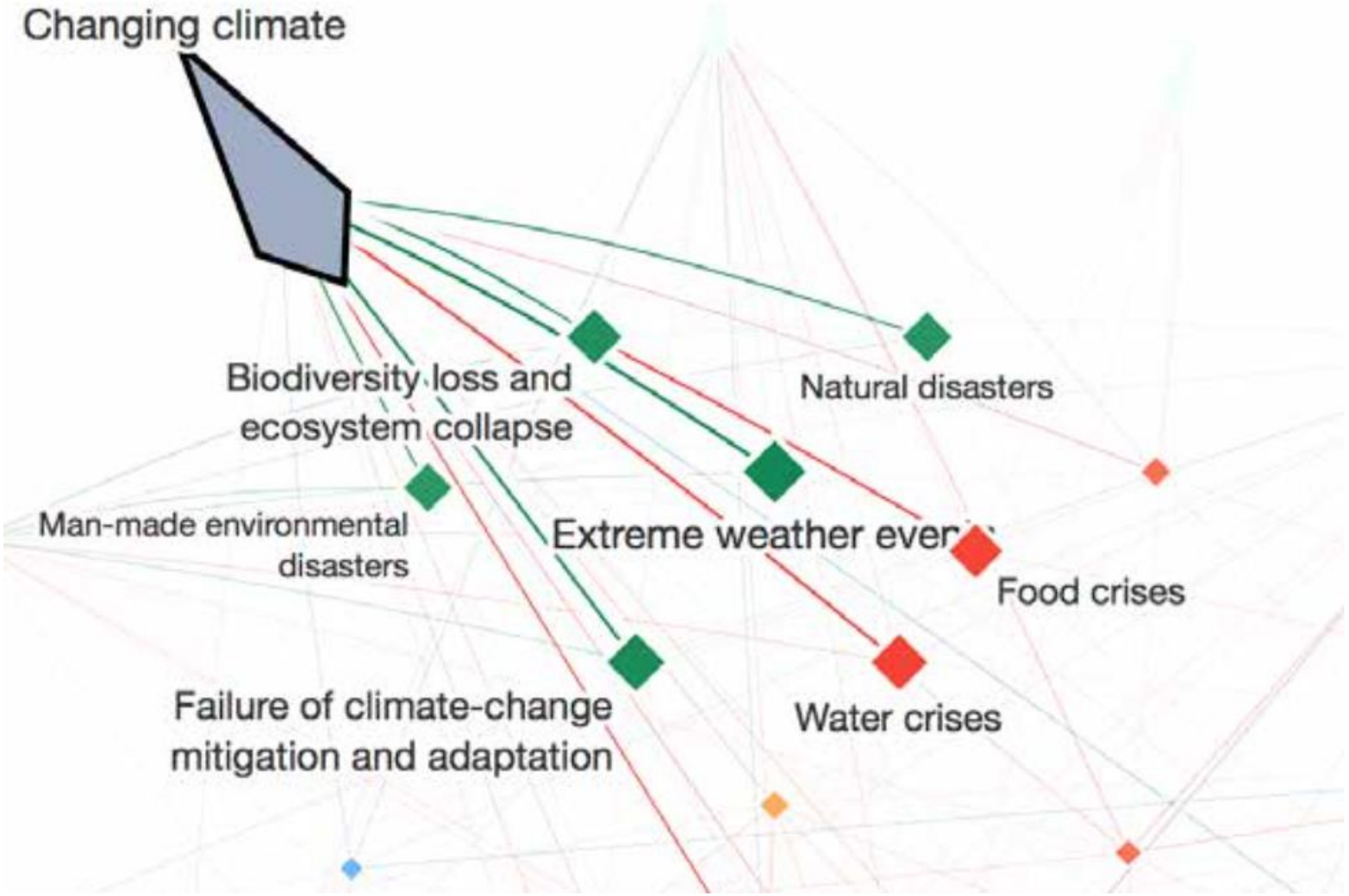
Winter



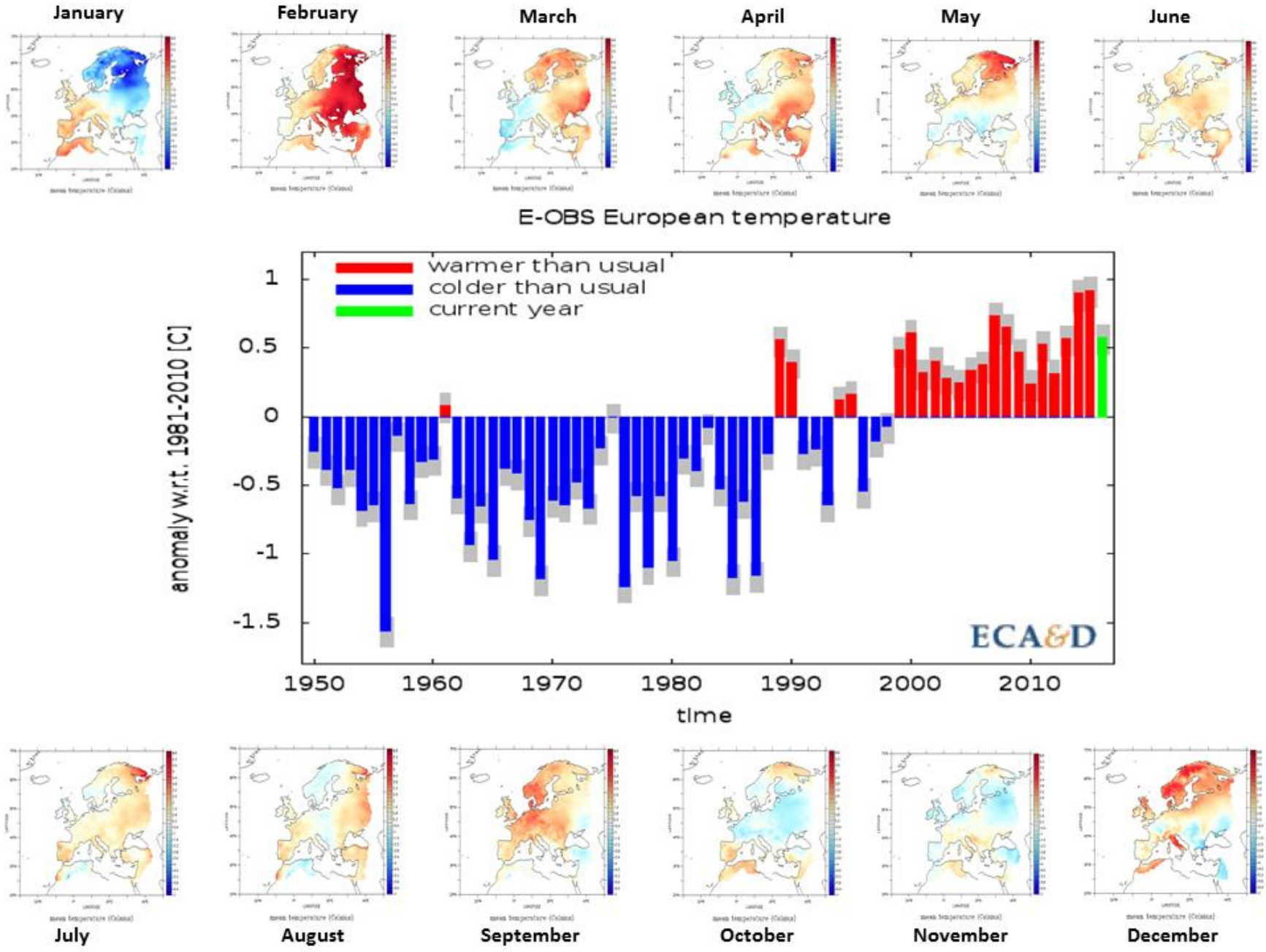
https://data.giss.nasa.gov/gistemp/


Apr-Jun 2017
L-OTI(°C) Anomaly vs 1951-1980
0.83
−4.1 −4.0 −2.0 −1.0 −0.5 −0.2 0.2 0.5 1.0 2.0 4.0 5.2

