

1 **Supplemental Materials**

3 **MESMO 3: Flexible phytoplankton stoichiometry and refractory DOM**

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7 These supplemental figures compare MESMO 3, newly described in this submission, with
8 its predecessor, MESMO 2, as well as with the World Ocean Atlas. The aim of the
9 comparison is to demonstrate that the new model simulates the ocean biogeochemistry
10 just as well as MESMO 2 for those properties that have previously been simulated.

12 Figure S1. Model-data comparison of surface ocean PO₄ and NO₃ concentrations. (a, b)
13 Observations are from the World Ocean Atlas 2013 (Garcia et al., 2013a). (c, d) MESMO 2
14 results are from Matsumoto et al. (2013). (e, f) MESMO 3 results are from this study. Unit =
15 μmol kg⁻¹.

17 Figure S2. POC export production at 100 m in MESMO 2 (left, Matsumoto et al., 2013) and
18 MESMO 3 (right, this study). Unit = mol C m⁻² year⁻¹.

20 Figure S3. Model-data comparison of dissolved O₂ concentrations. (a) Global mean vertical
21 profiles. Distribution of O₂ at 1000 m from: (b) World Ocean Atlas 2013 (Garcia et al.,
22 2013b), (c) MESMO 2 (Matsumoto et al., 2013), and (d) MESMO 3 (this study). Unit = μmol
23 O₂ kg⁻¹. The colored lines in (a) indicate: black = WOA2013, red = MESMO 2, green =
24 MESMO 3, and blue = MESMO 3+DOM_r (run ID=201027c, see main text).

26 Figure S4. Model-data comparison of Si(OH)₄ concentrations. Surface concentrations from:
27 (a) World Ocean Atlas 2013 (Garcia et al., 2013a) and (b) MESMO 3. Zonally averaged Si*
28 from (c) MESMO 2 (Matsumoto et al., 2013), and (d) MESMO 3 (this study). Si* = [Si(OH)₄]-
29 [NO₃]. Unit = μmol Si kg⁻¹.

31 Figure S5. Surface ocean FeT in MESMO 2 (left, Matsumoto et al., 2013) and MESMO 3
32 (right, this study). Unit = nmol Fe kg⁻¹.

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34 Figure S6. Annual mean depth-integrated N₂ fixation in MESMO 3. Unit = mol-N m⁻² year⁻¹.

