From field research ............

- O₃ interactions with **Climate** -> more arid conditions modifies
  - Soil moisture (SWC)
  - Gas exchange
  - Growing seasons
  - Species composition

- O₃ interactions with **Nitrogen + Climate** ->
  - Reduce pasture productivity and quality
  - Increase N effects compared to current conditions

To risk analysis modelling

- Stomatal flux-based approach (POD) better than AOT40 for O₃ risk assessment in the Mediterranean region, as it includes SWC.
- POD modelling requires: specific parameterization and dose-response functions

Ready for Mediterranean Vegetation (Forest, crops and pastures)!!!
Ozone interaction with Climate

(Annual pastures)

- Green biomass and stomatal conductance vary across years

☑ Dry years: less yield + low O3 absorption + more tolerant species (grasses) = less risk

González-Fernández et al. In preparation
Ozone interaction with Climate
(Annual pastures)

- High inter-annual variability meteorological conditions
- Soil moisture: Key variable for growth and spp composition
Ozone interaction with Nitrogen

(Annual pastures)

- O$_3$ reduces fertilization effect of N

YIELD /CANOPY SCALE:

- O$_3$ limited the fertilization effect of the soil N availability,
- Higher N could compensate O$_3$ effects on yield only when concentrations were moderate, but not under high O$_3$ levels

Calvete-Sogo et al., 2014
<table>
<thead>
<tr>
<th>Climate</th>
<th>O₃ effects</th>
<th>N effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>HUMID year</td>
<td>Higher O₃ flux</td>
<td>Less N sensitive spp</td>
</tr>
<tr>
<td>(more legumes)</td>
<td>More O₃ sensitive spp</td>
<td></td>
</tr>
<tr>
<td>DRY year</td>
<td>Lower O₃ flux</td>
<td>More N sensitive spp</td>
</tr>
<tr>
<td>(more grasses)</td>
<td>Less O₃ sensitive spp</td>
<td></td>
</tr>
</tbody>
</table>

Future climate: more arid climate will result in reduced pasture productivity and quality, and more important N effects than O₃ effects compared to current conditions.
Ozone risk analysis modelling

*From field research.......To risk analysis modelling*

- Stomatal flux-based approach (POD) better than AOT40 for O₃ risk assessment in the Mediterranean region, as it includes SWC.
- POD modelling requires: specific parameterization and dose-response function

Ready for Mediterranean Vegetation (Forest, crops and pastures)!!!

González-Fernández et al. In preparation
Ozone risk analysis modelling

2015: Ozone indicator EMEP Status Report - EMEP maps for O₃ flux model
- For generic specie (Beech&Birch)
- According to Mapping Manual 2010

ICP-Vegetation: Updating Chapter 3 Mapping Manual

Table III.17: Representative species for which species- and region-specific flux parameterisations have been derived by European region (see Annex 2 for the parameterisations).

<table>
<thead>
<tr>
<th>European region</th>
<th>Coniferous</th>
<th>Broadleaved Deciduous</th>
<th>Mediterranean broadleaved Evergreen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern Europe</td>
<td>Norway spruce</td>
<td>Birch</td>
<td>-</td>
</tr>
<tr>
<td>Atlantic Central Europe</td>
<td>Scots pine</td>
<td>Beech &amp; temperate Oak</td>
<td>-</td>
</tr>
<tr>
<td>Continental Central Europe</td>
<td>Norway spruce</td>
<td>Beech</td>
<td>-</td>
</tr>
<tr>
<td>Mediterranean Continental Europe</td>
<td>Aleppo pine</td>
<td>Beech</td>
<td>Holm oak</td>
</tr>
</tbody>
</table>

Critical levels available

Same specie but different parameterization according to climatic conditions
Proposal for EMEP/WGE collaboration in:

New Ozone Risk Maps:
- Ozone indicator: POD (Flux model)
- According to the updated Chapter 3 of the Mapping Manual
- Multi species approach
- Using new parameterization and critical levels for new receptors

2016: Create a working group (EMEP/WGE) to check
The feasibility and scope of the collaboration
¿For Crops? ¿For Forests?
Species selected (specific parameterization)
According to ecosystem/crops distribution
Time frame (years of calculations)
Agenda, resources, ......

......to be discussed at the Ozone Critical Levels Workshop
(Madrid, 7-9 November 2016)
Ozone Critical Levels Workshop
CIEMAT, Madrid, Spain
7\textsuperscript{th} – 9\textsuperscript{th} November, 2016

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ICP-Vegetation web page
Thank you for your attention!