Global risk most connected to Climate Change



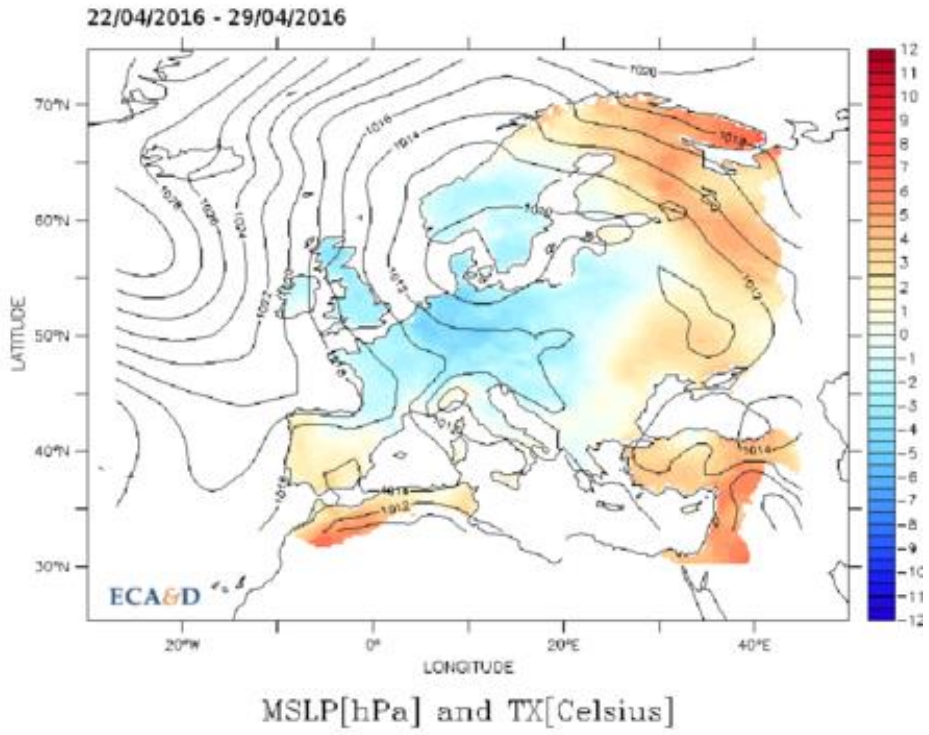
http://energyforhumanity.org/wp-content/uploads/2017/11/European_climate_leadership_report_2017_WEB.pdf

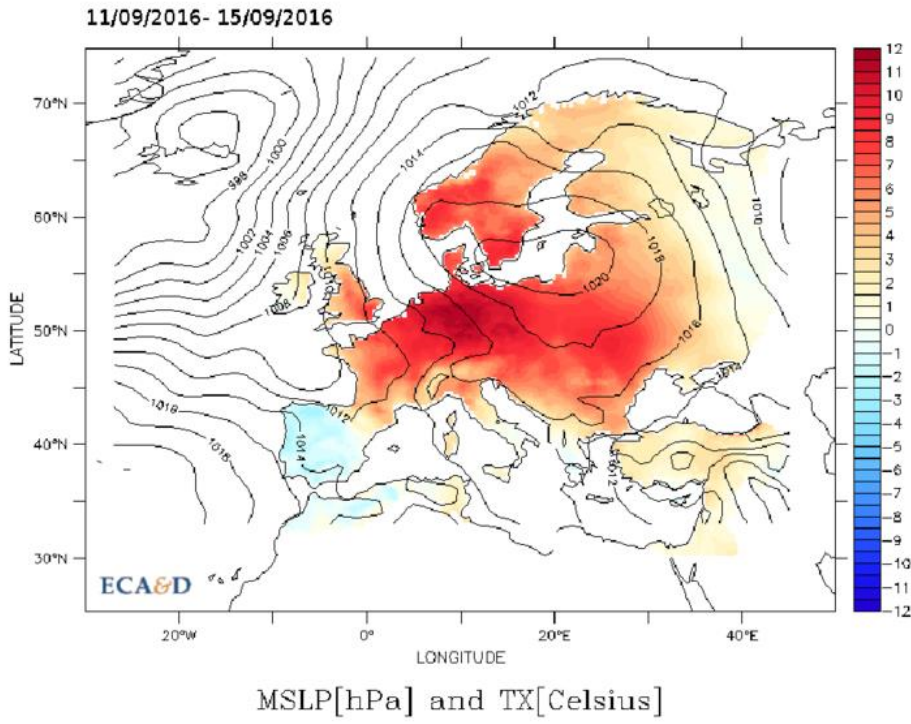


http://cib.knmi.nl/mediawiki/index.php/European_climate_in_2016

Exceptional air temperature event in 2016

- Average daily maximum temperature anomalies and mean sea level atmospheric pressure

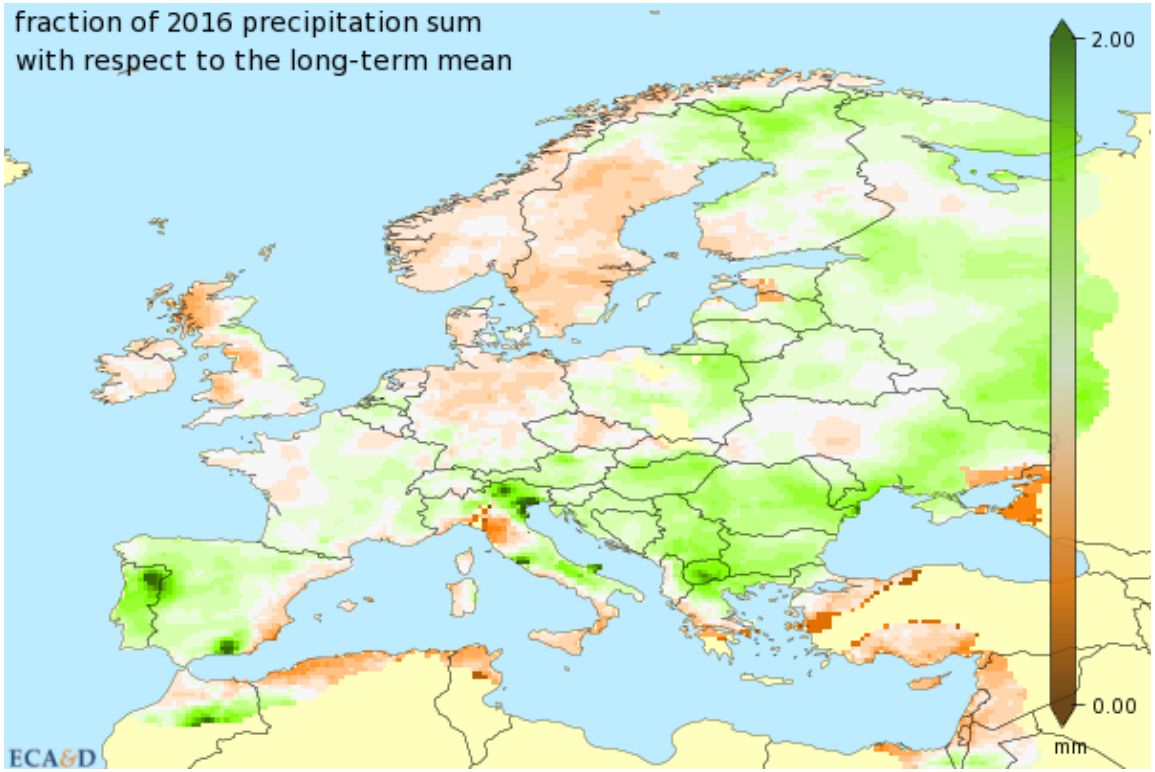




http://cib.knmi.nl/mediawiki/index.php/European_climate_in_2016

Precipitations

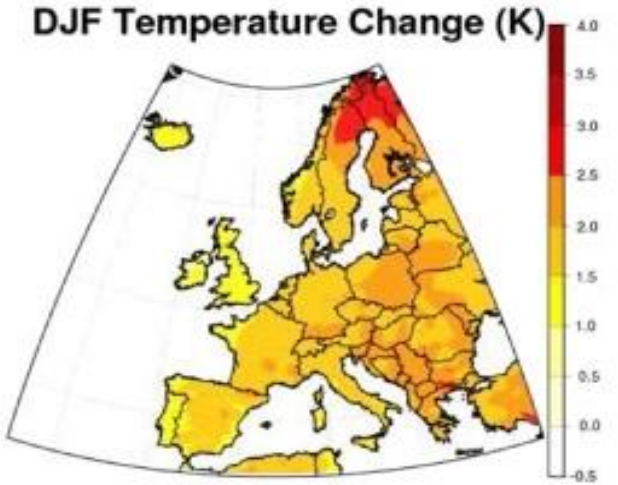
- Sum of annual precipitation in 2016 in relation to the average of 1981 to 2010.