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36 **References**

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Figure S1

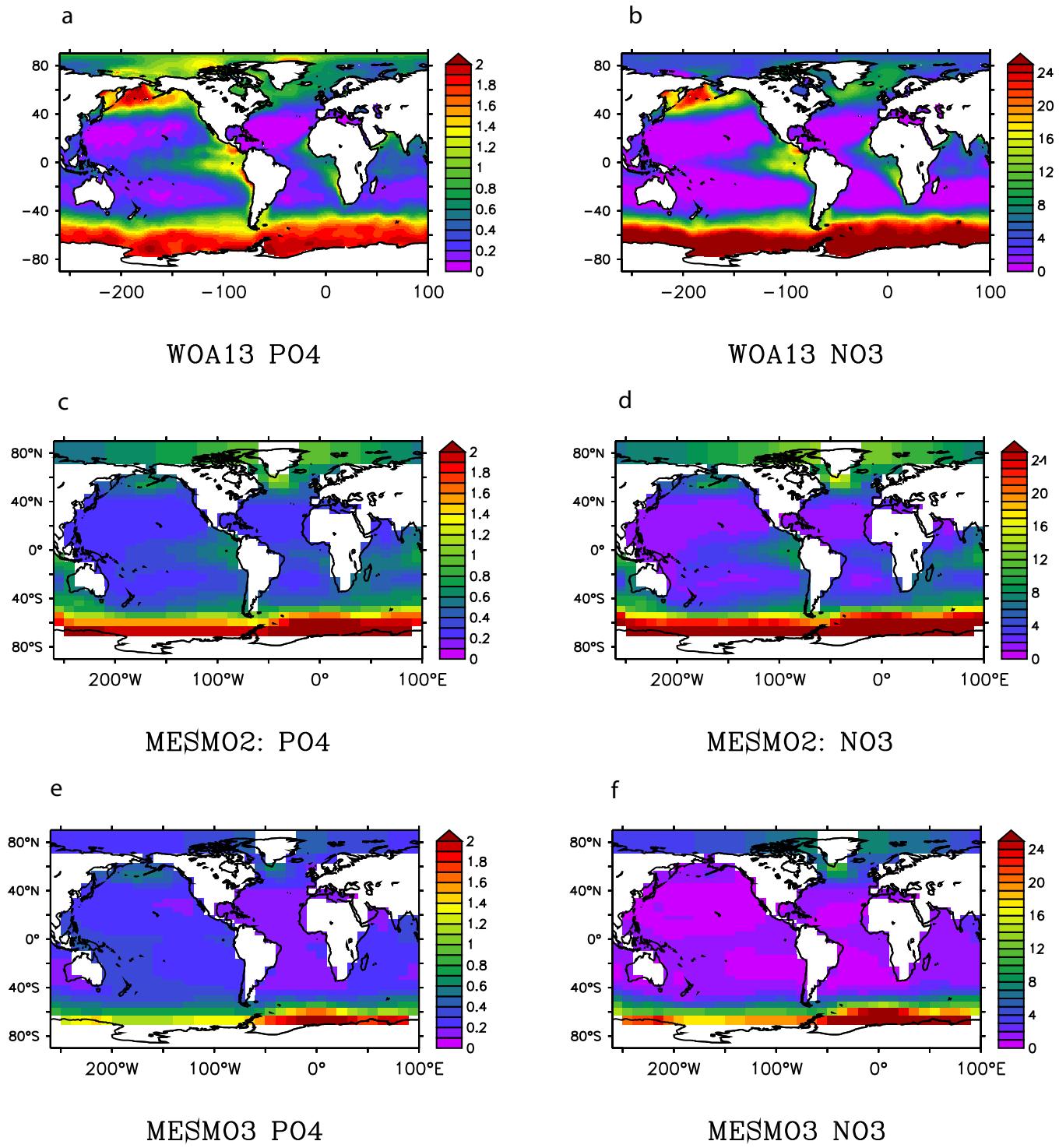
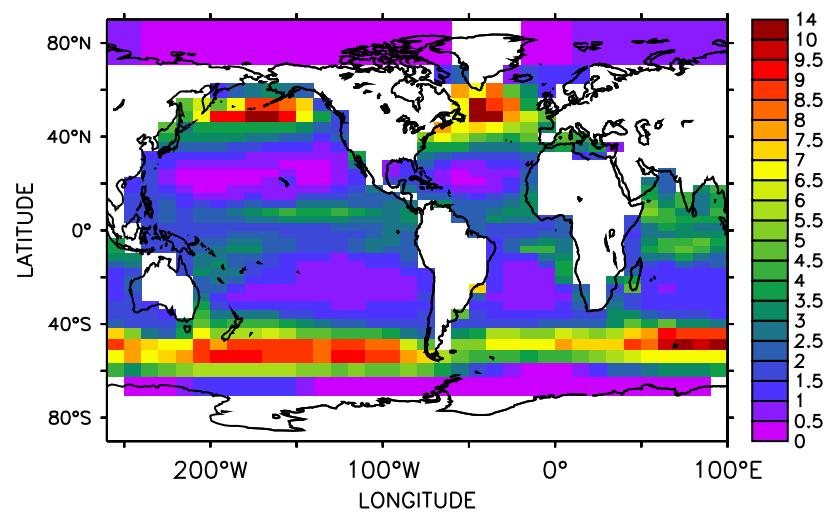
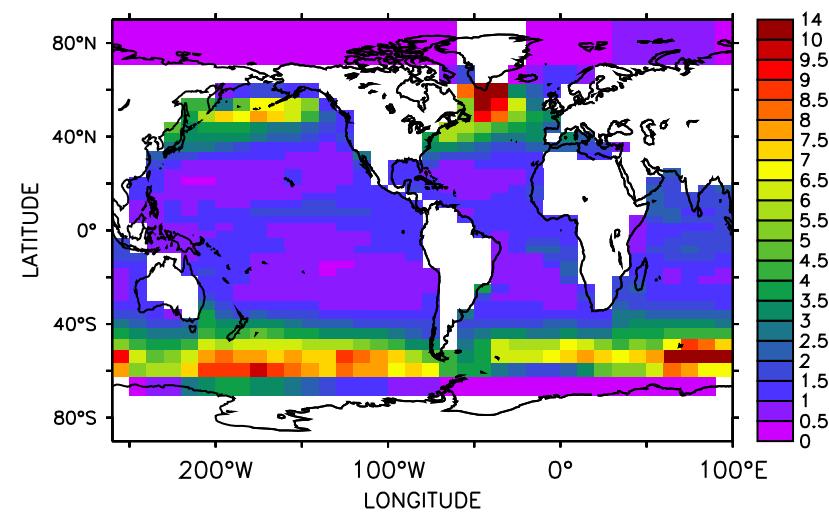