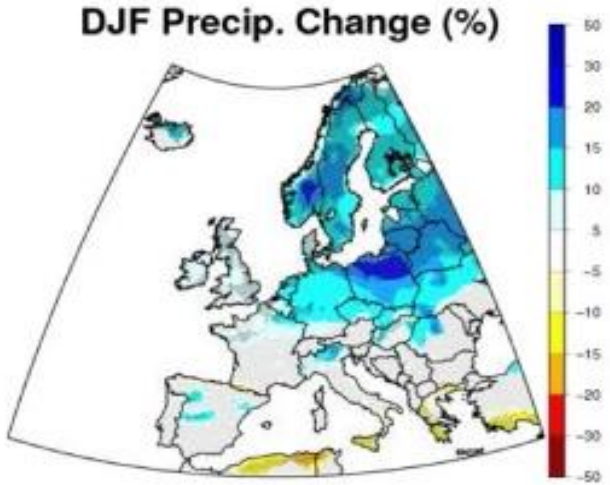


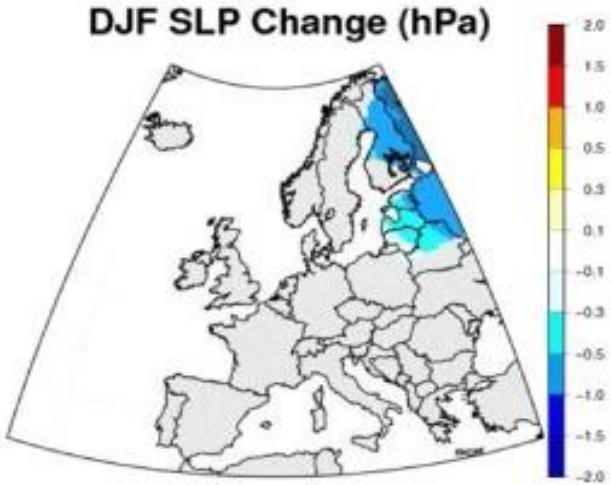
http://cib.knmi.nl/mediawiki/index.php/European_climate_in_2016

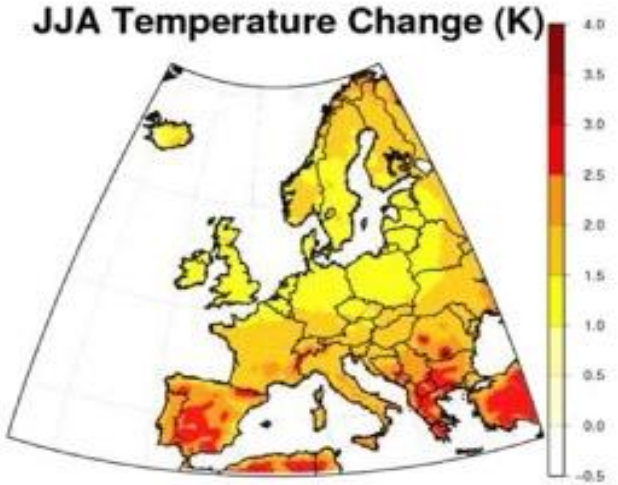
The European climate under a 2 °C global warming

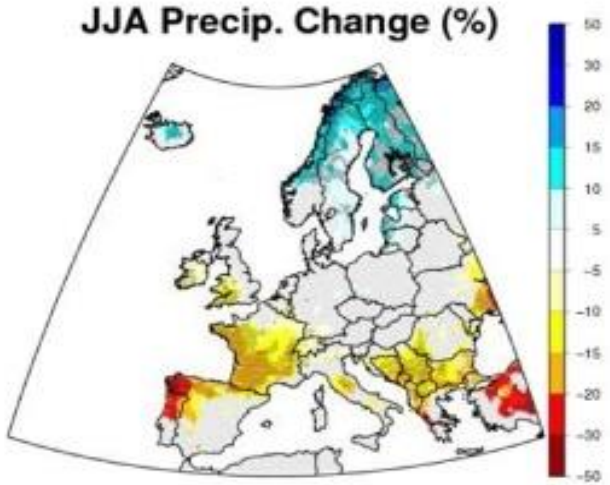
Robert Vautard et al 2014 Environ. Res. Lett. 9 034006 doi:10.1088/1748-9326/9/3/034006

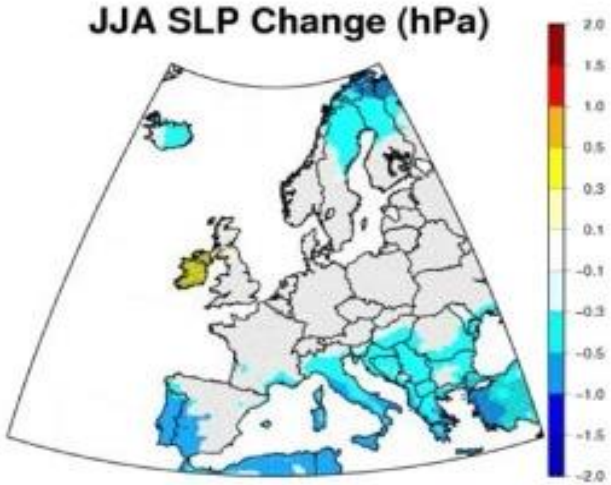




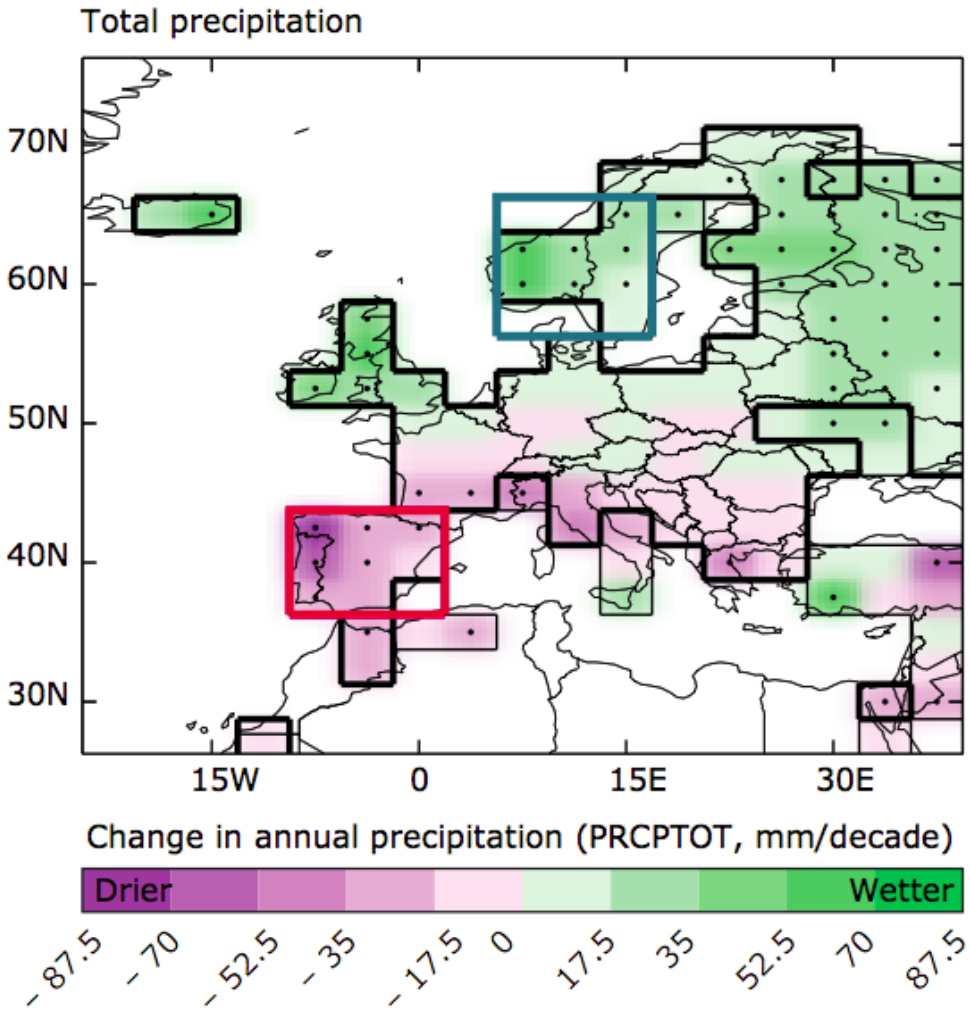






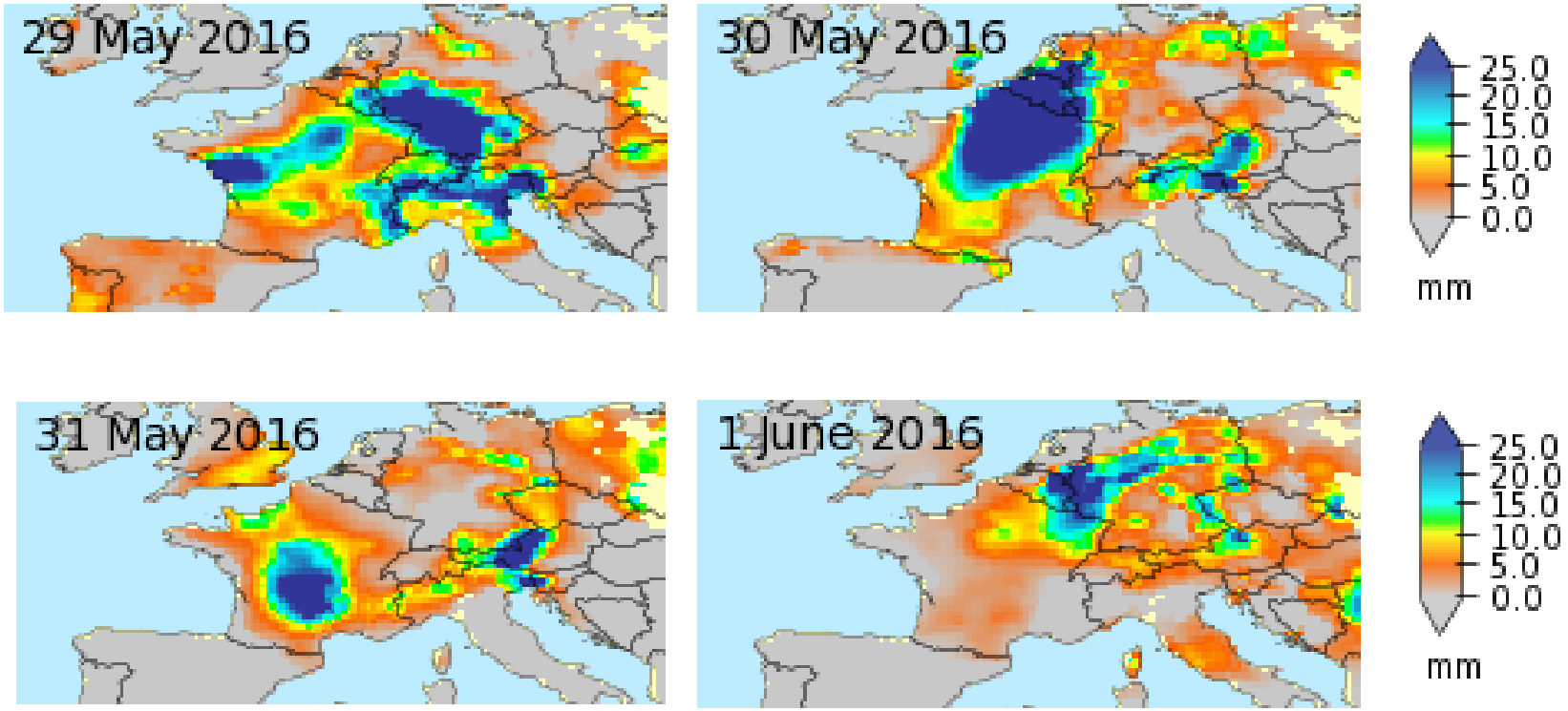


Climate change and precipitation



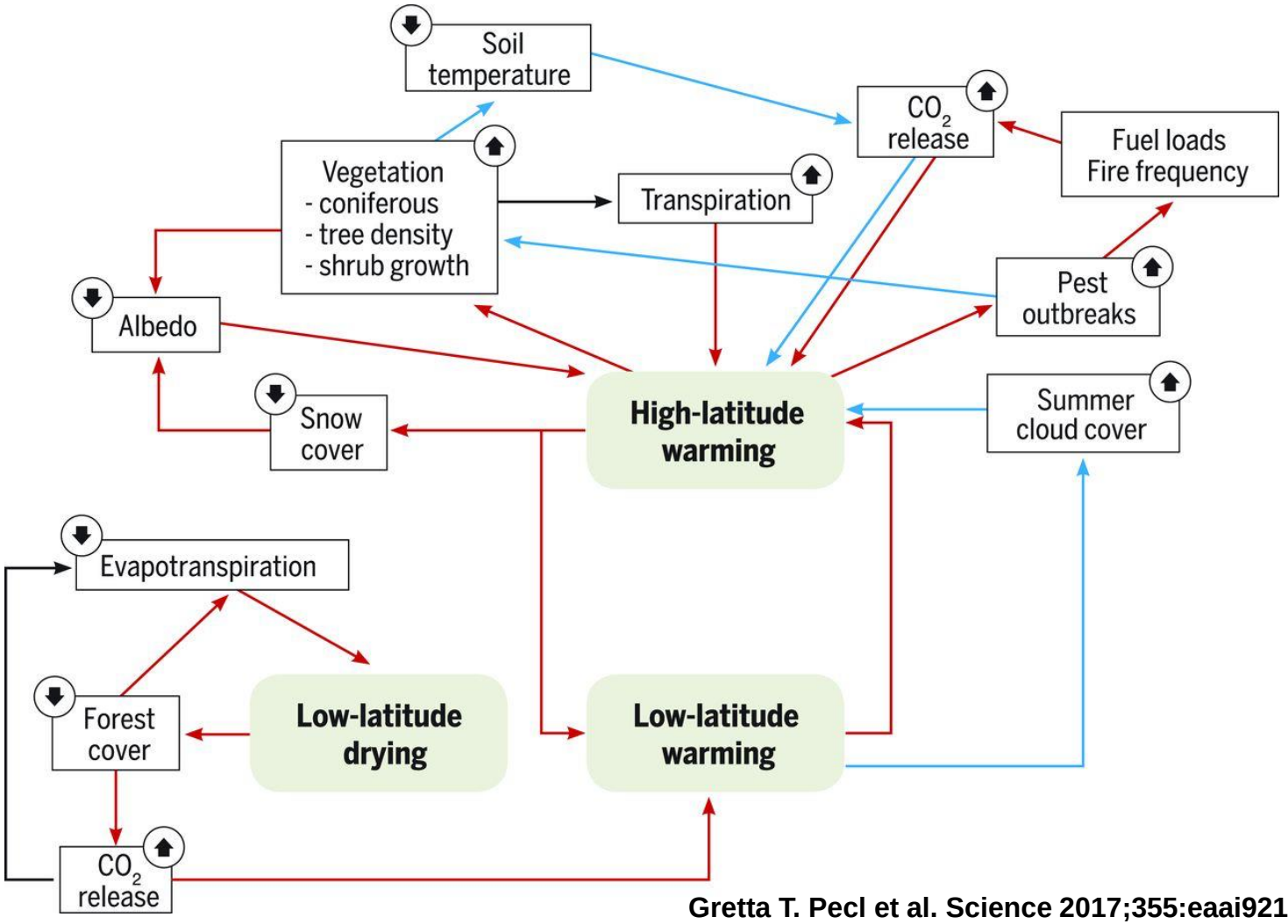
Precipitations intensity

- *29 May - 1 June 2016*



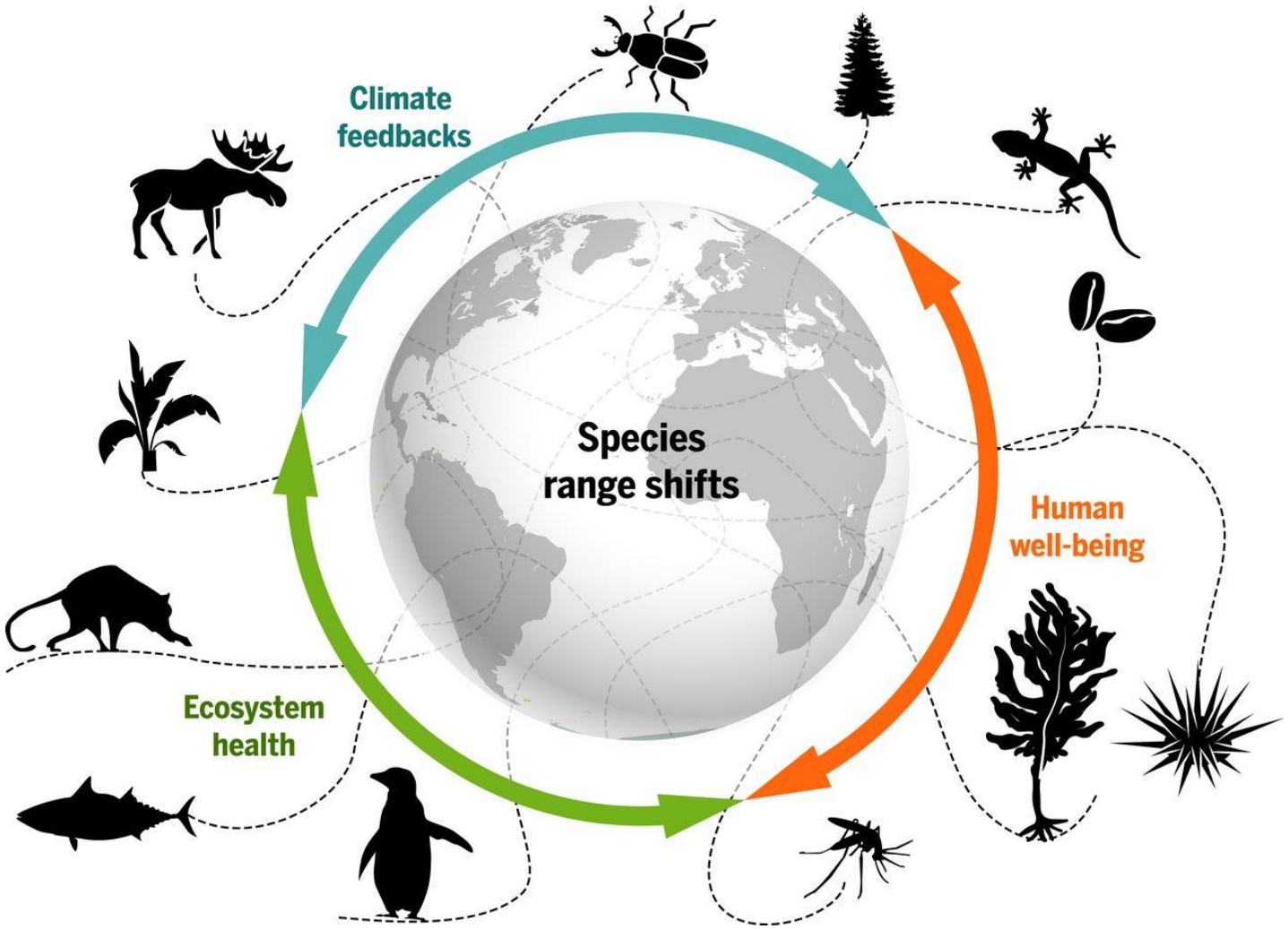
http://cib.knmi.nl/mediawiki/index.php/European_climate_in_2016