Figure S2



MESM02: POC export



MESM03 POC export

Figure S3

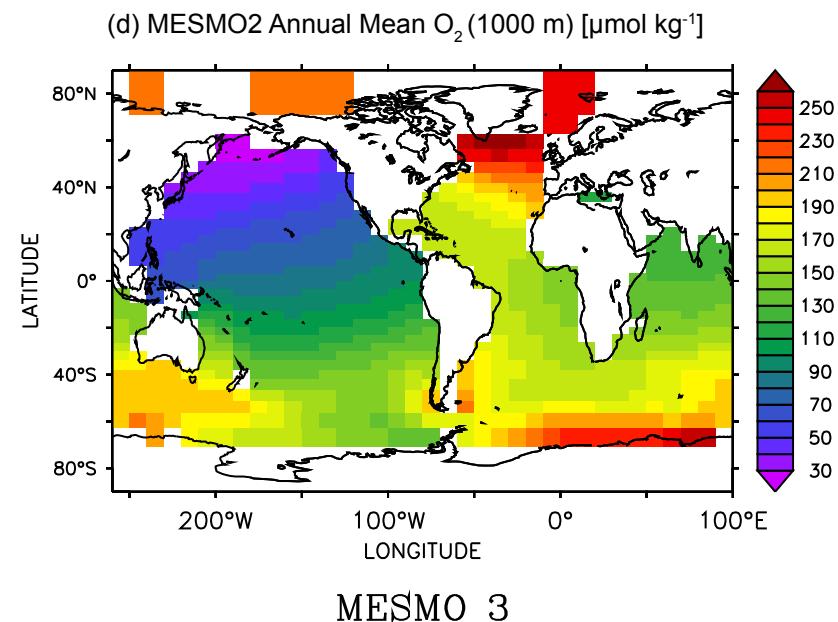
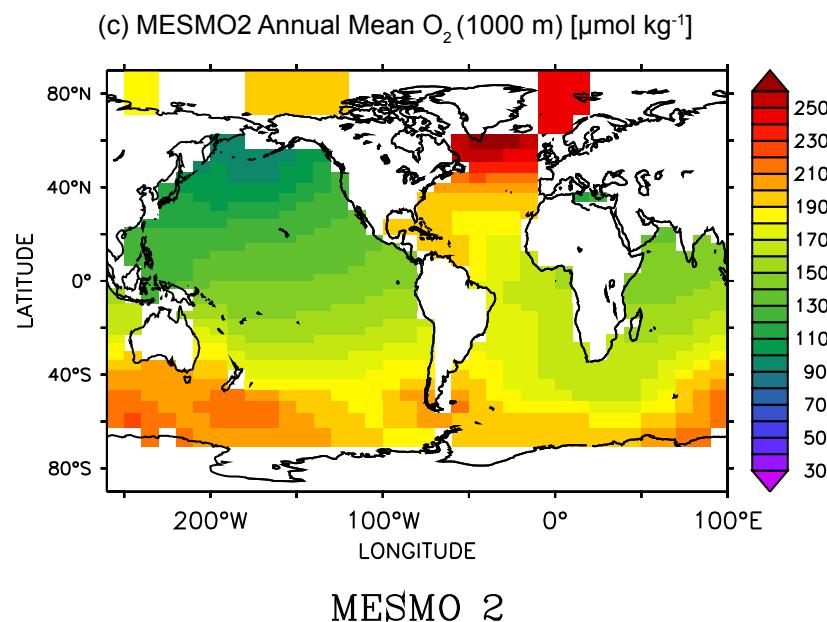
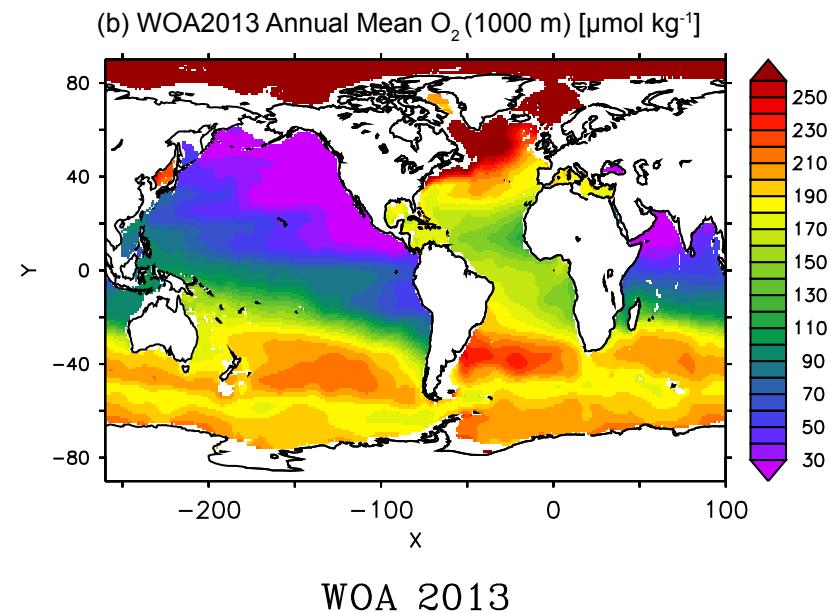
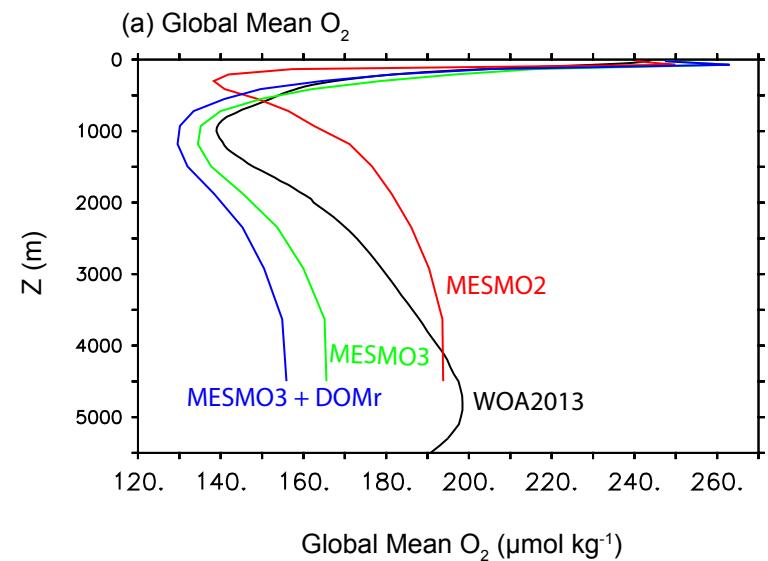