Climatic feedback and process brought by the redistribution of plant species in high latitudes



Gretta T. Pecl et al. Science 2017;355:eaai9214

As the global climate changes, human well-being, ecosystem function, and even climate itself are increasingly affected by the shifting geography of life.



Published by AAAS

Gretta T. Pecl et al. Science 2017;355:eaai9214

Impact of Climate Change

- The climate is recording big changes with increasing frequency of periods of:
  - Extreme heat
  - Extreme cold
  - Rainfall: quantity and intensity
  - Storms ...
- How to cope ?
  - ADAPTATION or disappear
  - Will migration of species be possible?
  - Will not she be too fast?

Climate Change and Flora

- Plants temporize well the temperature changes (root system well insulated)
- Start of vegetation according to a number of "hot" days (T °> T specific to the plant).
- On 650 plants (northern hemisphere) 1.9 days in advance / 10 years
- On 385 plants from England: 4.5 days between the 80s and the 90s

- Increased risk of late frost → flora or flower buds destroyed

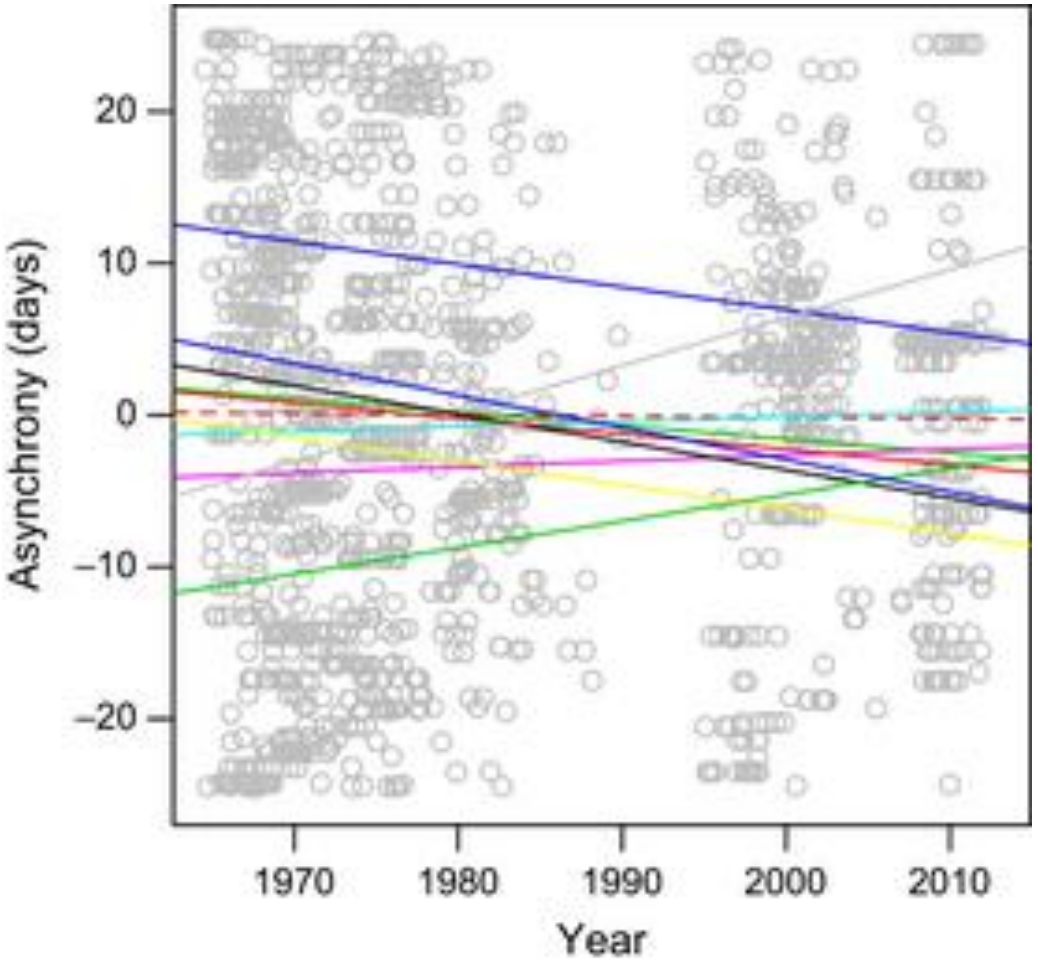
Climate Change and Flora

- Food = plants ... adaptation?
  - Reduction of nectar production, pollen input (drought, excessive humidity ...)
  - => Reductions of important honey productions
  - Some plants no longer produce (acacia in some areas ...)
- => Beekeepers -> react by changing the sources of supply of their hives
- Bees forage on new sources of honey: Cipan, honeydew ...

Climate Change and Pollination

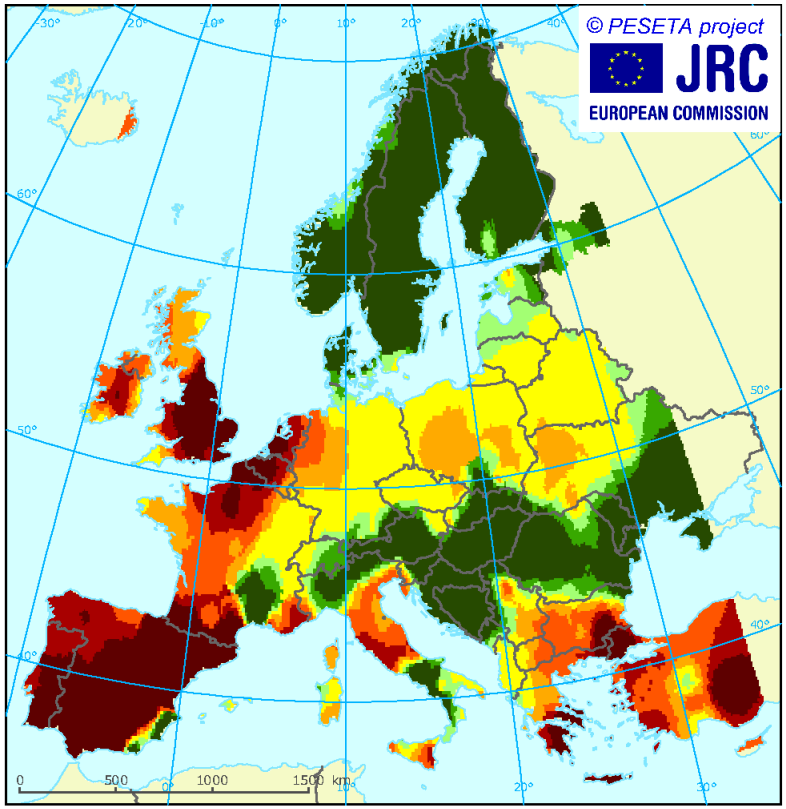
- Bees = 80% of the pollination
  - ➔ Synergy between the presence of the pollinator and the flower
  - ➔ Similar development !!!
    - If development engines ≠ ???
    - Lack of awareness of the signals used by plants and pollinators to be synergistic.
  - Development https://honeybeenet.gsfc.nasa.gov

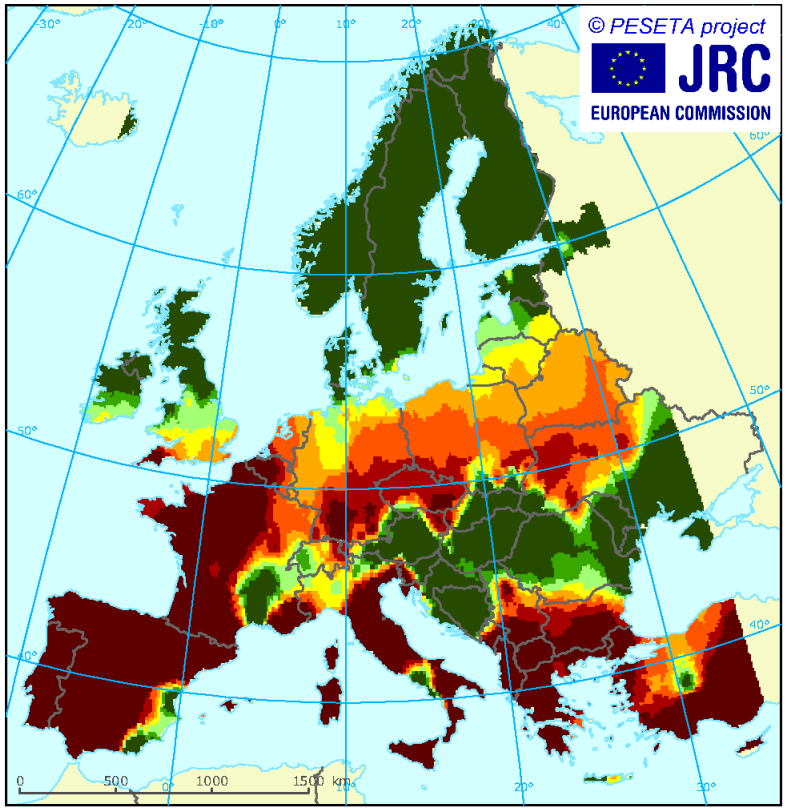
Biodiversity ensures plant–pollinator phenological synchrony against climate change



Ecology Letters
Volume 16, Issue 11, pages 1331-1338, 22 AUG 2013 DOI: 10.1111/ele.12170
http://onlinelibrary.wiley.com/doi/10.1111/ele.12170/full#ele12170-fig-0005

Climate Change and crops





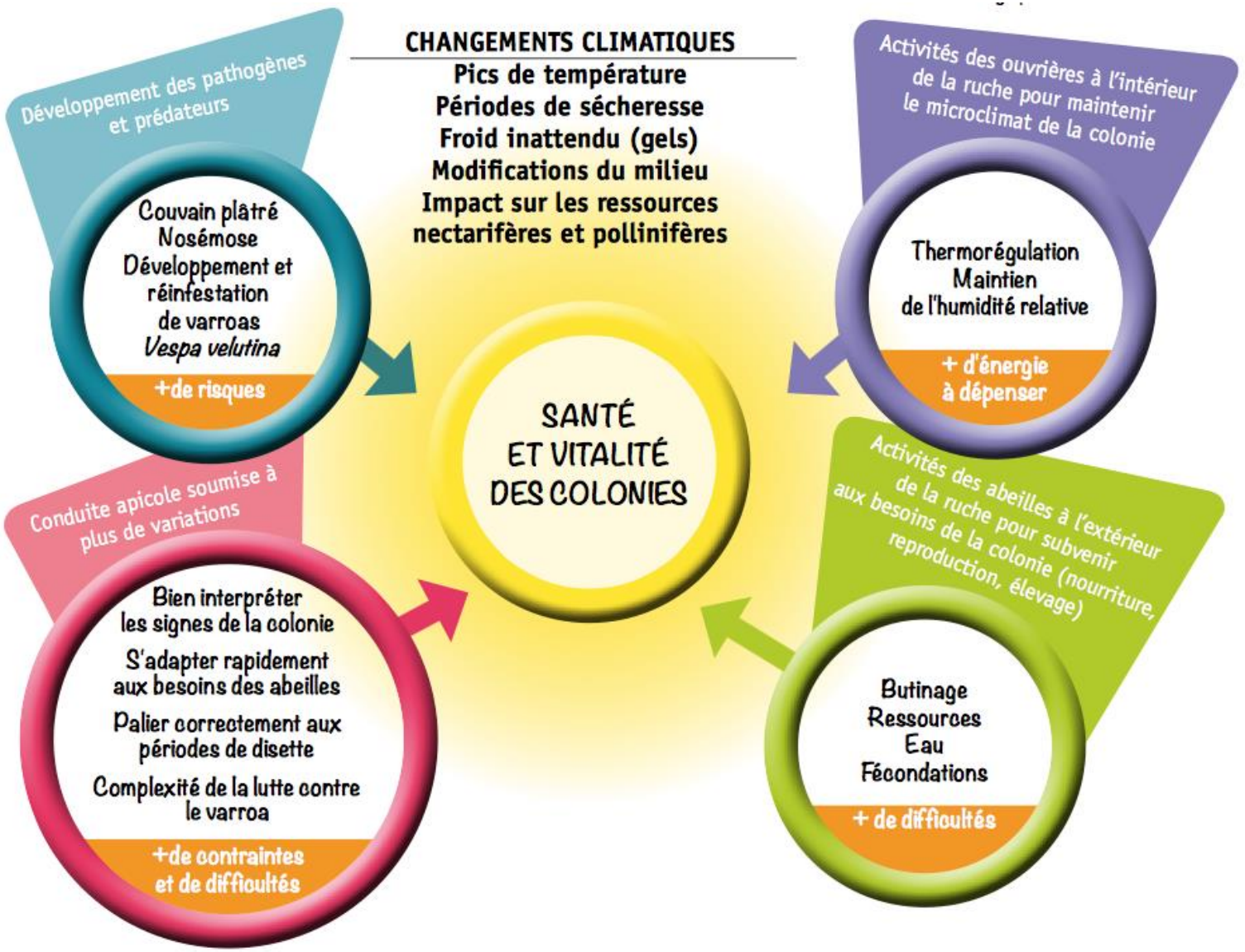
Simulated crop yield changes by 2080s relative to the period 1961–1990 under the HadCM3/HIRHAM (left) and ECHAM4/RCA3 (right) A2 scenario

Change in %

– 30 – 15 – 10 – 5 0 5 10 15 30

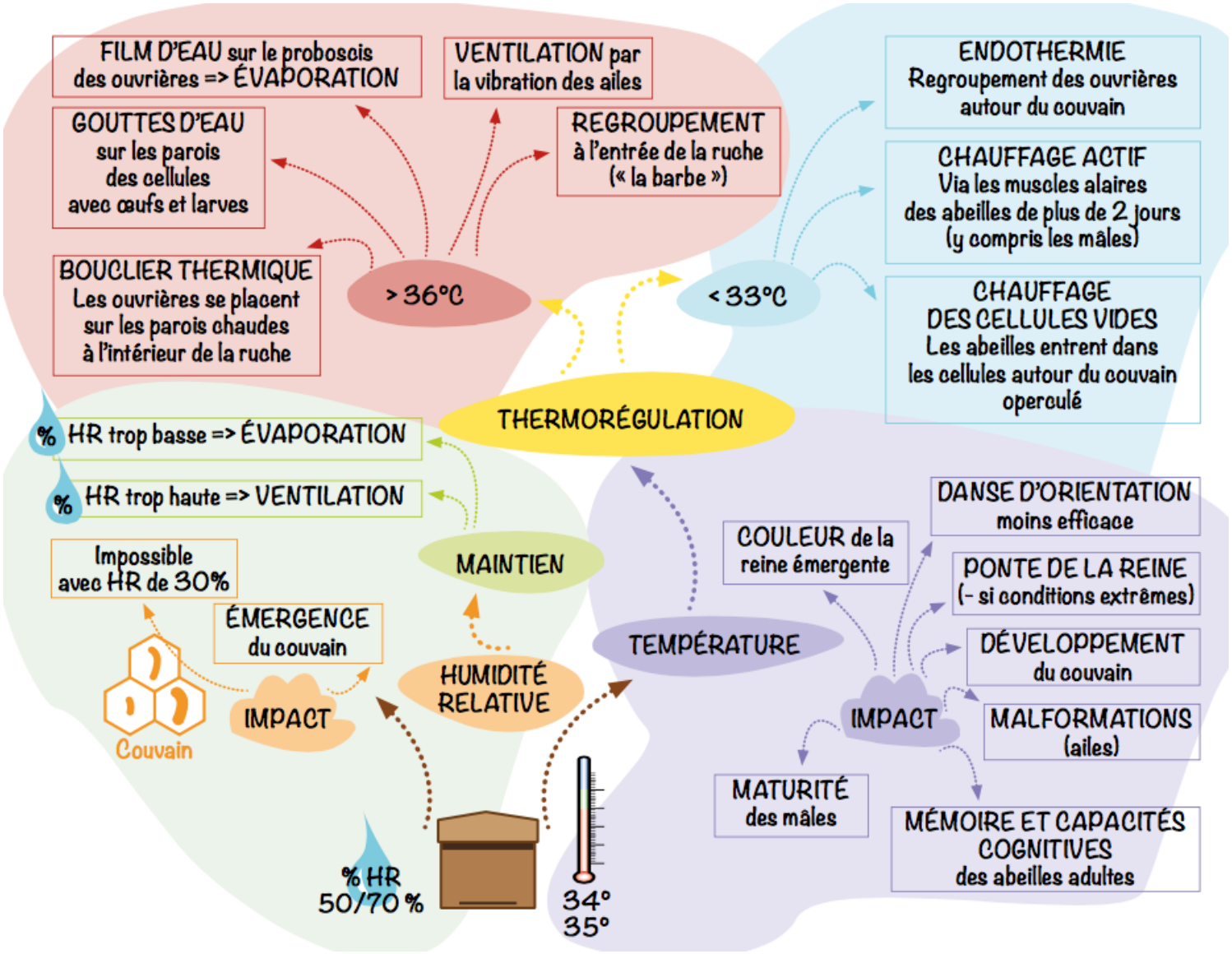
Climate Changes and Beekeeping

- Bee: great adaptability - survival under a wide variety of conditions
  - Other pollinators? Example of some drones
- The environment of the bee is also influenced
  - The climate of the hive
  - Pathogens
  - The honey flora
  - Water resources
  - Crop evolution (Catch crops…)