Figure S4

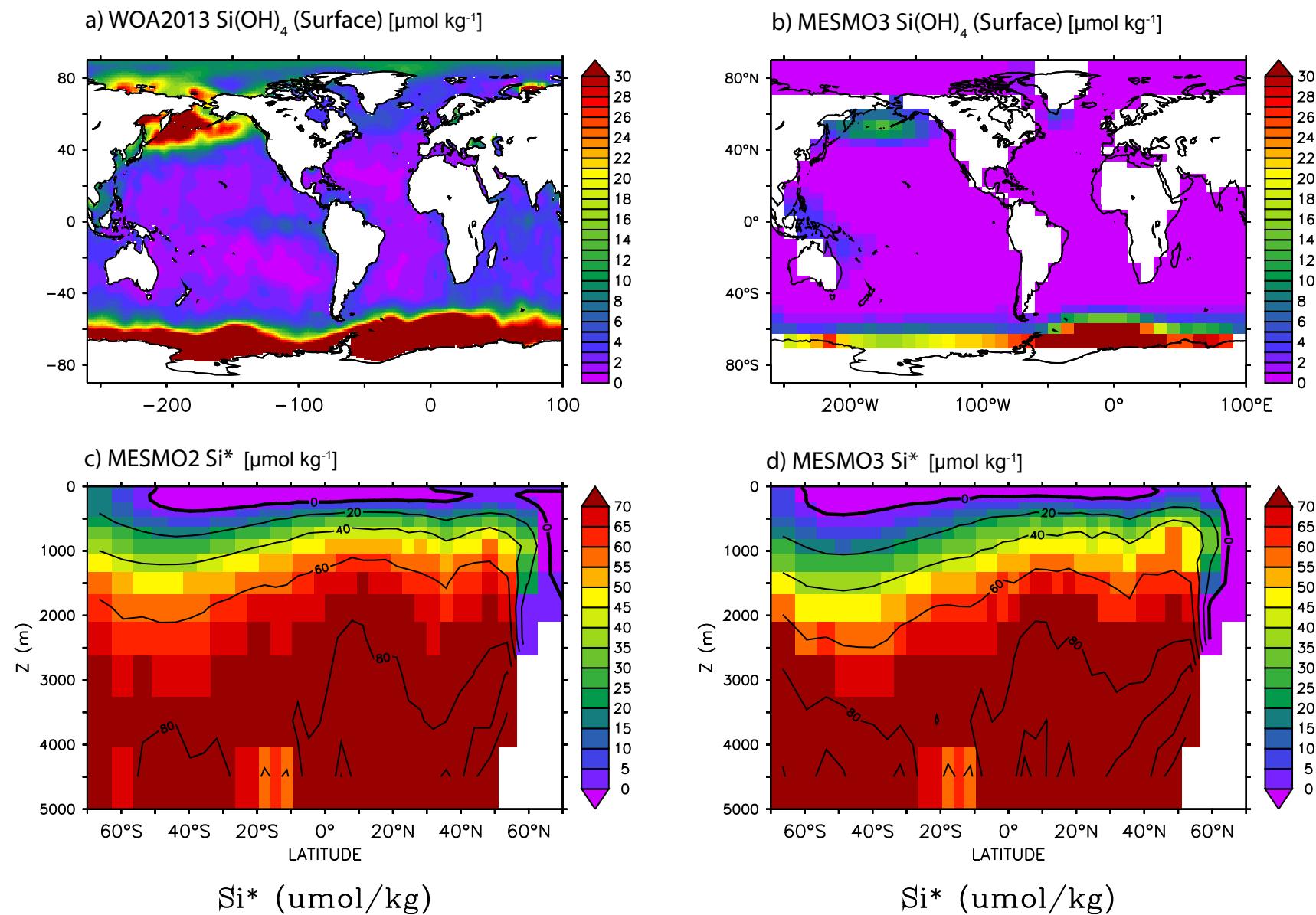
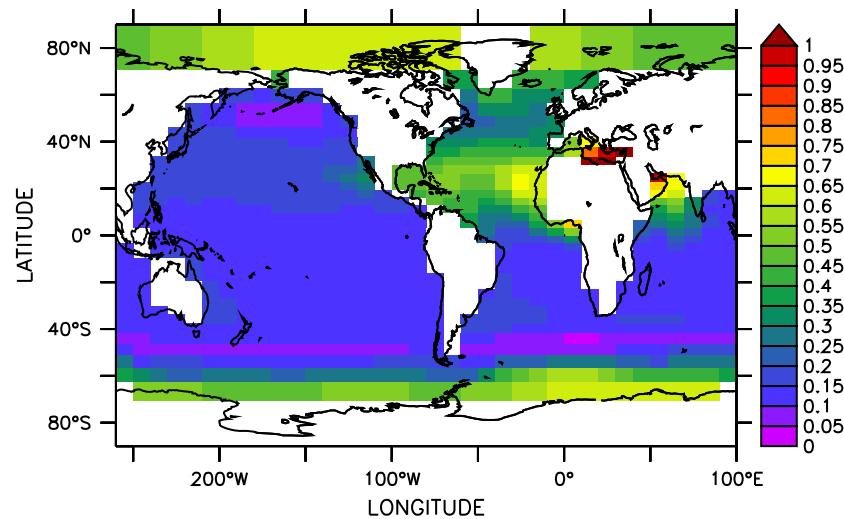