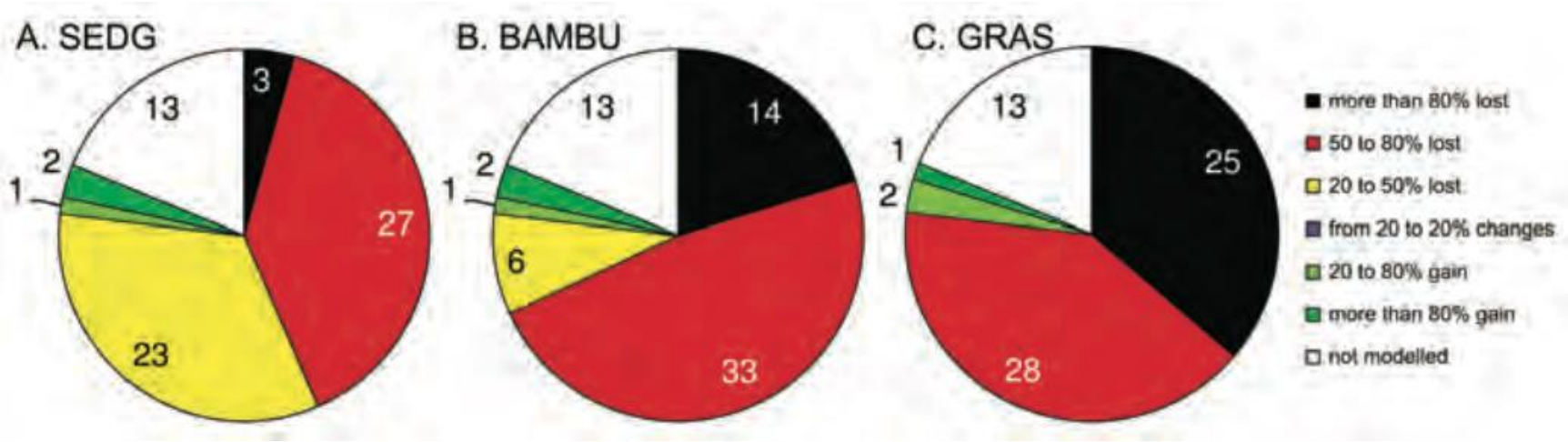

CHANGEMENTS CLIMATIQUES
Pics de température
Périodes de sécheresse
Froid inattendu (gels)
Modifications du milieu
Impact sur les ressources nectarifères et pollinifères
Développement des pathogènes et prédateurs
Couvain plâtré
Nosémose
Développement et réinfestation de varroas
Vespa velutina
+de risques
Activités des ouvrières à l'intérieur de la ruche pour maintenir le microclimat de la colonie
Thermorégulation
Maintien de l'humidité relative
+ d'énergie à dépenser
SANTÉ ET VITALITÉ DES COLONIES
Conduite apicole soumise à plus de variations
Bien interpréter les signes de la colonie
S'adapter rapidement aux besoins des abeilles
Palier correctement aux périodes de disette
Complexité de la lutte contre le varroa
+de contraintes et de difficultés
Activités des abeilles à l'extérieur de la ruche pour subvenir aux besoins de la colonie (nourriture, reproduction, élevage)
Butinage
Ressources
Eau
Fécondations
+ de difficultés

Climate Change and Bee Biology

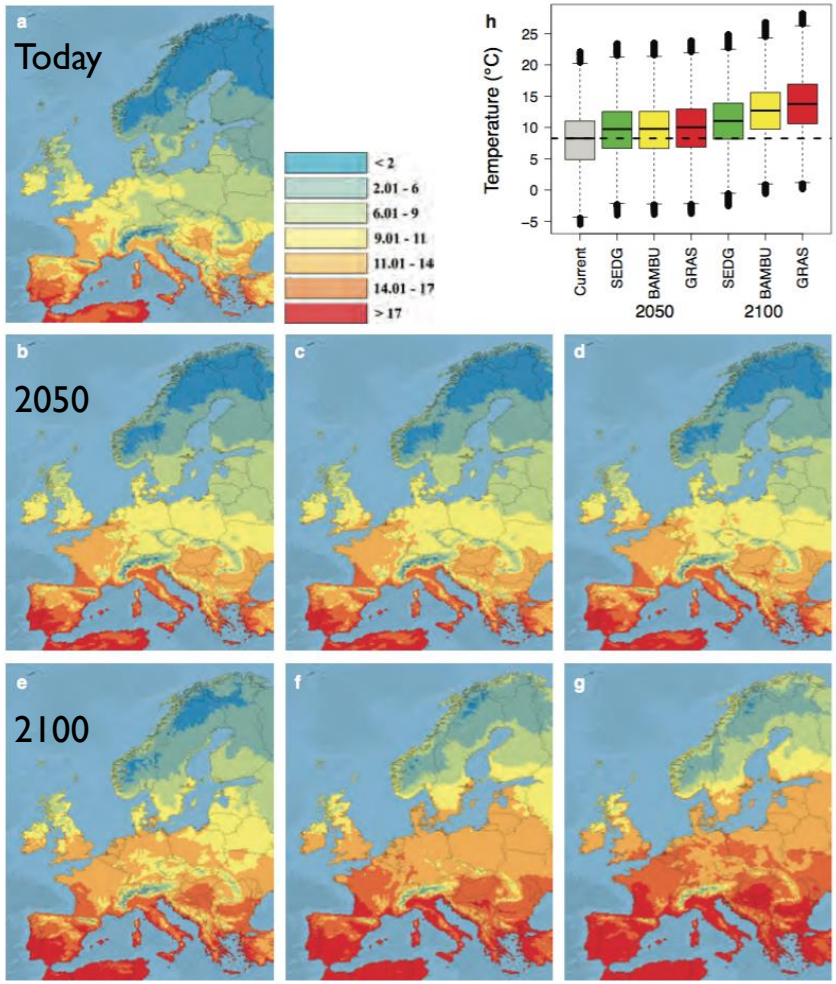
- Presence of brood for a longer period, especially at the end of the season
  - Cycle in Belgium that approaches that of the south of France
  - Late brooding colonies overwinter with smaller colonies
  - High variability of wintering with risk extremes

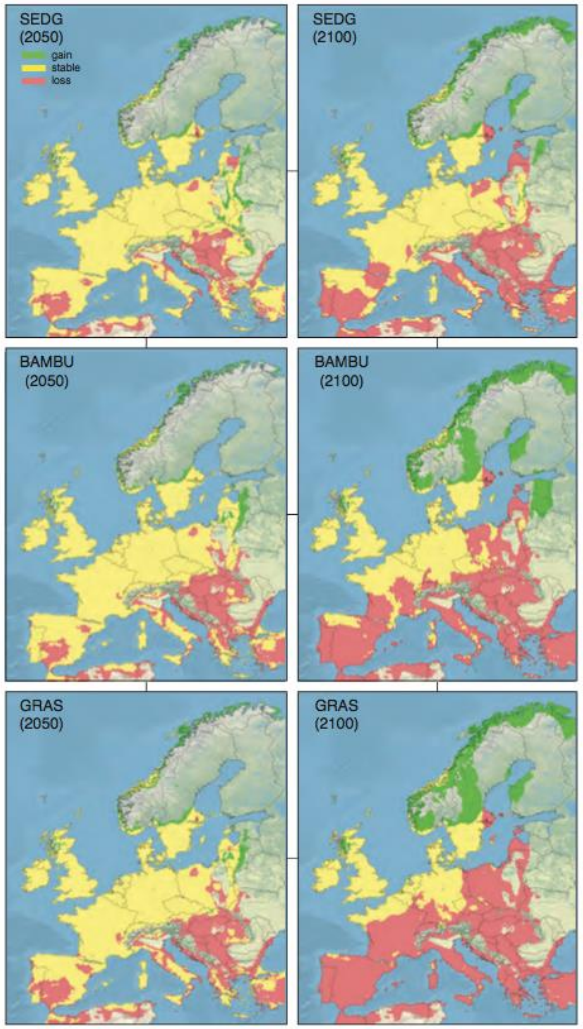

FILM D'EAU sur le proboscis des ouvrières => ÉVAPORATION
VENTILATION par la vibration des ailes
GOUTTES D'EAU sur les parois des cellules avec œufs et larves
REGROUPEMENT à l'entrée de la ruche (« la barbe »)
BOUCLIER THERMIQUE Les ouvrières se placent sur les parois chaudes à l'intérieur de la ruche
> 36°C
ENDOTHERMIE Regroupement des ouvrières autour du couvain
CHAUFFAGE ACTIF Via les muscles alaires des abeilles de plus de 2 jours (y compris les mâles)
< 33°C
CHAUFFAGE DES CELLULES VIDES Les abeilles entrent dans les cellules autour du couvain operculé
THERMORÉGULATION
% HR trop basse => ÉVAPORATION
% HR trop haute => VENTILATION
Impossible avec HR de 30%
MAINTIEN
ÉMERGENCE du couvain
Couvain
IMPACT
HUMIDITÉ RELATIVE
% HR 50/70 %
34° 35°
TEMPÉRATURE
COULEUR de la reine émergente
DANSE D'ORIENTATION moins efficace
PONTE DE LA REINE (- si conditions extrêmes)
DÉVELOPPEMENT du couvain
IMPACT
MALFORMATIONS (ailes)
MATURITÉ des mâles
MÉMOIRE ET CAPACITÉS COGNITIVES des abeilles adultes

Climate Changes and Bombus



Climate Changes and Bombus
Bombus terrestris





Honey!

- The EU experienced in 2016 one of the worst years of honey production
  - <50% of normal
  - Frozen flowers
  - Drought
  - Modification of nectariferous secretions

R.it | Ambiente

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Miele »

Caccia al miele degli dei: l'ultima corsa all'oro della Nuova Zelanda

Via la stanchezza di fine inverno, con i "fantastici 4" che danno

Berlino, la storia di un pasticcere di successo fuggito dalle bombe di Homs

B-Droid, l'ape robot per l'impollinazio artificiale: un alleato degli

2,1mila

La crisi del miele italiano: 2016, anno nero per le api

Pesticidi e cambiamenti climatici: la produzione made in Italy cala del 70%. Tra i primi effetti sul mercato l'aumento del 20% dei prezzi

di MONICA RUBINO

La producción de miel se desploma un 40 %

La fuerte sequía y la muerte de abejas por los productos fitosanitarios y la aparición de parásitos merman una campaña que se esperaba buena

Víctor Tomàs Alzira | 12.11.2016 | 22:13

M Biodiversité

PLANÈTE | BIODIVERSITÉ

ARTICLE SÉLECTIONNÉ DANS LA MATINALE DU 22/06/2017 > Découvrir l'application

2016, la pire année pour la production de miel en France

La récolte a atteint 9 000 tonnes de miel, soit un recul de 33,5 % par rapport au volume produit en 2015. Les apiculteurs se mobilisent à travers les « Apidays ».

Beekeeping pratices - Feeding

- Higher consumption during warm winters
  - Offset feeding period - need to feed a second time
  - The quantity of syrup given ± = honey harvested !!!
  - Increase in the number and scale of hungry periods
  - Necessity to feed in honey production period (withdrawal of supers)
- Reconsumption of the harvested honey

Beekeeping pratices - Feeding

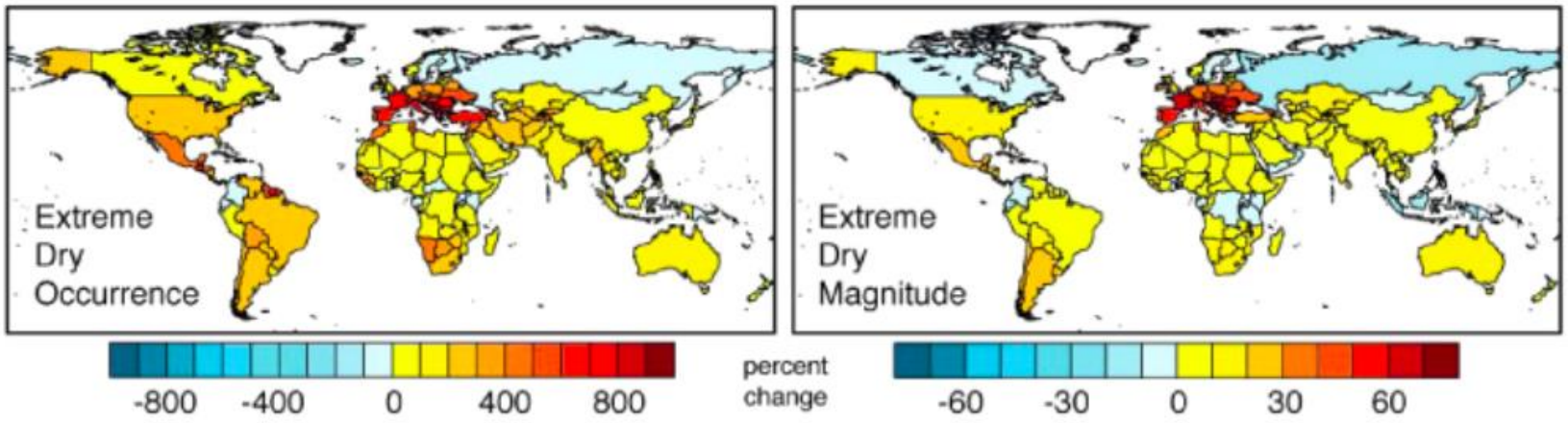
- Risks of adulteration of honey?
- We must be very careful with the syrups:
  - Quality
    - Honey is the best diet for bees
    - Inverted sucrose by bees is a very good solution
    - Avoid syrups made from starch
    - Avoid HFCS ...
    - The composition of the syrups or pastes must be known: the C≥4 must be close to 0.

Risks of adulteration of honey?

- Good practices
  - Limited reserves (2 executives) before placement of increases
  - Avoid all feeding during the period of potential honey flow
  - Use only good syrups
  - Caution with small colonies fed with sugar
  - Avoid robing
- Legally
  - We need to set sugar lift limits
- Research
  - We must have a better knowledge of the movements of reserves in the colonies.

Beekeeping pratices - Water

- The importance of water (especially in the south)
  - Lack of water can be a major cause of colony mortality
    - The presence of water points is essential for the survival of bees
  - Dryness also affects nectar secretions especially if the plants are not adapted to warm climates
  - Excess precipitations cleans nectar secretions



Beekeeping pratices - Pathogens

- Brood development for two months more than in the past => multiplication of varroa mites by ± 4
- Late foraging (September, October and even November) => Massive reinfestations by varroa mites

- Climatic shocks (especially cold) => increased risk of Chalk brood ...

- Climate changes may favor the development of certain pathogens at the expense of others.
  - Ex .: Nosema ceranae ⇔ Nosema apis

Beekeeping pratices – Colony follow up

- It is practically impossible to rely on general rules based on dates
  - We must be able to react quickly and interpret the situation according to the state of the colonies
  - It takes a lot of flexibility and can adapt quickly => equipment ready to serve: mini hives, feeding, harvest of other products ...
- Honeys harvested change from year to year much more than in the past.
- We must quickly detect the signs of production of honey, pollen, biological material ... to ensure harvests

Beekeeping pratices – Colony follow up

- For better monitoring, there are non-intrusive colony tracking systems.
  - Ex. Bee Smart, Arnia ...
    - Allows you to follow many parameters of the colonies: T °, humidity, vibrations ...
    - Provides information on hive status and inputs (type of pesticide (under development)
  - Technological => help beekeepers
  - Colonial monitoring => rapid intervention;
  - => understand colony decline

BEE SMART TECHNOLOGIES

Beekeeping pratices – Information

- The need for fast information is increasingly important
  - Sensors that automate measurements
  - Dissemination of information on websites
- Training must give the basics
  - To allow beekeepers to draw up good reports
  - To enable them to understand the drivers of production, pathology and reproduction
  - To enable them to make the right choices

Climate Change - Oportunity

- Action tracks: improving the flora
  - Foresters opted for diversity in front of climate change
  - Opportunities to enrich the flora: ex. : areas at risk of erosion
  - Plant breeding must take into account their nectar and pollen production
- It requires a deep reflection on the agriculture of tomorrow.
  - We must give a status to apicultural surfaces
  - Biodiversity is a key for pollination in the future
- Work differently: **nature must find its place**

Climate Changes

- Can be seen as an oportunity
  - *Apis mellifera* is one of the most adapted bee to manage the changes
- We have to
  - Adapt our beekeeping practices to become more reactive
  - To invest in new non intrusive tools to have a clear vision of the situation
  - Inform the farmers that our bees are an essential partner for the agriculture of tomorrow
  - To diversify our productions to maintain an economic equilibrium…

Thank you for your attention – Don’t forget

www.cari.be butine.info info@cari.be