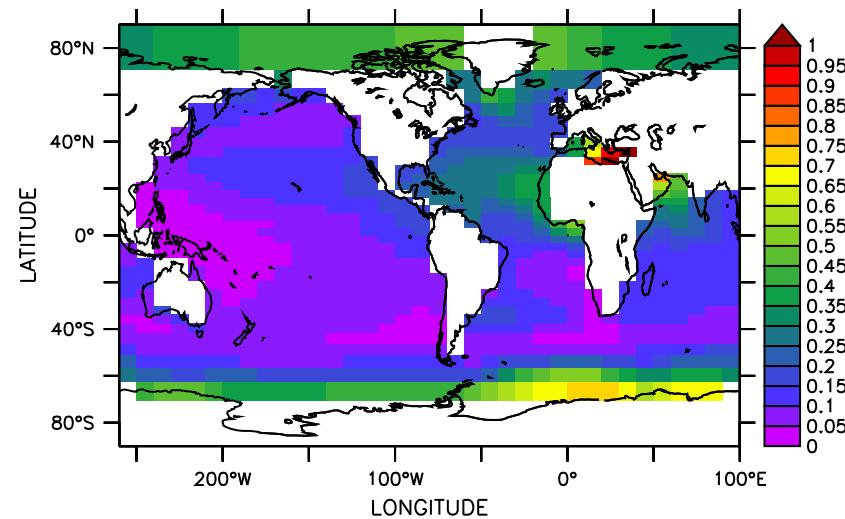


Figure S5



MESMO2:FeT



MESMO3 FeT

Figure S6

